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010001

MAIN DATA AND SPECIFICATIONS

Item	Engine model	4JA1	4JB1	4JB1T	4JB1TC
Engine type		Four-cycle, overhead valve, water cooled			
Combustion chamber type		Direct injection			
Cylinder liner type		Dry type, chrome plated, stainless steel tube			
Timing gear train system		Gear drive		Gear drive or Belt drive	Belt drive
No. of cylinders — bore x stroke	mm(in)	4 - 93 x 92 (3.66 x 3.62)		4 - 93 x 102 (3.66 x 4.02)	
No. of piston rings		Compression ring: 2/Oil ring: 1			
Total piston displacement	cm ³ (in ³)	2,499 (152.4)		2,771 (169.0)	
Compression ratio (to 1)		18.4	18.2	17.5	
Compression pressure	kg/cm ² (psi/kPa)	31 (441/3)			
Engine weight	kg(lb)	Approximately 226 (498)	Approximately 229 (505)	Approximately 250 (550)	Approximately 255 (562)
Fuel injection order		1 - 3 - 4 - 2			
Fuel injection timing BTDC	deg	12 (Gear drive)		12 (Gear drive) 10 (Belt drive)	11
Specified fuel type		SAE No. 2 diesel fuel			
Idling speed	rpm	750 - 790			
Valve clearances (At cold): Intake	mm(in)	0.4 (0.016)			
	Exhaust mm(in)	0.4 (0.016)			
Intake valves	Open at (BTDC)	deg	24.5	24.0	
	Close at (ABDC)	deg	55.5	55.0	
Exhaust valves	Open at (BBDC)	deg	54.0	54.0	
	Close at (ATDC)	deg	26.0	26.0	
Fuel system		BOSCH distributor VE type			
Injection pump type		Mechanical (All speed)			
Governor type					
Injection nozzle type		Single spring, hole with 4 orifices		Single spring, hole with 4 orifices (Gear drive)	
		—		Two springs, hole with 4 orifices (Belt drive)	

4JB1T : 4JB1 Engine with turbocharger.

4JB1TC: 4JB1 Engine with turbocharger and intercooler.

06F-2 4J DIESEL ENGINE

Item	Engine model	4JA1	4JB1	4JB1T	4JB1TC
Injection nozzle opening pressure (Service value)	kg/cm ² (psi/kPa)				
Single spring type (Gear drive models only)		185 (2,631/18,143)			185 (2,631/18,143)
Two spring type: (Belt drive models only)					
: First pressure		—			180 (2,560/17,653)
: Second pressure		—			274.5 (3,903/26,920)
					274.5 (3,903/26,920)
					224* (3,185/21,968)
Main fuel filter type		Cartridge paper element and water separator			
Lubricating system					
Lubricating method		Pressure circulation			
Specified engine oil (API grade)		CC or CD		CD	
Oil pressure	kg/cm ² (psi/kPa)/rpm	Approximately 1.0 (14.2/98.1)/770 (SAE 10W-30 API CD grade) engine oil at an oil temperature of 80°C (176°F)			
Oil pump type		Gear	Trochoid	Gear	
Oil filter type		Cartridge paper element			
*Bypass filter type		**Cartridge paper element			
Oil capacity	lit(US/UK gal)	5.5 (1.5/1.2)			
Oil cooler type		Water cooled			
Cooling system					
Water pump type		Centrifugal			
Thermostat type		Wax pellet with jiggle valve			
Air cleaner type		Dry paper element			
Battery type/voltage x No. of units		N702/12 x 1	NX120-7/12 x 1 or NX200-10/12 x 1		
Alternator capacity	V-A (Kw)	12 - 40 (480) or 12 - 50 (600)			
Starter motor output	V-Kw	12 - 2.0 or 12 - 2.2			

*For E.G.R (Exhaust Gas Recirculation) system equipped models only.

