

SECTION **EM**

ENGINE MECHANICAL

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SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:000000010282193

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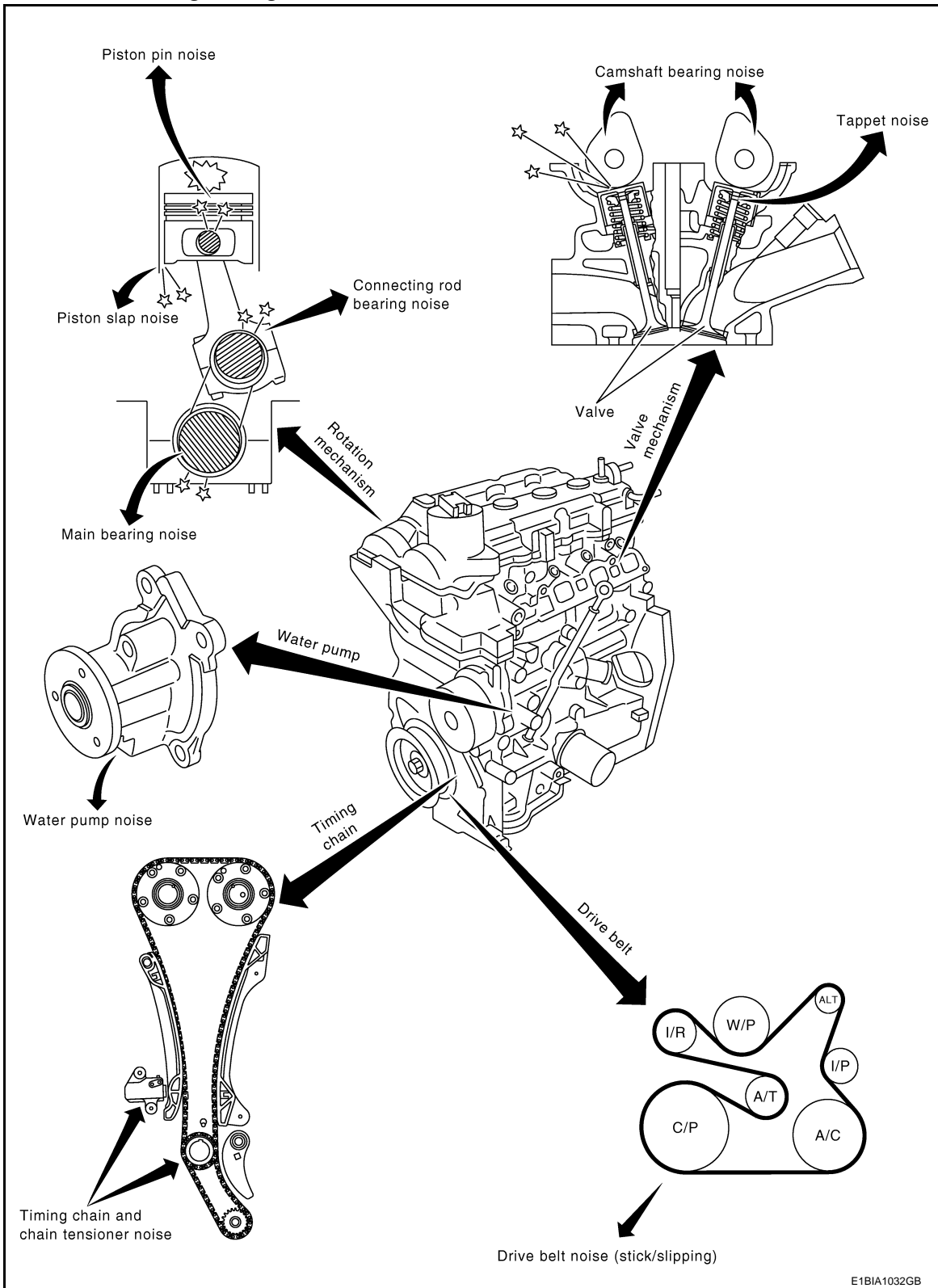
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NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HRA2DDT]

Use the Chart Below to Help You Find the Cause of the Symptom

INFOID:000000010282194

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-84
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-114 EM-114
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod small end clearance	EM-118 EM-121
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-118 EM-118 EM-118 EM-121
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod small end clearance Connecting rod bearing oil clearance	EM-118 EM-121
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-121 EM-118
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-102
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-114
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-23

A: Closely related B: Related C: Sometimes related —: Not related

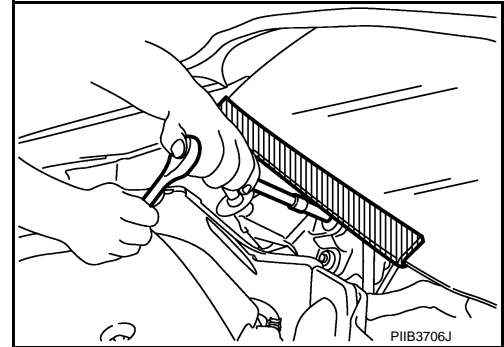
PRECAUTION

PRECAUTIONS

Precaution for Procedure without Cowl Top Cover

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc to prevent damage to windshield.

INFOID:0000000010479880



Precautions for Removing Battery Terminal

INFOID:0000000010508837

- With the adoption of Auto ACC function, ACC power is automatically supplied by operating the intelligent key or remote keyless entry or by opening/closing the driver side door. In addition, ACC power is supplied even after the ignition switch is turned to the OFF position, i.e. ACC power is supplied for a certain fixed time.
- When disconnecting the 12V battery terminal, turn off the ACC power before disconnecting the 12V battery terminal, observing "How to disconnect 12V battery terminal" described below.

NOTE:

Some ECUs operate for a certain fixed time even after ignition switch is turned OFF and ignition power supply is stopped. If the battery terminal is disconnected before ECU stops, accidental DTC detection or ECU data damage may occur.

- For vehicles with the 2-batteries, be sure to connect the main battery and the sub battery before turning ON the ignition switch.

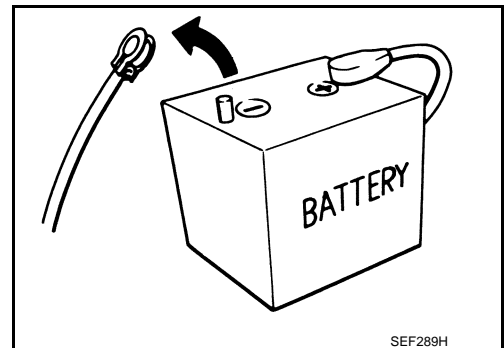
NOTE:

If the ignition switch is turned ON with any one of the terminals of main battery and sub battery disconnected, then DTC may be detected.

- After installing the 12V battery, always check "Self Diagnosis Result" of all ECUs and erase DTC.

NOTE:

The removal of 12V battery may cause a DTC detection error.



HOW TO DISCONNECT 12V BATTERY TERMINAL

Disconnect 12V battery terminal according to Instruction 1 or Instruction 2 described below. For vehicles parked by ignition switch OFF, refer to Instruction 2.

INSTRUCTION 1

1. Open the hood.
2. Turn key switch to the OFF position with the driver side door opened.
3. Get out of the vehicle and close the driver side door.
4. Wait at least 3 minutes. For vehicle with the engine listed below, remove the battery terminal after a lapse of the specified time.

- D4D engine : 20 minutes
- HRA2DDT : 12 minutes
- K9K engine : 4 minutes
- M9R engine : 4 minutes
- R9M engine : 4 minutes
- V9X engine : 4 minutes

CAUTION:

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PRECAUTIONS

[HRA2DDT]

< PRECAUTION >

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

5. Remove 12V battery terminal.

CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

INSTRUCTION 2 (FOR VEHICLES PARKED BY IGNITION SWITCH OFF)

1. Unlock the door with intelligent key or remote keyless entry.

NOTE:

At this moment, ACC power is supplied.

2. Open the driver side door.
3. Open the hood.
4. Close the driver side door.
5. Wait at least 3 minutes.

CAUTION:

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

6. Remove 12V battery terminal.

CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

Parts Requiring Angle Tightening

INFOID:000000010282197

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
 - Cylinder head bolts
 - Main bearing cap bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Never use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000010508838

CAUTION:

Comply with the following cautions to prevent any error and malfunction.

- **Before removing and installing any control units, first turn the ignition power source and accessory power source to the OFF, then disconnect both battery cables.**
- **After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.**
- **Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.**

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.

If turning the steering wheel is required with the battery disconnected or discharged, follow the operation procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.

NOTE:

Supply power using jumper cables if battery is discharged.

2. Open driver door.
3. Turn the ignition switch to the ON position.
(At this time, the steering lock will be released.)
4. Turn the ignition switch to OFF position with driver door open.
5. Wait for 3 minutes or longer with driver door open.

NOTE:

- Do not close driver door because the steering wheel locks when driver door is closed.

PRECAUTIONS

[HRA2DDT]

< PRECAUTION >

- The auto acc function is adapted to this vehicle. For this reason, even when the ignition switch is turned to OFF position, the accessory power source does not turned OFF and continues to be supplied for a certain amount of time.
6. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
 7. Perform the necessary repair operation.
 8. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from OFF position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
 9. Perform self-diagnosis check of all control units using CONSULT.

Liquid Gasket

INFOID:000000010282198

REMOVAL OF LIQUID GASKET

- After removing the mounting bolts and nuts, separate the mating surface using seal cutter (SST) and remove the old liquid gasket sealing.

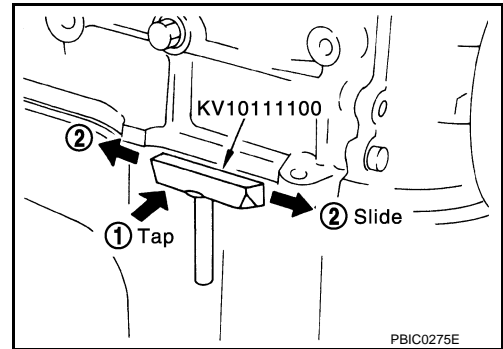
CAUTION:

Be careful not to damage the mating surfaces.

- Tap seal cutter to insert it (1), and then slide it (2) by tapping on the side as shown in the figure.
- In areas where seal cutter is difficult to use, use plastic hammer to lightly tap the parts, to remove it.

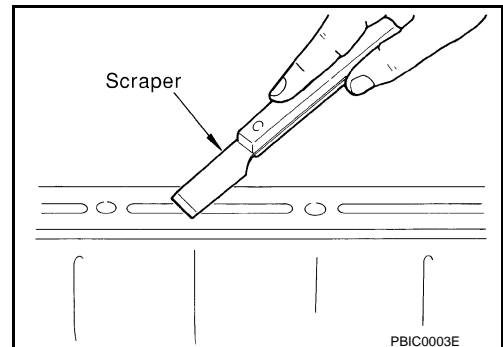
CAUTION:

If for some unavoidable reason tool such as screwdriver is used, be careful not to damage the mating surfaces.

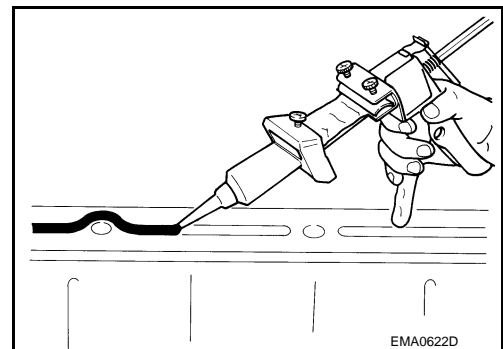


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old liquid gasket adhering to the liquid gasket application surface and the mating surface.
 - Remove the liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



3. Attach liquid gasket tube to the tube presser (commercial service tool).
Use Genuine Liquid Gasket or equivalent.
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.



PRECAUTIONS

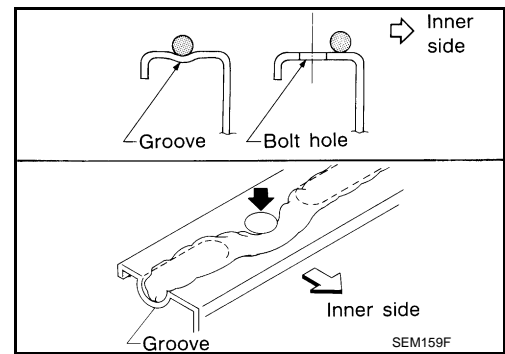
[HRA2DDT]

< PRECAUTION >

- As for the bolt holes, normally apply the liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of service manual.
- Within 5 minutes of liquid gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nut after the installation.
- Wait 30 minutes or more after installation before refilling engine oil and engine coolant.

CAUTION:

If there are specific instructions in this manual, observe them.



PREPARATION

< PREPARATION >

[HRA2DDT]

PREPARATION

PREPARATION

Special Service Tools

INFOID:000000010282199

A

EM

NISSAN tool number (RENAULT tool number) Tool name	Description
KV10111100 (—) Seal cutter	Removing oil pan (lower and upper) etc.
KV113E0010 (Mot.1566) Fuel tube adapter	Tool for removing fuel tube
KV10112100 (—) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
KV10117100 (—) Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor 1 For 22 mm (0.87 in) width hexagon nut
— (Mot.1533) Injector seal fitter	Tool for installing injector seal
— (Mot.1431) Flywheel locking tool	To lock flywheel

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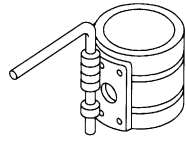
P

PREPARATION

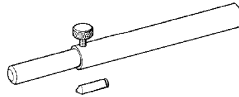
[HRA2DDT]

< PREPARATION >

NISSAN tool number (RENAULT tool number) Tool name	Description
EM03470000 (—) Piston ring compressor	Installing piston assembly into cylinder bore
KV113B0180 (Mot.1511) Valve seal drift	Tool for installing valve stem seals
Quick connector release	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
KV113B0090 (Mot.1335) Valve seal remover	Tool for removing valve stem seals



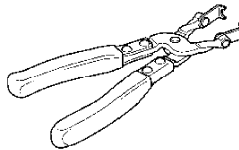
S-NT044



MBIB0378E



PBIC0198E

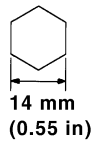


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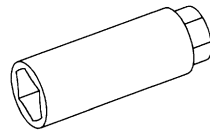
Commercial Service Tools

INFOID:000000010282200

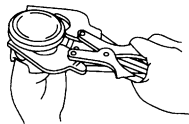
Tool name	Description
Spark plug wrench	Removing and installing spark plug
Piston ring expander	Removing and installing piston ring



14 mm
(0.55 in)



PBIC3874E

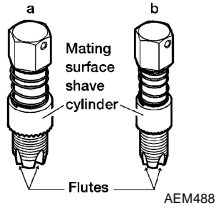

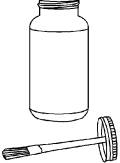
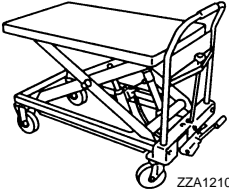
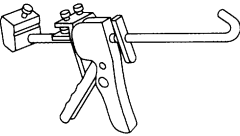


S-NT030

PREPARATION

< PREPARATION >

[HRA2DDT]

Tool name	Description
<p>Oxygen sensor thread cleaner</p> 	<p>Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) a = 18 mm (0.71 in) dia. for zirconia heated oxygen sensor b = 12 mm (0.47 in) dia. for titania heated oxygen sensor</p>
<p>Acoustic tension gauge</p> 	<p>Checking drive belt tension</p>
<p>Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)</p> 	<p>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>
<p>Manual lift table caddy</p> 	<p>Removing and installing engine</p>
<p>Tube presser</p> 	<p>Pressing the tube of liquid gasket</p>

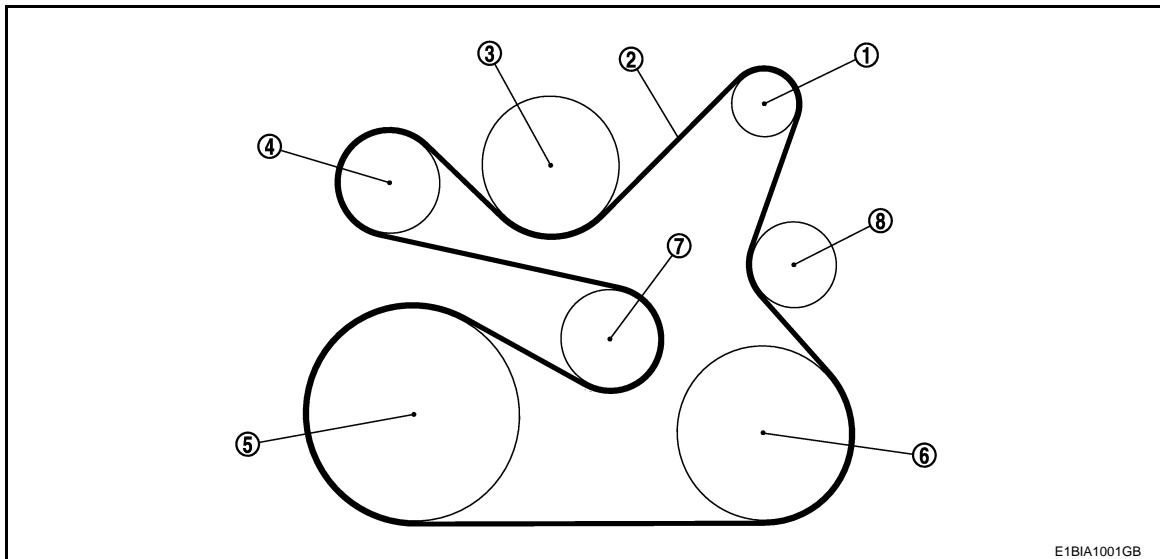
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PERIODIC MAINTENANCE

DRIVE BELT

Exploded View

INFOID:000000010282201



- | | | |
|------------------------------|-----------------|-------------------|
| 1. Alternator | 2. Drive belt | 3. Water pump |
| 4. Idler roller | 5. Idler pulley | 6. A/C Compressor |
| 7. Drive belt auto-tensioner | | |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Checking

INFOID:000000010282202

CAUTION:

- Replace the drive belt that has been removed with a new one.
- Drive belt auto-tensioner, idler pulley and idler roller must be replaced with new ones when the drive belt is replaced.
- Never run the engine without the drive belt to avoid damaging the crankshaft pulley.

Tension Adjustment

INFOID:000000010282203

Refer to [EM-114, "Drive Belts"](#).

Removal and Installation

INFOID:000000010282204

CAUTION:

- Replace the drive belt that has been removed with a new one.
- Drive belt auto-tensioner and idler pulley must be replaced with new ones when the drive belt is replaced.
- Never run the engine without the drive belt to avoid damaging the crankshaft pulley.

REMOVAL

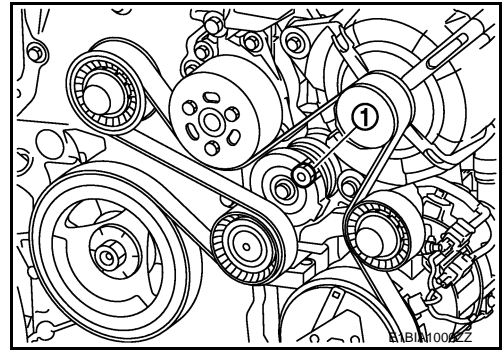
1. Remove front fender protector (RH). Refer to [EXT-31, "Exploded View"](#).

DRIVE BELT

[HRA2DDT]

< PERIODIC MAINTENANCE >

2. Release the tension on the drive belt by turning drive belt auto-tensioner (1) clockwise using a 16mm (0.63 in) socket and hold drive belt auto-tensioner to this position.



3. Remove drive belt.
4. Release the drive belt auto-tensioner until normal position.

CAUTION:

- Clean with a brush the v-block of the crankshaft pulley to remove all dust.

INSTALLATION

1. Rotate drive belt auto-tensioner clockwise using a 16mm (0.63 in) socket and hold it.
2. Install drive belt.

CAUTION:

- Check that drive belt is completely set to pulleys.
 - Check for engine oil, working fluid and engine coolant are not adhered to drive belt and each pulley groove.
3. Release the drive belt auto-tensioner until drive belt tension is apply.
 4. Turn crankshaft clockwise twice to set drive belt tension on all pulleys.
 5. Install in the reverse order of removal.

< PERIODIC MAINTENANCE >

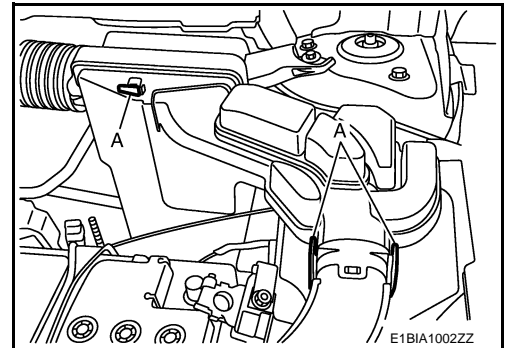
AIR CLEANER FILTER

Removal and Installation

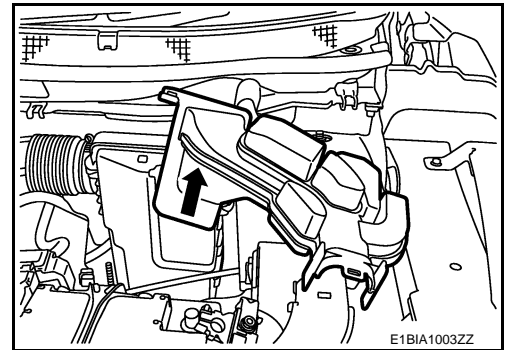
INFOID:000000010282205

REMOVAL

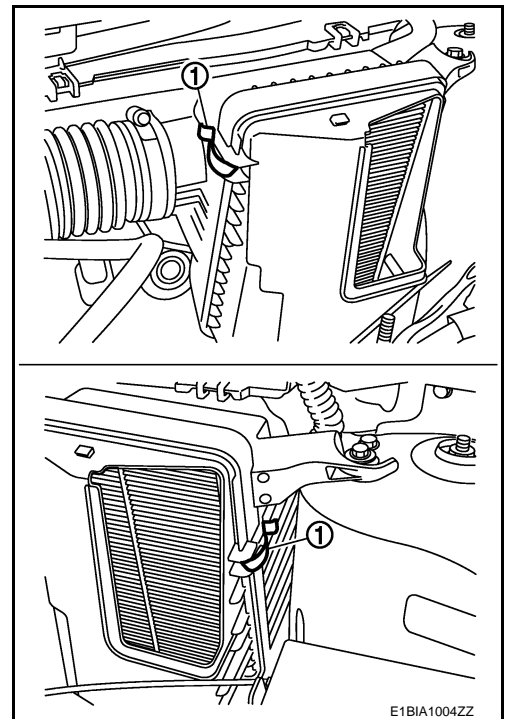
1. Press the points (A) to separate air resonator from air duct and air cleaner filter unit.



2. Remove air resonator following the arrow.



3. Unhook clips (1) on the air cleaner filter holder.

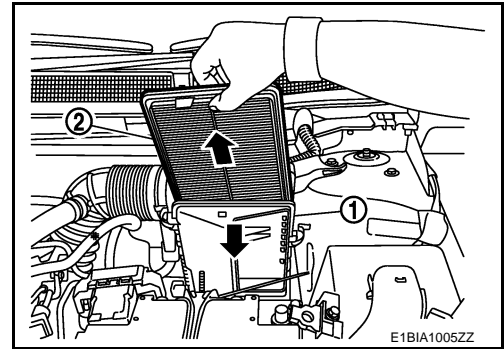


AIR CLEANER FILTER

[HRA2DDT]

< PERIODIC MAINTENANCE >

4. Separate air cleaner filter holder (1) from air cleaner filter unit and remove air cleaner filter (2).



INSTALLATION

Install in the reverse order of removal.

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SPARK PLUG

Removal and Installation

INFOID:000000010282206

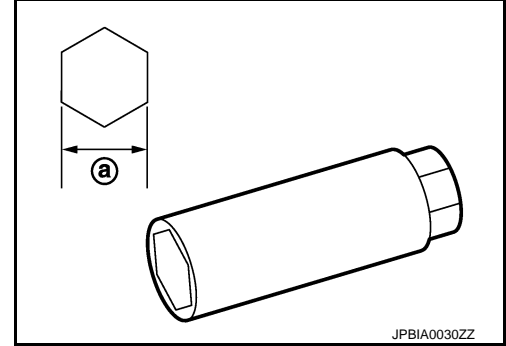
REMOVAL

1. Remove ignition coil. Refer to [EM-49, "Exploded View"](#).
2. Remove spark plug with a spark plug wrench (commercial service tool).

a : 14 mm (0.55 in)

CAUTION:

Never drop or shock spark plug.



INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:000000010282207

INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

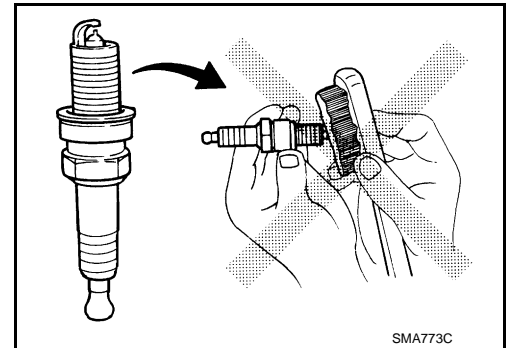
Spark plug (Standard type) : Refer to [EM-114, "Spark Plug"](#).

CAUTION:

- Never drop or shock spark plug.
- Never use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure : Less than 588 kPa (6 kg/cm², 85 psi)

Cleaning time : Less than 20 seconds



DRIVE BELT IDLER PULLEY

< REMOVAL AND INSTALLATION >

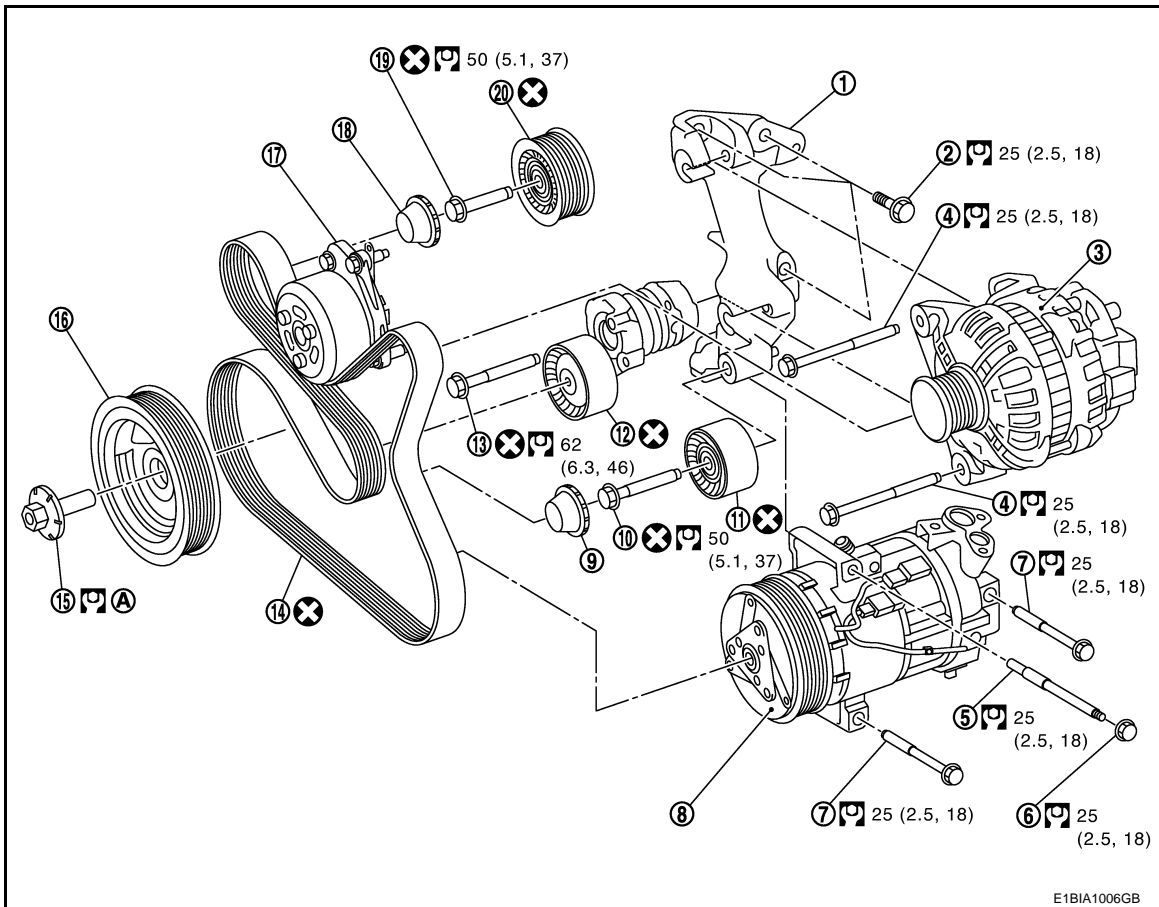
[HRA2DDT]

REMOVAL AND INSTALLATION

DRIVE BELT IDLER PULLEY

Exploded View

INFOID:000000010282210



E1BIA1006GB

- | | | |
|------------------------------------|---------------------------------------|-------------------------------|
| 1. Multifunction support bracket | 2. Multifunction support bracket bolt | 3. Alternator |
| 4. Alternator bolt | 5. A/C compressor stud | 6. A/C compressor nut |
| 7. A/C compressor bolt | 8. A/C compressor | 9. Cap |
| 10. Idler pulley bolt | 11. Idler pulley | 12. Drive belt auto-tensioner |
| 13. Drive belt auto-tensioner bolt | 14. Drive belt | 15. Crankshaft pulley bolt |
| 16. Crankshaft pulley | 17. Water pump | 18. Cap |
| 19. Idler roller bolt | 20. Idler roller | |

A Refer to [EM-58](#)

Refer to [GI-4. "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282211

CAUTION:

- Replace the drive belt that has been removed with a new one.
- Drive belt auto-tensioner, idler pulley and idler roller must be replaced with new ones when the drive belt is replaced.
- Never run the engine without the drive belt to avoid damaging the crankshaft pulley.

REMOVAL

1. Remove drive belt. Refer to [EM-21. "Removal and Installation"](#).
2. Remove drive belt auto-tensioner.
3. Remove the idler pulley and roller pulley.
4. Remove multifunction support bracket with the following procedure:

DRIVE BELT IDLER PULLEY

[HRA2DDT]

< REMOVAL AND INSTALLATION >

- a. Disconnect the battery cable from the negative terminal.
- b. Remove alternator. Refer to [CHG-28, "HRA2DDT : Removal and Installation"](#).
- c. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to [HA-31, "Removal and Installation"](#).
- d. Remove multifunction support bracket

INSTALLATION

1. Install in the reverse order of removal.

AIR CLEANER AND AIR DUCT

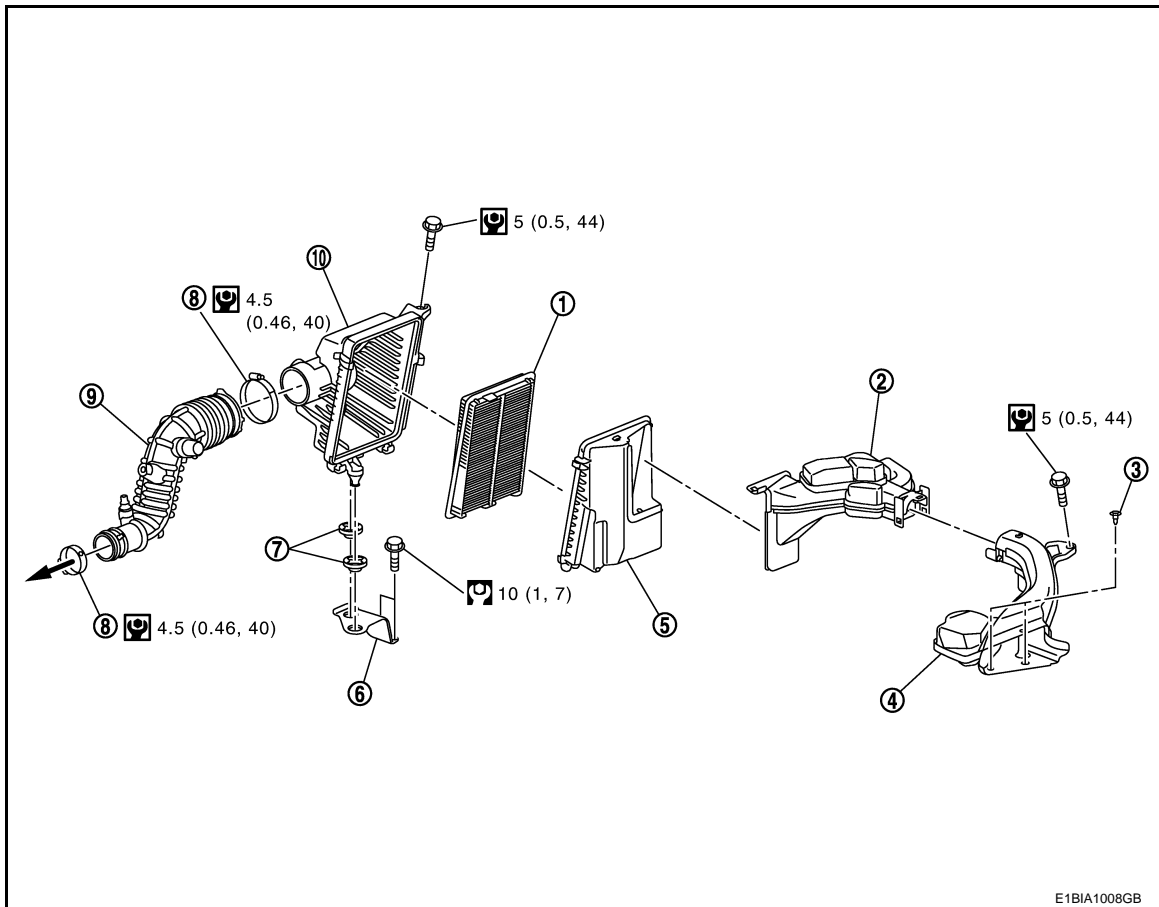
< REMOVAL AND INSTALLATION >

[HRA2DDT]

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:00000001028212



- | | | |
|-----------------------------|------------------|------------------------------------|
| 1. Air cleaner filter | 2. Air resonator | 3. Clip |
| 4. Air duct (inlet) | 5. Holder | 6. Air cleaner filter unit bracket |
| 7. Mounting rubber | 8. Clamp | 9. Air duct |
| 10. Air cleaner filter unit | | |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:00000001028213

REMOVAL

1. Remove air resonator.
2. Remove the air duct (inlet).
3. Remove air cleaner filter unit with air cleaner filter holder assembly.
 - Add matching marks if necessary for easier installation.
4. Disconnect:
 - EVAP vacuum hose from air duct.
 - bypass valve hose from air duct.
 - wastegate control valve from air duct.
 - Add matching marks if necessary for easier installation.
5. Remove air duct.

AIR CLEANER AND AIR DUCT

[HRA2DDT]

< REMOVAL AND INSTALLATION >

6. Remove air cleaner filter if necessary.

INSTALLATION

Note the following, and install in the reverse order of removal.

- Align marks. Attach each joint. Screw clamps firmly.

Inspection

INFOID:000000010282214

INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.

- If anything found, replace air duct and resonator.

INTAKE MANIFOLD

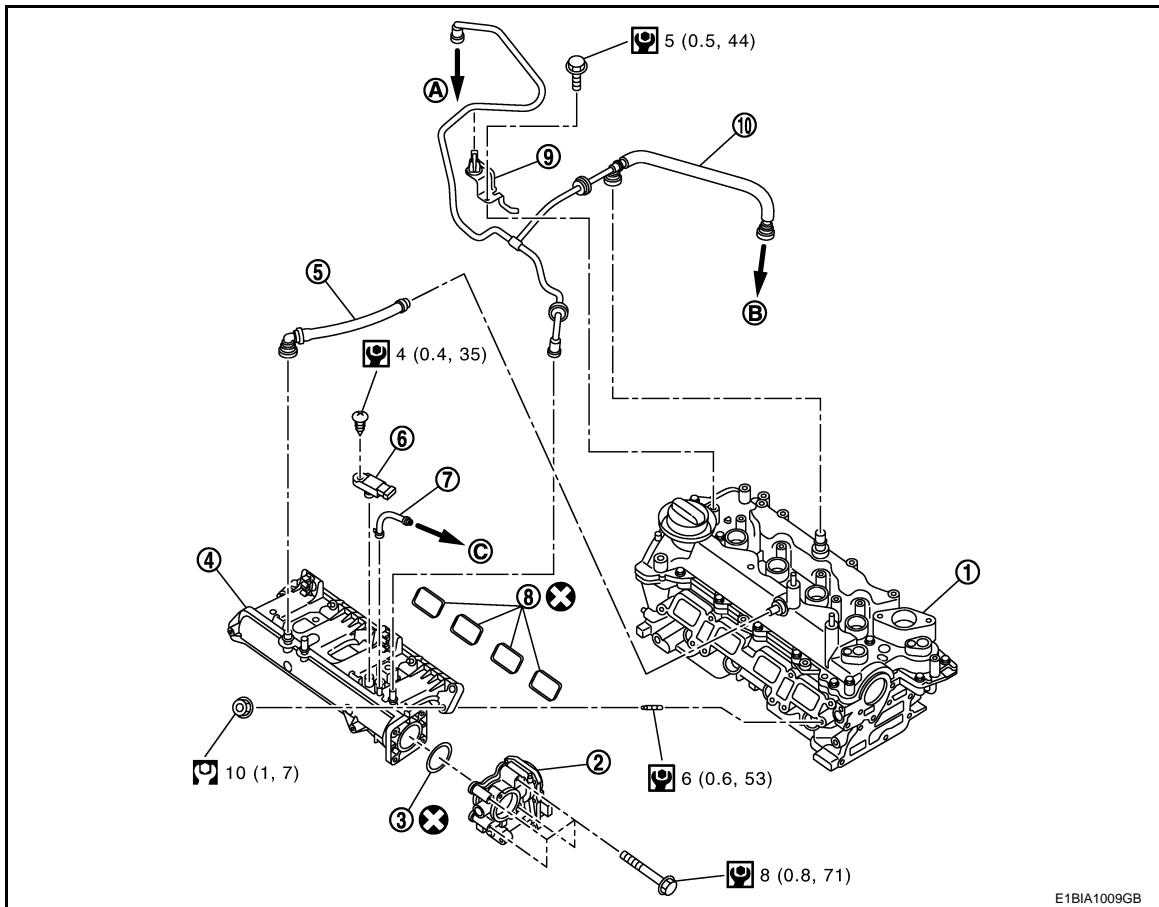
< REMOVAL AND INSTALLATION >

[HRA2DDT]

INTAKE MANIFOLD

Exploded View

INFOID:000000010282215



- | | | |
|--|---------------------------------------|-------------------------------------|
| 1. Cylinder head | 2. Electric throttle control actuator | 3. O-ring |
| 4. Intake manifold | 5. PCV hose | 6. Intake manifold pressure sensor |
| 7. Vacuum hose | 8. Intake manifold gasket | 9. EVAP canister purge hose bracket |
| 10. EVAP canister purge hose | | |
| A. To canister purge volume control solenoid valve | B. To air duct | C. To water outlet |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010282216

REMOVAL

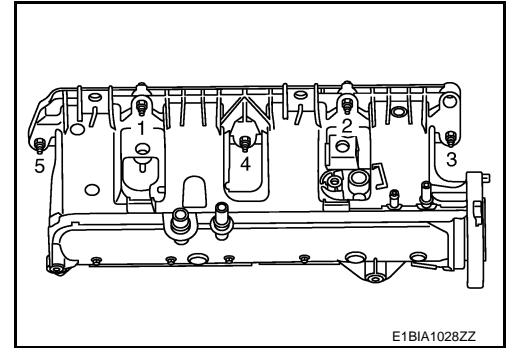
1. Remove charge air cooler inlet tube and hose. Refer to [EM-27. "Exploded View"](#).
2. Disconnect from intake manifold:
 - PCV hose.
 - EVAP canister purge hose.
 - Water outlet vacuum hose.
 - Brake booster hose.
3. Remove Intake manifold pressure sensor from intake manifold.
4. Remove oil level gauge.
CAUTION:
Cover the openings to avoid entry of foreign materials.
5. Remove electric throttle control actuator.
CAUTION:

INTAKE MANIFOLD

[HRA2DDT]

< REMOVAL AND INSTALLATION >

- Handle electric throttle control actuator carefully and avoid impacts.
 - Never disassemble or adjust electric throttle control actuator.
6. Remove intake manifold.
- Loosen bolts in the reverse of the order shown in the figure.

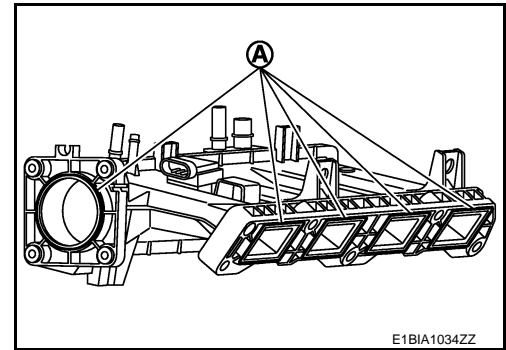


INSTALLATION

Note the following, and install in the reverse order of removal.

Intake Manifold

1. Oil and Install the gasket (A) to the intake manifold.

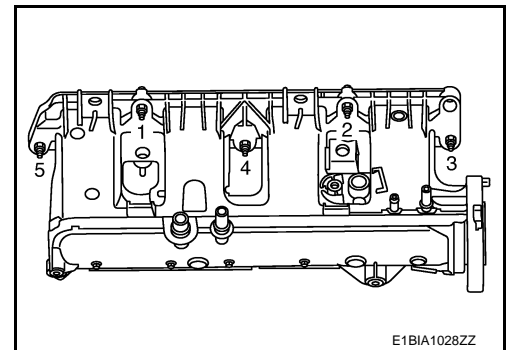


2. Place the intake manifold into the installation position.

CAUTION:

Make sure that the oil level gauge guide is not disconnected from the fixing clip of water inlet due to interference with intake manifold.

3. Tighten bolts in the numerical order shown in the figure.



Electric Throttle Control Actuator

- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform "Throttle Valve Closed Position Learning" after repair when removing harness connector of the electric throttle control actuator. Refer to [ECH-102, "Special Repair Requirement List"](#).
- Perform "Throttle Valve Closed Position Learning" and "Idle Air Volume Learning" after repair when replacing electric throttle control actuator. Refer to [ECH-102, "Special Repair Requirement List"](#) and [ECH-105, "Work Procedure"](#).

CHARGE AIR COOLER

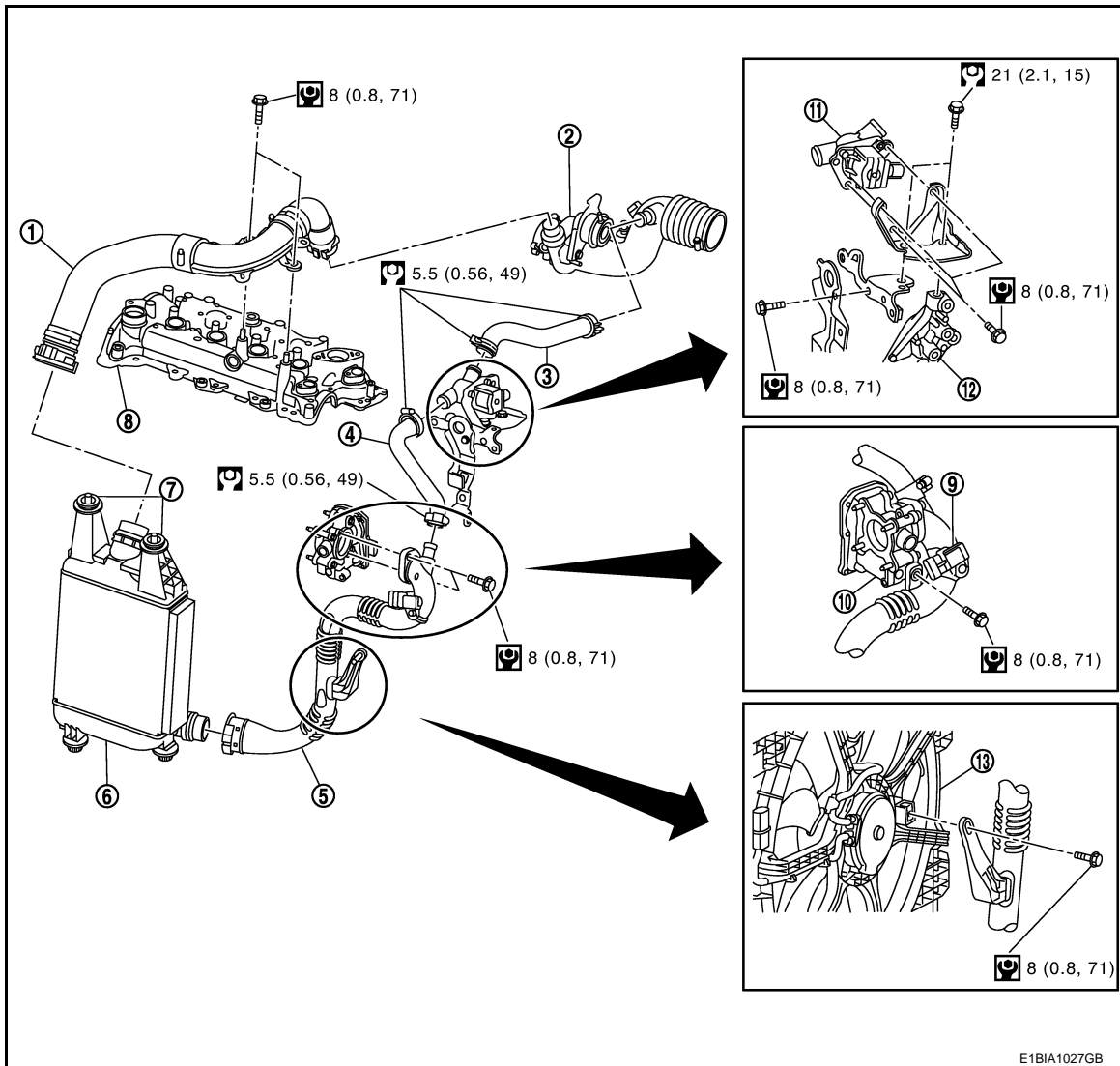
< REMOVAL AND INSTALLATION >

[HRA2DDT]

CHARGE AIR COOLER

Exploded View

INFOID:000000010287252



- | | | |
|--|-----------------------------|-----------------------------------|
| 1. Air inlet hose | 2. Turbocharger | 3. Electric blow off valve hose 1 |
| 4. Blow off valve hose 2 | 5. Air inlet tube | 6. Charge air cooler |
| 7. Mounting rubber | 8. Rocker cover | 9. Turbocharger boost sensor |
| 10. Electric throttle control actuator | 11. Electric blow off valve | 12. Cylinder head closing plate |
| 13. Cooling fan | | |

Refer to [GI-4. "Components"](#) for symbols description.

Removal and Installation

INFOID:000000010287253

REMOVAL

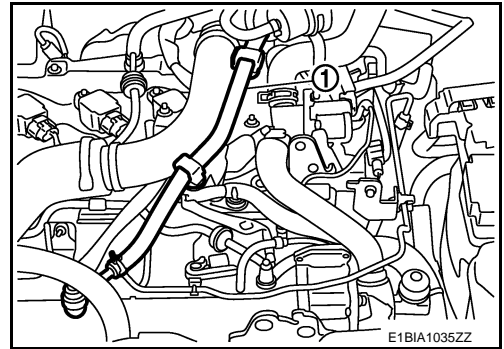
Air inlet hose

CHARGE AIR COOLER

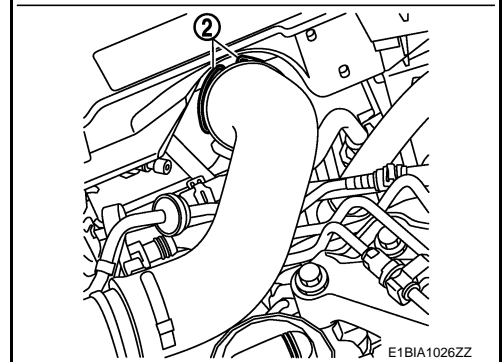
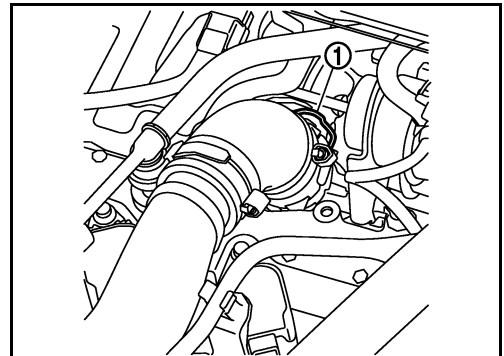
[HRA2DDT]

< REMOVAL AND INSTALLATION >

1. Unclip brake booster vacuum hose (1) from air inlet hose.



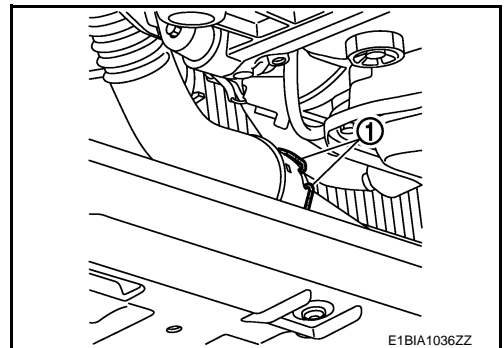
2. Remove charge air inlet hose nuts. Refer to [EM-27, "Exploded View"](#).
3. Disconnect air inlet hose from turbocharger by pulling on the clip (1).
4. Remove engine undercover.
5. Disconnect air inlet hose from charge aircooler by pulling on both end (2) of the clip.



6. Remove air inlet hose.

Air inlet tube.

1. Remove engine undercover.
2. Disconnect air inlet tube from charge aircooler by pulling on both end of the clip (1).



3. Remove air inlet tube bolt from cooling fan assembly.
4. Disconnect turbocharger boost sensor.
5. Disconnect electric blow off valve hose 2 from air inlet tube.

CHARGE AIR COOLER

< REMOVAL AND INSTALLATION >

[HRA2DDT]

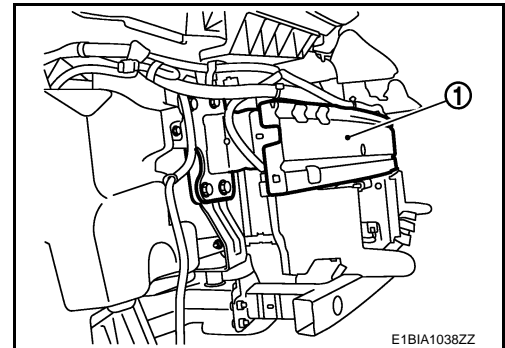
6. Remove air inlet tube.

Electric blow off valve.

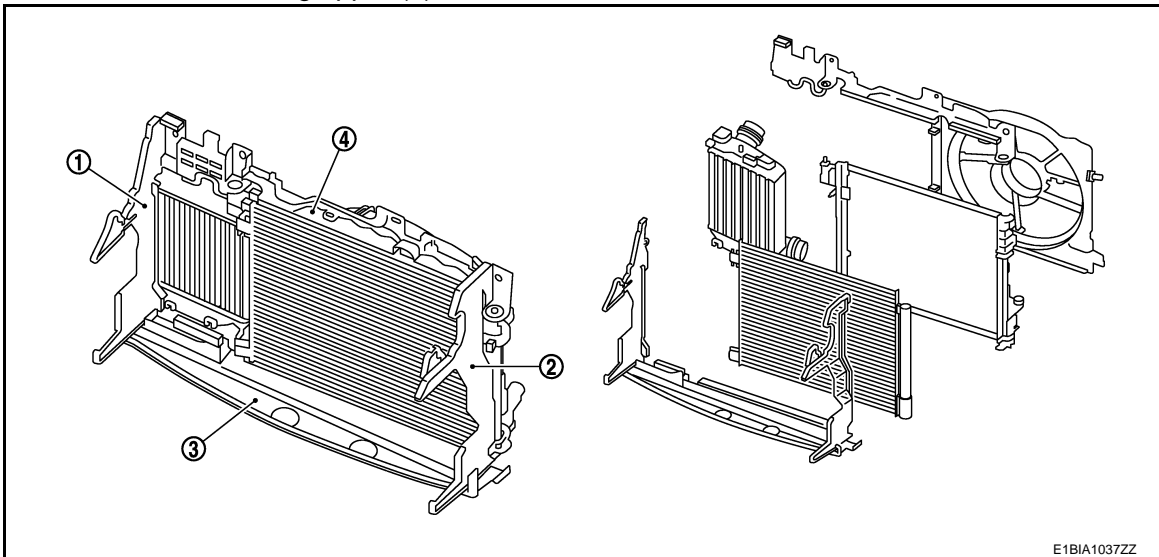
1. Remove electric blow off valve hose 1 from air duct.
2. Remove electric blow off valve hose 2 from air duct from air inlet tube.
3. Disconnect electric blow off valve connector.
4. Unclip vacuum hose from electric blow off valve bracket.
5. Remove engine slinger and bracket assembly (LH)
6. Remove electric blow off valve and bracket assembly bolt.
7. Separate electric blow off valve from bracket.

Charge air cooler.

1. Remove front bumper. Refer to [EXT-19, "Exploded View"](#).
2. Put aside front bumper reinforcement (1) with harness assembly.



3. Remove:
 - Radiator air guide RH (1).
 - Radiator air guide LH (2).
 - Radiator air guide lower (3).
 - Radiator bracket mounting upper (4)



4. Put aside radiator core support upper. Refer to [DLK-155, "HRA2DDT : Removal and Installation"](#) (Type 1), [DLK-333, "HRA2DDT : Removal and Installation"](#) (Type 2), [DLK-466, "HRA2DDT : Removal and Installation"](#) (Type 3), [DLK-602, "HRA2DDT : Removal and Installation"](#) (Type 4), [DLK-924, "HRA2DDT : Removal and Installation"](#) (Type 6)

CHARGE AIR COOLER

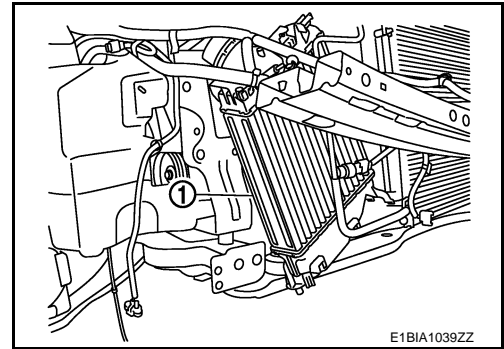
[HRA2DDT]

< REMOVAL AND INSTALLATION >

5. Unhook and rotate charge air cooler (1).
6. Remove charge air cooler.

CAUTION:

- Avoid interference between the charge air cooler and radiator.
- When removing charge air cooler, close opening on turbo charger and intake manifold with shop cloth or other suitable material.



INSTALLATION

Install in the reverse order of removal paying attention to the following points:

CAUTION:

Never reuse O-rings and gasket.

- Pay attention to identification mark and direction.
- Apply a neutral detergent (fluid) to the joint between hoses and pipes (oil is not permissible).
- Pay attention to air flow arrow on the electric blow off valve.

Inspection

INFOID:0000000010287254

INSPECTION AFTER REMOVAL

1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler in necessary.
 - Never deform core fins.
 - For cleaning procedure of charge air cooler core, refer to [CO-16, "Inspection"](#).

CATALYST

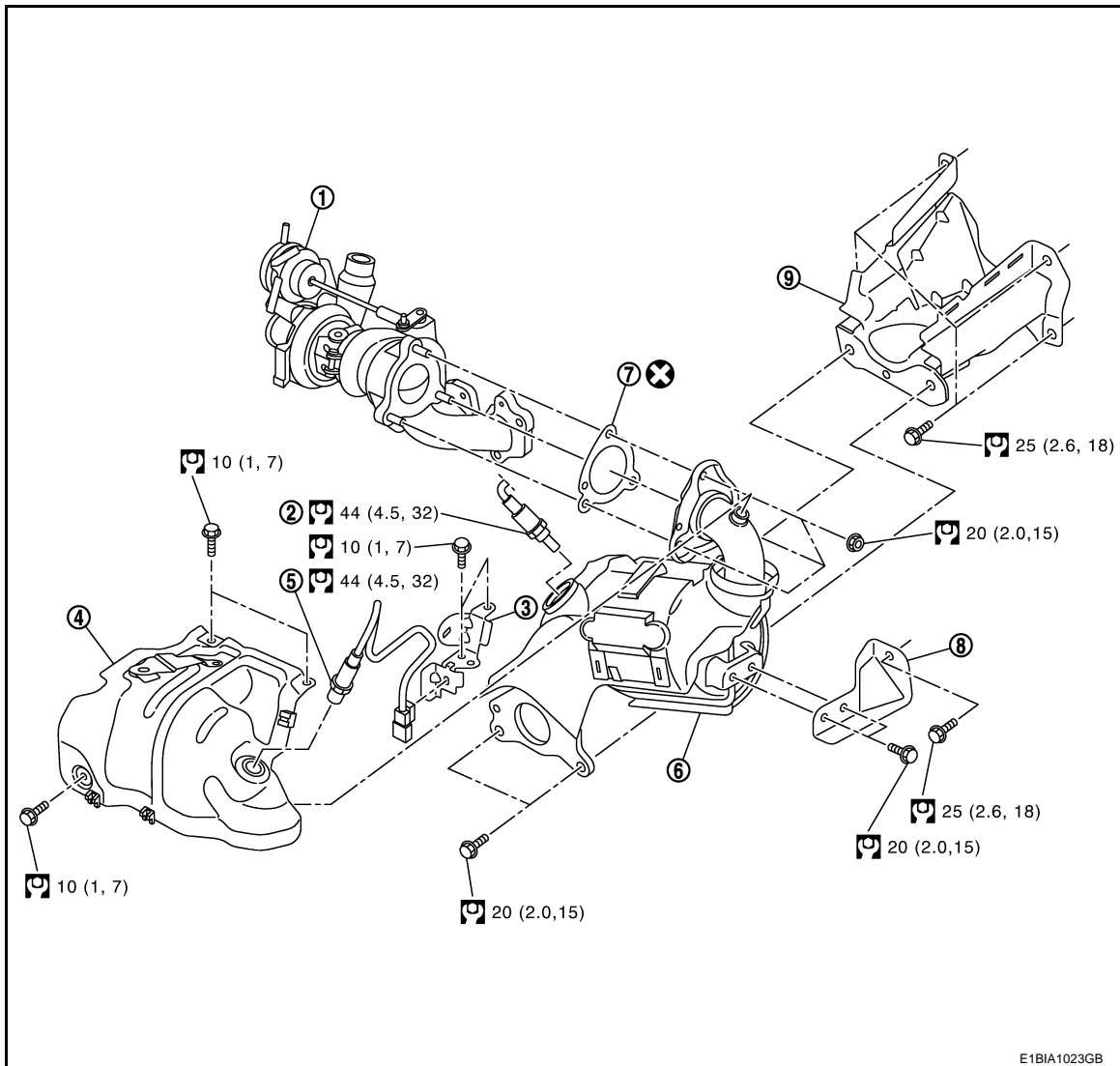
< REMOVAL AND INSTALLATION >

[HRA2DDT]

CATALYST

Exploded View

INFOID:000000010287257



- | | | |
|-----------------------------------|------------------------------------|---------------------------------------|
| 1. Turbocharger | 2. A/F sensor 2 | 3. A/F sensor 1 harness bracket |
| 4. Catalyst converter heat shield | 5. A/F sensor 1 | 6. Catalyst converter |
| 7. Gasket | 8. Catalyst converter side bracket | 9. Catalyst converter support bracket |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010287258

REMOVAL

1. Remove engine undercover.
2. Remove A/F sensor 1.
 - Using heated oxygen sensor wrench [SST: KV10117100], remove A/F sensor 1.
 - CAUTION:**
Handle A/F sensor 1 carefully and avoid impacts.
3. Remove A/F sensor 2.
 - Using heated oxygen sensor wrench [SST: KV10117100], remove A/F sensor 1.
 - CAUTION:**
Handle A/F sensor 1 carefully and avoid impacts.

CATALYST

[HRA2DDT]

< REMOVAL AND INSTALLATION >

4. Remove catalyst converter heat shield.
5. Remove front tube. Refer to [EX-6, "Exploded View"](#).
6. Remove nuts of catalyst converter turbocharger side.
7. Remove catalyst converter side bracket.
8. Remove catalyst converter.
9. Remove catalyst converter gasket.
10. Remove catalyst converter support bracket.

INSTALLATION

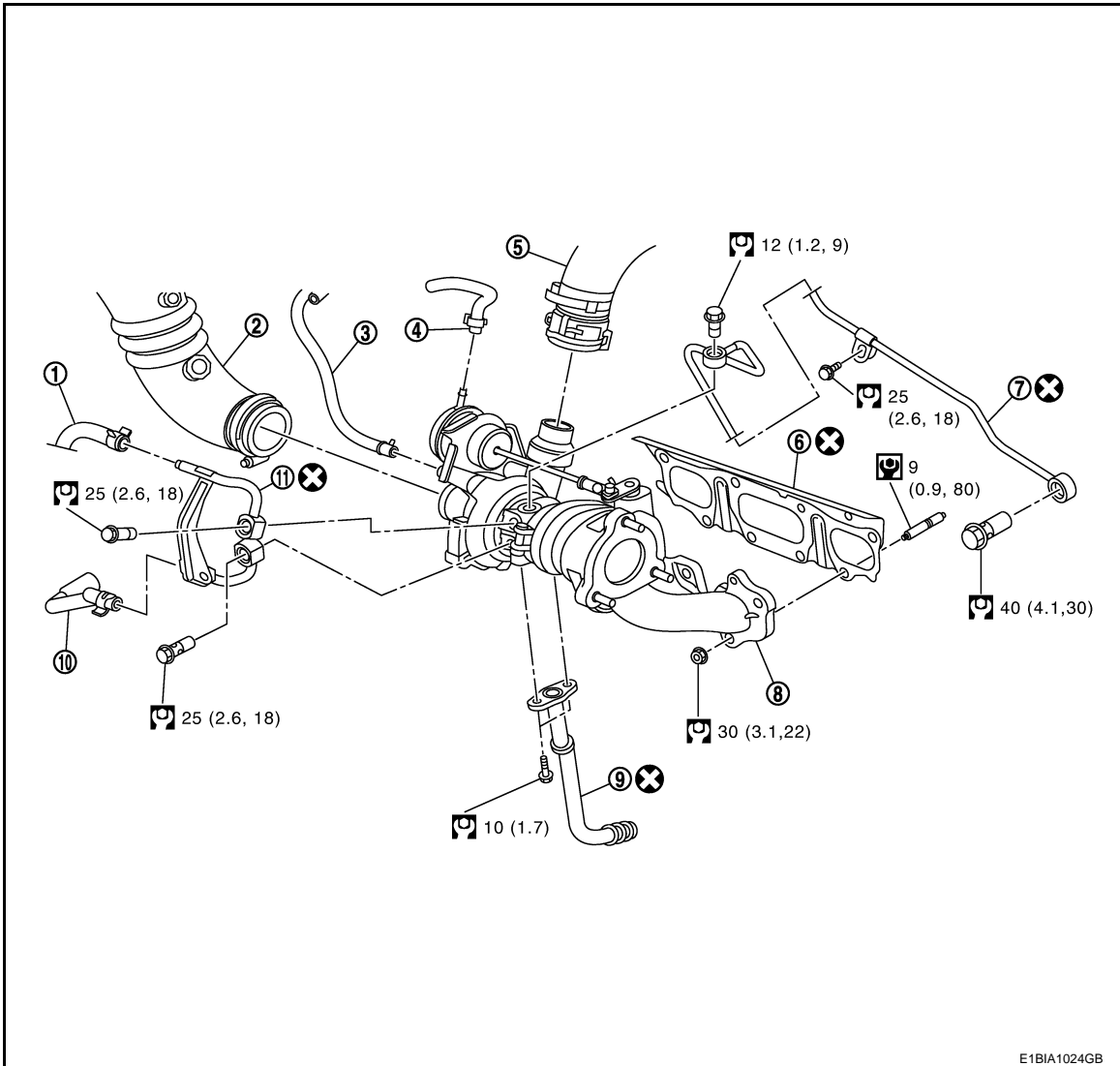
1. Install new gasket between turbocharger and catalyst.

2. Note the following, and install in the reverse order of removal.
A/F sensor 1
A/F sensor 2
 - Using heated oxygen sensor wrench [SST: KV10117100], install A/F sensors.**CAUTION:**
Prevent rust preventives from adhering to the sensor body.

TURBOCHARGER

Exploded View

INFOID:000000010287261



- | | | |
|--------------------|---|--|
| 1. Water hose | 2. Air duct | 3. Exhaust gas pressure take off hose |
| 4. Wastegate hose | 5. Air inlet hose | 6. Exhaust manifold and turbocharger assembly gasket |
| 7. Oil supply tube | 8. Exhaust manifold and turbocharger assembly | 9. Oil return pipe |
| 10. Water hose | 11. Turbocharger water pipe | |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010287262

REMOVAL

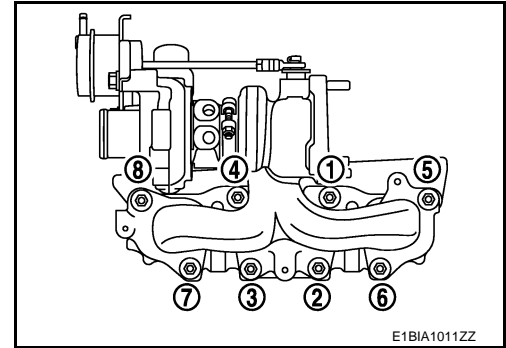
1. Drain engine coolant. Refer to [CO-11. "Draining"](#).
2. Remove engine undercover.
3. Remove air inlet hose. Refer to [EM-27. "Removal and Installation"](#).
4. Remove air cleaner filter unit assembly and air duct. Refer to [EM-23. "Exploded View"](#).
5. Remove turbocharger heat shield.

TURBOCHARGER

[HRA2DDT]

< REMOVAL AND INSTALLATION >

6. Disconnect from turbocharger:
 - Exhaust gas pressure take off hose.
 - Wastegate control hose.
7. Remove cowl top extension. Refer to [EXT-29. "Removal and Installation"](#).
8. Remove exhaust front tube. Refer to [EX-6. "Exploded View"](#).
9. Remove catalyst converter and catalyst converter support bracket. Refer to [EM-31. "Exploded View"](#).
10. Remove turbocharger assembly as follows. Refer to [EM-33. "Exploded View"](#):
 - a. Remove oil return tube and oil supply tube.
 - b. Disconnect water hose from turbocharger.
 - c. Remove mounting nuts of exhaust manifold in the reverse order as shown in the figure.



- d. Remove turbocharger and exhaust manifold assembly.
- e. Remove exhaust manifold gasket.

CAUTION:

- Be careful not to impact or damage turbocharger when removing.
- Never disassemble the turbocharger body.

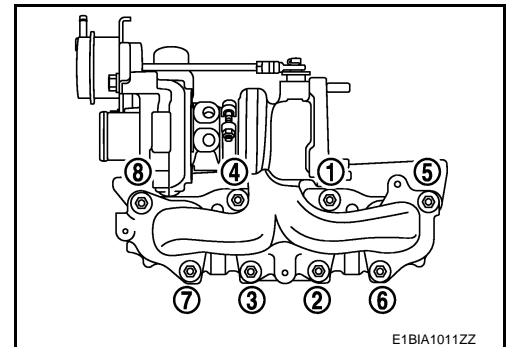
INSTALLATION

CAUTION:

Never reuse gasket, oil tube and water pipe.

Note the following, and Install in the reverse order of removal.

1. Install turbocharger and exhaust manifold assembly as follows:
 1. Install new exhaust manifold gasket.
 2. Tighten exhaust manifold bolts in the numerical order as shown in the figure.
 3. Torque tighten exhaust manifold bolts. Refer to [EM-37. "Exploded View"](#).



Inspection

INFOID:000000010287263

INSPECTION PROCEDURE

Trouble Diagnosis of Turbocharger

Check items before trouble diagnosis

1. Check that the engine oil level is between L (Low level) and H (High level) of the oil level gauge. [When the engine oil amount is more than H (High level), the engine oil flows into the inlet duct through the blow-by gas passage, and the turbocharger is misjudged failure.]
2. Ask the customer if he/she always runs the vehicle in idle engine speed to cool the engine oil down after driving.

TURBOCHARGER

< REMOVAL AND INSTALLATION >

[HRA2DDT]

- Replace the exhaust manifold and turbocharger assembly when any malfunction is found after unit inspections specified in the table below.
- If no malfunction is found after the unit inspections, judge that the turbocharger body has no non-standard conditions. Check the other parts again.

Inspection Location	Result	Symptoms likely to occur when the results shown on the left exist.			
		Oil leakage	Smoke	Noise	Poor power Poor acceleration
Turbine wheel	Wet with oil.	C	A	C	C
	Carbon deposits observed.	C	A	B	B
	“Rubs against” housing.	C	B	A	B
	Vane is bent or broken.			A	A
Compressor wheel	Inside of intake port is badly stained with oil.	B	B		
	“Rubs against” housing.	C	B	A	B
	Vane is bent or broken.			A	A
Check both turbine and compressor rotor shaft end play.	Heavy feel or catching when turned by hand.		C	C	B
	Cannot be turned by hand.				A
	Excessively loose bearing.	C	C	B	C
Rotor shaft, oil return port (Check inside using penlight.)	Carbon or sludge deposits in oil drain port.	C	A	C	C
Boost control valve actuator operation (using a handy pump)	<ul style="list-style-type: none"> • Does not operate smoothly when air pressure is gradually applied. • Stroke amount is not compliance with the air pressure. 				A

A: Highly possible. B: Possible. C: May exist.

INSPECTION AFTER REMOVAL

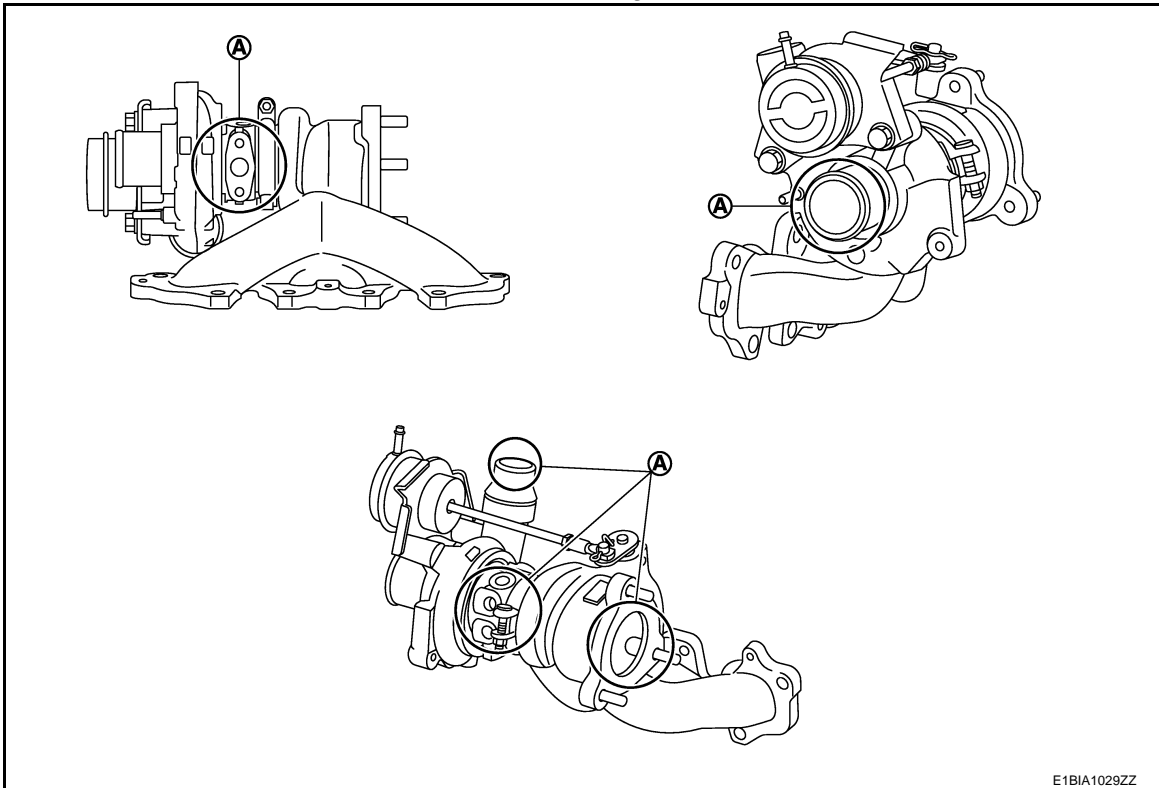
Turbocharger

TURBOCHARGER

< REMOVAL AND INSTALLATION >

[HRA2DDT]

Turbocharger



A. Check for leakage

CAUTION:

When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

Suction side : Between turbocharger and charge air cooler

Exhaust side : Between turbocharger and outlet duct

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

EXHAUST MANIFOLD

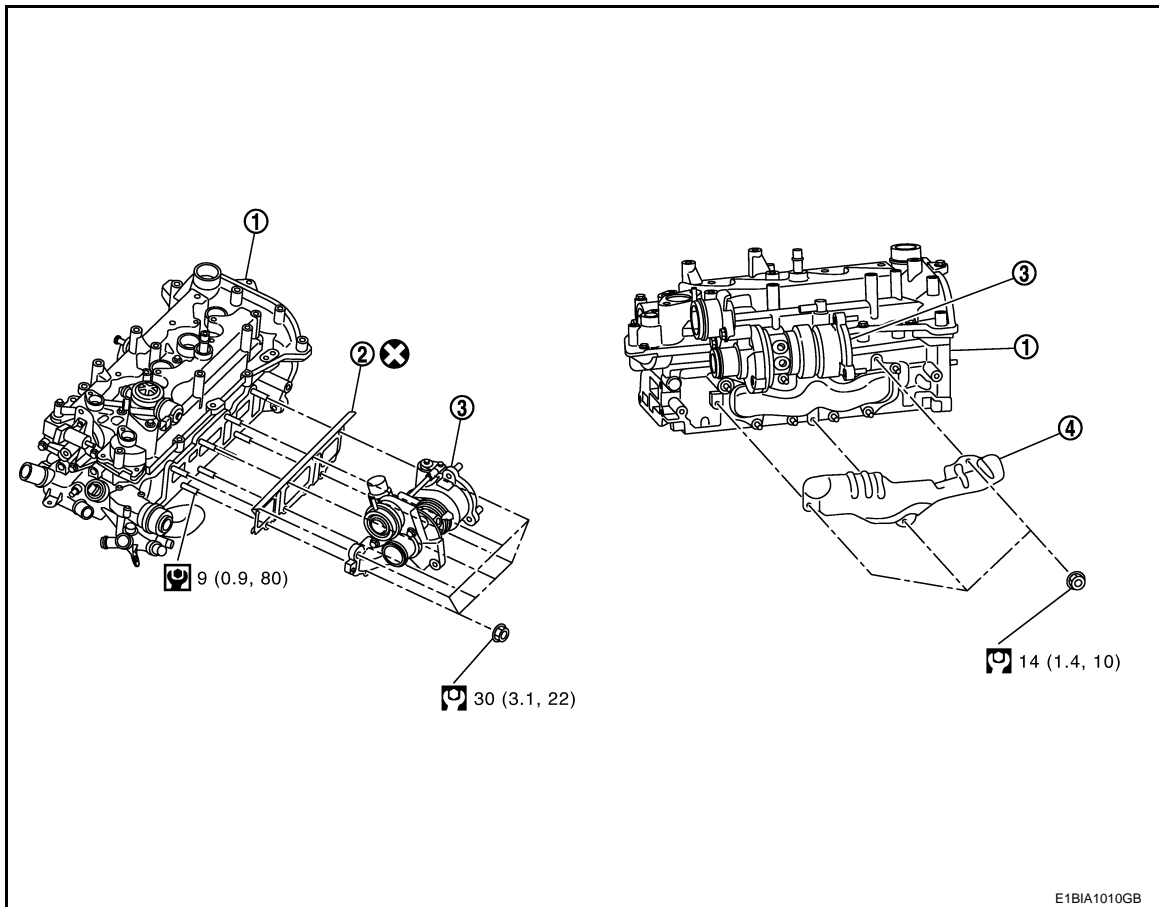
< REMOVAL AND INSTALLATION >

[HRA2DDT]

EXHAUST MANIFOLD

Exploded View

INFOID:000000010282217



1. Cylinder head
2. Exhaust manifold gasket
3. Exhaust manifold and turbocharger assembly
4. Exhaust manifold heat insulator

Refer to [GI-4. "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282218

REMOVAL

NOTE:

- Exhaust manifold and turbocharger are assembled in one part. Refer to [EM-33. "Removal and Installation"](#) for removal.

INSTALLATION

NOTE:

- Exhaust manifold and turbocharger are assembled in one part. Refer to [EM-33. "Removal and Installation"](#) for installation.

Inspection

INFOID:000000010282219

INSPECTION AFTER REMOVAL

NOTE:

- Exhaust manifold and turbocharger are assembled in one part. Refer to [EM-33. "Removal and Installation"](#) for inspection.

HIGH PRESSURE FUEL PUMP AND FUEL HOSE

< REMOVAL AND INSTALLATION >

[HRA2DDT]

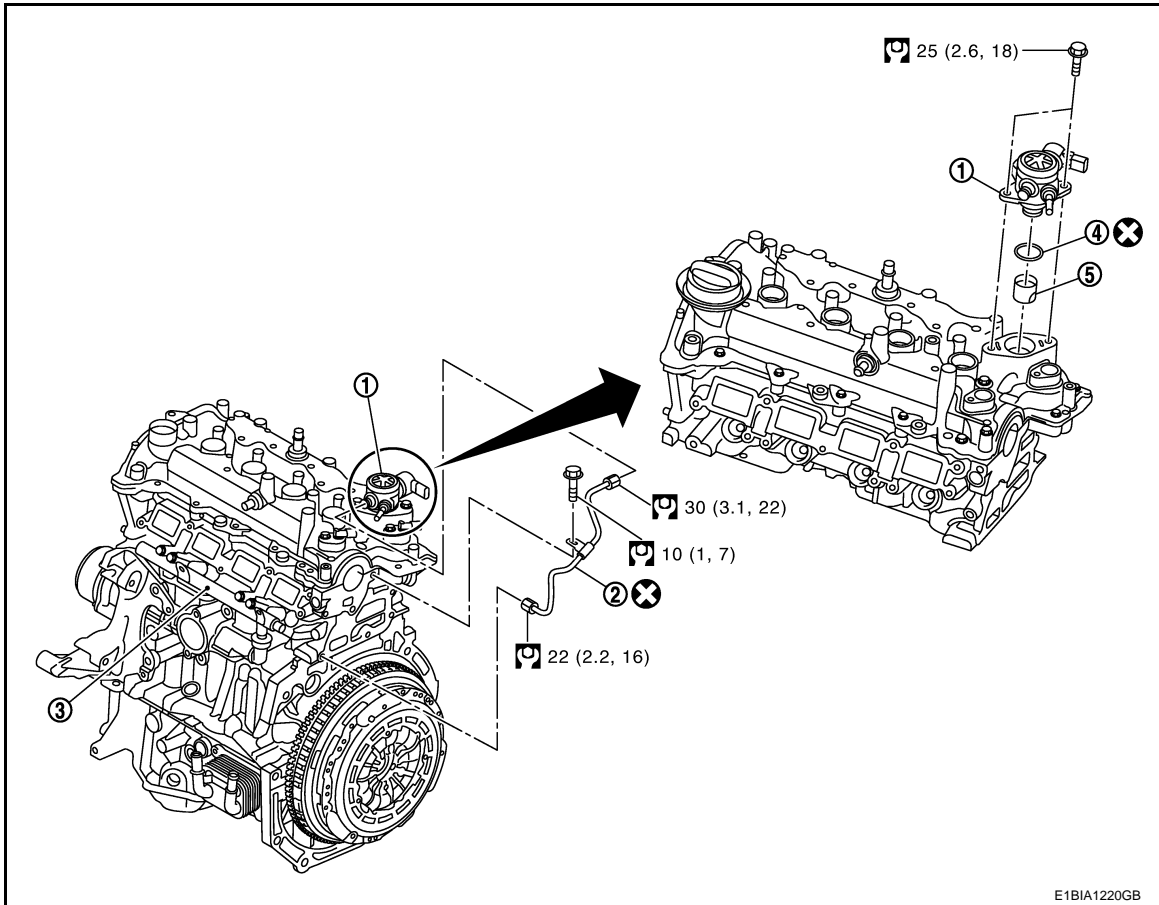
HIGH PRESSURE FUEL PUMP AND FUEL HOSE

Exploded View

INFOID:000000010287264

CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.



- | | | |
|-----------------------------------|-----------------------------------|----------------------------|
| 1. High pressure fuel pump | 2. High pressure fuel pipe | 3. High pressure fuel rail |
| 4. High pressure fuel pump O-ring | 5. High pressure fuel pump lifter | |

Refer to [GI-4, "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010287265

REMOVAL

WARNING:

- Be sure to read [FL-3, "General Precautions"](#) when working on the high pressure fuel system.
- Put a "CAUTION: FLAMMABLE" sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO2 fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.
- To avoid the danger of being scalded, never drain engine coolant when engine is hot.

1. Remove electric blow off valve. Refer to [EM-27, "Removal and Installation"](#).
2. Release fuel pressure.
3. Disconnect fuel feed hose quick connector with the following procedure. Disconnect fuel feed hose from high pressure fuel pump.

HIGH PRESSURE FUEL PUMP AND FUEL HOSE

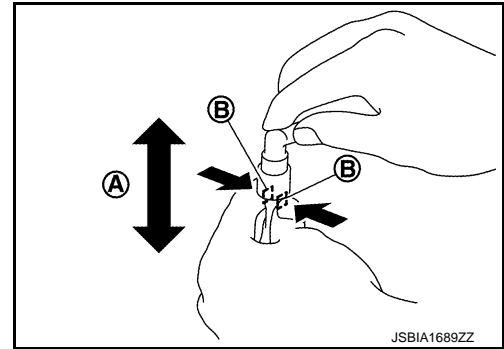
[HRA2DDT]

< REMOVAL AND INSTALLATION >

- a. Remove quick connector in the following procedures.
 - i. Hold the connector while pushing tabs, and pull out the tube.

- A : Pull
B : Push in tabs

- ii. If quick connector sticks to high pressure fuel pump, push and pull quick connectors several times until they start to move. Then disconnect them by pulling.



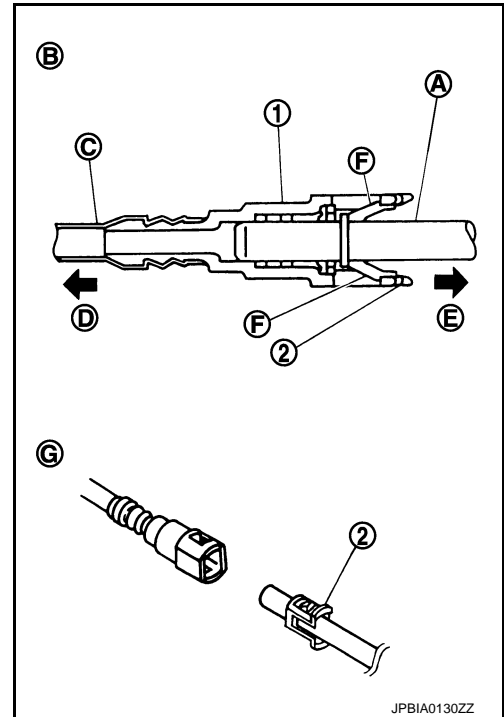
CAUTION:

- Quick connector (1) can be disconnected when the tabs of retainer (F) are depressed completely. Never twist it more than necessary.

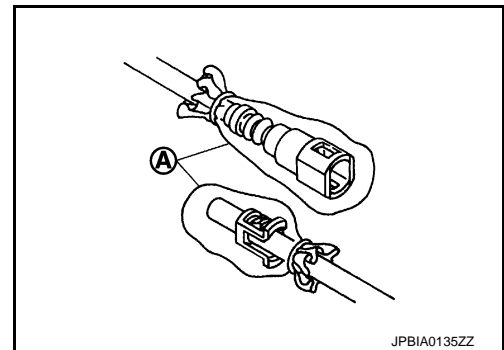
- B : Connection (cross-section)
D : To under floor fuel line
E : To engine
G : Disconnection

- Never use any tools to disconnected quick connector.
- Keep resin hose (C) away from heat. Be especially careful when welding near the resin hose.
- Prevent acid liquid such as battery electrolyte, etc. from getting on resin tube.
- Never bend or twist resin tube during installation and disconnection.
- Never remove the remaining retainer (2) on hard tube (or the equivalent) (A) except when resin tube or retainer is replaced.
- When resin tube or hard tube (or the equivalent) is replaced, also replace retainer with new one.

Retainer color : Green



- To prevent damage to each joint and protect it from the entry of foreign matter, cover the joint with plastic bag (A) or an equivalent.



4. Disconnect high pressure fuel pump connector.
5. Remove intake manifold. Refer to [EM-25. "Removal and Installation"](#).
6. Remove high pressure fuel pipe using [SST: KV113E0010 (Mot.1566)].
7. Remove high pressure fuel pump and lifter.

CAUTION:

To prevent damage to high pressure fuel pump and rocker cover, loosen high pressure fuel pump bolts alternately by one turn at a time until the reaction force applied on the high pressure fuel pump disappears.

INSTALLATION

HIGH PRESSURE FUEL PUMP AND FUEL HOSE

< REMOVAL AND INSTALLATION >

[HRA2DDT]

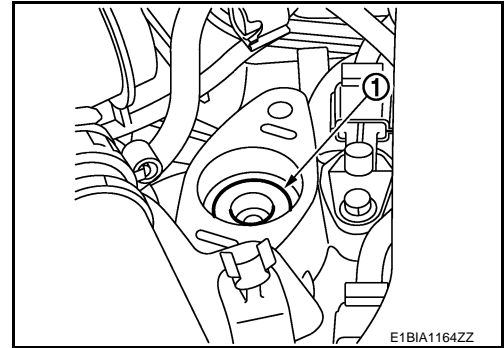
CAUTION:

- Do not reuse O-rings.
- To prevent damage to parts due to generated abnormal stress and eccentric load, always observe the installation procedure.

1. Install high pressure pump lifter in its housing.
2. Install high pressure fuel pump according to the following procedure.
 - a. Check that high pressure fuel pump lifter (1) is in low position.

NOTE:

If the high pressure fuel pump lifter is not in low position turn the engine by hand until reach high pressure fuel pump lifter low position.



- c. Install O-ring to high pressure fuel pump. When handling new O-ring, paying attention to the following caution items:

CAUTION:

- Do not reuse O-ring.
- Handle O-ring with bare hands. Never wear gloves.
- Lubricate O-ring with new engine oil.
- Never clean O-ring with solvent.
- Check that O-ring and its mating part are free of foreign material.
- Never damage O-ring with tools and fingernails during the installation. In addition, twisting or stretching O-ring is not allowed. If O-ring is stretched during the installation to high pressure fuel pump, never install high pressure fuel pump immediately.

- d. Install high pressure fuel pump lifter.
- e. Apply oil to the fitting area of O-ring and rocker cover side to install high pressure fuel pump.

CAUTION:

- Temporarily tighten bolt by hand. Alternately tighten bolt by one turn at a time until high pressure fuel pump reaches rocker cover.
- After a pump flange sitting, tighten the bolts to the specified torque.

3. Install the fuel tube, according to the following procedure using [SST: KV113E0010 (Mot.1566)].

CAUTION:

- When removing Fuel tube, always replace Fuel rail connector together with Fuel tube.
- Never reuse fuel tube.
- Never use fuel tube if its terminal tip is damaged.
- Observe the tightening order and the tightening torque.

- a. Temporarily tighten flare nut (A) and (B) of fuel tube (3) until seated.

1 : High pressure fuel pump

2 : Fuel rail connector

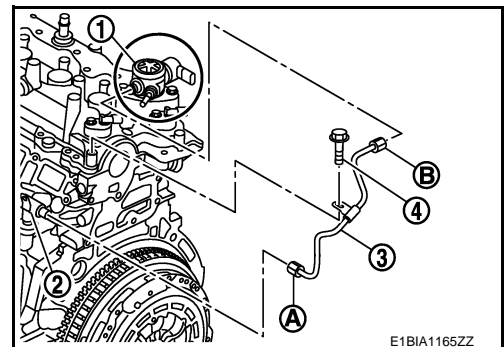
CAUTION:

When temporarily tightening flare nut, place pipe in the center of the nut inner diameter.

- b. Tighten bolt (4).
- c. Tighten flare nut (A) and (B) in alphabetical order.

CAUTION:

Always fit the tool completely with the nut.



HIGH PRESSURE FUEL PUMP AND FUEL HOSE

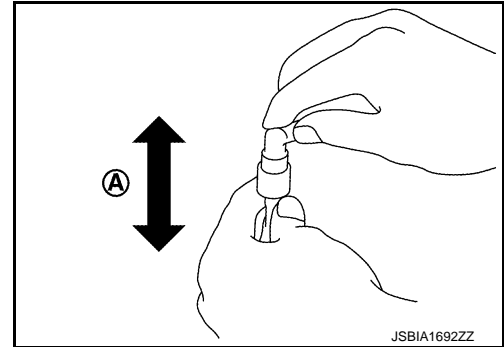
[HRA2DDT]

< REMOVAL AND INSTALLATION >

4. Connect fuel feed hose with the following procedure, and then install the fuel feed hose.
 - a. Check the connection for damage or any foreign materials.
 - b. Align the connector with the tube, then insert the connector straight into the tube until a click sound is heard.
 - c. After connecting, check that the connection is secured with following procedures.
 - Visually confirm that the two tabs are connected to the connector.
 - Pull (A) the tube and the connector to check that they are securely connected.

CAUTION:

If retainer cannot be installed smoothly, quick connector may be have not been installed correctly. Check connection again.



5. When replacing high pressure fuel pump, this procedure must be perform. Refer to [ECH-102, "Special Repair Requirement List"](#)
6. Install in the reverse order of removal after this step.

Inspection

INFOID:000000010287266

INSPECTION AFTER INSTALLATION

Check for Fuel Leakage

1. Turn ignition switch "ON" (with the engine stopped). With fuel pressure applied to fuel piping, check that there is no fuel leakage at connection points.

NOTE:
Use mirrors for checking at points out of clear sight.
2. Start the engine. With engine speed increased, check again that there is no fuel leakage at connection points.

CAUTION:
Never touch the engine immediately after it is stopped because the engine is extremely hot.

FUEL INJECTOR AND FUEL TUBE

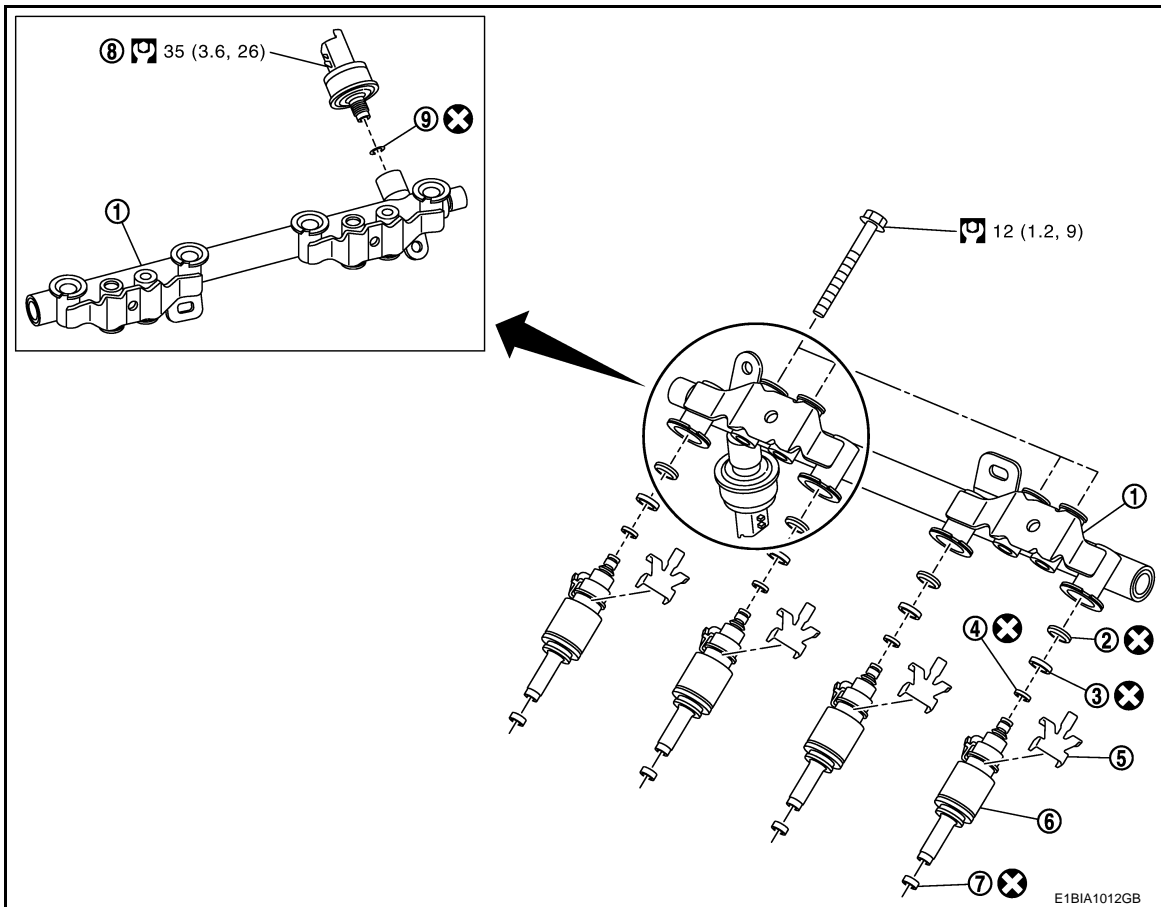
< REMOVAL AND INSTALLATION >

[HRA2DDT]

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:000000010282220



- | | | |
|-----------------|-------------------------|----------------------|
| 1. Fuel tube | 2. O-ring seal | 3. O-ring lower seal |
| 4. Ring stopper | 5. Holder | 6. Fuel Injector |
| 7. Seal ring | 8. Fuel pressure sensor | 9. Teflon ring seal |

Refer to [GI-4, "Components"](#) for symbols in the figure.

CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.

Removal and Installation

INFOID:000000010282221

WARNING:

- Put a "CAUTION: FLAMMABLE" sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO2 fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.

REMOVAL

Fuel injector and fuel tube removal.

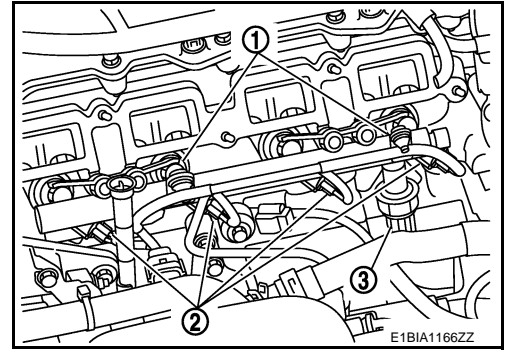
1. Release the fuel pressure. Refer to [ECH-121, "Work Procedure"](#).
2. Remove blow off valve. Refer to [EM-27, "Removal and Installation"](#)
3. Remove intake manifold. Refer to [EM-25, "Exploded View"](#).
4. Remove high pressure fuel pipe. Refer to [EM-38, "Exploded View"](#)
5. Unclip injection harness (1) from fuel tube.

FUEL INJECTOR AND FUEL TUBE

< REMOVAL AND INSTALLATION >

[HRA2DDT]

6. Disconnect:
 - Fuel injector connectors (2).
 - Fuel pressure sensor connector (3)



7. Remove fuel tube and fuel injector assembly.

CAUTION:

- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leakage from fuel tube.
- Never reuse fuel tube.

8. Remove fuel injector from fuel tube with the following procedure:

- a. Remove injector holder.
- b. Remove fuel injector by pulling straight.

CAUTION:

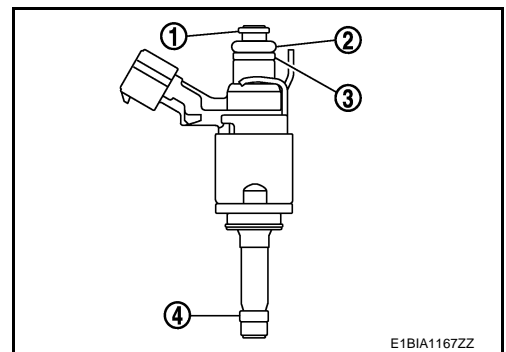
- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage fuel injector nozzle during removal.
- Never bump or drop fuel injector.

Fuel injector seal disassembly.

1. Remove carefully from fuel injector:
 - O-ring seal (1).
 - O-ring lower seal (2).
 - ring stopper (3).

CAUTION:

- Handle O-ring with bare hands. Never wear gloves.
- Lubricate O-ring with new engine oil.
- Never clean O-ring with solvent.
- Check that O-ring and its mating part are free of foreign material.
- When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring is stretched while installing, never insert it quickly into fuel tube.
- Insert O-ring straight into fuel tube. Never decenter or twist it.



2. Remove carefully from fuel injector teflon ring seal (4) following this procedure.

- Clean fuel injector
- CAUTION:**
It is forbidden to use a wire brush, sandpaper, etc.
- Cut fuel injector teflon ring seal with a pliers circlip.

CAUTION:

Take care to not damage fuel injector nozzle.

INSTALLATION

Fuel injector seal assembly.

FUEL INJECTOR AND FUEL TUBE

[HRA2DDT]

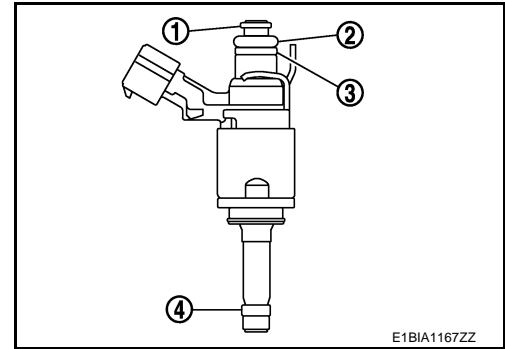
< REMOVAL AND INSTALLATION >

1. Install on fuel injector:

- O-ring seal (1).
- O-ring lower seal (2).
- ring stopper (3).

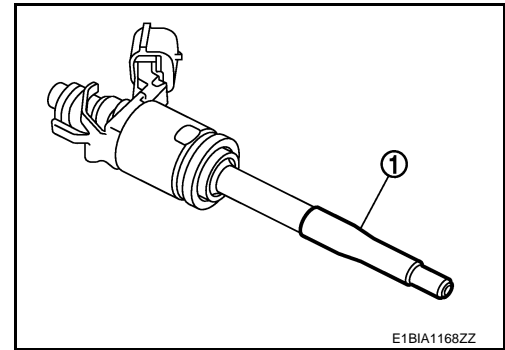
CAUTION:

- **Handle O-ring with bare hands. Never wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Never clean O-ring with solvent.**
- **Check that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring is stretched while installing, never insert it quickly into fuel tube.**
- **Insert O-ring straight into fuel tube. Never decenter or twist it.**



2. Install carefully on fuel injector teflon ring seal (4) following this procedure using [SST: Mot.1533 (—)].

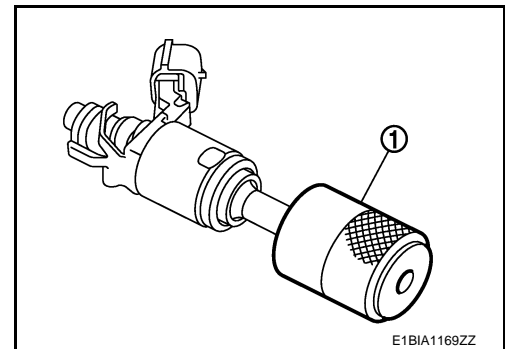
- Install on the fuel injector the cone (1) of [SST: Mot.1533 (—)].
- Install teflon ring seal on the cone (1) of [SST: Mot.1533 (—)].
- Push teflon ring seal into fuel injector groove.
- Remove the cone (1) of [SST: Mot.1533 (—)].



- Push the reforming tool (1) of [SST: Mot.1533 (—)] around fuel injector nozzle to retract teflon ring seal during 30 secondes minimum.

NOTE:

This operation is necessary to set correct outside diameter to teflon ring seal.



Fuel injector and fuel tube installation.

CAUTION:

Never reuse fuel tube.

1. Install fuel injector to fuel tube.
2. Set fuel tube and fuel injector assembly at its position for installation on cylinder head.

CAUTION:

For installation, be careful not to interfere with fuel injector nozzle.

3. Install fuel tube and injector assembly onto cylinder.
 - Tighten mounting bolts.
4. Connect harness connector to fuel injector.
5. When replacing fuel injector, this procedure must be performed. Refer to [ECH-102. "Special Repair Requirement List"](#).
6. Install remaining parts in the reverse order of removal.

Inspection

INFOID:000000010282222

INSPECTION AFTER INSTALLATION

FUEL INJECTOR AND FUEL TUBE

[HRA2DDT]

< REMOVAL AND INSTALLATION >

Check on Fuel Leakage

1. Turn ignition switch "ON" (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leakage at connection points.

NOTE:

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there are no fuel leakage at connection points.

CAUTION:

Never touch the engine immediately after stopped, as the engine becomes extremely hot.

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

OIL PAN (LOWER)

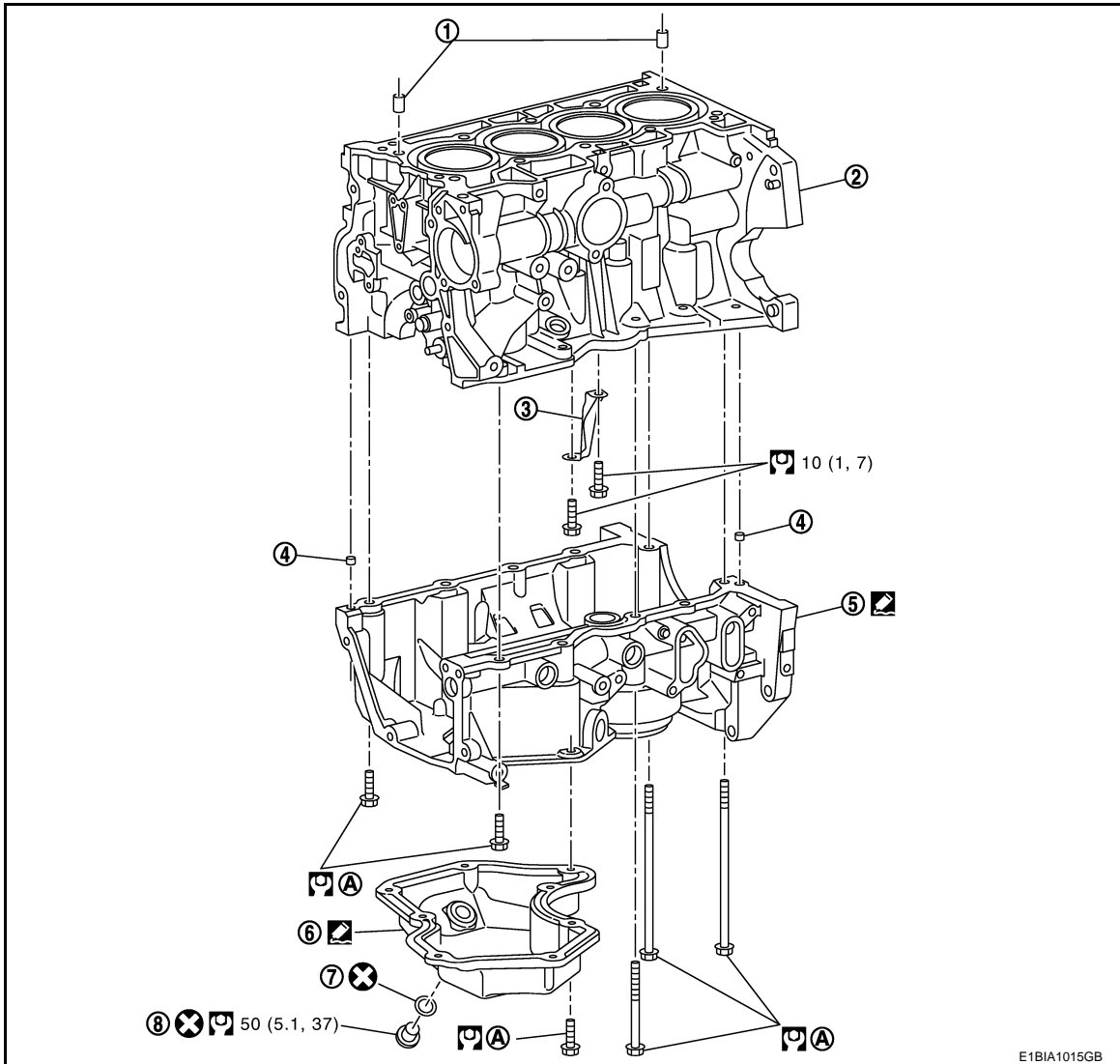
[HRA2DDT]

< REMOVAL AND INSTALLATION >

OIL PAN (LOWER)

Exploded View

INFOID:00000001028223



- | | | |
|----------------------|--------------------|--------------------|
| 1. Dowel pin | 2. Cylinder block | 3. Baffle plate |
| 4. Dowel pin | 5. Oil pan (upper) | 6. Oil pan (lower) |
| 7. Drain plug washer | 8. Drain plug | |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:00000001028224

REMOVAL

1. Drain engine oil. Refer to [LU-9. "Draining"](#).
2. Remove oil pan (lower) with the following procedure:

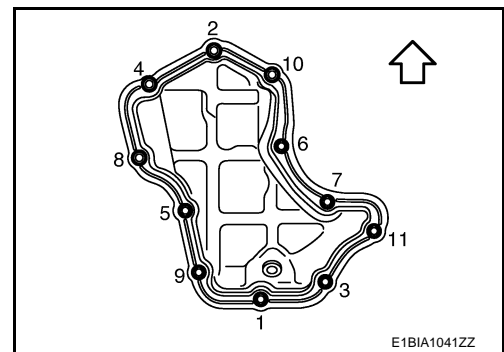
OIL PAN (LOWER)

[HRA2DDT]

< REMOVAL AND INSTALLATION >

- a. Loosen mounting bolts in reverse order as shown in the figure.

↶ : Engine front

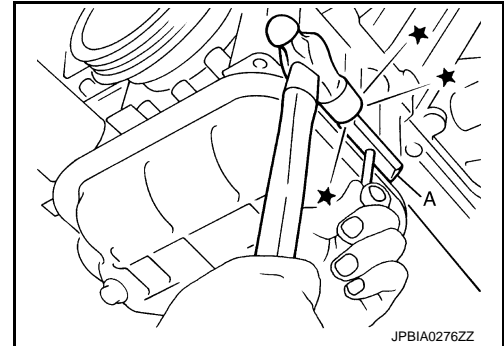


- b. Insert seal cutter [SST: KV10111100] (A) between oil pan (upper) and oil pan (lower).

CAUTION:

- Be careful not to damage the mating surface.
- Never insert a screwdriver. This damages the mating surfaces.

- c. Slide the seal cutter [SST: KV10111100] by tapping on the side of tool with a hammer.
d. Remove oil pan (lower).



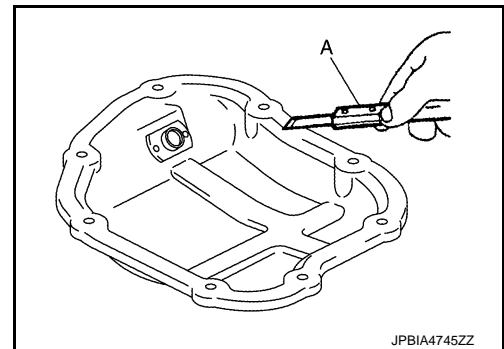
INSTALLATION

1. Install oil pan (lower) as follows:

- a. Use a scraper (A) to remove old liquid gasket from mating surfaces.
• Also remove old liquid gasket from mating surface of oil pan (upper).
• Remove old liquid gasket from the bolt holes and threads.

CAUTION:

Never scratch or damage the mating surface when cleaning off old liquid gasket.



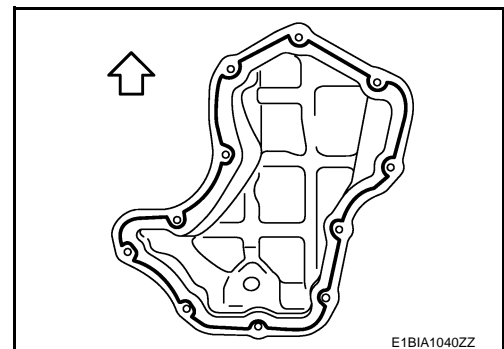
- b. Apply a continuous bead of liquid gasket (B) with a tube presser (commercial service tool) as shown in the figure.

- a : 7.5 - 9.5 mm (0.295 - 0.374 in)
c : ϕ 4.0 - 5.0 mm (0.157 - 0.197 in)
1 : Oil pan (lower)
↶ : Engine outside

Use Genuine Liquid Gasket or equivalent.

CAUTION:

Attaching should be done within 5 minutes after liquid gasket application.



A
EM
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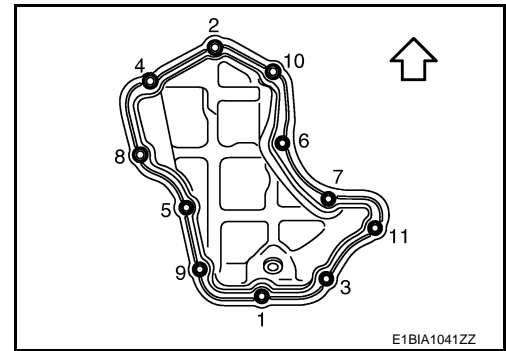
OIL PAN (LOWER)

[HRA2DDT]

< REMOVAL AND INSTALLATION >

c. Tighten bolts in numerical order as shown in the figure.

⇐ : Engine front



2. Install oil pan drain plug.
 - Refer to the figure of components of former page for installation direction of drain plug washer. Refer to [EM-46. "Exploded View"](#).
3. Install in the reverse order of removal after this step.
NOTE:
Wait at least 30 minutes after oil pan (lower) is installed before pouring engine oil.

Inspection

INFOID:000000010282225

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to [LU-8. "Inspection"](#).
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-9. "Refilling"](#).

IGNITION COIL, SPARK PLUG AND ROCKER COVER

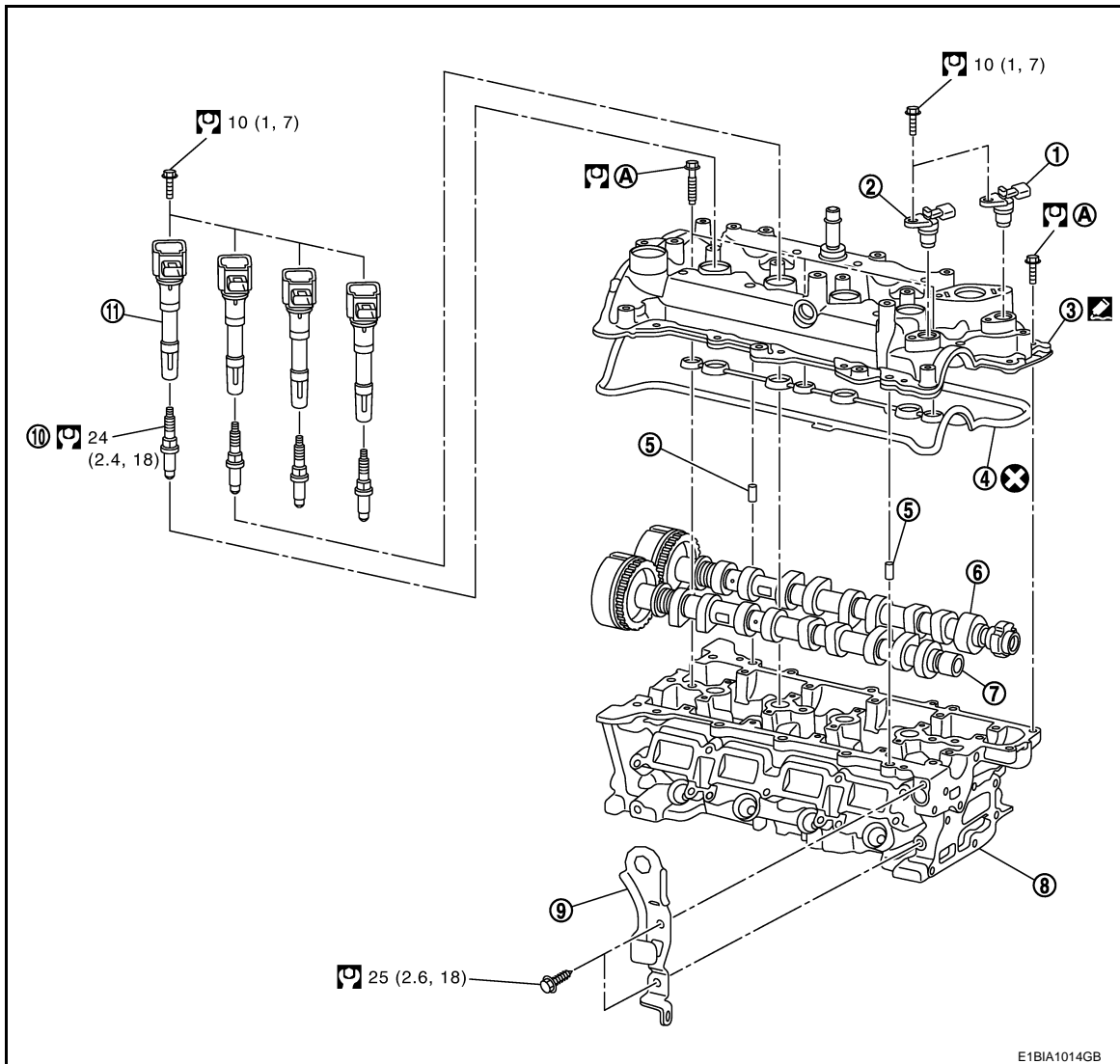
< REMOVAL AND INSTALLATION >

[HRA2DDT]

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

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- | | | |
|-----------------------------------|-----------------------------------|-------------------|
| 1. Camshaft position sensor (EXH) | 2. Camshaft position sensor (INT) | 3. Rocker cover |
| 4. Rocker cover gasket | 5. Dowel pin | 6. Camshaft (EXH) |
| 7. Camshaft (INT) | 8. Cylinder head | 9. Engine slinger |
| 10. Spark plug | 11. Ignition coil | |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010282227

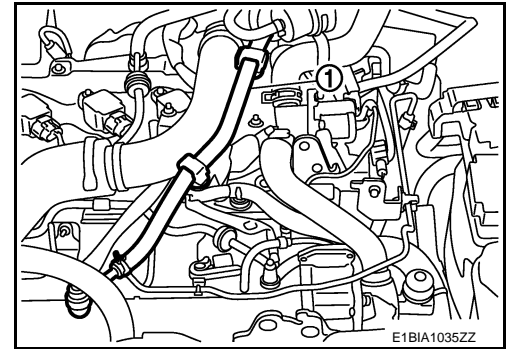
REMOVAL

IGNITION COIL, SPARK PLUG AND ROCKER COVER

< REMOVAL AND INSTALLATION >

[HRA2DDT]

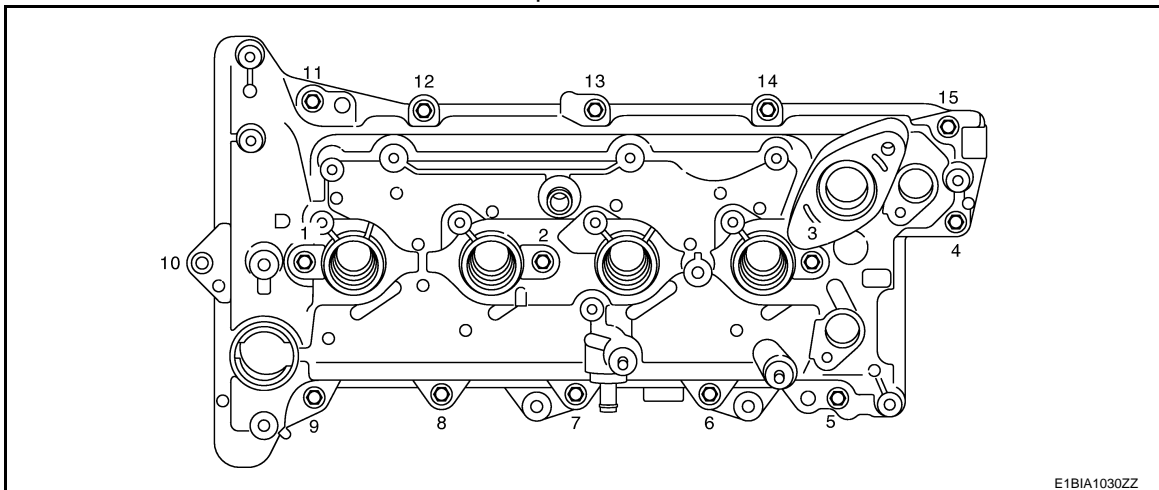
1. Remove brake booster hose (1).



2. Remove air inlet hose and electric blow off valve. Refer to [EM-27, "Removal and Installation"](#).
3. Remove ignition coil.
CAUTION:
 - Never drop or shock ignition coil.
 - Never disassemble ignition coil.
4. Remove spark plug. Refer to [EM-20, "Removal and Installation"](#).
5. Remove camshaft position sensor (INT and EXH). Refer to [EM-49, "Exploded View"](#).
6. Remove PCV hose from rocker cover. Refer to [EM-25, "Exploded View"](#).
7. Remove high pressure fuel pump. Refer to [EM-38, "Removal and Installation"](#).
8. Remove turbocharger heat shield.
9. Disconnect and unclip A/F sensors harness.
10. Remove rocker cover.
 - Loosen bolts in reverse order as shown in the figure.

NOTE:

Rocker cover bolts are not same, mark their positions.



11. Remove rocker cover gasket from rocker cover.
12. Use scraper to remove all traces of liquid gasket from cylinder head and front cover.

CAUTION:

Never scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION

1. Rocker cover with the following procedure:

IGNITION COIL, SPARK PLUG AND ROCKER COVER

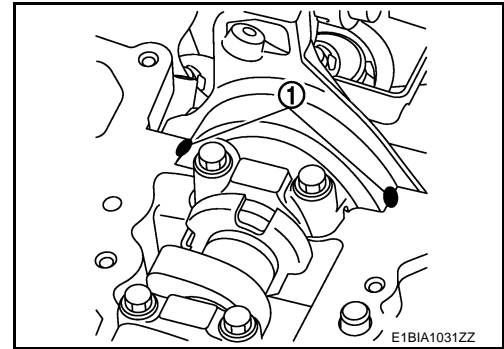
< REMOVAL AND INSTALLATION >

[HRA2DDT]

- a. Apply liquid gasket to the position (1) as shown in the figure.

- 1 : Cylinder head
- 2 : Front cover
- a : $\phi 2.5 - 3.5$ mm (0.10 - 0.14 in)

Use Genuine Liquid Gasket or equivalent.

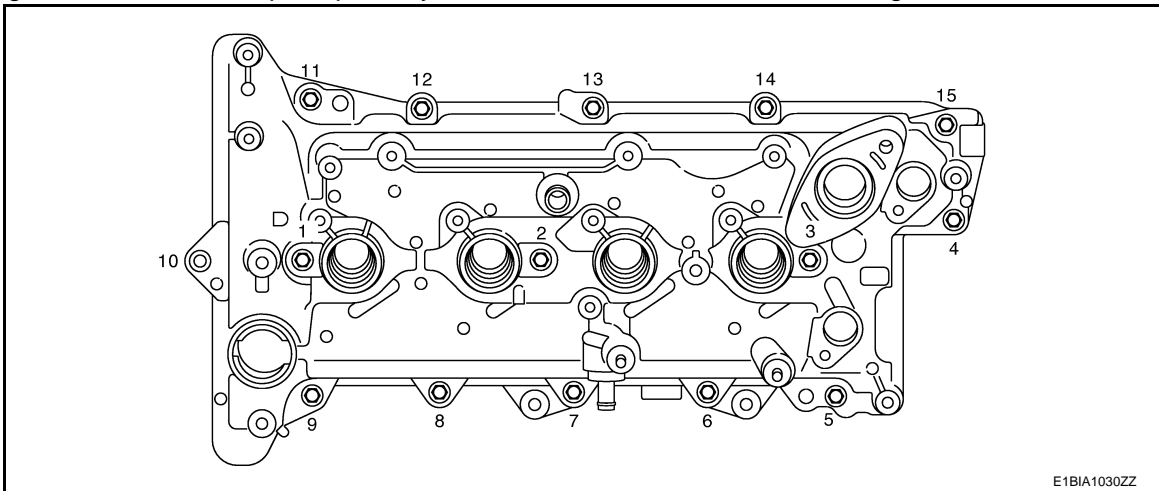


- b. Install rocker cover to cylinder head.

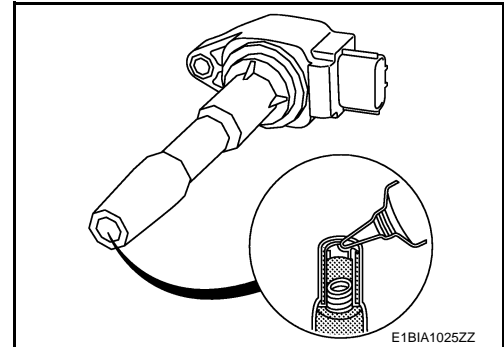
CAUTION:

Check the gasket is not dropped.

- Tighten bolts in two steps separately in numerical order as shown in the figure.



2. Apply a bead of grease of 2 mm (0.08 in) diameter on the internal perimeter of the coil as shown in the figure.



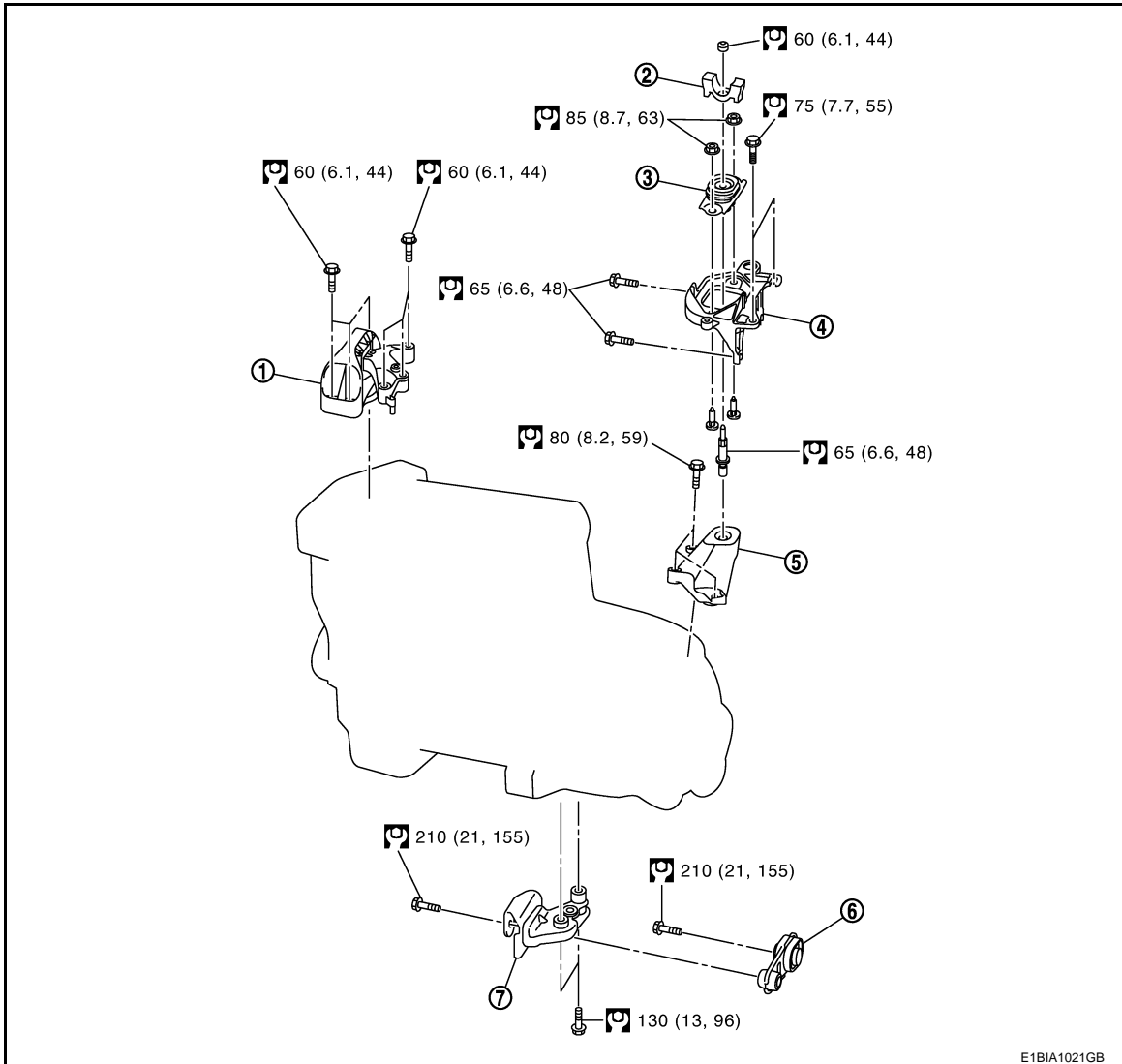
3. When replacing camshaft position sensor, this procedure must be performed. Refer to [ECH-102, "Special Repair Requirement List"](#).
4. Install in the reverse order of removal, for the rest of parts.

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:000000010282241



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- | | | |
|---------------------------------------|---------------------------------|-----------------------------------|
| 1. Engine mounting insulator (RH) | 2. Rubber | 3. Engine mounting insulator (LH) |
| 4. Engine mounting frame support (LH) | 5. Engine mounting bracket (LH) | 6. Rear torque rod |
| 7. Rear engine mounting bracket | | |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282242

WARNING:

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Never start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine section, refer to the applicable sections.
- Always use the support point specified for lifting.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HRA2DDT]

- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-36, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

NOTE:

When removing components such as hoses, tubes / lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

Preparation

1. Release fuel pressure.
2. Drain engine coolant from radiator. Refer to [CO-11, "Draining"](#).
CAUTION:
 - Perform this step when the engine is cold.
 - Never spill engine coolant on drive belt.
3. Remove the following parts.
 - Engine undercover
 - Front fender protector (RH and LH): Refer to [EXT-31, "Exploded View"](#).
 - Front road wheels and tires: Refer to [WT-60, "Removal and Installation"](#) (with TPMS) or [WT-73, "Removal and Installation"](#) (without TPMS).
 - Battery and battery tray: Refer to [PG-155, "Removal and Installation"](#).
 - Drive belt: Refer to [EM-21, "Removal and Installation"](#).
 - Air duct and air cleaner filter unit assembly: Refer to [EM-23, "Exploded View"](#).
 - Air inlet hose and air inlet tube. Refer to [EM-27, "Removal and Installation"](#)
 - Remove intake manifold. Refer to [EM-25, "Removal and Installation"](#)
 - Radiator hose (upper and lower): Refer to [CO-17, "Exploded View"](#).
 - Exhaust front tube: Refer to [EX-6, "Exploded View"](#).

Engine Room LH

1. Disconnect all connections of engine harness around the engine mounting insulator (LH), and then temporarily secure the engine harness onto the engine side.
CAUTION:
Protect connectors using a resin bag against foreign materials.
2. Disconnect fuel feed hose at engine side.
3. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining.
4. Disconnect control linkage from transaxle. Refer to [TM-28, "Exploded View"](#).
5. Remove ground cable at transaxle side.

Engine Room RH

1. Remove ground cable between front cover and vehicle.
2. Alternator and alternator bracket; Refer to [CHG-28, "HRA2DDT : Removal and Installation"](#).
3. Disconnect reservoir tank hose.
4. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. (with A/C models) Refer to [HA-31, "Exploded View"](#).

Vehicle Underbody

1. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to [BRC-138, "FRONT WHEEL SENSOR : Exploded View"](#).
2. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to [BR-37, "BRAKE CALIPER ASSEMBLY : Exploded View"](#).
3. Remove stabilizer connecting rod. Refer to [FSU-17, "Exploded View"](#).

ENGINE ASSEMBLY

[HRA2DDT]

< UNIT REMOVAL AND INSTALLATION >

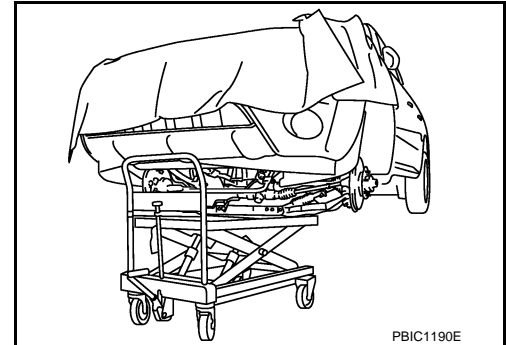
4. Remove steering knuckle mounting nuts and bolts. Refer to [ST-10, "Exploded View"](#).
5. Disconnect steering outer socket. Refer to [ST-12, "Exploded View"](#).
6. Remove drive shafts (LH and RH) and center bearing cover bracket. Refer to [FAX-22, "Removal and Installation \(LH\)"](#), and [FAX-26, "Removal and Installation \(RH\)"](#)
7. Disconnect intermediate shaft to steering column assembly. Refer to [ST-10, "Exploded View"](#).
8. Remove rear torque rod.
9. Remove front suspension member. Refer to [FSU-20, "Exploded View"](#).
10. Preparation for the separation work of transaxle is as follows:
 - Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [TM-38, "Exploded View"](#).

Removal

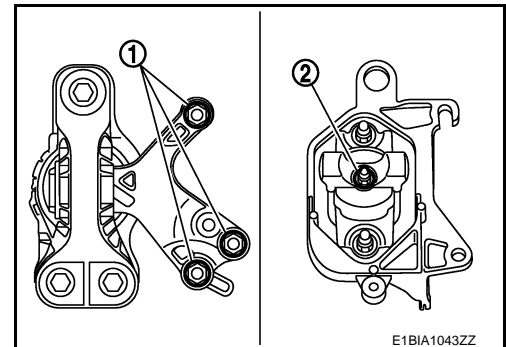
1. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.

CAUTION:

Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.



2. Remove engine mounting insulator (RH) (1).
3. Remove engine mounting insulator through bolt-securing nut (A).



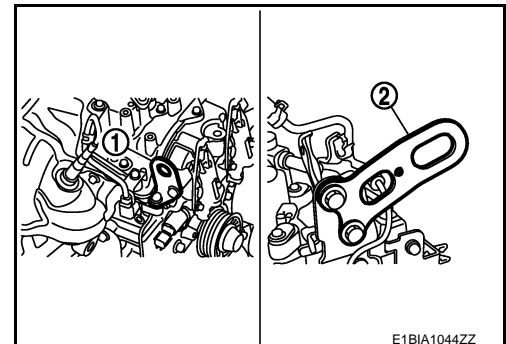
4. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly.

CAUTION:

- Make sure that no part interferes with the vehicle side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support the vehicle by setting jack or suitable tool at the rear.

Separation

1. Install engine slinger to cylinder head front left side (1) and rear right side (2).



2. Remove starter motor. Refer to [STR-24, "HRA2DDT : Exploded View"](#).
3. Lift with a hoist and separate the engine from the transaxle assembly.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HRA2DDT]

INSTALLATION

Note the following, and install in the reverse order of removal.

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Make sure that each mounting insulator is seated properly, and tighten mounting nuts and bolts.
- Tighten engine mounting insulator (RH) bolts.

Inspection

INFOID:000000010282243

INSPECTION AFTER INSTALLATION

Inspection for Leaks

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
Transmission / transaxle fluid	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluid*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

INFOID:000000010282244

NOTE:

Explained here is how to disassemble with engine stand supporting transmission surface. When using different type of engine stand, note with difference in steps and etc.

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-52. "Exploded View"](#).
2. Remove clutch cover and clutch disc. Refer to [CL-22. "HRA2DDT : Removal and Installation"](#).
3. Remove flywheel.
 - Secure flywheel with a stopper plate [SST: — (Mot.1431)], and remove mounting bolts.

CAUTION:

- Never disassemble flywheel.
- Never place flywheel with signal plate facing down.
- When handling signal plate, take care not to damage or scratch it.
- Handle signal plate in a manner that prevents it from becoming magnetized.

4. Lift the engine with a hoist to install it onto widely use engine stand.

CAUTION:

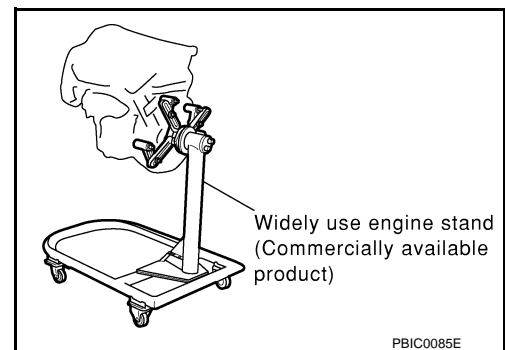
- Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
 - Intake manifold: Refer to [EM-25. "Exploded View"](#).
 - Exhaust manifold: Refer to [EM-37. "Exploded View"](#).
 - Rocker cover: Refer to [EM-49. "Exploded View"](#).

NOTE:

The figure shows an example of widely use engine stand that can support mating surface of transaxle with flywheel removed.

CAUTION:

Before removing the hanging chains, make sure the engine stand is stable and there is no risk of overturning.



5. Drain engine oil. Refer to [LU-9. "Draining"](#).

CAUTION:

Be sure to clean drain plug and install with new drain plug washer.

ENGINE UNIT

Disassembly

INFOID:000000010282245

1. Remove intake manifold. Refer to [EM-25, "Exploded View"](#).
2. Remove exhaust manifold. Refer to [EM-37, "Exploded View"](#).
3. Remove oil pan (lower). Refer to [EM-46, "Exploded View"](#).
4. Remove ignition coil, spark plug and rocker cover. Refer to [EM-49, "Exploded View"](#).
5. Remove fuel injector and fuel tube. Refer to [EM-42, "Exploded View"](#).
6. Remove timing chain. Refer to [EM-58, "Exploded View"](#).
7. Remove camshaft. Refer to [EM-77, "Exploded View"](#).
8. Remove cylinder head. Refer to [EM-69, "Exploded View"](#).

Assembly

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Assembly is the reverse order of disassembly.

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EM

C

D

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G

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P

TIMING CHAIN

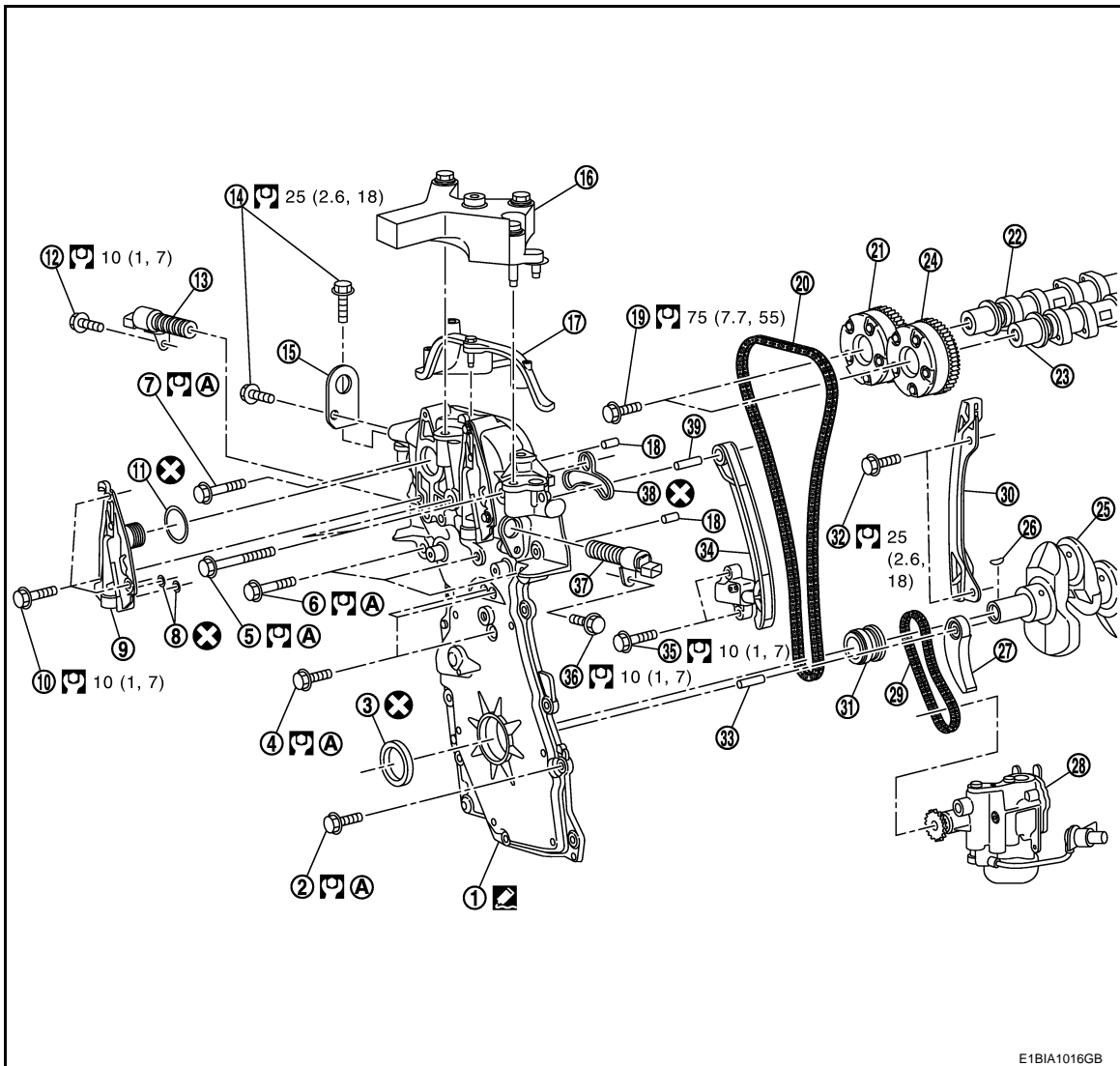
< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

TIMING CHAIN

Exploded View

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- | | | |
|--|---------------------------------------|--|
| 1. Front cover | 2. Front cover bolt | 3. Front oil seal |
| 4. Front cover bolt | 5. Front cover bolt | 6. Front cover bolt |
| 7. Front cover bolt | 8. Camshaft dephaser oil cover gasket | 9. Camshaft dephaser oil cover |
| 10. Camshaft dephaser oil cover bolt | 11. Camshaft dephaser oil cover seal | 12. Exhaust valve timing control solenoid valve. |
| 13. Exhaust valve timing control solenoid valve. | 14. Engine slinger bolts | 15. Engine slinger |
| 16. Engine mounting bracket (RH) | 17. Rocker cover | 18. Front cover dowel pin |
| 19. Camshaft sprocket bolt | 20. Timing chain | 21. Exhaust camshaft sprocket |
| 22. Exhaust camshaft | 23. Intake camshaft | 24. Intake camshaft sprocket |
| 25. Crankshaft | 26. Crankshaft sprocket key | 27. Oil pump drive chain tensioner |
| 28. Oil pump | 29. Oil pumpdrive chain | 30. Timing chain tension guide |
| 31. Oil pump sprocket | 32. Timing chain tension guide bolt | 33. Oil pump chain tensioner shaft |
| 34. Timing chain tensioner | 35. Timing chain tensioner bolts | 36. Intake valve timing control solenoid valve |

TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

37. Intake valve timing control solenoid valve.
38. Front cover seal valve.

39. Timing chain tension guide shaft

- A. Tightening must be done following the installation procedure.
Refer to [EM-59, "Removal and Installation"](#).

Refer to [GI-4, "Components"](#) for symbol marks in the figure.

Removal and Installation

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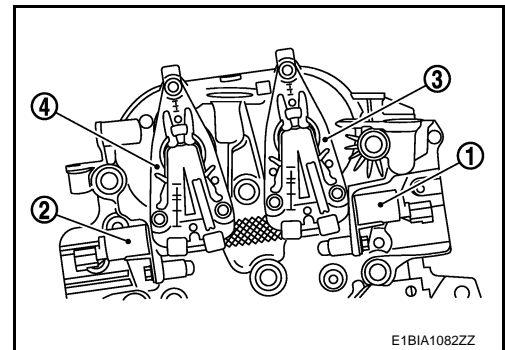
CAUTION:

The rotation direction indicated in the text indicates all directions seen from the engine front direction.

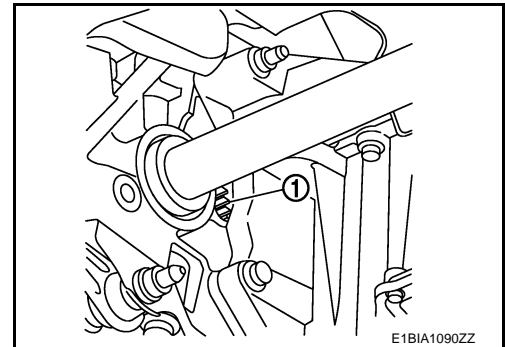
REMOVAL

1. Remove the following parts:
- rocker cover. Refer to [EM-49, "Exploded View"](#).
 - water pump pulley. Refer to [CO-22, "Exploded View"](#).
 - Idler roller. Refer to [EM-21, "Exploded View"](#)

2. Remove:
- intake valve timing control solenoid valve (1).
 - exhaust valve timing control solenoid valve (2).
 - intake camshaft dephaser oil cover (3).
 - exhaust camshaft dephaser oil cover (4).



3. Remove crankshaft pulley with the following procedure.
- a. Remove flywheel cover.
 - b. Lock the flywheel (1) using a flat blade screw driver.
 - c. Remove crankshaft pulley.



4. Remove front cover with the following procedure:

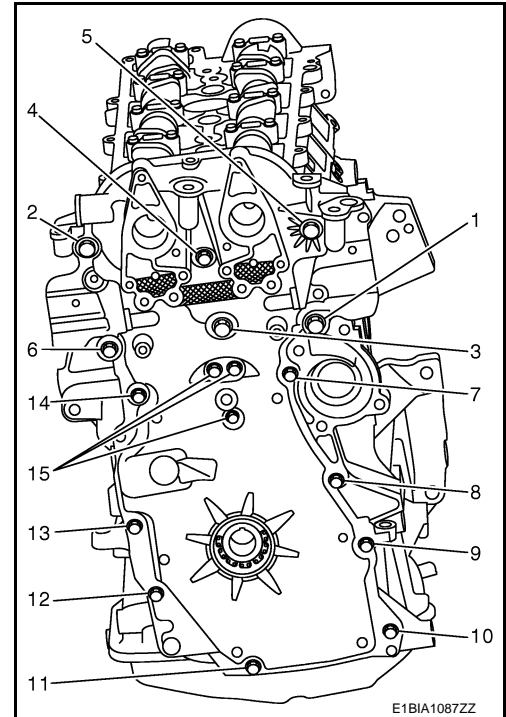
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TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

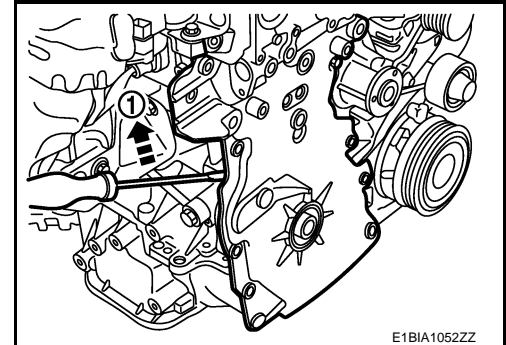
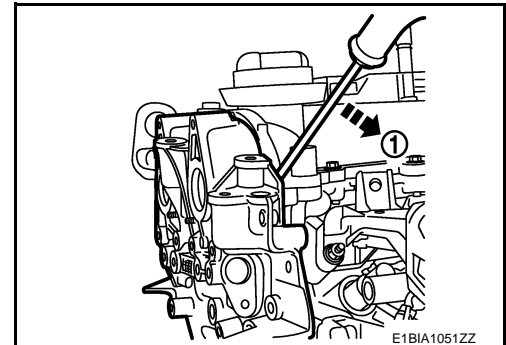
- a. Loosen bolts in the reverse of the order as shown in the figure.



- b. Separate the front cover using a flat blade screw driver (1).

CAUTION:

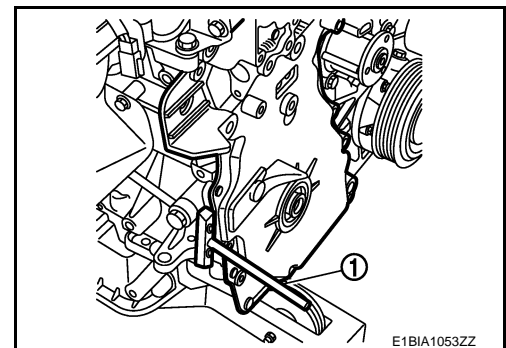
Be careful not to damage the matting surface.



- c. Remove front cover using seal cutter [SST: KV10111100].

CAUTION:

Be careful not to damage front cover.



TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

5. Remove front oil seal from front cover. Refer to [EM-87. "FRONT OIL SEAL : Removal and Installation"](#).
- Remove by lifting it up using a suitable hose.

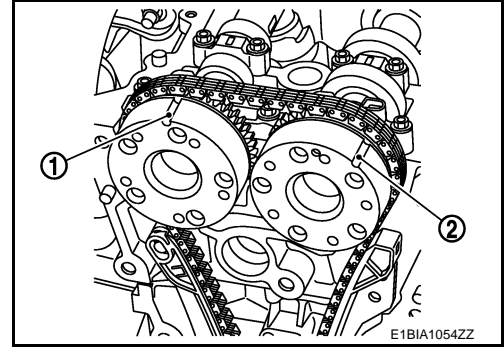
CAUTION:

Be careful not to damage front cover.

6. Check that the mark (1) on the exhaust camshaft timing sprocket and the mark (2) on the intake camshaft timing sprocket are positioned as shown in the figure.

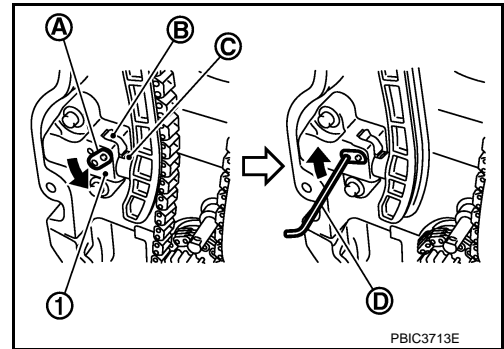
NOTE:

If the marks are not set correctly turn the engine until having same position as shown in the figure.



7. Remove chain tensioner (1) with the following procedure.
- a. Fully push down the chain tensioner lever (A), and then push the plunger (C) into the inside of tensioner.
- The tab (B) is released by fully pushing the lever down. As a result, the plunger can be moved.

- b. Pull up the lever to align its hole position with the body hole position.
- When the lever hole is aligned with the body hole position, the plunger is fixed.
 - When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



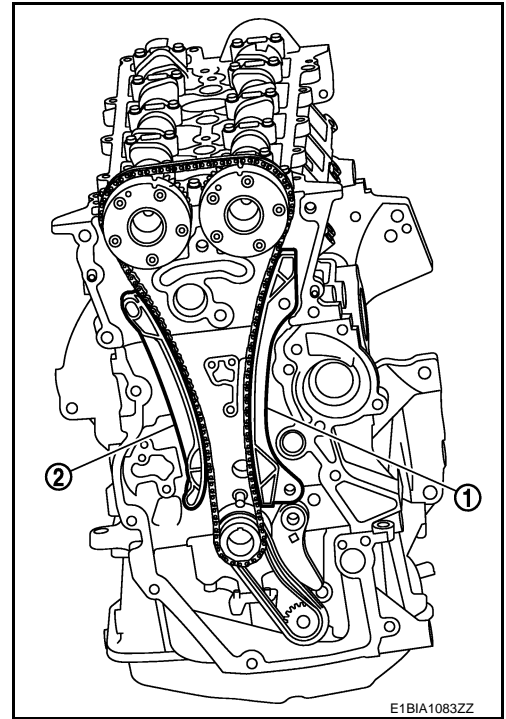
- c. Insert the stopper pin (D) into the body hole through the lever hole, and then fix the lever at the upper position.
- Figure shows the example that a hexagonal wrench for 2.5 mm (0.098 in) is used.
- d. Remove chain tensioner.

TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

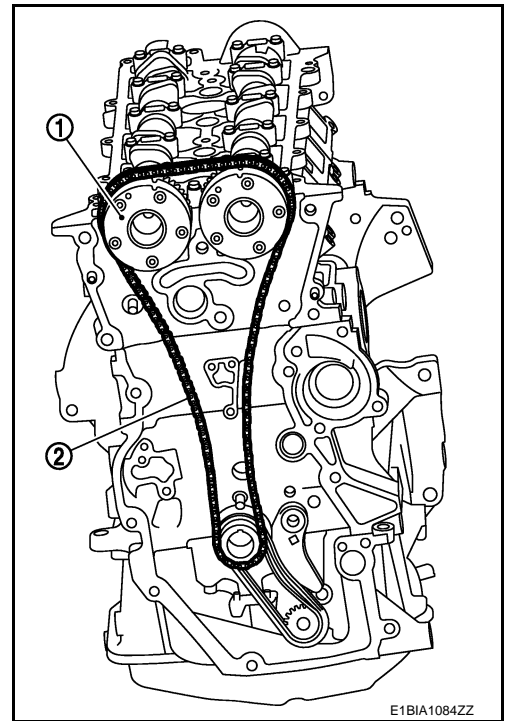
8. Remove the timing chain tension guide (2) and the timing chain slack guide (1).



9. Remove the timing chain (2).
- Pull the looseness of timing chain toward the camshaft sprocket (EXH) (1), and then remove the timing chain and start the removal from camshaft sprocket (EXH) side.

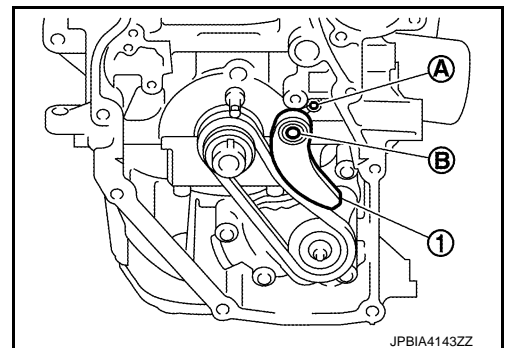
CAUTION:

Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.



10. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.

- a. Remove chain tensioner (1).
- Pull out from the shaft (B) and spring fixing holes (A).

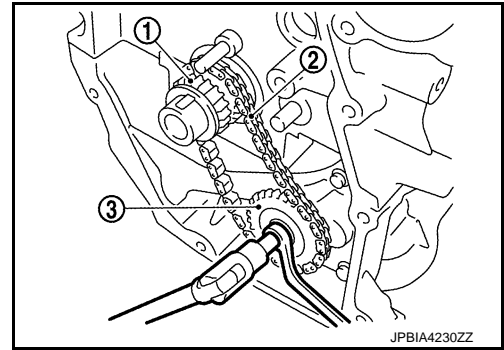


TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

- b. Hold the top of the oil pump shaft, and then loosen the oil pump sprocket nuts and remove them.
- c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

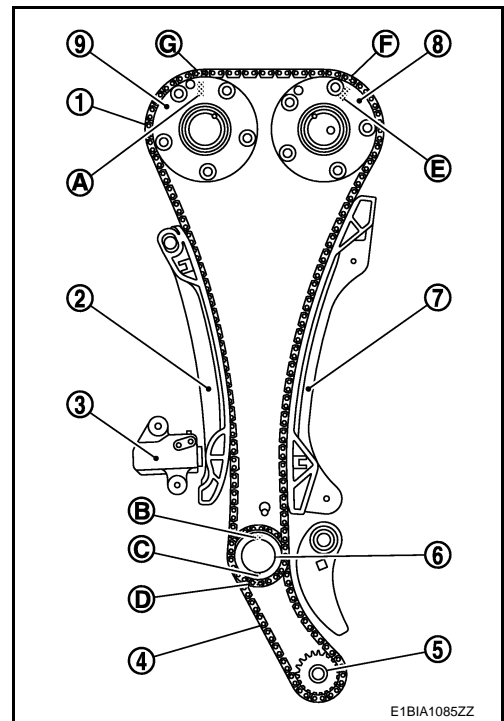


INSTALLATION

NOTE:

The figure shows the relationship between the matching mark on each timing chain and that on the corresponding sprocket, with the components installed.

- 1 : Timing chain
- 2 : Timing chain slack guide
- 3 : Chain tensioner
- 4 : Oil pump drive chain
- 5 : Oil pump sprocket
- 6 : Crankshaft sprocket
- 7 : Timing chain tension guide
- 8 : Camshaft sprocket (INT)
- 9 : Camshaft sprocket (EXH)
- A : Matching mark (Peripheral groove)
- B : Crankshaft key (Point straight up)
- C : Matching mark (Stamp)
- D : Colored link
- E : Matching mark (Peripheral groove)
- F : Colored link
- G : Colored link



1. Install the crankshaft sprocket and the oil pump drive related parts with the following procedure:

TIMING CHAIN

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

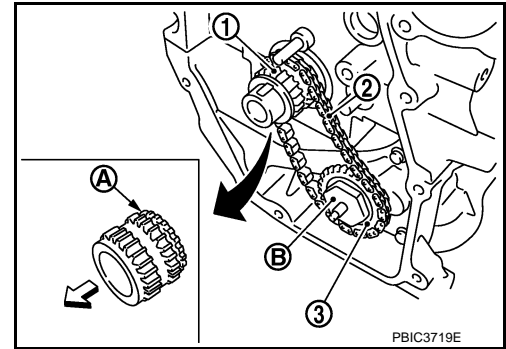
- a. Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇐ : Engine front

- Install the crankshaft sprocket so that its invalid gear area (A) is towards the back of the engine.
- Install the oil pump sprocket so that its hexagonal surface faces (B) the front of engine.

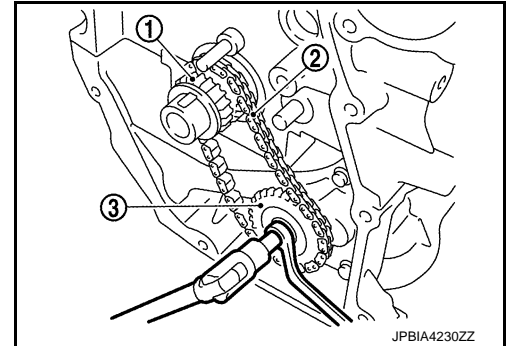
NOTE:

There is no matching mark in the oil pump drive related parts.



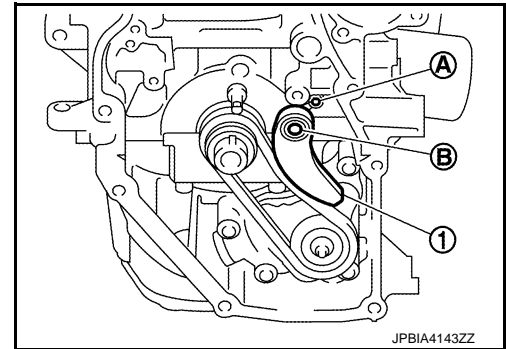
- b. Hold the top of the oil pump shaft, and then tighten the oil pump sprocket nuts.

- 1 : Crankshaft sprocket
- 2 : Oil pump drive chain
- 3 : Oil pump sprocket



- c. Install chain tensioner (1).

- Insert the body into the shaft (B) while inserting the spring into the fixing hole (A) of cylinder block front surface.
- Check that the tension is applied to the oil pump drive chain after installing.



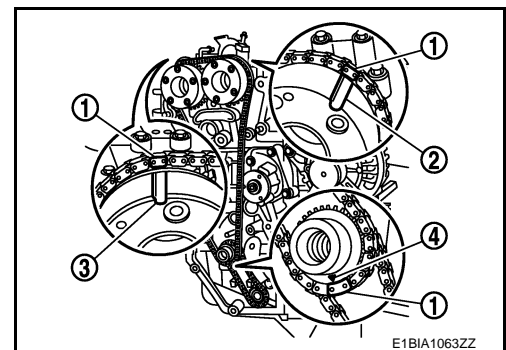
2. Install timing chain with the following procedure.

- 1 : Colored link
- 2 : INT matching mark (Peripheral groove)
- 3 : EXH matching mark (Peripheral groove)
- 4 : Crankshaft matching mark (Stamp)

- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

CAUTION:

- For the following note, after the matching marks are aligned, keep them aligned by holding them with a hand.
- To avoid skipped teeth, never rotate crankshaft and camshaft until front cover is installed.

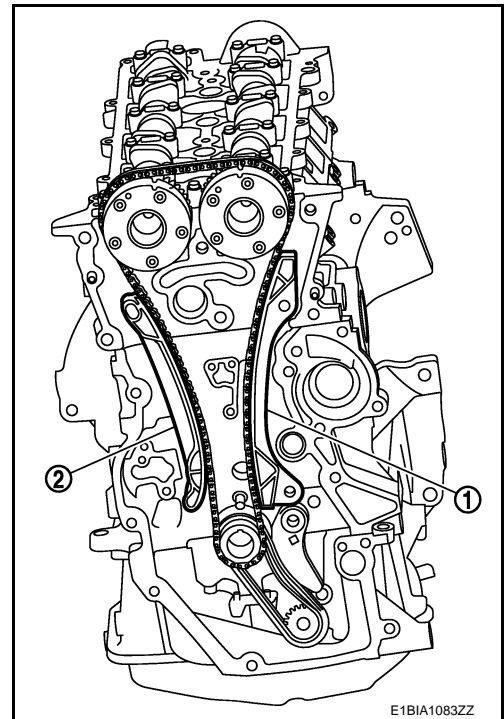


TIMING CHAIN

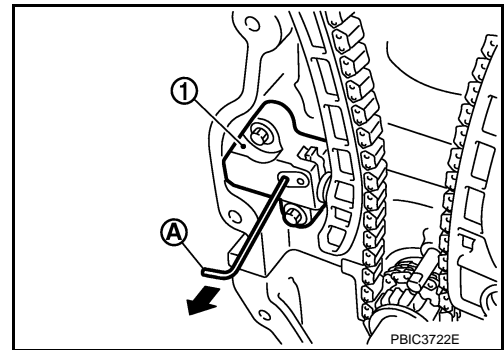
< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

3. Install timing chain tension guide (2) and timing chain slack guide (1).



4. Install chain tensioner (1).
 - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
 - Securely pull out the stopper pin after installing the chain tensioner.

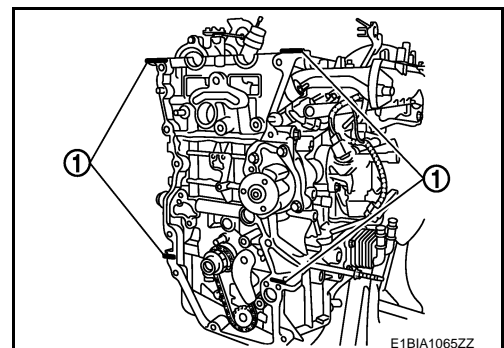


5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to [EM-87, "FRONT OIL SEAL : Removal and Installation"](#)
7. Install front cover seal. Refer to [EM-58, "Exploded View"](#).
 - **CAUTION:**
Be careful not to damage front cover.
8. Install front cover with the following procedure:
 - a. Clean front cover mounting surface and engine surface in contact with front cover.
 - Surface must be proper without any liquid gasket, water or dust.
 - b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

1 : Liquid gasket application area [ϕ 3.0 - 4.0 mm (0.12 - 0.16 in)]

CAUTION:

Applying excess of liquid gasket can create damage on parts during tightening sequence.



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TIMING CHAIN

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- c. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**

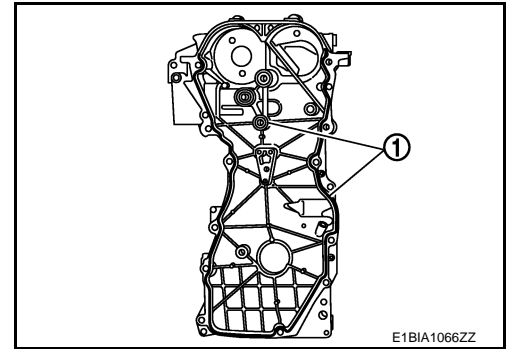
1 : Liquid gasket application area [ϕ 3.0 - 4.0 mm (0.12 - 0.16 in)]

NOTE:

Liquid gasket must be applied at a distance of 1.0mm (0.04 in) to 2.0mm (0.08 in) from the inside edge of the timing cover.

