

CONTENTS




1. GENERAL INFORMATIONS	1
1.1. General Repair Instructions	
1.2. Engine Specifications	
1.3. Torque Specifications	
1.4. Major Parts Fixing Bolts	
1.5. Engine Repair Kit	
1.6. Repair	
2. ENGINE ASSEMBLY	19
2.1. General Description	
2.2. Disassembly	
2.3. Inspection and Repair	
2.4. Reassembly	
3. LUBRICATING SYSTEM	61
3.1. General Description	
3.2. Oil Pump	
3.3. Oil Filter	
3.4. Oil Cooler	
4. COOLING SYSTEM	66
4.1. General Description	
4.2. Water Pump	
4.3. Thermostat	
5. FUEL SYSTEM	70
5.1. General Description	
5.2. Fuel Filter	
5.3. Injection Nozzle	
6. SPECIAL TOOL LIST	74
• WORLDWIDE NETWORK	

1.3. Torque Specifications

Standards bolts

The torque values given in the following table should be applied where a particular torque is not specified.

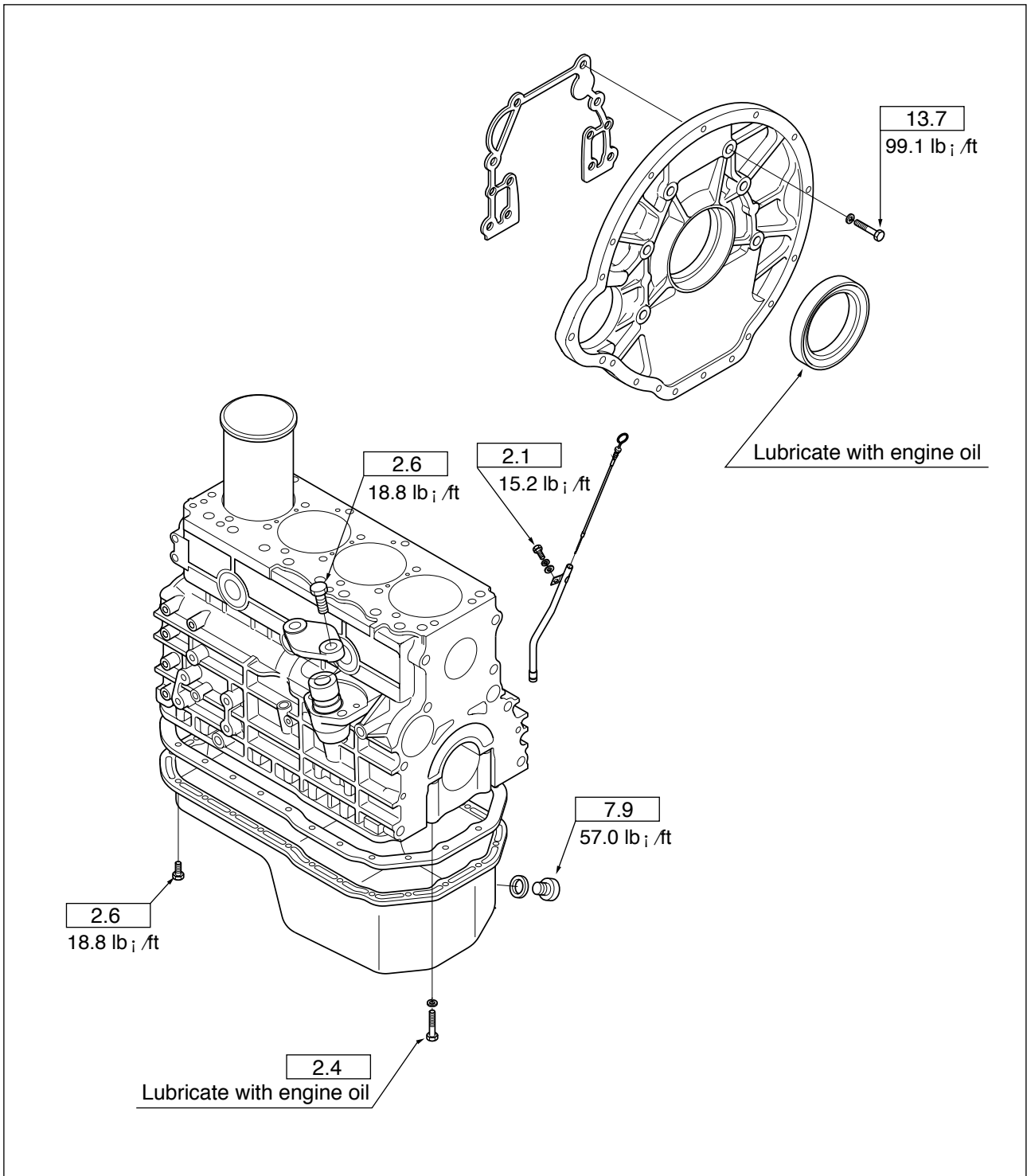
(Unit : kgf·m)

Bolt identification Bolt diameter ; pitch			
	4T Low carbon steel	7T High carbon steel	9T Alloy steel
6 ; 1.0	0.4-0.8	0.5-1.0	-
8 ; 1.25	0.8-1.8	1.2-2.3	1.7-3.1
10 ; 1.25	2.1-3.5	2.8-4.7	3.8-6.4
i 10 ; 1.5	2.0-3.4	2.8-4.6	3.7-6.1
12 ; 1.25	5.0-7.5	6.2-9.3	7.7-11.6
i 12 ; 1.75	4.6-7.0	5.8-8.6	7.3-10.9
14 ; 1.5	7.8-11.7	9.5-14.2	11.6-17.4
i 14 ; 2.0	7.3-10.9	9.0-13.4	10.9-16.3
16 ; 1.5	10.6-16.0	13.8-20.8	16.3-24.5
i 16 ; 2.0	10.2-15.2	13.2-19.8	15.6-23.4
18 ; 1.5	15.4-23.0	19.9-29.9	23.4-35.2
20 ; 1.5	21.0-31.6	27.5-41.3	32.3-48.5
22 ; 1.5	25.6-42.2	37.0-55.5	43.3-64.9
24 ; 2.0	36.6-55.0	43.9-72.5	56.5-84.7

The i indicates that the bolts are used for female-threaded parts that are made of soft materials such as casting, etc.

i Cylinder block and others

(unit : kgf/cm)