**Built-in to the oil filter element.

Note:
Engine Application Chart

	Vehicle Model	Transmission Model	Clutch Model
4JA1	KBD 4 × 2	MSG	Hydraulic
4JB1, 4JB1T, 4JB1TC	UBS	MUA	

0200

TORQUE SPECIFICATIONS

0201



STANDARD BOLTS

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

kg·m (lb.ft/N.m)

Bolt identification Bolt diameter x pitch (mm)	Material			
		4 T (Low carbon steel)	7 T (High carbon steel)	9 T (Alloy steel)
M 6 x 1.0		0.60±0.20 (4.33±1.44/5.88±1.96)	0.75±0.25 (5.43±1.80/7.35±2.45)	—
M 8 x 1.25		1.30±0.50 (9.40±3.62/12.74±4.90)	1.75±0.55 (12.66±4.00/17.15±5.39)	2.40±0.70 (17.36±5.06/23.52±6.86)
M10 x 1.25		2.80±0.70 (20.25±5.06/27.44±6.86)	3.75±0.95 (27.12±6.87/36.75±9.31)	5.10±1.30 (36.89±9.40/49.98±12.74)
M12 x 1.25		6.25±1.25 (45.21±9.04/61.25±12.25)	7.75±1.55 (56.06±11.21/75.95±15.19)	9.65±1.95 (69.80±14.10/94.57±19.11)
M14 x 1.5		9.75±1.95 (70.52±14.10/95.55±19.11)	11.85±2.35 (85.71±17.00/116.13±23.03)	14.50±2.90 (104.88±21.00/142.10±28.42)
M16 x 1.5		13.30±2.70 (96.20±19.53/130.34±26.46)	17.30±3.50 (125.13±25.32/169.54±34.30)	20.40±4.10 (147.55±29.66/199.92±40.18)
M18 x 1.5		19.20±3.80 (138.87±27.49/188.16±37.24)	24.90±5.00 (180.10±36.17/244.02±49.00)	29.30±5.90 (211.93±42.67/287.14±57.82)
M20 x 1.5		26.30±5.30 (190.23±38.33/257.74±51.94)	34.40±6.90 (248.82±49.41/337.12±67.62)	40.40±8.10 (292.21±58.59/395.92±79.38)
M22 x 1.5		33.90±8.30 (245.20±60.03/332.22±81.34)	46.25±9.25 (334.53±66.91/453.25±90.65)	54.10±10.80 (391.30±78.12/530.18±105.84)
M24 x 2.0		45.80±9.20 (331.27±66.54/448.84±90.16)	58.20±14.30 (420.96±103.43/570.36±140.14)	70.60±14.10 (510.65±101.99/691.88±138.18)
*M10 x 1.5		2.70±0.70 (19.53±5.06/26.46±6.86)	3.70±0.90 (26.76±6.50/36.26±8.82)	4.90±1.20 (35.44±8.68/48.02±11.76)
*M12 x 1.5		5.80±1.20 (41.95±8.68/56.84±11.76)	7.20±1.40 (52.08±10.13/70.56±13.72)	9.10±1.80 (65.82±13.02/89.18±17.64)
*M14 x 2.0		9.10±1.80 (65.82±13.02/89.18±17.64)	11.20±2.20 (81.01±15.91/109.76±21.56)	13.60±2.70 (98.37±19.53/133.28±26.46)
*M16 x 2.0		12.70±2.50 (91.86±18.08/124.46±24.50)	16.50±3.30 (119.34±23.87/161.70±32.34)	19.50±3.90 (141.04±28.21/191.10±38.22)

Note:

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

0204



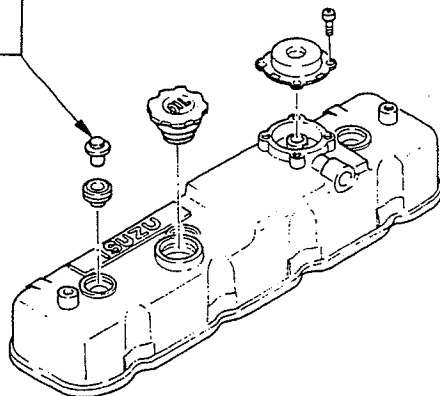
SPECIAL PARTS FIXING NUTS AND BOLTS

020401

Cylinder Head Cover, Cylinder Head, and Rocker Arm Shaft Bracket

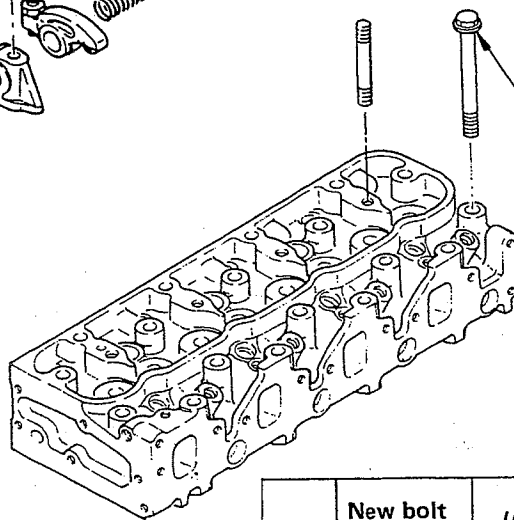
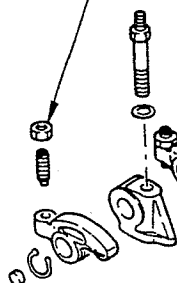
kg-m(lb.ft/N-m)

1.3 ± 0.5
($9.4 \pm 3.6/12.74 \pm 4.90$)



5.5 ± 0.5
($39.8 \pm 3.6/53.90 \pm 4.90$)

1.5 ± 0.5
($10.8 \pm 3.6/14.70 \pm 4.90$)



4JA1	New bolt	8.7 ± 0.5 ($62.9 \pm 3.6/85.26 \pm 4.90$)
	Reuse bolt	10.5 ± 0.5 ($75.9 \pm 3.6/102.90 \pm 4.90$)

All 4JB1	1st Step	2nd Step
	5.0 ± 0.5 ($36.2 \pm 3.6/49.00 \pm 4.90$)	$120^{\circ} + 30^{\circ}$ $- 0^{\circ}$

