



NISSAN

MODEL NEW **LD** SERIES
DIESEL ENGINE
LD20 & LD20T

SERVICE MANUAL

NISSAN

MODEL
LD SERIES
DIESEL ENGINE

QUICK REFERENCE INDEX

GENERAL INFORMATION

GI

MAINTENANCE

MA

ENGINE MECHANICAL

EM

ENGINE LUBRICATION & COOLING SYSTEMS

LC

ENGINE FUEL SYSTEM

EF

IMPORTANT NOTICE

Read the entire manual for the safety of the vehicle. The vehicle is equipped with a safety and security system. The skills of the mechanic and anyone using the vehicle are specifically recommended by Nissan. That Nissan is a safety vehicle by the safety of the vehicle.

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NISSAN MOTOR CO., LTD.

FOREWORD

This manual contains maintenance and repair procedures for the new model LD series diesel engine with a camshaft driven by a cogged type timing belt.

In order to assure your safety and the efficient functioning of the engine and vehicle, this manual and the Service Manual for models equipped with the LD series diesel engine, for example the NISSAN BLUEBIRD model U11 series Service Manual, should be read thoroughly. It is especially important that the PRECAUTIONS in the GI section be completely understood before starting any repair task.

All information in this manual is based on the latest product information at the time of publication. The right is reserved to make changes in specifications and methods at any time without notice.

IMPORTANT SAFETY NOTICE

The proper performance of service is essential for both the safety of the mechanic and the efficient functioning of the vehicle.

The service methods in this Service Manual are described in such a manner that the service may be performed safely and accurately.

Service varies with the procedures used, the skills of the mechanic and the tools and parts available. Accordingly, anyone using service procedures, tools or parts which are not specifically recommended by NISSAN must first completely satisfy himself that neither his safety nor the vehicle's safety will be jeopardized by the service method selected.



NISSAN MOTOR CO., LTD.

Export Service Department

Tokyo, Japan

GENERAL INFORMATION

GI

SECTION GI

CONTENTS

PRECAUTIONS	GI-2
HOW TO USE THIS MANUAL	GI-4
SPECIFICATIONS	GI-5
ENGINE SERIAL NUMBER	GI-6
RECOMMENDED LUBRICANTS	GI-7
TIGHTENING TORQUE OF STANDARD BOLT	GI-8

a. To keep
hot metal
maintain
Do not
engine

Apply oil
the wheels to
After looking
wheels with
checked for proper

Sw. 3. Verify steering



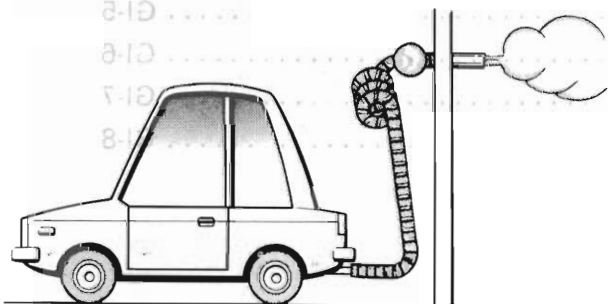
to protect the
with appropriate
viewing

PRECAUTIONS

Observe the following precautions that are not described in each individual section to ensure safe and proper service operations.

1. Do not operate the engine for an extended period of time without proper exhaust ventilation.

Keep the work area well ventilated and free of any inflammable materials. Special care should be taken when handling any inflammable or poisonous materials, such as diesel fuel, refrigerant gas, etc. If you are working in a pit or other enclosed area, be sure to properly ventilate before working with hazardous materials. Do not smoke while working on the vehicle.



SGI285

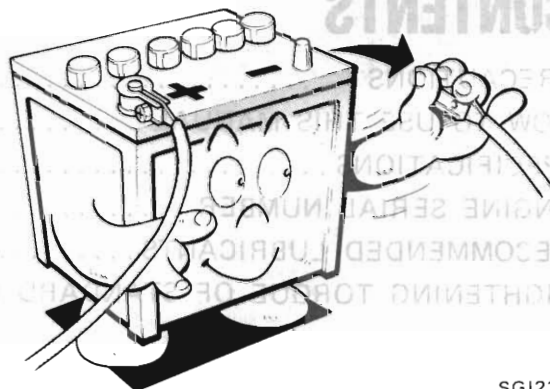
2. Before jacking up the vehicle, apply wheel chocks or other tire blocks to the wheels to prevent the vehicle from moving. After jacking up the vehicle, support the vehicle weight with rigid racks at the points designated for proper lifting and towing before working on the vehicle.

These operations should be done on a level surface.



SGI231

3. When removing a heavy component such as the engine or transaxle/transmission, take care not to lose your balance and drop it or cause it to hit against adjacent parts, especially against the brake parts such as brake tube, fuel tube, and master cylinder.
4. Before starting repairs which do not require battery power, always turn off the ignition switch, then disconnect the ground cable from the battery to prevent accidental short circuit.



SGI232

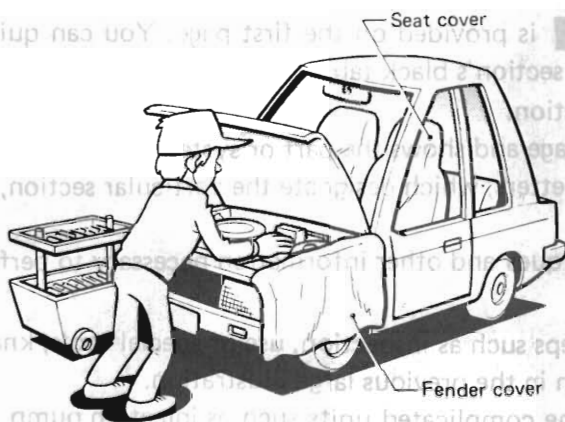
5. To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe and muffler. Do not remove the radiator cap when the engine is hot.



SGI233

6. To prevent scratches and soiling, protect fenders, upholstery and carpeting with appropriate covers before starting servicing. Take caution that keys, buckles or buttons on your person do not scratch the paint.

Precautions for Turbocharger



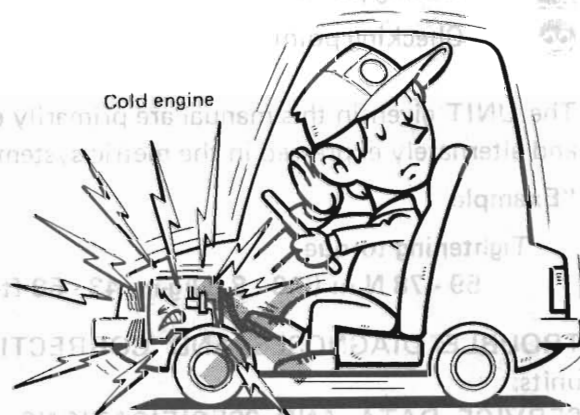
SG1234

7. Clean all disassembled parts in the designated liquid or solvent prior to inspection or assembly.
8. Replace oil seals, gaskets, packings, O-rings, locking washers, cotter pins, self-locking nuts, etc. as instructed and discard used ones.
9. Arrange the disassembled parts in accordance with their assembled locations and sequence.
10. After disconnecting vacuum hose or air hose, attach tag which indicates the proper connection to prevent incorrect connection.
11. Use only the lubricants specified in the applicable section or those indicated under "Recommended Fuel and Lubricants".
12. Use approved bonding agent, sealants or their equivalents when required.
13. The use of the proper tools and recommended essential tools should be used where specified for proper, safe and efficient service repairs.
14. When effecting repairs on the fuel, oil, water, vacuum or exhaust systems, make certain to check all affected lines for leaks.
15. Dispose of drained oil or the solvent used for cleaning parts in an appropriate manner.

The turbocharger system uses engine oil for lubrication and cooling of its rotating components. The turbocharger turbine turns at a speed in excess of 100,000 rpm at full throttle and its temperature can reach 870°C (1,600°F). It is essential to maintain a clean supply of oil flowing through the turbocharger system. Therefore, a sudden interruption of oil supply may cause a malfunction in the turbocharger.

For proper operation of the system, follow the procedure below.

1. Always use the recommended oil. Follow the instructions for proper time to change the oil and proper oil level.
2. Avoid accelerating engine to a high rpm immediately after starting.



SG1292

3. If engine had been operating at high rpm for an extended period of time, let it idle for a few minutes prior to shutting it off.

HOW TO USE THIS MANUAL

1. A **QUICK REFERENCE INDEX**, a black tab e.g. **EM** is provided on the first page. You can quickly find the first page of each section by matching it to the section's black tab.
2. **THE CONTENTS** are listed on the first page of each section.
3. **THE TITLE** is indicated on the upper portion of each page and shows the part or system.
4. **THE PAGE NUMBER** of each section consists of two letters, which designate the particular section, and a number (e.g. "EM-5").
5. **THE LARGE ILLUSTRATION** contains tightening torques and other information necessary to perform repairs.
6. **THE SMALL ILLUSTRATION** shows the important steps such as inspection, use of special tools, knacks of work and hidden or tricky steps which are not shown in the previous large illustration. Assembly, inspection and adjustment procedures for the complicated units such as injection pump, etc. are presented in a step-by-step format where necessary.
7. The followings **SYMBOLS AND ABBREVIATIONS** are used:



: Tightening Torque



: Should be lubricated with oil.



: Sealing point



: Checking point

S.D.S.: Service Data and Specifications

L.H., R.H.: Left-Hand, Right-Hand

Tool: Special Service Tools

8. The **UNIT** given in this manual are primarily expressed with the **SI UNIT** (International System of Unit), and alternately expressed in the metric system and in the yard/pound system.

"Example"

Tightening torque

59 - 78 N·m (6.0 - 8.0 kg-m, 43 - 58 ft-lb)

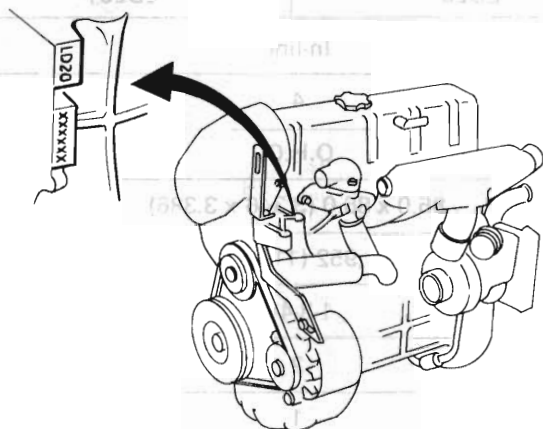
9. **TROUBLE DIAGNOSES AND CORRECTIONS** are included in sections dealing with complicated units.
10. **SERVICE DATA AND SPECIFICATIONS** and a list of **SPECIAL SERVICE TOOLS** are contained at the end of each section for quick reference of data and special tools.
11. The captions **WARNING** and **CAUTION** warn you of steps that must be followed to prevent personal injury and/or damage to some part of the engine.

SPECIFICATIONS

Engine model		LD20	LD20T
Cylinder arrangement		In-line	
Number of cylinders		4	
Valve arrangement		O.H.C.	
Bore x stroke	mm (in)	85.0 x 86.0 (3.346 x 3.386)	
Displacement	cm ³ (cu in)	1,952 (119.11)	
Firing order		1-3-4-2	
Number of piston rings	Compression	2	
	Oil	1	
Number of main bearings		5	
Compression ratio		22.2	21.0
Cetane number of diesel fuel		More than 45: Except Europe More than 51: Europe	

ENGINE SERIAL NUMBER

The engine serial number is stamped on the left-front side of cylinder block.



LD20 - XXXXXX

Serial No.

Engine model

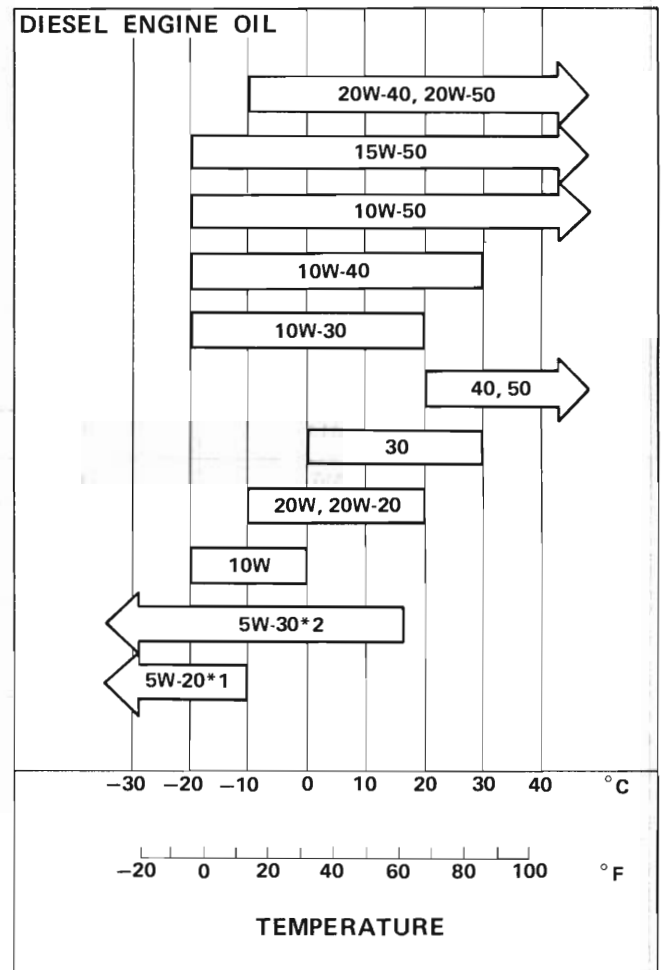
SG1303

RECOMMENDED LUBRICANTS

LUBRICANTS

Lubricant		Specifications	Remarks
Diesel engine oil	Non-turbo model	API CC or CD	For further details, refer to the recommended SAE viscosity chart.
	Turbo model	API CD	
Anti-freeze		—	Ethylene glycol base

SAE VISCOSITY NUMBER



- *1: Not recommended for sustained high speed driving.
- *2: Use only below 0°C (32°F) for turbo models.
- *3: On models equipped with a turbocharger, use 10W-30, 10W-40, 10W-50, 15W-50, 20W-20, 20W-40 or 20W-50 except under extremely cold conditions. Use 5W-30 only under extremely cold conditions.

TIGHTENING TORQUE OF STANDARD BOLT

Grade	Nominal size	Diameter mm	Pitch mm	Tightening torque		
				N·m	kg-m	ft-lb
4T	M6	6.0	1.0	3 - 4	0.3 - 0.4	2.2 - 2.9
	M8	8.0	1.25	8 - 11	0.8 - 1.1	5.8 - 8.0
			1.0	8 - 11	0.8 - 1.1	5.8 - 8.0
	M10	10.0	1.5	16 - 22	1.6 - 2.2	12 - 16
			1.25	16 - 22	1.6 - 2.2	12 - 16
	M12	12.0	1.75	26 - 36	2.7 - 3.7	20 - 27
			1.25	30 - 40	3.1 - 4.1	22 - 30
	M14	14.0	1.5	46 - 62	4.7 - 6.3	34 - 46
7T	M6	6.0	1.0	6 - 7	0.6 - 0.7	4.3 - 5.1
	M8	8.0	1.25	14 - 18	1.4 - 1.8	10 - 13
			1.0	14 - 18	1.4 - 1.8	10 - 13
	M10	10.0	1.5	25 - 35	2.6 - 3.6	19 - 26
			1.25	26 - 36	2.7 - 3.7	20 - 27
	M12	12.0	1.75	45 - 61	4.6 - 6.2	33 - 45
			1.25	50 - 68	5.1 - 6.9	37 - 50
	M14	14.0	1.5	76 - 103	7.7 - 10.5	56 - 76
9T	M6	6.0	1.0	8 - 11	0.8 - 1.1	5.8 - 8.0
	M8	8.0	1.25	19 - 25	1.9 - 2.5	14 - 18
			1.0	20 - 27	2.0 - 2.8	14 - 20
	M10	10.0	1.5	36 - 50	3.7 - 5.1	27 - 37
			1.25	39 - 51	4.0 - 5.2	29 - 38
	M12	12.0	1.75	65 - 88	6.6 - 9.0	48 - 65
			1.25	72 - 97	7.3 - 9.9	53 - 72
	M14	14.0	1.5	109 - 147	11.1 - 15.0	80 - 108

1. Special parts are excluded.
2. This standard is applicable to bolts having the following marks embossed on the bolt head.

Grade	Mark
4T	4
7T	7
9T	9

MAINTENANCE

SECTION MA

MA

CONTENTS

ENGINE MAINTENANCE	MA- 2
TROUBLE DIAGNOSES AND CORRECTIONS	MA-15
SERVICE DATA AND SPECIFICATIONS.....	MA-27
SPECIAL SERVICE TOOLS	MA-28



118 - 127 (mm)
(12 - 13 (in) x 04 (in))

4. Install roller cover.
Be sure to apply a coat of lubricant
mately 1 mm (0.1 in) thick and 2 mm
(in) wide to the roller cover
before install.

Approximately
10 mm (1 in)



Roller cover
10 x 10 mm



Tightening order

ENGINE MAINTENANCE

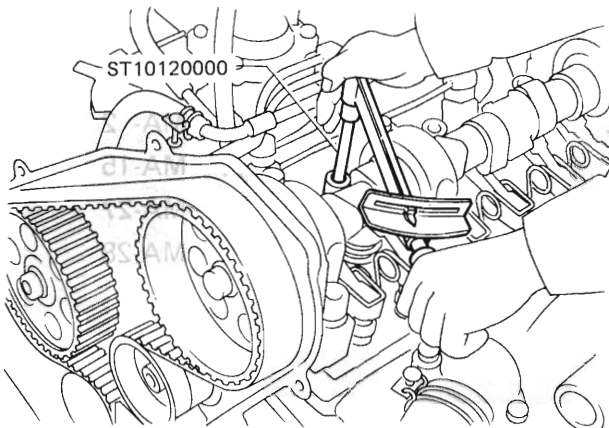
Retightening Cylinder Head Bolts and Manifold Nuts

Retightening should be performed while engine is cold [approximately 20°C (68°F)].

CYLINDER HEAD BOLTS

1. First loosen each cylinder head bolt slightly.
2. Retighten cylinder head bolt.

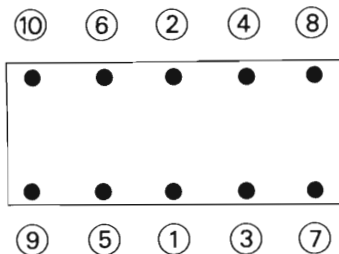
 : 118 - 127 N·m
(12 - 13 kg-m, 87 - 94 ft-lb)



SMA879A

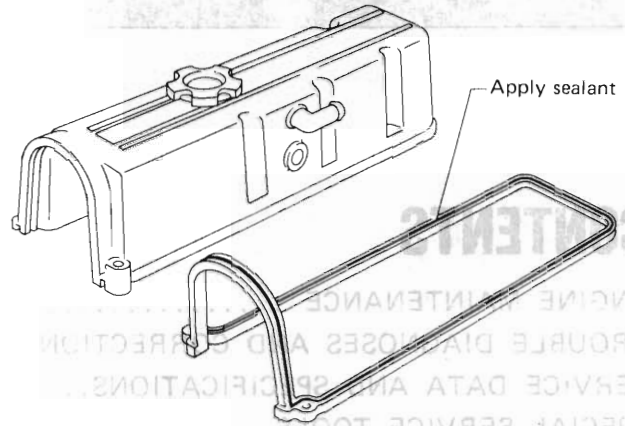
Tightening order

Tightening order



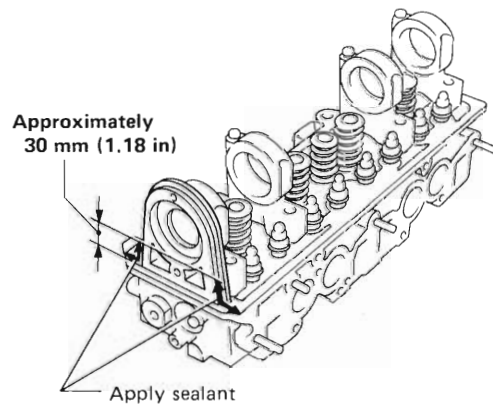
SMA880A

3. Apply approximately 1 mm (0.04 in) thick coating of sealant to groove in rocker cover gasket, and install gasket.



SMA881A

4. Install rocker cover.
Be sure to apply a coat of sealant [approximately 1 mm (0.04 in) thick and 3 mm (0.12 in) wide] to corners of front cam bracket before installation.



SMA882A

Rocker cover bolt

 : 7 - 11 N·m
(0.7 - 1.1 kg-m, 5.1 - 8.0 ft-lb)

ENGINE MAINTENANCE

Retightening Cylinder Head Bolts and Manifold Nuts (Cont'd)

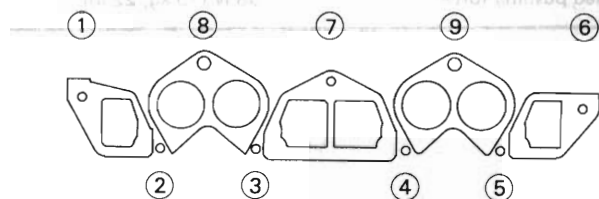
MANIFOLD AND EXHAUST TUBE NUTS

Tightening torque:

Unit		N·m	kg·m	ft·lb
Manifold	Bolt (M10)	34 - 44	3.5 - 4.5	25 - 33
	Bolt (M8)	18 - 22	1.8 - 2.2	13 - 16
	Nut	18 - 22	1.8 - 2.2	13 - 16
Exhaust tube		26 - 36	2.7 - 3.7	20 - 27

Never disassemble the intake manifold.

Tightening order

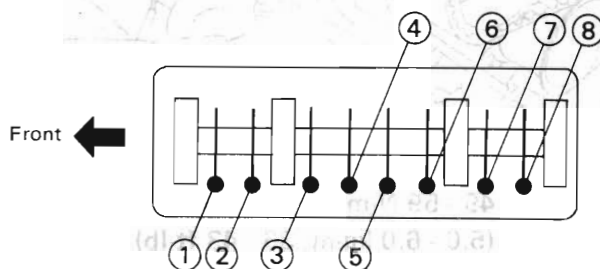


SMA883A

Adjusting Intake and Exhaust Valve Clearance

Adjustment should be made while engine is warm but not running.

1. Remove valve rocker cover.
2. Set No. 1 cylinder at top dead center on its compression stroke and adjust valve clearance ①, ②, ③ and ⑤.
3. Set No. 4 cylinder at top dead center on its compression stroke and adjust valve clearance ④, ⑥, ⑦ and ⑧.



SMA884A

Valve clearance:

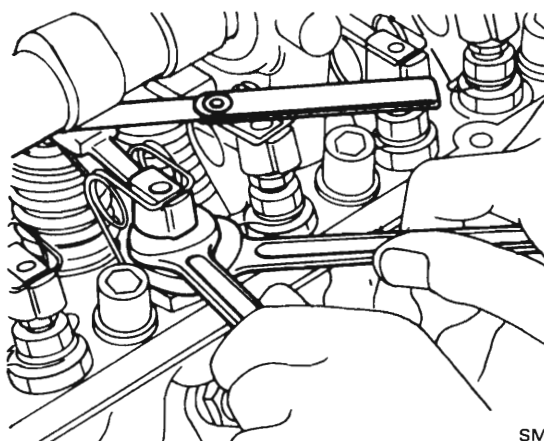
Intake

0.25 mm (0.010 in)

Exhaust

0.30 mm (0.012 in)

- 1) Loosen pivot lock nut and turn valve rocker pivot until specified clearance is obtained.

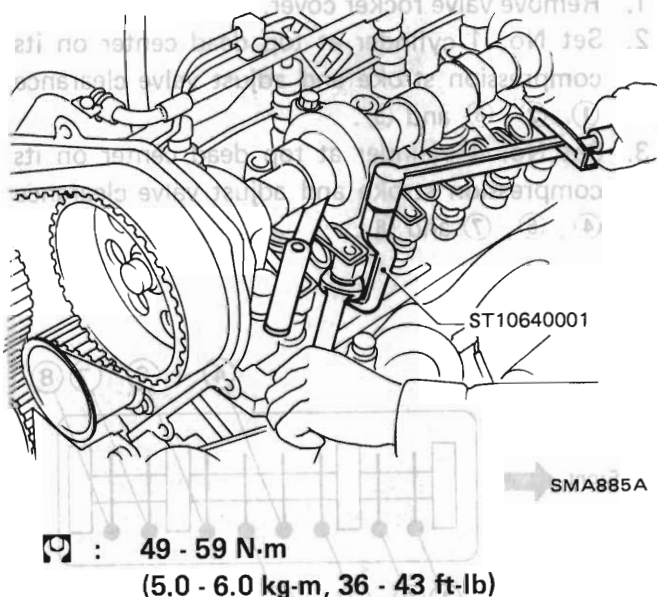


SMA033

ENGINE MAINTENANCE

Adjusting Intake and Exhaust Valve Clearance (Cont'd)

- After adjustment, tighten pivot lock nut using Tool and recheck clearance.



Checking Drive Belts

- Inspect for cracks, fraying, wear and oil adhesion. Replace if necessary.

The belts should not touch the bottom of the pulley groove.

- Check drive belt deflections by pushing midway between pulleys.

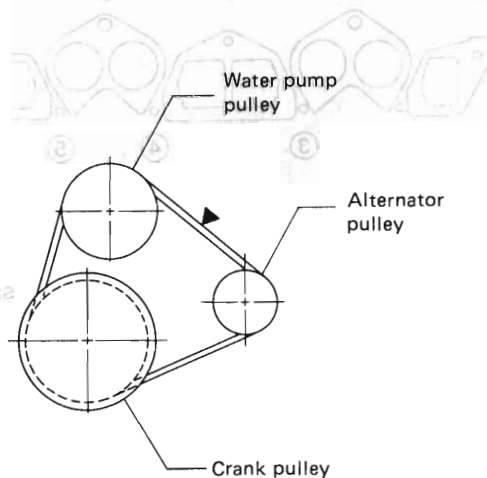
Adjust if belt deflections exceed the limit.

Standard model

Unit: mm (in)

	Used belt deflection		Set deflection of new belt
	Limit	Adjust deflection	
Alternator	18 (0.71)	10.5 - 12.5 (0.413 - 0.492)	8.5 - 10.5 (0.335 - 0.413)

Applied pushing force: 98 N (10 kg, 22 lb)



SMA886A

Air conditioner equipped model

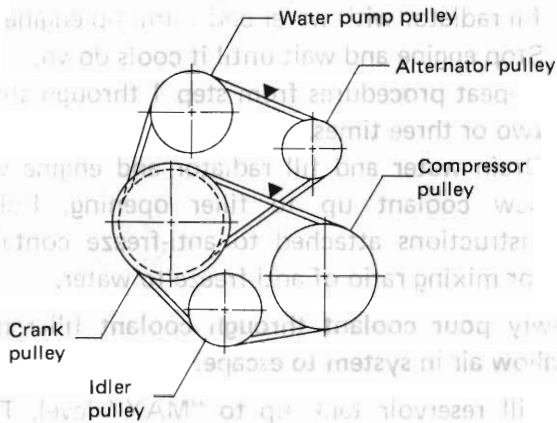
Unit: mm (in)

	Used belt deflection		Set deflection of new belt
	Limit	Adjust deflection	
Alternator	16 (0.63)	9.5 - 11.5 (0.374 - 0.453)	8 - 10 (0.31 - 0.39)
Air conditioner compressor	16 (0.63)	9 - 11 (0.35 - 0.43)	7 - 9 (0.28 - 0.35)

Applied pushing force: 98 N (10 kg, 22 lb)

ENGINE MAINTENANCE

Checking Drive Belts (Cont'd)



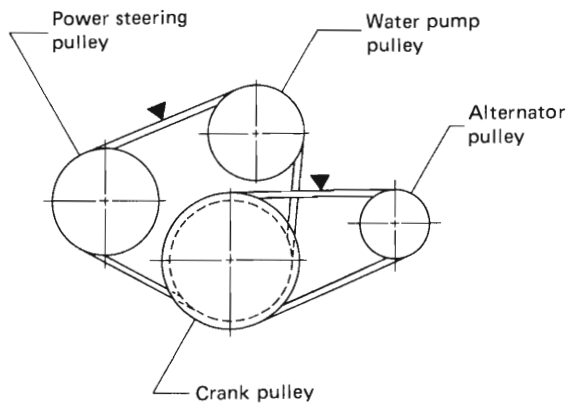
SMA887A

Power steering equipped model

Unit: mm (in)

	Used belt deflection		Set deflection of new belt
	Limit	Adjust deflection	
Alternator	18 (0.71)	10.5 - 12.5 (0.413 - 0.492)	8.5 - 10.5 (0.335 - 0.413)
Power steering oil pump	14 (0.55)	9.5 - 11.5 (0.374 - 0.453)	8 - 10 (0.31 - 0.39)

Applied pushing force: 98 N (10 kg, 22 lb)



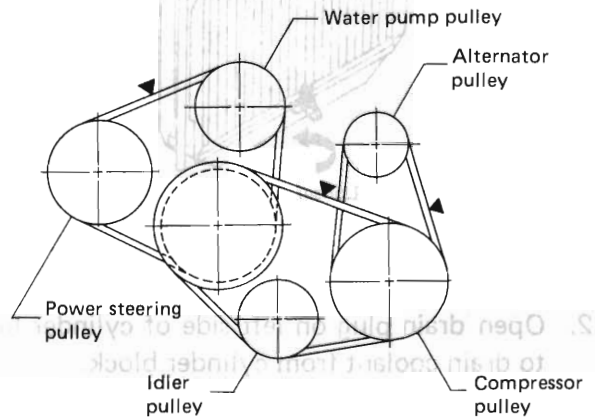
SMA888A

Power steering and air conditioner equipped model

Unit: mm (in)

	Used belt deflection		Set deflection of new belt
	Limit	Adjust deflection	
Alternator	16 (0.63)	9 - 11 (0.35 - 0.43)	7.5 - 9.5 (0.295 - 0.374)
Air conditioner compressor	16 (0.63)	9 - 11 (0.35 - 0.43)	7 - 9 (0.28 - 0.35)
Power steering oil pump	14 (0.55)	9.5 - 11.5 (0.374 - 0.453)	8 - 10 (0.31 - 0.39)

Applied pushing force: 98 N (10 kg, 22 lb)



SMA889A

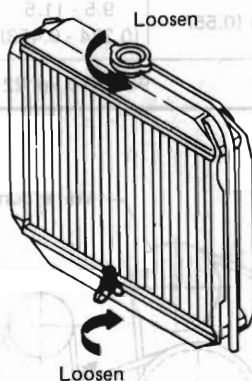
ENGINE MAINTENANCE

Changing Engine Coolant

WARNING:
To avoid being scalded, never attempt to change the coolant when engine is hot.

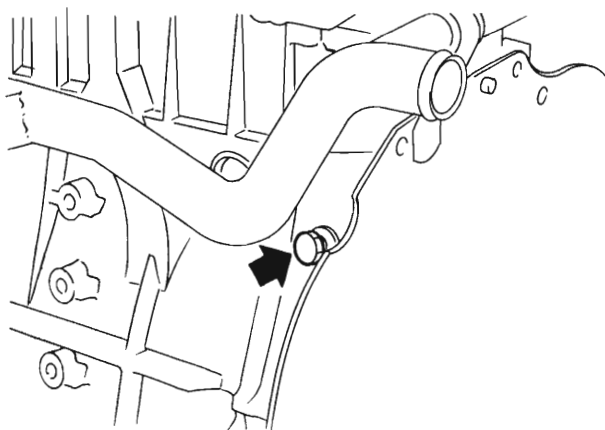
When changing engine coolant, set heater "TEMP" control lever at fully "HOT" position.

1. Open drain cock at bottom of radiator, and remove radiator cap.



CS009

2. Open drain plug on left side of cylinder block to drain coolant from cylinder block.



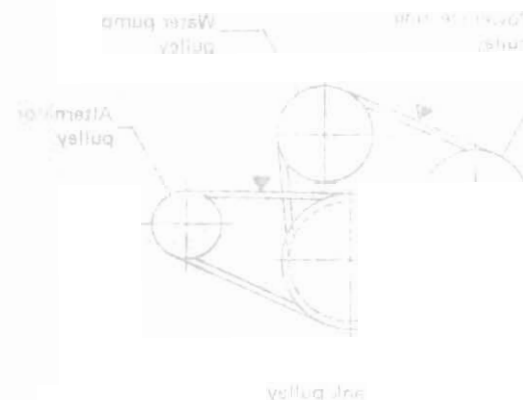
SMA890A

3. Close drain plug and drain cock securely. Then, fill radiator with water and warm up engine.
4. Stop engine and wait until it cools down.
5. Repeat procedures from step 1 through step 4 two or three times.
6. Drain water and fill radiator and engine with new coolant up to filler opening. Follow instructions attached to anti-freeze container for mixing ratio of anti-freeze to water.

Slowly pour coolant through coolant filler neck to allow air in system to escape.

7. Fill reservoir tank up to "MAX" level. Then close radiator cap.
8. Run engine and after it cools down, refill the radiator and engine with coolant up to the filler opening. Fill the reservoir tank with coolant up to "MAX" level.

Used belt data		Limit	Adjust deflection	Set deflection of new belt
15-18 mm	10.5 - 12.5	8.5 - 10.5	(0.413 - 0.453)	(0.338 - 0.413)
19-22 mm	9.5 - 11.5	8 - 10	(0.374 - 0.453)	(0.31 - 0.391)
98 N (10 kg 55 lbf)				



ENGINE MAINTENANCE

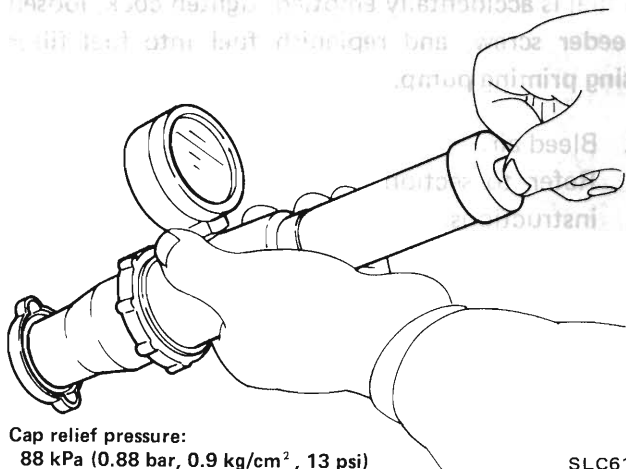
Checking Cooling System

CHECKING COOLING SYSTEM HOSES

Check hoses for proper attachment, leaks, cracks, damage, loose connections, chafing and deterioration.

CHECKING RADIATOR CAP

Apply pressure to radiator cap by means of a cap tester to see if it is satisfactory.

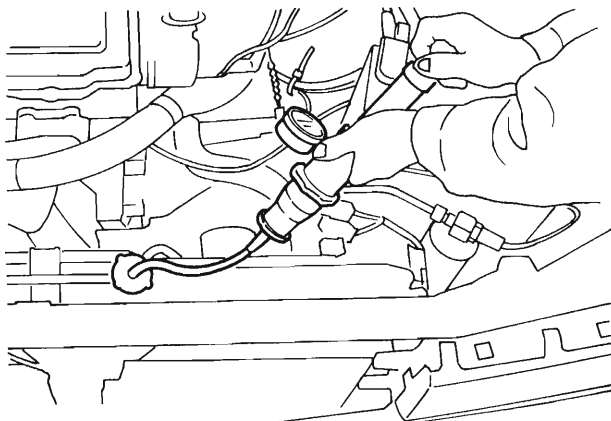


Cap relief pressure:
88 kPa (0.88 bar, 0.9 kg/cm², 13 psi)

SLC613

CHECKING COOLING SYSTEM FOR LEAKS

Apply pressure to the cooling system with a tester to check for leakage.



SMA814A

Testing pressure:

157 kPa

(1.57 bar, 1.6 kg/cm², 23 psi)

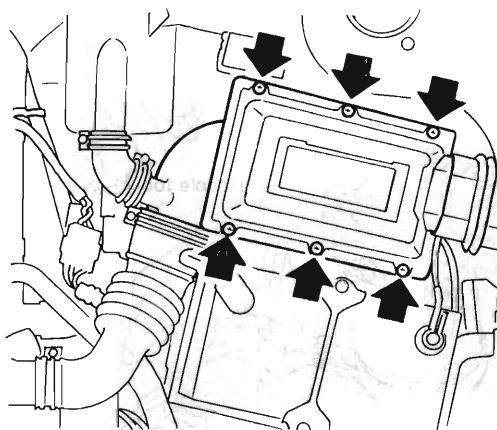
Checking Fuel Lines

HOSES, PIPING, CONNECTIONS, ETC.

Check fuel lines for loose connections, cracks and deterioration. Retighten loose connections and replace any damaged or deformed parts.

Replacing Air Cleaner Filter

The viscous paper type air cleaner filter does not require any cleaning between renewals.

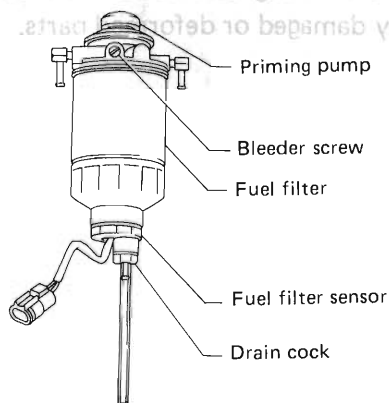


SMA894A

ENGINE MAINTENANCE

Checking Fuel Filter, Drain Water and Replacing Filter

This filter includes priming pump and fuel filter sensor.

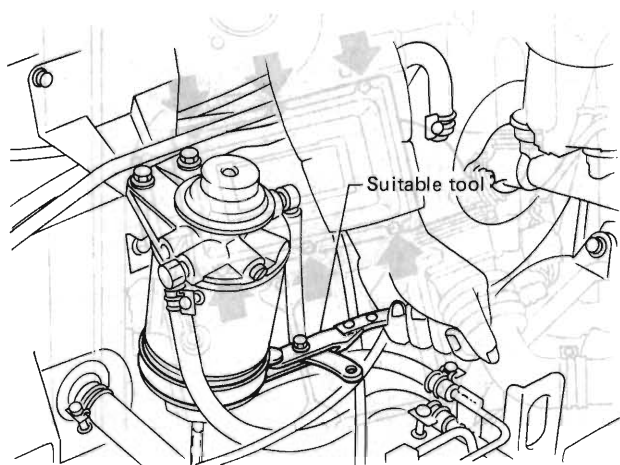


SMA895A

Reuse the fuel filter sensor.

REPLACING FUEL FILTER

1. Remove fuel filter sensor and drain fuel.
2. Remove fuel filter, using suitable Tool.



SMA896A

3. Install fuel filter sensor to new fuel filter.
4. Install fuel filter to priming pump.
5. Bleed air.
Refer to Section EF for fuel system bleeding instructions.

Start engine and check for leaks.

DRAIN WATER

1. Set a container under fuel filter.
2. Loosen drain cock and drain water.

Bleeder screw does not need to be loosened because air automatically enters from the drain passage. Loosening drain cock 4 to 5 turns causes water to start draining. Do not remove drain cock by loosening it excessively.

If fuel is accidentally emptied, tighten cock, loosen bleeder screw, and replenish fuel into fuel filter using priming pump.

3. Bleed air.

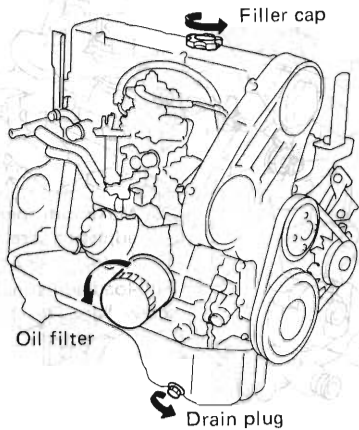
Refer to section EF for fuel system bleeding instructions.



ENGINE MAINTENANCE

— Changing Engine Oil and Oil Filter —

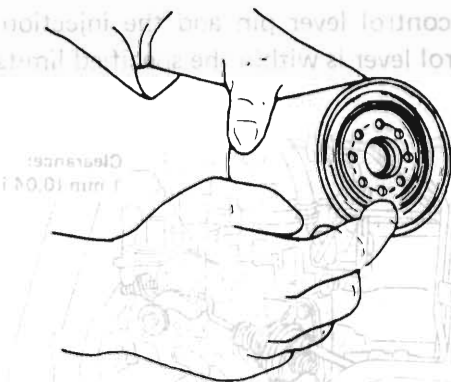
1. Warm up engine, and check for oil leakage from engine components.
2. Change engine oil and oil filter.



SMA897A

⚙️ : 29 - 39 N·m
(3.0 - 4.0 kg-m, 22 - 29 ft-lb)

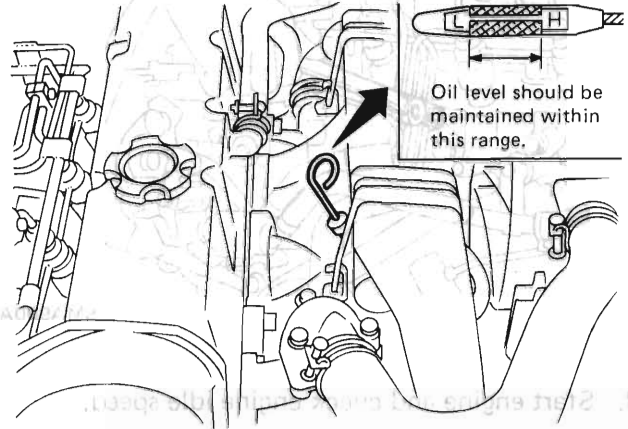
- a. Be careful not to burn yourself as engine oil is hot.
- b. Be sure to clean drain plug and install with washer.
- c. Before installing new oil filter, wipe oil filter mounting surface on cylinder block, and smear a little engine oil on rubber seal of oil filter.



SMA010

- d. When installing oil filter, turn the oil filter until it touches the oil filter bracket. Then turn it 2/3 turn further. If it is turned too far, oil leakage may occur.
- e. Use recommended engine oil.

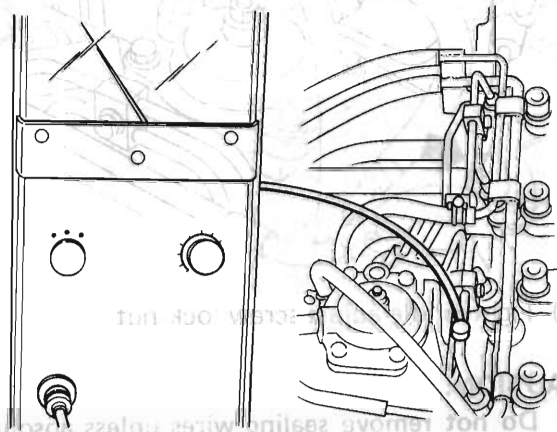
Start engine. Check area around drain plug and oil filter for any sign of oil leakage.
Run engine for a few minutes, then turn it off.
After several minutes, check oil level.



SMA898A

— Checking Idle Speed —

1. Warm up engine.
2. Attach tachometer's pickup to No. 1 fuel injection tube.

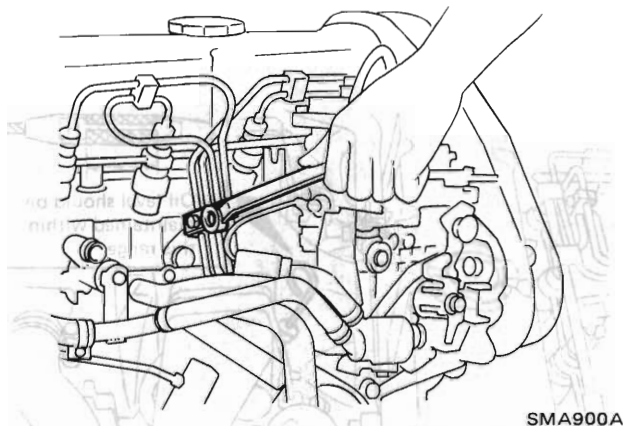


SMA899A

ENGINE MAINTENANCE

Checking Idle Speed (Cont'd)

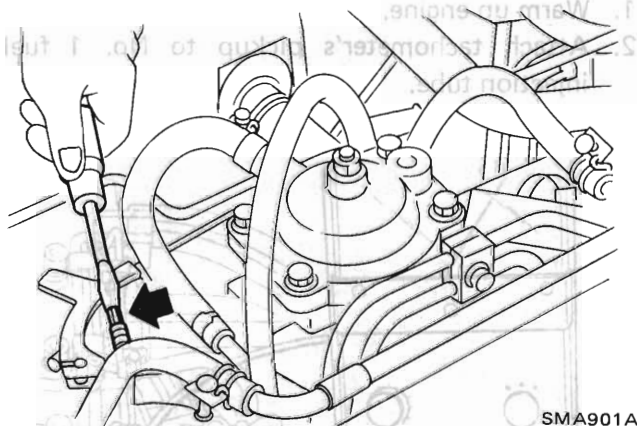
In order to take accurate reading of engine rpm, remove clamp that secures No. 1 fuel injection tube.



3. Start engine and check engine idle speed.

Idle speed (rpm)	
M/T	700 ± 50

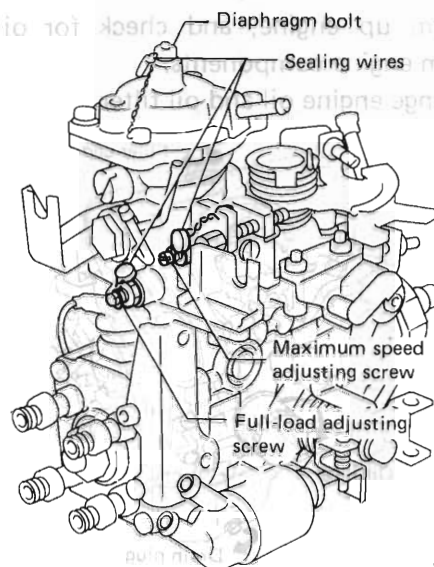
4. If engine idle speed is not within the specified value, proceed as follows.
 - (1) Loosen idle adjust screw lock nut.
 - (2) Turn idle adjust screw in either direction until the specified engine idle speed is obtained.



- (3) Tighten idle adjust screw lock nut.

CAUTION:

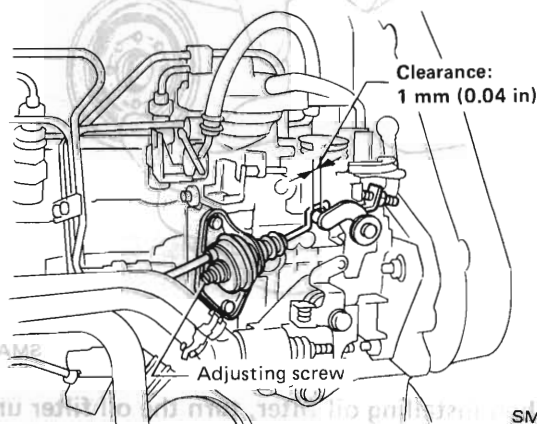
- a. Do not remove sealing wires unless absolutely necessary.



- b. Disturbing full-load adjusting screw and diaphragm bolt adjustment will change fuel flow characteristics, resulting in an improperly adjusted engine. Readjustment of fuel injection pump should be done using a pump tester.
- c. If maximum speed adjusting screw is turned in direction that increases control lever angle, engine damage may result.

AIR CONDITIONER EQUIPPED MODEL

1. Make certain that the clearance between the idle control lever pin and the injection pump control lever is within the specified limits.



2. Adjust idle speed to specified rpm without the air conditioner operating.

ENGINE MAINTENANCE

Checking Idle Speed (Cont'd)

3. Then check the idle speed when the air conditioner is operating and make sure it is correct.

Unit: rpm	
Idle speed (Air conditioner "ON")	800 ± 50

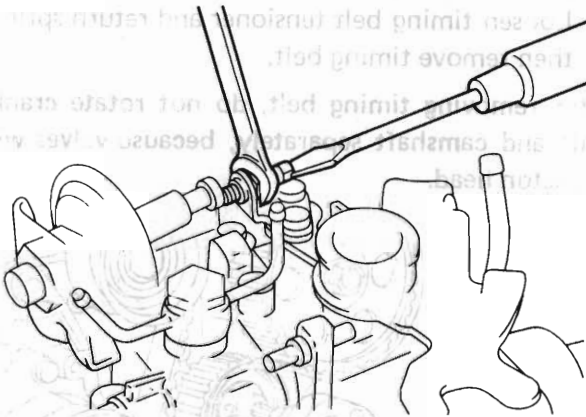
If not, adjust it by turning F.I.C.D. actuator stroke adjusting screw.

Adjustment of Dash Pot

ADJUST DASH POT

Unit: rpm

$1,500 \pm 100$



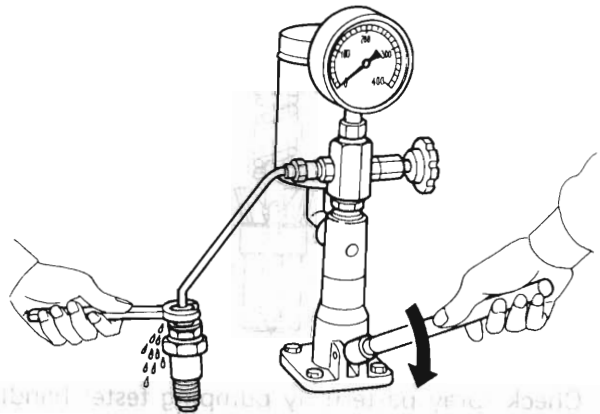
SEF996B

Checking Injection Nozzle

WARNING:

When using nozzle tester, be careful not to allow diesel fuel sprayed from nozzle to come into contact with your hand or body, and make sure that your eyes are properly protected.

1. Clean and check nozzles.
2. Install nozzle to injection nozzle tester and bleed air from flare nut.



EF791A

3. Check initial injection pressure by pumping tester handle one time per second.

Initial injection pressure:

12,259 - 13,239 kPa
(122.6 - 132.4 bar,
125 - 135 kg/cm²,
1,778 - 1,920 psi)

New nozzle initial injection pressure:

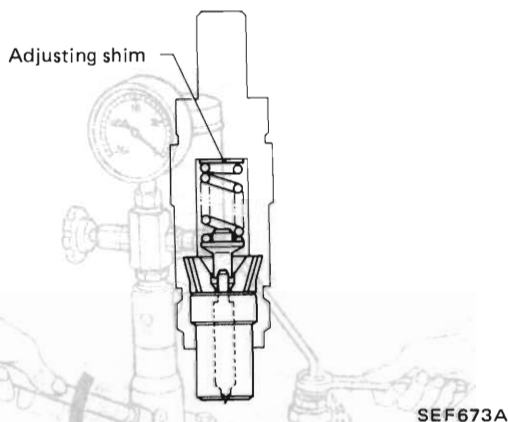
13,239 - 14,024 kPa
(132.4 - 140.2 bar,
135 - 143 kg/cm²,
1,920 - 2,033 psi)

Initial injection pressure must always be checked when installing a new nozzle.

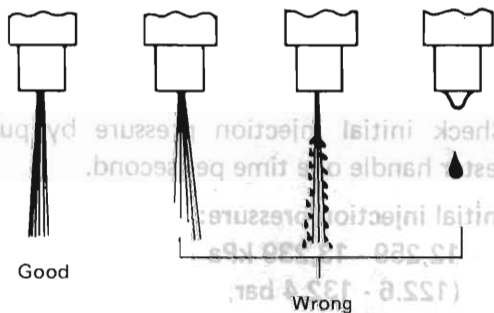
ENGINE MAINTENANCE

—Checking Injection Nozzle (Cont'd)

4. To adjust injection pressure, change adjusting shims.
 - a. Increasing the thickness of adjusting shims increases initial injection pressure. Decreasing shim thickness reduces initial injection pressure.
 - b. A shim thickness of 0.04 mm (0.0016 in) corresponds approximately to a difference of 471 kPa (4.71 bar, 4.8 kg/cm², 68 psi) in initial injection pressure.



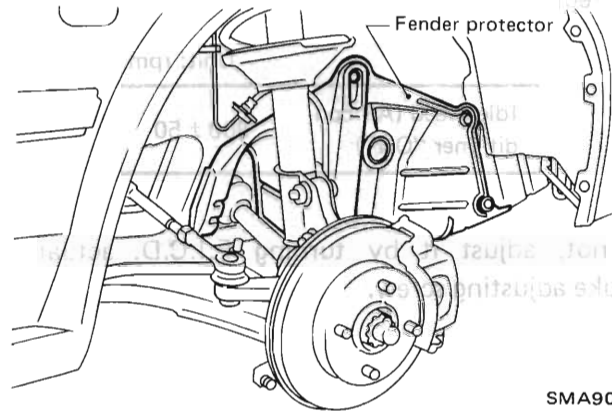
5. Check spray pattern by pumping tester handle one time per second.



6. Inadequate fuel spray pattern or drips from nozzle and is often use to improper contact of needle with seat. If such a failure is experienced, service injection nozzle. When servicing nozzle, refer to Injection Nozzle Assembly in section EF.

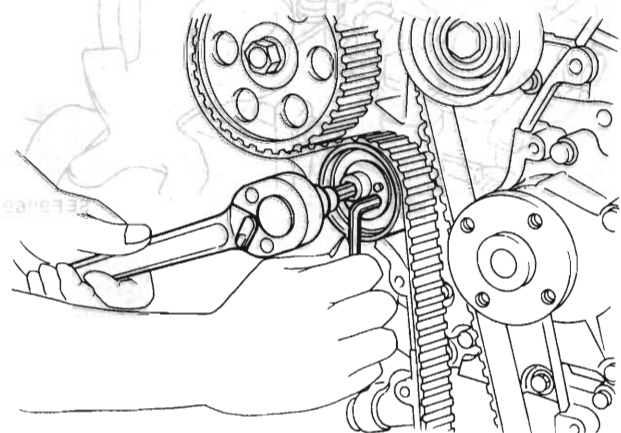
Changing Timing Belt

1. Jack up the vehicle.
2. Remove right fender protector.



3. Remove the following belts.
 - Alternator drive belt
 - Air conditioner compressor drive belt
 - Power steering oil pump drive belt
4. Set No. 1 cylinder at T.D.C. on its compression stroke.
5. Remove crank damper pulley and water pump pulley.
6. Remove dust covers and gasket.
7. Loosen timing belt tensioner and return spring, then remove timing belt.

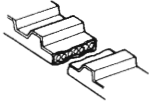
After removing timing belt, do not rotate crankshaft and camshaft separately, because valves will hit piston head.

