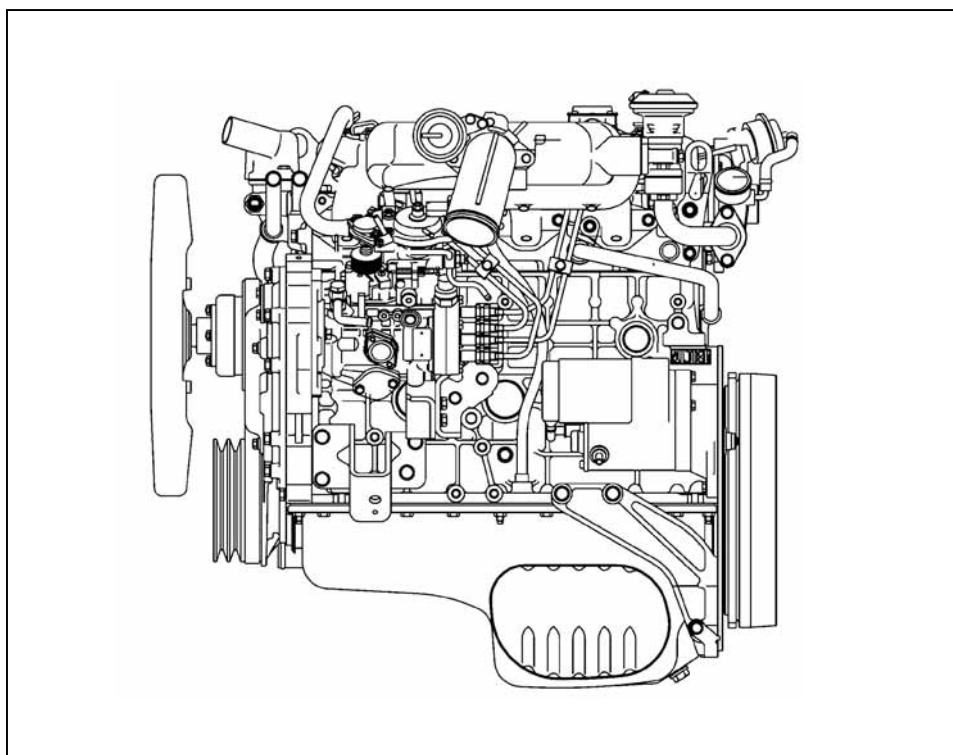


# 4JB1-TC ENGINE

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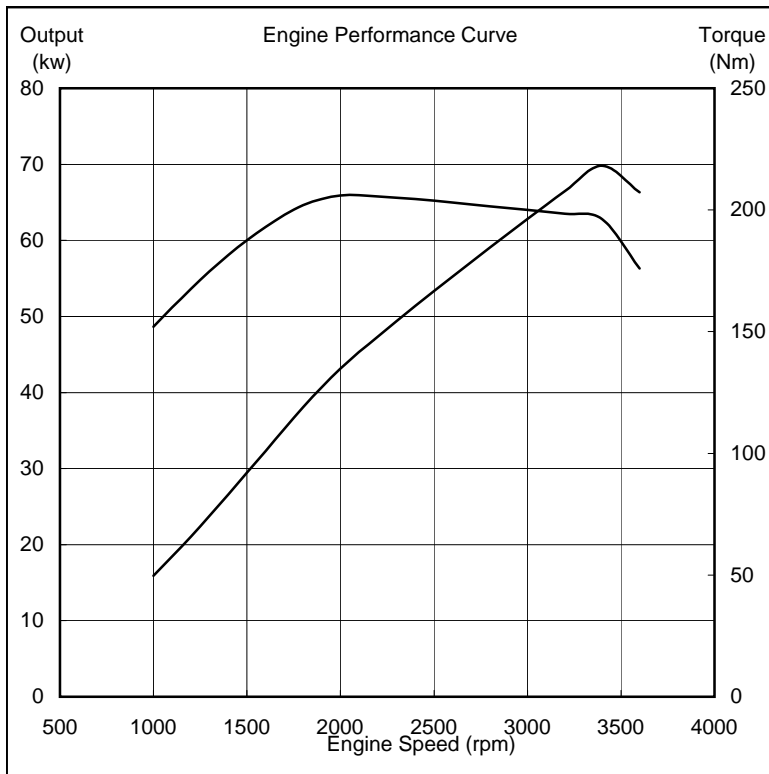
## *Mechanical Specification & Structure*

*Applicable To N\*R*

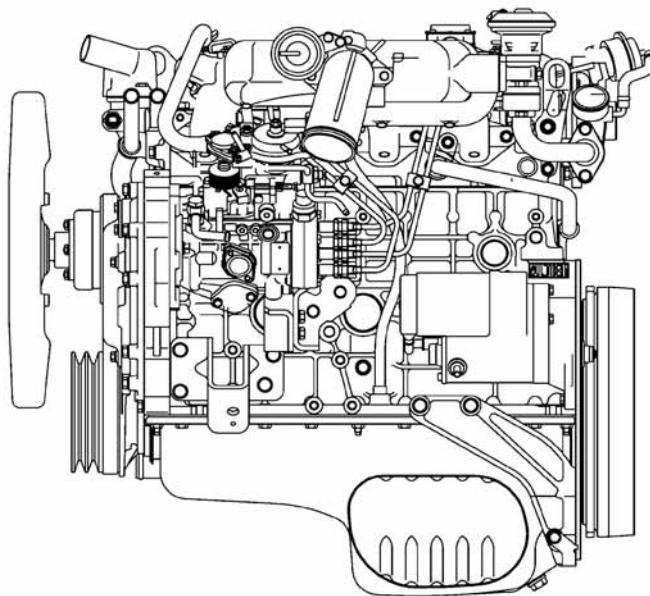


**ISUZU**  
ISUZU MOTORS LIMITED

## OUTLINE



	4JB1-TC
Applicable Emission	Euro 2
Maximum Output	70kw/3400rpm (95PS/3400rpm)
Maximum Torque	206Nm/2000rpm (21.0kgm/2000rpm)



The four cycle direct injection 4JB1-TC engine features two valves per cylinder that are operated via a single camshaft fitted to the engine block.

Auto-thermastic pistons with cast steel struts are used to reduce thermal expansion and resulting engine noise when the engine is cold.

Chrome plated dry type cylinder liners provide the highest durability.

The crankshaft has been tufftrided to provide a longer service life. Because the crankshaft is tufftrided, it cannot be reground.

The 4JB1-TC engine is equipped with the VE type mechanical fuel injection pump made by Bosch

**ENGINE MAIN DATA & SPECIFICATION**

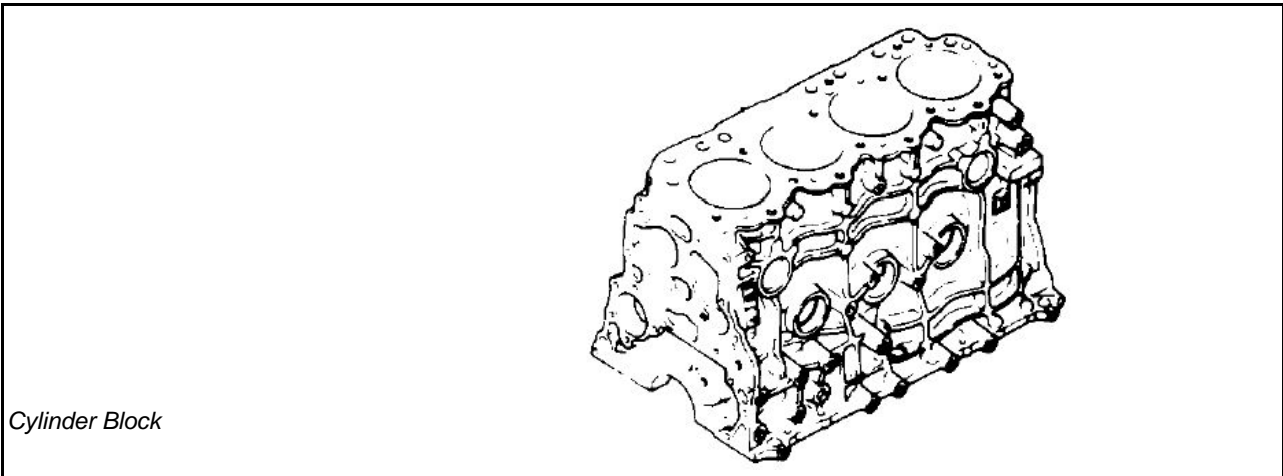
<b>General</b>	
Engine Model	4JB1-TC
Engine Type	Diesel, Four Cycle, Overhead Valve, Water Cooled
Engine Weight (Kg) (With Cooling Fan, Clutch Disc)	Approximately 256
Cylinder Layout - Number of Cylinders	Inline-Four Cylinders
Fuel Injection Order	1-3-4-2
Bore x Stroke (mm)	93.0 x 102.0
Total Displacement (cc)	2771
Combustion Camber Type	Direct Injection
Cylinder Liner	Dry Type
Idle Speed (rpm)	750 ± 25
<b>Fuel System</b>	
Injection Pump Type	BOSCH Distributor VE Type
Governor Type	Mechanical Variable All Speed
Injection Nozzle Type	Hole Nozzle
Number of Injection Hole	5
Diameter of Injection Hole (mm)	0.20
1st Stage Injection Nozzle Operating Pressure (Mpa)	19.5
2nd Stage Injection Nozzle Operating Pressure (Mpa)	26.5
Fuel Filter Type	Cartridge Paper Element and Water Separator
<b>Valve System</b>	
Valve Layout	Overhead Valve
Drive Type	Gear Drive
Intake Valve Open At BTDC (deg)	24.5
Intake Valve Close At ABDC (deg)	55.5
Exhaust Valve Open At BBDC (deg)	54.0
Exhaust Valve Close At ATDC (deg)	26.0
Intake Valve Clearance At Cold (mm)	0.4
Exhaust Valve Clearance At Cold (mm)	0.4
<b>Cooling System</b>	
Cooling Method	Water Cooled
Water Capacity (Liters) (Including Radiator)	10
Water Pump Type	Centrifugal
Water Pump Pulley Ratio (Crank / Pump)	1.2
Thermostat Type	Wax Pellet With Jiggle Valve
Thermostat Initial Opening Temperature (deg. C)	82
Thermostat Full Opening Temperature (deg. C)	95

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<b>Lubricating System</b>	
Lubricating Method	Pressure Circulation
Oil Pump Type	Gear
Oil Capacity (Litter)	6.6 - 7.1
Oil Filter Type	Cartridge Paper Element
<b>Starting System</b>	
Starter Motor Output (V-kW)	12 - 2.0 or 12 - 2.2
<b>Charge System</b>	
Alternator Output (V-A)	12 - 50 or 12 - 60
Regulator Type	IC

## MAIN CONSTRUCTION PARTS

### CYLINDER BLOCK



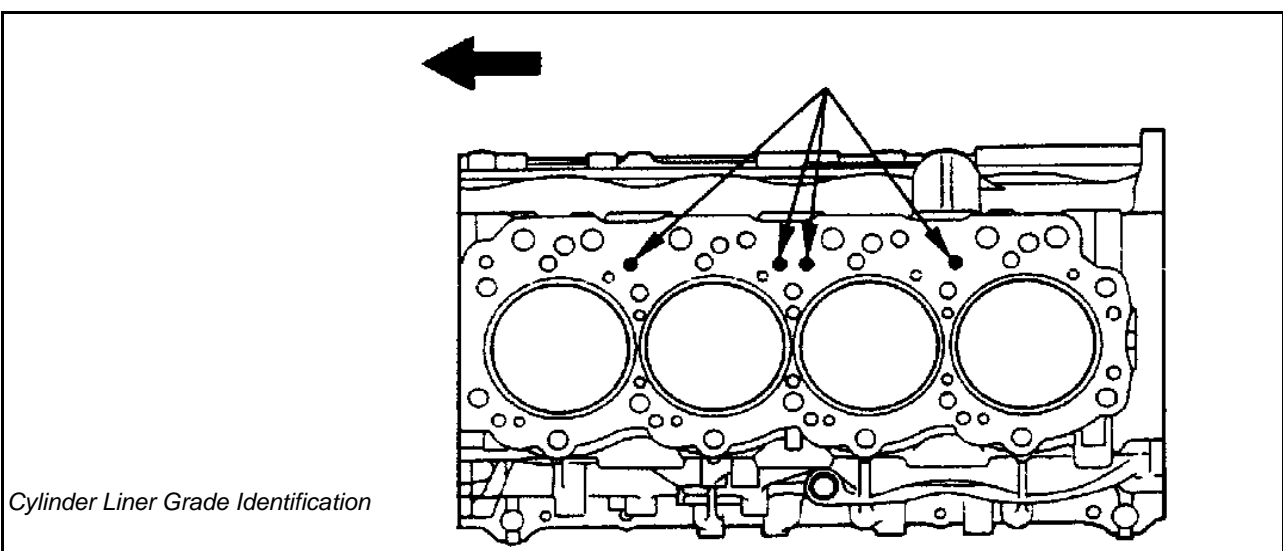
The cylinder block is a complex structure with cooling water and lubricating oil passages, and crankshaft supports in the lower part. The cylinder block is made of cast iron because it has to be strong enough to resist not only high temperatures, but also the high pressure gasses generated in the cylinders. It also needs to have sufficient corrosion resistance to withstand these gasses.

The water cooled cylinder block can be divided into a one-piece cast type and a liner type. In the liner type liners are inserted into the cylinder portion of the block. Furthermore, liners can be divided into a dry type and a wet type according to the cooling method employed.

With the dry liner type, thin sleeve is pressed into place inside the cylinder. When worn, the liner can be easily replaced. With dry liner type there is no possibility of cooling water leakage. When replacing liners, it is necessary to measure the liners to make sure that the dimensions meet the requirement, because heat conduction decreases if the liners do not closely fit the cylinder block.

With cylinder liners, the wear is greatest near the top of piston ring at top dead center, and the wear decreases towards bottom dead center. This is due to piston slapping, side pressure, and thermal expansion.

The sulfur contained in light oil is burnt to form  $\text{SO}_2$ , part of which is oxidized into  $\text{SO}_3$ . When the water vapor in the burnt gas reaches the dew point, sulfuric acid is generated by the reaction ( $\text{H}_2\text{O} + \text{SO}_3 = \text{H}_2\text{SO}_4$ ). The carbon generated by combustion absorbs the sulfuric acid, and causes serious chemical corrosion.



Production Line Use	Measurement in Service		Service Parts	
	Cylinder Body Bore Diameter Average (mm)	Liner Outside Diameter (mm)	Liner Grade ( Without Piston )	Liner Bore Diameter (mm)
1	95.001 – 95.010	95.011 – 95.020	1-AX (For piston size AX)	93.035 – 93.050
			1-CX (For piston size CX)	93.051 – 93.066
2	95.011 – 95.020	95.021 – 95.030	2-AX (For piston size AX)	93.035 – 93.050
			2-CX (For piston size CX)	93.051 – 93.066
3	95.021 – 95.030	95.031 – 95.040	3-AX (For piston size AX)	93.035 – 93.050
			3-CX (For piston size CX)	93.051 – 93.066
4	95.031 – 95.040	95.041 – 95.050	4-AX (For piston size AX)	93.035 – 93.050
			4-CX (For piston size CX)	93.051 – 93.066

The 4JB1 engine employs chrome plated dry type cylinder liner. Marks are made on top of the cylinder block to indicate the cylinder liner diameter.

This information is important when cylinder liners need to be replaced. The production line stamped cylinder liner grade on the top of cylinder body, the cylinder liner outside diameter grade 1, 2, 3 and 4.

If you find cylinder liner outside diameter grade "1" on the cylinder body and piston outside diameter "B" on the piston top or result of measurement of each parts, you will select service parts grade for cylinder liner "1-AX" grade and piston "AX" grade.

### Inspection Item

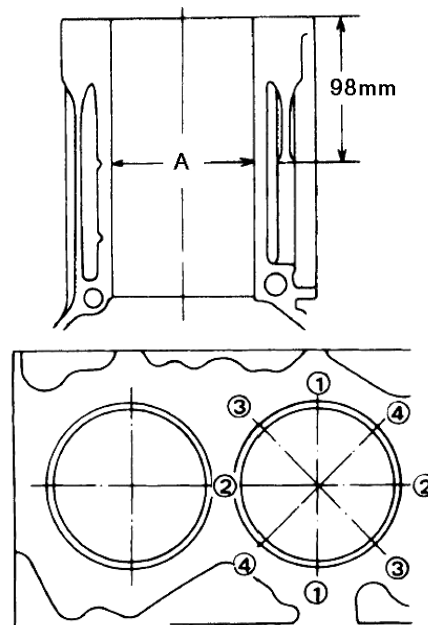
#### Cylinder Body Bore Measurement

Required Tool: Cylinder Indicator

Measure the point "A" across - , - , - and - .

Calculate the average value of the four measurements.

Service Standard: 95.001 - 95.040mm



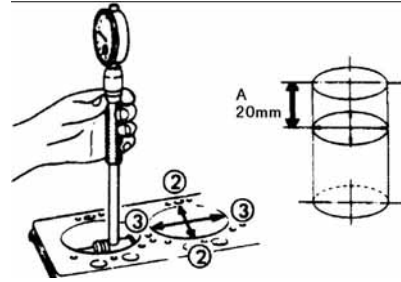
**Cylinder Liner Bore Measurement**

*Required Tool: Cylinder Indicator*

*Measure the point "A" across - - and - - .*

*Calculate the average value of the two measurements.*

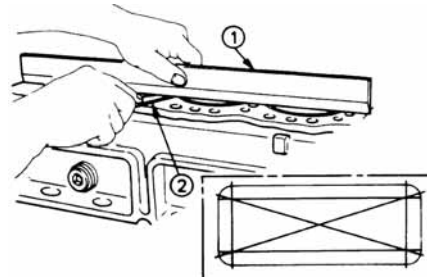
*Service Standard: 93.020 - 93.060mm*

**Cylinder Body Upper Face Warpage**

*Required Tool: Straight Edge, Feeler Gauge*

*Service Standard: 0.05mm or less*

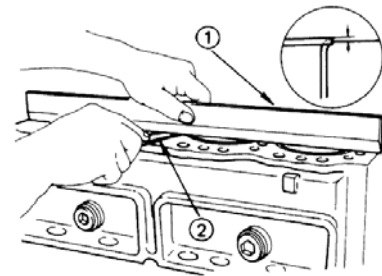
*Service Limit: 0.20mm*

**Cylinder Liner Projection**

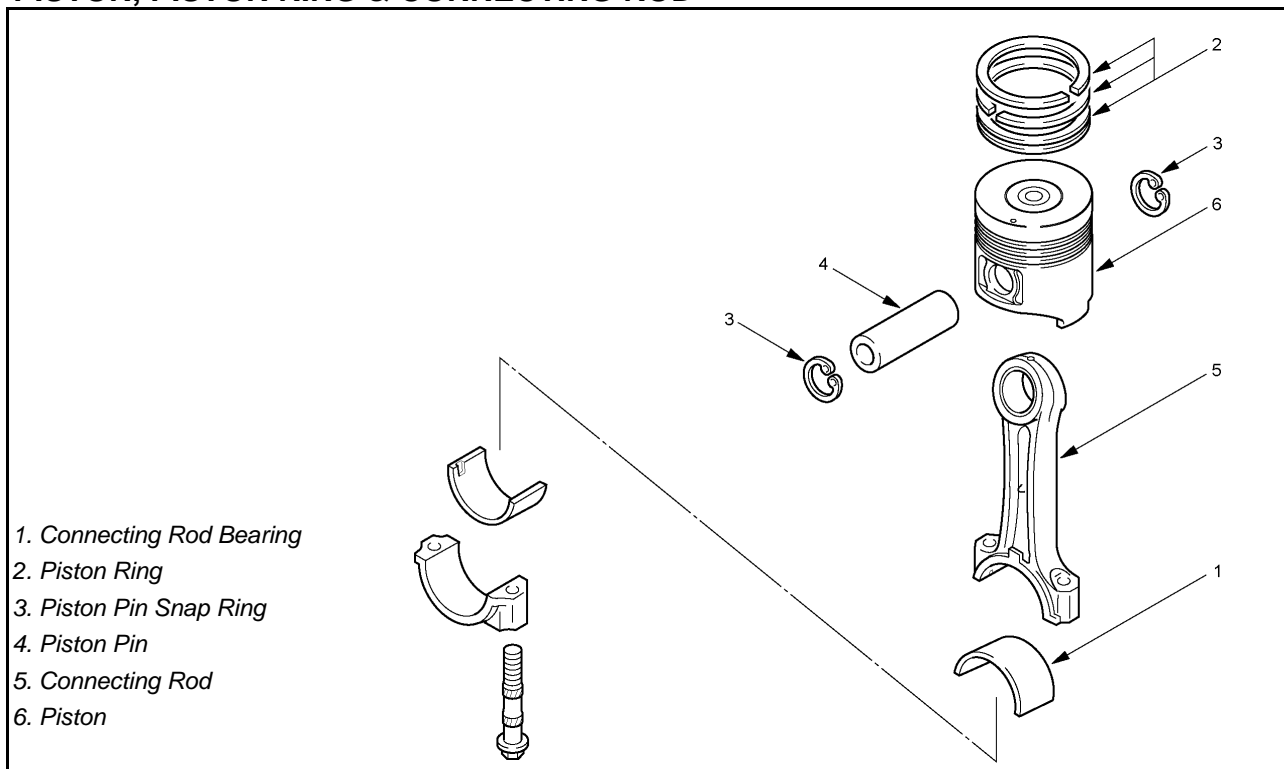
*Required Tool: Straight Edge, Feeler Gauge*

*Service Standard: 0 - 0.1mm*

*Service Limit: Between any two adjacent cylinders must not exceed 0.03mm*

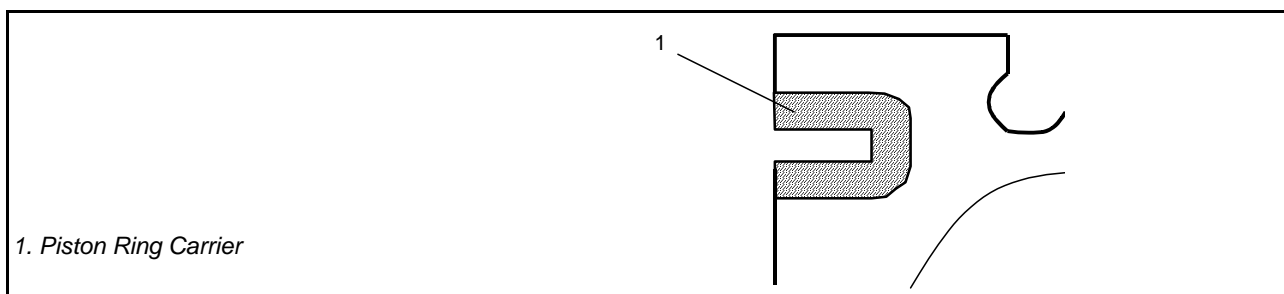


## PISTON, PISTON RING & CONNECTING ROD



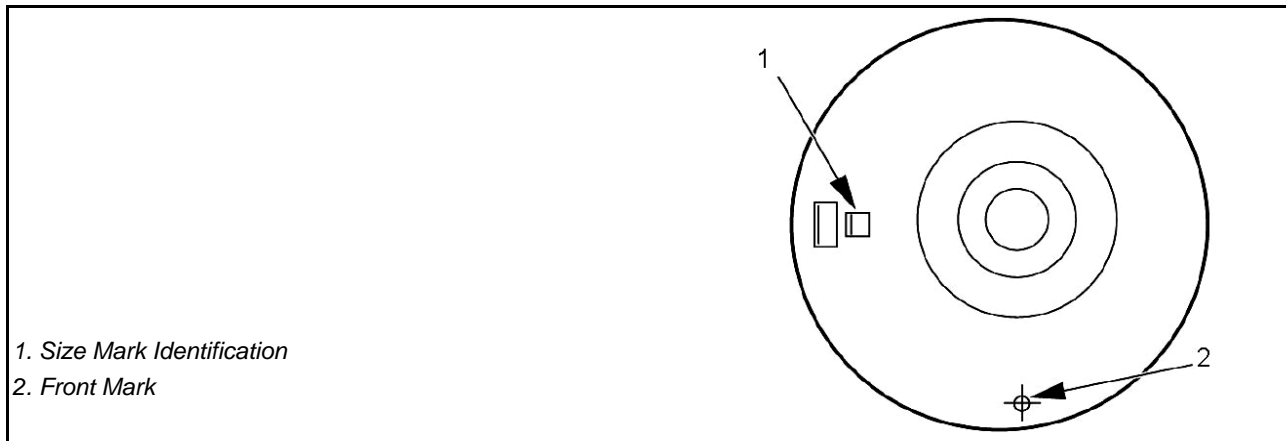
The 4JB1 engine accommodates the 4 pistons made of aluminum alloy. The pistons are exposed to high temperature and high pressure gas during the explosion stroke. The gas pressure is conveyed to the crankshaft, and most of the heat received is released to the cooling water via the cylinder walls. During operation, the pistons must undergo continuous reciprocating motion at high speed along the cylinder walls under side pressure, and at the same time maintain combustion pressure in the combustion chambers. Thus, various factors, such as piston weight, thermal expansion, shape, and dimensions, must be taken into account in designing the pistons.

With the offset piston, the piston pin center is offset a certain amount to the thrust side of the bore to reduce side forces on the piston and this marks for reduced piston slapping noise.



When the piston temperature rises, piston expansion will increase and this causes piston seizure or ring sticking. Then ring groove wear will increase, and reduce the gas sealing performance. Therefore, particularly, in the case of aluminum alloy pistons, a special cast iron ring carrier is cast into the top ring groove which is exposed to a great heat load and this improves wear resistance of the ring groove.



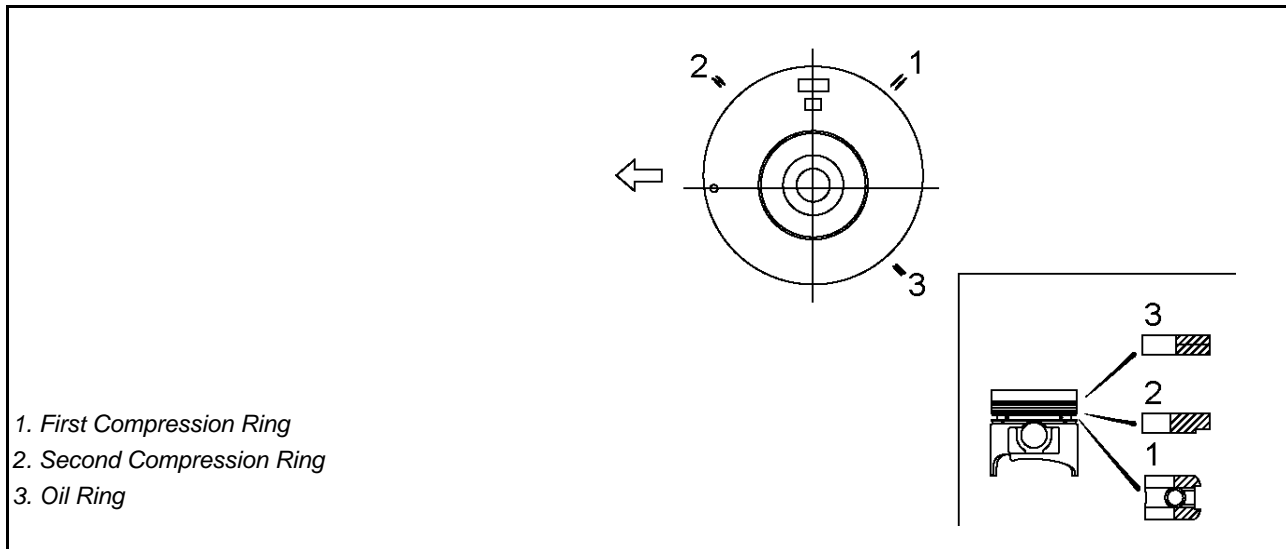


Size Mark	Outside Diameter (mm)	Service Grade	Service Piston Diameter (mm)
A	92.985 – 92.994	AX	92.989 – 93.004
B	92.995 – 93.004		
C	93.005 – 93.014	CX	93.005 – 93.020
D	93.015 – 93.024		

The piston diameter is essential information in case an engine is overhauled. A, B, C and D are the marks used to identify the piston diameter. These marks can be found at the top of the piston. Using the above diagram you can order the correct piston. The tolerance between the piston and the cylinder liner is important to assemble the engine.

