KOBELCO

SERVICE MANUAL

MITSUBSHI DIESEL ENGINE

6D3

(For industrial use)

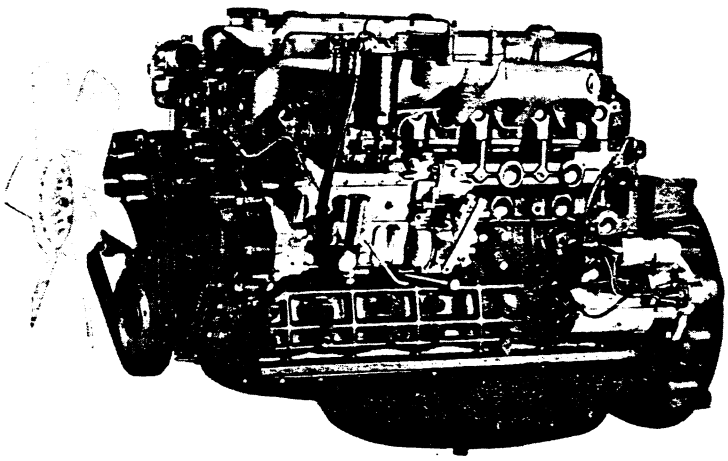
Applicable Machine: K907LC II

97821-04000-00 05/86

1. EXTERNAL VIEW

1.1 EXTERNAL VIEW PHOTOGRAPHS

6D31 Model



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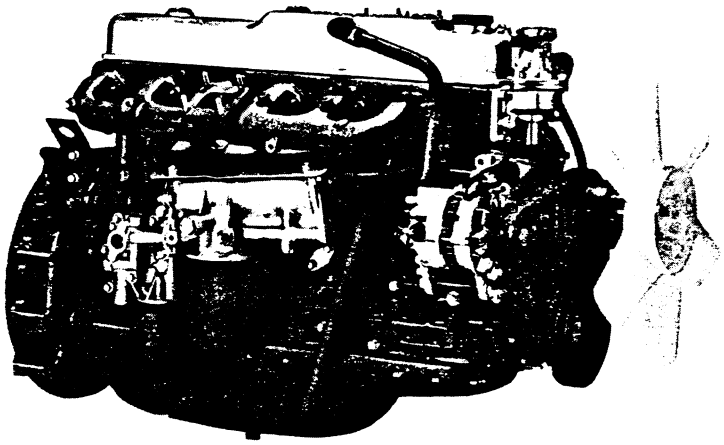

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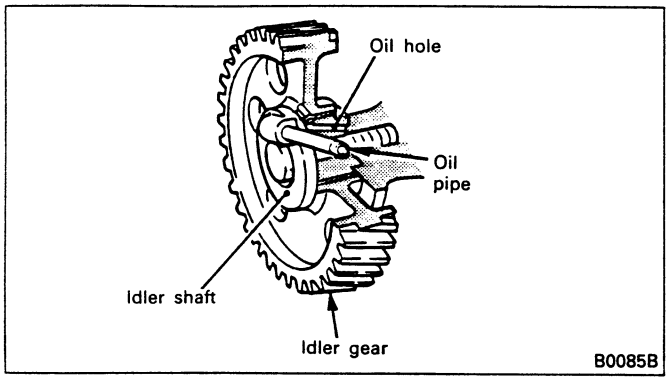
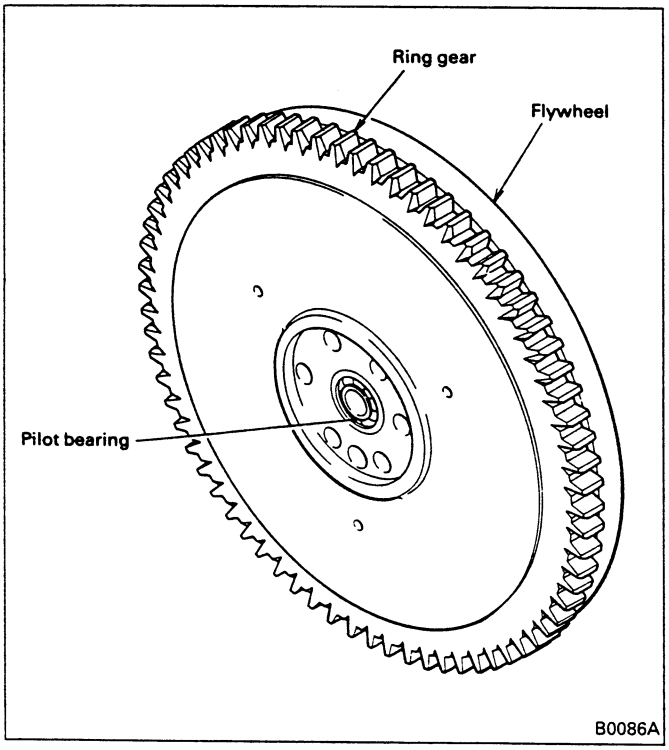


A bushing is press-fitted into the idler gear which turns on the idler shaft. The oil hole drilled through the idler shaft and gear provides an oil passage for lubrication of bushing and gears.
An oil pipe is installed in the idler shaft that is used for forced lubrication of the injection pump gear.

(8) Flywheel



The flywheel is made of cast iron. The pilot bearing of the transmission drive pinion is installed at its center. On its periphery, the ring gear is shrink-fitted that meshes with the starter pinion.
The ring gear tooth crests are induction-hardened for greater durability. At the same time, one side of the crests is chamfered to ensure that the starter pinion meshes easily when starter is operated.

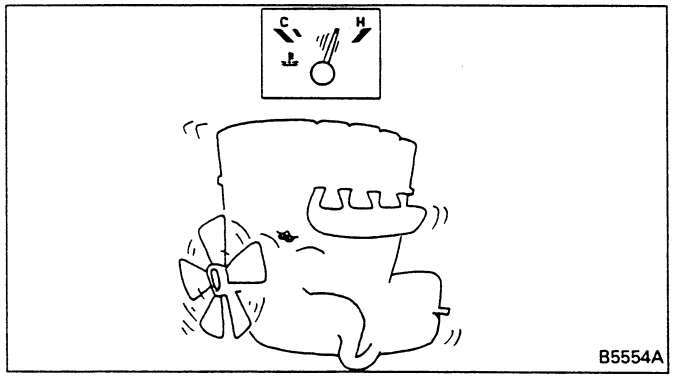
5. SERVICE PROCEDURES

5.1 ENGINE PROPER

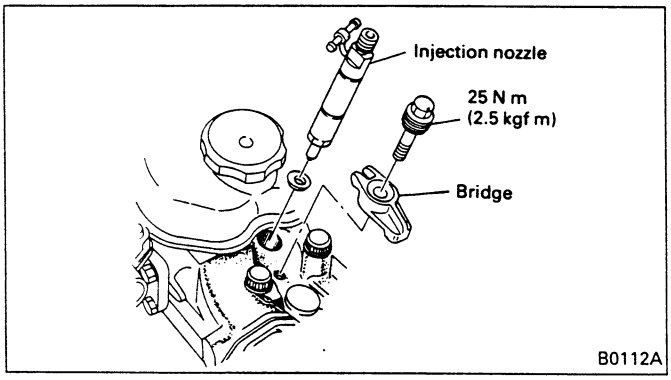
5.1.1 Measurement of Compression Pressure

Compression pressure must be measured prior to disassembly of the engine.
Measure the compression pressure at regular intervals and keep track of its changes. During the break-in period or after parts have been replaced with new ones, there is a slight increase in the pressure as the piston rings and valve seats fit snugly in position. As rough edges and friction between parts are gradually reduced, the pressure comes down.

Measurement Procedure

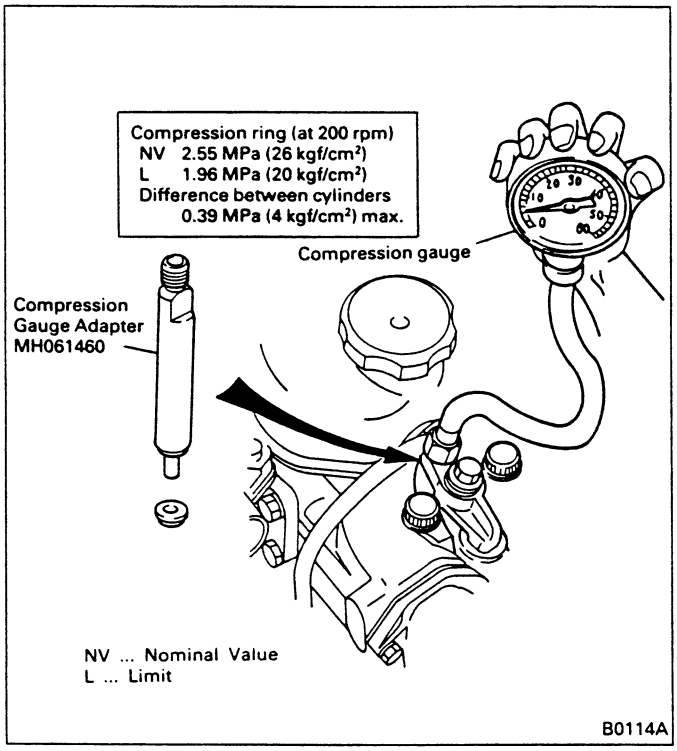


(1) Retighten the cylinder head bolts to specified torque and let the engine warm up until the coolant temperature reaches 75°C to 85°C.



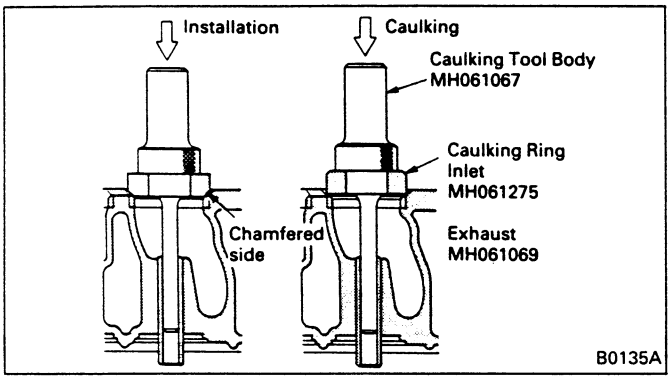
(2) Remove all injection nozzles from the cylinder head.

NOTE:
Cover the mounting holes and injection pipes to prevent entry of dust and dirt.