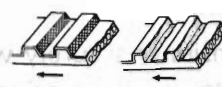


8. Visually check the condition of the timing belt. If any abnormalities are noted, check and correct.

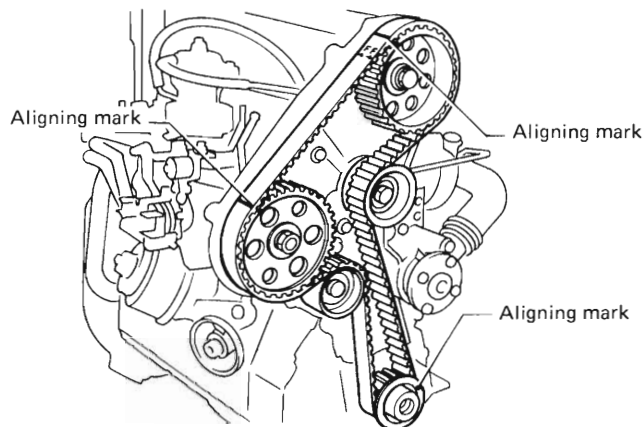
ENGINE MAINTENANCE

Changing Timing Belt (Cont'd)

Item to check	Problem	Cause
Belt is broken.	 SEM393A	- Improper handling - Poor belt cover sealing - Coolant leakage at water pump
Tooth is broken/ tooth root is cracked.	 SEM394A	- Camshaft jamming - Injection pump jamming - Damaged camshaft/crankshaft oil seal
Back surface is cracked/worn.	 SEM395A	- Tensioner jamming - Idler jamming - Overheated engine - Interference with belt cover
Side surface is worn.	 SEM396A	- Improper installation of belt - Malfunctioning crank pulley plate/timing belt plate - Side surface of belt is worn to such an extent that there is no trace of cutoff performed during manufacturing process. - Belt corners are worn and round. - Wicks are frayed and coming out.

Teeth are worn.	 SEM397A	- Poor belt cover sealing - Coolant leakage at water pump - Camshaft not functioning properly - Injection pump not functioning properly - Excessive belt tension - Canvas on tooth face is worn down. - Canvas on tooth is fluffy, rubber layer is worn down and faded white, or web is worn down and invisible.
Oil/Coolant or water is stuck to belt.		- Poor oil sealing of each oil seal - Coolant leakage at water pump - Poor belt cover sealing

- Confirm that No. 1 cylinder is set at T.D.C. on its compression stroke.
- Confirm that tensioner pulley and idler pulley can be rotated smoothly.
- Install the tensioner and temporarily fix it after turning it fully clockwise with a hexagonal wrench.
- Position timing belt so that the front marked "F" faces the front of the engine with the Nissan mark held between cam pulley and injection pump pulley.
With these marks held in their positions, align the alignment marks on cam pulley, injection pump pulley and crank pulley with those on the corresponding belts.



SMA910A

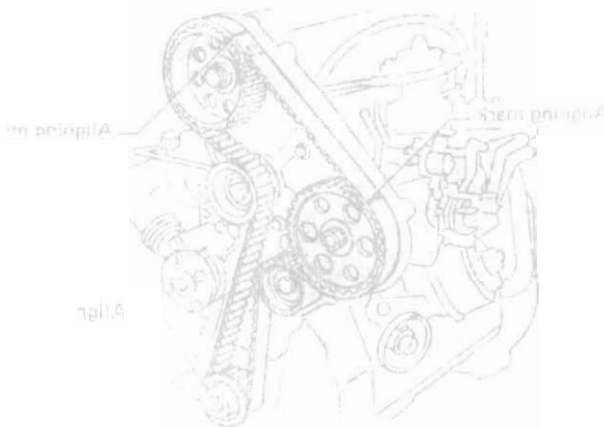
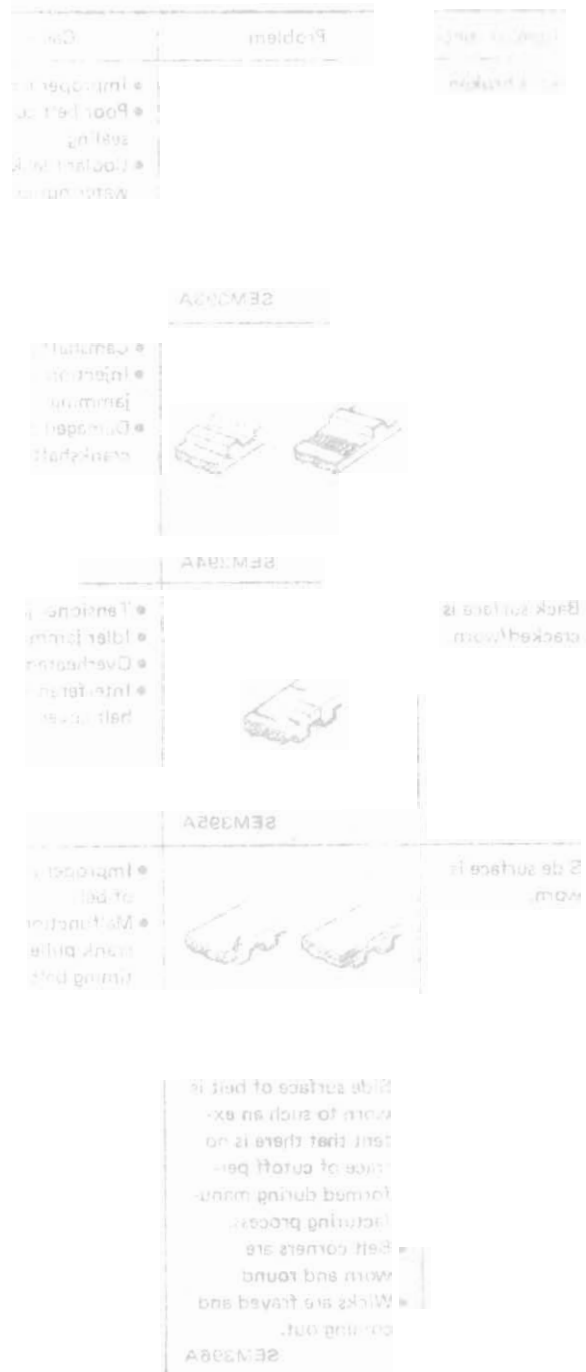
ENGINE MAINTENANCE

Changing Timing Belt (Cont'd)

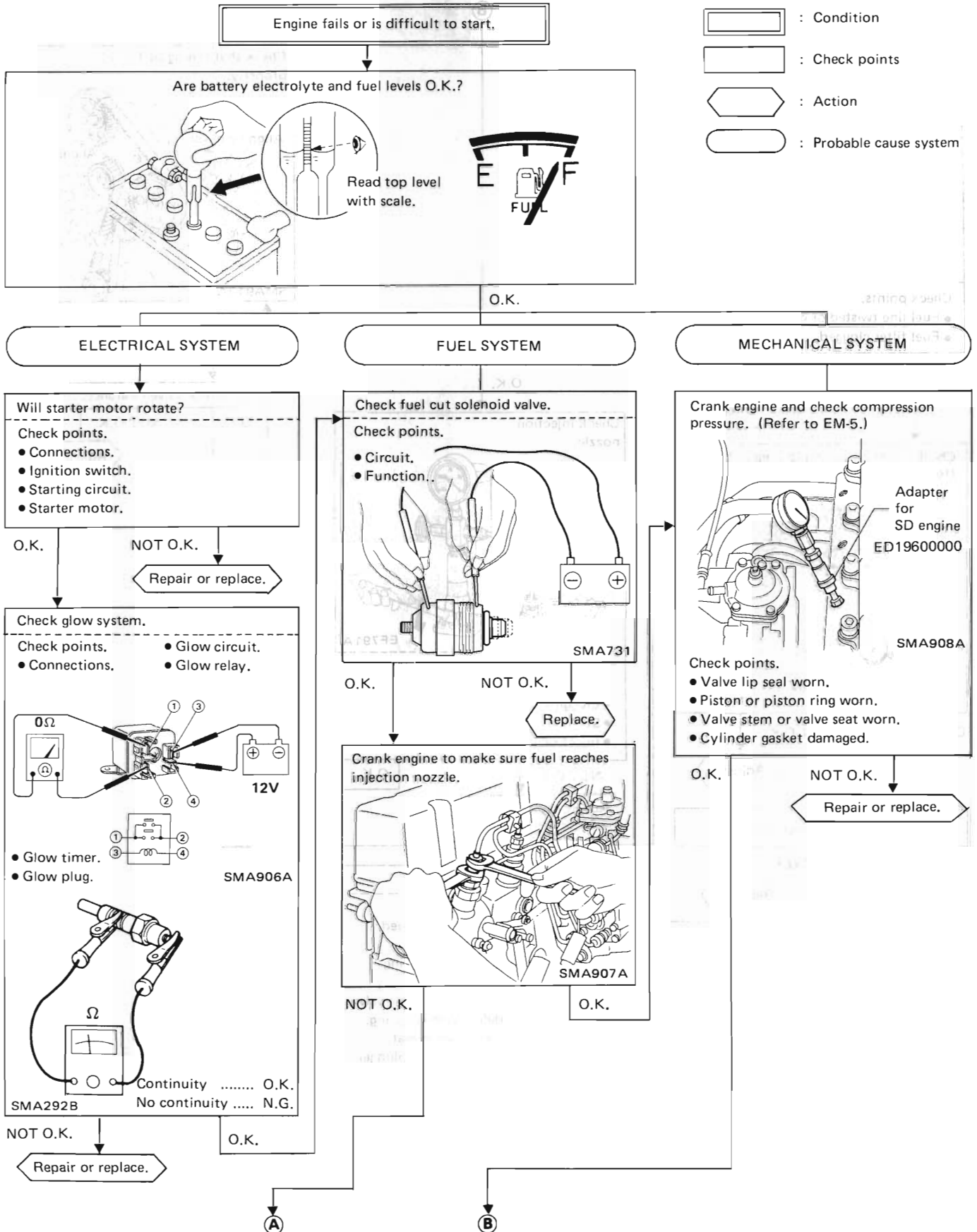
Ensure timing belt is clean and free from oil or water. Do not bend it.

13. Position the tensioner securely with a hexagonal wrench and loosen the tensioner bolt. Slowly turn the tensioner counterclockwise in relation to the return force of the spring to tighten the belt. Turn the crankshaft clockwise two complete rotations to take up belt slackness for proper tension.

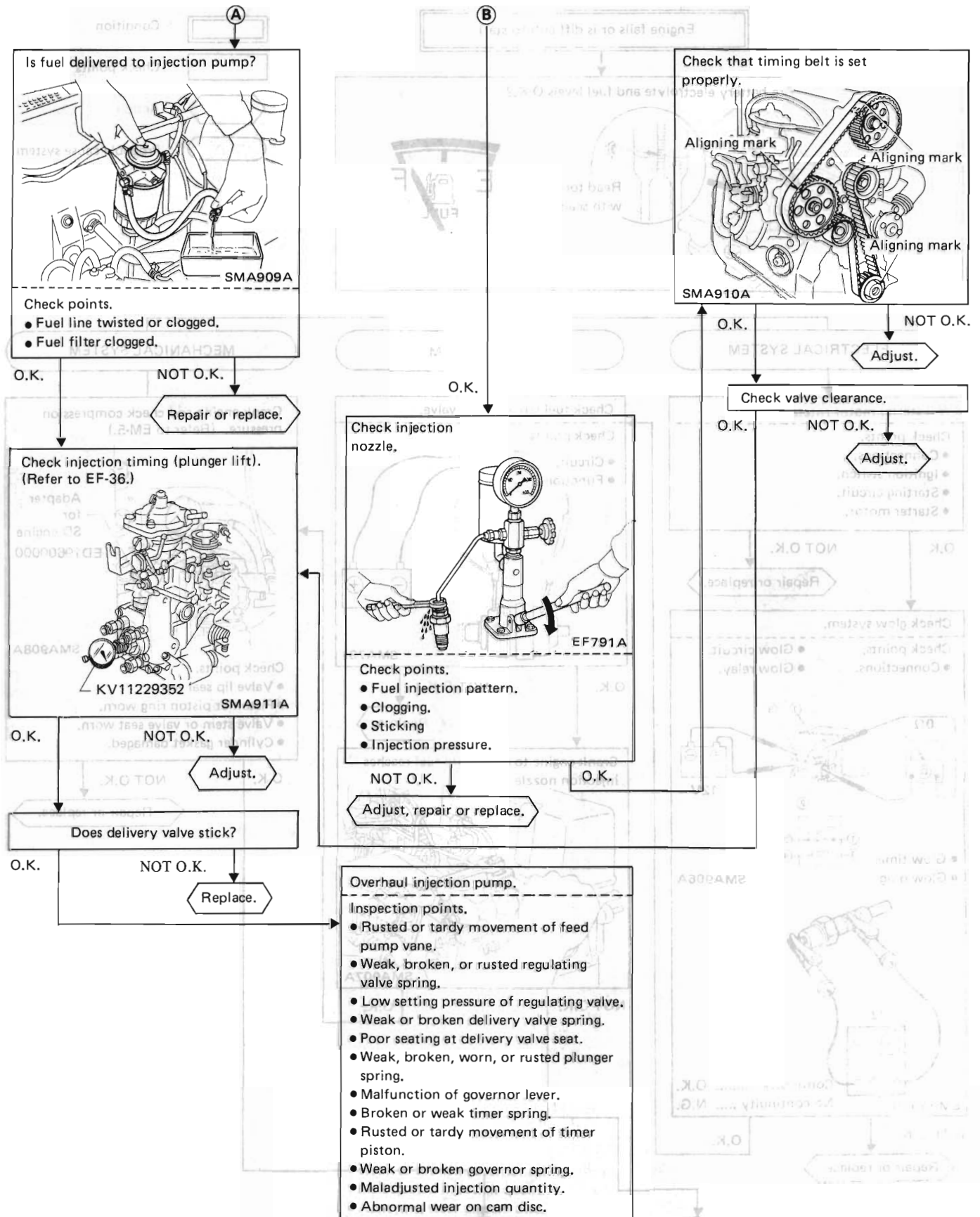
14. Tighten the tensioner bolt while holding the tensioner stationary with a hexagonal wrench. If the tensioner turns clockwise, excessive tension will be applied to the belt and will reduce the life of the belt.



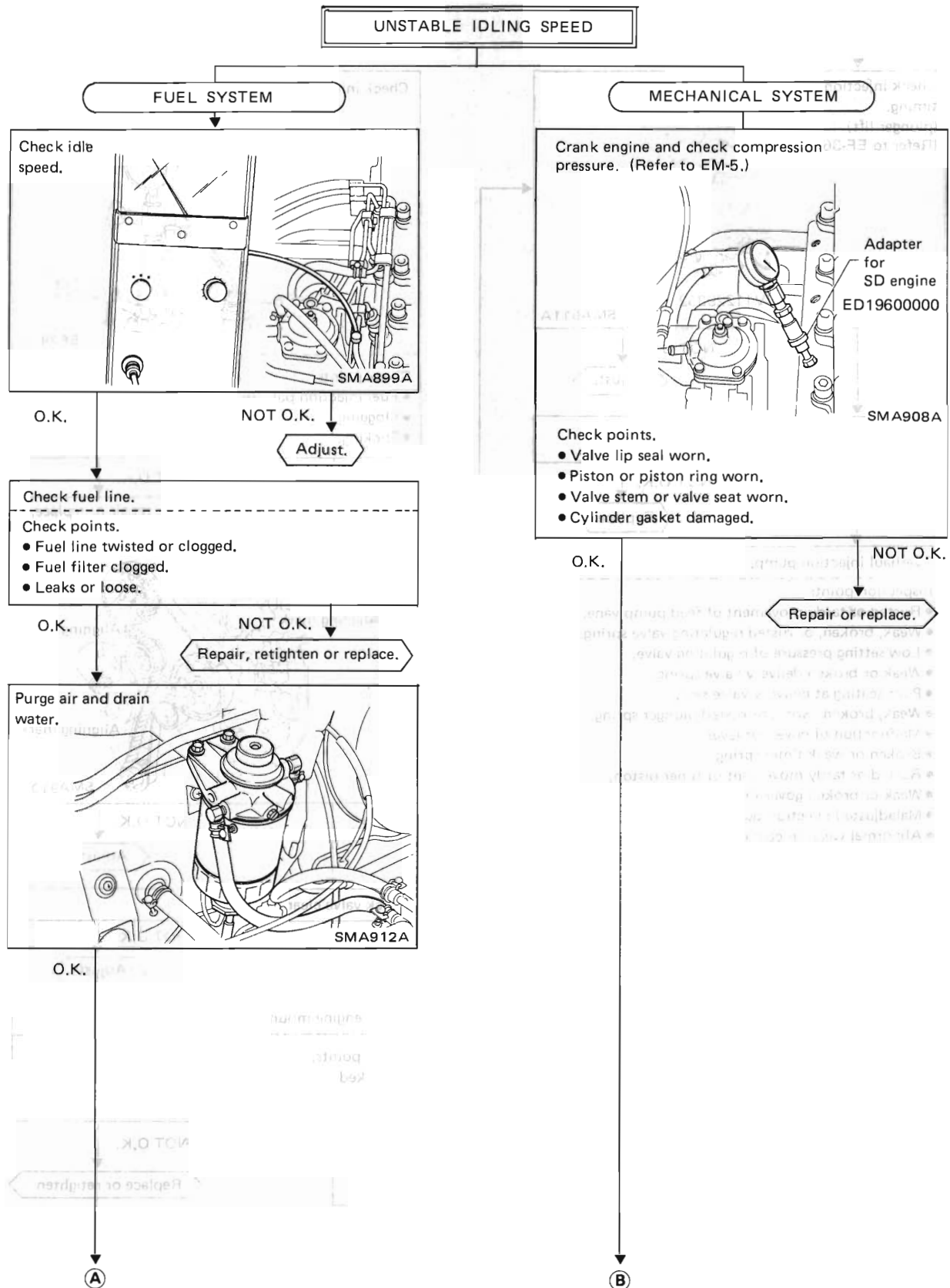
TROUBLE DIAGNOSES AND CORRECTIONS



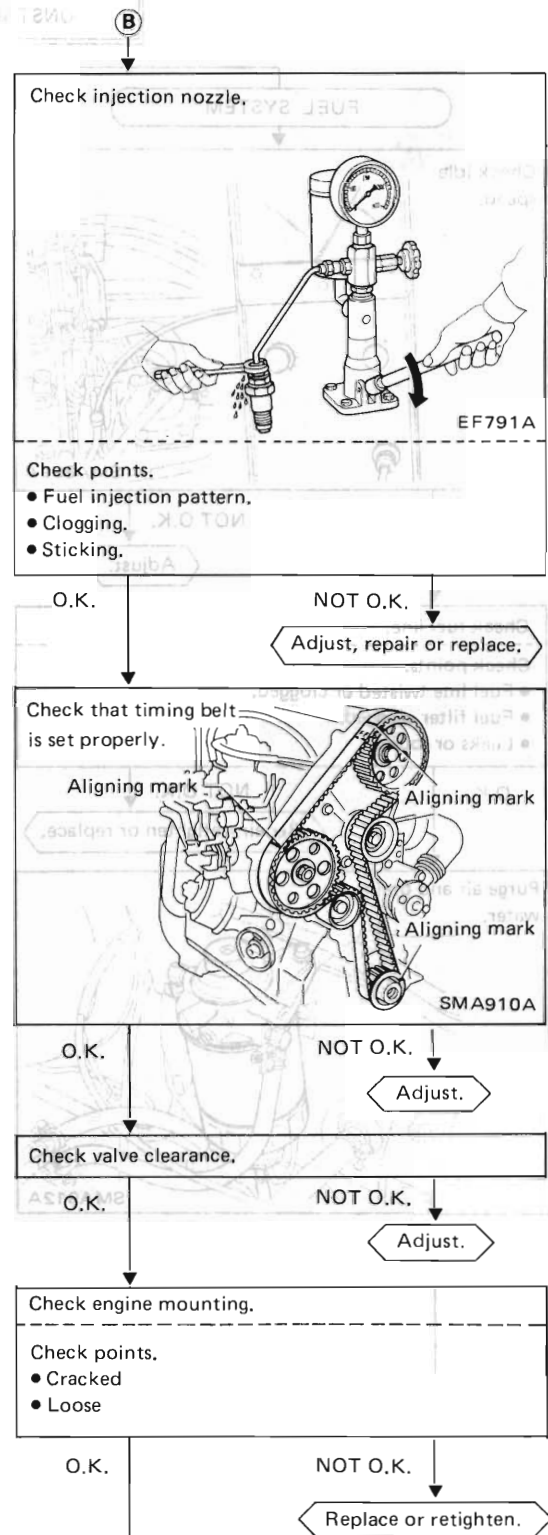
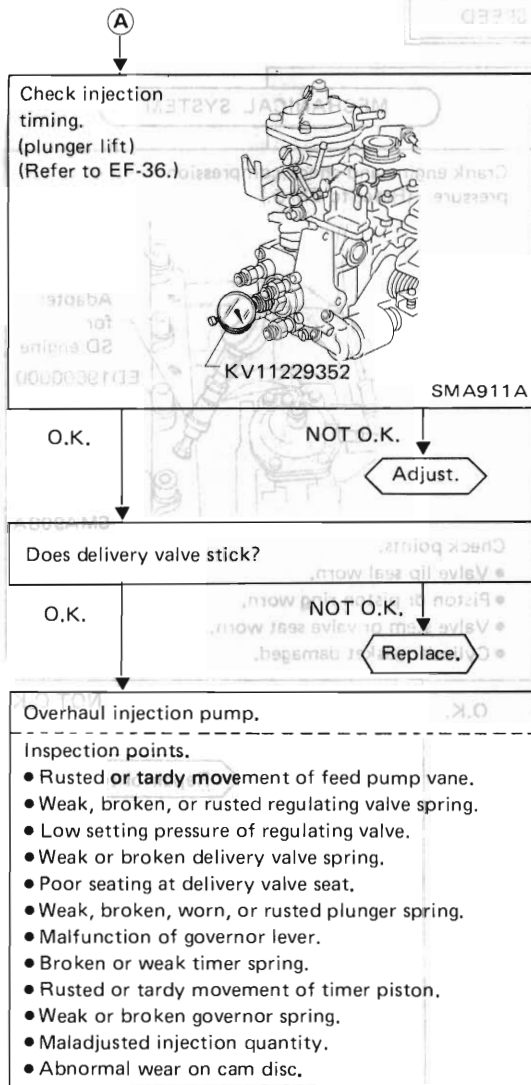
TROUBLE DIAGNOSES AND CORRECTIONS



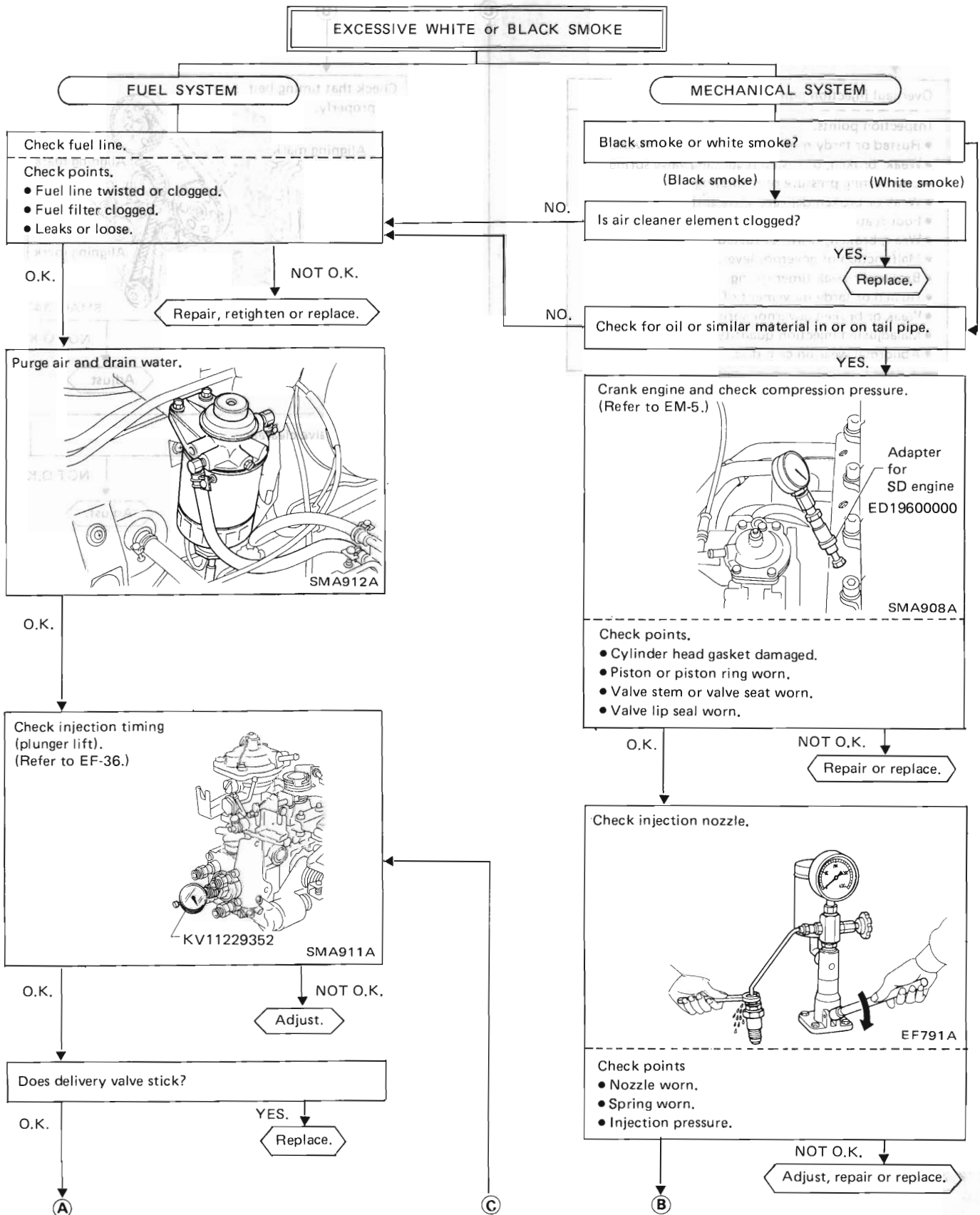
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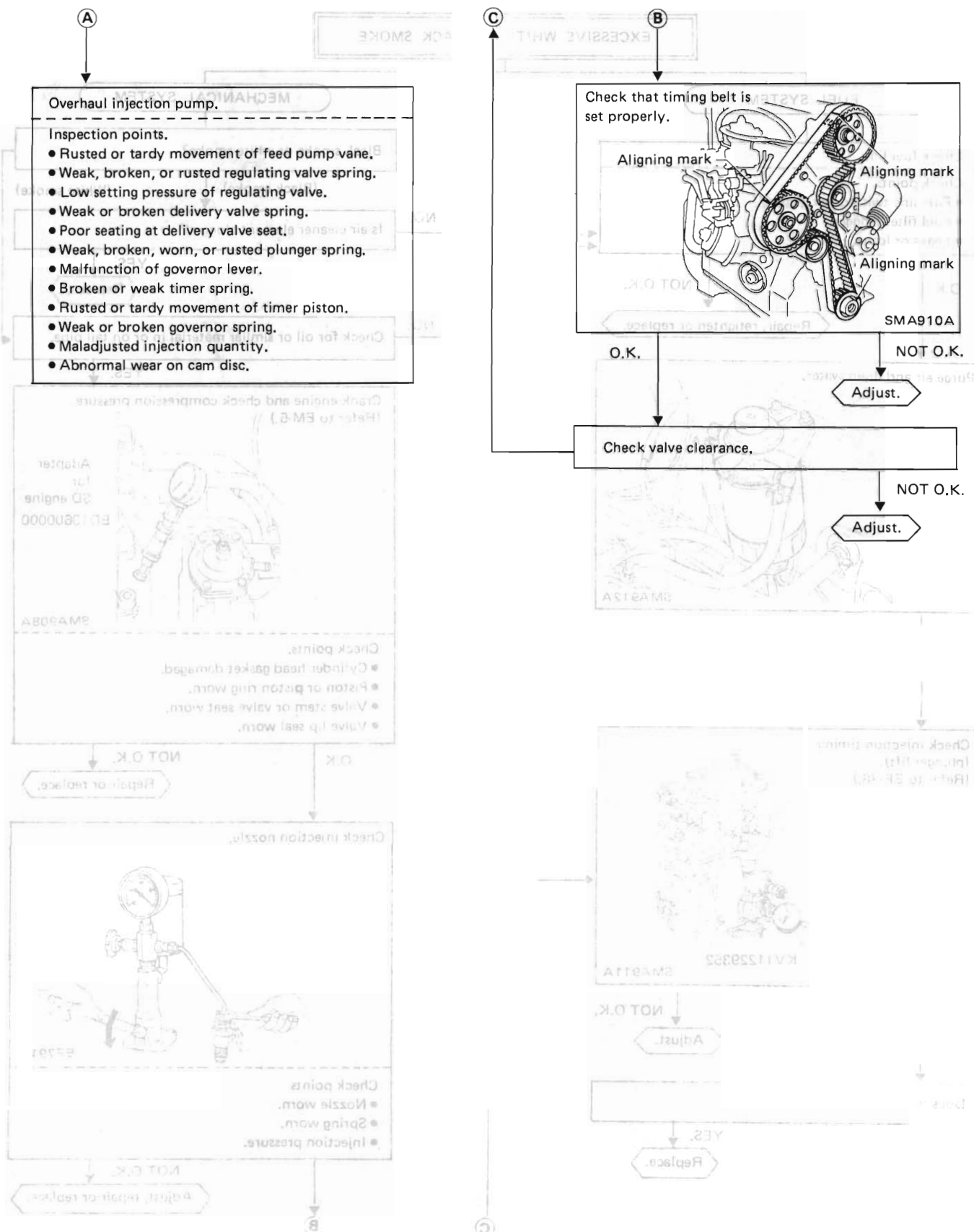
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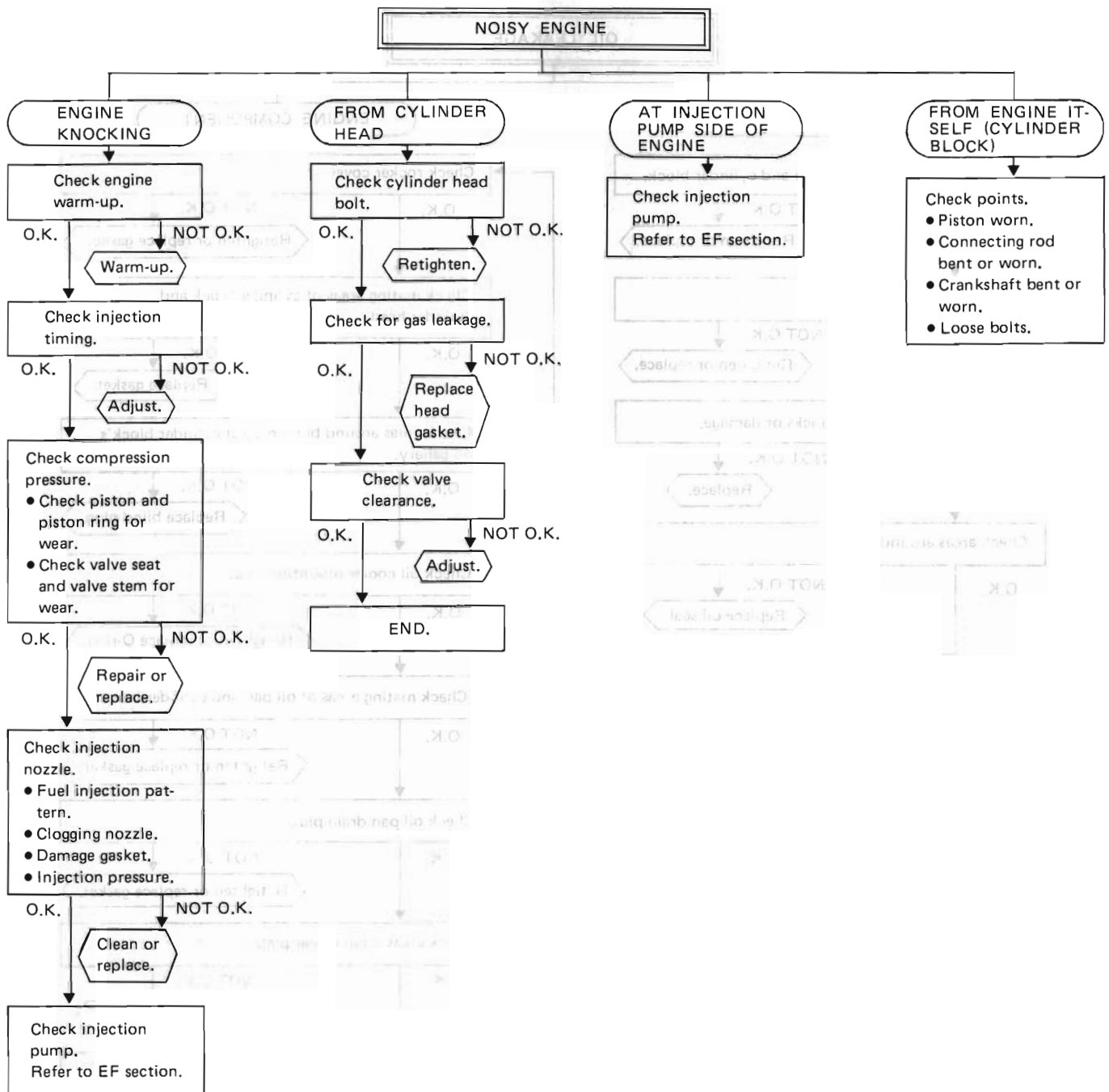
TROUBLE DIAGNOSES AND CORRECTIONS



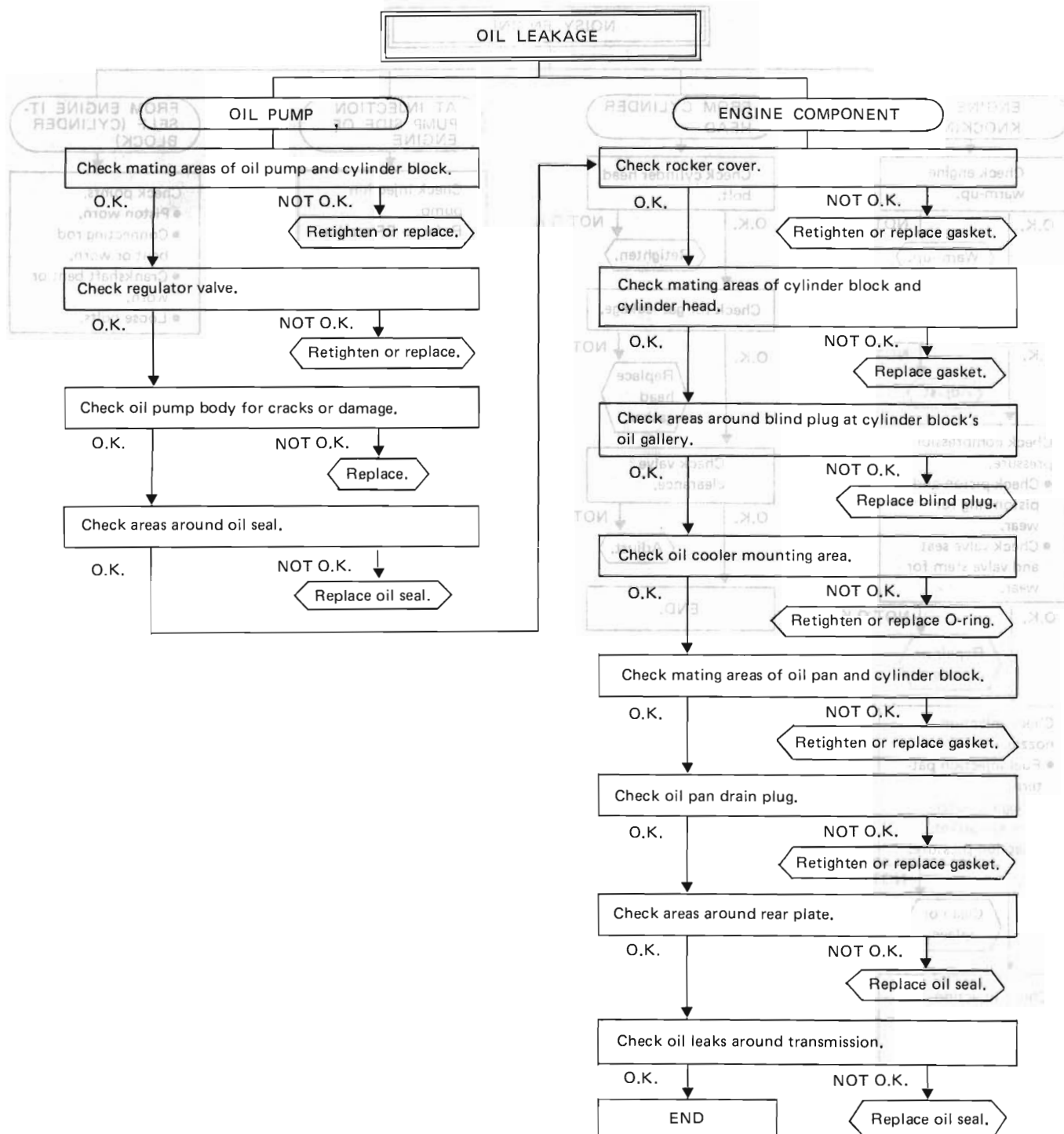
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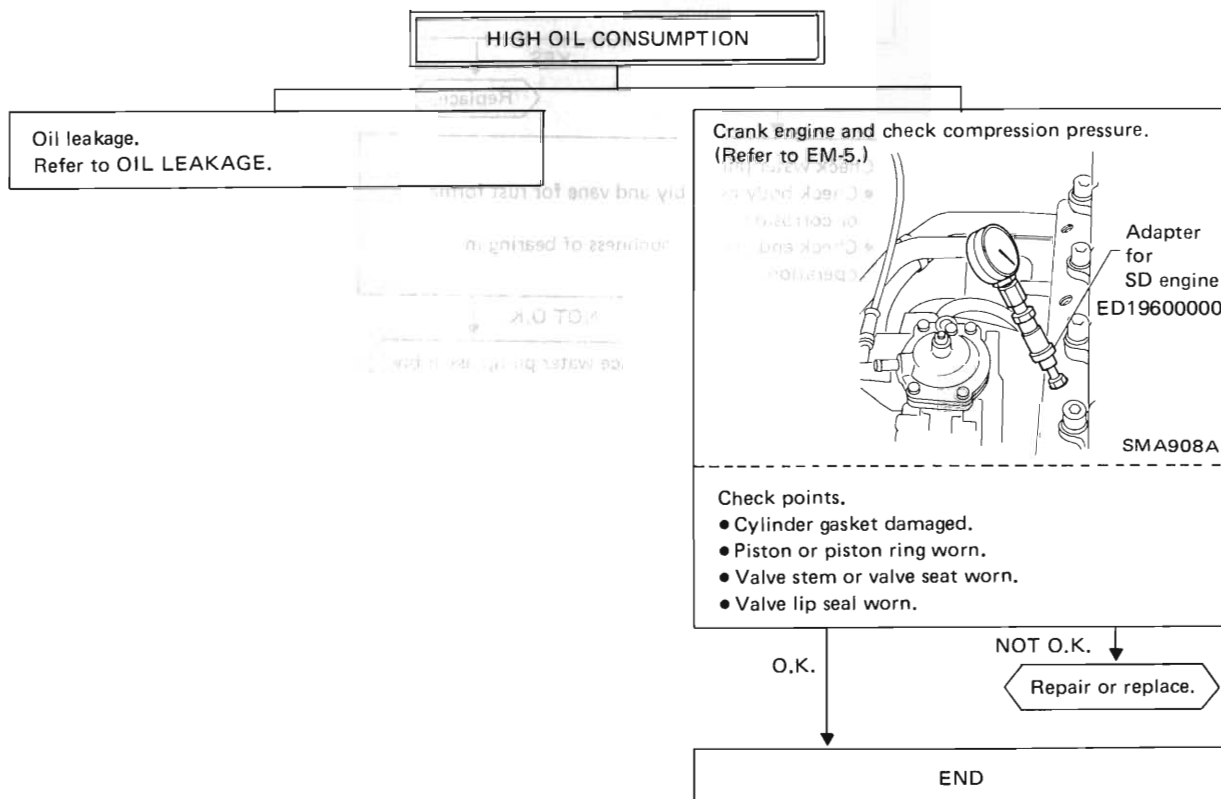
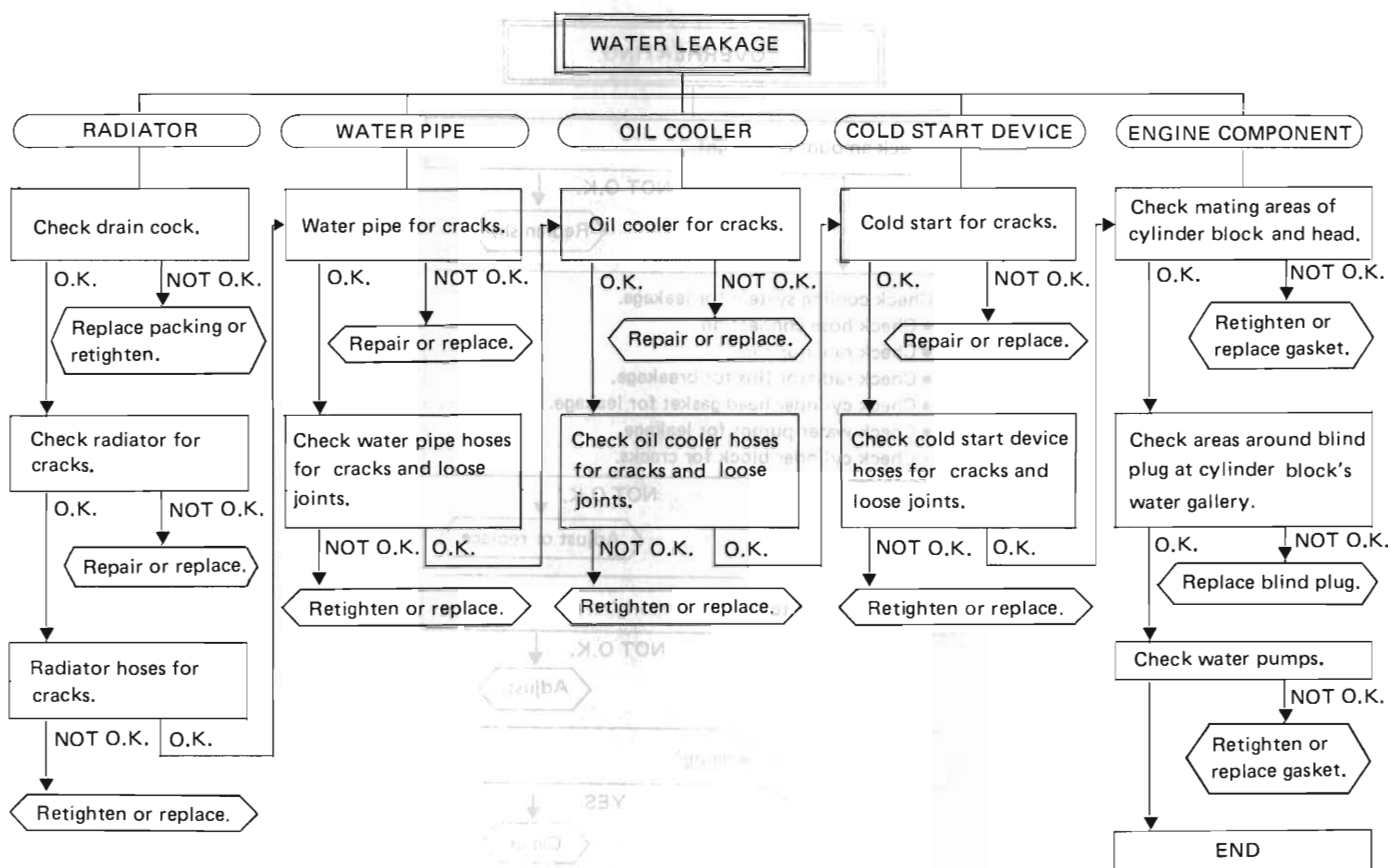
TROUBLE DIAGNOSES AND CORRECTIONS