**Note:**

The cylinder liner installation procedure may result in slight decreases in cylinder liner clearances. Always measure the cylinder liner clearance after installation to be sure that it is correct.



The aluminum alloy pistons of 4JA1 engine have an integrated toroidal shaped combustion chamber with centrally arranged swirl chambers.

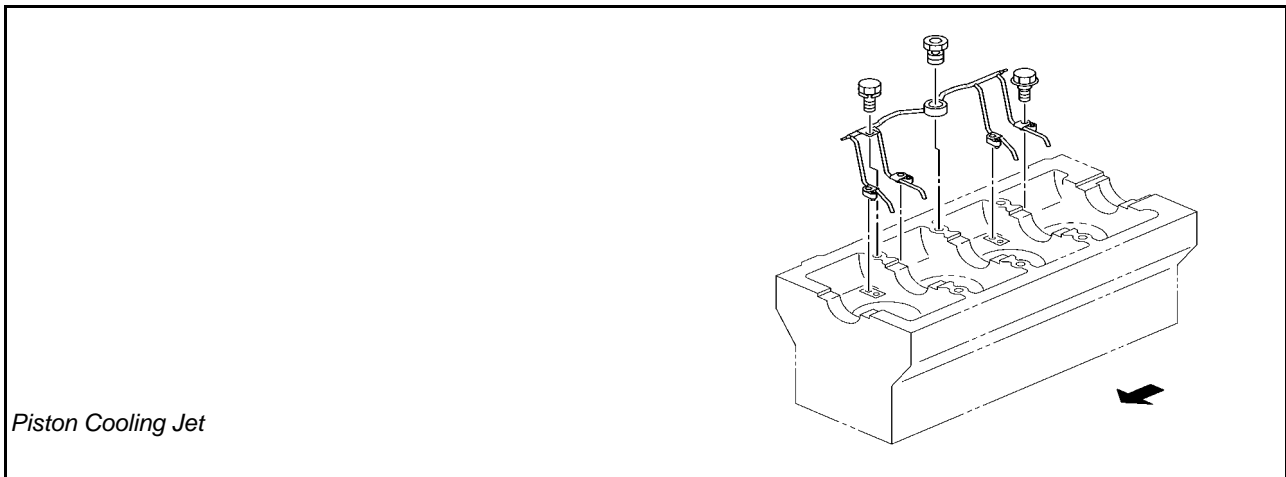
Two piston rings guarantee a fast build up of air pressure and one oil ring prevents oil from the sump entering the combustion chamber.

The piston rings are fitted into the ring grooves around the pistons to keep the combustion chamber airtight between the piston and cylinder. They also conduct the heat received by the pistons to the cylinder walls. The piston rings scrap off the oil sprayed on the cylinder walls to leave the minimum required oil film to lubricate the pistons and piston rings, and prevent excess oil from entering the combustion chambers.

The rings used mainly to maintain combustion pressure are called compression rings, and those used for scraping off excess oil, are known as oil rings.

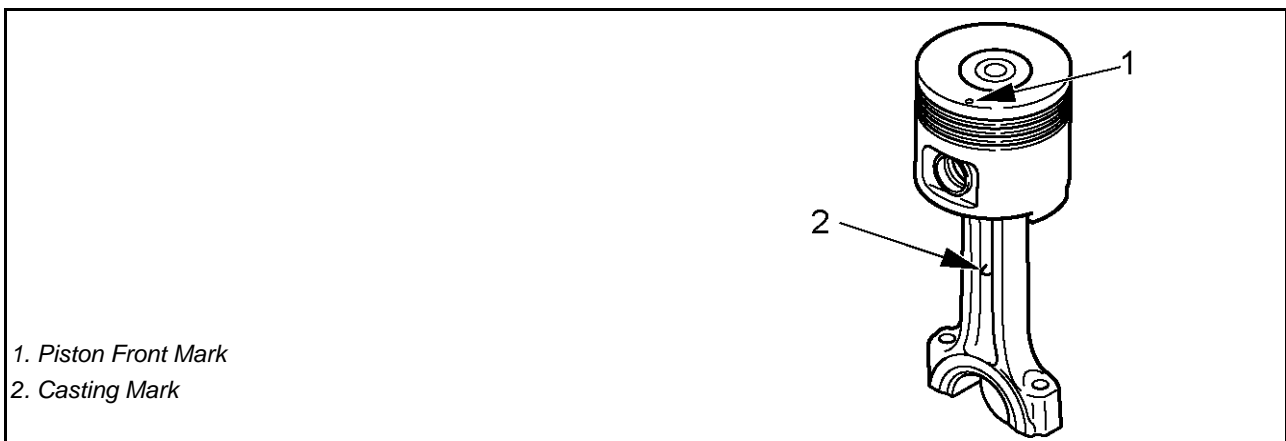
The compression rings alternately hit the top and bottom of the ring grooves as the pistons run up and down. During the explosion stroke the high pressure gas pushes down the rings. This is the only time they move ahead of the pistons. The compression rings also increase combustion pressure as the high pressure gas pushes the rings towards the cylinder walls from behind the rings.

Oil rings are tapered or grooved on their sliding surface to increase unit pressure so that a close fit with the cylinder walls can be maintained by their own tension. To meet demands for oil rings with greater unit pressure suitable for high speed engine, oil ring with expander have come into general use.



Four oil jets are placed under the pistons to cool the piston bottom. The jets are supplied with oil, directly from the oil pump.

The piston bottom is special shaped to guide the oil along the entire surface to ensure a sufficient cooling.



The connecting rod is a rod which connects a piston to the crankshaft, and transmits explosion forces imposed on the piston, to the crankshaft. The connecting rod is made of forging metal to resist compression, tension and bending forces.

One end of the connecting rod is connected to the piston with a piston pin, and is called the "small end".

While the other end is called "big end" generally a bushing is press-fitted to the small end, however the big end is divided into two pieces, and they are tightened to the crankshaft with bolts.

**Inspection Item****Piston Diameter & Piston Clearance Measurement**

Required Tool: Micrometer

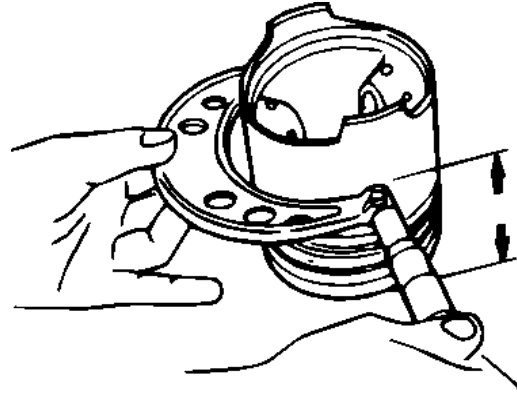
Measurement Point: 74mm

Grade A: 92.985 - 92.994mm

Grade B: 92.995 - 93.004mm

Grade A: 92.985 - 92.996mm

Grade A: 92.985 - 92.997mm

**Piston Ring & Ring Groove Clearance**

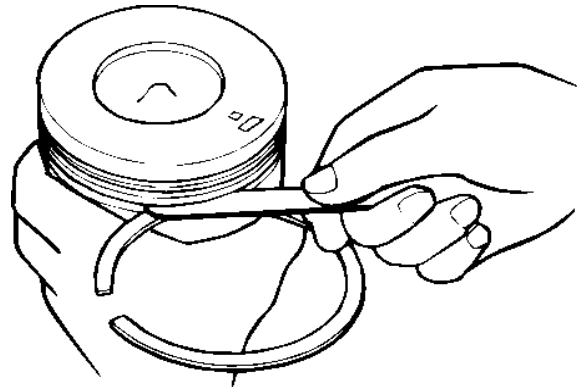
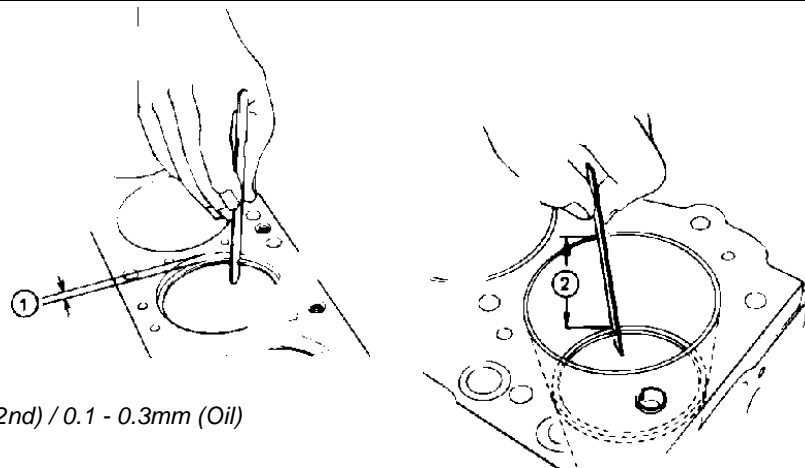
Required Tool: Feeler Gauge

Service Standard: 0.090 - 0.125mm (1st)

0.050 - 0.075mm (2nd)

0.03 - 0.07mm (Oil)

Service Limit: 0.150mm

**Piston Ring Gap**

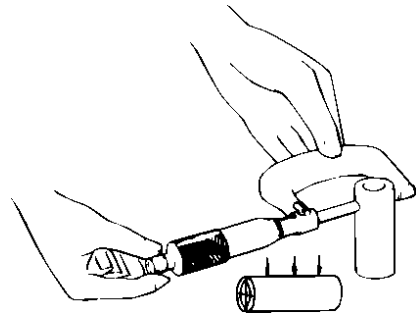
Required Tool: Feeler Gauge

Service Standard: 0.2 - 0.4mm (1st & 2nd) / 0.1 - 0.3mm (Oil)

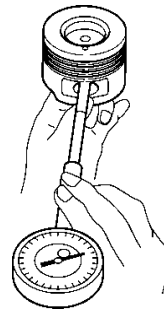
Service Limit: 1.5mm

**Piston Pin Diameter**

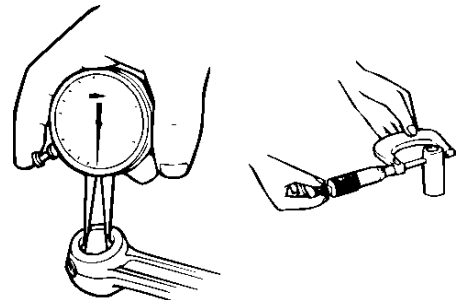
*Required Tool: Micrometer*  
*Service Standard: 30.995 - 31.000mm*  
*Service Limit: 30.970mm*

**Piston Pin & Piston Clearance**

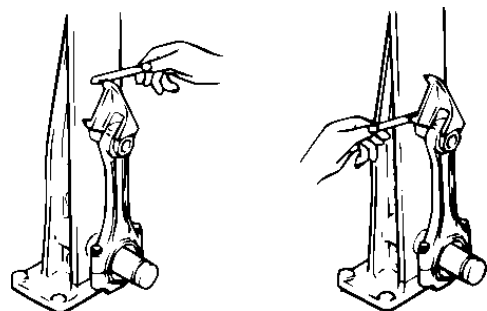
*Required Tool: Cylinder Indicator*  
*Service Standard: 0.002 - 0.004mm*  
*Service Limit: 0.04mm*

**Piston Pin & Connecting Rod Small End Bushing Clearance**

*Required Tool: Caliper Calibrator, Dial Indicator*  
*Service Standard: 0.008 - 0.020mm*  
*Service Limit: 0.050mm*

**Connecting Rod Alignment**

*Required Tool: Connecting Rod Aligner, Feeler Gauge*  
*Service Standard: 0.08mm or Less (Bend) / 0.05mm or Less (Twist)*  
*Service Limit: 0.20mm (Bend) / 0.15mm (Twist)*

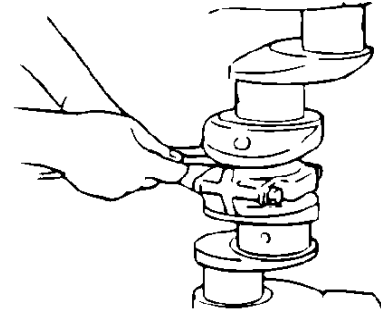
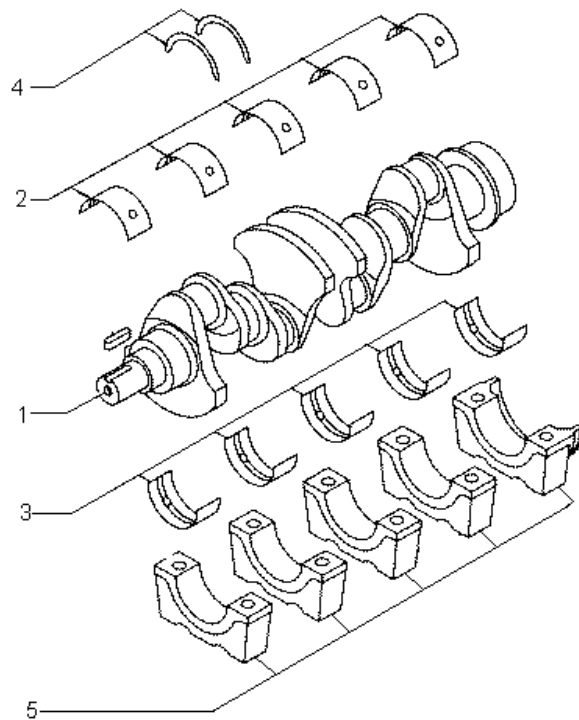


**Connecting Rod Thrust Clearance**

*Required Tool: Feeler Gauge*

*Service Standard: 0.23mm*

*Service Limit: 0.35mm*

**CRANKSHAFT**

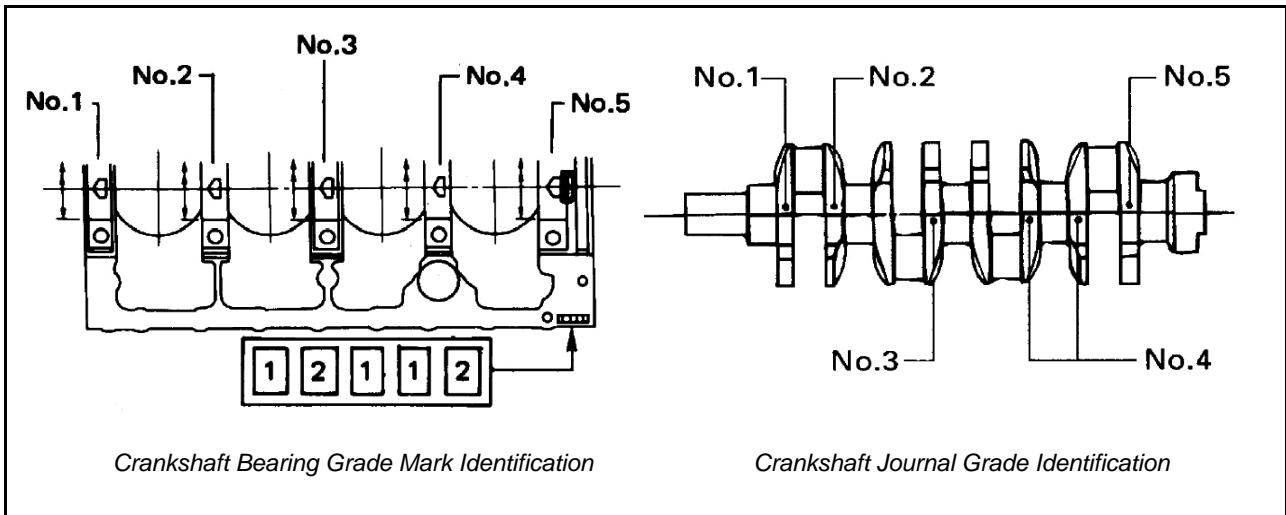
1. Crankshaft
2. Crankshaft Upper Bearing
3. Crankshaft Lower Bearing
4. Crankshaft Thrust Bearing
5. Crankshaft Bearing Cap

The crankshaft is the main shaft of the engine which takes the pressure of burnt gas generated during engine operation at the crankshaft pins via the connecting rods, converts the power into rotary motion, and transmits it to the outside.

The crankshaft balance relative to its axial center is maintained by adjusting the balance weights, specially by drilling holes in them.

**Note:**

To increase crankshaft strength, tufftriding (nitriding treatment) has been applied. Because of this, it is not possible to regrind the crankshaft surfaces. Therefore, under size bearing are not available.

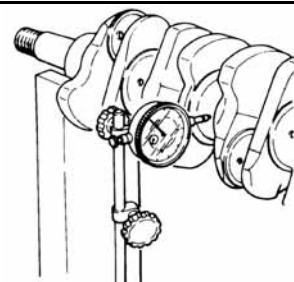


Main Bering Bore Diameter (mm)		Crankshaft Main Journal Diameter (mm)		Crankshaft Bering Size	Oil Clearance (mm)
Grade	Main Bearing Bore Diameter (mm)	Size Mark	Outside Diameter		
1	73.992 - 74.000	1 or	69.927 - 69.932	4	0.045 - 0.061
		2 or	69.922 - 69.927	4	0.050 - 0.066
		3 or	69.917 - 69.922	5	0.052 - 0.068
2	73.983 - 73.992	1 or	69.927 - 69.932	2	0.042 - 0.059
		2 or	69.922 - 69.927	3	0.044 - 0.061
		3 or	69.917 - 69.922	4	0.046 - 0.063
3	73.975 - 73.983	1 or	69.927 - 69.932	1	0.037 - 0.053
		2 or	69.922 - 69.927	2	0.039 - 0.055
		3 or	69.917 - 69.922	2	0.044 - 0.060

**Inspection Item**

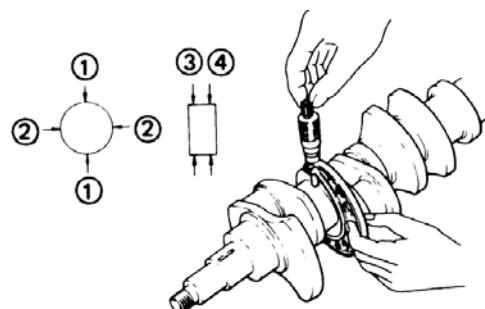
**Crankshaft Run-out**

Required Tool: Dial Indicator  
 Service Standard: 0.05mm or Less  
 Service Limit: 0.08mm



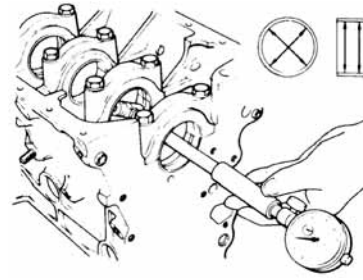
**Crankshaft & Crank Pin Diameter**

Required Tool: Micrometer  
 Measure the point , across - and - .  
 Service Standard: 69.917 - 69.932mm (Crankshaft Journal)  
 52.915 - 52.930mm (Crank Pin)  
 0.05mm or Less (Uneven Wear)  
 Service Limit: 69.91mm (Crankshaft Journal)  
 52.90mm (Crank Pin)  
 0.08mm (Uneven Wear)

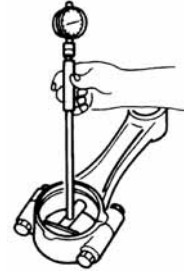


**Crankshaft Journal & Bearing Clearance**

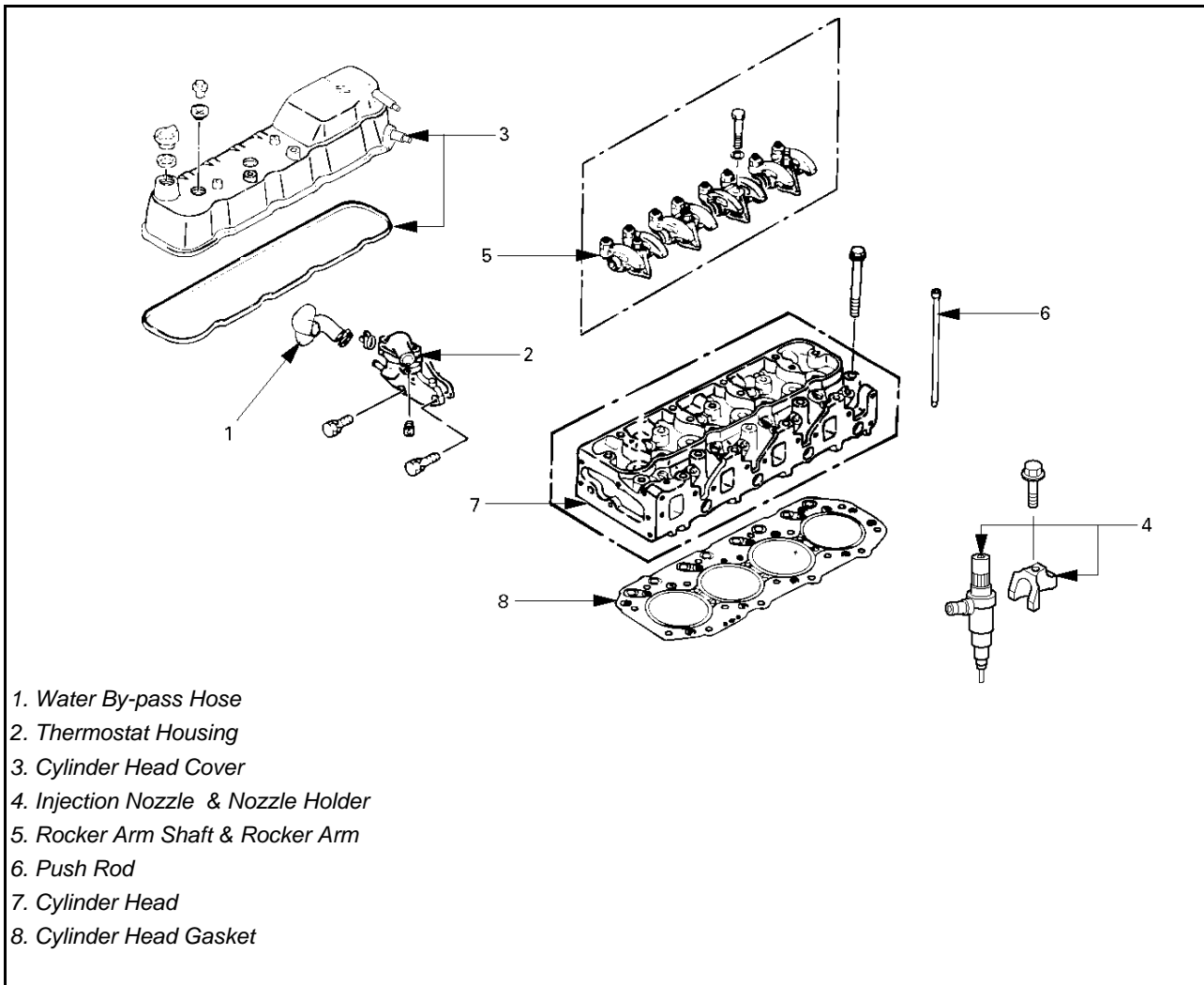
*Required Tool: Cylinder Indicator*  
*Service Standard: 0.035 - 0.080mm*  
*Service Limit: 0.110mm*

**Connecting Rod Bearing Inside Diameter**

*Required Tool: Cylinder Indicator*  
*Service Standard: 0.029 - 0.066mm*  
*Service Limit: 0.100mm*





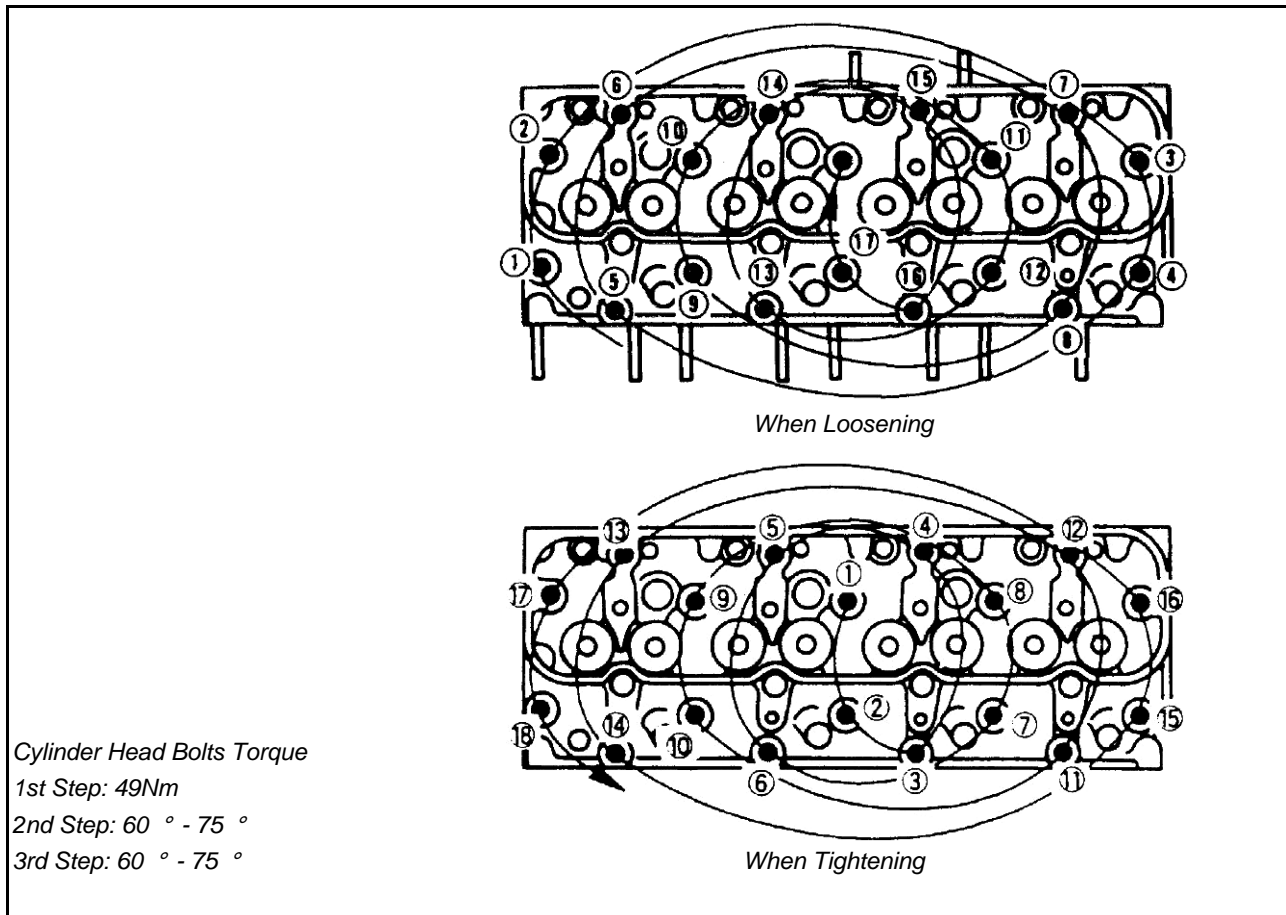
**CYLINDER HEAD**

The cylinder head is a vital component which forms the combustion chamber together with the cylinder block and piston. It is fitted with a valve mechanism and injection nozzles.