CAUTION:

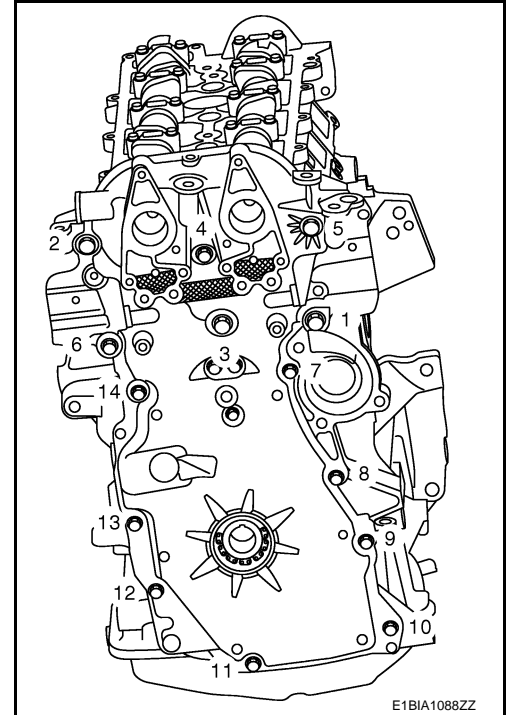
Applying excess of liquid gasket can create damage on parts during tightening sequence.



- d. Tighten bolts in the numerical order as shown in the figure following the procedure.

1. Tighten mounting bolts No. 14, 7, 10 and 12.

 : **8.0 N·m (0.8 kg·m, 71 in·lb)**



2. Tighten mounting bolts No. 1, 2, 3, 4, 5, 6,.

 : **55.0 N·m (5.6 kg·m, 41 ft·lb)**

3. Tighten mounting bolts No. 7, 8, 9, 10, 11, 12, 13, 14.

 : **25.0 N·m (2.6 kg·m, 18 ft·lb)**

CAUTION:


Be sure to wipe off any excessive liquid gasket leaking to surface.

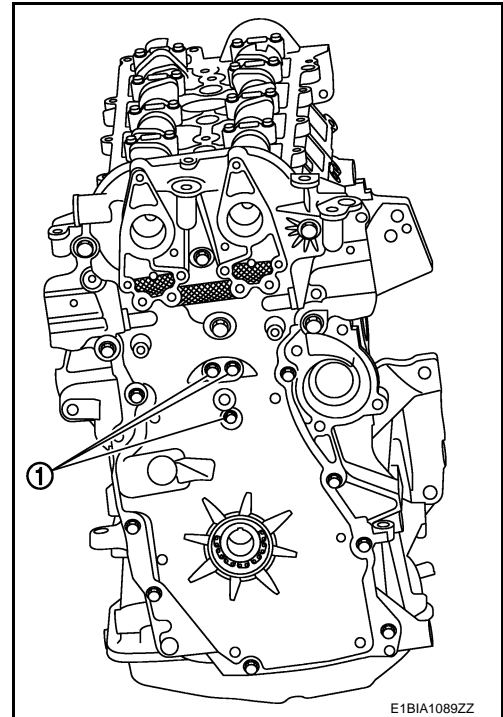
TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

- e. After all bolts are tightened, instal front cover bolts (1).

 : 10.0 N·m (1.0 kg·m, 7 ft·lb)

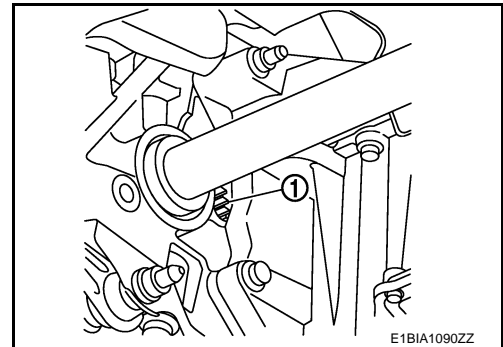


9. Insert crankshaft pulley by aligning with crankshaft key.
- When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
- CAUTION:**
Install protecting front oil seal lip section from any damage.

10. Tighten crankshaft pulley bolt with the following procedure:
- Lock the flywheel (1) using a flat blade screw driver.
- a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
- b. Tighten crankshaft pulley bolt.

 : 50.0 N·m (5.1 kg·m, 37 ft·lb)

- c. Turn another 200 degrees clockwise (angle tightening).
- Check the tightening angle with movement of one angle mark.



11. Check that crankshaft turns smoothly by rotating by hand clockwise.
12. Install in the reverse order of removal.

Inspection

INFOID:000000010351306

INSPECTION AFTER REMOVAL

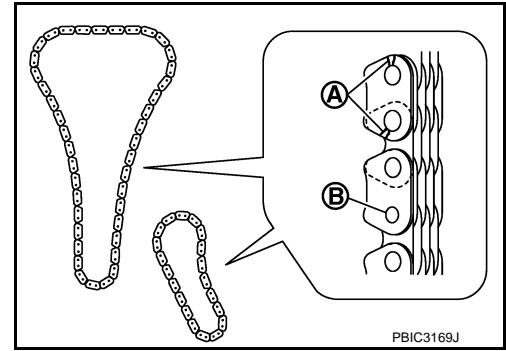
Timing Chain

TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

Check for cracks (A) and any excessive wear (B) at link plates and roller links of timing chain. Replace timing chain if necessary.



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INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate an unusualness. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

CYLINDER HEAD

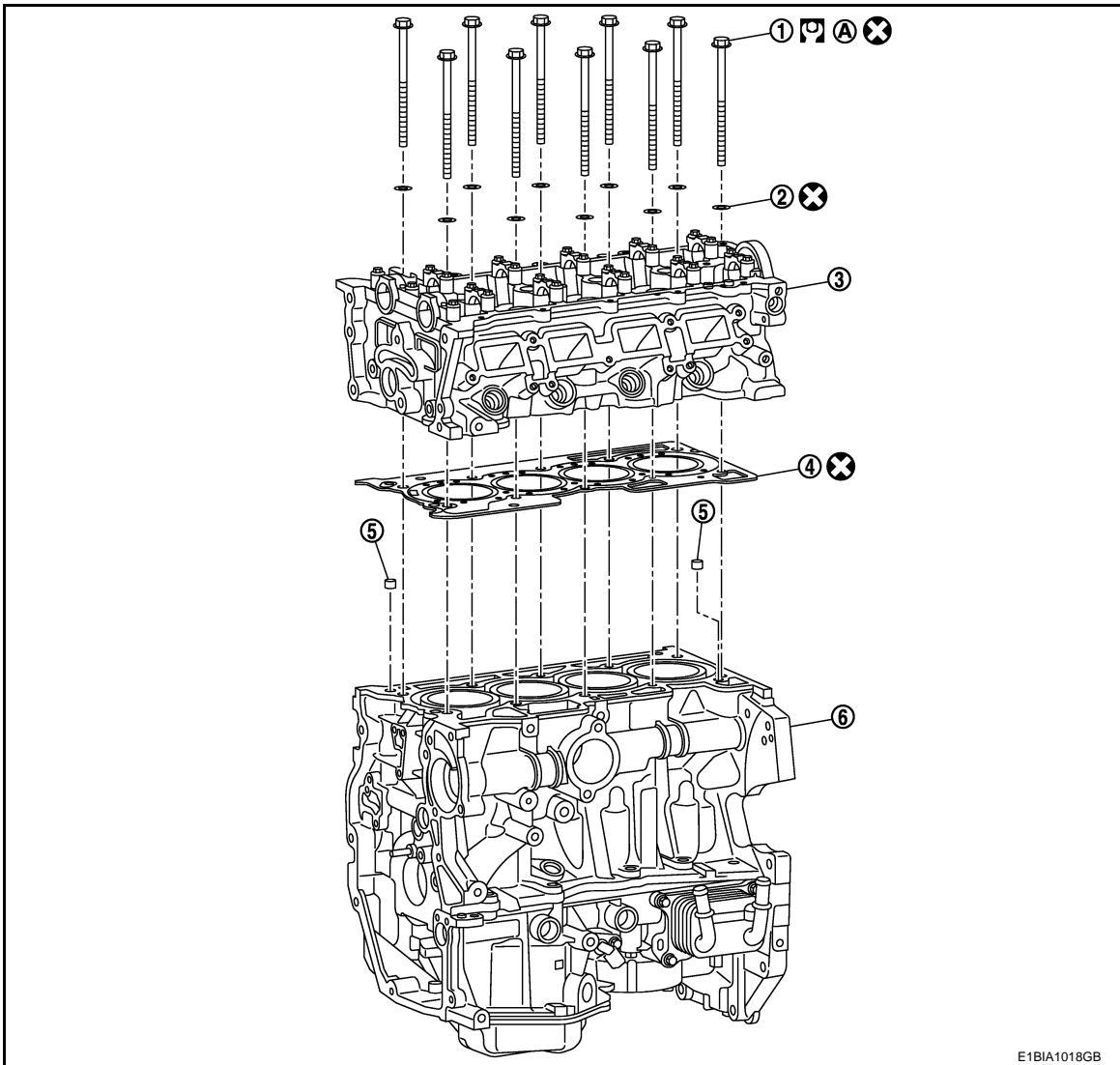
Exploded View

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REMOVAL

A

EM



1. Cylinder head bolt
 2. Cylinder head bolt washer
 3. Cylinder head
 4. Cylinder head gasket
 5. Dowel pin
 6. Cylinder block
- A. Tightening must be done following the installation procedure.
Refer to [EM-70](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

DISASSEMBLY

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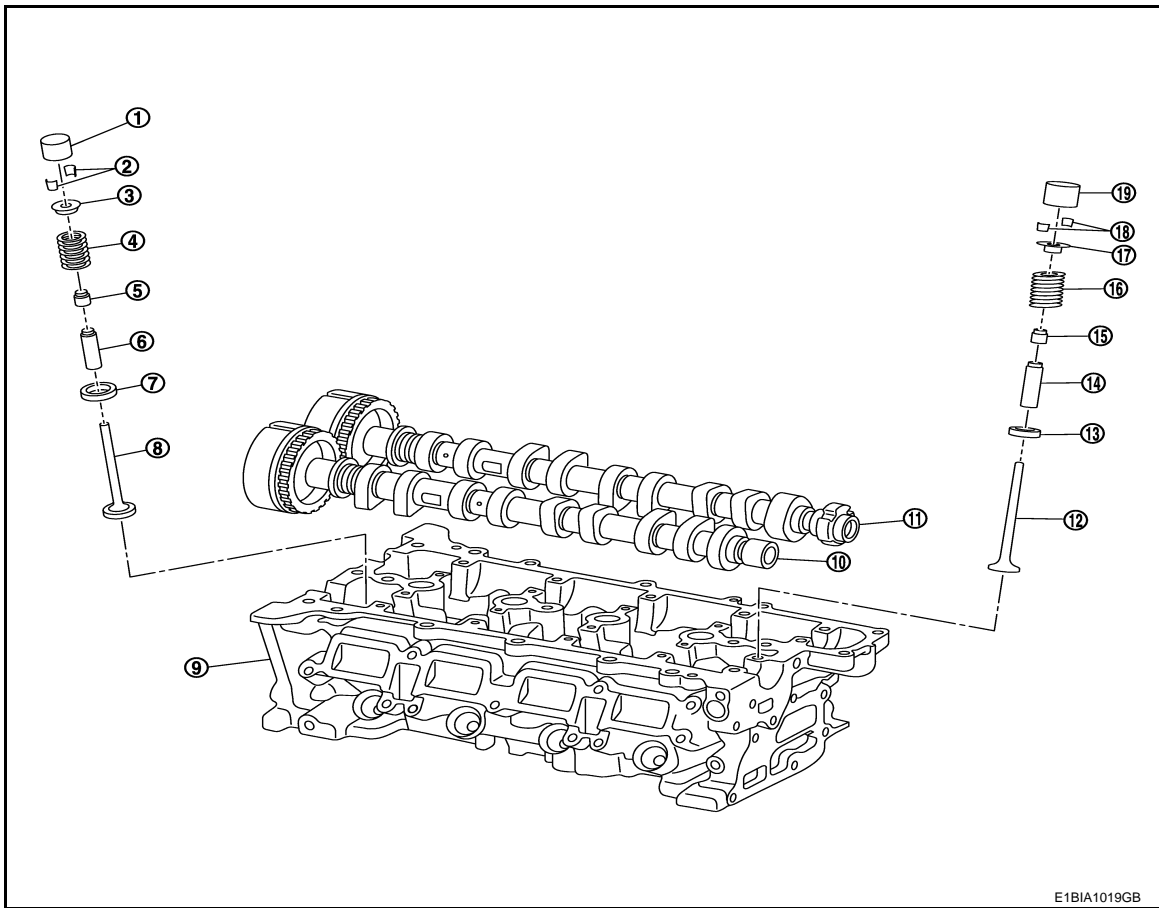
O

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CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]



- | | | |
|--------------------------|-----------------------------------|---------------------------------|
| 1. Intake valve lifter | 2. Intake valve collet | 3. Intake valve spring retainer |
| 4. Intake valve spring | 5. Intake valve oil seal | 6. Intake valve guide |
| 7. Intake valve seat | 8. Intake valve | 9. Cylinder head |
| 10. Intake camshaft | 11. Exhaust camshaft | 12. Exhaust valve |
| 13. Exhaust valve seat | 14. Exhaust valve guide | 15. Exhaust valve oil seal |
| 16. Exhaust valve spring | 17. Exhaust valve spring retainer | 18. Exhaust valve collet |
| 19. Exhaust valve lifter | | |

- A. Replacement must be following the disassembly and assembly procedure.
Refer to [EM-71](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282238

REMOVAL

1. Release fuel pressure. Refer to [ECH-121, "Work Procedure"](#).
2. Drain engine coolant and engine oil. Refer to [CO-11, "Draining"](#) and [LU-9, "Draining"](#).
CAUTION:
Perform this step when the engine is cold.
3. Remove the following components and related parts.
 - Intake manifold: Refer to [EM-25, "Exploded View"](#).
 - Fuel tube and fuel injector: Refer to [EM-42, "Exploded View"](#).
 - High pressure fuel pump: Refer to [EM-38, "Exploded View"](#)
 - Water outlet: Refer to [CO-27, "Exploded View"](#).
 - Exhaust manifold: Refer to [EM-37, "Exploded View"](#).
 - Rocker cover: Refer to [EM-49, "Exploded View"](#).
 - Front cover and timing chain: Refer to [EM-93, "Exploded View"](#).
 - Camshaft: Refer to [EM-77, "Exploded View"](#).

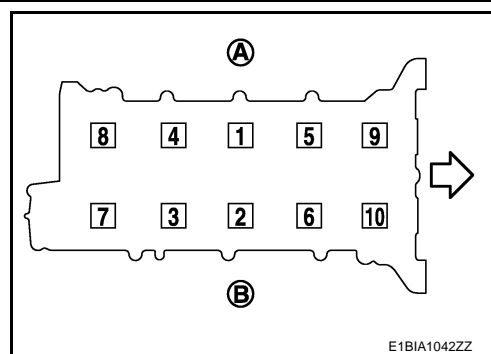
CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

- Remove cylinder head loosening bolts in reverse order as shown in the figure with cylinder head wrench (commercial service tool).

- A : INT side
B : EXH side
⇐ : Engine front



- Remove cylinder head gasket.

INSTALLATION

- Install new cylinder head gasket.
- Tighten cylinder head bolts in numerical order as shown in the figure with the following procedure to install cylinder head.

- A : INT side
B : EXH side
⇐ : Engine front

CAUTION:

Cylinder head bolts can not be reuse.

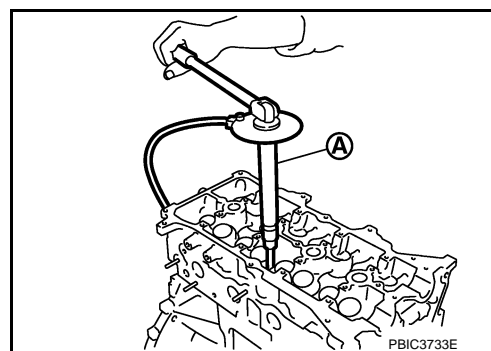
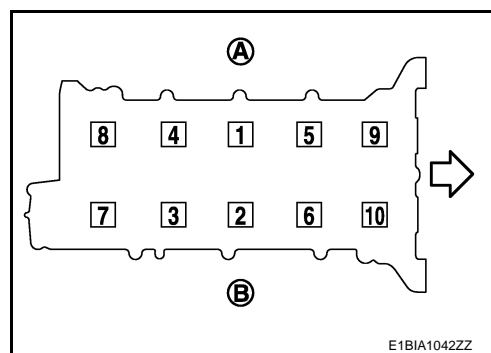
- Apply new engine oil to threads and seating surfaces of mounting bolts.
- Tighten all bolts.

: **25.0 N·m (2.6 kg-m, 18 ft-lb)**

- Turn all bolts 270 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- Install in the reverse order of removal after this step.

Disassembly and Assembly

INFOID:0000000010282239

DISASSEMBLY

- Remove spark plug with a spark plug wrench (commercial service tool).
- Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.
- Remove valve collet.

CYLINDER HEAD

[HRA2DDT]

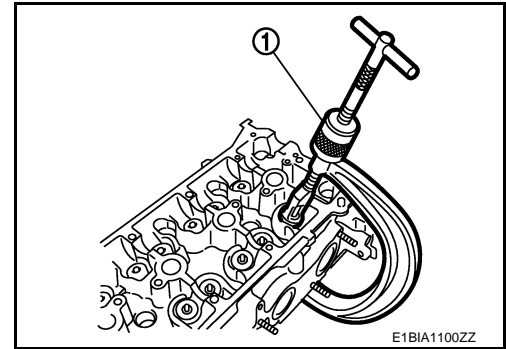
< UNIT DISASSEMBLY AND ASSEMBLY >

- Compress valve spring with the valve spring compressor (commercial service tool).
- Remove valve collet with a magnet hand.

CAUTION:

When working, be careful not to damage valve lifter holes.

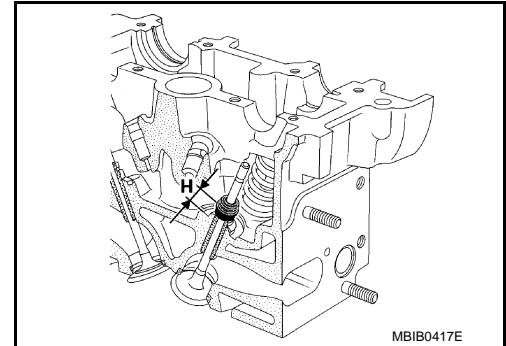
4. Remove valve spring retainer and valve spring.



5. Measure position "H" of one of the valve oil seal with the following procedure.

CAUTION:

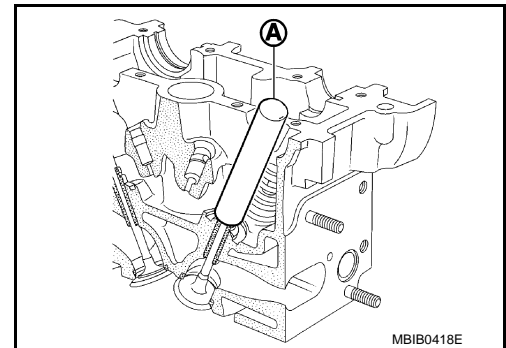
Before removing the valves and the valve oil seals, it is vital to measure position "H" of one of the valve oil seal in relation with the cylinder head using [SST: KV113B0330 (Mot. 1511)] or equivalent tool.



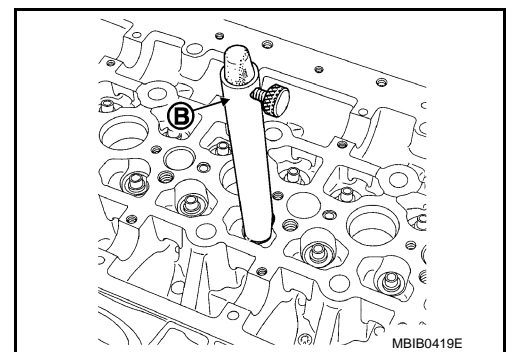
- a. Install the push rod (A) of [SST: KV113B0330 (Mot. 1511)] or equivalent tool on the valve oil seal.

NOTE:

The inner diameter of the push rod must be identical to that of the valve. In addition, the bottom of the push rod must come into contact with the metal upper section of the valve oil seal.



- b. Install the guide tube (B) over the push rod until the guide tube comes into contact with the cylinder head, locking the push rod with the knurled wheel.
- c. Remove the guide tube assembly and push rod, being careful not to loosen the knurled wheel.
- d. Push valve stem to combustion chamber side, and remove valve.
- Identify installation positions, and store them without mixing them up.
- e. Remove using [SST: KV113B0090 (Mot. 1335)] or equivalent valve oil seals.



7. Remove valve spring seat.

ASSEMBLY

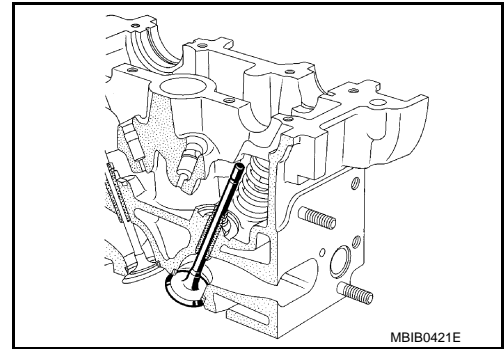
1. Check valve seat contact. Refer to [EM-74, "Inspection"](#)
2. Install valve.

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

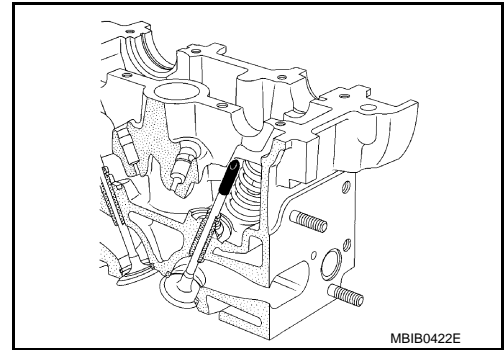
- Lubricate the inside of the valve guide.



3. Instal valve oil seal with the following procedure.
 - a. Install the barrel of [SST: KV113B0330 (Mot. 1511)] or equivalent tool on the valve stem.

NOTE:

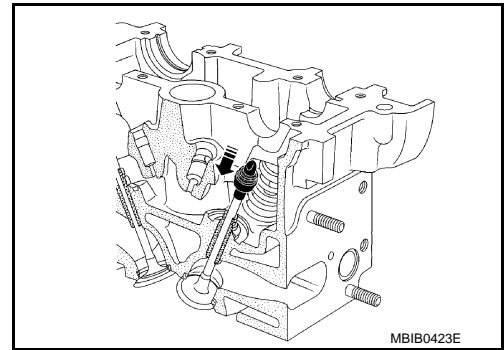
The inner diameter of the barrel must be identical to the diameter of the valve stem.



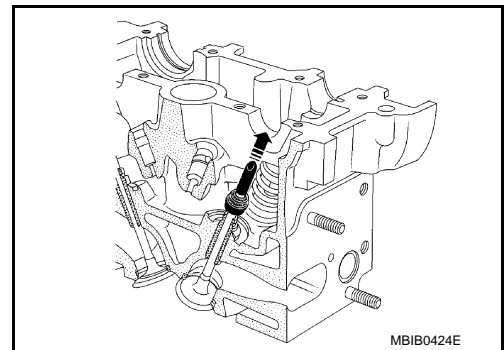
- b. Keep the valve pressed in contact with the valve seat
- c. Install the valve oil seal on the barrel of [SST: KV113B0330 (Mot. 1511)] or equivalent.

NOTE:

Never lubricate the valve oil seal before install them.



- d. Push the valve oil seal until it past the barrel of [SST: KV113B0330 (Mot. 1511)] or equivalent then remove the barrel of [SST: KV113B0330 (Mot. 1511)] or equivalent.



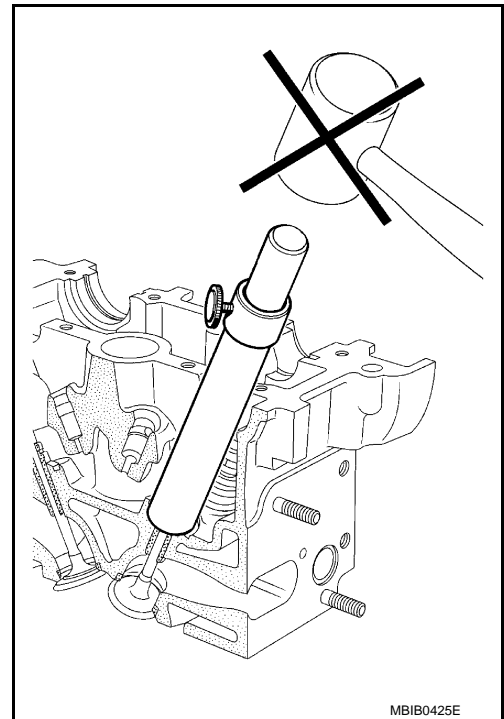
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CYLINDER HEAD

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

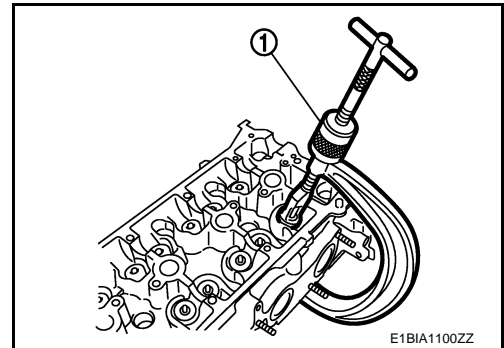
- e. Install guide tube and push rod of [SST: KV113B0330 (Mot. 1511)] or equivalent on the valve oil seal.
- f. Push the valve oil seal by tapping by hand on the sleeve of [SST: KV113B0330 (Mot. 1511)] or equivalent until guide tube reaches the cylinder head.



4. Repeat the operations for all the valves.
5. Install valve spring seat.
6. Install valve spring and valve spring retainer.
7. Install valve collet.
 - Compress valve spring with the valve spring compressor valve (commercial service tool).
 - Install valve collet with a magnet hand.

CAUTION:
When working, be careful not to damage valve lifter holes.

 - Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.
8. Install valve lifter.
9. Install spark plug with a spark plug wrench (commercial service tool).



Inspection

INFOID:000000010365193

INSPECTION AFTER REMOVAL

Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to [EM-102, "Inspection"](#).

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.

CAUTION:

Use utmost care not to allow gasket debris to enter passages for engine oil or engine coolant.

CYLINDER HEAD

[HRA2DDT]

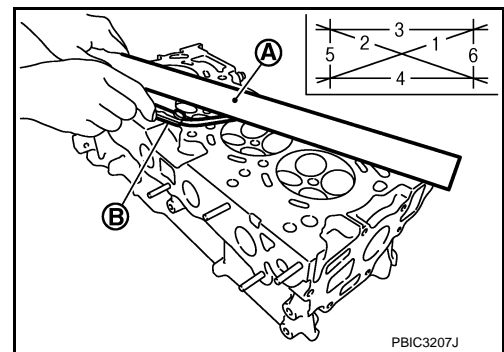
< UNIT DISASSEMBLY AND ASSEMBLY >

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions.

- A : Straightedge
B : Feeler gauge

Limit : Refer to [EM-116, "Cylinder Head"](#).

- If it exceeds the limit, replace cylinder head.



INSPECTION AFTER DISASSEMBLY

VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to [EM-116, "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

VALVE GUIDE CLEARANCE

Valve Stem Diameter

- Measure the diameter of valve stem with micrometer (A).

Standard : Refer to [EM-116, "Cylinder Head"](#).

Valve Guide Inner Diameter

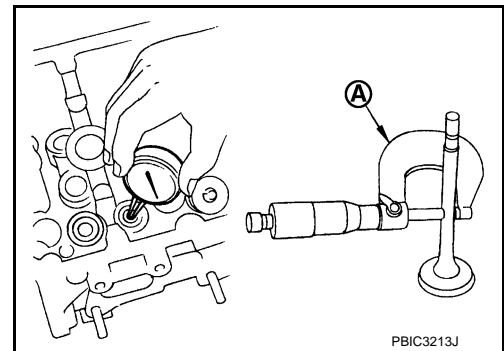
- Measure the inner diameter of valve guide with bore gauge.

Standard : Refer to [EM-116, "Cylinder Head"](#).

Valve Guide Clearance

- (Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

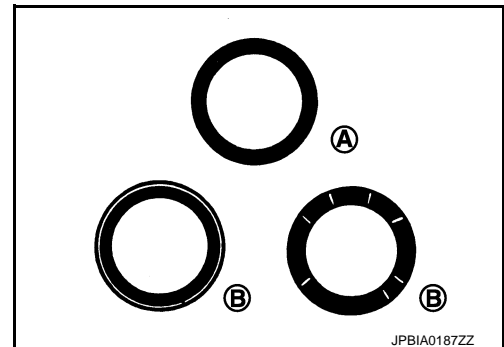
Standard and Limit : Refer to [EM-116, "Cylinder Head"](#).



VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.

A : OK



VALVE SPRING SQUARENESS

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

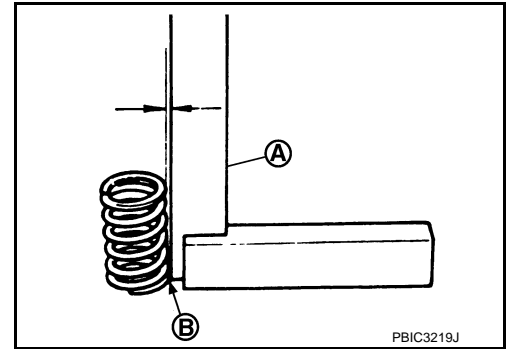
[HRA2DDT]

- Set a try square (A) along the side of valve spring and rotate spring. Measure the maximum clearance between the top of spring and try square.

B : Contact

Limit : Refer to [EM-116, "Cylinder Head"](#).

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

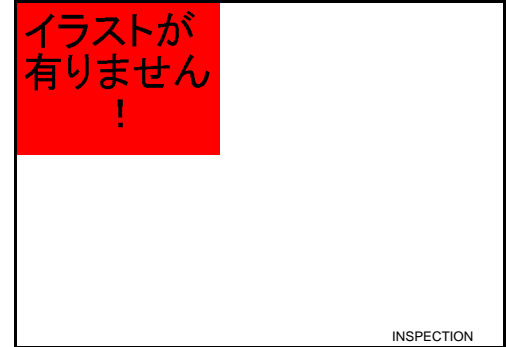
- Check valve spring pressure with valve spring seat installed at the specified spring height.

CAUTION:

Never remove valve spring seat from valve spring.

Standard : Refer to [EM-116, "Cylinder Head"](#)

- If the installation load or load with valve open is out of the standard, replace valve spring (with valve spring seat).



INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

CAMSHAFT

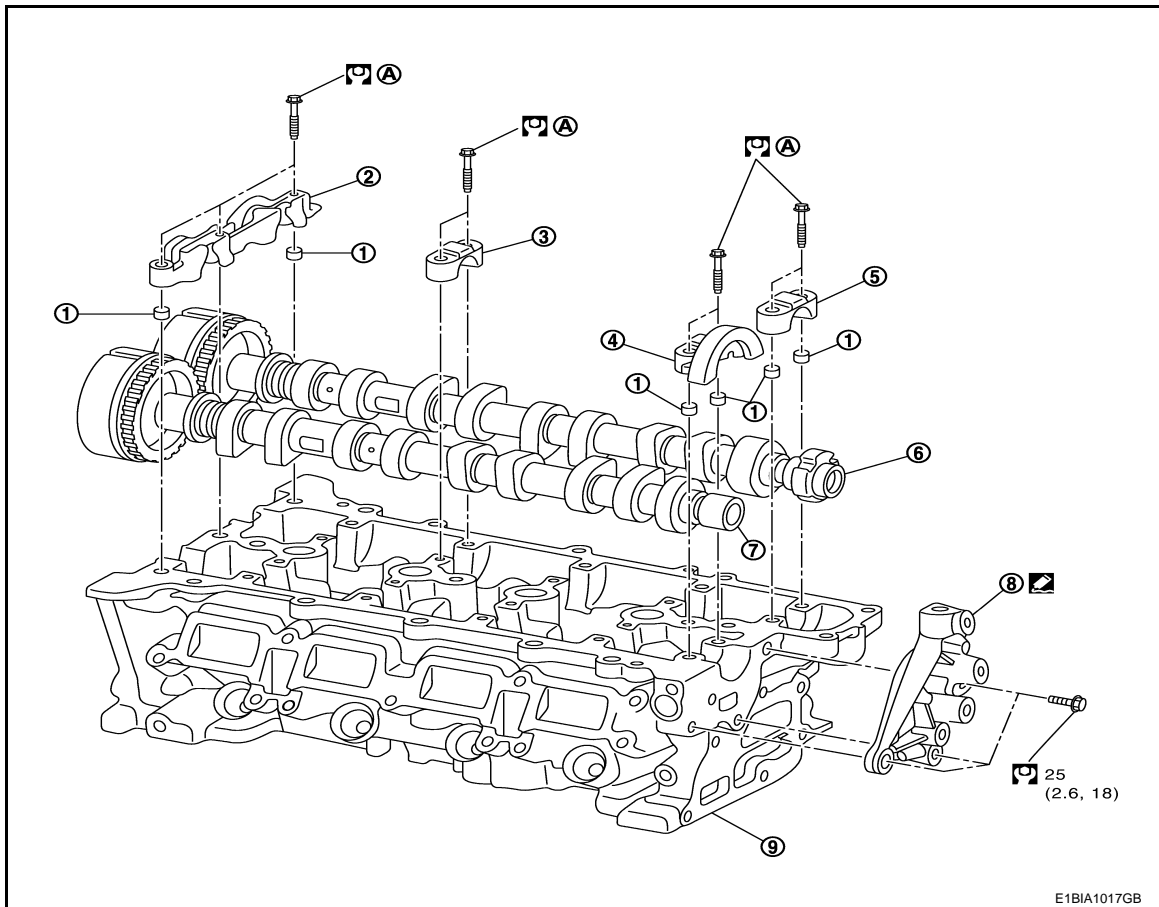
< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

CAMSHAFT

Exploded View

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- | | | |
|--|--|----------------------------------|
| 1. Exhaust and intake camshaft bearing cap guide | 2. Exhaust and intake camshaft bearing cap (timing chain side) | 3. Camshaft bearing cap (center) |
| 4. Exhaust camshaft bearing cap (gearbox side) | 5. Intake camshaft bearing cap (gearbox side) | 6. Exhaust camshaft |
| 7. Intake camshaft | 8. Cylinder head closing plate | 9. Cylinder head |
- A. Tightening must be done following the installation procedure.
Refer to [EM-77](#)

Refer to [GI-4. "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282232

CAUTION:

The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

1. Remove timing belt. Refer to [EM-59. "Removal and Installation"](#)
2. Remove cylinder head closing plate with the following procedure.
 - a. Remove cylinder head closing plate bolts. Refer to [EM-77. "Exploded View"](#)

CAMSHAFT

[HRA2DDT]

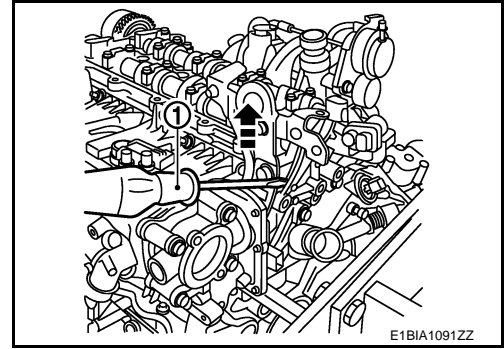
< UNIT DISASSEMBLY AND ASSEMBLY >

- b. Separate cylinder head closing plate from cylinder head using a flatblade screw driver (1).

CAUTION:

- Be careful not to damage the matting surface.

- c. Remove cylinder head closing plate.



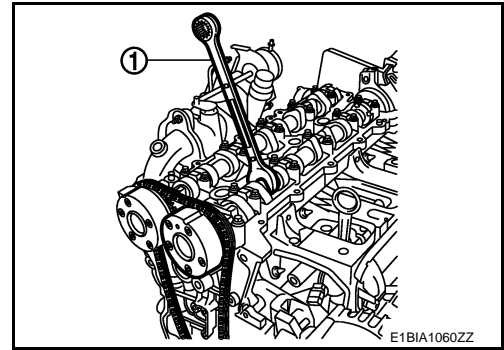
3. Remove intake camshaft sprocket with the following procedure.

CAUTION:

- It is strictly forbidden to apply any pressure to oil pan.
- Damage oil pan will irreparably damage the engine by:
 - blocking the strainer
 - Raising oil level above maximum, with a risk of engine racing

- a. Remove intake camshaft sprocket bolt.

- Hold intake camshaft using open end spanner (1)
- Loosen the bolts in several steps, and then remove them.
- Remove intake camshaft sprocket.



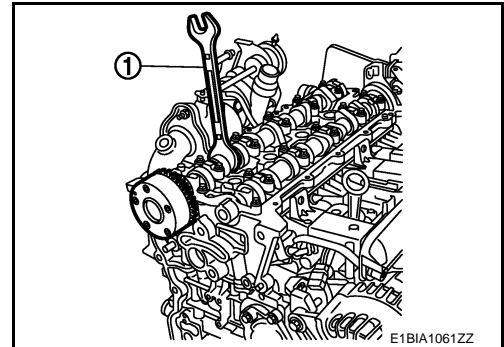
4. Remove exhaust camshaft sprocket with the following procedure.

CAUTION:

- It is strictly forbidden to apply any pressure to oil pan.
- Damage oil pan will irreparably damage the engine by:
 - blocking the strainer
 - Raising oil level above maximum, with a risk of engine racing

- a. Remove exhaust camshaft sprocket bolt.

- Hold exhaust camshaft using open end spanner (1)
- Loosen the bolts in several steps, and then remove them.
- Remove exhaust camshaft sprocket.

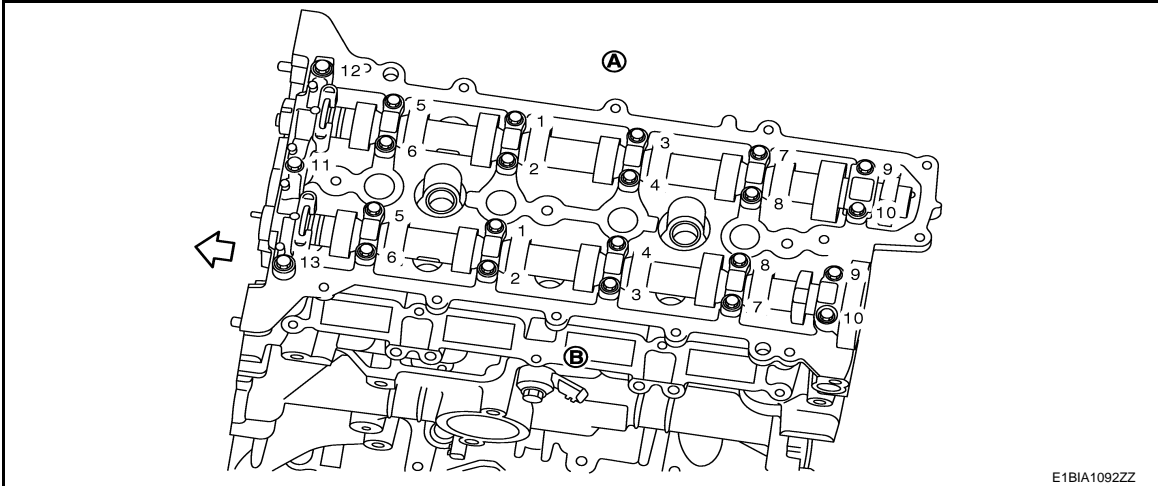


CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

5. Remove camshaft brackets with the following procedure.



- A : EXH side
B : INT side
⇐ : Engine front

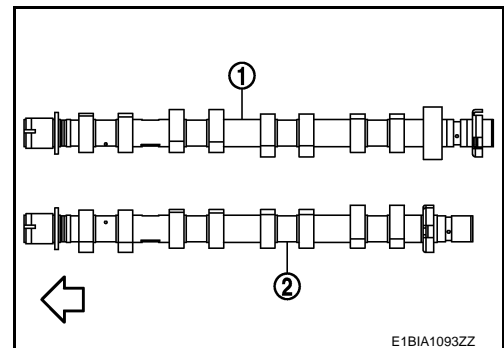
- a. Remove camshaft brackets (No.1 to 6).
 - Loosen bolts in several steps in the reverse of the order as shown in the figure.
 - Identify installation positions for each camshaft brackets, and store them without mixing them up.
6. Remove camshaft (EXH).
7. Remove camshaft (INT).
8. Remove valve lifter.
 - Identify installation positions for each camshaft brackets, and store them without mixing them up.

INSTALLATION

1. Install valve lifter with the following procedure.
 - If it is reused, install in its original positions.
 - a. Apply engine oil on each valve lifter housing.
 - b. Set each valve lifter into the repective seat of the cylinder head.
 - c. Apply engine oil on the valve lifter, on the sliding surface of cam.
2. Install camshaft.

- 1 : Camshaft (EXH)
2 : Camshaft (INT)
⇐ : Engine front

- Distinction between camshaft (INT and EXH) is performed with the different length of each one.



- Apply oil on the camshaft journal. of the cylinder head.

CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

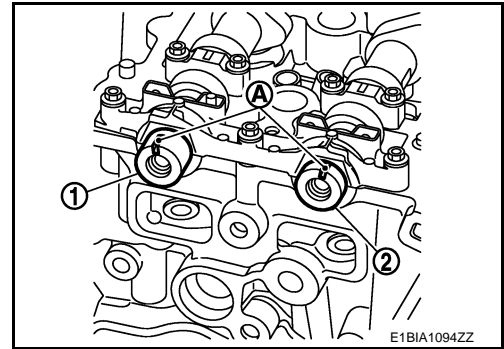
[HRA2DDT]

- Install camshafts to the cylinder head so that lugs (A) on front end are positioned as shown in the figure.

- 1 : Camshaft (EXH)
2 : Camshaft (INT)

NOTE:

Though camshaft does not stop at the portion as shown in the figure, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.



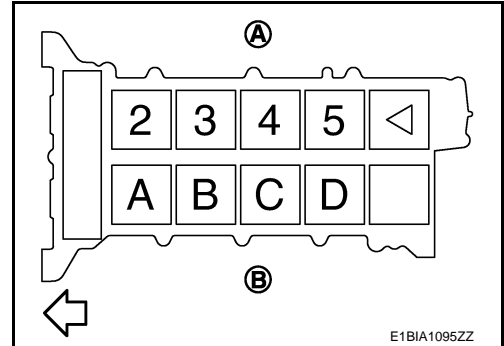
3. Install camshaft brackets (No. 1 to 6) aligning the identification marks on upper surface as shown in the figure.

- A : EXH side
B : INT side
↔ : Engine front

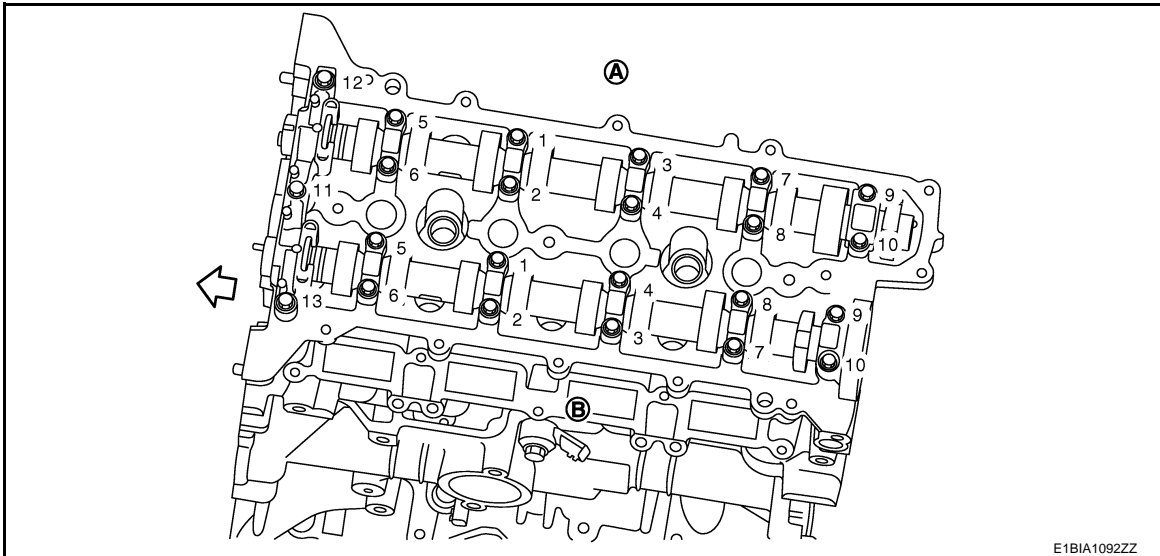
- Install so that identification mark can be correctly read when viewed from the INT side.

NOTE:

There is no identification mark for the bracket No.1 (INT and EXH) and for the bracket No. 6 (INT).



4. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.



- A : EXH side
B : INT side
↔ : Engine front

- a. Tighten No. 1 to 13 in numerical order.

: 4.0 N·m (0.4 kg·m, 3 ft·lb)

- b. Tighten No.1 to 13 in numerical order.

: 10.4 N·m (1.1 kg·m, 8 ft·lb)

5. Install cylinder head closing plate with the following procedure.

CAMSHAFT

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- a. Clean and degrease cylinder head closing plate.
- b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to cylinder head closing plate as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

1. Liquid gasket application area [ϕ 3.0 - 4.0 mm (0.12 - 0.16 in)]

NOTE:

Liquid gasket must be applied at a distance of 1.0 mm (0.04 in) to 2.0 mm (0.08 in) from the inside edge of the cylinder head closing plate.

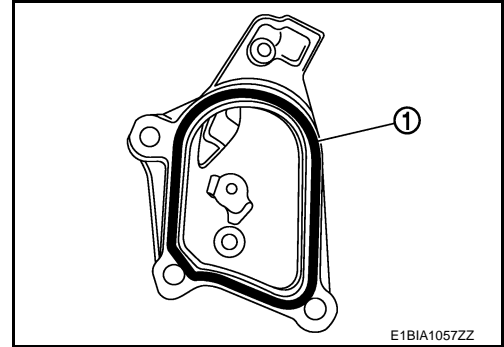
CAUTION:

Applying excess of liquid gasket can create damage on the parts during tightening sequency.

- c. Install cylinder head closing plate and bolts. Refer to [EM-77. "Exploded View"](#)
- d. Tighten cylinder head closing plate bolts.

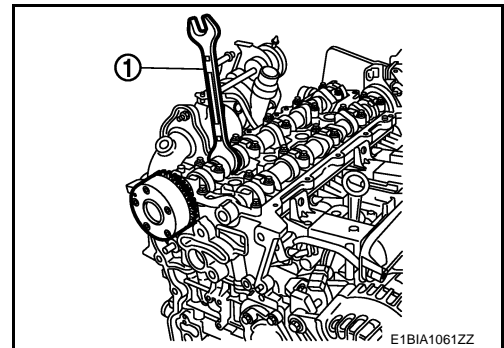
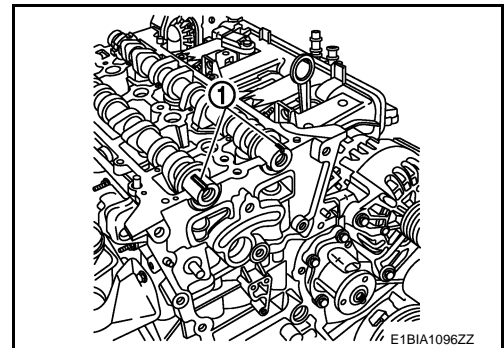
: **25.0 N-m (2.6 kg-m, 18 ft-lb)**

6. Install the camshaft sprockets (INT and EXH) to the camshafts (INT and EXH) with the following procedure.
- a. Check that the camshaft lugs (1) are still in the same position as shown in the figure.



- b. Install camshaft sprockets and mounting bolts (INT and EXH).
- c. Tighten the camshaft sprockets mounting bolts (INT and EXH).
 - Hold camshaft using open end spanner (1)
 - Tighten camshaft sprocket mounting bolt.

: **75 N-m (7.7 kg-m, 55 ft-lb)**



7. Install timing chain. Refer to [EM-59. "Removal and Installation"](#).
8. Check and adjust valve clearance. Refer to [EM-84. "Inspection and Adjustment"](#).
9. When replacing valve timing control solenoid valve. Refer to [ECH-102. "Special Repair Requirement List"](#).

Inspection

INFOID:000000010282233

INSPECTION AFTER REMOVAL

Oil Filter

- Check that there is no foreign material on the oil filter and check it for clogging.
- Check the oil filter for damage.
- If there is some damage, replace the oil filter, the plug, and the washer as a set.

Camshaft Runout

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CAMSHAFT

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

1. Put V-block on a precise flat table, and support camshaft.

CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Set a dial indicator vertically to journal.
3. Turn camshaft one turn with hands while avoiding the lubrication holes to check camshaft runout.

Standard and Limit

: Refer to [EM-114, "Camshaft"](#).

4. If it exceeds the limit, replace camshaft.

Camshaft Cam Height

1. Measure the camshaft cam height with a micrometer (A).

Standard and Limit

Intake

Exhaust

: Refer to [EM-114, "Camshaft"](#).

Cam wear limit:

: Refer to [EM-114, "Camshaft"](#).

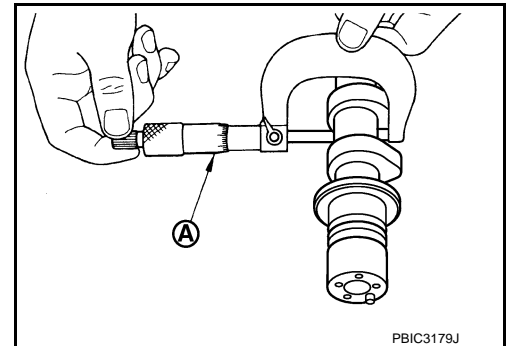
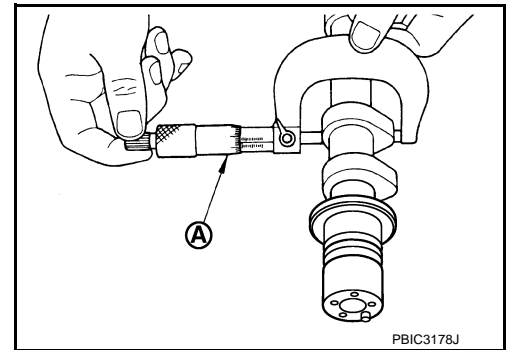
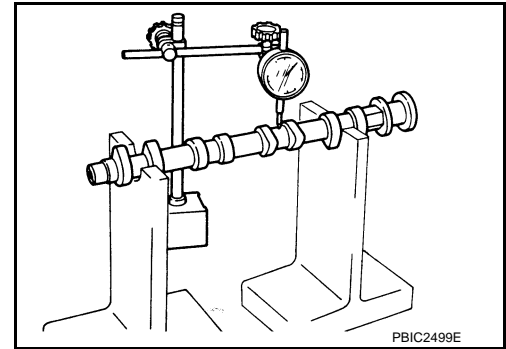
2. If wear exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

Measure the outer diameter of camshaft journal with a micrometer (A).

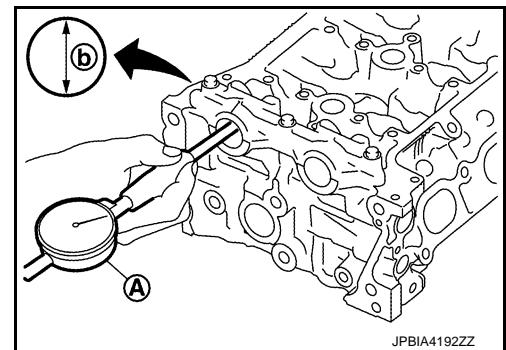
Standard: : Refer to [EM-114, "Camshaft"](#).



CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to "INSTALLATION" for the tightening procedure.
- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

Standard : Refer to [EM-114, "Camshaft"](#).



CAMSHAFT JOURNAL OIL CLEARANCE

- (Oil clearance) = (Camshaft bracket inner diameter) – (Camshaft journal diameter)

CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

Standard and Limit : Refer to [EM-114, "Camshaft"](#).

- If it exceeds the limit, replace either or both camshaft and cylinder head.

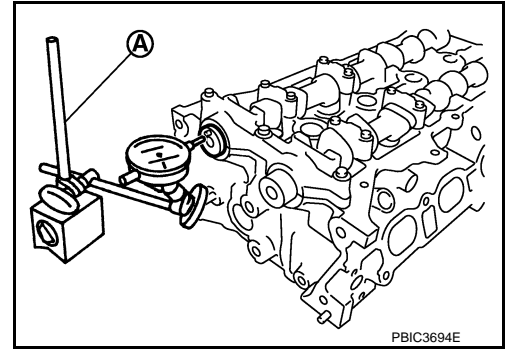
NOTE:

Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to [EM-77, "Removal and Installation"](#) for tightening procedure.
2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

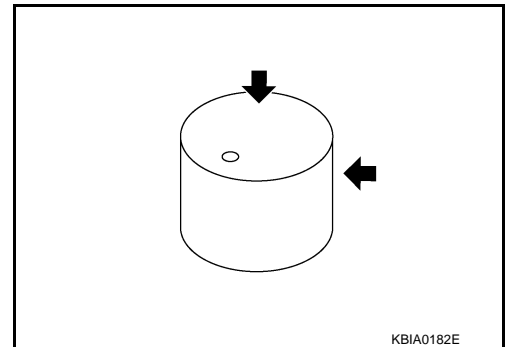
Standard and Limit : Refer to [EM-114, "Camshaft"](#).



Valve Lifter

Check if surface of valve lifter has any wear or cracks.

- If anything above is found, replace valve lifter. Refer to [EM-114, "Camshaft"](#).

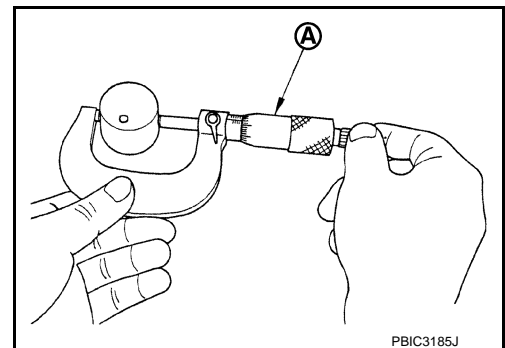


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter of valve lifter with a micrometer (A).

Standard : Refer to [EM-114, "Camshaft"](#).



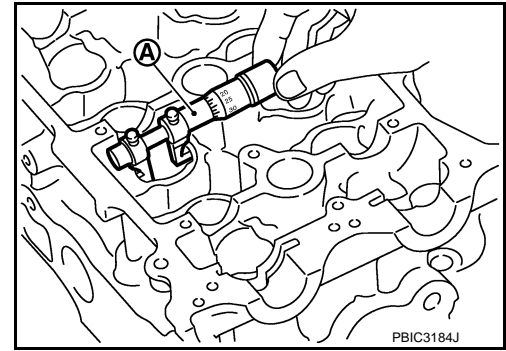
VALVE LIFTER HOLE DIAMETER

CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

Measure the diameter of valve lifter hole of cylinder head with an inside micrometer (A).



Standard : Refer to [EM-114, "Camshaft"](#).

VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) – (Valve lifter outer diameter)

Standard : Refer to [EM-114, "Camshaft"](#).

- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

Inspection and Adjustment

INFOID:000000010282208

INSPECTION

Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to [EM-49, "Exploded View"](#).

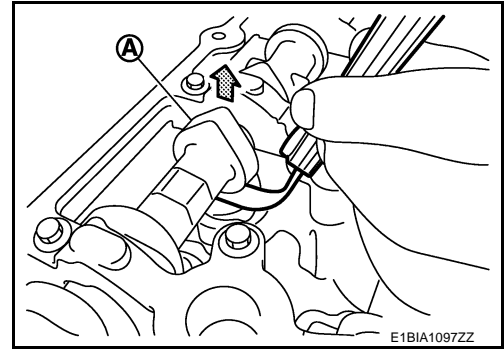
CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

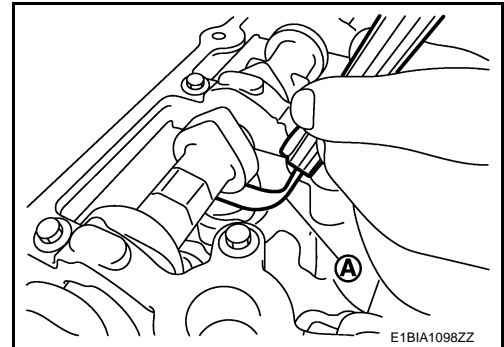
2. Measure the valve clearance with the following procedure:
 - a. Set cam to be checked in the same position as shown in the figure.
 - Rotate camshaft to set cam noses in the correct position.

A : Cam noses facing upward



- b. Use a feeler gauge (A), measure the clearance between valve lifter and camshaft.

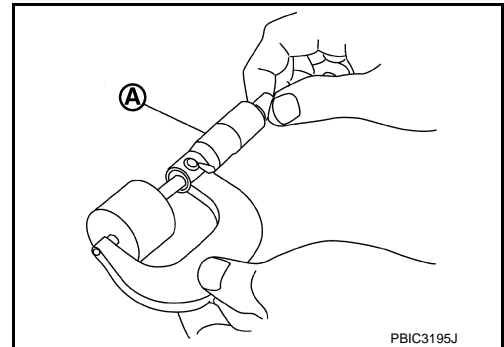
Valve clearance : Refer to [EM-84, "Inspection and Adjustment"](#).



3. If out of standard, perform adjustment. Refer to "ADJUSTMENT".

ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
1. Remove camshaft. Refer to [EM-77, "Exploded View"](#).
 2. Remove valve lifters at the locations that are out of the standard.
 3. Measure the center thickness of the removed valve lifters with a micrometer (A).



4. Use the equation below to calculate valve lifter thickness for replacement.

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t₁ = Removed valve lifter thickness

C₁ = Measured valve clearance

C₂ = Standard valve clearance:

Intake : 0.30 mm (0.012 in)

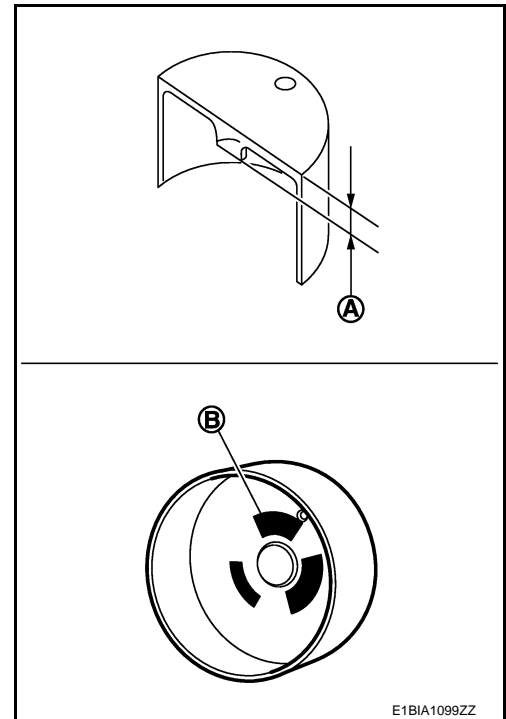
Exhaust : 0.50 mm (0.020 in)

CAMSHAFT

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Thickness of new valve lifter (A) can be identified by stamp mark (B) on the reverse side (inside the cylinder).
- Stamp mark "302" indicates 3.02 mm (0.1189 in) in thickness.



NOTE:

Available thickness of valve lifter: 31 sizes range 2.96 to 3.56 mm (0.1165 to 0.1402 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-114. "Camshaft"](#).

5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-77. "Exploded View"](#).
7. Install timing chain and related parts. Refer to [EM-58. "Exploded View"](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to ["EM-84. "Inspection and Adjustment"](#).
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

OIL SEAL FRONT OIL SEAL

FRONT OIL SEAL : Removal and Installation

INFOID:0000000010282235

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REMOVAL

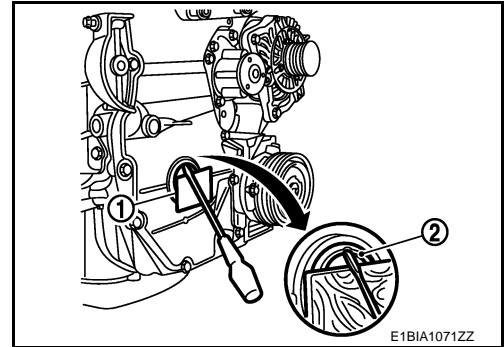
1. Remove the following parts.
 - Front fender protector (RH): Refer to [EXT-32. "Removal and Installation"](#).
 - Drive belt: Refer to [EM-21. "Removal and Installation"](#).
 - Crankshaft pulley: Refer to [EM-93. "Exploded View"](#).
2. Position a shim (1) on the timing cover.
3. Remove front oil seal using a flat blade screw driver (2).

NOTE:

Be careful to position the flat head of the screw driver behind the outer lip of the crankshaft seal.

CAUTION:

Be careful not to damage front cover and crankshaft.



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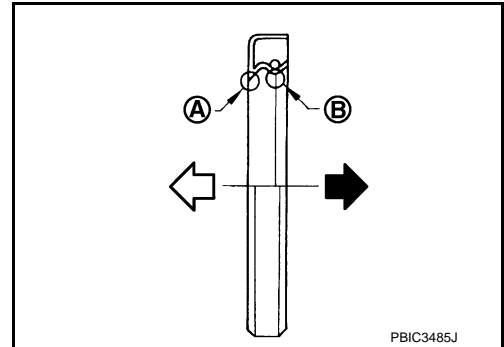
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INSTALLATION

1. Apply new engine oil to new front oil seal joint surface and seal lip.
2. Install front oil seal so that each seal lip is oriented as shown in the figure.

- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



H

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- Press-fit front oil seal using a suitable drift.
 - CAUTION:**
 - **Be careful not to damage front cover and crankshaft.**
 - **Press-fit oil seal straight to avoid causing burrs or tilting.**

3. Install in the reverse order of removal, for the rest of parts.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:0000000010282236

REMOVAL

1. Remove transaxle assembly. Refer to [TM-35. "Exploded View"](#).
2. Remove clutch cover and clutch disk. Refer to [CL-22. "HRA2DDT : Removal and Installation"](#).
3. Remove flywheel. Refer to [EM-93. "Exploded View"](#).

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OIL SEAL

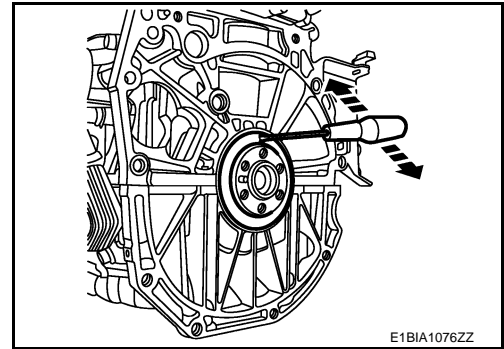
< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

4. Remove rear oil seal with a suitable tool.

CAUTION:

Be careful not to damage crankshaft and cylinder block.



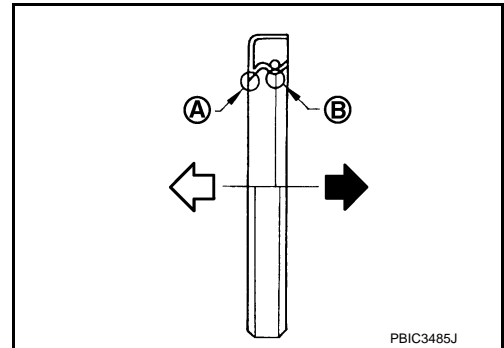
INSTALLATION

1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.

Use Genuine Liquid Gasket or equivalent.

2. Install rear oil seal so that each seal lip is oriented as shown in the figure.

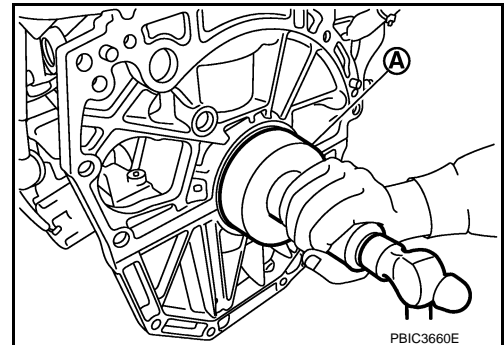
- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



• Press-fit rear oil seal with a suitable drift (A).

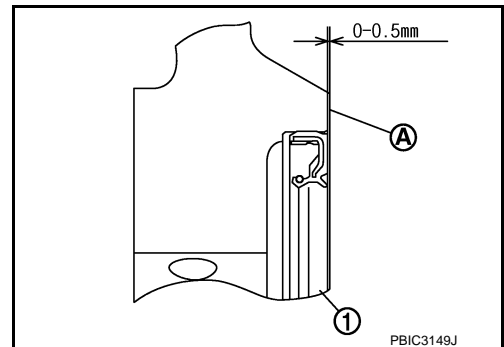
CAUTION:

- **Be careful not to damage crankshaft and cylinder block.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Never touch grease applied onto oil seal lip.**



• Press in rear oil seal (1) to the position as shown in the figure.

- A : Rear end surface of cylinder block
- b : 0 - 0.5 mm (0 - 0.020 in)



3. Install in the reverse order of removal, for the rest of parts.

OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

OIL PAN (UPPER)

Exploded View

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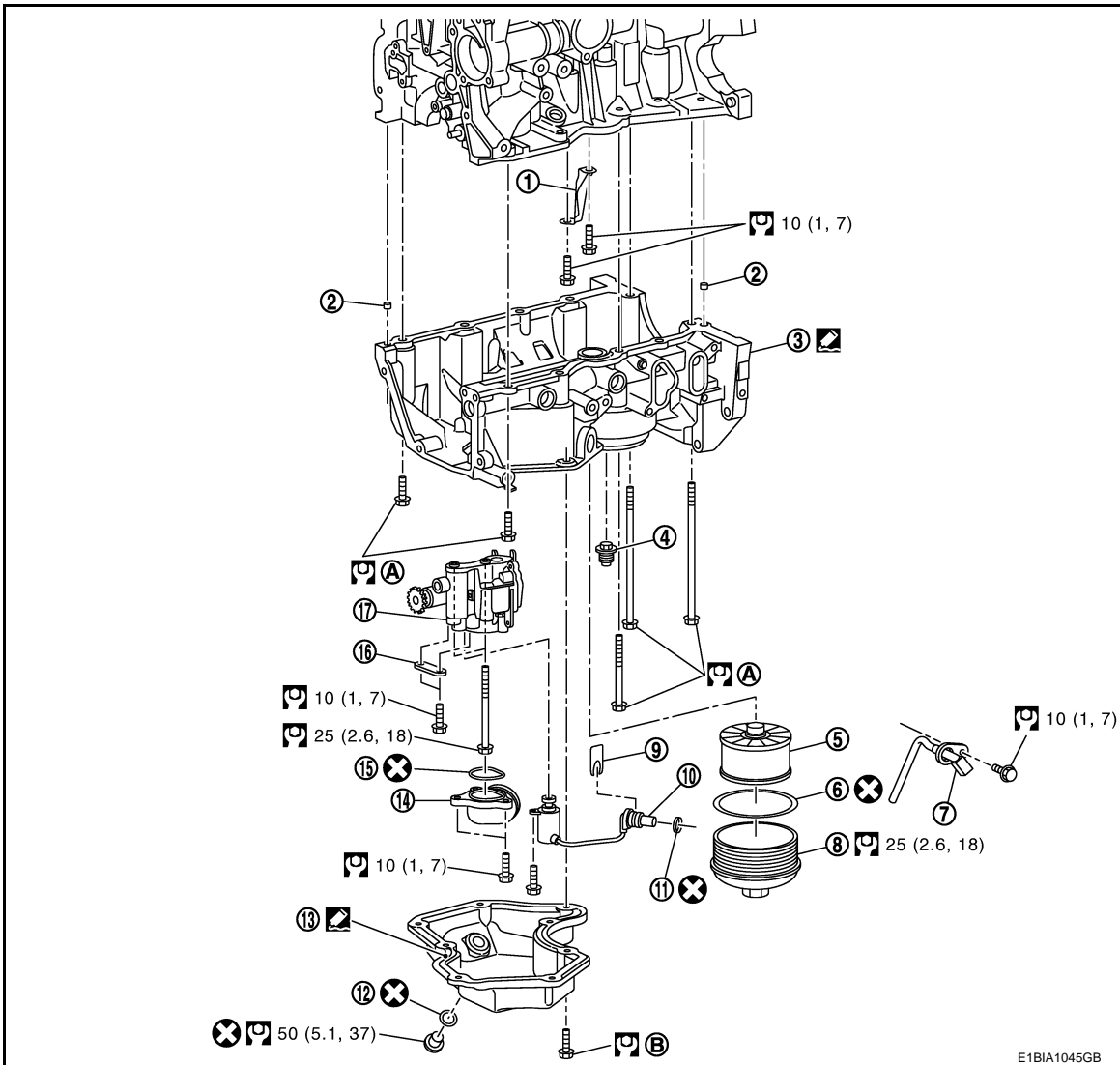
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- | | | |
|---|---|------------------------------|
| 1. Baffle plate | 2. Dowel pin | 3. Oil pan (upper) |
| 4. Oil pump release valve | 5. Oil filter | 6. O-ring |
| 7. Oil level sensor | 8. Oil filter cover | 9. Metal clip |
| 10. Oil pump solenoid valve | 11. Oil pump solenoid valve O-ring | 12. Drain plug washer |
| 13. Oil pan lower | 14. Oil pump strainer | 15. Oil pump strainer O-ring |
| 16. Oil pump bracket | 17. Oil pump | |
| A. Refer to EM-89. "Removal and Installation" | B. Refer to EM-46. "Removal and Installation" | |

Refer to [GI-4. "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282248

REMOVAL

1. Separate engine from gearbox.
2. Remove clutch disk and clutch cover. Refer to [CL-22. "HRA2DDT : Exploded View"](#).

OIL PAN (UPPER)

[HRA2DDT]

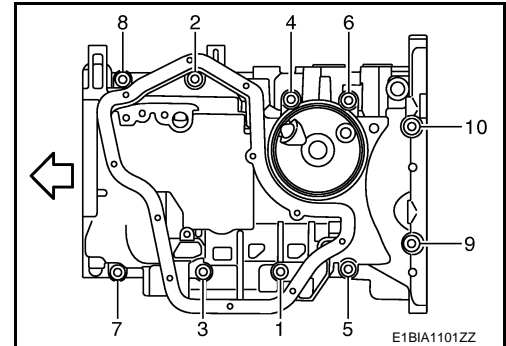
< UNIT DISASSEMBLY AND ASSEMBLY >

3. Remove flywheel. Refer to [EM-93, "Exploded View"](#).
4. Remove oil filter. Refer to [LU-10, "Removal and Installation"](#).
5. Remove the timing chain. Refer to [EM-58, "Exploded View"](#).
6. Remove the oil level sensor. Refer to [EM-89, "Exploded View"](#).
7. Remove the oil pan (lower). Refer to [EM-46, "Exploded View"](#).
8. Remove the oil pump. Refer to [LU-11, "Exploded View"](#).
9. Remove oil cooler. Refer to [LU-13, "Exploded View"](#).
10. Remove oil pan (upper) with the following procedure.
 - a. Loosen oil pan (upper) mounting bolts in the reverse of the order as shown in the figure.

CAUTION:

Take care to note the place and length of each bolt removed.

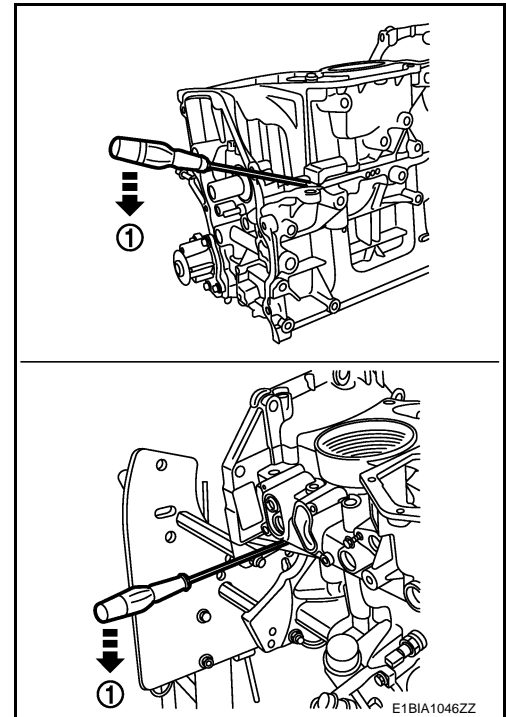
⇐ : Engine front



- b. Insert a flat-bladed screwdriver (1) and open up a crack between the oil pan (upper) cylinder block.

CAUTION:

- Be careful not to damage the mating surface.



OIL PAN (UPPER)

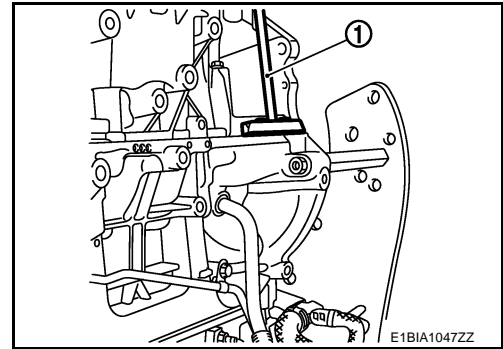
< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

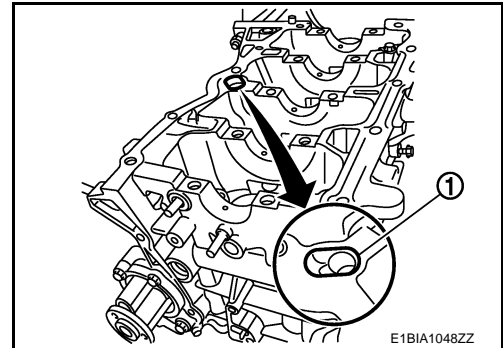
- c. Insert the seal cutter [SST: KV10111100] (1) between the oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of tool with a hammer.

CAUTION:

- Be careful not to damage the mating surface.
- A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off using a screwdriver, etc. outside the indicated location.



- d. Remove oil pan (upper)
e. Remove oil pan (upper) O-ring (1).



11. Remove rear oil seal from crankshaft. Refer to [EM-87. "REAR OIL SEAL : Removal and Installation"](#)

INSTALLATION

1. Install the oil pan (upper) in the following procedure:
- a. Use scraper to remove old liquid gasket from mating surfaces.
- Also remove the old liquid gasket from mating surface of cylinder block.
 - Remove old liquid gasket from the bolt holes and threads.

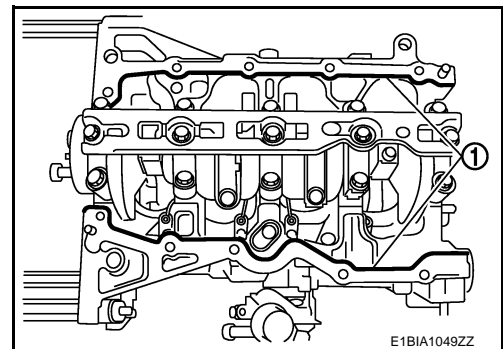
CAUTION:

Never scratch or damage the mating surfaces when cleaning off old liquid gasket.

- b. Install new oil pan (upper) oil seal.
- c. Apply a continuous bead of liquid gasket (1) with the tube presser (commercial service tool) to areas as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

Bead of liquid gasket diameter : $\phi 4.0 - 5.0$ mm (0.157 - 0.197 in)
Distance from inside edge : 7.5 - 9.5 mm (0.295 - 0.374 in)



CAUTION:

Attaching should be done within 5 minutes after coating.

OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

- d. Tighten bolts in the numerical order as shown in the figure.

↶ : Engine front

CAUTION:

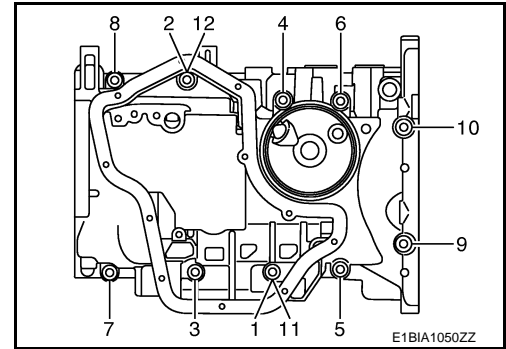
Install avoiding misalignment of both oil pan gasket and O-ring.

- The bolts are different according to the installation position.

CAUTION:

Take care to install correct size bolts for each position.

 : 25.0 N·m (2.6 kg·m, 18 ft-lb)



CAUTION:

Be sure to wipe off any excessive liquid gasket leaking to surface.

2. Install rear oil seal. Refer to [EM-87. "REAR OIL SEAL : Removal and Installation"](#).

CAUTION:

- The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).
- Never touch oil seal lip.

3. Install in the reverse order of removal, for the rest of parts.

Inspection

INFOID:000000010282249

INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-8. "Inspection"](#).
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-8. "Inspection"](#).

CYLINDER BLOCK

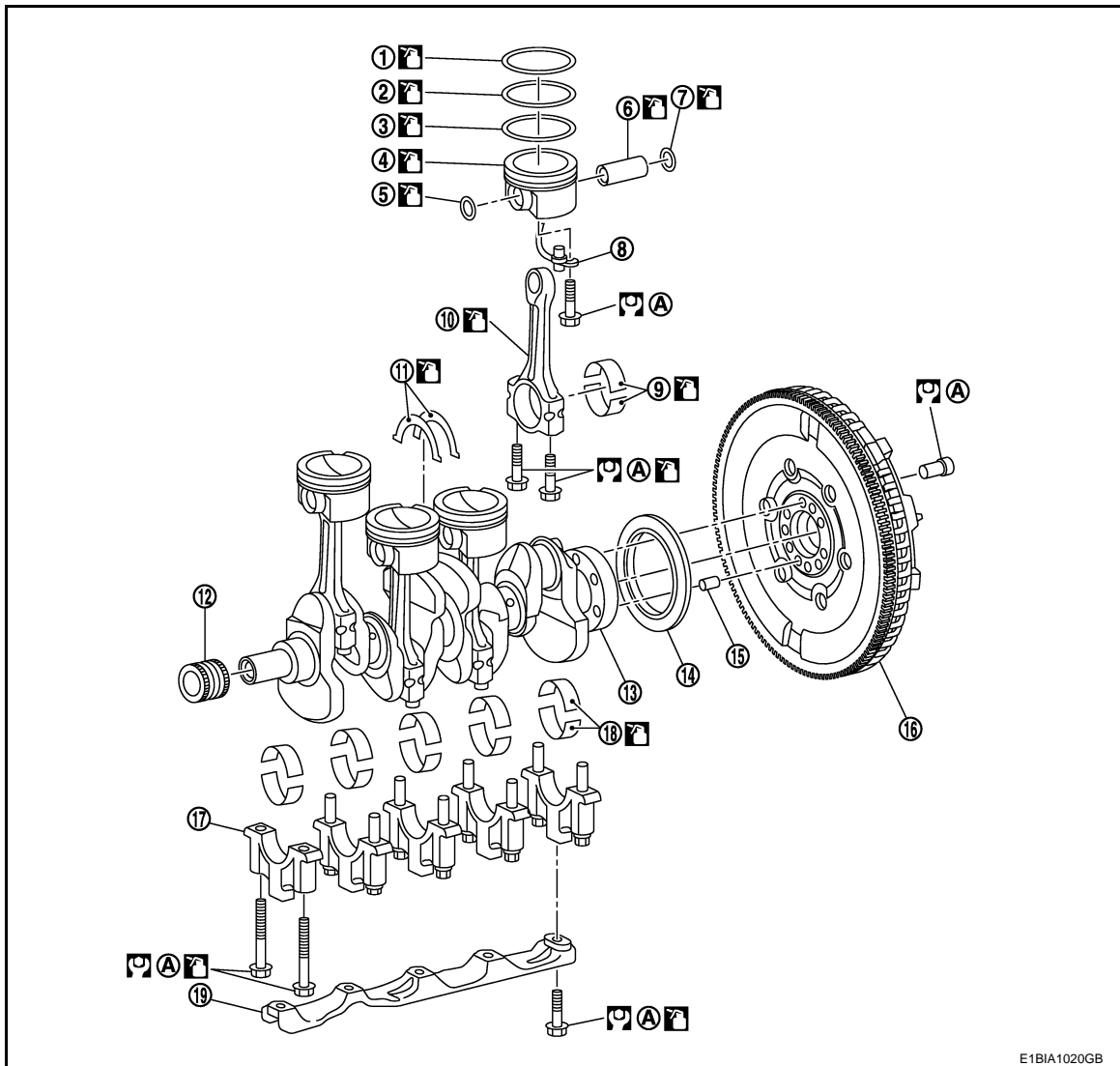
< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

CYLINDER BLOCK

Exploded View

INFOID:000000010282250



E1BIA1020GB

- | | | |
|-----------------------|------------------------------|---------------------------|
| 1. Top ring | 2. Second ring | 3. Oil ring |
| 4. Piston | 5. Snap ring | 6. Piston pin |
| 7. Snap ring | 8. Oil jet | 9. Connecting rod bearing |
| 10. Connecting rod | 11. Thrust bearing | 12. Crankshaft sprocket |
| 13. Crankshaft | 14. Crankshaft rear oil seal | 15. Dowel pin |
| 16. Flywheel | 17. Main bearing cap | 18. Main bearing |
| 19. Main bearing beam | | |

A. Tightening must be done following the assembly procedure.
Refer to [EM-93. "Disassembly and Assembly"](#)

Refer to [GI-4. "Components"](#) for symbols in the figure.

Disassembly and Assembly

INFOID:000000010282251

DISASSEMBLY

NOTE:

Explained here is how to disassemble with an engine stand supporting mating surface of transaxle. When using different type of engine stand, note with difference in steps and etc.

CYLINDER BLOCK

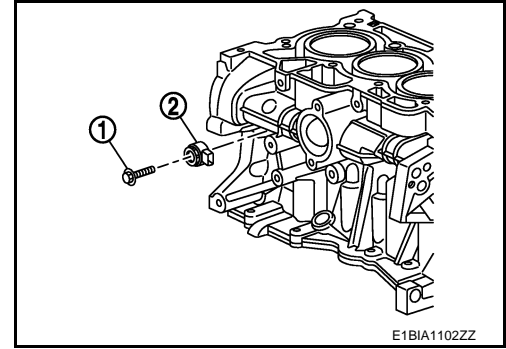
[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

1. Remove cylinder head. Refer to [EM-69, "Exploded View"](#).
2. Remove knock sensor bolt (1) and knock sensor (2).

CAUTION:

Carefully handle knock sensor avoiding shocks.

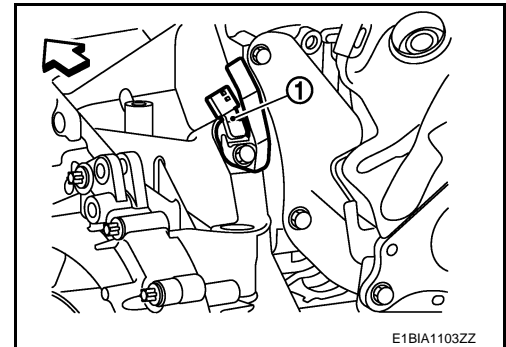


3. Remove crankshaft position sensor (POS) (1).

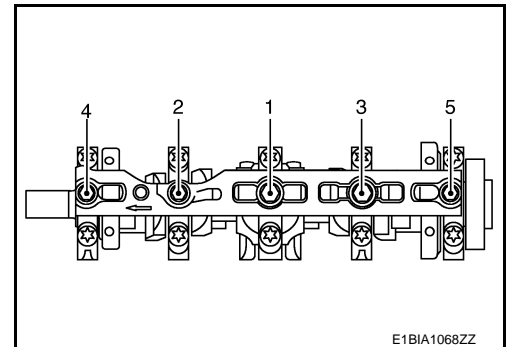
↶ : Engine front

CAUTION:

- Avoid impacts such as a dropping.
- Never disassemble.
- Keep it away from metal particles.
- Never place the sensor in a location where it is exposed to magnetism.



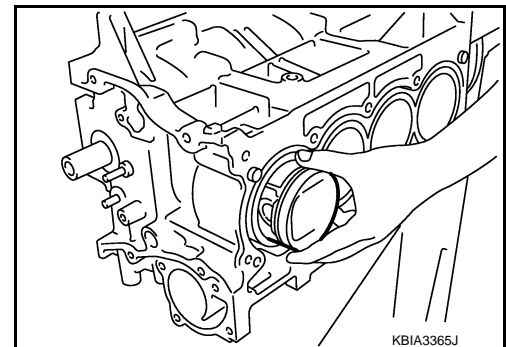
4. Remove oil pan (upper and lower). Refer to [EM-89, "Exploded View"](#).
5. Remove main bearing beam with the following procedure.
 - a. Loosen and remove bolts in several steps in reverse of the numerical order as shown in the figure.



6. Remove piston and connecting rod assembly with the following procedure:
 - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-102, "Inspection"](#).
 - a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
 - b. Remove connecting rod cap.
 - c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

CAUTION:

- Be careful not to damage matching surface with connecting rod cap.
- Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



7. Remove connecting rod bearings.

CAUTION:

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

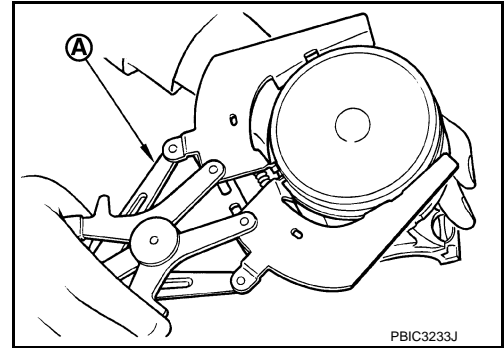
Identify installation positions, and store them without mixing them up.

8. Remove piston rings from piston.

- Before removing piston rings, check the piston ring side clearance. Refer to [EM-102, "Inspection"](#).
- Use a piston ring expander (commercial service tool) (A).

CAUTION:

- When removing piston rings, be careful not to damage the piston.
- Be careful not to damage piston rings by expanding them excessively.

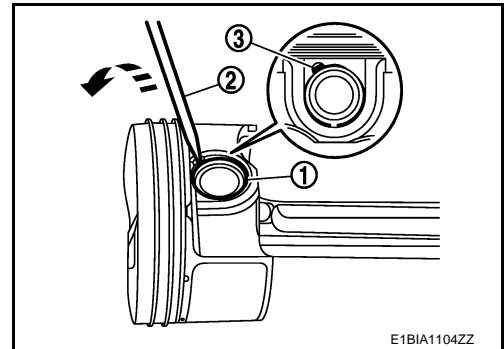


9. Remove piston from connecting rod.

- Remove snap ring (1) using a screwdriver (2) placed in the piston groove (3).
- Release the piston pin.

CAUTION:

- Be careful not to damage the piston and connecting rod.
- Identify installation positions, and store them without mixing them up.

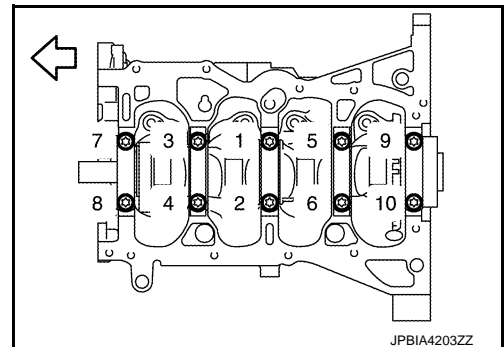


10. Remove the main bearing cap in the following procedure.

- Measure crankshaft end play before loosening main bearing cap bolts. Refer to [EM-102, "Inspection"](#).

a. Loosen and remove bolts in several steps in reverse of the numerical order as shown in the figure.

← : Engine front



b. Remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.

11. Remove crankshaft.

CAUTION:

- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.

12. Pull rear oil seal out from rear end of crankshaft.

13. Remove main bearings and thrust bearings from cylinder block and main bearing cap.

CAUTION:

Identify installation positions, and store them without mixing them up.

14. Remove oil jets.

CAUTION:

Identify installation positions, and store them without mixing them up.

ASSEMBLY

1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

CAUTION:


Use a goggles to protect your eye.

2. Install oil jets.

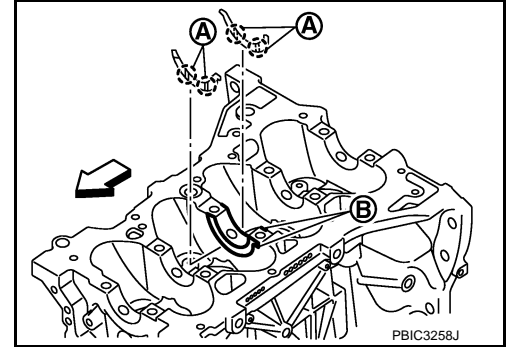
: 10.0 N·m (1.0 kg-m, 7 ft-lb)

3. Install main bearings and thrust bearings with the following procedure:

- a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block.
- b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

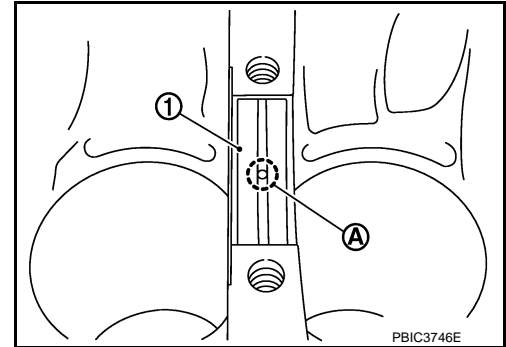
 : Engine front

- Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).




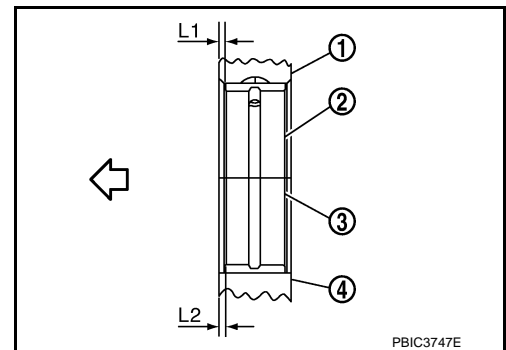
c. Install the main bearings (1) paying attention to the direction.

- Install the one with oil holes (A) onto cylinder block and the one without oil holes onto main bearing cap.
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.



- Install the main bearing in the position as shown in the figure.

- 1 : Cylinder block
- 2 : Main bearing (upper)
- 3 : Main bearing (lower)
- 4 : Main bearing cap
-  : Engine front



NOTE:

Install the main bearing in the center position with the following dimension. For service operation, the center position can be checked visually.

Journal position	No. 1	No. 2	No. 3	No. 4	No. 5
L1 [Unit: mm (in)]	1.65 - 2.05 (0.064 - 0.080)	1.25 - 1.65 (0.049 - 0.064)	2.30 - 2.70 (0.090 - 0.106)	1.25 - 1.65 (0.049 - 0.064)	1.60 - 2.00 (0.062 - 0.078)
L2 [Unit: mm (in)]	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)	2.30 - 2.70 (0.090 - 0.106)	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)

CAUTION:

Dimension L1 of journal No. 3 is the distance from the housing base end surface (bulk) (it is not the distance from the thrust bearing mounting end surface).

4. Install crankshaft to cylinder block.

CYLINDER BLOCK

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- While turning crankshaft by hand, check that it turns smoothly.

CAUTION:

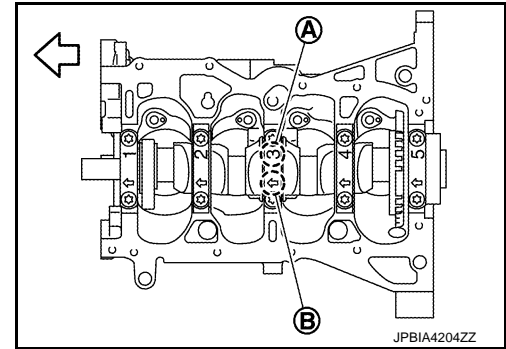
Never install rear oil seal yet.

5. Install main bearing caps.
 - Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).

← : Engine front

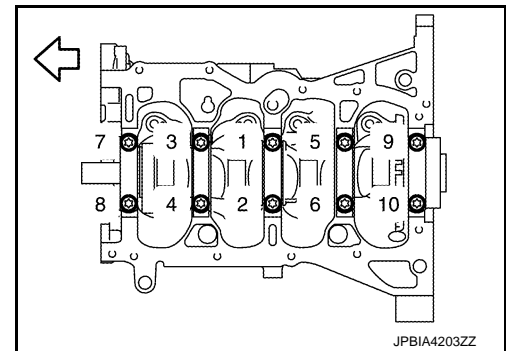
NOTE:

Main bearing cap cannot be replaced as a single parts, because it is machined together with cylinder block.



6. Tighten main bearing cap bolts in numerical order as shown in the figure with the following steps.

← : Engine front



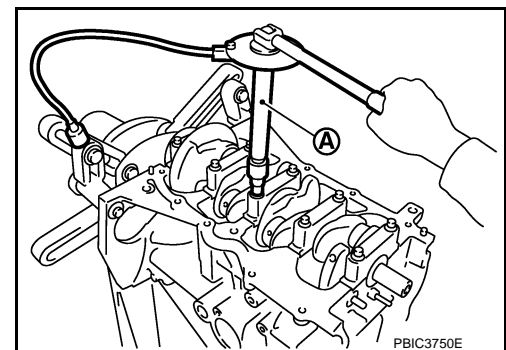
- a. Apply new engine oil to threads and seat surfaces of the mounting bolts.
- b. Tighten main bearing cap bolts.

: 32.4 N·m (3.3 kg·m, 24 ft·lb)

- c. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in numerical order as shown in the figure.

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- After installing the mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-102. "Inspection"](#).

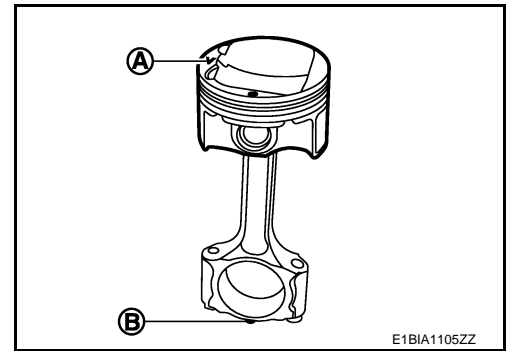
7. Install piston to connecting rod with the following procedure:

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

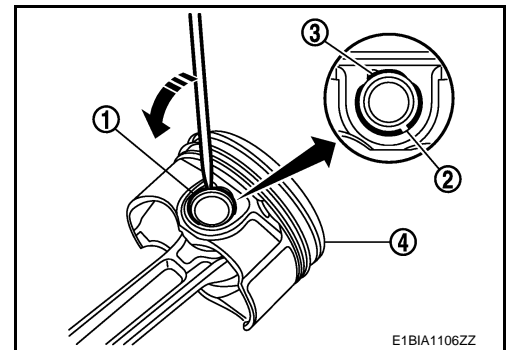
[HRA2DDT]

- a. Set so that the front mark (A) on the piston head is align with connecting rod mark as shown in the figure.



- b. Install piston pin.
- Insert piston pin through piston.
- NOTE:**
Check that piston pin slide and can be rotate easily when install.

- Install piston snap ring (1) using screwdriver.
- NOTE:**
Position end gap of snap ring (2) opposite to piston groove (3).
• After finishing work, check that the piston (4) moves freely.



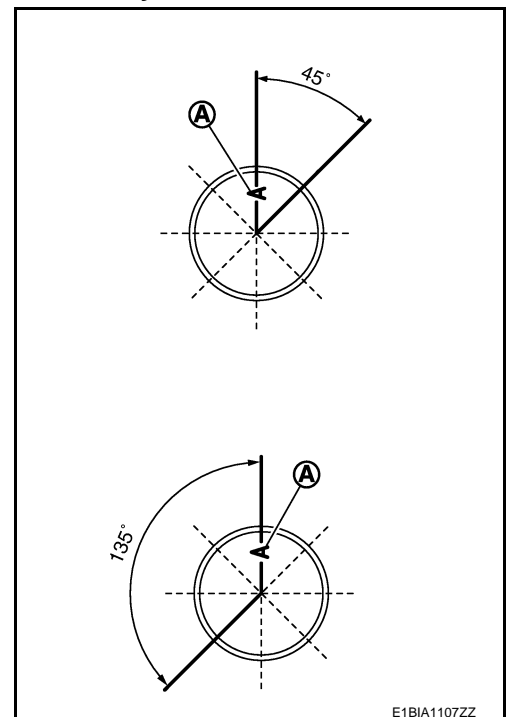
8. Using a piston ring expander (commercial service tool), install piston rings.

- CAUTION:**
- Be careful not to damage piston.
 - Be careful not to damage piston rings by expanding them excessively.
 - Position top ring and second with their end gap placed as shown in the figure referring to the piston front mark (A).

NOTE:
Install top ring and second ring with the stamped mark facing upward

Stamped mark:

- Top ring : GOE TOP
Second ring : GOE 5 TOP



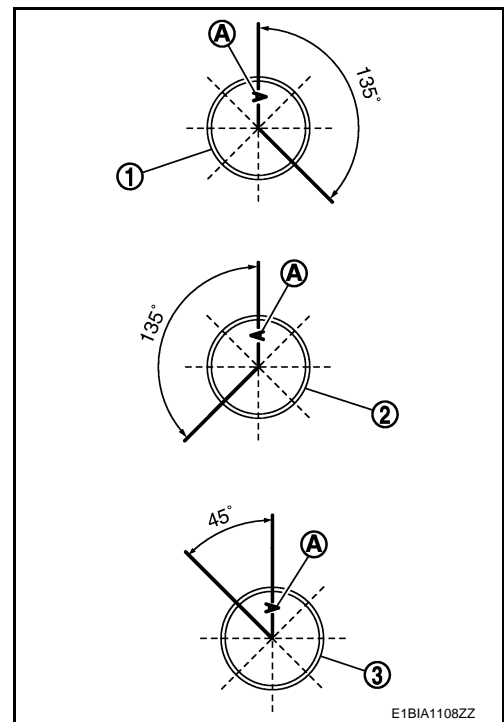
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

- Position the 3 parts oil ring with the end gap placed as shown in the figure referring to the piston front mark (A).

- 1 : Upper rail
- 2 : Spring
- 3 : Lower rail



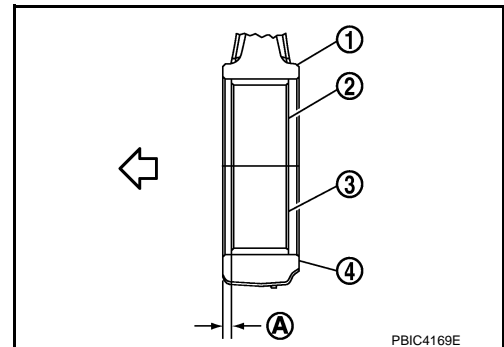
9. Install connecting rod bearings to connecting rod and connecting rod cap.
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
 - Install the bearing in the center position.

NOTE:

There is no stopper tab.

- Check that the oil holes on connecting rod and connecting rod bearing are aligned.
- Install the connecting rod in the dimension as shown in the figure.

- 1 : Connecting rod
- 2 : Connecting rod bearing (upper)
- 3 : Connecting rod bearing (lower)
- 4 : Connecting rod cap
- A : 2.05 - 2.07 mm (0.0807 - 0.0815 in)
- ← : Engine front



NOTE:

Install the connecting rod bearing in the center position with the dimension as shown in the figure. For service operation, the center position can be checked visually.

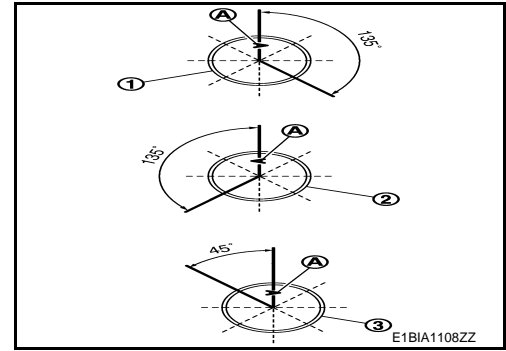
10. Install piston and connecting rod assembly to crankshaft.
- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
 - Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
 - Match the cylinder position with the cylinder number on connecting rod to install.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

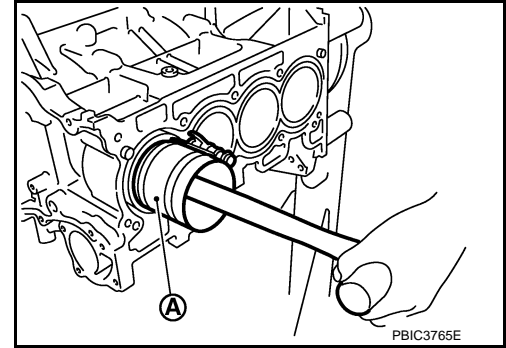
- Check that the piston mark (A) is facing towards timing chain face.



- Using the piston ring compressor [SST: EM03470000] (B) or suitable tool, install piston with the front mark on the piston head facing the front of the engine.

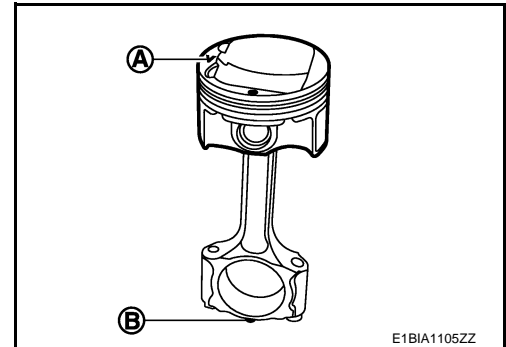
CAUTION:

- Be careful not to damage matching surface with connecting rod cap.
- Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



11. Install connecting rod cap.

- Install connecting rod so that the front mark (A) on the piston head is align with connecting rod mark as shown in the figure.



12. Inspect outer diameter of connecting rod bolts. Refer to [EM-102, "Inspection"](#).

13. Tighten connecting rod bolt with the following procedure:

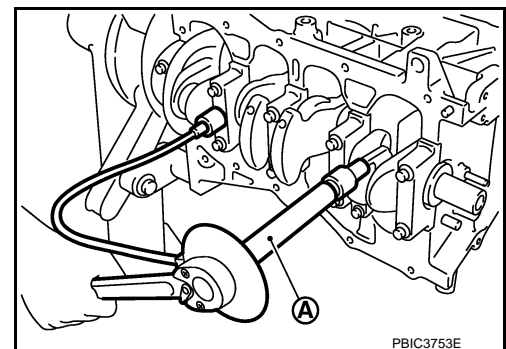
- Apply new engine oil to the threads and seats of connecting rod bolts.
- Tighten bolts in several steps.

: 25.0 N·m (2.6 kg-m, 18 ft-lb)

- Then turn all bolts 110 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgement by visual inspection without the tool.



CYLINDER BLOCK

[HRA2DDT]

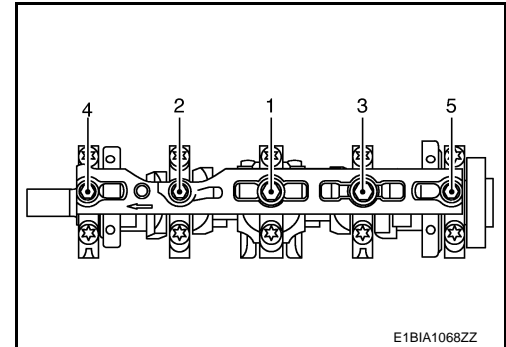
< UNIT DISASSEMBLY AND ASSEMBLY >

- After tightening connecting rod bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-102, "Inspection"](#).

14. Install main bearing beam with the following procedure.

- Install bolts.
- Tighten in numerical order as shown in the figure with the following steps.

: **25.0 N·m (2.6 kg·m, 18 ft·lb)**



15. Install oil pan (upper). Refer to [EM-89, "Exploded View"](#).

NOTE:

Install the rear oil seal after installing the oil pan (upper).

16. Install rear oil seal. Refer to [EM-87, "REAR OIL SEAL : Removal and Installation"](#).

17. Install flywheel with the following procedure.

- Lock flywheel using [SST — (Mot.1431)], and tighten bolts.

: **32.0 N·m (3.3 kg·m, 24 ft·lb)**

CAUTION:


Be careful not to damage or scratch and contact surface for clutch disc of flywheel.

- Then turn all bolts 110 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgement by visual inspection without the tool.

18. Install knock sensor (1).

 : Engine front

- Install connector so that they are positioned as shown in the figure.
- Tighten knock sensor.

: **20.0 N·m (2.0 kg·m, 15 ft·lb)**

CAUTION:

- **Never tighten mounting bolt while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**

NOTE:

- Check that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Check that knock sensor does not interfere with other parts.

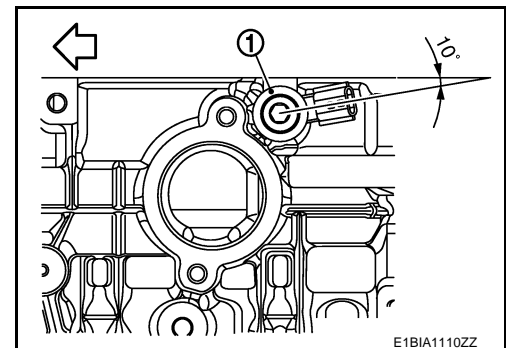
19. Install crankshaft position sensor (POS).

- Tighten crankshaft position sensor (POS).

: **8.0 N·m (0.8 kg·m, 71 in·lb)**

20. When replacing crankshaft position sensor, this procedure must be performed. Refer to [ECH-102, "Special Repair Requirement List"](#).

21. Assemble in the reverse order of disassembly after this step.



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

Inspection

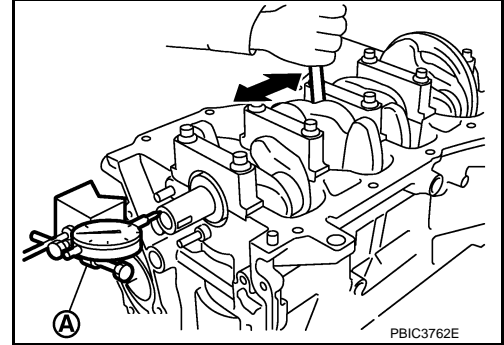
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CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

Standard and Limit : Refer to [EM-118, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

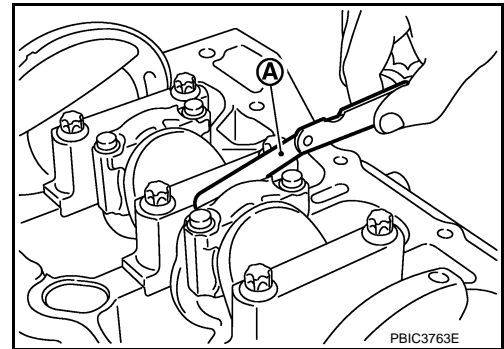


CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

Standard and Limit : Refer to [EM-118, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

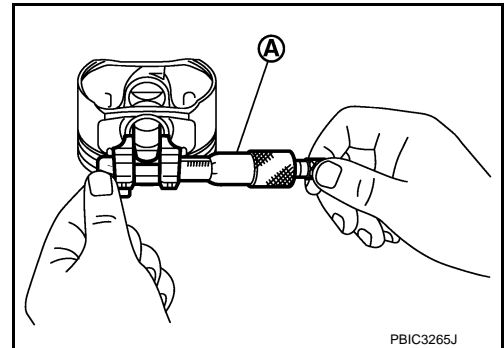


PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an inside micrometer (A).

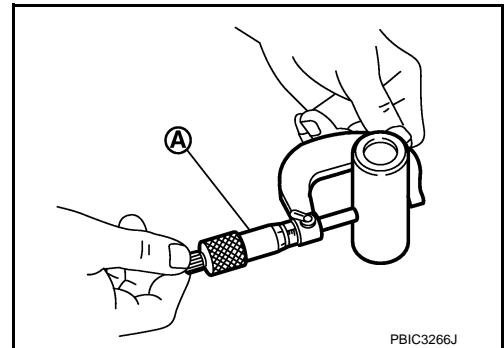
Standard : Refer to [EM-118, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-118, "Cylinder Block"](#).



Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

Standard : Refer to [EM-118, "Cylinder Block"](#).

CYLINDER BLOCK

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly. Refer to "".

NOTE:

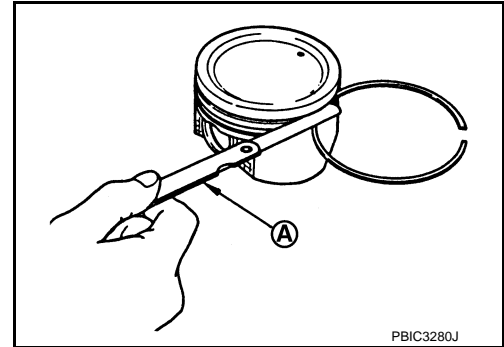
- Piston is available together with piston pin as assembly.
- Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)

PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with a feeler gauge (A).

Standard and Limit : Refer to [EM-118, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring.

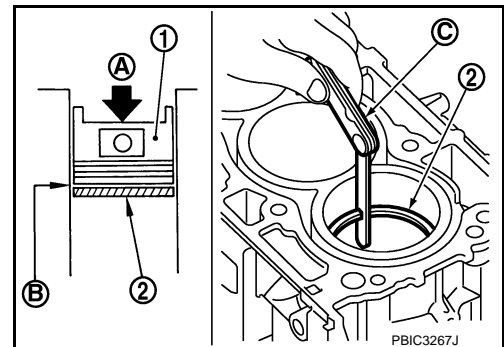


PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to "PISTON TO CYLINDER BORE CLEARANCE".
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap with a feeler gauge (C).

Standard and Limit : Refer to [EM-118, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace cylinder block.



CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-93, "Exploded View"](#).

2 : Connecting rod

A : Example

B : Measuring direction of inner diameter

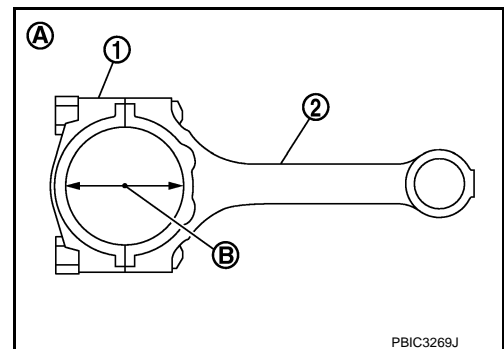
- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard : Refer to [EM-118, "Cylinder Block"](#).

- If out of the standard, replace connecting rod assembly.

CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter



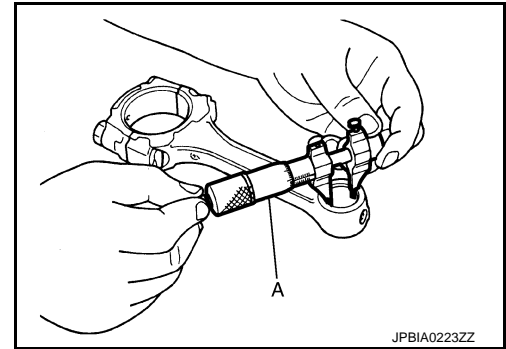
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

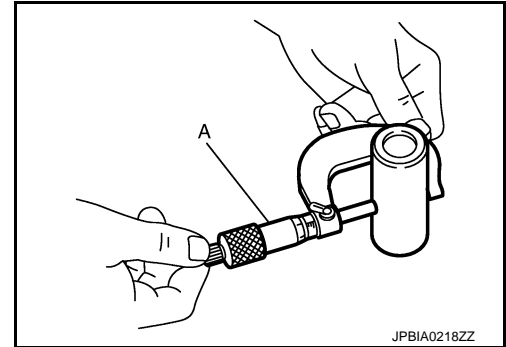
Standard : Refer to [EM-118, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-118, "Cylinder Block"](#).



Connecting Rod Bushing Oil Clearance

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

Standard and Limit : Refer to [EM-118, "Cylinder Block"](#).

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly. Refer to [EM-118, "Cylinder Block"](#).
- If replacing connecting rod assembly. Refer to [EM-121, "Connecting Rod Bearing"](#).

CYLINDER BLOCK TOP SURFACE DISTORTION

- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

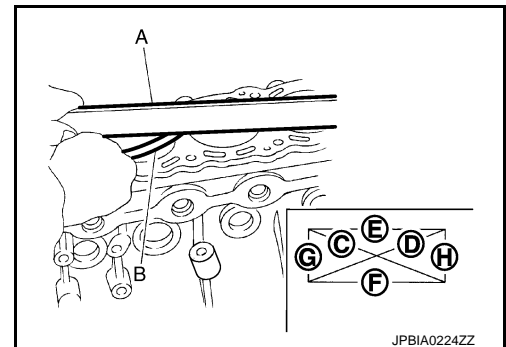
CAUTION:

Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge (A) and feeler gauge (B).

Limit : Refer to [EM-118, "Cylinder Block"](#).

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-93, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing housing with a bore gauge.

CYLINDER BLOCK

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Measure the position shown in the figure [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown in the figure. The smaller one is the measured value.

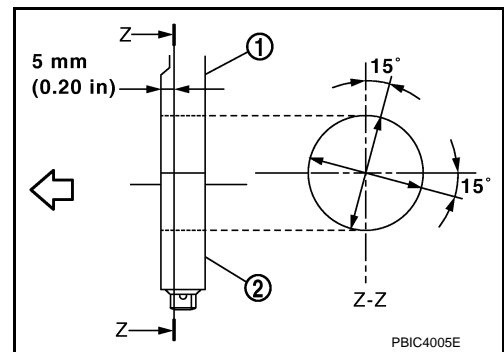
- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

Standard : Refer to [EM-118, "Cylinder Block"](#).

- If out of the standard, replace cylinder block and main bearing caps assembly.

NOTE:

Main bearing caps cannot be replaced as a single, because it is machined together with cylinder block.



PISTON TO CYLINDER BORE CLEARANCE

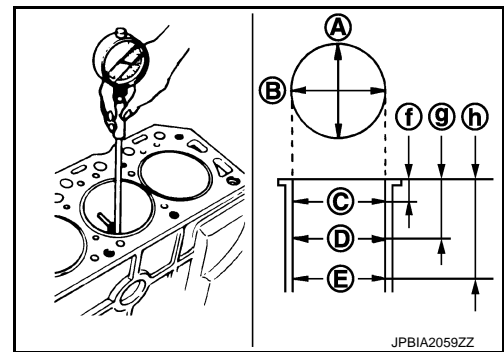
Cylinder Bore Inner Diameter

- Using a bore gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(A) and (B) directions at (C), (D), and (E)] [(A) is in longitudinal direction of engine]

- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 120 mm (4.72 in)

NOTE:

When determining cylinder bore grade, measure the cylinder bore (B) direction at (D) position.



Standard:

Cylinder bore inner diameter

: Refer to [EM-118, "Cylinder Block"](#).

Limit:

Out-of-round [Difference between (A) and (B)]

Taper [Difference between (C) and (D)]

: Refer to [EM-118, "Cylinder Block"](#).

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

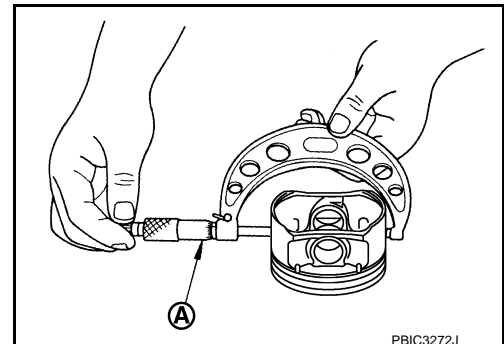
NOTE:

Oversize piston is not provided.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer (A).

Standard : Refer to [EM-118, "Cylinder Block"](#).



Piston to Cylinder Bore Clearance

CYLINDER BLOCK

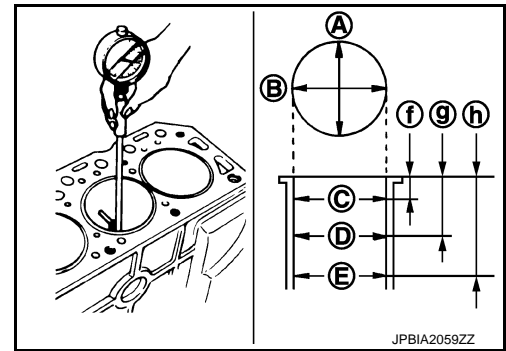
< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (B), position (D)].

- A : Direction A
- C : Position C
- E : Position E
- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 120 mm (4.72 in)

(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)



Standard and Limit : Refer to [EM-118, "Cylinder Block"](#).

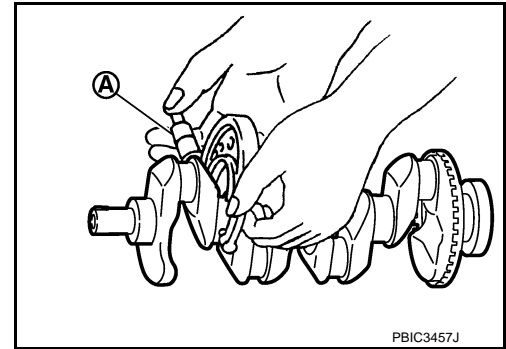
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-118, "Cylinder Block"](#).

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with a micrometer (A).

Standard : Refer to [EM-118, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-121, "Main Bearing"](#).



CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with a micrometer.

Standard : Refer to [EM-118, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-121, "Connecting Rod Bearing"](#).

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

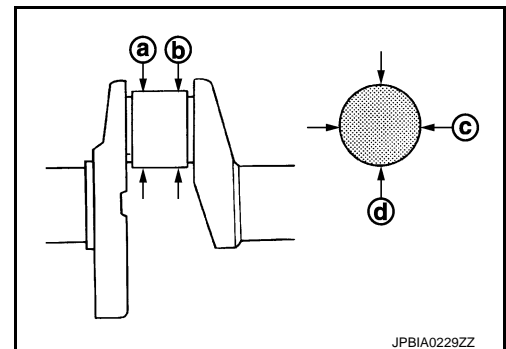
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between (a) and (b) at (c) and (d).
- Taper is indicated by the difference in dimension between (c) and (d) at (a) and (b).

Limit:

Out-of-round [Difference between (a) and (b)]

Taper [Difference between (c) and (d)]

: Refer to [EM-118, "Cylinder Block"](#).



- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to [EM-121, "Connecting Rod Bearing"](#) and/or [EM-121, "Main Bearing"](#).

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of the crankshaft.

CYLINDER BLOCK

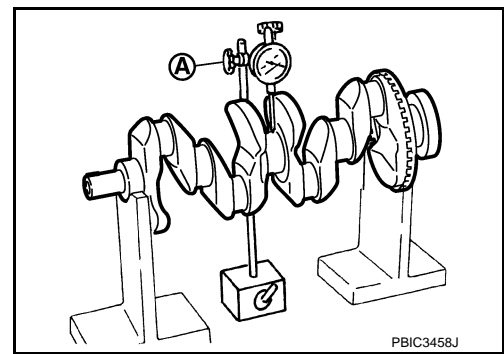
[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Place a dial indicator (A) straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the dial indicator. (Total indicator reading)

Standard and Limit : Refer to [EM-118, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

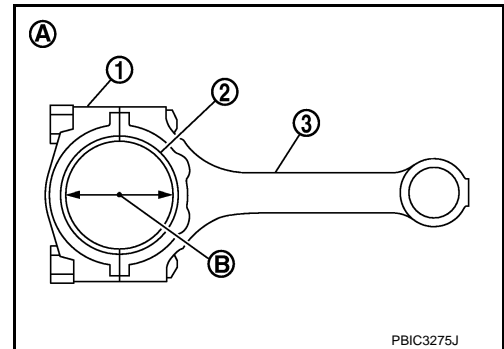
Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearing cap (1), and tighten connecting rod cap bolts to the specified torque. Refer to [EM-93, "Disassembly and Assembly"](#).

A : Example

B : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing with an inside micrometer.
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)



Standard and Limit : Refer to [EM-121, "Connecting Rod Bearing"](#).

- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to [EM-121, "Connecting Rod Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-93, "Disassembly and Assembly"](#).

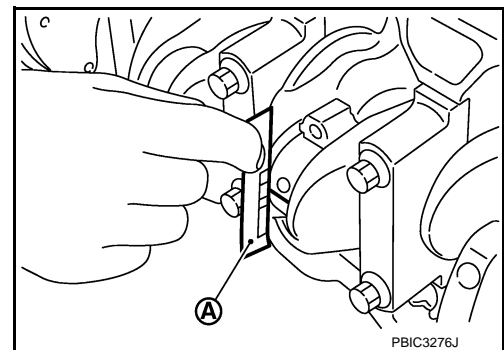
CAUTION:

Never rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



MAIN BEARING OIL CLEARANCE

Method by Calculation

CYLINDER BLOCK

[HRA2DDT]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-93, "Disassembly and Assembly"](#).

A : Example

B : Inner diameter measuring direction

- Measure the inner diameter of main bearing with a bore gauge. (Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

Standard and Limit : Refer to [EM-121, "Main Bearing"](#).

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-121, "Main Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-93, "Disassembly and Assembly"](#).

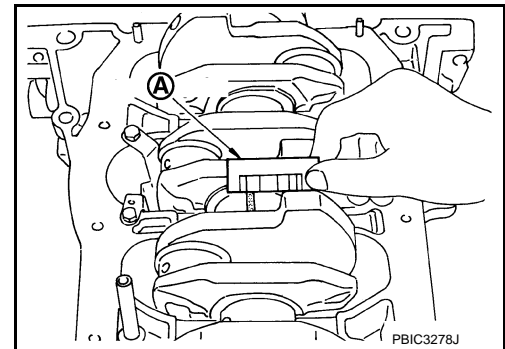
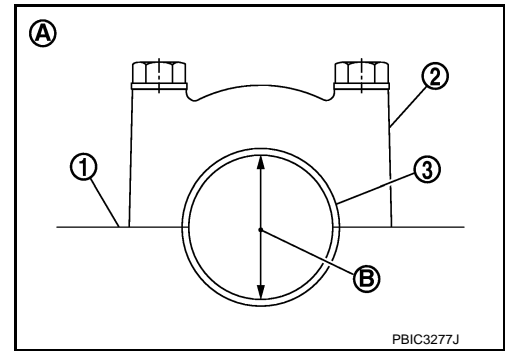
CAUTION:

Never rotate crankshaft.

- Remove main bearing cap and bearings, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



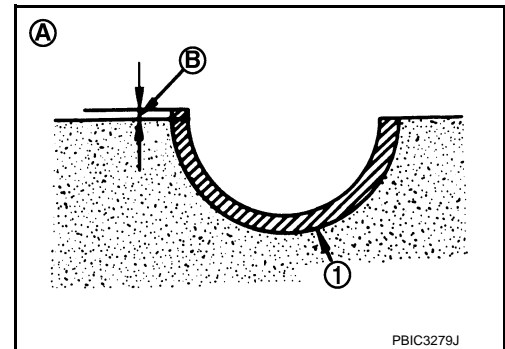
MAIN BEARING CRUSH HEIGHT

- When main bearing cap is removed after being tightened to the specified torque with main bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-93, "Disassembly and Assembly"](#).

A : Example

Standard : There must be crush height.

- If the standard is not met, replace main bearings.



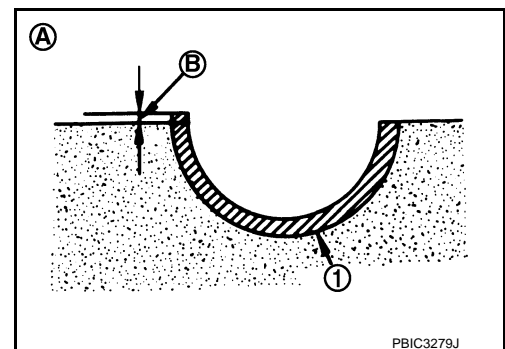
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-93, "Disassembly and Assembly"](#).

A : Example

Standard : There must be crush height.

- If the standard is not met, replace connecting rod bearings.



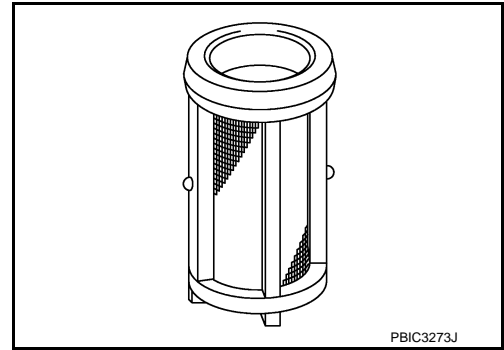
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

CLOGGED OR DAMAGED OIL FILTER (FOR INTAKE VALVE TIMING CONTROL)

- Check that there is no foreign material on the oil filter and check it for clogging.
- Clean it if necessary.
- Check the oil filter for damage.
- Replace it if necessary.



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

HOW TO SELECT PISTON AND BEARING

Description

INFOID:00000001028253

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

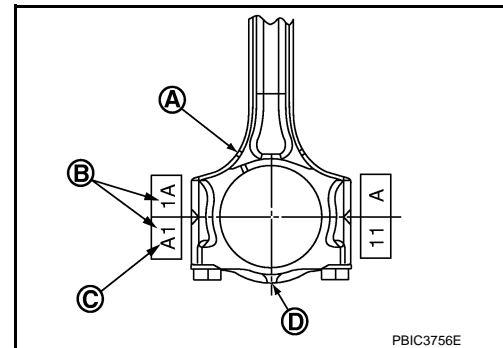
Connecting Rod Bearing

INFOID:00000001028254

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

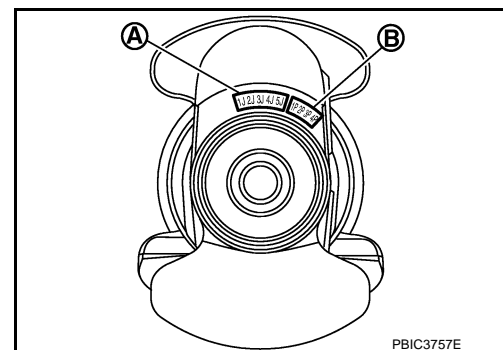
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- A : Oil hole
- B : Cylinder number
- D : Front mark



2. Apply crankshaft pin journal diameter grade stamped (B) on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".

- A : Main journal diameter grade (No. 1 to 5 from left)
- B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-102, "Inspection"](#).

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

2. Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

Connecting Rod Bearing Selection Table

Crankshaft pin journal diameter	Connecting rod big diameter												
	A	B	C	D	E	F	G	H	J	K	L	M	N
A	0	0	0	0	0	0	01	01	01	1	1	1	12
B	0	0	0	0	0	01	01	01	1	1	1	12	12
C	0	0	0	0	01	01	01	1	1	1	12	12	12
D	0	0	0	01	01	01	1	1	1	12	12	12	2
E	0	0	01	01	01	1	1	1	12	12	12	2	2
F	0	01	01	01	1	1	1	12	12	12	2	2	2
G	01	01	01	1	1	1	12	12	12	2	2	2	23
H	01	01	1	1	1	12	12	12	2	2	2	23	23
J	01	1	1	1	12	12	12	2	2	2	23	23	23
K	1	1	1	12	12	12	2	2	2	23	23	23	3
L	1	1	12	12	12	2	2	2	23	23	23	3	3
M	1	12	12	12	2	2	2	23	23	23	3	3	3
N	12	12	12	2	2	2	23	23	23	3	3	3	34
P	12	12	2	2	2	23	23	23	3	3	3	34	34
R	12	2	2	2	23	23	23	3	3	3	34	34	34
S	2	2	2	23	23	23	3	3	3	34	34	34	4
T	2	2	23	23	23	3	3	3	34	34	34	4	4
U	2	23	23	23	3	3	3	34	34	34	4	4	4
V	23	23	23	3	3	3	34	34	34	4	4	4	4
W	23	23	3	3	3	34	34	34	4	4	4	4	4

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Connecting Rod Bearing Grade Table

Connecting Rod Bearing Grade Table : Refer to [EM-121, "Connecting Rod Bearing"](#).

Main Bearing

INFOID:000000010282255

HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft Are Used

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

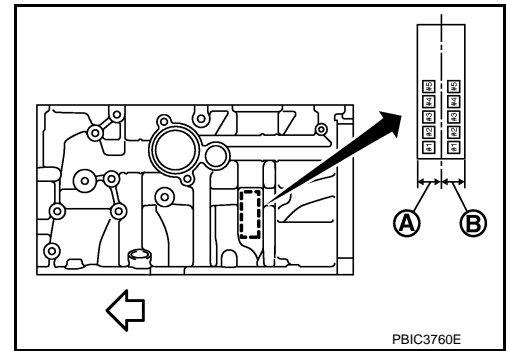
[HRA2DDT]

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on left side of cylinder block.

A : Basic stamp mark

↩ : Engine front

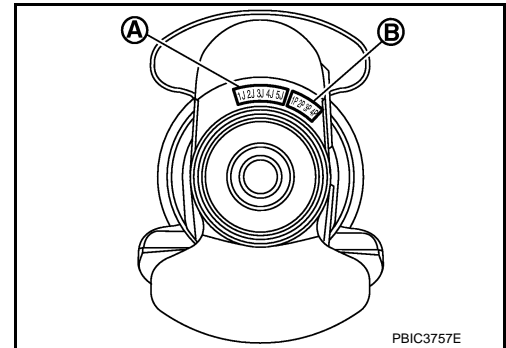
- If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".

A : Main journal diameter grade (No. 1 to 5 from left)

B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [EM-102, "Inspection"](#).
2. Apply the measured dimension to the "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HRA2DDT]

Main Bearing Selection Table

Crankshaft main journal diameter	I.D. mark	Axle diameter Unit mm (in)	Cylinder block main bearing housing inner diameter		I.D. mark		Hole diameter Unit: mm (in)																			
			A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W				
A	47.979 - 47.978 (1.8889 - 1.8889)	0	0	0	0	0	0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23		
B	47.978 - 47.977 (1.8889 - 1.8889)	0	0	0	0	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	2	23	23	3		
C	47.977 - 47.976 (1.8889 - 1.8888)	0	0	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	2	2	23	23	3	3		
D	47.976 - 47.975 (1.8888 - 1.8888)	0	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	2	2	23	23	23	3	3		
E	47.975 - 47.974 (1.8888 - 1.8887)	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	34		
F	47.974 - 47.973 (1.8887 - 1.8887)	0	01	01	01	1	1	1	1	12	12	12	2	2	2	2	2	23	23	23	3	3	3	34		
G	47.973 - 47.972 (1.8887 - 1.8887)	01	01	01	1	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34		
H	47.972 - 47.971 (1.8887 - 1.8886)	01	01	1	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	4		
J	47.971 - 47.970 (1.8886 - 1.8886)	01	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	3	34	34	4	4		
K	47.970 - 47.969 (1.8886 - 1.8885)	1	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	3	34	34	34	4	4		
L	47.969 - 47.968 (1.8885 - 1.8885)	1	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	45		
M	47.968 - 47.967 (1.8885 - 1.8885)	1	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	45	45		
N	47.967 - 47.966 (1.8885 - 1.8884)	12	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45		
P	47.966 - 47.965 (1.8884 - 1.8884)	12	12	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	45	45	5		
R	47.965 - 47.964 (1.8884 - 1.8883)	12	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	45	45	5	5		
S	47.964 - 47.963 (1.8883 - 1.8883)	2	2	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	45	45	5	5		
T	47.963 - 47.962 (1.8883 - 1.8883)	2	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	45	45	5	5		
U	47.962 - 47.961 (1.8883 - 1.8882)	2	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	45	45	5	5		
V	47.961 - 47.960 (1.8882 - 1.8882)	23	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	45	45	5	5		
W	47.960 - 47.959 (1.8882 - 1.8881)	23	23	3	3	3	3	34	34	34	4	4	4	4	4	4	4	4	4	4	45	45	5	5		

E1BIA1172GB

Main Bearing Grade Table

Main Bearing Grade Table : Refer to [EM-121, "Main Bearing"](#) .

A
EM
C
D
E
F
G
H
I
J
K
L
M
N
O
P

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:0000000010282256

GENERAL SPECIFICATIONS

Engine type	HRA2DDT	
Cylinder arrangement	In-line 4	
Displacement cm ³ (cu in)	1,197 (73.04)	
Bore and stroke mm (in)	72.2 x 73.1 (2.843 x 2.878)	
Valve arrangement	DOHC	
Firing order	1-3-4-2	
Number of piston rings	Compression	2
	Oil	1
Number of main bearings	5	
Compression ratio	10.1	

Drive Belts

INFOID:0000000010282257

Tension of drive belt	Auto adjustment by auto-tensioner
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Spark Plug

INFOID:0000000010282258

SPARK PLUG (PLATINUM-TIPPED TYPE)

Unit: mm (in)

Make	NGK
Standard type	ILKAR7F7G
Gap (Nominal)	0.65 (0.026)

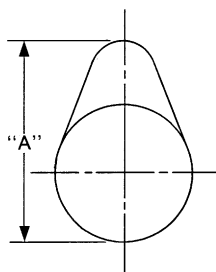
Camshaft

INFOID:0000000010282260

CAMSHAFT

Unit: mm (in)

Items			Standard	Limit
Camshaft runout	Intake	No.1	0.01(0.0004)	
		No.2 to 5	0.015 (0.0006)	
	Exhaust	No.1	0.01(0.0004)	
		No.2 to 6	0.015 (0.0006)	



SEM671

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

Items			Standard	Limit
Camshaft cam height "A"	Intake		44.322 - 44.522 (1.7450 - 1.7528)	—
	Exhaust		43.664 - 43.864 (1.7191 - 1.7269)	—
Camshaft journal diameter	Intake	No.1	27.934 - 28 (1.0998 - 1.1024)	—
	Intake	No.2 to 5	24.969 - 25 (0.9830 - 0.9843)	—
Camshaft journal diameter	Exhaust	No.1	27.934 - 28 (1.0998 - 1.1024)	—
	Exhaust	No.2 to 6	24.969 - 25 (0.9830 - 0.9843)	—
Camshaft bracket inner diameter	No. 1		28.044 - 28.076 (1.1041 - 1.1054)	—
	No. 2, 3, 4, 5, 6		25.040 - 25.060 (0.9858 - 0.9866)	—
Camshaft journal oil clearance	Intake	No.1	0.044 - 0.142 (0.0017 - 0.0056)	—
	Intake	No.2 to 5	0.040 - 0.091 (0.0016 - 0.0036)	—
Camshaft journal oil clearance	Exhaust	No.1	0.044 - 0.142 (0.0017 - 0.0056)	—
	Exhaust	No.2 to 6	0.040 - 0.091 (0.0016 - 0.0036)	—
Camshaft end play			0.203 - 0.239 (0.008 - 0.0094)	—
Camshaft radial play	No. 1		0.06 - 0.146 (0.002 - 0.0057)	—
	No. 2, 3, 4, 5, 6		0.05 - 0.09 (0.0020 - 0.0035)	—

*: Total indicator reading

VALVE LIFTER

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	29.964 - 29.987 (1.1797 - 1.1806)
Valve lifter hole diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.057 (0.0005 - 0.0022)

VALVE CLEARANCE

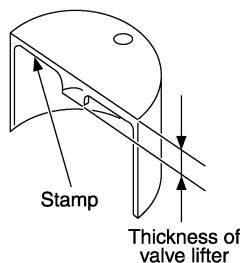
Unit: mm (in)

Items	Cold
Intake	0.25 - 0.35 (0.0098 - 0.0138)
Exhaust	0.46 - 0.54 (0.0181 - 0.0213)

*: Approximately 80°C (176°F)

AVAILABLE VALVE LIFTER

Thickness mm (in)	Identification mark
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KBIA0119E

2.96 (0.1165)	296
2.98 (0.1173)	298
3.00 (0.1181)	300
3.02 (0.1189)	302

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

Thickness mm (in)	Identification mark
3.04 (0.1197)	304
3.06 (0.1205)	306
3.08 (0.1213)	308
3.10 (0.1220)	310
3.12 (0.1228)	312
3.14 (0.1236)	314
3.16 (0.1244)	316
3.18 (0.1252)	318
3.20 (0.1260)	320
3.22 (0.1268)	322
3.24 (0.1276)	324
3.26 (0.1283)	326
3.28 (0.1291)	328
3.30 (0.1299)	330
3.32 (0.1307)	332
3.34 (0.1315)	334
3.36 (0.1323)	336
3.38 (0.1331)	338
3.40 (0.1339)	340
3.42 (0.1346)	342
3.44 (0.1354)	344
3.46 (0.1362)	346
3.48 (0.1370)	348
3.50 (0.1378)	350
3.52 (0.1386)	352
3.54 (0.1393)	354
3.56 (0.1402)	356

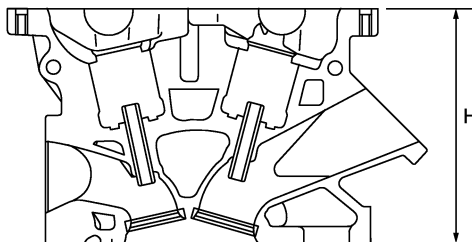
Cylinder Head

INFOID:000000010282261

CYLINDER HEAD

Unit: mm (in)

Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height "H"	124.8 (4.9134)	—



PBIC0924E

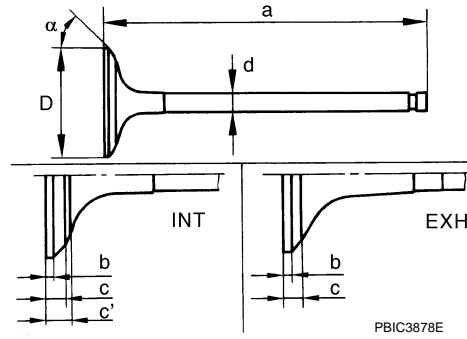
VALVE DIMENSIONS

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

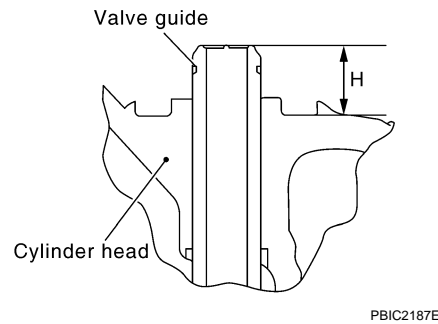
Unit: mm (in)



Valve head diameter "D"	Intake	26.48 - 26.72 (1.0425 - 1.0520)
	Exhaust	23.38 - 23.62 (0.9205 - 0.9299)
Valve length "a"	Intake	100.84 (3.9701)
	Exhaust	101.69 (4.0035)
"b"	Intake	1.15 (0.0453)
	Exhaust	1.42 (0.0559)
Valve stem diameter "d "	Intake	5.4705 - 5.4855 (0.2154 - 0.2160)
	Exhaust	5.455 - 5.470 (0.2148 - 0.2154)

VALVE GUIDE

Unit: mm (in)



Items		Standard
Valve guide	Inner diameter	4.8 - 5.0 (0.1890 - 0.1969)
	Valve guide clearance	
	Intake	0.015 - 0.047 (0.0006 - 0.0019)
	Exhaust	0.03 - 0.063 (0.0012 - 0.0025)

VALVE SPRING

Unit: mm (in)

Items		Standard
Mark on the outer diameter of the spring	Intake	Green
	Exhaust	Yellow
Internal diameter		17.6 - 18.0 (0.6929 - 0.7087)
Wire diameter	Intake	2.78 - 2.82 (0.1094 - 0.1110)
	Exhaust	2.58 - 2.62 (0.1016 - 0.1031)
Outer diameter	Intake	23.2 - 23.6 (0.9134 - 0.9291)
	Exhaust	22.8 - 23.2 (0.8976 - 0.9134)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

Free height	Intake	45.0 - 47.0 (1.7717 - 1.8504)
	Exhaust	58.5 - 60.5 (2.3031 - 2.3819)
Height during control	Intake	32.90 (1.2953)
	Exhaust	24.40 (0.9606)
Load during control	Intake	138 - 152 N (14.0 - 15.5 kg, 31 - 34 lb)
	Exhaust	277 - 303 N (28.2 - 30.9 kg, 62 - 68 lb)

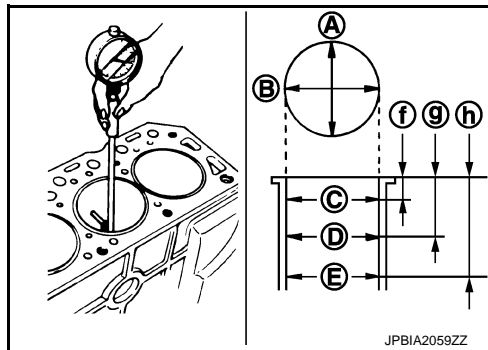
Items		Limit
Valve spring squareness	Intake	1.4 mm (0.055 in)
	Exhaust	1.8 mm (0.071 in)

Cylinder Block

INFOID:000000010282262

CYLINDER BLOCK

Unit: mm (in)



Cylinder block top surface distortion	Limit	0.1 (0.004)
Cylinder bore inner diameter	Standard	78.000 - 78.015 (3.0709 - 3.0715)
Out-of-round	Limit	0.015 (0.0006)
Taper		0.010 (0.0004)
Cylinder block main bearing housing inner diameter grade	Grade No. A	51.997 - 51.998 (2.0471 - 2.0472)
	Grade No. B	51.998 - 51.999 (2.0472 - 2.0472)
	Grade No. C	51.999 - 52.000 (2.0472 - 2.0472)
	Grade No. D	52.000 - 52.001 (2.0472 - 2.0473)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0474)
	Grade No. G	52.003 - 52.004 (2.0474 - 2.0474)
	Grade No. H	52.004 - 52.005 (2.0474 - 2.0474)
	Grade No. J	52.005 - 52.006 (2.0474 - 2.0475)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0476)
	Grade No. M	52.008 - 52.009 (2.0476 - 2.0476)
	Grade No. N	52.009 - 52.010 (2.0476 - 2.0476)
	Grade No. P	52.010 - 52.011 (2.0476 - 2.0477)
Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)	
Grade No. S	52.012 - 52.013 (2.0477 - 2.0478)	
Grade No. T	52.013 - 52.014 (2.0478 - 2.0478)	
Grade No. U	52.014 - 52.015 (2.0478 - 2.0478)	
Grade No. V	52.015 - 52.016 (2.0478 - 2.0479)	
Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)	
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

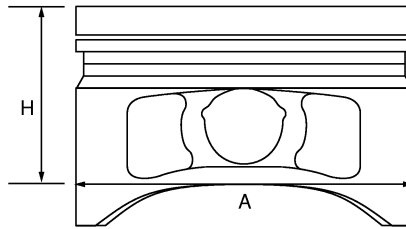
AVAILABLE PISTON

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

Unit: mm (in)



PBIC0188E

Item	Standard	Limit
Piston skirt diameter "A"	72.15 - 72.17 (2.8405 - 2.8413)	—
Piston pin hole diameter	19.996 - 20.002 (0.7872 - 0.7875)	—
Piston to cylinder bore clearance	0.030 - 0.050 (0.0012 - 0.0020)	—

PISTON RING

Unit: mm (in)

Items		Standard	Limit
Piston ring side clearance	Top	0.030 - 0.070 (0.0012 - 0.0028)	—
	2nd	0.030 - 0.050 (0.0012 - 0.0020)	—
	Oil (rail ring)	0.030 (0.0012)	—
Piston ring end gap	Top	0.15 - 0.30 (0.0059 - 0.0118)	—
	2nd	0.40 - 0.60 (0.0157 - 0.0236)	—
	Oil (rail ring)	0.20 - 0.90 (0.0079 - 0.0354)	—

PISTON PIN

Unit: mm (in)

Piston pin outer diameter		19.987 - 19.992 (0.7869 - 0.7871)
Piston to piston pin oil clearance	Standard	0.010 - 0.015 (0.0004 - 0.0006)

CONNECTING ROD

Unit: mm (in)

Connecting rod small end inner diameter	Standard	20.000 - 20.012 (0.7474 - 0.7879)
Connecting rod big end diameter	Grade No. A	45.677 - 45.678 (1.7983 - 1.7987)
	Grade No. B	45.678 - 45.679 (1.7987 - 1.7984)
	Grade No. C	45.679 - 45.680 (1.7984 - 1.7984)
	Grade No. D	45.680 - 45.681 (1.7984 - 1.7985)
	Grade No. E	45.681 - 45.682 (1.7985 - 1.7985)
	Grade No. F	45.682 - 45.683 (1.7985 - 1.7985)
	Grade No. G	45.683 - 45.684 (1.7985 - 1.7986)
	Grade No. H	45.684 - 45.685 (1.7986 - 1.7986)
	Grade No. J	45.685 - 45.686 (1.7986 - 1.7987)
	Grade No. K	45.686 - 45.687 (1.7987 - 1.7987)
	Grade No. L	45.687 - 45.688 (1.7987 - 1.7987)
	Grade No. M	45.688 - 45.689 (1.7987 - 1.7988)
	Grade No. N	45.689 - 45.690 (1.7988 - 1.7988)

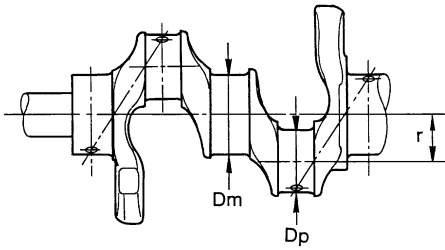
CRANKSHAFT

SERVICE DATA AND SPECIFICATIONS (SDS)

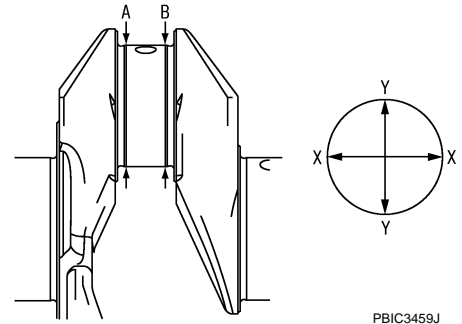
< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

Unit: mm (in)



SEM645



PBIC3459J

Crankshaft lateral clearance		0.098 - 0.3 (0.0039 - 0.0118)
Out-of-round	Limit	0.003 (0.0001)
Taper	Limit	0.004 (0.0002)
Runout [TIR*]	Limit	0.02 (0.0008)
Crankshaft end play	Standard	0.098 - 0.260 (0.0039 - 0.0102)
Crankshaft pin journal diameter grade. "Dp"	Grade No. A	42.009 - 42.010 (1.6539 - 1.6539)
	Grade No. B	42.008 - 42.009 (1.6539 - 1.6539)
	Grade No. C	42.007 - 42.008 (1.6538 - 1.6539)
	Grade No. D	42.006 - 42.007 (1.6538 - 1.6538)
	Grade No. E	42.005 - 42.006 (1.6538 - 1.6538)
	Grade No. F	42.004 - 42.005 (1.6537 - 1.6537)
	Grade No. G	42.003 - 42.004 (1.6537 - 1.6537)
	Grade No. H	42.002 - 42.003 (1.6536 - 1.6537)
	Grade No. J	42.001 - 42.002 (1.6536 - 1.6536)
	Grade No. K	42.000 - 42.001 (1.6535 - 1.6536)
	Grade No. L	41.999 - 42.000 (1.6535 - 1.6535)
	Grade No. M	41.998 - 41.999 (1.6535 - 1.6535)
	Grade No. N	41.997 - 41.998 (1.6534 - 1.6535)
	Grade No. P	41.996 - 41.997 (1.6534 - 1.6534)
	Grade No. R	41.995 - 41.996 (1.6533 - 1.6534)
	Grade No. S	41.994 - 41.995 (1.6533 - 1.6533)
	Grade No. T	41.993 - 41.994 (1.6533 - 1.6533)
Grade No. U	41.992 - 41.993 (1.6532 - 1.6533)	
Grade No. V	41.991 - 41.992 (1.6531 - 1.6532)	
Grade No. W	41.990 - 41.991 (1.6531 - 1.6531)	
Crankshaft main journal diameter grade. "Dm"	Grade No. A	47.979 - 47.978 (1.8889 - 1.8889)
	Grade No. B	47.978 - 47.977 (1.8889 - 1.8889)
	Grade No. C	47.977 - 47.976 (1.8889 - 1.8888)
	Grade No. D	47.976 - 47.975 (1.8888 - 1.8888)
	Grade No. E	47.975 - 47.974 (1.8888 - 1.8887)
	Grade No. F	47.974 - 47.973 (1.8887 - 1.8887)
	Grade No. G	47.973 - 47.972 (1.8887 - 1.8887)
	Grade No. H	47.972 - 47.971 (1.8887 - 1.8886)
	Grade No. J	47.971 - 47.970 (1.8886 - 1.8886)
	Grade No. K	47.970 - 47.969 (1.8886 - 1.8885)
	Grade No. L	47.969 - 47.968 (1.8885 - 1.8885)
	Grade No. M	47.968 - 47.967 (1.8885 - 1.8885)
	Grade No. N	47.967 - 47.966 (1.8885 - 1.8884)
	Grade No. P	47.966 - 47.965 (1.8884 - 1.8884)
	Grade No. R	47.995 - 47.964 (1.8884 - 1.8883)
	Grade No. S	47.994 - 47.963 (1.8883 - 1.8883)
	Grade No. T	47.963 - 47.962 (1.8883 - 1.8883)
Grade No. U	47.962 - 47.961 (1.8883 - 1.8882)	
Grade No. V	47.961 - 47.960 (1.8882 - 1.8882)	
Grade No. W	47.960 - 47.959 (1.8882 - 1.8881)	

*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]

Connecting Rod Bearing

INFOID:000000010282263

CONNECTING ROD BEARING GRADE TABLE

Unit: mm (in)

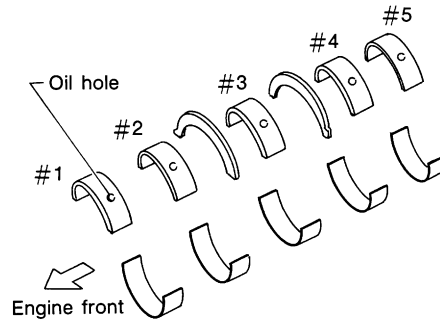
Grade number	Thickness	Identification color	Remarks	
0	1.815 - 1.818 (0.0715 - 0.0716)	Yellow	Grade and color are the same for upper and lower bearings.	
1	1.818 - 1.821 (0.0716 - 0.0717)	Black		
2	1.821 - 1.824 (0.0717 - 0.0718)	Blue		
3	1.824 - 1.827 (0.0718 - 0.0719)	Red		
4	1.827 - 1.830 (0.0719 - 0.0720)	Green		
01	UPR	1.815 - 1.818 (0.0715 - 0.0716)	Yellow	Grade and color are different for upper and lower bearings.
	LWR	1.818 - 1.821 (0.0716 - 0.0717)	Black	
12	UPR	1.818 - 1.821 (0.0716 - 0.0717)	Black	
	LWR	1.821 - 1.824 (0.0717 - 0.0718)	Blue	
23	UPR	1.821 - 1.824 (0.0717 - 0.0718)	Blue	
	LWR	1.824 - 1.827 (0.0718 - 0.0719)	Red	
34	UPR	1.824 - 1.827 (0.0718 - 0.0719)	Red	
	LWR	1.827 - 1.830 (0.0719 - 0.0720)	Green	

Main Bearing

INFOID:000000010282264

MAIN BEARING GRADE TABLE

Unit: mm (in)



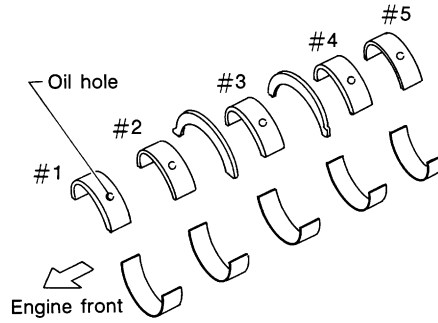
SEM685D

Grade number	Thickness	Identification color	Remarks
0	2.0000 - 2.0015 (0.0787 - 0.0788)	Black	Grade and color are the same for upper and lower bearings.
1	2.0030 - 2.0045 (0.0789 - 0.0789)	White	
2	2.0060 - 2.0075 (0.0790 - 0.0790)	Green	
3	2.0090 - 2.0105 (0.0791 - 0.0792)	Yellow	
4	2.0120 - 2.0135 (0.0792 - 0.0793)	Blue	
5	2.0150 - 2.0165 (0.0793 - 0.0794)	Red	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HRA2DDT]



SEM685D

Grade number		Thickness	Identification color	Remarks
01	UPR	2.0000 - 2.0015 (0.0787 - 0.0788)	Black	Grade and color are different for upper and lower bearings.
	LWR	2.0030 - 2.0045 (0.0789 - 0.0789)	White	
12	UPR	2.0030 - 2.0045 (0.0789 - 0.0789)	White	
	LWR	2.0060 - 2.0075 (0.0790 - 0.0790)	Green	
23	UPR	2.0060 - 2.0075 (0.0790 - 0.0790)	Green	
	LWR	2.0090 - 2.0105 (0.0791 - 0.0792)	Yellow	
34	UPR	2.0090 - 2.0105 (0.0791 - 0.0792)	Yellow	
	LWR	2.0120 - 2.0135 (0.0792 - 0.0793)	Blue	
45	UPR	2.0120 - 2.0135 (0.0792 - 0.0793)	Blue	
	LWR	2.0150 - 2.0165 (0.0793 - 0.0794)	Red	

PRECAUTION

PRECAUTIONS

Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:000000010715440

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

WARNING:

Always observe the following items for preventing accidental activation.

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision that would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see "SRS AIR BAG".
- Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

Always observe the following items for preventing accidental activation.

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000010715441

CAUTION:

Comply with the following cautions to prevent any error and malfunction.

- Before removing and installing any control units, first turn the ignition power source and accessory power source to the OFF, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.

If turning the steering wheel is required with the battery disconnected or discharged, follow the operation procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.
 - NOTE:**
Supply power using jumper cables if battery is discharged.
2. Open driver door.
3. Turn the ignition switch to the ON position.
(At this time, the steering lock will be released.)
4. Turn the ignition switch to OFF position with driver door open.
5. Wait for 3 minutes or longer with driver door open.

NOTE:

- Do not close driver door because the steering wheel locks when driver door is closed.

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PRECAUTIONS

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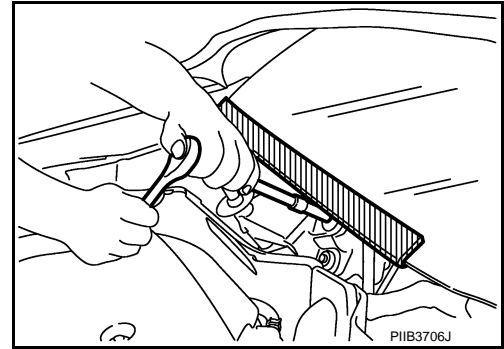
< PRECAUTION >

- The auto acc function is adapted to this vehicle. For this reason, even when the ignition switch is turned to OFF position, the accessory power source does not turned OFF and continues to be supplied for a certain amount of time.
6. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
 7. Perform the necessary repair operation.
 8. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from OFF position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
 9. Perform self-diagnosis check of all control units using CONSULT.

Precaution for Procedure without Cowl Top Cover

INFOID:000000010715442

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc to prevent damage to windshield.



Precaution for Handling High Pressure Fuel System

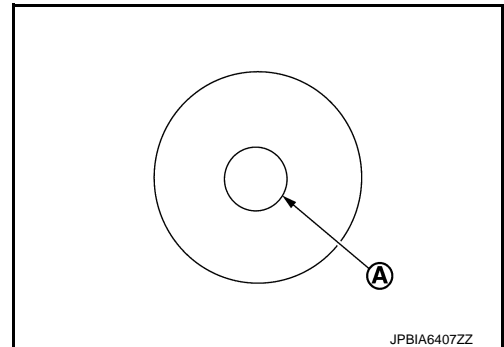
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- High pressure fuel system components are between high pressure fuel pump and fuel injector.
- Always release fuel pressure and never start the engine when performing removal and installation.
- When removing or installing parts without releasing fuel pressure, fuel may be splashed and, if fuel contacts skin or eyes, it may cause inflammation.

Special Cautions to Ensure the Safe Disposal of Sodium-filled Valves

INFOID:000000010715444

Handling and disposal of sodium-filled valves requires special care and consideration. Under conditions such as breakage with subsequent contact with water, metal sodium which lines the inner portion of valve will react violently, forming sodium hydroxide and hydrogen which may result in an explosion. Sodium-filled valve is identified on the top of its stem as shown in illustration.



Identification mark of sodium-filled valve (A)

Intake	: 4BA
Exhaust	: 4BB

DEALER DISPOSAL INSTRUCTIONS

CAUTION:

- Use approved shatter-resistant eye protection when performing this procedure.
- Perform this and all subsequent disposal work procedures in an open room, away from flammable liquids. Keep a fire extinguisher, rated at least 10 ABC, in close proximity to the work area.
- Be sure to wear rubber gloves when performing the following operations.
- Make sure the resultant (high alkalinity) waste water does not contact your skin. If the waste water does contact you, wash the contacted area immediately with large quantities of water.
- Dealers should check their respective state and local regulations concerning any chemical treatment or waste water discharge permits which may be required to dispose of the resultant (high alkalinity) waste water.

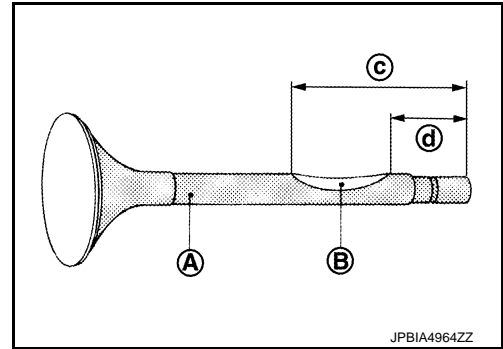
PRECAUTIONS

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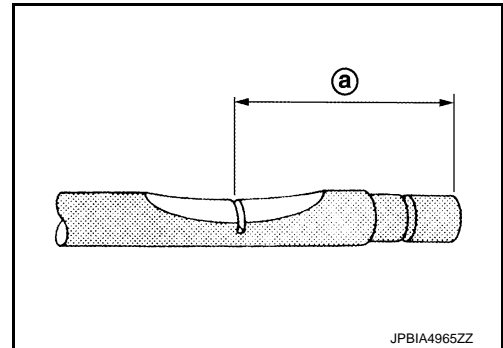
1. Clamp valve stem in a vice.
2. The valve has a specially-hardened surface. To cut through it, first remove a half-round section, approximately 30 mm (1.18 in) long using air-powered grinder until black color is removed and silver color appears.

- A : Black color
B : Silver color
c : 47 mm (1.85 in)
d : 17 mm (0.67 in)

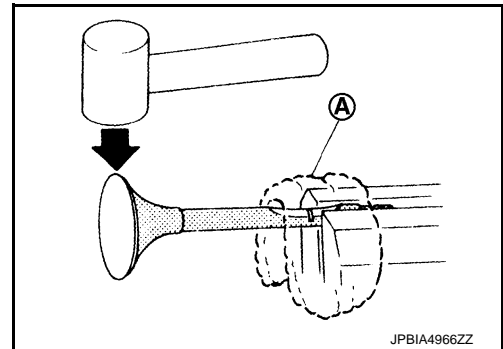


3. Use hacksaw to cut through approximately half the diameter of valve stem. Make the serration at a point 40 mm (1.57 in) from the end of valve stem.

- a : 32 mm (1.26 in)

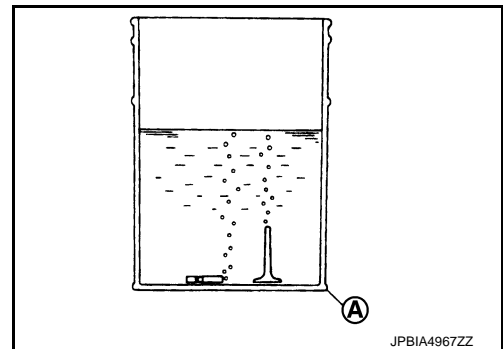


4. Cover the serrated end of the valve with a large shop towel (A). Strike the valve face end with a hammer, separating it into two pieces.
5. Fill a bucket (such as a 20 ℓ oil can) with at least 10 ℓ (2-1/4 Imp gal) of water. Carefully place the already cut (serrated) valves into the water one-at-a-time using a set of large tweezers and quickly move away at least 2.7 m (9 ft).



6. The valves should be placed in a standing position as shown in the illustration to allow complete reaction. After the bubbling action has subsided, additional valves can be placed into the bucket allowing each subsequent chemical reaction to subside. However, no more than 8 valves should be placed in the same 10 ℓ (2-1/4 Imp gal) amount of water. The complete chemical reaction may take as long as 4 to 5 hours. Remove the valves using a set of large tweezers after the chemical reaction has stopped. Afterwards, valves can be disposed as ordinary scrap.

- A : Bucket (Such as 20 ℓ oil can)



Precautions For Engine Service

INFOID:000000010715445

DISCONNECTING FUEL PIPING

- Before starting work, check no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

DRAINING ENGINE COOLANT

Drain engine coolant and engine oil when the engine is cooled.

INSPECTION, REPAIR AND REPLACEMENT

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PRECAUTIONS

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< PRECAUTION >

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

REMOVAL AND DISASSEMBLY

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Must cover openings of engine system with a tape or equivalent, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

ASSEMBLY AND INSTALLATION

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- After disassembling, or exposing any internal engine parts, change engine oil and replace oil filter with a new one.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

Parts Requiring Angle Tightening

INFOID:000000010715446

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
 - Camshaft sprocket (INT) bolt
 - Cylinder head bolts
 - Main bearing cap bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Liquid Gasket

INFOID:000000010715447

REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.