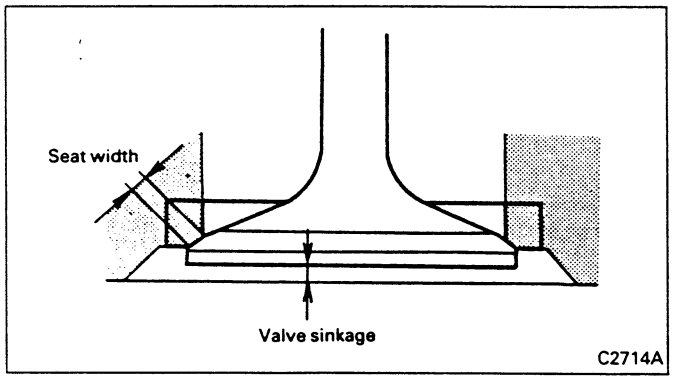
(3) Install Compression Gauge Adaptor (special tool) on the injection nozzle mounting hole together with a gasket and connect the compression gauge (measuring instrument).
(4) Turn the engine with the starter and read the compression gauge pointer value with the specified engine speed.

NOTE:
1. **Keep no fuel injected.**
2. **Make sure that the engine speed is also measured as compression pressure varies with the engine speed.**
3. **Make measurement for all cylinders, as wear and other conditions vary from one cylinder to another.**

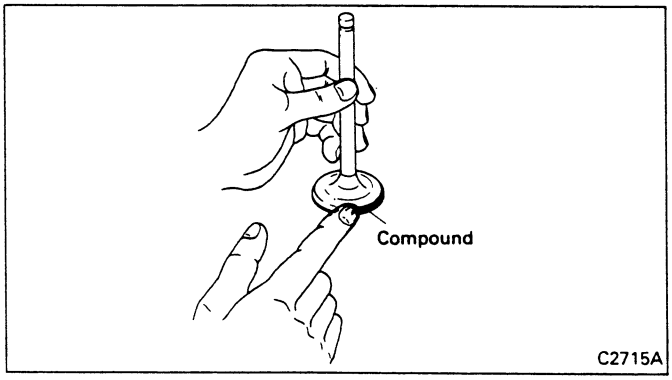


c) Dip the valve seat into liquid nitrogen and let it cool down. But heat the cylinder head sufficiently.
d) Using Caulking Tool Body and Caulking Ring (special tools), install the valve seat.

NOTE:
After pressing in position the valve seat with the chamfered side of the caulking ring, face the ring in the opposite direction to caulk the cylinder head.



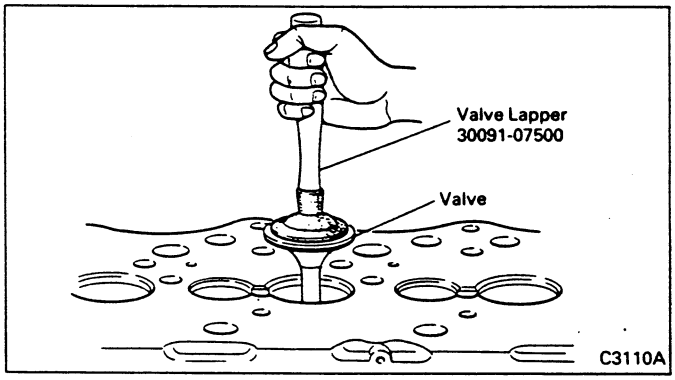
e) Reface the valve seat to obtain the nominal values for the seat width and valve sinkage.



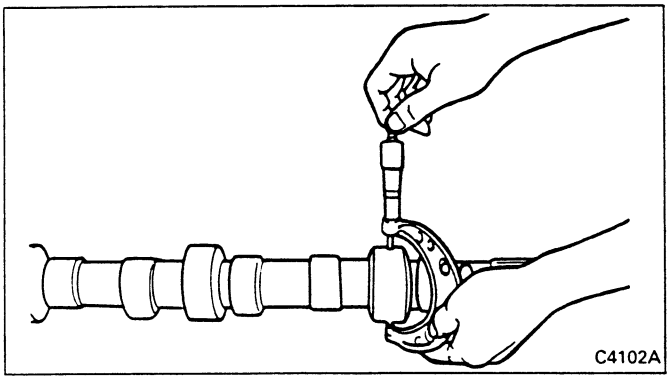
12) Seating of valve and valve seat

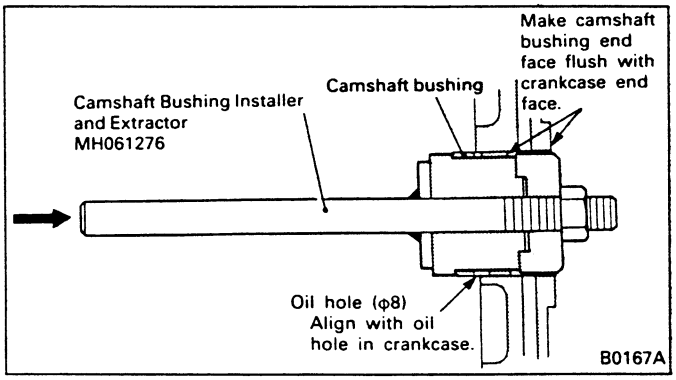
The valve and valve seat must be in even contact throughout the surfaces.
Whenever the valve or valve seat is corrected or replaced, they must be seated.
a) Apply a thin coat of compound evenly to the seating surface of the valve.

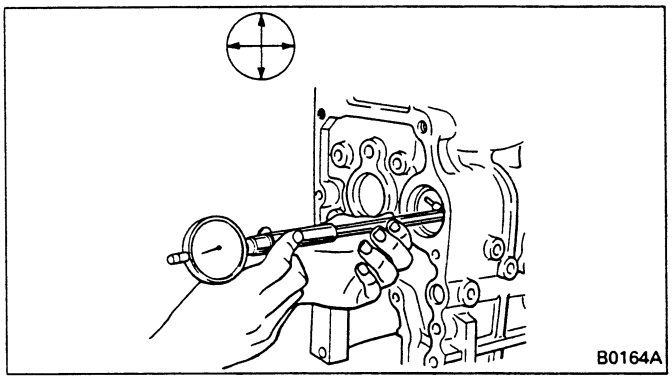
NOTE:
1. **Make sure that there is no compound on the stem of the valve.**
2. **Use intermediate mesh compound (120 to 150 meshes) first and then use fine mesh compound (200 meshes or more) for the finish.**
3. **Mix the compound with a small amount of engine oil and the compound can be applied evenly.**

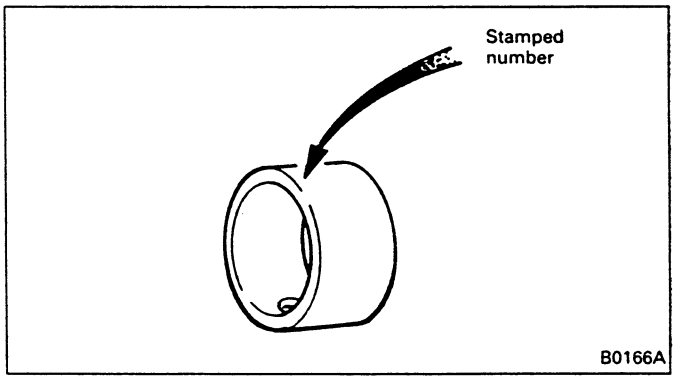


b) Using Valve Lapper (special tool), seat the valve on valve seat.
While turning the valve slightly at a time, strike it against the valve seat.
c) Wash off the compound with gas oil or similar object.
d) Seat the contact surfaces with engine oil.
e) Check if they are properly seated.

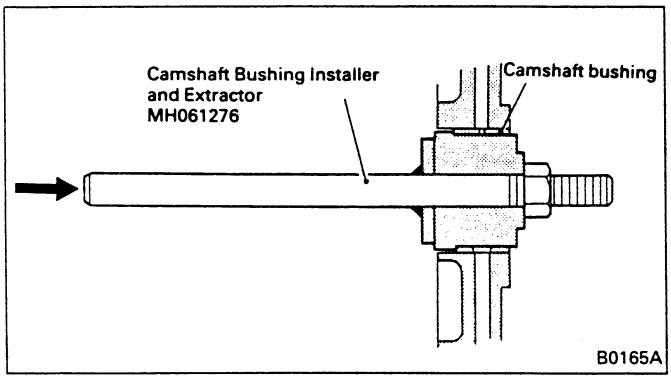








(d) Measure the camshaft journal O.D. and crankcase I.D. If the limit is exceeded, replace the bushing in the crankcase.



(e) Replacement of camshaft bushing

1) Removal

Remove the sealing cap through the camshaft hole in the rear-end face of the crankcase. Then, using Camshaft Bushing Installer and Extractor (special tool), remove the camshaft bushing.

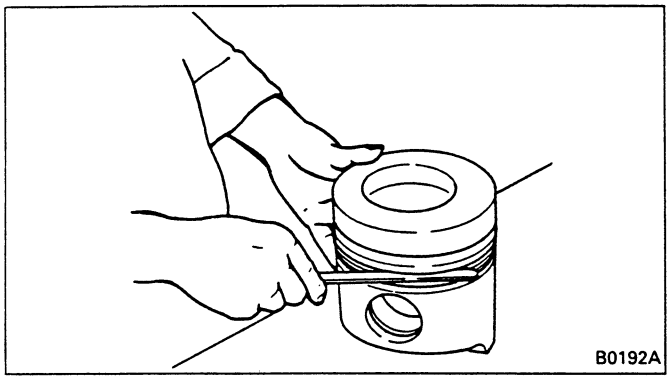
2) Installation

Identify bushings with a unique number stamped on the external surface, indicating the installation position.

Then, using Camshaft Bushing Installer and Extractor (special tool), press-fit the bushings.

Bushing No. (Ascending from front of engine)	Stamped number	I.D.	Width
No. 1	1	54.5	41
No. 2	2	54.5	21
No. 3	3	54	21
No. 4	4	53	21

If the marking is illegible, determine by measuring the I.D. and width.

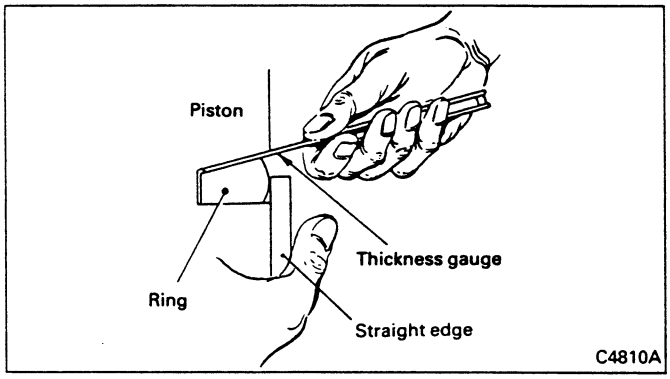


(f) Piston to piston ring clearance

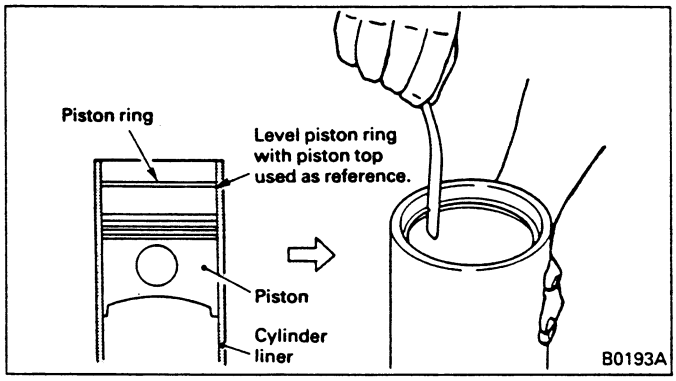
If the limit is exceeded, replace the piston ring or piston.

