

Service Manual

Diesel Engine 3.3 Liter (DB33A)

Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Read and understand all safety precautions and warnings before operating or performing lubrication, maintenance and repair on this product.

Basic safety precautions are listed in the "Safety" section of the Service or Technical Manual. Additional safety precautions are listed in the "Safety" section of the owner/operation/maintenance publication. Specific safety warnings for all these publications are provided in the description of operations where hazards exist. WARNING labels have also been put on the product to provide instructions and to identify specific hazards. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons. Warnings in this publication and on the product labels are identified by the following symbol.



Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

DAEWOO cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by DAEWOO is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.
















The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. DAEWOO dealers have the most current information available.

TO THE CUSTOMERS

This operation and maintenance manual is designed to serve as a reference for DHI's customers and distributors who wish to gain basic product knowledge on DHI's DB33 Diesel engine.

To maintain the engine in optimum condition and retain maximum performance for a long time, CORRECT OPERATION and PROPER MAINTENANCE are essential.

In this manual, the following symbols are used to indicate the type of service operations to be performed.

	Removal		Adjustment
	Installation		Cleaning
	Disassembly		Pay close attention-Important
	Reassembly		Tighten to specified torque
	Align the marks		Use special tools of manufacturer's
	Directional Indication		Lubricate with oil
	Inspection		Lubricate with grease
	Measurement		

If you have any question or recommendation in connection with this manual, please do not hesitate to contact our head office, dealers or authorized service shops.

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1. GENERAL INFORMATION

1.1. General Repair Instructions

1. For safety, park the truck on even ground or work station and fix the wheels using wedges and hand brake during operation.
2. Before performing service operations, disconnect the grounding cable from the battery to reduce the chance of cable damage and burning due to short-circuiting.
3. Before performing service operations release the air pressure in the machine air line system for safety. To not do so is extremely dangerous.
4. Use covers to prevent the components from damage or pollution.
5. Brake oil and anti-freeze solution must be handled with reasonable care as they cause paint damage.
6. The use of proper tools and special tools where specified is important for efficient and reliable service operation.
7. Use genuine DAEWOO parts exclusively.
8. Used cotter pins, gaskets, O-rings, oil seals, lock washers and self-lock nuts should be discarded and new ones should be prepared for installation as normal function of the parts can not be maintained if these parts are reused.
9. To facilitate proper and smooth reassembly operation, keep disassembled parts neatly in groups. Keeping bolts and nuts separate is very important as they vary in hardness and design depending on the position of installation.
10. Clean the parts before inspection or reassembly. Also clean oil ports, etc. using compressed air to make certain they are free from restrictions.
11. Lubricate rotating and sliding faces of parts with oil or grease before installation.
12. When necessary, use a sealant on gaskets to prevent leakage.
13. Carefully observe all specifications for bolts and nuts torques.
14. When a service operation is completed, make a final check to ensure that the service has been done properly.

1.2. Engine Specifications




Items		Engine Model	DB 33A
Engine type			Water-cooled, 4 cycle in-line, overhead valve type
Combustion chamber type			Direct injection type
Cylinder liner type			Dry type, casting liner
Timing gear system			Gear drive type
No. of piston ring			Compression ring 2, oil ring 1
No. of cylinder-bore ; stroke		(mm)	4-102 ; 100
Total piston displacement		(cc)	3,268 (199 cu in)
Compression ratio			17.5 : 1
Engine dimension(length ; width ; height)		(mm)	795 ; 701 ; 720 (31 ; 28 ; 28 in)
Engine weight(dry)		(kg)	340 (750 lbs)
Fuel injection order			1-3-4-2
Fuel injection timing(B.T.D.C static)			13 ; ~
Type of fuel used			High-speed diesel fuel (SAE No.2)
Injection pump type			VE (DOOWON)
Governor type			Mechanical governing
Injection nozzle type			Multi-hole type (6 hole) - VCO nozzle
Fuel injection pressure		(Kg/cm ²)	220 (3,128 psi)
Compression pressure		(kg/cm ²)	30 (at 200 RPM) (426 psi)
Low idle speed		(R.P.M)	775-825
High idle speed		(R.P.M)	2400-2500
Intake and exhaust valve clearance(at cold)		(mm)	0.4
Intake valve	Open at		28 (B.T.D.C)
	Close at		62 (A.B.D.C)
Exhaust valve	Open at		70 (B.B.D.C)
	Close at		28 (A.T.D.C)
Lubrication method			Pressurized circulation
Oil pump type			Gear type
Oil filter type			Full-flow type
Lubricating oil capacity		(§ /)	7.5 (Oil pan) (1.97 gal)
Oil cooler type			Water cooled
Cooling method			Pressurized circulation
Cooling water capacity(engine only)		(§ /)	7.5 (1.97 gal)
Thermostat type			Wax pallet type (with jiggle valve)
Generator voltage-capacity(V-A)			12-61
Starter Voltage-output(V-KW)			12-2.5

1.3. Torque Specifications

i Standards bolts

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

(Unit : kgf·m)

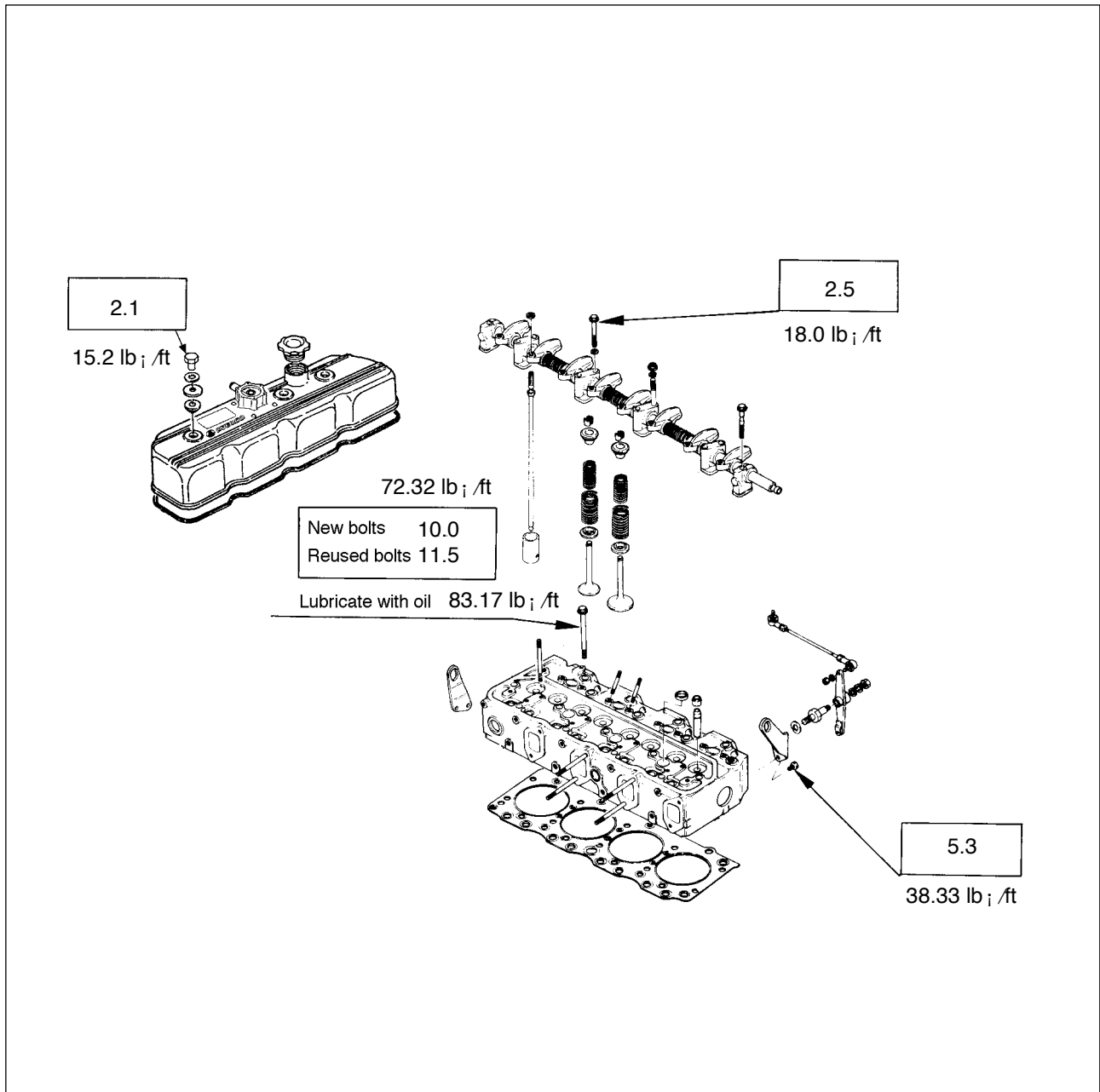
Bolt identification Bolt diameter i pitch			
	4T Low carbon steel	7T High carbon steel	9T Alloy steel
6 i 1.0	0.4-0.8	0.5-1.0	-
8 i 1.25	0.8-1.8	1.2-2.3	1.7-3.1
10 i 1.25	2.1-3.5	2.8-4.7	3.8-6.4
i 10 i 1.5	2.0-3.4	2.8-4.6	3.7-6.1
12 i 1.25	5.0-7.5	6.2-9.3	7.7-11.6
i 12 i 1.75	4.6-7.0	5.8-8.6	7.3-10.9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

1.4. Major Parts Fixing Bolts

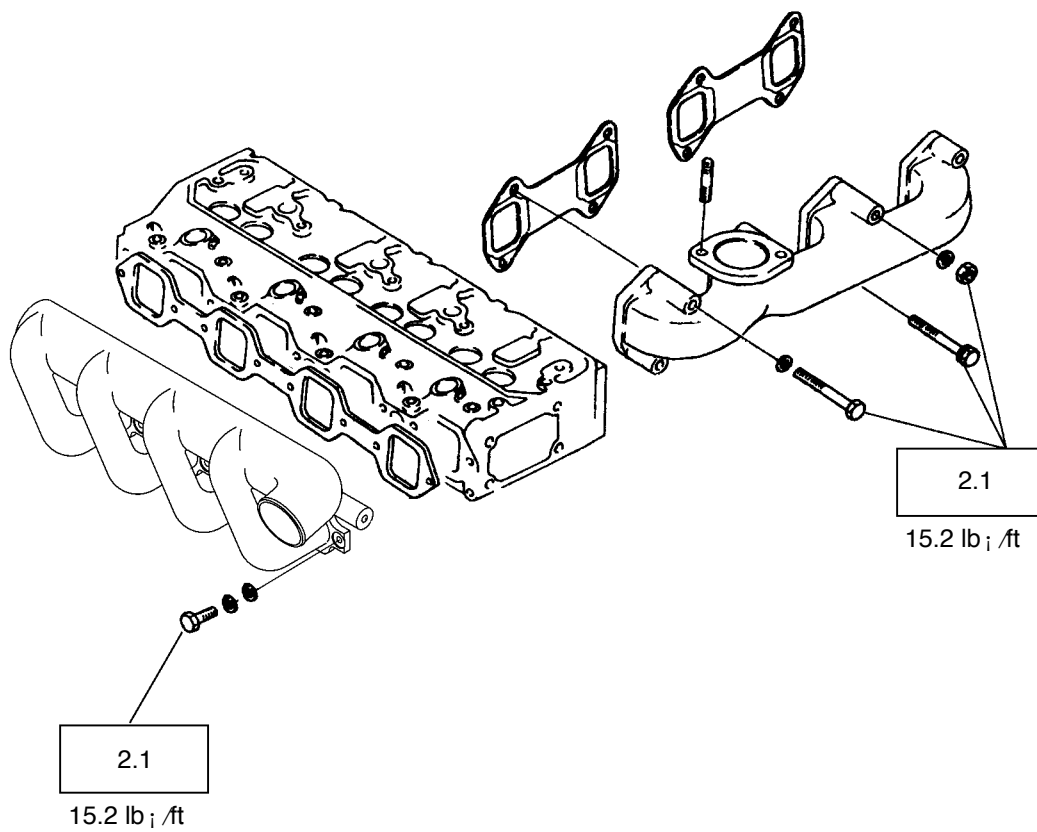
i Cylinder head and block

(unit : kgf·m)



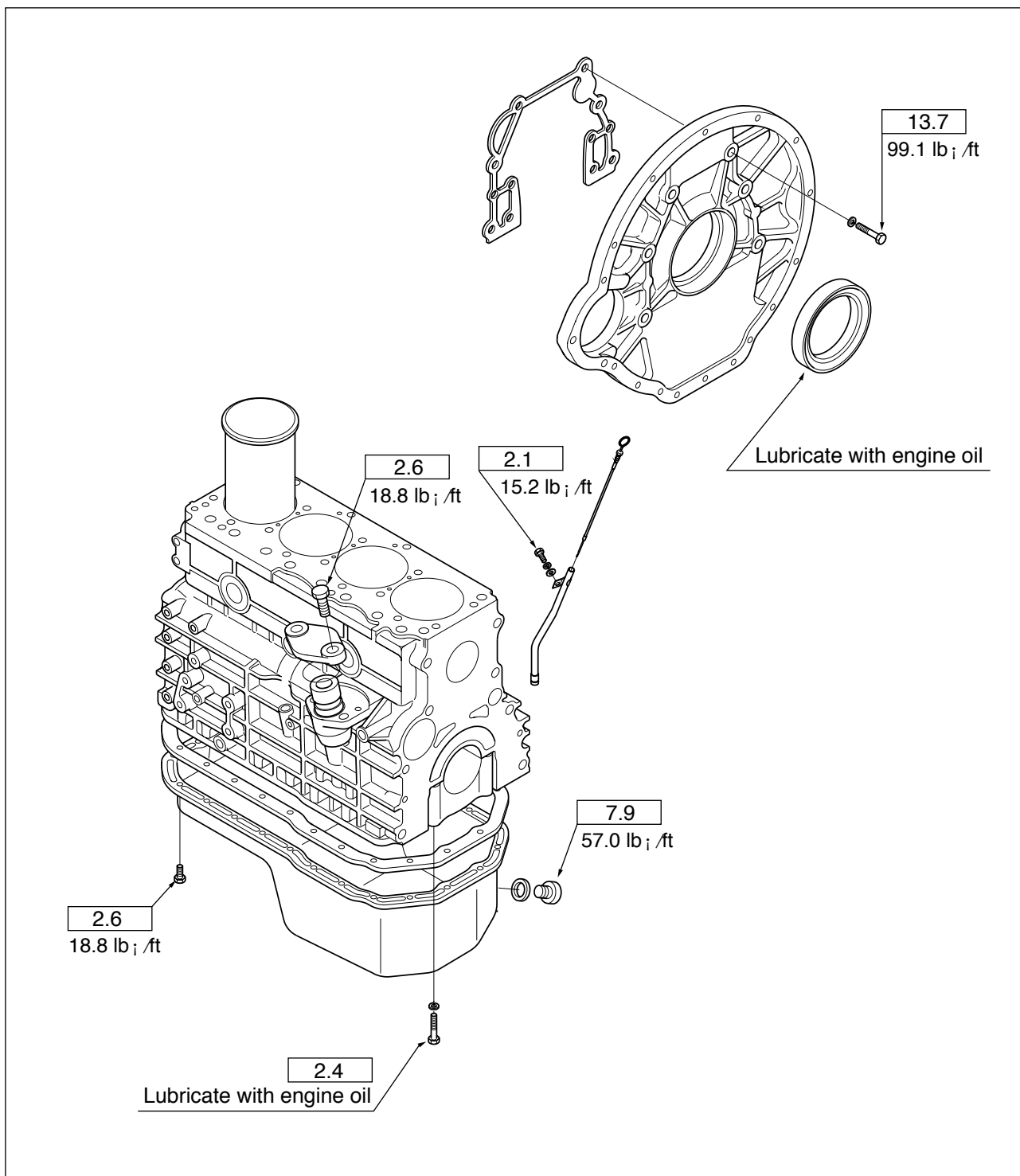
i Intake and exhaust manifold

(unit : kgf/cm)



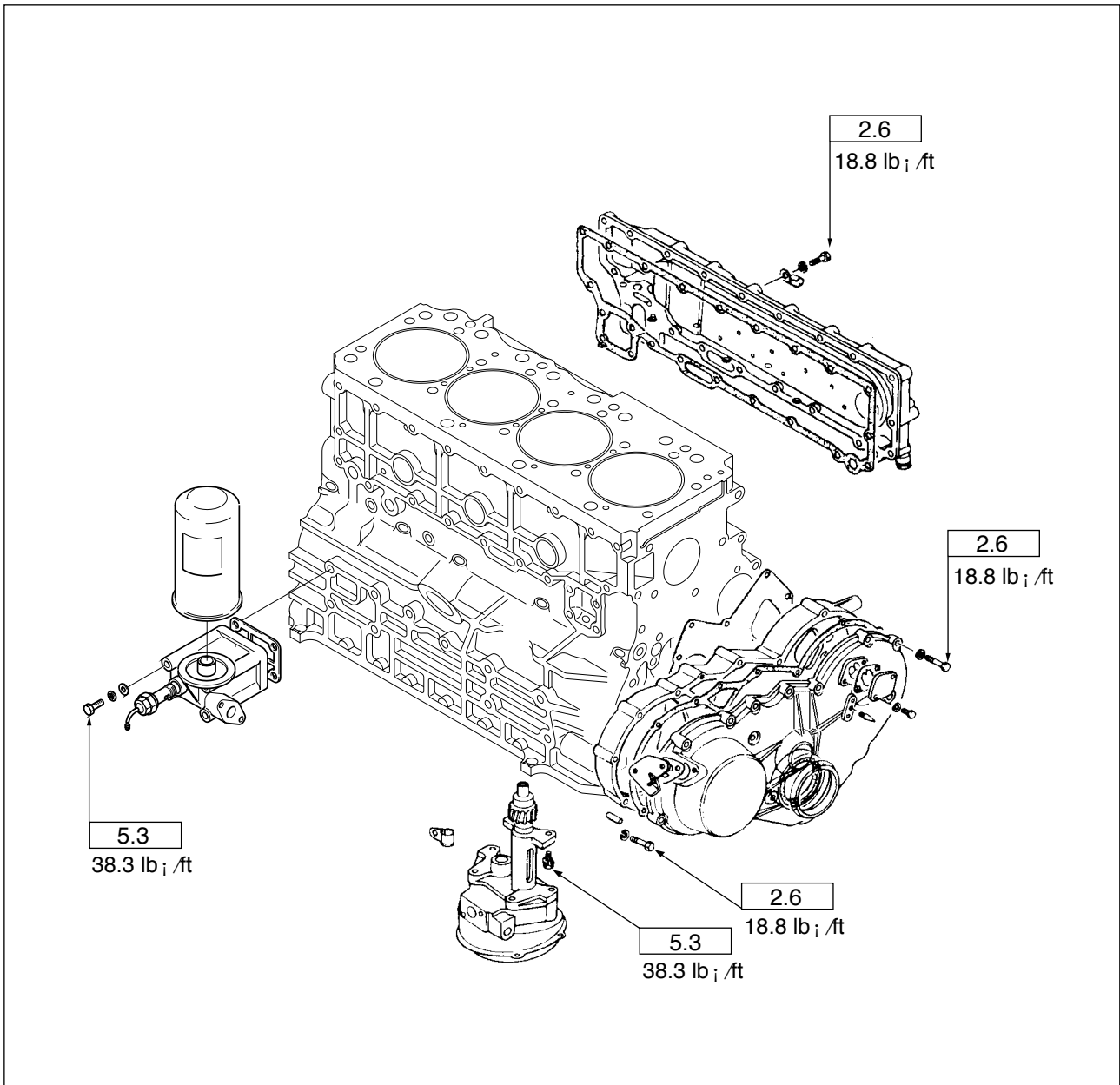
i Cylinder block and others

(unit : kgf/cm)



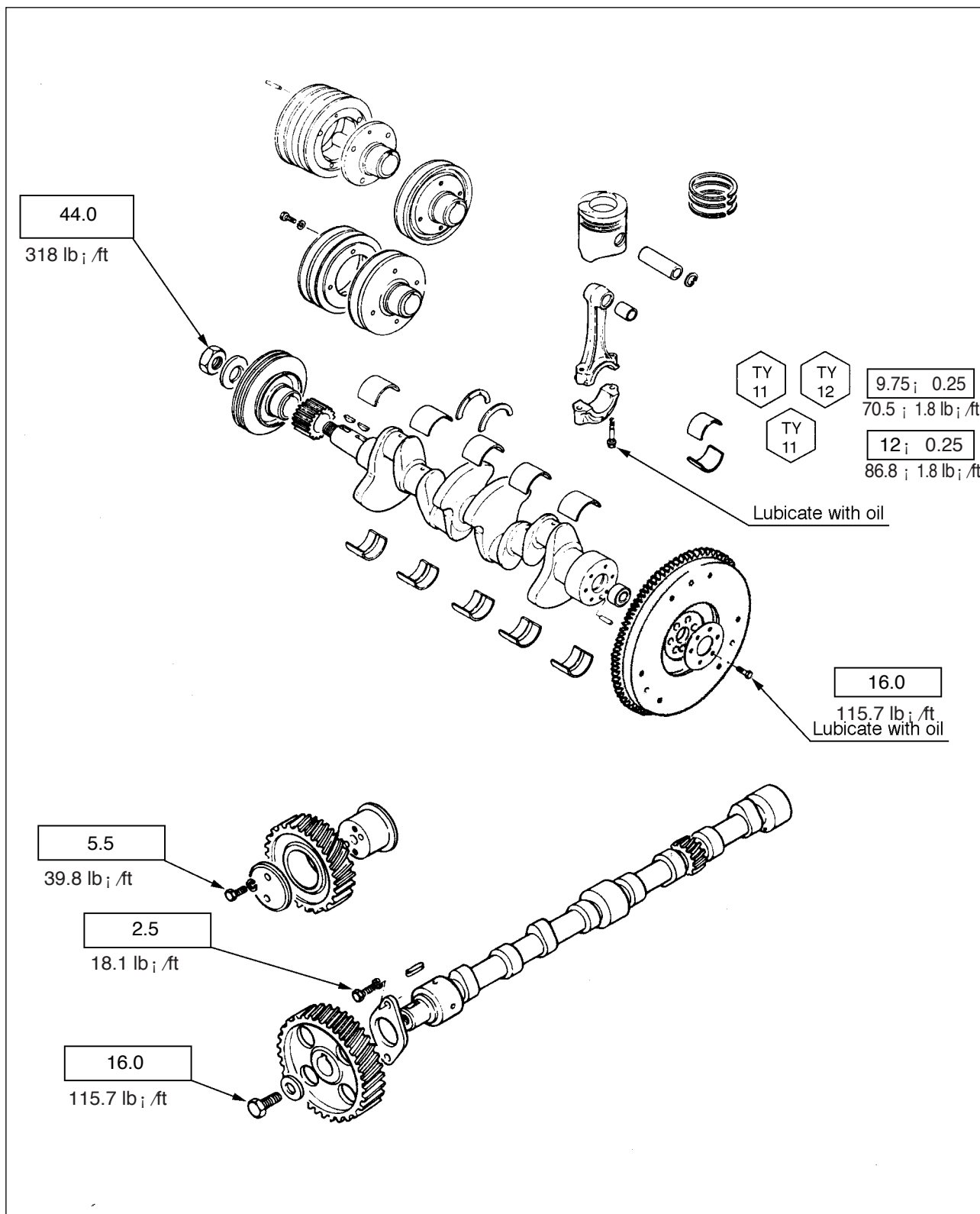
i Cylinder block and others

(unit : kgf·m)



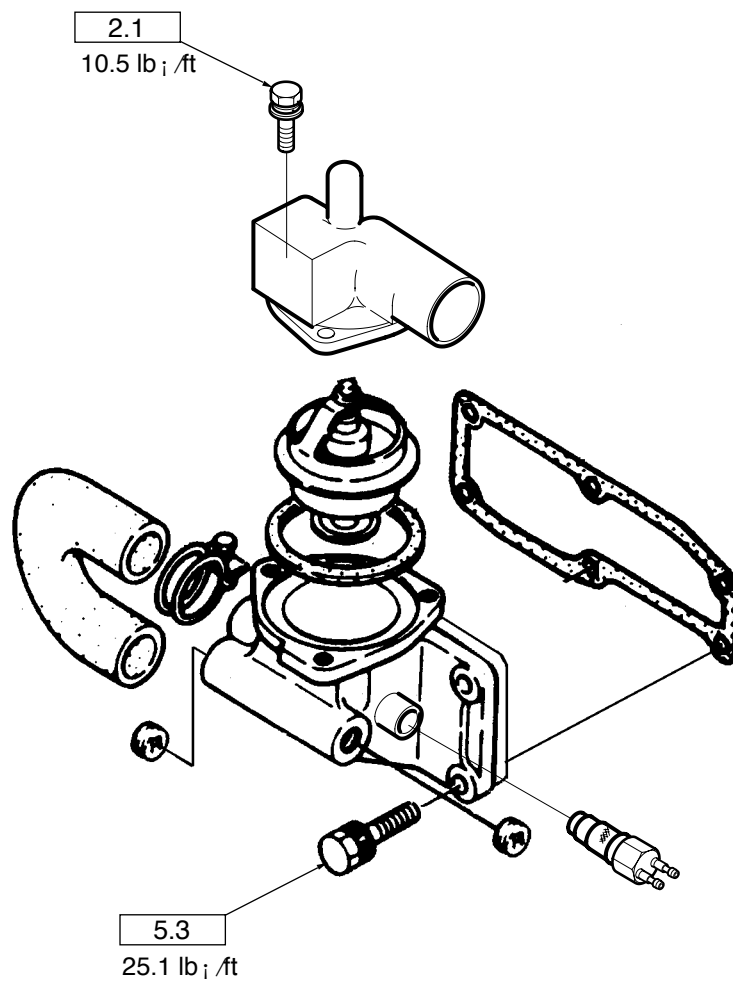
i Crankshaft and camshaft

(unit : kgf/cm)



i Thermostat and housing

(unit : kgf·m)

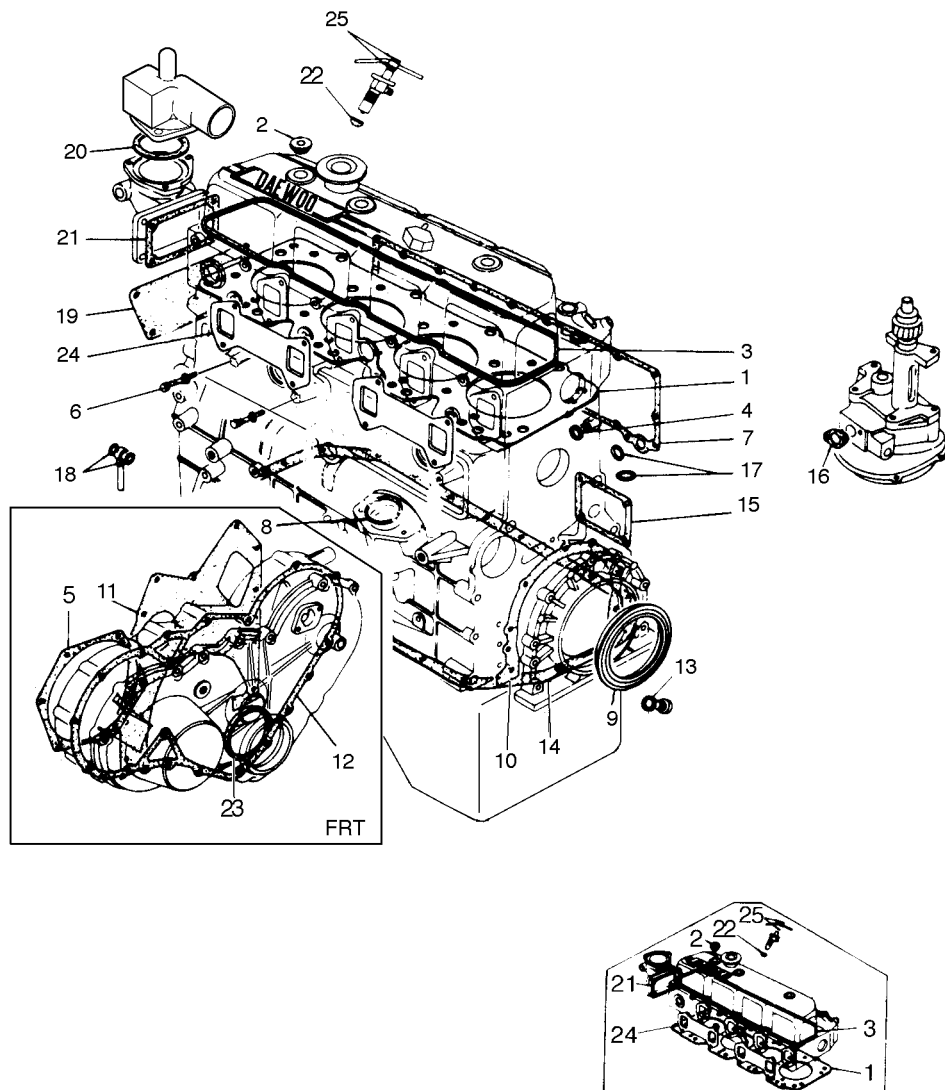


1.5. Engine Repair Kit



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 | |

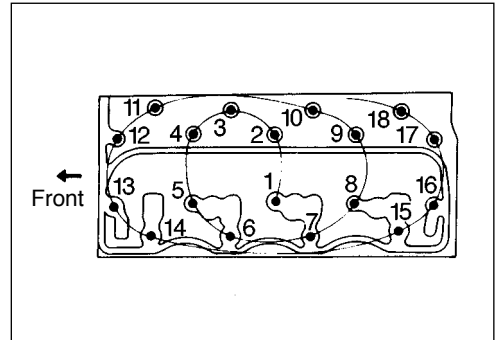
1.6. Repair

1.6.1. Cylinder Head Bolt



Tighten the cylinder head bolts in sequence as shown in the figure.

