

ENGINE

RE, RF, & RG series

RE10, RF8 AND RG8

SERVICE MANUAL

ENGINE SERVICE MANUAL

MODEL RE, RF & RG series

Applicable Engines & Engine Numbers

RF8 : RF8 - 100001 ~

RG8 : RG8 - 000001 ~

RE10 : RE10 - 100001 ~

FOREWORD

This service manual covers service procedures for the RF8, RG8 and RE10 diesel engines. In order for an engine to display 100% performance at all times, and to expand the life of each part, daily inspection and servicing must, of course, be performed according to plan, but proper overhaul and repair in accordance with the maintenance standard is also vital.

Keep this manual in the shop for everyone engaged in servicing of these engines.

Nissan Diesel Motor Co., Ltd. reserves the right to make changes for improvement at any time without prior notice.

Accordingly, some of the descriptions contained in this manual may not be applicable to your particular model.

QUICK REFERENCE INDEX

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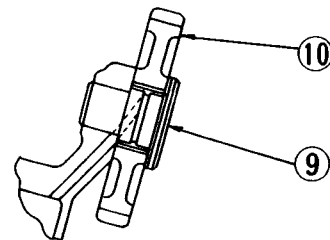
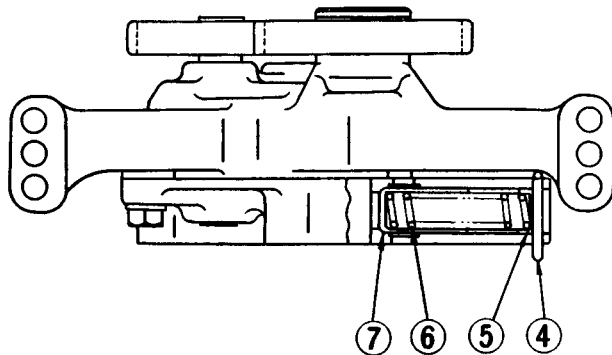
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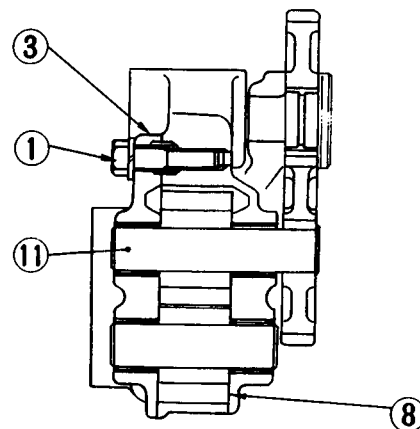
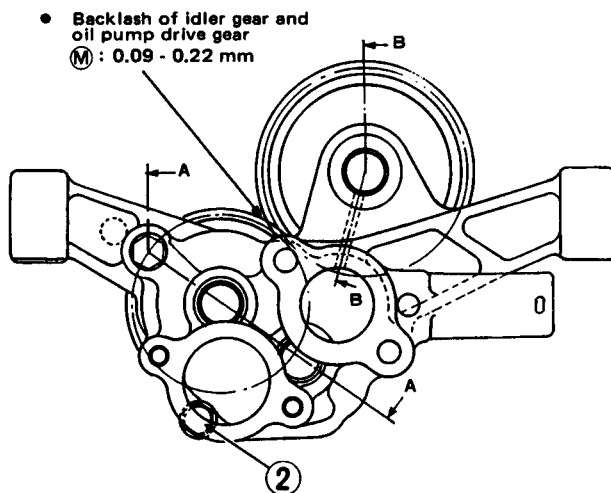
HOW TO USE THIS MANUAL

- ▶ **A quick reference index**, a black tab is provided on the first page, so you can quickly find the first page of each chapter by mating it to the chapter's black tab.
- ▶ **The contents** are listed on the first page of each chapter.
- ▶ **Construction illustration:**

The assembled unit is indicated. The construction illustration includes the names of the major components, items requiring adjustment after reassembling and their maintenance standards.



SECTION B-B



SECTION A-A

Ⓜ : Maintenance standard

► **Exploded: illustration:**

The number given to each part in the illustration corresponds to the number attached to each part name, and the number is determined according to the operation sequence.

No. ①, ②, ③ Disassembly sequence

Reassembly sequence is in the reverse order of disassembly.

The marks “★” and “☆” affixed to the part name number indicate that the key points of operation (precautions, technique, use of special tools, and other maintenance information) are explained in the text.

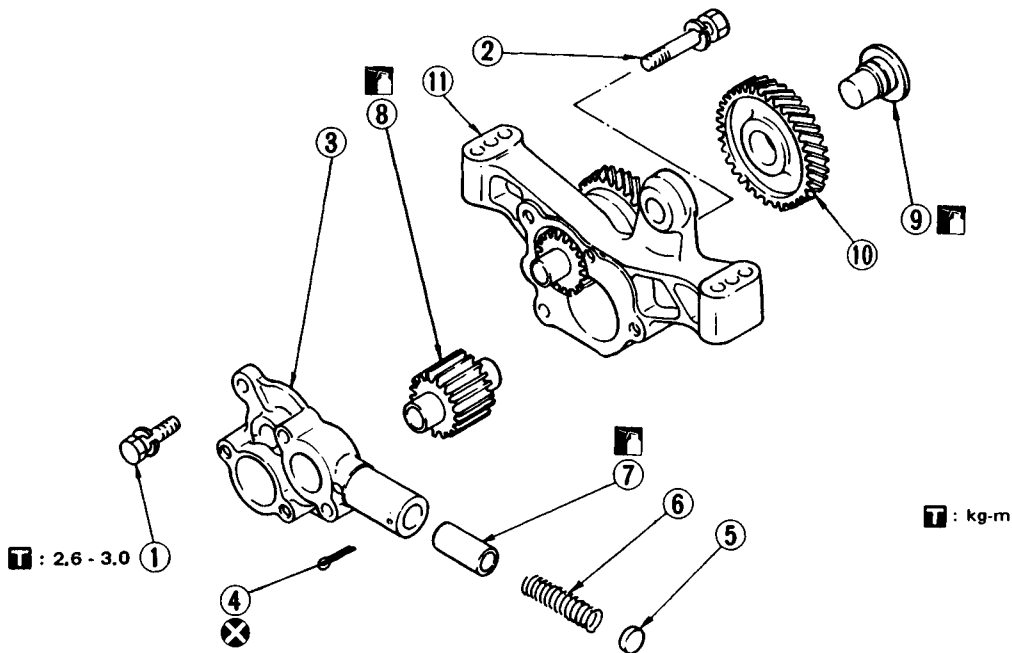
★: Key points of disassembly

☆: Key points of reassembly

The tightening torque necessary for maintenance and lubricating points are indicated by symbols in the illustration.

Note:

- Disassembly and assembly sequences show general examples and in some operations it may be possible to change sequences.



EGE1-001H

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | | |
|---------------|---------------------|--------------------|
| ① Bolt | ⑤ Spring seat | ⑨ Spindle |
| ② Bolt | ⑥ Spring | ⑩ Idler gear ass'y |
| ③ Cover ass'y | ⑦ Relief valve | ⑪ Pump gear ass'y |
| ④ Split pin | ⑧ Driven gear ass'y | (drive gear) |

► **Removal and installation, disassembly and reassembly:**

Explanation of removal and installation, disassembly and reassembly is limited to the parts indicated by the star marks “★” and “☆” affixed to the sequence number in the exploded illustration.

Note:

- If there are no “★” and “☆” marks affixed to the parts, general explanation is given for those parts.

- The following **marks** and **abbreviations** are used in this manual.

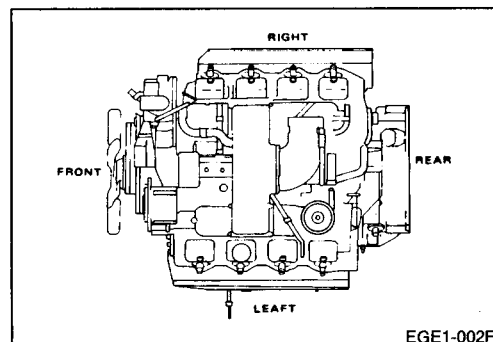
Marks :

-  : Tightening torque
 : Should be lubricated with grease. Unless otherwise indicated, use recommended multi-purpose grease.
 : Should be lubricated with oil.
 : Sealing point
 : Always replace after every disassembly.

Abbreviations

T.D.C.	: Top dead center
B.T.D.C.	: Before top dead center
A.T.D.C.	: After top dead center
B.B.D.C.	: Before bottom dead center
A.B.D.C.	: After bottom dead center
O.D.	: Outside diameter
I.D.	: Inside diameter
Dia.	: Diameter
O.S.	: Oversize
U.S.	: Undersize
Ass'y	: Assembly

- **Engine position:**



- **Unit:**

The metric system of measurement is used throughout this manual. When conversion of the corresponding **SI** unit (International System of Unit) or **English units** (Foot/pound system) of measurement is necessary, use the following:

1 mm		0.0394 in.
1 kg		9.807 N
		2.205 lb.
1 kgm		9.807 N·m
		7.23 lb. ft.
1 kg/cm ²		98.07 kPa
		14.223 psi
1 liter		0.220 Imp. gal.
		0.264 U.S. gal.

- **Specific terms related to the maintenance standard**

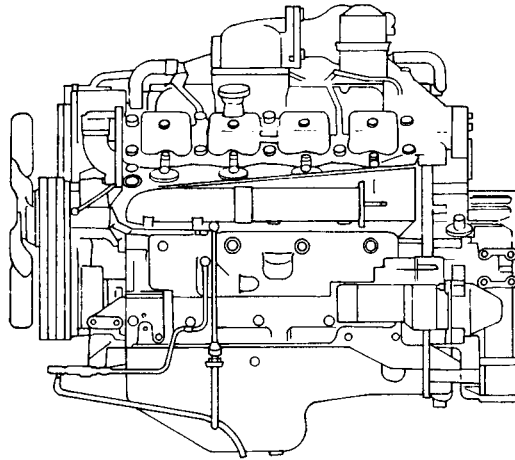
• **Maintenance standard**

"Maintenance standard" indicates the standard clearance when parts are assembled or the standard performances of assembly parts.

• **Service limit**

"Service limit" indicates the limit value where adjustment, correction or parts replacement must be done.

1. GENERAL



ER0-120

This chapter describes handling cautions of this manual and engine in general. Therefore, when repairing the RF8, RG8 and RE10 engines by using this manual, first read this chapter.

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SPECIFICATIONS

ENGINE SPECIFICATIONS

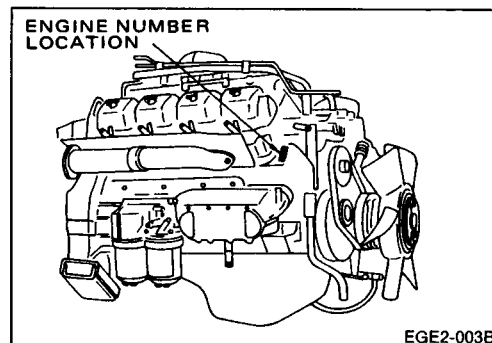
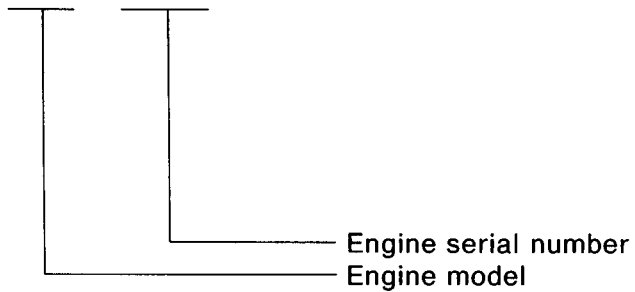
Item			Engine model	RF8	RG8	RE10	
Type				Diesel			
Cooling method				Water cooled			
Number of cylinders and cylinder arrangement				V8, vertical		V10, vertical	
Stroke cycle				4			
Combustion chamber				Direct fuel injection			
Valve mechanism				Overhead valve, gear driven, center camshaft			
Cylinder liner				Wet			
Bore x stroke [mm]				138.0 x 142.0	142 x 142	135.0 x 132.0	
Compression ratio				17.3 : 1			
Cylinder compression [kg/cm ² -rpm]				31.0 - 200			
Minimum engine speed under no-load conditions [rpm]				550 - 570	460 - 480	450 - 550	
Intake valve timing		Open		14° B.T.D.C.	18° B.T.D.C.	14° B.T.D.C.	
		Closed		44° A.B.D.C.	64° A.B.D.C.	44° A.B.D.C.	
Exhaust valve timing		Open		52° B.B.D.C.			
		Closed		20° A.T.D.C.			
Valve clearance [mm]		Intake		0.3 - 0.4			
		Exhaust		0.5 - 0.6			
Fuel system	Ignition system			Compression ignition			
	Fuel injection timing [B.T.D.C.]		Conventional type nozzle	17°	—		
			Two-spring type nozzle (Taiwan only)	18°	10.5°	18°	
	Ignition order			1R-1L-4R-4L-3L-2R-2L-3R		1R-1L-5R-5L-2R-2L-3R-3L-4R-4L	
	Fuel feed pump			Plunger type			
	Fuel filter		Main	Cartridge type			
			Primary	Filter paper			
	Fuel injection pump	Type	Bosch				
		Plunger diameter [mm]	12.0				
		Plunger lead	22+45				
		Cam lift [mm]	11.0	12.0	11.0		
		Governor	Centrifugal				
		Timer	Centrifugal				
	Fuel injection nozzle	Nozzle holder		Flange type			
		Nozzle		Multi-jet			
		Number of injection nozzle holes	Conventional type	5	—		
			Two-spring type	6	5		
		Injection pressure [kg/cm ²]	Conventional type	220	—		
			Two-spring type	180 - 220	180 - 230	180 - 220	
Over flow valve opening pressure [kg/cm ²]		Injection pump outlet		1.6			
		Fuel filter		1.3 ± 0.2			
Intake system	Air heater	Type		Ribbon			
		Voltage [V] x Current [A] x Number	Standard	22.5 x 85 x 2	22 - 85 x 2	22.5 x 85 x 2	
			Optional	22.5 x 170 x 2	—	22.5 x 170 x 2	

Item			Engine model	RF8	RG8	RE10
Lubricating system	Type			Forced circulation		
	Oil pump	Type		Gear pump		
		Amount of discharge [ℓ/rpm]		160/2500	160/2200	180/2500
		Safety valve opening pressure [kg/cm ²]		10.8	11.0	10.8
	Oil filter	Type	Full-flow type	Paper filter		
			By-pass type	Laminated filter plate type		
		Method of replacement		Disassembly		
		Short valve opening pressure [kg/cm ²]		1.2		
	Oil cooler	Type		Built-in, water cooled		
		Number of cores		10	12	
		Short valve opening pressure [kg/cm ²]		2.0		
Regulator valve opening pressure [kg/cm ²]			4.3	4.5	4.3	
Lubrication oil capacity [ℓ]			34		39	
Cooling system	Cooling system			Forced-circulation type		
	Radiator type			Corrugated fin		
	Outside diameter of cooling fan [mm]	Taiwan		ø600 or ø670	ø670	
		Except Taiwan		ø700	—	
	Water pump			Centrifugal, belt-driven type		
	Thermostat	Type		Wax-pellet type		
		Valve port diameter [mm]		50		
		Valve opening temperature [°C]		76.5, 82		82, 88
Valve lift/temperature [mm/°C]		More than 10/90, 95		More than 100 10/95,		
Electrical system	Starting motor	Type		Shift type		
		Output [V-kw]		24-6	24-7	24-8
	Alternator	Type		AC, diode-rectified		
		Output		24-40 or 24-50		
Regulator		IC-transistor type				
Auxiliary equipment	Air compressor	Type		Reciprocating type		
		Cooling system		Water-cooled		
	Hydraulic pump	Type		Vane, Gear driven		
		Regulating pressure [kg/cm ²]		135, 105		
	Engine rear PTO	Allowable maximum torque [kgm]		30.0		
		Direction of rotation		Clockwise (as viewed from the rear)		
Gear ratio (PTO: crankshaft)		1.0				

ENGINE NUMBERS

Engine serial numbers are stamped on the right-hand side of the front of the cylinder block, as shown in the following figure.

RF8	—	100001
RG8	—	000001
RE10	—	100001



LUBRICATION

RECOMMENDED FUEL AND LUBRICANTS

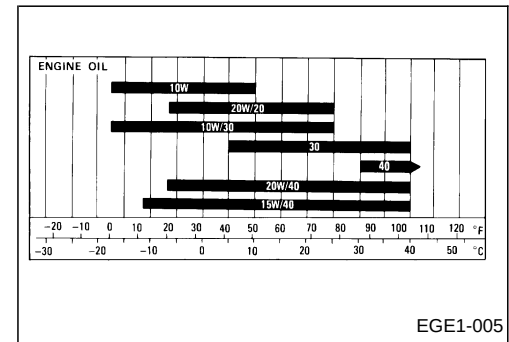
Lubricant		Specifications	Remarks
Engine oil		API CC or CD	For "Viscosity Number", refer to the undermentioned.
Power steering fluid		DEXRON ^R or DEXRON ^R II	GM ATF type
Bearing grease		NLGI No. 2	Lithium soap base
Antifreeze		—	Ethylene glycol base
Fuel	Above 20°F (– 7°C)	2-D Diesel fuel or equivalent blended diesel fuel	Check with the service establishment to be sure you get the properly blended fuel.
	Below 20°F (– 7°C)	1-D Diesel fuel or equivalent blended diesel fuel	

RECOMMENDED SAE VISCOSITY NUMBER

Use oil having the proper viscosity beforehand which meets temperatures forecast for areas where you are planning to drive.

CAPACITIES (APPROXIMATELY)

Item			Liter
Engine oil	Engine oil pan	RF8 & RG8 engines	24
		RE10 engine	29
	Total	RF8 & RG8 engines	34
		RE10 engine	39
Power steering system fluid			7.2
Cooling system		RF8 & RG8 engines	42
		RE10 engine	47



NOTE:

Capacities shown are for reference only. When filling, observe the specified level.

PRECAUTIONS

PREPARATION

When doing maintenance work on each section of the engine, the following points should be strictly observed:

- Park the vehicle in a level spot. If the area is not level, it will not be possible to perform oil inspections properly; it is also dangerous, since the vehicle may suddenly begin rolling down the incline.
- Set the parking brake to lock the wheels in place and chock both the front and rear wheels.
- Do not perform maintenance operations while the engine is still hot. Wait for it to cool first.
- Set the gearshift to neutral.
- Make sure the key is in the OFF position. When doing work on the electrical system, disconnect the battery cable from the negative terminal of the battery as well.
- When starting the engine to perform maintenance operations, be particularly careful not to touch any of the rotating parts. Also, make sure the area is well-ventilated when running the engine.

GENERAL REMARKS REGARDING DISASSEMBLY OPERATIONS

Establishing conditions prior to disassembly

Before starting to disassemble, check the nature of the problem to see if disassembly is really required. For example, if the problem is in the engine, is there any abnormal noise? insufficient output? oil leakage? As a result of disassembly and inspection, the cause of the trouble can be accurately determined.

Disassembly

When disassembling complicated assemblies, stamp parts that have no effect on the assembly functional and use matching marks in order to make reassembly easier. Also, when repairing the electrical system, be sure to remove the cable from the negative terminal of the battery first.

Inspection during disassembly

Each time you remove a part, inspect that part for correct assembly, cleanliness, wear, damage and so on. High efficiency cannot be obtained if all parts are disassembled prior to inspection.

Arrangement of disassembled parts

After disassembly, lay the parts down in the proper order so they will not get mixed up. Replace all packing materials, gaskets, split pins and so on with new ones.

Make sure your hands are clean before handling V-belts, rubber items and electrical components that are sensitive to water and oil. Place these parts in a different location from components that are covered with engine oil.

Cleaning disassembled parts

Clean or wash all parts before starting reassembly.

If disassembled parts are not cleaned before reassembly, it will be impossible to judge which parts are good and which are bad and discover part defects. In addition, foreign matter may adhere to the parts during reassembly and contaminate the engine, adversely affecting performance and possibly leading to engine trouble. Be sure to maintain the proper degree of cleanliness during repair operations.

Reassembly

During reassembly, be sure to use the right procedure to assemble the right part with the right standard (tightening torque, adjustment value, etc.). Also, do not forget to apply oil or grease where required.

Adjustment and operation check

Adjust parts to the specified standard value, using a gauge or tester. Ultimately it would be most efficient to operate or perform an inspection each time the assembly operation is performed.

CLEANING AND INSPECTION

CLEANING

Each component part must be cleaned of dirty oil, oil sludges, scale, carbon, old gasket or adhesives attached to it.

Cleaning methods are: high temperature steam cleaning, light oil cleaning, acid or alkaline solution cleaning, neutral detergent cleaning, trichlene solution steam cleaning, and magnas fluid cleaning.

In cleaning, unexpected crack or damage may often be found. It is important, therefore, to take sufficient care during cleaning not to overlook any defect on a part.

Cleaning metal parts

- **Cleaning with light oil**

Light oil features minimal permeability and solubility for matter adhered to the surface of the parts, and is therefore most suitable for cleaning parts with sliding surfaces or finely finished surfaces. For other portions, use a wire brush, a wooden spatula, or a piece of metal plate to scrape off foreign matter. Perform this preliminary cleaning before conducting final cleaning.

- **Cleaning with alkaline fluid**

For those parts composed of a single kind of material such as copper, cast iron, and aluminum, alkaline cleaning fluid may be used. However, for a metal product composed of two or more materials, such as bearing shell and bushing, cleaning with light oil, trichlene solvent, steam, or magnas fluid is recommended, because electrolytic corrosion may occur due to ionization in these type parts.

Note:

- **When handling alkaline fluid, prepare a boric acid solution so that if cleaning fluid accidentally falls on to the skin or clothes, or splashes into the eyes, it can be quickly neutralized.**

Cleaning rubber products

When cleaning rubber parts, use alcohol to remove foreign matter. Never use light oil, lamp oil or any other mineral oil.

Cleaning oil line

Pass a wire through the oil line in each part to make sure the line is not clogged, then squirt cleaning fluid from the nozzle to clean.

Rustproofing

When parts have been cleaned and the grease has been completely removed, coat the surfaces with clean oil to prevent the part from rusting.

INSPECTION

- During inspection, use measuring instruments in accordance with the maintenance standards and make pass/fail determinations accurately. When the values exceed the repair limit or wear limit, be sure to repair the part or replace it with a new one. When the standards for determining whether or not the part should be replaced are shown by clearances, replace the corresponding part or the whole of the assembly as needed.
- Even if the measured values are within the wear limit, in some cases it would be better to replace the part from the standpoint of preventive maintenance.
- When inspecting parts, be sure to check the external appearance as well, either through visual inspection, 'red check' or the like. When the problems listed below are observed in an external appearance check, the part should be repaired or replaced.

If even one of the following damages is noted during inspection, be sure to repair or replace the corresponding part with a new one. In addition, note that, in principle, all rubber parts such as O-rings, oil seals and the like should be replaced with new ones.

External appearance check items

- Uneven wear
- Stepped wear
- Damage
- Cracks
- Deformation
- Aging (spring, etc.)
- Warping
- Loose fits
- Abnormal noise (from bearings, etc.)
- Discoloration (from engine seizure, etc.)
- Rust
- Surface hardening

STANDARD TIGHTENING TORQUE

The tightening torque for the bolts used to fasten the major components is specified in this manual. In cases where the tightening torque is not specified, use the values in the table of standard values for bolt tightening torques shown below.

Standard tightening torque

[kgm]

Size	Pitch	Standard tightening torque		
		4T*	7T*	9T*
M3	0.5	0.05	0.08	0.12
M4	0.7	0.11	0.19	0.27
M5	0.8	0.23	0.38	0.55
M6	1.0	0.39	0.65	0.94
M8	1.25	0.95	1.6	2.3
M10	1.5	1.9	3.1	4.5
	1.25	2.0	3.3	4.8
M12	1.75	3.3	5.5	7.9
	1.25	3.6	6.0	8.6
M14	1.5	5.7	9.5	14
M16	1.5	8.7	14	21
M18	1.5	12	21	30
M20	1.5	18	29	42
M22	1.5	24	40	57
M24	2.0	28	47	68
	1.5	29	49	70

Material code	Marking code
4T	4 or 40
7T	7 or 70
9T	9 or 90

* These are the categories for bolt material. The codes in the right-hand column of the above table are stamped or embossed on the head of the bolt.

Tube and connector standard tightening torque

[kgm]

Item			Standard tightening torque
Flared nut	Tube outer diameter (mm)	4.75	1.3 - 1.8
		6.35	1.6 - 2.4
		8	3.0 - 4.0
		10	4.0 - 5.0
		12	6.0 - 8.0
		15	7.0 - 9.0
Nipple nut			2.1 - 2.9
Eye connector			4.3 - 5.8

2. MAINTENANCE

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BASIC MECHANICAL SYSTEM	2- 6	INTAKE AND EXHAUST SYSTEM	2-20
LUBRICATION SYSTEM	2- 9	OTHERS	2-22

PERIODIC MAINTENANCE SCHEDULES

NOTE:

- The maintenance or lubrication service shown below are to be performed at the indicated intervals (km, miles or months, whichever occurs first).
- Scheduled maintenance services beyond 60,000 km (36,000 miles) or 12 months should be continued at the same intervals as before except the initial maintenance.
- Under the following severe operating conditions, more frequent servicing will be required.
 - Operation in heavy dust conditions
 - Extended high-speed operation with vehicle fully-loaded to its GVW
 - Extended low-speed operation
 - Frequent stop-and-go operation
- Any replacement parts used for required maintenance service or repairs should be genuine Nissan Diesel parts.

EMISSIONS CONTROL SYSTEMS MAINTENANCE (FOR Taiwan ONLY)

To maintain efficient emissions control systems operation, have the maintenance services shown in this section performed at the intervals indicated.

CAUTION:

- Do not modify, alter, disconnect or remove any part of the vehicle which could affect, directly or indirectly, vehicle emissions.

MAINTENANCE INTERVALS

RF8 and RE10 engines

Item	Maintenance intervals															Remarks	
○: Initial change (oil and fluid only) and Initial inspection ●: Servicing schedule	Kilometers x 1,000	1	5	10	15	20	25	30	35	40	45	50	55	60	Reference page		
	Miles x 1,000	0.6	3	6	9	12	15	18	21	24	27	30	33	36			
	Months	—	1	2	3	4	5	6	7	8	9	10	11	12			
Change engine oil and filter			○	Every 10,000 km or 6 months											(1)	2-10	
			○	Every 15,000 km or 6 months											(1) (7)	2-10	
Replace fuel filter element														●		2-18	
Replace primary fuel filter element								●						●		2-19	
Replace air cleaner element (Dry type)														●	(2)	2-21	
Replace air cleaner element (Metallic type)		Replace every 3 years													(2)	2-21	
Change coolant (incl. anticorrosive) and clean inside								●						●	(3)	2-12	
Change coolant (incl. antifreeze) and clean inside														●	(4)	2-12	
Check condition of exhaust																2-22	
Inspect and clean air cleaner element																2-20	
Tighten cylinder head and manifold bolts			○											●		2-9	
Check compression pressure														●		2-8	
Check valve clearance			○											●		2-6	
Check engine for oil leakage		○	●	●	●	●	●	●	●	●	●	●	●	●		2-9	
Check cleanliness and level of engine oil		○	●	●	●	●	●	●	●	●	●	●	●	●		2-9	
Check for fuel leakage		○	●	●	●	●	●	●	●	●	●	●	●	●		2-17	
Drain sediment from primary fuel filter				●	●	●	●	●	●	●	●	●	●	●		2-18	
Check injection pressure and pattern of injection nozzle														●		-	
Check injection timing and injection quantity of injection pump														●		2-14	
Check fuel feed pump for proper functioning														●		-	
Check coolant level			●	●	●	●	●	●	●	●	●	●	●	●		2-11	
Check V-belt for looseness and damage			○/●	●	●	●	●	●	●	●	●	●	●	●		2-7	
Check for coolant leakage					●			●			●			●		2-11	
Check water tank cap for proper functioning														●		2-14	
Check function of thermostat														●		2-13	
Check carbon on air heater unit				●		●		●		●		●		●	(5)	-	
Check condition of crank damper															(6)	2-8	

REMARKS: (1) Replace the engine oil filter if the warning light comes on, even before the scheduled replacement.

(2) If the warning light comes on even before the scheduled replacement, clean or replace element.

(3) Service every 6 months.

(4) Service every 12 months.

(5) Manual heat type only

(6) Initial inspection: After initial 200,000 km, subsequent inspection: Every 100,000 km

(7) With large size bypass oil filter (for CGB520 series only)

RG8 engine (For Taiwan only)

Abbreviations: A = Adjust, R = Replace, I = Inspect. Correct, adjust or replace if necessary.

C = Cleaning, RB = Rebuilding, T = Tighten to specified torque, □ = Initial maintenance

Maintenance Item		Maintenance interval														Remarks	
		Kilometers x 1,000	Daily	1	5	10	15	20	25	30	35	40	45	50	55	60	Reference page
		Miles x 1,000		0.6	3	6	9	12	15	18	21	24	27	30	33	36	
		Months		—	1	2	3	4	5	6	7	8	9	10	11	12	
*Idle speed																I	2-15
Acceleration and deceleration																I	2-16
*Air intake system (duct, hose and clamp)						I		I		I		I		I		I	2-21
Intake* and exhaust manifold				□												I	2-7
*Air filter element					I/C		I/C		I/C		I/C		I/C		I/C	R	2-20
Cylinder compression pressure																I	2-8
*Valve clearance				□												A	2-6
*Engine oil and oil filters	Oil CC or CD class			□													2-10
Every 10,000 km or 6 months : R																	
Oil level contamination		I	□	I	I	I	I	I	I	I	I	I	I	I	I	I	2-9
Oil pressure		I															-
Coolant and fuel level		I		I	I	I	I	I	I	I	I	I	I	I	I	I	2-11
Coolant, oil and fuel leakage		I	□			I				I			I			I	2-9, 2-11, 2-17
Strainer (if equipped)		I															-
*Fuel filter element																R	2-18
*Primary fuel filter element (if equipped)				I Drain	I Drain	I Drain	I Drain	I Drain	I Drain	R	I Drain	I Drain	I Drain	I Drain	I Drain	R	2-19
*Governor setting (checking seals)																	2-14
Every 30,000 km or 6 months : I																	
*Nozzle (injector tip)																	2-16
Every 80,000 km : C																	
*Nozzle holder (injector)																	2-17
Every 240,000 km : RB																	
*Injection pump timing																	2-14
Every 60,000 km or 12 months : I																	
Fuel tubing																I	2-17
Accelerator linkage																I	2-16
Drive belt		I		I	I	I	I	I	I	I	I	I	I	I	I	I	2-7
Crank damper																	2-8
Every 100,000 km : I																	
Cooling system (hose and clamp)		I															2-11
Engine coolant																R	2-12
Water filter (if equipped)																R	-
Thermostat																I	2-13
Fan clutch																I	2-13
Fan and fan shroud																I	2-13
Exhaust tubing and muffler					□											I	2-22
Alternator																I	2-22
Starter																I	2-22
Condition of exhaust				I	I	I	I	I	I	I	I	I	I	I	I	I	2-22
Cylinder head bolt				□												T	2-9
Water tank cap																I	2-14

“*” refers to items related to the Emission Control System Maintenance.

ENGINE MAINTENANCE PROCEDURE

BASIC MECHANICAL SYSTEM

CHECK VALVE CLEARANCE

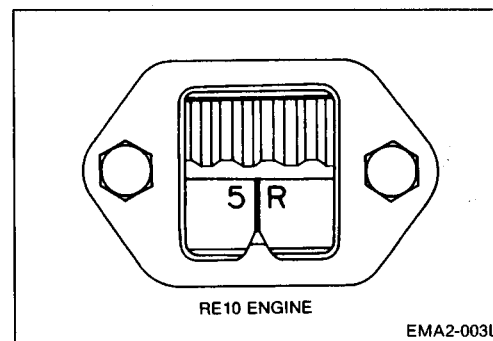
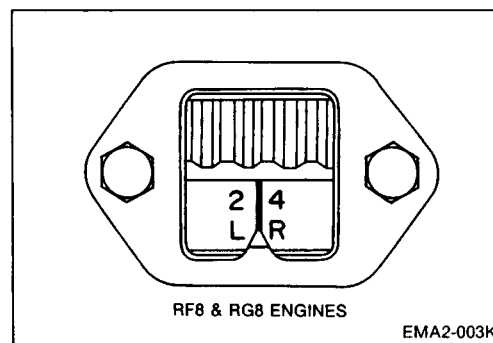
Inspection and adjustment procedures

Check the valve clearance with a feeler gauge.

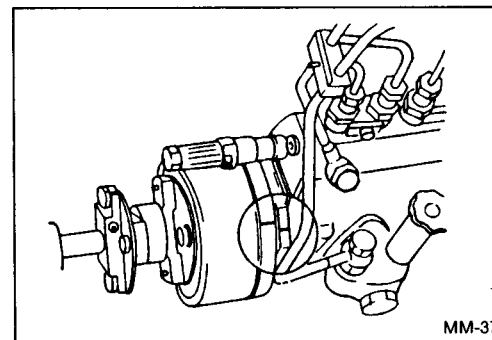
- 1) Align the flywheel housing pointer with the stamp on the flywheel.

Note:

- When turning the flywheel to align the stamp, turn it counterclockwise when viewed from behind the engine.



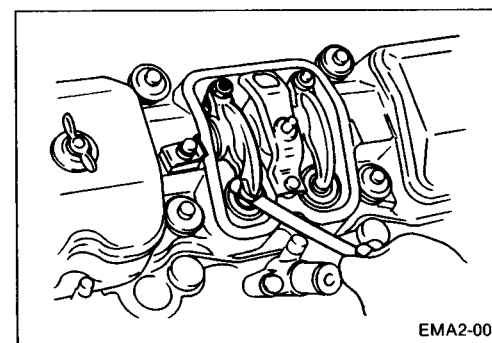
- 2) When the stamps on the injection pump housing and timer are close to each other, it indicates T.D.C. on the compression stroke. When they are located opposite to each other, it indicates T.D.C. on the exhaust stroke.



- 3) Using a feeler gauge, inspect the valves indicated by a circle in the following chart in sequence.

Note:

- The cylinders and valves are numbered starting from the side of the fan.



<Engine models RF8, RG8>

IN: Intake valve EX: Exhaust valve

Cylinder number	Right bank								Left bank							
	1		2		3		4		1		2		3		4	
Valve arrangement	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
	IN	EX	IN	EX	IN	EX	IN	EX	EX	IN	EX	IN	EX	IN	EX	IN
Right bank No. 4 cylinder compression T.D.C.	●			●	●		●	●		●			●		●	
Right bank No. 4 cylinder exhaust T.D.C.		●	●			●			●		●	●		●		●

<Engine model RE10>

IN: Intake valve EX: Exhaust valve

Cylinder number	Right bank										Left bank									
	1		2		3		4		5		1		2		3		4		5	
Valve arrangement	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
	IN	EX	IN	EX	IN	EX	IN	EX	IN	EX	EX	IN	EX	IN	EX	IN	EX	IN	EX	IN
Right bank No. 5 cylinder compression T.D.C.																				
Right bank No. 5 cylinder exhaust T.D.C.																				

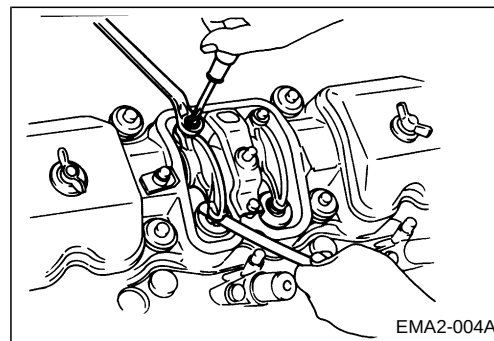
- 4) If the valve clearance is not within the specified range, loosen the lock nut located at the tip of the rocker arm and adjust the adjusting screw with a standard screwdriver. After properly adjusting, tighten the lock nut and recheck the valve clearance.

Lock nut

T : 3.5 - 4.5 kg-m

Unit: mm

Item		Maintenance standard
Valve clearance (While cold)	Intake	0.30 - 0.40
	Exhaust	0.50 - 0.60



INTAKE AND EXHAUST MANIFOLDS

Check the intake and exhaust manifold mounting bolts and nuts for proper torque. Also check the manifolds for damage or traces of leakage at the cylinder head connections.

Intake manifold

T : M8.....1.0 - 1.3 kg-m
M10.....1.9 - 2.3 kg-m

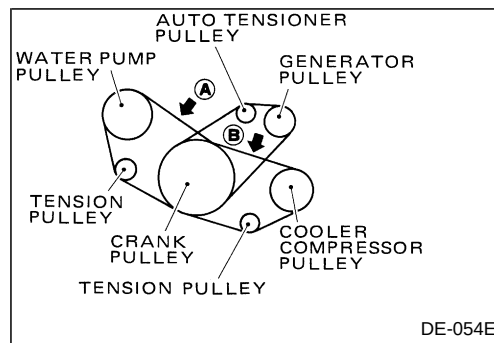
Exhaust manifold

T : M12.....5.5 - 6.5 kg-m

CHECK V-BELT FOR LOOSENESS AND DAMAGE

Point of inspection

Check the slack of the V-belt by pushing it in the middle between the respective pulleys. Also, check the whole circumference for damage.



Judgment standard

The V-belt deflection is as follows when a force of about 10 kg is applied to the mid part.
Replace all belts as a unit if belt is damaged.

[mm]

V-belt		Deflection
A	Water pump pulley - crank pulley	11 - 14
B	Crank pulley - cooler compressor pulley	10.5 - 13.5

CRANK DAMPER

Check interval:

Initial inspection

After initial

200,000 km

Subsequent inspection

100,000 km

Inspection procedure

Check the condition of the crank damper rubber. Replace if cracked along the outer perimeter or if peeling or torn at the contact point.

Note:

- Be careful not to confuse peeling paint for cracks.

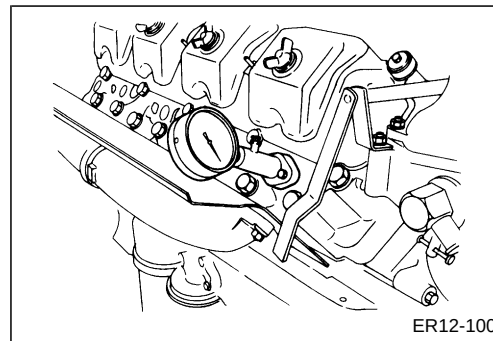
CHECK COMPRESSION PRESSURE

Point of inspection

Check the engine compression pressure each cylinder with a compression gauge.

Note:

- Be sure to remove all nozzle before the inspection.
- Be sure to crank the engine by means of the starter. The fuel injection pump should not inject fuel.



Judgment standard

[kg/cm²]

Maintenance standard	Compression pressure limit	Variance among cylinders
29, min.	21 (180 - 220 rpm)	4 or less

TIGHTEN CYLINDER HEAD BOLTS

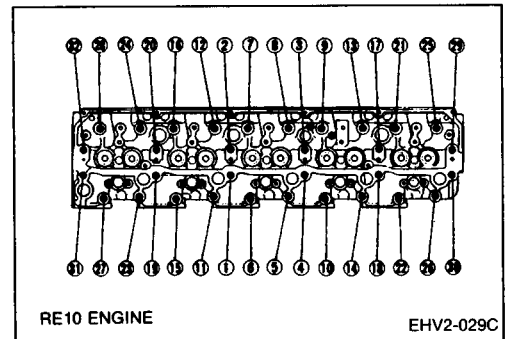
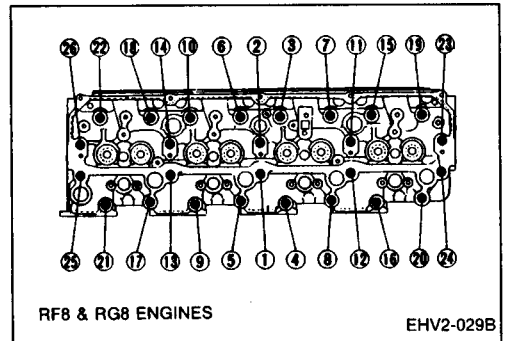
Point of inspection

Inspect the cylinder head bolts and manifold bolts for tightness.

- Sequence of tightening cylinder head bolts

Judgment standard

T : 28 - 30 kg-m



LUBRICATION SYSTEM

CHECK ENGINE FOR OIL LEAKAGE

Point of inspection

Check each part of the engine lubricating system for oil leakage.

CHECK CLEANLINESS AND LEVEL OF ENGINE OIL

Point of inspection

Pull out the oil level gauge and inspect the oil sticking the gauge.

Note:

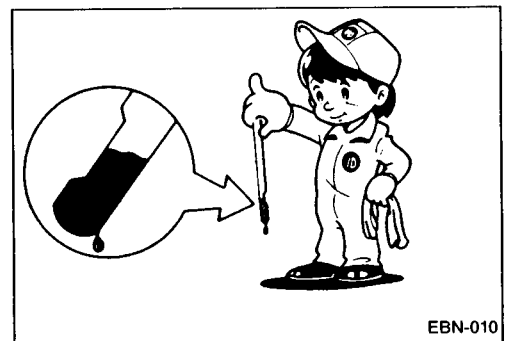
- Checking should be done on level ground before starting the engine. Otherwise, the oil level cannot be checked correctly.

Judgment standard

If the oil level is low, add more until it reaches the HIGH level. Change the oil if it is excessively contaminated.

Note:

- Do not add oil above the HIGH level.



CHANGE ENGINE OIL AND OIL FILTER

Method of change

- 1) Loosen the oil filler cap.
- 2) Remove the drain plugs from the bottom of the oil pan and oil filter, and drain thoroughly.
- 3) Install the oil pan and oil filter drain plugs.

Oil pan drain plug

 : 10 - 13 kg-m

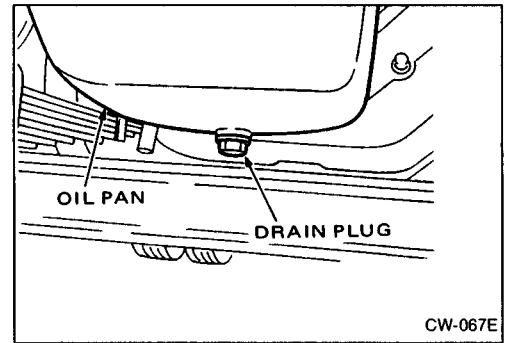
Oil filter drain plug

 : 1.6 - 2.2 kg-m

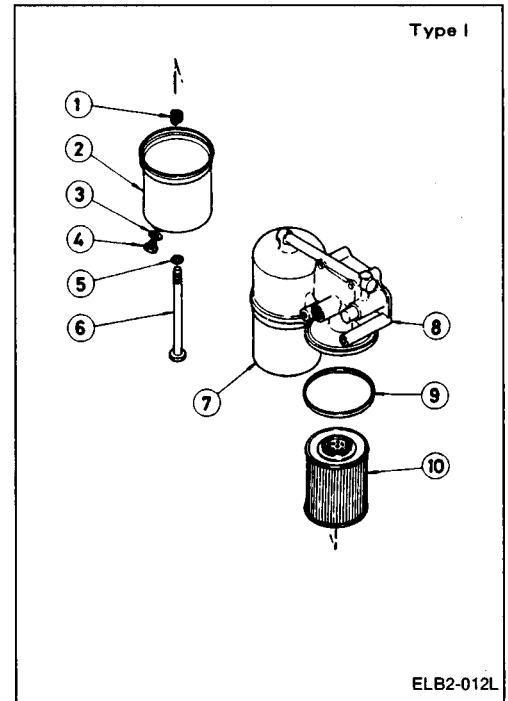
- 4) Loosen the center bolt, and remove the filter case, element and spring.
- 5) Clean all filter parts, except the element, in cleaning fluid.
- 6) Discard the old element, and insert the new element and packing.
- 7) Reassembly each part correctly.

Type I: Full-flow oil filter

- ① Set spring
- ② Filter case
- ③ Packing
- ④ Drain plug
- ⑤ Packing
- ⑥ Center bolt
- ⑦ Bypass filter
- ⑧ Filter body
- ⑨ Packing
- ⑩ Element



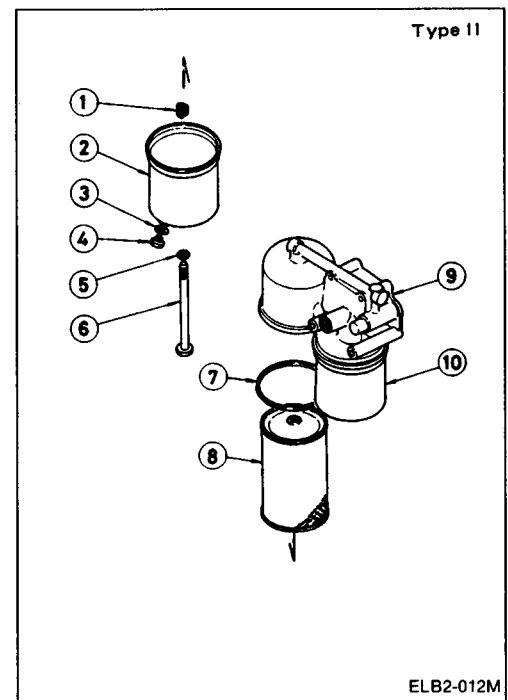
CW-067E



ELB2-012L

Type II: Bypass oil filter

- ① Set spring
- ② Filter case
- ③ Packing
- ④ Drain plug
- ⑤ Packing
- ⑥ Center bolt
- ⑦ Packing
- ⑧ Element
- ⑨ Filter body
- ⑩ Full-flow filter



ELB2-012M

Oil filter center bolt

T : 6.0 - 7.0 kg-m

Note:

- **Do not excessively tighten the center bolt.**
- 8) Pour oil through the oil filler up to the “HIGH” on the oil dipstick. Wait until the oil surface has stabilized (wait at least six minutes), check the oil level again, and make sure that the level is sufficient.

Note:

- **Do not fill oil pan above the “HIGH” level on the gauge.**
 - **Be extremely careful not to allow any dirt or dust to enter the oil filler during refilling. If oil is spilled, wipe it out.**
- 9) Start the engine and allow engine oil to lubricate the functional parts.
Stop the engine and wait for approximately six minutes. Then check the oil level. If it is lower than the specified level, add engine oil to that level.

Note:

- **Use the oil dipstick located on the engine compartment side.**

COOLING SYSTEM

CHECK FOR COOLANT LEAKAGE

Point of inspection

Check to ensure water is not leaking from the radiator, rubber hose, water pump, and heater circuit. Further, check the rubber hose for cracks and deterioration and the hose band for proper attachment.

Judgment standard

Replace the rubber hose if it is cracked or damaged.

WATER HOSE AND CLAMP

Check the water rubber hose and clamp of the cooling system for installation, cracks or damage. Replace faulty parts if necessary.

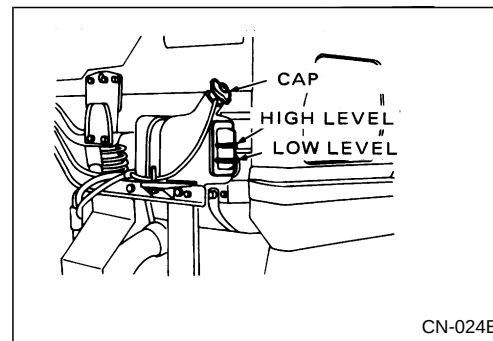
CHECKING THE COOLANT LEVEL

Point of inspection

Check the coolant level in the water tank. The coolant level should be between the HIGH and LOW lines. If the coolant level is below the LOW line, add the proper coolant solution to the HIGH lines.

Note:

- **Always use soft water, such as tap water, and avoid using HARD water (river water, well water, etc.). Use of hard water can cause the formation of scales in the**



CN-024E

cooling system, resulting in the overheating of the engine.

CHANGE COOLANT AND CLEAN INSIDE

Point of change and flushing

Flush the interior of the cooling system whenever any heavy contamination in the coolant is noticed. Flushing removes water scale and fat from the cooling system, and restores its original cooling efficiency, which greatly reduces the possibility of the engine overheating.

Flushing procedure

<To clean the cooling system>

The cooling system must be flushed when the coolant temperature is higher than 80°C and the engine is run at high idle. If the water temperature is too low, the thermostat will remain closed, and the flushing agent will not circulate in the radiator, so no flushing effect will occur.

- 1) Drain the cooling water from each water drain cock completely.
- 2) Close the drain cock, and pour city water and flushing agent into the water tank.
- 3) Run the engine at high idling speed (refer to the flushing agent manufacturer's instruction). Cover the front end of the radiator to prevent the temperature of the fluid in the cooling system from dropping. Observe the fluid level carefully for five minutes after starting the engine. If it lowers, add city water.
- 4) After flushing, stop the engine, and thoroughly drain the fluid from each drain cock.
- 5) Close the drain cocks, and add fresh city water. Start the engine and run it at high idle until the water temperature goes above 80°C. Then stop the engine, and drain the water from the drain cocks once again. Repeat this operation two or more times, until only clean water is discharged from the drain cocks. Dirty or colored water from the drain cocks means that fat or scale is still in the cooling system.
- 6) After completing the flushing operation, close each drain cock securely, and add fresh city water with antifreeze (or anticorrosive) up to the specified level. Then start the engine, and purge the air from the system until the coolant level is stabilized at the specified position. If the coolant level lowers during this operation, add fresh city water with antifreeze (or anticorrosive).

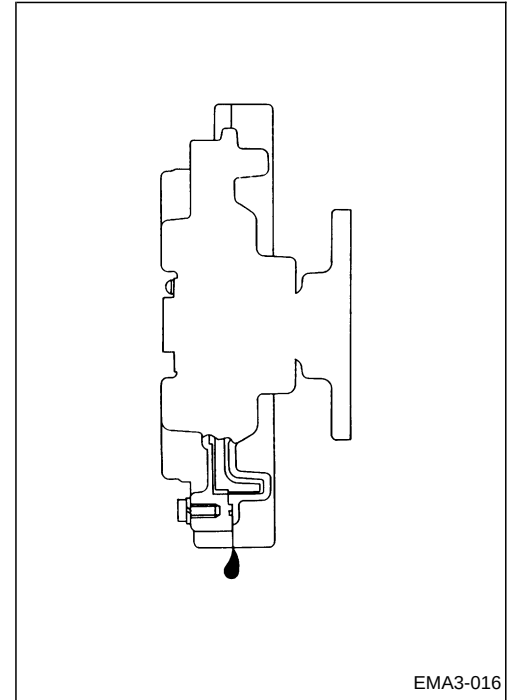
FAN CLUTCH

Ensure that the engine is off when checking the fan clutch.

- 1) Check the fan clutch for oil leakage. If leakage is present, replace the fan clutch assembly.
- 2) Check the fan clutch for proper operation:
 - Rotate the cooling fan by hand (adjacent parts should be cool) to ensure it moves smoothly without binding.
 - Then, start the engine and operate it until the pointer of the water temperature gauge stays within the "H" range. Stop the engine to ensure that the cooling fan no longer rotates by hand.

Note:

- The fan clutch operates in a manner similar to a "direct drive" when the temperature of parts near the bimetal located at the front center of the clutch reaches approximately 55°C. For this reason, it is best to measure the temperature of those parts to assure proper maintenance during inspection.



EMA3-016

COOLING FAN AND FAN SHROUD

Check the cooling fan and shroud for proper installation, cracks or damage. Replace faulty parts.

CHECK FUNCTION OF THERMOSTAT

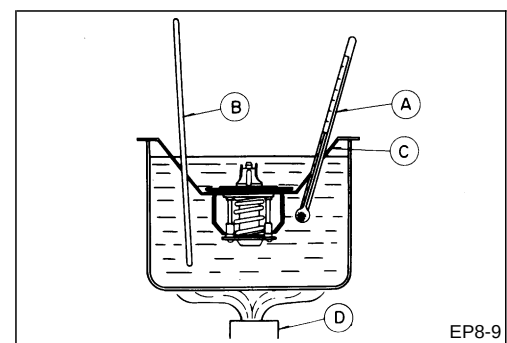
Point of Inspection

- Ⓐ Bar thermometer
- Ⓑ stirring rod
- Ⓒ Thermostat holder
- Ⓓ Heat source

Remove the thermostat and check the valve opening temperature and valve lift, using the equipment shown below.

Judgement standard

Make sure that the valve opening temperature and valve lift of the thermostat are within the specified values. Replace the thermostat if it reaches the wear limit.



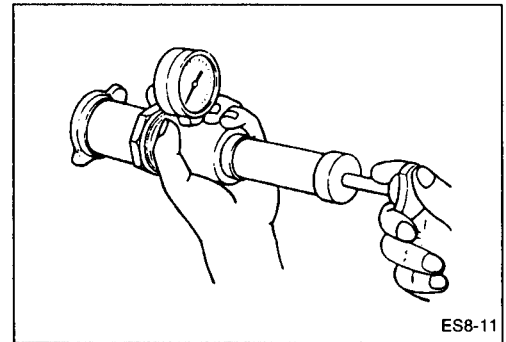
EP8-9

CHECK WATER TANK CAP FOR PROPER FUNCTIONING

Point of inspection

< Inspection with tester >

Check the pressure relief valve with a radiator cap tester to make sure it opens within the specified pressure range.



< Inspection without tester >

- 1) Pressure-regulating valve
Press down the cap spring with a finger to ensure there is repulsive force. Also, check the sealing rubber for deterioration.
- 2) Vacuum valve
Manually ensure the valve opens and closes.

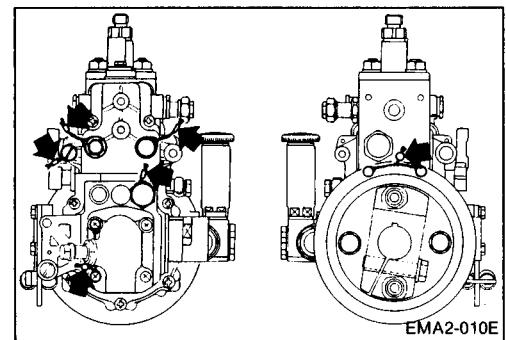
FUEL SYSTEM

GOVERNOR SETTING

Ensure that the parts shown in the figure below are secured with sealing caps and wires. If the cap or wire is broken, check and adjust the injection pump and governor.

CAUTION:

- Any unauthorized adjustments in the injection pump and governor settings, other than as specified, can cause serious damage to the engine.

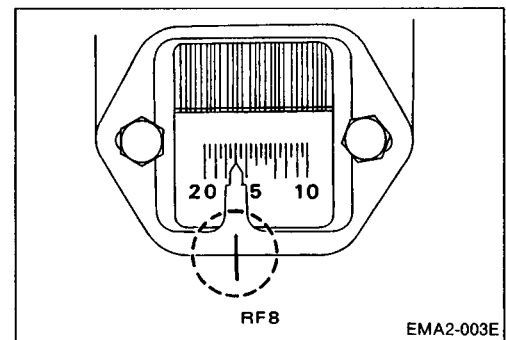


CHECK INJECTION TIMING

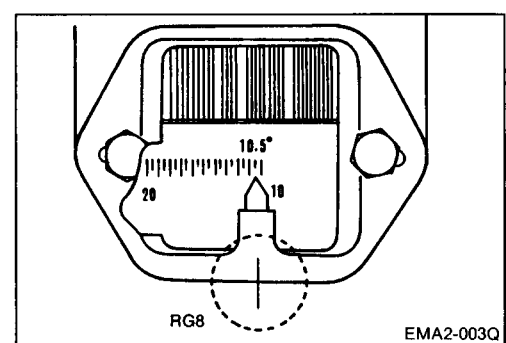
Point of inspection

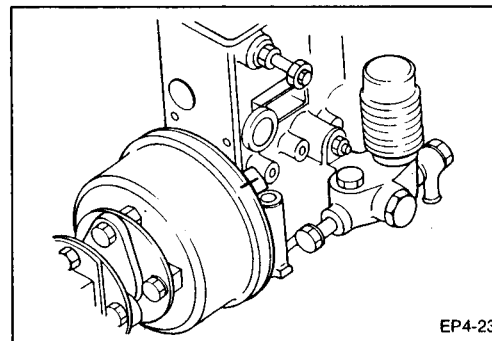
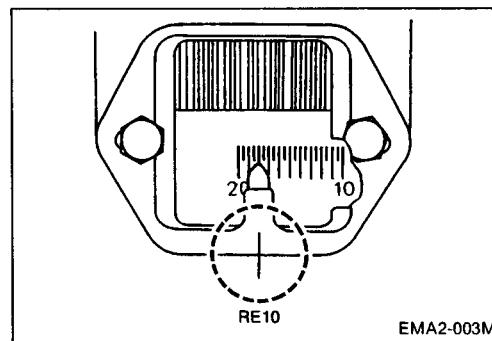
Make sure that the pointer and the notch on the flywheel housing are aligned with each other.

Rotate the flywheel in the standard direction, and using the piston of the reference cylinder, set the pointer to the B.T.D.C. on the compression stroke. In this condition, inspect that the notch on the injection pump housing aligns with that of the timer.



Engine model	B.T.D.C.	Reference cylinder
RF8	17°	No. 4 cylinder right bank
	18°	No. 4 cylinder right bank: for TAIWAN ONLY
RG8	10.5°	No. 4 cylinder right bank
RE10	18°	No. 5 cylinder right bank: for TAIWAN ONLY





IDLE SPEED

NOTE:

When checking engine idle speed ensure that the engine idle control knob inside the cab is set to the low-speed position.

- 1) Start the engine and warm it up to the normal operating temperature.
- 2) Allow the engine to idle and observe the engine speed. on the tachometer.
- 3) If idle speed is not within specified range, adjust as follows:

Idle speed

RF8 engine: 550 - 570 rpm

RG8 engine: 460 - 480 rpm

RE10 engine: 450 - 550 rpm

NOTE:

If equipped with an air conditioner, the air conditioner switch must be turned off when checking idle speed.

Idle Speed Adjustment

- Loosen the lock nut on the idle adjusting bolt.
- Turn the idle adjusting bolt to obtain the correct idle speed.
- Tighten the lock nut.

T : 0.5 - 0.7 kg-m

NOTE:

- Accelerate the engine two or three times. Allow the engine to return to idle speed and observe the tachometer reading. If the idle speed is not within the specified range, check the accelerator linkage for binding and repeat idle adjustment.

ACCELERATION AND DECELERATION

- 1) Start the engine and warm it up to the normal operating temperature.
- 2) Depress the accelerator pedal to ensure that engine speed smoothly increases from idle to the maximum and that it returns to idle.

NOTE:

- If the engine does not accelerate smoothly, disengage the accelerator linkage from the injection pump and operate the fuel control lever of the injection pump to check engine acceleration. If the engine rotates smoothly, the accelerator linkage may be faulty. Check and repair the linkage. If engine operation is erratic, the injection pump or governor may be faulty. Check and repair these parts.

ACCELERATOR LINKAGE

Check accelerator linkage for bent rods, interference with adjacent parts or looseness.

NOZZLE (INJECTOR TIP)

Cleaning nozzle

- 1) Remove the nozzle holder assembly from the engine.
- 2) Clamp the nozzle holder into a vise with the holder plate (157944-9520).

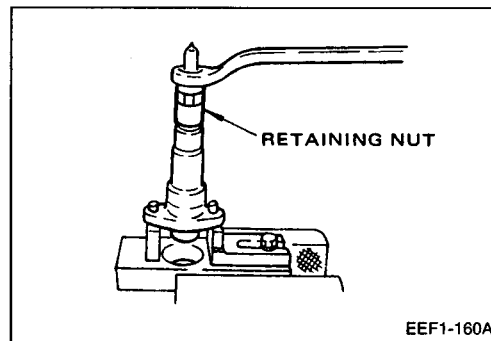
NOTE:

- The 157944-9520 is the assembly number of the nozzle holder plate.

- 3) Loosen the retaining nut, and then remove the nozzle from the nozzle holder. Do not drop the nozzle needle.
- 4) Pull the nozzle needle from the nozzle body.

NOTE:

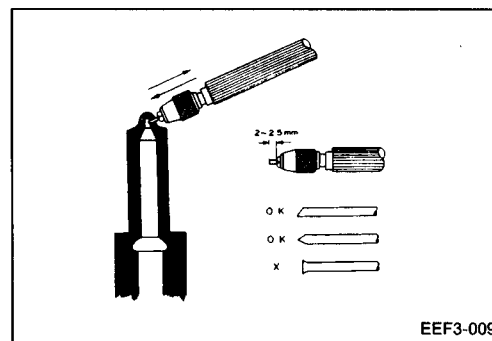
- Do not use the nozzle needle in another nozzle body.
- 5) Remove carbon from around the openings by using the corner of a hard piece of wood. Do not use waste or any other material to push carbon into the openings.



6) Removing carbon in openings

Use the pin vise (99727 Z5004) and wire 0.29mm dia. to clean the openings.

- Allowing too much wire to protrude at the tip of the pin vise will permit the wire to bend inside the nozzle, in which case withdrawal proves difficult. The wire should protrude no more than 2 to 2.5 mm.
- Carefully push the carbon into the nozzle. Too much force will bend the wire. Proceed slowly.

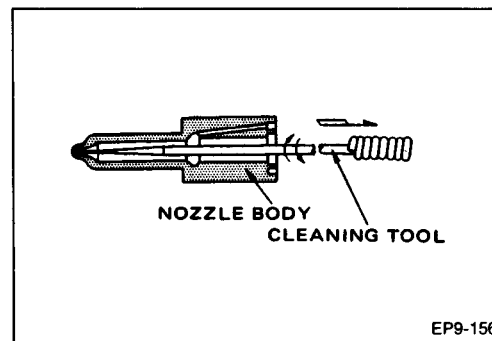


- Remove carbon at the inside end of the openings with the nozzle cleaning tool (99726 Z5000). Exercise care to avoid damaging the surface which the nozzle needle contacts. The use of compressed air may clog the openings with foreign particles. Always use the special tool, instead.

7) Tighten the retaining nut.

Retaining nut

T : 6 - 8 kg-m



NOZZLE HOLDER (INJECTOR)

Rebuild the nozzle holder at the specified interval. Check and adjust the nozzle opening pressure and spray pattern. Refer to the "EF" section for rebuilding procedures.

WARNING

Fuel from the injection nozzle is injected under extremely high pressure. If it is directed at your hand, etc., serious injury may result. KEEP YOUR HANDS AWAY FROM THE NOZZLE DURING TESTS.

FUEL TUBING

Check the fuel rubber hose and clamp of the fuel system for installation, cracks or damage.

Replace faulty parts if necessary.

Check the fuel tubing for fractures, damage or improper installation. Replace faulty parts if necessary. Whenever the fuel tubing is disconnected, be sure to bleed air from the fuel system.

CHECK FOR FUEL LEAKAGE

Point of inspection

Check to see if fuel is leaking from the fuel tank, injection pump, fuel filter, primary fuel filter and fuel line.

REPLACE FUEL FILTER ELEMENT

Method of replacement

- 1) Place a container under the filter. Remove the filter with a filter wrench. Drain any remaining fuel into the container.

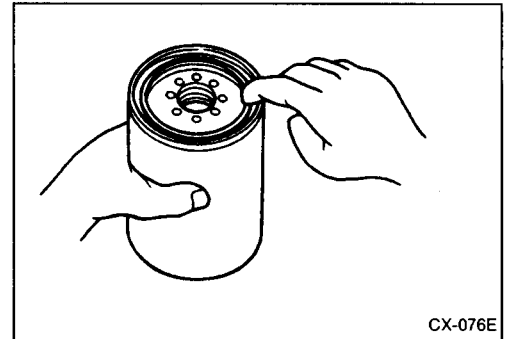
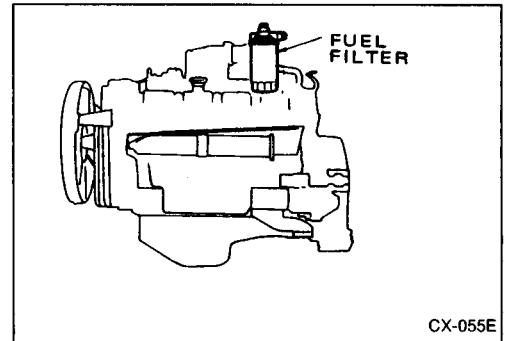
- 2) Apply a thin coat of clean engine oil to the gasket of the new filter.

Note:

- Installation of the fuel filter without coating the gasket with oil may damage the gasket resulting in loss of fuel and fire hazard due to spilled fuel.
- 3) Install the new fuel filter. After the gasket comes in contact with the bracket sealing surface, tighten an additional three-fourths of a turn.

Note:

- When installing the fuel filter, securely tighten it three-fourths of a turn using the exclusive filter wrench provided in the vehicle.



BLEEDING AIR FROM THE FUEL SYSTEM

Refer to "PURGING AIR FROM FUEL SYSTEM."

DRAIN SEDIMENT FROM PRIMARY FUEL FILTER

Draining procedure

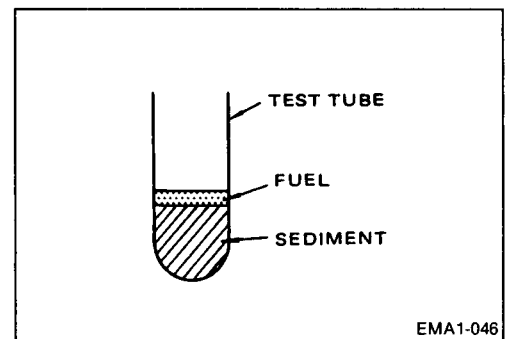
Note:

- It is not necessary to drain all the fuel in the primary fuel filter case.

Place a receiver under the filter, then loosen the drain plug to drain sediment.

Put the drained precipitates in a glass container such as a test tube. If there is fuel on top of the water, dust and precipitates, it indicates that the precipitates have been removed.

Bleed air from the fuel system after draining sediments.



REPLACE PRIMARY FUEL FILTER ELEMENT

Method of replacement

- 1) Place a suitable oil can under the drain cock, and drain the fuel and sediment.
Also loosen the filler plug to speed up draining.
- 2) Loosen the center bolt, and remove the filter case, spring and element.
- 3) Clean each part in light oil.
- 4) Replace the element and packings.
- 5) Reassemble each part correctly, and after reassembly, be sure to bleed air from the fuel system.

Fuel filter center bolt

T : 6.0 - 7.0 kg-m

Note:

- After replacement, fill the filter with fuel through the filler plug hole. Then bleed air out of the fuel system.
- Do not excessively tighten bolts and plugs.

- ① Filter cover
- ② Packing
- ③ Element
- ④ Seat
- ⑤ Spring
- ⑥ Filler plug
- ⑦ O-ring
- ⑧ Filter case
- ⑨ Packing
- ⑩ Drain plug
- ⑪ Packing
- ⑫ Center bolt

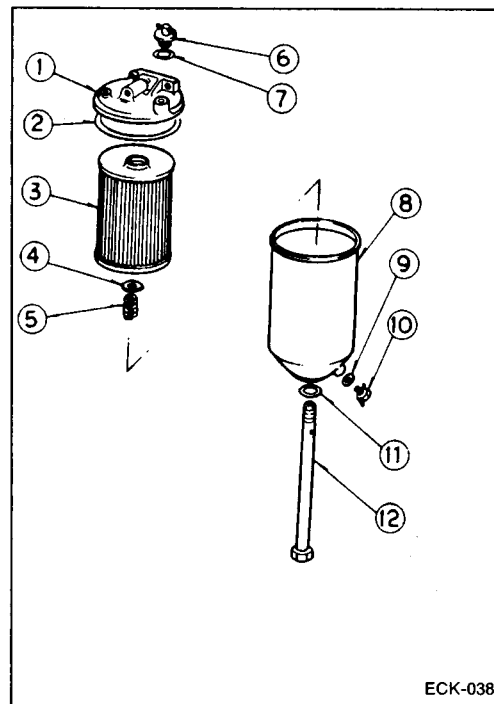
Bleeding air from the fuel system

Refer to "PURGING AIR FROM FUEL SYSTEM."

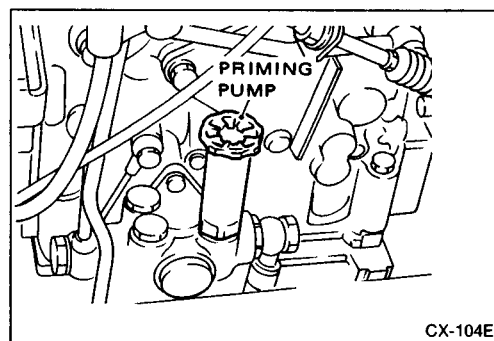
PURGING AIR FROM FUEL SYSTEM

Air entrapped in the fuel system will cause poor injection of the fuel, thus resulting in difficult starting, jerking, or even stoppage of the engine. After completing any service procedure on the fuel system (inspection, replacement of fuel filter element, or reconnection of any fuel pipe), be sure to bleed air from the fuel system

- 1) Twist the knob on the priming pump, which is connected to the injection pump, and the knob will rise up by itself.

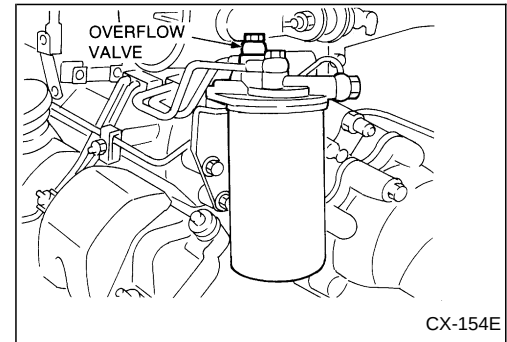


ECK-038



CX-104E

- 2) Move the priming pump's knob up and down to send fuel from fuel tank into the filter.
Continue this procedure until the overflow valve of the fuel filter no longer gives off a "hissing" sound and movement of the priming pump is difficult. The air bleeding operation is now complete.



- 3) After bleeding air, return the pump knob to its original position. Start the engine, and make sure that no fuel is leaking from the fuel system. Fuel leaks can cause a fire. If a leak is discovered, immediately repair the affected part or contact the nearest service station.

INTAKE AND EXHAUST SYSTEM

INSPECT AND CLEAN AIR CLEANER ELEMENT

Point of inspection

<Dry type>

Remove the element and check the filter paper for contamination and damage.

Clean the dust cover.

Note:

- **Never remove the inner element unless it needs to be replaced.**

<Metallic type>

Remove the outer element and check it for clogging or damage and the packing for peeling or deterioration. If the outer element is clogged, clean in oil.

Judgement standard

<Dry type>

Clean the dust cover if it is excessively contaminated. Replace the paper element if it is damaged.

Replace the element if the warning light illuminates even after cleaning the element.

<Metallic type>

If the outer element is damaged or the packing is peeling or deteriorated, replace both inner and outer elements.

Method of cleaning element (Dry type)

<Clean the element>

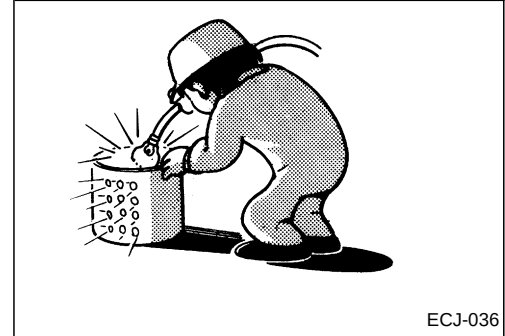
Note:

- Never clean the inner element.



<Point of inspecting element>

After the outer element has been thoroughly dried, shine light through from the inside of the outer element, and check it for damage, pin holes, and thinned areas; also check the packing for damage and/or deformation. Replace the elements (outer and inner) if necessary.



REPLACE AIR CLEANER ELEMENT

Method of replacement

Replace the air cleaner element by removing it.

Note:

- Replace inner and outer elements as a unit.

Judgement standard

Clean the air cleaner element if the warning light illuminates between the specified replacement intervals. Replace the element if the warning light continues to illuminate even after cleaning the element.

Precautions for handling cleaner

- 1) Be sure to install the element and dust cover securely. Loose or improper installation will allow dust to enter, preventing the normal functioning of the air cleaner.
- 2) Do not touch the filter paper of the element directly with your hand. Wear gloves. Use special care not to stain the element with oils.

AIR INTAKE SYSTEM (DUCT, HOSE AND CLAMP)

Check the air intake duct connections for loose clamps or cracked hoses. Check the connection between the air filter and air intake manifold especially. Tighten loose clamps, if any.

EXHAUST TUBING AND MUFFLER

Check the various connections of the exhaust tubing for looseness. Tighten loose parts as necessary. Also check for any sign of gas leakage from connections or muffler.

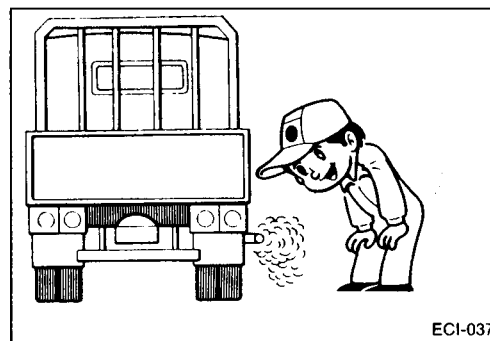
CHECK CONDITION OF EXHAUST

Point of inspection

Warm up the engine sufficiently, then visually inspect exhaust smoke during idling, acceleration and deceleration with the vehicle at a stop.

Judgement standard

Colorless or pale blue smoke	Complete combustion
Black smoke	Incomplete combustion
White smoke	Burning oil Exhaust smoke may become white when the temperature is low or before the engine warms up.



OTHERS

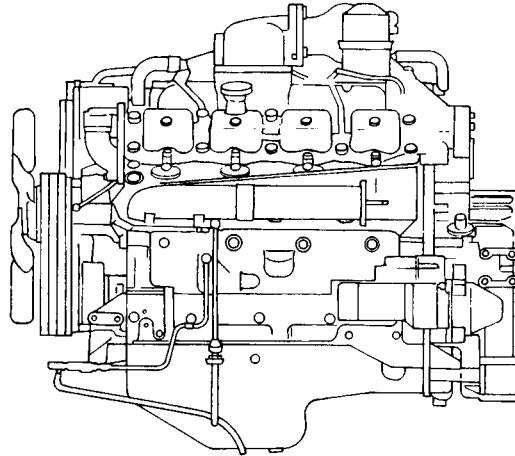
ALTERNATOR

Check the ball bearings for proper rotation and abnormal noise.

STARTING MOTOR

Inspect the moving connector of the magnetic valve.

3. DISASSEMBLY JUDGMENT



ER0-120

This chapter covers the judgment for disassembling the RF8, RG8 and RE10 engines.

CONTENTS

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DIAGNOSIS

DIAGNOSIS GUIDE

The diagnosis guide is a table which can be used for seeking out the cause of trouble without disassembling the engine on the basis of the symptoms of the problem complained of by the user and the result of checks performed in the shop with the engine mounted in the body.

HOW TO USE THE GUIDE

- 1) Open the page of the guide corresponding to the trouble symptom complained of by the user.
- 2) Check all of the points listed in the page.
- 3) If there is any applicable item in the checking points, the cause of the trouble may be assumed in the following manner.
 - Each item in the “Symptoms and checking points” section corresponds to one or more items in the “Cause of trouble” section through the dot mark “•”. If there are more than one applicable “Cause of trouble” items, the item having the largest number of dot marks should be regarded as the central cause of the trouble.
 - The “cause” items having no dot mark can be regarded as not being the cause of the trouble.

Note:

- If more than one cause is assumed, the repair should begin with the simplest operation.

DIFFICULT ENGINE STARTING

Cause of trouble		Symptoms and checking points									
		Starter fails to rotate	Slow starter rotation (less than 100 rpm)	Insufficient starter rotation	Sound of magnetic SW is heard with starter SW ON	Little exhaust smoke	Moderate exhaust smoke	Excessive exhaust smoke	Engine cannot be cranked manually	Engine lacks power	Poor fuel consumption or oil consumption
Electrical system	Discharged battery	●	●		●						
	Poor connection of connector and terminal	●			●						
	Breaks in electrical wire	●									
	Faulty starter	●	●								
	Faulty starter SW and starter relay	●									
	Faulty air heater			●	●			●			
Fuel system	Lack of fuel			●		●					
	Faulty feed pump			●						●	
	Incorrectly installed fuel pipe			●		●					
	Faulty injection pump			●		●	●			●	
	Faulty nozzle			●		●	●			●	●
	Clogged fuel filter element			●		●	●			●	●
	Air in fuel system			●		●					
	Incorrect injection timing			●				●		●	
	Broken or damaged fuel pipe			●		●					
	Clogged gauge filter			●		●				●	
Engine proper & others	Damaged ring gear	●			●						
	Damaged or seized rotating engine parts	●							●		
	High engine oil viscosity		●				●				
	Incorrect valve clearance			●				●		●	●
	Inadequate compression pressure			●				●		●	●
	Incorrect valve timing			●				●			
	Clogged air cleaner element			●				●			
	Faulty clutch and subsequent power train (Check by connecting and disconnecting the clutch)	●			●				●		

Cause of trouble		Symptoms and checking points							
		Poor engine starting	Poor fuel consumption or oil consumption	Engine lacks power	Exhaust smoke gradually turns black	Exhaust smoke suddenly turns black	High blow-by gas pressure	Irregular idling	Engine knocks
Intake system	Accumulation of sludge in air heater	●	●	●	●				
	Clogged air cleaner element	●	●	●	●				
	Half-opened intake shutter			●		●			
Fuel system	Excessive injection quantity		●						
	Uneven plunger wear		●	●	●			●	●
	Malfunction of delivery valve	●	●	●	●			●	●
	Faulty nozzle	●	●	●	●			●	●
	Poor fuel quality			●		●		●	●
	Excessively advanced injection timing	●		●				●	●
Engine proper	Wear on piston rings, and cylinder liner	●	●	●					●
	Excessive oil in oil pan		●			●			
WHITE EXHAUST SMOKE									
	Delayed injection timing	●		●				●	●
	Engine temperature too low	●	●	●			●	●	●
	Engine oil leakage down through valve stem						●		
	Wear on piston ring or cylinder liner	●	●	●					●
	Excessive oil in oil pan		●						
	Incorrect valve clearance	●		●			●	●	●

IRREGULAR ENGINE OPERATION		Symptoms and checking points												
Cause of trouble		Black exhaust smoke	White exhaust smoke	Engine lacks power	Difficulty in starting engine	Poor fuel consumption	Engine knock	Engine stabilizes at two speeds	Engine often stalls	Irregular idling	Specified maximum rpm is not achieved	Specified maximum rpm is exceeded	Low compression pressure	
Fuel system	Incorrect adjustment of link or rod			●	●			●	●		●			
	Fuel leakage from injection pipe			●	●	●	●			●	●			
	Uneven injection quantity			●		●	●			●				
	Malfunction of governor								●	●	●	●		
	Uneven injection pressure of nozzle	●		●		●	●			●				
	Improper fuel spray of nozzle	●		●		●	●			●				
	Improper adjustment of idle spring					●		●	●	●				
	Improper adjustment of damper spring							●	●					
	Malfunction of delivery valve	●		●			●			●	●			
	Air in fuel system			●	●		●			●	●			
Engine proper	Improper placement of valve seat		●	●	●								●	
	Improper valve clearance		●	●						●			●	
	Incorrect valve timing		●		●		●			●	●	●	●	
	Incorrect compression pressure	●		●	●		●			●				
	Engine temperature too low		●	●			●			●	●			
Others	Deteriorated engine mount rubber								●	●				
	Improper adjustment of idling						●		●	●				
	Rusted control wire				●			●	●	●		●		

DECREASED ENGINE POWER		Symptoms and checking points													
Cause of trouble		Little exhaust smoke	Black exhaust smoke	White exhaust smoke	Poor fuel consumption	Poor oil consumption	Difficulty in starting engine	Engine overheats	Excessive blow-by gas	Specified maximum rpm is not achieved	Engine knock	Irregular idling	Low compression pressure	Low specific gravity of fuel	
Fuel system	Improper fuel quality		●		●		●				●	●		●	
	Improper adjustment of injection quantity	●	●		●		●			●					
	Clogged fuel filter element	●					●			●					
	Water or air in fuel system						●				●	●			
	Low fuel pressure (overflow valve)	●			●		●					●			
	Improper fuel spray from nozzle		●		●		●	●			●	●			
	Improper injection timing		●	●	●		●			●	●	●			
	Malfunction of delivery valve		●								●	●			
	Malfunction of feed pump	●					●			●					
	Malfunction of injection pump	●			●		●			●					
Intake and exhaust system	Clogged air cleaner element		●			●	●	●							
	Thin or hot intake air		●	●				●			●			●	
	Half-opened intake shutter		●		●	●		●							
	Accumulation of carbon to air heater		●		●	●		●							
	Clogged or crushed exhaust pipe or muffler	●	●					●	●						
	Half-opened exhaust shutter	●	●					●	●						
Engine proper	Wear on piston rings and cylinder liner		●			●	●		●				●		
	Worn, sticking, or broken piston ring			●		●	●		●		●		●		
	Seized piston			●					●		●		●		
	Worn or seized valve stem			●					●		●		●		
	Improper seating of valve insert			●			●		●		●		●		
Others	Improper selection of gear while traveling				●			●							
	Improper adjustment of control valve						●			●		●			
	Poor returning of engine stop wire						●			●					

EXCESSIVE OIL CONSUMPTION		Symptoms and checking points											
Cause of trouble		Continuous emission of white smoke at high-speed running	Engine emits white smoke after idling	Engine lacks power	Difficulty in starting engine	Poor fuel consumption	Engine overheated previously	Oil attaching to exhaust pipe and manifold	High blow-by gas pressure	Low compression pressure	Engine knock	Engine oil measuring method incorrect	
Engine proper	Worn piston rings and cylinder liner	●		●	●	●			●	●			
	Aligned piston ring end gaps	●							●	●			
	Insufficient piston ring tension	●					●						
	Improper break-in of piston ring	●							●				
	Inversely fitted piston rings	●											
	Broken or seized piston rings	●		●	●				●	●	●		
	Worn piston ring	●		●	●				●	●			
	Scuffing of cylinder liner	●							●				
	Worn valve stem or guide		●					●	●				
	Worn valve stem seal		●					●					
Others	Leakage of engine oil											●	
	Excess of engine oil	●										●	
	Improper quality of engine oil												
	Clogged air cleaner element		●			●							

EXCESSIVE FUEL CONSUMPTION		Symptoms and checking points	Engine lacks power	Black exhaust smoke	White exhaust smoke	Engine knock	Engine overheats	Poor oil consumption	High blow-by gas pressure	Low compression pressure	Irregular idling
Cause of trouble											
Fuel system	Maladjusted nozzle injection pressure										
	Improper fuel spray from nozzle										
	Maladjusted injection quantity										
	Improper seating of delivery valve seat										
	Improper injection timing										
Engine proper	Worn or seized piston, or piston ring										
	Worn cylinder liner										
	Improper seating between valve seat and insert										
	Maladjusted valve clearance										
Others	Clogged air cleaner element										
	Half-opened intake shutter										
	Half-opened exhaust shutter										
	Clogged or crushed exhaust pipe or muffler										
	Engine temperature too high										
Chassis	Dragged brake										
	Clutch slip										
	Seizure in drive line										
	Insufficient tire inflation pressure										
Driving habits	Unnecessary acceleration and deceleration										
	Improper gear shifting										
	Prolonged idling										

NOISY ENGINE		Symptoms and checking points						
Cause of trouble		Engine lacks power	Black exhaust smoke	White exhaust smoke	Poor fuel consumption	Engine overheats	High blow-by gas pressure	Low compression pressure
Fuel system	Improper timer advance angle	●		●		●		
	Uneven injection quantity	●	●		●			
	Injection timing too early	●	●			●		
	Injection timing delayed	●		●		●		
	Uneven nozzle injection pressure	●			●	●		
	Improper fuel spray from nozzle	●		●	●	●		
	Malfunction of delivery valve	●		●	●	●		
	Poor fuel quality	●						
Others	Wear or seizure on rotating and sliding portions	●	●	●			●	●
	Insufficient intake air quantity	●	●					
	Improper valve clearance, or seizure of valve	●						●
	Low intake air temperature			●				
	Engine too cold, or overheated			●				
	Insufficient compression pressure and compression air temperature	●					●	
	Excessive oil coming up into cylinder	●		●			●	

ENGINE OVERHEATS

Symptoms and checking points

Excessive reduction of cooling water

Cooling water reduces in quantity only after high-speed operation

Engine lacks power

Engine noisy in operation

High blow-by gas pressure

Water temperature difference between water inlet and outlet is small

Water temperature difference between water inlet and outlet is great

Radiator remains cold even after engine warm up

Air bubbles appear in water tank only when water temperature is high

Air bubbles appear in water tank only after engine racing

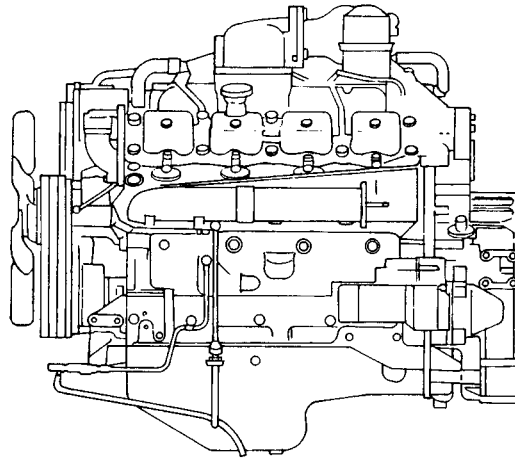
Air bubbles is radiator

Cooling water acidified

Cause of trouble

[illegible]

4. ENGINE DISASSEMBLY AND REASSEMBLY



ER0-120

This chapter covers engine disassembly and reassembly. Refer to the chapter 5 "Engine proper" when inspecting the cylinder block, piston, crankshaft, etc.

CONTENTS

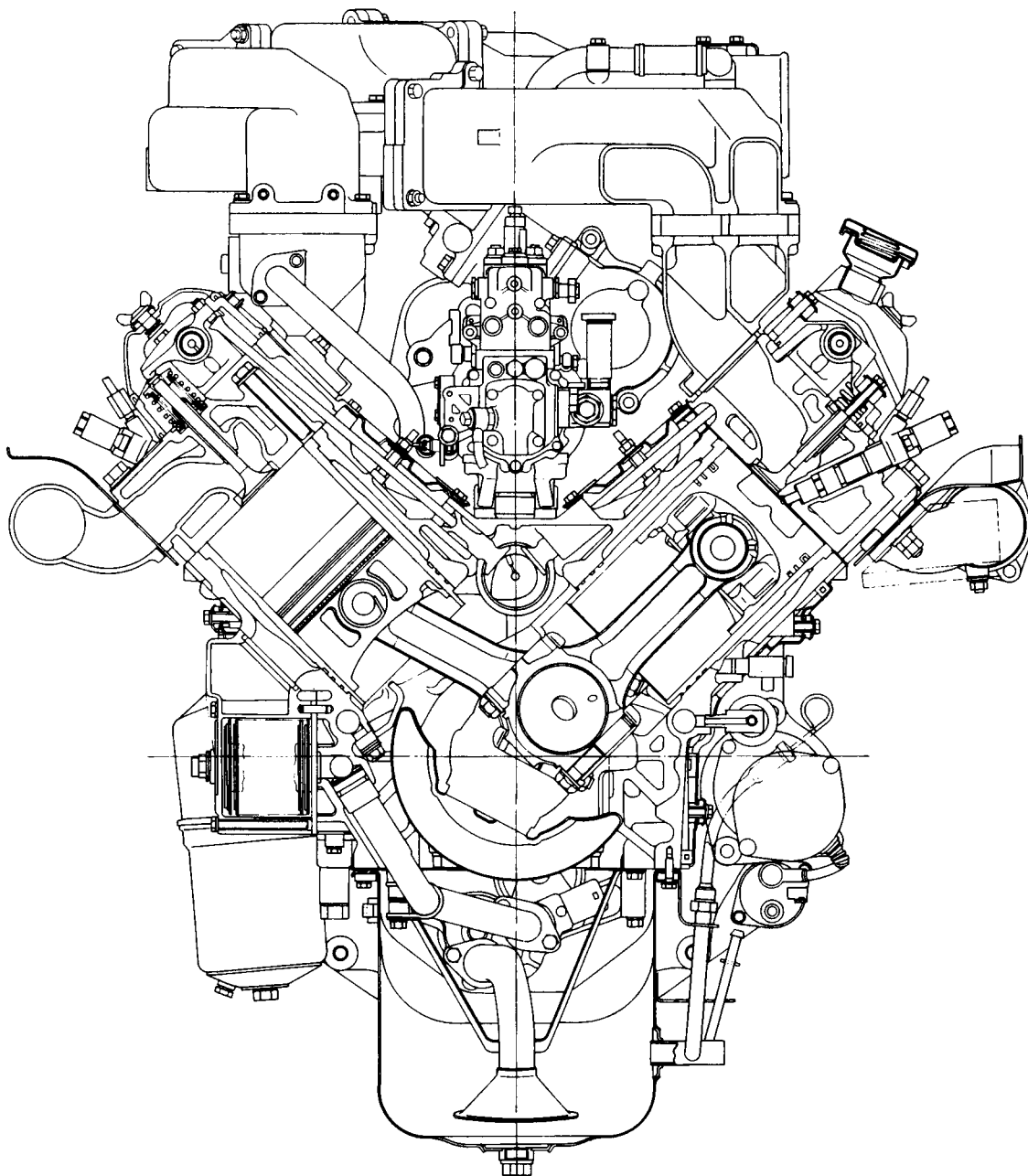
CONSTRUCTION	4- 3	OUTSIDE OF ENGINE	4-10
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CONSTRUCTION

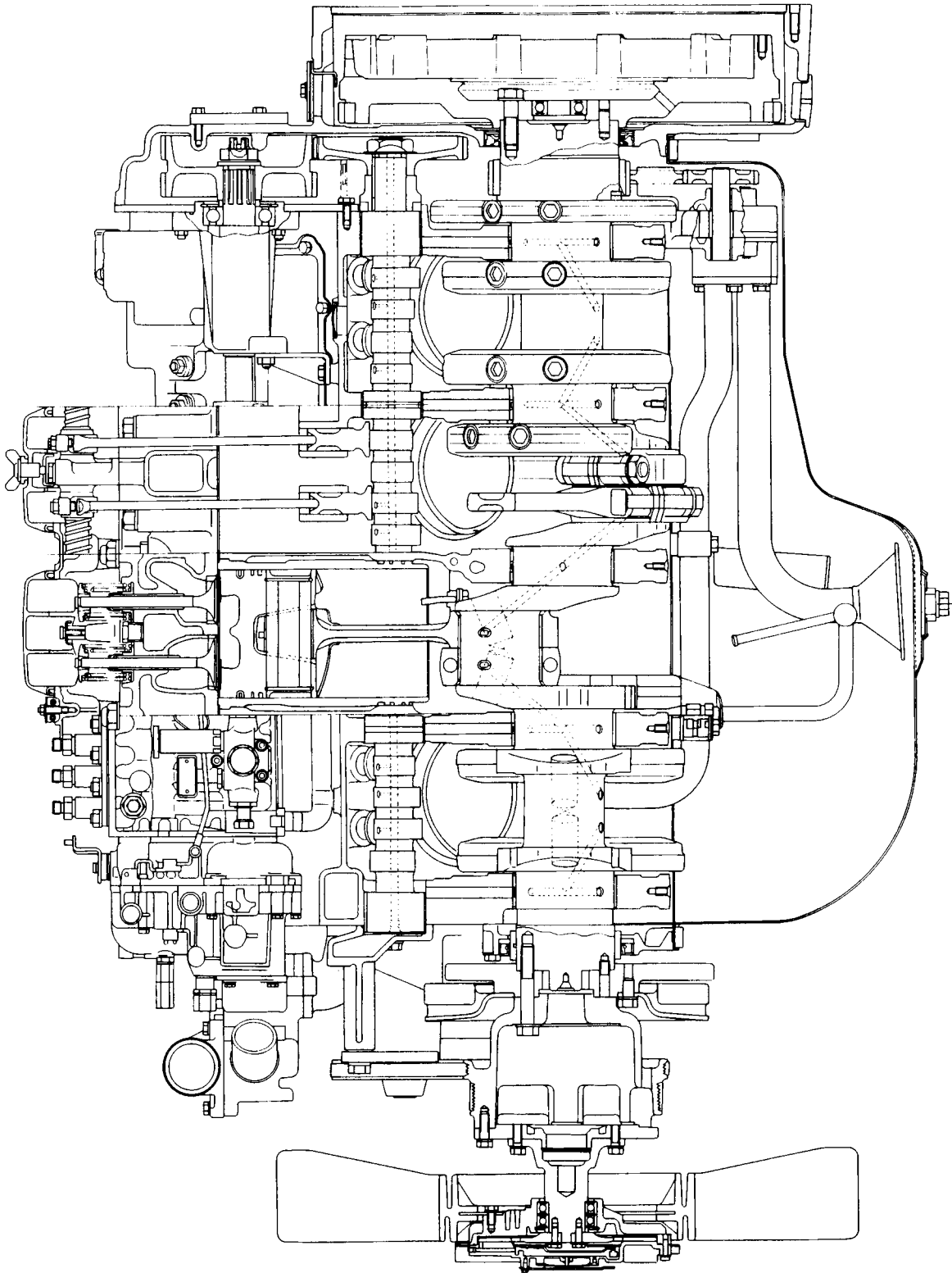
ENGINE

Construction illustration

< Engine model RG8 >



EDR2-002C

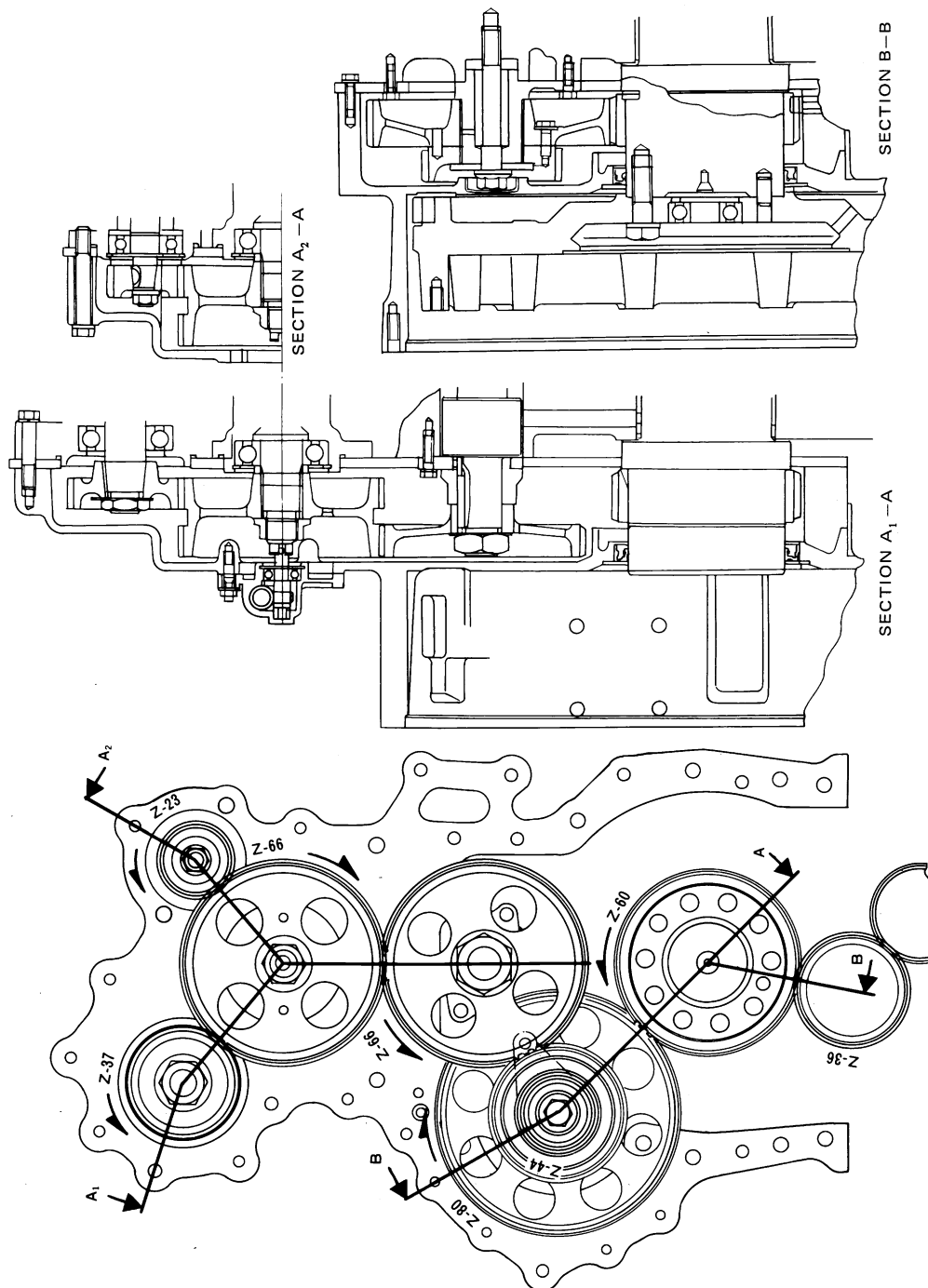


EDR2-001D

GEAR TRAIN

Without engine rear PTO

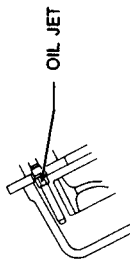
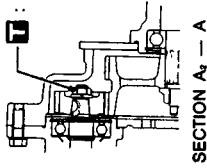
<Engine models RF8 and RE10>



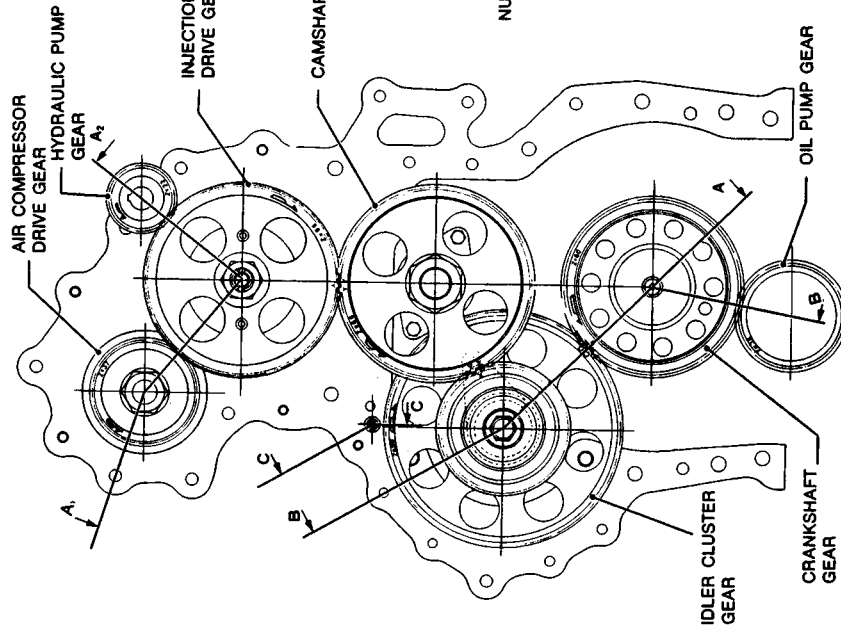
< Engine model RG8 >

T : kgm

T : 5.5 - 6.5



SECTION C - C

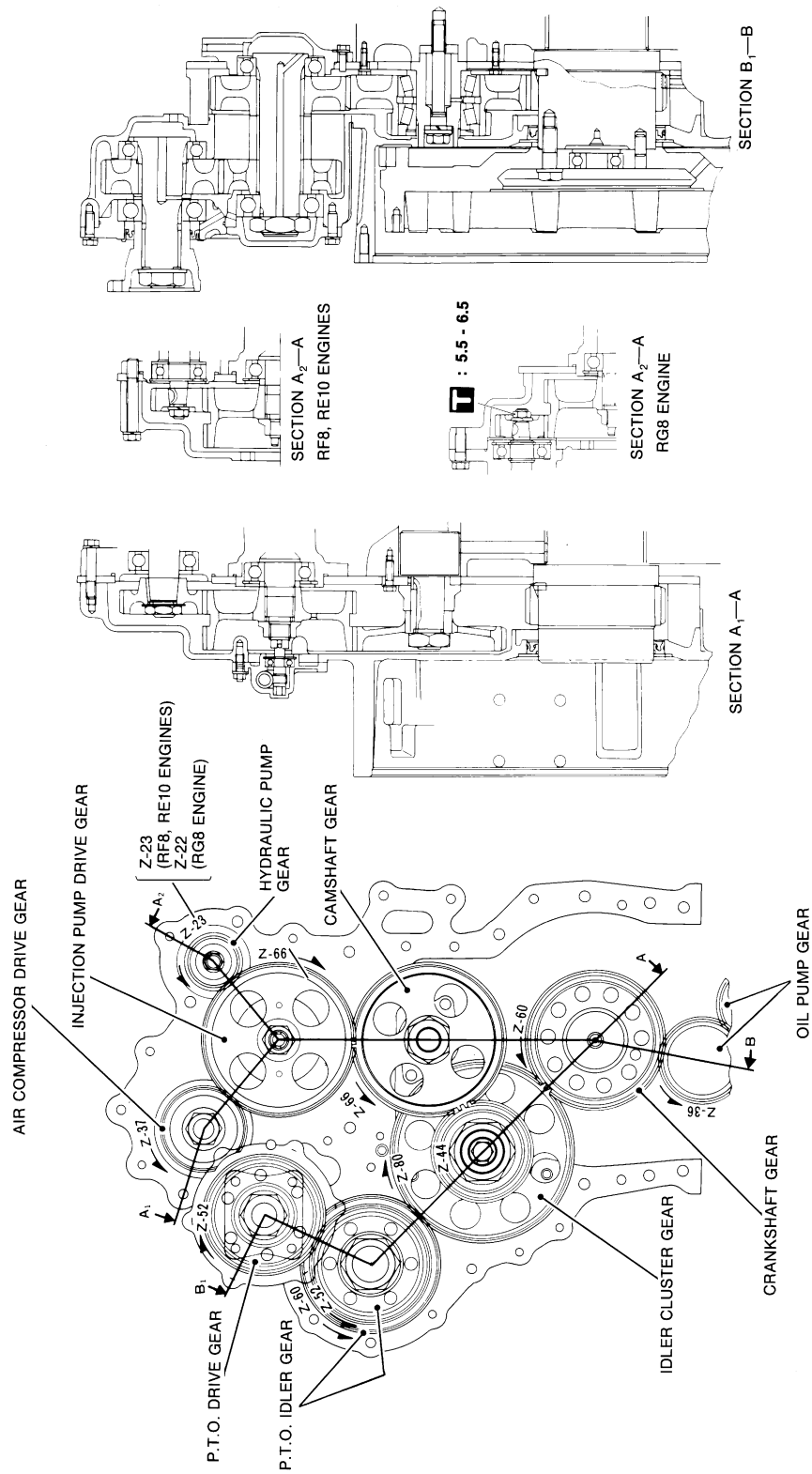


SECTION B - B

SECTION A - A

EDR2-003H

With engine rear PTO

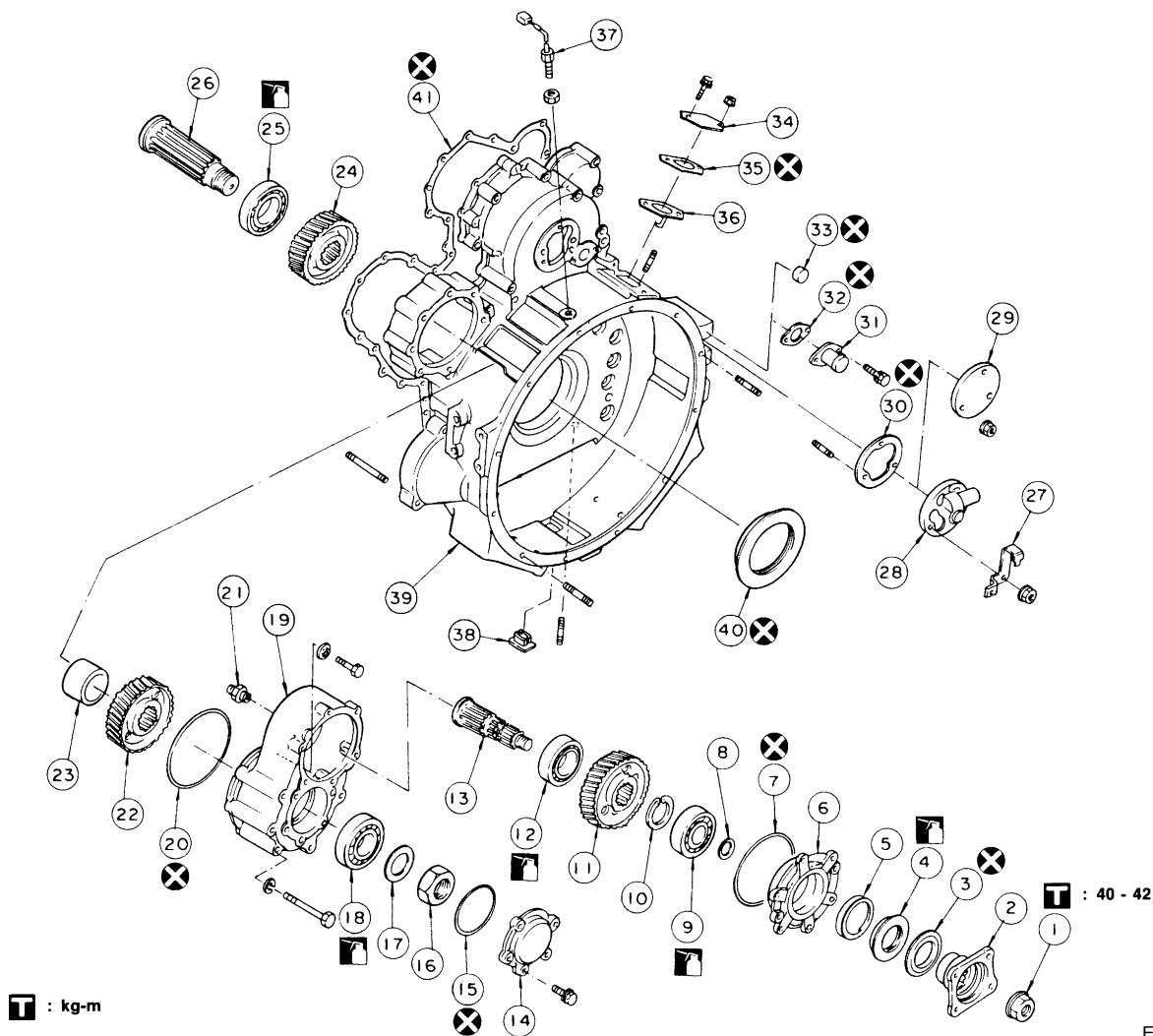


T : kg-m

T : 5.5 - 6.5

EDR2-003K

ENGINE REAR PTO



T : kg-m

EDR2-109C

- ① Nut
- ② Companion flange
- ③ Oil seal
- ④ Ball bearing
- ⑤ Outer race
- ⑥ Bearing holder
- ⑦ O-ring
- ⑧ Snap ring
- ⑨ Ball bearing
- ⑩ Snap ring
- ⑪ P.T.O. gear
- ⑫ Ball bearing
- ⑬ P.T.O. drive shaft
- ⑭ Idler cover

- ⑮ O-ring
- ⑯ Nut
- ⑰ Washer
- ⑱ Ball bearing
- ⑲ P.T.O. gear case
- ⑳ O-ring
- ㉑ Connector
- ㉒ Idler gear
- ㉓ Spacer
- ㉔ P.T.O. gear
- ㉕ Ball bearing
- ㉖ Idler shaft
- ㉗ Stay

- ㉘ Meter drive assembly
- ㉙ Cover
- ㉚ Gasket
- ㉛ Filler
- ㉜ Gasket
- ㉝ Plug
- ㉞ Cover
- ㉟ Gasket
- ㊱ Pointer
- ㊲ N-TDC sensor
- ㊳ Rubber cap
- ㊴ Flywheel housing
- ㊵ Oil seal
- ㊶ Gasket

ENGINE REMOVAL

PREPARATORY OPERATIONS

- 1) Turn the key switch off and disconnect the grounding cable from the negative terminal of the battery.
- 2) Tilt the cab.