The cylinder head is made of cast iron having great heat resistance and strength. It is exposed to burnt gas at high temperatures, and therefore must be airtight against compression and explosion pressures.

The exhaust valves and injection nozzles, in particular, have complex water cooling passages to cool them uniformly since they are heated to high temperatures.

The cylinder head is mounted on the cylinder block with a gasket between them. Unless the mounting bolts are tightened evenly in the proper order, problems such as burnt gas leakage and gasket damage can result. Because the cylinder head is a casting, it can in some cases become distorted over a long period. It is necessary, therefore, to check the flatness of its seating surface whether it is removed or installed.



Loosen the cylinder head bolts in numerical order a little at a time. They need to be checked for cracks and damages when dismantled.

The cylinder head bolts are tightened according to the torque tightening method in numerical order.

Gasket Grade Mark	Piston Projection	Gasket Thickness (mm)
	0.758 – 0.813	1.60
	0.813 – 0.859	1.65
	0.859 – 0.914	1.70

A cylinder gasket has to seal the combustion gases, lubricant oil and cooling water at the same time. The cylinder head gasket is of a metal 4 layer type of which the thickness can be identified even when the cylinder head is assembled to the engine.

The thickness of the cylinder head gasket can be retrieved from three different marks that are located under the intake manifold. In case of an overhaul of the engine the thickness of the cylinder head gasket can be determined by measuring the piston projection.

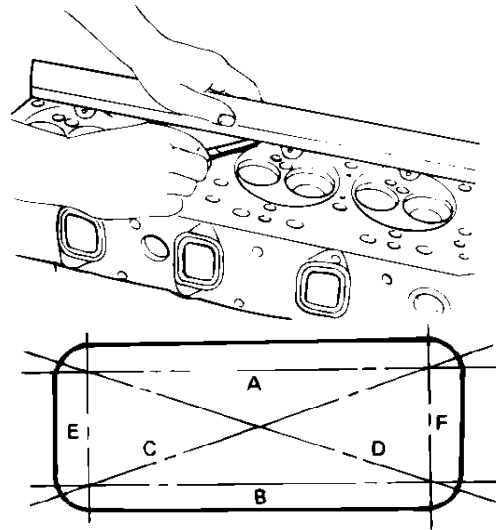
**Inspection Item****Cylinder Head Lower Face Warpage**

*Required Tool: Straight Edge, Feeler Gauge*

*Service Standard: 0.05mm or Less*

*Service Limit: 0.20mm*

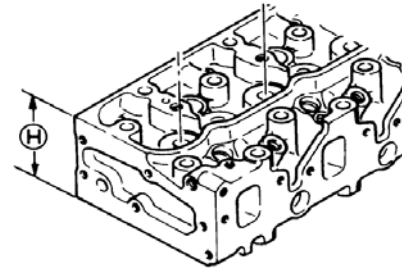
*Maximum Grinding Allowance: 0.30mm*

**Cylinder Head Height**

*Required Tool: Height Gauge*

*Service Standard: 91.95 - 92.05mm*

*Service Limit: 91.55mm*

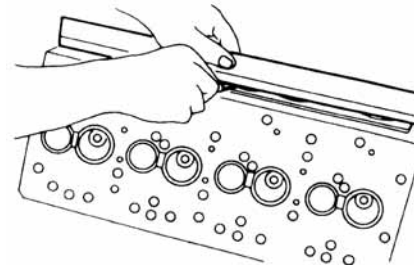
**Manifold Fitting Face Warpage**

*Required Tool: Straight Edge, Feeler Gauge*

*Service Standard: 0.05mm or Less*

*Service Limit: 0.20mm*

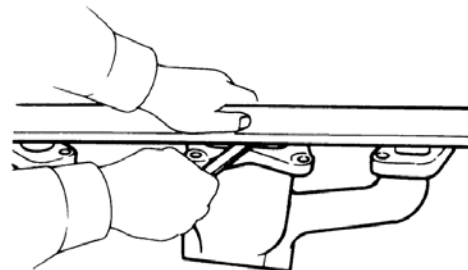
*Maximum Grinding Allowance: 0.40mm*

**Exhaust Manifold Warpage**

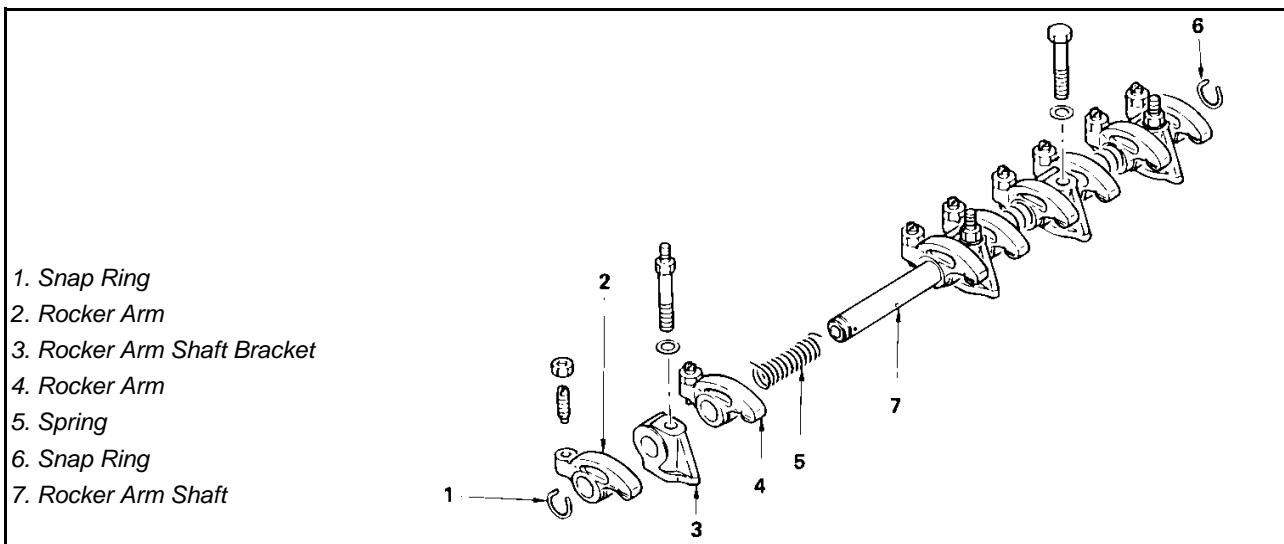
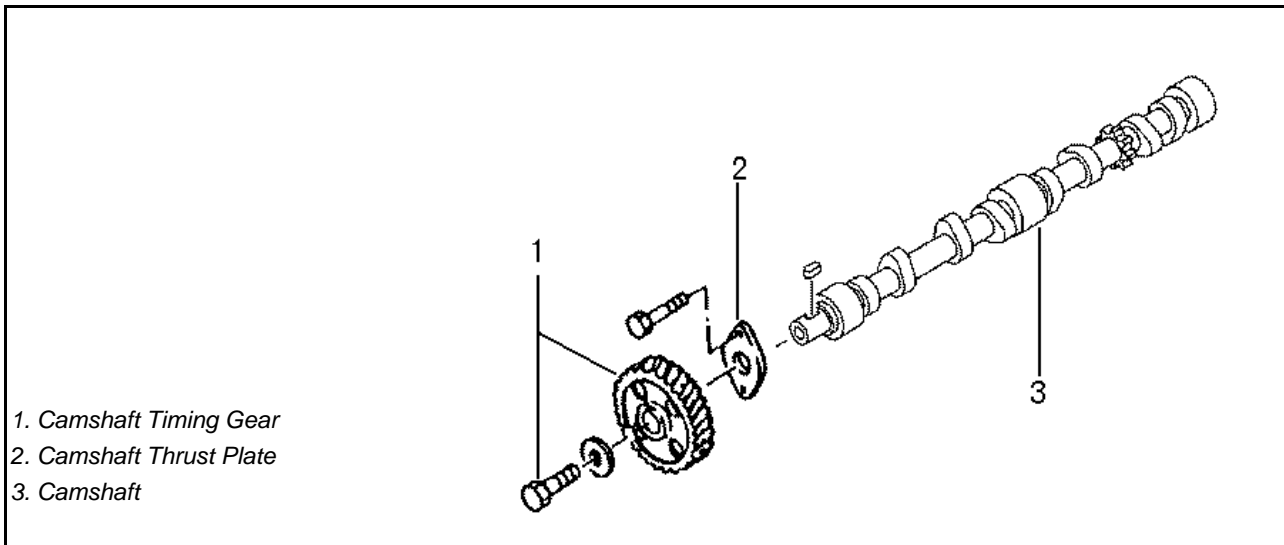
*Required Tool: Straight Edge, Feeler Gauge*

*Service Standard: 0.05mm or Less*

*Service Limit: 0.20mm*



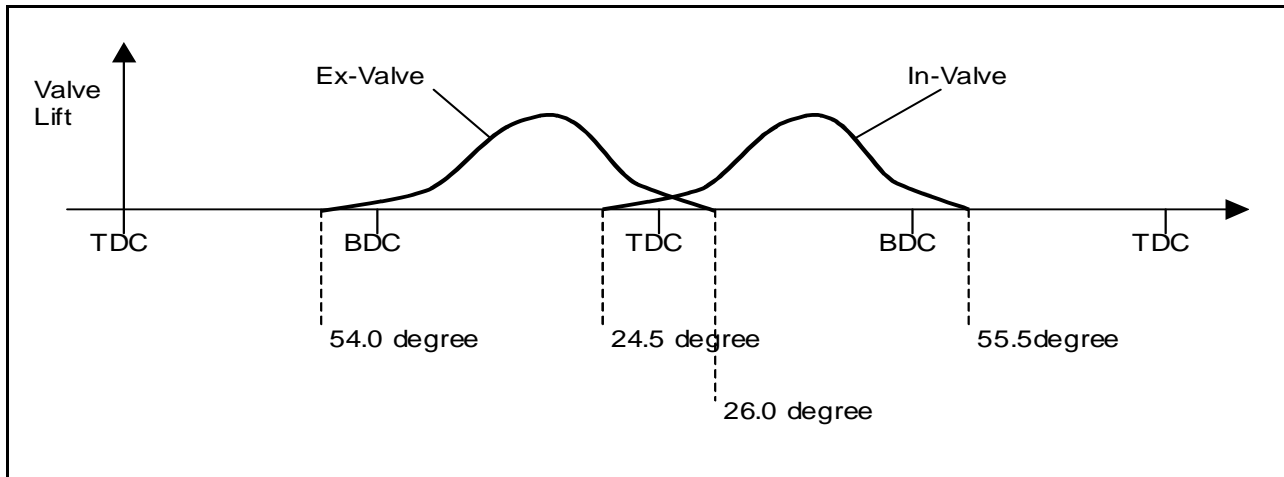
## VALVE MECHANISM



The valve mechanism opens and closes the intake and exhaust valves at the correct moment to raise intake and exhaust efficiency and assure satisfactory delivery of engine performance. The crankshaft indirectly of engine performance. The crankshaft indirectly drives the camshaft through a gear. It consists of a crank gear, idler gear, camshaft gear, camshaft, tappets, push rods, rocker arms, valves and valve springs.

The camshaft has intake and exhaust cams for every cylinder.

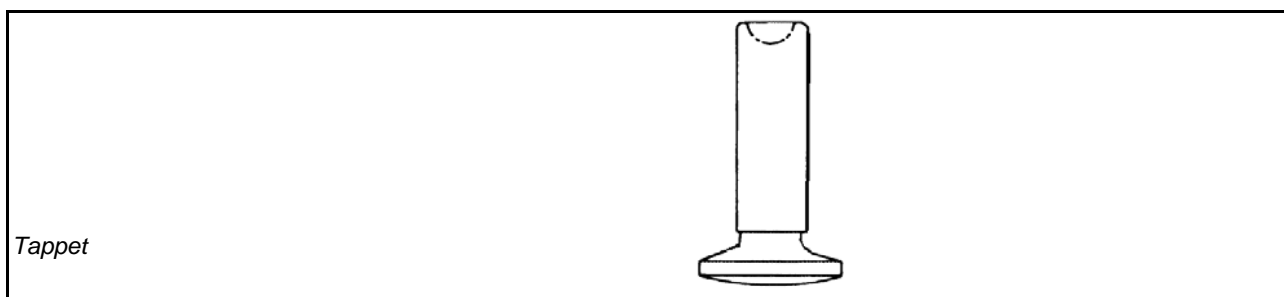
Engine performance, involving valve opening and closing timing and firing order, depends particularly on the cams. The rocker arm is a lever moving about the rocker arm shaft, and conveys the motion of the push rod driven by the cam to open and close the valve. The purpose of the camshaft and rocker arms is to open and close the intake and exhaust valves to control the combustion timing. If these parts are worn or damaged, it will seriously affect engine performance.



Valve timing means the valve opening and closing operation peculiar to an engine, and can be expressed by the crankshaft rotary angle. The valves do not open and close exactly at top dead center and bottom dead center because the intake air would not flow in immediately upon the opening of the intake valve. There is some delay due to the fact that the intake air has a moment of inertia and that the intake air passage area does not instantaneously increase. It follows, therefore, more air can be drawn into the cylinder by opening the valve slightly before top dead center.

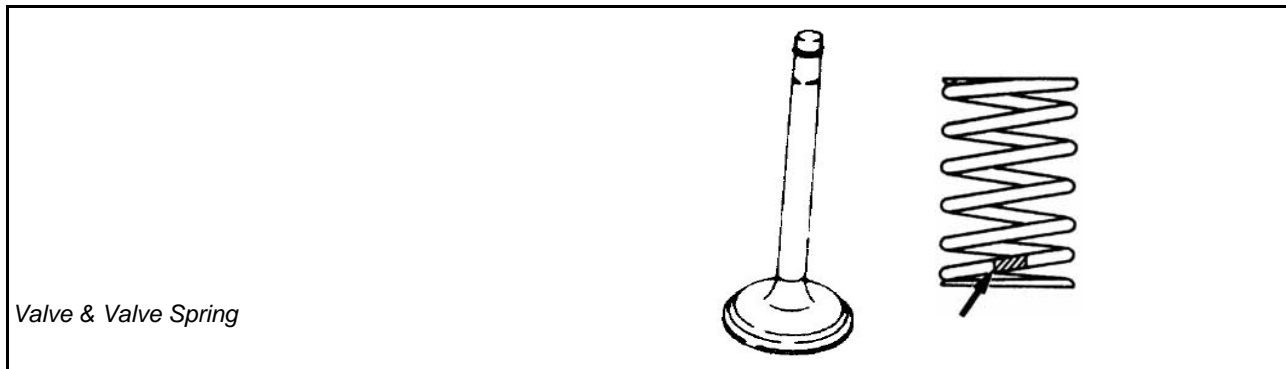
Air keeps flowing into the cylinder as long as there is a negative pressure, so the intake valve is closed after the piston begins to rise from bottom dead center. The exhaust valve is opened before bottom dead center to assure smooth discharge of exhaust gas, and closed after top dead center, as the combustion chamber pressure is high.

It is known from the above description that there is a overlap period where both the intake and exhaust valves are open near top dead center. This is to discharge the remaining burnt gas by the intake of a fresh charge of air. This condition is known as valve overlap. The timing is controlled by the camshaft.



Tappets operate to convey the cam action to the valves through push rod and rocker arms. Tappets have to withstand large forces these are the pressure of burnt gas, the tensile force of valve springs and inertia force of moving parts.

Therefore, tappets are made of special cast iron, and the surface in contact with the cam is hardened by a suitable heat treatment. Furthermore, the bottom surfaces of the tappet is machined to a spherical surface to prevent the cam and tappet from deviating wear. To put it other way, each cam and tappet are offset to turn the tappet during operation and this makes for even contact with each other, and to improve the contact condition.



The purpose of the intake and exhaust valves is to assist passage of as much air and discharge gas as possible in the very short time of a single cycle of this piston. In addition the valves prevent high pressure gas leaking while in the are the closed position being able to open and close correctly despite exposure to high temperature burnt gas. Further, they have to withstand operation over an extended period.

The valves supported by valve guides, operate only in the vertical plane. The valve face is machined to angle of  $45^\circ$  to seal the gas and convey heat to the valve seat when the valve is closed. The valves are made of heat resistant steel because the intake valves have to withstand temperatures up to about  $400^\circ$  and the exhaust valves operate in a temperature from  $500^\circ$  to  $800^\circ$ .

The valve spring holds the valve to the valve seat while it is closed to keep the combustion chamber airtight. Valve springs hold the working parts of the intake and exhaust valve mechanism to the cams by spring tension while the valves are in motion, thereby correctly opening and closing the valve according to the cam profile.

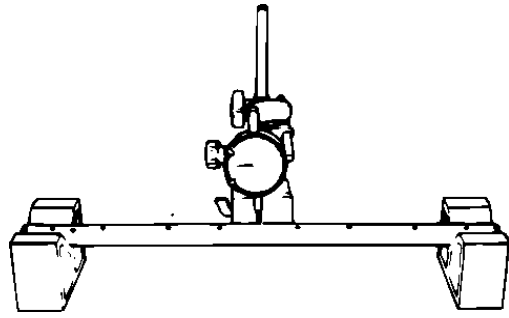
The valve spring is generally a combination of two coil springs, that is, an inner and outer, each having a different tension value. This prevents valve surge during high speed engine operation.

If the valve spring end is suddenly compressed by the rocker arm, the spring is not uniformly compressed, but is compressed from one end to the other. If this cycle is over-lapped with forced vibration from the cam, the amplitude grows, and sever stress is partially applied, possibly causing spring fatigue or breakage. This phenomenon is called valve spring surge.

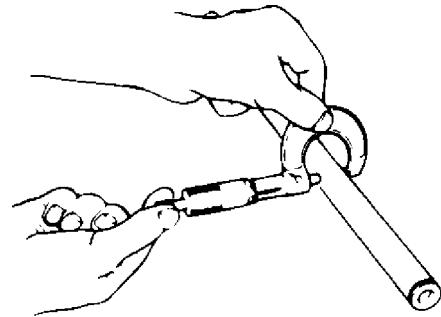
This phenomenon alters the valve spring opening and closing position and can result in reduced output power, increase noise, or in the worst case, breakage of the intake and exhaust valve mechanism. This can be prevented by using double springs.

**Inspection Item****Rocker Arm Shaft Run-out**

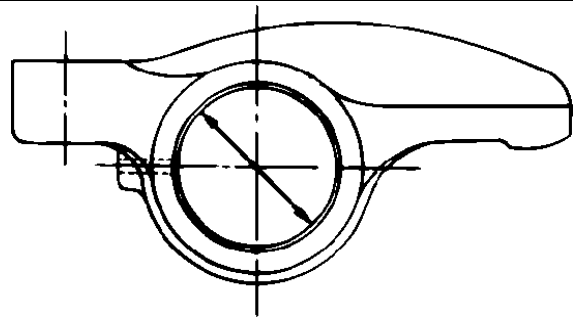
Required Tool: Dial Indicator, V-Block  
 Service Limit: 0.2mm

**Rocker Arm Shaft Outside Diameter**

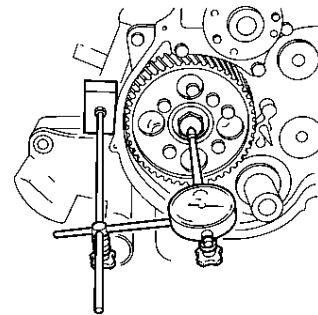
Required Tool: Micrometer  
 Service Standard: 18.98 - 19.00mm  
 Service Limit: 18.90mm

**Rocker Arm Inside Diameter**

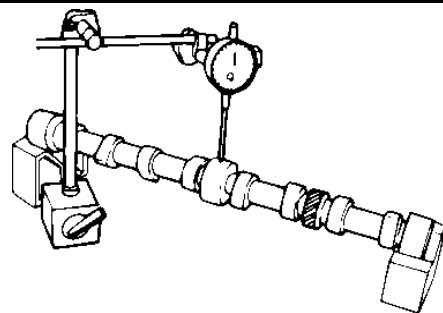
Required Tool: Caliper Calibrator, Dial Indicator  
 Service Standard: 19.010 - 19.030mm  
                           0.01 - 0.05mm (Clearance)  
 Service Limit: 19.100mm  
                           0.20mm (Clearance)

**Camshaft End Play**

Required Tool: Dial Indicator  
 Service Standard: 0.08mm  
 Service Limit: 0.20mm

**Camshaft Run-out**

Required Tool: Dial Indicator, V-Block  
 Service Standard: 0.02mm or Less  
 Service Limit: 0.10mm



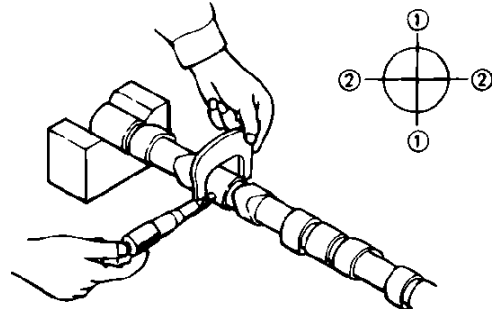
**Camshaft Journal Diameter**

*Required Tool: Micrometer*

*Measure the point across 1 - 1 & 2 - 2*

*Service Standard: 49.945 - 49.975mm*

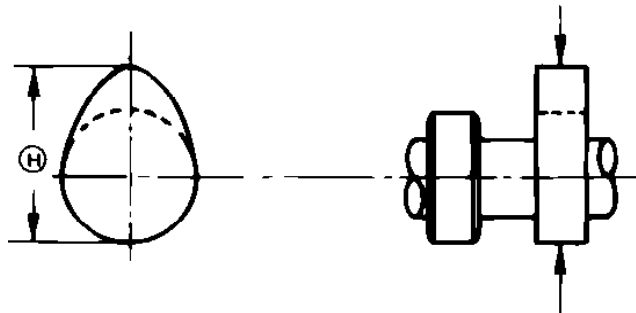
*Service Limit: 49.60mm*

**Cam Height**

*Required Tool: Micrometer*

*Service Standard: 42.016mm*

*Service Limit: 41.65mm*

**Camshaft Bearing Inside Diameter**

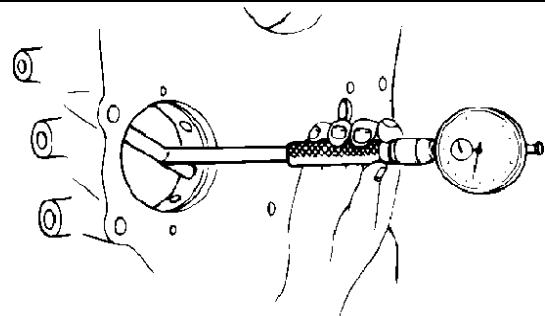
*Required Tool: Cylinder Indicator*

*Service Standard: 50.00 - 50.03mm*

*0.055mm (Camshaft Bearing Clearance)*

*Service Limit: 50.08mm*

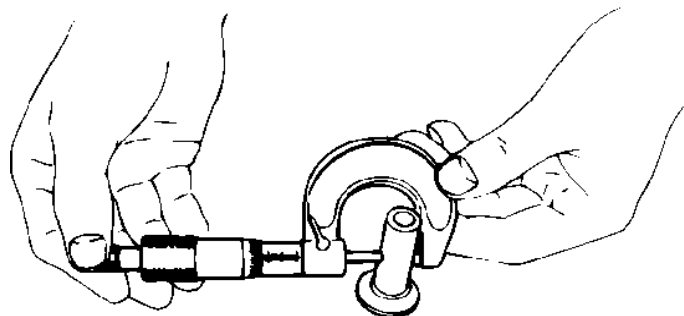
*0.12mm (Camshaft Bearing Clearance)*

**Tappet Outside Diameter**

*Required Tool: Micrometer*

*Service Standard: 12.97 - 12.99mm*

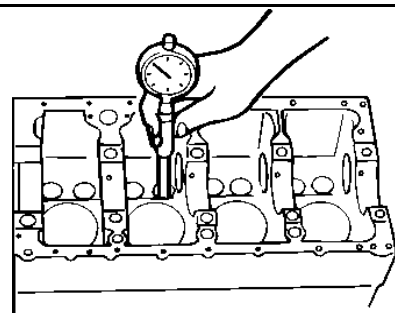
*Service Limit: 12.95mm*

**Tappet & Cylinder Body Clearance**

*Required Tool: Cylinder Indicator*

*Service Standard: 0.03mm*

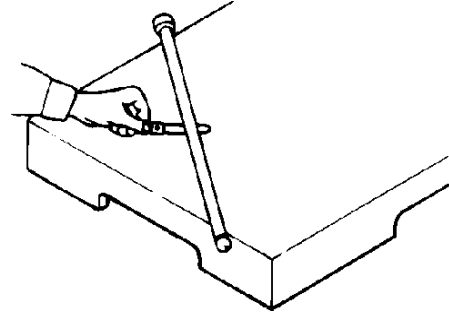
*Service Limit: 0.10mm*



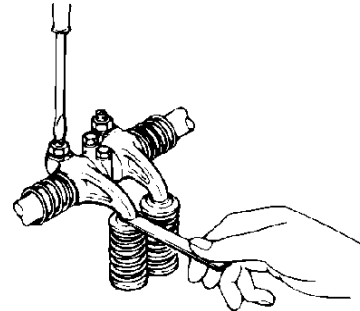


**Push Rod Curvature**

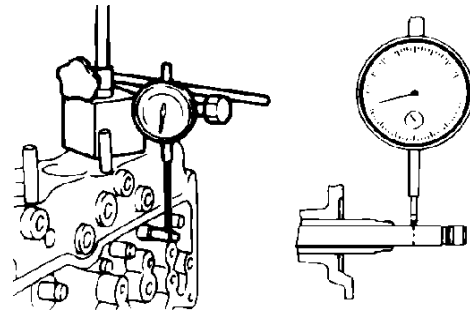
Required Tool: Feeler Gauge  
 Service Limit: 0.4mm or Less

**Valve Clearance**

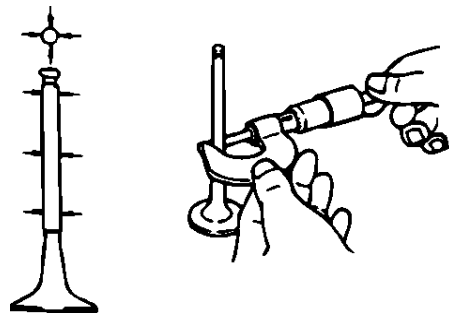
Required Tool: Feeler Gauge  
 Service Standard: 0.4mm (In & Ex)