TROUBLE DIAGNOSES AND CORRECTIONS



TROUBLE DIAGNOSES AND CORRECTIONS

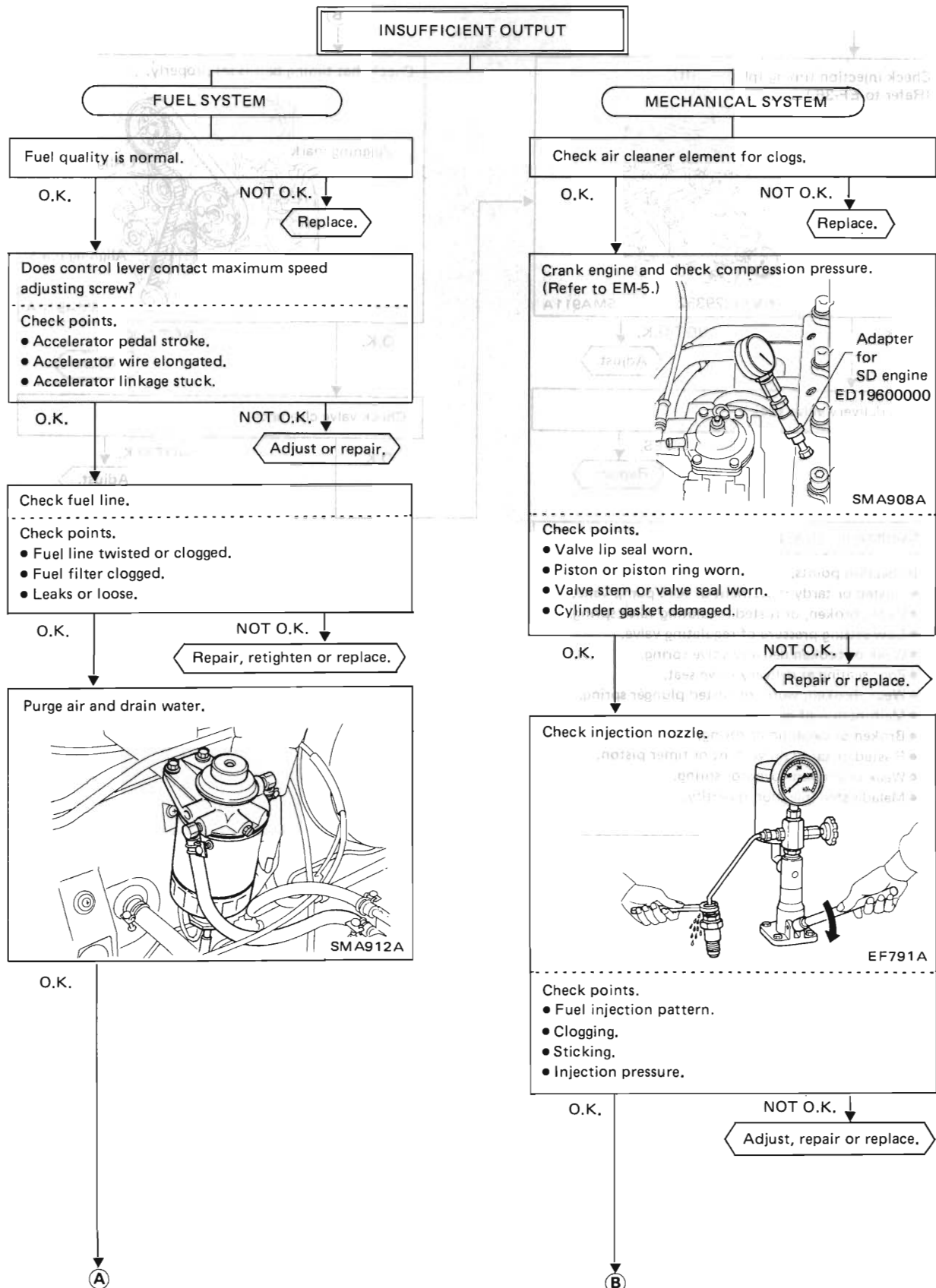


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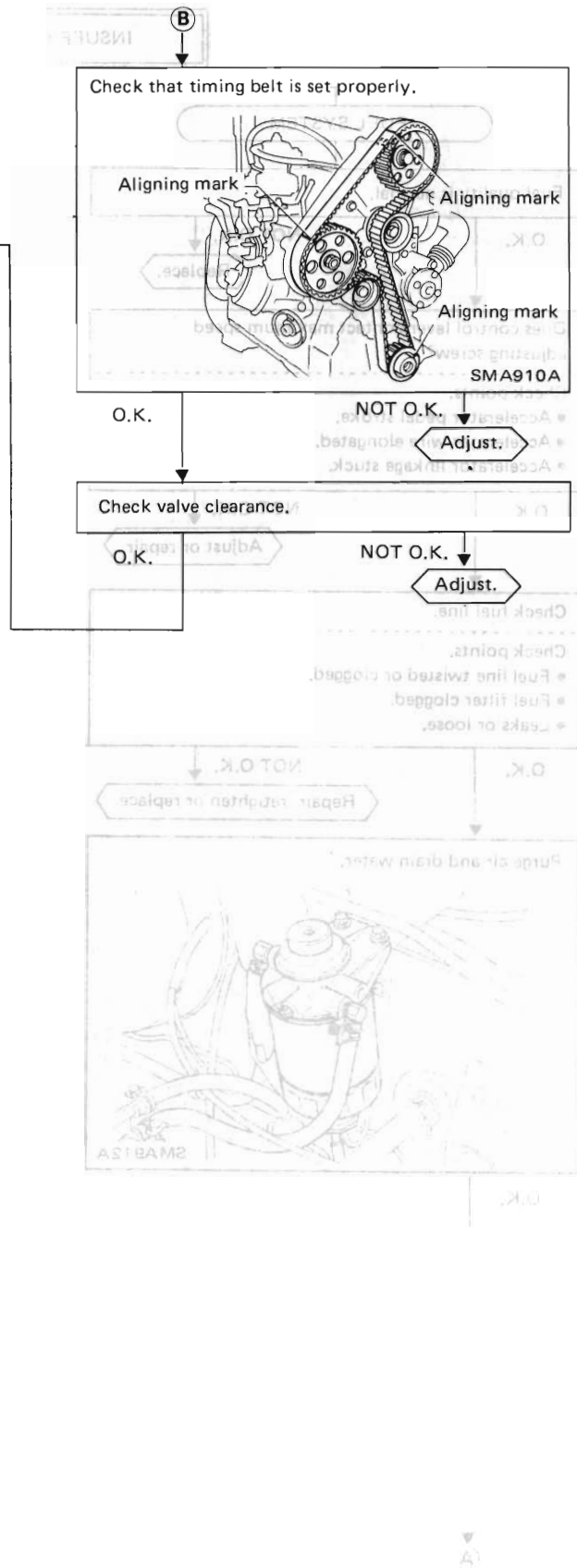
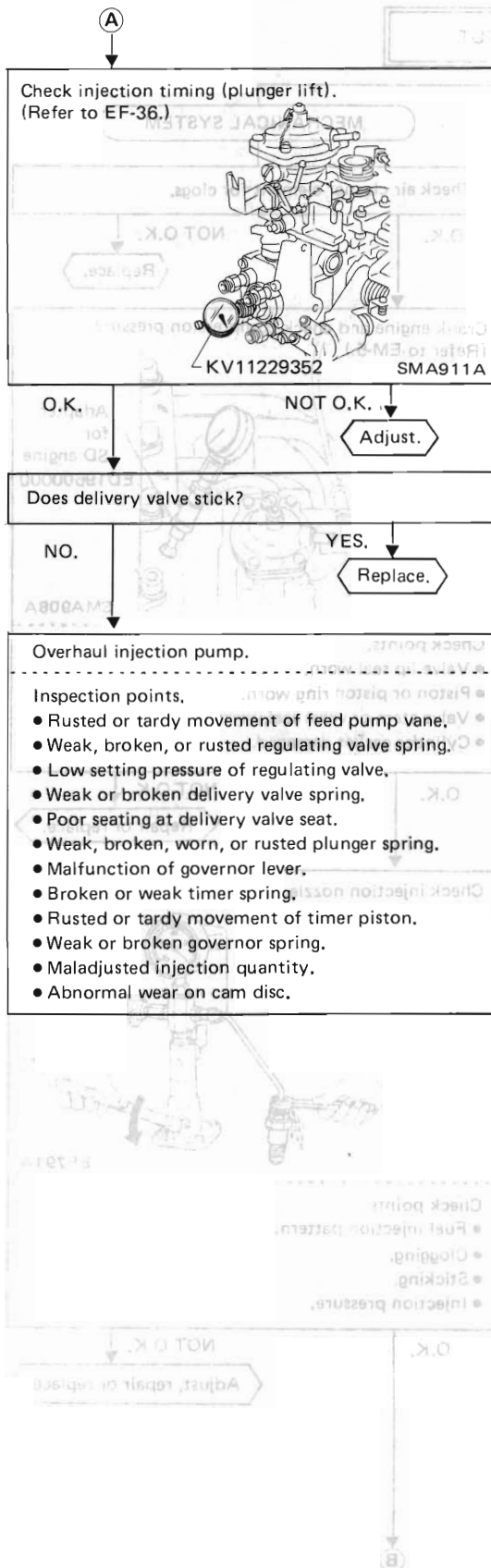
graph TD
    Start([OVERHEATING]) --> Step1[Check amount of coolant.]
    Step1 -- O.K. --> Step2[Check cooling system for leakage.  
• Check hose connection  
• Check radiator cap.  
• Check radiator fins for breakage.  
• Check cylinder head gasket for leakage.  
• Check water pumps for leakage.  
• Check cylinder block for cracks.]
    Step1 -- NOT O.K. --> Action1{{Replenish.}}
    Action1 --> Step2
    Step2 -- O.K. --> Step3[Check fan belt tension.]
    Step2 -- NOT O.K. --> Action2{{Adjust or replace.}}
    Action2 --> Step3
    Step3 -- O.K. --> Step4[Is cooling system clogging?]
    Step3 -- NOT O.K. --> Action3{{Adjust.}}
    Action3 --> Step4
    Step4 -- NO --> Step5[Is thermostat sticking?]
    Step4 -- YES --> Action4{{Clean.}}
    Action4 --> Step5
    Step5 -- NO --> Step6[Check water pump.  
• Check body assembly and vane for rust formation or corrosion.  
• Check end play or roughness of bearing in operation.]
    Step5 -- YES --> Action5{{Replace.}}
    Action5 --> Step6
    Step6 -- O.K. --> End1[END]
    Step6 -- NOT O.K. --> Action6{{Replace water pump assembly.}}
    Action6 --> End1

```

TROUBLE DIAGNOSES AND CORRECTIONS



TROUBLE DIAGNOSES AND CORRECTIONS



SERVICE DATA AND SPECIFICATIONS

Inspection and Adjustment

BASIC MECHANICAL SYSTEM

Unit: mm (in)

Valve clearance Hot	Intake	0.25 (0.010)		
	Exhaust	0.30 (0.012)		
Drive belt Deflection	New	Used	Deflection limit	
Standard model	Alternator	8.5 - 10.5 (0.335 - 0.413)	10.5 - 12.5 (0.413 - 0.492)	18 (0.71)
Air conditioner equipped model	Alternator	8 - 10 (0.31 - 0.39)	9.5 - 11.5 (0.374 - 0.453)	16 (0.63)
	Air conditioner compressor	7 - 9 (0.28 - 0.35)	9 - 11 (0.35 - 0.43)	16 (0.63)
Power steering equipped model	Alternator	8.5 - 10.5 (0.335 - 0.413)	10.5 - 12.5 (0.413 - 0.492)	18 (0.71)
	Power steering oil pump	8 - 10 (0.31 - 0.39)	9.5 - 11.5 (0.374 - 0.453)	14 (0.55)
Power steering and air conditioner equipped model	Alternator	7.5 - 9.5 (0.295 - 0.374)	9 - 11 (0.35 - 0.43)	16 (0.63)
	Air conditioner compressor	7 - 9 (0.28 - 0.35)	9 - 11 (0.35 - 0.43)	16 (0.63)
	Power steering oil pump	8 - 10 (0.31 - 0.39)	9.5 - 11.5 (0.374 - 0.453)	14 (0.55)
Applied pressure force N (kg, lb)		98 (10, 22)		

INJECTION AND FUEL SYSTEM

Item	Non-turbo	Turbo
Injection timing (plunger lift) mm (in)	0.73 ± 0.04 (0.0287 ± 0.0016)	0.64 ± 0.04 (0.0252 ± 0.0016)
Idle speed rpm	700 ± 50	
Idle speed of air conditioner "ON" rpm	800 ± 50	
Initial injection pressure kPa (bar, kg/cm ² , psi)		
New	13,239 - 14,024 (132.4 - 140.2, 135 - 143, 1,920 - 2,033)	
Used	12,259 - 13,239 (122.6 - 132.4, 125 - 135, 1,778 - 1,920)	

COOLING SYSTEM

Radiator cap relief pressure kPa (bar, kg/cm ² , psi)	88 (0.88, 0.9, 13)
Cooling system leakage testing pressure kPa (bar, kg/cm ² , psi)	157 (1.57, 1.6, 23)

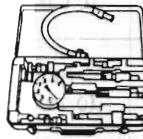
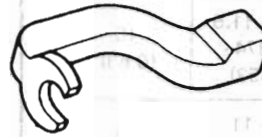
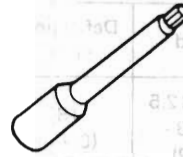
TIGHTENING TORQUE

Unit	N-m	kg-m	ft-lb
Cylinder head bolt	118 - 127	12 - 13	87 - 94
Rocker cover	7 - 11	0.7 - 1.1	5.1 - 8.0
Manifold	M10	34 - 44	25 - 33
	M8	18 - 22	13 - 16
Alternator to bracket	37 - 51	3.8 - 5.2	27 - 38
Alternator to adjust bar	14 - 17	1.4 - 1.7	10 - 12
Injection pump fixing nut and bolt	16 - 21	1.6 - 2.1	12 - 15
Injection tube	22 - 25	2.2 - 2.5	16 - 18
Spill tube	39 - 49	4.0 - 5.0	29 - 36
Injection nozzle	59 - 69	6.0 - 7.0	43 - 51
Oil pan drain plug	29 - 39	3.0 - 4.0	22 - 29
Glow plug	20 - 25	2.0 - 2.5	14 - 18
Glow plug connecting plate	1.0 - 1.5	0.1 - 0.15	0.7 - 1.1
Tensioner bolt	31 - 39	3.2 - 4.0	23 - 29
Idler bolt	31 - 39	3.2 - 4.0	23 - 29

SPECIAL SERVICE TOOLS

Inspection and Adjustment

Tool number		Tool name	
ST10120000		Cylinder head bolt wrench	
ST10640001		Pivot adjuster	
ED19600000		Compression gauge set	



INJECTION AND FUEL SYSTEM

Turbo	Non-turbo
0.73 ± 0.04 (10.028)	0.73 ± 0.04 (10.028)
0.94 ± 0.04 (10.028)	0.94 ± 0.04 (10.028)

700 ± 50

800 ± 50

Pressure (kg/cm ²)	Pressure (kg/cm ²)
13.258 - 13.258 (132.8 - 132.8)	13.258 - 13.258 (132.8 - 132.8)
13.258 - 13.258 (132.8 - 132.8)	13.258 - 13.258 (132.8 - 132.8)

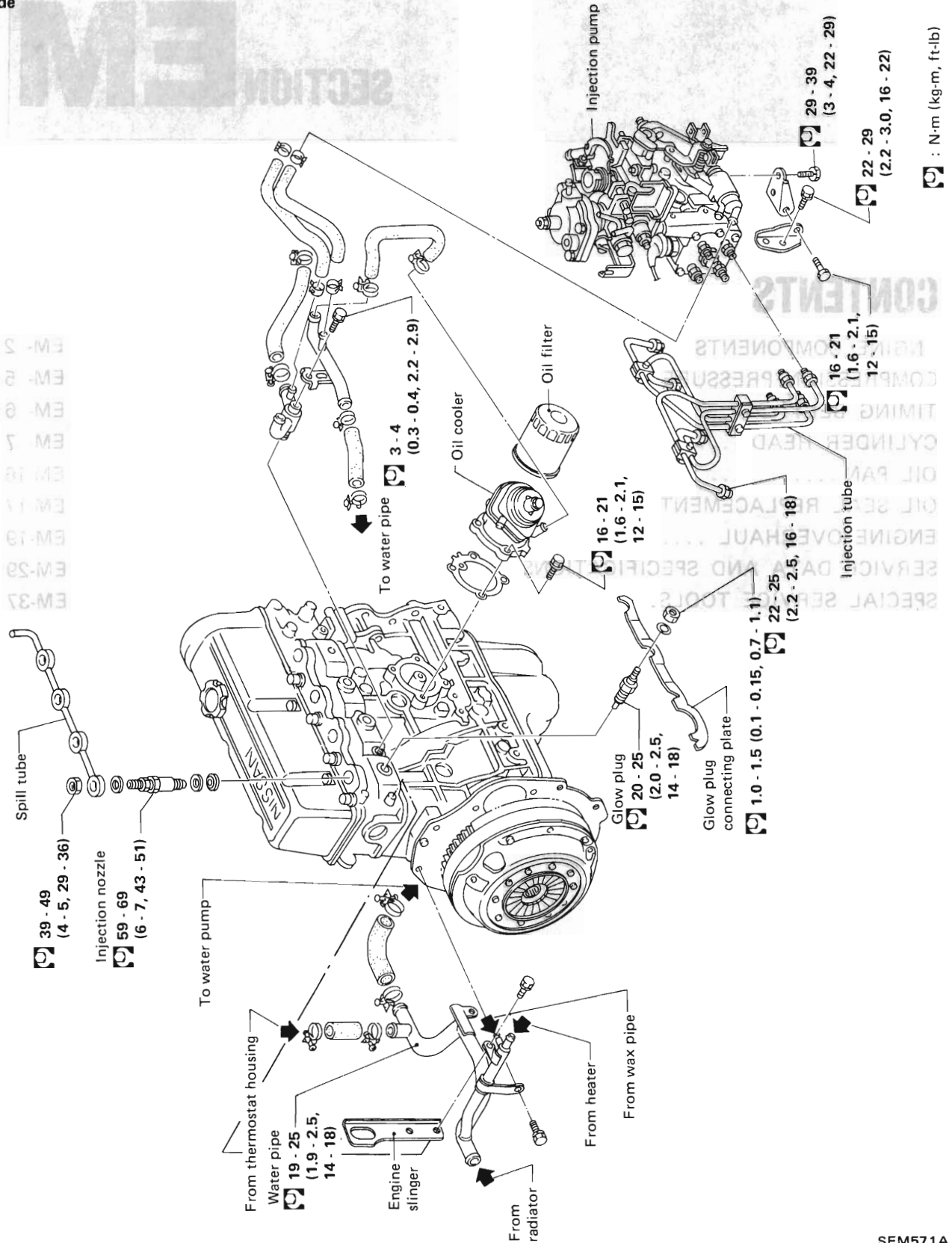
CONTENTS

ENGINE COMPONENTS	EM- 2
COMPRESSION PRESSURE	EM- 5
TIMING BELT	EM- 6
CYLINDER HEAD	EM- 7
OIL PAN	EM-16
OIL SEAL REPLACEMENT	EM-17
ENGINE OVERHAUL	EM-19
SERVICE DATA AND SPECIFICATIONS	EM-29
SPECIAL SERVICE TOOLS	EM-37

ENGINE COMPONENTS

Outer Parts

Right side

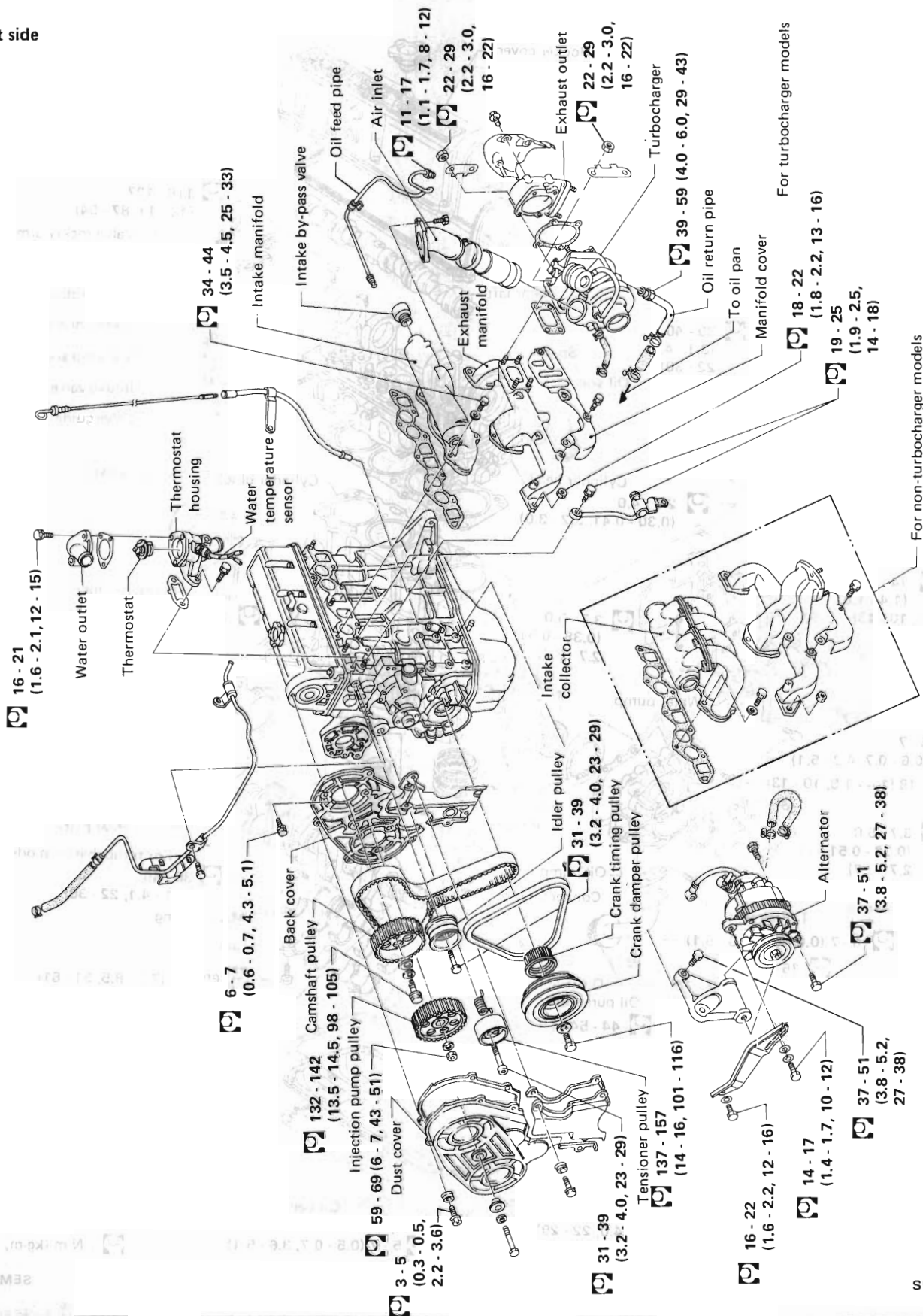


SEM571A

ENGINE COMPONENTS

Outer Parts (Cont'd)

Left side

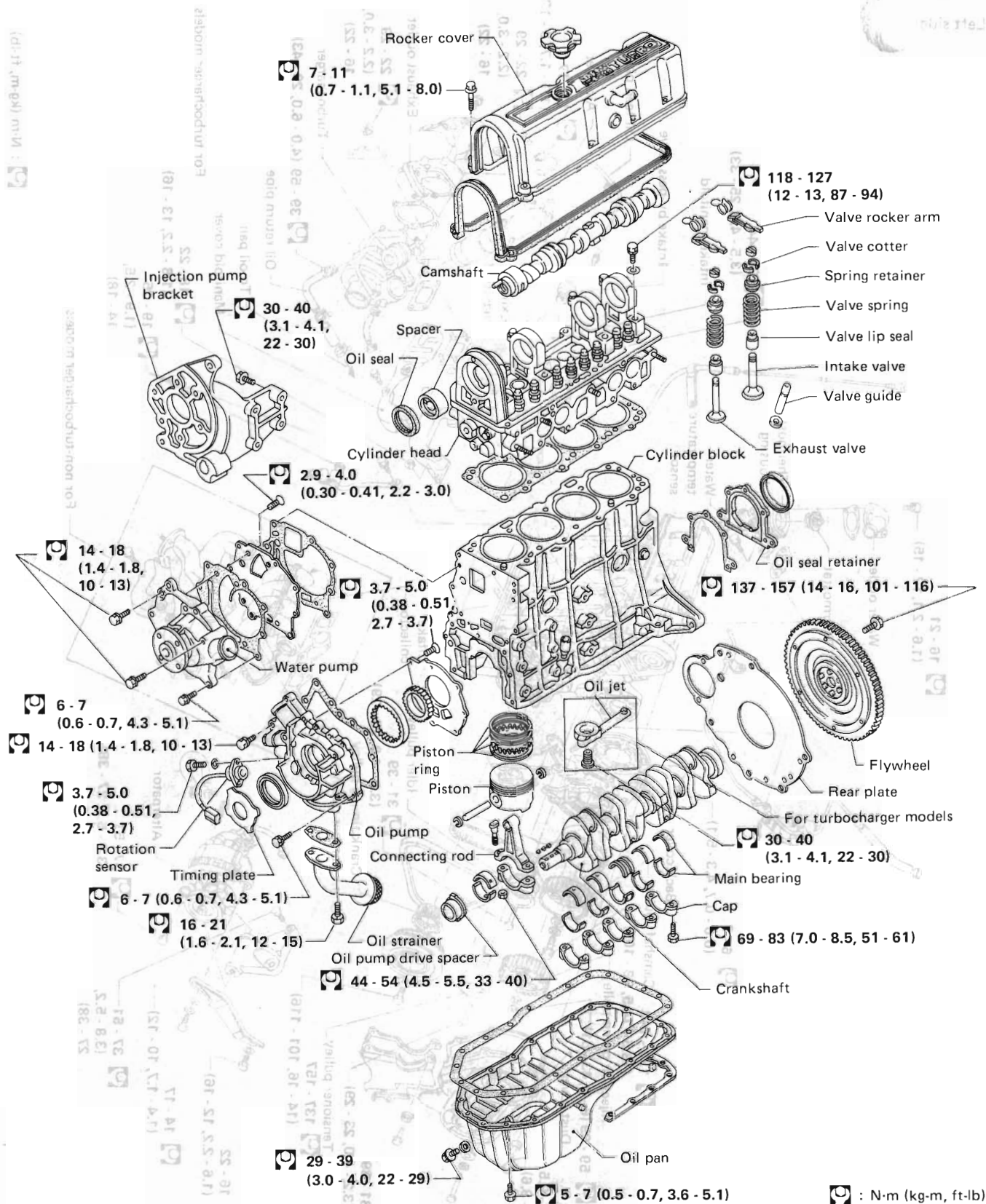


□ : N·m (kg-m, ft-lb)

SEM572A

ENGINE COMPONENTS

Body Parts

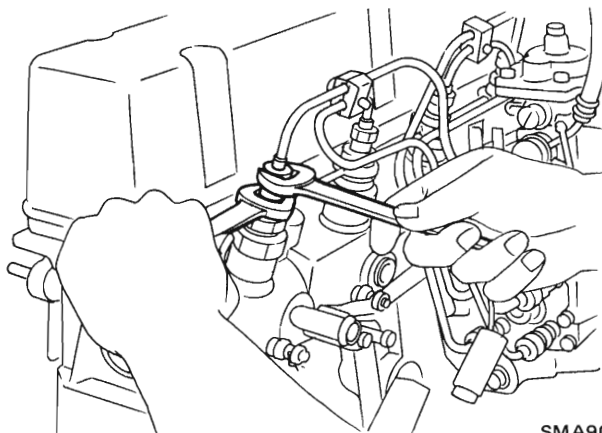


COMPRESSION PRESSURE

Measurement of Compression Pressure

1. Warm up engine.
2. Remove following parts:
 - Spill tube assembly
 - Injection tubes on nozzle side
 - Nozzle assemblies

To prevent spill tube and injection tubes from breaking, remove them by gripping nozzle holder.

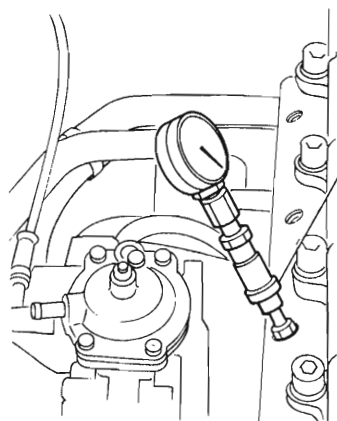


SMA907A

CAUTION:

Remove nozzle washer with a pair of tweezers. Do not forget to remove this washer; otherwise, it may get lost when the engine is cranked.

3. Attach compression gauge adapter.



Adapter for SD engine ED19600000

SMA908A

4. Disconnect fuel cut solenoid connector.
5. Crank engine and read gauge indication.

Compression pressure:

Unit: kPa (bar, kg/cm², psi) at rpm

	Non-turbo	Turbo
Standard	3,138 (31.4, 32, 455)/200	2,942 (29.4, 30, 427)/200
Minimum	2,452 (24.5, 25, 356)/200	2,354 (23.5, 24, 341)/200
Differential limit between cylinders	490 (4.9, 5, 71)/200	

6. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through the nozzle holes and retest compression.
 - If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.
 - If pressure stays low, valve may be sticking or seating improperly.
 - If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past the gasketed surface.

COMPLET BELT TIMING

When servicing timing belt, refer to Changing Timing Belt in section MA.

Compression pressure:

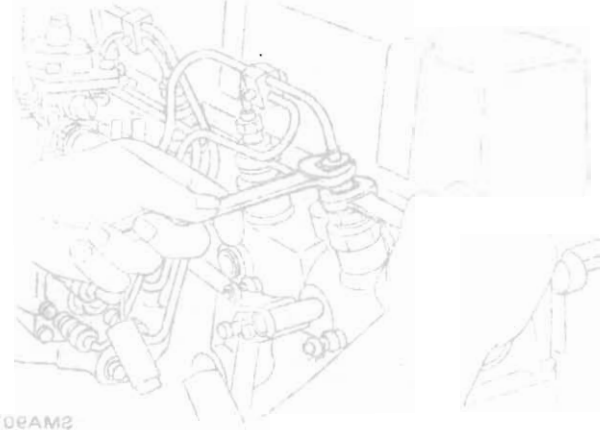
Unit: kPa (bar, mmHg, psi) at 1000 rpm

	Non-turbo	Turbo
Standard	3,138 (31.4, 32.5, 485/1500)	3,943 (39.4, 30.5, 433/1500)
Minimum	2,482 (24.8, 26.5, 358/1500)	2,584 (25.8, 24.5, 341/1500)
Differential limit between cylinders	480 (4.8, 5.7/1500)	

- If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through the nozzle holes and retest compression.
- If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.
- If pressure stays low, valve may be sticking or seating improperly.
- If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past the gasketed surface.

- Warm up engine.
- Remove following parts:
 - Spill tube assembly
 - Injection tubes on nozzle side
 - Nozzle assemblies

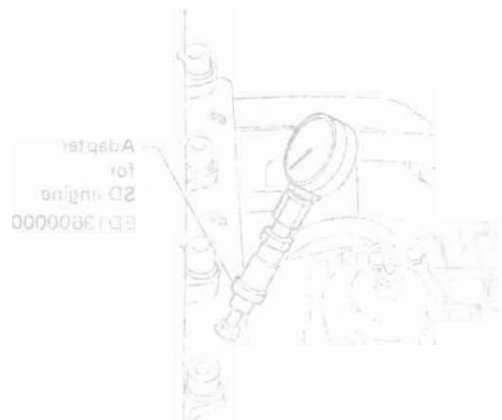
To prevent spill tube and injection tubes from breaking, remove them by gripping nozzle holder.



2MA907A

CAUTION: Remove nozzle washer with a pair of tweezers. Do not forget to remove this washer; otherwise, it may get lost when the engine is cranked.

Attach compression gauge adapter.

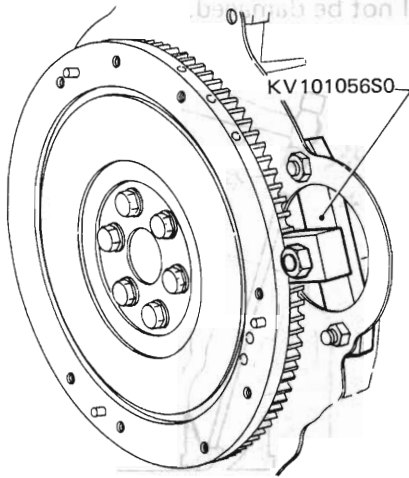


2A980A

CYLINDER HEAD

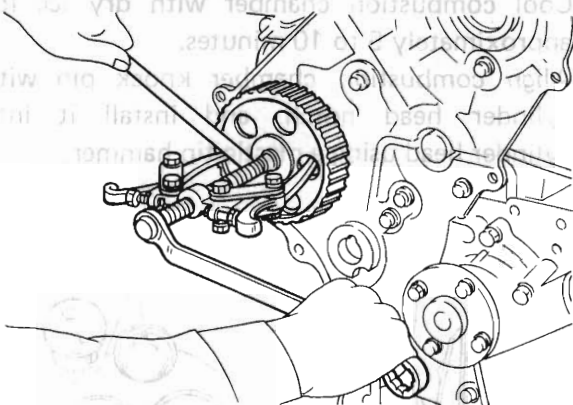
Removal

1. Install Tool, to prevent crankshaft rotation.



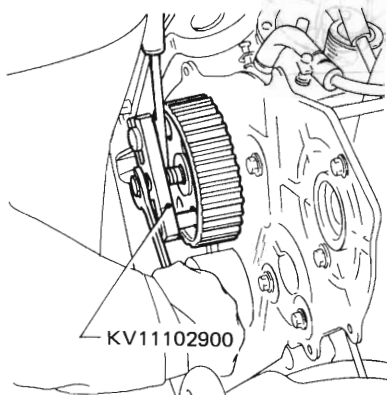
SEM747A

2. Remove timing belt.
3. Remove camshaft pulley, injection pump pulley and idler pulley.
If they are difficult to remove, use a pulley.



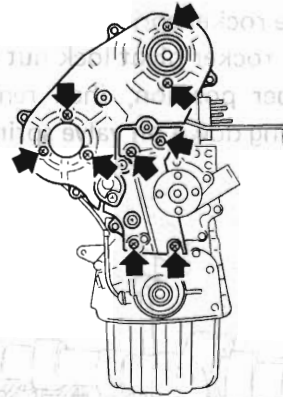
SEM574A

When removing injection pump pulley with vehicle loaded



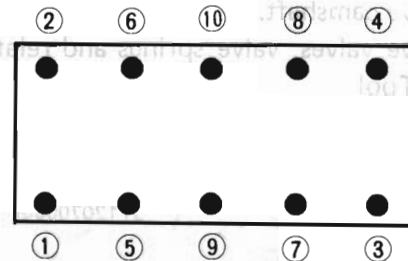
SEM578A

4. Remove back covers.



SEM576A

5. Remove injection tubes.
6. Remove cylinder head.
Loosen in numerical order.



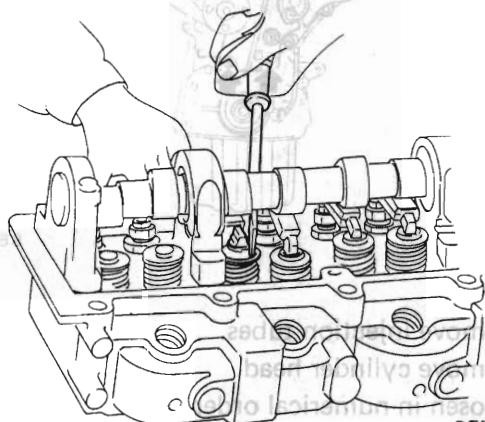
SEM577A

The bolts should be loosened in two or three stages.

CYLINDER HEAD

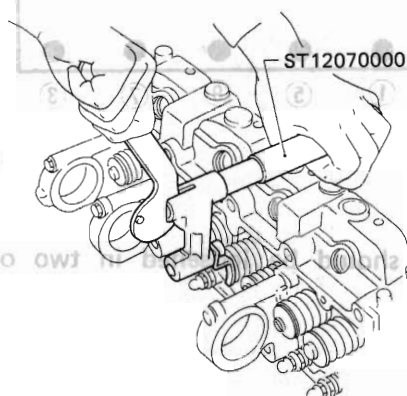
Disassembly

1. Remove glow plug connecting plate and glow plugs.
2. Remove valve rocker spring.
3. Loosen valve rocker pivot lock nut and set cam nose to upper position, then remove rocker arm by pressing down on valve spring.



SEM579A

4. Remove camshaft.
5. Remove valves, valve springs and related parts using Tool.



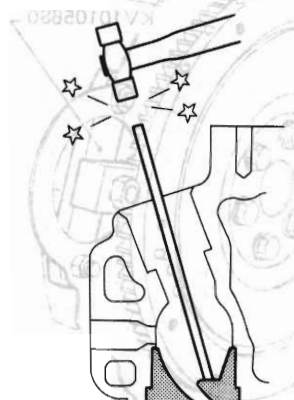
SEM580A

COMBUSTION CHAMBER REPLACEMENT

Usually combustion chamber should not be removed.

However, if there are cracks or extensive damage, it should be replaced.

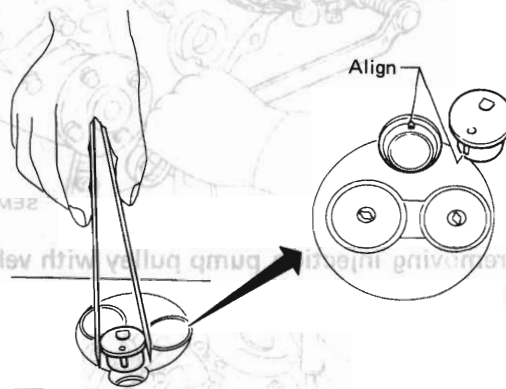
1. Remove combustion chamber so that cylinder head will not be damaged.



SEM581A

Be careful not to scratch inside of nozzle hole.

2. Install combustion chamber.
 - (1) Cool combustion chamber with dry ice for approximately 5 to 10 minutes.
 - (2) Align combustion chamber knock pin with cylinder head notch, and install it into cylinder head using a plastic-tip hammer.



SEM874

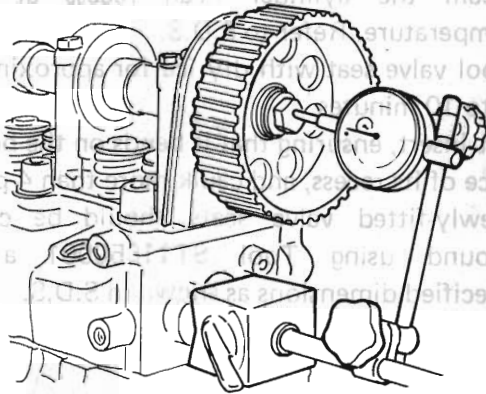
CYLINDER HEAD

Inspection

CAMSHAFT END PLAY

Camshaft end play:

Maximum 0.38 mm (0.0150 in)

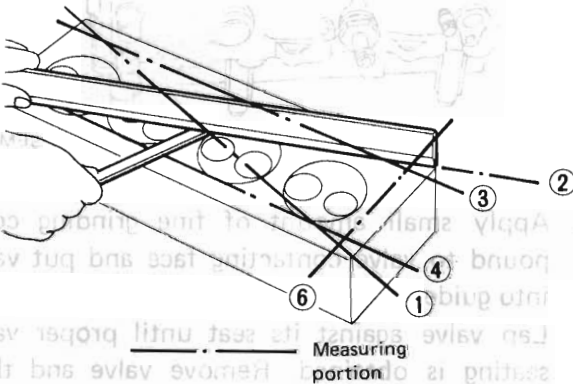


SEM582A

CYLINDER HEAD DISTORTION

Warpage of surface

Less than 0.1 mm (0.004 in)



SEM868

If beyond the specified limit, resurface it.

Cylinder head nominal height:

LD20 & LD20T

89.5±0.1 mm

Correct amount limit

(Correct amount including cylinder block side):

0.1 mm (0.004 in)

VALVE GUIDE CLEARANCE

- Valve guide clearance should be measured parallel to rocker arm. (Generally, a large amount of wear occurs in this direction.)

Stem to guide clearance:

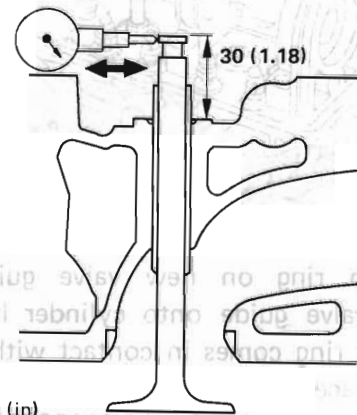
Maximum limit

0.10 mm (0.0039 in)

Maximum allowable deflection

(Dial indicator reading)

0.2 mm (0.008 in)



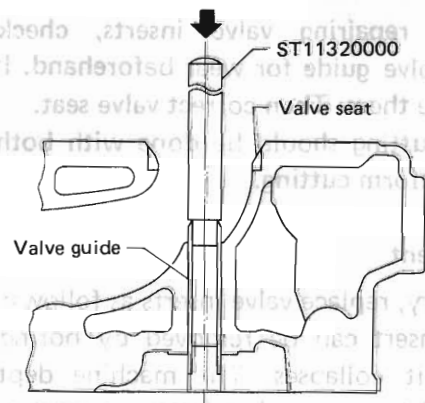
Unit: mm (in)

SEM586A

Replacement

Replace valve and/or valve guide.

- To remove valve guide, use a press [under a 20 kN (2t, 2.2 US ton, 2.0 Imp ton) pressure] or a hammer and Tool.



SEM299

CYLINDER HEAD

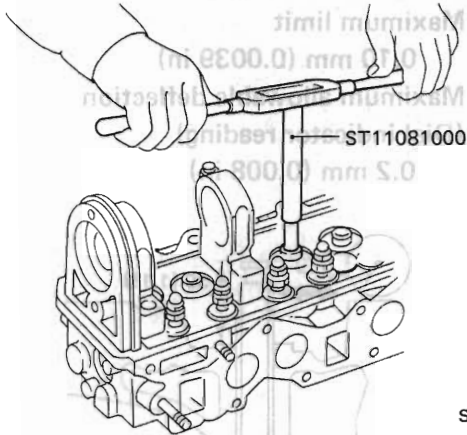
Inspection (Cont'd)

2. Ream cylinder head valve guide hole.

Reaming bore:

12.223 - 12.234 mm

(0.4812 - 0.4817 in)



SEM587A

3. Fit snap ring on new valve guide. Press service valve guide onto cylinder head until the snap ring comes in contact with cylinder head surface.
4. Ream the bore using Tool ST1103200.

Reaming bore:

8.000 - 8.018 mm

(0.3150 - 0.3157 in)

VALVE INSERTS

Check valve inserts for evidence of pitting at valve contact surface, and reseal or replace if worn excessively.

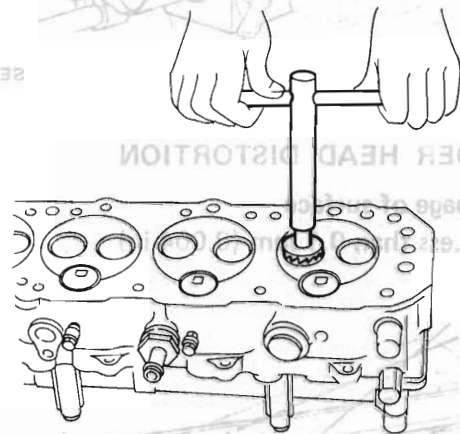
- When repairing valve inserts, check valve and valve guide for wear beforehand. If worn, replace them. Then correct valve seat.
- The cutting should be done with both hands for uniform cutting.

Replacement

If necessary, replace valve inserts as follows:

1. Old insert can be removed by boring it out until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the insert recess in the cylinder head.

2. Select a suitable valve seat insert and check its outside diameter.
3. Machine the cylinder head recess in concentric circles which center on the valve guide.
4. Ream the cylinder head recess at room temperature. Refer to S.D.S.
5. Cool valve seat with dry ice for approximately 5 to 10 minutes.
6. Fit insert, ensuring that it bends on the bottom face of its recess, and caulk more than 4 points.
7. Newly-fitted valve seats should be cut or ground using Tool ST11650001 at the specified dimensions as shown in S.D.S.



SEM301

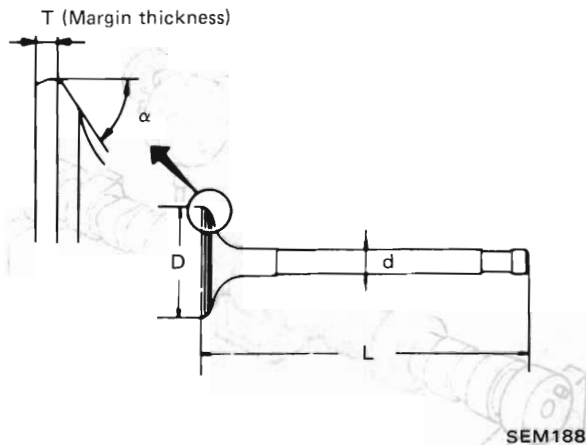
8. Apply small amount of fine grinding compound to valve contacting face and put valve into guide. Lap valve against its seat until proper valve seating is obtained. Remove valve and then clean valve and valve seat.

CYLINDER HEAD

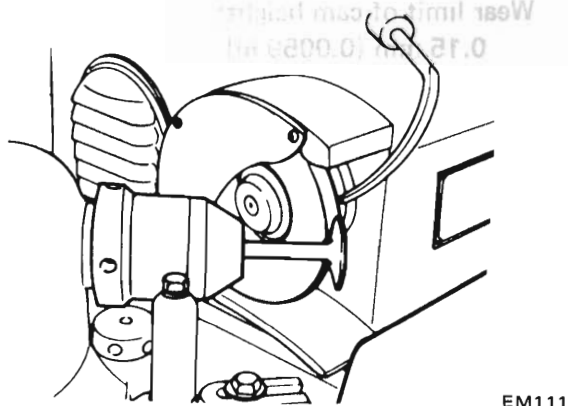
Inspection (Cont'd)

VALVE DIMENSIONS

Check dimensions in each valve. For dimensions, refer to S.D.S.



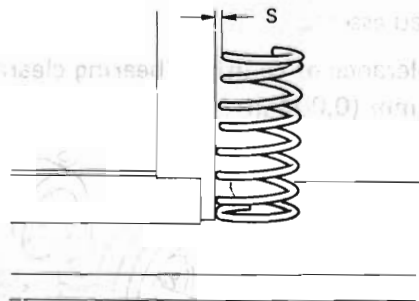
When valve head has been worn down to 0.5 mm (0.020 in) in-margin-thickness, replace the valve. Grinding allowance for valve stem end surface is 0.5 mm (0.020 in) or less.



VALVE SPRING SQUARENESS

Out of square:

2.2 mm (0.087 in)



VALVE SPRING PRESSURE LOAD

Refer to S.D.S.

ROCKER ARM AND VALVE ROCKER PIVOT

Check pivot head, and cam contact and pivot contact surfaces of rocker arm for damage or wear.

If faulty, replace them.

A faulty pivot must be replaced together with the corresponding rocker arm.

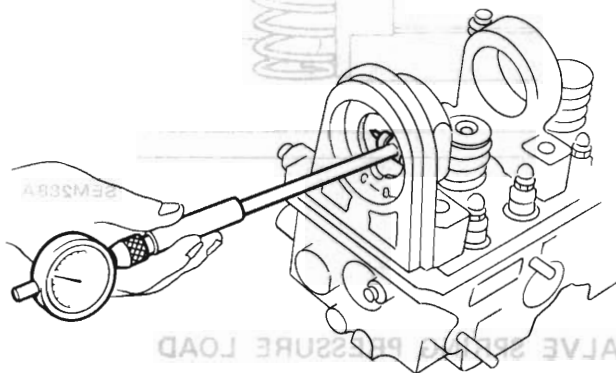
CYLINDER HEAD

Inspection (Cont'd)

CAMSHAFT BEARING CLEARANCE

Measure the inside diameter of camshaft bearing with an inside dial gauge and the outside diameter of camshaft journal with a micrometer. If any malfunction is found, replace camshaft or cylinder head assembly.

Max. tolerance of camshaft bearing clearance:
0.1 mm (0.004 in)

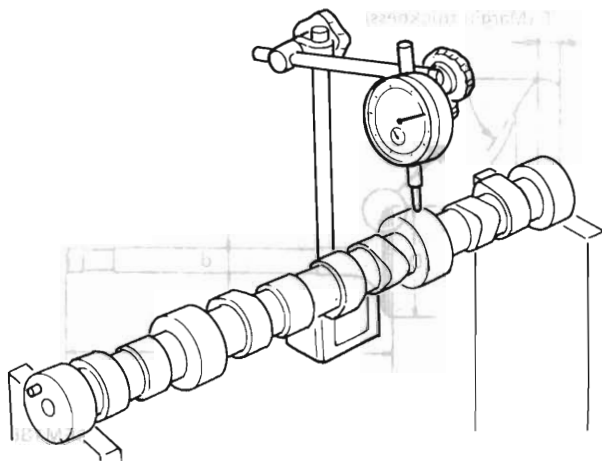


SEM619A

Do not remove camshaft brackets. If camshaft bracket were removed such as when resurfacing cylinder head, install them by checking for a smooth rotation with the camshaft.

CAMSHAFT ALIGNMENT

1. Check camshaft, camshaft journal and cam surface for bend, wear or damage.

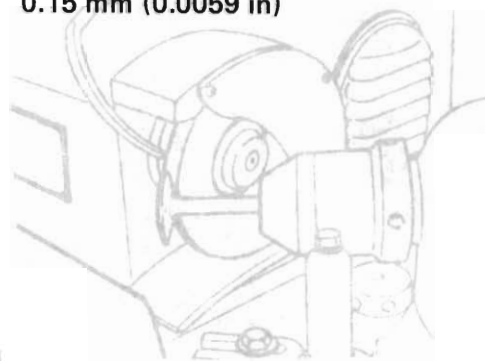


SEM610A

Camshaft bend:
Limit 0.05 mm (0.0020 in)

2. Measure camshaft cam height.

Wear limit of cam height:
0.15 mm (0.0059 in)



EM11

CYLINDER HEAD

Assembly

1. Install valve component parts.

Install valve spring with its narrow pitch side toward cylinder head side.

- a. When installing valve, apply engine oil on the valve stem and lip of valve oil seal.
- b. Check whether the valve face is free from foreign matter.

2. Install valve rocker pivot assembly.

Screw valve rocker pivots joined with lock nuts into pivot bushing.

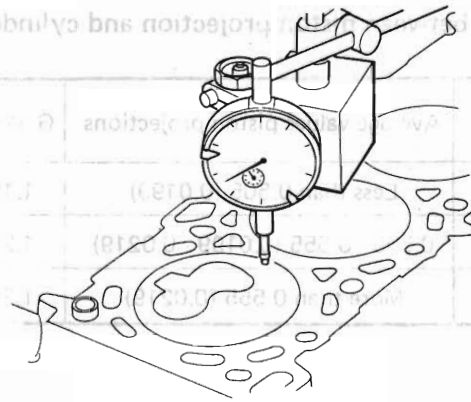
Install valve rocker spring retainer.

Fully screw in valve rocker pivot.

3. Install camshaft assembly in cylinder head carefully.

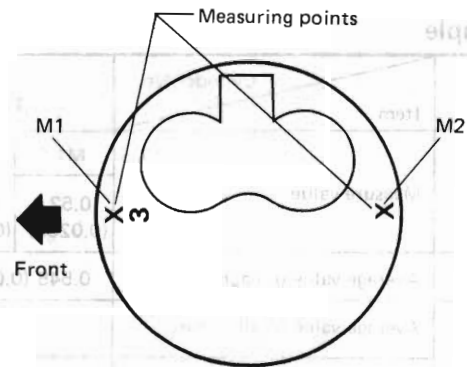
Do not damage the bearing inside.

4. Install valve rocker guides.
5. Install rocker arms by pressing valve springs down.
6. Install valve rocker springs.
7. After assembling cylinder head, turn camshaft until No. 1 piston is at T.D.C. on its compression stroke.



SEM593A

Be sure to measure the projection at two points for every cylinder as shown.



SEM911

Installation

1. Install cylinder head gasket.

Non-turbo model only

- a. When replacing only cylinder head gasket, install same grade gasket as the one formerly used.
- b. When replacing or repairing cylinder block, cylinder head, piston, connecting rod and crankshaft, select gasket as follows:

Step 1:

Measure piston projection.

- (i) Set dial gauge on cylinder block surface to zero.
- (ii) Set dial gauge at measuring point of piston, being careful not to disturb its zero setting.

- (iii) Set each piston at its Top Dead Center. With piston held in that position, measure its projections at two points, M1 and M2, and record measured values.

Step 2:

Calculate the average value of measured projections for each cylinder.

Step 3:

Calculate the average value of projections for all pistons.

Step 4:

Round off the average value.

Step 5:

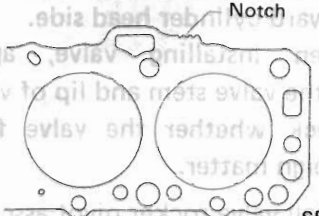
Determine the gasket thickness, referring to chart A.

CYLINDER HEAD

Installation (Cont'd)

Relation between piston projection and cylinder head gasket (Chart A)

Unit: mm (in)

Grade	Average values piston projections	Gasket thickness	Number of identifications	
A	Less than 0.505 (0.0199)	1.15 (0.0453)	1	
B	0.505 - 0.555 (0.0199 - 0.0219)	1.20 (0.0472)	2	
C	More than 0.555 (0.0219)	1.25 (0.0492)	3	

Step 6:

Check to see if the average value of each projection in step 2 is larger than the max. value of the standard projection (of selected gasket) plus 0.05 mm (0.0020 in).

Step 7:

If it does, use gasket that is 1 grade thicker.
If it does not, use gasket that was selected in step 4.

Example

Step	Item	Cylinder No.	1		2		3		4		
			M1	M2	M1	M2	M1	M2	M1	M2	
1.	Measure value		0.53 (0.0209)	0.56 (0.0220)	0.59 (0.0232)	0.55 (0.0217)	0.53 (0.0209)	0.58 (0.0228)	0.58 (0.0228)	0.51 (0.0201)	
2.	Average value of each piston		0.545 (0.0215)		0.57 (0.0224)		0.555 (0.0219)		0.545 (0.0215)		
3.	Average value of all pistons		0.55375 (0.02180)								
4.	Round off value		0.55 (0.0217)								* 1
5.	Determined gasket thickness (Temporally)		1.20 (0.0472) (Grade B)								
6.	X: Maximum value of standard projection of selected gasket ... 0.555 (0.0219) (in chart A) + 0.05 (0.0020) = 0.605 (0.0238) Y: Maximum value in step 2 = 0.57 (0.0224) The relationship between X and Y is "X ≥ Y".										* 2
7.	Determined gasket thickness (Finally)		The same gasket as was determined temporarily in step 5. 1.20 (0.0472) (Grade B)								

*1: If the average value of projections for all pistons is, for example, 0.55 (3) 75, as shown in the Table above, it should be rounded off as follows:

If the digit in the third decimal place (which is enclosed by a circle in this case) is smaller than 5, the average value should be regarded as 0.55 mm (0.0217 in); if it is larger than 5, the average value should be regarded as 0.56 mm (0.0220 in).

*2: If X is smaller than Y ("X < Y"), for example, if a value greater than 0.605 mm (0.0238 in) is found in step 2, use 1.25 mm (0.0492 in) (Grade C) gasket.

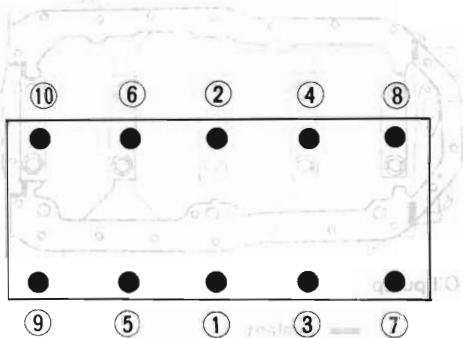
CYLINDER HEAD

Installation (Cont'd)

2. Install cylinder head.

- (1) Make sure that No. 1 cylinder is at Top Dead Center.
- (2) Make sure that No. 1 cam of camshaft is at T.D.C. on its compression stroke.
- (3) Tighten cylinder head bolts to the specified torque in the sequence as follows.

Tightening order



SMA880A

- : **Cylinder head bolt**
- 1st
78 N·m
(8 kg-m, 58 ft-lb)
- 2nd
118 - 127 N·m
(12 - 13 kg-m, 87 - 94 ft-lb)

3. Install back covers.

- : **Back cover bolt**
- 3 - 4 N·m
(0.3 - 0.4 kg-m, 2.2 - 2.9 ft-lb)

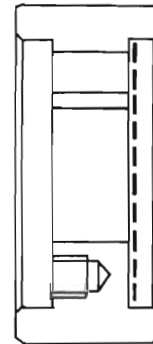
4. Install camshaft pulley spacer and camshaft pulley.

- : **Camshaft pulley**
- 132 - 142 N·m
(13.5 - 14.5 kg-m, 98 - 105 ft-lb)

Install by applying sealer to the back of cam pulley spacer.

When installing cam pulley spacer, be careful that dust lip of camshaft front oil seal is not rolled back.

After applying sealer, immediately install cam pulley and cam pulley bolt.