Note:

- **Visually check to make sure that the tilt stopper is being locked.**

- 3) Drain the engine oil, power steering oil and cooling water, and remove the air in the air reservoir.

REMOVING PARTS AROUND THE ENGINE

- 1) Remove the noise cover from around the engine.
- 2) Remove the transmission noise cover.
- 3) Remove the air cleaner assembly and related parts.
- 4) Remove the car cooler compressor and related parts when equipped with an air conditioner.
- 5) Disconnect all wiring, pipes and linkages.
- 6) Disconnect the propeller shaft from the transmission.
- 7) Disconnect the control linkage, then remove the transmission assembly using a transmission jack.
- 8) Disconnect the water hose, then remove the radiator assembly.
- 9) Disconnect the exhaust manifold from the exhaust tube.
- 10) Remove the cab blower noise cover.

DISMOUNTING ENGINE

- 1) Remove the engine mount bracket on the engine side and the cushion rubber.
- 2) Attach the chain to the engine lifter, then dismount the engine assembly from the vehicle body by suspending it using a crane.

Note:

- **Before lifting the engine using a chain of less than 2.5 meters in length, remove the intake duct, tubes, etc., which may interfere with it. Or use the specified lifting device (99785 97000) to lift the engine.**

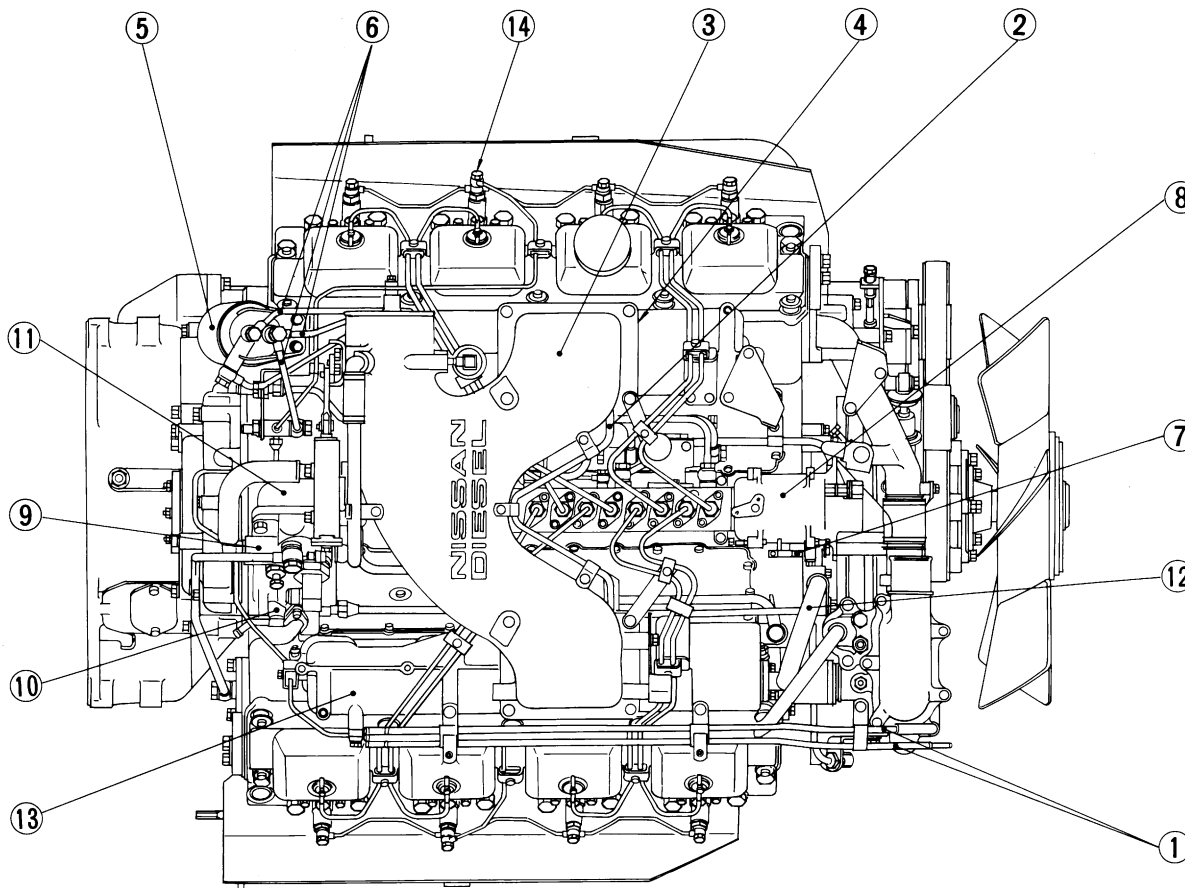
DISASSEMBLY AND REASSEMBLY

Procedures for assembly and disassembly noted here are based on the RF8 and RG8 engines. In the case of the RE10 engine, however, the number of cylinders, externally mounted components, etc. are different, so the nature of the operations and operational procedures will differ slightly. As much as possible, these differences are noted herein. Please note, however, that in the case of equivalent operations the procedures for the RE10 engine are omitted.

OUTSIDE OF ENGINE

UPPER SIDE OF ENGINE

Engine model RF8



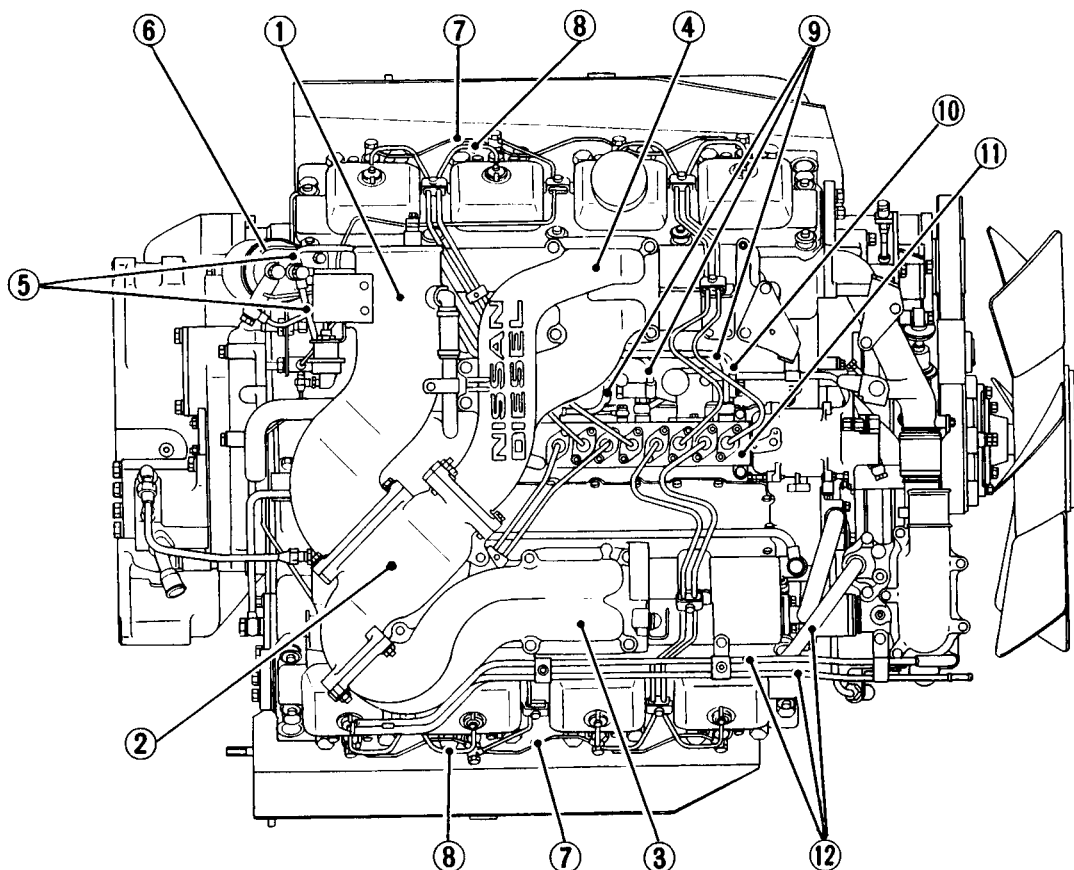
EDR2-117B

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly).

- | | |
|--|---|
| ① Water tube | ☆☆⑧ Injection pump assembly |
| ② Wire harness of air heater | ⑨ Air compressor assembly |
| ③ Air intake duct assembly | ⑩ Hydraulic pump assembly |
| ④ Air heater assembly (right and left) | ⑪ Injection pump support assembly |
| ⑤ Fuel filter assembly | ⑫ Breather pipe |
| ⑥ Fuel tube and others | ⑬ Air intake manifold |
| ⑦ Accel link | ⑭ Nozzle holder assembly (right and left) |

Marks “★” and “☆☆” indicate that the key points of operation are explained in the text.

Engine model RG8



EDR2-117C

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly).

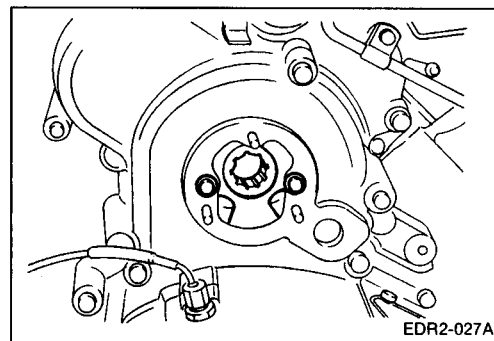
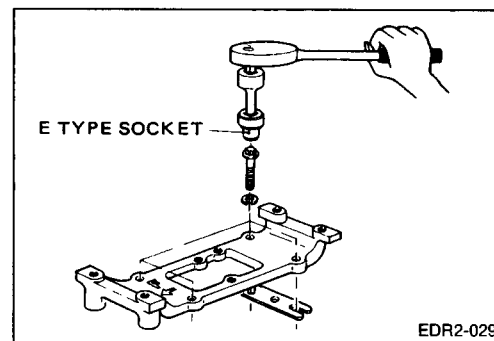
- | | |
|-------------------------|------------------------------|
| ① Air intake duct | ⑦ Fuel spill tube |
| ② Air duct | ⑧ Fuel injection tube |
| ③ Air duct (right side) | ⑨ Fuel outlet tube |
| ④ Air duct (left side) | ⑩ Fuel inlet tube |
| ⑤ Fuel tube | ☆☆ ⑪ Injection pump assembly |
| ⑥ Fuel filter assembly | ⑫ Water tube |

Marks “★” and “☆☆” indicate that the key points of operation are explained in the text.

Key points of disassembly

⑧ (RF8) ⑪ (RG8) Injection pump assembly

- 1) Removing the injection pump bracket:
Do not remove it unless it is damaged. When removing the injection pump bracket, always use E type socket (99739 97000).
- 2) Removing the injection pump support assembly:
Screw two guide bolts (M8 X 1.25) into the bolt holes in the meter driver mounting and fix the injection pump drive gear to the flywheel housing. Then remove the mounting nut.

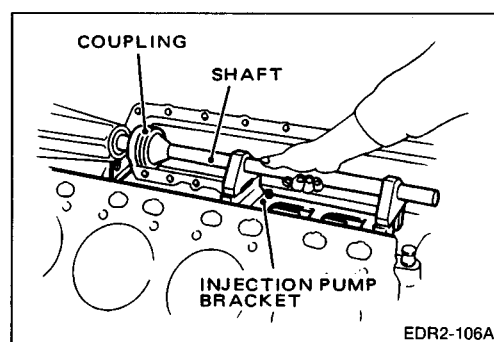
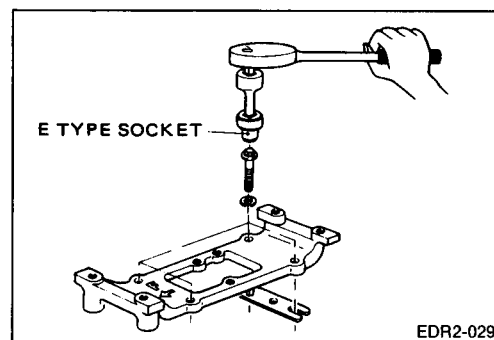


Key points of reassembly

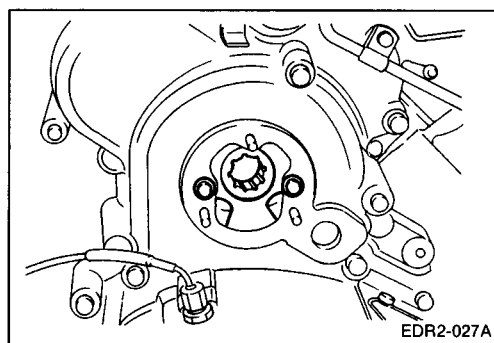
⑧ (RF8) ⑪ (RG8) Injection pump assembly

- 1) Installing the injection pump bracket:
Do not remove it unless it is damaged. When installing the injection pump bracket, always use E type socket (99739 97000).
- 2) Centering the injection pump bracket:
Set a bracket setting tool (99720 96000) in place, then slide the shaft and adjust by changing the thickness of the injection pump bracket shims so the axis of the injection pump support enters the hole on the end of the shaft smoothly.

Shim thickness [mm]: 0.05, 0.10, 0.20, 0.30



- 3) Installing the injection pump support assembly:
Install the nuts and remove the two guide bolts which secure the injection pump drive gear to the flywheel housing from the holes at the meter driver.



4) Installing the injection pump assembly:

- Turn the flywheel in the standard direction of rotation to align the scribed injection timing line at the No.4R cylinder compression stroke (RF8, RG8 engines) or the No.5R cylinder compression stroke (RE10 engine) with the pointer. If not aligned properly, rotate the flywheel in the reverse direction sufficiently, and reexecute the alignment operation.

Note:

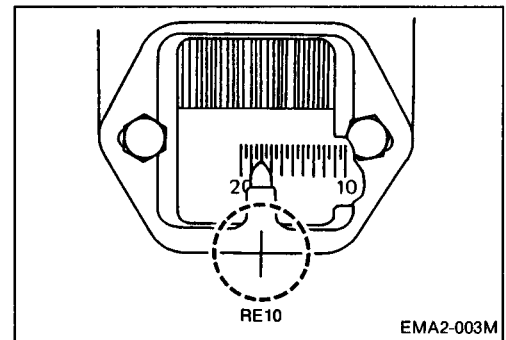
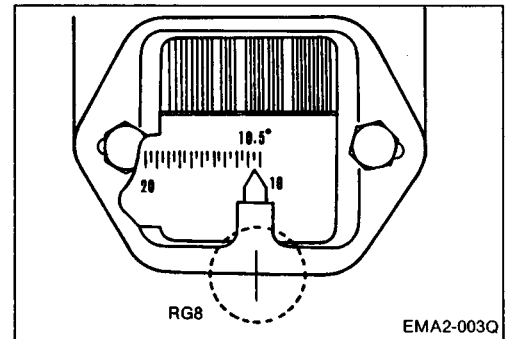
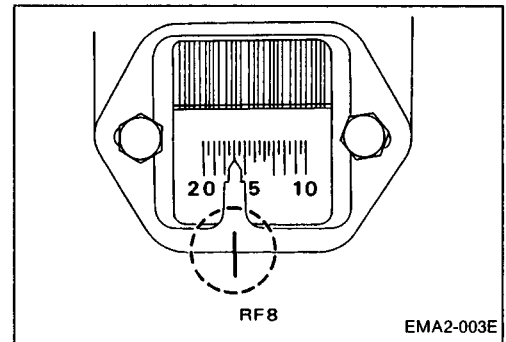
• Fuel injection timing

RF8: 17° B.T.D.C.; engine equipped with conventional type nozzle

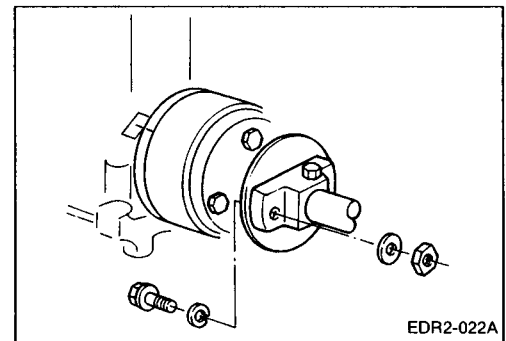
18° B.T.D.C.; engine equipped with two-spring type nozzle (Taiwan only)

RG8: 10.5° B.T.D.C.

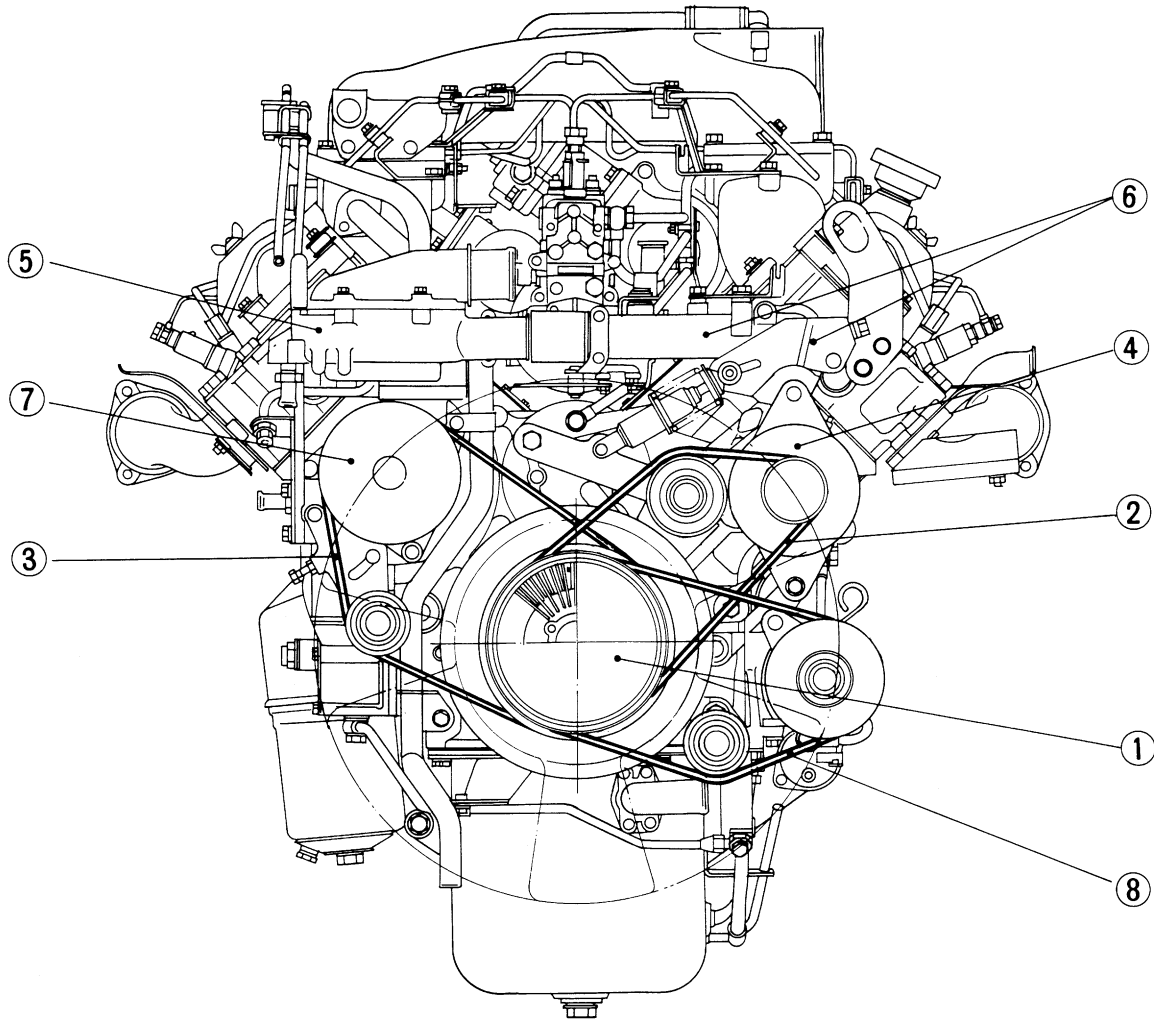
RE10: 18° B.T.D.C.



- Align the mark on the injection pump with the scribed line on the timer, then connect the coupling.



FRONT SIDE OF ENGINE Engine model RF8



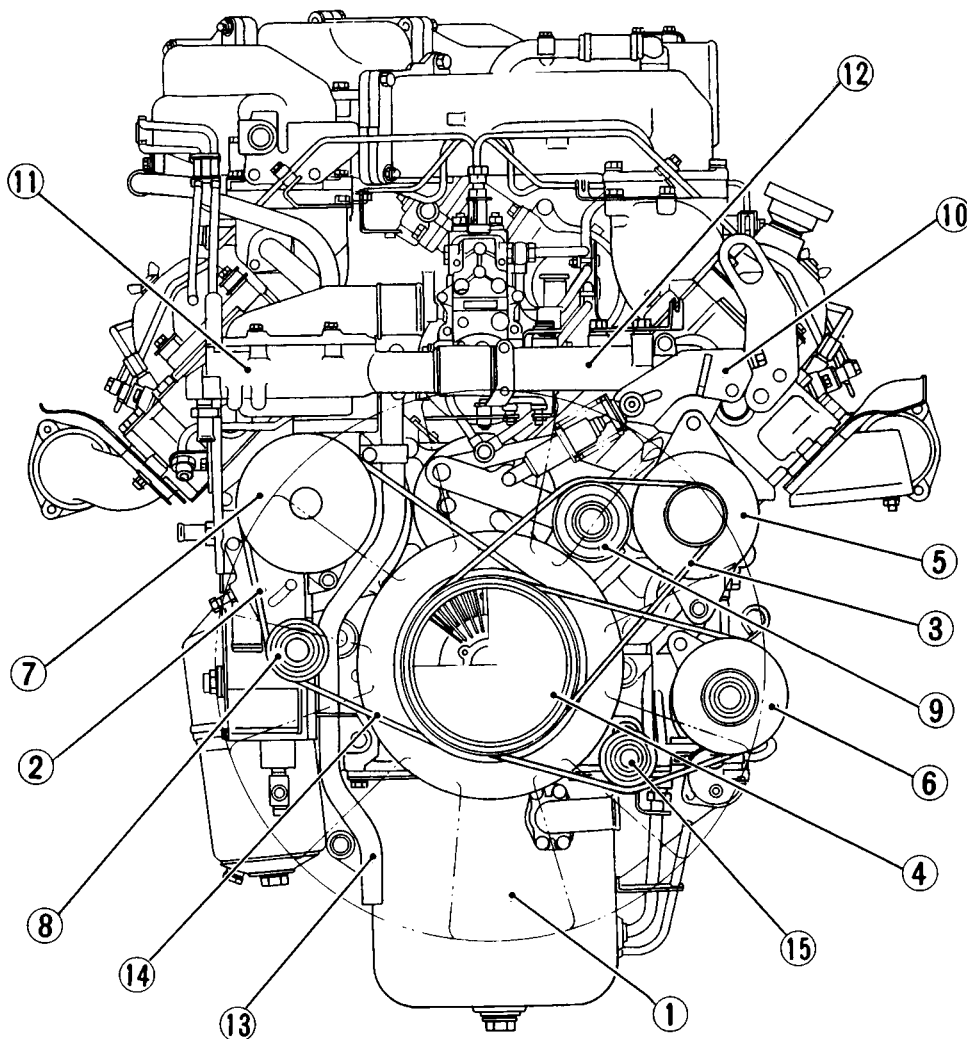
EDR2-118B

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | |
|--------------------------|--------------------------------|
| ☆① Cooling fan | ④ Alternator assembly |
| Fan clutch | ⑤ Thermostat housing |
| Fan clutch adapter | ⑥ Water duct |
| ☆② Alternator drive belt | ⑦ Water pump assembly |
| ☆③ Water pump drive belt | ⑧ Cooler compressor drive belt |

Marks “★” and “☆” indicate that the key points of operation are explained in the text.

Engine model RG8



EDR2-118E

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | |
|---------------------------|---|
| ☆ ① Cooling fan | ⑨ Auto tensioner pulley |
| ☆ ② Water pump drive belt | ⑩ Alternator drive belt adjusting bracket |
| ☆ ③ Alternator drive belt | ⑪ Thermostat housing |
| ④ Crank pulley | ⑫ Water duct |
| ⑤ Alternator assembly | ⑬ Breather pipe |
| ⑥ Cooler compressor | ⑭ Water pump drive belt |
| ⑦ Water pump assembly | ⑮ Tension pulley |
| ⑧ Tension pulley | |

Marks “★” and “☆” indicate that the key points of operation are explained in the text.

Key points of reassembly

③ (RF8) ② (RG8) Water pump drive belt

Attach the tension pulley. Then place the belt on the unit and stretch it with the tension pulley adjustment bolt.

- “L” dimensions: 11 - 14 mm (when the center of the belt between the water pump and the tension pulley is pressed with 10 kg of force)

T : 1st time	10.0 - 12.0 kg-m
T : 2nd time	Loosen
T : 3rd time	10.0 - 12.0 kg-m

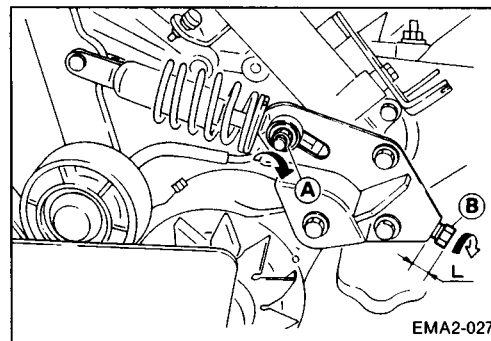
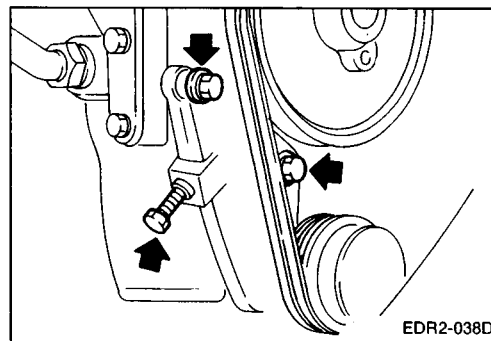
② (RF8) ③ (RG8) Alternator drive belt

- Turn the adjusting bolt (B), located on the alternator adjusting bracket, clockwise until the specified length “L” (shown in the figure on the right) is obtained.

Length “L”: 19.5 mm, max.

- Tighten the tensioner spring mounting nut (A) (shown in the figure on the right).

T : 3.3 - 3.9 kgm



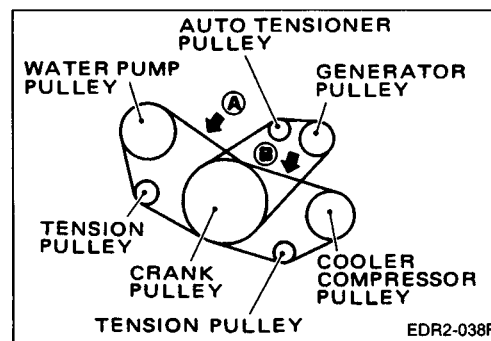
① Cooling fan

Install the fan shroud support and fan shroud.

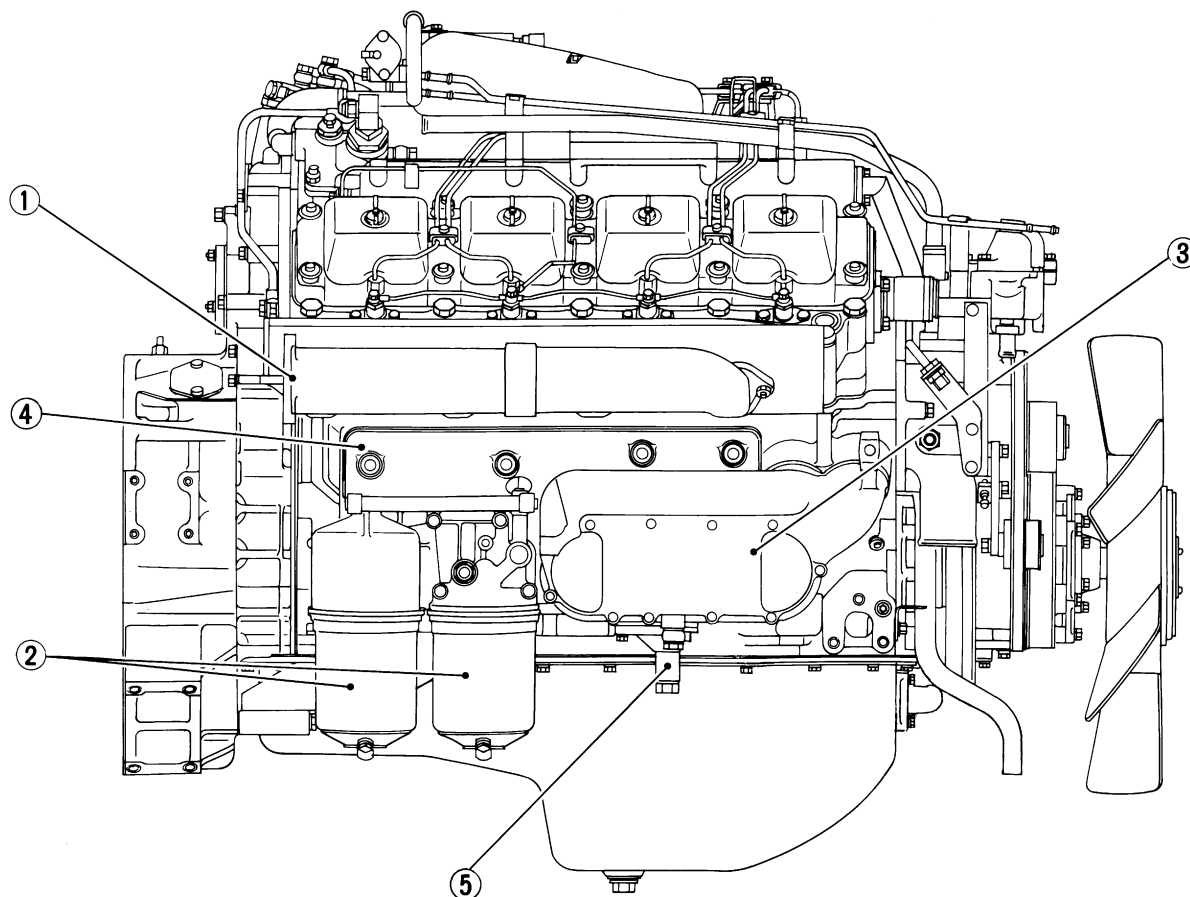
- Make sure that the clearance between the fan and fan shroud is 5.0 to 11.0 mm.

Note:

- Refer to the figure at right for the belt layout.
- Measuring points are shown in the figure at right.
- Deflection A: 10.5 - 13.5 mm
B: 11.0 - 14.0 mm
Deflection weight 10 kg constant



RIGHT SIDE OF ENGINE Engine model RF8



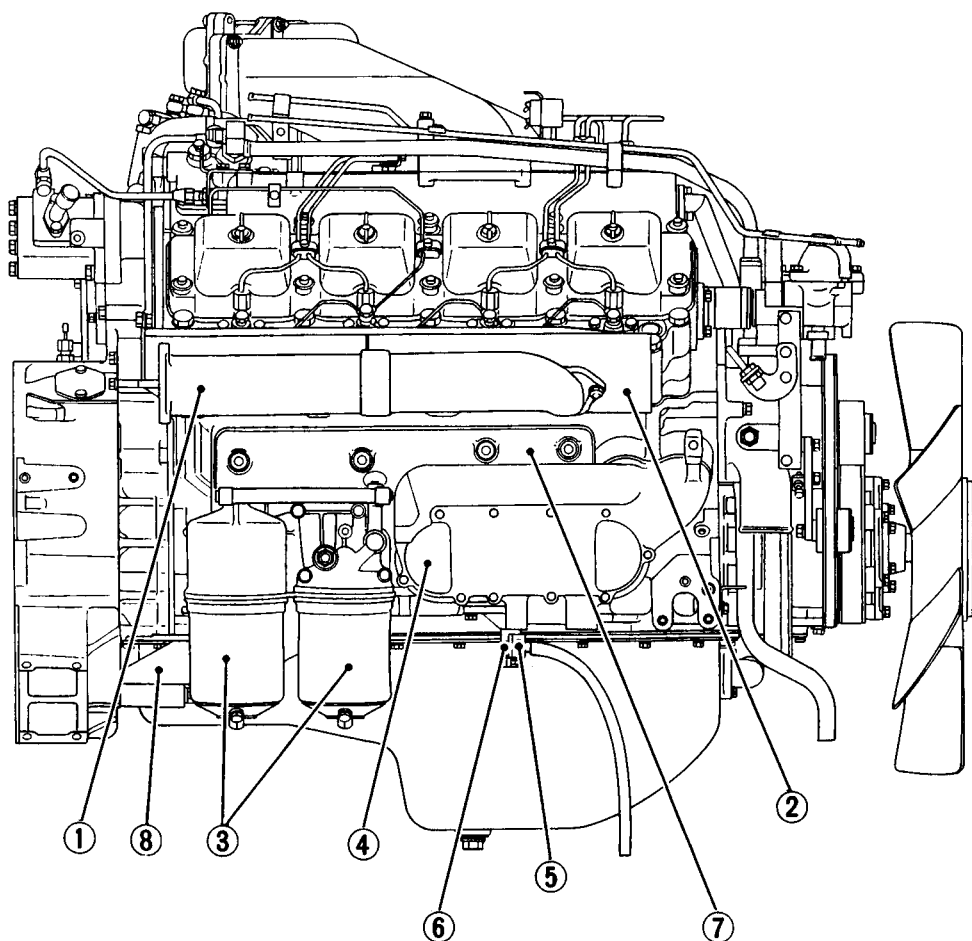
EDR2-119B

Disassembly sequence (Reassembly sequence is in the reverse order of reassembly.)

- ① Exhaust manifold
- ② Oil filter assembly
- ③ Oil cooler assembly
- ④ Cylinder block shield
- ☆⑤ Oil cooler short valve assembly

Marks “★” and “☆” indicate that the key points of operation are explained in the text.

Engine model RG8



EDR2-119C

Disassembly sequence (Reassembly sequence is in the reverse order of reassembly.)

- | | |
|---------------------------------|------------------------------------|
| ① Exhaust manifold | ⑤ Water drain cock |
| ② Exhaust manifold shield plate | ☆⑥ Oil cooler short valve assembly |
| ③ Oil filter assembly | ⑦ Cylinder block shield plate |
| ④ Engine oil cooler assembly | ⑧ Stiffener |

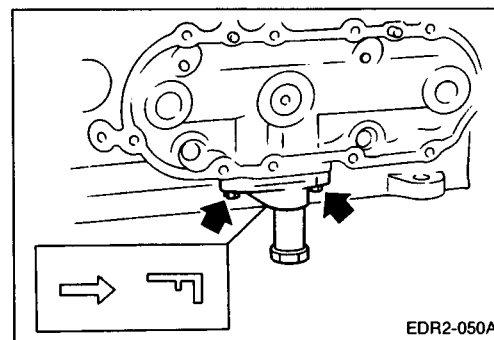
Marks “★” and “☆” indicate that the key points of operation are explained in the text.

Key point of reassembly

⑤ (RF8) ⑥ (RG8) Oil cooler valve assembly

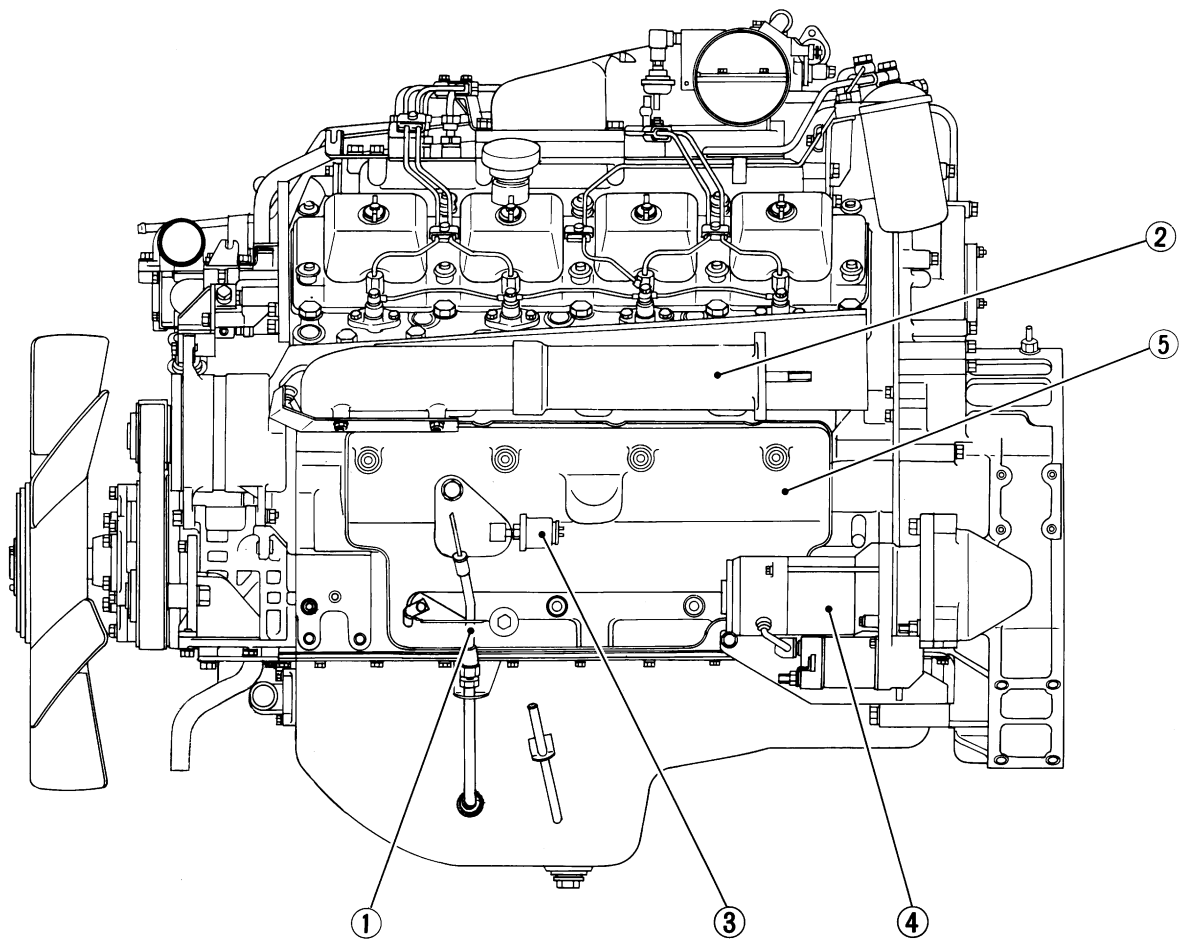
Install the oil cooler short valve assembly.

- Install the short valve so that mark “→ F” faces the front of the engine.



EDR2-050A

LEFT SIDE OF ENGINE Engine model RF8

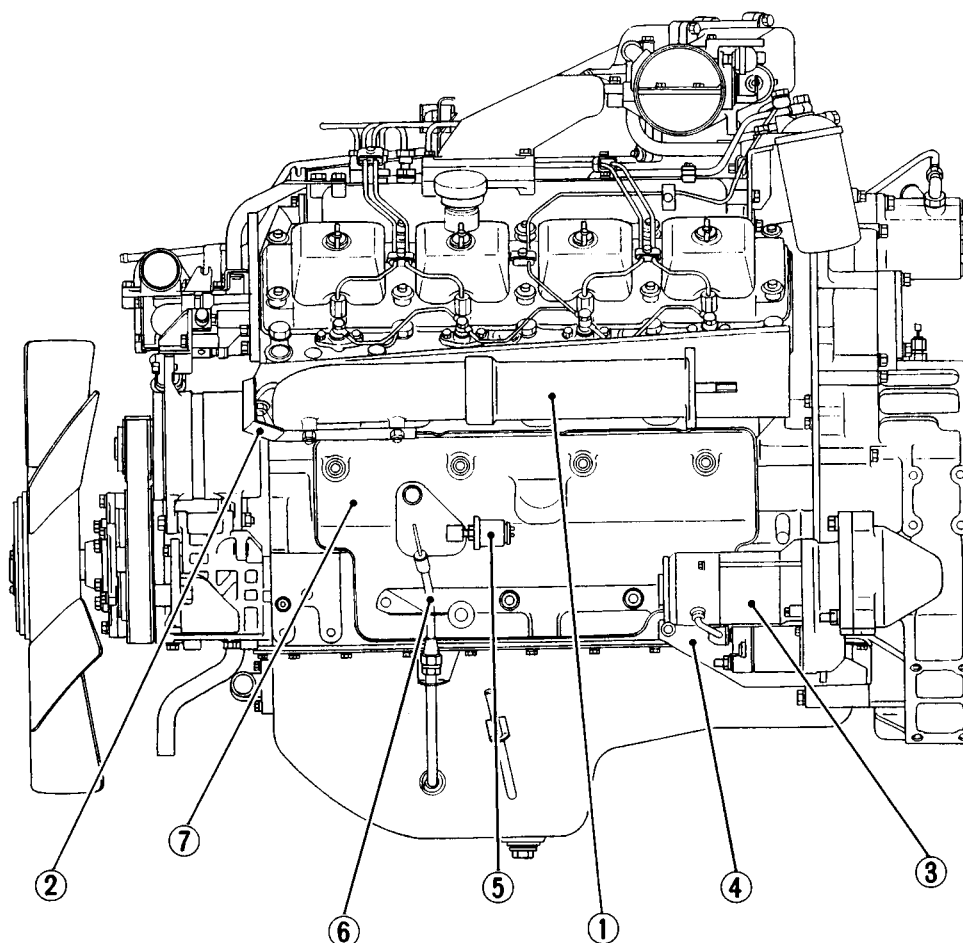


EDR2-120B

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- ① Oil level guide
- ② Exhaust manifold
- ③ Oil pressure switch
- ④ Starting motor assembly
- ⑤ Cylinder block shield

Engine model RG8

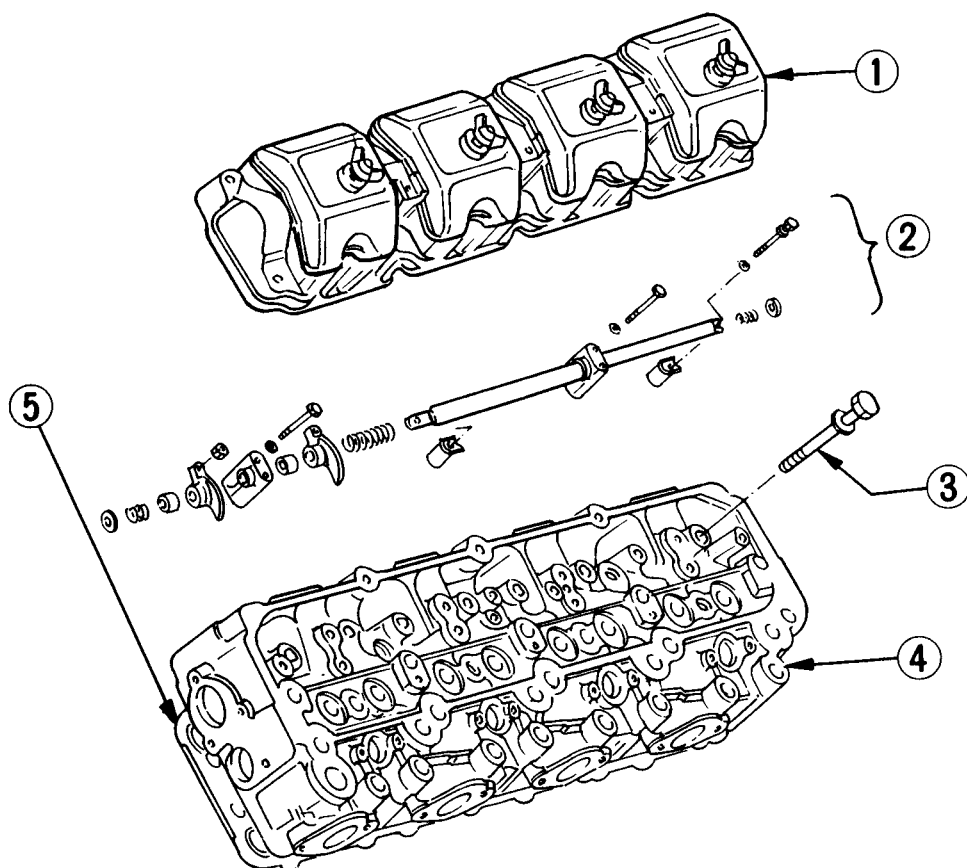


EDR2-120C

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | |
|---------------------------------|-------------------------------|
| ① Exhaust manifold | ⑤ Oil pressure switch |
| ② Exhaust manifold shield plate | ⑥ Oil level guide |
| ③ Starting motor assembly | ⑦ Cylinder block shield plate |
| ④ Stiffener | |

CYLINDER HEAD



EDR2-114B

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- ☆ ① Cylinder head cover assembly
- ☆☆ ② Valve rocker assembly
- ☆☆ ③ Cylinder head bolt
- ④ Cylinder head assembly
- ⑤ Cylinder head gasket

Marks “☆☆” and “☆” indicate that the key points of operation are explained in the text.

Key points of disassembly

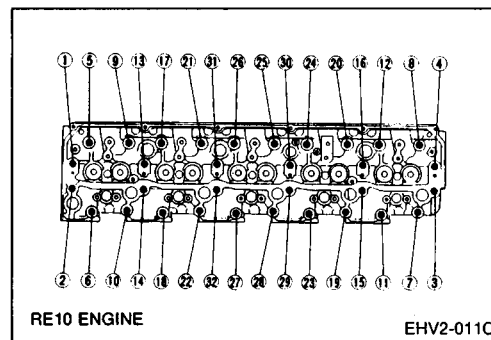
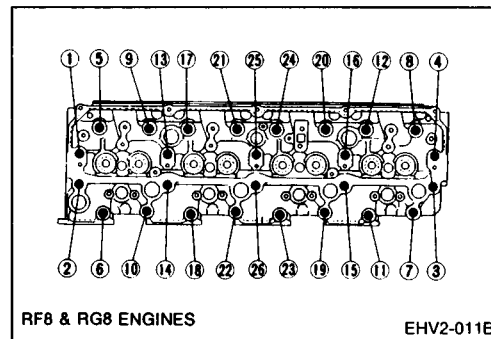
② Valve rocker assembly

- When removing the valve rocker assembly, be sure to loosen the mounting bolts proceeding from the outside in.

③ Cylinder head bolt

Loosening order of cylinder head bolts:

- Be sure to loosen the bolts diagonally proceeding from the outside in.



Key points of reassembly

③ Cylinder head bolt

Tightening order of cylinder head bolts:

- Be sure to tighten the bolts to the specified torque starting with inner ones and proceeding to the outer ones, and repeating the tightening after all bolts have been tightened once. Also make sure that the push rods are properly situated.

Note:

- Tighten the cylinder head bolts in the reverse order of loosening.

T : 1st time		15.0 - 16.0 kg-m
T : 2nd time		28.0 - 30.0 kg-m

② Valve rocker assembly

- When installing the valve rocker assembly, be sure to tighten the mounting bolts starting with inner ones and proceeding to the outer ones.

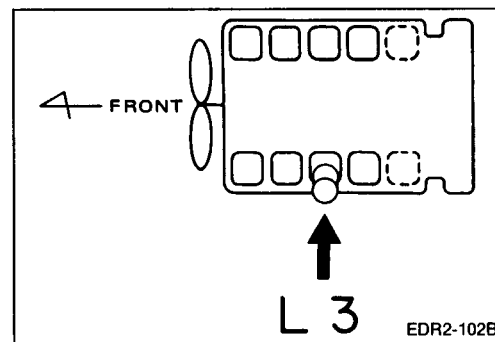
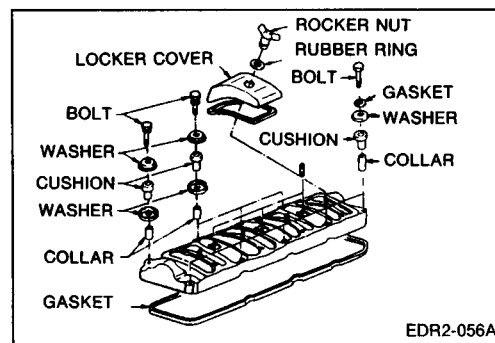
T : 4.0 - 5.0 kg-m

① Head cover assembly:

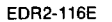
Attaching the cylinder head cover:

- When attaching the cylinder head cover, be especially careful of the type of collars, cushions, and washers which are used.

- Install the rocker cover with attached oil filler at the third cylinder from the front of the left bank.
However, RF8-CG: LH, No.2



ENGINE PROPER



Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

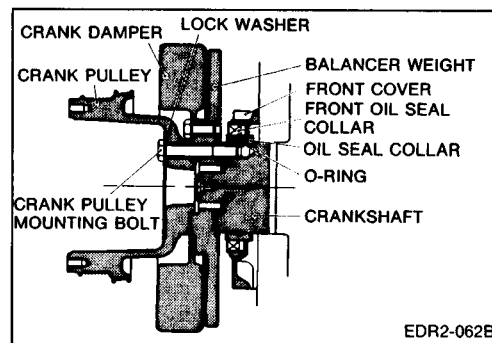
- | | |
|---|--|
| <ul style="list-style-type: none"> ① Water drain hose ② Water drain cock assembly ③ Oil pressure switch ④ Connector ⑤ Connector bolt ⑥ Bolt ⑦ Spring washer ⑧ Plain washer ⑨ Cushion rubber ⑩ Cylinder block shield ⑪ Spacer ⑫ Oil level gauge ☆⑬ Oil level guide ☆⑭ Oil pan ⑮ Oil pan gasket ⑯ Oil filler connector ⑰ Gasket ⑱ O-ring ⑲ Oil drain plug ⑳ Gasket ㉑ Oil screen assembly ㉒ Gasket ㉓ Spacer ㉔ Outlet pipe assembly ㉕ Gasket ㉖ O-ring ㉗ Oil pump assembly ㉘ Piston oil jet bolt ㉙ Piston oil jet nut ㉚ Nut ☆㉛ Connecting rod bearing cap ㉜ Lower shell metal ㉝ Cap bolt ㉞ Upper shell metal ★㉟ Connecting rod ㊱ 1st ring ㊲ 2nd ring ㊳ Oil ring ㊴ Snap ring ㊵ Piston pin ☆㊶ Piston ㊷ Bushing ㊸ Cylinder liner ㊹ Water seal rubber ring ㊺ Water seal rubber ring ㊻ Water seal rubber ring ㊼ Bolt ★☆㊽ Crank pulley ㊾ Lock plate ㊿ Crank damper ① Crank weight ② Front cover ③ Gasket ④ Front oil seal ⑤ Flywheel bolt | <ul style="list-style-type: none"> ★☆⑤⑥ Flywheel assembly ⑤⑦ Lock plate ⑤⑧ Balancer weight ⑤⑨ Ball bearing ⑤⑩ Stiffener ⑤⑪ Rear oil seal ☆⑤⑫ Flywheel housing ⑤⑬ Gasket ⑤⑭ Rear end plate ⑤⑮ Gasket ☆⑤⑯ Speed sensor ⑤⑰ Lock nut ⑤⑱ Bracket ⑤⑲ Pointer cover ⑤⑳ Gasket ⑤㉑ Pointer ⑤㉒ Plate ⑤㉓ Meter drive assembly ⑤㉔ Cover ⑤㉕ Gasket ⑤㉖ Gasket ⑤㉗ O-ring ★☆⑤㉘ Main bearing side bolt ⑤㉙ Seal washer ⑤㉚ Main bearing cap bolt ★☆⑤㉛ Main bearing cap ⑤㉜ Main shell metal ⑤㉝ Thrust washer ⑤㉞ Thrust washer ★☆⑤㉟ Crankshaft assembly ⑤㊱ Front oil seal sleeve ⑤㊲ O-ring ⑤㊳ Straight pin ⑤㊴ Balancer weight bolt ⑤㊵ Camshaft nut ⑤㊶ Lock washer ★☆⑤㊷ Camshaft gear ⑤㊸ Camshaft collar ⑤㊹ Locating washer ⑤㊺ Key ⑤㊻ Camshaft assembly ☆⑤㊼ Push rod cover ⑤㊽ Spacer ⑤㊾ 1st camshaft bushing ⑤㊿ 2nd camshaft bushing ① 3rd camshaft bushing ② 4th camshaft bushing ③ Rear camshaft bushing ④ Idler shaft bolt ⑤ Idler plate ★☆⑥ Idler cluster gear ⑦ Idler bushing ⑧ Idler gear shaft ⑨ Cylinder block |
|---|--|

Marks “★” and “☆” indicate that the key points of operation are explained in the text.

Key points of disassembly

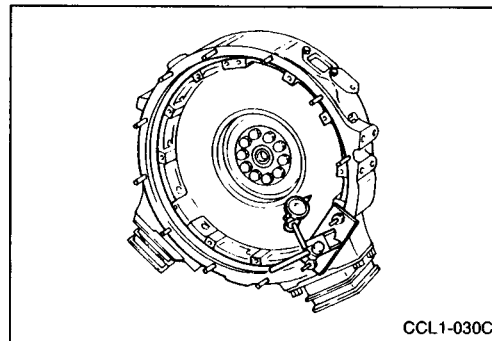
④⑧ Crank pulley

Straighten the lock washers, then remove the crank pulley mounting bolts. The crank pulley, crank damper and balancer weight can then be removed as a unit.

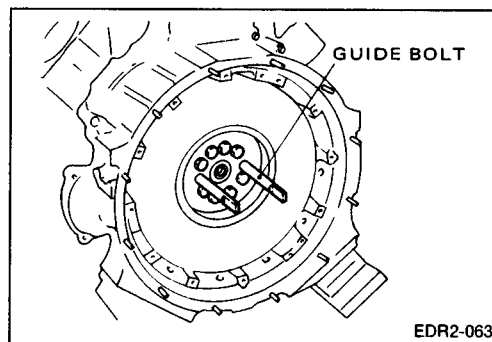


⑤⑥ Flywheel

1) Before removing the flywheel, measure and record the lateral runout of the clutch disc surface of the flywheel.



2) Remove the flywheel utilizing the guide bolts (99687 97001).

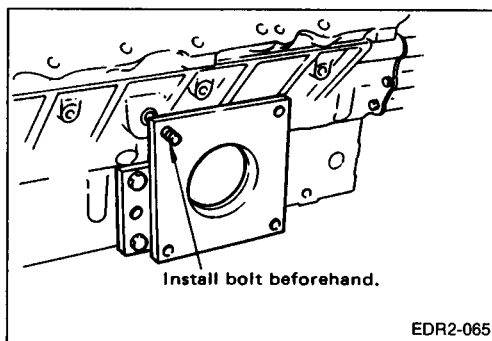
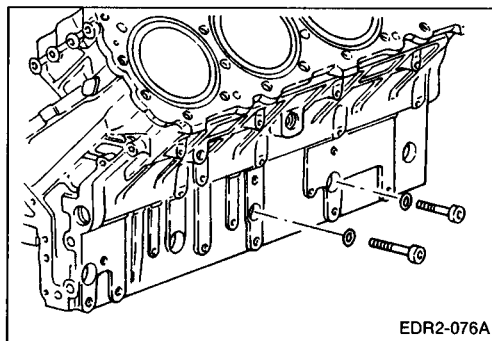


Engine stand attachment

⑦⑧ Main bearing side bolt

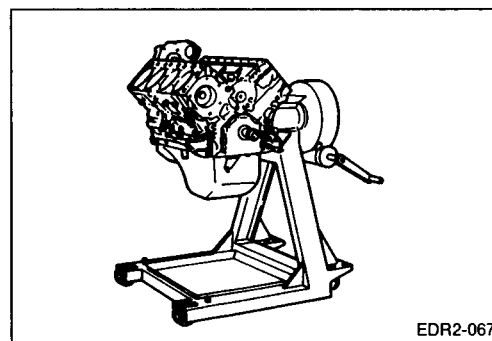
Attach the engine stand attachment (99554 97001).

- Be sure to insert a mounting bolt in the upper left corner of the engine stand before attaching to the engine.
- Using the special hex wrench (99545 97000), remove the No. 3 and No. 4 main bearing side bolts on the left side of the cylinder block in advance.



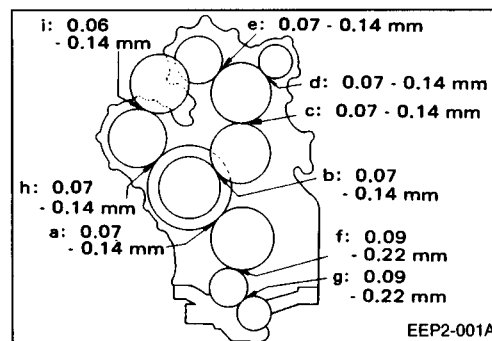
Engine stand

Raise the engine using a hoist, and mount it on the engine stand (99550 96001).



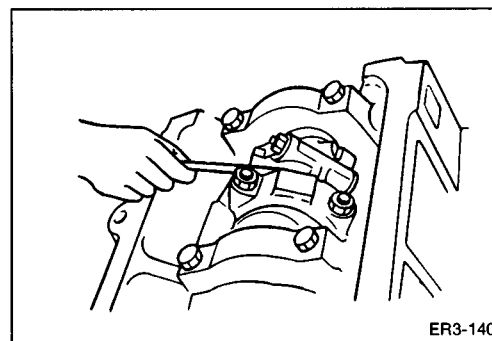
Gear train

Measure and record the backlash of the gear train.



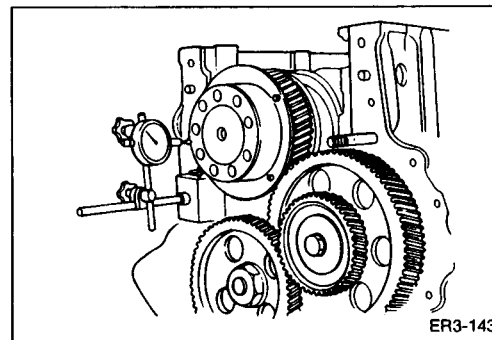
35 Piston and connecting rod assembly

Before removing the piston assembly and connecting rod assembly, measure and record the side clearance at the large end of the connecting rod for each cylinder.



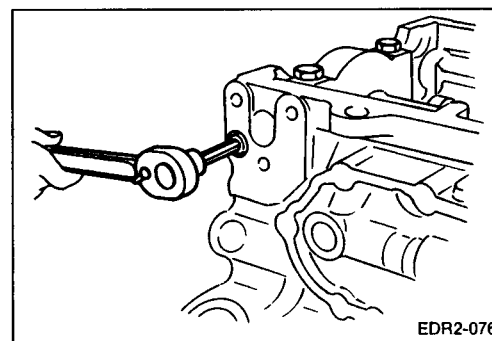
65 Crankshaft

Measure and record the crankshaft end play.



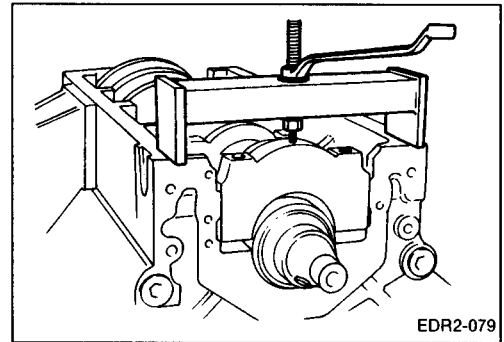
78 Main bearing side bolt

Remove the main bearing cap side bolt using a hexagonal wrench (99545 97000).



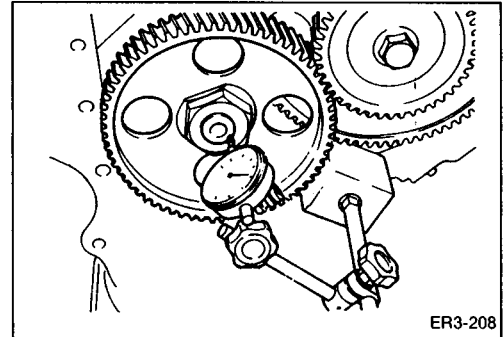
⑧1 Main bearing cap

Remove the main bearing cap using a special puller (99601 97000).



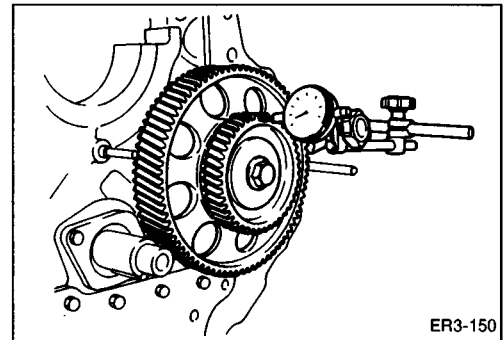
⑨2 Camshaft gear

Measure and record the camshaft end play before removing the camshaft gear.



⑩6 Idler gear

Measure and record the idler gear (cluster gear) end play.



Key points of reassembly

⑨7 Push rod cover

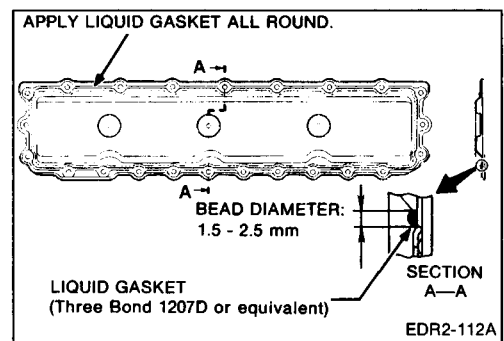
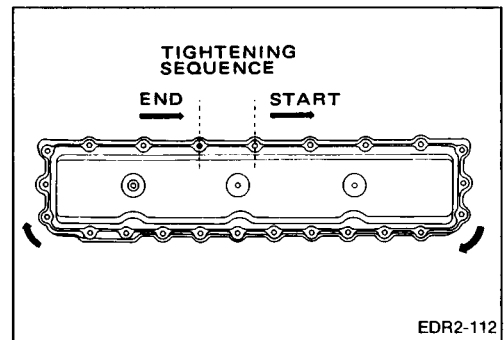
When the push rod cover which has been removed is used again, apply an appropriate amount of liquid gasket (Three Bond No.1207 or equivalent) to the contacting surface of the block and cover. Then install the push rod cover according to the tightening order with the gasket in place.

Install the main bearing shell in its original position.

The thrust washer has an oil groove which should face the crankshaft when installed. Install upper and lower washers of the same thickness with the grooves facing the same direction.

Note:

- Before applying liquid gasket, remove any dust, oil and water from the flanged surface of all parts.
- Apply an equal amount of liquid gasket to the flanged surface without breaks. Be sure to overlap the gasket ends.
- Install the parts within 10 minutes after liquid gasket application.
- After installing the parts, ensure all parts are properly set in their positions.
- If any of the parts are removed for some reason after installation, completely remove all traces of liquid gasket



installation, completely remove all traces of liquid gasket from the mating surfaces of the parts before applying new liquid gasket again.

⑧1 Main bearing cap

- 1) Attach the main bearing cap using a special guide bolt.

Guide bolt

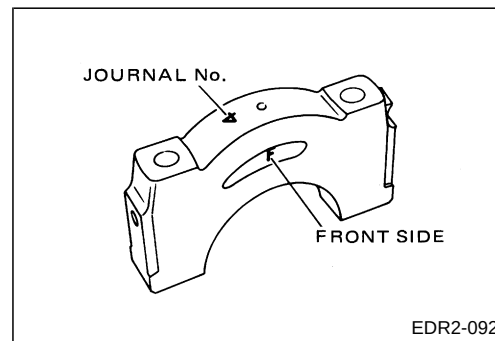
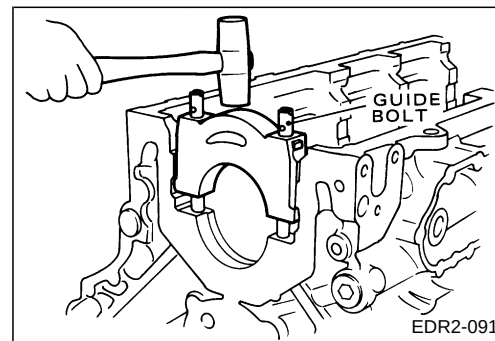
99687 97000 (RF8 and RE10 engines)

99687 97004 (RG8 engine)

- 2) Attaching direction of the main bearing cap.
Tighten the main bearing cap bolts.

T : 26 - 30 kg-m (RF8, RE10 engines)

T : 42 - 45 kg-m (RG8 engine)

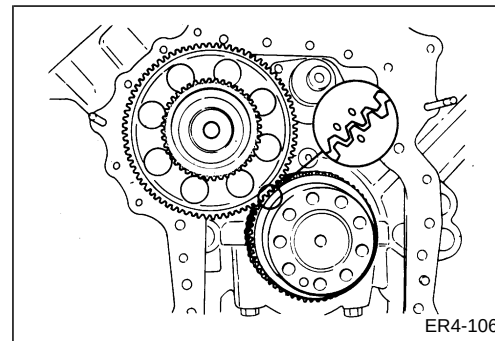


⑩⑥ Idler gear

- 1) Installing the idler gear (cluster gear) assembly.

<Without engine rear PTO>

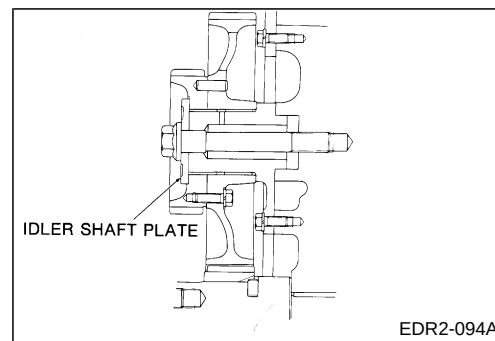
- Align the marks on the crank gear and idler gear, and install the cluster gear assembly onto the idler shaft. Then tighten the idler shaft bolt with the idler shaft plate in place.



Note:

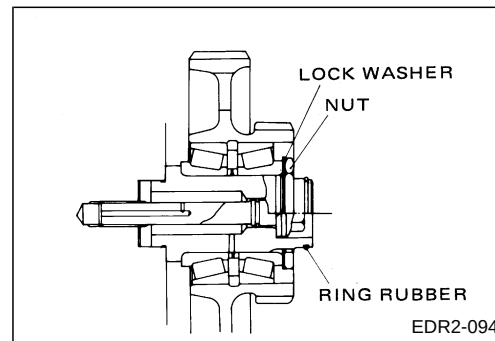
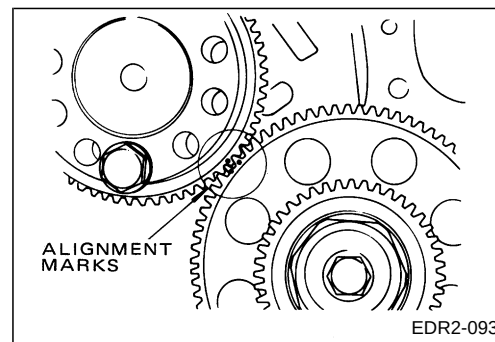
- Install the idler shaft plate with the grooved side (on the flat surface) facing the idler shaft bolt seat (that is, the rear side of the engine).

T : 13 - 16 kg-m

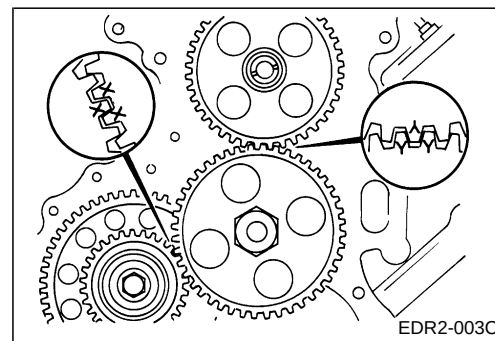


<With engine rear PTO>

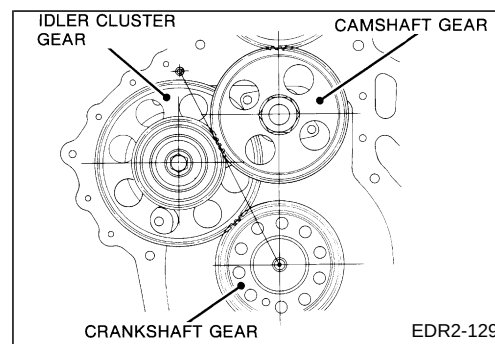
- Align the marks on the crank gear and idler gear, and install the idler gear assembly onto the idler shaft. Then tighten the idler shaft nut with the lock washer in place.



- Align the marks on the idler gear and injection pump drive gear, then install them.

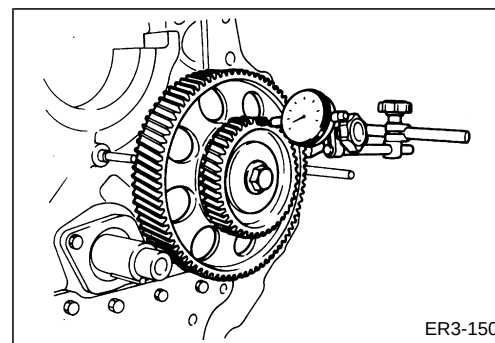


- Install the oil jets used to lubricate the gear train with the oil holes (1.0 mm diameter) facing the center of the crankshaft.



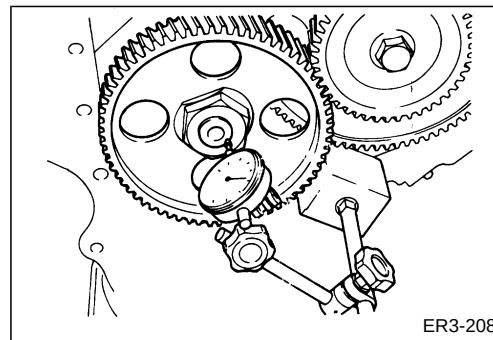
106 Idler gear

Measure and record the idler gear (cluster gear) end play.



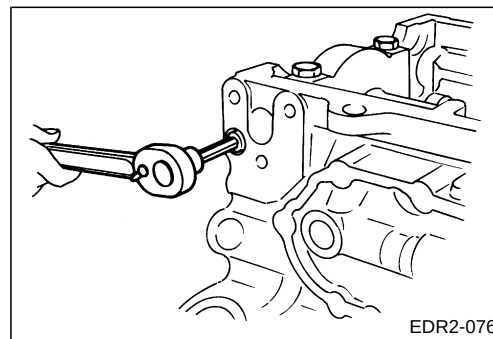
⑨② Camshaft gear

Measure and record the camshaft end play after installing the camshaft gear.



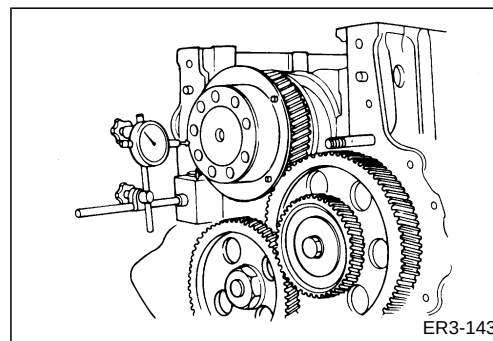
⑦⑧ Main bearing side bolt

- 1) Install the main bearing cap side bolt using a hexagonal wrench (99545 97000).



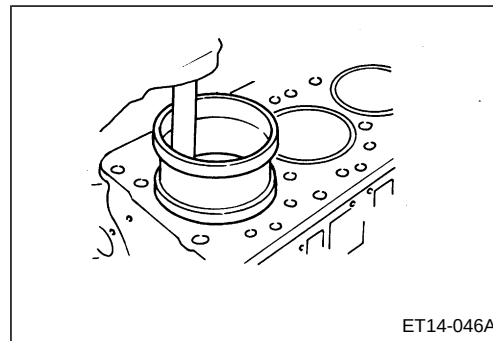
⑧⑤ Crankshaft

Measure and record the crankshaft end play.



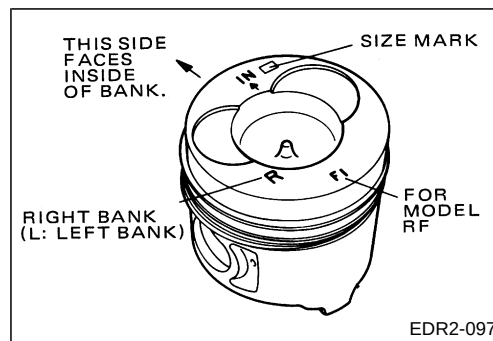
④① Piston assembly

- 1) Install the piston assembly with a connecting rod using a piston insert tool (99631 97002 for RF8 engine, or 99631 97600 for RG8 engine, or 99631 97000 for RE10 engine).

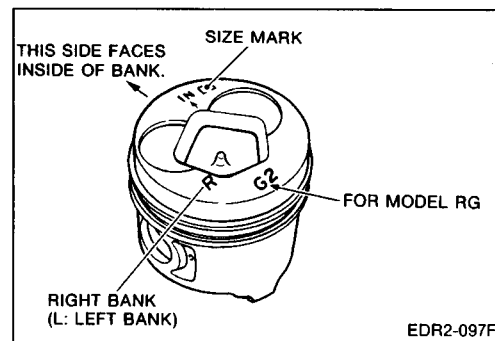


- 2) Position and direction of the piston:

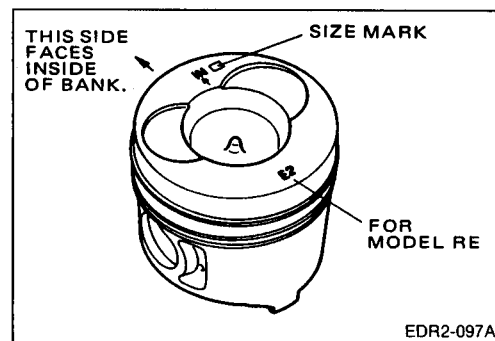
- RF8



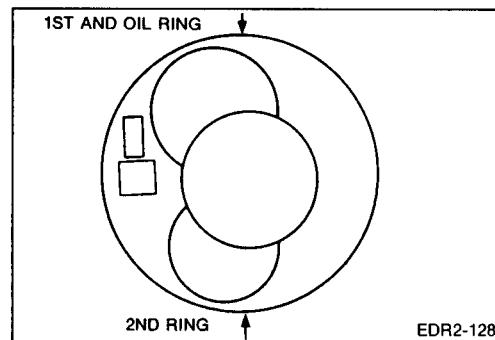
• RG8



• RE10



- 3) Do not install the piston ring in such a way that its gap faces the direction of the piston pin and is in a vertical direction.



③① Connecting rod bearing cap

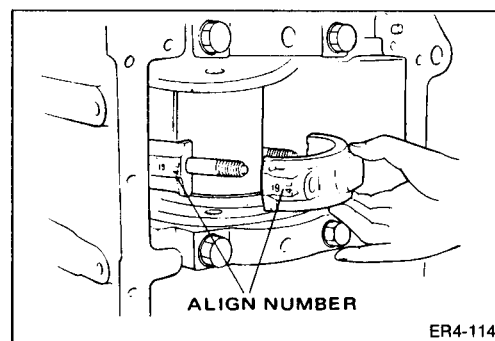
Align the marks stamped on the end faces of the connecting rod and cap. Tighten the cap nuts.

Note:

- Apply a coat of engine oil to the cap nut seating surfaces and bolt threads before installation.

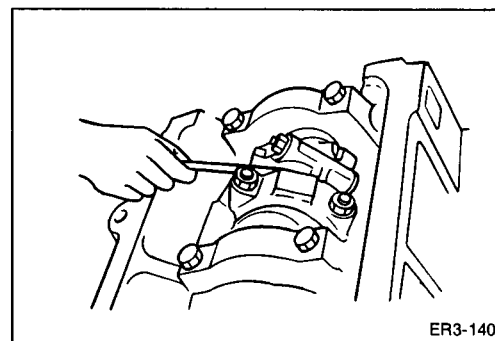
T : 18.0 - 20.0 kg-m (RF8, RE10 engines)

T : 23.0 - 25.0 kg-m (RG8 engine)



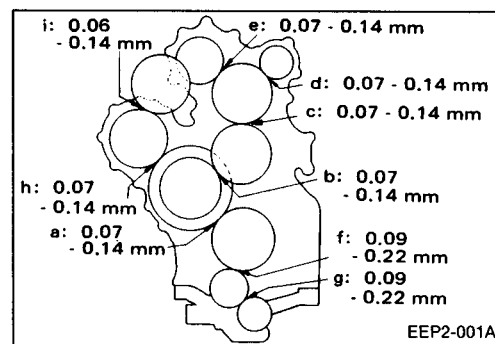
③① Piston and connecting rod assembly

After installing the piston assembly and connecting rod assembly, measure and record the side clearance at the large end of the connecting rod for each cylinder.



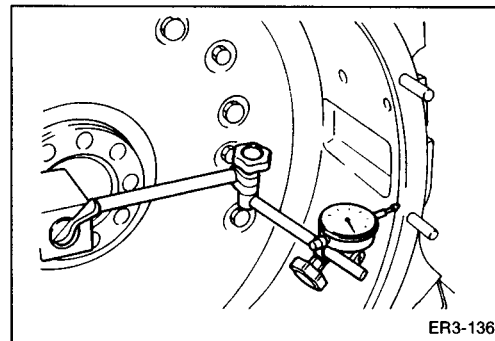
Gear train

Measure and record the backlash of the gear train.



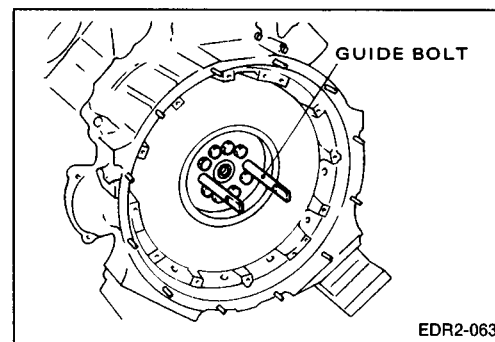
62 Flywheel housing

Measure the misalignment of the flywheel housing.

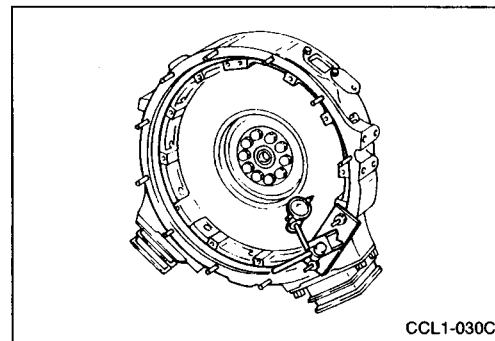


56 Flywheel

1) Install the flywheel utilizing the guide bolt (99687 97001).



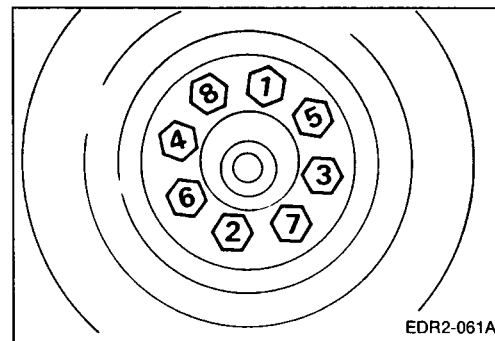
2) Measure the runout of the clutch disc contacting surface on the flywheel after installing the flywheel.



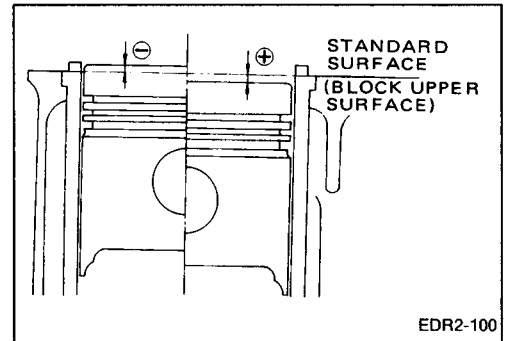
48 Crank pulley

1) Install the crank pulley assembly. Tighten the crank pulley bolts in a criss-cross fashion to the specified torque. After tightening all bolts, recheck all bolts for the specified torque setting.

T : 18.0 - 20.0 kg-m

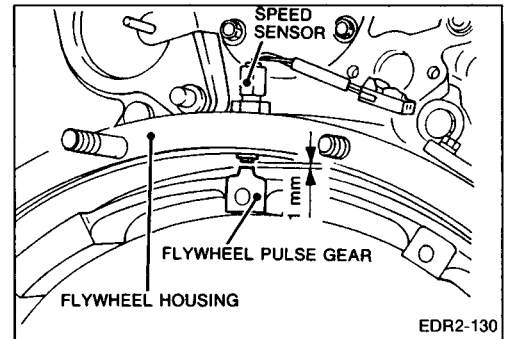


- 2) Place each piston at its top dead center on the compression stroke, and measure the piston top clearance at this position.



66 Speed sensor

Install the speed sensor (pickup) on top of the flywheel housing and adjust the clearance between the tip of the sensor and the outer perimeter of the flywheel pulse gear. For details, refer to the adjustment procedure described below.



< Adjustment procedure >

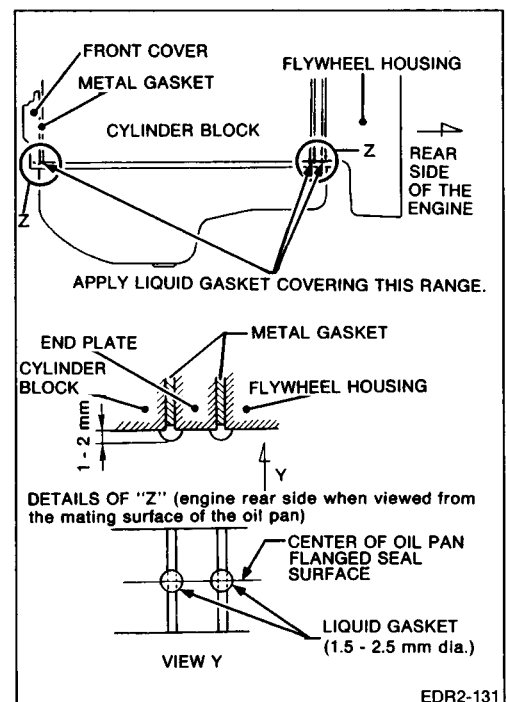
- Tighten the speed sensor until the tip end is in contact with the outer perimeter of the pulse gear, then back off one rotation.
- Using a feeler gauge, measure the clearance between the tip of the speed sensor and the outer perimeter of the pulse gear. The clearance must be 1 mm.
- Tighten the lock nut.

14 Oil pan

Before installing the oil pan, apply a coat of liquid gasket (Three Bond 1207D or equivalent) sparingly to the mating surfaces of the front cover, end plate located at the flywheel, and the gasketed joint.

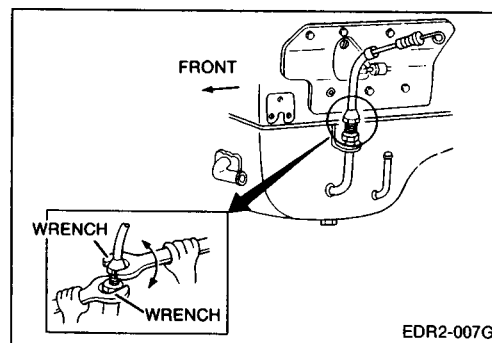
Notes:

- Before applying liquid gasket, remove any dust, oil and water from the flanged surfaces of the parts.
- Install the parts within 10 minutes after liquid gasket application.
- Ensure the oil pan is correctly installed.
- If any of the parts are removed for some reason, completely remove all traces of liquid gasket from the parts before applying new liquid gasket again.

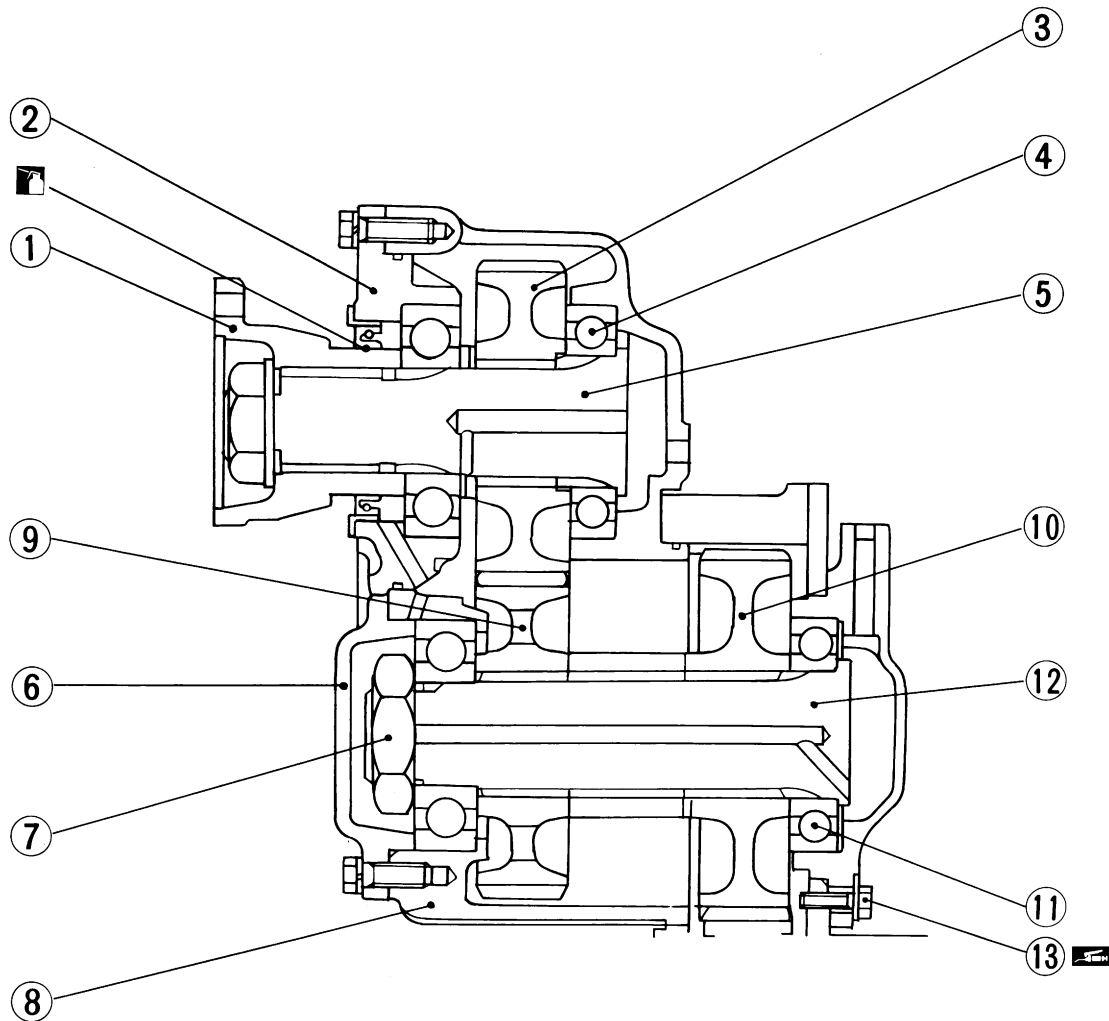


⑬ Oil level guide

Install the oil level guide on the oil pan. Use a wrench to prevent the connector from turning and tighten the flare nut.



ENGINE REAR PTO



EDR2-115A

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | |
|------------------------|-----------------|
| ① Companion flange | ⑧ PTO gear case |
| ☆② Bearing holder | ⑨ Idler gear |
| ③ PTO gear | ⑩ PTO gear |
| ④ Ball bearing (small) | ☆⑪ Ball bearing |
| ⑤ PTO drive shaft | ⑫ Idler shaft |
| ⑥ Idler cover | ⑬ Bolt |
| ⑦ Nut | |

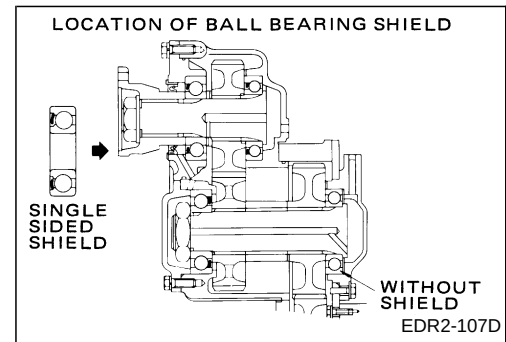
Marks “★” and “☆” indicate that the key points of operation are explained in the text.

Key points of reassembly

⑪ Ball bearing

Installing the ball bearing:

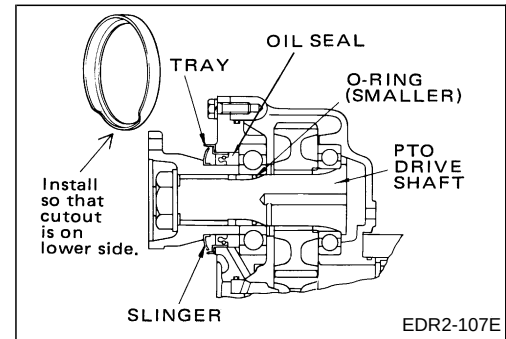
When installing the ball bearing, make sure that the shield plate faces toward the correct direction.



⑫ Bearing holder

1) Inserting the oil tray:

Insert the oil tray with its cutout portion facing toward the oil way side of the bearing holder.



2) Apply a coat of engine oil to the sealing lip of the oil seal.

ENGINE INSTALLATION

MOUNTING ENGINE

- 1) Raise the engine assembly using a crane and move it to the mounting position of the vehicle body.
- 2) Gently lower the engine, then align the front and rear engine mounting positions and tighten the bolts.

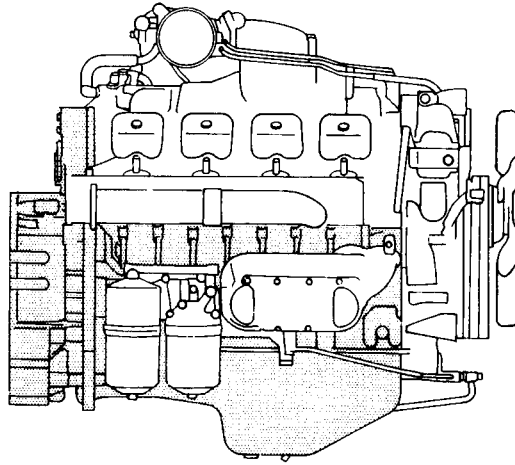
INSTALLING PARTS AROUND ENGINE

- 1) Install the rear cab mount bracket.
- 2) Connect the exhaust tube with the exhaust manifold.
- 3) Install the radiator assembly and connect the water hose.
- 4) Mount the transmission assembly using a transmission jack. Then connect the control linkage, cables and wires.
- 5) Connect the transmission with the propeller shaft. Connect all wiring, pipes and linkages.
- 6) Install the car cooler compressor and accessories when equipped with an air conditioner.
- 7) Install the air cleaner assembly and related parts and connect the air hose.

PREPARATORY OPERATIONS PRIOR TO STARTING ENGINE

- 1) Fill the engine oil, power steering oil and engine cooling water.
- 2) Remove the air in the fuel system.
- 3) Adjust the valve clearance.
- 4) Install the V-belt and adjust the tension.
- 5) Connect the cable to the negative terminal of the battery.
- 6) Start up the engine, then remove the air in the power steering system.
- 7) Check to make sure that there is no leakage of air, cooling water, fuel or oil from any connecting points.
- 8) Install the transmission under cover, engine room side cover, under cover and other covers.

5. ENGINE PROPER



ER0-122

This chapter describes the method of cleaning and inspecting the cylinder block, piston, crankshaft, etc., and the method of replacing the cylinder liner, etc.

CONTENTS

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GEAR TRAIN	5-16	REPLACING CONNECTING ROD	
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INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect the parts for cracks and other damage carefully. If faulty, replace with a new one.

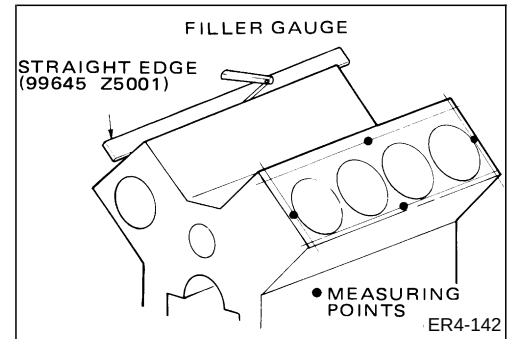
CYLINDER BLOCK

FLATNESS OF THE TOP SURFACE

Using a straight edge (99645 Z5001), measure the flatness of the top surface.

[mm]

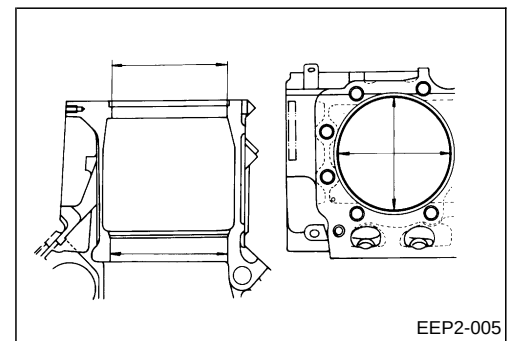
Item	Maintenance standard	Remarks
Axial direction	0.10, max.	—
Perpendicular direction	0.02, max.	



OUT-OF-ROUNDNESS OF THE LINER FITTING I.D. AND FITTING LENGTH

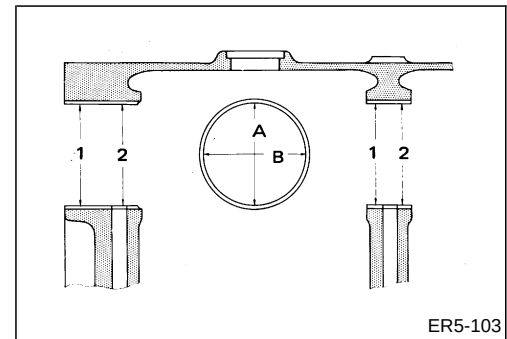
[mm]

Item	Maintenance standard	Remarks
I.D. out-of-roundness	0.025,max	
Fitting length	Upper	0.014T - 0.031L
	Lower	0.010T - 0.035L
		L: Loose T: Tight



CAMSHAFT BUSHING

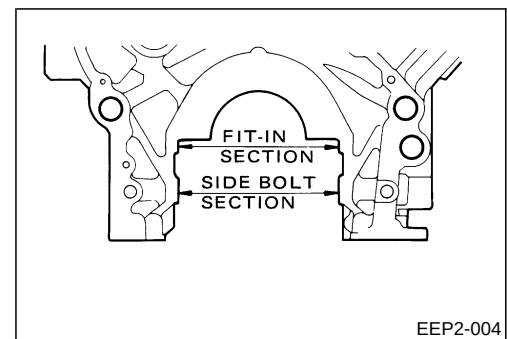
Measure and record the inside diameter of the camshaft bushing.



CLEARANCE BETWEEN THE MAIN BEARING CAP AND BLOCK FITTING SECTION

[mm]

Item	Maintenance standard	Remarks
Fit-in section	0.05T - 0.02L	L: Loose T: Tight
Side bolt section	0 - 0.07L	

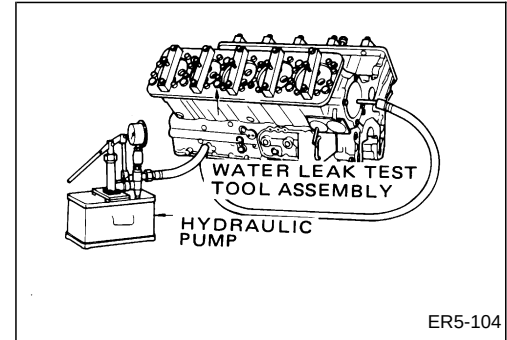


WATER PRESSURE TEST

Using a hydraulic pump (99570 Z5000) and a cylinder block attachment (99561 97000), perform a water pressure test.

[kg/cm²]

	Maintenance standard
Water pressure	4.0



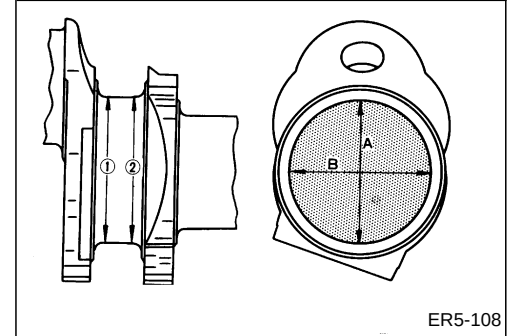
CRANKSHAFT

OUTSIDE DIAMETER OF THE JOURNAL

Measure and record the outside diameter of the journal. If the measured value has reached the service limit, grind the journal to the undersize, and install the undersize main bearing shell.

[mm]

Item	Maintenance standard	Service limit	Remarks
S.T.D	109.87 - 109.89	109.00	Rounded ends R = 4.0 mm
0.25U.S.	109.62 - 109.64	—	
0.50U.S.	109.37 - 109.39	—	
0.75U.S.	109.12 - 109.14	—	



U.S.: Undersize

OUT-OF-ROUNDNESS OF THE JOURNAL

If the out-of-roundness has exceeded the maintenance standard, grind the journal to the undersize, and install the undersize main bearing shell.

[mm]

Maintenance standard	Service limit
0.005, max.	0.06

TAPER OF THE JOURNAL

If the taper has exceeded the maintenance standard, grind the journal to the undersize, and install the undersize main bearing shell.

[mm]

Maintenance standard	Service limit
0.01, max.	—

OUTSIDE DIAMETER OF THE CRANKSHAFT PIN

Measure and record the outside diameter of the crankshaft pin. If the measured value has reached the service limit, grind the pin to the undersize, and install the undersize bearing shell.

<Engine models RF8, RE10>

[mm]

Item	Maintenance standard	Service limit	Remarks
S.T.D	84.89 - 84.91	84.00	Rounded ends R = 5.0 mm
0.25U.S.	84.64 - 84.66	—	
0.50U.S.	84.39 - 84.41	—	
0.75U.S.	84.14 - 84.16	—	

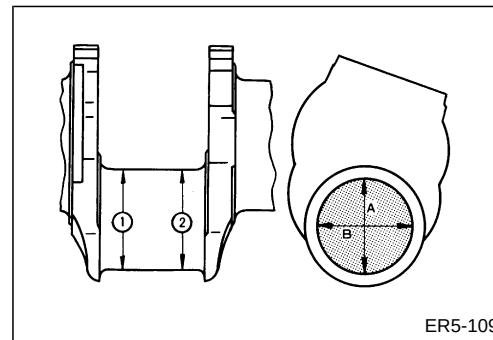
U.S.: Undersize

<Engine model RG8>

[mm]

Item	Maintenance standard	Service limit	Remarks
S.T.D	89.89 - 89.91	89.00	Rounded ends R = 5.0 mm
0.25U.S.	89.64 - 89.66	—	
0.50U.S.	89.39 - 89.41	—	
0.75U.S.	89.14 - 89.16	—	

U.S.: Undersize



OUT-OF-ROUNDNESS OF THE CRANKSHAFT PIN

If the out-of-roundness has reached the service limit, grind the pin to the undersize, and install the undersize bearing shell.