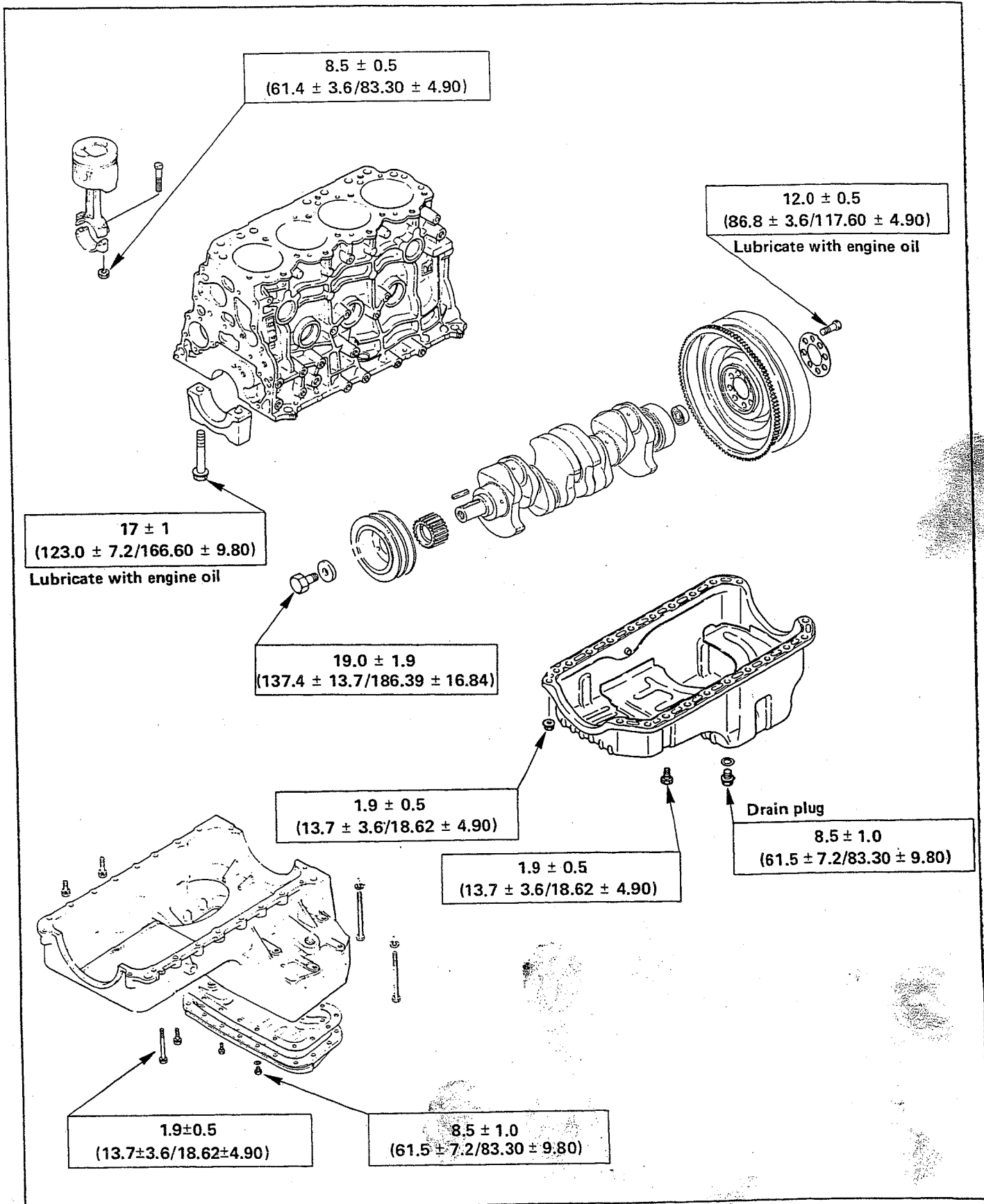
Lubricate with the engine oil

020402



**Crankshaft Bearing Cap, Connecting Rod Bearing Cap,
Crankshaft Damper Pulley, Flywheel, and Oil Pan**

kg-m(lb.ft/N-m)