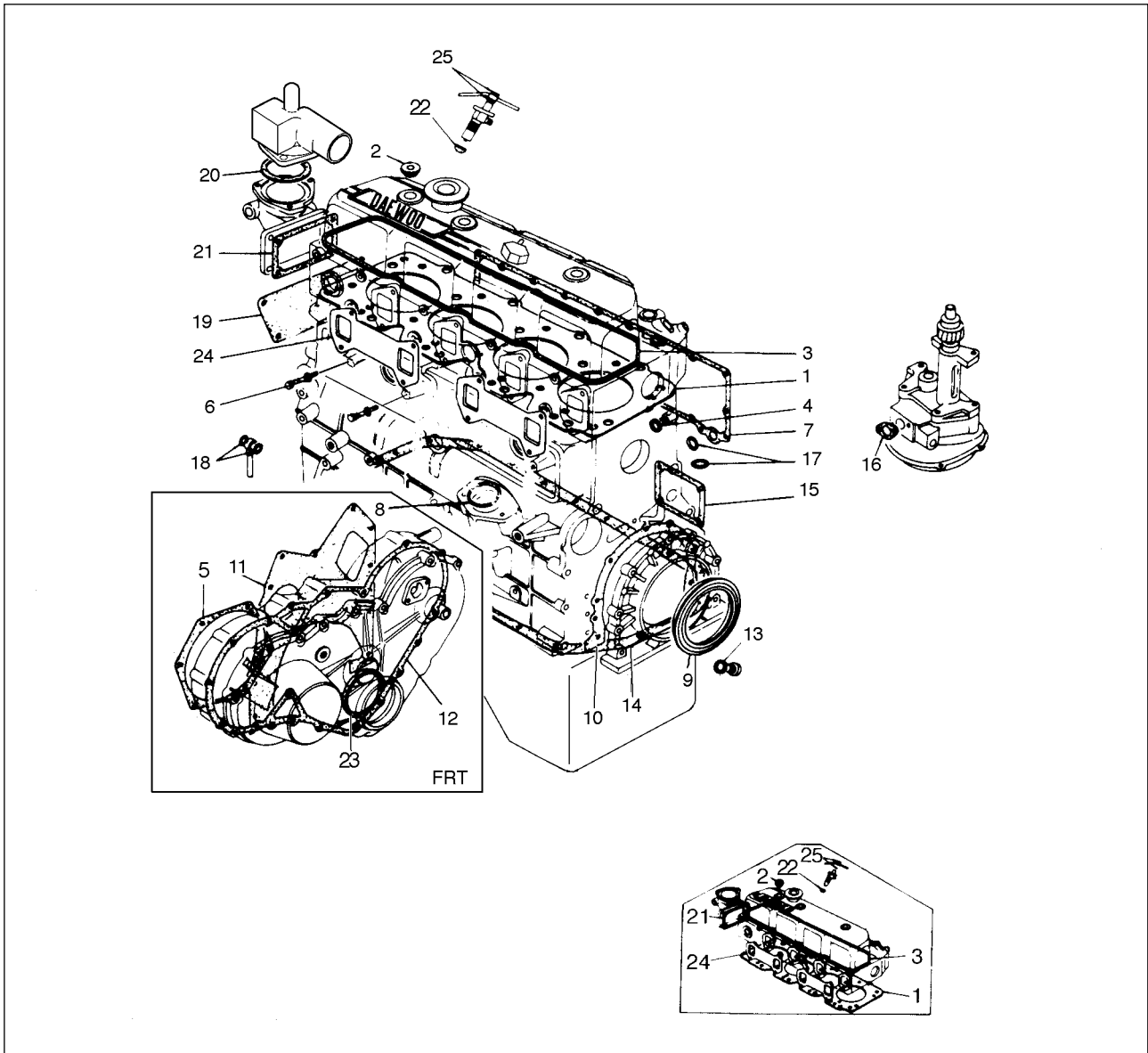


1.5. Engine Repair Kit



Part No. 1 ; >25 : Engine disassembly components

Part No. 1, 3, 21, 22, 25 : Engine top disassembly components



- | | |
|--|---------------------------------|
| 1. Gasket : Cylinder head | 14. Gasket : Oil pan and body |
| 2. Gasket : Cylinder head cover and bolt | 15. Gasket : Oil filter |
| 3. Gasket : Head cover | 16. Gasket : Oil pump and pipe |
| 4. Gasket : Relief valve | 17. Gasket : Oil filter pipe |
| 5. Gasket : Injection pump | 18. Gasket : Oil jet pipe |
| 6. Gasket : Tappet chamber and bolt | 19. Gasket : Water pump |
| 7. Gasket : Oil cooler | 20. Gasket : Outlet pipe |
| 8. Gasket : Oil pump cover | 21. Gasket : Thermostat housing |
| 9. Oil seal : Crankshaft(RR) | 22. Gasket : Nozzle gasket |
| 10. Gasket : Retainer | 23. Oil seal : Crank gear case |
| 11. Gasket : Case and cylinder block | 24. Gasket : Exhaust manifold |
| 12. Gasket : Cover and case | 25. Gasket : Injection nozzle |
| 13. Gasket : Oil pan drain plug | |

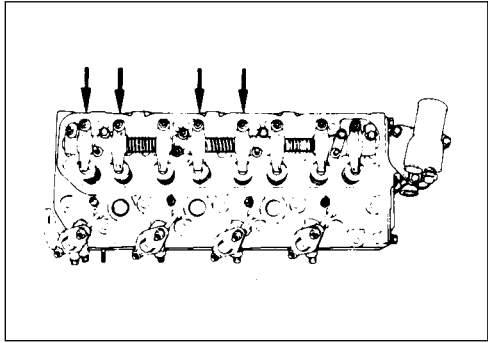
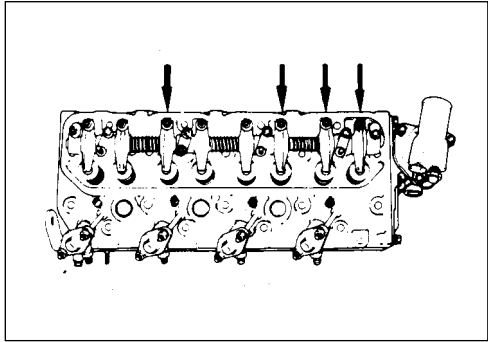


Adjust the clearances of valves marked with an arrow



Rocker arm screw lock nut torque (kgf/cm)	2.5 (18.1 lb _i /ft)
---	-----------------------------------

After adjusting the valve clearances referring to the drawing, turn the crankshaft one full turn in the rotative direction and align the TDC mark with the pointer, then adjust the remaining valve clearances.