[mm]

Maintenance standard	Service limit
0.005, max.	0.06

TAPER OF THE CRANKSHAFT PIN

If the taper has exceeded the service limit, grind the pin to the undersize, and install the undersize bearing shell.

[mm]

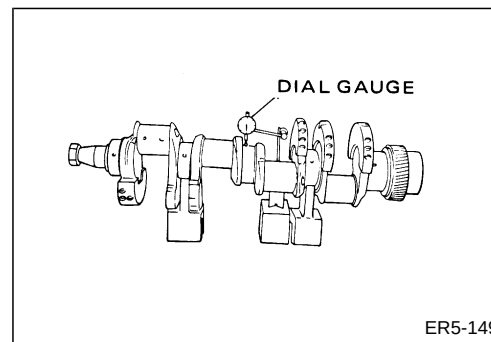
Maintenance standard	Service limit
0.01, max.	—

RUNOUT

Support the No. 2 and No. 4 journals (RF8 and RG8 engines) or No. 2 and No. 5 journals (RE10 engine), and measure the runout of each part.

[mm]

Item	Maintenance standard	Service limit
At journal	0.03, max.	0.40
Front oil seal contacting surface	0.01, max.	—
Rear flywheel mounting surface	0.02, max.	—



END PLAY

If the end play measured during disassembly has reached the specified service limit, replace the upper and lower thrust washers as a unit with a suitable set of thrust washers so that the end play is within the maintenance standard.

[mm]

Maintenance standard	Service limit
0.05 - 0.14	0.50

Size mark		Thickness [mm]
Type of thrust washer	A	3.995 - 4.025
	B	3.970 - 4.000
	C	3.945 - 3.975
	0.15 O.S.	4.145 - 4.175
	0.30 O.S.	4.295 - 4.325

O.S.: Oversize

MAIN BEARING SHELL

CLEARANCE BETWEEN MAIN BEARING SHELL AND CRANKSHAFT JOURNAL

With the main bearing shell assembled to the cylinder block, tighten the main bearing cap to the specified torque and measure the inside diameter of the main bearing shell.

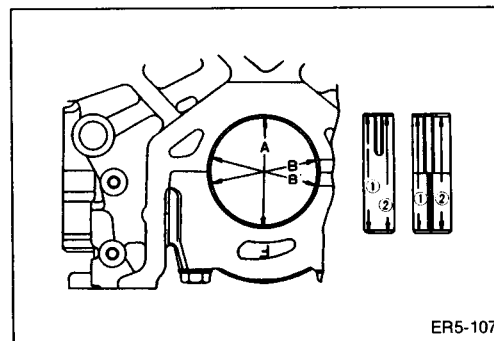
Calculate the clearance between the journal O.D. and main bearing shell I.D. from the measured values.

[kgm]

Item	Tightening torque
RF8, RE10 engines	26 - 30
RG8 engine	42 - 45

[mm]

Maintenance standard	Service limit
0.04 - 0.13	0.20



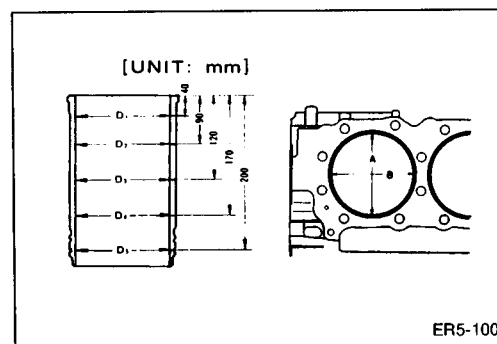
CYLINDER LINER

Measure the cylinder liner without dismounting it from the cylinder block. (Measurement should be made at 40, 90, 120, 170 and 200 mm positions from the top of the cylinder block.)

INSIDE DIAMETER

[mm]

Item	Maintenance standard	Service limit
RF8 engine	138.00 - 138.03	138.25
RG8 engine	142.00 - 142.03	142.25
RE10 engine	134.99 - 135.02	135.25



OUT-OF-ROUNDNESS

[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.03, max.	—
RG8 engine		
RE10 engine		

TAPER

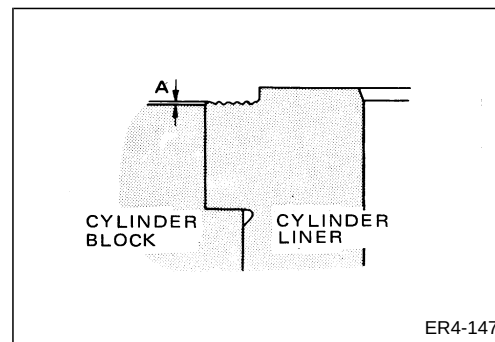
[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.03, max.	—
RG8 engine		
RE10 engine		

DISTANCE BETWEEN THE TOP SURFACE OF THE CYLINDER BLOCK AND THE FLANGE AND ITS DIFFERENCE BETWEEN CYLINDERS

[mm]

Item		Maintenance standard	Service limit
Distance A	RF8 engine	0.01 - 0.07	—
	RG8 engine	0.01 - 0.03	
	RE10 engine	0.01 - 0.07	
Difference between cylinders	RF8 engine	0.05, max.	—
	RG8 engine		
	RE10 engine		



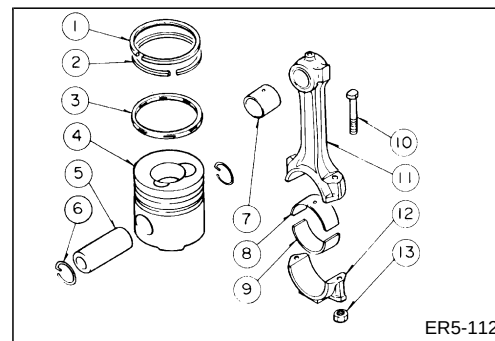
PISTON AND CONNECTING ROD

It is necessary to examine the piston and connecting rod. When they are disassembled, keep the component parts grouped by cylinder numbers.

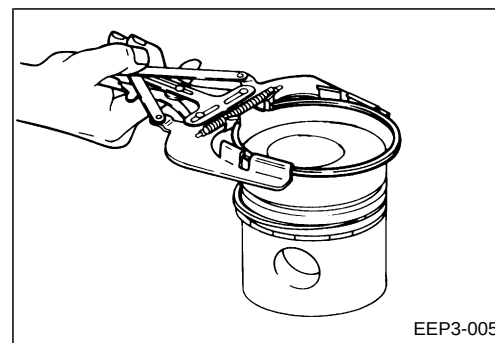
Note:

- When overhauling, all the pistons and connecting rods should be, in principle, replaced as a set.

- ① 1st ring
- ② 2nd ring
- ③ Oil ring
- ④ Piston
- ⑤ Piston pin
- ⑥ Snap ring
- ⑦ Bushing
- ⑧ Bearing shell (upper)
- ⑨ Bearing shell (lower)
- ⑩ Bolt
- ⑪ Connecting rod
- ⑫ Connecting rod cap
- ⑬ Nut



- Using a piston ring tool (99630 Z0001), remove the piston rings.



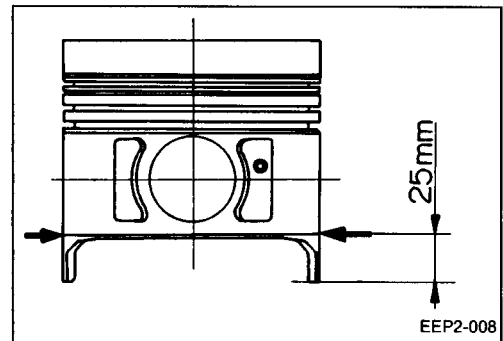
ENGINE PROPER

PISTON

Outside diameter

Measurement should be made at 25.0 mm position from the bottom side of the piston at a right angle to the piston pin axis.
[mm]

Item	Maintenance standard	Service limit
RF8 engine	137.930 - 137.960	—
RG8 engine	141.930 - 141.960	—
RE10 engine	134.831 - 134.861	—



Clearance between the piston and cylinder liner

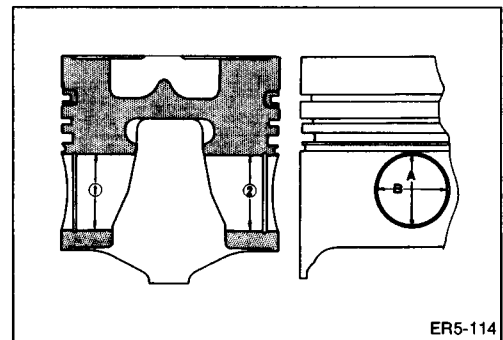
Calculate the clearance between the cylinder liner I.D. and piston I.D. from the measured values.
[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.06 - 0.08	—
RG8 engine	0.04 - 0.10	—
RE10 engine	0.149 - 0.169	—

Piston pin bore I.D.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	46.00 - 46.02	46.10
RG8 engine	50.00 - 50.02	50.10
RE10 engine	46.00 - 46.02	46.10

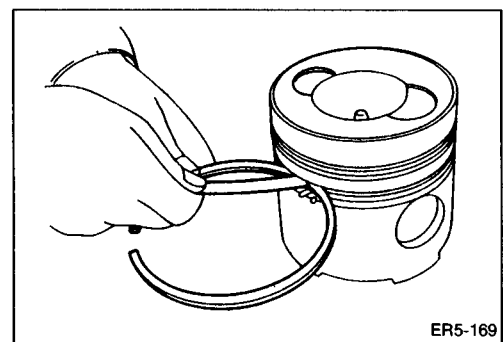


PISTON RING

Clearance between the piston ring and ring groove

[mm]

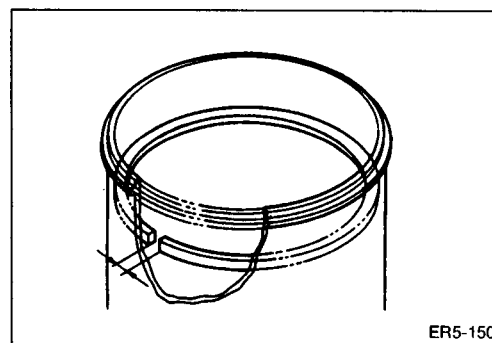
Item		Maintenance standard	Service limit
1st	RF8 engine	0.06 - 0.08	0.40
	RG8 engine	0.07 - 0.11	
	RE10 engine		
2nd	RF8 engine	0.02 - 0.04	0.40
	RG8 engine		
	RE10 engine	0.03 - 0.07	
Oil	RF8 engine	0.02 - 0.06	0.20
	RG8 engine		
	RE10 engine		



End gap

[mm]

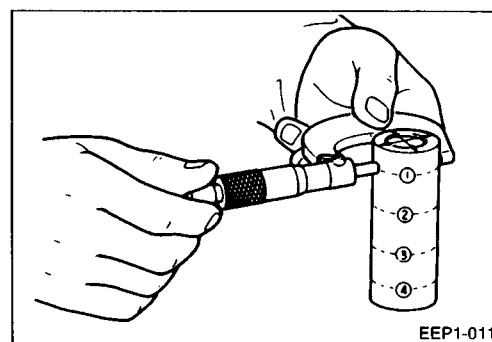
Item		Maintenance standard	Service limit
1st		0.33 - 0.48	2.0
2nd	RG8 engine	0.40 - 0.55	2.0
	RG8 engine	0.45 - 0.60	
	RE10 engine	0.40 - 0.55	
Oil	RF8 engine	0.25 - 0.45	2.0
	RG8 engine		
	RE10 engine	0.30 - 0.50	



PISTON PIN Outside diameter

[mm]

Item	Maintenance standard	Service limit
RF8 engine	45.99 - 46.00	45.90
RG8 engine	49.99 - 50.00	49.90
RE10 engine	45.99 - 46.00	45.90



Clearance between the piston pin and piston pin bore

Calculate the clearance between the piston pin O.D. and piston pin bore I.D. from the measured values.

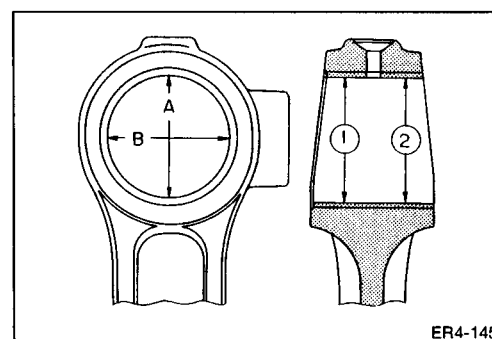
[mm]

Item	Maintenance standard	Service limit
RF8 engine	0 - 0.03	0.10
RG8 engine		
RE10 engine		

CONNECTING ROD Small end bushing I.D.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	46.03 - 46.04	—
RG8 engine	50.03 - 50.04	—
RE10 engine	46.03 - 46.04	—



Clearance between the small end bushing and piston pin

Calculate the clearance between the piston pin O.D. and small end bushing I.D. from the measured values.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.03 - 0.05	0.10
RG8 engine		
RE10 engine		

Clearance between large end bearing and crank pin

Fit each bearing shell to the connecting rod with the same cylinder No., then tighten the connecting rod and cap to the specified torque.

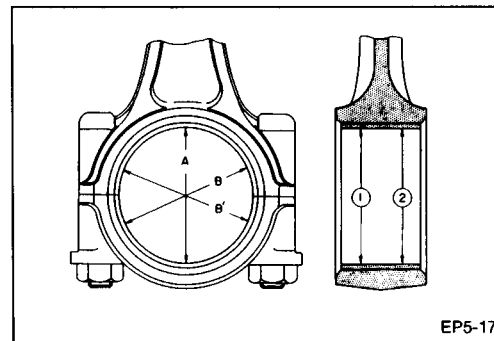
[kgm]

Item	Tightening torque
RF8 engine	18 - 20
RG8 engine	23 - 25
RE10 engine	18 - 20

Calculate the clearance between the crank pin O.D. and bearing shell I.D. from the measured values.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.046 - 0.112	0.2
RG8 engine		
RE10 engine		



EP5-17

Bend and twist

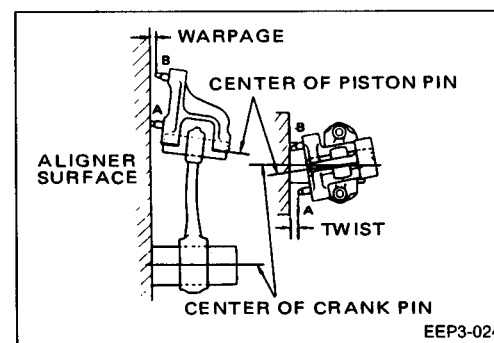
Mount the connecting rod fitted with the connecting rod cap to the connecting rod aligner, and insert the piston pin into the small end bushing. Measure the clearance at the aligner pin (A) or (B) to check the bend and twist of the connecting rod. If the dimension between the two ends of the connecting rod (i.e. between the crank pin center and the piston pin center) is other than 250 mm, calculate the bend or twist by using the following equation:

Bend or twist

$$= \frac{250}{\text{Dimension between pins (A) and (B)}} \times \text{measured value (mm)}$$

[mm]

Item	Dimension between pins (A) and (B)
RF8 engine	237.5 ± 0.02
RG8 engine	
RE10 engine	242.5 ± 0.02



EEP3-024

[mm]

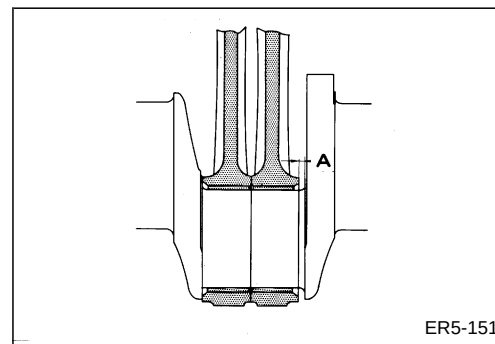
Item		Maintenance standard	Service limit	Remarks
Bend	RF8 engine	0.05, max.	—	When the dimension between pins is 250 mm
	RG8 engine			
	RE10 engine			
Twist	RF8 engine	0.06, max.	—	
	RG8 engine			
	RE10 engine			

Side clearance between the connecting rod and crank pin

Check the value (A) measured when the engine was disassembled.

[mm]

Item	Maintenance standard	Service limit	Remarks
RF8 engine	0.20 - 0.45	—	Measure with one side set zero
RG8 engine			
RE10 engine			



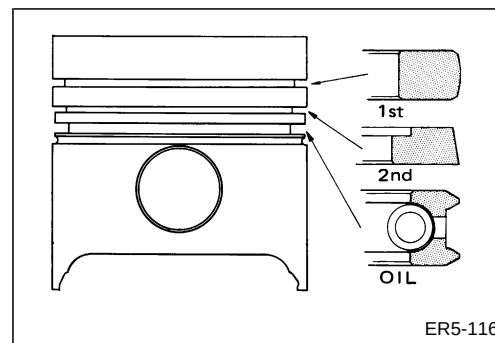
ER5-151

Reassembling piston and connecting rod

- Using a piston ring tool (99630 Z0001), remove the piston rings.

Note:

- Be sure to install so that the manufacture's mark faces upward.

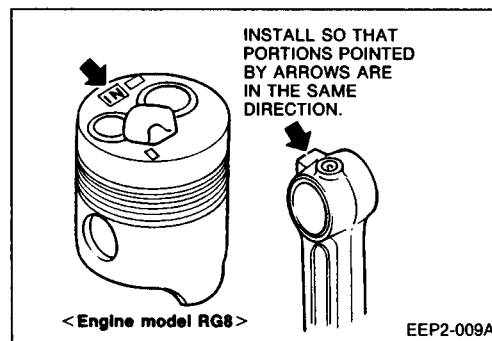
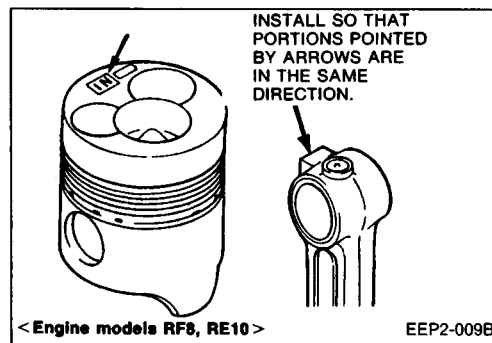


ER5-116

- Install the piston, piston pin, snap ring and connecting rod.

Note:

- The balancer weight fitted side of the connecting rod small end and the mark "IN" stamped side of the piston must face toward the same direction.



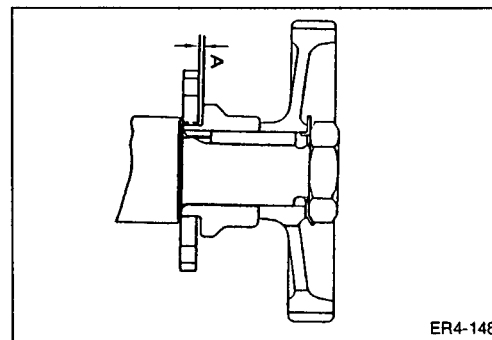
CAMSHAFT

END PLAY

If the end play measured during disassembly of the engine has reached the specified service limit, replace the locating plate with a new one.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.07 - 0.23	0.50
RG8 engine		
RE10 engine		



OUTSIDE DIAMETER OF THE JOURNAL

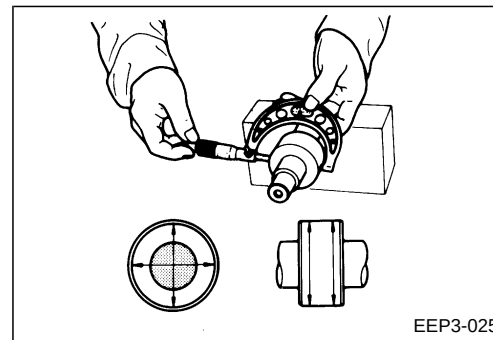
Measure the outside diameters of each journal. If the measured value has exceeded the service limit, replace the camshaft.

[mm]

Item		Maintenance standard	Service limit	Remarks
No. 1	S.T.D	65.69 - 65.78	65.43	RF8 engine RG8 engine RE10 engine
	0.2U.S.	65.52 - 65.54	—	
No. 2	S.T.D	65.89 - 65.98	65.63	
	0.2U.S.	65.72 - 65.74	—	
No. 3	S.T.D	66.09 - 66.18	65.83	
	0.2U.S.	65.92 - 65.94	—	
No. 4	S.T.D	66.29 - 66.38	66.03	
	0.2U.S.	66.12 - 66.14	—	
No. 5	S.T.D	66.49 - 66.58	66.23	
	0.2U.S.	66.32 - 66.34	—	
No. 6	S.T.D	66.69 - 66.78	66.43	RE10 engine
	0.2U.S.	66.52 - 66.54	—	

S.T.D: Standard parts

U.S.: Undersize (shows grinding dimension)



CLEARANCE BETWEEN THE JOURNAL AND BUSH-ING

Calculate the clearance between the journal O.D. and the camshaft bushing I.D. previously measured in "Cylinder block". If the clearance has exceeded the service limit, replace the camshaft bushing. If the clearance still exceeds the service limit even when a new camshaft bushing is installed, grind the camshaft journal, and install the undersize bushing.

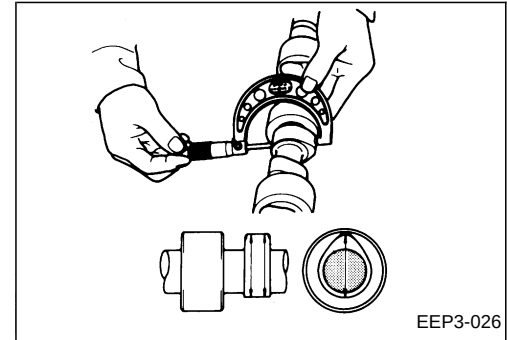
[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.02 - 0.11	0.20
RG8 engine		
RE10 engine		

CAM PROFILE HEIGHT

[mm]

Item		Maintenance standard	Service limit	Remarks
RF8 engine	Intake	55.55 - 55.58	55.08	
	Exhaust			
RG8 engine	Intake	55.46 - 55.49	54.99	
	Exhaust	55.55 - 55.58	55.89	
RE10 engine	Intake	55.55 - 55.58	55.08	
	Exhaust			

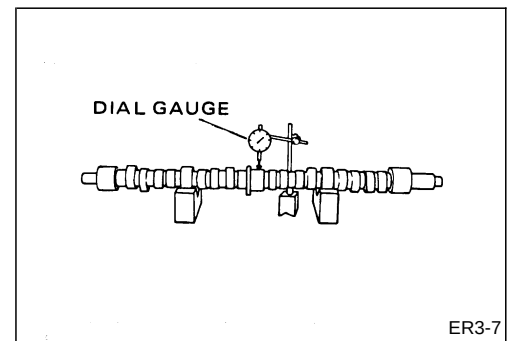


RUNOUT

Support the No. 2 and No. 4 journals (RF8, RG8 engines) or No. 2 and No. 5 journals (RE10 engine), and measure the runout of the No. 3 or No. 4 journal.

[mm]

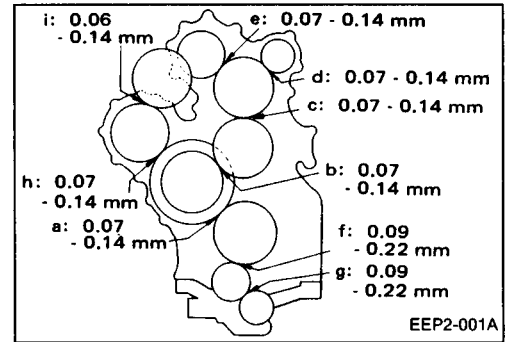
Item	Maintenance standard	Service limit	Remarks
RF8, RG8 engines	0.03, max.	0.06	When No. 2 and No. 4 journals are supported
RE10 engine	0.03, max.	0.06	When No. 2 and No. 5 journals are supported



GEAR TRAIN

GEAR TRAIN BACKLASH

Check the backlash between gears measured during disassembly of the engine proper. If it has exceeded the service limit, replace the gear with a new one.

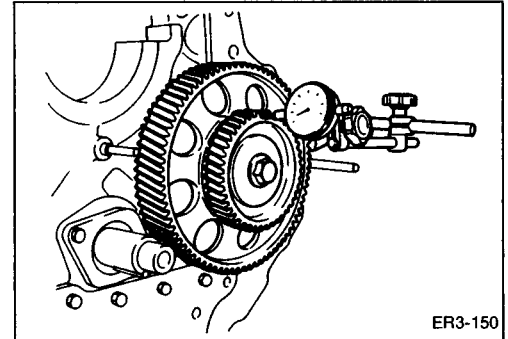


IDLER GEAR (CLUSTER GEAR) END PLAY

Check the end play of the idler gear (cluster gear) measured during disassembly of the engine proper. If it has exceeded the service limit, replace the idler shaft and plate or idler gear (cluster gear) with new ones.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.05 - 0.20	0.30
RG8 engine		
RE10 engine		

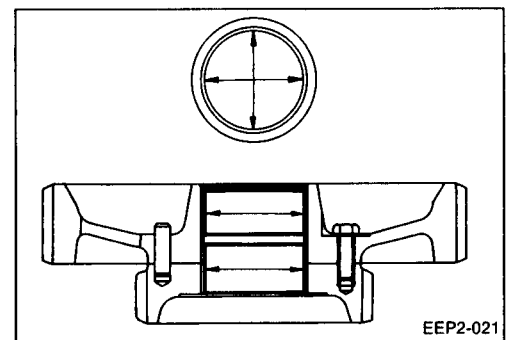


CLEARANCE BETWEEN THE IDLER GEAR (CLUSTER GEAR) BUSHING AND SHAFT

Calculate the clearance between the idler gear (cluster gear) bushing I.D. and idler shaft O.D. from the measured values.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.03 - 0.06	0.20
RG8 engine		
RE10 engine		



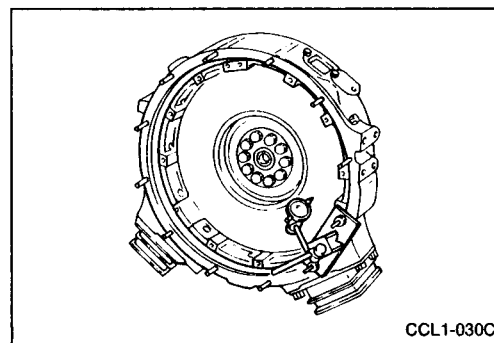
FLYWHEEL

LATERAL RUNOUT OF CLUTCH DISC SURFACE

Check the lateral runout of the clutch disc surface measured during disassembly of the engine proper.

[mm]

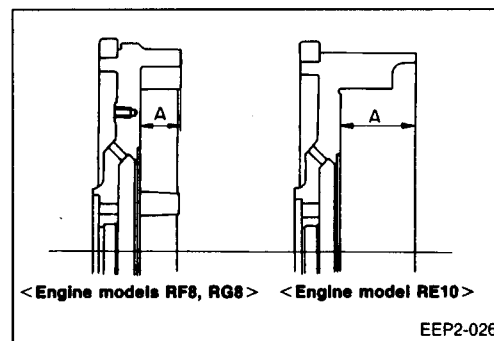
Item	Maintenance standard	Service limit
RF8 engine	0.1, max.	0.15
RG8 engine		
RE10 engine		



DECREASE IN CLUTCH DISC CONTACTING SURFACE

[mm]

Item		Maintenance standard	Service limit
Dimension (A)	RF8 engine	47.9 - 48.1	50.1
	RG8 engine		
	RE10 engine	91.3 - 91.5	93.5



FLYWHEEL HOUSING, REAR END PLATE AND FRONT COVER

Note:

- In principle, the oil seal and gaskets should be replaced with new ones at time of overhauling. Do not use the old parts.

CRANK PULLEY AND DAMPER

Check the crank pulley for cracks and damage. Also check the damper for damage, cracks, and separation from the disc.

REPAIR AND REPLACEMENT

REPLACING CYLINDER LINER

- 1) Using a cylinder liner tool (99600 97001 for RF8 engine or 99600 97600 for RG8 engine or 99600 97000 for RE10 engine), remove the faulty cylinder liner and install a new one.

Note:

- Prior to installation, be sure to remove rust, carbon and scale from the liner fitting surface and liner flange contacting surface of the cylinder block.
 - Apply soapy water to the liner fitting surface and the rubber ring, and make sure that the rubber ring is free from twists or any other damage prior to installation.
 - Be sure to install the liner with the I.D. size mark (S, M, L) on the top end of the flange facing toward the inside of the bank at an angle of 45°.
- 2) After installing the cylinder liner, make sure that the inside diameter, out-of-roundness, taper and flange projection are all within the maintenance standards.

Note:

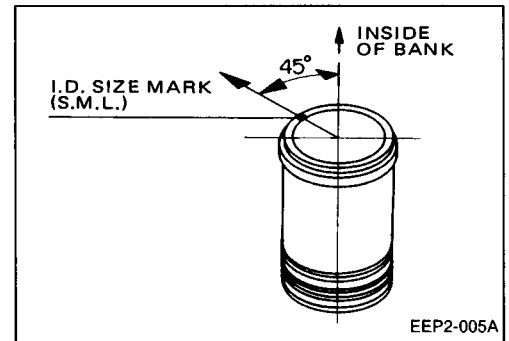
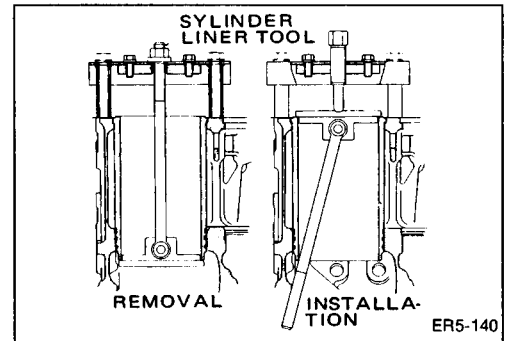
- Before measuring these, be sure to tighten the main bearing cap to the specified torque.

[mm]

Item	Tightening torque
RF8 engine	26 - 30
RG8 engine	42 - 45
RE10 engine	26 - 30

[mm]

Item		Maintenance standard
Inside diameter	RF8 engine	138.00 - 138.03
	RG8 engine	142.00 - 142.03
	RE10 engine	134.99 - 135.02
Out-of-roundness	RF8 engine	0.03, max.
	RG8 engine	
	RE10 engine	
Taper	RF8 engine	0.03, max.
	RG8 engine	
	RE10 engine	
Flange projection	RF8 engine	0.01 - 0.07
	RG8 engine	0.01 - 0.03
	RE10 engine	0.01 - 0.07
Flange projection difference between cylinders	RF8 engine	0.05, max.
	RG8 engine	
	RE10 engine	



CORRECTING THE CAMSHAFT

- 1) Grind the camshaft journal so that the clearance between the journal O.D. and camshaft bushing I.D. will be within the maintenance standards when an undersize camshaft bushing is used.

Clearance between the journal O.D. and bushing I.D.

[mm]

Item	Maintenance standard	Service limit
RF8 engine	0.02 - 0.11	0.20
RG8 engine		
RE10 engine		

Journal O.D. when a 0.2 mm undersize bushing is used

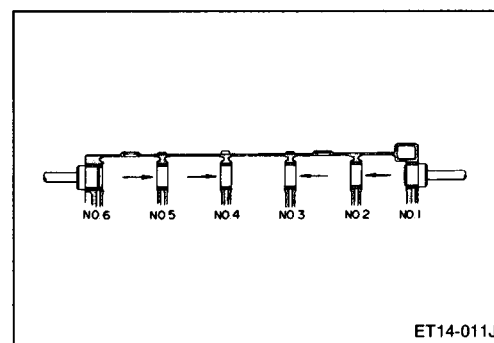
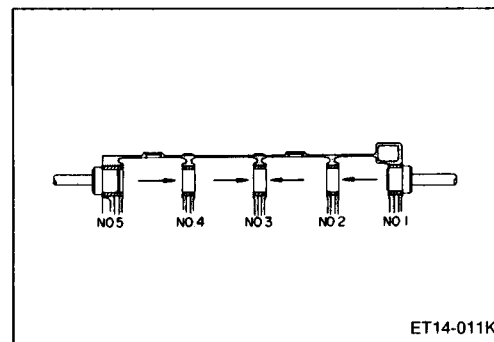
[mm]

Location	Journal grinding dimension	Remarks
No. 1	65.52 - 65.54	RF8 engine RG8 engine RE10 engine
No. 2	65.72 - 65.74	
No. 3	65.92 - 65.94	
No. 4	66.12 - 66.14	
No. 5	66.32 - 66.34	
No. 6	66.52 - 66.54	RE10 engine

REPLACING CAMSHAFT BUSHING DRIVING OUT CAMSHAFT BUSHING

Using a cam bushing remover (99590 97002), drive out the camshaft bushings.

- 1) RF8, RG8 engines: Drive out the bushings No. 1 thru No. 3 toward the engine rear, and No. 4 and No. 5 toward the engine front.
- 2) RE10 engine: Drive out the bushings No. 1 thru No. 3 toward the engine rear, and No. 4 thru No. 6 toward the engine front.



DRIVING IN CAMSHAFT BUSHING

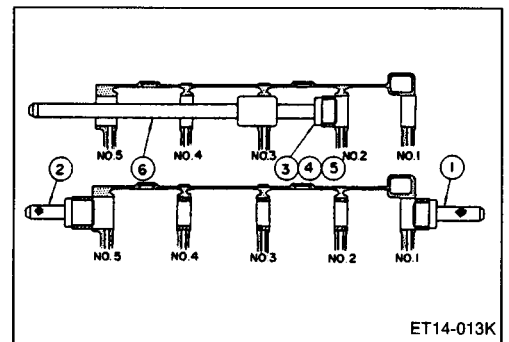
Drive in the camshaft bushings using a cam bushing tool (99590 97003 for RF8, RG8 engines, or 99590 97004 for RE10 engine).

Note:

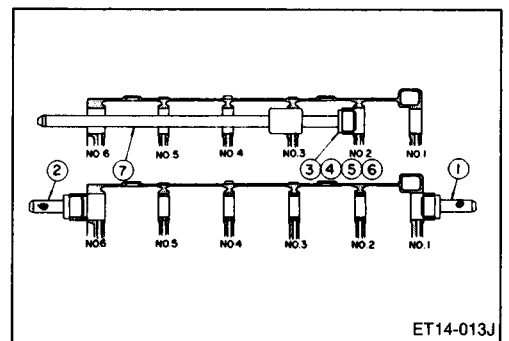
- When driving in the bushings, be sure to align the oil hole of each bushing to the oil way of the block, with the cutout portion on the chamfered side facing upward and rearward.

Part name		Part number (Location)	
		RF8, RG8 engines	RE10 engine
① - ⑥ or ① - ⑦	Cam bushing replacer assembly	99590 97003	99590 97004
①	Cam bushing replacer tool	99594 97000 (No. 1)	99594 97000 (No. 1)
②		99594 97001 (No. 5)	99594 97002 (No. 6)
③		99595 97006 (No. 2)	99595 97006 (No. 2)
④		99595 97007 (No. 3)	99595 97007 (No. 3)
⑤		99595 97008 (No. 4)	99595 97008 (No. 4)
⑥		—	99595 97009 (No. 5)
⑥ or ⑦	Cam bushing replacer bar	99597 97000 (No. 2, 3, 4)	99597 97000 (No. 2, 3, 4, 5)

- 1) RF8, RG8 engines: Drive in the bushings No. 2 thru No. 4 from the front side first, then No. 1 and No. 5 from the outside.



- 2) RE10 engine: Drive in the bushings No. 2 thru No. 5 from the front side first, then No. 1 and No. 6 from the outside.



CORRECTING THE CRANKSHAFT JOURNAL SECTION

Grind the crankshaft journal so that the clearance between the undersize main bearing shell I.D. and the journal O.D. are within the maintenance standard.

PIN SECTION

Grind the crankshaft pin so that the clearance between the undersize bearing shell I.D. and the crankshaft pin O.D. are within the maintenance standard.

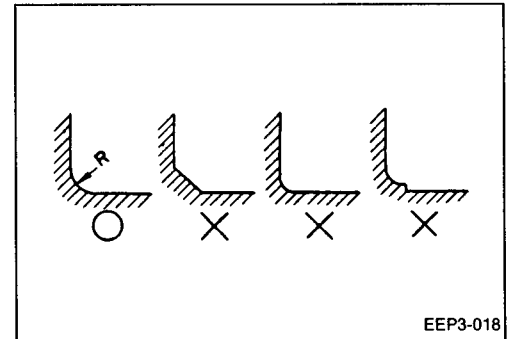
GRINDING DIMENSION

The grinding dimensions for the journal and pin are as follows.

Note:

- Be careful to prevent the width of the journal and crank pin sections from increasing.
- Finish both the rounding corners as shown in the figure.
R = 4 mm (journal section), R = 5 mm (pin section)
- Be sure to keep the out-of-roundness and taper within maintenance standards.

[mm]



EEP3-018

Item		Maintenance standard	Remarks
Out-of-roundness	RF8 engine	0.005, max.	Both journal and pin sections
	RG8 engine		
	RE10 engine		
Taper	RF8 engine	0.01, max.	
	RG8 engine		
	RE10 engine		

[mm]

Item		Maintenance standard
Clearance between the journal O.D. and main bearing shell I.D.	RF8 engine	0.04 - 0.13
	RG8 engine	
	RE10 engine	
Clearance between the pin O.D. and bearing shell I.D.	RF8 engine	0.04 - 0.11
	RG8 engine	
	RE10 engine	

Journal section

Type of main bearing shell	Journal grinding dimension [mm]
S.T.D	Grinding is not necessary.
0.7U.S.	
0.25U.S.	
0.50U.S.	109.62 - 109.64
0.75U.S.	109.37 - 109.39
0.75U.S.	109.12 - 109.14

S.T.D: Standard

U.S.: Undersize

Pin section

RF8, RE10 engines

Type of bearing shell	Pin grinding dimension [mm]
S.T.D	Grinding is not necessary.
0.07U.S.	
0.25U.S.	84.64 - 84.66
0.50U.S.	84.39 - 84.41
0.75U.S.	84.14 - 84.16

RG8 engine

Type of bearing shell	Pin grinding dimension [mm]
S.T.D	Grinding is not necessary.
0.07U.S.	
0.25U.S.	89.64 - 89.66
0.50U.S.	89.39 - 89.41
0.75U.S.	89.14 - 89.16

S.T.D: Standard

U.S.: Undersize

REPLACING CRANKSHAFT ACCESSORIES

CRANK GEAR

- 1) Using a puller, remove the crank gear.
- 2) Warm the crank gear in a bath of oil maintained at approx. 200°C, and install it onto the crankshaft by aligning its keyway with the straight pin.

Note:

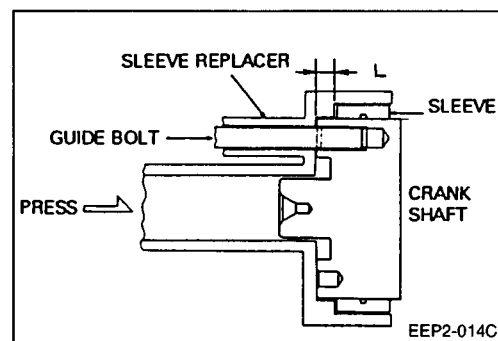
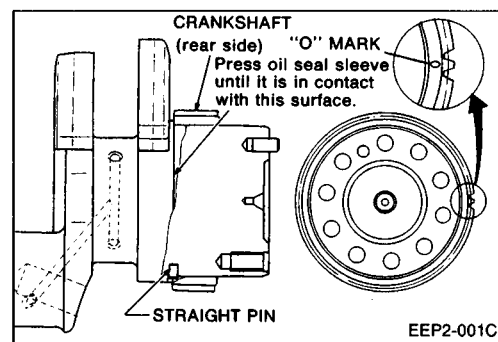
- Be sure to install the crank gear with "O" stamped on the end face facing toward the rear side (i.e. outside).

FRONT OIL SEAL SLEEVE

- 1) Using a puller, remove the oil seal sleeve.
- 2) Using a sleeve replacer (99691 97004), press the oil seal sleeve onto the crankshaft.
- 3) Make sure that the oil sleeve is pressed to within the maintenance standards.

[mm]

Specification	Maintenance standard
Oil seal sleeve press-fit length "L"	12



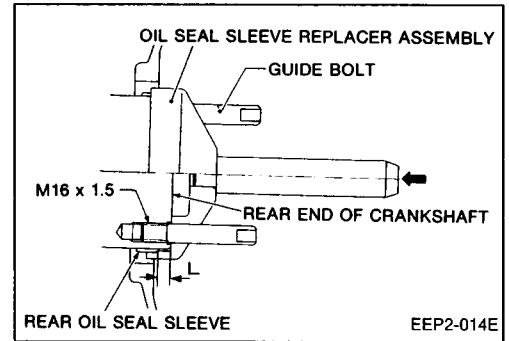
REAR OIL SEAL SLEEVE AND OIL SEAL

< Engine models RF8, RE10 >

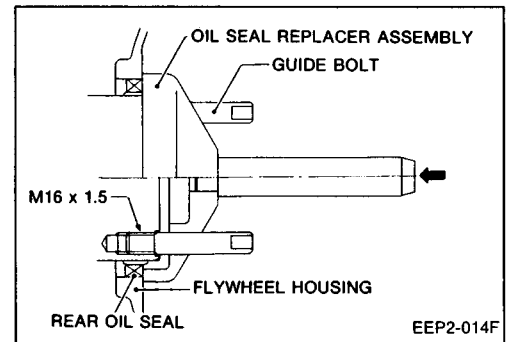
- 1) Using a puller, remove the oil seal sleeve.
- 2) Using a sleeve replacer (99691 97003), press the oil seal sleeve onto the crankshaft.
- 3) Make sure that the oil seal seal sleeve is pressed to within the maintenance standards.

[mm]

Specification	Maintenance standard
Oil seal sleeve press-fit length "L"	11.0 - 12.0

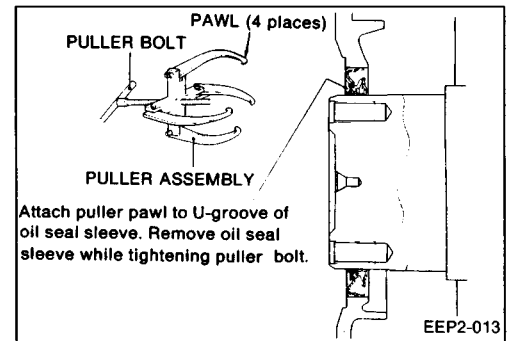


- 4) Using a sleeve replacer (99691 97002), press the oil seal onto the flywheel housing.

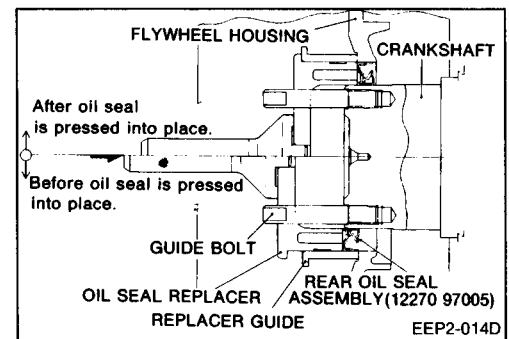


< Engine model RG8 >

- 1) Using a puller (99692 97000), remove the sleeve together with the oil seal.



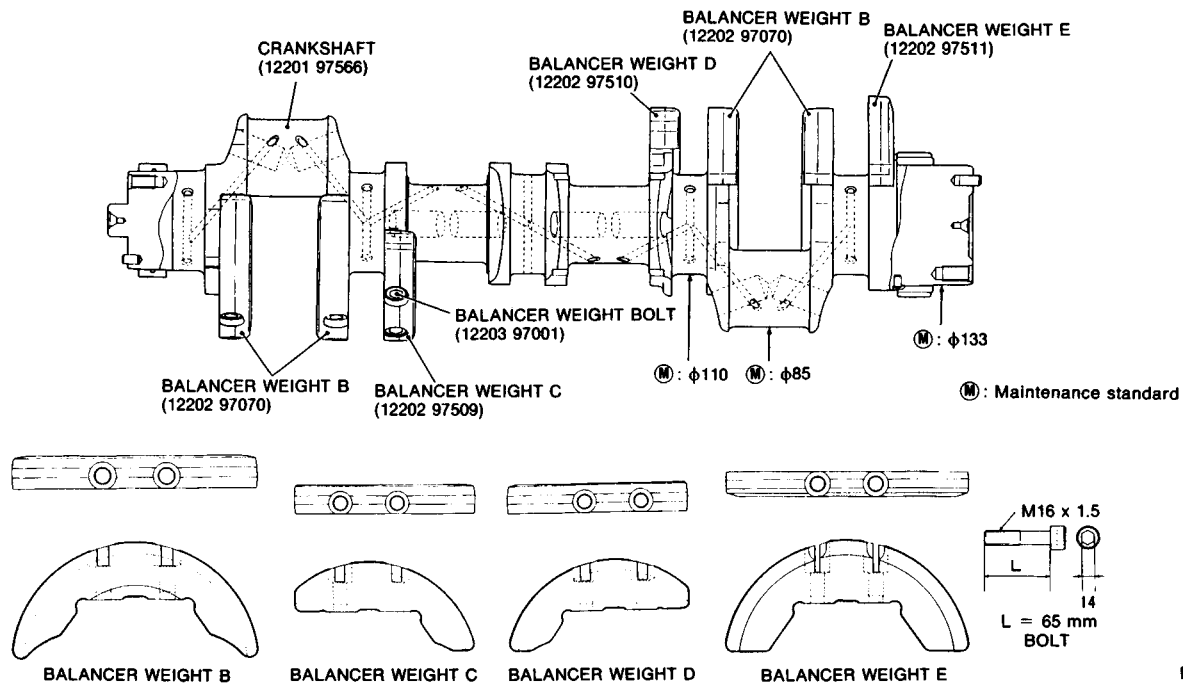
- 2) Using a replacer (99691 97005), press the sleeve together with the oil seal onto the flywheel housing. The oil seal is also pressed onto the flywheel housing.



REMOVING AND INSTALLING BALANCER WEIGHT

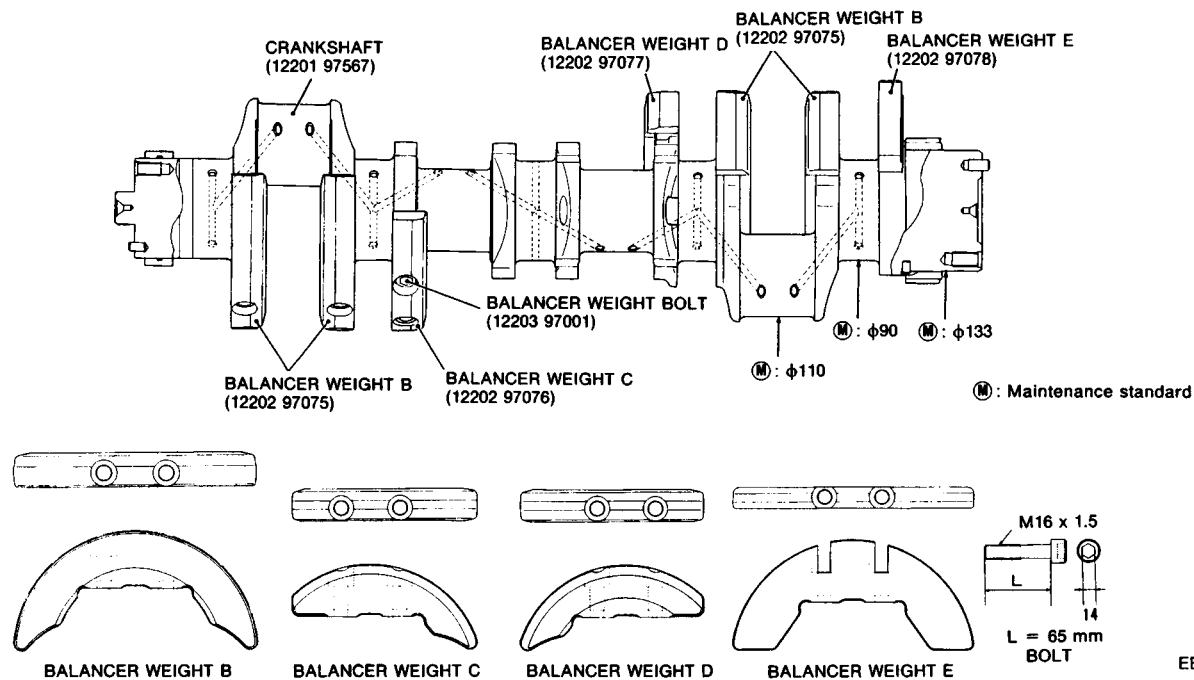
Construction, Exploded illustration

< RF8 engine >



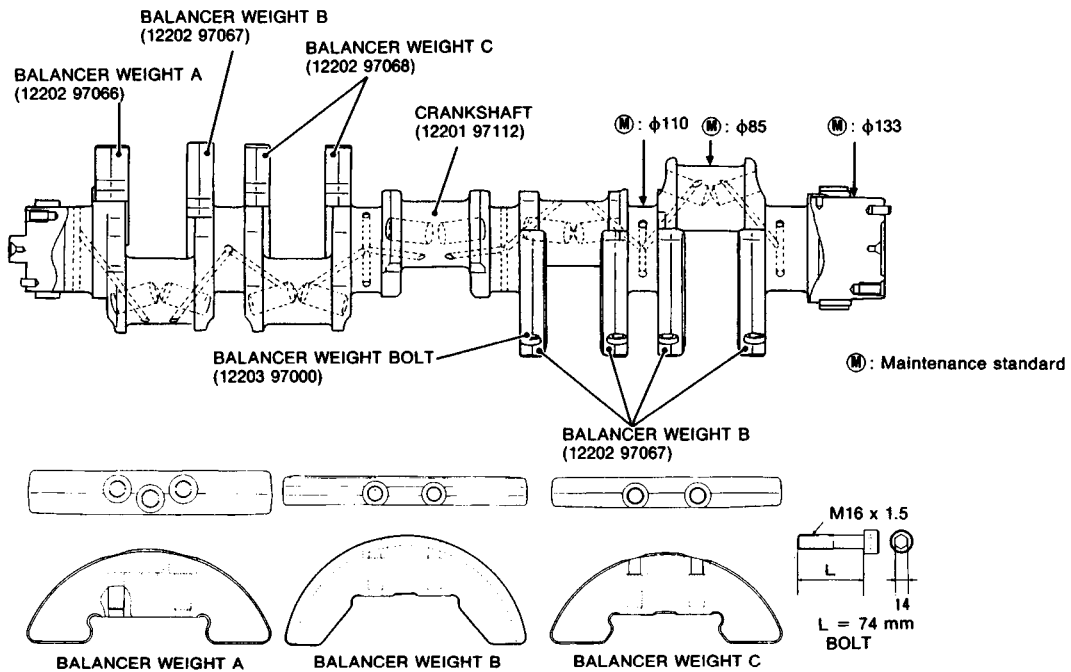
EEP2-015E

< RG8 engine >



EEP2-015G

< RE10 engine >



EEP2-015D

Removing

- 1) Put an alignment mark on each balancer weight and crankshaft.
- 2) Loosen the bolt with a hexagonal wrench, and remove the balancer weight.

Installation

- 1) Align the alignment marks which were put on before removal, and install the balancer weight.

Note:

- Apply engine oil to the threaded portion and seating surface of the mounting bolt. Be careful not to allow dirt or dust to attach to the contact surface of the balancer weight and the crankshaft.
- Align the bolt holes and install balancer weight A. Install the other balancer weights so that their machined surface faces the journal.

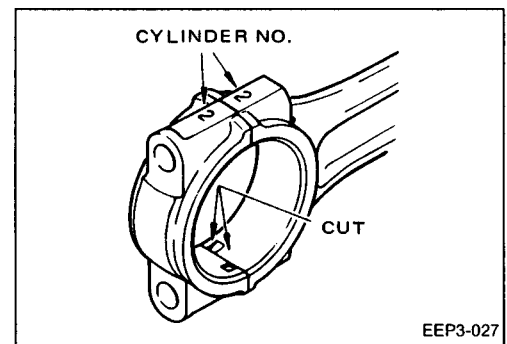
2) Tighten the balancer weight mounting bolts.

[kgm]

Tightening method	Tightening sequence	Tightening torque
Preliminary tightening	1	10
	2	15
	3	18.0 - 19.0
	4	0 (Loosen)
Tightening	1	10
	2	15
	3	18.0 - 19.0
Additional tightening	1	Tap (Fit)
	2	18.0 - 19.0

REPLACING CONNECTING ROD

After the connecting rod has been replaced with a new one, stamp the cylinder number in the same position as before.



REPLACING CONNECTING ROD SMALL END BUSHING

Use a remover assembly (99740 97001 for engine models RF8, RE10 and 99740 97002 for engine model RG8) and replacer (99740 97003 for engine models RF8, RE10 and 99740 97004 for engine model RG8) replace the connecting rod small end bushing.

REPLACING

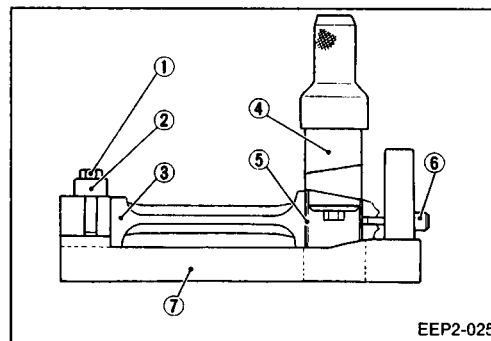
- 1) Removing connecting rod end bushings
 - Place a stand (at least 30 mm in height) in position via a V-block being careful not to obstruct the hole from which the bushing is removed.
 - Place the connecting rod on the stand, set in position using the set pin and tighten the bolt via a holder.

Note:

- Always place the connecting rod on the stand with the large chamfered side of the large end facing down.

- Set the remover in position and press the bushing out.

- ① Bolt
- ② Holder
- ③ Connecting rod
- ④ Remover assembly
- ⑤ Bushing
- ⑥ Set pin
- ⑦ Stand



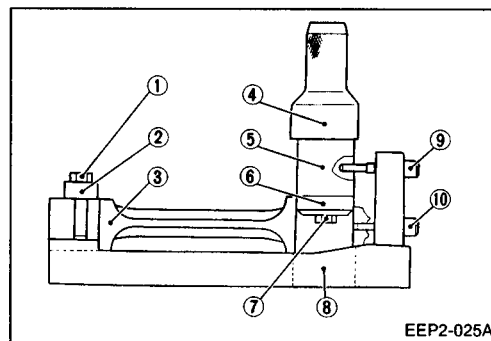
2) Installing connecting rod end bushings

- Attach a new bushing to the replacer and tighten with the bolts via a bushing holder.
- Set the replacer assembly in position using the bushing set pin.
- Lightly press the head of the replacer to remove the bushing set pin.
- Apply a coat of engine oil to the outer perimeters of the bushing and holder.
- Press the bushing into place.

Note:

- Ensure the bushing is 1 mm inside the small end surface of the connecting rod after installation.**

- ① Bolt
- ② Holder
- ③ Connecting rod
- ④ Replacer assembly
- ⑤ Bushing
- ⑥ Bushing holder
- ⑦ Bolt
- ⑧ Stand
- ⑨ Bushing set pin
- ⑩ Connecting rod set pin



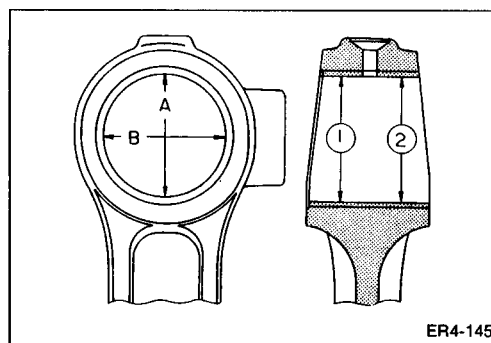
3) Finish the inside diameter of the bushing within the maintenance standard after installing the bushing.

[mm]

Item	Maintenance standard
RF8 engine	46.03 - 46.04
RG8 engine	50.03 - 50.04
RE10 engine	46.03 - 46.04

Note:

- Always position the connecting rod on the stand with the larger chamfered side of its large end facing down.**
- Be sure to apply a coat of engine oil to the outer periphery of the inserter when installing the bushing.**
- When inserting a new bushing for SP into the inserter, ensure that the side having the smaller chamfer is inserted first.**
- Press in the bushing until it is aligned with the end face of the connecting rod small end.**



REPLACING CLUSTER GEAR BUSHING

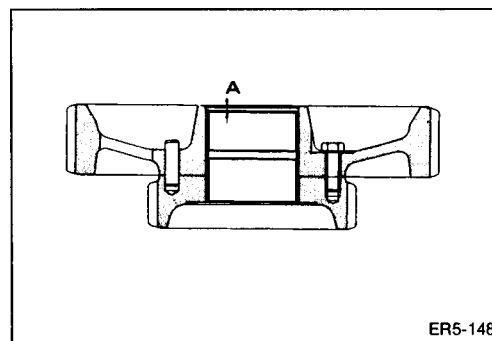
- 1) Press in the cluster gear bushing until its end face is aligned with the boss section end face of the small gear.

Note:

- When the bushing is aligned with the boss section end face, the opposite side (i.e. dimension (A) with the boss section end face of the large gear) is lowered by 3 mm.
- 2) After pressing the bushing, finish the bushing I.D. so that the clearance between the bushing and the idler gear shaft is within the maintenance standard.

[mm]

Item	Maintenance standard
RF8 engine	50.00 - 50.02
RG8 engine	
RE10 engine	



ER5-148

CORRECTING FLYWHEEL

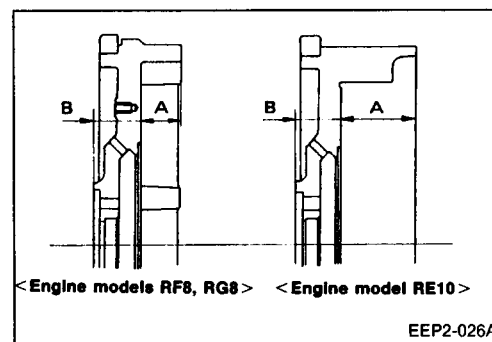
- 1) Grind or machine the clutch disc so that the runout of the contacting surface will be within the maintenance standards. However, the grinding tolerance should be 2.0 mm or less. If dimension B is smaller than the wear limit, replace the flywheel assembly.

Note:

- The flange portion should also be ground so that the flywheel depth (A) meets maintenance standards at all times.

[mm]

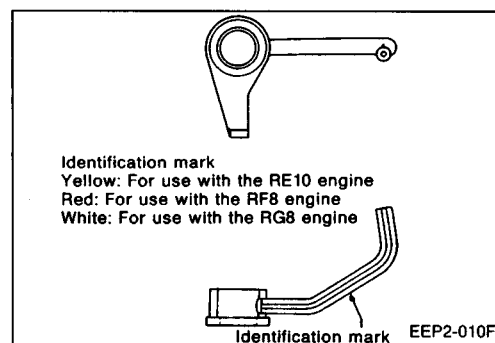
Item		Maintenance standard	Service limit
Flywheel depth (A)	RF8 engine	47.9 - 48.1	50.1
	RG8 engine		
	RE10 engine	91.3 - 91.5	93.5
Flywheel thickness (B)	RF8 engine	55.5	53.5
	RG8 engine		
	RE10 engine	53.5	51.5



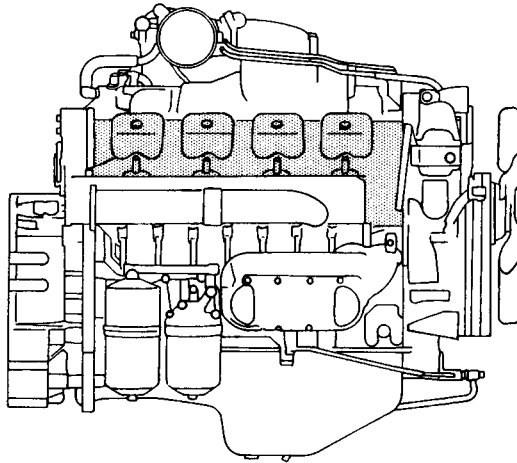
EEP2-026A

PISTON COOLING OIL JET

Before installing an oil jet, check its identification mark to ensure the oil jet meets the engine model.



6. CYLINDER HEAD AND VALVE MECHANISM



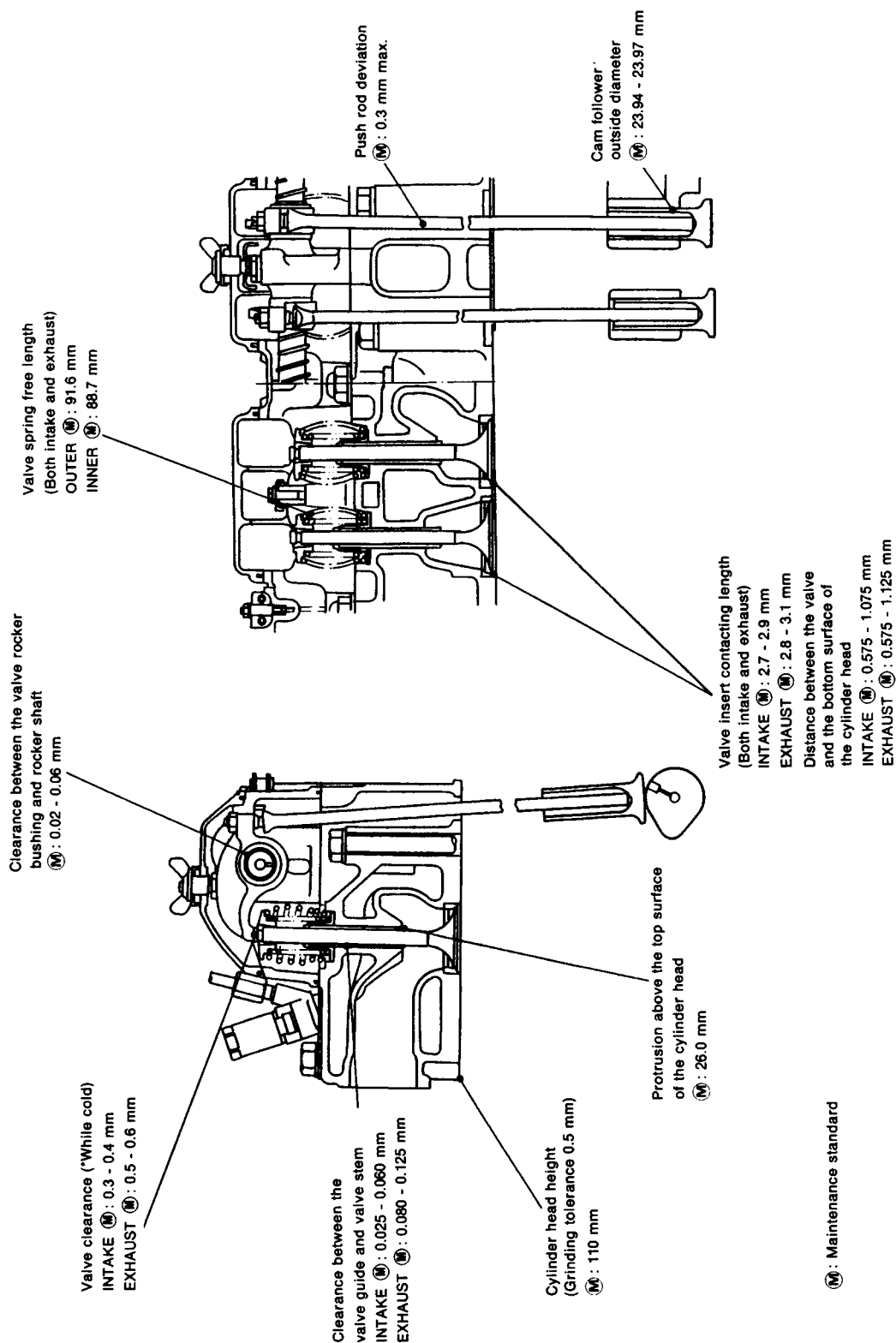
ER0-123

CONTENTS

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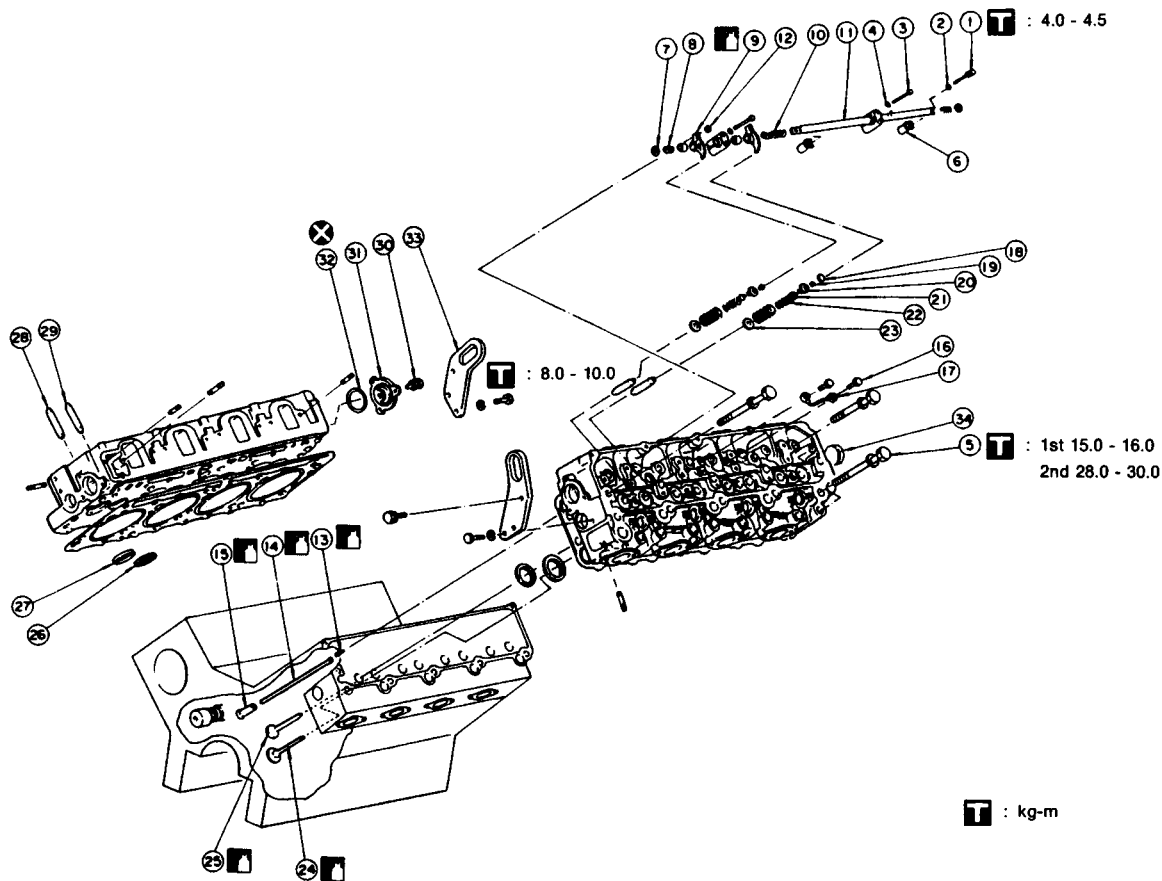
CONSTRUCTION

Construction illustration



EHV2-001C

Exploded illustration



EHV2-002F

- | | | |
|-------------------------|----------------------------------|------------------------|
| ① Bolt | ⑬ Adjusting screw | ⑳ Exhaust valve |
| ② Spring washer | ⑭ Push rod | ㉑ Inlet valve |
| ③ Bolt | ⑮ Cam follower | ㉒ Inlet valve insert |
| ④ Spring washer | ⑯ Eye connector | ㉓ Exhaust valve insert |
| ⑤ Cylinder head bolt | ⑰ Oil tube | ㉔ Exhaust valve guide |
| ⑥ Rocker shaft bracket | ⑱ Valve stem cap | ㉕ Inlet valve guide |
| ⑦ Washer | ㉒ Split collar | ㉖ Bolt |
| ⑧ Spring | ㉓ Spring seat (upper) | ㉗ Water tube adapter |
| ⑨ Rocker arm | ㉔ Valve stem seal | ㉘ Rubber ring |
| ⑩ Spring | ㉕ Valve spring (inner and outer) | ㉙ Engine lifter |
| ⑪ Rocker shaft assembly | ㉖ Spring seat (lower) | ㉚ Plug |
| ⑫ Nut | | |

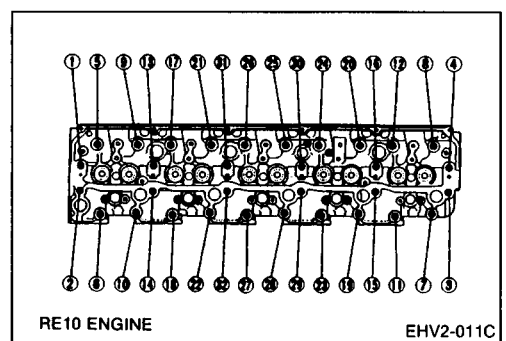
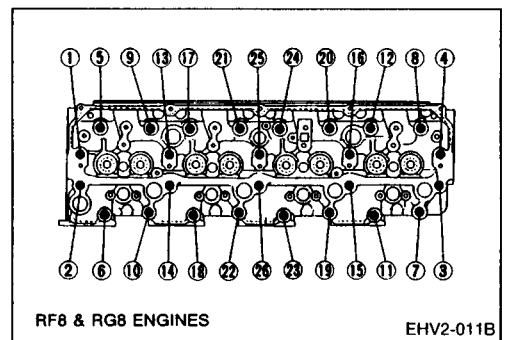
REMOVAL

For trucks, perform the dismounting operation with the engine mounted.

- 1) Chock the wheels, then tilt the cab.
- 2) Turn the key switch off and disconnect the cable from the negative terminal of the battery.
- 3) Drain the engine cooling water.
- 4) Remove the right and left side covers for the engine room.
- 5) Disconnect the water hose, tube and wire harness.
- 6) Remove the air intake duct and air heater assembly.
- 7) Remove the air bleeder pipe.
- 8) Remove the fuel system.
 - Remove the fuel filter assembly and bracket.
 - Remove the fuel lines.
 - Remove the injection nozzle tube and spill tube.
 - Remove the injection nozzle.

Note:

- **When removing fuel lines, use a pan to catch dripping fuel so that fuel does not get on engine parts. If any fuel is spilled on engine parts, use a rag to completely remove all spilled fuel.**
- 9) Remove the accelerator linkage.
 - 10) Remove the air intake manifold and gaskets.
 - 11) Remove the thermostat housing.
 - 12) Remove the alternator assembly.
 - 13) Remove the alternator tension bracket and water duct.
 - 14) Remove the exhaust system.
 - Disconnect the exhaust outlet and exhaust tube.
 - Remove the exhaust outlet.
 - Remove the exhaust manifold, exhaust manifold shield and gaskets.
 - 15) Remove the head cover assembly with a rocker cover.
 - 16) Remove the valve rocker assembly mounting bolts.
-
- 17) Remove the cylinder head bolts by loosening them gradually in the order shown in the figure.
 - 18) Remove the valve rocker assembly.
 - 19) Pull out the push rod.



20) Remove the cylinder head assembly.

Note:

- **Use a crane or other devices to dismount the cylinder head.**

INSTALLATION

- 1) Install the cylinder head assembly with the cylinder head gasket in place.

Note:

- Use a crane or other devices to install the cylinder head.

- 2) Insert the push rod.
- 3) Place the valve rocker assembly on the cylinder head.

- 4) Insert the cylinder head bolts, then tighten them in two stages uniformly following the sequence shown in the figure.

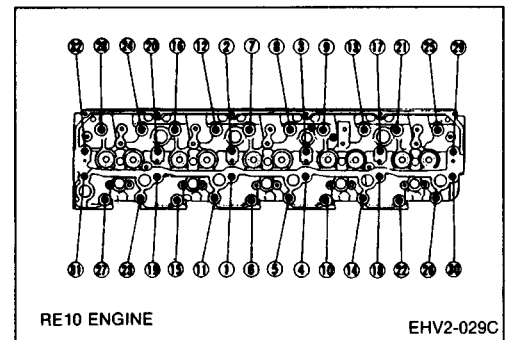
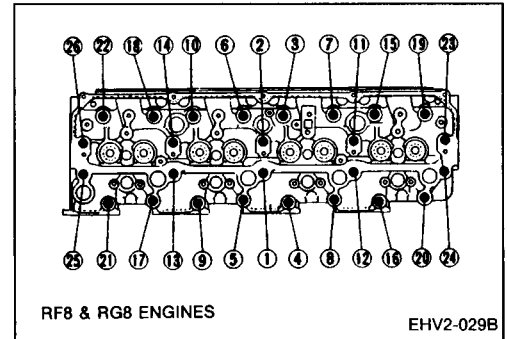
T : 1st time 15.0 - 16.0 kgm

T : 2nd time 28.0 - 30.0 kgm

- 5) Tighten the valve rocker assembly mounting bolts.

T : 4.0 - 5.0 kgm

- 6) Install the head cover assembly with the rocker cover.
- 7) Install the exhaust system.
 - Install the exhaust manifold with the exhaust manifold shield and gaskets in place.
 - T** : 5.5 - 6.5 kgm
 - Install the exhaust outlet and connect the exhaust tube.



- 8) Install the water duct, alternator tension bracket and alternator assembly.
- 9) Install the air intake manifold with the gaskets in place.
- 10) Install the thermostat housing.
- 11) Install the water pipe.
- 12) Install the accelerator linkage.
- 13) Install the fuel system.
 - Install the injection nozzle.
 - Install the injection nozzle tube and spill tube.
 - Install the fuel filter bracket and fuel filter.
 - Install the fuel lines.

[kgm]

Part		Tightening torque
Injection nozzle holder		2.5 - 3.5
Injection nozzle tube	Pump side	3.0 - 4.0
	Nozzle side	2.5 - 3.5
Spill tube		3.0

- 14) Install the air bleeder pipe.
- 15) Install the air heater assembly and air intake duct.
- 16) Connect the water hose, tube and wire harness.
- 17) Install the right and left side covers for the engine room.

- 18) Supply the engine cooling water from the water tank.
- 19) Connect the cable to the negative terminal of the battery.
- 20) Start up the engine and check to make sure that there is no water leakage from any part. Then check the cooling water level.

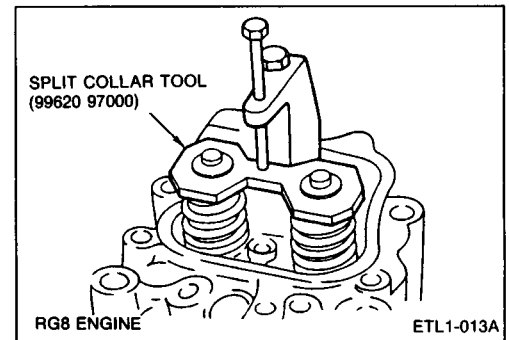
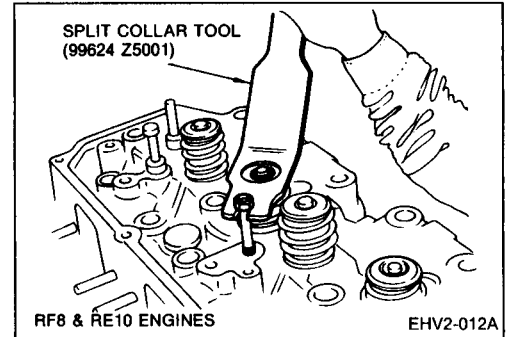
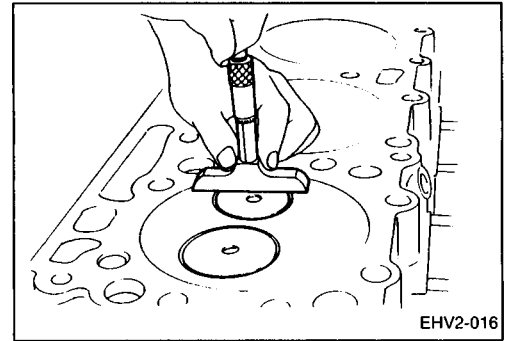
DISASSEMBLY

CYLINDER HEAD ASSEMBLY

- 1) Measure the distance between the valve and the bottom surface of the cylinder head prior to disassembling the cylinder head assembly.

Note:

- **Be sure to remove the carbon from the valve and the bottom surface of the cylinder head.**
- 2) Remove the valve stem cap from the intake valve only.
 - 3) Remove the split collar using a split collar tool (RF8 & RE10: 99624 Z5001, RG8: 99620 97000).



- 4) Remove the upper spring seat, outer and inner valve spring, valve stem seal and lower spring seat.
- 5) Remove the intake and exhaust valves from the bottom surface of the cylinder head.

Note:

- **All the parts removed should be grouped together for each valve.**

VALVE ROCKER ASSEMBLY

- 1) Remove the valve rocker brackets at both ends.
- 2) Remove the washer, valve rocker spring, valve rocker and midway valve rocker bracket.

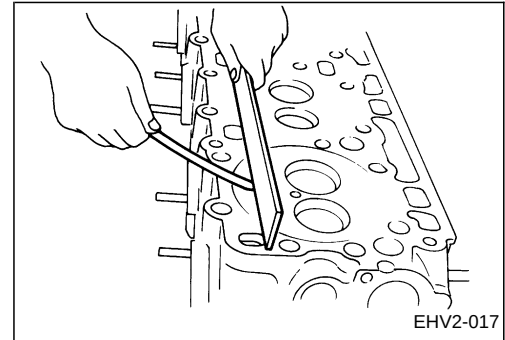
INSPECTION

CYLINDER HEAD

Flatness

[mm]

Part	Maintenance standard	Service limit
Axial direction	0.05, max.	0.20
Perpendicular direction	0.02, max.	0.20

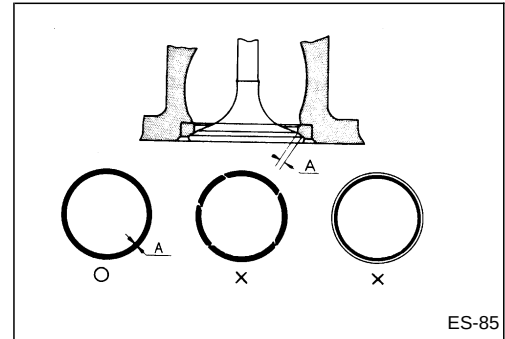


VALVE INSERT

Valve and valve insert contacting length

[mm]

Part	Maintenance standard	Service limit
Intake	2.7 - 2.9	3.4
Exhaust	2.8 - 3.1	3.5



VALVE

Distance between the valve and the bottom surface of the cylinder head

Check the value measured before disassembling the cylinder head.

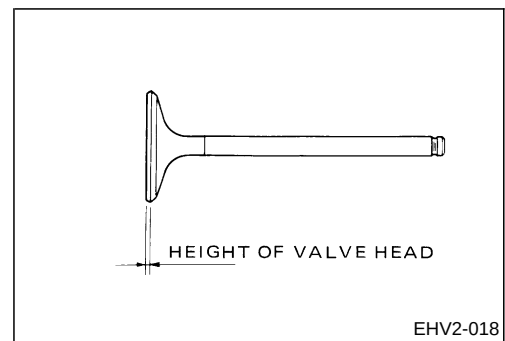
[mm]

Part	Maintenance standard	Service limit
Intake	0.58 - 1.07	—
Exhaust	0.58 - 1.12	—

Valve head dimension

[mm]

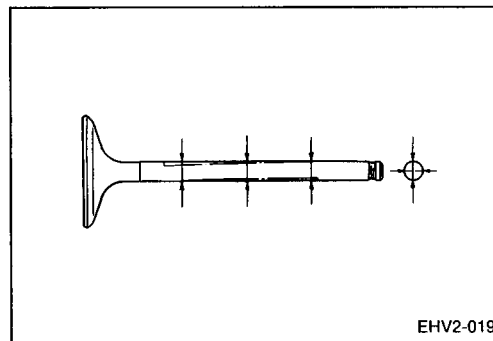
Part	Maintenance standard	Service limit
Intake	2.0	1.8
Exhaust	1.5	1.3



Valve stem outside diameter

[mm]

Part	Maintenance standard	Service limit
Intake	9.960 - 9.975	9.83
Exhaust	11.895 - 11.920	11.83

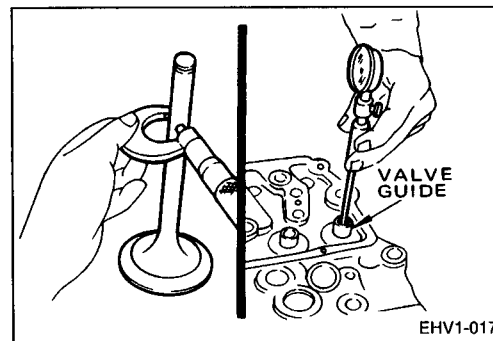


VALVE GUIDE

Clearance between the valve stem and valve guide

[mm]

Part	Maintenance standard	Service limit
Intake	0.025 - 0.060	0.2
Exhaust	0.080 - 0.125	0.2

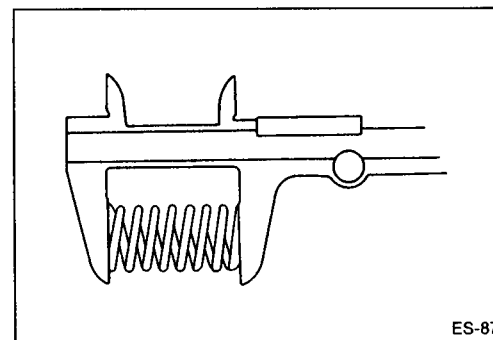


VALVE SPRING

Free length

[mm]

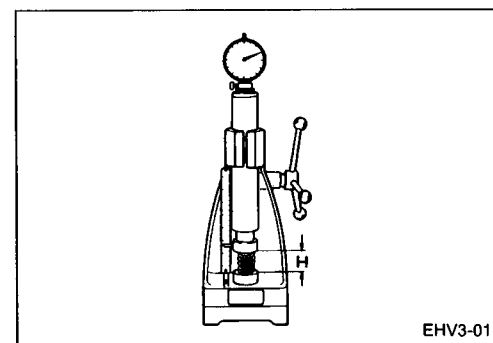
Part	Maintenance standard	Service limit	Remarks
Outer	91.6	—	Both intake and exhaust
Inner	88.7	—	



Tension

[kg]

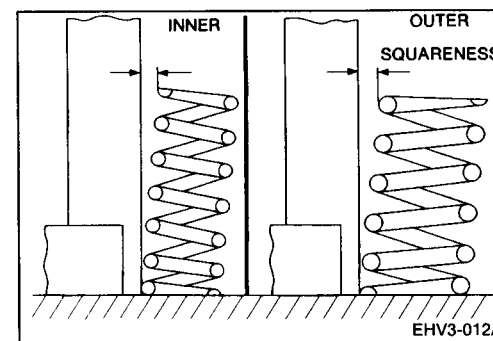
Part	Maintenance standard	Service limit	Remarks
Outer	41.6 - 46.0	—	When compressed to 59.1 mm
Inner	22.0 - 24.4	—	When compressed to 56.6 mm



Squareness

[mm]

Part	Service limit	Remarks
Outer	3.0	Both intake and exhaust
Inner	3.0	

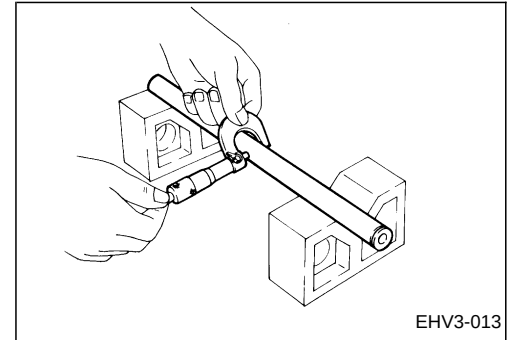


VALVE ROCKER AND RELATED PARTS

Rocker shaft outside diameter

[mm]

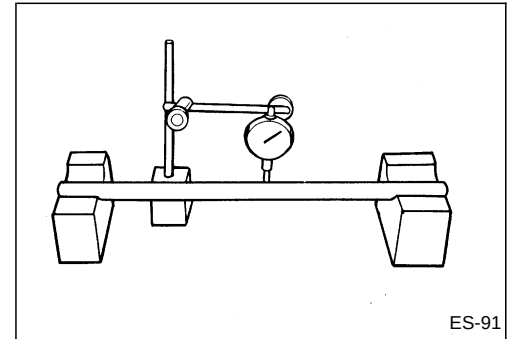
Maintenance standard	Service limit
24.99 - 25.00	24.90



Rocker shaft runout

[mm]

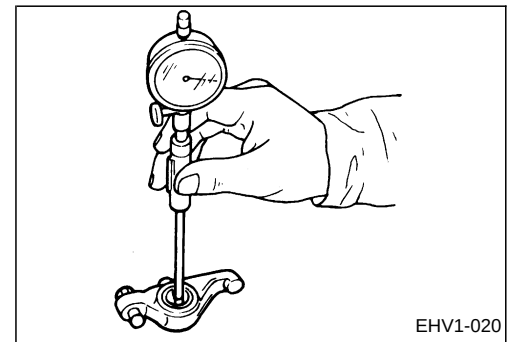
Maintenance standard	Service limit
0.03, max.	0.05



Valve rocker bushing inside diameter

[mm]

Maintenance standard	Service limit
25.02 - 25.04	25.10



Clearance between the valve rocker bushing and rocker shaft

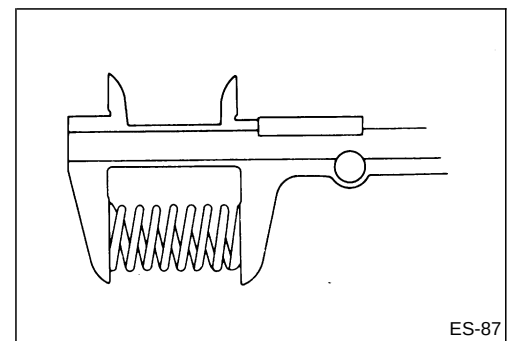
[mm]

Maintenance standard	Service limit
0.02 - 0.06	0.2

Valve rocker spring free length

[mm]

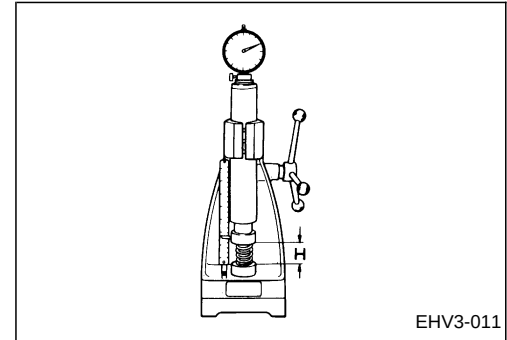
Part	Maintenance standard	Service limit
Inside	112.0	—
Valve rocker	29.0	—



Valve rocker spring tension

[kg]

Part	Maintenance standard	Service limit	Remarks
Inside	4.6	3.6	When compressed to 82 mm
Valve rocker	4.6	3.6	When compressed to 11 mm



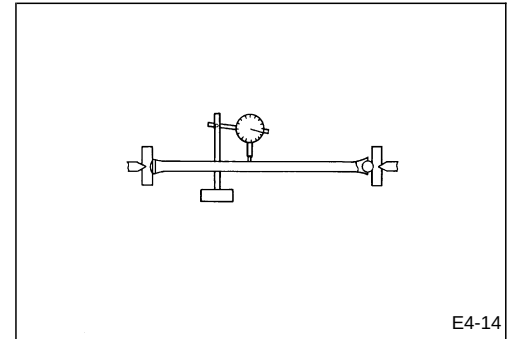
PUSH ROD

Deviation

Measure the deviation while supporting the center of the spherical surfaces at both ends of the push rod.

[mm]

Maintenance standard	Service limit
0.3, max.	0.5

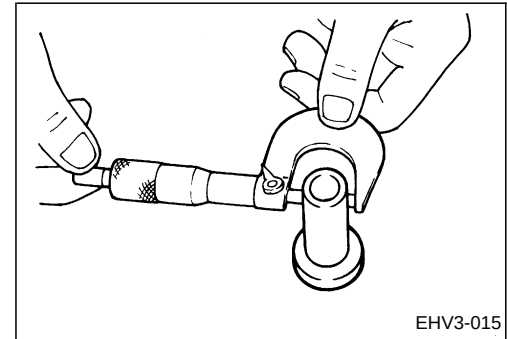


CAM FOLLOWER

Outside diameter

[mm]

Maintenance standard	Service limit
23.94 - 23.97	23.85



Clearance between the cam follower and cam follower hole

[mm]

Maintenance standard	Service limit
0.03 - 0.08	0.20

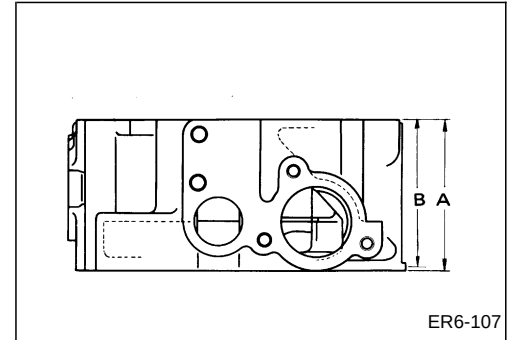
REPAIR AND REPLACEMENT

CORRECTING THE CYLINDER HEAD

Using a surface grinder, grind the cylinder head. The amount of grinding should not exceed 0.5 mm.

[mm]

Item	Maintenance standard (A)	Service limit (B)
Cylinder head height	110	109.5



CORRECTING VALVE

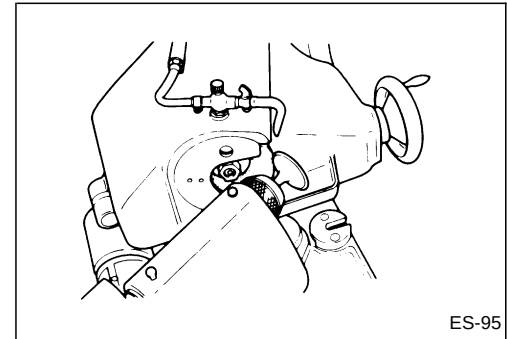
- Using a valve refacer, repair the valve face portion. If the thickness of the valve face exceeds the service limit after repaired, replace it with a new one.

Note:

- There should be no stepped wear on the valve face.

[mm]

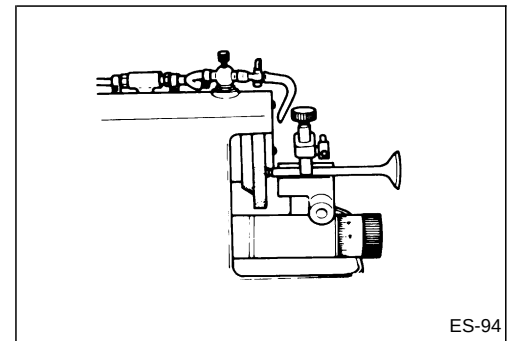
Item		Maintenance standard	Service limit
Valve face angle	Intake	44°30' - 45°	—
	Exhaust	44°30' - 45°	—
Valve head thickness	Intake	2.0	1.8
	Exhaust	1.5	1.3



- Using a valve refacer or oil stone, repair the valve stem end.

Note:

- Finish the valve stem end surface to be perpendicular to the axis. Also, the finished surface should have no scrape marks or scratches.



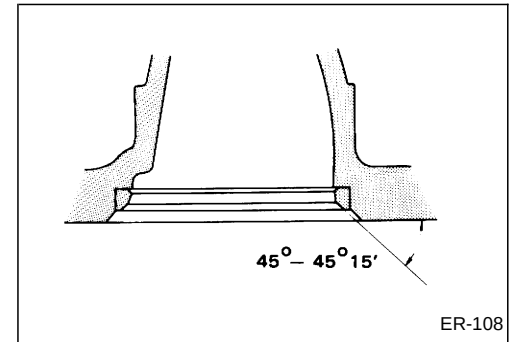
CORRECTING THE VALVE INSERT

- 1) Using a valve seat grinder, repair the seat surface of the valve insert.

Note:

- There should be no stepped wear on the seat surface of the valve insert.

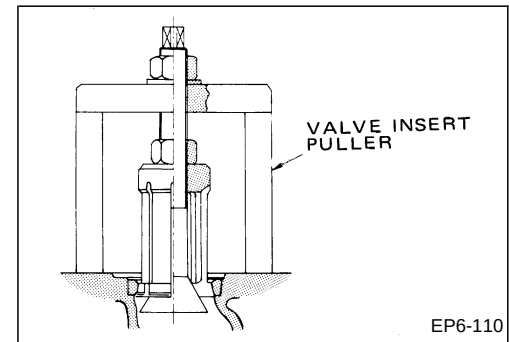
Item		Maintenance standard	Service limit
Seat surface angle	Intake	45° - 45°15'	—
	Exhaust	45° - 45°15'	—



REPLACING VALVE INSERT

- 1) Using a valve insert remover (special tool), remove the intake and exhaust valve inserts.

Item	Part number
Valve insert puller	99660 97002



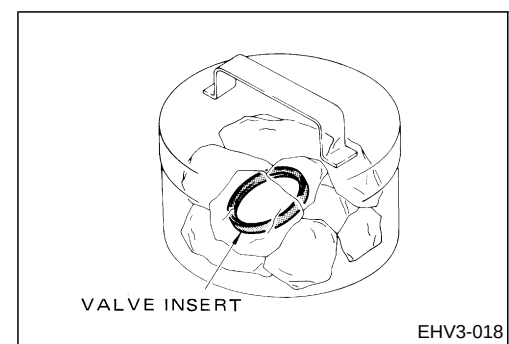
- 2) Fit the intake and exhaust valve inserts. Make sure to cold-fit them.

Cold-fitting procedure

- Keep the valve insert in dry ice for more than five minutes. Use of alcohol will improve the cooling effect.

Note:

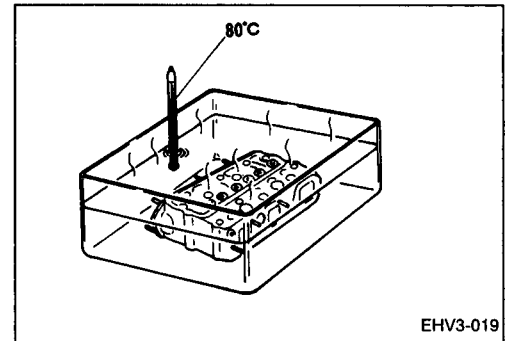
- Do not touch the cold valve insert or dry ice directly, or it will cause chilblains.



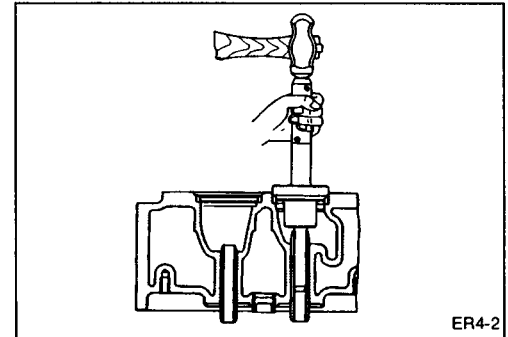
- Immerse the cylinder head in hot water until its temperature exceeds 80°C.

Note:

- **Do not touch the cylinder head or hot water directly, or it will cause a scald.**



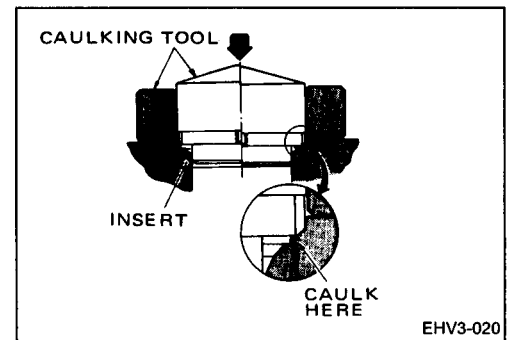
- Take out the cylinder head and valve inserts, then fit the valve inserts quickly into the cylinder head using valve insert replacers (99665 97502 for inlet valve side and 99665 97500 for exhaust valve side).



- After fitting the valve inserts, caulk four locations around the insert (on the exhaust side only) using a valve insert caulking tool (99670 97001).

Note:

- **Be careful not to exceed a pressure of 1,500 kg when caulking, and do not caulk the insert at the same spot that was caulked previously.**



LAPPING VALVE

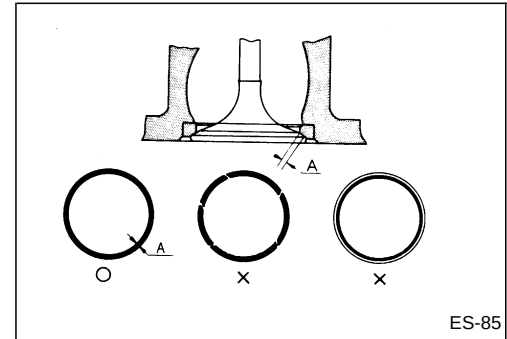
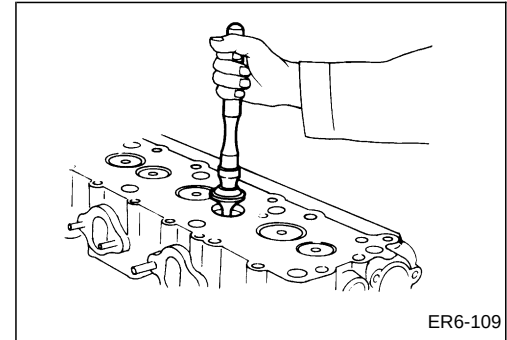
After repairing or replacing the valve or valve insert, be sure to perform valve lapping.

- 1) Apply grinding compound uniformly to the seat of the valve.

- 2) Apply a coat of engine oil to the valve stem, then insert the valve into the valve guide. With the lapping rod coming into contact with the valve head, lap the valve by rotating it while lightly tapping the valve insert.
- 3) After completing the lapping operation, wash the lapping compound away, and then apply engine oil to the seating surface, and perform lapping with oil.
- 4) After oil lapping, coat the contacting surface of the valve with red lead and repeat lapping operation in the same manner as previously done with the grinding compound, then check the condition of the valve surface. Repeat lapping until the valve surface is properly corrected.

[mm]

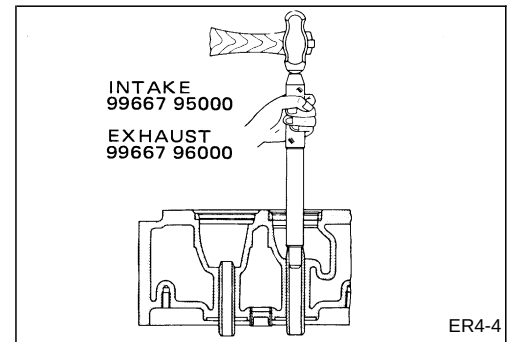
Item		Maintenance standard	Service limit
Valve and valve insert contacting dimension	Intake	2.7 - 2.9	3.4
	Exhaust	2.8 - 3.1	3.5



REPLACING VALVE GUIDE

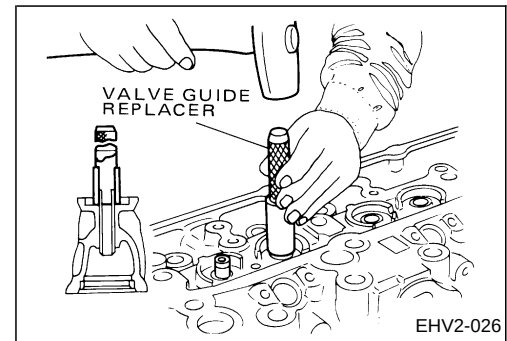
- 1) Using a valve guide remover (special tool), drive out the valve guide from the bottom side of the cylinder head.

Item		Part number
Valve guide remover	Intake	99667 95000
	Exhaust	99667 96000



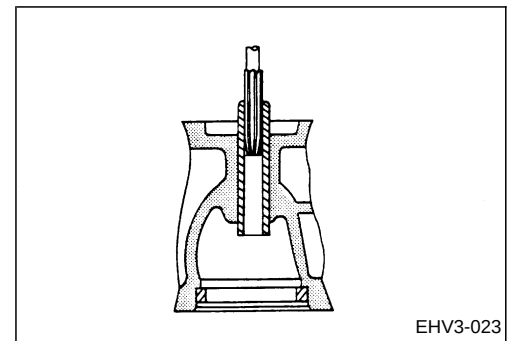
- 2) Using a valve guide replacer (special tool), drive the valve guide perpendicularly into place until the lower end of the tool just touches the surface of the cylinder head.

Item		Part number
Valve guide replacer	Intake	99666 97003
	Exhaust	99666 97004



- 3) After driving in the valve guide, finish the inside diameter to the maintenance standard with a reamer (special tool).

Item		Part number
Reamer	Intake	99662 96000
	Exhaust	99662 97000



REPLACING VALVE ROCKER BUSHING

- 1) Fix the valve rocker, and drive out the bushing using a press tool.

Note:

- Mark the bushing clinching position on the valve rocker prior to removing the bushing.
- Take care so that the fitting surface of the bushing is not damaged when the bushing is driven out.

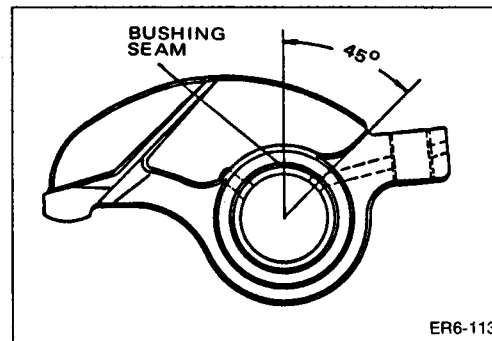
- 2) Correctly line up the bushing clinching mark on the valve rocker with the bushing, and drive in the bushing using a press tool.

Note:

- After driving in the bushing, check to make sure that the valve rocker and bushing oil holes are aligned.
- 3) After driving in the bushing, finish the inside diameter of the bushing with a reamer.

[mm]

Item	Maintenance standard
Valve rocker bushing inside diameter	25.02 - 25.04



REASSEMBLY

Before reassembling, be sure to apply engine oil to each sliding surface.

CYLINDER HEAD ASSEMBLY

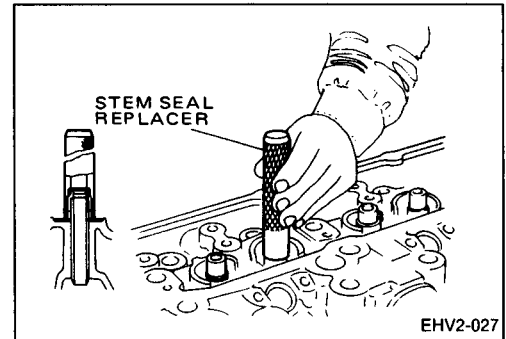
1) Install the lower spring seat.

2) Using a special valve stem seal replacer, install the stem seal to the valve guide.