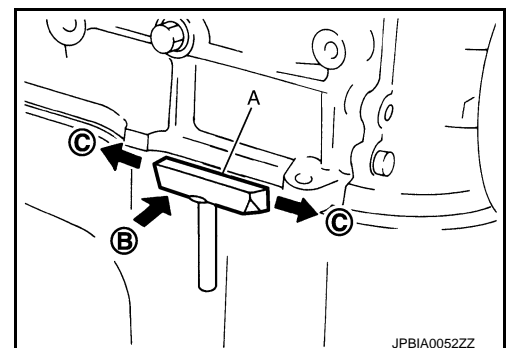
CAUTION:

Be careful not to damage the mating surfaces.

- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, use a plastic hammer to lightly tap the parts, to remove it.

CAUTION:

If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.



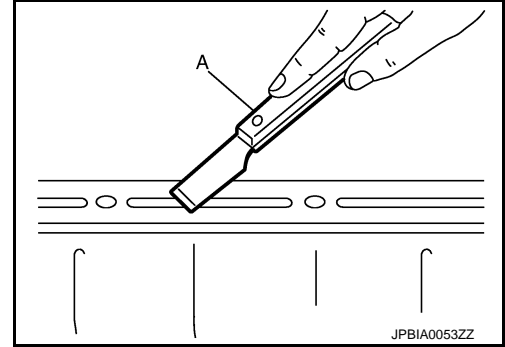
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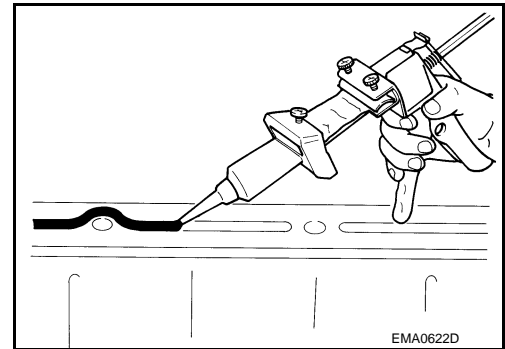
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LIQUID GASKET APPLICATION PROCEDURE

- Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
 - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
- Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



- Attach liquid gasket tube to the tube presser (commercial service tool).
Use Genuine Liquid Gasket or equivalent.
- Apply liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for liquid gasket application, apply liquid gasket to the groove.

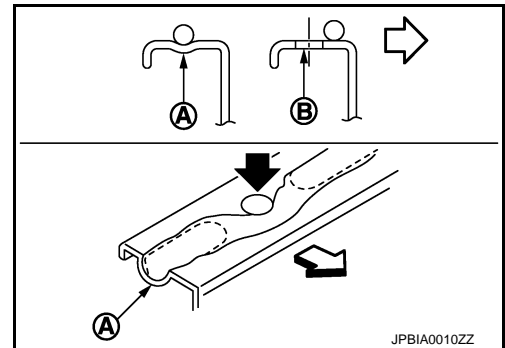


- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

(A) : Groove

⇐ : Inside

- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.



CAUTION:

If there are specific instructions in this manual, observe them.

Precautions for Removing Battery Terminal

INFOID:0000000010715448

- With the adoption of Auto ACC function, ACC power is automatically supplied by operating the intelligent key or remote keyless entry or by opening/closing the driver side door. In addition, ACC power is supplied even after the ignition switch is turned to the OFF position, i.e. ACC power is supplied for a certain fixed time.
- When disconnecting the 12V battery terminal, turn off the ACC power before disconnecting the 12V battery terminal, observing "How to disconnect 12V battery terminal" described below.

NOTE:

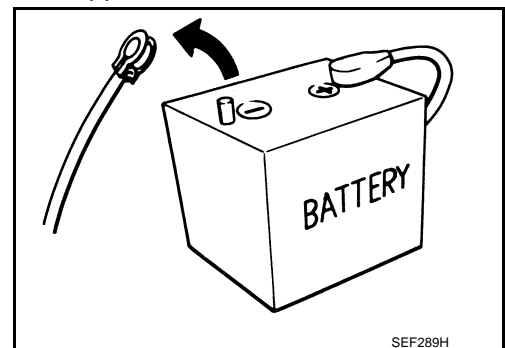
Some ECUs operate for a certain fixed time even after ignition switch is turned OFF and ignition power supply is stopped. If the battery terminal is disconnected before ECU stops, accidental DTC detection or ECU data damage may occur.

- For vehicles with the 2-batteries, be sure to connect the main battery and the sub battery before turning ON the ignition switch.

NOTE:

If the ignition switch is turned ON with any one of the terminals of main battery and sub battery disconnected, then DTC may be detected.

- After installing the 12V battery, always check "Self Diagnosis Result" of all ECUs and erase DTC.



PRECAUTIONS

[MR20DD]

< PRECAUTION >

NOTE:

The removal of 12V battery may cause a DTC detection error.

HOW TO DISCONNECT 12V BATTERY TERMINAL

Disconnect 12V battery terminal according to Instruction 1 or Instruction 2 described below.

For vehicles parked by ignition switch OFF, refer to Instruction 2.

INSTRUCTION 1

1. Open the hood.
2. Turn key switch to the OFF position with the driver side door opened.
3. Get out of the vehicle and close the driver side door.
4. Wait at least 3 minutes.

CAUTION:

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

5. Remove 12V battery terminal.

CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

INSTRUCTION 2 (FOR VEHICLES PARKED BY IGNITION SWITCH OFF)

1. Unlock the door with intelligent key or remote keyless entry.

NOTE:

At this moment, ACC power is supplied.

2. Open the driver side door.
3. Open the hood.
4. Close the driver side door.
5. Wait at least 3 minutes.

CAUTION:

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

6. Remove 12V battery terminal.

CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

PREPARATION

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Special Service Tools

INFOID:000000010715449

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Tool number Tool name	Description
KV10111100 Seal cutter	Removing oil pan (upper and lower) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	Disassembling and assembling valve mechanism Part ① is a component of KV10116200, but Part ② is not so.
KV10112100 Angle wrench	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor 1 For 22 mm (0.87 in) width hexagon nut
KV10107902 Valve oil seal puller ① KV10116100 Valve oil seal puller adapter	Removing valve oil seal
KV10115600 Valve oil seal drift	Installing valve oil seal Use side A. a: 20 (0.79) dia. d: 8 (0.31) dia. b: 13 (0.51) dia. e: 10.7 (0.421) c: 10.3 (0.406) dia. f: 5 (0.20) Unit: mm (in)

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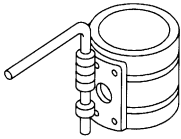
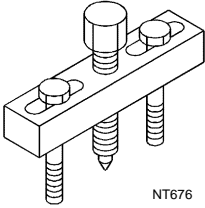
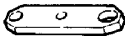
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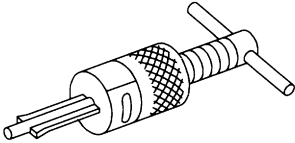
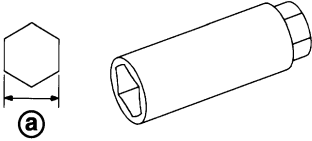
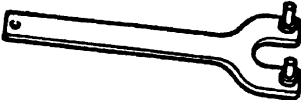
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Tool number Tool name	Description
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore
 S-NT044	
KV11103000 Pulley puller	Removing crankshaft pulley
 NT676	
KV11105210 Stopper plate	Fixing drive plate and flywheel
 ZZA0009D	

Commercial Service Tools

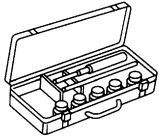
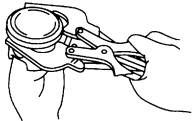
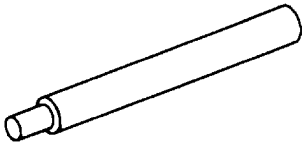
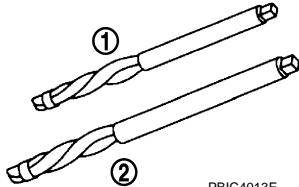
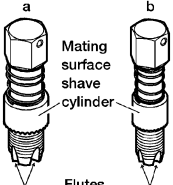
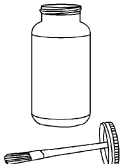
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Tool name	Description
Pilot bushing puller	Removing pilot converter
 S-NT045	
Spark plug wrench	Removing and installing spark plug Ⓐ: 14 mm (0.55 in)
 JPBIA0399ZZ	
Pulley holder	Crankshaft pulley removing and installing
 ZZA1010D	

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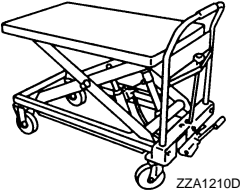
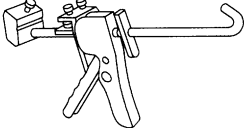
Tool name	Description
<p>Valve seat cutter set</p> <div style="text-align: center;">  <p>S-NT048</p> </div>	<p>Finishing valve seat dimensions</p>
<p>Piston ring expander</p> <div style="text-align: center;">  <p>S-NT030</p> </div>	<p>Removing and installing piston ring</p>
<p>Valve guide drift</p> <div style="text-align: center;">  <p>PBIC4012E</p> </div>	<p>Removing and installing valve guide</p>
<p>Valve guide reamer</p> <div style="text-align: center;">  <p>PBIC4013E</p> </div>	<p>① Reaming valve guide inner hole ② Reaming hole for oversize valve guide</p>
<p>Oxygen sensor thread cleaner</p> <div style="text-align: center;">  <p>AEM488</p> </div>	<p>Reconditioning the exhaust system threads before installing a new heated oxygen sensor (Use with anti-seize lubricant shown below.) a: 18 mm (0.71 in) dia. for zirconia heated oxygen sensor b: 12 mm (0.47 in) dia. for titania heated oxygen sensor</p>
<p>Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)</p> <div style="text-align: center;">  <p>AEM489</p> </div>	<p>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>

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Tool name	Description
Manual lift table caddy <div style="text-align: center;">  <p>ZZA1210D</p> </div>	Removing and installing engine
Tube presser <div style="text-align: center;">  <p>S-NT052</p> </div>	Pressing the tube of liquid gasket

Lubricant or/and Sealant

INFOID:000000010715451

Name	Description	Note
Three bond 1215	Cylinder block	Water drain plug
Three bond 1217H	<ul style="list-style-type: none"> • Oil pan (lower) • Rocker cover • Timing chain • Oil pan (upper) • Camshaft • Cylinder block 	—
Three bond 1386B	Cylinder block	Plug

BASIC INSPECTION**CAMSHAFT VALVE CLEARANCE****Inspection and Adjustment**

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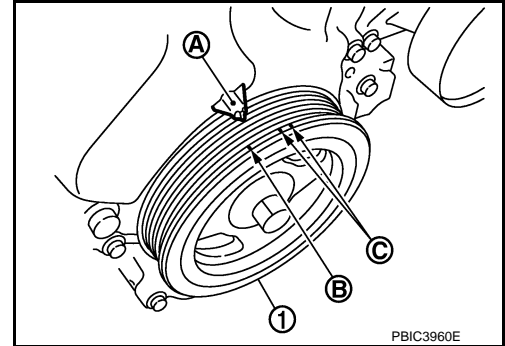
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INSPECTION

Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to [EM-170, "Exploded View"](#).
2. Measure the valve clearance with the following procedure:
 - a. Set No. 1 cylinder at TDC of its compression stroke.
 - Rotate crankshaft pulley ① clockwise and align TDC mark (no paint) ② to timing indicator ③ on front cover.

③ : White paint mark (Not use for service)



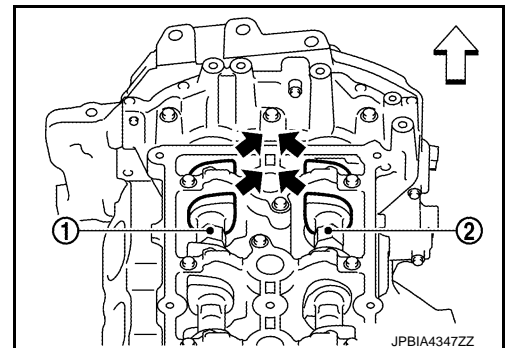
- At the same time, check that both intake and exhaust cam noses of No. 1 cylinder face inside (←) as shown in the figure.

① : Camshaft (INT)

② : Camshaft (EXH)

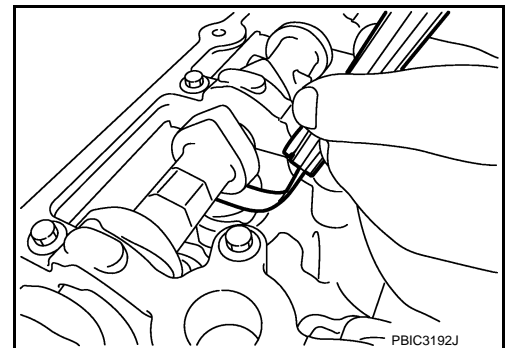
← : Engine front

- If they do not face inside, rotate crankshaft pulley once more (360 degrees) and align as shown in the figure.



- b. Using a feeler gauge, measure the clearance between valve lifter and camshaft.

Valve clearance : Refer to [EM-249, "Camshaft"](#).



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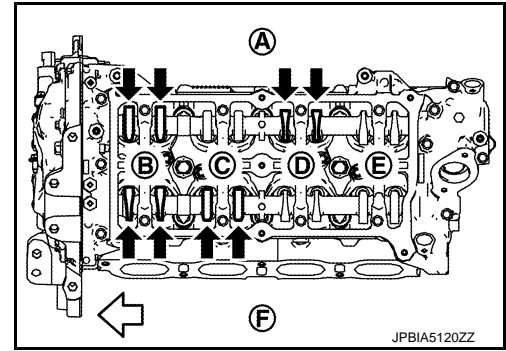
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CAMSHAFT VALVE CLEARANCE

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< BASIC INSPECTION >

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below [locations indicated with black arrow (←) in the figure] with a feeler gauge.



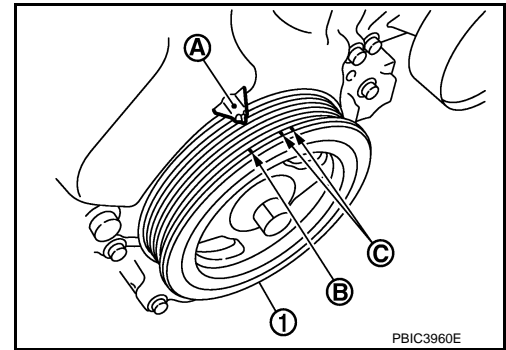
- (A) : Exhaust side
- (B) : No. 1 cylinder
- (C) : No. 2 cylinder
- (D) : No. 3 cylinder
- (E) : No. 4 cylinder
- (F) : Intake side
- ← : Engine front

Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 1 cylinder at compression TDC	EXH	x		x	
	INT	x	x		

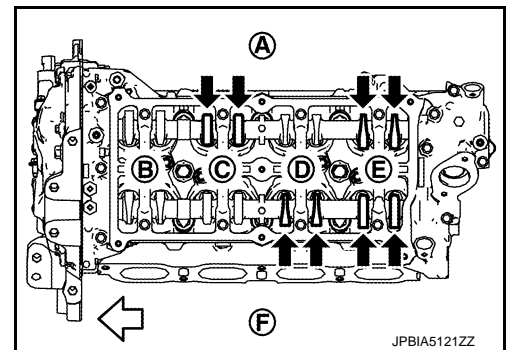
- c. Set No. 4 cylinder at TDC of its compression stroke.

- Rotate crankshaft pulley ① one revolution (360 degrees) and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

- (C) : White paint mark (Not use for service)



- By referring to the figure, measure the valve clearance at locations marked "x" as shown in the table below [locations indicated with black arrow (←) in the figure] with a feeler gauge.



- (A) : Exhaust side
- (B) : No. 1 cylinder
- (C) : No. 2 cylinder
- (D) : No. 3 cylinder
- (E) : No. 4 cylinder
- (F) : Intake side
- ← : Engine front

Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at compression TDC	EXH		x		x
	INT			x	x

3. If out of standard, perform adjustment. Refer to "ADJUSTMENT".

ADJUSTMENT

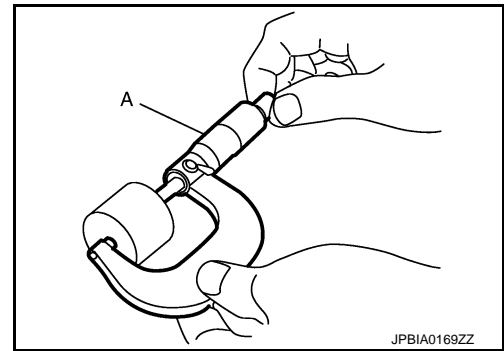
- Perform adjustment depending on selected head thickness of valve lifter.
- Remove camshaft. Refer to [EM-196. "Exploded View"](#).
 - Remove valve lifters at the locations that are out of the standard.

CAMSHAFT VALVE CLEARANCE

[MR20DD]

< BASIC INSPECTION >

3. Measure the center thickness of the removed valve lifters with a micrometer (A).



4. Use the equation below to calculate valve lifter thickness for replacement.

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t₁ = Removed valve lifter thickness

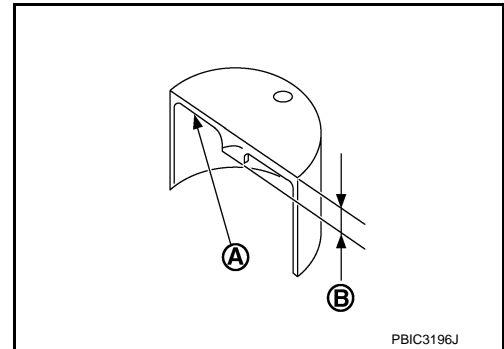
C₁ = Measured valve clearance

C₂ = Standard valve clearance:

Intake : 0.28 mm (0.011 in)

Exhaust : 0.30 mm (0.012 in)

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder).
- Stamp mark "302H" indicates 3.02 mm (0.1189 in) in thickness.



NOTE:

Available thickness of valve lifter: 26 sizes range 3.00 to 3.50 mm (0.1181 to 0.1378 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-249. "Camshaft"](#).

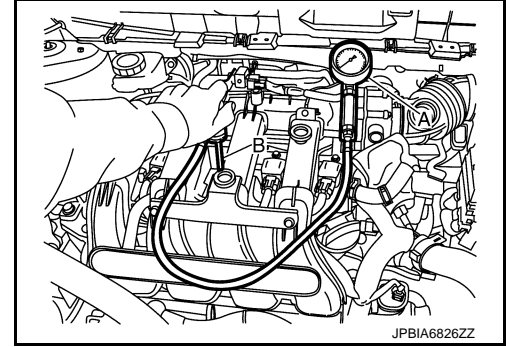
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-196. "Exploded View"](#).
7. Install timing chain and related parts. Refer to [EM-183. "Exploded View"](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to "INSPECTION".
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

COMPRESSION PRESSURE

Inspection

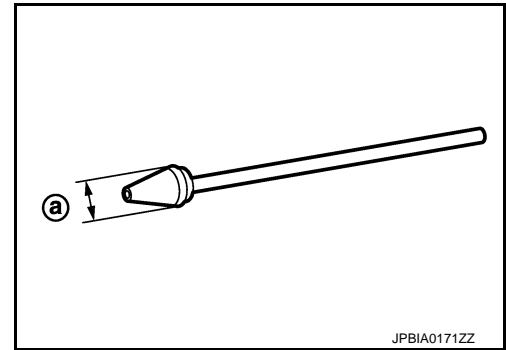
INFOID:000000010715453

1. Warm up engine thoroughly. Then, stop it.
2. Release the fuel pressure. Refer to [ECM-135, "Work Procedure"](#).
3. Remove ignition coil and spark plug from each cylinder. Refer to [EM-170, "Exploded View"](#).
4. Connect engine tachometer (not required in use of CONSULT).
5. Install compression gauge (A) with an adapter (B) (commercial service tool) onto spark plug hole.



- Use the adapter whose picking up end inserted to spark plug hole is smaller than 20 mm (0.79 in) in diameter. Otherwise, it may be caught by cylinder head during removal.

Ⓐ : 20 mm (0.79 in)



6. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and the engine rpm. Perform these steps to check each cylinder.

Compression pressure : Refer to [EM-248, "General Specification"](#).

CAUTION:

Always use a fully charged battery to obtain the specified engine speed.

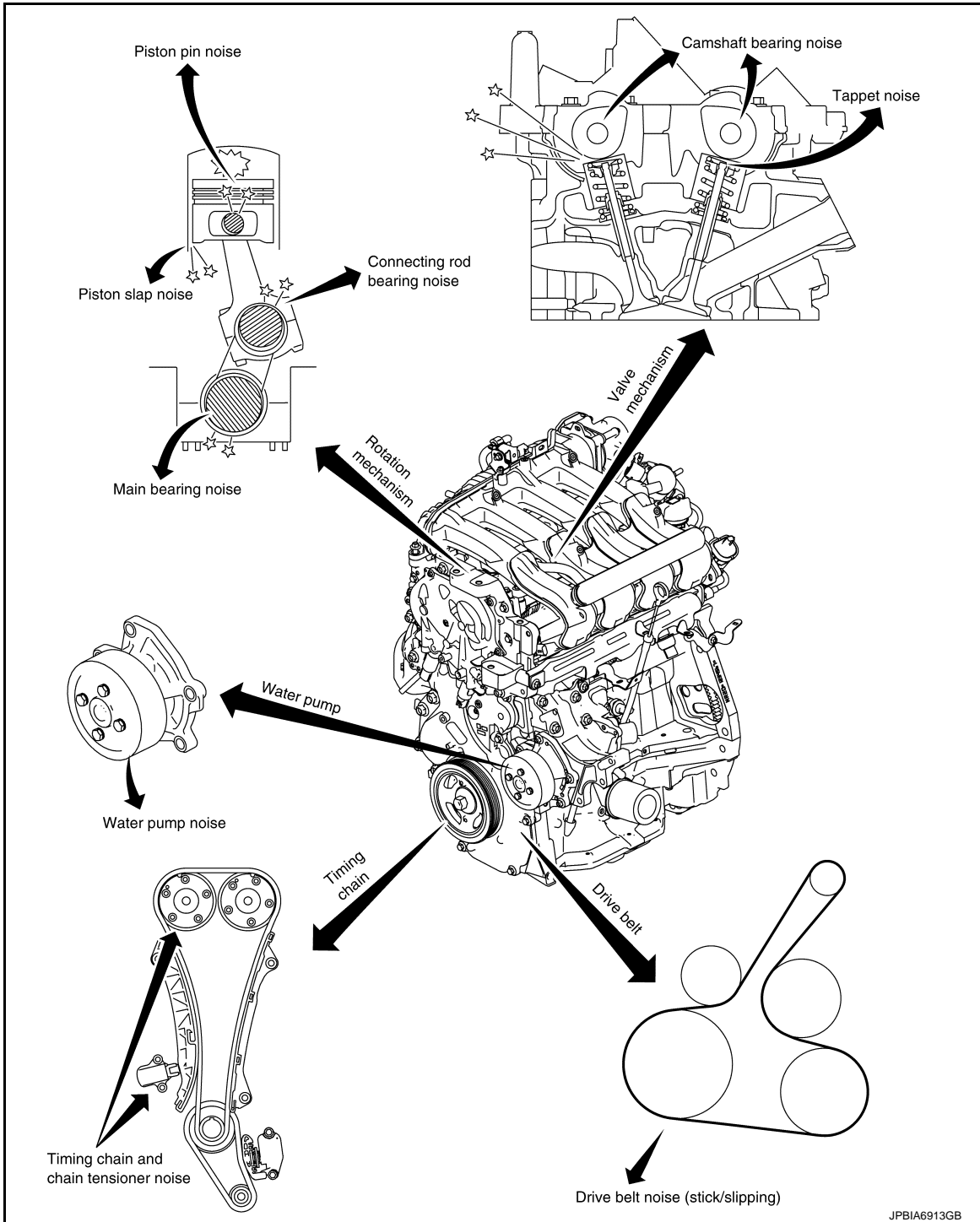
- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check the engine speed again with normal battery gravity.
 - If compression pressure is below minimum value, check valve clearances, and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
 - If some cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to recheck it for compression.
 - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
 - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
 - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
7. After inspection is completed, install removed parts.
 8. Start the engine, and check that the engine runs smoothly.
 9. Perform trouble diagnosis. If DTC appears, erase it. Refer to [ECM-65, "CONSULT Function"](#).

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH troubleshooting Chart

INFOID:000000010715454



1. Locate the area where noise occurs.
 2. Confirm the type of noise.
 3. Specify the operating condition of engine.
 4. Check specified noise source.
- If necessary, repair or replace these parts.

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NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[MR20DD]

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-133
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-249
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-253
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-253
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-253 EM-256
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-257 EM-253
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-194 EM-183
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-139
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-49

A: Closely related B: Related C: Sometimes related —: Not related

PERIODIC MAINTENANCE

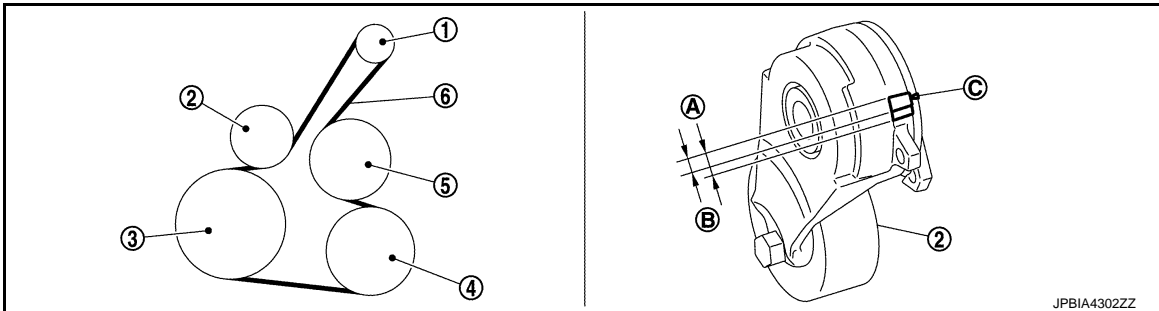
DRIVE BELTS

Exploded View

INFOID:000000010715455

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EM



- | | | |
|----------------------|--|---------------------|
| ① Alternator | ② Drive belt auto-tensioner | ③ Crankshaft pulley |
| ④ A/C compressor | ⑤ Water pump | ⑥ Drive belt |
| Ⓐ Possible use range | Ⓑ Range when new drive belt is installed | Ⓒ Indicator |

Removal and Installation

INFOID:000000010715456

REMOVAL

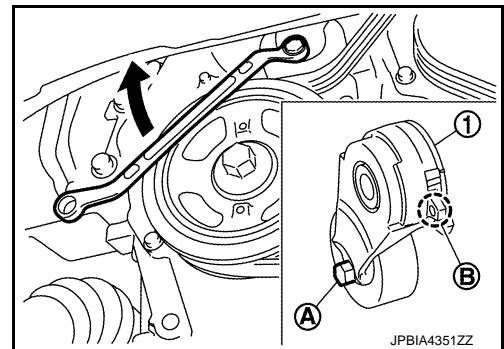
1. Remove front wheel and tire (RH). Refer to [WT-60. "Exploded View"](#) (with TPMS) or [WT-73. "Exploded View"](#) (without TPMS).
2. Remove front fillet molding (RH). Refer to [EXT-37. "Exploded View"](#).
3. Remove front fender protector (RH). Refer to [EXT-31. "Exploded View"](#).

4. Hold the hexagonal part Ⓐ of drive belt auto-tensioner ① with a wrench securely. Then move the wrench handle in the direction of arrow (loosening direction of tensioner).

CAUTION:

Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.

5. Insert a rod approximately 6 mm (0.24 in) in diameter such as short-length screwdriver into the hole Ⓑ of the retaining boss to drive belt auto-tensioner.
 - Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.



INSTALLATION

CAUTION:

- Confirm drive belt is completely set to pulleys.
- Check for engine oil, working fluid and engine coolant are not adhered to drive belt and each pulley groove.

1. Release drive belt auto-tensioner, and apply tension to drive belt.
2. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
3. Confirm tension of drive belt at indicator (notch on fixed side) is within the possible use range. Refer to [EM-139. "Exploded View"](#).

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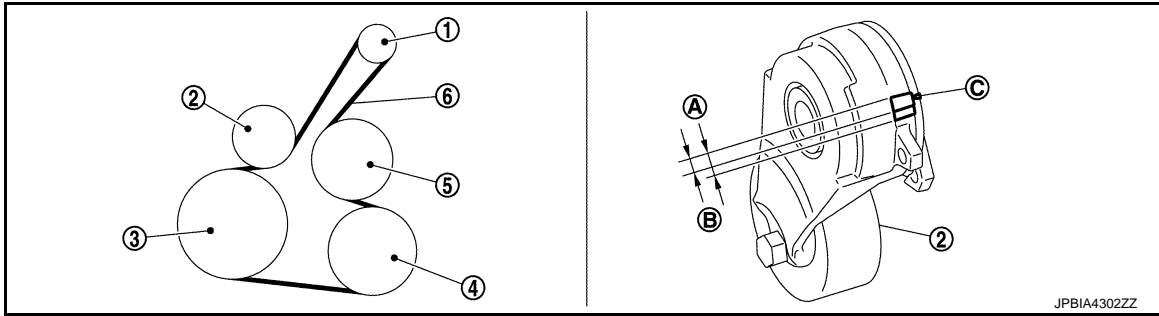
DRIVE BELTS

< PERIODIC MAINTENANCE >

[MR20DD]

Inspection

INFOID:000000010715457



- | | | |
|----------------------|--|---------------------|
| ① Alternator | ② Drive belt auto-tensioner | ③ Crankshaft pulley |
| ④ A/C compressor | ⑤ Water pump | ⑥ Drive belt |
| Ⓐ Possible use range | Ⓑ Range when new drive belt is installed | Ⓒ Indicator |

WARNING:

Perform this step when engine is stopped.

- Check that the indicator (notch on fixed side) of drive belt auto-tensioner is within the possible use range Ⓐ in the figure.

NOTE:

- Check the drive belt auto-tensioner indication when the engine is cold.
- When new drive belt is installed, the indicator (notch on fixed side) should be within the range Ⓑ in the figure.
- Visually check entire drive belts for wear, damage or cracks.
- If the indicator (notch on fixed side) is out of the possible use range or belts is damaged, replace belts.

Adjustment

INFOID:000000010715458

Refer to : [EM-248, "Drive Belt"](#).

AIR CLEANER FILTER

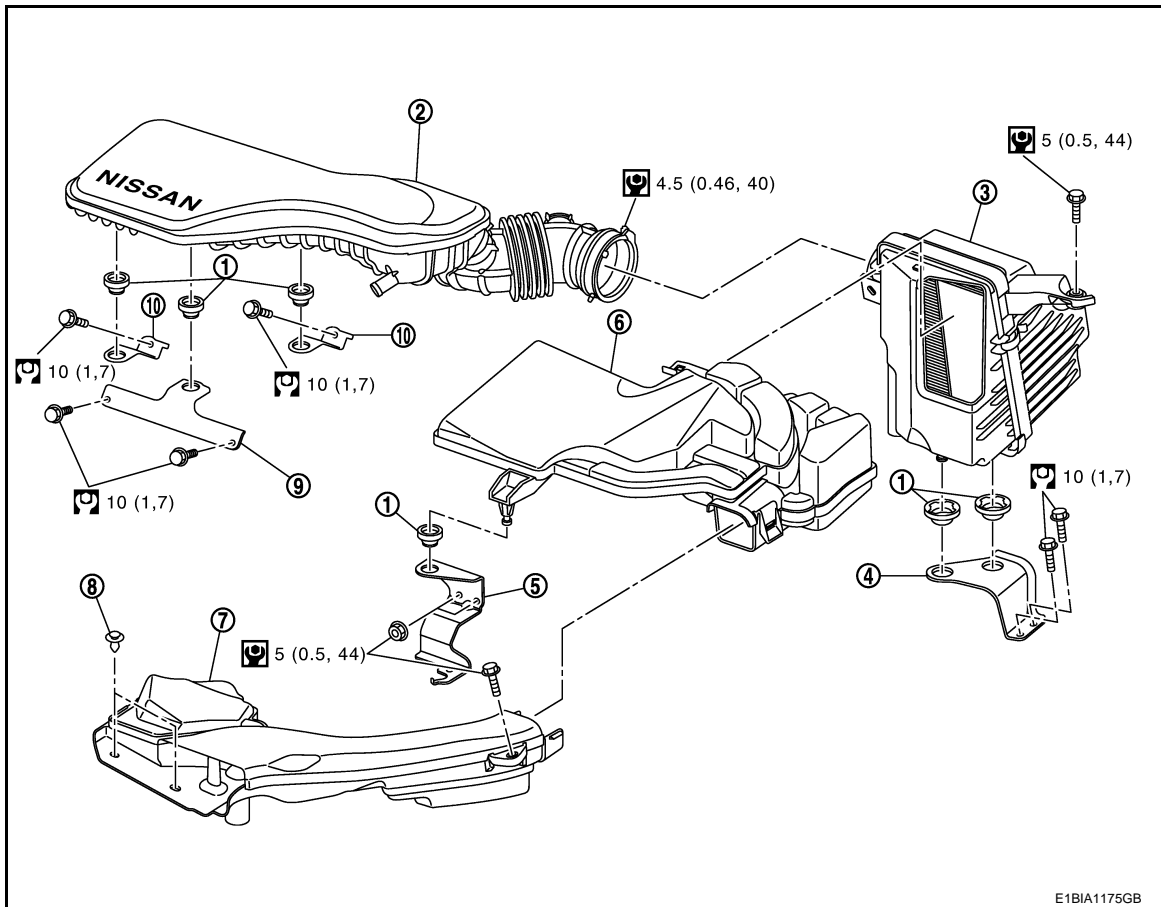
< PERIODIC MAINTENANCE >

[MR20DD]

AIR CLEANER FILTER

Exploded View

INFOID:000000010715459



- | | | |
|-----------------------------------|-------------------------|------------------------------------|
| ① Mounting rubber | ② Air duct assembly | ③ Air cleaner filter unit assembly |
| ④ Air cleaner filter unit bracket | ⑤ Air resonator bracket | ⑥ Air Resonator |
| ⑦ Air duct inlet | ⑧ Clip | ⑨ Air duct assembly bracket 1 |

⑩ Air duct assembly bracket 2

⊗ : Always replace after every disassembly.

Ⓜ : N·m (kg·m, in·lb)

Removal and Installation

INFOID:000000010715460

REMOVAL

1. Release air resonator pawls and remove to upper direction.

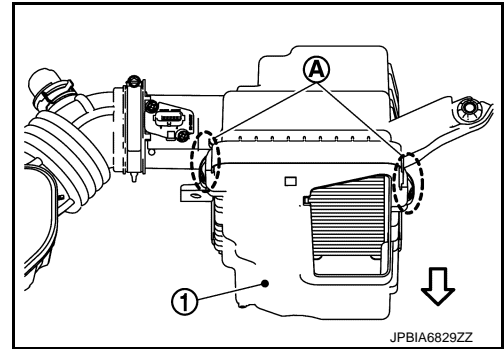
AIR CLEANER FILTER

[MR20DD]

< PERIODIC MAINTENANCE >

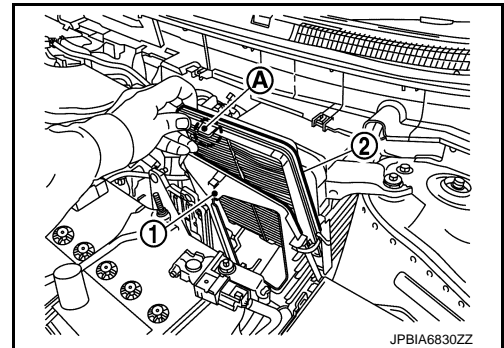
2. Remove the clips (A) of air cleaner cover (1).

⇐ : Vehicle front



3. Shift air cleaner cover (1) to car front side and remove air cleaner element (2).

(A) : Projection



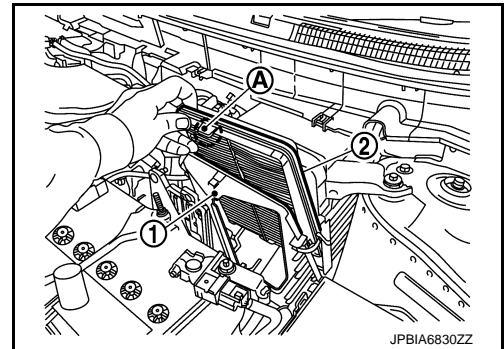
INSTALLATION

Install in the reverse order of removal.

- Insert the projection (A) of air cleaner element (2) in such a way so that it becomes the position (upper front side of car) of illustration.

(A) : Projection

- Verify that there is no looseness in air cleaner cover and has been fixed accurately.
- Check that pawls of air resonator are engaged.



Inspection (Dry Paper Type)

INFOID:000000010715461

INSPECTION AFTER REMOVAL

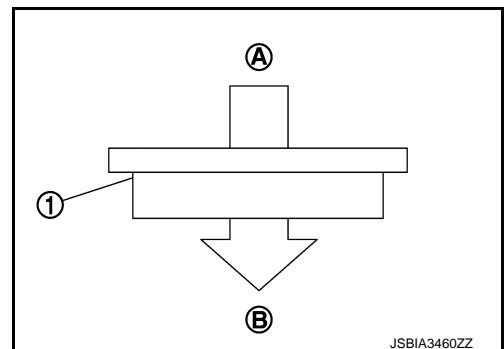
Examine with eyes that there is no stain, clogging, or damage on air cleaner element.

- Remove dusts (such as dead leaves) on air cleaner element surface and inside cleaner case.
- To clean air cleaner element (1), blow air on it from the air intake manifold side (A) to remove trash or dust.

(B) Ambient air side
⇐ Air blow direction

CAUTION:

- When blowing air on the air cleaner element, attach the cover to the air cleaner case and stay away from the vehicle as much as possible to prevent the entry of dirt into the air cleaner case.
- Never blow air from the ambient air side to prevent clogging. When the ambient air side needs to be cleaned, attach the cover to the intake manifold side and lightly dust by hand.



- If clogging or damage is observed, replace the air cleaner element.

AIR CLEANER FILTER

[MR20DD]

< PERIODIC MAINTENANCE >

MAINTENANCE INTERVAL

Refer to [MA-22, "MR20DD : Periodic Maintenance"](#).

A

Inspection (Viscous Paper Type)

INFOID:000000010715462

EM

INSPECTION AFTER REMOVAL

Examine with eyes that there is no stain, clogging, or damage on air cleaner element.

- Remove dusts (such as dead leaves) on air cleaner element surface and inside cleaner case.
- If clogging or damage is observed, replace the air cleaner element.

C

CAUTION:

Never clean the viscous paper type air cleaner element by blowing as there is a risk of deterioration of its performance

D

MAINTENANCE INTERVAL

Refer to [MA-22, "MR20DD : Periodic Maintenance"](#).

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SPARK PLUG

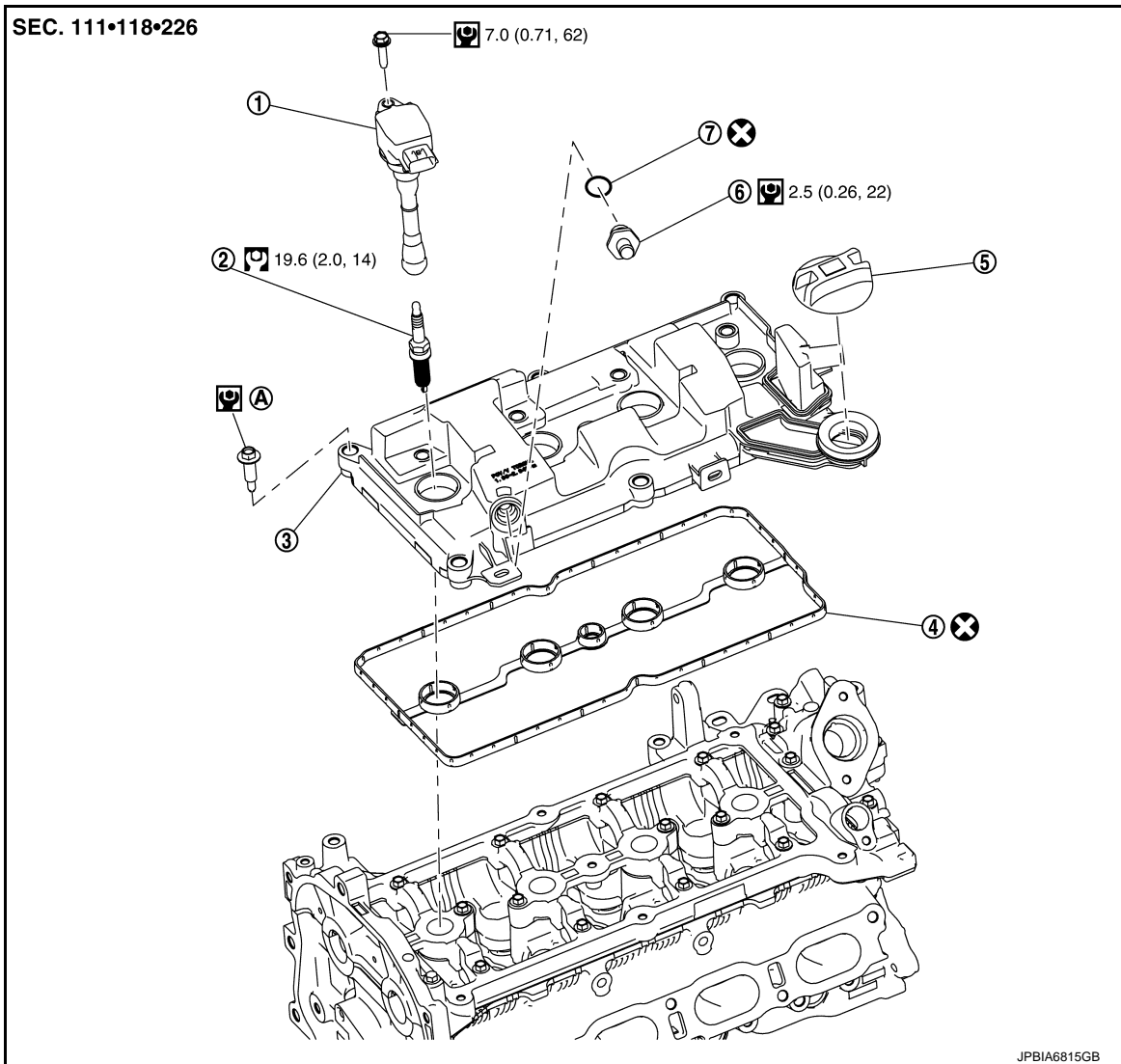
< PERIODIC MAINTENANCE >

[MR20DD]

SPARK PLUG

Exploded View

INFOID:000000010715463



- | | | |
|-----------------------|------------------|----------------|
| ① Ignition coil | ② Spark plug | ③ Rocker cover |
| ④ Rocker cover gasket | ⑤ Oil filler cap | ⑥ PCV valve |
| ⑦ O-ring | | |

Comply with the installation procedure when tightening. Refer to [EM-170](#)

⊗ : Always replace after every disassembly.

⊙ : N·m (kg·m, ft·lb)

⊙ : N·m (kg·m, in·lb)

Removal and Installation

INFOID:000000010715464

REMOVAL

1. Remove resonator of air duct assembly. Refer to [EM-147, "Exploded View"](#).
2. Remove ignition coil. Refer to [EM-170, "Exploded View"](#).

SPARK PLUG

[MR20DD]

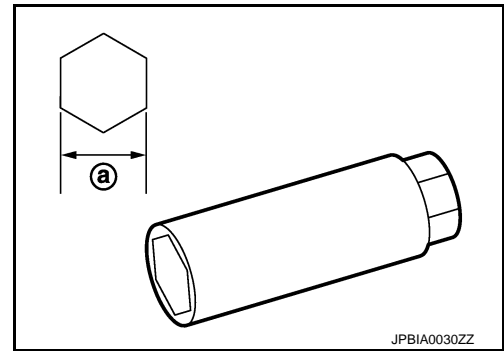
< PERIODIC MAINTENANCE >

- Remove spark plug with a spark plug wrench (commercial service tool).

(a) : 14 mm (0.55 in)

CAUTION:

Never drop or shock spark plug.



INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:000000010715465

INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

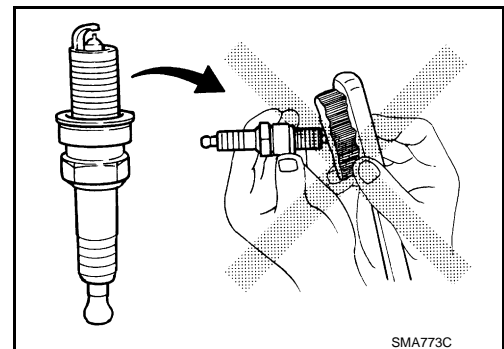
Spark plug (Standard type) : Refer to [EM-248, "Spark Plug"](#).

CAUTION:

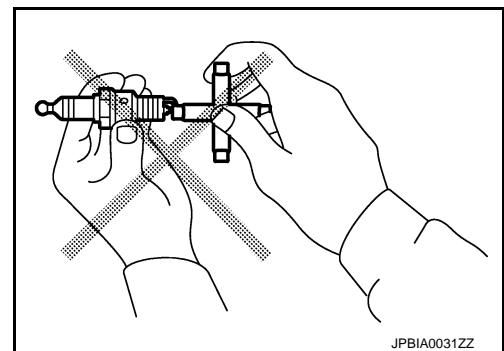
- Never drop or shock spark plug.
- Never use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure : Less than 588 kPa (5.88 bar, 6 kg/cm², 85 psi)

Cleaning time : Less than 20 seconds



- Checking and adjusting plug gap is not required between replacement intervals.
- Measure spark plug gap. when it exceeds the limit, replace spark plug even if it is with in the specified replacement mileage. Refer to [EM-248, "Spark Plug"](#).



DRIVE BELT AUTO-TENSIONER

< REMOVAL AND INSTALLATION >

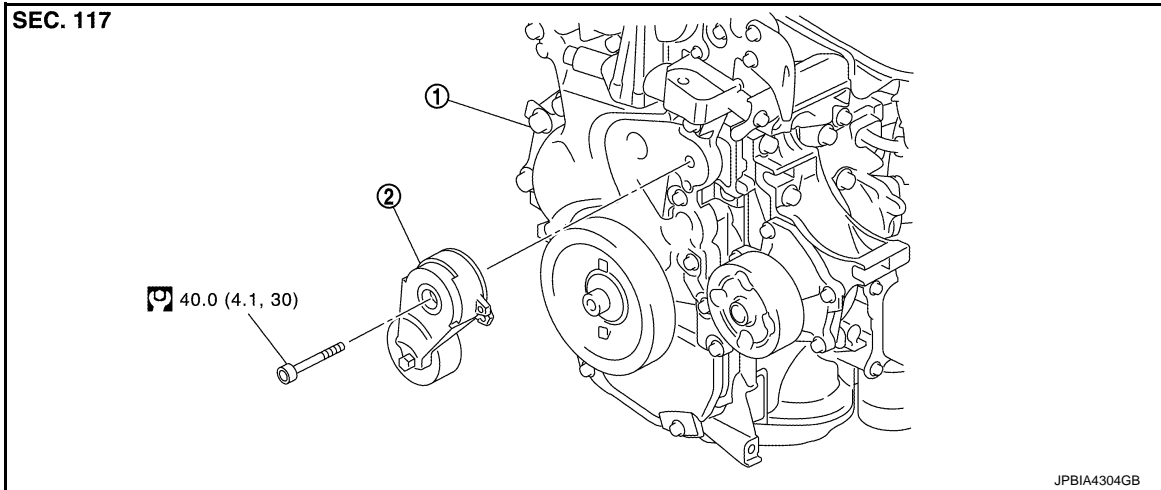
[MR20DD]

REMOVAL AND INSTALLATION

DRIVE BELT AUTO-TENSIONER

Exploded View

INFOID:0000000010715468



① Front cover

② Drive belt auto-tensioner

: N·m (kg·m, ft·lb)

Removal and Installation

INFOID:0000000010715469

Removal

1. Remove drive belt. Refer to [EM-139, "Removal and Installation"](#).
 - Keep each auto-tensioner pulley arm locked after drive belts are removed.
2. Support the bottom surface of engine using a transmission jack, and then remove the rear torque rod and the engine mounting insulator (RH). Refer to [EM-172, "Exploded View"](#).

CAUTION:

When using the jack, apply a piece of wood to the oil pan (lower) mounting bolt to protect the bottom of engine from being scratched.

3. Remove drive belt auto-tensioner mounting bolt ② from service hole ③ of right side member ①.

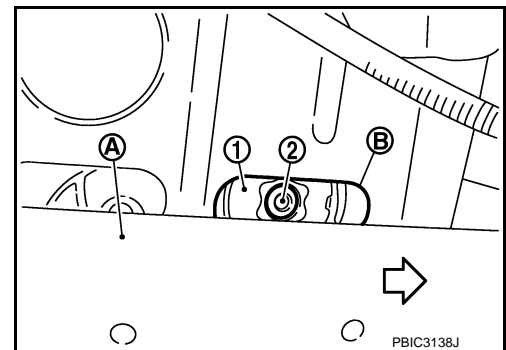
① : Drive belt auto-tensioner

← : Vehicle front

NOTE:

Lift the front side of engine with a jack supporting the bottom of engine and align drive belt auto-tensioner mounting bolt position with the service hole.

4. Remove drive belt auto-tensioner.



Installation

Install in the reverse order of removal.

CAUTION:

When installing drive belt auto-tensioner, be careful not to interfere with water pump pulley.

AIR CLEANER AND AIR DUCT

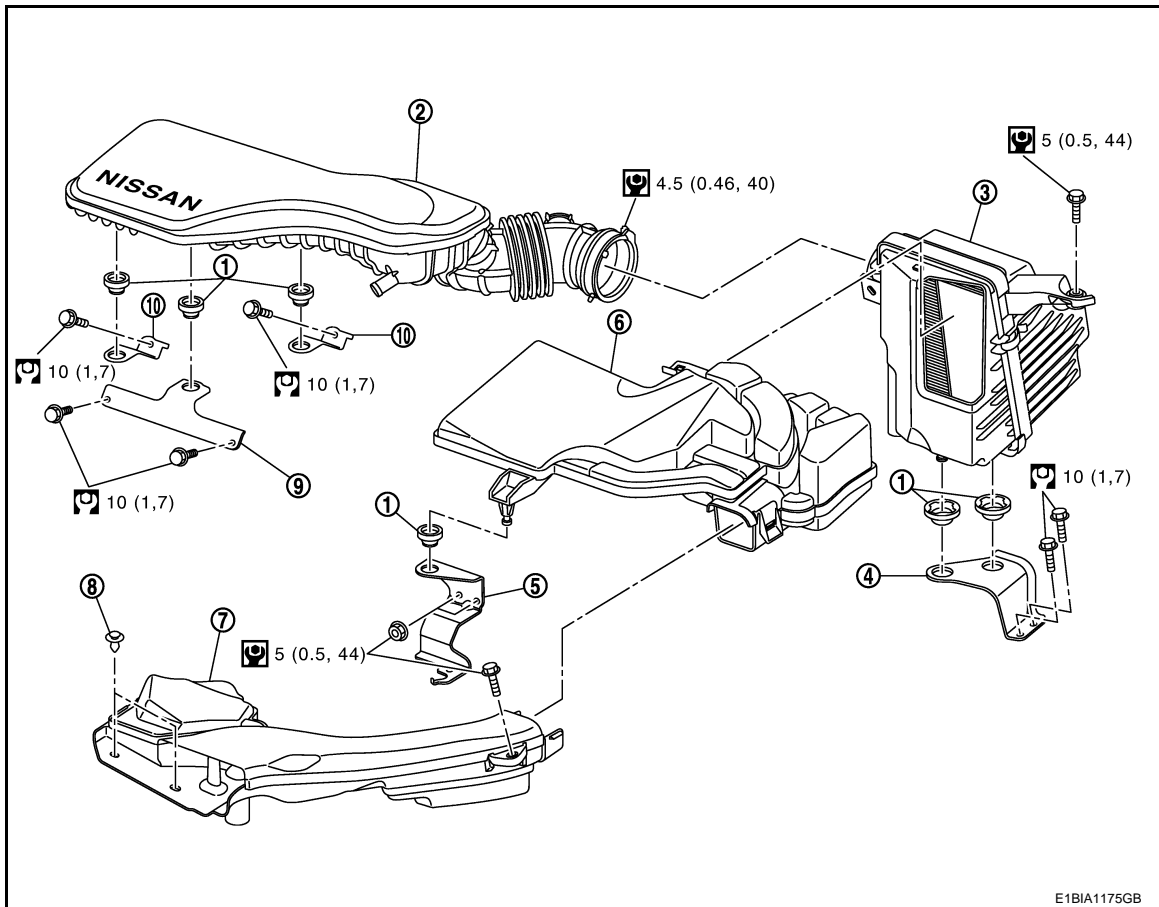
< REMOVAL AND INSTALLATION >

[MR20DD]

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:000000010715470



- | | | |
|-----------------------------------|-------------------------|------------------------------------|
| ① Mounting rubber | ② Air duct assembly | ③ Air cleaner filter unit assembly |
| ④ Air cleaner filter unit bracket | ⑤ Air resonator bracket | ⑥ Air Resonator |
| ⑦ Air duct inlet | ⑧ Clip | ⑨ Air duct assembly bracket 1 |

- ⑩ Air duct assembly bracket 2

⊗ : Always replace after every disassembly.

Ⓜ : N·m (kg·m, in·lb)

Removal and Installation

INFOID:000000010715471

REMOVAL

NOTE:

Mass air flow sensor is removable under the car-mounted condition.

1. Release the air resonator pawls and remove to upper direction. Refer to [EM-147, "Exploded View"](#)
2. Remove air duct inlet clips.
3. Release the air duct inlet pawls and remove to upper direction. Refer to [EM-147, "Exploded View"](#)
4. Disconnect mass air flow sensor harness connector.
5. Loosen clamps of air duct assembly.
 - Add mating marks if necessary for easier installation.
6. Remove air cleaner assembly (cover and body).
7. Remove mass air flow sensor from air cleaner body, if necessary.

CAUTION:

AIR CLEANER AND AIR DUCT

[MR20DD]

< REMOVAL AND INSTALLATION >

Handle the mass air flow sensor with following cares.

- Never shock the mass air flow sensor.
- Never disassemble the mass air flow sensor.
- Never touch the sensor of the mass air flow sensor.

8. Disconnect PCV hose.
9. Remove air duct assembly.
10. Remove bracket, if necessary.

INSTALLATION

Note the following, and install in the reverse order of removal.

Air cleaner body

CAUTION:

Check that mounting rubber is positioned in the mounting location and be careful not to allow it to be dislocated when installing air cleaner body.

Air duct assembly

- To install air duct assembly ①, align the matching marks Ⓐ on both ends with the others.

- ② : Air cleaner body
- ③ : Electric throttle control actuator
- ← : Vehicle front

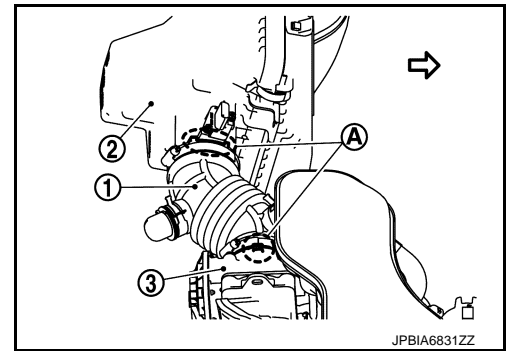
CAUTION:

Never allow foreign materials (i.e. lint) to adhere to the mounting part of air duct assembly and each mating part.

- Install hose clamps and tighten to the torque specified below.



: 4.5 Nm (0.46 kg-m, 40 in-lb)



Inspection

INFOID:000000010715472

INSPECTION AFTER REMOVAL

Inspect air duct assembly for crack or tear.

- If anything found, replace air duct assembly.

INTAKE MANIFOLD

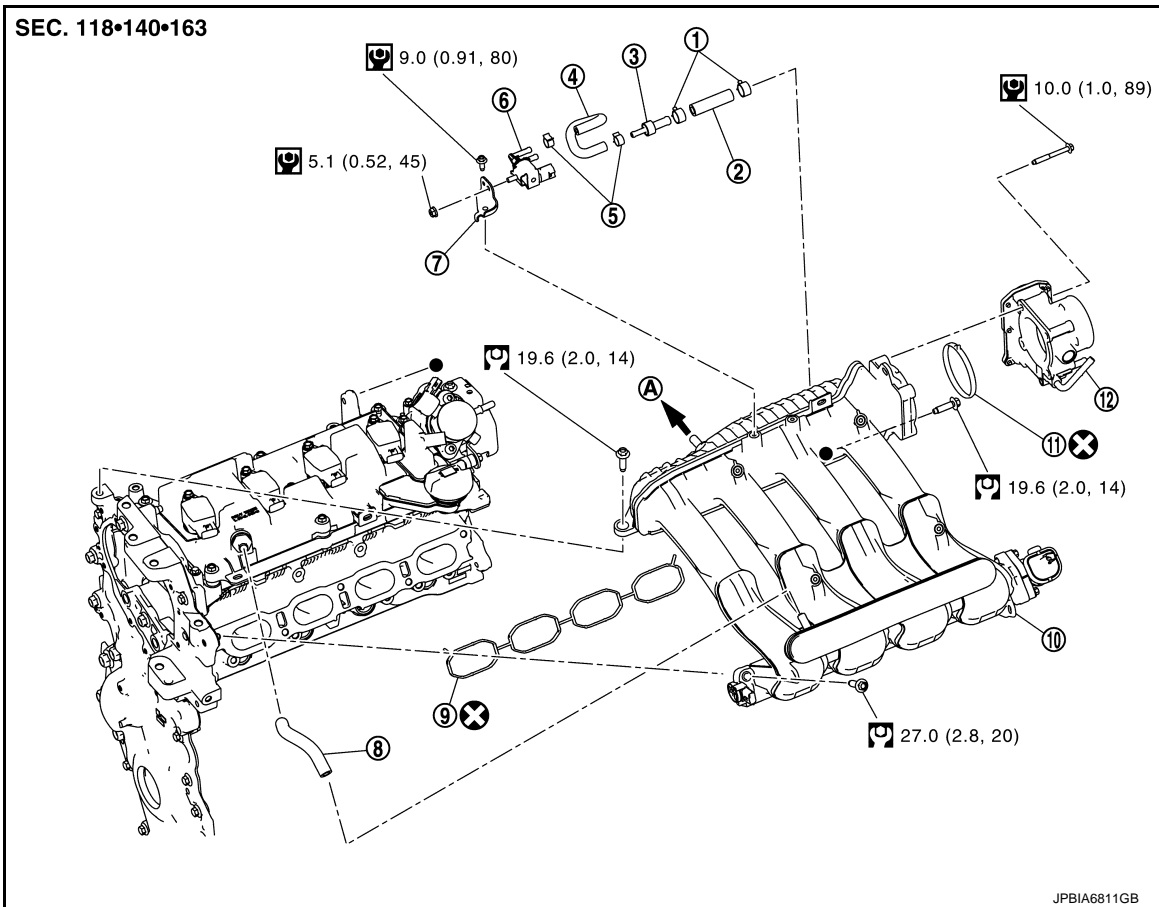
< REMOVAL AND INSTALLATION >

[MR20DD]

INTAKE MANIFOLD

Exploded View

INFOID:000000010715473



- | | | |
|-------------------|-------------|---|
| ① Clamp | ② EVAP hose | ③ Connector |
| ④ EVAP hose | ⑤ Clamp | ⑥ EVAP canister purge volume control solenoid valve |
| ⑦ Bracket | ⑧ PCV hose | ⑨ Gasket |
| ⑩ Intake manifold | ⑪ Gasket | ⑫ Electric throttle control actuator |

(A) To brake booster

⊗ : Always replace after every disassembly.

⊞ : N·m (kg-m, ft-lb)

⊞ : N·m (kg-m, in-lb)

Removal and Installation

INFOID:000000010715474

REMOVAL

1. Remove air cleaner assembly and air duct assembly. Refer to [EM-147, "Exploded View"](#).
2. Pull out oil level gauge.

CAUTION:

Cover the oil level gauge guide openings to avoid entry of foreign materials.

INTAKE MANIFOLD

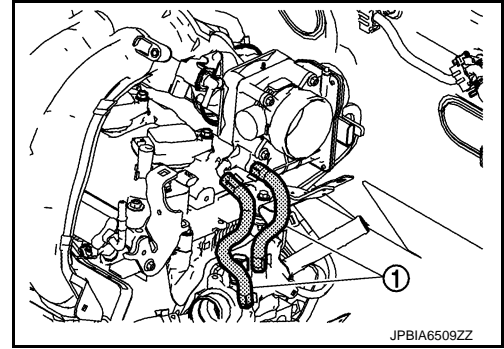
< REMOVAL AND INSTALLATION >

[MR20DD]

3. Disconnect water hoses ① from electric throttle control actuator as follows:
- Drain engine coolant from radiator or attach plug to prevent engine coolant leakage when engine coolant is not drained. Refer to [CO-38, "Draining"](#).

CAUTION:

Perform this step when the engine is cold.



4. Remove electric throttle control actuator.

CAUTION:

- Handle carefully to avoid any shock to electric throttle control actuator.
- Never disassemble electric throttle control actuator.

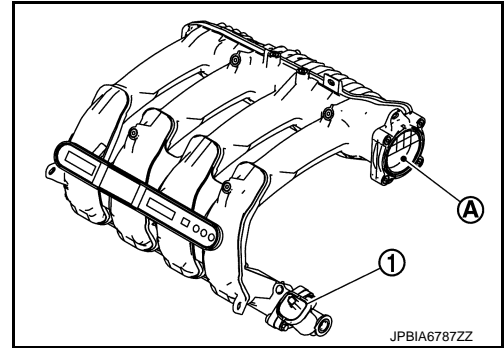
5. Disconnect vacuum hose from intake manifold.
6. Disconnect PCV hose from intake manifold and rocker cover.
7. Remove intake manifold with the following procedure:

CAUTION:

- Handle carefully to avoid any shock to intake manifold runner control valve motor ①.

Ⓐ : Electric throttle control actuator side

- Never remove intake manifold runner control valve motor. (Not designed for disassembly)
- Cover engine openings to avoid entry of foreign materials.

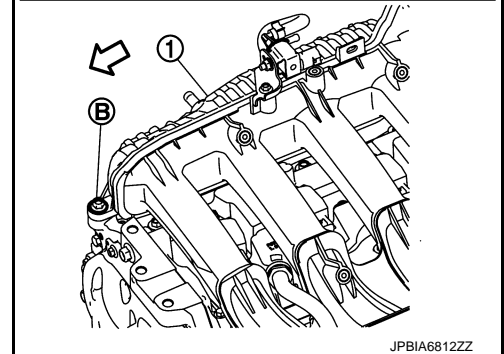
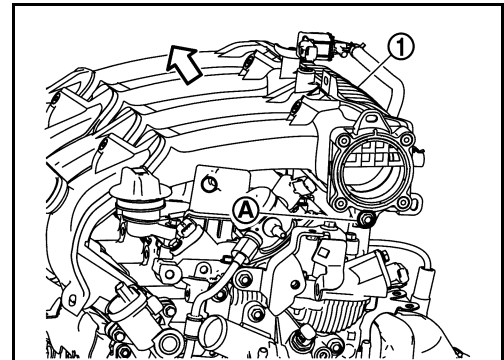


- a. Loosen and remove intake manifold mounting bolts Ⓐ and Ⓑ.

① : Intake manifold

⇐ : Engine front

- b. Remove harness clip from intake manifold side.
c. Disconnect EVAP hose from intake manifold.
d. Disconnect harness connector from EVAP canister purge volume control valve.



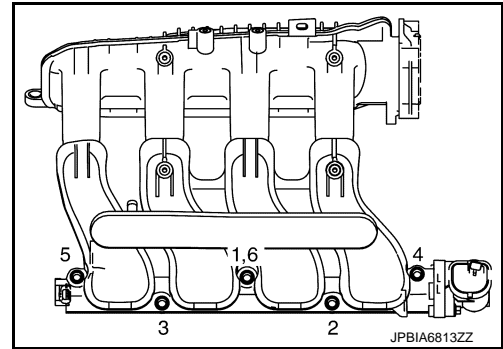
INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

[MR20DD]

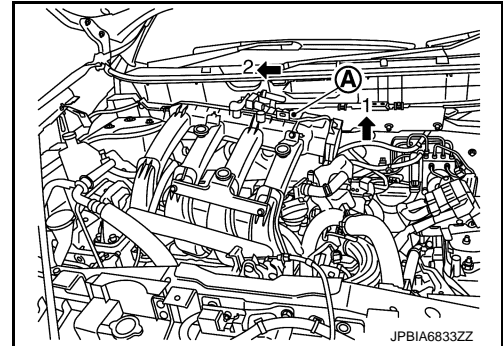
- e. Loosen mounting bolts in the order from 5 to 1 shown in the figure.

CAUTION:
Cover engine openings to avoid entry of foreign materials.

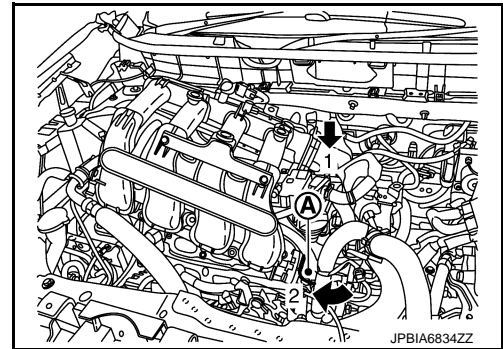


- f. Lift the surge tank side (A) of intake manifold to move it in the direction of engine front.

NOTE:
Keep off the brake reservoir tank and A/C low pressure pipe.



- g. Lower the surge tank side to pull out intake manifold runner control valve (A) from between harness and cylinder head.



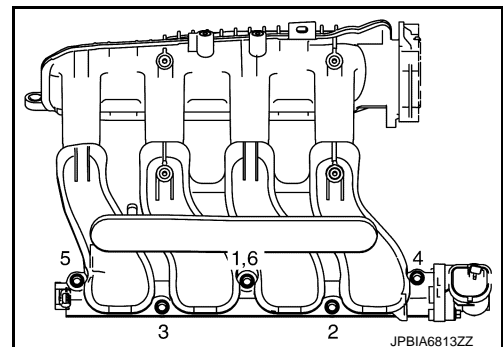
8. Remove brackets from intake manifold, if necessary. (For air duct assembly and/or engine cover)
9. Remove EVAP canister purge volume control solenoid valve from intake manifold, if necessary.

INSTALLATION

Note the following, and install in the reverse order of removal.

Intake Manifold

1. Check if gasket is not dropped from the installation groove of intake manifold.
2. Install intake manifold with the following procedure:
 - a. Temporary tighten in the order 4 to 5 as shown in the figure.
 - b. Tighten in the order from 1 to 6 as shown in the figure.



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INTAKE MANIFOLD

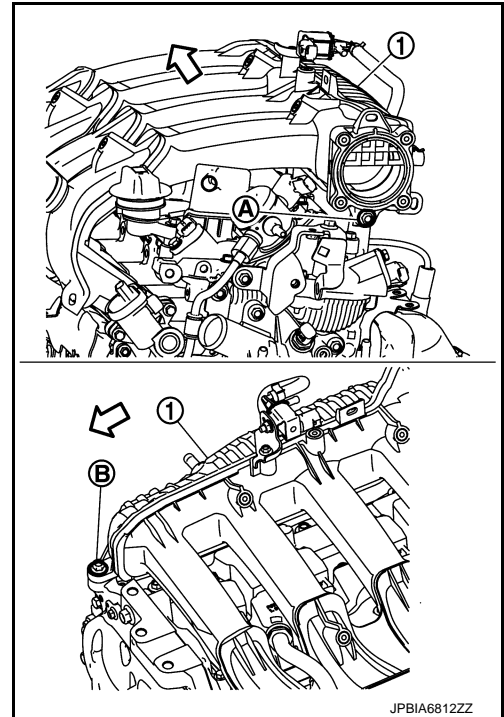
[MR20DD]

< REMOVAL AND INSTALLATION >

- c. Tighten intake manifold mounting bolt (A). Then tighten intake manifold mounting bolt (B).

① : Intake manifold

← : Engine front



Electric Throttle Control Actuator

- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform “Throttle Valve Closed Position Learning” after repair when removing harness connector of the electric throttle control actuator. Refer to [ECM-128. "Description"](#).
- Perform “Throttle Valve Closed Position Learning” and “Idle Air Volume Learning” after repair when replacing electric throttle control actuator. Refer to [ECM-128. "Description"](#) and [ECM-129. "Description"](#).

EXHAUST MANIFOLD

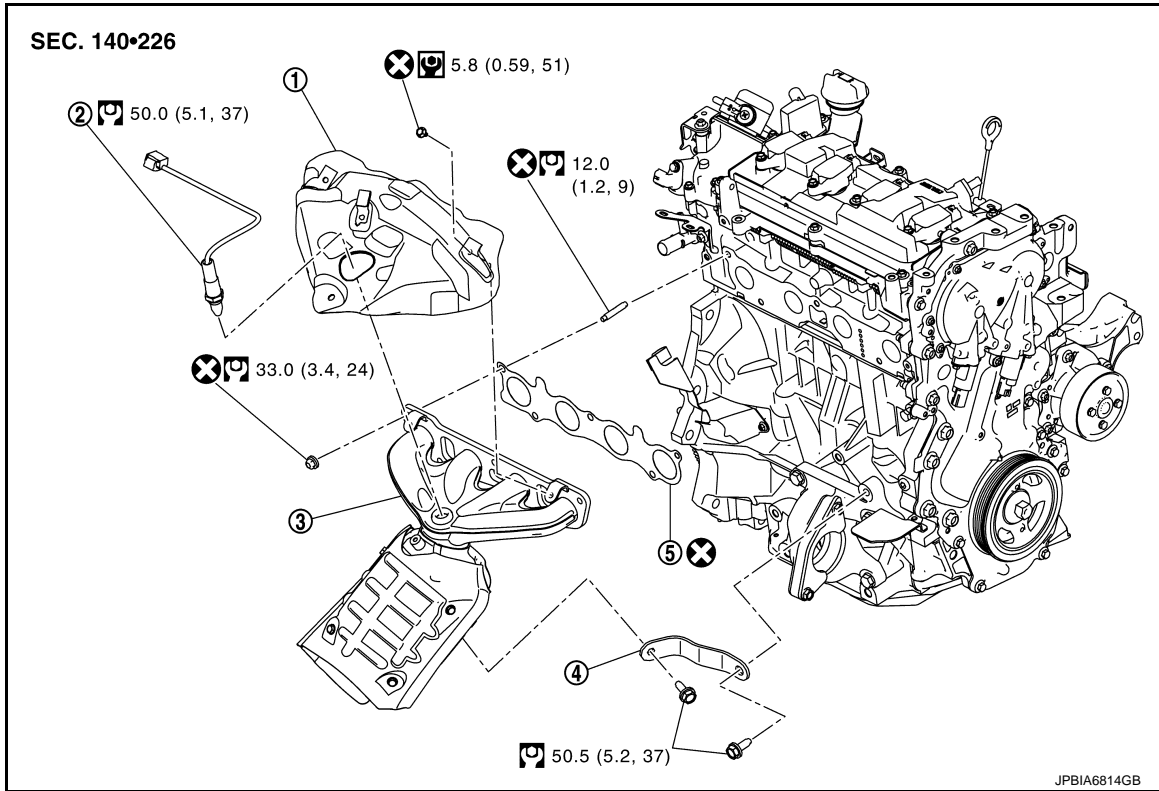
< REMOVAL AND INSTALLATION >

[MR20DD]

EXHAUST MANIFOLD

Exploded View

INFOID:000000010715475



- ① Exhaust manifold cover ② Air fuel ratio sensor 1 ③ Exhaust manifold
④ Exhaust manifold stay ⑤ Gasket

⊗ : Always replace after every disassembly.

⊞ : N·m (kg·m, ft·lb)

⊞ : N·m (kg·m, in·lb)

Removal and Installation

INFOID:000000010715476

REMOVAL

1. Remove intake manifold. Refer to [EM-149. "Exploded View"](#).
2. Remove the air fuel ratio sensor 1.
 - Using heated oxygen sensor wrench [SST: KV10117100], remove air fuel ratio sensor 1.**CAUTION:**
Handle air fuel ratio sensor 1 carefully and avoid impacts.
3. Remove exhaust manifold cover.
4. Remove exhaust front tube. Refer to [EX-11. "Exploded View"](#).

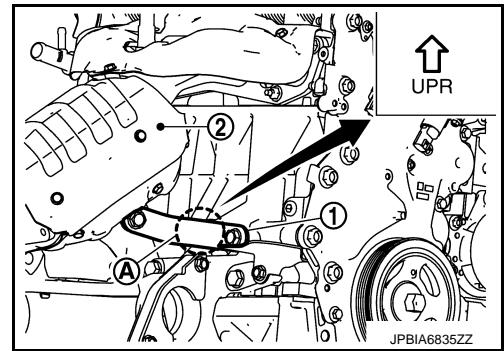
EXHAUST MANIFOLD

[MR20DD]

< REMOVAL AND INSTALLATION >

5. Remove exhaust manifold stay ①.

- ② : Exhaust manifold
- Ⓐ : Upper mark



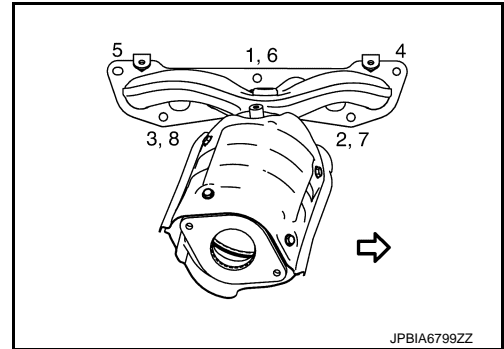
6. Remove exhaust manifold.

- Loosen nuts in the order from 5 to 1 as shown in the figure.

⇐ : Engine front

NOTE:

Disregard No. 6 to 8 when loosening.



7. Remove gasket.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

8. Remove stud bolts from cylinder head.

Torx : Size E8

INSTALLATION

CAUTION:

Never reuse stud bolts, mounting nuts, and gasket. Always replace them with new ones.

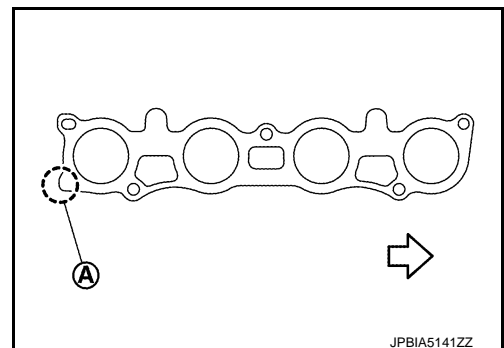
1. Install stud bolts to cylinder head.

Torx : Size E8

2. Install gasket to cylinder head as shown in the figure.

Ⓐ : Identification

⇐ : Engine front



3. Install exhaust manifold with the following procedure:

EXHAUST MANIFOLD

[MR20DD]

< REMOVAL AND INSTALLATION >

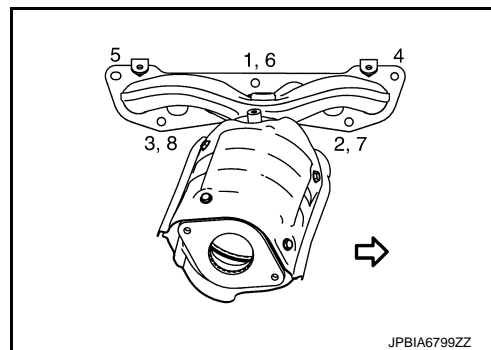
- a. Tighten nuts in the order from 1 to 8 as shown in the figure.

↶ : Engine front

NOTE:

No. 6 to 8 mean double of nuts No. 1 to 3.

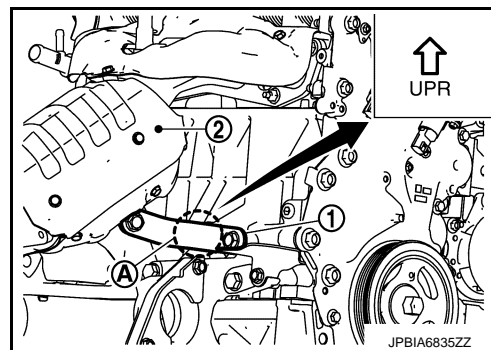
- b. Retighten nuts in the order from 1 to 8 as shown in the figure.



4. Install exhaust manifold stay ① in the direction as shown in the figure.

② : Exhaust manifold

Ⓐ : Upper mark



5. Install remaining parts in the reverse order of removal.

- Air fuel ratio sensor 1

CAUTION:

Prevent rust preventives from adhering to the sensor body.

NOTE:

If a stud bolt on the exhaust front tube side comes off, install it with a torque socket (E7).

Inspection

INFOID:000000010715477

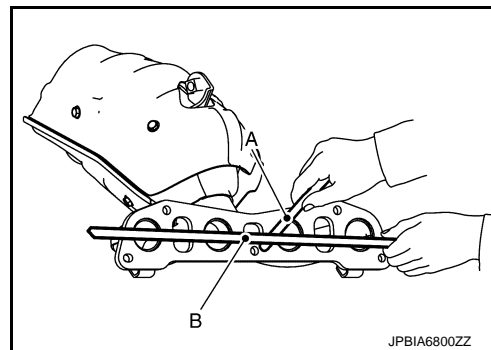
INSPECTION AFTER REMOVAL

Surface Distortion

- Using feeler gauge (A) and straightedge (B), check the surface distortion of exhaust manifold mating surface in each exhaust port and entire part.

Limit : Refer to [EM-249, "Exhaust Manifold"](#).

- If it exceeds the limit, replace exhaust manifold.



INSPECTION AFTER INSTALLATION

Check the joint of parts with the engine in running state. Check that there is no leakage of exhaust gas and abnormal sound.

OIL PAN (LOWER)

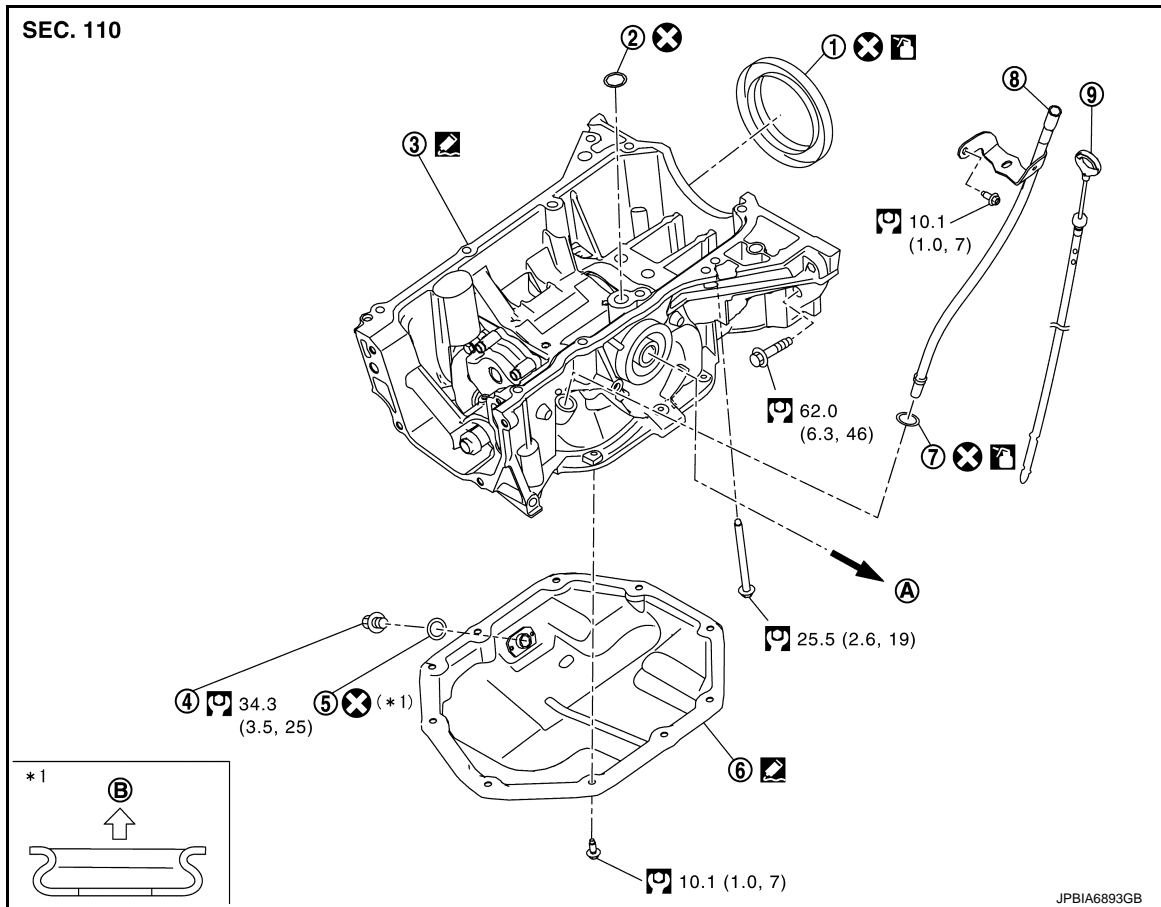
< REMOVAL AND INSTALLATION >

[MR20DD]

OIL PAN (LOWER)

Exploded View

INFOID:000000010715478



- | | | |
|-----------------|-------------------------|-------------------|
| ① Rear oil seal | ② O-ring | ③ Oil pan (upper) |
| ④ Drain plug | ⑤ Drain plug washer | ⑥ Oil pan (lower) |
| ⑦ O-ring | ⑧ Oil level gauge guide | ⑨ Oil level gauge |
| Ⓐ To oil cooler | Ⓑ Oil pan (lower) side | |

↶ : Oil pan side

⊗ : Always replace after every disassembly.

Ⓜ : N·m (kg·m, ft·lb)

🛢 : Should be lubricated with oil.

🔧 : Sealing point

Removal and Installation

INFOID:000000010715479

REMOVAL

1. Remove engine under cover.
2. Drain engine oil. Refer to [LU-23, "Draining"](#).
3. Remove oil pan (lower) with the following procedure:

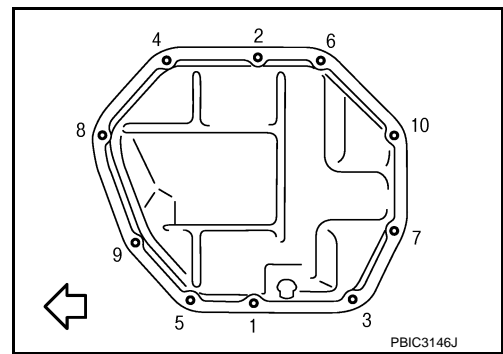
OIL PAN (LOWER)

[MR20DD]

< REMOVAL AND INSTALLATION >

- a. Loosen mounting bolts in reverse order as shown in the figure.

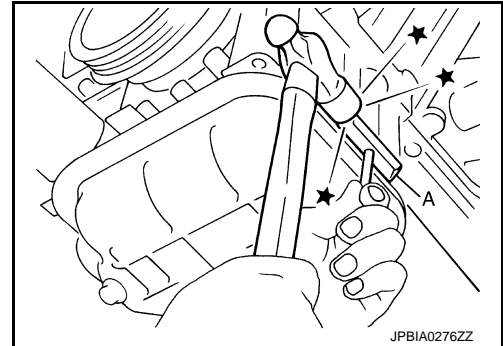
← : Engine front



- b. Insert seal cutter [SST: KV10111100] (A) between oil pan (upper) and oil pan (lower).

CAUTION:

- Be careful not to damage the mating surface.
- Since factory default liquid gasket has better adhesion than conventional one, never pick the area forcibly with a screw driver.



INSTALLATION

CAUTION:

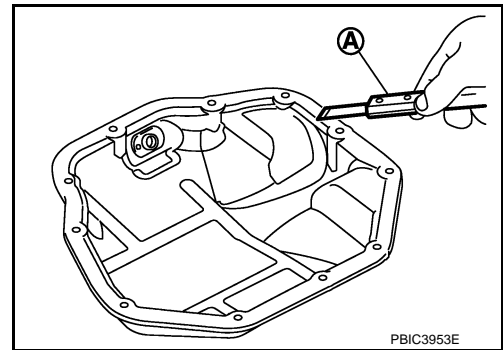
Do not reuse O-rings or washers.

Note the following, and install in the reverse order of removal.

1. Install oil pan (lower) with the following procedure:
 - a. Use a scraper (A) to remove old liquid gasket from mating surfaces.
 - Also remove old liquid gasket from mating surface of oil pan (upper).
 - Remove old liquid gasket from the bolt holes and threads.

CAUTION:

Never scratch or damage the mating surface when cleaning off old liquid gasket.



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OIL PAN (LOWER)

[MR20DD]

< REMOVAL AND INSTALLATION >

- b. Apply a continuous bead of liquid gasket (A) with a tube presser (commercial service tool) as shown in the figure.

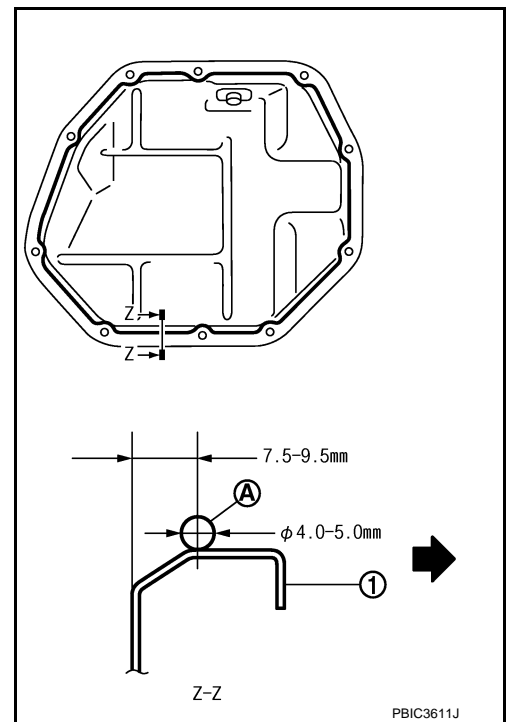
① : Oil pan (lower)

← : Engine outside

Use Genuine Liquid Gasket (Three Bond 1217H) or equivalent.

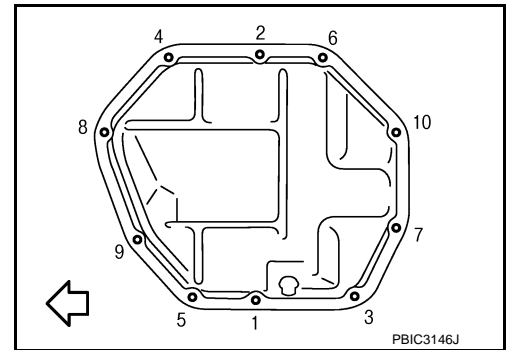
CAUTION:

Attaching should be done within 5 minutes after liquid gasket application.



- c. Tighten bolts in numerical order as shown in the figure.

⇐ : Engine front



2. Install drain plug.
3. Install in the reverse order of removal after this steps.

NOTE:

Wait at least 30 minutes after oil pan is installed before pouring engine oil.

Inspection

INFOID:000000010715480

INSPECTION AFTER REMOVAL

Clean oil strainer portion [part of the oil pan (upper)] if any object attached.

INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to [LU-22. "Inspection"](#).
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-22. "Inspection"](#).

HIGH PRESSURE FUEL PUMP AND FUEL HOSE

< REMOVAL AND INSTALLATION >

[MR20DD]

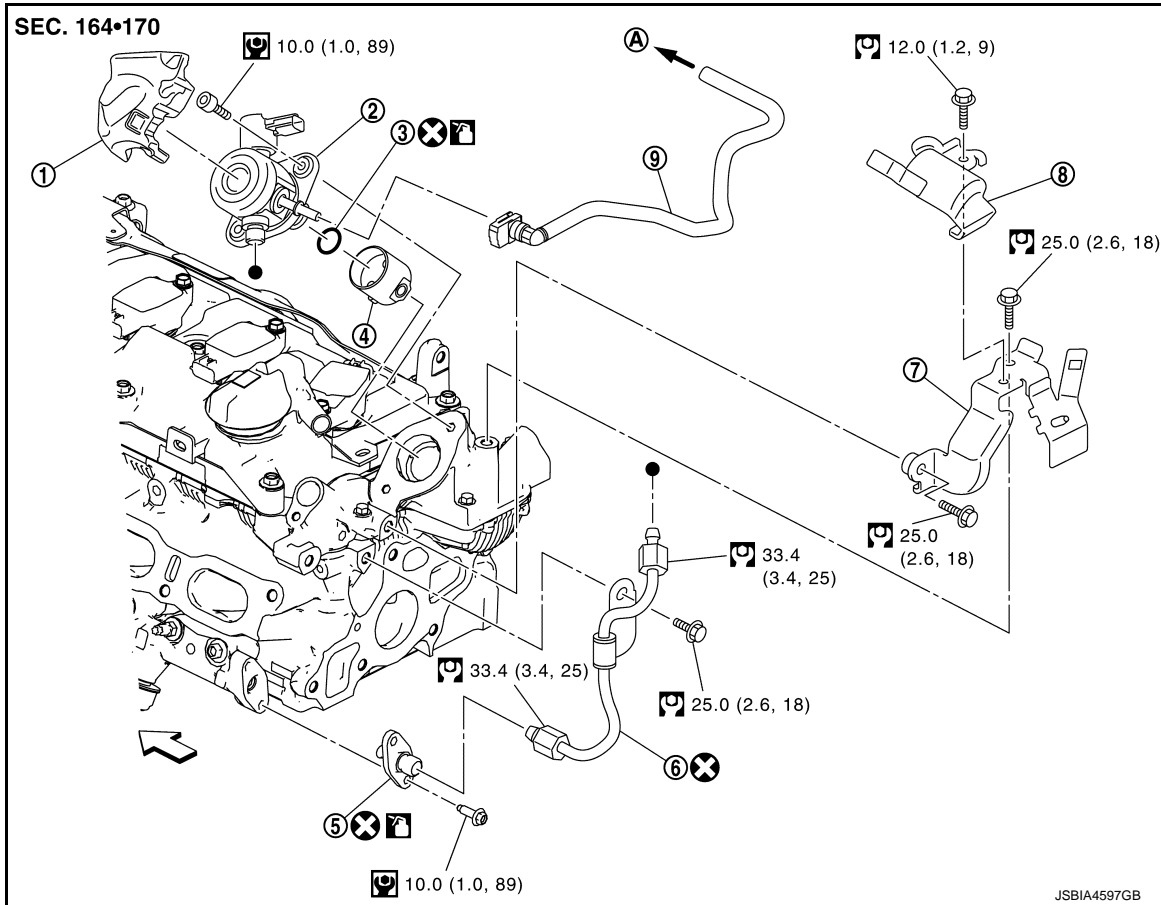
HIGH PRESSURE FUEL PUMP AND FUEL HOSE

Exploded View

INFOID:000000010715481

CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.



- | | | |
|-------------------------------------|---------------------------------|------------------|
| ① High pressure fuel pump insulator | ② High pressure fuel pump | ③ O-ring |
| ④ High pressure fuel pump lifter | ⑤ Fuel rail connector | ⑥ Fuel tube |
| ⑦ Bracket | ⑧ Fuel pump connector protector | ⑨ Fuel feed hose |

Ⓐ To centralized under-floor piping

← : Engine front

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

● : Indicates that the parts is connected at points with same symbols in actual vehicle.

Removal and Installation

INFOID:000000010715482

REMOVAL

WARNING:

- Be sure to read [EM-124, "Precaution for Handling High Pressure Fuel System"](#) when working on the high pressure fuel system.
- Put a "CAUTION: FLAMMABLE" sign in the workshop.

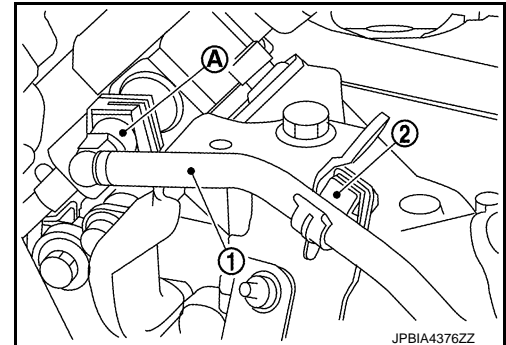
HIGH PRESSURE FUEL PUMP AND FUEL HOSE

< REMOVAL AND INSTALLATION >

[MR20DD]

- Be sure to work in a well ventilated area and furnish workshop with a CO2 fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.
- To avoid the danger of being scalded, never drain engine coolant when engine is hot.

1. Release fuel pressure. Refer to [ECM-135. "Work Procedure"](#).
2. Remove fuel pump connector protector, and remove high pressure fuel pump insulator.
3. Disconnect quick connector (A) with the following procedure.
 - a. Disconnect fuel feed hose (1) from bracket hose clamp (2).



- b. Disengage (A) and pull up (B) the pawl of the fuel feed hose connector retainer (C) to disconnect the fuel feed hose from high pressure fuel pump.

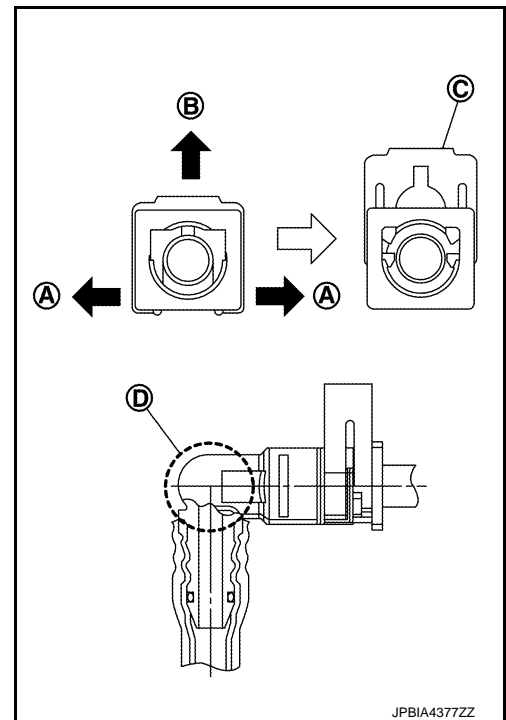
NOTE:

If the fuel feed hose is stuck, hold the fuel pipe by hand and disconnect it by pushing and pulling.

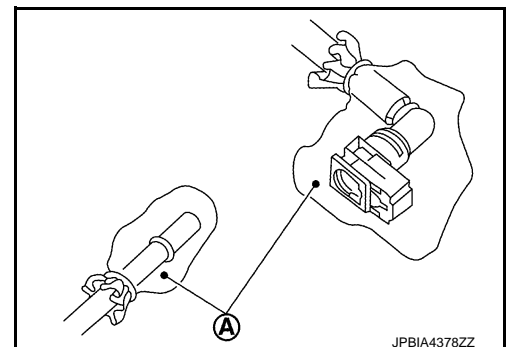
CAUTION:

- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Never expose parts to battery electrolyte or other acids.
- Never bent or twist connection between quick connector and fuel feed hose (with damper) during installation/removal.
- Pull quick connector holding (D).
- Never remove the retainer.
- Prepare a tray and waste beforehand as fuel leaks out.
- Never pull with lateral force applied. O-ring inside quick connector may be damaged.

Retainer color : Red



- To prevent damage to each joint and protect it from the entry of foreign matter, cover the joint with plastic bag (A) or an equivalent.



4. Remove intake manifold. Refer to [EM-149. "Removal and Installation"](#).
5. Remove fuel tube.
6. Remove fuel rail connector.

HIGH PRESSURE FUEL PUMP AND FUEL HOSE

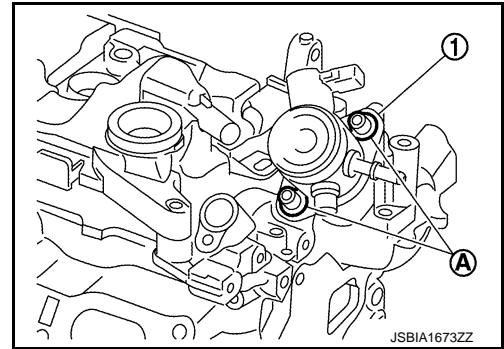
< REMOVAL AND INSTALLATION >

[MR20DD]

7. Remove high pressure fuel pump ① and lifter.

CAUTION:

To prevent damage to high pressure fuel pump and camshaft bracket, loosen bolt ① alternately by one turn at a time until the reaction force applied on the high pressure fuel pump disappears.



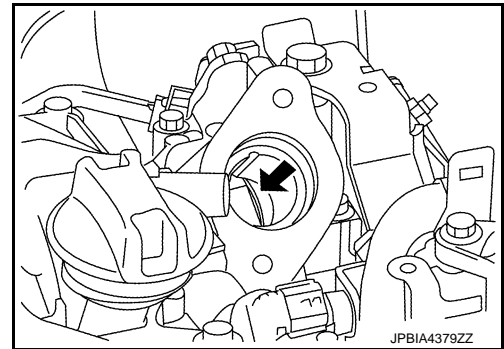
INSTALLATION

CAUTION:

- Do not reuse O-rings.
- To prevent damage to parts due to generated abnormal stress and eccentric load, always observe the installation procedure.

1. Install high pressure fuel pump according to the following procedure.

- a. Check the orientation of pump cam from the mounting area (view arrow) of high pressure fuel pump.

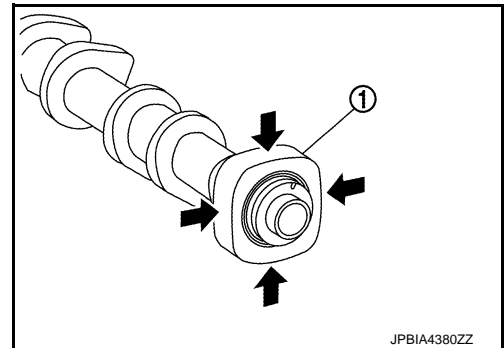


- b. Aim pump cam at the BDC area (arrow position).

① : Camshaft (EXH)

NOTE:

For BDC area, anywhere within the area indicated by arrow can be accepted.



- c. Install O-ring to high pressure fuel pump. When handling new O-ring, paying attention to the following caution items:

CAUTION:

- Do not reuse O-ring.
- Handle O-ring with bare hands. Never wear gloves.
- Lubricate O-ring with new engine oil.
- Never clean O-ring with solvent.
- Check that O-ring and its mating part are free of foreign material.
- Never damage O-ring with tools and fingernails during the installation. In addition, twisting or stretching O-ring is not allowed. If O-ring is stretched during the installation to high pressure fuel pump, never install high pressure fuel pump immediately.

- d. Install high pressure fuel pump lifter.

- e. Apply oil to the fitting area of high pressure fuel pump O-ring and camshaft bracket side to install high pressure fuel pump.

- f. Install high pressure fuel pump. To prevent damage to high pressure fuel pump and camshaft bracket, the following instructions must be observed.

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HIGH PRESSURE FUEL PUMP AND FUEL HOSE

< REMOVAL AND INSTALLATION >

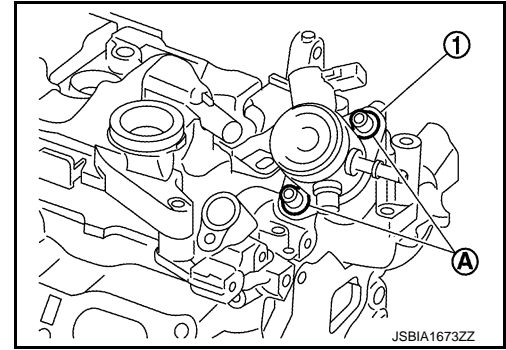
[MR20DD]

CAUTION:

- Temporarily tighten bolt (A) by hand. Alternately tighten bolt by one turn at a time until high pressure fuel pump reaches camshaft bracket.

① : High pressure fuel pump

- After a pump flange sitting, tighten the bolts to the specified torque.



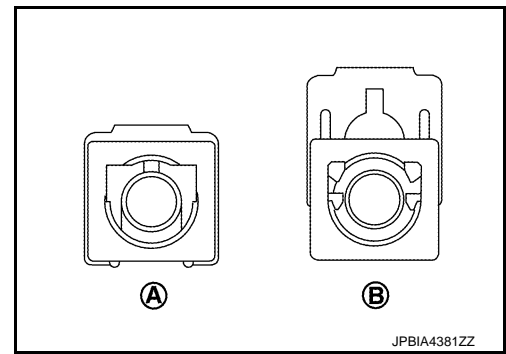
2. Connect fuel feed hose with the following procedure, and then install the fuel feed hose.
 - a. Check no foreign substances are deposited in and around matching pipe and quick connector, and no damage on them.
 - b. Quick connector shall be inserted gradually, aligning with the axis of the matching pipe.
 - c. Insert the retainer until it clicks and check the retainer is locked. After insertion, pull the connector and check that the connector is locked.

(A) : Lock position

(B) : Unlock position

CAUTION:

If retainer cannot be installed smoothly, quick connector may have not been installed correctly. Check connection again.

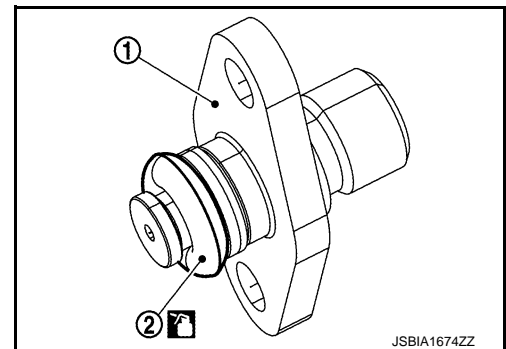


- d. After attaching the quick connector and fix the hose to the clamp.
3. Install new fuel rail connector (1).

② : O-ring

CAUTION:

- Never reuse fuel rail connector.
- Handle O-ring with bare hands. Never wear gloves.
- Lubricate O-ring with new engine oil.
- Never clean O-ring with solvent.
- Check that O-ring and its mating part are free of foreign material.
- Never scratch O-ring with tools or fingernails when installing fuel rail connector.
- Insert new fuel rail connector straight into fuel rail. Never decenter or twist the fuel rail connector during insertion.



4. Install the fuel tube with the following procedure.

CAUTION:

- When removing fuel tube, always replace fuel rail connector together with fuel tube.
- Never reuse fuel tube.
- Never use fuel tube if its terminal tip is damaged.
- Observe the tightening order and the tightening torque.

HIGH PRESSURE FUEL PUMP AND FUEL HOSE

[MR20DD]

< REMOVAL AND INSTALLATION >

- a. Temporarily tighten flare nut ① and ② of fuel tube ③ until seated.

① : High pressure fuel pump

② : Fuel rail connector

CAUTION:

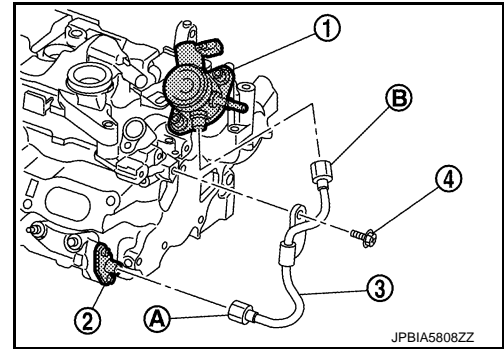
When temporarily tightening flare nut, place pipe in the center of the nut inner diameter.

- b. Temporarily tighten bolt ④ until the seat of bracket is seated.
c. Tighten flare nut ① and ② in alphabetical order.

CAUTION:

Always fit the tool completely with the nut.

- d. Tighten bolt ④.
5. Install in the reverse order of removal after this step.



Inspection

INFOID:0000000010715483

INSPECTION AFTER INSTALLATION

Check for Fuel Leakage

1. Turn ignition switch "ON" (with the engine stopped). With fuel pressure applied to fuel piping, check that there is no fuel leakage at connection points.

NOTE:

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there is no fuel leakage at connection points.

CAUTION:

Never touch the engine immediately after it is stopped because the engine is extremely hot.

FUEL INJECTOR AND FUEL TUBE

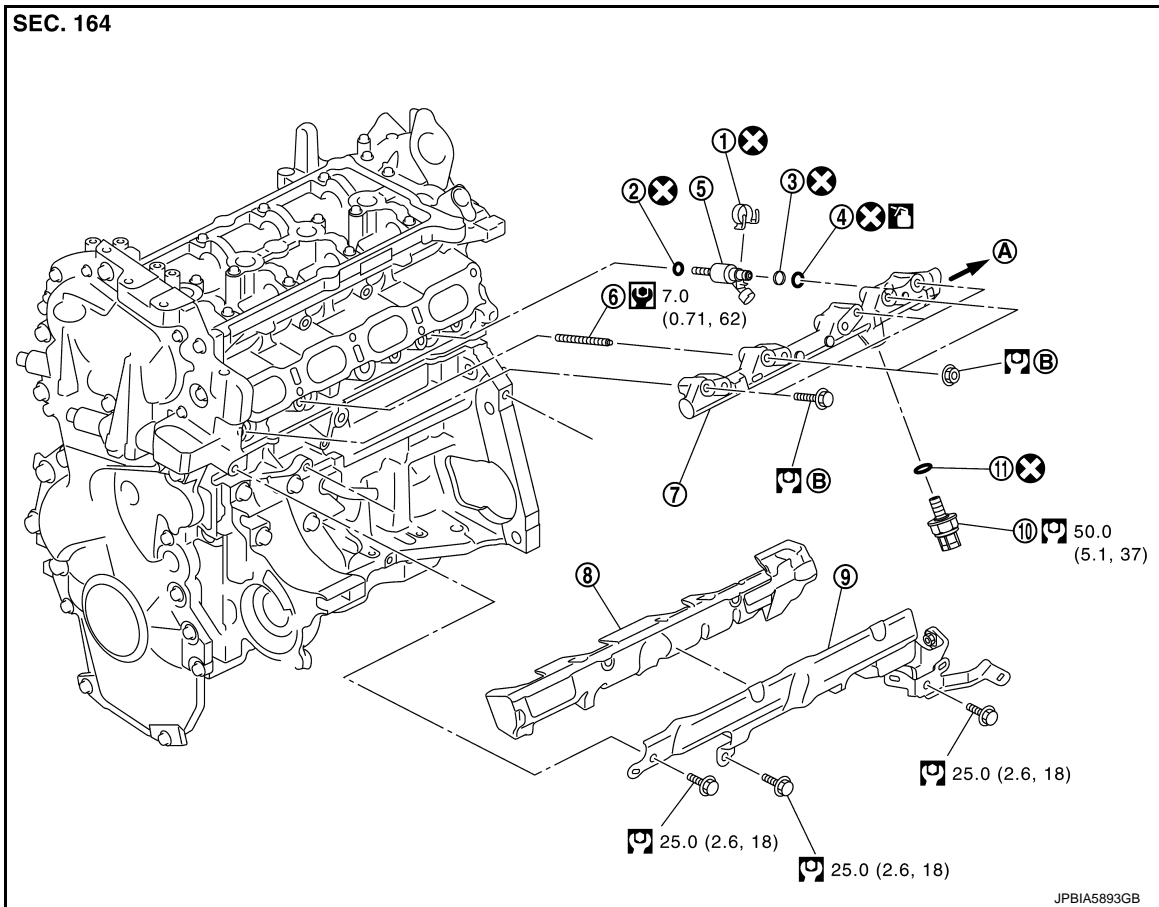
[MR20DD]

< REMOVAL AND INSTALLATION >

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:000000010715484



- | | | |
|--|--|-------------------|
| ① Holder | ② Seal ring (white) | ③ Backup ring |
| ④ O-ring (blue) | ⑤ Fuel injector | ⑥ Stud bolt |
| ⑦ Fuel rail | ⑧ Fuel rail insulator | ⑨ Fuel rail cover |
| ⑩ Fuel pressure sensor | ⑪ Gasket | |
| Ⓐ To fuel rail connector and fuel tube.
Refer to EM-159 . | Ⓑ Comply with the assembly procedure
when tightening. Refer to EM-164 | |

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

CAUTION:

- Never remove or disassemble parts unless instructed as shown in the figure.

Removal and Installation

INFOID:000000010715485

WARNING:

- Be sure to read [EM-124, "Precaution for Handling High Pressure Fuel System"](#) when working on the high pressure fuel system.
- Put a "CAUTION: FLAMMABLE" sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO₂ fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.

FUEL INJECTOR AND FUEL TUBE

< REMOVAL AND INSTALLATION >

[MR20DD]

- To avoid the danger of being scalded, never drain engine coolant when engine is hot.

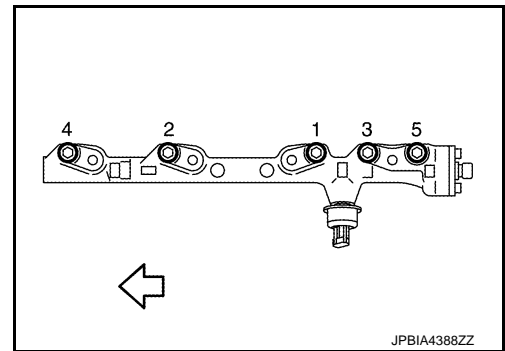
REMOVAL

1. Release the fuel pressure. Refer to [ECM-135, "Work Procedure"](#).
2. Remove oil level gauge. Refer to [EM-222, "Exploded View"](#).
3. Remove intake manifold. Refer to [EM-149, "Exploded View"](#).
4. Remove alternator. Refer to [CHG-52, "MR20DD : Exploded View"](#).
5. Remove oil level gauge guide. Refer to [EM-222, "Exploded View"](#).
6. Remove fuel rail cover, and then remove fuel rail insulator.
7. Remove fuel tube and fuel rail connector. Refer to [EM-159, "Exploded View"](#).
8. Disconnect fuel pressure sensor harness connector.
9. Disconnect fuel injector harness connector.
10. Remove fuel pressure sensor, if necessary.
11. Remove fuel rail.
 - Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front

CAUTION:

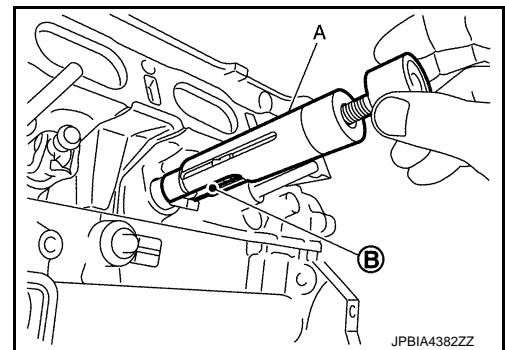
- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leakage from fuel rail.



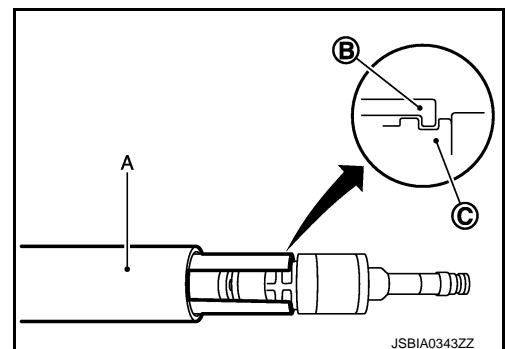
12. Remove fuel injector from cylinder head as per the following.

CAUTION:

- Be careful with remaining fuel that may go out from fuel rail.
 - Be careful not to damage injector nozzles during removal.
 - Never bump or drop fuel injector.
 - Never disassemble fuel injector.
- a. Remove injector holder.
 - b. Install an remover [SST: KV10119600 (—)] (A) to the injector connector side so that cutout (B) of injector remover faces the injector connector side.



- Hook pawl portion (B) of injector remover [SST: KV10119600 (—)] (A) to groove portion (C) of injector

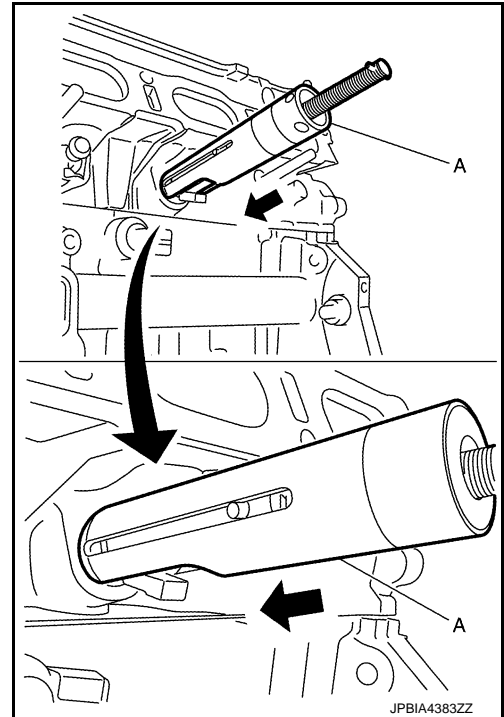


FUEL INJECTOR AND FUEL TUBE

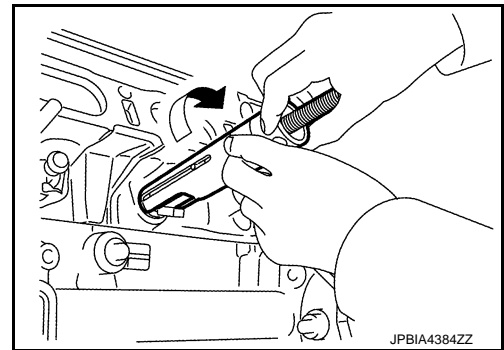
< REMOVAL AND INSTALLATION >

[MR20DD]

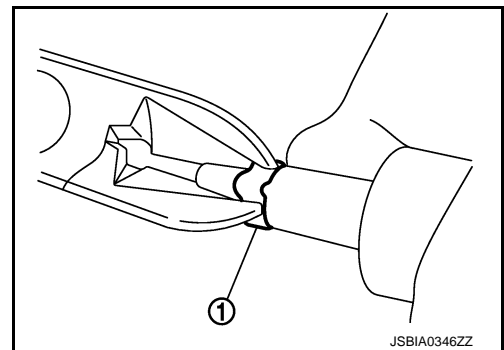
- c. Press down body portion of injector remover [SST: KV10119600 (—)] (A) until it contacts cylinder head.



- d. Tighten injector remover [SST: KV10119600 (—)] clockwise and remove injector from cylinder head.



- e. Cut seal ring ① while pinching it. Be careful not to damage injector.



INSTALLATION

CAUTION:

Do not reuse O-rings.

1. Install seal ring to fuel injector as per the following:

CAUTION:

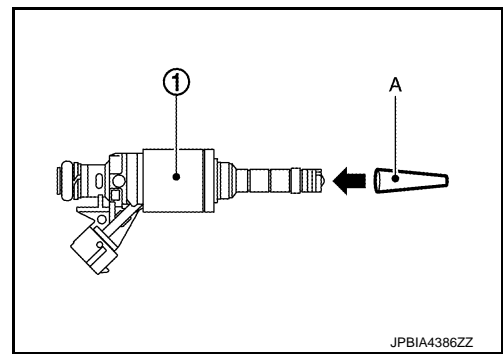
- Handle seal ring with bare hands. Never wear gloves.
- Never apply engine oil to seal ring.
- Never clean seal ring with solvent.

FUEL INJECTOR AND FUEL TUBE

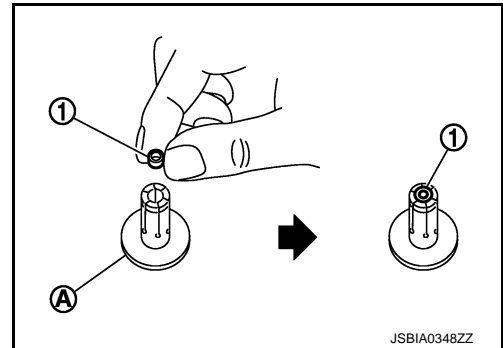
[MR20DD]

< REMOVAL AND INSTALLATION >

- a. Install an injector seal drift set [SST: KV101197S0 (—)] (A) to fuel injector ①.



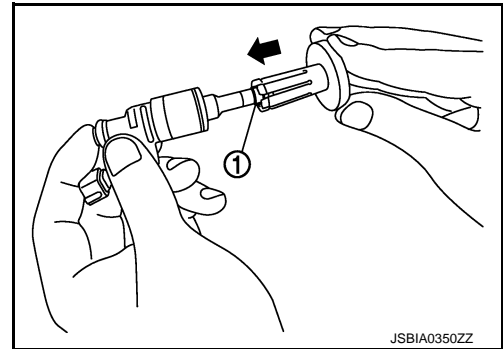
- b. Set seal ring ① to injector seal drift set [SST: KV101197S0 (—)] (A).



- c. Straightly insert seal ring ①, which is set in step 2, to fuel injector as shown in the figure and install.

CAUTION:

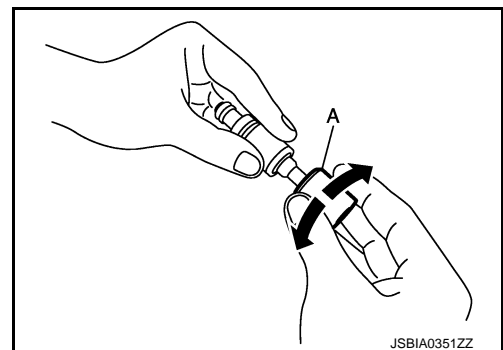
Be careful that seal ring does not exceed the groove portion of fuel injector.



- d. Insert injector seal drift set [SST: KV101197S0 (—)] (A) to injector and rotate clockwise and counterclockwise by 90° while pressing seal ring to fit it.

NOTE:

Compress seal ring, because this operation is for rectifying stretch of seal ring caused by installation and for preventing sticking when inserting injector into cylinder head.



2. Install O-ring and backup ring to fuel injector. When handing new O-ring and backup ring, paying attention to the following caution items:

CAUTION:

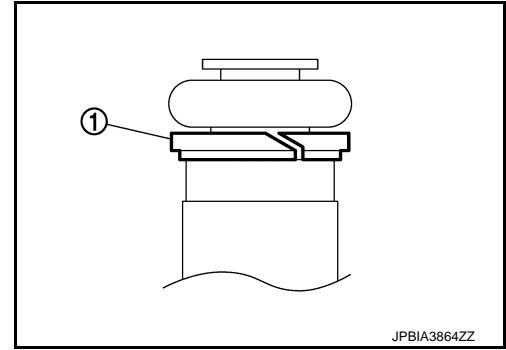
- Do not reuse O-ring.
- Handle O-ring with bare hands. Never wear gloves.
- Lubricate O-ring with new engine oil.
- Never clean O-ring with solvent.
- Check that O-ring and its mating part are free of foreign material.
- When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring was stretched while it was being attached, never insert it quickly into fuel tube.

FUEL INJECTOR AND FUEL TUBE

< REMOVAL AND INSTALLATION >

[MR20DD]

- Insert new O-ring straight into fuel rail. Never decenter or twist it.
- Always install the back up ring ① in the right direction as instructed.



3. Install fuel injector ① to fuel rail ② as per the following:

- ③ : O-ring (blue)
- ④ : Backup ring

a. Install fuel injector holder ⑤ to fuel injector.

CAUTION:

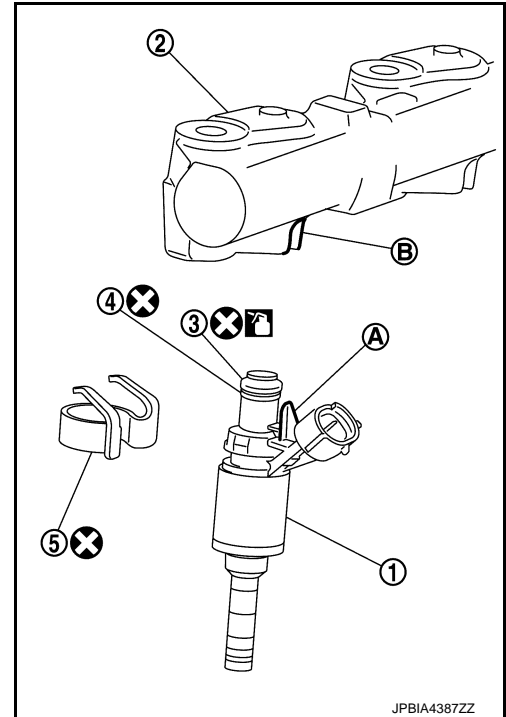
- Never reuse fuel injector holder. Replace it with a new one.
- Be careful to keep fuel injector holder from interfering with O-ring. If interference occurs, replace O-ring.

b. Insert fuel injector into fuel rail with fuel injector holder attached.

- Insert it while matching it to the axial center.
- Insert so that protrusion (A) of fuel injector is aligned to cutout (B).

c. Check that installation is complete by checking that fuel injector does not rotate or come off.

- Check that protrusions of fuel injectors and fuel rail are aligned with cutouts of clips after installation.



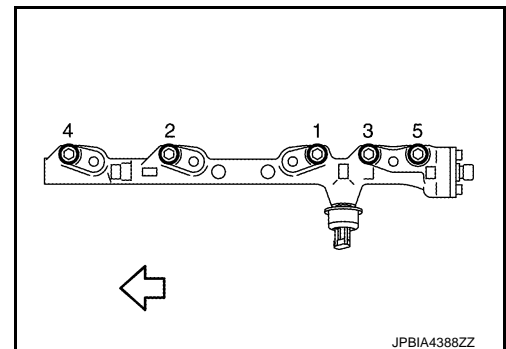
4. Install fuel rail and fuel injector assembly to cylinder head.

- Tighten mounting bolts and nuts in two steps in numerical order as shown in the figure.

← : Engine front

1st step : 10.0 N·m (1.0 kg·m, 89 in·lb)

2nd step : 20.5 N·m (2.1 kg·m, 15 ft·lb)



5. Connect injector harness connector.
6. Install fuel pressure sensor, if removed.
7. Install fuel rail insulator.

CAUTION:

- As covering part of fuel tube connector at the back end of common rail can easily move because of its shape, do not remove it before installation.
- Install the insulator so that it is placed under lower side of intake manifold flange.

8. Install in the reverse order of removal after this step.

FUEL INJECTOR AND FUEL TUBE

< REMOVAL AND INSTALLATION >

[MR20DD]

Inspection

INFOID:000000010715486

A

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

1. Turn ignition switch "ON" (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leakage at connection points.

NOTE:

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there are no fuel leakage at connection points.

CAUTION:

Never touch the engine immediately after stopped, as the engine becomes extremely hot.

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IGNITION COIL, SPARK PLUG AND ROCKER COVER

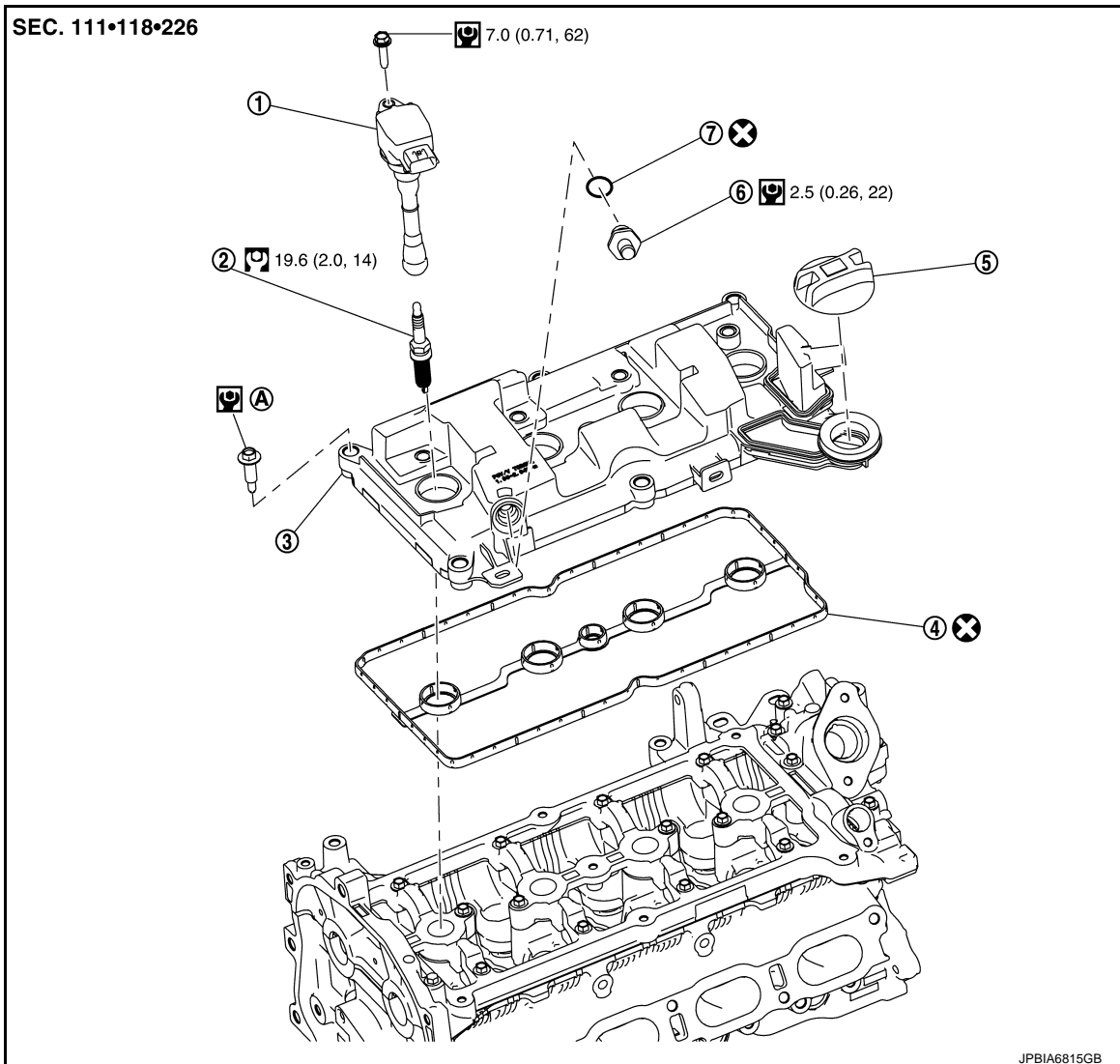
< REMOVAL AND INSTALLATION >

[MR20DD]

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:000000010715487



- ① Ignition coil
- ② Spark plug
- ③ Rocker cover
- ④ Rocker cover gasket
- ⑤ Oil filler cap
- ⑥ PCV valve
- ⑦ O-ring

Comply with the installation procedure when tightening. Refer to [EM-170](#)

⊗ : Always replace after every disassembly.

⊞ : N·m (kg·m, ft·lb)

⊞ : N·m (kg·m, in·lb)

Removal and Installation

INFOID:000000010715488

REMOVAL

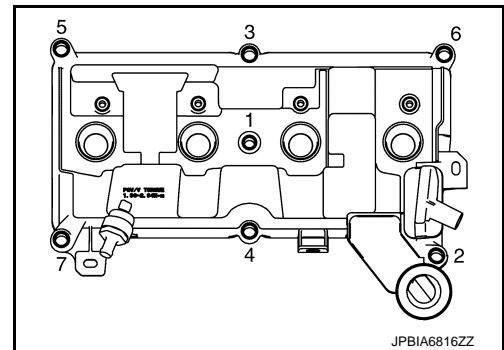
1. Remove intake manifold. Refer to [EM-149, "Exploded View"](#).
2. Remove PCV valve and PCV hose, if necessary.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

[MR20DD]

< REMOVAL AND INSTALLATION >

- Remove ignition coil.
CAUTION:
 - Never drop or shock ignition coil.
 - Never disassemble ignition coil.
- Remove rocker cover.
 - Loosen bolts in the order from 7 to 1 shown in the figure.



- Remove rocker cover gasket from rocker cover.
- Use scraper to remove all traces of liquid gasket from camshaft bracket.
CAUTION:
Never scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION

CAUTION:

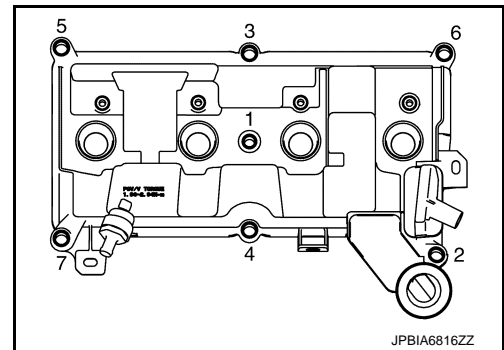
Do not reuse O-ring.

- Install the rocker cover gasket to rocker cover.
CAUTION:
Check the gasket is not dropped.
- Install rocker cover.
 - Tighten bolts in two steps separately in the order from 1 to 7 as shown in the figure.

 **1st step** : 1.96 N·m (0.20 kg·m, 17 in·lb)

 **2nd step** : 8.33 N·m (0.85 kg·m, 74 in·lb)

- Install in the reverse order of removal, for the rest of parts.



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ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[MR20DD]

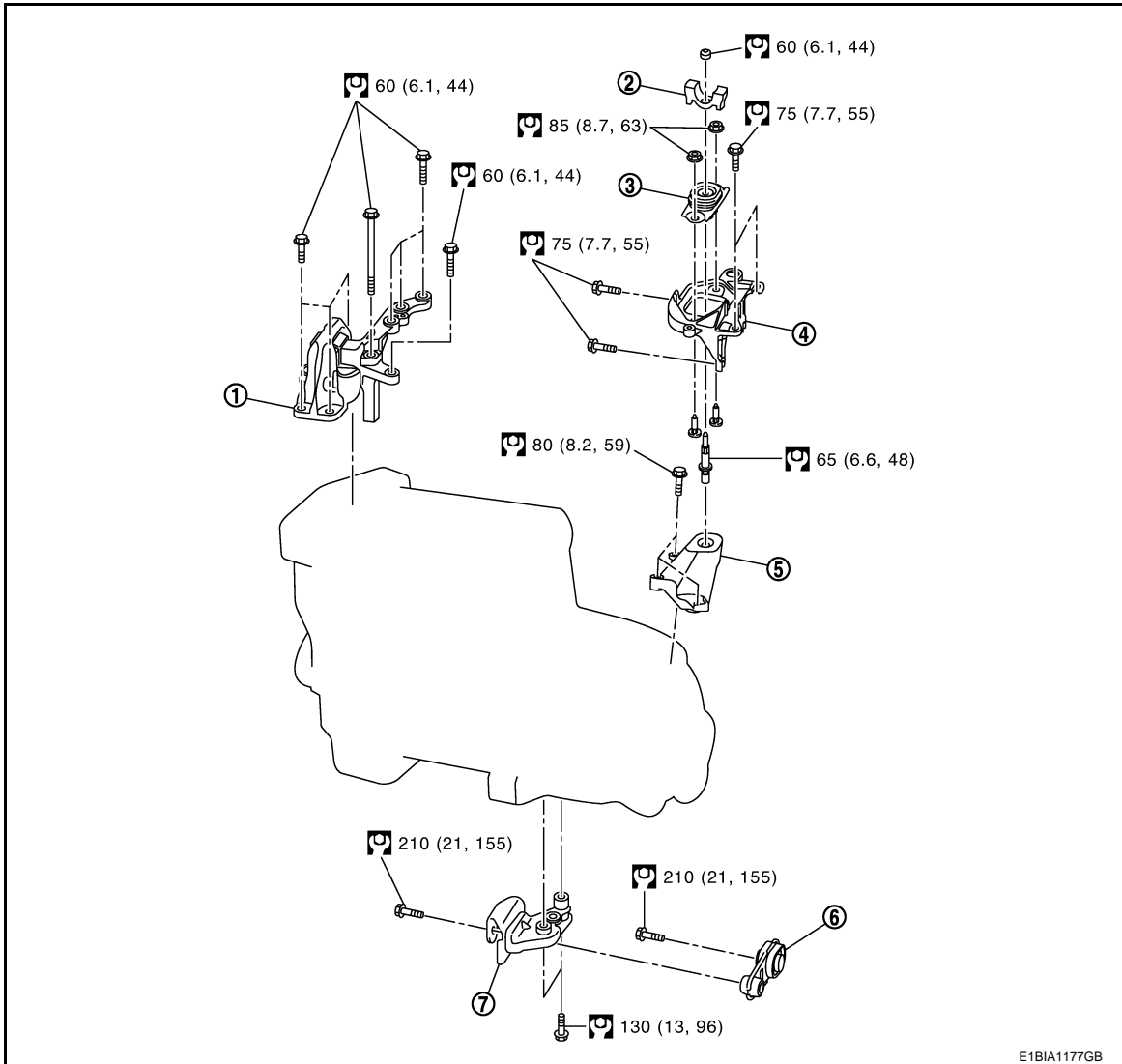
UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:000000010715489

MT Model



E1BIA1177GB

- ① Engine mounting insulator (RH)
- ② Rubber
- ③ Engine mounting insulator (LH)
- ④ Engine mounting frame support (LH)
- ⑤ Engine mounting bracket support (LH)
- ⑥ Rear torque rod
- ⑦ Rear torque rod bracket

⊗ : Always replace after every disassembly.

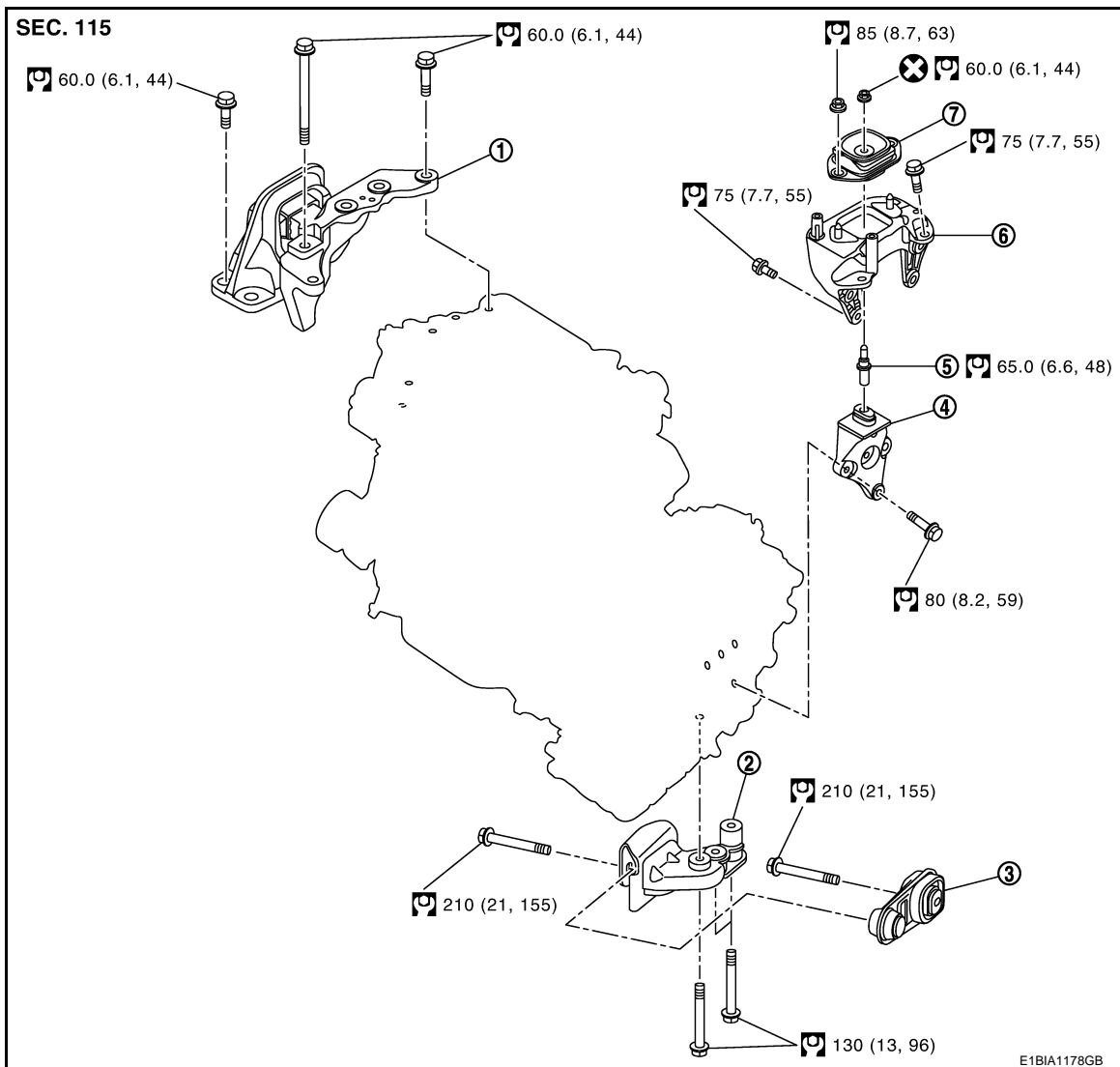
⊞ : N·m (kg·m, ft·lb)

CVT Model

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[MR20DD]



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- ① Engine mounting insulator (RH)
- ② Rear torque rod bracket
- ③ Rear torque rod
- ④ Engine mounting bracket (LH)
- ⑤ Stud bolt
- ⑥ Engine mounting bracket support (LH)
- ⑦ Engine mounting insulator (LH)
- ⊗ : Always replace after every disassembly.
- Ⓜ : N·m (kg·m, ft·lb)

Removal and Installation

INFOID:000000010715490

WARNING:

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Never start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[MR20DD]

- For supporting points for lifting and jacking point at rear axle, refer to [GI-36, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

NOTE:

When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

Preparation

1. Release the fuel pressure. Refer to [ECM-135, "Work Procedure"](#).
2. Drain engine coolant from radiator. Refer to [CO-38, "Draining"](#).
CAUTION:
 - Perform this step when the engine is cold.
 - Never spill engine coolant on drive belts.
3. Remove the following parts.
 - Engine under cover.
 - Front road wheels and tires: Refer to [WT-60, "Exploded View"](#) (with TPMS) or [WT-73, "Exploded View"](#) (without TPMS).
 - Front fender protector (RH and LH): Refer to [EXT-31, "Exploded View"](#).
 - Drive belts: Refer to [EM-139, "Exploded View"](#).
 - Engine cover.
 - Battery: Refer to [PG-155, "Removal and Installation"](#).
 - Battery tray: Refer to [PG-154, "Exploded View"](#).
 - TCM: Refer to [TM-391, "Exploded View"](#). (CVT models)
 - Air duct, air duct assembly, and air cleaner assembly: Refer to [EM-147, "Exploded View"](#).
 - Radiator hose (upper and lower): Refer to [CO-43, "Exploded View"](#).
 - Exhaust front tube: Refer to [EX-11, "Exploded View"](#).

Engine Room LH

1. Disconnect all connections of engine harness around the battery, and then temporarily secure the engine harness into the engine side.
CAUTION:
Protect connectors using a resin bag against foreign materials during the operation.
2. Disconnect fuel feed tube at engine side.
3. Disconnect heater hoses
4. Disconnect control cable from transaxle. Refer to [TM-385, "Exploded View"](#) (CVT models) or [TM-28, "Exploded View"](#) (MT models).
5. Remove EVAP hoses. Refer to [EM-149, "Exploded View"](#).

Engine Room RH

1. Disconnect vacuum hose from intake manifold. Refer to [EM-149, "Exploded View"](#).
2. Disconnect A/C piping from A/C compressor. Refer to [HA-33, "Exploded View"](#) (Type 1), [HA-76, "Exploded View"](#) (Type 2), [HA-123, "Exploded View"](#) (Type 3) or [HA-171, "Exploded View"](#) (Type 4).
3. Disconnect ground cable above the alternator.

Vehicle Underbody

1. Disconnect steering lower joint at steering gear assembly side, and release steering shaft. Refer to [ST-12, "Exploded View"](#).
2. Remove ground cable at transaxle side.
3. Remove rear propeller shaft. Refer to [DLN-186, "Exploded View"](#). (4WD models)
4. Remove front wheel sensor (RH and LH) for ABS from steering knuckle. Refer to [BRC-138, "FRONT WHEEL SENSOR : Exploded View"](#).
5. Remove lock plate of brake hose from strut. Refer to [BR-19, "FRONT : Exploded View"](#) (LHD models) or [BR-63, "FRONT : Exploded View"](#) (RHD models).

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[MR20DD]

- Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to the following table:

TYPE	Reference
LHD models	BR-37. "BRAKE CALIPER ASSEMBLY : Exploded View"
RHD models	BR-80. "BRAKE CALIPER ASSEMBLY : Exploded View"

- Disconnect steering outer sockets from steering knuckle. Refer to [ST-13. "Disassembly and Assembly"](#).
- Remove front drive shafts (RH and LH). Refer to [FAX-22. "Exploded View \(LH\)"](#) (2WD models), [FAX-24. "Exploded View \(RH\)"](#) (2WD models) or [FAX-60. "Exploded View \(LH\)"](#) (4WD models), [FAX-62. "Exploded View \(RH\)"](#) (4WD models).

NOTE:

Cap or plug openings to prevent fluid from spilling.

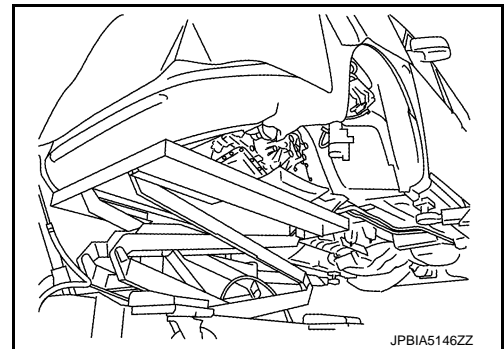
- Remove rear torque rod.
- Remove stabilizer connecting rod. Refer to [FSU-17. "Exploded View"](#).
- Remove front suspension member. Refer to [FSU-20. "Exploded View"](#).
- Preparation for the separation work of transaxle is as follows:
 - Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-218. "Exploded View"](#).

Removal

- Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.

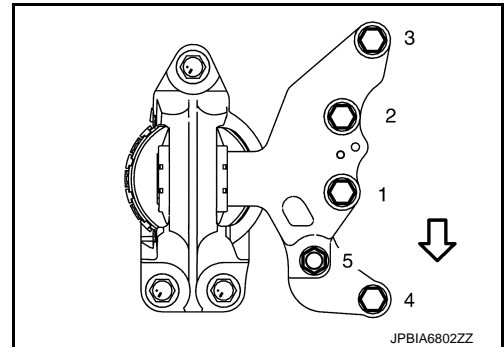
CAUTION:

Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



- Remove engine mounting bolts on engine mounting insulator (RH).
 - Loosen mounting bolts in the reverse order as shown in the figure.

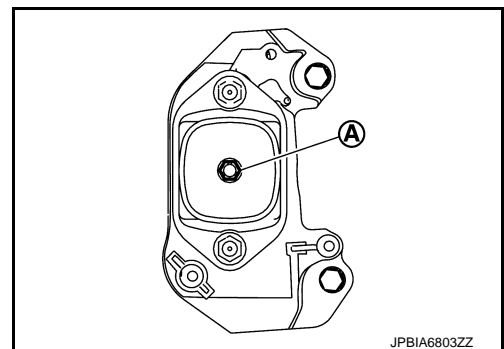
← : Vehicle front



- Remove engine mounting insulator (LH) mounting nut (A) to the transaxle.
- Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.

CAUTION:

- Check that no part interferes with the vehicle side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support the vehicle by setting jack or suitable tool at the rear.



ENGINE ASSEMBLY

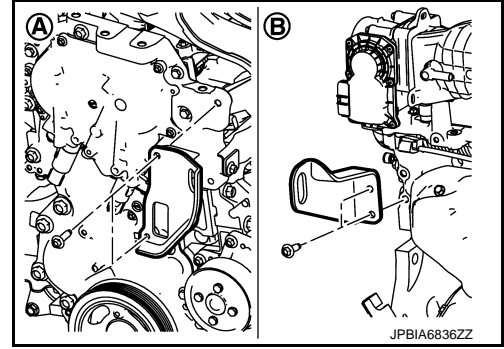
[MR20DD]

< UNIT REMOVAL AND INSTALLATION >

Separation

1. Install engine slinger to front cover front left side (A) and cylinder head rear right side (B).

Slinger bolts : **32.9 N·m (3.4 kg·m, 24 ft·lb)**



2. Remove starter motor. Refer to [STR-25, "MR20DD : Exploded View"](#).
3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-35, "Exploded View"](#) (6MT models) or [TM-415, "Exploded View"](#) (CVT models).

INSTALLATION

Note the following, and install in the reverse order of removal.

CAUTION:

- **Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.**
- **Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.**

Inspection

INFOID:000000010715491

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

INFOID:000000010715492

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NOTE:

Explained here is how to disassemble with engine stand supporting transaxle surface. When using different type of engine stand, note with difference in steps and etc.

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [TM-35, "Exploded View"](#) (MT models) or [TM-415, "Exploded View"](#) (CVT models).
2. Install engine to engine stand with the following procedure:
 - a. Remove flywheel or drive plate. Refer to [EM-178, "Exploded View"](#) or [EM-181, "Exploded View"](#).
 - b. Lift the engine with a hoist to install it onto widely use engine stand.

CAUTION:

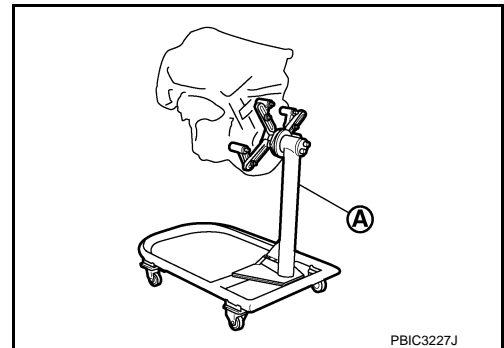
- Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
 - Intake manifold: Refer to [EM-149, "Exploded View"](#).
 - Exhaust manifold: Refer to [EM-153, "Exploded View"](#).

NOTE:

The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with drive plate removed.

CAUTION:

Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.



3. Drain engine oil. Refer to [LU-23, "Draining"](#).

CAUTION:

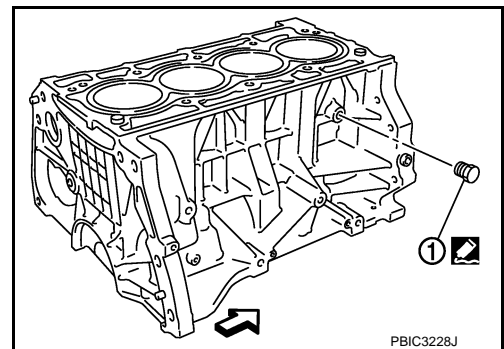
Be sure to clean drain plug and install with new drain plug washer.

4. Drain engine coolant by removing water drain plug (1) from inside of the engine.

⇐ : Engine front

Tightening torque : Refer to [EM-223, "Disassembly and Assembly"](#).

Use Genuine Liquid Gasket (Three Bond 1217H) or equivalent.



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FLYWHEEL

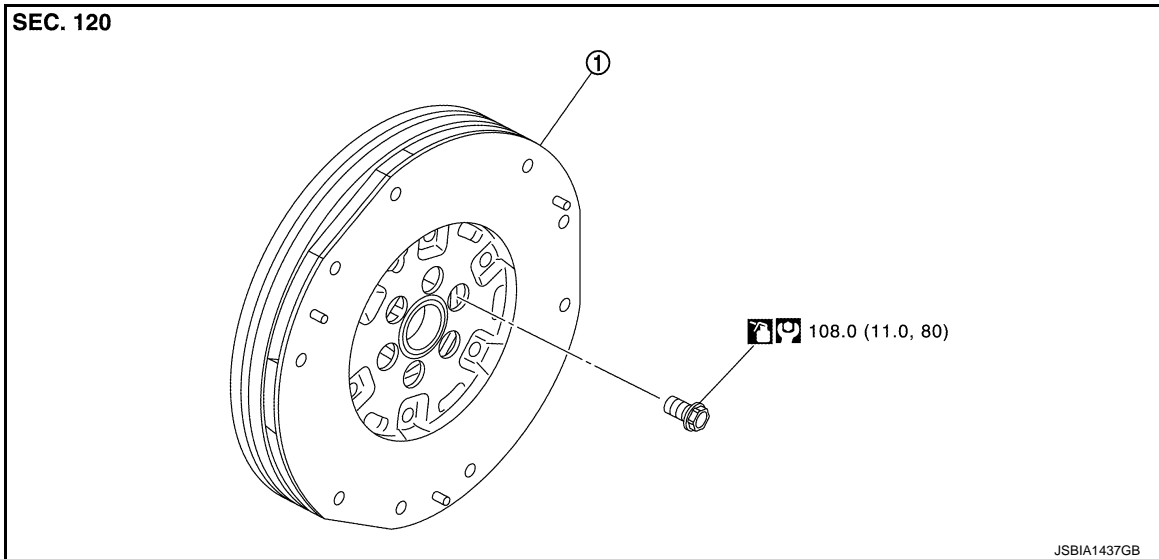
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]


FLYWHEEL


Exploded View

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① Flywheel

 : N·m (kg·m, ft·lb)

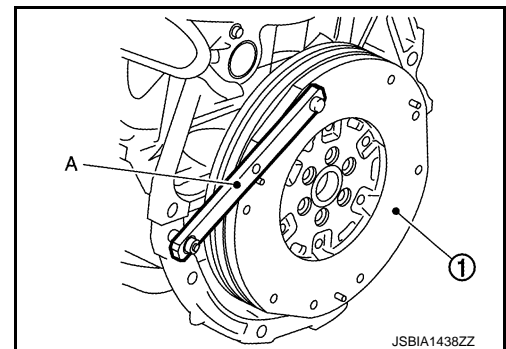
 : Should be lubricated with oil.

Removal and Installation

INFOID:000000010715494

REMOVAL

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-172, "Exploded View"](#).
2. Remove flywheel.
 - Secure flywheel ① with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.



CAUTION:

- Never disassemble them.
- Never place them with signal plate facing down.
- When handling signal plate, take care not to damage or scratch them.
- Handle signal plate in a manner that prevents them from becoming magnetized.

INSTALLATION

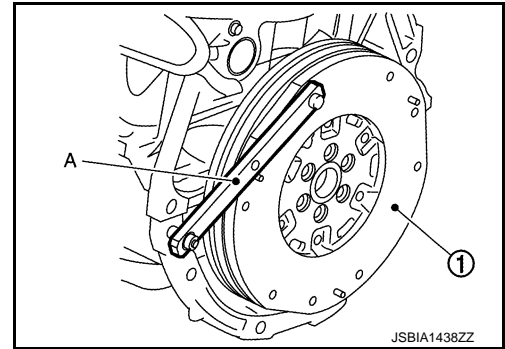
1. Install flywheel.

FLYWHEEL

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Secure flywheel ① with a stopper plate [SST: KV11105210] (A), and tighten mounting bolts.
- Using TORX socket (size E20), tighten mounting bolts.



CAUTION:

Never damage or scratch and contact surface for clutch disc of flywheel.

Inspection

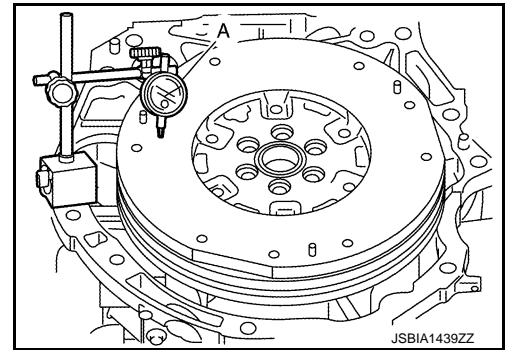
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FLYWHEEL DEFLECTION

- Measure the deflection of flywheel contact surface to torque with a dial indicator (A).
- Measure the deflection at 210 mm (8.27 in) diameter.

Limit : 0.45 mm (0.0177 in) or less.

- If measured value is out of the standard, replace flywheel.
- If a trace of burn or discoloration is found on the surface, repair it with sandpaper.



MOVEMENT AMOUNT OF FLYWHEEL

CAUTION:

Never disassemble double mass flywheel.

Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

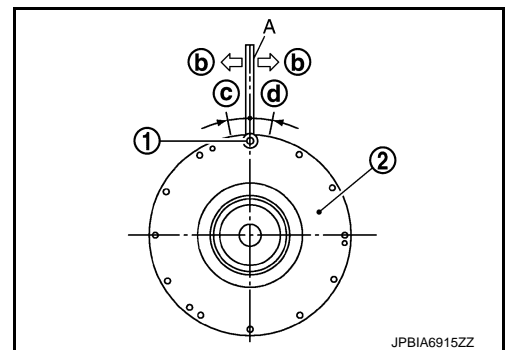
Standard : 1.8 mm (0.071 in) or less

- If measured value is out of the standard, replace flywheel.

Movement Amount in Radial (Rotation) Direction

Check the movement amount of radial (rotation) direction with the following procedure:

1. Install clutch cover mounting bolt ① to clutch cover mounting hole, and place a torque wrench (A) on the extended line of the flywheel ② center line.
 - Tighten bolt at a force of 9.8 N·m (1.0 kg·m, 87 in·lb) to keep it from loosening.
2. Put a mating mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of ⑥ [9.8 N·m (1.0 kg·m, 87 in·lb)] in each direction, and mark the movement amount on the mass on the transaxle side.
4. Measure the dimensions of movement amounts ③ and ④ on circumference of the flywheel on the transaxle side.



Limit : 33.2 mm (1.307 in) or less.

FLYWHEEL

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

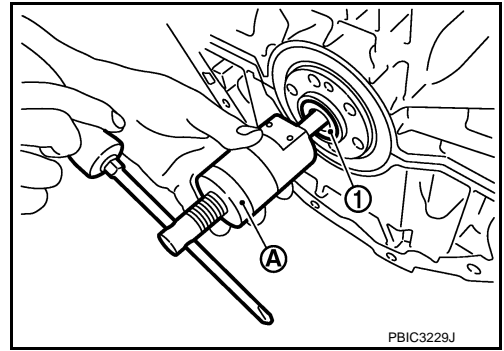
- If measured value is out of the standard, replace flywheel.

DRIVE PLATE

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

3. Remove pilot converter ①, from the rear end of the crankshaft. Use a pilot bush puller (commercial service tool) (A), if necessary.

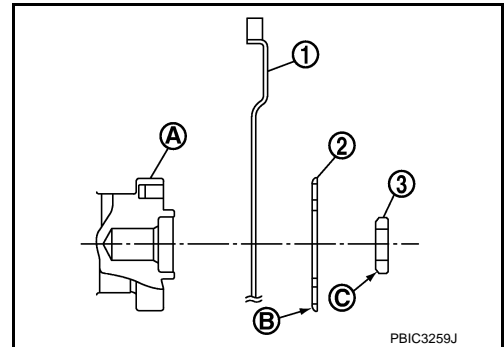


INSTALLATION

1. Install drive plate ①, reinforcement plate ② and pilot converter ③ as shown in figure.

- (A) : Crankshaft rear end
- (B) : Rounded
- (C) : Chamfered

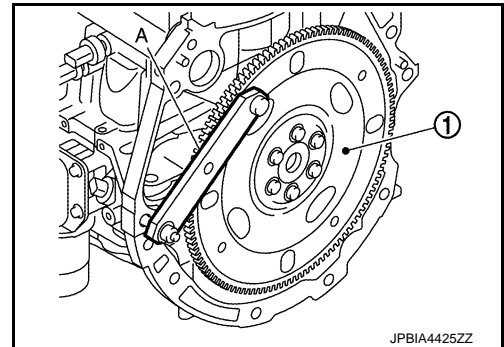
- Using a drift of 33 mm (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops.



CAUTION:

Be careful not to damage or scratch and contact surface for clutch disc of flywheel.

2. Install drive plate.
 - Secure drive plate ① with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.
 - Using TORX socket (size E20), tighten mounting bolts.
 - Install mounting bolts in diagonal order.



Inspection

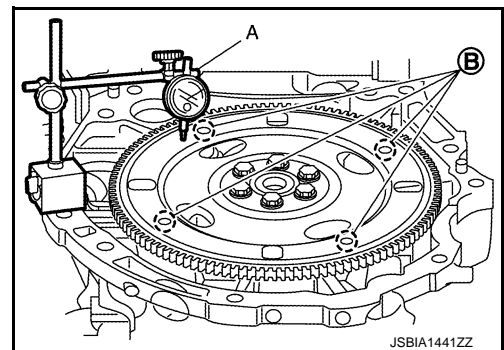
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DRIVE PLATE DEFLECTION

- Measure the deflection of drive plate contact surface to torque converter with a dial indicator (A).
- Measure the deflection at the area limited between 11.0 mm (0.433 in) dia and 20.6 mm (0.811 in) dia around hole (B).

Limit : 0.20 mm (0.0079 in) or less.

- If measured value is out of the standard, replace drive plate.



TIMING CHAIN

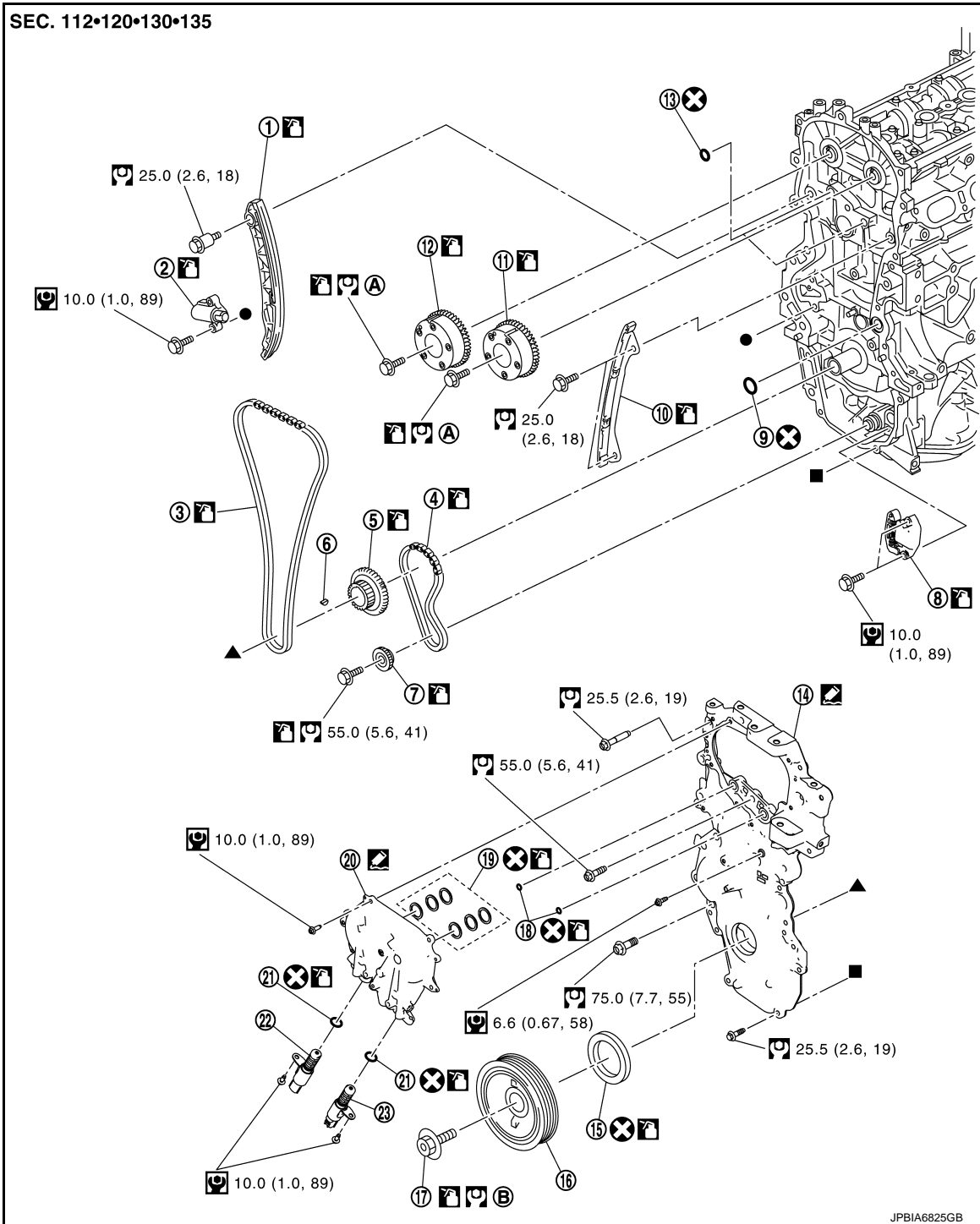
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

TIMING CHAIN

Exploded View

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- | | | |
|------------------------------|--|---------------------------|
| ① Slack guide | ② Timing chain tensioner | ③ Timing chain |
| ④ Balancer unit timing chain | ⑤ Crankshaft sprocket | ⑥ Crankshaft key |
| ⑦ Balancer unit sprocket | ⑧ Balancer unit timing chain tensioner | ⑨ O-ring |
| ⑩ Timing chain tension guide | ⑪ Camshaft sprocket (INT) | ⑫ Camshaft sprocket (EXH) |
| ⑬ O-ring | ⑭ Front cover | ⑮ Front oil seal |
| ⑯ Crankshaft pulley | ⑰ Crankshaft pulley bolt | ⑱ O-ring |

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TIMING CHAIN

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

- ⑱ O-ring
- ⑲ Exhaust valve timing control solenoid valve
- Ⓐ Comply with the installation procedure when tightening. Refer to [EM-197. "Removal and Installation"](#)
- ⓧ : Always replace after every disassembly.
- Ⓜ : N·m (kg-m, ft-lb)
- Ⓝ : N·m (kg-m, in-lb)
- Ⓛ : Should be lubricated with oil.
- Ⓢ : Sealing point
- , ▲, ■ : Indicates that the part is connected at points with same symbol in actual vehicle.
- Ⓚ VTC cover
- Ⓣ Intake valve timing control solenoid valve
- Ⓑ Comply with the installation procedure when tightening. Refer to [EM-184. "Removal and Installation"](#)
- Ⓜ : N·m (kg-m, ft-lb)
- Ⓝ : N·m (kg-m, in-lb)
- Ⓛ : Should be lubricated with oil.
- Ⓢ : Sealing point
- , ▲, ■ : Indicates that the part is connected at points with same symbol in actual vehicle.