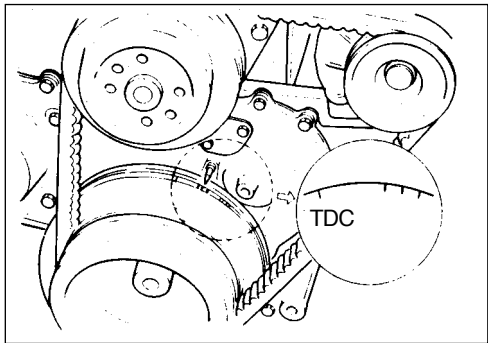
1.6.3. Injection Timing



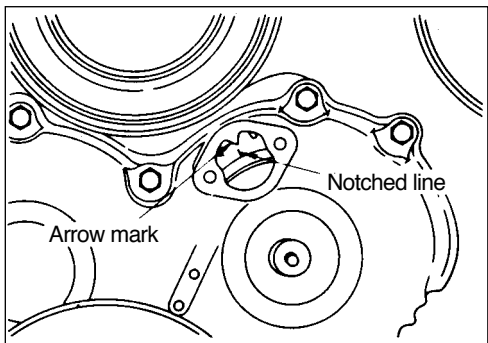
Inspection

Check the notched line on the crankshaft pulley and timing pointer are aligned.

Setting Timing (BTDC)
Engine : 13; BTDC
I/P : Plunger Lift 0.3mm (.0118 in)

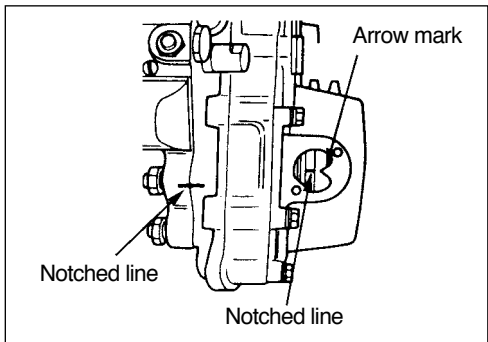


Remove the inspection hole cover at the front of gear case cover.
Check the alignment between the notched line on the camshaft gear and the arrow mark of gear case cover.



Check the notched line on the injection pump is in alignment with the notched line on the timing gear cover.

Check the alignment of the notched lines injection pump and bracket.



1.6.8. Fuel System

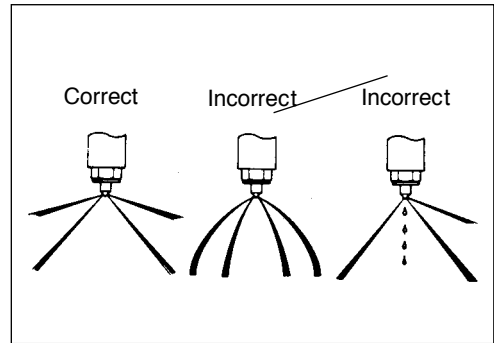


Injection nozzle

Check the spraying condition and injection starting pressure.

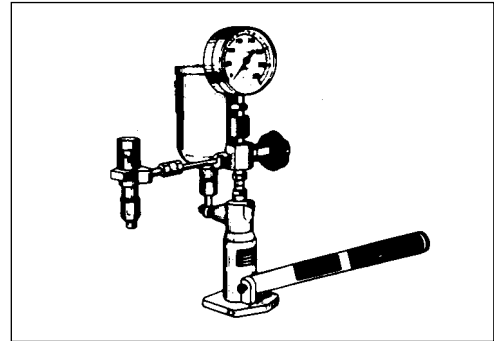


Injection starting pressure (kg/cm ²)	220 (3.128 psi)
---	--------------------



Adjustment

Adjust the injection starting pressure with the adjusting screw using a nozzle tester.

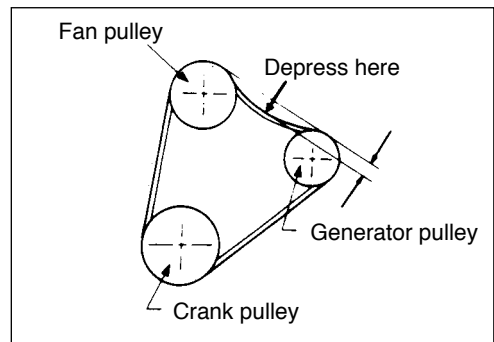


1.6.9. Fan Belt

(mm)



Specified belt deflection	10 (.393 in)
---------------------------	-----------------