Torque(kg \cdot m)	11.5 (83.2 lb \cdot /ft)
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1.6.2 Valve Clearance

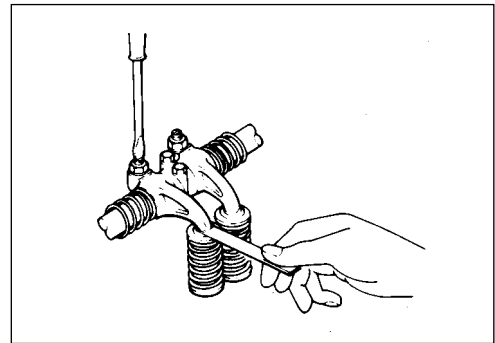


Adjust the valve clearance in the following manner using a feeler gauge.

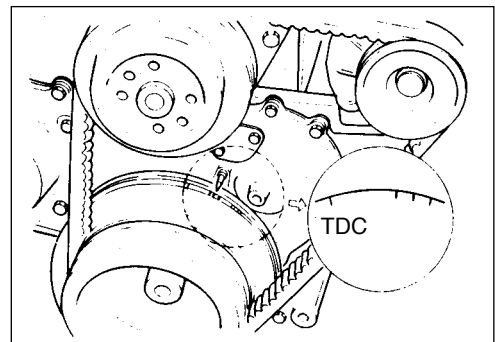


Standard(in cold)

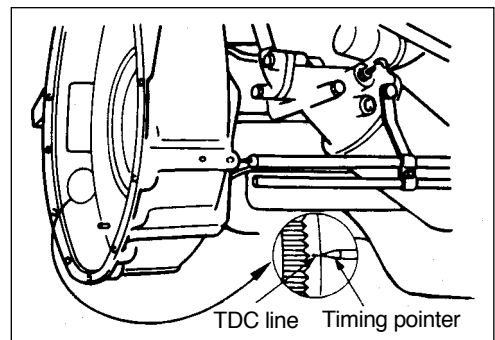
Intake and exhaust (mm)	0.4 (.016 in)
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1. Bring the piston in either the No. 1 cylinder or the No. 4 cylinder to top dead center on the compression stroke by turning the crankshaft until the TDC notched line on the crankshaft pulley is aligned the timing pointer.
2. Check to see if there is play in the No. 1 intake and exhaust valve rocker arms.
If the No. 1 cylinder intake and exhaust valve rocker arms are depressed, the No. 4 piston is at TDC on the compression stroke.



The same results can be obtained by using the TDC line on flywheel and pointer.



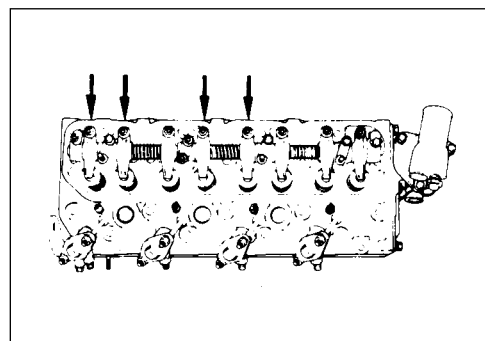
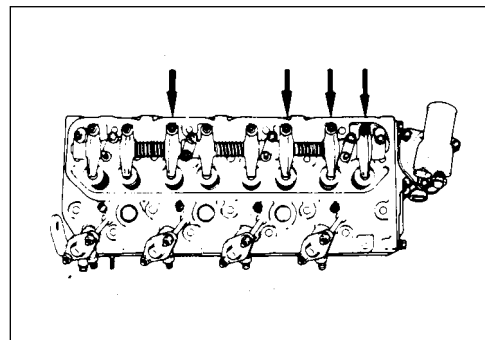


Adjust the clearances of valves marked with an arrow



Rocker arm screw lock nut torque (kgf·m)	2.5 (18.1 lb _i /ft)
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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.



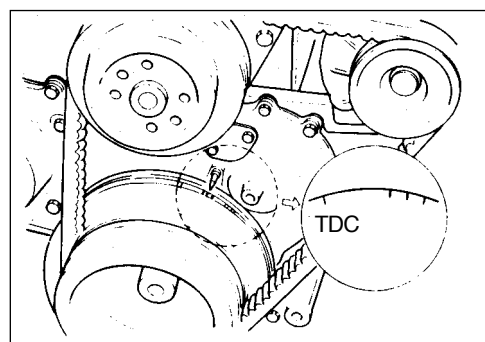
1.6.3. Injection Timing



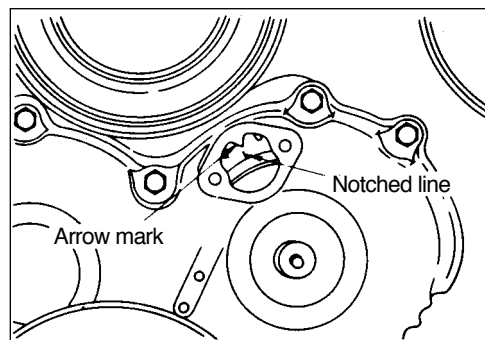
Inspection

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

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

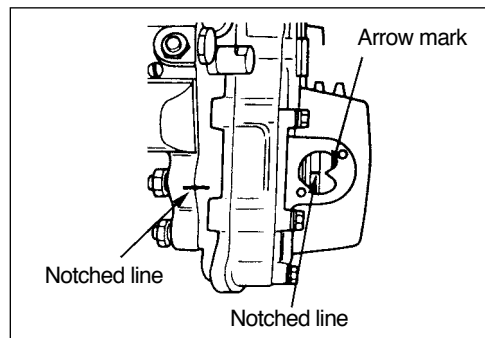


Remove the inspection hole cover at the front of gear case cover.
Check the alignment between the notched line on the camshaft gear and the arrow mark of gear case cover.



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.

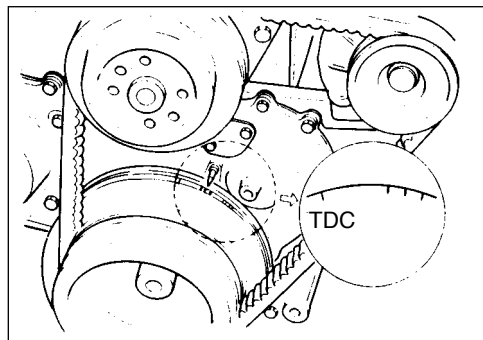




Injection timing adjustment

1. Adjust fuel injection timing with crank pulley notched line and timing pointer.

Adjust the timing pointer with the marking on the pulley.

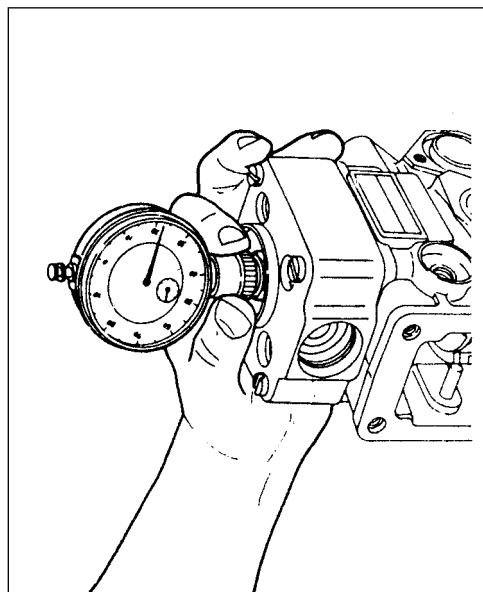


- Disconnect the inj. pipes (4pieces) from I/P

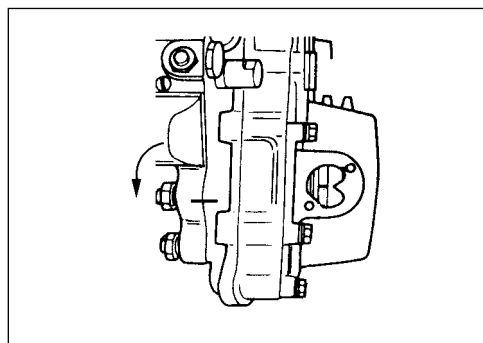


2. Remove 2 fixing bolts of timing flange and injection pump.

Remove bolt located at the center.
Insert the dial gauge to check the plunger lift.



3. Turn the timing flange to adjust the plunger lift to 0.3mm.





4. Install the No. 1 injection pipe and tighten to specified torque.

Injection pipe nut torque (kgf·m)	3 ± 0.5 (21.7~25.3 lb _f ·ft)
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Do not overtighten the delivery valve holder. It will distort the injection pump body shape and adversely affect control rack operation.

1.6.4. Compression Pressure



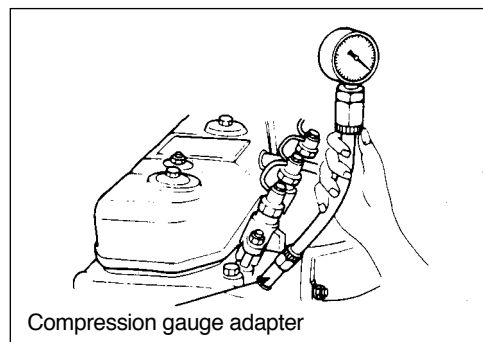
Remove the glow plugs from all cylinders, then check the compression pressure in each cylinder with a compression gauge by engaging starter.

(kg/cm², 200 rpm)

Standard	Limit
30	22 ± 0.3 (312~327 psi)



Compression gauge adapter



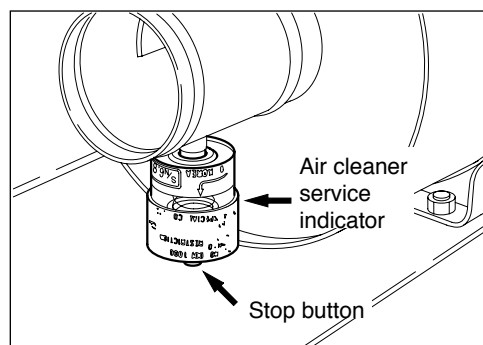
Compression gauge adapter

1.6.5. Air Cleaner



Dry type air cleaner

- Observe the air cleaner service indicator
- Clean the air cleaner element and dust pan when the RED band in the service indicator looks in the visible position.



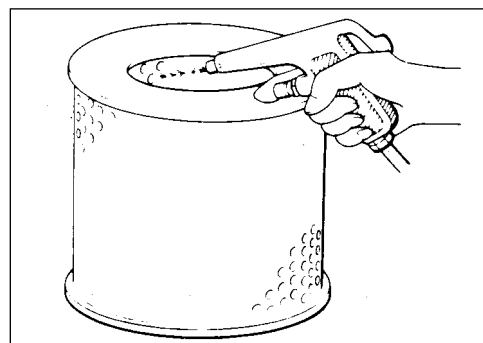
Air cleaner service indicator

Stop button



Cleaning primary filter element

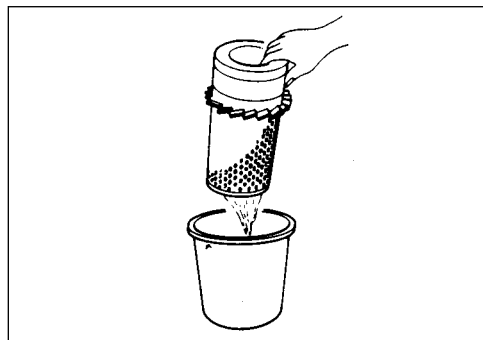
- Direct air inside of the element and blow out dusts from the pleats completely.
(Maximum air pressure does not exceed 2.1 kg/cm²)
- Always replace the secondary element.
Do not attempt to reuse it by cleaning.





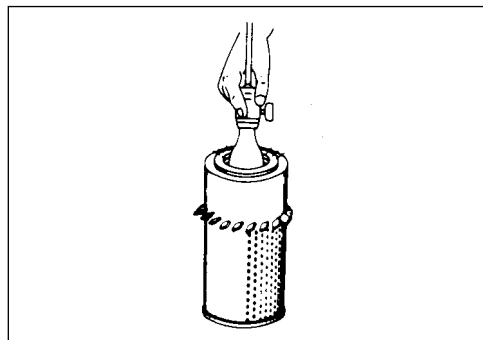
Detergent

- ⌋ Wash the element in warm water and nonsudsing household detergent.
- ⌋ Rinse the element with clean water
- ⌋ Dry it thoroughly with natural air or electric fan. Don't use a flame or compressed air for drying. It damages the element.



Checking element

- ⌋ Insert a light inside the clean and dry element and examine it.
- ⌋ Discard the element if tears, rips or damages are found.
- ⌋ Wrap and store good elements in a clean, dry place.

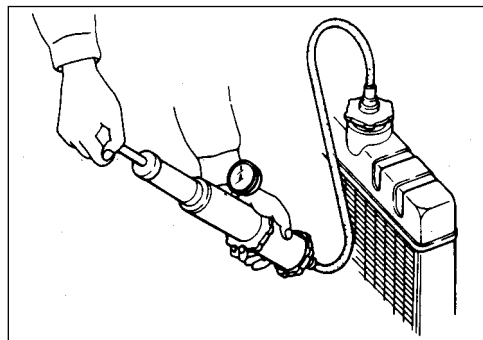


1.6.6. Radiator



- ⌋ Install the radiator cap tester and pressurize the radiator.
- ⌋ Inspect the cooling system if there any leak.

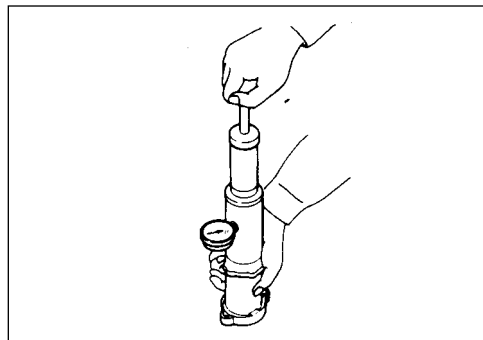
Measuring pressure (kg/cm ²)	1.0 (14.2 psi)
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Radiator cap

Pressure valve opening pressure (kg/cm ²)	0.87 (12.4 psi)
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Vaccum valve opening pressure (kg/cm ²)	0.05 (.71 psi)
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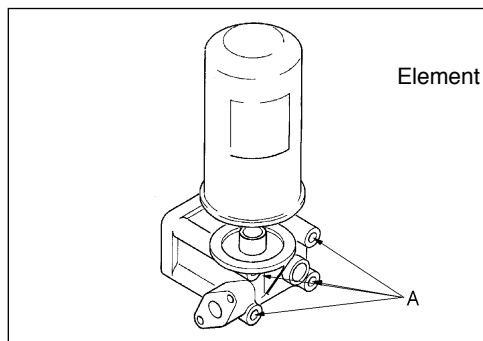


1.6.7. Lubricating System



Oil filter replacement

- ⌋ Before installing a new filter element apply a small amount of clean engine oil to the element gasket.
- ⌋ Install the new element. When the gasket contacts the base, tighten it 3/4 of a turn more. Do not overtighten.



1.6.8. Fuel System

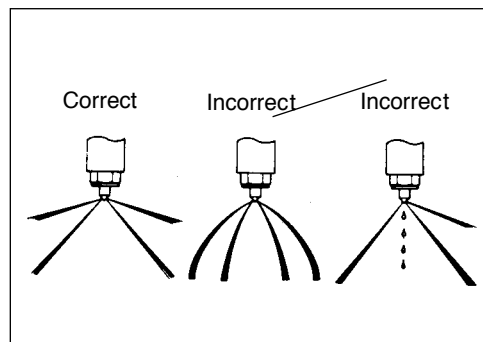


Injection nozzle

Check the spraying condition and injection starting pressure.

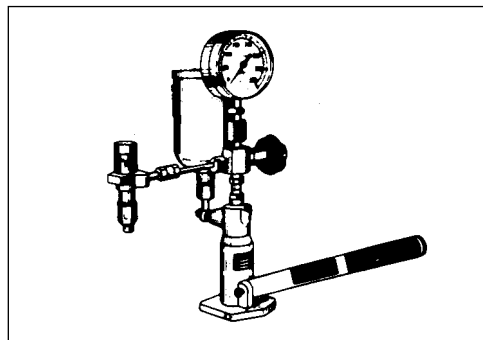


Injection starting pressure (kg/cm ²)	220 (3.128 psi)
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Adjustment

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

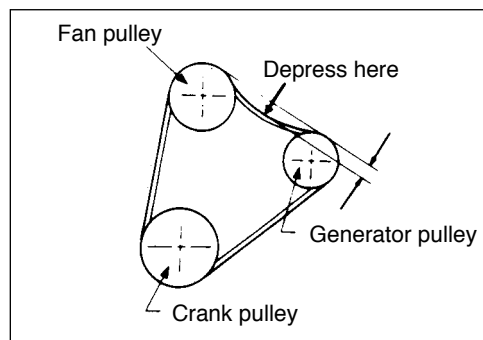


1.6.9. Fan Belt

(mm)



Specified belt deflection	10 (.393 in)
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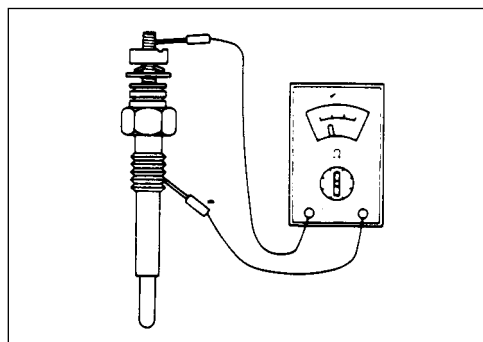
1.6.10. Glow Plug



Inspection(Resistance)

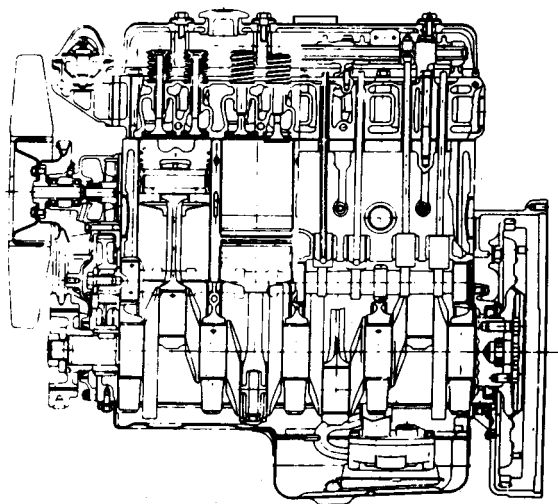
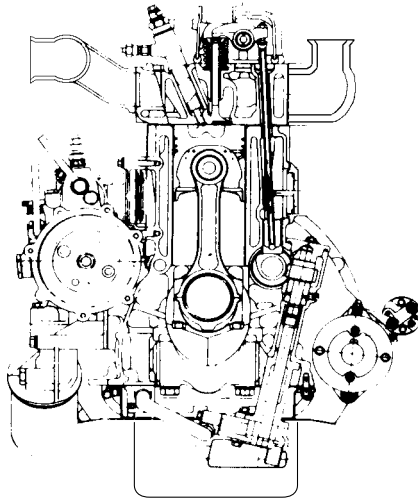
Silver color	4.5 Ω
Black color	1.6Ω

Check the continuity across the plug terminals and body.



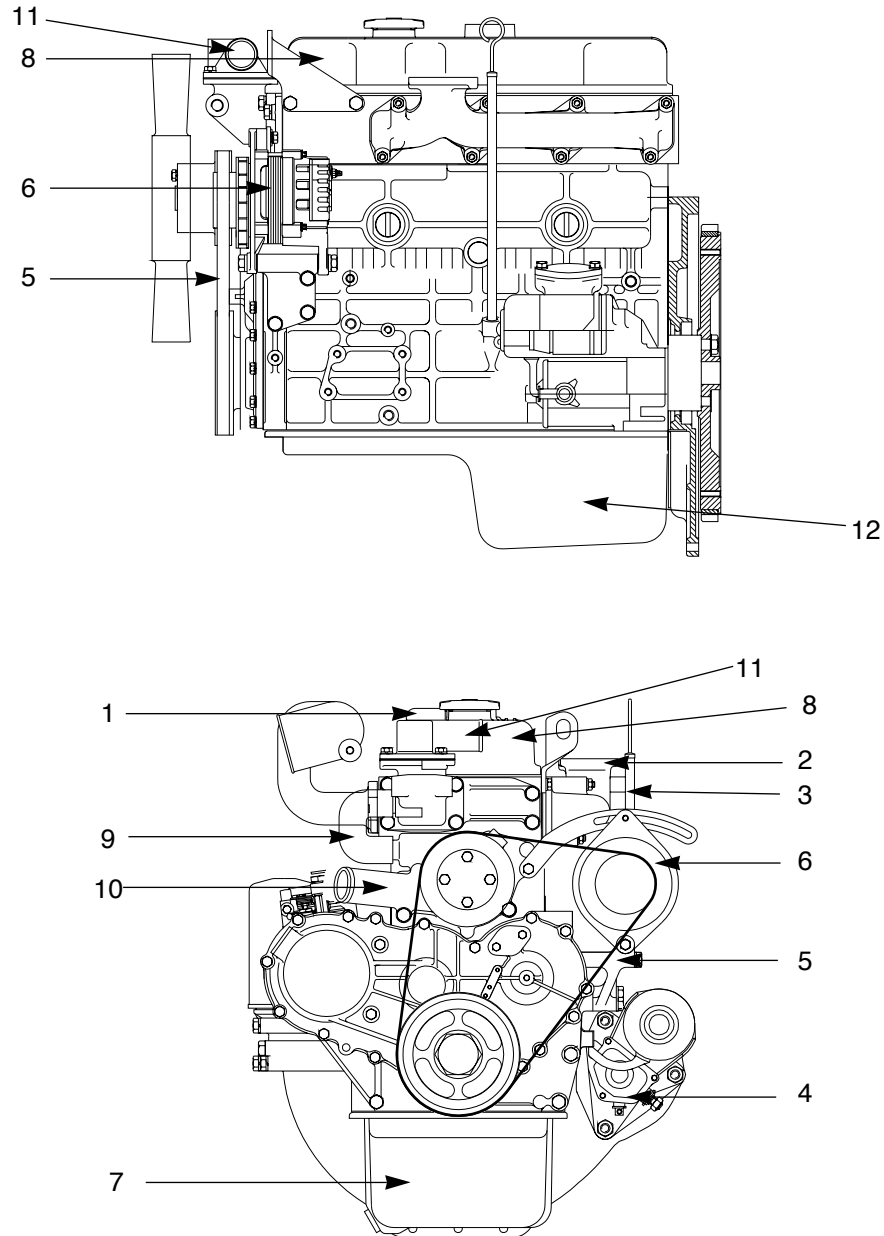
2. Engine Assembly

2.1. General Description



2.2. Disassembly

2.2.1. External Parts (A)



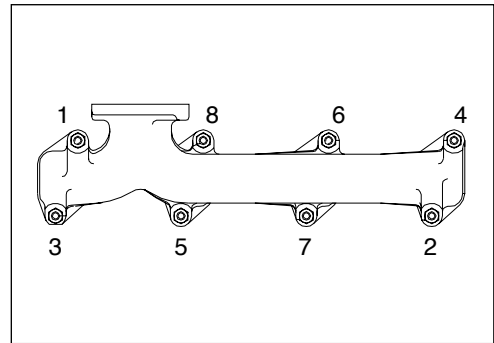
<Disassembly steps>

- | | |
|-----------------------------------|---------------------------------|
| 1. Breather hose | 7. Oil pan |
| 2. Exhaust manifold | 8. Cylinder head cover |
| 3. Oil guide tube and level gauge | 9. Rubber hose |
| 4. Starter | 10. Water pump |
| 5. Cooling fan belt | 11. Thermostat housing assembly |
| 6. Alternator | |

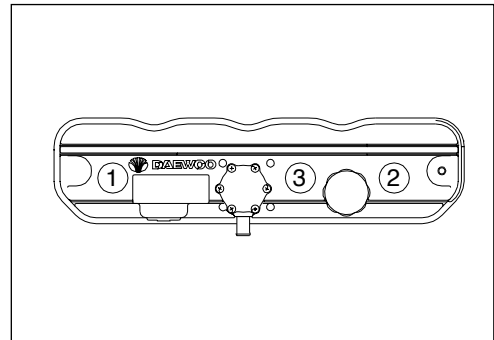


Important operations

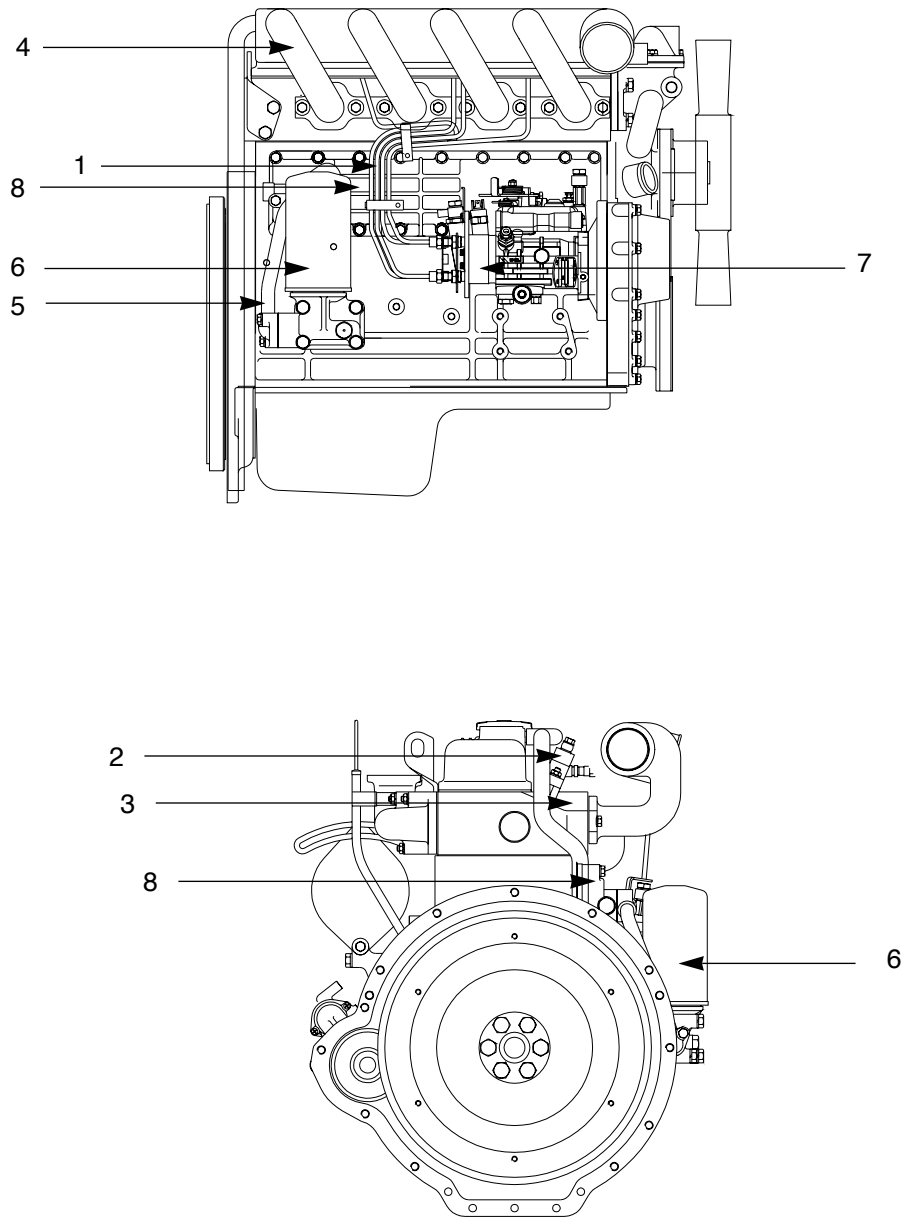
- i Exhaust manifold assembly(2)
Loosen the manifold fixing bolts in sequence of figure's shown.