NOTE:

1. **Remove carbon and measure the clearance throughout the entire periphery of the piston.**
2. **Replace piston rings as a set.**



For the 1st compression ring, press the ring against the piston with a straightedge.

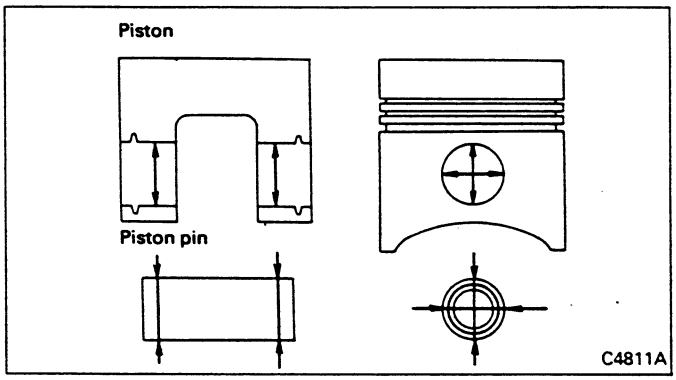


(g) Piston ring gap

Put the piston ring in the standard gauge or crankcase cylinder sleeve by pushing it with piston and measure the ring gap.

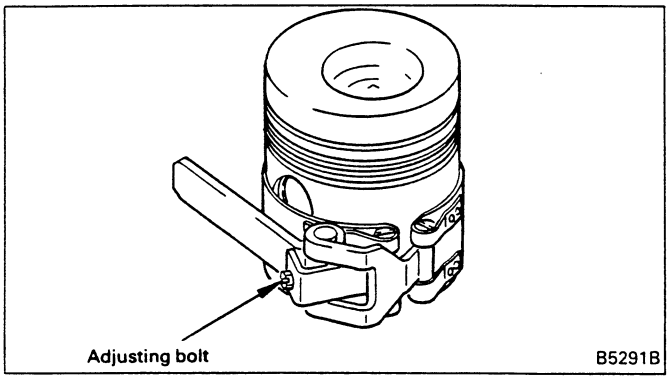
If the limit is exceeded, replace.

Standard I.D.: 100 ± 0



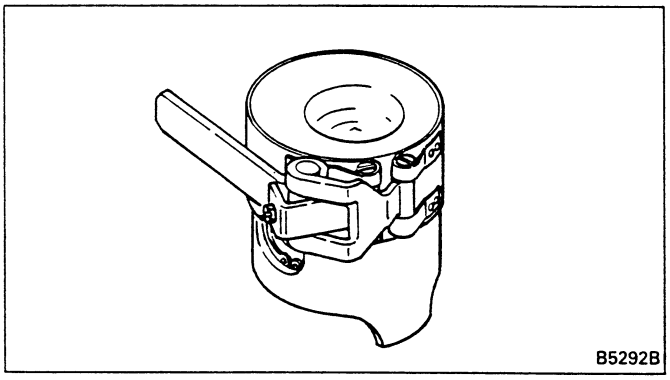
(h) Piston to piston pin clearance

If the limit is exceeded, replace the piston pin or piston.

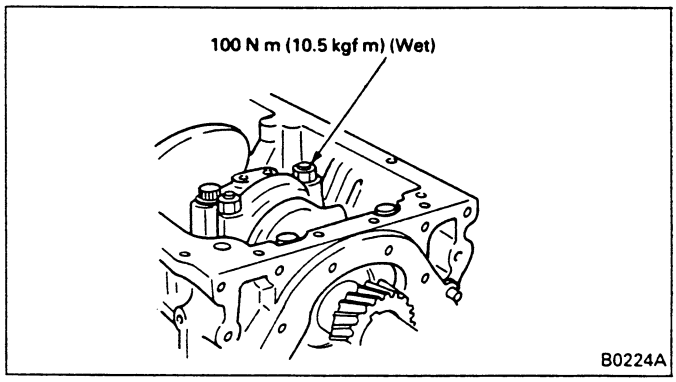


Use of Piston Guide

With the Piston Guide lined up with the piston skirt, set the lever in position and adjust with the adjusting bolt to match the clamp I.D. with piston O.D.
On completion of adjustment, remove the Piston Guide from piston and apply engine oil to piston external surfaces, Piston Guide internal surfaces, and cylinder liner internal surfaces.



After these procedures have been completed, install Piston Guide to the piston with their top surfaces flush with each other and tap piston top with a mallet or other soft object into position so as not to damage to the piston.



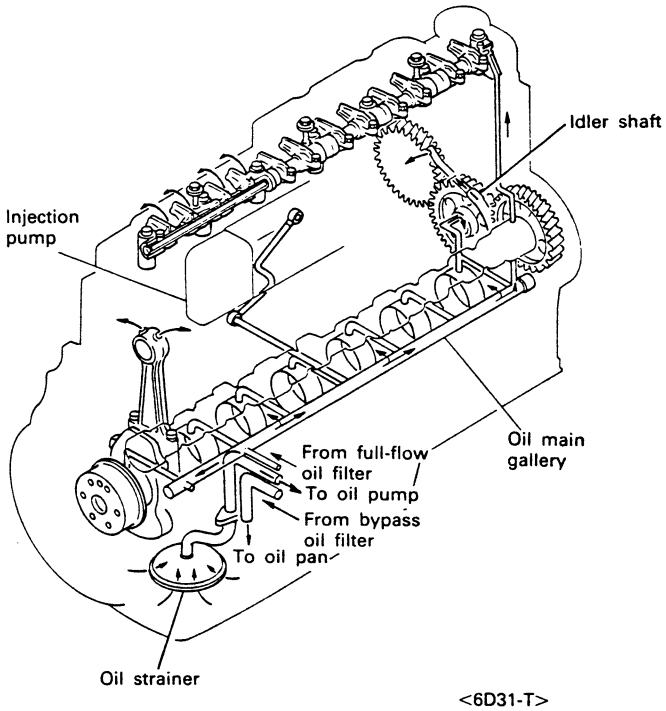
(h) Fit the lower connecting rod bearing to the connecting rod cap and tighten the connecting rod to specification.

NOTE:
The lug sides of the connecting rod and connecting rod cap must be in the same direction.

(i) Check the connecting rod end play [See 5.1.5 (1), (b)].
(j) Check piston for projection [See 5.1.5 (1), (a)].

1. GENERAL

The engine is lubricated by a gear-type oil pump that forces engine oil through the oil cooler and oil filter into the engine for lubrication of various engine parts.
The illustration below shows the flow of engine oil.



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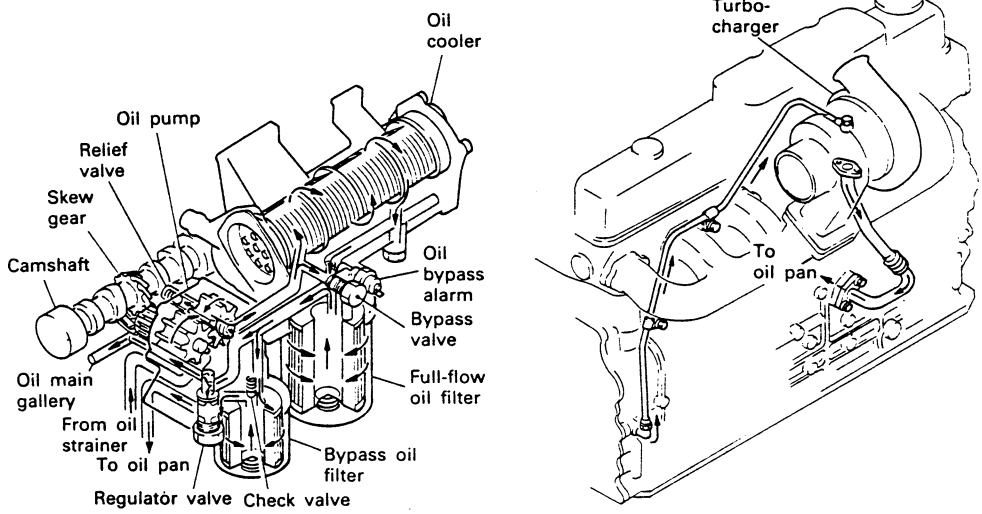