Apply bonding agent to --- portion

SEM592A

5. Install injection pump pulley and idler pulley.

- : **Injection pump pulley bolt**
- 59 - 69 N·m
(6.0 - 7.0 kg-m, 43 - 51 ft-lb)
- Idler pulley bolt**
- 31 - 39 N·m
(3.2 - 4.0 kg-m, 23 - 29 ft-lb)

6. Install timing belt and adjust belt tension.

7. Install dust covers.

- : **3 - 5 N·m**
(0.3 - 0.5 kg-m, 2.2 - 3.6 ft-lb)

8. Install rocker cover.

Refer to Retightening Cylinder Head Bolts in section MA.

Confirm rocker cover bolts, washers and gasket are free from oil.

- : **6 - 9 N·m**
(0.6 - 0.9 kg-m, 4.3 - 6.5 ft-lb)

9. Install intake and exhaust manifold.

Refer to Retightening Manifold Nuts in section MA.

10. After assembling all disassembled parts, fill radiator with coolant up to the specified level.

Refer to Changing Engine Coolant (Sections MA and LC).

Removal

1. Drain engine oil.
2. Remove oil pan.
3. Remove oil strainer from oil pump assembly.

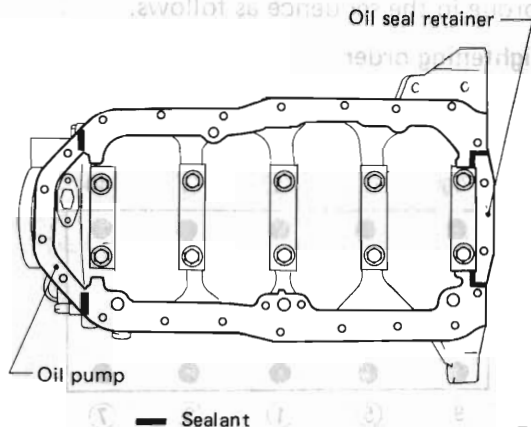


SEM523A

Installation

1. Install oil strainer.
2. Apply sealant.

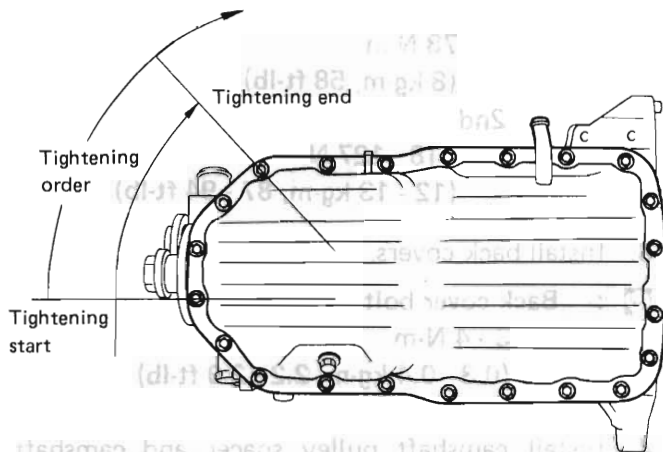
16 - 21 N·m
(1.6 - 2.1 kg-m, 12 - 15 ft-lb)



SEM604A

3. Install oil pan and reinforcement.

5 - 7 N·m
(0.5 - 0.7 kg-m, 3.6 - 5.1 ft-lb)



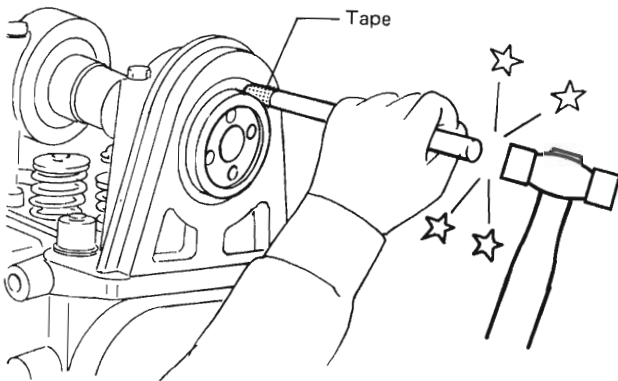
SEM605A

In order to retain clearance between oil pan and rear end plate 1 mm (0.04 in), install oil pan a little more to the front of the bolt.

OIL SEAL REPLACEMENT

— Replacement of Camshaft Oil Seal —

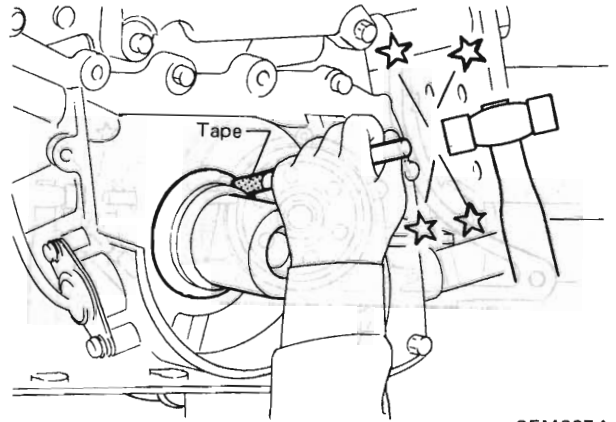
1. Remove timing belt.
2. Remove camshaft pulley, injection pump pulley and idler pulley.
3. Remove back covers.
4. Remove camshaft pulley spacer.
5. Remove camshaft oil seal.
6. Apply engine oil to camshaft oil seal and install it in place.



7. Install timing belt.

Replacement of Crankshaft Front Oil Seal

1. Remove timing belt.
2. Remove crankshaft front oil seal.
3. Apply engine oil to crankshaft front oil seal and install it in place.



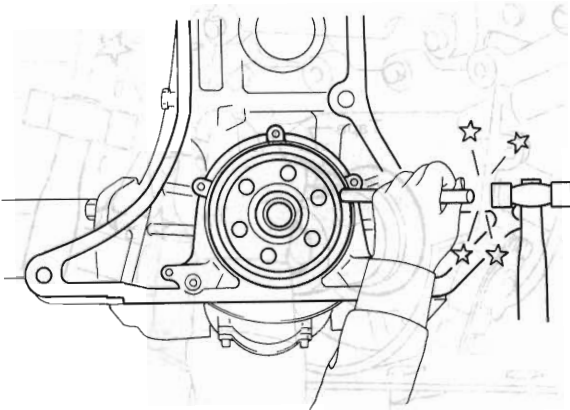
4. Install timing belt.

OIL SEAL REPLACEMENT

Replacement of Crankshaft

Rear Oil Seal

1. Remove flywheel.
2. Remove crankshaft rear oil seal.
3. Apply engine oil to crankshaft rear oil seal and install it in place.

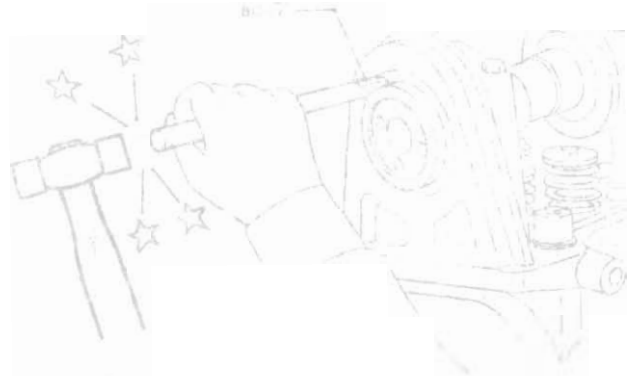


SEM607A

SEM608A

Replacement of Valve Oil Seal

1. Remove valve rocker arm.
2. Remove camshaft.
3. Remove valves, valve springs and related parts.
4. Remove valve oil seals.
5. Apply engine oil to valve oil seal and install it in place.



SEM609

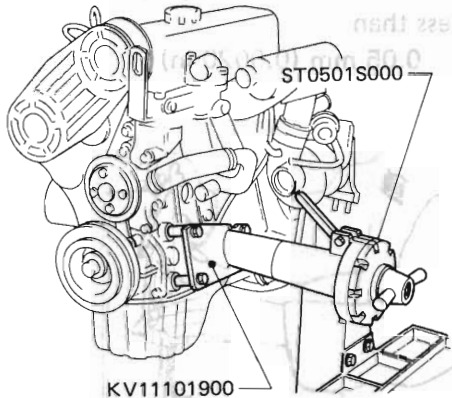
Install timing belt

ENGINE OVERHAUL

Disassembly

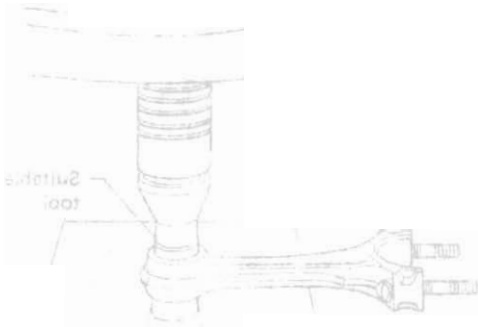
PISTON AND CRANKSHAFT

1. Place engine on work stand.



SEM609A

2. Remove timing belt.
3. Drain coolant and remove water pump.
4. Drain oil.
5. Remove oil pan and oil pump.
6. Remove cylinder heads.
7. Remove pistons.
8. Remove bearing cap and crankshaft.



SEM302

Inspection

PISTON RING SIDE CLEARANCE

Side clearance:

Top ring

0.060 - 0.100 mm

(0.0024 - 0.0039 in)

Limit 0.2 mm

(0.008 in)

2nd ring

0.040 - 0.080 mm

(0.0016 - 0.0031 in)

Limit 0.15 mm

(0.0059 in)

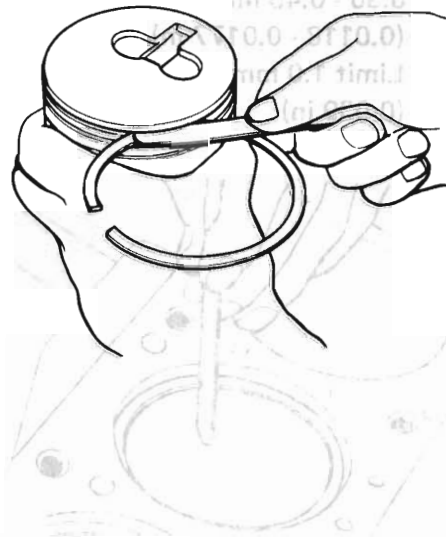
Oil ring

0.030 - 0.070 mm

(0.0012 - 0.0028 in)

Limit 0.1 mm

(0.004 in)



SEM305

ENGINE OVERHAUL

Inspection (Cont'd)

PISTON RING GAP

Ring gap:

Top ring

Without mark

0.20 - 0.29 mm
(0.0079 - 0.0114 in)

With mark

0.14 - 0.22 mm
(0.0055 - 0.0087 in)

Limit

0.6 mm
(0.024 in)

2nd ring

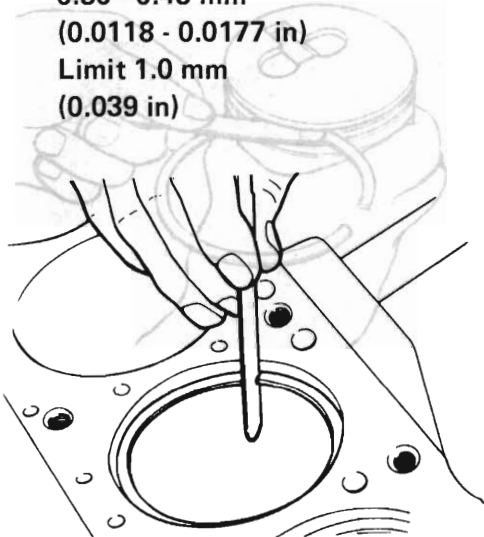
0.20 - 0.35 mm
(0.0079 - 0.0138 in)

Limit 0.8 mm
(0.031 in)

Oil ring

0.30 - 0.45 mm
(0.0118 - 0.0177 in)

Limit 1.0 mm
(0.039 in)



EM130

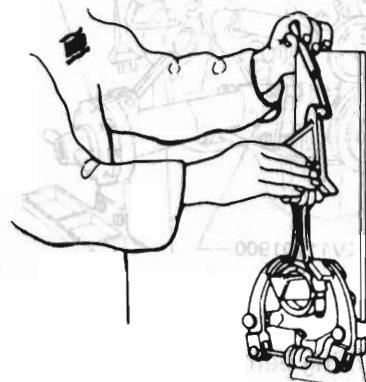
CONNECTING ROD BEND AND TORSION

Bend and torsion

[per 100 mm (3.94 in) length]:

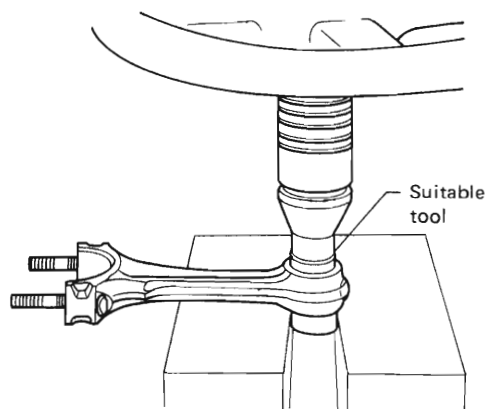
Less than

0.05 mm (0.0020 in)



EM133

CONNECTING ROD BEARING REPLACEMENT

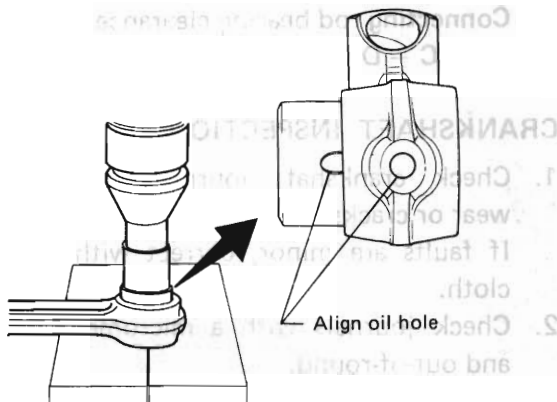


SEM906

ENGINE OVERHAUL

Inspection (Cont'd)

- Coat new bearing with oil.
- Align oil hole.



SEM907

Ream the bore.

Ream bore:

Non-turbo model

25.025 - 25.038 mm
(0.9852 - 0.9857 in)

Turbo model

26.025 - 26.038 mm
(1.0246 - 1.0251 in)

BEARING CLEARANCE

Bearing clearance

Main bearing

0.036 - 0.063 mm
(0.0014 - 0.0025 in)

Limit 0.12 mm
(0.0047 in)

Connecting rod bearing

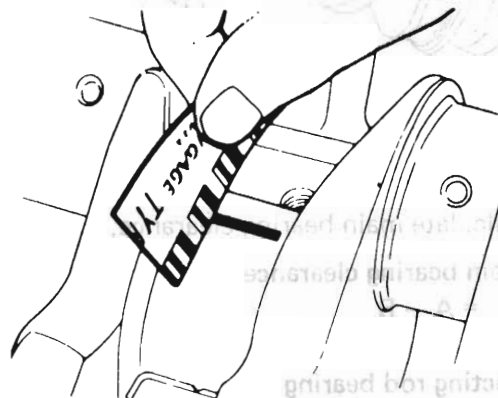
0.024 - 0.066 mm
(0.0009 - 0.0026 in)

Limit 0.12 mm
(0.0047 in)

Method A

CAUTION:

- Do not turn crankshaft or connecting rod while the plastigage is being inserted.
- When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use thicker main bearing or undersized bearing so that the specified bearing clearance is obtained.



EM142

Method B

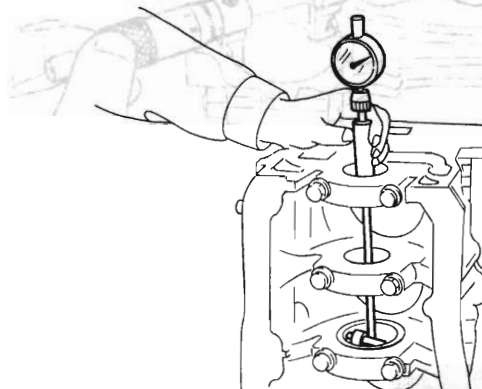
Main bearing

1. Install main bearings to cylinder block and main bearing cap.
2. Install main bearing cap to cylinder block.

Tighten all bolts in correct order and in two or three stages.

 : 69 - 83 N·m
(7.0 - 8.5 kg-m, 51 - 61 ft-lb)

3. Measure inside diameter "A" of main journal.

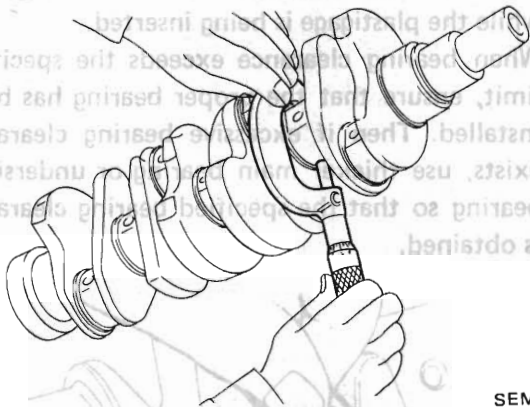


SEM611A

ENGINE OVERHAUL

Inspection (Cont'd)

4. Measure outside diameter "B" of main journal in crankshaft.



SEM612A

5. Calculate main bearing clearance.

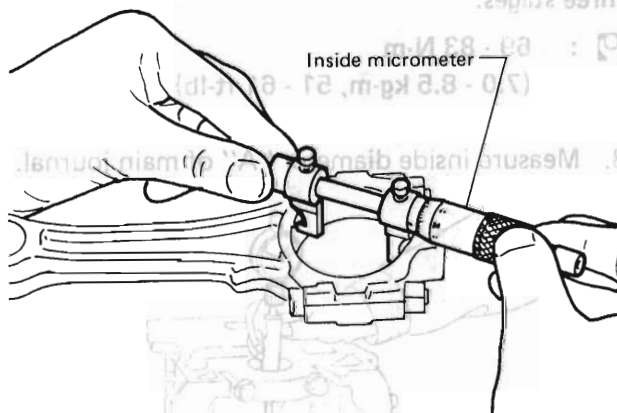
$$\text{Main bearing clearance} = A - B$$

Connecting rod bearing

1. Install connecting rod bearing to connecting rod and cap.
2. Install connecting rod cap to connecting rod.

Torque: 44 - 54 N·m
(4.5 - 5.5 kg-m, 33 - 40 ft-lb)

3. Measure inside diameter "C" of bearing.



SEM507A

4. Measure outside diameter "D" of crank pin journal bearing in crankshaft.
5. Calculate connecting rod bearing clearance.

Connecting rod bearing clearance

$$= C - D$$

CRANKSHAFT INSPECTION

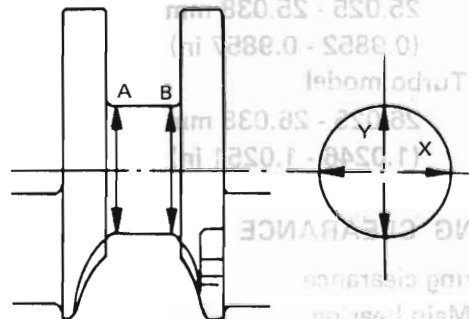
1. Check crankshaft journal for score, bias, wear or cracks.
If faults are minor, correct with fine crocus cloth.
2. Check journals with a micrometer for taper and out-of-round.

Out-of-round (X-Y):

Less than 0.03 mm (0.0012 in)

Taper (A-B)

Less than 0.03 mm (0.0012 in)



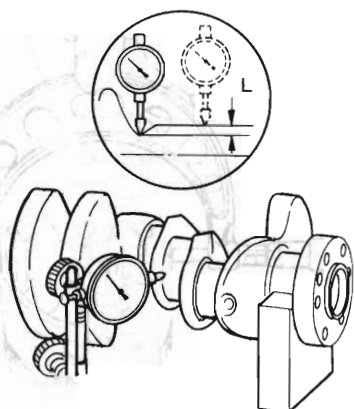
EM757

ENGINE OVERHAUL

Inspection (Cont'd)

- a. When regrinding crank pin and crank journal, measure "L" dimension in fillet roll. Make sure the measurements exceed the specified limit. If the measurements are within the specified limit, do not regrind.

L: More than 0.13 mm (0.0051 in)



SEM964

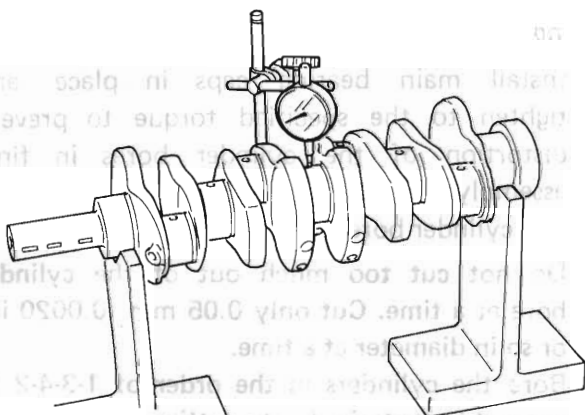
- b. Do not grind off fillet roll.
- c. Refer to S.D.S. for regrinding crankshaft and available service parts.

CRANKSHAFT RUNOUT

Check crankshaft runout.

Runout [T.I.R. (Total Indicator Reading)]

Less than 0.05 mm (0.0020 in)

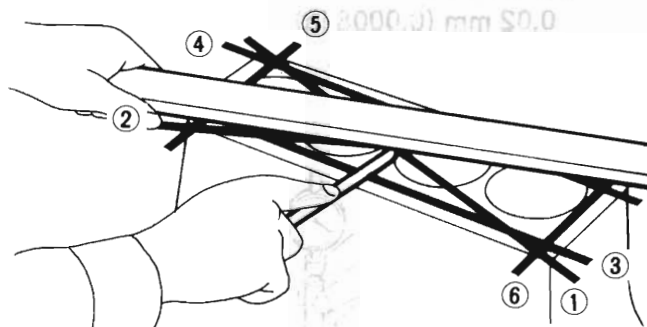


SEM652A

CYLINDER BLOCK DISTORTION AND WEAR

Warpage of surface:

Less than 0.1 mm (0.004 in)



SEM901

If beyond the specified limit, resurface it.

Cylinder block nominal height from crank shaft center:

LD20 & LD20T

227.45±0.05 mm

Correct amount limit

(Correct amount including cylinder head side):

0.1 mm (0.004 in)

Using a bore gauge, measure cylinder bore for wear, out-of-round or taper.

ENGINE OVERHAUL

Inspection (Cont'd)

Standard inside diameter:

85.000 - 85.050 mm

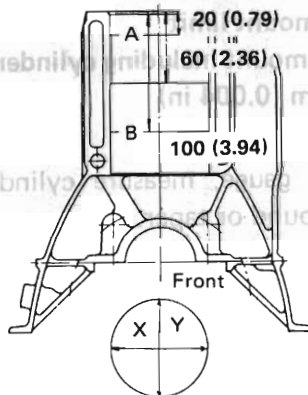
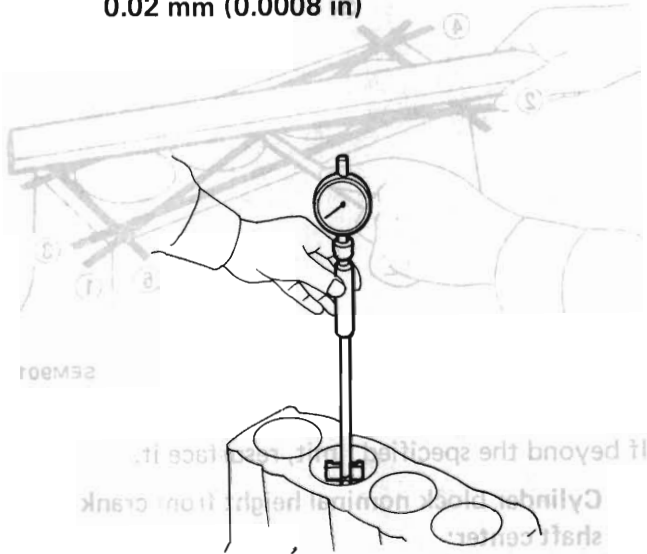
(3.3465 - 3.3484 in)

Out-of-round (X-Y) limit:

0.02 mm (0.0008 in)

Taper (A-B) limit:

0.02 mm (0.0008 in)



Unit: mm (in)

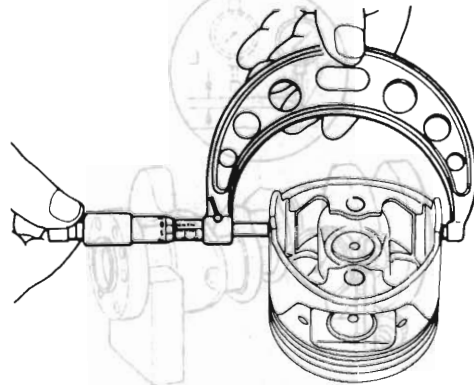
EM125

CYLINDER BORING

When any cylinder needs boring, all other cylinders must also be bored at the same time.

Determining bore size

1. Determine piston oversize according to amount of cylinder wear. Refer to S.D.S.
2. The size to which cylinders must be honed is determined by adding piston-to-cylinder clearance to the piston skirt diameter.



EM126

Rebored size calculation

$$D = A + B - C = A + [0.030 \text{ to } 0.050 \text{ mm} (0.0012 \text{ to } 0.0020 \text{ in})]$$

Where:

D = Rebored diameter

A = Skirt diameter as measured

B = Piston-to-wall clearance

C = Honing allowance

0.02 mm (0.0008 in)

Boring

1. Install main bearing caps in place, and tighten to the specified torque to prevent distortion of the cylinder bores in final assembly.
2. Cut cylinder bores.
 - Do not cut too much out of the cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.
 - Bore the cylinders in the order of 1-3-4-2 to prevent heat strain due to cutting.

ENGINE OVERHAUL

Inspection (Cont'd)

3. Hone the cylinders to the required size referring to S.D.S.
 - Use clean sharp stones of proper grade.
 - Cross-hatch pattern should be approximately 45°.
4. Measure the finished cylinder bore for out-of-round and taper.

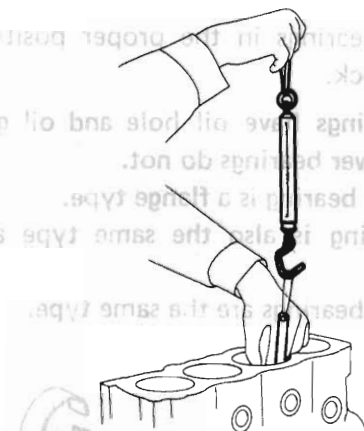
Measuring piston-to-cylinder clearance

Measure the extracting force, and pull feeler gauge straight upward.

It is recommended that piston and cylinder be heated to 20°C (68°F).

Feeler gauge thickness:
0.06 mm (0.0024 in)

Extracting force:
5.9 - 11.8 N
(0.6 - 1.2 kg, 1.3 - 2.6 lb)

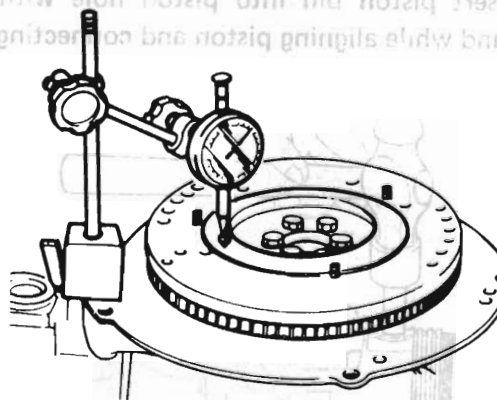


SEM550

FLYWHEEL RUNOUT

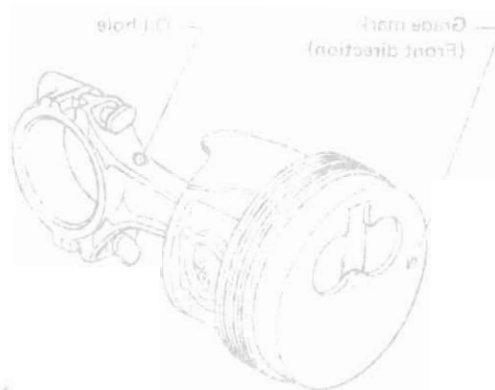
Runout (Total indicator reading)

Less than 0.15 mm (0.0059 in)



EM426

Install ring on flywheel, heating ring gear to about 180 to 220°C (356 to 428°F).

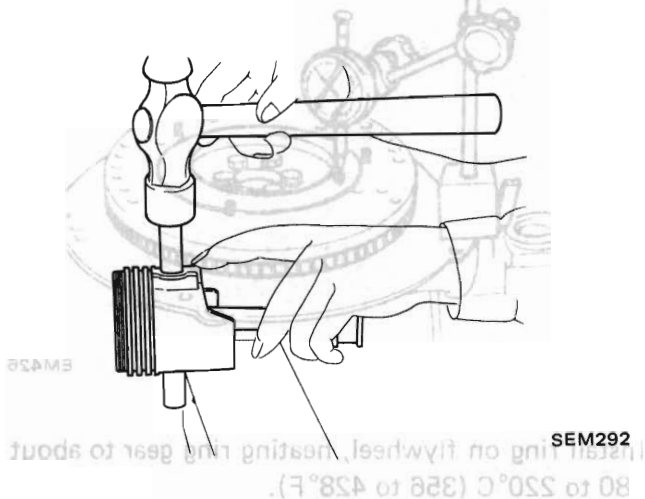


ENGINE OVERHAUL

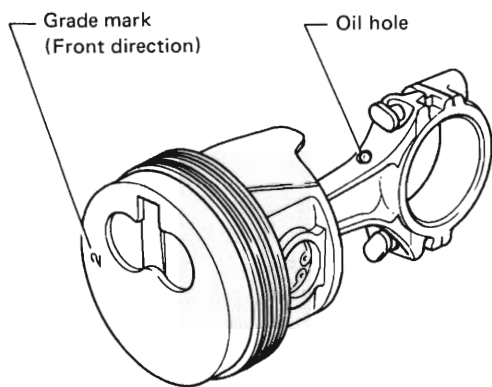
Assembly

PISTON AND CONNECTING ROD

- a. Heat piston with a heater or hot water [approximately 60 to 70°C (140 to 158°F)], insert piston pin into piston hole with your hand while aligning piston and connecting rod.



- b. Arrange so that oil jet of connecting rod big end is directed toward the right side of cylinder block.

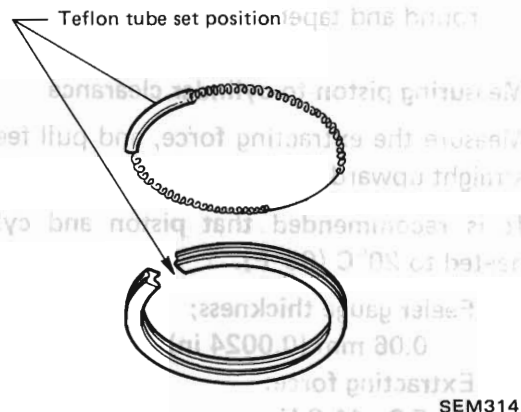


- c. Connecting rods are marked at side of big end for identifying the designated cylinder.

INSTALLING PISTON RINGS

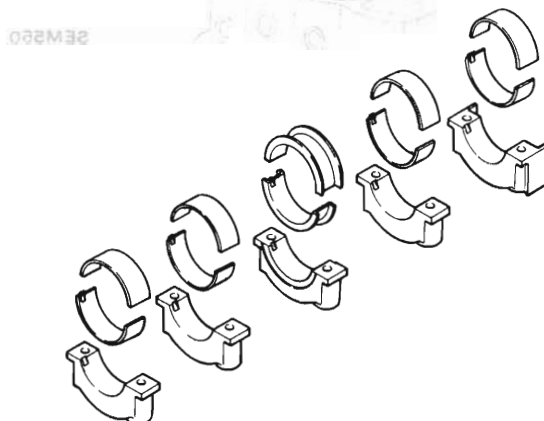
Install so that stamped mark on ring faces upward.

- a. Use top ring which has no mark when bore grade stamped near cylinder block bore is (1) or (2); use ring with "S" mark when bore grade is (3), (4) or (5).
- b. Align teflon tube with ring gap.



CRANKSHAFT

1. Set main bearings in the proper position on cylinder block.
- a. Upper bearings have oil hole and oil groove, however lower bearings do not.
- b. Only center bearing is a flange type.
- c. Front bearing is also the same type as rear bearing.
- d. Other inter-bearings are the same type.



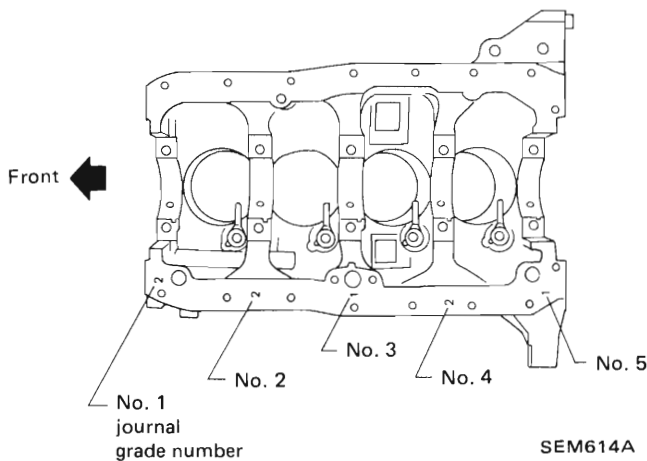
ENGINE OVERHAUL

Assembly (Cont'd)

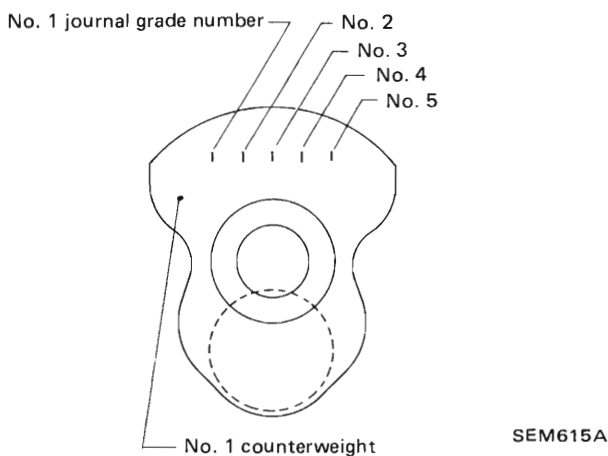
2. If either crankshaft, cylinder block or main bearing is reused again, it is necessary to measure main bearing clearance.

If all of crankshaft, cylinder block and main bearing are replaced with new ones, it is necessary to select thickness of main bearings as follows:

- a. The grade number of each cylinder block main journal is punched on the respective cylinder block.



- b. The grade number of each crankshaft main journal is punched on the respective crankshaft.



- c. Select suitable thickness of main bearing according to the following table.

	Main journal grade number			
	0	1	2	
	Main bearing grade number			
Crankshaft journal grade number	0	0	1	2
	1	1	2	3

For example:

Main journal grade number: 1

Crankshaft journal grade number: 2

Main bearing grade number = 1 + 2 = 3

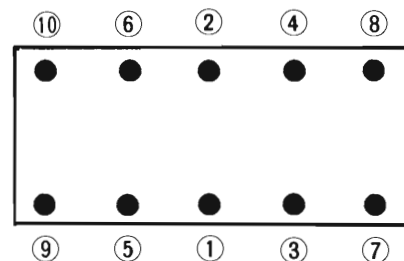
Main bearing

Refer to S.D.S.

3. Install main bearing cap and tighten bolts to the specified torque.

 : 69 - 83 N·m
(7.0 - 8.5 kg-m, 51 - 61 ft-lb)

- Tighten in two or three stages.



SEM616A

ENGINE OVERHAUL

Assembly (Cont'd)

After securing bearing cap bolts, ascertain that crankshaft turns smoothly by hand.

4. Install piston assembly.
5. Measure crankshaft free end play.

Crankshaft free end play

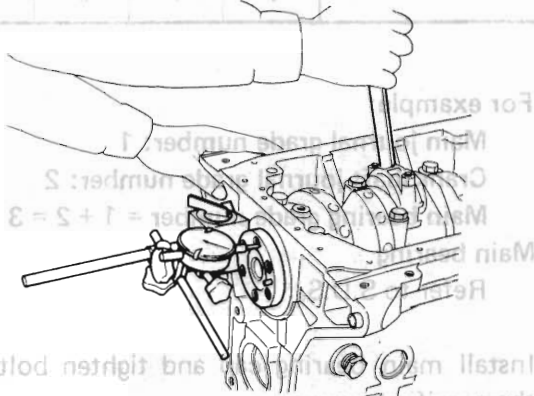
Standard

0.05 - 0.18 mm

(0.0020 - 0.0071 in)

Limit

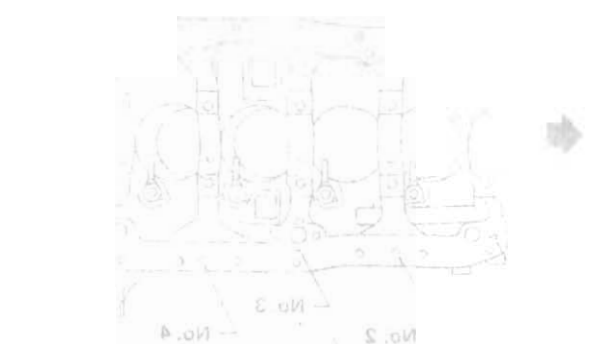
0.30 mm (0.0118 in)



After securing bearing cap bolts, ascertain that crankshaft turns smoothly by hand.

4. Install piston assembly.

5. Measure crankshaft free end play.



After securing bearing cap bolts, ascertain that crankshaft turns smoothly by hand.

4. Install piston assembly.

5. Measure crankshaft free end play.



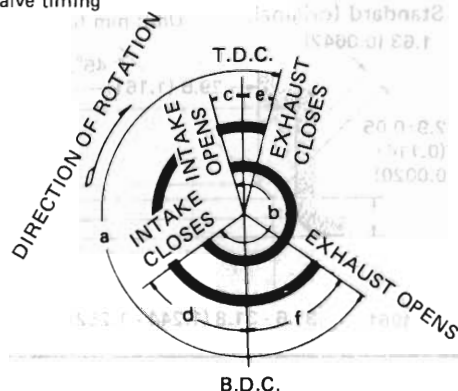
SERVICE DATA AND SPECIFICATIONS

General Specifications

Inspection and Adjustment

Engine		LD20
Item		
Cylinder arrangement		L-4
Displacement	cm ³ (cu in)	1,952 (119.11)
Bore x stroke	mm (in)	85 x 86 (3.35 x 3.39)
Valve arrangement		O.H.C.
Firing order		1-3-4-2
Number of piston rings		
Compression		2
Oil		1
Number of main bearings		5
Compression ratio		
Non-turbo		22.2
Turbo		21.0

Valve timing



EM120

Unit: degree

a	b	c	d	e	f
248	232	14	38	8	60

Unit: kPa (bar, kg/cm², psi)/rpm

	Non-turbo	Turbo
Compression pressure		
Standard	3,138 (31.4, 32, 455)/200	2,942 (29.4, 30, 427)/200
Minimum	2,452 (24.5, 25, 356)/200	2,354 (23.5, 24, 341)/200
Difference limit between cylinders	490 (4.9, 5, 71)/200	

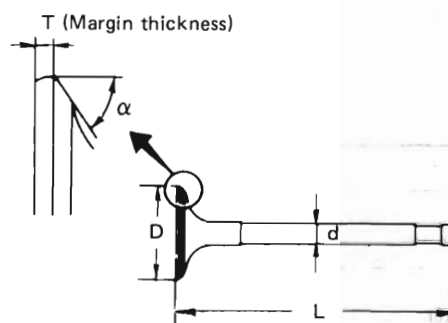
CYLINDER HEAD

Unit: mm (in)

	Standard	Limit
Head surface flatness	Less than 0.05 (0.0020)	0.1 (0.004)

VALVE

Unit: mm (in)



SEM188

	Non-turbo	Turbo
Valve head diameter "D"		
Intake	39.0 - 39.2 (1.5354 - 1.5433)	39.24 - 39.44 (1.5449 - 1.5528)
Exhaust	32.0 - 32.2 (1.260 - 1.268)	
Valve length "L"		
Intake	116.83 - 117.27 (4.5996 - 4.6169)	
Exhaust	117.03 - 117.47 (4.6075 - 4.6248)	
Valve stem diameter "d"		
Intake	7.965 - 7.980 (0.3136 - 0.3142)	
Exhaust	7.945 - 7.960 (0.3128 - 0.3134)	
Valve seat angle "α"	45° 15' - 45° 45'	
Valve margin "T" Limit	0.5 (0.020)	
Valve stem end surface grinding limit	0.5 (0.020)	
Valve clearance Hot		
Intake	0.25 (0.010)	
Exhaust	0.30 (0.012)	
Valve clearance Cold		
Intake	0.18 (0.007)	
Exhaust	0.25 (0.010)	

SERVICE DATA AND SPECIFICATIONS

Inspection and Adjustment (Cont'd)

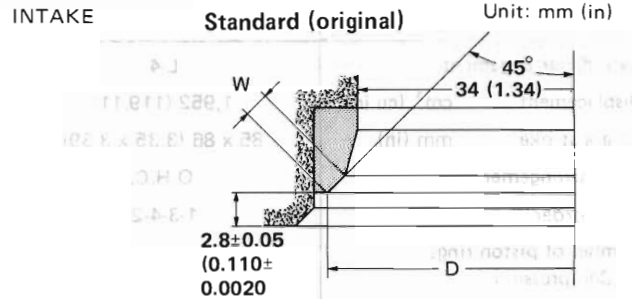
Valve spring

Free height	mm (in)	49.77 (1.9594)
Pressure height	mm/N (mm/kg, in/lb)	30.0/512.9 (30.0/52.3, 1.181/115.3)
Assembled height	mm/N (mm/kg, in/lb)	40.0/226 (40.0/23, 1.575/51)
Out of square ("S")	mm (in)	2.2 (0.087)

Valve guide

	Unit: mm (in)	
	Standard	Service
Valve guide	12.023 - 12.034	12.223 - 12.234
Outer diameter	(0.4733 - 0.4738)	(0.4812 - 0.4817)
Valve guide	8.000 - 8.018	0.3150 - 0.3157
Inner diameter		
[Finished size]		
Cylinder head valve	11.985 - 11.996	12.185 - 12.196
guide hole diameter	(0.4718 - 0.4723)	(0.4797 - 0.4802)
Interference fit of	0.027 - 0.049	(0.0011 - 0.0019)
valve guide		
	Standard	Max. tolerance
Stem to guide clearance		
Intake	0.020 - 0.053	0.1 (0.004)
	(0.0008 - 0.0021)	
Exhaust	0.040 - 0.073	
	(0.0016 - 0.0029)	
Valve deflection limit	0.2 (0.008)	

Valve seat



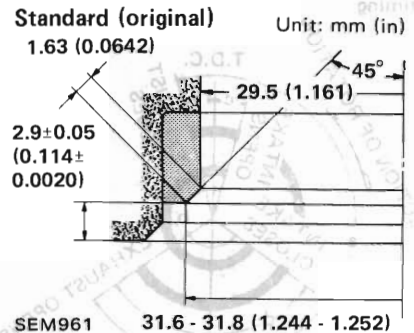
Valve seat diameter "D"

Non-turbo	38.6 - 38.8 (1.520 - 1.528)
Turbo	39.0 - 39.2 (1.535 - 1.543)

Valve seat width "W"

Non-turbo	1.91 (0.0752)
Turbo	2.33 (0.0917)

EXHAUST



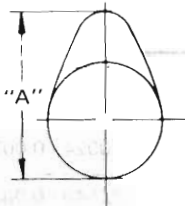
SERVICE DATA AND SPECIFICATIONS

Inspection and Adjustment (Cont'd)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Max. tolerance
Camshaft journal to bearing clearance	0.038 - 0.067 (0.0015 - 0.0026)	0.1 (0.004)
Inner diameter of camshaft bearing	48.000 - 48.016 (1.8898 - 1.8904)	
Outer diameter of camshaft journal	47.949 - 47.962 (1.8878 - 1.8883)	
Camshaft runout [T.I.R.] *	Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft end play	0.08 - 0.38 (0.0031 - 0.0150)	



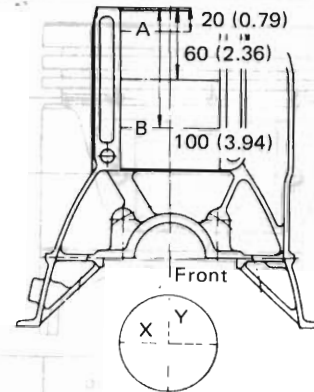
EM671

Cam height "A"	Intake	39.95 - 40.00 (1.5728 - 1.5748)
	Exhaust	40.30 - 40.35 (1.5866 - 1.5886)
Wear limit of cam height		0.15 (0.0059)

* Total indicator reading.

CYLINDER BLOCK

Unit: mm (in)



EM125

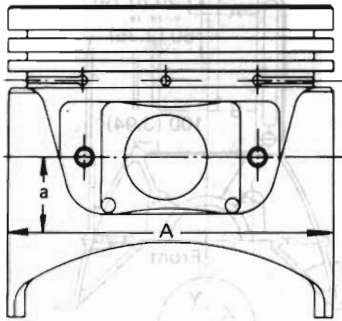
	Standard	Wear limit
Surface flatness	Less than 0.05 (0.0020)	0.10 (0.0039)
Cylinder bore	Grade No. 1 85.000 - 85.010 (3.3465 - 3.3468)	—
	Grade No. 2 85.010 - 85.020 (3.3468 - 3.3472)	
	Grade No. 3 85.020 - 85.030 (3.3472 - 3.3476)	
	Grade No. 4 85.030 - 85.040 (3.3476 - 3.3480)	
	Grade No. 5 85.040 - 85.050 (3.3480 - 3.3484)	
	Inner diameter	—
Out-of-round (X-Y)	Less than 0.02 (0.0008)	—
	Taper (A-B)	—
Difference in inner diameter between cylinders	Less than 0.05 (0.0020)	—
Piston to cylinder clearance	0.05 - 0.07 (0.0020 - 0.0028)	—
Main journal inner diameter	Grade No. 0 63.645 - 63.654 (2.5057 - 2.5061)	—
	Grade No. 1 63.654 - 63.663 (2.5061 - 2.5064)	
	Grade No. 2 63.663 - 63.672 (2.5064 - 2.5068)	

SERVICE DATA AND SPECIFICATIONS

Inspection and Adjustment (Cont'd)

Piston

Unit: mm (in)



EM714

Model		Non-turbo	Turbo
Piston skirt diameter "A"	Grade No. 1	84.94 - 84.95 (3.3441 - 3.3445)	
	Grade No. 2	84.95 - 84.96 (3.3445 - 3.3449)	
	Grade No. 3	84.96 - 84.97 (3.3449 - 3.3453)	
	Grade No. 4	84.97 - 84.98 (3.3453 - 3.3457)	
	Grade No. 5	84.98 - 84.99 (3.3457 - 3.3461)	
	Standard	84.96 - 85.01 (3.3449 - 3.3468)	
	Over-size		
	0.5 (0.020)	85.44 - 85.49 (3.3638 - 3.3657)	
	1.0 (0.039)	85.94 - 85.99 (3.3835 - 3.3854)	
	"a" dimension	19.5 (0.768)	
Piston pin hole diameter		24.991 - 24.999 (0.9839 - 0.9842)	25.991 - 25.999 (1.0233 - 1.0236)
Piston clearance to cylinder block		0.05 - 0.07 (0.0020 - 0.0028)	

Piston-pin

Unit: mm (in)

Model	Non-turbo	Turbo
Piston pin outer diameter	24.994 - 25.000 (0.9840 - 0.9843)	25.994 - 26.000 (1.0234 - 1.0236)
Interference fit of piston pin to piston	0 - 0.004 (0 - 0.0002)	
Piston pin to connecting rod clearance	0.025 - 0.044 (0.0010 - 0.0017)	

Piston ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.060 - 0.100 (0.0024 - 0.0039)	0.2 (0.008)
	2nd	0.040 - 0.080 (0.0016 - 0.0031)	0.15 (0.0059)
	Oil	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
Ring gap	Top	Without mark 0.20 - 0.29 (0.0079 - 0.0114)	0.6 (0.024)
		With mark 0.14 - 0.22 (0.0055 - 0.0087)	
	2nd	0.20 - 0.35 (0.0079 - 0.0138)	0.8 (0.031)
	Oil (rail ring)	0.30 - 0.45 (0.0118 - 0.0177)	1.0 (0.039)

CONNECTING ROD

Unit: mm (in)

Model		Non-turbo	Turbo
Center distance		138.50 - 138.53 (5.4527 - 5.4539)	
Bend, Torsion [per 100 mm (3.94 in)]	Std.	Less than 0.025 (0.0010)	
	Limit	0.05 (0.0020)	
Piston pin bore dia.		25.025 - 25.038 (0.9852 - 0.9857)	26.025 - 26.038 (1.0246 - 1.0251)
Big end play	Std.	0.2 - 0.3 (0.008 - 0.012)	
	Limit	0.6 (0.024)	

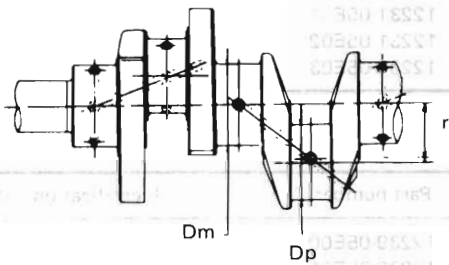
SERVICE DATA AND SPECIFICATIONS