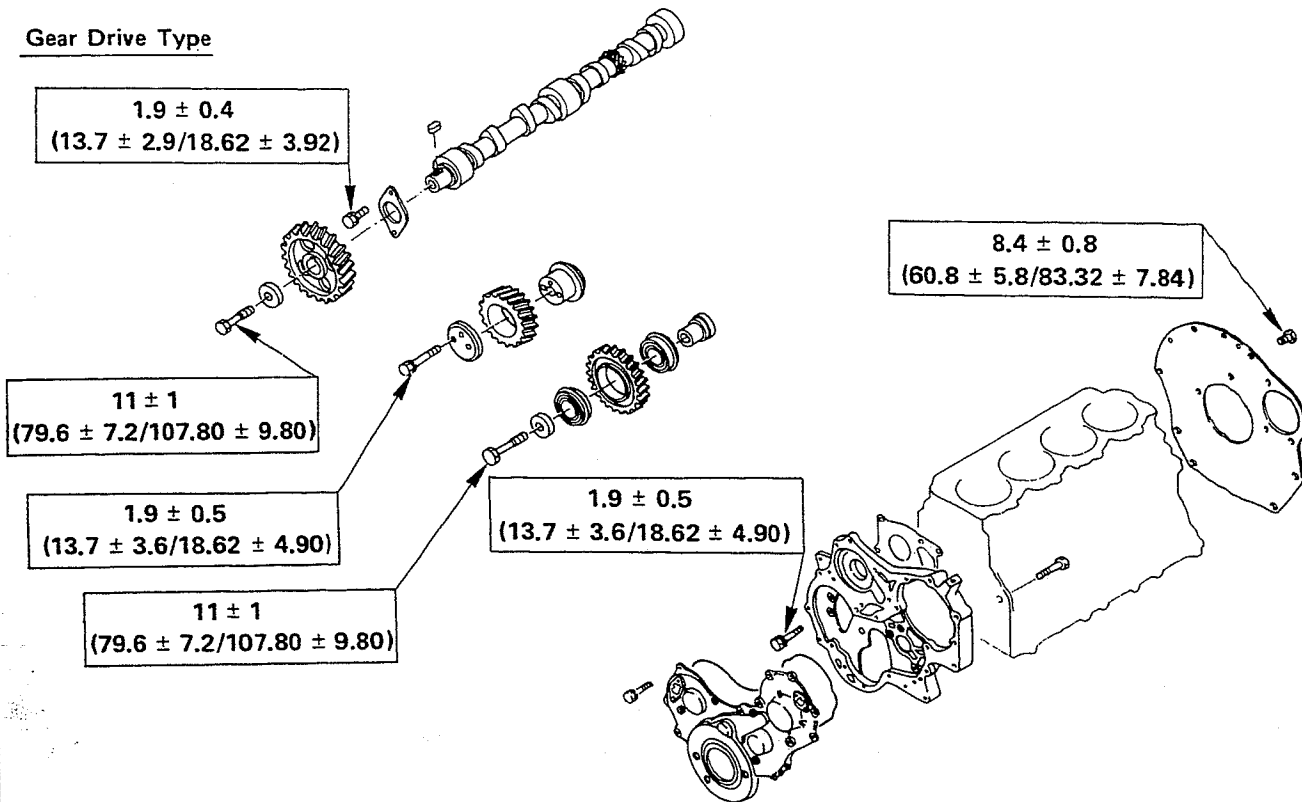
02040301



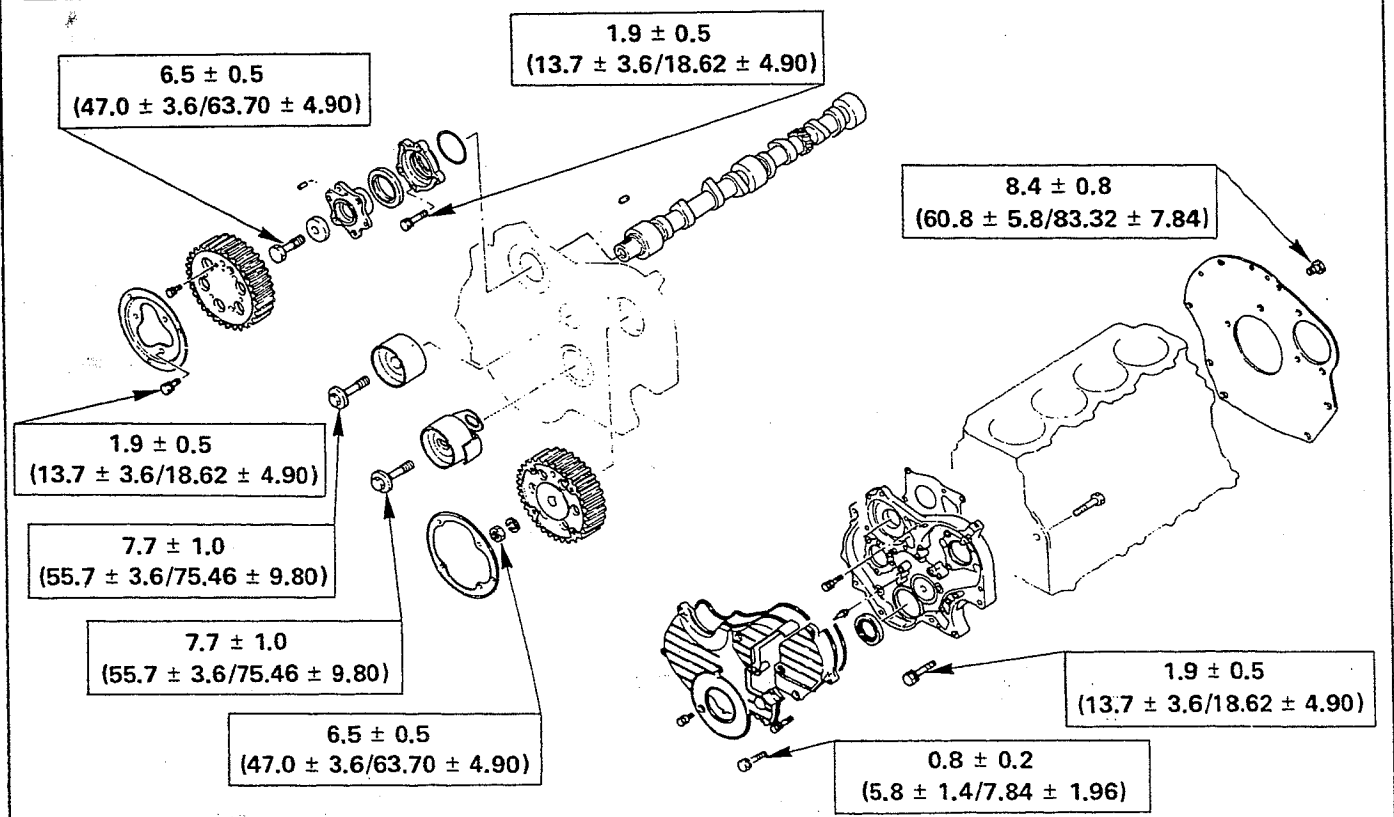
Timing Gear Case, Pulley Housing, Timing Gear, Timing Pulley, and Camshaft

kg-m(lb.ft/N-m)