- i Cylinder head cover(8)
Loosen the head cover bolts in sequence of figure's shown



2.2.2. External Parts (B)



<Disassembly steps>

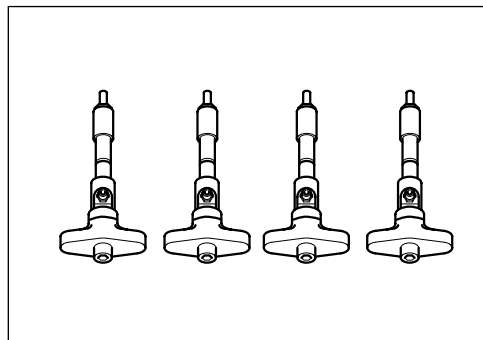
- | | |
|------------------------|------------------------|
| 1. Fuel injection pipe | 5. Oil pipe |
| 2. Injection nozzle | 6. Oil filter assembly |
| 3. Glow plug | 7. Injection pump |
| 4. Intake manifold | 8. Oil cooler assembly |



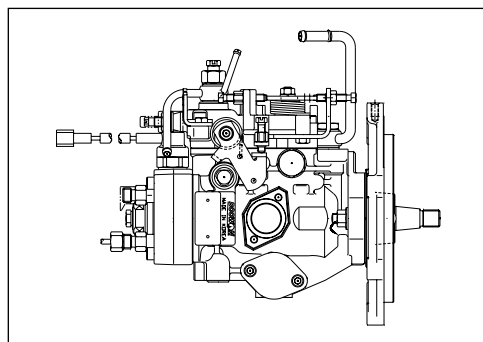
Important operations

- i Engine control cable.
Disassemble the engine control cable.

- i Injection nozzle(2)
Avoid damaging the nozzle tips or other parts during disassembly.

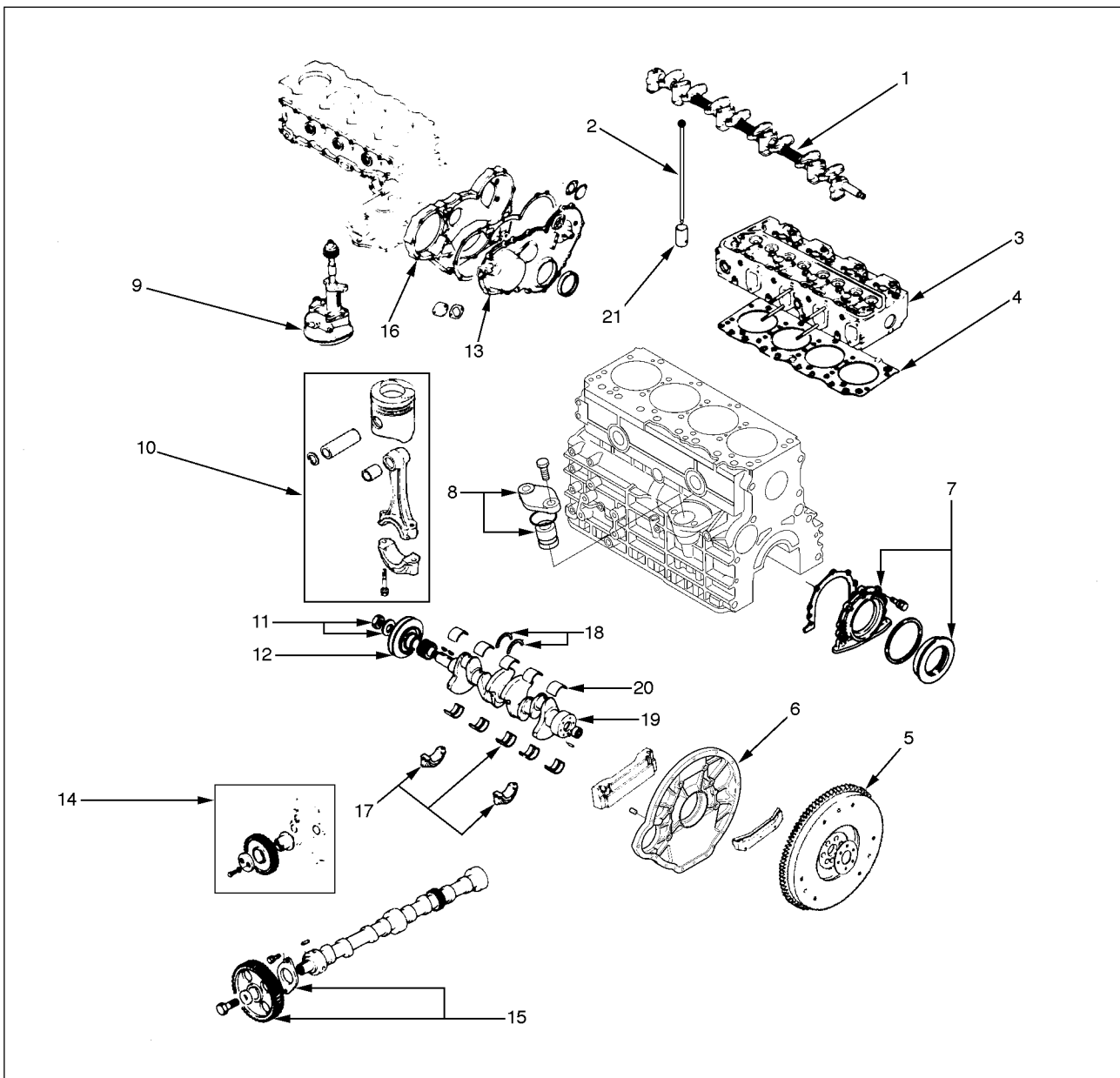


- i Injection pump assembly(7)
When disassembling the injection pump, cap or tape the delivery valve holder to avoid dirt entry.



2.2.3. Internal Parts

i Major Components



<Disassembly steps>

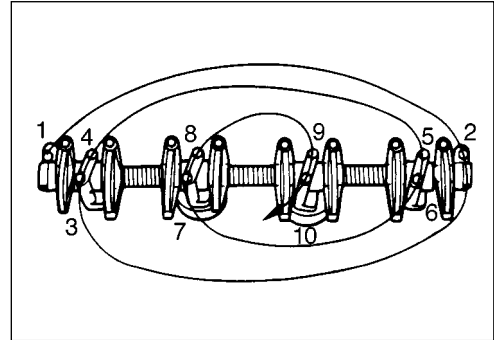
- | | |
|--|--|
| 1. Rocker arm shaft assembly | 12. Crankshaft pulley |
| 2. Push rod | 13. Gear case cover |
| 3. Cylinder head assembly | 14. Idle gear |
| 4. Cylinder head gasket | 15. Camshaft assembly |
| 5. Fly wheel | 16. Timing gear case |
| 6. Fly wheel housing | 17. Crankshaft bearing cap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



Important operations

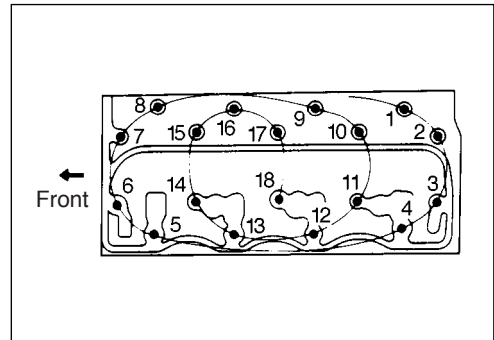
1. Rocker arm shaft assembly (1)

Loosen the rocker arm shaft assembly bolts a little at a time in numerical sequence as shown in the figure.



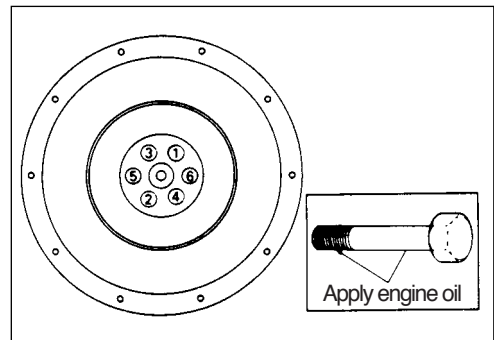
2. Cylinder head assembly (3)

Loosen the cylinder head bolts a little at a time in the numerical sequence as shown in the figure.



3. Flywheel (5)

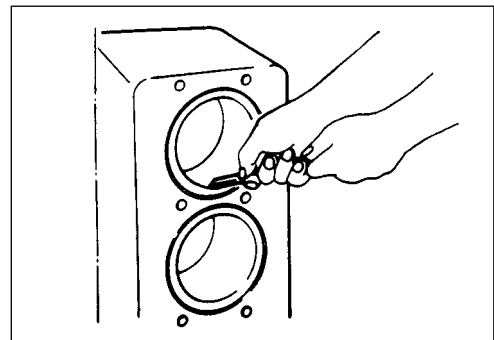
Loosen the flywheel bolts a little at a time in numerical sequence as shown in the figure.



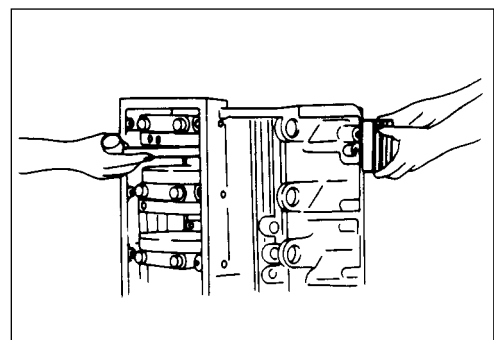
4. Piston assembly (10)

Remove any carbon deposits from the upper part of the cylinder bore using a scraper.

This will prevent damage to the piston and the piston rings when they are removed from the cylinder bore.



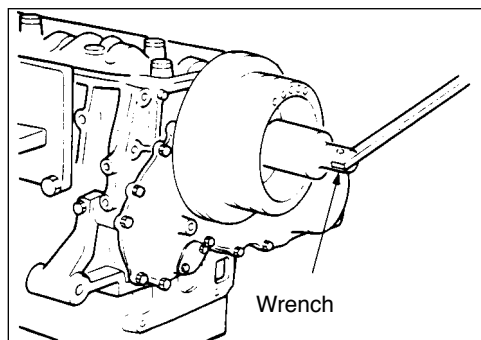
Position the piston to the top by turning the crankshaft, remove the piston assembly from cylinder using a wooden bar or hammer.





1 Crankshaft front nut and washer (11)

Wrench : 41 mm

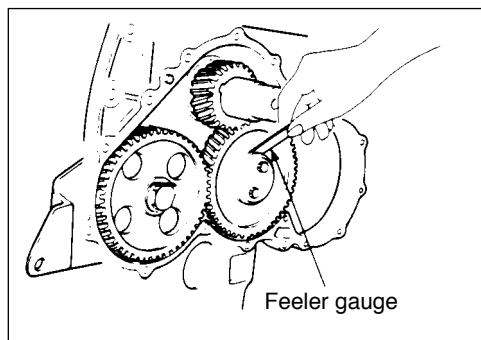


1 Idle gear (14)

Measure the following points before disassembly.

Idle gear end play. (mm)

Standard	Limit
0.058 \pm 0.115 (.002~0.0045 in)	0.2 (.0078 in)

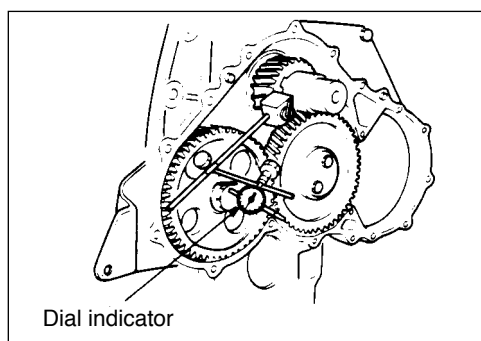


Backlash

(mm)

Standard	Limit
0.10 \pm 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)

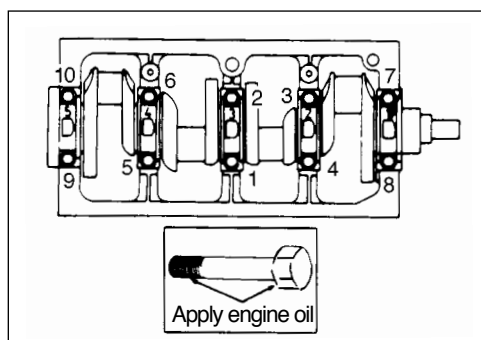
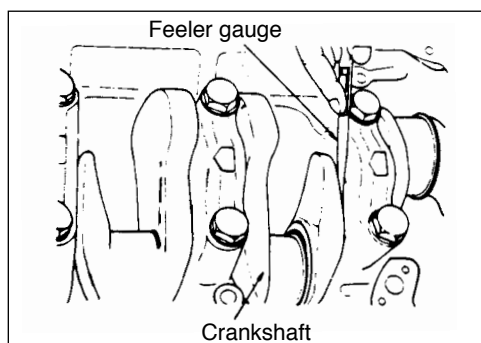
Measure the crankshaft end play before disassembly.

Crankshaft end play (mm)

Standard	Limit
0.10 \pm 0.17 (.0039~.0067 in)	0.3 (.012 in)

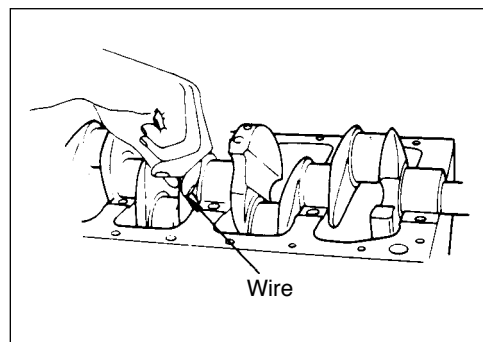
Includes the crankshaft gear, camshaft gear and idle gear.

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



1 **Thrust bearing (18)**

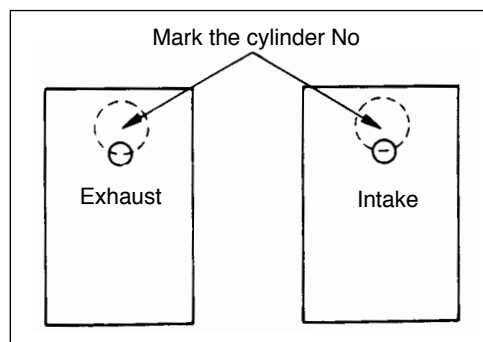
Remove the thrust bearing with steel wire.



1 **Tappet (21)**

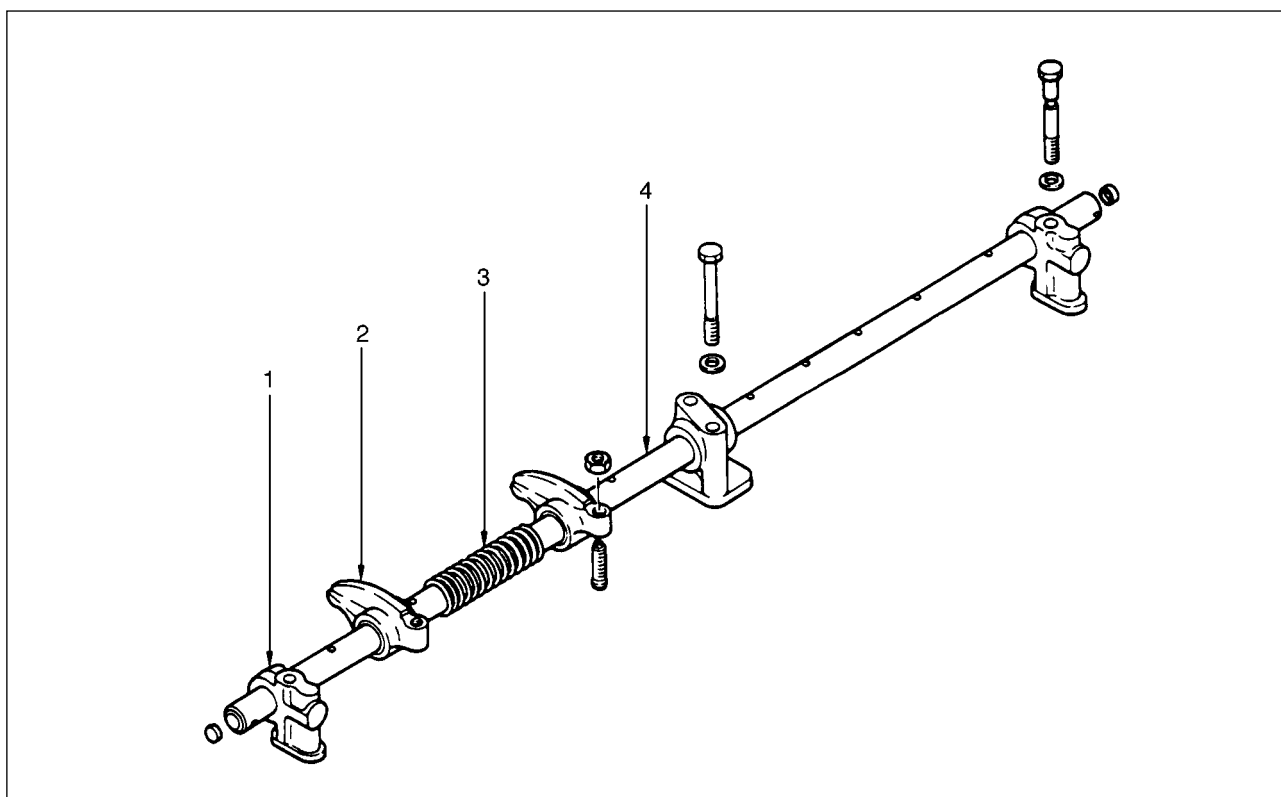
Remove the tappets and mark the cylinder number each tappet.

(Be careful against the damages)



2.2.4. General Components

1 **Rocker arm, Bracket and shaft assembly**



<Disassembly steps>

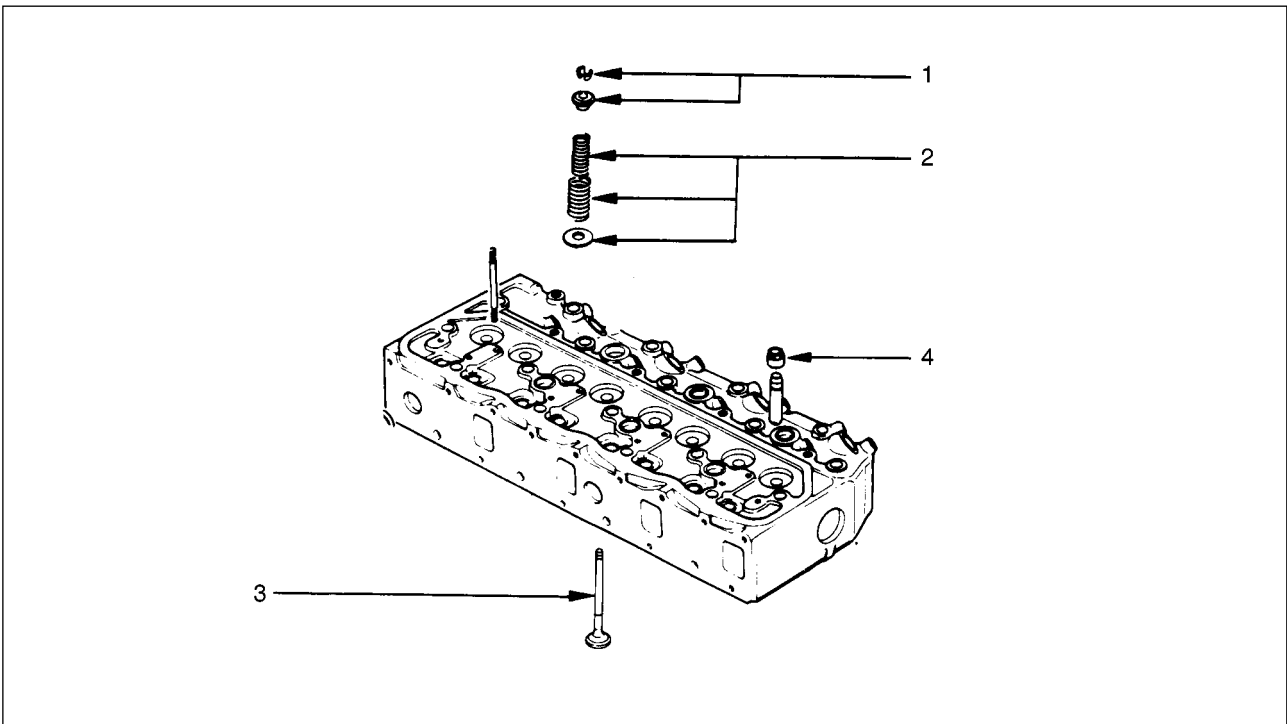
1. Bracket

2. Rocker arm

3. Spring

4. Rocker arm shaft

i Cylinder head assembly



<Disassembly steps>

1. Spring retainer and valve cotter
2. Spring and spring seat

3. Valve
4. Valve stem oil seal



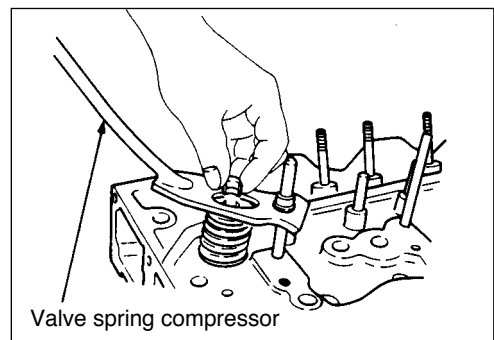
Important operations

Mark the cylinder No. each component when it disassembles.

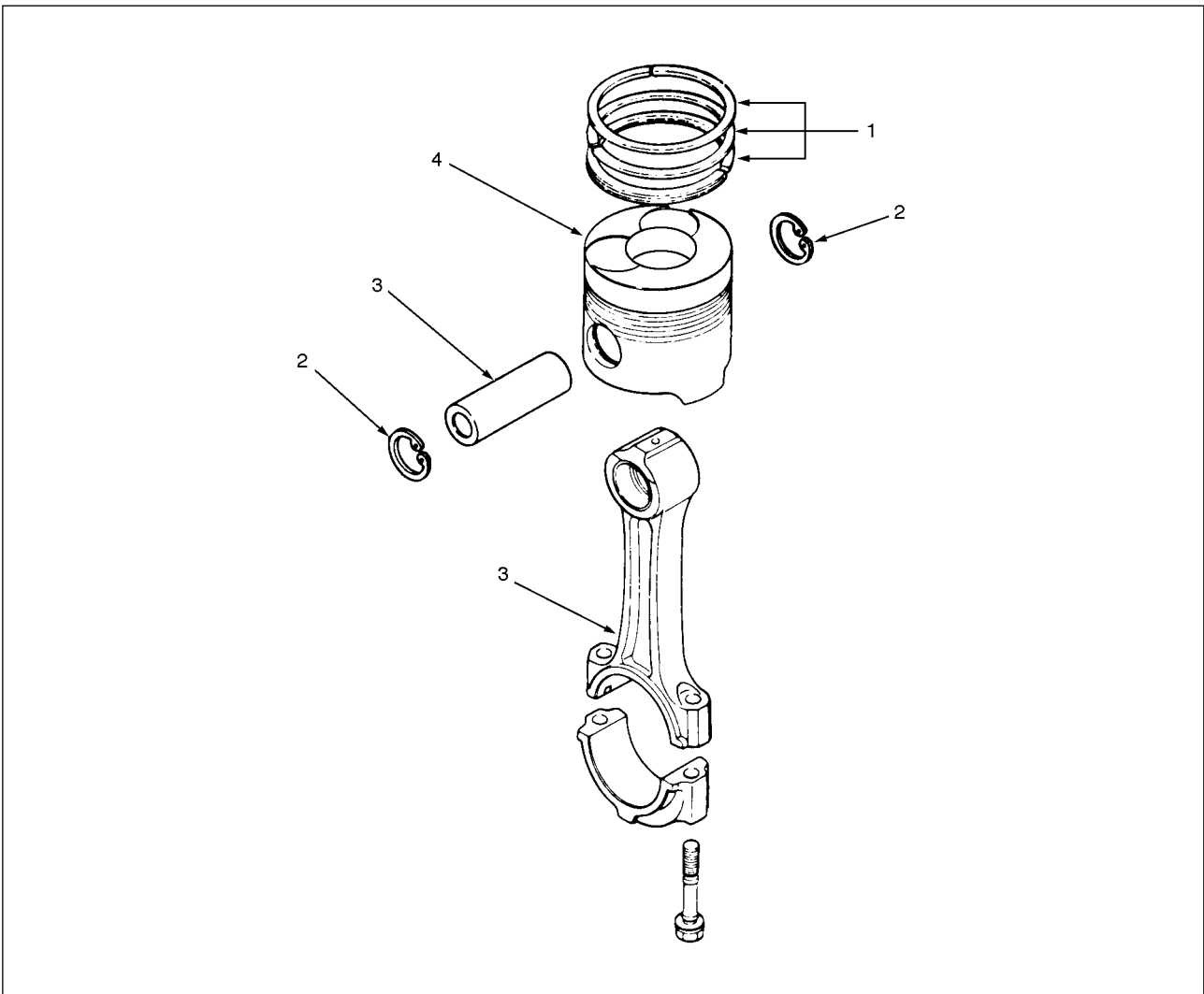
- i Valve spring
- i Valve
- i Valve seat



- i Retainer and valve cotter (1)
- Spring compressor



i Piston and connecting-rod assembly



<Disassembly steps>

1. Piston ring
2. Snap ring

3. Piston pin and connecting-rod
4. Piston



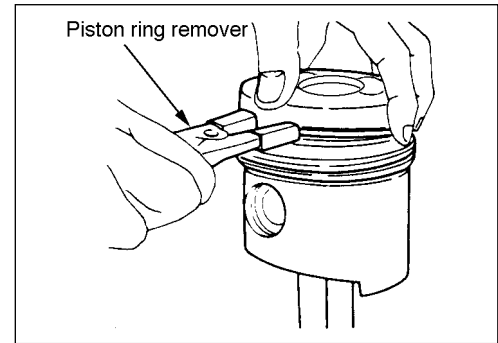
Important operations

Mark the cylinder No. each component when it disassembles.

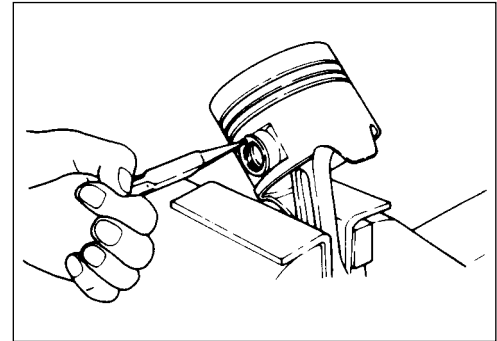
- i Piston ring
- i Piston
- i Piston pin
- i Connecting-rod



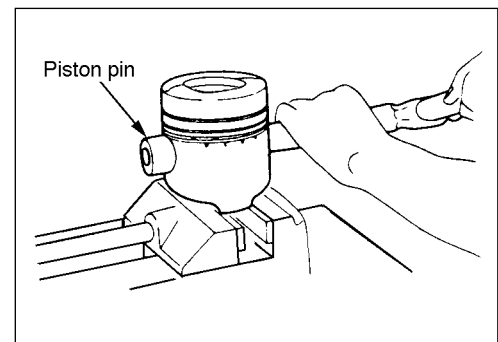
- 1 **Piston ring (1)**
Remove the piston rings



- 1 **Snap ring (2)**
Remove the piston pin snap ring



- 1 **Piston pin and connecting-rod (3)**
Pull out the piston pin with brass bar



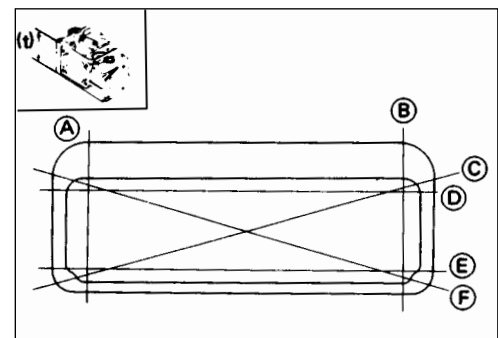
2.3. Inspection and Repair

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

2.3.1. Cylinder Head

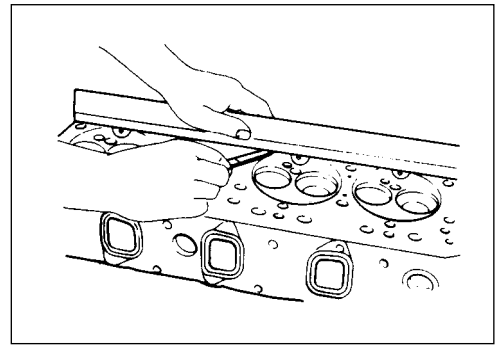


- Lower face warpage
 - 1 Use a straight edge and a feeler guage to measure the four sides and the two diagonals of the cylinder head lower face.