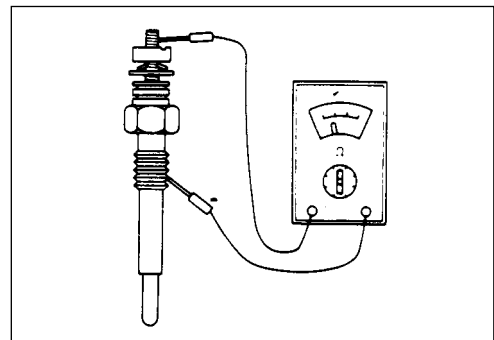
1.6.10. Glow Plug



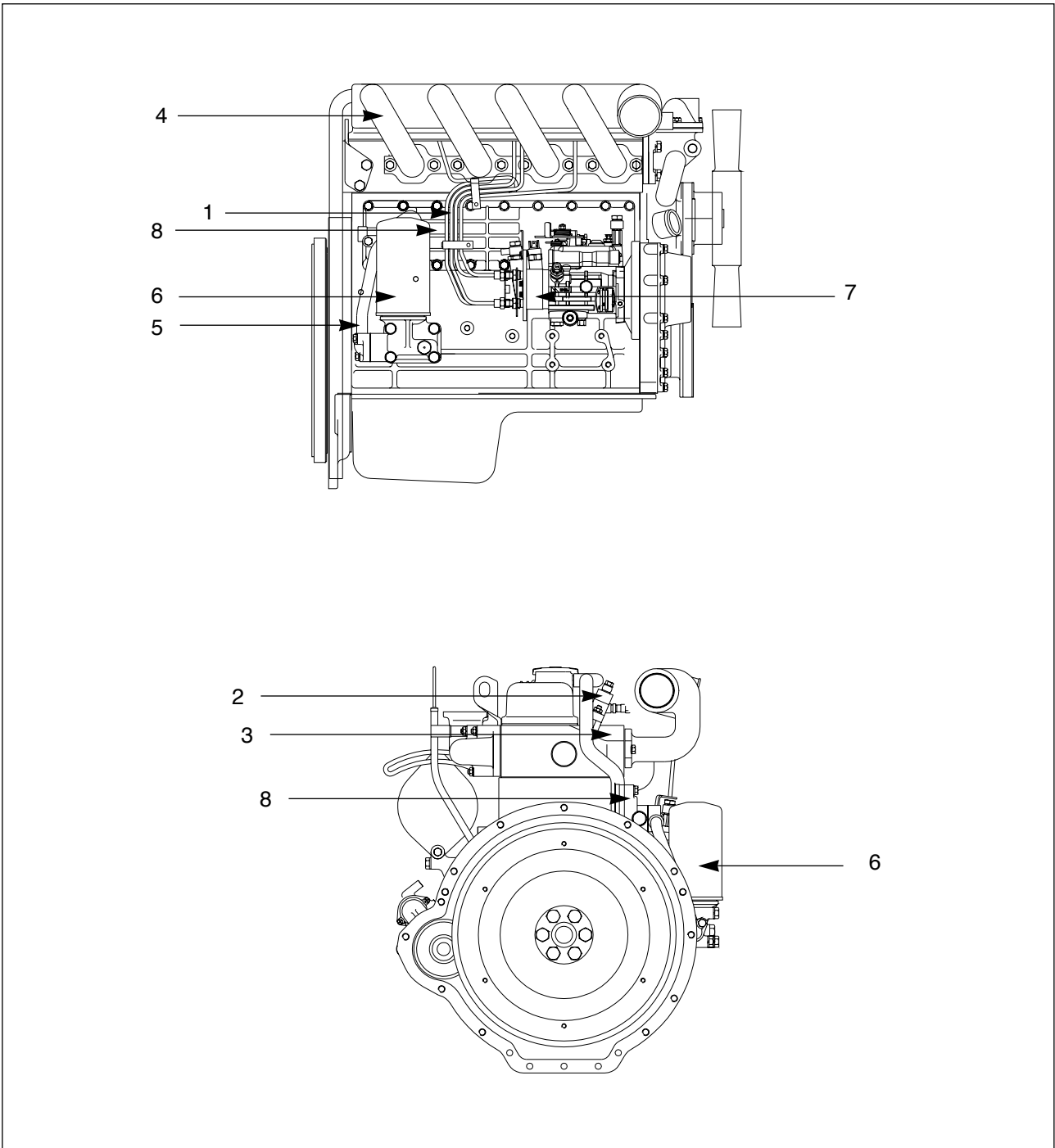
Inspection(Resistance)

Silver color	4.5 Ω
Black color	1.6Ω

Check the continuity across the plug terminals and body.



2.2.2. External Parts (B)



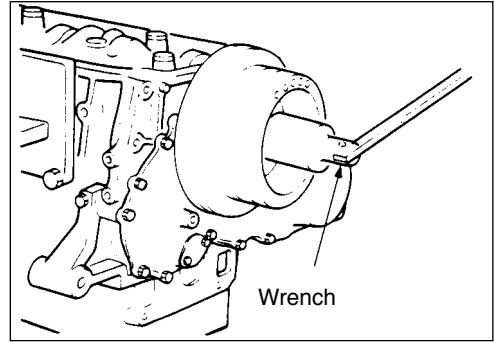
<Disassembly steps>

- | | |
|------------------------|------------------------|
| 1. Fuel injection pipe | 5. Oil pipe |
| 2. Injection nozzle | 6. Oil filter assembly |
| 3. Glow plug | 7. Injection pump |
| 4. Intake manifold | 8. Oil cooler assembly |



1 Crankshaft front nut and washer (11)

Wrench : 41 mm

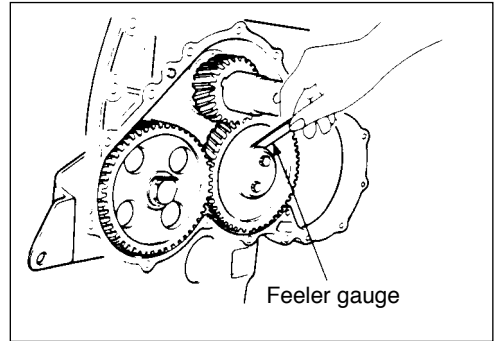


1 Idle gear (14)

Measure the following points before disassembly.

Idle gear end play. (mm)

Standard	Limit
0.058 ; >0.115 (.002~0.0045 in)	0.2 (.0078 in)

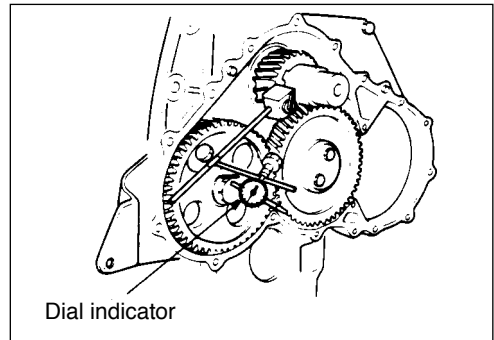


Backlash

(mm)

Standard	Limit
0.10 ; >0.17 (.0039~.0069 in)	0.3 (.012 in)

Includes the crankshaft gear, camshaft gear and idle gear.



1 Crankshaft bearing cap and bearing (17)

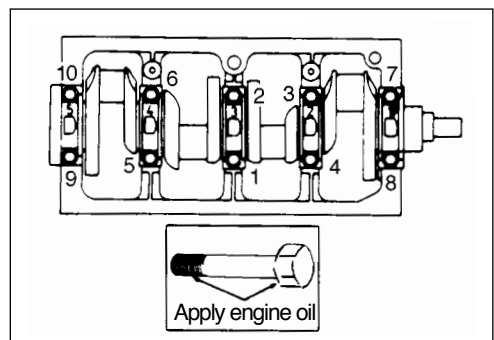
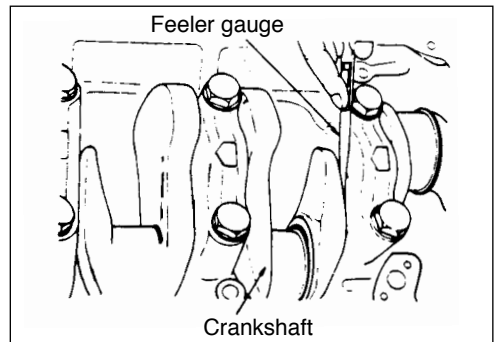
Measure the crankshaft end play before disassembly.