**Valve Stem & Valve Guide Clearance**

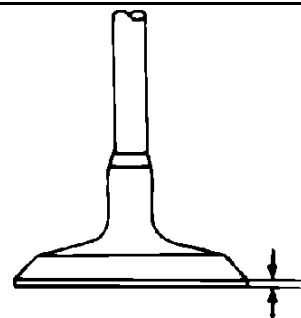
Required Tool: Dial Indicator with Stand  
 Service Standard: 0.039 - 0.069mm (In) / 0.064 - 0.096mm (Ex)  
 Service Limit: 0.200mm (In) / 0.250mm (Ex)

**Valve Stem Outside Diameter**

Required Tool: Micrometer  
 Service Standard: 7.946 - 7.961mm (In) / 7.921 - 7.936mm (Ex)  
 Service Limit: 7.880mm (In) / 7.850mm (Ex)

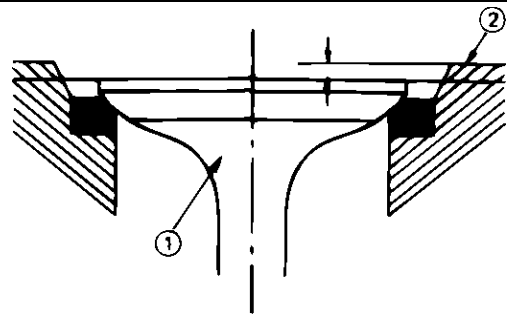
**Valve Thickness**

Required Tool: Vernier Caliper  
 Service Standard: 1.79mm (In) / 1.83mm (Ex)  
 Service Limit: 1.50mm

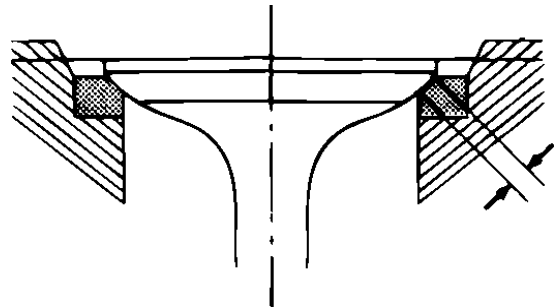


**Valve Depression**

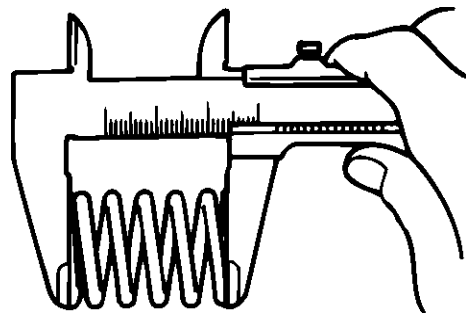
Required Tool: Straight Edge, Depth Gauge  
 Service Standard: 0.73mm (In) / 1.28mm (Ex)  
 Service Limit: 0.70mm (In) / 1.20mm (Ex)

**Valve Contact Width**

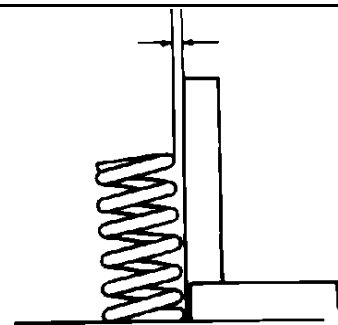
Required Tool: Vernier Caliper  
 Service Standard: 1.7mm (In) / 2.0mm (Ex)  
 Service Limit: 2.2mm (In) / 2.5mm (Ex)

**Valve Spring Free Height**

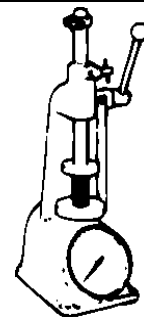
Required Tool: Vernier Caliper  
 Service Standard: 48.0mm  
 Service Limit: 47.1mm

**Valve Spring Squareness**

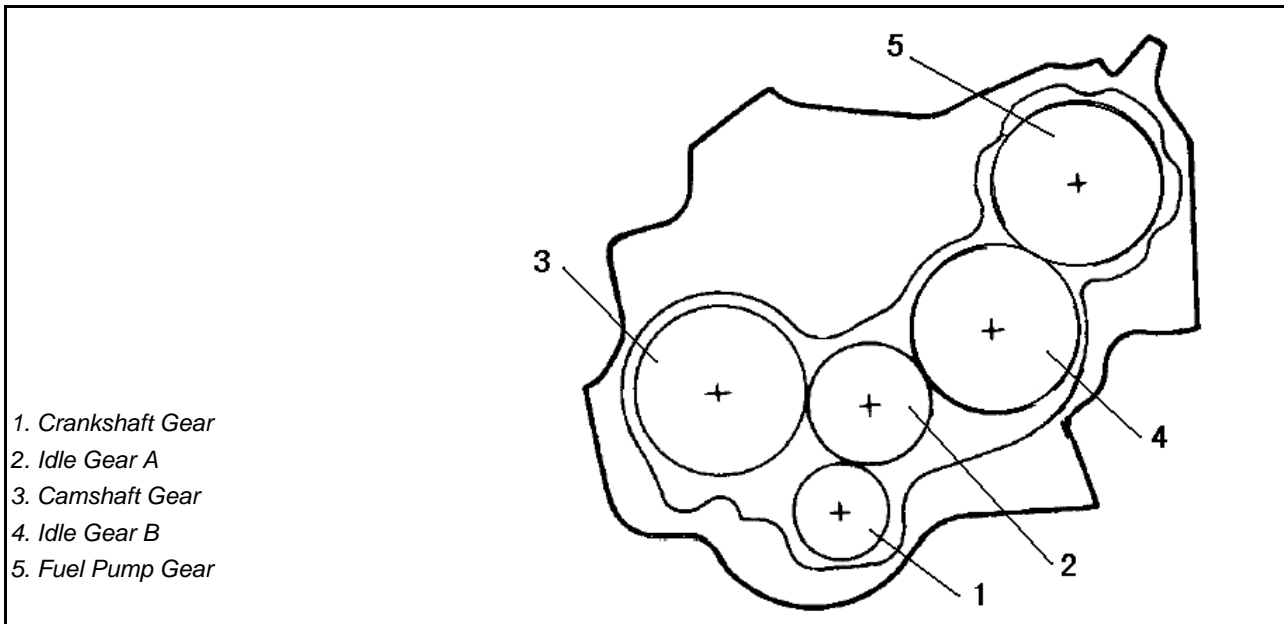
Required Tool: Steel Square  
 Service Limit: 1.7mm

**Valve Spring Tension**

Required Tool: Spring Tester  
 Compressed Height: 38.9mm  
 Service Standard: 296.2N  
 Service Limit: 257.9N

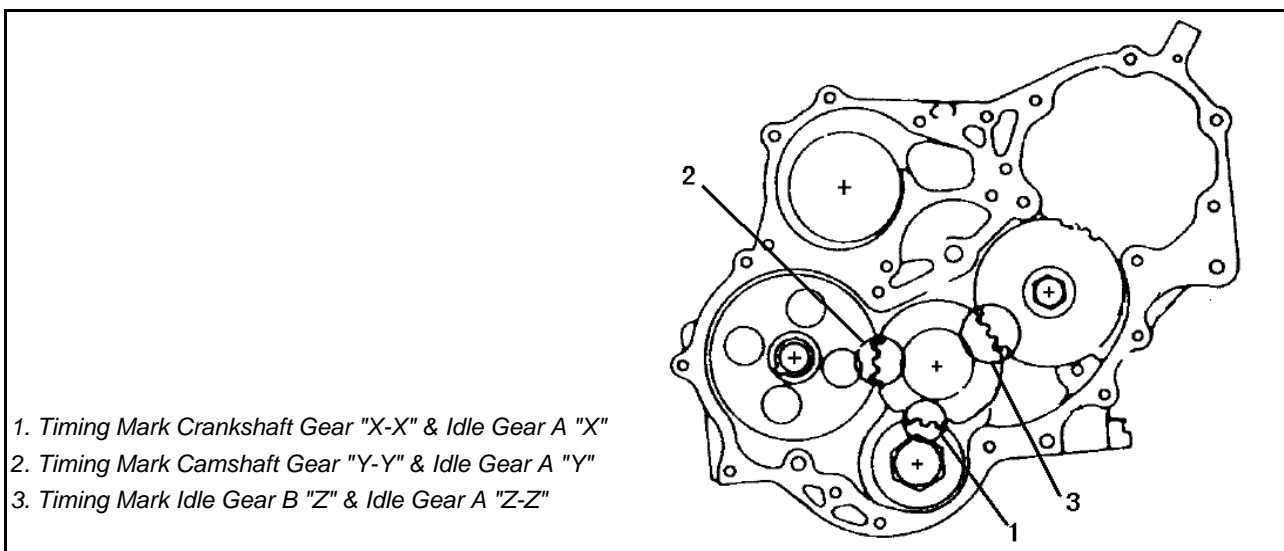


## TIMING GEAR TRAIN



The 4JB1-TC engine used a gear type timing system. Benefits of a gear type timing system are;

- Stiff and compact construction
- Maintenance free
- Direct power drive



The crankshaft gear (21 teeth) has a timing mark "X-X" that corresponds with a timing mark on the idler gear A.

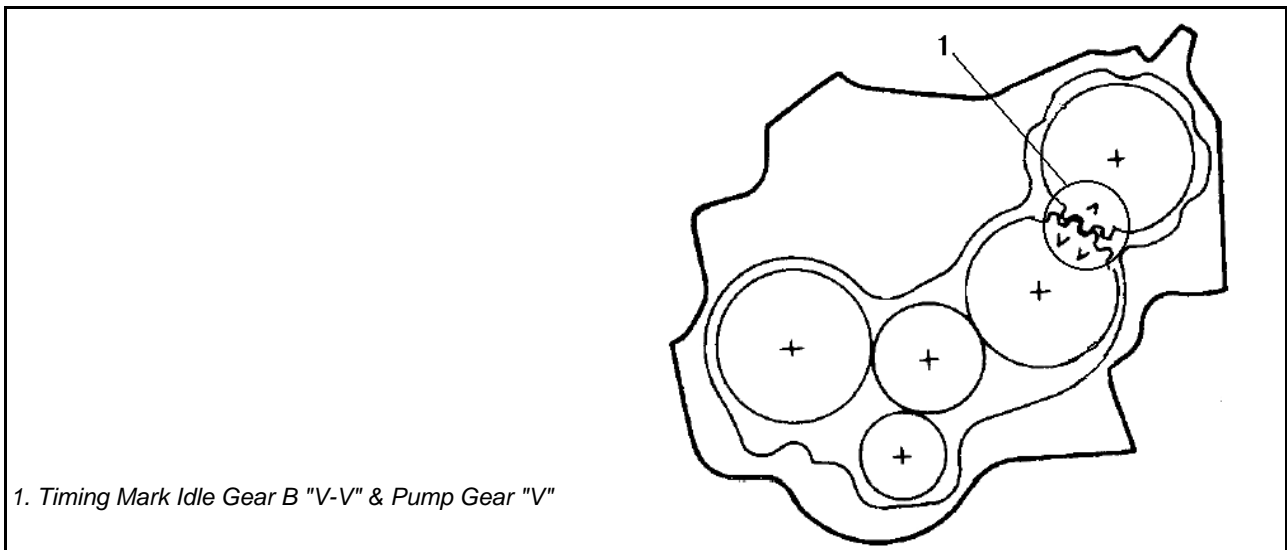
The idler gear A is a gear that transfers the rotating force to the idler gear B and camshaft gear. The bearing is supplied with oil via the hollow shaft.

It has timing mark "Y" which correspond to timing mark on the camshaft gear, and "Z-Z" which corresponded to timing mark on the idler gear B, and "X" which corresponded to timing mark on the crankshaft gear.

The number of teeth of the idler gear A is 31 teeth.

The idler gear B has timing marks "Z" which corresponded to timing marks on the idler gear A, and "V-V" which corresponded to the fuel pump gear.

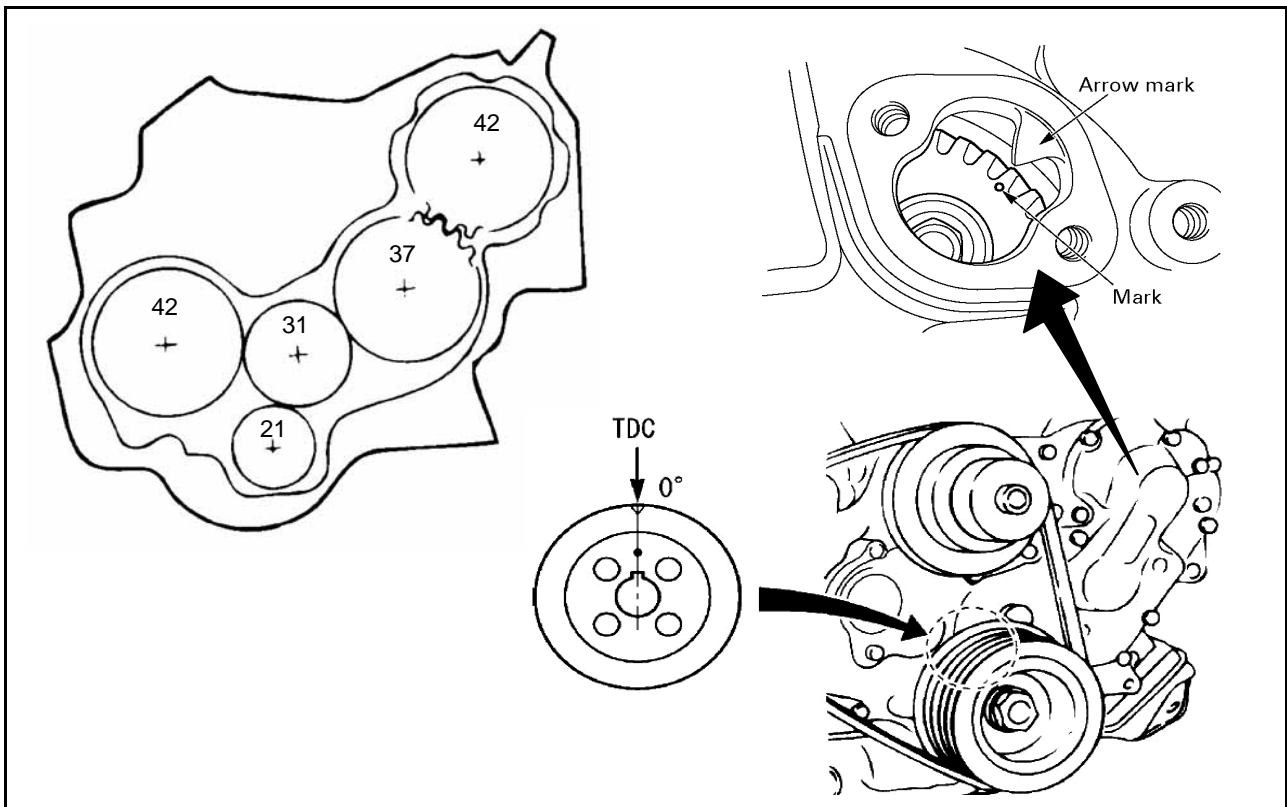
The number of teeth of the idler gear B is 37 teeth.



The fuel pump gear is fixed to the fuel pump with a center bolt and positioned by a key to the fuel pump shaft.

The fuel pump pulley has a timing mark "V" which corresponds to timing marks on idler gear B.

The fuel pump gear has 42 teeth.

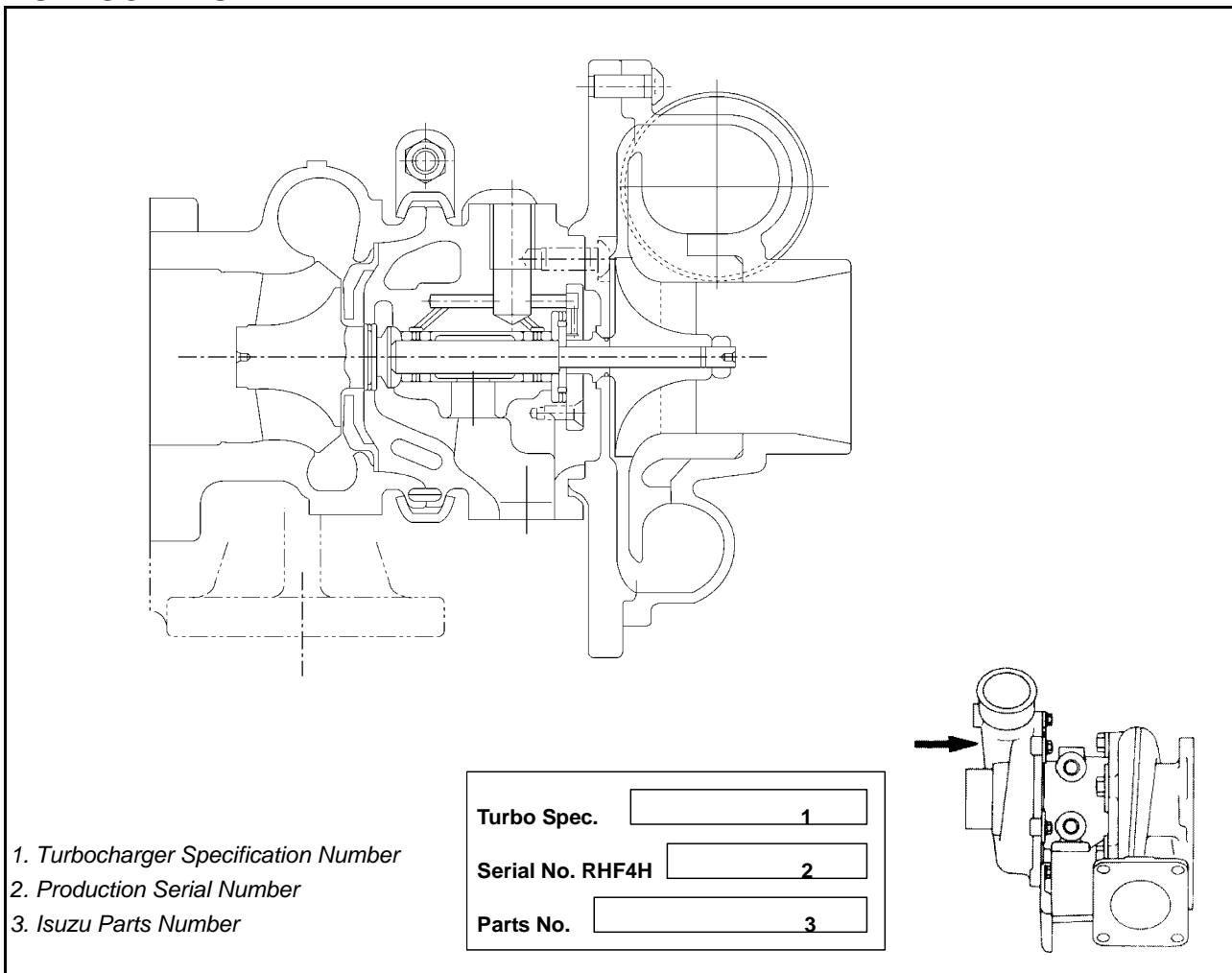


In case the gear case is removed, two or three different timing marks are visible on the gears. To inspect or set the alignment of the timing gear, inspection holes are available in the timing case. Under normal circumstances, a cover seals these inspection holes. When the covers are removed, the second mark of the gear becomes visible. These marks are used for aligning timing related parts that do not require disassembling of the timing case.

Please take in account that when timing gears are aligned using the timing gear marks shown in the picture above, that you have to rotate the crankshaft to top dead center to check the timing through the inspection holes.

Top dead center can be identified by the marks on the crankshaft pulley and the timing gear case.

## TURBOCHARGER



A water-cooled turbocharger, with floating bearings, made by Ishikawajima-Harima Heavy Ind. Co., Ltd. is used. The 4JB1 engine has RHF 4 type.

The turbocharger internal mechanism consists of the turbine wheel, the compressor wheel, and the radial bearings. These parts are supported by the bearing housing.

The turbocharger external mechanism consists of the compressor housing air intake port and the turbine housing air exhaust port.

The turbocharger increases air intake efficiency. This results in increased engine power, reduced fuel consumption, and minimal engine noise.

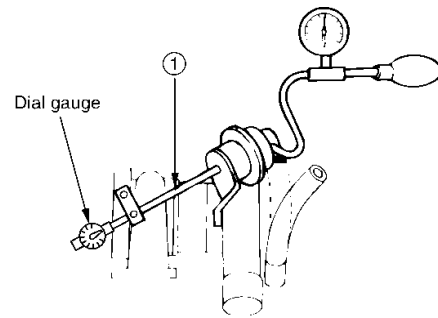
The turbocharger operates at very high speeds and temperatures. Part materials have been carefully selected and machined to extremely high precision.

Turbocharger servicing requires great care and expertise.

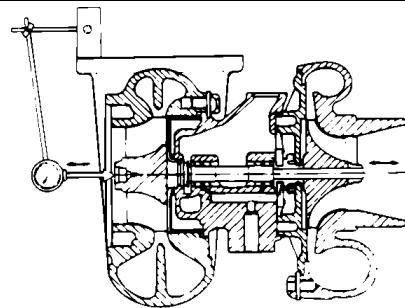
If reduced performance is noted, check the engine for damage or wear. If there is no apparent engine damage or wear, trouble with the turbocharger is indicated.

**Inspection Item****Waste Gate Operating Pressure**

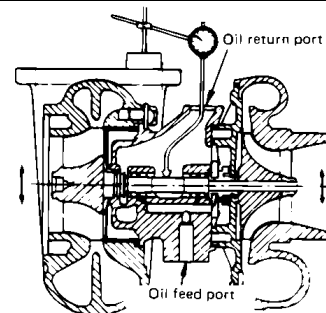
Required Tool: Pressure Gauge  
 Service Standard: 105 - 113KPa (782 - 848mHg)  
 when the rod is moved to 2mm

**Wheel Shaft End Play**

Required Tool: Dial Indicator  
 Service Standard: 0.02 - 0.08mm  
 Service Limit: 0.09mm

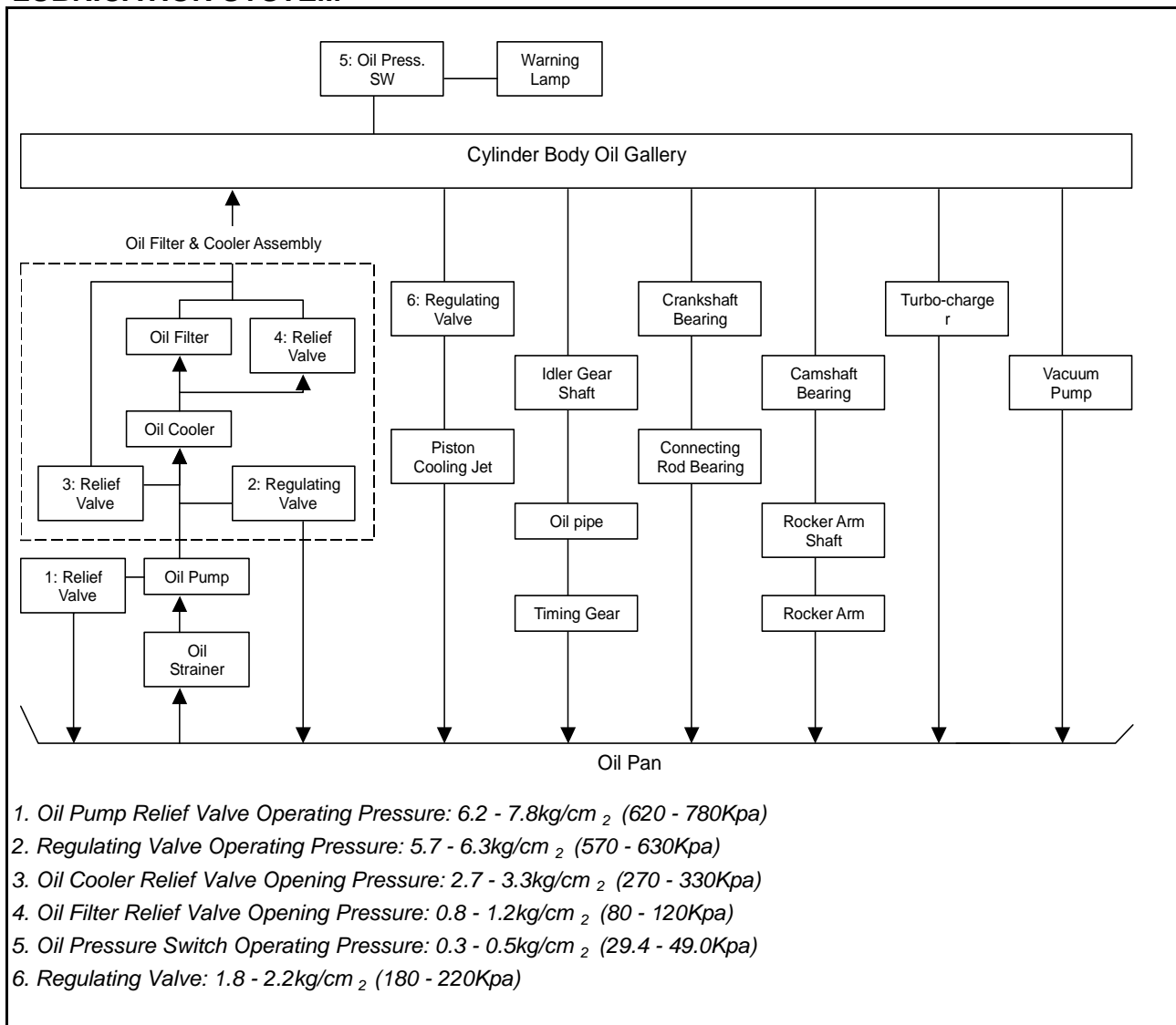
**Wheel Shaft & Bearing Clearance**

Required Tool: Dial Indicator  
 Service Standard: 0.07 - 0.12mm  
 Service Limit: 0.16mm



## ENGINE LUBRICATION

### LUBRICATION SYSTEM

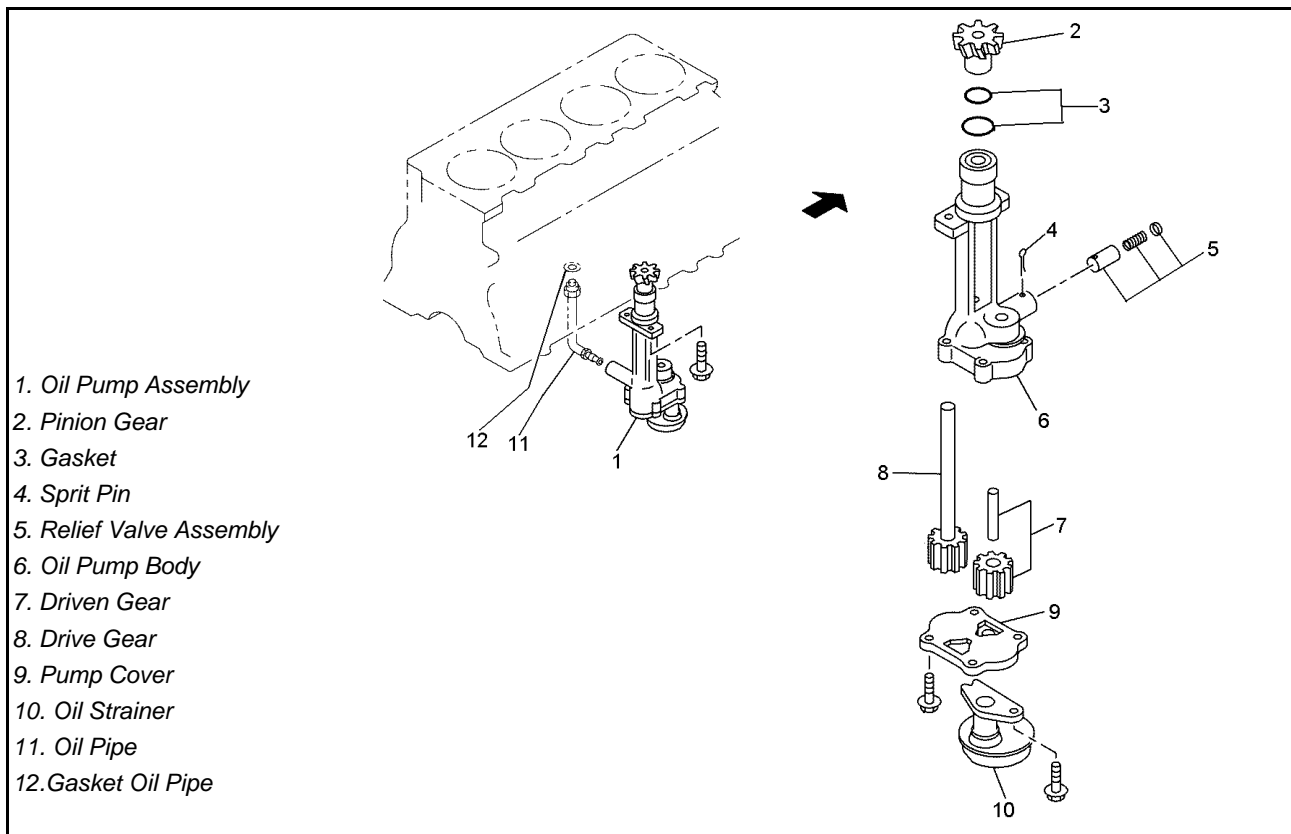


Lubricating oil is pumped from the oil pump to the cylinder body oil gallery through the oil cooler and oil filter. It is then delivered to the vital parts of the engine from the cylinder body oil gallery. The engine has many sliding and rotating parts. These parts constantly generate friction, which acts as a frictional resistance. The process of forming an oil film to prevent direct contact of these friction-causing parts, converting their friction into fluid friction, and thus minimizing frictional resistance is called lubrication. The entire oil supply route is called a lubricating system. Oil not only reduces friction between moving parts but cools, cleans, seals, prevents rusting, and keeps dust out.