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)

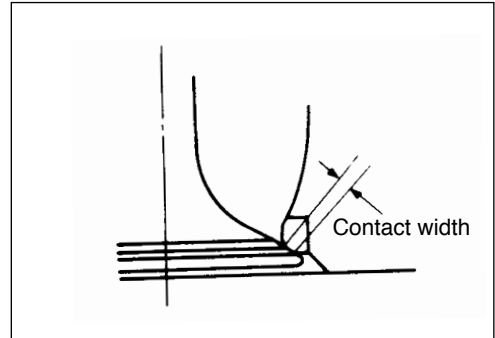


2.3.2. Valve, Valve Guide and Valve Seat Insert



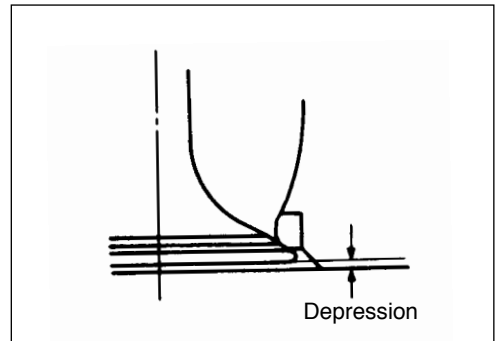
Valve contact width (mm)

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

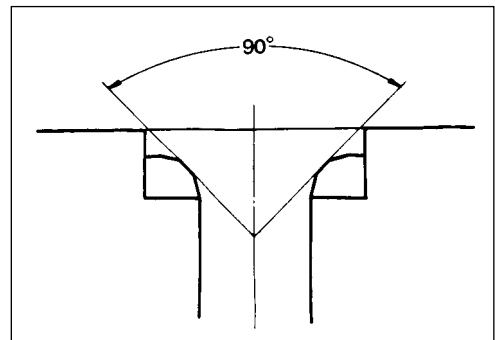


Valve depression (mm)

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



Valve seat angle



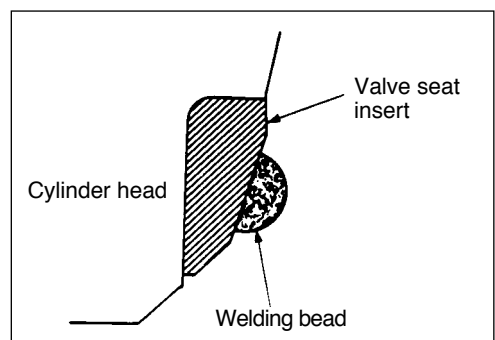
Valve seat angle

Valve seat insert replacement

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

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

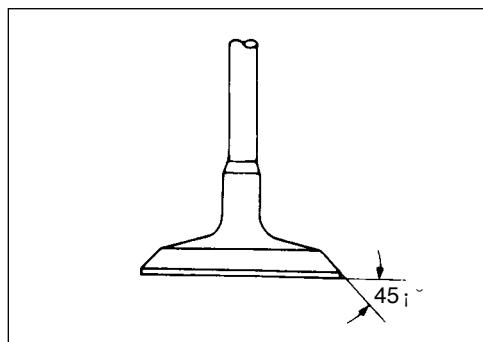
Installation : Use a bench press to smoothly press the valve seat insert.





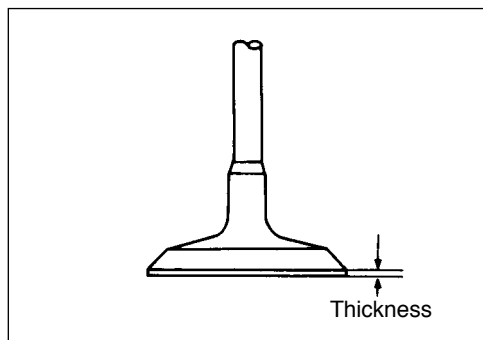
Valve seat angle

Intake valve seat angle	45° ~
Exhaust valve seat angle	45° ~



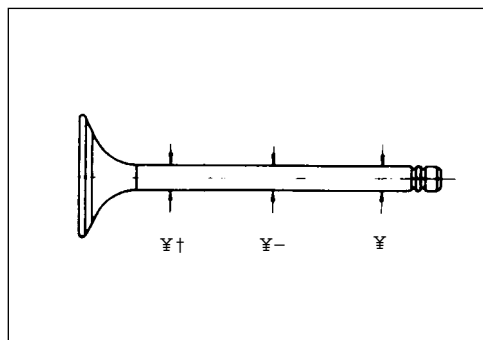
Valve seat angle (mm)

Standard	Limit
1.5 (.059 in)	1.0 (.039 in)



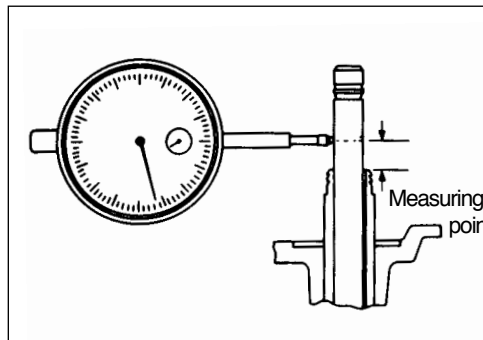
Valve stem outer diameter (mm)

	Standard	Standard
Intake valve	8.946 ~ 8.961 (.352 ~ .353 in)	8.88 (.350 in)
Exhaust valve	8.921 ~ 8.936 (.351 ~ .352 in)	8.88 (.350 in)

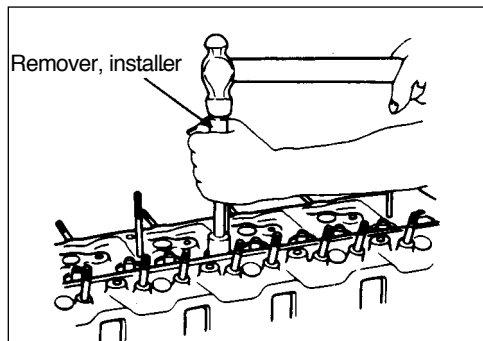


Valve stem outer diameter (mm)

	Standard	Standard
Intake	0.04 ~ 0.07 (.002 ~ .003 in)	0.2 (.008 in)
Exhaust	0.06 ~ 0.09 (.002 ~ .009 in)	0.25 (.010 in)



Valve guide replacement Remover, installer



2.3.3. Valve Spring

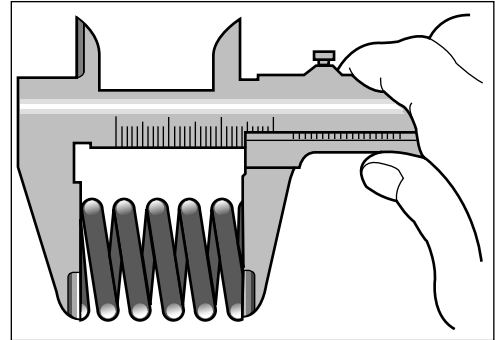
Valve Spring Free Length



Use a vernier caliper to measure the valve spring free length.

If the measured value is less than the specified limit, the valve spring must be replaced.

		Standard	Limit	Remark
Exhaust and Intake Valve Spring Free Length		49.0 mm (1.93 in)	47.0 mm (1.85 in)	for Industrial
Free length	Inner	52.4 mm (2.06 in)	50.0 mm (1.97 in)	for Automotive
	Outer	53.6 mm (2.11 in)	50.6 mm (1.99 in)	



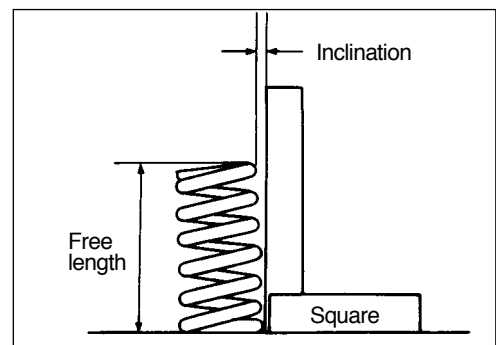
Valve Spring Inclination



Use a surface plate and a square to measure the valve spring inclination.

If the measured value exceeds the specified limit, the valve spring must be replaced.

		Standard	Limit	Remark
Valve spring Inclination		less than 1.3 mm (.051 in)	2.7 mm (.106 in)	for Industrial
Free length	Inner	-	1.0 mm (.039 in)	for Automotive
	Outer	-	1.0 mm (.039 in)	

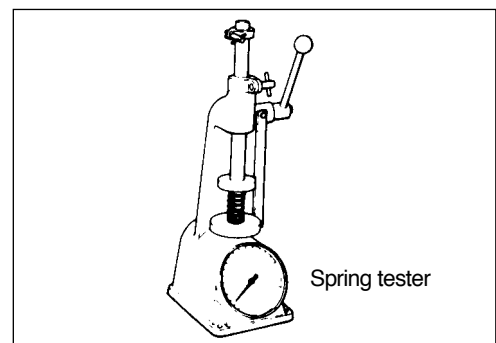


Valve Spring Tension



Use a spring tester to measure the valve spring tension if the measured value is less than the specified limit, the valve spring must be replaced.

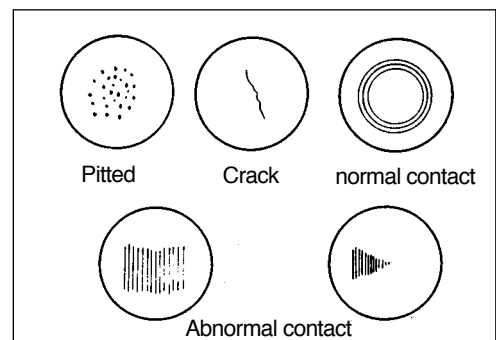
		Standard	Limit	Remark
Valve Spring Tension at 40 mm Set Length		14.5 kg (32 lbs)	11.5 kg (25.4 lbs)	for Industrial
Inner	42mm (1.65 in)	10.9 kg (24 lbs)	9.9 kg (21.8 lbs)	for Automotive
Outer	44mm (1.73 in)	23.0 kg (50.7 lbs)	20.0 kg (44.1 lbs)	



2.3.4. Tappet



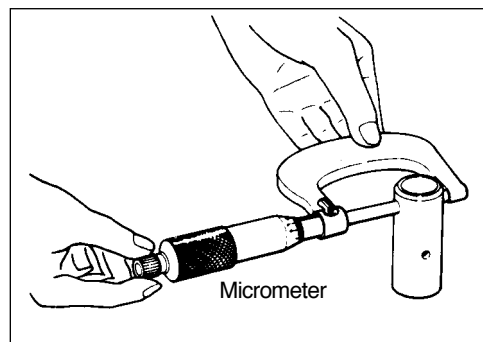
Inspect the tappets for excessive wear, damage and any abnormalities.





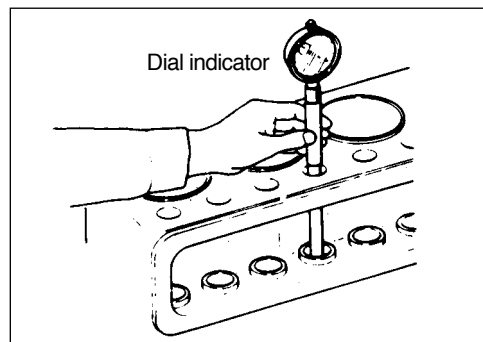
Diameter (mm)

Standard	Limit
27.97 \pm 0.02 (1.10 in)	0.2 (1.09 in)



Clearance between the tappet and cylinder body (mm)

Standard	Limit
0.02 \pm 0.054 (.0008~.002 in)	0.1 (.004 in)



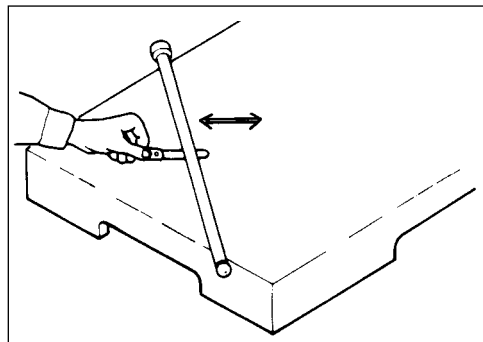
2.3.5. Push Rod



Run-out

Limit (mm)	0.03 (.0012 in)
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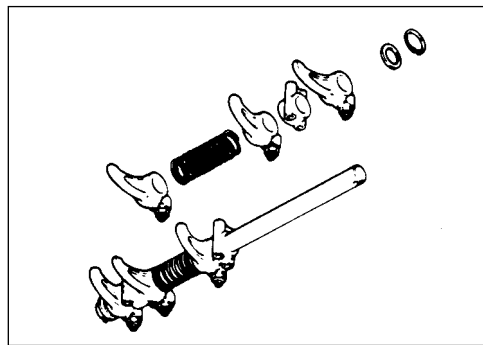
- Use a feeler gauge to measure the push rod run-out
- Roll the push rod along a smooth flat surface as shown in the figure.



2.3.6. Rocker Arm Shaft Assembly

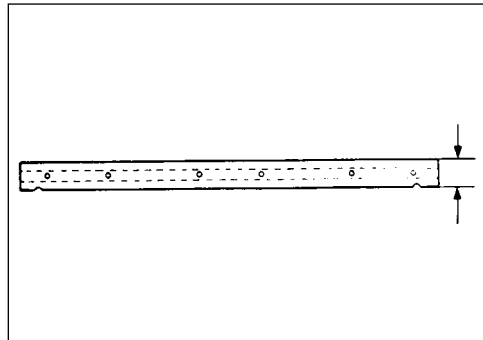


Inspect all disassembled parts for wear, damage and any abnormalities.



Rocker arm shaft (mm)

Standard	Limit
18.98~19.00 (.747~.748 in)	18.85 (.742 in)





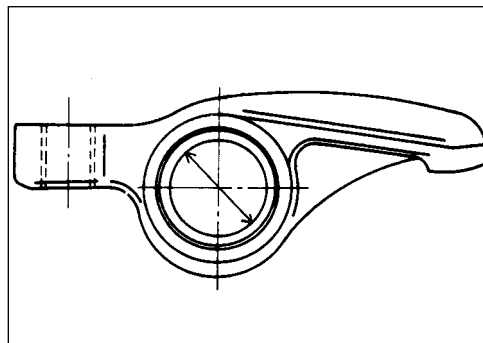
Rocker arm bushing (mm)

Standard	Limit
19.01~19.03 (.748 ; >.749 in)	19.05 (.75 in)



Clearance between rocker arm shaft and bushing (mm)

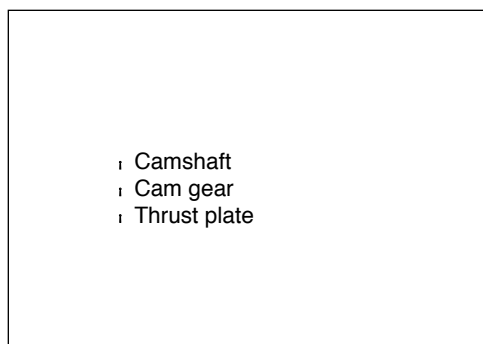
Standard	Limit
0.01 ; >0.05 (.0004 ; >.0020 in)	0.2 (.0079 in)



2.3.7. Camshaft Assembly

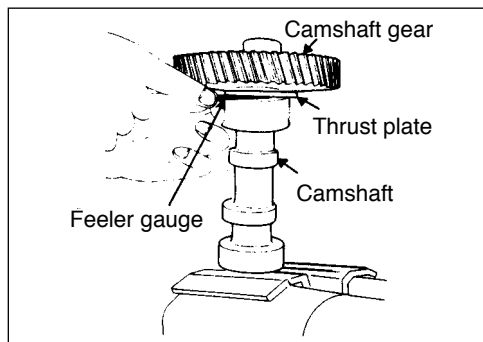


Inspect all disassembled parts for wear, damage and any abnormalities.



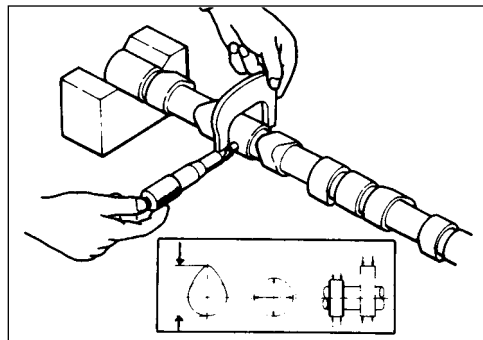
End play (mm)

Standard	Limit
0.050 ; >0.114 (.0020 ; >.0045 in)	0.2 (.0079 in)



Camshaft journal diameter (mm)

Standard	Limit
55.94 ; >55.97 (2.202~2.204 in)	55.60 (2.189 in)



**Run-out** (mm)

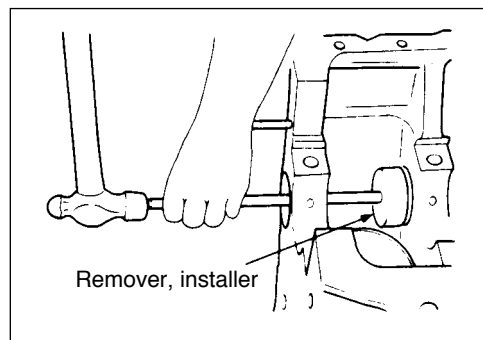
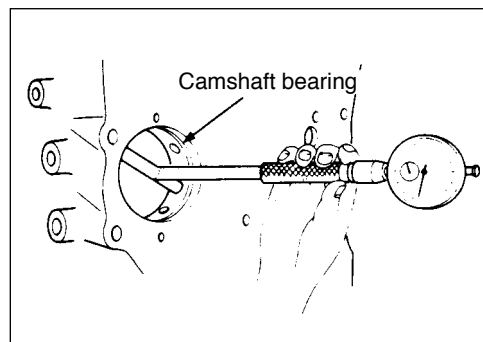
Standard	56.00 \pm 56.03 (2.205~2.206 in)
----------	---------------------------------------

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

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

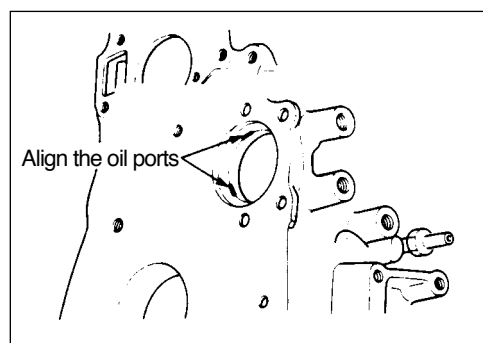
**Camshaft bearing replacement**

Remover, installer



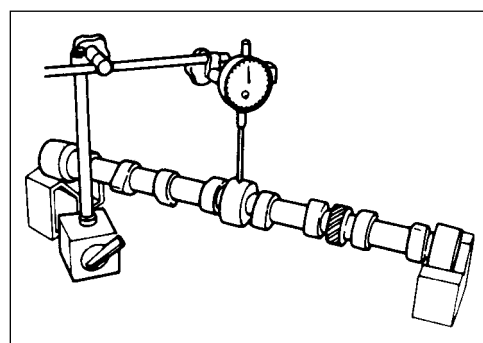
Align the camshaft oil holes with the cylinder body oil ports.

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)
----------	------------------

- 1 Place the camshaft on a measuring stand.
- 1 Use a dial indicator to measure the camshaft run-out
- 1 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·m)	14.0 (101.3 lb·ft)
--------------------------	-----------------------

- 1 Refer to the standard backlash table at "Major components disassembly"



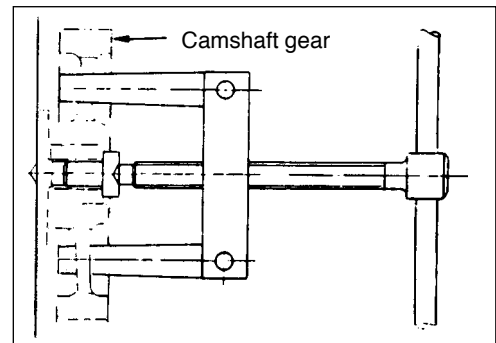
Cam gear and thrust plate replacement

Disassembly : Gear puller

Install : Use a bench press and a hammer



Torque (kgf·m)	16.0 (115.7 lb _f ·ft)
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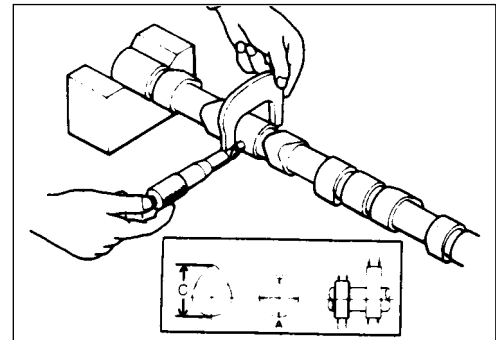
Cam lobe height

(mm)

	Standard	Limit
Cam lobe height (C)	47.7 (1.88 in)	46.5 (1.83 in)
Cam journal diameter (A,B)	56.0 (2.20 in)	55.6 (2.19 in)

Use a micrometer to measure the cam lobe height and journal diameter.

If the measured number is less than the specified limit, the camshaft must be replaced.



2.3.8. Idle Gear and Idle Gear Shaft

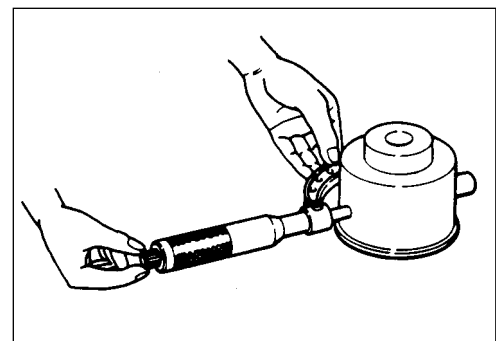


Shaft outside diameter

(mm)

Standard	Limit
44.94 ; >44.97 (1.76~1.77 in)	44.84 (1.765 in)

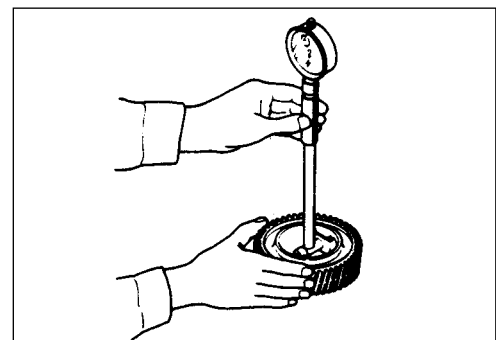
use a micro.



Clearance between shaft and gear

(mm)

Standard	Limit
0.009 ; >0.060 (.0004~.0023 in)	0.2 (.008 in)



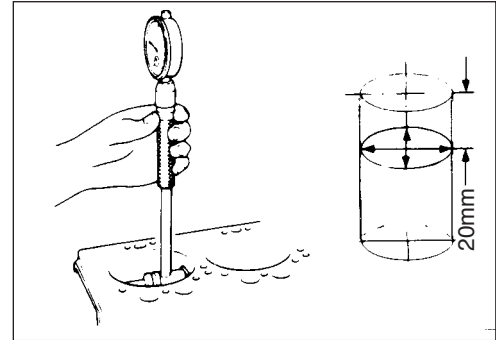
2.3.9. Cylinder Block and Liner



Cylinder bore measurement

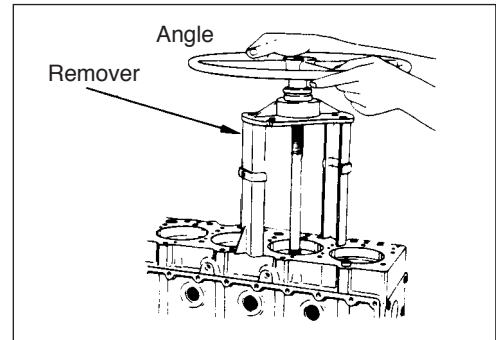
Measuring point : Approx. 20mm below from upper face (Maximum wear portion) (mm)

	Standard	Limit
For steel liner	105.00 \pm 0.04 (4.13~4.14 in)	105.10 (4.14 in)
For cast liner	105.99 \pm 0.01 (4.17~4.179 in)	106.10 (4.18 in)



Cylinder liner replacement

Disassembly : Removeer
Angle for steel liner only



Installation

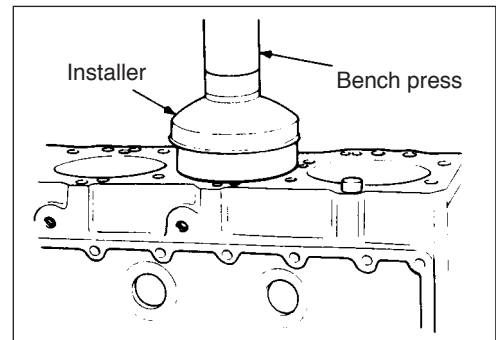
Installer

- Use a bench press to apply an initial seating force of 500kg to the cylinder liner.
- And then apply a final seating force of 2,500kg to fully seat the cylinder liner.



Steel liner	Tight fit (standard) (mm)	0.001 \pm 0.019 (.0004~.0007 in)
Cast liner	Loose fit (mm)	0.005 \pm 0.026 (.0002~.0010 in)

After installing the liner measure the cylinder liner projection and inner diameter.

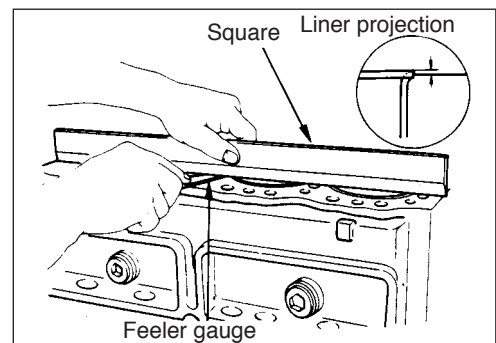


Liner projection

Standard (mm)	0.03 \pm 0.010 (.0011~.0004 in)
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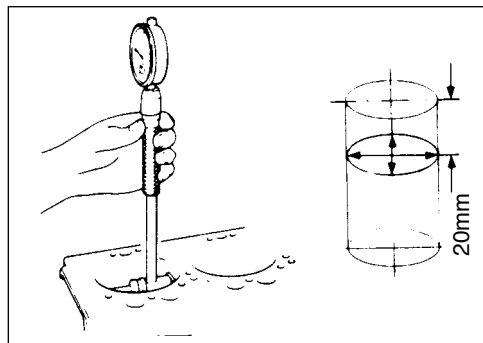
- For the cast liner, removal or installation is done easily.