Inspection and Adjustment (Cont'd)

CRANKSHAFT

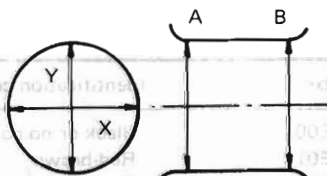
Unit: mm (in)

Main journal dia. "Dm"	Grade No. 0	
	59.949 - 59.956 (2.3602 - 2.3605)	
	Grade No. 1	
	59.942 - 59.949 (2.3599 - 2.3602)	
Pin journal dia. "Dp"	49.961 - 49.974 (1.9670 - 1.9675)	
Center distance "r"	43.00 (1.6929)	
Out-of-round (X-Y) and taper (A-B)	Std.	Less than 0.01 (0.0004)
	Limit	0.03 (0.0012)
Runout [T.I.R.]	Std.	Less than 0.05 (0.0020)
	Limit	0.10 (0.0039)
Free end play	Std.	0.05 - 0.18 (0.0020 - 0.0071)
	Limit	0.30 (0.0118)



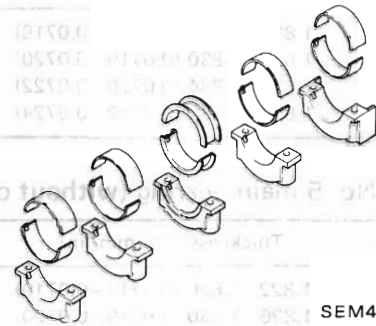
EM737

Out-of-round X-Y
Taper A-B



EM715

AVAILABLE MAIN BEARING



SEM447

SERVICE DATA AND SPECIFICATIONS

Inspection and Adjustment (Cont'd)

No. 1 and No. 5 main bearing (with oil groove)

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Part number	Identification color
0	1.822 - 1.826 (0.0717 - 0.0719)	24 (0.94)	12215-05E00	Black or no color
1	1.826 - 1.830 (0.0719 - 0.0720)		12215-05E01	Red-brown
2	1.830 - 1.834 (0.0720 - 0.0722)		12215-05E02	Green
3	1.834 - 1.838 (0.0722 - 0.0724)		12215-05E03	Yellow

No. 1 and No. 5 main bearing (without oil groove)

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Part number	Identification color
0	1.822 - 1.826 (0.0717 - 0.0719)	24 (0.94)	12239-05E00	Black or no color
1	1.826 - 1.830 (0.0719 - 0.0720)		12239-05E01	Red-brown
2	1.830 - 1.834 (0.0720 - 0.0722)		12239-05E02	Green
3	1.834 - 1.838 (0.0722 - 0.0724)		12239-05E03	Yellow

No. 2 and No. 4 main bearing (with oil groove)

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Part number	Identification color
0	1.822 - 1.826 (0.0717 - 0.0719)	24 (0.94)	12231-05E00	Black or no color
1	1.826 - 1.830 (0.0719 - 0.0720)		12231-05E01	Red-brown
2	1.830 - 1.834 (0.0720 - 0.0722)		12231-05E02	Green
3	1.834 - 1.838 (0.0722 - 0.0724)		12231-05E03	Yellow

No. 2 and No. 4 main bearing (without oil groove)

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Part number	Identification color
0	1.822 - 1.826 (0.0717 - 0.0719)	24 (0.94)	12239-05E00	Black or no color
1	1.826 - 1.830 (0.0719 - 0.0720)		12239-05E01	Red-brown
2	1.830 - 1.834 (0.0720 - 0.0722)		12239-05E02	Green
3	1.834 - 1.838 (0.0722 - 0.0724)		12239-05E03	Yellow

No. 3 main bearing (with oil groove)

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Part number	Identification color
0	1.822 - 1.826 (0.0717 - 0.0719)	24 (0.94)	12247-05E00	Black or no color
1	1.826 - 1.830 (0.0719 - 0.0720)		12247-05E01	Red-brown
2	1.830 - 1.834 (0.0720 - 0.0722)		12247-05E02	Green
3	1.834 - 1.838 (0.0722 - 0.0724)		12247-05E03	Yellow

No. 3 main bearing (without oil groove)

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Part number	Identification color
0	1.822 - 1.826 (0.0717 - 0.0719)	24 (0.94)	12255-05E00	Black or no color
1	1.826 - 1.830 (0.0719 - 0.0720)		12255-05E01	Red-brown
2	1.830 - 1.834 (0.0720 - 0.0722)		12255-05E02	Green
3	1.834 - 1.838 (0.0722 - 0.0724)		12255-05E03	Yellow

SERVICE DATA AND SPECIFICATIONS

Inspection and Adjustment (Cont'd)

Main bearing undersize

Unit: mm (in)

Crank journal diameter "Dm"

Standard 59.942 - 59.956
(2.3599 - 2.3605)

Undersize 59.692 - 59.706
0.25 (0.0098) (2.3501 - 2.3506)

AVAILABLE CONNECTING ROD BEARING

Connecting rod bearing undersize

Unit: mm (in)

Crank pin diameter "Dp"

Standard 49.961 - 49.974
(1.9670 - 1.9675)

Undersize 49.901 - 49.914
0.06 (0.0024) (1.9646 - 1.9651)

0.12 (0.0047) 49.841 - 49.854
(1.9622 - 1.9628)

0.25 (0.0098) 49.711 - 49.724
(1.9571 - 1.9576)

Bearing clearance

Unit: mm (in)

Main bearing clearance

Standard 0.036 - 0.063
(0.0014 - 0.0025)

Limit 0.12 (0.0047)

Connecting rod bearing clearance

Standard 0.024 - 0.066
(0.0009 - 0.0026)

Limit 0.12 (0.0047)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Flywheel

Runout [T.I.R.] Less than 0.15 (0.0059)

SERVICE DATA AND SPECIFICATIONS

(Cont'd) Tightening Torque

ENGINE OUTER PARTS

Unit	N·m	kg-m	ft-lb
Alternator bracket	37 - 51	3.8 - 5.2	27 - 38
Alternator to adjusting bar bolt	14 - 17	1.4 - 1.7	10 - 12
Alternator to bracket	37 - 51	3.8 - 5.2	27 - 38
Crank pulley bolt	137 - 157	14.0 - 16.0	101 - 116
Dust cover bolt	3 - 5	0.3 - 0.5	2.2 - 3.6
Back cover bolt	6 - 7	0.6 - 0.7	4.3 - 5.1
Engine mounting bracket			
M8	22 - 29	2.2 - 3.0	16 - 22
M10	45 - 60	4.6 - 6.1	33 - 44
Glow plug	20 - 25	2.0 - 2.5	14 - 18
Glow plug connecting plate	1.0 - 1.5	0.1 - 0.15	0.7 - 1.1
Injection pump bracket	30 - 40	3.1 - 4.1	22 - 30
Injection pump drive gear nut	59 - 69	6.0 - 7.0	43 - 51
Injection pump nut	16 - 21	1.6 - 2.1	12 - 15
Injection tube flare nut	22 - 25	2.2 - 2.5	16 - 18
Manifold Bolt and Nut			
Upper bolt (M10)	34 - 44	3.5 - 4.5	25 - 33
Lower nut & bolt (M8)	18 - 22	1.8 - 2.2	13 - 16
Injection nozzle	59 - 69	6.0 - 7.0	43 - 51
Oil cooler bracket bolt	16 - 21	1.6 - 2.1	12 - 15
Oil feed pipe bolt	19 - 25	1.9 - 2.5	14 - 18
Oil pump bolt			
M6	6 - 7	0.6 - 0.7	4.3 - 5.1
M8	14 - 18	1.4 - 1.8	10 - 13
Power steering pump bracket bolt	30 - 40	3.1 - 4.1	22 - 30
Spill tube nut	39 - 49	4.0 - 5.0	29 - 36
Tensioner pulley	31 - 39	3.2 - 4.0	23 - 29
Camshaft pulley bolt	132 - 142	13.5 - 14.5	98 - 105
Idler pulley bolt	31 - 39	3.2 - 4.0	23 - 29
Thermostat housing	16 - 21	1.6 - 2.1	12 - 15
Vacuum pump pipe bolt	26 - 32	2.7 - 3.3	20 - 24
Water outlet bolt	16 - 21	1.6 - 2.1	12 - 15
Water pump bolt			
M6	6 - 7	0.6 - 0.7	4.3 - 5.1
M8	14 - 18	1.4 - 1.8	10 - 13

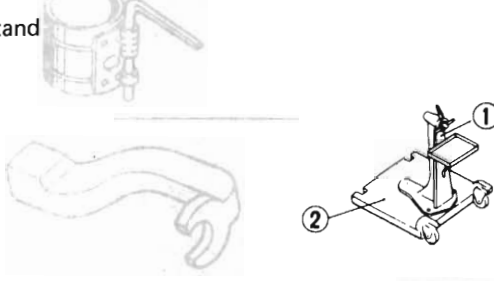
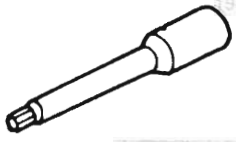
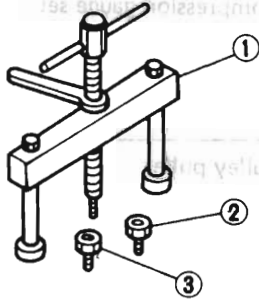
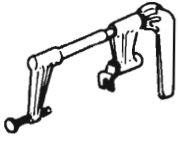
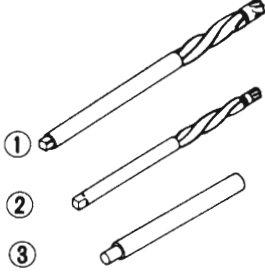
ENGINE BODY PARTS

Unit	N·m	kg-m	ft-lb
Connecting rod big end nut	44 - 54	4.5 - 5.5	33 - 40
Cylinder head bolt	118 - 127	12 - 13	87 - 94
Flywheel bolt	137 - 157	14 - 16	101 - 116
Main bearing cap bolt	69 - 83	7.0 - 8.5	51 - 61
Oil pan bolt	5 - 7	0.5 - 0.7	3.6 - 5.1
Oil pan drain plug	29 - 39	3.0 - 4.0	22 - 29
Oil strainer bolt	16 - 21	1.6 - 2.1	12 - 15
Pivot lock nut	49 - 59	5.0 - 6.0	36 - 43
Rocker cover bolt	7 - 11	0.7 - 1.1	5.1 - 8.0

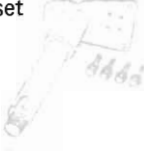
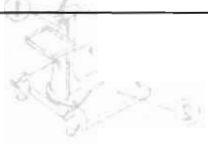
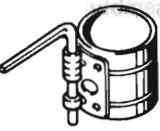
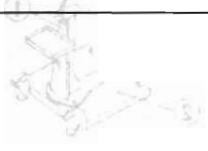
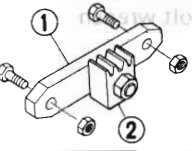
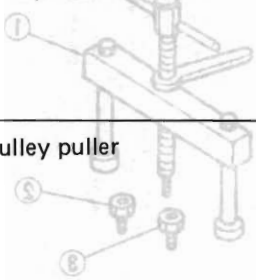
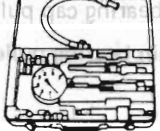
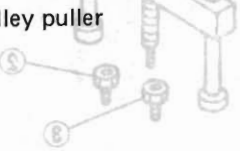
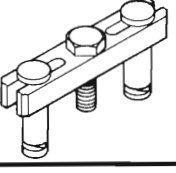
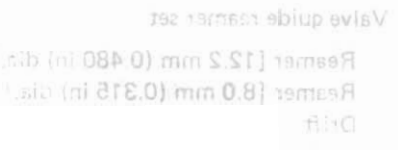
TURBOCHARGER-RELATED PARTS

	N·m	kg-m	ft-lb
Oil jet bolt	30 - 40	3.1 - 4.1	22 - 30
Oil return tube flare nut	39 - 59	4.0 - 6.0	29 - 43
Turbocharger nut	22 - 29	2.2 - 3.0	16 - 22
Exhaust outlet nut	22 - 29	2.2 - 3.0	16 - 22
Oil feed pipe flare nut	11 - 17	1.1 - 1.7	8 - 12

SPECIAL SERVICE TOOLS

Tool number	Tool name	
KV11101900 (LD20 engine)	Engine attachment	
ST0501S000 ① ST05011000 ② ST05012000	Engine stand assembly Engine stand Base	
ST10120000	Cylinder head bolt wrench	
KV101041S0	Crankshaft main bearing cap puller Crankshaft main bearing puller Adapter Adapter	
ST12070000	Valve lifter	
KV101039S0 ① ST11081000 ② ST11032000 ③ ST11320000	Valve guide reamer set Reamer [12.2 mm (0.480 in) dia.] Reamer [8.0 mm (0.315 in) dia.] Drift	

SPECIAL SERVICE TOOLS

Tool number	Tool name		
ST11650001	Valve seat cutter set		
EM03470000	Piston ring compressor		
ST10640001	Pivot adjuster		
KV101056S0 ① KV10105610 ② KV10105630	Engine stopper		
ED19600000	Compression gauge set		
KV11102900	Pulley puller		
			
			

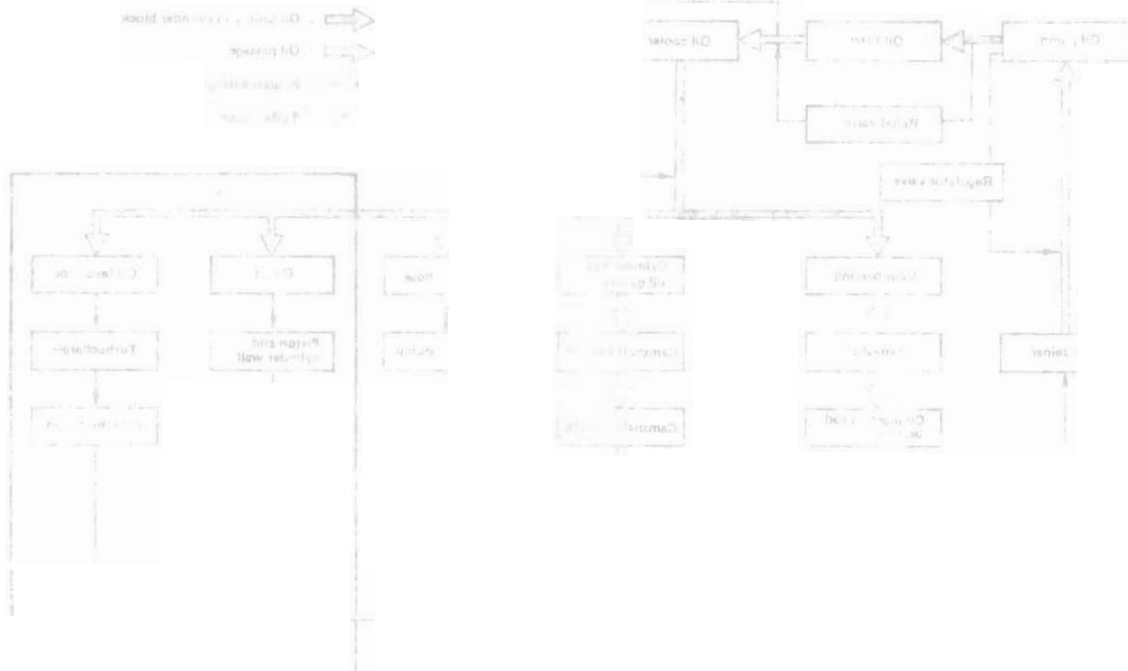
ENGINE LUBRICATION & COOLING SYSTEMS

SECTION LC

LC

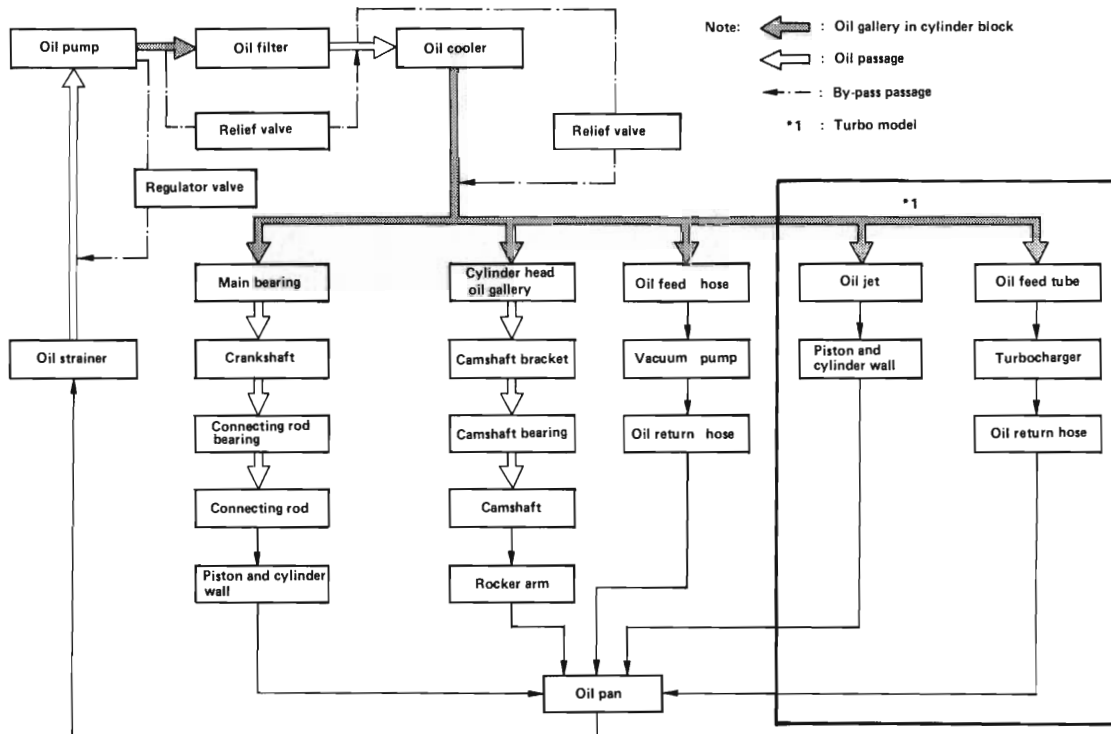
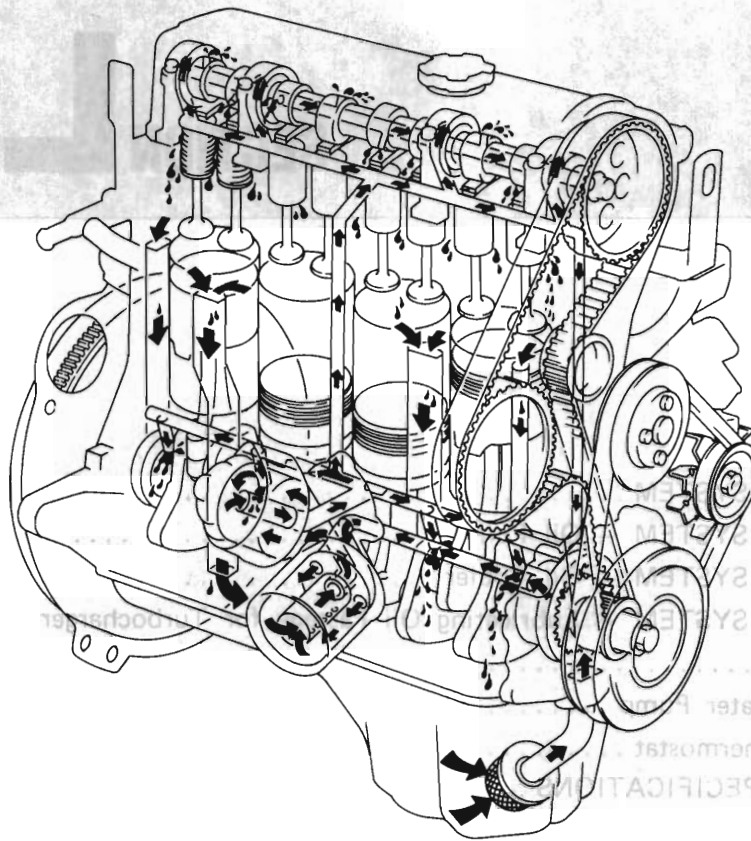
CONTENTS

ENGINE LUBRICATION SYSTEM	LC- 2
ENGINE LUBRICATION SYSTEM — Oil Pump	LC- 4
ENGINE LUBRICATION SYSTEM — Oil Cooler	LC- 6
ENGINE LUBRICATION SYSTEM — Lubricating Oil Passage for Turbocharger	LC- 7
COOLING SYSTEM	LC- 8
COOLING SYSTEM — Water Pump	LC-10
COOLING SYSTEM — Thermostat	LC-11
SERVICE DATA AND SPECIFICATIONS	LC-12



ENGINE LUBRICATION SYSTEM

Lubrication Circuit



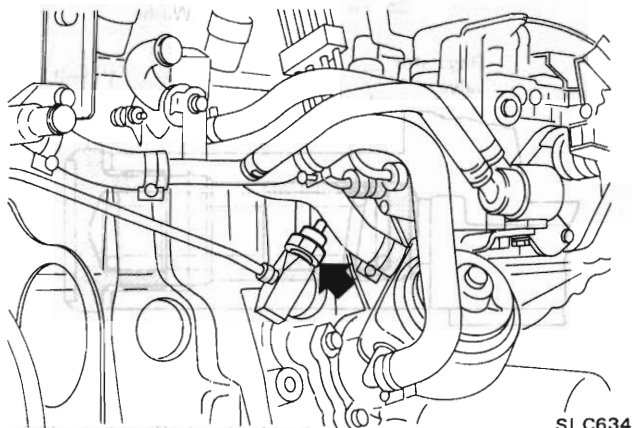
SLC632

ENGINE LUBRICATION SYSTEM

Oil Pressure Check (On-vehicle service)

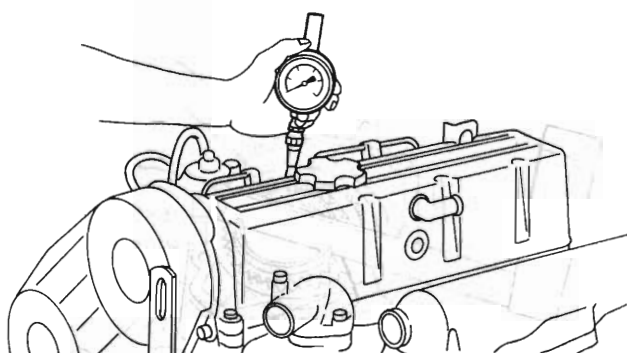
Be careful not to burn yourself, as the engine and oil may be hot.

1. Warm up engine.
2. Stop engine and remove oil pressure switch.

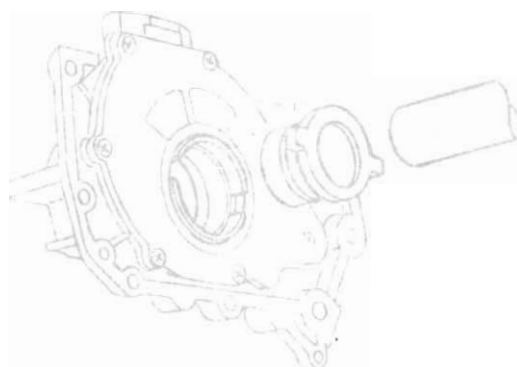


3. Install pressure gauge.
4. Start engine and check oil pressure with engine running under no-load.

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
600	98 (1.0, 1, 14)
2,000	294 (2.9, 3, 43)
5,000	392 (3.9, 4, 57)



The table at left shows data tested when SAE 10W-30 oil is used and oil temperature is between 77 and 83°C (171 and 181°F). Slight difference will be found because of oil viscosity or oil temperature. If difference is extreme, check oil passage and oil pump for oil leaks.

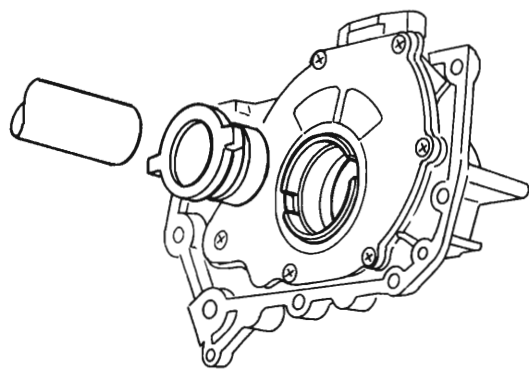
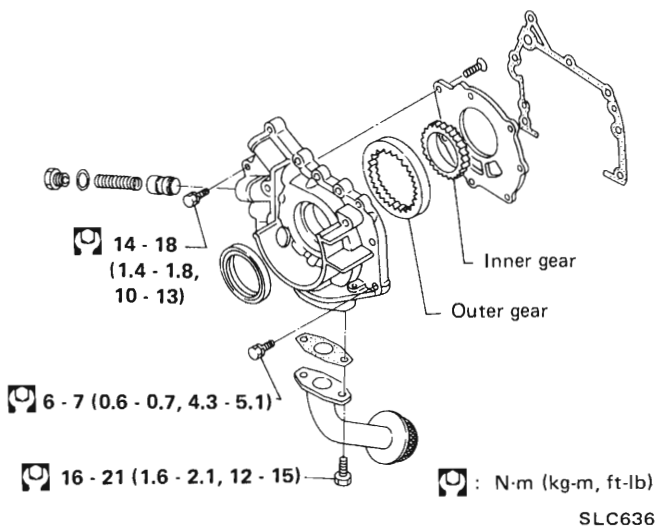


ENGINE LUBRICATION SYSTEM—Oil Pump

Disassembly and Assembly

1. Remove timing belt, referring to Changing Timing Belt in section MA.
2. Remove back covers.
3. Drain oil.
4. Remove oil pan.
5. Remove oil pump assembly.
6. Install oil pump assembly.

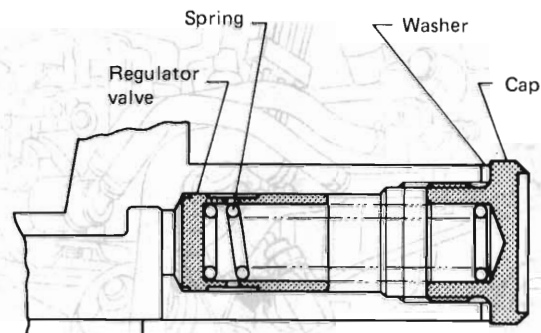
Always replace with new gasket when installing oil pump; apply engine oil to inner and outer gear.



SLC639

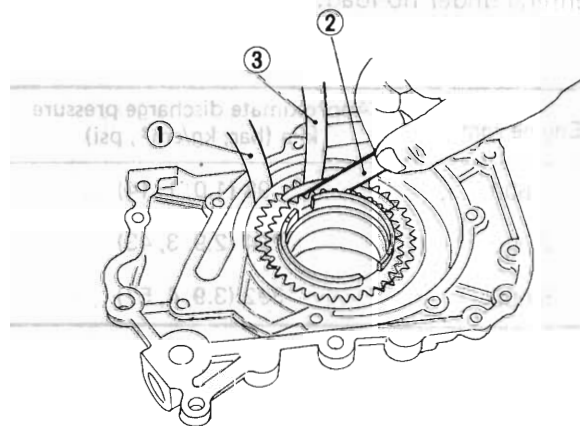
Inspection

1. Visually inspect components for wear and damage.
2. Check oil pressure regulator valve sliding surface and valve spring.

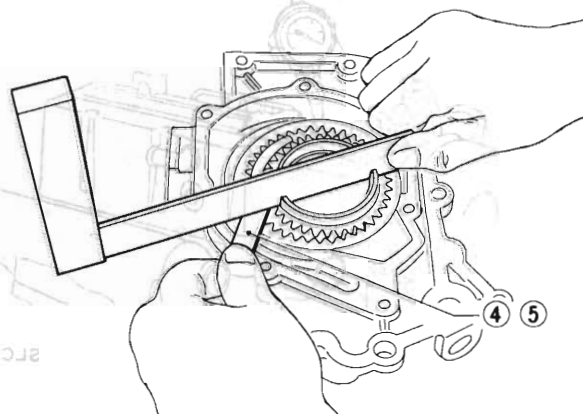


SLC295

3. Using a feeler gauge, check the following clearances.



SLC637



SLC638

ENGINE LUBRICATION SYSTEM— Oil Pump

Inspection (Cont'd)

If any exceed the limit, replace gear set or entire oil pump assembly.

Unit : mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
--------------------------------	-------------------------------

Inner gear to crescent clearance ②	0.12 - 0.23 (0.0047 - 0.0091)
------------------------------------	-------------------------------

Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
------------------------------------	-------------------------------

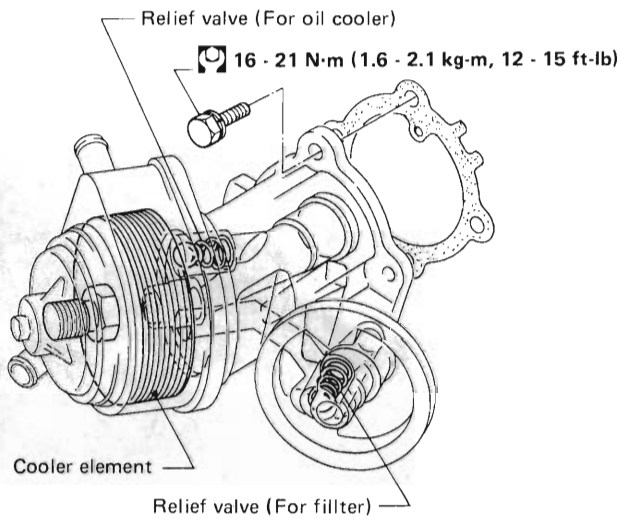
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
-----------------------------------	-------------------------------

Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)
-----------------------------------	-------------------------------

ENGINE LUBRICATION SYSTEM—Oil Cooler

Disassembly and Assembly

1. Drain coolant.
 2. Remove coolant hoses.
 3. Drain oil.
 4. Remove oil filter.
 5. Remove oil cooler.
 6. Install oil filter.
- When installing the oil cooler bracket gasket, align the hole and the protrusion on the cylinder block.
 - Always replace with new gasket.



SLC640

Inspection

OIL PRESSURE RELIEF VALVE

Inspect it for smooth operation by pushing the ball.

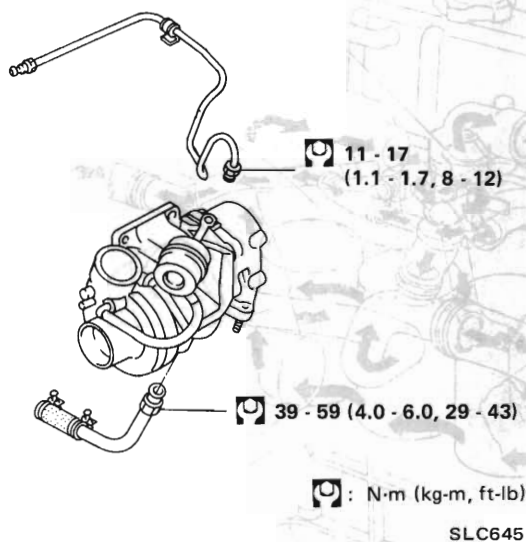
Body to outer gear	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent	0.12 - 0.23 (0.0047 - 0.0091)
Outer gear to crescent	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear	0.08 - 0.09 (0.0030 - 0.0035)
Housing to outer gear	0.09 - 0.11 (0.0035 - 0.0043)

ENGINE LUBRICATION SYSTEM— Lubricating Oil Passage for Turbocharger

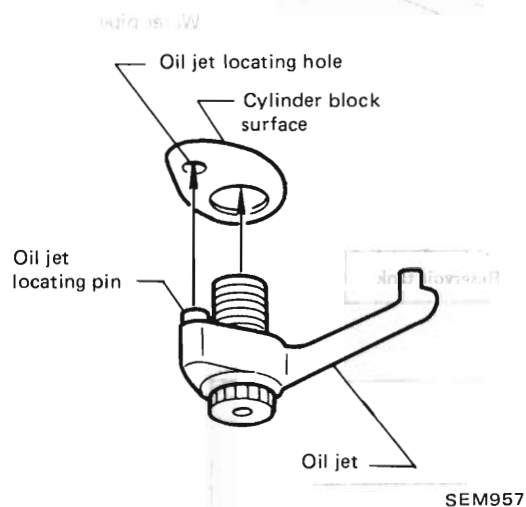
Disassembly and Assembly

LUBRICATING OIL PASSAGE

After installation, run engine for a few minutes and check for leaks.



OIL JET

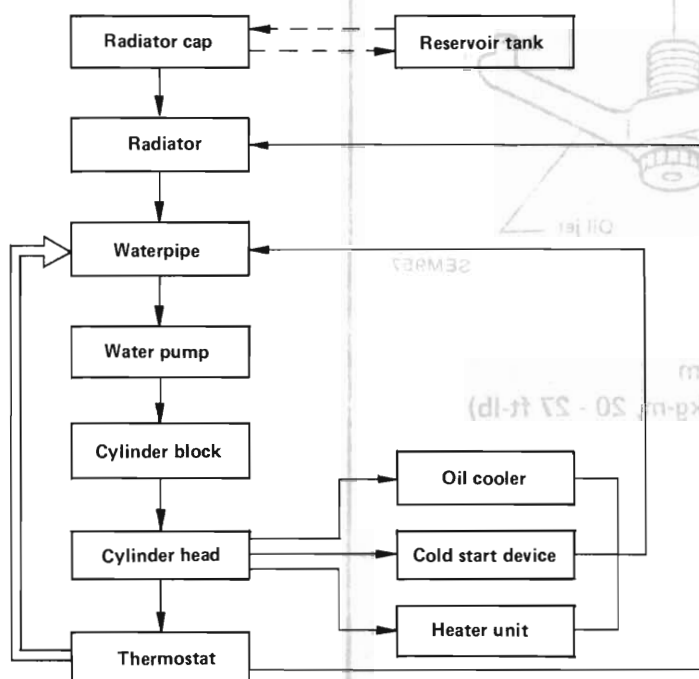
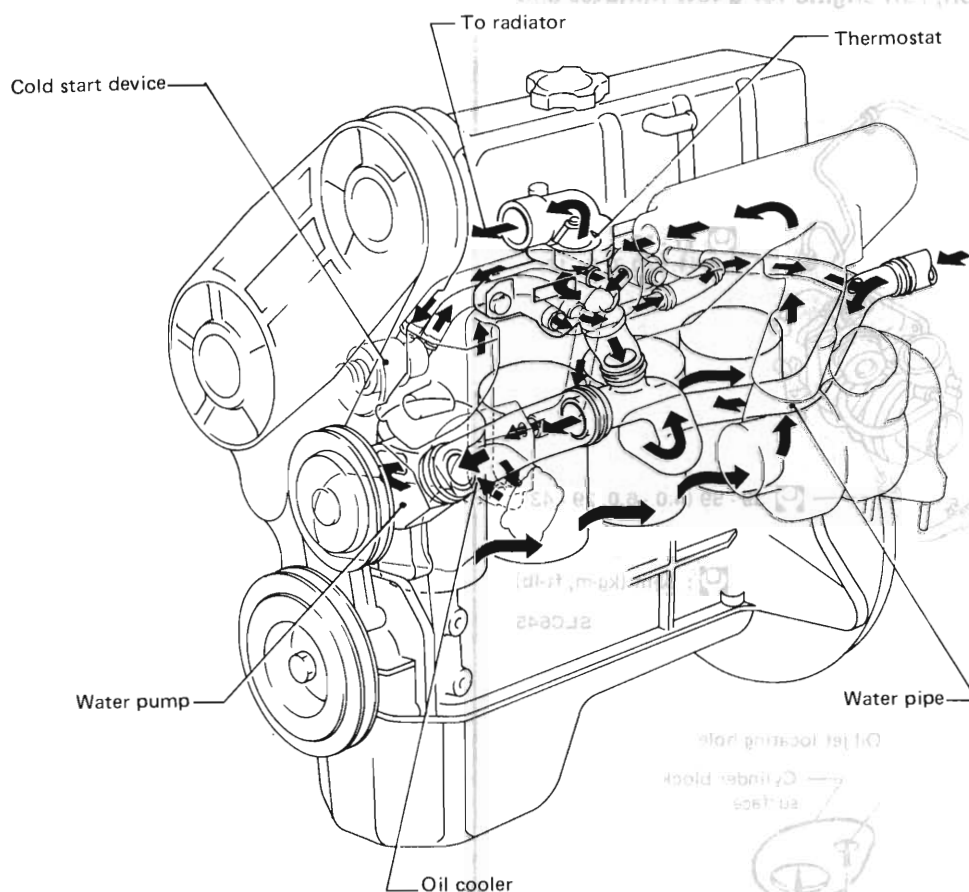


: Oil jet
26 - 36 N·m
(2.7 - 3.7 kg-m, 20 - 27 ft-lb)

COOLING SYSTEM

Cooling Circuit

To avoid the danger of being scalded, never attempt to drain coolant when engine is hot.
Always replace with new gasket and O-ring.



← : By-pass passage

SLC646

COOLING SYSTEM

Changing Engine Coolant

Checking Cooling System

Refer to changing Engine Coolant in section MA.

WARNING:

Never remove the radiator cap when the engine is hot, serious burns could be caused by high pressure fluid escaping from the radiator.

Wrap a thick cloth around the cap and carefully remove the cap by turning it a quarter turn to allow built-up pressure to escape and then turn the cap all the way off.

CHECKING COOLING SYSTEM HOSES

Refer to checking cooling system hoses in section MA.

CHECKING COOLING SYSTEM FOR LEAKS

Refer to Checking Cooling System for Leaks in section MA.

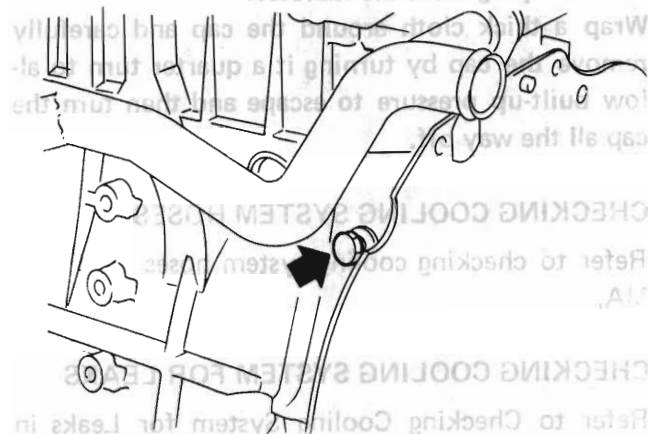
CHECKING RADIATOR CAP

Refer to Checking Radiator Cap in section MA.

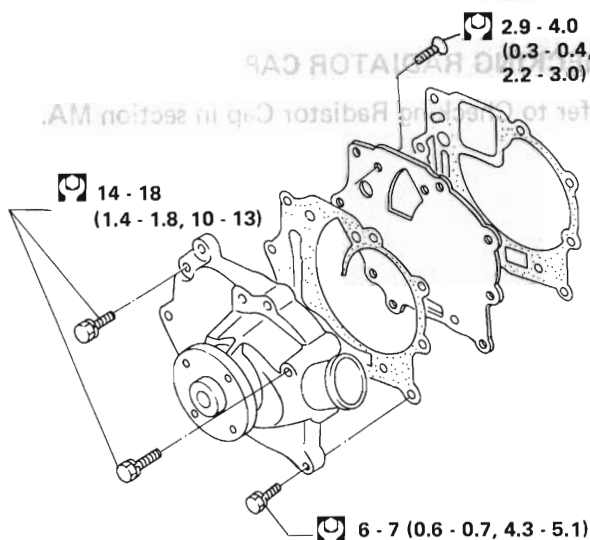
COOLING SYSTEM—Water Pump

Disassembly and Assembly (On-vehicle service)

Drain coolant from drain plugs on cylinder block and on radiator.



SMA890A



: N·m (kg-m, ft-lb)

SLC647

Water pump cannot be disassembled and should be replaced as a unit. Always replace with new gasket. After installing water pump, connect hose and clamp securely, then check for leaks using cap tester.

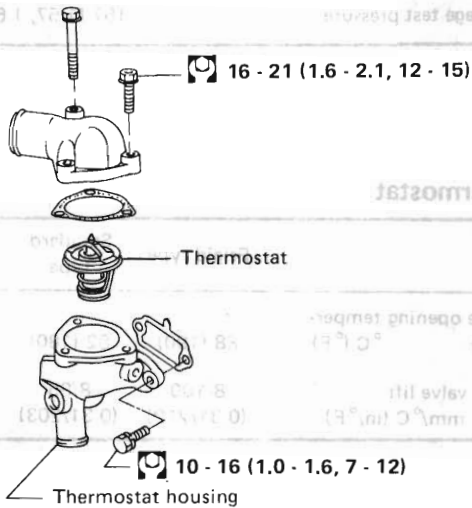
Inspection

Check for excessive end play and rough operation.

COOLING SYSTEM—Thermostat

Disassembly and Assembly

Drain coolant from drain plugs on cylinder block side and on radiator.



: N·m (kg·m, ft·lb)

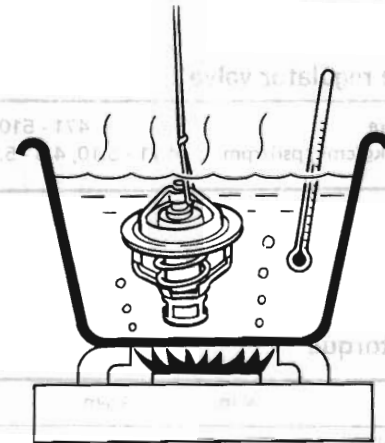
SLC648

Always replace with new gasket. After installation, run engine for a few minutes and check for leaks.

Inspection

1. Check the valve seating at ordinary temperatures. It should seat tightly.
2. Check valve opening temperature and maximum valve lift.

	Frigid type	Standard type	Tropical type
Valve opening temperature °C (°F)	88 (190)	82 (180)	76.5 (170)
Maximum valve lift mm/°C (in/°F)	8/100 (0.31/212)	8/95 (0.31/203)	8/90 (0.31/194)



SLC556

3. Then check if valve closes at 5°C (9°F) below valve opening temperature.

SERVICE DATA AND SPECIFICATIONS

Engine Lubrication System

Oil pressure check

Engine rpm	Approximate discharge pressure kPa (bar, kg/cm ² , psi)
600	98 (1.0, 1, 14)
2,000	294 (2.9, 3, 43)
5,000	392 (3.9, 4, 57)

Oil pump

Unit: mm (in)

Body to outer gear clearance ①	0.11 - 0.20 (0.0043 - 0.0079)
Inner gear to crescent clearance ②	0.12 - 0.23 (0.0047 - 0.0091)
Outer gear to crescent clearance ③	0.21 - 0.32 (0.0083 - 0.0126)
Housing to inner gear clearance ④	0.05 - 0.09 (0.0020 - 0.0035)
Housing to outer gear clearance ⑤	0.05 - 0.11 (0.0020 - 0.0043)

Oil pressure regulator valve

Opening pressure	471 - 510
kPa (bar, kg/cm ² , psi)/rpm	(4.71 - 5.10, 4.8 - 5.2, 68 - 74)

Tightening torque

Unit	N·m	kg·m	ft-lb
Oil pump securing bolt			
M6	6 - 7	0.6 - 0.7	4.3 - 5.1
M8	14 - 18	1.4 - 1.8	10 - 13
Oil pump cover screw	4 - 5	0.4 - 0.5	2.9 - 3.6
Regulator valve cap bolt	39 - 49	4 - 5	29 - 36
Oil strainer bolt	16 - 21	1.6 - 2.1	12 - 15
Oil pressure switch	10 - 16	1.0 - 1.6	7 - 12
Turbocharger			
Oil inlet tube to cylinder block	11 - 17	1.1 - 1.7	8 - 12
Oil inlet tube to turbocharger	11 - 17	1.1 - 1.7	8 - 12
Oil outlet pipe to turbocharger	39 - 59	4.0 - 6.0	29 - 43
Oil jet	30 - 40	3.1 - 4.1	22 - 30

Engine Cooling System

Radiator

kPa (bar, kg/cm², psi)

Cap relief pressure	88 (0.88, 0.9, 13)
Leakage test pressure	157 (1.57, 1.6, 23)

Thermostat

	Frigid type	Standard type	Tropical type
Valve opening temperature °C (°F)	88 (190)	82 (180)	76.5 (170)
Max. valve lift mm/°C (in/°F)	8/100 (0.31/212)	8/95 (0.31/203)	8/90 (0.31/194)

Tightening torque

Unit	N·m	kg·m	ft-lb
Water pump bolt			
M6	6 - 7	0.6 - 0.7	4.3 - 5.1
M8	14 - 18	1.4 - 1.8	10 - 13
Water pump pulley bolt	6 - 10	0.6 - 1.0	4.3 - 7.2
Thermostat housing	10 - 16	1.0 - 1.6	7 - 12
Water outlet bolt	16 - 21	1.6 - 2.1	12 - 15

ENGINE FUEL

SECTION EF

CONTENTS

INJECTION SYSTEM	EF- 2
INJECTION PUMP	EF- 4
INJECTION NOZZLE ASSEMBLY	EF-49
BLEEDING FUEL SYSTEM	EF-56
TURBOCHARGER	EF-57

INJECTION SYSTEM

CAUTION:

- Disassembly and assembly of the injection pumps should be done only in service shops authorized by NISSAN or by the pump manufacturer.
- The pump tester is required for servicing the pump.
- Before removing fuel injection pump from vehicle, check closely to make sure that it is definitely malfunctioning.

Refer to Trouble-shooting in section MA.

EF-3
EF-4
EF-4B
EF-5B
EF-5V

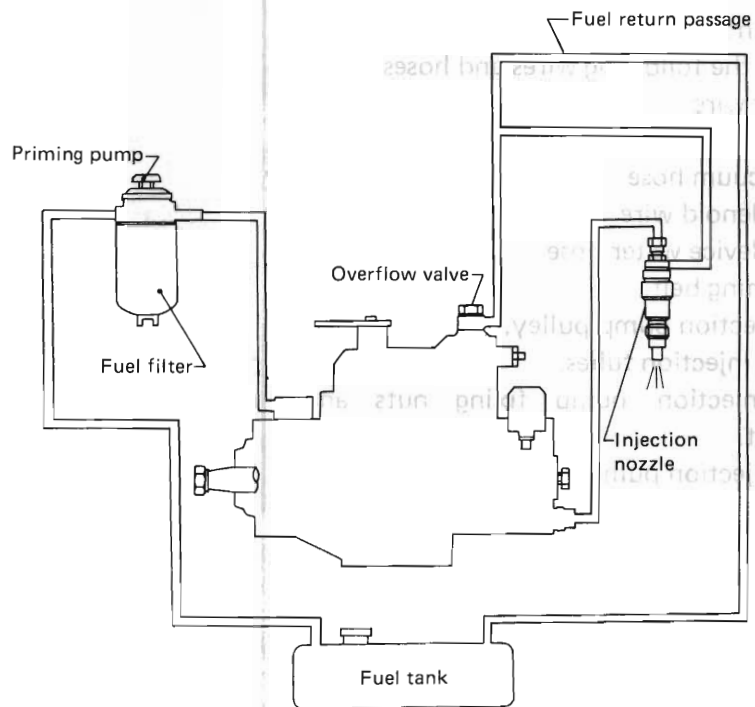


CONTENTS

INJECTION SYSTEM
INJECTION PUMP ..
INJECTION NOZZLE ASSEMBLY
BLEEDING FUEL SYSTEM
TURBOCHARGER ..

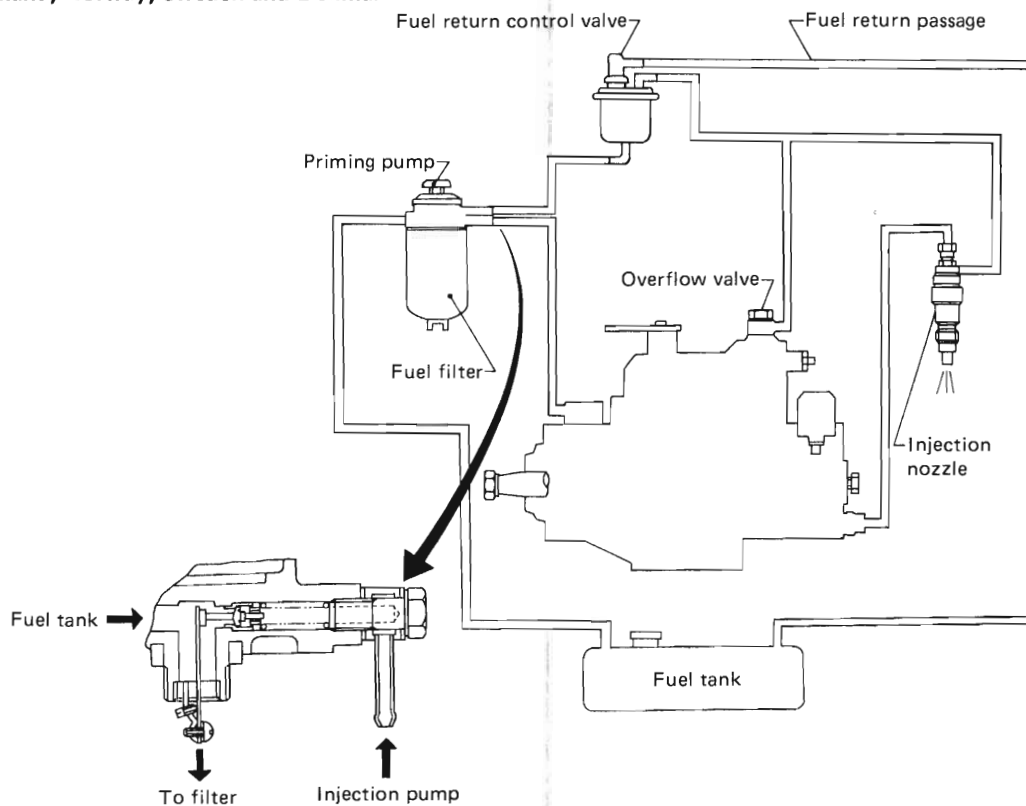
INJECTION SYSTEM

Fuel System



SEF953B

Only for Finland, Norway, Sweden and Denmark

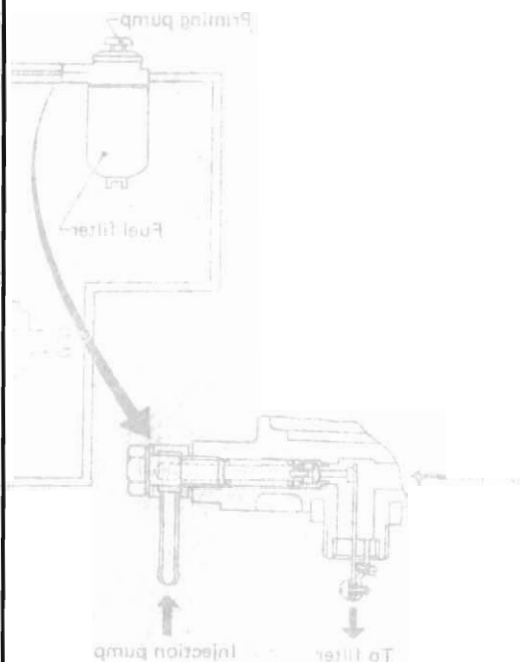
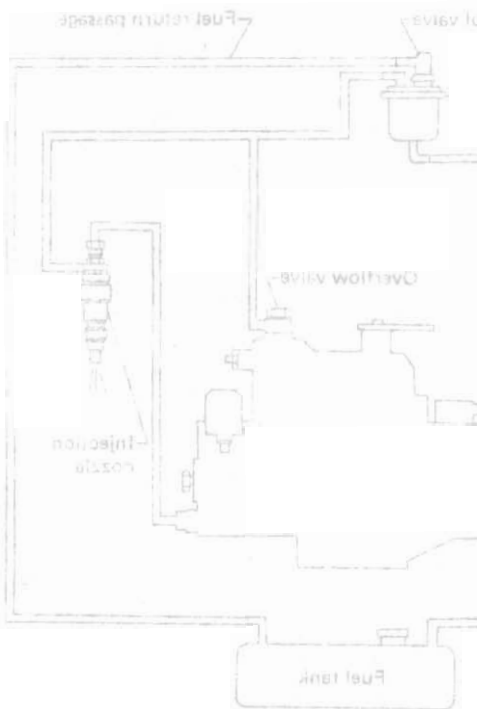
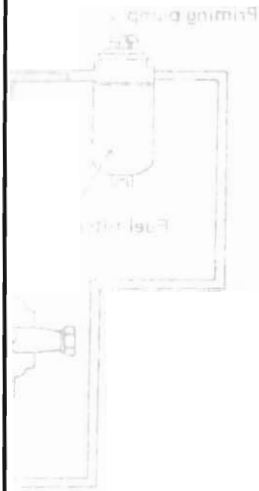
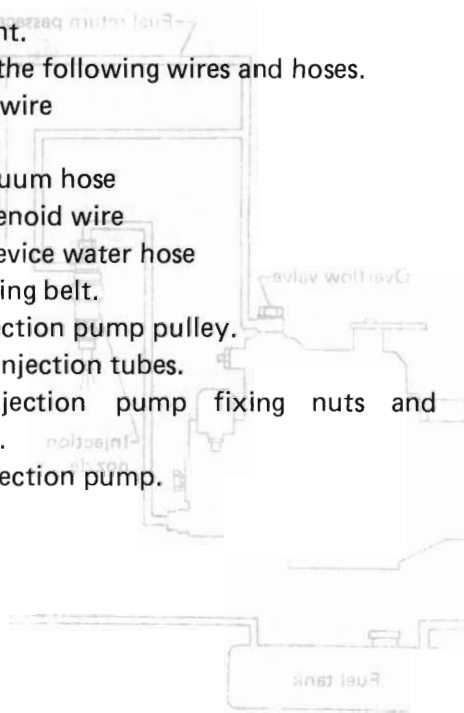


SEF954B

INJECTION PUMP

Removal

1. Drain coolant.
2. Disconnect the following wires and hoses.
 - Accelerator wire
 - Fuel hose
 - F.I.C.D. vacuum hose
 - Fuel cut solenoid wire
 - Cold start device water hose
3. Remove timing belt.
4. Remove injection pump pulley.
5. Remove all injection tubes.
6. Remove injection pump fixing nuts and bracket bolt.
7. Take out injection pump.

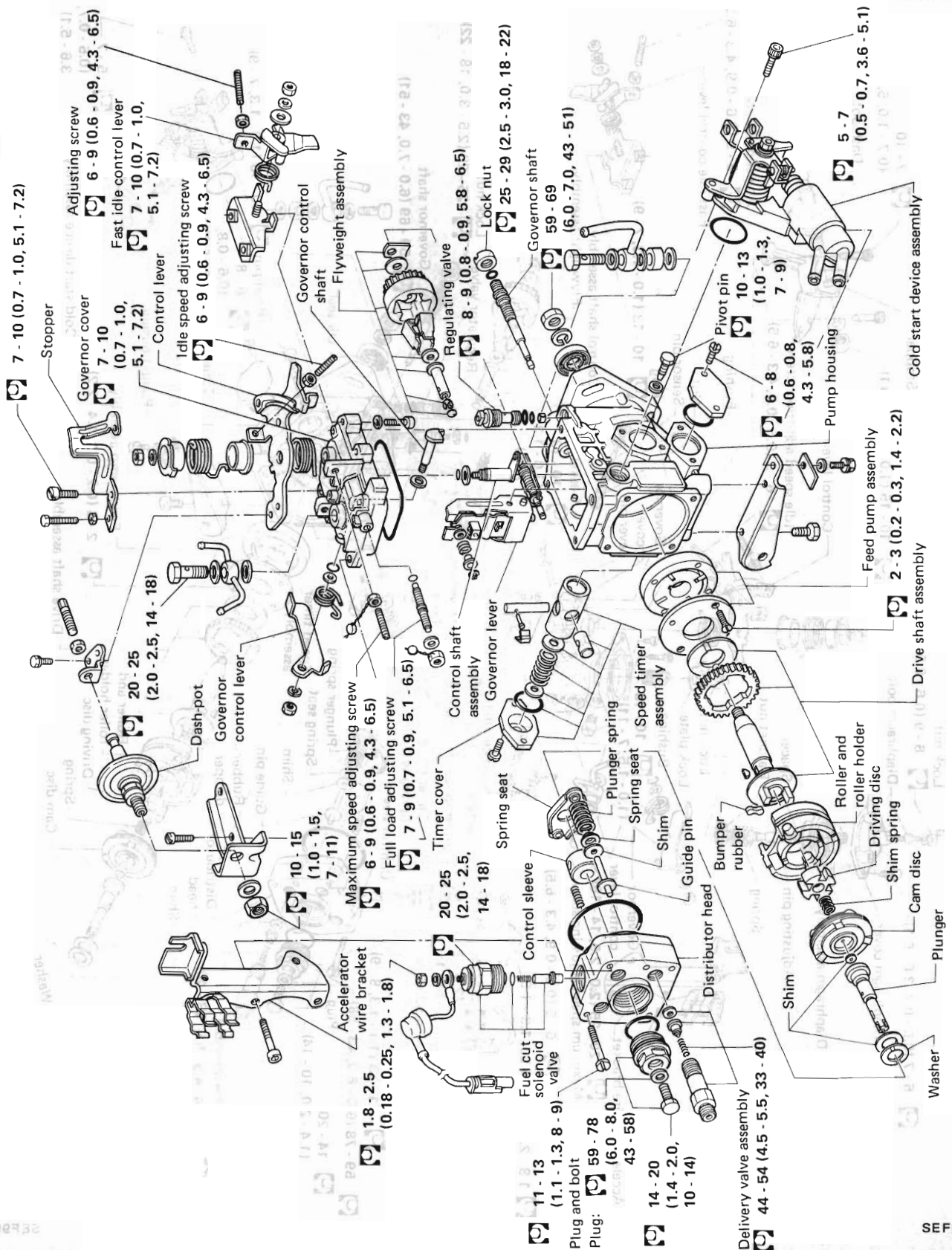


Only for Finland, Norway, Sweden and Denmark

INJECTION PUMP

Disassembly

Non-turbo model



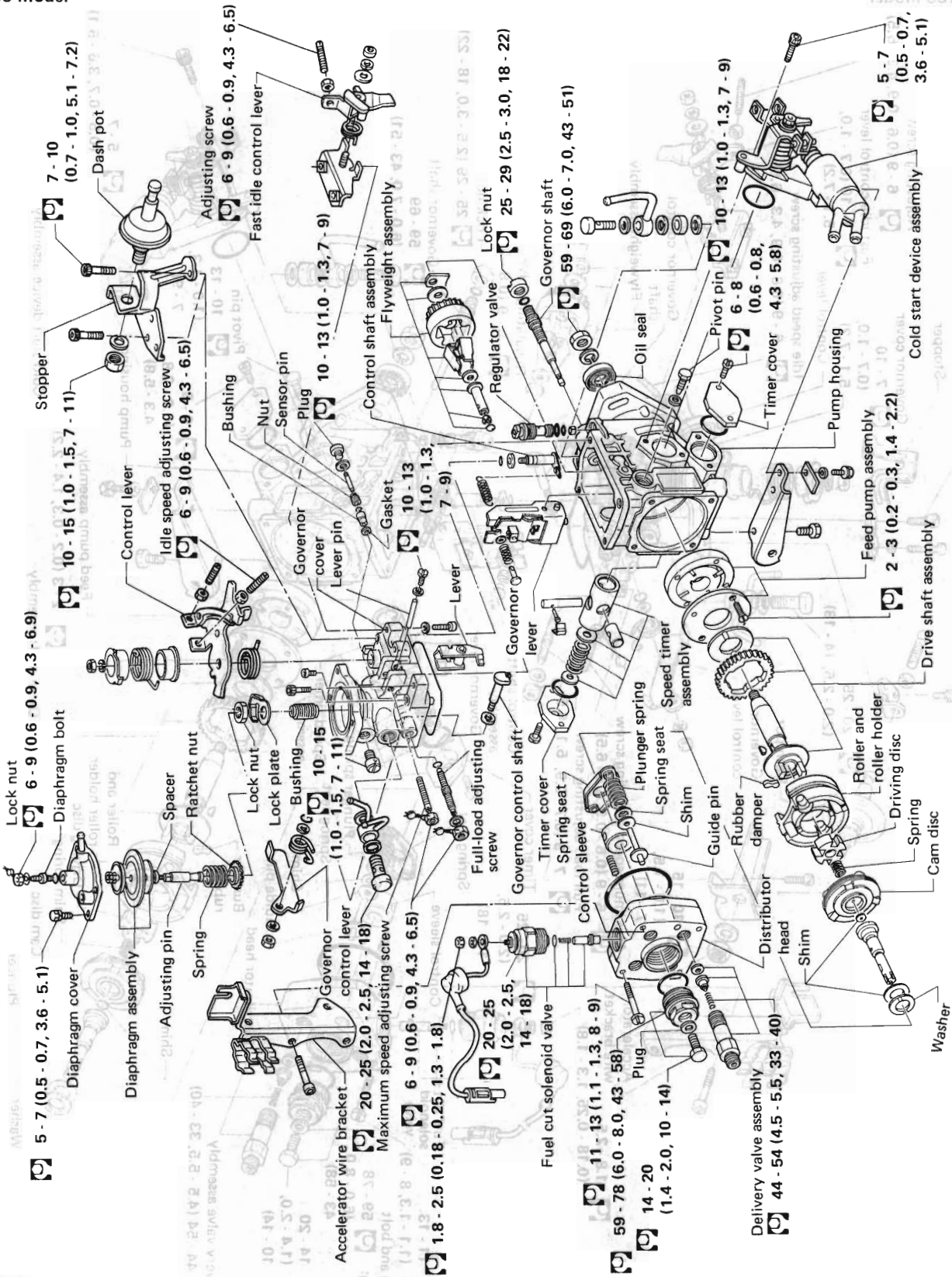
: N-m (kg-m, ft-lb)

SEF955B

INJECTION PUMP

Disassembly (Cont'd)

Turbo model



: N-m (kg-m, ft-lb)

SEF956B

INJECTION PUMP

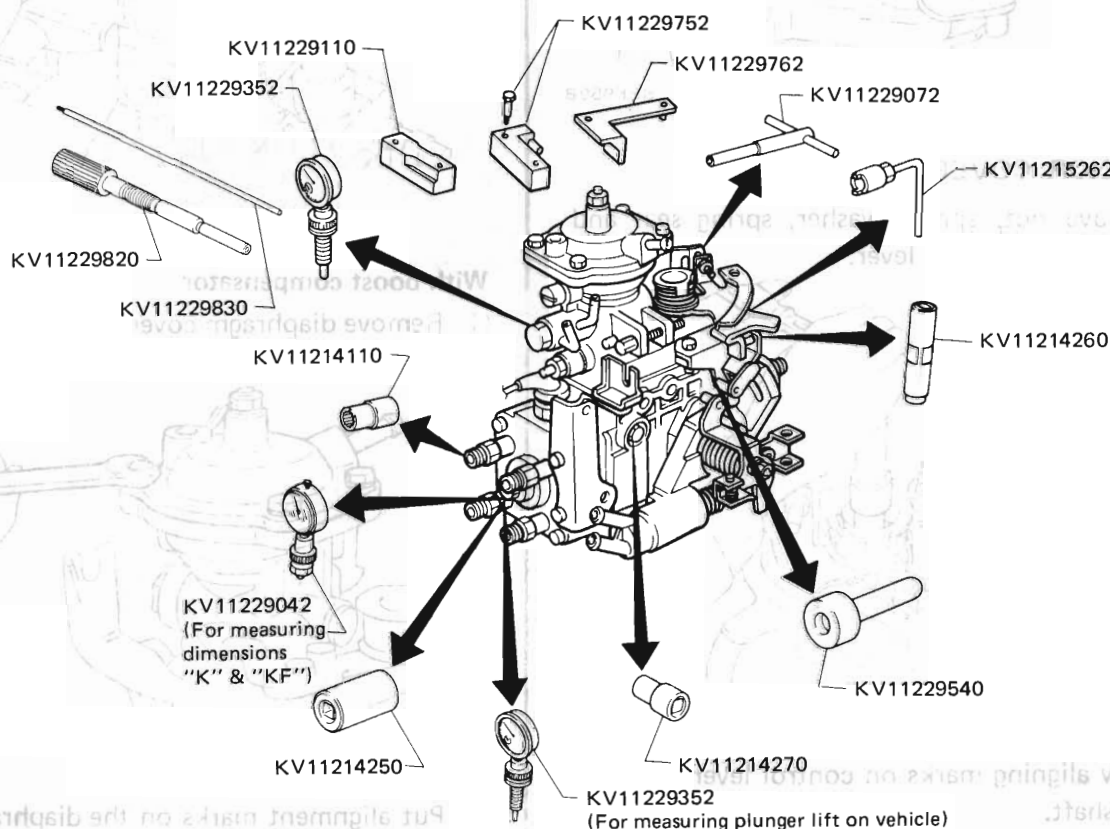
Disassembly (Cont'd)

PREPARATION

- Before performing disassembly and adjustment, test fuel injection pump and note test results except when testing is impossible.
- Prior to beginning to disassemble fuel injection pump, clean all dust and dirt from its exterior.

- Disconnect overflow valve, and drain fuel.
- Clean work bench completely, removing all foreign matter.
- Collect only those service tools necessary for disassembling and reassembling.
- Be careful not to bend or scratch any parts.

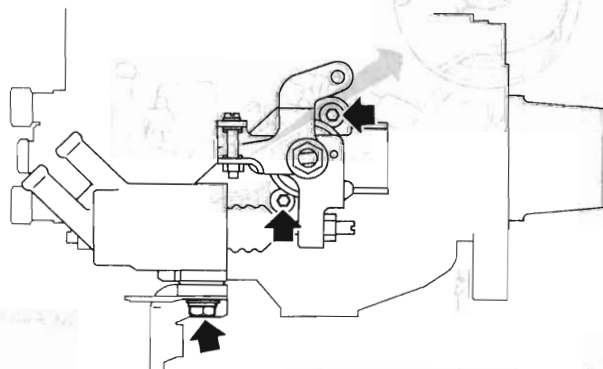
Special tools for disassembling and reassembling fuel injection pump.



SEF957B

COLD START DEVICE

Remove cold start device assembly.

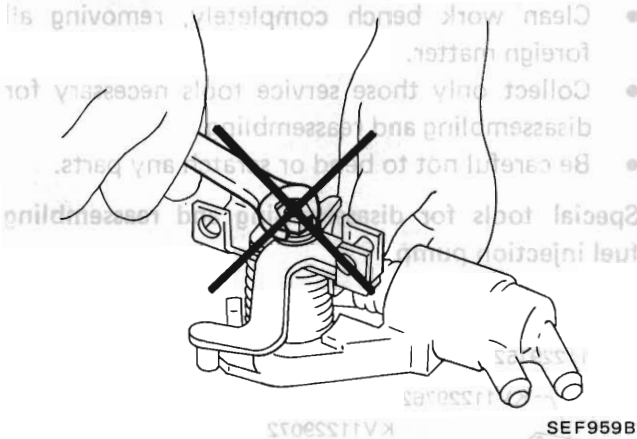


SEF958B

INJECTION PUMP

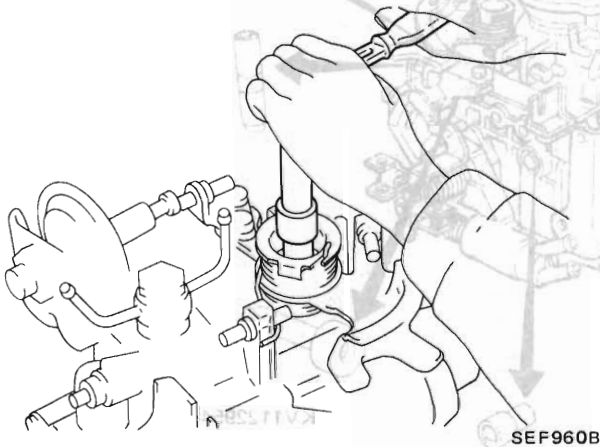
Disassembly (Cont'd)

Never disassemble the cold start device linkage.

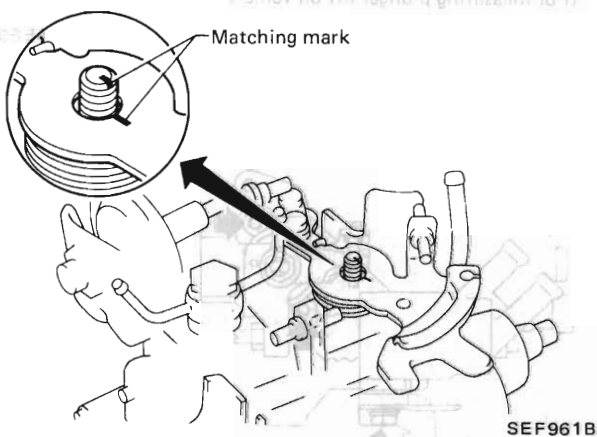


GOVERNOR COVER

1. Remove nut, spring washer, spring seat and spring from control lever.



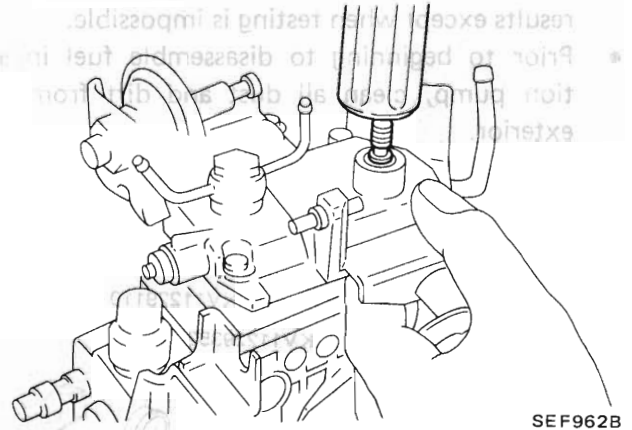
2. Draw aligning marks on control lever and control shaft.



3. Without boost compensator

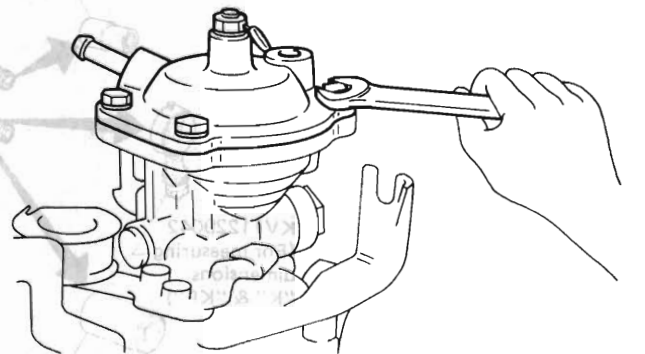