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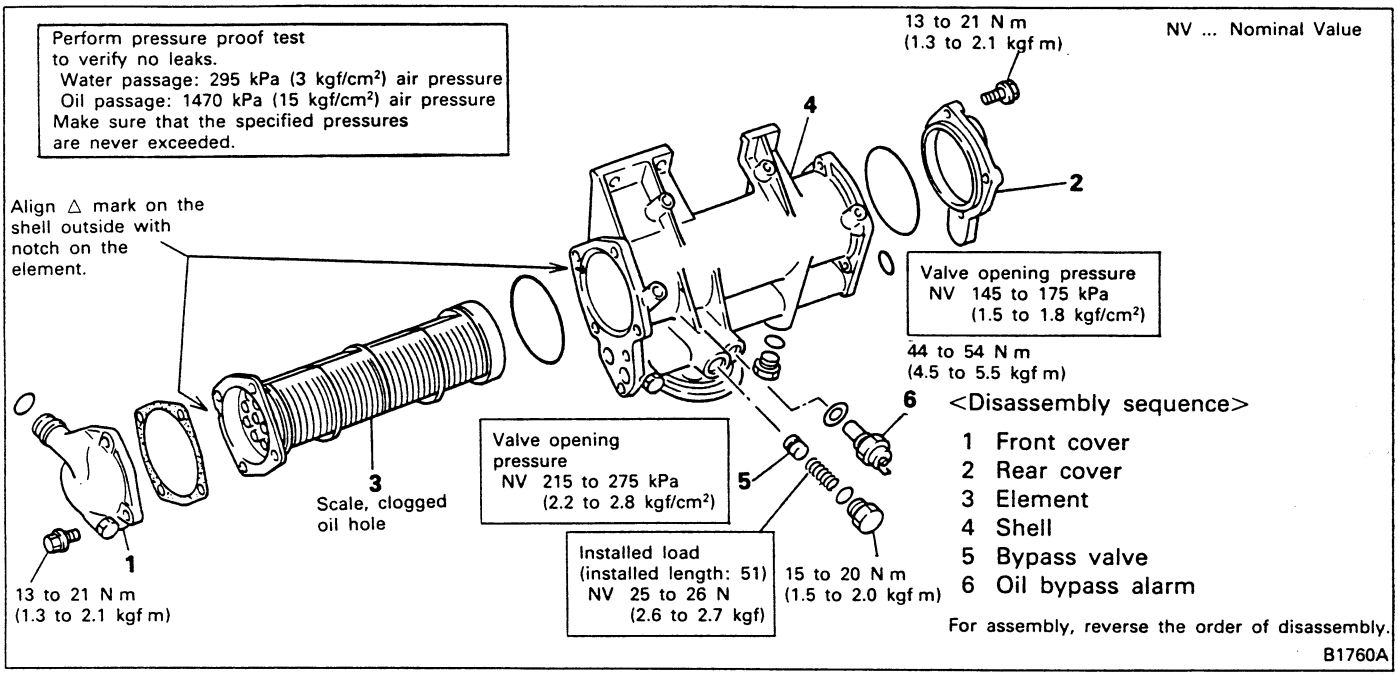
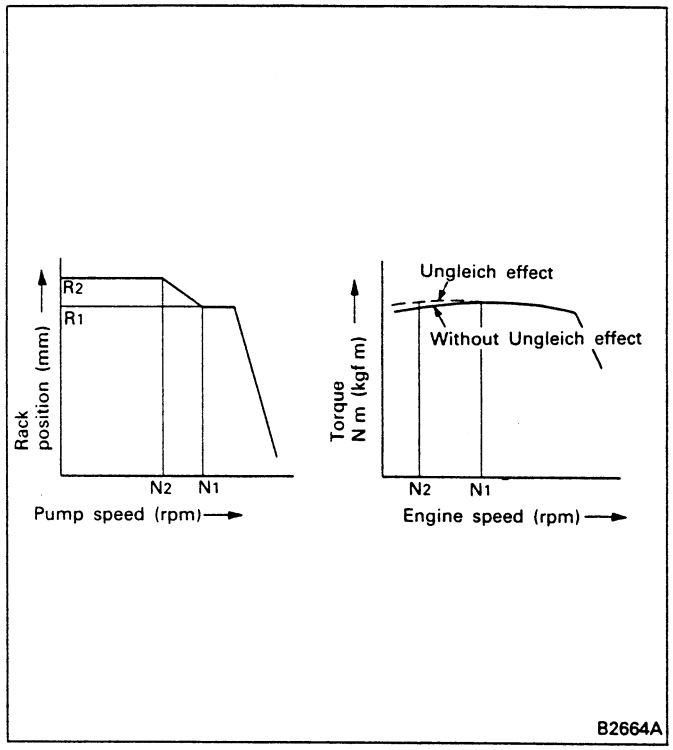
5.2.2 Oil Cooler



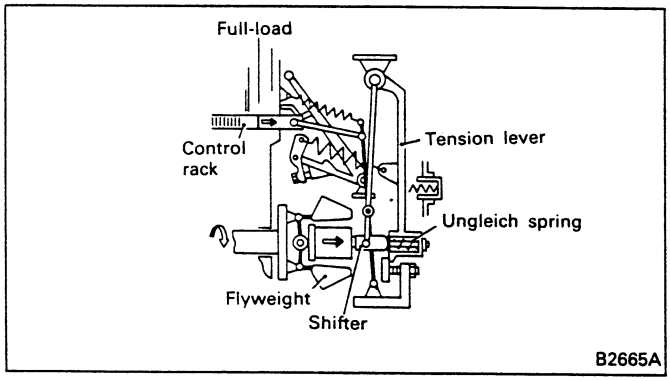
NOTE:
See 5.2.1 (4) for inspection of bypass valve spring.

5.3 CLEANING OF OIL COOLER

(1) Check the oil path and bypass valve of the oil cooler element for carbon deposits and sludge formation. If contaminated, wash in a cleaning oil.
(2) If the element and cover are seriously scaled, wash with referring to 5.6 "CLEANING OF COOLING SYSTEM" in GROUP 14.

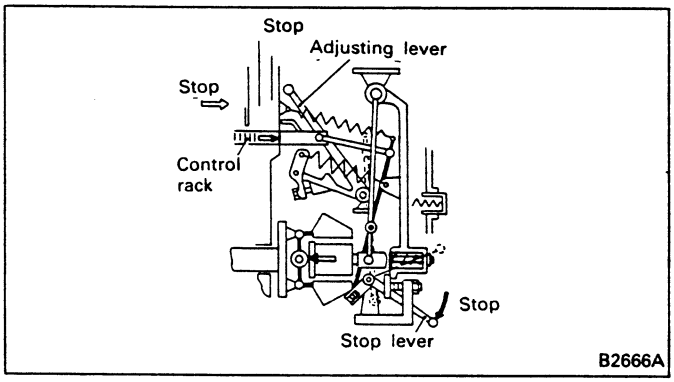


When the engine speed is low (N2) and the centrifugal force of flyweight smaller than the set tension of the Ungleich spring, the shifter is moved as much as the Ungleich stroke to the left, so the control rack moves in the direction (R2) that fuel is increased to increase the torque of the engine at low speeds.



As the engine speed increases (N1), the centrifugal force of flyweight increases. If it becomes larger than the set tension of the Ungleich spring, the Ungleich spring is slowly compressed before the start of high speed control, and the control rack moves in the direction that fuel is reduced. The Ungleich stroke is completed at the position where the shifter directly touches the tension lever (R1).

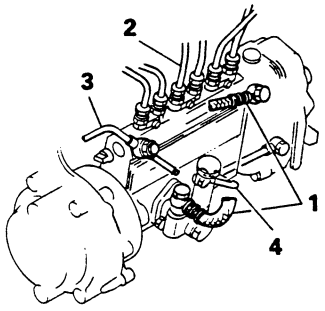
(e) Stopping of engine



When the stop lever is moved to the stop position, the control rack is moved to the stop position to stop the engine regardless of the position of the adjusting lever.

5.1 A TYPE INJECTION PUMP

5.1.1 Removal



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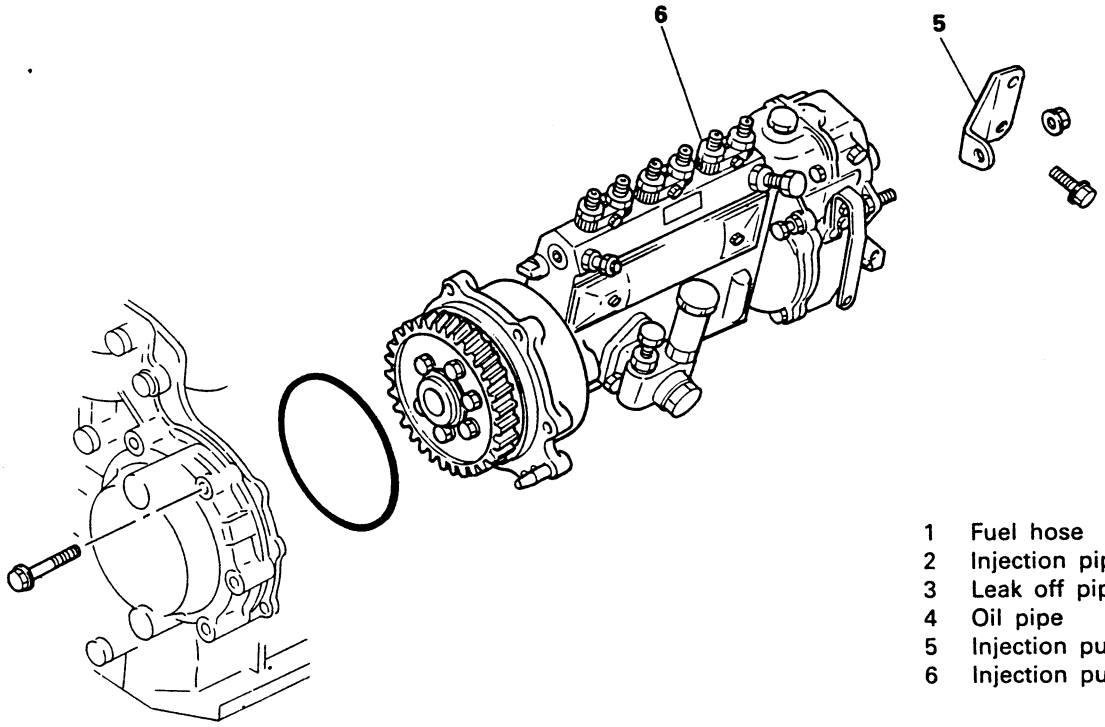

1 Fuel hose
2 Injection pipe
3 Leak off pipe
4 Oil pipe
5 Injection pump stay
6 Injection pump

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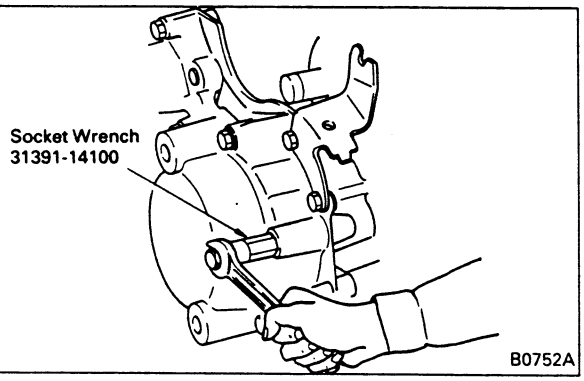

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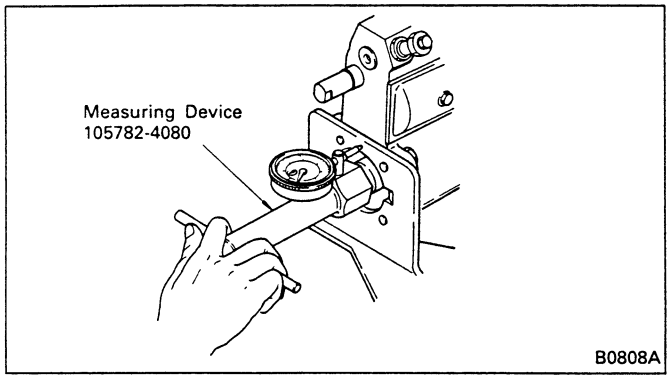
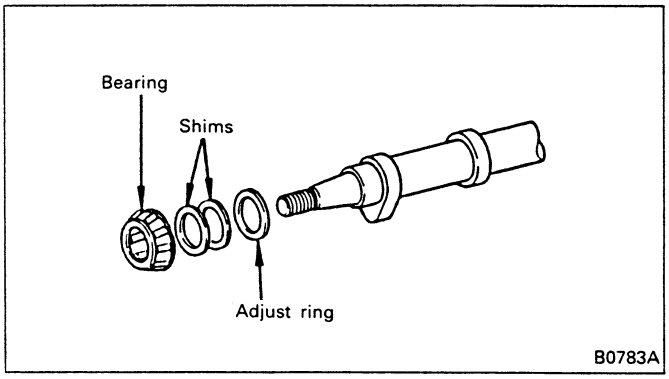
(1) Hold the injection pump by hand, and remove five timer case attaching bolts.
Then, remove the injection pump, pulling it rearward.
Use of Socket Wrench (special tool) will make the removal of timer case attaching bolts easier.