Removal and Installation

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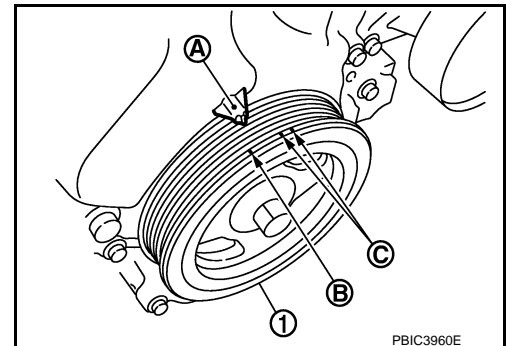
REMOVAL

CAUTION:

The rotating direction in the text indicates all directions seen from the engine front.

1. Drain engine oil. Refer to [LU-23. "Draining"](#).
- CAUTION:**
Perform this step when engine is cold.
2. Remove rocker cover. Refer to [EM-170. "Exploded View"](#).
3. Remove drive belts. Refer to [EM-139. "Removal and Installation"](#).
4. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:
 - a. Rotate crankshaft pulley ① clockwise and align TDC mark (no paint) ② to timing indicator ③ on front cover.

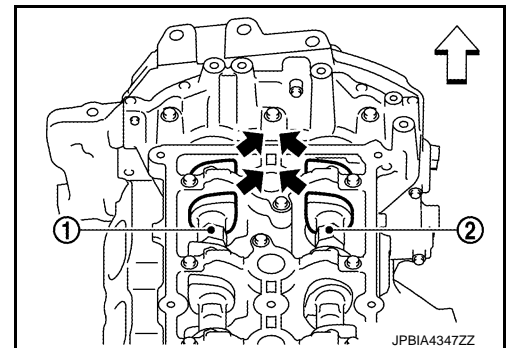
Ⓒ : White paint mark (Not use for service)



- b. At the same time, check that the cam noses of the No. 1 cylinder are located (↔) as shown in the figure.

- ① : Camshaft (INT)
- ② : Camshaft (EXH)
- ↔ : Engine front

- If not, rotate crankshaft pulley one revolution (360 degrees) and align as shown in the figure.



5. Remove crankshaft pulley with the following procedure:

TIMING CHAIN

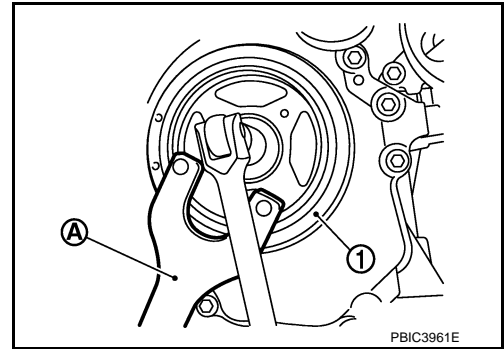
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

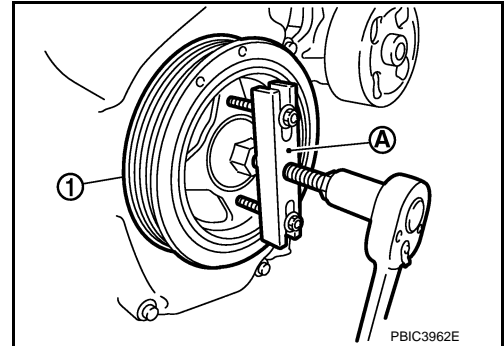
- a. Fix crankshaft pulley ① with a pulley holder (A) (commercial service tool), loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.

CAUTION:

Never remove the crankshaft pulley bolt as they will be used as a supporting point for the pulley puller [SST: KV11103000].



- b. Attach a pulley puller [SST: KV11103000] (A) in the M6 thread hole on crankshaft pulley ①, and remove crankshaft pulley.



6. Remove oil pan (lower). Refer to [EM-156, "Exploded View"](#).

NOTE:

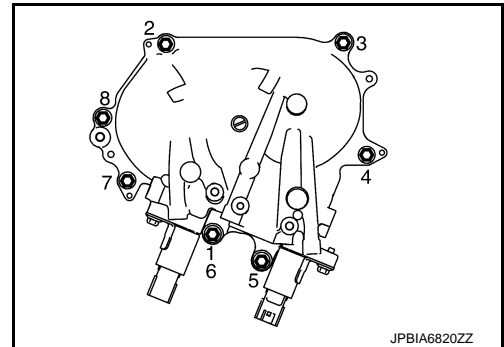
If crankshaft sprocket and balancer unit component are not removed, this step is unnecessary.

7. Remove intake valve timing control solenoid valve and exhaust valve timing control solenoid valve.
8. Remove idler pulley assembly. Refer to [EM-146, "Exploded View"](#).
9. Remove VTC cover.

- Loosen mounting bolts in the order from 8 to 1 as shown in the figure.

NOTE:

Disregard No. 6 when loosening.



10. Remove front cover with the following procedure:

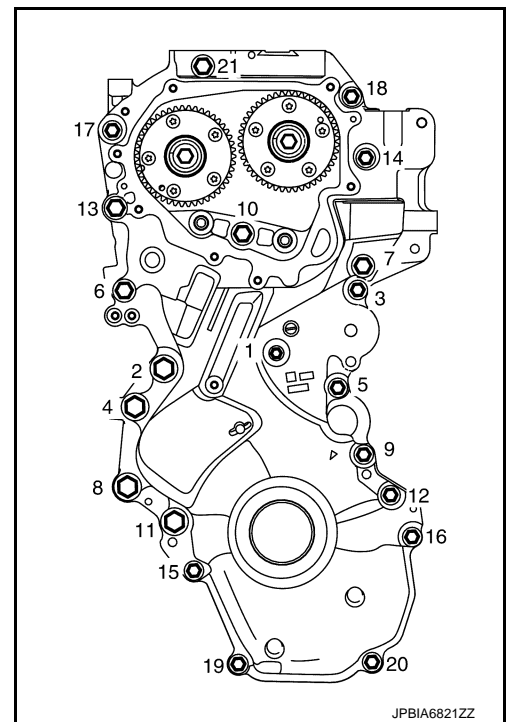
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TIMING CHAIN

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

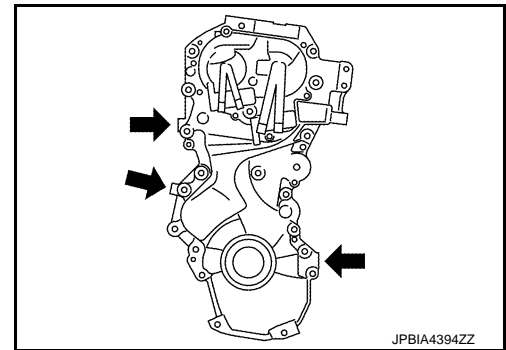
- a. Loosen mounting bolts in the order from 21 to 1 as shown in the figure.



- b. Cut liquid gasket by prying the position (←) shown in the figure, and then remove the front cover.

CAUTION:

- Be careful not to damage the mating surface.
- A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.



11. Remove front oil seal from front cover.

CAUTION:

Be careful not to damage front cover.

- Lift up front oil seal using a screwdriver.

12. Remove timing chain tensioner with the following procedure:

- a. Push in timing chain tensioner plunger.

TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

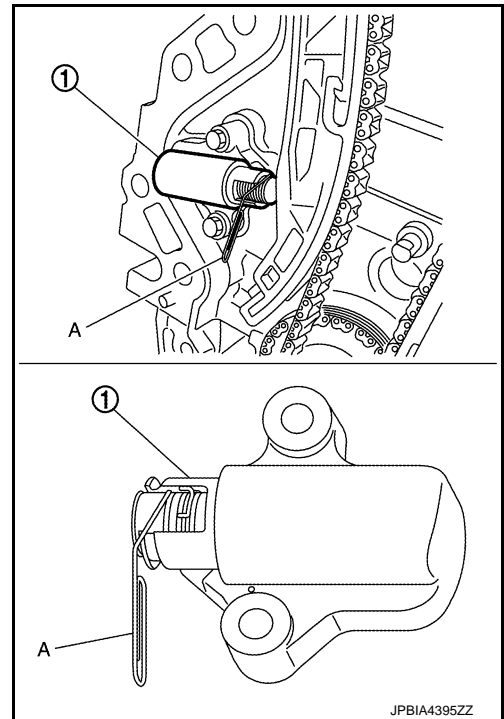
- b. Insert a stopper pin (A) into the body hole, and then fix it with the plunger pushed in.

① : Timing chain tensioner

NOTE:

Use approximately 1.5 mm (0.059 in) diameter, hard metal pin as a stopper pin.

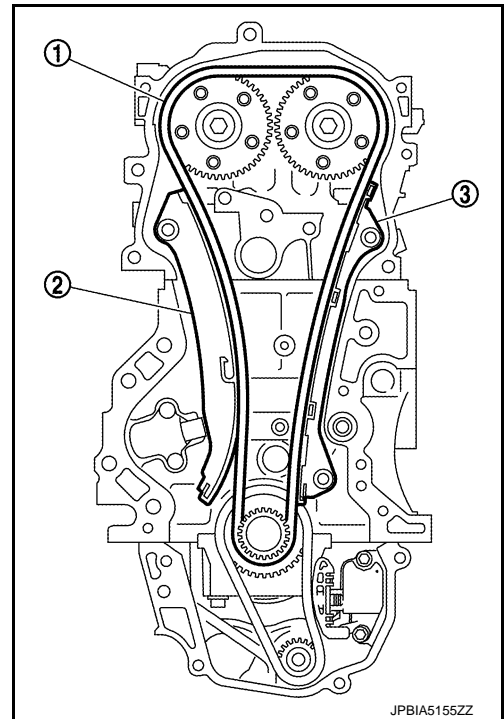
- c. Remove timing chain tensioner.



13. Remove slack guide (2), tension guide (3) and timing chain (1).

CAUTION:

Never rotate each crankshaft and camshaft individually while timing chain is removed. It causes interference between valve and piston.



14. Remove crankshaft sprocket and balancer unit drive component with the following procedure:

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TIMING CHAIN

[MR20DD]

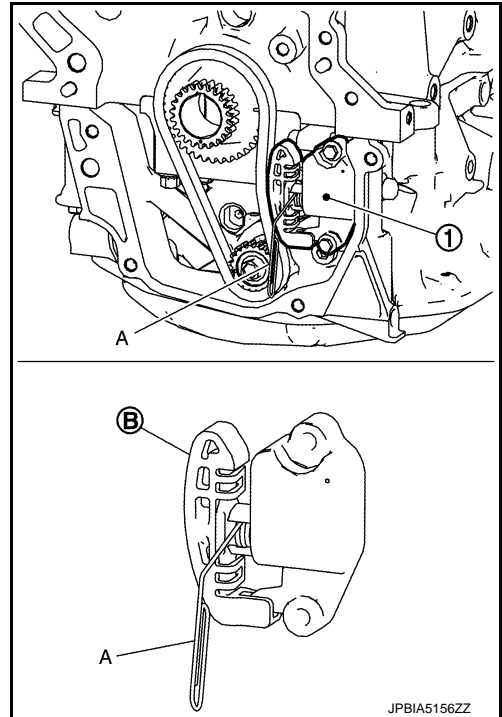
< UNIT DISASSEMBLY AND ASSEMBLY >

- a. Press the balancer unit timing chain slack guide (B) toward balancer unit timing chain tensioner (1).
- b. Insert a stopper pin (A) into tensioner body slit to secure the balancer unit timing chain slack guide.

NOTE:

Use a hard metal pin with the diameter of approximately 1.5 mm (0.059 in) as a stopper pin.

- c. Remove balancer unit timing chain tensioner.
 - When the holes on lever and tensioner body cannot be aligned, align these holes by slightly moving the balancer unit timing chain slack guide.



- d. Hold the WAF part of balancer shaft [WAF: 19 mm (0.75 in)] (A), and then loosen the balancer unit sprocket bolt.

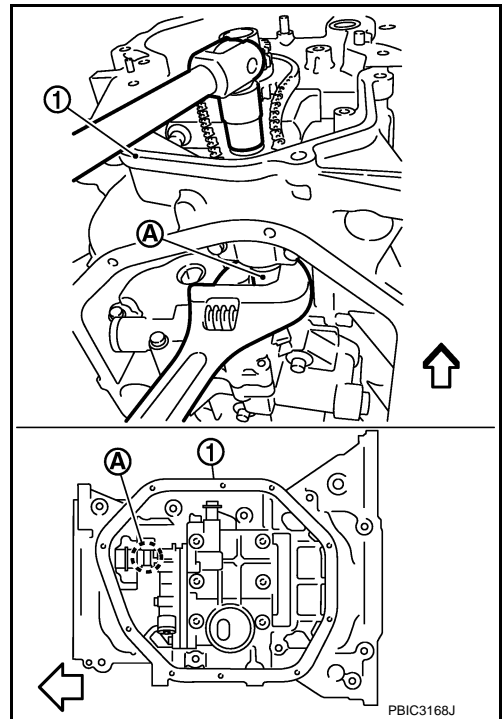
① : Oil pan (upper)

⇐ : Engine front

CAUTION:

- Secure the balancer unit shaft with the WAF part.
- Never loosen the balancer unit sprocket bolt by tightening the balancer unit drive chain.

- e. Remove crankshaft sprocket, balancer unit sprocket and balancer unit timing chain as a set.



INSTALLATION

CAUTION:

Do not reuse O-rings.

NOTE:

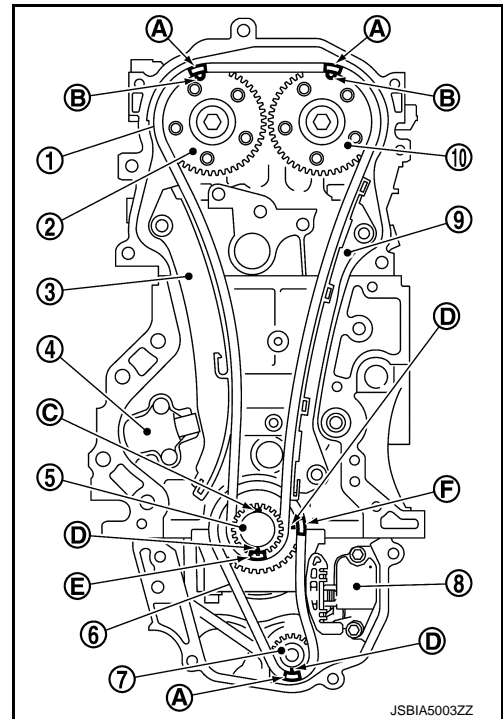
TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

The figure shows the relationship between the matching mark on each timing chain and that on the corresponding sprocket, with the components installed.

- ① : Timing chain
- ② : Camshaft sprocket (EXH)
- ③ : Slack guide
- ④ : Timing chain tensioner
- ⑤ : Crankshaft sprocket
- ⑥ : Balancer unit timing chain
- ⑦ : Balancer unit sprocket
- ⑧ : Balancer unit timing chain tensioner
- ⑨ : Tension guide
- ⑩ : Camshaft sprocket (INT)
- Ⓐ : Matching mark (dark blue link)
- Ⓑ : Matching mark (stamping)
- Ⓒ : Crankshaft key position (straight up)
- Ⓓ : Matching mark (stamping)
- Ⓔ : Matching mark (yellow link)
- Ⓕ : Matching mark (white link)



*: There are two outer grooves in camshaft sprocket (INT). The wider one is a matching mark.

1. Check that crankshaft key points straight up.
2. If the tension guide (front cover side) is removed, install it to the front cover.

CAUTION:

Check the joint condition by sound or feeling.

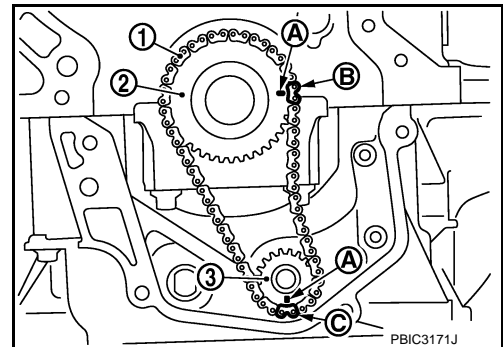
3. Install crankshaft sprocket ②, balancer unit sprocket ③ and balancer unit timing chain ①.

- Ⓐ : Matching mark (stamping)
- Ⓑ : Matching mark (white link)
- Ⓒ : Matching mark (dark blue link)

- Install it by aligning matching marks on each sprocket and balancer unit timing chain.
- If these matching marks are not aligned, rotate the balancer shaft slightly to correct the position.

CAUTION:

Check matching mark position of each sprocket after installing the balancer unit timing chain.



TIMING CHAIN

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

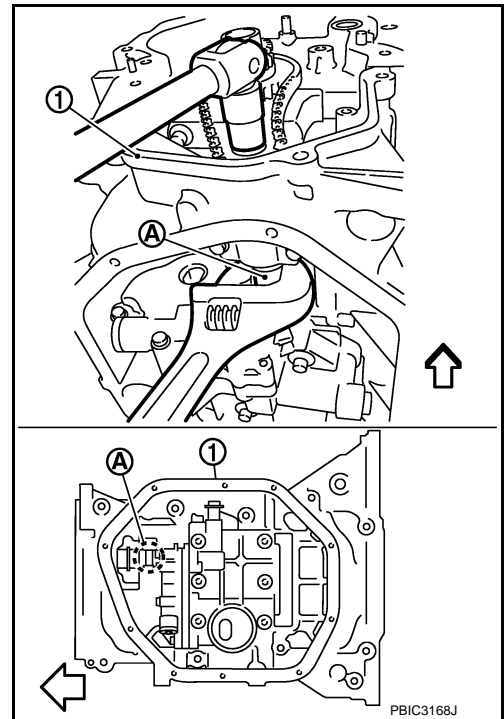
4. Hold the WAF part of balancer unit shaft [WAF: 19 mm (0.75 in)] (A), and then tighten the balancer shaft sprocket bolt.

① : Oil pan (upper)

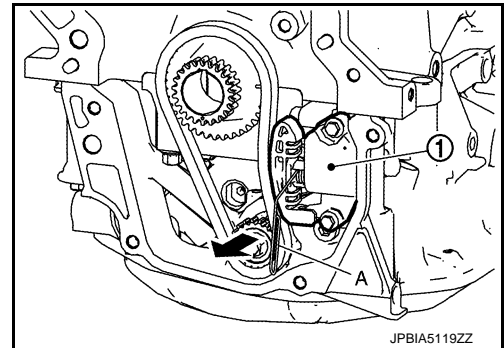
← : Engine front

CAUTION:

- Secure the balancer unit shaft with the WAF part.
- Never loosen the balancer shaft sprocket bolt by tightening the balancer unit timing chain.



5. Install balancer unit timing chain tensioner (1).
- Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
 - Securely pull out (←) the stopper pin after installing the balancer unit timing chain tensioner.
 - Check matching mark position of balancer unit timing chain and each sprocket again.



TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

6. Align the matching marks of each sprocket with the matching marks of timing chain.

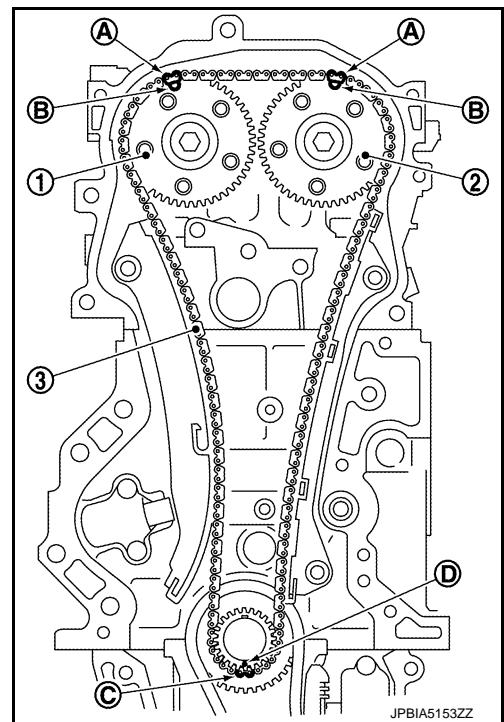
- ① : Camshaft sprocket (EXH)
- ② : Camshaft sprocket (INT)
- ③ : Timing chain
- Ⓐ : Matching mark (dark blue link)
- Ⓑ : Matching mark (stamping)
- Ⓒ : Matching mark (yellow link)
- Ⓓ : Matching mark (stamping)

*: There are 2 outer grooves in camshaft sprocket (INT). The wider one is a matching mark.

- If these matching marks are not aligned, rotate the camshaft slightly by holding the hexagonal portion to correct the position.

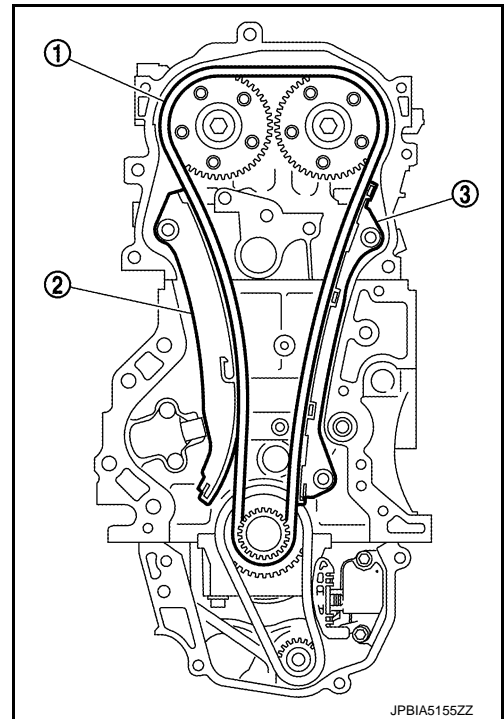
CAUTION:

Check matching mark position of each sprocket and timing chain again after installing the timing chain.



7. Install the tension guide ③ and the slack guide ②.

- ① : Timing chain



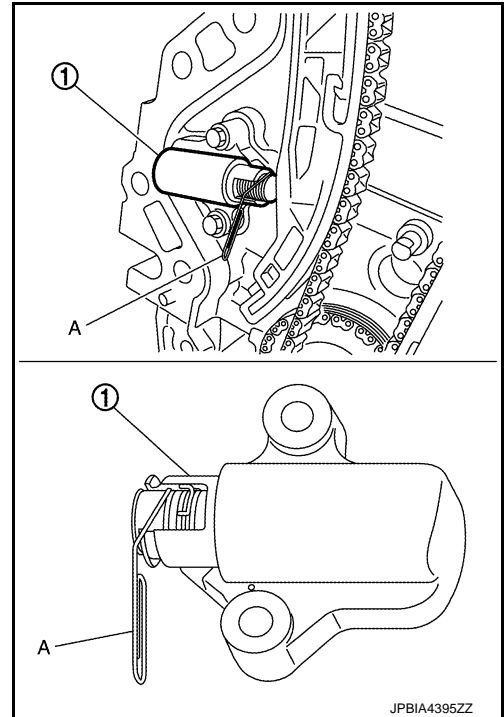
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TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

8. Install timing chain tensioner ①.
 - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
 - Securely pull out the stopper pin after installing the timing chain tensioner.



9. Check matching mark position of timing chain and each sprocket again.
10. Install front oil seal. Refer to [EM-206. "FRONT OIL SEAL : Removal and Installation"](#).
11. Install front cover with the following procedure:
 - a. Install new O-ring to cylinder block.

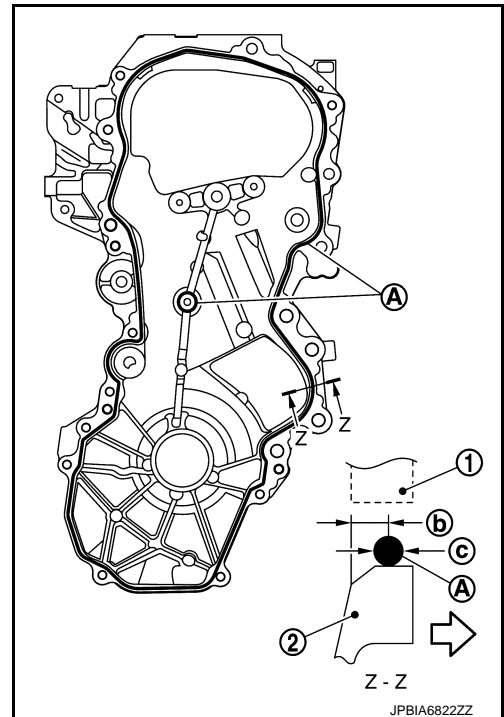
CAUTION:

- Do not reuse O-ring.
- Never misalign O-ring.

- b. Apply a continuous bead of liquid gasket (A) with a tube presser (commercial service tool) to front cover ② as shown in the figure.

- ⓑ : 4.0 - 5.6 mm (0.157 - 0.220 in)
- ⓒ : ϕ 3.4 - 4.4 mm (0.134 - 0.173 in)
- ⇐ : Engine outside

Use Genuine Liquid Gasket (Three Bond 1217H) or equivalent.



- c. Check that matching marks of timing chain and each sprocket are still aligned. Then install front cover.

CAUTION:





 - Check O-ring on cylinder block is correctly installed.
 - Be careful not to damage front oil seal by interference with front end of crankshaft.

TIMING CHAIN

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

- d. Install front cover, and tighten mounting bolts in the order from 1 to 22 as shown in the figure.
- Refer to the following for the installation position of bolts.

- M6 bolt** : No. 1
 : 6.6 N·m (0.67 kg-m, 58 in-lb)
- M10 bolts** : No. 6, 7, 10, 13, 21
 : 55.0 N·m (5.6 kg-m, 41 ft-lb)
- M12 bolts** : No. 2, 4, 8, 11
 : 75.0 N·m (7.7 kg-m, 55 ft-lb)
- M8 bolts** : Except the above
 : 25.0 N·m (2.6 kg-m, 19 ft-lb)

CAUTION:

Attaching should be done within 5 minutes after liquid gasket application.

- e. After all bolts are tightened, retighten them to specified torque in numerical order as shown in the figure.

CAUTION:

Be sure to wipe off any excessive liquid gasket leaking.

12. Install VTC cover according to the following instructions:

- a. a. Apply liquid gasket (A) (Three Bond 1217H or an equivalent) evenly (no break, no overlap) to the position shown in the figure. Refer to [EM-126. "Liquid Gasket"](#).

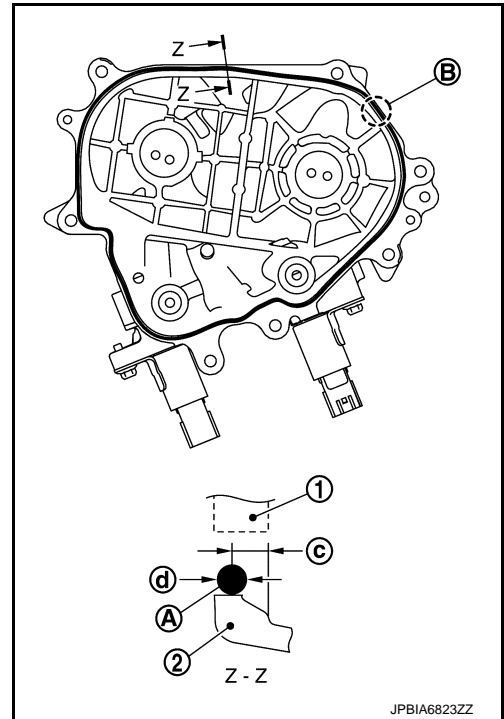
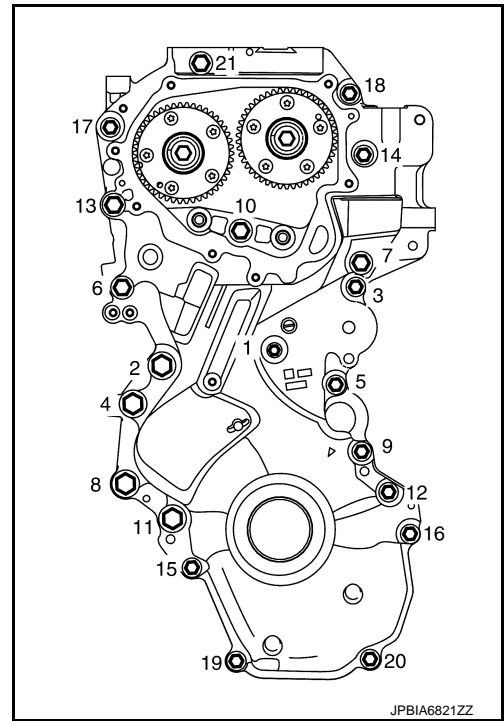
- ① : Front cover
 ② : VTC cover
 (B) : Start/End of liquid gasket application
 (C) : 4.0 – 5.6 mm
 (d) : $\phi 3.4 - 4.4$ mm

CAUTION:

Install within 5 minutes after applying liquid gasket.

NOTE:

Overlap the start and end of liquid gasket application positions at least 5 mm.



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TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

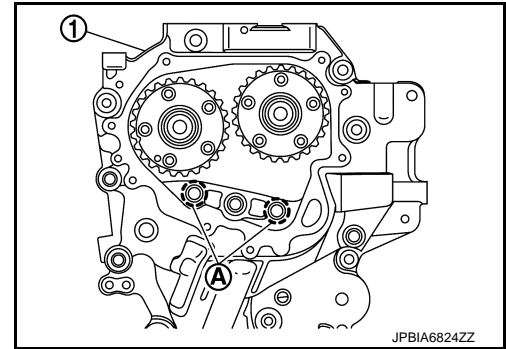
[MR20DD]

- b. Install O-ring to the groove of front cover ①.

Ⓐ : O-ring installation position

CAUTION:

Oil filter must be inserted to the end of O-ring installation part.



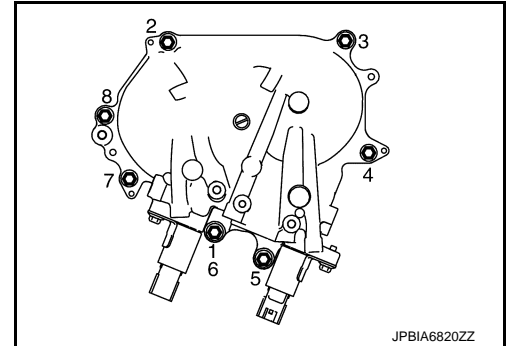
- c. Tighten mounting bolts to the specified torque in the order from 1 to 8 as shown in the figure.

CAUTION:

After tightening mounting bolts, wipe out extra liquid gasket.

NOTE:

Bolt 1 must be tightened twice, the second tightening is shown by 6.



13. Install crankshaft pulley with the following procedure:

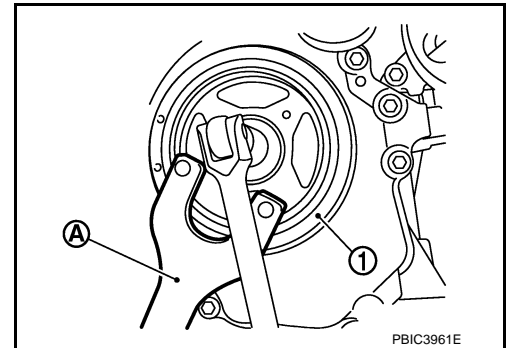
- a. When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).

CAUTION:

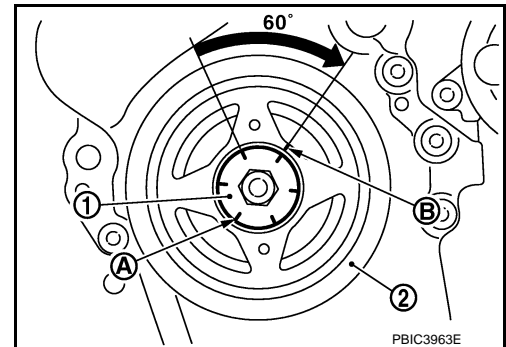
Never damage front oil seal lip portion.

- b. Secure crankshaft pulley ① with a pulley holder (commercial service tool) Ⓐ.
- c. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
- d. Tighten crankshaft pulley bolt.

 : 29.4 N·m (3.0 kg-m, 22 ft-lb)



- e. Put a paint mark Ⓑ on crankshaft pulley ②, matching with any one of six easy to recognize angle marks Ⓐ on crankshaft pulley bolt ① flange.
- f. Turn another 60 degrees clockwise (angle tightening).
- Check the tightening angle with movement of one angle mark.
- g. Check that crankshaft rotates clockwise smoothly.



14. Install remaining parts in the reverse order of removal.

Inspection

INFOID:000000010715501

INSPECTION AFTER REMOVAL

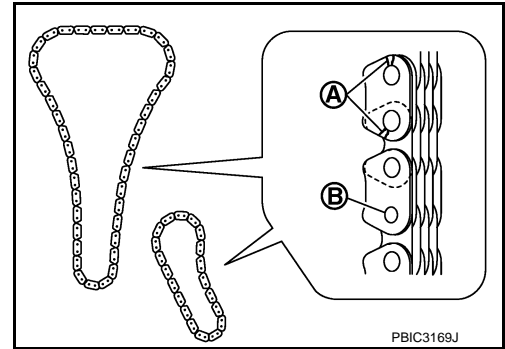
Timing Chain

TIMING CHAIN

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

Check for cracks (A) and any excessive wear (B) at link plates and roller links of timing chain. Replace timing chain if necessary.



INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59. "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate an unusualness. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

CAMSHAFT

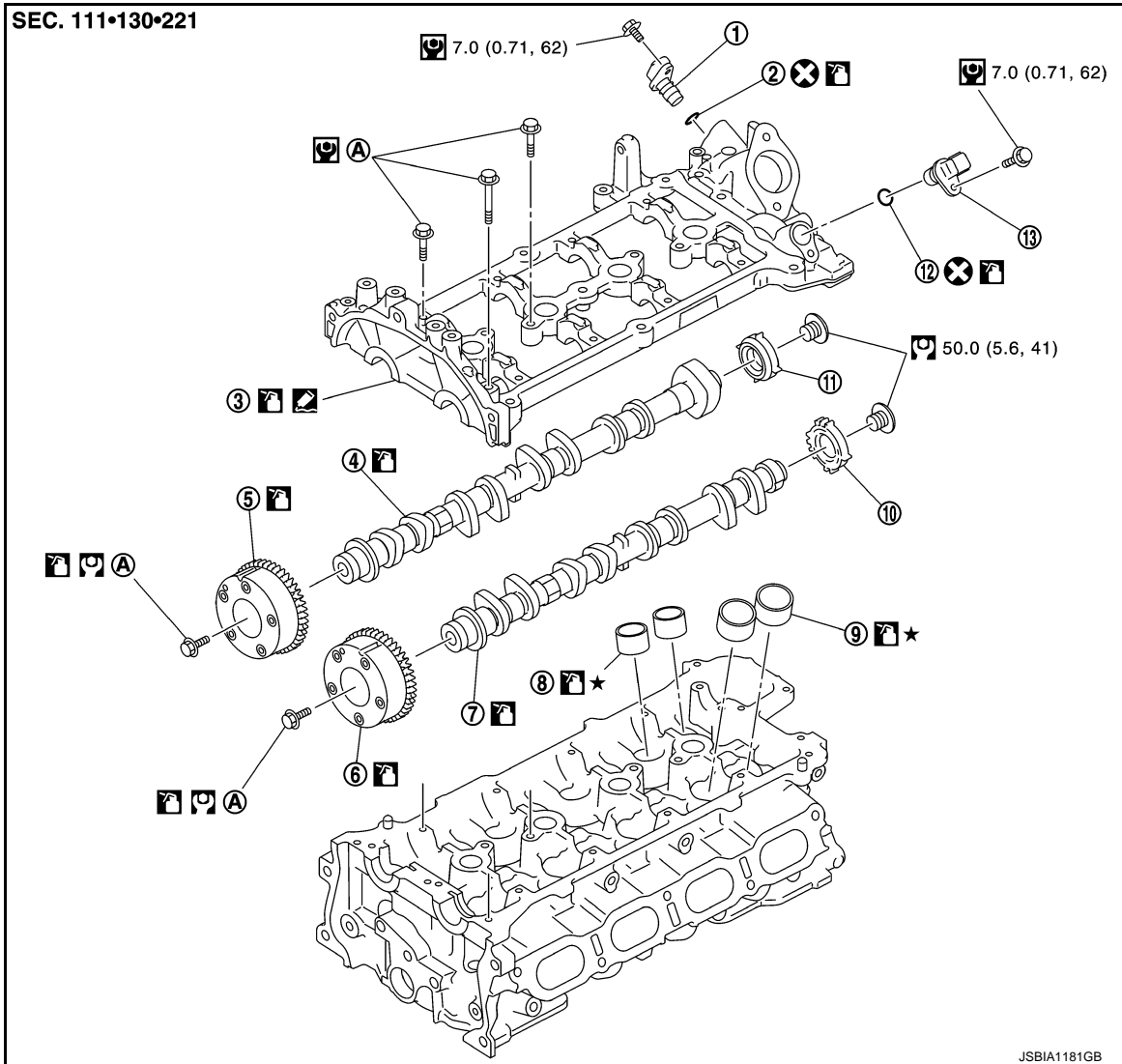
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

CAMSHAFT

Exploded View

INFOID:000000010715502



- | | | |
|--|---------------------------|---------------------------|
| ① Exhaust valve timing control position sensor | ② O-ring | ③ Camshaft bracket |
| ④ Camshaft (EXH) | ⑤ Camshaft sprocket (EXH) | ⑥ Camshaft sprocket (INT) |
| ⑦ Camshaft (INT) | ⑧ Valve lifter (EXH) | ⑨ Valve lifter (INT) |
| ⑩ Signal plate (INT) | ⑪ Signal plate (EXH) | ⑫ O-ring |
| ⑬ Camshaft position sensor (PHASE) | | |

(A) Comply with the assembly procedure when tightening. Refer to [EM-197](#)

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

★ : Select with proper thickness.

Removal and Installation

INFOID:000000010715503

CAUTION:

The rotating direction in the text indicates all directions seen from the engine front.

REMOVAL

1. Remove the following parts.
 - Intake manifold: Refer to [EM-149, "Exploded View"](#).
 - Rocker cover: Refer to [EM-170, "Exploded View"](#).
 - Front cover and timing chain related parts: Refer to [EM-183, "Exploded View"](#).

NOTE:

Removal of oil pump drive related part is not necessary.

2. Remove camshaft position sensor (PHASE) and exhaust valve timing control position sensor from camshaft bracket.

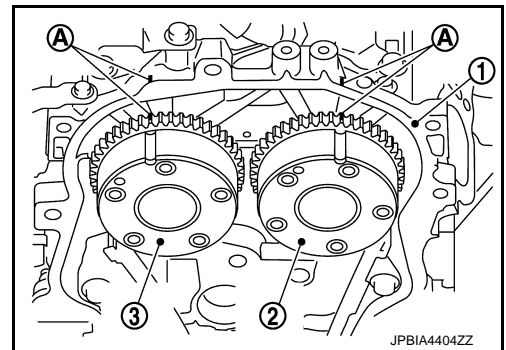
CAUTION:

- Handle camshaft position sensor (PHASE) and exhaust valve timing control position sensor carefully and avoid impacts.
- Never disassemble camshaft position sensor (PHASE) and exhaust valve timing control position sensor.
- Never place sensor where it is exposed to magnetism.

3. Put the matching mark (A) on the camshaft sprocket (INT) (2), camshaft sprocket (EXH) (3) and the camshaft bracket (1) as shown in the figure.

NOTE:

It prevents the knock pin of the camshaft (INT) from engaging with the incorrect pin hole when installing the camshaft sprocket (INT).

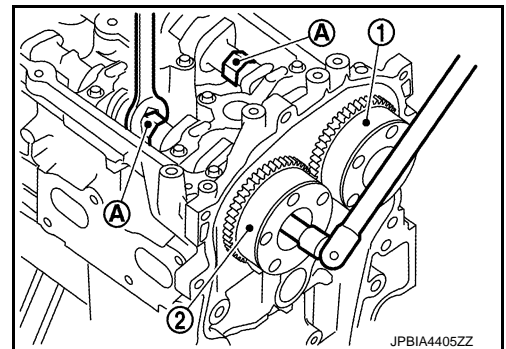


4. Remove camshaft sprockets (INT and EXH).
 - Secure hexagonal part (A) of camshaft with a wrench. Loosen camshaft sprocket mounting bolts and remove camshaft sprocket.

- ① : Camshaft sprocket (INT)
- ② : Camshaft sprocket (EXH)

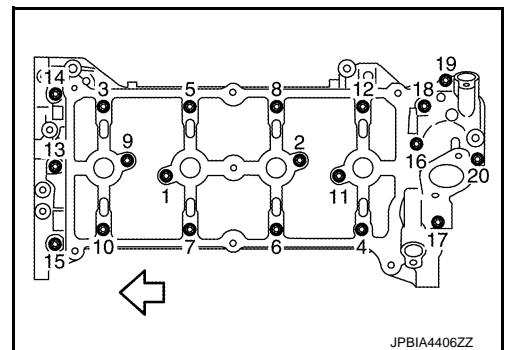
CAUTION:

- Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.
- Never loosen the mounting bolts with securing anything other than the camshaft hexagonal part or with tensioning the timing chain.



5. Remove camshaft bracket with the following procedure:
 - a. Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front



A
EM
C
D
E
F
G
H
I
J
K
L
M
N
O
P

CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

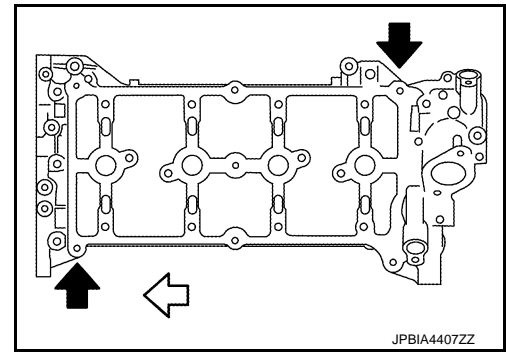
[MR20DD]

- b. Cut liquid gasket by prying the position (←) shown in the figure, and then remove the camshaft bracket.

← : Engine front

CAUTION:

- Never damage the mating surface.
- A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.



- Remove camshafts.
- Remove valve lifters.
 - Identify installation positions, and store them without mixing them up.
- Remove signal plate from camshaft, if necessary.

INSTALLATION

CAUTION:

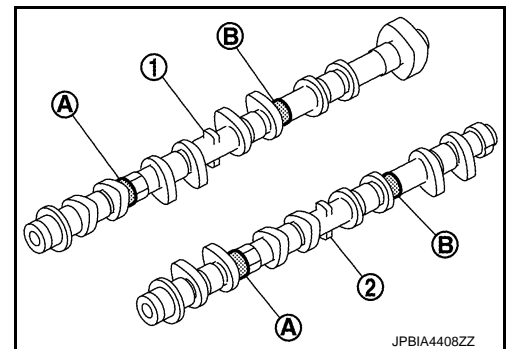
Do not reuse O-rings.

- Install valve lifters.
 - Install them in the original positions.
- Install camshafts.
 - Clean camshaft journal to remove any foreign material.
 - Distinguish between the intake and the exhaust by looking at the different shapes of the front and rear ends of the camshaft or using the identification colors (A) and (B).

① : Camshaft (EXH)

② : Camshaft (INT)

Identification color	(A)	(B)
Camshaft (EXH)	—	Brown
Camshaft (INT)	Purple	—



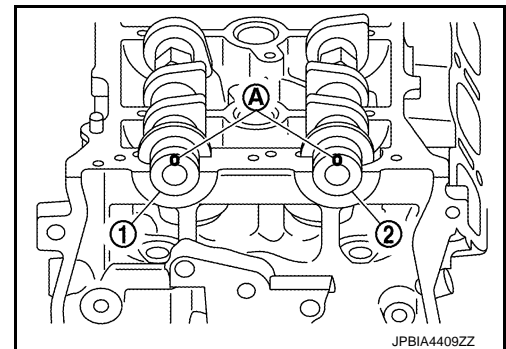
- Install camshafts so that camshaft dowel pins (A) on the front side are positioned as shown in the figure.

① : Camshaft (EXH)

② : Camshaft (INT)

NOTE:

Though camshaft does not stop at the positions as shown in the figure, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.



- Install camshaft bracket with the following procedure:
 - Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.

CAMSHAFT

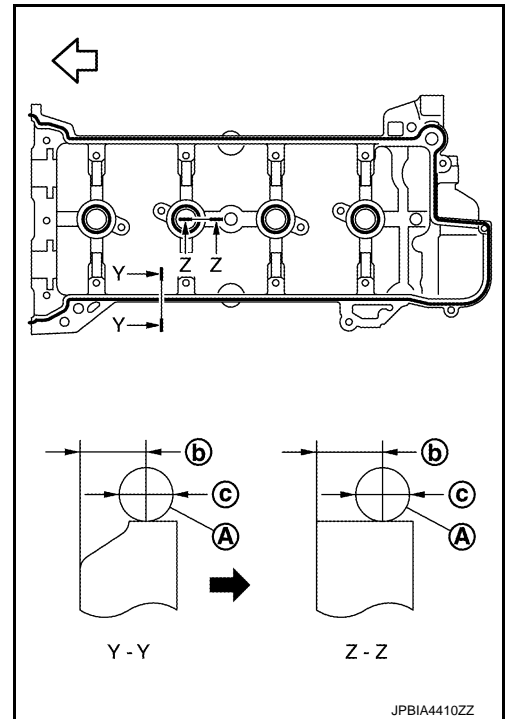
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- b. Apply liquid gasket (A) to camshaft bracket as shown in the figure.

- (b) : Plug hole inner wall
- (c) : ϕ 3.4 - 4.4 mm (0.134 - 0.173 in)
- ↶ : Engine front
- ← : Engine outside

Use Genuine Liquid Gasket (Three Bond 1217H) or equivalent.



- c. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

↶ : Engine front

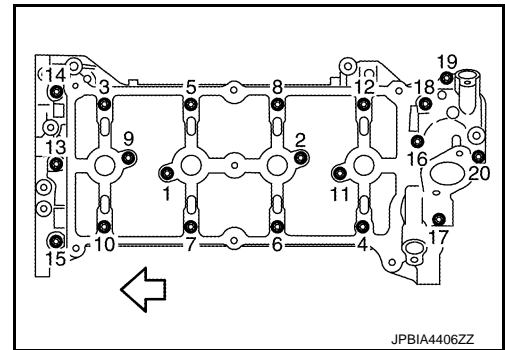
- There are two types of mounting bolts. Refer to the following for locating bolts.

M6 bolts [thread length: 57.5 mm (2.264 in)]

: 13, 14, and 15 in the figure

M6 bolts [thread length: 35.0 mm (1.378 in)]

: Except the above



- i. Tighten mounting bolts in numerical order.

: **1.96 N-m (0.20 kg-m, 17 in-lb)**

- ii. Tighten mounting bolts in numerical order.

: **5.88 N-m (0.60 kg-m, 52 in-lb)**

- iii. Tighten mounting bolts in numerical order.

: **9.5 N-m (0.97 kg-m, 84 in-lb)**

CAUTION:

After tightening mounting bolts of camshaft brackets, be sure to wipe off excessive liquid gasket from the mating surface of cylinder head.

4. Install the camshaft sprocket to the camshaft with the following procedure.

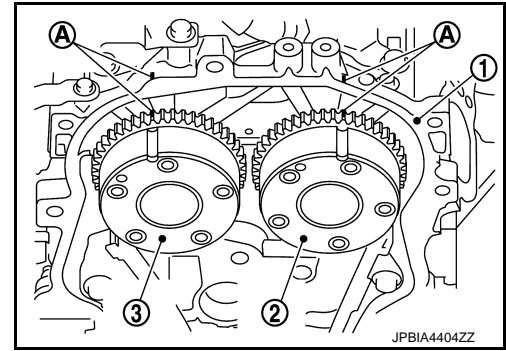
CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- a. When the camshaft sprocket (INT) ② and camshaft sprocket (EXH) ③ is removed, refer to the paint mark (A) put according to step "3". Securely align the knock pin and the pin hole, and then install them.

① : Camshaft bracket



- b. Tighten bolts in the following steps.
- Secure the hexagonal part of camshaft using wrench to tighten mounting bolt.
- i. Tighten camshaft mounting bolt.

: 35.0 N·m (3.6 kg·m, 26 ft·lb)

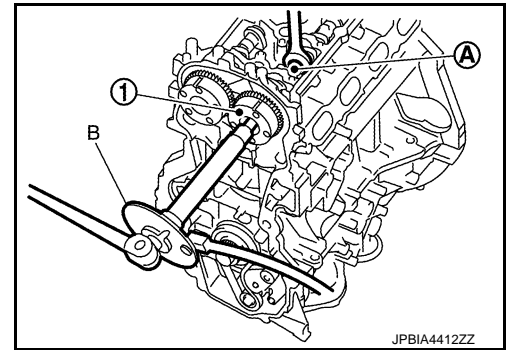
- ii. Turn 30 degrees clockwise (angle tightening).

CAUTION:

Check the tightening angle by using an angle wrench [SST: KV10112100] (B) or protractor. Never judge by visual inspection without an angle wrench.

① : Camshaft sprocket

Ⓐ : Camshaft hexagonal part



5. Install timing chain and related parts. Refer to [EM-183, "Exploded View"](#).
6. Inspect and adjust valve clearance. Refer to [EM-133, "Inspection and Adjustment"](#).
7. Install remaining parts in the reverse order of removal.

Inspection

INFOID:000000010715504

INSPECTION AFTER REMOVAL

Camshaft Runout

1. Put V-block on a precise flat table, and support No. 2 and 5 journal of camshaft.

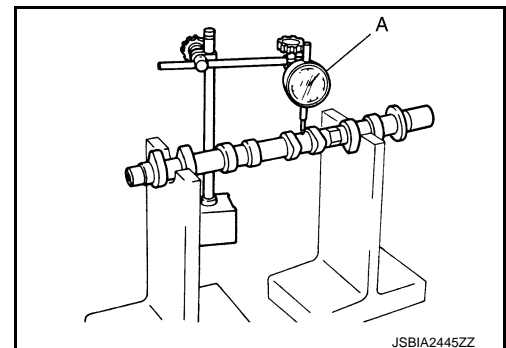
CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Set dial indicator (A) vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on dial indicator. (Total indicator reading)

Standard and Limit : Refer to [EM-249, "Camshaft"](#).

4. If it exceeds the limit, replace camshaft.



Camshaft Cam Height

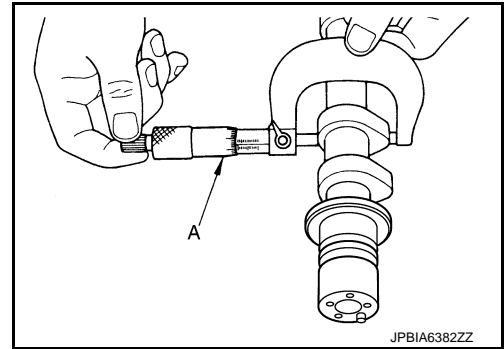
CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

1. Measure the camshaft cam height with a micrometer (A).

Standard and Limit : Refer to [EM-249, "Camshaft"](#).



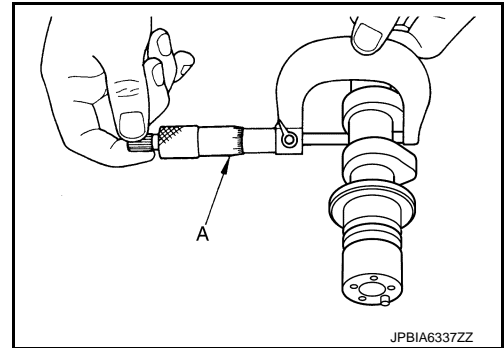
2. If it exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL OUTER DIAMETER

Measure the outer diameter of camshaft journal with a micrometer (A).

Standard : Refer to [EM-249, "Camshaft"](#).

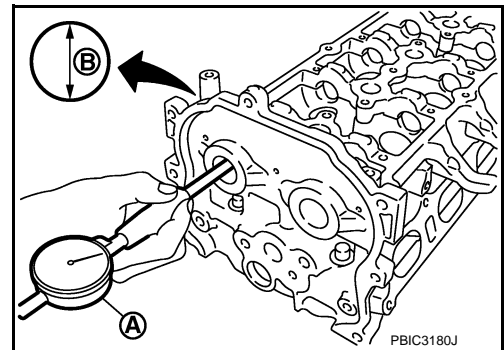


CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque. Refer to [EM-197, "Removal and Installation"](#).
- Measure the inner diameter of camshaft bracket with a cylinder gauge (A).

Ⓑ : Measuring direction of inner diameter

Standard : Refer to [EM-249, "Camshaft"](#).



CAMSHAFT JOURNAL OIL CLEARANCE

- (Oil clearance) = (Camshaft bracket inner diameter) – (Camshaft journal diameter)

Standard and Limit : Refer to [EM-249, "Camshaft"](#).

- If it exceeds the limit, replace camshaft or cylinder head, or both.

NOTE:

Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to [EM-197, "Removal and Installation"](#).

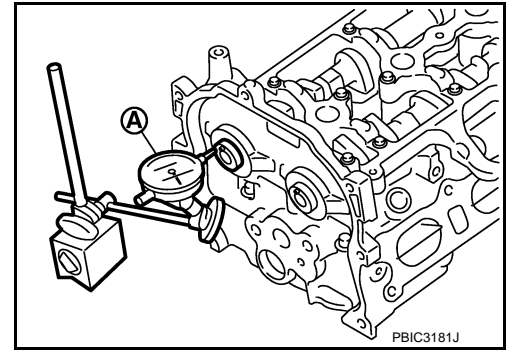
CAMSHAFT

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

2. Install dial indicator in thrust direction on front end of camshaft. Read the end play of dial indicator (A) when camshaft is moved forward/backward (in direction to axis).

Standard and Limit : Refer to [EM-249. "Camshaft"](#).



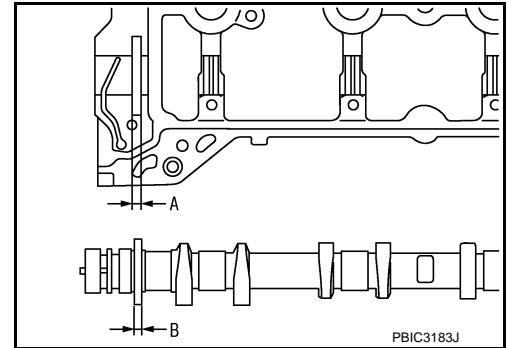
- Measure the following parts if out of the standard.
 - Dimension (A) for groove of cylinder head No. 1 journal

Standard : 4.000 - 4.030 mm (0.1575 - 0.1587 in)

- Dimension (B) for camshaft flange

Standard : 3.877 - 3.925 mm (0.1526 - 0.1545 in)

- Refer to the standards above, and then replace camshaft and/or cylinder head.



Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.

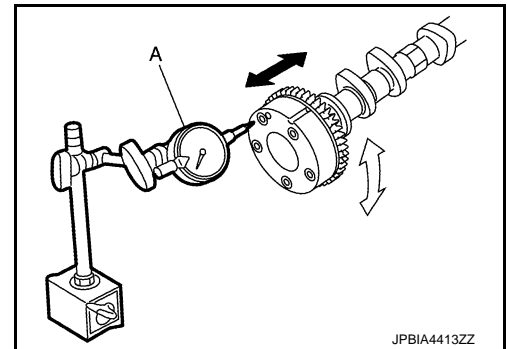
CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Measure the camshaft sprocket runout with a dial indicator (A). (Total indicator reading)

Limit : Refer to [EM-249. "Camshaft"](#).

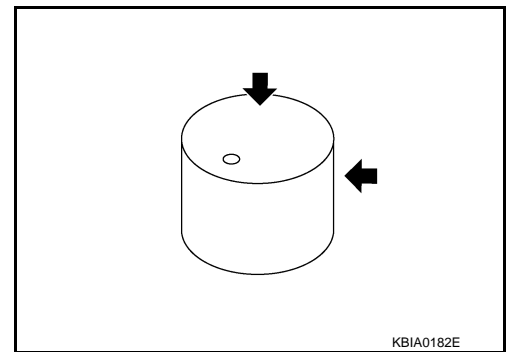
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

Check if surface of valve lifter has any wear or cracks.

- If anything above is found, replace valve lifter. Refer to [EM-249. "Camshaft"](#).



Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

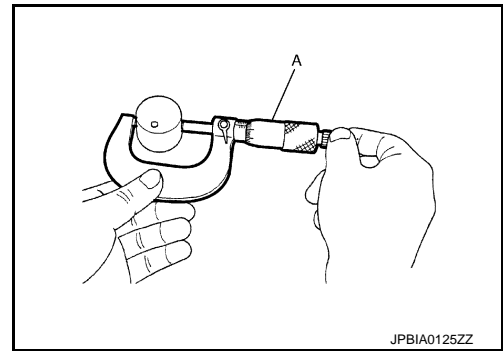
CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Measure the outer diameter of valve lifter with a micrometer (A).

Standard : Refer to [EM-249, "Camshaft"](#).



VALVE LIFTER HOLE DIAMETER

Measure the inner diameter of valve lifter hole of cylinder head with an inside micrometer (A).

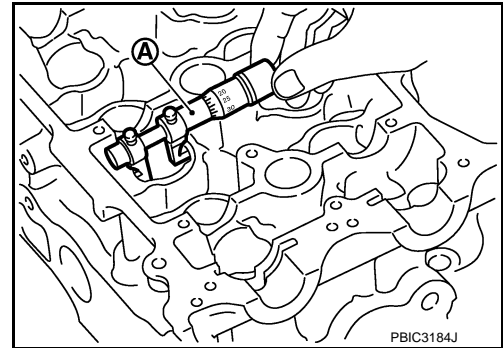
Standard : Refer to [EM-249, "Camshaft"](#).

VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) – (Valve lifter outer diameter)

Standard : Refer to [EM-249, "Camshaft"](#).

- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.



INSPECTION AFTER INSTALLATION

Inspection of Camshaft Sprocket (INT), (EXH) Oil Groove

CAUTION:

- Perform this inspection only when DTC P0011 or P0014 is detected in self-diagnostic results of CONSULT and it is directed according to inspection procedure of EC section. Refer to [ECM-157, "Diagnosis Procedure"](#) (P0011) or [ECM-161, "Diagnosis Procedure"](#) (P0014).
 - Check when engine is cold so as to prevent burns by the splashing engine oil.
1. Check engine oil level. Refer to [LU-22, "Inspection"](#).
 2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
 - a. Release the fuel pressure. Refer to [ECM-135, "Work Procedure"](#).
 - b. Remove intake manifold. Refer to [EM-149, "Exploded View"](#).
 - c. Disconnect ignition coil and injector harness connectors.
 - d. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket (RH) and engine mounting insulator (RH). Refer to [EM-172, "Exploded View"](#).
 3. Remove intake or exhaust valve timing control solenoid valve. Refer to [EM-183, "Exploded View"](#).
 - Lift the front side of the engine with a jack base to remove intake or exhaust valve timing control solenoid valve.
 4. Clean the mounting area of intake or exhaust valve timing control solenoid valve, and then insert a clean waste with no oil adhesion into the oil hole of the cylinder head.
 5. Install engine mounting insulator (RH) and engine mounting bracket (RH). (After the removal of intake or exhaust valve timing control solenoid valve and insertion of a waste into the oil hole.)
 6. Perform cranking to check that engine oil comes out from the oil hole (mounting hole of intake or exhaust valve timing control solenoid valve) of cylinder head.
 - Regarding the engine oil check, judge it by the amount of oil adhered to the wasted inserted into the oil hole.

WARNING:

- Never insert fingers into the oil hole.
- Never touch rotating parts (drive belt, idler pulleys and crankshaft pulley, etc.).

CAUTION:

CAMSHAFT

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

-
- **Never perform cranking without installing the engine mounting insulator (RH) and engine mounting bracket (RH).**
 - **Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.**
 - **Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belt, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.**
7. Perform the following inspection if engine oil does not come out from intake or exhaust valve timing control solenoid valve oil hole of the cylinder head.
 - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-20, "Engine Lubrication System"](#) and [LU-21, "Engine Lubrication System Schematic"](#).
 8. Remove components between intake or exhaust valve timing control solenoid valve and camshaft sprocket (INT) or (EXH), and then check each oil groove for clogging.
 - Clean oil groove if necessary. Refer to [LU-20, "Engine Lubrication System"](#) and [LU-21, "Engine Lubrication System Schematic"](#).
 9. After inspection, install removed parts in the reverse order.

OIL SEAL

VALVE OIL SEAL

VALVE OIL SEAL : Removal and Installation

INFOID:000000010715505

A

EM

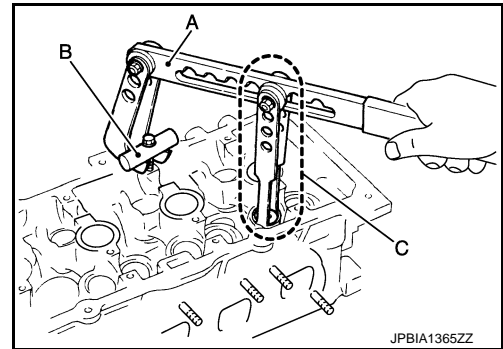
REMOVAL

1. Remove camshafts. Refer to [EM-196. "Exploded View"](#).
2. Remove valve lifters. Refer to [EM-196. "Exploded View"](#).
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.

CAUTION:

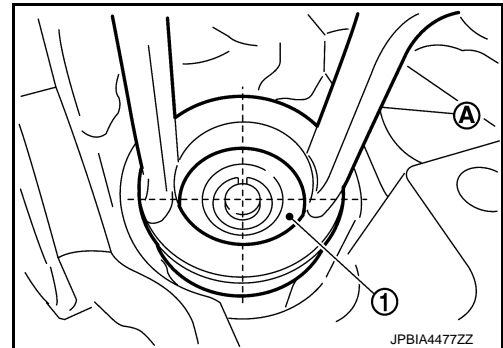
When rotating crankshaft, be careful to avoid scarring front cover with timing chain.

4. Remove valve collet.
 - Compress valve spring with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Remove valve collet with magnet hand.

**CAUTION:**

- Never damage valve lifter holes.
- Fit the attachment [SST: KV10115900] in the center of valve spring retainer to press it.

- ① : Valve spring retainer
 (A) : Attachment

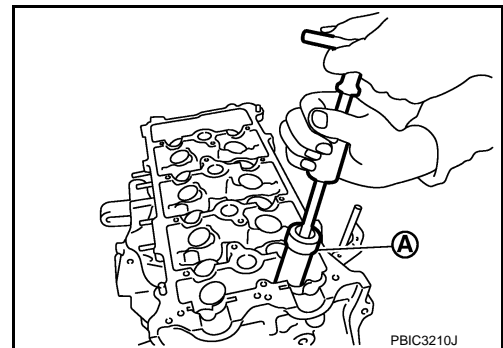


5. Remove valve spring retainer and valve spring (with valve spring seat).

CAUTION:

Never remove valve spring seat from valve spring.

6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.

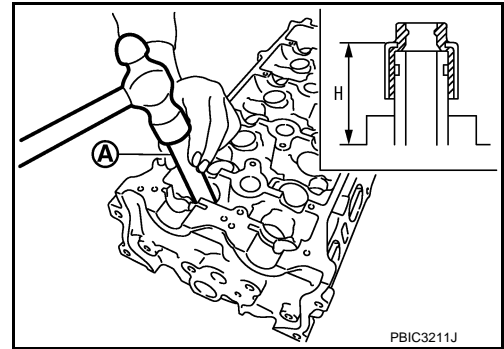
OIL SEAL

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

2. Press in valve oil seal to the height (H) shown in the figure with the valve oil seal drift [SST: KV10115600] (A).

Height (H) : 15.1 - 15.7 mm (0.594 - 0.618 in)



3. Install in the reverse order of removal, for the rest of parts.

FRONT OIL SEAL

FRONT OIL SEAL : Removal and Installation

INFOID:000000010715506

REMOVAL

1. Remove the following parts.
 - Front fender protector (RH): Refer to [EXT-31, "Exploded View"](#).
 - Drive belt: Refer to [EM-139, "Exploded View"](#).
 - Crankshaft pulley: Refer to [EM-222, "Exploded View"](#).
2. Remove front oil seal with a suitable tool.

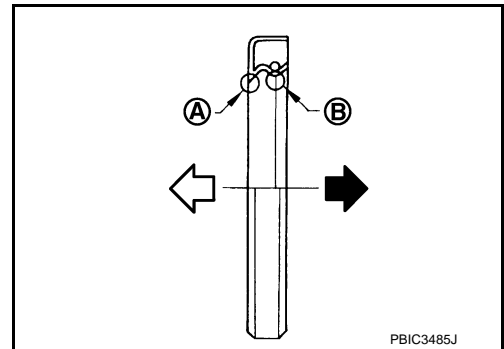
CAUTION:

Never damage front cover and crankshaft.

INSTALLATION

1. Apply new engine oil to new front oil seal joint surface and seal lip.
2. Install front oil seal so that each seal lip is oriented as shown in the figure.

- (A) : Dust seal lip
- (B) : Oil seal lip
- ⇐ : Engine outside
- ← : Engine inside



- Press-fit front oil seal using a suitable drift with outer diameter 57 mm (2.24 in) and inner diameter 45 mm (1.77 in).

Within 0.3 mm (0.012 in) toward engine front (crankshaft pulley side)

Within 0.5 mm (0.020 in) toward engine rear (crankshaft sprocket side)

CAUTION:

- **Never damage front cover and crankshaft.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**

3. Install in the reverse order of removal, for the rest of parts.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:000000010715507

REMOVAL

OIL SEAL

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

1. Remove transaxle assembly. Refer to [TM-415, "Exploded View"](#) (CVT models) or [TM-35, "Exploded View"](#) (6MT models).
2. Remove clutch cover and clutch disk (6MT models). Refer to [CL-19, "MR20DD : Exploded View"](#)
3. Remove drive plate (CVT models) or flywheel (6MT models). Refer to [EM-181, "Exploded View"](#) (CVT models) or [EM-178, "Exploded View"](#) (6MT models).
4. Remove rear oil seal with a suitable tool.

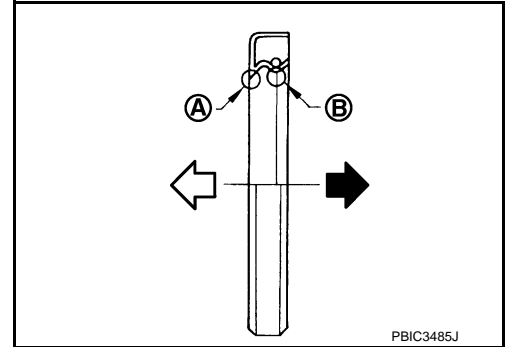
CAUTION:

Never damage crankshaft and cylinder block.

INSTALLATION

1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Liquid Gasket or equivalent.
2. Install rear oil seal so that each seal lip is oriented as shown in the figure.

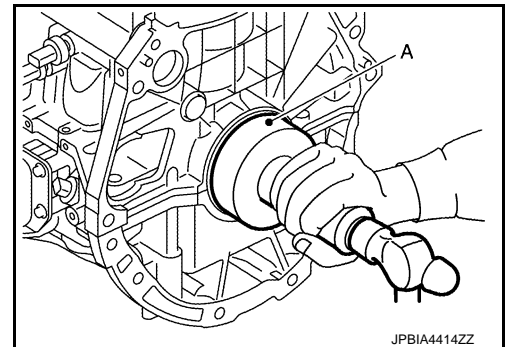
- Ⓐ : Dust seal lip
- Ⓑ : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



- Press-fit rear oil seal with a suitable drift (A) outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in).

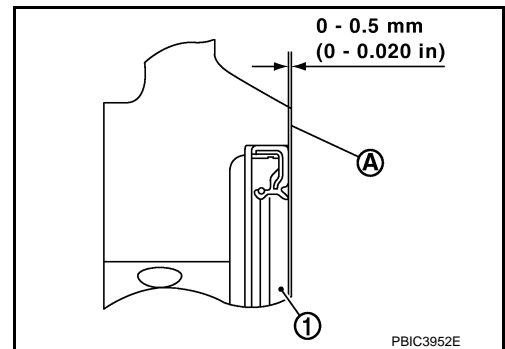
CAUTION:

- **Never damage crankshaft and cylinder block.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Never touch grease applied onto oil seal lip.**



- Press in rear oil seal ① to the position as shown in the figure.

- Ⓐ : Rear end surface of cylinder block



3. Install in the reverse order of removal, for the rest of parts.

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

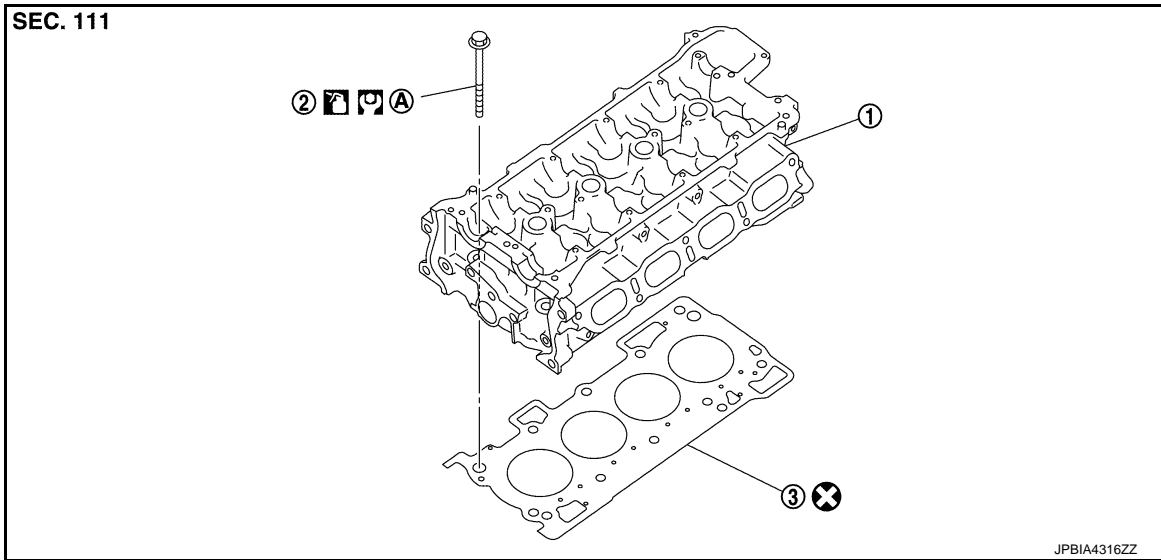
[MR20DD]

CYLINDER HEAD

Exploded View

INFOID:000000010715508

REMOVAL



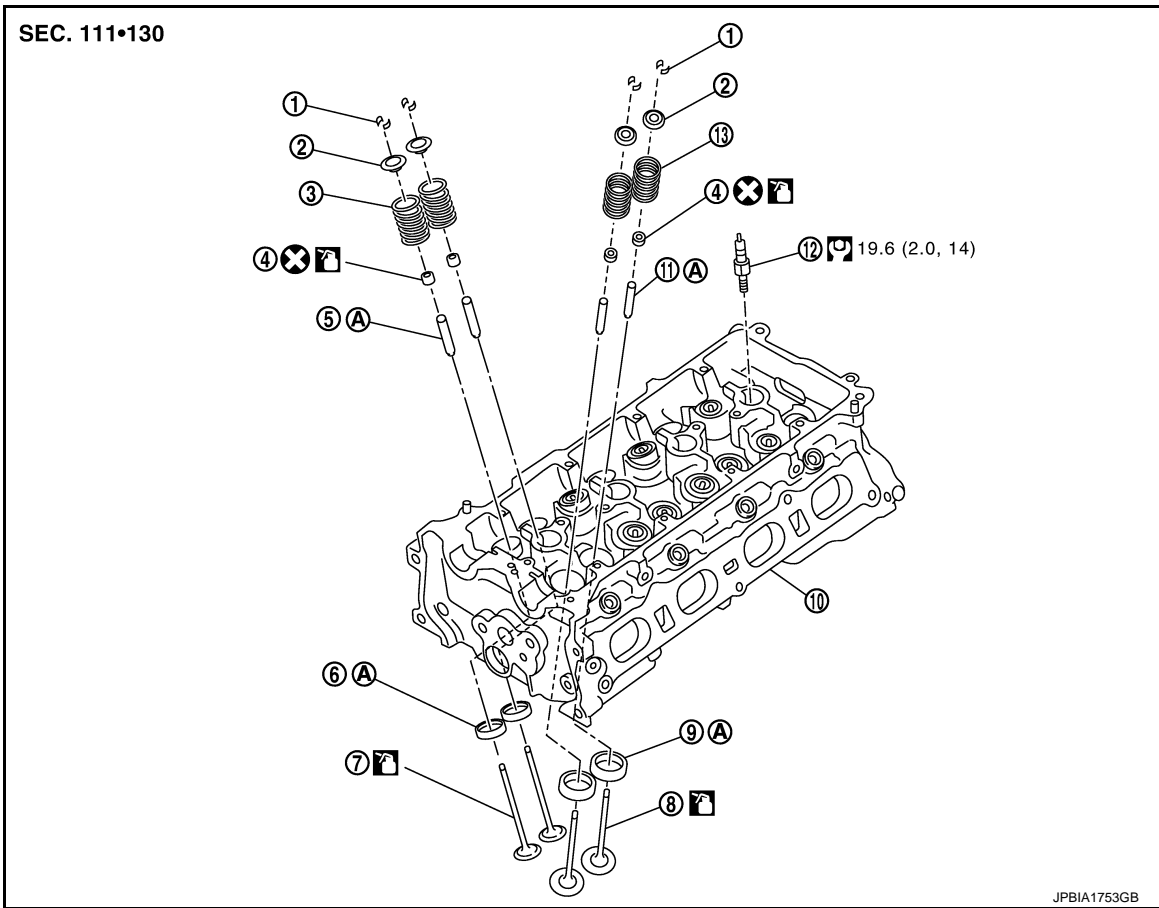
- ① Cylinder head assembly
- ② Cylinder head bolt
- ③ Cylinder head gasket
- Ⓐ Comply with the installation procedure when tightening. Refer to [EM-209](#)
- ⊗ : Always replace after every disassembly.
- Ⓜ : N·m (kg-m, ft-lb)
- Ⓛ : Should be lubricated with oil.

DISASSEMBLY

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]



- | | | |
|---|-------------------------|---|
| ① Valve collet | ② Valve spring retainer | ③ Valve spring (with valve spring seat) (EXH) |
| ④ Valve oil seal | ⑤ Valve guide (EXH) | ⑥ Valve seat (EXH) |
| ⑦ Valve (EXH) | ⑧ Valve (INT) | ⑨ Valve seat (INT) |
| ⑩ Cylinder head | ⑪ Valve guide (INT) | ⑫ Spark plug |
| ⑬ Valve spring (with valve spring seat) (INT) | | |
- Ⓐ Comply with the installation procedure when tightening. Refer to [EM-210](#)
- ⊗ : Always replace after every disassembly.
- Ⓜ : N·m (kg·m, ft·lb)
- Ⓛ : Should be lubricated with oil.

Removal and Installation

INFOID:000000010715509

REMOVAL

1. Release fuel pressure. Refer to [ECM-135, "Work Procedure"](#).
2. Drain engine coolant and engine oil. Refer to [CO-38, "Draining"](#) and [LU-23, "Draining"](#).
3. Remove the following components and related parts.
 - Intake manifold: Refer to [EM-149, "Exploded View"](#).
 - Exhaust manifold: Refer to [EM-153, "Exploded View"](#).
 - High pressure fuel pump: Refer to [EM-159, "Exploded View"](#).
 - Fuel tube and fuel injector assembly: Refer to [EM-164, "Exploded View"](#).
 - Water outlet: Refer to [CO-53, "Exploded View"](#).
 - Rocker cover: Refer to [EM-170, "Exploded View"](#).
 - Front cover, timing chain: Refer to [EM-183, "Exploded View"](#).

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

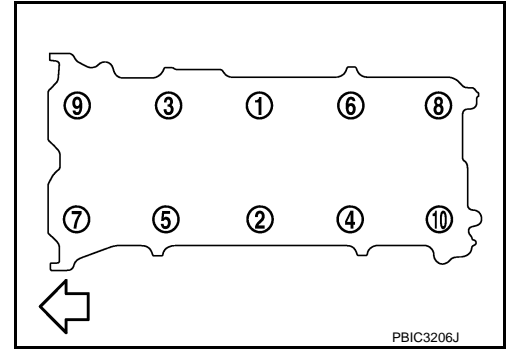
[MR20DD]

- Camshaft: Refer to [EM-196, "Exploded View"](#).

4. Remove cylinder head.
 - Loosen cylinder head bolts in the order from 10 to 1 as shown in the figure.

⇐ : Engine front

- Using TORX socket (size: E18), loosen cylinder head bolts.



5. Remove cylinder head gasket.

INSTALLATION

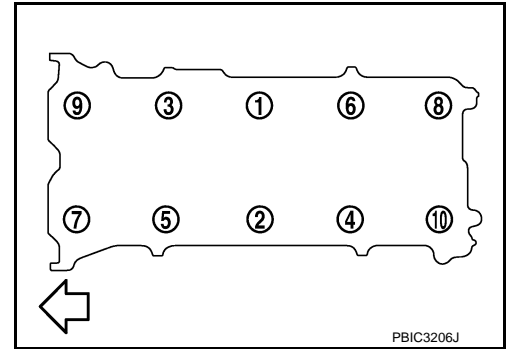
1. Install cylinder head gasket.
2. Install cylinder head, and tighten cylinder head bolts in the order from 1 to 10 as shown in the figure with the following procedure.

⇐ : Engine front

CAUTION:

If cylinder head bolts are reused, check their outer diameters before installation. Refer to [EM-215, "Inspection"](#).


- a. Apply new engine oil to threads and seating surface of mounting bolts.
- b. Tighten all cylinder head bolts.



: 40.0 N·m (4.1 kg·m, 30 ft·lb)

- c. Turn all cylinder head bolts 100 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100]  or protractor. Never judge by visual inspection without the tool.

- d. Completely loosen.

: 0 N·m (0 kg·m, 0 ft·lb)

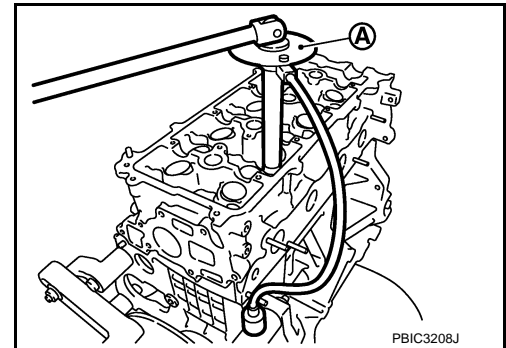
CAUTION:

In this step, loosen cylinder head bolts in reverse order that indicated in the figure.

- e. Tighten all cylinder head bolts.

: 40.0 N·m (4.1 kg·m, 30 ft·lb)

- f. Turn all cylinder head bolts 95 degrees clockwise (angle tightening).
 - g. Turn all cylinder head bolts 95 degrees clockwise again (angle tightening).
3. Install in the reverse order of removal, for the rest of parts.



Disassembly and Assembly

INFOID:000000010715510

DISASSEMBLY

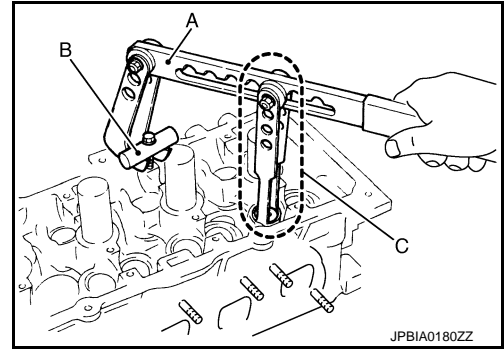
1. Remove spark plug with spark plug wrench (commercial service tool).
2. Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

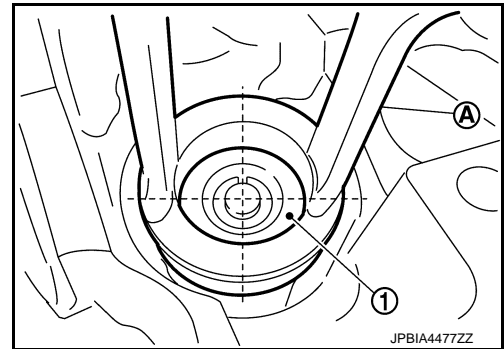
[MR20DD]

3. Remove valve collet.
 - Compress valve spring with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Remove valve collet with a magnet hand.



CAUTION:

- Be careful not to damage valve lifter holes.
- Fit the attachment [SST: KV10115900 (J-26336-20)] (A) in the center of valve spring retainer (1) to press it.

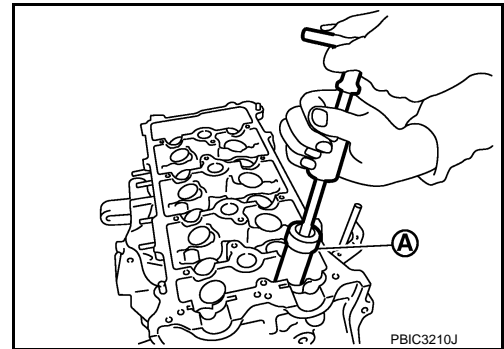


4. Remove valve spring retainer and valve spring (with valve spring seat).

CAUTION:

Never remove valve spring seat from valve spring.

5. Push valve stem to combustion chamber side, and remove valve.
 - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seal with a valve oil seal puller [SST: KV10107902] (A).



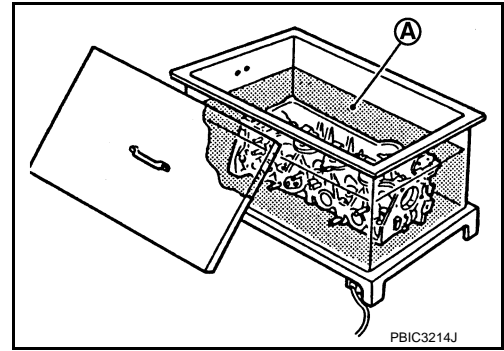
7. When valve seat must be replaced.
 - Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this. Refer to [EM-251, "Cylinder Head"](#).
- CAUTION:**
Never bore excessively to prevent cylinder head from scratching.
8. When valve guide must be replaced.

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

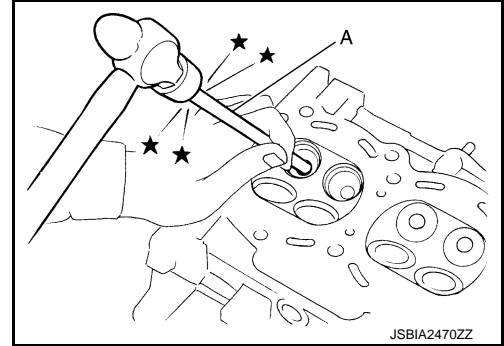
- a. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).



- b. Drive out valve guide with a hammer and valve guide drift (commercial service tool) (A).

CAUTION:

Cylinder head contains heat, wear protective equipment to avoid getting burned.



ASSEMBLY

1. When valve guide is removed, install it.

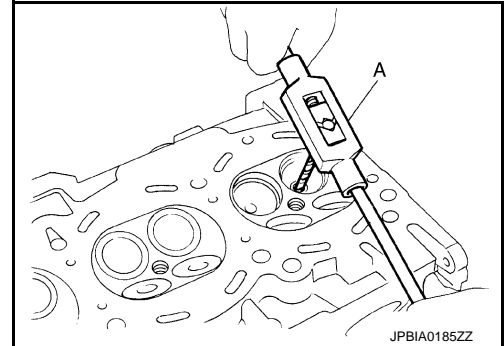
CAUTION:

Replace with oversize [0.2 mm (0.008 in)] valve guide.

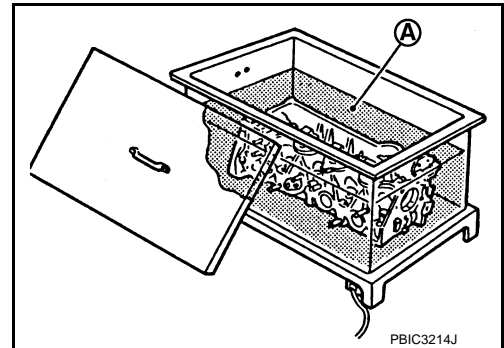
- a. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool) (A).

For service parts: Oversize [0.2 mm (0.008 in)]

Refer to [EM-251, "Cylinder Head"](#).



- b. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).



CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

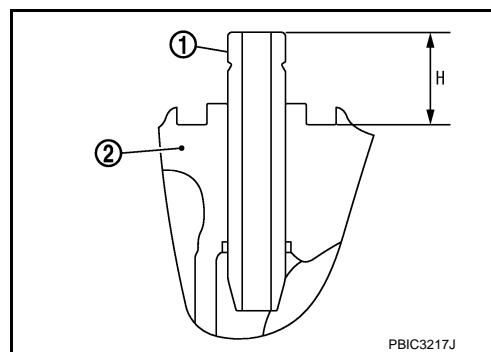
- c. Press valve guide ① from camshaft side to dimensions as shown in the figure.

② : Cylinder head

Projection (H) : Refer to [EM-251, "Cylinder Head"](#).

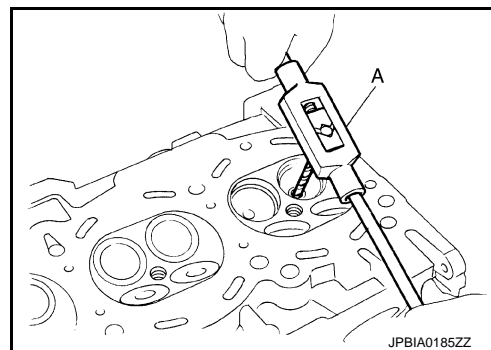
CAUTION:

Cylinder head contains heat, wear protective equipment to avoid getting burned.



- d. Apply reamer finish to valve guide with a valve guide reamer (commercial service tool) (A).

Standard : Refer to [EM-251, "Cylinder Head"](#).



2. When valve seat is removed, install it.

CAUTION:

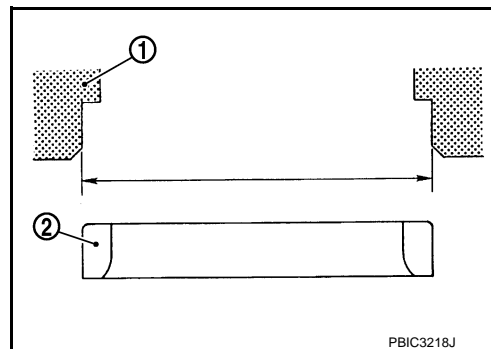
Replace with **oversize [0.5 mm (0.020 in)] valve seat**.

- a. Ream cylinder head ① recess diameter for service valve seat ②.

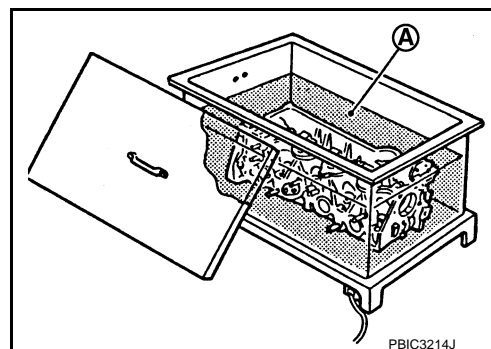
For service parts: Oversize [0.5 mm (0.020 in)]

Refer to [EM-251, "Cylinder Head"](#).

- Be sure to ream in circles concentric to the valve guide center. This will enable valve seat to fit correctly.



- b. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).



- c. Provide valve seats cooled well with dry ice. Press-fit valve seat into cylinder head.

CAUTION:

- **Never touch cold valve seats directly.**
- **Cylinder head contains heat, wear protective equipment to avoid getting burned.**

CYLINDER HEAD

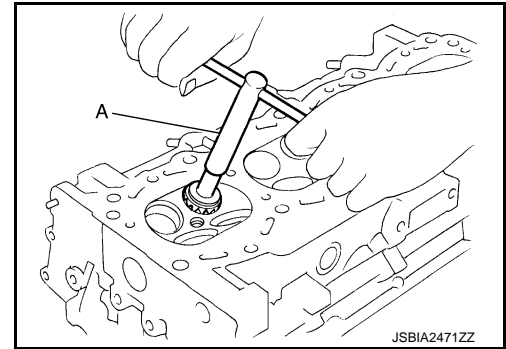
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- d. Using valve seat cutter set (commercial service tool) (A) or valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to [EM-251, "Cylinder Head"](#).

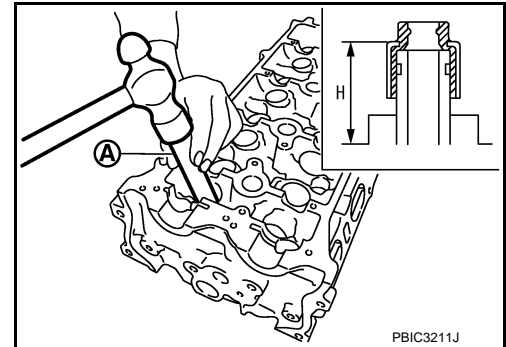
CAUTION:

When using valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with the cutter or cutting many different times may result in stage valve seat.



- e. Using compound, grind to adjust valve fitting.
f. Check again for normal contact. Refer to [EM-215, "Inspection"](#).
3. Install valve oil seal.
• Install with a valve oil seal drift [SST: KV10115600] (A) to match dimension in the figure.
NOTE:
Dimension is height that measured before installing valve spring (with valve spring seat).

Height (H) : 15.1 - 15.7 mm (0.594 - 0.618 in)

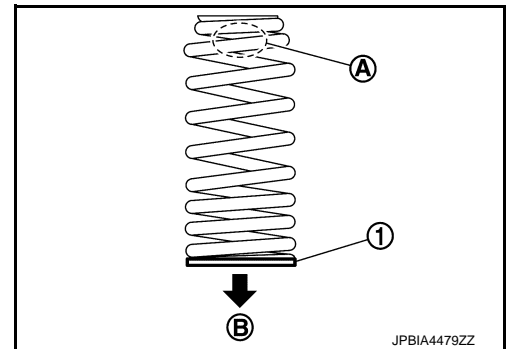


4. Install valve.
• Install larger diameter to intake side.
5. Install valve spring (with valve spring seat).
• Install smaller pitch (valve spring seat side) to cylinder head side (B).

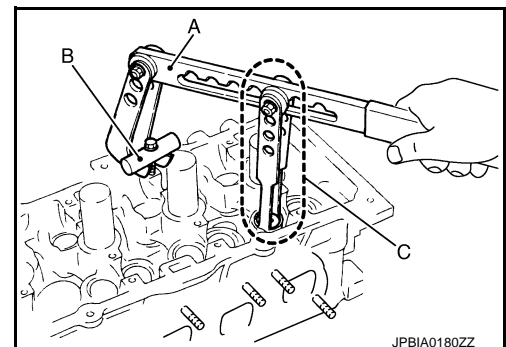
① : Valve spring seat (Do not remove from valve spring.)

- Confirm identification color (A) of valve spring.

Intake : White
Exhaust : Orange



6. Install valve spring retainer.
7. Install valve collet.
• Compress valve spring with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Install valve collet with a magnet hand.



CAUTION:

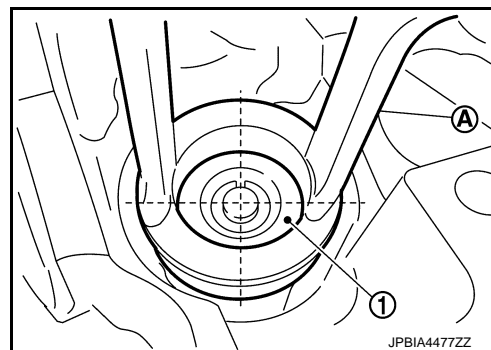
- Be careful not to damage valve lifter holes.

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Fit the attachment [SST: KV10115900 (J-26336-20)] ① in the center of valve spring retainer ① to press it.
- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.



8. Install valve lifter.
 - Install it in the original position.
9. Install spark plug with spark plug wrench (commercial service tool).

Inspection

INFOID:000000010715511

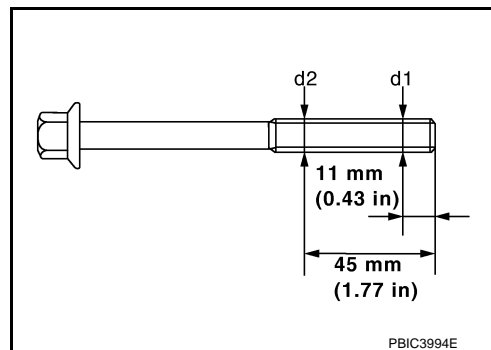
INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between (d1) and (d2) exceeds the limit, replace them with a new one.

Limit [(d1) – (d2)]: 0.15 mm (0.0059 in)

- If reduction of outer diameter appears in a position other than (d2), use it as (d2) point.



Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checked. Refer to [EM-231, "Inspection"](#).

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.

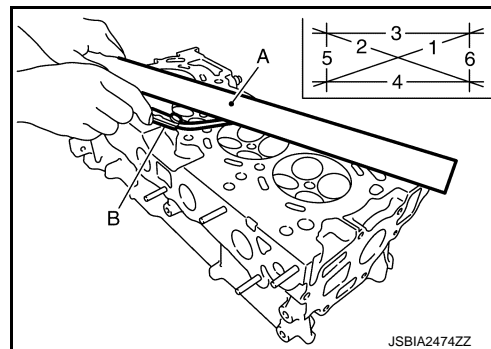
CAUTION:

Never allow gasket debris to enter passages for engine oil or water.

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions using straightedge (A) and feeler gauge (B).

Limit: Refer to [EM-251, "Cylinder Head"](#).

- If it exceeds the limit, replace cylinder head.



INSPECTION AFTER DISASSEMBLY

VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to [EM-251, "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

VALVE GUIDE CLEARANCE

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

Valve Stem Diameter

- Measure the diameter of valve stem with micrometer (B).

Standard: Refer to [EM-251, "Cylinder Head"](#).

Valve Guide Inner Diameter

- Measure the inner diameter of valve guide with bore gauge (A).

Standard: Refer to [EM-251, "Cylinder Head"](#).

Valve Guide Clearance

- (Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

Standard and Limit: Refer to [EM-251, "Cylinder Head"](#).

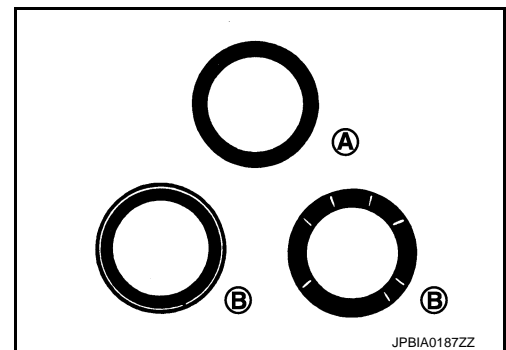
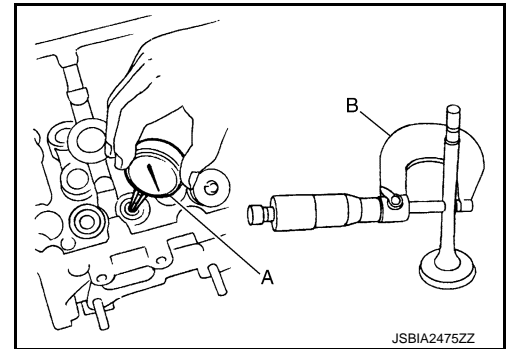
- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to [EM-210, "Disassembly and Assembly"](#).

VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.

Ⓐ : OK

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions Ⓑ even after the recheck, replace valve seat. Refer to [EM-210, "Disassembly and Assembly"](#).



VALVE SPRING SQUARENESS

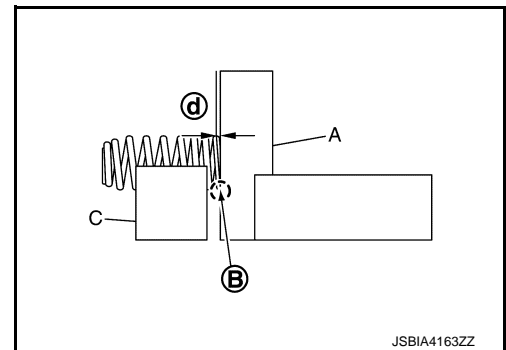
- Set a try square (A) along the side of valve spring and rotate spring. Measure the maximum clearance ⓓ between the top of spring and try square.

Ⓑ : Contact

C : V-block

Limit : Refer to [EM-251, "Cylinder Head"](#).

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

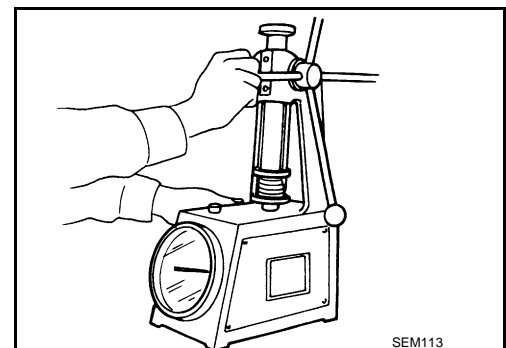
- Check valve spring pressure with valve spring seat installed at the specified spring height.

CAUTION:

Never remove valve spring seat from valve spring.

Standard : Refer to [EM-251, "Cylinder Head"](#).

- If the installation load or load with valve open is out of the standard, replace valve spring (with valve spring seat).



CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59. "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

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OIL PAN (UPPER)

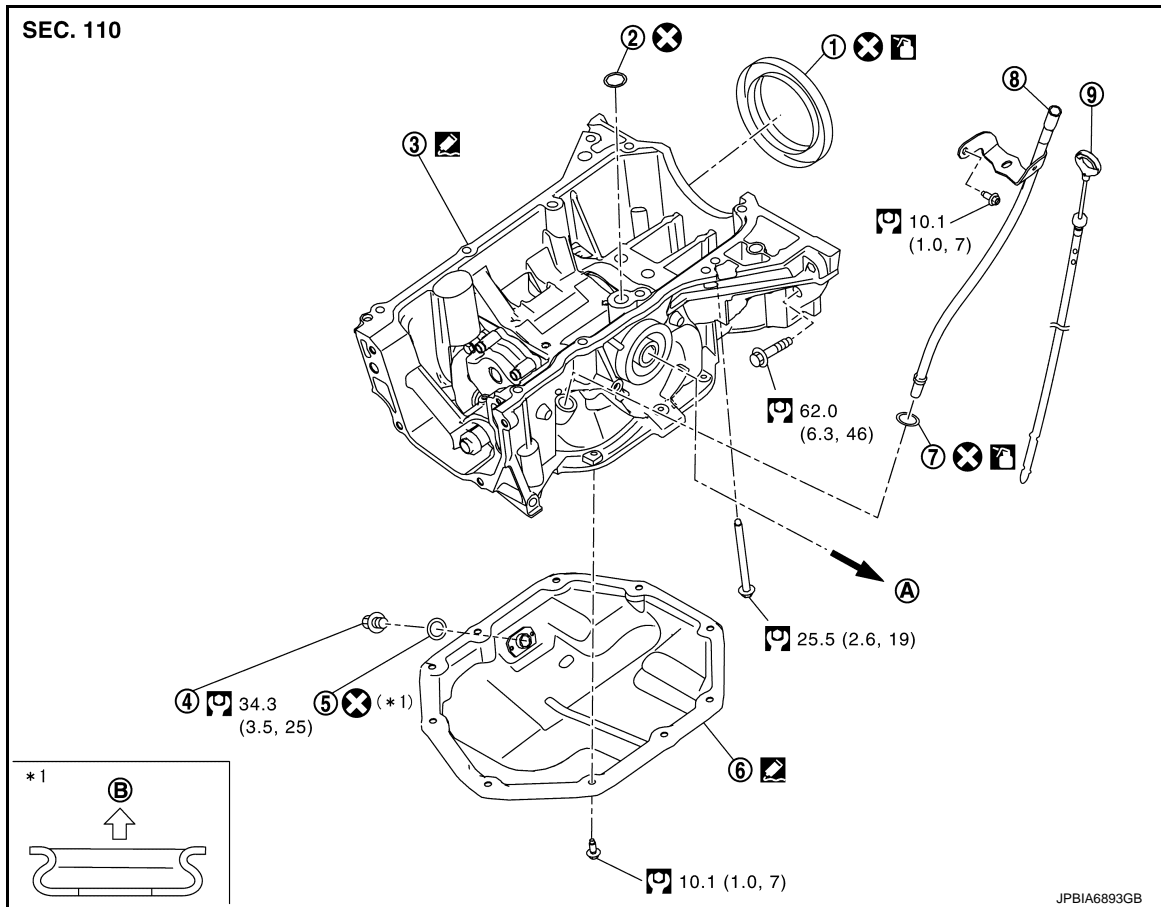
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

OIL PAN (UPPER)

Exploded View

INFOID:000000010715512



- | | | |
|-------------------|--------------------------|-------------------|
| ① Rear oil seal | ② O-ring | ③ Oil pan (upper) |
| ④ Drain plug | ⑤ Drain plug washer | ⑥ Oil pan (lower) |
| ⑦ O-ring | ⑧ Oil level gauge guide | ⑨ Oil level gauge |
| (A) To oil cooler | (B) Oil pan (lower) side | |

← : Oil pan side

⊗ : Always replace after every disassembly.

Ⓜ : N·m (kg·m, ft·lb)

🛢 : Should be lubricated with oil.

🖌 : Sealing point

Removal and Installation

INFOID:000000010715513

REMOVAL

1. Remove oil pan (lower). Refer to [EM-156, "Exploded View"](#).
2. Remove oil filter. Refer to [LU-25, "Removal and Installation"](#).
3. Remove water hoses of oil cooler.
4. Remove oil level gauge and oil level gauge guide.
5. Remove front cover, timing chain, balancer unit timing chain, and other related parts. Refer to [EM-183, "Exploded View"](#).

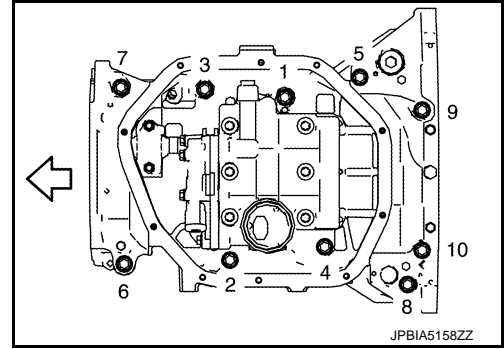
OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

6. Remove oil pan (upper) with the following procedure:
 - a. Loosen bolts in the order from 10 to 1 as shown in the figure.

← : Engine front

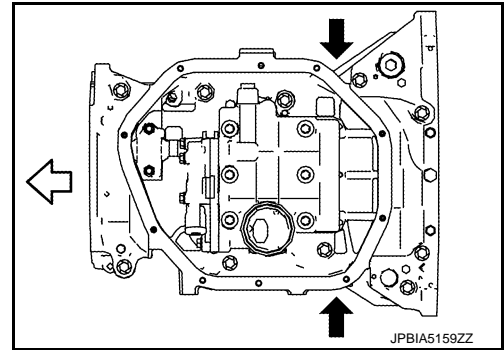


- b. Insert a screwdriver shown by the arrow (↔) in the figure and open up a crack between oil pan (upper) and cylinder block.

← : Engine front

CAUTION:

A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.



- c. Insert seal cutter [SST: KV10111100] between oil pan (upper) and cylinder block, and slide it by tapping on the side of the tool with a hammer.

CAUTION:

Be careful not to damage the mating surface.

7. Remove O-ring between cylinder block and oil pan (upper).
 8. Remove rear oil seal. Refer to [EM-206. "REAR OIL SEAL : Removal and Installation"](#).
 9. Remove oil temperature sensor, if necessary.
 10. Remove oil cooler, if necessary. Refer to [LU-26. "Exploded View"](#).

INSTALLATION

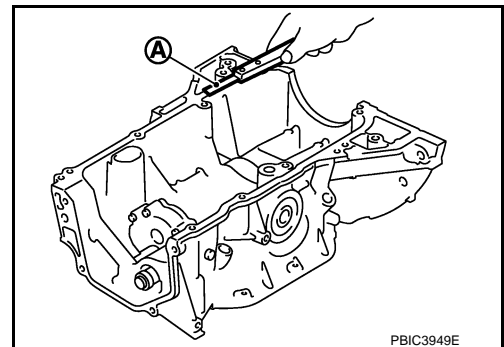
CAUTION:

Do not reuse O-rings.

1. Install oil pan (upper) with the following procedure:
 - a. Use a scraper (A) to remove old liquid gasket from mating surfaces.
 - Remove the old liquid gasket from mating surface of cylinder block.
 - Remove old liquid gasket from the bolt holes and threads.

CAUTION:

Never scratch or damage the mating surfaces when cleaning off old liquid gasket.



OIL PAN (UPPER)

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

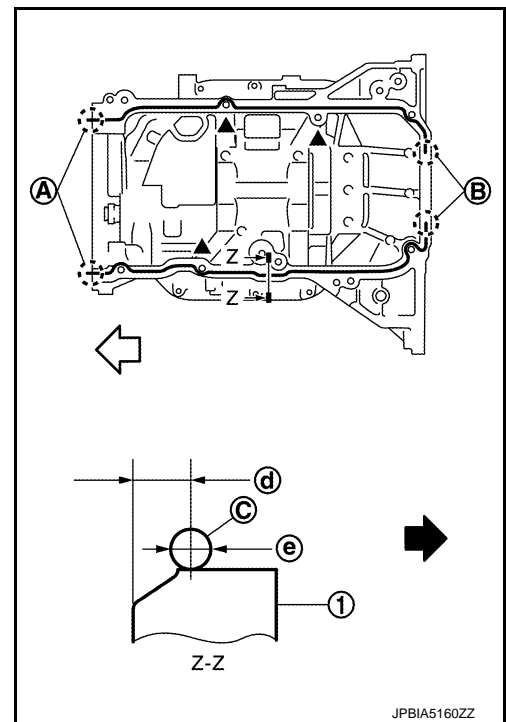
- b. Apply a continuous bead of liquid gasket © with a tube presser (commercial service tool) as shown in the figure.

- ① : Oil pan (upper)
- Ⓐ : 2 mm (0.08 in) protruded to outside
- Ⓑ : 2 mm (0.08 in) protruded to rear oil seal mounting side
- Ⓓ : 6.5 mm (0.26 in)
- Ⓔ : $\phi 4.0 - 5.0$ (0.157 - 0.197 in)
- ⇐ : Engine front
- ← : Engine outside

Use Genuine Liquid Gasket (Three Bond 1217H) or equivalent.

CAUTION:

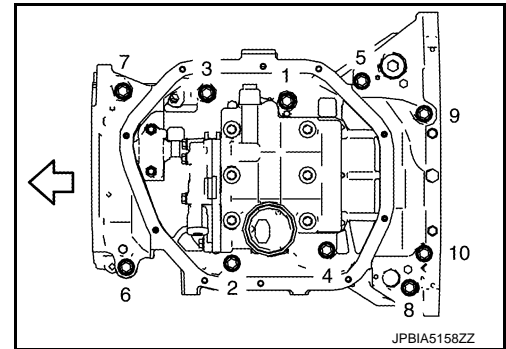
- Apply liquid gasket to outside of bolt hole for the positions shown by ▲ marks.
- Attaching should be done within 5 minutes after liquid gasket application.



JPBIA5160ZZ

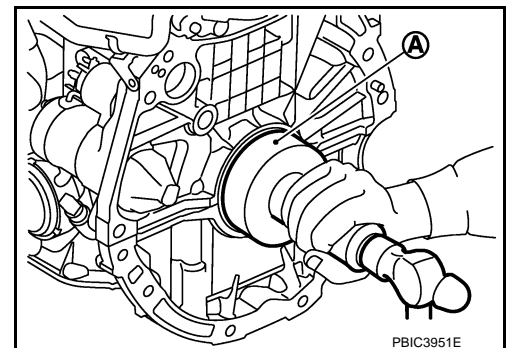
- c. Install new O-ring at cylinder block side.
- CAUTION:**
Install avoiding misalignment of O-ring.
- d. Tighten bolts in the order from 1 to 10 as shown in the figure.

- ⇐ : Engine front



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2. Install rear oil seal with the following procedure.
- CAUTION:**
- The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).
 - Always replace rear oil seal with new one.
 - Never touch oil seal lip.
- a. Wipe off liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a scraper.
- b. Apply engine oil to entire outside area of rear oil seal.
- c. Press-fit the rear oil seal using a suitable drift Ⓐ with outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in).



PBIC3951E

OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Press-fit to the specified dimensions as shown in the figure.

- ① : Rear oil seal
- Ⓐ : Cylinder block rear end surface
- Ⓑ : 0 - 0.5 mm (0 - 0.020 in)

CAUTION:

- **Never touch the grease applied to the oil seal lip.**
- **Be careful not to damage the rear oil seal mounting part of oil pan (upper) and cylinder block or the crankshaft.**
- **Press-fit straight, checking that rear oil seal does not curl or tilt.**

NOTE:

The standard surface of the dimension is the rear end surface of cylinder block.

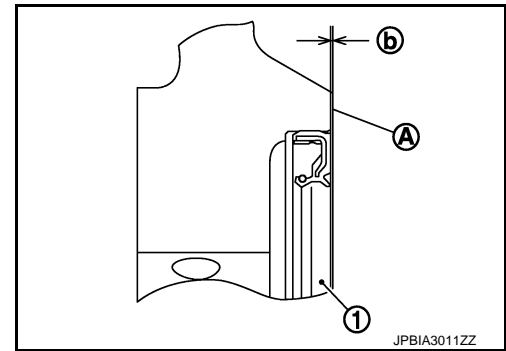
3. Install in the reverse order of removal, for the rest of parts.

Inspection

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INSPECTION AFTER REMOVAL

Clean oil strainer portion (part of the oil pump) if any object attached.



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CYLINDER BLOCK

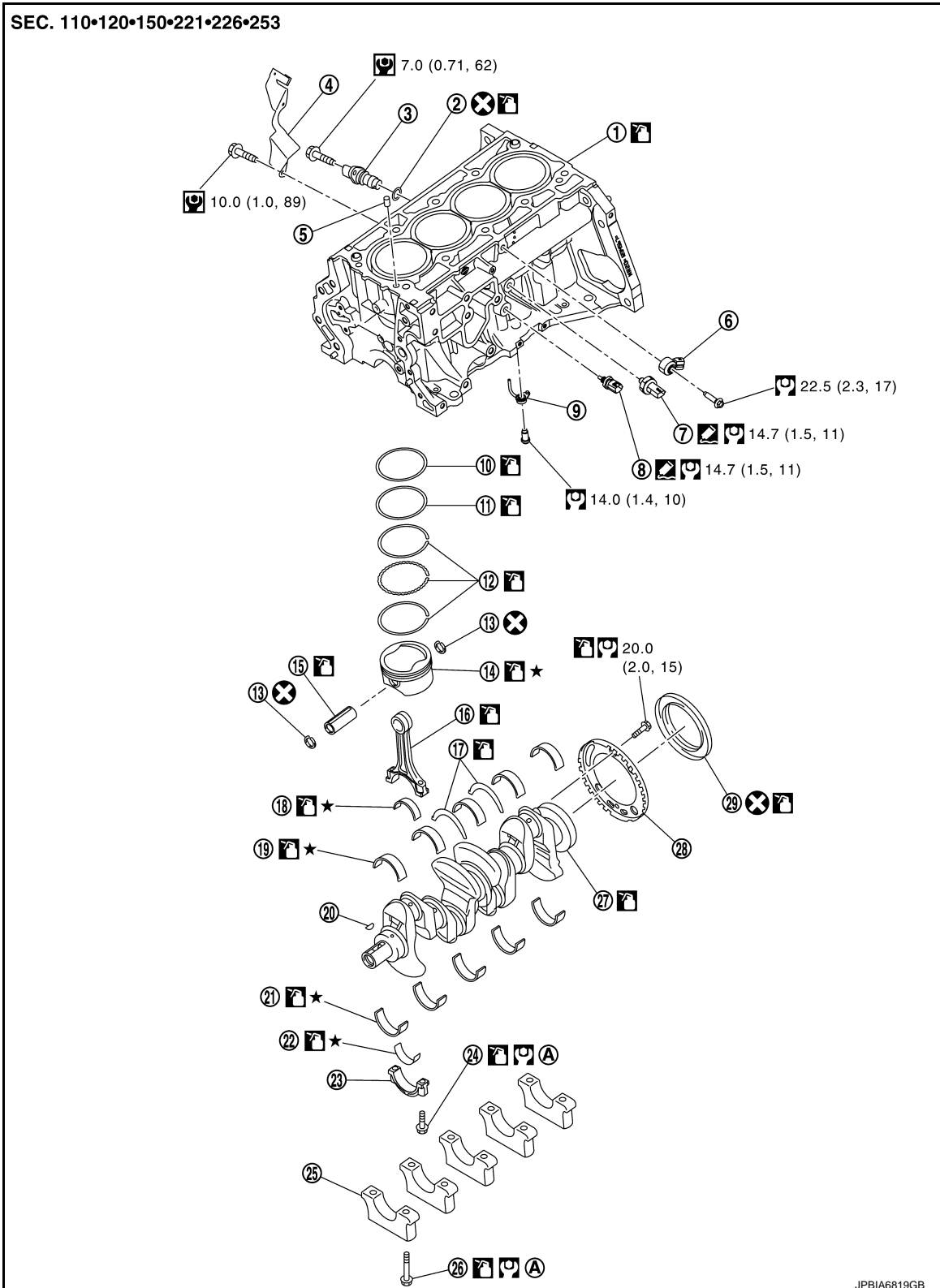
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

CYLINDER BLOCK

Exploded View

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JPBIA6819GB

- | | | |
|--|--|------------------------------------|
| ① Cylinder block | ② O-ring | ③ Crankshaft position sensor (POS) |
| ④ Crankshaft position sensor (POS) cover | ⑤ Oil filter (for intake valve timing control) | ⑥ Knock sensor |

CYLINDER BLOCK

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

- | | | |
|----------------------------------|--------------------------|----------------------------------|
| ⑦ Oil pressure switch | ⑧ Oil temperature sensor | ⑨ Oil jet |
| ⑩ Top ring | ⑪ Second ring | ⑫ Oil ring |
| ⑬ Snap ring | ⑭ Piston | ⑮ Piston pin |
| ⑯ Connecting rod | ⑰ Thrust bearing | ⑱ Connecting rod bearing (upper) |
| ⑲ Main bearing (upper) | ⑳ Crankshaft key | ㉑ Main bearing (lower) |
| ㉒ Connecting rod bearing (lower) | ㉓ Connecting rod cap | ㉔ Connecting rod cap bolt |
| ㉕ Main bearing cap | ㉖ Main bearing cap bolt | ㉗ Crankshaft |
| ㉘ Signal plate | ㉙ Rear oil seal | |

Ⓐ Comply with the installation procedure when tightening. Refer to [EM-223](#)

⊗ : Always replace after every disassembly.

Ⓜ : N·m (kg·m, ft·lb)

Ⓜ : N·m (kg·m, in·lb)

Ⓜ : Sealing point

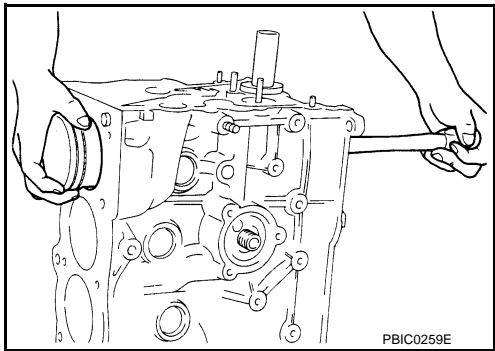
Ⓜ : Should be lubricated with oil.

★ : Select with proper thickness.

Disassembly and Assembly

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DISASSEMBLY

- Remove oil pan (upper). Refer to [EM-218, "Exploded View"](#).
 - Remove thermostat housing. Refer to [CO-51, "Exploded View"](#).
 - Remove knock sensor.
CAUTION:
Handle it carefully and avoid impacts.
 - Remove crankshaft position sensor (POS) cover and crankshaft position sensor (POS).
CAUTION:
 - **Handle crankshaft position sensor (POS) carefully and avoid impacts.**
 - **Never disassemble.**
 - **Never place crankshaft position sensor (POS) in a location where it is exposed to magnetism.**
 - Remove oil filter (for intake valve timing control).
 - Remove piston and connecting rod assembly with the following procedure:
 - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-102, "Inspection"](#).
 - a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
 - b. Remove connecting rod cap.
 - c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.
CAUTION:
 - **Be careful not to damage matching surface with connecting rod cap.**
 - **Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.**
- 
- Remove connecting rod bearings.
CAUTION:
When removing them, note the installation position. Keep them in the correct.

CYLINDER BLOCK

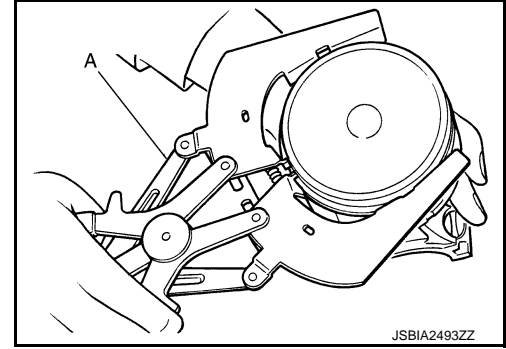
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

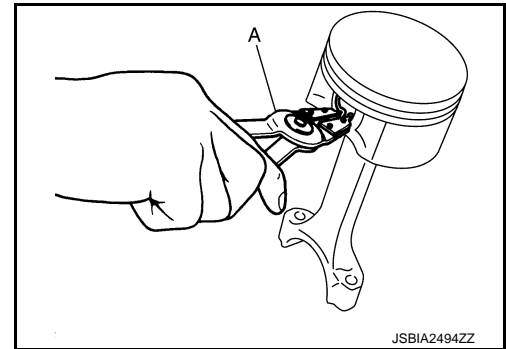
8. Remove piston rings from piston.
- Before removing piston rings, check the piston ring side clearance. Refer to [EM-102, "Inspection"](#).
 - Use a piston ring expander (commercial service tool) (A).

CAUTION:

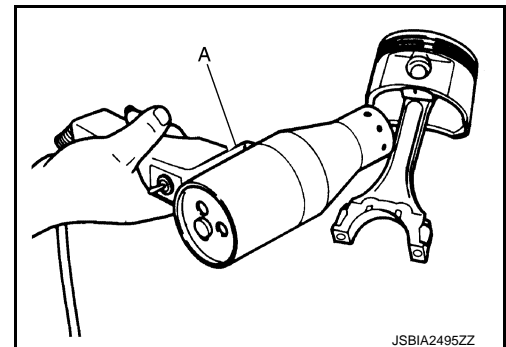
- When removing piston rings, be careful not to damage the piston.
- Be careful not to damage piston rings by expanding them excessively.



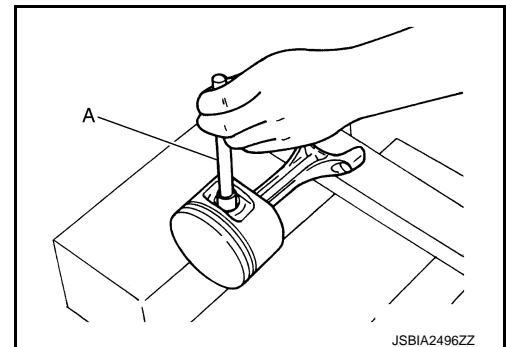
9. Remove piston from connecting rod with the following procedure:
- a. Using snap ring pliers (A), remove snap rings.



- b. Heat piston to 60 to 70°C (140 to 158°F) with an industrial use drier (A) or equivalent.



- c. Push out piston pin with stick (A) of outer diameter approximately 18 mm (0.71 in).



10. Remove main bearing cap bolts.
- Measure crankshaft end play before loosening main bearing cap bolts. Refer to [EM-231, "Inspection"](#).

CYLINDER BLOCK

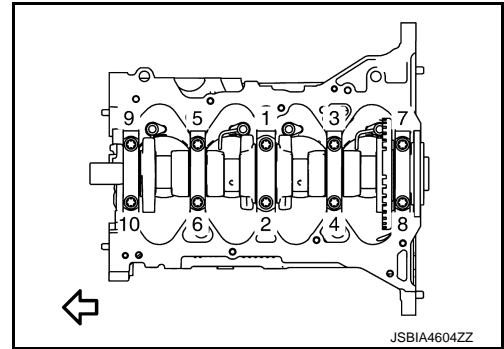
[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Loosen and remove main bearing cap bolts in the order from 10 to 1 as shown in the figure.

↶ : Engine front

- Use TORX socket.



- Remove main bearing caps.
 - Tap main bearing caps lightly with a plastic hammer for removal.

CAUTION:

Be careful not to damage the mounting surface.

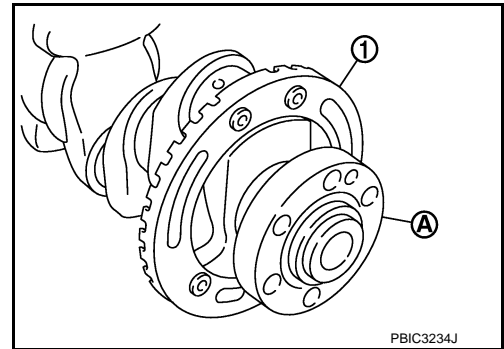
- Remove crankshaft.

CAUTION:

- Be careful not to damage or deform signal plate ① mounted on rear end of crankshaft ②.
- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.
- Never remove signal plate unless it is necessary to do so.

NOTE:

When removing or installing signal plate, use TORX socket.



- Pull rear oil seal out from rear end of crankshaft.

- Remove main bearings and thrust bearings from cylinder block and main bearing caps.

CAUTION:

Identify installation positions, and store them without mixing them up.

ASSEMBLY

CAUTION:

Do not reuse O-rings or washers.

- Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.

CAUTION:

Use a goggles to protect your eye.

- Install each plug to cylinder block as shown in the figure.

② : Washer

↶ : Engine front

CAUTION:

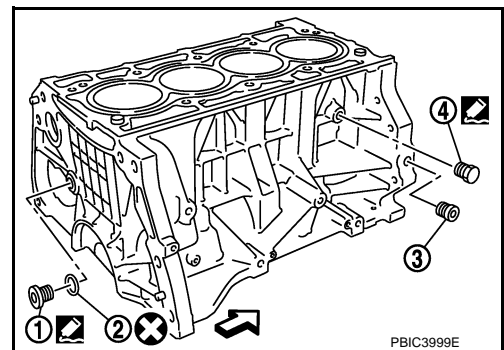
Do not reuse washer.

- Apply liquid gasket to the thread of water drain plug ④. Use **Genuine Liquid Gasket (Three Bond 1215)** or equivalent.

- Apply sealant to the thread of plug ①. Use **genuine high strength thread locking sealant (Three Bond 1386B)** or equivalent.

NOTE:

Do not apply liquid gasket or high strength thread locking sealant to the plug ③.



- Tighten each plug as specified below.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

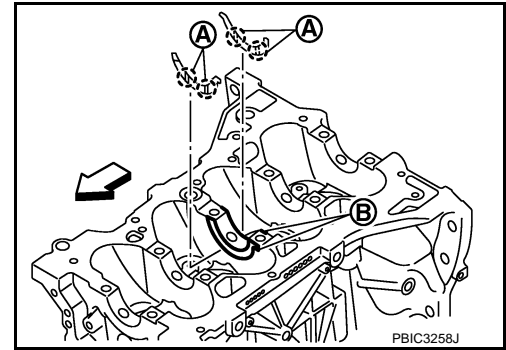
Part	Washer	Tightening torque
①	Yes	54.0 N·m (5.5 kg-m, 40 ft-lb)
③	No	19.6 N·m (2.0 kg-m, 14 ft-lb)
④	No	9.8 N·m (1.0 kg-m, 87 in-lb)

3. Install main bearings and thrust bearings with the following procedure:

- a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and main bearing cap.
- b. Install thrust bearings to the both sides of the No. 3 journal housing ② on cylinder block.

⇐ : Engine front

- Install thrust bearings with the oil groove ① facing crankshaft arm (outside).

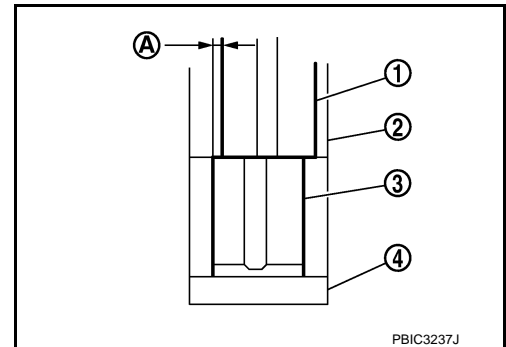


c. Install the main bearings paying attention to the direction.

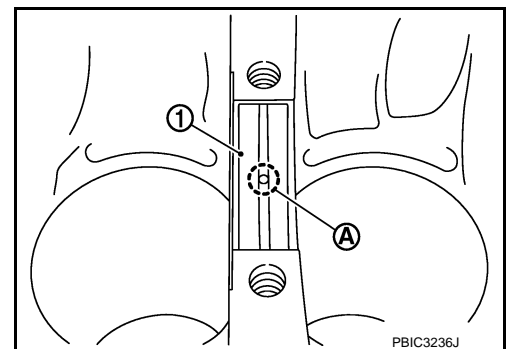
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.
- When installing, align main bearing to the center position of cylinder block and main bearing cap.
- The difference ① between main bearing (upper) ① and main bearing (lower) ③ should be 0.85 mm (0.0335 in) or less when installing.

② : Cylinder block

④ : Main bearing cap



- Ensure the oil holes on cylinder block and oil holes ① on the main bearings ① are aligned.



4. Install signal plate to crankshaft if removed.

- a. Set the signal plate with the flange facing toward the counter weight side (engine front side) to the crankshaft rear surface.
- b. Apply new engine oil to threads and seat surfaces of mounting bolts.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- c. Position crankshaft ② and signal plate ① using a dowel pin (service part), and tighten mounting bolts in the order from 1 to 4 as shown in the figure using TORX socket.

Ⓐ : Dowel pin hole

NOTE:

Dowel pin of crankshaft and signal plate is provided as a set for each.

- d. Tighten mounting bolts in numerical order as shown in the figure again.
- e. Remove dowel pin. (service parts)

CAUTION:

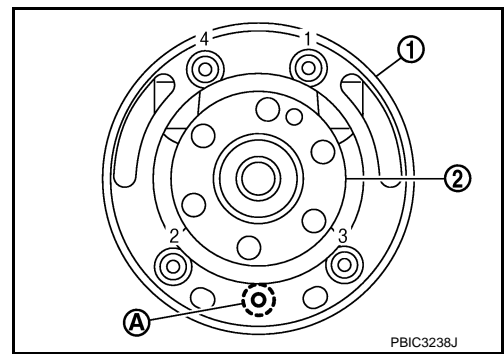
Be sure to remove dowel pin.

5. Install crankshaft to cylinder block.
- While turning crankshaft by hand, check that it turns smoothly.
6. Install main bearing caps with the following procedure:
- a. Install main bearing caps referring to the journal No. stamp Ⓐ and front mark Ⓑ as shown in the figure.

↶ : Engine front

NOTE:

Main bearing cap cannot be replaced as a single part, because it is machined together with cylinder block.



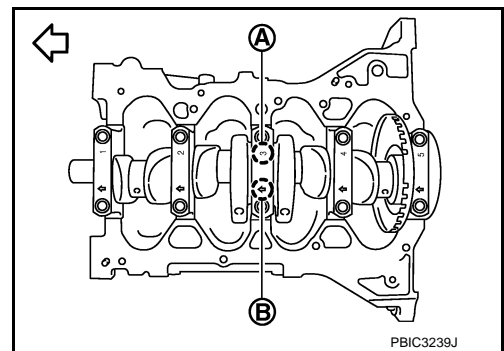
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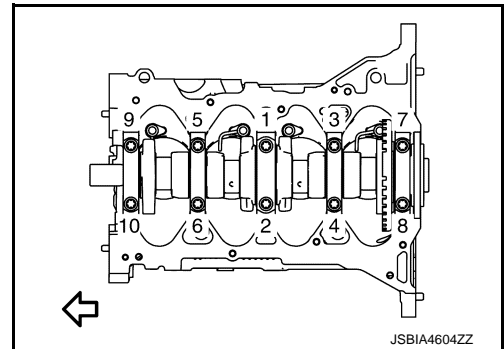
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- b. Tighten main bearing cap bolts in the order from 1 to 10 as shown in the figure with the following procedure:

↶ : Engine front

- i. Apply new engine oil to threads and seat surfaces of mounting bolts.
- ii. Tighten main bearing cap bolts.

: 34.3 N·m (3.5 kg·m, 25 ft·lb)



J

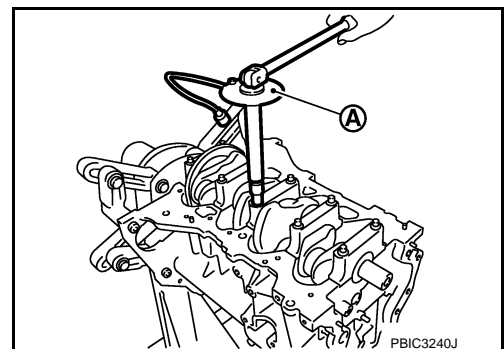
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- iii. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in order from No. 1 to 10 in the figure.

CAUTION:

Confirm the tightening angle by using an angle wrench [SST: KV10112100] Ⓐ or protractor. Never judge by visual inspection without the tool.



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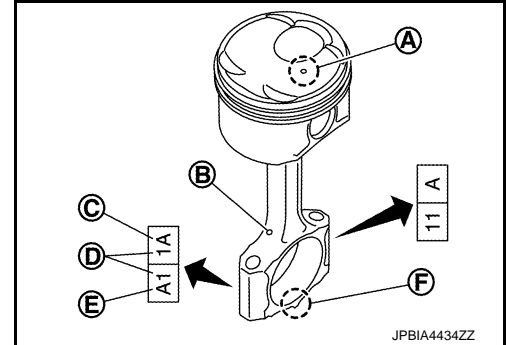
- After installing mounting bolts, check that crankshaft can be rotated smoothly by hand.
 - Check crankshaft end play. Refer to [EM-231, "Inspection"](#).
7. Install piston to connecting rod with the following procedure:

CYLINDER BLOCK

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

- a. Using snap ring pliers, install new snap ring to the groove of the piston rear side.
 - Insert it fully into groove to install.
- b. Assemble piston to connecting rod.
 - Using an industrial use drier or similar tool, heat the piston until the piston pin can be pushed in by hand without excess force [approximately 60 to 70°C (140 to 158°F)]. From the front to the rear, insert piston pin into piston and connecting rod.
 - Assemble so that the front mark (A) on the piston head and the oil hole (B) and the cylinder number (D) on connecting rod are positioned as shown in the figure.



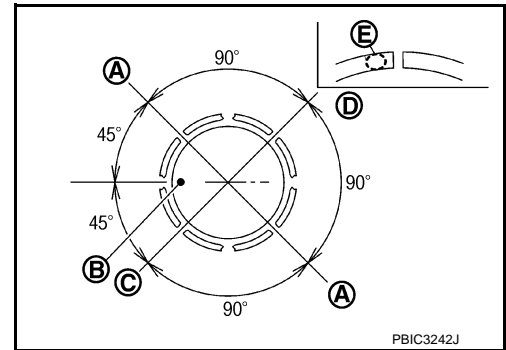
- (C) : Management code
- (E) : Big end diameter grade
- (F) : Front mark (connecting rod cap)

- c. Install new snap ring to the groove of the piston front side.
 - Insert it fully into groove to install.
 - After installing, check that connecting rod moves smoothly.
8. Using a piston ring expander (commercial service tool), install piston rings.

CAUTION:

- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.
- Position each ring with the gap as shown in the figure referring to the piston front mark.

- (A) : Oil ring upper or lower rail gap
- (B) : Front mark
- (C) : Second ring and oil ring spacer gap
- (D) : Top ring gap
- (E) : Stamped mark



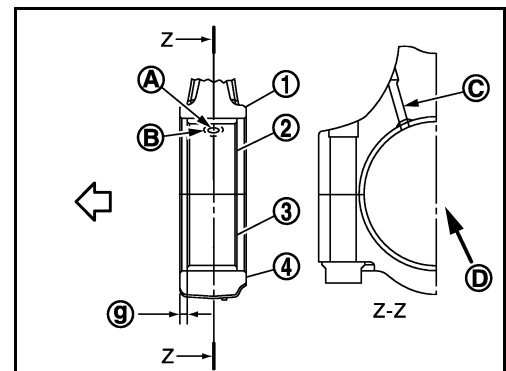
CAUTION:

Never contact the rail end gap under the oil ring with the oil drain cast groove of piston.

- Install second ring with the stamped surface facing upward.

9. Install connecting rod bearing upper (2) and lower (3) to connecting rod (1) and connecting rod cap (4).

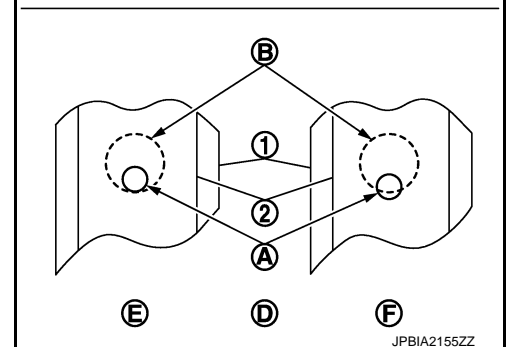
- (C) : Oil hole (connecting rod)
- (D) : View D
- (E) : OK
- (F) : NG
- (G) : 2.55 - 2.95 mm (0.1004 - 0.1161 in)
- ← : Engine front



- Install the connecting rod in the dimension shown in the figure.
- Check that connecting rod bearing oil hole (A) is completely in the inside of connecting rod oil hole chamfered area (B).
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.

NOTE:

- There is no positioning tab.



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

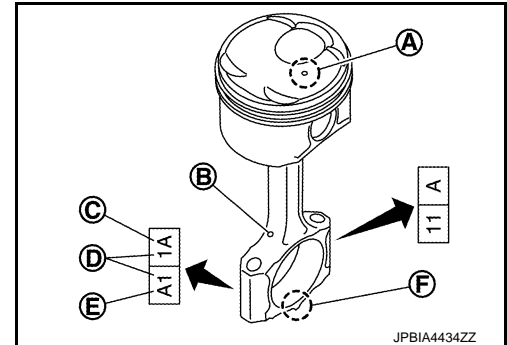
- Install the connecting rod bearings in the center of connecting rod and connecting rod cap as shown in the figure. For service operation, the center position can be checked, visually.

10. Install piston and connecting rod assembly to crankshaft.

- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number ① on connecting rod to install.

- Ⓑ : Oil hole
- Ⓒ : Management code
- Ⓔ : Big end diameter grade
- Ⓕ : Front mark (connecting rod cap)

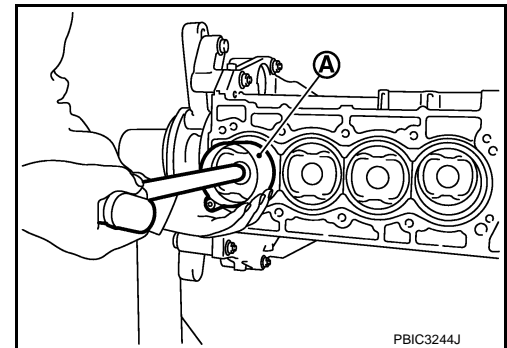
- Install so that front mark Ⓐ on the piston head faces the front of engine.



- Using a piston ring compressor [SST: EM03470000] Ⓐ or suitable tool, install piston with the front mark on the piston head facing the front of the engine.

CAUTION:

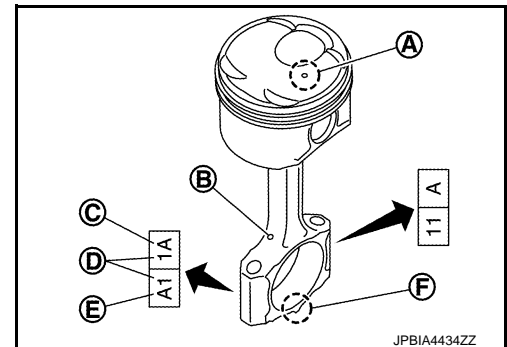
Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



11. Install connecting rod cap.

- Match the stamped cylinder number marks ① on connecting rod with those on connecting rod cap to install.

- Ⓐ : Front mark (piston)
- Ⓑ : Oil hole
- Ⓒ : Management code
- Ⓔ : Big end diameter grade
- Ⓕ : Front mark (connecting rod cap)



12. Tighten connecting rod cap bolt with the following procedure:

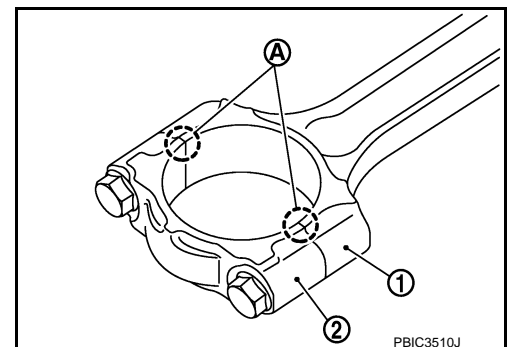
CAUTION:

- Check that there is no gap in the thrust surface Ⓐ of the joint between connecting rod ① and connecting rod cap ② and that these parts are in the correct position. And then, tighten the connecting rod cap bolts.
- If the connecting rod cap bolts are reused, measure the outer diameter. Refer to [EM-231, "Inspection"](#).

- a. Apply new engine oil to the threads and seats of connecting rod cap bolts.
- b. Tighten connecting rod cap bolts.

: 27.5 N·m (2.8 kg·m, 20 ft·lb)

- c. Completely loosen connecting rod cap bolts.



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

: 0 N·m (0 kg·m, 0 ft·lb)

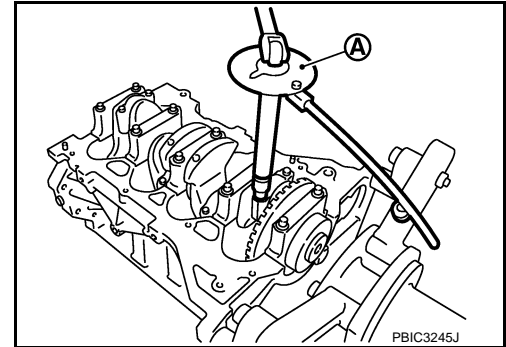
d. Tighten connecting rod cap bolts.

: 19.6 N·m (2.0 kg·m, 14 ft·lb)

e. Then turn all connecting rod cap bolts 60 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100] (A) or protractor. Never judge by visual inspection without the tool.



- After tightening connecting rod cap bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-231, "Inspection"](#).

13. Install oil pan (upper). Refer to [EM-218, "Exploded View"](#).

NOTE:

Install the rear oil seal after installing the oil pan (upper).

14. Install rear oil seal. Refer to [EM-206, "REAR OIL SEAL : Removal and Installation"](#).

15. Install drive plate. Refer to [EM-181, "Removal and Installation"](#)

16. Install knock sensor.

- Install knock sensor (1) with harness connector facing toward the rear of engine.

(A) : Cylinder block left side

← : Engine front

CAUTION:

- Never tighten mounting bolts while holding the harness connector.
- If any impact by dropping is applied to knock sensor, replace it with a new one.

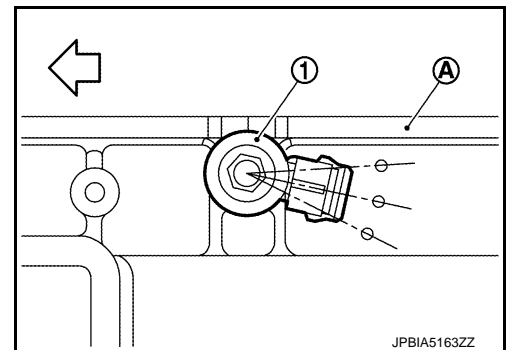
NOTE:

- Check that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Check that knock sensor does not interfere with other parts.

17. Install crankshaft position sensor (POS) and crankshaft position sensor (POS) cover.

CAUTION:

- Handle crankshaft position sensor (POS) carefully and avoid impacts.
- Never disassemble.
- Never place crankshaft position sensor (POS) in a location where it is exposed to magnetism.

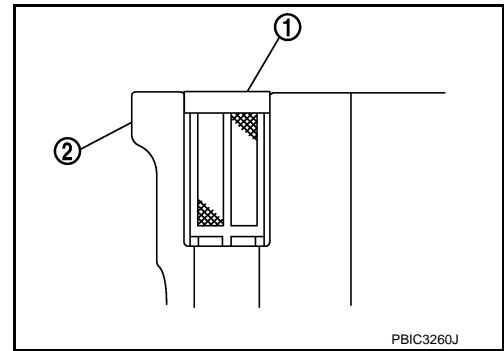


CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

18. Install oil filter (for intake valve timing control) ① in the direction shown in the figure.
- Check that the oil filter (for intake valve timing control) does not protrude from the upper surface of cylinder block ② after installation.



19. Assemble in the reverse order of disassembly.

Inspection

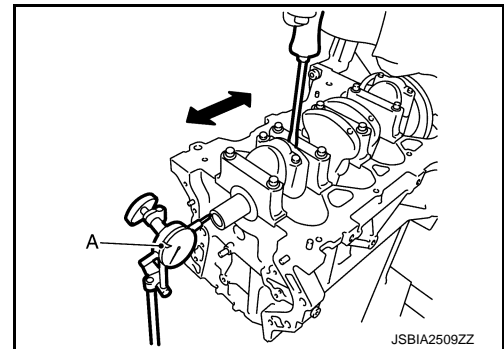
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CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

Standard and Limit : Refer to [EM-253, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

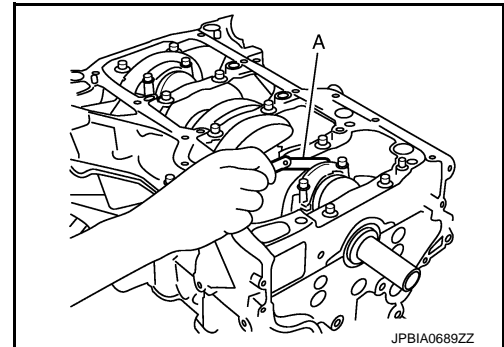


CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

Standard and Limit : Refer to [EM-253, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

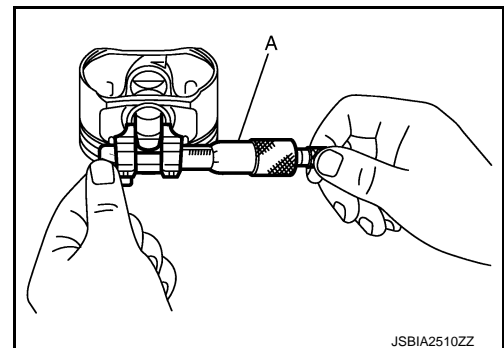


PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an inside micrometer (A).

Standard : Refer to [EM-253, "Cylinder Block"](#).



Piston Pin Outer Diameter

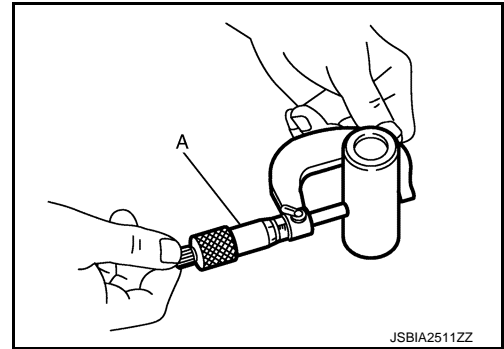
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-253, "Cylinder Block"](#).



Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

Standard : Refer to [EM-253, "Cylinder Block"](#).

- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly. Refer to [EM-240, "Description"](#).

NOTE:

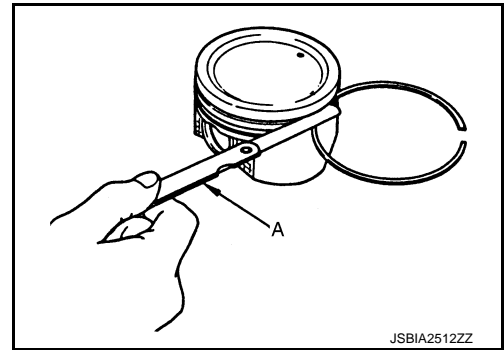
- Piston is available together with piston pin as assembly.
- Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)

PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with a feeler gauge (A).

Standard and Limit : Refer to [EM-253, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.

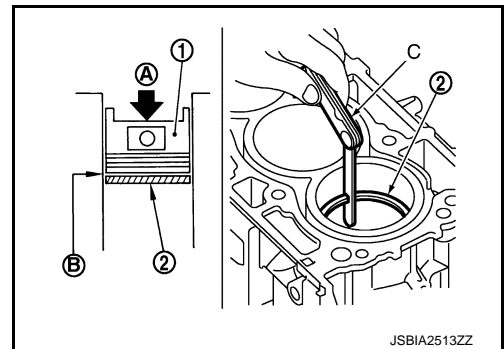


PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to "PISTON TO CYLINDER BORE CLEARANCE".
- Lubricate with new engine oil to piston ① and piston ring ②, and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap with a feeler gauge (C).

Standard and Limit : Refer to [EM-253, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, rebore cylinder and use oversized piston and piston rings.



CONNECTING ROD BEND AND TORSION

CYLINDER BLOCK

[MR20DD]

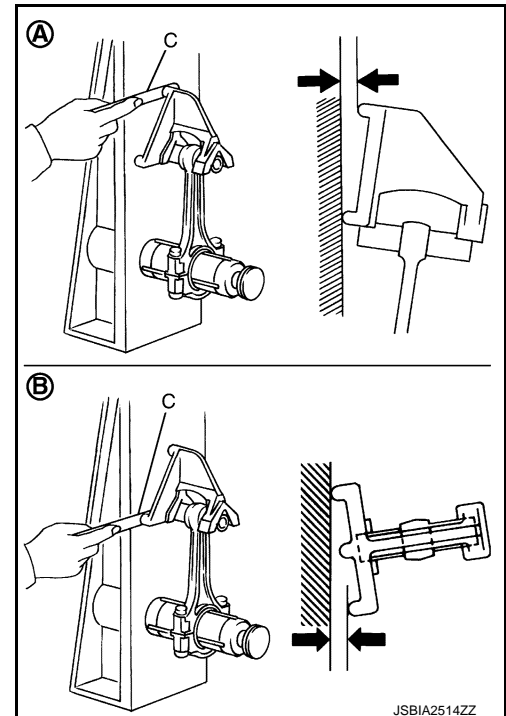
< UNIT DISASSEMBLY AND ASSEMBLY >

- Check with a connecting rod aligner.

- Ⓐ : Bend
- Ⓑ : Torsion
- C : Feeler gauge

Limit : Refer to [EM-253, "Cylinder Block"](#).

- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap ① without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-223, "Disassembly and Assembly"](#).

- ② : Connecting rod
- Ⓐ : Example
- Ⓑ : Measuring direction of inner diameter

- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard : Refer to [EM-253, "Cylinder Block"](#).

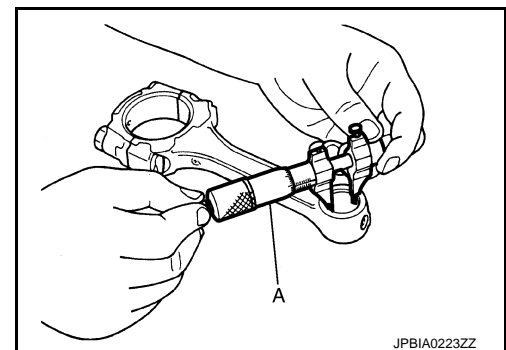
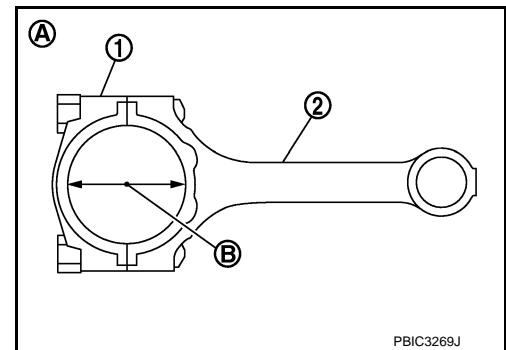
- If out of the standard, replace connecting rod assembly.

CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

Standard : Refer to [EM-253, "Cylinder Block"](#).



Piston Pin Outer Diameter

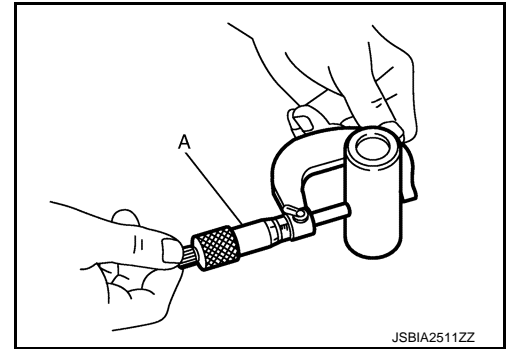
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-253, "Cylinder Block"](#).



Connecting Rod Bushing Oil Clearance

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

Standard and Limit : Refer to [EM-253, "Cylinder Block"](#).

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly. Refer to [EM-240, "Piston"](#).
- If replacing connecting rod assembly. Refer to [EM-241, "Connecting Rod Bearing"](#).

CYLINDER BLOCK TOP SURFACE DISTORTION

- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

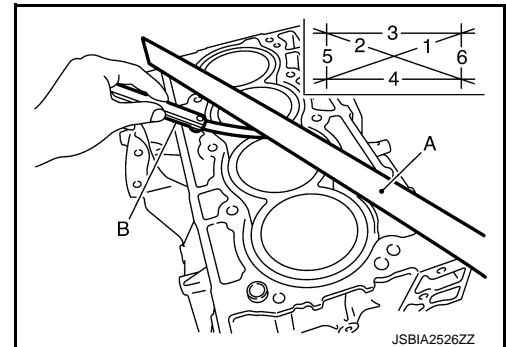
CAUTION:

Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge (A) and feeler gauge (B).

Limit : Refer to [EM-253, "Cylinder Block"](#).

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-223, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing housing with a cylinder gauge.
- Measure the position shown in the figure [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown in the figure. The smaller one is the measured value.

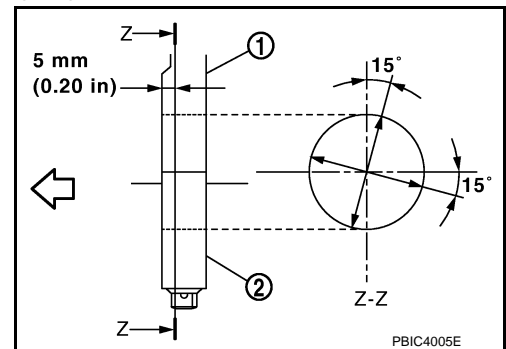
- ① : Cylinder block
- ② : Main bearing cap
- ← : Engine front

Standard : Refer to [EM-253, "Cylinder Block"](#).

- If out of the standard, replace cylinder block and main bearing caps assembly.

NOTE:

Main bearing caps cannot be replaced as a single, because it is machined together with cylinder block.



PISTON TO CYLINDER BORE CLEARANCE

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

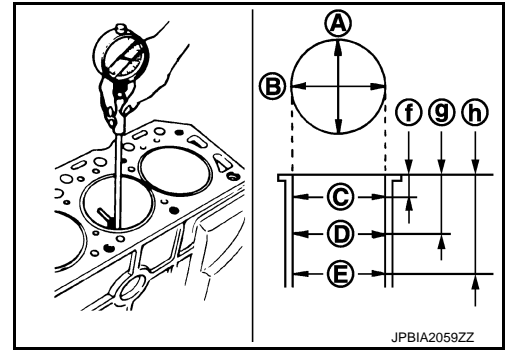
Cylinder Bore Inner Diameter

- Using a cylinder gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [A and B directions at C, D, and E] [A is in longitudinal direction of engine]

- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 130 mm (5.12 in)

NOTE:

When determining cylinder bore grade, measure the cylinder bore B direction at D position.



Standard:

Cylinder bore inner diameter

: Refer to [EM-253, "Cylinder Block"](#).

Limit:

Out-of-round [Difference between A and B]

Taper [Difference between C and D]

: Refer to [EM-253, "Cylinder Block"](#).

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

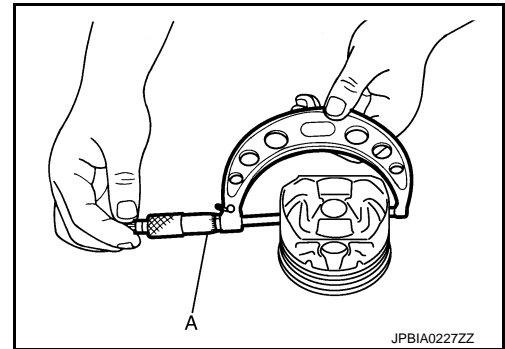
NOTE:

Oversize piston is not provided.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer (A).

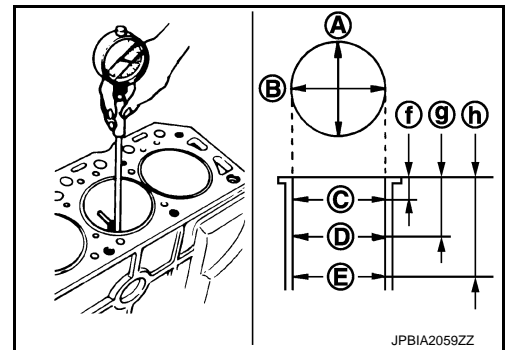
Standard : Refer to [EM-253, "Cylinder Block"](#).



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction B, position D].

- A : Direction A
- C : Position C
- E : Position E
- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 130 mm (5.12 in)



(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard and Limit : Refer to [EM-253, "Cylinder Block"](#).

CYLINDER BLOCK

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

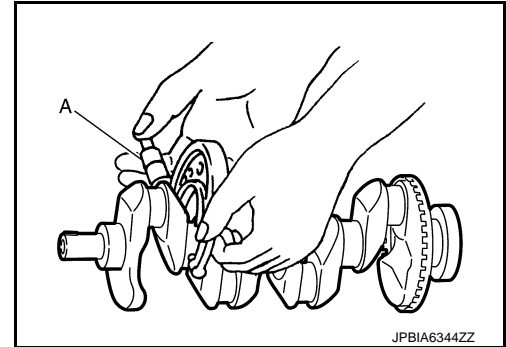
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-240, "Piston"](#).

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with a micrometer (A).

Standard : Refer to [EM-253, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-243, "Main Bearing"](#).



CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with a micrometer.

Standard : Refer to [EM-253, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-241, "Connecting Rod Bearing"](#).

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

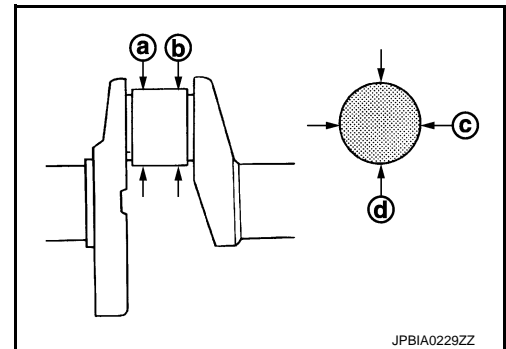
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between (c) and (d) at (a) and (b).
- Taper is indicated by the difference in dimension between (a) and (b) at (c) and (d).

Limit:

Out-of-round [Difference between (X) and (Y)]

Taper [Difference between (A) and (B)]

: Refer to [EM-253, "Cylinder Block"](#).



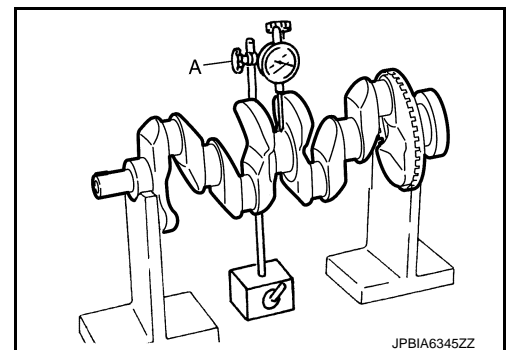
- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to [EM-241, "Connecting Rod Bearing"](#) and/or [EM-243, "Main Bearing"](#).

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of the crankshaft.
- Place a dial indicator (A) straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the dial indicator. (Total indicator reading)

Standard and Limit : Refer to [EM-253, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

CYLINDER BLOCK

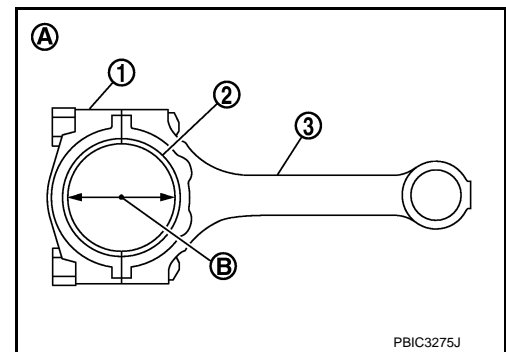
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Install connecting rod bearings ② to connecting rod ③ and connecting rod bearing cap ①, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-223, "Disassembly and Assembly"](#).

- Ⓐ : Example
- Ⓑ : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing with an inside micrometer.
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)



Standard and Limit : Refer to [EM-256, "Connecting Rod Bearing"](#).

- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to [EM-241, "Connecting Rod Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-241, "Connecting Rod Bearing"](#).

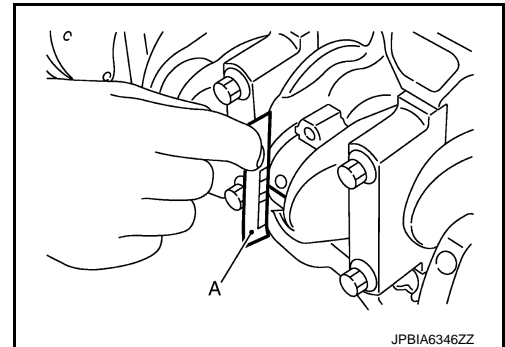
CAUTION:

Never rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



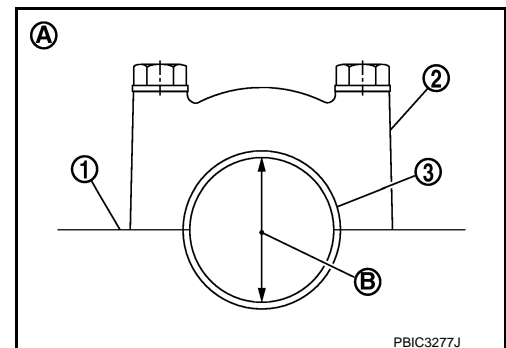
MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings ③ to cylinder block ① and main bearing cap ②, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-223, "Disassembly and Assembly"](#).

- Ⓐ : Example
- Ⓑ : Inner diameter measuring direction

- Measure the inner diameter of main bearing with a cylinder gauge.
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)



Standard and Limit : Refer to [EM-257, "Main Bearing"](#).

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-243, "Main Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-223, "Disassembly and Assembly"](#).

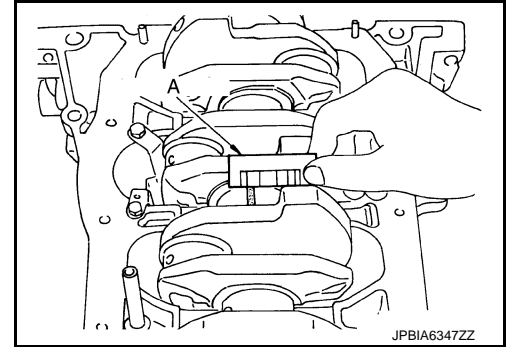
CAUTION:

Never rotate crankshaft.

- Remove main bearing cap and bearings, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



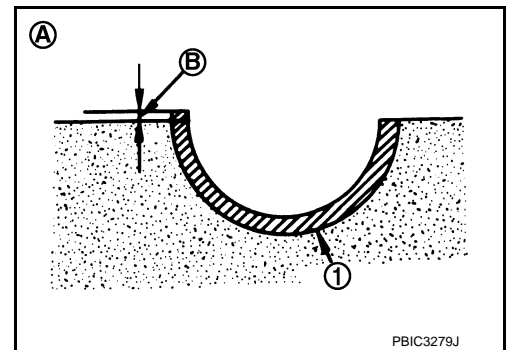
MAIN BEARING CRUSH HEIGHT

- When main bearing cap is removed after being tightened to the specified torque with main bearings ① installed, the tip end of bearing must protrude ②. Refer to [EM-223, "Disassembly and Assembly"](#).

① : Example

Standard : There must be crush height.

- If the standard is not met, replace main bearings.