Gear Drive Type



Belt Drive Type



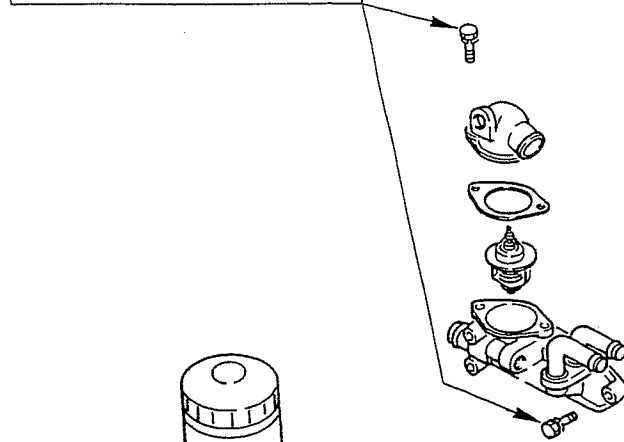
020404



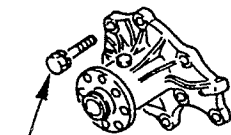
Cooling and Lubricating System

kg·m(lb.ft/N·m)

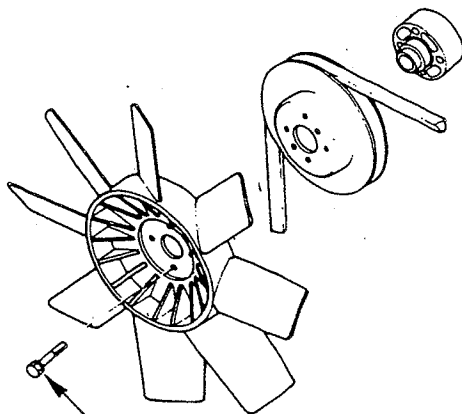
1.9 ± 0.5
($13.7 \pm 3.6/18.62 \pm 4.90$)



1.9 ± 0.5
($13.7 \pm 3.6/18.62 \pm 4.90$)



2.0 ± 0.5
($14.5 \pm 3.6/19.60 \pm 4.90$)

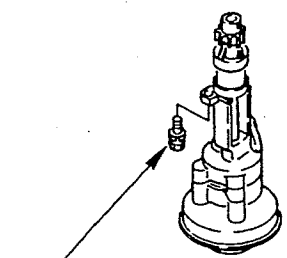


0.8 ± 0.2
($5.8 \pm 1.4/7.84 \pm 1.96$)

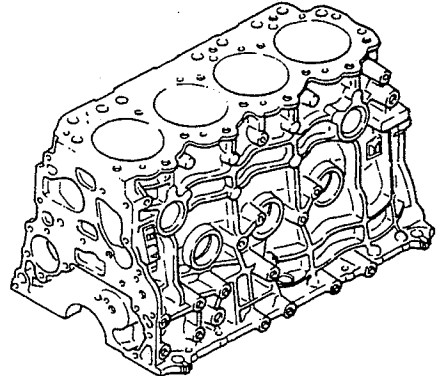
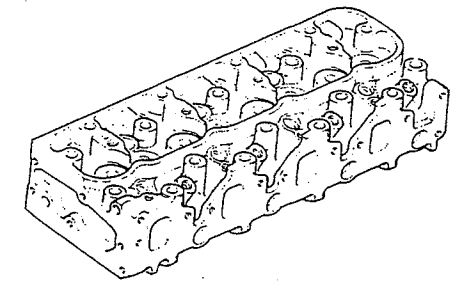
0.8 ± 0.2
($5.8 \pm 1.5/7.84 \pm 1.96$)

1.9 ± 0.5
($13.7 \pm 3.6/18.62 \pm 4.90$)