Note:

- Be sure to push in the stem seal by hand.

Item	Part number	
Stem seal replacer	Intake	99674 97008
	Exhaust	99674 97009



3) Insert the intake and exhaust valves.

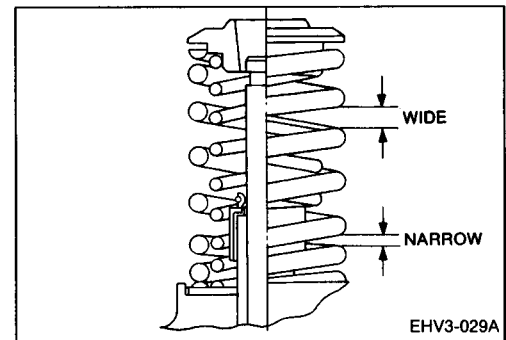
Note:

- Be sure to insert them respectively in their original positions.

4) Install the inner and outer valve springs and upper spring seat.

Note:

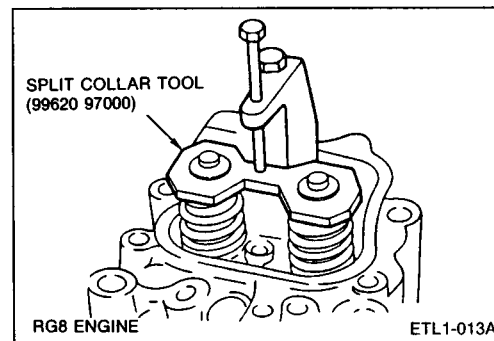
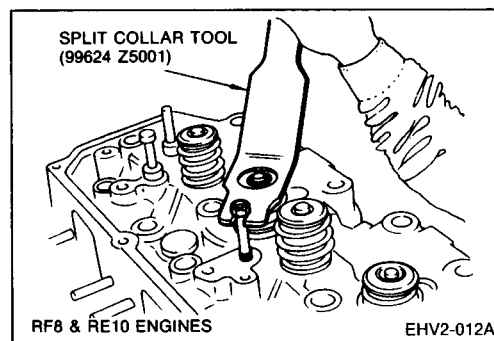
- When installing the inner and outer springs, be sure to install them so that the side which has a smaller spring winding pitch (i.e. the side painted white) faces the lower spring seat side.



- 5) Using a split collar tool (RF8 & RE10: 99624 Z5001, RG8: 99620 97000), install the split collar.

Note:

- Larger side of the split collar should be for the exhaust side.



- 6) Measure the distance between the valve and the bottom surface of the cylinder head and check to make sure that it does not exceed the maintenance standard.

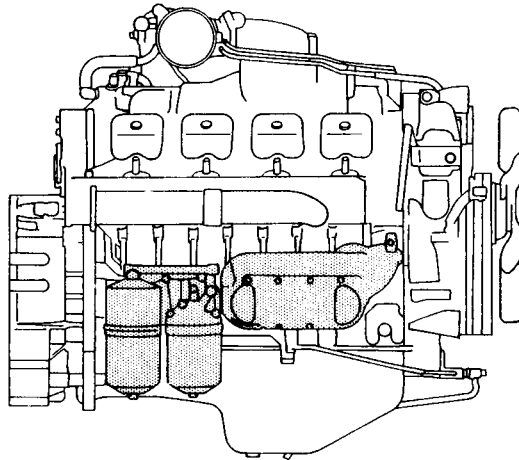
[mm]

Item		Maintenance standard
Distance between the valve and the bottom surface of the cylinder head	Intake	0.58 - 1.07
	Exhaust	0.58 - 1.12

VALVE ROCKER ASSEMBLY

- 1) Fit the valve rocker bracket, intake and exhaust valve rockers, valve rocker spring and washer onto the rocker shaft.
- 2) Fit the valve rocker brackets at both ends.

7. LUBRICATION SYSTEM



ER0-124

The lubricating system consists of an oil pump, oil cooler, short valve assembly, oil filter and other components. Flow of oil after the main gallery is illustrated in the lubricating system diagram.

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OIL COOLER	7-10	INSTALLATION	7-20
CONSTRUCTION	7-10	OIL JET	7-21
REMOVAL	7-11	CONSTRUCTION	7-21
DISASSEMBLY	7-11	REMOVAL	7-21
INSPECTION	7-11	INSPECTION	7-21
REASSEMBLY	7-12	INSTALLATION	7-21

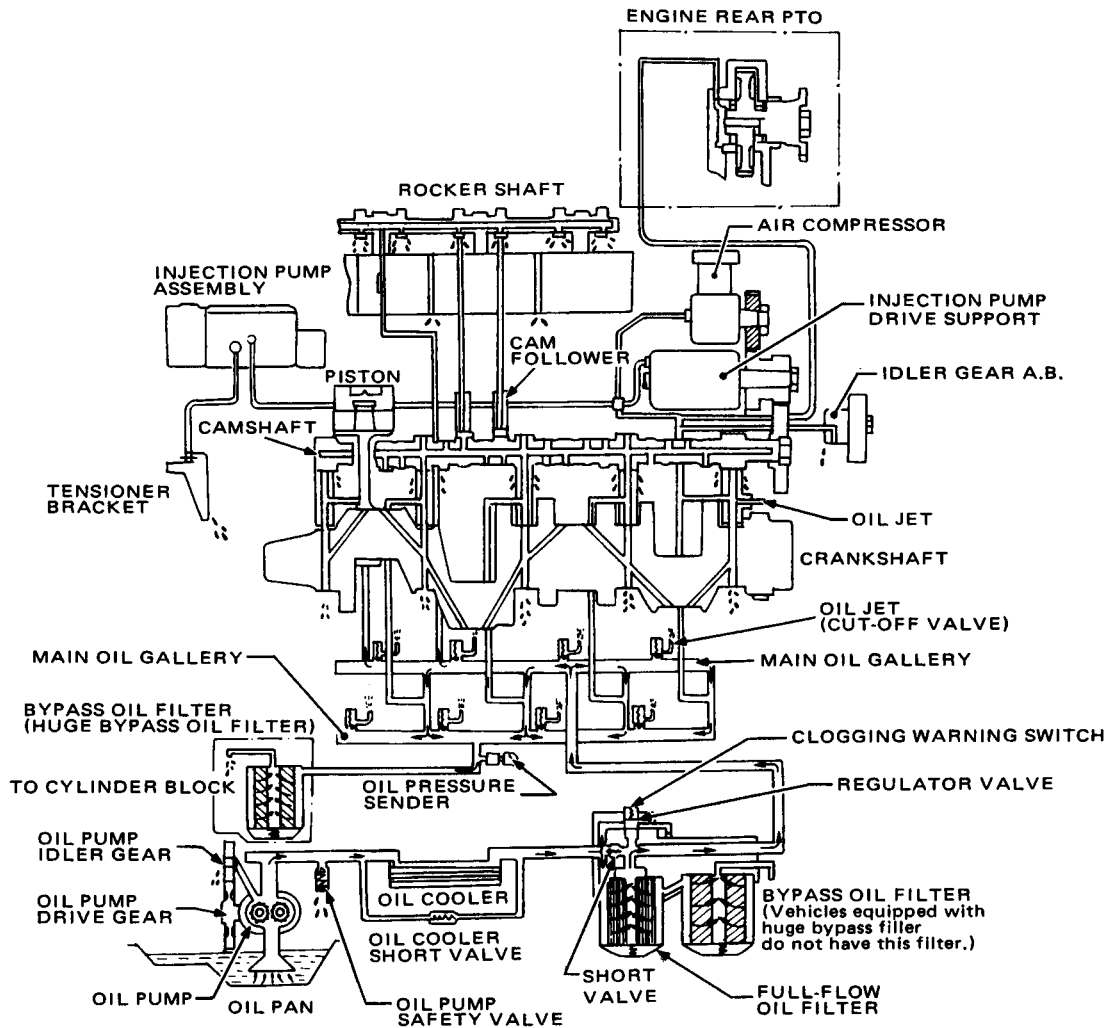
SPECIFICATIONS

Engine model			RF8	RG8	RE10
Item					
Oil pump	Type		Gear type		
Oil filter	Full flow		Paper element type		
	Bypass	Standard	Paper element type		
		Large size(*)			
Oil cooler	Type		Built-in, water cooled		
Lubrication oil capacities [liter]	Full capacity	Standard	34	39	
		Equipped with large size bypass filter	36	41	
	Oil pan capacity	H	24	29	
		L	16	19	

* CGB 520 model only

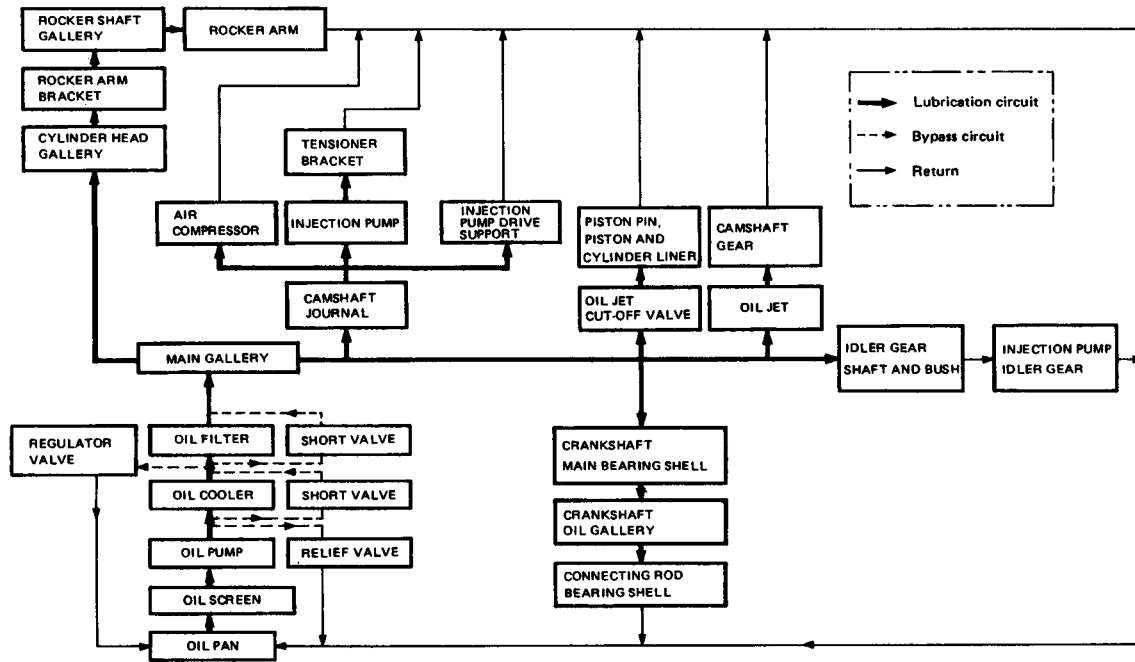
LUBRICATION SYSTEM

LUBRICATION SYSTEM DIAGRAM (FOR RF8 MODEL)



ELB2-001S

LUBRICATION CIRCUIT

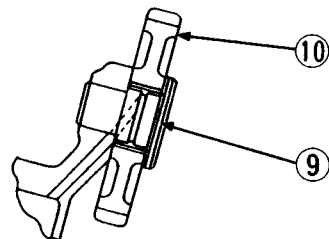
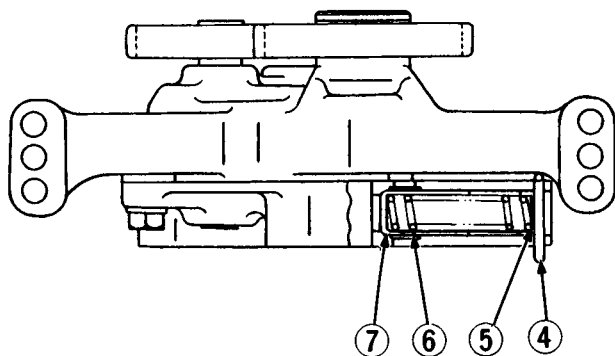


ELB2-001T

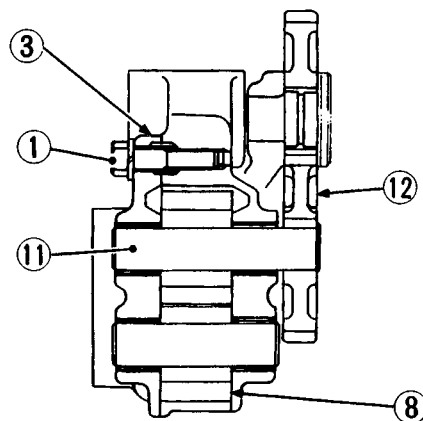
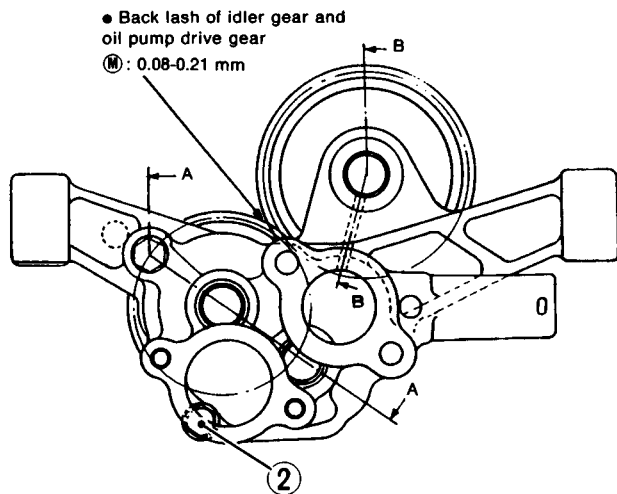
OIL PUMP

CONSTRUCTION

Construction illustration



SECTION B-B



SECTION A-A

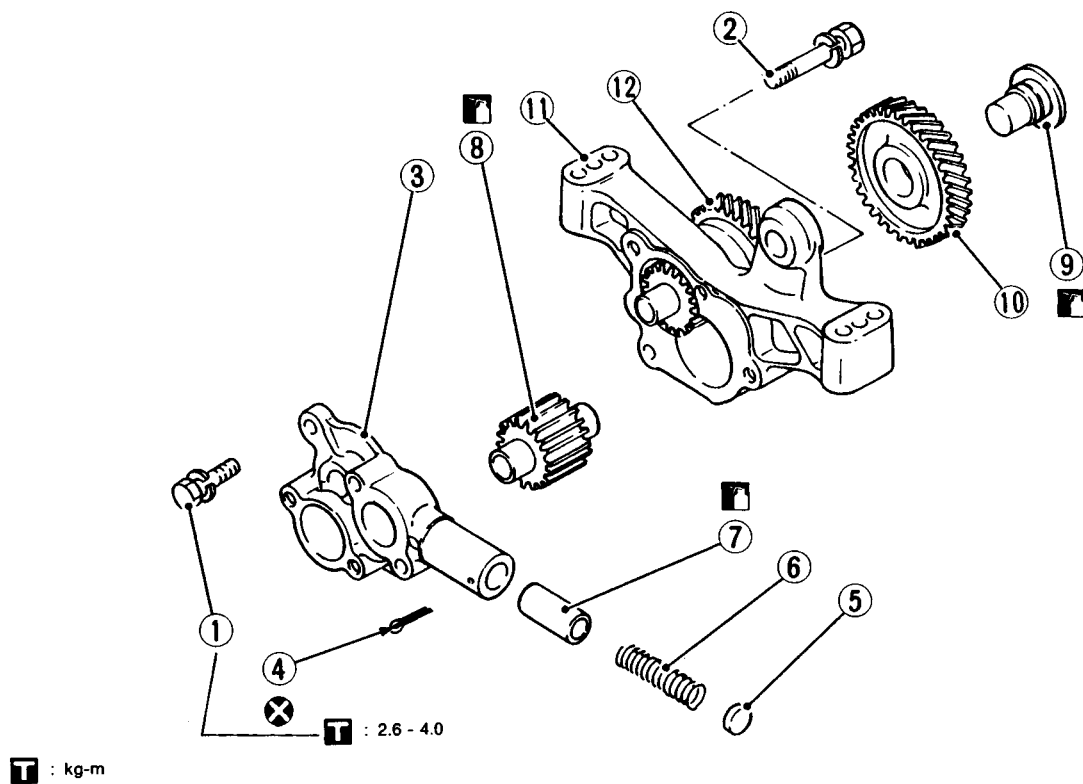
(M): Maintenance standard

ELB2-002D

- ① Bolt
- ② Bolt
- ③ Cover assembly
- ④ Split pin
- ⑤ Spring seat
- ⑥ Spring
- ⑦ Relief valve

- ⑧ Driven gear assembly
- ⑨ Spindle
- ⑩ Idler gear assembly
- ⑪ Pump gear assembly (Drive gear)
- ⑫ Head gear

Exploded illustration



ELB2-003G

- ① Bolt
- ② Bolt
- ③ Cover assembly
- ④ Split pin
- ⑤ Spring seat
- ⑥ Spring
- ⑦ Relief valve

- ⑧ Driven gear assembly
- ⑨ Spindle
- ⑩ Idler gear assembly
- ⑪ Pump gear assembly
(Drive gear)
- ⑫ Head gear

REMOVAL

- 1) Remove the drain plug from the oil pan and drain the engine oil into an oil tray.
- 2) Remove the oil level gauge and guide.
- 3) Remove the oil pan and gasket.
- 4) Remove the oil screen and oil pipe.
- 5) Remove the oil pump assembly.

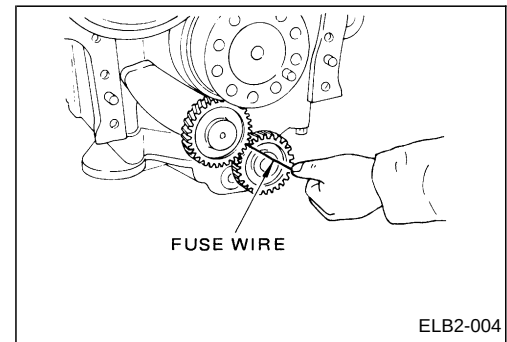
INSPECTION

Clean the oil pump assembly thoroughly with cleaning fluid. After cleaning, inspect for cracks or any other damage carefully. If faulty, replace with a new one.

Idler gear and head gear backlash

[mm]

Maintenance standard	Service limit
0.08 - 0.21	0.50



Crank gear and idler gear backlash

[mm]

Maintenance standard	Service limit
0.08 - 0.21	0.50

Spindle and idler gear bushing clearance

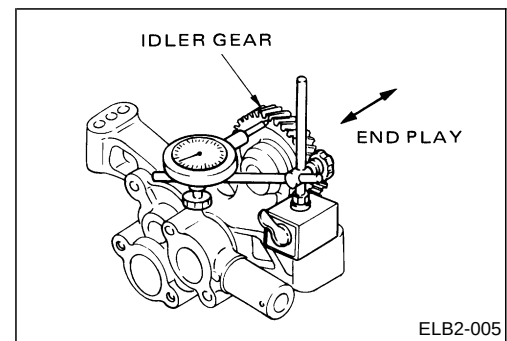
[mm]

Maintenance standard	Service limit
0.08 - 0.15	—

Idler gear end play

[mm]

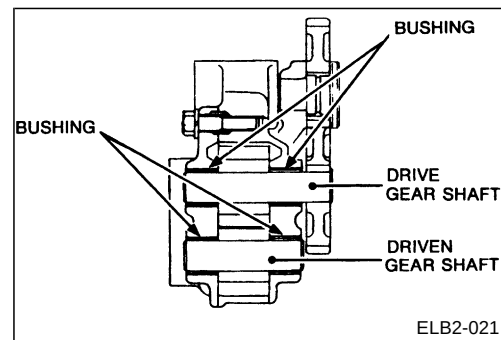
Maintenance standard	Service limit
0.10 - 0.27	0.50



Gear shaft and bushing clearance

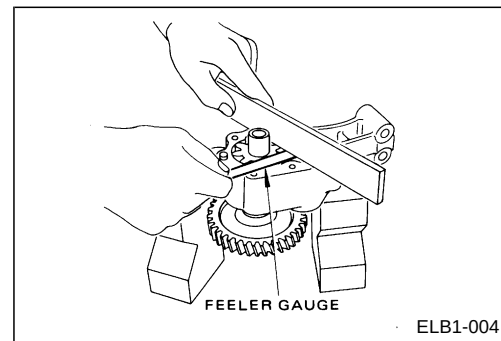
[mm]

Item	Maintenance standard	Service limit
Drive gear shaft and bushing	0.04 - 0.08	0.12
Driven gear shaft and bushing		

**Side clearance**

[mm]

Maintenance standard	Service limit	Remarks
0.05 - 0.11	0.15	One side: 0 mm

**Relief valve spring tension and free length**

Item	Maintenance standard	Service limit	Remarks
Spring tension [kg]	27 - 30	24	When compressed to 66.6 mm
Spring free length [mm]	76.3	—	

INSTALLATION

- 1) Install the oil pump assembly.

T : 3.5 - 5.0 kgm

- 2) Install the oil pipe and oil screen.

[kgm]

Tightening point		Tightening torque
Oil outlet pipe		3.5
Oil screen	Flange section	3.5 - 5.0
	Support section	1.7 - 2.3

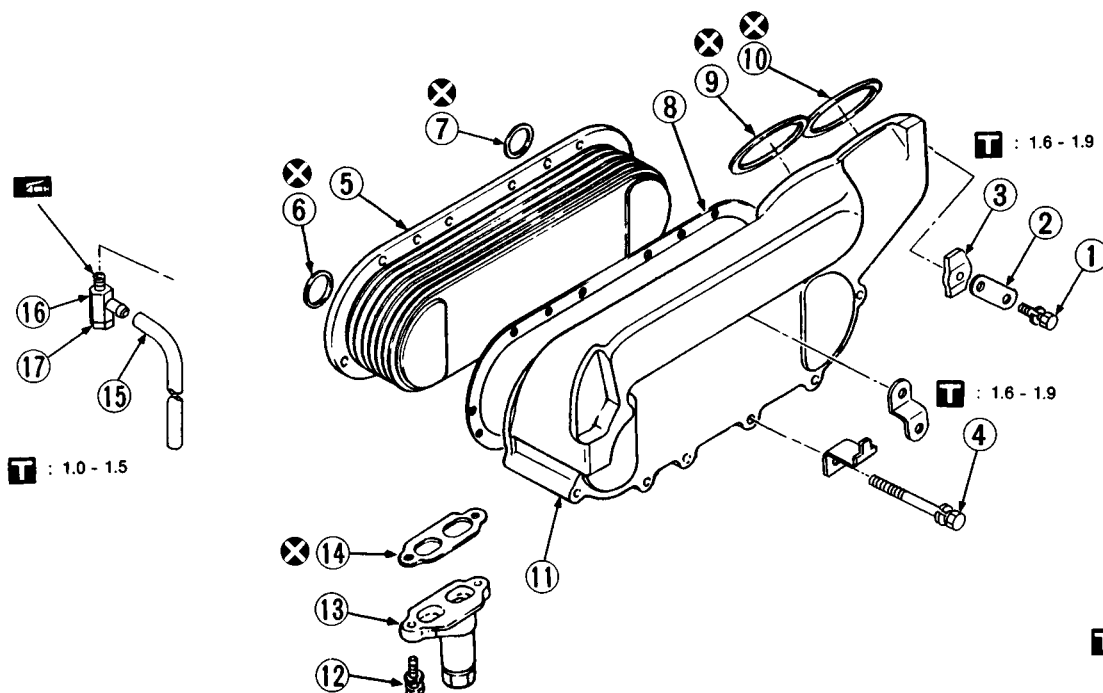
- 3) Install the oil pan with the gasket in place.
- 4) Install the drain plug of the oil pan with the gasket in place.
T : 10 - 13 kgm
- 5) Install the oil level gauge and guide.
- 6) Add the specified amount of engine oil.

OIL COOLER

CONSTRUCTION

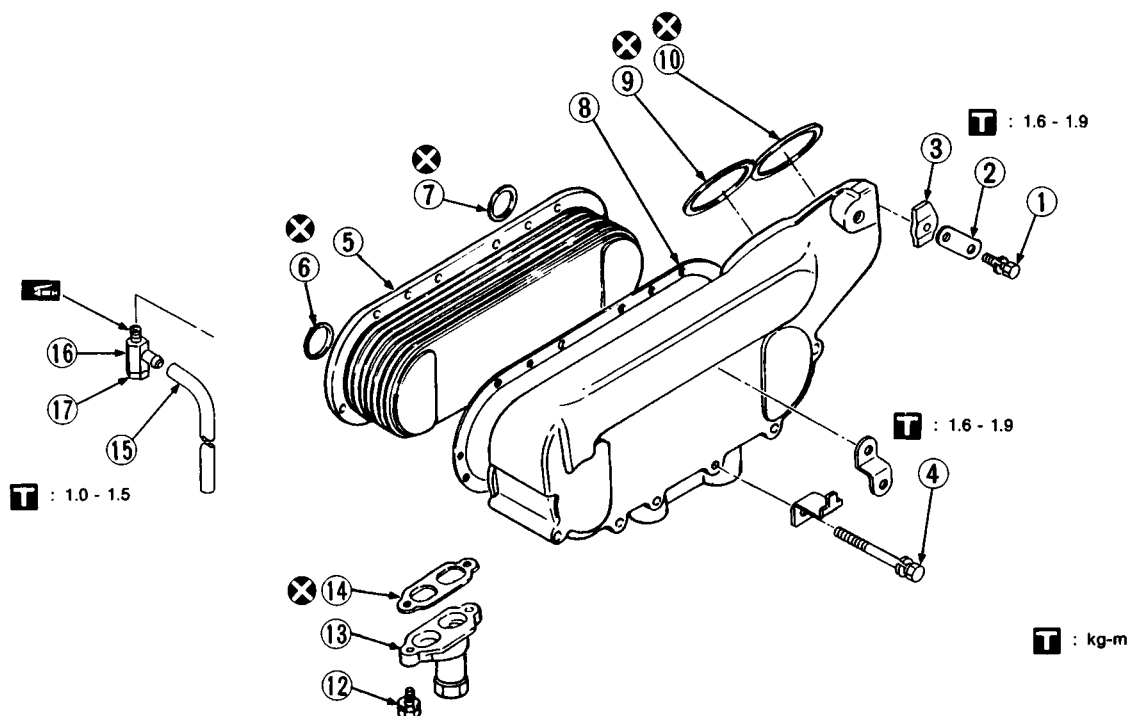
Construction illustration

< Engine model RF8 >



ELB2-007K

< Engine models RG8 & RE10 >

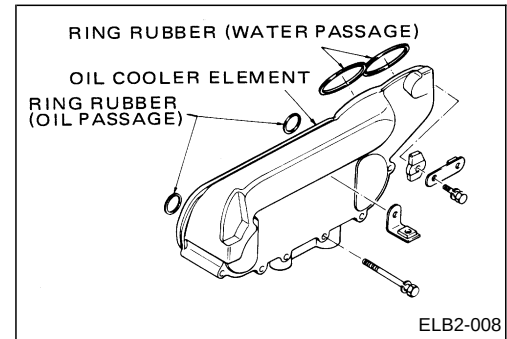


ELB2-007L

- | | | |
|----------------------|----------------------|------------------------|
| ① Bolt | ⑦ Rubber ring | ⑬ Short valve assembly |
| ② Stay | ⑧ Gasket | ⑭ Gasket |
| ③ Equalizer | ⑨ Rubber ring | ⑮ Hose |
| ④ Bolt | ⑩ Rubber ring | ⑯ Drain cock |
| ⑤ Oil cooler element | ⑪ Oil cooler housing | ⑰ Spindle |
| ⑥ Rubber ring | ⑫ Bolt | |

REMOVAL

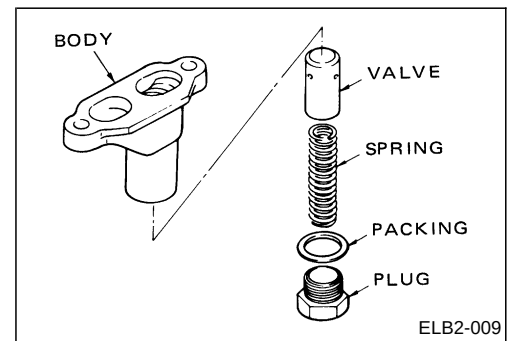
- 1) Remove the drain plug from the oil pan and drain the engine oil into an oil tray.
- 2) Drain the cooling water by loosening the water drain cock.
- 3) Remove the water tube and gasket.
- 4) Remove the equalizer and stay.
- 5) Loosen the oil cooler housing mounting bolt and remove the housing and oil cooler element.



DISASSEMBLY

Short valve assembly

- 1) Remove the short valve assembly and gasket from the cylinder block.
- 2) Remove the plug of the short valve and separate the packing, spring and valve.



INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect for cracks or any other damage carefully. If faulty, replace with a new one.

In addition, when water scale is attached to the oil cooler element, clean with caustic soda solvent or the like, and then wash thoroughly with water.

Short valve

Examine the condition of short valve and valve seat contacting surface for damage or uneven wear, and the valve spring for breaks or aging. If any abnormality is noted, replace the short valve assembly.

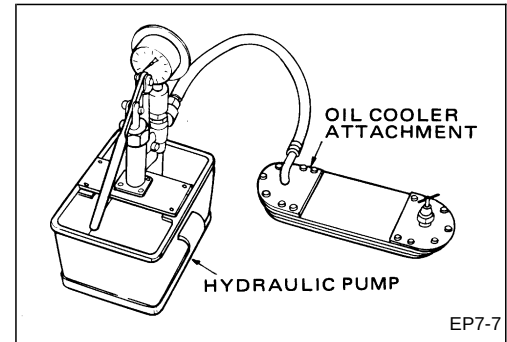
[kg/cm²]

Item	Maintenance standard	Service limit
Short valve opening pressure	1.8 - 2.2	—

Leakage in cooler element

Using the oil cooler attachment (99578 97001) and hydraulic pump (99570 Z5000), perform a water pressure test on the oil cooler element. If any abnormality is noted, replace the element.

Maintenance standard	Service limit
No leakage should exist at a water pressure of 5 kg/cm ² .	—



REASSEMBLY

When reassembling, apply a coat of engine oil to the sliding surfaces.

Short valve

- 1) Install the short valve and spring, then install the cap with the packing in place.
- 2) Install the short valve assembly for the oil cooler with the gasket in place.

INSTALLATION

- 1) Install the element into the oil cooler housing with the gasket in place.
- 2) Install the oil cooler assembly to the cylinder block with rubber rings placed in the inlets and outlets for oil and water.

ⓘ : 1.6 - 1.9 kgm

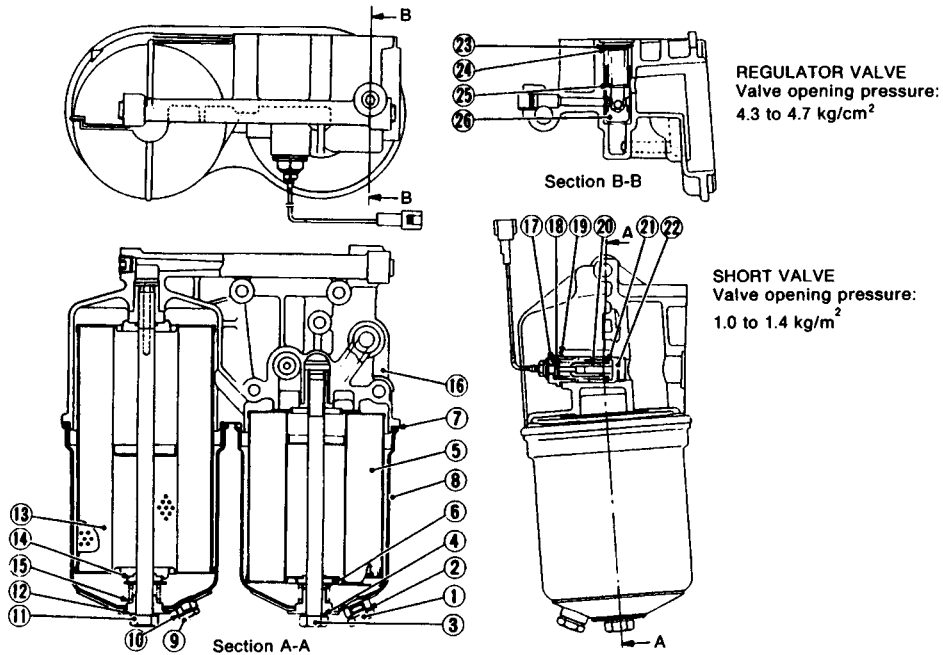
- 3) Install the equalizer.
- 4) Install the water tube with the gasket in place.
- 5) Close the water drain cock and refill the specified amount of cooling water.
- 6) Add the specified amount of engine oil from the oil filler.
- 7) Start up the engine and check to make sure that there is no leakage of air and engine oil.
- 8) Stop the engine, then check the level of engine oil using a level gauge.

OIL FILTER

CONSTRUCTION

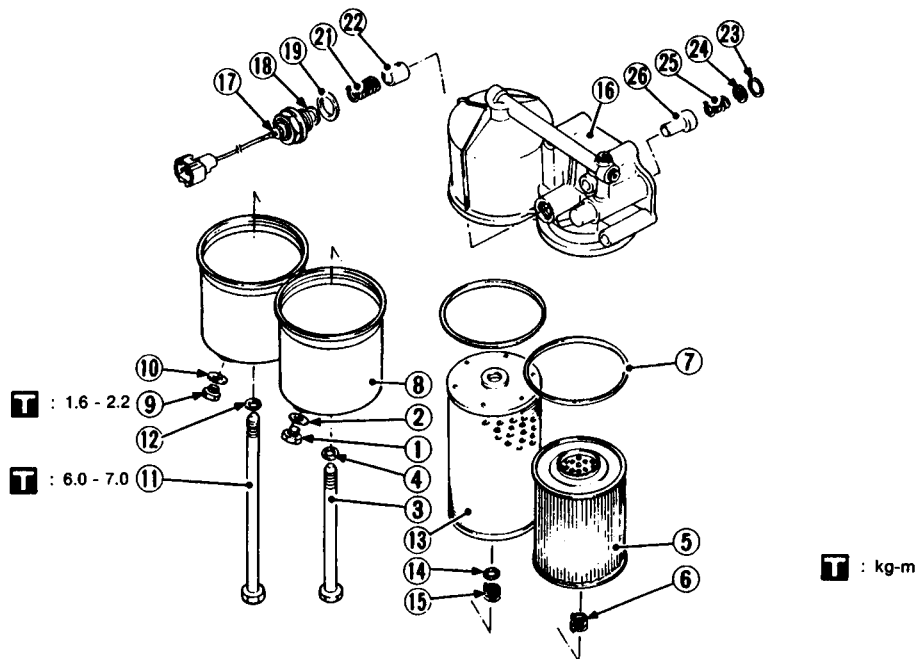
TYPE I (FULL-FLOW AND BYPASS OIL FILTERS)

Construction illustration



ELB2-011J

Exploded illustration

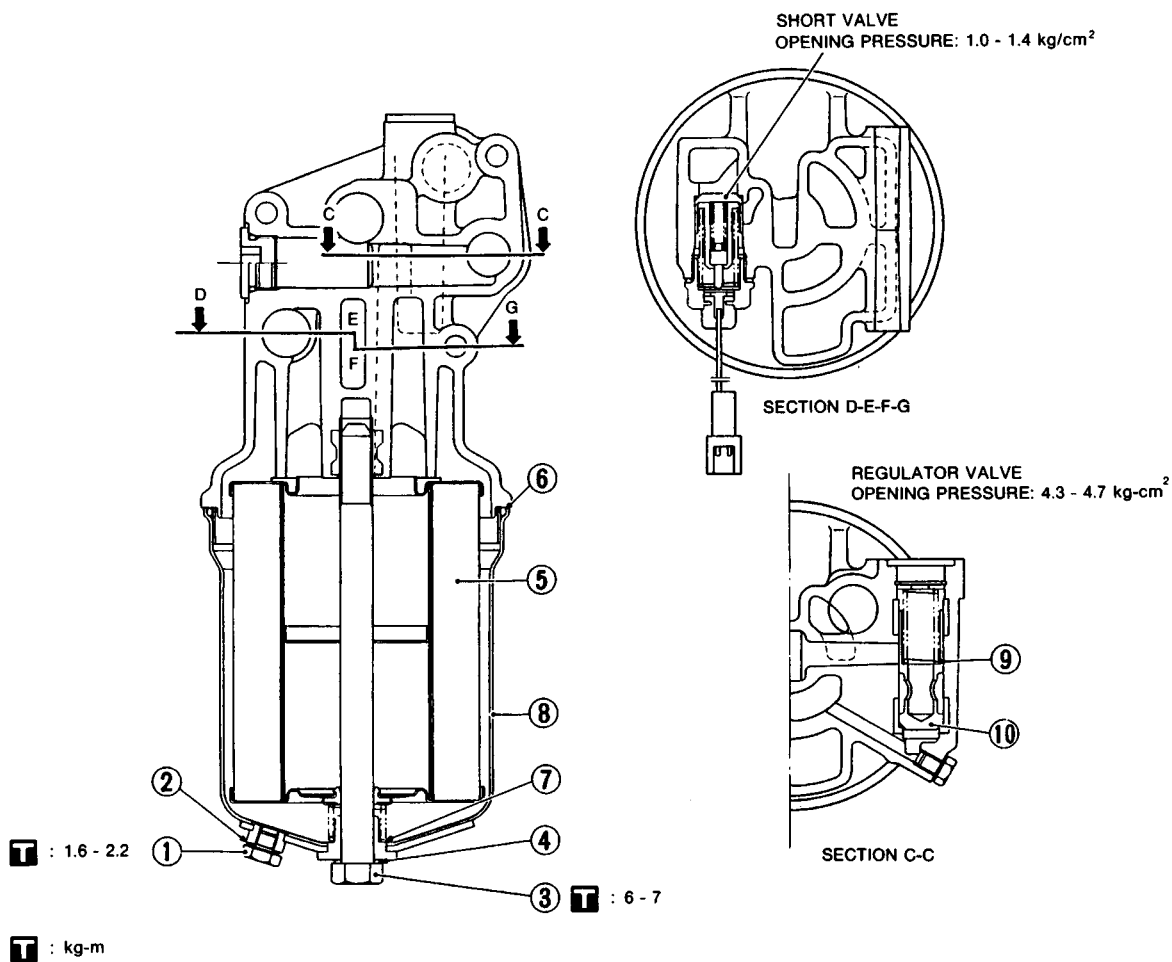


ELB2-012N

- ① Drain plug
- ② Packing
- ③ Center bolt
- ④ Packing
- ⑤ Element assembly
- ⑥ Set spring
- ⑦ Packing
- ⑧ Body
- ⑨ Drain plug
- ⑩ Packing
- ⑪ Center bolt
- ⑫ Packing
- ⑬ Element assembly

- ⑭ Spring seat
- ⑮ Spring
- ⑯ Cover assembly
- ⑰ Switch assembly
- ⑱ Washer
- ⑲ Packing
- ⑳ Contactor
- ㉑ Spring
- ㉒ Short valve assembly
- ㉓ Snap ring
- ㉔ Washer
- ㉕ Valve spring
- ㉖ Regulator valve

TYPE II (FULL FLOW) Construction illustration



ELB2-013G

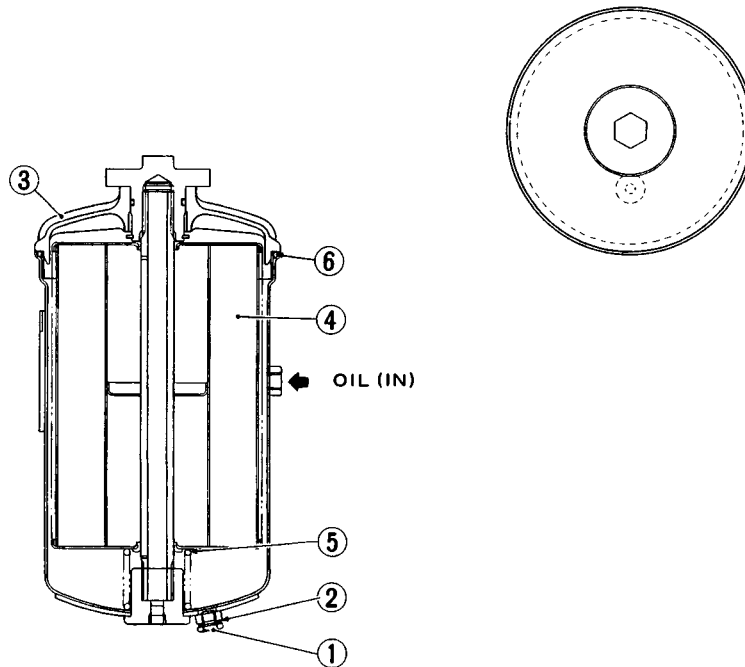
- ① Drain plug
- ② Packing
- ③ Center bolt
- ④ Packing
- ⑤ Element assembly

- ⑥ O-ring
- ⑦ Spring
- ⑧ Oil filter case
- ⑨ Spring
- ⑩ Regulator valve

Note:

- Type II is for the CGB520 model only.

TYPE II (LARGE SIZE BYPASS OIL FILTER)
Construction illustration



ELB2-019F

- ① Drain plug
- ② Packing
- ③ Cover

- ④ Element assembly
- ⑤ Spring
- ⑥ O-ring

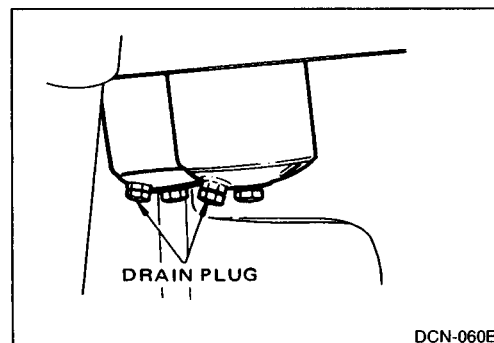
Note:

- Type II is for the CGB520 model only.

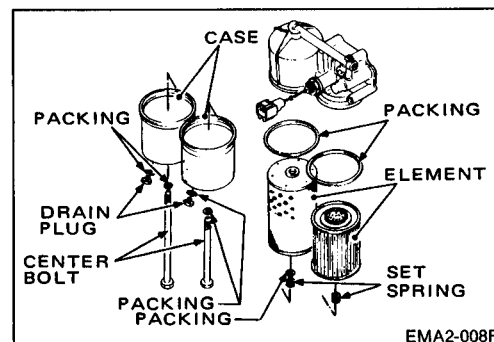
REMOVAL

TYPE I (FULL-FLOW AND BYPASS OIL FILTERS)

- 1) Remove the drain plug from the oil pan and drain the engine oil into the oil tray.
- 2) Remove the drain plug from the oil filter and drain the engine oil left in the filter to the oil tray.



- 3) Loosen the center bolts, then remove the cases, element assemblies, set springs and packings.
- 4) Remove the oil filter cover assembly (oil filter bracket assembly).



TYPE II (FULL-FLOW OIL FILTER)

- 1) Remove the drain plug from the oil filter and drain the engine oil left in the filter into the oil tray.
- 2) Disconnect the oil pipe from the oil filter.
- 3) Remove the oil filter assembly from the vehicle body.
- 4) Loosen the center bolts, then remove the case, element assembly, set spring and packings.

TYPE II (LARGE SIZE BYPASS OIL FILTER)

- 1) Remove the drain plug from the oil filter and drain the engine oil left in the filter into the oil tray.
- 2) Disconnect the oil hose from the oil filter.
- 3) Unscrew the oil filter assembly mounting bolt and remove the oil filter assembly from the vehicle body.

DISASSEMBLY

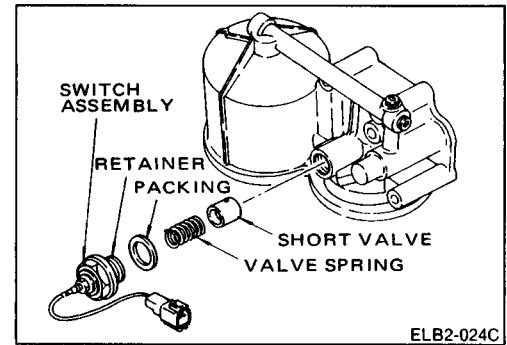
OIL FILTER SHORT VALVE

Type I

Remove the clogging alarm switch assembly first, then remove the retainer, packing, valve spring and short valve assembly.

Type II

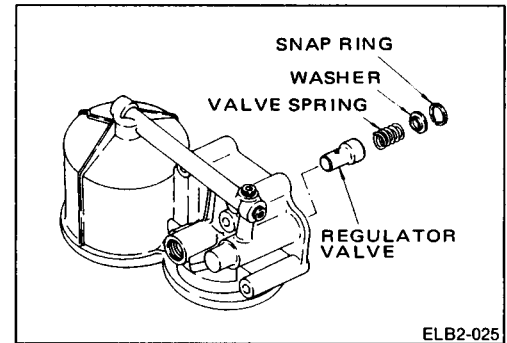
Remove the clogging alarm switch assembly first, then remove the packing, valve spring, contactor case, contactor, contactor spring and short valve.



REGULATOR VALVE

Type I

Remove the snap ring first, then remove the washer, valve spring and regulator valve.



Type II

Remove the plug first, then remove the valve, valve spring and regulator valve.

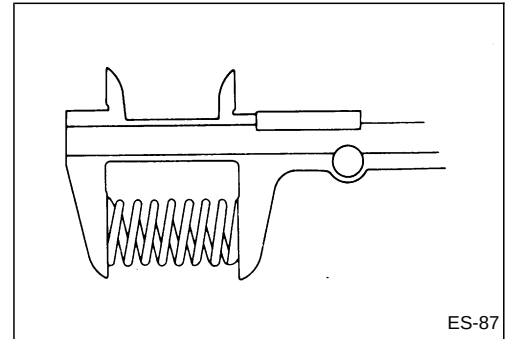
INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect for cracks or any other damage carefully. If faulty, replace with a new one.

Spring free length

[mm]

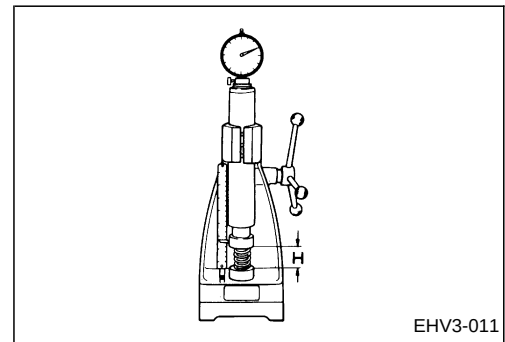
Item	Classification	Maintenance standard	Service limit
Oil filter short valve	TYPE I	62.7	—
	TYPE II	74.5	—
Regulator valve	TYPE I	49.5	—
	TYPE II	54.5	—



Spring tension

[kg]

Item	Classification	Maintenance standard	Service limit	Remarks (H)
Oil filter short valve	TYPE I	4.0 - 4.4	—	When compressed to 47 mm
	TYPE II	4.0	—	When compressed to 40.5 mm
Regulator valve	TYPE I	16.3 - 18.1	—	When compressed to 36.2 mm
	TYPE II	9.9	—	When compressed to 40 mm



REASSEMBLY

Oil filter short valve

Type I

Install the short valve assembly, valve spring and retainer onto the cover, then install the clogging alarm switch assembly with the packing in place.

Type II

Install the short valve, valve spring and contactor case, then install the clogging alarm switch with the packing in place.

Regulator valve

Type I

Install the regulator valve, valve spring and washer, then fix with the snap ring.

Type II

Install the regulator valve and spring, then install the plug with the packing in place.

INSTALLATION

TYPE I (FULL-FLOW AND BYPASS OIL FILTERS)

- 1) Install the oil filter cover assembly (oil filter bracket assembly) onto the cylinder block.
- 2) Install the packings, element assemblies, set springs and cases, then tighten the center bolts with the packings in place.

T : 6.0 - 7.0 kgm

- 3) Install the plug with the packing in place.

T : 1.6 - 2.2 kgm

- 4) Open the cap of the oil filler and refill the specified amount of engine oil.
- 5) Start up the engine and check to make sure that there is no leakage of engine oil.
- 6) Check the level of engine oil using a level gauge.

TYPE II (FULL-FLOW OIL FILTER)

- 1) Install the packing, element assembly, washer, set spring and case onto the cover assembly, then fasten them with the center bolt.

T : 6.0 - 7.0 kgm

- 2) Install the drain plug with the packing in place.

T : 1.6 - 2.2 kgm

- 3) Install the oil filter assembly onto the vehicle body.
- 4) Connect the oil pipe to the oil filter.
- 5) Start up the engine and check to make sure that there is no leakage of engine oil.
- 6) Check the level of engine oil using a level gauge.

TYPE II (LARGE SIZE BYPASS OIL FILTER)

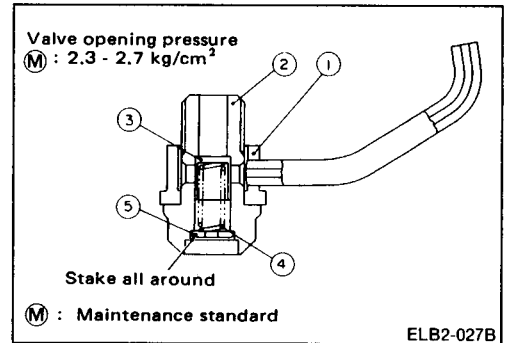
- 1) Install the set spring and element assembly into the oil filter case, then install the cover with the packing in place.
- 2) Install the drain plug with the packing in place.
- 3) Install the oil filter assembly onto the vehicle body.
- 4) Connect the oil hose to the oil filter.
- 5) Start up the engine and check to make sure that there is no leakage of engine oil.
- 6) Check the level of engine oil using a level gauge.

OIL JET

CONSTRUCTION

Construction illustration

- ① Oil jet
- ② Oil jet bolt
- ③ Valve
- ④ Valve spring
- ⑤ Valve spring plate



REMOVAL

- 1) Loosen the oil jet bolt and remove it together with the oil jet.

INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect for cracks or any other damage carefully. If faulty, replace with a new one.

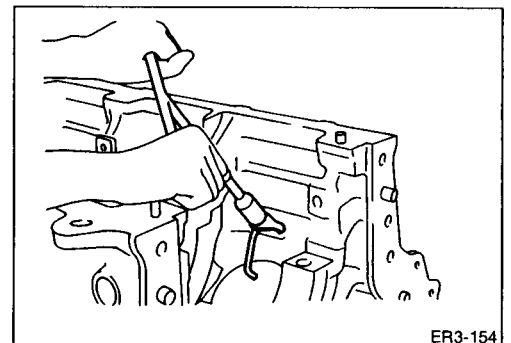
[kg/cm²]

Maintenance standard	Service limit
2.3 - 2.7	—

INSTALLATION

- 1) Align the location plate of the oil jet to the hole, then fix the oil jet with the oil jet bolt.

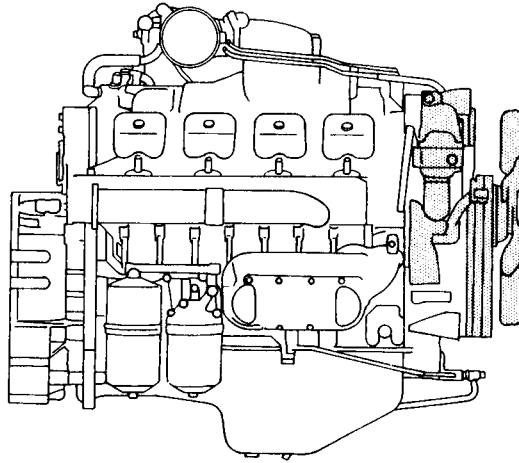
T : 5.0 - 6.0 kgm



- 2) When installing, attach the oil jet to applied engines.

Engine model	Discrimination paint
RF8	Red
RG8	White
RE10	Yellow

8. COOLING SYSTEM



ER0-125

The cooling system consists of a water pump, thermostat, radiator, water tank, fan and fan drive.

CONTENTS

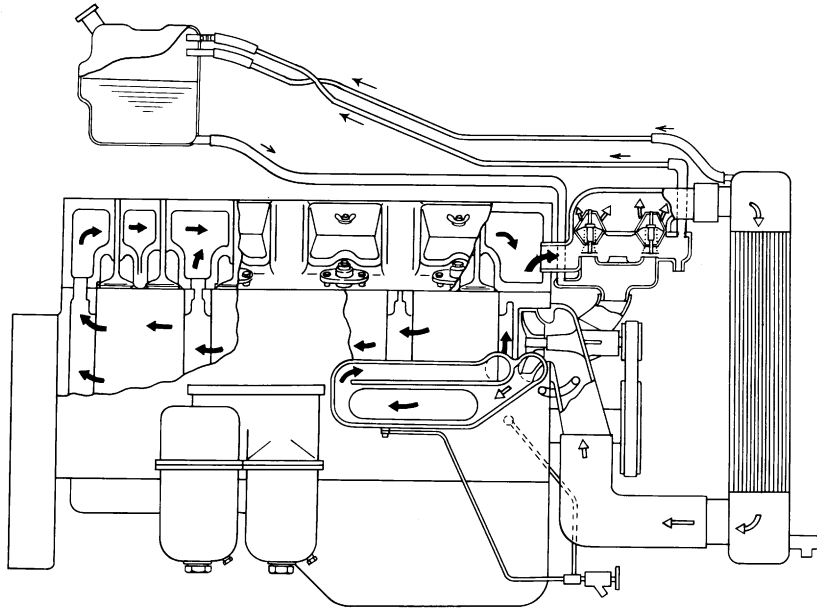
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THERMOSTAT	8-11		

SPECIFICATIONS

Model		RF8	RG8	RE10
Cooling system		Forced-circulation type		
Radiator type		Corrugated fin		
Outside Diameter of cooling fan [mm]	Taiwan	ø600 or ø670	ø670	
	Except Taiwan	ø700	—	
Water pump		Centrifugal, belt-driven type		
Thermostat		Wax-pellet type		
Fan clutch		Temperature sensitive type		
Cooling water capacity [ℓ]		42		47

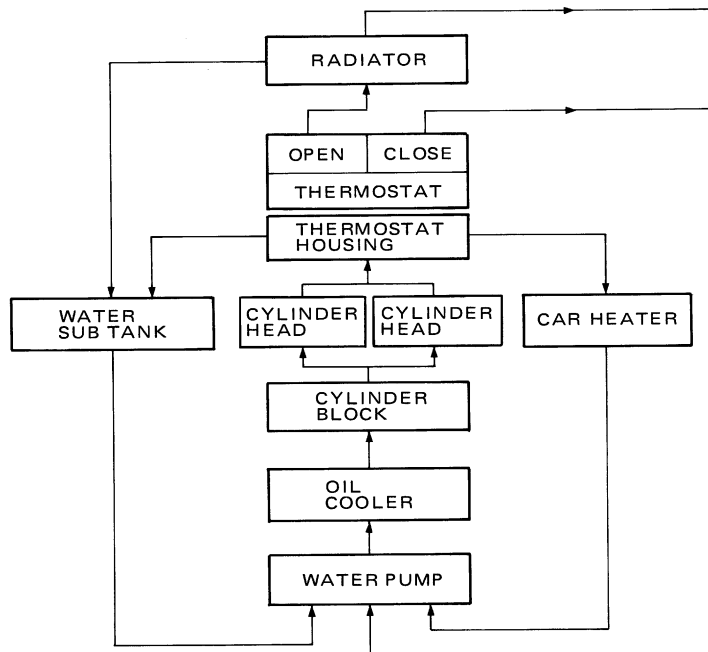
SYSTEM DIAGRAM

COOLING SYSTEM DIAGRAM



EEC2-001F

COOLING CIRCUIT

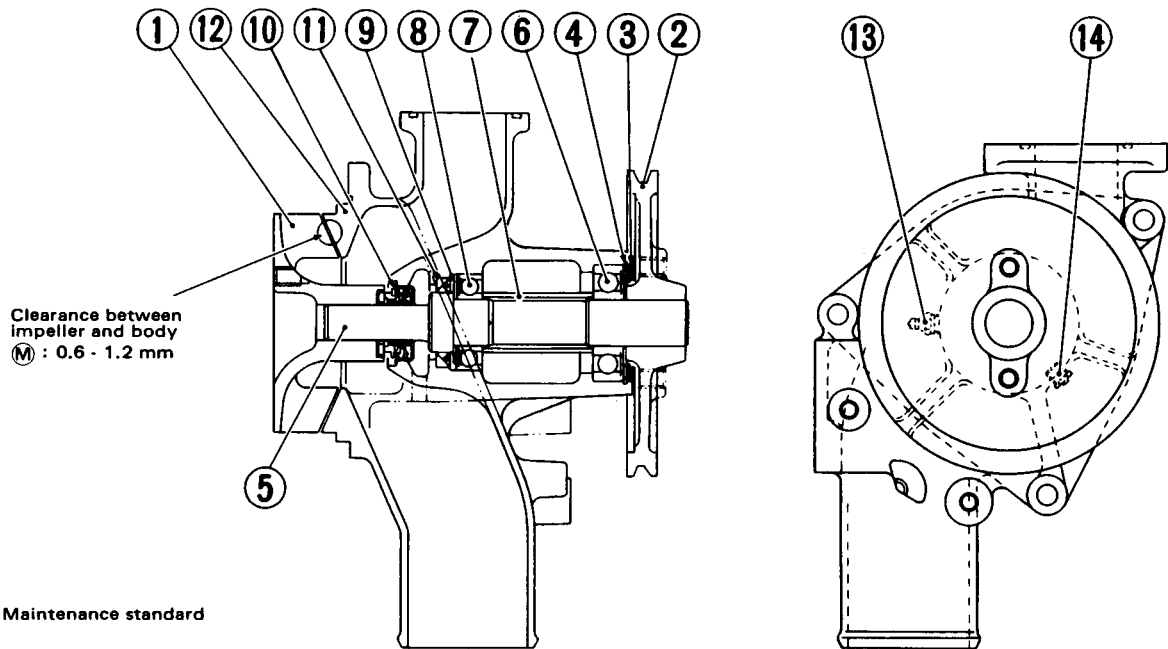


EEC2-001J

WATER PUMP

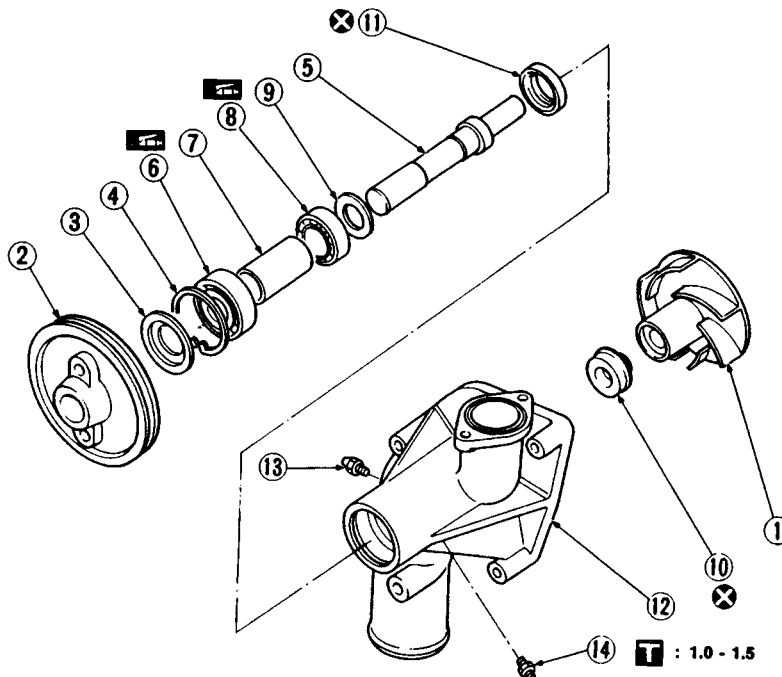
CONSTRUCTION

Construction illustration



EEC2-002J

Exploded illustration



EEC2-003J

- | | |
|----------------|-----------------------|
| ① Impeller | ⑧ Ball bearing |
| ② Pulley | ⑨ Washer |
| ③ Dust cover | ⑩ Water seal assembly |
| ④ Snap ring | ⑪ Oil seal |
| ⑤ Shaft | ⑫ Body |
| ⑥ Ball bearing | ⑬ Grease nipple (in) |
| ⑦ Spacer | ⑭ Grease nipple (out) |

EXTERNAL APPEARANCE CHECK AND CORRECTION

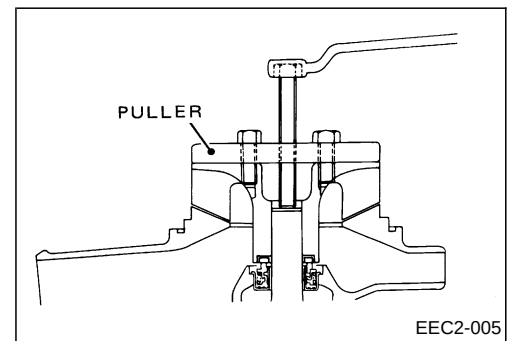
- 1) If water leakage or any trace of it is noticed at the hole on the underside of the pump body, check the condition of the water seal and impeller. If even only one of them is damaged, both should be replaced as a unit in principle.
- 2) If grease leakage is noticed at the hole on the underside of the pump body or on the pulley side, replace the ball bearing on the side where leakage is noticed.
- 3) Check for interference of the impeller with the vehicle body or the bearing's axial play due to wear of the ball bearing. If even only one of them is excessive, replace the two ball bearings as a unit.

REMOVAL

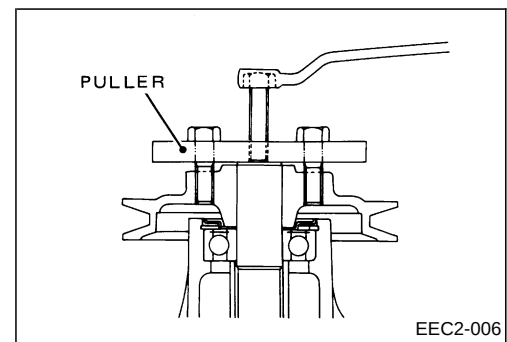
- 1) Drain the engine cooling water.
- 2) Loosen the mounting bolts and nuts for the V-belt rigid tensioner, then remove the V-belt from the water pump pulley.
- 3) Disconnect the hoses connected to the water pump.
- 4) Remove the water pump and O-ring.

DISASSEMBLY

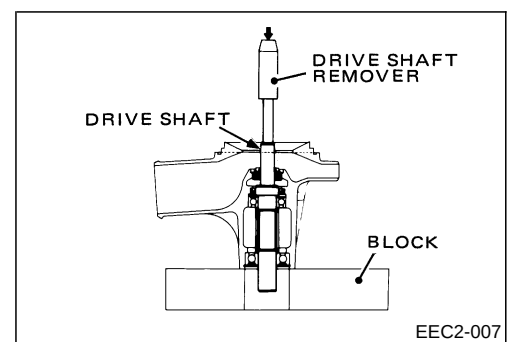
- 1) Using a puller (99749 97500), remove the impeller.



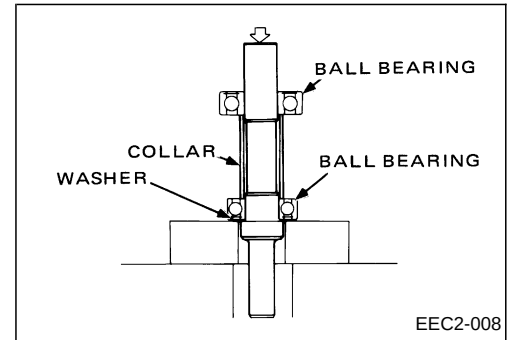
- 2) Using a puller (99749 97500), remove the water pump pulley.
- 3) Remove the dust cover and snap ring.



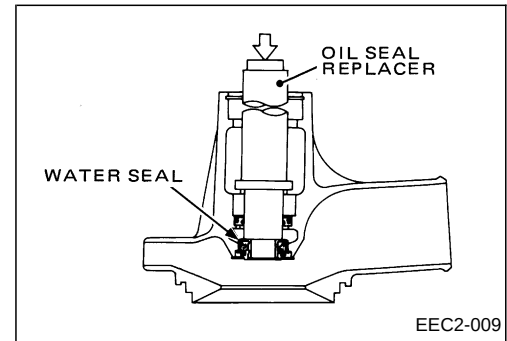
- 4) Using a drive shaft remover (99758 97500), remove the shaft assembly with the ball bearing and spacer.



- 5) Using a press tool, press out the ball bearing together with the spacer and washer.



- 6) Using an oil seal replacer (99759 97500), drive out the water seal.
 7) Using an oil seal replacer (99759 97500), remove the oil seal.
 8) Remove the water seal from the impeller.



INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. Especially for the impeller and the inside of the body, remove water scales and rust and, if necessary, clean them with caustic soda solvent or the like, then wash thoroughly with water. While cleaning, inspect the parts for cracks and other damage carefully. If faulty, replace with a new one.

Outside diameter of the shaft where the impeller is fitted

[mm]

Maintenance standard	Service limit
20.051 - 20.060	—

Fitting allowance of the impeller and shaft

[mm]

Maintenance standard	Remarks
0.023T - 0.053T	T: tight

Outside diameter of the shaft where the pulley is fitted

[mm]

Maintenance standard	Service limit
25.002 - 25.015	—

Fitting allowance of the pulley and shaft

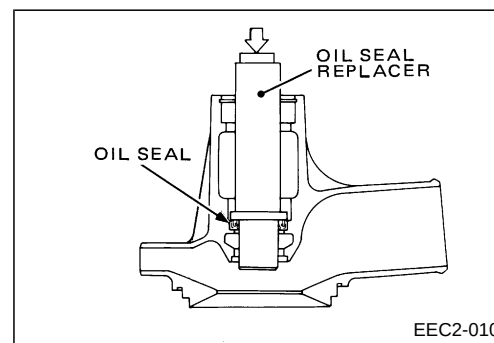
[mm]

Engine model	Maintenance standard	Remarks
RF8	0.03T - 0.07T	T: tight
RG8	0.048T - 0.082T	
RE10	0.03T - 0.07T	

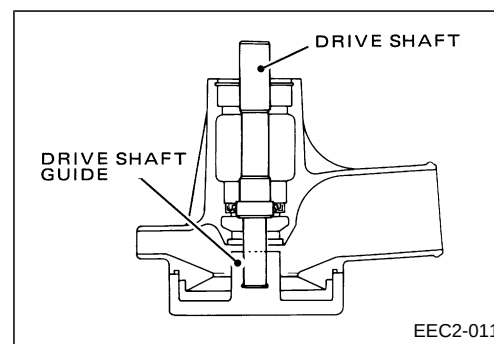
REASSEMBLY

When reassembling the water pump, make sure new water seal assemblies, oil seals and O-rings are used.

- 1) Using an oil seal replacer (99759 97500), drive the oil seal into the body.



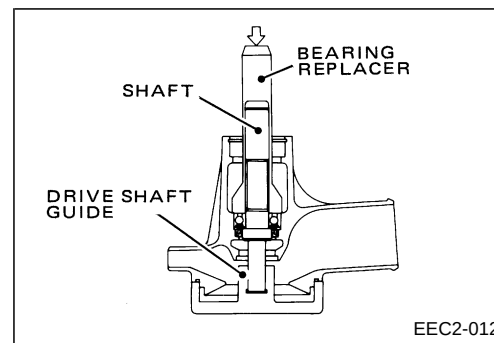
- 2) Set the drive shaft guide (99789 97500) on the body and insert the drive shaft.



- 3) Insert the washer, then press in the ball bearing on the impeller side using the bearing replacer (99757 97500).

Note:

- Make sure the rolling contact surface of the bearing is filled with grease.

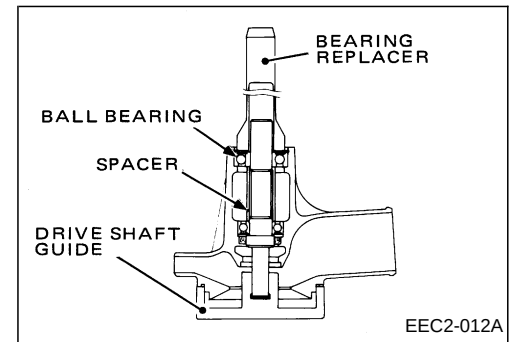


- 4) Insert the spacer, then press in the ball bearing on the pulley side using the bearing replacer (99757 97500).

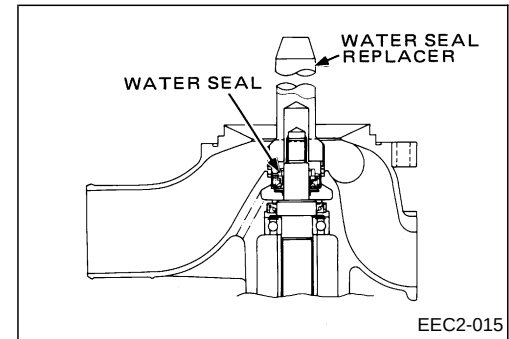
Note:

- **Make sure the rolling contact surface of the bearing is filled with grease.**

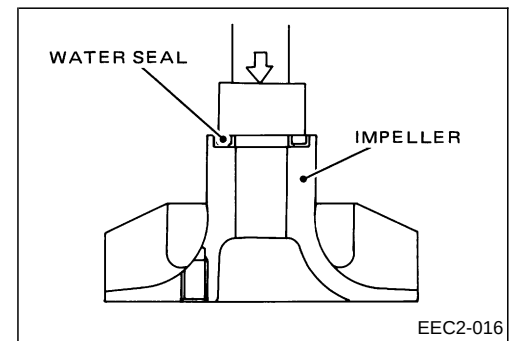
- 5) Install the snap ring and dust cover.
6) Press the pulley onto the drive shaft using a press tool.



- 7) Apply bonding agent (Three Bond 1102) to the outer periphery of the water seal, then press it into the pump body using a water seal replacer (99753 97000).



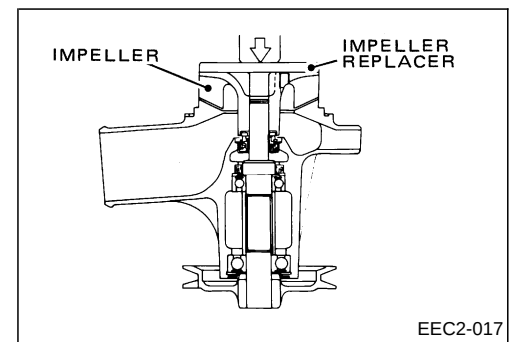
- 8) Press the water seal into the impeller.



- 9) Using an impeller replacer (99749 97502), press in the impeller so that the clearance between the body and the impeller is within the maintenance standard.

[mm]

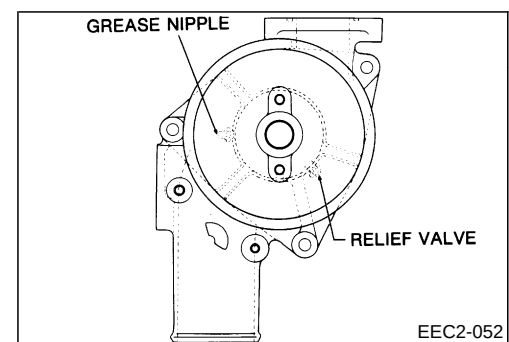
Maintenance standard	Remarks
0.6 - 1.2	Measure perpendicularly to the body surface.



- 10) Using a grease gun, apply grease through the grease nipple until grease flows out of the relief valve.

Approx. grease amount: 130 grams

Recommended grease: Showa Sekiyu Sunlight #2



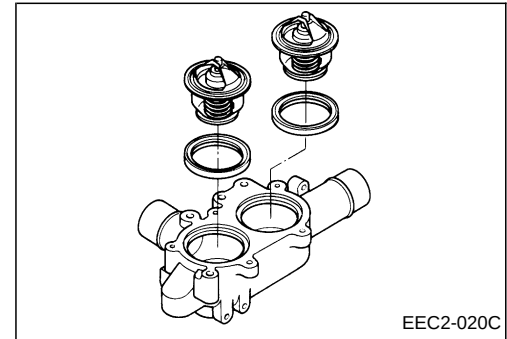
INSTALLATION

- 1) Install the water pump on to the cylinder block with the O-ring in place.
- 2) Connect hoses to the water pump.
- 3) Place the V-belt for driving the pump on the water pump pulley, then the adjust tension.
- 4) Add the specified amount of engine cooling water.

THERMOSTAT

REMOVAL

- 1) Drain the engine cooling water.
- 2) Disconnect the radiator hose from the water outlet, then remove the water outlet and gasket.
- 3) Remove the thermostat.



INSPECTION

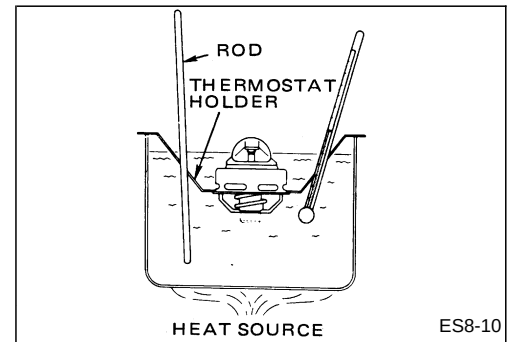
Check the operation of the thermostat, using a tool similar to that shown at right.

<Engine models RF8, RG8>

Item		Maintenance standard	Service limit
Valve opening temperature [°C]	76.5°C	74.5 - 78.5	73.0 - 80.0
	82°C	80.0 - 84.0	78.5 - 85.5
Valve lift [mm]	76.5°C	More than 10/90°C	Below 8.5/90°C
	82°C	More than 10/95°C	Below 8.5/95°C

<Engine model RE10>

Item		Maintenance standard	Service limit
Valve opening temperature [°C]	82°C	80.0 - 84.0	78.5 - 85.5
	88°C	86.0 - 90.0	84.5 - 91.5
Valve lift [mm]	82°C	More than 10/95°C	Below 8.5/95°C
	88°C	More than 10/100°C	Below 8.5/100°C



INSTALLATION

- 1) Install the thermostat to the specified position in the thermostat housing.
- 2) Install the water outlet and gasket, then connect the radiator hose to the water outlet.
- 3) Add the specified amount of engine cooling water.

RADIATOR AND WATER TANK

FLUSHING COOLING SYSTEM

- 1) Drain the cooling water, then fill the system with tap water and run the engine again for additional flushing.
- 2) Flush repeatedly with tap water until the water drained from the cooling system is completely clean.
- 3) Remove any dirt and dust accumulated between the radiator core fins and tubes.

INSPECTION

Inspect the radiator and water tank for cracks and other damage. If faulty, replace with a new one.

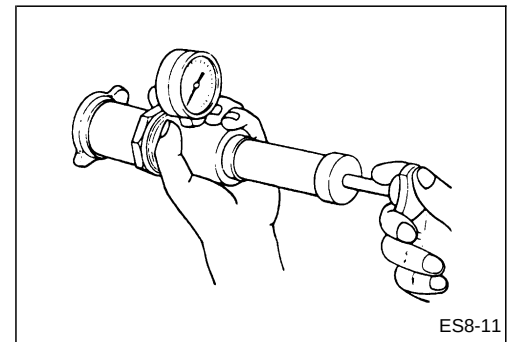
Leakage test for the radiator

Plug all openings with wooden taps or the like, dip the entire radiator into a container of water, and direct compressed air of 1.0 kg/cm^2 into the radiator core to determine if air leakage is noticed. If air leakage is noticed, repair or replace the radiator.

Water tank cap valve opening pressure

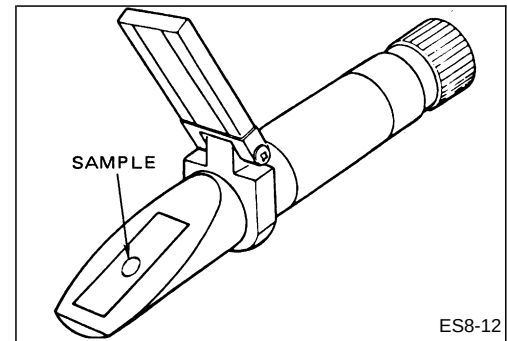
[kg/cm²]

Maintenance standard	Remark
0.5 - 0.7	Pressure side



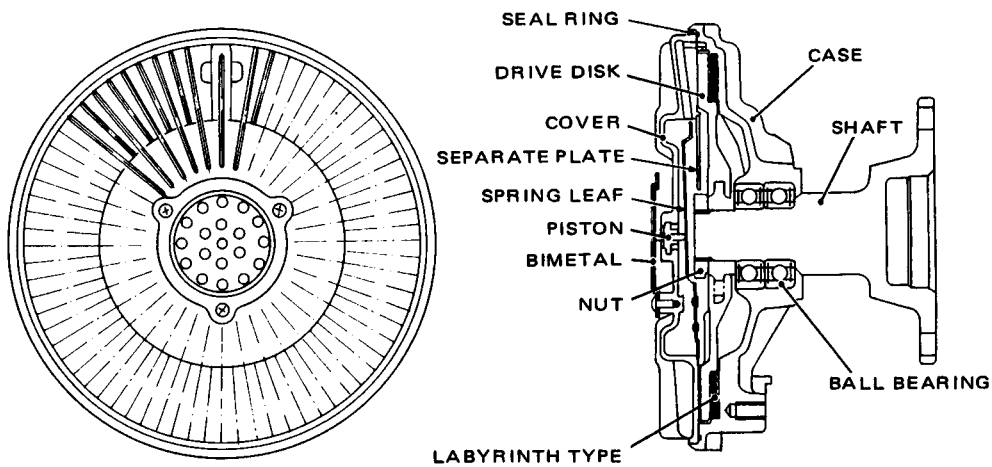
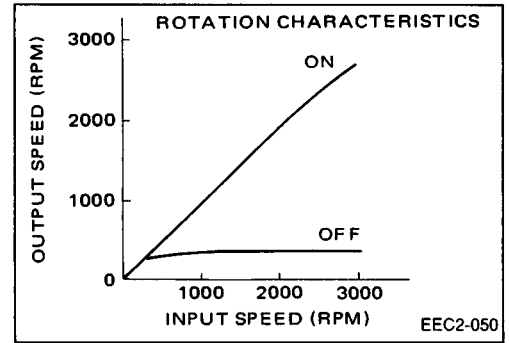
Cooling water

Using a tester, check antifreeze concentration. Add antifreeze to the cooling system so that the concentration will be suitable for weather in which the vehicle is to be operated.



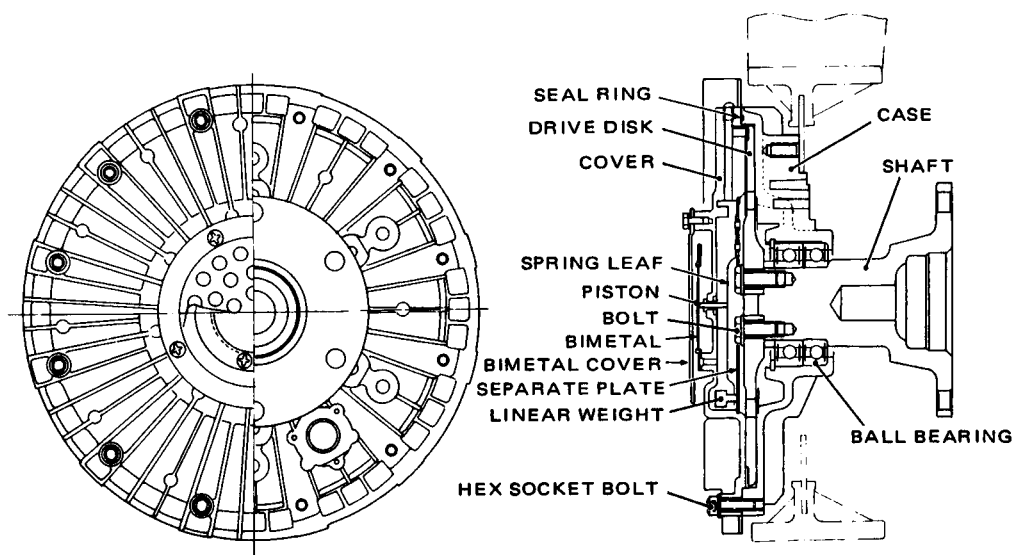
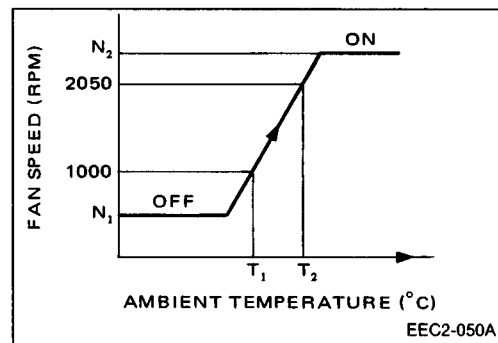
FAN CLUTCH

CONSTRUCTION STANDARD TYPE



EEC2-039C

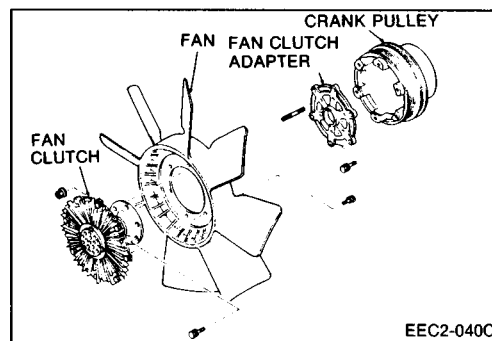
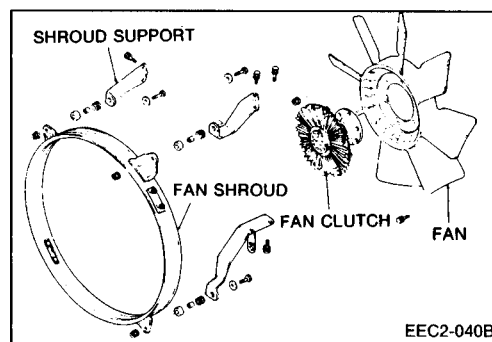
LINEAR TYPE



EEC2-039B

REMOVAL

- 1) Remove the fan shroud and shroud support.
- 2) Remove the fan and the fan clutch assembly as a unit.
- 3) Remove the fan from the fan clutch assembly.



INSPECTION

EXTERNAL APPEARANCE CHECK

After removing the fan clutch, inspect the exterior for cracks, silicone oil leakage or any other damage. If faulty, replace the fan clutch assembly. Never disassemble it.

Note:

- Care should be given lest the bimetal is damaged or deformed during removal and inspection.

OPERATION TEMPERATURE CHECK

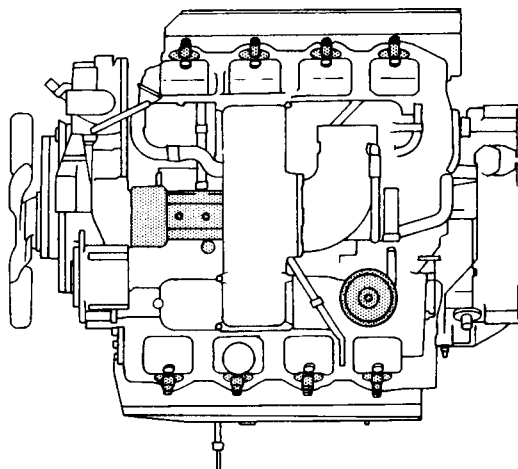
- 1) Install the fan on the fan clutch and rotate the fan drive shaft continuously at a constant speed.
- 2) Install a thermometer and a drier, then blow hot air onto the bimetal.
- 3) Check to make sure that the speed of the fan changes from low to high when the thermometer indicates the following temperature.

Engine model	Type	r.p.m.	Operating temperatures (°C)
RF8	Linear type	2400	60 ± 10 - 75 ± 5
	Standard type	2300	65 ± 5
RG8	Linear type	2400	60 ± 10 - 75 ± 5
RE10			

INSTALLATION

- 1) Install the fan onto the fan clutch assembly.
- 2) Install the fan clutch assembly with fan onto the fan clutch adapter.

9. FUEL SYSTEM



ER0-126

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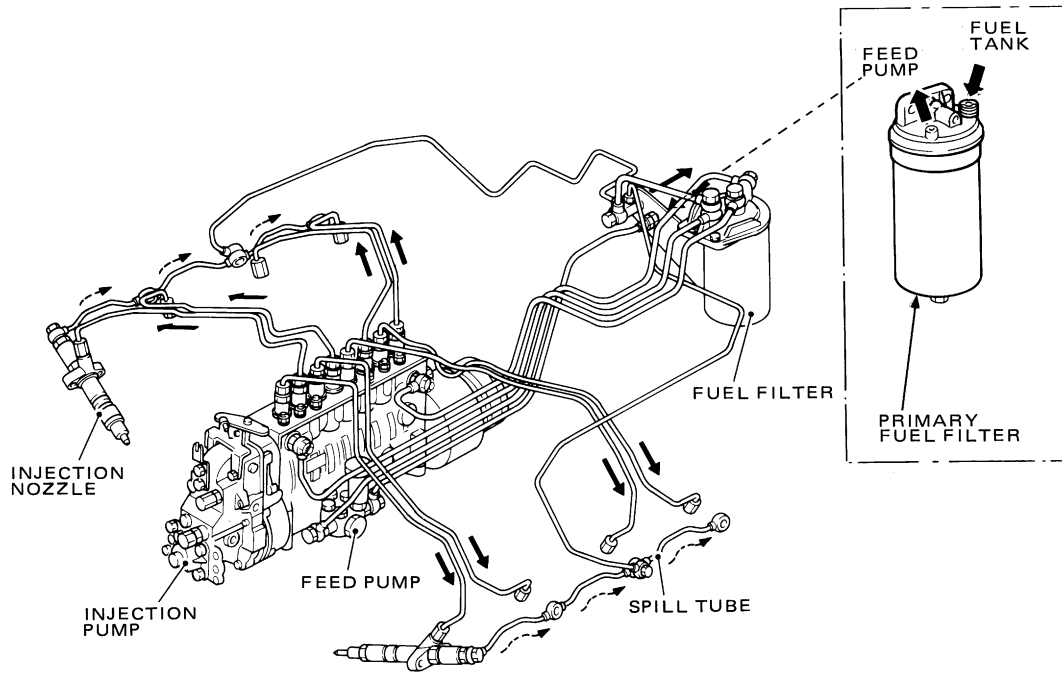
SPECIFICATIONS

Item		Engine model	RF8	RG8	RE10
Fuel injection timing [B.T.D.C.]		Conventional (One-spring type nozzle)	17°	—	
		Two-spring type nozzle*	18°	10.5°	18°
Ignition order			1R-1L-4R-4L-3L-2R-2L-3R		1R-1L-5R-5L-2R-2L-3R-3L-4R-4L
Fuel injection pump	Type		Bosch type		
	Plunger diameter [mm]		12.0		
	Cam lift [mm]		11.0	12.0	11.0
	Governor		Centrifugal		
	Timer		Centrifugal		
Fuel injection nozzle	Nozzle holder		Flange type		
	Nozzle		Multi-jet		
	Number of injection nozzles	Conventional type nozzle	5	—	
		Two-spring type nozzle*	6	5	
	Injection pressure [kg/cm ²]	Conventional type nozzle	220	—	
		Two-spring type nozzle*	180 — 220	180 — 230	180 — 220
Fuel filter		Primary	Filter paper		
		Main	Cartridge type		
Overflow valve opening pressure [kg/cm ²]		Injection pump outlet	1.6		
		Fuel filter	1.3±0.2		

* : Taiwan only

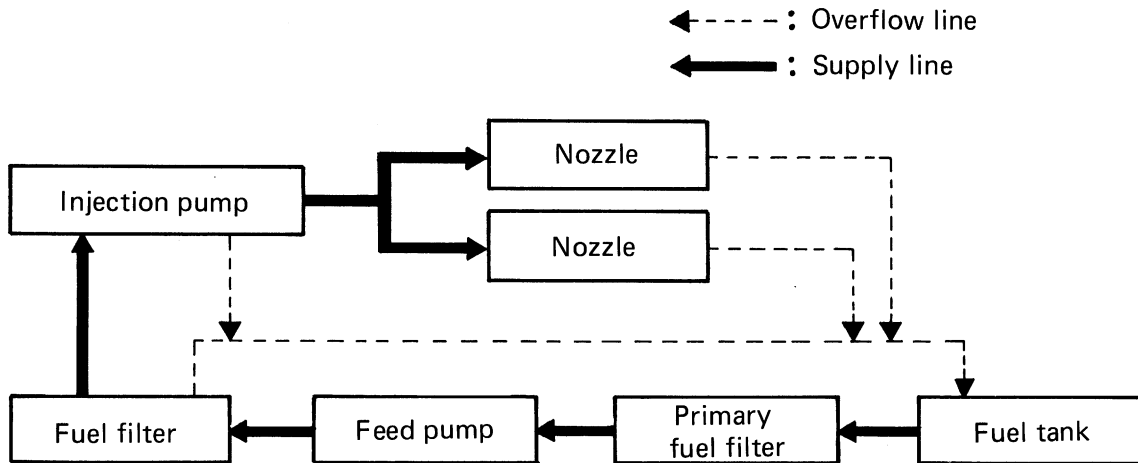
FUEL SYSTEM

FUEL SYSTEM DIAGRAM



EEF2-001D

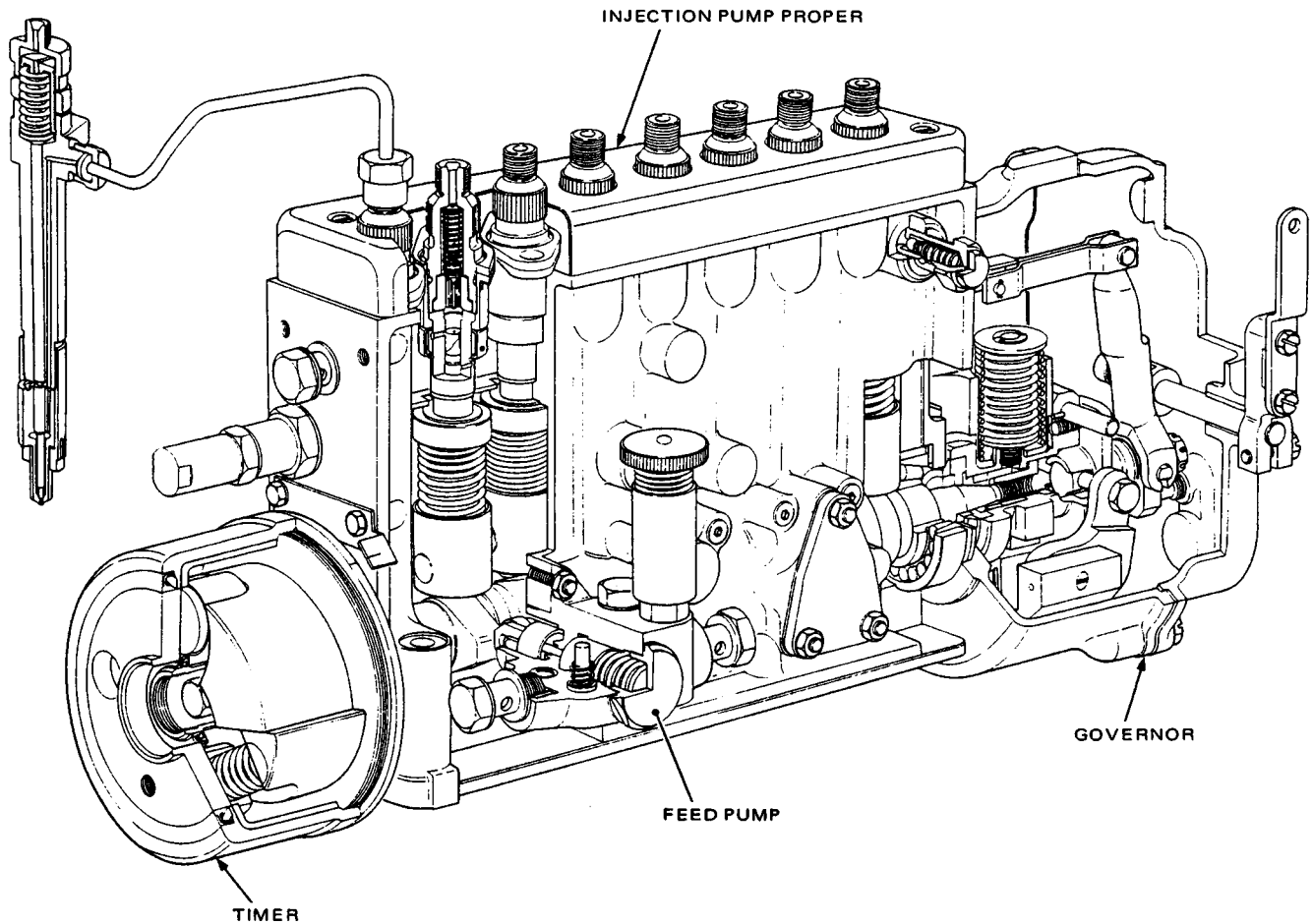
FUEL CIRCUIT



EEF2-001E

INJECTION PUMP ASSEMBLY

CONSTRUCTION

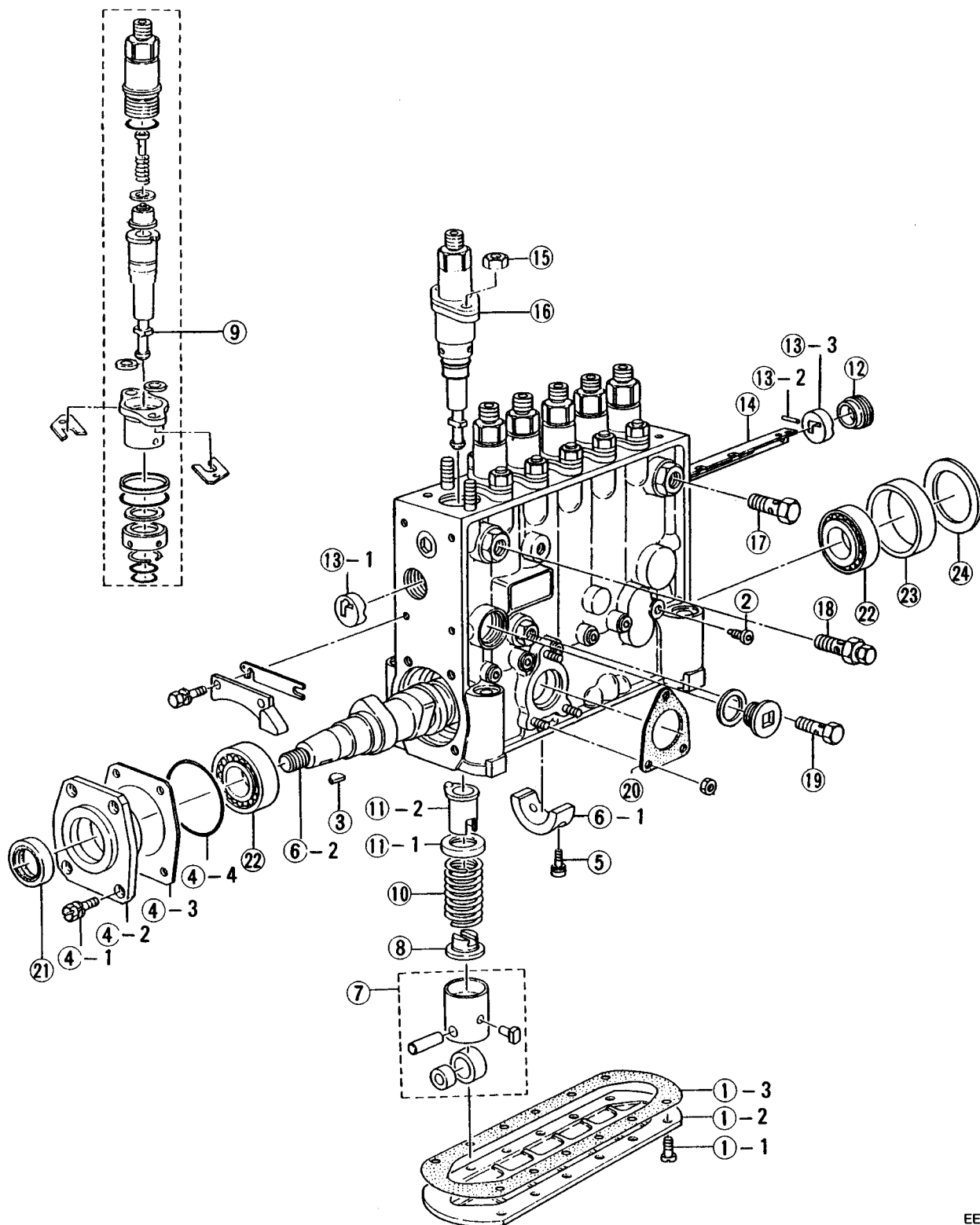


EEF1-272

Note:

- The above illustration shows a general composition of the injection pump assembly including the injection pump proper, feed pump, timer and governor. The shape and construction are not necessarily the same as those on the engine shown in this manual.

INJECTION PUMP PROPER CONSTRUCTION



EEF1-013F

Disassembly sequence (Reassembly sequence is in the reverse of disassembly.)

- | | | |
|------------------------|------------------------|-------------------|
| ① -1 Screw | ★☆☆⑥ -2 Camshaft | ⑭ Control rack |
| ① -2 Cover | ★☆☆⑦ Tappet | ⑮ Nut |
| ① -3 Gasket | ⑧ Spring seat | ⑯ Plunger block |
| ② Pin | ⑨ Plunger | ⑰ Eye bolt |
| ③ Key | ⑩ Spring | ⑱ Over flow valve |
| ④ -1 Bolt | ★☆☆⑪ -1 Spring seat | ⑲ Eye bolt |
| ④ -2 Cover | ★☆☆⑪ -2 Control sleeve | ⑳ Gasket |
| ④ -3 Shim | ★☆☆⑫ Bush | ㉑ Oil seal |
| ④ -4 O-ring | ⑬ -1 Bushing | ㉒ Bearing |
| ⑤ Bolt | ⑬ -2 Pin | ㉓ Ring |
| ★☆☆⑥ -1 Center bearing | ⑬ -3 Bushing | ㉔ Shim |

Marks “★” and “☆☆” indicate that the key points of operation are explained in the text.

Note:

This illustration is for the 6-cylinder engine. As for 8-(RF8, RG8) and 10-(RE10) cylinder engines, the fundamental construction of the injection pump proper is the same as that of the 6-cylinder engine.

DISASSEMBLY & REASSEMBLY

Key points of disassembly & reassembly

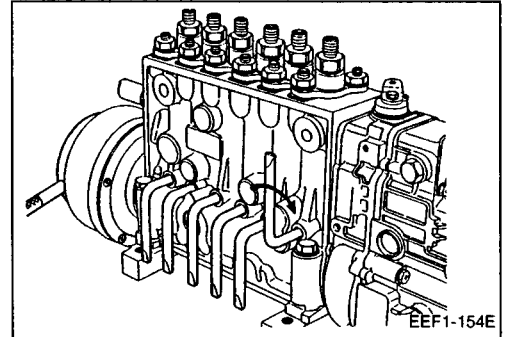
Note:

- Reassembly sequence is in the reverse of disassembly.

⑥ Center bearing and Camshaft

Operate the spanner to position the tappets in the top lead center position. Then, insert the tappet holders into each cylinder's plug hole to separate the tappets from the camshaft.

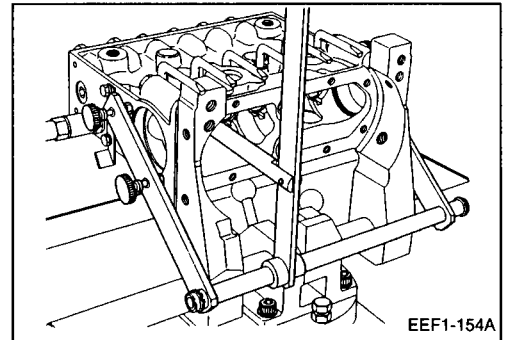
Part Name	Part Number	Remarks
Tappet holder	157931-4800	Cam lift: 10 mm; 11 mm; 12 mm



⑦ Tappet

- 1) Attach the tappet inserter to both end-faces of the pump housing.

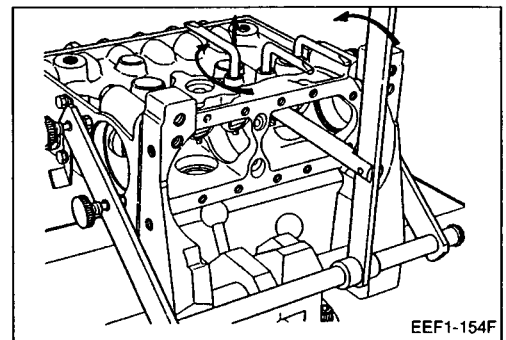
Part Name	Part Number	Remarks
Tappet insert Shaft	157921 89000	



- 2) Operate the tappet inserter lever to raise the tappet, and then remove the tappet holder.

Note:

- Return the lever slowly after removing the tappet holder, as the plunger spring force may cause the tappet assembly to spring out.

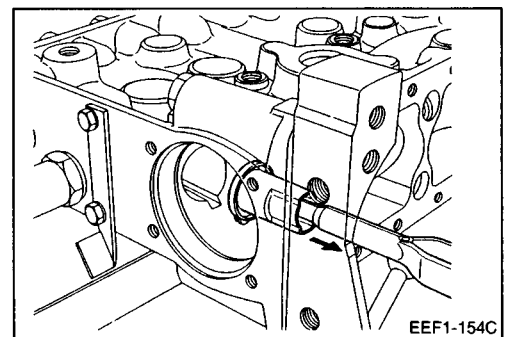


⑪ Spring seat and control sleeve

Using the plunger inserter (157921-5620), remove the control sleeve and the upper spring seat together.

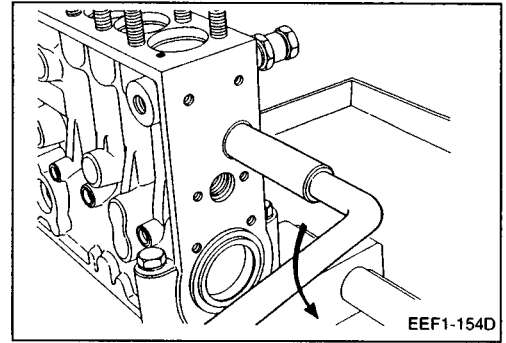
Note:

- If the ball attached to the sleeve and the pump housing's tappet guide groove are not aligned during control sleeve removal, the control sleeve and upper spring seat cannot be removed.