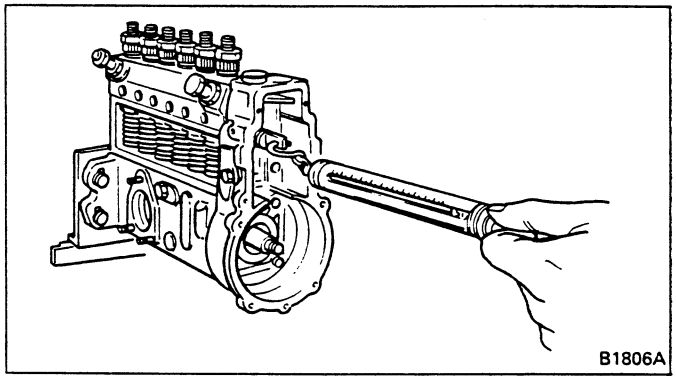
(9) Temporarily mount the bearing cover to measure the camshaft end play with Measuring Device (special tool). If the limit is exceeded, adjust with shims or replace bearing.

NOTE:
Use shims of almost equal thickness for the governor and timer end.

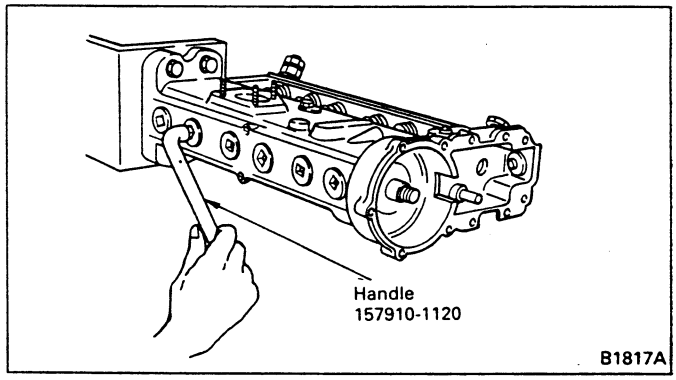
Shim Thickness (mm)

Timer end	0.10, 0.12, 0.14, 0.16, 0.18, 0.30, 0.50, 1.00
Governor end	0.10, 0.12, 0.14, 0.16, 0.18, 0.30, 0.50, 0.70, 1.00, 1.40

After installing the bearing cover in position, measure again end play to ensure that it is up to specification.

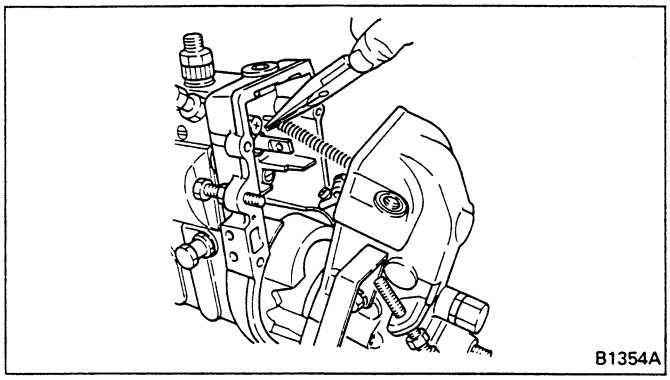


(10) With Tappet Insert (special tool) removed, measure the sliding resistance of the control rack. (At stationary)
Turn the camshaft to check that the value is within the specified range when measured at any position.



(11) Apply sealant to screw plug and install it with Handle (special tool).
(12) Install the governor.
(13) Install the following parts after adjusting the injection pump:

- Control rack cover
- Cover plate
- Timer case
- Feed pump
- Auto timer [See 5.4.4.]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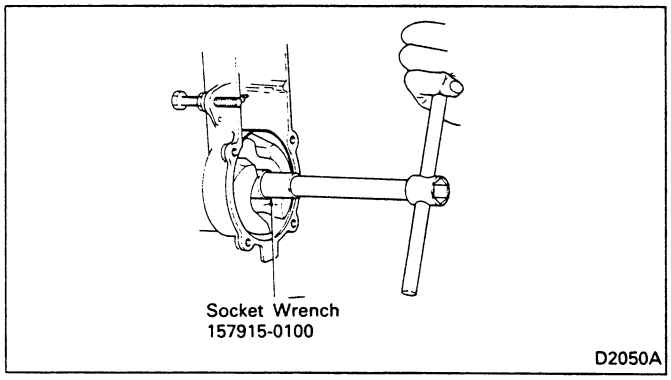
(2) Remove the start spring using long-nose pliers.



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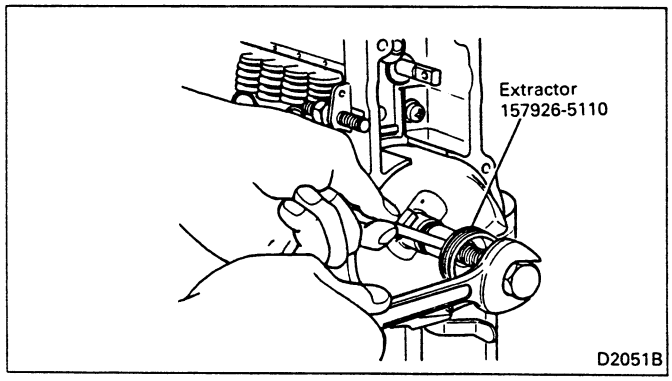
(3) Remove the round nut using Socket Wrench or Round Nut Wrench (special tools).



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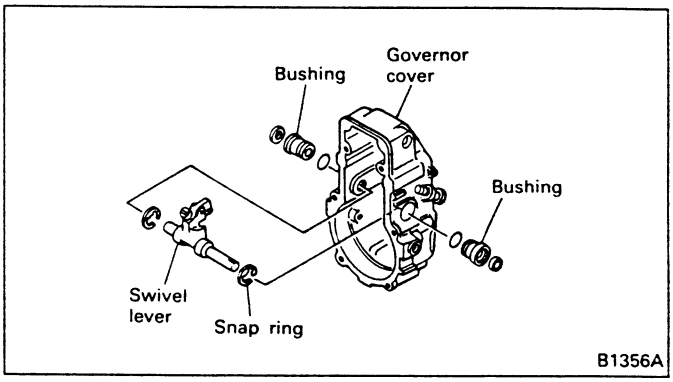
(4) Screw in Extractor (special tool) to the flyweight and extract it.



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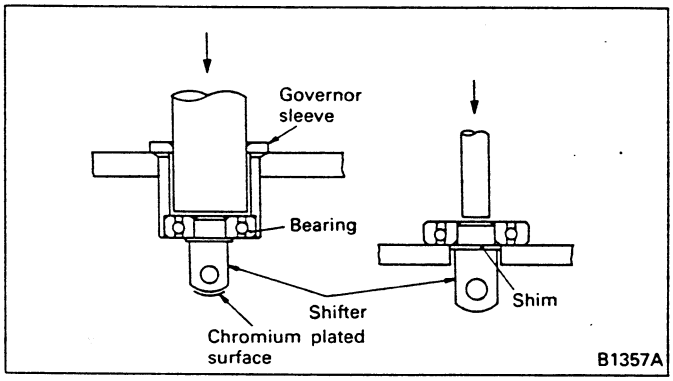
(5) Removal of Swivel Lever

Remove the snap ring from the lever bushing and tap lightly the swivel lever shaft from the adjusting lever mounting side to remove the bushing from both ends. Then, remove the swivel lever.

NOTE:
Do not remove the swivel lever from the governor cover unless such removal is necessary for parts replacement or for correcting unsmooth motion.



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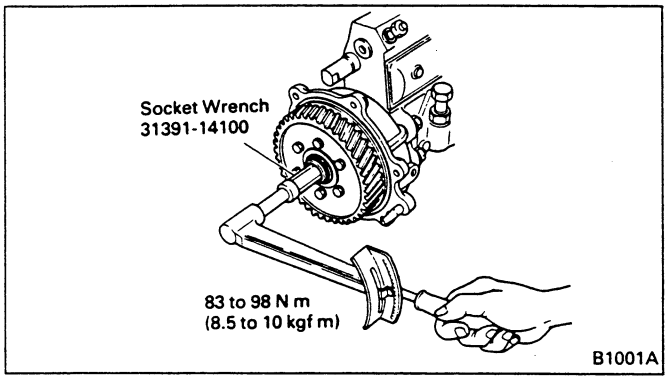
(6) Replacement of Governor Sleeve or Guide lever

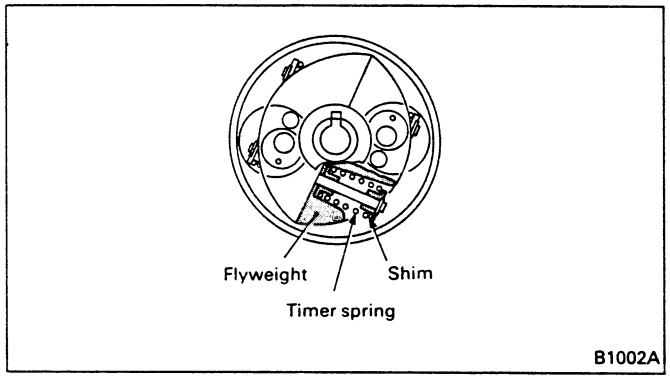
(a) Using a press, remove the bearing in the governor sleeve and remove the guide lever assembly shifter from the bearing.

5.4.4 Installation



Mount the auto timer onto the camshaft, aligning it with the camshaft key. Using Socket Wrench (special tool), tighten the round nut to specification.

5.4.5 Test and Adjustment

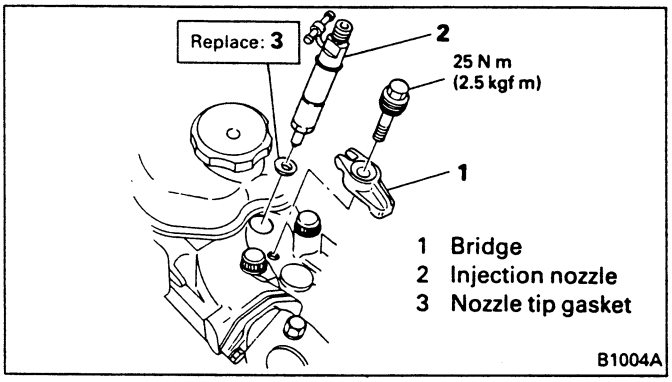


Whenever the auto timer has been disassembled, its advance angle must be measured and adjusted with the manufacturer's measuring device.
To adjust the advance characteristics of the auto timer, add or reduce the adjusting shims or replace the spring.
To reduce the advance angle, increase the shim thickness.