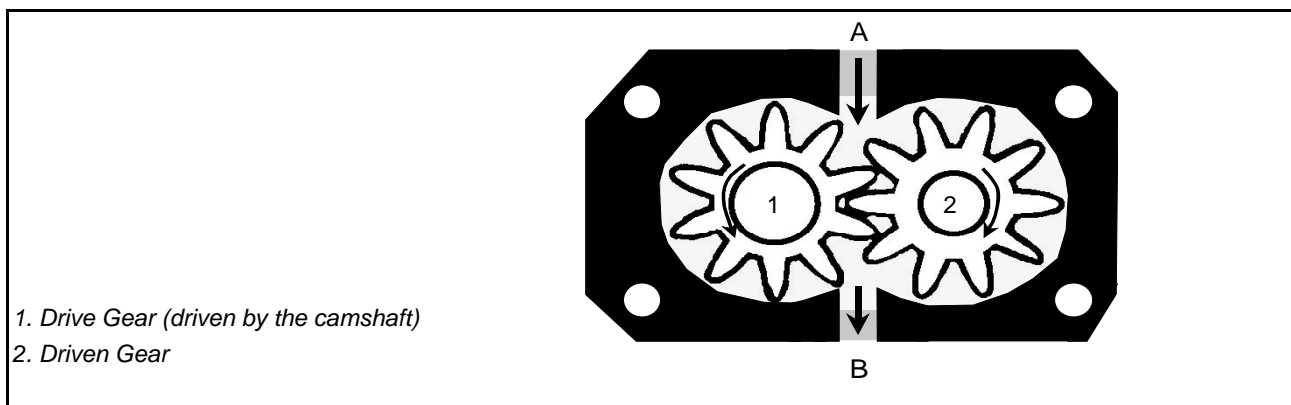
A forced circulation system which pressure-feeds oil from an oil pump is generally used. The forced circulation lubrication system consists of an oil pan, oil pump, oil filter, oil cooler, and oil gallery in the cylinder block.



## OIL PUMP



The oil pump is installed on the cylinder body by means of two bolts, and it is driven by the gear on the camshaft to conduct oil in the oil pan to the parts to be lubricated.



The gear type oil pump is adopted to the 4JA1 engine.

The geared pump is structured as shown in the picture. The oil pump driven gear turns along the inner surface of the housing together with the pump gear which is driven by the camshaft. As a result, a negative pressure is created between the gears and the housing which draws the oil out of the oil pan through a strainer (from A). The drawn oil is discharged along the housing (to B), and pressure-fed to the oil gallery.

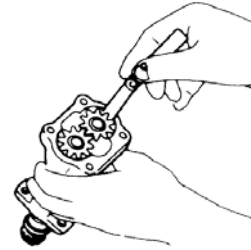
The efficiency of the geared pump varies with the clearance between the gears and housing, oil pipe resistance, oil feed pressure, rpm and oil viscosity.

**Inspection Item****Gear Teeth & Body Inner Wall Clearance**

*Required Tool: Feeler Gauge*

*Service Standard: 0.14mm*

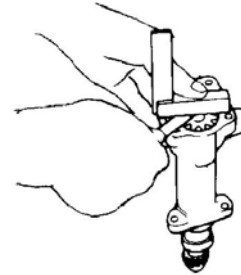
*Service Limit: 0.20mm*

**Gear & Body Clearance**

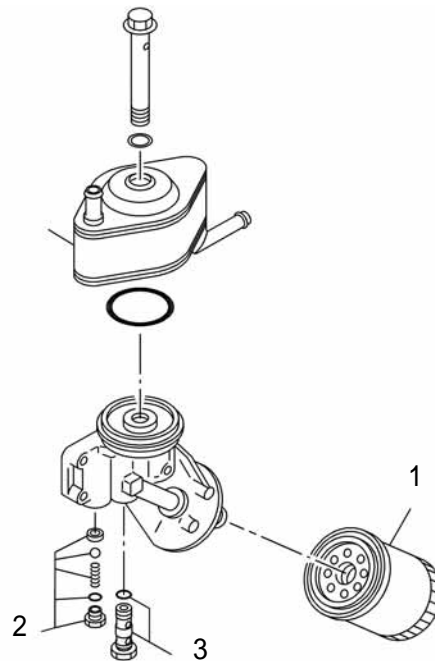
*Required Tool: Feeler Gauge, Steel Square*

*Service Standard: 0.06mm*

*Service Limit: 0.15mm*

**OIL FILTER & OIL COOLER**

1. Oil Filter
2. Oil Cooler Relief Valve
3. Regulating Valve



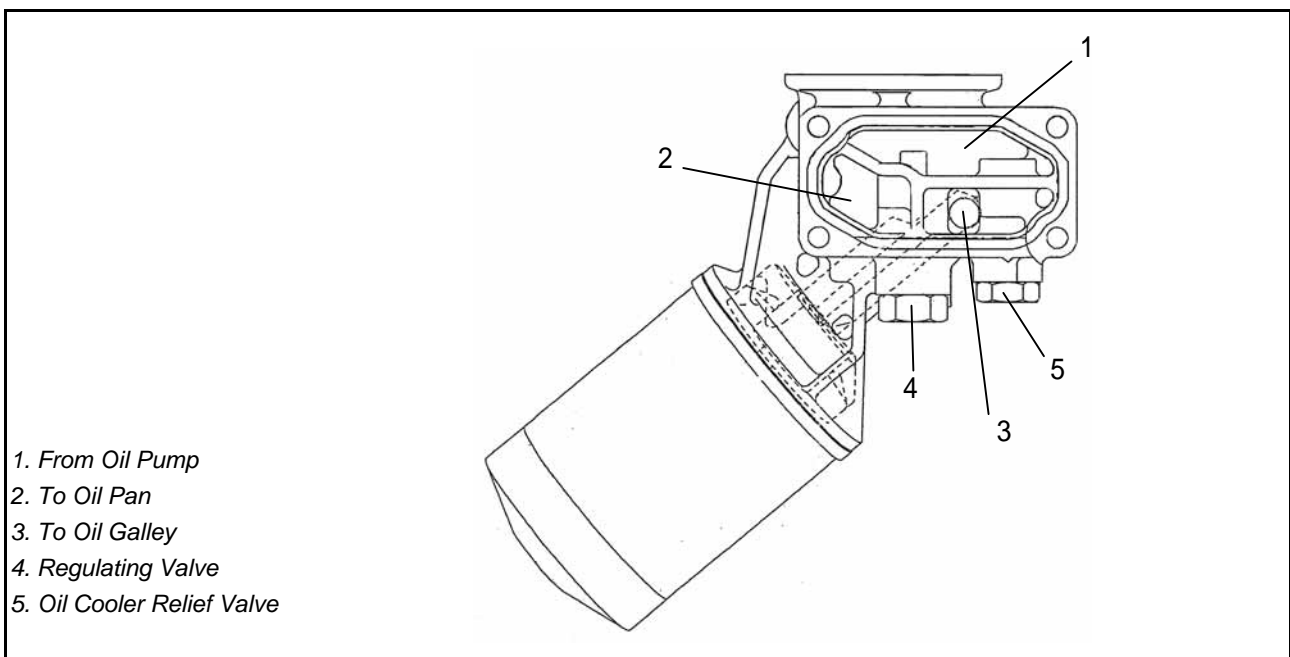
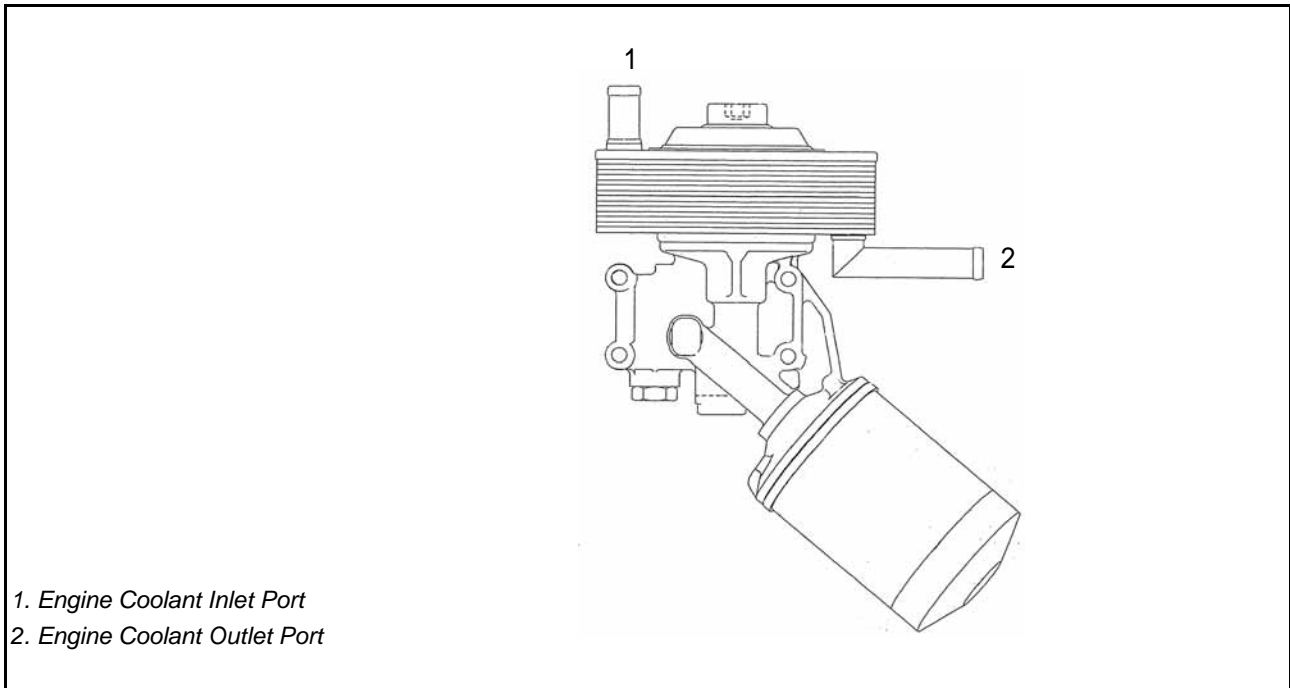
Engine oil will slowly become contaminated by metal fragments produced by the friction of the working and sliding parts of the engine, and by carbon and sludge generated by fuel combustion.

Heavy sediment will settle to the bottom of the oil pan, while particles in suspension will be fed with the oil to engine parts, possibly causing accelerated wear and seizure.

It is for these reason that an oil filter is installed in the oil passage to remove such foreign particles.

The filter is either a full-flow type, which allows all the oil to pass through it, or a partial-flow type, which allows only part of the oil to pass through. The full-flow type is used for 4JB1 engine.

A bypass valve is built into the oil filter. In case of filter element become clogged, the oil can be directly fed to the oil gallery without going through the element. Thus safe lubrication of the system is assumed.



Lubricating oil for the most part often acts as a coolant for surfaces that are subject to severe friction. When the temperature of lubricating oil exceeds 125 - 130 degree centigrade, its lubricating performance, stable up to this temperature, suddenly drops, and it becomes difficult to maintain the oil film. As a result, rotating and sliding parts may begin to stick.

Therefore, vehicles operated under severe conditions, that is, under extreme load at high speed for extended periods, are equipped with an oil cooler to prevent the lubricating oil from overheating.

The plate tube type oil cooler allows lubricating oil to pass through the tube whose outer surfaces are cooled by engine coolant.

Inspection to determine if any clogging up of the oil cooler elements has occurred, when the oil cooler unit is detached from the engine, pour oil or light oil into the oil cooler element through the inlet port, and check to see that it flows away from the outlet port. However if the oil cooler unit is attached to the engine, the following procedure is recommended;

1) Check oil gallery pressure at idling speed

If the oil cooler element is clogged up, the oil gallery pressure reading will be increased 1 to 2 kg/cm<sub>2</sub> (100 - 200 Kpa) over the normal figure. This increased pressure is due to an oil pressure loss in the oil cooler element.

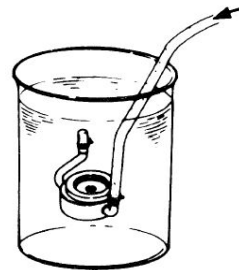
2) Check the oil temperature in the oil gallery

If the oil cooler element is clogged up, the oil temperature in the oil gallery will be higher than normal. If the engine operates at high speed, or is heavily loaded, the oil temperature will increase rapidly.

### ***Inspection Item***

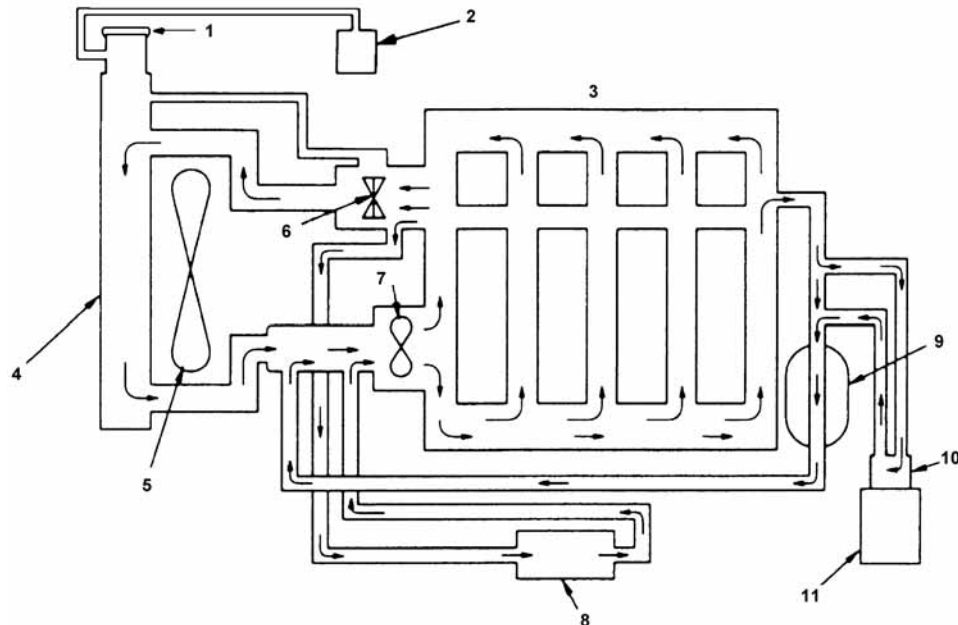
#### **Water Leakage**

1. *Submerge the oil cooler water passage.*
  2. *Apply compressed air (200Kpa /2kg/cm<sup>2</sup>)*
- If air bubbles rise to the surface, there is water leakage.*



## ENGINE COOLING

### COOLING SYSTEM



1. Radiator Cap
2. Reservoir Tank
3. Cylinder Head
4. Radiator
5. Cooling Fan
6. Thermostat
7. Water Pump
8. Car Heater Unit
9. Oil Cooler
10. Cold Starting Device
11. Fuel Injection Pump

The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostat.

The heat generated by fuel combustion in the cylinder heats the component parts around the combustion chambers of the engine. If these parts are not properly cooled, the inside engine temperature rises sharply and overheats, thus reducing output power.

It also adversely affects the lubricating oil supplied to the moving parts of the engine, possibly reducing lubrication performance, altering oil properties, or causing abnormal wear and seizure.

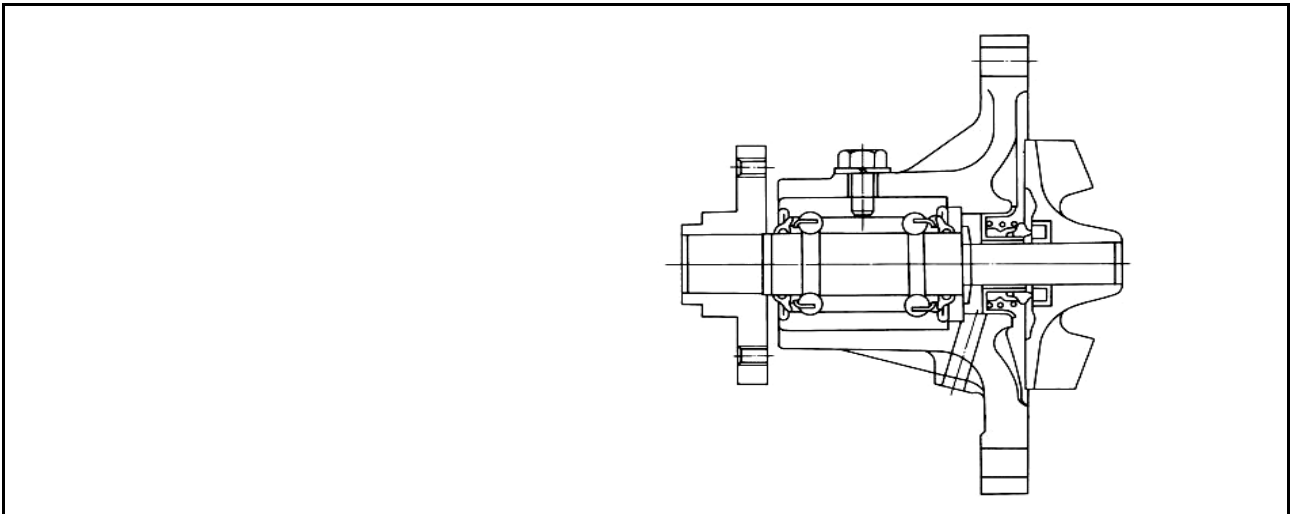
To quickly increase cold engine coolant temperature for smooth engine operation, the coolant is circulated by the water pump and through the by-pass hose and back to the cylinder body. The coolant does not circulate through the radiator.

Overcooling, on the other hand, can lower thermal efficiency and deteriorate combustion. It can also accelerate cylinder liner wear as the sulfur dioxide generated in the combustion stroke is combined with the water in the gas to form a corrosive substance.

The cooling system is designed to prevent engine overheating and overcooling, and maintain engine operation at an appropriate temperature.

When the coolant temperature reaches specified value, the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.

The thermostat will be fully open when the coolant temperature reaches specified value. All of the coolant is now circulating through the radiator for effective engine cooling.

**WATER PUMP**

The water pump is a centrifugal impeller type and is driven by V type drive belt.

The water pump draws the coolant from the radiator, feeds it through the oil cooler into the cylinder block to cool the outer surfaces of the cylinders, and then into the cylinder head.

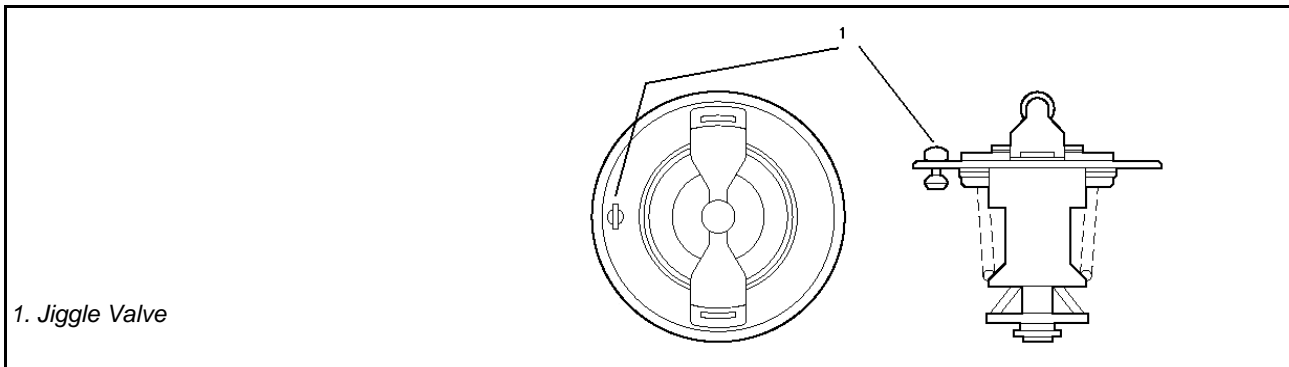
The water in the cylinder head is directed by a water jet to cool the outer surfaces of the nozzle holders and around the valve seats.

After cooling the cylinder head, the water runs through the water outlet pipe to the radiator.

The water outlet pipe has a thermostat to regulate the engine cooling water temperature.

If the cooling water temperature is below the valve operating temperature, the cooling water is fed back through the water pump by-pass into the engine without returning to the radiator.

## THERMOSTAT



The thermostat is a wax pellet type with a jiggle valve and has an opening temperature of 82°C - 95 ° C. The full opening valve lift is more than 10 mm.

The thermostat opens and closes the water outlet pipe and radiator water passage according to the cooling water temperature to control it and prevent the engine from overheating or overcooling.

When the cooling water is cold immediately after starting the engine, the water passage is closed by the valve, and the cooling water keeps circulating through the by-pass circuit without going through the radiator, thus permitting speedy engine warm up. As the water temperature rises, the valve opens to connect the water passage to the radiator and the by-pass circuit is closed so that the engine temperature may be kept at an appropriate level.

If the engine becomes overcooled during operation, the water passage valve is automatically closed. This thermostat has wax sealed inside its casing, and the valve opens or closes when the wax expands or contracts, moving a spring. When the cooling water temperature is low, the wax is solid and contracted so that the valve is closed under the pressure of the spring. When the water temperature rises, the wax liquefies and expands to push the spring and valve down, to open the valve.

A complete cut off of the cooling water to the radiator when the thermostat is fully closed will shorten engine warm up time, but the system cannot be filled with cooling water because air will remain trapped inside the engine. Therefore, the thermostat is generally fitted with a small air vent.

The jiggle valve releases the air while cooling water is being added, and closes when even the slightest water pressure is applied as the engine start running, thereby preventing the cooling water from flowing out.

### ***Inspection Item***

#### **Thermostat Operating Temperature**

*Required Tool: Thermometer, Agitating Rod*

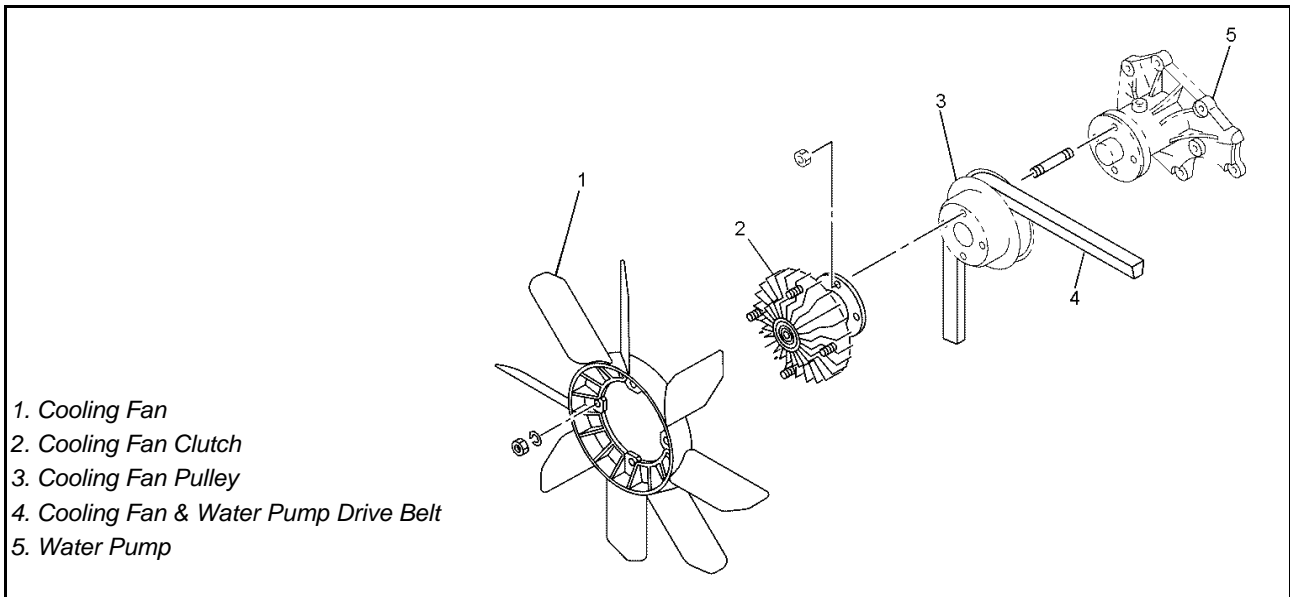
*Initial Opening Temperature: 82*

*Full Opening Temperature: 95*

*Valve Lift: 10mm*

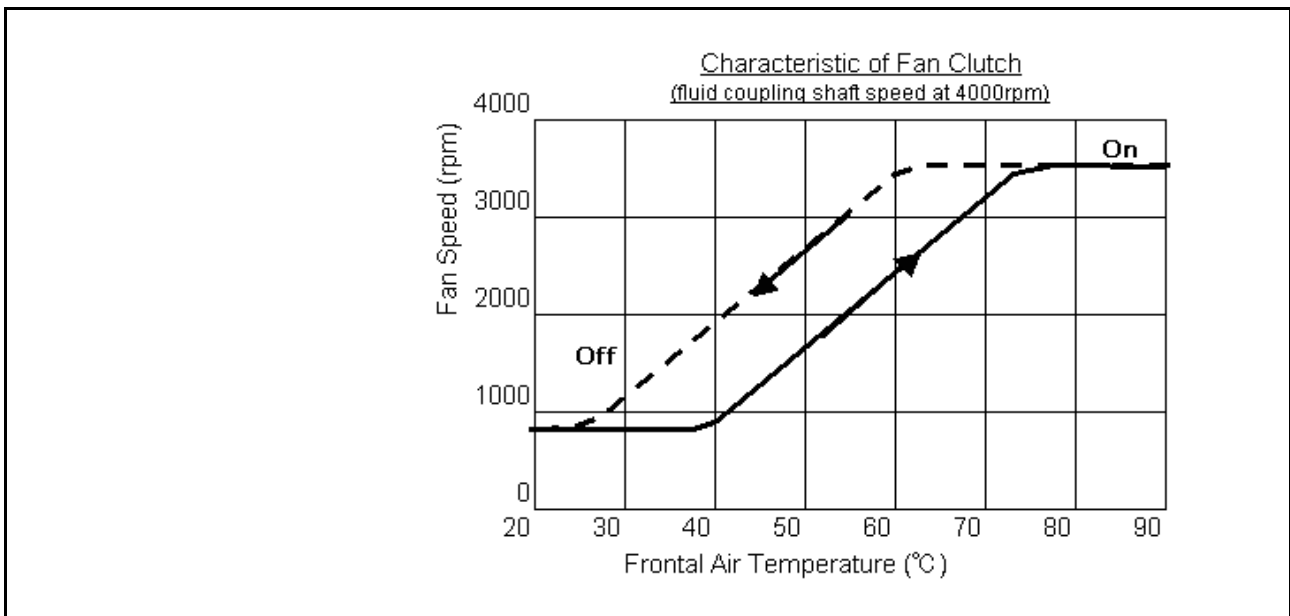


## COOLING FAN & FAN CLUTCH



The cooling fan consists of seven plastic blades and is fitted with a fan clutch of the fluid coupling type filled with silicon oil.