Crankshaft end play (mm)

Standard	Limit
0.10 ; >0.17 (.0039~.0067 in)	0.3 (.012 in)

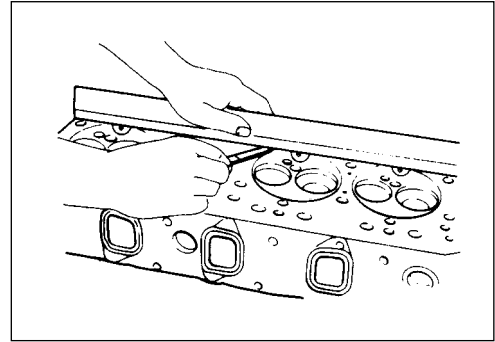
Includes the crankshaft gear, camshaft gear and idle gear.

Loosen the crankshaft bearing cap bolts in numerical sequence as shown in the figure.



Lower face warpage and height (mm)

	Standard	Limit
Warpage	0.05 or less (.002 in)	0.2 (.008 in)
Thickness (reference)	89.95 ± 0.05 (3.54~3.55 in)	89.75 (3.53 in)

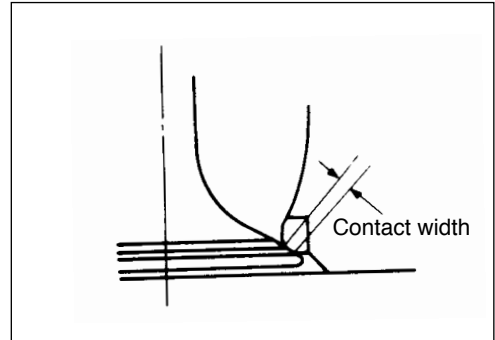


2.3.2. Valve, Valve Guide and Valve Seat Insert



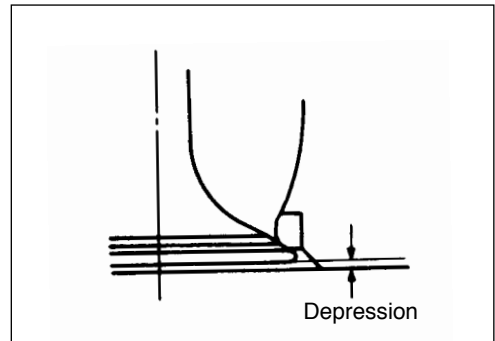
Valve contact width (mm)

Standard	Limit
1.5 (.059 in)	2.0 (.079 in)

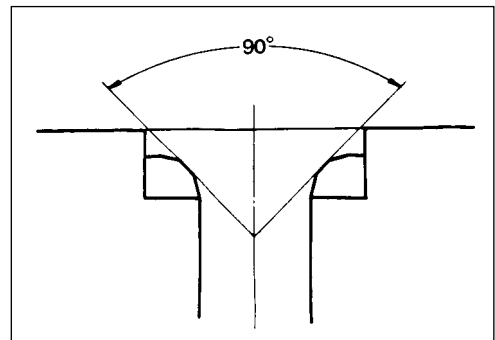


Valve depression (mm)

Standard	Limit
1.0 (.039 in)	2.5 (.098 in)



Valve seat angle



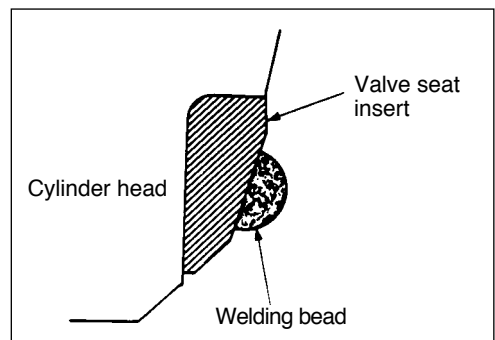
Valve seat angle

Valve seat insert replacement

Removal : Arc weld the entire inside circumference of the valve seat insert.

- ı Cooling the valve insert for a few minutes and pull out with a screw driver.

Installation : Use a bench press to smoothly press the valve seat insert.



**Run-out** (mm)

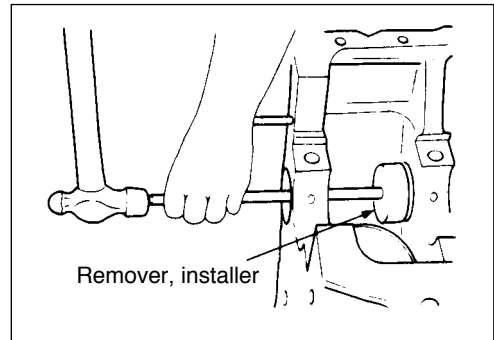
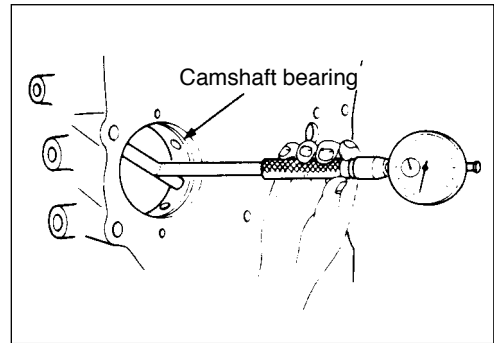
Standard	56.00 \pm 0.03 (2.205~2.206 in)
----------	--------------------------------------

**Clearance between camshaft journal and body** (mm)

Standard	Limit
0.03 \pm 0.09 (.001~.004 in)	0.15 (.006 in)

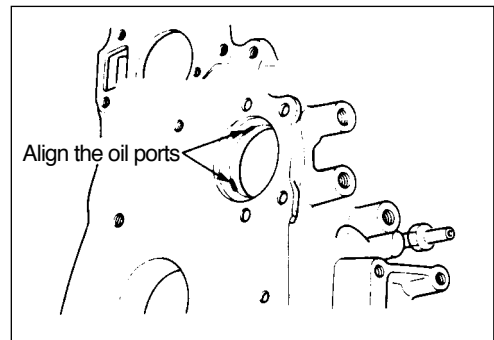
**Camshaft bearing replacement**

Remover, installer



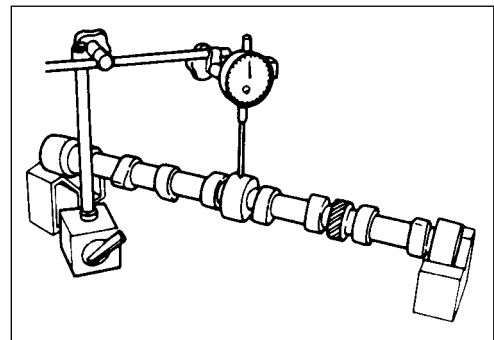
Align the camshaft oil holes with the cylinder body oil ports.