Shim Thickness
0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0 mm

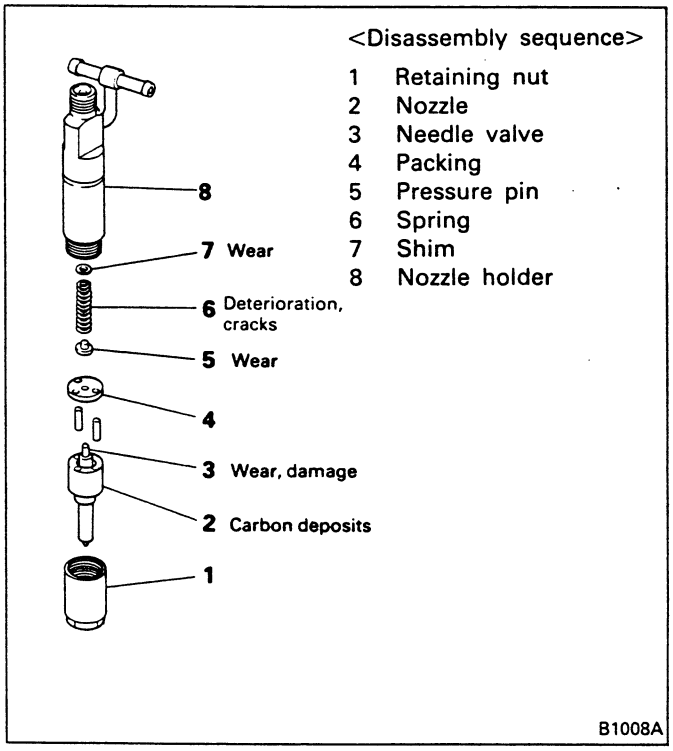
5.5 INJECTION NOZZLE

5.5.1 Removal and Installation

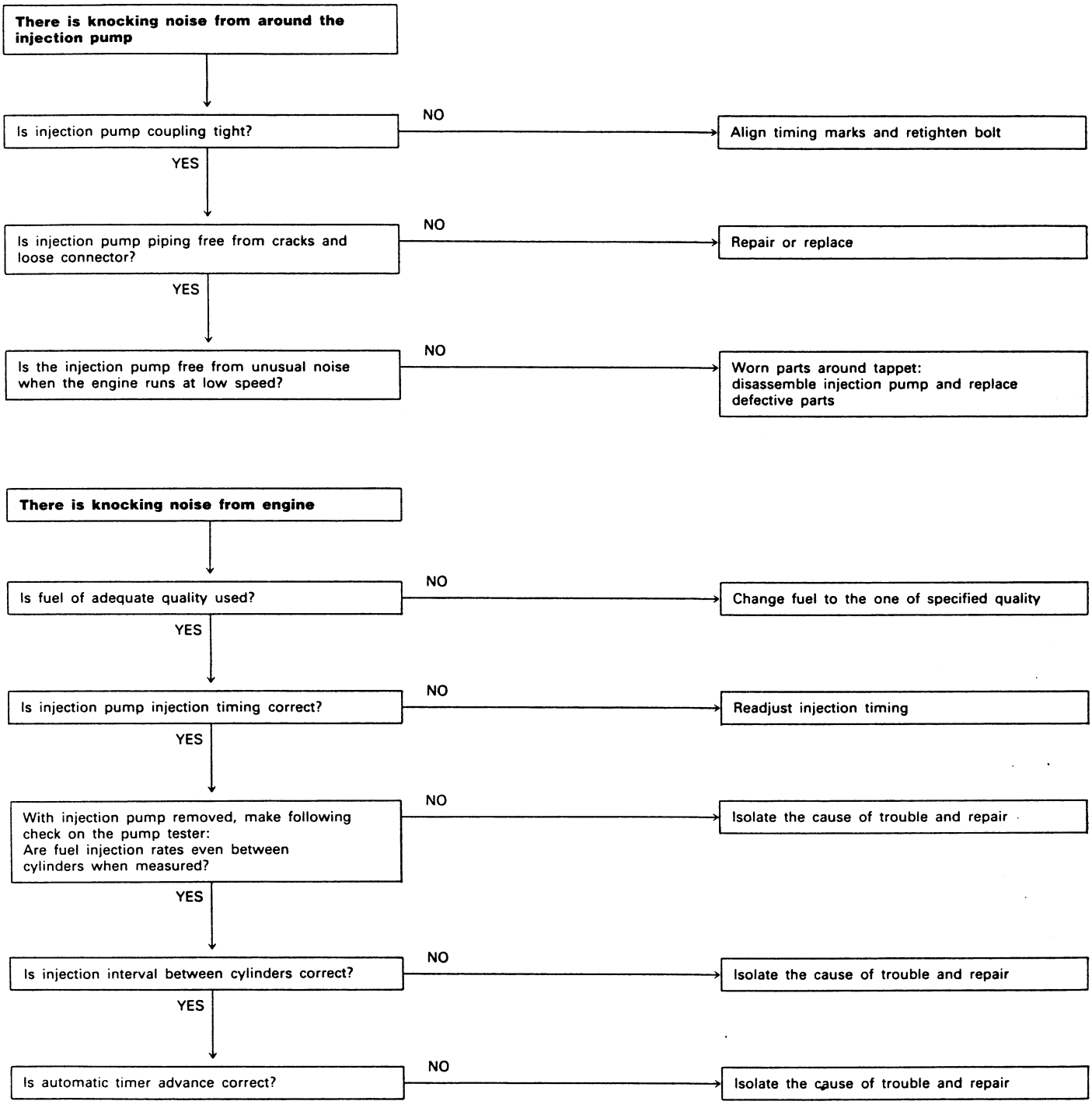


NOTE:
Cover pipes, injection nozzle, and injection pump to prevent entry of dust and dirt. If the injection nozzle is removed, provide adequate means to prevent entry of dust into the cylinder.

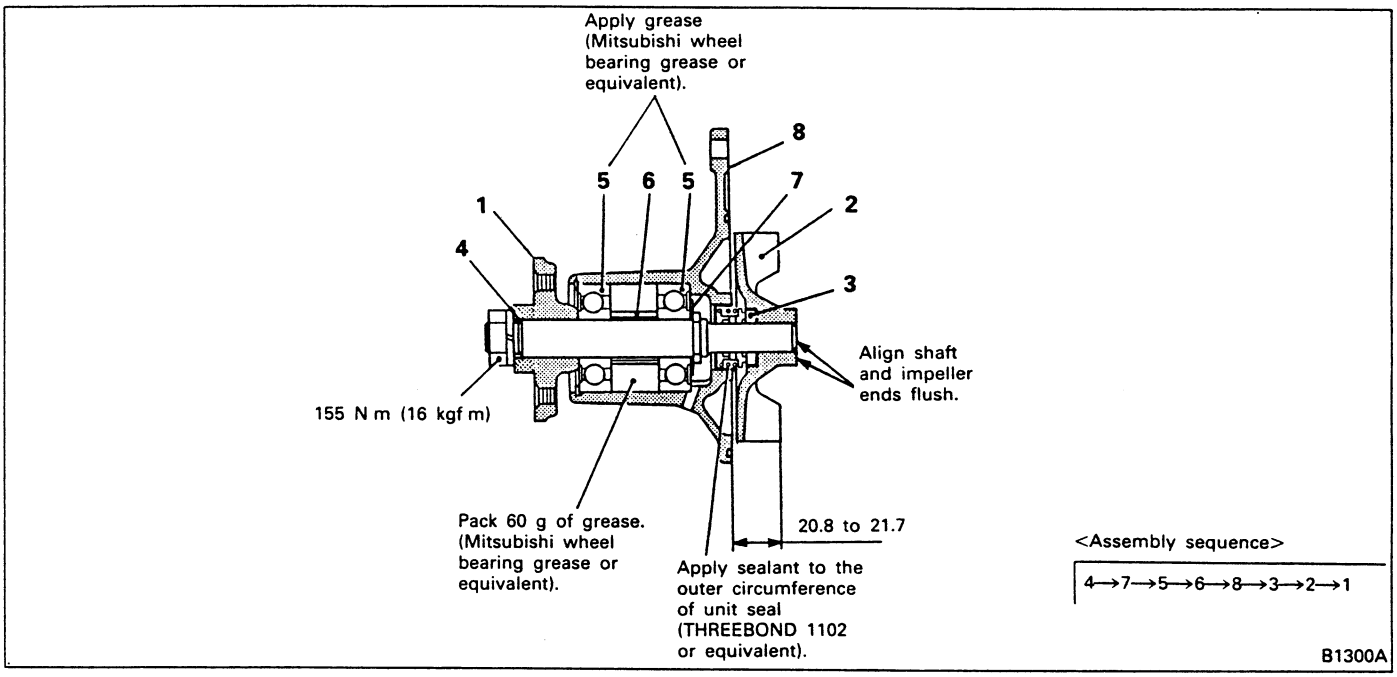
5.5.2 Disassembly



NOTE:
Make sure that the combination of the nozzle and needle valve is not changed.


There is knocking noise from around the injection pump
Is injection pump coupling tight?
NO
Align timing marks and retighten bolt
YES
Is injection pump piping free from cracks and loose connector?
NO
Repair or replace
YES
Is the injection pump free from unusual noise when the engine runs at low speed?
NO
Worn parts around tappet: disassemble injection pump and replace defective parts
There is knocking noise from engine
Is fuel of adequate quality used?
NO
Change fuel to the one of specified quality
YES
Is injection pump injection timing correct?
NO
Readjust injection timing
YES
With injection pump removed, make following check on the pump tester: Are fuel injection rates even between cylinders when measured?
NO
Isolate the cause of trouble and repair
YES
Is injection interval between cylinders correct?
NO
Isolate the cause of trouble and repair
YES
Is automatic timer advance correct?
NO
Isolate the cause of trouble and repair