The engine cooling capacity is designed to prevent engine overheating even at a high ambient temperature. Thus, it is unnecessary for the fan to run fast when the engine is running fast at a low ambient temperature. High speed operation of the fan increases noise and causes a marked power loss. The fan clutch senses and drop in the ambient temperature and controls the fan speed.



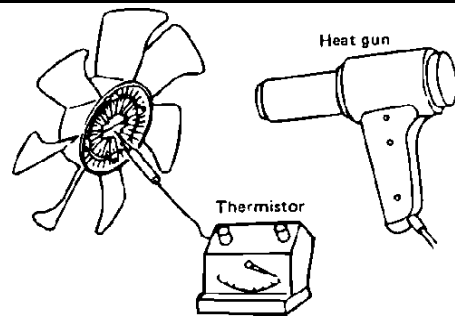


**Inspection Item****Thermostat Operating Temperature**

Required Tool: Thermistor, Heat Gun

Warm up the bimetal up to 80 deg. C.

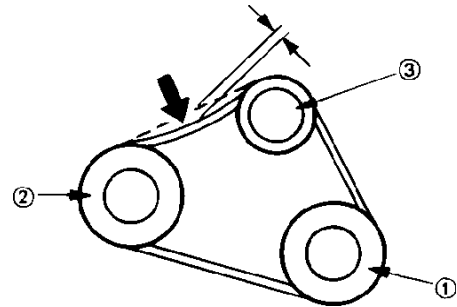
If the fan clutch rotates more readily, silicone grease is leaking internally.

**Cooling Fan Drive Belt Deflection**

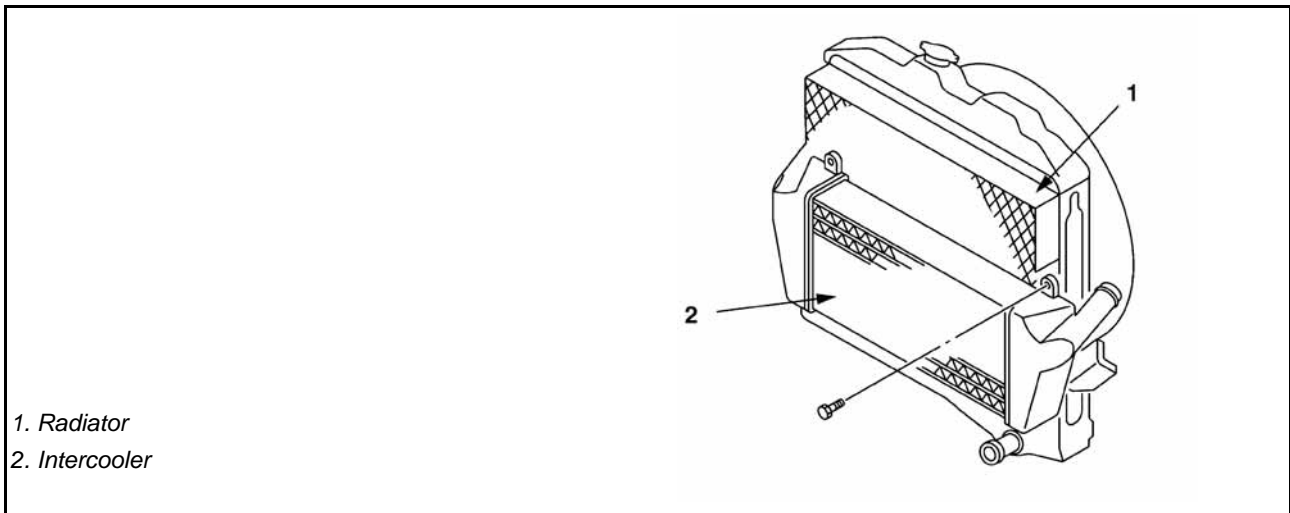
Required Tool: Ruler

Apply a force of 98Nm (10kg) to the drive belt mid-portion.

Service Standard: 8 - 12 mm



## RADIATOR & RADIATOR CAP



The radiator is a device for a large volume of water in close contact with a large volume of air so that heat will transfer from the water to the air.

The radiator core is divided into two separate and intricate compartments; water passes through one, and air passes through the other.

The radiator is a tube type with corrugated fins. The corrugated fin type also consists of a series of long tubes extending from the top to bottom of the radiator.

While fins are placed between the tubes and have a corrugation shape. Radiation efficiency is great in spite of the same volume of the radiator, because of the corrugated fin has a great radiation area.

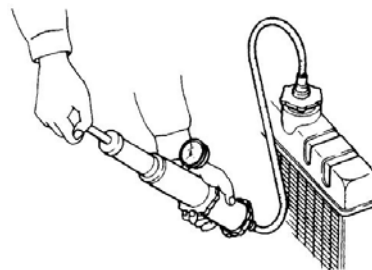
Furthermore the louver on the corrugated fin increases air speed and this makes for increased radiation efficiency.

The radiator cap has a pressure valve, which is used to maintain the pressure in the radiator at required level, and thus increases the capacity and cooling efficiency of the water pump. There is also a vacuum valve to take fresh air from the out side if the radiator pressure is reduced when the engine cools off, thereby protecting the radiator from collapse.

### ***Inspection Item***

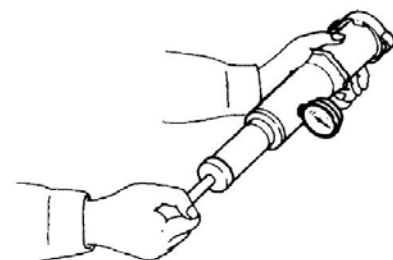
#### **Radiator Pressure Proof**

Required Tool: Radiator Cap Tester  
Testing Pressure: 147KPa (1.5kg/cm<sup>2</sup>)

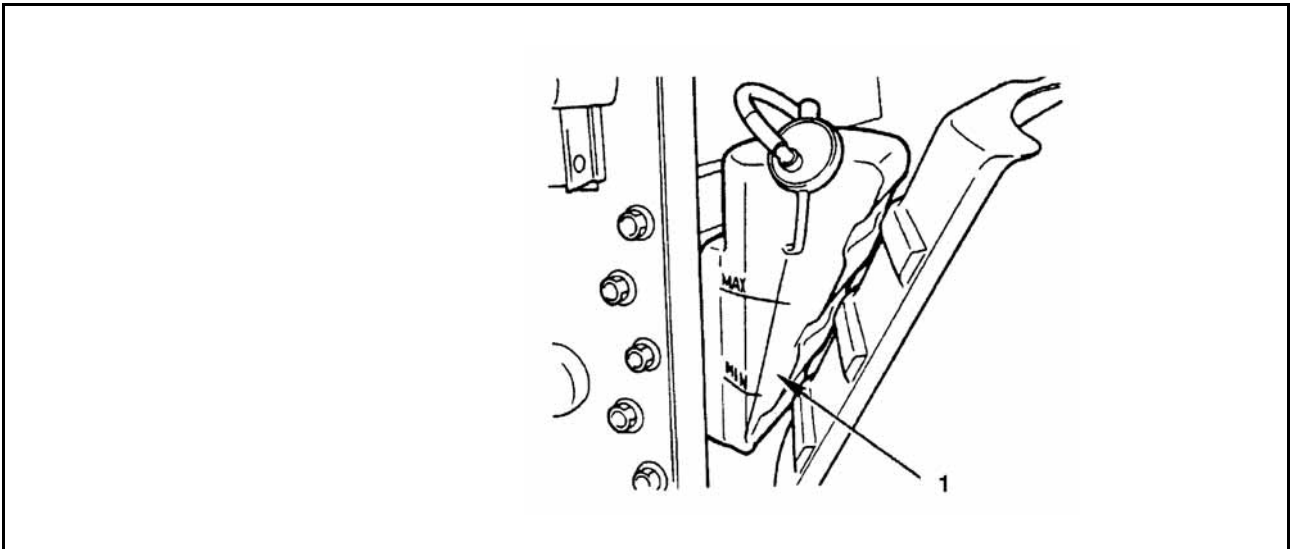


#### **Radiator Cap Pressure Proof**

Required Tool: Radiator Cap Tester  
Positive Pressure: 88.2 - 118KPa (0.9 - 1.2kg/cm<sup>2</sup>)  
Negative Pressure: 1.0 - 3.9KPa (0.01 - 0.04kg/cm<sup>2</sup>)



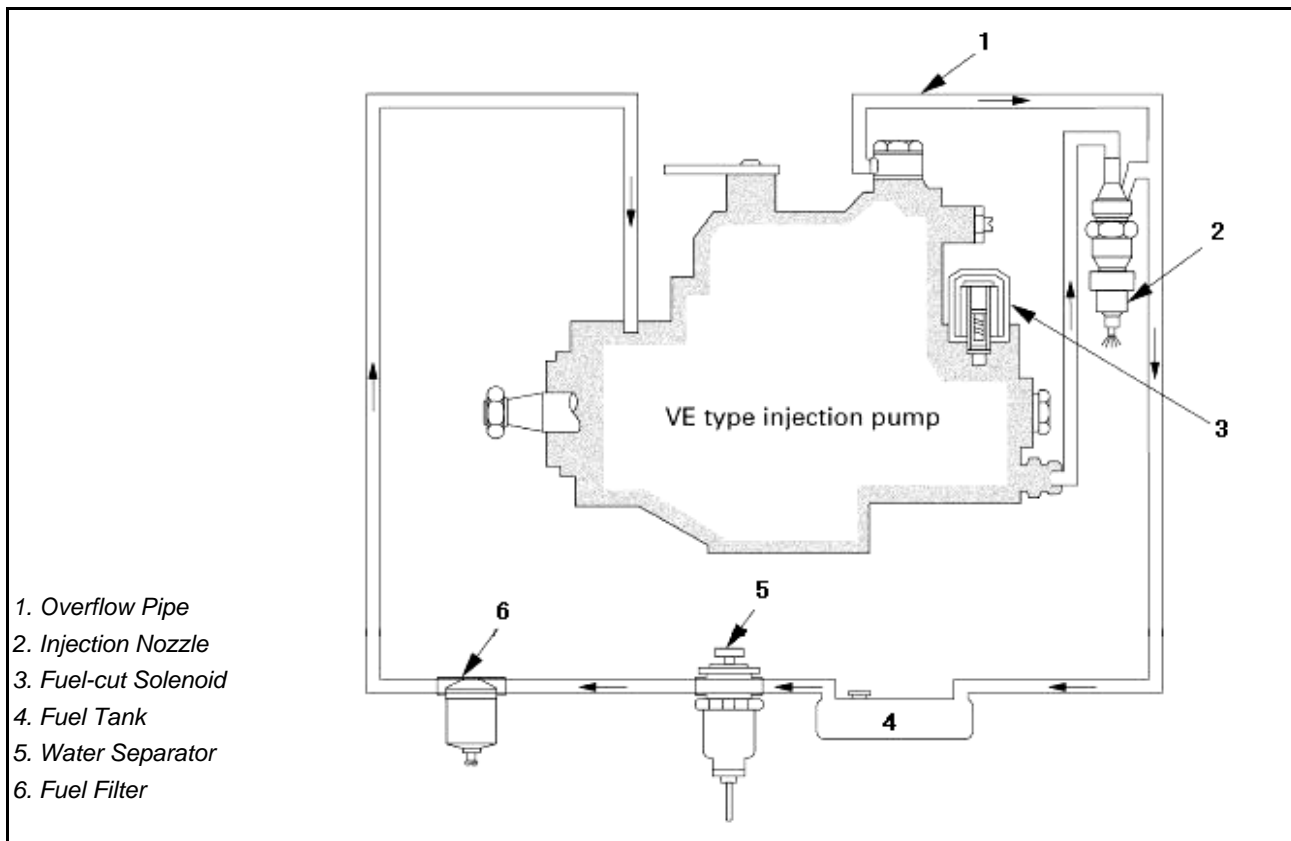
## RESERVE TANK



The reserve tank is employed to prevent coolant loss, and to control the internal pressure of the radiator tank, namely to ensure cooling efficiency. Generally, the coolant volume expands by about 5% when the temperature exceeds 90 °C, and expanded volume of coolant overflows from the radiator. Therefore, the radiator has a suitable sized upper tank which corresponds to the increase in the volume of coolant. This prevents coolant loss to a large degree. Vapor, on the other hand, is forced out of the radiator.

When the coolant temperature in the radiator falls, for example when the engine is stopped, the internal pressure in the radiator becomes negative which causes the coolant to be drawn back into the radiator. Thus coolant loss is prevented, and the period between topping up the radiator is greatly increased.

## FUEL SYSTEM

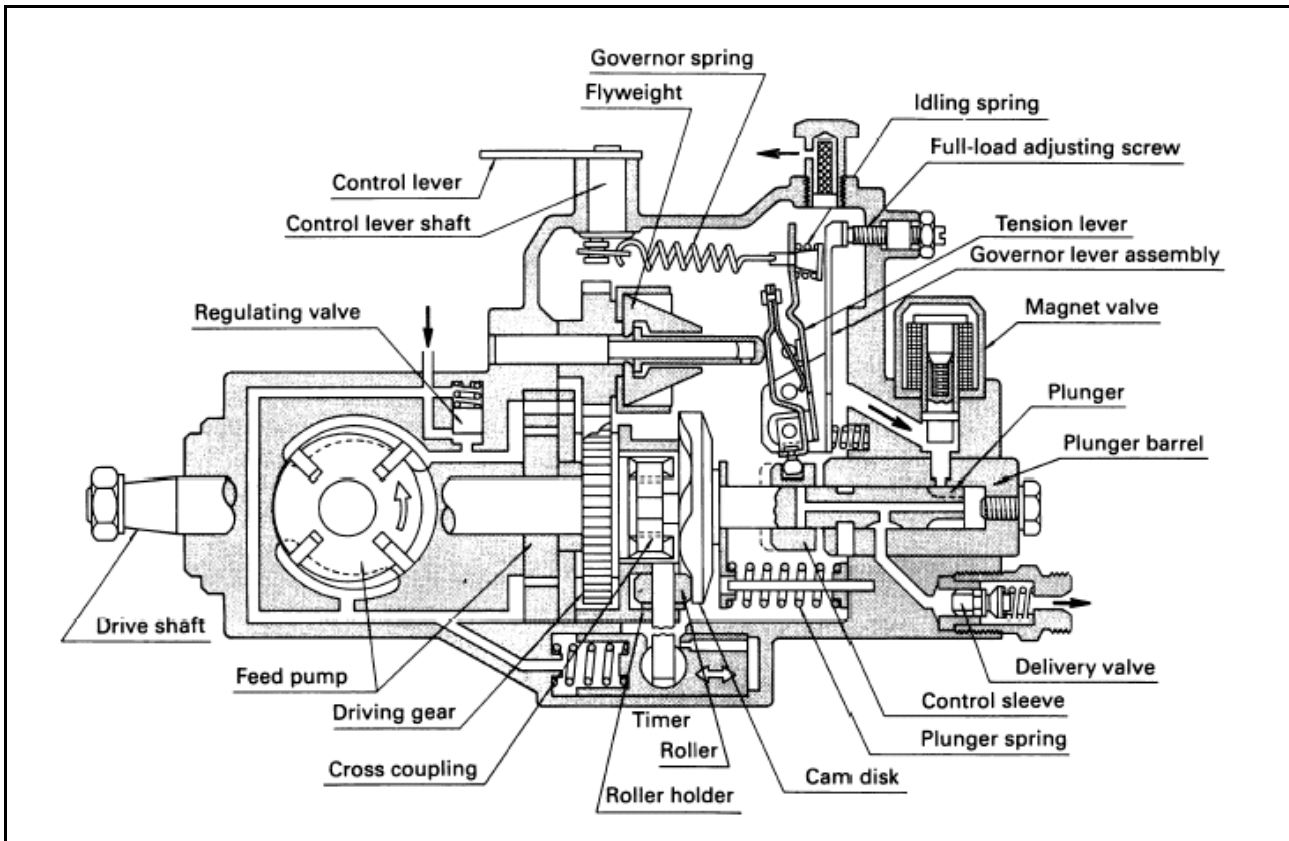


The fuel system consists of the fuel tank, the water separator, the fuel filter, the injection pump, and the injection nozzle.

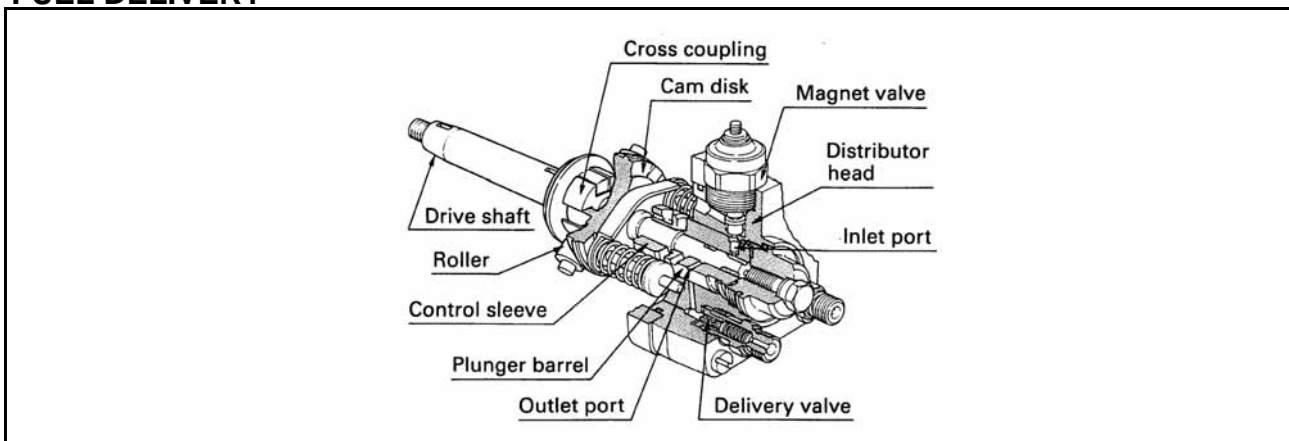
The fuel in the fuel tank of a diesel engine is pumped up into a fuel filter by a feed pump, where water and dust are removed from the fuel before fed to the injection pump.

The injection pump feeds the fuel at very high pressure through injection pipes, and injects it into the combustion chambers of the engine through injection nozzles. The feed pump increase the fuel feed rate in direct proportion to the engine speed, but the amount of fuel required to be injected into the cylinders varies with vehicle running conditions, and not in direct proportion to engine speed. Thus, there is always an excess of fuel from the feed pump. Therefore, the fuel return pipes run from the nozzles and injection pump to the fuel tank via fuel filter to return the excess fuel to the fuel tank.

## FUEL INJECTION PUMP



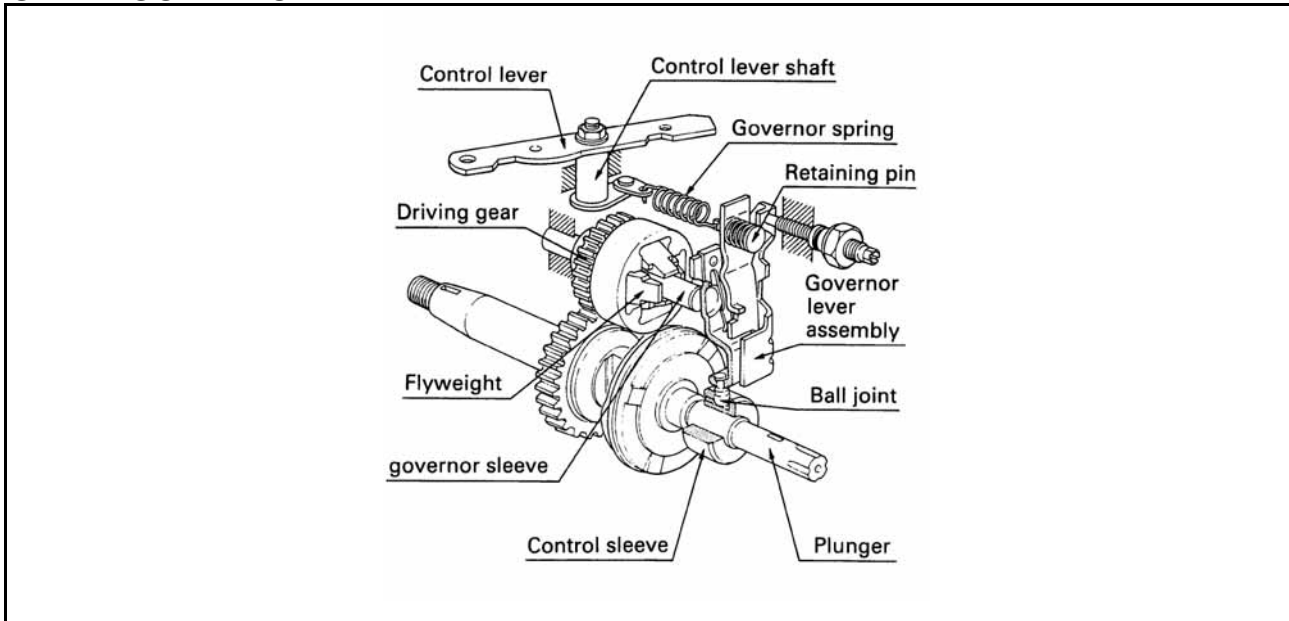
## FUEL DELIVERY



The drive shaft rotated by the engine timing belt or gear, rotates the cam disk through a cross coupling. The cam disk's press-fitted pin fits into a groove in the plunger to rotate the plunger. To reciprocate the plunger, the cam disk is also equipped with raised face cams, arranged uniformly around the circumference of the cam disk. The cam disk's face cams are always in contact with the roller holder assembly's rollers because the cam disk and the plunger are press against the roller holder assembly by the set force of the two plunger springs. Because of this plunger can follow cam disk movement. Therefore, as the cam disk is rotated on the roller holder assembly by the drive shaft, simultaneous plunger rotation and reciprocating movement is possible.

The roller assembly construction is such that it can only rotate in a certain angle range in accordance with timer operation.

Because the plunger rotates and reciprocates simultaneously, suction of the fuel into the pressure chamber, pressurization in the pressure chamber, delivery into the engine cylinder are possible.

**SPEED GOVERNOR**

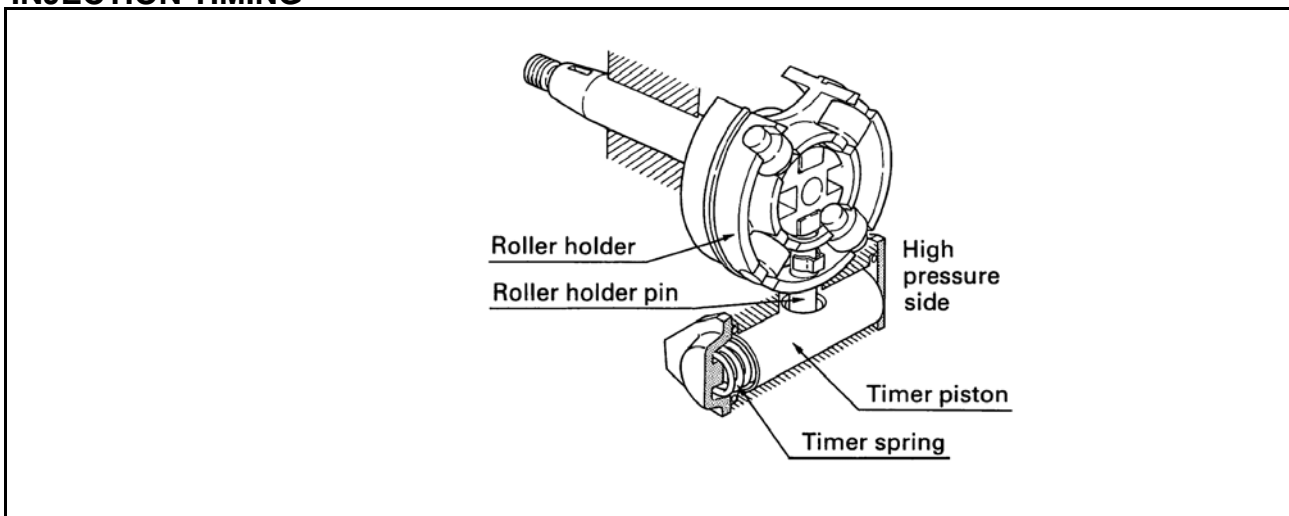
The governor is located in the upper part of the injection pump chamber. Four flyweights and a governor sleeve are held in the flyweight holder, which is mounted on the governor shaft. The flyweight holder is rotated and accelerated by the drive shaft gear, through rubber dampers. The governor lever assembly is supported by pivot bolts in the pump housing, and the ball joint at the bottom of the lever assembly is inserted into the control sleeve, which slides over the outside surface of the plunger. The top of the lever assembly (the tension lever) is connected to the governor spring by a retaining pin, while the opposite end of the governor spring is connected to the control lever shaft. The control lever shaft is inserted into the governor cover and a control lever shaft. The accelerator pedal is connected directly to the control lever by a cable, and the governor spring set force changes in response to the control lever piston (i.e. accelerator pedal position).

Injection quantity control is governed by the mutually opposing forces of the flyweight centrifugal force and the governor spring's set force.

The flyweight centrifugal force, which changes in response to engine speed, acts on the governor lever through the governor sleeve.

The governor spring's set force, which is dependant on control lever position, i.e. accelerator pedal position, acts on the governor lever through the retaining pin.