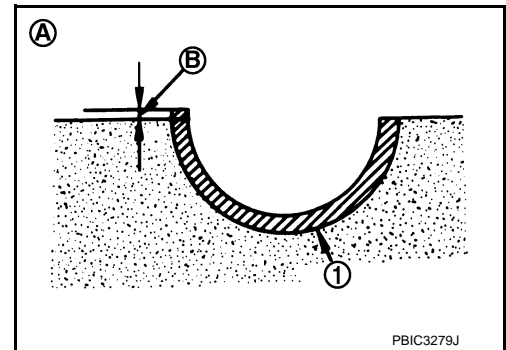
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod cap is removed after being tightened to the specified torque with connecting rod bearings ① installed, the tip end of bearing must protrude ②. Refer to [EM-223, "Disassembly and Assembly"](#).

① : Example

Standard : There must be crush height.

- If the standard is not met, replace connecting rod bearings.



MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (d1) and (d2) at two positions as shown in the figure.

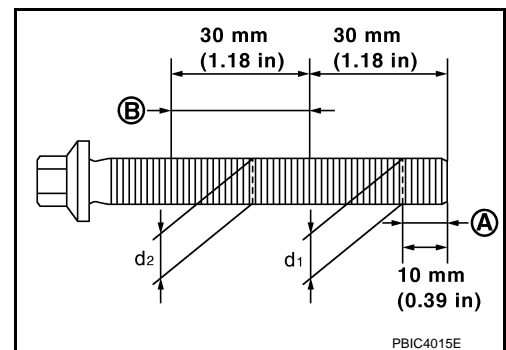
① : (d1) measuring position

② : (d2) measuring position

- If reduction appears in places other than ② range, regard it as (d2).

Limit [(d1) – (d2)]: 0.15 mm (0.0059 in)

- If it exceeds the limit (a large difference in dimensions), replace main bearing cap mounting bolt with a new one.



CONNECTING ROD CAP BOLT OUTER DIAMETER

CYLINDER BLOCK

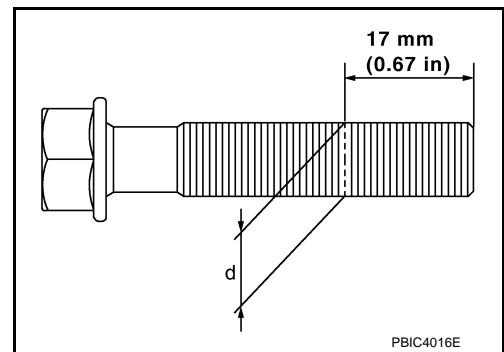
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

- Measure the outer diameter (d) at position as shown in the figure.
- If reduction appears in a position other than (d), regard it as (d).

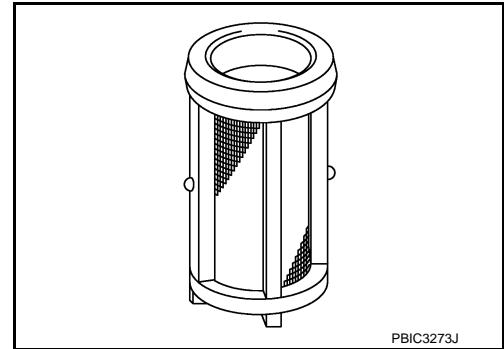
Limit: 7.75 mm (0.3051 in)

- When (d) exceeds the limit (when it becomes thinner), replace connecting rod cap bolt with a new one.



CLOGGED OR DAMAGED OIL FILTER (FOR VALVE TIMING CONTROL)

- Check that there is no foreign material on the oil filter and check it for clogging.
 - Clean it if necessary.
- Check the oil filter for damage.
 - Replace it if necessary.



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

HOW TO SELECT PISTON AND BEARING

Description

INFOID:000000010715518

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.
Between cylinder block and piston	Piston and piston pin assembly (piston is available together with piston pin as an assembly.)	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

Piston

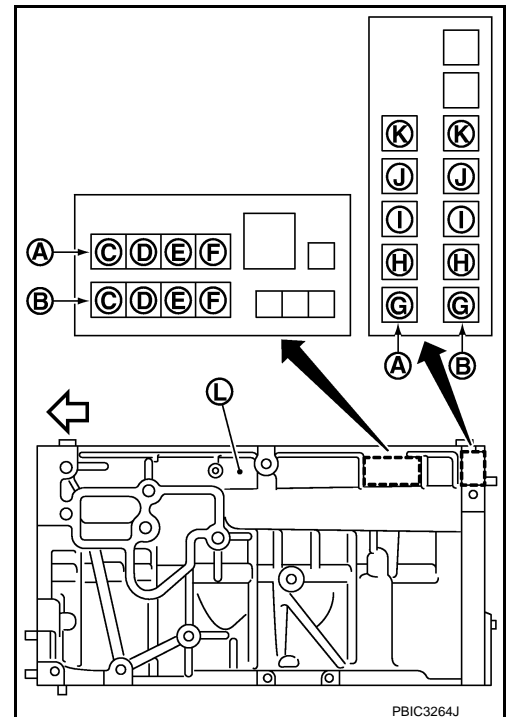
INFOID:000000010715519

WHEN NEW CYLINDER BLOCK IS USED

- Check the cylinder bore grade on rear left side of cylinder block (L), and select piston of the same grade.

- (A) : Correction stamp
- (B) : Standard stamp
- (C) : Cylinder No. 1 bore grade
- (D) : Cylinder No. 2 bore grade
- (E) : Cylinder No. 3 bore grade
- (F) : Cylinder No. 4 bore grade
- (G) : No. 1 main bearing housing grade
- (H) : No. 2 main bearing housing grade
- (I) : No. 3 main bearing housing grade
- (J) : No. 4 main bearing housing grade
- (K) : No. 5 main bearing housing grade
- ↔ : Engine front

- If there is a correction stamp mark on the cylinder block, use it as a correct reference.



WHEN CYLINDER BLOCK IS REUSED

1. Measure the cylinder bore inner diameter. Refer to [EM-253, "Cylinder Block"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".

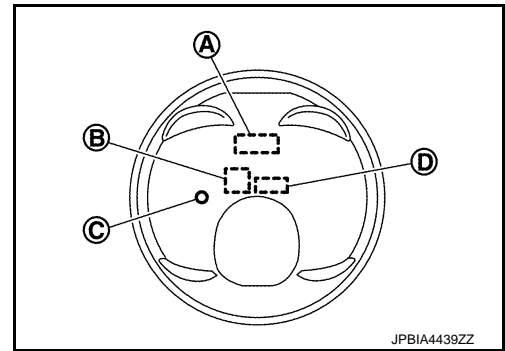
HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

3. Select piston of the same grade.

- (A) : Identification code
- (B) : Piston grade number
- (C) : Front mark
- (D) : Sub grade number



PISTON SELECTION TABLE

Unit: mm (in)

Grade number (Mark)	1	2 [or no mark (piston only)]
Cylinder bore Inner diameter	84.000 - 84.010 (3.3071 - 3.3075)	84.010 - 84.020 (3.3075 - 3.3079)
Piston skirt diameter	83.970 - 83.980 (3.3059 - 3.3063)	83.980 - 83.990 (3.3063 - 3.3067)

NOTE:

Piston is available together with piston pin as an assembly.

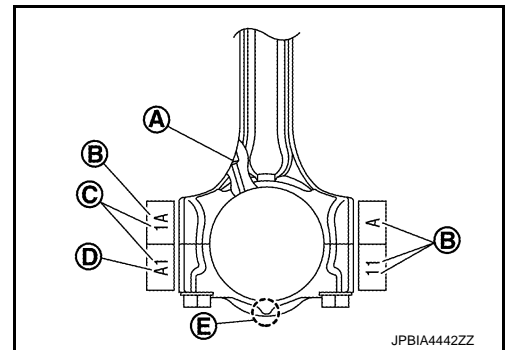
Connecting Rod Bearing

INFOID:000000010715520

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

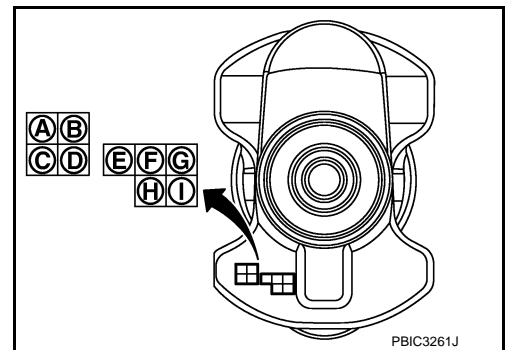
1. Apply connecting rod big end diameter grade stamped on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- (A) : Oil hole
- (B) : Management code
- (C) : Cylinder number
- (D) : Big end diameter grade
- (E) : Front mark



2. Apply crankshaft pin journal diameter grade stamped on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".

- (A) : No. 1 pin journal diameter grade
- (B) : No. 2 pin journal diameter grade
- (C) : No. 3 pin journal diameter grade
- (D) : No. 4 pin journal diameter grade
- (E) : No. 1 main journal diameter grade
- (F) : No. 2 main journal diameter grade
- (G) : No. 3 main journal diameter grade
- (H) : No. 4 main journal diameter grade
- (I) : No. 5 main journal diameter grade



3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".

4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

HOW TO SELECT PISTON AND BEARING

[MR20DD]

< UNIT DISASSEMBLY AND ASSEMBLY >

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-231, "Inspection"](#).
2. Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

CONNECTING ROD BEARING SELECTION TABLE

Connecting rod big end diameter Unit: mm (in)		Mark													
		Hole diameter													
Mark	Axle diameter	47.000 - 47.001 (1.8504 - 1.8504)	47.001 - 47.002 (1.8504 - 1.8505)	47.002 - 47.003 (1.8505 - 1.8505)	47.003 - 47.004 (1.8505 - 1.8505)	47.004 - 47.005 (1.8505 - 1.8506)	47.005 - 47.006 (1.8506 - 1.8506)	47.006 - 47.007 (1.8506 - 1.8507)	47.007 - 47.008 (1.8507 - 1.8507)	47.008 - 47.009 (1.8507 - 1.8508)	47.009 - 47.010 (1.8508 - 1.8508)	47.010 - 47.011 (1.8508 - 1.8508)	47.011 - 47.012 (1.8508 - 1.8509)	47.012 - 47.013 (1.8509 - 1.8509)	
		A	43.970 - 43.971 (1.7311 - 1.7311)	0	0	0	0	0	01	01	01	1	1	1	12
B	43.969 - 43.970 (1.7311 - 1.7311)	0	0	0	0	01	01	01	1	1	1	12	12	12	
C	43.968 - 43.969 (1.7310 - 1.7311)	0	0	0	01	01	01	1	1	1	12	12	12	2	
D	43.967 - 43.968 (1.7310 - 1.7310)	0	0	01	01	01	1	1	1	12	12	12	2	2	
E	43.966 - 43.967 (1.7309 - 1.7310)	0	01	01	01	1	1	1	12	12	12	2	2	2	
F	43.965 - 43.966 (1.7309 - 1.7309)	01	01	01	1	1	1	12	12	12	2	2	2	23	
G	43.964 - 43.965 (1.7309 - 1.7309)	01	01	1	1	1	1	12	12	12	2	2	2	23	
H	43.963 - 43.964 (1.7308 - 1.7309)	01	1	1	1	12	12	12	2	2	2	23	23	23	
J	43.962 - 43.963 (1.7308 - 1.7308)	1	1	1	12	12	12	2	2	2	23	23	23	3	
K	43.961 - 43.962 (1.7307 - 1.7308)	1	1	12	12	12	2	2	2	23	23	23	3	3	
L	43.960 - 43.961 (1.7307 - 1.7307)	1	12	12	12	2	2	2	23	23	23	3	3	3	
M	43.959 - 43.960 (1.7307 - 1.7307)	12	12	12	2	2	2	23	23	23	3	3	3	34	
N	43.958 - 43.959 (1.7306 - 1.7307)	12	12	2	2	2	23	23	23	3	3	3	3	34	
P	43.957 - 43.958 (1.7306 - 1.7306)	12	2	2	2	23	23	23	3	3	3	34	34	34	
R	43.956 - 43.957 (1.7305 - 1.7306)	2	2	2	23	23	23	3	3	3	34	34	34	4	
S	43.955 - 43.956 (1.7305 - 1.7305)	2	2	23	23	23	3	3	3	34	34	34	4	4	
T	43.954 - 43.955 (1.7305 - 1.7305)	2	23	23	23	3	3	3	34	34	34	4	4	4	
U	43.953 - 43.954 (1.7304 - 1.7305)	23	23	23	3	3	3	34	34	34	4	4	4	4	

PBIC4077E

CONNECTING ROD BEARING GRADE TABLE

Connecting rod bearing grade table : Refer to [EM-256, "Connecting Rod Bearing"](#).

UNDERSIZE BEARINGS USAGE GUIDE

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind the crankshaft pin so that the connecting rod bearing oil clearance satisfies the standard.

CAUTION:

HOW TO SELECT PISTON AND BEARING

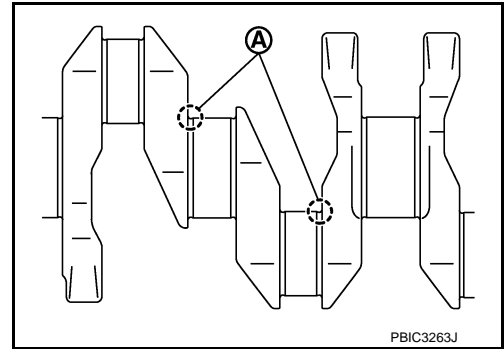
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)] (A).

Bearing undersize table

: Refer to [EM-256, "Connecting Rod Bearing"](#).



Main Bearing

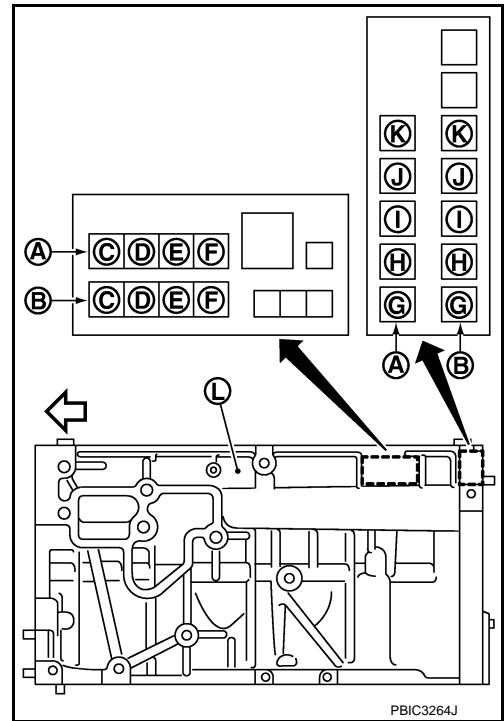
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WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear left side of cylinder block (L).

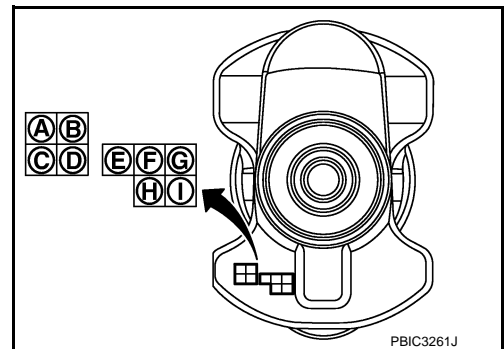
- (A) : Correction stamp
- (B) : Standard stamp
- (C) : Cylinder No. 1 bore grade
- (D) : Cylinder No. 2 bore grade
- (E) : Cylinder No. 3 bore grade
- (F) : Cylinder No. 4 bore grade
- (G) : No. 1 main bearing housing grade
- (H) : No. 2 main bearing housing grade
- (I) : No. 3 main bearing housing grade
- (J) : No. 4 main bearing housing grade
- (K) : No. 5 main bearing housing grade
- ← : Engine front

- If there is a correction stamp mark on cylinder block, use it as a correct reference.



2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".

- (A) : No. 1 pin journal diameter grade
- (B) : No. 2 pin journal diameter grade
- (C) : No. 3 pin journal diameter grade
- (D) : No. 4 pin journal diameter grade
- (E) : No. 1 main journal diameter grade
- (F) : No. 2 main journal diameter grade
- (G) : No. 3 main journal diameter grade
- (H) : No. 4 main journal diameter grade
- (I) : No. 5 main journal diameter grade



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".

CAUTION:

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

There are two main bearing selection tables. One is for No. 1 and 4 journals and the other is for No. 2, 3 and 5 journals. Make certain to use the appropriate table. This is due to differences in the specified clearances.

4. Apply the symbol obtained to the “Main Bearing Grade Table” to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

WHEN CYLINDER BLOCK AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [EM-231, "Inspection"](#).
2. Apply the measured dimension to the “Main Bearing Selection Table”.
3. Read the symbol at the cross point of selected row and column in the “Main Bearing Selection Table”.

CAUTION:

There are two main bearing selection tables. One is for No. 1 and 4 journals and the other is for No. 2, 3 and 5 journals. Make certain to use the appropriate table. This is due to differences in the specified clearances.

4. Apply the symbol obtained to the “Main Bearing Grade Table” to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

MAIN BEARING SELECTION TABLE (No. 1 AND 4 JOURNAL)

Cylinder block main bearing housing inner diameter Unit: mm (in)		Crankshaft main journal diameter Unit: mm (in)		Mark																							
				Hole diameter		Axle diameter																					
Mark		Axle diameter		A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W				
A	51.978 - 51.979 (2.0464 - 2.0464)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
B	51.977 - 51.978 (2.0463 - 2.0464)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
C	51.976 - 51.977 (2.0463 - 2.0463)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
D	51.975 - 51.976 (2.0463 - 2.0463)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
E	51.974 - 51.975 (2.0462 - 2.0463)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
F	51.973 - 51.974 (2.0462 - 2.0462)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
G	51.972 - 51.973 (2.0461 - 2.0462)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
H	51.971 - 51.972 (2.0461 - 2.0461)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
J	51.970 - 51.971 (2.0461 - 2.0461)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
K	51.969 - 51.970 (2.0460 - 2.0461)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
L	51.968 - 51.969 (2.0460 - 2.0460)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
M	51.967 - 51.968 (2.0459 - 2.0460)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
N	51.966 - 51.967 (2.0459 - 2.0459)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
P	51.965 - 51.966 (2.0459 - 2.0459)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
R	51.964 - 51.965 (2.0458 - 2.0459)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
S	51.963 - 51.964 (2.0458 - 2.0458)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
T	51.962 - 51.963 (2.0457 - 2.0458)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
U	51.961 - 51.962 (2.0457 - 2.0457)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
V	51.960 - 51.961 (2.0457 - 2.0457)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
W	51.959 - 51.960 (2.0456 - 2.0457)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

PBIC4078E

A
EM
 C
 D
 E
 F
 G
 H
 I
 J
 K
 L
 M
 N
 O
 P

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

MAIN BEARING SELECTION TABLE (No. 2, 3 AND 5 JOURNAL)

Cylinder block main bearing housing inner diameter Unit: mm (in)	Crankshaft main journal diameter Unit: mm (in)	Mark		Hole diameter																			
		A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W		
Mark	Axle diameter																						
A	51.978 - 51.979 (2.0464 - 2.0464)	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
B	51.977 - 51.978 (2.0463 - 2.0464)	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	
C	51.976 - 51.977 (2.0463 - 2.0463)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	
D	51.975 - 51.976 (2.0463 - 2.0463)	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	
E	51.974 - 51.975 (2.0462 - 2.0463)	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	
F	51.973 - 51.974 (2.0462 - 2.0462)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	
G	51.972 - 51.973 (2.0461 - 2.0462)	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	5	56	
H	51.971 - 51.972 (2.0461 - 2.0461)	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	
J	51.970 - 51.971 (2.0461 - 2.0461)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	
K	51.969 - 51.970 (2.0460 - 2.0461)	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	6	
L	51.968 - 51.969 (2.0460 - 2.0460)	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	6	6	
M	51.967 - 51.968 (2.0459 - 2.0460)	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	6	6	6	
N	51.966 - 51.967 (2.0459 - 2.0459)	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	6	6	6	67	
P	51.965 - 51.966 (2.0459 - 2.0459)	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	6	6	6	67	67	
R	51.964 - 51.965 (2.0458 - 2.0459)	34	34	4	4	4	45	45	45	5	5	5	56	56	56	56	6	6	6	67	67	67	
S	51.963 - 51.964 (2.0458 - 2.0458)	34	4	4	4	45	45	45	5	5	5	56	56	56	56	6	6	6	67	67	67	7	
T	51.962 - 51.963 (2.0457 - 2.0458)	4	4	4	45	45	45	5	5	5	56	56	56	56	6	6	6	67	67	67	7	7	
U	51.961 - 51.962 (2.0457 - 2.0457)	4	4	45	45	45	5	5	5	56	56	56	56	6	6	6	67	67	67	7	7	7	
V	51.960 - 51.961 (2.0457 - 2.0457)	4	45	45	45	5	5	5	56	56	56	56	6	6	6	67	67	67	7	7	7	7	
W	51.959 - 51.960 (2.0456 - 2.0457)	45	45	45	5	5	5	56	56	56	56	6	6	6	67	67	67	7	7	7	7	7	

PBIC4079E

MAIN BEARING GRADE TABLE (ALL JOURNALS)

Main bearing grade table (All journals) : Refer to [EM-257, "Main Bearing"](#).

UNDERSIZE BEARING USAGE GUIDE

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use undersize (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the standard.

CAUTION:

HOW TO SELECT PISTON AND BEARING

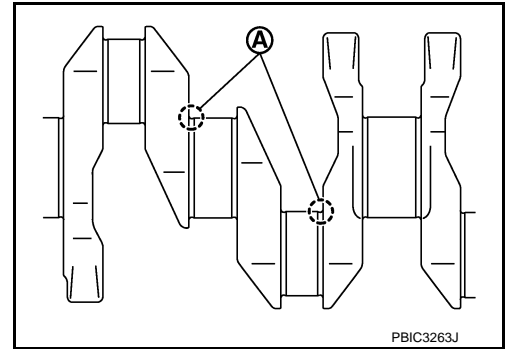
< UNIT DISASSEMBLY AND ASSEMBLY >

[MR20DD]

In grinding crankshaft main journal to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)] (A).

Bearing undersize table:

Refer to [EM-257, "Main Bearing"](#).



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:0000000010735677

GENERAL SPECIFICATIONS

Engine type		MR20DD
Cylinder arrangement		In-line 4
Displacement cm ³ (cu in)		1,997 (121.86)
Bore and stroke mm (in)		84.0×90.1 (3.307×3.547)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		11.2
Compression pressure kPa (bar, kg/cm ² , psi)/250 rpm	Standard	1,530 (15.3, 15.6, 222)
	Minimum	1,280 (12.8, 13.1, 186)
	Differential limit between cylinders	100 (1.0, 1.0, 15)

Unit: degree

Valve timing ↔: Intake valve ↔: Exhaust valve	VTC Minimum phasing (Mechanical)			VTC Maximum phasing (Mechanical)		
	a	b	c	d	e	f
	EXH valve opening angle	INT valve opening angle	INT open	INT close	EXH close	EXH open
VTC Minimum phasing (Mechanical)	220	240	18	78	0	40
VTC Maximum phasing (Mechanical)			24	36	57	17

Drive Belt

INFOID:0000000010735678

DRIVE BELT

Tension of drive belt	Belt tension is not necessary, as it is automatically adjusted by drive belt auto-tensioner.
-----------------------	--

Spark Plug

INFOID:0000000010735679

SPARK PLUG

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Unit: mm (in)

Make	NGK	
Standard type	DILKAR7D11H	
Gap (Nominal)	Standard	1.1 (0.043)
	Limit	1.3 (0.051)

Exhaust Manifold

INFOID:000000010735680

EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Each exhaust port	0.3 (0.012)
	Entire part	0.7 (0.028)

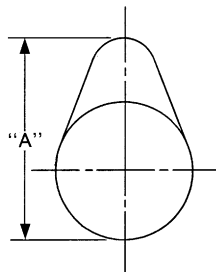
Camshaft

INFOID:000000010735681

CAMSHAFT

Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0012 - 0.0028)	
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9843 - 0.9851)	—
Camshaft journal diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9823 - 0.9831)	—
Camshaft end play		0.075 - 0.153 (0.0030 - 0.0060)	0.24 (0.0094)
Camshaft cam height "A"	Intake	45.265 - 45.455 (1.7821 - 1.7896)	45.085 (1.7750)
	Exhaust	43.775 - 43.965 (1.7234 - 1.7309)	43.575 (1.7156)
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)



SEM671

*: Total indicator reading

VALVE LIFTER

Unit: mm (in)

Items		Standard
Valve lifter outer diameter	Intake	33.977 - 33.987 (1.3377 - 1.3381)
	Exhaust	29.977 - 29.987 (1.1802 - 1.1806)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Valve lifter hole diameter	Intake	34.000 - 34.021 (1.3386 - 1.3394)
	Exhaust	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance		0.013 - 0.044 (0.0005 - 0.0017)

VALVE CLEARANCE

Unit: mm (in)

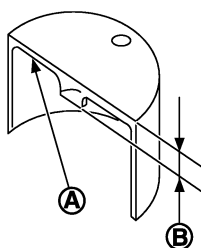
Items	Cold	Hot* (reference data)
Intake	0.24 - 0.32 (0.009 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.26 - 0.34 (0.010 - 0.013)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

AVAILABLE VALVE LIFTER

Unit: mm (in)

Identification mark (A)	Thickness (B)
-------------------------	---------------



JPBIA0170ZZ

300H	3.00 (0.1181)
302H	3.02 (0.1189)
304H	3.04 (0.1197)
306H	3.06 (0.1205)
308H	3.08 (0.1213)
310H	3.10 (0.1220)
312H	3.12 (0.1228)
314H	3.14 (0.1236)
316H	3.16 (0.1244)
318H	3.18 (0.1252)
320H	3.20 (0.1260)
322H	3.22 (0.1268)
324H	3.24 (0.1276)
326H	3.26 (0.1283)
328H	3.28 (0.1291)
330H	3.30 (0.1299)
332H	3.32 (0.1307)
334H	3.34 (0.1315)
336H	3.36 (0.1323)
338H	3.38 (0.1331)
340H	3.40 (0.1339)
342H	3.42 (0.1346)
344H	3.44 (0.1354)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Identification mark (A)	Thickness (B)
346H	3.46 (0.1362)
348H	3.48 (0.1370)
350H	3.50 (0.1378)

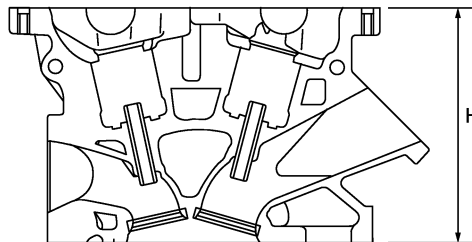
Cylinder Head

INFOID:000000010735682

CYLINDER HEAD

Unit: mm (in)

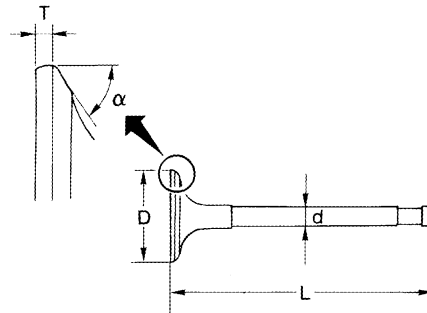
Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height "H"	130.9 (5.15)	—



PBIC0924E

VALVE DIMENSIONS

Unit: mm (in)



JSBIA1166ZZ

Valve head diameter "D"	Intake	33.8 - 34.1 (1.331 - 1.343)
	Exhaust	27.6 - 27.9 (1.087 - 1.098)
Valve length "L"	Intake	106.42 (4.19)
	Exhaust	105.41 (4.15)
Valve stem diameter "d"	Intake	5.465 - 5.480 (0.2152 - 0.2157)
	Exhaust	5.455 - 5.470 (0.2148 - 0.2154)
Valve seat angle "α"		45°15' - 45°45'
Valve margin "T"	Intake	1.2 (0.047)
	Exhaust	1.4 (0.055)

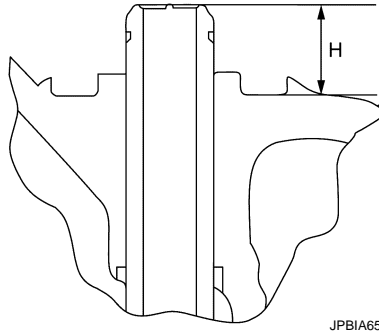
VALVE GUIDE

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Unit: mm (in)

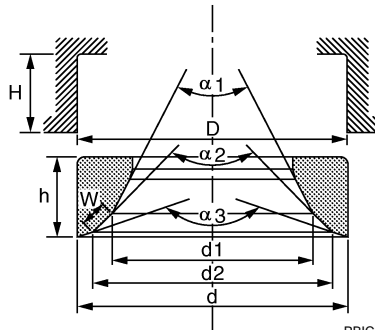


JPBIA6515ZZ

Items		Standard	Oversize (service) [0.2 (0.008)]
Valve guide	Outer diameter	9.523 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)
	Inner diameter (Finished size)	5.500 - 5.518 (0.2165 - 0.2172)	
Cylinder head valve guide hole diameter		9.475 - 9.496 (0.3730 - 0.3739)	9.675 - 9.696 (0.3809 - 0.3817)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	
Projection length "H"		13.35 - 13.65 (0.5256 - 0.5374)	

VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (service) [0.5 (0.02)]
Cylinder head seat recess diameter "D"	Intake	34.700 - 34.727 (1.3661 - 1.3672)	35.200 - 35.227 (1.3858 - 1.3869)
	Exhaust	28.700 - 28.727 (1.1299 - 1.1310)	29.200 - 29.227 (1.1496 - 1.1507)
Valve seat outer diameter "d"	Intake	34.808 - 34.824 (1.3704 - 1.3710)	35.308 - 35.324 (1.3901 - 1.3907)
	Exhaust	28.808 - 28.824 (1.1342 - 1.1348)	29.308 - 29.324 (1.1539 - 1.1545)
Valve seat interference fit		0.081 - 0.124 (0.0032 - 0.0049)	
Diameter "d1"*1	Intake	31.8 (1.252)	
	Exhaust	25.3 (0.996)	
Diameter "d2"*2	Intake	33.1 - 33.6 (1.303 - 1.323)	
	Exhaust	26.9 - 27.4 (1.059 - 1.079)	
Angle "α1"	Intake	70°	
	Exhaust	45°	
Angle "α2"		88°45' - 90°15'	
Angle "α3"		120°	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Contacting width "W" ^{*3}	Intake	1.0 - 1.4 (0.039 - 0.055)	
	Exhaust	1.2 - 1.6 (0.047 - 0.063)	
Height "h"	Intake	5.9 - 6.0 (0.232 - 0.236)	5.03 - 5.13 (0.1980 - 0.2020)
	Exhaust		4.95 - 5.05 (0.1949 - 0.1988)
Depth "H"	Intake	6.04 (0.2378)	
	Exhaust	6.05 (0.2382)	

*1: Diameter made by intersection point of conic angles "α1" and "α2"

*2: Diameter made by intersection point of conic angles "α2" and "α3"

*3: Machining data

VALVE SPRING

Items	Standard	
	Intake	Exhaust
Free height	49.4 - 49.6 mm (1.945 - 1.953 in)	54.5 - 54.7 mm (2.146 - 2.154 in)
Installation height	38.46 mm (1.514 in)	38.46 mm (1.514 in)
Installation load	151 - 175 N (15.4 - 17.9 kg, 34 - 39 lb)	257 - 289 N (26.2 - 29.5 kg, 57.8 - 65.0 lb)
Height during valve open	28.86 mm (1.1362 in)	30.03 mm (1.1823 in)
Load with valve open	344 - 392 N (35.0 - 40.0 kg, 77.3 - 88.1 lb)	450 - 502 N (45.9 - 51.2 kg, 101.2 - 112.9 lb)
Identification color	White	Yellow green

Unit: mm (in)

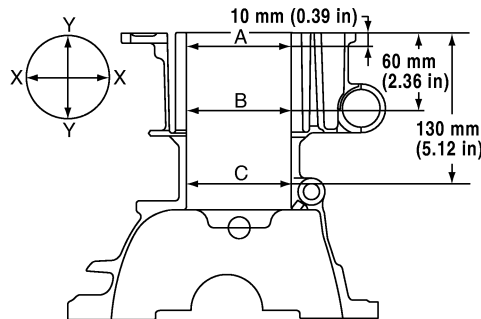
Items	Limit
Valve spring squareness	1.0 (0.039)

Cylinder Block

INFOID:000000010735683

CYLINDER BLOCK

Unit: mm (in)



PBIC4017E

Cylinder block top surface distortion	Limit	0.1 (0.004)	
Cylinder bore inner diameter	Standard	Grade No. 1	84.000 - 84.010 (3.3071 - 3.3075)
		Grade No. 2	84.010 - 84.020 (3.3075 - 3.3079)

SERVICE DATA AND SPECIFICATIONS (SDS)

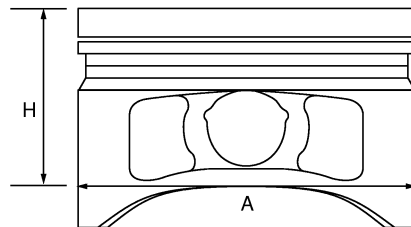
< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Out-of-round	Limit	0.015 (0.0006)
Taper		0.010 (0.0004)
Main bearing housing inner diameter grade	Grade No. A	55.997 - 55.998 (2.2046 - 2.2046)
	Grade No. B	55.998 - 55.999 (2.2046 - 2.2047)
	Grade No. C	55.999 - 56.000 (2.2047 - 2.2047)
	Grade No. D	56.000 - 56.001 (2.2047 - 2.2048)
	Grade No. E	56.001 - 56.002 (2.2048 - 2.2048)
	Grade No. F	56.002 - 56.003 (2.2048 - 2.2048)
	Grade No. G	56.003 - 56.004 (2.2048 - 2.2049)
	Grade No. H	56.004 - 56.005 (2.2049 - 2.2049)
	Grade No. J	56.005 - 56.006 (2.2049 - 2.2050)
	Grade No. K	56.006 - 56.007 (2.2050 - 2.2050)
	Grade No. L	56.007 - 56.008 (2.2050 - 2.2050)
	Grade No. M	56.008 - 56.009 (2.2050 - 2.2051)
	Grade No. N	56.009 - 56.010 (2.2051 - 2.2051)
	Grade No. P	56.010 - 56.011 (2.2051 - 2.2052)
	Grade No. R	56.011 - 56.012 (2.2052 - 2.2052)
	Grade No. S	56.012 - 56.013 (2.2052 - 2.2052)
Grade No. T	56.013 - 56.014 (2.2052 - 2.2053)	
Grade No. U	56.014 - 56.015 (2.2053 - 2.2053)	
Grade No. V	56.015 - 56.016 (2.2053 - 2.2053)	
Grade No. W	56.016 - 56.017 (2.2053 - 2.2054)	

AVAILABLE PISTON

Unit: mm (in)



PBIC0188E

Piston skirt diameter "A"	Standard	Grade No. 1	83.970 - 83.980 (3.3059 - 3.3063)
		Grade No. 2	83.980 - 83.990 (3.3063 - 3.3067)
Measure point "H"			39.2 (1.543)
Piston pin hole diameter			19.993 - 19.999 (0.7871 - 0.7874)
Piston to cylinder bore clearance	Standard		0.020 - 0.040 (0.0008 - 0.0016)
	Limit		0.08 (0.0031)

PISTON RING

Unit: mm (in)

Items		Standard	Limit
Piston ring side clearance	Top	0.04 - 0.08 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.03 - 0.07 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.055 - 0.155 (0.0022 - 0.0061)	—
Piston ring end gap	Top	0.20 - 0.30 (0.0079 - 0.0118)	0.49 (0.0193)
	2nd	0.50 - 0.65 (0.0197 - 0.0256)	0.81 (0.0319)
	Oil (rail ring)	0.15 - 0.45 (0.0059 - 0.0177)	0.76 (0.0299)

PISTON PIN

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Unit: mm (in)

Items	Standard	Limit
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	—
Piston to piston pin oil clearance	0.002 - 0.006 (0.0001 - 0.0002)	—

CONNECTING ROD

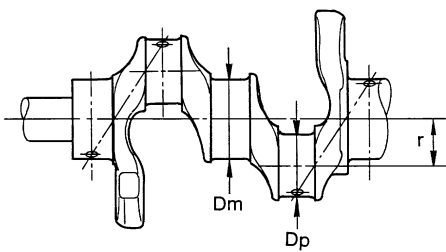
Unit: mm (in)

Center distance		138.97 - 139.07 (5.47 - 5.48)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*	Standard	20.000 - 20.012 (0.7874 - 0.7879)
Connecting rod bushing oil clearance	Standard	0.005 - 0.023 (0.0002 - 0.0009)
	Limit	0.03 (0.0012)
Connecting rod side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.4 (0.016)
Connecting rod big end diameter grade	Grade No. A	47.000 - 47.001 (1.8504 - 1.8504)
	Grade No. B	47.001 - 47.002 (1.8504 - 1.8505)
	Grade No. C	47.002 - 47.003 (1.8505 - 1.8505)
	Grade No. D	47.003 - 47.004 (1.8505 - 1.8505)
	Grade No. E	47.004 - 47.005 (1.8505 - 1.8506)
	Grade No. F	47.005 - 47.006 (1.8506 - 1.8506)
	Grade No. G	47.006 - 47.007 (1.8506 - 1.8507)
	Grade No. H	47.007 - 47.008 (1.8507 - 1.8507)
	Grade No. J	47.008 - 47.009 (1.8507 - 1.8507)
	Grade No. K	47.009 - 47.010 (1.8507 - 1.8508)
	Grade No. L	47.010 - 47.011 (1.8508 - 1.8508)
	Grade No. M	47.011 - 47.012 (1.8508 - 1.8509)
Grade No. N	47.012 - 47.013 (1.8509 - 1.8509)	

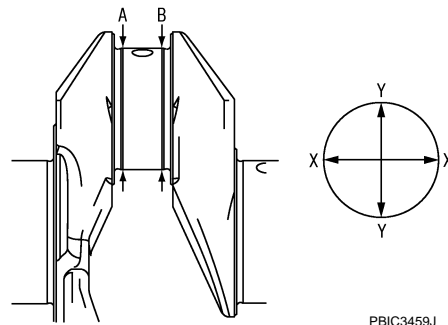
*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



SEM645



PBIC3459J

Center distance "r"		44.89 - 44.97 (1.7673 - 1.7705)
Out-of-round	Limit	0.0035 (0.0001)
Taper	Limit	
Runout [TIR*]	Standard	0.05 (0.0020)
	Limit	0.1 (0.004)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.3 (0.012)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

Crankshaft pin journal diameter "Dp" grade.	Grade No. A	43.970 - 43.971 (1.7311 - 1.7311)
	Grade No. B	43.969 - 43.970 (1.7311 - 1.7311)
	Grade No. C	43.968 - 43.969 (1.7310 - 1.7311)
	Grade No. D	43.967 - 43.968 (1.7310 - 1.7310)
	Grade No. E	43.966 - 43.967 (1.7309 - 1.7310)
	Grade No. F	43.965 - 43.966 (1.7309 - 1.7309)
	Grade No. G	43.964 - 43.965 (1.7309 - 1.7309)
	Grade No. H	43.963 - 43.964 (1.7308 - 1.7309)
	Grade No. J	43.962 - 43.963 (1.7308 - 1.7308)
	Grade No. K	43.961 - 43.962 (1.7307 - 1.7308)
	Grade No. L	43.960 - 43.961 (1.7307 - 1.7307)
	Grade No. M	43.959 - 43.960 (1.7307 - 1.7307)
	Grade No. N	43.958 - 43.959 (1.7306 - 1.7307)
	Grade No. P	43.957 - 43.958 (1.7306 - 1.7306)
	Grade No. R	43.956 - 43.957 (1.7305 - 1.7306)
	Grade No. S	43.955 - 43.956 (1.7305 - 1.7305)
Grade No. T	43.954 - 43.955 (1.7305 - 1.7305)	
Grade No. U	43.953 - 43.954 (1.7304 - 1.7305)	
Crankshaft main journal diameter "Dm" grade.	Grade No. A	51.978 - 51.979 (2.0464 - 2.0464)
	Grade No. B	51.977 - 51.978 (2.0463 - 2.0464)
	Grade No. C	51.976 - 51.977 (2.0463 - 2.0463)
	Grade No. D	51.975 - 51.976 (2.0463 - 2.0463)
	Grade No. E	51.974 - 51.975 (2.0462 - 2.0463)
	Grade No. F	51.973 - 51.974 (2.0462 - 2.0462)
	Grade No. G	51.972 - 51.973 (2.0461 - 2.0462)
	Grade No. H	51.971 - 51.972 (2.0461 - 2.0461)
	Grade No. J	51.970 - 51.971 (2.0461 - 2.0461)
	Grade No. K	51.969 - 51.970 (2.0460 - 2.0461)
	Grade No. L	51.968 - 51.969 (2.0460 - 2.0460)
	Grade No. M	51.967 - 51.968 (2.0459 - 2.0460)
	Grade No. N	51.966 - 51.967 (2.0459 - 2.0459)
	Grade No. P	51.965 - 51.966 (2.0459 - 2.0459)
	Grade No. R	51.964 - 51.965 (2.0458 - 2.0459)
	Grade No. S	51.963 - 51.964 (2.0458 - 2.0458)
Grade No. T	51.962 - 51.963 (2.0457 - 2.0458)	
Grade No. U	51.961 - 51.962 (2.0457 - 2.0457)	
Grade No. V	51.960 - 51.961 (2.0457 - 2.0457)	
Grade No. W	51.959 - 51.960 (2.0456 - 2.0457)	

*: Total indicator reading

Connecting Rod Bearing

INFOID:000000010735684

CONNECTING ROD BEARING GRADE TABLE

Unit: mm (in)

Grade number	Thickness	Identification color	Remarks
0	1.494 - 1.497 (0.0588 - 0.0589)	Black - Black	Grade and color are the same for upper and lower bearings.
1	1.497 - 1.500 (0.0589 - 0.0591)	Brown - Brown	
2	1.500 - 1.503 (0.0591 - 0.0592)	Green - Green	
3	1.503 - 1.506 (0.0592 - 0.0593)	Yellow - Yellow	
4	1.506 - 1.509 (0.0593 - 0.0594)	Blue - Blue	
01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Grade and color are different between upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0591)	
12	UPR	1.497 - 1.500 (0.0589 - 0.0591)	
	LWR	1.500 - 1.503 (0.0591 - 0.0592)	
23	UPR	1.500 - 1.503 (0.0591 - 0.0592)	
	LWR	1.503 - 1.506 (0.0592 - 0.0593)	
34	UPR	1.503 - 1.506 (0.0592 - 0.0593)	
	LWR	1.506 - 1.509 (0.0593 - 0.0594)	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[MR20DD]

UNDERSIZE TABLE

Unit: mm (in)

Items	Thickness	Crank pin journal diameter
US 0.25 (0.0098)	1.623 - 1.631 (0.0639 - 0.0642)	Grind so that bearing clearance is the specified value.

CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.037 - 0.047 (0.0015 - 0.0019)
	Limit	0.07 (0.0028)

Main Bearing

INFOID:000000010735685

MAIN BEARING GRADE TABLE (ALL JOURNALS)

Unit: mm (in)

Grade number	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0786 - 0.0787)	Black - Black	Grade and color are the same for upper and lower bearings.
1	1.999 - 2.002 (0.0787 - 0.0788)	Brown - Brown	
2	2.002 - 2.005 (0.0788 - 0.0789)	Green - Green	
3	2.005 - 2.008 (0.0789 - 0.0791)	Yellow - Yellow	
4	2.008 - 2.011 (0.0791 - 0.0792)	Blue - Blue	
5	2.011 - 2.014 (0.0792 - 0.0793)	Pink - Pink	
6	2.014 - 2.017 (0.0793 - 0.0794)	Purple - Purple	
7	2.017 - 2.020 (0.0794 - 0.0795)	White - White	
01	UPR	1.996 - 1.999 (0.0786 - 0.0787)	Grade and color are different between upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	
23	UPR	2.002 - 2.005 (0.0788 - 0.0789)	
	LWR	2.005 - 2.008 (0.0789 - 0.0791)	
34	UPR	2.005 - 2.008 (0.0789 - 0.0791)	
	LWR	2.008 - 2.011 (0.0791 - 0.0792)	
45	UPR	2.008 - 2.011 (0.0791 - 0.0792)	
	LWR	2.011 - 2.014 (0.0792 - 0.0793)	
56	UPR	2.011 - 2.014 (0.0792 - 0.0793)	
	LWR	2.014 - 2.017 (0.0793 - 0.0794)	
67	UPR	2.014 - 2.017 (0.0793 - 0.0794)	
	LWR	2.017 - 2.020 (0.0794 - 0.0795)	

UNDERSIZE TABLE

Unit: mm (in)

Items	Thickness	Main journal diameter
US 0.25 (0.0098)	2.126 - 2.134 (0.0837 - 0.0840)	Grind so that bearing clearance is the specified value.

MAIN BEARING OIL CLEARANCE

Unit: mm (in)

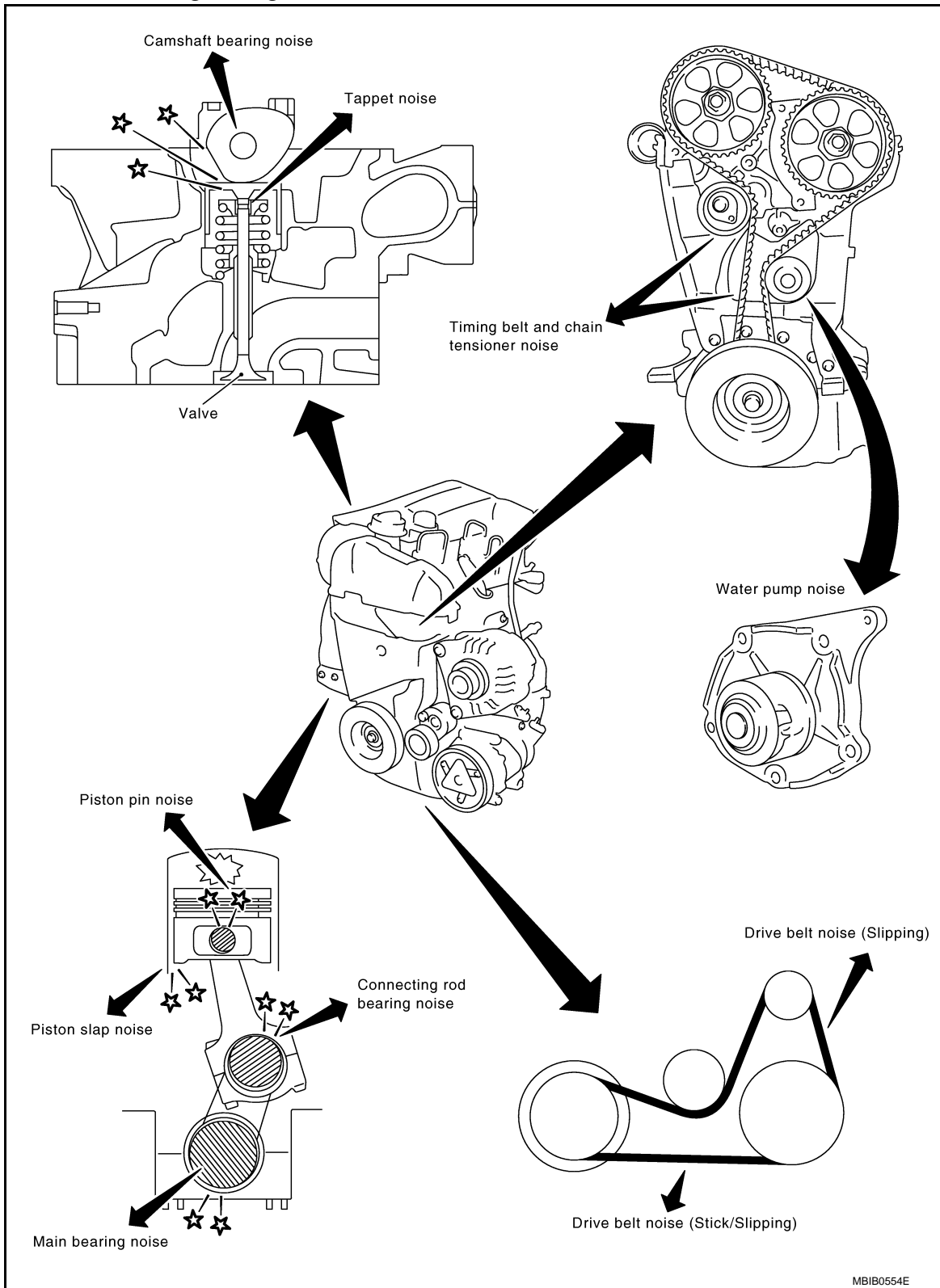
Main bearing oil clearance	Standard	No. 1 and 4	0.024 - 0.034 (0.0009 - 0.0013)
		No. 2, 3 and 5	0.012 - 0.022 (0.0005 - 0.0009)
	Limit		

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:000000010282040



NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[K9K]

Use the Chart Below to Help You Find the Cause of the Symptom

INFOID:000000010282041

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-316
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring end gap	EM-348
Front of engine Timing belt cover	Tapping or ticking	A	A	—	B	B	B	Timing belt tensioner noise	Timing belt tensioner operation	EM-331
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-274
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-75

A: Closely related B: Related C: Sometimes related —: Not related

< PRECAUTION >

PRECAUTION

PRECAUTIONS

Precautions for Removing Battery Terminal

INFOID:0000000010508844

- With the adoption of Auto ACC function, ACC power is automatically supplied by operating the intelligent key or remote keyless entry or by opening/closing the driver side door. In addition, ACC power is supplied even after the ignition switch is turned to the OFF position, i.e. ACC power is supplied for a certain fixed time.
- When disconnecting the 12V battery terminal, turn off the ACC power before disconnecting the 12V battery terminal, observing "How to disconnect 12V battery terminal" described below.

NOTE:

Some ECUs operate for a certain fixed time even after ignition switch is turned OFF and ignition power supply is stopped. If the battery terminal is disconnected before ECU stops, accidental DTC detection or ECU data damage may occur.

- For vehicles with the 2-batteries, be sure to connect the main battery and the sub battery before turning ON the ignition switch.

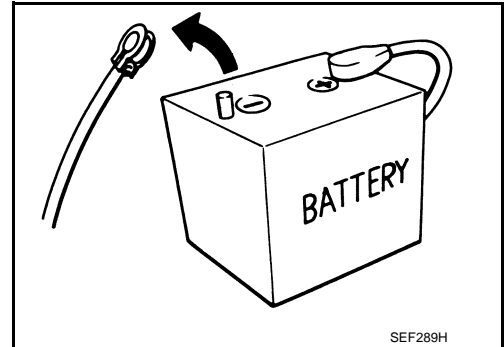
NOTE:

If the ignition switch is turned ON with any one of the terminals of main battery and sub battery disconnected, then DTC may be detected.

- After installing the 12V battery, always check "Self Diagnosis Result" of all ECUs and erase DTC.

NOTE:

The removal of 12V battery may cause a DTC detection error.



HOW TO DISCONNECT 12V BATTERY TERMINAL

Disconnect 12V battery terminal according to Instruction 1 or Instruction 2 described below.

For vehicles parked by ignition switch OFF, refer to Instruction 2.

INSTRUCTION 1

1. Open the hood.
2. Turn key switch to the OFF position with the driver side door opened.
3. Get out of the vehicle and close the driver side door.
4. Wait at least 3 minutes. For vehicle with the engine listed below, remove the battery terminal after a lapse of the specified time.

D4D engine	: 20 minutes
HRA2DDT	: 12 minutes
K9K engine	: 4 minutes
M9R engine	: 4 minutes
R9M engine	: 4 minutes
V9X engine	: 4 minutes

CAUTION:

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

5. Remove 12V battery terminal.

CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

INSTRUCTION 2 (FOR VEHICLES PARKED BY IGNITION SWITCH OFF)

1. Unlock the door with intelligent key or remote keyless entry.

NOTE:

At this moment, ACC power is supplied.

2. Open the driver side door.
3. Open the hood.
4. Close the driver side door.
5. Wait at least 3 minutes.

PRECAUTIONS

< PRECAUTION >

[K9K]

CAUTION:

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

6. Remove 12V battery terminal.

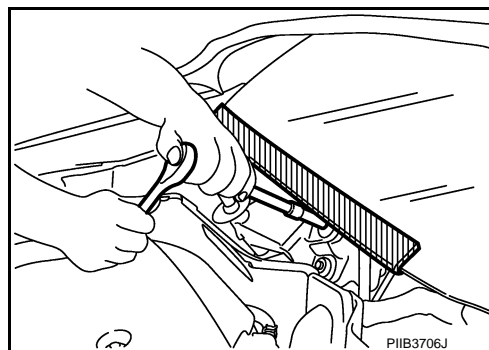
CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

Precaution for Procedure without Cowl Top Cover

INFOID:000000010499436

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc to prevent damage to windshield.



Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:000000010499438

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

WARNING:

Always observe the following items for preventing accidental activation.

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision that would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see "SRS AIR BAG".
- Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

Always observe the following items for preventing accidental activation.

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000010282043

NOTE:

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition switch in the "LOCK" position.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

PRECAUTIONS

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< PRECAUTION >

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.

NOTE:

Supply power using jumper cables if battery is discharged.

2. Use the Intelligent Key or mechanical key to turn the ignition switch to the "ACC" position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.
5. When the repair work is completed, return the ignition switch to the "LOCK" position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT.

Parts Requiring Angular Tightening

INFOID:000000010282044

- Use an angle wrench for the final tightening of the following engine parts.
 - Cylinder head bolts
 - Lower cylinder block bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precaution for Liquid Gasket

INFOID:000000010282045

REMOVAL OF LIQUID GASKET

- After removing the mounting bolts and nuts, separate the mating surface using a seal cutter and remove the liquid gasket.

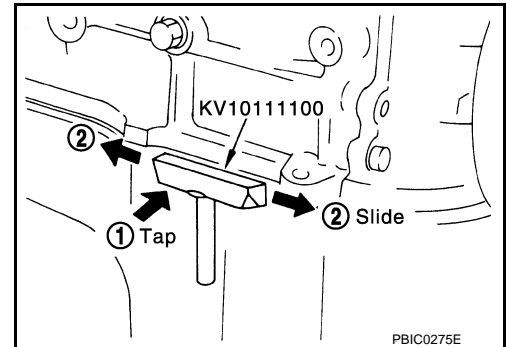
CAUTION:

Be careful not to damage the mating surfaces.

- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap the liquid gasket applied area.

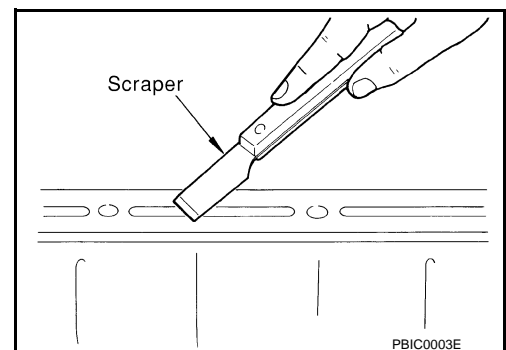
CAUTION:

If for some unavoidable reason a tool such as a flat-bladed screwdriver is used, be careful not to damage the mating surfaces.



LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
 - Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts and bolt holes.
2. Wipe the gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.
3. Attach the liquid gasket to the tube presser.
Use Genuine Liquid Gasket or equivalent.

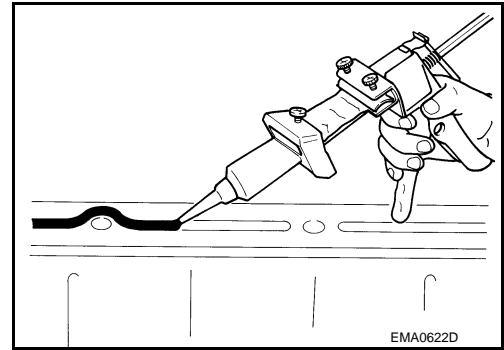


PRECAUTIONS

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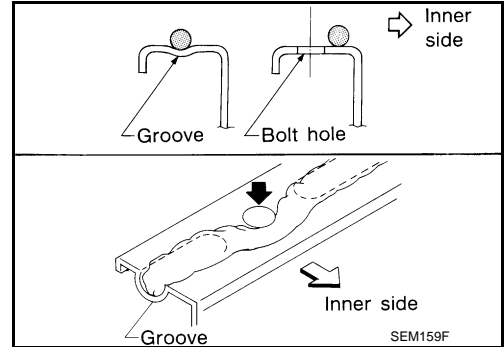
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the gasket to the groove.



- As for the bolt holes, normally apply the gasket inside the holes. If specified, it should be applied outside the holes. Make sure to read the instruction in this manual.
- Within five minutes of gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten after the installation.
- After 30 minutes or more have passed from the installation, fill the engine oil and coolant.

CAUTION:

If there are instructions in this manual, observe them.



Precaution for Diesel Equipment

INFOID:000000010282046

CLEANLINESS

CLEANLINESS INSTRUCTIONS WHICH MUST BE FOLLOWED WHEN WORKING ON THE HIGH PRESSURE DIRECT INJECTION SYSTEM

Risks relating to contamination

The system is very sensitive to contamination. The risks caused by the introduction of contamination are:

- Damage or destruction of the high pressure injection system and the engine,
- Seizing or leaking of a component.

All After-Sales operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) get into the system during dismantling or into the circuits via the fuel unions.

The cleanliness principle must be applied from the filter to the injectors.

WHAT ARE THE SOURCES OF CONTAMINATION?

Contamination is caused by:

- Metal or plastic chips,
- Paint,
- Fibers:
 - Boxes,
 - Brushes,
 - Paper,
 - Clothing,
 - Cloths,
- Foreign bodies such as hair,
- Ambient air,
- Etc.

IMPORTANT: It is not possible to clean the engine using a high pressure washer because of the risk of damaging connections. In addition, moisture may collect in the connectors and create electrical connection malfunctions.

INSTRUCTIONS TO BE FOLLOWED BEFORE ANY WORK IS CARRIED OUT ON THE INJECTION SYSTEM

- Ensure that you have the plugs for the unions to be opened (bag of plugs sold at the Parts Stores - Nissan part No.: 16609 00Q0B, Renault part No.: 77 01 476 857). Plugs are to be used once only. After use, they must be thrown away (once used they are soiled and cleaning is not sufficient to make them reusable). Unused plugs must be thrown away.

PRECAUTIONS

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< PRECAUTION >

- Ensure that you have hermetically resealable plastic bags for storing removed parts. Stored parts will therefore be less subject to the risk of impurities. The bags must be used only once, and after use they must be thrown away.
- Lint-free towelettes to be used for high pressure supply pump related service purpose. The use of a normal cloth or paper for cleaning purposes is forbidden. These are not lint-free and may contaminate the fuel circuit of the system. Each lint-free cloth should only be used once.

INSTRUCTIONS TO BE FOLLOWED BEFORE OPENING THE FUEL CIRCUIT

- For each operation, use new thinner (used thinner contains impurities). Pour it into a clean receptacle.
- For each operation, use a clean brush which is in good condition (the brush must not shed its bristles).
- Use a brush and thinners to clean the connections to be opened.
- Blow compressed air over the cleaned parts (tools, cleaned the same way as the parts, connections and injection system zone). Check that no bristles remain adhered.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover these with latex gloves.

INSTRUCTIONS TO BE FOLLOWED DURING THE OPERATION

- As soon as the circuit is open, all openings must be plugged to prevent impurities from entering the system. The plugs to be used are available from the Parts Stores - Nissan part No.: 16609 00Q0B, Renault part No.: 77 01 476 857. They must not, under any circumstances, be reused.
- Close the hermetically sealed bag, even if it has to be reopened shortly afterwards. Ambient air carries contamination.
- All components of the injection system that are removed must be stored in a hermetically sealed plastic bag once the plugs have been inserted.
- The use of a brush, thinner, bellows, sponge or normal cloth is strictly forbidden once the circuit has been opened. These items are likely to allow impurities to enter the system.
- A new component replacing an old one must not be removed from its packaging until it is to be fitted to the vehicle.

Instructions for Fitting the Plugs

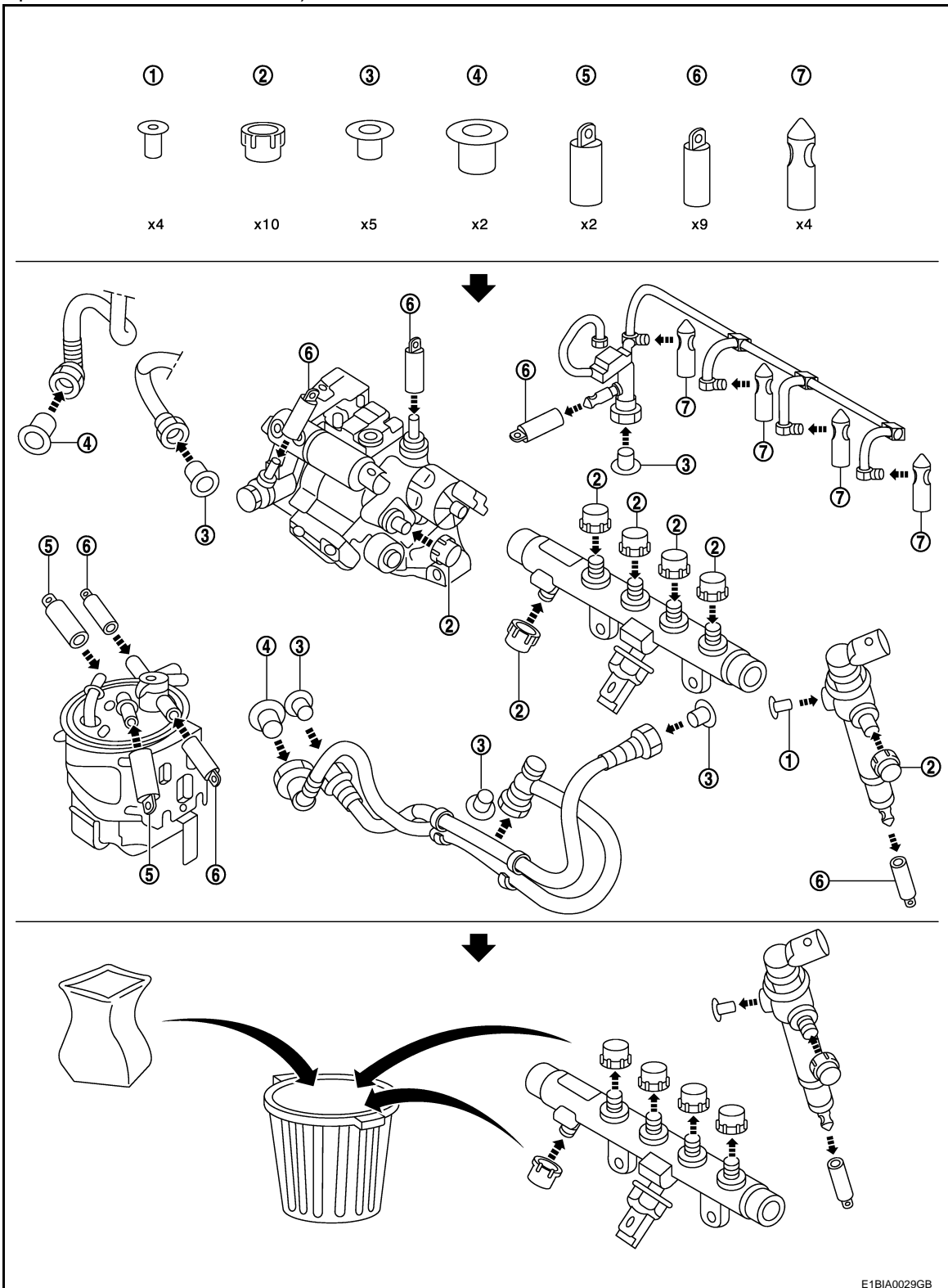
Nissan part number: 16609 00Q0B

PRECAUTIONS

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(Renault part number: 77 01 476 857)



CAUTION:

- The engine must not run with:
 - Diesel containing more than 10% diester
 - Petrol, even in very small amounts.
- The system can inject the diesel into the engine at a pressure of up to 140,000 kPa (1,400 bar, 1,428 kg/cm², 20,300 psi). Before carrying out any work, check that the injector rail is no longer pressurized and that the fuel temperature is not too high.
- You must respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.

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PRECAUTIONS

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SPECIAL FEATURES

CAUTION:

- The engine must not operate with:
 - Diesel engine fuel containing more than 10% diester,
 - Petrol, even in tiny quantities.
- The system can inject the diesel into the engine at a pressure up to 1400 bars. Before carrying out any work, check that the injector rail is not under pressure and that the fuel temperature is not too high.
- You must respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.
- Removal of the interior of the pump and injectors is prohibited. Only the flow actuator, the fuel temperature sensor and the venturi can be replaced.
- For safety reasons, it is strictly forbidden to slacken a injection tube union when the engine is running.
- It is not possible to remove the pressure sensor from the fuel rail because this may cause circuit contamination malfunctions. If the pressure sensor fails, the pressure sensor, the rail and the five injection tubes must be replaced.
- It is strictly forbidden to remove any high pressure supply pump pulley marked number 070 575. If the pump is being replaced, the pulley must be replaced.
- It is forbidden to repair the wiring connecting the knock sensor (accelerometer) and the CKP sensor (engine speed sensor). If the wiring should fail, it has to be replaced with new wiring.
- Applying 12 volts directly to any component in the system is prohibited.
- Ultrasonic carbon removal and cleaning are prohibited.
- Never start the engine without the battery being connected correctly.
- It is essential to replace all the disconnected air inlet plastic pipes.

INSTRUCTIONS FOR INJECTION TUBES

CAUTION:

All the injection tube removed must be systematically replaced along with the clips.

TIGHTENING THE INJECTION TUBES

NOTE:

fit the pump/rail pipe before the rail/injector pipes.

Rail-pump pipe

- Undo the rail,
- Grease the threads of the injection tube nuts,
- Insert the injection tube olive into the taper of the high pressure pump outlet,
- Insert the injection tube olive into the taper of the high pressure rail inlet.
- Move the nut into position by hand, on the rail side then the pump side,
- Tighten the rail,
- Tighten the injection tube nuts on the rail side then on the pump side.

Rail/injector pipes

- Undo the rail,
- Grease the threads of the injection tube nuts,
- Insert the injection tube olive into the taper of the high pressure injector inlet,
- Insert the injection tube olive into the taper of the high pressure rail outlet,
- Move the nuts into position by hand, on the injector side then the rail side,
- Tighten the rail,
- Ensure that the new clip, supplied with the new injection tube, is fitted,
- Tighten the nuts of the injection tubes on the injector side first and then on the fuel rail side.

NOTE:

Before fitting a new injection tube, move back the nuts on the pipe then lightly lubricate the nut threads with the oil from the sachet provided in the parts kit.

CHECKING SEALING AFTER REPAIR

CAUTION:

After any operation, check that there are no diesel leaks.

- Reprime the circuit using the priming pump.
- Start the engine and allow to warm up at idle speed, visually inspecting for any fuel leaks.
- Apply tracing fluid around the high pressure connections of the pipe that has been replaced.
- Once the engine coolant temperature is above 50°C and provided there are no malfunctions present, carry out a road test, taking the engine speed up to 4000 rpm at least once to check that there are no leaks.
- Perform a visual inspection after the road test to make sure that there are no high pressure leaks.
- Clean off the tracing fluid.

PRECAUTIONS

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< PRECAUTION >

Installation of Thread Inserts

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Threaded holes on all engine component parts can be repaired by using thread inserts.

Precautions For Engine Service

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DISCONNECTING FUEL PIPING

- Before starting work, check no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

C

DRAINING ENGINE COOLANT

Drain engine coolant and engine oil when the engine is cooled.

D

INSPECTION, REPAIR AND REPLACEMENT

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

E

REMOVAL AND DISASSEMBLY

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Must cover openings of engine system with a tape or equivalent, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

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ASSEMBLY AND INSTALLATION

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- After disassembling, or exposing any internal engine parts, change engine oil and replace oil filter with a new one.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

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PREPARATION

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PREPARATION

PREPARATION

Special Service Tool

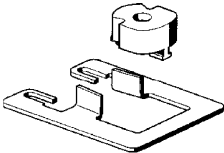
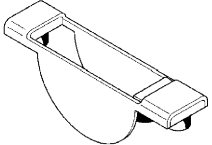
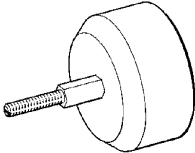
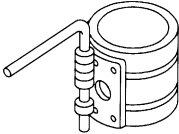
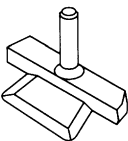
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NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0020 (Emb. 880) Sliding hammer	Inertia extractor
KV113B0060 (Mot. 582-01) Ring gear stopper	Flywheel immobilizing tool.
KV113B0110 (Mot. 1430) TDC set pin	Set of TDC pins
KV113B0120 (Mot. 1485-01) Oil jet remover	Tool for removing the piston bottom oil jets
KV113B0130 (Mot. 1489) TDC set pin	TDC setting pin
KV113B0140 (Mot. 1492) Bearing assembling set	Tool for installing connecting rod bearing

PREPARATION

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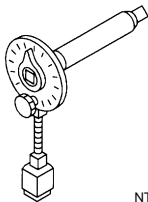
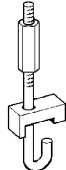
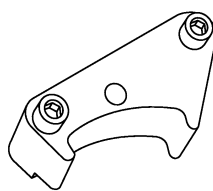
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NISSAN tool number (RENAULT tool No.) Tool name	Description	
KV113B0150 (Mot. 1492-03) Bearing assembling adapter  MBIB0375E	Adaptation kit for installing the detachable cap connecting rod bearing	A EM C
KV113B0160 (Mot. 1493-01) Bearing insert  MBIB0376E	Tool for installing main bearing	D E F
KV113B0170 (Mot. 1494) Oil jet remover plate	Tool for removing oil jets	G
KV113B0190 (Mot. 1567) Clip pliers	Pliers for exhaust gas recycling pipe clips	H
KV113B0210 (Mot. 1585) Front oil seal drift  MBIB0381E	Tool for installing crankshaft seals, flywheel end	I J
KV113B0220 (Mot. 1586) Front oil seal drift set	Tool for installing crankshaft seals, timing end	K
KV113B0230 (Mot. 1632) Camshaft seal insert	Tool for installing inlet camshaft seals	L
KV113B0240 (Rou. 15-01) Shaft protector	Internal shaft protector 16 mm (0.63 in) dia.	M
EM03470000 (—) Piston ring compressor  NT044	Installing piston assembly into cylinder bore	N O
KV10111100 (—) Seal cutter  NT046	Removing oil pan	P

PREPARATION

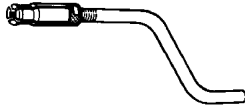
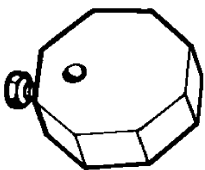
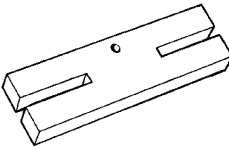
< PREPARATION >

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NISSAN tool number (RENAULT tool No.) Tool name	Description	
KV10112100 (—) Angle wrench	 <p style="text-align: right; margin-right: 50px;">NT014</p>	Tightening bolts for bearing cap, cylinder head, etc. in angle
— (Mot. 1638) Belt tension gauge		 <p style="text-align: right; margin-right: 50px;">MBIB0382E</p>
— (Mot. 1606-A) Camshaft pulley holder	 <p style="text-align: right; margin-right: 50px;">MBIB1922E</p>	Tool for locking sprockets for toothed timing belt

Commercial Service Tool

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NISSAN tool number (RENAULT tool No.) Tool name	Description	
KV113B0030 (Mot. 11) Crankshaft bearing remover	 <p style="text-align: right; margin-right: 50px;">MBIB0359E</p>	Crankshaft bearing extractor
KV113B0040 (Mot. 251-01) Dial gauge stand set		 <p style="text-align: right; margin-right: 50px;">MBIB0360E</p>
KV113B0050 (Mot. 252-01) Dial gauge stand set	 <p style="text-align: right; margin-right: 50px;">MBIB0361E</p>	Thrust plate for measuring the protrusion of cylinder liners used with KV113B0040 (Mot. 251-01).

PREPARATION

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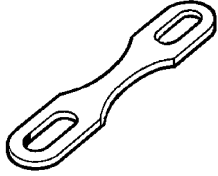
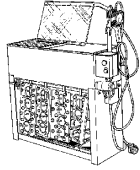

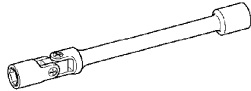
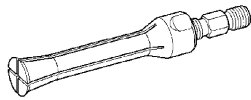
[K9K]

NISSAN tool number (RENAULT tool No.) Tool name	Description	A
KV113B0090 (Mot. 1335) Valve seal remover	Tool for removing valve stem seals	EM
KV113B0180 (Mot. 1511-01) Valve seal drift	Tool for installing valve stem seals	C D E
KV113B0200 (Mot. 1573) Cylinder head stand	Cylinder head support	F G H
KV113E0010 (Mot. 1566) Fuel spill tube spanner	Spanner for installing and removing high pressure pipes	I J
WS39930000 (—) Tube presser	Pressing the tube of liquid gasket	K L M
Manual lift table caddy	Removing and installing engine	N O
Piston ring expander	Removing and installing piston ring	P

PREPARATION

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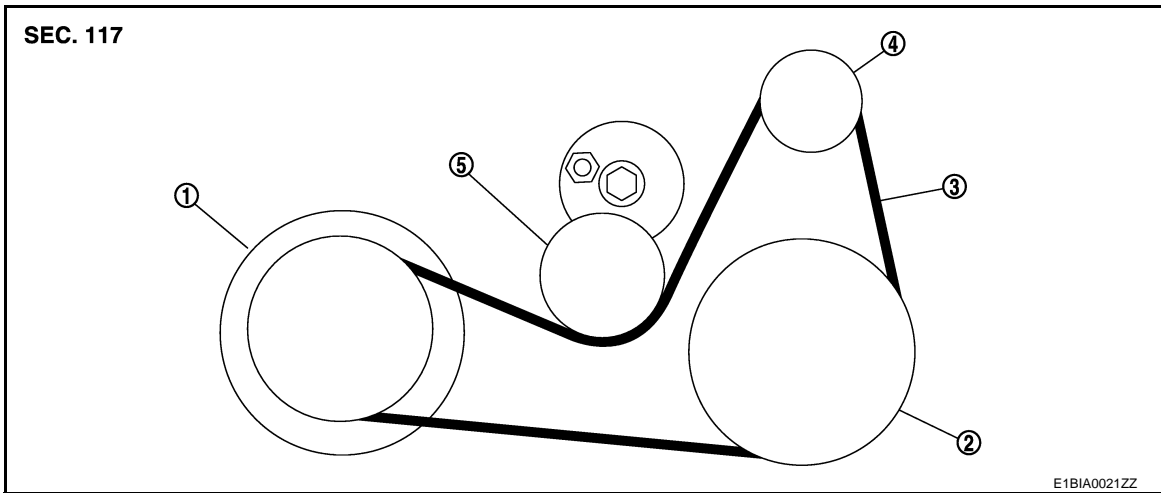
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NISSAN tool number (RENAULT tool No.) Tool name	Description
(Mot. 588)	Liner retaining strap
 <small>MBIB0364E</small>	
(664000) Cylinder head test container	Tool for testing the cylinder head, including: a tray and the various kits suited for each model of cylinder head (plug, sealing plate, blanking plate).
 <small>MBIB0383E</small>	
Torx socket	Standard 1/2" (12.7 mm) square drive 8/12/14 female torx socket.
(Mot. 1505) (Mot. 1715) Frequency meter	Tool for belt tension checking with frequency
 <small>MBIB1423E</small>	
Glow plug wrench	Articulated wrench for removing and installing the glow plugs
 <small>MBIB0387E</small>	
Main bearing wrench	Wrench for removing main bearings
 <small>MBIB0388E</small>	

PERIODIC MAINTENANCE

DRIVE BELT

Exploded View



- | | | |
|----------------------|-----------------------------------|---------------|
| 1. Crankshaft pulley | 2. A/C compressor or Idler pulley | 3. Drive belt |
| 4. Alternator | 5. Drive belt auto-tensioner | |

Removal and Installation

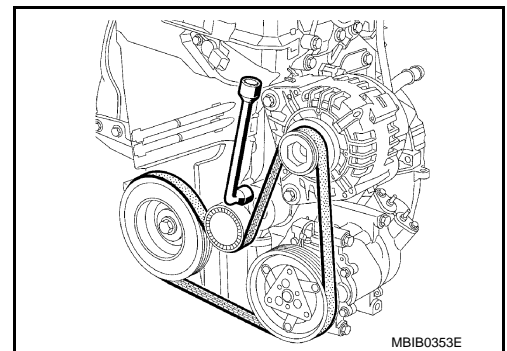
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CAUTION:

- Replace any belt that has been removed with a new one.
- Auto-tensioner must be replaced with new ones when the belt is replaced.
- Never run the engine without the drive belts to avoid damaging the crankshaft pulley.

REMOVAL

1. Remove RH front wheel.
2. Remove front fender protector (RH) front side bolts and clips. And keep a service area. Refer to [EXT-29](#), "[Removal and Installation](#)".
3. Remove drive belt.
 - Turn clockwise adjusting bolt.



4. If necessary, remove auto-tensioner.

INSTALLATION

1. Install auto-tensioner mounting bolt.

Auto-tensioner mounting bolt : 40 N-m (4.1 kg-m, 30 ft-lb)

2. Install the drive belt.

CAUTION:

- Make sure belt is correctly engaged with the pulley groove.
- Check for oil and coolant on belt and each pulley groove.

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DRIVE BELT

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3. Make sure that tension of each belt is within the standard.

Inspection

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INSPECTION

WARNING:

Be sure to perform when the engine is stopped.

1. Inspect drive belt for cracks, fraying, wear and oil. Replace drive belt if necessary.
2. Manually evaluate the drive belt tension (tension cannot be measured using frequency meter).
3. Replace drive belt when tension is beyond normal operating limit.

CAUTION:

Auto-tensioner must be replaced with a new one when the belt is replaced.

Adjustment

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Belt tensioning is not necessary, as it is automatically adjusted by auto-tensioner.

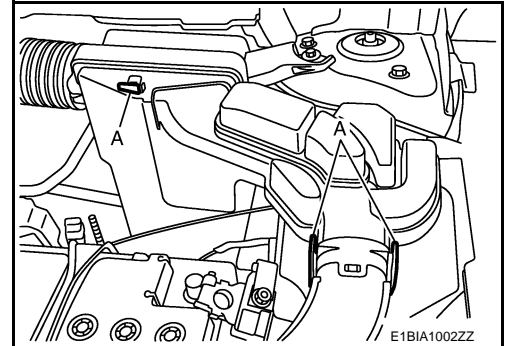
AIR CLEANER FILTER

Removal and Installation

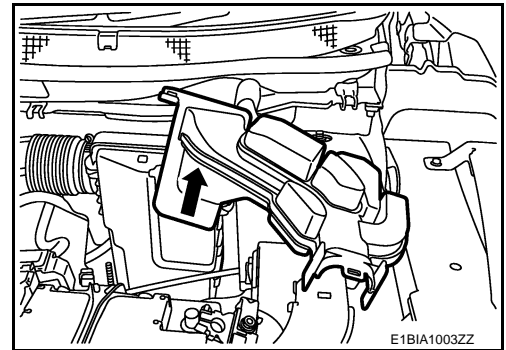
INFOID:000000010282054

REMOVAL

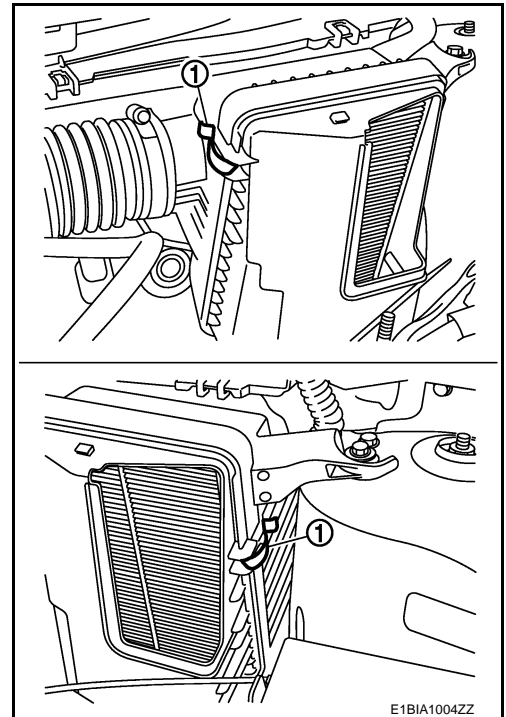
1. Press the points (A) to separate air resonator from air duct and air cleaner filter unit.



2. Remove air resonator following the arrow.



3. Unhook clips (1) on the air cleaner filter holder.



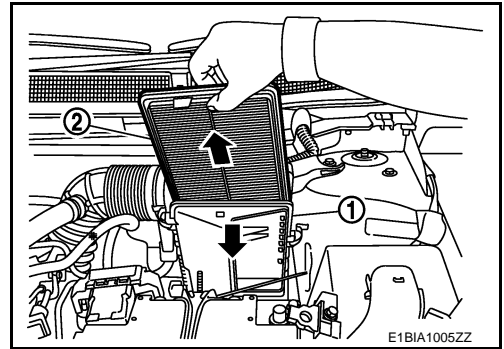
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AIR CLEANER FILTER

[K9K]

< PERIODIC MAINTENANCE >

4. Separate air cleaner filter holder (1) from air cleaner filter unit and remove air cleaner filter (2).



INSTALLATION

Install in the reverse order of removal.

DRIVE BELT AUTO-TENSIONER

< REMOVAL AND INSTALLATION >

[K9K]

REMOVAL AND INSTALLATION

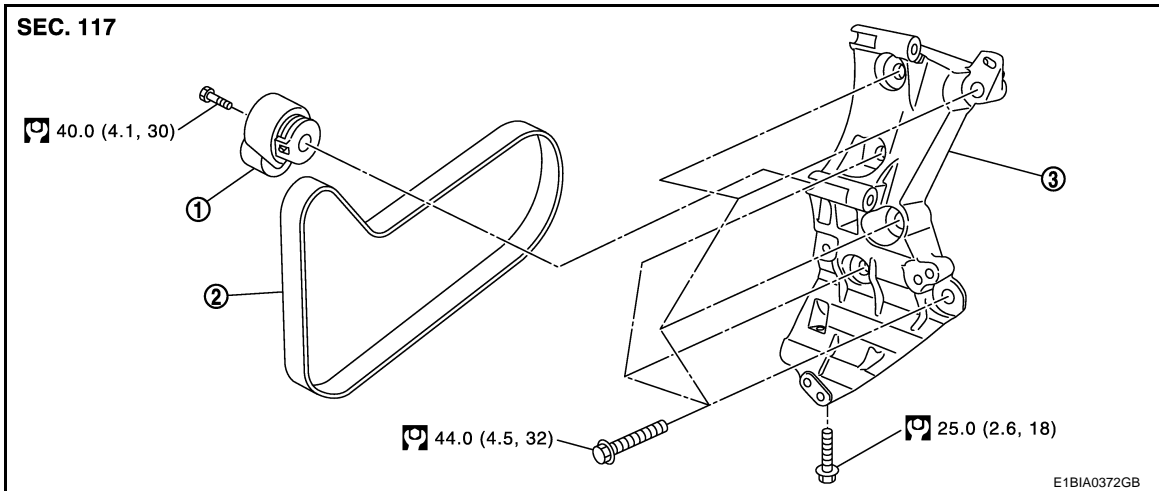
DRIVE BELT AUTO-TENSIONER

Exploded View

INFOID:000000010282057

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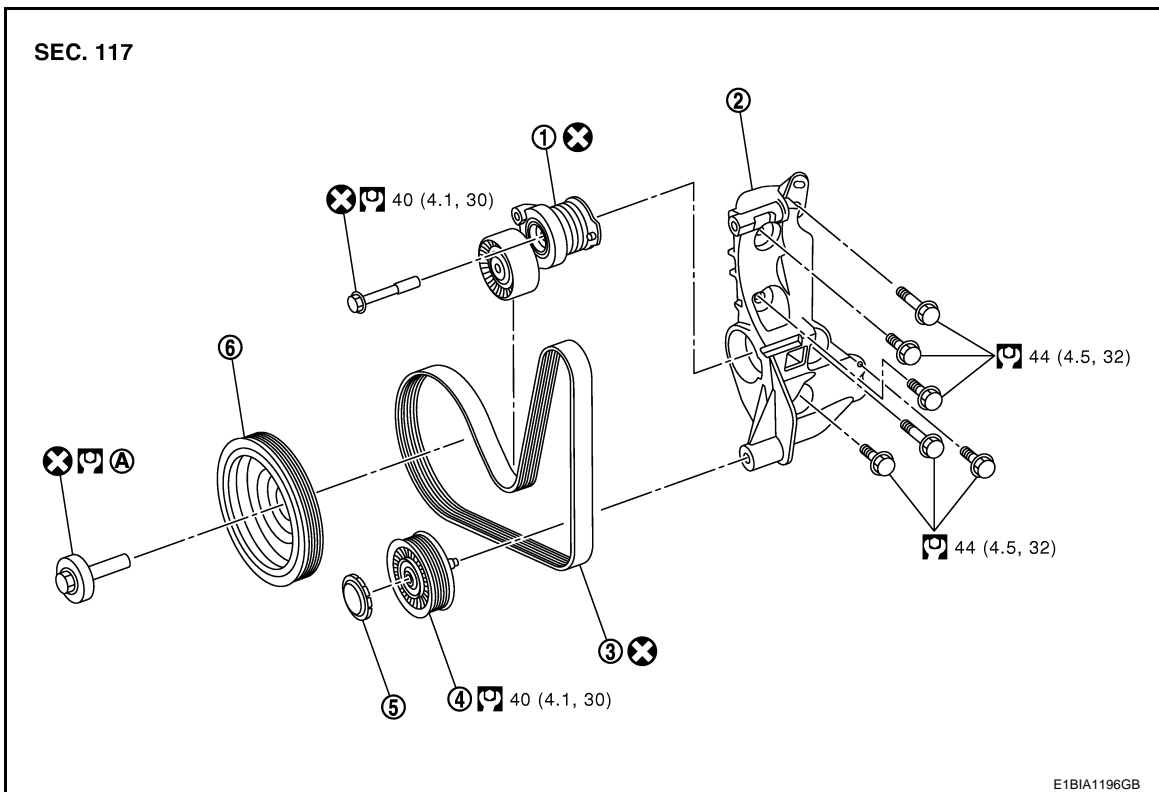
WITH A/C



1. Drive belt auto-tensioner
2. Drive belt
3. Multifunction bracket

Refer to [GI-4, "Components"](#) for symbols in the figure.

WITHOUT A/C



1. Drive belt auto-tensioner
 2. Multifunction bracket
 3. Drive belt
 4. Idler pulley
 5. Idler pulley cover
 6. Cranshaft pulley
- A. Refer to [EM-331](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

DRIVE BELT AUTO-TENSIONER

< REMOVAL AND INSTALLATION >

[K9K]

Removal and Installation

INFOID:000000010282058

CAUTION:

- Replace any belt that has been removed with a new one.
- Auto-tensioner must be replaced with new ones when the belt is replaced.
- Do not run the engine without the drive belts to avoid damaging the crankshaft pulley.

REMOVAL

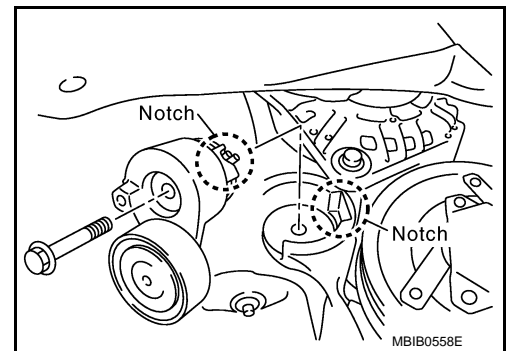
1. Remove engine undercover.
2. Remove RH front wheel.
3. Remove right side splash cover.
4. Remove drive belt. Refer to [EM-273. "Removal and Installation"](#).
5. Remove auto-tensioner.
6. Remove idler pulley (Models without A/C only)

INSTALLATION

1. Install auto-tensioner mounting bolt.

 **40.0 N·m (4.1 kg-m, 30 ft-lb)**

Align the notch and tighten mounting bolt.



2. Install idler pulley (Models without A/C only)

 **40.0 N·m (4.1 kg-m, 30 ft-lb)**

3. Install the drive belt. Refer to [EM-273. "Removal and Installation"](#).
4. Release drive belt auto-tensioner, and apply tension to drive belt.
5. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.

AIR CLEANER AND AIR DUCT

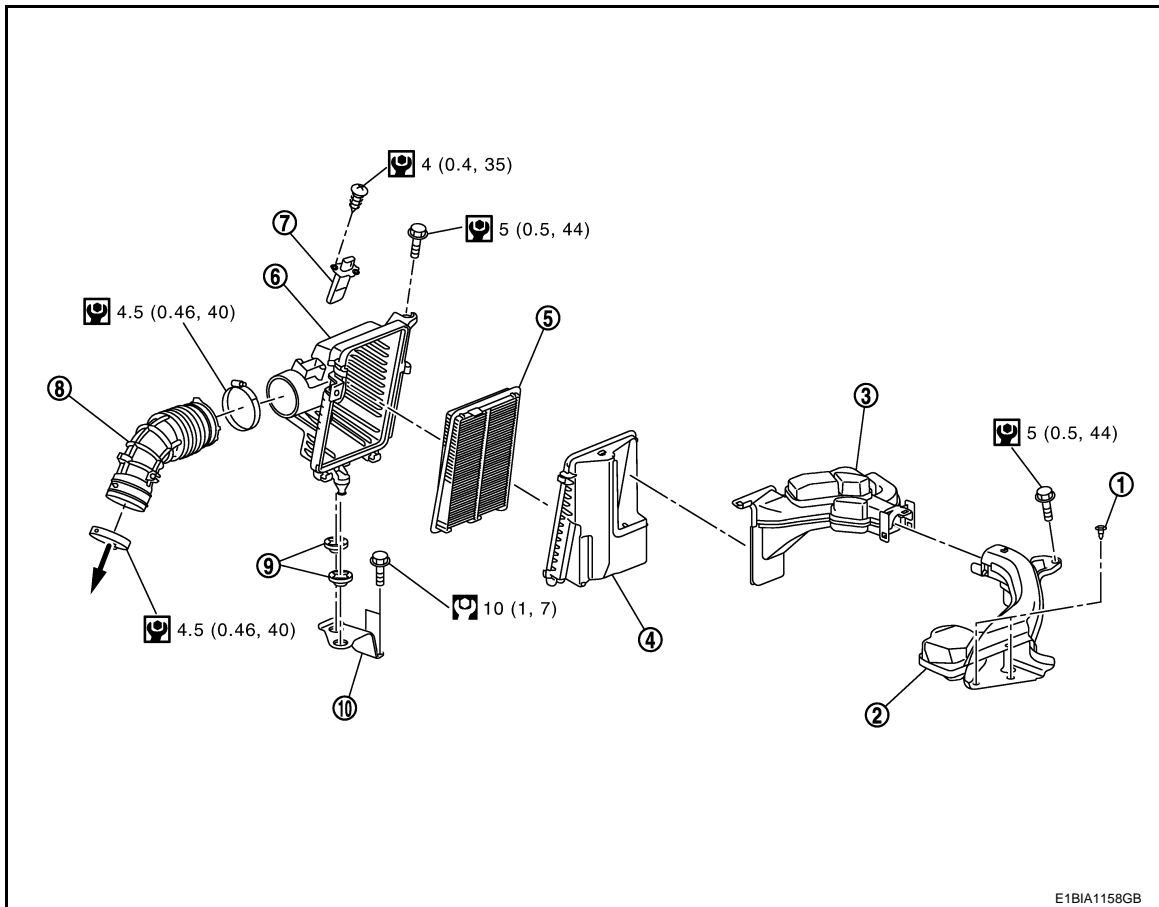
< REMOVAL AND INSTALLATION >

[K9K]

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:000000010478308



- | | | |
|-------------------------------------|--------------------------|--------------------------------|
| 1. Clip | 2. Air duct (inlet side) | 3. Air duct (air cleaner side) |
| 4. Holder | 5. Air filter element | 6. Air cleaner filter unit |
| 7. Mass air flow sensor | 8. Air hose | 9. Mounting rubber |
| 10. Air cleaner filter unit bracket | | |

Refer to [GI-4. "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282060

REMOVAL

1. Remove air duct (air cleaner side).
2. Remove air duct (inlet side).
3. Disconnect mass air flow sensor.
4. Disconnect air hose from air cleaner filter unit.
5. Remove air cleaner filter unit.
6. Remove air hose.
7. Remove air filter element if necessary.

INSTALLATION

- Install in the reverse order of removal.

Inspection

INFOID:000000010287198

INSPECTION AFTER REMOVAL

AIR CLEANER AND AIR DUCT

< REMOVAL AND INSTALLATION >

[K9K]

Inspect air ducts, air cleaner and hose for crack or tear.

- If anything found, replace air duct and resonator assembly.

CHARGE AIR COOLER

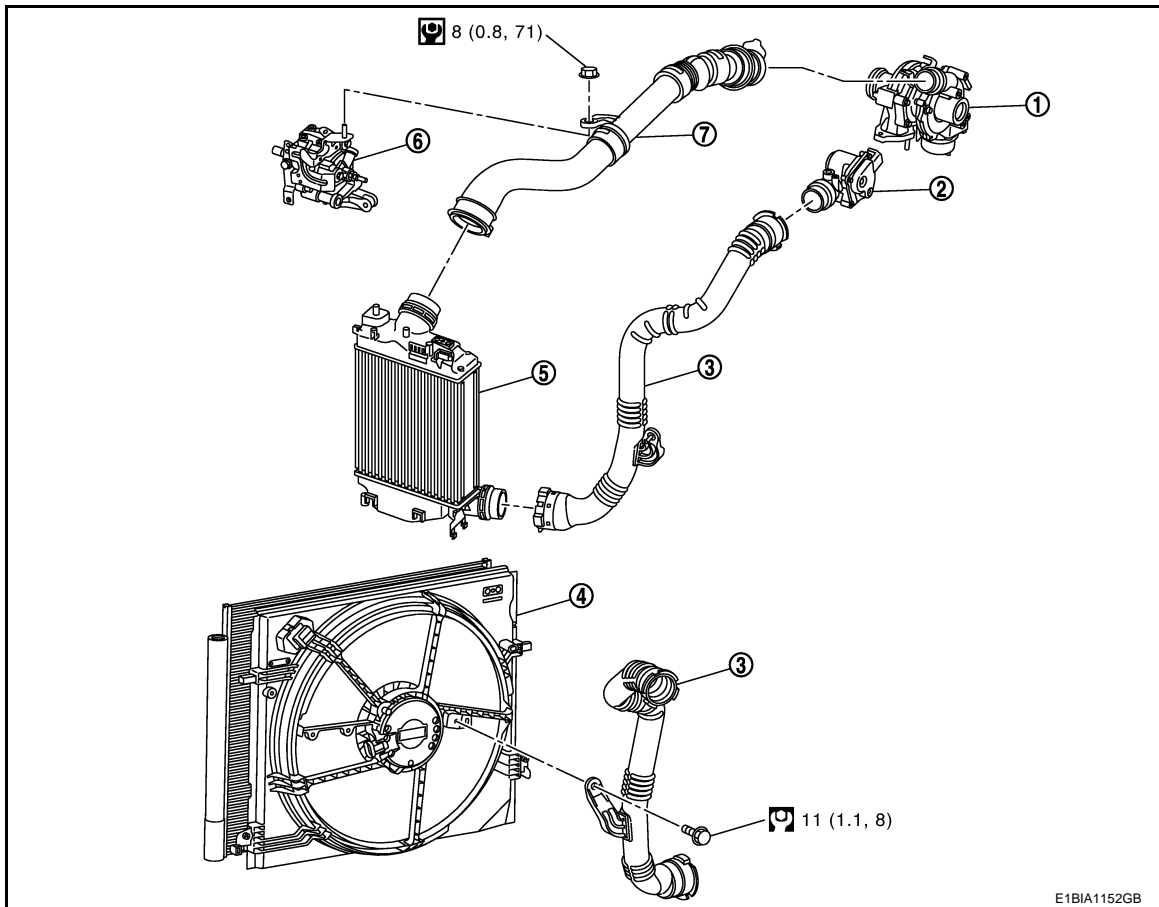
< REMOVAL AND INSTALLATION >

[K9K]

CHARGE AIR COOLER

Exploded View

INFOID:000000010287199



- | | | |
|-------------------|---------------------------------------|-----------------------|
| 1. Turbocharger | 2. Electric throttle control actuator | 3. Air inlet tube |
| 4. Cooling fan | 5. Charge air cooler | 6. High pressure pump |
| 7. Air inlet hose | | |

Refer to [GI-4. "Components"](#) for symbols description.

Removal and Installation

INFOID:000000010282062

REMOVAL

Air inlet hose and tube.

1. Remove engine cover.
2. Remove air inlet hose and tube. Refer to [EM-281. "Exploded View"](#).

Charge air cooler.

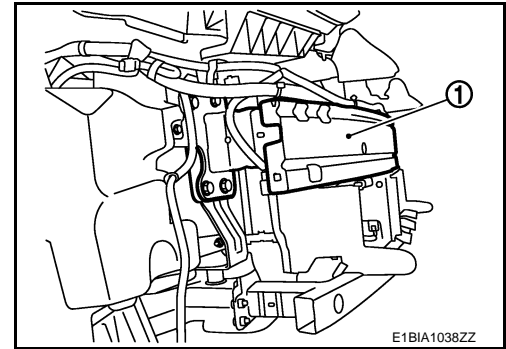
1. Remove front bumper. Refer to [EXT-19. "Removal and Installation"](#).

CHARGE AIR COOLER

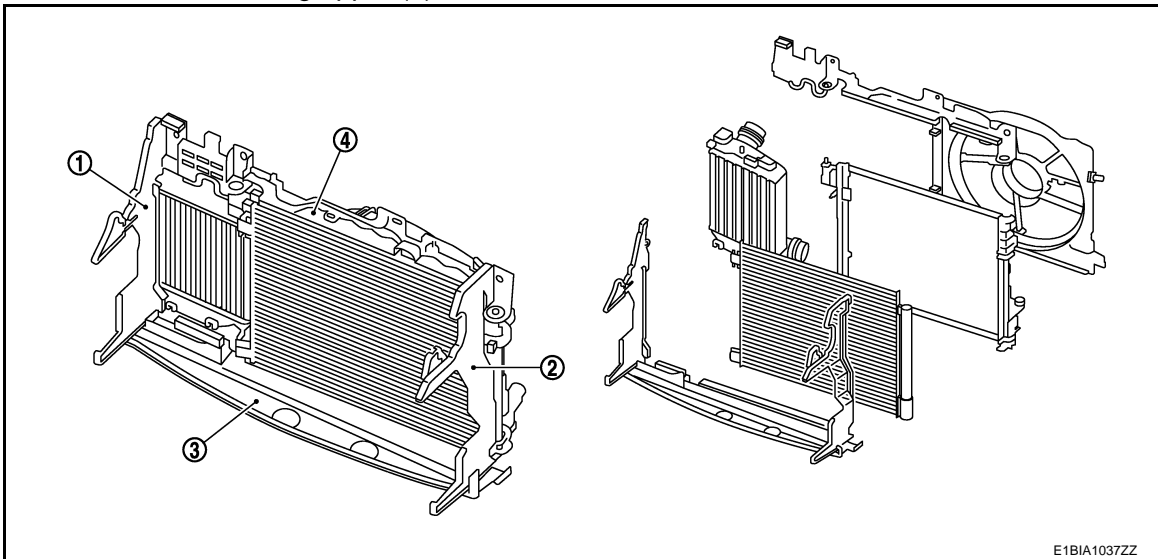
[K9K]

< REMOVAL AND INSTALLATION >

- Put aside front bumper reinforcement (1) with harness assembly.



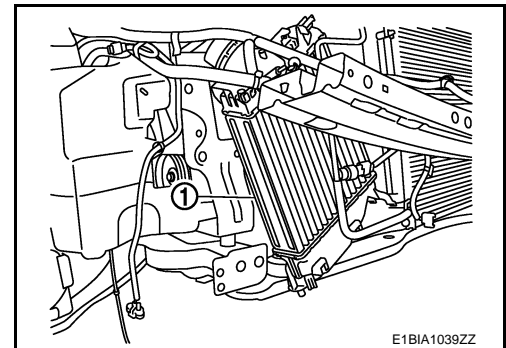
- Remove:
 - Radiator air guide RH (1).
 - Radiator air guide LH (2).
 - Radiator air guide lower (3).
 - Radiator bracket mounting upper (4)



- Put aside radiator core support upper. Refer to [DLK-155, "HRA2DDT : Removal and Installation"](#) (Type 1), [DLK-336, "K9K : Removal and Installation"](#) (Type 2), [DLK-467, "K9K : Removal and Installation"](#) (Type 3), [DLK-605, "K9K : Removal and Installation"](#) (Type 4).
- Unhook and rotate charge air cooler (1).
- Remove charge air cooler.

CAUTION:

- Avoid interference between the charge air cooler and radiator.
- When removing charge air cooler, close opening on turbo charger and intake manifold with shop cloth or other suitable material.



INSTALLATION

- When replacing the electric throttle control actuator, this procedure must be performed. Refer to [ECK-130, "Special Repair Requirement List"](#).

Install in the reverse order of removal paying attention to the following points:

- Apply a neutral detergent (fluid) to the joint between hoses and pipes (oil is not permissible).
- Pay attention to identification mark and direction.
- When installing air inlet hoses and tubes. Refer to [EM-281, "Exploded View"](#).

CHARGE AIR COOLER

< REMOVAL AND INSTALLATION >

[K9K]

Inspection

INFOID:000000010287200

A

INSPECTION AFTER REMOVAL

1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler in necessary.
 - Never deform core fins.

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EGR SYSTEM

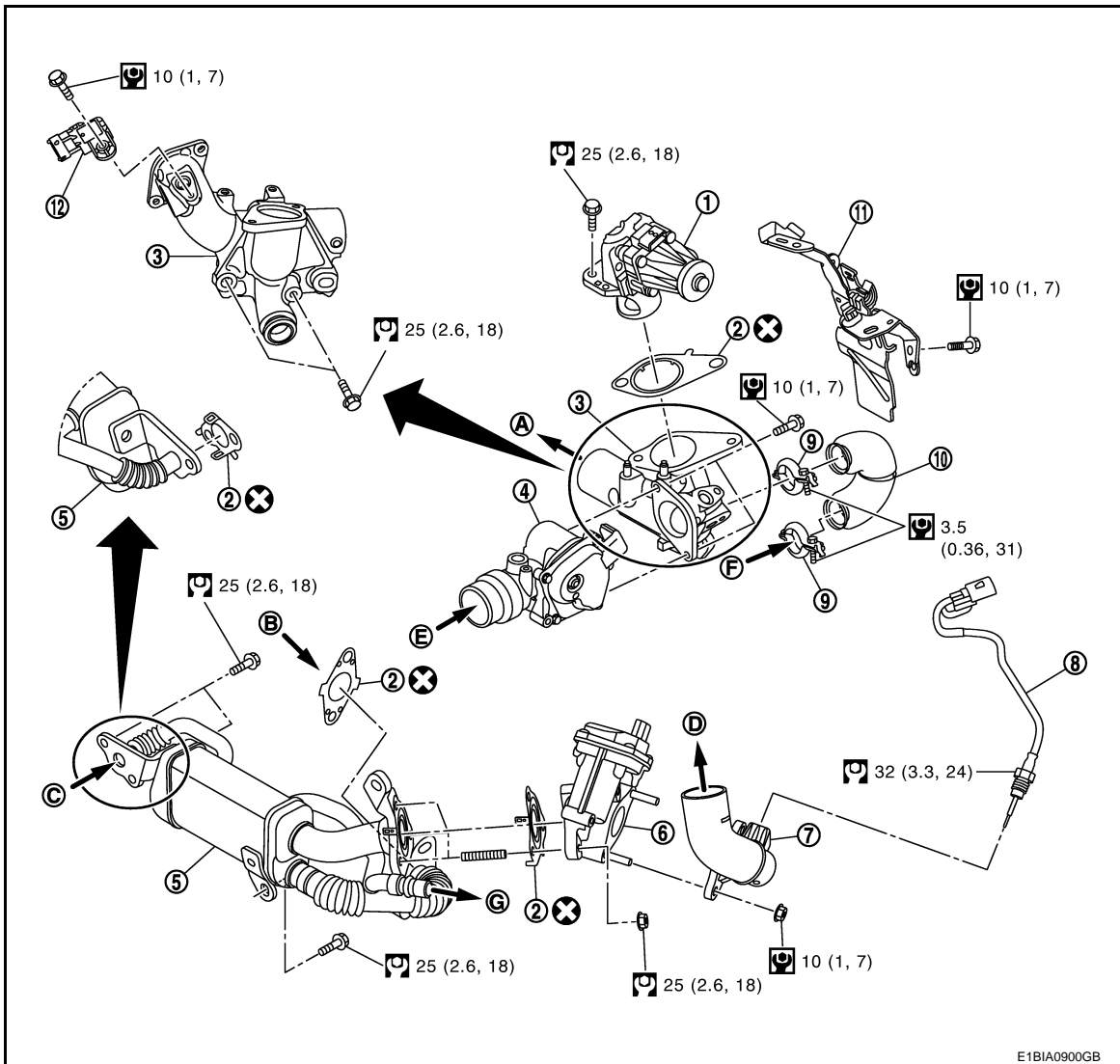
< REMOVAL AND INSTALLATION >

[K9K]

EGR SYSTEM

Exploded View

INFOID:000000010287201



- | | | |
|---------------------------------------|-----------------------------------|------------------------------|
| 1. High pressure EGR valve | 2. Gasket | 3. High pressure EGR housing |
| 4. Electric throttle control actuator | 5. Low pressure EGR cooler | 6. Low pressure EGR valve |
| 7. Low pressure EGR intake tube | 8. Exhaust gas temperature sensor | 9. Clamp |
| 10. High pressure EGR pipe | 11. EGR bracket | |
| A. To EGR tube | B. From DPF | C. From cylinder block |
| D. To turbocharger air inlet pipe | E. From charge air cooler | F. From exhaust manifold |
| G. To thermoplunger | | |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010287202

REMOVAL

NOTE:

Exhaust Gas Recycling system is divided in two:

- High pressure Exhaust Gas Recycling.
- Low pressure Exhaust Gas Recycling.

High pressure Exhaust Gas Recycling.

1. Remove air cleaner case. Refer to [EM-279, "Exploded View"](#).
2. Remove turbocharger air inlet pipe. Refer to [EM-287, "Exploded View"](#).
3. Remove air inlet tube and air inlet hose. Refer to [EM-281, "Exploded View"](#).
4. Remove electric throttle control actuator.
5. Disconnect high pressure EGR solenoid valve connector. Refer to [EM-284, "Exploded View"](#).
6. Remove high pressure EGR volume control valve mounting bolts .
7. Remove high pressure EGR volume control valve. Refer to [EM-284, "Exploded View"](#).

CAUTION:

- Handle carefully to avoid any shock to EGR volume control valve.
- Never disassemble EGR volume control valve.
- Cover engine openings to avoid entry of foreign materials.

CAUTION:

High pressure EGR volume control valve housing, high pressure EGR pipe and EGR tube are connected.

To remove those parts, it is necessary to follow the procedure below.

- Drain engine coolant. Refer to [CO-65, "Draining"](#)

CAUTION:

Perform this step when the engine is cold.

- Remove turbocharger. Refer to [EM-287, "Exploded View"](#).
- Remove high pressure EGR pipe. Refer to [EM-284, "Exploded View"](#).
- Remove EGR tube. Refer to [EM-284, "Exploded View"](#).
- Remove high pressure EGR volume control valve housing. Refer to [EM-284, "Exploded View"](#).

CAUTION:

- Handle carefully to avoid any shock to EGR volume control valve.
- Never disassemble EGR volume control valve.
- Cover engine openings to avoid entry of foreign materials.

Low pressure Exhaust Gas Recycling.

1. Drain engine coolant. Refer to [CO-65, "Draining"](#)
CAUTION:
Perform this step when the engine is cold.
2. Remove Diesel Particle Filter. Refer to [EX-17, "Exploded View"](#).
3. Remove turbocharger. Refer to [EM-287, "Exploded View"](#).
4. Remove exhaust gas temperature sensor on the low pressure EGR intake tube. Refer to [EM-284, "Exploded View"](#).
5. Remove low pressure EGR intake tube. Refer to [EM-284, "Exploded View"](#).
6. Remove low pressure EGR volume control valve mounting bolts. Refer to [EM-284, "Exploded View"](#).
7. Remove low pressure EGR volume control valve. Refer to [EM-284, "Exploded View"](#).

CAUTION:

- Handle carefully to avoid any shock to EGR volume control valve.
- Never disassemble EGR volume control valve.
- Cover engine openings to avoid entry of foreign materials.

8. Remove low pressure EGR cooler mounting bolts. Refer to [EM-284, "Exploded View"](#).
9. Remove low pressure EGR cooler. Refer to [EM-284, "Exploded View"](#).

INSTALLATION

Note the following, and install in the reverse order of removal.

CAUTION:

Clean each joint surface before installation.

EGR SYSTEM

< REMOVAL AND INSTALLATION >

[K9K]

1. Perform "EGR volume control valve position learning". Refer to [ECK-138. "Work Procedure"](#). when removing or replacing EGR volume control valve.
2. Perform "Low pressure EGR volume control valve position learning". Refer to [ECK-139. "Work Procedure"](#). when removing or replacing low pressure EGR volume control.
3. When replacing the EGR volume control valve, this procedure must be performed. Refer to [ECK-130. "Special Repair Requirement List"](#).
4. When replacing the low pressure EGR volume control valve, this procedure must be performed. Refer to [ECK-130. "Special Repair Requirement List"](#).

TURBOCHARGER

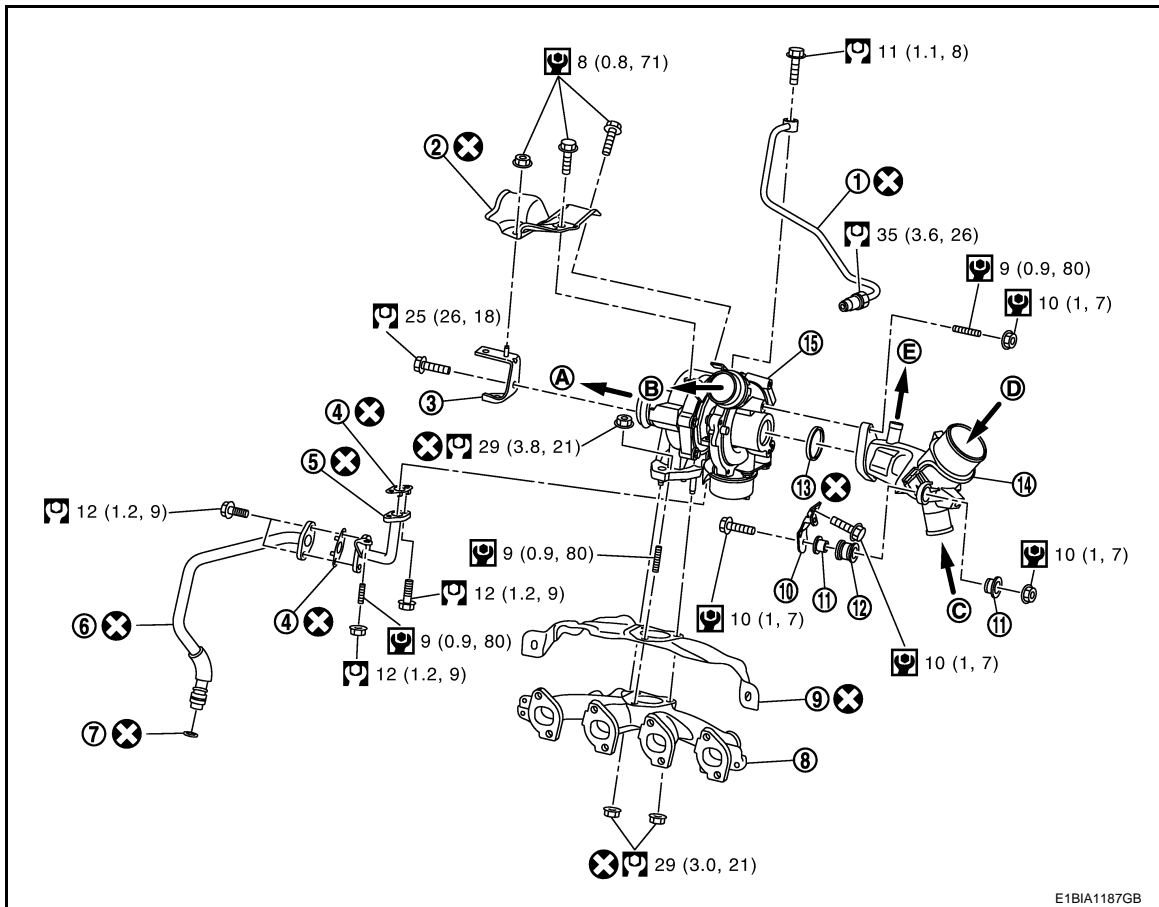
< REMOVAL AND INSTALLATION >

[K9K]

TURBOCHARGER

Exploded View

INFOID:000000010287203



- | | | |
|-------------------------------------|---------------------------------|--------------------------|
| 1. Oil supply tube | 2. Heat insulator | 3. Bracket |
| 4. Gasket | 5. Oil return pipe | 6. Oil return pipe |
| 7. O-ring | 8. Exhaust manifold | 9. Gasket |
| 10. Bracket | 11. Spacer | 12. Rubber |
| 13. Gasket | 14. Turbocharger air inlet pipe | 15. Turbocharger |
| A. To DPF | B. To charge air cooler | C. From low pressure EGR |
| D. From turbocharger air inlet pipe | E. To blow by hose | |

Refer to [GI-4, "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010282069

REMOVAL

1. Remove cowl top. Refer to [EXT-29, "Exploded View"](#)
2. Remove air cleaner case. Refer to [EM-275, "Removal and Installation"](#).
3. Drain engine coolant. Refer to [CO-65, "Draining"](#).
4. Remove air inlet tube and air inlet hose. Refer to [EM-281, "Exploded View"](#)
5. Remove diesel particulate filter assembly. Refer to [EX-17, "Exploded View"](#).
6. Remove EGR volume control valve housing. Refer to [EM-284, "Exploded View"](#).
7. Remove EGR cooler.
8. Remove oil tubes.
9. Remove turbocharger assembly (1) as follows.

TURBOCHARGER

[K9K]

< REMOVAL AND INSTALLATION >

NOTE:

After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.

10. Remove turbocharger oil outlet hose.

CAUTION:

Be careful not to deform each turbocharger piping when pulling out the assembly.

11. Remove turbocharger outlet duct.

INSTALLATION

Install in the reverse order of removal.

NOTE:

Apply LOCTITE FRENETANCHE or equivalent to the threads of the turbocharger oil inlet pipe union to the cylinder head.

Inspection

INFOID:000000010287204

INSPECTION AFTER REMOVAL

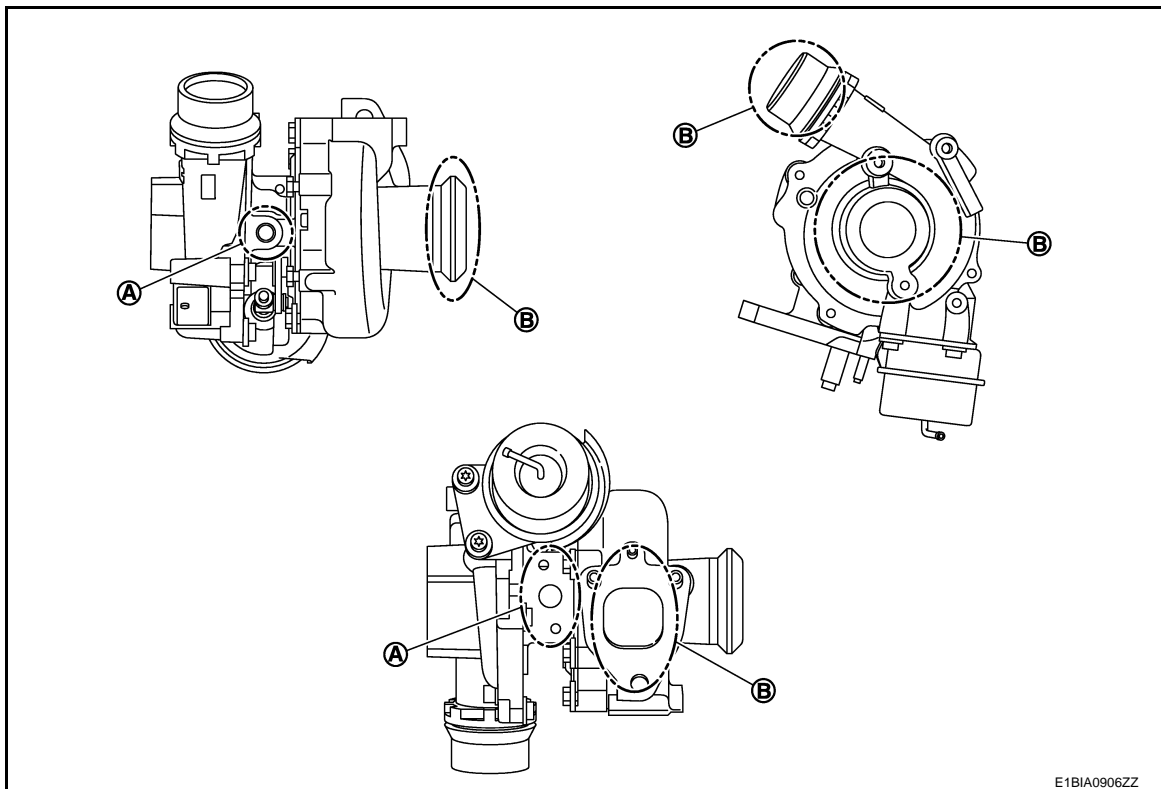
Turbocharger

CAUTION:

When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

Suction side : Between turbocharger and air cleaner

Exhaust side : Between turbocharger and outlet duct



A : Check for gas leaks

B : Check fo oil leaks

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

EXHAUST MANIFOLD

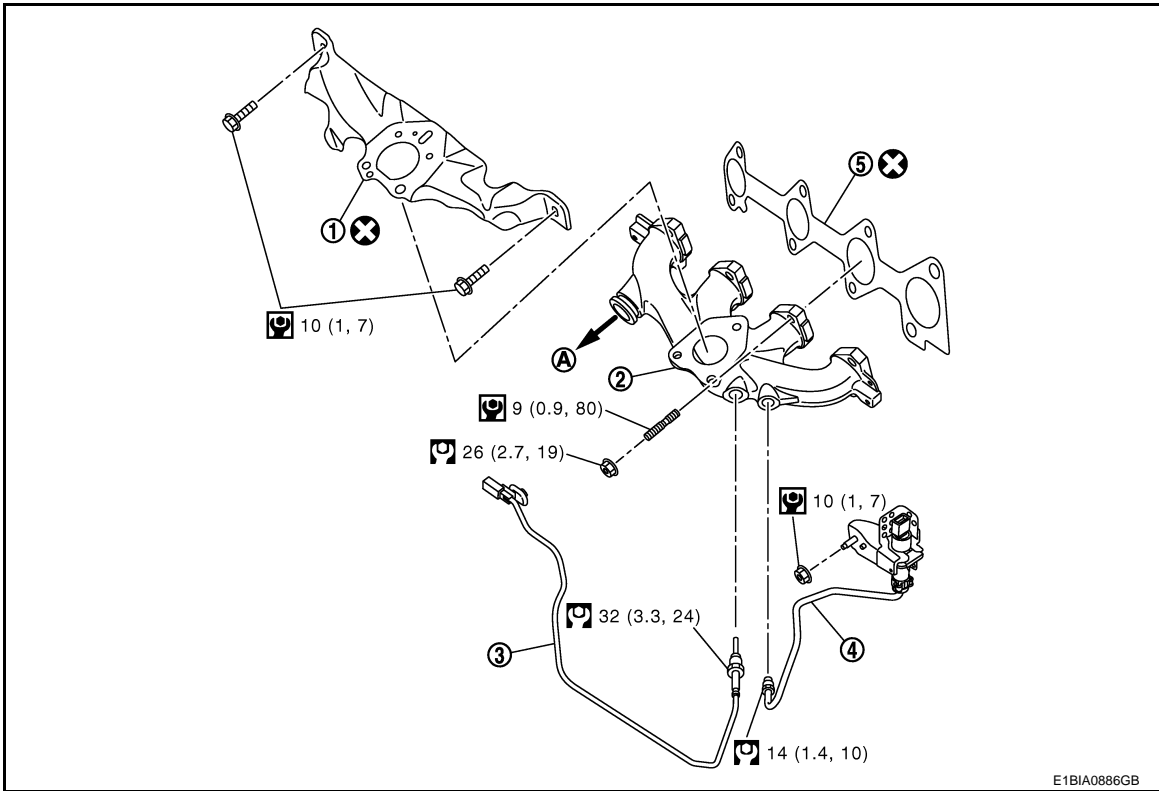
< REMOVAL AND INSTALLATION >

[K9K]

EXHAUST MANIFOLD

Exploded View

INFOID:000000010287205



- | | | |
|----------------------------------|---------------------|-------------------------------------|
| 1. Gasket | 2. Exhaust manifold | 3. Exhaust gas temperature sensor 1 |
| 4. Exhaust gas pressure sensor 1 | 5. Gasket | |
| A. To high pressure EGR pipe | | |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

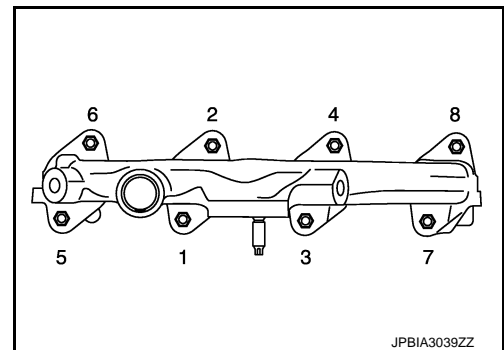
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REMOVAL

1. Remove turbocharger assembly. Refer to [EM-287. "Removal and Installation"](#).
2. Loosen exhaust manifold mounting nuts in the reverse order as shown. Then remove exhaust manifold.

CAUTION:

Be careful not to deform each turbocharger piping when pulling out the assembly.



INSTALLATION

1. Clean the surface of exhaust manifold and cylinder head.
2. Install new gasket to cylinder head.

EXHAUST MANIFOLD

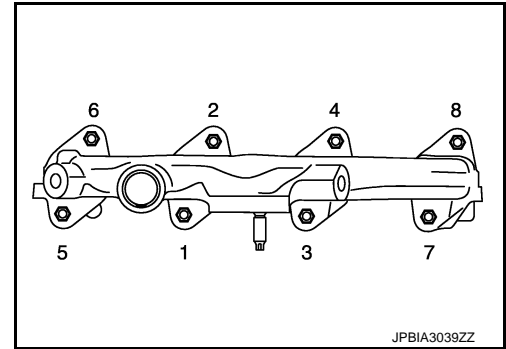
< REMOVAL AND INSTALLATION >

[K9K]

3. Tighten the mounting nuts in numerical order as shown.

: **26.0 N·m (2.7 kg-m, 19 ft-lb)**

4. Install in reverse order of removal after this step.



Inspection

INFOID:000000010287206

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

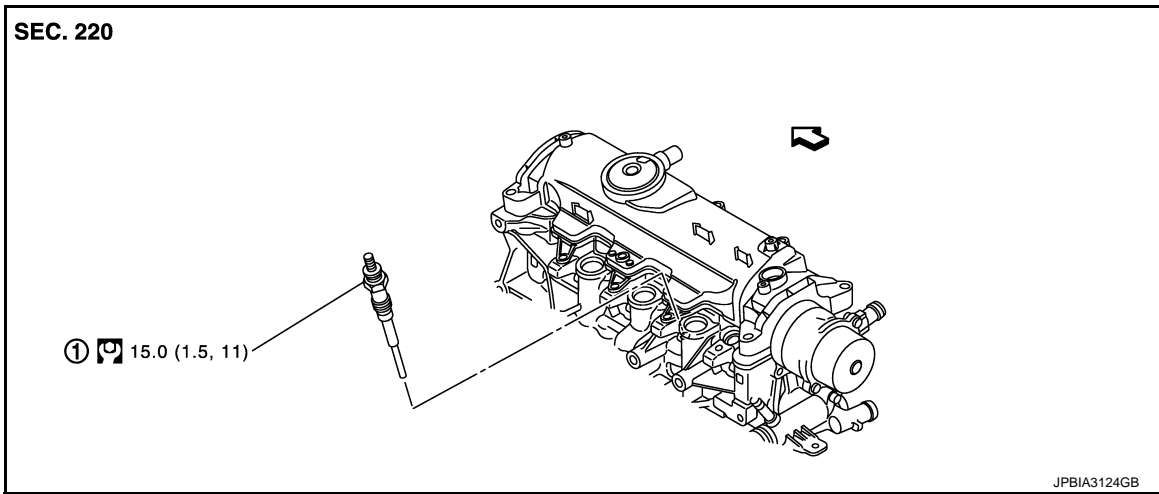
GLOW PLUG

< REMOVAL AND INSTALLATION >

[K9K]

GLOW PLUG

Exploded View



1. Glow plug

↔ Engine front

Ⓜ : N·m (kg-m, ft-lb)

Removal and Installation

INFOID:0000000010282075

REMOVAL

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect battery ground cable.
2. Remove engine cover. Refer to [EM-281. "Removal and Installation"](#).
3. Disconnect harness connector from glow plug.
4. Remove glow plug.

CAUTION:

- When removing or installing, do not use such tools as an air impact wrench.
- Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]

INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.

Ⓜ: 15.0 N·m (1.5 kg-m, 11 ft-lb)

3. Install remaining parts in reverse order of removal.

VACUUM PUMP

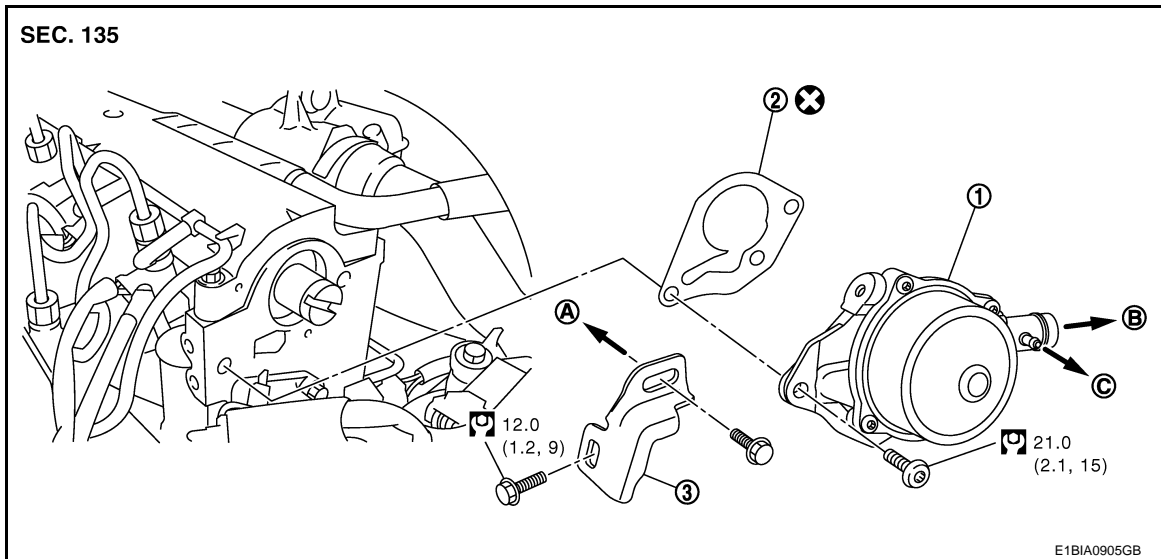
< REMOVAL AND INSTALLATION >

[K9K]

VACUUM PUMP

Exploded View

INFOID:000000010287207



- | | | |
|--|---------------------|--|
| 1. Vacuum pump | 2. Gasket | 3. Vacuum pump bracket |
| A. To electric throttle control actuator | B. To brake booster | C. To turbocharger boost control solenoid valve. |

Refer to [GI-4. "Components"](#) For symbol marks in the figure.

Removal and Installation

INFOID:000000010287208

REMOVAL

1. Remove air cleaner case. Refer to [EM-279. "Exploded View"](#).
2. Disconnect vacuum hose from vacuum pump side.
3. Remove vacuum pump bracket.
4. Remove vacuum pump.

INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:000000010287209

INSPECTION BEFORE REMOVAL

1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
 - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

Standard : -86.6 to -101.3 kPa (-866 to -1,013 mbar, -650 to -760 mmHg, -25.59 to -29.92 inHg)

INJECTION TUBE AND FUEL INJECTOR

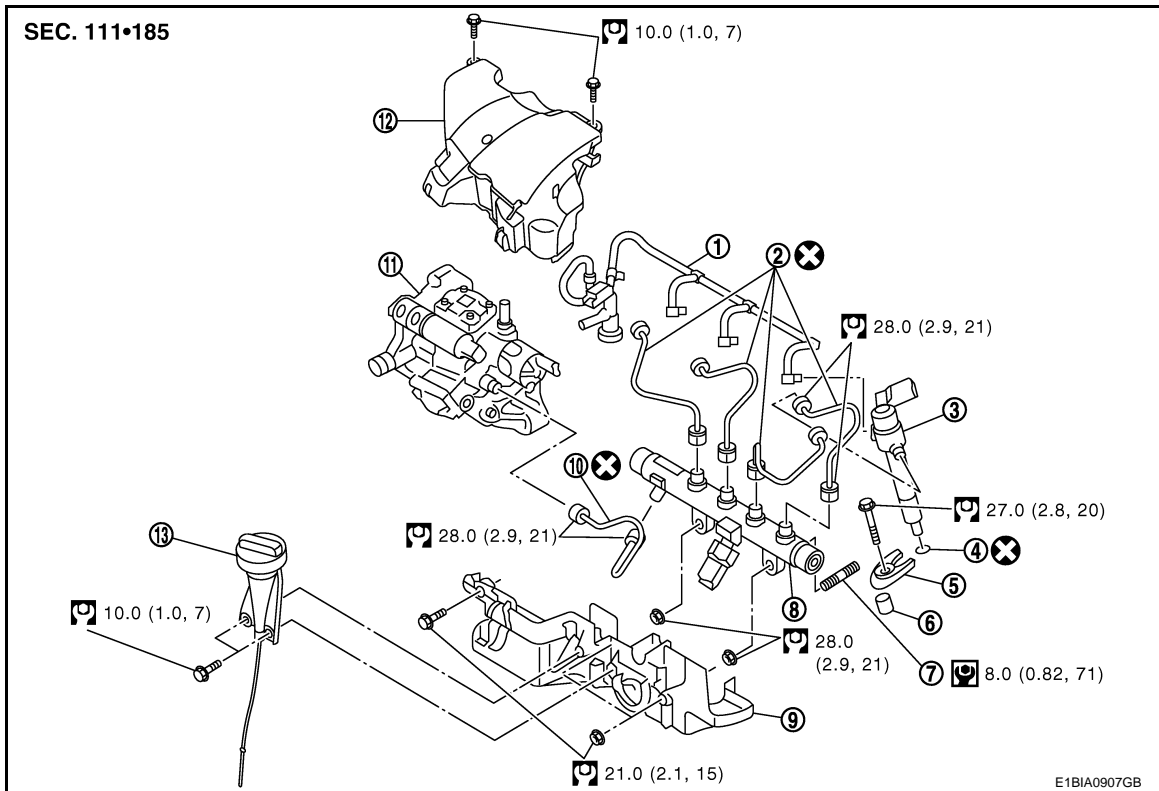
< REMOVAL AND INSTALLATION >

[K9K]

INJECTION TUBE AND FUEL INJECTOR

Exploded View

INFOID:000000010287210



- | | | |
|---------------------------|-------------------------------|--|
| 1. Spill hose | 2. Injection tube | 3. Fuel injector |
| 4. Heat protection washer | 5. Fuel injector bracket | 6. Fuel injector bracket spacer |
| 7. Fuel rail stud bolt | 8. Fuel rail | 9. High pressure protection cover (lower) |
| 10. Injection tube | 11. High pressure supply pump | 12. High pressure protection cover (upper) |
| 13. Oil level gauge guide | | |

Refer to [GI-4, "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:000000010287211

REMOVAL

CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to [FL-30, "General Precautions"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.
- It is forbidden to open an injector. If you open an injector by mistake, you will have to change it. This is because of the manufacturing and installation tolerances and because there is a risk of contaminating the inside of the injector.
- The rod filter of the injector must not be removed.

NOTE:

It is possible to replace a single injection tube.

1. Disconnect the battery cable from negative terminal.
2. Remove air inlet tube and air inlet hose. Refer to [EM-281, "Exploded View"](#).
3. Remove oil level gauge guide and plug the hole.
4. Remove injection tube protection cover.
5. Remove the neck located on the fuel rail,

INJECTION TUBE AND FUEL INJECTOR

[K9K]

< REMOVAL AND INSTALLATION >

NOTE:

Undo the nut on the pump side or the injector side, then the nut located on the rail side. Undo the nuts for each pipe in turn. Move the nut along the pipe keeping the olive in contact with the taper.

6. Remove all the injection tubes.
7. Plug all the holes in the injection circuit.
8. Remove fuel rail.
9. Disconnect fuel return pipe.
10. Manually remove the injector diesel return hose.

CAUTION:

Never force on the diesel injector return hose

11. Plug all the holes of the injection circuit.
12. Disconnect the injector harness connector.
13. Unscrew the injector bracket.
14. Remove the injector.
15. Pull off the flame shield washer.

INSTALLATION

CAUTION:

All the injection tubes removed must be systematically replaced.

1. Clean the injector sockets and the injector bodies, as well as their brackets using a lint-free cloth (use the wipes recommended for this purpose, dipped in clean solvent).
2. Dry off using a different new wipe.
3. Insert a large diameter screwdriver (diameter > 8 mm (0.315 in)) into the well to block the opening to the combustion chamber.
4. Blast out any scale residue in the well using a compressed air nozzle.
5. Remove the screwdriver and repeat the cleaning operation for the injector well concerned twice in succession.
6. Replace the flame shield washer with a new one.
7. Position the injector.
8. Tighten its mounting bracket.

: 27.0 N·m (2.8 kg-m, 20 ft-lb)

9. Install injection tubes with new one.
10. Finger tightens the nuts.
11. Before fitting the new injection tubes, lightly lubricate the nut threads with the oil from the sachet provided in the new parts kit.

NOTE:

Fit the pump/rail pipe before the rail/injector tubes.

12. Fit the pump-rail injection tube as follow:
 - Remove the protective plugs from the high pressure pump outlet, the high pressure rail inlet and the pipe.
 - Insert the injection tube olive into the taper of the high pressure pump outlet,
 - Insert the injection tube olive into the taper of the high pressure rail inlet.
 - Finger tighten the nuts of the injection tube starting with the one located on the rail side.
13. Install the rail-injector injection tube.
14. Tighten the injection tube nut.

: 28.0 N·m (2.9 kg-m, 21 ft-lb)

15. Connect fuel return pipe.
16. When replacing the injector, this procedure must be performed. Refer to [ECK-130. "Special Repair Requirement List"](#).
17. Install in the reverse order to removal for the other refitting operations.

INJECTION TUBE AND FUEL INJECTOR

< REMOVAL AND INSTALLATION >

[K9K]

Inspection

INFOID:000000010287267

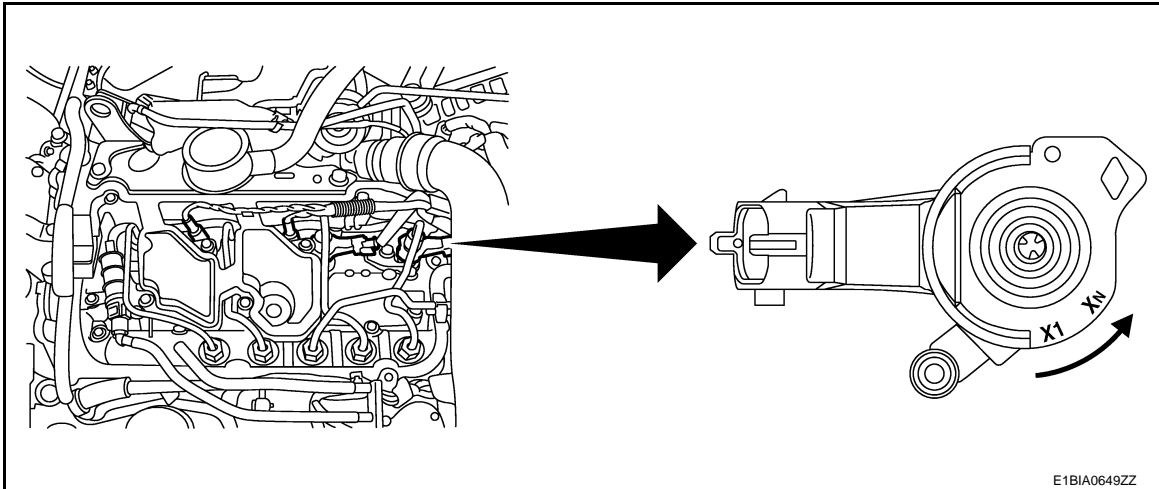
INSPECTION AFTER INSTALLATION

- When replacing fuel injector, note the injector IMA code and the corresponding cylinder number.

NOTE:

IMA codes are from X1 to XN.

- Program the injectors using diagnostic tool.



- Start the engine and check for fuel leak for one minute after starting.

CAUTION:

After any operation, check that there are no diesel leaks. Refer to [FL-30. "General Precautions"](#).

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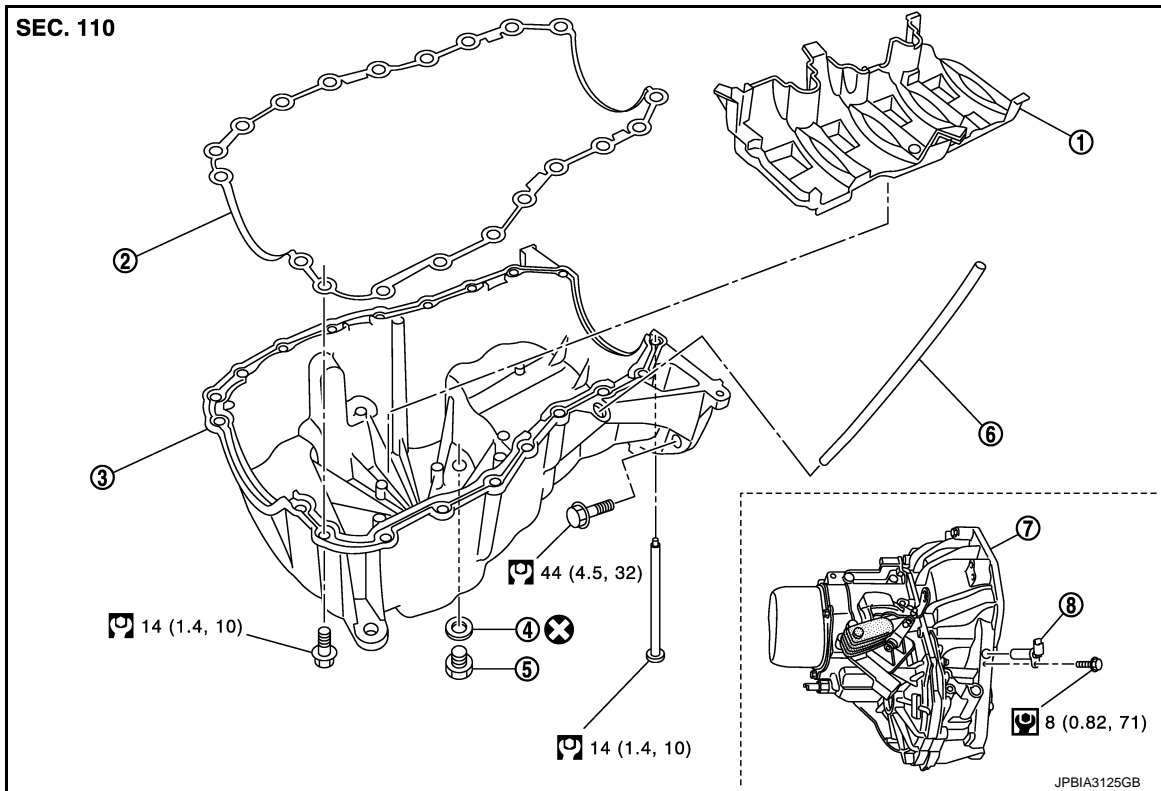
OIL PAN

< REMOVAL AND INSTALLATION >

[K9K]

OIL PAN

Exploded View



- | | | |
|-----------------|-------------------------------------|--------------------------|
| 1. Baffle plate | 2. Gasket | 3. Oil pan |
| 4. O-ring | 5. Drain plug | 6. Oil level gauge guide |
| 7. Transaxle | 8. Crankshaft position sensor (POS) | |

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

Removal and Installation

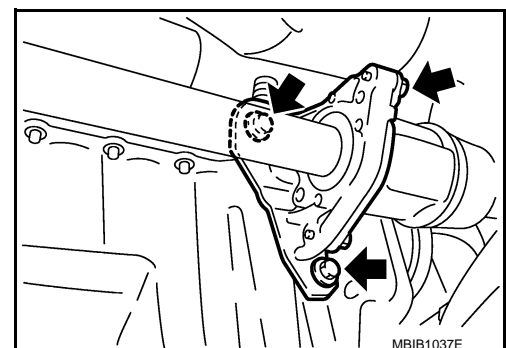
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REMOVAL

CAUTION:

Never drain engine oil when the engine is hot to avoid the danger of being scalded.

1. Remove RH front wheel. Refer to [WT-60. "Removal and Installation"](#). (with TPMS) or [WT-73. "Removal and Installation"](#) (without TPMS).
2. Remove fender protector RH. Refer to [EXT-32. "Removal and Installation"](#).
3. Remove engine mounting bracket. Refer to [EM-318. "Exploded View"](#).
4. Remove center bearing bracket as shown.

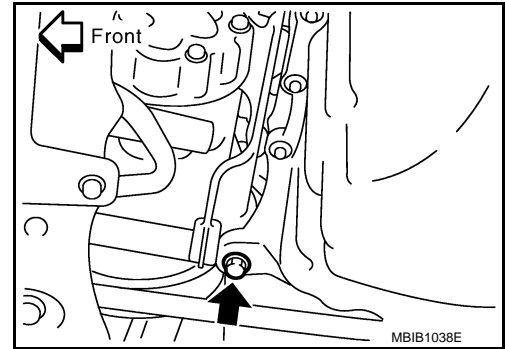


OIL PAN

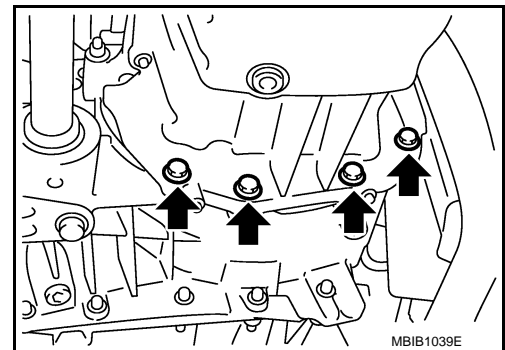
< REMOVAL AND INSTALLATION >

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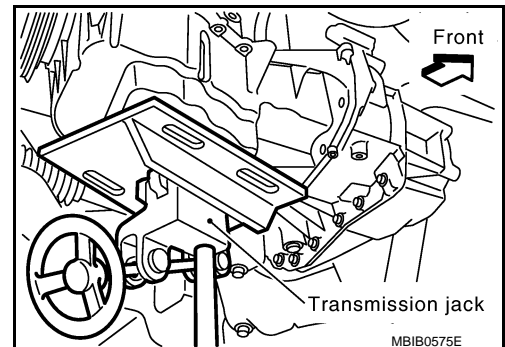
5. Remove A/C compressor bracket mounting bolt as shown.



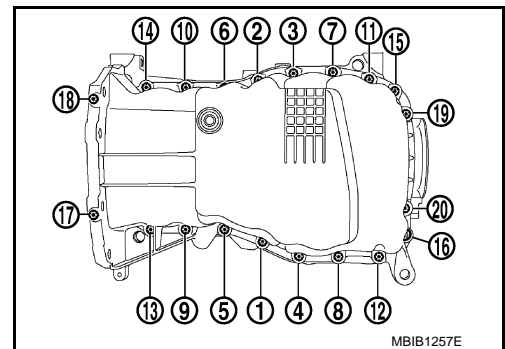
6. Remove oil level gauge guide.
7. Drain engine oil. Refer to [LU-36, "Draining"](#).
CAUTION:
Perform when engine is cold.
8. Remove oil pan and transaxle joint bolts.



9. Support the engine bottom of the oil pan with a transmission jack etc.



10. Remove oil pan bolt reverse order as shown.



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OIL PAN

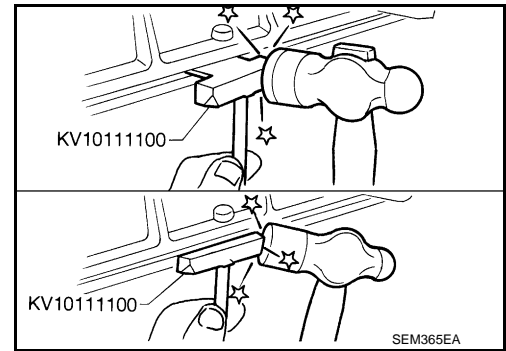
[K9K]

< REMOVAL AND INSTALLATION >

- Insert seal cutter (special service tool) between upper oil pan and cylinder block. Slide tool by tapping on the side of the tool with a hammer.

CAUTION:

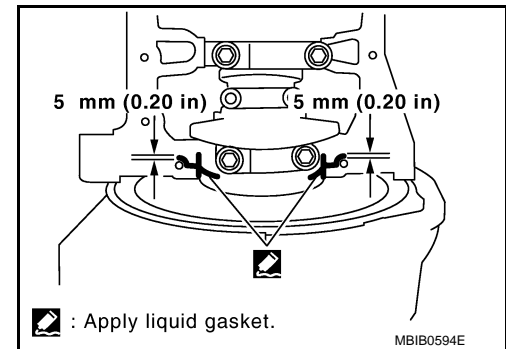
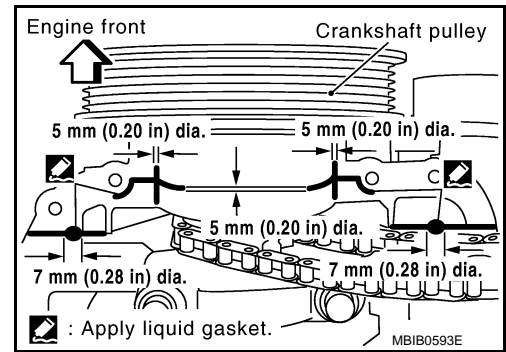
Exercise care never damage mating surface.



11. Remove oil pan and baffle plate.

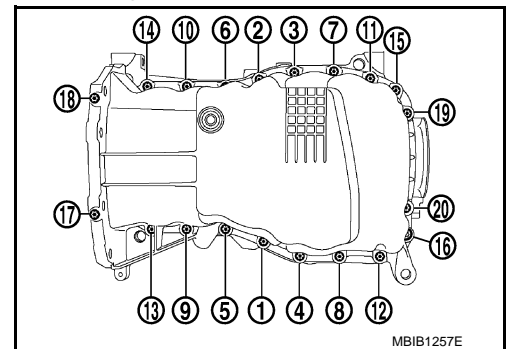
INSTALLATION

- Install in the reverse order of removal paying attention to the following.
1. Apply liquid gasket as shown.
 - Use Genuine Liquid Gasket or equivalent.



2. Install baffle plate.
3. Install oil pan.
 - Tighten the mounting bolts of oil pan on the clutch housing without locking.
 - Tighten the bolts in the numerical order shown in the figure.

 : 14 N·m (1.4 kg-m, 10 ft-lb)



- Tighten the mounting bolts of oil pan on the clutch housing.

 : 44 N·m (4.5 kg-m, 10 ft-lb)

4. At least 30 minutes after oil pan is installed, pour engine oil.

OIL PAN

< REMOVAL AND INSTALLATION >

[K9K]

Inspection

INFOID:000000010287214

A

INSPECTION AFTER REMOVAL

Clean oil pump assembly if any object attached.

INSPECTION AFTER INSTALLATION

- Inspection the engine oil level. Refer to [LU-35, "Inspection"](#).
- Start the engine, and make sure there is no leak of engine oil. Refer to [LU-35, "Inspection"](#).

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HIGH PRESSURE SUPPLY PUMP

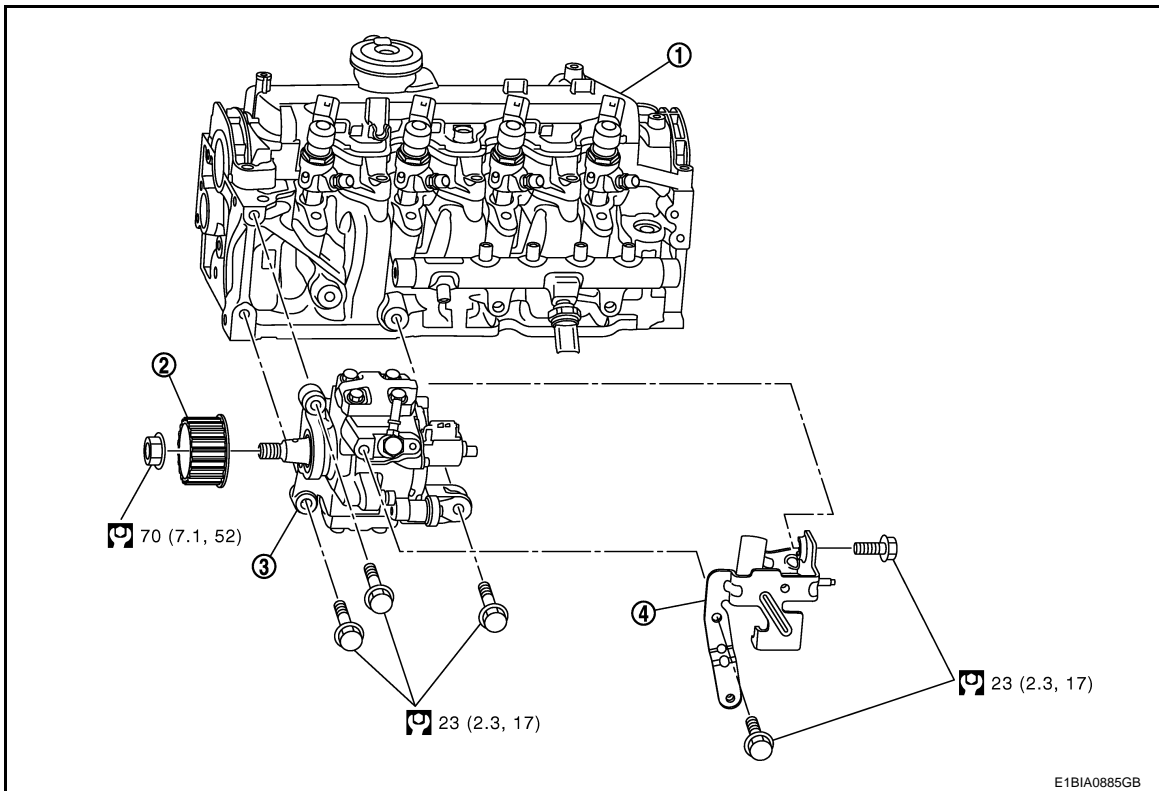
< REMOVAL AND INSTALLATION >

[K9K]

HIGH PRESSURE SUPPLY PUMP

Exploded View

INFOID:0000000102872.15



1. Cylinder head
2. High pressure supply pump sprocket
3. High pressure supply pump
4. High pressure supply pump protector

Refer to [GI-4, "Components"](#) for symbol marks in the figure.

Removal and Installation

INFOID:0000000102872.16

REMOVAL

CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to [FL-30, "General Precautions"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.

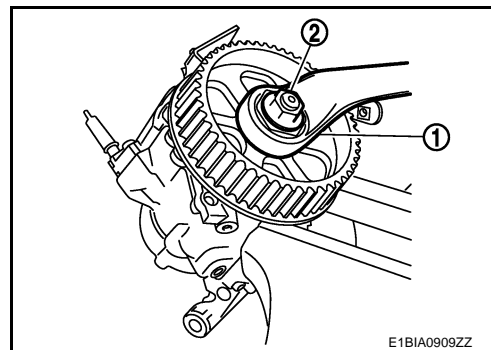
1. Disconnect the battery cable from the negative terminal.
2. Remove air inlet hose. Refer to [EM-281, "Exploded View"](#).
3. Remove the timing belt. Refer to [EM-305, "Exploded View"](#).
4. Remove the neck located on the fuel rail.
5. Remove the oil level gauge guide and plug the hole.
6. Remove high pressure protection cover. Refer to [EM-293, "Exploded View"](#).
7. Carefully disconnect:
 - The connectors from the flow actuator,
 - The connectors from the fuel temperature sensor,
 - On the pump, the fuel supply and return pipes.
 - The return pipe connecting the injectors with the pump.
8. Remove the injection tube connecting the pump to the rail. Refer to [EM-293, "Exploded View"](#).
9. Plug all the holes of the injection circuit.
10. Remove the three mounting bolts from the high pressure supply pump then remove it.

HIGH PRESSURE SUPPLY PUMP

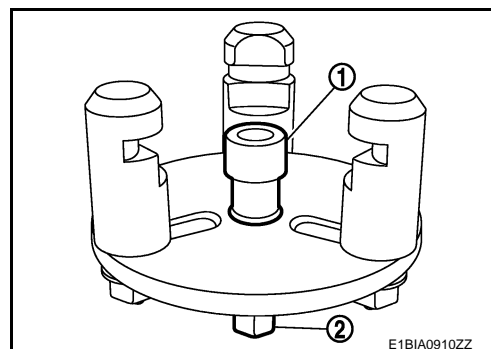
[K9K]

< REMOVAL AND INSTALLATION >

11. In case of high pressure supply pump replacement:
 - Install the high pressure supply pump in a vice with jaws.
 - Immobilise the high pressure supply pump sprocket with a off-set spanner (1).
 - Remove the high pressure supply pump sprocket nut (2).



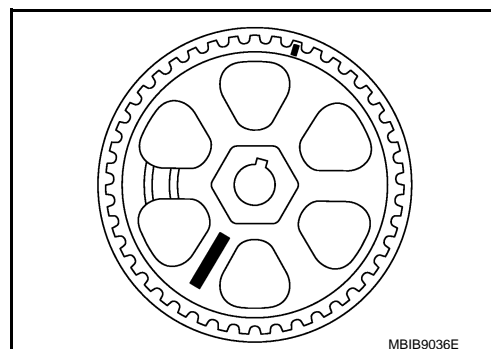
- Remove the end piece (1) of the tool [SST: — (Mot.1525)] by unscrewing the bolt (2).
- Protect the contact areas between the tool [SST: — (Mot.1525)] equipped with the tool [SST: — (Mot.1525-02)] and the high pressure supply pump sprocket.
- Fit the tool [SST: — (Mot.1525)] equipped with the tool [SST: — (Mot.1525-02)] to remove the high pressure supply pump sprocket.
- Remove the high pressure supply pump sprocket.



INSTALLATION

1. In case of high pressure supply pump replacement:
 - Install the high pressure supply pump sprocket.
 - Torque tighten the high pressure supply pump sprocket.

: **70.0 N-m (7.1 kg-m, 52 ft-lb)**



2. Install the pump then position the mounting bolts without tightening them.
3. Before fitting the new injection tube, lightly lubricate the nut threads with the oil from the sachet provided in the new parts kit.
4. Refit the injection tube, to do this:
 - remove the protective plugs,
 - insert the injection tube olive into the taper of the high pressure pump outlet,
 - insert the injection tube olive into the taper of the high pressure rail inlet.
5. Finger tighten the nuts of the injection tube starting with the one located on the rail side.
6. Tighten the mounting bolts on the high pressure pump.

: **23.0 N-m (2.3 kg-m, 17 ft-lb)**

7. Tighten the injection tube nut.

: **28.0 N-m (2.9 kg-m, 21 ft-lb)**

8. Refit high pressure supply pump protector.

HIGH PRESSURE SUPPLY PUMP

[K9K]

< REMOVAL AND INSTALLATION >

9. When replacing the high pressure fuel pump, this procedure must be performed. Refer to [ECK-130, "Special Repair Requirement List"](#).
10. Refit in the reverse order to removal for the other refitting operations.
11. Test the sealing of the high pressure after it has been repaired (refer to "SPECIAL FEATURES" in [EM-263, "Precaution for Diesel Equipment"](#)).

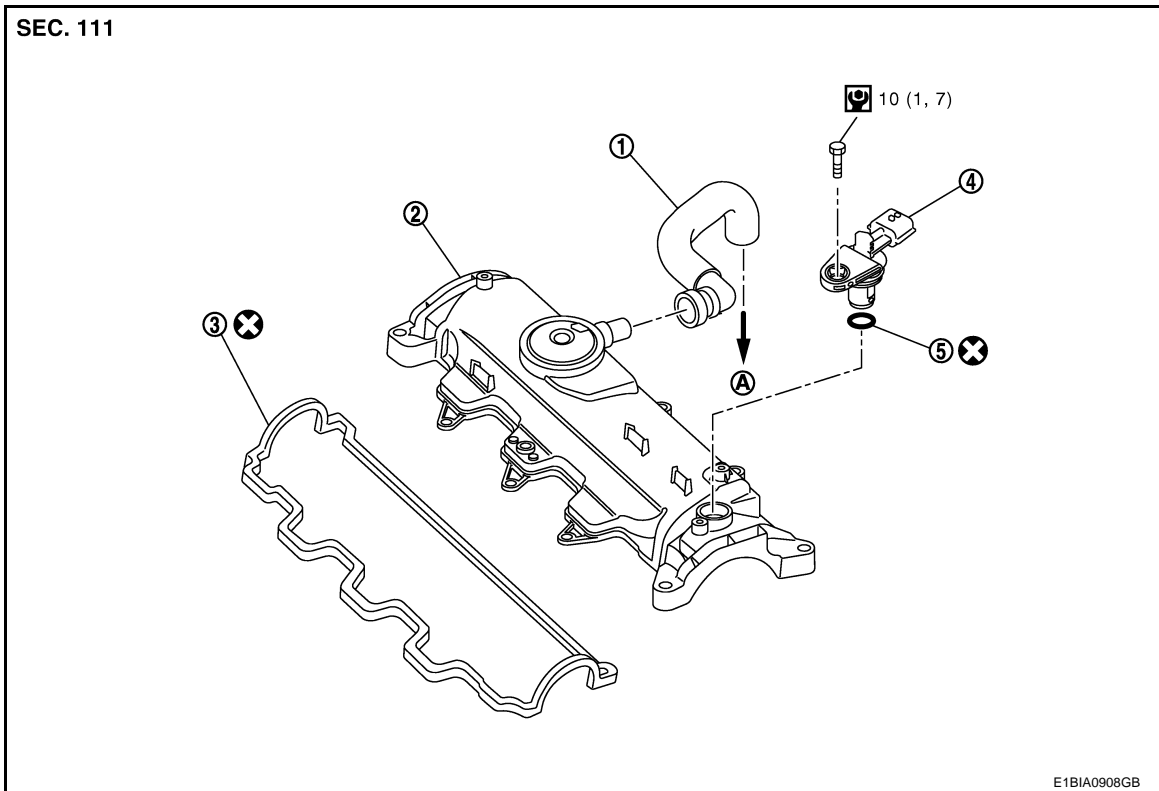
ROCKER COVER

< REMOVAL AND INSTALLATION >

[K9K]

ROCKER COVER

Exploded View



1. Blow-by hose
2. Rocker cover
3. Gasket
4. Camshaft position sensor
5. O-ring
- A. To turbocharger air inlet pipe

Refer to [GI-4. "Components"](#) for symbol marks in the figure.

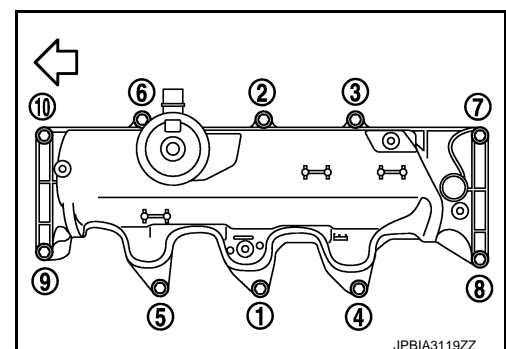
Removal and Installation

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REMOVAL

1. Remove air cleaner case. Refer to [EM-279. "Exploded View"](#).
2. Remove inlet tube and air inlet hose. Refer to [EM-281. "Exploded View"](#).
3. Remove high pressure protection cover (upper). Refer to [EM-293. "Exploded View"](#).
4. Remove electric throttle control actuator.
5. Remove fuel injector. Refer to [EM-293. "Exploded View"](#).
6. Remove rocker cover.
 - Loosen holding bolts in the reverse order as shown in the figure and remove.