Cylinder liner inner diameter (mm)

	Liner Grade	Standard
For steel liner	A	102.021 \pm 0.017 (4.016~4.017 in)
	C	102.041 \pm 0.017 (4.017~4.018 in)
For cast liner	A	102.021 \pm 0.017 (4.016~4.017 in)
	B	102.031 \pm 0.017 (4.017 in)

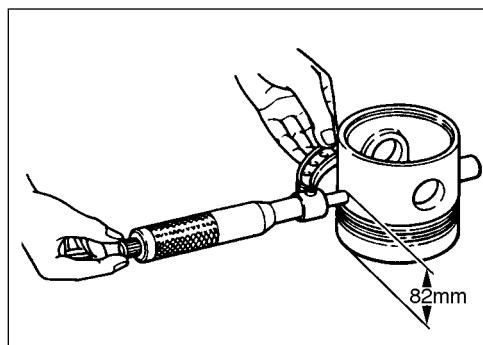


2.3.10. Piston, Piston Pin and Piston Ring



Piston outer diameter (mm)

	Piston grade	Standard
For steel liner	A	101.955 \pm 0.015 (4.014~4.015 in)
	C	101.975 \pm 0.015 (4.015~4.016 in)
For cast liner	A	101.953 \pm 0.015 (4.014~4.015 in)
	B	101.963 \pm 0.015 (4.014~4.015 in)



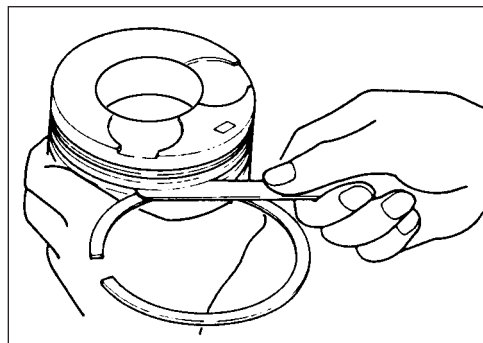
Piston and liner bore clearance

Standard (mm)	0.055~ 0.075
---------------	--------------



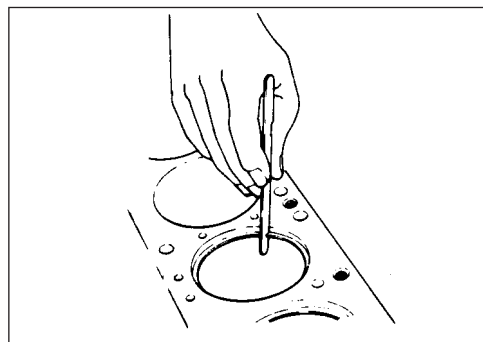
Piston ring and ring groove clearance (mm)

	Standard	Limit
1st compression ring	0.085 \pm 0.011 (.003~.009 in)	0.2 (.008 in)
2nd compression ring	0.035 \pm 0.055 (.001~.002 in)	0.15 (.006 in)
Oil ring	0.03 \pm 0.07 (.001~.003 in)	0.15 (.006 in)



Piston ring gap (mm)

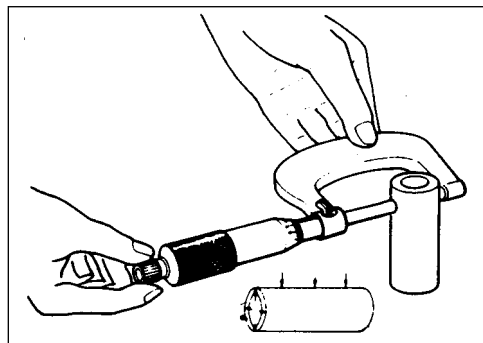
	Standard	Limit
1st compression ring	0.25 \pm 0.45 (.010~.018 in)	1.5 (.006 in)
2nd compression ring	0.2 \pm 0.4 (.008~.016 in)	1.5 (.006 in)
Oil ring	0.2 \pm 0.4 (.008~.016 in)	1.5 (.006 in)





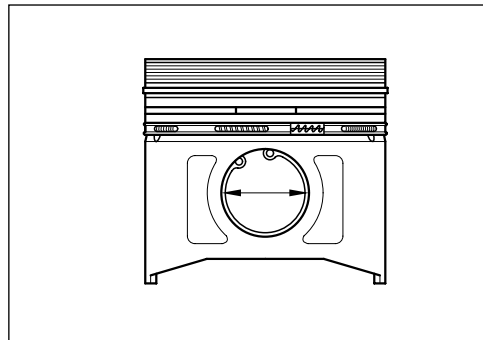
Piston pin outside diameter (mm)

Standard	Limit
35.000 _{-0.005} ^{+0.005} (1.377~1.378 in)	34.95 (1.376 in)



Piston pin and piston clearance (mm)

Limit (mm)	0.005 (.0002 in)
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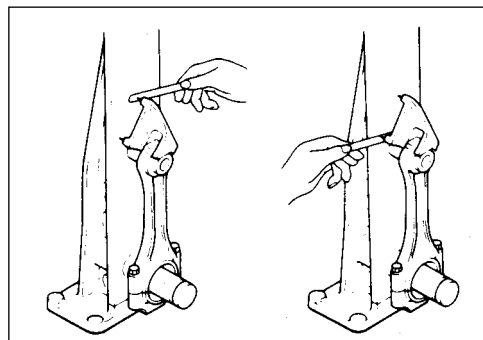


2.3.11. Connecting Rod and Bearing



Connecting rod alignment (parallelism) Alignment (per length of 100mm (3.94 in)) (mm)

Standard	Limit
0.05 (.002 in)	0.2 (.009 in)



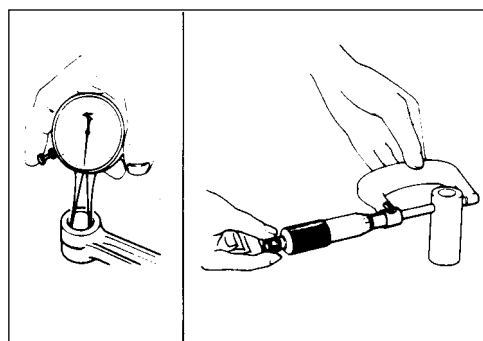
Bushing inside diameter

Standard	35.017~35.025 (1.379~1.380 in)
----------	-----------------------------------

Use a caliper calibrator and micrometer to measure the piston pin and connecting rod small end bushing clearance.

Piston pin and connecting rod small end bushing (mm)

Standard	Limit
0.01~0.03 (.0004~.0012 in)	0.05 (.002 in)



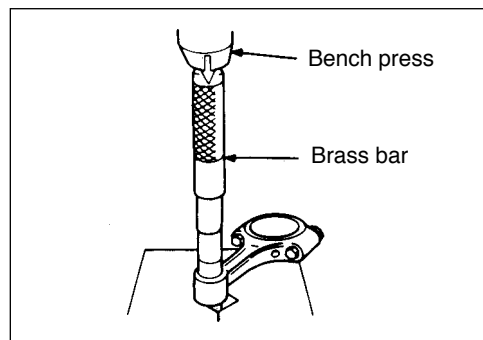


Bushing replacement

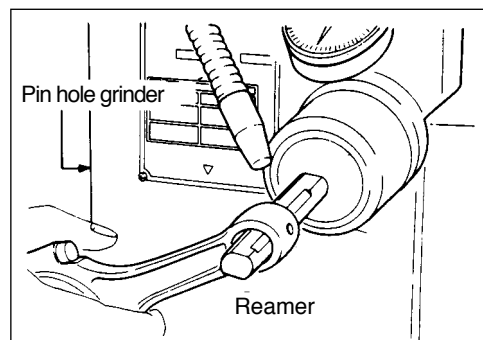
Removal : Use a brass bar and a bench press



Installation : Use a brass bar and a bench press. The connecting rod bushing oil port must be aligned with the connecting rod oil port.



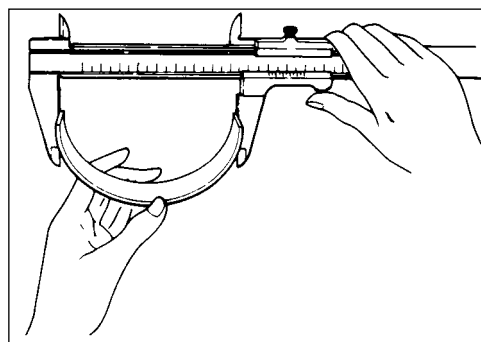
After new bushing installation, ream the bushing inside diameter with a pin hole grinder or a reamer to fit the piston pin.



Connecting rod bearing

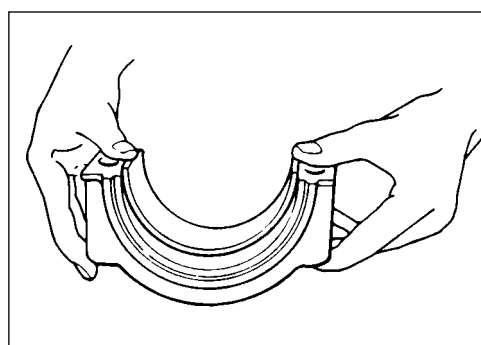
Bearing spread

Standard (mm)	68.00 _j >68.01 (2.677~2.678 in)
---------------	---



Bearing tension

1. Fit the connecting rod bearing lower half into the connecting rod bearing cap.
2. Check the connecting rod bearing lower half tension.
If the tension is insufficient, the bearing must be replaced.
3. Reassemble the connecting rod and bearing cap.



2.3.12. Crankshaft and Bearing

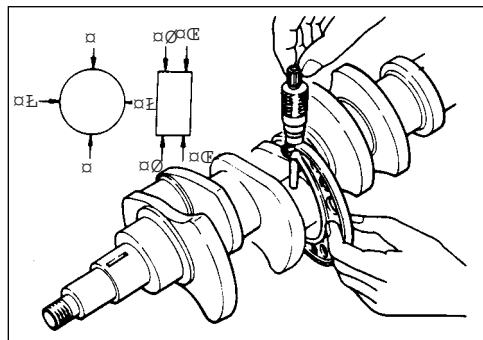
1. Crankshaft and bearing inspection
1. Inspect the crankshaft journal and pin surfaces for excessive wear and damage.
2. Inspect the oil seal fitting surfaces of the crankshaft front and rear ends for excessive wear and damage.
3. Replace or repair the crankshaft if any excessive wear or damage is found.
4. Inspect the crankshaft oil ports for obstructions.
5. Use high pressure air to clean the oil ports if necessary.



Crankshaft pin outside diameter

Standard (mm)	63.932 _j ~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 _j 0.25 (86.7 _j 1.81 lb _j /ft)	9.75 _j 0.25 (70.51 _j 1.81 lb _j /ft)
Bolt type	A	B

A : Bolt head

B : or

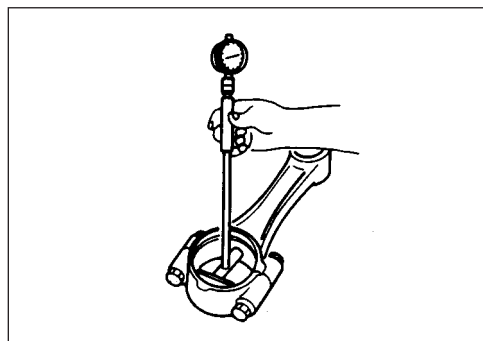


Inside diameter

- 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 _j ~0.07 (.001~.003 in)	0.10 (.004 in) (mm)

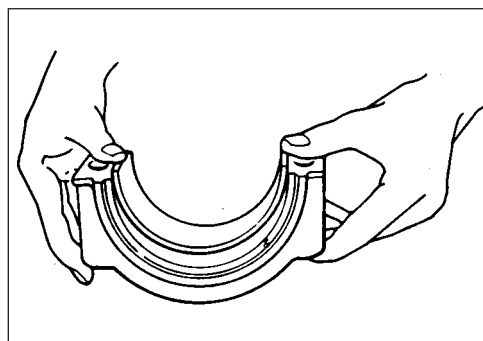
Under size Bearing specifications	0.25 _j ~0.50 (.010~.020 in)
--------------------------------------	---

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.

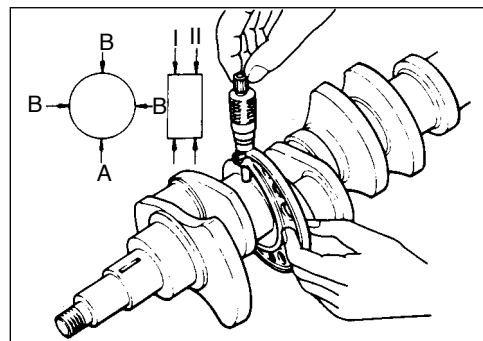




Crankshaft journal outside diameter

Standard (mm)	75.913 _i >75.925 (2.989 in.)
---------------	--

Use a micrometer to measure the crankshaft journal outside diameter across points ϵ and ϵ at the two points ⌚ and ⌚ .



Journal bearing cap reassembly

Torque (kgf·m)	24 (173.6 lb _i /ft)
----------------	-----------------------------------



Inside diameter

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



Journal bearing nominal diameter (mm)	76 _{s j} (2.992 in)
---------------------------------------	---------------------------------

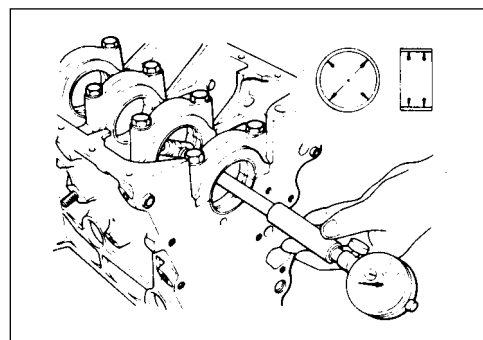
Refer to
"Major components disassembly"
- Crankshaft bearing cap.



Crankshaft journal and bearing clearance (mm)

	Standard	Limit
Center bearing	0.065 _i >0.116 (.003~.006 in)	0.15 (.006 in)
Other bearings	0.025~0.076 (.001~.003 in)	0.11 (.004 in)

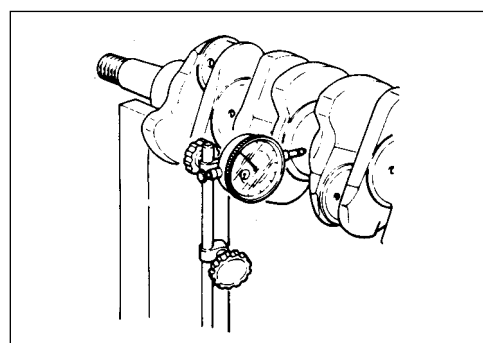
Under size Bearing specifications (mm)	0.25~0.50 (.010~.020 in)
---	-----------------------------



Crankshaft run-out (mm)

Standard	Limit
0.05 (.002 in)	0.40 (.016 in)

1. Mount the crankshaft on a set of v-blocks.
2. Set a dial indicator to the center of the crankshaft journal
3. Gently turn the crankshaft in the normal direction of engine rotation.
4. Read the dial indicator(TIR) as you turn the crankshaft.





Crankshaft gear

Inspect the crankshaft gear

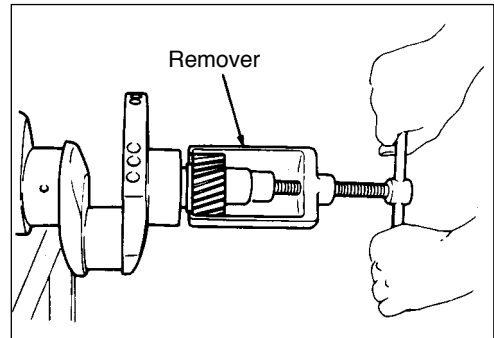
- Before the gear disassembly, check the crank gear backlash.
- If excessive wear or any damage is found through the inspection, replace the crankshaft gear.

Refer to
"Major components disassembly"
- Gear backlash.



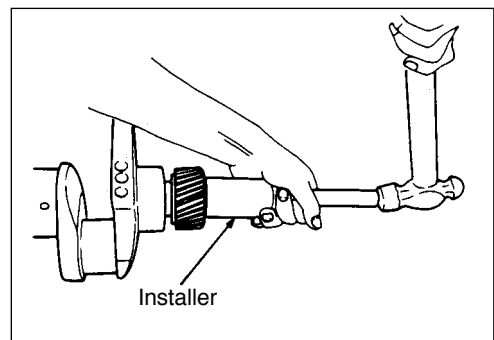
Crankshaft gear replacement

Removal : Remover



Installation

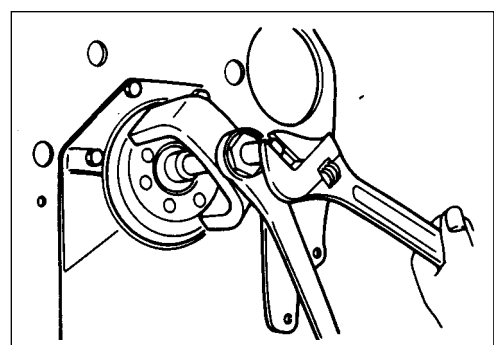
Installer



Pilot bearing replacement

Removal : remover

Installation : Use a brass bar and hammer.

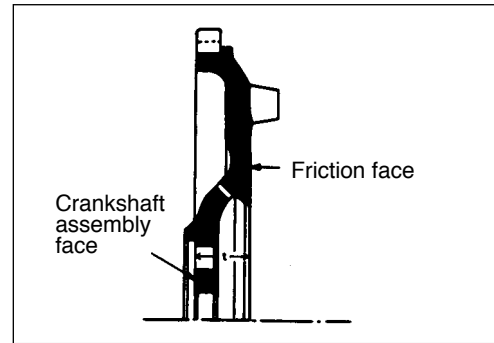


2.3.13. Flywheel and Housing(Rear Oil Seal)



Flywheel thickness (Friction face) (mm)

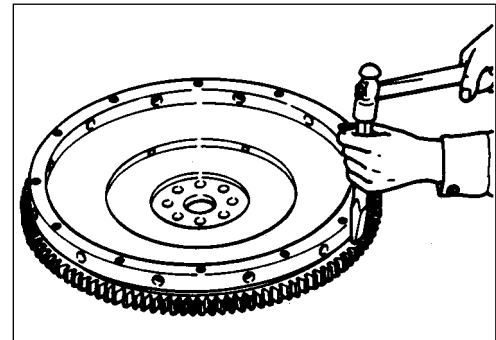
Standard	Limit
33.4 \pm 33.6 (1.315~1.323 in)	32.5 (1.280 in)



Ring gear replacement

Removal : Use a brass bar and hammer

-Strike around the edges of the ring gear with a hammer and brass bar to remove it.

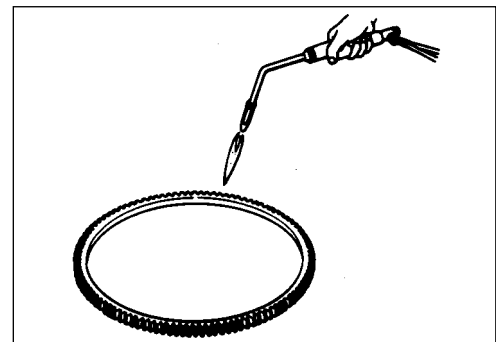


Installation :

-Heat the ring gear evenly with a gas burner to invite thermal expansion.

Do not allow the temperature of the ring gear to exceed 200 $^{\circ}$ C (390 $^{\circ}$ F)

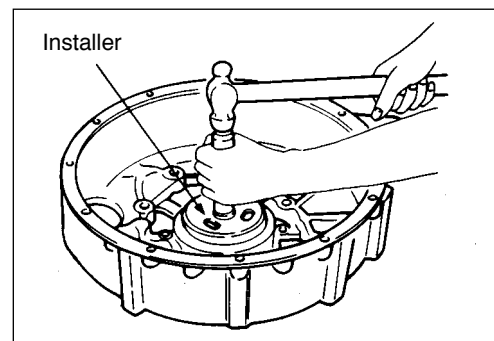
-Use a hammer to install the ring gear when it is sufficiently heated.



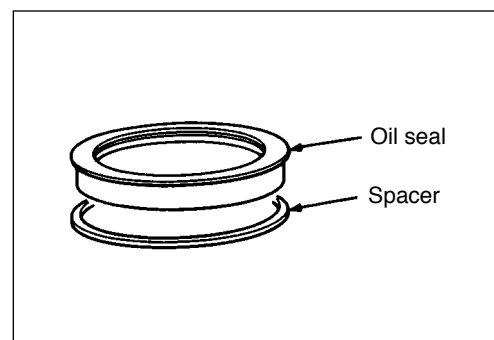
Flywheel housing oil seal replacement

Removal : Use a pry bar and hammer.

Installation : Use a oil seal installer.



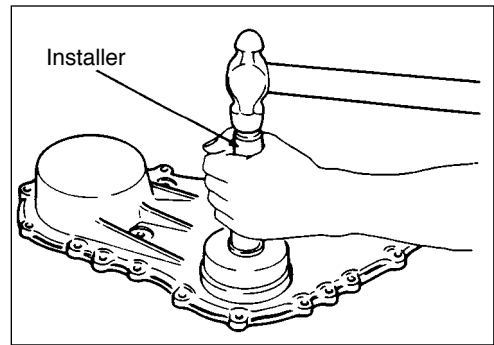
If the crankshaft contact area wears excessively, move the contact area with a oil seal spacer. Install new oil seal and discard the used one.



2.3.14. Timing Gear Case Cover



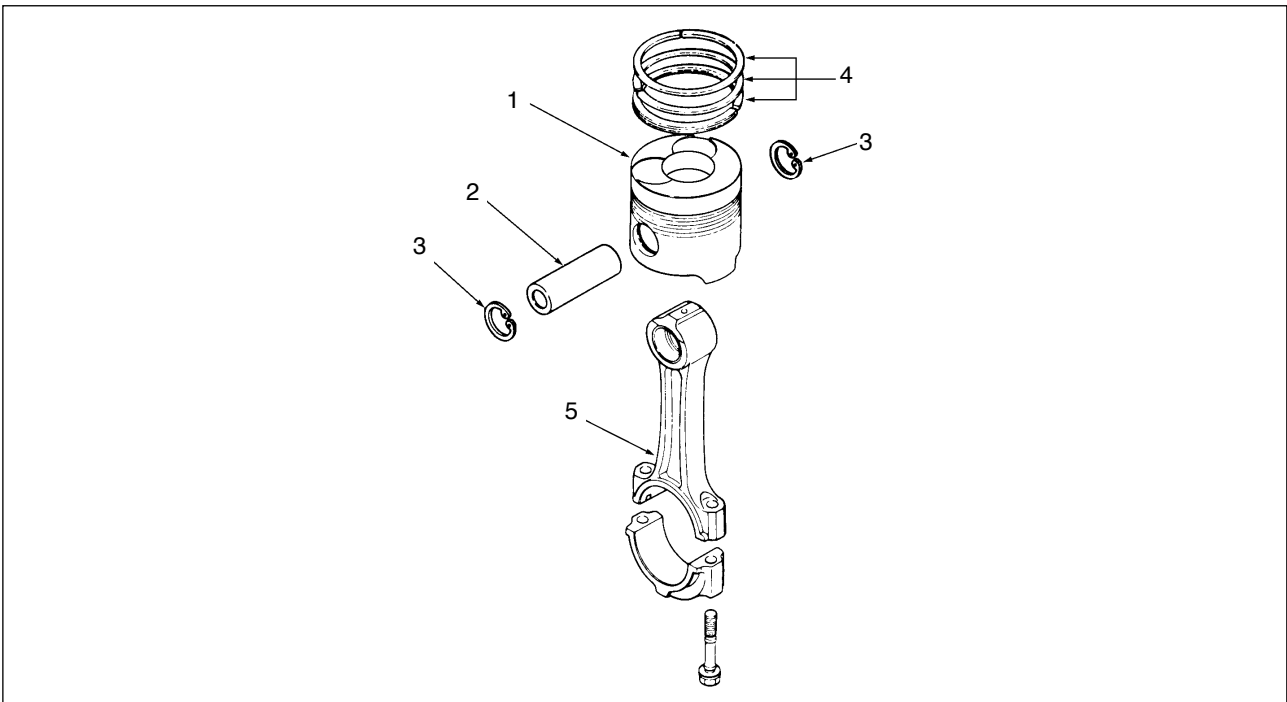
Oil seal replacement
Installation : Installer



2.4. Engine Reassembly

2.4.1. Minor Components

i Piston and connecting-rod assembly



<Disassembly steps>

- 1. Piston
- 2. Piston pin

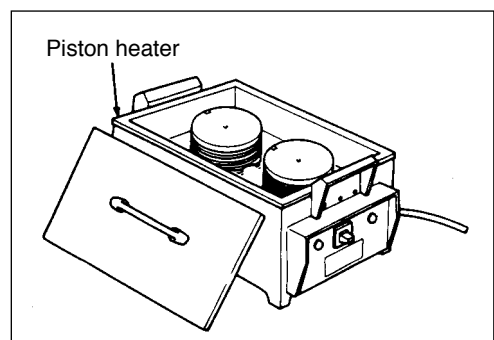
- 3. Snap ring
- 4. Piston ring
- 5. Connecting rod



Important operation



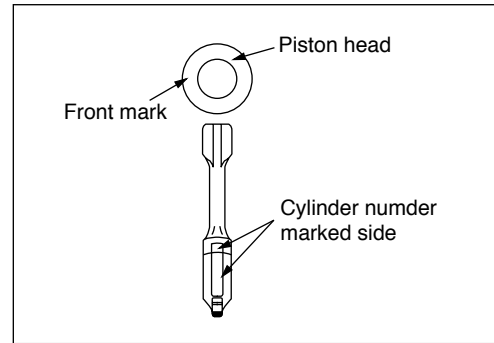
i **Piston (1)**
Use a piston heater to heat the piston approximately
60i (140ç)





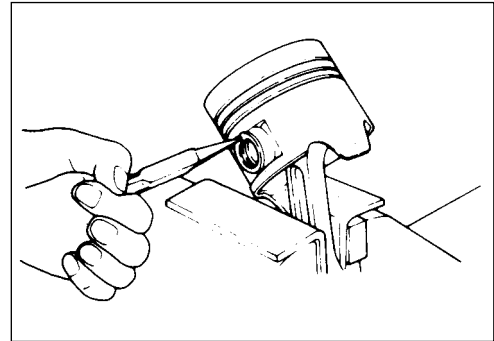
Piston pin and connecting-rod (2)

1. Install the connecting-rod to the piston with setting the marks as illustrated.
2. Install the piston pin into the piston and the connecting-rod bushing



Snap ring (3)

1. Use a pair of snap ring pliers to install the piston pin snap ring.
2. Check that the piston moves smoothly on the piston pin.

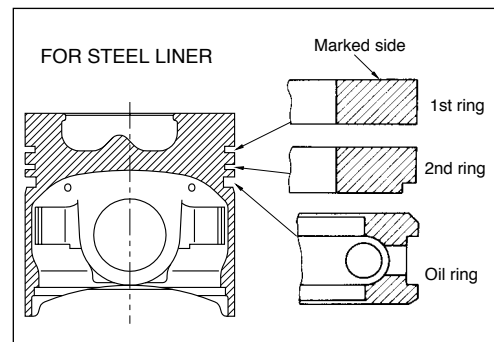


Piston ring (4)

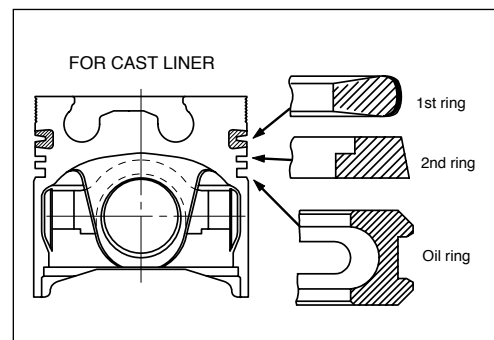
1. Use a piston ring installer to install the three piston rings.

- Install the piston rings in the following order: oil ring → 2nd compression ring → 1st compression ring.

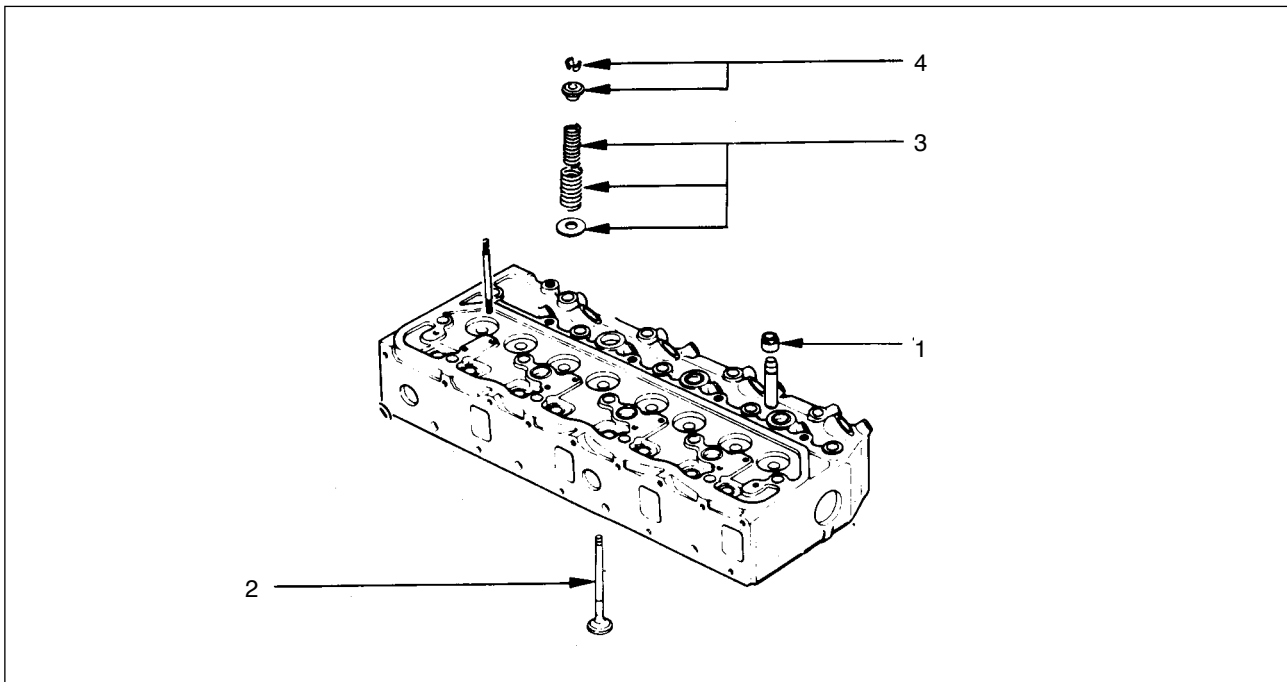
ⓘ The marked side of the two compression rings must be facing up. The undercut side of the 2nd compression ring will be facing down. As the oil ring has no any facing mark, it may face in either direction.



2. Lubricate the piston ring surfaces with engine oil.
3. Check the piston ring rotate smoothly in the piston ring grooves.
4. Use Cr-coating piston ring for cast liner and normal piston ring for steel liner.