Remove governor cover.

Move control shaft down by lightly tapping on the end with a wooden mallet.

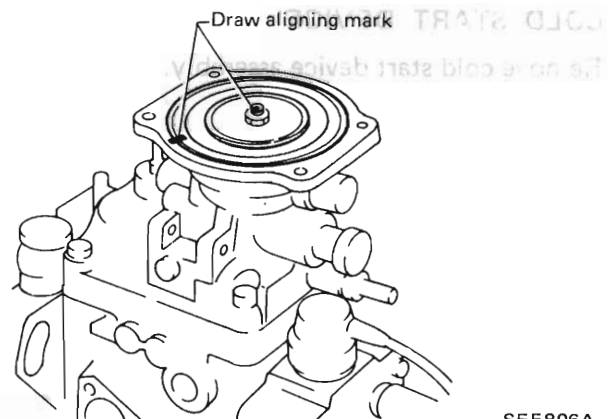


With boost compensator

- (1) Remove diaphragm cover.



- (2) Put alignment marks on the diaphragm, adjusting pin and governor cover.

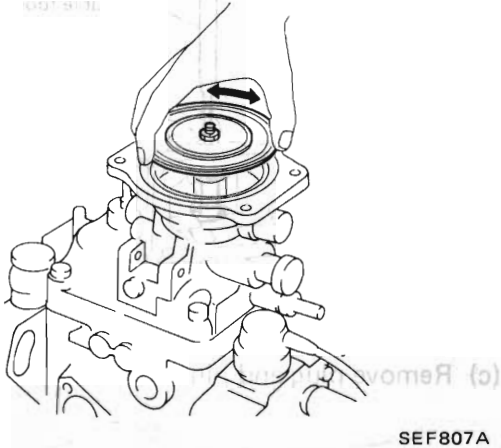


INJECTION PUMP

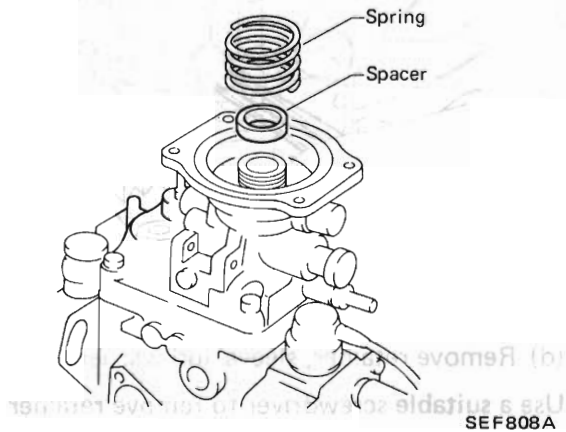
Disassembly (Cont'd)

(3) Remove the diaphragm assembly.

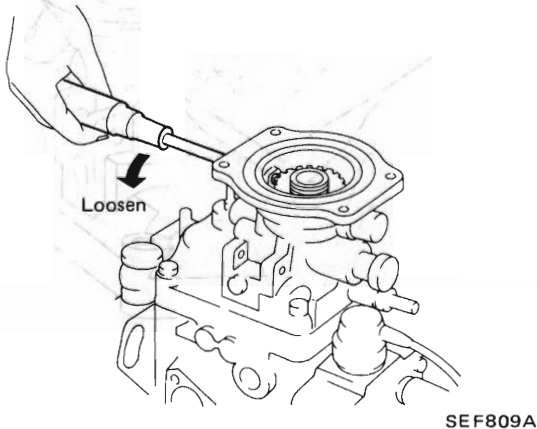
Rotate the diaphragm to locate the position from which it is withdrawn.



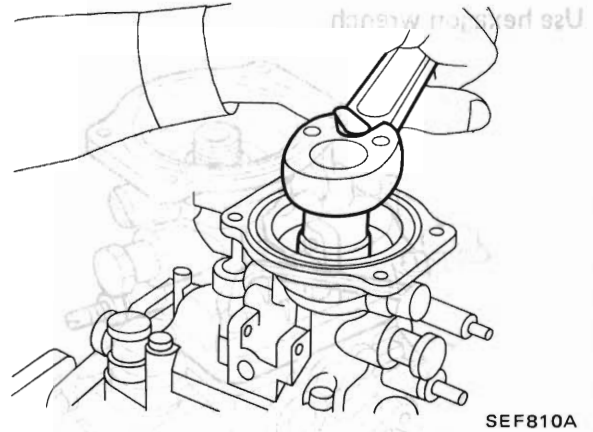
(4) Remove boost compensator spring and spacer.



(5) Remove the ratchet nut.

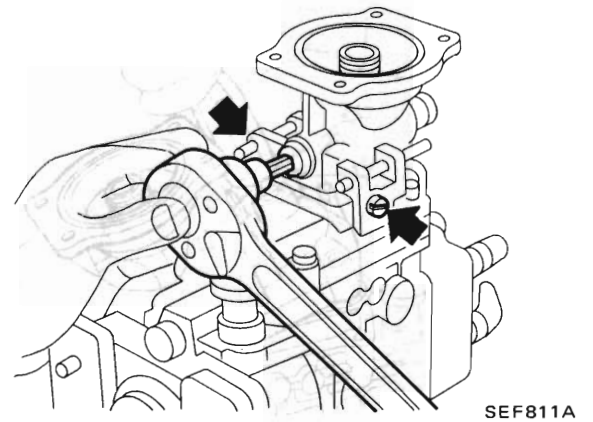


(6) Remove lock nut and lock plate.



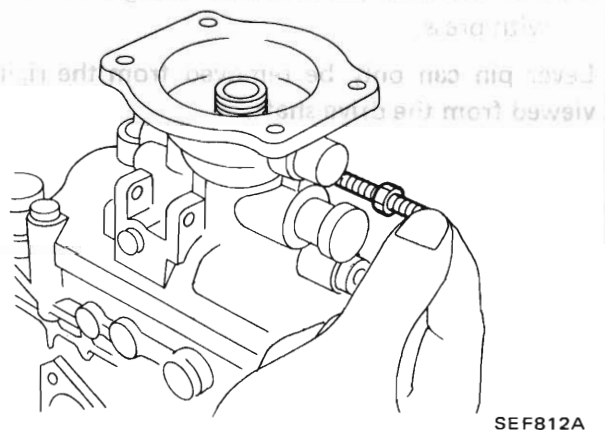
Use a redesigned socket to prevent interference with the housing. [Outer diameter 31 mm (1.22 in)]

(7) Remove governor cover plugs.



(8) Remove governor cover.

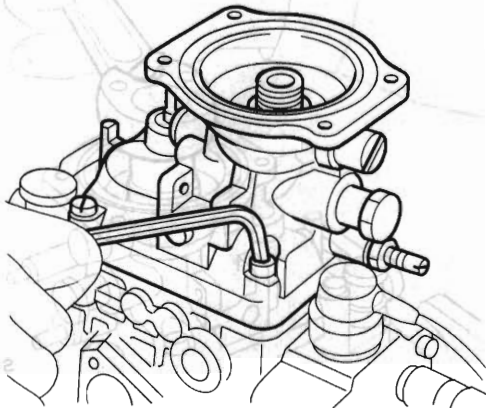
(a) Remove sealing wire and maximum speed adjusting screws.



INJECTION PUMP

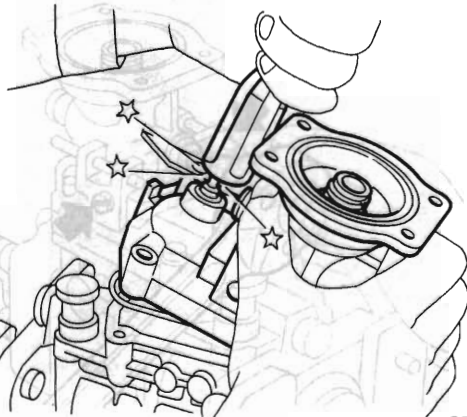
Disassembly (Cont'd)

- (b) Remove governor cover fixing bolts and screws.
Use hexagon wrench.



SEF835A

- (c) Move control shaft down by lightly tapping on the end with a wooden mallet.



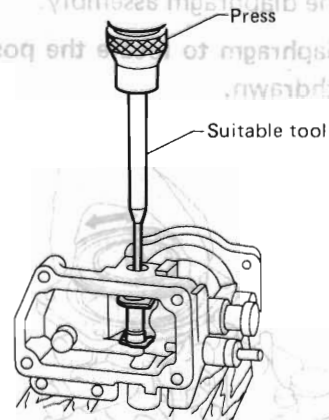
SEF836A

- (9) Remove boost compensator parts.
(a) Remove plugs.
(b) Remove lever pin and lever using suitable drift with press.

Lever pin can only be removed from the right as viewed from the drive shaft.

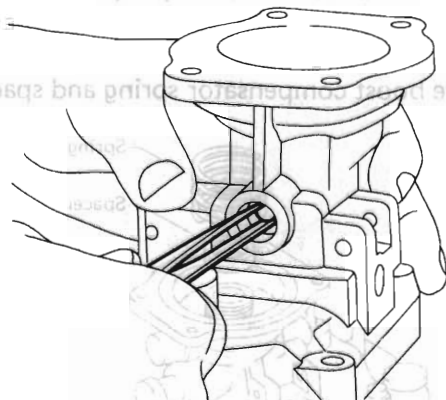


SEF812A



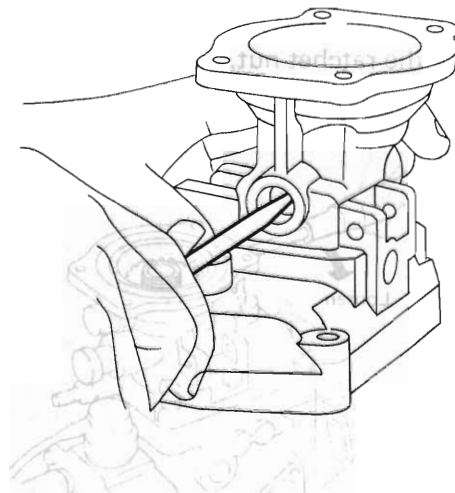
SEF837A

- (c) Remove plug and pin.



SEF420A

- (d) Remove retainer, sleeve and washer.
Use a suitable screwdriver to remove retainer.



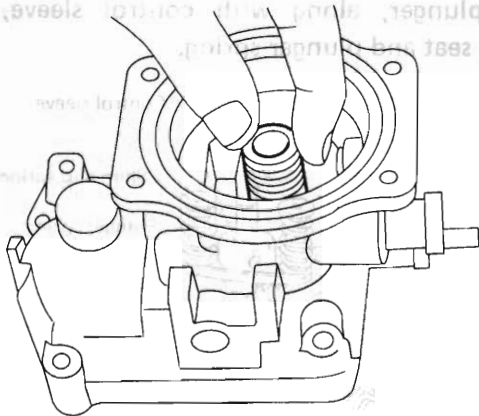
SEF421A

SEF833A

INJECTION PUMP

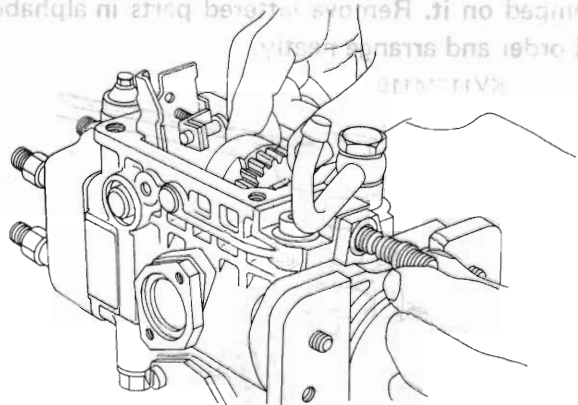
Disassembly (Cont'd)

- (e) Remove bushing.



SEF423A

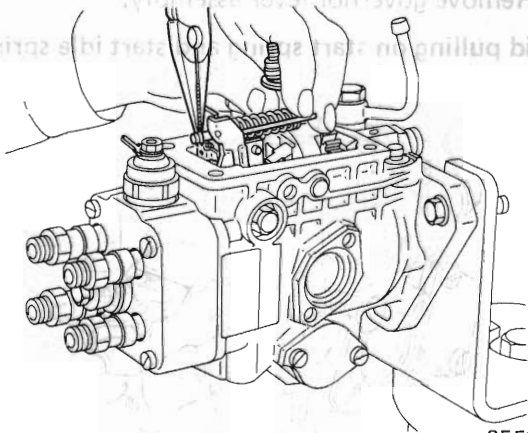
3. Remove governor sleeve, washer and flyweight, along with flyweight holder, then remove washer and shim(s).



SEF978B

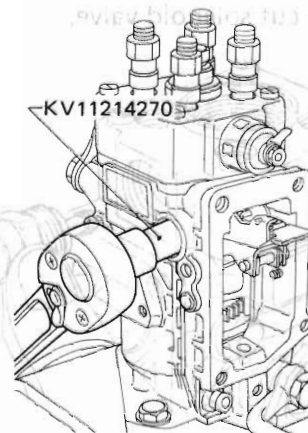
INTERNAL PARTS

1. Remove control shaft from tension lever.



SEF964B

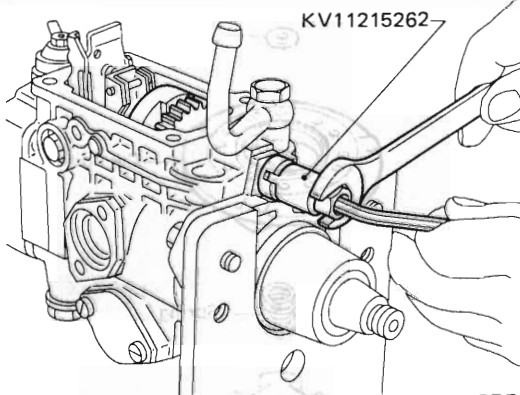
4. Loosen left and right governor pivot bolts.



SEF979B

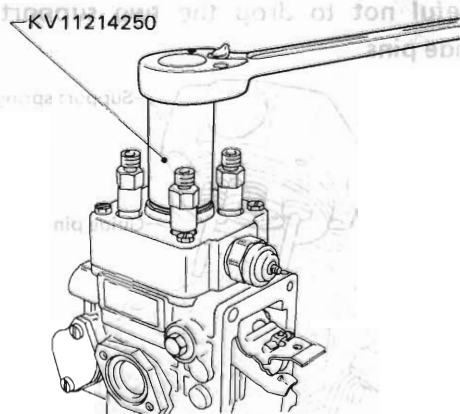
2. Remove governor shaft.

Loosen lock nut by turning it clockwise.



SEF965B

5. Remove plug.



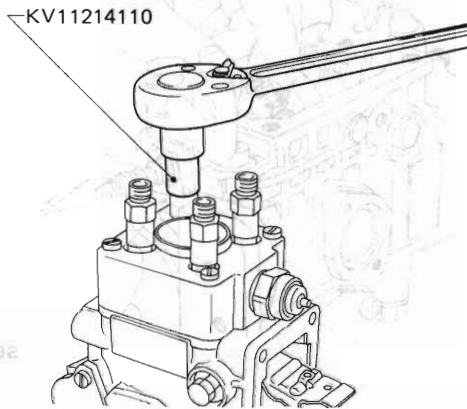
SEF033A

INJECTION PUMP

Disassembly (Cont'd)

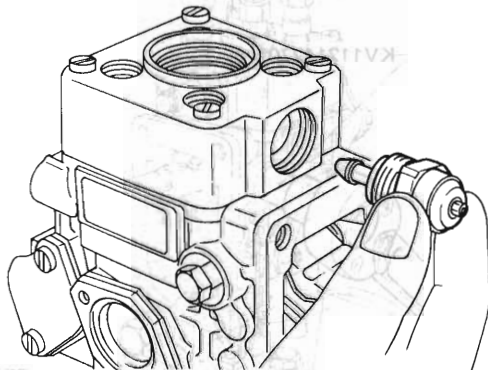
6. Remove delivery valve holder, spring, delivery valve and gasket.

Distributor head has letters (A, B, C and D) stamped on it. Remove lettered parts in alphabetical order and arrange neatly.



SEF034A

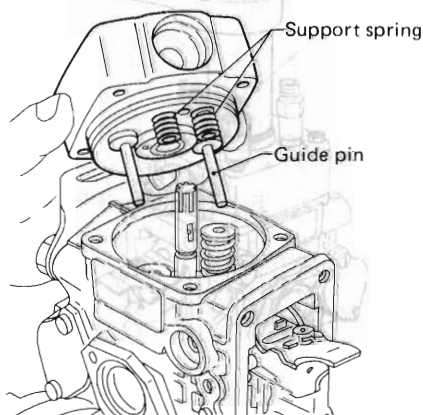
7. Remove fuel cut solenoid valve.



SEF035A

8. Remove distributor head.

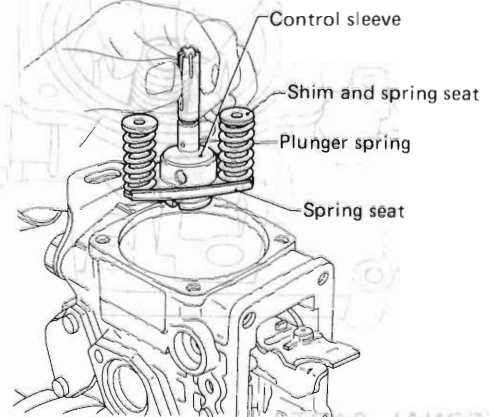
Be careful not to drop the two support springs and guide pins.



SEF475

9. Remove plunger assembly.

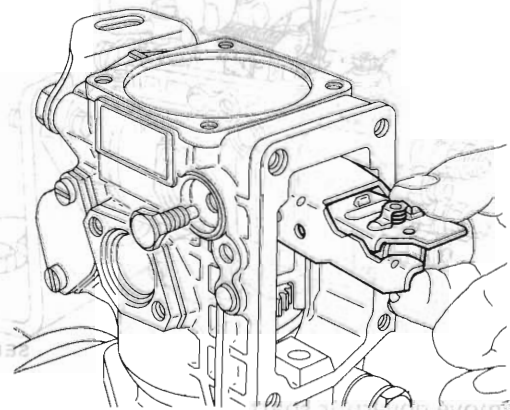
Lift plunger, along with control sleeve, shim, spring seat and plunger spring.



SEF476

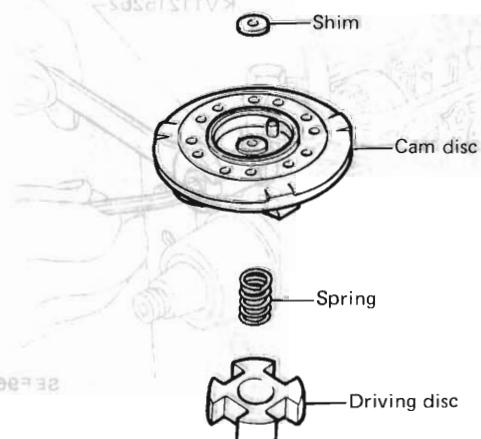
10. Remove governor lever assembly.

Avoid pulling on start spring and start idle spring.



SEF477

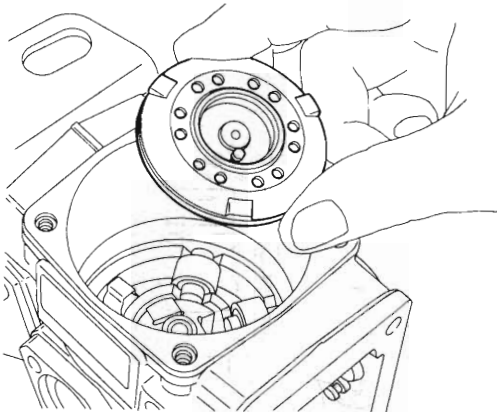
11. Remove shim, cam disc, spring and driving disc.



SEF478

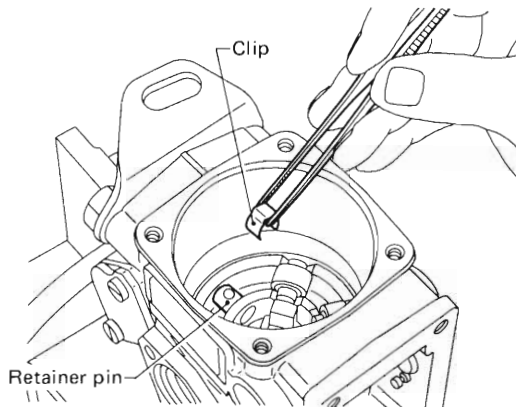
INJECTION PUMP

Disassembly (Cont'd)



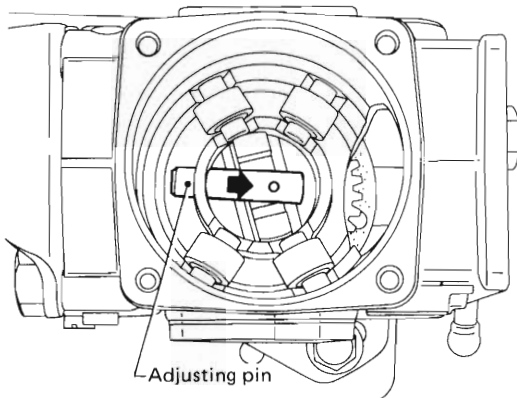
SEF479

12. Remove clips and pins.



SEF480

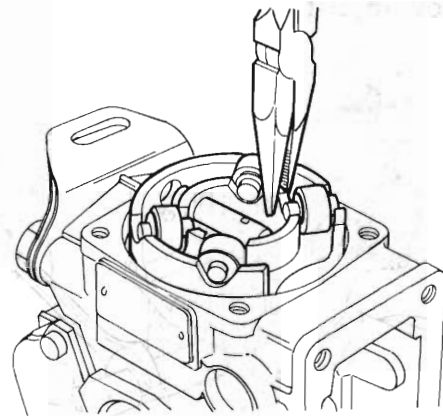
13. Move adjusting pin to center of roller holder, as shown.



SEF481

14. Lift out roller holder with rollers without tilting.

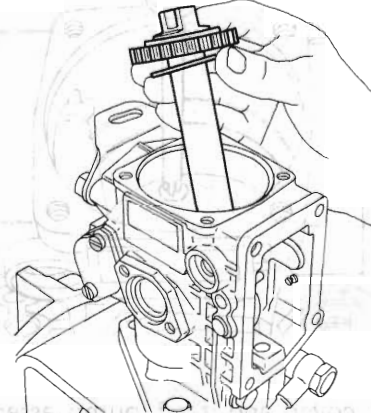
Be careful not to drop rollers.



SEF482

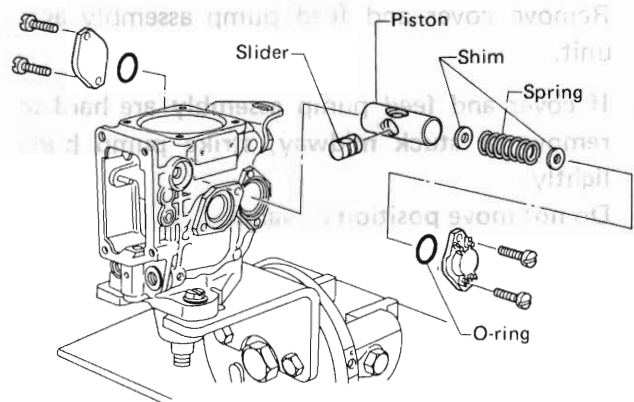
15. Remove drive shaft.

- a. Be careful not to scratch inner surface of fuel injection pump body.
- b. Use care to avoid dropping key.



SEF483

16. Remove speed timer cover, O-ring, shims, spring, piston and slider.

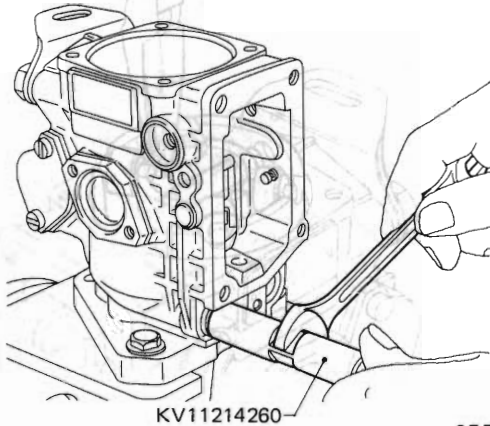


SEF513

INJECTION PUMP

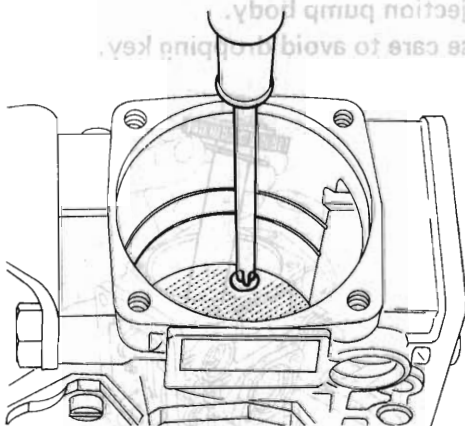
Disassembly (Cont'd)

17. Remove regulating valve.



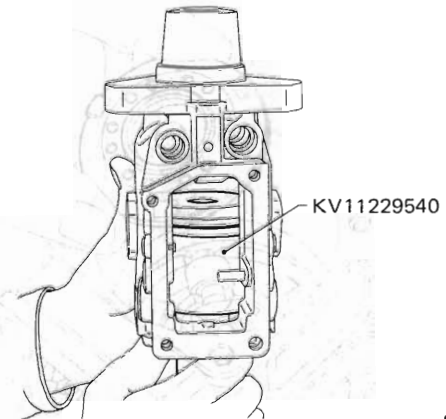
SEF485

18. Loosen screw from feed pump cover.

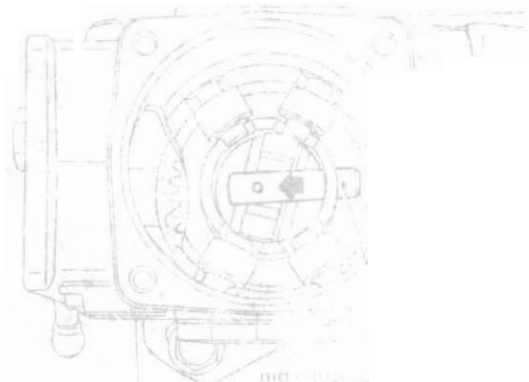


19. Remove cover and feed pump assembly as a unit.

- 1) Insert Tool into fuel injection pump housing.
- 2) Turn injection pump's top side down, as shown.
- 3) Remove cover and feed pump assembly as a unit.
- a. If cover and feed pump assembly are hard to remove or stuck midway, strike pump body lightly.
- b. Do not move position of vanes.



SEF487



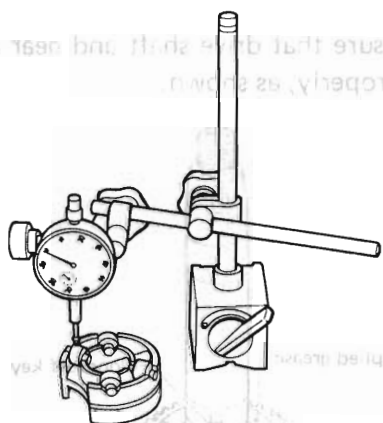
INJECTION PUMP

Inspection

It should be noted that the following service part assemblies should always be replaced as a unit.

- Distributor head, control sleeve and plunger
 - Feed pump assembly (rotor and vanes with eccentric ring)
 - Plunger spring kit
 - Roller assembly
 - Flyweight kit
 - Governor lever assembly
1. Wash all parts completely.
 2. Replace worn or damaged parts.
 3. Control edge of plunger must be sharp and contact surfaces must not exhibit any noticeable running tracks. If such is not the case, replace plunger.
 4. Check for height of all rollers.

Difference in max. and min. roller height should be less than 0.02 mm (0.0008 in).

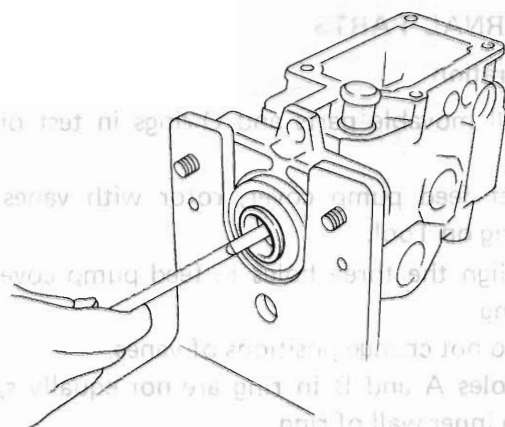


SEF504

5. Check oil seal for worn or folded over sealing lip and fuel leakage. If necessary, replace it with new one.

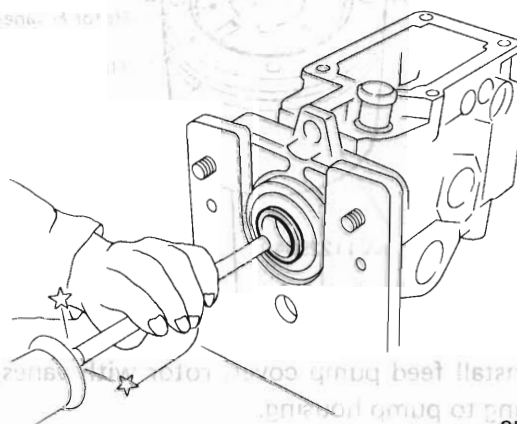
Replacement of oil seal

1. Remove oil seal.



SEF788A

2. Apply grease to oil seal.
3. Install oil seal.



SEF789A

INJECTION PUMP

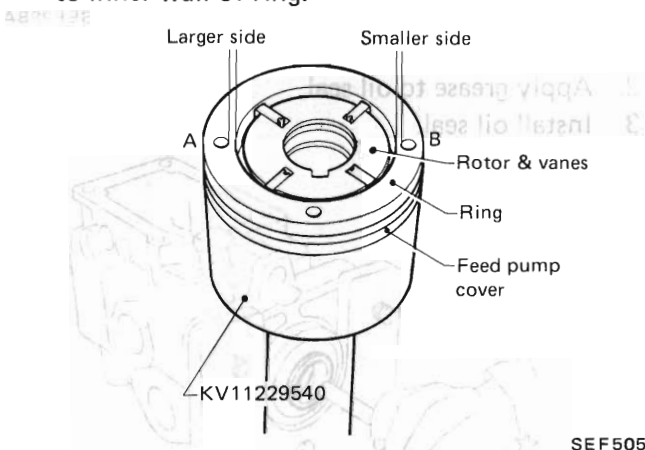
Assembly

INTERNAL PARTS

Preparation

Dip all movable parts and O-rings in test oil and clean.

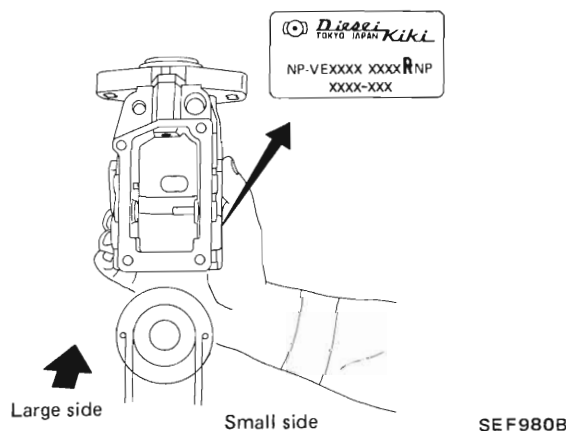
1. Set feed pump cover, rotor with vanes, and ring on Tool.
- 1) Align the three holes in feed pump cover and ring.
- 2) Do not change positions of vanes.
- 3) Holes A and B in ring are not equally spaced to inner wall of ring.



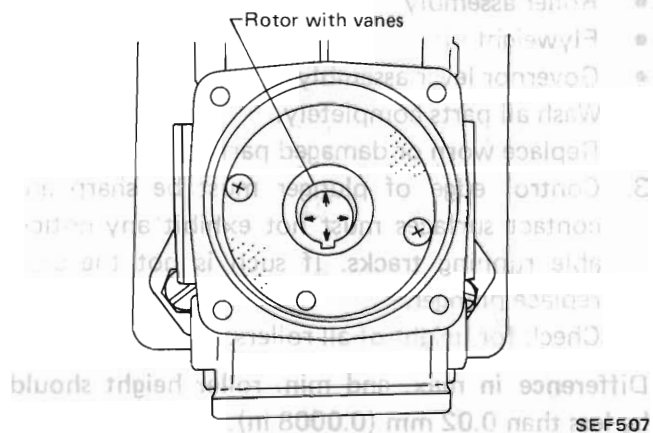
2. Install feed pump cover, rotor with vanes, and ring to pump housing.

Be careful to install liner correctly. If left and right are reversed, fuel will not be discharged from feed pump.

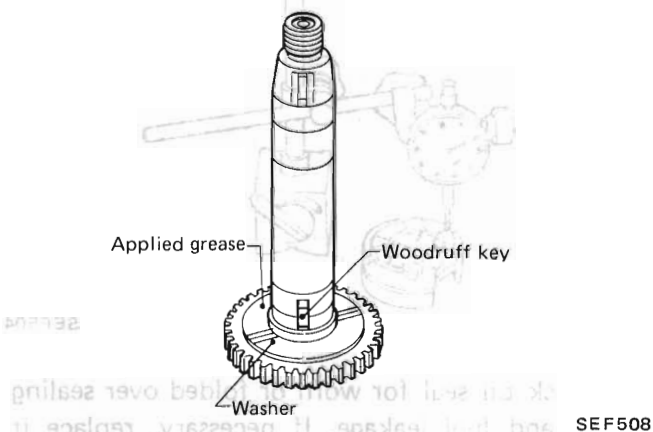
When fuel injection pump rotates in direction "R"



3. Turn fuel injection pump 180°, and remove Tool. Tighten screw to retain pump cover.
- a. **When tightening screws, be careful not to scratch inner wall of pump housing.**
- b. **After tightening screws, make sure that rotor with vanes moves smoothly.**



4. Make sure that drive shaft and gear are assembled properly, as shown.



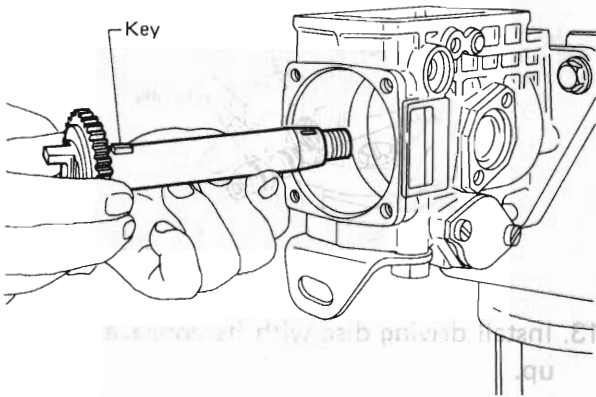
Do not forget bumper rubbers.

INJECTION PUMP

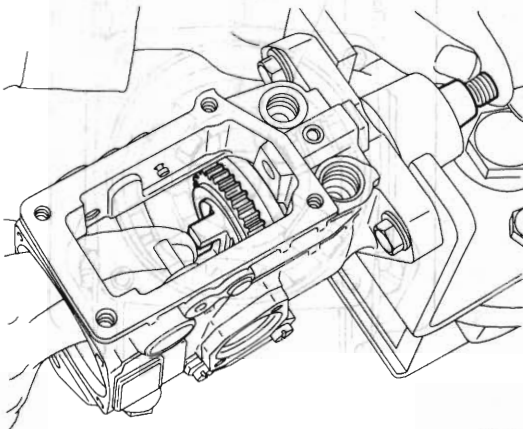
Assembly (Cont'd)

5. Install drive shaft to housing while key in drive shaft engages with key groove in rotor.

Be careful not to scratch oil seals and inner wall of housing.

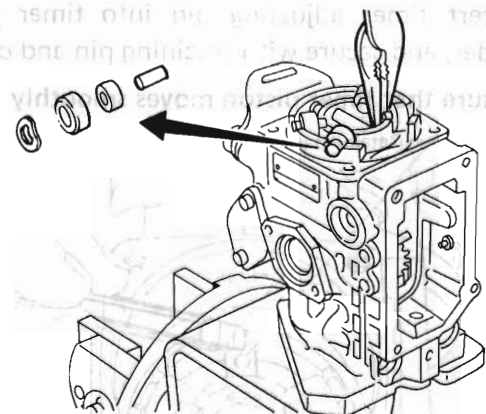


SEF494



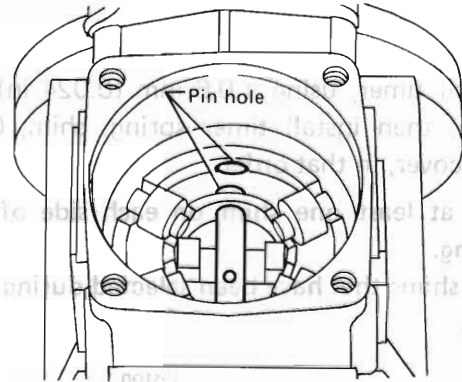
SEF495

6. Set drive shaft's nail parallel to timer.
7. Install roller and holder.
 - a. Do not interchange roller positions. If they are interchanged, refer to Inspection for correction.
 - b. Make sure that washer is situated outward of rollers.



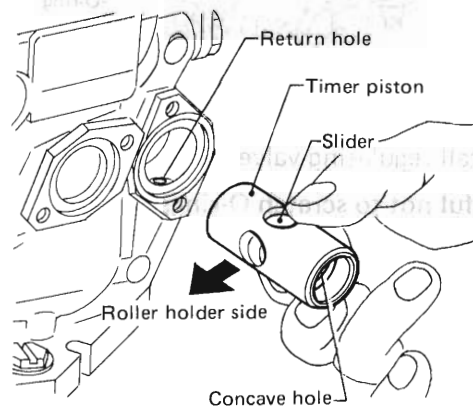
SEF509

8. Align holder and timer adjusting pin holes.



SEF510

9. Install timer piston and slider as a unit.
 - a. Make sure that hole in slider faces towards roller holder.
 - b. Make sure that concave hole in piston is on same side as return hole.



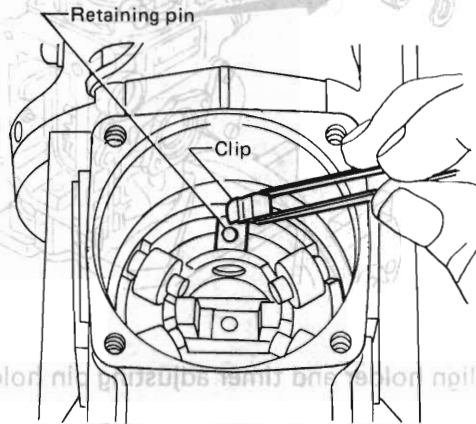
SEF511

INJECTION PUMP

Assembly (Cont'd)

10. Insert timer adjusting pin into timer piston slider, and secure with retaining pin and clip.

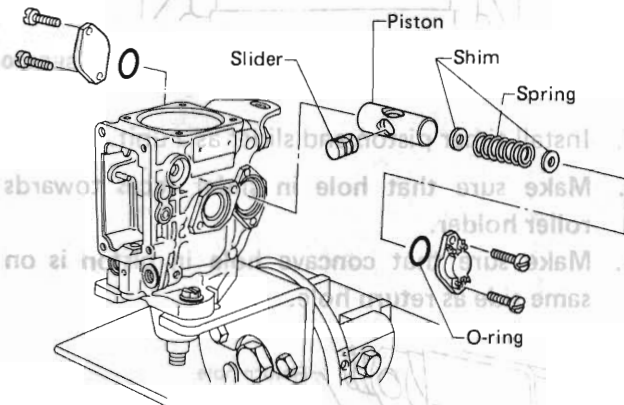
Make sure that timer piston moves smoothly.



SEF512

11. Install timer, using a 0.6 mm (0.024 in) thick shim, then install timer spring, shim, O-ring, and cover, in that order.

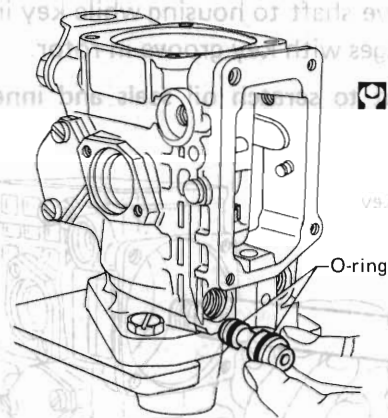
- Use at least one shim on each side of timer spring.
- Use shims that have been selected during bench test.



SEF513

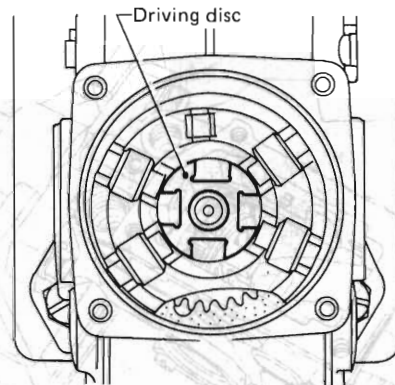
12. Install regulating valve.

Be careful not to scratch O-rings.



SEF514

13. Install driving disc with its concave side facing up.



SEF515

14. Measurement of plunger spring set length (dimension "KF").

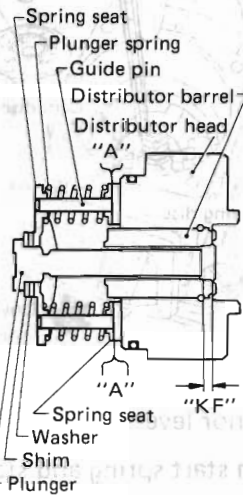
Dimension "KF" is the distance between the end face of the distributor barrel and the end face of the plunger.

- (1) Install distributor head, as shown.

INJECTION PUMP

Assembly (Cont'd)

- Do not insert shim into "A" position when measuring "KF" dimension.



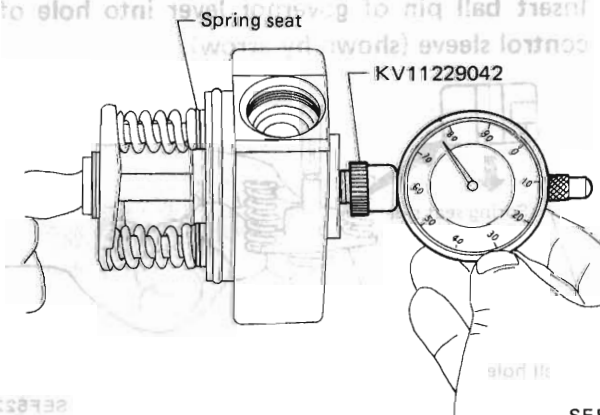
SEF516

- Set dial gauge so that it can compress 25 mm (0.98 in), and reset to zero.



SEF491

- Apply force (not enough to compress plunger spring) to plunger's bottom in axial direction, and measure dimension "KF" with dial gauge, as shown.



SEF855

- Determine the shim to be used by calculating difference between standard and measured dimensions.

Refer to S.D.S. for "KF".

[Example]

When measured (dial gauge reading) value is 5.4 mm,

$KF \text{ mm} - 5.4 \text{ mm} = \text{Shim thickness to be used}$

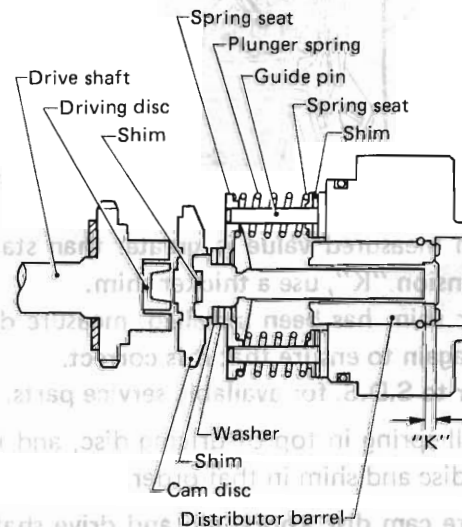
- When there are not shims available of a thickness which matches specified dimensions, use slightly thicker shim.
- Use the same size shim on each side of distributor head.
- Refer to S.D.S. for available service parts.

- Adjustment of plunger dimensions (Measurement of dimension "K").

Dimension "K" is the distance from the end face of the distributor barrel to the end face of the plunger top, when the plunger is at the bottom dead center position.

- Install parts as shown.

- Do not install "spring" that is inserted between driving disc and cam disc.
- When inserting plunger and shim into cam disc, make sure that knock pin of cam disc is situated in groove at bottom of plunger.



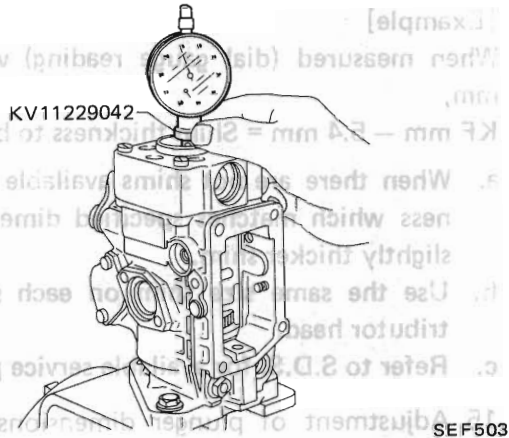
SEF456C

INJECTION PUMP

Assembly (Cont'd)

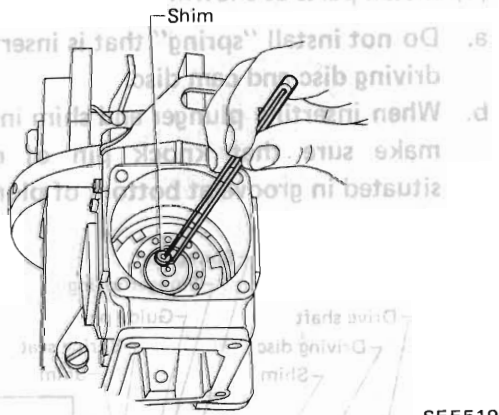
(2) Using a dial gauge, measure dimension as shown.

- Rotate drive shaft so that plunger is set at bottom dead center.
- Securely mount distributor head with screws.



(3) Determine shim to be used by calculating difference between measured (dial gauge reading) value and standard dimension "K", and install that shim on cam disc.

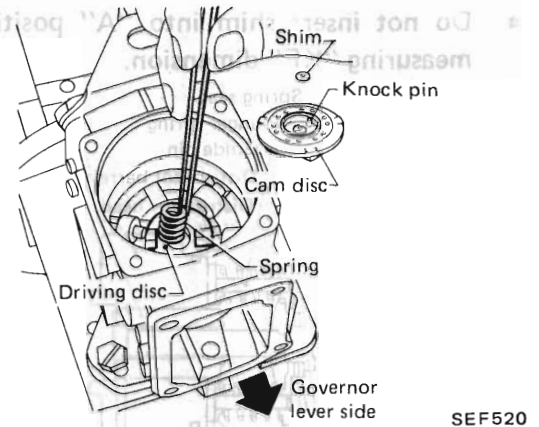
Refer to S.D.S. for "K".



- When measured value is greater than standard dimension "K", use a thicker shim.
- After shim has been installed, measure dimension again to ensure that it is correct.
- Refer to S.D.S. for available service parts.

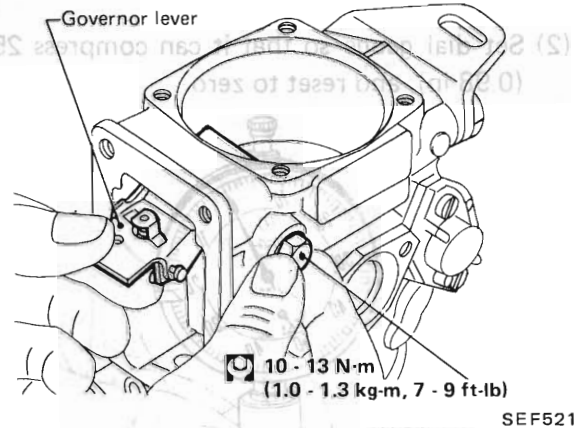
16. Install spring in top of driving disc, and install cam disc and shim in that order.

Make sure cam disc knock pin and drive shaft key way face governor lever side.



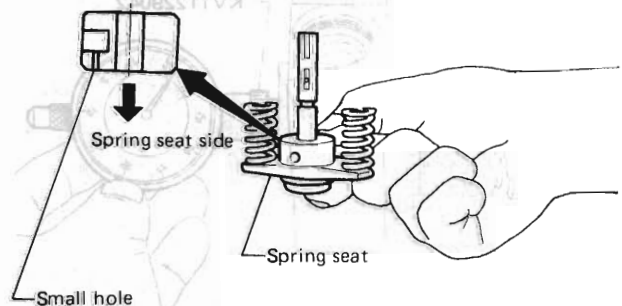
17. Install governor lever.

Avoid pulling on start spring and start idle spring.



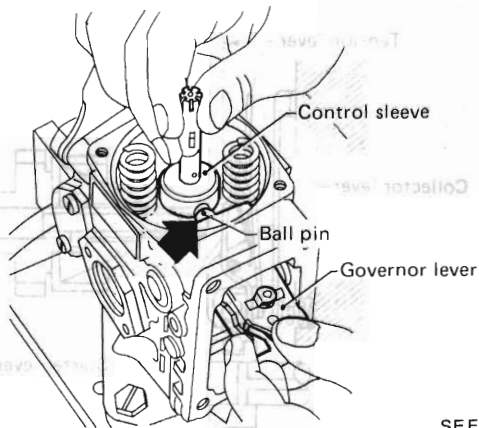
18. Install plunger assembly.

- Make sure control sleeve is installed with its small hole facing spring seat side.
- When inserting plunger and shim into cam disc, make sure that knock pin of cam disc is situated in groove at bottom of plunger.
- Insert ball pin of governor lever into hole of control sleeve (shown by arrow).



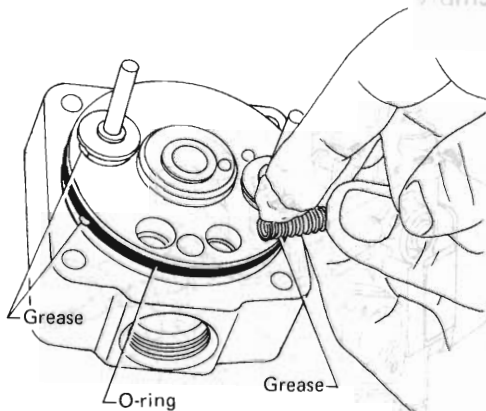
INJECTION PUMP

Assembly (Cont'd)



SEF523

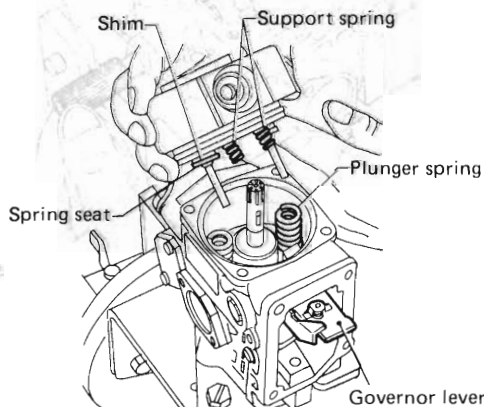
19. Apply a coat of grease to guide pin, shim and spring seat, and attach these parts to distributor head.



SEF492

20. Install distributor head.

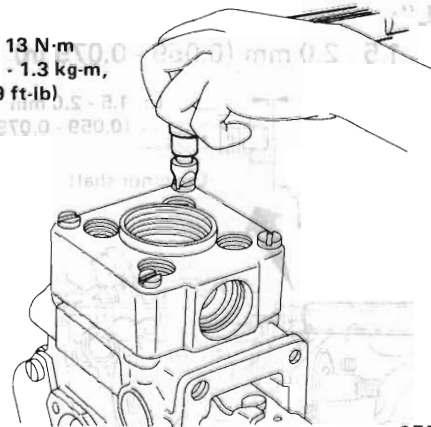
- Always face support spring toward governor lever.
- Be careful not to drop spring.
- After installing distributor head, make sure that guide pin is at guide hole of spring seat.



SEF524

21. Tighten distributor head.

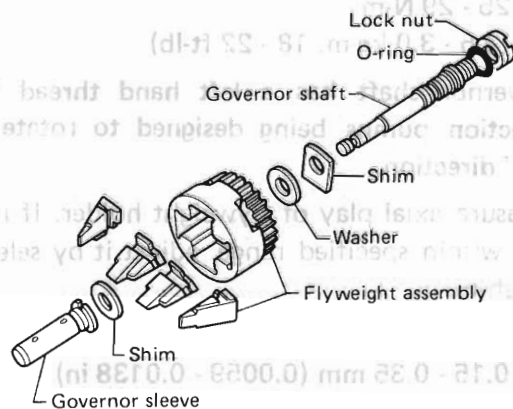
11 - 13 N·m
(1.1 - 1.3 kg-m,
8 - 9 ft-lb)



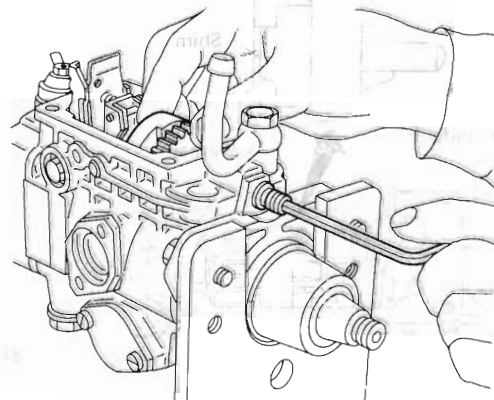
SEF046A

22. Attach governor weight assembly.

When installing governor shaft, be careful not to scratch O-rings.



SEF502



SEF984B

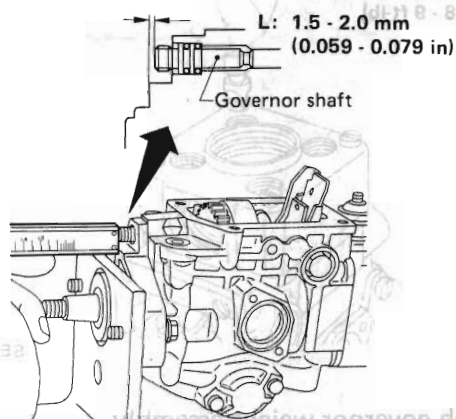
INJECTION PUMP

Assembly (Cont'd)

23. Adjust dimension "L", as shown:

"L":

1.5 - 2.0 mm (0.059 - 0.079 in)



a. Tighten lock nut to specified torque.

☞ : 25 - 29 N·m

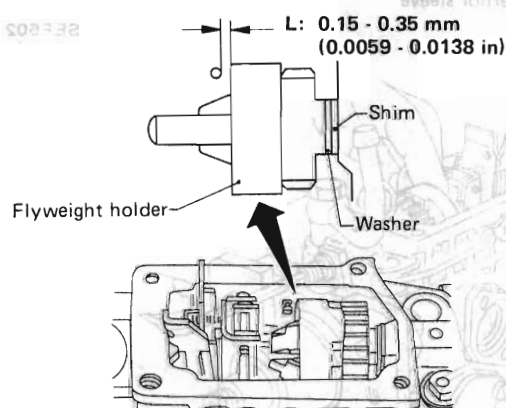
(2.5 - 3.0 kg-m, 18 - 22 ft-lb)

b. Governor shaft has a left hand thread for injection pumps being designed to rotate in "R" direction.

24. Measure axial play of flyweight holder. If it is not within specified range, adjust it by selecting shim.

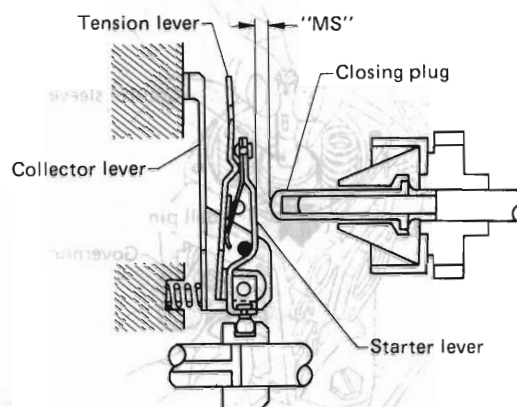
"L":

0.15 - 0.35 mm (0.0059 - 0.0138 in)

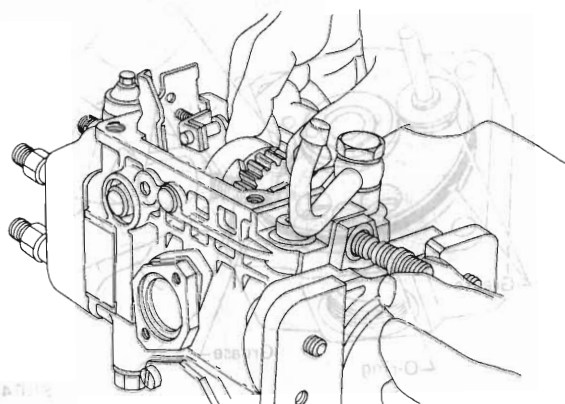


25. Measurement of dimension "MS" (for determining starting amount of fuel injection)

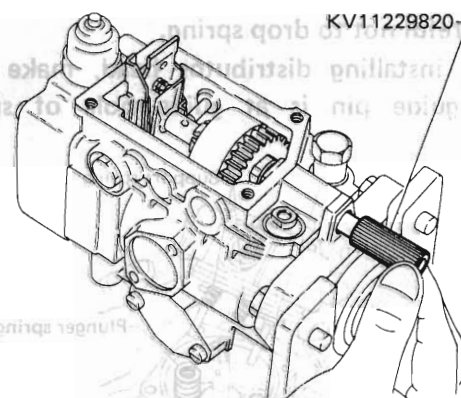
Dimension "MS" is the distance from closing plug to start lever.



(1) Remove lock nut, governor shaft and flyweight assembly.



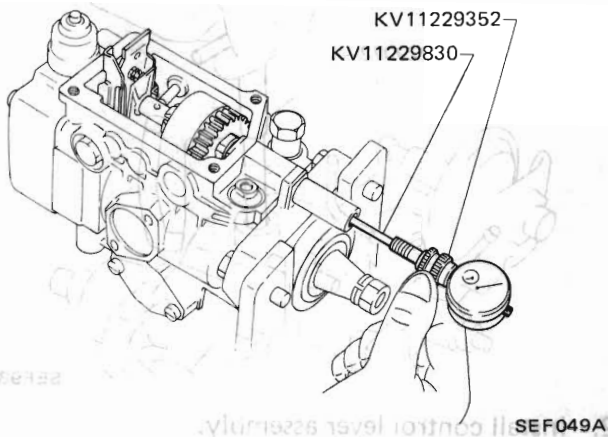
(2) Install Tool at governor shaft position.



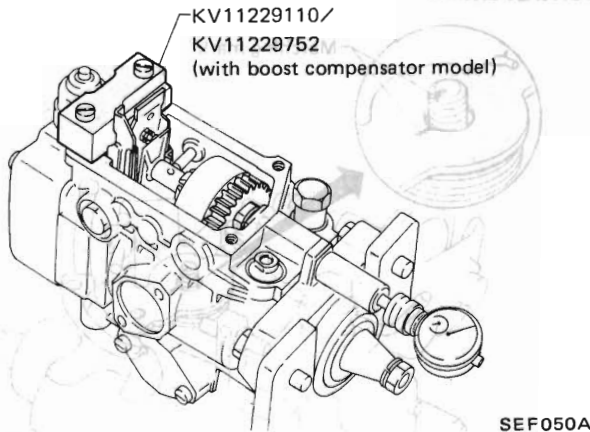
INJECTION PUMP

Assembly (Cont'd)

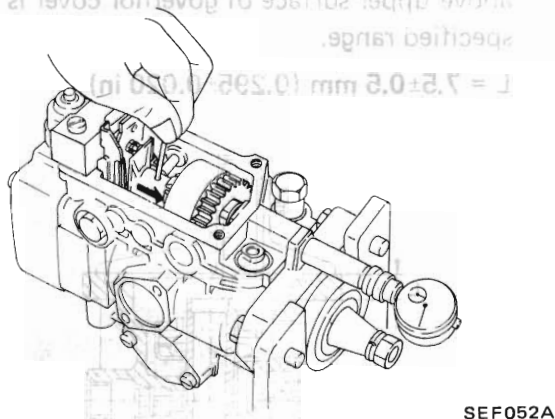
- (3) Install Tool (dial gauge) with rod.



- (4) Install Tool (Block gauge) to pump housing.



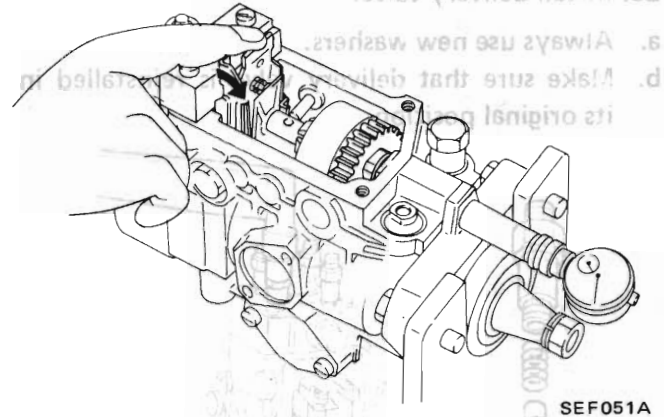
- (5) Push governor sleeve against flyweight. Hold governor sleeve in that position and set dial gauge to zero.



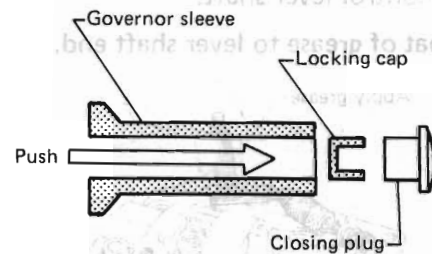
- (6) Push tension lever until it comes into contact with stopper pin. Back governor sleeve up until

start lever contacts tension lever. At this point, read dial gauge.

Refer to S.D.S. for dimension "MS".

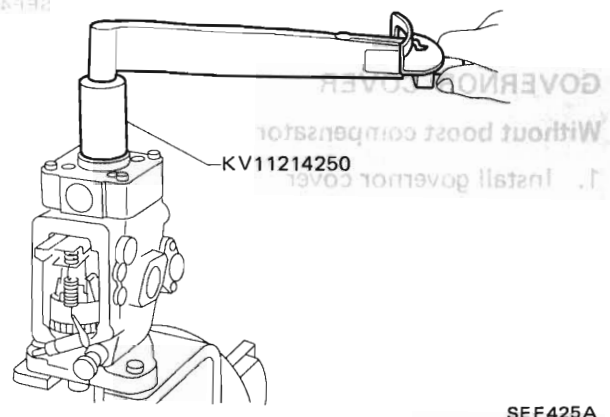


- (7) If dial gauge indication is not within this range, replace closing plug and adjust dimension "MS" to that range.



Refer to S.D.S. for available service part.

26. Install plug with new O-ring.



INJECTION PUMP

Assembly (Cont'd)

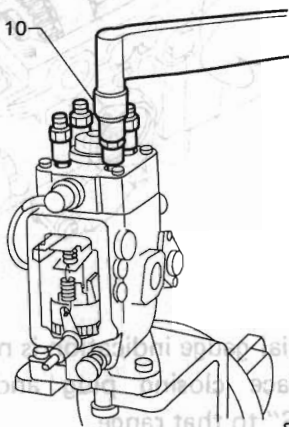
27. Install fuel cut solenoid valve and plug.

Always replace plugs with new ones.

28. Install delivery valve.

- Always use new washers.
- Make sure that delivery valve is reinstalled in its original position.

KV11214110

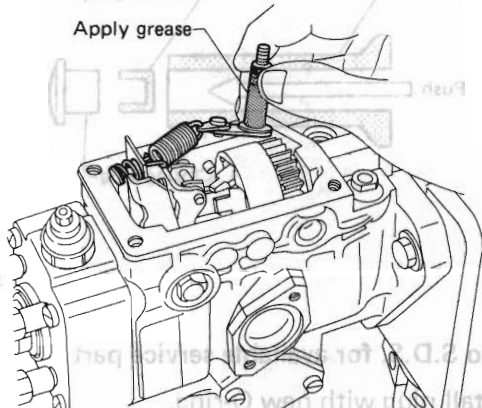


SEF426A

29. Install control lever shaft.

Apply a coat of grease to lever shaft end.

Apply grease

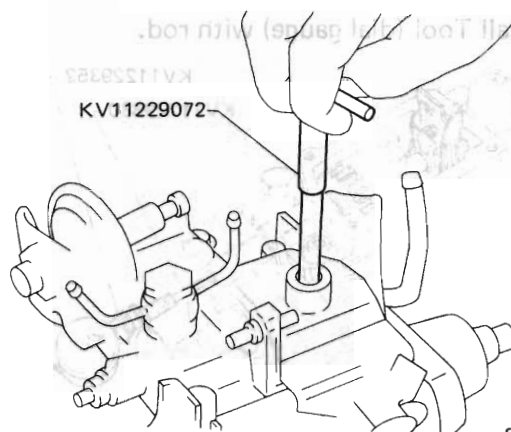


SEF427A

GOVERNOR COVER

Without boost compensator

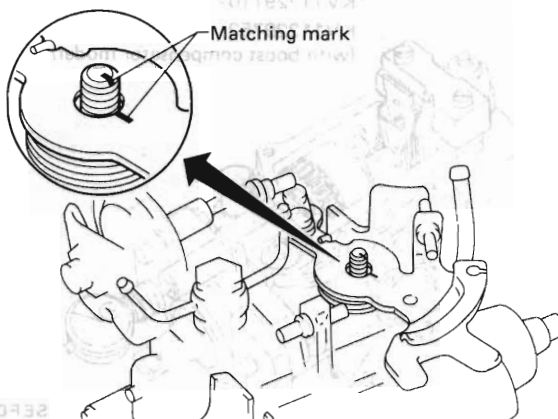
1. Install governor cover.



SEF985B

2. Install control lever assembly.

Align aligning marks of speed control lever and control shaft.

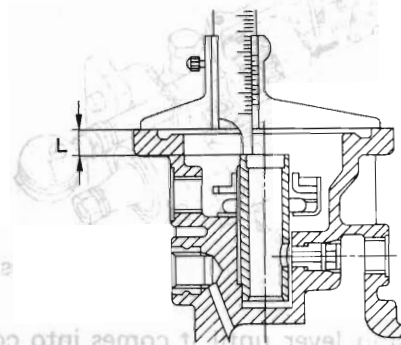


SEF961B

With boost compensator

1. Position adjusting rod bushing so that its height above upper surface of governor cover is within specified range.

$$L = 7.5 \pm 0.5 \text{ mm } (0.295 \pm 0.020 \text{ in})$$



SEF178C

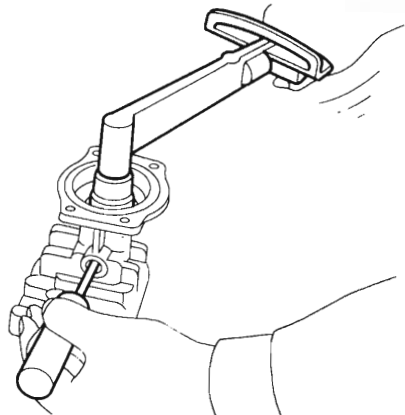
INJECTION PUMP

Assembly (Cont'd)

Ensure that holes in adjusting rod bushing and governor cover are aligned properly.

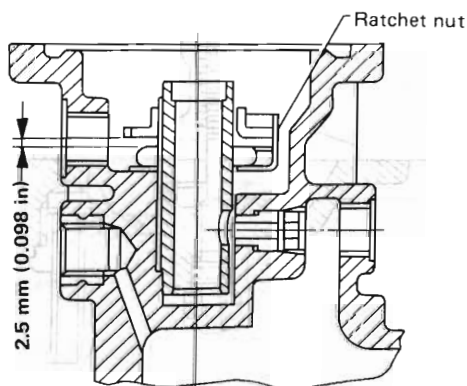
2. Install lock plate and lock nut.

☞ : 25 - 34 N·m
(2.5 - 3.5 kg-m, 18 - 25 ft-lb)



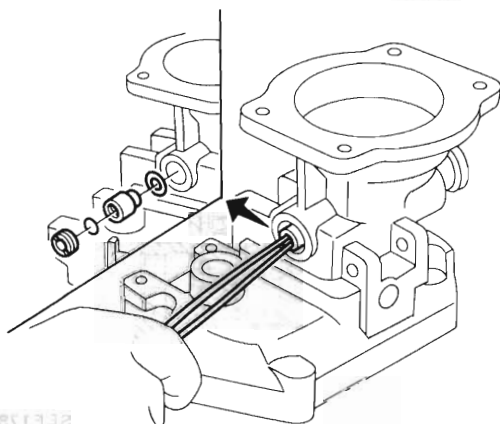
SEF429B

3. Fully tighten the ratchet nut and, from that position, back off approximately 2.5 revolutions.



SEF842A

4. Install washer, sleeve and retainer.

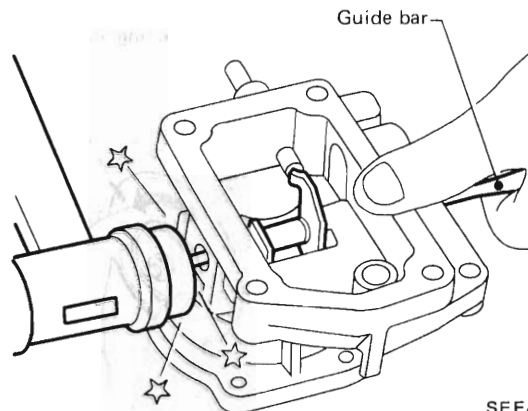


SEF430A

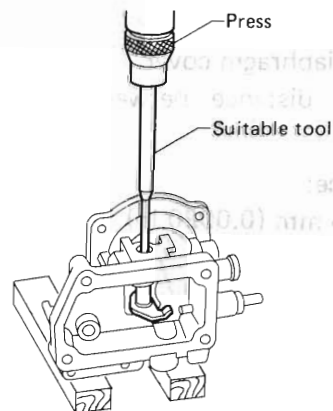
5. Install pin.

6. Install lever with press.

- Install pin on the right side as viewed from the drive shaft.
- Use a suitable bar as a guide to properly install lever.



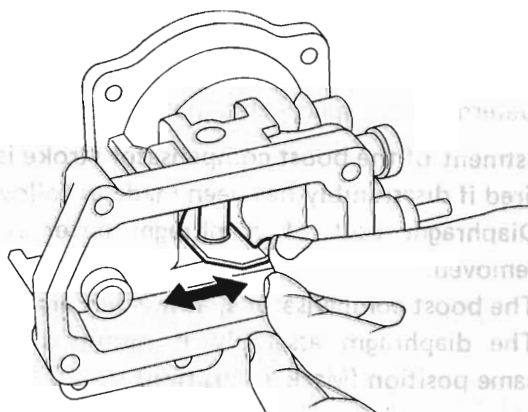
SEF432A



SEF838A

- Drive pin in until pin head is approx. 10 mm (0.39 in) below the surface.

Ensure that lever moves smoothly.



SEF839A

INJECTION PUMP

Assembly (Cont'd)

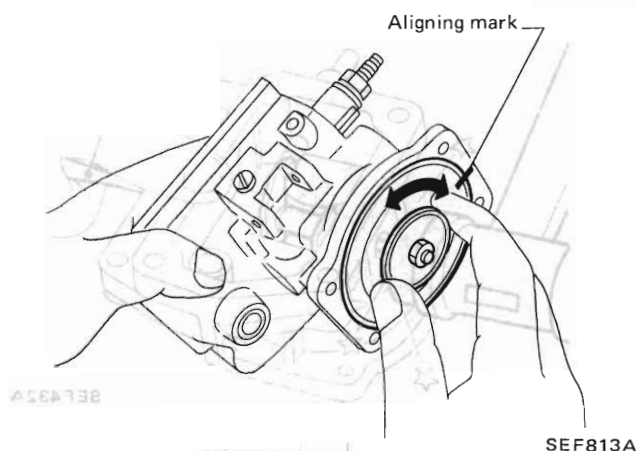
7. Check lever position.

(1) Install block gauge.

(2) Install the diaphragm assembly.

Move it and set it in the position where it starts to become difficult to move.

Make sure the aligning mark is aligned.

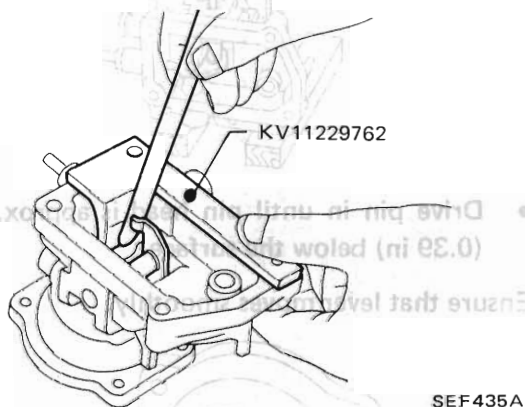


(3) Install diaphragm cover.

(4) Measure distance between block gauge and lever.

Clearance:

0.05 mm (0.0020 in)



8. Determine the spacer thickness.

Adjustment of the boost compensator stroke is not required if disassembly has been made as follows:

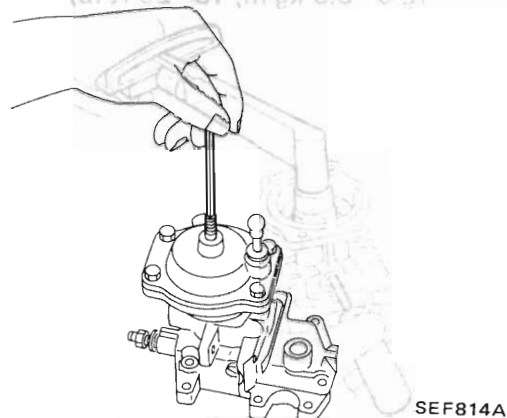
- Diaphragm bolt of diaphragm cover is not removed.
- The boost compensator spacer is not changed.
- The diaphragm assembly is mounted in the same position (Marked position).

(1) Tighten diaphragm bolt until bolt touches

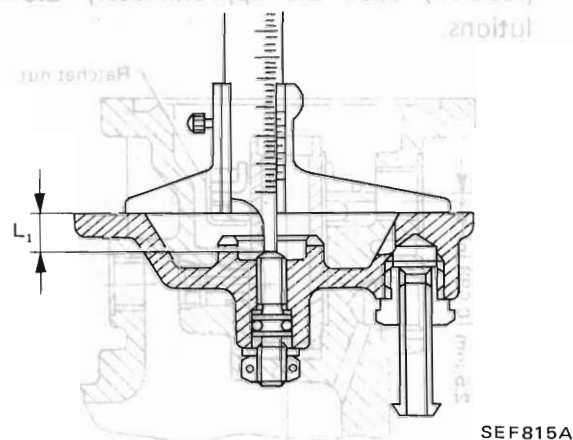
diaphragm.

(Slight resistance is felt when the bolt touches the diaphragm.)

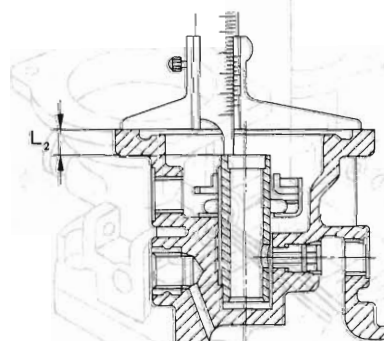
(2) From that position, tighten the diaphragm bolt an additional 1/2 rotations; tighten the lock nut.



(3) Remove diaphragm cover and measure distance (L_1) between diaphragm bolt and diaphragm cover and record it.



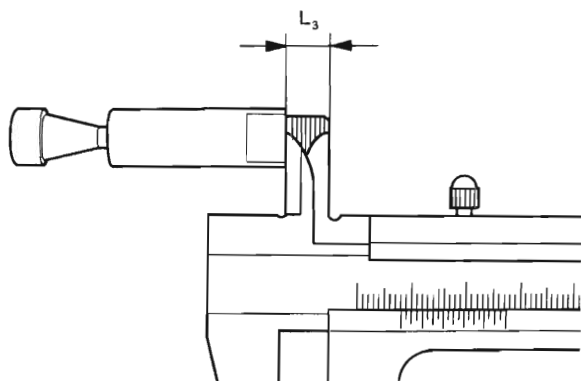
(4) Measure distance (L_2) between bushing and governor cover and record it.



INJECTION PUMP

Assembly (Cont'd)

- (5) Measure length (L_3) of thread of adjusting pin and record it.



SEF816A

- (6) Determine the thickness of spacers using the following equation.

Spacer thickness

$$= (L_1 + L_2 - L_3) - \text{Boost compensator stroke}$$

Example:

$$L_1 = 10.5 \text{ mm}$$

$$L_2 = 7.5 \text{ mm}$$

$$L_3 = 10.5 \text{ mm}$$

$$\text{Boost compensator stroke} = 3.5 \text{ mm}$$

Spacer thickness

$$= (10.5 + 7.5 - 10.5) - 3.5$$

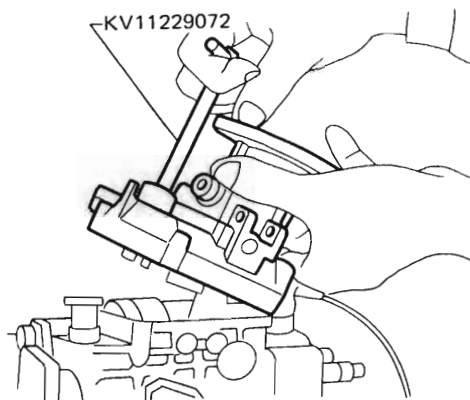
$$= (18.0 - 10.5) - 3.5$$

$$= 7.5 - 3.5$$

$$= 4.0 \text{ mm}$$

Refer to S.D.S. for available service parts and boost compensator stroke.

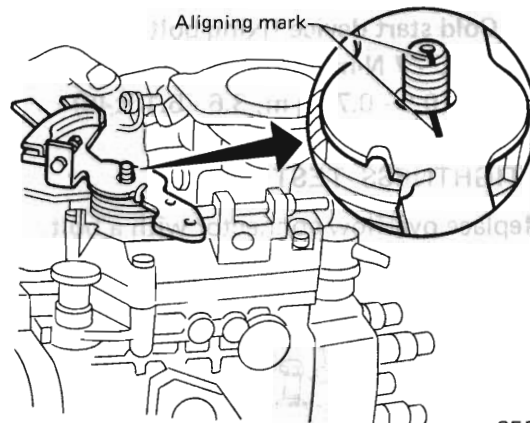
9. Install governor cover.



SEF436A

10. Install control lever.