5.2.3 Reassembly

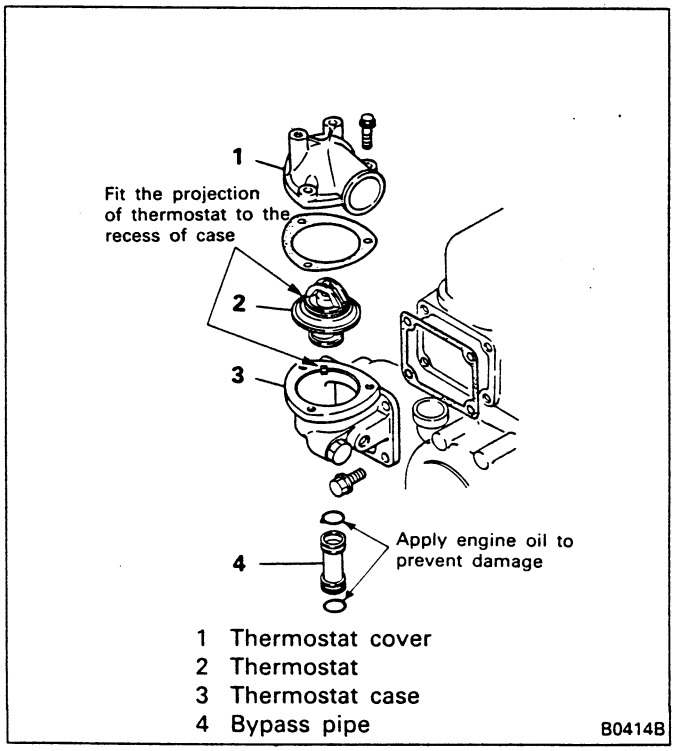


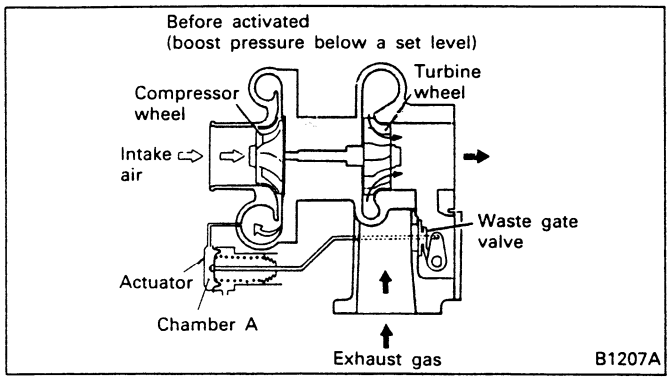
NOTE:

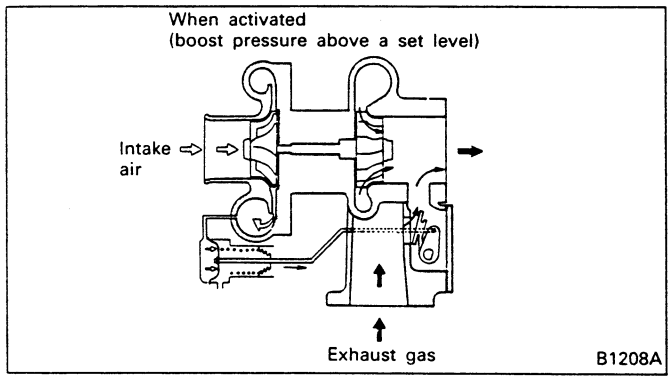
1. **After reassembly, install the water pump onto the timing gear case and make sure that the impeller is not in contact with the timing gear case.**
2. **Reassembly of the flange and impeller into the water pump shaft is allowed up to two times.**

5.3 THERMOSTAT

5.3.1 Removal and Installation





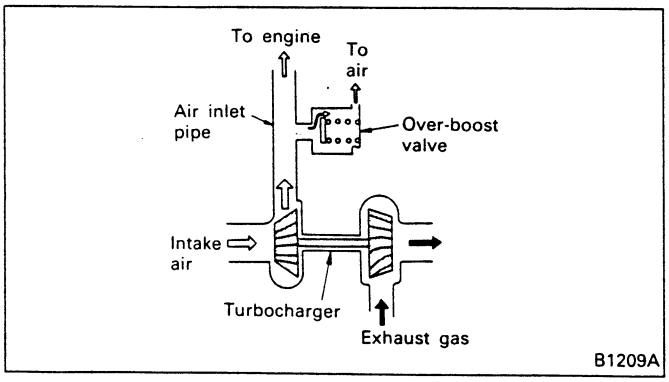


(a) Waste gate mechanism

The waste gate mechanism relieves part of exhaust gases with the engine at high rpm range, allowing it to bypass the turbine wheel. This controls the boost pressure at an optimum level and prevents the turbocharger overrun as well as pressure buildup inside the exhaust manifold.

The boost pressure is introduced from the compressor cover through rubber hose to the chamber A of actuator.

The boost pressure over a predetermined level being applied to the chamber A overcomes the spring force to open the waste gate valve, which decreases the volume of exhaust gas blown against the turbine wheel. This, in turn, reduces the speeds of turbine and compressor wheel to lower the boost pressure.

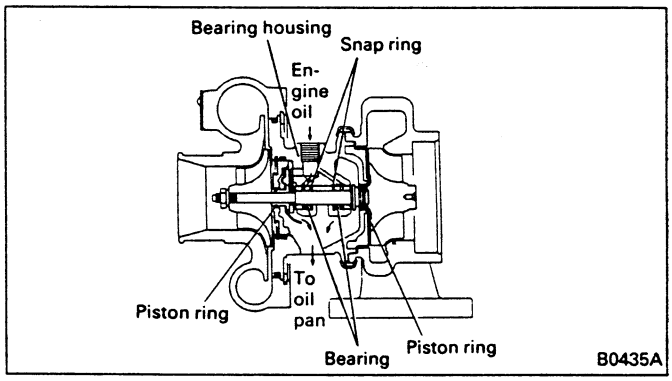


(b) Function of over-boost valve

The over-boost valve functions when the boost pressure abnormally increases due to a waste gate valve malfunction.

If the boost pressure inside the air inlet pipe exceeds a predetermined level, the over-boost valve is forced to open by the pressure to release it in atmosphere. This protects the engine from undue boost pressure.

When the over-boost valve is opened, a hiss is heard. In such an event, it is necessary to check and repair the turbocharger promptly.



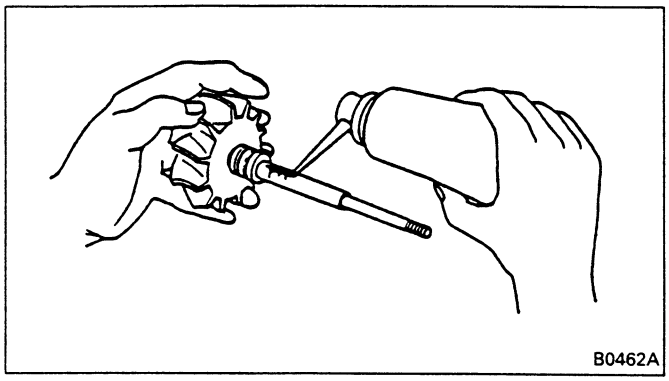
(c) Lubrication of turbocharger

The turbocharger is lubricated as follows.

From the oil main gallery in the rear of engine, engine oil is introduced through the oil pipe to the turbocharger bearing housing.

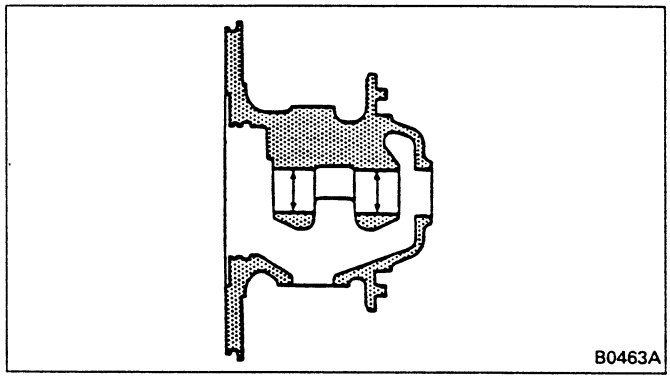
The engine oil passes through the oil hole in the bearing housing to lubricate bearing and is returned through the outlet at the bottom of the bearing housing to the crankcase and to the oil pan.

The piston rings mounted at both ends of the turbine wheel shaft function as an oil seal.



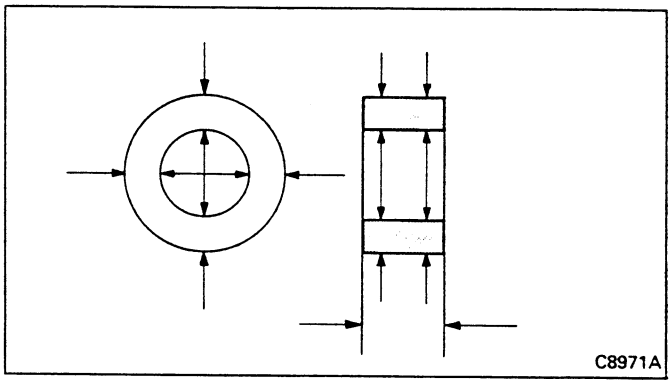
5) Apply clean engine oil to all sliding surfaces.

(b) Inspection



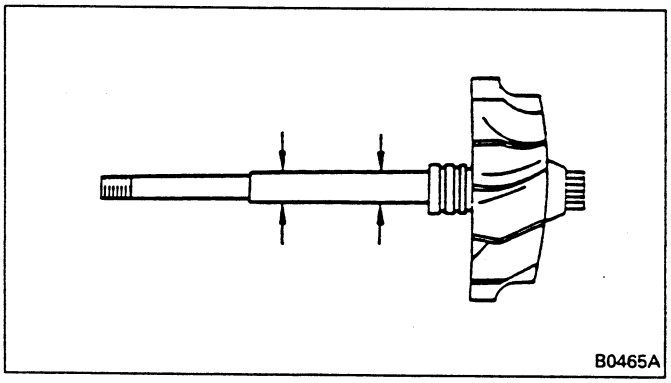
1) Bearing housing

Measure the I.D. of bearing hole.
If the measurement exceeds the limit, replace the bearing housing.



2) Bearing

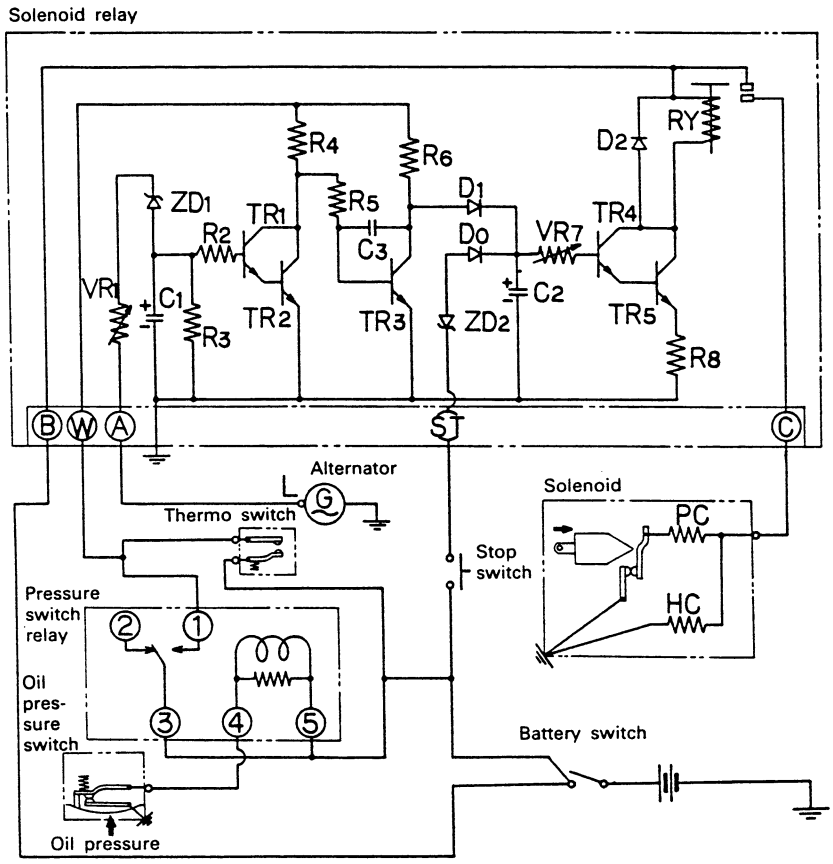
Measure O.D., I.D., and length of the bearing.
If the measurement exceeds the limit, replace the bearing.