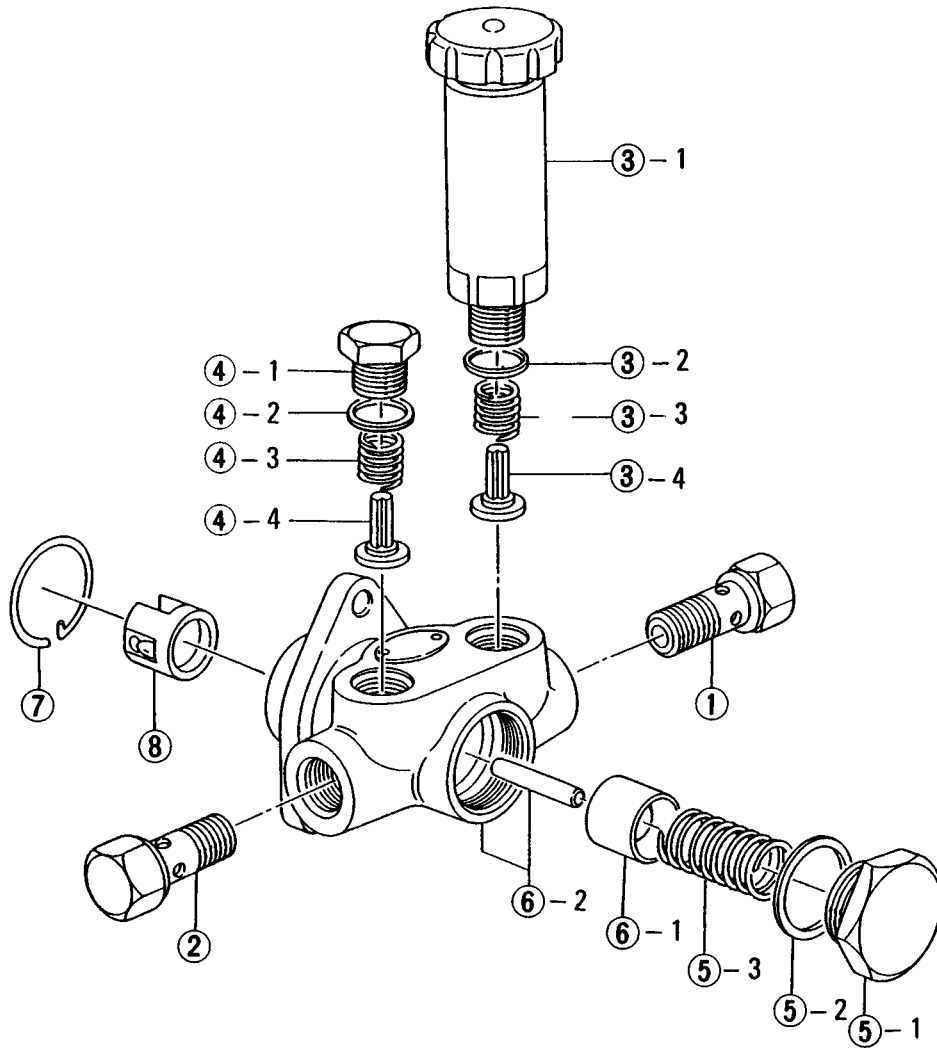


⑫ **Bushing**

Using the special wrench (157915-6500), remove the governor side screw bushing.



FEED PUMP CONSTRUCTION



EEF1-016F

Disassembly sequence (Reassembly sequence is in the reverse of disassembly.)

- | | |
|-------------------|-------------|
| ① Eye bolt | ④ -4 Valve |
| ② Eye bolt | ⑤ -1 Plug |
| ③ -1 Priming pump | ⑤ -2 Gasket |
| ③ -2 Gasket | ⑤ -3 Spring |
| ③ -3 Spring | ⑥ -1 Piston |
| ③ -4 Valve | ⑥ -2 Rod |
| ④ -1 Plug | ⑦ Snap ring |
| ④ -2 Gasket | ⑧ Tappet |
| ④ -3 Spring | |

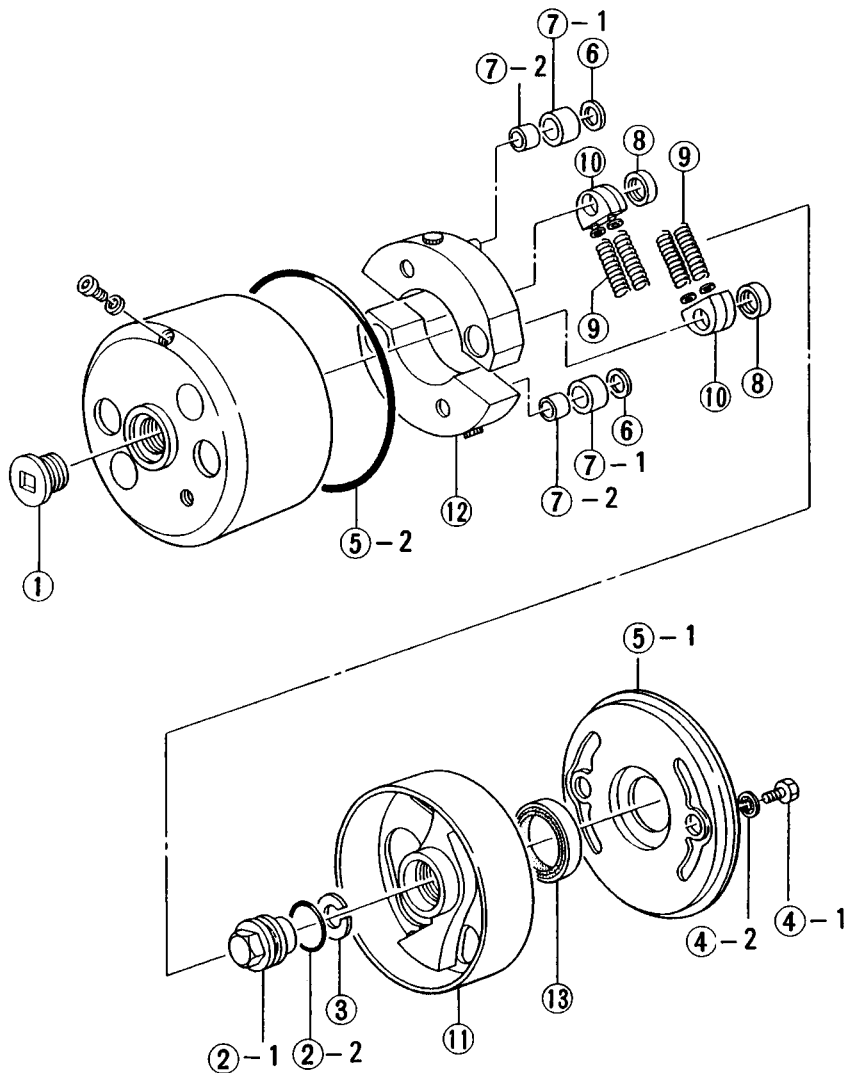
FUEL SYSTEM

TIMER

CONSTRUCTION

SP timer

SD-D timer



EEF1-018D

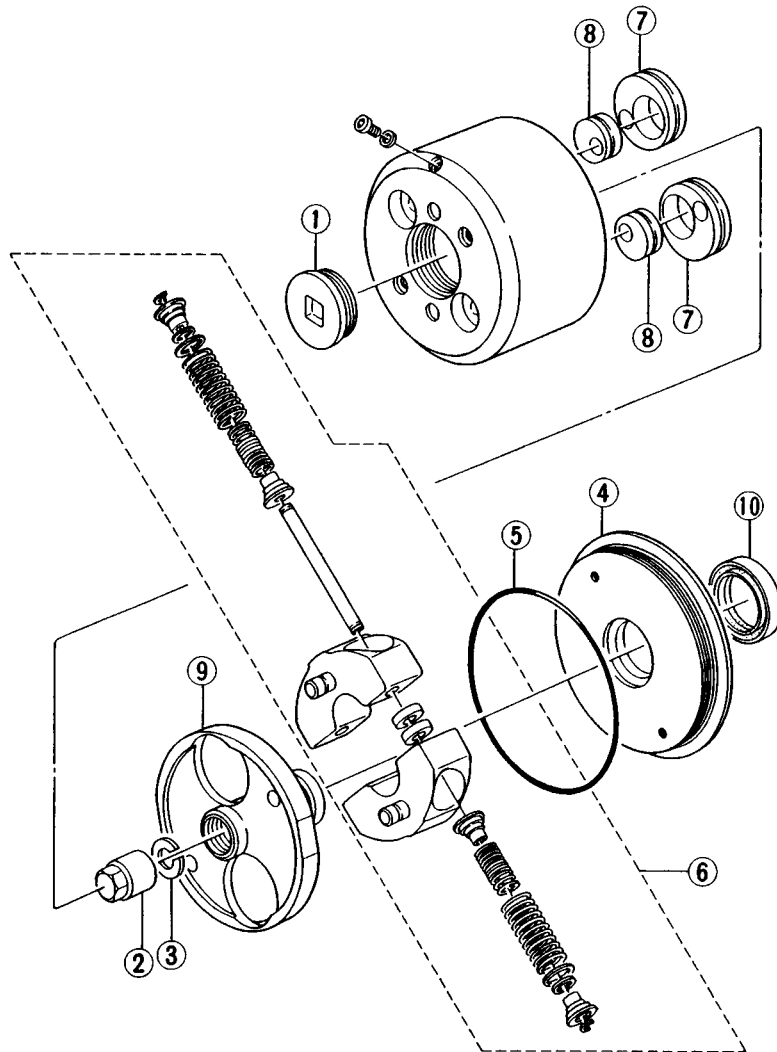
Disassembly sequence (Reassembly sequence is in the reverse of disassembly.)

- ① Cap
- ② -1 Nut
- ② -2 O-ring
- ③ Spring washer
- ④ -1 Bolt
- ④ -2 Gasket
- ⑤ -1 Cover
- ⑤ -2 O-ring
- ⑥ Washer

- ☆☆ ⑦ -1 Roller
- ☆☆ ⑦ -2 Bushing
- ⑧ Retainer
- ⑨ Spring
- ⑩ Spring seat
- ⑪ Flange
- ⑫ Flyweight
- ⑬ Oil seal

Marks “★” and “☆☆” indicate that the key points of operation are explained in the text.

SPG timer



EEF1-018E

Disassembly sequence (Reassembly sequence is in the reverse of disassembly.)

- ① Cap
- ② Nut
- ③ Spring washer
- ④ Cover
- ⑤ O-ring

- ★☆☆ ⑥ Flyweight ass'y
- ⑦ Eccentric cam
- ⑧ Eccentric cam
- ⑨ Flange
- ⑩ Oil seal

Marks “★” and “☆☆” indicate that the key points of operation are explained in the text.

FUEL SYSTEM

DISASSEMBLY & REASSEMBLY

Key points of disassembly & reassembly

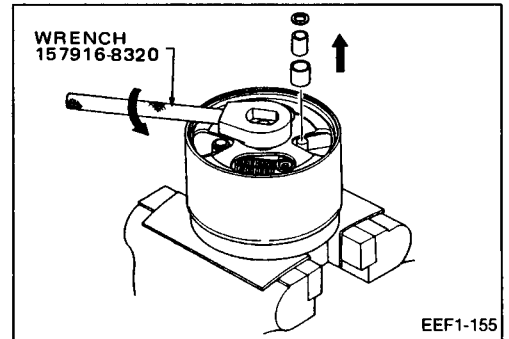
Note:

- Reassembly sequence is in the reverse of disassembly

< SP and SD-D timers >

⑦ Roller and bushing

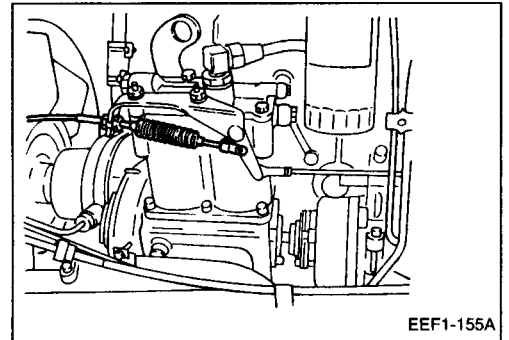
Turn the wrench to compress the timing device spring and remove the washer, roller and bushing from the flyweight pin.



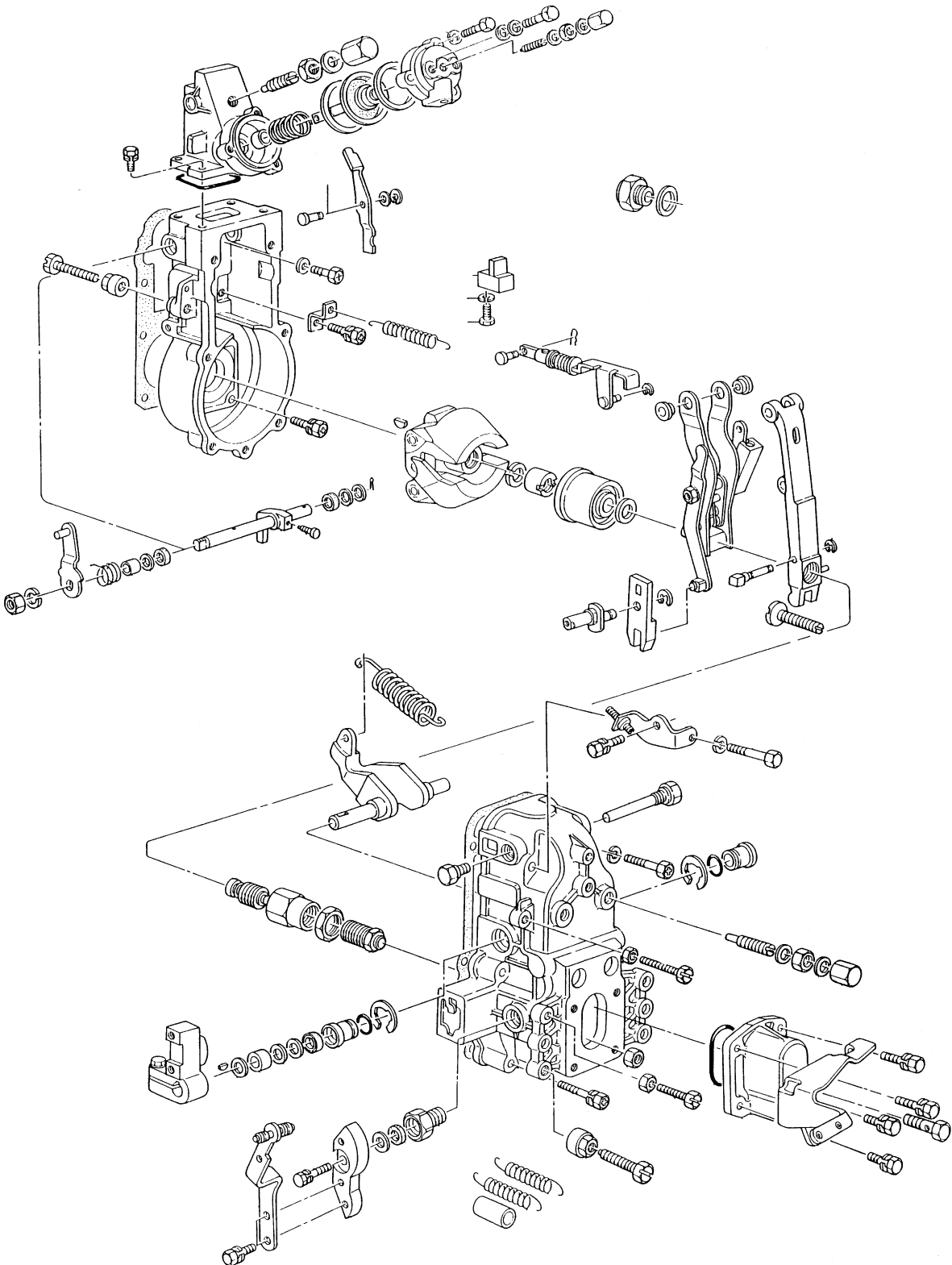
< SPG timer >

⑥ Flyweight ass'y

To remove the snap ring, compress the springs using the spring compressor (157921-9820).

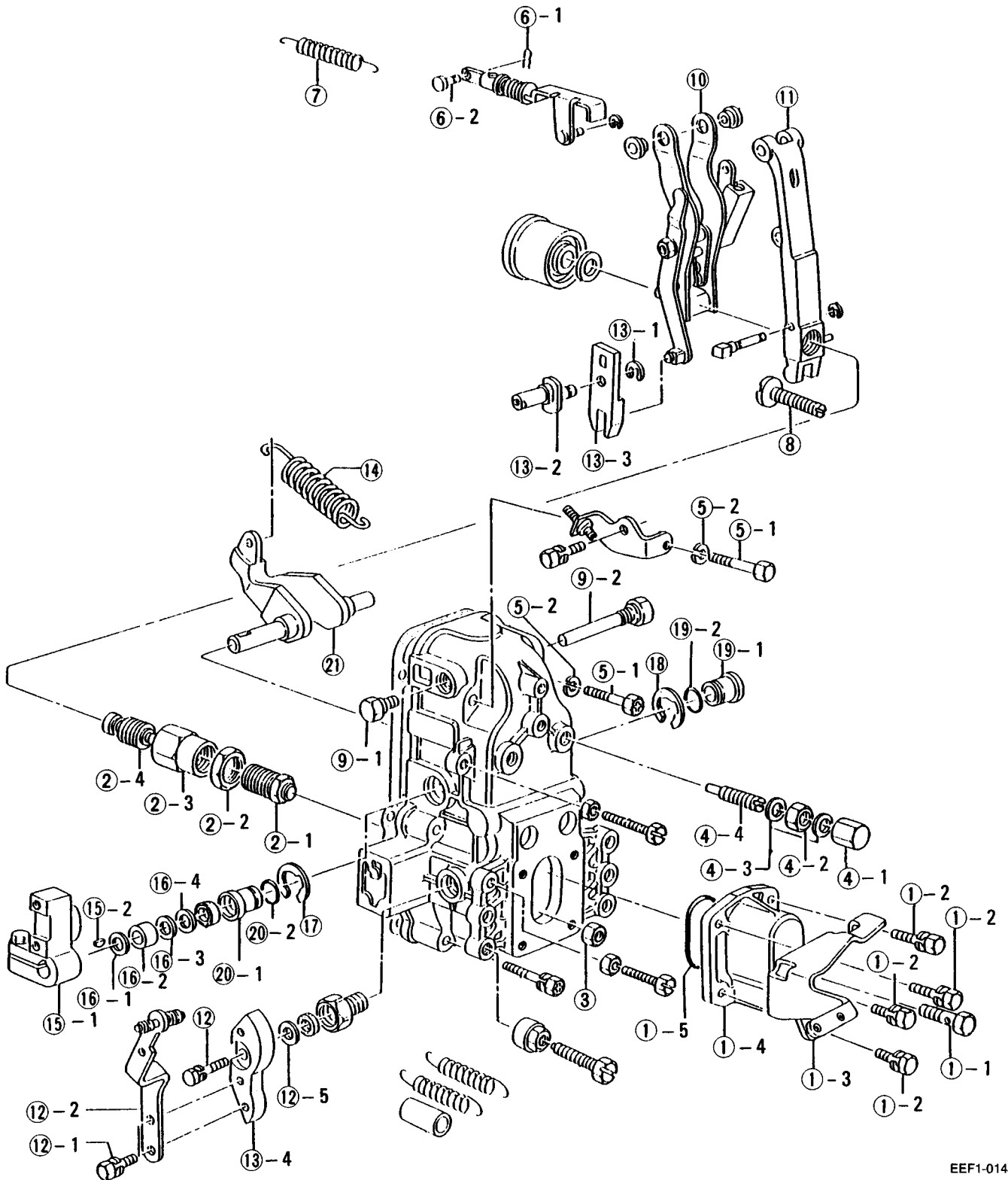


GOVERNOR
CONSTRUCTION
Whole view



EEF1-014R

Governor cover



EEF1-014S

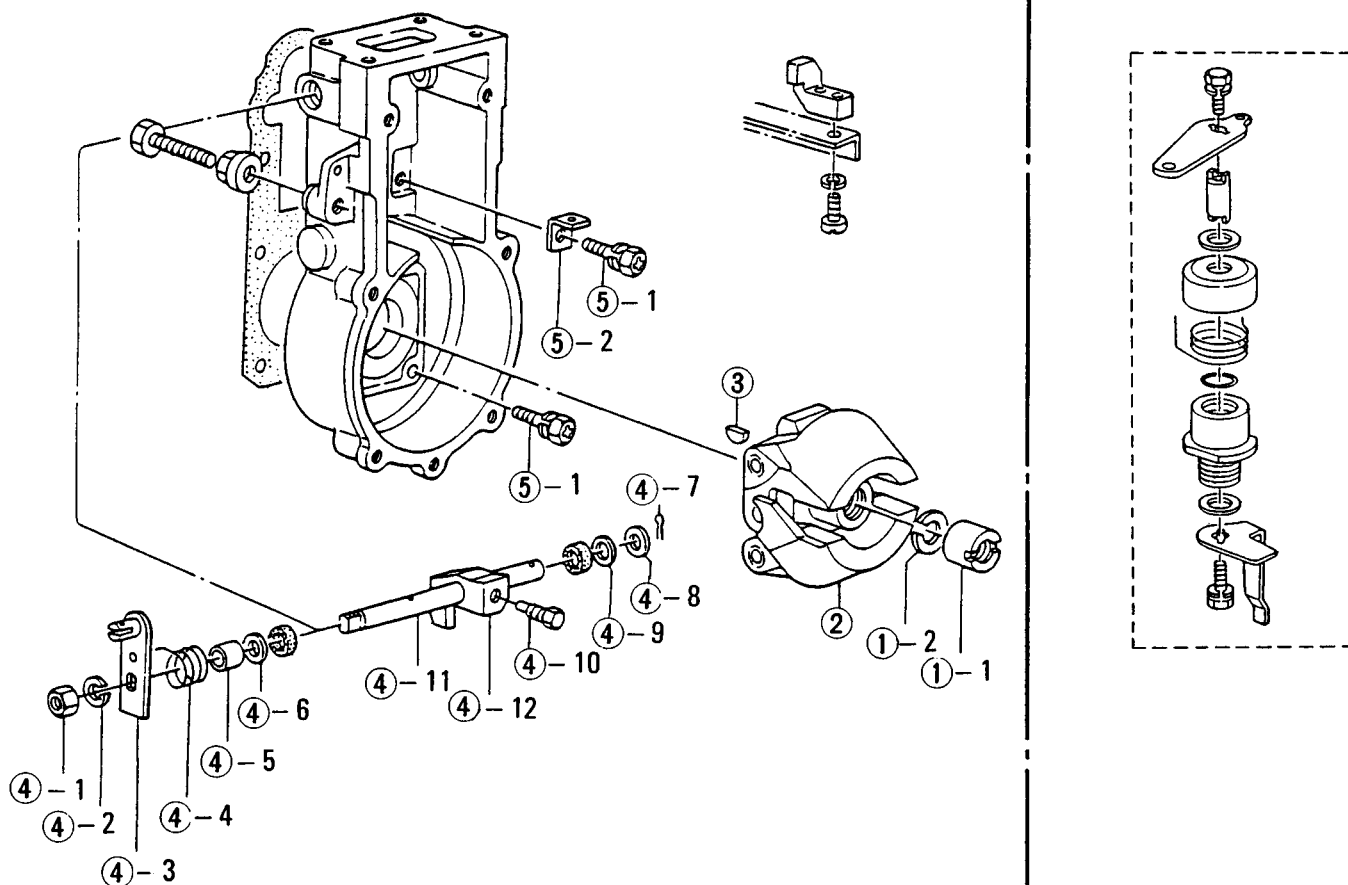
Disassembly sequence (Reassembly sequence is in the reverse of disassembly.)

- ①-1 Eye bolt
- ①-2 Bolt
- ①-3 Bracket
- ①-4 Cover
- ①-5 O-ring
- ②-1 Spring capsule
- ②-2 Nut
- ②-3 Nut
- ②-4 Spring capsule
- ③ Nut
- ④-1 Cap nut
- ④-2 Nut
- ④-3 Gasket
- ④-4 Spring capsule
- ⑤-1 Bolt
- ⑤-2 Spring washer

- ⑥-1 Snap ring
- ⑥-2 Pin
- ⑦ Spring
- ⑧ Screw
- ⑨-1 Plug
- ⑨-2 Pin
- ⑩ Guide lever ass'y
- ⑪ Tension lever
- ⑫-1 Bolt
- ⑫-2 Lever
- ⑫-3 Bolt
- ⑫-4 Lever
- ⑫-5 Shim
- ⑬-1 Snap ring
- ⑬-2 Shaft

- ⑬-3 Lever
- ⑭ Spring
- ⑮-1 Lever
- ⑮-2 Key
- ⑯-1 Washer
- ⑯-2 Collar
- ⑯-3 Shim
- ⑯-4 Shim
- ⑰ Snap ring
- ⑱ Snap ring
- ⑲-1 Bushing
- ⑲-2 O-ring
- ⑳-1 Bushing
- ⑳-2 O-ring
- ㉑ Swivel lever

Governor housing



EEF1-014T

Disassembly sequence (Reassembly sequence is in the reverse of disassembly.)

- | | |
|--------------------|----------------|
| ① -1 Nut | ④ -6 Washer |
| ① -2 Spring washer | ④ -7 Split pin |
| ② Flyweight ass'y | ④ -8 Washer |
| ③ Key | ④ -9 Shim |
| ④ -1 Nut | ④ -10 Bolt |
| ④ -2 Spring washer | ④ -11 Shaft |
| ④ -3 Lever | ④ -12 Lever |
| ④ -4 Spring | ⑤ -1 Bolt |
| ④ -5 Collar | ⑤ -2 Plate |

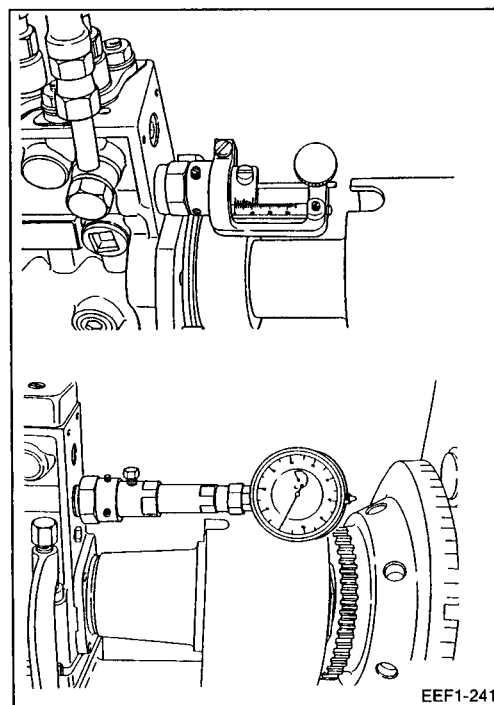
ADJUSTMENT

Setting the control rod's zero position

- 1) Remove the rack limiter (or rack cap) mounted on the pump's drive side and then mount the measuring device used for setting the control rod position.

Note:

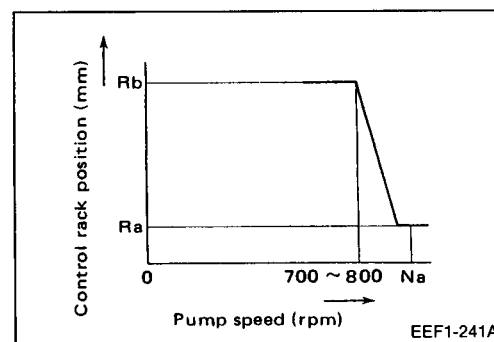
- If a boost compensator is installed on the pump's drive side, remove it and then mount the measuring device.



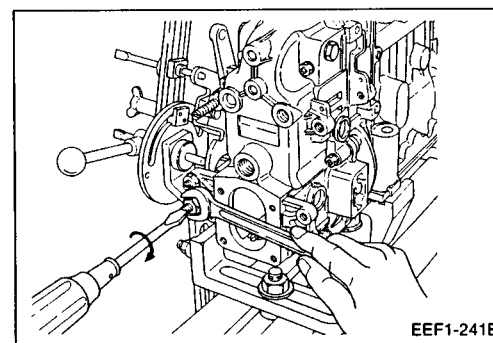
Flyweight lift and full load position

Total flyweight lift includes the lift necessary for high-speed control and the lift necessary for idling.

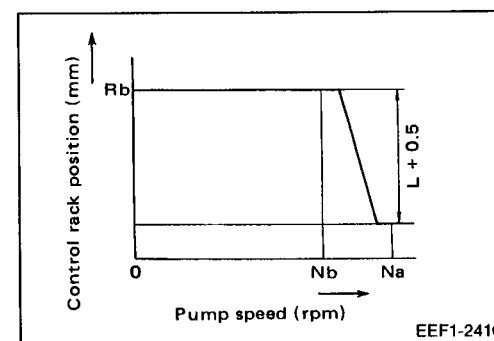
- 1) Temporarily fix the load control lever in the full load position (control rod position "Rb".)
- 2) Temporarily set the speed control lever so that governor control starts at a pump speed of approximately 700 rpm - 800 rpm.



- 3) Increase the pump speed to "Na rpm" and adjust using the full load stopper bolt so that the control rod position is "Ra".



- 4) Next, lower the pump speed to "Nb rpm" and adjust the high-speed lift to "L" using the stroke adjusting screw.

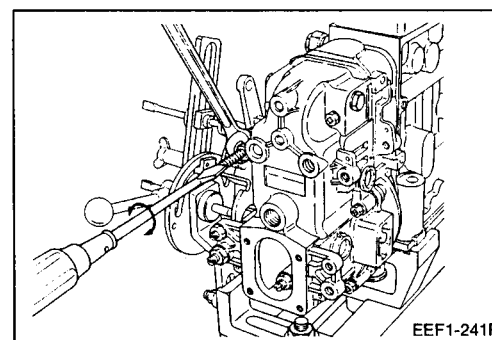
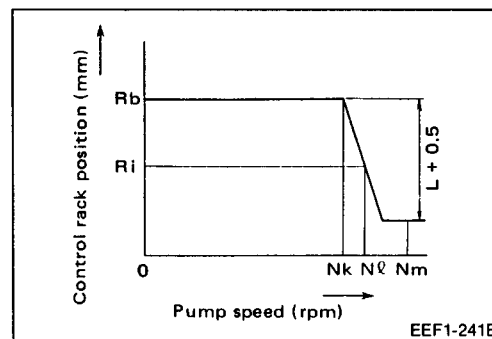
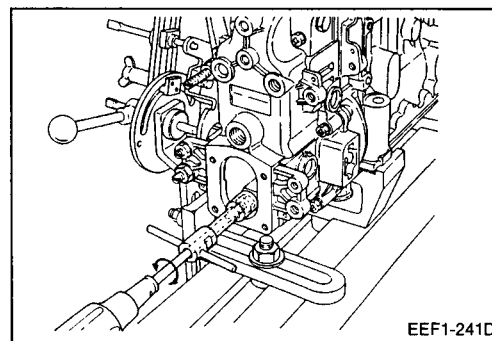


Maximum-speed control and speed droop

- 1) Set the load control lever to the full position. Temporarily fix the speed control lever in the maximum speed position.
- 2) Slowly increase the pump speed, adjust the minimum speed stopper bolt so that the control rod starts moving in the fuel-decrease direction at "Nk rpm" and then fix the lock nut.
- 3) Further increase the pump speed and check that the pump speed is "Nl rpm" or less when the control rod is at the "Ri" position.
Also increase the pump speed and confirm the flyweight lift (L) for high speed control.

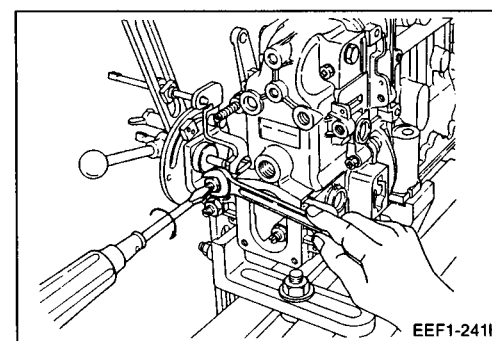
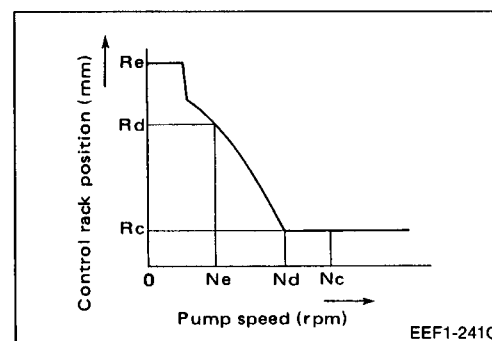
Note:

- When the high-speed droop confirmation point is at the point where the damper spring is operating, adjust the idling and damper springs and then make the above adjustments and confirmations.
 - Replace the governor spring if the specified values cannot be obtained.
- 4) Further increase the pump speed and confirm that the control rod is in the non-injection zone (or 3cc/1000st or less) at "Nm rpm".

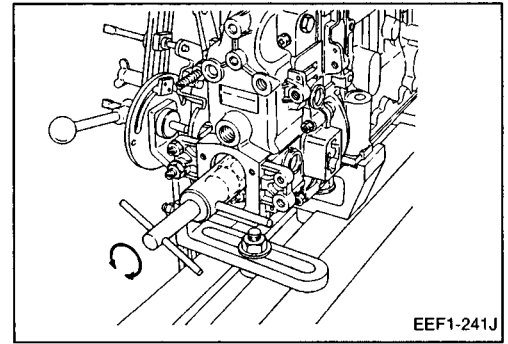


Idling

- 1) Drive the pump at "Nc rpm" (Nd + 100 rpm).
- 2) Adjust the control rod position to "Rc" using the idle adjusting screw.

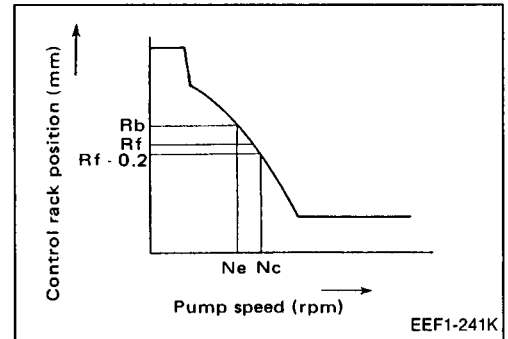


- 3) Decrease the pump speed to "Ne rpm" and adjust the idling spring capsule using the wrench (157916-2620) so that the control rod position is "Rd".
- 4) Confirm that the control rod position is "Re" or more when the pump speed is 0 rpm and that the control rod position is "Rc" when the pump speed is increased to "Nd rpm".

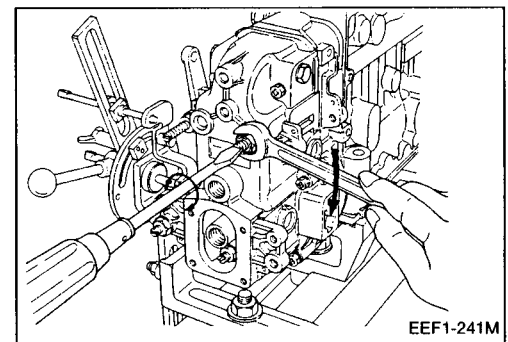
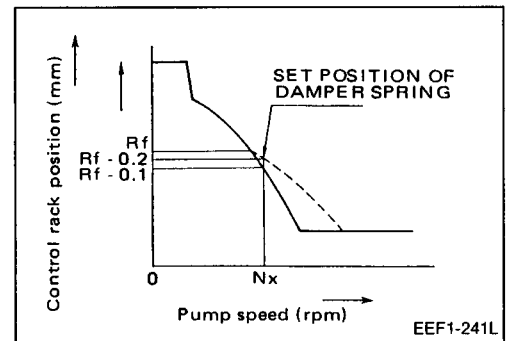


Damper spring

- 1) Hold the load control lever at the idling position.
- 2) Slowly increase the pump speed from idling speed "Ne rpm", and maintain the pump speed of "Nc rpm" where the control rod position is "Rf-0.2mm".

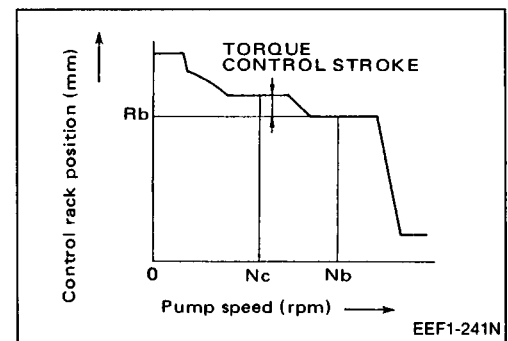


- 3) Screw in the damper spring so that the rod position is "Rf"-0.1mm and fix it with the lock nut.



Positive torque control (When installed)

- 1) Drive the pump at "Nc rpm" and hold the load control lever in the full load position.
- 2) Next, adjust the torque control spring capsule using the wrench (157916-2620) so that the torque control stroke is the specified value. After adjustment, fix it securely with a lock nut.



- 3) Slowly increase the pump speed from "Nc rpm" and adjust the screw so that the torque control spring starts to take effect at "Nf rpm".

Note:

- When shims are used, adjust by varying the shim thickness.

- 4) Increase the pump speed and confirm that the torque control spring stops taking effect at "Nh rpm".
- 5) Increase and decrease the pump speed between "Nc rpm" and "Nb rpm" and confirm that the torque control stroke is the specified value.

Note:

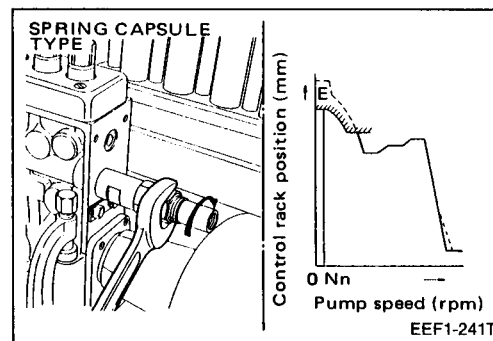
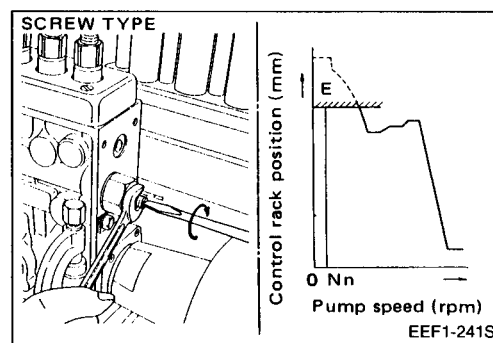
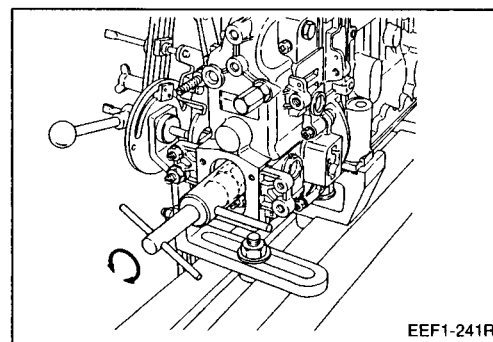
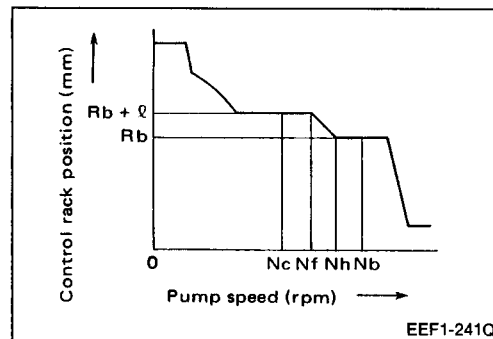
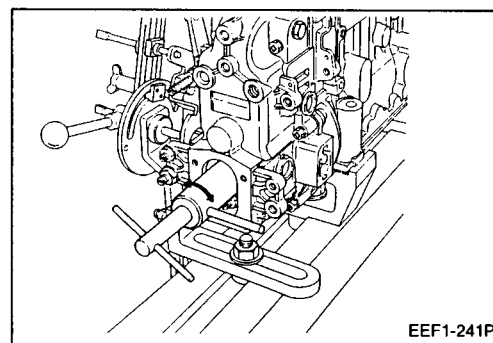
- If the torque control stroke is not the specified value, readjust using the spring capsule screw.
- If the torque control spring does not stop taking effect at the specified speed, replace the spring capsule.

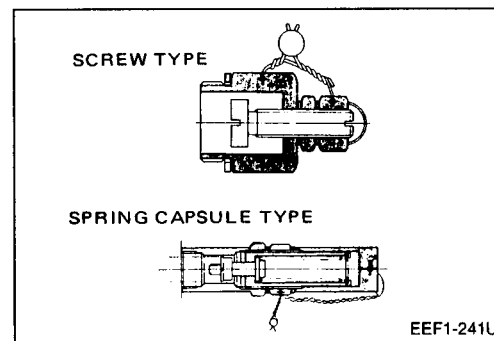
Smoke limiter

- 1) Hold the load control lever in the full load position.
- 2) Maintain the pump speed at "Nn rpm".
- 3) Screw in the spring capsule or screw and lock it at point E, where the specified fuel injection quantity may be obtained.

Note:

- There is no rack limiter when a boost compensator is mounted on the drive side.





INJECTION PUMP CALIBRATION DATA
ENGINE MODEL RF8

- PUMP NO. 16713 97800 (For Taiwan)
- PUMP NO. 16713 97767

The above data is given on the page that follow.
The data below will be issued later separately.

ENGINE MODEL RG8

- PUMP NO. 16713 97818

ENGINE MODEL RE10

- PUMP NO. 16713 97173

INJECTION PUMP CALIBRATION DATA

ENGINE MODEL RF8 PUMP NO. 16713 97800

Injection pump: PE8P
106087-7750

Governor: EP/RFD-C
105487-6130

Timing device: EP/SPG
105681-0930

1. Test Conditions:

Pump rotation: clockwise (viewed from drive side)
 Nozzle & Nozzle Holder Ass'y: 105780-8140 (BOSCH Type No. EF8511/9A)
 Nozzle: 105780-0000 Nozzle Holder: 105780-2080
 (BOSCH Type No. DN12 SD12T) (BOSCH Type No. EF8511/9)
 Nozzle opening pressure: 175 kg/cm² Transfer pump pressure: 1.6 kg/cm²
 Injection pipe: Inner Dia. 3 mm × Outer Dia. 8 mm – Length 600 mm
 Test Oil: ISO4113 or SAE Standard Test Oil (SAE J967d) Oil Temp.: 40⁺⁵°C
 Overflow valve opening pressure: 1.6 kg/cm²

2. Injection Timing:

Pre-stroke: No. 1 Plunger 3.65±0.05 mm Note: Adjust with control rack position of mm

Injection order: 1_{45°±30'}8, 1_{90°±30'}7, 1_{135°±30'}5, 1_{180°±30'}4, 1_{225°±30'}3, 1_{270°±30'}6, 1_{315°±30'}2,

(interval: °±30')

Plungers are numbered from the Governor side.

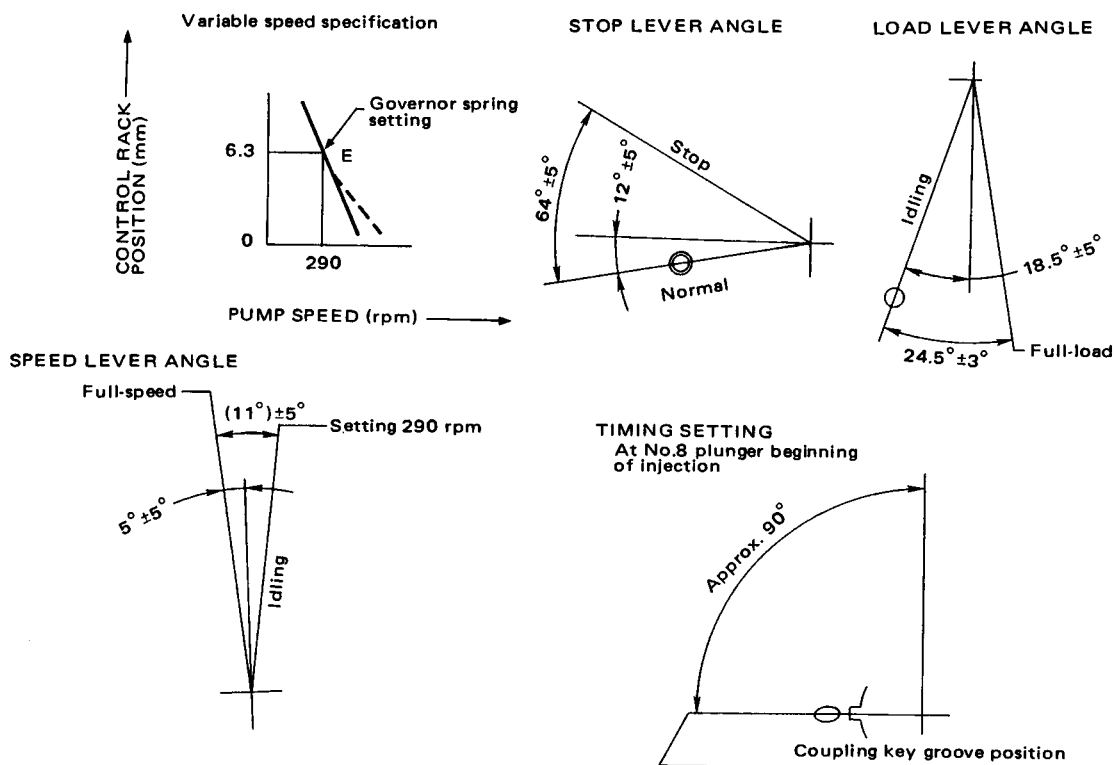
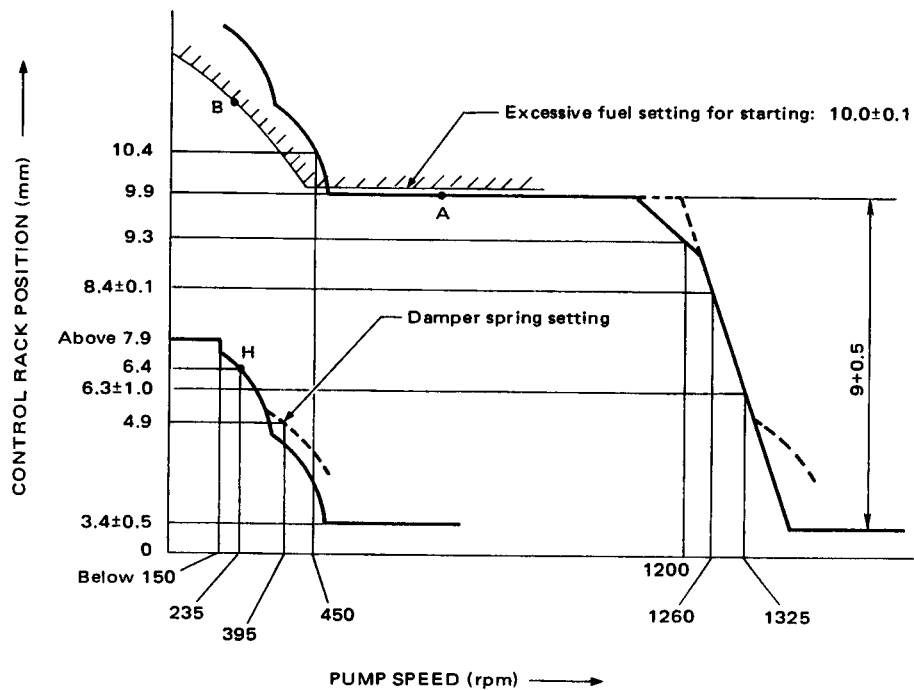
4. Injection Quantity:

Adjusting Point	Rack Position (mm)	Pump Speed (rpm)	Injection Q'ty (cc/1000 strokes)	Max. var bet. cyl (%)	Fixed	Remarks
A	9.9	700	123.3 - 125.3	±4	Rack	Basic
H	Approx. 6.4	235	8.4 - 12.4	±10	Rack	
A	9.9	700	123.3 - 125.3	—	Lever	Basic
B	—	100	Above 155.0	—	Lever	After setting excessive fuel for starting

5. Timing Advance Specification:

Pump speed (rpm)	Below [N ₁ + 50]	(Measure) N ₁	(Measure)
Advance Angle (deg.)	Start	Below 0.5	Finish 3.0 - 4.0

3. Governor Adjustment



EEF1-273

ENGINE MODEL RF8 PUMP NO. 16713 97767

Injection pump: PE8P
106087-7900

Governor: EP/RFD-C
105487-5130

Timing device: EP/SPG
105681-0930

1. Test Conditions:

Pump rotation: clockwise (viewed from drive side)
 Nozzle & Nozzle Holder Ass'y: 105780-8140 (BOSCH Type No. EF8511/9A)
 Nozzle: 105780-0000 Nozzle Holder: 105780-2080
 (BOSCH Type No. DN12 SD12T) (BOSCH Type No. EF8511/9)
 Nozzle opening pressure: 175 kg/cm² Transfer pump pressure: 1.6 kg/cm²
 Injection pipe: Inner Dia. 3 mm × Outer Dia. 8 mm – Length 600 mm
 Test Oil: ISO4113 or SAE Standard Test Oil (SAE J967d) Oil Temp.: 40⁺⁵°C
 Overflow valve opening pressure: 1.6 kg/cm²

2. Injection Timing:

Pre-stroke: No. 1 Plunger 3.65±0.05 mm Note: Adjust with control rack position of mm

Injection order: 1_{45°±30'}8, 1_{90°±30'}7, 1_{135°±30'}5, 1_{180°±30'}4, 1_{225°±30'}3, 1_{270°±30'}6, 1_{315°±30'}2,

(interval: °±30')

Plungers are numbered from the Governor side.

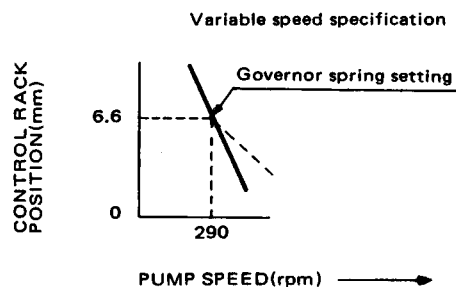
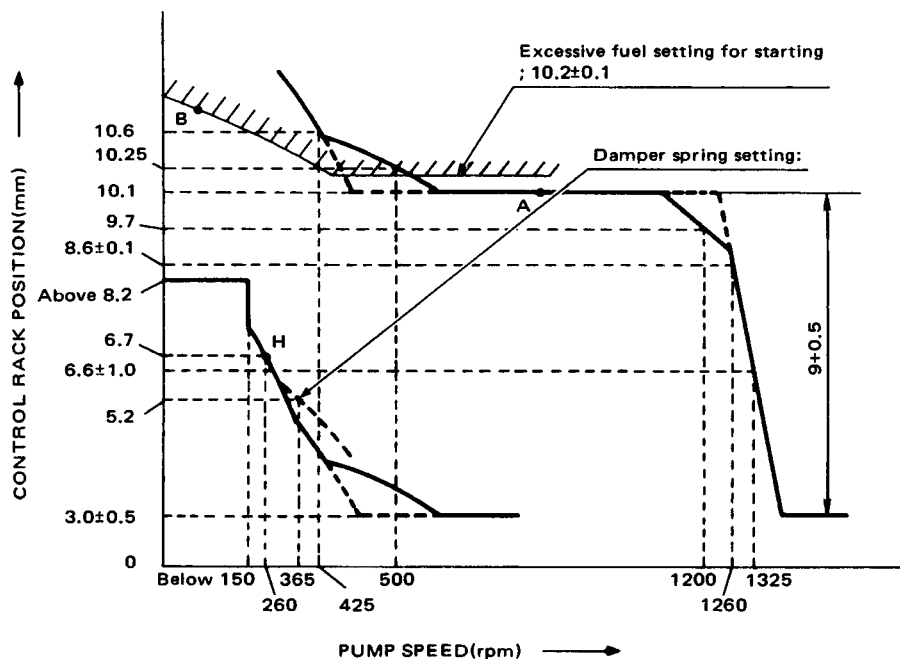
4. Injection Quantity:

Adjusting Point	Rack Position (mm)	Pump Speed (rpm)	Injection Q'ty (cc/1000 strokes)	Max. var bet. cyl (%)	Fixed	Remarks
A	10.1	700	126.7 - 128.7	±4	Rack	Basic
H	Approx. 6.7	260	9.1 - 13.1	±10	Rack	
A	10.1	700	126.7 - 128.7	—	Lever	Basic
B	—	100	Above 187.0	—	Lever	After setting excessive fuel for starting

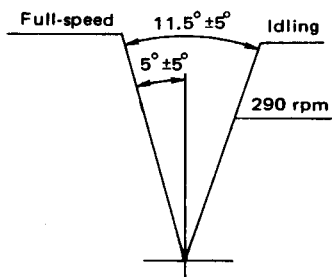
5. Timing Advance Specification:

Pump speed (rpm)	Below 500	450	1,100
Advance Angle (deg.)	Start	Below 0.5	Finish 3.0 - 4.0

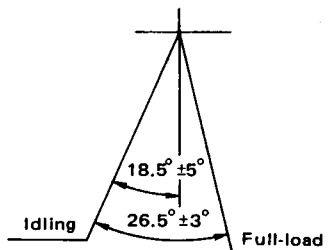
3. Governor Adjustment



LEVER ANGLE
SPEED CONTROL
LEVER ANGLE

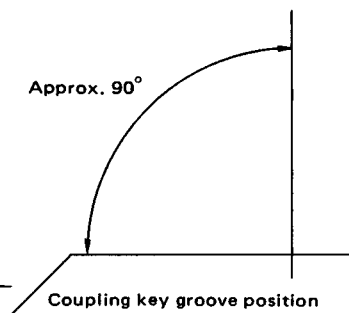


LOAD-CONTROL
LEVER ANGLE



TIMING SETTING

At No. 8 plunger beginning of injection



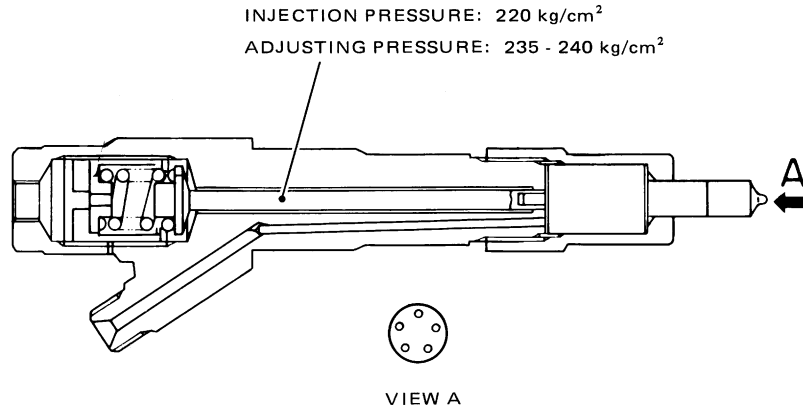
EEF1-112Z

NOZZLE AND NOZZLE HOLDER

CONSTRUCTION

TYPE I (CONVENTIONAL TYPE: RF8 ENGINE)

Construction illustration



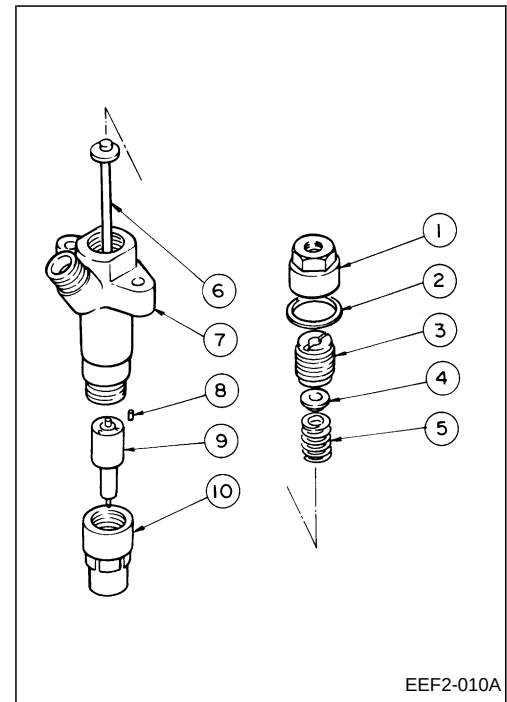
EEF2-009C

Exploded illustration

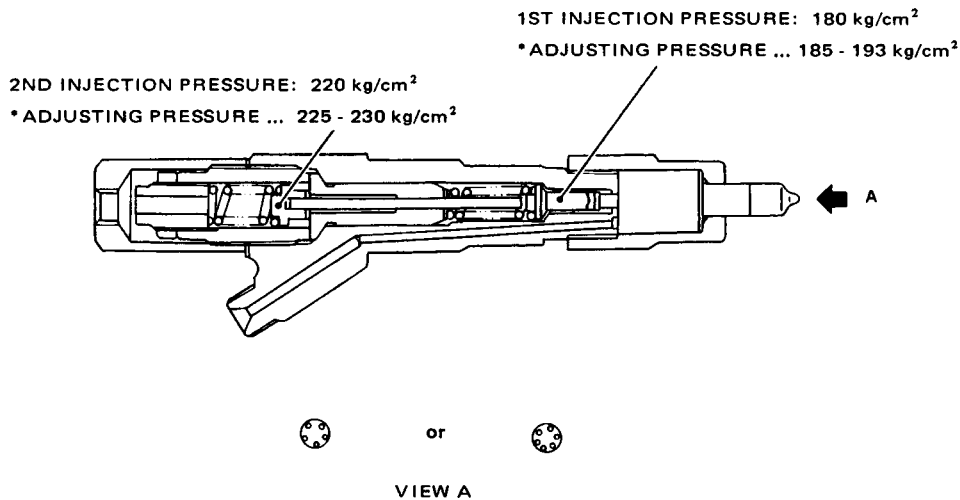
- ① Cap nut
- ② Gasket
- ③ Adjusting screw
- ④ Spring seat
- ⑤ Nozzle spring
- ⑥ Push rod
- ⑦ Nozzle holder
- ⑧ Pin
- ⑨ Nozzle
- ⑩ Retaining nut

Note:

- Numbers before part names do not indicate the disassembly sequence.



TYPE II (TWO-SPRING TYPE: RF8 AND RE10 ENGINES) Construction illustration



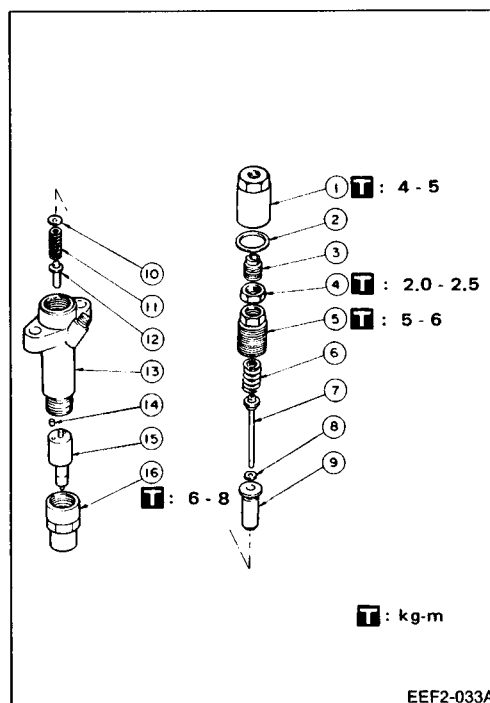
EEF2-009B

Exploded illustration

- ① Cap nut
- ② Gasket
- ③ Adjusting screw
- ④ Nut
- ⑤ Set screw
- ⑥ No. 2 spring
- ⑦ No. 2 push rod
- ⑧ Shim (for pre-lift adjustment)
- ⑨ Spacer
- ⑩ Shim (for valve opening pressure adjustment)
- ⑪ No. 1 spring
- ⑫ No. 2 push rod
- ⑬ Nozzle holder
- ⑭ Pin
- ⑮ Nozzle
- ⑯ Retaining nut

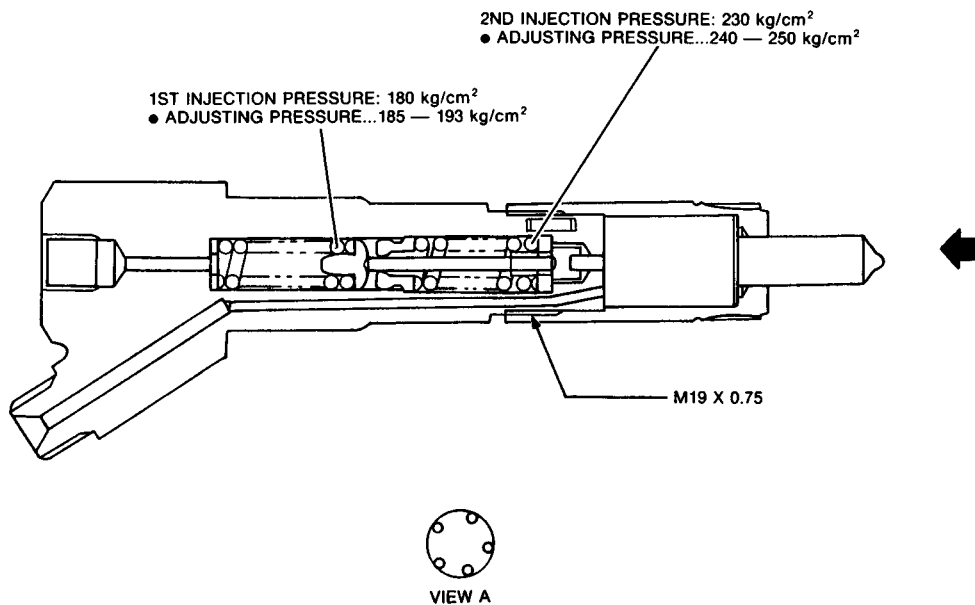
Note:

- Numbers before part names do not indicate the disassembly sequence.



TYPE III (TWO-SPRING TYPE: RG8 ENGINE)

Construction illustration



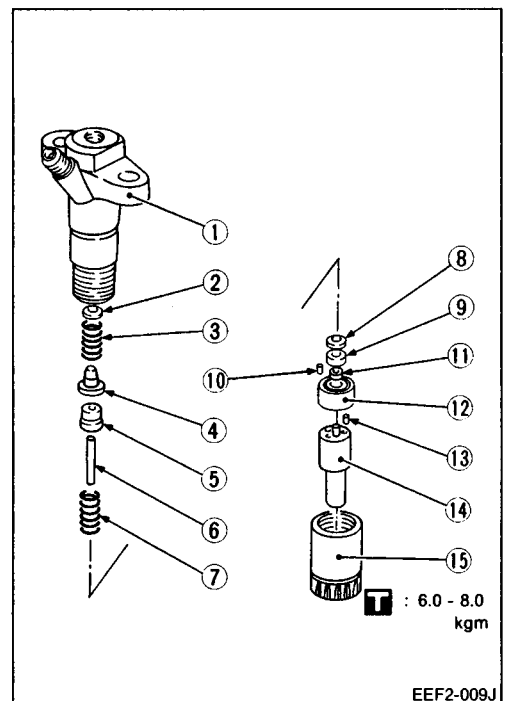
EEF2-009H

Exploded illustration

- ① Nozzle holder
- ② No. 1 shim (for valve opening pressure adjustment)
- ③ No. 1 spring
- ④ No. 1 spring seat
- ⑤ Collar
- ⑥ Push rod
- ⑦ No. 2 spring
- ⑧ No. 2 shim (for valve opening pressure adjustment)
- ⑨ No. 2 spring seat
- ⑩ Pin
- ⑪ Lift piece
- ⑫ Spacer
- ⑬ Pin
- ⑭ Retaining nut
- ⑮ Nozzle

Note:

- Numbers before part names do not indicate the disassembly sequence.



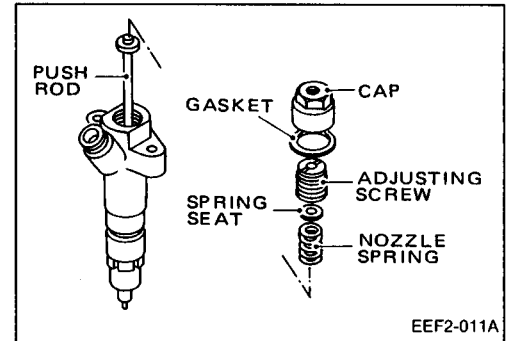
REMOVAL

- 1) Chock the wheels, then tilt the cab.
- 2) Turn the key switch off and disconnect the cable from the negative terminal of the battery.
- 3) Remove the injection nozzle tube and spill tube.

DISASSEMBLY

TYPE I (CONVENTIONAL TYPE: RF8 ENGINE)

- 1) With the injection orifice downward, clamp the nozzle holder in a vise. Remove the cap nut.
- 2) Remove the adjusting screw and separate the upper spring seat, nozzle spring, and push rod.
- 3) Reverse the nozzle holder and clamp it in the vise. Remove the nozzle nut.
- 4) Remove the nozzle from the nozzle holder. Do not drop the nozzle needle.



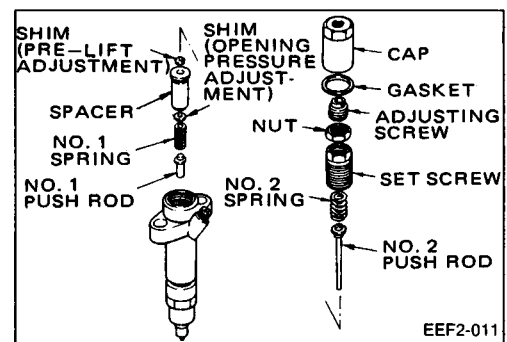
TYPE II (TWO-SPRING TYPE: RF8 AND RE10 ENGINES)

- 1) With the injection orifice downward, clamp the nozzle holder in a vise.
- 2) Remove the cap nut and gasket.

- 3) Loosen the nut and remove the adjusting nut. Then separate the No. 2 spring, No. 2 push rod and the pre-lift adjustment shim.
- 4) Remove the set screw, then separate the spacer, injection valve opening pressure adjustment shim, No.1 spring and No.1 push rod.
- 5) With the injection orifice upward, clamp the nozzle holder in a vise. Then loosen the retaining nut and separate the nozzle assembly and pin.
- 6) Remove the nozzle needle from the nozzle body.

Note:

- Do not use the nozzle needle in another nozzle body.

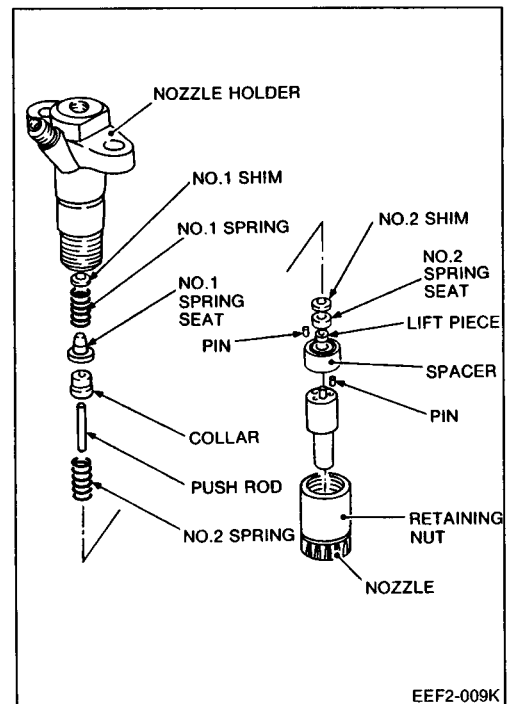


TYPE III (TWO-SPRING TYPE: RG8 ENGINE)

- 1) With the injection orifice downward, clamp the nozzle holder in a vise.
- 2) Loosen the retaining nut and remove the nozzle assembly and pin.
- 3) Remove the spacer, lift piece, pin, No. 2 spring seat, No. 2 spring shim, No. 2 spring, push rod, collar, No. 1 spring seat, No. 1 spring and No. 1 spring shim.
- 4) Remove the nozzle needle from the nozzle body.

Note:

- Do not use the nozzle needle in another nozzle body.



INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect the parts for cracks and other damage carefully. If faulty, replace with a new one.

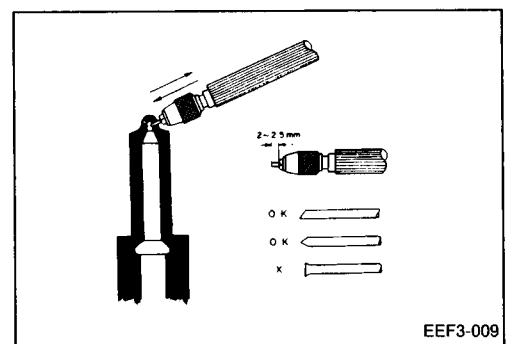
Note:

- Remove carbon around the injection orifices using a wire brush, etc.

- 1) Remove carbon in the injection orifices using a pin vise (99727 Z5004).

[mm]

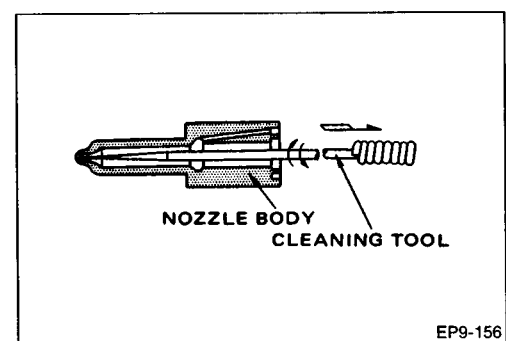
Nozzle hole dia.	Wire dia.
0.32	0.29



- 2) Remove carbon at the inside end of the injection orifices with a nozzle cleaner (99726 Z5000).

Note:

- Exercise care to avoid damaging the sheet surface which the nozzle needle contacts. The use of compressed air may clog the orifices with foreign particles. Always use the nozzle cleaner, instead.
- 3) Visually inspect the nozzle needle valve seat and injection axis for damage, and inspect the nozzle body valve seat for damage and carbon.
 - 4) Reattach the needle to the nozzle body in clean light oil.



- 5) Holding the nozzle body vertically, confirm that the nozzle needle will fall to the valve seat due to its own weight when it is dropped from a position of about 1/3 removed.

REASSEMBLY

Reassembly is the reverse of disassembly. Exercise special care regarding the following points.

Note:

- **Fit the nozzle into the nozzle holder after cleaning the contacting surfaces and retaining nut with clean light oil.**
- **Replace gaskets with new ones every time the nozzle and nozzle holder are assembled.**

TYPE I (CONVENTIONAL TYPE: RF8 ENGINE)

Reassembly is the reverse of disassembly. When tightening the nozzle nut, keep it centered and tighten.

T : 6 - 8 kgm

TYPE II (TWO-SPRING TYPE: RF8 AND RE10 ENGINES)

For reassembly, refer to "Adjustment".

[kgm]

Item	Tightening torque
Cap nut	4 - 5
Retaining nut	6 - 8
Adjusting screw lock nut	2 - 2.5
Set screw	5 - 6

TYPE III (TWO-SPRING TYPE: RG8 ENGINE)

For reassembly, refer to "Adjustment".

[kgm]

Item	Tightening torque
Retaining nut	6 - 8

ADJUSTMENT

TYPE I (CONVENTIONAL TYPE: RF8)

Clean the nozzle and tester carefully. Make sure that the light oil to be used in the tester contains no dirt.

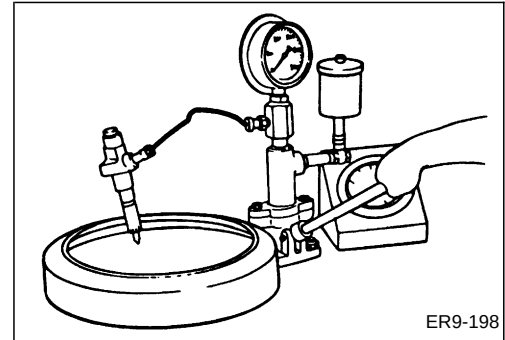
- 1) With the nozzle holder adjusting screw loosened, attach the nozzle to the tester. Eject fuel two or three times to force out any dirt.
- 2) Operate the lever of the tester at sixty strokes per minute and read the gauge during fuel ejection.

- 3) Either tighten the adjusting screw or adjust by loosening it so that the injection pressure becomes the specified pressure. Make this adjustment using a screw driver in accordance with the gauge reading.

Maintenance standard

220 kg/cm²

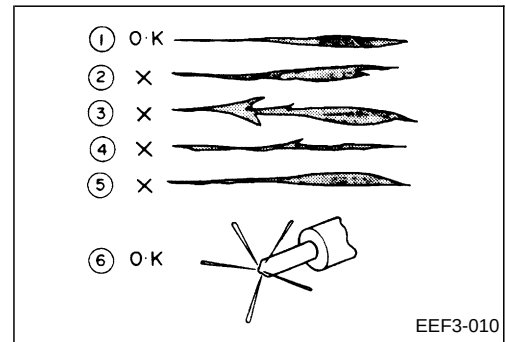
- 4) After completing this adjustment, tighten the cap nut to a torque of 4 to 5 kgm and recheck the initial injection pressure.
The pointer of the pressure gauge will fluctuate during fuel ejection. Consider the center of the swing as the correct reading.



Checking spray and fuel leakage

During adjustment of the initial injection pressure with the nozzle tester, note the state of the spray and look for fuel leakage. If a problem develops, the nozzle needle and nozzle body seat are worn or scored. If the extent is slight, repair can be effected by lapping with compound. Otherwise, the nozzle body and needle must be replaced as a set.

- ① Uniform and symmetrical
- ② Not symmetrical
- ③ Branching
- ④ Thin stream
- ⑤ Stepped injection
- ⑥ Must be evenly injected from five orifices



TYPE II (TWO-SPRING TYPE: RF8 AND RE10)

[COMPLETE DISASSEMBLY METHOD]

Adjusting the nozzle injection valve opening pressure adjustment

- 1) Install the nozzle assembly using a retaining nut (157892-1420) on the nozzle holder.

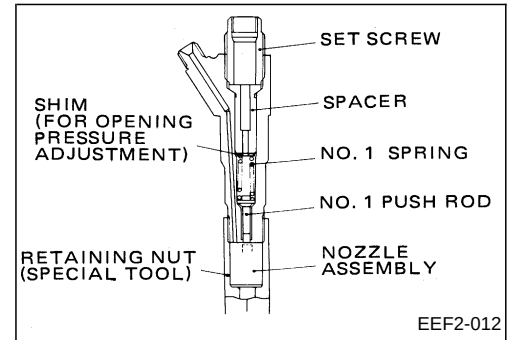
Ⓜ : 6 - 8 kgm

Note:

- Be sure to tighten the nut only after confirming that the knock pin is completely within the nozzle.
- 2) Remove the screw at the end of the retaining nut (157892-1420).

- 3) Assemble the No. 1 push rod, No. 1 spring, injection valve opening pressure adjustment shim and spacer on the nozzle holder, and fasten them with the set screw.

T : 5 - 6 kgm



- 4) Measure the injection valve opening pressure using a nozzle tester (with a 500 kg/cm² gauge).

	[kg/cm ²]
	Maintenance standard
Valve opening pressure	185 - 193

- 5) If the injection valve opening pressure is outside the specified range, adjust it to the specified injection valve opening pressure by changing the thickness of the injection valve opening pressure adjustment shim.

Note:

- When using a shim, always measure the thickness of the shim with a micrometer before assembling.

	[mm]
Pre-lift (valve opening pressure) adjusting shim thickness	
	0.50, 0.52, 0.54, 0.56, 0.58, 0.60, 0.70, 0.80, 0.90, 1.00, 0.10, 0.20, 0.30, 0.40

Note:

- Be sure to use one shim at most when adjusting the injection valve opening pressure.

Adjusting the pre-lift

- 1) Attach the dial gauge (157954-3800) to the adjusting device (157892-0220).

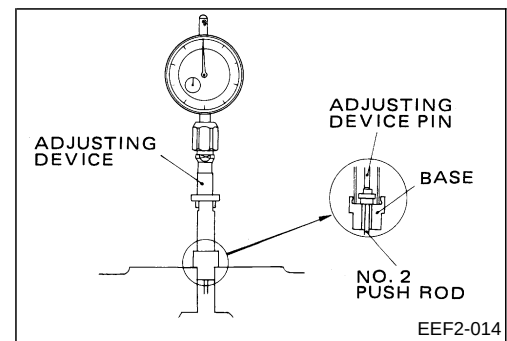
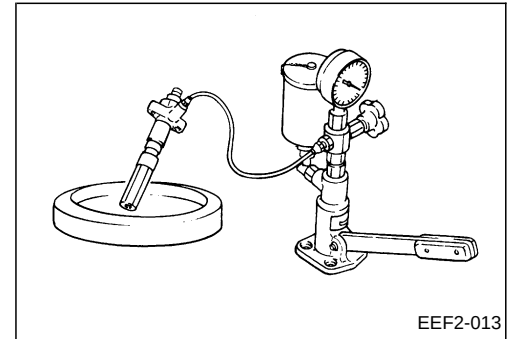
Note:

- Be sure to use a pin with a length of 60.5 mm.

- 2) Clamp the base (157892-1800) in a vise, and with the No. 2 push rod assembled and the adjusting device (157892-0220) set in the base, adjust the dial gauge to read "0".
- 3) Install the push rod into the nozzle holder.

Note:

- Do not install the No. 2 spring nor the pre-lift adjustment shim.



- 4) Attach the adjusting device to the nozzle holder's set screw section, and fix it in place with the middle screw. Holding the dial gauge holder section, move it up and down and confirm the motion of the dial gauge.
- 5) Holding the dial gauge by the holder section, press it down and read the dial gauge deflection (lift dimension: h).

Note:

- The dial gauge should be read with 1/100 mm increments.

- 6) Select the pre-lift adjustment shim as follows.

$$t = (\ell + h)$$

t: Shim thickness (measured value)

ℓ: Pre-lift value (standard value)

h: Lift dimension (measured value in item 5) above)

Select a shim with a thickness T within 0.015 mm of t in the above formula, i.e., $T = t \pm 0.015$ mm.

[mm]

Thickness of pre-lift (valve opening pressure) adjusting shim

0.50, 0.52, 0.54, 0.56, 0.58, 0.60, 0.70, 0.80, 0.90, 1.00, 0.10, 0.20, 0.30, 0.40

- 7) Remove the adjusting device from the nozzle holder.

Adjusting the no. 2 spring

- 1) Assemble the No. 2 spring adjusting screw and nut on the nozzle holder.

Note:

- The pre-lift adjustment shim is not yet installed. Therefore, the No. 1 and No. 2 push rods will be in contact (running into each other).

- 2) Using a nozzle tester, adjust the No. 2 spring with the adjusting screw, and fix it in place with the nut.

T : 2 - 2.5 kgm

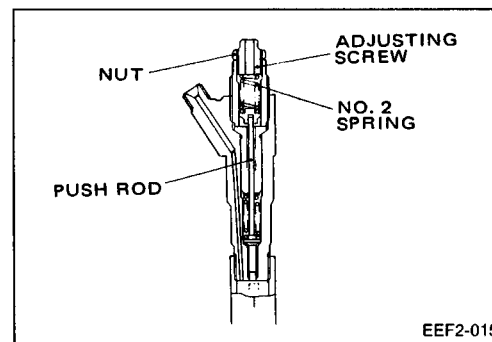
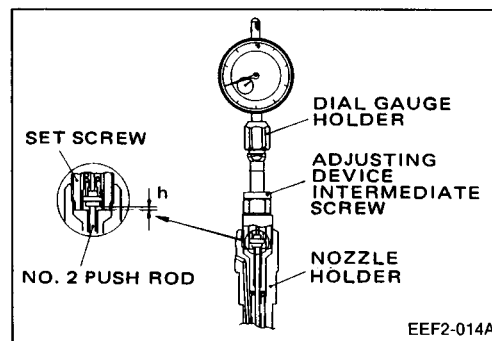
[kg/cm²]

Item	Maintenance standard
Valve opening pressure	253 - 259

Confirming the nozzle (needle valve) full lift amount

- 1) Install the screw in the retaining nut (157892-1420).
- 2) Attach the connector (157892-1320) to the nozzle holder set screw.

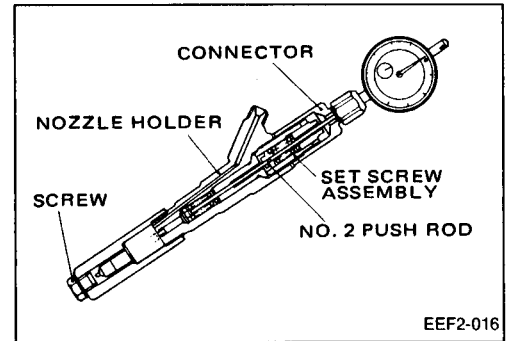
T : 4 - 5 kgm



- 3) Attach the dial gauge to the connector.

Note:

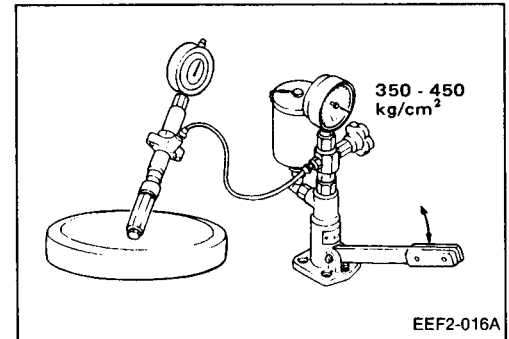
- **Be sure to use a dial gauge pin with a length of 50 mm.**
- 4) Set the dial gauge to read "0".
 - 5) Using the nozzle tester, remove the air from within the retaining nut. Also confirm that there is no fuel leakage.



- 6) Operate the nozzle tester, and pressurize to between 350 and 450 kg/cm². Read the nozzle needle's full lift amount "L" with the dial gauge, and record it.

Note:

- **At this point, the dimension L is the sum of the pre-lift and pre-lift adjustment shim thickness.**
- 7) Remove the connector (along with the dial gauge) from the nozzle holder.

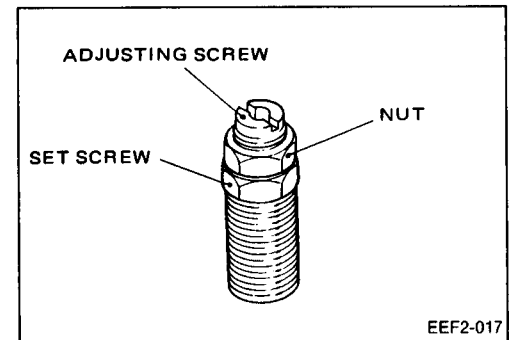


Inserting the pre-lift adjustment shim

- 1) Remove the set screw assembly (set screw, adjusting screw and nut as a unit) and No. 2 push rod from the nozzle holder.

Note:

- **Do not loosen the nut. If the nut is loosened, the No. 2 spring adjustment pressure will change.**



- 2) Insert the pre-lift shim selected in item 6) under the heading "Adjusting the pre-lift" between the spacer and the No. 2 push rod. After attaching to the nozzle holder and assembling the No. 2 spring, assemble and tighten the set screw assembly.

T : 5 - 6 kgm

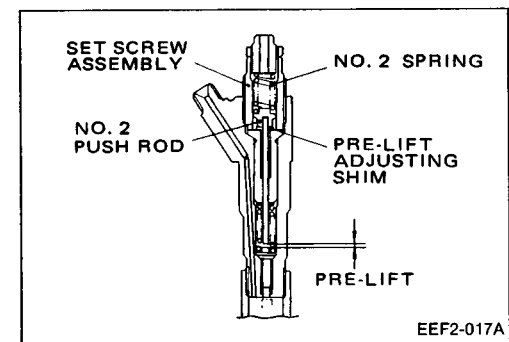
Note:

- **At this point, push rods No. 1 and No. 2 should be separated by the amount of the pre-lift spacing.**

- 3) Attach the connector (157892-1320) to the nozzle holder set screw, attach the gauge, and set the gauge to "0".

T : 4 - 5 kgm

- 4) Using the nozzle tester, remove the air from within the retaining nut.



- 5) Operate the nozzle tester, and pressurize to between 350 and 450 kg/cm². Read the nozzle needle's full lift amount "S" with the dial gauge, and record it.

Note:

- At this point, the dimension S will be the needle valve full lift minus the pre-lift amount.

Confirming the pre-lift

- 1) Confirm the pre-lift value from the L dimension measured in item 6) under the heading "Confirming the nozzle (needle valve) full lift amount" and the S dimension measured in item 5) under the heading "Inserting the pre-lift adjustment shim".

$$\Delta \ell = L - S \text{ [mm]}$$

$\Delta \ell$: Pre-lift value (measured value)

L: Needle valve full lift amount (measured value)

B: Needle valve lift amount from which the pre-lift amount has been subtracted (measured value)

- 2) Confirm that the $\Delta \ell$ dimension falls within the specified pre-lift value $\ell \pm 0.02 \text{ mm}$.

[mm]

Item	Maintenance standard
Pre-lift: ℓ	0.06 - 0.10

- 3) If the $\Delta \ell$ dimension does not fall within the specified distance $0.08 \text{ mm} \pm 0.02 \text{ mm}$, replace the pre-lift adjustment shim and repeat the procedures under the headings "Confirming the nozzle (needle valve) full lift amount" and "Inserting the pre-lift adjustment shim" above. Select the thickness of the new shim (t') according to the following formulas.

$$t' = t + (\ell - \Delta \ell)$$

where,

t': New shim thickness

t: Installed shim thickness

$$T = t' \pm 0.015$$

where,

T: Thickness of shim actually used.

Confirming the No. 2 spring adjustment pressure

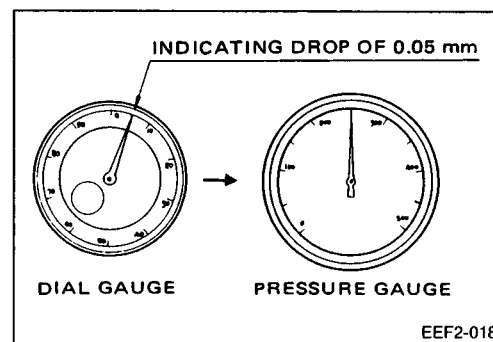
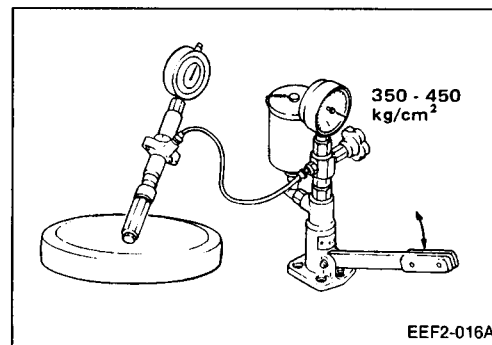
< Nozzle cover method >

- 1) After confirming the pre-lift, pressurize to 350 to 450 kg/cm² and set the needle valve of the nozzle to full lift.
- 2) When the needle valve is in the full lift state, release the nozzle tester handle. As the pressure in the nozzle tester chamber falls, the needle valve lift amount will also fall. When the dial gauge reads 0.05 mm, read the pressure gauge and confirm that the value is within the maintenance standard.

[kg/cm²]

Item	Maintenance standard
Valve opening pressure	235 - 240

Note:



- 1. Read the pressure gauge indication at the instant the needle valve lift value reaches the specified dimension (0.05 mm).
 - 2. Locate the dial and pressure gauges so that they can be read simultaneously.
- 3) If the No. 2 spring adjustment pressure is not within the maintenance standard, adjust it following the procedure described under the heading "Adjusting the No. 2 spring", then confirm it again.

Note:

- Adjustment and confirmation of the pre-lift system is unnecessary.
- 4) Remove the connector (157892-1320) together with the dial gauge.

Final inspection

- 1) Remove the retaining nut (157892-1420), and attach the normal retaining nut.

T : 6 - 8 kgm

Note:

- Be sure to tighten the retaining nut only after confirming that the knock pin is completely within the nozzle.

- 2) Attach the cap nut.

T : 4 - 5 kgm

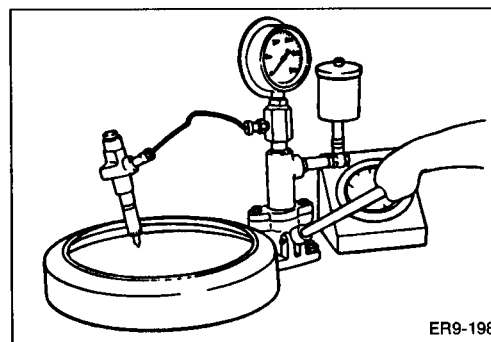
- 3) Attach the nozzle to the nozzle tester and confirm the initial injection pressure.

[kg/cm²]

Item	Maintenance standard
Injection beginning pressure (1st stage)	180

Note:

- The spray ejected from the nozzle can cause structural collapse of living tissues by penetrating deeply, and can cause blood poisoning if it gets into the blood. Exert utmost caution to avoid getting the spray on your hands.



- 4) Inspect the spray pattern and inspect for leakage and plugged spray holes. If there is wear or damage due to fuel impurities or carbon on the nozzle needle or nozzle body sheet surface, correct minor wear or damage by lapping with compound.

In addition, the nozzle needle and the body must be replaced as a set.

- ① Uniform and symmetrical
- ② Not symmetrical
- ③ Branching
- ④ Thin spray
- ⑤ Stepped injection
- ⑥ Must be evenly injected from the five orifices

TYPE II (TWO-SPRING TYPE: RF8 AND RE10)

[SIMPLE TYPE]

Inspecting the initial injection pressure and spray pattern

- 1) Attach the nozzle to the nozzle tester and confirm the initial injection pressure.

[kg/cm²]

Item	Maintenance standard
Injection beginning pressure (1st stage)	180

Note:

- The spray ejected from the nozzle, can cause structural collapse of living tissues by penetrating deeply, and can cause blood poisoning if it gets into the blood. Exert utmost caution to avoid getting the spray on your hands.

- 2) Inspect the spray pattern and inspect for leakage and plugged spray holes.

- ① Uniform and symmetrical
- ② Not symmetrical
- ③ Branching
- ④ Thin spray
- ⑤ Stepped injection
- ⑥ Must be evenly injected from all the orifices

- 3) When the result of the inspection is that there are abnormalities in the nozzle, either replace the nozzle or disassemble it completely and adjust it according to the complete disassembly method described under the heading "Two-spring type nozzle".

Confirming the No.2 Spring Adjustment Pressure

< Nozzle cover method >

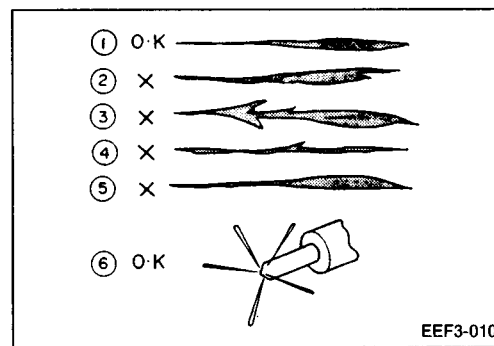
- 1) Remove the retaining nut and attach an adjustment retaining nut (157892-1420).

T : 6 - 8 kgm

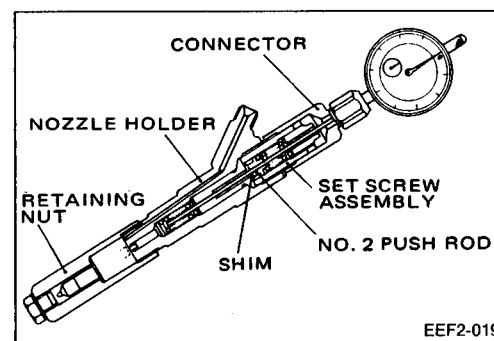
Note:

- Be sure to tighten the retaining nut only after confirming that the knock pin is completely within the nozzle.

- 2) Remove the cap nut and attach the connector (157892-1320)



EEF3-010



EEF2-019

together with the dial gauge. Use a pin with a length of 50 mm.

T : 4 - 5 kgm

- 3) Attach the nozzle holder to the nozzle tester and after removing the air from within the retaining nut, completely lift the needle valve by pressurizing the nozzle tester to between 350 and 450 kg/cm².

- 4) When the needle valve is in the full lift state, release the nozzle tester handle. As the pressure in the nozzle tester chamber falls, the needle valve lift amount will also fall. When the dial gauge reads 0.05 mm, read the pressure gauge and confirm that the value is within the maintenance standard.

[kg/cm²]

Item	Maintenance standard
Valve opening pressure	235 - 240

Note:

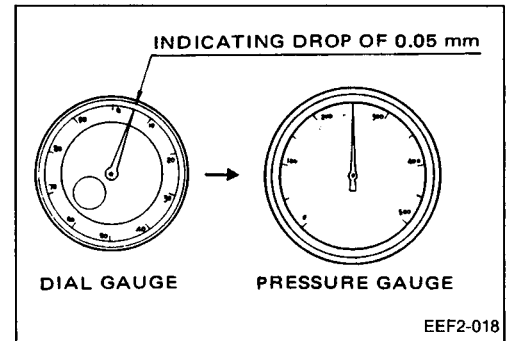
- Read the pressure gauge indication at the instant the needle valve lift value reaches the specified dimension (0.05 mm).
 - Locate the dial and pressure gauges so that they can be read simultaneously.
- 5) If the result of the inspection is that the No. 2 spring adjustment pressure is not within the specified pressure range, adjust the pressure according to the complete dis-assembly method described under the heading "Two-spring type nozzle".

Note:

- At this point, adjustment and confirmation of the pre-lift system are unnecessary.

Final inspection

Check the initial injection pressure, and inspect the spray pattern and check for fuel leaks according to the procedures described under the heading "Inspecting the initial injection pressure and spray pattern".

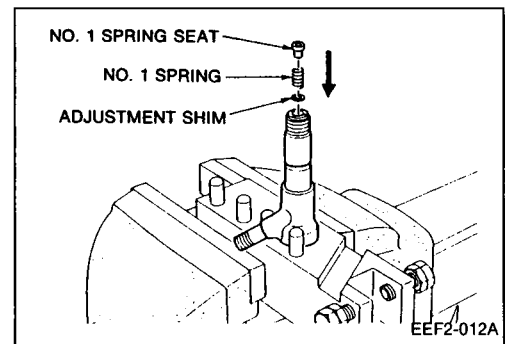


TYPE III (TWO-SPRING TYPE: RG8) [COMPLETE DISASSEMBLY METHOD]

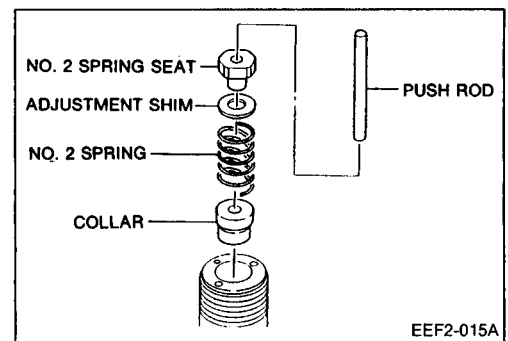
Reassembly and adjustment

1) With the nozzle side facing up, place the nozzle holder in a vise using plates (157992-2820).

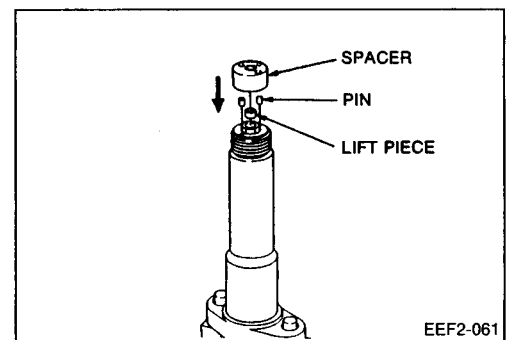
2) Install the No. 1 pressure adjustment shim, No. 1 spring and No. 1 spring seat, in that order, on the nozzle holder body.



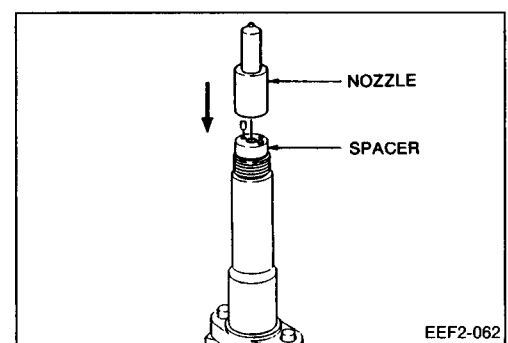
3) Install the collar, No. 2 spring, No. 2 pressure adjustment shim, No. 2 spring seat and push rod.



4) Install the pin, lift piece and spacer on the nozzle holder.

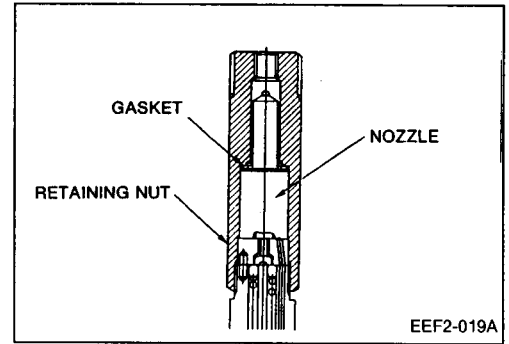


5) Install the nozzle and pin on the spacer.



- 6) After installing gasket (157892-1500) on the nozzle, secure the nozzle to the nozzle holder using retaining nut (157892-4000) furnished.

T : 6 - 8 kgm



No. 1 valve opening pressure adjustment

- 1) Using a nozzle tester (equipped with a 500 kg/cm² gauge), measure No. 1 valve opening pressure.

[kg/cm²]

Item	Maintenance standard
Valve opening pressure	185 - 193

- 2) If the No. 1 valve opening pressure is outside specifications, replace the adjustment shim with a suitable one until the specified opening pressure is obtained.

Note:

- When using a shim, always measure the thickness of the shim with a micrometer before assembling.
- Adding a 0.01 mm thick shim corresponds to a change of approximately 1.2 kg/cm² in valve opening pressure.

[mm]

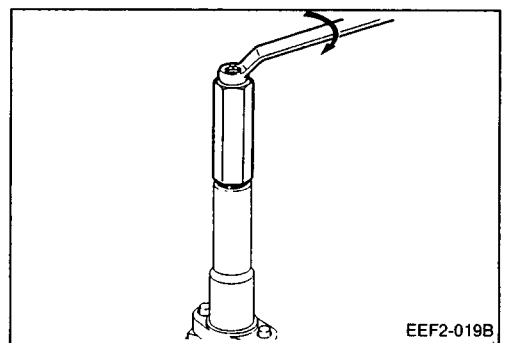
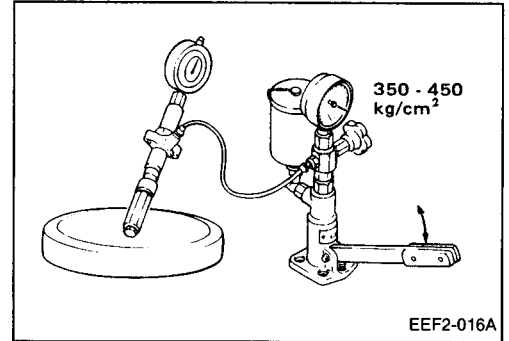
Pre-lift (valve opening pressure) adjusting shim thickness
0.40, 0.50, 0.52, 0.54, 0.56, 0.58, 0.60, 0.70

Before checking the needle valve full lift and pre-lift, or checking or adjusting the No. 2 valve opening pressure, install the special service tool.

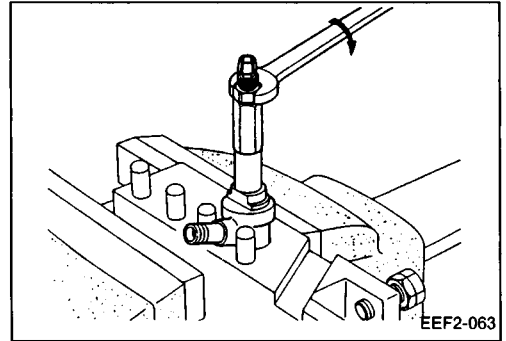
Note:

- The nozzle cover type refers to a retaining nut (157892-4000) whose end has a plug (157892-1600) installed.

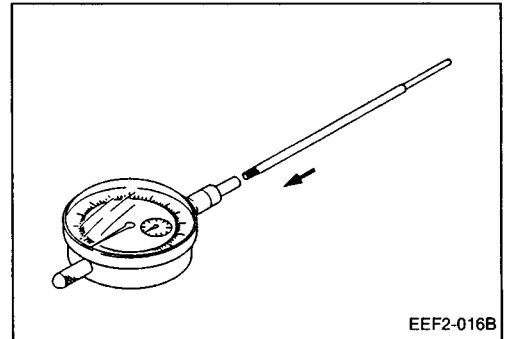
- 1) Install plug (157892-1600) on retaining nut (157892-4000) using gasket (026508-1140).



- 2) Place the nozzle holder body in a vise with the nozzle facing up, then install holder (157892-4100) in the nozzle holder.
- 3) Install nut (157892-1000) on the holder.



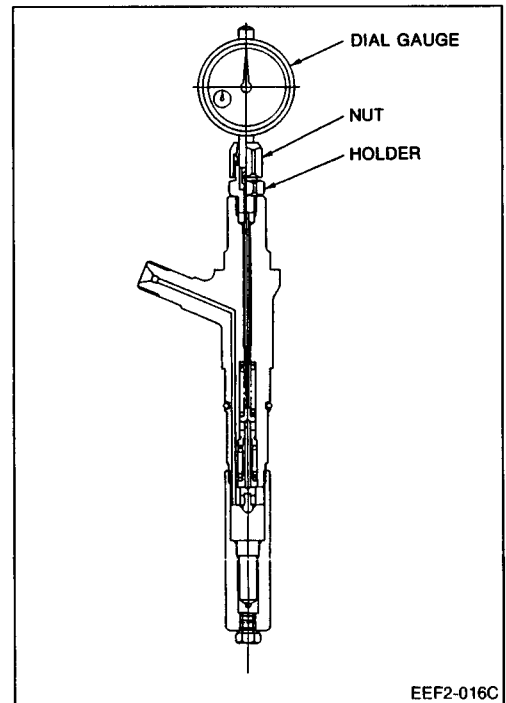
- 4) Install pin (157892-5300) on dial gauge (157954-3800).
ℓ: 60 mm



- 5) Install the dial gauge on the nozzle holder assembly so that pin (157892-5300) is in contact with the upper surface of the No. 1 spring seat; then snugly tighten the dial gauge using a nut.

Note:

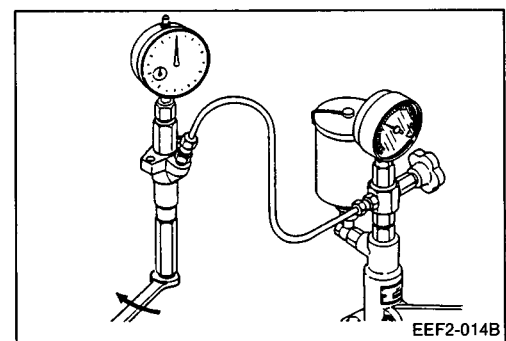
- Do not overtighten the nut as this may jam the gauge shaft resulting in malfunctioning.



- 6) Install the nozzle holder assembly on the nozzle tester and reset the dial gauge to "0".
- 7) Loosen plug (157892-1600) on the end of the retaining nut (furnished as a special service tool), activate the nozzle tester to purge air from the plug opening, then tighten the plug (157892-1600).

Note:

- Air can be purged at a pressure of 100 kg/cm².



Checking needle valve full lift

< Nozzle cover method >

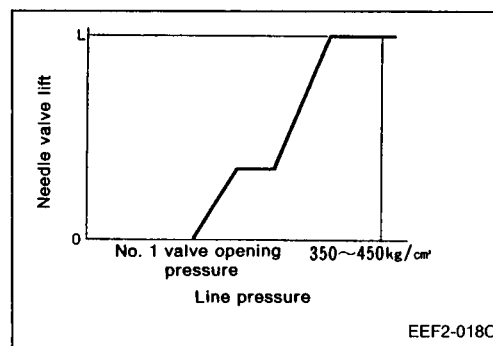
- 1) Activate the nozzle tester. When the line pressure is in the 350 - 450 kg/cm² range, the needle valve is completely lifted. Record the full-lift length "L".