The oil holes of No. 1 camshaft bearing(front side are two otherwise is one.

**Camshaft run-out (T.I.R)** (mm)

Standard	0.1 (.004 in)
----------	------------------

- ⌋ Place the camshaft on a measuring stand.
- ⌋ Use a dial indicator to measure the camshaft run-out
- ⌋ Note the total indicator reading (T.I.R).

**Camshaft bearing**

Replace the camshaft gear if any damages or excessive backlash are found.



Gear bolt torque (kgf \cdot m)	14.0 (101.3 lb \cdot /ft)
----------------------------------	--------------------------------

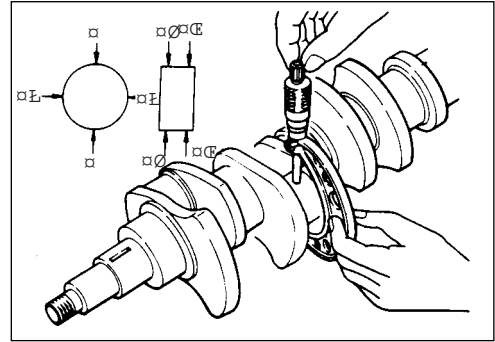
⌋ Refer to the standard backlash table at "Major components disassembly"



Crankshaft pin outside diameter

Standard (mm)	63.932 _i - 63.944 (2.517~2.517 in)
---------------	--

Use a micrometer to measure the crankshaft pin outside diameter across points \square and \square at the two points \square and \square



Connecting rod bearing cap reassembly

Connecting rod bolt torque (kgf m)	12 _i 0.25 (86.7 _i 1.81 lb _i /ft)	9.75 _i 0.25 (70.51 _i 1.81 lb _i /ft)
Bolt type	A	B

A : Bolt head

B : or

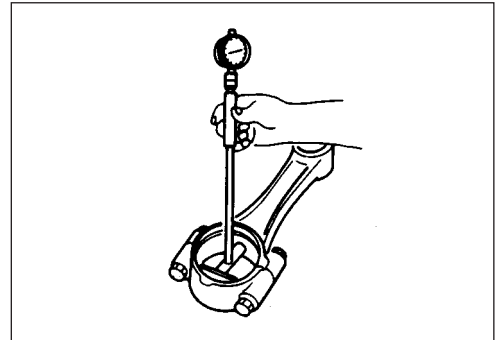


Inside diameter

- Apply engine oil to bearing surface.
- Measure the connecting rod inside diameter with an inside dial indicator.



Connecting rod bearing nominal diameter (mm)	64 _s j (2.52 in)
--	--------------------------------



Crankshaft pin and bearing clearance (mm)

Standard	Limit
0.03 _i >0.07 (.001~.003 in)	0.10 (.004 in) (mm)

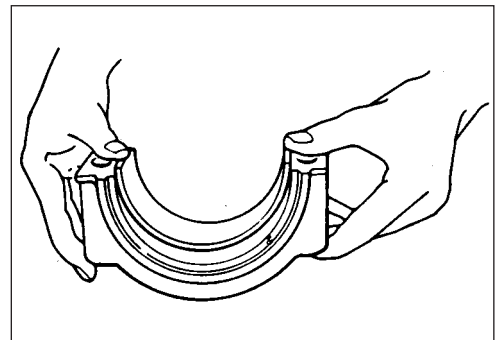
Under size Bearing specifications	0.25 _i >0.50 (.010~.020 in)
-----------------------------------	---

Crankshaft journal bearing



Tension

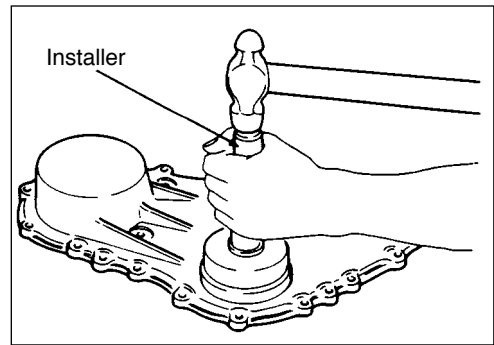
Fit the journal bearing into the journal bearing cap and check the tension with the same method of connecting rod cap bearing.



2.3.14. Timing Gear Case Cover



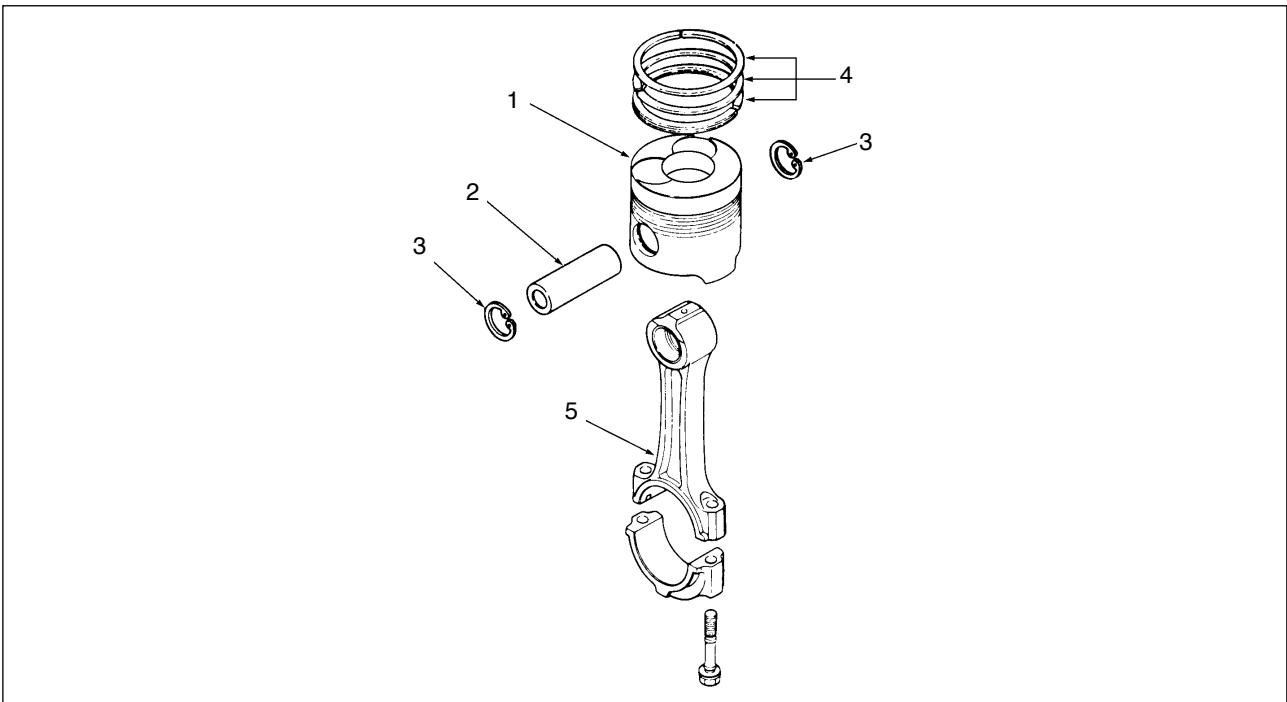
Oil seal replacement
Installation : Installer