1 Cylinder head assembly



<Disassembly steps>

1. Valve stem oil seal
2. Valve

3. Spring seat and spring
4. Spring retainer and cotter key



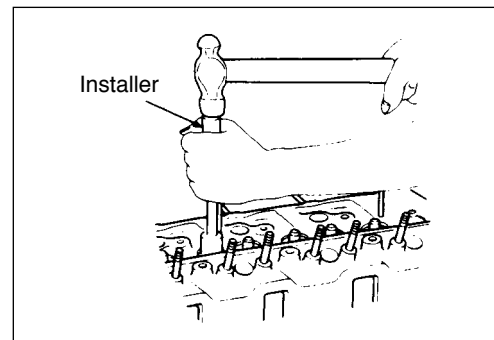
Important operation



1 Valve stem oil seal (1)

Installer

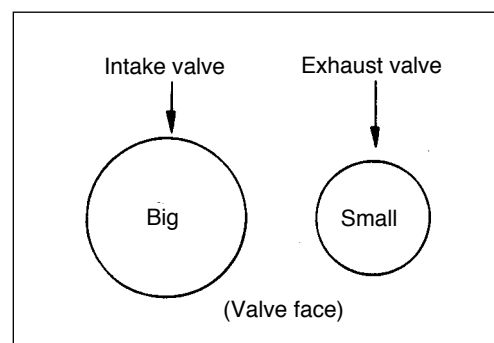
Lubricate the oil seals and valve guides and install the oil seals with an installer.



1 Intake and exhaust valves (2)

1. Lubricate valve stems with engine oil.

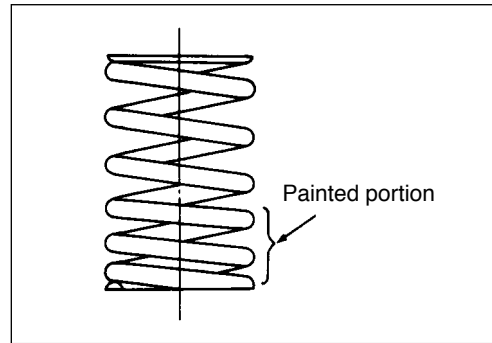
2. Install the valves to the intake and exhaust guides. Install the valves to their original lapped valve seats.





1 Spring seat and spring (3)

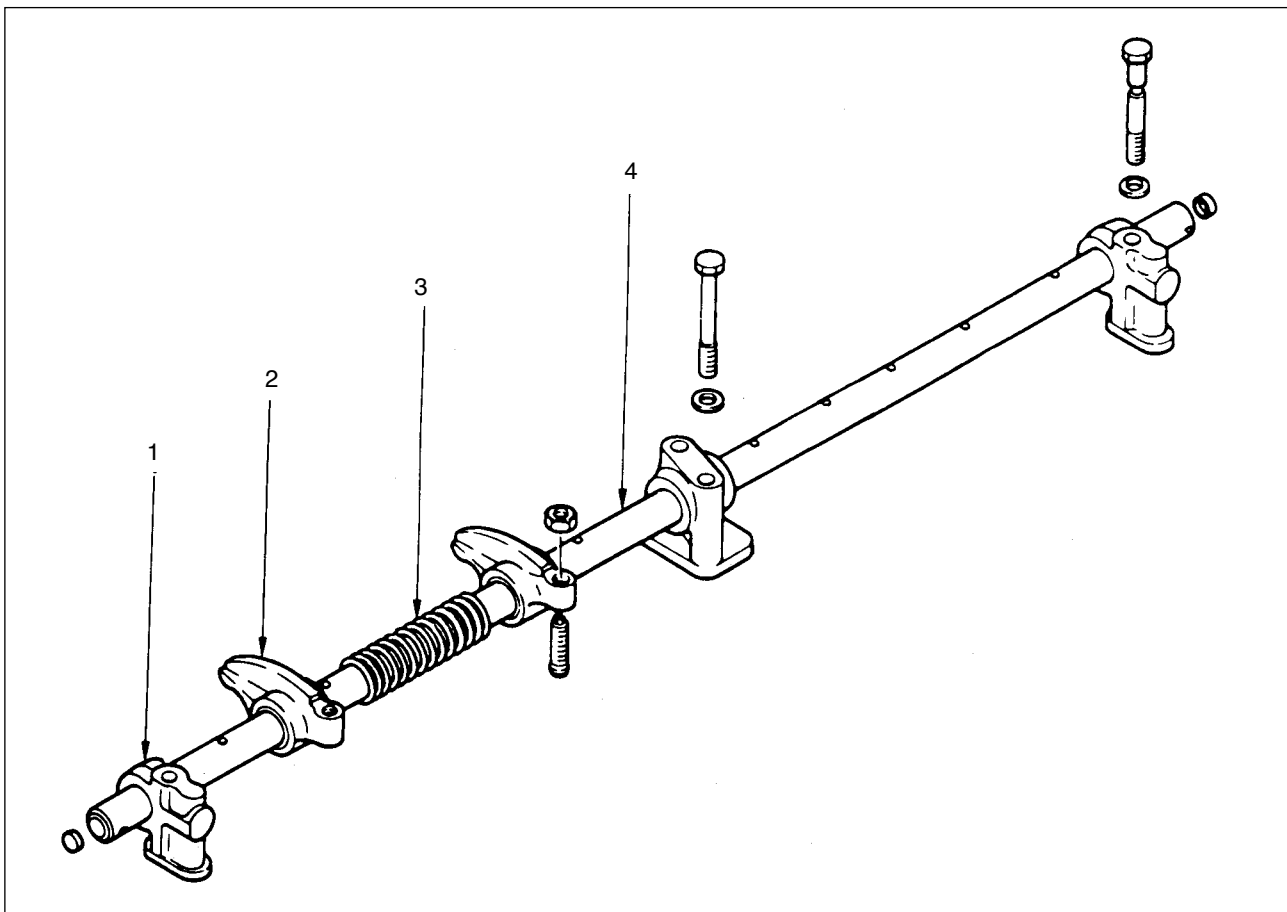
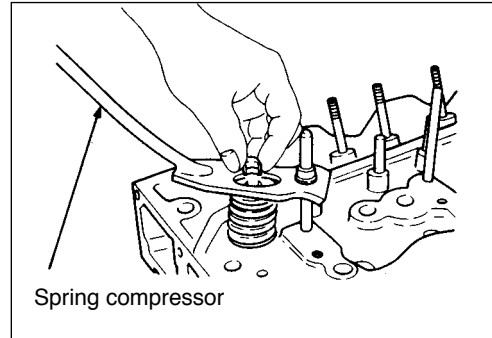
Install the valve springs with their painted end (the close pitched end) facing down.



1 Spring retainer and cotter key (4)

Installer : Spring compressor

- Use a spring compressor to push the valve spring into position.
- Install the cotter key
- Set the cotter key by tapping lightly around the head of the collar with a rubber hammer.



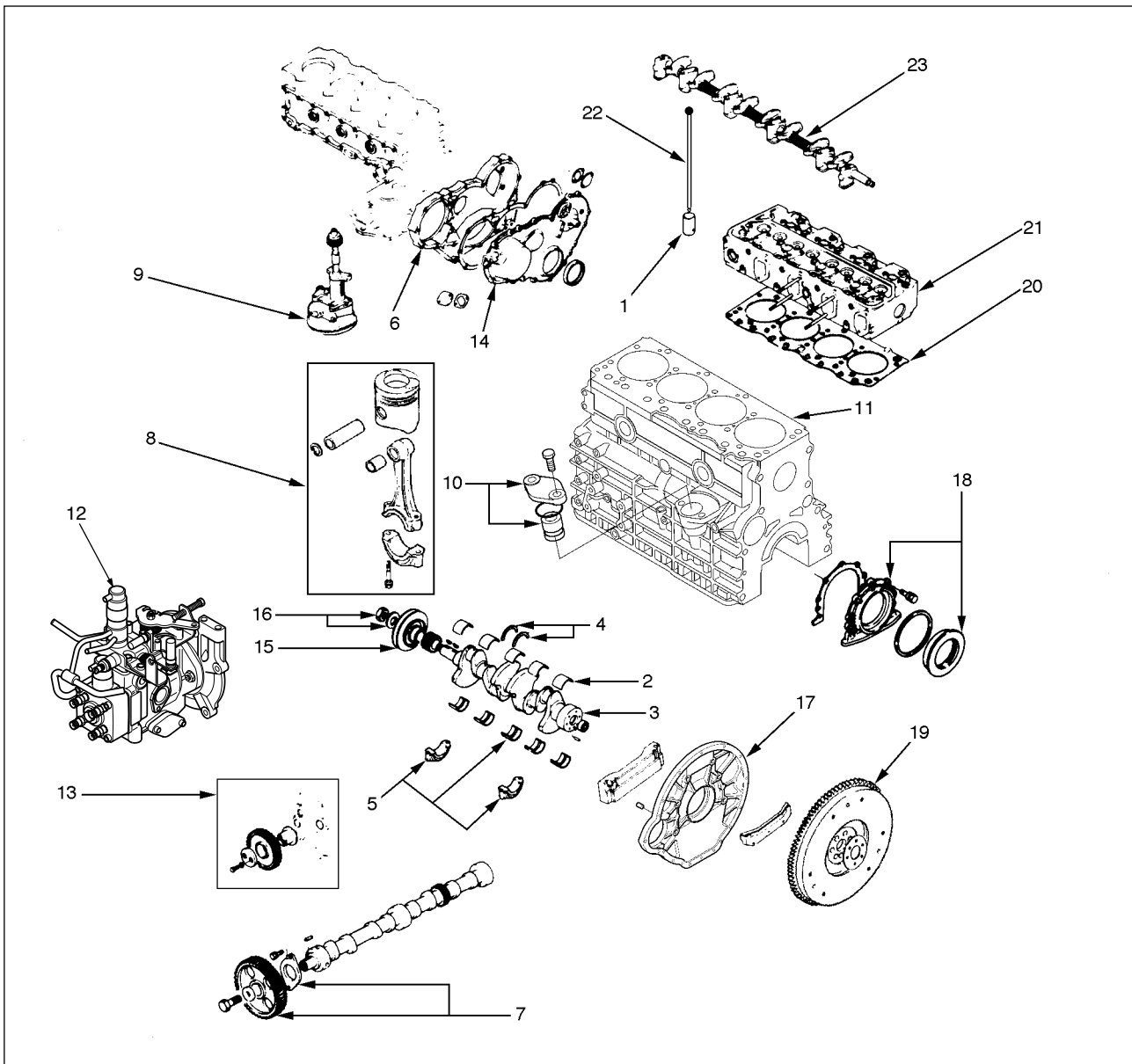
<Disassembly steps>

1. Bracket
2. Rocker arm

3. Spring
4. Rocker arm shaft

2.4.2. Internal Parts

i 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 | |



Important operation



1 Crankshaft bearing (upper) (2)



1 Crankshaft bearing (lower) (5)

Center lower half bearing has no oil groove and oil hole while others all have oil groove and oil hole.



1 Crank shaft (3)

Install the crankshaft so that the crank gear assembled part is directed to the front of the engine.



1 Thrust bearing (4)

Install the thrust bearings with the oil groove side facing the crankshaft contact face.



1 Crankshaft bearing cap

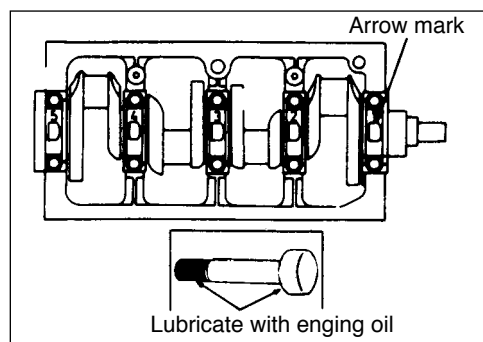
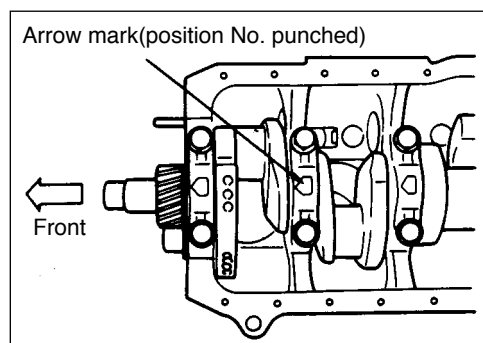
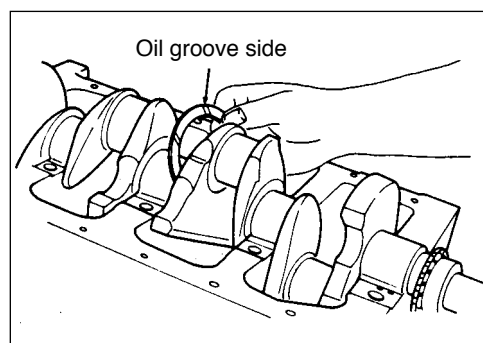
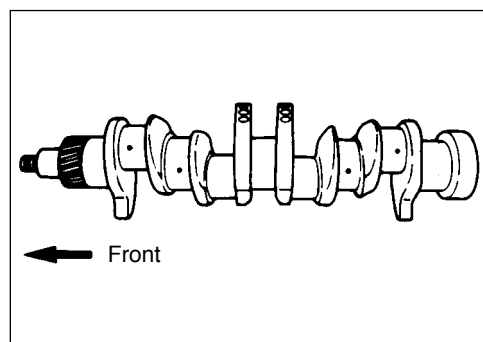
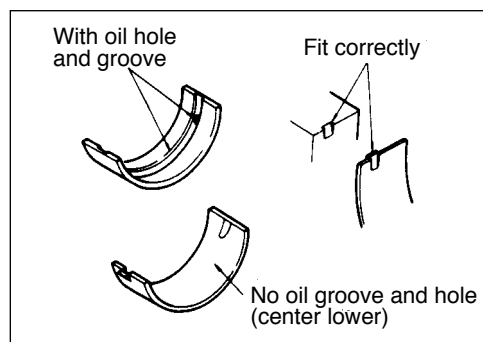
- Lubricate the bearing cap bolts with engine oil
- Install the bearing caps to the crankshaft. The arrow mark must be pointing to the front of the engine.



Tighten the bearing cap bolts to the specified torque a little at a time in the numerical order shown in the figure.

Torque (kgf·m)	24 (173.6 lb _i /ft)
----------------	-----------------------------------

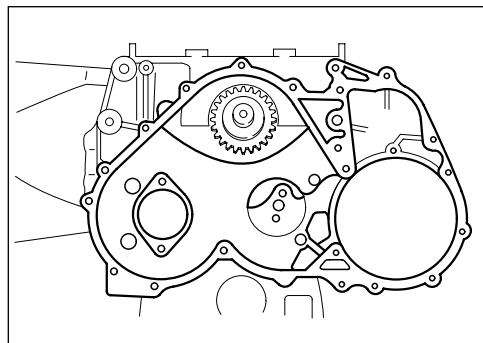
Check that the crankshaft turns smoothly by manually rotating it.





Timing gear case (6)

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

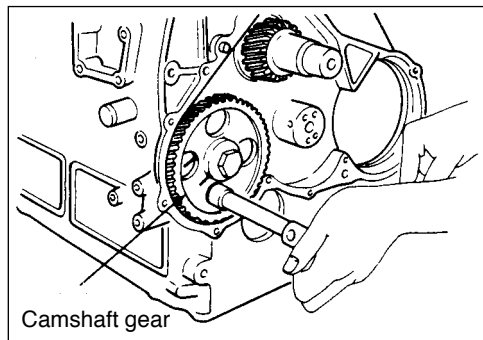


Camshaft (7)

Tighten the thrust plate bolts through the camshaft gear hole.

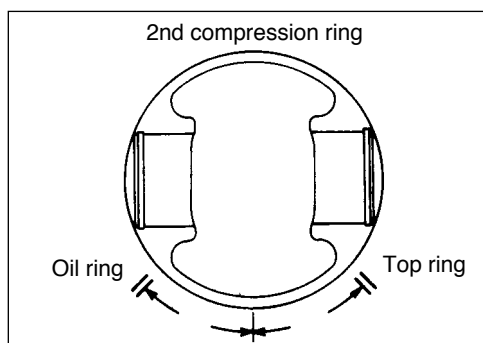
Torque (kgf·m)

Thrust plate bolt	2.1 (15.2 lb _i / ft)
Camshaft gear bolt	16 (115.7 lb _i / ft)

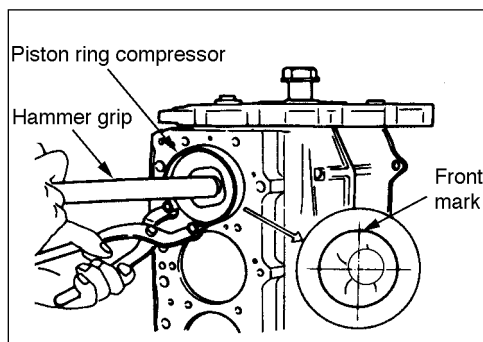


Piston and connecting rod assembly (8)

Position the piston ring gaps as shown in the figure.



Position the piston front mark towards the front of the engine. Use a hammer grip to push the piston in until it makes contact with the crank pin. At the same time, rotate the crankshaft until the crank pin reaches its highest point.



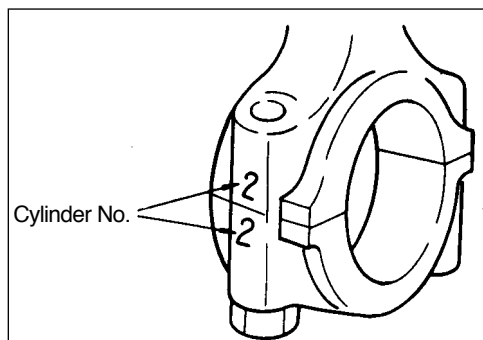
Set the bearing cap cylinder number marks and the connecting-rod cylinder number marks.

The marks must be facing the exhaust manifold.

Connecting rod cap bolt

Bolt head	11	11 12
Torque (kgf·m)	12 ± 0.25 (86.8 ± 1.8 lb _i / ft)	9.75 ± 0.25 (70.5 ± 1.8 lb _i / ft)

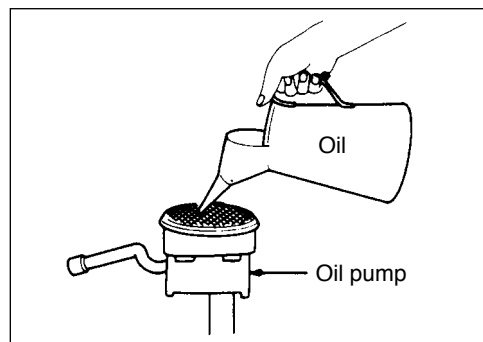
-Lubricate the connecting-rod cap bolt threads and setting faces with MoS grease.





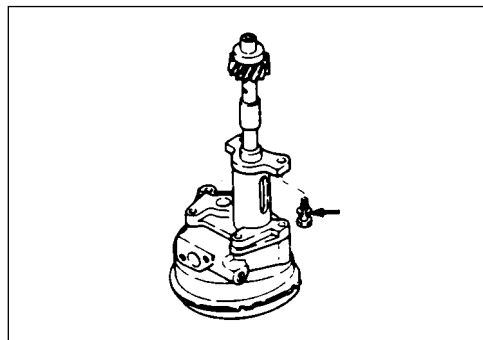
1 Oil pump assembly(9)

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



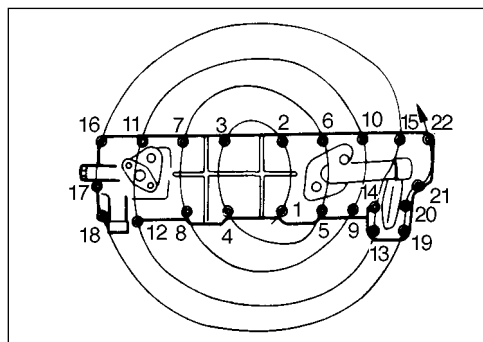
1 Oil pump mounting bolts

Torque (kgf·m)	3.8 (27.5 lb _i /ft)
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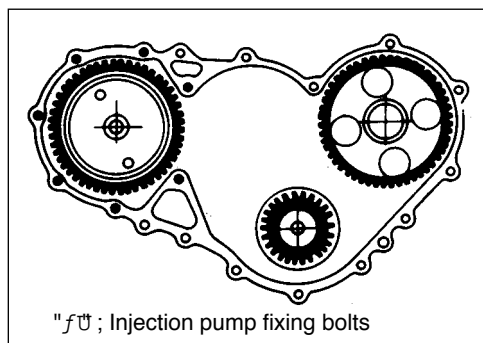
1 Oil cooler(11)

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

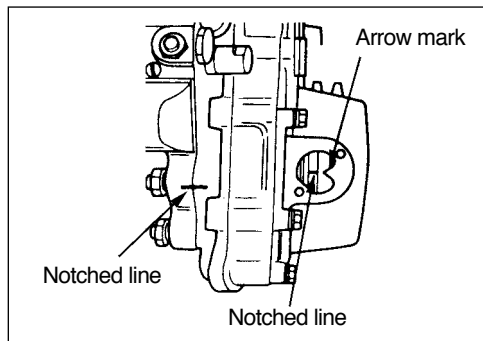


1 Injection pump assembly (12)

Torque (kgf·m)	2.6 (18.8 lb _i /ft)
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Check the punched line of the injection pump body is aligned to the pump bracket line.

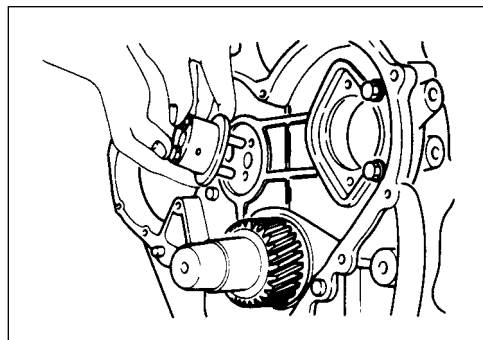




Idle gear(13)

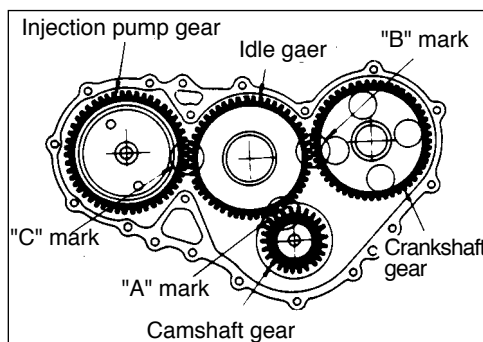
Use the thrust collar fixing bolt as a guide to install the idler gear shaft.

The oil port must be facing the camshaft.



Set the timing marks (A,B,C) as shown in the figure.

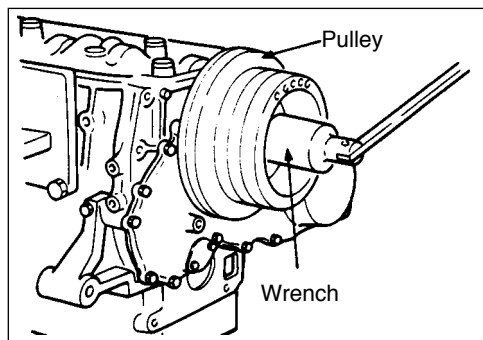
Idle gear bolt Torque (kgf \cdot m)	2.6 (18.8 lb \cdot ft)
--	-----------------------------



Crankshaft front nut (16)

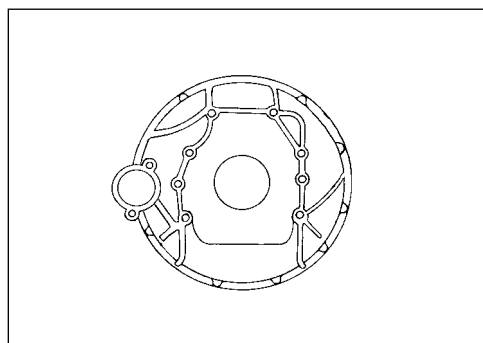
Wrench : 41 mm

Torque (kgf \cdot m)	2.6 (18.8 lb \cdot ft)
------------------------	-----------------------------



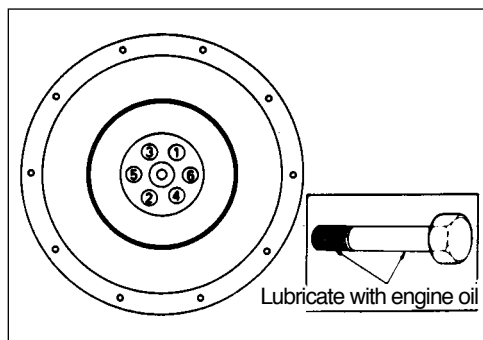
Flywheel housing (17)

Fixing bolts torque 14kgf \cdot m (101.25 lb \cdot ft)



Flywheel (19)

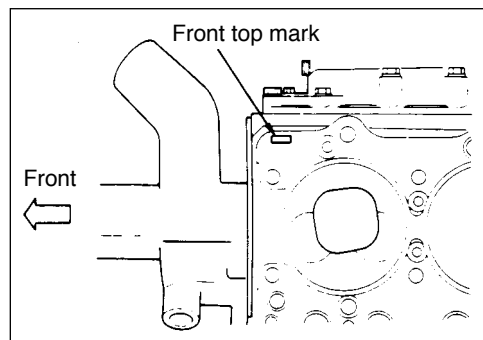
Torque (kgf \cdot m)	16.0 (115.7 lb \cdot ft)
------------------------	-------------------------------





i Cylinder head gasket (20)

The gasket "TOP" mark must be facing up and "FRONT" mark is towards the front of the engine.



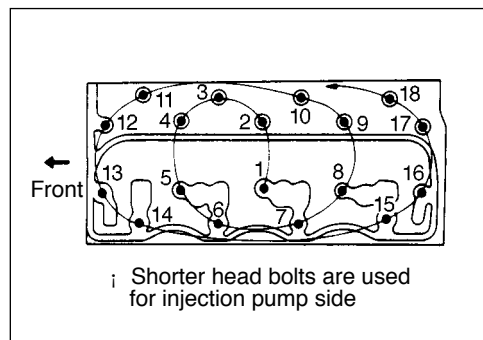
i Cylinder head assembly (21)

Carefully place the cylinder head on the cylinder body. Lubricate the head bolts and contact face of the cylinder head.



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

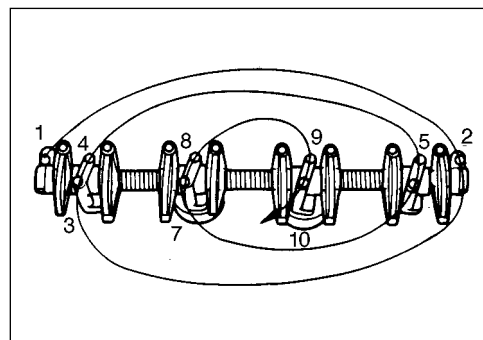
1st step	2nd step
7.0 (50.6 lb _i /ft)	11.5 (83.2 lb _i /ft)



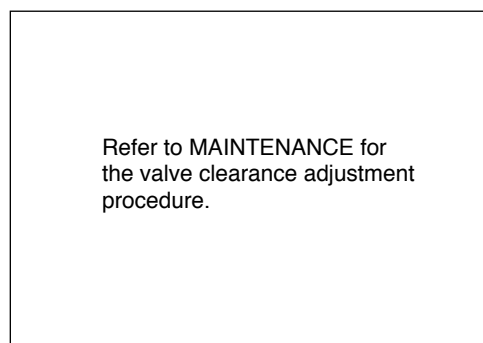
i Rocker arm shaft assembly (23)

Tighten the rocker arm bracket bolts to the specified torque a little at a time in the numerical order shown in the figure.