Align aligning mark of the control lever and control lever shaft.



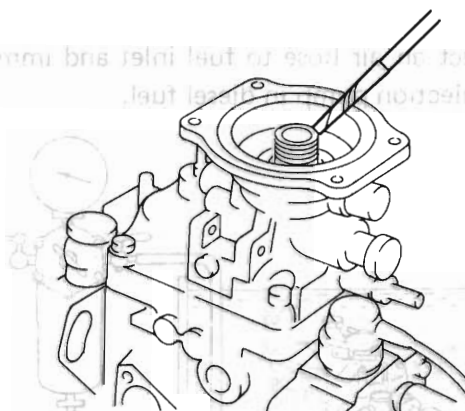
SEF986B

11. Install compensator spring.

12. Fill recommended lubrication oil into the bushing.

Recommended oil & oil capacity shell clavus.

4 - 5 ml (0.14 - 0.18 Imp fl oz)



SEF817A

13. Install diaphragm assembly with spacer.

Set diaphragm assembly in the position where it starts to become difficult to move.

Make sure the aligning mark is aligned.

14. Install diaphragm cover.

INJECTION PUMP

Assembly (Cont'd)

COLD START DEVICE

Install cold start device assembly.

Always use a new O-ring.

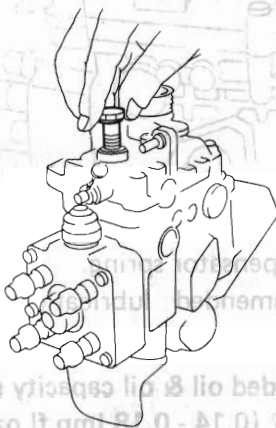
 : Cold start device fixing bolt

5 - 7 N·m

(0.5 - 0.7 kg-m, 3.6 - 5.1 ft-lb)

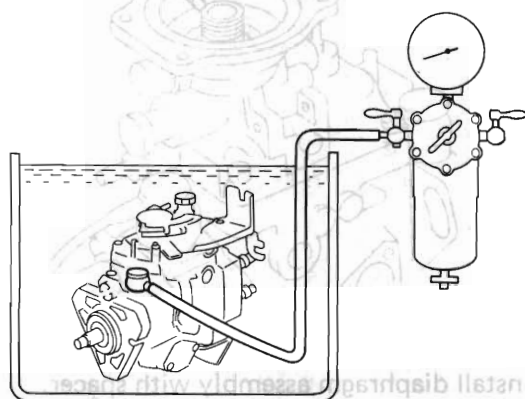
AIR TIGHTNESS TEST

1. Replace overflow connector with a bolt.



SEF790A

2. Connect an air hose to fuel inlet and immerse fuel injection pump in diesel fuel.

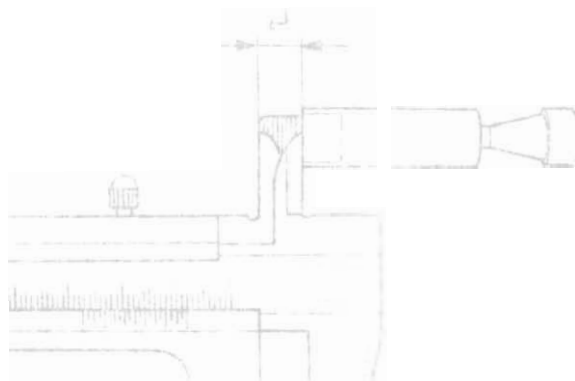


SEF791A

3. Apply pressure of 392 kPa (3.9 bar, 4 kg/cm², 57 psi) and check that there are no leaks. If there is any leakage, repair it.

of thread of adjusting

Measure length
and record it



SEF818A

(8) Determine the thickness of spacers using the following equation

Spacer thickness

$= (L_1 + L_2 - L_3) - \text{Boost compensator stroke}$

Example:

$L_1 = 10.5 \text{ mm}$

$L_2 = 7.5 \text{ mm}$

$L_3 = 10.5 \text{ mm}$

Boost compensator stroke = 3.5 mm

Spacer thickness

$= (10.5 + 7.5 - 10.5) - 3.5$

$= (18.0 - 10.5) - 3.5$

$= 7.5 - 3.5$

$= 4.0 \text{ mm}$

Refer to S.D.S. for available service parts and boost

compensator stroke.

19. Install governor cover.



SEF438A

INJECTION PUMP

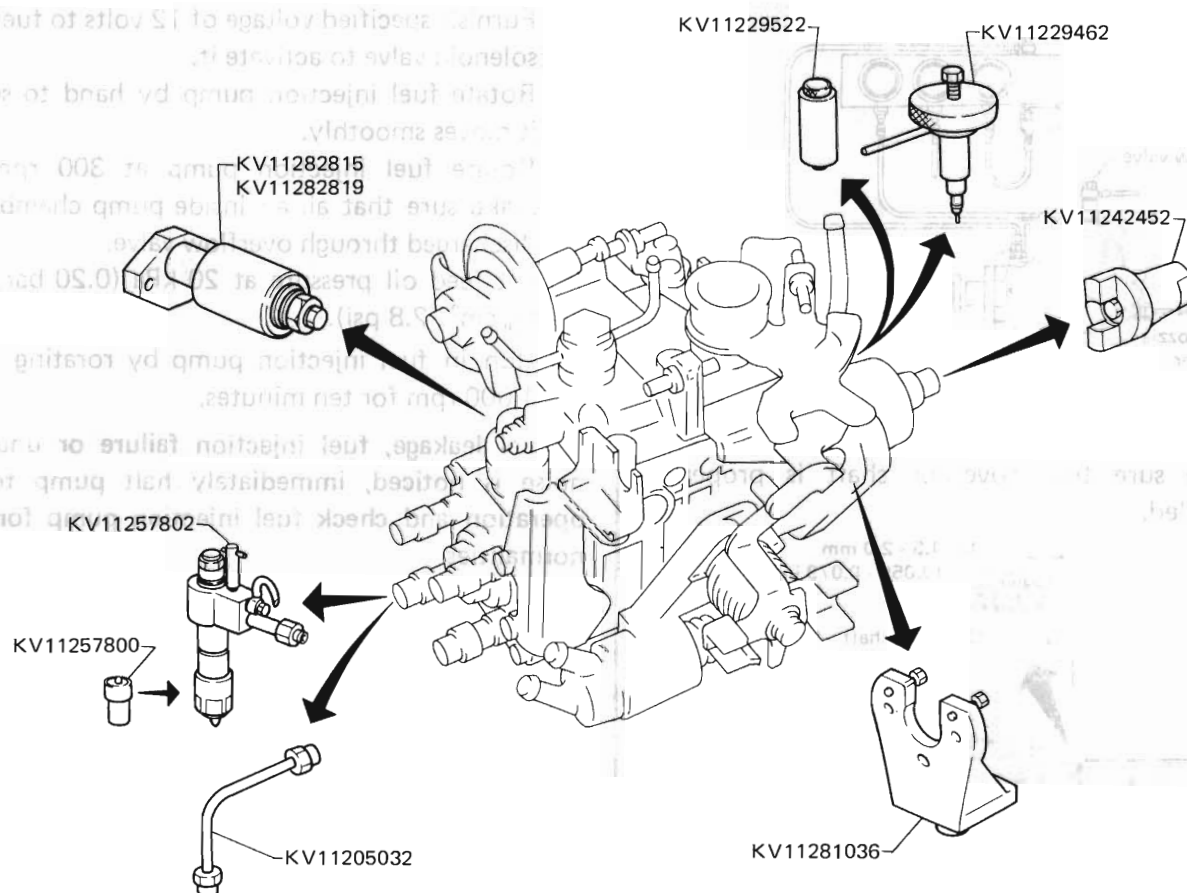
Testing of Injection Pump

PREPARATION

Injection pump test conditions

Nozzle		KV11257800
Nozzle holder		KV11257802
Nozzle starting pressure	kPa (bar, kg/cm ² , psi)	14,711 - 15,201 (147.1 - 152.0, 150 - 155, 2,133 - 2,204)
Nozzle tube Inner dia. x outer dia. x length	mm (in)	KV11205032 2.0 x 6.0 x 840 (0.079 x 0.236 x 33.07)
Fuel feed pressure	kPa (bar, kg/cm ² , psi)	20 (0.20, 0.2, 2.8)
Fuel (test oil)		ISO4113 or SAE J967d
Fuel temperature	°C (°F)	45 - 50 (113 - 122)
Rotating direction		Right (observed from the drive shaft)
Injection sequence		1-3-4-2

1. Prepare necessary service tools.

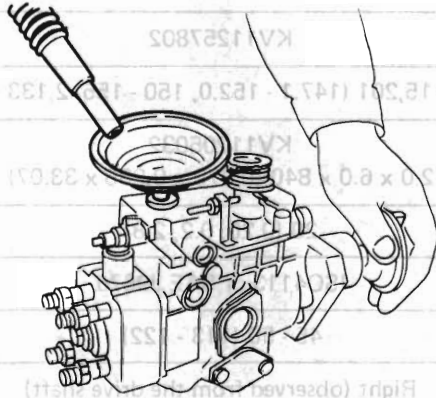


INJECTION PUMP

Testing of Injection Pump (Cont'd)

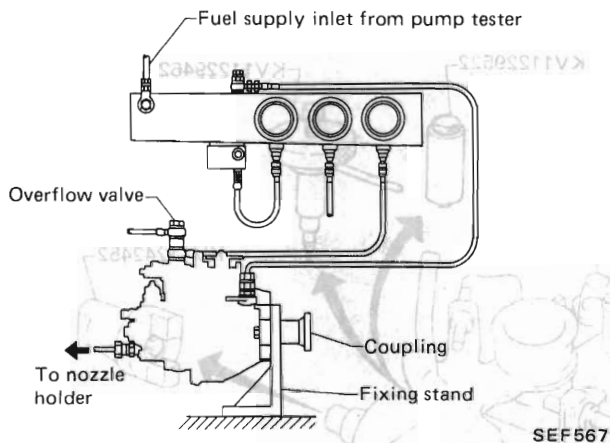
2. Pour test oil into fuel injection pump.

Test oil should be ISO4113, SAE J967d test oil or its equivalent.

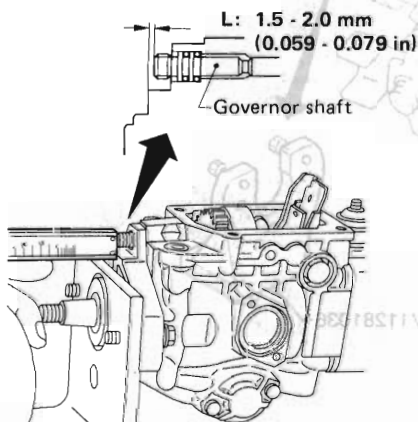


3. Install fuel injection pump to pump tester.

4. Connect necessary piping.



5. Make sure that governor shaft is properly installed.

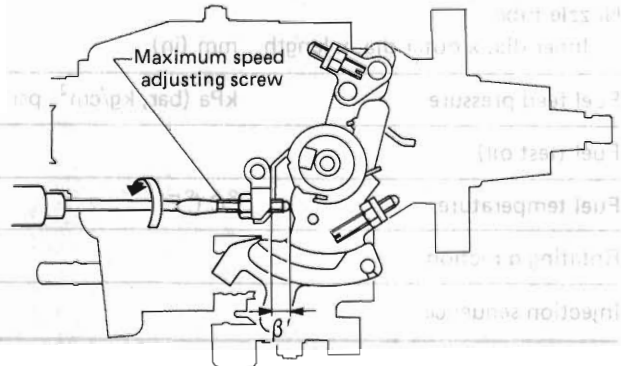


6. Run in fuel injection pump as follows:

(1) Maintain test oil in tank to 45 to 50°C (113 to 122°F).

(2) Set control lever at "full load" using a spring.

Set maximum speed adjusting screw in position shown, by turning counterclockwise.



(3) Furnish specified voltage of 12 volts to fuel-cut solenoid valve to activate it.

(4) Rotate fuel injection pump by hand to see if it moves smoothly.

(5) Rotate fuel injection pump at 300 rpm to make sure that all air inside pump chamber is discharged through overflow valve.

(6) Set feed oil pressure at 20 kPa (0.20 bar, 0.2 kg/cm², 2.8 psi).

(7) Run in fuel injection pump by rotating it at 1,000 rpm for ten minutes.

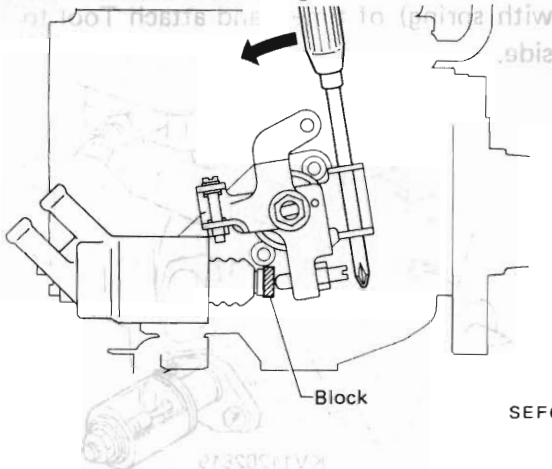
If fuel leakage, fuel injection failure or unusual noise is noticed, immediately halt pump tester operation and check fuel injection pump for abnormalities.

INJECTION PUMP

Testing of Injection Pump (Cont'd)

ADJUSTMENT

Set block [length about 15 mm (0.59 in)] between cold start device and linkage.



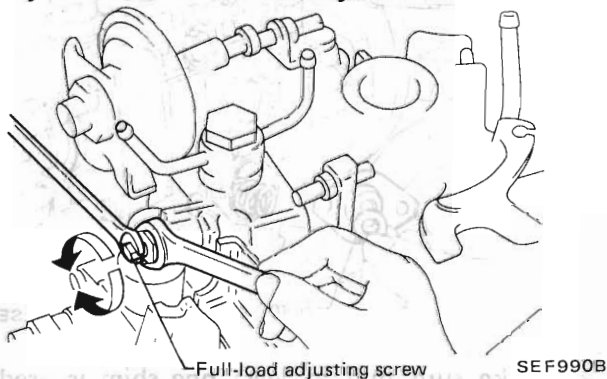
Preadjustment of full-load delivery

1. Set control lever at "full load" by pulling spring or using suitable equipment.

Set maximum speed adjusting screw in position shown, by turning counterclockwise. Refer to step 6-(2) in Preparation.

2. Furnish specified voltage of 12 volts to activate fuel-cut solenoid valve.
3. Rotate fuel injection pump at specified rpm, and measurement amount of fuel injection.

Refer to S.D.S. for full-load fuel injection quantity of adjustment value on fuel injection tester.



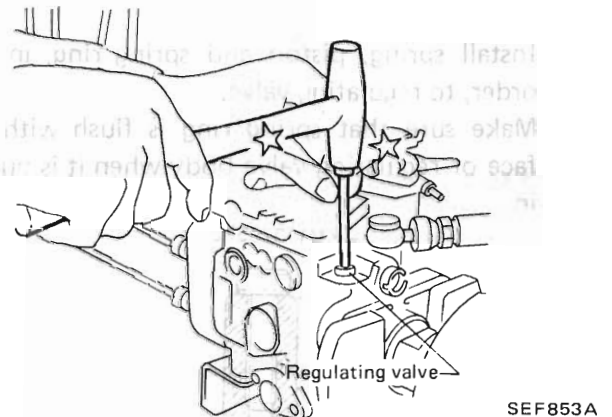
4. Calculate allowable imbalance of fuel injection quantity.

$$\left(\begin{matrix} \text{Allowable} \\ \text{imbalance} \end{matrix} \right) = \left(\begin{matrix} \text{Max. or Min.} \\ \text{injection volume} \\ \text{among delivery} \\ \text{valves} \end{matrix} \right) - \left(\begin{matrix} \text{Mean injection} \\ \text{volume of} \\ \text{all delivery} \\ \text{valves} \end{matrix} \right)$$

5. If the value of allowable imbalance is out of the specification, replace delivery valve assembly.

Adjustment of feed pump pressure

1. Repeat steps 1 and 2 outlined under heading "Preadjust Full Load Delivery".
2. Measure feed pump pressure at specified fuel injection pump rpm.
 - a. When measured pressure is lower than specifications.

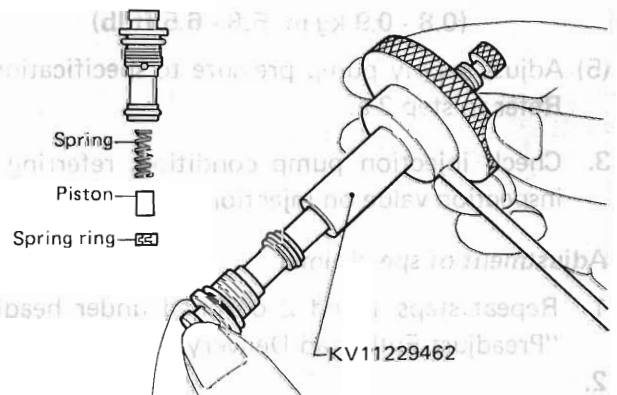


Push in plug that is driven into regulating valve body.

Be careful not to push plug in too far.

- b. When measured pressure is higher than specifications.

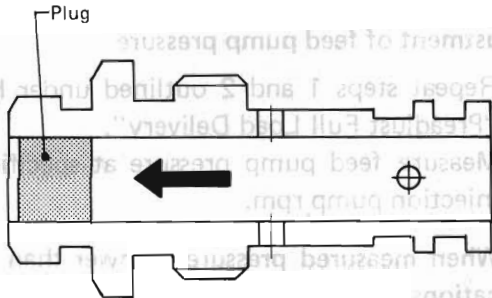
- (1) Remove regulating valve from fuel injection pump, and disassemble regulating valve using Tool.



INJECTION PUMP

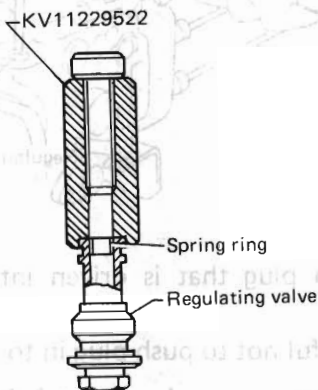
Testing of Injection Pump (Cont'd)

- (2) Drive plug out until it is flush with end face of regulating valve.



SEF573

- (3) Install spring, piston and spring ring, in that order, to regulating valve. Make sure that spring ring is flush with end face or regulating valve body when it is pushed in.



SEF637

- (4) Attach regulating valve to fuel injection pump.

Regulating valve
8 - 9 N·m
(0.8 - 0.9 kg-m, 5.8 - 6.5 ft-lb)

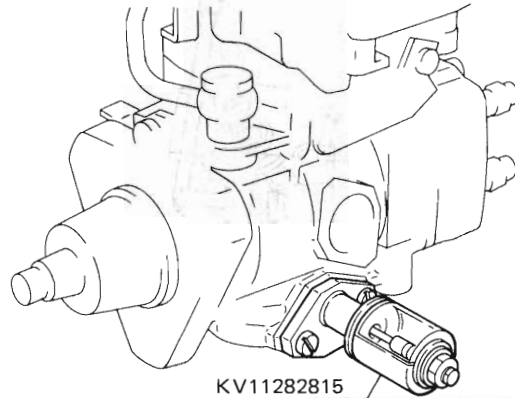
- (5) Adjust supply pump pressure to specifications. Refer to step 2-a.
3. Check injection pump condition, referring to inspection value on injection pump tester.

Adjustment of speed timer

- Repeat steps 1 and 2 outlined under heading "Preadjust Full-Load Delivery".
- Remove cover from high pressure side (side

without spring) of timer, and attach Tool to that side.

- Remove cover from low-pressure side (side with spring) of timer, and attach Tool to that side.

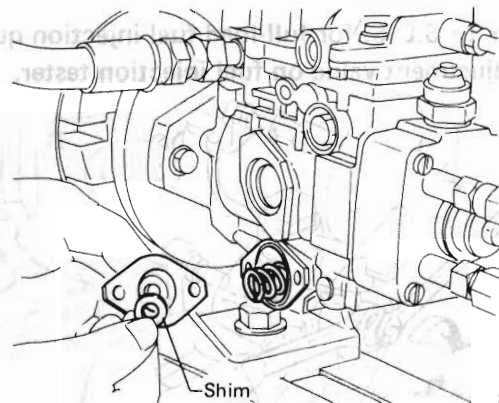


SEF991B

3. Measure timer piston strokes at specified fuel injection pump rpm.

Refer to S.D.S. for timer piston stroke of adjustment value.

4. If timer piston stroke is not within specified range, remove cover from low pressure side of timer and adjust piston stroke by adding shim(s).



SEF575

- Make sure that at least one shim is used on each side of timer spring.
- Refer to S.D.S. for available service parts.

Adjustment of fuel injection under full-load

- Set control lever at "full load" by pulling spring or using suitable equipment.

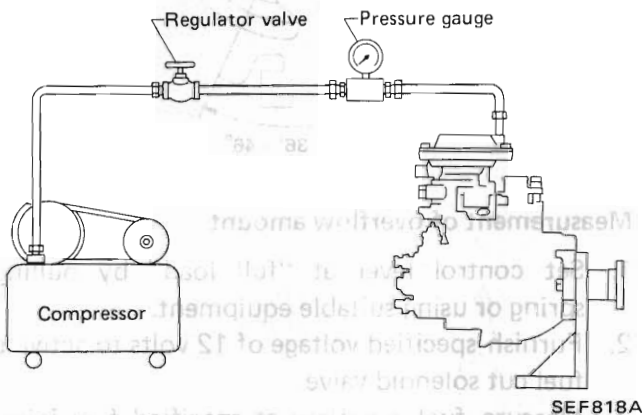
INJECTION PUMP

Testing of Injection Pump (Cont'd)

2. Furnish specified voltage of 12 volts to activate fuel cut solenoid valve.
3. Measure fuel injection at specified fuel injection pump rpm.
4. If fuel injection is not within standard range, adjust it by turning full-load adjusting screw.
5. Check injection pump condition, referring to inspection value.

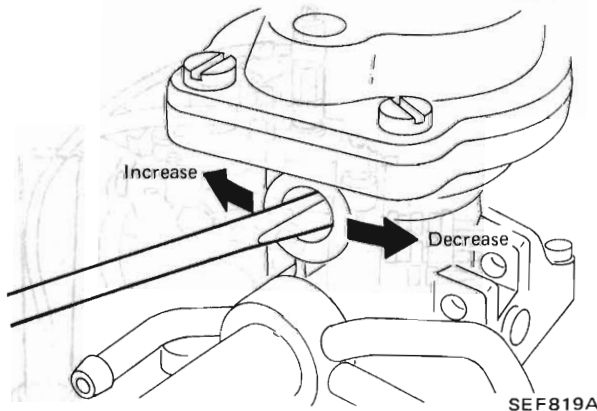
With boost compensator

- Make adjustment by changing the set pressure of the boost compensator.



Refer to S.D.S. for full load injection amount.

If not the specified injection quantity, turn the ratchet nut.



Be careful not to damage threads.

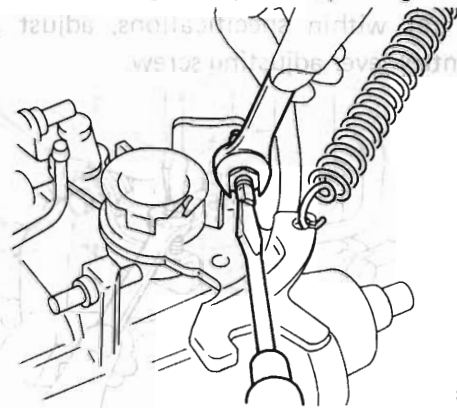
Adjustment of fuel injection during idle

1. Pull spring until idle speed adjusting screw comes into contact with stopper.
2. Furnish specified voltage of 12 volts to activate fuel cut solenoid valve.

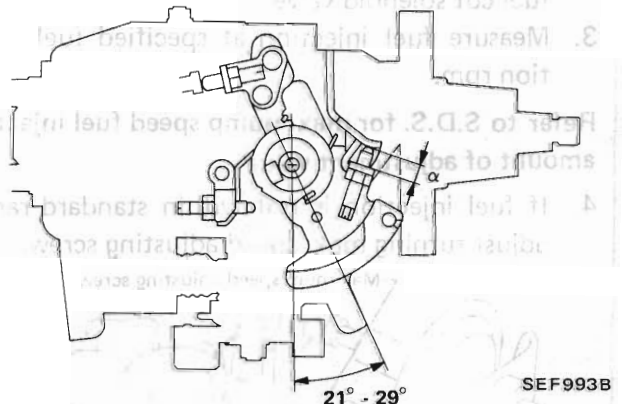
3. Measure fuel injection at specified fuel injection pump rpm.

Refer to S.D.S. for idle fuel injection amount of adjustment value.

4. If fuel injection is not within specified range, adjust by turning idle speed adjusting screw.



- a. Tightening this screw will increase fuel injection amount.
- b. Make sure that control lever angle is set at 21 to 29° range. If control lever angle is not within specified range, adjust it by repositioning control lever on control shaft. (One serration pitch: 15°) After control lever has been repositioned, be sure to measure amount of fuel injection at idle speed again.



5. Check injection pump condition, referring to inspection value.

Adjustment of fuel injection during start

1. Set control lever at "full load" by pulling spring or a suitable equipment.

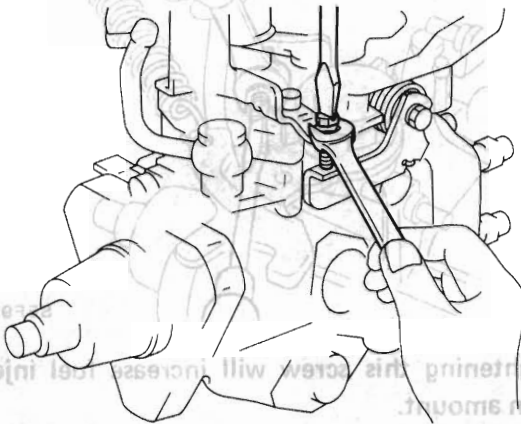
INJECTION PUMP

Testing of Injection Pump (Cont'd)

2. Furnish specified voltage of 12 volts to activate fuel cut solenoid valve.
3. Measure fuel injection at specified fuel injection pump rpm.

Refer to S.D.S. for start fuel injection amount of adjustment value.

4. If not within specifications, adjust governor control lever adjusting screw.



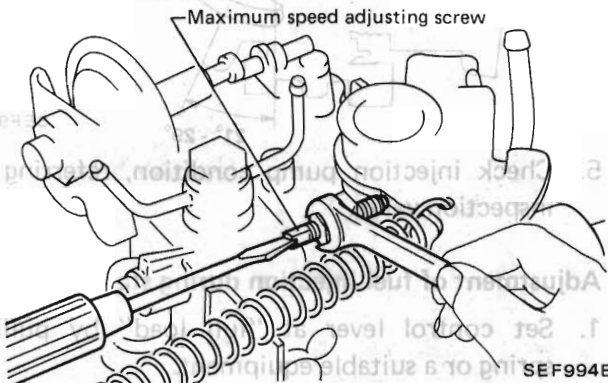
Make sure "MS" dimension is within specification. Refer to step 25 for Injection Pump Assembly.

Adjustment of fuel injection at max. pump rpm

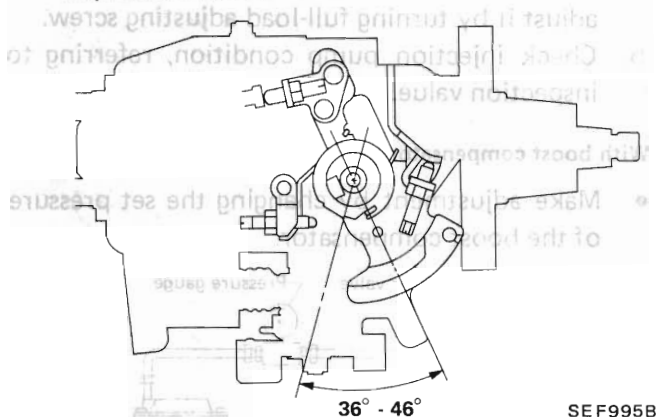
1. Set control lever at "full load" by pulling spring or a suitable equipment.
2. Furnish specified voltage of 12 volts to activate fuel cut solenoid valve.
3. Measure fuel injection at specified fuel injection rpm.

Refer to S.D.S. for max. pump speed fuel injection amount of adjustment value.

4. If fuel injection is not within standard range, adjust turning max. speed adjusting screw.



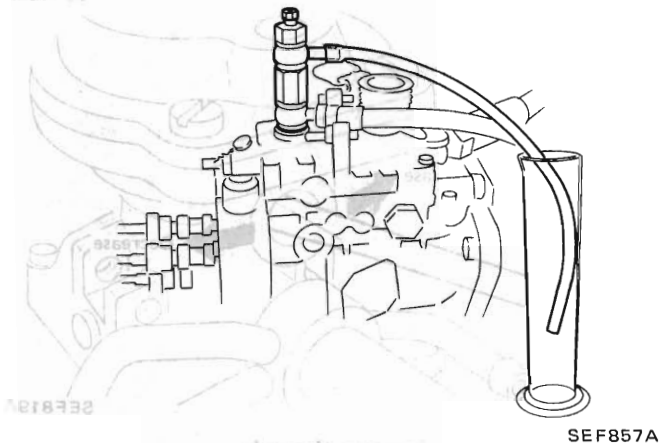
- a. Tightening screw will increase fuel injection.
 - b. Make sure that control lever angle is within 36° to 46° range.
5. Check injection pump condition referring to inspection value.



Measurement of overflow amount

1. Set control lever at "full load" by pulling spring or using suitable equipment.
2. Furnish specified voltage of 12 volts to activate fuel cut solenoid valve.
3. Measure fuel overflow at specified fuel injection rpm.

Refer to S.D.S. for overflow amount of inspection value.



Operation check of fuel cut solenoid valve

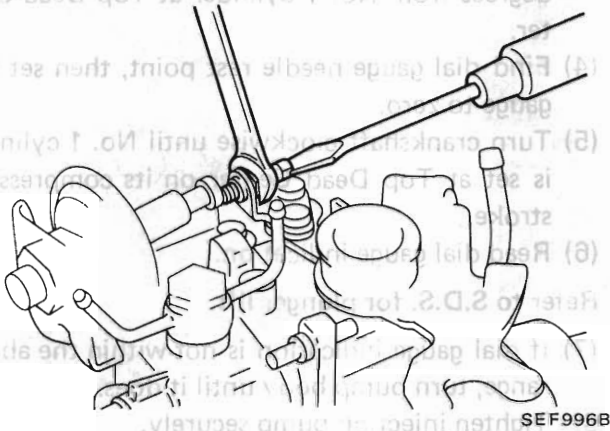
When engine is idling and fuel cut solenoid valve current is OFF, be sure there is no injection. This check has to be done for approx. 5 seconds.

INJECTION PUMP

Testing of Injection Pump (Cont'd)

Adjustment of dash pot

Adjust dash pot so that its stem protrudes 6 mm (0.24 in) when idling.

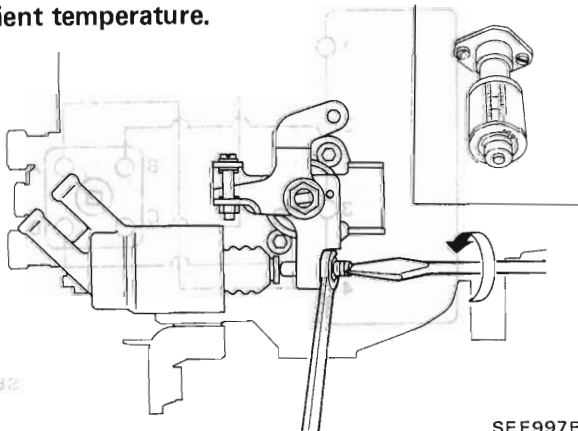


Adjustment of cold start device

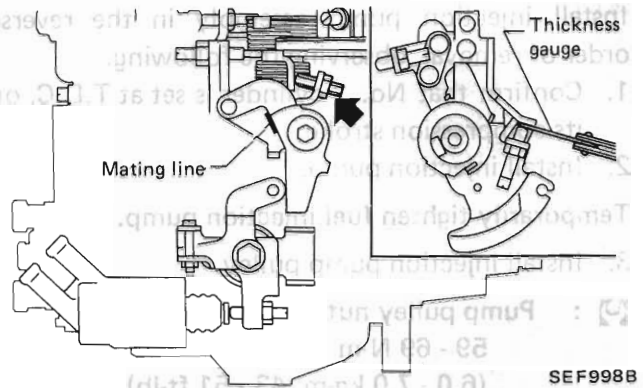
Cold start device adjustment should be done after all the injection pump adjustments have finished.

1. Measure the ambient temperature with a thermometer.
2. At this time, ensure that the speed timer piston stroke is the specified value.
If not within specification, adjust timer stroke with cold start device adjusting screw.

Refer to S.D.S. for speed timer piston stroke and ambient temperature.

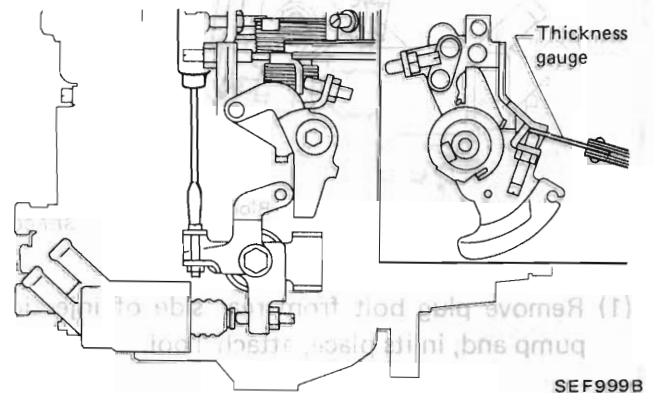


3. Insert 0.9 ± 0.05 mm (0.0035 ± 0.0020 in) thickness gauge between idle adjusting screw and control lever and align mating line with fast idle control lever by adjusting fast idle control lever adjusting screw.



4. Fully loosen cold start device lever adjusting screw, select thickness gauge whose thickness equals the specified clearance [obtained from S.D.S.: ± 0.05 mm (0.0020 in)] between idle adjusting screw and stopper, and retighten cold start device lever adjusting screw until cold start device lever contacts fast idle control lever.

Temperature should be below 30°C (86°F) during adjustment.



Inspection of load timer

1. Set control lever at partial load position.

Refer to S.D.S. for fuel control lever angle.

2. Measure timer piston stroke and fuel injection quantity.

INJECTION PUMP

Installation

Install injection pump assembly in the reverse order of removal, observing the following.

1. Confirm that No. 1 cylinder is set at T.D.C. on its compression stroke.
2. Install injection pump.

Temporarily tighten fuel injection pump.

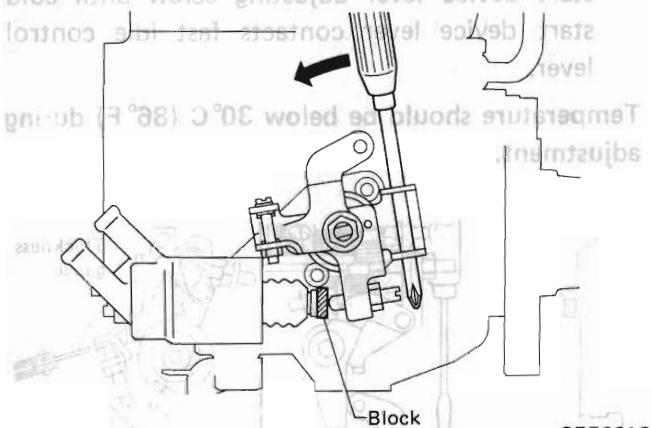
3. Install injection pump pulley.

 : Pump pulley nut
59 - 69 N·m
(6.0 - 7.0 kg-m, 43 - 51 ft-lb)

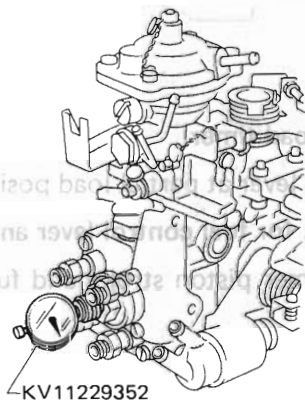
4. Install timing belt.

Refer to charging Timing Belt in MA section.

5. Adjust injection timing.
 - a. Turn cold start device linkage clockwise.
 - b. Set block [length about 15 mm (0.59 in)] between cold start device and linkage.



- (1) Remove plug bolt from rear side of injection pump and, in its place, attach Tool.



- (2) Make sure to loosen pump nuts and bracket bolt.
- (3) Turn crankshaft counterclockwise 20 to 25 degrees from No. 1 cylinder at Top Dead Center.
- (4) Find dial gauge needle rest point, then set the gauge to zero.
- (5) Turn crankshaft clockwise until No. 1 cylinder is set at Top Dead Center on its compression stroke.
- (6) Read dial gauge indication.

Refer to S.D.S. for plunger lift.

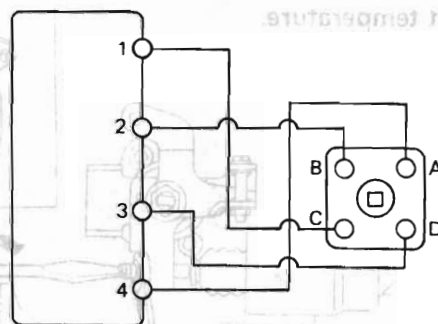
- (7) If dial gauge indication is not within the above range, turn pump body until it does.
6. Tighten injection pump securely.

Always replace plug bolt gasket.

 : Plug bolt
14 - 20 N·m
(1.4 - 2.0 kg-m, 10 - 14 ft-lb)

7. Connect fuel injection tube in the order of 4, 3, 2 and 1.

 : Injection tube flare nut
22 - 25 N·m
(2.2 - 2.5 kg-m, 16 - 18 ft-lb)



8. Bleed air.

Refer to "Bleeding Fuel System" in EF section.

INJECTION PUMP

Service Data and Specifications

INSPECTION AND ADJUSTMENT

Installation of injection pump

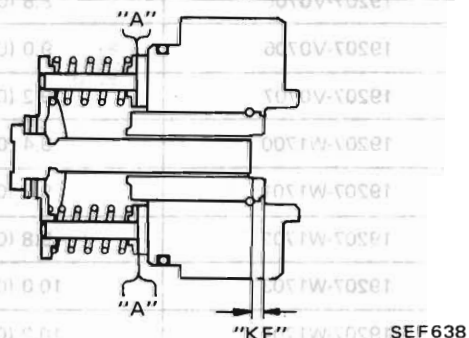
Plunger lift	mm (in)
Non-turbo	0.73±0.04 (0.0287±0.0016)
Turbo	0.64±0.04 (0.0252±0.0016)

Pump numbers

Part number	Pump number	Remarks
16700-05E10	104749-2100	LD20 (with A/T)
	104749-2101	
	104749-2102	
16700-05E20	104749-2140	LD20 (with M/T)
	104749-2141	
	104749-2142	
16700-08E10	104740-2040	LD20T (Europe)
	104740-2041	

Use of adjustment value and adjusting shim when installing injection pump

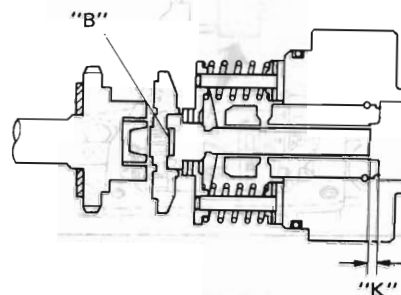
Item	Applied parts No.	16700-05E10 16700-05E20	16700-08E10
Dimension "KF" mm (in)		5.7 - 5.9 (0.224 - 0.232)	5.65 - 5.85 (0.2224 - 0.2303)



Adjusting shim ("A" position)

Part number	Thickness mm (in)
16882-V0700	0.5 (0.020)
16882-V0701	0.8 (0.031)
16882-V0702	1.0 (0.039)
16882-V0703	1.2 (0.047)
16882-V0704	1.5 (0.059)
16882-V0705	1.8 (0.071)
16882-V0706	2.0 (0.079)

Parts No.	16700-05E10 16700-05E20	16700-08E10
Item		
Dimension "K" mm (in)	3.2 - 3.4 (0.126 - 0.134)	3.2 - 3.4 (0.126 - 0.134)

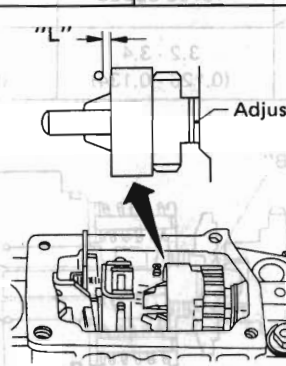


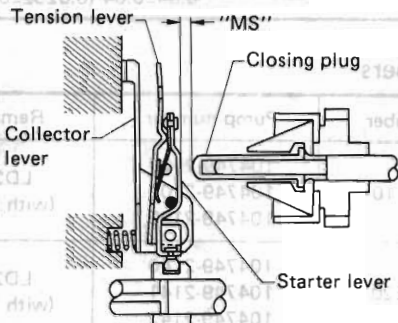
Adjusting shim ("B" position)

Part number	Thickness mm (in)
16884-V0700	1.92 (0.0756)
16884-V0701	2.00 (0.0787)
16884-V0702	2.08 (0.0819)
16884-V0703	2.16 (0.0850)
16884-V0704	2.24 (0.0882)
16884-V0705	2.32 (0.0913)
16884-V0706	2.40 (0.0945)
16884-V0707	2.48 (0.0976)
16884-V0708	2.56 (0.1008)
16884-V0709	2.64 (0.1039)
16884-V0710	2.72 (0.1071)
16884-V0711	2.80 (0.1102)
16884-V0712	2.88 (0.1134)

INJECTION PUMP

Service Data and Specifications (Cont'd)

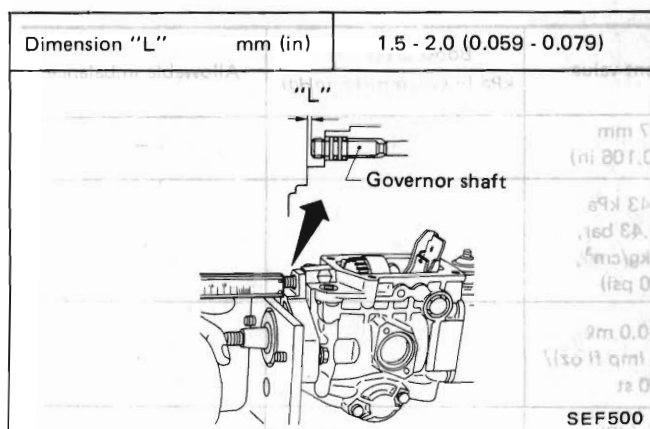
Axial play of flyweight holder "L" mm (in)		0.15 - 0.35 (0.0059 - 0.0138)
		
SEF499		
Adjusting shim		
Part number	Thickness mm (in)	
19208-V0700	1.05 (0.0413)	
19208-V0701	1.25 (0.0492)	
19208-V0702	1.45 (0.0571)	
19208-V0703	1.65 (0.0650)	
19208-V0704	1.85 (0.0728)	

Applied parts No.	16700-05E10 16700-05E20	16700-08E10
Item		
Dimension "MS" mm (in)	1.1 - 1.3 (0.043 - 0.051)	0.4 - 0.6 (0.016 - 0.024)
		
SEF856		

Adjusting closing plug	
Part number	Thickness mm (in)
19207-V0700	7.8 (0.307)
19207-V0701	8.0 (0.315)
19207-V0702	8.2 (0.323)
19207-V0703	8.4 (0.331)
19207-V0704	8.6 (0.339)
19207-V0705	8.8 (0.346)
19207-V0706	9.0 (0.354)
19207-V0707	9.2 (0.362)
19207-W1700	9.4 (0.370)
19207-W1701	9.6 (0.378)
19207-W1702	9.8 (0.386)
19207-W1703	10.0 (0.394)
19207-W1704	10.2 (0.402)
19207-W3400	10.4 (0.409)
19207-W3401	10.6 (0.417)

INJECTION PUMP

Service Data and Specifications (Cont'd)



Spacer

Part number	Thickness mm (in)
19275-W3400	3.8 (0.150)
19275-W3401	4.0 (0.157)
19275-W3402	4.2 (0.165)
19275-W3403	4.4 (0.173)
19275-W3404	4.6 (0.181)
19275-W3405	4.8 (0.189)
19275-W3406	5.0 (0.197)

Boost compensator

Boost compensator	Stroke mm (in)	3.4 - 3.6 (0.134 - 0.142)
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Adjustment value on injection pump tester

Applied parts No. 16700-05E10

Item	Injection pump rpm	Adjustment value	Boost pressure kPa (mbar, mmHg, inHg)	Allowable imbalance
Timer piston stroke	900	2.6 - 3.2 mm (0.102 - 0.126 in)	—	—
Feed pump pressure	900	284 - 343 kPa (2.84 - 3.43 bar, 2.9 - 3.5 kg/cm ² , 41 - 50 psi)	—	—
Fuel injection quantity				
Start	100	40.0 - 50.0 mL (1.41 - 1.76 Imp fl oz)/ 1,000 st	—	—
Idle	325	6.7 - 9.7 mL (0.24 - 0.34 Imp fl oz)/ 1,000 st	—	3.0 mL (0.11 Imp fl oz)/ 1,000 st
Full-load	900	31.3 - 32.3 mL (1.10 - 1.14 Imp fl oz)/ 1,000 st	—	2.5 mL (0.09 Imp fl oz)/ 1,000 st
Max. speed	2,700	7.2 - 13.2 mL (0.25 - 0.46 Imp fl oz)/ 1,000 st	—	—
Load timer	900	Fuel injection quantity 9.0 - 11.0 mL (0.32 - 0.39 Imp fl oz)/1,000 st Timer piston retard 1.3 - 1.9 mm (0.051 - 0.075 in)		—

INJECTION PUMP

Service Data and Specifications (Cont'd)

Applied parts No. 16700-05E20

Item	Injection pump rpm	Adjustment value	Boost pressure kPa (mbar, mmHg, inHg)	Allowable imbalance
Timer piston stroke	900	2.1 - 2.7 mm (0.083 - 0.106 in)	—	—
Feed pump pressure	900	284 - 343 kPa (2.84 - 3.43 bar, 2.9 - 3.5 kg/cm ³ , 41 - 50 psi)	—	—
Fuel injection quantity				
Start	100	40.0 - 50.0 mL (1.41 - 1.76 Imp fl oz)/ 1,000 st	—	—
Idle	325	6.7 - 9.7 mL (0.24 - 0.34 Imp fl oz)/ 1,000 st	—	3.0 mL (0.11 Imp fl oz)/ 1,000 st
Full-load	900	31.3 - 32.3 mL (1.10 - 1.14 Imp fl oz)/ 1,000 st	—	2.5 mL (0.09 Imp fl oz)/ 1,000 st
Max. speed	2,700	7.2 - 13.2 mL (0.24 - 0.46 Imp fl oz)/ 1,000 st	—	—
Load timer	900	Fuel injection quantity 9.0 - 11.0 mL (0.32 - 0.39 Imp fl oz)/1,000 st Timer piston retard 1.2 - 1.8 mm (0.047 - 0.071 in)	—	—

Applied parts No. 16700-08E10

Item	Injection pump rpm	Adjustment value	Boost pressure kPa (mbar, mmHg, inHg)	Allowable imbalance