2.4. Engine Reassembly

2.4.1. Minor Components

i Piston and connecting-rod assembly



<Disassembly steps>

1. Piston
2. Piston pin

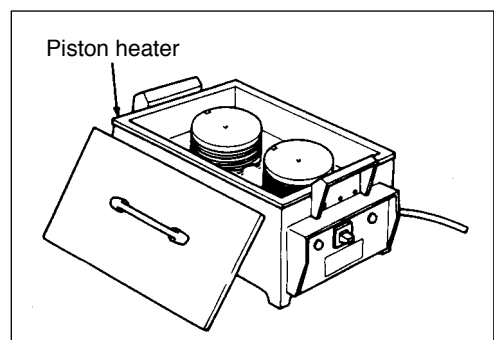
3. Snap ring
4. Piston ring
5. Connecting rod



Important operation

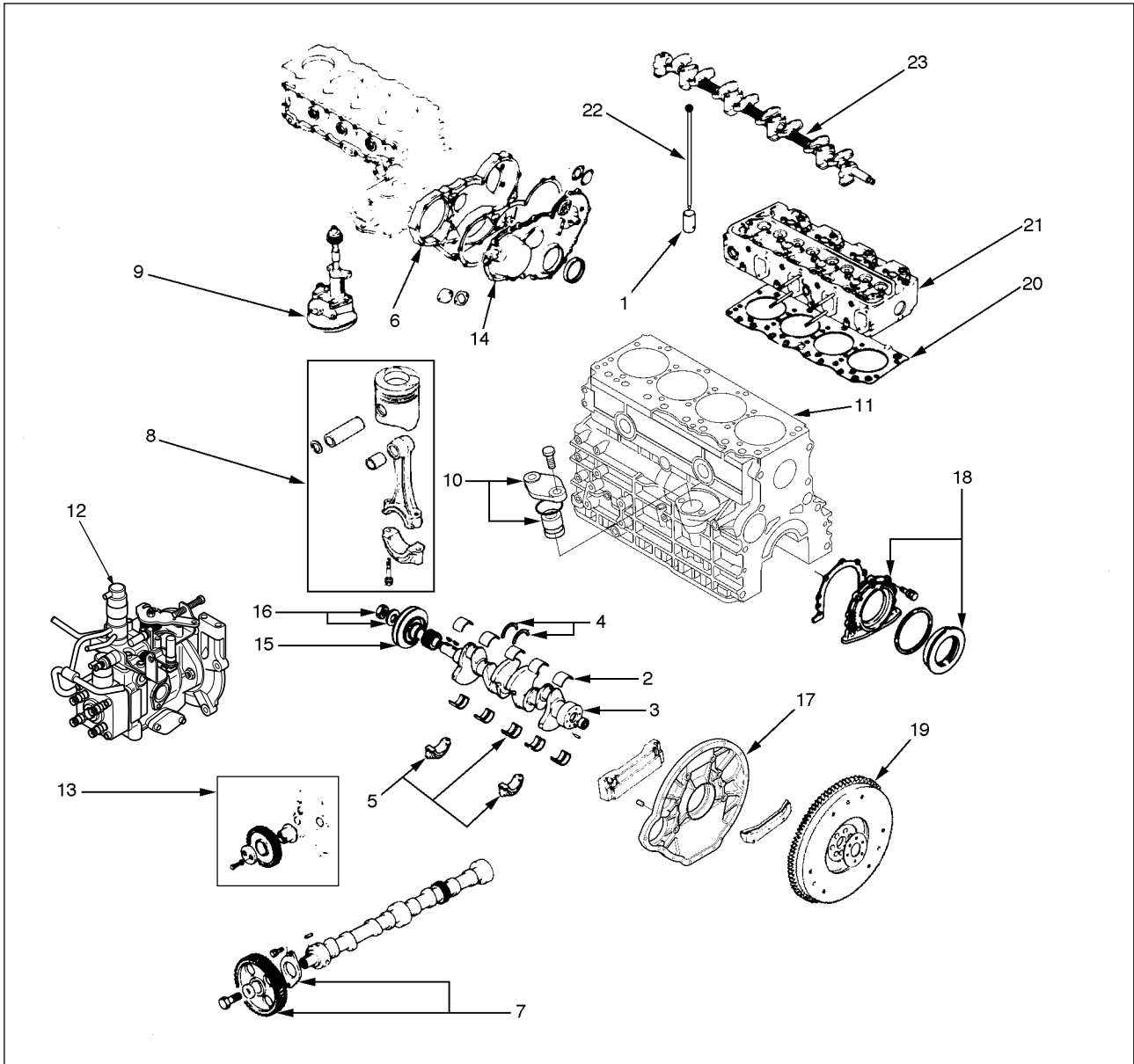


i **Piston (1)**
Use a piston heater to heat the piston approximately
60i (140ç)