← : Engine front



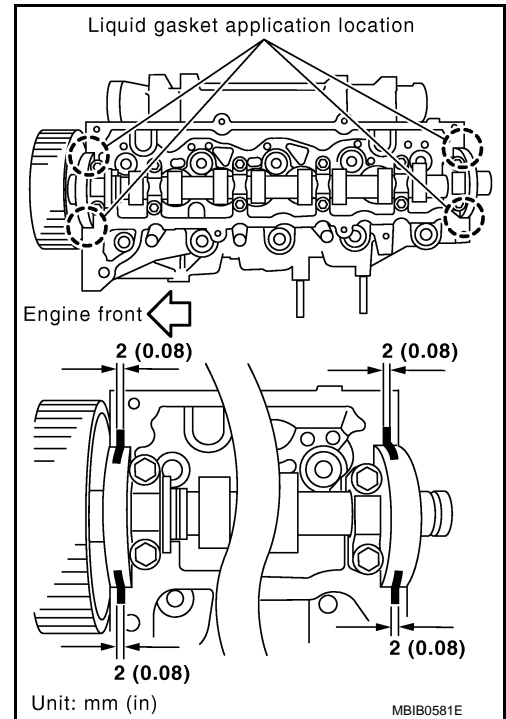
INSTALLATION

ROCKER COVER

[K9K]

< REMOVAL AND INSTALLATION >

1. Apply liquid gasket on locations shown in the figure.
 - Use Genuine Liquid gasket or equivalent.

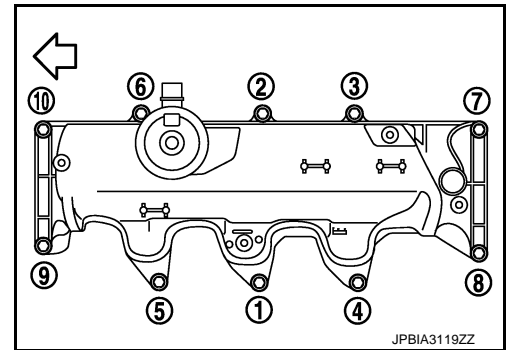


2. Tighten holding bolts in the numerical order as shown in the figure.

← : Engine front

: **12 N·m (1.2 kg-m, 9 ft-lb)**

3. Install in the reverse order of removal after this steps.



TIMING BELT

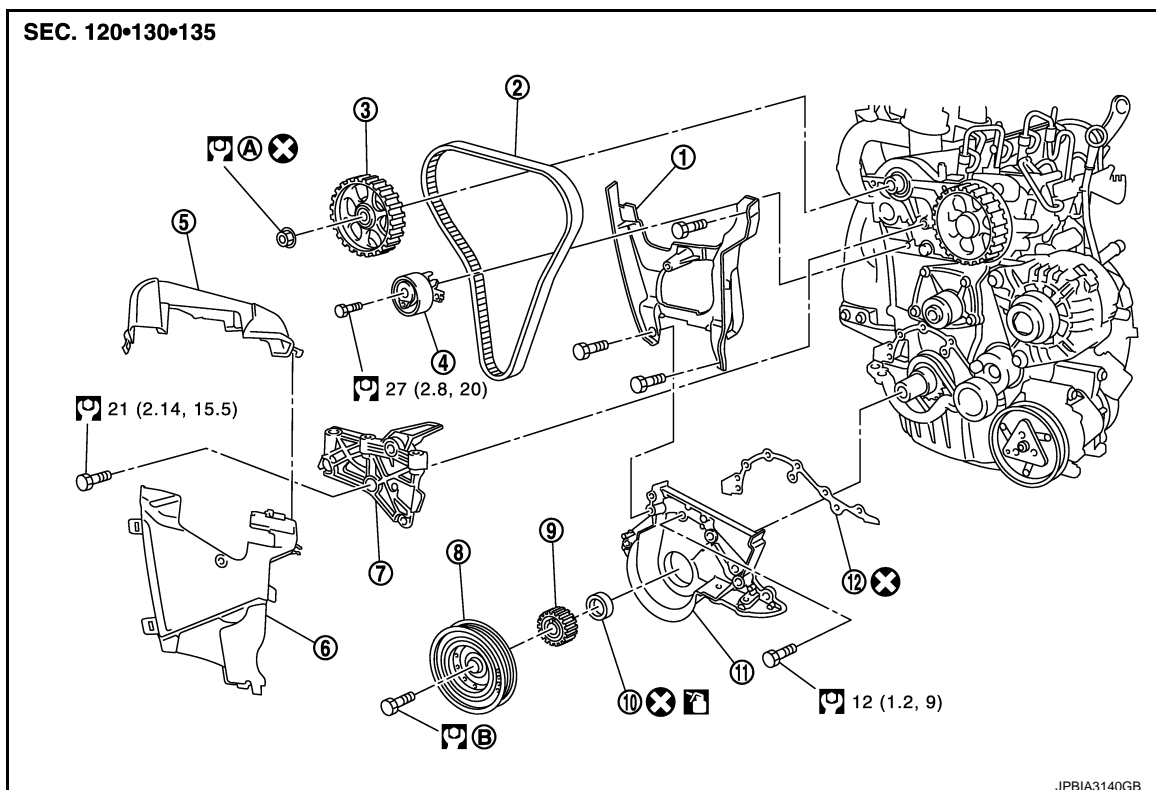
< REMOVAL AND INSTALLATION >

[K9K]

TIMING BELT

Exploded View

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- | | | |
|------------------------------------|----------------------------|----------------------------|
| 1. Timing belt inner cover | 2. Timing belt | 3. Camshaft sprocket |
| 4. Timing belt tensioner | 5. Timing belt upper cover | 6. Timing belt lower cover |
| 7. Cylinder head suspended bracket | 8. Crankshaft pulley | 9. Crankshaft sprocket |
| 10. Rear oil seal | 11. Rear oil seal retainer | 12. Gasket |

A Comply with the assembly procedure when tightening. Refer to [EM-324](#)

B Comply with the assembly procedure when tightening. Refer to [EM-305](#)

Refer to [GI-4, "Components"](#) for symbol marks in the figure

Removal and Installation

INFOID:000000010287220

CAUTION:

- Apply new engine oil to parts marked in illustration before installation.
- Replace any belt that has been removed.
- Never turn the engine in the direction opposite to that of normal operation.
- When replacing the timing belt, be sure to replace the timing belt tensioner.
- Never run the engine without the drive belts to avoid damaging the crankshaft pulley.

REMOVAL

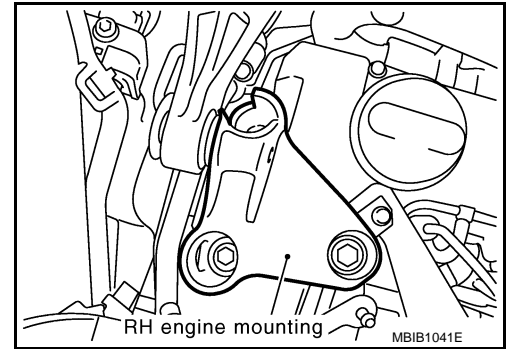
1. Disconnect battery cable from the negative terminal.
2. Remove front wheel RH.
3. Remove fender protector RH. Refer to [EXT-31, "Exploded View"](#)
4. Remove drive belt, and auto-tensioner. Refer to [EM-273, "Removal and Installation"](#).
5. Remove RH engine torque rod.

TIMING BELT

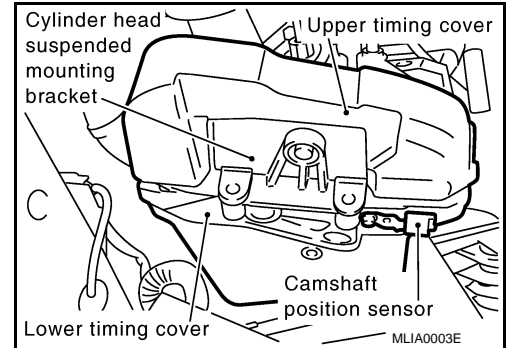
< REMOVAL AND INSTALLATION >

[K9K]

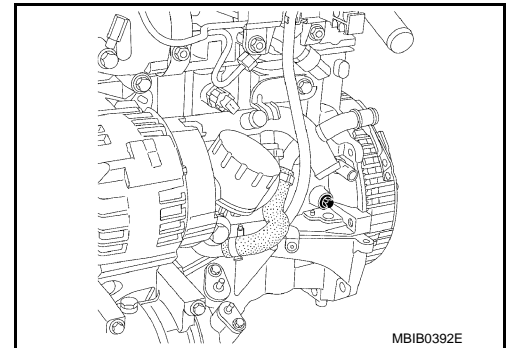
6. Remove RH engine mounting.



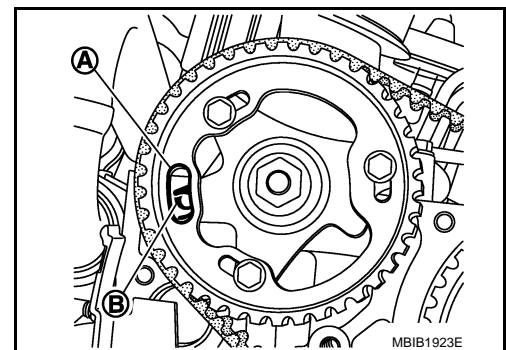
7. Remove RH engine mounting support bracket and RH engine mounting insulator.
8. Remove upper timing cover, camshaft position sensor and cylinder head suspended mounting bracket.



9. Remove timing belt lower cover.
10. Remove the TDC pin bolt.



11. Rotate the crankshaft clockwise, until the position (A) of the camshaft pulley becomes opposite of the position (B) on the cylinder head.

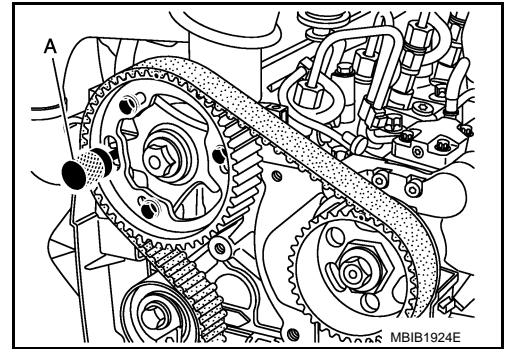


TIMING BELT

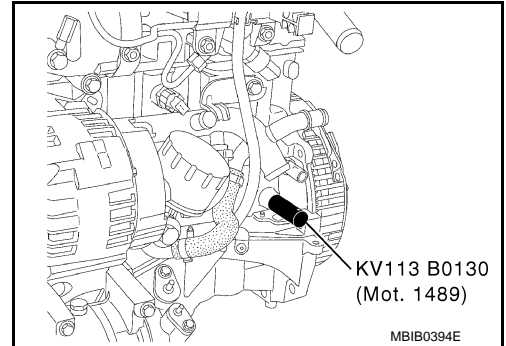
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< REMOVAL AND INSTALLATION >

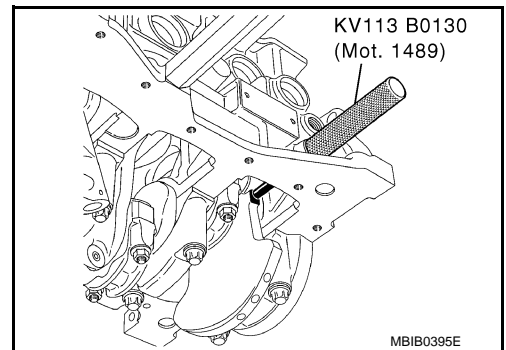
12. Insert TDC set pin [SST: KV113B0110 (Mot. 1430)] (A) into the camshaft pulley and cylinder head hole.



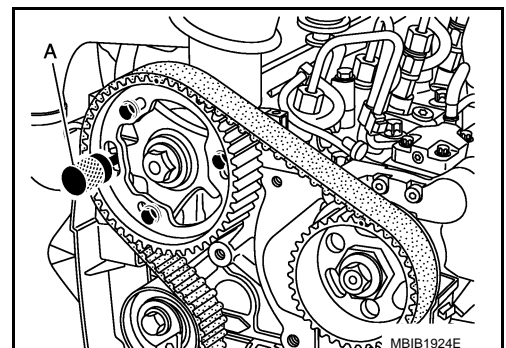
13. Screw in the TDC pin (special service tool).



14. Turn the engine clockwise (timing side) until the crankshaft reaches the TDC pin (special service tool).



15. The pin [SST: KV113B0110 (Mot. 1430)] (A) must engage in the camshaft pulley and cylinder head holes.

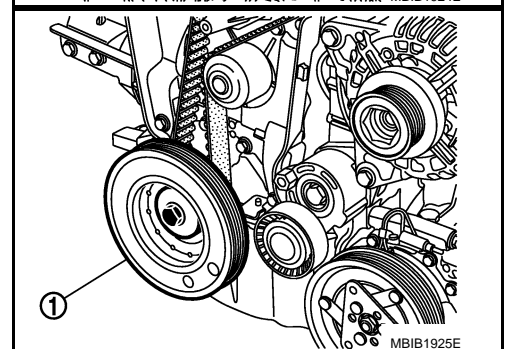


16. Insert flat-bladed screwdriver into the place of crankshaft position sensor to block crankshaft and loosen crankshaft pulley bolt (1).

17. Remove crankshaft pulley.

CAUTION:

Never remove fixing bolts. Keep loosened fixing bolts in place to protect removed crankshaft pulley from dropping.



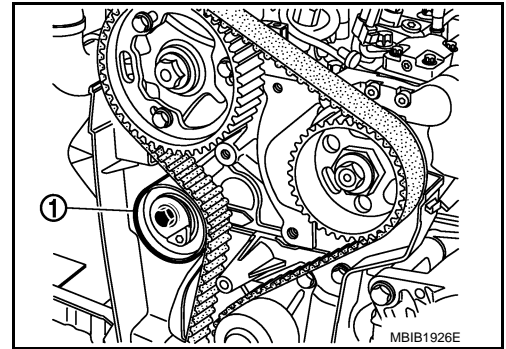
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TIMING BELT

[K9K]

< REMOVAL AND INSTALLATION >

18. Slacken the timing belt by loosening the bolt of tensioner (1), then remove timing belt.



INSTALLATION

Install in the reverse order of removal paying attention to the following.

TIMING ADJUSTMENT

CAUTION:

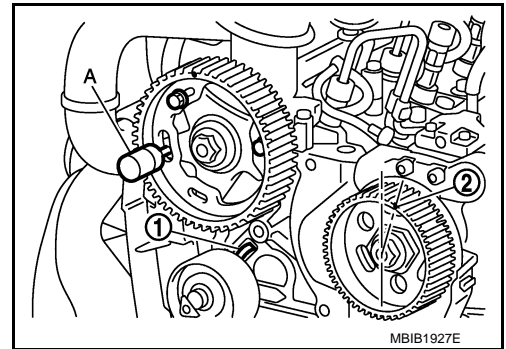
It is essential to degrease the end of the crankshaft, the bore of the crankshaft sprocket and the bearing faces of the drive belt pulley to prevent any slip between the timing and the crankshaft which would risk destroying the engine.

1. Install timing belt tensioner.

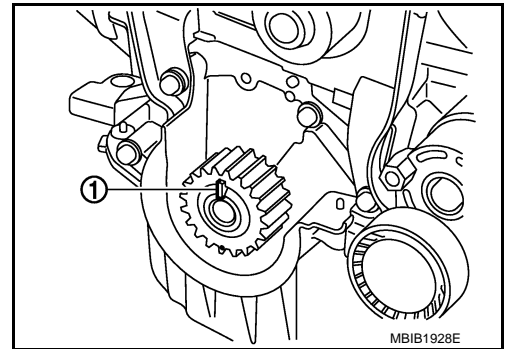
NOTE:

Put the timing belt tensioner spigot (1) in the cylinder head groove.

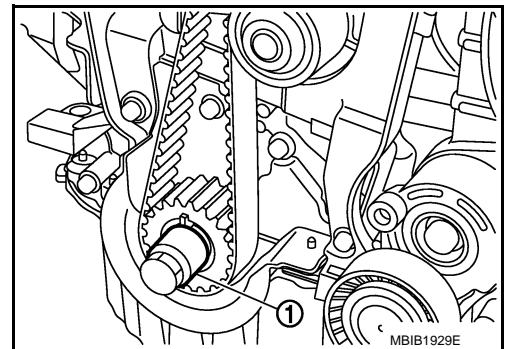
2. Insert Tool KV113B0110 (Mot. 1430) (A) in the camshaft pulley and cylinder head holes.
3. Check that the mark on the high pressure pump pulley (2) has shifted one tooth to the right of vertical axle.



4. Turn crankshaft to set Tool KV113B0130 (Mot. 1489) (the crankshaft groove (1) must be facing upwards).



5. Tighten old crankshaft pulley bolt with a spacer (1) (which does not cover the timing sprocket mark).

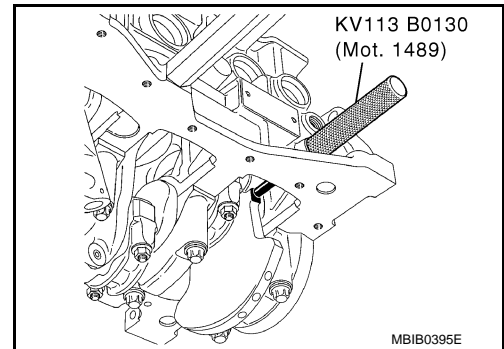


TIMING BELT

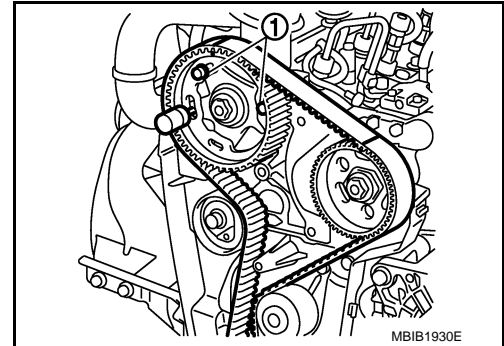
[K9K]

< REMOVAL AND INSTALLATION >

6. Insert tool KV113B0130 (Mot. 1489) to crankshaft.

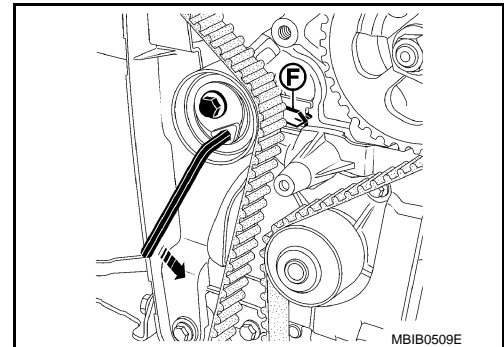


7. Remove one wheel bolt from crankshaft pulley, and then loosen the other two bolts (1).



8. Install the timing belt, aligning the marks on the belt with those on the camshaft and fuel injection pump sprockets (19 teeth spaces on the belt between the marks on the camshaft and pump sprockets).

9. Using a 6 mm (0.24 in) Allen key, move the movable index (F) of the tension wheel into the position shown below, by turning the key counterclockwise.



10. Tighten the tension wheel bolt.

 : 27 N·m (2.8 kg-m, 20 ft-lb)

11. Check that the camshaft pulley wheel bolts are not fully up against the camshaft pulley wheel.
12. Install and tighten camshaft pulley wheel bolt.

 : 14 N·m (1.4 kg-m, 10 ft-lb)

13. Remove Tool KV113B0130 (Mot. 1489) and Tool KV113B0110 (Mot. 1430).

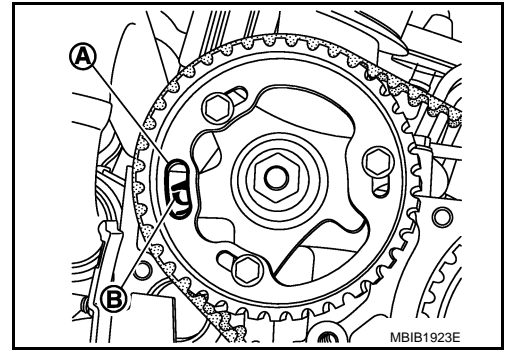
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TIMING BELT

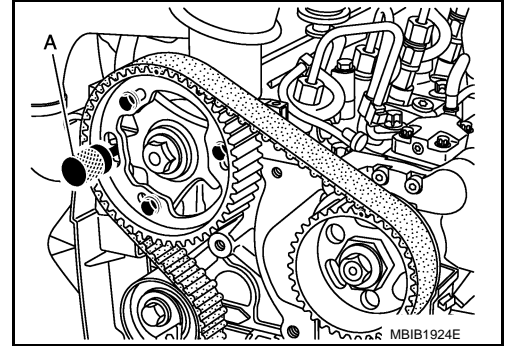
[K9K]

< REMOVAL AND INSTALLATION >

14. Turn the crankshaft two full turns in a clockwise direction (timing side). Just before the hole (A) of the camshaft pulley is opposite the cylinder head hole (B), insert tool KV113B0130 (Mot. 1489) into the cylinder block.
15. Then turn the crankshaft slowly and smoothly against TDC set pin.



16. Insert TDC set pin [SST: KV113B0110 (Mot. 1430)] (A). If the pin cannot be inserted, perform the following.
 - a. Remove TDC set pin [SST: KV113B0130 (Mot. 1489)].
 - b. Loosen camshaft pulley wheel bolts.
 - c. Turn camshaft pulley to adjust.
 - d. Confirm that the crankshaft sprocket groove is facing upward.
 - e. Loosen timing belt tensioner bolt.

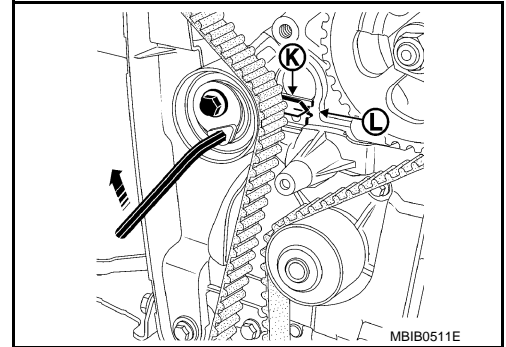


- f. Move the movable index of the drive belt tensioner into the position as shown in the figure, by turning the key clockwise.
 - g. Tighten timing belt tensioner bolt.

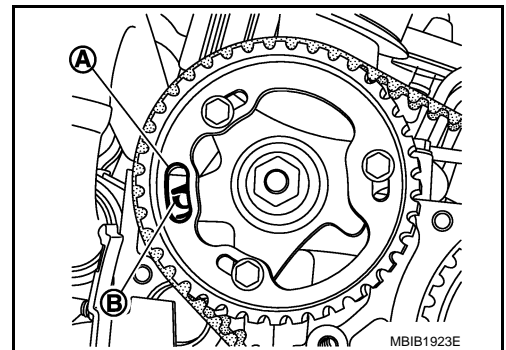
 : 27 N·m (2.8 kg-m, 20 ft-lb)

- h. Install and tighten camshaft sprocket wheel bolts.

 : 14 N·m (1.4 kg-m, 10 ft-lb)



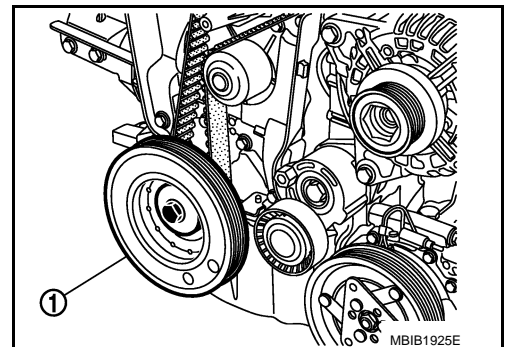
- i. Turn the crankshaft two revolutions in a clockwise direction (timing side). Just before the hole (A) of the camshaft pulley is opposite the cylinder head hole (B), insert TDC set pin [SST: KV113B0130 (Mot. 1489)] into the cylinder block.
 - j. Then turn the crankshaft slowly and smoothly against TDC set pin.



17. Install crankshaft pulley (1), and tighten the bolts as follows:
 - a. Tighten the bolt.

 : 120 N·m (12 kg-m, 89 ft-lb)

- b. Turn the bolt 95 degrees \pm 15 degrees clockwise (angle tightening).



TIMING BELT

[K9K]

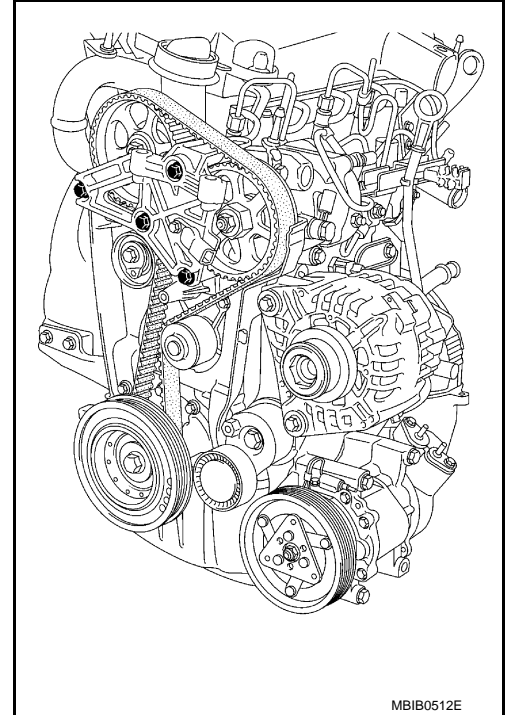
< REMOVAL AND INSTALLATION >

18. Remove TDC set pin [SST: KV113B0130 (Mot. 1489)] and TDC set pin [SST: KV113B0110 (Mot. 1430)].
19. Apply liquid gasket to the thread of TDC pin plug.
20. Install TDC pin plug.

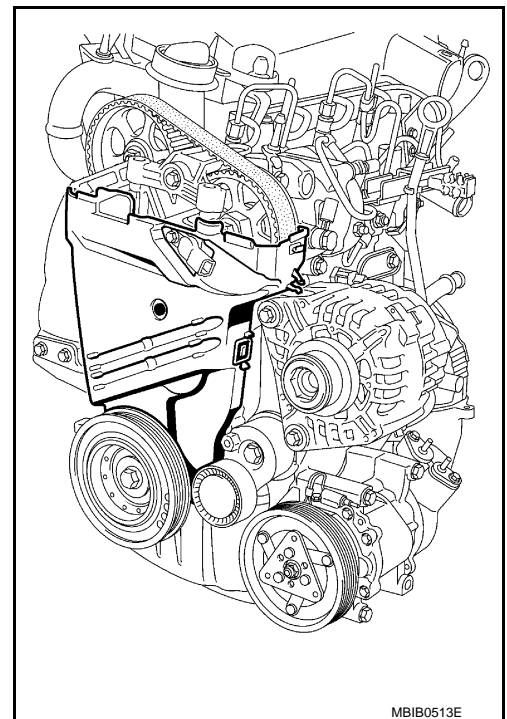
 : 20 N·m (2.0 kg-m, 15 ft-lb)

21. Install the cylinder head suspended bracket.

 : 21 N·m (2.1 kg-m, 15 ft-lb)



22. Install the lower timing cover by positioning the tab (M) into the hole (N) on the inner timing cover.



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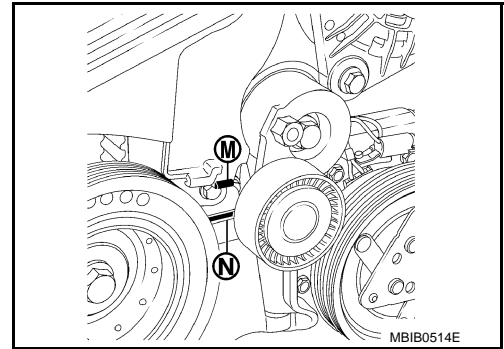
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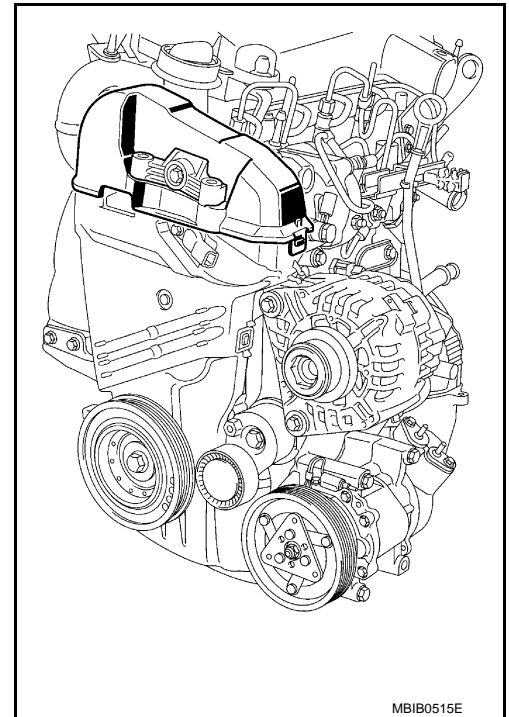
TIMING BELT

< REMOVAL AND INSTALLATION >

[K9K]



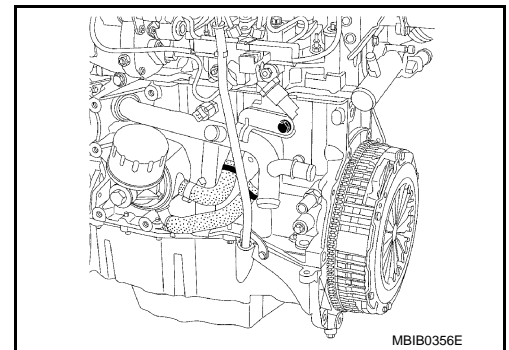
23. Install the upper timing cover.



24. Install the water pipe.

 : 22 N·m (2.2 kg-m, 16 ft-lb)

25. Install the two water hoses.



26. Install the drive belt.

CAUTION:

- Make sure belt is correctly engaged with the pulley groove.
- Check for oil and coolant on belt and each pulley groove.

27. Make sure that tension of each belt is within the standard.

CAMSHAFT

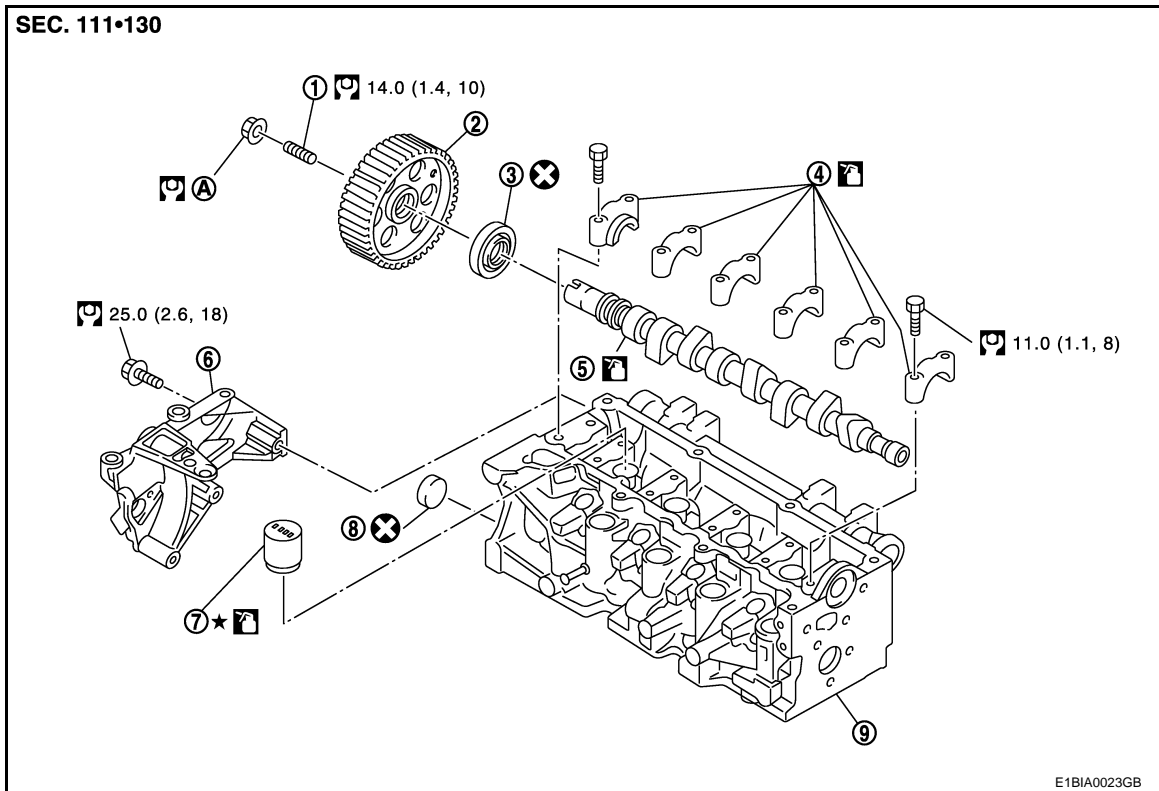
< REMOVAL AND INSTALLATION >

[K9K]

CAMSHAFT

Exploded View

INFOID:000000010282092



- | | | |
|--------------------------------|----------------------|------------------------------------|
| 1. Camshaft sprocket stud bolt | 2. Camshaft sprocket | 3. Oil seal |
| 4. Camshaft bracket | 5. Camshaft | 6. Cylinder head suspended bracket |
| 7. Valve lifter | 8. Cap | 9. Cylinder head |

A. 30.0 N·m (3.1 kg-m, 22 ft-lb) and 86 degrees

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282093

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

REMOVAL

- Remove the following parts.
 - Battery ground cable
 - Undercover
 - RH front wheel
 - RH head light assembly
- Remove right side splash cover.
- Remove engine cover.
- Remove air inlet tube and electric throttle control actuator. Refer to [EM-281, "Exploded View"](#).
- Remove vacuum pump. Refer to [EM-292, "Exploded View"](#).
- Remove drive belt. Refer to [EM-277, "Exploded View"](#).
- Remove rocker cover. Refer to [EM-303, "Removal and Installation"](#).
- Support underneath of engine by setting a manual lift table caddy (commercial service tool) or equivalent tool.

CAUTION:

CAMSHAFT

[K9K]

< REMOVAL AND INSTALLATION >

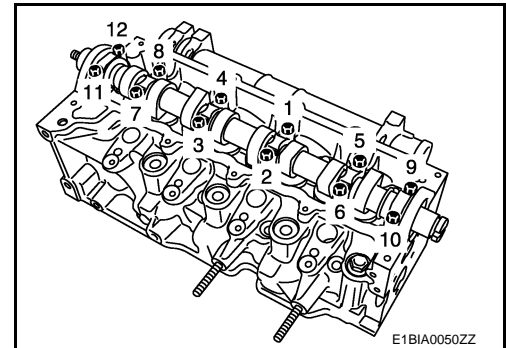
Put a piece of wood or something similar as supporting surface, secure a completely stable condition.

9. Remove timing belt. Refer to [EM-305. "Removal and Installation"](#).
10. Remove camshaft brackets.
11. Remove camshaft.
12. Remove valve lifter.

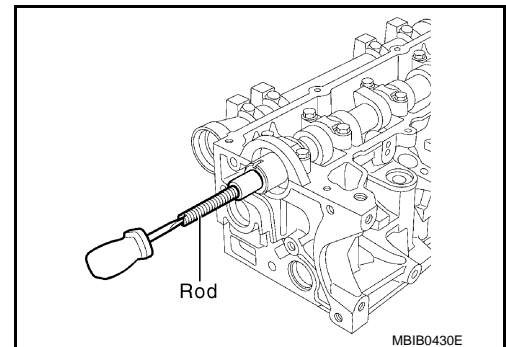
INSTALLATION

1. Install valve lifter.
2. Install camshaft.
3. Install camshaft bracket and tighten bolts in numerical order as shown in the figure.

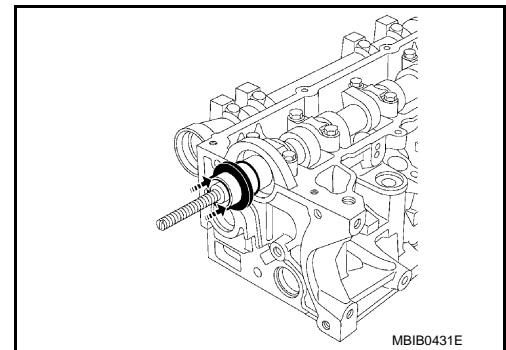
: 11 N·m (1.1 kg·m, 8 ft·lb)



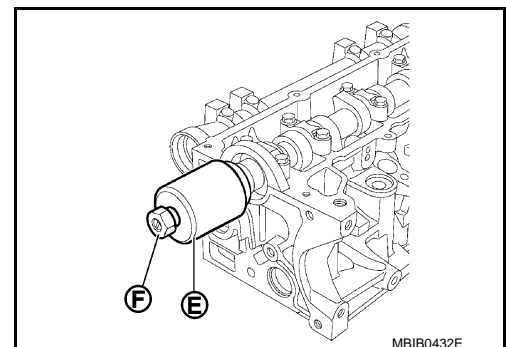
4. Screw the shouldered rod of camshaft seal insert [SST: KV113B0230 (Mot. 1632)] onto the stud of the camshaft.
5. Install the old seal on the camshaft.



6. For the new seal, put the protector with the seal on the camshaft, taking care not to touch the seal.



7. Install the cover (E) and the collar nut (F) of camshaft seal insert [SST: KV113B0230 (Mot. 1632)].

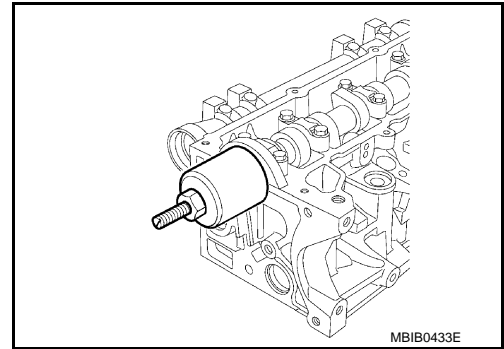


CAMSHAFT

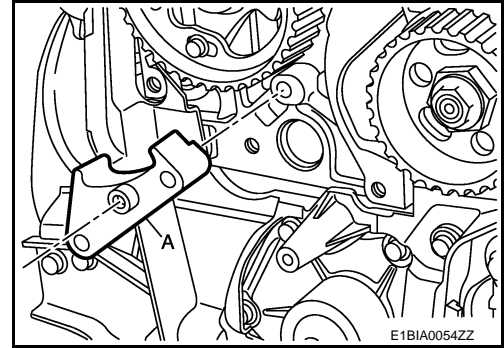
[K9K]

< REMOVAL AND INSTALLATION >

- Screw the collar nut until the cover touches the cylinder head.
- Install vacuum pump. Refer to [EM-292. "Removal and Installation"](#).



- Install camshaft sprocket and sprocket holder [SST: — (Mot. 1606-A)] (A).
- Install timing belt. Refer to [EM-305. "Removal and Installation"](#).
- Install in the reverse order of removal.



Inspection

INFOID:000000010282094

INSPECTION AFTER REMOVAL

Camshaft Runout

- Put V-block on a precise flat table, and support No. 2 and 4 journal of camshaft.

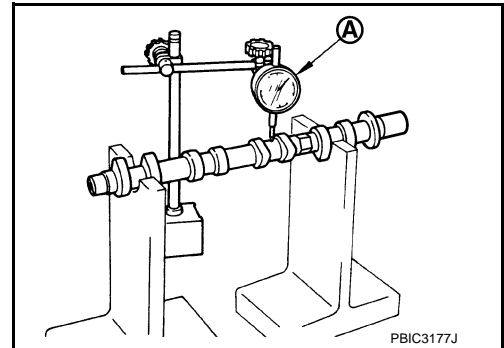
CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

- Set dial indicator (A) vertically to No. 3 journal.
- Turn camshaft to one direction with hands, and measure the camshaft runout on dial indicator. (Total indicator reading)

Standard : Refer to [EM-352. "Camshaft"](#).

- If it exceeds the limit, replace camshaft.

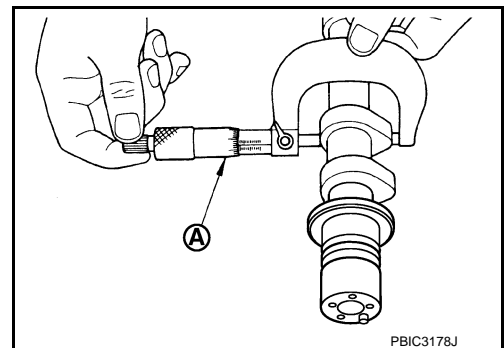


Camshaft Cam Height

- Measure the camshaft cam height with a micrometer (A).

Standard : Refer to [EM-352. "Camshaft"](#).

- If it exceeds the limit, replace camshaft.



Camshaft End Play

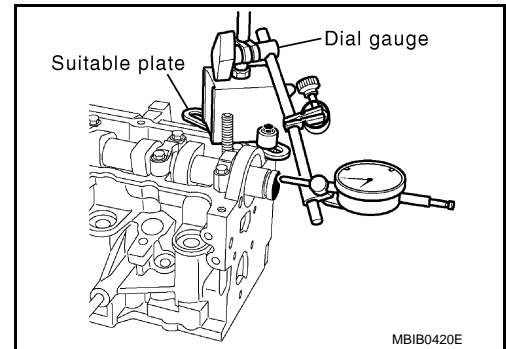
CAMSHAFT

[K9K]

< REMOVAL AND INSTALLATION >

1. Install the camshaft.
2. Install the camshaft brackets.
3. Check the end play.

Standard : Refer to [EM-352, "Camshaft"](#).



Valve Lifter

1. Measure outer diameter of valve lifter.

Intake and exhaust : Refer to [EM-352, "Camshaft"](#)

2. Measure inner diameter of valve lifter hole in cylinder head.

Intake and exhaust : Refer to [EM-352, "Camshaft"](#)

3. Calculate the valve lifter clearance.
(Valve lifter clearance) = (Valve lifter hole inner diameter) – (Valve lifter diameter)

Intake and exhaust : Refer to [EM-352, "Camshaft"](#)

Inspection and Adjustment

INFOID:000000010282055

INSPECTION

1. Place the valves of the cylinder concerned at the "end of exhaust - beginning of intake" position and inspect the clearance (X).

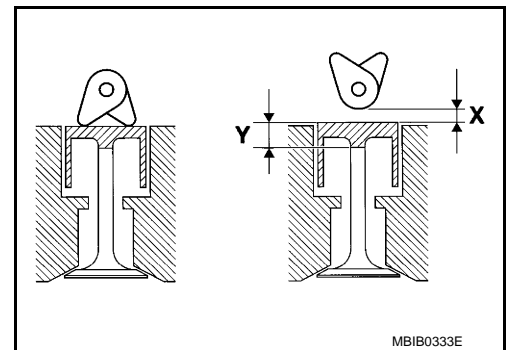
NOTE:

Dimension (Y) corresponds to the tappet thickness sizes (there are 25 sizes at the service parts).

2. Compare the values recorded with the values specified, then replace the tappets which are not within tolerance.

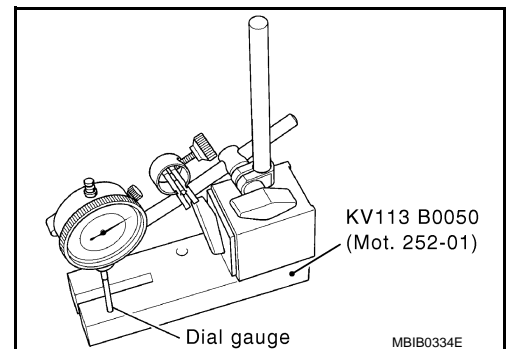
Clearance, when the engine is cold:

Refer to [EM-352, "Camshaft"](#).



ADJUSTMENT

1. The camshaft must be removed to replace the tappets.
Determining dimension (Y).
2. Set up the following assembly using dial gauge stand [KV113B0050 (Mot. 252-01) (commercial service tool) or equivalent tool] and dial gauge, then calibrate the gauge.

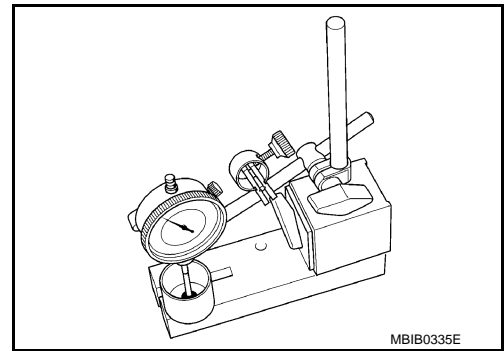


CAMSHAFT

< REMOVAL AND INSTALLATION >

[K9K]

3. Raise the gauge extension (without modifying the position of the magnetic support/gauge assembly), then slide in the tappet to be measured.
Note dimension (Y) and repeat the operation for the tappets where the valve clearance is not within tolerance.
Select the various thicknesses of the tappet(s). The service parts supplies 25 sizes of single-piece tappets. Refer to [EM-352](#). "[Camshaft](#)".



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ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

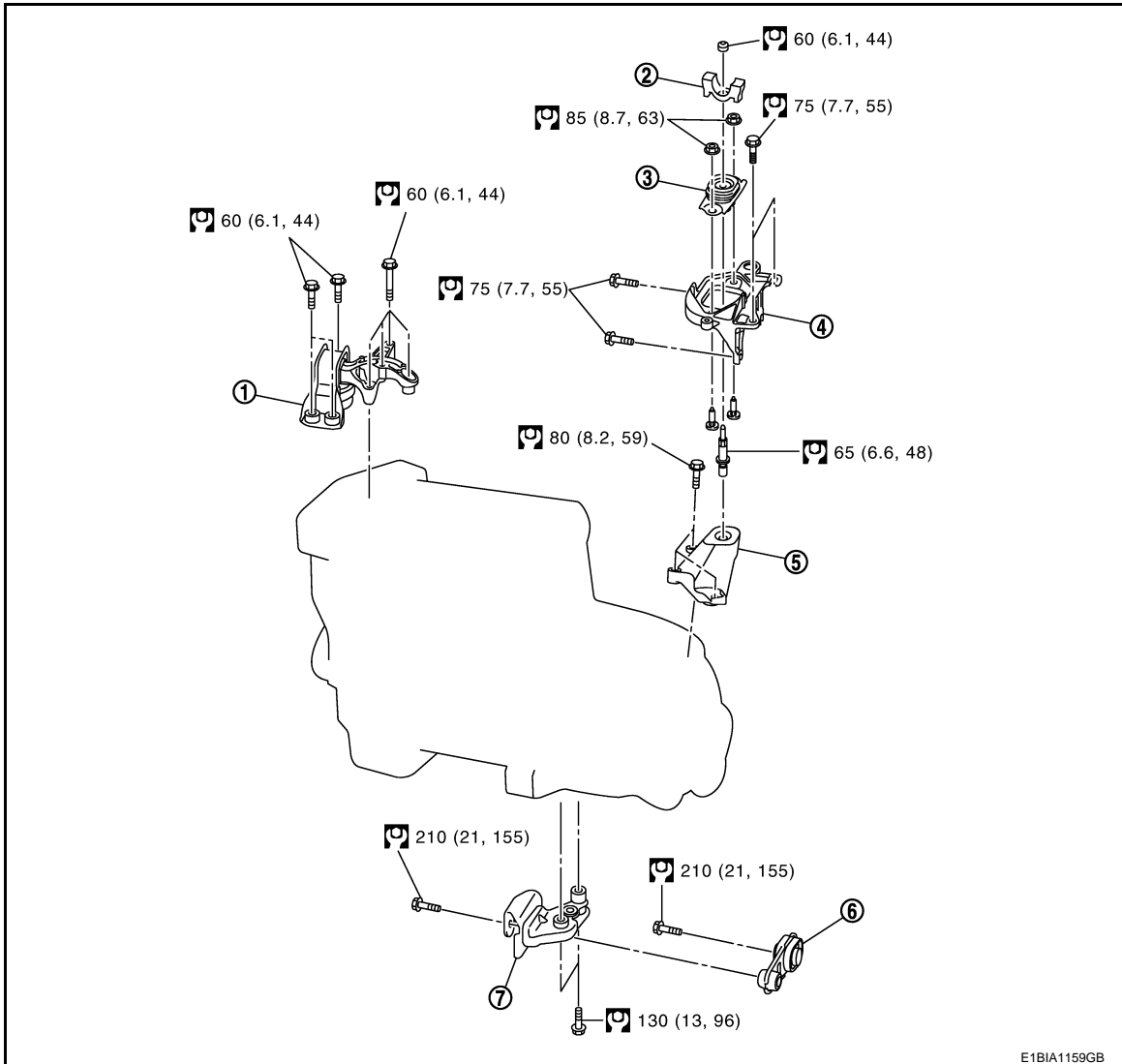
[K9K]

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:000000010282095



- | | | |
|---------------------------------------|---------------------------------|-----------------------------------|
| 1. Engine mount insulator (RH) | 2. Rubber | 3. Engine mounting insulator (LH) |
| 4. Engine mounting frame support (LH) | 5. Engine mounting bracket (LH) | 6. Rear torque rod |
| 7. Rear engine mounting bracket | | |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282096

WARNING:

- Situate vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and coolant are cool enough.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[K9K]

- If items or work required are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-36, "Garage Jack and Safety Stand and 2-Pole Lift"](#) or [GI-37, "Board-On Lift"](#).

NOTE:

When removing components such as hoses, tubes / lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

Description of Work

Remove engine and transaxle assembly from vehicle downward. Separate engine and transaxle.

Preparation

Remove the following parts.

- Battery ground cable
- Undercover
- Right side splash cover
- LH/RH front wheel
- RH head light assembly

Engine Room

1. Drain engine coolant. Refer to [CO-65, "Draining"](#).
CAUTION:
Perform when engine is cold.
2. Remove engine cover.
3. Remove air cleaner case and air duct (suction). Refer to [EM-279, "Exploded View"](#).
4. Remove radiator upper hose. Refer to [CO-70, "Exploded View"](#).
5. Remove reservoir tank and hoses.
6. Remove fuel feed and return tubes.
7. Remove vacuum hose.
8. Remove turbocharger air duct. Refer to [EM-281, "Exploded View"](#).
9. Disconnect heater hoses.
10. Disconnect engine room harness from the engine side and set it aside for easier work.
11. Disconnect transaxle side harness and clutch hose.
12. Disconnect drain hose transaxle side.
13. Disconnect shift cable and select cable. Refer to [TM-28, "Removal and Installation"](#).
14. Loosen wire bracket.
15. Disconnect all the body-side vacuum hoses and air hoses at engine side.
16. Disconnect fuel feed and return hoses, and plug it to prevent fuel from draining.

Vehicle Underbody

1. Remove drive shaft lock pin and lock nut. Refer to [FAX-22, "Removal and Installation \(LH\)"](#) and [FAX-26, "Removal and Installation \(RH\)"](#).
2. Remove ABS sensor from brake caliper.
3. Remove strut lower bolts.
4. Remove drive shaft assembly RH and LH.
5. Remove drive belt. Refer to [EM-278, "Removal and Installation"](#).
6. Remove A/C compressor with piping connected from engine. Temporarily secure it on body with a rope to avoid putting load on it.
7. Remove exhaust front tube. Refer to [EX-15, "Exploded View"](#).
8. Remove engine rear mounting bracket.

ENGINE ASSEMBLY

[K9K]

< UNIT REMOVAL AND INSTALLATION >

9. Remove front suspension member stay. Refer to [FSU-21. "Removal and Installation"](#)

Removal

1. Install engine slingers (1) into front right of cylinder head and engine slinger (2) into rear left of cylinder head.
2. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a jack or trestle. Securely support bottom of engine and transaxle.

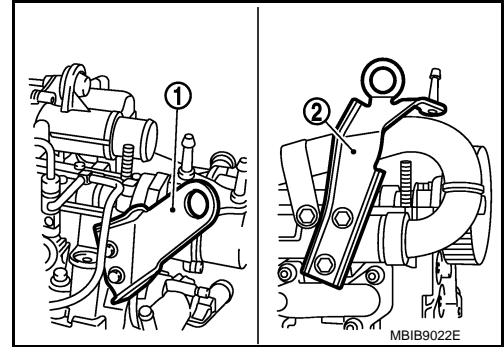
CAUTION:

Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.

3. Remove RH and LH engine mounting bolts.
4. Remove engine and transaxle assembly from vehicle downward by carefully operating supporting tools.

CAUTION:

- During the operation, make sure that no part interferes with body side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal operation, always be careful to prevent vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support vehicle by setting a jack or equivalent tool at the rear.



Separation Work

CAUTION:

During the operation, secure support the engine by placing a piece of wood under the engine oil pan, transaxle oil pan and suspended the engine slinger by baby crane (movable hoist) etc.

1. Remove starter motor.
2. Separate engine and transaxle.
3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-35. "Exploded View"](#).

INSTALLATION

Install in the reverse order of removal.

- Do not allow oil to get on mounting insulator. Be careful not to damage mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to components illustration.
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.

Inspection

INFOID:000000010282097

INSPECTION AFTER INSTALLATION

Inspection for Leaks

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59. "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[K9K]

Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage	A
Transmission / transaxle fluid	MT Models	Level / Leakage	Leakage	Level / Leakage	
Other oils and fluid*		Level	Leakage	Level	EM
Fuel		Leakage	Leakage	Leakage	C
Exhaust gases		—	Leakage	—	

*: Power steering fluid, brake fluid, etc.

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UNIT DISASSEMBLY AND ASSEMBLY

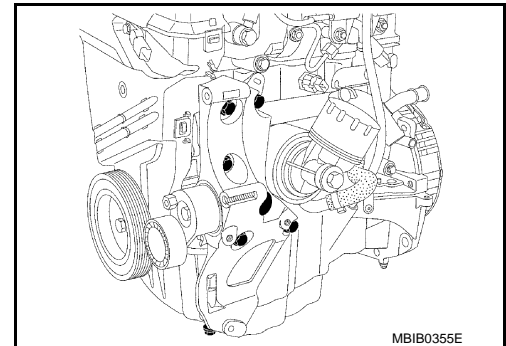
ENGINE STAND SETTING

Setting

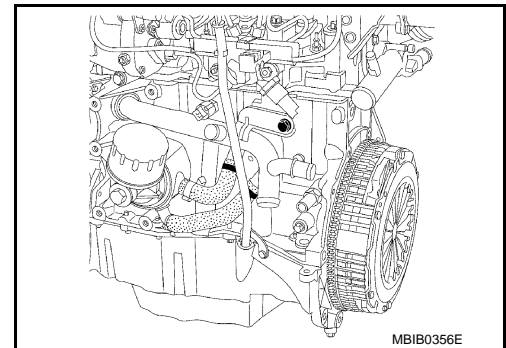
INFOID:000000010282098

Before the engine is mounted on the engine sub-attachment, the engine's electrical harness must be removed and the engine oil drained.

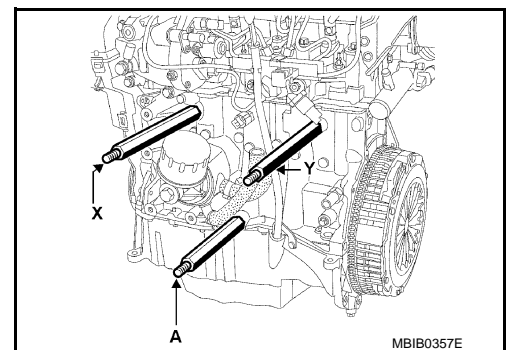
1. Remove the drive belt. Refer to [EM-273. "Removal and Installation"](#).
2. Remove the alternator.
3. Remove the air conditioning compressor.
4. Remove the multifunction support.



5. Remove the coolant inlet pipe on the water pump.



6. Place the rods (A), (X), (Y) on the cylinder block.



CYLINDER HEAD

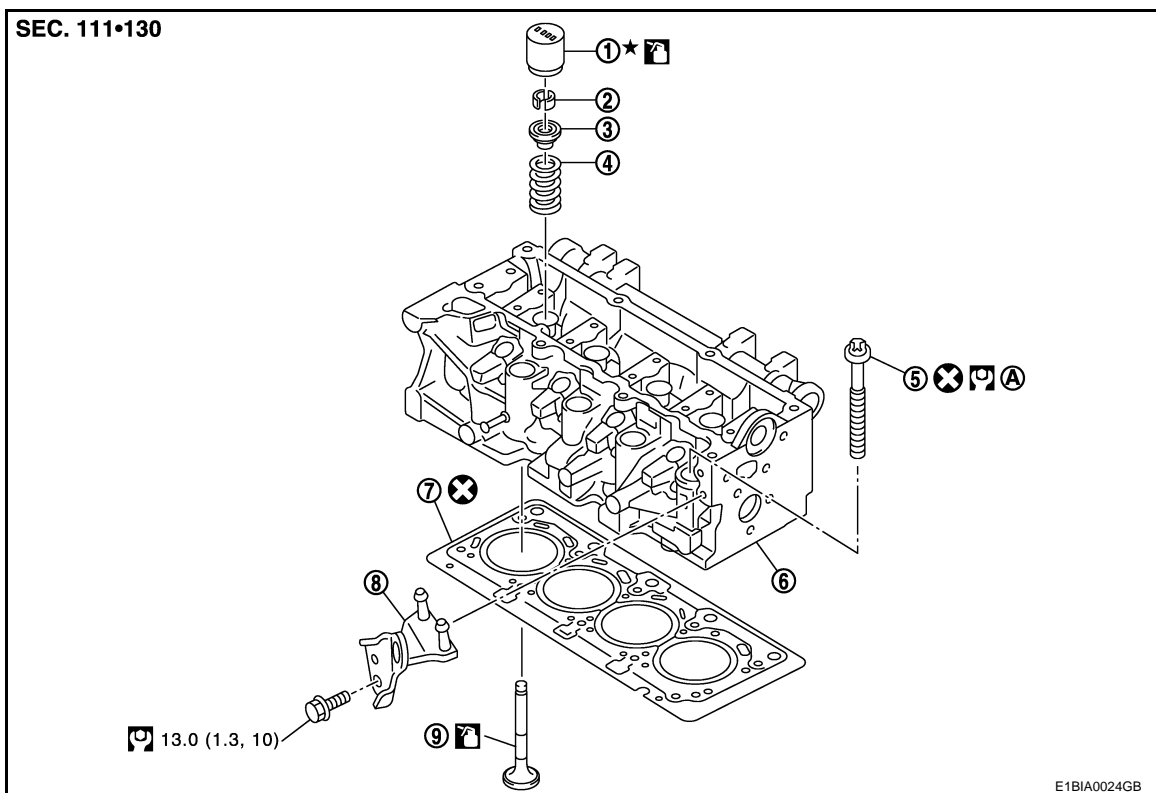
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

CYLINDER HEAD

Exploded View

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| 1. Valve lifter | 2. Valve collet | 3. Valve spring retainer |
| 4. Valve spring | 5. Cylinder head bolt | 6. Cylinder head |
| 7. Cylinder head gasket | 8. Engine slinger | 9. Valve |
- A. 25.0 N·m (2.6 kg·m, 18ft·lb) and 255 degrees

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282100

REMOVAL

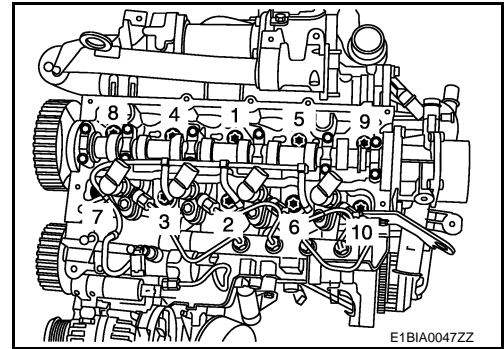
1. Remove the following parts.
 - Engine cover.
 - Air inlet tube: Refer to [EM-281, "Exploded View"](#).
 - Rocker cover: Refer to [EM-303, "Removal and Installation"](#).
 - Injection tube and fuel injector: Refer to [EM-293, "Removal and Installation"](#).
 - High pressure supply pump: [EM-300, "Removal and Installation"](#).
 - Exhaust manifold: Refer to [EM-289, "Removal and Installation"](#).
 - Timing belt: Refer to [EM-305, "Removal and Installation"](#).
 - Camshaft: Refer to [EM-313, "Removal and Installation"](#).

CYLINDER HEAD

[K9K]

< UNIT DISASSEMBLY AND ASSEMBLY >

2. Remove cylinder head bolts in reverse order as shown in the figure and remove cylinder head.
3. Remove cylinder head gasket.



INSTALLATION

1. Position the pistons at mid-stroke.
2. Install new cylinder head gasket using the centering dowels of the cylinder block.

NOTE:

The gasket faces (cylinder head and rocker cover) must be clean, dry and free from grease (in particular, remove finger marks).

3. Install cylinder head and tighten cylinder head bolts in the numerical order as shown in the figure.

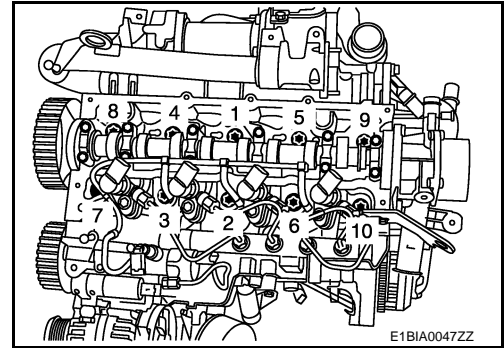
: 25.0 N·m (2.6 kg·m, 18 ft·lb)

4. Turn all bolts 255 degrees clockwise (angle tightening) in the numerical order as shown in the figure.

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100 (—)] or protractor. Avoid judgment by visual inspection without the tool.

5. Install in the reverse order of removal after this step.



Disassembly and Assembly

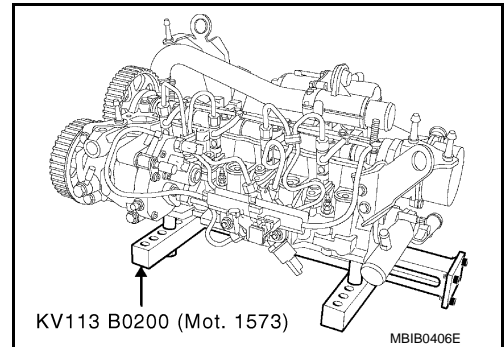
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DISASSEMBLY

1. Place the cylinder head on cylinder head stand [KV113B0200 (Mot. 1573) (commercial service tool) or equivalent tool].

CAUTION:

Pay strict attention to the rules regarding cleanliness. Refer to [EM-263, "Precaution for Diesel Equipment"](#).



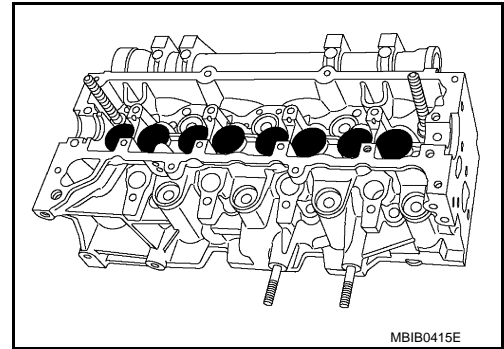
2. Remove high pressure supply pump and related parts. Refer to [EM-300, "Removal and Installation"](#).
3. Remove the injectors and glow plugs. Refer to [EM-293, "Removal and Installation"](#) and [EM-291, "Removal and Installation"](#).
4. Remove the vacuum pump and water outlet and thermostat assembly. Refer to [EM-292, "Removal and Installation"](#) and [CO-80, "Removal and Installation"](#).
5. Remove the front engine slinger, EGR assembly, air inlet pipe and exhaust manifold. Refer to [EM-284, "Removal and Installation"](#) and [EM-289, "Removal and Installation"](#).
6. Remove the camshaft sprocket. Refer to [EM-313, "Removal and Installation"](#).
7. Remove the camshaft brackets. Refer to [EM-313, "Removal and Installation"](#).

CYLINDER HEAD

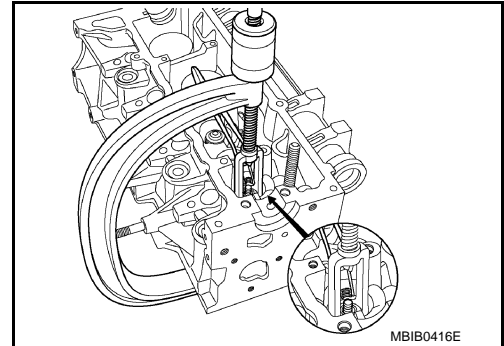
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

8. Remove the tappets, noting their position.

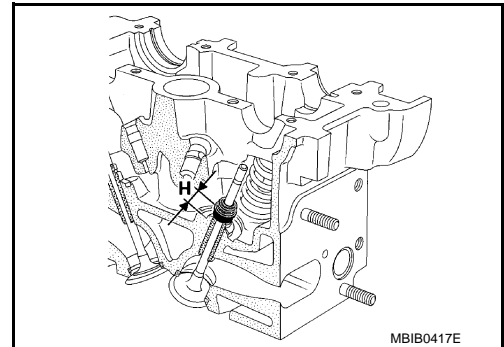


9. Compress the valve springs using the valve lifter. Remove the valve collets, valve spring retainers and valve springs.



NOTE:

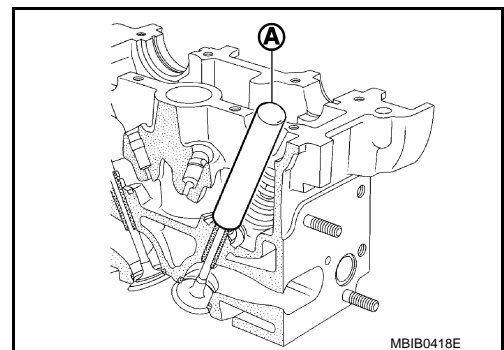
Before removing the valves and the valve stem seals, it is vital to measure position "H" of one of the old seals in relation to the cylinder head using valve seal drift [KV113B0180 (Mot. 1511-01) (commercial service tool) or equivalent tool].



10. Install the push rod (A) of valve seal drift [KV113B0180 (Mot. 1511-01) (commercial service tool) or equivalent tool] on the valve stem seal.

NOTE:

The inner diameter of the push rod must be identical to that of the valve. In addition, the bottom of the push rod must come into contact with the metal upper section of the valve stem seal.



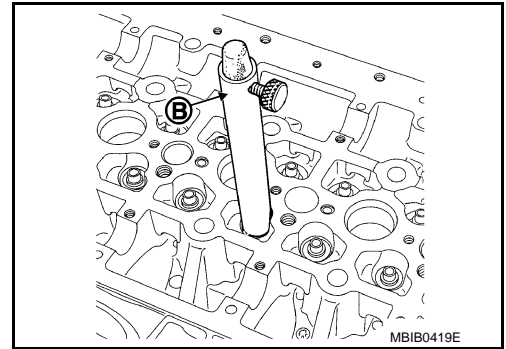
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CYLINDER HEAD

[K9K]

< UNIT DISASSEMBLY AND ASSEMBLY >

11. Install the guide tube (B) over the push rod until the guide tube comes into contact with the cylinder head, locking the push rod with the knurled wheel.
12. Remove the guide tube assembly plus push rod, being careful not to loosen the knurled wheel.
13. Remove the valves and valve guide seals using the valve seal remover [KV113B0090 (Mot. 1335) (commercial service tool) or equivalent tool].



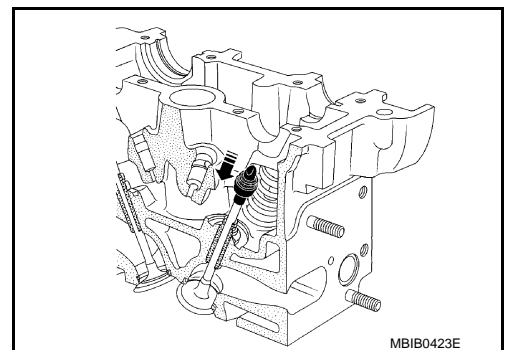
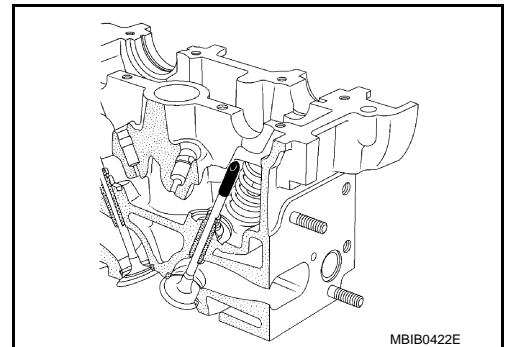
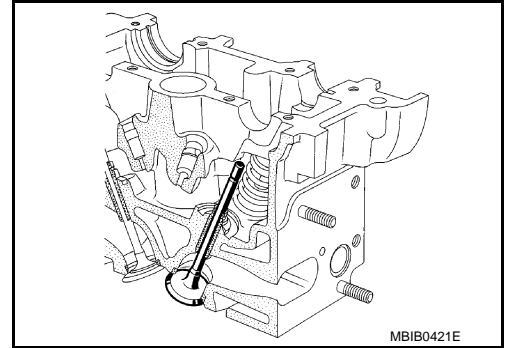
ASSEMBLY

1. Install new valves and grind them gently into their respective seats. Clean all the parts thoroughly, mark them for identification purposes, then carry out the refitting operation. Lubricate the inside of the valve guide.
 - It is imperative to fit the valve stem seals using valve seal drift [KV113B0180 (Mot. 1511-01) (commercial service tool) or equivalent tool].

NOTE:

Do not lubricate the valve stem seals before fitting them.

2. Place the valve in the cylinder head.
3. Place the barrel of valve seal drift [KV113B0180 (Mot. 1511-01) (commercial service tool) or equivalent tool] over the valve stem (the inner diameter of the barrel must be identical to the diameter of the valve stem).
4. Keep the valve pressed against its seat.
5. Place the valve stem seal (not lubricated) over the tool barrel.

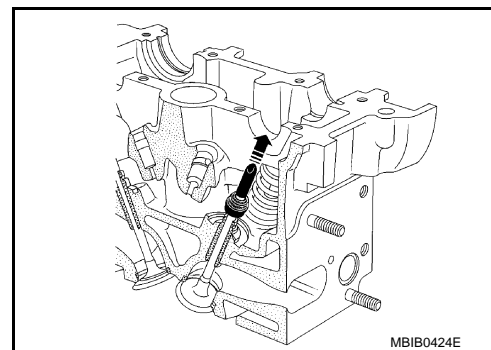


CYLINDER HEAD

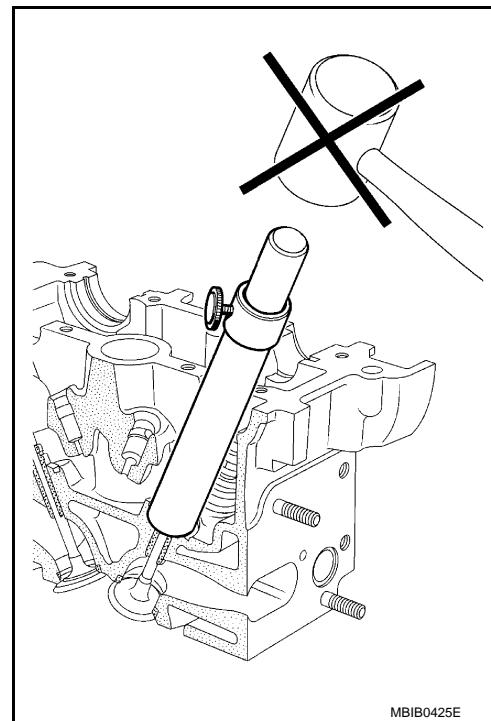
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

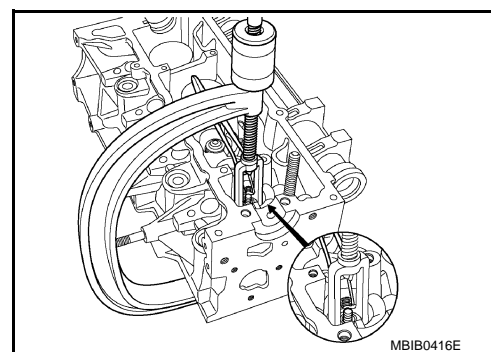
6. Push the valve stem seal past the tool barrel, then withdraw the barrel.



7. Place the guide tube plus push rod assembly on the valve stem seal.
8. Push the valve stem seal down by tapping the top of the sleeve with the palm of your hand until the guide tube touches the cylinder head.
9. Repeat these operations for all the valves.



10. Install the valve springs and valve spring retainers using valve spring compressor.
11. Install the valve collets using tweezers.
12. Install in the reverse order of removal after this step.



Cleaning

INFOID:000000010282102

- It is very important not to scratch the gasket faces of any aluminum components.
- Use suitable tool to dissolve any part of the seal which remains stuck to the metal surface.
- Apply the dissolving product to the part to be cleaned, wait approximately 10 minutes, then remove it using a wooden spatula.
- Wear gloves while carrying out this operation.
- Do not allow this dissolving product to drip on to the paintwork.
- **Great care should be taken when performing this operation, to prevent foreign objects from entering the pipes taking oil under pressure to the camshafts (pipes in both the cylinder head and its cover) and the oil return pipes.**

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- Failure to follow these instructions could lead to the blocking of the oilways, resulting in rapid and serious damage to the engine.

Inspection

INFOID:000000010282103

INSPECTION AFTER REMOVAL

Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checked. Refer to [EM-356, "Cylinder Block"](#).

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.

CAUTION:

Use utmost care not to allow gasket debris to enter passages for engine oil or water.

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions using straightedge and feeler gauge.

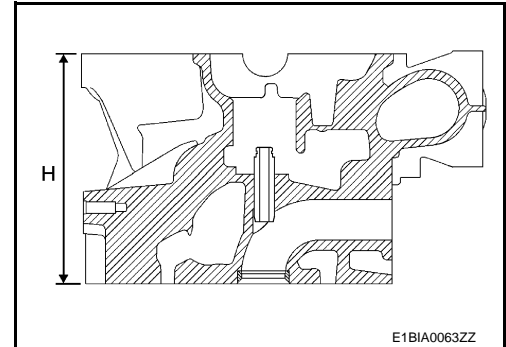
Limit : Refer to [EM-354, "Cylinder Head"](#).

- If it exceeds the limit, replace cylinder head.

Cylinder Head Height

Measure the height of cylinder head (H).

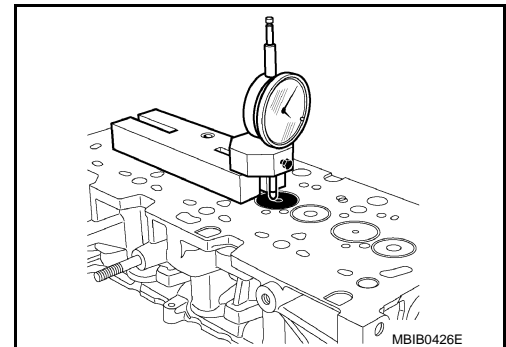
Standard : Refer to [EM-354, "Cylinder Head"](#).



Valve protrusion

Check the valve protrusion using dial gauge stand set [KV113B0040 (Mot.251-01) (commercial service tool) or equivalent tool] and dial gauge stand set [KV113B0050 (Mot.252-01) (commercial service tool) or equivalent tool] as shown.

Standard : -0.07 to 0.07 mm (-0.0028 to 0.0028 in)



INSPECTION AFTER DISASSEMBLY

Valve

Measure the valves as follows.

- Stem diameter (d)

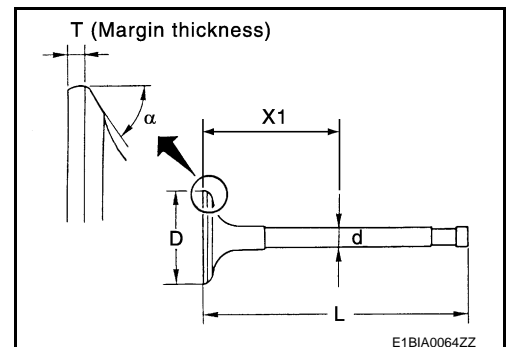
Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Face angle (α)

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)



CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- Head diameter (D)

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Valve length (L)

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Valve margin (T)

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

Valve Seat

Measure the valve seats as follows.

- Seat angle (α)

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Contacting width (X)

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Seat outer diameter (D):

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Cylinder head seat recess diameter (D)

Intake : Refer to [EM-354, "Cylinder Head"](#)

Exhaust : Refer to [EM-354, "Cylinder Head"](#)

Valve Guide Clearance

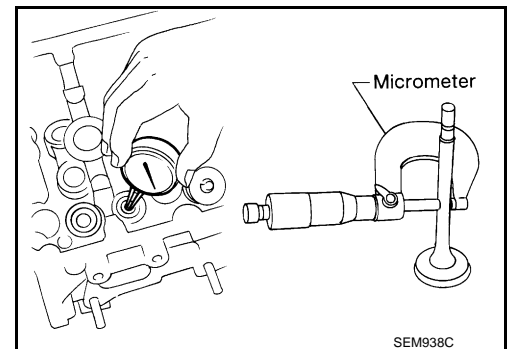
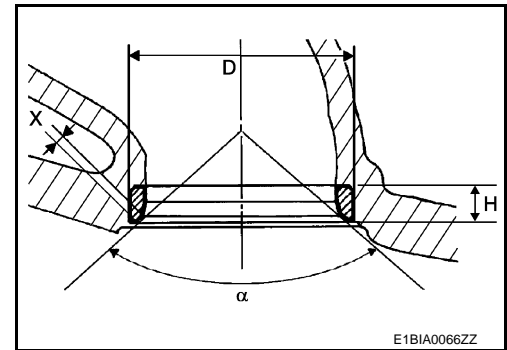
1. Measure diameter of valve stem with micrometer.
2. Measure inner diameter of valve guide with inside micrometer.
3. Calculate the valve guide clearance.
(Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

Intake : 0.020 - 0.050 mm (0.0008 - 0.0020 in)

Exhaust : 0.030 - 0.063 mm (0.0012 - 0.0025 in)

- If it exceeds the limit, replace and/or valve guide.

Valve Spring



CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

Measure the valve spring as follows.

- Free height

Intake and exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Length under load

Intake and exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Full pressed height

Intake and exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Wire diameter

Intake and exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Inner diameter

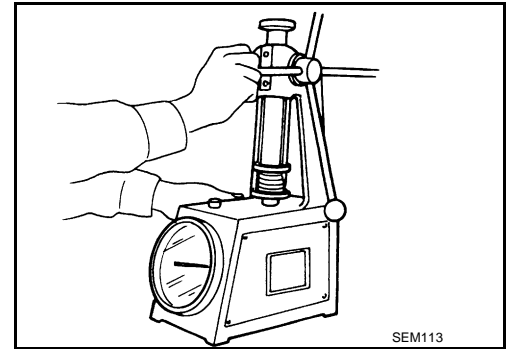
Intake and exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Outer diameter

Intake and exhaust : Refer to [EM-354, "Cylinder Head"](#)

- Squareness

Intake and exhaust : Refer to [EM-354, "Cylinder Head"](#)



CYLINDER BLOCK

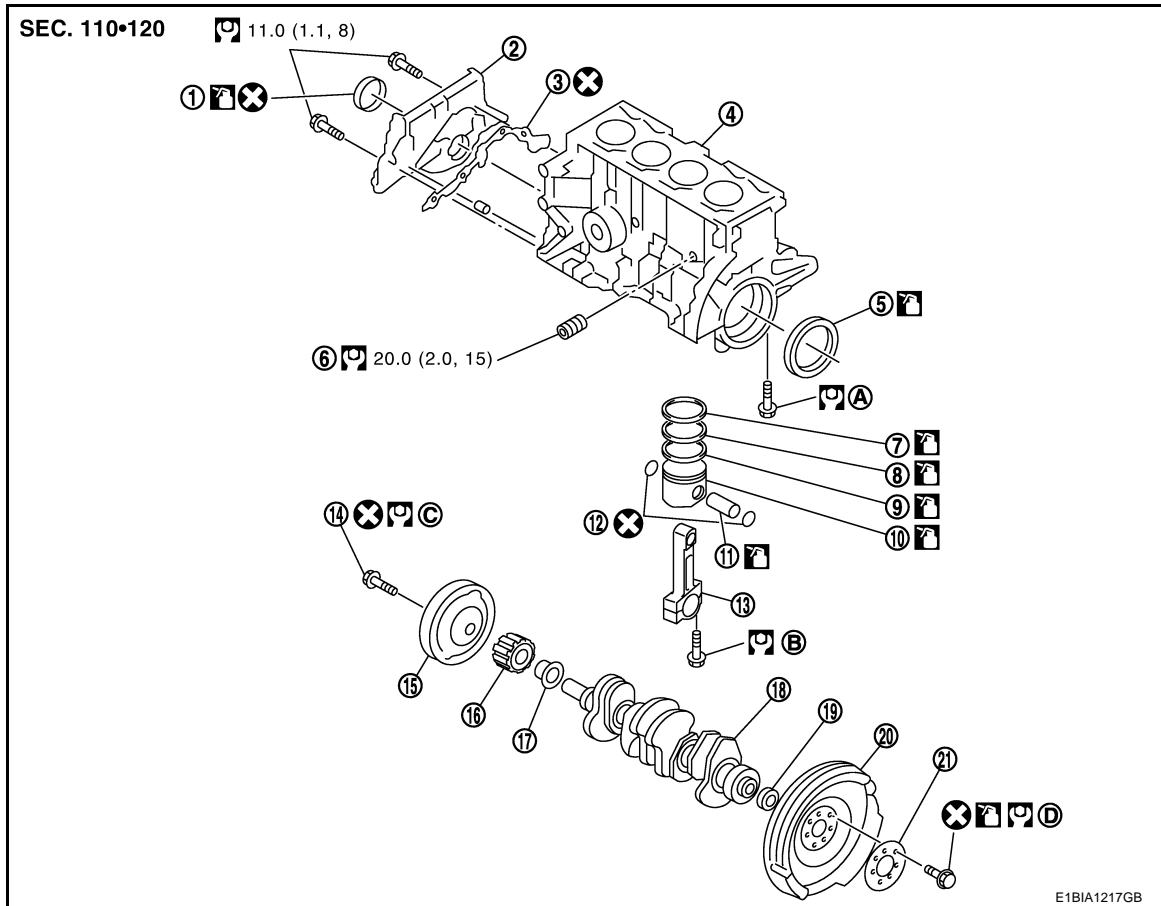
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

CYLINDER BLOCK

Exploded View

INFOID:000000010282104



- | | | |
|---------------------------------------|--|-------------------------|
| 1. Oil seal | 2. Crankshaft cover | 3. Gasket |
| 4. Cylinder block | 5. Oil seal | 6. TDC pin plug |
| 7. Top ring | 8. Second ring | 9. Oil ring |
| 10. Piston | 11. Piston pin | 12. Snap ring |
| 13. Connecting rod | 14. Crankshaft pulley bolt | 15. Crankshaft pulley |
| 16. Crankshaft sprocket (timing belt) | 17. Crankshaft sprocket (oil pump drive chain) | 18. Crankshaft |
| 19. Pilot bushing | 20. Flywheel | 21. Reinforcement plate |

A. 25.0 N·m (2.6 kg-m, 18 ft-lb) and 47 degrees

B. 20.0 N·m (2.0 kg-m, 15 ft-lb) and 45 degrees

C. 120.0 N·m (12 kg-m, 89 ft-lb) and 95 degrees

D. 20.0 N·m (2.0 kg-m, 15 ft-lb) and 36 degrees

Refer to [GI-4. "Components"](#) for symbols in the figure.

Disassembly and Assembly

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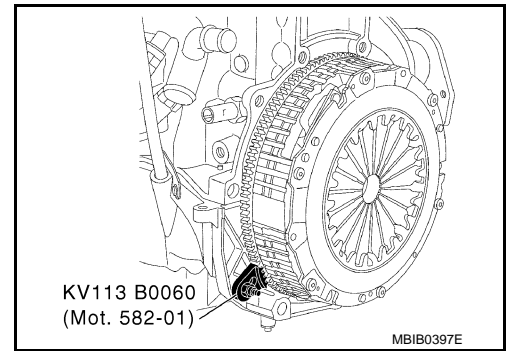
DISASSEMBLY

CYLINDER BLOCK

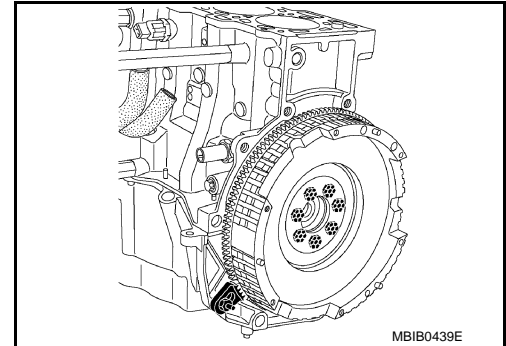
[K9K]

< UNIT DISASSEMBLY AND ASSEMBLY >

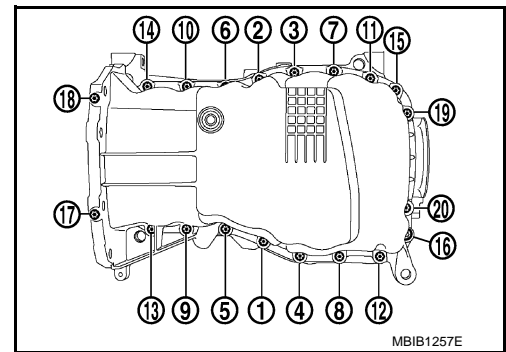
1. Install the ring gear stopper [SST: KV113B0060 (Mot. 582-01)].
2. Remove the clutch housing.



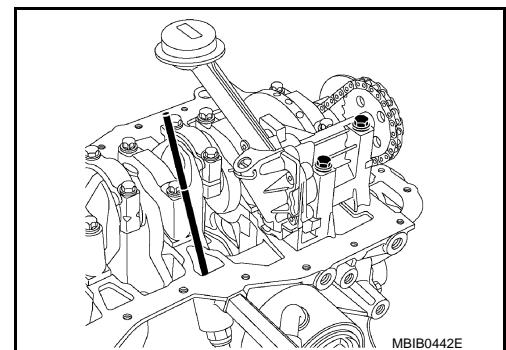
3. Remove the flywheel.



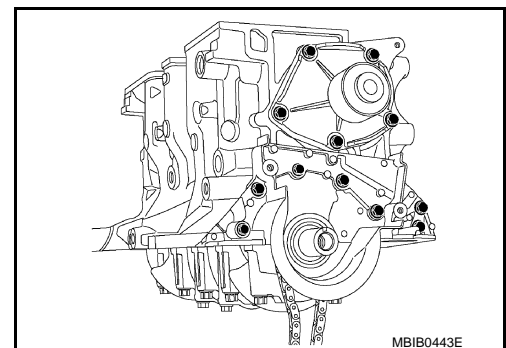
4. Remove the oil pan bolt in reverse order as shown.



5. Remove the oil level sensor.
6. Remove the oil pump.



7. Remove the crankshaft cover.
8. Remove the water pump.

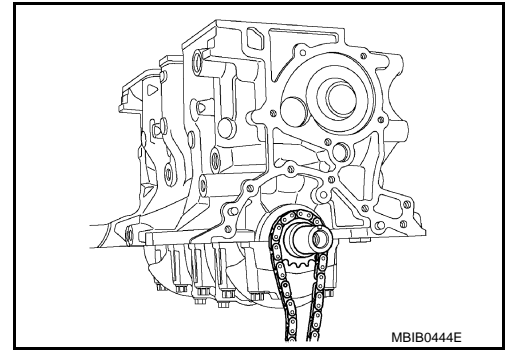


CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

9. Remove the oil pump chain.
10. Remove the oil pump drive sprocket.



WARNING:

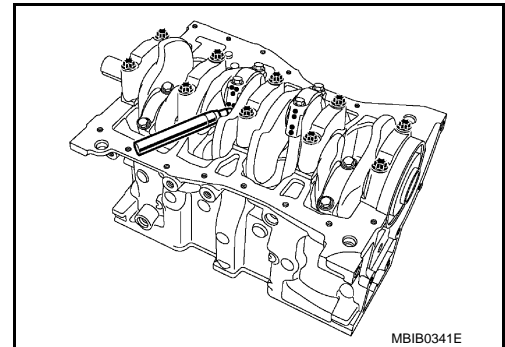
Do not use a sharp point to mark the bearing caps in relation to their connecting rods to avoid starting a crack in the rod. Use a permanent marker pen.

11. Remove the big end cap bolts and the connecting rod/piston assemblies.

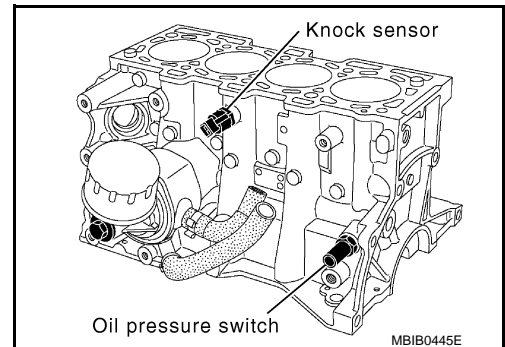
NOTE:

It is essential to mark the position of the main bearing cap, as the category may be different for each bearing.

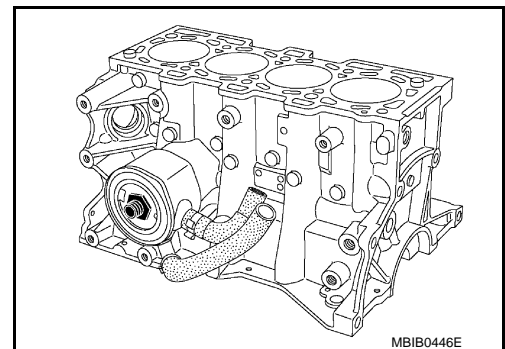
12. Remove the main bearing caps.
13. Remove the crankshaft.



14. Remove the oil pressure switch, the knock sensor and oil filter bracket connecting bolt.



15. Remove the oil cooler connecting bolt.



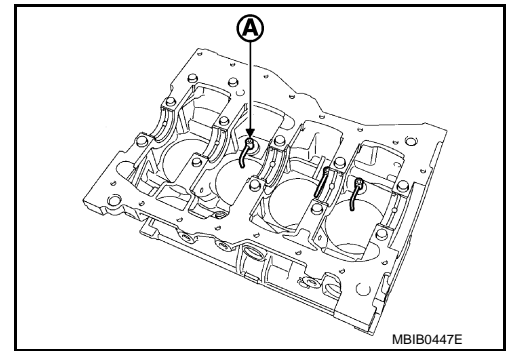
A
EM
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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

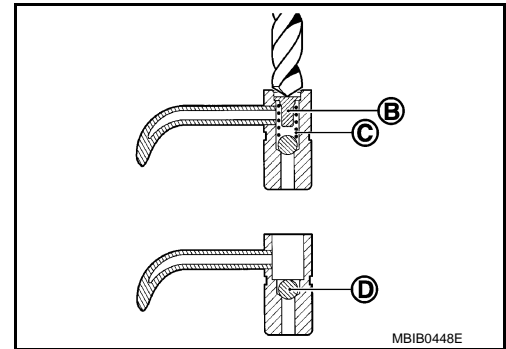
[K9K]

16. To remove the oil jets (A), they must be drilled with a 7 mm (0.28 in) diameter drill. This is necessary in order to remove the spring stop (B) and the spring (C).

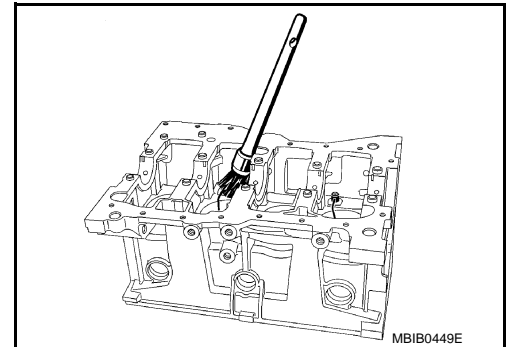


NOTE:

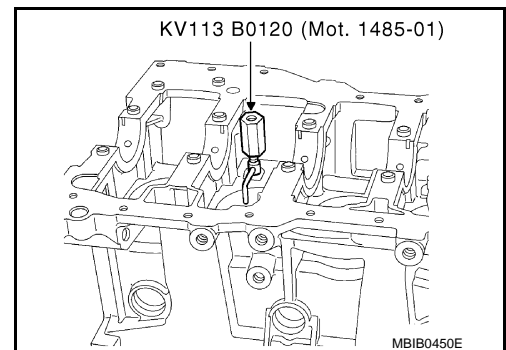
Do not remove the ball (D) to prevent from entering the cooling circuit.



17. Remove the using a suitable brush.



18. Screw oil jet remover [SST: KV113B0120 (Mot. 1485-01)] in the drilled out jets using a 6 mm (0.24 in) Allen key which must slide into the tool.

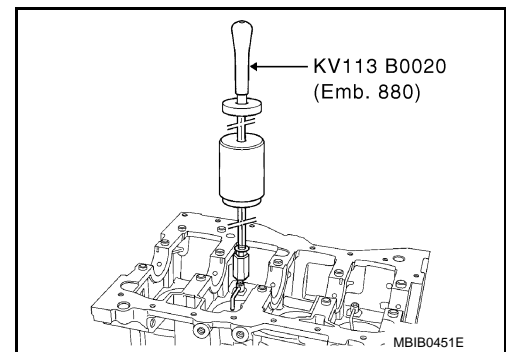


CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

19. Screw sliding hammer [SST: KV113B0020 (Emb. 880)] onto oil jet remover [SST: KV113B0120 (Mot. 1485-01)] and remove the oil jet.



20. To remove the piston pin, remove the snap ring using a screwdriver, then release the pin.

Removing the Piston Pins

NOTE:

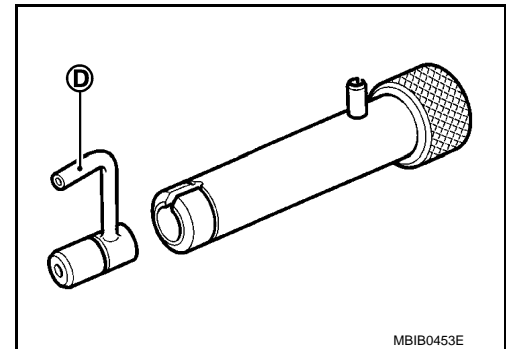
It is imperative to mark the connecting rod to match it to its piston, because the piston height classes in the same engine may be different (see Technical Specifications section).

ASSEMBLY

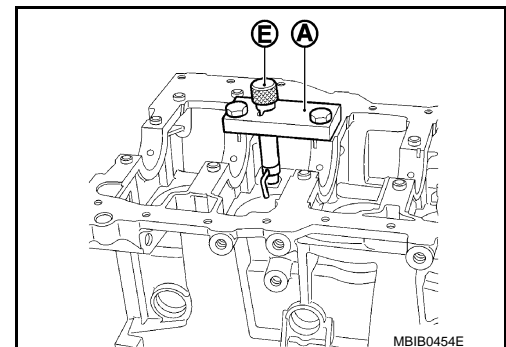
1. The oil jets must be installed using oil jet remover plate [SST: KV113B0170 (Mot. 1494)].
2. Install oil jets for NO. 1 and NO. 3 cylinders with the following procedure.
 - a. Install plate (A) of oil jet remover plate [SST: KV113B0170 (Mot. 1494)] onto the cylinder block (as shown in the figure) without tightening the two bolts (C).
 - b. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
 - c. Tighten the two bolts (C).
 - d. Remove the guide rod.
 - e. Install the push rod instead of the guide rod, then insert the oil jet into the push rod.

NOTE:

Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.



- f. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).



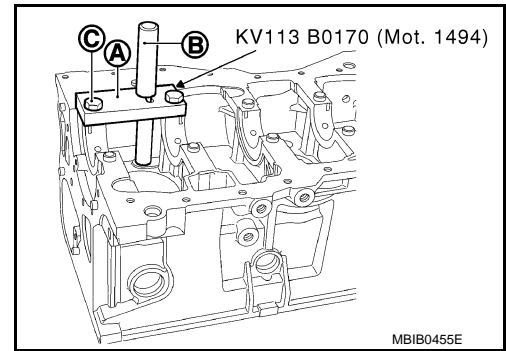
3. Install oil jets for NO. 1 and NO.4 cylinders with the following procedure.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

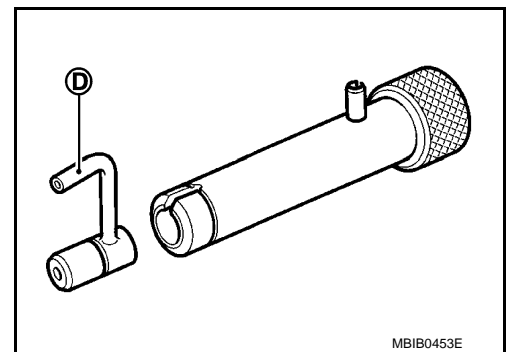
- a. Fit plate (A) of oil jet remover plate [SST: KV113B0170 (Mot. 1494)] onto the cylinder block (as shown in the figure) without tightening the two bolts (C).



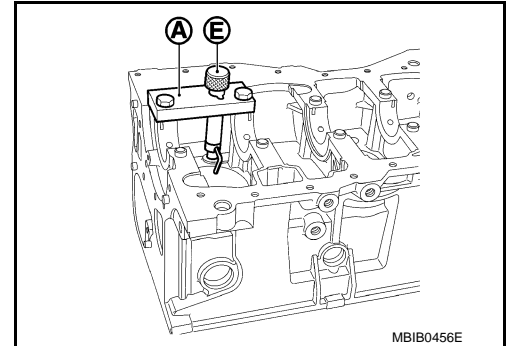
- b. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
 c. Tighten the two bolts (C).
 d. Remove the guide rod.
 e. Position the push rod instead of the guide rod, then insert the oil jet into the push rod.

NOTE:

Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.



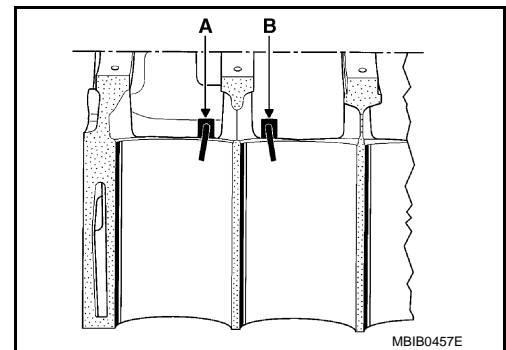
- f. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).



4. Check orientation of the oil jets (see diagram below).

A	Orientation of the oil jets of No. 2 and No. 4 cylinders
B	Orientation of the oil jets of No. 1 and No. 3 cylinders

5. Clean the cylinder block and crankshaft by passing a wire through the lubrication channels.
 6. Install oil level gauge guide tube.



7. Select main bearing with the following procedure.
 a. Identify the category of crankshaft main journal diameter (A) with checking the marking of crankshaft as shown in the figure.

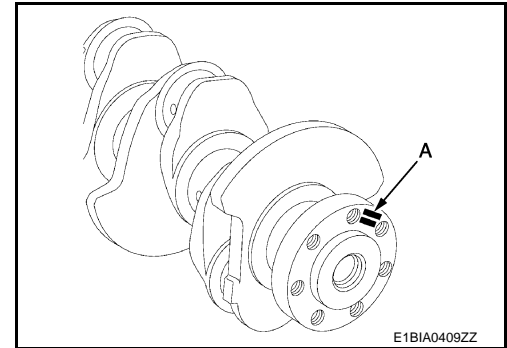
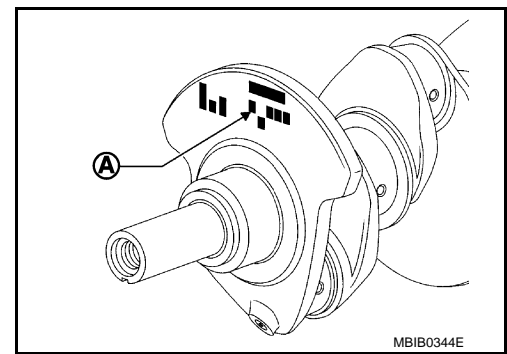
NOTE:

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

The marking has 5 digits. Left end is the diameter category of No. 1 bearing (flywheel side) and right end is the diameter category of No. 5 bearing (Sprocket side).



Detail of the marking (A):

- (1) Line indicating the diameter category of the journal.
- (2) Diameter category of the journal No. 1, flywheel end.
- (3) Diameter category of the journal No. 5, timing end.
- (4) Line indicating the diameter category of crankpin.
- (5) Diameter category of crankpin No. 1, flywheel end.
- (6) Diameter category crankpin No. 5, timing end

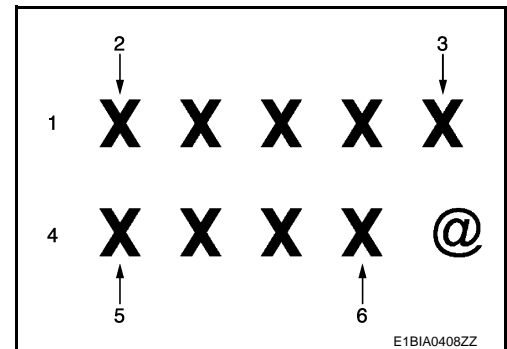


Table Of Journal Diameter Classes

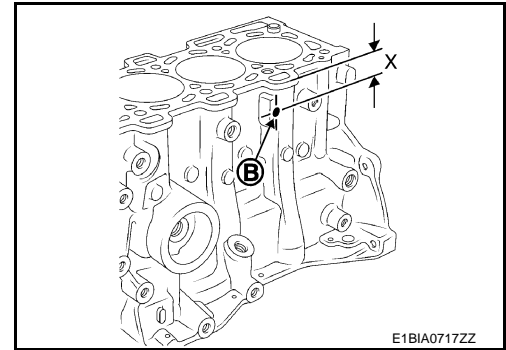
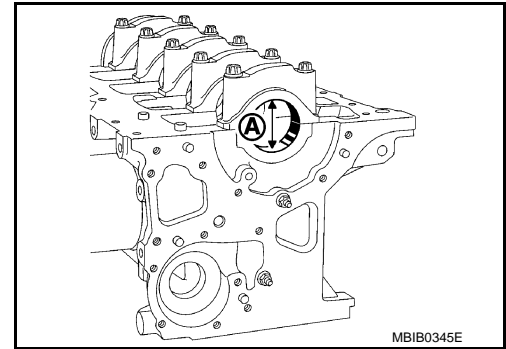
Journal diameter category mark	Journal diameter category [Diameter mm (in)]
A, G, K, R, W	D1 [47.990 - 47.997 (1.8894 - 1.8896)]
B, H, L, S, Y	D2 [47.997 - 48.003 (1.8896 - 1.8899)]
C, J, O, T, Z	D3 [48.003 - 48.010 (1.8899 - 1.8902)]

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- b. Identify the category of main bearing journal inner diameter on the cylinder block (A) with measuring the length between cylinder block top surface and drilled hole (B).



Position of (B)	Category marking [Inner diameter (A) mm (in)]
X = 33 mm (1.30 in)	1 or Blue [51.936 - 51.942 (2.0447 - 2.0450)]
X = 43 mm (1.69 in)	2 or Red [51.942 - 51.949 (2.0450 - 2.0452)]

NOTE:

X gives the diameter class of bearing 1 or blue, or, 2 or red.

- c. Select main bearing category by referring to the table.

Category of main bearing journal inner diameter on the cylinder block	Category of crankshaft main journal diameter	Main bearing category [Thickness mm (in)]
1 or Blue	D1	C1 (Yellow) [1.949 - 1.955 (0.0767 - 0.0770)]
	D2	C2 (Blue) [1.946 - 1.952 (0.0766 - 0.0769)]
	D3	C3 (Black) [1.943 - 1.949 (0.0765 - 0.0767)]
2 or Red	D1	C4 (Red) [1.953 - 1.959 (0.0769 - 0.0771)]
	D2	C1 (Yellow) [1.949 - 1.955 (0.0767 - 0.0770)]
	D3	C2 (Blue) [1.946 - 1.952 (0.0766 - 0.0769)]

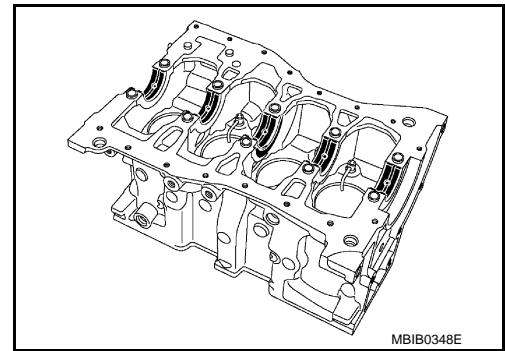
8. Install main bearing with the following procedure.

CYLINDER BLOCK

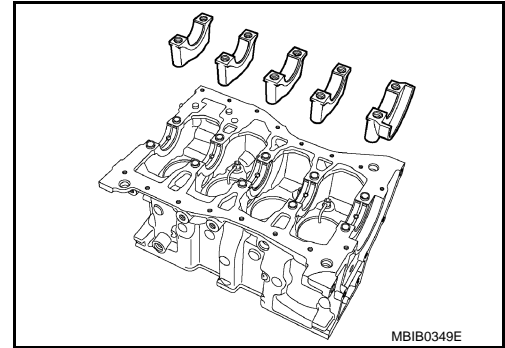
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

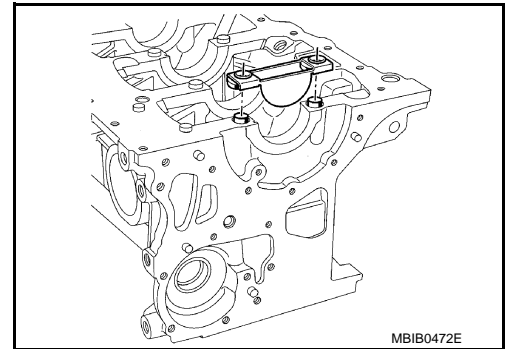
- a. Position the grooved main bearing on the cylinder block.



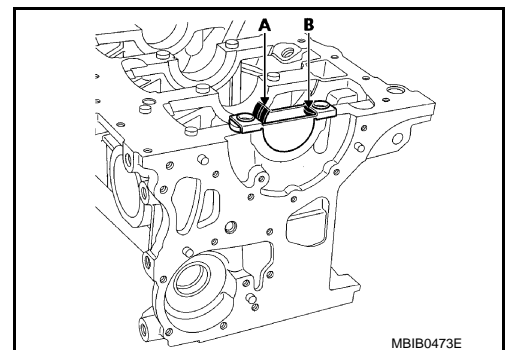
- b. Install the smooth bearing cap on the bearings.



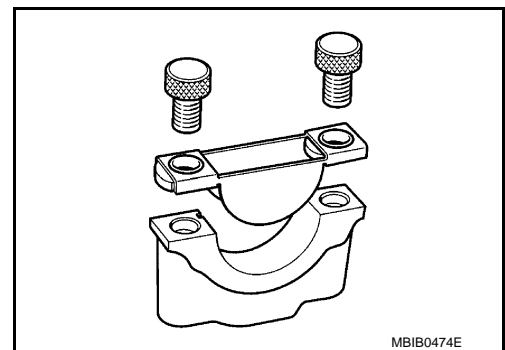
- c. Position bearing insert [SST: KV113B0160 (Mot. 1493-01)] on the cylinder block.



- d. Install the bearing cap in bearing insert [SST: KV113B0160 (Mot. 1493-01)], then press at (A) until the bearing cap is touching at (B) with bearing insert.



- e. Position bearing insert [SST: KV113B0160 (Mot. 1493-01)] on the bearing cap.



A

EM

C

D

E

F

G

H

I

J

K

L

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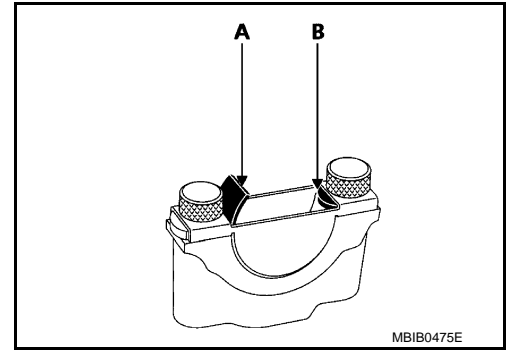
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CYLINDER BLOCK

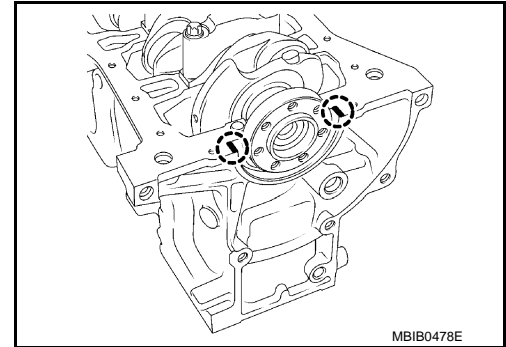
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- f. Install the main bearing in bearing insert [SST: KV113B0160 (Mot. 1493-01)], then press at (A) until the main bearing is touching at (B) with bearing insert.
- g. Lubricate the main bearing with engine oil.
- h. Install the crankshaft.
- i. Install the lateral shims on bearing No. 3, putting the grooves on the crankshaft side.



- j. Degrease the gasket faces (of the cylinder block and bearing No. 1). They should be clean, dry and free from grease (in particular, remove finger marks).
- k. Lay two beads of liquid sealant with a width of 4 mm (0.16 in) on bearing No. 1 of the cylinder block.



- l. Install the main bearing caps on bearing cap No. 1 (these are numbered from 1 - 5 and these numbers should be positioned opposite the water pump). Then tighten the bolts to a torque of:

: **25.0 N·m (2.6 kg-m, 18 ft-lb)**

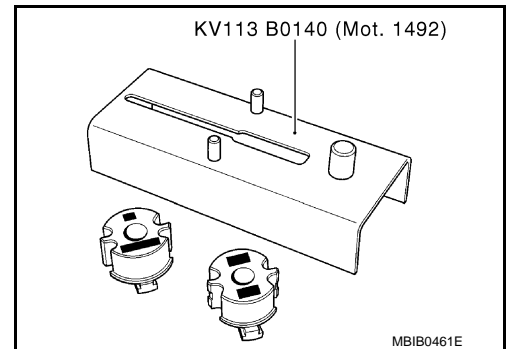
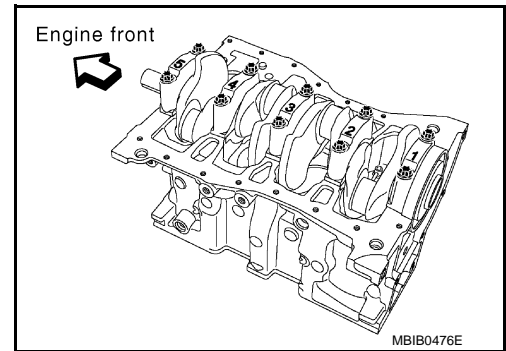
- m. Turn all bolts 47 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100 (—)] or protractor. Avoid judgment by visual inspection without the tool.

- n. Check the lateral play. Refer to [EM-348. "Inspection"](#).

- 9. Install connecting rod bearing with the following procedure.
The connecting rod bearing are installed using bearing assembling set [SST: KV113B0140 (Mot. 1492)] and bearing assembling adapter [SST: KV113B0150 (Mot. 1492-03)].

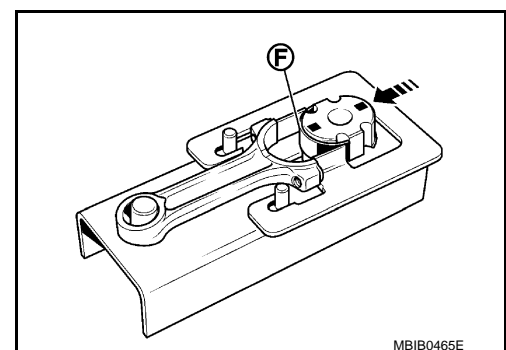
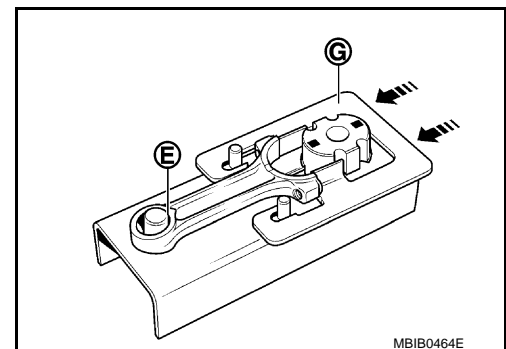
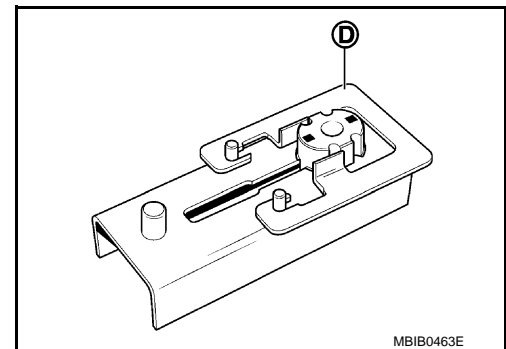
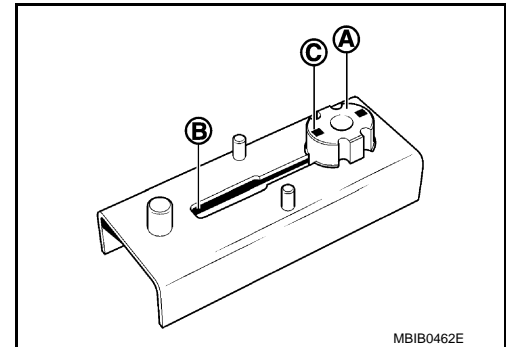
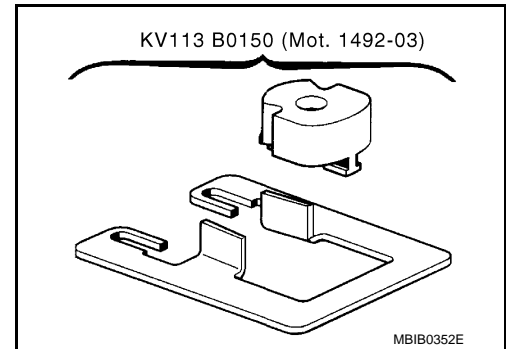


CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- a. Slide the connecting rod bearing support (A) of bearing assembling adapter [SST: KV113B0150 (Mot. 1492-03)] (positioning the engraved mark (B) as shown in the figure) into the groove (C) of the base of bearing assembling set [SST: KV113B0140 (Mot. 1492)].
- b. Install the guide (D) of bearing assembling adapter [SST: KV113B0150 (Mot. 1492-03)] onto the base (as shown in the figure).
- c. Lay the body of the connecting rod on the base of the tool (as shown in the diagram). Check that the lower part (E) of the small end is touching the centering pin and push the guide (G) in the direction of the arrow.
- d. Lay the connecting rod bearing [with a width of 20.625 mm (0.8120 in)] (F) on the connecting rod bearing support, then push it in the direction of the arrow (as shown in the figure).



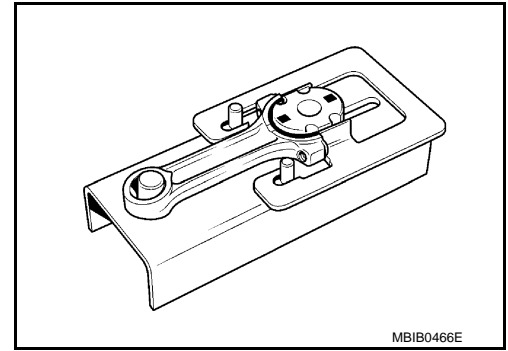
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CYLINDER BLOCK

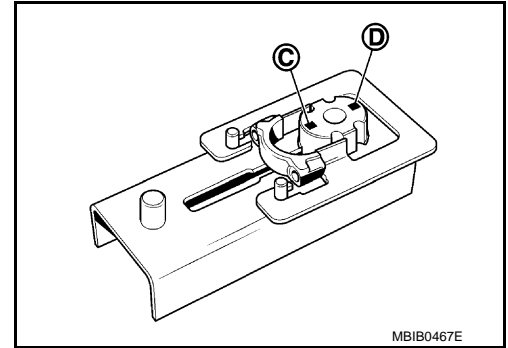
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- e. Bring the connecting rod support up against the base of the connecting rod body.
- f. Remove the connecting rod body support and repeat the operation for the remaining connecting rod bodies.



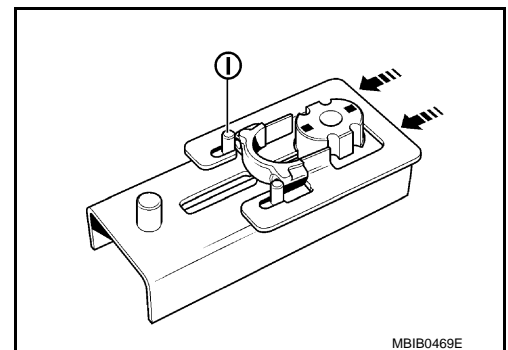
- g. Position the connecting rod bearing support either on the engraved mark (C) if the width of the connecting rod bearing is equal to 20.625 mm (0.8120 in).
- h. Position the connecting rod bearing support either on the engraved mark (D) if the width of the connecting rod bearing is equal to 17.625 mm (0.6939 in).



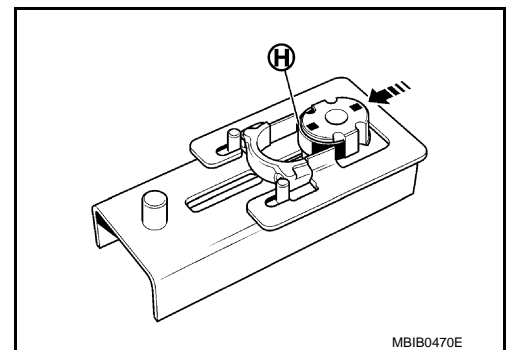
- i. Install the connecting rod cap as shown in the figure.



- j. Push the guide (in the direction of the arrow) until the connecting rod cap is in contact with the pins (I) on the base of the tool.



- k. Install the connecting rod bearing (H) on the bearing support, then push it in the direction of the arrow (as shown in the figure).

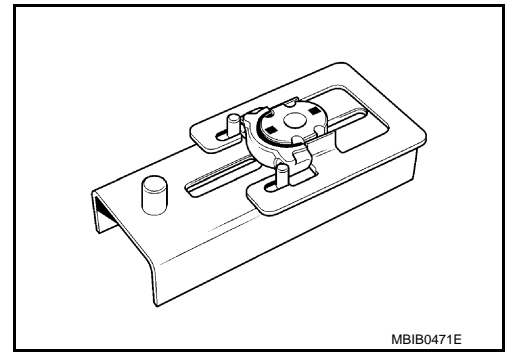


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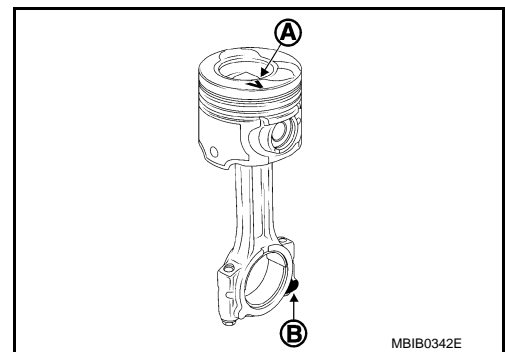
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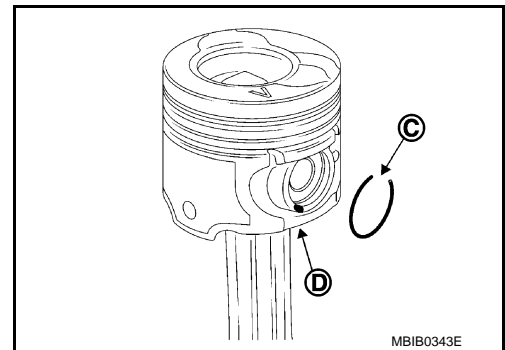
- l. Bring the connecting rod bearing support up against the base of the connecting rod cap.
- m. Remove the connecting rod bearing support and repeat the operation for the remaining connecting rod caps.



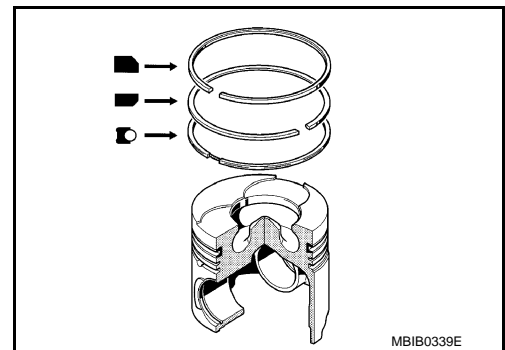
- 10. Assemble connecting rod and piston with the following procedure.
 - a. The pistons have a mark engraved on their heads indicating the engine rear side.
 - Oil the piston pin.
 - Check that the piston pins rotate correctly in the new piston and in the matching connecting rod.
 - b. Point the mark (A) engraved on the top of the piston upwards and the flat (B) of the big end downwards as shown in the figure.



- c. Position the opening (C) of the snap rings opposite the removal and fitting channel (D).
 - d. Install snap ring.
 - Rings set to their original adjustment must be free within their channels.
 - Ensure the snap rings are fitted the correct way, with the word TOP pointing upwards.



- e. Ensure the break in each piston ring is correctly oriented as shown in the figure.
 - f. Apply new engine oil to the pistons.
 - g. Install the connecting rod/piston assemblies into the cylinder block using the ring, being careful to fit them the right way round (mark towards the flywheel).
 - h. Install the connecting rods onto the oiled crankshaft pins of the crankshaft.
 - i. Install the connecting rod caps, ensuring they are correctly matched.
 - j. Tighten the connecting rod cap bolts.



: 20.0 N·m (2.0 kg-m, 15 ft-lb)

- k. Turn all bolts 45 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100 (—)] or protractor. Avoid judgment by visual inspection without the tool.

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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- I. Inspect that the big end lateral play. Refer to [EM-348, "Inspection"](#).
11. Install the oil pump sprocket and chain.
12. Tighten oil pump mounting bolts.


: **25.0 N·m (2.6 kg-m, 18 ft-lb)**

13. Install water pump, Refer to [CO-75, "Removal and Installation"](#).

NOTE:

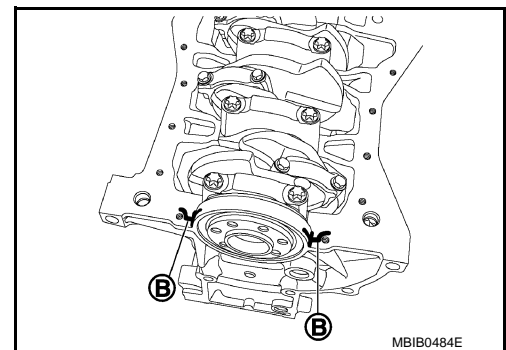
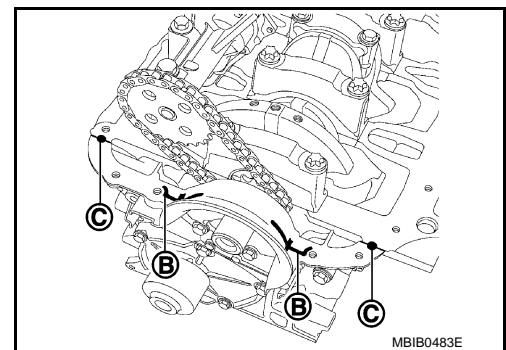
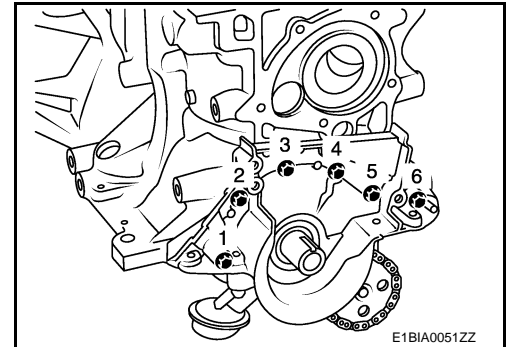
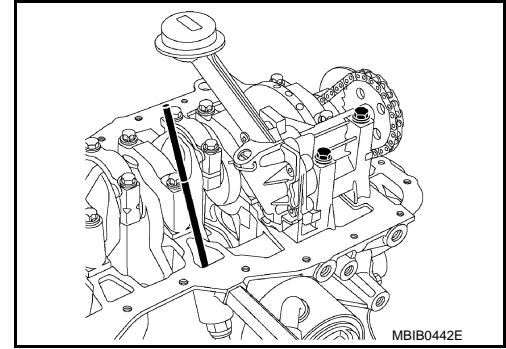
The gasket faces (cylinder block, crankshaft cover and water pump) must be clean, dry and free from grease (in particular, remove finger marks).

14. Install crankshaft cover oil seal with a new one.
15. Install the crankshaft cover in the numerical order as shown in the figure.

: **11.0 N·m (1.1 kg-m, 8 ft-lb)**

16. Apply two beads (B) of liquid gasket, with a diameter of 5 mm (0.20 in).
Apply two points (C) of liquid gasket, with a diameter of 5 mm (0.20 in) at the intersection of the crankshaft cover and the cylinder block.
 - Use Genuine Liquid Gasket or equivalent.

17. Apply two beads (B) of liquid gasket, with a diameter of 5 mm (0.20 in).
 - Use Genuine Liquid Gasket or equivalent.
18. Install the oil pan Refer to [EM-296, "Removal and Installation"](#).

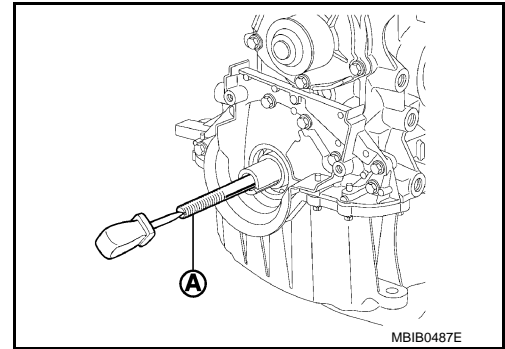


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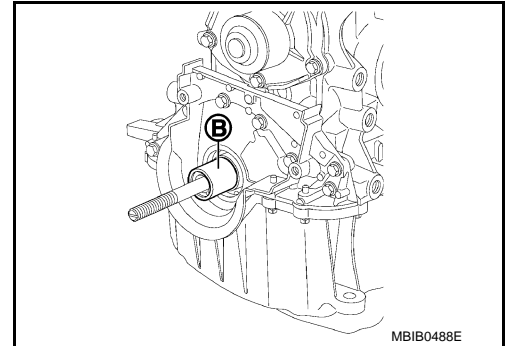
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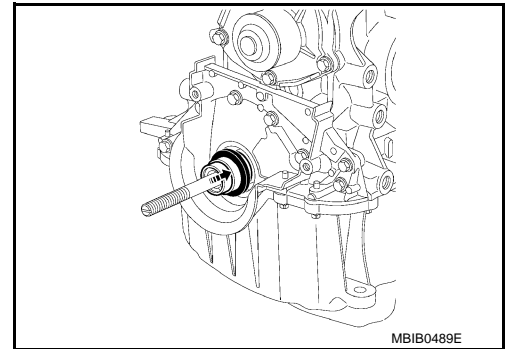
19. Crankshaft elastomer seal, timing side.
20. Screw the threaded rod (A) of front oil seal drift set [SST: KV113B0220 (Mot. 1586)] into the crankshaft.



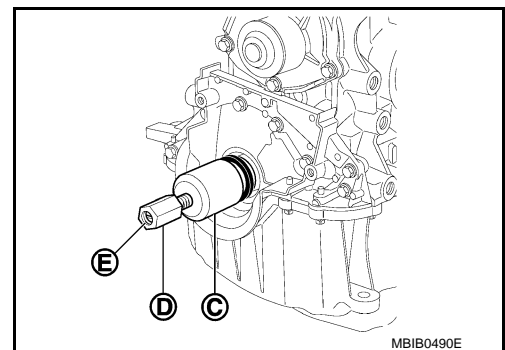
21. Position the spacer (B) of front oil seal drift set [SST: KV113B0220 (Mot. 1586)] on the crankshaft.



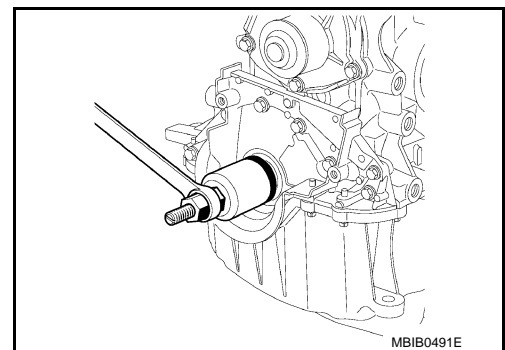
22. Install the protector complete with the seal onto the spacer, taking care not to touch the seal.



23. Install the cover (A) and the nut (B) (putting the threaded part (C) of the nut on the side away from the engine) of front oil seal drift set [SST: KV113B0220 (Mot. 1586)].



24. Tighten the nut until the cover touches the spacer.



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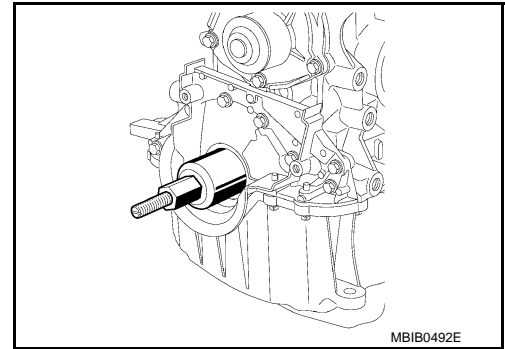
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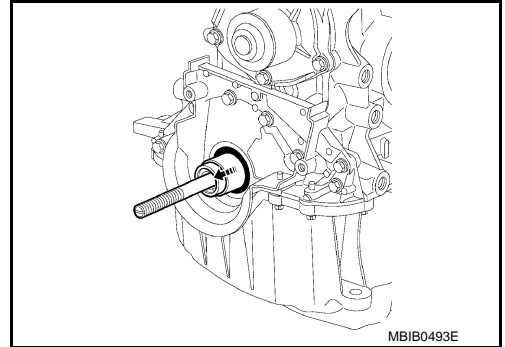
CYLINDER BLOCK

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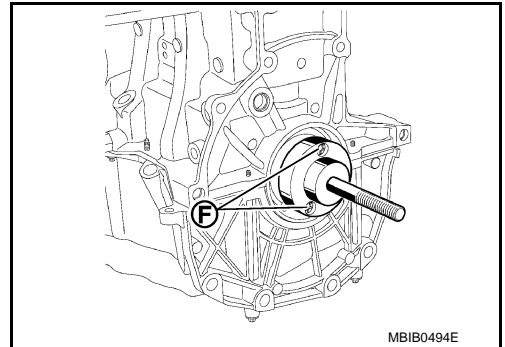


25. Remove the nut, the cover, the protector and the threaded rod.

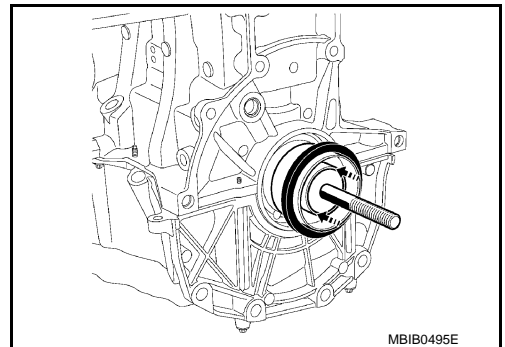


26. Crankshaft elastomer seal, flywheel side.

27. Install front oil seal drift set [SST: KV113B0210 (Mot. 1585)] on the crankshaft, securing it with bolts (F).



28. Put the protector complete with the seal on front oil seal drift set [SST: KV113B0210 (Mot. 1585)], being careful not to touch the seal.

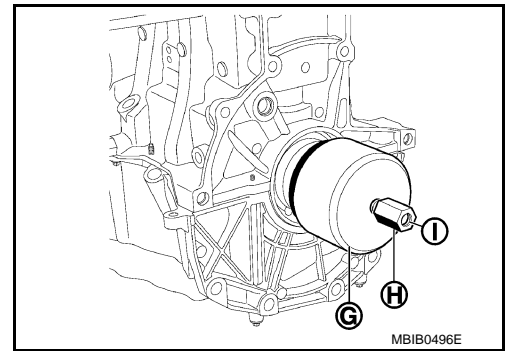


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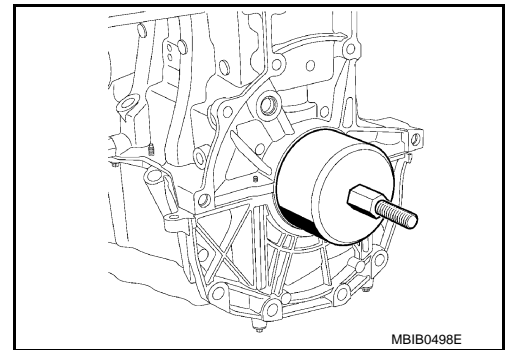
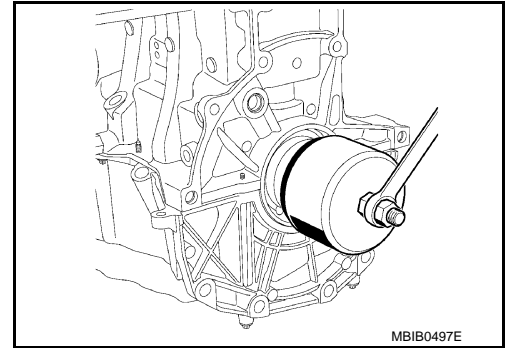
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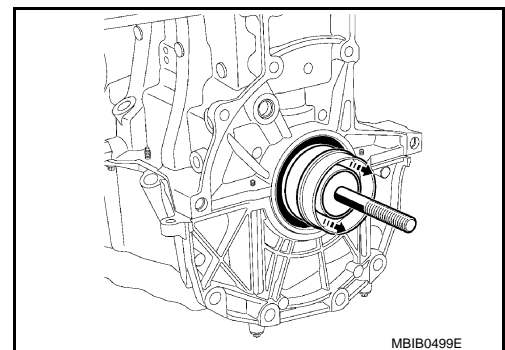
29. Install the cover (G) and nut (H) (putting the threaded part (I) of the nut on the side away from the engine) of front oil seal drift set [SST: KV113B0210 (Mot. 1585)].



30. Tighten the nut until the cover touches the cylinder block.



31. Remove the nut, the cover, the protector and the threaded rod.



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32. Install ring gear stopper [SST: KV113B0060 (Mot. 582-01)] and tighten flywheel bolts with new one.

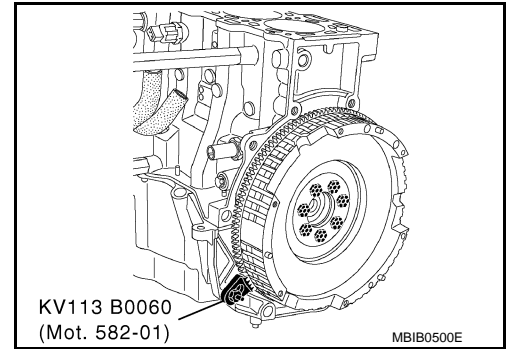
: 20.0 N·m (2.0 kg-m, 15 ft-lb)

33. Turn all bolts 36 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100 (—)] or protractor. Avoid judgment by visual inspection without the tool.

34. Install the clutch housing.
35. Remove ring gear stopper [SST: KV113B0060 (Mot. 582-01)].



Inspection

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CYLINDER BLOCK TOP SURFACE DISTORTION

- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

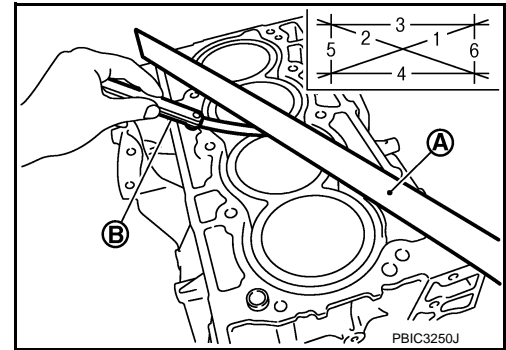
CAUTION:

Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge (A) and feeler gauge (B).

Limit : Refer to [EM-356, "Cylinder Block"](#).

- If it exceeds the limit, replace cylinder block.



PISTON PROTRUSION

1. Clean the piston head.
2. Turn the crankshaft one turn in its operating direction to bring piston No. 1 close to TDC.
3. Install dial gauge stand set [KV113B0050 (Mot. 252-01) (commercial service tool) or equivalent tool] on the piston.
4. Install dial gauge stand set [KV113B0040 (Mot. 251-01) (commercial service tool) or equivalent tool] equipped with a gauge on dial gauge stand set [KV113B0050 (Mot. 252-01) (commercial service tool) or equivalent tool], and find TDC.

NOTE:

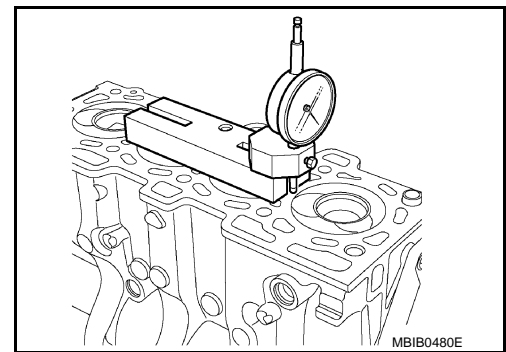
All measurements must be carried out along the longitudinal axis of the engine, in order to eliminate any errors due to tilting of the piston.

WARNING:

The gauge follower must not be in the valve clearance.

5. Inspect the piston protrusion.

Standard : Refer to [EM-356, "Cylinder Block"](#).



CRANKSHAFT LATERAL PLAY

1. Install crankshaft.

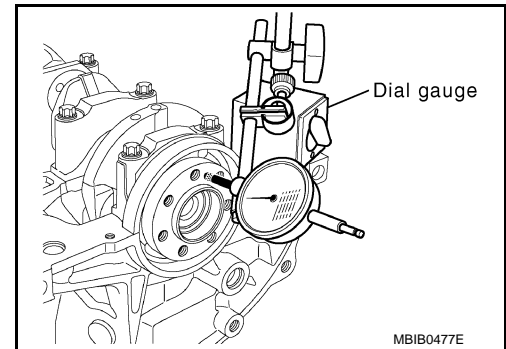
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

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2. Inspect the lateral play.

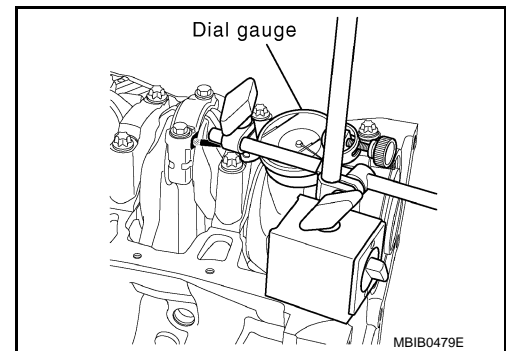
Standard : Refer to [EM-356, "Cylinder Block"](#).



CONNECTING ROD BIG END LONGITUDINAL PLAY

1. Install crankshaft.
2. Install piston and connecting rod assembly.
3. Inspect that the big end lateral play.

Standard : Refer to [EM-356, "Cylinder Block"](#).

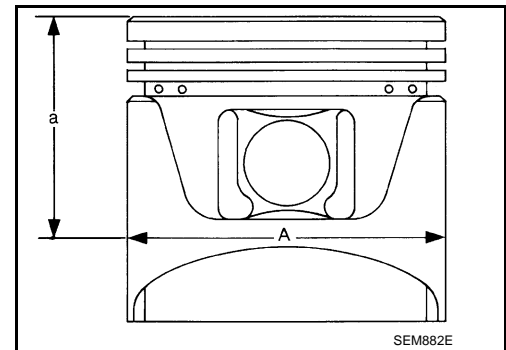


PISTON DIAMETER

Measure the piston diameter.

The piston diameter (A) must be measured at height (a) = 56 mm (2.205 in).

Standard : Refer to [EM-356, "Cylinder Block"](#).



PISTON RING THICKNESS

Measure piston ring thickness with micrometer.

Standard : Refer to [EM-356, "Cylinder Block"](#).

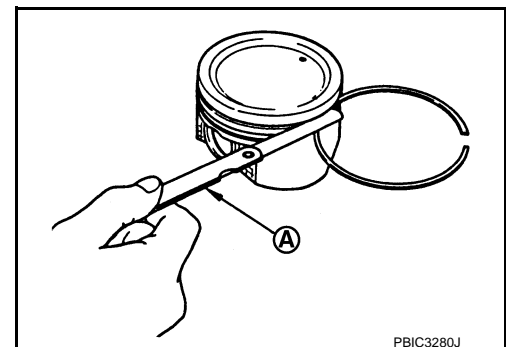
- The piston rings are supplied ready adjusted.

PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with a feeler gauge (A).

Standard : Refer to [EM-356, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.



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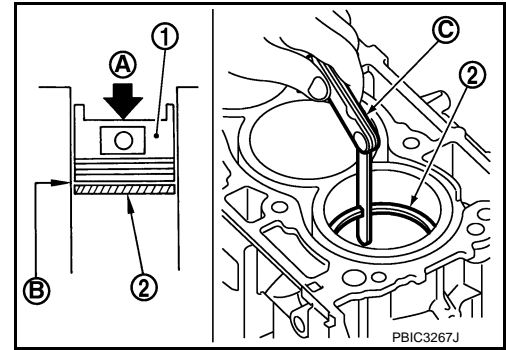
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PISTON RING END GAP

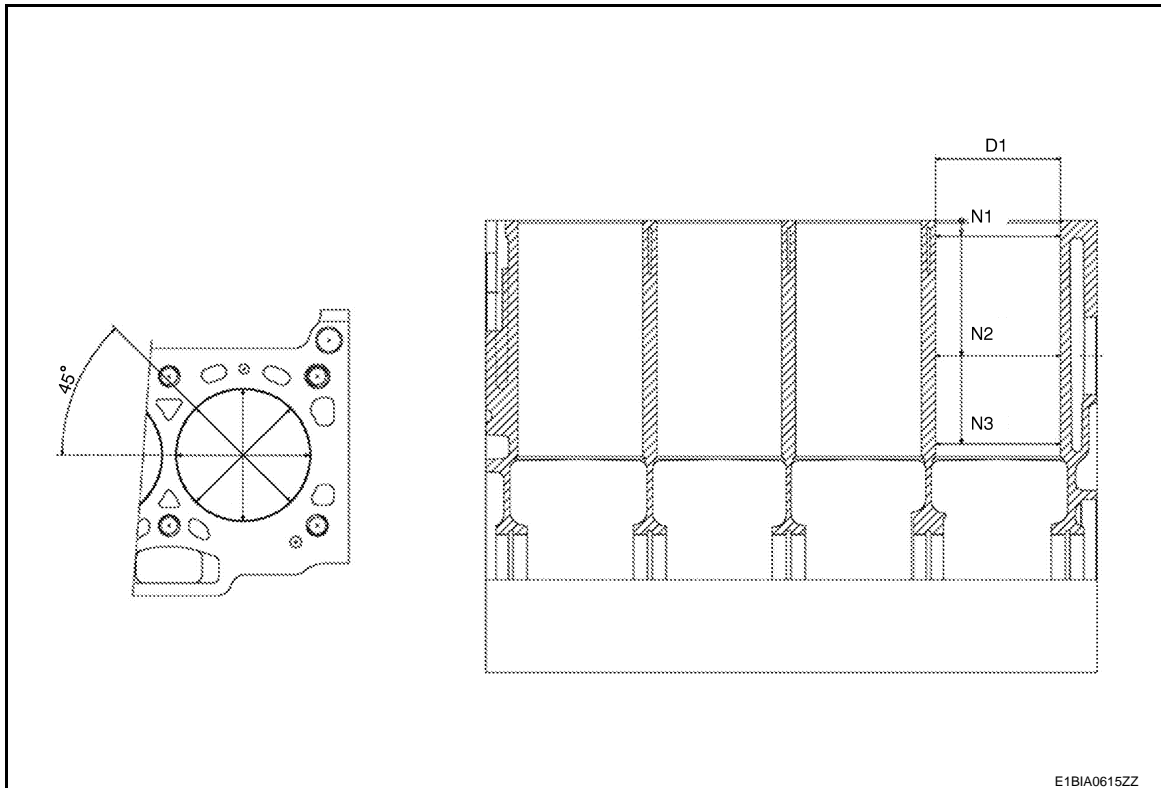
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap with a feeler gauge (C).

Standard : Refer to [EM-356, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring.



CHECKING THE DIAMETER, OUT-OF-ROUNDNESS AND TAPER OF BARRELS



Using a Dial gauge, measure the diameter (D1) of the cylinder block barrels at intervals of 45° (4 diagonals) at 3 levels (N1), (N2) and (N3):

- 10 mm,
- 64 mm,
- 117 mm,

depth from the cylinder head joint face and note these 12 diameter values for each cylinder.

Check that these 48 diameter measurements are all within the barrel diameter tolerance.

Diameter tolerance : **76.00 - 76.02 mm (2.992 - 2.993 in)**

Check that the difference between the largest and the smallest diameters at each depth level in each cylinder is within the out-of-roundness tolerance.

Maximum out-of-roundness permitted **0.01 mm (0.0004 in)**

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

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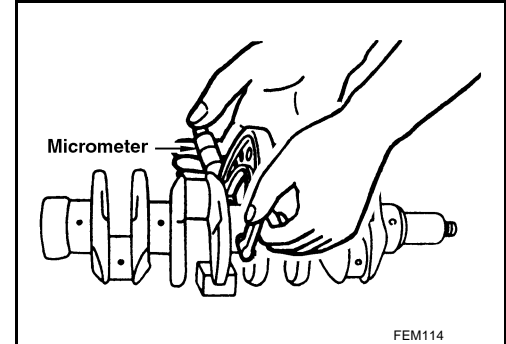
Check that the difference between the largest and the smallest diameters in the same vertical plane of each diameter of each cylinder barrel is within the taper tolerance.

Maximum taper permitted 0.01 mm (0.0004 in)

CRANKSHAFT MAIN JOURNAL DIAMETER

Use micrometer to measure crankshaft main journal diameter.

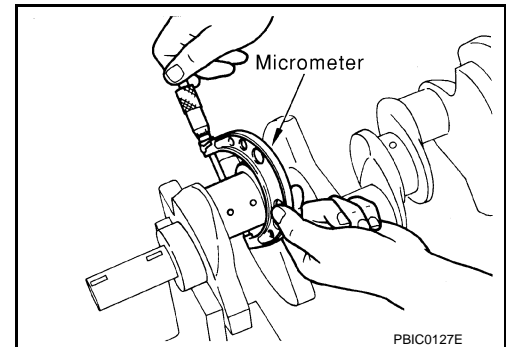
Standard : Refer to [EM-356, "Cylinder Block"](#).



CRANKSHAFT PIN JOURNAL DIAMETER

Use micrometer to measure crankshaft pin journal diameter.

Standard : Refer to [EM-356, "Cylinder Block"](#).



FLYWHEEL ISNPECTION

For a dual mass flywheel which has worked: presence of a free rotation angle. This angle is measured by fixing the primary flywheel and turning the secondary flywheel. The dual mass flywheel free rotation angle must not exceed 15° or 3 cm in linear movement measured on the edge.

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SERVICE DATA AND SPECIFICATIONS (SDS)

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SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

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GENERAL SPECIFICATIONS

Cylinder arrangement	In-line 4	
Displacement cm ³ (cu in)	1.461 (89.15)	
Bore and stroke mm (in)	76 x 80.5 (2.99 x 3.17)	
Valve arrangement	SOHC	
Firing order	1-3-4-2	
Number of piston rings	Compression	2
	Oil	1
Number of main bearings	5	
Compression ratio	15.2	
Compression pressure kPa (bar, kg/cm ² , psi)	Maximum pressure must be at least 1,800 (18, 18.36, 261)	

Valve timing	<p style="text-align: right;">PBIC0187E</p>					
	a	b	c	d	e	f
	200°	191°	-9°	20°	-7°	27°

Drive Belt

INFOID:0000000010282108

DRIVE BELT

Tension of drive belt	Auto adjustment by auto-tensioner
-----------------------	-----------------------------------

Camshaft

INFOID:0000000010282109

CAMSHAFT

Unit: mm (in)

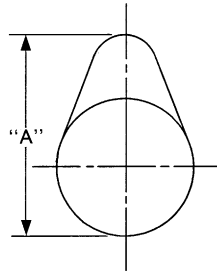
Items	Standard
Camshaft bracket inner diameter	No. 1, 2, 3, 4, 5 25.04 - 25.06 (0.9858 - 0.9866)
	No. 6 28.04 - 28.06 (1.1039 - 1.1047)
Camshaft journal diameter	No. 1, 2, 3, 4, 5 24.979 - 25.000 (0.9834 - 0.9843)
	No. 6 27.979 - 28.000 (1.1015 - 1.1024)
Camshaft end play	0.080 - 0.178 (0.0031 - 0.0070)
Camshaft runout	Less than 0.05 (0.0020)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[K9K]

Items		Standard
Camshaft cam height "A"	Intake	44.012 - 44.018 (1.7327 - 1.7329)
	Exhaust	44.592 - 44.598 (1.7555 - 1.7557)



SEM671

VALVE LIFTER

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	34.965 - 34.985 (1.3767 - 1.3774)
Valve lifter hole diameter	35.000 - 35.040 (1.3780 - 1.3795)
Valve lifter clearance	0.015 - 0.075 (0.0006 - 0.0030)

VALVE CLEARANCE

Unit: mm (in)

Items	Cold
Intake	0.125 - 0.250 (0.0049 - 0.0098)
Exhaust	0.325 - 0.450 (0.0128 - 0.0177)

AVAILABLE VALVE LIFTER

Unit: mm (in)

Part number	Thickness
13229BN700	7.550 (0.2972)
13229BN701	7.575 (0.2982)
13229BN702	7.600 (0.2992)
13229BN703	7.625 (0.3002)
13229BN704	7.650 (0.3012)
13229BN705	7.675 (0.3022)
13229BN706	7.700 (0.3031)
13229BN707	7.725 (0.3041)
13229BN708	7.750 (0.3051)
13229BN709	7.775 (0.3061)
13229BN710	7.800 (0.3071)
13229BN711	7.825 (0.3081)
13229BN712	7.850 (0.3091)
13229BN713	7.875 (0.3100)
13229BN714	7.900 (0.3110)
13229BN715	7.925 (0.3120)
13229BN716	7.950 (0.3130)
13229BN717	7.975 (0.3140)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[K9K]

Part number	Thickness
13229BN718	8.000 (0.3150)
13229BN719	8.025 (0.3159)
13229BN720	8.050 (0.3169)
13229BN721	8.075 (0.3179)
13229BN722	8.100 (0.3189)
13229BN723	8.125 (0.3199)
13229BN724	8.150 (0.3209)

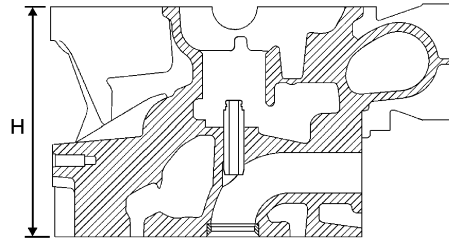
Cylinder Head

INFOID:000000010282110

CYLINDER HEAD

Unit: mm (in)

Items	Standard
Cylinder head gasket thickness	0.68 - 0.74 (0.0269 - 0.0291)
Head surface distortion	Less than 0.05 (0.002)
Normal cylinder head height "H"	127 (5.000)



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VALVE DIMENSIONS

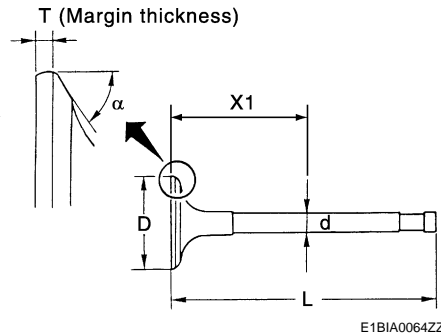
Items		Standard
Valve head diameter "D"	mm (in)	Intake 33.38 - 33.62 (1.314 - 1.324)
		Exhaust 28.88 - 29.12 (1.137 - 1.146)
Valve length "L"	mm (in)	Intake 100.74 - 101.16 (3.9661 - 3.9827)
		Exhaust 100.54 - 100.96 (3.9583 - 3.9748)
Valve stem diameter "d"	mm (in)	Intake 5.969 - 5.985 (0.2350 - 0.2356) Measuring point (X1) is 41 (1.61)
		Exhaust 5.955 - 5.971 (0.2344 - 0.2351) Measuring point (X1) is 31 (1.22)
Valve seat angle "α"	degree	45°00' (45.00°)
Valve margin "T"	mm (in)	1.0 (0.039)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

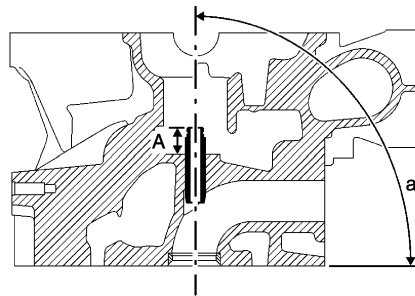
[K9K]

Items		Standard	
Valve lift	mm (in)	Intake	8.0 (0.315)
		Exhaust	8.6 (0.339)



VALVE GUIDE

Items		Standard	
Valve guide	mm (in)	Length	40.35 - 40.65 (1.5886 - 1.6004)
		Outer diameter	10.956 - 11.062 (0.4313 - 0.4355)
		Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)
Cylinder head valve guide hole diameter	mm (in)	11.0 (0.4431)	
Valve guide clearance	mm (in)	Intake	0.020 - 0.050 (0.0008 - 0.0020)
		Exhaust	0.030 - 0.063 (0.0012 - 0.0025)
Projection length "A"	mm (in)	Intake	14.0 (0.5512)
		Exhaust	14.2 (0.5591)
Valve guide inclination angle "a"	degree	90°00' (90.00°)	



VALVE SEAT

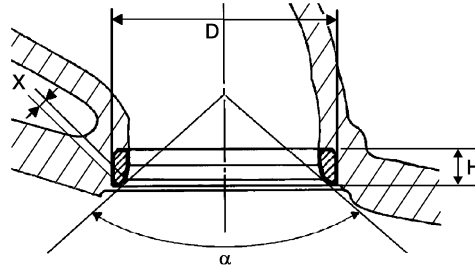
Items		Standard	
Cylinder head seat recess diameter "D"	mm (in)	Intake	34.444 - 34.474 (1.3561 - 1.3572)
		Exhaust	29.955 - 29.985 (1.1793 - 1.1805)
Valve seat outer diameter "D"	mm (in)	Intake	34.534 - 34.550 (1.3596 - 1.3602)
		Exhaust	30.035 - 30.048 (1.1825 - 1.1830)
Angle "α"	degree	89°30' (89.50°)	
Contacting width "X"	mm (in)	1.8 (0.071)	
Valve seat height "H"	mm (in)	Intake	4.61 - 4.69 (0.1815 - 0.1846)
		Exhaust	5.63 - 5.71 (0.2217 - 0.2248)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[K9K]

Items		Standard
Cylinder head seat recess depth "H"	mm (in)	Intake 6.0 (0.236)
		Exhaust 7.0 (0.276)



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VALVE SPRING

Items		Standard
Free height	mm (in)	43.31 (1.7051)
Pressure	N (kg, lb) at height mm (in)	218 - 242 (22.2 - 24.7, 49.0 - 54.4) at 33.80 (1.3307)
		477 - 523 (48.7 - 53.3, 107.2 - 117.6) at 24.80 (0.9764)
Spring squareness	mm (in)	1.2 (0.047)
Full pressed height	mm (in)	23.40 (0.9213)
Diameter of wire	mm (in)	3.45 (0.1358)
Outer diameter at the top of spring	mm (in)	20.8 - 21.2 (0.8189 - 0.8346)
Outer diameter at the bottom of spring	mm (in)	25.5 - 25.9 (1.0039 - 1.0197)
Inner diameter at the top of spring	mm (in)	13.9 - 14.3 (0.5472 - 0.5630)
Inner diameter at the bottom of spring	mm (in)	18.6 - 19.0 (0.7323 - 0.7480)

Cylinder Block

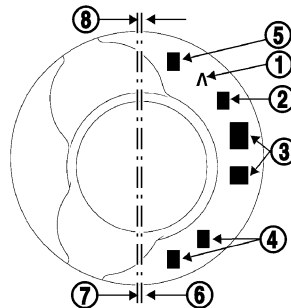
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CYLINDER BLOCK

Unit: mm (in)

Items	Standard
Cylinder block top surface clearance	Less than 0.05 (0.002)

PISTON MARKING



MBIB0337E

1	Direction of fitting of the piston mark towards the flywheel
2	Height between the piston pin and the top of the piston (see table below).