Note:

- Read the dial gauge in units of 1/100 mm.
- Checking the full-lift length of the needle valve is required to determine whether or not the nozzle seat is worn or the nozzle assembly is of a specified type.

[mm]

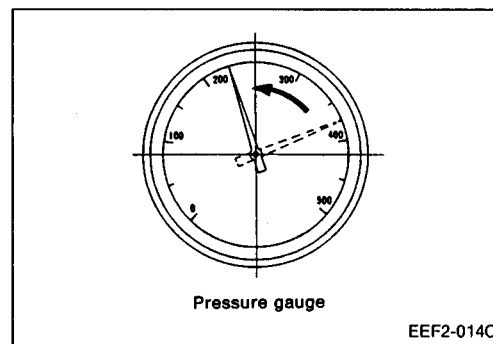
Item	Maintenance standard
pre-lift: ℓ	0.37



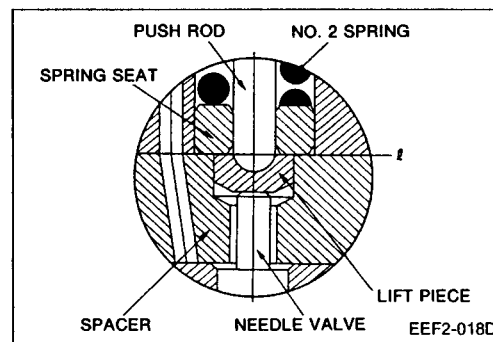
Checking needle valve pre-lift

< Nozzle cover method >

- 1) When the nozzle tester handle is left unattended with the needle valve fully lifted, both the line pressure and the dial gauge indication (needle valve lift) decrease.



- 2) When No. 2 spring action ceases and the needle valve no longer goes down, read the dial gauge indication (valve lift : ℓ) to ensure it is within specifications. Refer to the figure at right and the figure corresponding to step 3) below.



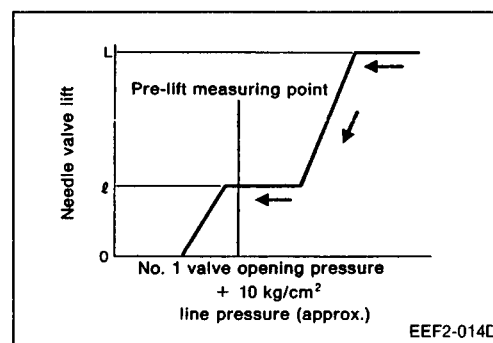
- 3) When the needle valve reaches the pre-lift measuring point (No. 1 valve opening pressure plus approximately 10 kg/cm²), read the dial gauge indication.

Note:

- Determine the point (corresponding to the No. 1 valve opening pressure plus approximately 10 kg/cm²) while decreasing line pressure.

[mm]

Item	Maintenance standard
Pre-lift: ℓ	0.05 - 0.09



- 4) If the pre-lift length is outside specifications, replace the pin, lift piece, spacer and nozzle with a service kit.

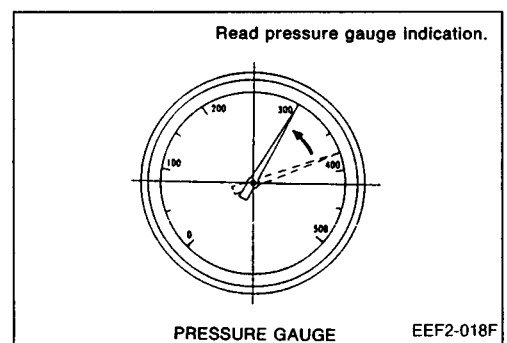
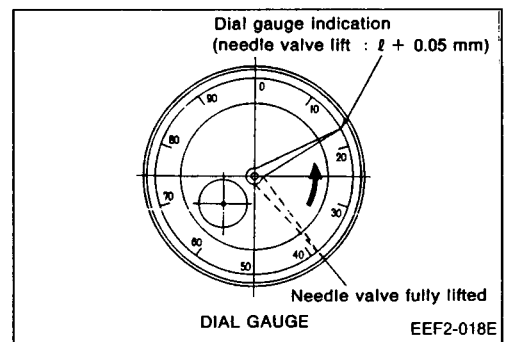
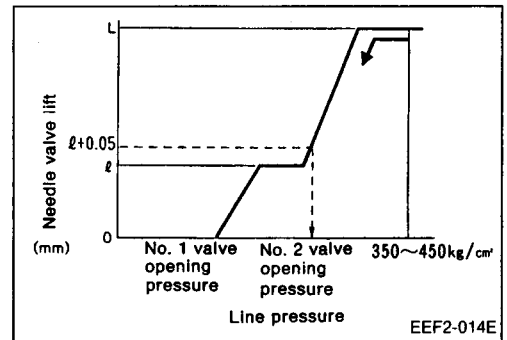
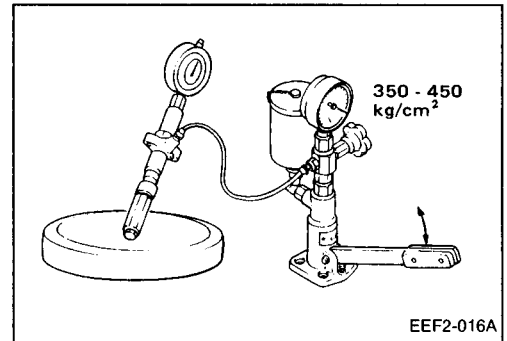
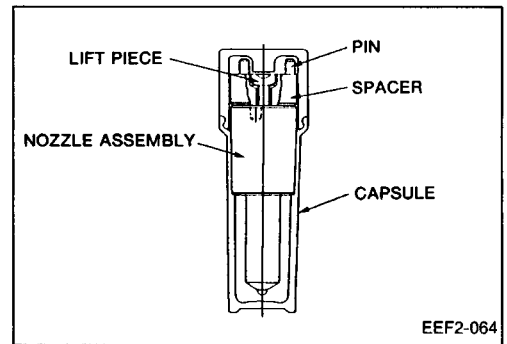
Service kit part No.

Engine	Zexel part No.
RG8	105019-0240

Checking the No. 2 valve opening pressure

< Nozzle cover method >

- 1) After checking the needle valve pre-lift, activate the nozzle tester and increase the line pressure in the 350 - 450 kg/cm² range until the needle valve is fully lifted.
- 2) When the nozzle tester handle is left unattended with the needle valve fully lifted, both the line pressure and the dial gauge indication (valve lift) decrease.
- 3) Read the pressure gauge indication the instant the dial gauge registers the specified needle valve lift (pre-lift "ℓ" plus 0.05 mm).



Adjusting the No. 2 valve opening pressure

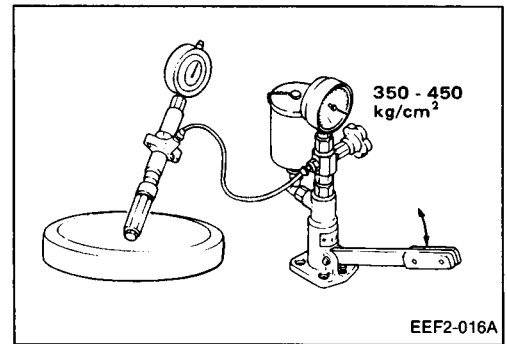
Note:

- After properly adjusting the No. 1 valve opening pressure, adjust the No. 2 valve opening pressure.
If shim(s) need to be replaced during pressure adjustment, replace only No. 2 shim(s).

- Using a nozzle tester (provided with a 500 kg/cm² gauge), measure the No. 2 valve opening pressure.

[kg/cm²]

Item	Maintenance standard
Valve opening pressure	240 - 250



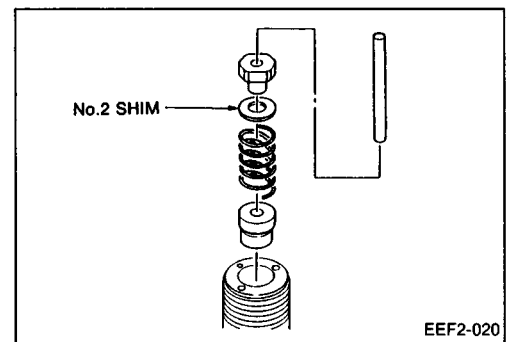
- If the No. 2 valve opening pressure is outside specifications, disassemble the nozzle section of the nozzle holder and replace the No. 2 spring shim.

Note:

- Before installing a shim, measure its thickness using a micrometer.
- Adding a 0.01 mm thick shim corresponds to a change of approximately 1.2 kg/cm² in valve opening pressure.

[mm]

Thickness of pre-lift (valve opening pressure) adjustment shim
0.40, 0.50, 0.52, 0.54, 0.56, 0.58, 0.60, 0.70



Retaining nut replacement

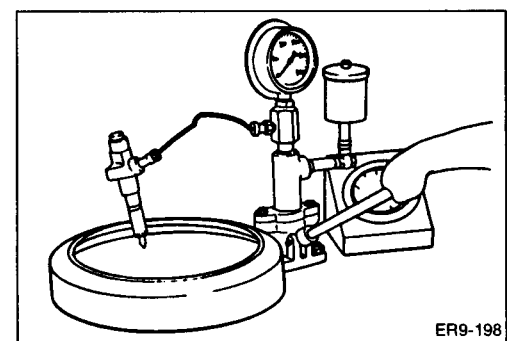
- Remove the dial gauge, nut, holder and gasket.
- Remove the retaining nut (furnished as a service tool) and gasket, then install the specified retaining nut in its place.

T : 6 - 8 kgm

- Attach the nozzle to the nozzle tester and confirm the initial injection pressure.

[kg/cm²]

Item	Maintenance standard
Injection beginning pressure (1st stage)	180



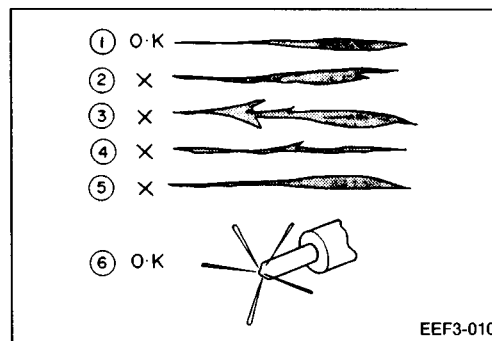
Note:

- The spray ejected from the nozzle can cause structural collapse of living tissues by penetrating deeply, and can cause blood poisoning if it gets into the blood. Exert utmost caution to avoid getting the spray on your hands.

- 4) Inspect the spray pattern and inspect for leakage and plugged spray holes. If there is wear or damage due to fuel impurities or carbon on the nozzle needle or nozzle body sheet surface, correct minor wear or damage by lapping with compound.

In addition, the nozzle needle and the body must be replaced as a set.

- ① Uniform and symmetrical
- ② Not symmetrical
- ③ Branching
- ④ Thin spray
- ⑤ Stepped injection
- ⑥ Must be evenly injected from the five orifices



EEF3-010

TYPE III (TWO-SPRING TYPE: RG8)

[SIMPLE TYPE]

Inspecting the initial injection pressure and spray pattern

- 1) For inspection procedures, refer to steps 3) and 4) under the topic "Retaining Nut Replacement" previously outlined.

INSTALLATION

- 1) Install the nozzle holder assembly onto the cylinder head.

T : 2.5 - 3.5 kgm

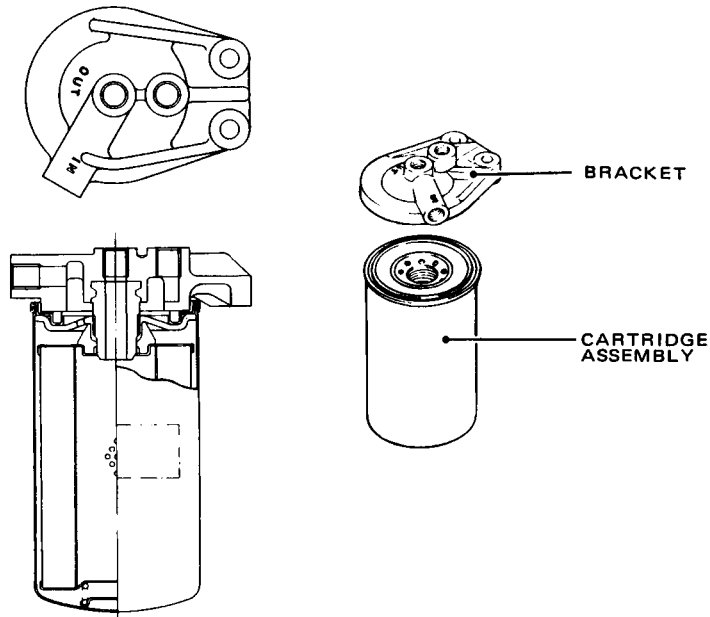
- 2) Install the spill tube and injection nozzle tube.
- 3) Remove the air in the fuel system.
- 4) Connect the battery cable to the negative terminal of the battery.

FUEL FILTER

CONSTRUCTION

FUEL FILTER

Construction and exploded illustration

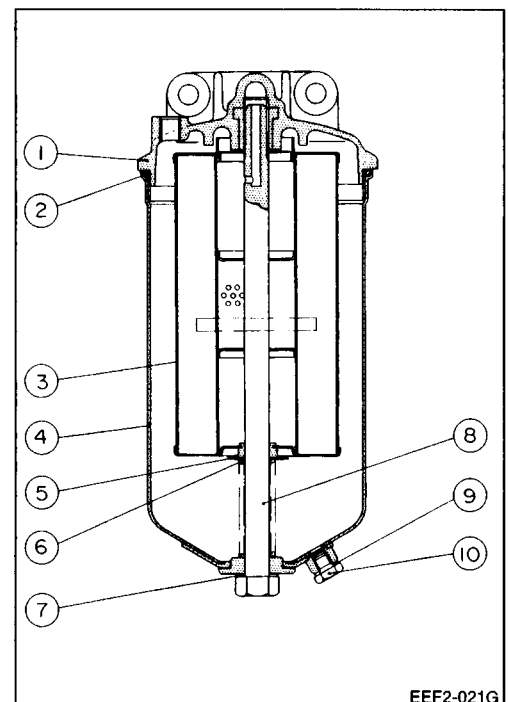


EEF2-021F

PRIMARY FUEL FILTER

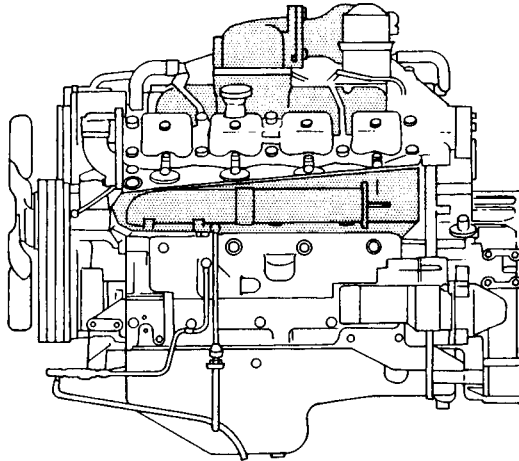
Construction illustration

- ① Filter cover
- ② Packing
- ③ Element
- ④ Filter case
- ⑤ Seat
- ⑥ Spring
- ⑦ Packing
- ⑧ Center bolt
- ⑨ Packing
- ⑩ Drain cock



EEF2-021G

10. AIR INTAKE AND EXHAUST SYSTEM



ER0-127

The air intake and exhaust system consists of an air cleaner, air intake shutter, exhaust shutter and air cylinder.

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AIR INTAKE AND EXHAUST SYSTEM		CONSTRUCTION	10- 8
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HOW TO REPLACE ELEMENT	10- 7	REASSEMBLY	10-16
		INSTALLATION	10-18

SPECIFICATIONS

AIR FILTER

Type	Dry paper element
------	-------------------

EXHAUST BRAKE

Type	Cylinder
Operation	Air

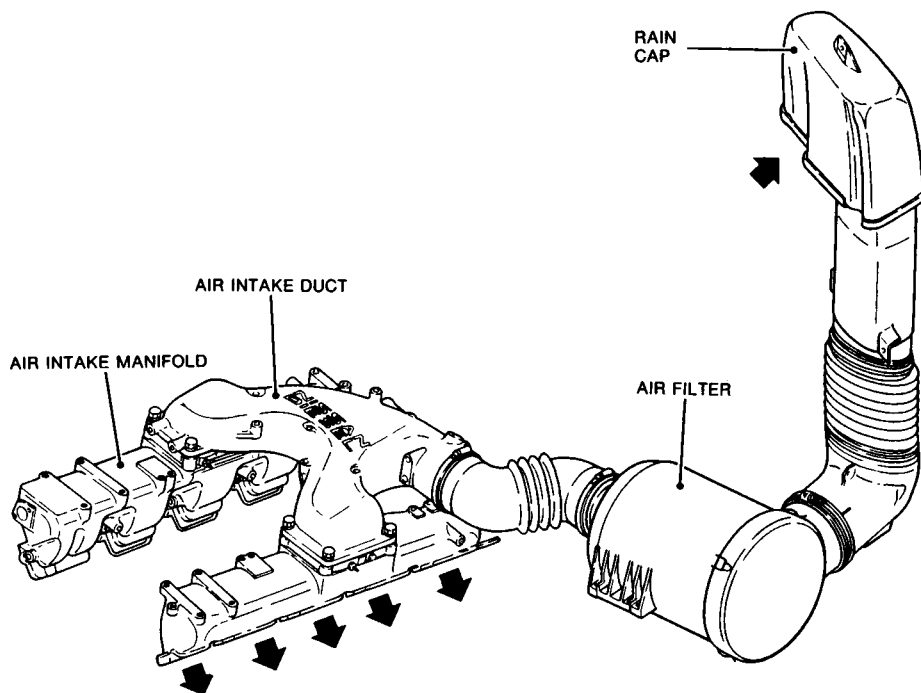
AIR INTAKE SHUTTER

Type	RF8, RE10 engines	Cylinder
	RG8 engine	Actuator
Operation		Air

AIR INTAKE AND EXHAUST SYSTEM DIAGRAM

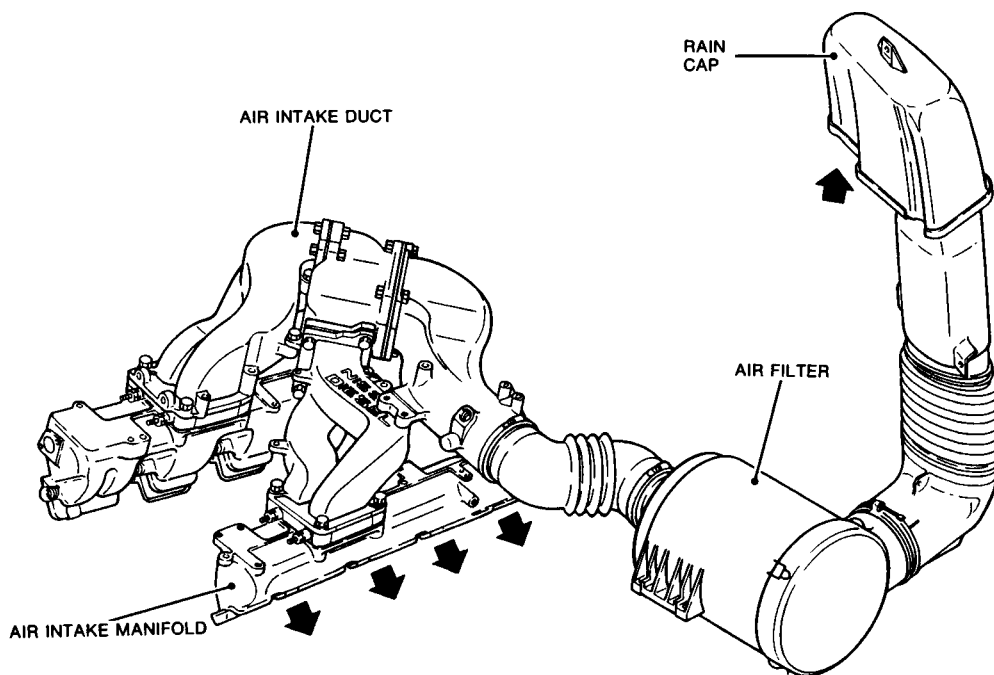
AIR INTAKE SYSTEM

< Engine models RF8, RE10 >



EIE2-001G

< Engine model RG8 >

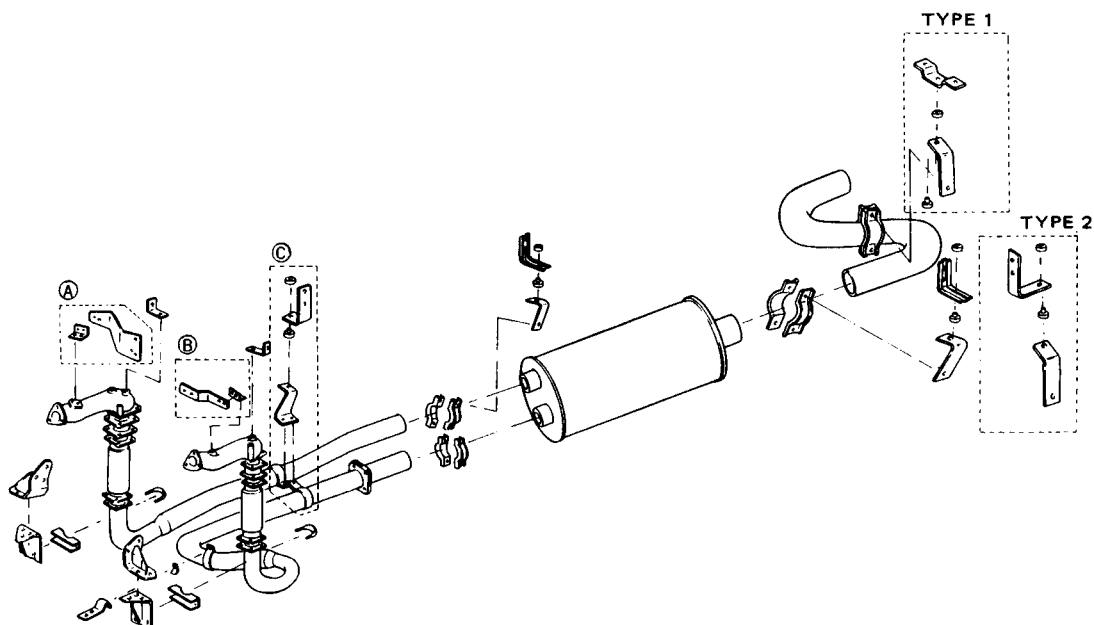


EIE2-001H

EXHAUST SYSTEM

Note:

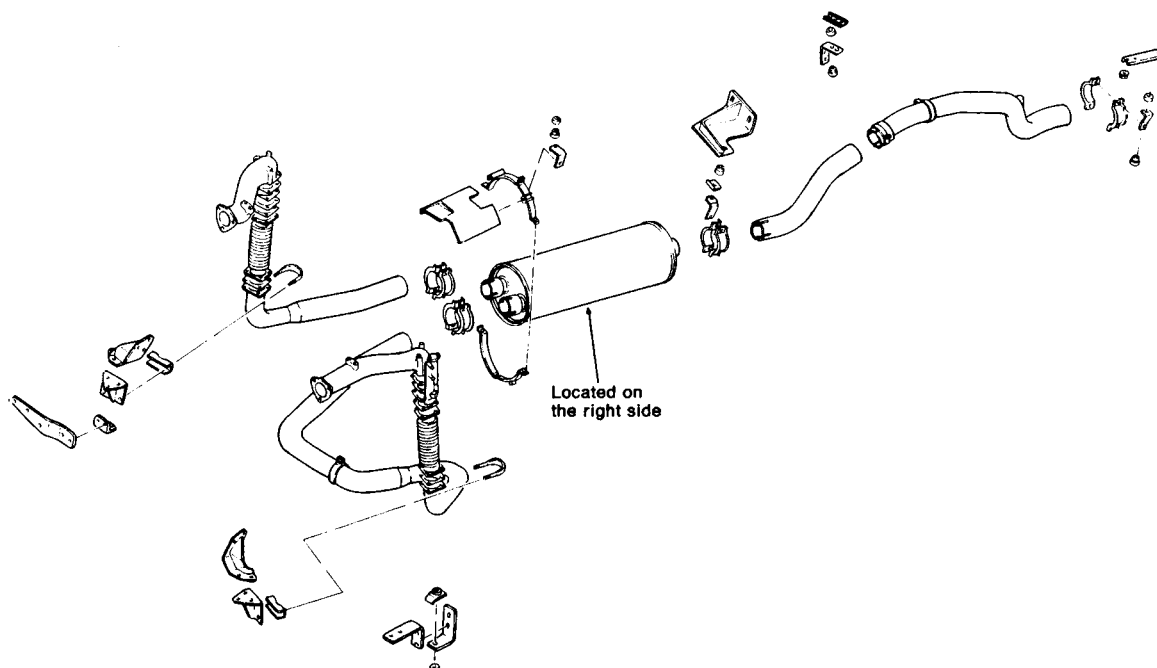
- This illustration is for CW series truck models.



EIE2-002H

Note:

- This illustration is for CK series truck models.

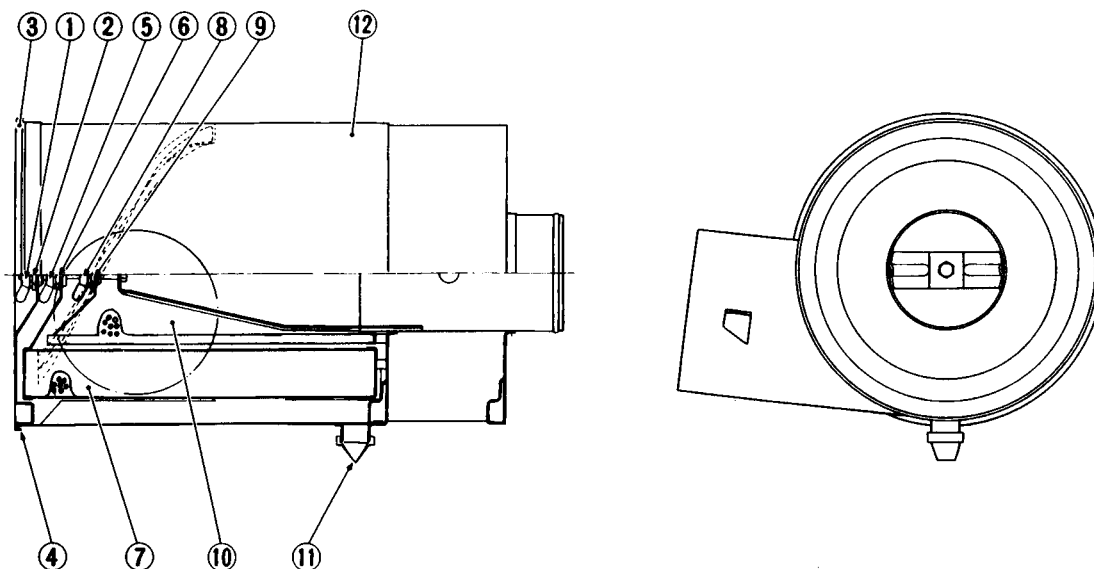


EIE2-0026A

AIR CLEANER

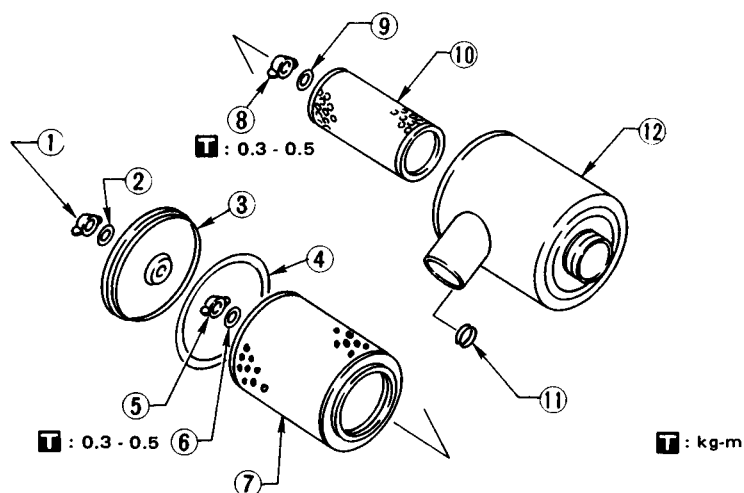
CONSTRUCTION

Construction illustration



EIE2-005E

Exploded illustration



EIE2-006J

- ① Wing nut
- ② Packing
- ③ Cover
- ④ Packing

- ⑤ Wing nut
- ⑥ Packing
- ⑦ Element assembly (outer)
- ⑧ Wing nut

- ⑨ Packing
- ⑩ Element assembly (inner)
- ⑪ Evacuator valve
- ⑫ Body

HOW TO REPLACE ELEMENT

Park the vehicle on level ground, block both the front and rear wheels, and turn off the key and battery switches.

- 1) Tilt the cab.
- 2) Loosen the wing nut and remove the cover together with the packing.
- 3) Loosen the wing nut and remove the element.
- 4) Inspect the element and packing for damage or deformation, and replace if faulty.
- 5) Clean the inside of the filter body. Then insert the element and tighten the wing nut with the packing in place.
- 6) Install the packing and cover. Then tighten the wing nut with the packing in place.

EXHAUST BRAKE

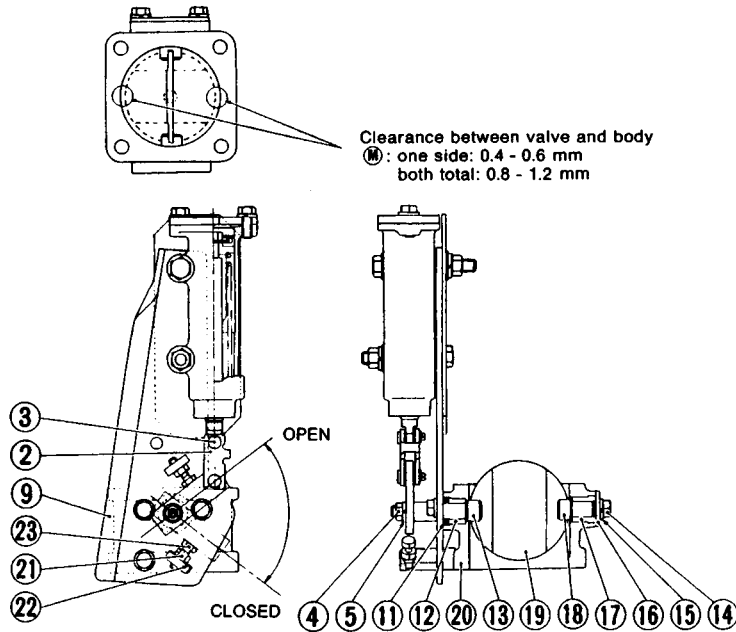
CONSTRUCTION

EXHAUST SHUTTER

Engine models RF8, RE10

< Construction illustration >

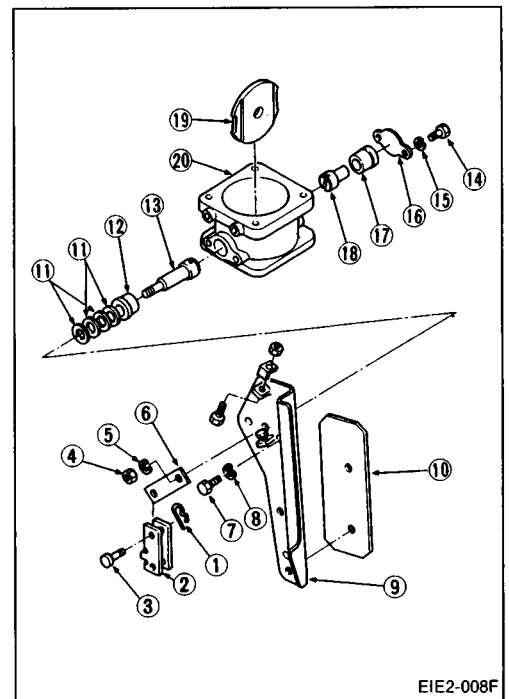
Ⓜ: Maintenance standard



EIE2-007V

< Exploded illustration >

- ① Snap ring
- ② Link
- ③ Clevis pin
- ④ Nut
- ⑤ Spring washer
- ⑥ Lever
- ⑦ Bolt
- ⑧ Spring washer
- ⑨ Shield plate
- ⑩ Shield plate
- ⑪ Seal ring
- ⑫ Bushing
- ⑬ Spindle
- ⑭ Bolt
- ⑮ Spring washer
- ⑯ Cover
- ⑰ Bushing
- ⑱ Spindle
- ⑲ Valve
- ⑳ Body
- ㉑ Nut
- ㉒ Lock washer
- ㉓ Bolt

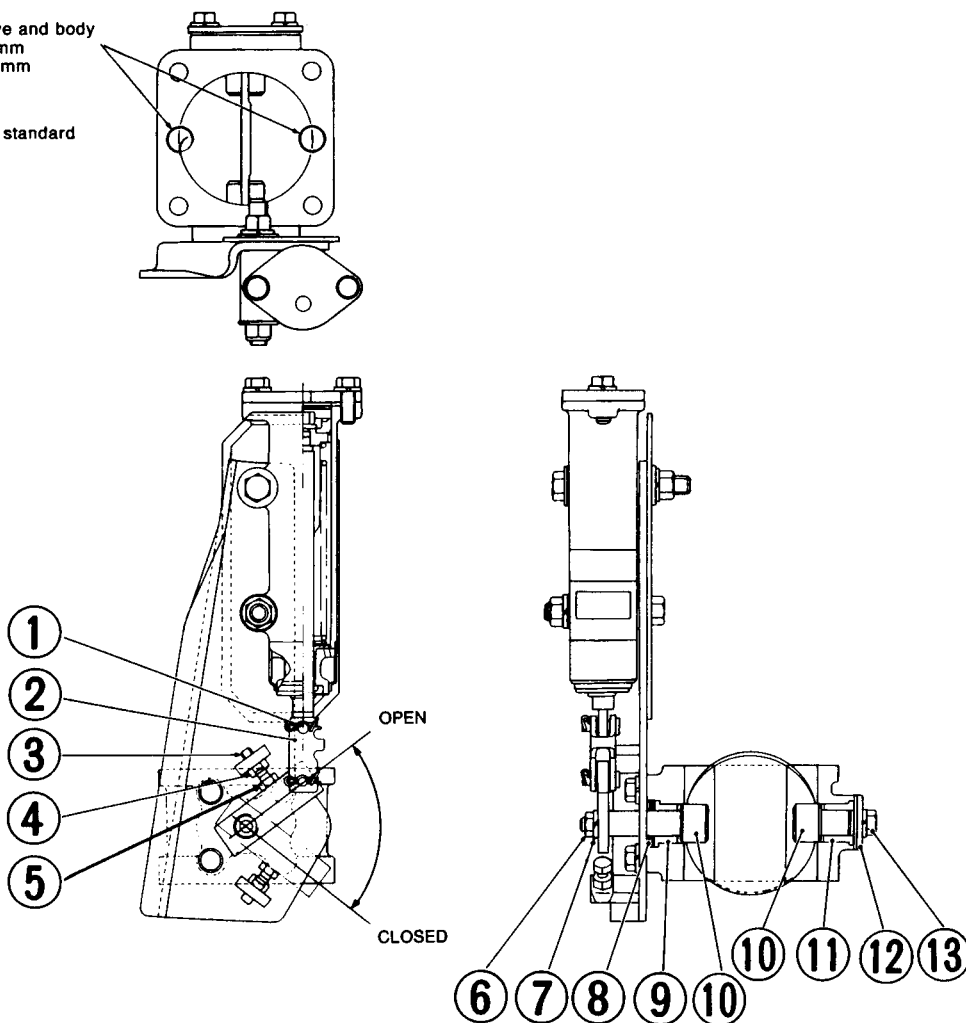


EIE2-008F

< Engine model RG8 >

Clearance between valve and body
 (M): one side: 0.8 - 1.0 mm
 both total: 1.6 - 2.0 mm

(M): Maintenance standard

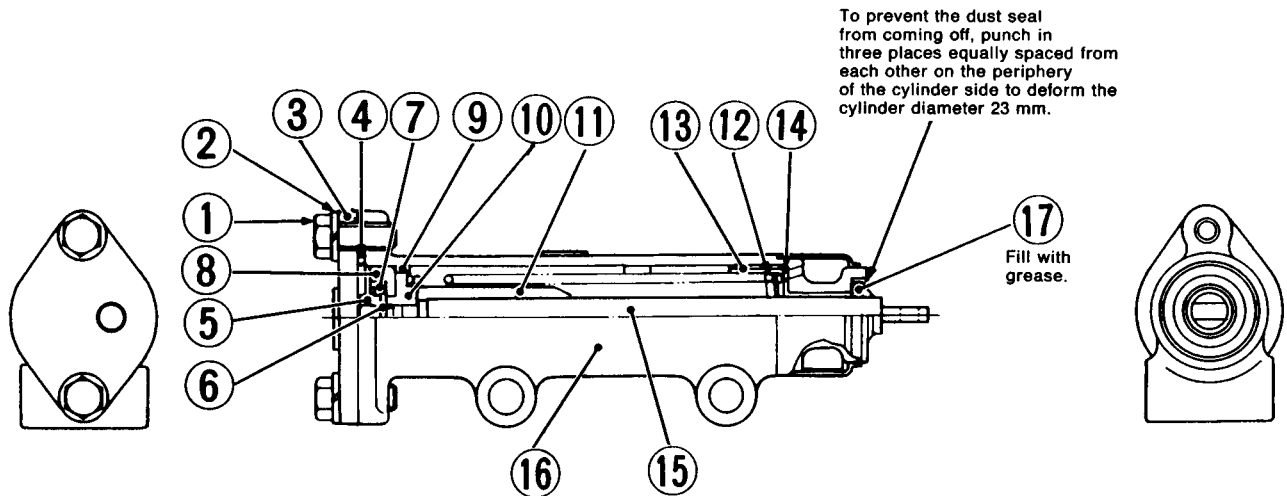


- ① Clevis pin
- ② Link
- ③ Lock washer
- ④ Nut
- ⑤ Bolt
- ⑥ Nut
- ⑦ Spring washer
- ⑧ Seal ring
- ⑨ Bushing
- ⑩ Spindle
- ⑪ Bushing
- ⑫ Cover
- ⑬ Bolt

EIE2-007U

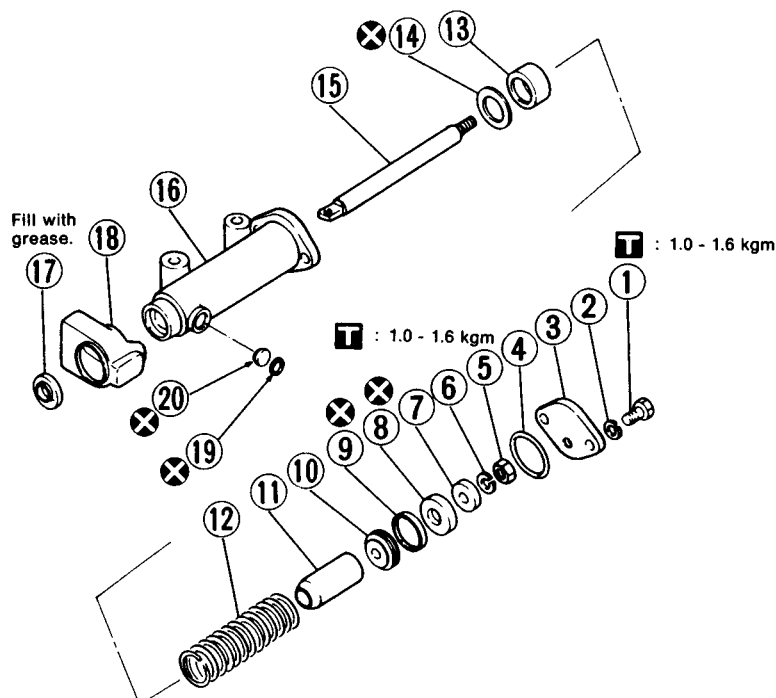
EXHAUST BRAKE AIR CYLINDER

Construction illustration



EIE2-009D

Exploded illustration



EIE2-010F

- ① Bolt
- ② Spring washer
- ③ Cover
- ④ O-ring
- ⑤ Nut
- ⑥ Spring washer
- ⑦ Retainer

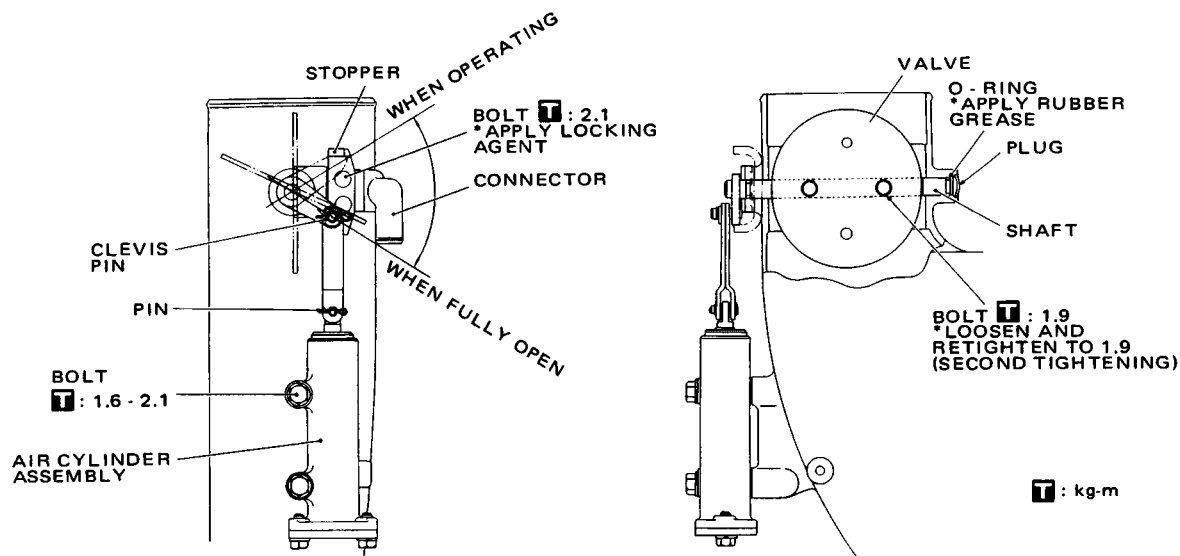
- ⑧ Packing
- ⑨ Ring
- ⑩ Plate
- ⑪ Protector
- ⑫ Spring
- ⑬ Spring guide
- ⑭ Washer

- ⑮ Shaft
- ⑯ Body
- ⑰ Dust seal
- ⑱ Cover
- ⑲ Retaining ring
- ⑳ Filter

AIR INTAKE SHUTTER

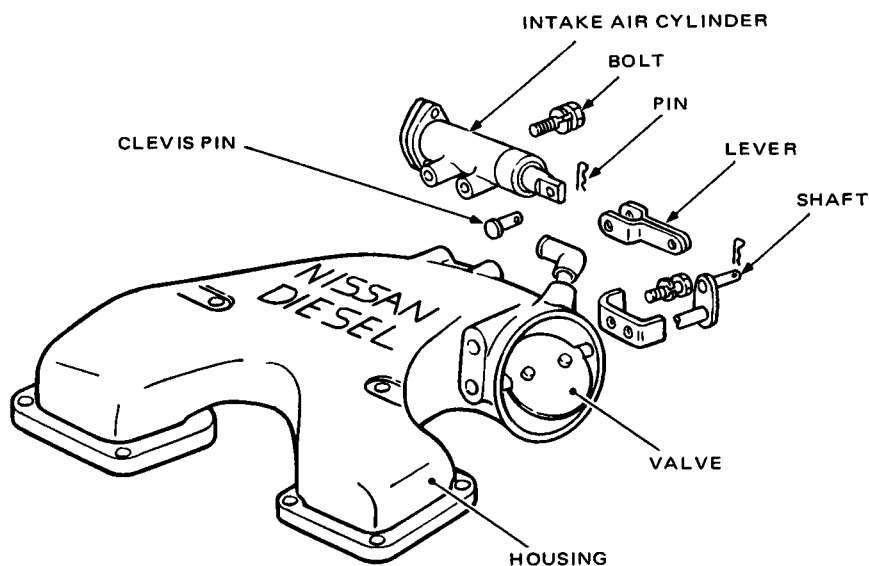
Engine models RF8, RE10

< Construction illustration >



EIE2-007L

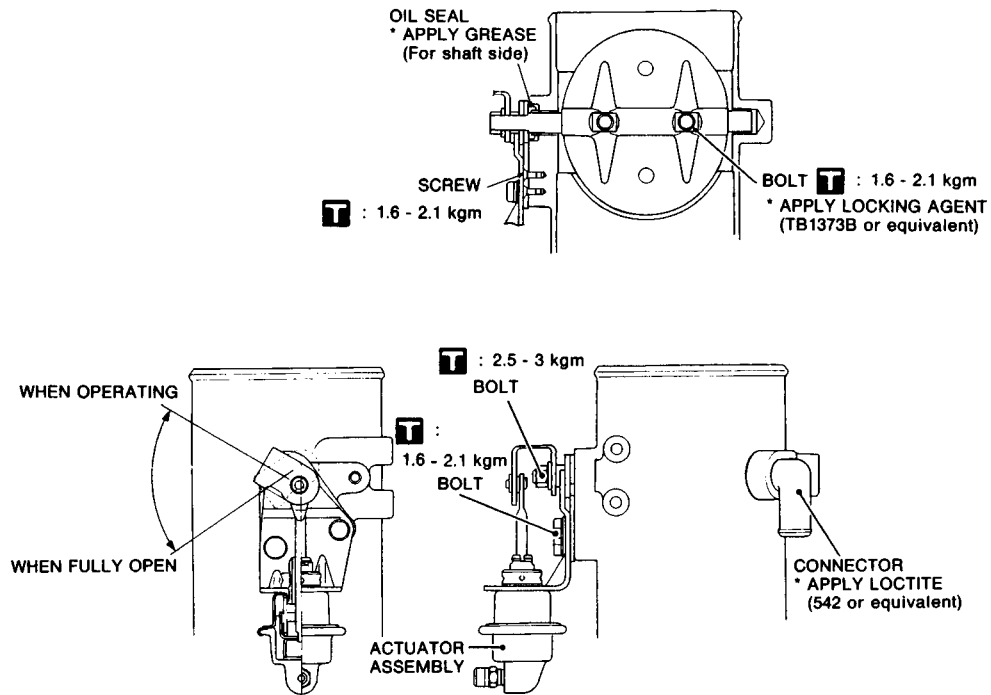
< Exploded illustration >



EIE2-019B

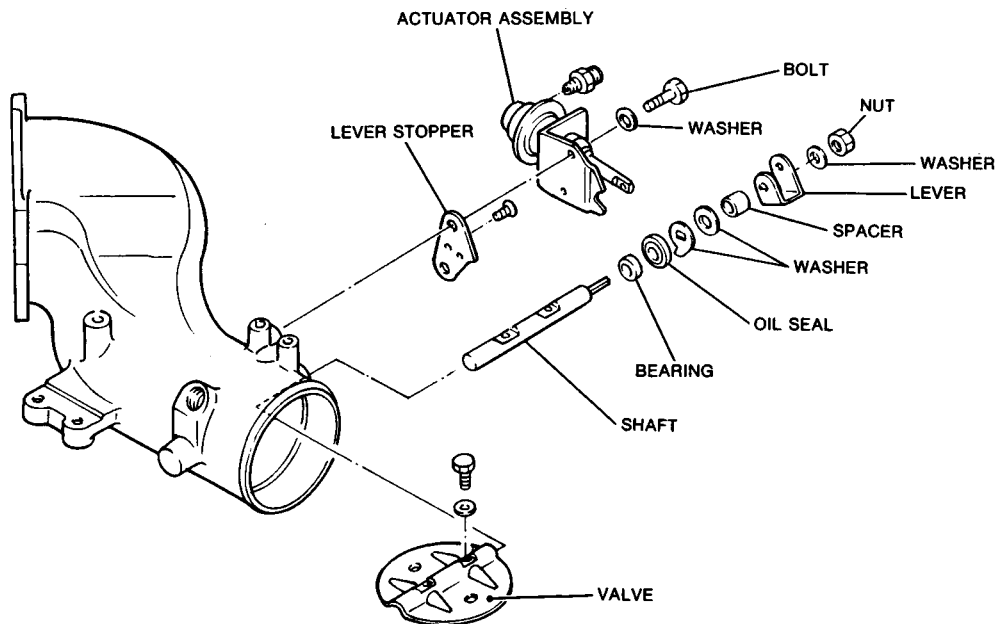
Engine model RG8

< Construction illustration >



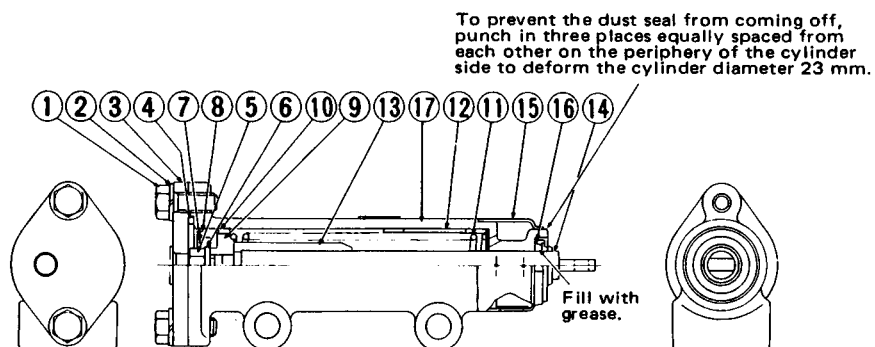
EIE2-012F

< Exploded illustration >



EIE2-013C

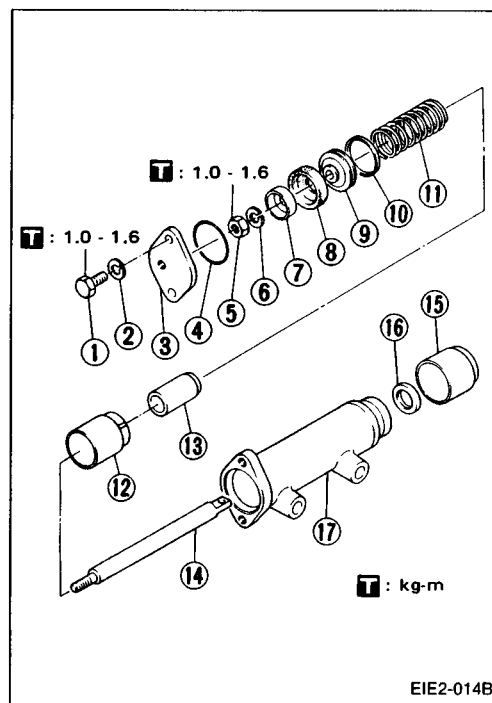
INTAKE SHUTTER AIR CYLINDER (Engine models RF8, RE10 only) Construction illustration



EIE2-013A

Exploded illustration

- ① Bolt
- ② Spring washer
- ③ Cover
- ④ O-ring
- ⑤ Nut
- ⑥ Spring washer
- ⑦ Retainer
- ⑧ Packing
- ⑨ Plate
- ⑩ Ring
- ⑪ Spring
- ⑫ Protector
- ⑬ Guide
- ⑭ Shaft
- ⑮ Cover
- ⑯ Dust seal
- ⑰ Cylinder

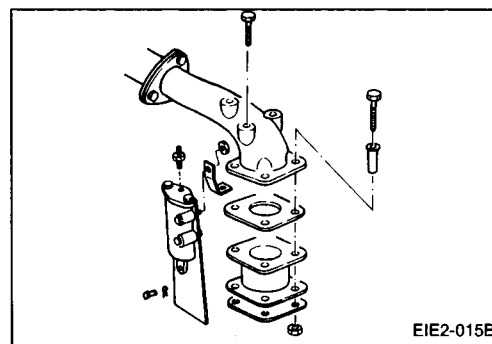


EIE2-014B

REMOVAL

Removing the exhaust brake

- 1) Tilt the cab.
- 2) Disconnect the air hose from the air cylinder.
- 3) Remove the mounting bolt holding the exhaust shutter.
- 4) Loosen the exhaust tube shutter.
- 5) Remove the exhaust brake assembly.
- 6) Remove the split pin and air cylinder mounting bolt, then separate the air cylinder and the exhaust shutter.



Removing the air intake shutter

- 1) Tilt the cab.
- 2) Disconnect the air tube from the air cylinder.
- 3) Loosen the mounting bolt for the intake shutter and remove the intake shutter assembly (with the air cylinder) and gasket.
- 4) Remove the split pin and air cylinder mounting bolt, then disconnect the intake shutter and the air cylinder.

DISASSEMBLY

Exhaust brake air cylinder

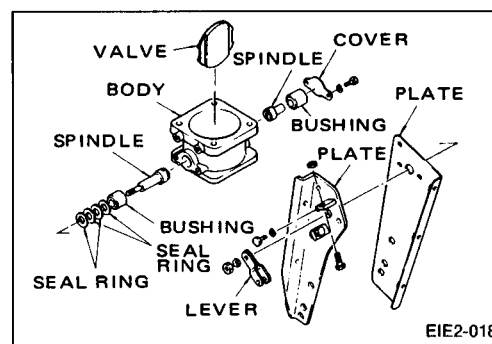
- 1) Remove the cover and O-ring.

Note:

- **Be careful when removing the cover — the shaft assembly may come out due to spring tension.**
- 2) Remove the shaft assembly and spring from the cylinder.
 - 3) Remove the retainer, packing, plate, ring, spring and protector.
 - 4) Remove the dust seal, retainer ring and the filter from the cylinder.

Exhaust shutter

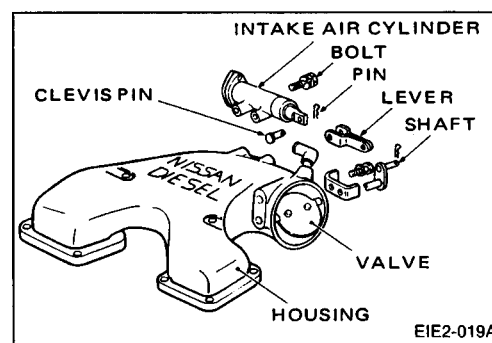
- 1) Remove the lever.
- 2) Separate the plate and the shutter assembly, then remove the seal ring.
- 3) Remove the bushing, spindle and valve.



Air intake shutter

< Engine models RF8, RE10 >

- 1) Remove the valve from the shaft.
- 2) Knock out the straight pin from the housing.
- 3) Remove the shaft assembly from the housing.
- 4) Remove the O-ring from the shaft.



< Engine model RG8 >

- 1) Remove the valve from the shaft.
- 2) Remove the stopper lever together with the mounting screw.
- 3) Remove the shaft assembly from the housing.
- 4) Remove the O-ring from the shaft.

Intake shutter air cylinder

- 1) Remove the cover and O-ring.

Note:

- **Be careful when removing the cover — the shaft assembly may come out due to spring tension.**
- 2) Remove the shaft assembly from the cylinder.
 - 3) Remove the retainer, packing, plate, ring, spring, protector and guide.
 - 4) Remove the dust seal and the cover from the cylinder.

INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, carefully inspect for cracks or any other damage. If faulty, replace with a new one.

EXHAUST BRAKE AIR CYLINDER

Spring tension

[kg]

Maintenance standard	Remarks
7.9	When compressed to 113.2 mm

EXHAUST SHUTTER

Spindle outer diameter

[mm]

Maintenance standard	Service limit
13.75 - 13.80	—

Clearance between spindle and bushing

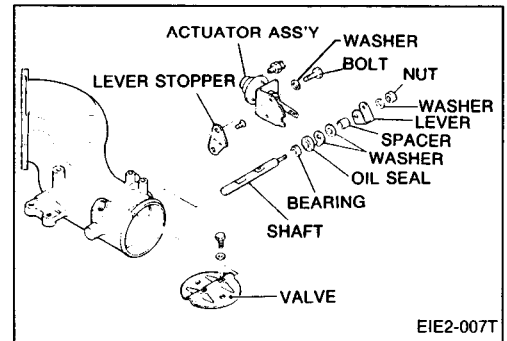
[mm]

Maintenance standard	Service limit
0.25 - 0.35	—

Radial play of spindle

[mm]

Maintenance standard	Service limit
0.5 - 2.5	—



Clearance between valve and body

[mm]

Item			Maintenance standard	Service limit
Clearance between valve and body	One side	RF8 engine	0.4 - 0.6	—
		RG8 engine	0.8 - 1.0	—
		RE10 engine	0.4 - 0.6	—
	Both total	RF8 engine	0.8 - 1.2	—
		RG8 engine	1.6 - 2.0	—
		RE10 engine	0.8 - 1.2	—

AIR INTAKE SHUTTER AIR CYLINDER

Spring tension

[kg]

Maintenance standard	Service limit
5.5	When compressed to 102.0 mm

REASSEMBLY

When reassembling, replace all packings, O-rings, etc. with new ones. Apply the specified grease on each rotating and specified sliding surface. On sliding surfaces which are not specified, apply a coat of engine oil.

Exhaust brake air cylinder

When reassembling the air cylinder, apply a coat of Molycoat (BR2 Plus Glass grease or equivalent) to the inside of the cylinder, the shaft surface and the packing.

- 1) Install the dust seal filter and retaining ring to the cylinder.
- 2) Install the protector, spring, ring, plate, packing and retainer to the shaft and fasten the nut with the spring washer in place.

T : 1.0 - 1.6 kgm

- 3) Insert the shaft assembly in the cylinder.
- 4) Install the cover with the O-ring in place.

T : 1.0 - 1.6 kgm

Exhaust shutter

- 1) Insert the spindle, valve and bushing in the body, then fit the seal ring onto the spindle as shown in the following figure.

Note:

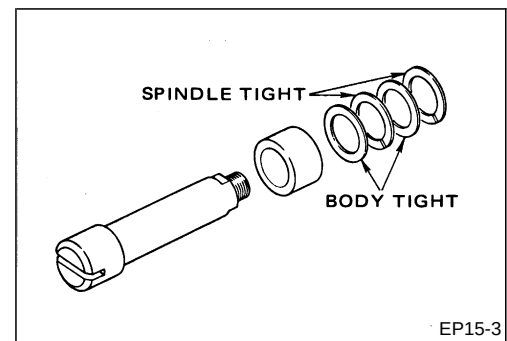
- Install the seal rings so that rings with different shapes are placed next to each other.

- 2) Install the shutter assembly to the plate.

T : 1.0 - 1.6 kgm

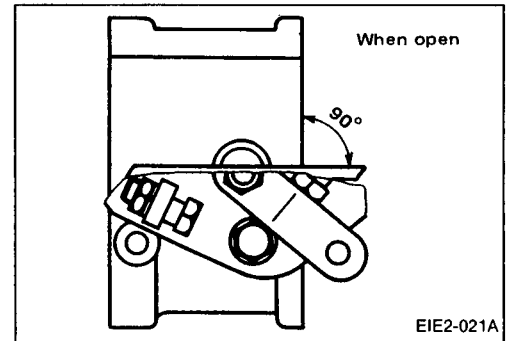
- 3) Install the lever to the spindle.

T : 1.0 - 1.6 kgm



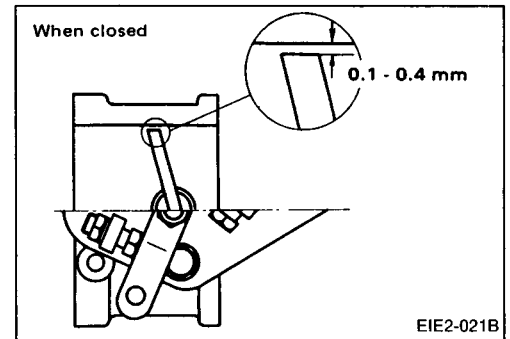
- 4) Turn the lever open all the way until it hits the stopper bolt. Adjust the stopper bolt with the lever in this position so that the valve and the body flange surface make a 90 degree angle.

Then, turn the lever shut all the way until it hits the stopper bolt again. Adjust the stopper bolt with the lever in this position so that valve-to-body clearance is 0.1 to 0.4 mm for one side, and 0.5 mm or less when both sides are added. After adjustment, fasten the stopper bolt with the lock nut.



[mm]

Item			Maintenance standard	Service limit
Clearance between valve and body	One side	RF8 engine	0.4 - 0.6	—
		RG8 engine	0.8 - 1.0	—
		RE10 engine	0.4 - 0.6	—
	Both total	RF8 engine	0.8 - 1.2	—
		RG8 engine	1.6 - 2.0	—
		RE10 engine	0.8 - 1.2	—



T : 1.0 - 1.6 kgm

Air intake shutter

< Engine models RF8, RE10 >

- 1) Fit the O-ring onto the shaft and install them to the housing.

Note:

- Be sure to apply a coat of grease (Sunlight No. 2) to the shaft grooves and O-ring.
- 2) Install the shaft to the housing, then drive in the straight pin to the housing and position the shaft.
 - 3) Install the valve to the shaft.

T : 1.9 kgm

< Engine model RG8 >

- 1) Press the oil seal into the housing and install the shaft.
- 2) Install the valve to the shaft.

Note:

- Apply a coat of locking agent. (TB1373B or equivalent)

T : 1.6 - 2.1 kgm

- 3) Secure the actuator on the housing

T : 1.6 - 2.1 kgm

Air cylinder for intake shutter

- 1) Install the dust seal and cover to the cylinder.
- 2) Install the guide, protector, spring, ring, plate, packing and retainer to the shaft and fasten the nut with the spring washer in place.

T : 1.0 - 1.6 kgm

- 3) Insert the shaft assembly in the cylinder, then install the cover with the O-ring in place.

T : 1.0 - 1.6 kgm

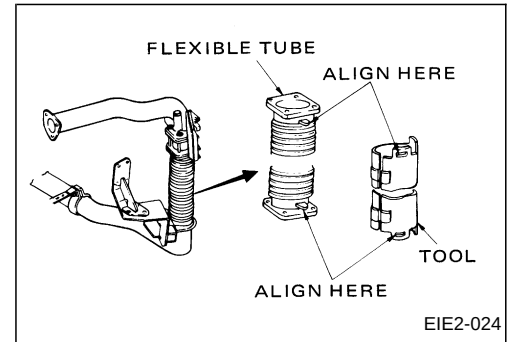
INSTALLATION

Prior to installation, connect the exhaust valve and air cylinder in advance.

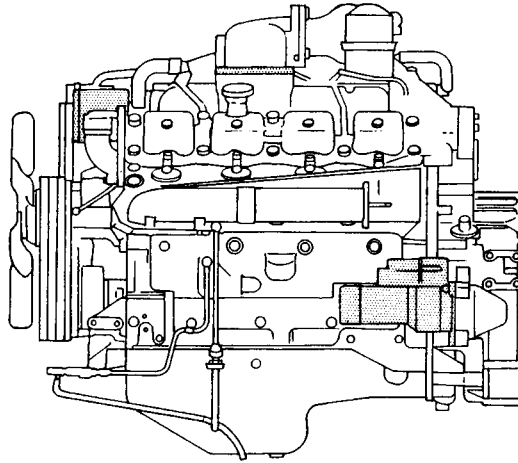
Install the air cylinder to the plate first. Then connect the shaft of the air cylinder assembly and the clevis with a pin.

Installing exhaust break

- 1) Fit the gasket onto the exhaust break assembly and temporarily tighten the exhaust shutter mounting bolt.
- 2) Align the jig for installing flexible tube (99780 97502).
- 3) Tighten the exhaust shutter mounting bolt securely.
- 4) Tighten the exhaust tube clamp securely.
- 5) Remove the jig for installing the flexible tube.
- 6) Connect the air hose with the air cylinder.
- 7) Install the exhaust break cover, engine room cover and other covers.



11. ELECTRICAL SYSTEM



ER0-128

The electrical system consists of a starting motor, alternator, etc.

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CONSTRUCTION	11-20		

SPECIFICATIONS

STARTING MOTOR

Item	Model	0350-602-0320	0350-702-0390	0350-802-0030
Type	Shift			
Output	[V-kW]	24-6.0	24-7.0	24-8.0
Rated time	[Second]	30		
Applicable engine model		RF8	RG8	RE10

ALTERNATOR

Item	Model	0201-102-2972	0201-152-0052
Output	[V-A]	24-40	24-50
Type of regulator	IC transistor (Built-in)		
Applicable engine model	RF8, RG8, RE10		

AIR HEATER

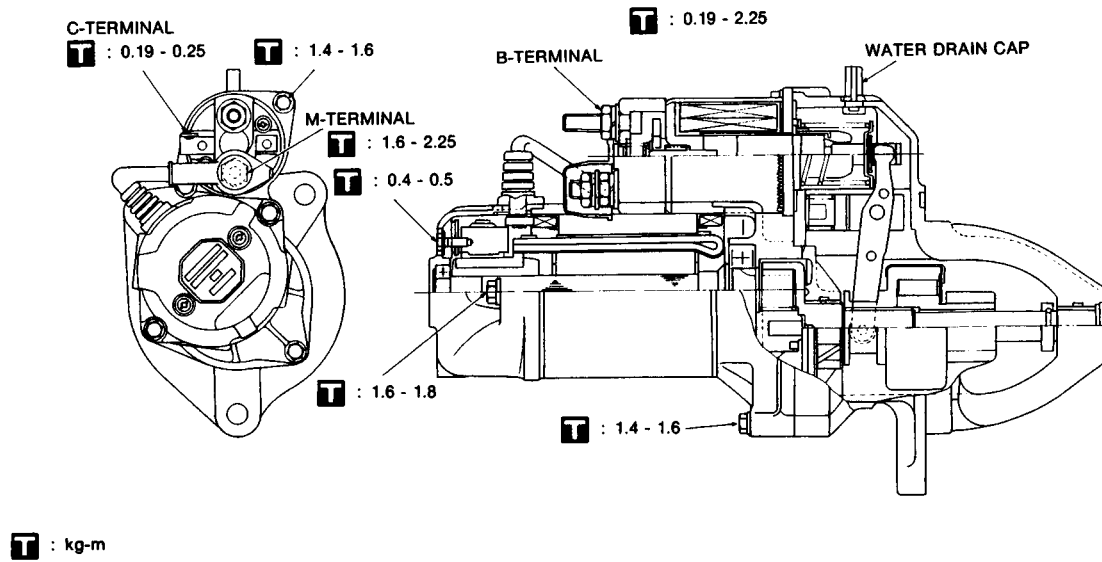
Type	Ribbon		
Rated current [V-A]	RF8, RE10	22.5-85, 22.5-170	
	RG8	22.5-85	
Rated time	[Second]	60, max.	

STARTING MOTOR

— MODELS: 0350 602 0320, 0350 702 0390 and 0350 802 0030 —

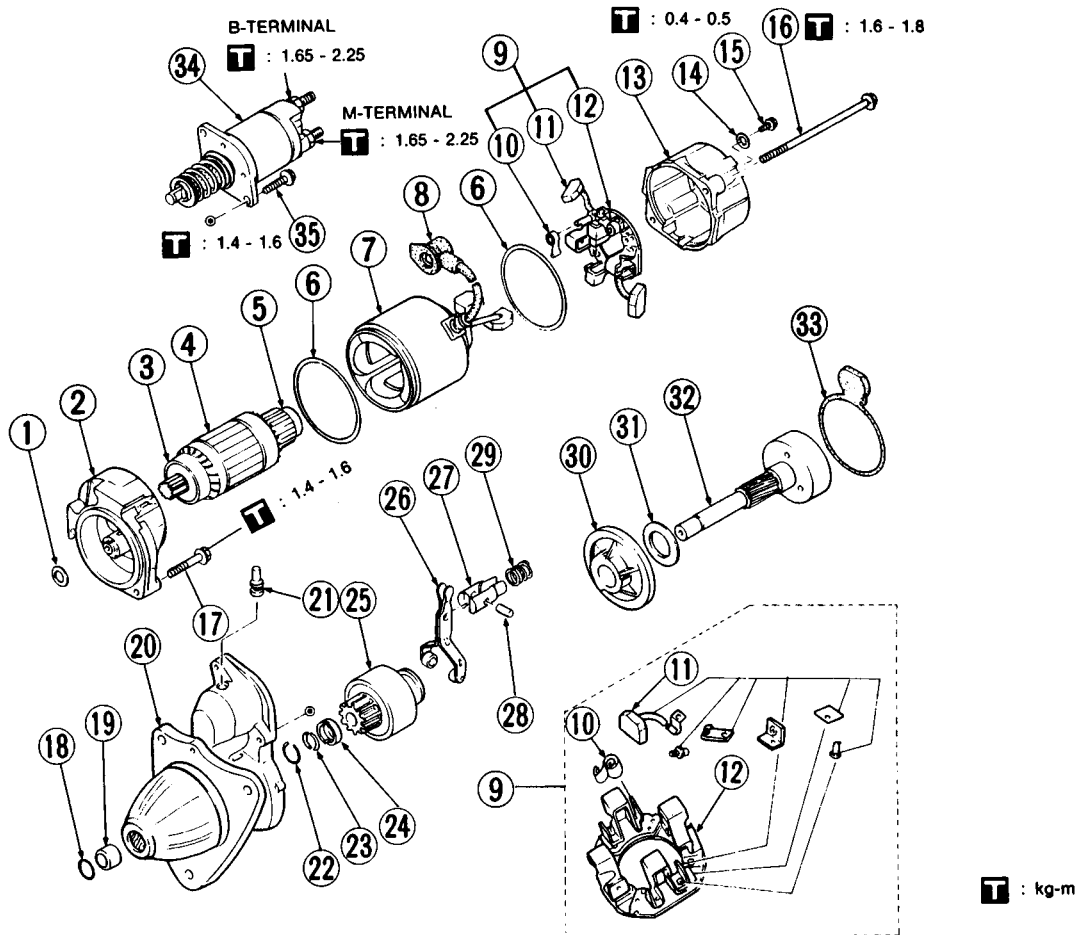
CONSTRUCTION

Construction illustration



EEE2-003G

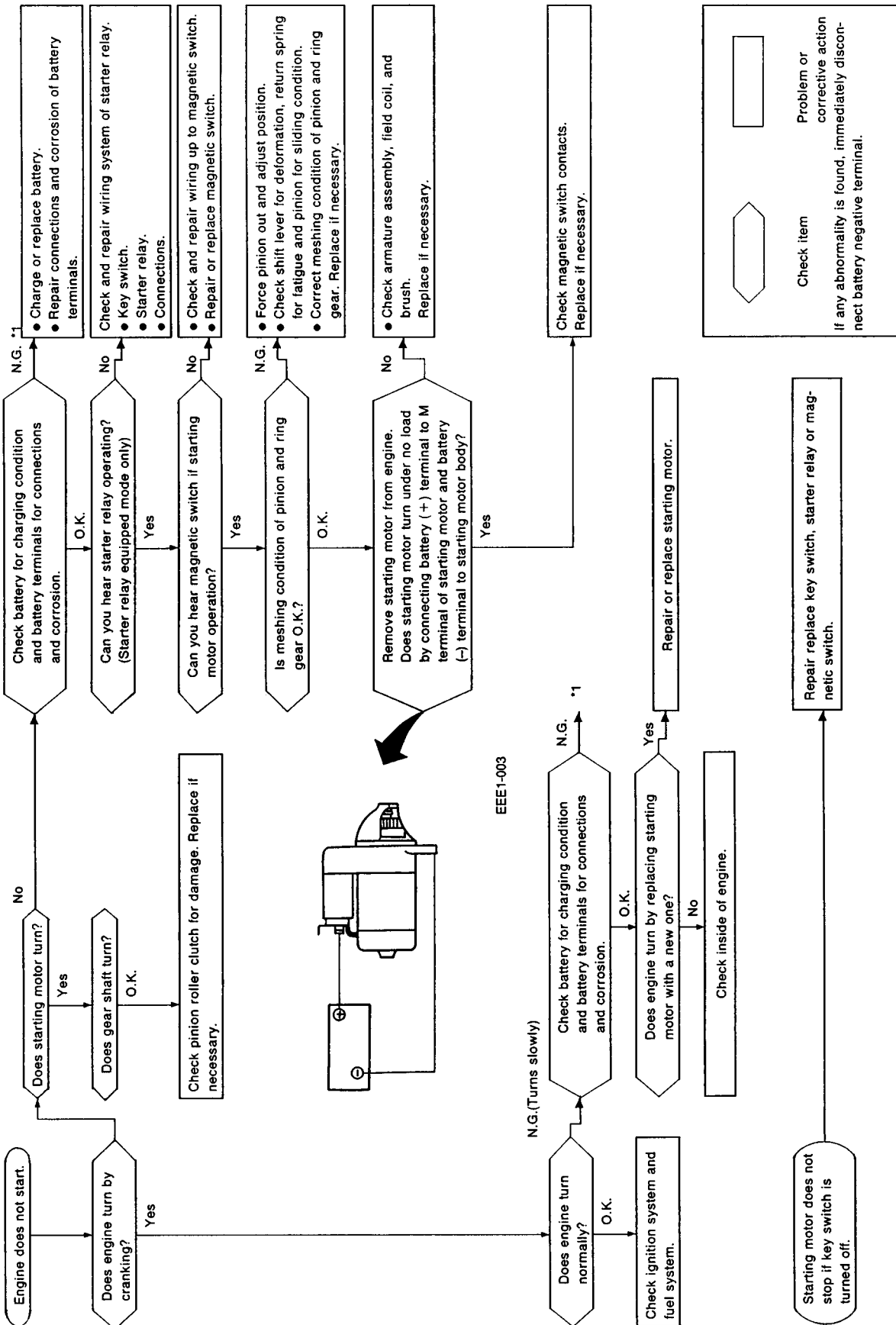
Exploded illustration



EEE2-004H

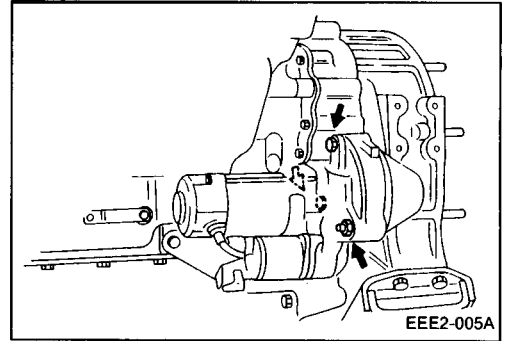
- | | | |
|-------------------------|-------------------|-----------------------|
| ① Shim washer | ⑬ Rear bracket | ②⑤ Pinion assembly |
| ② Gear case | ⑭ Washer | ②⑥ Shift lever |
| ③ Ball bearing | ⑮ Screw | ②⑦ Shift lever holder |
| ④ Armature assembly | ⑯ Through bolt | ②⑧ Rod |
| ⑤ Bearing | ⑰ Bolt | ②⑨ Coil spring |
| ⑥ O-ring | ⑱ Cover | ③⑩ Center holder |
| ⑦ Yoke assembly | ⑲ Metal | ③⑪ Shim washer |
| ⑧ Cable assembly | ⑳ Pinion case | ③⑫ Pinion shaft |
| ⑨ Brush holder assembly | ㉑ Water drain cap | ③⑬ Packing |
| ⑩ Brush spring | ㉒ Retaining ring | ③⑭ Engage switch |
| ⑪ Brush | ㉓ Hook | ③⑮ Bolt |
| ⑫ Brush holder | ㉔ Pinion stopper | |

TROUBLESHOOTING



REMOVAL

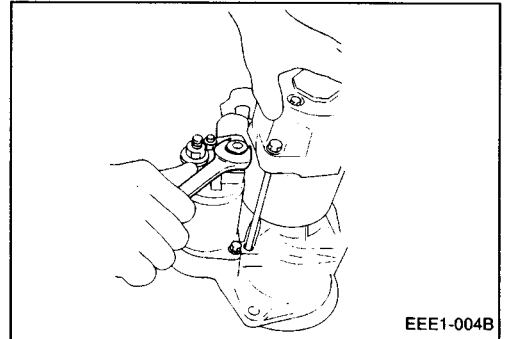
- 1) Turn the key switch off and disconnect the cable from the negative terminal of the battery.
- 2) Remove the engine under cover and other covers.
- 3) Remove the harness and so on from the starter motor.
- 4) Remove the starter motor assembly.



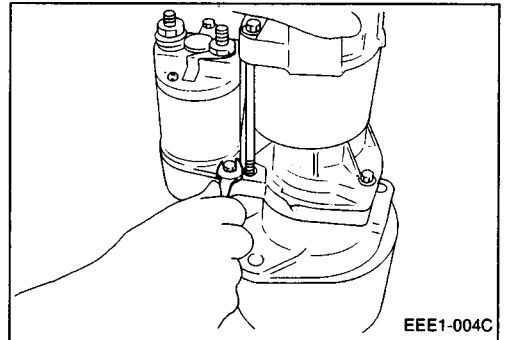
DISASSEMBLY

REMOVING THE MAGNETIC SWITCH ASSEMBLY

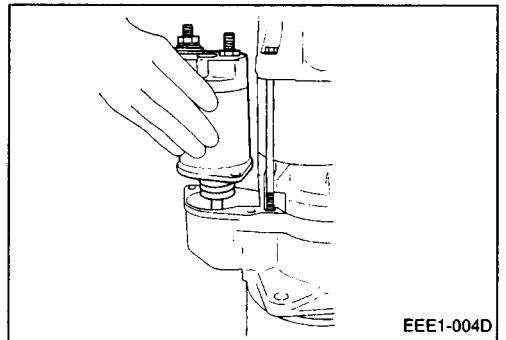
- 1) Shift the terminal cover and remove terminal nut M.
- 2) Disconnect the M lead wire from terminal M.



- 3) Remove the set bolts of the magnetic switch assembly.



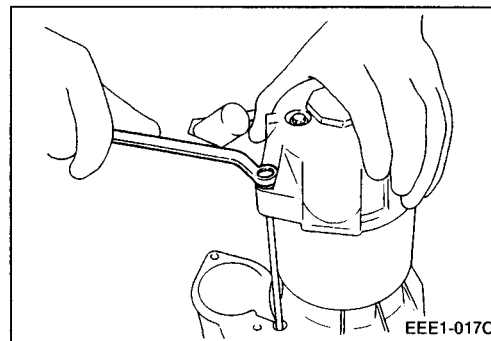
- 4) Pull the switch to remove.



- 5) Remove the moving core. (Disconnect it from the lever.)

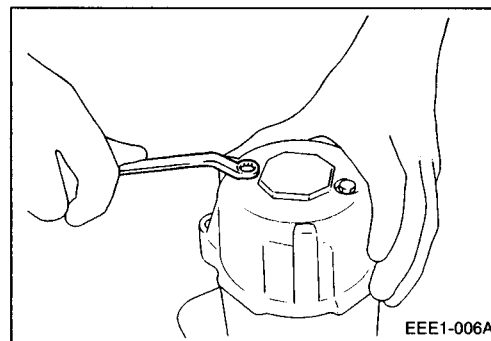
REMOVING THE THROUGH BOLTS

- Remove the two through bolts.

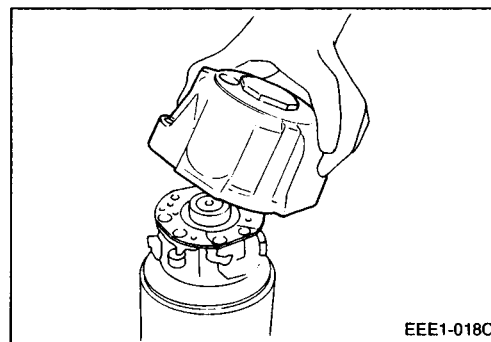


REMOVING THE BRUSH HOLDER ASSEMBLY

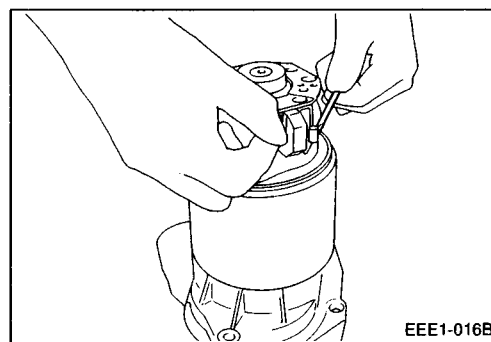
- 1) Remove the set bolts of the brush holder assembly.



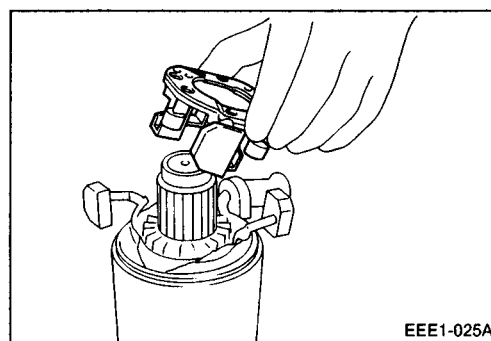
- 2) Remove the rear bracket.



- 3) Raise the brush spring and take out the brush.

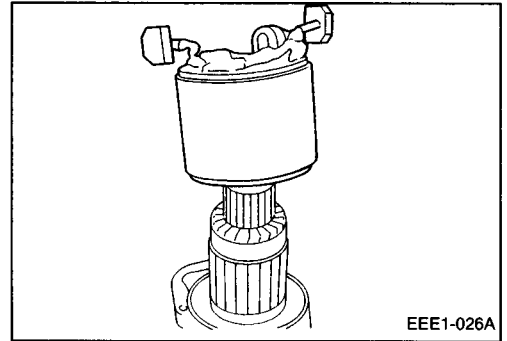


- 4) Remove the brush holder assembly.



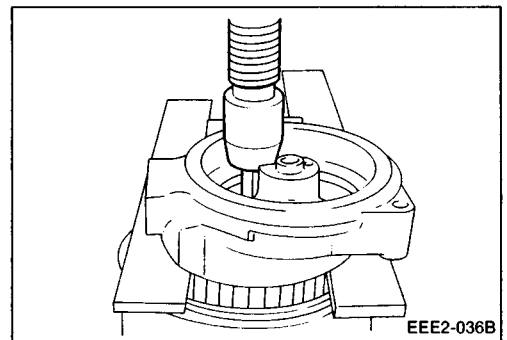
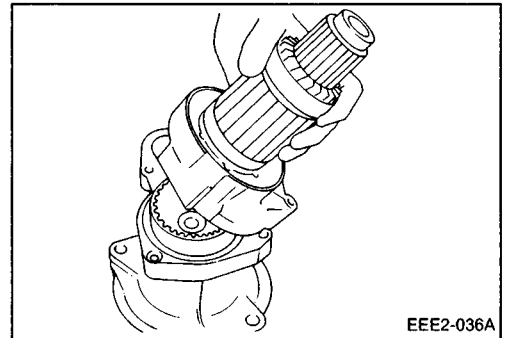
REMOVING THE YOKE & FIELD

- Separate the yoke & field from the gearcase.



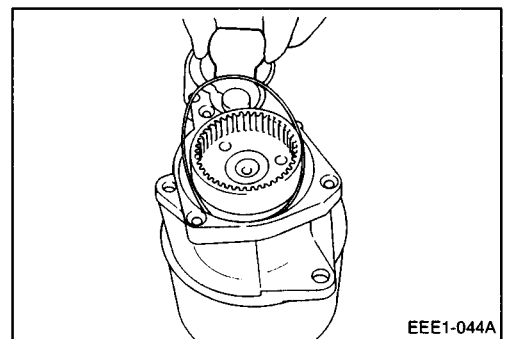
REMOVING THE ARMATURE ASSEMBLY

- 1) Remove the set bolt.
- 2) Separate the armature assembly together with the gearcase from the pinion case.
- 3) Remove the armature assembly from the gear case. (Push the armature gear with a press.)

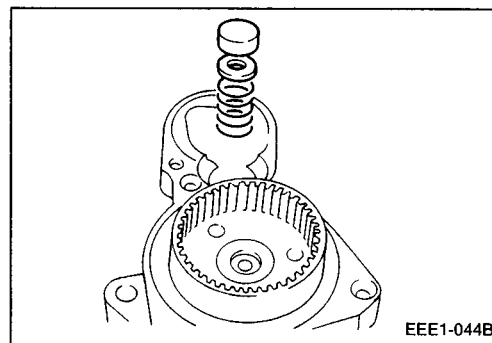


REMOVING THE PINION CLUTCH

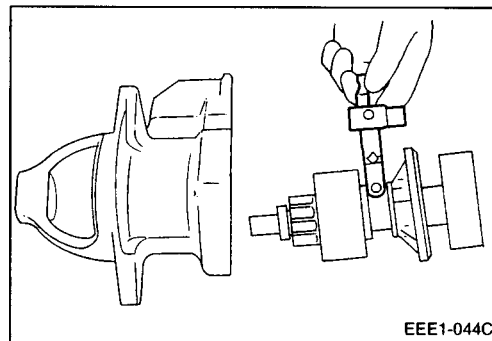
- 1) Remove the packing.



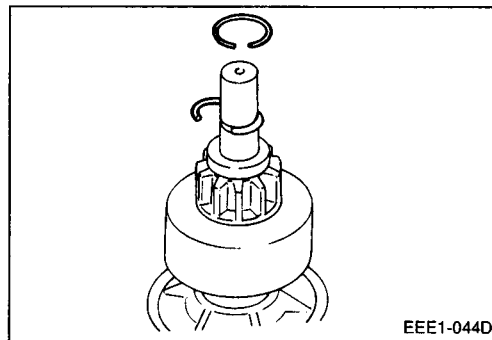
2) Remove the collar and the packing.



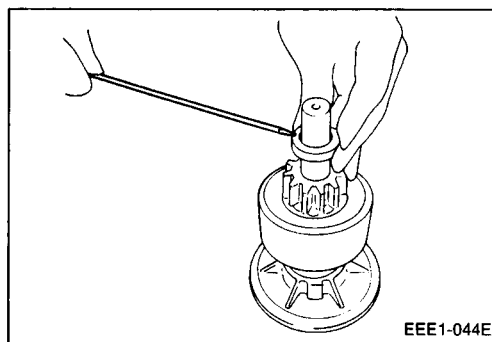
3) Remove the lever, pin, etc. from the pinion case. (With the pinion installed on the shaft)



4) Remove the clip. (Remove the clip from the pinion stopper groove by pushing the clip inward.)

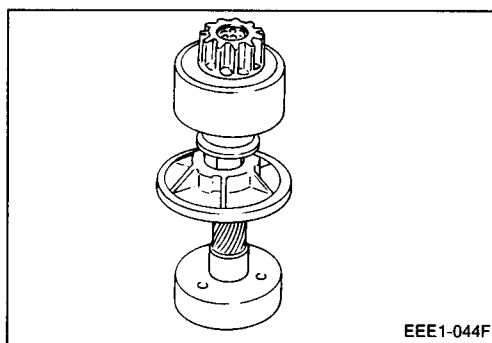


5) Lower the pinion stopper and remove the two hooks.



6) Separate the pinion clutch from the shaft.

7) Separate the holder-center from the shaft.



INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect the parts for cracks and other damage carefully. If faulty, replace with a new one.

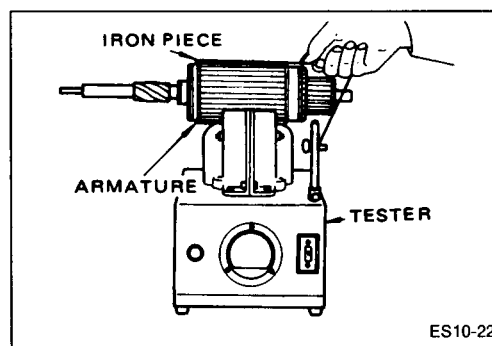
Note:

- If a maintenance standard table is not classified by model, it shows that the reference value is the same for both models.

ARMATURE COIL

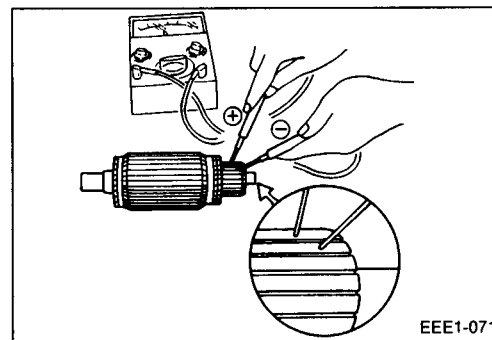
Coil layer

Check with a growler tester. If the iron piece vibrates when the armature is turned while it is contacting the armature core mounted to the growler tester, the armature is shorted and must be replaced.



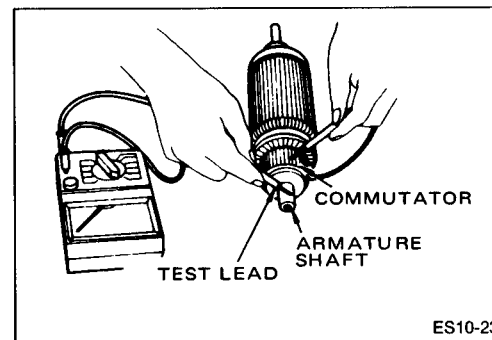
Continuity test

Make sure there is continuity between the segments.



Coil insulation test

Check the insulation between commutator and shaft. If there is continuity, the armature coil and shaft insulation is faulty, and should therefore be replaced.

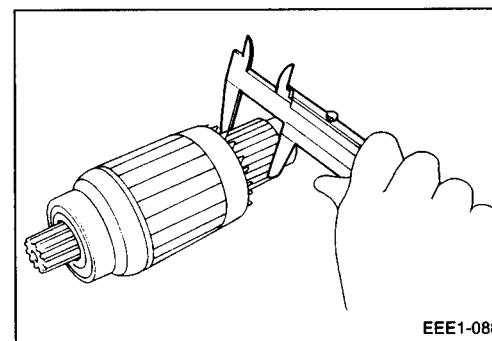


Outside diameter of the commutator

[mm]

Model	Maintenance standard	Service limit
0350-602-0320	40.0	38.0, max.
0350-702-0390	44.0	42.0
0350-802-0030		

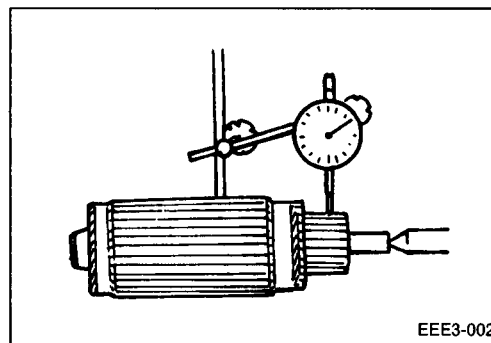
When the sliding surface is rough, polish it with #500 or #600 sandpaper prior to measurement.



Runout

[mm]

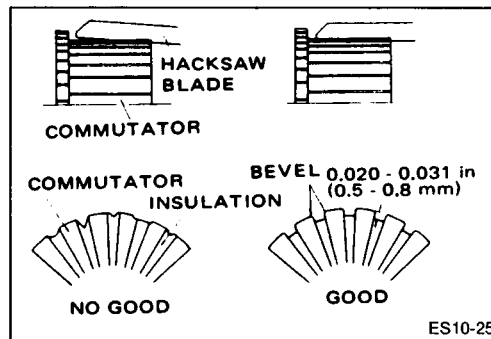
Maintenance standard	Service limit
0.05, max.	0.1



Depth of undercut

[mm]

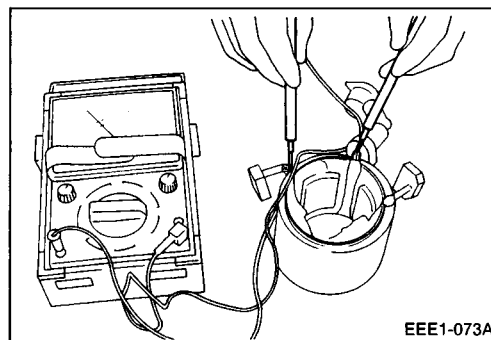
Maintenance standard	Service limit
0.5 - 0.8	0.2



YOKE & FIELD COIL

Continuity test

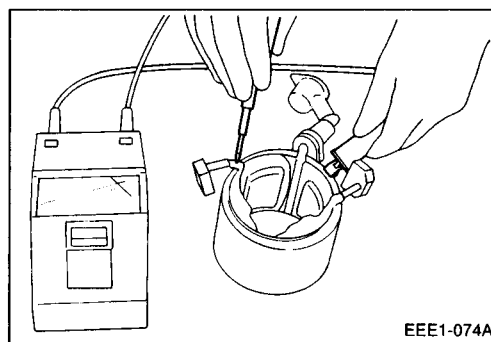
Check for continuity between terminals connecting the field coil's brushes.



Insulation test

[MΩ]

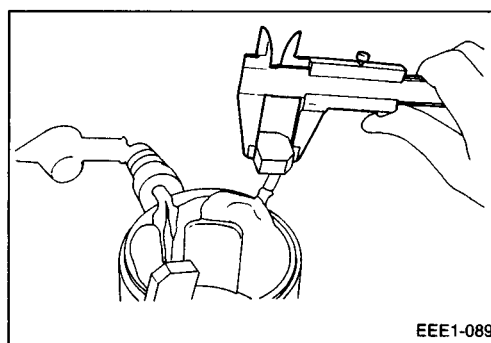
Maintenance standard	Service limit
1, min.	0.5, max.



Brush height

[mm]

Model	Maintenance standard	Service limit
0350-602-0320	20.0	14, max.
0350-702-0390	22.0	15
0350-802-0030		

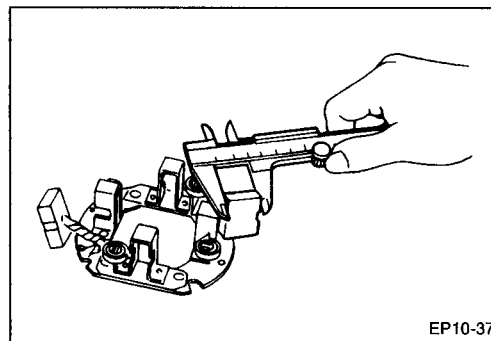


BRUSH & BRUSH HOLDER

Brush height

[mm]

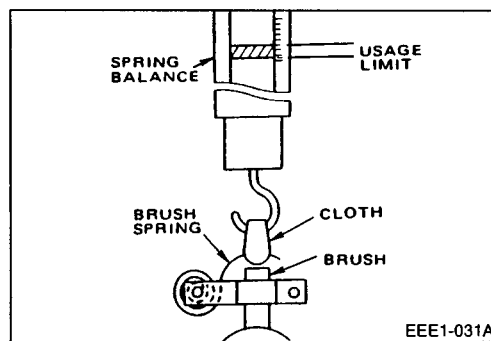
Model	Maintenance standard	Service limit
0350-602-0320	20.0	14, max.
0350-702-0390	22.0	15, max.
0350-802-0030		



Brush spring tension

[kg]

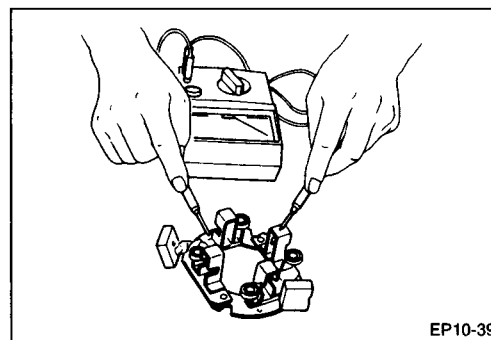
Model	Maintenance standard	Service limit
0350-602-0320	3.0	2.1, max.
0350-702-0390	2.8	1.96, max.
0350-802-0030		



Insulation test

[MΩ]

Maintenance standard	Service limit
1, min.	0.5, max.

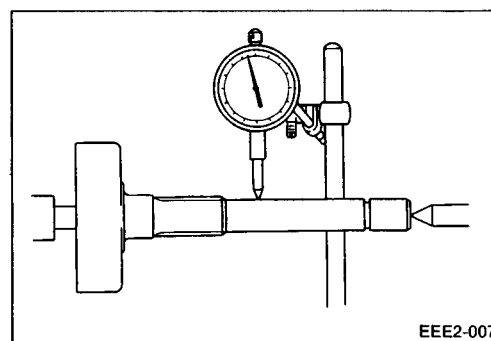


OUTPUT SHAFT

Shaft runout

[mm]

Maintenance standard	Service limit
0.05, max.	0.1, min.

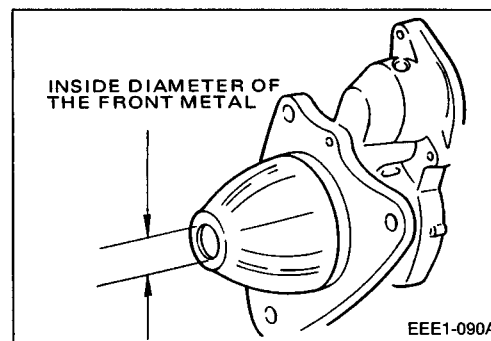


BRACKET (METAL)

Inside diameter of the front metal

[mm]

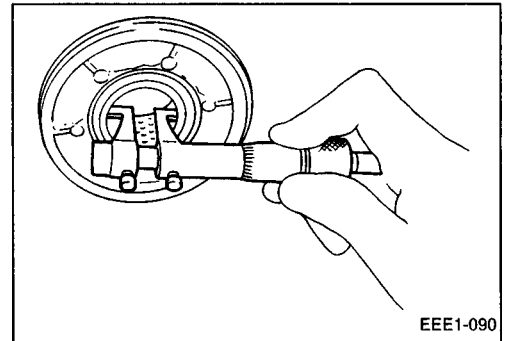
Model	Maintenance standard	Service limit
0350-602-0320	19.0	19.2
0350-702-0390	20.0	20.2
0350-802-0030		



Inside diameter of the holder metal

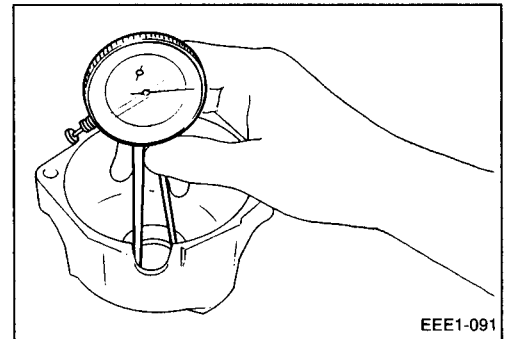
[mm]

Model	Maintenance standard	Service limit
0350-602-0320	28.0	28.2
0350-702-0390	35.0	35.2
0350-802-0030		

**Inside diameter of the rear bracket (bearing fitting portion)**

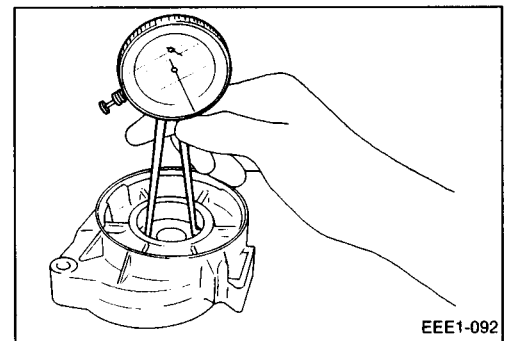
[mm]

Model	Maintenance standard	Service limit
0350-602-0320	32.0	32.1
0350-702-0390	35.0	35.1
0350-802-0030		

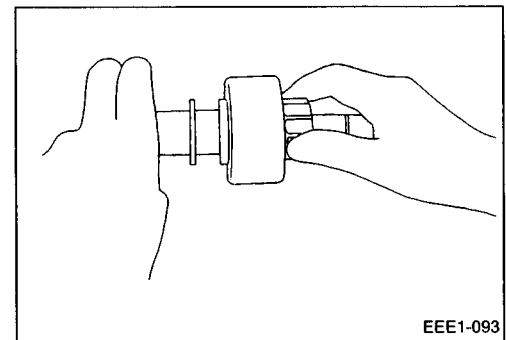
**Inside diameter of the gear case**

[mm]

Model	Maintenance standard	Service limit
0350-602-0320	52.0	52.1
0350-702-0390	62.0	62.1
0350-802-0030		

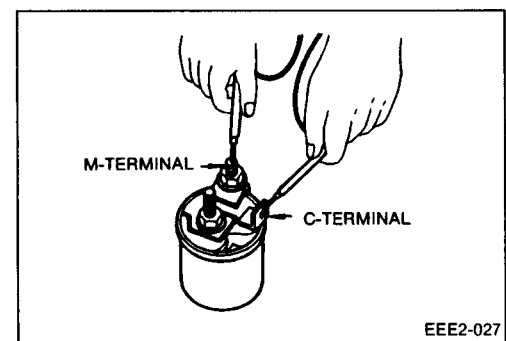
**PINION & CLUTCH****Clutch effect**

Install the pinion and clutch onto the output shaft and turn the gear while supporting the shaft. It is OK if the shaft turns only in one direction, but not in the opposite direction.

**MAGNETIC SWITCH****Continuity test (Series coil resistance)**

[Ω]

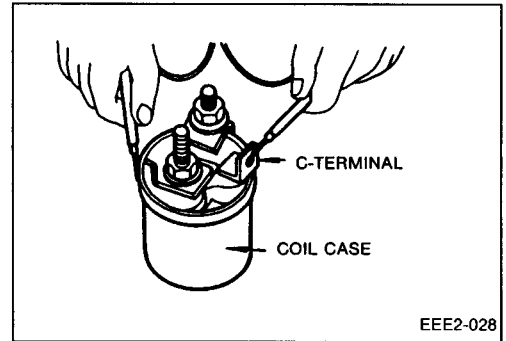
Maintenance standard	Service limit
0.12 - 0.15	—



Continuity test (Shunt coil resistance)

[Ω]

Model	Maintenance standard	Service limit
0350-602-0320	0.6 - 0.8	—
0350-702-0390	0.4 - 0.5	—
0350-802-0030		



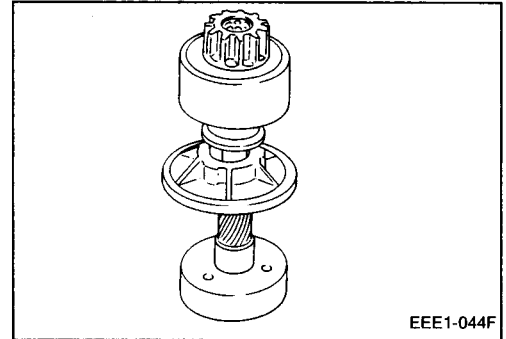
REASSEMBLY

INSTALLING THE PINION CLUTCH ASSEMBLY

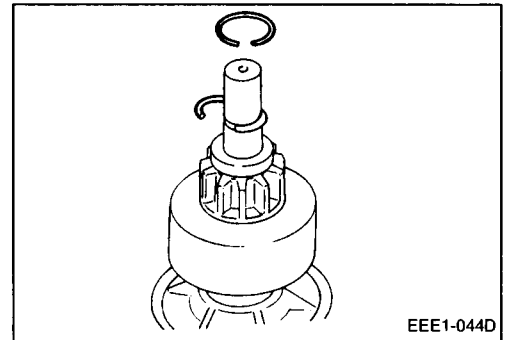
- 1) Insert a shim onto the shaft and install the holder.
- 2) Install the pinion clutch.

Note:

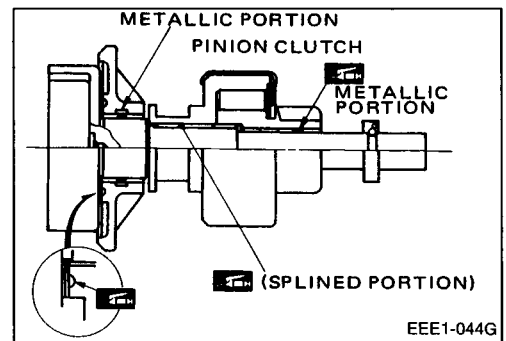
- Be sure to insert a shim.