2.4.2. Internal Parts

Major components



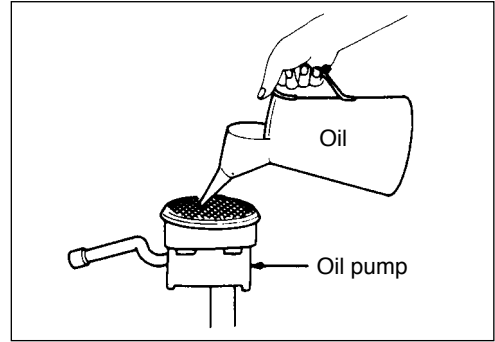
<Disassembly steps>

- | | |
|--|-------------------------------------|
| 1. Tappet | 13. Idle gear |
| 2. Crankshaft bearing(upper) | 14. Timing gear case cover |
| 3. Crankshaft | 15. Crankshaft pulley |
| 4. Thrust bearing | 16. Crankshaft front nut and washer |
| 5. Crankshaft bearing cap and bearing(lower) | 17. Flywheel housing |
| 6. Timing gear case | 18. Rear oil seal assembly |
| 7. Camshaft assembly | 19. Flywheel |
| 8. Piston and connecting rod assembly | 20. Cylinder head gasket |
| 9. Oil pump assembly | 21. Cylinder head assembly |
| 10. Oil pump cover | 22. Push rod |
| 11. Oil cooler | 23. Rocker arm shaft assembly |
| 12. Injection pump assembly | |



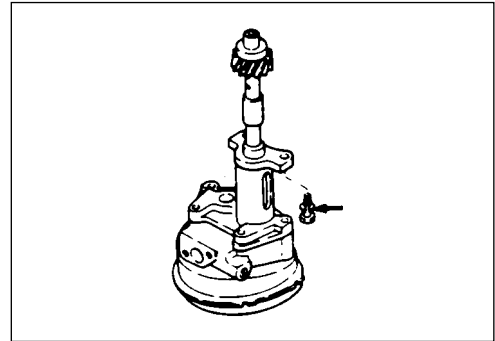
1 Oil pump assembly(9)

Full up the oil pump with engine oil and install the pump to the cylinder body.



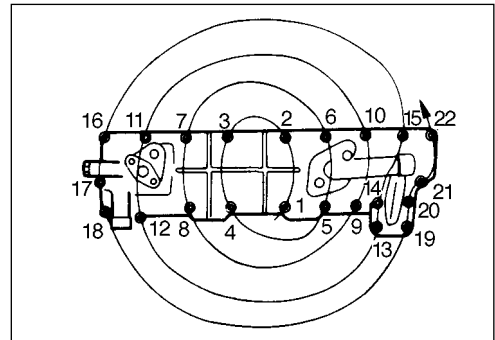
1 Oil pump mounting bolts

Torque (kgf·m)	3.8 (27.5 lb _i /ft)
----------------	-----------------------------------



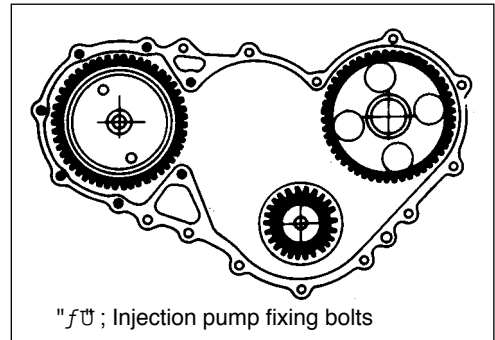
1 Oil cooler(11)

Tighten the cooler bolts to the specified torque. Start from the middle and work out to either side.

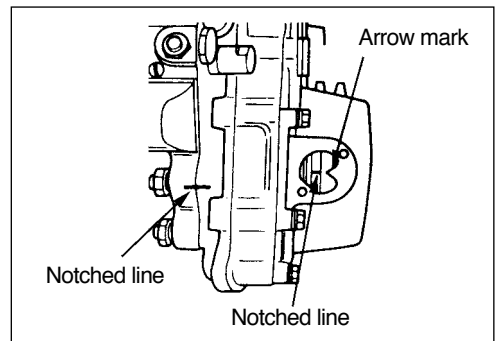


1 Injection pump assembly (12)

Torque (kgf·m)	2.6 (18.8 lb _i /ft)
----------------	-----------------------------------



Check the punched line of the injection pump body is aligned to the pump bracket line.



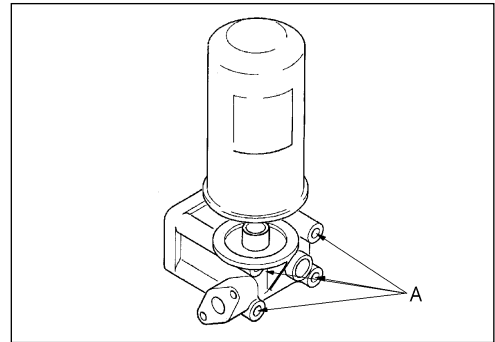


Important operation



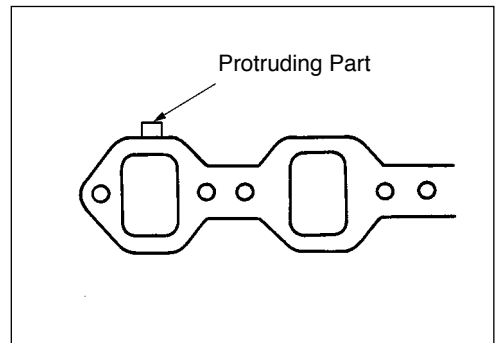
1 Main oil filter and bracket (1) (kgf·m)

'A' bolt torque	5.3 (38.3 lb _i /ft)
-----------------	-----------------------------------



3 Intake manifold assembly (3)

Install the gasket with its protruding part facing up.



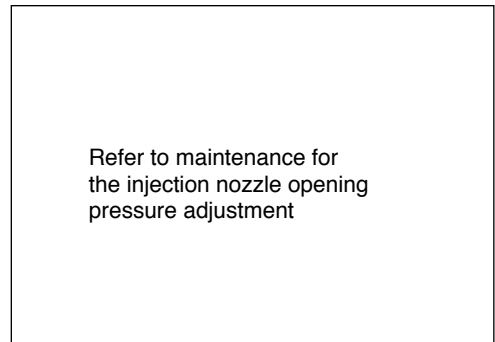
4 Glow plug (4)

Torque (kgf·m)	5.3 (38.3 lb _i /ft)
----------------	-----------------------------------



5 Injection nozzle (5)

Adjusting the opening pressure with adjust screw using a nozzle tester.



Replace the nozzle gasket and dust cover with new one.

Tighten the injection pipe sleeve nut and flange nut.

Torque (kgf·m)	2.6 (18.8 lb _i /ft)
----------------	-----------------------------------