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

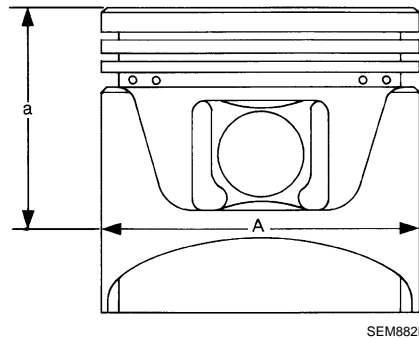
[K9K]

3	Used by the supplier only
4	Used by the supplier only
5	Used by the supplier only
6	Piston axis of symmetry
7	Piston pin hole axis
8	Offset between the hole axis (7) and the piston's axis of symmetry (6) is 0.3 mm (0.012 in)

PISTON

Unit: mm (in)

Items	Standard
Piston skirt diameter "A" mm (in)	75.938 - 75.952 (2.9897 - 2.9902)
"a" dimension mm (in)	56.0 (2.205)
Piston pin hole diameter mm (in)	Category J 41.605 - 41.646 (1.6380 - 1.6396)
	Category K 41.647 - 41.688 (1.6396 - 1.6413)
	Category L 41.689 - 41.730 (1.6413 - 1.6429)
	Category M 41.731 - 41.772 (1.6429 - 1.6446)
	Category N 41.773 - 41.814 (1.6446 - 1.6462)
Capacity of combustion chamber m ℓ (Imp fl oz)	19.89 - 20.39 (0.78 - 0.80)
Piston protrusion mm (in)	0.023 - 0.281 (0.009 - 0.011)



PISTON RING

Unit: mm (in)

Items	Standard
Thickness	Top 1.97 - 1.99 (0.0776 - 0.0783)
	2nd 1.97 - 1.99 (0.0776 - 0.0783)
	Oil ring 2.47 - 2.49 (0.0972 - 0.0980)
Side clearance	Top 0.10 - 0.12 (0.0039 - 0.0047)
	2nd 0.08 - 0.10 (0.0031 - 0.0039)
	Oil ring 0.03 - 0.07 (0.0011 - 0.0027)
Piston ring end gap	Top 0.20 - 0.35 (0.0079 - 0.0138)
	2nd 0.70 - 0.90 (0.0276 - 0.0354)
	Oil ring 0.25 - 0.50 (0.0098 - 0.0197)

PISTON PIN

Unit: mm (in)

Items	Standard
Length	57.97 - 60.0 (2.282 - 2.362)
Piston pin outer diameter	25.995 - 26.000 (1.0234 - 1.0236)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[K9K]

CONNECTING ROD

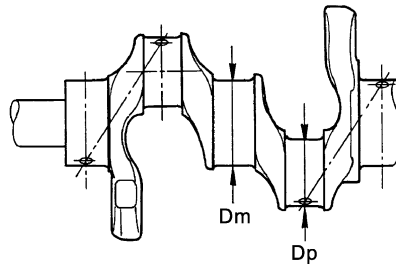
Unit: mm (in)

Items	Standard
Center distance	133.75 (5.266)
Connecting rod small end diameter (with bush)	26.013 - 26.025 (1.0241 - 1.0246)
Connecting rod big end diameter	47.610 - 47.627 (1.8744 - 1.8751)
Big end longitudinal play	0.205 - 0.467 (0.0081 - 0.0184)
Big end radial play	0.016 - 0.07 (0.0006 - 0.0027)

CRANKSHAFT

Unit: mm (in)

Items	Standard
Main journal diameter "Dm"	47.99 - 48.01 (1.8894 - 1.8902)
Pin journal diameter "Dp"	43.96 - 43.98 (1.7307 - 1.7315)
Maximum run-out allowed on the flywheel bearing face of the flywheel	0.6 (0.024)
Lateral play (without lateral shim)	0.045 - 0.252 (0.0018 - 0.0099)
Lateral play (with lateral shim)	0.045 - 0.852 (0.0018 - 0.0335)
Journal radial play	0.010 - 0.054 (0.0004 - 0.0021)



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Turbocharger

INFOID:0000000010282112

Items	Standard
Regulation value operating vacuum	kPa (bar, kg/cm ² , psi) 40 (0.4, 0.4, 5.8)
Valve rod moving length	mm (in) 1.4 (0.055)

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:000000010281953

A

EM

C

D

E

F

G

H

I

J

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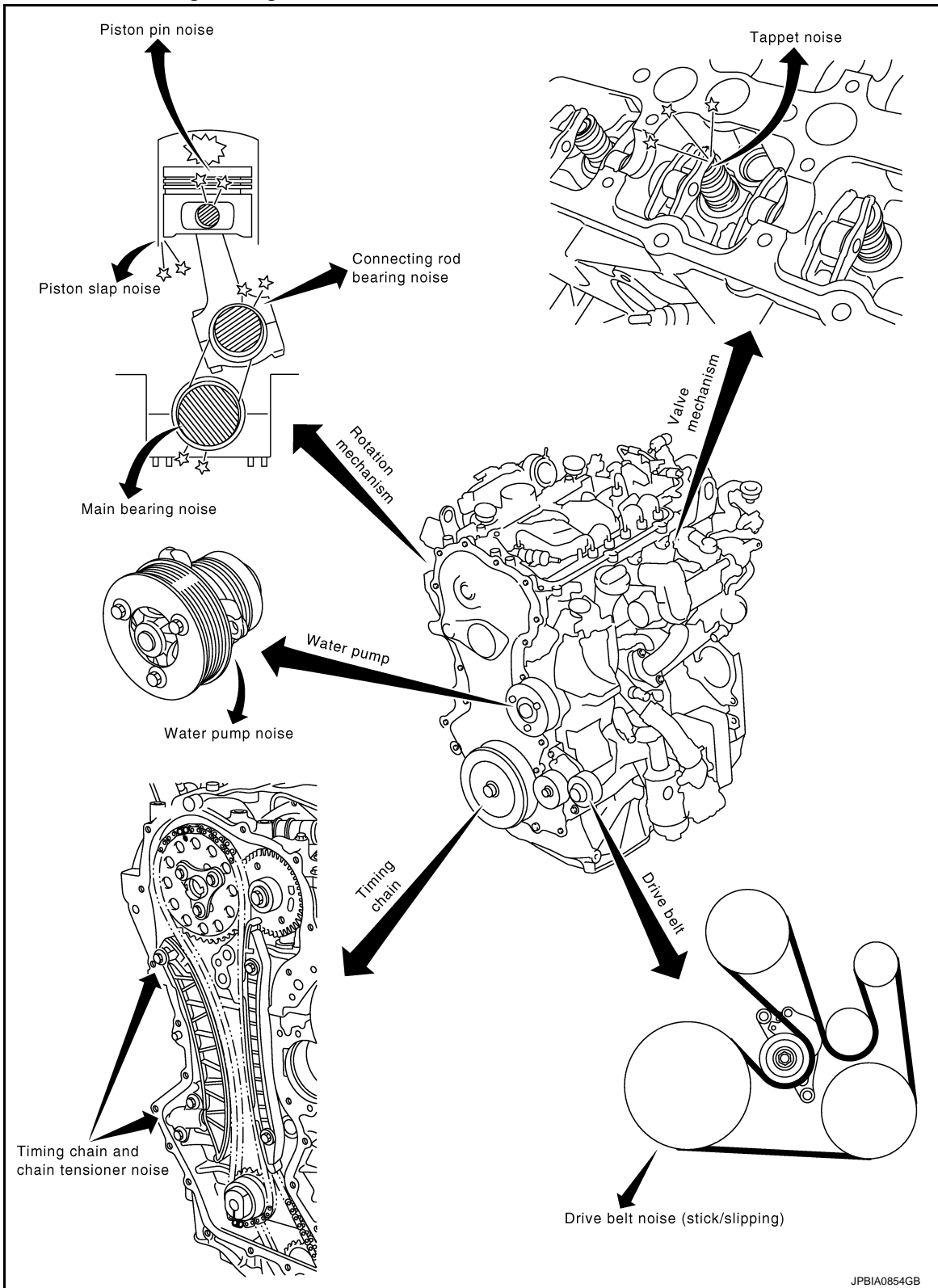
L

M

N

O

P



NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[R9M]

Use the Chart Below to Help You Find the Cause of the Symptom

INFOID:000000010281954

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Cylinder head	Ticking or clicking	A	C	—	B	B	—	Hydraulic tappet noise	Out of oil	EM-404
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance	EM-421
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-459
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring side clearance Piston ring end gap	EM-459
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-459
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance	EM-459
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-418
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-378
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-100, "Exploded View"

A: Closely related B: Related C: Sometimes related —: Not related

PRECAUTION

PRECAUTIONS

Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:000000010499455

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

WARNING:

Always observe the following items for preventing accidental activation.

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision that would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see "SRS AIR BAG".
- Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

Always observe the following items for preventing accidental activation.

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

Precautions for Removing Battery Terminal

INFOID:000000010508841

- With the adoption of Auto ACC function, ACC power is automatically supplied by operating the intelligent key or remote keyless entry or by opening/closing the driver side door. In addition, ACC power is supplied even after the ignition switch is turned to the OFF position, i.e. ACC power is supplied for a certain fixed time.
- When disconnecting the 12V battery terminal, turn off the ACC power before disconnecting the 12V battery terminal, observing "How to disconnect 12V battery terminal" described below.

NOTE:

Some ECUs operate for a certain fixed time even after ignition switch is turned OFF and ignition power supply is stopped. If the battery terminal is disconnected before ECU stops, accidental DTC detection or ECU data damage may occur.

- For vehicles with the 2-batteries, be sure to connect the main battery and the sub battery before turning ON the ignition switch.

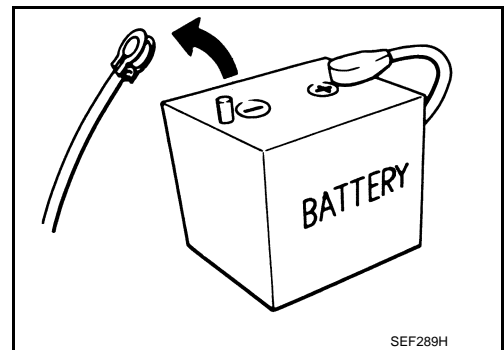
NOTE:

If the ignition switch is turned ON with any one of the terminals of main battery and sub battery disconnected, then DTC may be detected.

- After installing the 12V battery, always check "Self Diagnosis Result" of all ECUs and erase DTC.

NOTE:

The removal of 12V battery may cause a DTC detection error.



HOW TO DISCONNECT 12V BATTERY TERMINAL

Disconnect 12V battery terminal according to Instruction 1 or Instruction 2 described below. For vehicles parked by ignition switch OFF, refer to Instruction 2.

INSTRUCTION 1

1. Open the hood.

PRECAUTIONS

[R9M]

< PRECAUTION >

2. Turn key switch to the OFF position with the driver side door opened.
3. Get out of the vehicle and close the driver side door.
4. Wait at least 3 minutes. For vehicle with the engine listed below, remove the battery terminal after a lapse of the specified time.

D4D engine	: 20 minutes
HRA2DDT	: 12 minutes
K9K engine	: 4 minutes
M9R engine	: 4 minutes
R9M engine	: 4 minutes
V9X engine	: 4 minutes

CAUTION:

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

5. Remove 12V battery terminal.

CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

INSTRUCTION 2 (FOR VEHICLES PARKED BY IGNITION SWITCH OFF)

1. Unlock the door with intelligent key or remote keyless entry.

NOTE:

At this moment, ACC power is supplied.

2. Open the driver side door.
3. Open the hood.
4. Close the driver side door.
5. Wait at least 3 minutes.

CAUTION:

While waiting, never operate the vehicle such as locking, opening, and closing doors. Violation of this caution results in the activation of ACC power supply according to the Auto ACC function.

6. Remove 12V battery terminal.

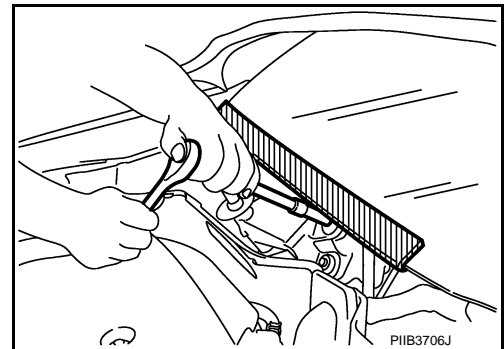
CAUTION:

After installing 12V battery, always check self-diagnosis results of all ECUs and erase DTC.

Precaution for Procedure without Cowl Top Cover

INFOID:000000010499453

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc to prevent damage to windshield.



Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000010281956

CAUTION:

Comply with the following cautions to prevent any error and malfunction.

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition switch in the LOCK position.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

PRECAUTIONS

[R9M]

< PRECAUTION >

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.

NOTE:

Supply power using jumper cables if battery is discharged.

2. Use the Intelligent Key or mechanical key to turn the ignition switch to the ACC position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.
5. When the repair work is completed, return the ignition switch to the LOCK position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT.

Parts Requiring Angular Tightening

INFOID:000000010281957

- Use an angle wrench for the final tightening of the following engine parts.
 - Cylinder head bolts
 - Main bearing cap bolts
 - Timing sprocket bolts
 - Crankshaft pulley bolt
 - Wear compensation gear bolt
 - Camshaft sprocket (for fuel pump) bolt
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Precaution for Liquid Gasket

INFOID:000000010281958

REMOVAL OF LIQUID GASKET

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST:KV10111100 (—)] (A) and remove old liquid gasket sealing.

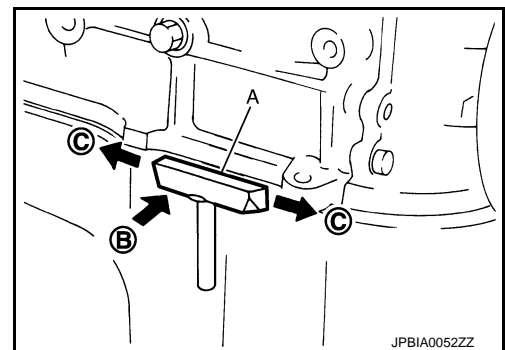
CAUTION:

Be careful not to damage the mating surfaces.

- Tap the seal cutter to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter is difficult to use, use a plastic hammer to lightly tap the parts, to remove it.

CAUTION:

If for some unavoidable reason a tool such as a flat-bladed screwdriver is used, be careful not to damage the mating surfaces.



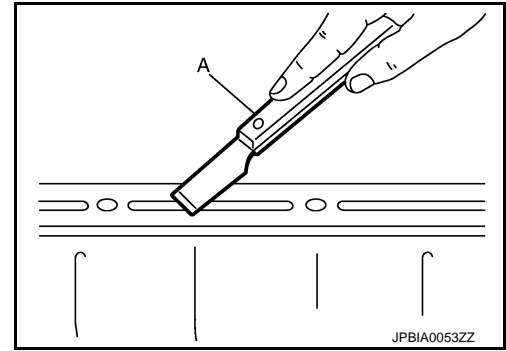
LIQUID GASKET APPLICATION PROCEDURE

PRECAUTIONS

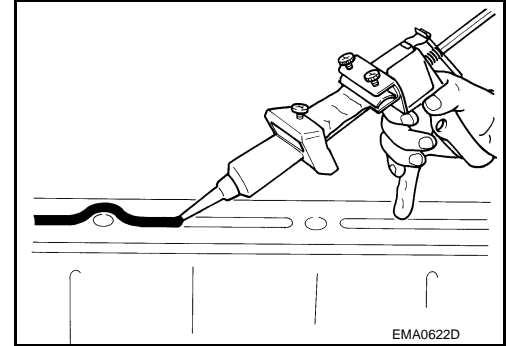
[R9M]

< PRECAUTION >

1. Using a scraper (A), remove the old liquid gasket adhering to the gasket application surface and the mating surface.
 - Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts and bolt holes.
2. Wipe the gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



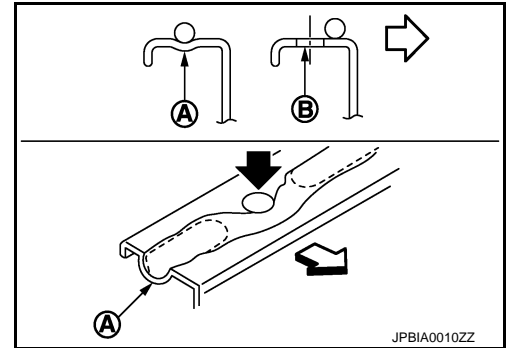
3. Attach the liquid gasket to the tube presser (commercial service tool).
Use Genuine Liquid Gasket or equivalent.
4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.
 - If there is a groove for the liquid gasket application, apply the gasket to the groove.



- As for the bolt holes, normally apply the gasket inside the holes. If specified, it should be applied outside the holes. Check to read the instruction in this manual.

A : Groove
B : Bolt hole
⇐ : Inside

- Within five minutes of gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten after the installation.
- After 30 minutes or more have passed from the installation, fill the engine oil and coolant.



CAUTION:

If there are instructions in this manual, observe them.

Precaution for Diesel Equipment

INFOID:000000010281959

CLEANLINESS

CLEANLINESS INSTRUCTIONS WHICH MUST BE FOLLOWED WHEN WORKING ON THE HIGH PRESSURE DIRECT INJECTION SYSTEM

Risks relating to contamination

The system is very sensitive to contamination. The risks caused by the introduction of contamination are:

- Damage or destruction of the high pressure injection system and the engine
- Seizing or leaking of a component

All After-Sales operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) get into the system during dismantling or into the circuits via the fuel unions.

The cleanliness principle must be applied from the fuel filter to the fuel injectors.

WHAT ARE THE SOURCES OF CONTAMINATION?

Contamination is caused by:

- Metal or plastic chips
- Paint
- Fibers:
- Boxes
- Brushes

PRECAUTIONS

[R9M]

< PRECAUTION >

- Paper
- Clothing
- Cloths
- Foreign bodies such as hair
- Ambient air
- Etc.

WARNING:

It is not possible to clean the engine using a high pressure washer because of the risk of damaging connections. In addition, moisture may collect in the connectors and create electrical connection malfunctions

INSTRUCTIONS TO BE FOLLOWED BEFORE ANY WORK IS CARRIED OUT ON THE INJECTION SYSTEM

- Check that you have the plugs for the unions to be opened (bag of plugs sold at the Parts Stores). Plugs are to be used once only. After use, they must be thrown away (once used they are soiled and cleaning is not sufficient to make them reusable). Unused plugs must be thrown away.
- Check that you have hermetically resealable plastic bags for storing removed parts. Stored parts will therefore be less subject to the risk of impurities. The bags must be used only once, and after use they must be thrown away.
- Lint-free towelettes to be used for fuel pump related service purpose. The use of a normal cloth or paper for cleaning purposes is forbidden. These are not lint-free and may contaminate the fuel circuit of the system. Each lint-free cloth should only be used once.

INSTRUCTIONS TO BE FOLLOWED BEFORE OPENING THE FUEL CIRCUIT

- For each operation, use new thinner (used thinner contains impurities). Pour it into a clean receptacle.
- For each operation, use a clean brush which is in good condition (the brush must not shed its bristles).
- Use a brush and thinners to clean the connections to be opened.
- Blow compressed air over the cleaned parts (tools, cleaned the same way as the parts, connections and injection system zone). Check that no bristles remain adhered.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover these with latex gloves.

INSTRUCTIONS TO BE FOLLOWED DURING THE OPERATION

- As soon as the circuit is open, all openings must be plugged to prevent impurities from entering the system. The plugs to be used are available from the Parts Stores. They must not, under any circumstances, be reused.
- Close the hermetically sealed bag, even if it has to be reopened shortly afterwards. Ambient air carries contamination.
- All components of the injection system that are removed must be stored in a hermetically sealed plastic bag once the plugs have been inserted.
- The use of a brush, thinner, bellows, sponge or normal cloth is strictly forbidden once the circuit has been opened. These items are likely to allow impurities to enter the system.
- A new component replacing an old one must not be removed from its packaging until it is to be fitted to the vehicle.

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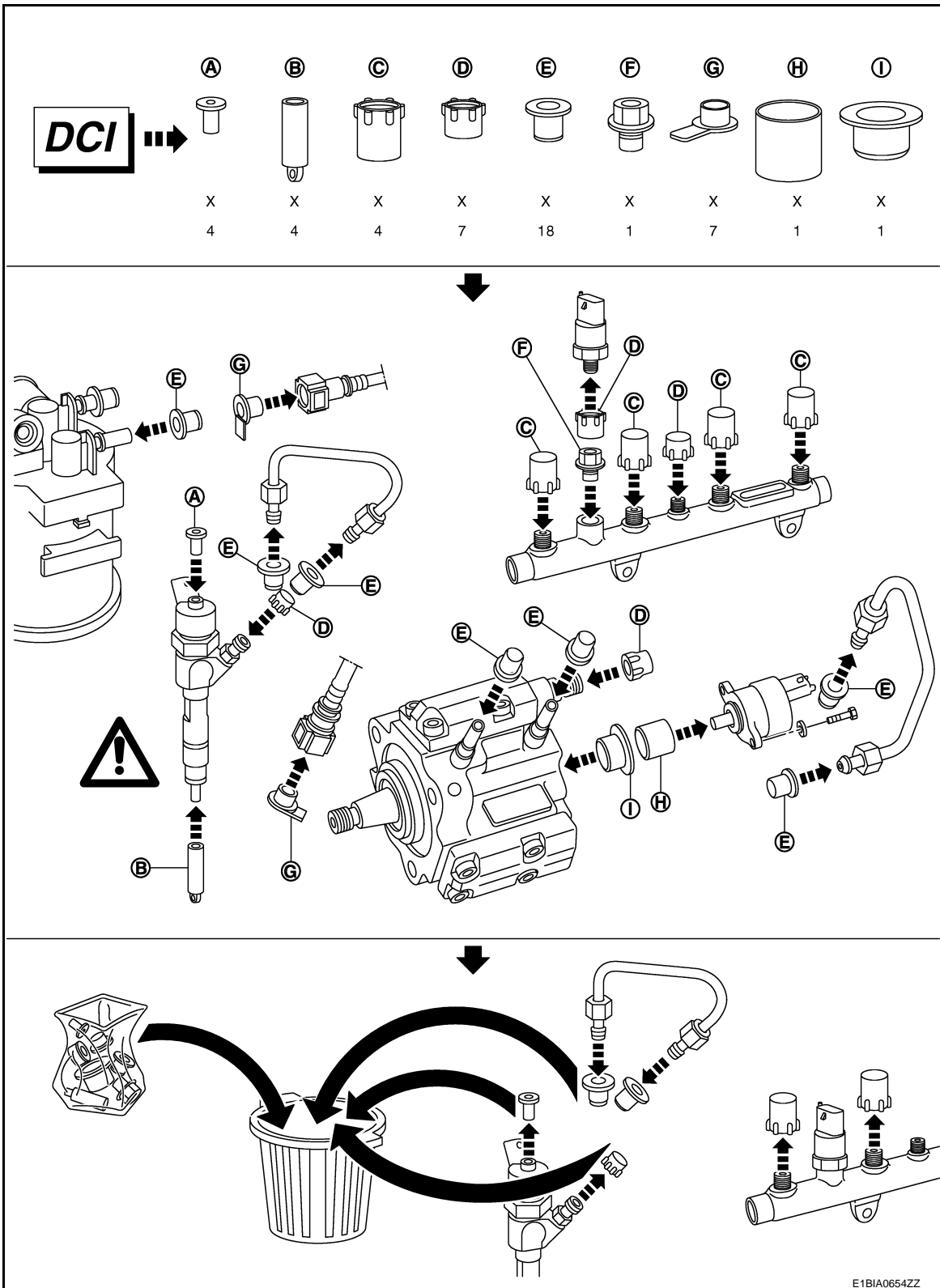
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PRECAUTIONS

< PRECAUTION >

[R9M]



SPECIAL FEATURES

CAUTION:

- The engine must not operate with:
 - Diesel fuel other than those required by the regulations for cetane number. Refer to [FL-43, "General Precautions"](#).
 - Petrol, even in tiny quantities

PRECAUTIONS

[R9M]

< PRECAUTION >

- Before carrying out any work, check that the fuel rail is not under pressure and that the fuel temperature is not too high. [The system can inject the diesel into the engine at a pressure up to 160,000 kPa (1,600 bar, 1,632 kg/cm², 23,200 psi)].
- Respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.
- Remove of the interior of the fuel pump and fuel injectors is prohibited.
- For safety reasons, it is strictly forbidden to slacken an injection tube union when the engine is running.
- It is not possible to remove the fuel pressure sensor from the fuel rail because this may cause circuit contamination malfunctions. If the fuel pressure sensor fails, the fuel pressure sensor, the fuel rail and the fuel injection tubes must be replaced.
- It is strictly forbidden to remove the fuel pump pulley.
- Applying 12 volts directly to any component in the system is prohibited.
- Ultrasonic carbon removal and cleaning are prohibited.
- Never start the engine without the battery being connected correctly.

CHECKING SEALING AFTER REPAIR

CAUTION:

After any operation, check that there is no diesel leakage.

- Start the engine and check for fuel leak for one minute after starting.
- Apply tracing fluid around the high pressure connections of the pipe that has been replaced.
- Once the engine coolant temperature is above 50°C (122F) and provided there are no malfunctions present, carry out a road test, taking the engine speed up to 4,000 rpm at least once to check that there is no leakage.
- Perform a visual inspection after the road test to check that there is no high pressure leakage.
- Clean off the tracing fluid.

Precautions For Engine Service

INFOID:0000000010281960

DISCONNECTING FUEL PIPING

- Before starting work, check no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

DRAINING ENGINE COOLANT

Drain engine coolant and engine oil when the engine is cooled.

INSPECTION, REPAIR AND REPLACEMENT

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

REMOVAL AND DISASSEMBLY

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Must cover openings of engine system with a tape or equivalent, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

ASSEMBLY AND INSTALLATION

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.

PRECAUTIONS

[R9M]

< PRECAUTION >

- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- After disassembling, or exposing any internal engine parts, change engine oil and replace oil filter with a new one.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

PREPARATION

< PREPARATION >

[R9M]

PREPARATION

PREPARATION

Special Service Tools

INFOID:0000000010281961

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NISSAN tool number (RENAULT tool No.) Tool name	Description
— (Mot. 1979) Piston ring compressor	Installing piston assembly into cylinder bore
KV10111100 (—) Seal cutter	Removing oil pan and front cover, etc
KV10112100 (—) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
KV10114400 (—) Heated oxygen sensor wrench	Loosening or tightening air fuel ratio sensor a: 22 mm (0.87 in)
— (Mot. 1970) TDC set pin	To lock engine at TDC
— (Mot. 1969) Camshaft timing tool	To lock camshaft when changing timing chain

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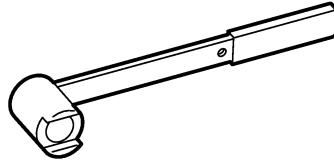
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PREPARATION

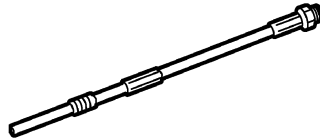
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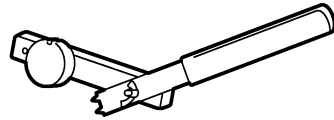
NISSAN tool number (RENAULT tool No.) Tool name	Description
— (Mot. 1770) Crankshaft pulley locking tool	To lock crankshaft pulley
— (Mot. 1772) Compression gauge adapter	Connecting compression gauge and glow plug hole
— (Mot. 1773) Positioning tool	To position the gear and apply for the right clearance (wear compensation gear)
— (Mot. 1959) TORX Socket	Removing and installing drive plate or flywheel Size: T55+
— (Mot. 1972) Piston cooler fitting tool	Installing piston cooling jet cooler (9.5 degree orientation)
— (Mot. 1485-01) Piston cooler removing tool	Removing piston cooling jet cooler
— (Mot. 1431) Flywheel locking tool	To lock flywheel
— (Emb. 880) Piston cooler fitting tool	Pin extractor tool



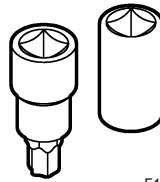
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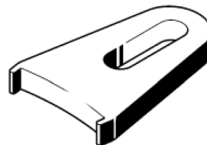
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Commercial Service Tools

INFOID:000000010281962

PREPARATION

< PREPARATION >

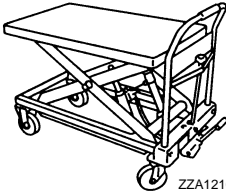
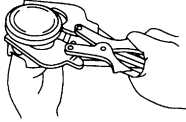
[R9M]

NISSAN tool number (RENAULT tool No.) Tool name	Description	A
KV113B0040 (Mot. 251-01) Dial indicator stand set	Gauge stand used with KV113B0050 (Mot. 252-01)	EM
KV113B0050 (Mot. 252-01) Dial indicator stand set	Thrust plate for measuring the protrusion of piston used with KV113B0040 (Mot. 251-01)	C D E F
KV113B0090 (Mot. 1335) Valve seal remover	Tool for removing valve oil seals	G H
KV113B0180 (Mot. 1511-01) Valve seal drift	Tool for installing valve oil seals	I J K
KV113B0200 (Mot. 1573) Cylinder head stand	Cylinder head and cylinder head housing support	L M
Tube presser	Pressing the tube of liquid gasket	N O
Valve spring compressor	Disassembling valve mechanism	P

PREPARATION

< PREPARATION >

[R9M]

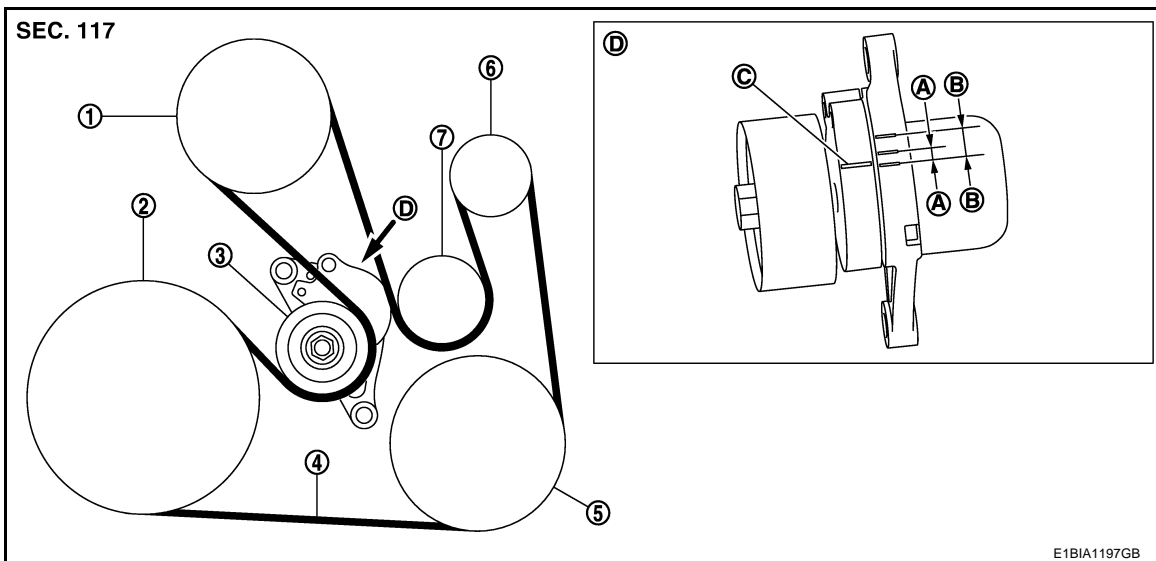
NISSAN tool number (RENAULT tool No.) Tool name	Description
Manual lift table caddy  ZZA1210D	Removing and installing engine
Piston ring expander  NT030	Removing and installing piston ring

PERIODIC MAINTENANCE

DRIVE BELT

Exploded View

INFOID:0000000010281963



- | | | |
|---|-----------------------------------|------------------------------|
| 1. Water pump | 2. Crankshaft pulley | 3. Drive belt auto-tensioner |
| 4. Drive belt | 5. A/C compressor or Idler roller | 6. Alternator |
| 7. Idler pulley | | |
| A. Range when new drive belt is installed | B. Possible use range | C. Indicator |
| D. View | | |

Checking

INFOID:0000000010281964

WARNING:

Be sure to perform this step when the engine is stopped.

- Check that the indicator (C) (notch on fixed side) of drive belt auto-tensioner is within the possible use range (B).

NOTE:

- Check the drive belt auto-tensioner indication when the engine is cold.
- When new drive belt is installed, the indicator (notch on fixed side) should be within the range (A) in the figure.
- Visually check entire drive belt for wear, damage or cracks.
- If the indicator (notch on fixed side) is out of the possible use range or belt is damaged, replace drive belt.

CAUTION:

Drive belt auto-tensioner and idler pulley must be replaced with new ones when the drive belt is replaced.

Tension Adjustment

INFOID:0000000010281965

Refer to [EM-274, "Adjustment"](#).

Removal and Installation

INFOID:0000000010281966

CAUTION:

- Replace the drive belt that has been removed with a new one.
- Drive belt auto-tensioner and idler pulley must be replaced with new ones when the drive belt is replaced.
- Never run the engine without the drive belt to avoid damaging the crankshaft pulley.

REMOVAL

1. Remove front fender protector (RH). Refer to [EXT-31, "Exploded View"](#).

DRIVE BELT

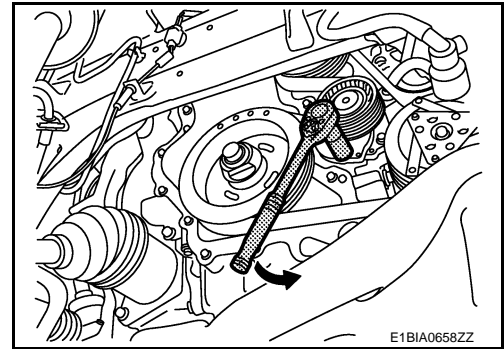
< PERIODIC MAINTENANCE >

[R9M]

2. Hold the hexagonal part of drive belt auto-tensioner pulley with a hexagonal socket (A) securely. Then move the wrench handle in the direction of arrow (loosening direction of tensioner).

CAUTION:

Never place hand in a location where pinching may occur if the holding tool accidentally comes off.

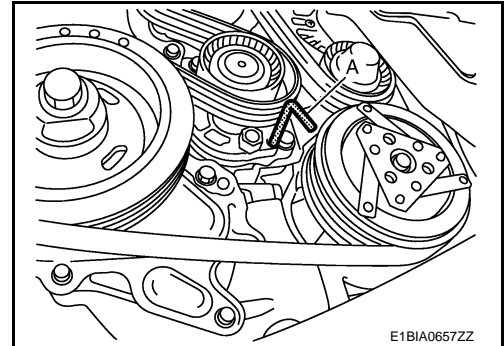


3. Insert a stopper pin (A) in diameter such as short-length screw-driver into the hole of the retaining boss to fix drive belt auto-tensioner pulley.

- Keep drive belt auto-tensioner pulley arm locked after drive belt is removed.

NOTE:

Use approximately 3.0 mm (0.118 in) dia. hard metal pin as a stopper pin.



4. Remove drive belt.

INSTALLATION

1. Install drive belt.

CAUTION:

- Check that drive belt is completely set to pulleys.
- Check for engine oil, working fluid and engine coolant are not adhered to drive belt and each pulley groove.

2. Release drive belt auto-tensioner, and apply tension to drive belt.
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Check that the indicator (notch on fixed side) of drive belt auto-tensioner is within the range when new drive belt is installed. Refer to [EM-373. "Checking"](#).

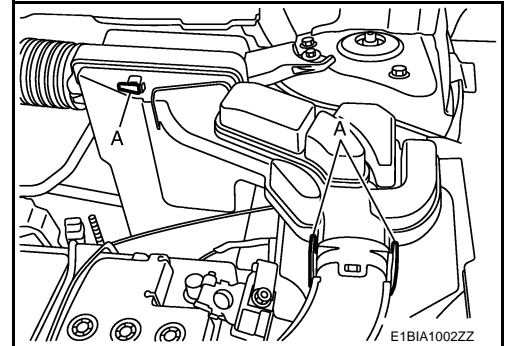
AIR CLEANER FILTER

Removal and Installation

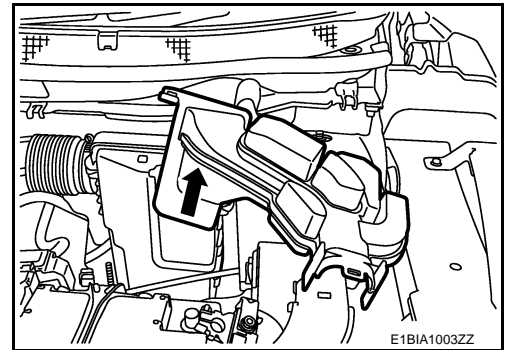
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REMOVAL

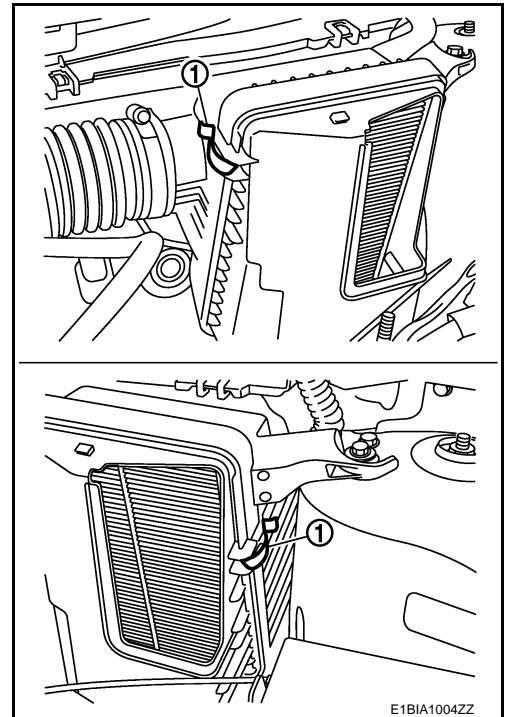
1. Press the points (A) to separate air resonator from air duct and air cleaner filter unit.



2. Remove air resonator following the arrow.



3. Unhook clips (1) on the air cleaner filter holder.



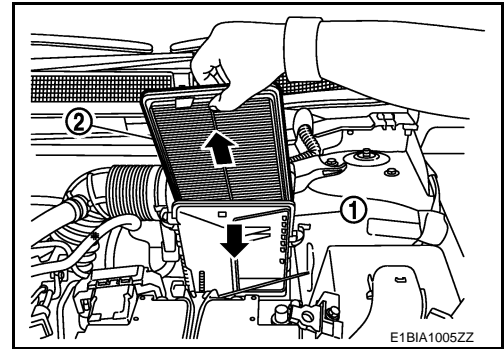
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AIR CLEANER FILTER

[R9M]

< PERIODIC MAINTENANCE >

4. Separate air cleaner filter holder (1) from air cleaner filter unit and remove air cleaner filter (2).



INSTALLATION

Install in the reverse order of removal.

DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

< REMOVAL AND INSTALLATION >

[R9M]

REMOVAL AND INSTALLATION

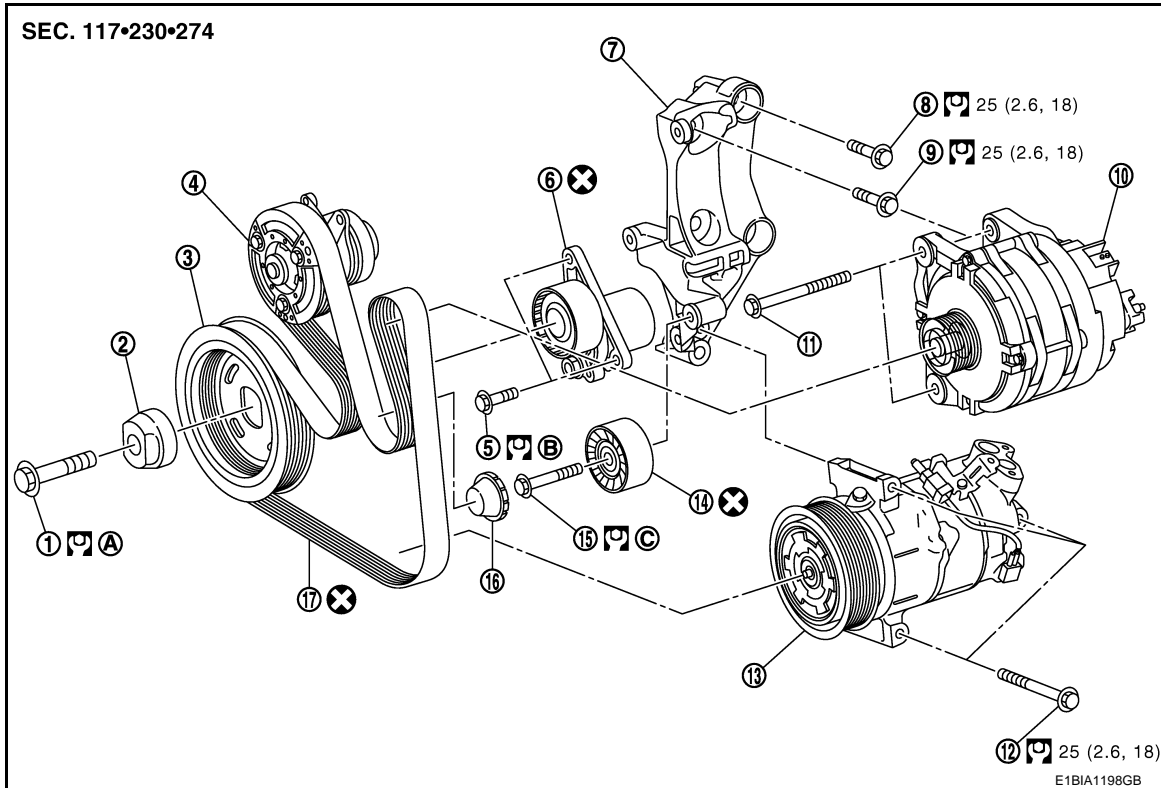
DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

Exploded View

INFOID:000000010281969

EM

With A/C



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|----------------------------------|---------------------------------------|---------------------------------------|
| 1. Crankshaft pulley bolt | 2. Crankshaft spacer | 3. Crankshaft pulley |
| 4. Water pump | 5. Drive belt auto-tensioner bolt | 6. Drive belt auto-tensioner |
| 7. Multifunction support bracket | 8. Multifunction support bracket bolt | 9. Multifunction support bracket bolt |
| 10. Alternator | 11. Alternator bolt | 12. A/C compressor bolt |
| 13. Compressor | 14. Idler pulley | 15. Idler pulley bolt |
| 16. Idler pulley cap | 17. Drive belt | |
- A. Refer to [EM-413, "Removal and Installation"](#) B. Refer to [EM-378, "Removal and Installation"](#) C. Refer to [EM-378, "Removal and Installation"](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

Without A/C

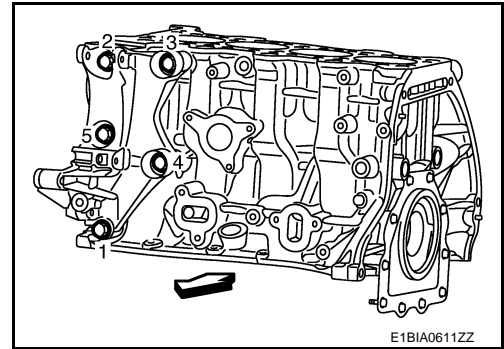
DRIVE BELT AUTO TENSIONER AND IDLER PULLEY

[R9M]

< REMOVAL AND INSTALLATION >

- Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front



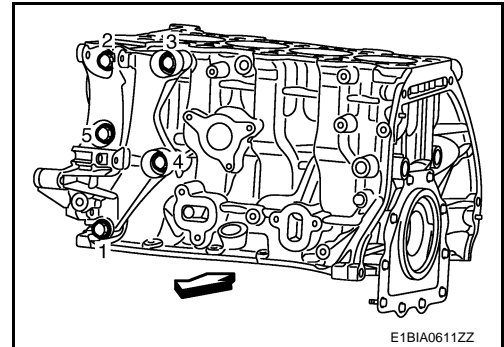
INSTALLATION

Note the following, and install in the reverse order of removal.

Multifunction support bracket

- Tighten mounting bolts in numerical order as shown in the figure.

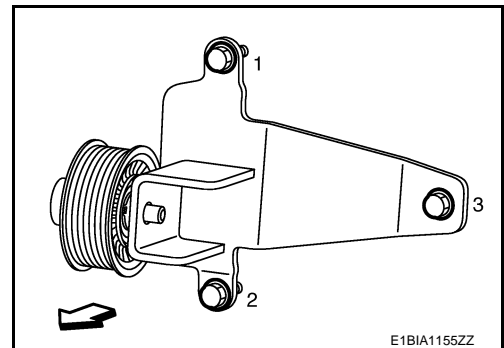
← : Engine front



Idler roller bracket (without A/C Models)

- Tighten mounting bolts in numerical order as shown in the figure.

← : Engine front



Idler pulley bolt

- Tighten drive belt idler pulley bolt.

Drive belt idler pulley bolt 44 Nm (4.5kg-m, 32ft-lb)

Auto-tensioner bolts

- Tighten drive belt auto-tensioner bolts.

Drive belt auto-tensioner bolts 25 Nm (2.6kg-m, 18ft-lb)

Idler roller bolt (without A/C Models)

- Tighten drive belt idler roller bolt (without A/C Models).

Drive belt idler roller bolt 45 Nm (4.7kg-m, 34ft-lb)

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AIR CLEANER AND AIR DUCT

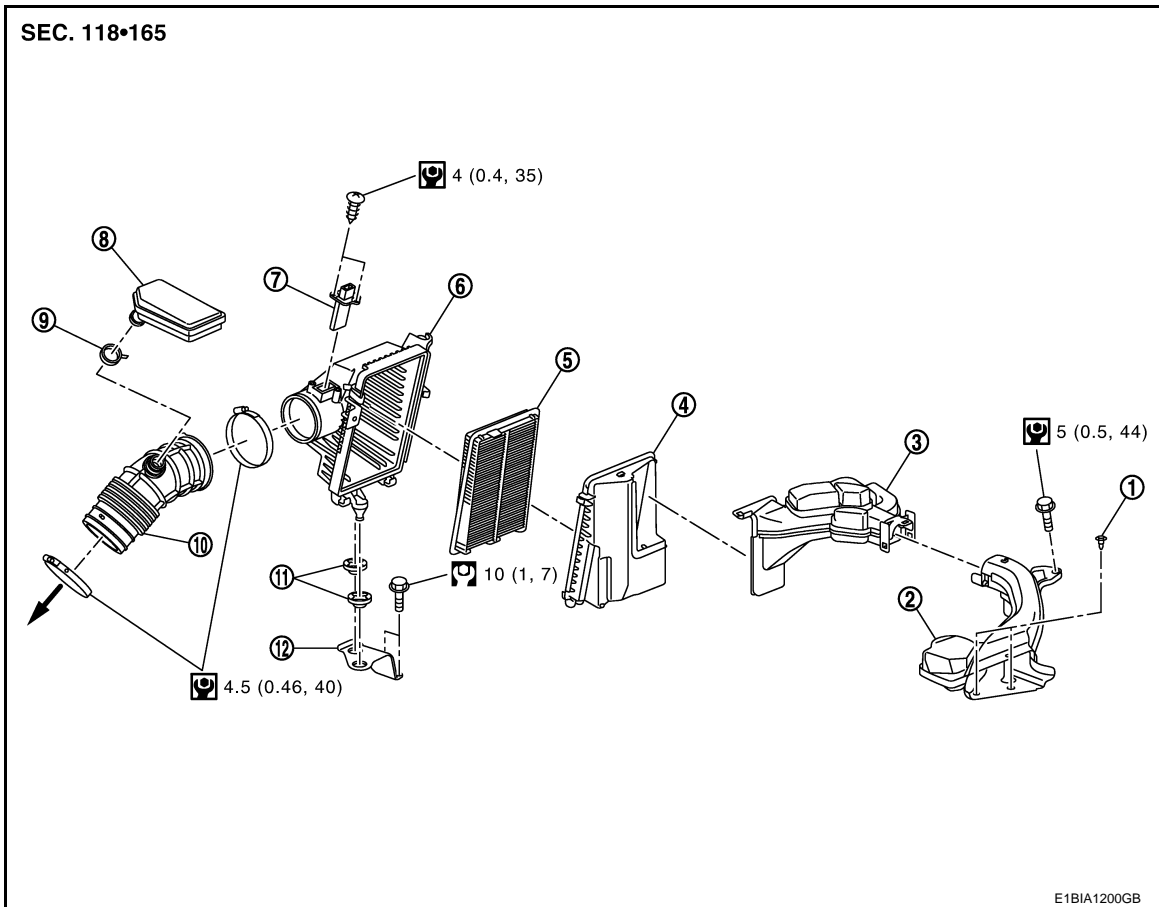
< REMOVAL AND INSTALLATION >

[R9M]

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:000000010281971



- | | | |
|-------------------------|--------------------------|-------------------------------------|
| 1. Clip | 2. Air duct (inlet side) | 3. Air duct (air cleaner side) |
| 4. Holder | 5. Air filter element | 6. Air cleaner filter unit |
| 7. Mass air flow sensor | 8. Resonator | 9. Clamp |
| 10. Air hose | 11. Mounting rubber | 12. Air cleaner filter unit bracket |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010499449

REMOVAL

1. Remove air duct (air cleaner side).
2. Remove air duct (inlet side).
3. Disconnect mass air flow sensor.
4. Disconnect air hose from air cleaner filter unit.
5. Remove air cleaner filter unit.
6. Remove air hose.
7. Remove air filter element if necessary.

INSTALLATION

- Install in the reverse order of removal.

Inspection

INFOID:000000010281973

INSPECTION AFTER REMOVAL

AIR CLEANER AND AIR DUCT

< REMOVAL AND INSTALLATION >

[R9M]

Inspect air ducts, air cleaner and hose for crack or tear.

- If anything found, replace air duct assembly.

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CHARGE AIR COOLER

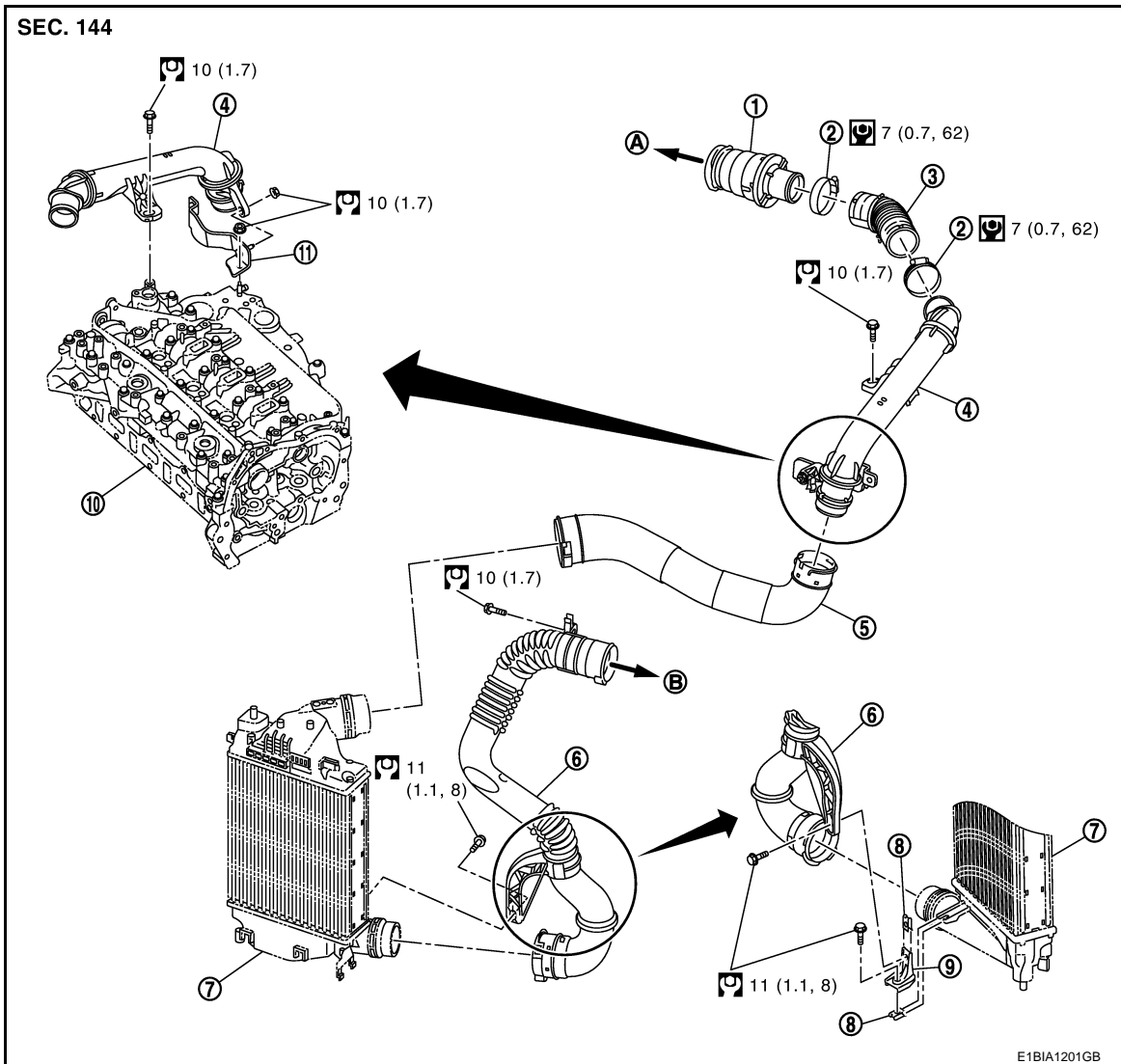
[R9M]

< REMOVAL AND INSTALLATION >

CHARGE AIR COOLER

Exploded View

INFOID:000000010281974



- | | | |
|----------------------------------|------------------------------|-----------------------------|
| 1. Silencer | 2. Air inlet hose 1 | 3. Clamp Air inlet hose 2 |
| 4. Air inlet tube 1 | 5. Air inlet hose 2 | 6. Air inlet tube 2 |
| 7. Charge air cooler | 8. Metal clip | 9. Air inlet tube 2 bracket |
| 10. Cylinder head air inlet pipe | 11. Air inlet tube 1 bracket | |
| A. To turbocharger | B. To throttle chamber | |

Refer to [GI-4. "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010499450

REMOVAL

Air inlet hose and tube.

1. Remove engine cover.
2. Remove air inlet hose and tube. Refer to [EM-281. "Exploded View"](#).

Charge air cooler.

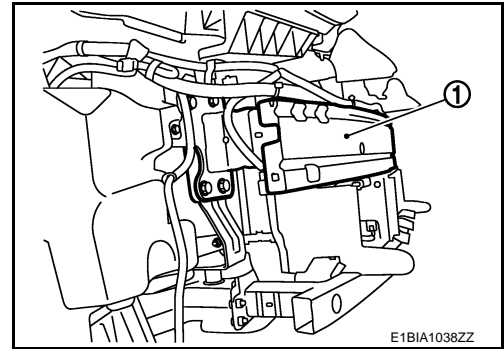
1. Remove front bumper. Refer to [EXT-19. "Exploded View"](#).

CHARGE AIR COOLER

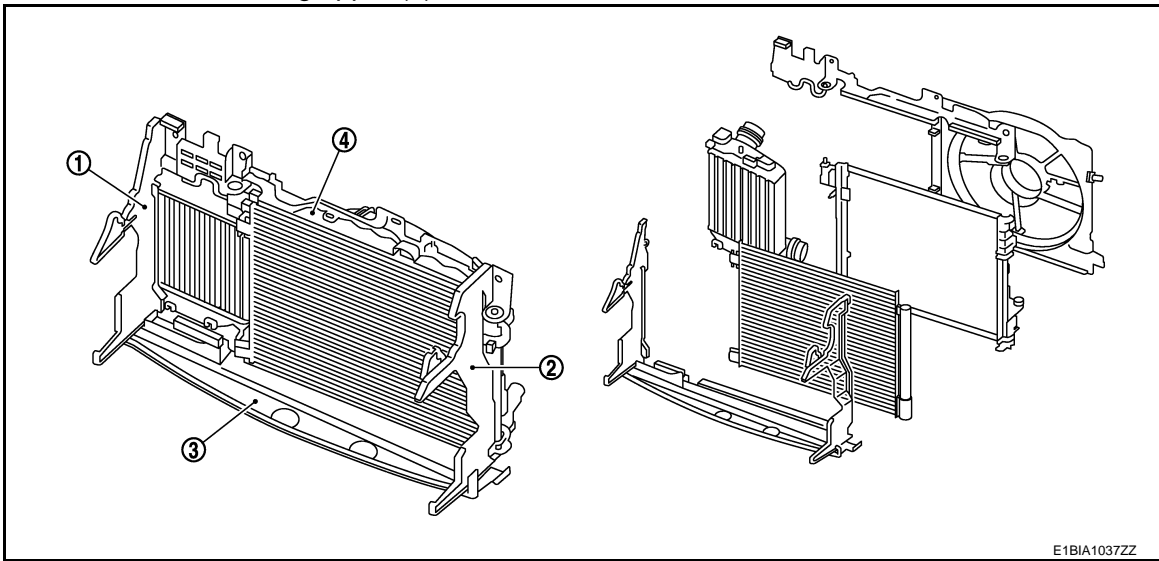
[R9M]

< REMOVAL AND INSTALLATION >

- Put aside front bumper reinforcement (1) with harness assembly.



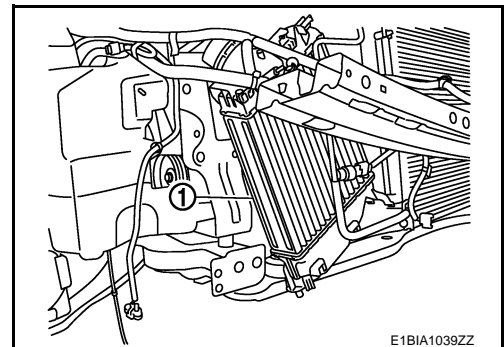
- Remove:
 - Radiator air guide RH (1).
 - Radiator air guide LH (2).
 - Radiator air guide lower (3).
 - Radiator bracket mounting upper (4)



- Put aside radiator core support upper. Refer to [DLK-155, "HRA2DDT : Removal and Installation"](#) (Type 1), [DLK-338, "R9M : Removal and Installation"](#) (Type 2), [DLK-469, "R9M : Removal and Installation"](#) (Type 3), [DLK-607, "R9M : Removal and Installation"](#) (Type 4), [DLK-787, "R9M : Removal and Installation"](#) (Type 5), [DLK-928, "R9M : Removal and Installation"](#) (Type 6),
- Unhook and rotate charge air cooler (1).
- Remove charge air cooler.

CAUTION:

- Avoid interference between the charge air cooler and radiator.
- When removing charge air cooler, close opening on turbo charger and intake manifold with shop cloth or other suitable material.



INSTALLATION

Install in the reverse order of removal paying attention to the following points:

- Apply a neutral detergent (fluid) to the joint between hoses and pipes (oil is not permissible).
- Pay attention to identification mark and direction.
- When installing air inlet hoses and tubes. Refer to [EM-281, "Exploded View"](#).

Inspection

INSPECTION AFTER REMOVAL

CHARGE AIR COOLER

< REMOVAL AND INSTALLATION >

[R9M]

1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler if necessary.
 - Do not deform core fins.
 - For cleaning procedure of charge air cooler core, refer to [EM-283, "Inspection"](#).

EGR SYSTEM

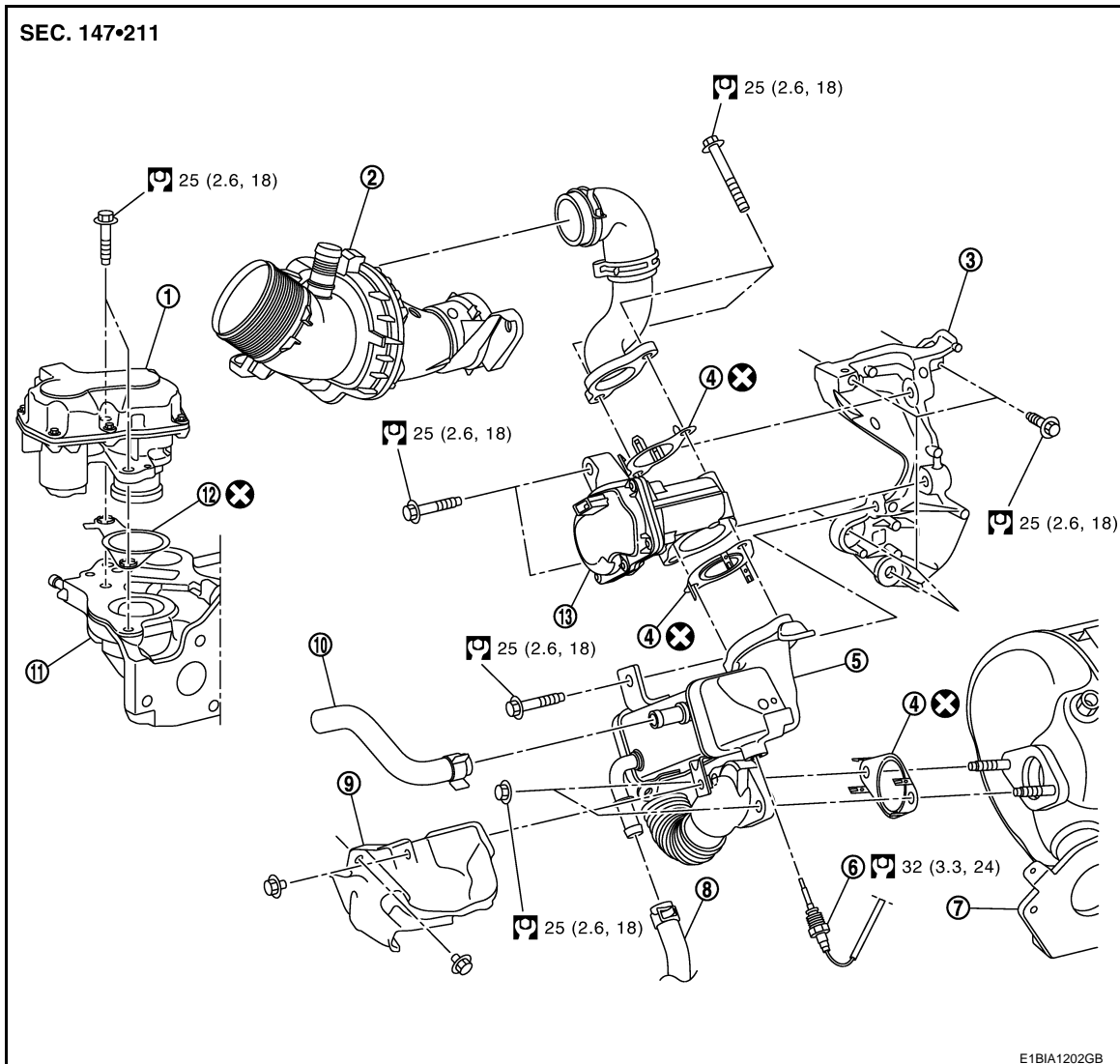
< REMOVAL AND INSTALLATION >

[R9M]

EGR SYSTEM

Exploded View

INFOID:000000010281977



- | | | |
|---|--------------------------------|---|
| 1. EGR volume control valve | 2. Turbocharger air inlet pipe | 3. EGR low pressure assembly bracket |
| 4. Gasket | 5. EGR cooler | 6. EGR cooler outlet temperature sensor |
| 7. Diesel particulate filter | 8. Water hose | 9. EGR heat shield |
| 10. Water hose | 11. Intake manifold | 12. Gasket |
| 13. EGR low pressure volume control valve | | |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281978

REMOVAL

1. Drain engine coolant. Refer to [CO-89, "Draining"](#).
CAUTION:
Perform this step when the engine is cold.
2. Remove battery. Refer to [PG-155, "Removal and Installation"](#).
3. Remove air inlet tube from turbocharger. Refer to [EM-382, "Exploded View"](#).

EGR SYSTEM

[R9M]

< REMOVAL AND INSTALLATION >

4. Remove air duct assembly. Refer to [EM-380, "Exploded View"](#).
5. Remove cowl top cover and extension cowl top. Refer to [EXT-29, "Removal and Installation"](#).
6. Remove diesel particle filter. Refer to [EX-24, "Removal and installation"](#).
7. Remove the swirl valve. Refer to [EM-387, "Exploded View"](#).
8. Remove EGR volume control valve on the intake manifold.
CAUTION:
 - Handle carefully to avoid any shock to EGR volume control valve.
 - Never disassemble EGR volume control valve.
 - Cover engine openings to avoid entry of foreign materials.
9. Remove low pressure EGR volume control valve on the EGR cooler.
CAUTION:
 - Handle carefully to avoid any shock to EGR volume control valve.
 - Never disassemble EGR volume control valve.
 - Cover engine openings to avoid entry of foreign materials.
10. Remove EGR heat shield.
11. Disconnect water hose on the EGR cooler.
12. Remove EGR cooler outlet temperature sensor.
13. Remove EGR cooler.
14. Remove EGR cooler tube.
 - Loosen mounting bolts in reverse order as shown in the figure.

INSTALLATION

Note the following, and install in the reverse order of removal.

CAUTION:

Clean each joint surface before installation.

1. Perform "EGR volume control valve position learning". Refer to [EC9-151, "Work Procedure"](#). when removing or replacing EGR volume control valve.
2. Perform "Low pressure EGR volume control valve position learning". Refer to [EC9-152, "Work Procedure"](#). when removing or replacing low pressure EGR volume control.

INTAKE MANIFOLD

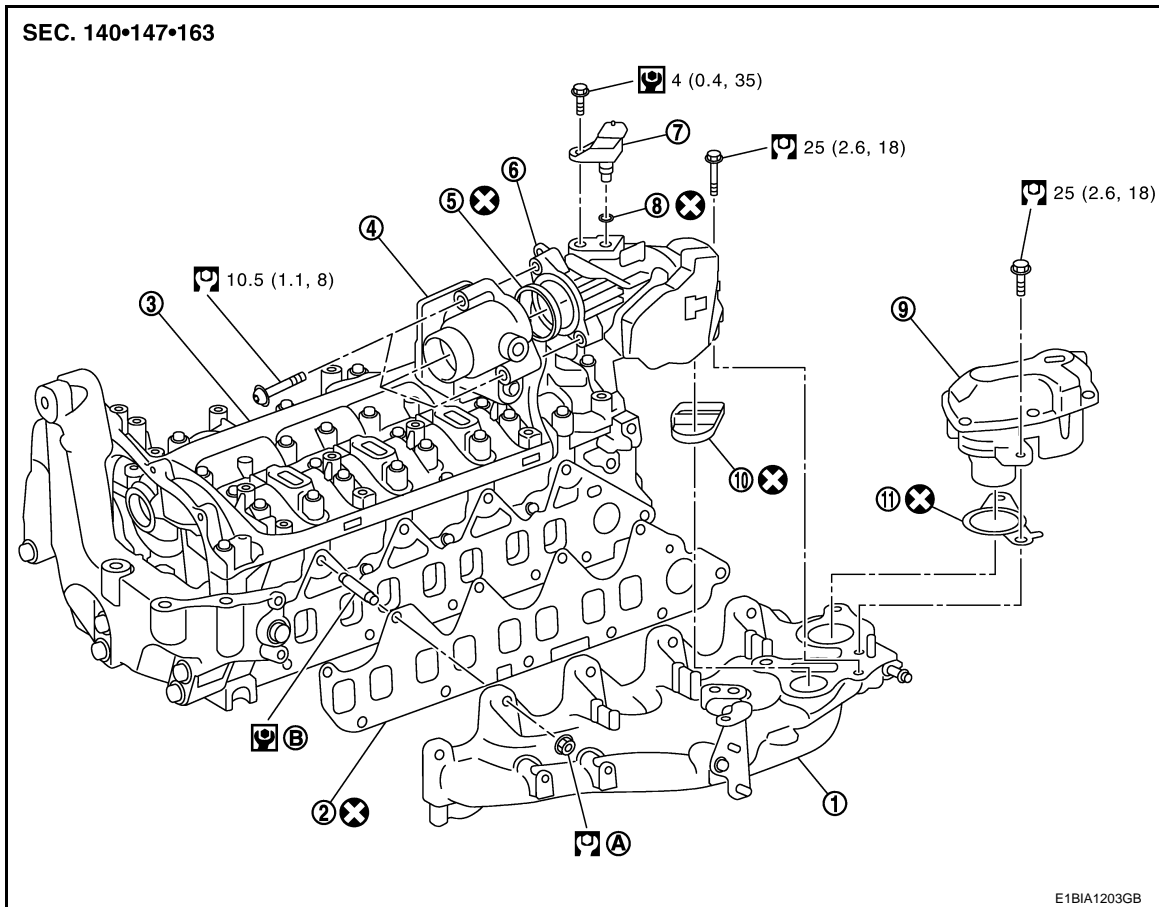
< REMOVAL AND INSTALLATION >

[R9M]

INTAKE MANIFOLD

Exploded View

INFOID:000000010281979



- | | | |
|--|--|-----------------------------|
| 1. Intake manifold | 2. gasket | 3. Cylinder head |
| 4. Throttle valve | 5. O-ring | 6. Swirl valve |
| 7. Air inlet pressure and temperature sensor | 8. Gasket | 9. EGR volume control valve |
| 10. Gasket | 11. Gasket | |
| A. Refer to EM-387, "Removal and Installation" | B. Refer to EM-387, "Removal and Installation" | |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281980

REMOVAL

1. Remove air duct (inlet). Refer to [EM-380, "Exploded View"](#).
2. Remove air inlet hose 1 and air inlet tube 1. Refer to [EM-382, "Exploded View"](#).
3. Use a refrigerant equipment to discharge the refrigerant.
4. Remove low pressure flexible hose fixing bolt from compressor and high pressure flexible hose fixing bolt from compressor.
5. Put aside low pressure flexible hose and high pressure flexible hose.
6. Remove throttle valve from intake manifold.
7. Remove swirl valve from intake manifold.
8. Remove EGR volume control valve from intake manifold.

CAUTION:

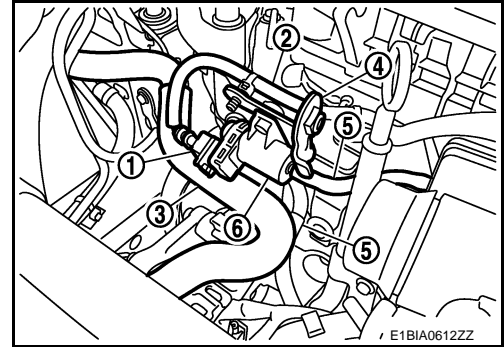
INTAKE MANIFOLD

[R9M]

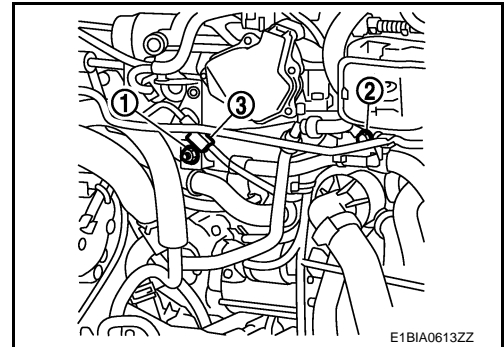
< REMOVAL AND INSTALLATION >

- Handle carefully to avoid any shock to EGR volume control valve.
- Never disassemble EGR volume control valve.

9. Disconnect coolant outlet unit regulation solenoid valve connector (1).
10. Unclip coolant outlet unit regulation solenoid valve connector harness (2) and put aside.
11. Unclip water hose (3) from coolant outlet unit regulation solenoid valve bracket (4).
12. Disconnect vacuum hose (5) from coolant outlet unit regulation solenoid valve.
13. Remove coolant outlet unit regulation solenoid valve (6) and bracket (4) assembly.



14. Remove oil level gauge and oil level gauge guide.
15. Remove water hose from intake manifold.
16. Disconnect terminal nut and connector from the alternator.
17. Remove engine harness bracket nuts (1) and bolt (3).
18. Unclip coolant temperature sensor (3).

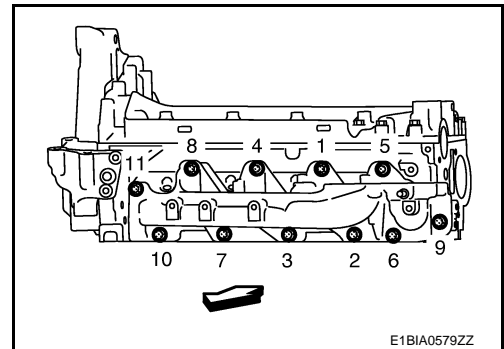


19. Put aside engine harness.
20. Unclip vacuum hose on the intake manifold and put aside.
21. Remove intake manifold with the following procedure:
 - a. Loosen mounting nuts in reverse order as shown in the figure.

← : Engine front

- b. Remove intake manifold and gasket.

CAUTION:
Cover engine openings to avoid entry of foreign materials.



INSTALLATION

Note the following, and install in the reverse order of removal.

CAUTION:

- Clean each joint surface before installation.
- Replace intake manifold stud if loosened.

 : 8 N·m (0.8 kg·m, 71 in·lb)

Intake Manifold

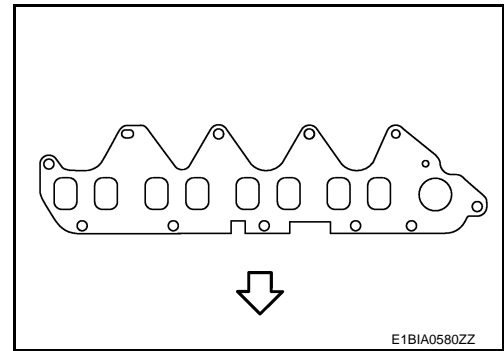
INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

[R9M]

1. Install gasket to cylinder head as shown in the figure.

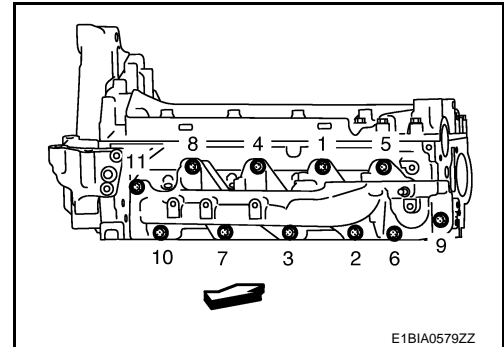
↶ : Engine front



2. Install intake manifold.
 - Tighten mounting nuts in two steps separately.

↶ : Engine front

 **First step: 10 N·m (1.0 kg·m, 7 ft·lb)**



 **Second step: 25 N·m (2.6 kg·m, 18 ft·lb)**

3. Perform "Throttle valve position learning". Refer to [EC9-149, "Work Procedure"](#). and "Swirl control valve position learning". Refer to [EC9-150, "Work Procedure"](#). when removing or replacing throttle valve or swirl valve.
4. Perform "EGR volume control valve position learning". Refer to [EC9-151, "Work Procedure"](#). when removing or replacing EGR volume control valve.
5. When replacing EGR volume control valve, throttle valve or swirl valve, this procedure must be performed. Refer to [EC9-143, "Special Repair Requirement List"](#)

Inspection

INFOID:000000010281981

INSPECTION AFTER REMOVAL

Surface Distortion

- Check the surface distortion of the intake manifold mating surface with a straightedge and a feeler gauge.

Standard : Refer to [EM-472, "Intake Manifold"](#).

- If it exceeds the standard, replace intake manifold.

TURBOCHARGER

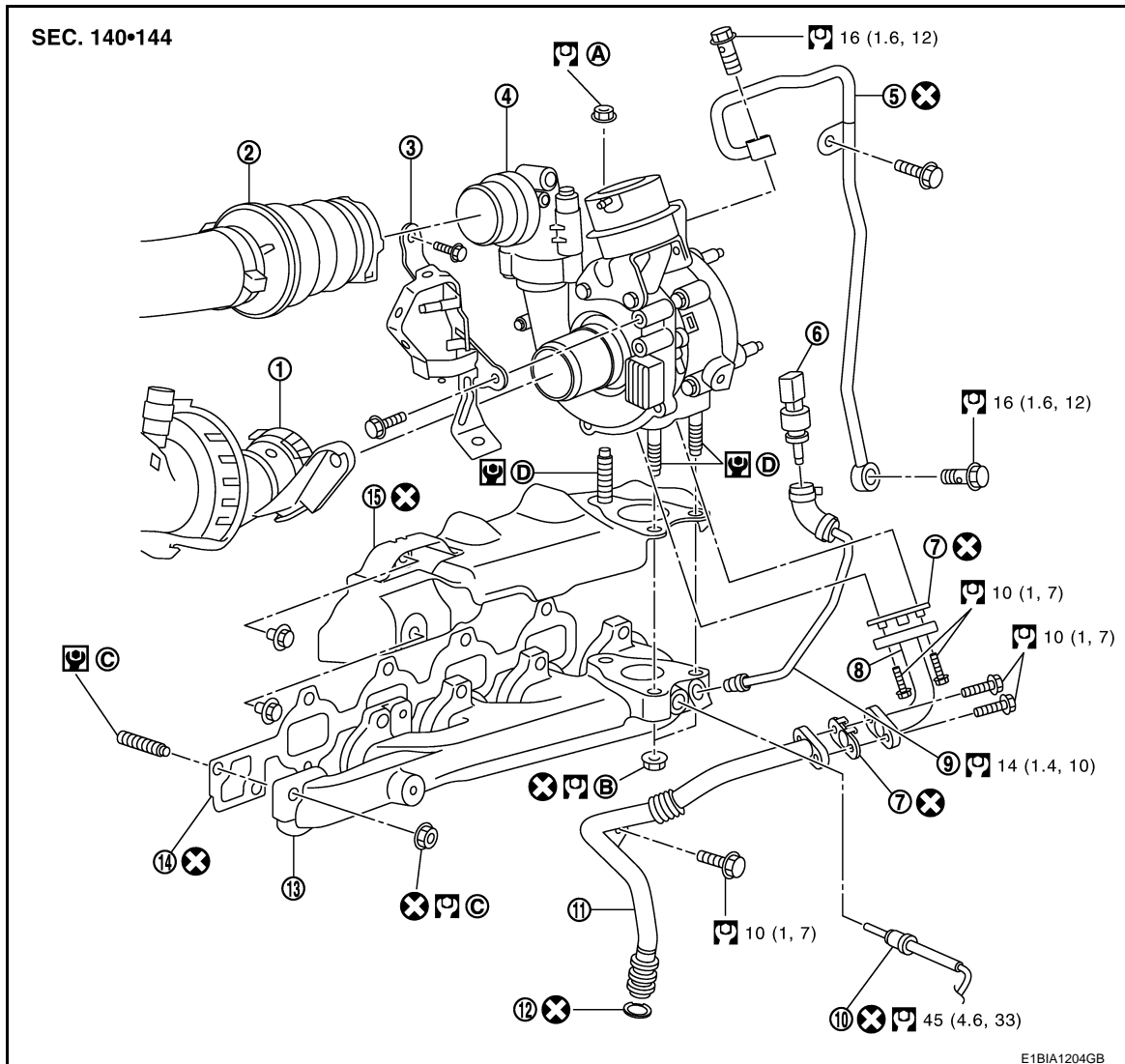
< REMOVAL AND INSTALLATION >

[R9M]

TURBOCHARGER

Exploded View

INFOID:000000010281982



- | | | |
|------------------------------------|-----------------------------|---|
| 1. Turbocharger air inlet pipe | 2. Air inlet pipe 1 | 3. Diesel particle filter bracket |
| 4. Turbocharger | 5. Oil tube | 6. Exhaust gas pressure sensor |
| 7. Gasket | 8. Oil tube | 9. Exhaust gas pressure sensor tube |
| 10. Exhaust gas temperature sensor | 11. Oil tube | 12. O-ring |
| 13. Exhaust manifold | 14. Exhaust manifold gasket | 15. Exhaust manifold heat shield gasket |

A. Refer to [EM-390, "Removal and Installation"](#)

B. Refer to [EM-390, "Removal and Installation"](#)

C. Refer to [EM-393, "Removal and Installation"](#)

D. Refer to [EM-390, "Removal and Installation"](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281983

REMOVAL

1. Disconnect the battery from negative terminal.
2. Remove air inlet tube from turbocharger. Refer to [EM-382, "Exploded View"](#).

TURBOCHARGER

[R9M]

< REMOVAL AND INSTALLATION >

3. Remove air duct assembly. Refer to [EM-380, "Exploded View"](#).
4. Remove cowl top cover and extension cowl top. Refer to [EXT-29, "Removal and Installation"](#).
5. Disconnect vacuum hose from turbocharger.
6. Remove exhaust front tube. Refer to [EX-22, "Removal and Installation"](#).
7. Remove diesel particle filter. Refer to [EX-24, "Removal and installation"](#).
8. Remove oil tube from turbocharger.
9. Remove exhaust gas temperature sensor. Refer to [EX-27, "EXHAUST GAS TEMPERATURE SENSOR ON THE EXHAUST GAS COOLER : Removal and installation"](#).
10. Remove exhaust gas pressure sensor and exhaust gas pressure tube assembly. Refer to [EX-29, "Removal and installation"](#).

CAUTION:

Be careful not to impact or damage exhaust gas pressure sensor.

11. Remove turbocharger from exhaust manifold.

CAUTION:

Never disassemble or adjust the turbocharger body.

INSTALLATION

Note the following and install in the reverse order of removal.

CAUTION:

- Clean each joint surface before installation.
- Replace turbocharger stud if loosened.

 : 9 N·m (0.9 kg·m, 80 in·lb)

1. Install turbocharger.
 - Tighten the mounting nuts in two steps separately.

 1st step: 15.0 N·m (1.5 kg·m, 11 ft·lb)

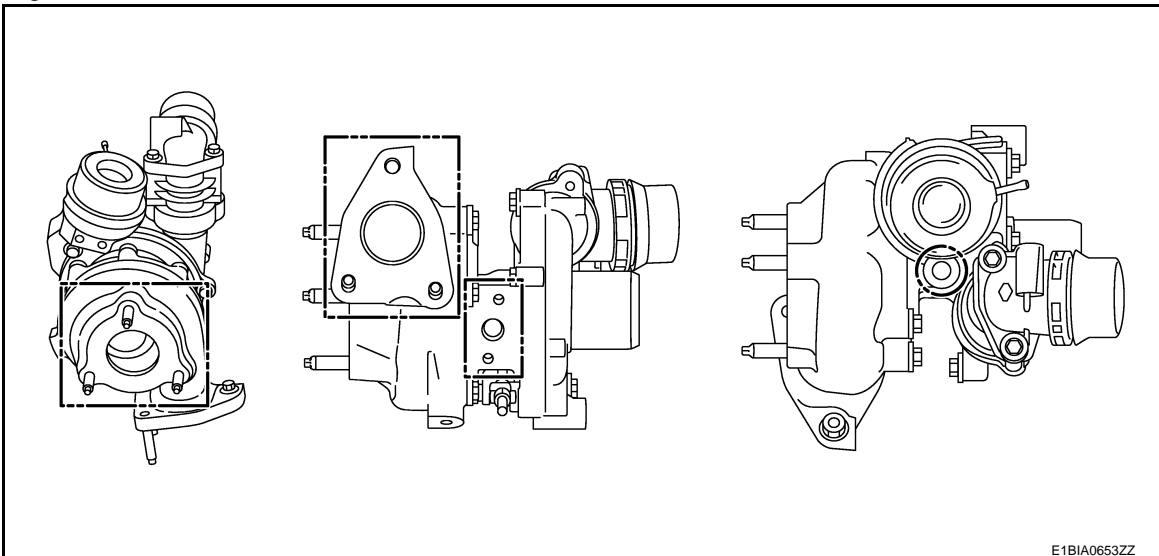
 2nd step: 25.0 N·m (2.6 kg·m, 18 ft·lb)

Inspection

INFOID:000000010281984

INSPECTION AFTER REMOVAL

Turbocharger



E1BIA0653ZZ

Check there is no leakage on the different side of the turbocharger (exhaust gas and oil)

TURBOCHARGER

< REMOVAL AND INSTALLATION >

[R9M]

CAUTION:

When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary malfunction:

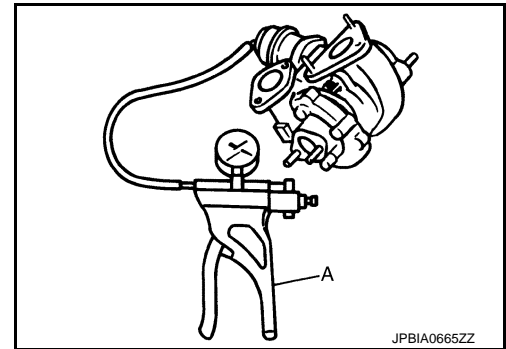
- Suction side: Between turbocharger and air cleaner
- Between turbocharger and charge air cleaner
- Exhaust side: Between turbocharger and diesel particle filter
- Between turbocharger and exhaust manifold

Turbocharger Boost Control

- Connect the handy vacuum pump (A) to the actuator, and check that the rod strokes smoothly in compliance with the following pressure.

Standard (value of vacuum/value of rod moving):

Refer to [EM-473, "Turbocharger"](#).



INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

EXHAUST MANIFOLD

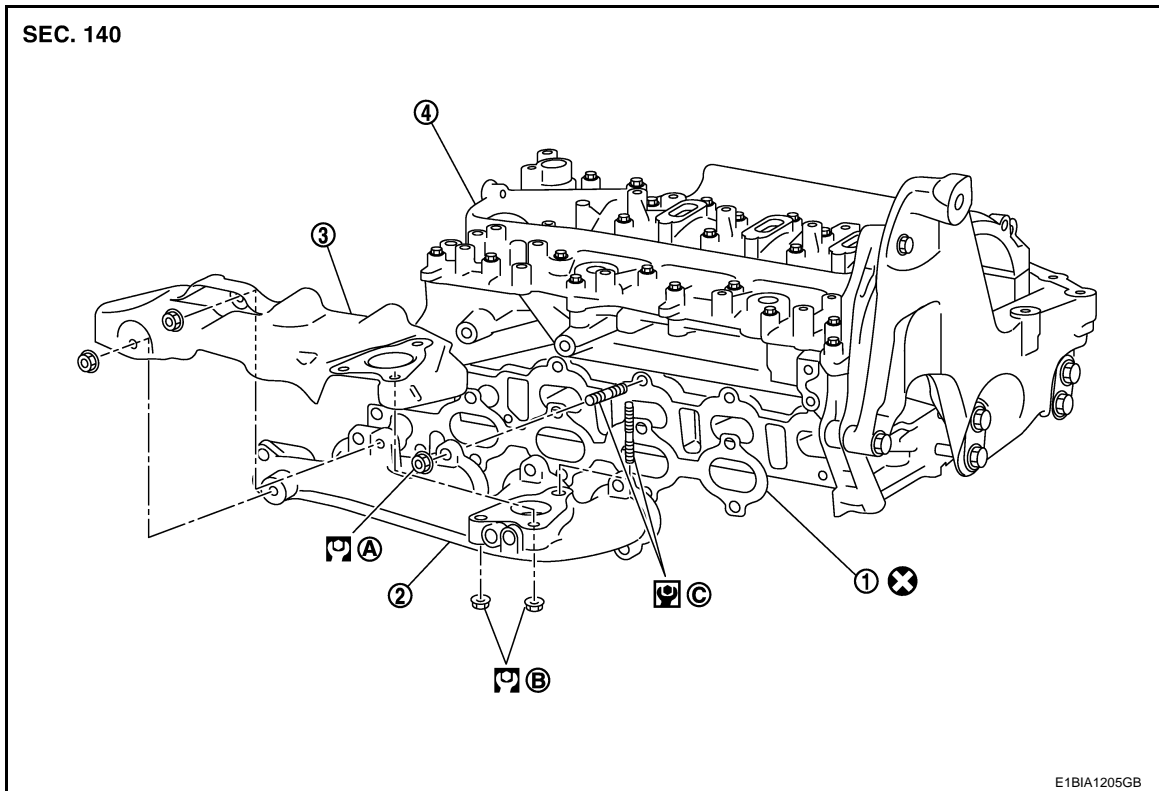
< REMOVAL AND INSTALLATION >

[R9M]

EXHAUST MANIFOLD

Exploded View

INFOID:000000010281985



- | | | |
|--|--|--|
| 1. Exhaust manifold gasket | 2. Exhaust manifold | 3. Exhaust manifold heat shield gasket |
| 4. Cylinder head | | |
| A. Refer to EM-393, "Removal and Installation" | B. Refer to EM-393, "Removal and Installation" | C. Refer to EM-393, "Removal and Installation" |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281986

REMOVAL

1. Disconnect battery negative terminal.
2. Remove diesel particle filter. Refer to [EX-24, "Removal and installation"](#).
3. Remove turbocharger. Refer to [EM-390, "Removal and Installation"](#).
4. Remove air cleaner case. Refer to [EM-380, "Removal and Installation"](#).
5. Remove exhaust gas pressure sensor. Refer to [EX-29, "Removal and installation"](#)
6. Remove exhaust gas temperature sensor. Refer to [EX-27, "EXHAUST GAS TEMPERATURE SENSOR ON THE EXHAUST GAS COOLER : Removal and installation"](#)
7. Remove exhaust manifold.

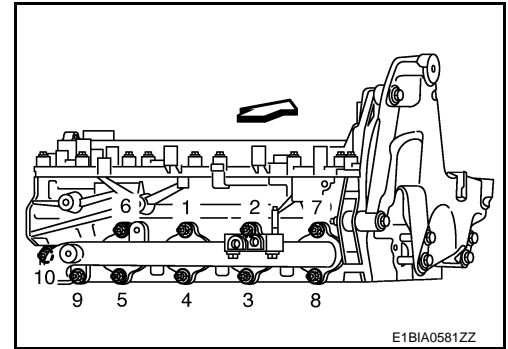
EXHAUST MANIFOLD

[R9M]

< REMOVAL AND INSTALLATION >

- Loosen mounting nuts in the reverse order as shown in the figure.

↩ : Engine front



- Remove gasket.

CAUTION:

- Cover engine openings to avoid entry of foreign materials.

INSTALLATION

Note the following, and install in the reverse order of removal.

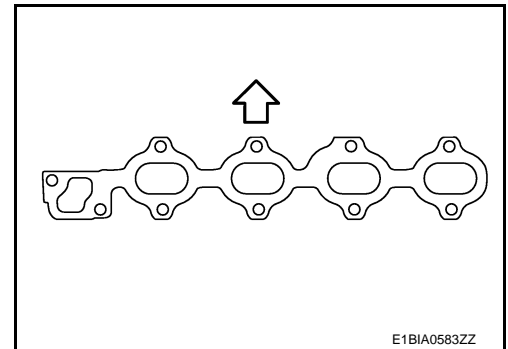
CAUTION:

- Clean each joint surface before installation.
- Replace exhaust manifold stud if loosened.

 : 9 N·m (0.9 kg·m, 80 in·lb)

- Install gasket to cylinder head as shown in the figure.

↩ : Engine front



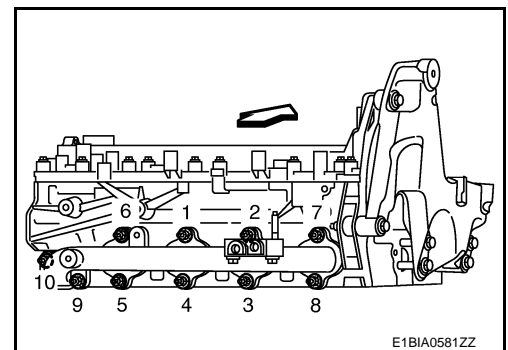
- Install exhaust manifold.

- Tighten the mounting nuts in two steps separately in numerical order as shown in the figure.

↩ : Engine front

 1st step: 15.0 N·m (1.5 kg·m, 11 ft·lb)

 2nd step: 30.0 N·m (3.1 kg·m, 22 ft·lb)



- Install in the reverse order of removal, for the rest of parts.

Inspection

INFOID:000000010281987

INSPECTION AFTER REMOVAL

Surface Distortion

- Check the surface distortion of the exhaust manifold mating surface with a straightedge and a feeler gauge.

Standard : Refer to [EM-472, "Exhaust Manifold"](#).

EXHAUST MANIFOLD

< REMOVAL AND INSTALLATION >

[R9M]

- If it exceeds the standard, replace exhaust manifold.

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

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OIL PAN (LOWER) AND OIL STRAINER

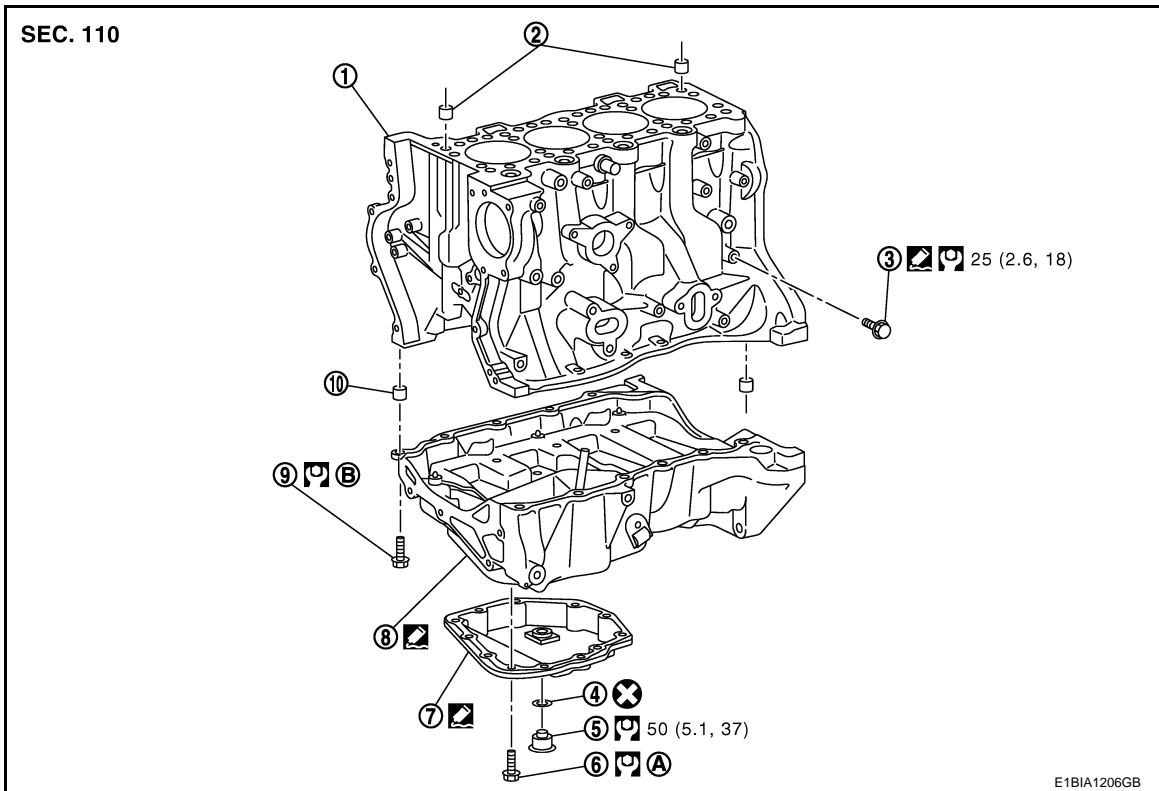
< REMOVAL AND INSTALLATION >

[R9M]

OIL PAN (LOWER) AND OIL STRAINER

Exploded View

INFOID:000000010281988



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|--|--|-------------------------|
| 1. Cylinder block | 2. Bush | 3. TDC pin plug |
| 4. Gasket | 5. Oil pan drain plug | 6. Oil pan (lower) bolt |
| 7. Oil pan (lower) | 8. Oil pan (upper) | 9. Oil pan (upper) bolt |
| A. Refer to EM-396, "Removal and Installation" | B. Refer to EM-437, "Removal and Installation" | |

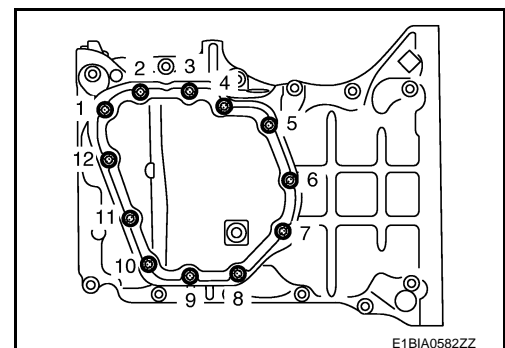
Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281989

REMOVAL

1. Remove engine undercover.
2. Drain engine oil. Refer to [LU-49, "Draining"](#).
CAUTION:
Perform this step when engine is cold.
3. Remove oil pan (lower) with the following procedure:
 - a. Loosen mounting bolts in reverse order shown in the figure.



OIL PAN (LOWER) AND OIL STRAINER

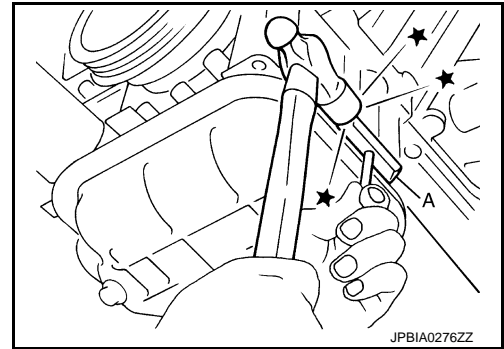
[R9M]

< REMOVAL AND INSTALLATION >

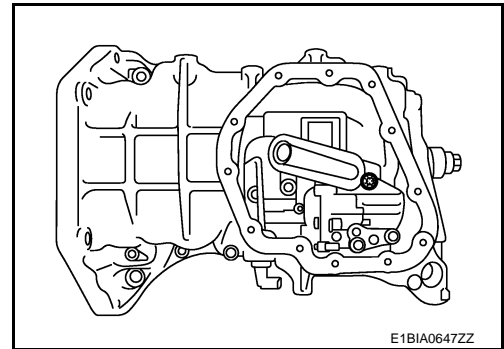
- b. Insert the seal cutter [SST:KV10111100 (—)] (A) between oil pan (upper) and oil pan (lower). Slide tool by tapping on the side of the tool with a hammer.

CAUTION:

- Be careful not to damage mating surface.
- Never insert screwdriver, or oil pan flange will be deformed.



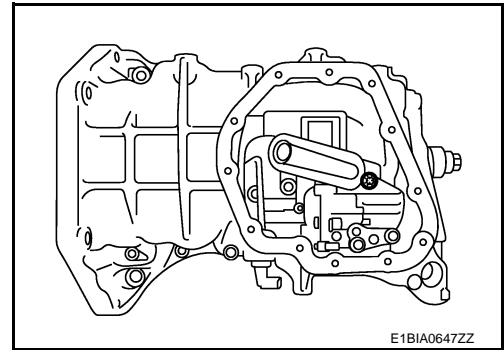
- c. Remove oil pan (lower).
4. Remove oil strainer.
- Loosen mounting bolt.



INSTALLATION

1. Install oil strainer.
- Tighten oil strainer mounting bolts.

: 10.0 N·m (1.0 kg-m, 7 ft-lb)

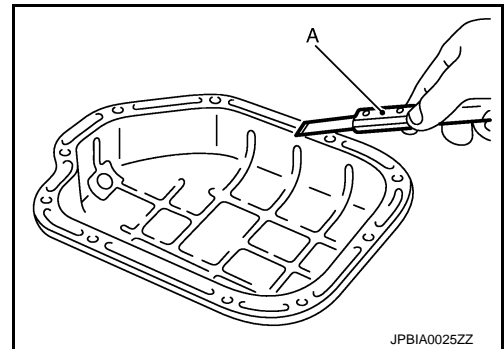


2. Install oil pan (lower) with the following procedure:
- a. Use a scraper (A) to remove old liquid gasket from mating surfaces.

CAUTION:

Never scratch or damage the mating surfaces when cleaning off old liquid gasket.

- Remove old liquid gasket from the bolt holes and threads.



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OIL PAN (LOWER) AND OIL STRAINER

[R9M]

< REMOVAL AND INSTALLATION >

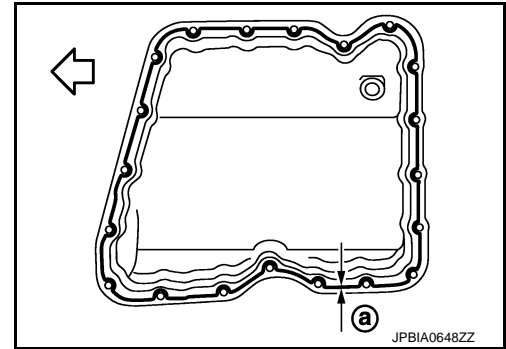
- b. Apply a continuous bead of liquid gasket with the tube presser (commercial service tool) as shown in the figure.

a : 3.0 - 7.0 mm (0.118 - 0.276 in)

↔ : Engine front

Use Genuine Liquid Gasket or equivalent

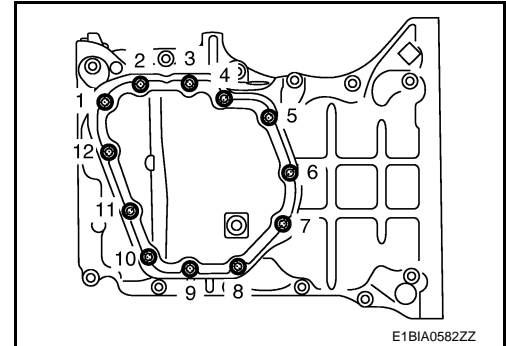
CAUTION:
Attaching should be done within 5 minutes after coating.



- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

 **1st step: 5.0 N-m (0.51 kg-m, 44 in-lb)**

 **2nd step: 12.0 N-m (1.2 kg-m, 9 ft-lb)**



3. Install in the reverse order of removal, for the rest of parts.

NOTE:

At least 30 minutes after oil pan is installed, pour engine oil.

Inspection

INFOID:0000000010281990

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to [LU-48. "Inspection"](#).
2. Start engine, and check there is no leak of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-48. "Inspection"](#).

GLOW PLUG

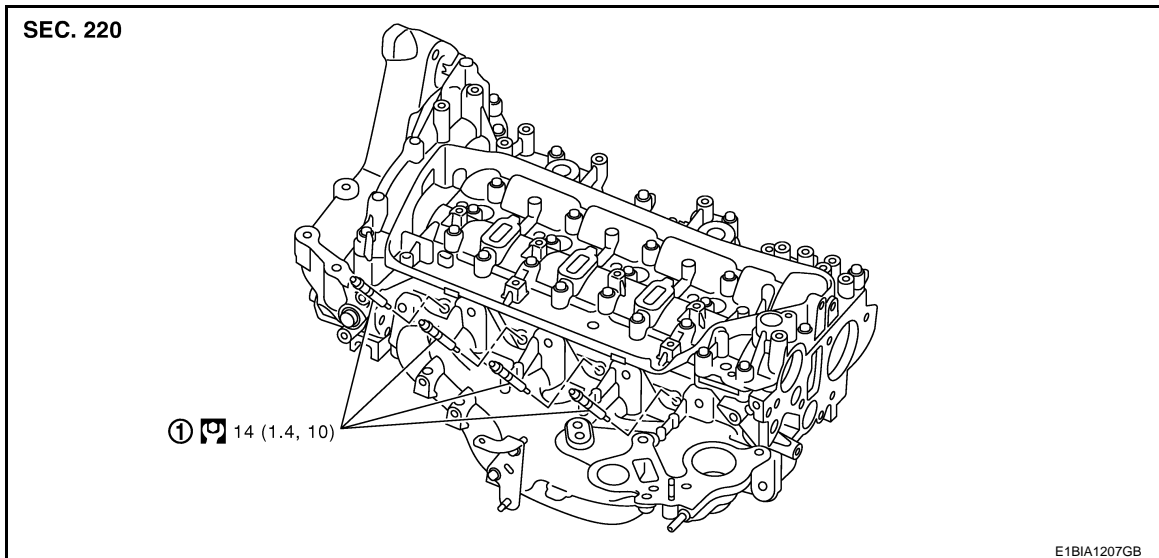
< REMOVAL AND INSTALLATION >

[R9M]

GLOW PLUG

Exploded View

INFOID:000000010281991



1. Glow plug

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281992

REMOVAL

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Disconnect the battery cable from the negative terminal.
2. Remove air inlet hose 1. Refer to [EM-382, "Exploded View"](#)
3. Remove damper valve from intake manifold. Refer to [EM-387, "Exploded View"](#)
4. Remove swirl valve from intake manifold. Refer to [EM-387, "Exploded View"](#)
5. Disconnect harness connector from glow plug.
6. Remove glow plug.

CAUTION:

- **When removing or installing, never use such tools as an air impact wrench.**
- **Handle it carefully without giving any impact, even after removal.**

INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install in the reverse order of removal, for the rest of parts.

VACUUM PUMP

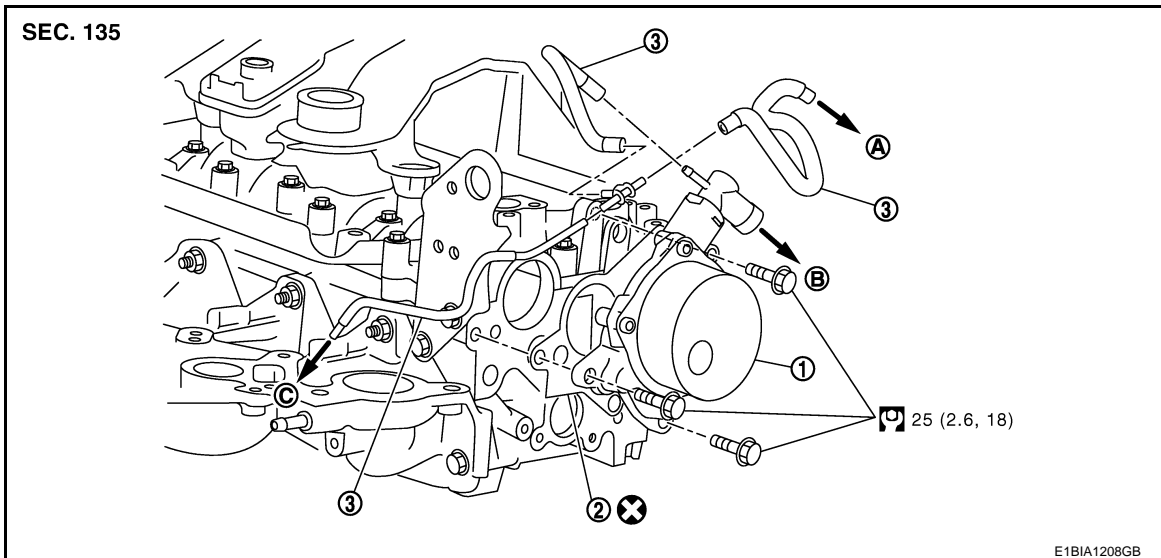
< REMOVAL AND INSTALLATION >

[R9M]

VACUUM PUMP

Exploded View

INFOID:000000010281993



- | | | |
|---------------------|---|---|
| 1. Vacuum pump | 2. Gasket | 3. Vacuum hose |
| A. To brake booster | B. To turbocharger boost control solenoid valve | C. To coolant outlet unit regulation solenoid valve |

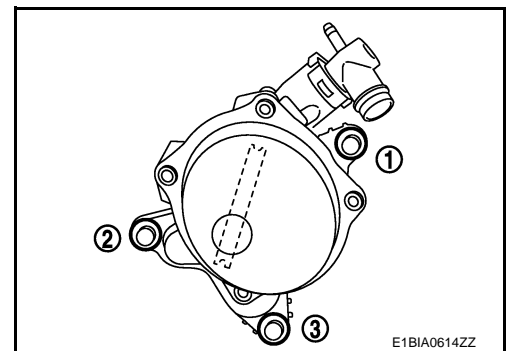
Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281994

REMOVAL

1. Remove battery. Refer to [PG-155, "Removal and Installation"](#).
2. Disconnect vacuum hoses.
3. Remove vacuum pump.
 - Loosen mounting bolts in reverse order as shown in the figure.



INSTALLATION

Note the following, and install in the reverse order of removal.

Vacuum pump

VACUUM PUMP

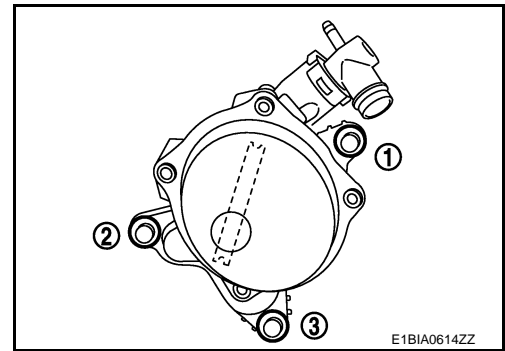
[R9M]

< REMOVAL AND INSTALLATION >

- Tighten mounting bolts in numerical order as shown in the figure.

CAUTION:

Be sure to check that the vacuum pump is in contact with the cylinder head before tightening the mounting bolts.



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OIL SEPARATOR

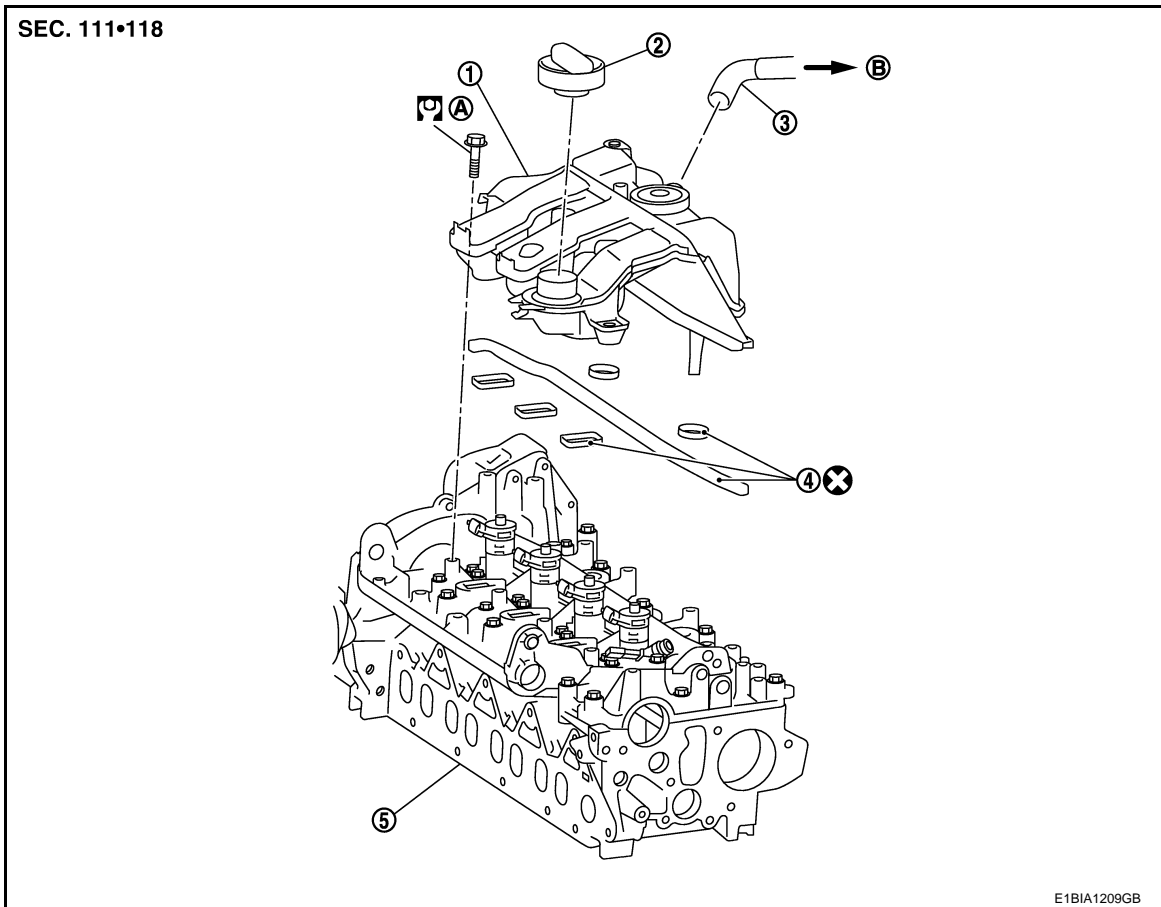
< REMOVAL AND INSTALLATION >

[R9M]

OIL SEPARATOR

Exploded View

INFOID:000000010281995



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|--|-----------------------------------|-------------|
| 1. Oil separator | 2. Oil filler plug | 3. PCV hose |
| 4. Gasket | 5. Cylinder head | |
| A. Refer to EM-402. "Removal and Installation" | B. To turbocharger air inlet pipe | |

Refer to [GI-4. "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281996

REMOVAL

1. Remove fuel injection cover.
2. Remove PCV hose.
3. Disconnect harness connector of fuel injector.
4. Loosen oil separator insulator mounting bolts.
5. Remove oil separator.

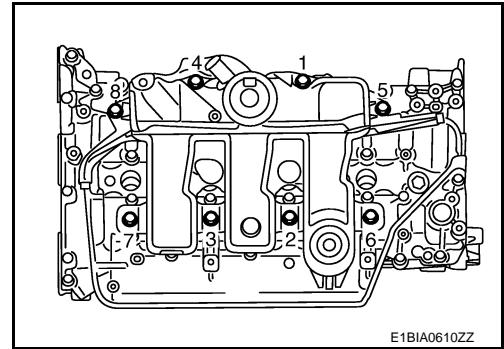
OIL SEPARATOR

[R9M]

< REMOVAL AND INSTALLATION >

- Loosen mounting bolts in the reverse order as shown in the figure.

← : Engine front



- Remove oil separator insulator.

INSTALLATION

- Install gaskets to oil separator.

CAUTION:

Check the gasket is not dropped.

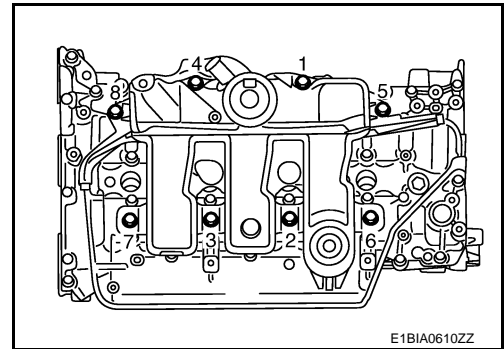
- Install oil separator.

- Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

← : Engine front

 **1st step: 5.0 N·m (0.51 kg-m, 44 in-lb)**

 **2nd step: 10.0 N·m (1.0 kg-m, 7 ft-lb)**



- Install in the reverse order of removal, for the rest of parts.

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INJECTION TUBE AND FUEL INJECTOR

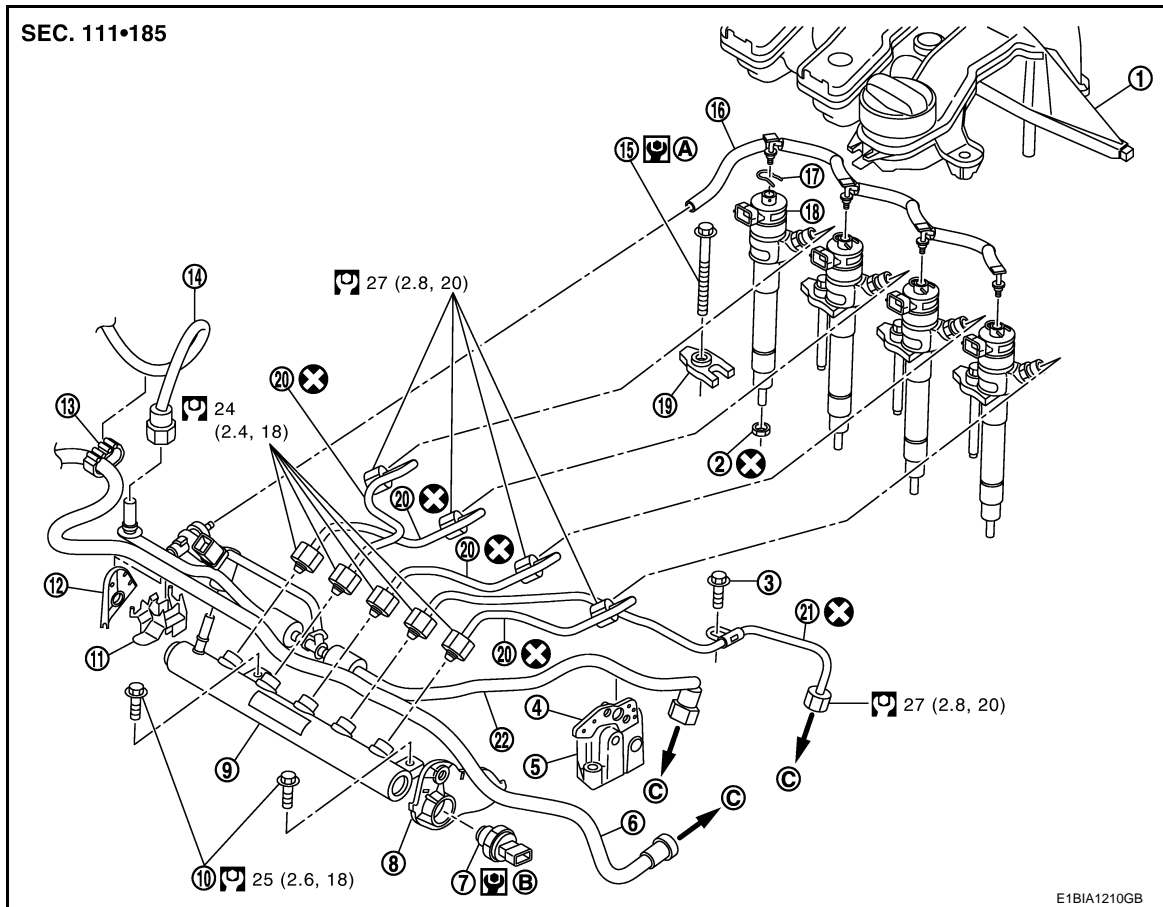
< REMOVAL AND INSTALLATION >

[R9M]

INJECTION TUBE AND FUEL INJECTOR

Exploded View

INFOID:000000010281997



- | | | |
|--|--|-----------------------------------|
| 1. Oil separator | 2. Fuel injector spacer | 3. Injection tube (center) bolt |
| 4. Injection rail protector seal | 5. Cylinder head | 6. Fuel hose |
| 7. Fuel rail pressure sensor | 8. Injection rail protector seal | 9. Injection rail |
| 10. Injection rail bolts | 11. Bracket | 12. Injection rail protector seal |
| 13. Clip | 14. Fuel hose | 15. Fuel injector support bolt |
| 16. Fuel return hose | 17. Clip | 18. Injector |
| 19. Fuel injector support | 20. Injection tube | 21. Injection tube (center) |
| 22. Fuel hose | | |
| A. Refer to EM-404, "Removal and Installation" | B. Refer to EM-404, "Removal and Installation" | C. To fuel pump |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010281998

REMOVAL

CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to [EM-364, "Precaution for Diesel Equipment"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.
- It is forbidden to open an fuel injector. If you open an fuel injector by mistake, you will have to change it.

NOTE:

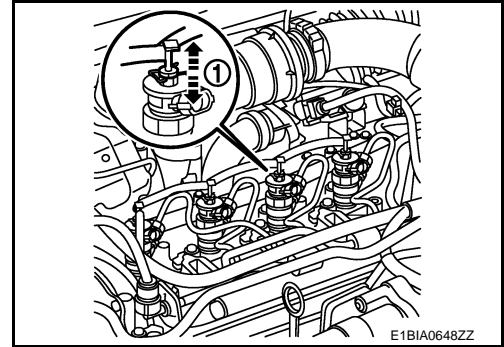
It is possible to replace a single injection tube.

INJECTION TUBE AND FUEL INJECTOR

[R9M]

< REMOVAL AND INSTALLATION >

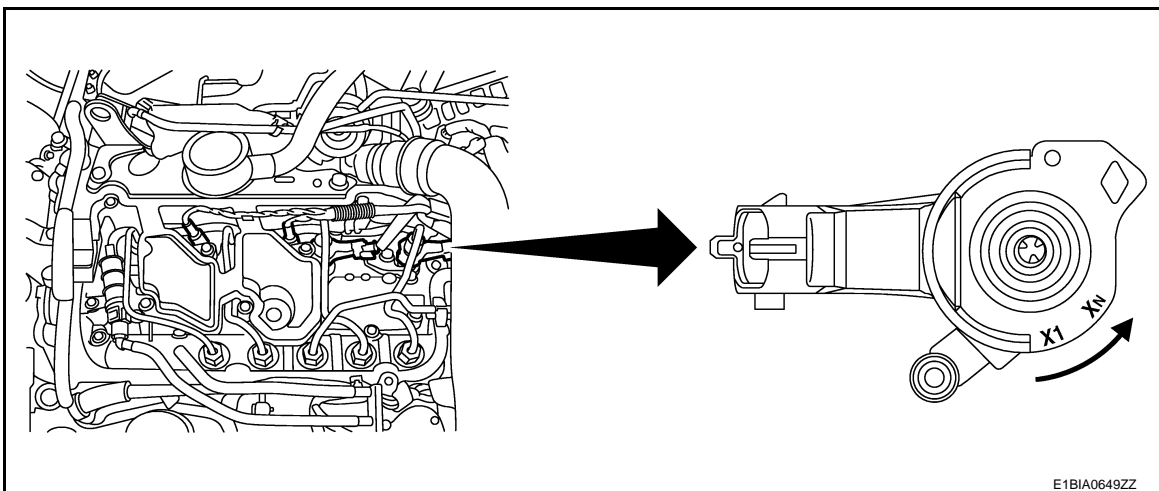
1. Remove the battery. Refer to [PG-155, "Removal and Installation"](#).
2. Remove oil separator. Refer to [EM-402, "Exploded View"](#).
3. Remove fuel return hose.
 - Move without removing the fuel return hose clip using a flat blade screwdriver.
4. Disconnect and remove fuel hose.



5. Remove fuel collector and injection tube (center).
 6. Remove injection tube (No. 1, 2, 3, 4).
 - Put a paint mark or tag on injection tubes to identify each cylinder.
 7. Remove fuel injectors with the following procedure:
 - a. Remove fuel injector. While rotating it to left and right, raise it to remove.
 - If fuel injector spacer remains in cylinder head, hook it with tip of a flat-bladed screwdriver and pull it out.
- CAUTION:**
- Handle fuel injector carefully without giving an impact.
 - Never disassemble fuel injector.
8. Remove injection rail and injection rail protector.
 9. **CAUTION:**
In case of fuel rail pressure sensor fitted with a color ring:
 - replacing the sensor is forbidden
 - the injector rail must be completely replaced if the fuel rail pressure sensor fails.
 10. Plug all the holes in the injection circuit.

INSTALLATION

1. If an injector is replaced, note the IMA code and the corresponding cylinder number and perform "injector adjustment value registration". Refer to [EC9-147, "Work Procedure"](#).



NOTE:

IMA code are from X1 to XN

After connecting the battery programs the injectors using the diagnostic tool.

2. Install fuel injector, injection tubes and fuel rail with the following procedure:
 - a. Install fuel injector spacer to fuel injector, and insert them into cylinder head.

INJECTION TUBE AND FUEL INJECTOR

[R9M]

< REMOVAL AND INSTALLATION >

CAUTION:

- Completely remove any foreign material among fuel injector and cylinder head.

- b. Install injection rail, injection tube (center).
 - Finger tighten until contact the injection tube nuts.
- c. Install fuel injector support.

CAUTION:

Be sure to fit fuel injector support without looseness.

NOTE:

In case of cylinder head replacement, pre-tighten the fuel injector support bolt and after loosen the fuel injector support bolt.

Pre-tightening fuel injector support bolt (in case of cylinder head replacement)

20 Nm (2.0kg-m, 15 ft-lb)

Tighten fuel injector support bolt.

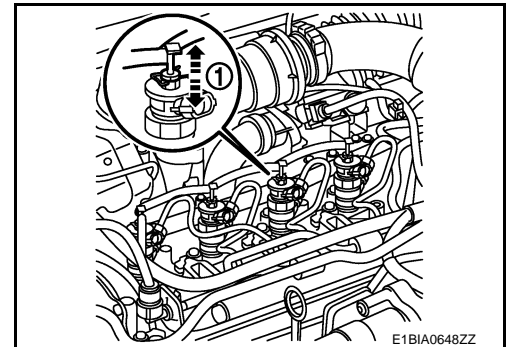
Fuel injector support bolt 7Nm (0.7kg-m, 62 in-lb)

- e. Turn 180 degrees clockwise (angle tightening).
 - f. Install injection tube (No. 1, 2, 3, 4) in the original position (temporarily).
 - Finger tighten until contact the injection tube nuts.
- CAUTION:**
Never put injection tubes under stress.
- g. Tighten injection rail mounting bolts and all injection tube nuts (specified torque).
3. Install fuel return hose onto fuel injectors with the following procedure.

NOTE:

Failure to observe the following procedure may lead to an immobilising default.

- Fit the clip on the fuel return hose.
- Install fuel return hose onto fuel injectors.
- Always carry out a "push-pull" test (1), to check that the fuel return hose is correctly fitted onto fuel injector.
- Always carry out a "push-pull" test, to check that the fuel return hose is correctly fitted onto fuel hose.



4. Install in the reverse order of removal, for the rest of parts.

Inspection

INFOID:000000010281999

INSPECTION AFTER INSTALLATION

- When replacing fuel injector, this procedure must be performed. Refer to [EC9-143, "Special Repair Requirement List"](#)
- When replacing fuel injector, note the injector IMA code and the corresponding cylinder number.

NOTE:

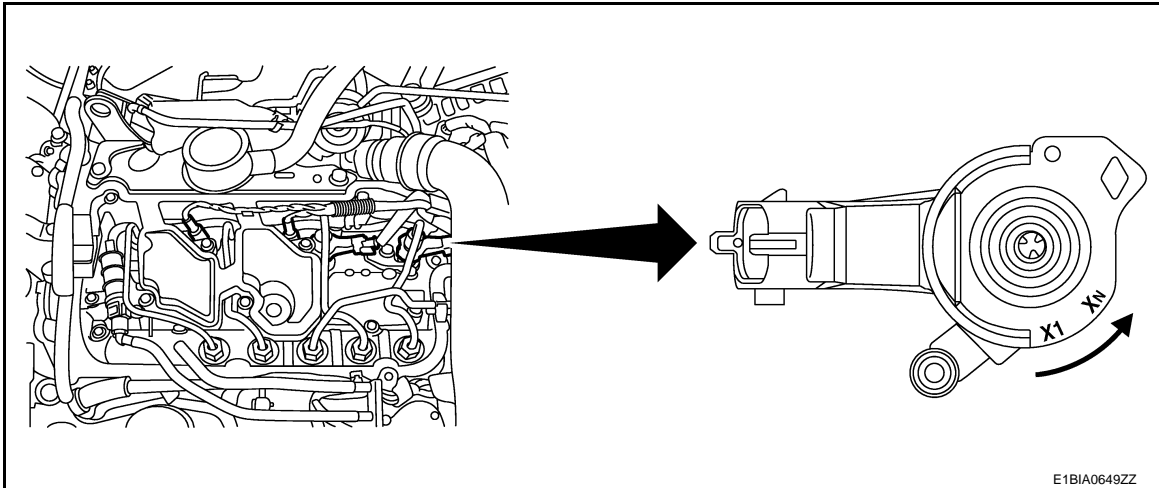
IMA codes are from X1 to XN.

- Program the injectors using diagnostic tool.

INJECTION TUBE AND FUEL INJECTOR

< REMOVAL AND INSTALLATION >

[R9M]



- Start the engine and check for fuel leak for one minute after starting.

CAUTION:

After any operation, check that there are no diesel leaks. Refer to [EM-364, "Precaution for Diesel Equipment"](#).

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FUEL PUMP

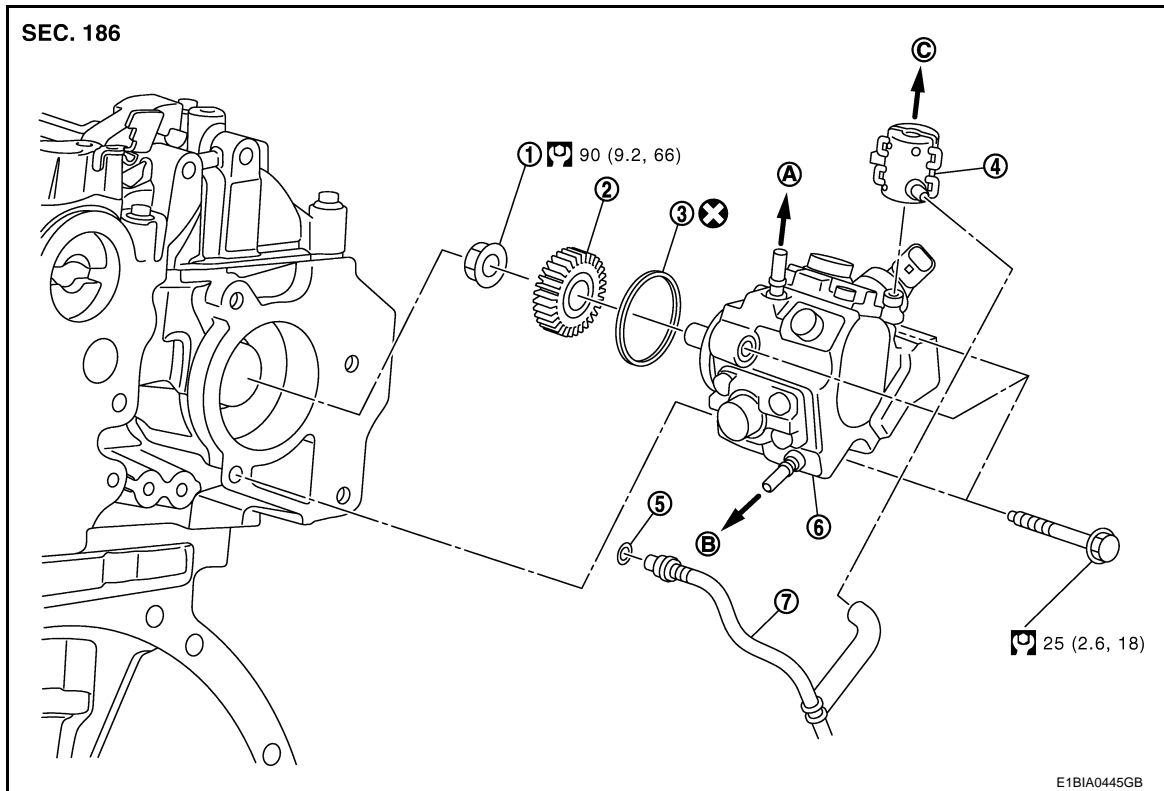
< REMOVAL AND INSTALLATION >

[R9M]

FUEL PUMP

Exploded View

INFOID:000000010282000



- | | | |
|-------------------|-----------------------|-------------------------------|
| 1. Fuel pump nut | 2. Fuel pump sprocket | 3. Fuel pump gasket |
| 4. Fuel collector | 5. Gasket | 6. Fuel pump |
| 7. Fuel pump | | |
| A. To fuel tank | B. To fuel filter | C. To injection tube (center) |

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282001

REMOVAL

CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to [EM-364, "Precaution for Diesel Equipment"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.
- Never disassemble or adjust the fuel pump body.

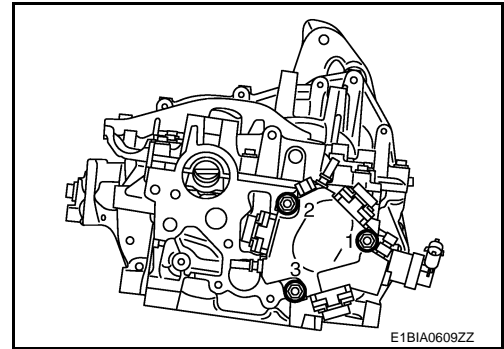
1. Remove the battery. Refer to [PG-155, "Removal and Installation"](#).
2. Remove fuel injection cover.
3. Remove air duct assembly and air cleaner case. Refer to [EM-380, "Exploded View"](#).
4. Remove fuel collector. Refer to [EM-408, "Exploded View"](#).
5. Disconnect fuel hoses from fuel pump. Refer to [EM-404, "Exploded View"](#) and [EM-404, "Exploded View"](#).
6. Remove the injection tube (center). Refer to [EM-404, "Exploded View"](#).
7. Plug all the holes of the injection circuit.
8. Remove the fuel pump.

FUEL PUMP

[R9M]

< REMOVAL AND INSTALLATION >

- Loosen mounting bolts in the reverse order as shown in the figure.



- In case of replacement of the fuel pump you need to install the old fuel pump sprocket on the new fuel pump. Refer to [EM-410, "Removal and Installation"](#).

INSTALLATION

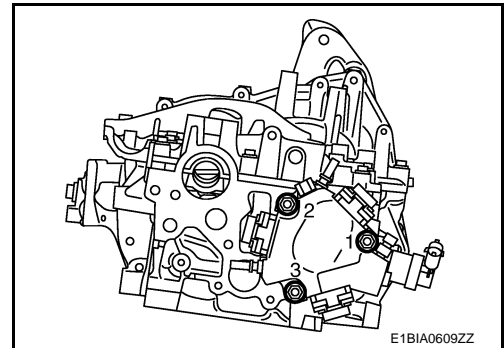
- Install fuel pump.

CAUTION:

Be sure to check that the fuel pump is in contact with the cylinder head before tightening the mounting bolts.

- Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

 **25.0 N-m (2.6 kg-m, 18 ft-lb)**



- Install the injection tube (center). Refer to [EM-404, "Exploded View"](#).
 - Finger tighten until contact the injection tube nuts.
- Install in the reverse order of removal, for the rest of parts.
- Perform "Fuel pump learning value clearing". Refer to [EC9-158, "Description"](#). when replacing fuel pump.
- When replacing or removing fuel pump, this procedure must be performed. Refer to [EC9-143, "Special Repair Requirement List"](#).

Inspection

INFOID:000000010282002

INSPECTION AFTER INSTALLATION

- Start the engine and check for fuel leak for one minute after starting.

CAUTION:

After any operation, check that there are no diesel leaks. Refer to [EM-364, "Precaution for Diesel Equipment"](#).

FUEL PUMP SPROCKET

< REMOVAL AND INSTALLATION >

[R9M]

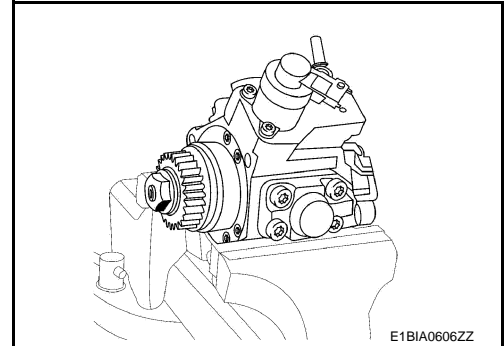
FUEL PUMP SPROCKET

Removal and Installation

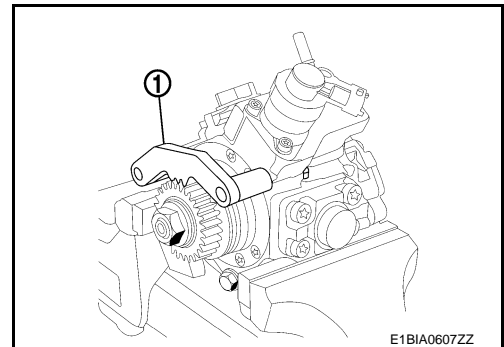
INFOID:000000010282003

REMOVAL

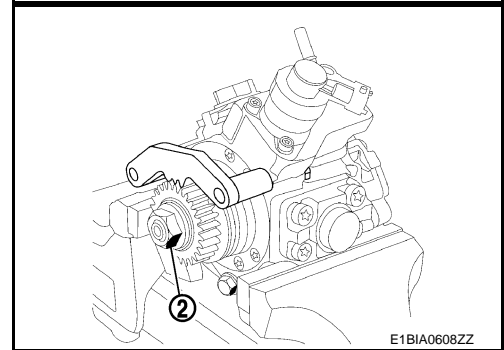
1. Lock the high pressure fuel pump sprocket on the work-bench in a vice with protective jaws.



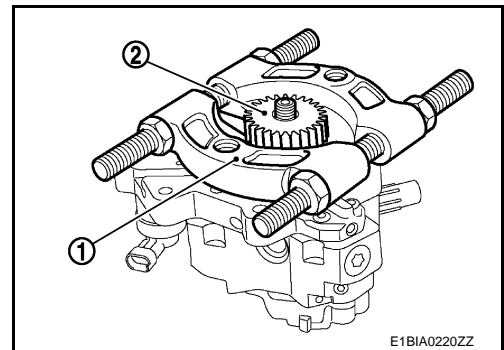
2. Using the tool [SST (Mot.1906)] (1), lock the high pressure fuel pump sprocket.



Remove the high pressure fuel pump sprocket nut (2).



3. Fit a separator (1) from the puller kit under the high pressure fuel pump sprocket (2).

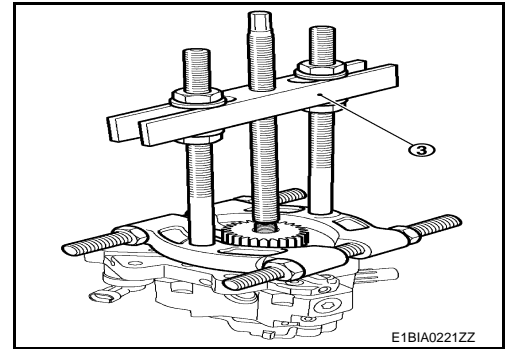


FUEL PUMP SPROCKET

< REMOVAL AND INSTALLATION >

[R9M]

4. Put the bracket (3) on the separator.



5. Remove the high pressure fuel pump sprocket.

INSTALLATION

1. Refit the sprocket to the new high pressure fuel pump.
2. Screw in the new high pressure fuel pump sprocket on the work bench, without tightening it.
3. Lock the high pressure fuel pump sprocket on the workbench in a vice with protective jaws.
4. Torque tighten the high pressure fuel pump sprocket nut.

: **90 N·m (9.2 kg-m, 66 ft-lb)**

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TIMING CHAIN

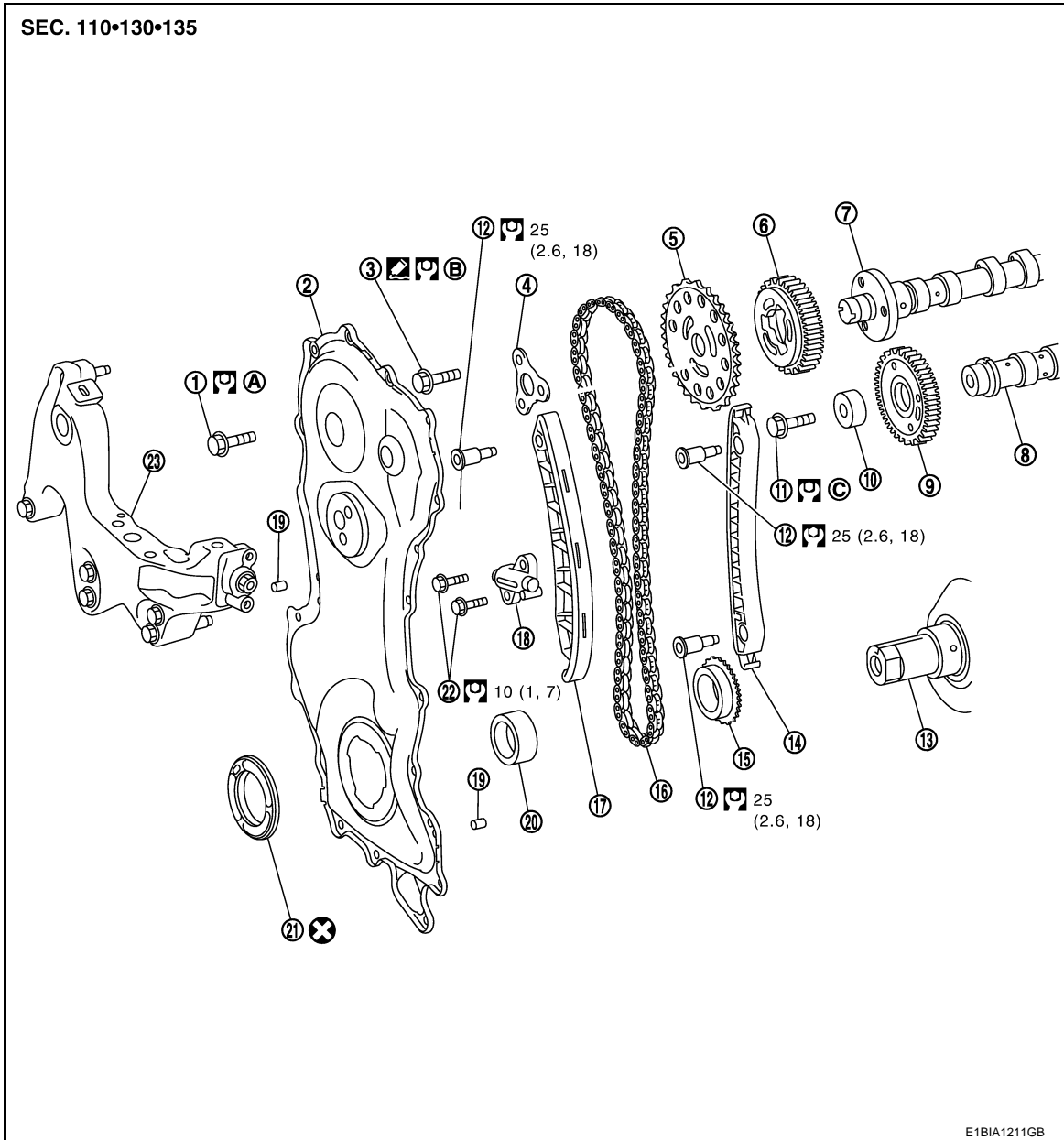
< REMOVAL AND INSTALLATION >

[R9M]

TIMING CHAIN

Exploded View

INFOID:000000010282004



- | | | |
|--|---|---|
| 1. Front cover bolt | 2. Front cover | 3. Exhaust camshaft timing sprocket bolts |
| 4. Timing sprocket spacer | 5. Exhaust camshaft timing sprocket (front) | 6. Exhaust camshaft timing sprocket (rear) |
| 7. Exhaust camshaft | 8. Intake camshaft | 9. Intake camshaft timing sprocket |
| 10. Intake camshaft timing sprocket spacer | 11. Intake camshaft timing sprocket bolt | 12. Timing chain tensioner guide and timing chain guide bolts |
| 13. Crankshaft | 14. Timing chain guide | 15. Crankshaft sprocket |
| 16. Timing chain | 17. Timing chain tensioner guide | 18. Timing chain tensioner |
| 19. Timing cover pin | 20. Crankshaft spacer | 21. Front oil seal |
| 22. Timing chain tensioner bolts | 23. Engine mounting bracket (RH) | |

TIMING CHAIN

[R9M]

< REMOVAL AND INSTALLATION >

- A. Refer to [EM-413, "Removal and Installation"](#) B. Refer to [EM-413, "Removal and Installation"](#) C. Refer to [EM-419, "Removal and Installation"](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

NOTE:

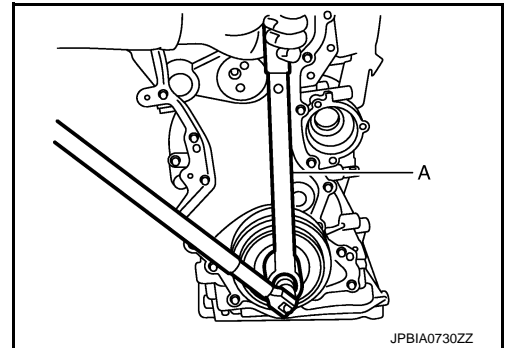
Oil pump related parts cannot be removed with an onboard condition. Refer to [EM-437, "Removal and Installation"](#).

Removal and Installation

INFOID:000000010282005

REMOVAL

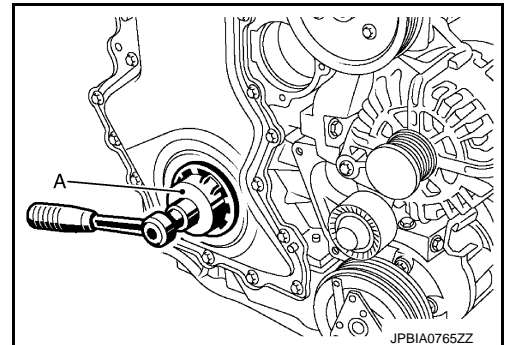
1. Drain engine oil. Refer to [LU-49, "Draining"](#).
CAUTION:
Perform this step when the engine is cold.
2. Disconnect the battery cable from the negative terminal.
3. Remove the following parts:
 - Engine undercover
 - Load wheel tire (RH)
 - Fender protector (RH): Refer to [EXT-31, "Exploded View"](#).
 - Drive belt: Refer to [EM-373, "Removal and Installation"](#).
 - Fuel filter: Refer to [FL-46, "Removal and Installation"](#).
4. Remove crankshaft pulley with the following procedure:
 - a. Set the crankshaft pulley locking tool [SST: — (Mot. 1770)] (A) and loosen crankshaft pulley bolt.



- b. Remove crankshaft pulley and spacer.
 - Pull crankshaft pulley with both hands to remove it.**CAUTION:**
Be careful not to damage front oil seal lip.
5. Remove front oil seal. Refer to [EM-427, "FRONT OIL SEAL : Removal and Installation"](#).
 - Set logs of the service tool (A) the front oil seal notches. Turn counterclockwise until it locks.

NOTE:

The service tool is supplied in the new front oil seal parts kit.



6. Remove the through bolt between lower torque rod and engine mounting bracket (rear), and hold the engine mounting bracket (rear) with a transmission jack. Refer to [EM-429, "Exploded View"](#).
CAUTION:
Never hold the oil pan (lower).
7. Remove the upper torque rod and the engine mounting insulator (RH). Refer to [EM-429, "Exploded View"](#).
8. Remove engine mounting bracket and engine mounting stay (front and rear).
9. Remove water pump pulley. Refer to [CO-100, "Exploded View"](#).

TIMING CHAIN

[R9M]

< REMOVAL AND INSTALLATION >

10. Remove front cover with the following procedure:
 - a. Loosen front cover mounting bolts.
 - b. Use the seal cutter [SST: KV10111100 (—)] to cut liquid gasket for removal.

CAUTION:

Never use a screwdriver or something similar.

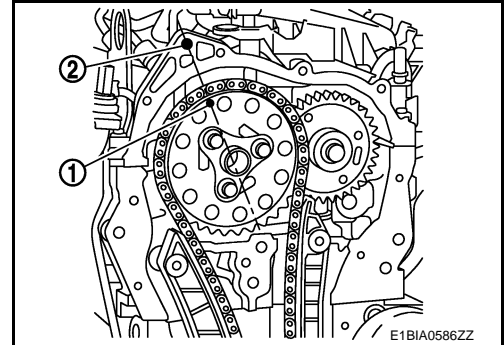
NOTE:

Unstick the front cover by hand, using a jerking motion to ensure it is not damaged.

11. Align the hole (1) on the exhaust camshaft timing sprocket (front) with the hole (2) on the rocker cover.

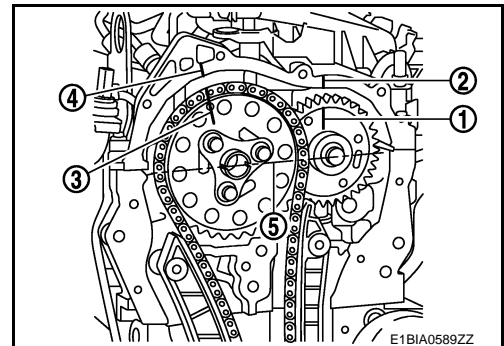
• **NOTE:**

Turn the crankshaft clockwise using the tool [SST: — (Mot.1770)].

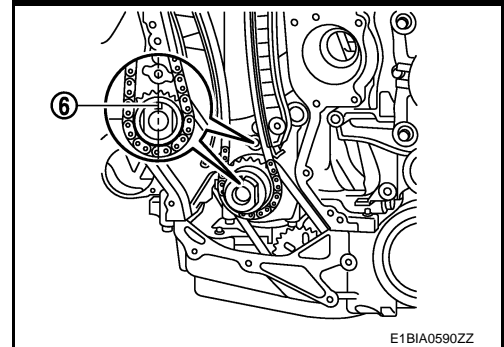


12. Remove the TDC pin plug.
13. In place of plug, manually tighten the tool [SST: — (Mot.1970)].
14. Turn the crankshaft clockwise until it makes contact with the pin.
15. Make a mark:

- on the intake camshaft timing sprocket (1) and the rocker cover (2) (vertically).
- on the hole (3) on the exhaust camshaft timing sprocket (front) and on the rocker cover (4).



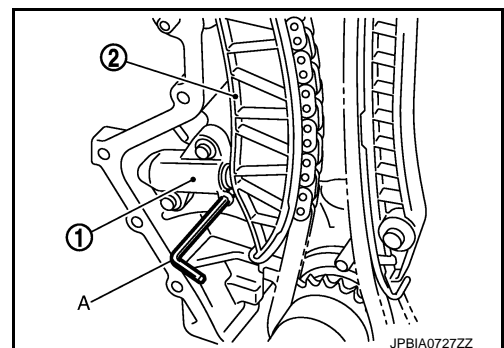
- Check the mark alignment (5) and (6).



16. Loosen the exhaust camshaft timing sprocket bolts (front).
17. Compress the timing chain tensioner (1) with timing chain tensioner guide (2), and then insert a stopper pin (A) into hole on timing chain tensioner.

NOTE:

Use approximately 3.0 mm (0.118 in) dia. hard metal pin as a stopper pin



TIMING CHAIN

< REMOVAL AND INSTALLATION >

[R9M]

18. Remove the timing chain with the following procedure:

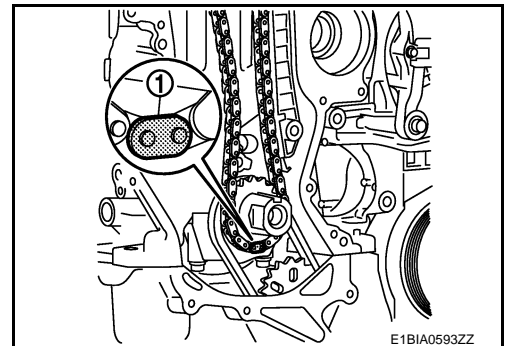
- a. the timing hydraulic tensioner,
- b. the timing chain tensioner guide,
- c. the exhaust camshaft timing sprocket bolts,
- d. the timing sprocket spacer,
- e. the crankshaft spacer,
- f. the "Exhaust camshaft timing sprocket (front) - timing chain - crankshaft sprocket" assembly,
- g. the timing chain guide,
- h. the tool [SST: — (Mot.1970)].

INSTALLATION

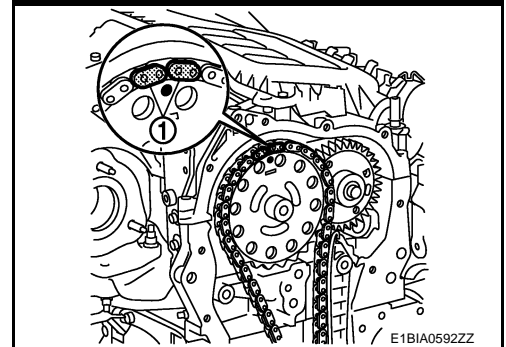
1. Set the engine at TDC.
2. Install the tool [SST: — (Mot.1970)].
3. Install timing chain guide.
4. Tighten timing chain guide bolts.

 **Timing chain guide bolts: 25 N-m (2.6 kg-m, 18 ft-lb)**

5. Install the crankshaft sprocket onto the crankshaft.
6. Position:
 - a. the timing chain on the crankshaft sprocket (align the sprocket mark with the cooper chain link (1)).



- b. the timing chain on the exhaust camshaft timing sprocket (front) (align the sprocket mark with the cooper chain link (1)).



7. Install the exhaust camshaft timing sprocket (front) onto the exhaust camshaft.
8. Place the timing sprocket spacer on the exhaust camshaft timing sprocket (front).
9. Finger tighten the exhaust camshaft timing sprocket bolts.

NOTE:

Allow the timing sprocket to rotate freely.

10. Install the crankshaft spacer.
11. Install the timing chain tensioner guide.
12. Tighten the bolt of the timing chain tensioner guide.

TIMING CHAIN

< REMOVAL AND INSTALLATION >

[R9M]

 **Timing chain tensioner guide bolts: 25 N-m (2.6 kg-m, 18 ft-lb)**

13. Install the timing hydraulic tensioner with its locking pin.

NOTE:

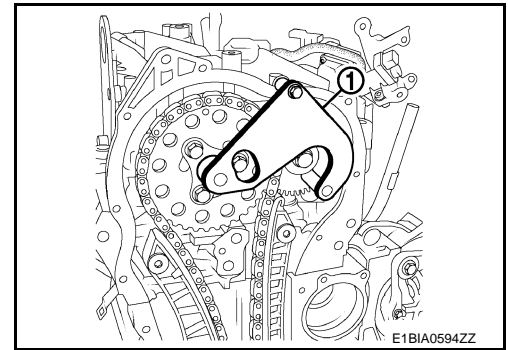
Check that the hydraulic tensioner is in contact with the cylinder block before tightening the bolts.

14. Tighten the bolts of the timing hydraulic tensioner.

 **Timing hydraulic tensioner bolts: 10 N-m (1.0 kg-m, 7 ft-lb)**

15. Remove the locking pin.

16. Engage the collet of the tool [SST: — (Mot.1969)] (15) into the exhaust camshaft groove.



17. Turn the tool to align the shafts on the spacer and the hole of the rocker cover.

18. Detach the collet of the tool from the exhaust camshaft groove.

19. Engage the pins of the tool in the holes in the intake camshaft timing sprocket.

NOTE:

Do not install the collet of the tool into the groove on the exhaust side of the camshaft.

20. Turn the tool to align the shafts on the spacer and the hole of the rocker cover.

21. Install the collet of the tool into the groove on the exhaust camshaft without forcing it (if necessary, start the previous operation again).

22. Install the rocker cover onto the tool [SST: — (Mot.1969)].

23. Tighten the exhaust camshaft timing sprocket bolts.

 **Exhaust camshaft timing sprocket bolts: 10 N-m (10 kg-m, 7 ft-lb)**

24. Turn 40 degrees clockwise (angle tightening).

25. Remove:

a. the bolts from the tool [SST: — (Mot.1969)],

b. the tool [SST: — (Mot.1969)],

c. the tool [SST: — (Mot.1970)],

26. Tighten the TDC hole plug.

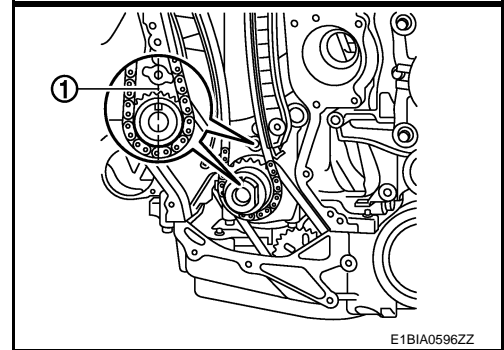
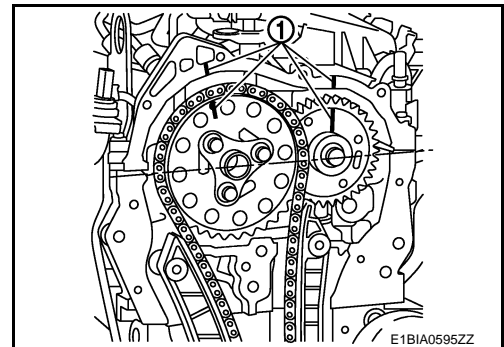
 **TDC hole plug: 25 N-m (2.6 kg-m, 18 ft-lb)**

TIMING CHAIN

< REMOVAL AND INSTALLATION >

[R9M]

27. Check the marks (1) (if necessary, start the previous operation again).



28. Install front cover with the following procedure:

- a. Apply liquid gasket to the front cover side, referring to the application point shown in the figure.

1 lower side:

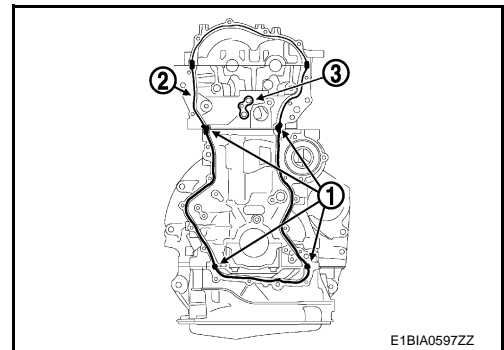
5.0 - 9.0 mm (0.098 - 0.177 in) in diameter

2 upper side:

4.0 - 8.0 mm (0.118 - 0.276 in) in diameter

3 center:

1.5 - 3.5 mm (0.394 - 0.591 in) long



Use Genuine Liquid Gasket or equivalent.

NOTE:

Liquid gasket should be applied to the front cover side because the workspace is narrow.

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TIMING CHAIN

[R9M]

< REMOVAL AND INSTALLATION >

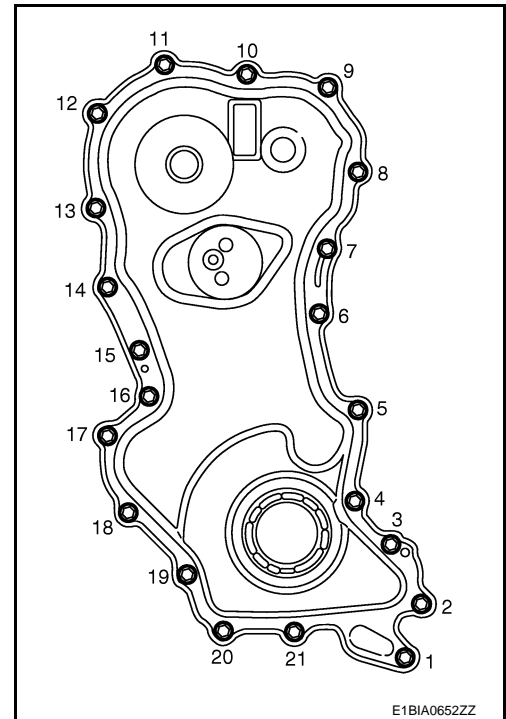
b. Install the timing cover. Refer to [EM-412. "Exploded View"](#).

i. Pre-tighten the timing cover bolts.

: **5.0 N·m (0.51 kg-m, 44 in-lb)**

ii. Tighten the timing cover bolts.

: **15 N·m (1.6 kg-m, 12 ft-lb)**



29. Install crankshaft pulley. Refer to [EM-377. "Exploded View"](#)

30. Tighten crankshaft pulley bolt

 **Crankshaft pulley bolt : 50 N·m (5.1 kg-m, 37 ft-lb)**

31. Turn 150 degrees clockwise (angle tightening).

32. Install in the reverse order of removal, for the rest of the parts.

Inspection

INFOID:000000010282006

INSPECTION AFTER INSTALLATION

Inspection for Leaks

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59. "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

TIMING SPROCKET

< REMOVAL AND INSTALLATION >

[R9M]

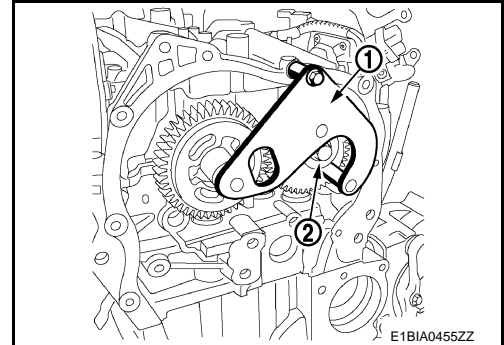
TIMING SPROCKET

Removal and installation

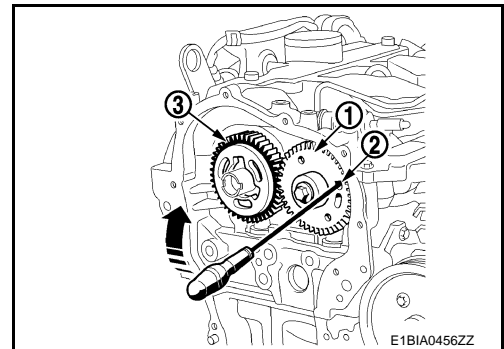
INFOID:000000010282007

REMOVAL

1. Remove the timing chain. Refer to [EM-412. "Exploded View"](#).
2. Immobilise the intake camshaft timing sprocket using the tool [SST: -(Mot.1969)] (1)
3. Loosen the intake camshaft timing sprocket bolt (2).
4. Remove the tool [SST: -(Mot.1969)] .



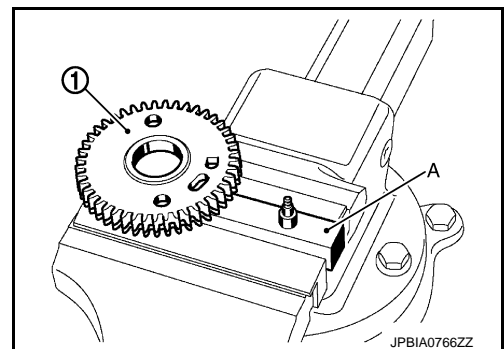
5. Place a screw driver in the hole (2), compress the spring of the intake camshaft timing sprocket (1) and remove the exhaust camshaft timing sprocket (rear) (3).



6. Remove. Refer to [EM-412. "Exploded View"](#):
 - a. the screwdriver,
 - b. the intake camshaft timing sprocket bolt,
 - c. the intake camshaft timing sprocket spacer,
 - d. the intake camshaft timing sprocket.

INSTALLATION

1. Install the intake camshaft timing sprocket with the following procedure:
 - a. Set the intake camshaft timing sprocket (1) on base plate of positioning tool [SST: — (Mot. 1773)] (A).



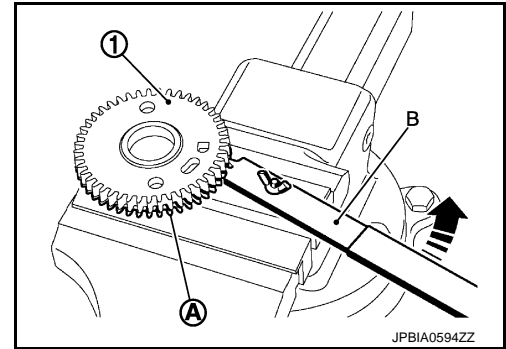
TIMING SPROCKET

[R9M]

< REMOVAL AND INSTALLATION >

- b. Set the lever (B) in the lower gear teeth (A). Pivot the lever counterclockwise until the two gear teeth are aligned.

1 : Wear compensation gear

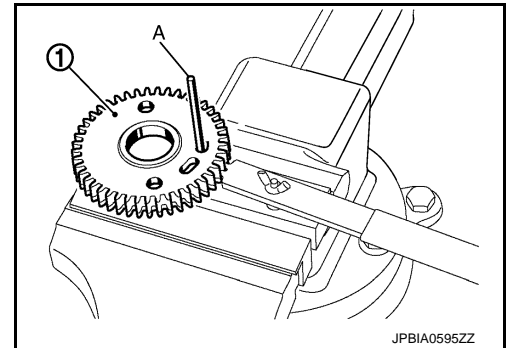


- c. Set a stopper pin (A) in the gear hole.

1 : Wear compensation gear

NOTE:

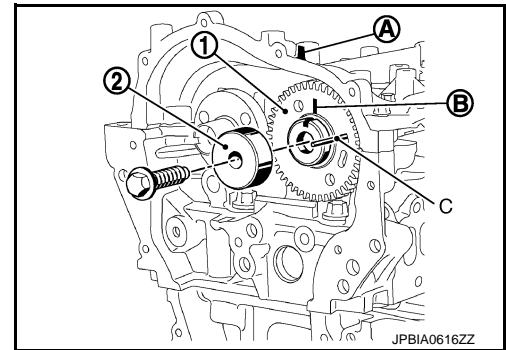
- Use approximately 4.0 mm (0.157 in) dia. hard metal pin as a stopper pin



- d. Install intake camshaft timing sprocket (1) and intake camshaft timing sprocket spacer (2) to the camshaft.
- e. Align matching mark (B) on intake camshaft timing sprocket and mark (A) of cylinder head housing.

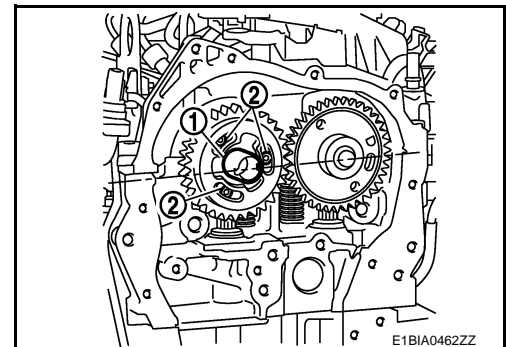
C : Stopper pin

- f. Temporarily tighten mounting bolt.



2. Install exhaust camshaft timing sprocket (rear) with the following procedure:

- Check that the exhaust camshaft groove (1) is horizontal (large ring facing upwards).
- Center the exhaust camshaft timing sprocket (rear) openings on the camshaft hub mounting holes (2).
- Set the exhaust camshaft timing sprocket (rear) fully onto the camshaft (right side) hub.
- Remove stopper pin.



- Re-install the tool [SST: -(Mot.1969)] to immobilise the intake camshaft timing sprocket.
- Tighten the intake camshaft timing sprocket bolts

Intake camshaft timing sprocket bolt:

20 Nm (2.0 kg-m, 15 ft-lb)

- Turn 35 degrees clockwise (angle tightening).
- Install in the reverse order of removal.