Time piston stroke	900	2.3 - 2.9 mm (0.091 - 0.114 in)	32.7 - 35.3 (327 - 353, 245 - 265, 9.65 - 10.43)	—
Feed pump pressure	900	284 - 343 kPa (2.84 - 3.43 bar, 2.9 - 3.5 kg/cm ² , 41 - 50 psi)	32.7 - 35.3 (327 - 353, 245 - 265, 9.65 - 10.43)	—
Fuel injection quantity				
Start	100	40.0 - 50.0 mL (1.41 - 1.76 Imp fl oz)/ 1,000 st	0	—
Idle	325	4.5 - 7.5 mL (0.16 - 0.26 Imp fl oz)/ 1,000 st	0	3.0 mL (0.11 Imp fl oz)/ 1,000 st
Full-load (Base)	600	29.9 - 30.9 mL (1.05 - 1.09 Imp fl oz)/ 1,000 st	0	2.5 mL (0.09 Imp fl oz)/ 1,000 st
Max. speed	2,700	16.7 - 12.7 mL (0.24 - 0.45 Imp fl oz)/ 1,000 st	66.7 - 69.3 (667 - 693, 500 - 520, 19.69 - 20.47)	—
Full-load*	900	37.0 - 38.0 mL (1.30 - 1.34 Imp fl oz)/ 1,000 st	32.7 - 35.3 (327 - 353, 245 - 265, 9.65 - 10.43)	—

* After adjusting base full-load fuel injection quantity, adjust fuel injection quantity by turning boost compensator ratchet nut.

INJECTION PUMP

Service Data and Specifications (Cont'd)

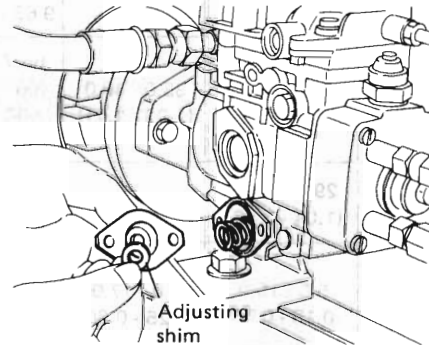
Inspection value on injection pump tester

Feed pump pressure

Fuel injection pump rpm	Specified pressure kPa (bar, kg/cm ² , psi)	
	16700-05E10 16700-05E20	16700-08E10
900	275 - 353 (2.75 - 3.53, 2.8 - 3.6, 40 - 51)	275 - 353 (2.75 - 3.53, 2.8 - 3.6, 40 - 51)
1,200	—	333 - 412 (3.33 - 4.12, 3.4 - 4.2, 48 - 60)
1,800	481 - 559 (4.81 - 5.59, 4.9 - 5.7, 70 - 81)	—
2,300	608 - 686 (6.08 - 6.86, 6.2 - 7.0, 88 - 100)	—
2,400	—	637 - 716, (6.37 - 7.16, 6.5 - 7.3, 92 - 104)

Speed timer (Timer piston stroke)

Fuel injection pump rpm	Timer piston stroke mm (in)		
	16700-05E10	16700-05E20	16700-08E10
900	2.5 - 3.3 (0.098 - 0.130)	2.0 - 2.8 (0.079 - 0.110)	2.2 - 3.0 (0.087 - 0.118)
1,200	—	—	3.6 - 4.8 (0.142 - 0.189)
1,800	6.8 - 8.0 (0.268 - 0.315)	6.4 - 7.6 (0.252 - 0.299)	—
2,300	8.1 - 9.0 (0.319 - 0.354)	8.1 - 9.0 (0.319 - 0.354)	—
2,400	—	—	8.9 - 9.8 (0.350 - 0.386)



SEF575

Adjusting shim

Part number	Thickness mm (in)
16880-V0700	0.6 (0.024)
16880-V0701	0.7 (0.028)
16880-V0702	0.9 (0.035)
16880-V0703	1.0 (0.039)
16880-V0704	1.2 (0.047)

INJECTION PUMP

Service Data and Specifications (Cont'd)

Fuel injection quantity

Setting condition of fuel injection pump	Fuel injection pump rpm	Standard fuel injection ml (Imp fl oz)/1,000 stroke		
		16700-05E10 16700-05E20	16700-08E10	Boost pressure kPa (mbar, mmHg, inHg)
Idle	325	6.2 - 10.2 (0.22 - 0.36)	4.0 - 8.0 (0.14 - 0.28)	0
	500	Max. 4.0 (0.14)	—	—
Full-load	600	29.3 - 33.3 (1.03 - 1.17)	29.4 - 31.4 (1.03 - 1.11)	0
	900	30.8 - 32.8 (1.08 - 1.15)	36.5 - 38.5 (1.28 - 1.36)	32.7 - 35.3 (327 - 353, 245 - 265, 9.65 - 10.43)
	2,200	—	35.0 - 40.0 (1.23 - 1.41)	66.7 - 69.3 (667 - 693, 500 - 520, 19.69 - 20.47)
	2,300	29.5 - 33.5 (1.04 - 1.18)	—	—
	900	5.0 - 15.0 (0.18 - 0.53)	7.0 - 17.0 (0.25 - 0.60)	32.7 - 35.3 (327 - 353, 245 - 265, 9.65 - 10.43)
Max. pump speed	2,700	6.7 - 13.7 (0.24 - 0.48)	6.2 - 13.2 (0.22 - 0.46)	66.7 - 69.3 (667 - 693, 500 - 520, 19.69 - 20.47)
	2,800	Max. 6.0 (0.21)	Max. 6.0 (0.21)	66.7 - 69.3 (667 - 693, 500 - 520, 19.69 - 20.47)
Fuel overflow (10 sec at 900 rpm)		35.0 - 79.0 (1.23 - 2.78)	—	—
(10 sec at 1,000 rpm)		—	36.0 - 80.0 (1.27 - 2.82)	—

*This test is performed at control lever angle "γ".

Allowable imbalance

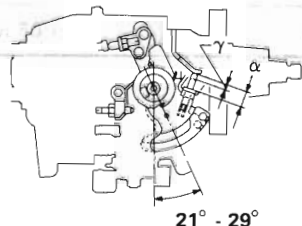
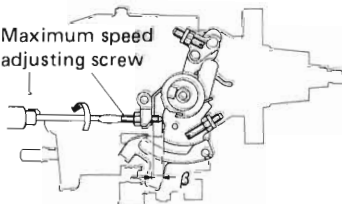
Allowable imbalance ml (Imp fl oz)/ 1,000 stroke	Idle	3.0 (0.11)
	Full-load	2.5 (0.09)

INJECTION PUMP

Service Data and Specifications (Cont'd)

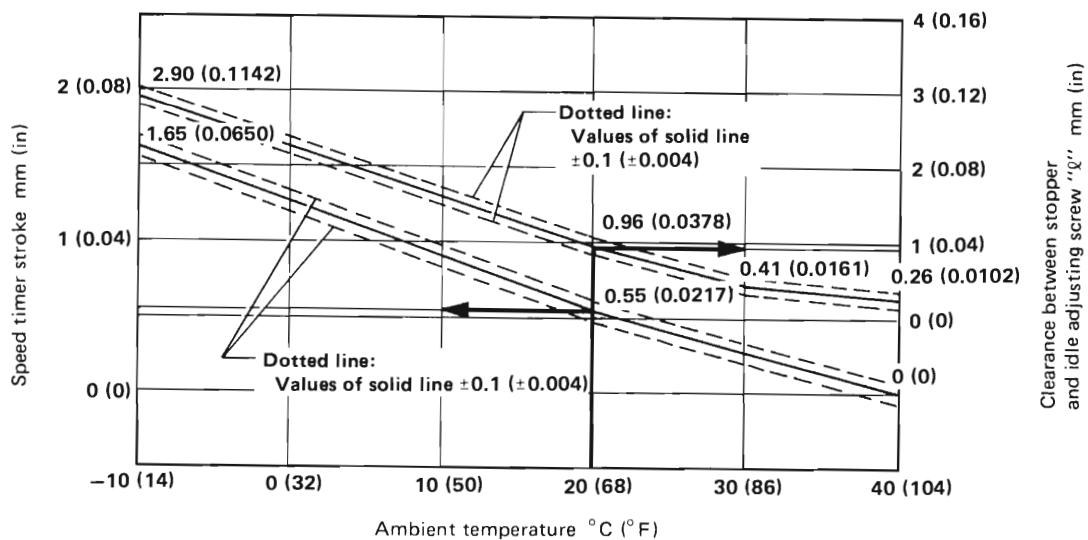
Fuel control lever angle

Check the adjustment screws' protrusions to determine if the control lever is set at the correct angles for idle and maximum speed.

		Unit: mm (in)	
Control lever position	Figure	Projection of screw	
Idle	 α: Idle γ: Partial load SEF453C	α	7.6 - 11.7 (0.299 - 0.461)
		γ	5.7 - 6.3 (0.224 - 0.248)
Maximum	 Maximum speed adjusting screw SEF988B	β	11.2 - 14.6 (0.441 - 0.575)

Cold start device adjustment

Relationship between speed timer stroke and clearance between idle adjusting screw and stopper

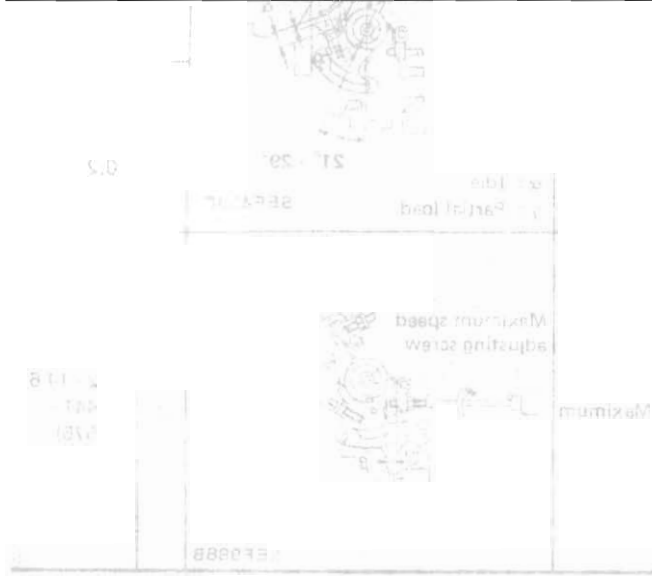


INJECTION PUMP

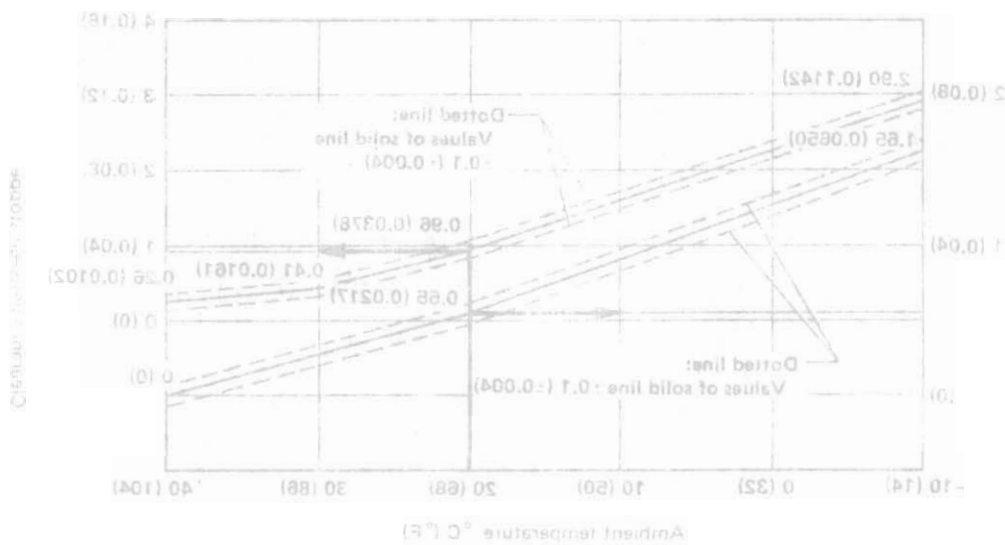
Service Data and Specifications (Cont'd)

Cold start device inspection

Ambient temperature °C (°F)	Speed timer stroke mm (in)	Clearance between stopper and idle adjusting screw deg.	Remarks
20±0.5 (68±0.9)	0.55±0.2 (0.022±0.008)	2±0.5°	
-10 (14)	1.65 (0.0650)	6°	Reference value



Relationship between speed timer stroke and clearance between idle adjusting screw and stopper



INJECTION PUMP

Service Data and Specifications (Cont'd)

TIGHTENING TORQUE

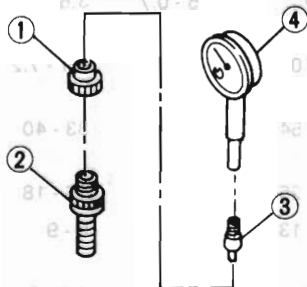
Unit	N·m	kg·m	ft·lb
Cold start device fixing bolt	5 - 7	0.5 - 0.7	3.6 - 5.1
Control shaft to control lever	7 - 10	0.7 - 1.0	5.1 - 7.2
Delivery valve to distributor head	44 - 54	4.5 - 5.5	33 - 40
Delivery valve to tube	22 - 25	2.2 - 2.5	16 - 18
Distributor head to pump housing	11 - 13	1.1 - 1.3	8 - 9
Fast idle control lever adjusting screw nut	6 - 9	0.6 - 0.9	4.3 - 6.5
Feed pump cover to pump housing	2 - 3	0.2 - 0.3	1.4 - 2.2
Fuel cut solenoid valve	20 - 25	2.0 - 2.5	14 - 18
Fuel inlet connector to pump housing	2 - 3	0.2 - 0.3	1.4 - 2.2
Full load adjusting screw lock nut	6 - 9	0.6 - 0.9	4.3 - 6.5
Governor control shaft nut	7 - 10	0.7 - 1.0	5.1 - 7.2
Governor cover to pump housing	7 - 10	0.7 - 1.0	5.1 - 7.2
Governor shaft lock nut	25 - 29	2.5 - 3.0	18 - 22
Injection pump pulley nut	59 - 69	6.0 - 7.0	43 - 51
Lock plate lock nut	25 - 34	2.5 - 3.5	18 - 25
Maximum and idle speed adjusting screw lock nut	6 - 9	0.6 - 0.9	4.3 - 6.5
Overflow valve	20 - 25	2.0 - 2.5	14 - 18
Pivot pin to pump housing	10 - 13	1.0 - 1.3	7 - 9
Plug bolt	14 - 20	1.4 - 2.0	10 - 14
Plug to distributor head	59 - 78	6.0 - 8.0	43 - 58
Regulating valve to pump housing	8 - 9	0.8 - 0.9	5.8 - 6.5
Speed timer cover to pump housing	6 - 8	0.6 - 0.8	4.3 - 5.8

INJECTION PUMP

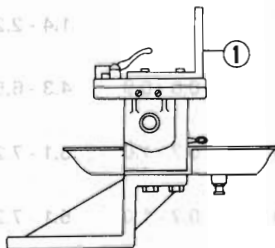
Special Service Tools

(Cont'd)

Adjusting device on vehicle

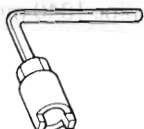
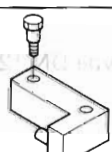
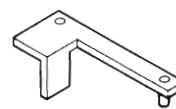
Tool number	Tool name	
KV11229352	Measuring device (Set length of plunger spring)	
① KV11229350	Holder	
② KV11229360	Nut	
③ KV11229370	Pin	
④ KV11254410	Dial gauge	

Disassembling and assembling tools

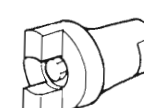
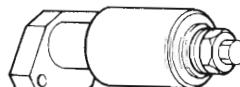
KV11294005 ① KV11244260	Universal vice assembly Injection pump attaching plate	
KV11229072	Insert device	
KV11214110	Socket wrench for delivery valve	
KV11214270	Socket wrench for governor pivot bolt	
KV11214260	Socket wrench for regulating valve	
KV11214250	Socket wrench for distributor head plug	

INJECTION PUMP

Special Service Tools (Cont'd)

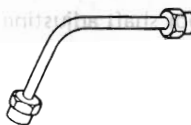
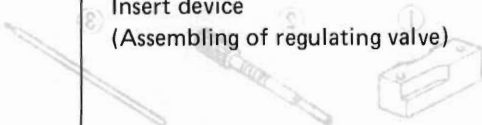
Tool number	Tool name	
KV11215262	Governor shaft adjusting device	
KV11229540	Feed pump holder	
KV11229852 ① KV11229110 ② KV11229820 ③ KV11229830	"MS" measuring device set Block gauge Dummy shaft Rod	
KV11229042	"K" & "KF" measuring device	
KV11229752	Block gauge for "MS" dimension (For boost compensator)	
KV11229762	Block gauge (For boost compensator)	

Adjusting device on pump tester

KV11281036	Fixing stand	
KV11242452	Coupling	
KV11282815 KV11282819	Measuring device (Timer advance angle)	

INJECTION PUMP

Special Service Tools (Cont'd)

Tool number	Tool name	
KV11205032	Injection pipe [840 mm (33.07 in)]	
KV11229462	Extractor (Disassembling of regulating valve)	
KV11229522	Insert device (Assembling of regulating valve)	
KV11257802	Nozzle holder (Bosch type EF8511-9A)	
KV11257800	Nozzle (Bosch type DN 12SD12T)	
		
		
		
		

INJECTION NOZZLE ASSEMBLY

Disassembly

CAUTION:

Plug flare nut with a cap or rag so that no dust enters the nozzle. Cover nozzle tip for protection of needle.

Removal and Installation

1. Remove fuel injection tube and spill tube assembly.
2. Remove injection nozzle assembly.

Also remove washers from nozzle end.

3. Install injection nozzle in the reverse order of removal.

 : Injection nozzle to engine

59 - 69 N·m

(6.0 - 7.0 kg-m, 43 - 51 ft-lb)

Injection nozzle to tube

22 - 25 N·m

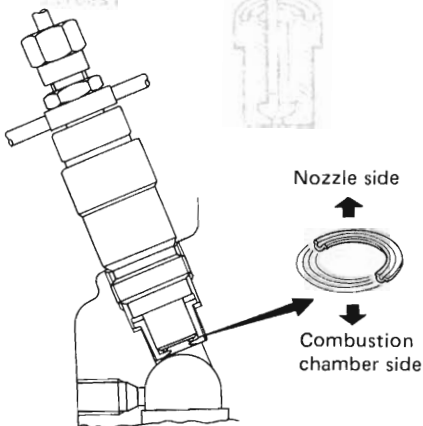
(2.2 - 2.5 kg-m, 16 - 18 ft-lb)

Spill tube

39 - 49 N·m

(4.0 - 5.0 kg-m, 29 - 36 ft-lb)

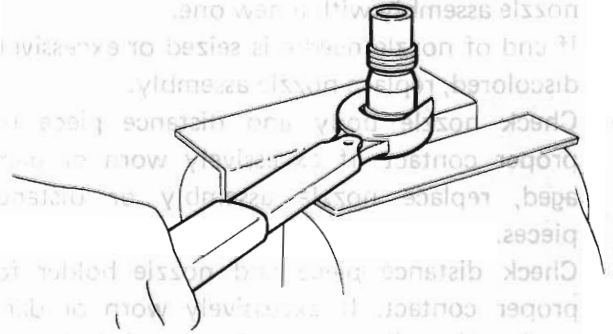
- a. Always clean nozzle holes.
- b. Always use new injection nozzle gasket.
- c. Note that small washer should be installed in specified direction.



SEF006C

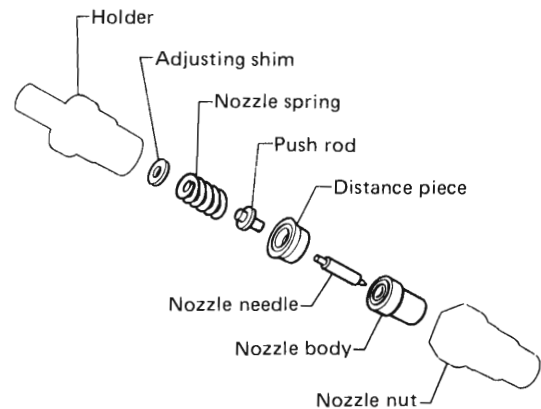
- d. Bleed air from fuel system.

1. Loosen nozzle nut while preventing nozzle top from turning.



SEF669A

2. Arrange all of disassembled parts in the order shown below.



SEF670A

INJECTION NOZZLE ASSEMBLY

Inspection

Thoroughly clean all disassembled parts with fresh kerosene or solvent.

- If nozzle needle is damaged or fused, replace nozzle assembly with a new one.
- If end of nozzle needle is seized or excessively discolored, replace nozzle assembly.
- Check nozzle body and distance piece for proper contact. If excessively worn or damaged, replace nozzle assembly or distance pieces.
- Check distance piece and nozzle holder for proper contact. If excessively worn or damaged, replace distance piece or nozzle holder.
- Check nozzle spring for excessive wear or damage. If excessively worn or damaged, replace it with a new spring.



Cleaning

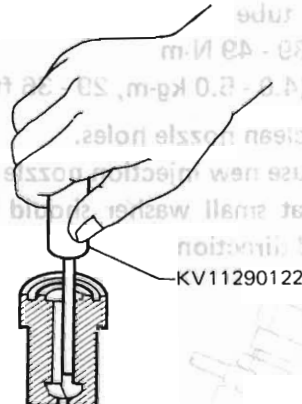
- Do not touch the nozzle mating surface with your fingers.
- To wash the nozzles, use a wooden stick and brass brush with clean diesel fuel.

- Remove any carbon from exterior of nozzle body (except wrapping angle portion) by using Tool.

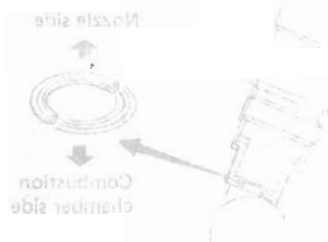


SEF830

- Clean oil sump of nozzle body using Tool.



SEF831



SEF008C

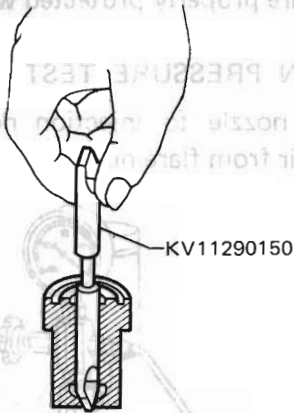
d. Bleed air from fuel system.

INJECTION NOZZLE ASSEMBLY

Cleaning (Cont'd)

3. Clean nozzle seat by using Tool.

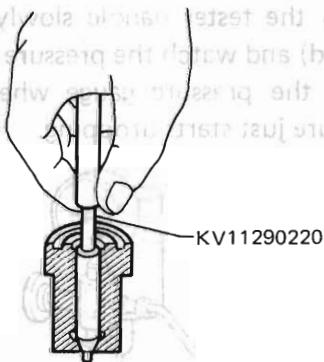
This job should be performed with extra precautions, since efficiency of nozzle depends greatly on a good nozzle seat.



SEF832

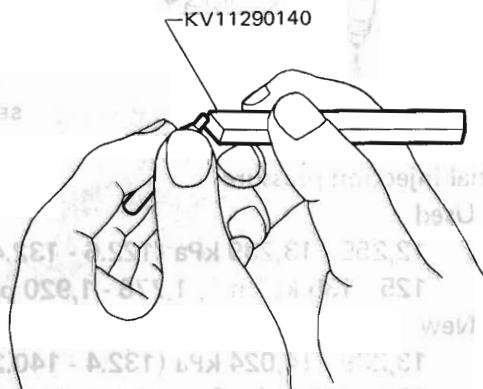
4. Clean spray hole of nozzle body by using Tool.

To prevent spray hole from canting, always clean it by starting with inner side and working towards outside.



SEF833

5. Decarbonate nozzle needle tip by using Tool.

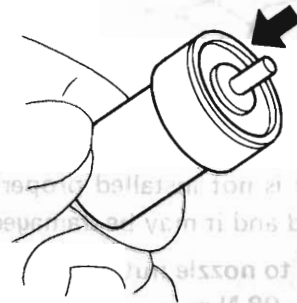


SEF834

6. Check sinking test.

- (1) Pull needle about halfway out from body and then release it.
- (2) Needle should sink into body very smoothly from just its own weight.
- (3) Repeat this test and rotate needle slightly each time.

If needle fails to sink smoothly from any position, replace both needle and body as a unit.

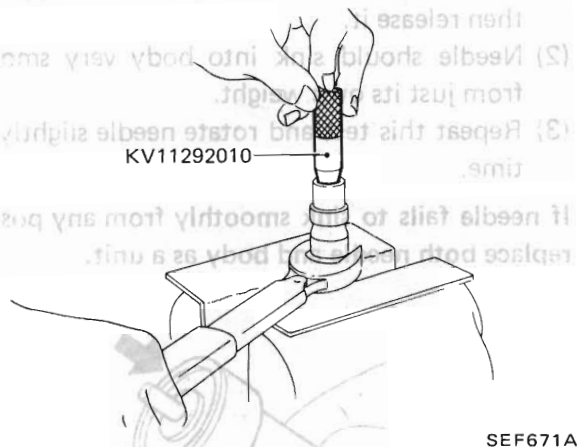


SEF835

INJECTION NOZZLE ASSEMBLY

Assembly

Assemble in the reverse order of disassembly, observing the following.



If nozzle body is not installed properly, Tool cannot be removed and it may be damaged.

 : Holder to nozzle nut
78 - 98 N·m
(8.0 - 10.0 kg·m, 58 - 72 ft·lb)

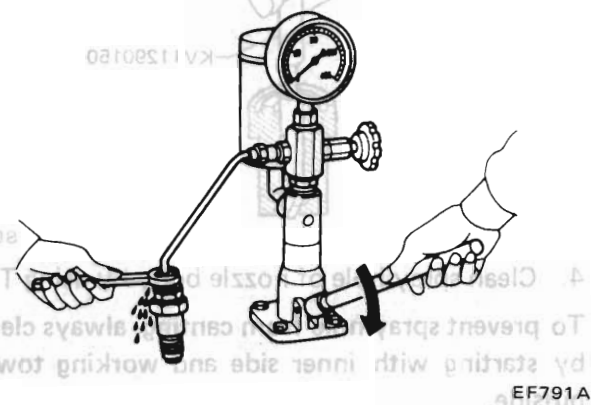
Test and Adjustment

WARNING:

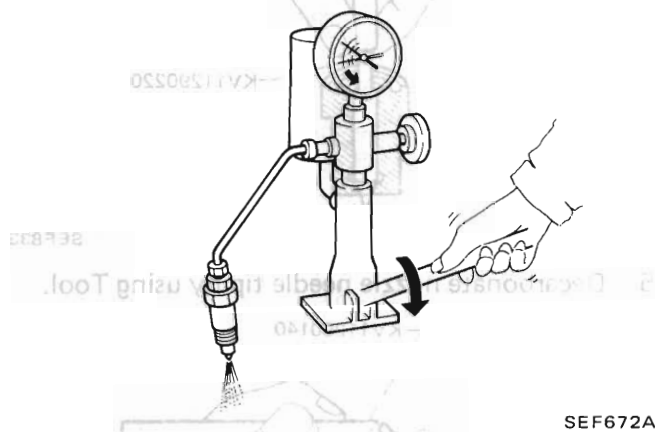
When using nozzle tester, be careful not to allow diesel fuel sprayed from nozzle to come into contact with your hand or body, and make sure that your eyes are properly protected with goggles.

INJECTION PRESSURE TEST

1. Install nozzle to injection nozzle tester and bleed air from flare nut.



2. Pump the tester handle slowly (one time per second) and watch the pressure gauge.
3. Read the pressure gauge when the injection pressure just starts dropping.



Initial injection pressure:

Used

12,259 - 13,239 kPa (122.6 - 132.4 bar,
125 - 135 kg/cm², 1,778 - 1,920 psi)

New

13,239 - 14,024 kPa (132.4 - 140.2 bar,
135 - 143 kg/cm², 1,920 - 2,033 psi)

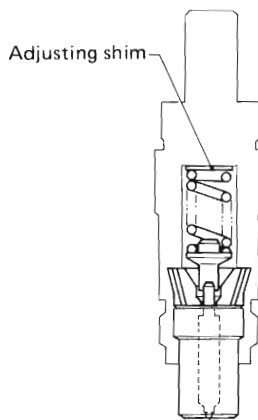
INJECTION NOZZLE ASSEMBLY

Test and Adjustment (Cont'd)

New nozzle is required to always check initial injection pressure.

4. To adjust injection pressure, change adjusting shims.
 - a. Increasing the thickness of adjusting shims increases initial injection pressure. Decreasing thickness reduces initial pressure.
 - b. A shim thickness of 0.04 mm (0.0016 in) corresponds approximately to a difference of 471 kPa (4.71 bar, 4.8 kg/cm², 68 psi) in initial injection pressure.

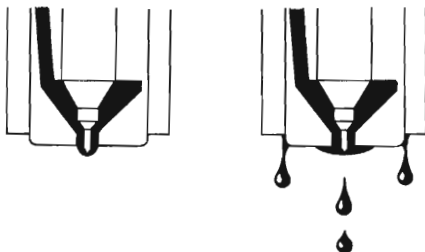
Refer to S.D.S. for adjusting shim.



SEF673A

LEAKAGE TEST

1. Maintain the pressure at about 981 to 1,961 kPa (9.8 to 19.6 bar, 10 to 20 kg/cm², 142 to 284 psi) below initial injection pressure.
2. Check that there is no dripping from the nozzle tip or around the body.



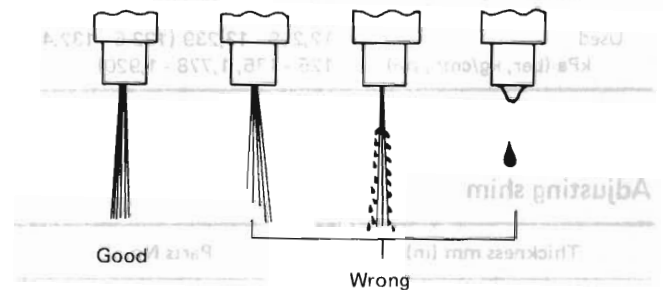
Good

Faulty

SEF674A

SPRAY PATTERN TEST

1. Pump the tester handle one time per second.
2. Check the spray pattern.



EF794

3. If the spray pattern is not correct, clean or replace nozzle.

TIGHTENING TORQUE

Part	Unit	Value
Injection nozzle to engine	N·m	5.0 - 7.0
Injection to tube fitting	N·m	2.5 - 3.5
Ball valve nut	N·m	4.0 - 5.0
Nozzle holder to nozzle nut	N·m	8.0 - 10.0

3. If there is leakage, clean, overhaul or replace nozzle.

INJECTION NOZZLE ASSEMBLY

Service Data and Specifications

INSPECTION AND ADJUSTMENT

Injection nozzle assembly

Initial injection pressure

New	13,239 - 14,024 (132.4 - 140.2, kPa (bar, kg/cm ² , psi)
Used	12,259 - 13,239 (122.6 - 132.4, kPa (bar, kg/cm ² , psi)

Adjusting shim

Thickness mm (in)	Parts No.
0.50 (0.0197)	16613-V0700
0.54 (0.0213)	16613-V0702
0.58 (0.0228)	16613-V0704
0.62 (0.0244)	16613-V0706
0.66 (0.0260)	16613-V0708
0.70 (0.0276)	16613-V0710
0.74 (0.0291)	16613-V0712
0.78 (0.0307)	16613-V0714
0.82 (0.0323)	16613-V0716
0.86 (0.0339)	16613-V0718
0.90 (0.0354)	16613-V0720
0.94 (0.0370)	16613-V0722
0.98 (0.0386)	16613-V0724
1.00 (0.0394)	16613-V0760

TIGHTENING TORQUE

	N·m	kg·m	ft·lb
Injection nozzle to engine	59 - 69	6.0 - 7.0	43 - 51
Injection to tube flare nut	22 - 25	2.2 - 2.5	16 - 18
Spill tube nut	39 - 49	4.0 - 5.0	29 - 36
Nozzle holder to nozzle nut	78 - 98	8.0 - 10.0	58 - 72

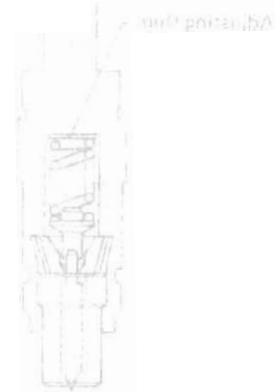
New nozzle is required to always check initial injection pressure.

To adjust injection pressure, change adjusting shim.

Increasing the thickness of adjusting shims increases initial injection pressure. Decreasing thickness reduces initial pressure.

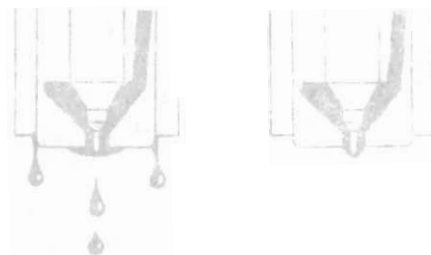
A shim thickness of 0.04 mm (0.0016 in) corresponds approximately to a difference of 4.71 kPa (4.71 bar, 4.8 kg/cm², 68 psi) in initial injection pressure.

Refer to S.D.S. for adjusting shim.



LEAKAGE TEST

Maintain the pressure at about 981 to 1,081 kPa (9.8 to 10.8 bar, 10 to 20 kg/cm², 142 to 284 psi) below initial injection pressure. Check that there is no dripping from the nozzle tip or around the body.



SEFB7AA

3. If there is leakage, clean, overhaul or replace nozzle.

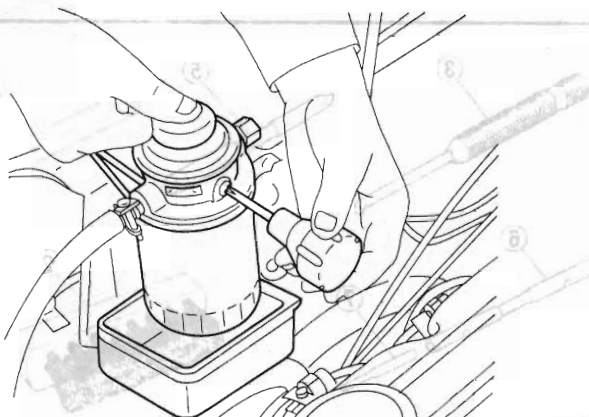
INJECTION NOZZLE ASSEMBLY

Special Service Tools

Tool number	Tool name	
KV11289004	Nozzle cleaning kit	
① KV11290012 ② KV11290110 ③ KV11290122 ④ KV11290140 ⑤ KV11290150 ⑥ KV11290210 ⑦ KV11290220	Box Brush Nozzle oil sump scraper Nozzle needle tip cleaner Nozzle seat scraper Nozzle holder Nozzle hole cleaning needle	
KV11292010	Nozzle centering device	

BLEEDING FUEL SYSTEM

Air should be bled out of fuel system when injection pump is removed or fuel system is repaired.



SEF007C

1. Loosen priming pump vent screw and priming. Make sure that fuel overflows at air vent screw hole.
2. Tighten vent screw.
3. Then, disconnect fuel return hose.
4. Prime priming pump to make sure that fuel overflows at hose end.
5. Install fuel return hose.



Tool number	Tool name
1004	Nozzle cleaning kit
KA11380013	Box
KA11380010	Brush
KA11380033	Nozzle oil pump scraper
KA11380140	Nozzle needle tip cleaner
KA11380180	Nozzle seat scraper
KA11380210	Nozzle holder
KA11380250	Nozzle hole cleaning needle
KA11380210	Nozzle centering device

TURBOCHARGER

Inspection

Condition 1: Low engine power

Probable cause

Corrective action

Air leak at the connection of compressor housing and suction hose/inlet tube, or inlet tube and intake manifold.

Correct the connection.

Exhaust gas leak at the connection of turbine housing and exhaust manifold, connecting tube or exhaust outlet

Correct the connection or replace gasket.

By-pass valve is stuck open.

Stuck or worn journal or bearing

Broken shaft

Sludge on back of turbine wheel

Broken turbine wheel

Replace turbocharger assembly.

Condition 2: Excessively high engine power

Probable cause

Corrective action

Disconnected or cracked rubber hose

Correct or replace rubber hose.

By-pass valve is stuck closed.

Replace turbocharger assembly.

Controller diaphragm is broken.

TURBOCHARGER

Inspection (Cont'd)

Condition 3: Excessively high oil consumption or exhaust shows pale blue smoke

Probable cause

Corrective action

Oil leak at the connection of lubricating oil passage

Correct the connection.

Oil leak at oil seal of turbine

Oil leak at oil seal of compressor

Replace turbocharger assembly.

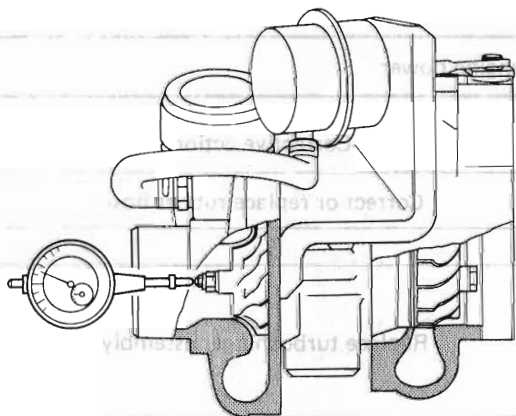
Worn journal or bearing

1. Inspect turbine and compressor wheel as follows:

- Visually check for cracks, clogging, deformity or other damage.
- Revolve wheels to make sure that they turn freely without any abnormal noise or friction.
- Measure play in axial direction.

Play (axial direction):

0.013 - 0.091 mm (0.0005 - 0.0036 in)



SEF950B

2. Check operation of by-pass valve controller.

- Move by-pass valve to make sure that it is not sticking or scratched.
- Measure rod end play of the by-pass valve controller.

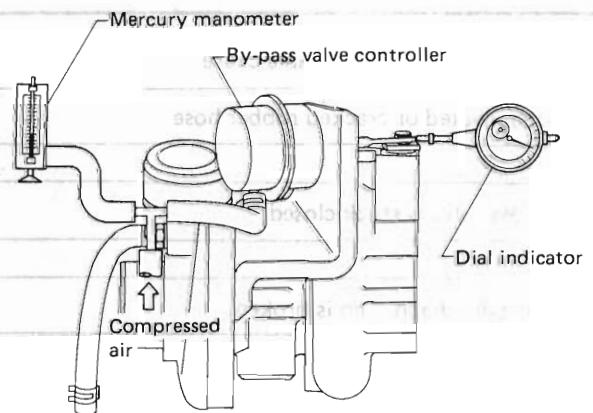
Do not apply more than 98 kPa (0.98 bar, 1.0 kg/cm², 14 psi) pressure to controller diaphragm.

By-pass valve controller stroke/pressure:

0.38 mm (0.0150 in)/72.0 - 77.3 kPa

(720 - 773 mbar, 540 - 580 mmHg,

21.26 - 22.83 inHg)



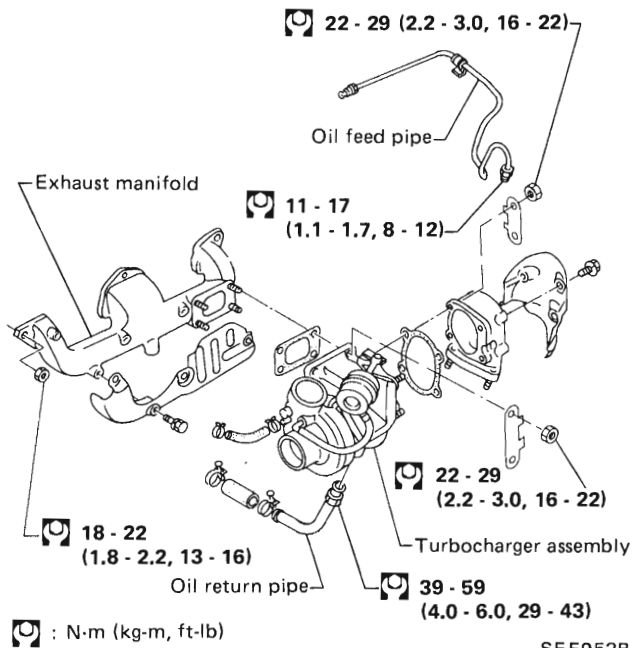
SEF951B

Always replace the turbocharger as an assembly if faulty.

TURBOCHARGER

Removal and Installation

Turbocharger should not be disassembled.



1. Remove the following.

- Exhaust outlet
- Air duct and hoses
- Oil feed pipe and oil return pipe
- Turbocharger

2. When installing turbocharger to exhaust manifold, securely tighten nuts and bend up new lock washers.



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