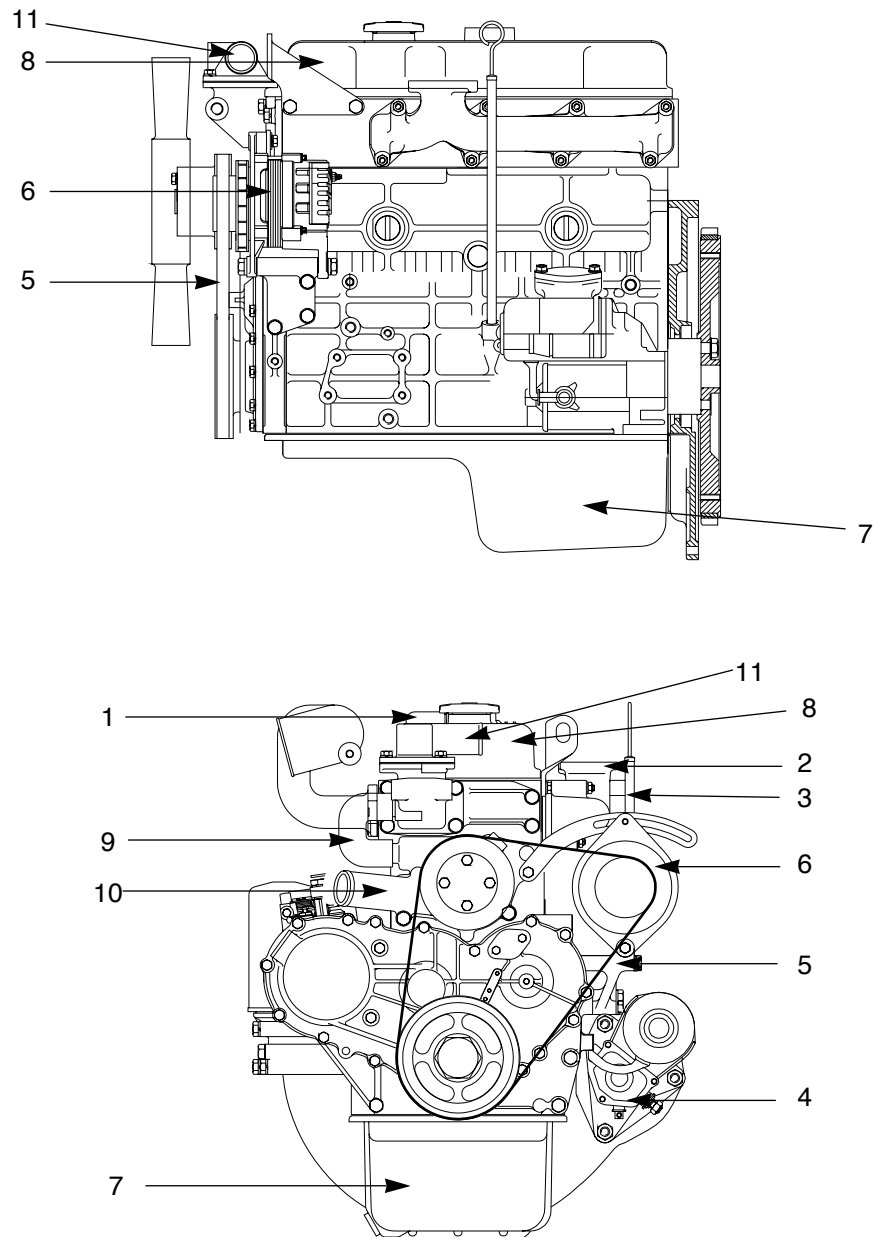
Torque (kgf·m)	3.1 (22.4 lb _i /ft)
----------------	-----------------------------------



Adjust the valve clearance



2.4.3. External parts (A)



<Disassembly steps>

1. Breather hose
2. Exhaust manifold
3. Oil guide tube and level gauge
4. Starter
5. Cooling fan belt
6. Alternator

7. Oil pan
8. Cylinder head cover
9. Rubber hose
10. Water pump
11. Thermostat housing assembly



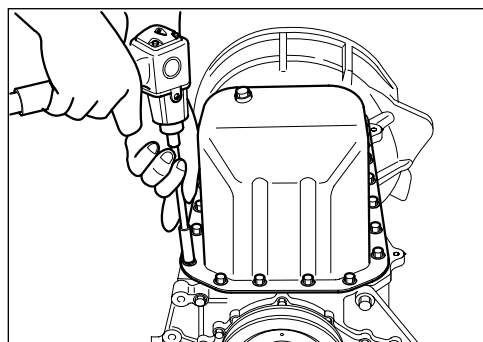
Important operation



1 Oil pan (1)

- Apply liquid gasket to the cylinder block and oil pan.
- Install oil pan gasket and oil pan.

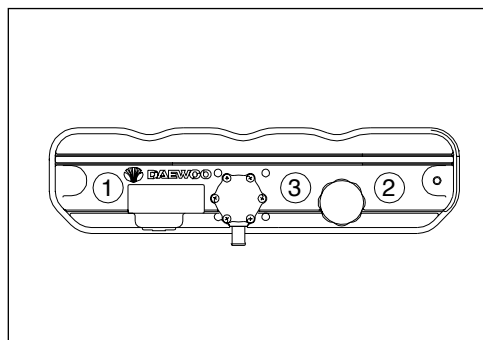
Bolt torque (kgf·m)	1.6 (11.6 lb _i /ft)
---------------------	-----------------------------------



2 Cylinder head cover (2)

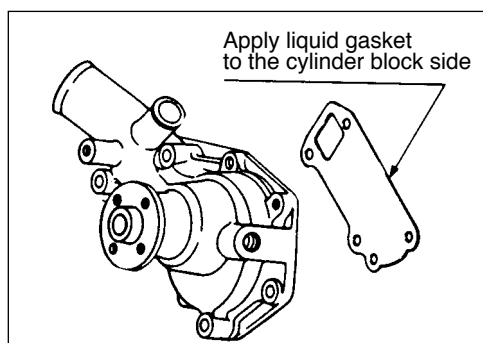
Bolt torque (kgf·m)	2.1 (15.2 lb _i /ft)
---------------------	-----------------------------------

Tighten the bolts as shown in the figure.



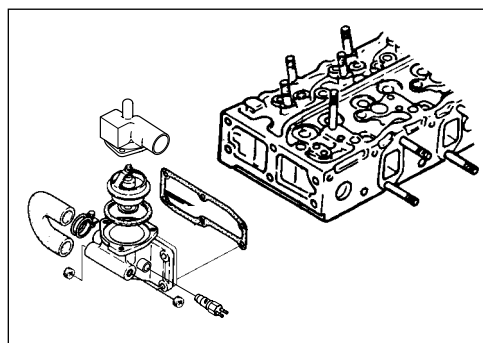
3 Water pump assembly (3)

Apply liquid gasket(belco bond No. 4) to the water pump gasket before installing the water pump.



5 Thermostat housing assembly (5)

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





1 Cooling fan belt (13)

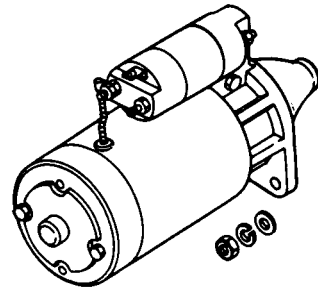
Adjust the cooling fan belt tension.

Refer to Maintenance for
the fan bolt tension adjustment



1 Starter motor (9)

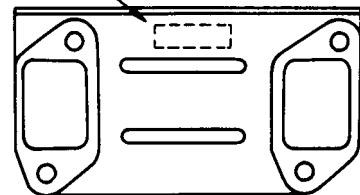
Torque (kgf·m)	8.6 (62.2 lb _i /ft)
----------------	-----------------------------------



1 Exhaust manifold (11)

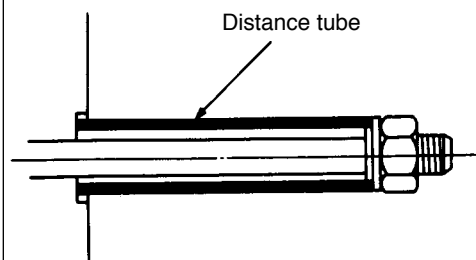
Carefully install the gasket with the "TOP" mark side facing up.

"TOP" mark



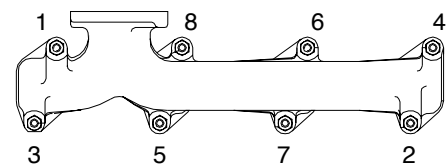
Install either end of the distance tube in the spot facing.

Distance tube

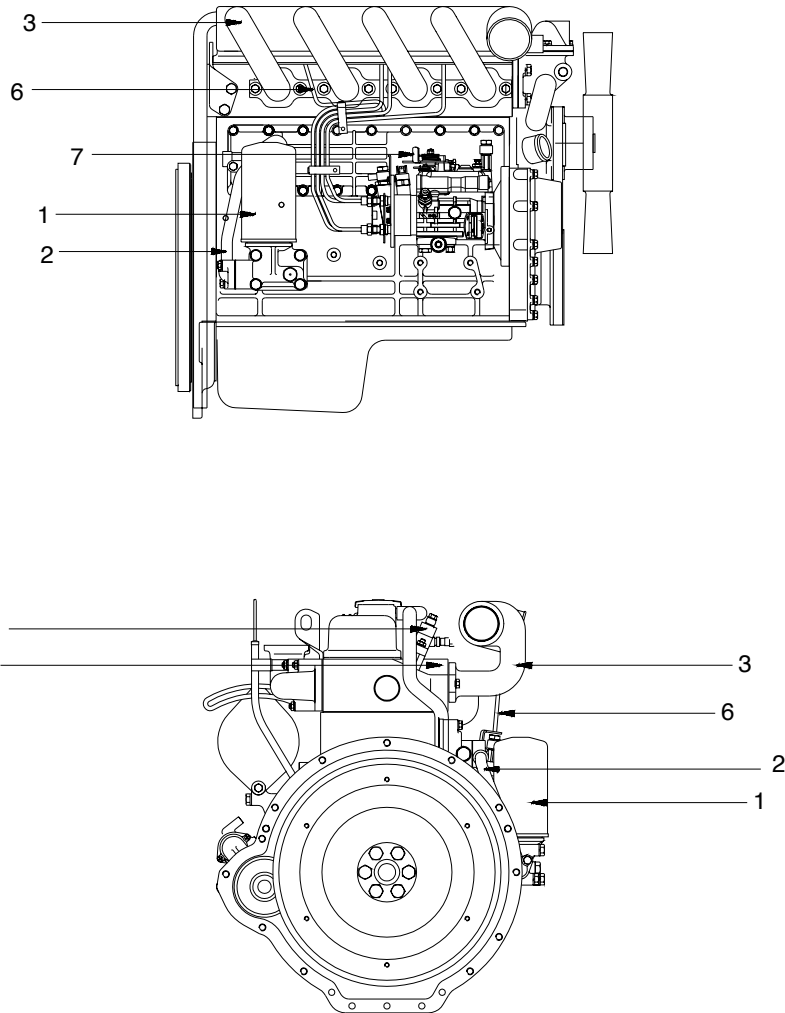


Tighten the exhaust manifold and gasket fixing bolts in numerical order as shown in the figure.

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



2.4.4. External Parts (B)



<Disassembly steps>

1. Oil filter and bracket
2. Oil pipe
3. Intake manifold
4. Glow plug

5. Injection nozzle
6. Injection pipe
7. Engine control lever

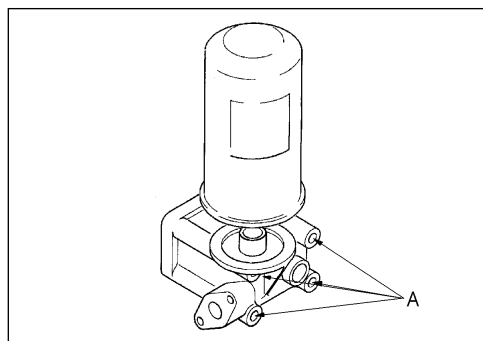


Important operation



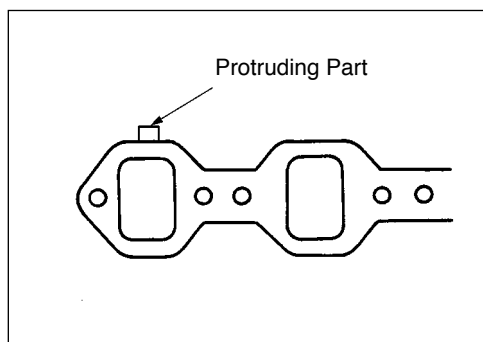
1 Main oil filter and bracket (1) (kgf·m)

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



3 Intake manifold assembly (3)

Install the gasket with its protruding part facing up.



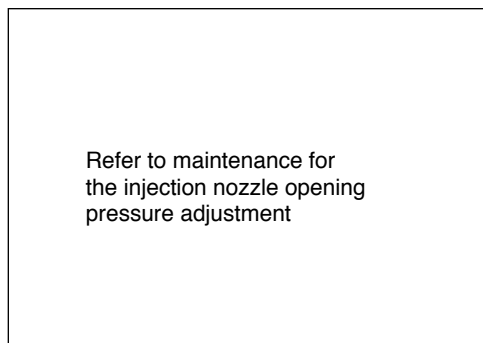
4 Glow plug (4)

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



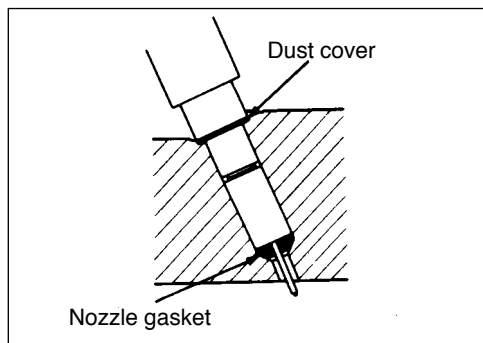
5 Injection nozzle (5)

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)
----------------	-----------------------------------





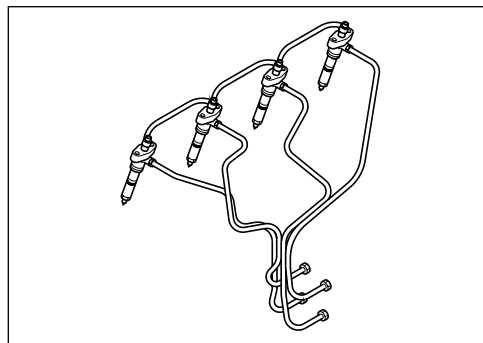
i Fuel injection pipe (6)

Torque (kgf·m)	3.0 (21.7 lb _i /ft)
----------------	-----------------------------------

Delivery valve holder must be tightened as specified torque.

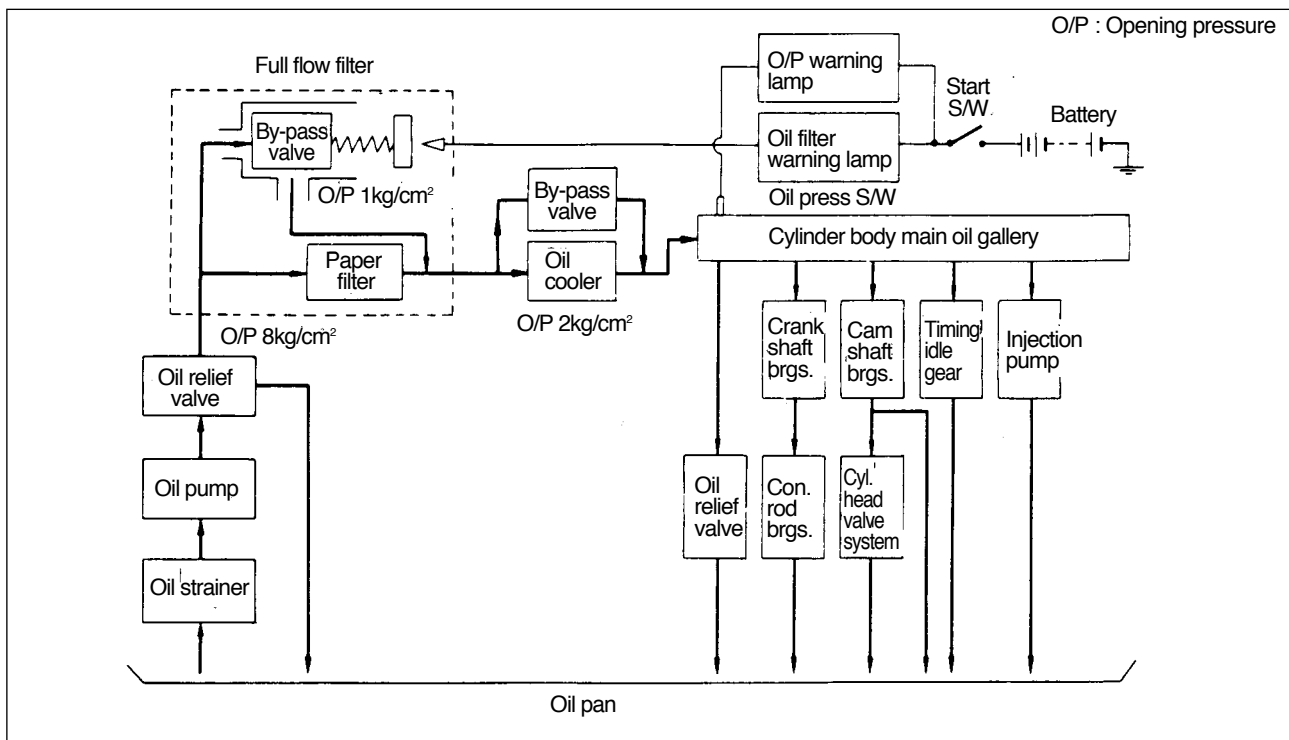
Excessive torque causes leakage at control rack and pipe.

Delivery valve Holder torque (kgf·m)	4.0~4.5 (28.9~32.5 lb _i /ft)
---	--



3. Lubricating System

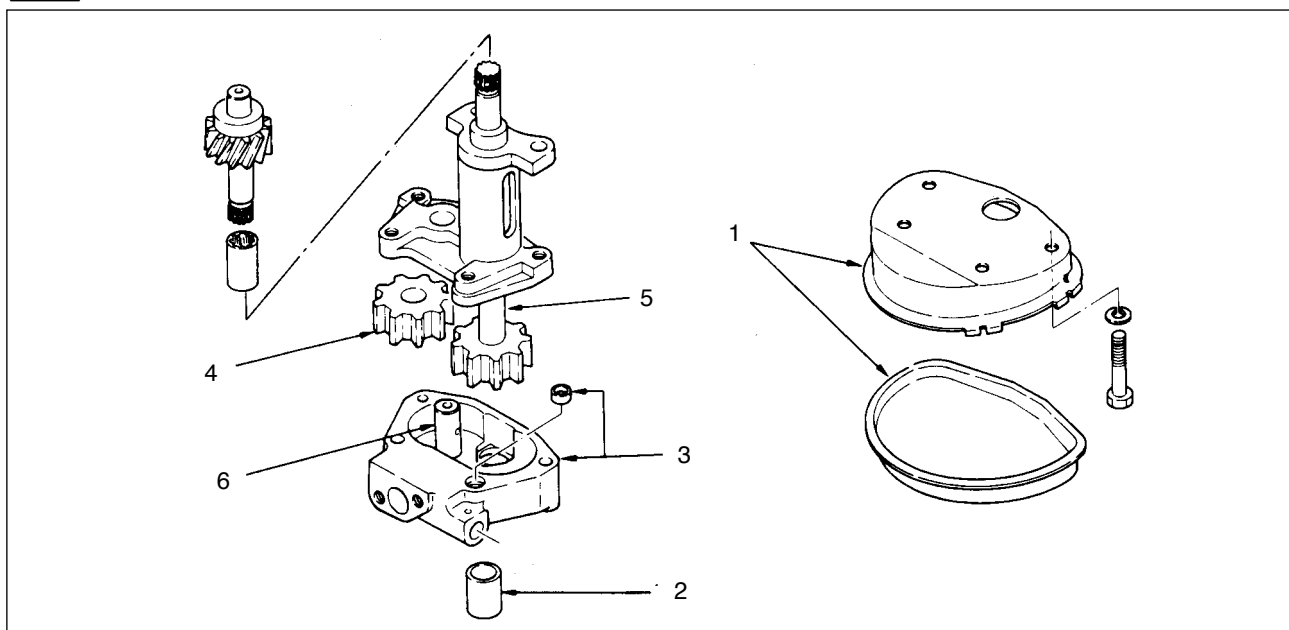
3.1. General Description



3.2. Oil Pump



Disassembly



<Disassembly steps>

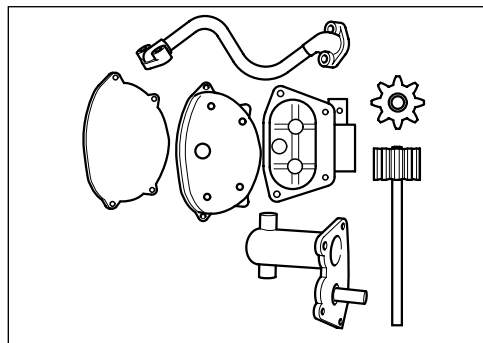
- | | | |
|-----------------|--------------------|-------------------------|
| 1. Strainer | 3. Cover and dowel | 5. Drive shaft and gear |
| 2. Suction pipe | 4. Drive gear | 6. Driven gear shaft |



Inspection and repair

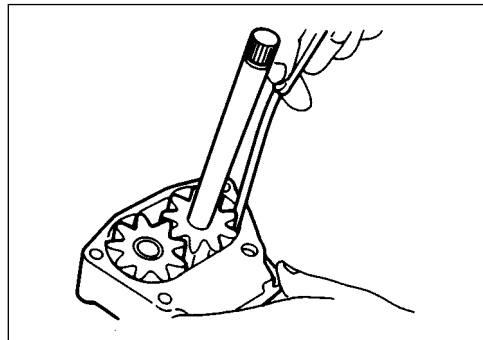
Make the necessary adjustments, repairs and part replacements if excessive wear or damage is found through inspection.

Visually inspect the disassembled parts for excessive wear and damage.



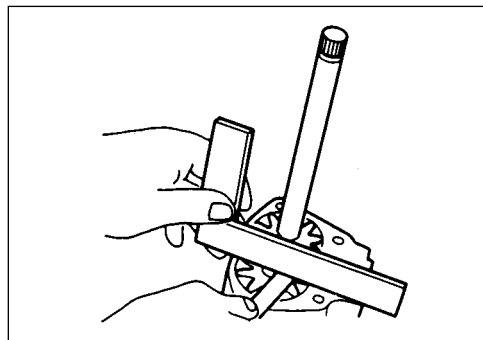
Oil pump cover and oil pump drive gear clearance.

Limit (mm)	0.18 (.007 in)
------------	-------------------



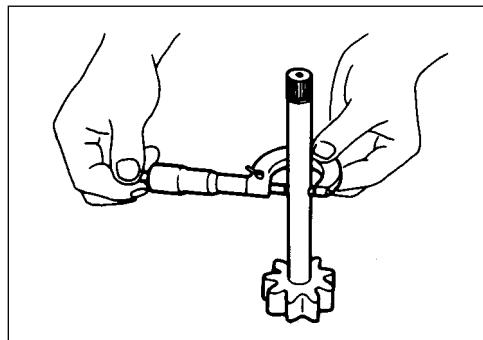
Cover and driven gear clearance

Limit (mm)	0.12 (.005 in)
------------	-------------------



Drive gear shaft diameter (mm)

Standard	Limit
16.0	15.9 (.626 in)





Reassembly

To Assemble, follow the disassembly procedures in reverse order.

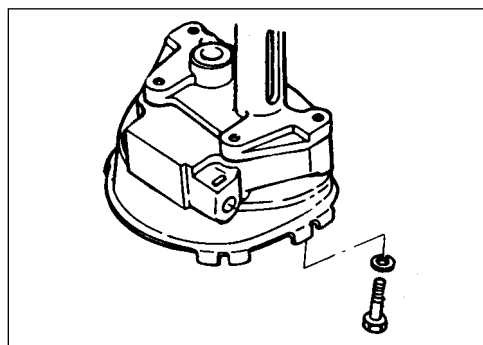


Important operation



Strainer (1)

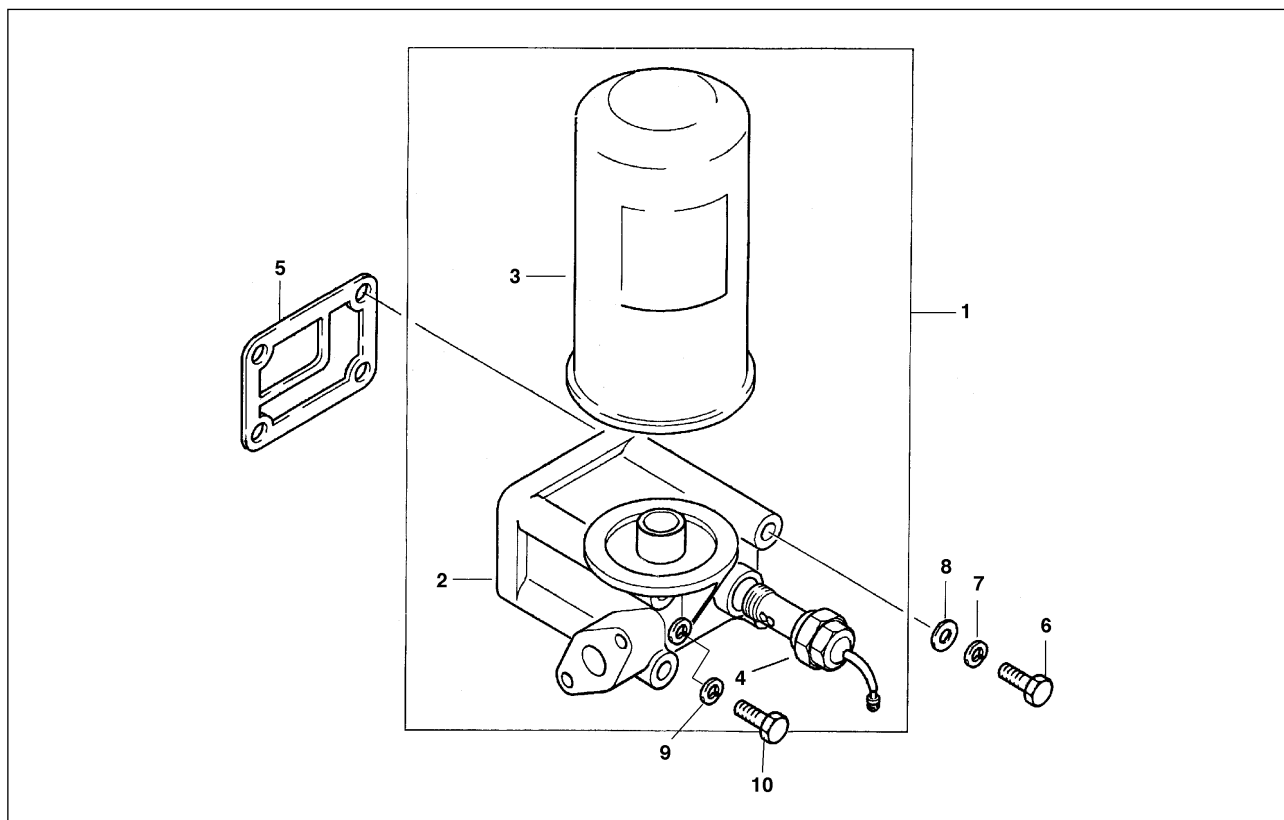
Torque (kgf·m)	1.0 i > 1.8 (7.233~13.0 lb _i / ft)
----------------	--



3.3. Oil Filter



Disassembly



<Disassembly steps>

1. Oil filter ass'y

2. Head-oil filter

3. Element-oil filter

4. Relief valve ass'y

5. Gasket

6. Bolt

7. Spring washer

8. Plain washer

9. O-Ring

10. Plug-screw



Inspection and repair

Make the necessary adjustments, repairs and part replacements if excessive wear or damage is found through inspection.



Reassembly

To reassemble follow the disassembly procedures in reverse order.

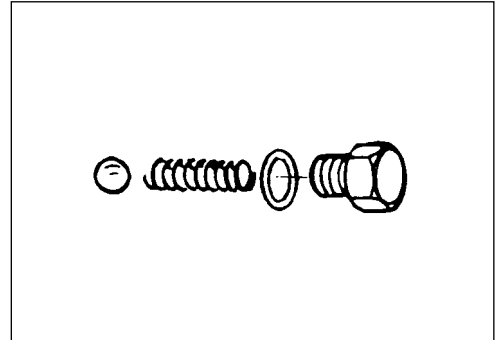


Important operation



i Relief Valve (1)

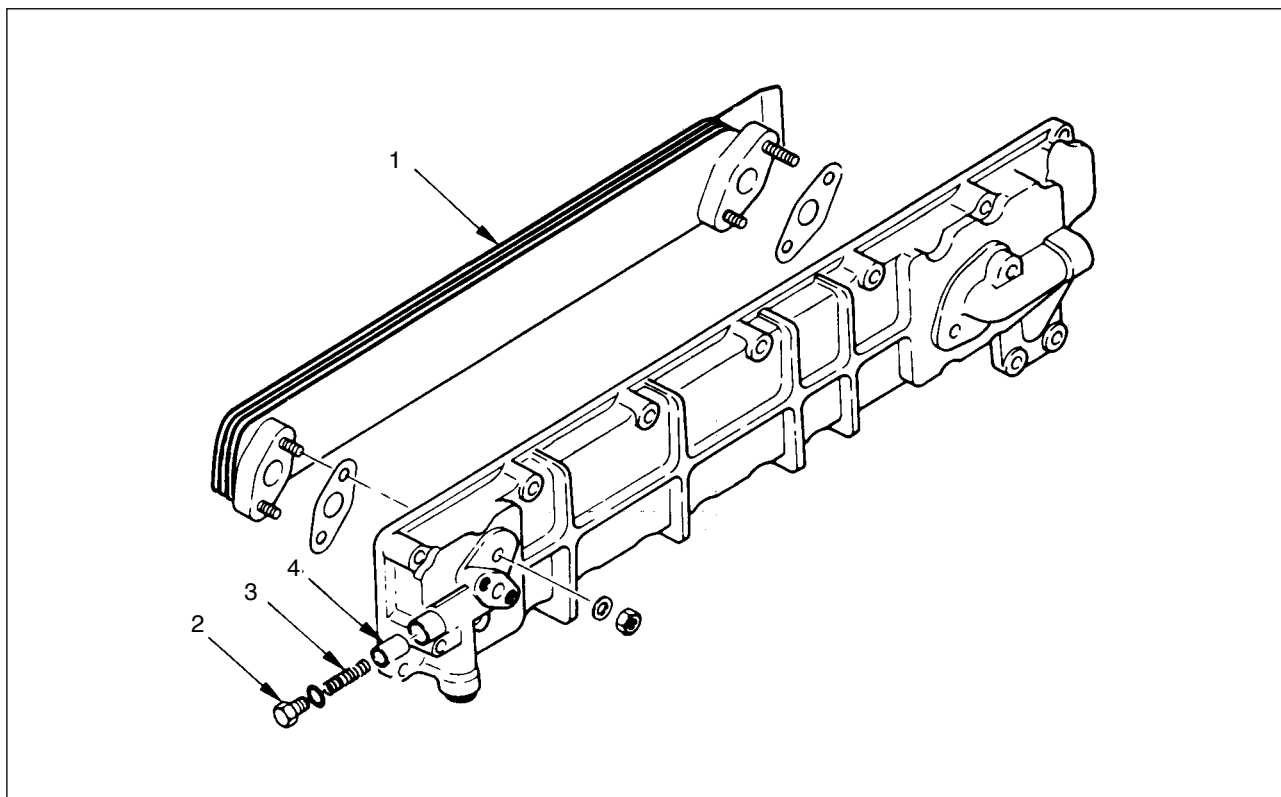
Torque (kgf·m)	2.5 (18.1 lb _i /ft)
----------------	-----------------------------------



3.4. Oil Cooler



Disassembly



<Disassembly steps>

1. Element
2. Bolt

3. Spring
4. By-pass valve



Inspection and repair

Make the necessary adjustments, repairs and part replacements if excessive wear or damage is found through inspection.