3) Shaft and turbine wheel

a) Measure O.D. of the shaft and turbine wheel journal.
If the measurement exceeds the limit, replace the shaft and turbine wheel.
Replace the piston ring with a new one.

(1) Run Off Type



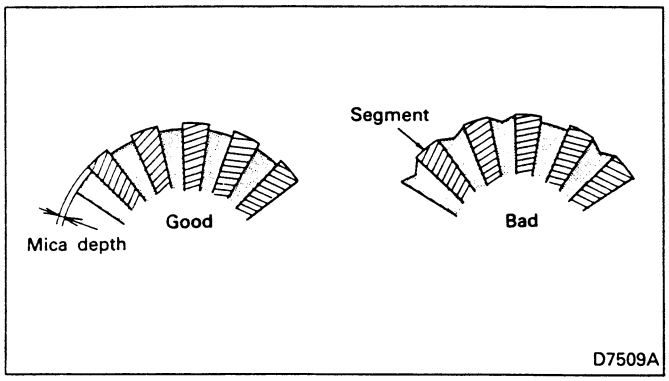
B4926A

(a) Start circuit

1) Current flows from the solenoid relay (B) to the RY coil and applies the voltage to the collectors of TR4 and TR5 but RY does not operate, as there is no input to the base.

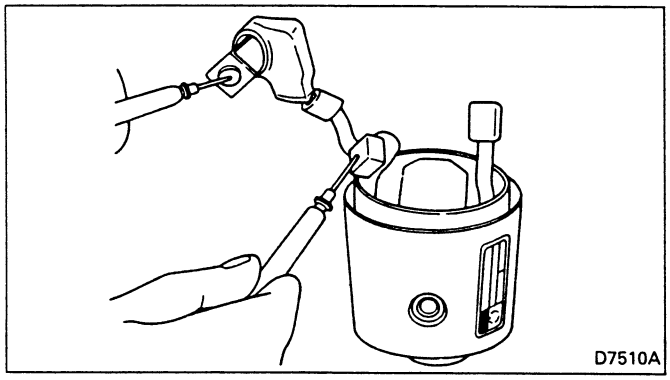
2) Current also flows from the oil pressure switch to the solenoid relay (W) to R4 to R5 and applies the voltage to the base of TR3. When the voltage is applied to the base of TR3, current flow from R6 to C and E of TR3 to the ground, and RY does not operate, as there is no input to TR4 and TR5 of the stop circuit.

3) The engine starts, and a voltage of 24V or more is applied from the terminal "L" of the alternator through VR1 to ZD1 (Zener voltage 24V), and charge begins with the time constant (Oil pressure timer) determined by VR1 and C1. (At this point the engine oil pressure increases beyond the specified value and the engine enters the operating state.) The charge voltage passes through R2. If it becomes higher than the level of the emitter of TR1, current flows from R4 to C and E of TR1 and biases TR2. TR2 passes current from R4 to C and E of TR2 and to the ground, and the circuit from R5 to base of TR3 is caused to be OFF. (Oil pressure switch circuit opened)



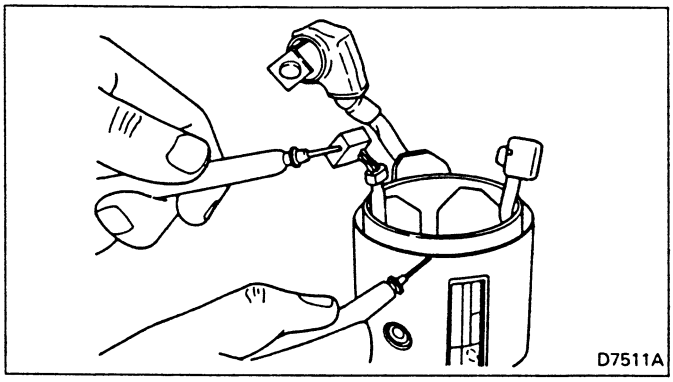
3) Measure the mica depth of groove between segments. If it does not reach the limit, correct.

(2) Field Coil



(a) Coil open circuit test

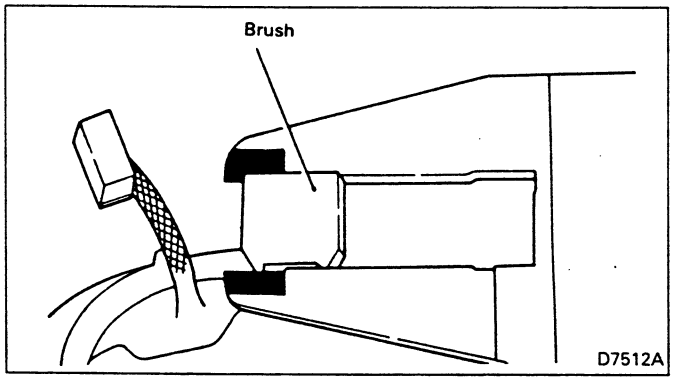
Check to ensure that there is continuity between the terminal lead and brush (+).
If there is no continuity, indicating an open circuit, replace the yoke assembly.



(b) Coil earth test

Check to ensure that there is no continuity between the yoke and brush (+).
If there is continuity indicating that the coil is earthed, check for poor insulation. If repair is impossible, replace the yoke assembly.

(3) Brush and Brush Holder

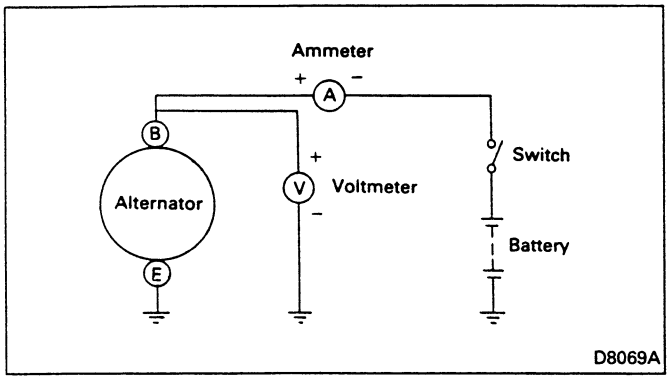


(a) Brush wear

Measure the brush length and, if the measurement is less than the limit, replace the brush.
If the brush is unevenly worn or develops rough surfaces, correct with sandpaper (No. 300 to 500).

NOTE:
Correct the brush contact surface to a curve of the commutator.

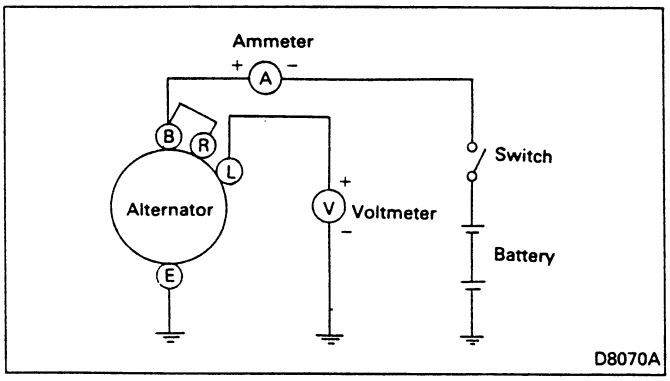
(3) Performance Test (On-vehicle)



(a) Provide a switch between the battery and alternator B terminal. With the switch turned off, connect an ammeter (60 A class) and voltmeter.
(b) Turn on the switch and make sure that the voltmeter indicates the battery voltage.
(c) Start up the engine and immediately turn on all lamp switches. Then, increase the engine speed and read the maximum current value when the alternator speed reaches 5 000 rpm.
(d) If the current reading is 70% or more of the nominal output, the alternator may be regarded as in good condition.

NOTE:
The on-vehicle test is an easier way of inspection; the test bench inspection is necessary for more accurate results.

(4) IC Regulator Regulated Voltage Test (On Test Bench)

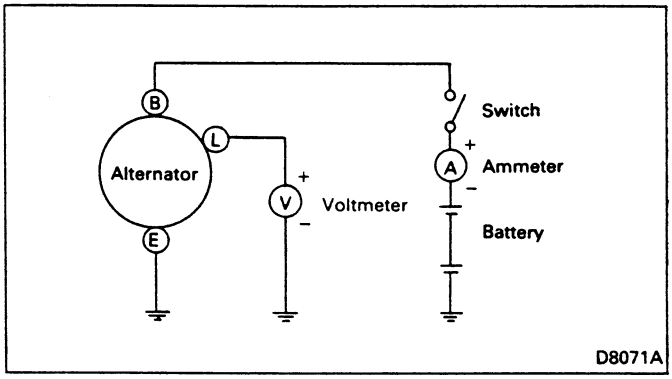


IC regulator regulated voltage

28 to 29 V <24 V type>	Measured across terminals "L" and "E" at 5 000 rpm, load 5 A or less

Use a fully-charged battery. Turn on the switch and gradually increase the alternator speed up to 5 000 rpm. Check that the current value at this speed is 5 A or less.
The regulator is in good condition if the regulated voltage under this condition is within specification. If not, replace the regulator assembly as the regulated voltage is not readjustable.

(5) IC Regulator Regulated Voltage Test (On-vehicle)



(a) Connect a voltmeter and ammeter and provide a switch.
(b) The regulator is in good condition if the voltmeter registers 0 when the switch turns ON. If the voltmeter pointer deflects, the alternator or wiring is defective.
(c) With the ammeter terminal shorted to prevent flow of the starter current through it, start the engine.
(d) Increase the engine speed to around 2 000 rpm and read the regulated voltage value if the charge current is 5 A or less.
If the charge current is 5 A or more, continue charging for a while or replace it with a fully-charged battery. Or, a 1/4 Ω (25 W) resistor may be connected in series to the battery to limit the charge current.
(e) The regulator is in good condition if the regulator voltage is within specification.
If not, replace the regulator assembly as the regulator voltage is not readjustable.