CAMSHAFT

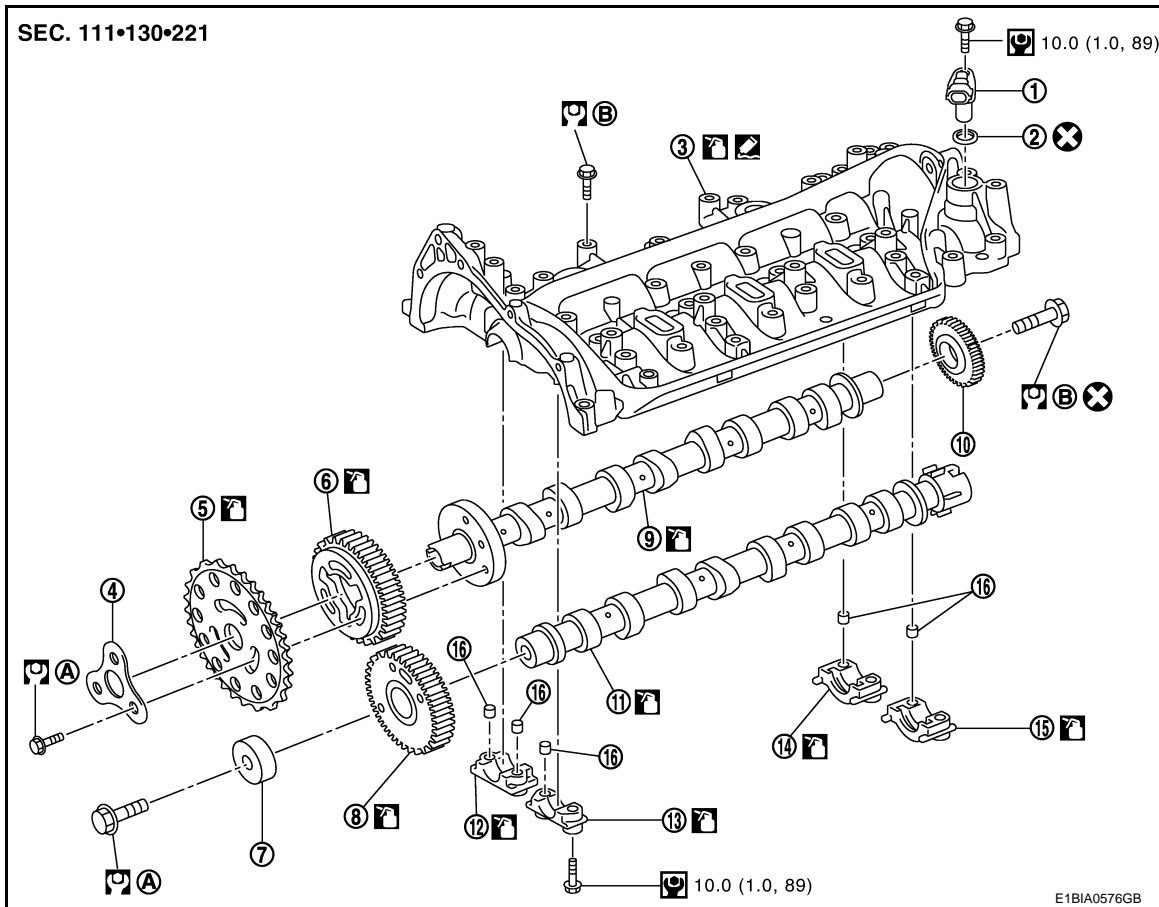
< REMOVAL AND INSTALLATION >

[R9M]

CAMSHAFT

Exploded View

INFOID:000000010282008



- | | | |
|---|---|--|
| 1. Camshaft position sensor | 2. O-ring | 3. Cylinder head housing |
| 4. Timing sprocket spacer | 5. Exhaust camshaft timing sprocket (front) | 6. Exhaust camshaft timing sprocket (rear) |
| 7. Intake camshaft timing sprocket spacer | 8. Intake camshaft timing sprocket | 9. Exhaust camshaft |
| 10. Camshaft sprocket (for fuel pump) | 11. Intake camshaft | 12. Camshaft bracket |
| 13. Camshaft bracket | 14. Camshaft bracket | 15. Camshaft bracket |
| 16. Camshaft bracket pin | | |
- A. Refer to [EM-413, "Removal and Installation"](#) or [EM-419, "Removal and installation"](#)
- B. Refer to [EM-421, "Removal and Installation"](#)

Refer to [GI-4, "Components"](#) for symbols shown in the figure.

Removal and Installation

INFOID:000000010282009

REMOVAL

- Remove the following parts.
 - Oil separator: Refer to [EM-402, "Exploded View"](#).
 - Fuel injector: Refer to [EM-404, "Exploded View"](#).
 - Engine slinger (front side): Refer to [EM-440, "Exploded View"](#).
 - Front cover and timing chain related parts: Refer to [EM-412, "Exploded View"](#).
 - Fuel pump: Refer to [EM-408, "Exploded View"](#).
 - Vacuum pump: Refer to [EM-400, "Exploded View"](#).
- Remove camshaft position sensor.

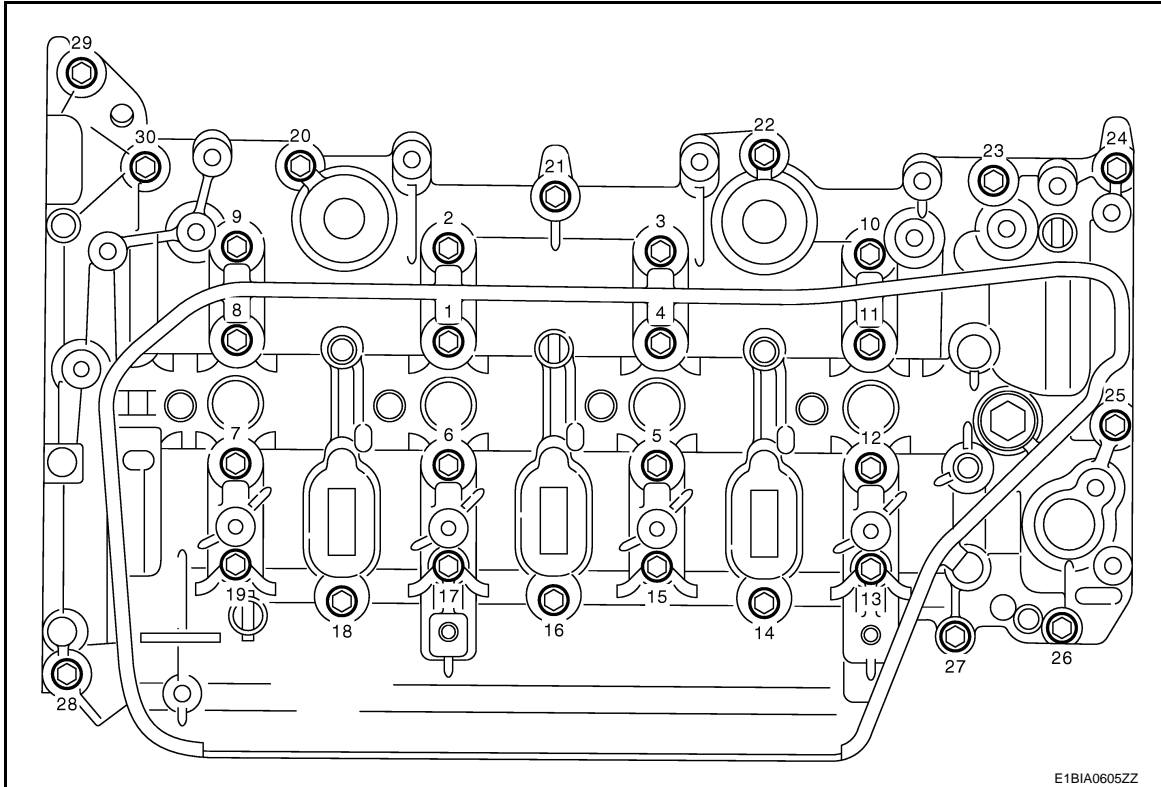
CAMSHAFT

< REMOVAL AND INSTALLATION >

[R9M]

CAUTION:

- Handle camshaft position sensor carefully and avoid impacts.
 - Never disassemble camshaft position sensor.
 - Never place sensor where it is exposed to magnetism.
3. Remove cylinder head housing with the following procedure:
 - a. Loosen mounting bolts in reverse order as shown in the figure.



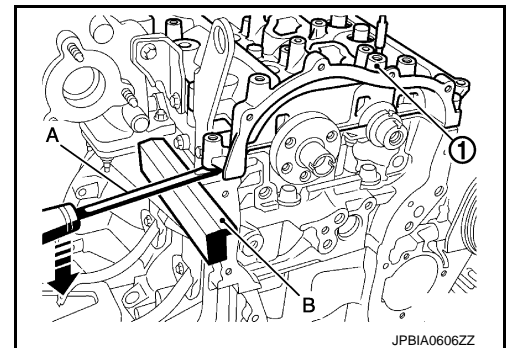
← : Engine front

- b. Remove the cylinder head housing (1) using a flat-blade screwdriver (A).

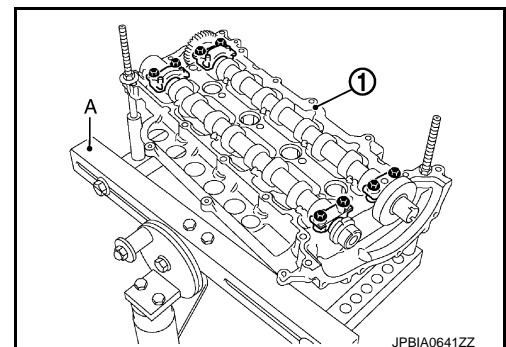
B : Protective shim (suitable tool)

CAUTION:

Be careful not to damage the mating surface.



4. Remove camshafts with the following procedure:
 - a. Install cylinder head housing (1) to cylinder head stand [commercial service tool: KV113B0200 (Mot.1573)] (A).
 - b. Loosen mounting bolts, and remove camshaft brackets and camshafts.
 - Mark camshafts and camshaft brackets so they are placed in the same position and direction for installation.



CAMSHAFT

[R9M]

< REMOVAL AND INSTALLATION >


- Remove camshaft sprocket (for fuel pump) from camshaft (right side), if necessary.

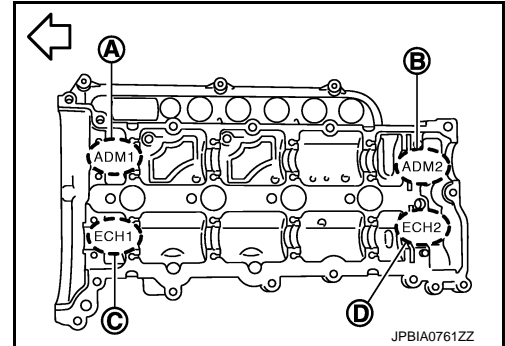
INSTALLATION

- When camshaft sprocket (for fuel pump) is removed, install it.
 - Tighten mounting bolt.

: **30 N·m (3.1 kg-m, 22 ft-lb)**

- Install camshaft to cylinder head housing with the following procedure:
 - Clean camshaft journal to remove any foreign material.
 - Install camshafts.
 - Refer to the figure to install camshaft bracket in its original.

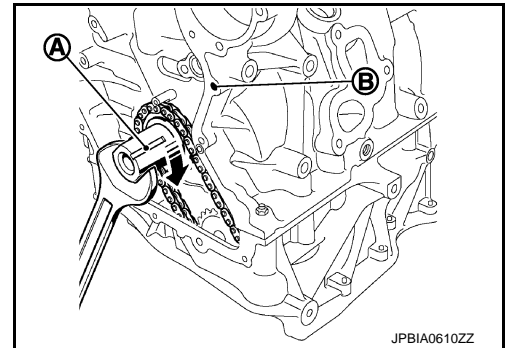
- A. : Part marking ADM1
- B. : Part marking ADM2
- C. : Part marking ECH1
- D. : Part marking ECH2
-  : Engine front




- Tighten camshaft bracket mounting bolts.
 - Finger tighten the camshaft bracket mounting bolts, until they just make contact.
- Install cylinder head housing with the following procedure:
 - Align the crankshaft groove (A) with the cylinder block hole (B).

NOTE:

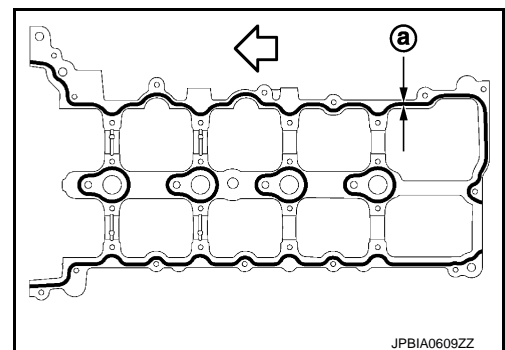
This is for the purpose of preventing interferences of valve and piston head.



- Remove foreign material completely from cylinder head housing backside and cylinder head installation face.
- Apply liquid gasket to cylinder head as shown in the figure.

- a : 0.5 - 2.5 mm (0.020 - 0.098 in)
-  : Engine front

Use Genuine Liquid Gasket or equivalent.

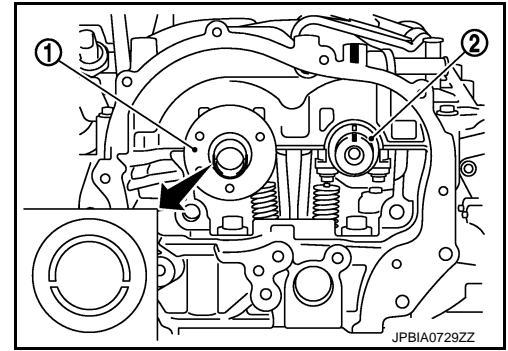


CAMSHAFT

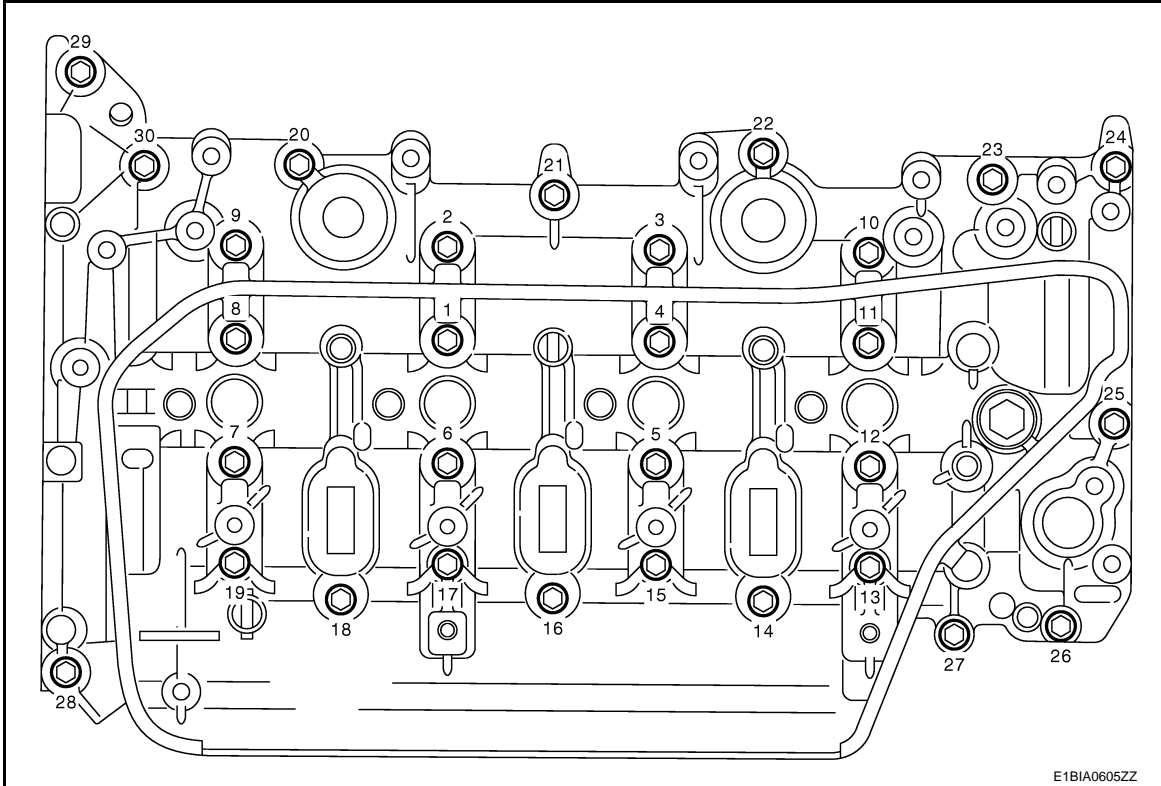
[R9M]

< REMOVAL AND INSTALLATION >

- d. Install so that camshafts are positioned in the directions shown in the figure.
- Parallelize the groove of camshaft (right side) (1) to face the offset side upward.
 - Fit the groove of camshaft (left side) (2) and boss of cylinder head housing.



- e. Tighten mounting bolts of cylinder head housing in the following steps.



↶ : Engine front

- Tighten in order and successively, the cylinder head housing bolts No. 6, 4, 8 and 12 to gradually fit the cylinder head housing on the cylinder head.
- Tighten the remaining bolts (temporarily).
- Loosen bolts No. 6, 4, 8 and 12.
- Tighten the bolts No. 6, 4, 8 and 12 (temporarily).
- Tighten bolts in numerical order.

: **5.0 N·m (0.51 kg-m, 44 in-lb)**

- Tighten bolts in numerical order.

: **12.0 N·m (1.2 kg-m, 9 ft-lb)**

CAUTION:

After tightening mounting bolts of cylinder head housing, be sure to wipe off excessive liquid gasket from the mating surface of cylinder head.

- Install timing chain and related parts. Refer to [EM-412, "Exploded View"](#).

CAMSHAFT

[R9M]

< REMOVAL AND INSTALLATION >

5. Install in the reverse order of removal, for the rest of parts

Inspection

INFOID:000000010282010

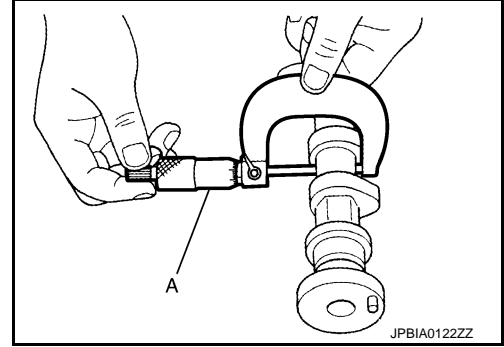
INSPECTION AFTER REMOVAL

Camshaft Journal oil clearance

CAMSHAFT JOURNAL

- Measure the camshaft journal with a micrometer (A).

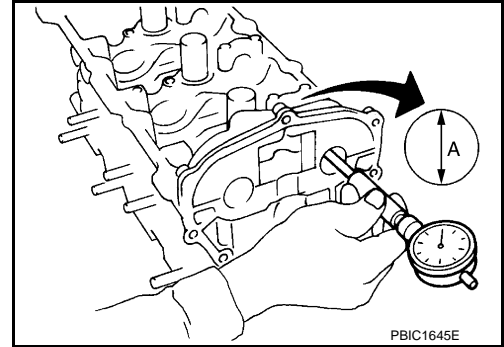
Standard : Refer to [EM-473, "Camshaft"](#).



CYLINDER HEAD HOUSING AND CAMSHAFT BRACKET INNER DIAMETER

- Measure the inner diameter (A) of cylinder head housing and camshaft bracket with a bore gauge.

Standard : Refer to [EM-473, "Camshaft"](#).



CAMSHAFT JOURNAL OIL CLEARANCE

- (Oil clearance) = (Bracket inner diameter) – (Camshaft journal diameter)

Standard : Refer to [EM-473, "Camshaft"](#).

- If it exceeds the standard, replace camshaft or/and cylinder head housing and cylinder head assembly.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level

CAMSHAFT

< REMOVAL AND INSTALLATION >

[R9M]

Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

OIL SEAL FRONT OIL SEAL

FRONT OIL SEAL : Removal and Installation

INFOID:000000010282011

A

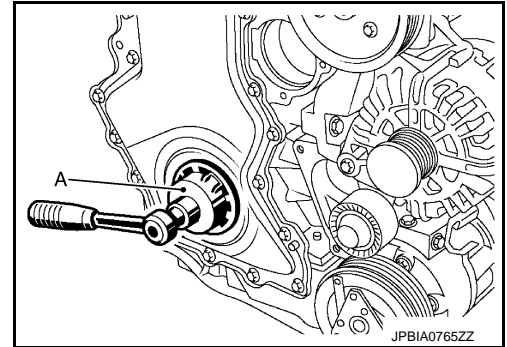
EM

REMOVAL

1. Remove the following parts.
 - Front fender protector (RH): Refer to [EXT-31. "Exploded View"](#).
 - Drive belt: Refer to [EM-373. "Removal and Installation"](#).
 - Crankshaft pulley: Refer to [EM-377. "Exploded View"](#).
2. Remove front oil seal using service tool (A).

NOTE:

The service tool is supplied in the new seal parts kit.



C

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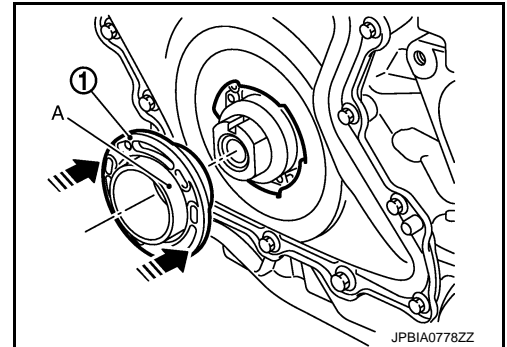
G

INSTALLATION

1. Install front oil seal with the following procedure:
 - a. Fit the protector (A) to front oil seal (1).
 - Align the front oil seal notches with front cover notches.

NOTE:

The protector is supplied in the new seal parts kit.



H

I

J

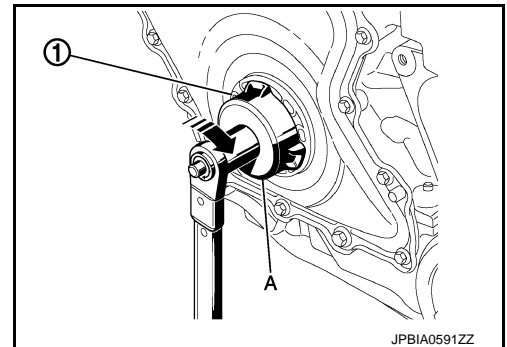
K

- b. Tighten to front oil seal (1) using service tool (A).

47 N·m (4.8 kg-m, 35 ft-lb)

NOTE:

The service tool is supplied in the new seal parts kit.



L

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N

O

- c. Remove the protector.
2. Install in the reverse order of removal, for the rest of parts.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:000000010282012

REMOVAL

1. Remove transaxle assembly. Refer to [TM-88. "Exploded View"](#) or [TM-148. "Exploded View"](#).

P

OIL SEAL

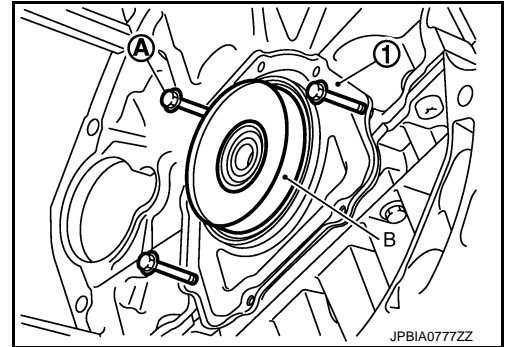
[R9M]

< REMOVAL AND INSTALLATION >

2. Remove clutch cover and clutch disk. Refer to [CL-26, "R9M : Removal and Installation"](#).
3. Remove rear oil seal retainer.

INSTALLATION

1. Install rear oil seal retainer with the following procedure:
 - a. Set guide bolt (A) and protector (B) to rear oil seal retainer (1).
NOTE:
The protector is supplied in the new seal parts kit.
 - b. Move the rear oil seal retainer evenly by hand until it makes contact with the cylinder block.

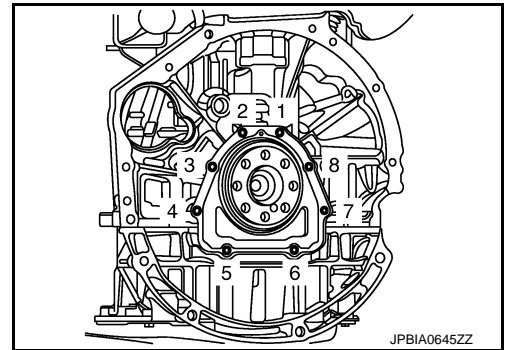


- c. Remove guide bolts and protector.
 - d. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.
 - i. Tighten bolts No. 1 and 5.

: **5.0 N·m (0.51 kg-m, 44 in-lb)**

- ii. Tighten No. 1 to 8 in numerical order as shown.

: **12.0 N·m (1,2 kg-m, 9 ft-lb)**



2. Install in the reverse order of removal, for the rest of parts.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[R9M]

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:000000010282013

2WD

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EM

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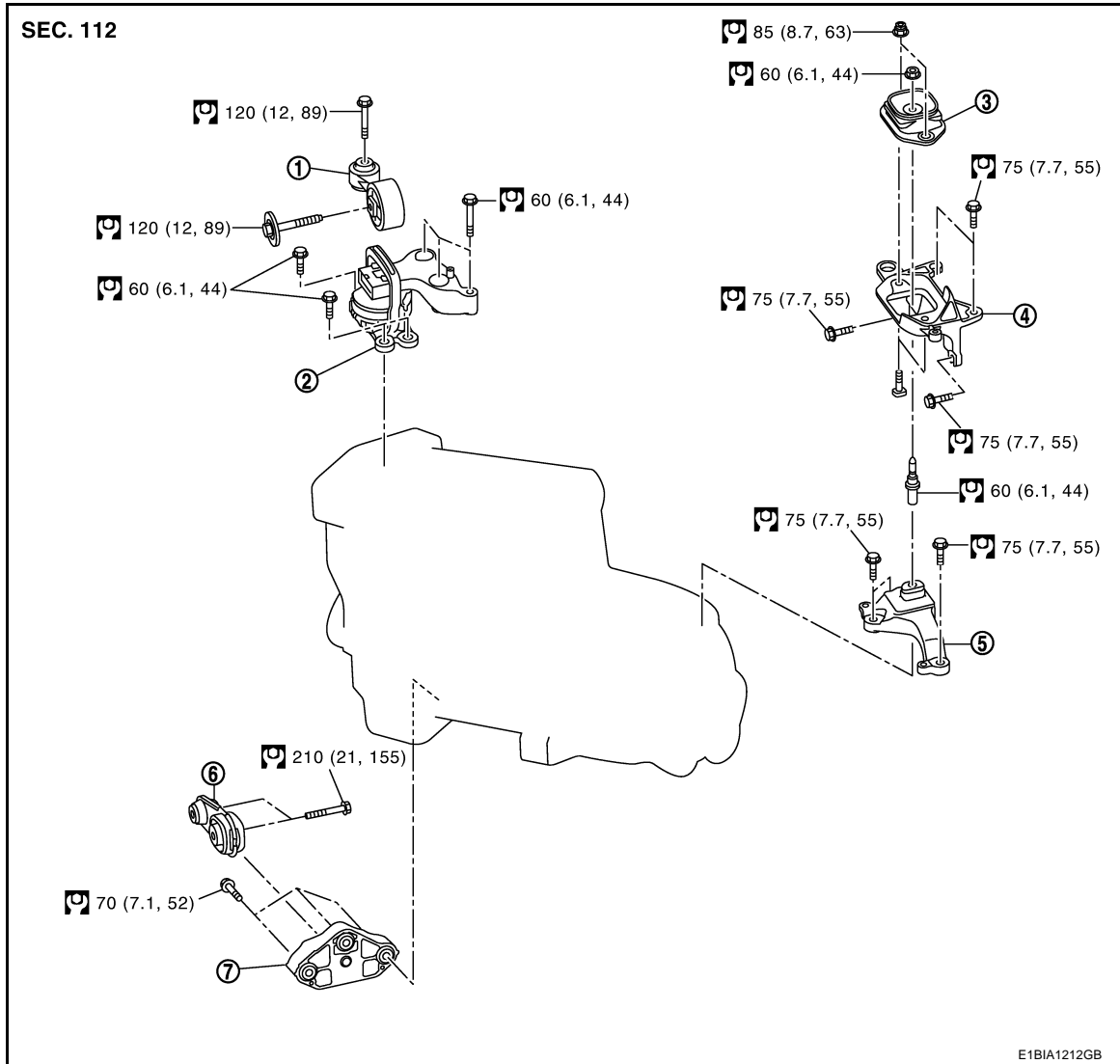
L

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P



1. Upper torque rod
2. Engine mounting insulator (RH)
3. Engine mounting insulator (LH)
4. Engine mounting frame support (LH)
5. Engine mounting bracket (LH)
6. Rear torque rod
7. Rear engine mounting bracket

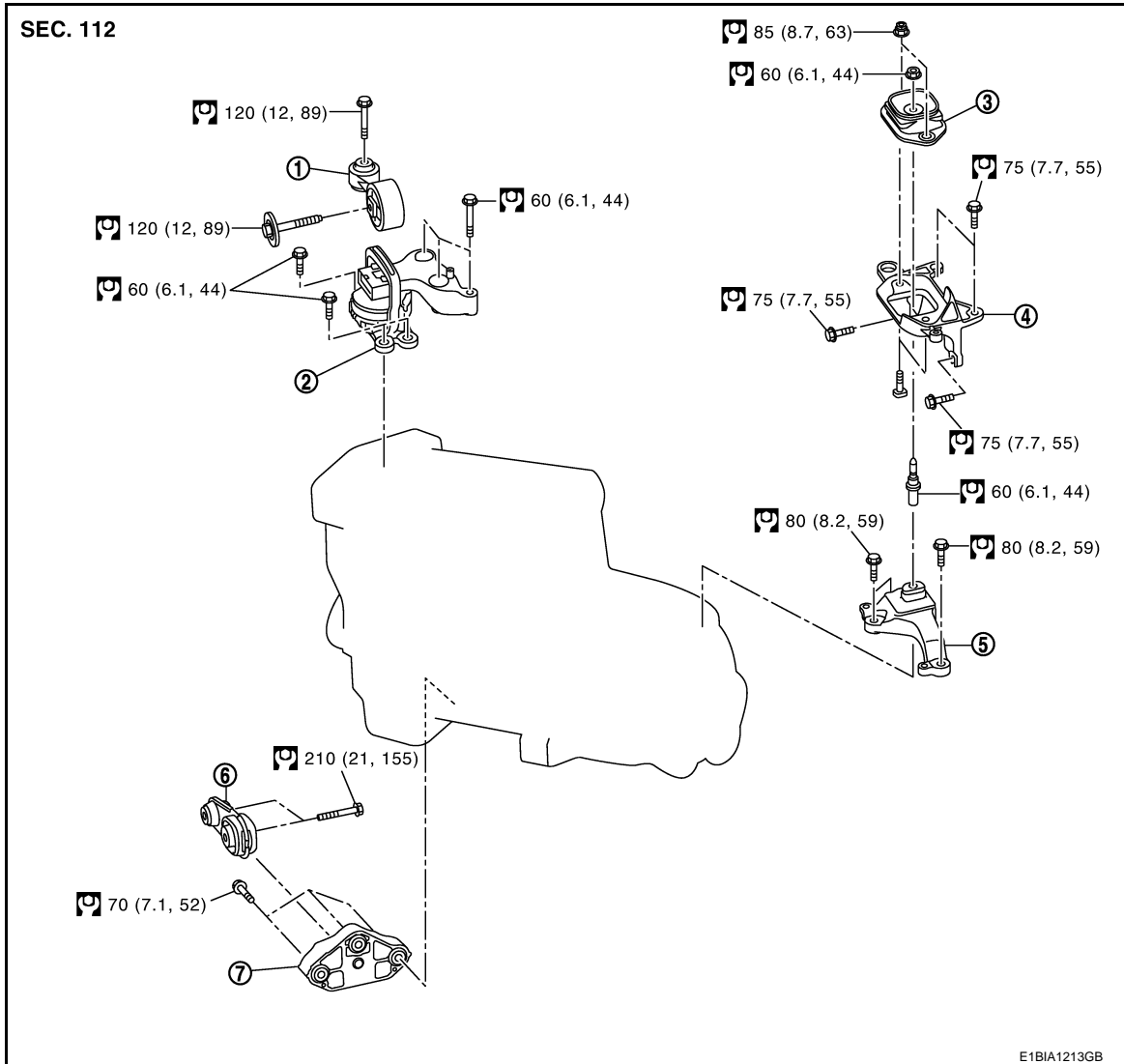
Refer to [GI-4, "Components"](#) for symbols in the figure.

4WD

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[R9M]



1. Upper torque rod
2. Engine mounting insulator (RH)
3. Engine mounting insulator (LH)
4. Engine mounting frame support (LH)
5. Engine mounting bracket (LH)
6. Rear torque rod
7. Rear engine mounting bracket

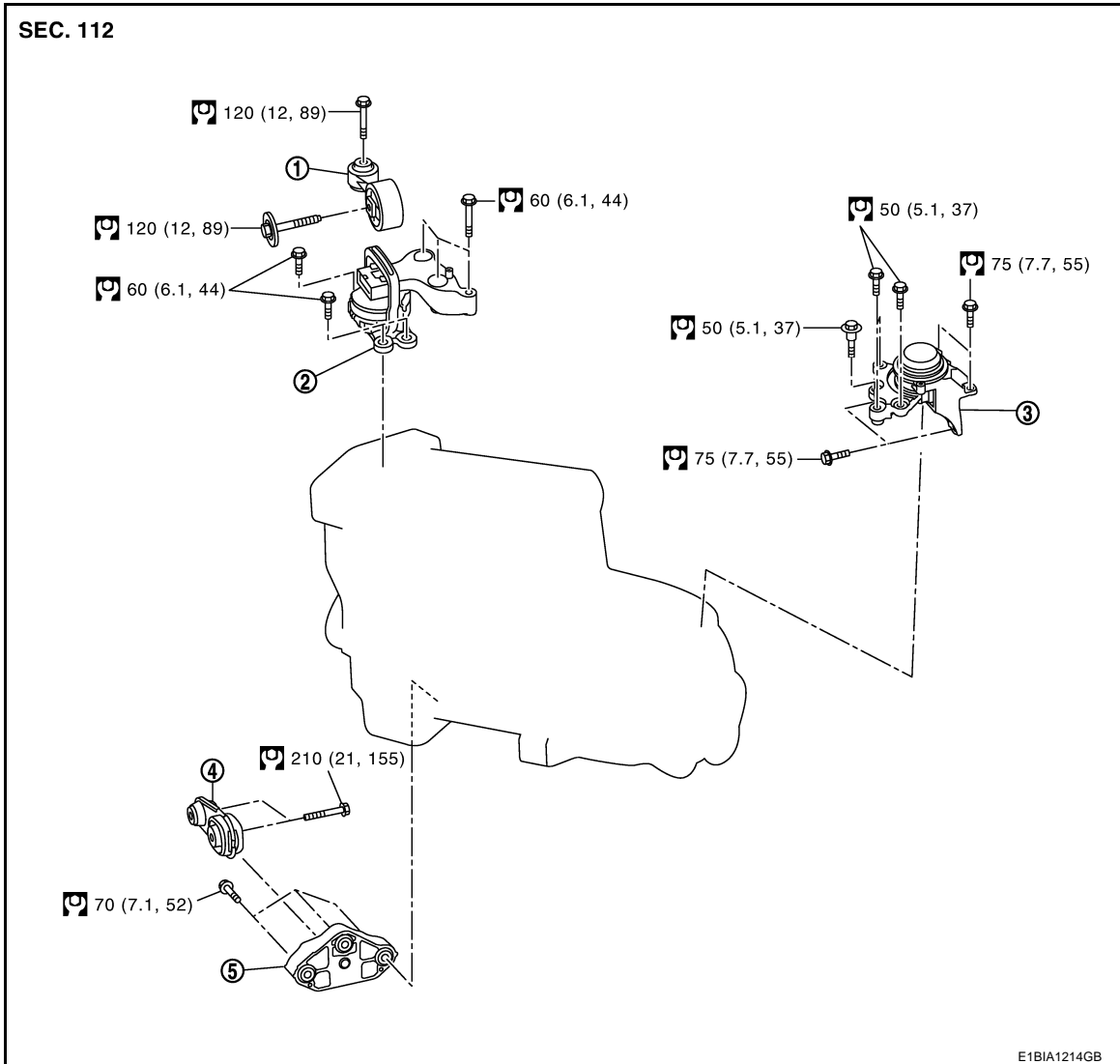
Refer to [GI-4, "Components"](#) for symbols in the figure.

CVT

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[R9M]



1. Upper torque rod
2. Engine mounting insulator (RH)
3. Engine mounting insulator (LH)
4. Rear torque rod
5. Rear engine mounting bracket

Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282014

WARNING:

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Never start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-36, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

NOTE:

ENGINE ASSEMBLY

[R9M]

< UNIT REMOVAL AND INSTALLATION >

When removing components such as hoses, tubes / lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

Preparation

1. Drain engine coolant from radiator. Refer to [CO-89, "Draining"](#).
CAUTION:
 - Perform this step when the engine is cold.
 - Never spill engine coolant on drive belt.
2. Remove the following parts.
 - Engine undercover
 - Engine cover
 - Front fender protector (RH and LH): Refer to [EXT-31, "Exploded View"](#).
 - Road wheels tire (RH and LH): Refer to [WT-60, "Removal and Installation"](#) or [WT-73, "Removal and Installation"](#).
 - Battery and battery tray: Refer to [PG-155, "Removal and Installation"](#).
 - Air inlet tubes and air inlet hoses: Refer to [EM-382, "Exploded View"](#).
 - Air duct (inlet) and air duct/air cleaner case assembly: Refer to [EM-380, "Exploded View"](#).
 - Radiator hose (upper and lower) and cooling fan assembly: Refer to [CO-95, "Exploded View"](#).
 - Exhaust front tube: Refer to [EX-22, "Exploded View"](#).

Engine Room LH

1. Remove ECM and bracket.
2. Remove harness bracket from engine mounting insulator (LH).
3. Disconnect all connections of engine harness around the engine mounting insulator (LH), and then temporarily secure the engine harness into the engine side.
CAUTION:
Protect connectors using a resin bag against foreign materials during the operation.
4. Disconnect fuel hoses from fuel pump. Refer to [EM-404, "Exploded View"](#) and [EM-408, "Exploded View"](#).
5. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining.
6. Disconnect shift cable/select cable from transaxle. Refer to [TM-83, "Removal and Installation"](#) or [TM-143, "Removal and Installation"](#).
7. Remove ground cable from transaxle side.
8. Disconnect vacuum hose from brake booster.

Engine Room RH

1. Remove ground cable.
2. Disconnect reservoir tank hose (lower).
3. Remove alternator. Refer to [CHG-31, "R9M : Removal and Installation"](#).
4. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to [HA-121, "Removal and Installation"](#).

Vehicle Underbody

1. Remove front wheel sensor (LH and RH) for ABS from steering knuckle. Refer to [BRC-138, "FRONT WHEEL SENSOR : Removal and Installation"](#).
2. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to [BR-35, "BRAKE PAD : Exploded View"](#).
3. Remove two mounting bolts which fix steering knuckle and strut. Refer to [FSU-20, "Exploded View"](#).
4. Remove rear torque rod.
5. Remove propeller shaft (4WD models). Refer to [DLN-186, "Removal and Installation"](#).
6. Remove drive shaft (LH and RH). Refer to [FAX-22, "Removal and Installation \(LH\)"](#) and [FAX-26, "Removal and Installation \(RH\)"](#) (2WD models) or [FAX-60, "Removal and Installation \(LH\)"](#) and [FAX-63, "Removal and Installation \(RH\)"](#) (4WD models).

ENGINE ASSEMBLY

[R9M]

< UNIT REMOVAL AND INSTALLATION >

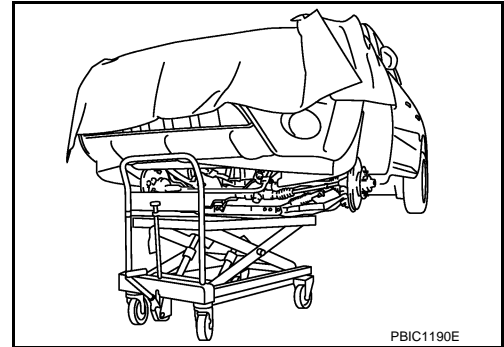
7. Remove stabilizer connecting rod mounting nut and cap at strut side (RH and LH). Refer to [FSU-18, "Removal and Installation"](#).
8. Disconnect intermediate shaft to steering column assembly. Refer to [ST-10, "Exploded View"](#).
9. Disconnect clutch pipe. Refer to [CL-15, "Exploded View"](#).
10. Remove front suspension member. Refer to [FSU-21, "Removal and Installation"](#).
11. Preparation for the separation work of transaxle is as follows:
 - Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side.

Removal

1. Use a manual lift table caddy (commercial service tool) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.

CAUTION:

Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



2. Remove upper torque rod.
3. Remove mounting bolts on engine mounting insulator (RH).
4. Remove mounting bolts on engine mounting insulator (LH).
5. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.

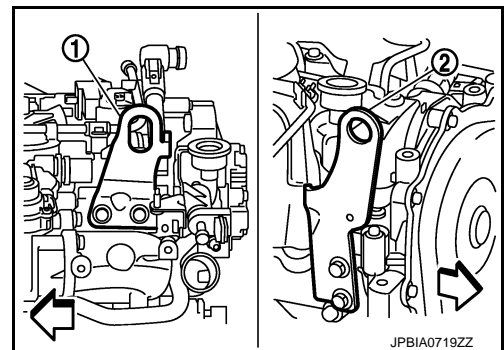
CAUTION:

- Check that no part interferes with the vehicle side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support the vehicle by setting jack or suitable tool at the rear.

Separation

1. Set a hoist to engine slinger (rear side) (1) and engine slinger (front side) (2).

← : Engine front



2. Remove starter motor. Refer to [STR-32, "R9M : Removal and Installation"](#).
3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [EM-440, "Exploded View"](#).

INSTALLATION

Note the following, and install in the reverse order of removal.

CAUTION:

- Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[R9M]

Inspection

INFOID:000000010282015

INSPECTION AFTER INSTALLATION

Inspection for Leaks

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-59, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
Transmission / transaxle fluid	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluid*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

INFOID:000000010282016

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NOTE:

Explained here is how to disassemble with engine stand supporting transaxle surface. When using different type of engine stand, note with difference in steps and etc.

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-429, "Exploded View"](#).

2. Install engine to engine stand with the following procedure:

a. Remove flywheel. Refer to [EM-447, "Disassembly and Assembly"](#)

- Secure crankshaft using a crankshaft pulley locking tool [SST: — (Mot.1770)], and remove mounting bolts.

CAUTION:

Never disassemble them.

b. Lift the engine with a hoist to install it onto widely use engine stand.

CAUTION:

Use the engine stand that has a load capacity [approximately 225 kg (496 lb) or more] large enough for supporting the engine weight.

- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.

- Intake manifold: Refer to [EM-387, "Exploded View"](#).

- Exhaust manifold: Refer to [EM-393, "Exploded View"](#).

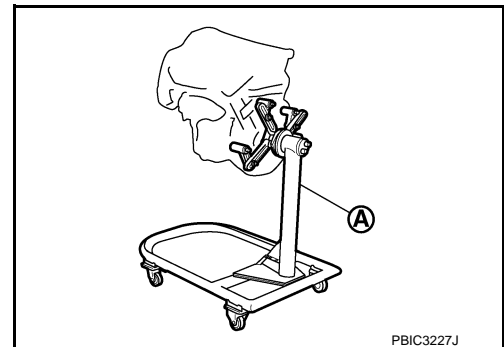
- Oil separator: Refer to [EM-402, "Exploded View"](#).

NOTE:

The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel removed.

CAUTION:

Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.



3. Drain engine oil. Refer to [LU-49, "Draining"](#).

CAUTION:

Be sure to clean drain plug and install with new gasket.

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ENGINE UNIT

Disassembly

INFOID:000000010282017

Preparing the old engine to be returned to the engine renovation plant

1. Clean the engine
2. Drain the oil and coolant from the used engine.
3. Secure the old engine to the stand and in the same conditions as the standard replacement engine :
 - fit the plastic plug welds and covers,
 - fit the cardboard cover over the whole assembly.

Parts to leave on the old engine or to include in the return box:

- the dipstick,
- the oil filter,
- the oil filter unit,
- the cylinder head,
- the water pump,
- the vacuum pump,
- the high pressure pump,
- the injectors,
- the heater plugs,
- the crankshaft accessories pulley,
- the cylinder head suspended mounting.

Parts to be removed from the old engine and fitted on the new engine

- all the coolant circuit pipes,
- the coolant pump inlet pipe,
- the coolant inlet unit,
- the intake manifold,
- the exhaust manifold,
- the turbocharger,
- the exhaust gas recirculation solenoid valve,
- the damper valve,
- the exhaust gas recirculation low pressure solenoid valve,
- the exhaust gas cooler,
- the swirl valve,
- the particle filter,
- the alternator,
- the air conditioning compressor,
- the clutch mechanism-plate,
- the flywheel.

Assembly

INFOID:000000010282018

Assembly is the reverse order of disassembly.

OIL PAN (UPPER)

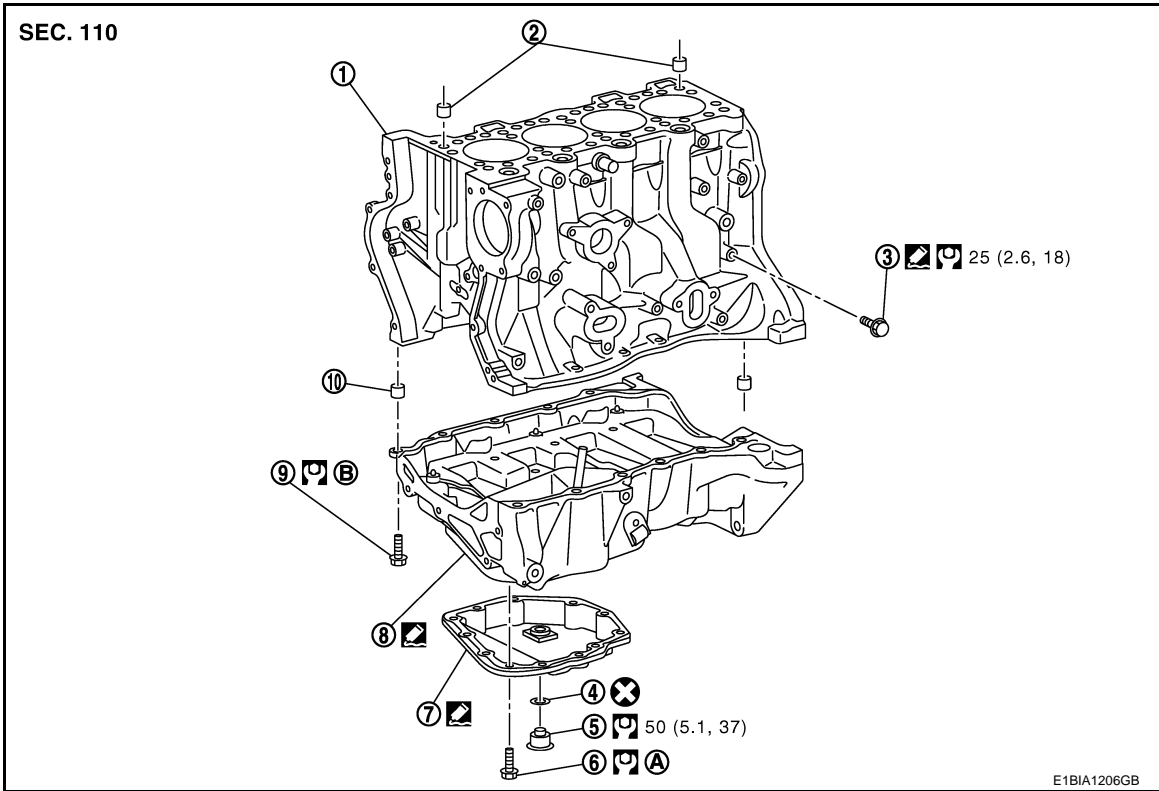
< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

OIL PAN (UPPER)

Exploded View

INFOID:000000010282019



- | | | |
|------------------------------------|--|-------------------------|
| 1. Cylinder block | 2. Bush | 3. TDC pin plug |
| 4. Gasket | 5. Oil pan drain plug | 6. Oil pan (lower) bolt |
| 7. Oil pan (lower) | 8. Oil pan (upper) | 9. Oil pan (upper) bol |
| 10. Bush | | |
| A. Refer to EM-396 | B. Refer to EM-437, "Removal and Installation" | |

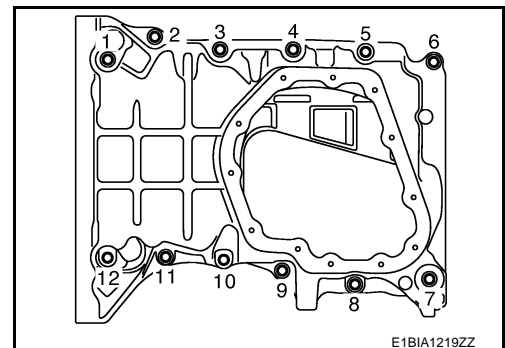
Refer to [GI-4, "Components"](#) for symbols in the figure.

Removal and Installation

INFOID:000000010282020

REMOVAL

1. Remove oil pan (lower). Refer to [EM-396, "Removal and Installation"](#).
2. Remove oil strainer and oil pump. Refer to [LU-55, "Exploded View"](#)
3. Remove rear oil seal retainer. Refer to [EM-427, "REAR OIL SEAL : Removal and Installation"](#).
4. Remove oil pan (upper) with the following procedure:
 - a. Loosen mounting bolts in reverse order as shown in the figure.



OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

- b. Insert the seal cutter [SST: KV10111100 (—)] between oil pan (upper) and cylinder block.
 - Slide tool by tapping on the side of the tool with a hammer.

CAUTION:

 - **Be careful not to damage mating surface.**
- c. Remove the oil pan (upper) from the cylinder block.


INSTALLATION

- 1. Install oil pump and oil pump baffle plate with the following procedure:
 - a. Install oil pump (1), oil pump baffle plate, oil pump drive chain and oil pump sprocket.
 - b. Tighten oil pump mounting bolts (A) in two steps.

 **1st step: 5.0 N-m (0.51 kg-m, 44 in-lb)**

 **2nd step: 25.0 N-m (2.6 kg-m, 18 ft-lb)**

- c. Tighten oil stainer bolt (B).

 **8.0 N-m (1 kg-m, 7 ft-lb)**

- 2. Install oil pan (upper) with the following procedure:
 - a. Use a scraper (A) to remove old liquid gasket from mating surfaces.

CAUTION:

Never scratch or damage the mating surfaces when cleaning off old liquid gasket.

 - Also remove old liquid gasket from mating surface of cylinder block.
 - Remove old liquid gasket from the bolt holes and threads.
 - b. Apply a continuous bead of liquid gasket with the tube presser (commercial service tool) to areas shown in the figure.

: 3.0 - 7.0 mm (0.118 - 0.276 in)

Use Genuine Liquid Gasket or equivalent

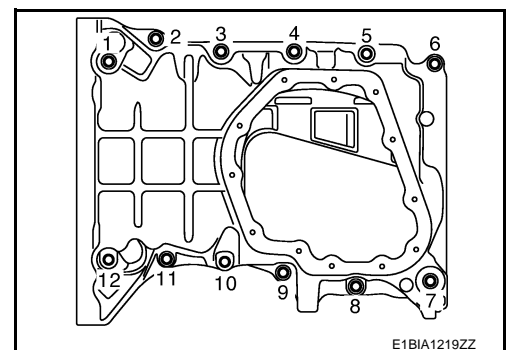
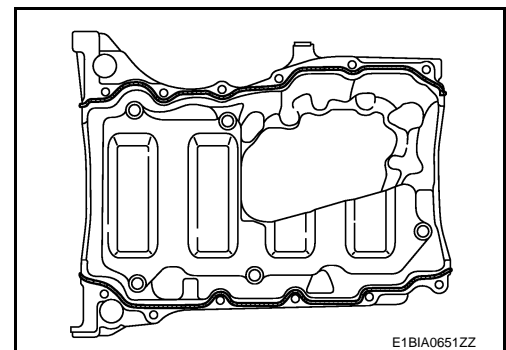
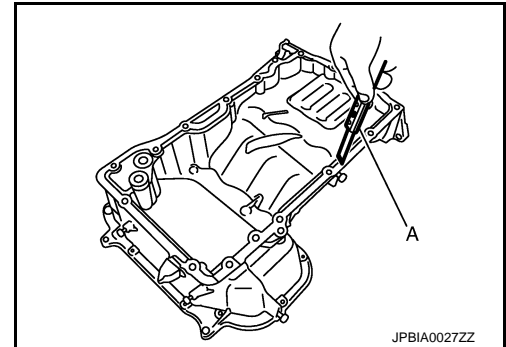
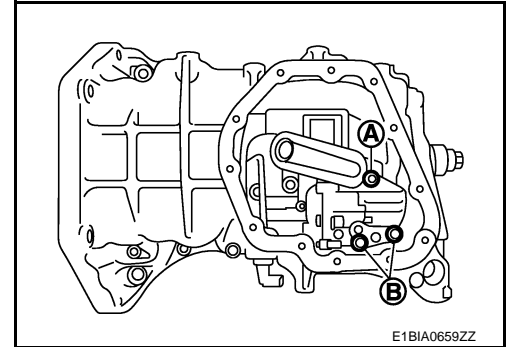
CAUTION:

- **At the bolt holes marked, liquid gasket should be applied inside holes.**
- **Attaching should be done within 5 minutes after coating.**

- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.

 **1st step: 10.0 N-m (1.0 kg-m, 7 ft-lb)**

 **2nd step: 25.0 N-m (2.6 kg-m, 18 ft-lb)**



OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

3. Install rear oil seal retainer. Refer to [EM-427. "REAR OIL SEAL : Removal and Installation"](#).
4. Install in the reverse order of removal, for the rest of parts.

NOTE:

At least 30 minutes after oil pan is installed, pour engine oil.

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CYLINDER HEAD

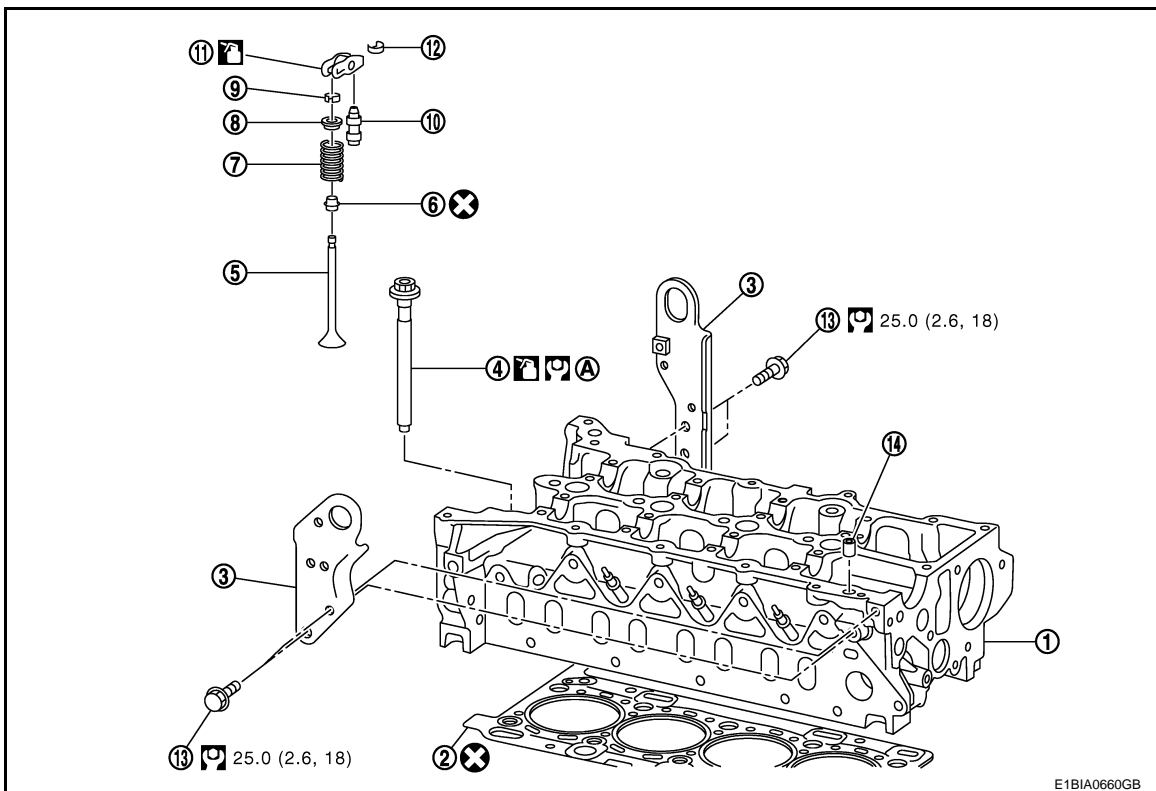
< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

CYLINDER HEAD

Exploded View

INFOID:000000010282021



- | | | |
|-----------------------|--------------------------|------------------------|
| 1. Cylinder head | 2. Cylinder head gasket | 3. Engine slinger |
| 4. Cylinder head bolt | 5. Valve | 6. Valve oil seal |
| 7. Valve spring | 8. Valve spring retainer | 9. Valve collet |
| 10. Tappet | 11. Hydraulic tappet | 12. Valve rocker clips |
| 13. Slinger bolt | 14. Bush | |

A. Refer to [EM-447, "Disassembly and Assembly"](#)

Refer to [GI-4, "Components"](#) for symbols in the figure.

Disassembly and Assembly

INFOID:000000010282022

DISASSEMBLY

1. Remove the following components and related parts.
 - Turbocharger: Refer to [EM-390, "Exploded View"](#).
 - Intake manifold: Refer to [EM-387, "Exploded View"](#).
 - Exhaust manifold: Refer to [EM-393, "Exploded View"](#).
 - Water outlet and thermostat assembly: Refer to [EM-446, "Exploded View"](#).
 - Front cover, timing chain: Refer to [EM-446, "Exploded View"](#).
 - Camshaft: Refer to [EM-440, "Exploded View"](#)

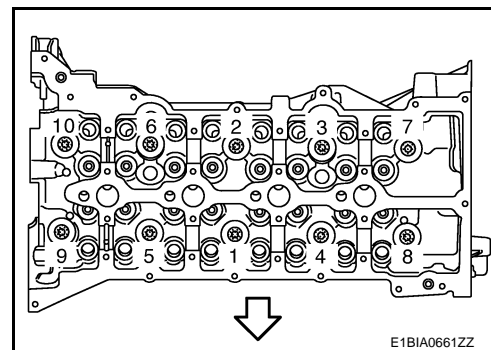
CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

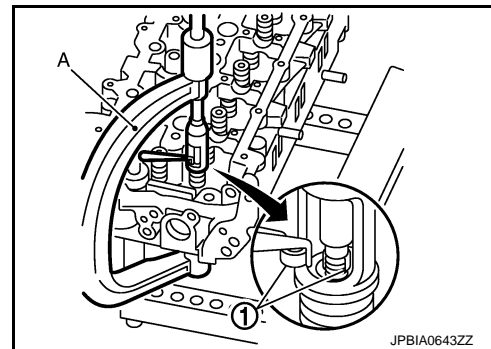
[R9M]

2. Remove cylinder head.
 - Loosen mounting bolts in reverse order as shown in the figure.

↶ : Engine front



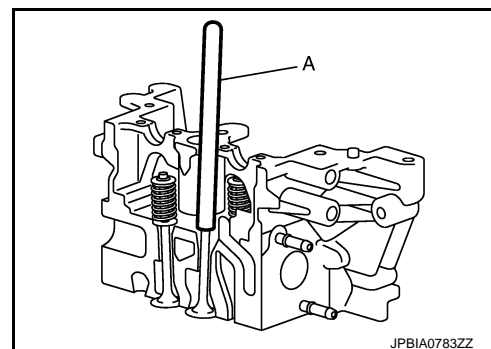
3. Remove cylinder head gasket.
4. Set the cylinder head assembly to the cylinder head support [commercial service tool: KV113B0200 (Mot.1573)].
5. Remove hydraulic tappet.
CAUTION:
Be sure to immerse the hydraulic tappets in a bath of engine oil to ensure no air enters.
6. Remove valve collet (1).
 - Compress valve spring with valve spring compressor (commercial service tool) (A).



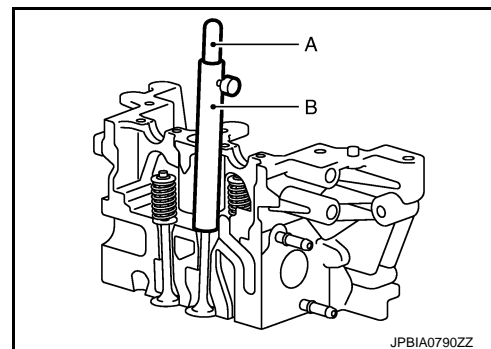
7. Remove valve spring retainer and valve spring.
8. Check dimension of valve oil seal mounting position before removing valve and valve oil seal with the following procedure:
 - a. Install the push rod (A) of valve seal drift [commercial service tool: KV113B0180 (Mot.1511-01)] on the valve oil seal.

NOTE:

The inner diameter of the push rod must be identical to that of the valve. In addition, the bottom of the push rod must come into contact with the metal upper section of the valve oil seal.



- b. Install the guide tube (B) over the push rod (A) until the guide tube comes into contact with the cylinder head, locking the push rod with the knurled wheel.
 - Remove the guide tube assembly plus push rod, being careful not to loosen the knurled wheel.



9. Push valve stem to combustion chamber side, and remove valve.

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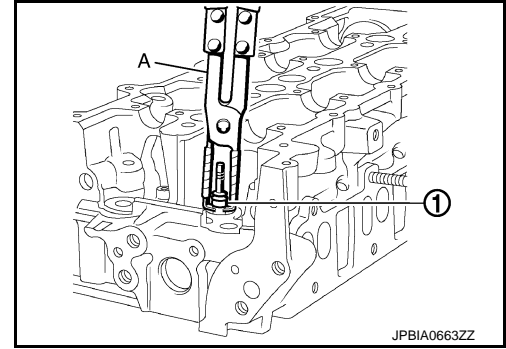
CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

- Identify installation positions, and store them without mixing them up.

10. Remove valve oil seal (1) with a valve oil seal puller [commercial service tool: KV113B0090 (Mot.1335)] (A).



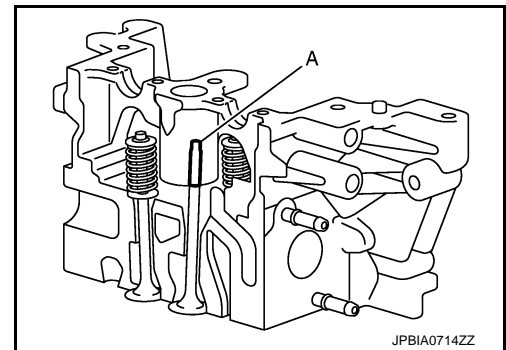
ASSEMBLY

1. Install valve.

NOTE:

Install larger diameter to intake side.

2. Install valve oil seal with the following procedure:
 - a. Position the protector (A) of valve seal drift [commercial service tool: KV113B0180 (Mot.1511-01)] on the valve.

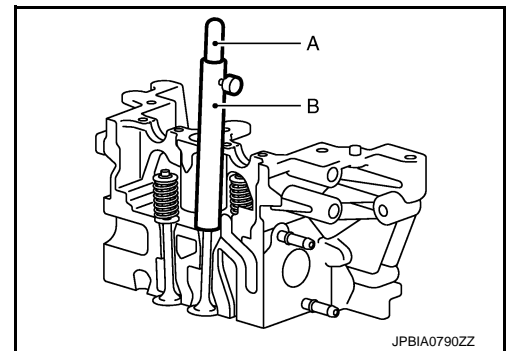


- b. Position a valve oil seal on the protector. Move the valve oil seal past the protector.

CAUTION:

Never lubricate valve oil seal.

- c. Remove the protector.
- d. Push in the push rod (A) of valve seal drift [commercial service tool: KV113B0180 (Mot. 1511-01)] with palm of the hand until the guide tube (B) makes contact with the cylinder head.



3. Install valve spring.

NOTE:

The intake and exhaust valve springs are identical.

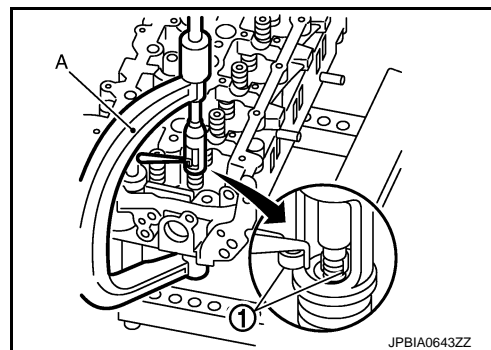
4. Install valve spring retainer.
5. Install valve collet (1).

CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

- Compress valve spring with a valve spring compressor (commercial service tool) (A).
- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.



6. Install hydraulic tappet.
 - Check that the tappets are filled with oil before refitting them.
7. Install cylinder head gasket with the following procedure:

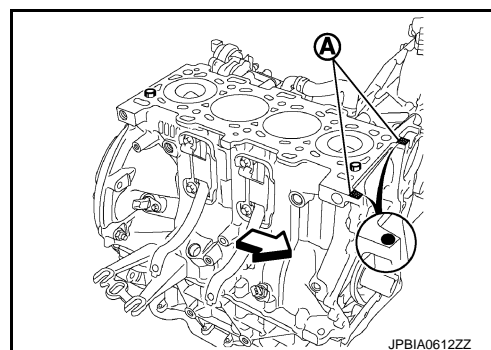
CAUTION:

Before installing cylinder head, inspect piston protrusion.

- a. Apply liquid gasket to position (A) shown in the figure.

↔ : Engine front

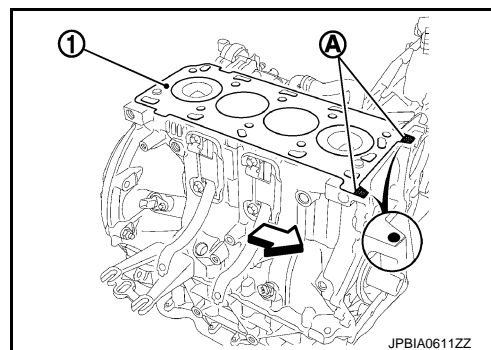
Use Genuine Liquid Gasket or equivalent.



- b. Install cylinder head gasket (1), and apply liquid gasket to position (A) shown in the figure.

↔ : Engine front

Use Genuine Liquid Gasket or equivalent.



8. Install cylinder head, and tighten mounting bolts in numerical order as shown in figure with the following procedure:

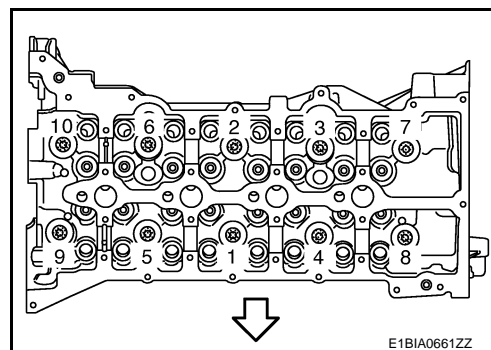
↔ : Engine front

- a. Tighten all bolts.

: **5.0 N·m (0.51 kg·m, 44 in·lb)**

- b. Tighten all bolts.

: **30.0 N·m (3.1 kg·m, 22 ft·lb)**



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CYLINDER HEAD

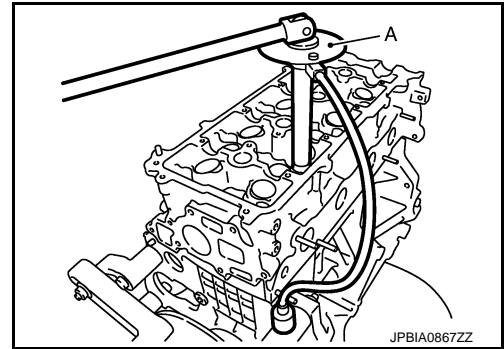
[R9M]

< UNIT DISASSEMBLY AND ASSEMBLY >

- c. Turn all bolts 300 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using an angle wrench [SST: KV10112100 (—)] (A) or protractor. Never judge by visual inspection without the tool.



9. Assemble in the reverse order of disassembly, for the rest of parts.

Inspection

INFOID:000000010282023

INSPECTION AFTER DISASSEMBLY

Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checked.

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.

CAUTION:

Never allow gasket debris to enter passages for engine oil or water.

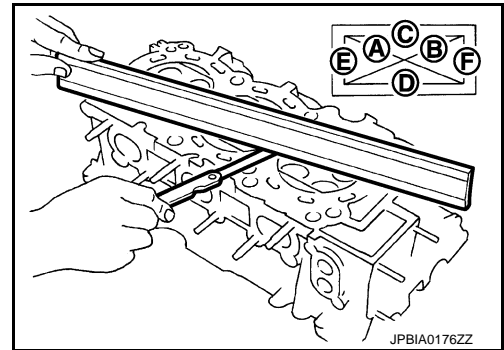
2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions (A - F).

Standard: Refer to [EM-473, "Cylinder Head"](#).

- If it exceeds the standard, replace cylinder head and cylinder head housing.

NOTE:

Cylinder head cannot be replaced as a single part, because it is machined together with cylinder head housing. Replace whole cylinder head housing and cylinder head assembly.



VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to [EM-473, "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact.

VALVE GUIDE CLEARANCE

Valve Stem Diameter

- Measure the diameter of valve stem with micrometer (A).

Standard : Refer to [EM-473, "Cylinder Head"](#).

Valve Guide Inner Diameter

- Measure the inner diameter of valve guide with bore gauge.

Standard : Refer to [EM-473, "Cylinder Head"](#).

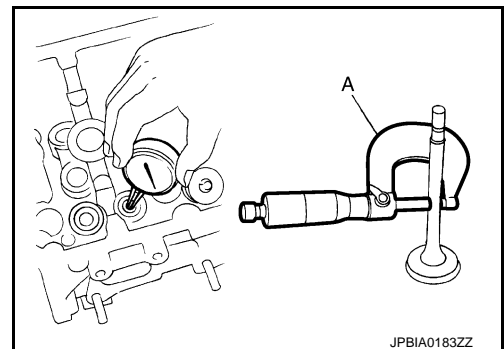
Valve Guide Clearance

- (Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

Standard : Refer to [EM-473, "Cylinder Head"](#).

- If it exceeds the standard, replace valve and/or cylinder head and cylinder head housing.

VALVE SEAT CONTACT



CYLINDER HEAD

< UNIT DISASSEMBLY AND ASSEMBLY >

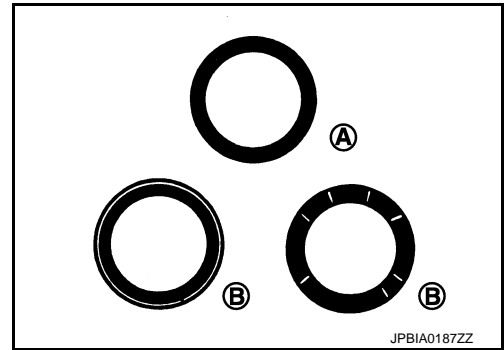
[R9M]

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.

A : OK

B : NG

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace cylinder head and cylinder head housing.

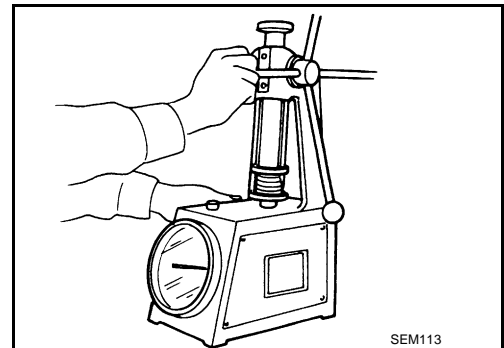


VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

- Check valve spring pressure with valve spring seat installed at the specified spring height.

Standard : Refer to [EM-473. "Cylinder Head"](#).

- If the pressure height is out of the standard, replace valve spring.



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CYLINDER BLOCK

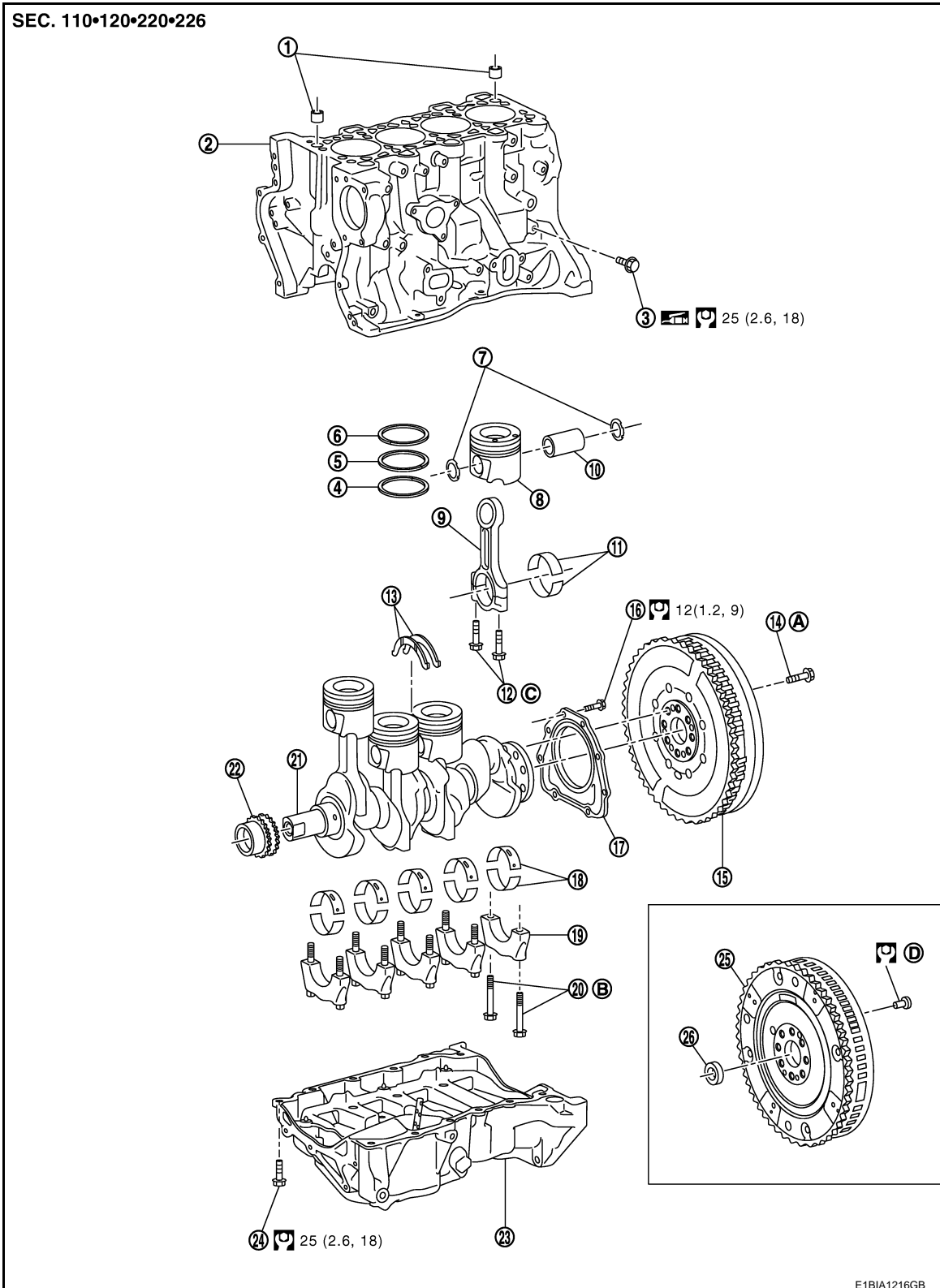
< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

CYLINDER BLOCK

Exploded View

INFOID:000000010282024



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|------------------------------------|-------------------|---------------------|
| 1. Centring dowe | 2. Cylinder block | 3. TDC hole plug |
| 4. Scraper ring | 5. Sealing ring | 6. Compression ring |
| 7. Gudgeon pin locking spring ring | 8. Piston | 9. Con rod |

EM-446

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

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| 10. Piston pin | 11. Con rod bearing shell | 12. Con rod bolt |
| 13. crankshaft thrust washer | 14. Flywheel bolts (M/T Models) | 15. Flywheel (M/T Models) |
| 16. Crankshaft seal on gearbox end bolt | 17. Crankshaft seal on gearbox end | 18. Crankshaft bearing shell |
| 19. Crankshaft bearing cap | 20. Crankshaft bearing cap bolt | 21. Crankshaft |
| 22. Timing sprocket | 23. Oil pan upper | 24. Oil pan upper bolts |
| 25. Drive plate (CVT Models) | 26. Pilot bushing | |
| A. Refer to EM-447 | B. Refer to EM-447 | C. Refer to EM-447 |
| D. Refer to EM-447 | | |

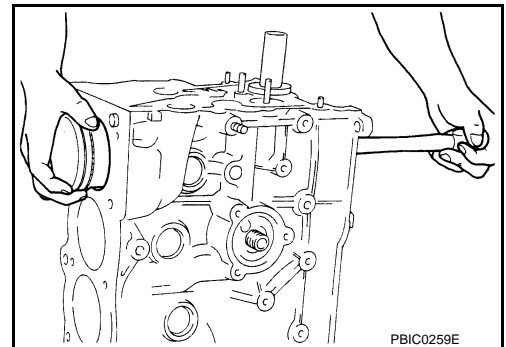
Refer to [GI-4, "Components"](#) for symbols shown in the figure.

Disassembly and Assembly

INFOID:000000010282025

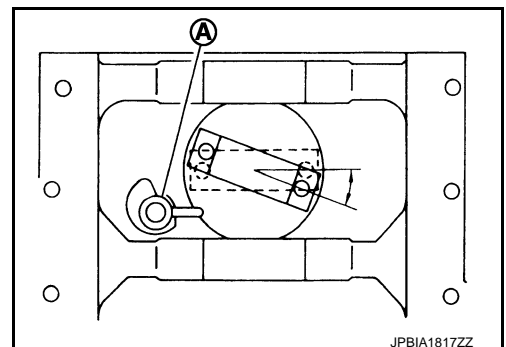
Disassembly

1. Remove oil level sensor.
CAUTION:
Handle it carefully and avoid impacts.
2. Remove crankshaft position sensor.
CAUTION:
 - Handle it carefully and avoid impacts.
 - Never place sensor in a location where it is exposed to magnetism.
3. Remove rear oil seal retainer.
4. Remove pilot bushing using the pilot bushing puller (commercial service tool), if necessary.
5. Remove oil pan (upper). Refer to [EM-437, "Exploded View"](#).
6. Remove oil pump related parts. Refer to [EM-412, "Exploded View"](#).
7. Remove piston and connecting rod assembly with the following procedure:
 - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-459, "Inspection"](#).
- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- b. Remove connecting rod cap.
 - Put a paint mark on cap to identify each cylinder.
- c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.



CAUTION:

- Be careful not to damage oil jets (A), cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.
- Never disassemble oil jets.



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

8. Remove connecting rod bearings.

CAUTION:

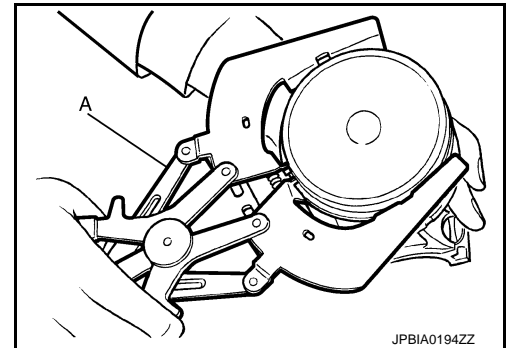
When removing them, note the installation position. Keep them in the correct.

9. Remove piston rings from piston.

- Before removing piston rings, check the piston ring side clearance. Refer to [EM-459, "Inspection"](#).
- Use a piston ring expander (commercial service tool) (A).

CAUTION:

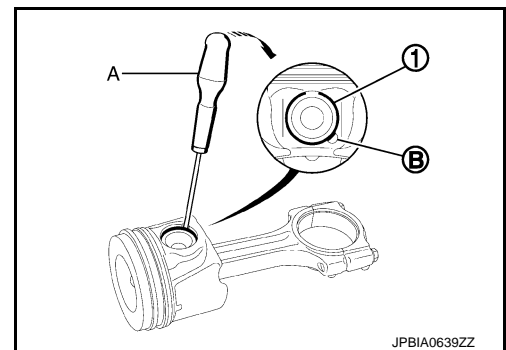
- **When removing piston rings, be careful not to damage the piston.**
- **Be careful not to damage piston rings by expanding them excessively.**



JPBIA0194ZZ

10. Remove the snap rings (1) using a screwdriver (A), and then release the piston pin.

B : Channel



JPBIA0639ZZ

11. Remove main bearing cap mounting bolts with the following procedure:

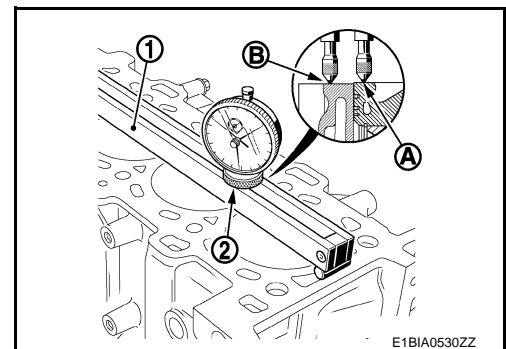
- Measure crankshaft end play before loosening main bearing cap mounting bolts. Refer to [EM-459, "Inspection"](#).

a. **NOTE:**

Always mark the position of each crankshaft bearing shell using an indelible marker pen, in relation to the crankshaft bearing number

Remove:

- the crankshaft bearing cap bolts,
- the crankshaft bearing caps,
- the crankshaft,
- the crankshaft bearing shells.

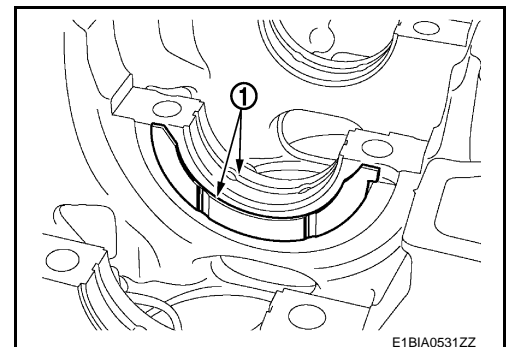


E1BIA0530ZZ

NOTE:

Always mark the position of each crankshaft bearing shell using an indelible marker pen, in relation to the crankshaft bearing number

12. Remove the crankshaft thrust washer (1)



E1BIA0531ZZ

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

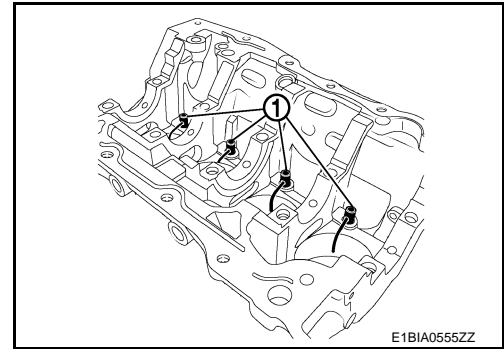
[R9M]

13.

Remove piston base cooling jets (1) following this procedure:

CAUTION:

Wear goggles with side protectors for this operation.



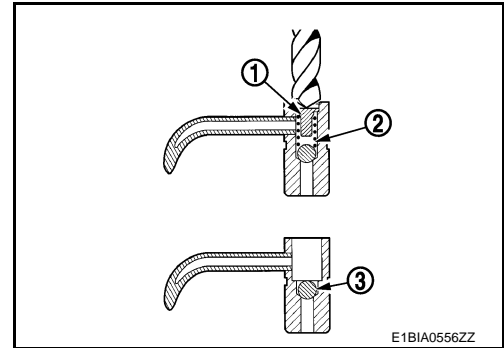
a.

- Drill the piston base cooling jets using a [7 mm (0.3in)] diameter drill bit.

NOTE:

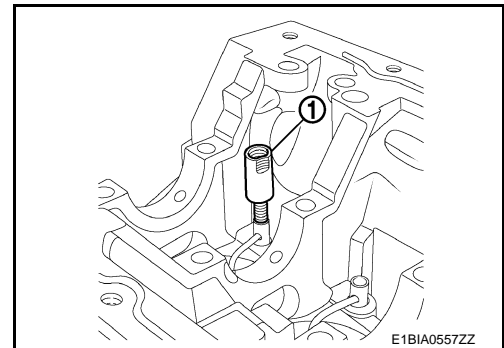
Do not take out the ball from the piston base cooling nozzle, otherwise swarf may enter the lubrication circuit

- Remove the spring tappet (1) and the springs (2) without taking out the ball (3).
- Remove any swarf present with a brush with non abrasive bristles and a compressed air nozzle.



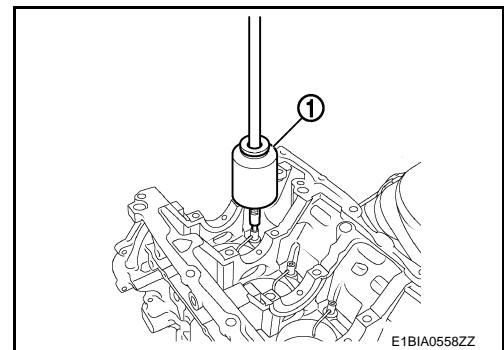
b.

- Screw the tool [SST: Mot. 1485-01] (1) into the drilled piston base cooling jets using a [6 mm (0.2 in)] Allen key, which slides into the tool [SST: Mot. 1485-01].



c.

- Screw the tool [SST: Emb. 880] (1) on the tool [SST: Mot. 1485-01].
- Remove the piston base cooling jets.
- Fit a blanking plug whenever a piston base cooling jet is removed.



Assembly

1. Fully air-blow engine coolant and engine oil passages in the cylinder block, cylinder bore and crankcase to remove any foreign matter.

CAUTION:

Use a goggles to protect your eye.

2. Install the new piston base cooling jet following procedure:

a. Remove the blanking plugs.

- b. Use pressurised air and clean cloths to clean the oil circuit, the cylinders and the joint faces to ensure there is no swarf present.

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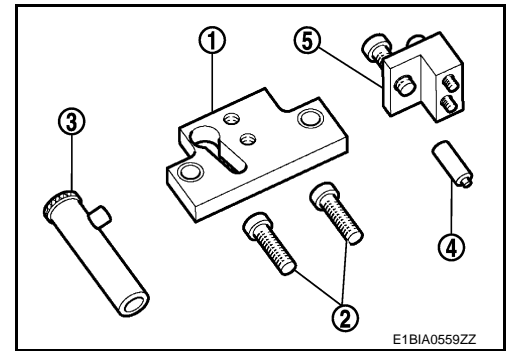
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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

c. Description of the tool [SST: Mot. 1972]

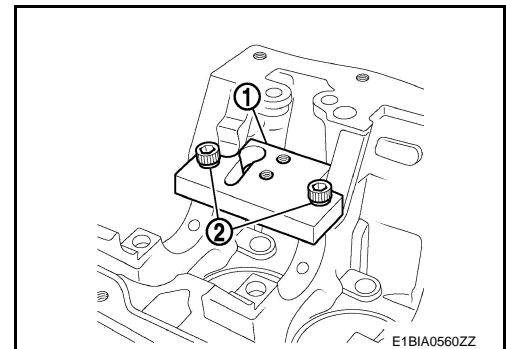


The tool [SST: Mot. 1972] consists of :

- a plate (1),
- a plate bolt (2),
- a pushrod (3),
- an end piece (4),
- a system nut-screw (5).

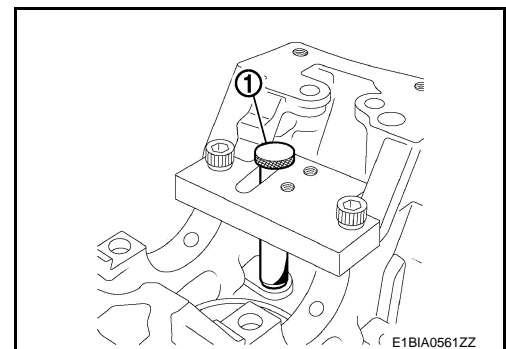
d.

- Fit the plate (1) of the tool [SST: Mot. 1972] on the cylinder block without tighten the bolts (2)



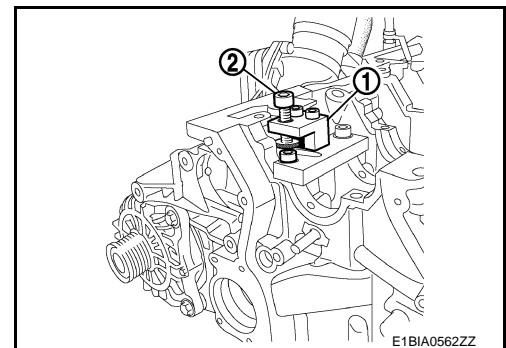
e.

- Fit the piece of the tool [SST: Mot. 1972] in the push-rod of the tool [SST: Mot. 1972].
- Place the "end piece - pushrod" (1) assembly of the tool [SST: Mot. 1972] in the plate to centre the plate above the opening of the piston base cooling jet.
- Tighten the plate bolts.
- Remove the "end piece - pushrod" assembly from the plate.



f.

- Insert the piston base cooling jet in the pushrod.
- Place the "pushrod - piston base cooling jet" assembly in the plate by presenting the jet in front of its opening.
- Fit the system nut-screw (1) on the plate.
- Tighten the bolt (2) to has retaining wall of the pushrod on the plate.
- Remove the tool [SST: Mot. 1972].



3. Install main bearings and thrust bearings with the following procedure:

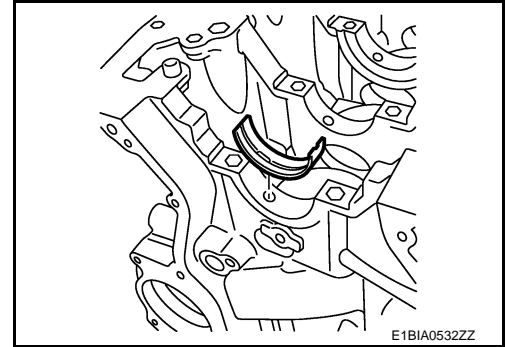
EM-450

CYLINDER BLOCK

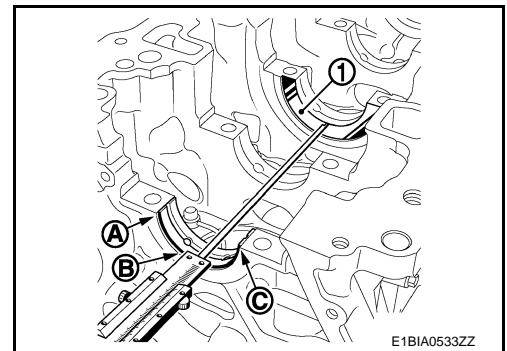
[R9M]

< UNIT DISASSEMBLY AND ASSEMBLY >

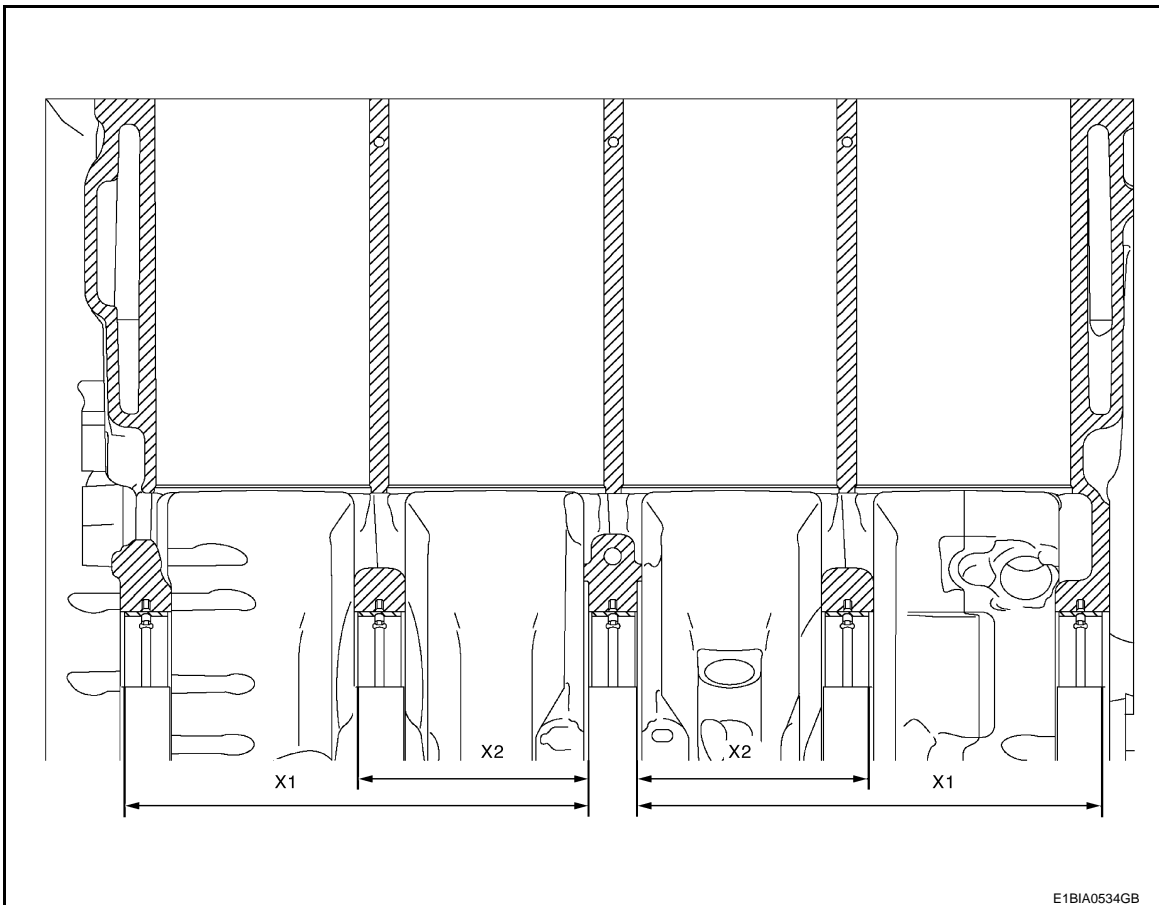
- a. Remove dust, dirt, and engine oil from the bearing mating surfaces of the cylinder block and main bearing cap.
- b. Centre the grooved bearing shell on bearing No.1 of the cylinder block while aligning the groove of the bearing shell with the hole of the bearing.
 - Secure the flush bearing shell and push from the opposite side the position of the bearing shell flush with the bearing.



c.



d.



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CYLINDER BLOCK

[R9M]

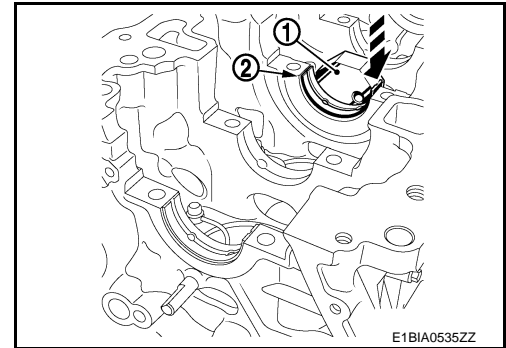
< UNIT DISASSEMBLY AND ASSEMBLY >

- e. Measure the distance (X1) between the bearing face (1) and the edge of the bearing shell at points (A), (B) and (C) using a depth gauge.
- f. If necessary, adjust the position of the bearing shell to the value (X1) = [179 mm (7.0 in)].
- g. Repeat the previous operations for the bearing shells of the bearings No 2, 4 and 5.
- h. If necessary, adjust the position of the bearing shells:
 - of bearings No. 2 and 4 to the value (X2) = [88 mm (3.5 in)].
 - of the bearing No. 5 to the value (X1) = [176 mm (6.9 in)].

i.

Place:

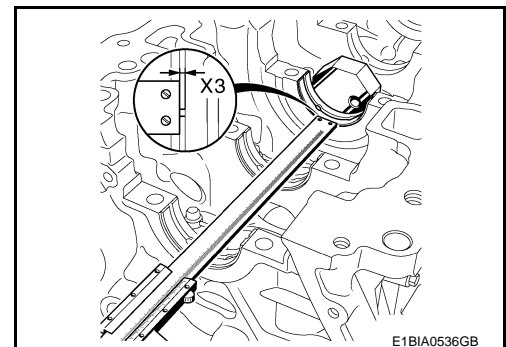
- a rectified shim (1) against the mating face of the crankshaft thrust washer on bearing No.3
- the grooved bearing shell against the rectified shim.



- Secure the flush bearing shell against the rectified shim at (2) and push from the opposite side to position the bearing shell flush with the bearing..

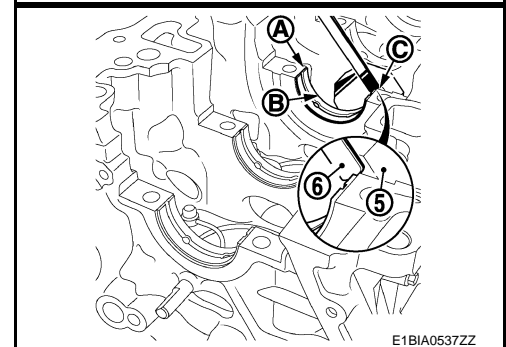
j.

- Measure the distance (X3) between the bearing face of the thrust washer and the bearing shell edge using a depth gauge.



k.

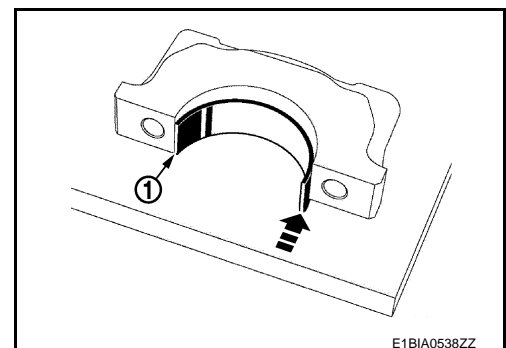
- Centre the grooved bearing shell on the bearing, aligning the shell with the hole groove.
- Adjust the position of the bearing shell at points (A), (B) and (C) using the rectified shim (1) and a set of feeler gauges (thickness of the shim (2) = (X3) : [2 mm (0.1 in)]).



l.

Place:

- the bearing cap on a bench,
- a non-grooved bearing shell against the bench.
- Secure the flush bearing shell with the bearing cap at (1) and push from the opposite side to bring the bearing shell flush with the bearing cap.



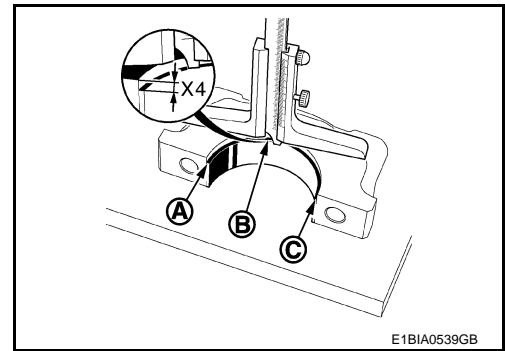
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

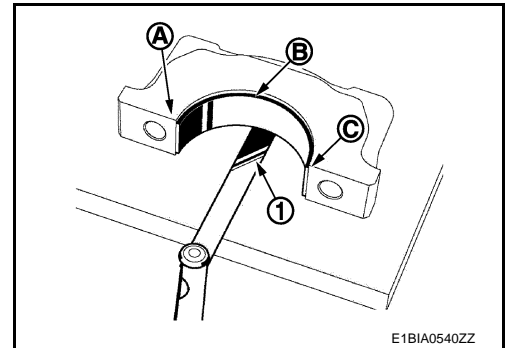
m.

- Measure the distance (X4) between the edge of the bearing shell and the wall of the bearing cap at points (A), (B) and (C) using a depth gauge.



n.

- Adjust the position of the bearing shell at point (A), (B) and (C) using a set of feeler gauges (feeler gauges (thickness of the shim (1) = X4 : [2 mm (0.1 in)])
- Repeat the previous operations for the other bearing caps.

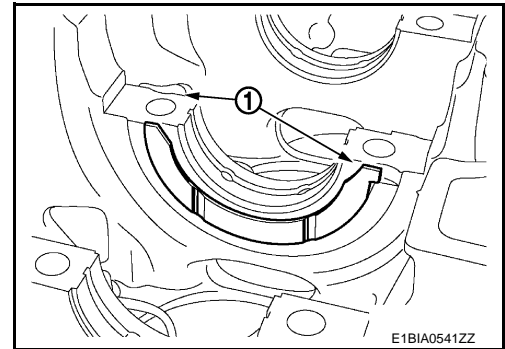


o.

- Position the crankshaft thrust washers on the cylinder block (washer plug (1) in the cylinder block notch)
- Use engine oil to lubricate the crankshaft journal bearing shells and thrust washers (only the face making contact with the crankshaft).

NOTE:

Ensure the bearing shells and the thrust washers do not move when refitting the crankshaft and bearing caps.



4. Install crankshaft, the bearing caps and the crankshaft bearing bolts.

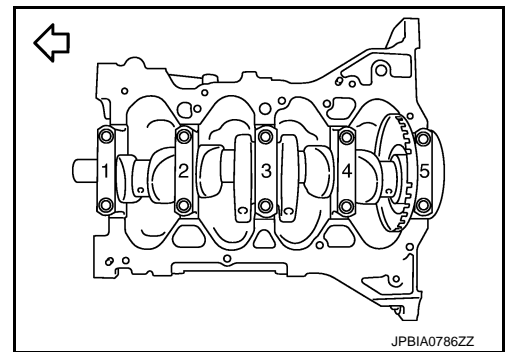
NOTE:

Check that the bearing caps are in contact with the cylinder block before tightening the bearing cap bolts.

5. Install main bearing caps with the following procedure:

- a. Align the identification number to the journal position to install as shown in the figure.

← : Engine front



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CYLINDER BLOCK

[R9M]

< UNIT DISASSEMBLY AND ASSEMBLY >

- b. Tighten new main bearing cap bolts in numerical order as shown in the figure with the following procedure:

⇐ : Engine front

- i. Pretighten main bearing cap bolts.

: 25.0 N·m (2.6 kg·m, 18 ft·lb)

Tighten main bearing cap bolts.

: 25.0 N·m (2.6 kg·m, 18 ft·lb)

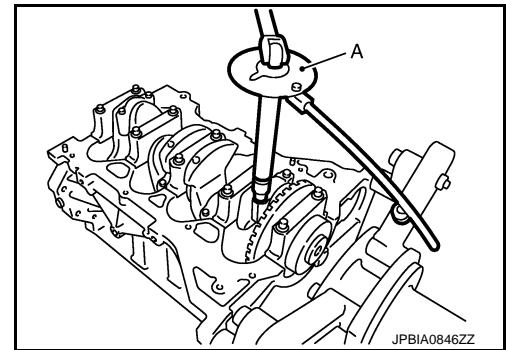
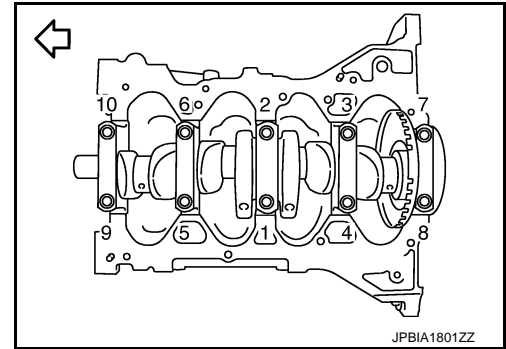
CAUTION:

Be sure to check that the main bearing cap is in contact with the cylinder block before tightening the bolts.

- ii. Turn bolts 110 degrees clockwise (angle tightening).

CAUTION:

Confirm the tightening angle by using an angle wrench [SST: KV10112100 (—)] (A) or protractor. Never judge by visual inspection without the tool.



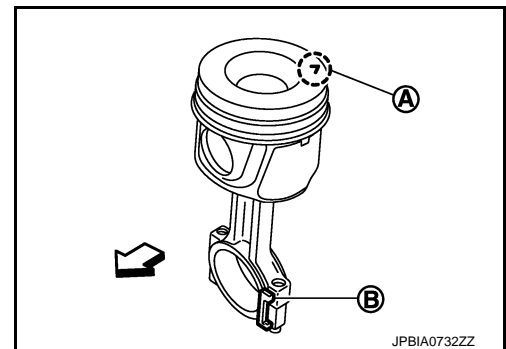
- After installing mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-459, "Inspection"](#).
- If replacing the crankshaft, always identify the piston height category to refit in each cylinder to guarantee that the piston protrusion in relation to the cylinder block remains within the tolerance, before refitting the con rod - piston assemblies. Refer to [EM-459, "Inspection"](#).

6. Install piston to connecting rod with the following procedure:

- a. Install snap ring to the groove of the piston rear side.
- Insert it fully into the groove.
- b. Assemble piston to connecting rod.
- Point the mark engraved (A) on the piston head facing and the bosses (B) of the big end as shown in the figure.

⇐ : Engine front

- Piston pin can be pushed in by hand without excessive force. From the front to the rear, insert piston pin into piston and connecting rod.



- c. Install snap ring to the groove of the piston front side.
- Insert it fully into the groove.
 - After installing, check that connecting rod moves smoothly.
7. Using a piston ring expander (commercial service tool), install piston rings.

CAUTION:

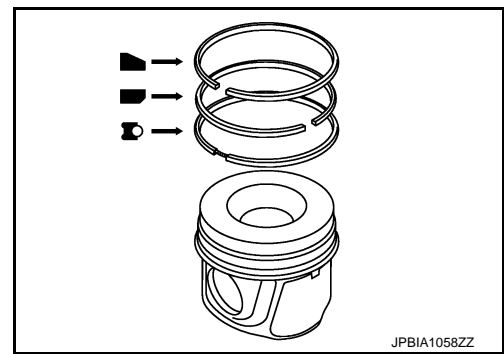
- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

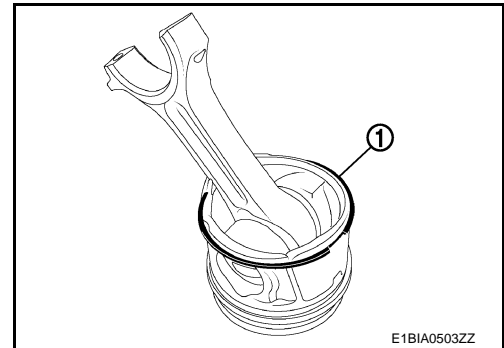
[R9M]

- Position each ring with the gap as shown in the figure referring to the piston front mark.



8.

- Fit the scraper ring (1) with the hand by way of the con rod.

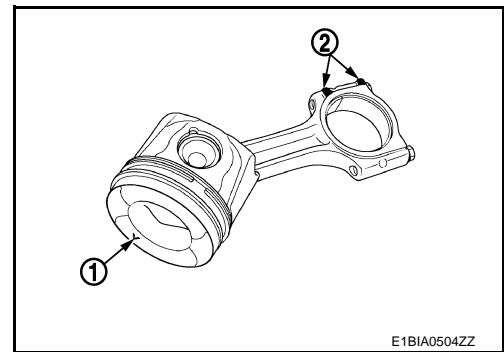


9.

- Lubricate piston pin with engine oil.
- Position the con rod in relation to the piston (piston marking (1) "V" is opposite the machined bosses (2) on the big end)

NOTE:

Piston marking V engine flywheel end, Con rod marking (machined bosses) timing end.



10. Engage the pin in the piston and in the small end.

NOTE:

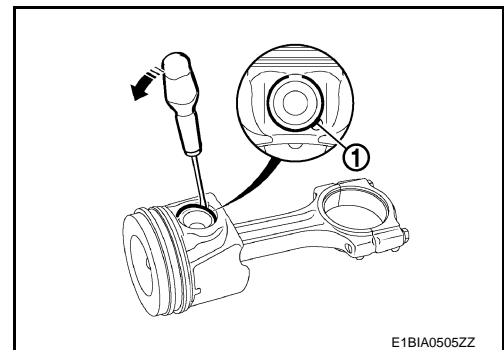
Check that the piston pin slides and rotates easily in the piston and the small end.

11.

- Refit the locking spring ring to the piston pin using a flat screwdriver (apply pressure in the groove (1)).

NOTE:

Position the opening in the locking spring ring towards the piston crown.



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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

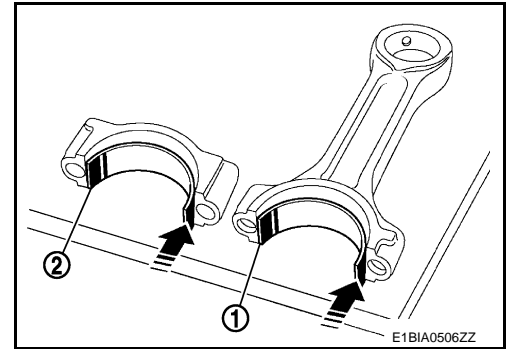
12.

Place:

- the con rod body on the bench,
- the con rod upper bearing shell (width = [18.2 mm (0.7 in)])
- Secure the flush bearing shell of the con rod body mating face on side (1) and push from the opposite side until the con rod body mating face is flush.

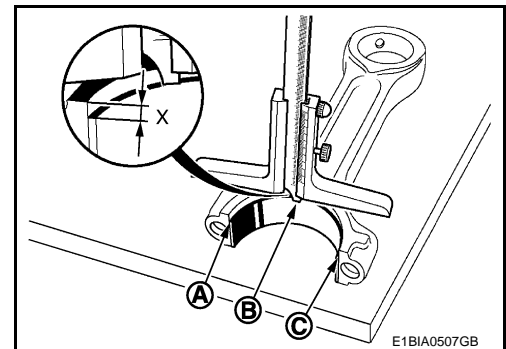
Place:

- the con rod cap on the bench,
- the con rod lower bearing shell (width = [18.2 mm (0.7 in)])
- Secure the flush bearing shell of the con rod cap mating face on side (2) and push from the opposite side until the con rod cap mating face is flush.



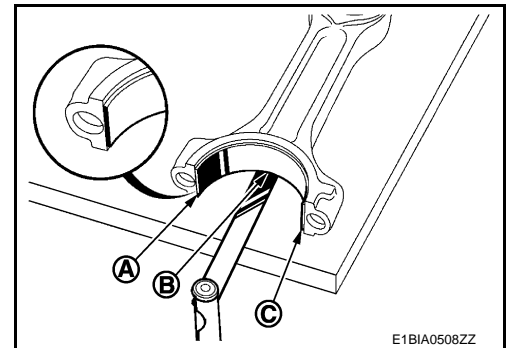
13.

- Measure the distance (X) between the edge of the bearing shell and the wall of the con rod body at points (A), (B) and (C).



14.

- Centre the bearing shell on the con rod body.
- Adjust the position of the bearing shell at points (A), (B) and (C) using a set of feeler gauges = X: [2 mm (0.1 in)].
- Repeat the previous operations on the remaining con rod bodies and caps



Lubricate with engine oils:

- the cylinder block barrels,
- the piston rings
- the piston skirts,
- the crankshaft crankpins

- Orient the piston rings on the piston pin axis.

15. Lubricate the tool [SST: Mot.1979].

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

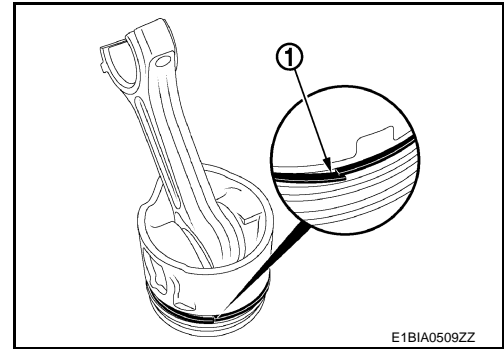
[R9M]

16.

- Check that the piston rings are correctly engaged in the piston grooves
- Put the piston on a plane and clean surface.
- Verify the absence of over lap (1) of the tips of the scraper ring.

NOTE:

Manipulate the piston exclusively by the skirt or the con rod, without touching the scraper ring.



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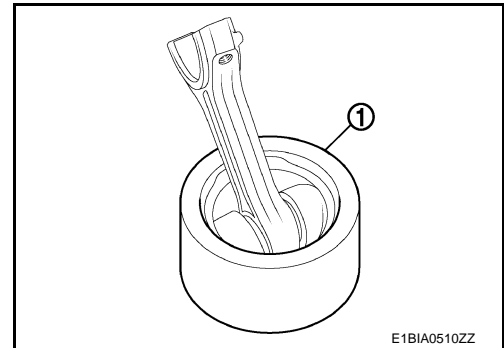
D

17.

- Insert the tool [SST: Mot.1979] (1) on the piston, conical part the first one, by the con rod.

NOTE:

The engagement of the tool [SST: Mot.1979] on the piston has to be made without forcing. If resistance during the engagement occurs, put off the tool and to re-engage it.



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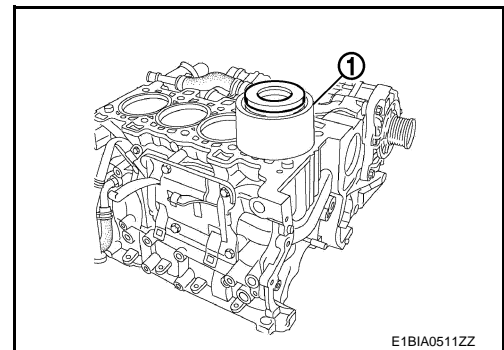
G

18.

- Check that the pistons correspond to the cylinder block barrels (No. 1 timing end)
- Place the "con rod - piston - tool" (1) assembly in the cylinder.

NOTE:

Position the point of the "V" engaged on the piston towards the flywheel end.



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19. **WARNING:**

Failure to observe the following procedure may result in destruction of the engine.

- Gradually insert the "con rod - piston" assembly in the cylinder (avoid any contact between the con rod and the piston base cooling jet) using only of the hand.
- Position the big end on the crankshaft crankpin.
- Refit the con rod cap, ensuring that the con rod caps and bodies correspond. Refer to [EM-459, "Inspection"](#).

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20.

- a. Tighten new connecting rod cap bolts.

N

: 25.0 N·m (2.6 kg·m, 18 ft·lb)

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CYLINDER BLOCK

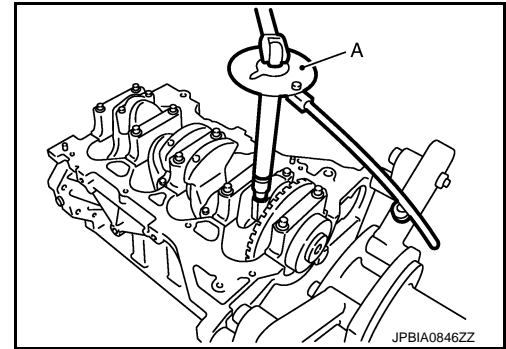
< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

- b. Turn bolts 110 degrees clockwise (angle tightening).

CAUTION:

Confirm the tightening angle by using an angle wrench [SST: KV10112100 (—)] (A) or protractor. Never judge by visual inspection without the tool.



- After tightening connecting rod cap bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-459, "Inspection"](#).
- Check the piston protrusion. Refer to [EM-459, "Inspection"](#).

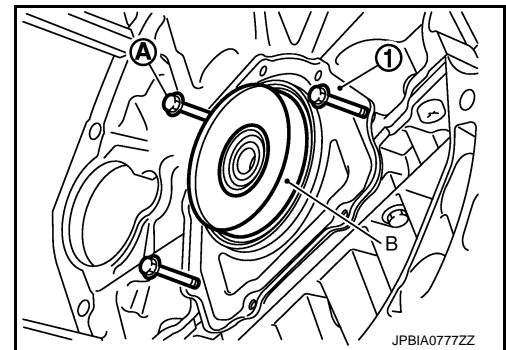
21. Install oil pump and related parts.
22. Install oil pan (upper). Refer to [EM-437, "Exploded View"](#).
23. Install rear oil seal retainer with the following procedure:

- a. Set guide bolt (A) and protector (B) to rear oil seal retainer (1).

NOTE:

The protector is supplied in the new oil seal parts kit.

- b. Move the rear oil seal retainer evenly by hand until it makes contact with the cylinder block.

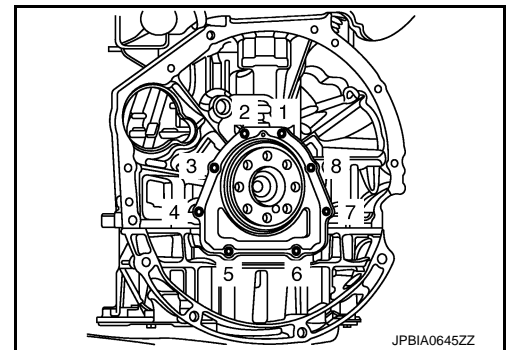


- c. Tighten mounting bolts in two steps separately in numerical order as shown in the figure.
i. Tighten mounting bolts No.1 and 5.

: 5.0 N·m (0.51 kg·m, 44 in·lb)

- ii. Tighten mounting bolts No. 1 to 8 in numerical order as shown.

: 12.0 N·m (1.2 kg·m, 106 in·lb)



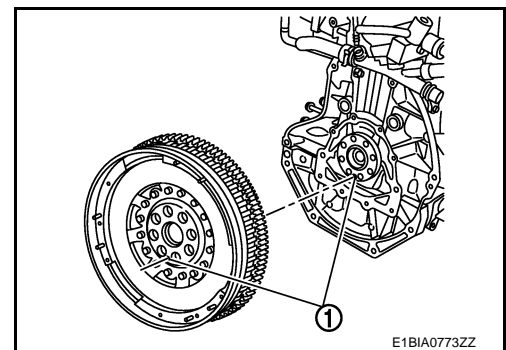
24. Install pilot bushing.
• Using the drift, force fit the pilot bushing until its front end contacts crankshaft.

25. Install flywheel by aligning the mark (1).

NOTE:

The openings of the flywheel bolts must be aligned.

- a. Install bolts without tightening them.
b. Fix flywheel using flywheel locking tool [SST: — (Mot.1431)].



CYLINDER BLOCK

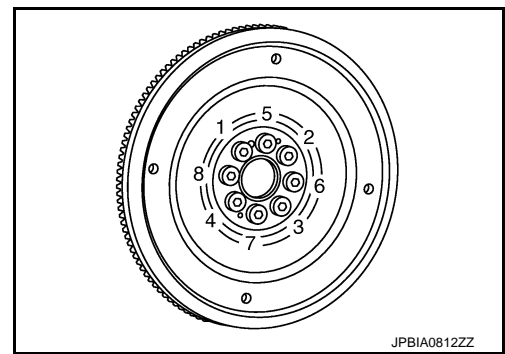
< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

- c. Tighten bolts in numerical order as shown in the figure with the following procedure:
- Tighten mounting bolts.

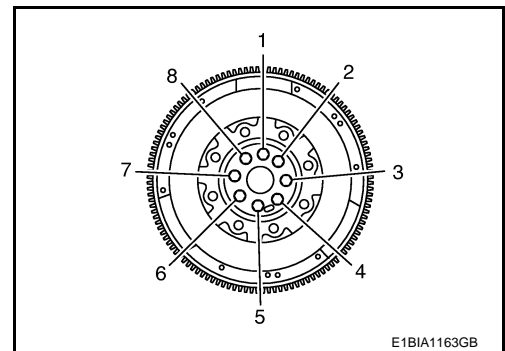
: **40.0 N·m (4.1 kg·m, 30 ft·lb)**

- Turn 50 degrees clockwise (angle tightening).



26. Install drive plate.
- Install bolts without tightening them.
 - Fix drive plate using flywheel locking tool [SST: — (Mot.1431)].
 - Tighten bolts in numerical order as shown in the figure with the following procedure:
- Tighten mounting bolts.

: **50.0 N·m (5.1 kg·m, 37 ft·lb)**



27. Assemble in the reverse order of disassembly.

Inspection

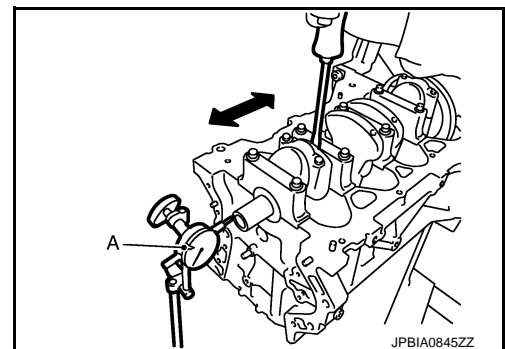
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CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace thrust bearings, and measure again. If it still exceeds the standard, also replace crankshaft.

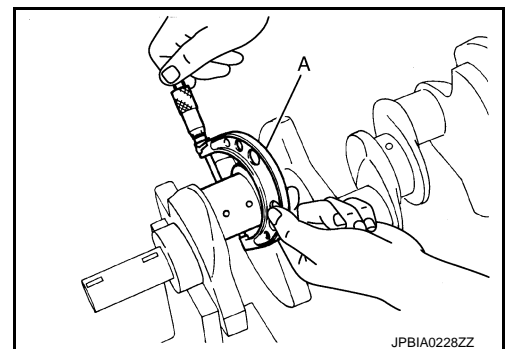


CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with a micrometer (A).

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, measure the connecting rod bearing oil clearance. Refer to "CONNECTING ROD BEARING OIL CLEARANCE".



CRANKSHAFT MAIN JOURNAL DIAMETER

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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

- Measure the outer diameter of crankshaft main journals with a micrometer.

Standard : Refer to [EM-475, "Cylinder Block"](#).

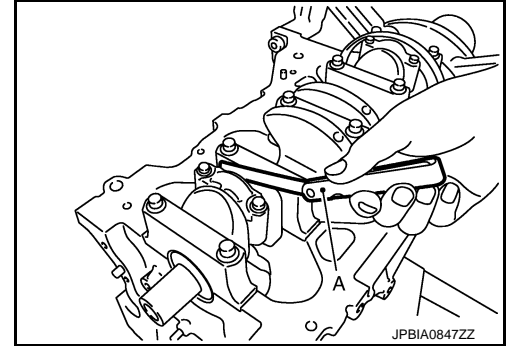
- If it exceeds the standard, measure the main bearing oil clearance. Refer to "MAIN BEARING OIL CLEARANCE".

CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace connecting rod, and measure again. If it still exceeds the standard, also replace crankshaft.



CONNECTING ROD BIG END DIAMETER

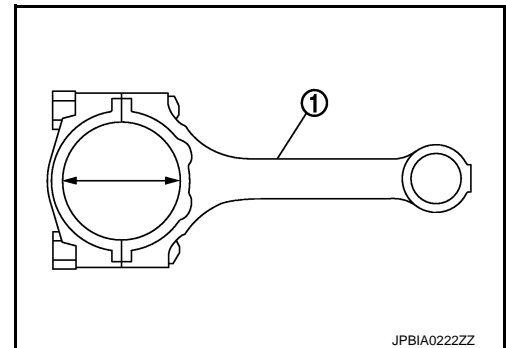
- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-447, "Disassembly and Assembly"](#).

1 : Connecting rod

- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace connecting rod assembly.

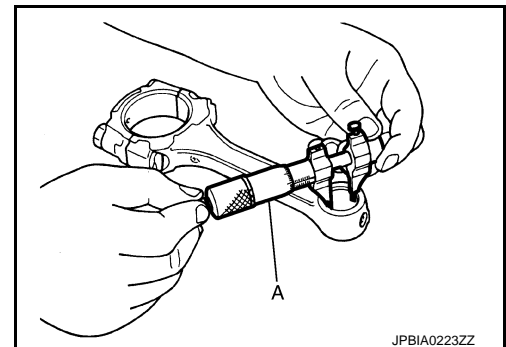


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

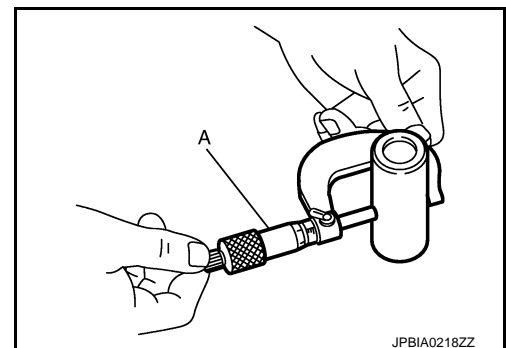
Standard : Refer to [EM-475, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-475, "Cylinder Block"](#).



Connecting Rod Bushing Oil Clearance

CYLINDER BLOCK

[R9M]

< UNIT DISASSEMBLY AND ASSEMBLY >

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

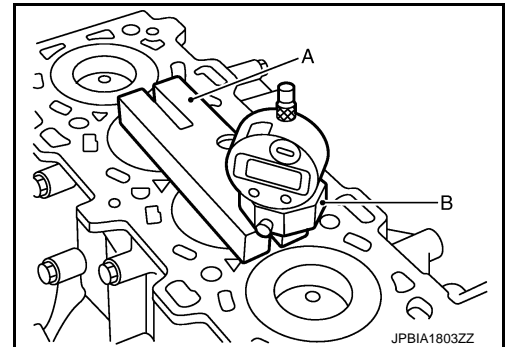
Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly. Refer to "PISTON PROTRUSION".

PISTON PROTRUSION

Measure the protrusion of piston with the following procedure:

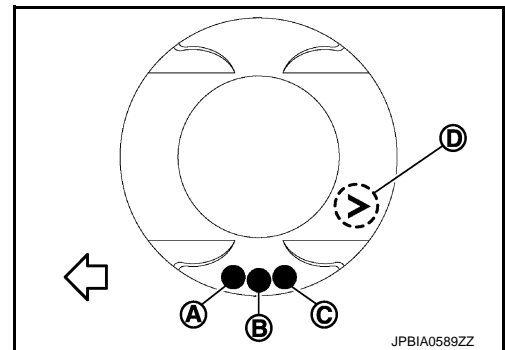
1. Set piston at a point close to the TDC.
2. Set the dial indicator stand set [commercial service tool: KV113B0040 (Mot.251-01)] (B) and [commercial service tool: KV113B0050 (Mot.252-01)] (A) at the location as shown in the figure.
3. Set the indicator scale to "0" where the piston protrusion is maximized.
4. Move the dial indicator stand so that the tip of dial indicator can contact the cylinder block. Read the difference.



Standard : Refer to [EM-475, "Cylinder Block"](#).

5. If measured value is out of the standard, replace piston. Select a piston in "Piston Protrusion Grade".

- A : Date of manufacture
- B : Piston grade
- C : Modification in production suffix
- D : Mark engraved
- ↶ : Engine front



Piston Protrusion Grade:

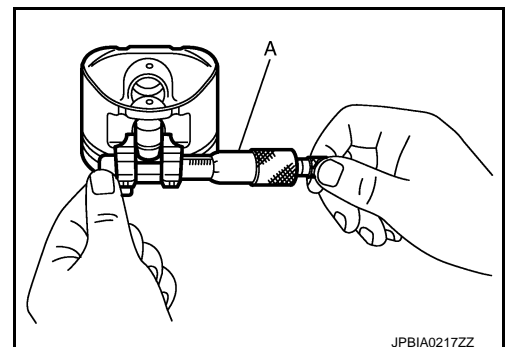
Refer to [EM-475, "Cylinder Block"](#).

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an inside micrometer (A).

Standard : Refer to [EM-475, "Cylinder Block"](#).



Piston Pin Outer Diameter

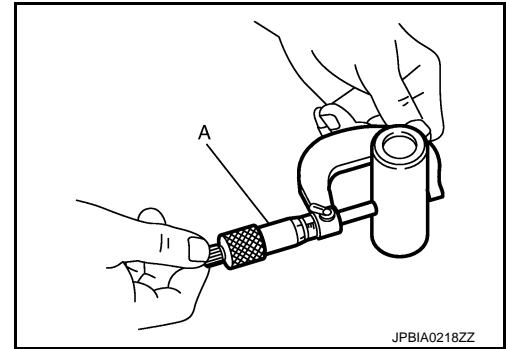
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-475, "Cylinder Block"](#).



Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace piston and piston pin an assembly.

NOTE:

Piston is available together with piston pin as assembly.

PISTON RING SIDE CLEARANCE

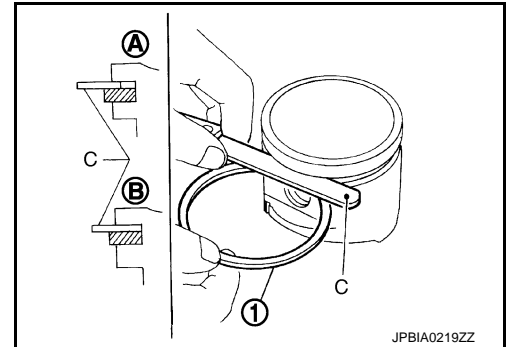
- Measure the side clearance of piston ring (1) and piston ring groove with a feeler gauge (C).

A : OK

B : NG

Standard : Refer to [EM-475, "Cylinder Block"](#) .

- If it exceeds the standard, replace piston ring, and measure again.
If it still exceeds the standard, also replace piston.



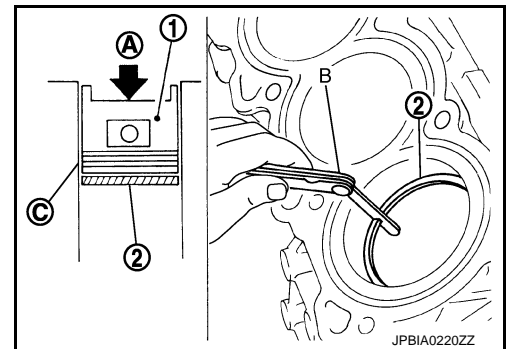
PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to "PISTON TO CYLINDER BORE CLEARANCE".
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder with piston, and measure piston ring end gap with a feeler gauge (B).

C : Measuring point

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace piston ring, and measure again.
If it still exceeds the standard, replace cylinder block and piston rings.



CYLINDER BLOCK TOP SURFACE DISTORTION

- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

CAUTION:

Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

CYLINDER BLOCK

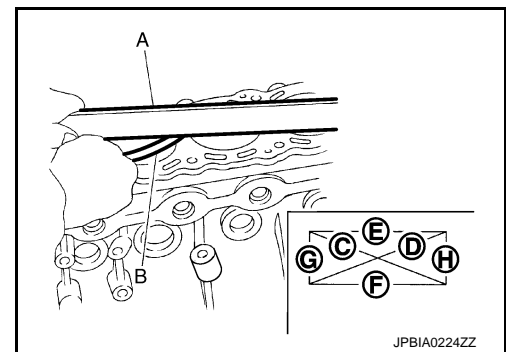
[R9M]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Measure the distortion on the cylinder block upper face at different points in six directions (C, D, E, F, G and H) with a straight edge (A) and feeler gauge (B).

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-447, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing housing with a bore gauge.

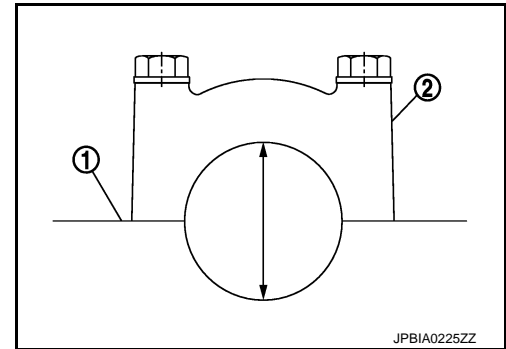
- 1 : Cylinder block
- 2 : Main bearing cap

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace cylinder block and main bearing caps assembly.

NOTE:

Main bearing caps cannot be replaced individually, because it is machined together with the cylinder block.



PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

- Using a bore gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder.

Standard:

Cylinder bore inner diameter

: Refer to [EM-475, "Cylinder Block"](#).

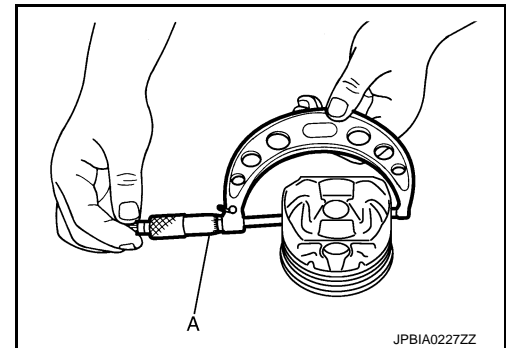
- If it exceeds the standard, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer (A).

Standard : Refer to [EM-475, "Cylinder Block"](#).

Measurepoint : Refer to [EM-475, "Cylinder Block"](#).



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter.

(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard : Refer to [EM-475, "Cylinder Block"](#).

- If it exceeds the standard, replace piston and piston pin assembly and/or cylinder block.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

- Install connecting rod bearings (1) to connecting rod (2) and connecting rod bearing cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-447, "Disassembly and Assembly"](#).
- Measure the inner diameter of connecting rod bearing with an inside micrometer.
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)

Standard : Refer to [EM-479, "Connecting Rod Bearing"](#).

- If it exceeds the standard. Replace connecting rod bearing or/and connecting rod.

Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-447, "Disassembly and Assembly"](#).

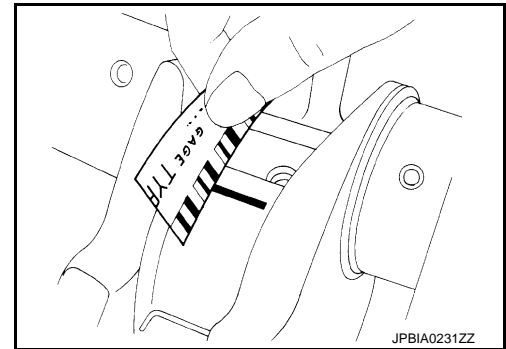
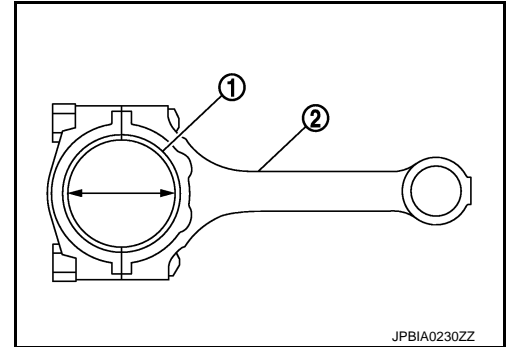
CAUTION:

Never rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the standard is the same as that described in "Method by Calculation".



MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-447, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing with a bore gauge.
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

Standard : Refer to [EM-479, "Main Bearing"](#).

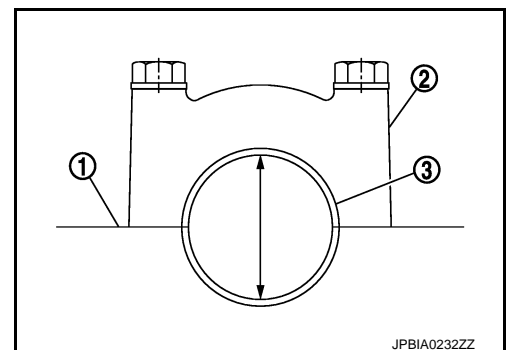
- If it exceeds the standard, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-479, "Main Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in the crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-447, "Disassembly and Assembly"](#).

CAUTION:

Never rotate crankshaft.



CYLINDER BLOCK

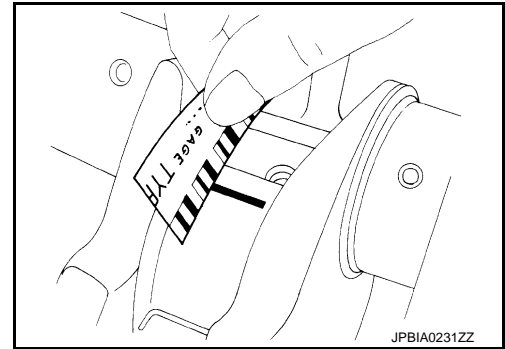
< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

- Remove main bearing cap and bearings, and using the scale on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the standard is the same as that described in "Method by Calculation".



FLYWHEEL INSPECTION

For a dual mass flywheel which has worked: presence of a free rotation angle. This angle is measured by fixing the primary flywheel and turning the secondary flywheel. The dual mass flywheel free rotation angle must not exceed 15° or 30mm (1.2 in) in linear movement measured on the edge.

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

HOW TO SELECT PISTON AND BEARING

Description

INFOID:000000010282027

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Piston protrusion	Piston	Piston grade (piston height)	Refer to EM-459, "Inspection" .

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

Main Bearing

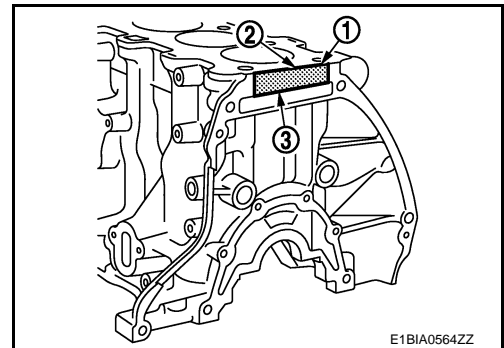
INFOID:000000010282028

WHEN NEW CYLINDER BLOCK AND CRANKSHAFT ARE USED

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear side of cylinder block.
 - * This engine only has one cylinder bore grade.

(1) : cylinder block bearing diameter category:

- Identification by letter of the crankshaft bearing diameter,
- the order of the marking letters goes from the bearing on the timing end to the bearing on the flywheel end.
- (2) : cylinder diameter category.
- (3) : marking only for factory use.



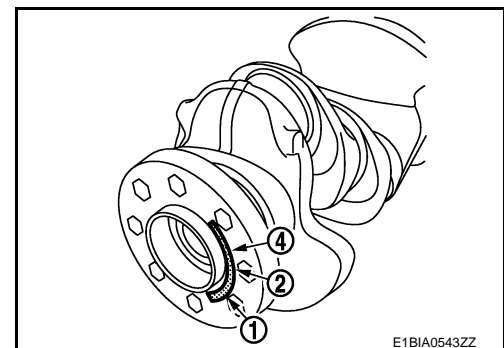
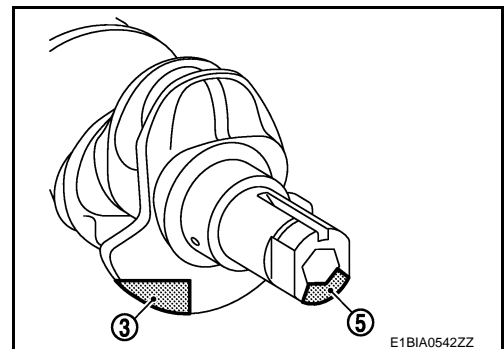
WORKING OUT THE CLASS OF MAIN BEARING (ORIGINAL FITMENT)

Marking (1) On The Crankshaft

Identify the category of crankshaft main journal diameter (A) with checking the marking of crankshaft as shown in the figures.

NOTE:

The marking has 5 digits. Left end is the diameter category of No. 1 bearing (flywheel side) and right end is the diameter category of No. 5 bearing (sprocket side).



HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

Detail of the marking (1):

- (1) : Line indicating the diameter category of the journal.
- identification by letters corresponding to the diameter of the journal
- the order of the marking letters goes from the bearing on the timing end to the bearing on the flywheel end,
- (2) :Line indicating the diameter class of the crankpins,
- (3), (4) : Last five numbers of the crankshaft part number,
- (5): Line reserved for the factory.

Table Of Journal Diameter Classes

Unit: mm (in)

Journal class mark on the crankshaft	Journal diameter
A,B,C	51.485 - 51.487 (2.0270)
D, E	51.488 - 51.489 (2.0271)
F, G, H	51.490 - 51.492 (2.0272)
K, L, M	51.495 - 51.497 (2.0274)
N, O	51.498 - 51.499 (2.0275)
P, Q, R	51.500 - 51.502 (2.0276)
S, T	51.503 - 51.504 (2.0277)
U	51.505 (2.0278)

WHEN CYLINDER BLOCK AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [EM-459. "Inspection"](#).
2. Apply the measured dimension to "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in "Main Bearing Selection Table".
4. Apply the symbol obtained from "Main Bearing Grade Table" to select main bearing.

MAIN BEARING SELECTION TABLE

- B* = Blue (bearing shell colour mark)
- N** = Black (bearing shell colour mark)
- J*** = Yellow (bearing shell colour mark)

Table of distribution of upper journals 1, 2, 4 and 5

Cylinder block bearing diameter class mark														
	A	B	C	E	H	J	K	L	M	P	S	T	U	Z

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

		Cylinder block bearing diameter class mark													
Crank shaft journal diameter class mark	A	B*													
	B	B													
	C	N**	B												
	D	N	B												
	E	N			B										
	F	N					B								
	G	N							B						
	H	N								B					
	I	N									B				
	J	N										B			
	K	N											B		
	L	N												B	
	M	J***	N										B		
	N	J		N											
	O	J			N										
	P	J					N								
	Q	J						N							
	R	J							N						
	S	J								N					
	T	J									N				
U	J										N				

Table of the distribution of lower journals 1, 2, 4 and 5

B* = Blue (bearing shell colour mark)
 N** = Black (bearing shell colour mark)
 J*** = Yellow (bearing shell colour mark)

Cylinder block bearing diameter class mark															
		A	B	C	E	H	J	K	L	M	P	S	T	U	Z

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

		Cylinder block bearing diameter class mark																
Crank shaft journal diameter class mark	A	N**							B*								A	
	B	N							B								EM	
	C	N							B									
	D	N							B									
	E	N							B								C	
	F	N							B									
	G	N							B									
	H	J***	N							B								D
	I	J	N															
	J	J	N															E
	K	J	N															
	L	J	N															
	M	J	N															F
	N	J	N															
	O	J	N															G
	P	J	N															
	Q	J	N															
	R	J	N															H
	S	J																
	T	J																I
U	J																	

Table of the distribution of upper journal 3

W* = White (bearing shell colour mark)
 N** = Black (bearing shell colour mark)
 J*** = Yellow (bearing shell colour mark)

Cylinder block bearing diameter class mark																
		A	B	C	E	H	J	K	L	M	P	S	T	U	Z	

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

		Cylinder block bearing diameter class mark														
Crank shaft journal diameter class mark	A														N**	
	B														N	
	C	J***													N	
	D	J												N		
	E	J											N			
	F	J										N				
	G	J									N					
	H	J								N						
	I	J							N							
	J	J						N								
	K	J					N									
	L	J				N										
	M	W***	J											N		
	N	W	J													
	O	W	J													
	P	W	J													
	Q	W	J													
	R	W	J													
	S	W	J													
	T	W	J													
U	W	J														

Table of the distribution of lower journals 3

W* = White (bearing shell colour mark)
 N** = Black (bearing shell colour mark)
 J*** = Yellow (bearing shell colour mark)

Cylinder block bearing diameter class mark															
	A	B	C	E	H	J	K	L	M	P	S	T	U	Z	

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[R9M]

		Cylinder block bearing diameter class mark				A
Crank shaft journal diameter class mark	A	J***		N**		
	B	J		B		EM
	C	J		B		
	D	J		B		
	E	J		B		C
	F	J		B		
	G	J		B		
	H	W*	J		B	D
	I	W	J			
	J	W	J			E
	K	W		J		
	L	W		J		
	M	W		J		F
	N	W		J		
	O	W		J		G
	P	W		J		
	Q	W		J		H
	R	W		J		I
	S	W				
	T	W				
U	W					

Example:

- diameter category of journal No. 1 marked on the crankshaft = N,
- diameter category of crankshaft bearing No.1 marked on the cylinder block = M,
- thickness class to of the upper and lower bearing shells of bearing No. 1 to refit = Black Mark.

Identification of the crankshaft bearing shells

	Marking	Colour Mark	Thickness mm(in)	
Lower shell bearing	33281R or 4	Blue	1.989(0.0783)	L
	3875R or 3	Black	1.985(0.0781)	
	37686R or 2	Yellow	1.981(0.0780)	M
	31153R or 1	White	1.977(0.0787)	
Upper bearing shell bearing	53785R or 4	Blue	1.989(0.0783)	
	54889R or 3	Black	1.985(0.0781)	N
	56848R or 2	Yellow	1.981(0.0780)	
	53368R or 1	White	1.977(0.0787)	O

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[R9M]

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

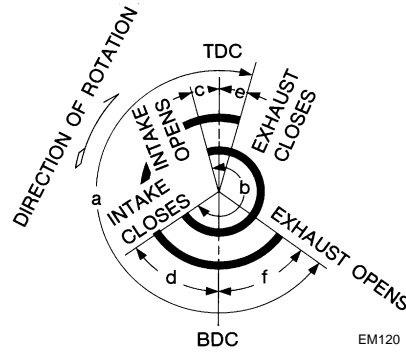
General Specification

INFOID:0000000010282029

GENERAL SPECIFICATIONS

Engine type		R9M
Cylinder arrangement		In-line 4
Displacement	cm ³ (cu in)	1,598 (97.51)
Bore and stroke	mm (in)	80.0 x 79.5 (3.1496 x 3.1299)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		15.4

Valve timing



Unit: degree

a	b	c	d	e	f
198	187	- 11	18	- 17	35

Drive Belts

INFOID:0000000010282030

DRIVE BELT

Tension of drive belt	Belt tensioning is not necessary, as it is automatically adjusted by drive belt auto-tensioner.
-----------------------	---

Intake Manifold

INFOID:0000000010282031

INTAKE MANIFOLD

Unit: mm (in)

Items	Standard
Surface distortion	0.05 (0.0020)

Exhaust Manifold

INFOID:0000000010282032

EXHAUST MANIFOLD

Unit: mm (in)

Items	Standard
Surface distortion	0.7 (0.028)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[R9M]

Turbocharger

INFOID:000000010282033

		Valve rod moving length
Value of vacuum	25 kPa (250 mbar, 187.525 mmHg, 7.3825 inHg)	2.95 - 5.95 mm (0.1161 - 0.2343 in)
	More than 60 kPa (600 mbar, 450.06 mmHg, 17.718 inHg)	The rod should not move

Camshaft

INFOID:000000010282034

CAMSHAFT

Unit: mm (in)

Items	Standard
Camshaft journal diameter	24.979 - 25.000 (0.9834 - 0.9843)
Cylinder head housing and camshaft bracket inner diameter	25.040 - 25.061 (0.9858 - 0.9867)
Camshaft journal oil clearance	0.060 (0.0024)

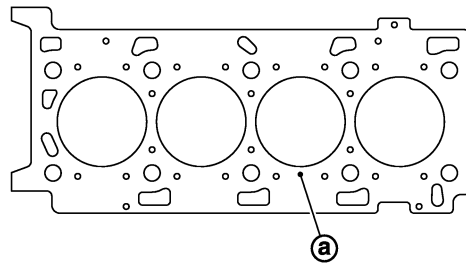
Cylinder Head

INFOID:000000010282035

CYLINDER HEAD

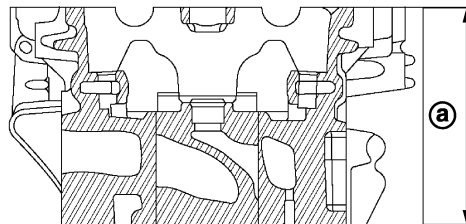
Unit: mm (in)

Items	Standard
Head surface distortion	0.05 (0.0020)



JPBIA0791ZZ

Cylinder head gasket thickness "a"	1.116 - 1.184 (0.0439 - 0.0466)
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JPBIA0792ZZ

Normal cylinder head height "a"	131.5 (5.18)
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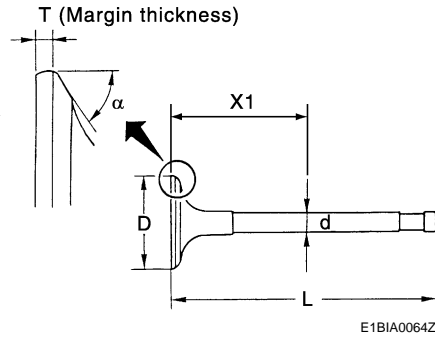
VALVE DIMENSIONS

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[R9M]

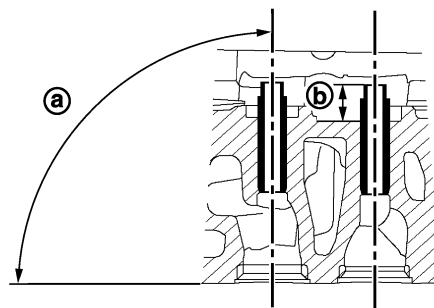
Unit: mm (in)



Item		Standard
Valve head diameter "D"	Intake	23.38 - 23.62 (0.9205 - 0.9299)
	Exhaust	23.28 - 23.62 (0.9165 - 0.9260)
Valve length "L"	Intake	104.17 (4.1)
	Exhaust	104.06 (4.097)
Valve stem diameter "d"	Intake	5.970 - 5.985 (0.2350 - 0.2356)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Measuring point "X1"		35.0 (1.378)
Valve seat angle "α"		45° - 45°15'
Valve margin "T"	Intake	1.84 (0.072)
	Exhaust	1.35 (0.531)
Valve lift amount		8.0 (0.315)

VALVE GUIDE

Unit: mm (in)



Items		Standard
Valve guide	Outer diameter	11.033 - 11.044 (0.4344 - 0.4348)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)
Cylinder head valve guide hole diameter		10.987 - 11.013 (0.4326 - 0.4336)
Interference fit of valve guide		0.020 - 0.057 (0.0008 - 0.0022)
Valve guide clearance	Intake	0.015 - 0.048 (0.0006 - 0.0019)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)
Valve guide angle "a"		90°
Projection length "b"		14.0 (0.551)

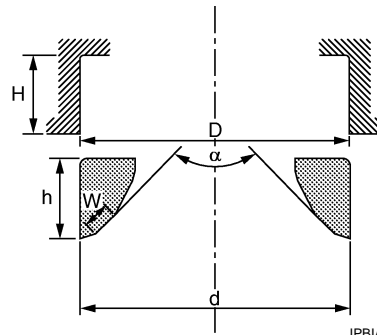
VALVE SEAT

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[R9M]

Unit: mm (in)



JPBIA0787ZZ

Items		Standard
Cylinder head seat recess diameter "D"	Intake	28.163 - 28.191 (1.1088 - 1.1099)
	Exhaust	26.986 - 27.014 (1.0624 - 1.0635)
Valve seat outer diameter "d"	Intake	28.276 - 28.292 (1.1132 - 1.1139)
	Exhaust	27.076 - 27.092 (1.0660 - 1.0666)
Valve seat interference fit	Intake	0.085 - 0.129 (0.0033 - 0.0051)
	Exhaust	0.062 - 0.106 (0.0024 - 0.0042)
Angle "α"		89°30'
Contacting width "W"*1	Intake	1.40 (0.0551)
	Exhaust	1.544 (0.0608)
Height "h"	Intake	4.56 - 4.64 (0.1795 - 0.1827)
	Exhaust	4.905 - 4.985 (0.1931 - 0.1963)
Depth "H"	Intake	6.95 (0.2736)
	Exhaust	7.25 (0.2854)

*1: Machining data

VALVE SPRING

Free height		46.90 mm (1.8465 in)
Pressure height	200 - 220 N (20.4 - 22.4 kg, 45 - 49 lb)	34.90 mm (1.3740 in)
	353 - 387 N (36.0 - 39.5 kg, 79 - 87 lb)	26.90 mm (1.0591 in)
Full pressed height		24.40 mm (0.9606 in)
Diameter of the wire		2.78 - 2.82 mm (0.1094 - 0.1110 in)
Inner diameter		13.90 - 14.30 mm (0.5472 - 0.5630 in)
Outer diameter		19.50 - 19.90 mm (0.7677 - 0.7835 in)
Valve spring squareness		1.4 mm (0.055 in)

Cylinder Block

INFOID:0000000010282036

CRANKSHAFT

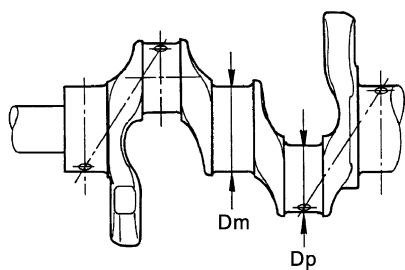
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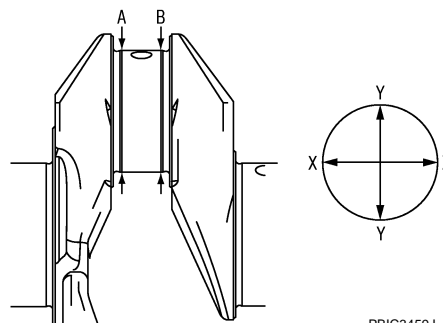
[R9M]

Unit: mm (in)

Item	Standard
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PBIC3459J

Crankshaft main journal diameter "Dm"	GRADE mark A	51.485 (2.0270)
	GRADE mark B	51.486 (2.0270)
	GRADE mark C	51.487 (2.0270)
	GRADE mark D	51.488 (2.0271)
	GRADE mark E	51.489 (2.0271)
	GRADE mark F	51.490 (2.0272)
	GRADE mark G	51.491 (2.0272)
	GRADE mark H	51.492 (2.0272)
	GRADE mark I	51.493 (2.0273)
	GRADE mark J	51.494 (2.0273)
	GRADE mark K	51.495 (2.0274)
	GRADE mark L	51.496 (2.0274)
	GRADE mark M	51.497 (2.0274)
	GRADE mark N	51.498 (2.0275)
	GRADE mark O	51.499 (2.0275)
	GRADE mark P	51.500 (2.0276)
	GRADE mark Q	51.501 (2.0276)
	GRADE mark R	51.502 (2.2048)
	GRADE mark S	51.503 (2.2048)
GRADE mark T	51.504 (2.2049)	
GRADE mark U	51.505 (2.2049)	
Crankshaft pin journal diameter "Dp"	48.000 - 48.020 (1.8898 - 1.8905)	
Crankshaft end play	0.112 - 0.438 (0.004 - 0.0172)	

CONNECTING ROD

Unit: mm (in)

Item	Standard	
Center distance (big end and small end)	Grade 1	127.17 - 127.185 (5.0067 - 5.0073)
	Grade 2	127.185 - 127.2 (5.0073 - 5.0079)
	Grade 3	127.2 - 127.215 (5.0079 - 5.0098)
	Grade 4	127.215 - 127.23 (5.0098 - 5.001)
Connecting rod big end diameter	51.58 - 51.600 (2.0307 - 2.0315)	
Connecting rod bushing end diameter	32.02 - 32.04 (1.1819 - 1.1827)	
Connecting rod bushing end oil clearance	0.020 - 0.038 (0.0008 - 0.0015)	
Connecting rod side clearance	0.021 - 0.48 (0.0083 - 0.0189)	

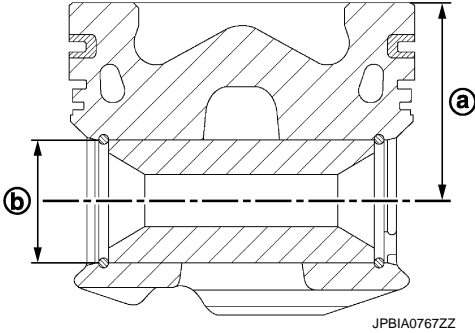
SERVICE DATA AND SPECIFICATIONS (SDS)

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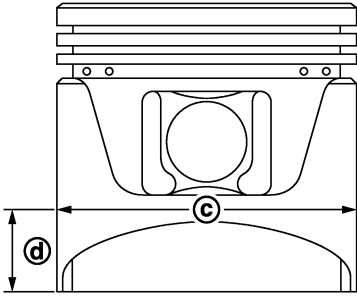
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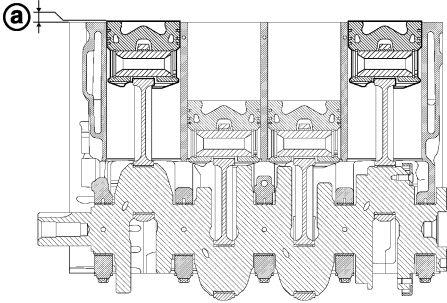
PISTON PROTRUSION GRADE

Unit: mm (in)

Item	Standard	
		
Piston height "a"	Grade R	45.911 (1.8075)
	Grade S	45.946 (1.8089)
	Grade T	45.981 (1.8103)
	Grade U	46.016 (1.8116)
	Grade X	46.031 (1.8130)
Piston pin hole diameter "b"	32.012 - 32.017 (1.2603 - 1.2605)	
Piston to cylinder bore clearance	0.192 - 0.236 (0.0076 - 0.0093)	

AVAILABLE PISTON

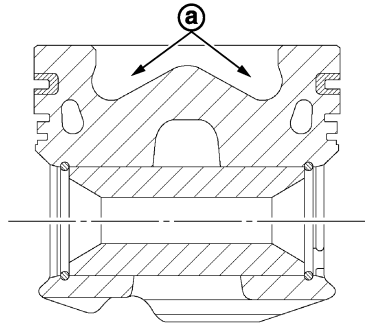
Item	Standard
	
Piston skirt diameter "c"	79.835 mm (3.1431 in)
Measure point "d"	42 mm (1.6535 in)

	
Piston protrusion "a"	0.387 - 0.551 mm (0.0159 - 0.0217 in)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

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Capacity of combustion chamber "a"

24.65 - 25.35 cm³ (1.5041 - 1.546 cu in)

PISTON RING

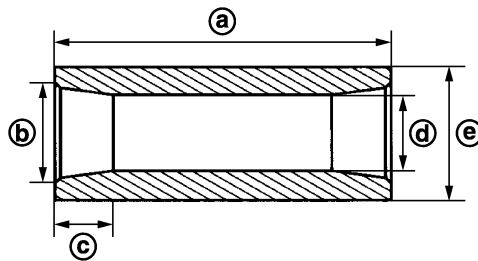
Unit: mm (in)

Items		Standard
Piston ring side clearance	Top	0.09 - 0.13 (0.0035 - 0.0051)
	2nd	0.08 - 0.12 (0.0031 - 0.0047)
	Oil ring	0.05 (0.002)
Piston ring end gap	Top	0.2 - 0.35 (0.0079 - 0.0138)
	2nd	0.7 - 0.9 (0.0276 - 0.0354)
	Oil ring	0.25 - 0.50 (0.0098 - 0.0197)

PISTON PIN

Unit: mm (in)

Items	Standard



JPBIA0768ZZ

Length "a"	59.85 (2.3563)
Diameter of chamfer "b"	23.85 - 24.15 (0.9390 - 0.9508)
Length of the chamfer "c"	8.7 (0.343)
Piston pin inner diameter "d"	13.8 - 14.1 (0.543 - 0.555)
Piston pin outer diameter "e"	29.995 - 30.005 (1.1809 - 1.1813)
Piston to piston pin oil clearance	0.012 - 0.023 (0.0005 - 0.0009)

CYLINDER BLOCK

Unit: mm (in)

Item	Standard
Cylinder block top surface distortion	0.05 (0.0020)
Cylinder bore inner diameter	80.004 - 84.034 (3.1498 - 3.1509)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[R9M]

Cylinder block main bearing housing inner diameter	Grade mark A	55.4975 - 55.4985 (2.1849 - 2.185)
	Grade mark B	55.4985 - 55.4995 (2.185)
	Grade mark C	55.4995 - 55.5005 (2.185 - 2.1851)
	Grade mark E	55.5005 - 55.5015 (2.1851)
	Grade mark H	55.5015 - 55.5025 (2.1851)
	Grade mark J	55.5025 - 55.5035 (2.1851 - 2.1852)
	Grade mark K	55.5035 - 55.5045 (2.1852)
	Grade mark L	55.5045 - 55.5055 (2.1852 - 2.1853)
	Grade mark M	55.5055 - 55.5065 (2.1853)
	Grade mark P	55.5065 - 55.5075 (2.1853)
	Grade mark S	55.5075 - 55.5085 (2.1853 - 2.1854)
	Grade mark T	55.5085 - 55.5095 (2.1854)
	Grade mark U	55.5095 - 55.5105 (2.1854)
Grade mark Z	55.5105 - 55.5115 (2.1854 - 2.1855)	

Main Bearing

INFOID:000000010282037

MAIN BEARING GRADE TABLE

	Marking	Thickness	Identification color
Lower shell bearing	33281R or 4	1.989 mm (0.0783 in)	Blue
	38751R or 3	1.985 mm (0.0781 in)	Black
	37686R or 2	1.981 mm (0.0780 in)	Yellow
	31153R or 1	1.977 mm (0.0778 in)	White
Upper shell bearing	53785R or 4	1.989 mm (0.0783 in)	Blue
	54889 or 3	1.985 mm (0.0781 in)	Black
	7527 (upper)	1.981 mm (0.0780 in)	Yellow
	7521 (lower)	1.977 mm (0.0778 in)	White

MAIN BEARING OIL CLEARANCE

Unit: mm (in)

Main bearing oil clearance	Standard	0.035 - 0.065 (0.0014 - 0.0026)
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Connecting Rod Bearing

INFOID:000000010282038

CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.053 - 0.093 (0.0021 - 0.0037)
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