- 3) Install the pinion stopper.



- 4) Apply a coat of grease to the metallic portion and shim.

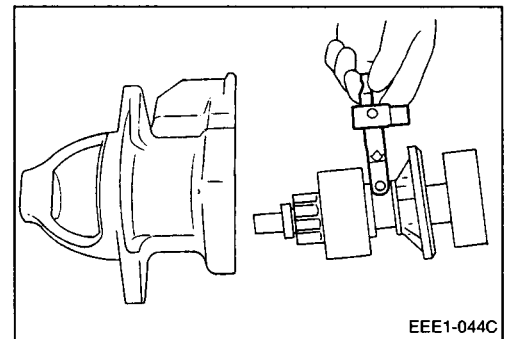


INSTALLING THE FRONT PARTS

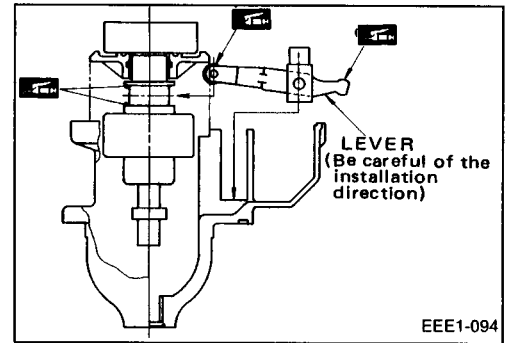
- 1) Install the lever and holder.
- 2) Install the lever roller onto the pinion clutch shifter.
- 3) Install the lever and shaft into the pinion case.
- 4) Make sure the holder slides lightly into the innermost part of the pinion case.

Note:

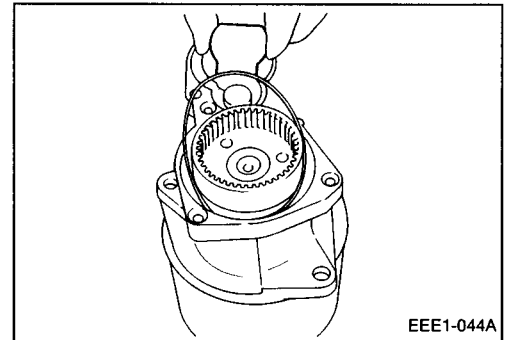
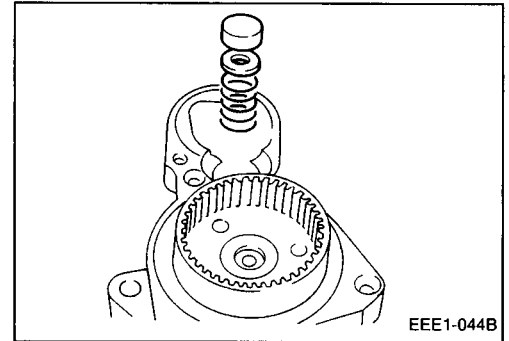
- Be careful not to install the lever in the wrong direction.



- 5) Install the spring and collar onto the lever holder.

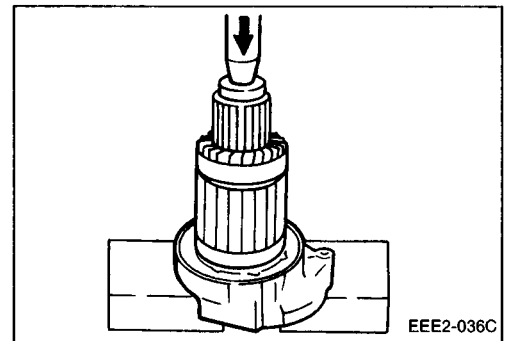


- 6) Install the packing O-ring so that it fits the outer circumference of the center holder.



INSTALLING THE ARMATURE

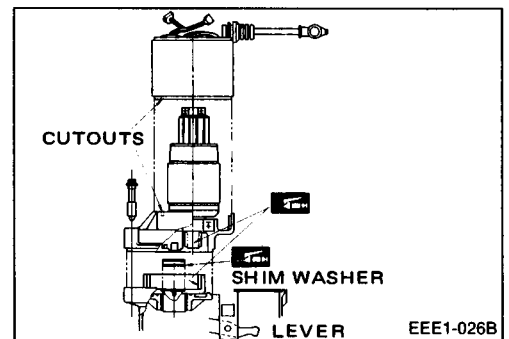
- 1) Press-fit the armature into the gear case using a press.



- 2) Install a shim (0.2 mm thick) onto the projection of the gear case.
 3) Attach the pinion case to the gear case and tighten the bolts.
 4) Install the yoke and field coil. (Install by aligning the cutout portions.)

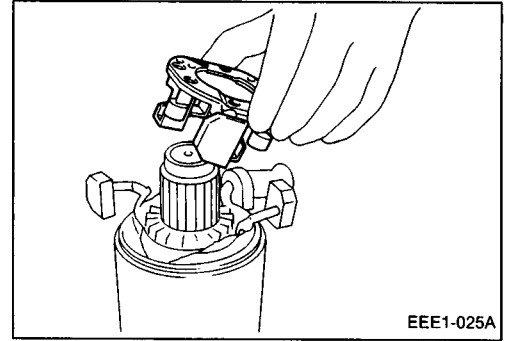
Note:

- Be sure to install a shim as it supports the thrust load of the shaft after installation.

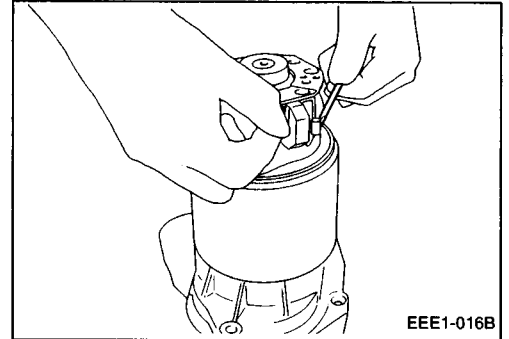


INSTALLING THE BRUSH HOLDER

- 1) Insert the holder into the commutator.
- 2) Align the holder locating part with the M lead.

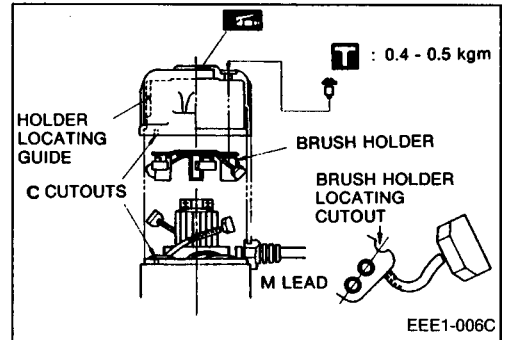


- 3) Raise the spring and insert the brush into the holder. (The brush on the field coil side should be inserted into the positive holder.)



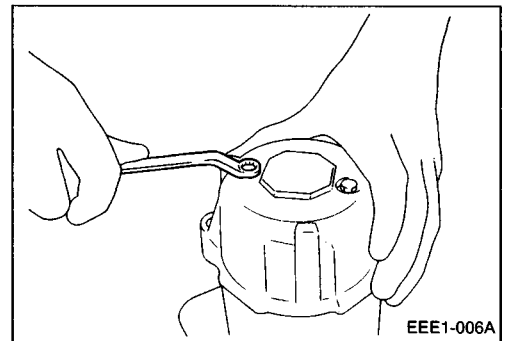
INSTALLING THE REAR PARTS

- 1) Align the rear bracket locating guide with the holder locating part and insert the holder into the rear bracket.



- 2) Tighten the brush holder set bolts.

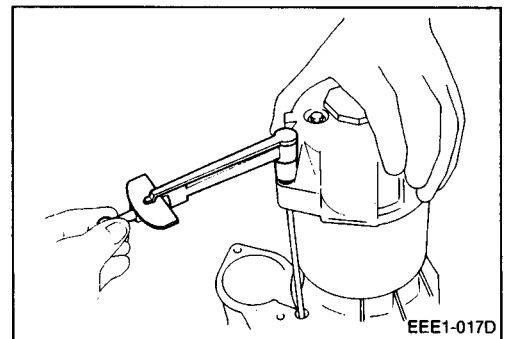
T : 0.4 - 0.5 kgm



TIGHTENING THE THROUGH BOLTS

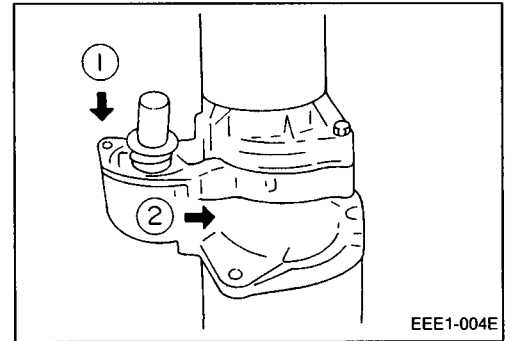
- Using a torque wrench, tighten the through bolts.

T : 1.60 - 1.80 kgm

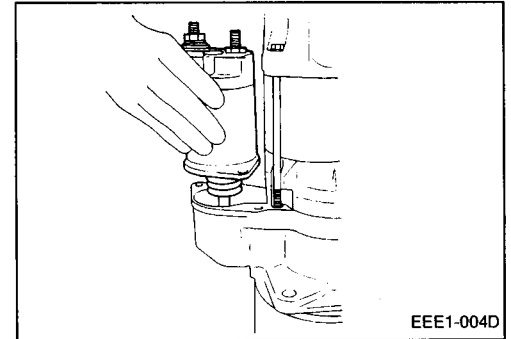


INSTALLING THE MAGNETIC SWITCH ASSEMBLY

- 1) Install the moving core onto the lever in the sequence of ① and ②.

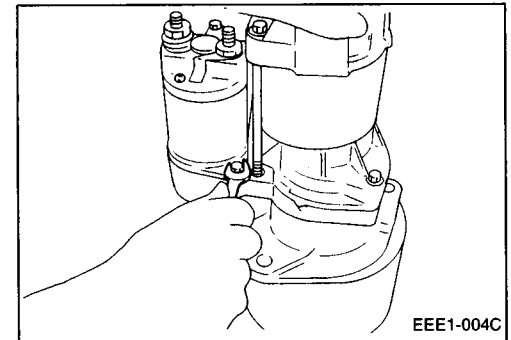


- 2) Align the magnetic switch with the moving core.



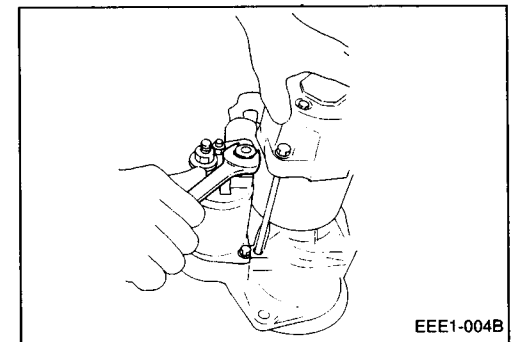
- 3) Tighten the set bolts.

T : 1.40 - 1.60 kgm



- 4) Install the M lead onto the magnetic switch M terminal.
- 5) Tighten using the nut.

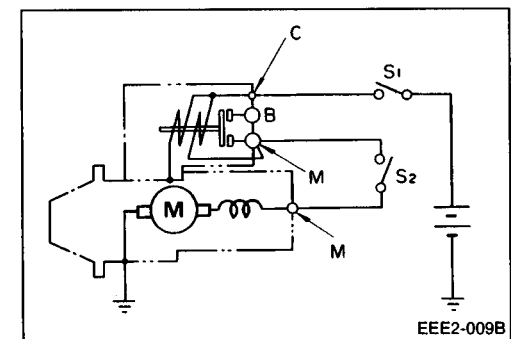
T : 1.65 - 2.25 kgm



ADJUSTMENT

Measure and check the clearance between the pinion and pinion stopper when the pinion is pushed out by the magnetic switch.

- 1) Connect the wires inserting (a) the switch S1 between the C terminal of the magnetic switch and the battery and (b) the switch S2 between the M terminal and the M terminal of the motor section.
- 2) Turn on the switch S1 and turn off the switch S2. Then turn on the switch S2 after checking to make sure that the pinion has slid.

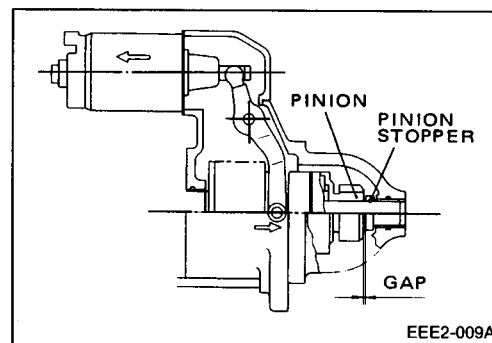


- 3) In 2), measure the clearance between the pinion and pinion stopper when the pinion is slightly pushed back.

[mm]

Maintenance standard	Service limit
0.3 - 0.5	—

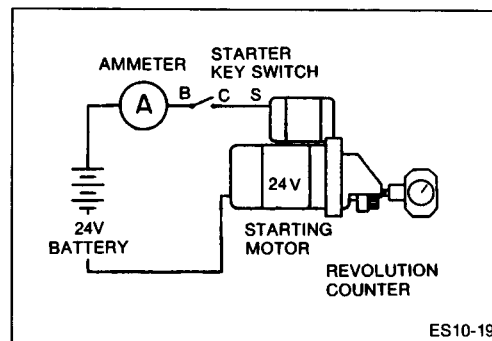
- 4) If the clearance is out of the maintenance standard, replace the starter motor assembly with a new one. (Clearance cannot be adjusted.)



INSPECTION AFTER REASSEMBLY (WITHOUT ANY LOAD)

Connect the wires as shown in the following figure. Then turn off the key switch and measure the current and motor speed rotating the starter motor with the terminal voltage of 24V.

Item		Maintenance standard	Service limit
Current [A]	0350-602-0320	Less than 100	—
	0350-802-0030		
	0350-702-0390	Less than 120	—
RPM [rpm]	0350-602-0320	More than 4,000	—
	0350-802-0030		
	0350-702-0390		



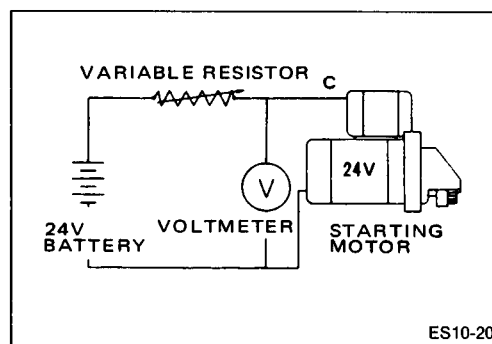
- 1) Turn the switch on and off to ensure that the pinion gear pops smoothly in and out.

- 2) Measure the lowest voltage required for the pinion gear to pop out. Prepare a variable resistor, a battery and a voltmeter as testing devices and connect the wires as shown in the following figure.

For this purpose, set the resistance to a high level to keep the voltage applied to the starter motor low at first. Then gradually decrease the resistance to increase the voltage.

[V]

Model	Maintenance standard	Service limit
0350-602-0320	Less than 16	—
0350-702-0390		
0350-802-0030		

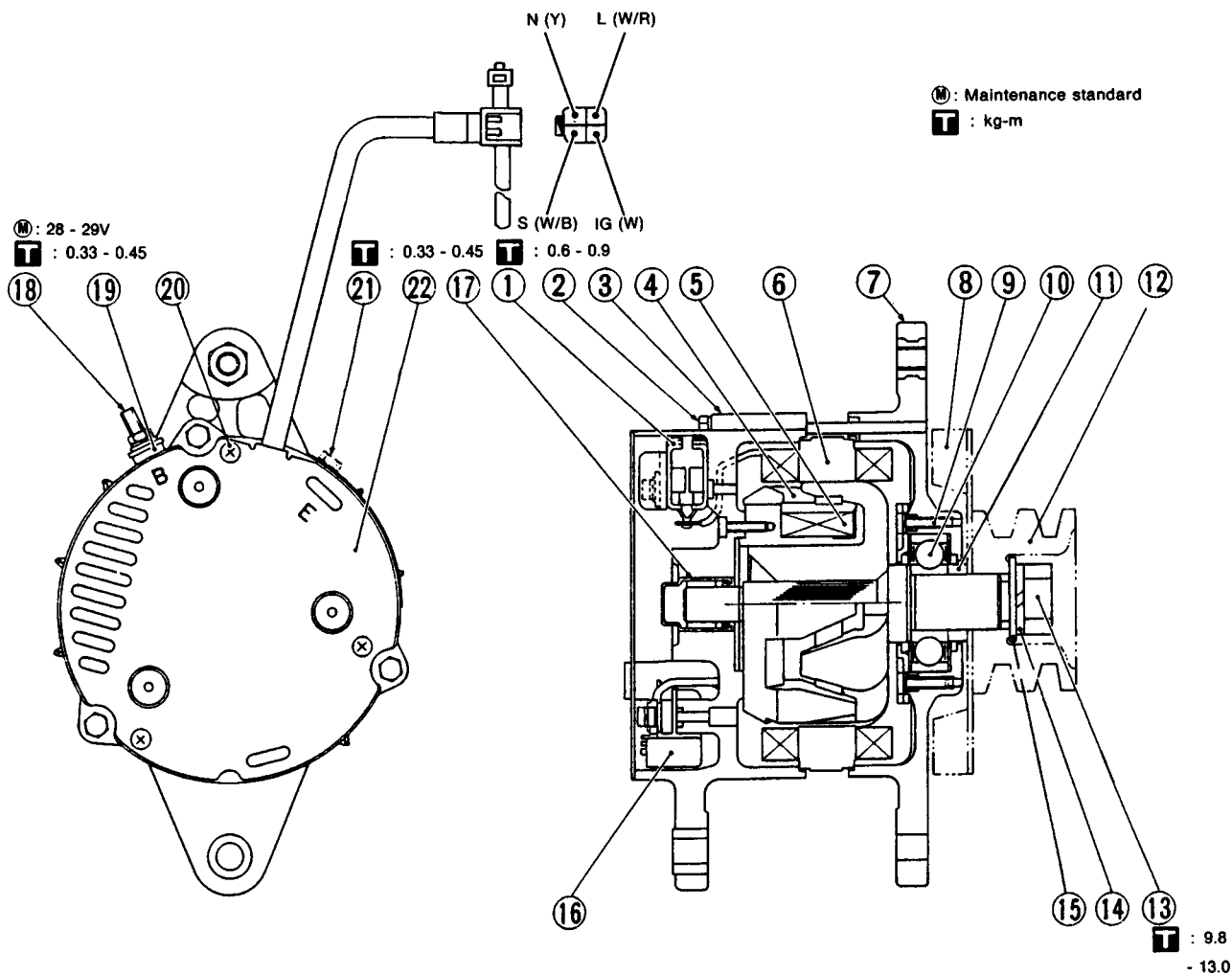


ALTERNATOR

— MODELS: 0201-102-2972 and 0201-152-0052 —

CONSTRUCTION

Construction illustration



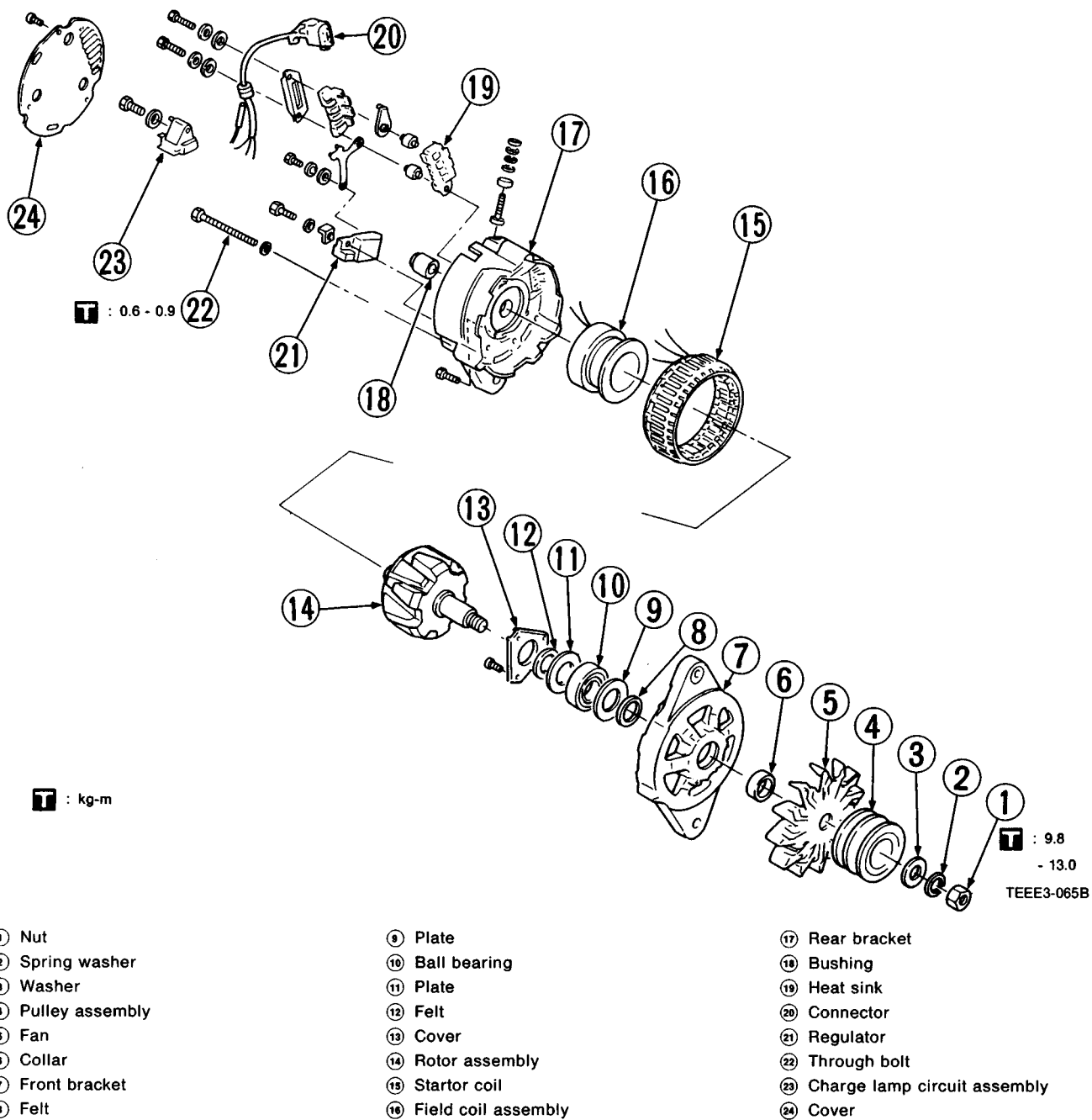
EEE1-011U

- ① Heat sink
- ② Through bolt
- ③ Rear bracket
- ④ Rotor assembly
- ⑤ Field coil assembly
- ⑥ Stator coil
- ⑦ Front bracket
- ⑧ Fan

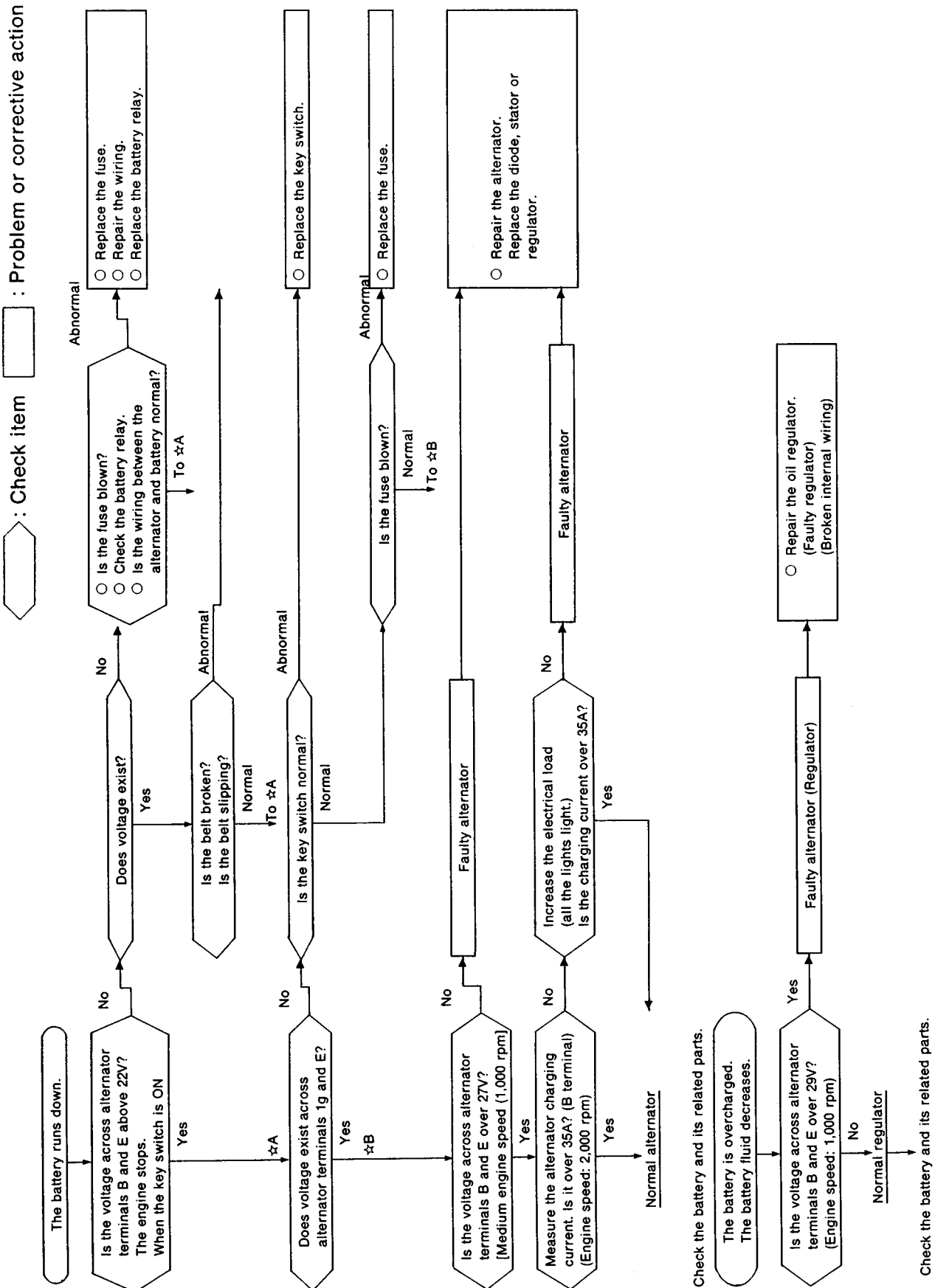
- ⑨ Screw
- ⑩ Ball bearing
- ⑪ Collar
- ⑫ Pulley assembly
- ⑬ Nut
- ⑭ Spring washer
- ⑮ Washer

- ⑯ Regulator assembly
- ⑰ Bushing
- ⑱ Terminal B
- ⑲ Insulator
- ⑳ Screw
- ㉑ Terminal E
- ㉒ Cover

Exploded illustration

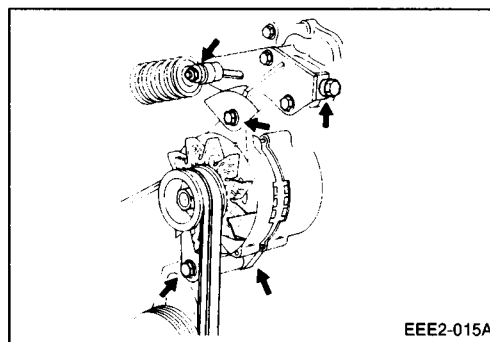


TROUBLE SHOOTING



REMOVAL

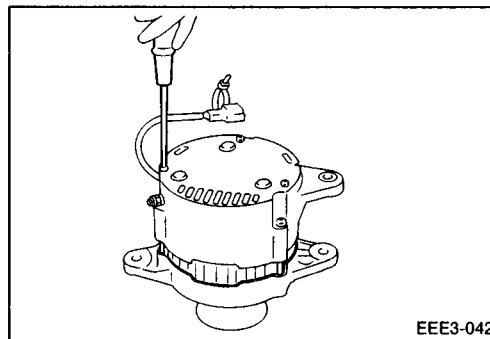
- 1) Turn the key switch off, then disconnect the cable from the negative terminal of the battery.
- 2) Tilt the cab.
- 3) Disconnect the wiring harness connector from the alternator.
- 4) Lower the tension of the adjust bar and remove the V-belt from the alternator pulley.
- 5) Remove the adjust bar and the alternator mounting bolt. Then remove the alternator assembly from the engine.



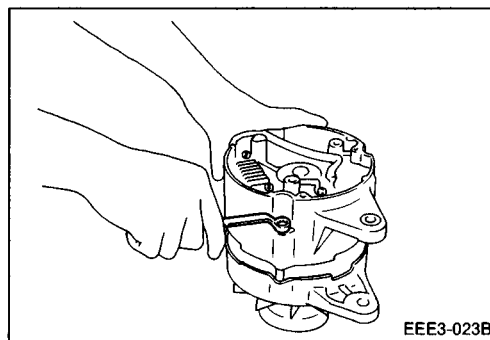
DISASSEMBLY

DISASSEMBLING THE FRONT PARTS

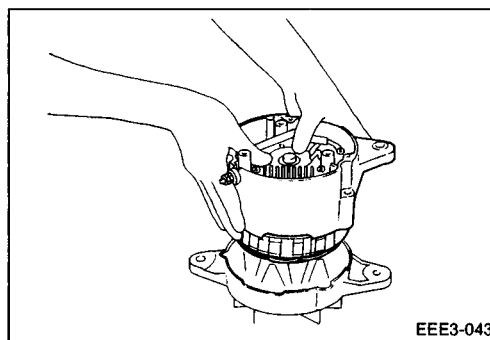
- 1) Remove the cover.



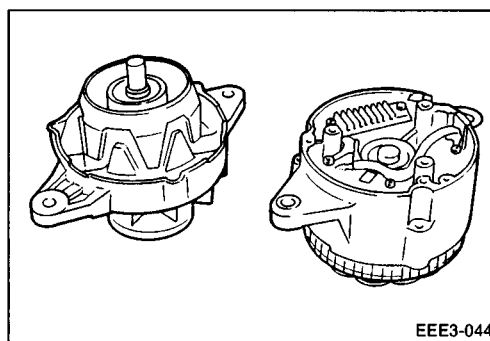
- 2) Remove the three (3) through bolts.



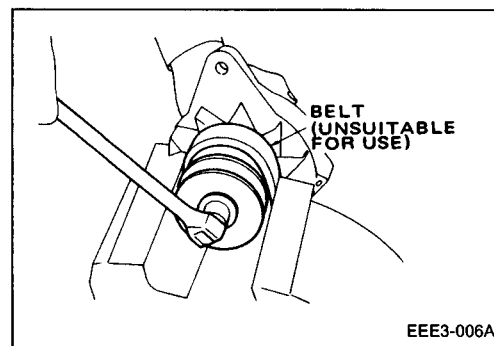
- 3) Separate the front part from the rear part.
 - To do this, raise the stator together with the rear bracket.



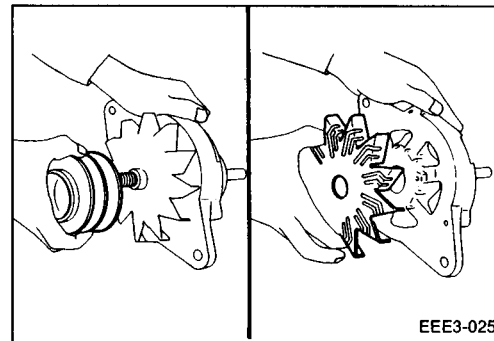
- Separate the stator from the rear bracket.



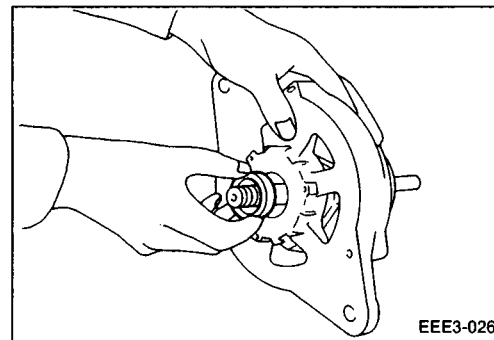
- 4) Remove the pulley assembly.
- Wrap the V-groove of the pulley with an old belt (unsuitable for use), and place the pulley in a vise.
 - Remove the nut securing the pulley.



- Remove the pulley and fan.



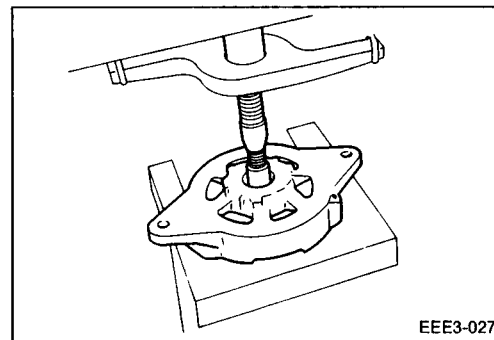
- Remove the collar.



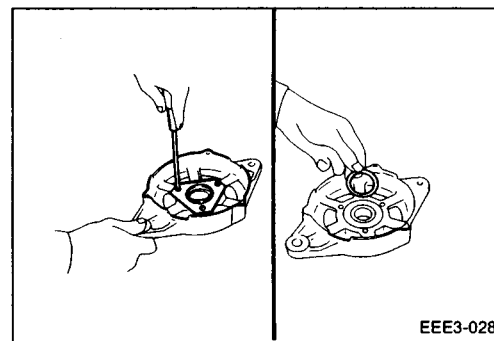
- 5) Extract the rotor.
- Remove rotor from the front bracket using a press.

Note:

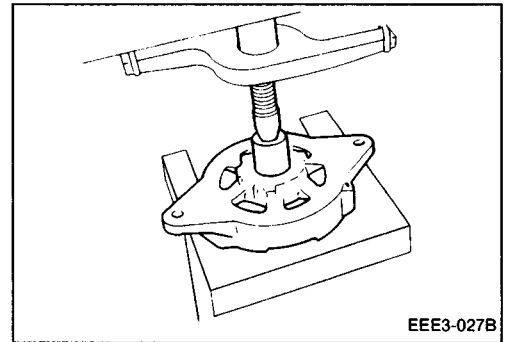
- **Support the rotor during removal. Otherwise, it will drop to the floor.**



- 6) Separate the front bearing.
- Loosen the three setscrews and remove the bearing cover.
 - Remove the felt and D-plate.

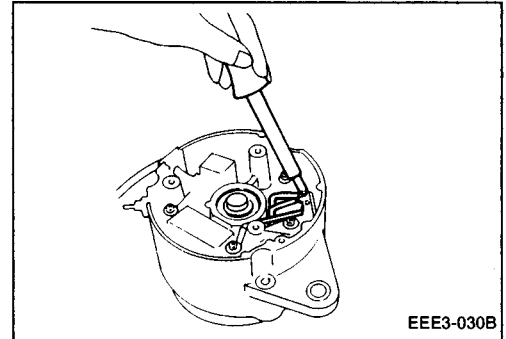


- Remove the ball bearing from the front bracket using a press.

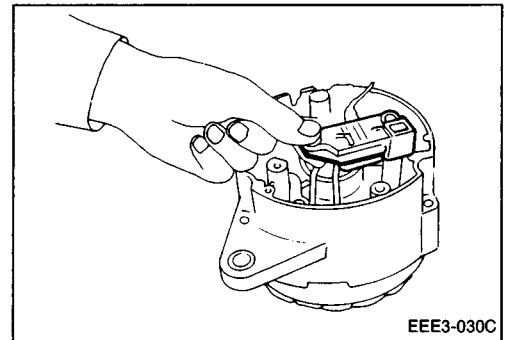


DISASSEMBLING THE REAR PARTS

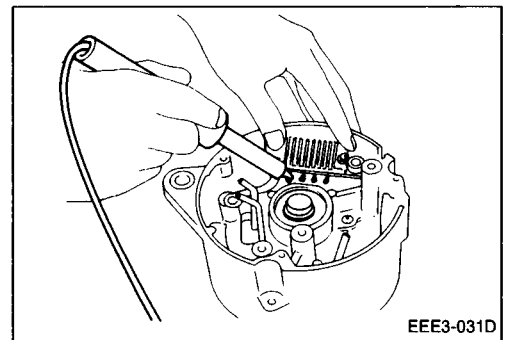
- 1) Remove the IC-regulator.
 - Remove the N lead (soldered portion) from the stator.
 - Remove the soldered portions of the lead wires (R, L, N) from the coupler.



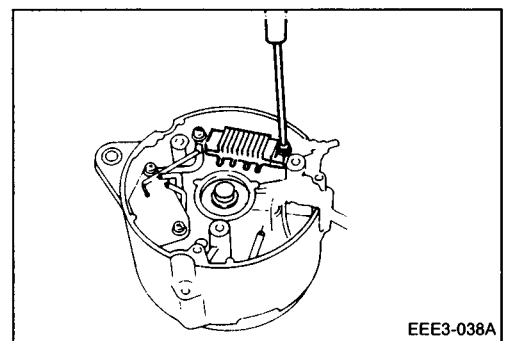
- Remove the two setscrews from the IC-regulator, and remove the regulator. (Pull the N lead wire out.)



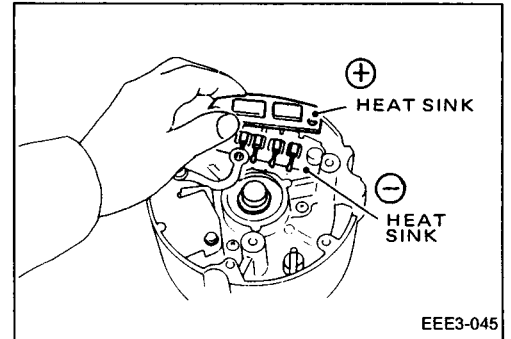
- 2) Remove the heat sink.
 - Remove the solder from the connecting portion of the stator and diode using a soldering iron.
 - Widen the pawl of the connecting portion and separate the stator lead wire.



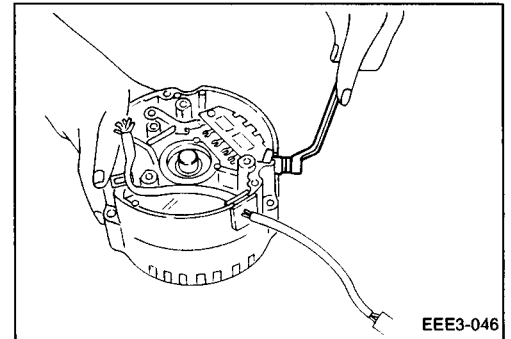
- Loosen the two heat sink set screws and remove the fin.



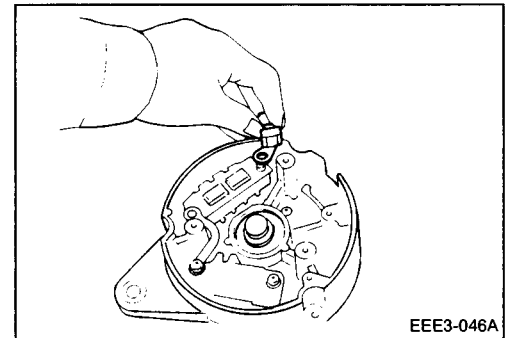
- Remove the positive side heat sink.



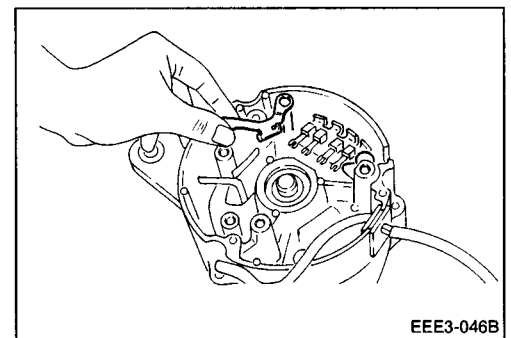
- 3) Remove the B terminal.
- Loosen and remove the nut.
 - Remove the insulator.
 - Extract the B terminal.



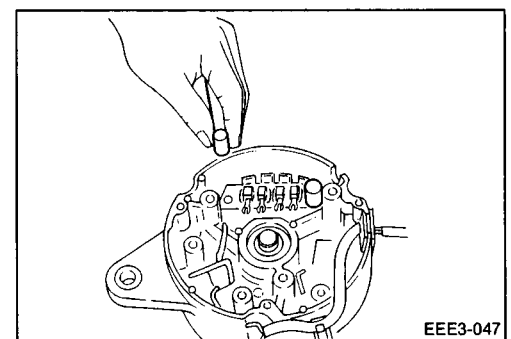
- Remove the support (B).



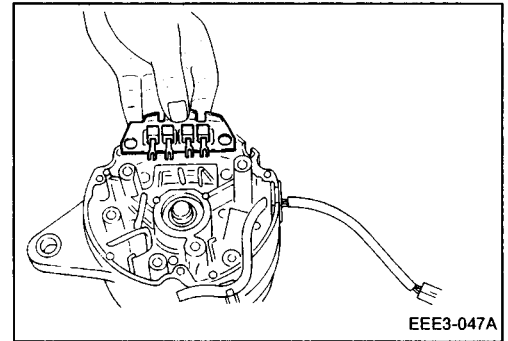
- Remove the plate.



- 4) Remove the negative side heat sink.
- Remove the IF bushing.

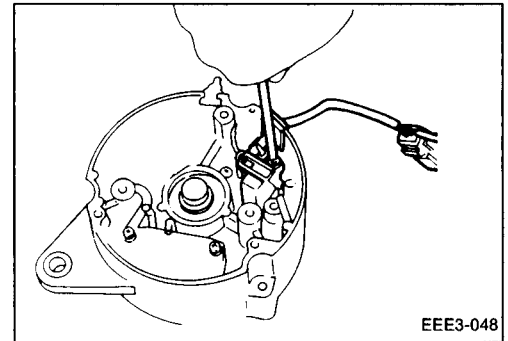


- Remove the heat sink.



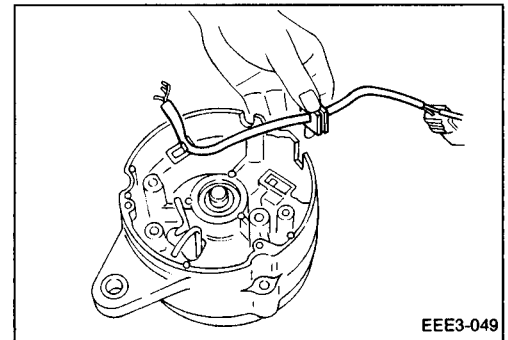
5) Removing the connector.

- Remove the solder from the stator S lead wire.
- Loosen the connector setscrew and remove it.

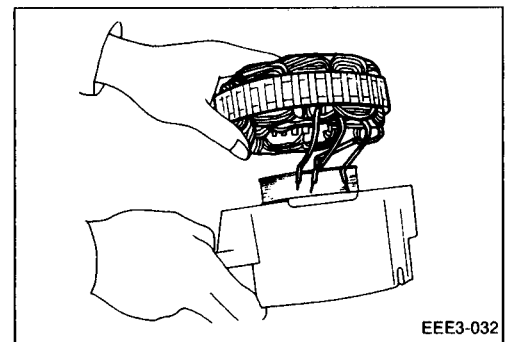


6) Removing the coupler.

- Remove the coupler from the bracket.

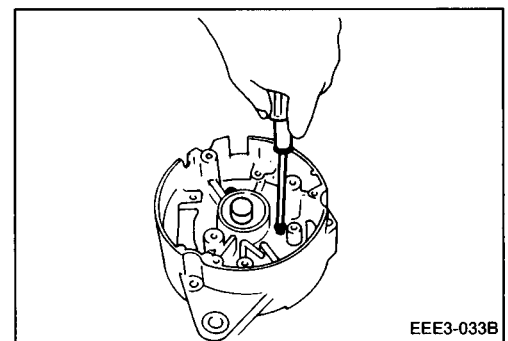


7) Remove the stator assembly from the rear bracket.

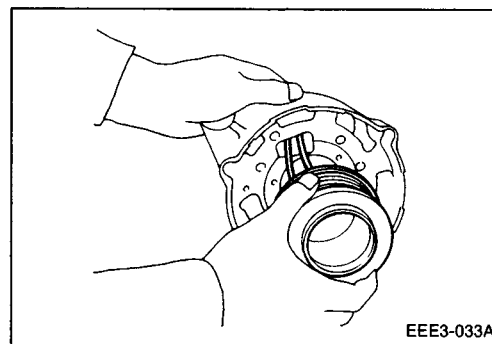


8) Remove the field coil assembly.

- Loosen the three setscrews.



- Remove the field coil assembly from the front bracket.



INSPECTION

- Inspect the pulley for wear, cracks or damage. If faulty, replace.
- Inspect each terminal for corrosion or damage. If faulty, repair or replace.

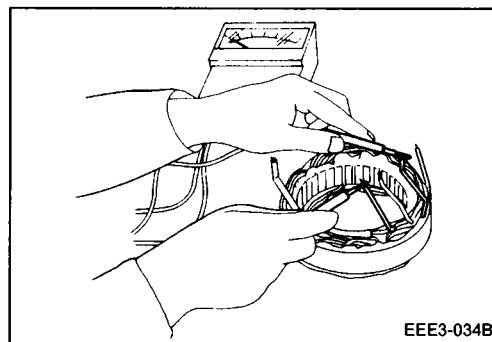
STATER COIL

Continuity test for stator coil

[Ω]

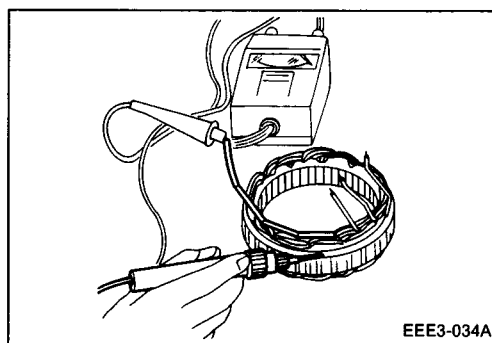
Model	Maintenance standard	Service limit	Remarks
0201-102-2972	0.36 - 0.44	—	Between two phases
0201-152-0052	0.20 - 0.24	—	

If there is no continuity, the stator coil is broken and the stator coil assembly must be replaced.



Insulation test for stator coil

Ensure that there is no continuity. If there is continuity, the stator coil is shorted and the stator assembly must be replaced.



FIELD COIL

Continuity test for field coil

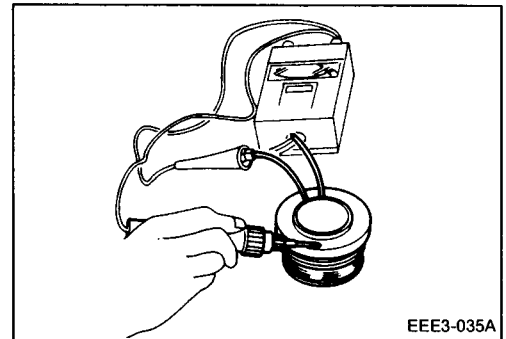
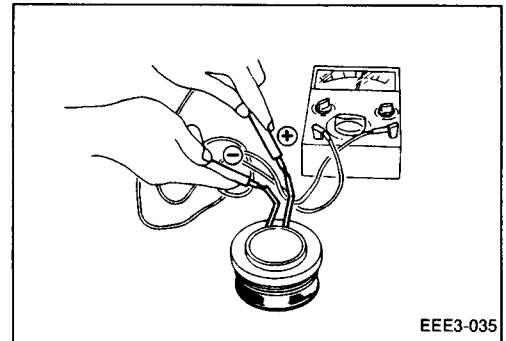
[Ω]

Model	Maintenance standard	Service limit
0201-102-2972	7.0 - 8.6	—
0201-152-0052	5.6 - 6.8	—

If there is no continuity, the field coil is broken and the field coil assembly must be replaced.

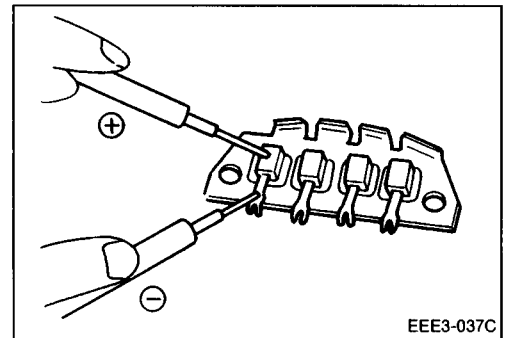
Insulation test for field coil

Ensure that there is no continuity. If there is continuity, the field coil is shorted and the field coil assembly must be replaced.

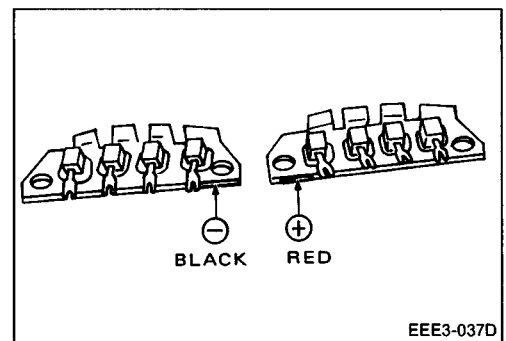


HEAT SINK (DIODE)

- Attach one test lead of a circuit tester to the heat sink plate and the other to one diode terminal to check if continuity exists. With one test lead remaining attached to the heat sink plate, shift the other test lead to the other diode terminal to check if continuity does not exist. Similarly, conduct the above tests on the other two diodes. Continuity must exist in one direction only. If it exists in both directions, replace that diode.



- There are positive and negative heat sinks as shown in the figure.
- Positive and negative characteristics of the heat sink depend on the diode that is installed. (The red and black indicate positive and negative respectively.)

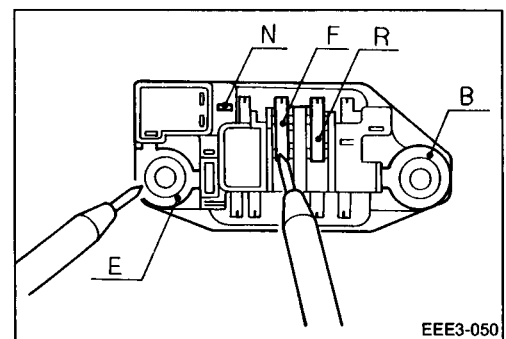


REGULATOR

- Measure the resistance across terminals F and E.
- When the test leads are attached as shown in the figure, several ohms (Ω) resistance should exist and when the test leads are attached in the opposite way, there should be no continuity. (The regulator is faulty if several ohms resistance does not exist.)

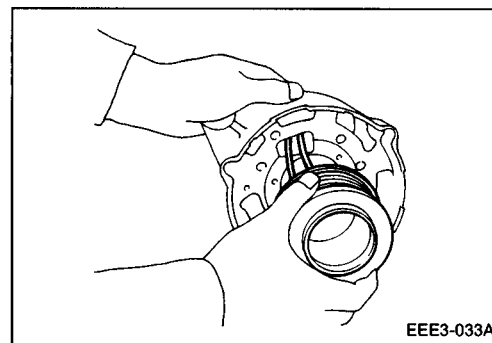
Note:

- Resistance may vary depending on a tester.

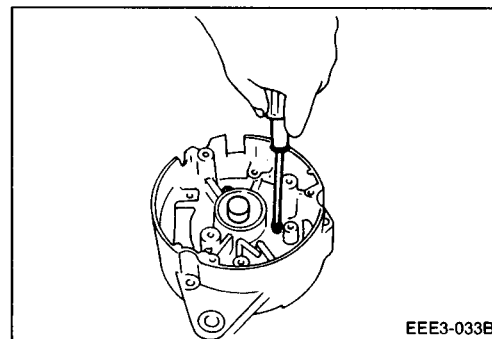


REASSEMBLY

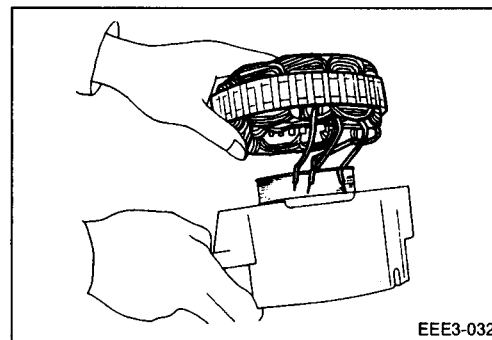
- 1) Field coil installation.
 - Install the field coil on the rear bracket.
 (Install so that the coil fits in the rear bracket.)



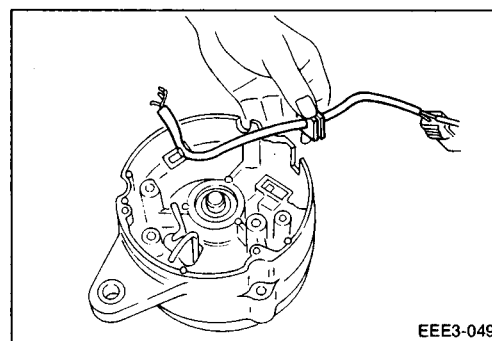
- Secure the coil with three setscrews.
T : 0.19 - 0.25 kgm



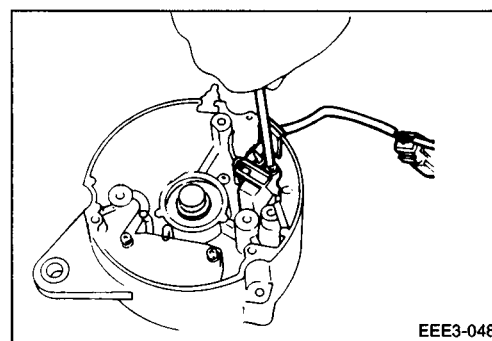
- 2) Install the stator coil.
 - Install the stator coil onto the rear bracket.



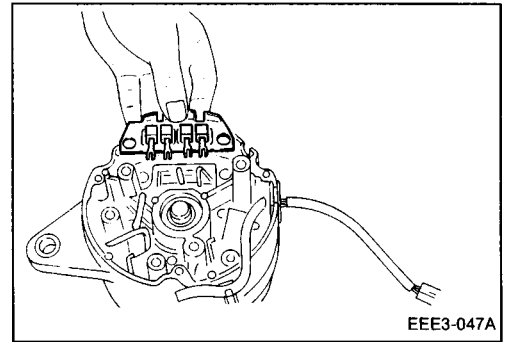
- 3) Install the coupler
 - Install the coupler onto the rear bracket.



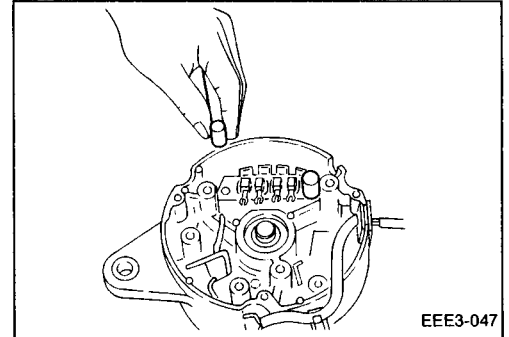
- 4) Install the connector.
 - Install the connector with setscrews.
 - Solder the lead wire from the coupler.
 - Solder the S lead wire from the stator.



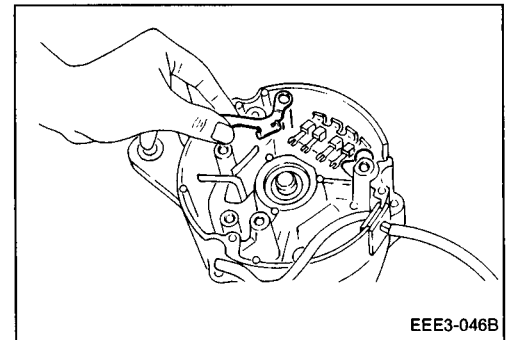
- 5) Install the heat sink (-) (diode)
- Install the heat sink (-).



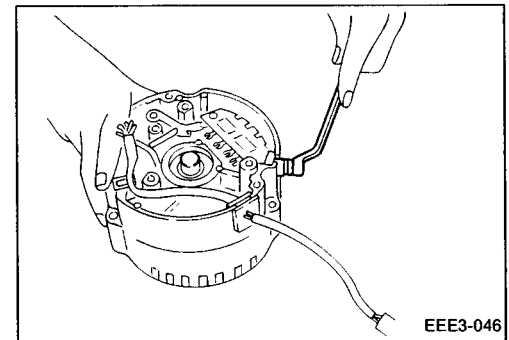
- Install the two (2) IF bushings.



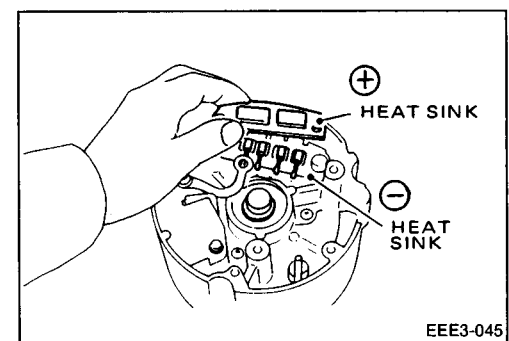
Install the plate.



- 6) Install the B terminal.
- Install the support B and insulator, and install them on the bracket.
 - Install the B terminal, and temporarily tighten it. (Refer to the item 7) for final tightening.)

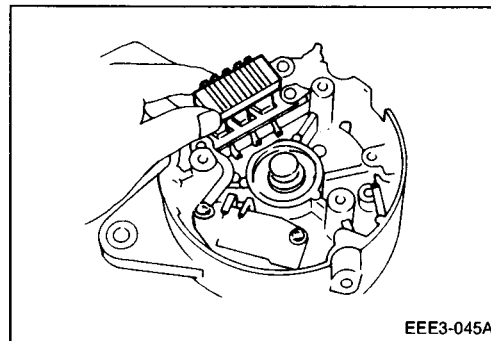


- 7) Install the heat sink (+)
- Install the heat sink together with the IF bushing.



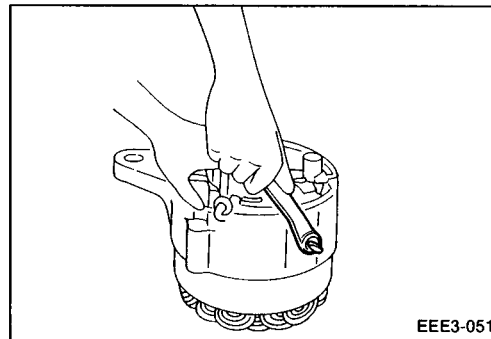
- Install the fin on the heat sink.
(Apply a coat of compound to the part of the fin that contacts the heat sink.)
- Tighten the two (2) setscrews.

T : 0.19 - 0.25 kgm



- Tighten the B terminal. (Final tightening)

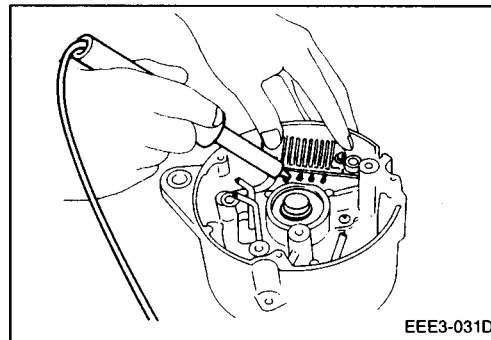
T : 0.33 - 0.45 kgm



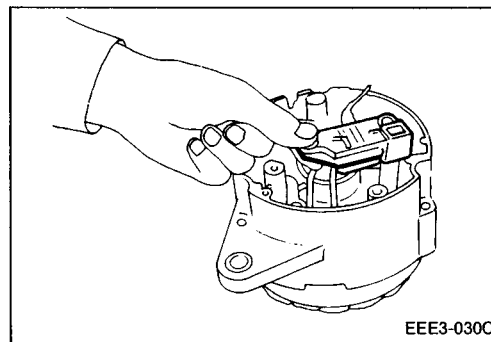
- Solder the stator and diode.
(Pinch the lead wire from the stator in the pawl of the diode lead and solder it.)

Note:

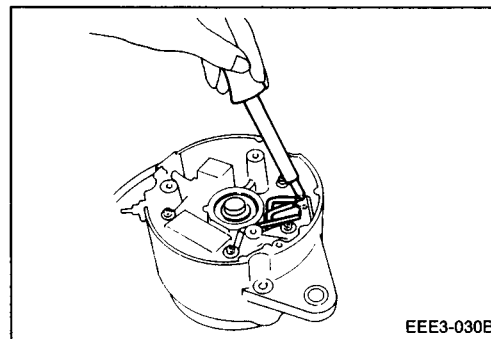
- Soldering should be done within 2 seconds using a 80 to 100W soldering iron.



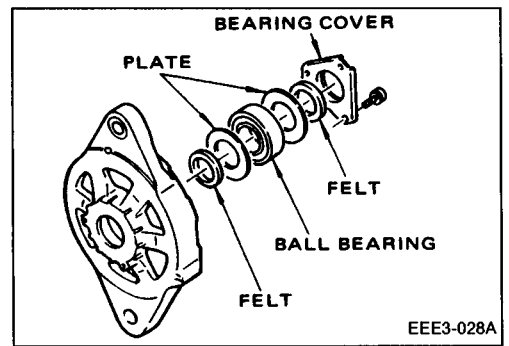
- 8) Install the regulator.
- Install the regulator and tighten with two (2) setscrews.



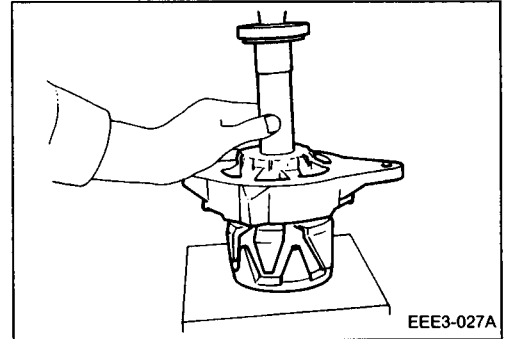
- Solder the lead wire from the coupler.
- Solder the N lead wire from the stator.



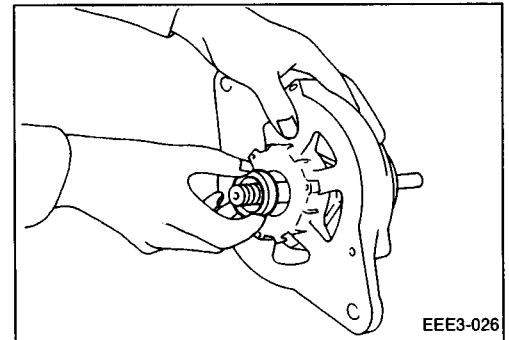
- 9) Install the front bearing.
- Insert the felt and retainer into the bracket.
 - Press-fit the bearing using a press.



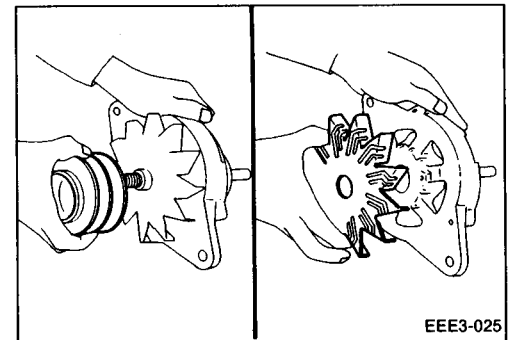
- 10) Install the rotor assembly.
- Insert the felt and retainer into the bracket.
 - Press-fit the rotor into the bracket using a press.



- Install the collar.



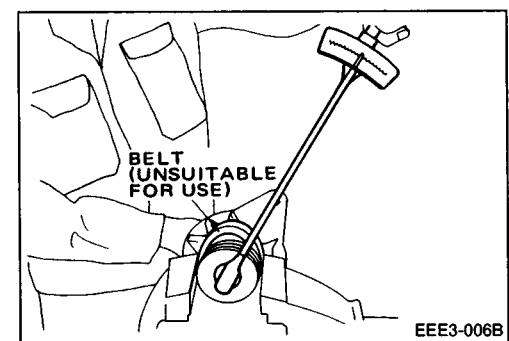
- Install the fan and pulley.



- 11) Wrap the groove of the pulley with an old belt (unsuitable for use), and place the pulley in a vise.

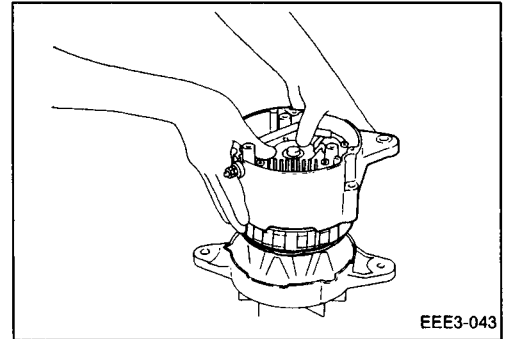
- Install the nuts using the washers, and tighten.

T : 9.8 - 13.0 kgm



12) Installing the front and rear parts.

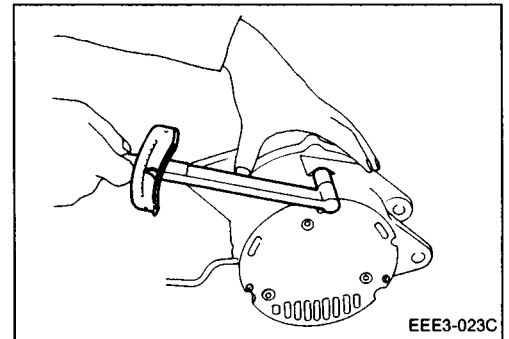
- Install the rear part onto the front part.



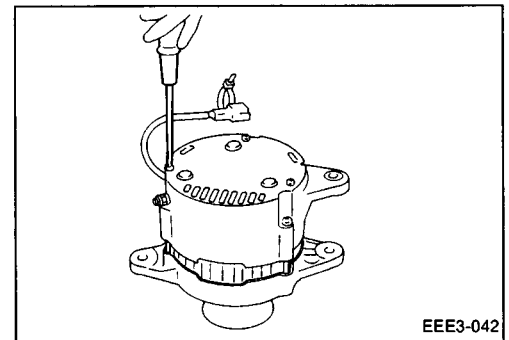
13) Tighten the through bolt.

- Using a torque wrench, tighten the through bolt.

T : 0.6 - 0.9 kgm



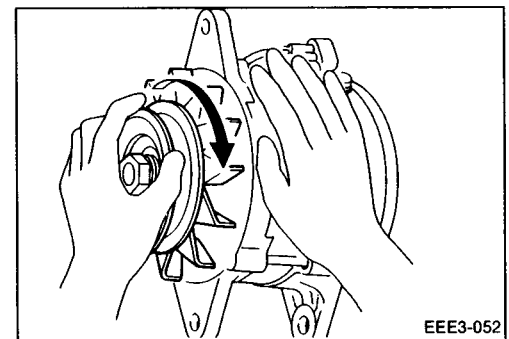
14) Install the cover.



ADJUSTMENT

1) Checking the rotation

- Manually turn the pulley to make sure it rotates lightly.

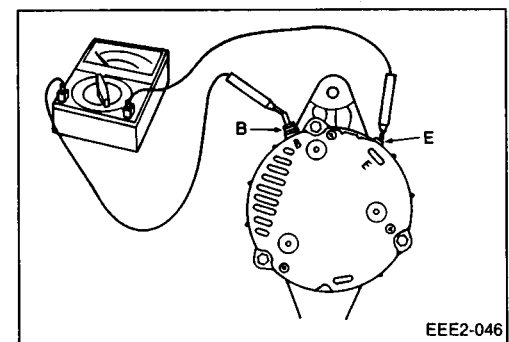


2) Checking the continuity of the terminal.

- Measure the resistance across the terminals B and E.
[If the resistance across the terminals is several ohms (Ω) or infinite (X), it is OK.]

Note:

- If the resistance is 0 (Ω), insulation is poor.



INSTALLATION

Installation sequence is in the reverse order of disassembly.

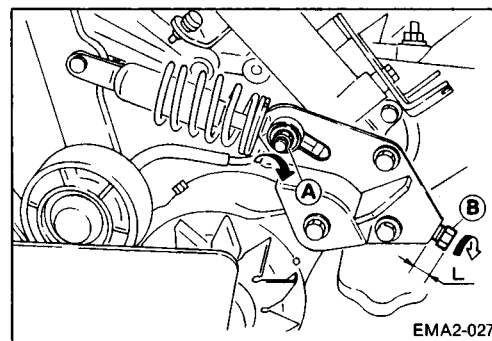
ADJUSTMENT

- Turn the adjusting bolt ⑧ on the generator adjusting bracket clockwise until the specified length "L" (shown in the figure on the right) is obtained.

Length "L": 19.5 mm, max.

- Tighten the tensioner spring mounting nut ⑨ (shown in the figure on the right).

T : 3.3 - 3.9 kgm



INSPECTION AFTER REASSEMBLY

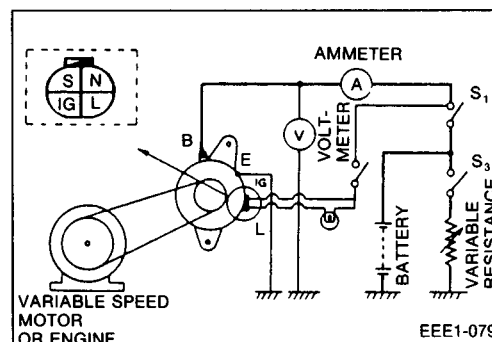
PERFORMANCE TEST

Measuring alternator speed at 27 volts

Turn on the switch SW1 and turn off the switch SW2. Then gradually increase the alternator speed until the voltage reaches 27V, and measure the speed.

[rpm]

Model	Maintenance standard	Service limit
0201-102-2972	Less than 900	—
0201-152-0020		



Measuring output current

- Set the variable resistor to 0, then close switches SW1 and SW2.
- Holding the alternator speed at the rated rpm, adjust the variable resistor until the terminal voltage reaches the specified value. Read the output current.

< Terminal voltage: 28V at 5,000 rpm >

[A]

Model	Maintenance standard	Service limit
0201-102-2972	40, min.	—
0201-152-0052	50, min.	—

Measuring adjusting voltage

Turn on the switch SW1 and turn off the SW2. Then increase the alternator speed to the rated 5,000 rpm., and read the voltage.

[V]

Model	Maintenance standard	Service limit
0201-102-2972	28 - 29	—
0201-152-0052	28 - 29	—

Note:

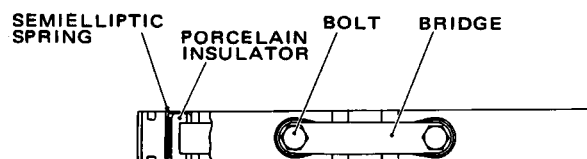
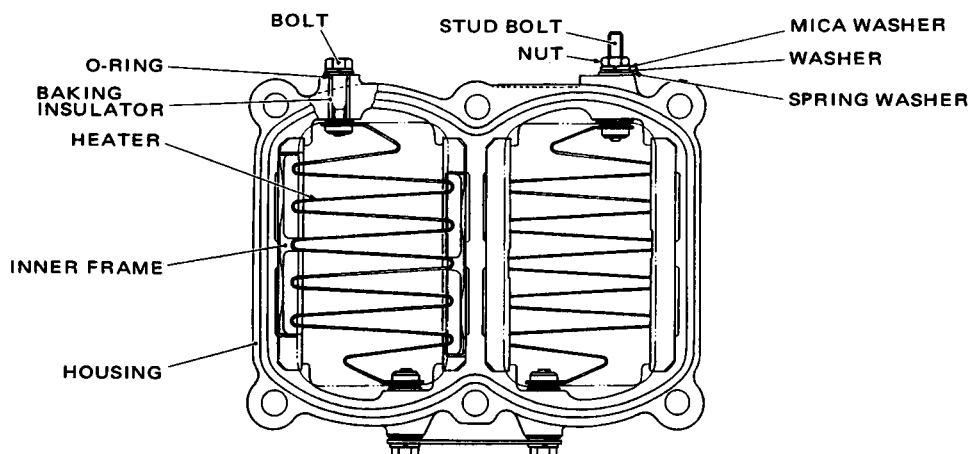
- Lead cables connecting the following in the performance test should have section areas of 8 mm² or greater and length of 2.5 m or less:
 - (1) Terminal B of the alternator and the positive terminal of the battery
 - (2) Terminals E, L and the battery terminals
- Be sure to use switches with small contact resistance for the circuit.
- Performance test should be conducted at the ambient temperature of 20°C.

AIR HEATER

CONSTRUCTION

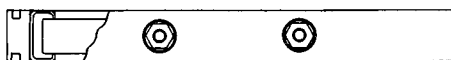
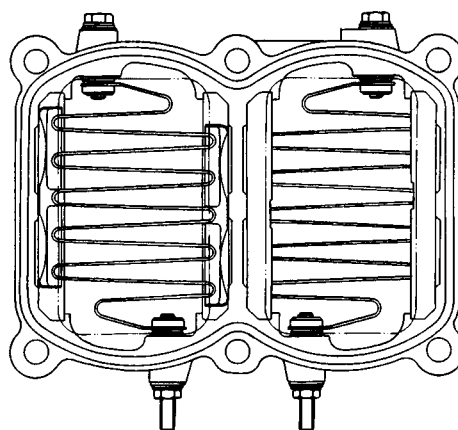
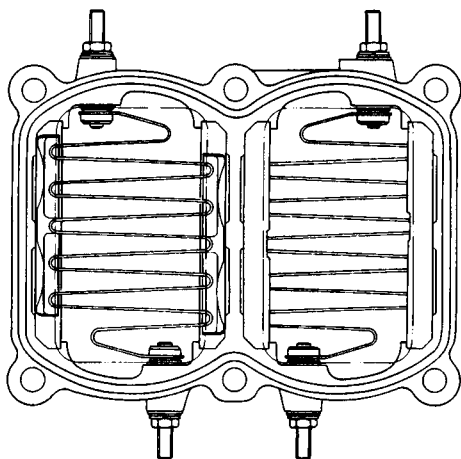
ENGINE MODELS RF8, RE10

Construction illustration (Type I)



EEE2-023B

Construction illustration (Type II)



EEE2-023C

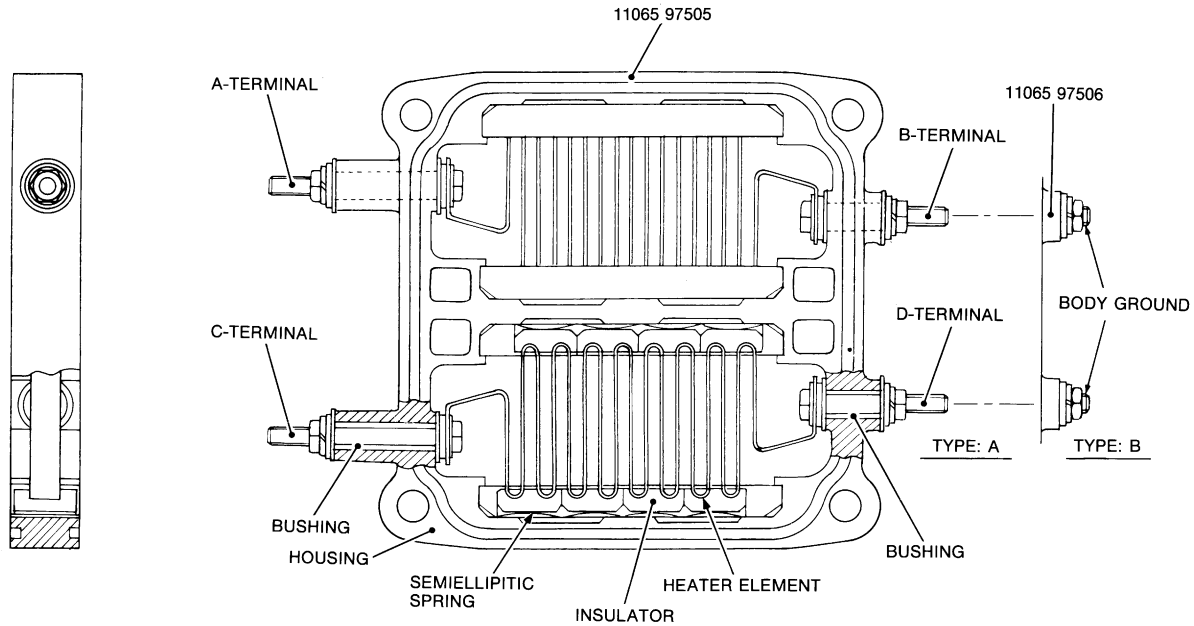
Note:

Type I 22.5V - 85A

Type II ... 22.5V - 170A

ENGINE MODEL RG8

Construction illustration

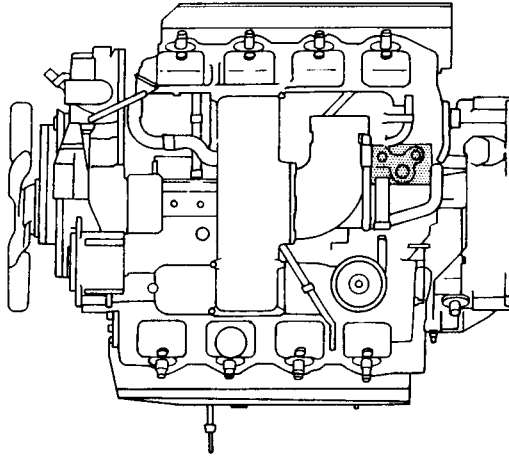


EEE2-023E

INSPECTION

- 1) Check the wiring for condition and breaks. If there is a broken wire, replace as an air heater assembly.
- 2) If carbon accumulates on the ribbon heater, clean it. Check for a broken wire. If there is a broken wire, replace as an air heater assembly.

12. AUXILIARY EQUIPMENT



ER0-129

Auxiliary equipment consists of an air compressor and power steering oil pump.

CONTENTS

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DISASSEMBLY	12- 6	REASSEMBLY	12-20
INSPECTION	12- 7	INSTALLATION	12-27
REASSEMBLY	12- 9	INSPECTING RELIEF VALVE PRESSURE	12-28
HYDRAULIC PUMP	12-11		

SPECIFICATIONS

AIR COMPRESSOR

Item	Model	S12W
Type		F9560 W12-1
Bore x stroke-No. of cylinders	mm	95 x 60-1
Theoretical discharge	[cc/rev.]	425
Normal maximum speed	[rpm]	2,400
Normal maximum pressure	[kg/cm ²]	8.3 - 8.8
Cooling method		Water cooled

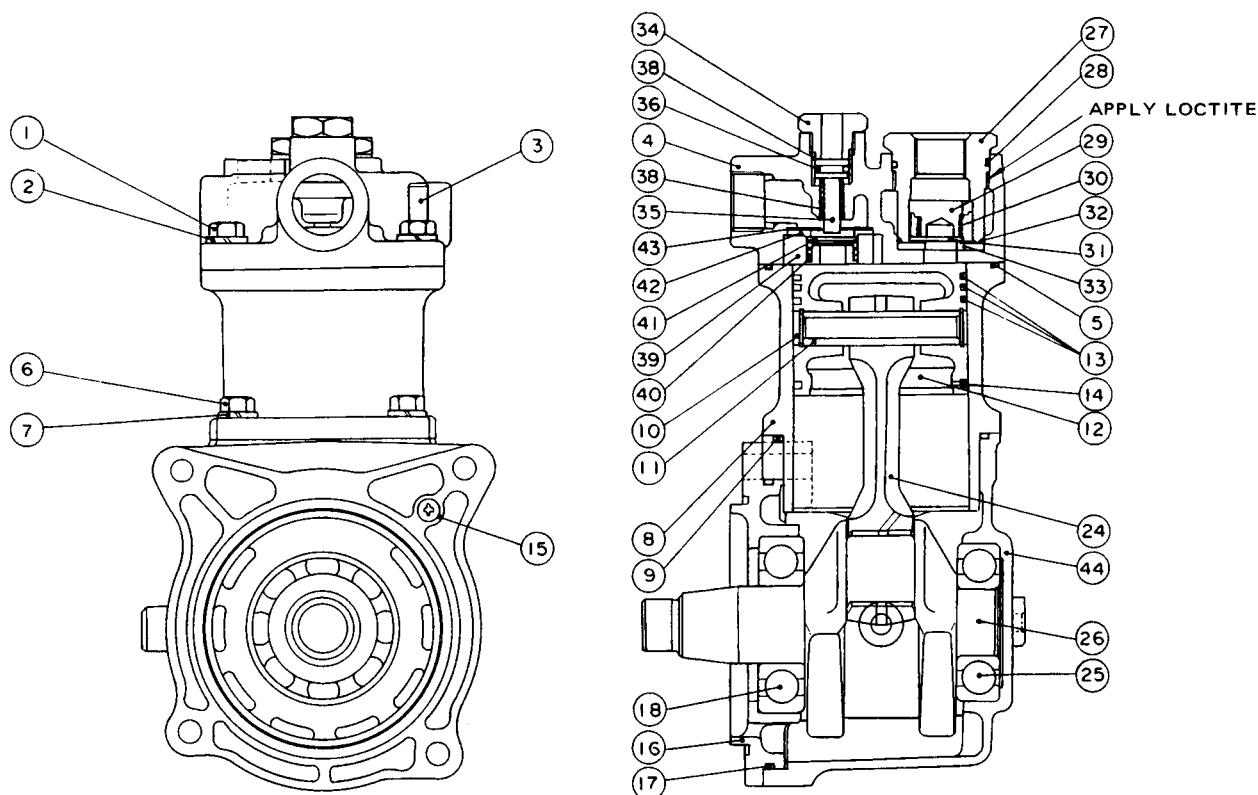
HYDRAULIC PUMP

Item	Model	475-03282	PV123-35-15	PV132-25-25
Type		Vane (1 rotor)		Vane (2 rotor)
Drive method		Gear		
Discharge amount	[cc/rev.]	20		28
Flow control volume	[ℓ/min]	18		23
Relief valve adjusting pressure	[kg/cm ²]	135		125
Name plate color		Black	Red	Blue
Application		RF8, RE10	RG8	CGB truck model

AIR COMPRESSOR

CONSTRUCTION

Construction illustration

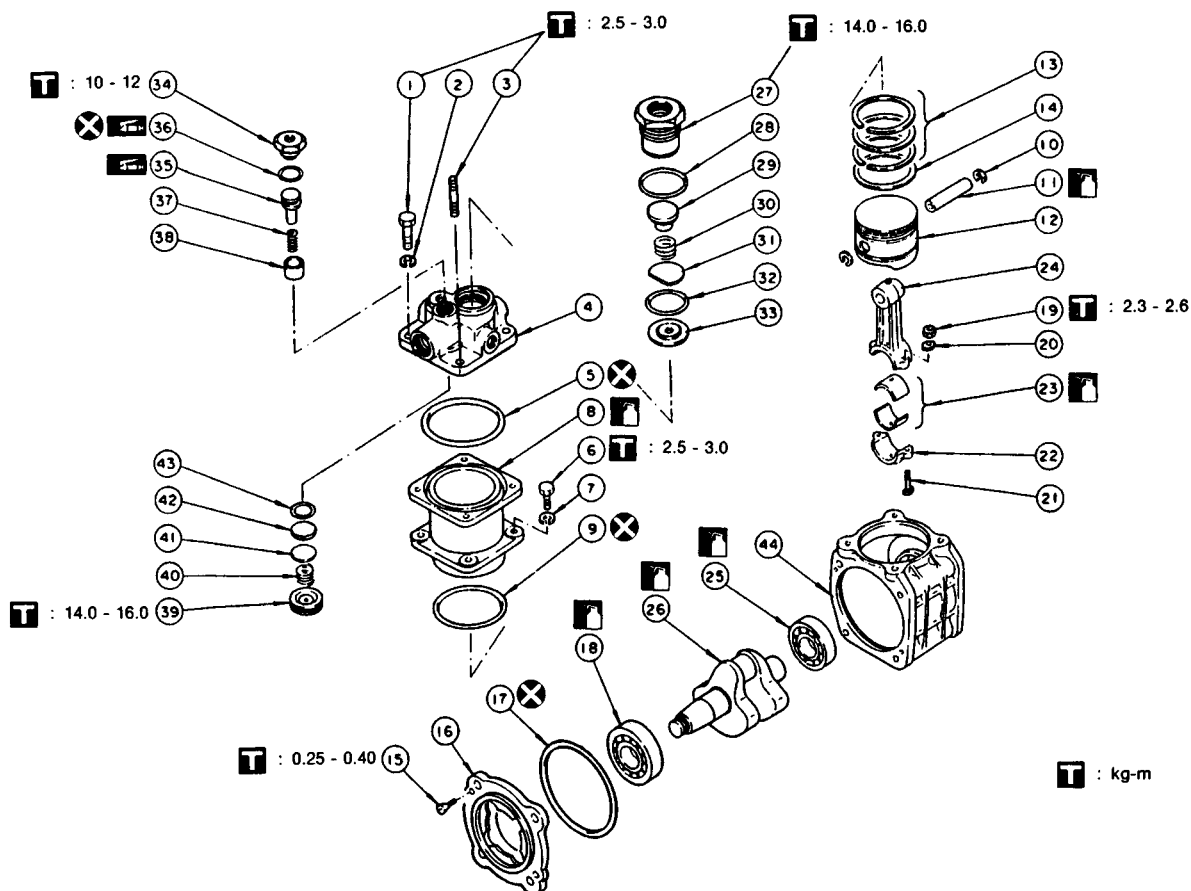


EEA2-001C

Note:

- Parts names are shown in the exploded illustration.

Exploded illustration



EEA2-002K

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | | |
|----------------------|--------------------------|---------------------------|
| ① Bolt | ⑩ Bearing case | ③① Delivery valve |
| ② Spring washer | ⑪ O-ring | ③② O-ring |
| ③ Stud bolt | ★⑫ Ball bearing | ③③ Delivery valve seat |
| ④ Cylinder head | ⑬ Nut | ③④ Connector |
| ⑤ O-ring | ⑭ Lock washer | ☆③⑤ Unloader valve |
| ⑥ Bolt | ⑮ Bolt | ③⑥ O-ring |
| ⑦ Spring washer | ⑯ Connecting rod cap | ③⑦ Unloader valve spring |
| ☆⑧ Cylinder liner | ⑰ Connecting rod metal | ③⑧ Unloader valve guide |
| ⑨ O-ring | ☆⑱ Connecting rod | ★☆③⑨ Suction valve holder |
| ⑩ Clip | ★⑲ Ball bearing | ④① Suction valve spring |
| ⑪ Piston pin | ⑳ Crankshaft | ④② Suction valve |
| ☆⑫ Piston | ☆㉑ Delivery valve holder | ④③ Suction valve seat |
| ☆⑬ Piston ring | ㉒ O-ring | ④④ Suction valve packing |
| ☆⑭ Piston ring (oil) | ㉓ Spring holder | ④⑤ Crankcase |
| ⑮ Screw | ㉔ Delivery valve spring | |

Marks "★" and "☆" indicate that the key points of operation are explained in the text.

REMOVAL AND INSTALLATION

Preparatory operations prior to removal

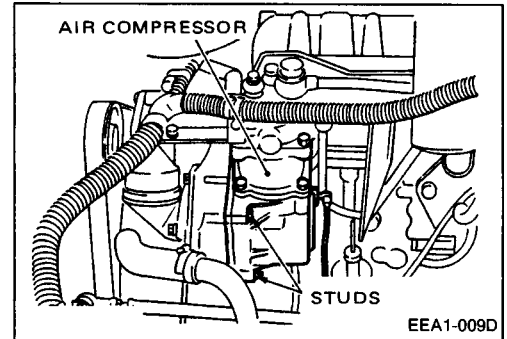
- 1) Chock the wheels, then tilt the cab.
- 2) Turn the key switch off, then disconnect the cable from the negative terminal of the battery.
- 3) Drain the cooling water by opening the drain cock.

Removal and installation

- 1) Remove the water tube, oil tube, air inlet hose, delivery tube, unloader tube and other tubes.
- 2) Remove the three bolts and one nut, then pull out the air compressor to the back side along the stud being careful not to drop the O-ring.

T : 3.5 - 5.0 kgm

- 3) Start up the engine and check to make sure that there is no leakage of oil, air or cooling water.

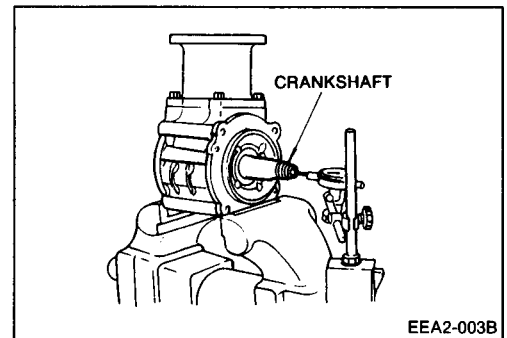


DISASSEMBLY

Key points of disassembly

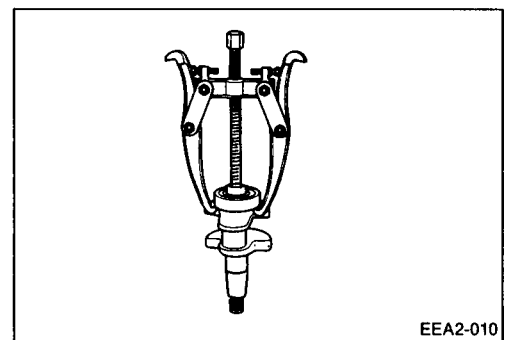
Note:

- Before disassembly, measure and record the crankshaft end play.



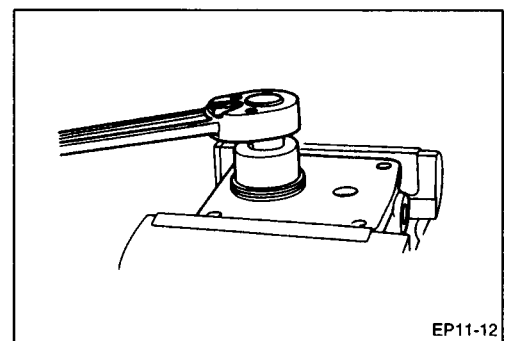
18 25 Ball bearing

Using a puller, remove the ball bearing from the crankshaft.



39 Suction valve holder assembly

Using a valve holder tool (99744 97003), remove the suction valve holder assembly. Then remove the suction valve, valve spring and valve seat.



INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect the parts for cracks and other damage carefully. If faulty, replace with a new one.

Clearance between the piston and cylinder

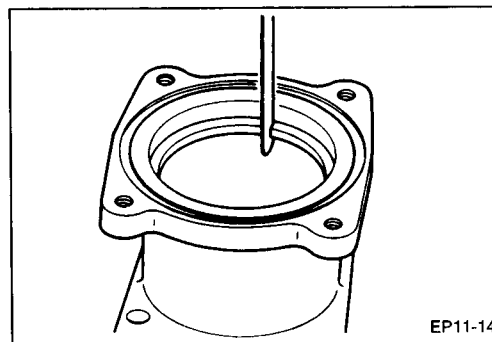
[mm]

Item	Maintenance standard	Service limit
Piston top	0.18 - 0.25	0.28
Piston skirt	0.08 - 0.15	0.18

Piston ring end gap

[mm]

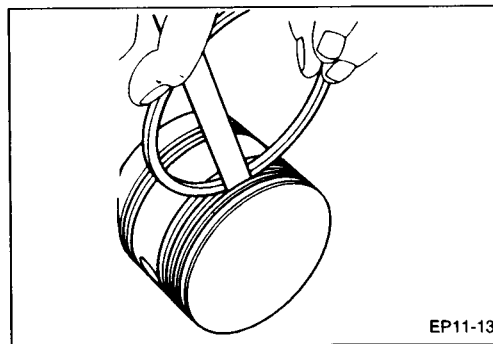
Item	Maintenance standard	Service limit
Compression ring	0.15 - 0.30	1.00
Oil ring	0.2 - 0.7	1.00



Clearance between the piston ring and ring groove

[mm]

Item	Maintenance standard	Service limit
Compression ring	0.01 - 0.045	0.08
Oil ring	—	—



Clearance between piston pin and piston pin hole

[mm]

Maintenance standard	Service limit
0.01T - 0.02L	0.08L

T: Tight L: Loose

Clearance between the connecting rod small end and piston pin

[mm]

Maintenance standard	Service limit
0.02 - 0.04	0.07

Clearance between the connecting rod large end bushing and crank pin

[mm]

Maintenance standard	Service limit
0.02 - 0.09	0.10

Crankshaft end play

[mm]

Maintenance standard	Service limit
0.1 - 0.7	1.0

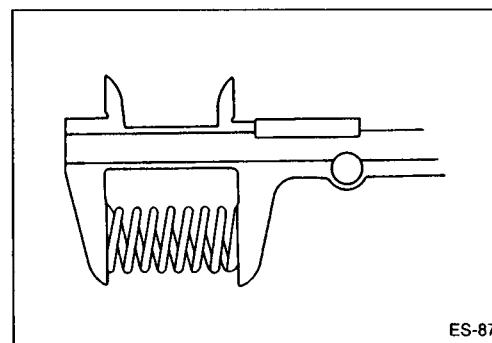
Note:

- Check the end play of the crankshaft measured while disassembling.

Valve spring free length

[mm]

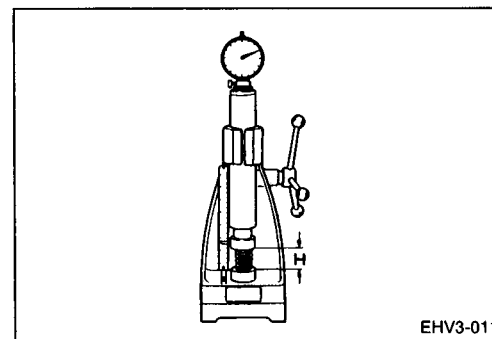
Item	Maintenance standard	Service limit
Suction valve	11.5	(10.3)
Delivery valve	13.4	(12.5)



Valve spring tension

[kg]

Item	Maintenance standard	Service limit	Remarks
Suction valve	1.25	0.87	When compressed to 7.5 mm
Delivery valve	1.1	0.80	When compressed to 10 mm



REASSEMBLY

Key points of reassembly

When reassembling, replace all packings, O-rings, etc. with new ones. Moreover, apply a coat of engine oil to each rotating and sliding surface.

③⑨ Suction valve holder assembly

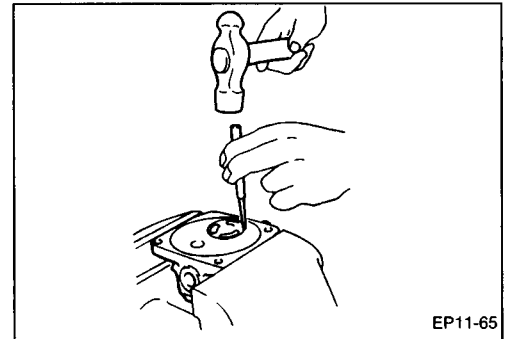
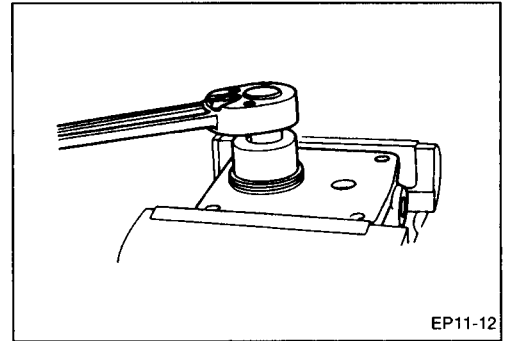
- 1) Using a special tool (99744 97003), install the suction valve into the cylinder head with the packing in place.

T : 14.0 - 16.0 kgm

- 2) Using a punch, stake the periphery of the suction valve holder in three locations so that the suction valve does not rotate.

Note:

- Do not stake the same portion that has previously been staked.
- Avoid staking the sealing surface of the O-ring.



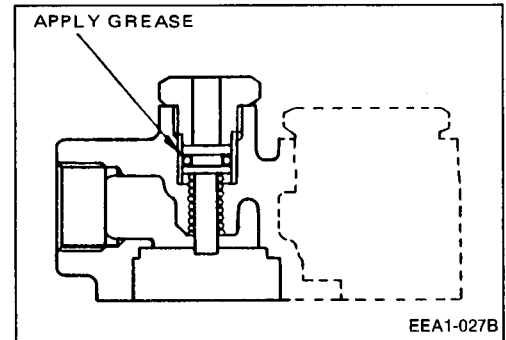
③⑤ Unloader valve

Install the O-ring and unloader spring to the unloader valve and attach the packing connector.

T : 10.0 - 12.0 kgm

Note:

- Fill the O-ring and its groove with grease.



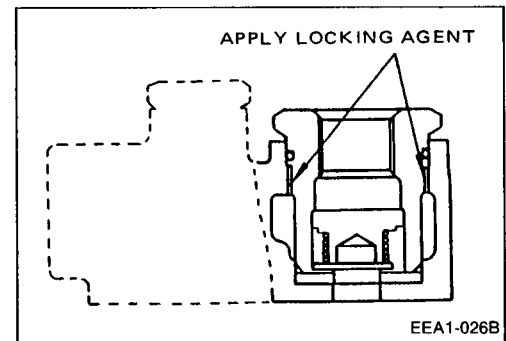
②⑦ Delivery valve holder

Install the delivery valve holder together with the delivery valve seat, valve spring and O-ring.

T : 14.0 - 16.0 kgm

Note:

- Apply a coat of screw lock (Lock Tite 572) to the entire threaded surface of the delivery valve on the cylinder head side.

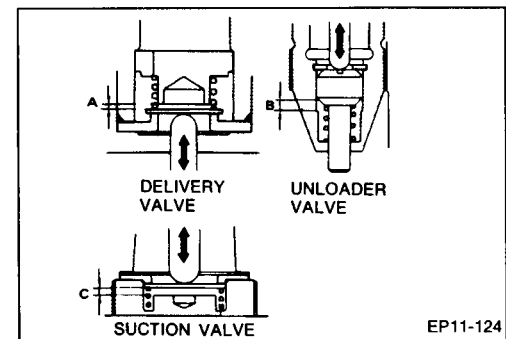


Note:

- Using an inspection rod, check each valve lift to ensure it is within specifications.

[mm]

Valve type	Maintenance standard
Suction valve	Approx. 2.5
Unloader valve	Approx. 1.5
Delivery valve	Approx. 2.7



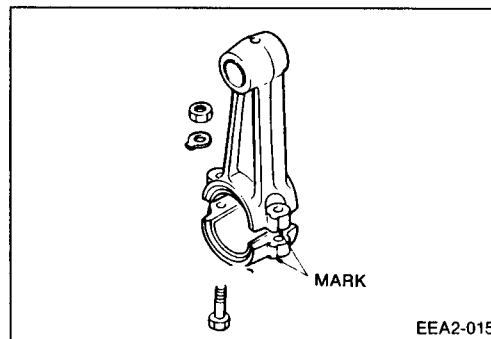
⑭ Connecting rod

Install the connecting rod to the crankshaft.

T : 2.3 - 2.6 kgm

Note:

- Assemble with the matching marks of the connecting rod and bearing cap on the same side.



⑬ Piston ring (oil)

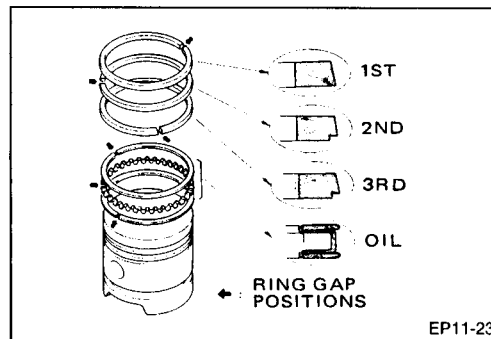
⑫ Piston ring

⑪ Piston

Install the piston ring onto the piston.

Note:

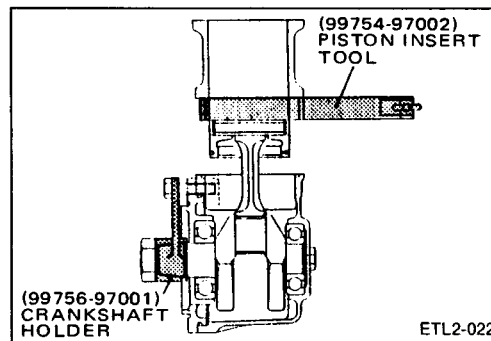
- Do not install the piston ring with its gap facing in the direction of the piston pin nor the perpendicular direction of the piston pin. Install with manufacturer's mark facing up.



⑧ Cylinder liner

Install the O-ring onto the cylinder liner, then, using a piston insert (99754 97002) and a crankshaft holder (99756 97001), install them into the crankcase with the O-ring in place.

T : 2.5 - 3.0 kgm



Note:

- After reassembling, check to make sure that the end play of the crankshaft is within the maintenance standard.