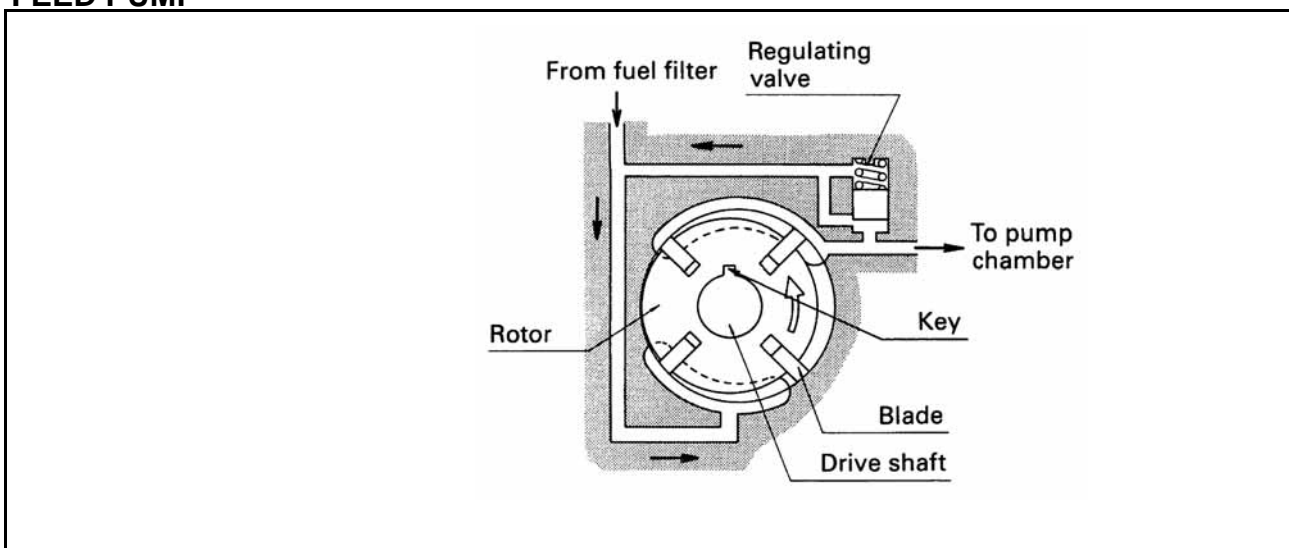
## INJECTION TIMING



In the lower part of the injection pump is the timer, in the centre of which the timer piston is positioned.

On the low pressure side of the timer piston is a timer spring with a predetermined set force; the pump chamber fuel pressure acts on the opposite side (high pressure side). The timer piston position changes in accordance with the balance of these two forces, to rotate the roller holder via the roller holder pin. When the timer piston compresses the timer spring, the injection timing is advanced (the roller holder rotates in the reverse rotation direction), and through timer piston movement in the opposite direction the injection timing is retarded. Injection timing is controlled by the above.

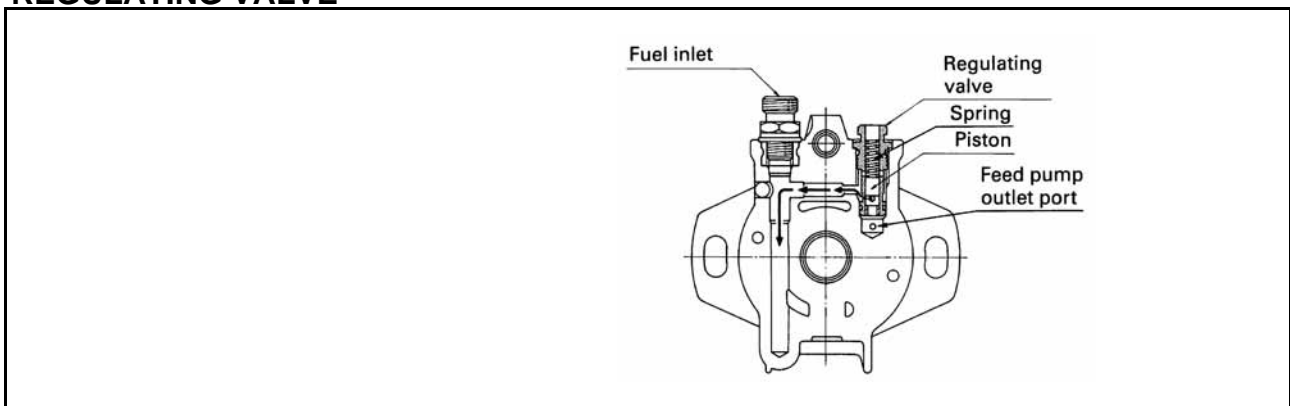
## FEED PUMP



The feed pump comprise a rotor, blades and liner.

Drive shaft rotation is transmitted through a key to the rotor to rotate the rotor.

The inside circumference of the liner is eccentric to the center of rotor rotation. Four blades are installed in the rotor. Centrifugal force forces the blades outwards during rotation to contact the inside surface of the liner and form four fuel chambers. Therefore, the volume of these four chambers increases through rotor rotation to suck fuel from the fuel tank. Conversely, when the volume of these four chambers decreases fuel is pressurized.

**REGULATING VALVE**

Feed pump fuel delivery pressure increases proportionately with an increase in injection pump speed.

However, the total fuel injection quantity necessary for the engine is considerably less than that delivered by the feed pump. Therefore, in order to prevent an excessive increase in the pump chamber pressure caused by the excess fuel, and to adjust the pump chamber pressure so that it is usually within the specified limit, a regulating valve is installed near the feed pump outlet. The timer performs timing control using the pump chamber pressure, which is regulated by the regulating valve.

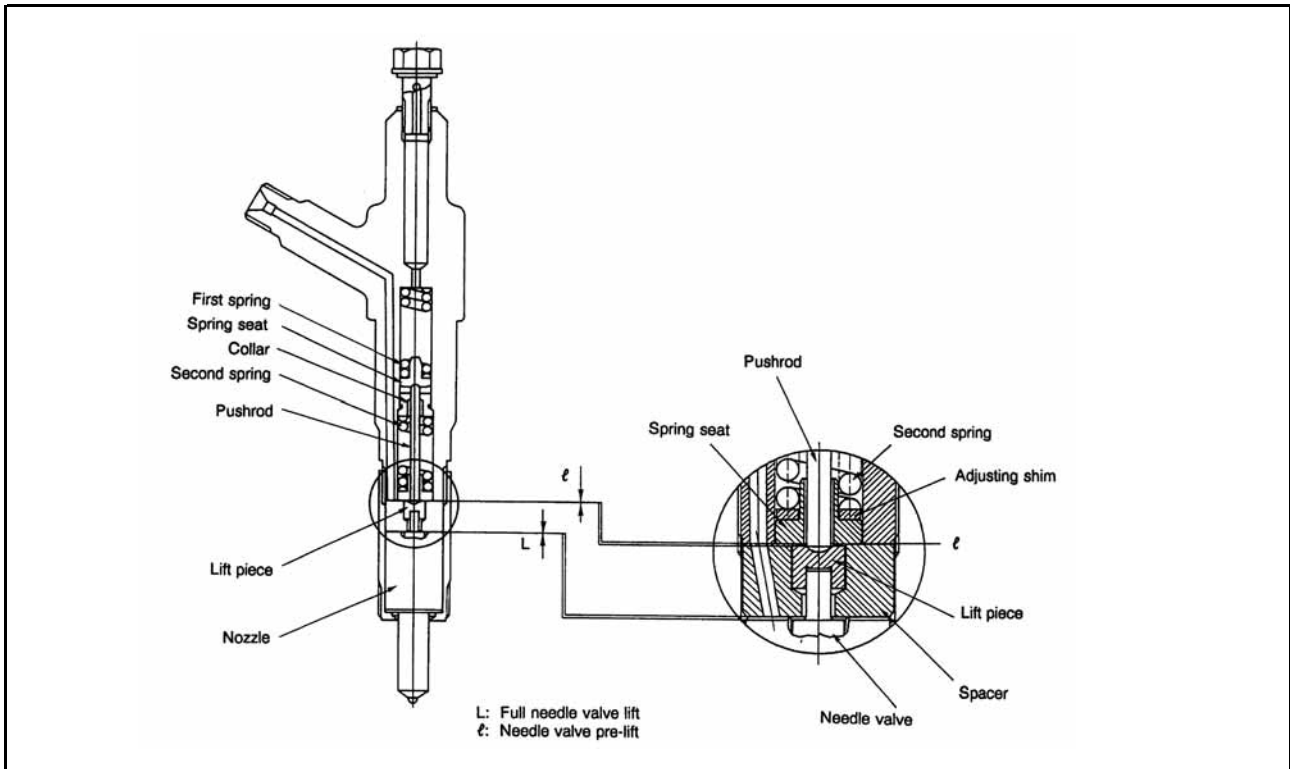


## FUEL INJECTION NOZZLE

The fuel is injected inside the combustion chamber by means of single stage injectors with five holes. These holes have a diameter of 0.2mm.

-Desired Operating Pressure: 19.5 MPa (1st) / 26.5 MPa (2nd)

-Adjusting Operating Pressure: 20.0 - 21.0 MPa (1st) / 27.5 - 28.5 MPa (2nd)



This nozzle is following unique constructions.

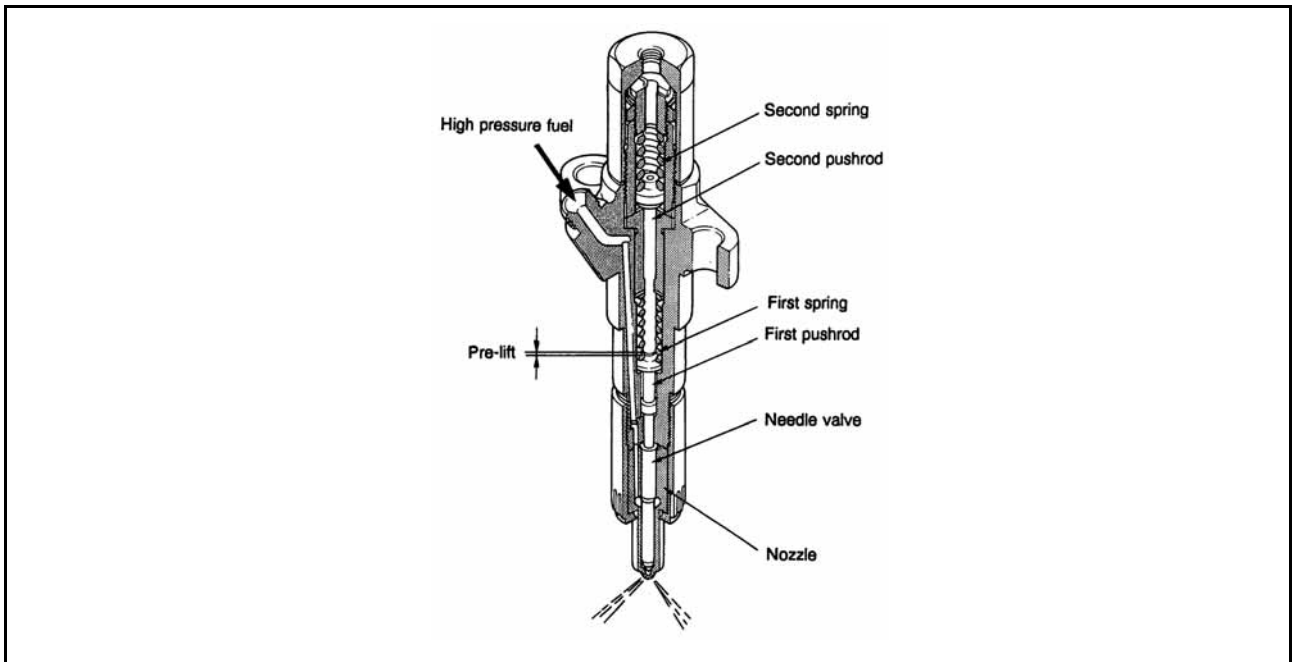
The position of the first and second springs are reversed, with the first spring located at the top.

The nozzle holder body is unified construction, decreasing the number of component parts.

Pre-lift is provided between the lift piece and the spring seat.

Pre-lift is adjusted at the factory. (Pre-lift is ensured through the assembly of the nozzle, spacer and lift piece.

Full needle valve lift, second opening pressure and pre-lift can be measured simultaneously.

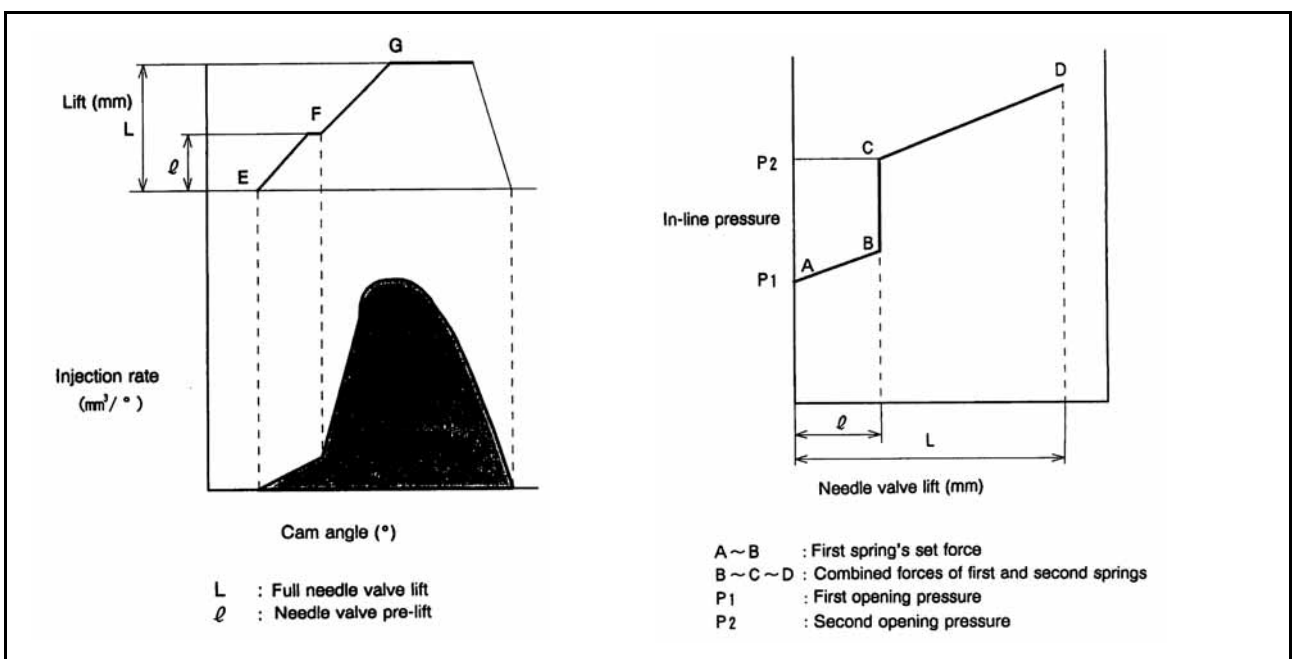


### 1st Opening Pressure

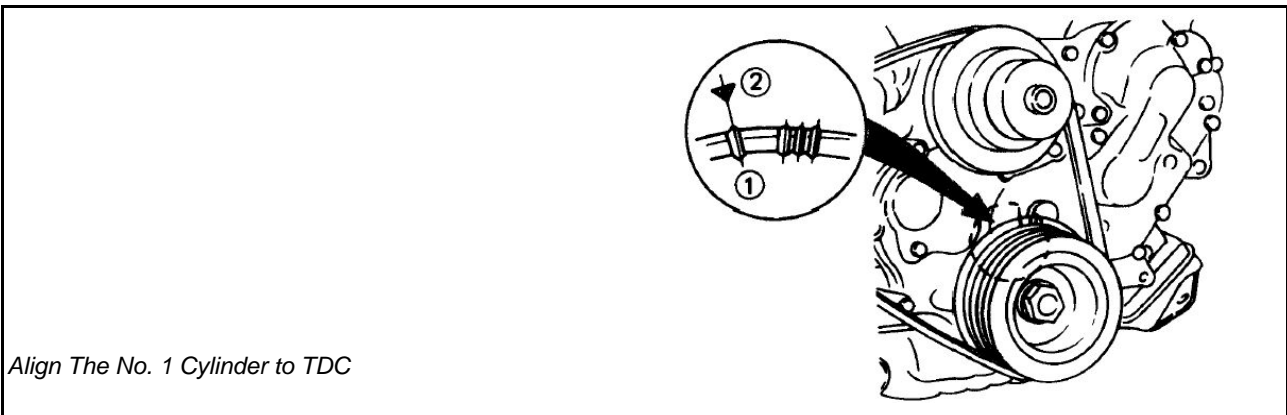
The force of the high pressure fuel delivered by the injection pump acts to push the needle valve up. When this force exceeds the set force of the first spring, the nozzle's needle valve pushes the first pushrod up and the valve opens. (First opening pressure is represented by point E in the bottom left hand picture, and point A in the bottom right picture.)

### 2nd Opening Pressure

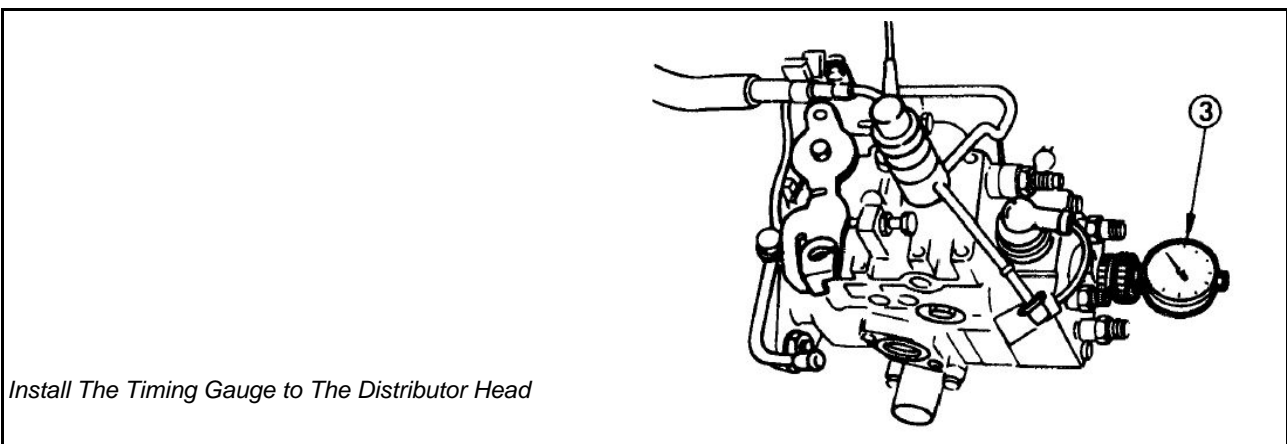
When the first pushrod has been lifted through the pre-lift, it cocontacts the second pushrod. As the set force of the second spring is acting on the second pushrod, the combined forces of both the first spring and the second spring then act on the needle valve, which will not lift unless these forces are overcome. When the high pressure fuel (i.e. in-line pressure) overcomes the combined forces of the first and second springs, the needle valve is again lifted and main injection can begin. (Second opening pressure is represented by point F in the bottom left picture and B - C in the bottom right picture.)



## INJECTION TIMING ADJUSTMENT

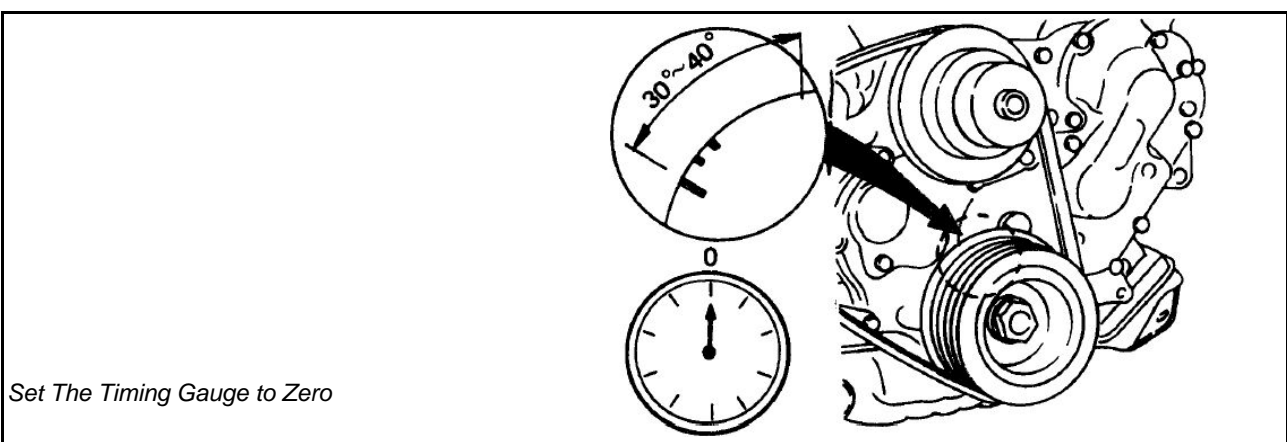


1) Rotate the crankshaft and bring the piston in the No.1 cylinder to TDC on the compression stroke. Then, crankshaft pulley TDC line must be aligned with the timing mark .

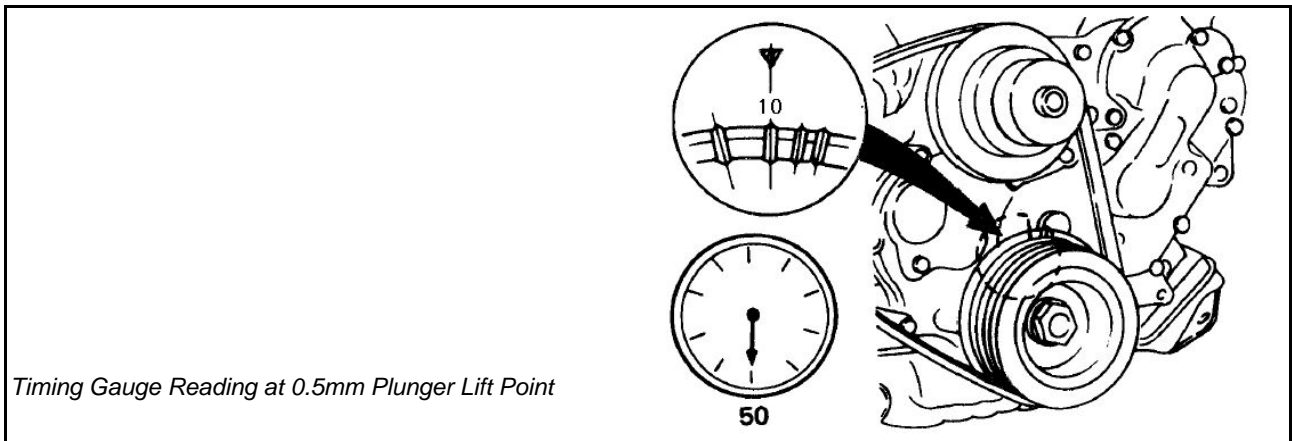


2) Disconnect the injection pipe from the injection pump and remove a bolt from the distributor head. Insert a screw driver into a hole in the fast idle lever and turn the lever to cancel the cold starting device function.

3) Install the static timing gauge to the distributor head.

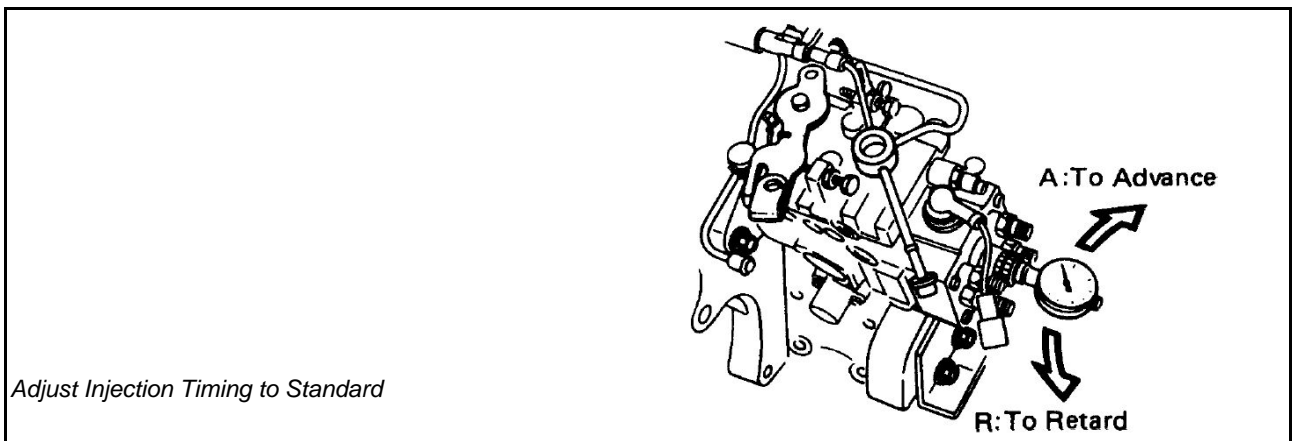


3) Rotate the crankshaft to bring the piston in the No.1 cylinder to a point 30 - 40 ° BTDC. And set the timing gauge needle to zero.



4) Rotate the crankshaft clockwise and read the crankshaft timing pulley timing mark when the timing gauge indicated 0.5mm lift point.

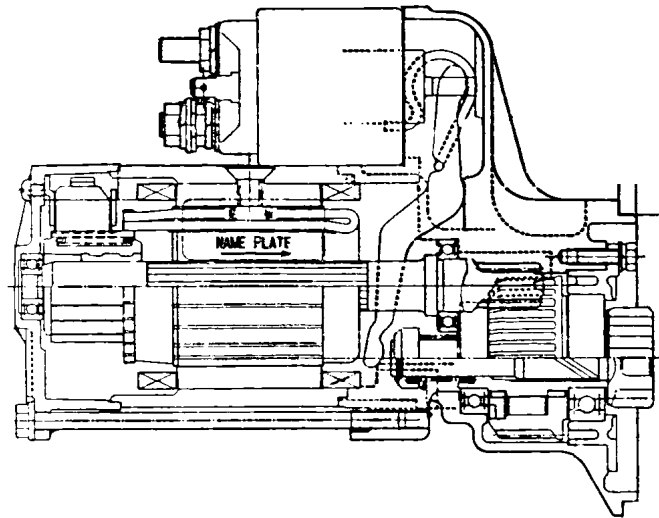
-Standard: BTDC 4°



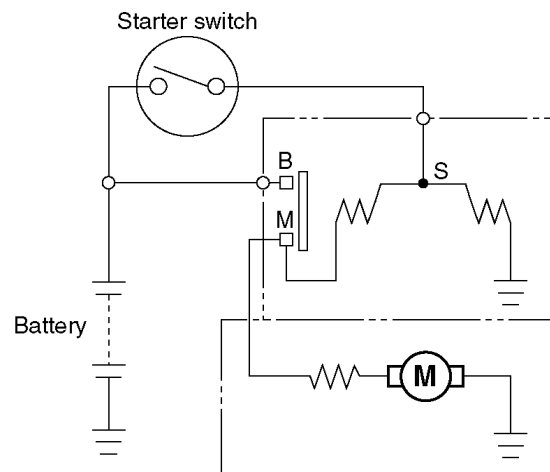
5) If the injection timing is out of standard, adjust the injection pump setting angle depending on indicated timing.