Reassembly

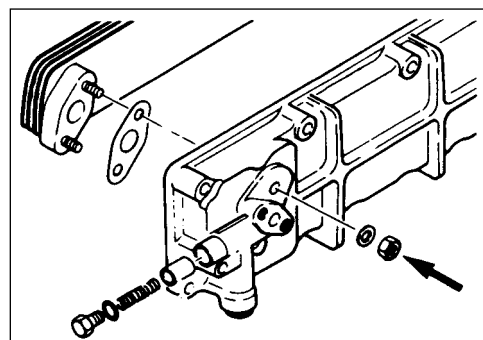
To reassemble follow the disassembly procedures in reverse order.



Important operation

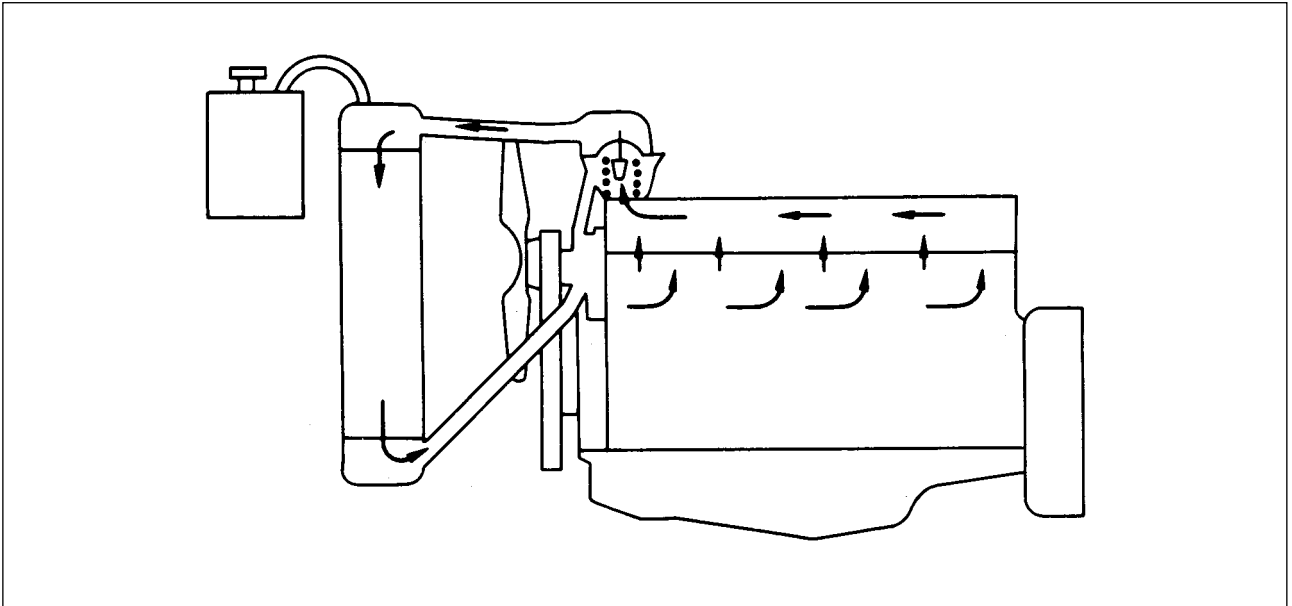
i Element (1)

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



4. Cooling System

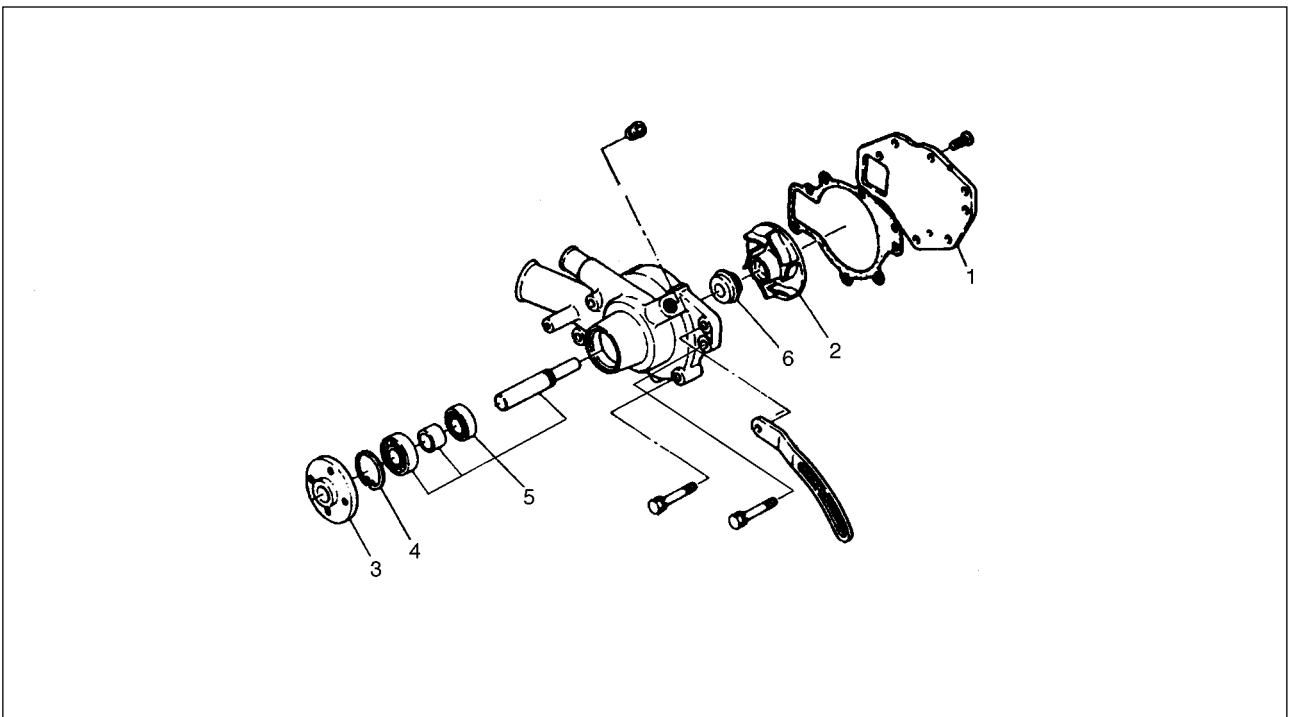
4.1. General Description



4.2. Water Pump



Disassembly



<Disassembly steps>

1. Cover
2. Impeller

3. Center-Fan
4. Snap ring

5. Shaft bearing and spacer
6. Seal unit, washer and seal

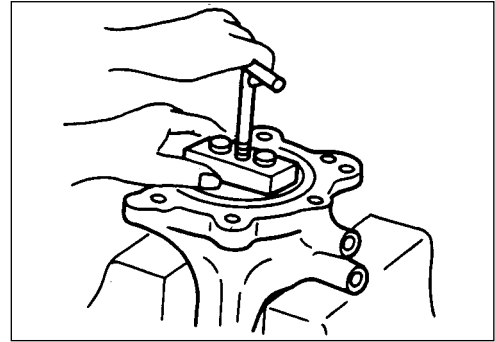


Important operation



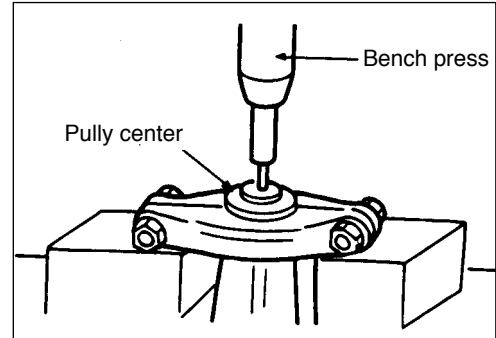
Impeller (2)

Removal : Remover



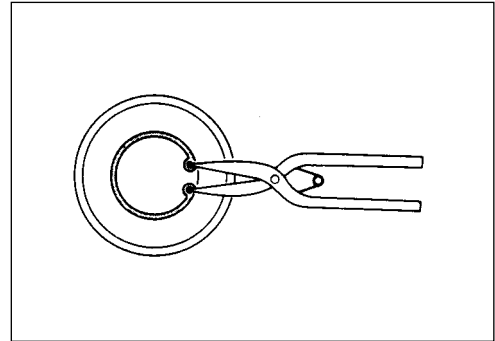
Pulley center (3)

Remove the pulley center using a bench press and a bar.



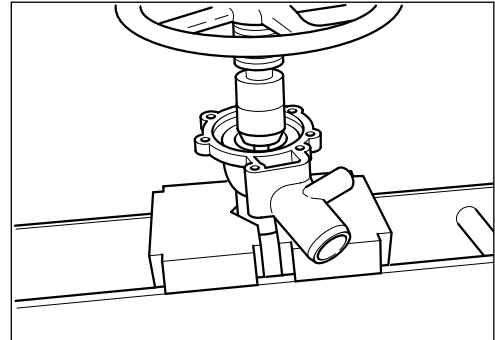
Snap ring (4)

Remove the snap ring using a snap ring plier.



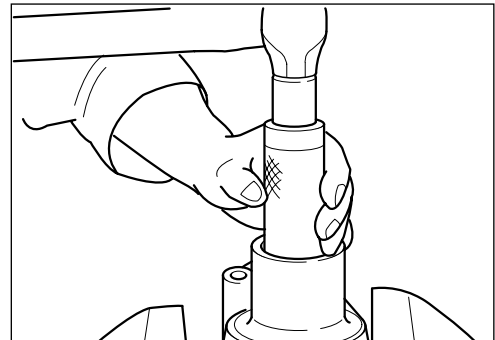
Shaft, bearing and spacer (5)

Remove the shaft and bearings using a bench press and suitable remover.



Seal unit, Washer and seal (6)

Remove the seal unit using a bench press and suitable remover.





Inspection and repair

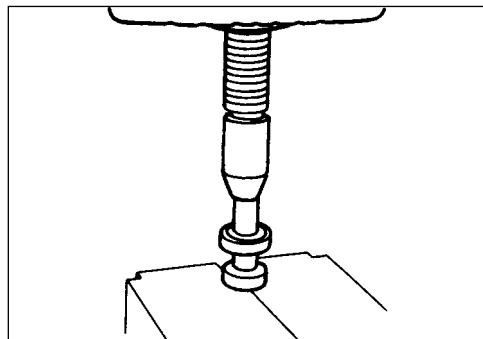
Make the necessary adjustments, repairs and part replacements if excessive wear or damage is found through inspection.

Bearing replacement



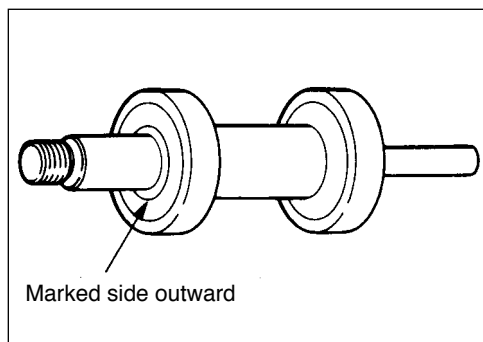
Removal ;

Use a bench press



Assembly

Use a bench press to install two bearings with a marked side outward.



Reassembly

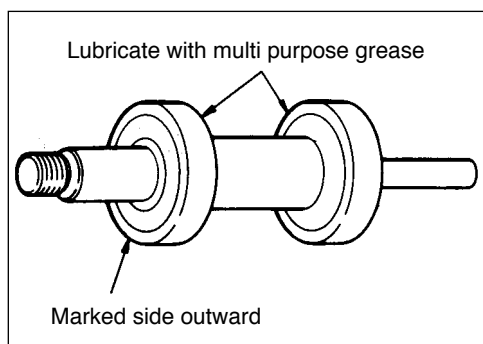
To assemble, follow the disassembly procedures in reverse order.



Important operation

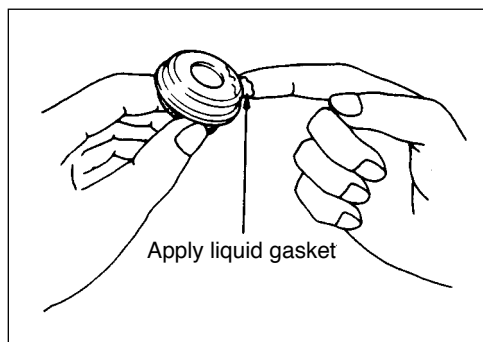
1 Shaft, bearing and spacer (5)

Lubricate the bearing with multi-purpose grease.



1 Washer, seal and seal unit (6)

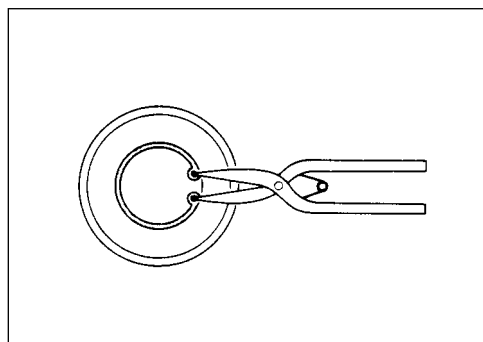
Apply a thin coat of liquid gasket(Belco bond No. 4) to the seal unit outer periphery before installation.





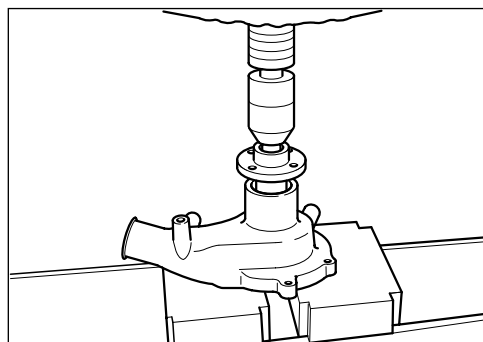
1 Snap ring (4)

Install the snap ring using a snap ring plier.



1 Pulley center (5)

Install the pulley center using a bench press.

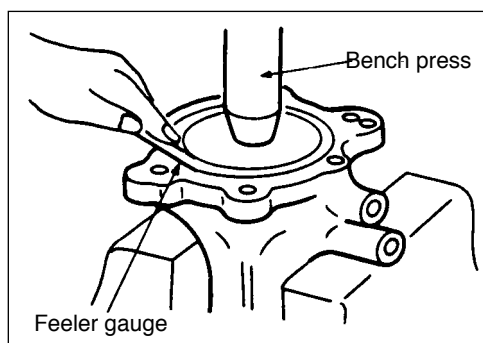


1 Impeller (2)

Install the impeller to the shaft using a bench press.

Use a feeler gauge to measure the clearance between the impeller and the pump body.

Standard (mm)	0.3 ~ 0.8 (.012 ~ .031 lb /ft)
---------------	-----------------------------------



4.3. Thermostat



Inspection and repair

Make the necessary adjustments, repairs and part replacements if excessive wear or damage is found through inspection.

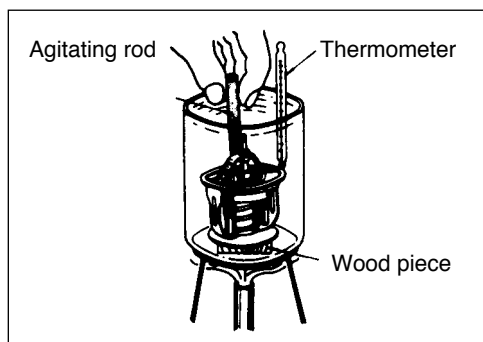


Valve opening temperature

Standard (°C)	80 ~ 84 (176°F ~ 183°F)
---------------	----------------------------

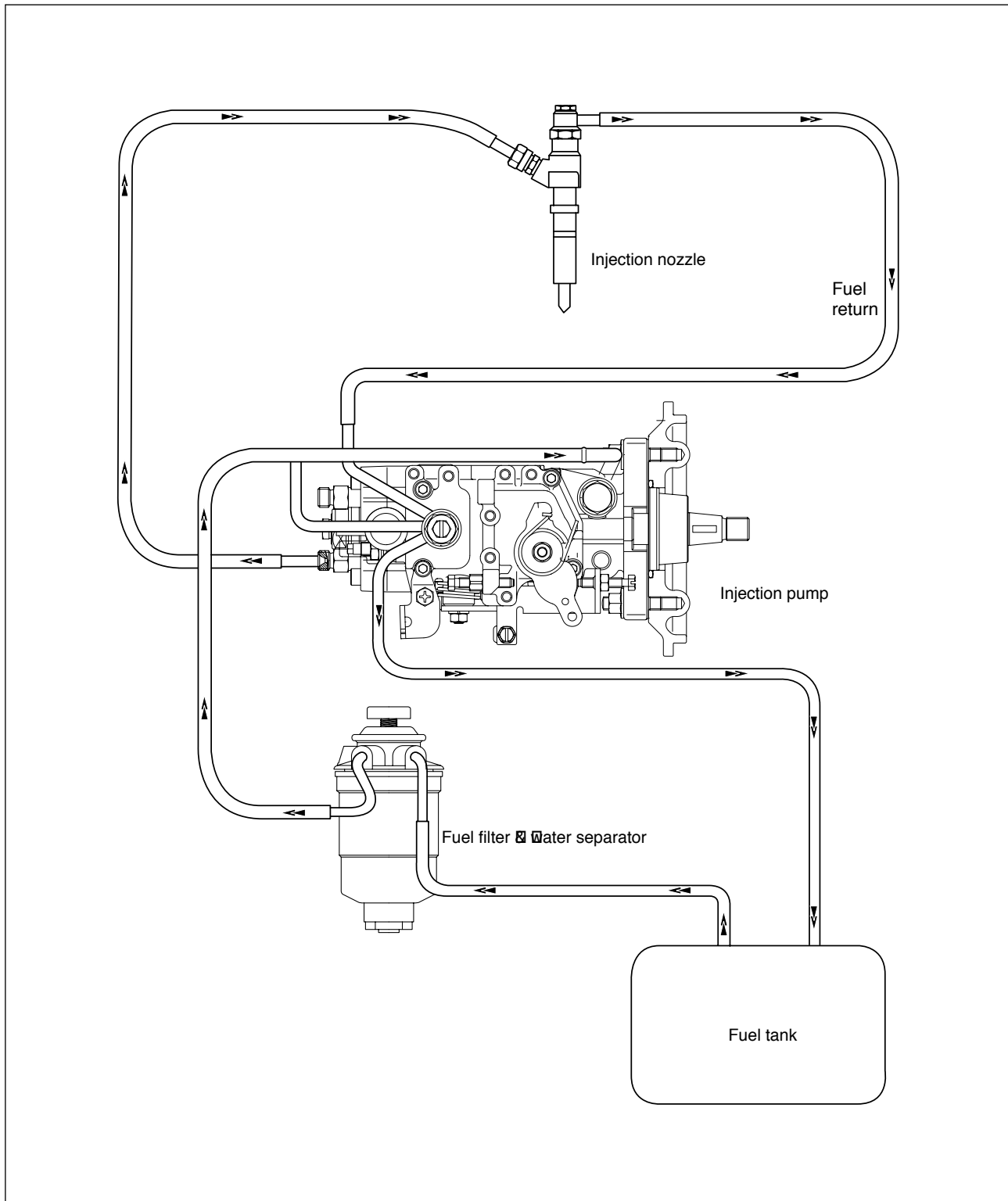
Valve lift(at testing temperature)

Standard	approx. 10 mm (at 95°C) (.393 in (at 203°F))
----------	---



5. Fuel System

5.1. General Description



5.2. Fuel Filter



Inspection and repair

Make the necessary adjustments, repairs and part replacements if excessive wear or damage is found through inspection.



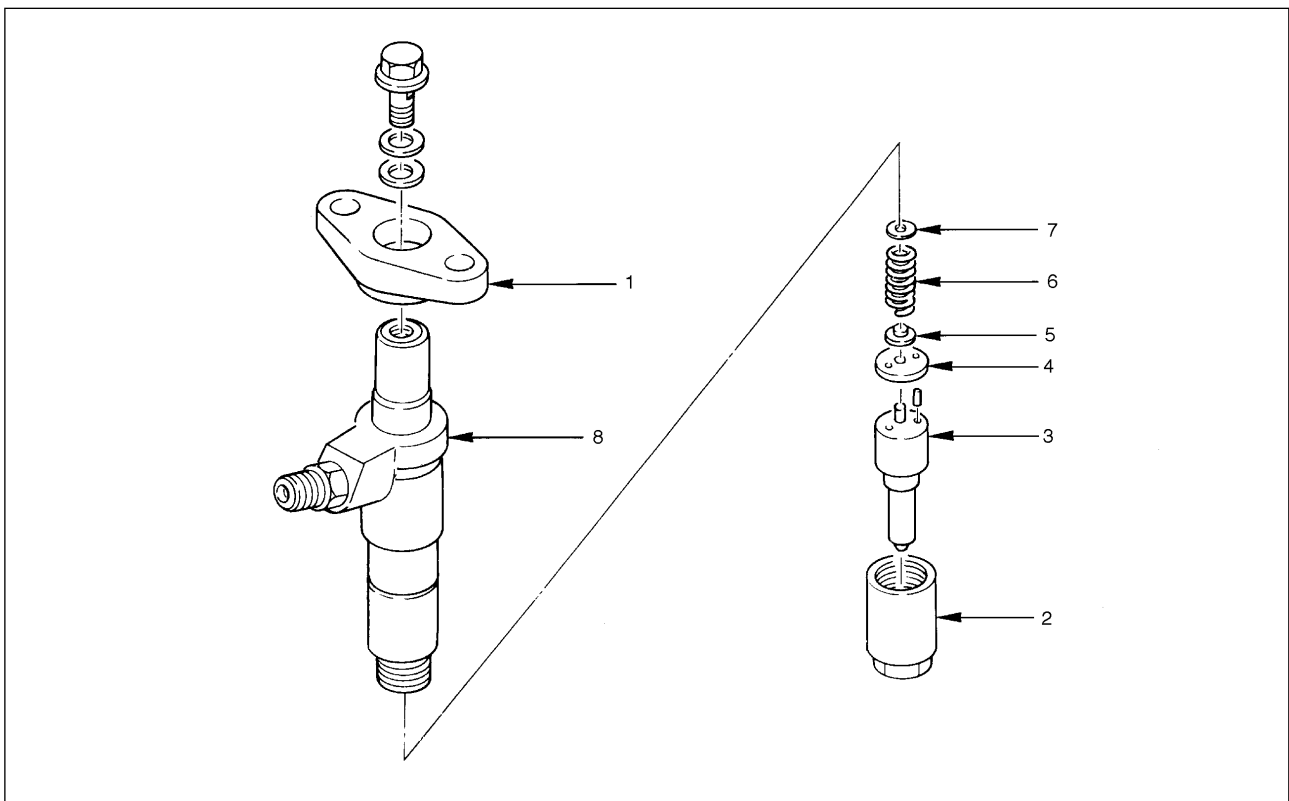
Reassembly

To assemble, follow the disassembly procedures in reverse order.

5.3. Injection Nozzle



Disassembly



<Disassembly steps>

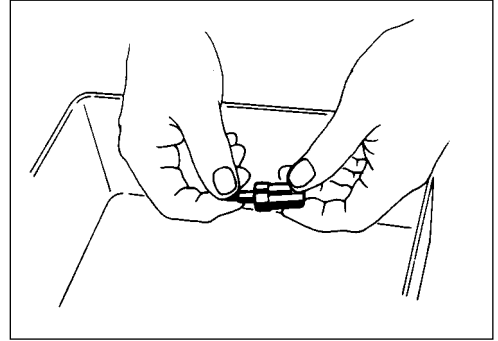
- | | | |
|---------------------|------------------|-----------------------|
| 1. Plunger | 4. Spacer | 7. Adjust shim |
| 2. Retaining nut | 5. Spring seat | 8. Nozzle holder body |
| 3. Injection nozzle | 6. Nozzle spring | |



Important operation

1 Injection nozzle (3)

Remove the nozzle assembly from the nozzle body.
Keep the parts separately to maintain the proper
needle valve to body combination.



Inspection and repair

Make the necessary adjustments, repairs and part
replacements if excessive wear or damage is found
through inspection.



Reassembly

To assemble, follow the disassembly procedures in
reverse order.

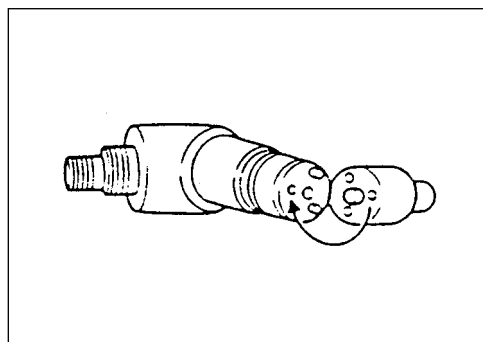


Important operation



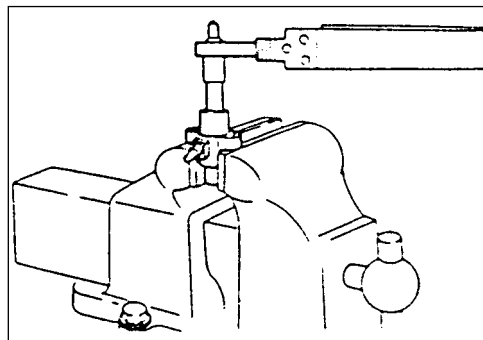
1 Injection nozzle (3)

Align the nozzle dowel pin with the dowel hole in the nozzle holder body.



1 Retaining nut (2)

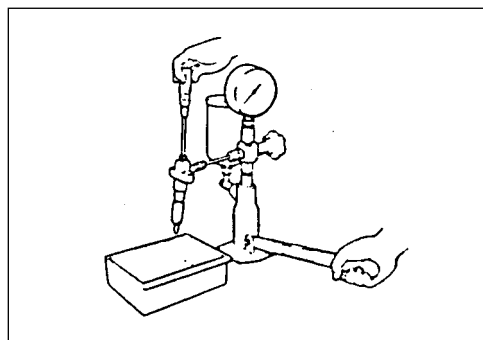
Torque (kgf·m)	6~8 (43.4~57.9 lb _f ·ft)
----------------	---




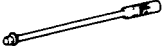
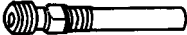

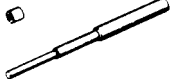

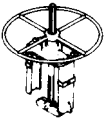


1 Adjust shim (7)



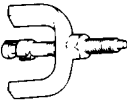

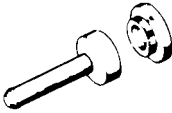



The injection nozzle injection starting pressure can be adjusted after the adjusting shim is installed.

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



6. Special Tool List

No.	Figure	Tool name
1.		Cylinder head bolt wrench
2.		Injection pump
3.		Compression gauge adapter
4.		Valve spring compressor
5.		Valve guide remover and installer
6.		Camshaft bearing remover and installer
7.		Cylinder remover
8.		Cylinder liner remover angle
9.		Cylinder liner installer

No.	Figure	Tool name
10.		Crankshaft gear remover
11.		Crankshaft gear installer
12.		Crankshaft pilot bearing remover
13.		Crankshaft rear oil seal installer
14.		Crankshaft front oil seal installer
15.		Valve stem oil seal installer
16.		Piston ring compressor
17.		Water pump impeller remover