[mm]

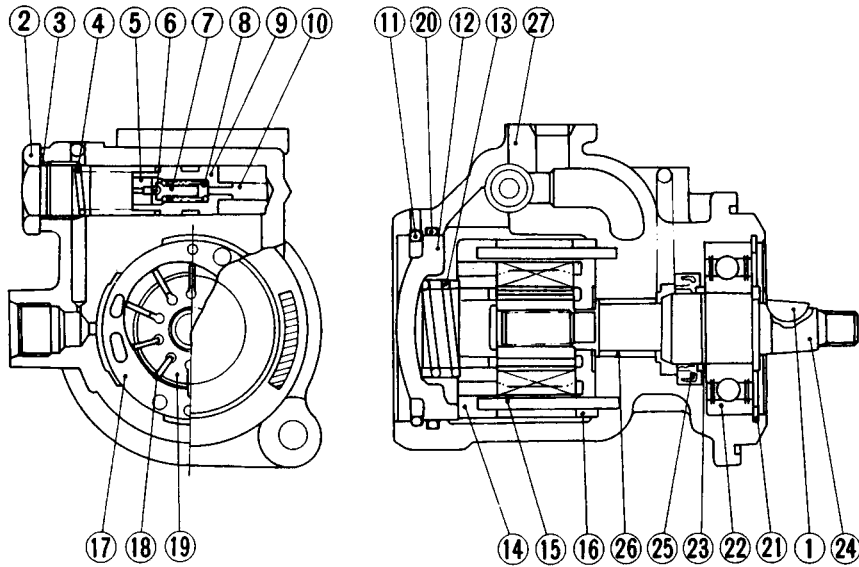
Maintenance standard	Service limit
0.1 - 0.7	1.0

HYDRAULIC PUMP

CONSTRUCTION

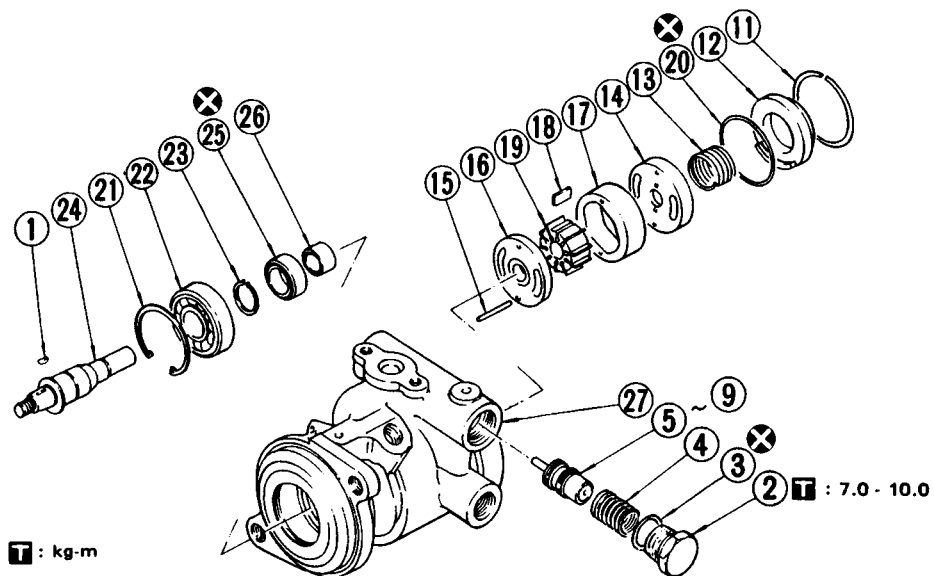
MODEL: PV123-35-15

Construction illustration



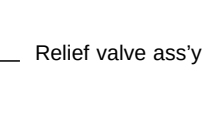
EEA2-016D

Exploded illustration

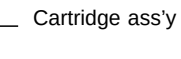


EEA2-017M

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | |
|---|---|
| <ul style="list-style-type: none"> ① Key ② Plug ③ O-ring ④ Valve spring ★⑤ Valve seat _____ ★⑥ Steel ball _____ ★⑦ Poppet _____ ★⑧ Relief valve spring _____ ★⑨ Spool _____ ⑩ Rod ⑪ Retaining ring ★⑫ Cover ⑬ Spring ⑭ Side plate B | <ul style="list-style-type: none"> ⑮ Dowel pin ⑯ Side plate A ★⑰ Cam ring _____ ★⑱ Vane _____ ★⑲ Rotor _____ ⑳ O-ring ㉑ Snap ring ㉒ Ball bearing ㉓ Snap ring ㉔ Shaft ㉕ Oil seal ㉖ Bushing ㉗ Body |
|---|---|
- 

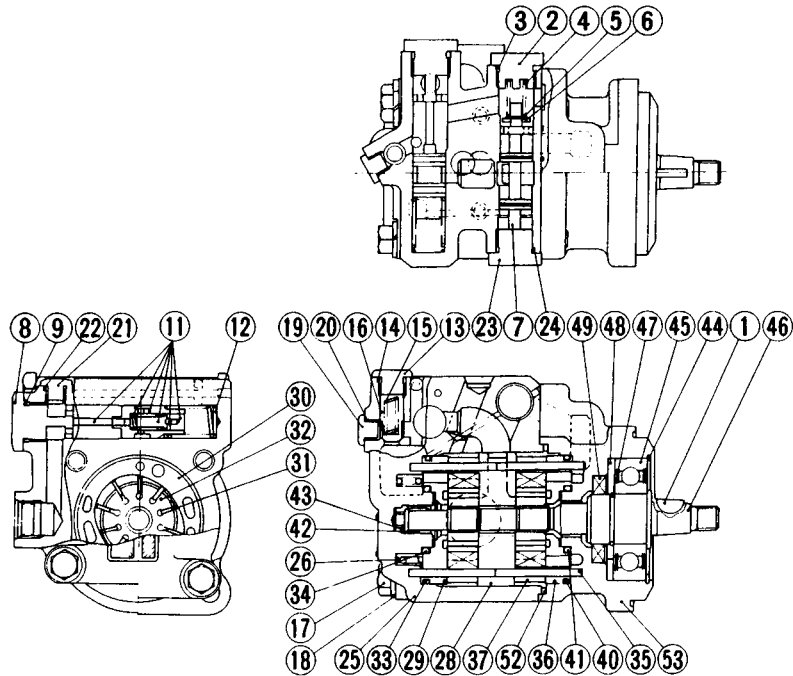
Relief valve ass'y



Cartridge ass'y

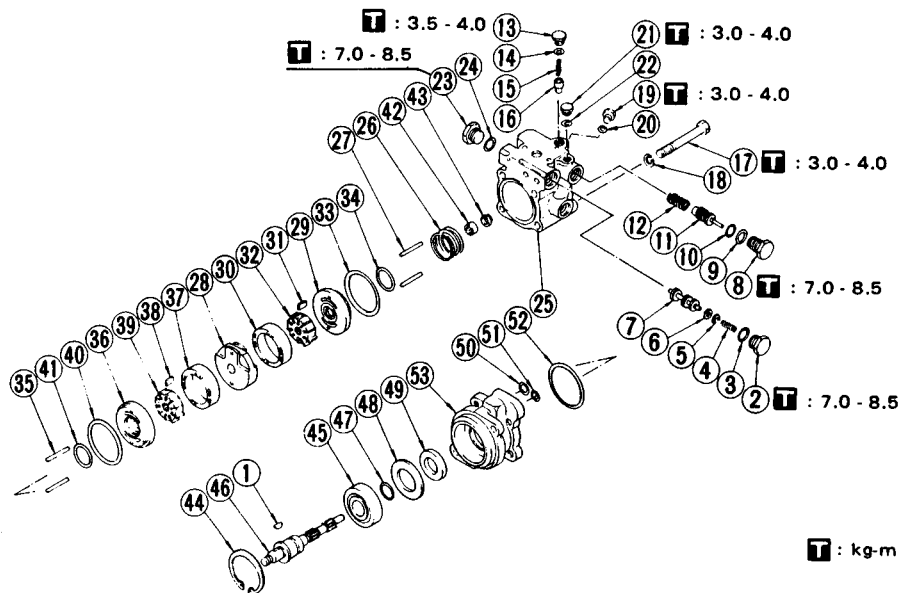
Marks “★” and “☆” indicate that the key points of operation are explained in the text.

MODEL: PV132-25-25 Construction illustration



EEA2-016E

Exploded illustration



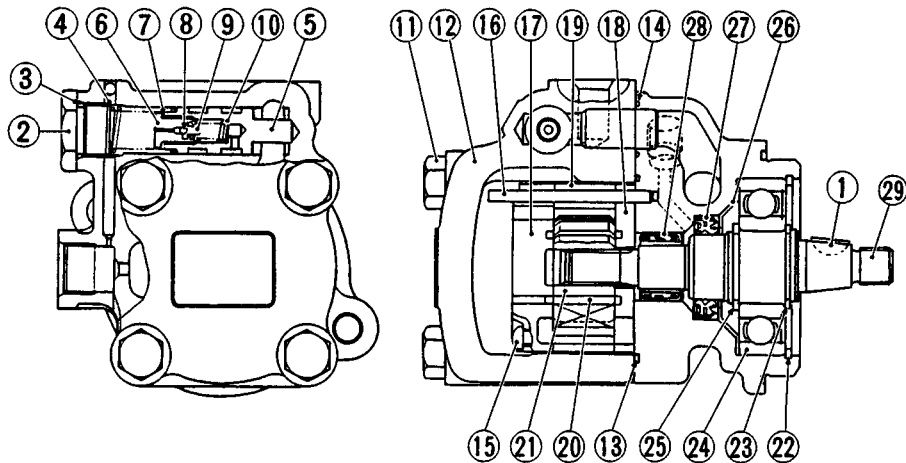
EEA2-017J

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | | |
|---|---|--|
| <ul style="list-style-type: none"> ① Key ② Plug ③ O-ring ④ Spring ⑤ Retaining ring ⑥ Valve seat ⑦ Spool valve ⑧ Connector ⑨ O-ring ⑩ O-ring ★⑪ Relief valve ass'y ⑫ Spring ⑬ Plug ⑭ O-ring ⑮ Spring ⑯ Pilot spool ⑰ Bolt ⑱ Spring | <ul style="list-style-type: none"> ⑲ Plug ⑳ O-ring ㉑ Plug ㉒ O-ring ㉓ Plug ㉔ O-ring ㉕ Cover ㉖ Spring ㉗ Dowel pin ㉘ Plate ㉙ Side plate ★③① Cam ring _____ ★③② Vane _____ ★③③ Rotor _____ ③④ O-ring ③⑤ O-ring ③⑥ Dowel pin ③⑦ Side plate | <ul style="list-style-type: none"> ★③⑦ Cam ring _____ ★③⑧ Vane _____ ★③⑨ Rotor _____ ④① O-ring ④② O-ring ★④③ Needle bearing ④④ Collar ④⑤ Snap ring ④⑥ Ball bearing ④⑦ Shaft ④⑧ O-ring ④⑨ Collar ④⑩ Oil seal ⑤① O-ring ⑤② O-ring ⑤③ O-ring ⑤④ Body |
|---|---|--|
- Cartridge ass'y
 Cartridge ass'y

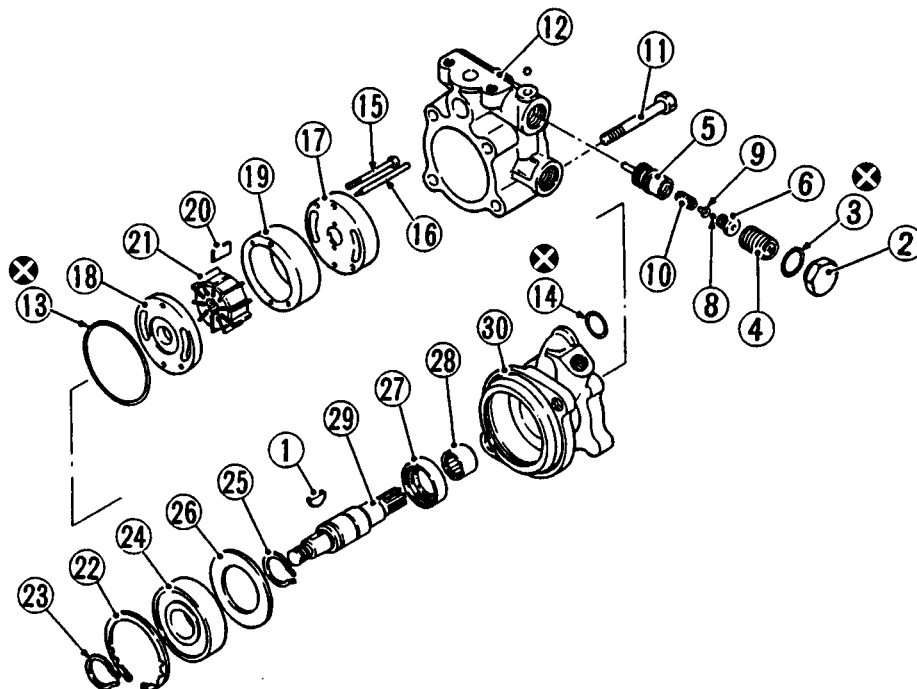
The Marks “★” and “☆” indicate that the key points of operation are explained in the text.

MODEL: 475-03282
Construction illustration



EEA1-033B

Exploded illustration



EEA1-033F

Disassembly sequence (Reassembly sequence is in the reverse order of disassembly.)

- | | |
|---|--|
| <ul style="list-style-type: none"> ① Key ② Plug ③ O-ring ④ Spring ⑤ Flow control valve ★⑥ Relief valve ⑦ Shim ⑧ Ball ⑨ Ball retainer ⑩ Spring ⑪ Bolt ⑫ Rear body ⑬ O-ring ⑭ O-ring ⑮ Screw | <ul style="list-style-type: none"> ⑮ Straight pin ⑮ Pressure plate ⑮ Side plate ★⑮ Cam ring _____ ★⑮ Vane _____ ★⑮ Rotor _____ ⑮ Snap ring ⑮ Snap ring ⑮ Ball bearing ⑮ Snap ring ⑮ Retaining ring ★⑮ Oil seal ★⑮ Needle bearing ⑮ Shaft ⑮ Front body |
|---|--|

Cartridge ass'y

Marks “★” and “☆” indicate that the key points of operation are explained in the text.

REMOVAL

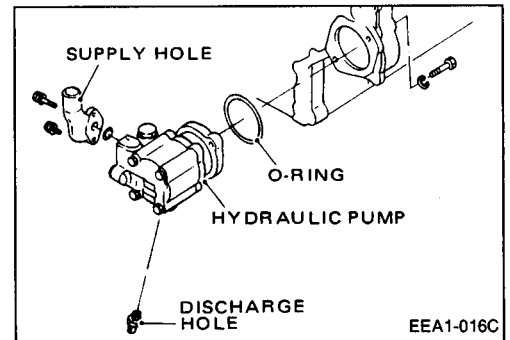
Park the vehicle in a level spot and chock the front and rear wheels.

- 1) Disconnect the oil tube, then drain the power steering oil inside the hydraulic pump and oil reservoir.

Note:

- Prepare an oil tray.
- Plug the disconnected hoses with blind caps to keep them free from dust or other foreign matters.
- If the engine oil is drained just after the engine is stopped, the hot oil may scald. Do not perform operations until the temperature of the oil is lowered to 50°C.

- 2) Disconnect the inlet and outlet tubes.
- 3) Remove the hydraulic pump assembly.



DISASSEMBLY (KEY POINTS OF DISASSEMBLY)

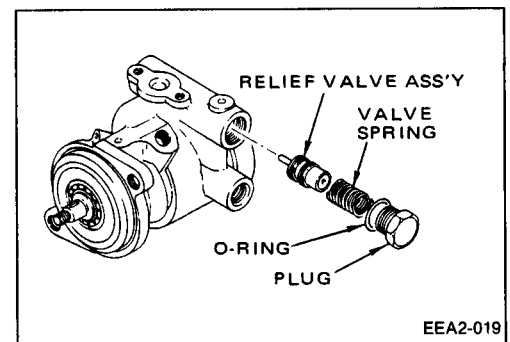
MODEL: PV123-35-15

⑤ - ⑨ Relief valve assembly

Remove the plug, then remove the relief valve assembly and spring.

Note:

- If the discharge pressure is not within the maintenance standard, replace the relief valve assembly.

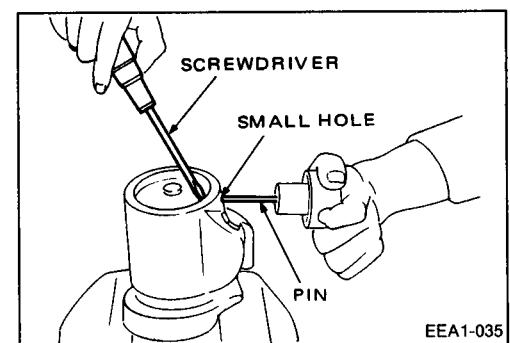


⑫ Cover

Clamp the hydraulic pump assembly in a vise. Remove the cover using a screw driver while pressing the retaining ring by inserting a pin into the small hole on the body.

Note:

- Be careful not to damage the body I.D. section.

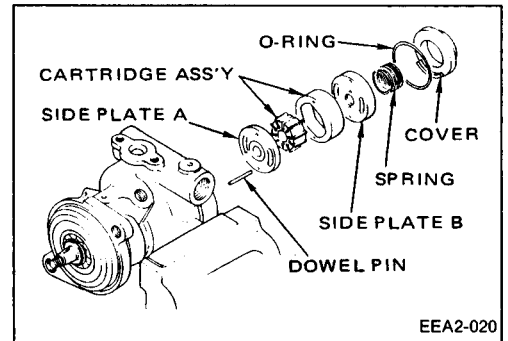


⑰ - ⑲ Cartridge assembly

Remove the cover and separate the spring, O-ring, side plate A, side plate B, dowel pin and cartridge assembly.

Note:

- Make matching marks on the outer peripheries of the cam rings of side plates A and B so that they can be correctly reassembled.



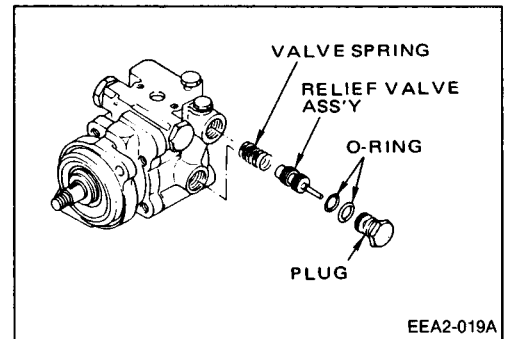
MODEL: PV132-25-25

⑪ Relief valve assembly

Remove the plug, then remove the relief valve assembly and the spring.

Note:

- If the discharge pressure is not within the maintenance standard, replace the relief valve assembly.

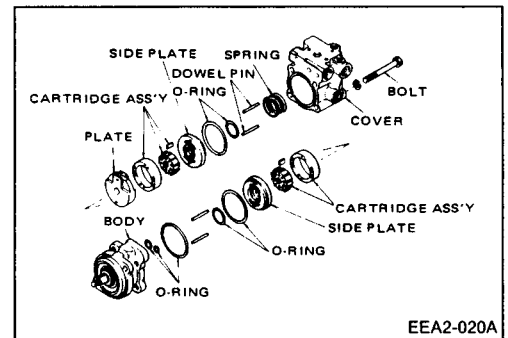


③① - ③② } Cartridge assembly
③⑦ - ③⑨ }

Remove the cover and separate the spring, side plate, O-ring, dowel pin, cam ring and cartridge assembly.

Note:

- Care should be given lest the cartridge assembly (composed of the rotor and vane) of the main pump (on the operator's side) is confused with that of the sub-pump.

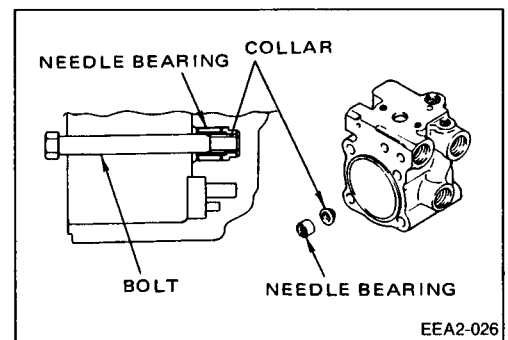


④② Needle bearing

Remove the needle bearing from the cover.

Note:

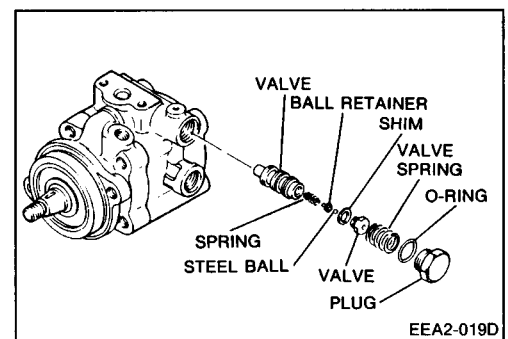
- To remove the needle bearings, screw a bolt (M8 X 1.25) into the threaded hole in the collar, and pull out the needle bearings with the bolt.
- Do not remove the needle bearing unless it is damaged.



MODEL: 475-03282

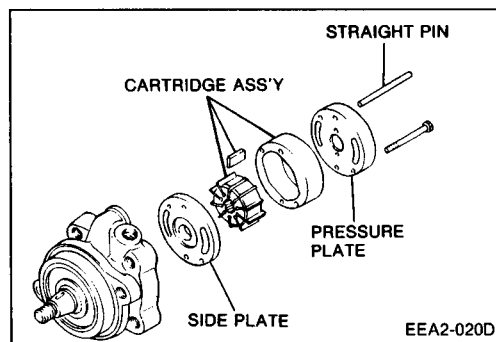
⑥ Relief valve assembly

Remove the plug, then remove the relief valve assembly and spring.



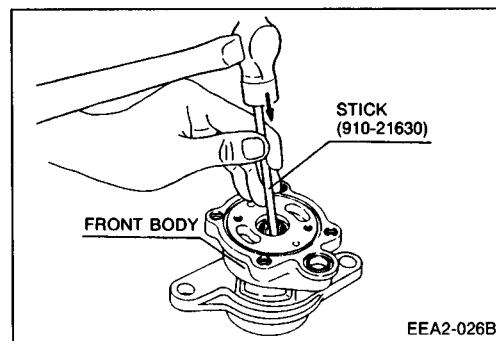
①9 - ②1 Cartridge assembly

Remove the screw and separate the pressure plate, cartridge assembly, side plate and straight pin.



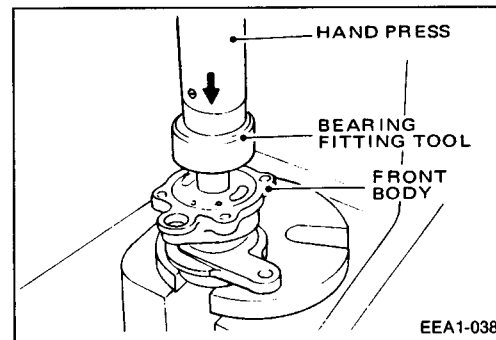
②7 Oil seal

Using a stick (910-21630), remove the oil seal from the body.



②8 Needle bearing

Using a press fit (910-22956), pull out the needle bearing from the front body.



INSPECTION

Clean all the disassembled parts thoroughly with cleaning fluid. While cleaning, inspect the parts for cracks and other damage carefully. If faulty, replace with a new one.

MODEL: PV123-35-15 AND PV132-25-25

Decrease in shaft oil seal lip outside diameter

[mm]

Maintenance standard	Service limit
—	0.05

Clearance between the relief valve outside diameter and body inside diameter

[mm]

Maintenance standard	Service limit
0.013 - 0.020	0.03

AUXILIARY EQUIPMENT

Side plate indentation

[mm]

Maintenance standard	Service limit
—	0.03

Unloader valve outside diameter and body inside diameter (2-rotor only)

[mm]

Maintenance standard	Service limit
—	0.04

MODEL: 475-03282

Clearance between the relief valve outside diameter and body inside diameter

[mm]

Maintenance standard	Service limit
—	0.03

Ball bearing play

[mm]

Maintenance standard	Service limit
—	0.04

REASSEMBLY

Note:

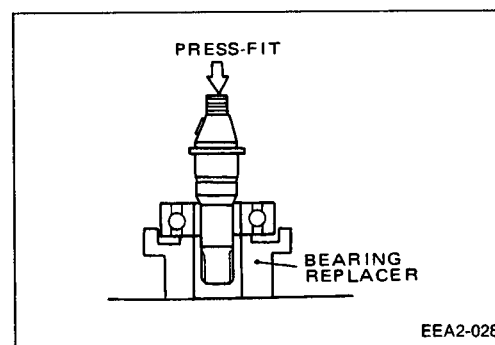
- This section is not just a key points explanation, but rather a full explanation.

MODEL: PV123-35-15

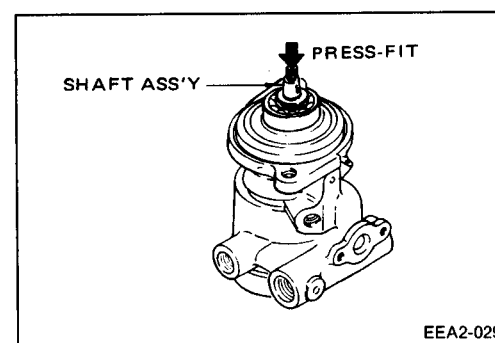
- 1) Using a special tool and a presser, press the oil seal into the body.
- 2) Press the ball bearing into the shaft from the driving side of the shaft using a special tool and a presser, then install the snap ring.
- 3) Install the shaft assembly (with the ball bearing) into the body, then install the snap ring.

Note:

- If the shaft cannot be pressed in up to the specified position by hand, gently press it in using a press tool.
- When installing the shaft, be careful not to scratch or damage the sealing lip of the oil seal with the spline of the shaft.



EEA2-028

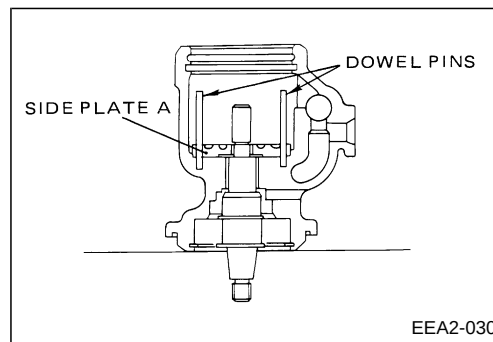


EEA2-029

- 4) Fit the dowel pins to the body, then install the side plate A.

Note:

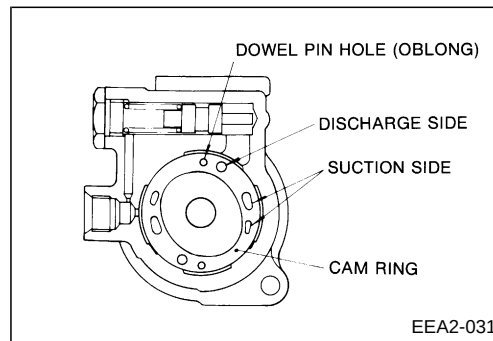
- Be sure to apply a few drops of power steering oil to the sliding surface of the side plate prior to installation.
- Be sure to install the side plate with the dowel pin oblong hole facing toward the relief valve side.



- 5) Install the cam ring aligning it with the dowel pins.

Note:

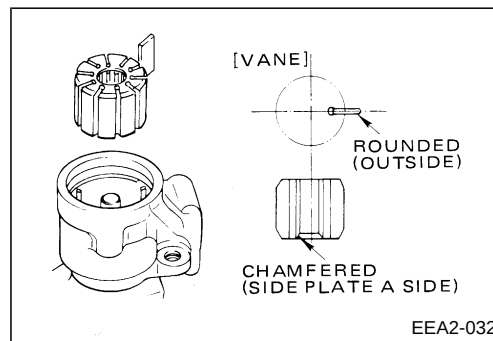
- Be sure to install the cam ring aligning it with the side plate hole.



- 6) Install the rotor aligning it with the spline of the shaft, then fit the vane into the rotor groove.

Note:

- Be sure to install the rotor with the chamfered spline side facing the side plate A.
- Be sure to install the vane with the rounded end face side facing outward.

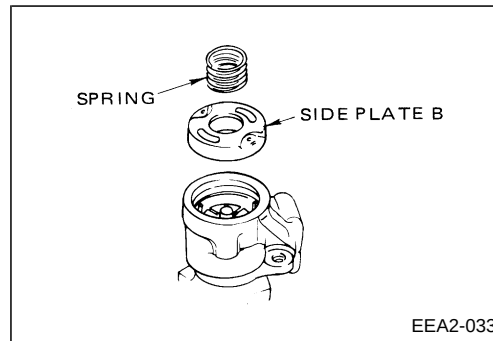


- 7) Install the side plate B and spring.

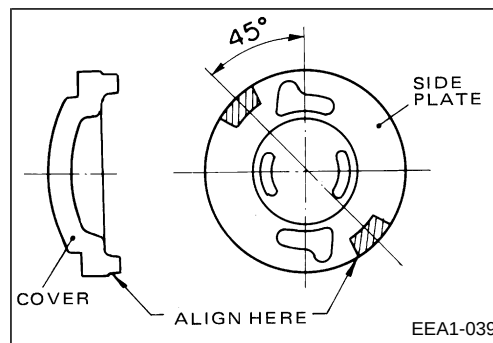
Note:

- Be sure to apply a few drops of power steering oil to the sliding surface of the side plate prior to installation.
- Turn the shaft by hand and check to make sure that it rotates smoothly.

- 8) Apply a coat of rubber grease to the O-ring, then install it into the body.



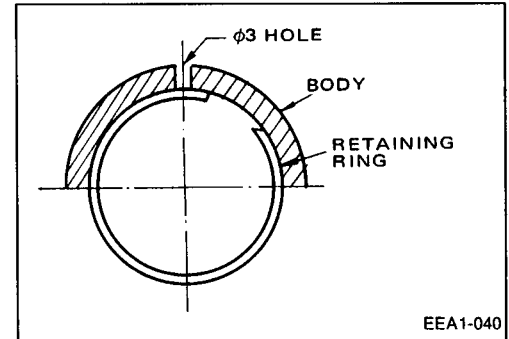
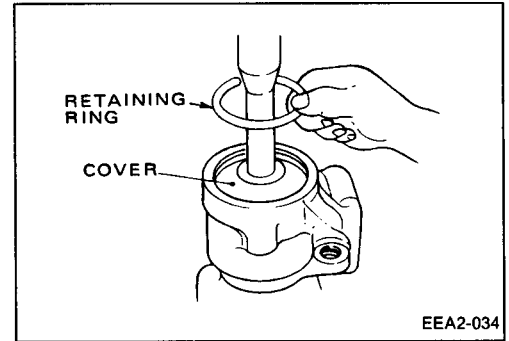
- 9) Install the cover positioning it carefully so that the two lugs which function as stoppers do not block the side plate port.



- 10) Using a press, secure the cover and fix it with the retaining ring.

Note:

- Be sure to install so that the disassembly hole (with a diameter of 3 mm) is located near the opening of the retaining ring.

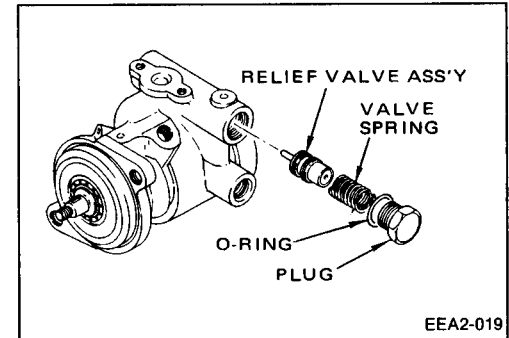


- 11) Insert the relief valve assembly. Then fasten it with the plug to which the O-ring has been attached, with the spring placed between the valve assembly and the plug.

T : 7.0 - 10.0 kgm

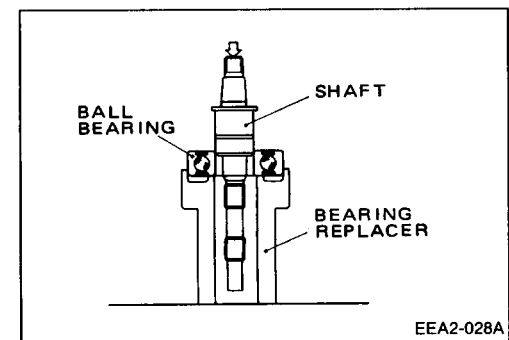
- 12) Press the key into the shaft. Then install the drive gear and fasten it with the nut.

T : 5.0 kgm

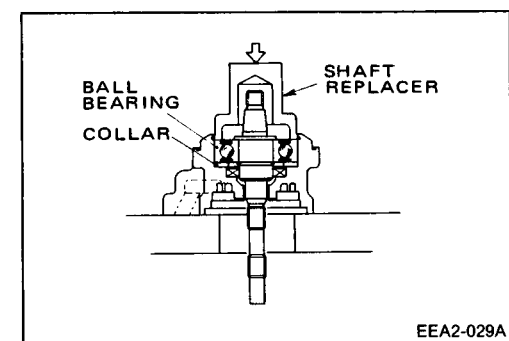


MODEL: PV132-25-25

- 1) Press the oil seal into the body.
- 2) Press the ball bearing onto the shaft using a special tool and a presser.
- 3) Install the retaining ring onto the shaft using a special tool.



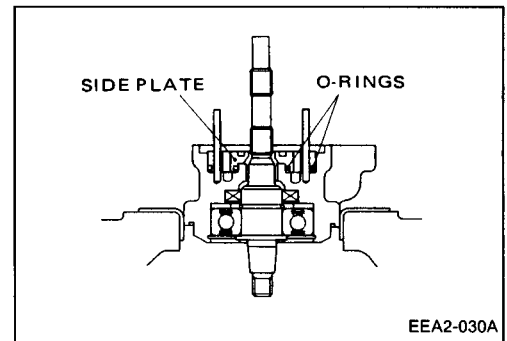
- 4) Install the collar, then press in the shaft assembly using a special tool and fix it with the snap ring.



5) Fit the dowel pins to the body, then install the side plate A.

Note:

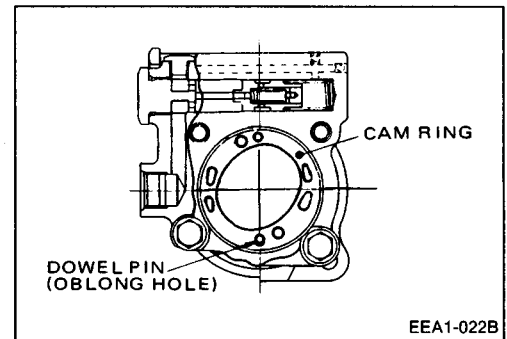
- Be sure to apply a few drops of power steering oil to the sliding surface of the side plate prior to installation.
- Be sure to install the side plate with the dowel pin oblong hole facing opposite to the relief valve.



6) Install the cam ring aligning it with the dowel pins.

Note:

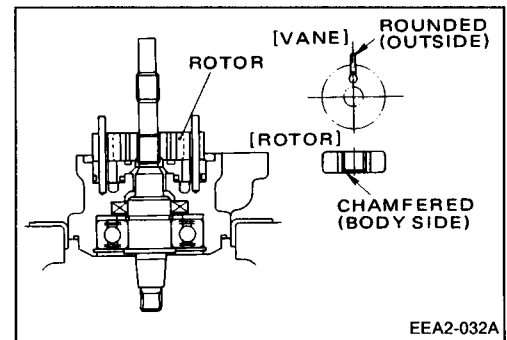
- Be sure to install the cam ring aligning it with the side plate hole.



7) Install the rotor aligning it with the spline of the shaft, then fit the vane into the rotor groove.

Note:

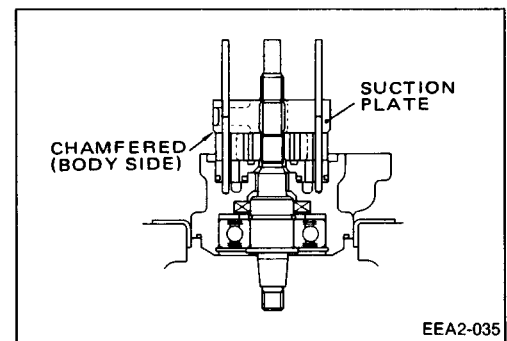
- Be sure to install the vane with the rounded side end face facing outward.
- Be sure to install the rotor with the chamfered spline side facing the body.



8) Install the suction plate.

Note:

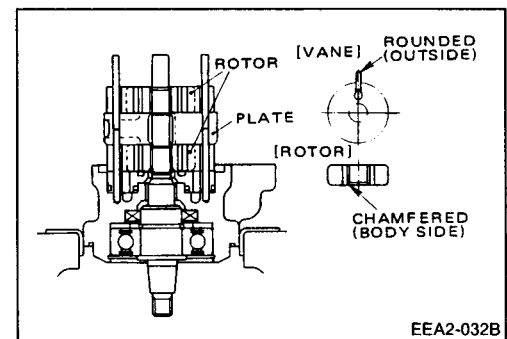
- Be sure to install the plate with the chamfered side outer periphery facing the body.



9) Install the rotor aligning it with the spline of the shaft, then fit the vane into the rotor groove.

Note:

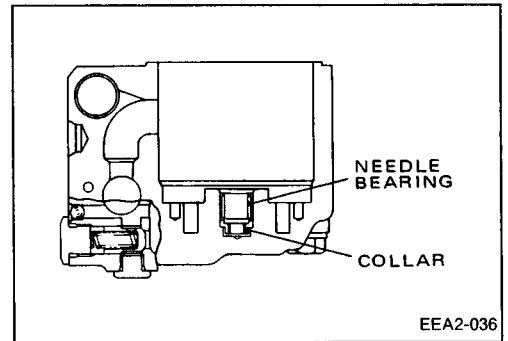
- Be sure to install the vane with the rounded side end face facing outward.
- Be sure to install the rotor with the chamfered spline side facing the body.



- 10) Insert the collar into the cover, then press in the needle bearing.

Note:

- Be sure to install the needle bearing with the side on which the mark has been stamped facing the body.

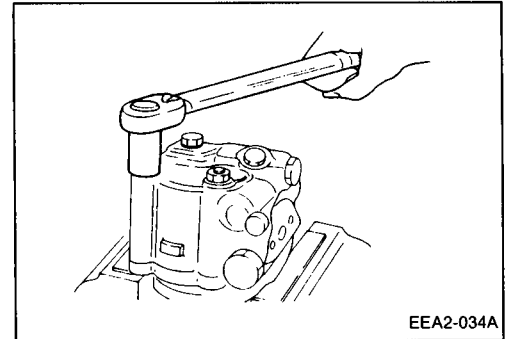


- 11) Install the cover onto the body assembly with the O-ring in place.

T : 3 - 4 kgm

Note:

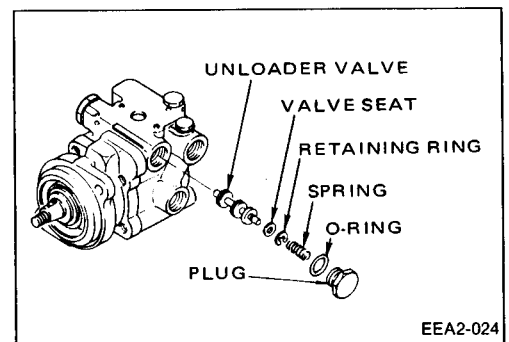
- After installing the cover, turn the shaft by hand and check to make sure that it rotates smoothly.



- 12) Install the plug with the O-ring in place on the opposite side of the relief valve plug.

- 13) Insert the unloader valve assembly and spring, then install the plug with the O-ring in place.

T : 7 - 8.5 kgm

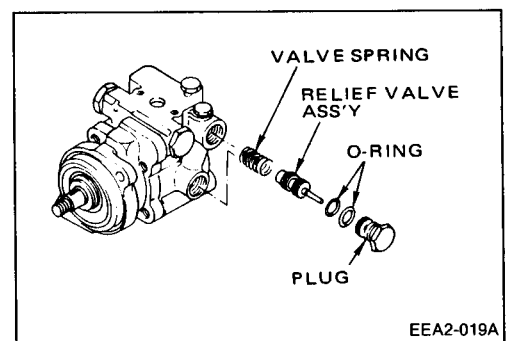


- 14) Insert the relief valve assembly with the spring in place, then install the plug with the O-ring in place.

T : 7 - 8.5 kgm

Note:

- The "A", "B", "C" marks on the pump body and on the relief valve ass'y should be matched when assembling.



- 15) Insert the pilot spool and spring, then install the plug with the O-ring in place.

T : 3.5 - 4.0 kgm

- 16) Install the plug with the O-ring in place.

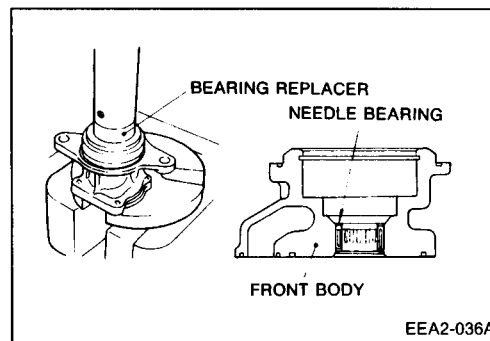
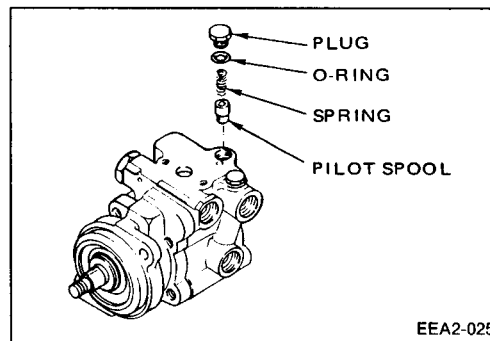
T : 3.0 - 4.0 kgm

- 17) Press the key into the shaft. Then install the drive gear and fasten it with the nut.

T : 6.0 kgm

MODEL: 475-03282

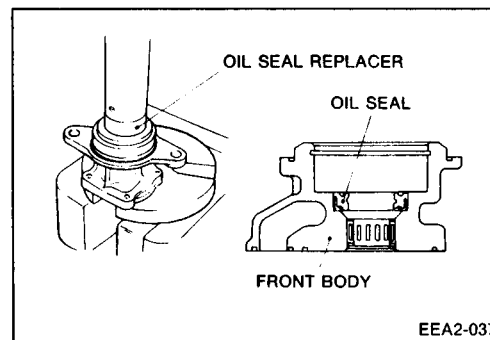
- 1) Using a press fit (910-22956), press the needle bearing into the front body with a press.



- 2) Using a press fit (910-22959), press the oil seal into the front body with a press.

Note:

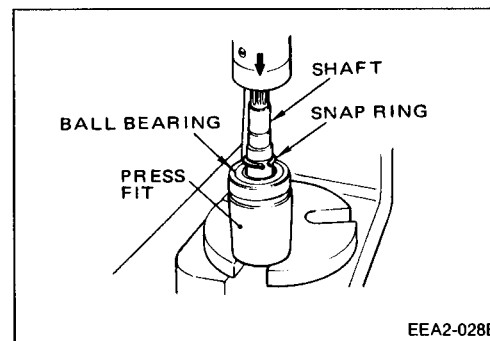
- Press the oil seal until it is flush with the body end face.



- 3) Fit the ball bearing onto the shaft using a press fit (910-22955) and a presser, then fix it with the snap ring.

Note:

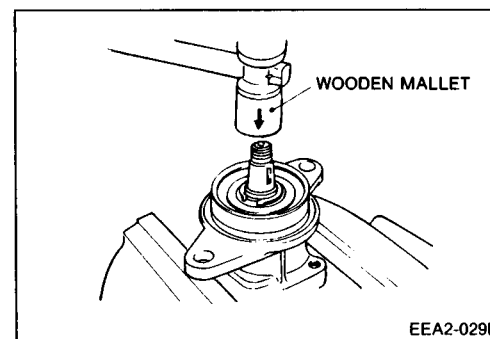
- Always press the ball bearing from the drive side.



- 4) Install the plate in the front body, install the shaft assembly, then secure with snap ring using pliers (910-22570).

Notes:

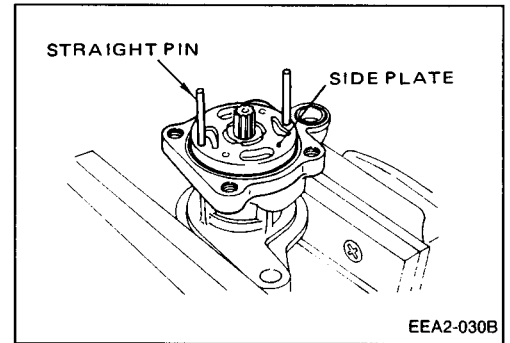
- If the shaft is hard to insert up to the specified position by hand, lightly tap with a wooden mallet.
- Do not allow shaft splines to scratch the oil seal lip during shaft installation.



- 5) Insert the straight pins into the front body, then install the side plate, aligning it with the straight pins.

Note:

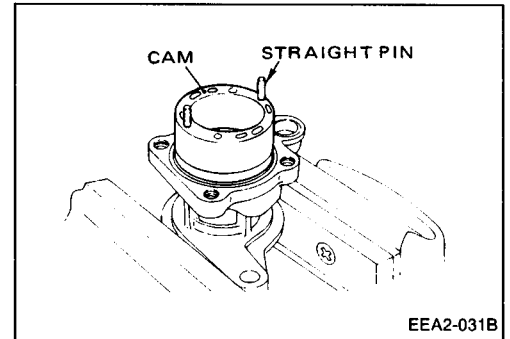
- Be sure to install the side plate with its groove facing upward (i.e. the driving side).



- 6) Install the cam aligning it with the straight pins.

Note:

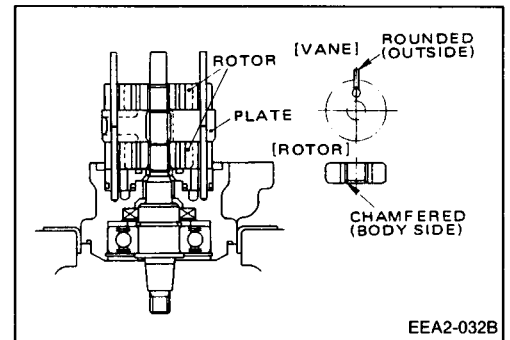
- Be sure to install the cam correctly aligning it with the side plate hole.



- 7) Install the rotor aligning it with the spline of the shaft, then fit the vane into the groove of the rotor.

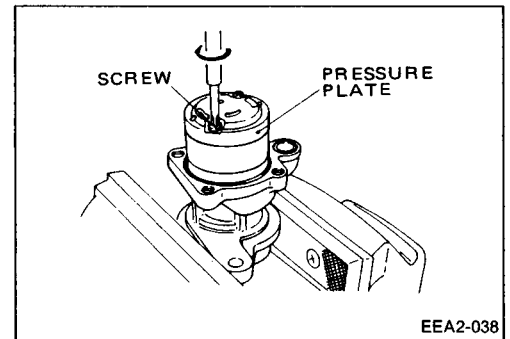
Note:

- Be sure to install the vane with the rounded end face side facing outward.



- 8) Install the pressure plate aligning it with the straight pins, then fasten it with the screw.

T : 0.6 - 0.9 kgm

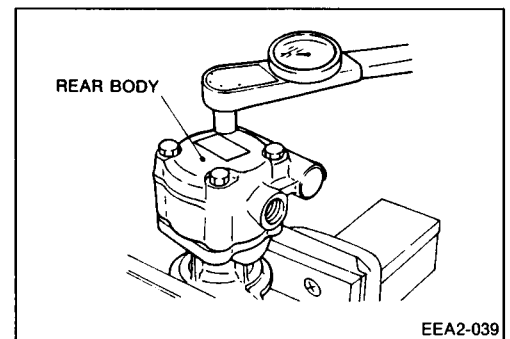


- 9) Fit the O-ring into the front body and install the rear body.

Note:

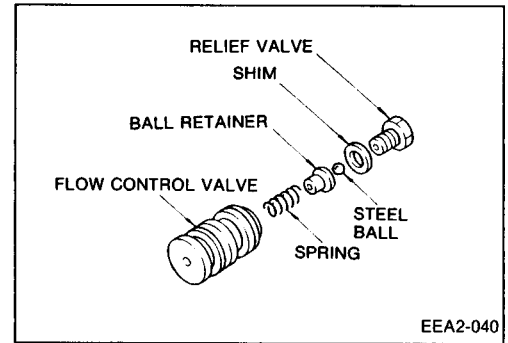
- Tighten the bolts diagonally.

T : 7.0 - 9.0 kgm



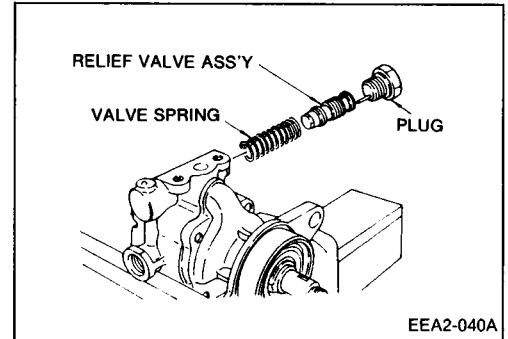
- 10) Fit the spring, ball retainer and steel ball into the flow control valve, then install the relief valve with the shim in place.

T : 1.0 - 1.4 kgm



- 11) Install valve assembly and spring in this order into the rear body and fasten them with the plug with the O-ring in place.

T : 5.0 - 6.0 kgm

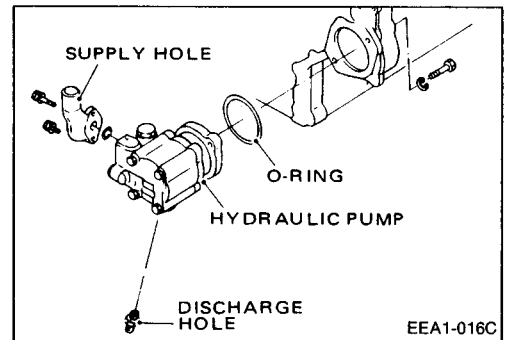


- 12) Press the key into the shaft. Then install the drive gear and fasten it with the nut.

T : 5.0 kgm

INSTALLATION

- 1) Install the hydraulic pump assembly with the O-ring in place.
- 2) Connect the inlet and outlet tubes.
- 3) Add the power steering oil and purge the excess air.
 - (1) Jack up the front axle and chock the rear wheels.
 - (2) Fill the reservoir with oil to the specified level.
 - (3) Idle the engine and turn the steering wheel fully to the right and left several times. Then check the level and add more oil as needed.
 - (4) Repeat the operation in step (3) until the oil level stabilizes at the specified level.
 - (5) Turn the steering wheel and check to make sure that both right and left wheels move smoothly.
 - (6) Lower the jack on the front axle, and check to make sure that there is no oil leakage from the line or the connector.
 - (7) Check to make sure that the specified amount of oil is contained in the reservoir.



INSPECTING RELIEF VALVE PRESSURE

- 1) Cut the joint in two at an appropriate point between the oil pump and the power steering, and install a stop valve there. Also install a pressure gauge (200 kg/cm²) between the oil pump and the stop valve. Then remove the air in the piping after ensuring that there is no oil leakage from the connecting portion and that the stop valve is fully open.

Note:

- **Prior to inspection, idle the engine until the temperature of the oil reaches 50 to 60°C.**
- 2) While maintaining the engine speed at 600 rpm, gradually close the stop valve, keeping an eye on the pressure gauge dial at the same time. The dial reading will indicate the relief valve adjustment pressure when the stop valve has been completely shut.

[kg/cm²]

Model	PV123-35-15	475-03282	PV132-25-25
Relief valve adjusting pressure	133 - 140		123-130

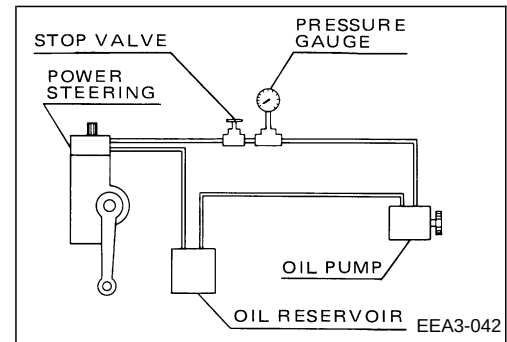
If the oil pressure exceeds the adjustment pressure plus 10 kg/cm², the relief valve is not working correctly. If, on the other hand, the oil pressure fails to increase, either the oil pump is malfunctioning, or there is a permanent leak in the relief valve.

Note:

- **Do not keep the stop valve closed for more than 15 seconds during the pressure check.**
- **If the relief valve pressure cannot be adjusted, replace the relief valve (PV123-35-15 and PV132-25-25) with a relief valve assembly.**
If the relief valve is a 475-03282 type, adjust relief valve pressure using the shim built into it.

MODEL: 475-03282

Shim thickness	Pressure increase
0.5 mm	6.2 kg/cm ²
0.2 mm	2.5 kg/cm ²



13. SERVICE DATA

CONTENTS

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MAINTENANCE

SERVICE DATA

Part	Item			Maintenance standard	Remarks			
Engine proper	Valve clearance [mm]			Intake	0.3 - 0.4			
				Exhaust	0.5 - 0.6			
	Valve timing	RF8 RE10	Intake	Open	14° B.T.D.C.			
			Exhaust	Closed	44° A.B.D.C.			
				Open	52° B.B.D.C.			
					Closed	20° A.T.D.C.		
		RG8				Intake	Open	18° B.T.D.C.
			Exhaust			Closed	64° A.B.D.C.	
				Open		52° B.B.D.C.		
					Closed	20° A.T.D.C.		
	V-belt for looseness [mm]	Water pump pulley-crank pulley (A)				11 - 14	When midpoint is pressed with a force of about 10 kg.	
		Crank pulley-cooler compressor pulley (B)			10.5 - 13.5			
	Compression pressure [kg/cm ²]	Maintenance standard			29, min.			
		Compression pressure limit			21 (180 - 220 rpm)			
		Variance among cylinders			4 or less			
	Thermostat	Valve opening temperature [°C]	Low temperature		76.5	RF8, RG8		
			High temperature		82			
			Valve lift/temperature [mm/°C]	Low temperature		82	RE10	
				High temperature		88		
		Low temperature		10/90	RF8, RG8			
				High temperature		10/95		
			Low temperature	10/95	RE10			
				High temperature		10/100		
Fuel system	Injection timing [B.T.D.C.]		RF8	17°	Conventional type			
				18°	Two-spring type			
			RG8	10.5°				
			RE10	18°				
	Idle speed [rpm]		RF8	550 - 570				
			RG8	460 - 480				
			RE10	450 - 550				
	Injection pressure [kg/cm ²]		RF8	220	Conventional type			
				180 - 220	Two-spring type			
			RG8	180 - 230				
RE10			180 - 220					

TIGHTENING TORQUE

[kgm]

Part		Tightening torque	Remarks
Valve clearance adjusting lock nut		3.5 - 4.5	
Intake manifold nut	M8	1.0 - 1.3	
	M10	1.9 - 2.3	
Exhaust manifold nut	M12	5.5 - 6.5	
Cylinder head bolt		28.0 - 30.0	
Oil pan drain plug		10.0 - 13.0	
Oil filter drain plug		1.6 - 2.2	
Oil filter center bolt		6.0 - 7.0	
Idle adjusting lock nut		0.5 - 0.7	
Injection nozzle retaining nut		6.0 - 8.0	
Fuel filter center bolt		6.0 - 7.0	

ENGINE DISASSEMBLY AND REASSEMBLY

TIGHTENING TORQUE

Part		Tightening torque	Remarks
Oil jet connector bolt		5.0 - 6.0	
End plate mounting bolt		1.6 - 2.1	
Main bearing cap bolt	RF8 and RE10	26.0 - 30.0	
	RG8	42.0 - 45.0	
Main bearing cap side bolt		10.0 - 11.0	
Idler shaft mounting bolt		1.6 - 2.1	
Idler shaft bolt		13.0 - 16.0	
Idler gear mounting nut		12.0	With P.T.O.
Air compressor mounting bolt		3.5 - 5.0	
Air compressor drive gear mounting nut		19.0 - 21.0	
Injection pump drive gear mounting nut		40.0 - 45.0	
Camshaft gear mounting nut		50.0 - 60.0	Prevent gear from turning before tightening.
Connecting rod bearing cap nut	RF8 and RE10	18.0 - 20.0	Apply oil to nut seating surface and threads.
	RG8	23.0 - 25.0	
Oil pump mounting bolt		3.5 - 5.0	
Oil outlet pipe mounting bolt		3.5 - 5.0	
Oil screen mounting bolt	Flange side	3.5 - 5.0	
	Support side	1.7 - 2.3	
Flywheel housing mounting bolt	M10	3.1 - 3.7	
	M12	5.5 - 6.4	
Stiffener mounting bolt	Block side	12.0	
	Housing side	15.0	
Flywheel mounting bolt		28.0 - 31.0	
Crank pulley bolt		18.0 - 20.0	
Cylinder head bolt	1st time	15.0 - 16.0	
	2nd time	28.0 - 30.0	
Valve rocker assembly mounting bolt		4.0 - 5.0	
Exhaust manifold mounting nut		5.5 - 6.5	
Oil cooler mounting bolt		1.6 - 1.9	
Water pump tension pulley mounting bolt	1st time	10.0 - 12.0	
	2nd time	Loosen	
	3rd time	10.0 - 12.0	
Cooling fan mounting bolt		1.6 - 2.1	
Nozzle holder assembly mounting bolt		2.5 - 3.5	
Intake manifold mounting bolt	M8	1.0 - 1.3	
	M10	1.9 - 2.3	
Injection pump mounting bolt		3.5 - 4.0	
Nozzle tube connector	Pump side	3.0 - 4.0	
	Nozzle side	2.5 - 3.5	
Oil pan drain plug		10.0 - 13.0	
Engine mounting bracket mounting bolt	Front	10.0 - 12.0	
	Rear		
Engine lifter mounting bolt		8.0 - 10.0	
Push rod cover mounting bolt		1.5 - 2.3	

ENGINE PROPER

SERVICE DATA

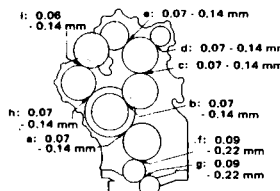
[mm]

Part	Item				Maintenance standard	Service limit	Remarks	
Cylinder block	Flatness of the top surface		Axial direction		0.10, max.	—		
			Perpendicular direction		0.02, max.			
	Bore at liner location	Out-of-round		0.025, max.	—	L: Loose T: Tight		
		Interference	Upper side		0.014T - 0.031L		—	
	Lower side		0.010T - 0.035L					
	Bearing cap-to-block clearance		At lower inner side		0.05T - 0.02L	—	L: Loose T: Tight	
			At side bolt		0 - 0.07L			
Water pressure test				[kg/cm ²]	4.0	—		
Cylinder liner	Bore diameter (measured with liner installed in cylinder bore)	Bore diameter	RF8		138.00 - 138.03	138.25	Measuring position: 40, 90, 120, 170 and 200 (from upper side)	
			RG8		142.00 - 142.03	142.25		
			RE10		134.99 - 135.02	135.25		
		Out-of-round		0.03, max.	—			
		Taper						
	Protrusion of flanged section beyond cylinder block upper surface		Protrusion	RF8 & RE10	0.01 - 0.07	—		
				RG8	0.01 - 0.03			
			Difference among adjacent liners		0.05, max.			
Piston	Outside diameter (oblong direction)		RF8		137.930 - 137.960	—		
			RG8		141.930 - 141.960			
			RE10		134.831 - 134.861			
	Clearance to cylinder liner		RF8		0.06 - 0.08	—		
			RG8		0.04 - 0.10			
			RE10		0.149 - 0.169			
	Piston pin bore diameter		RF8 & RE10		46.00 - 46.02	46.10		
			RG8		50.00 - 50.02	50.10		
Top clearance				0.30 - 0.84		—		
Piston ring	Piston ring-to-groove clearance		1st	RG8 & RE10	0.07 - 0.11	0.40		
				RF8	0.06 - 0.08			
			2nd	RF8 & RG8	0.02 - 0.04			
				RE10	0.03 - 0.07			
			Oil ring		0.02 - 0.06			0.20
	End gap clearance	1st	0.33 - 0.48			2.0		
		2nd	RF8	0.40 - 0.55				
			RG8	0.45 - 0.60				
			RE10	0.40 - 0.55				
		Oil ring	RF8 & RG8	0.25 - 0.45				
RE10			0.30 - 0.50					
Piston pin	Outside diameter			RF8 & RE10	45.99 - 46.00	45.90		
				RG8	49.99 - 50.00	49.90		
	Piston-to-pin bore clearance			0 - 0.03		0.10		

[mm]

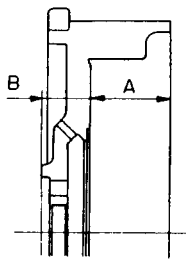
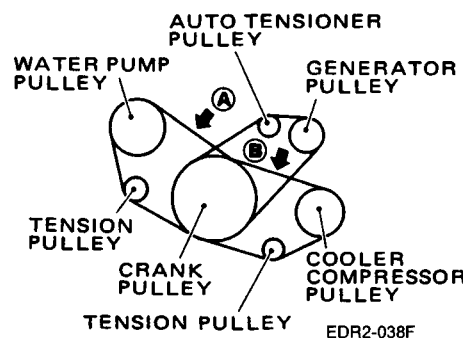
Part	Item			Maintenance standard	Service limit	Remarks	
Connecting rod	Small end bearing-to-piston pin clearance			0.03 - 0.05	0.10		
	Large end bearing-to-crank pin clearance			0.046 - 0.112	0.20		
	Small end bushing I.D.		RF8 & RE10	46.03 - 46.04	—		
			RG8	50.03 - 50.04	—		
	Bend			0.05, max.	—	When distance between pins is 250 mm	
	Twist			0.06, max.	—		
	Side clearance to crank pin			0.20 - 0.45	—	With either side clearance held at “0”	
Crankshaft	Outside diameter at journal (“U.S.” stands for undersize and refers to amount requiring polishing.)		S.T.D.	109.87 - 109.89	109.00	R at both corners: 4.0 mm	
			0.25 U.S.	109.62 - 109.64	—		
			0.50 U.S.	109.37 - 109.39	—		
			0.75 U.S.	109.12 - 109.14	—		
	Out-of-round at journal			0.005, max.	0.06		
	Taper at journal			0.01, max.	—		
	Outside diameter at crank pin (U.S. stands for undersize and refers to amount requiring polishing.)		RF8, RE10 engines	S.T.D.	84.89 - 84.91	84.00	R at both corners: 5.0 mm
				0.25 U.S.	84.64 - 84.66	—	
				0.50 U.S.	84.39 - 84.41	—	
				0.75 U.S.	84.14 - 84.16	—	
			RG8 engine	S.T.D.	89.89 - 89.91	89.00	
				0.25 U.S.	89.64 - 89.66	—	
				0.50 U.S.	89.39 - 89.41	—	
				0.75 U.S.	89.14 - 89.16	—	
	Out-of-round at crank pin			0.005, max.	0.06	RF8: Support No. 2 and No. 4 journals during measurement. RE10: Support No. 2 and No. 5 journals during measurement.	
	Taper at crank pin			0.01, max.	—		
	Runout	At journal		0.03, max.	0.40		
On contacting surface of front oil seal		0.01, max.	—				
On front mating surface of flywheel		0.02, max.	—				
End play			0.05 - 0.14	0.50			
Main bearing shell	Clearance to crankshaft journal			0.04 - 0.13	0.20		

[mm]

Part	Item			Maintenance standard	Service limit	Remarks
Main bearing shell	Clearance to crankshaft journal			0.04 - 0.13	0.20	
Camshaft	Outside diameter at journal (U.S. stands for undersize and refers to amount requiring polishing.)	No. 1	S.T.D.	65.69 - 65.78	65.43	All models
			0.2 U.S.	65.52 - 65.54	—	
		No. 2	S.T.D.	65.89 - 65.98	65.63	
			0.2 U.S.	65.72 - 65.74	—	
		No. 3	S.T.D.	66.09 - 66.18	65.83	
			0.2 U.S.	65.92 - 65.94	—	
		No. 4	S.T.D.	66.29 - 66.38	66.03	
			0.2 U.S.	66.12 - 66.14	—	
		No. 5	S.T.D.	66.49 - 66.58	66.23	
			0.2 U.S.	66.32 - 66.34	—	
		No. 6	S.T.D.	66.69 - 66.78	66.43	RE10
			0.2 U.S.	66.52 - 66.54	—	
	Runout			0.03, max.	0.06	RF8 & RG8: Support No. 2 and No. 4 journals during measurement. RE10: Support No. 2 and No. 5 journals during measurement.
	Journal-to-camshaft bushing clearance			0.02 - 0.11	0.20	
Cam profile height		RF8 & RE10	Intake	55.55 - 55.58	55.08	
			Exhaust			
		RG8	Intake	55.46 - 55.49	54.99	
			Exhaust	55.55 - 55.58	55.89	
End play			0.07 - 0.23	0.50		
Gear train	Each gear backlash		a, b, c, d, e, h	0.07 - 0.14	0.30	 i: 0.06 - 0.14 mm a: 0.07 - 0.14 mm d: 0.07 - 0.14 mm c: 0.07 - 0.14 mm h: 0.07 - 0.14 mm b: 0.07 - 0.14 mm f: 0.09 - 0.22 mm e: 0.07 - 0.14 mm g: 0.09 - 0.22 mm
			f, g	0.09 - 0.22	0.50	
			i	0.06 - 0.14	0.30	
	Cluster gear	Shaft-to-bushing clearance		0.03 - 0.06	0.20	
		End play		0.05 - 0.20	0.30	

EEP2-001B

[mm]

Part	Item		Maintenance standard	Service limit	Remarks
Flywheel	Surface runout at clutch disc		0.1, max.	0.15	 EEP2-019E
	Depth from flange end surface(A)	RF8 & RG8	47.9 - 48.1	50.1	
		RE10	91.3 - 91.5	93.5	
	Wear at clutch disc contacting surface location (B)	RF8 & RG8	55.5	53.5	
		RE10	53.5	51.5	
V-belt	Deflection (when midpoint is pressed with a force of 10 kg)	Water pump belt	11 - 14	 EDR2-038F	
		Cooler compressor belt	10.5 - 13.5		

CYLINDER HEAD AND VALVE MECHANISM

SERVICE DATA

[mm]

Part	Item		Maintenance standard	Service limit	Remarks
Cylinder head	Height		110	109.5	Polishing allowance: 0.5 mm
	Flatness	Axial direction	0.05, max.	0.20	
		Perpendicular direction	0.02, max.	0.20	
	Upper and lower surface parallelism		0.05, max.	—	
	Gasket thickness		1.50 - 1.60	—	When tightened to specified torque
Valve insert	Seat surface angle	Intake	45° - 45°15′	—	Seat angle in relation to head mounting surface
		Exhaust			
	Valve and valve insert contacting length	Intake	2.7 - 2.9	3.4	
		Exhaust	2.8 - 3.1	3.5	
Valve	Face angle	Intake	44°30′ - 45°	—	Face angle in relation to head mounting surface
		Exhaust			
	Valve stem outside diameter	Intake	9.960 - 9.975	9.830	
		Exhaust	11.895 - 11.920	11.830	
	Valve head dimension	Intake	2.0	1.8	
		Exhaust	1.5	1.3	
	Distance between the valve and the bottom surface of the cylinder head	Intake	0.58 - 1.07	—	
		Exhaust	0.58 - 1.12	—	
	Valve clearance	Intake	0.3 - 0.4	—	While cold
Exhaust		0.5 - 0.6	—		
Valve guide	Inside diameter	Intake	10.00 - 10.02	10.15	
		Exhaust	12.00 - 12.02	12.16	
	Clearance between the valve stem and valve guide	Intake	0.025 - 0.060	0.20	
		Exhaust	0.080 - 0.125	0.20	
Protrusion beyond head top surface at "drivein" position			20.5	—	
Valve spring	Free length	Outer	91.6	—	Both intake and exhaust
		Inner	88.7	—	
	Tension [kg]	Outer	41.6 - 46.0	—	When compressed to 59.1 mm (intake and exhaust)
		Inner	22.0 - 24.4	—	When compressed to 56.6 mm (intake and exhaust)
	Squareness			—	3.0

[mm]

Part	Item		Maintenance standard	Service limit	Remarks																	
Valve rocker and related parts	Rocker shaft outside diameter		24.99 - 25.00	24.90																		
	Rocker shaft runout		0.03, max.	0.05																		
	Valve rocker bushing inside diameter		25.02 - 25.04	25.10																		
	Clearance between the valve rocker bushing and rocker shaft		0.02 - 0.06	0.20																		
	Inside spring	Free length	112.0	—																		
		Tension [kg]	4.6	3.6	When compressed to 82 mm																	
	Valve rocker spring	Free length	29.0	—																		
		Tension [kg]	4.6	3.6	When compressed to 11 mm																	
Push rod runout			0.3, max.	0.5	With both ends supported																	
Cam follower	Outside diameter		23.94 - 23.97	23.85																		
	Clearance between the cam follower and cam follower hole		0.03 - 0.08	0.20																		
Other	Valve clearance adjustment sequence (mark “●” refers to adjustable valves.)																					
	Cylinder No.		Right bank (R)										Left bank (L)									
			1R		2R		3R		4R		5R		1L		2L		3L		4L		5L	
	Valve No.		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
			In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust	In-take	Ex-haust
	RF8 RG8	No. 4R (at TDC on compression stroke)	●			●			●	●				●			●		●	●		
		No. 4R (at TDC on exhaust stroke)		●	●		●	●					●		●	●		●				
	RE10	No. 5R (at TDC on compression stroke)	●			●			●		●	●	●	●	●					●	●	
		No. 5R (at TDC on exhaust stroke)		●	●		●	●		●						●	●	●	●			●

TIGHTENING TORQUE

[kgm]

Part		Tightening torque	Remarks
Cylinder head bolt	1st time	15.0 - 16.0	
	2nd time	28.0 - 30.0	
Valve rocker bracket mounting bolt		4.0 - 4.5	
Exhaust manifold mounting nut		5.5 - 6.5	
Air intake manifold mounting nut	M8	1.0 - 1.3	
	M10	1.9 - 2.3	
Injection nozzle holder mounting bolt		2.5 - 3.5	
Injection nozzle tube	Pump side	3.0 - 4.0	
	Flange side	2.5 - 3.5	
Spill tube		3.0	
Engine lifter mounting bolt		8.0 - 10.0	

LUBRICATION SYSTEM

SERVICE DATA

[mm]

Part	Item			Maintenance standard	Service limit	Remarks	
Oil pump	Side clearance			0.05 - 0.11	0.15		
	Backlash between crank gear and idler gear			0.08 - 0.21	0.50		
	Backlash between idler gear and head gear			0.08 - 0.21	0.50		
	Idler gear end play			0.10 - 0.27	0.50		
	Spindle-to-idler gear bushing clearance			0.08 - 0.15	0.12		
	Drive-to-driven gear bushing clearance			0.04 - 0.08	0.12		
	Relief valve	Valve opening pressure [kg/cm ²]		11	—		
		Spring free length		76.3	—		
		Spring tension [kg]		27 - 30	24	When compressed to 66.6 mm	
Oil cooler	Short valve opening pressure [kg/cm ²]			1.8 - 2.2	—		
	Cooler core hydraulic test pressure [kg/cm ²]			5	—		
Oil filter	Short valve	Valve opening pressure [kg/cm ²]	“Tsuchiya” make	1.0 - 1.4	—		
			“Nichiro” make	1.0 - 1.4	—		
		Spring free length	“Tsuchiya” make	62.7	—		
			“Nichiro” make	74.5	—		
		Spring tension [kg]	“Tsuchiya” make	4.0 - 4.4	—	When compressed to 47 mm	
			“Nichiro” make	4.0	—	When compressed to 40.5 mm	
	Regulator valve	Dual type	Valve opening pressure [kg/cm ²]	“Tsuchiya” make	4.3 - 4.7	—	
			Spring free length	“Tsuchiya” make	49.5		
			Spring tension [kg]	“Tsuchiya” make	16.3 - 18.1		When compressed to 36.2 mm
		Single type	Valve opening pressure [kg/cm ²]	“Nichiro” make	4.3 - 4.7	—	
			Spring free length	“Nichiro” make	54.5	—	
			Spring tension [kg]	“Nichiro” make	9.9	—	When compressed to 40.0 mm
Piston cooling oil jet valve opening pressure [kg/cm ²]				2.3 - 2.7	—		

TIGHTENING TORQUE

[kgm]

Part		Tightening torque	Remarks
Oil pump cover cover mounting bolt		2.6 - 4.0	
Oil pump assembly mounting bolt		3.5 - 5.0	
Oil screen mounting bolt	At flange	3.5 - 5.0	
	At support	1.7 - 2.3	
Oil outlet pipe		3.5	
Oil pan drain plug		10.0 - 13.0	
Center bolt (for full-flow and bypass oil filters)		6.0 - 7.0	
Drain plug (for full-flow and bypass oil filters)		1.6 - 2.2	
Oil jet connector bolt		5.0 - 6.0	
Oil cooler housing mounting bolt		1.6 - 1.9	

COOLING SYSTEM

SERVICE DATA

[mm]

Part	Item		Maintenance standard	Service limit	Remarks
Water pump	Outside diameter of shaft at impeller		20.051 - 20.060	—	
	Fit of impeller and shaft		0.023T - 0.053T	—	T: Tight
	Outside diameter of shaft at pulley		25.002 - 25.015	—	
	Fit of pulley and shaft		0.048T - 0.082T	—	T: Tight RG8 engine
			0.03T - 0.07T	—	T: Tight RF8, RE10 engines
Body-to-impeller clearance		0.6 - 1.2	—	To be measured in vertical direction in relation to body surface	
Thermostat	Valve opening temperature	76.5°C	74.5 - 78.5	73.0 - 80.0	RF8, RG8 engines
		82°C	80.0 - 84.0	78.5 - 85.5	RF8, RG8, RE10 engines
		88°C	86.0 - 90.0	84.5 - 91.5	RE10 engine
	Valve lift	76.5°C	10, min. (90°C)	8.5, max. (90°C)	RF8, RG8 engines
		82°C	10, min. (95°C)	8.5, max. (95°C)	RF8, RG8, RE10 engines
		88°C	10, min. (100°C)	8.5, max. (100°C)	RE10 engine
Water tank cap relief pressure [kg/cm ²]		0.5 - 0.7	—	Pressure side	
Radiator leak test pressure [kg/cm ²]		1.0	—	Air pressure	
Fan clutch switching temperature [°C]		CD and CW series vehicles	60 - 70	—	ON-OFF control
		Other trucks	70 - 80	—	Linear fan clutch
Cooling fan-to-fan shroud clearance		Tractor	5.0	—	All around
		Except tractors	25.0	—	All around (Radiator with fan shroud)
V-belt tension adjustment	Water pump-to-crank pulley		11 - 14	—	Force required: 10 kg
	Crank pulley-to-cooler compressor pulley		10.5 - 13.5	—	Force required: 10 kg

TIGHTENING TORQUE

[kgm]

Part	Tightening torque	
Water pump mounting bolt	1.0 - 1.3	
Cooling fan mounting bolt	2.1 - 2.7	
Fan clutch mounting bolt	3.5 - 5.0	

FUEL SYSTEM

SERVICE DATA

[mm]

Part	Item		Maintenance standard	Service limit	Remarks
Pump body	Pump housing-to-tappet clearance		0.03 - 0.08	0.2	
	Depression on contacting surfaces of lower spring seat and plunger		—	0.2	
	Control sleeve groove width		—	10.1	
	Rod groove width-to-steel ball clearance		0.06, max.	0.1	
	Camshaft axial play		0.02 - 0.06	0.10	
	Sliding resistance of control rod		150 g, max.		
Feed pump	Roller outside diameter		14.98 - 15.00	14.9	
	Roller-to-roller pin clearance		0.04 - 0.08	0.15	
RFD governor	Tension lever-to-pin and guide lever bore-to-pin clearances		0.02 - 0.09	0.20	
	Flyweight-to-bore clearance		0.02 - 0.05	0.08	
	Speed setting lever shaft-to-bushing clearance		0.02 - 0.08	0.15	
	Rod control shaft-to-bushing clearance		0.02 - 0.08	0.15	
2-spring type nozzle	1st valve opening pressure [kg/cm ²]		180	—	Regulated pressure 185 - 193
	2nd valve opening pressure [kg/cm ²]	RF8 RE10	220	—	Regulated pressure [Nozzle cover method] 235 - 240 [Push rod contacting method] 253 - 259
		RG8	230	—	Regulated pressure [Nozzle cover method] 240 - 250
Conventional nozzle	Valve opening pressure [kg/cm ²]		220	—	Regulated pressure 225 - 233

TIGHTENING TORQUE

Nozzle and nozzle holder

[kgm]

Part		Tightening torque	Remarks
Nozzle holder assembly mounting bolt		2.5 - 3.5	Alternately tighten the two bolts in several stages.
2-spring type nozzle	Cap nut	4.0 - 5.0	RF8, RE10
	Retaining nut	6.0 - 8.0	
	Adjusting screw lock nut	2.0 - 2.5	RF8, RE10
	Setscrew	5.0 - 6.0	RF8, RE10
Conventional nozzle	Cap nut	4.0 - 5.0	RF8
	Retaining nut	6.0 - 8.0	RF8

Fuel tank

[kgm]

Part	Tightening torque	Remarks
Drain plug	5.0 - 7.0	

AIR INTAKE AND EXHAUST SYSTEM

SERVICE DATA

Exhaust brake system

[mm]

Item			Maintenance standard	Service limit	Remarks
Spindle outer diameter			13.75 - 13.80	—	
Clearance between spindle and bushing			0.25 - 0.35	—	
Radial play of spindle			0.5 - 2.5	—	
Clearance between valve and body	One side	RF8, RE10	0.4 - 0.6	—	
		RG8	0.8 - 1.0	—	
	Both sides	RF8, RE10	0.8 - 1.2	—	
		RG8	1.6 - 2.0	—	
Air cylinder spring tension			7.9 kg	—	When compressed to 113.2 mm (all except CG series models)
			11.7 kg	—	When compressed to 106.0 mm (CG series models)

Air intake shutter

[mm]

Item	Maintenance standard	Service limit	Remarks
Shaft outer diameter	13.966 - 13.984	—	
Clearance between housing and shaft	0.016 - 0.052	—	
Air cylinder spring tension	5.5 kg	—	When compressed to 102.0 mm

TIGHTENING TORQUE

Exhaust brake system

[kgm]

Part		Tightening torque	Remarks
Cover mounting bolt		2.1 - 2.7	
Lever mounting nut at spindle		1.0 - 1.6	
Stopper bolt lock nut		0.5 - 0.7	
Plate & air cylinder mounting bolt		2.1 - 2.7	
Exhaust shutter mounting bolt		1.0 - 1.6	
Air cylinder	Cover mounting bolt	1.0 - 1.6	
	Plate mounting nut	1.0 - 1.6	

Air intake shutter

[kgm]

Part		Tightening torque	Remarks
Valve mounting bolt	RF8 and RE10	1.9	Coat of grease (Sunlight No. 2)
	RG8	1.6 - 2.1	Coat of locking agent (TB1373B or equivalent)
Air cylinder cover mounting bolt		1.0 - 1.6	
Air intake shutter actuator mounting bolt		1.6 - 2.1	

ELECTRICAL SYSTEM

SERVICE DATA

Starting motor

Part	Item			Maintenance standard	Service limit	Remarks
Bracket section	Metal inside diameter	Front	0350 602 0320	19.0	19.2	
			0350 702 0390	20.0	20.2	
			0350 802 0030			
		Holder	0350 602 0320	28.0	28.2	
			0350 702 0390	35.0	35.2	
			0350 802 0030			
	Inside diameter at bearing	Commutator side	0350 602 0320	32.0	32.1	
			0350 702 0390	35.0	35.1	
			0350 802 0030			
		Gear side	0350 602 0320	52.0	52.1	
			0350 702 0390	62.0	62.1	
			0350 802 0030			
Commutator	Outside diameter		0350 602 0320	40.0	38.0, max.	
			0350 702 0390	44.0	42.0	
			0350 802 0030			
	Runout			0.05, max.	0.1	
Undercut depth			0.5 - 0.8	0.2		
Brush	Brush height		0350 602 0320	20.0	14.0, max.	
			0350 702 0390	22.0	15.0	
			0350 802 0030			
	Brush spring tension [kg]		0350 602 0320	3.0	2.1, max.	When spring is set
			0350 702 0390	2.8	1.96, max.	
			0350 802 0030			
Magnetic switch	Series coil resistance [Ω]		0.12 - 0.15		—	
	Shunt coil resistance [Ω]	0350 602 0320	0.6 - 0.8		—	
		0350 702 0390	0.4 - 0.5	—		
		0350 802 0030				
	Contactor point deflection	0350 602 0320	1.0 - 2.0		—	
		0350 702 0390	2.0 - 3.0	—		
		0350 802 0030				
Output shaft	Shaft runout			0.05, max.	0.1, min.	
	Strut gap			0.1 - 0.5		
Insulation resistance	Armature, field [MΩ]			1.0, min.	0.5, max.	
	Brush holder [MΩ]			1.0, min.	0.5, max.	

Alternator

Part	Item			Maintenance standard	Service limit	Remarks
Coil	Resistance [Ω]	Stator coil	0201 102 2972	0.36 - 0.44	—	Between two phases
			0201 152 0052	0.20 - 0.24	—	
		Field coil	0201 102 2972	7.0 - 8.6	—	
			0201 152 0052	5.6 - 6.8	—	
Output current [A]			0201 102 2972	40, min.	—	28V 5000 rpm
			0201 152 0052	50, min.	—	
Regulating voltage [V]				28.5±0.5	—	At 20°C
Speed required to increase voltage to 27 volts [rpm]				900, max.	—	At 20°C

TIGHTENING TORQUE

Starting motor

[kgm]

Part	Tightening torque	Remarks
C terminal	0.19 - 0.25	
B and M terminals	1.65 - 2.25	
Magnetic switch mounting bolt	0.6 - 0.9	
Through bolt	1.4 - 1.6	
Brush holder mounting bolt	0.37 - 0.50	

Alternator

[kgm]

Part		Tightening torque	Remarks
Screw	Size M4	0.10 - 0.14	
	Size M5	0.19 - 0.25	
Pulley mounting nut		9.8 - 13.0	
B and E terminals		0.33 - 0.45	
Through bolt		0.6 - 0.9	

AUXILIARY EQUIPMENT

SERVICE DATA

Model: S12W

[mm]

Part	Item			Maintenance standard	Service limit	Remarks
Performance	Charging performance	Compressor speed	400 rpm	124, max.	—	Tank capacity: 30 liters
			2,000 rpm	32, max.	—	
Compressor	Piston-to-cylinder clearance	Piston top		0.18 - 0.25	0.28	Replace piston or cylinder.
		Piston skirt		0.08 - 0.15	0.18	
	Piston ring end gap	Compression ring		0.15 - 0.30	1.00	Replace ring.
		Oil ring		0.20 - 0.70	1.00	
	Piston ring-to-ring groove clearance	Compression ring		0.01 - 0.045	0.08	Replace piston or cylinder.
		Oil ring		—	—	
	Piston pin bore-to-piston pin clearance			0.01T - 0.02L	0.08L	T: Tight; L: Loose
	Connecting rod small end-to-piston pin clearance			0.02 - 0.04	0.07	Replace piston pin or connecting rod.
	Connecting rod large end bushing-to-crank pin clearance			0.02 - 0.09	0.10	Replace bushing or crankshaft.
	Crankshaft end play			0.1 - 0.7	1.0	
Cylinder head	Suction valve spring	Free length		11.5	(10.3) for reference	
		Tension [kg]		1.25	0.87	When spring length is 7.5 mm
	Delivery valve spring	Free length		13.4	(12.5) for reference	
		Tension [kg]		1.1	0.8	When spring length is 10 mm

Hydraulic pump

Model: PV123-35-15 and PV132-25-25

[mm]

Item	Maintenance standard	Service limit	Remarks
Side plate depression	—	0.03	
Relief valve outside diameter-to-body inside diameter clearance	0.013 - 0.020	0.03	
Shaft oil seal lip outside diameter wear	—	0.05	
Unloader valve outside diameter-to-body inside diameter clearance	—	0.04	2-rotor only

Model: 475-03282

[mm]

Item	Maintenance standard	Service limit	Remarks
Relief valve outside diameter-to-body inside diameter clearance	—	0.03	
Ball bearing play	—	0.04	

TIGHTENING TORQUE
Air compressor
Model: S12W

[kgm]

Part	Tightening torque	Remarks
Suction valve holder	14.0 - 16.0	
Delivery valve holder	14.0 - 16.0	
Unloader valve connector	10.0 - 12.0	
Cylinder head mounting bolt and nut	2.5 - 3.0	
Cylinder liner mounting bolt	2.5 - 3.0	
Connecting rod cap mounting bolt and nut	2.3 - 2.6	
Bearing case setscrew	0.25 - 0.40	
Air compressor drive gear mounting nut	19.0 - 21.0	

Hydraulic pump
Model: PV123-35-15 and PV132-25-25

[kgm]

Part	Tightening torque	Remarks
Relief valve plug	1 rotor	7.0 - 10.0
Spool valve connector	2-rotors	7.0 - 8.5
Pilot spool plug		7.0 - 8.5
Cover mounting bolt		3.5 - 4.0
Blind plug		3.0 - 4.0

Model: 475-03282

[kgm]

Part	Tightening torque	Remarks
Pump body mounting bolt	7.0 - 9.0	
Pressure plate mounting screw	0.6 - 0.9	
Relief valve plug	5.0 - 6.0	
Relief valve	1.0 - 1.4	

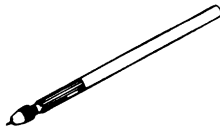
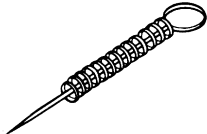
14. SPECIAL TOOLS

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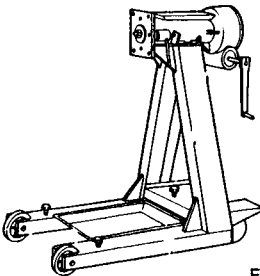
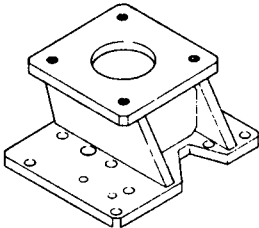
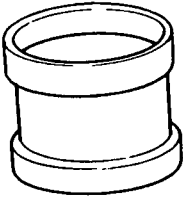
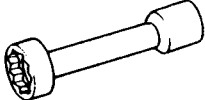
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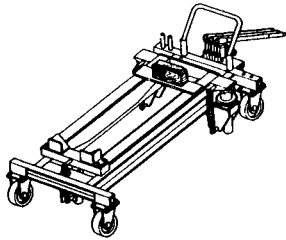
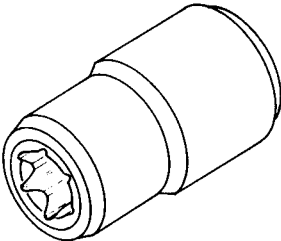
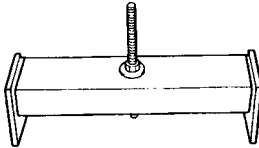
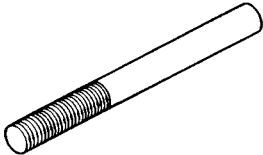
NOZZLE AND NOZZLE HOLDER

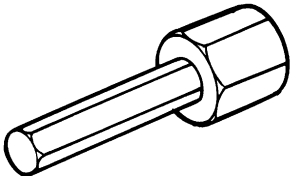
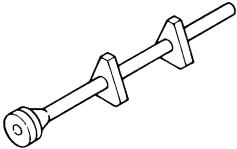
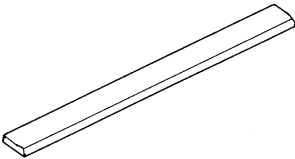
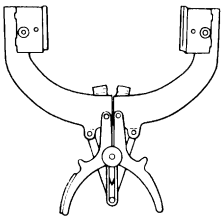
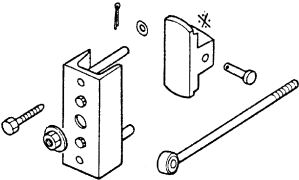
Tool name and part No.	Use	Shape
Pin vise 99727 Z5004	Used to clean nozzle hole.	 EP14-121
Nozzle cleaner 99726 Z5000	Used to remove carbon from rear side of nozzle.	 EP14-122

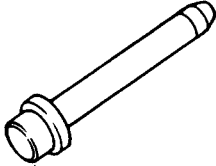
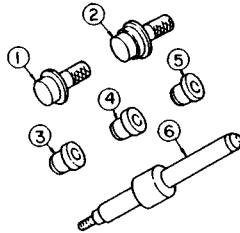
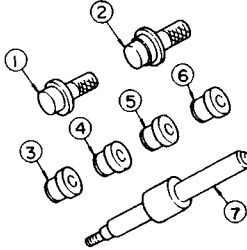
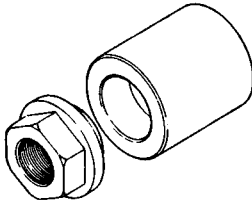
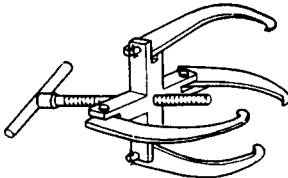
SPECIAL TOOLS

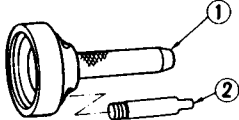
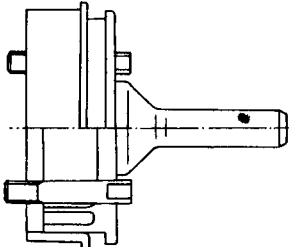
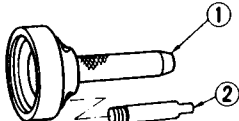
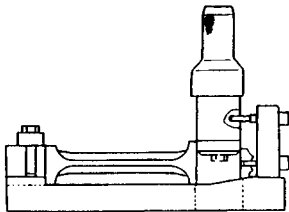
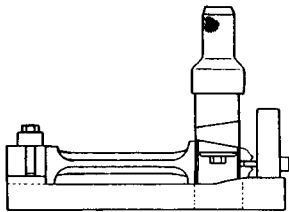
ENGINE DISASSEMBLY AND REASSEMBLY

Tool name and part No.	Use	Shape
Guide bolt 99687 97001	Used to remove/install flywheel. M16 x 1.5	 ER14-151
Engine stand 99550 96001	Used to disassemble/reassemble engine.	 ET14-001
Engine stand attachment 99554 97001	Used to install engine on engine stand.	 EP14-100
Piston insert tool 99631 97002 (RF8 engine) 99631 97600 (RG8 engine) 99631 97000 (RE10 engine)	Used as a guide when inserting piston into cylinder liner.	 ET14-045C
Cylinder head bolt socket wrench 99664 96000	Used to remove/install (tighten) cylinder head bolt.	 EP14-105

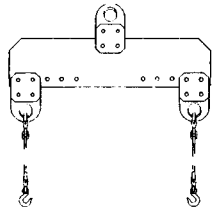
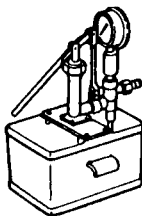
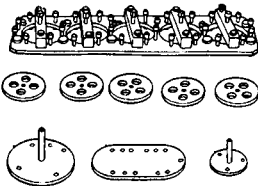
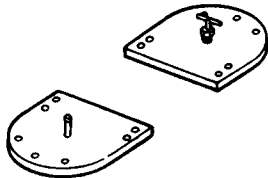
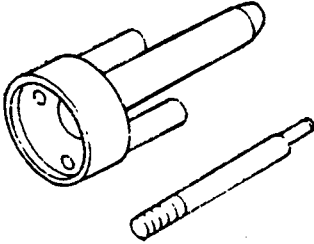
Tool name and part No.	Use	Shape
Engine jack 99890 Z0001	Used to remove/install engine.	 CTL1-050
Filter wrench 99755 Z0000	Used to remove only cartridge oil filter.	 ETL2-002
E-type socket 99739 97000	Used to remove/install injection pump bracket.	 ER14-100
Main bearing cap puller 99601 97000	Used to remove main bearing cap.	 ER14-103
Guide bolt 99687 97000 (RF8, RE10 engines) 99687 97004 (RG8 engine)	Used as a guide when installing main bearing cap. M16 x 2.0 (RF8, RE10 engines) M18 x 2.0 (RG8 engine)	 ER14-107

Tool name and part No.	Use	Shape
Hex wrench 99545 97000	Used to remove/install main bearing cap side bolt. Width across flats: 10 mm	 ER14-102
Bracket setting tool assembly 99720 96000	Used as a centering tool when installing injection pump bracket on cylinder block.	 ETL2-003
Straight edge 99645 Z5001	Used to measure cylinder flatness.	 ES14-8
Piston ring tool 99630 Z0001	Used to remove/install piston ring. (101 to 177 mm dia.)	 EP14-111
Cylinder liner tool 99600 97001 (RF8 engine) 99600 97600 (RG8 engine) 99600 97000 (RE10 engine)	Used to remove/install cylinder liner.	 ER14-105

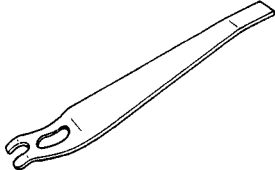
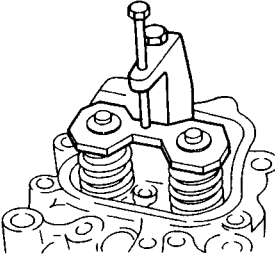
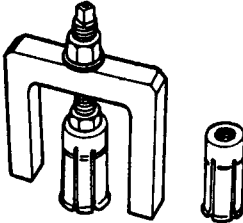
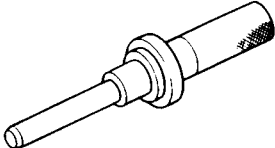
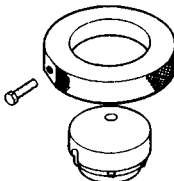
Tool name and part No.	Use	Shape
Cam bush remover 99590 97002	Used to remove camshaft bushing.	 ET14-010A
Cam bush tool 99590 97003 (RF8, RG8 engines)	Used to install camshaft bushing.	 ET14-012E
Cam bush tool 99590 97004 (RE10 engine)	Used to install camshaft bushing.	 ET14-012F
Collar replacer 99718 97000	Used to install front oil seal collar.	 EP14-107
Rear oil seal sleeve re- mover 99692 97000 (RG8 engine)	Used to remove oil seal sleeve and oil seal as a unit.	 ETL2-039

Tool name and part No.	Use	Shape
Sleeve replacer assembly 99691 97003 (RF8, RE10 engines)	Used to install oil seal sleeve. ① 99718 97004 ② 99687 97002	 ETL2-006B
Rear oil seal sleeve replacer 99691 97005 (RG8 engine)	Used to install oil seal sleeve and oil seal as a unit.	 ETL2-006E
Rear oil seal replacer 99691 97002 (RF8, RE10 engines)	Used to install oil seal.	 ETL2-006B
Connecting rod bush replacer tool assembly 99740 97003 (RF8, RE10 engines) 99740 97004 (RG8 engine)	Used to install connecting rod small end bushing.	 ETL2-027A
Connecting rod bush remover tool 99740 97001 (RF8, RE10 engines) 99740 97002 (RG8 engine)	Used to remove connecting rod small end bushing.	 ETL2-026

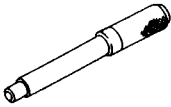
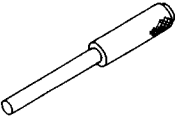
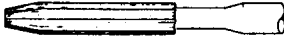
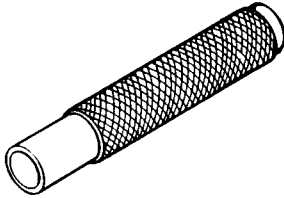
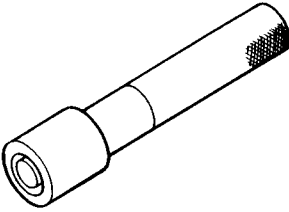
SPECIAL TOOLS

Tool name and part No.	Use	Shape
Engine hanger 99785 97000	Used when dismantling or mounting the engine.	 ETL2-040
Hydraulic pump 99570 Z5000	Used to conduct hydraulic tests on cylinder block, cylinder head and oil cooler element.	 EP14-119
Cylinder block & cylinder head attachment assembly 99561 97000		 ER14-104
Oil cooler attachment 99578 97001		 EP14-118
Front oil seal sleeve replacer 99691 97004	Used to install front oil seal sleeve.	 ETL2-006D

CYLINDER HEAD AND VALVE MECHANISM

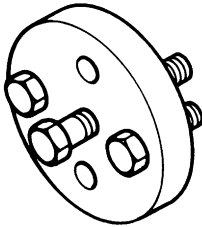
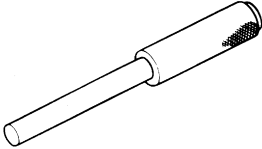
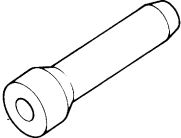
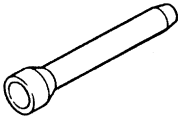
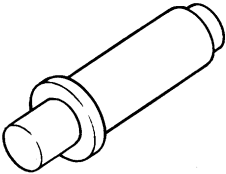
Tool name and part No.	Use	Shape
Split collar tool 99624 Z5001 (RF8, RE10 engines)	Used to remove/install split collar.	 ET14-043A
Split collar tool 99620 97000 (RG8 engine)	Used to remove/install split collar.	 ETL1-013
Valve insert puller 99660 97002	Used to remove valve insert.	 ER14-111
Valve insert replacer (intake) 99665 97502	Used to fit intake valve insert (cold fit).	 ER14-112
Valve insert replacer (exhaust) 99665 97500	Used to fit exhaust valve insert (cold fit).	
Valve insert caulking tool 99670 97001	Used to caulk exhaust valve insert.	 EP14-115

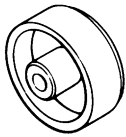
SPECIAL TOOLS

Tool name and part No.	Use	Shape
Valve guide remover (intake) 99667 95000	Used to remove intake valve guide.	 ETL2-004
Valve guide remover (exhaust) 99667 96000	Used to remove exhaust valve guide.	 ETL2-004A
Reamer (intake) 99662 96000	Used to ream intake valve guide bore.	 ER14-150
Reamer (exhaust) 99662 97000	Used to ream exhaust valve guide bore.	
Stem seal replacer (intake) 99674 97008	Used to install intake valve stem seal.	 ER14-115
Stem seal replacer (exhaust) 99674 97009	Used to install exhaust valve stem seal.	
Valve guide replacer (intake) 99666 97003	Used to drive intake valve guide into cylinder head bore.	 ER14-114
Valve guide replacer (exhaust) 99666 97004	Used to drive exhaust valve guide into cylinder head bore.	

COOLING SYSTEM

WATER PUMP [TOOL KIT: 99742 97500]

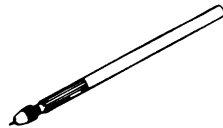
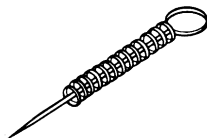
Tool name and part No.	Use	Shape
Impeller and pulley puller 99749 97500	Used to remove impeller and pulley.	 ET14-093B
Drive shaft remover 99758 97500	Used to remove drive shaft.	 ET14-129
Bearing replacer 99757 97500	Used to remove ball bearing.	 ET14-130
Water seal replacer 99753 97000	Used to remove/install water seal.	 ETL2-009
Oil seal replacer 99759 97500	Used to remove/install oil seal or remove water seal.	 ETL2-011

Tool name and part No.	Use	Shape
Drive shaft guide 99789 97500	Used to install drive shaft.	 ET14-131
Impeller replacer 99749 97502	Used to install impeller.	 ETL2-007

SPECIAL TOOLS

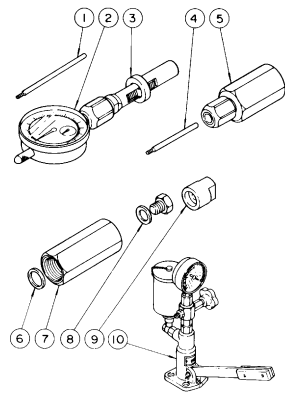
FUEL SYSTEM

NOZZLE AND NOZZLE HOLDER

Tool name and part No.	Use	Shape
Pin vise 99727 Z5004	Used to clean nozzle hole.	 EP14-121
Nozzle cleaner 99726 Z5000	Used to remove carbon from rear side of nozzle.	 EP14-122

SERVICE TOOLS FOR 2-SPRING TYPE NOZZLE

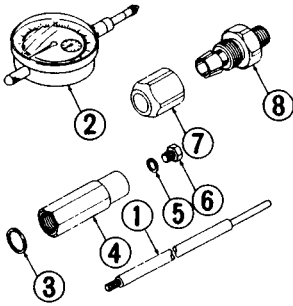
Engine models RF8, RE10

Tool name and part No.	Use	Shape
Adjusting device 105789-0560 ① 157892-1100 Pin (L = 60.5) ② 157954-3800 Dial gauge ③ 157892-0220 Adjusting device ④ 157892-1200 Pin (L = 50) ⑤ 157892-1320 Connector assembly ⑥ 157892-1500 Gasket ⑦ 157892-1420 Retaining nut ⑧ 026508-1140 Gasket ⑨ 157892-1800 Base ⑩ 105785-1010 Nozzle tester	Used to adjust opening pressure of 2-stage valve-open type nozzle.	 ETL2-008

Note:

- Dial gauge and nozzle tester (500 kg/cm²) are commercially available.

Engine model RG8

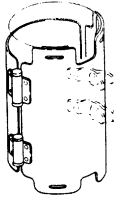
Tool name and part No.	Use	Shape
Adjusting device ① 157892-5300 Pin ② 157954-3800 Dial gauge ③ 157892-1500 Gasket ④ 157892-4000 Retaining nut ⑤ 026508-1140 Gasket ⑥ 157892-1600 Plug ⑦ 157892-4100 Holder ⑧ 157892-1000 Nut	Used to adjust opening pressure of 2-stage valve-open type nozzle.	

ETL2-008A

Note:

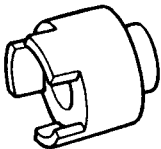
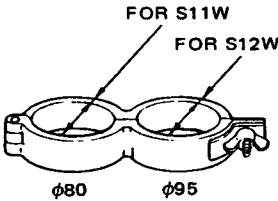
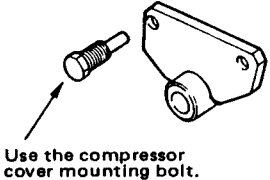
- Dial gauge and nozzle tester (500 kg/cm²) are commercially available.

AIR INTAKE AND EXHAUST SYSTEM

Tool name and part No.	Use	Shape
Flexible tube setting tool 99780 97502	Used to install flexible tube.	 ETL3-021

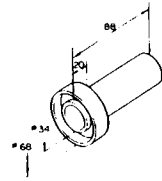
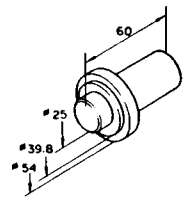
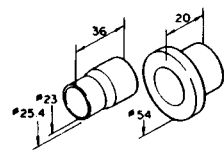
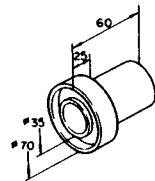
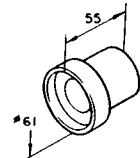
AUXILIARY EQUIPMENT

AIR COMPRESSOR

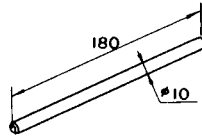
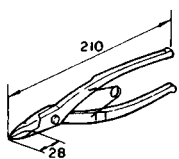
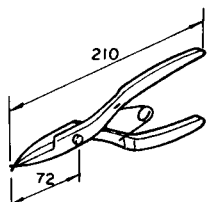
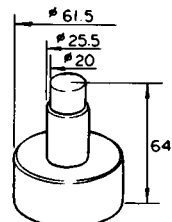
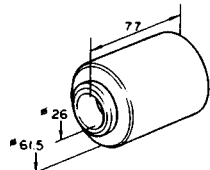
Tool name and part No.	Use	Shape
Valve holder tool 99744 97003	Used to remove/install air conditioner compressor suction valve holder.	 EP14-164
Piston insert kit (A + B) 99750 97001 Piston insert tool A: 99754 97002	Used to install piston in air compressor (single type only) Size differs for S11W and S12W units.	 ETL2-021
Crankshaft holder B: 99756 97001	Used with piston insert tool to install piston in air compressor.	 ETL2-012A

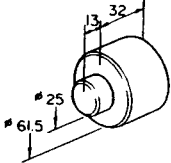
HYDRAULIC PUMP

Model: PV123-35-15 and PV132-25-25

Tool name and part No.	Use	Shape
Bearing replacer tool	Used to install ball bearing for 1-rotor type hydraulic pump.	 ETL2-013
Oil seal replacer tool	Used to install oil seal for 1-rotor type hydraulic pump.	 ETL2-014
Retaining ring replacer tool	Used to install retaining ring for 2-rotor type hydraulic pump.	 ETL2-015
Bearing replacer tool	Used to install ball bearing for 2-rotor type hydraulic pump.	 ETL2-016
Shaft replacer tool	Used to install shaft assembly 2-rotor type hydraulic pump.	 ETL2-017

Model: 475-03282

Tool name and part No.	Use	Shape
Stick 910-21630	Used to drain oil from oil pan.	 ETL2-018
Pliers 910-21632	Used to remove/install retaining ring.	 ETL2-019
Pliers 910-22570	Used to remove/install retaining ring.	 ETL2-019A
Press fit tool 910-22959	Used to install oil seal.	 ETL2-020
Press fit tool 910-22956	Used to install needle bearing.	 ETL2-020A

Tool name and part No.	Use	Shape
Press fit tool 910-22955	Used to install ball bearing.	 ETL2-020B