## ELECTRICAL PARTS

### STARTER MOTOR



*Starter Assembly*



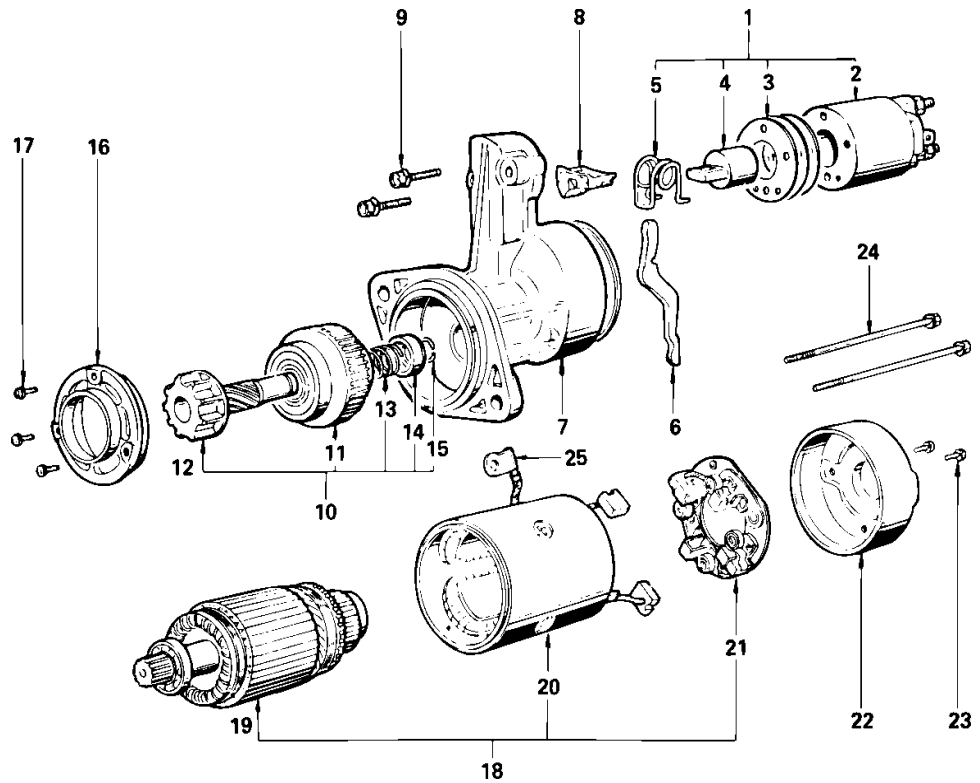
*Connecting Diagram*

The starting system employs a magnetic type reduction starter in which the motor shaft is also used as a pinion shaft.

When the starter switch is turned on, the contacts of magnetic switch are closed, and the armature rotates.

At the same time, the plunger is attracted, and the pinion is pushed forward by the shift lever to mesh with ring gear. Then, the ring gear runs to start the engine.

On the 4JB1-TC engine has an output of 2.0 or 2.2 kW made by Hitach.



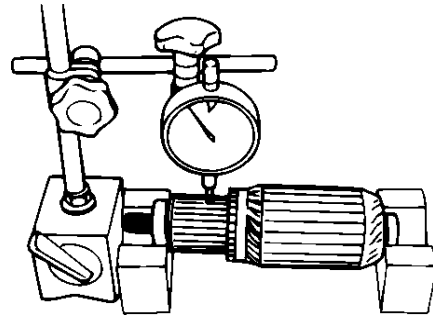
1. Magnetic Switch Assembly
2. Magnetic Switch
3. Adjusting Shims
4. Plunger
5. Torsion Spring
6. Shift Lever
7. Gear Case
8. Dust Cover
9. Bolt
10. Pinion Assembly
11. Clutch
12. Pinion Shaft
13. Return Spring
14. Pinion Stopper
15. Pinion Stopper Clip
16. Bearing Retainer
17. Screw
18. Motor Assembly
19. Armature
20. Yoke
21. Brush Holder
22. Rear Cover
23. Screw
24. Through Bolt
25. Lead Wire

**Inspection Item****Commutator Run-out**

Required Tool: Dial Indicator, V-Block

Service Standard: 0.02mm

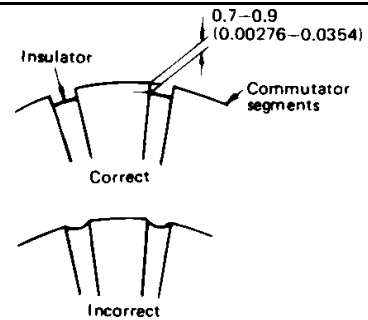
Service Limit: 0.05mm

**Commutator Mica Segments Wear**

Required Tool: Vernier Caliper

Service Standard: 0.7 - 0.9mm

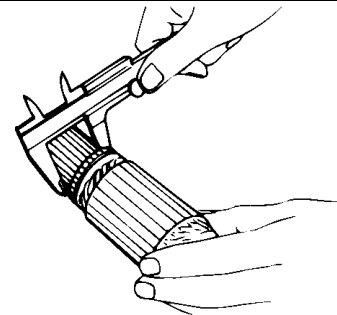
Service Limit: 0.2mm

**Commutator Outside Diameter**

Required Tool: Vernier Caliper

Service Standard: 35mm

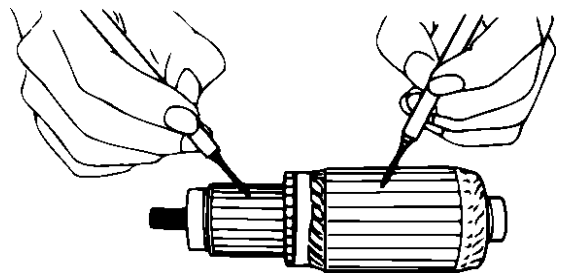
Service Limit: 34mm

**Armature Grounding Test**

Required Tool: Circuit Tester

Hold one probe of the circuit tester against the commutator segment. And, hold the other circuit tester probe against the armature core.

If the circuit tester indicates continuity, the armature is grounded.

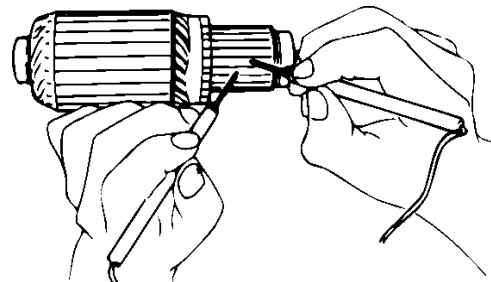
**Armature Continuity Test**

Required Tool: Circuit Tester

1 Hold the circuit tester probes against two armature core segments.

2 Repeat Step 1 at different segments of the armature core.

There should be continuity between all segments of the armature core.



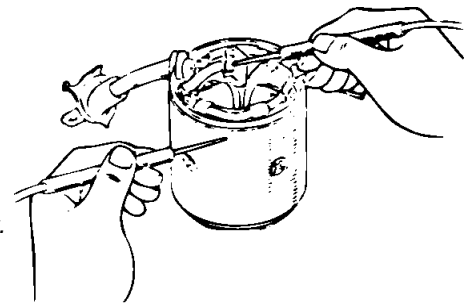
**Yoke Field Winding Ground Test**

*Required Tool: Circuit Tester*

*Hold one circuit tester probe against the field winding end or brush.*

*Hold the other circuit tester probe against the bare surface of the yoke body.*

*If there is continuity, the field coil is grounded.*

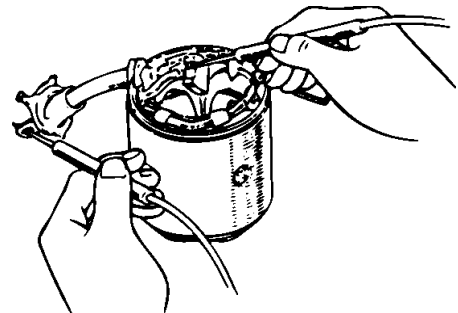
**Yoke Field Winding Continuity Test**

*Required Tool: Circuit Tester*

*Hold one circuit tester probe against the "C" terminal lead wire.*

*Hold the other circuit tester probe against the field winding brush.*

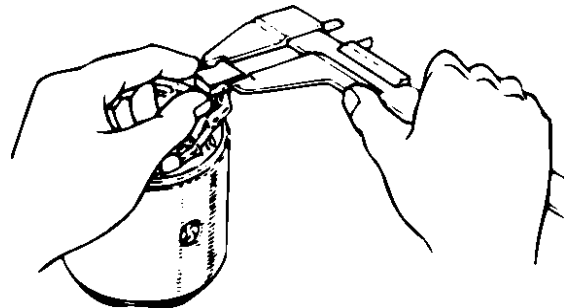
*There should be continuity.*

**Brush Length**

*Required Tool: Vernier Caliper*

*Service Standard: 16.0mm (2.0kw) or 14.5mm (2.2kw)*

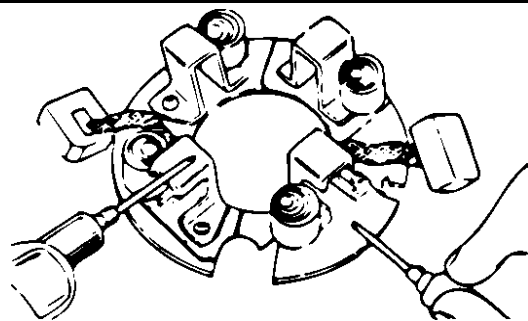
*Service Limit: 10.0mm*

**Brush Holder Insulation Test**

*Required Tool: Circuit Tester*

*Touch one probe to the holder plate and the other probe to the positive brush holder.*

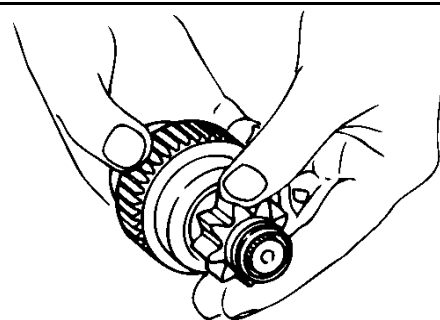
*There should be no continuity.*

**Overrunning Clutch**

*Inspect the overrunning clutch gear teeth for excessive wear and damage.*

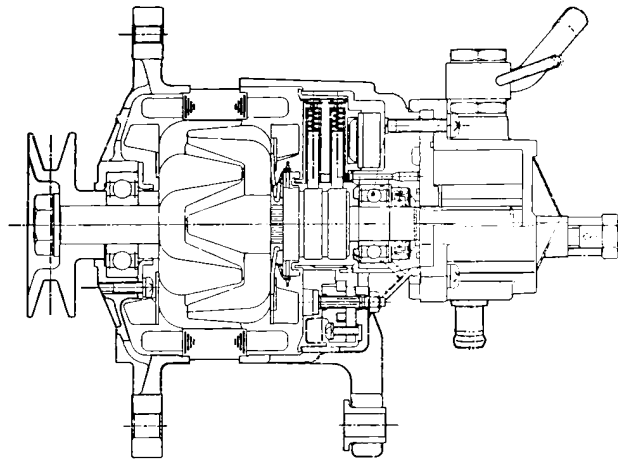
*Rotate the pinion clockwise. It should turn smoothly.*

*Try to rotate the pinion in the opposite direction. The pinion should lock.*

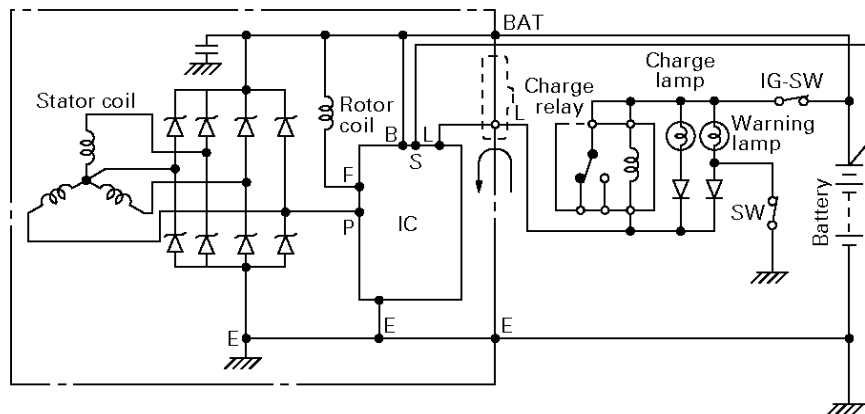




## GENERATOR



Generator Assembly



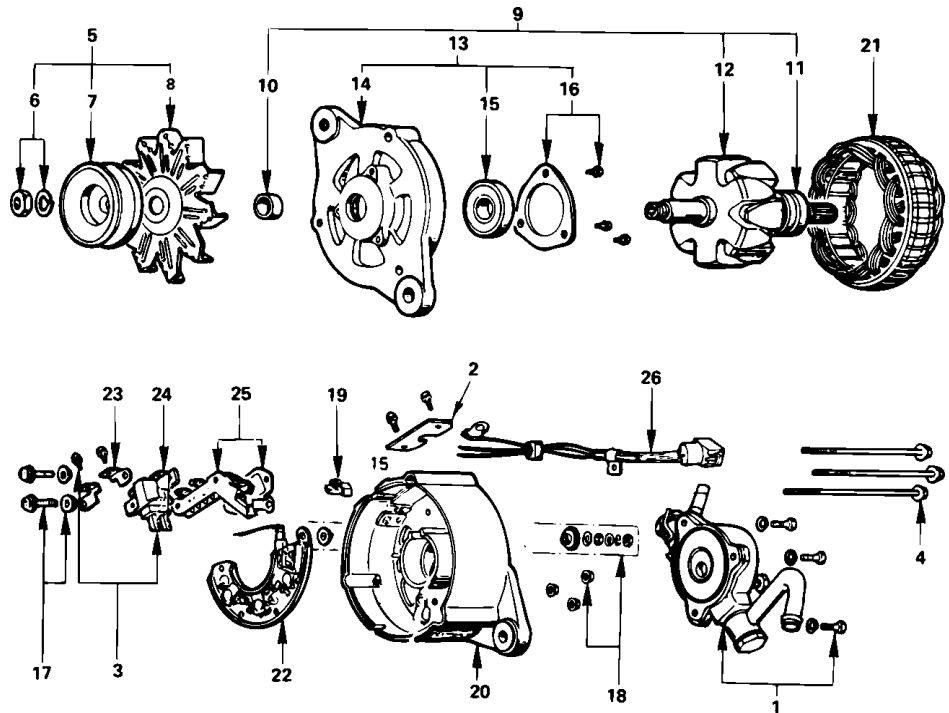
Connecting Diagram

The basic charging system is the IC integral regulator charging system. The internal components are connected electrically as shown in connecting diagram.

The generator features a solid state regulator that is mounted inside the generator. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame.

On the 4JB1-TC engine, two type of outputs (50A or 60A) can be used depends on vehicle specification.

1. Vacuum Pump
2. Cover
3. Brush
4. Through Bolt
5. Pulley Assembly
6. Pulley Nut
7. Pulley
8. Fan
9. Rotor Assembly
10. Speacer
11. Ball Bearing
12. Rotor
13. Front Cover Assembly
14. Front Cover
15. Ball Bearing
16. Bearing Retainer
17. Screw
18. Terminal Bolt & Nut
19. Condenser
20. Rear Cover
21. Stator
22. Diode
23. Holder Plate
24. Brush Holder
25. IC Regulator Assembly
26. Lead Wire
27. Mold Terminal
28. IC Regulator



### Inspection Item

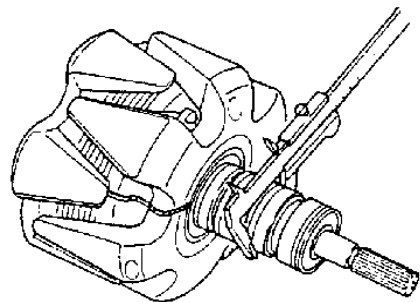
#### Rotor Slip Ring Wear

Required Tool: Vernier Caliper

Check the rotor slip ring surfaces for contamination and roughness. If rough, polish with #500-600 sandpaper.

Service Standard: 34.6mm

Service Limit: 33.6mm

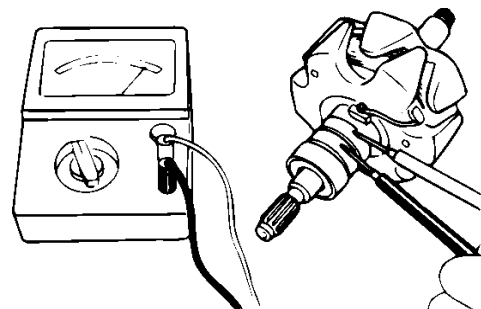


#### Rotor Slip Ring Continuity Test

Required Tool: Circuit Tester

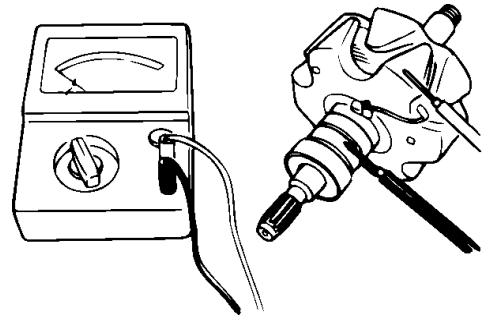
Check for continuity between slip rings.

There should be continuity.



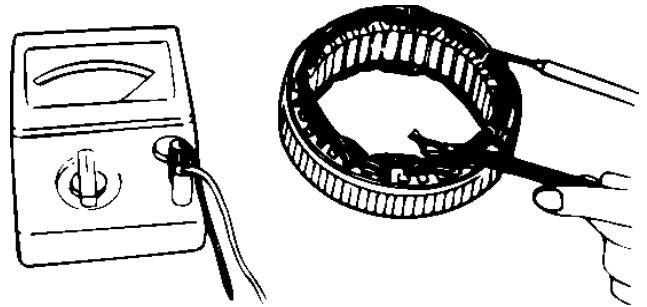
**Rotor Slip Ring Insulation Test**

Required Tool: Circuit Tester  
 Check for continuity between the slip rings and the rotor core or shaft.  
 There should be no continuity.



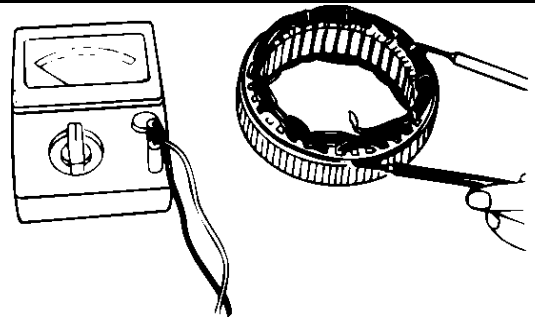
**Stator Coil Continuity Test**

Required Tool: Circuit Tester  
 Check for continuity across the stator coils.  
 There should be continuity.



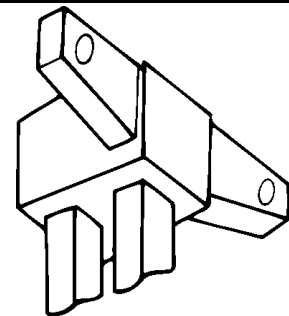
**Stator Coil Insulation Test**

Required Tool: Circuit Tester  
 Check for continuity between each stator coils and the stator core.  
 There should be no continuity.



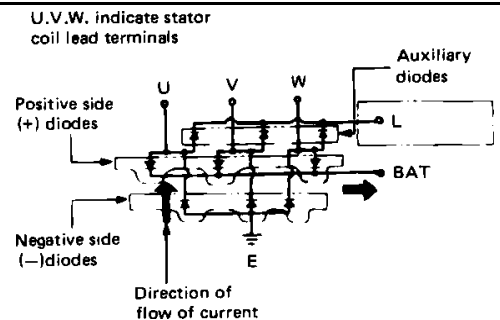
**Brush Length**

Required Tool: Vernier Caliper  
 Service Standard: 20mm  
 Service Limit: 6mm

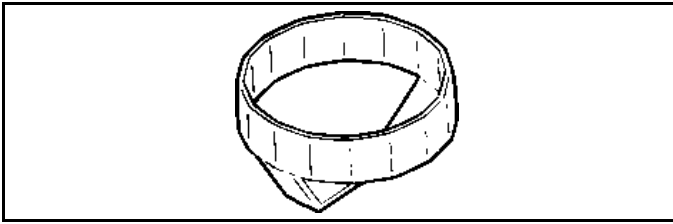


**Diode Insulation Test**

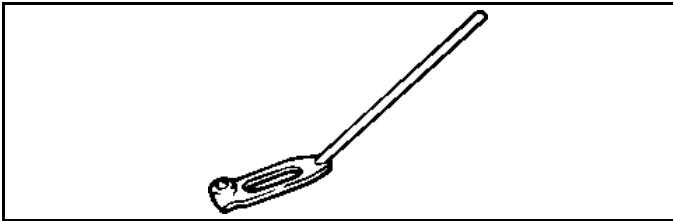
Required Tool: Circuit Tester  
 Check for continuity between the battery and each of the three stator coil lead terminals. If there is continuity, the diode is normal.  
 Reverse the polarity of the test probes. If there is no continuity, the diode is normal.



## SPECIAL TOOLS



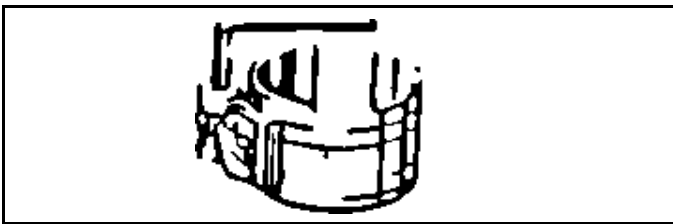
5-8840-0200-0  
Oil Filter Wrench (89.0mm / 3.5 in)



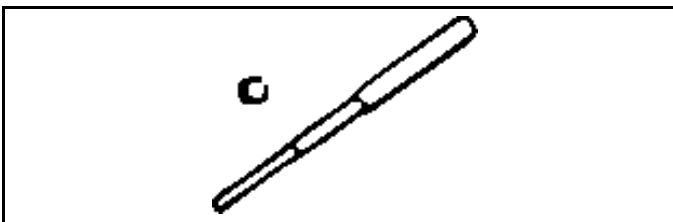
9-8523-1423-0  
Valve Spring Compressor



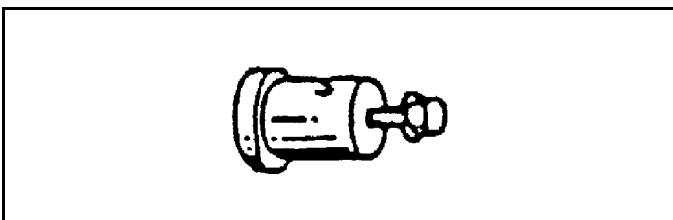
5-8840-2033-0  
Oil Seal Installer



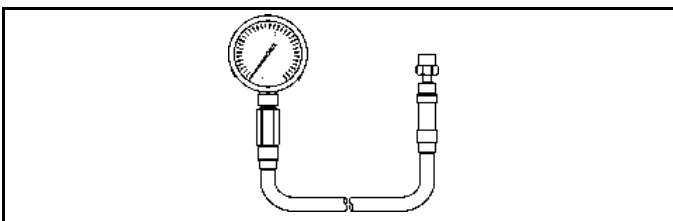
5-8840-9018-0  
Piston Ring Compressor



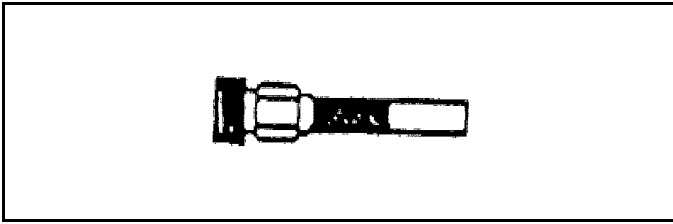
9-8523-1212-0  
Valve Guide Replacer



5-8840-2036-0  
Front Oil Seal Installer



5-8840-2675-0  
Compression Gauge



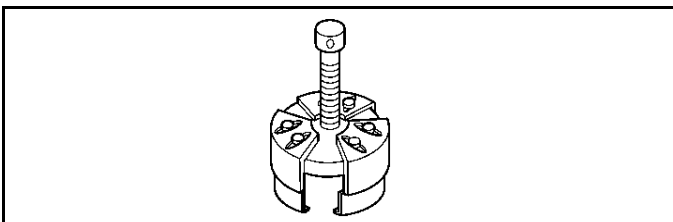
5-8531-7001-0  
Gauge Adapter



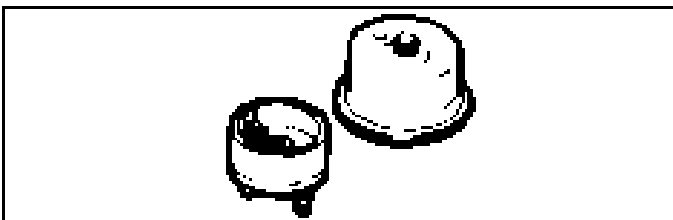
5-8840-0266-0  
Angle Gauge



5-8840-2038-0  
Camshaft Bearing Replacer



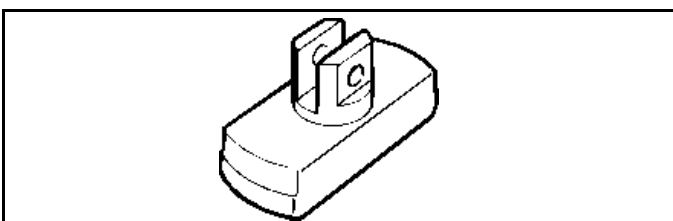
5-8840-2360-0  
Rear Oil Seal Remover



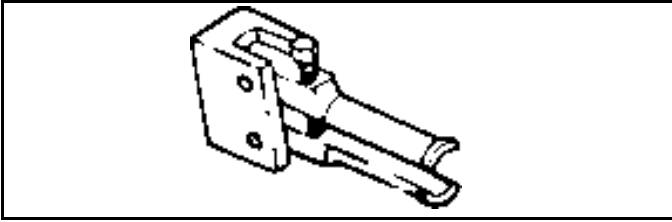
5-8840-2359-0  
Rear Oil Seal Installer



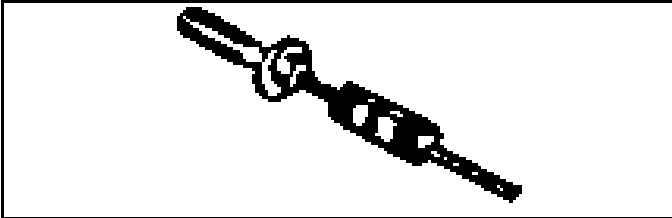
5-8840-2040-0  
Cylinder Liner Installer



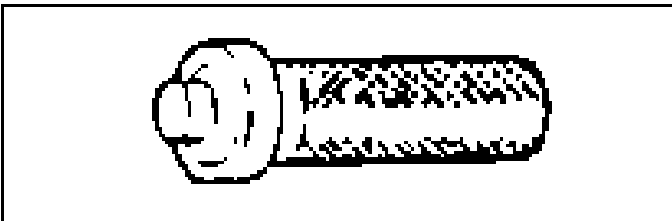
5-8840-2039-0  
Cylinder Liner Remover



5-8840-2000-0  
Pilot Bearing Remover



5-8840-0019-0  
Sliding Hammer



5-8522-0024-0  
Pilot Bearing Installer