3.0 ± 0.5
($21.7 \pm 3.6/29.40 \pm 4.90$)



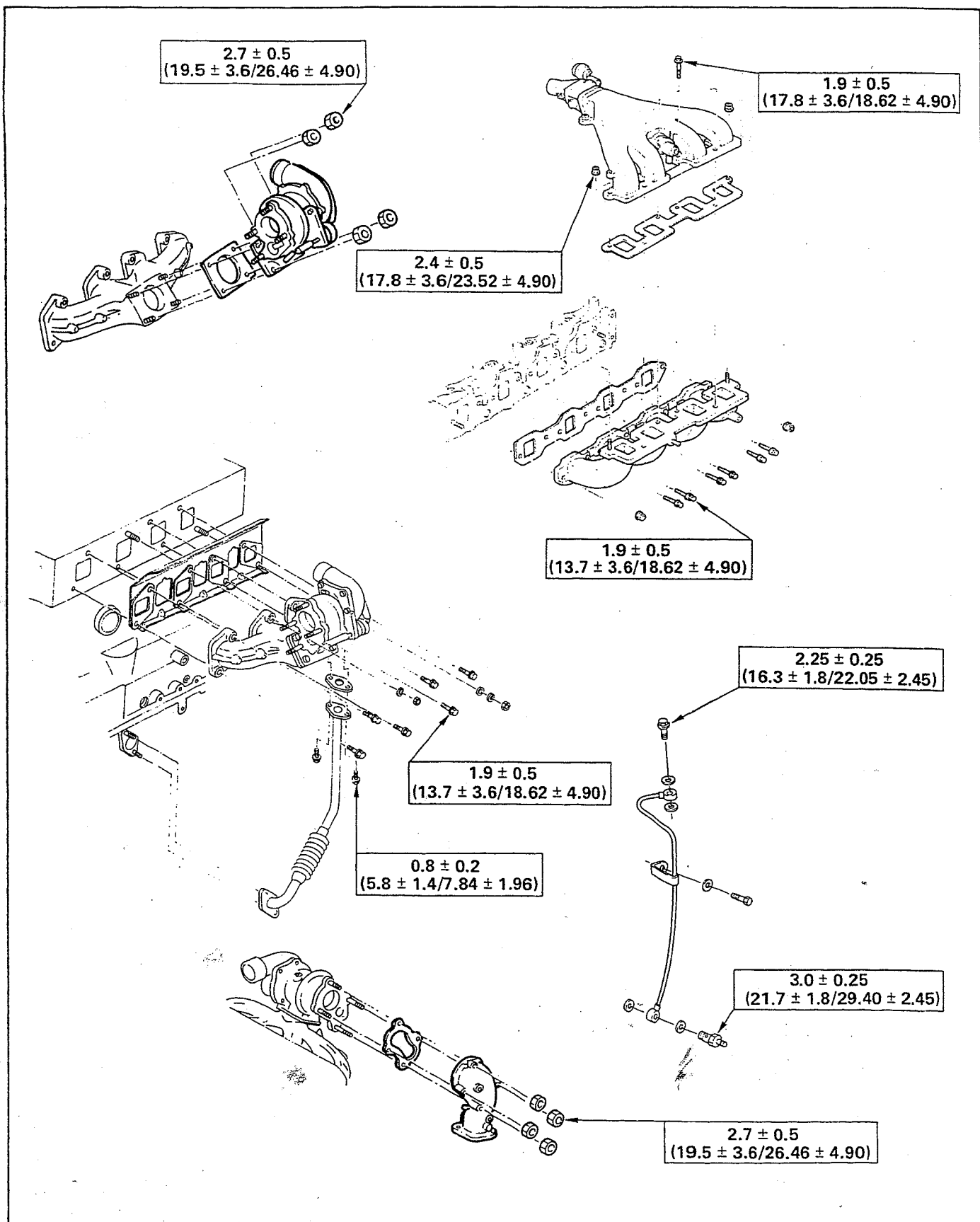
1.9 ± 0.5
($13.7 \pm 3.6/18.62 \pm 4.90$)





Intake Manifold, Exhaust Manifold, and Turbocharger

kg·m(lb.ft/N·m)

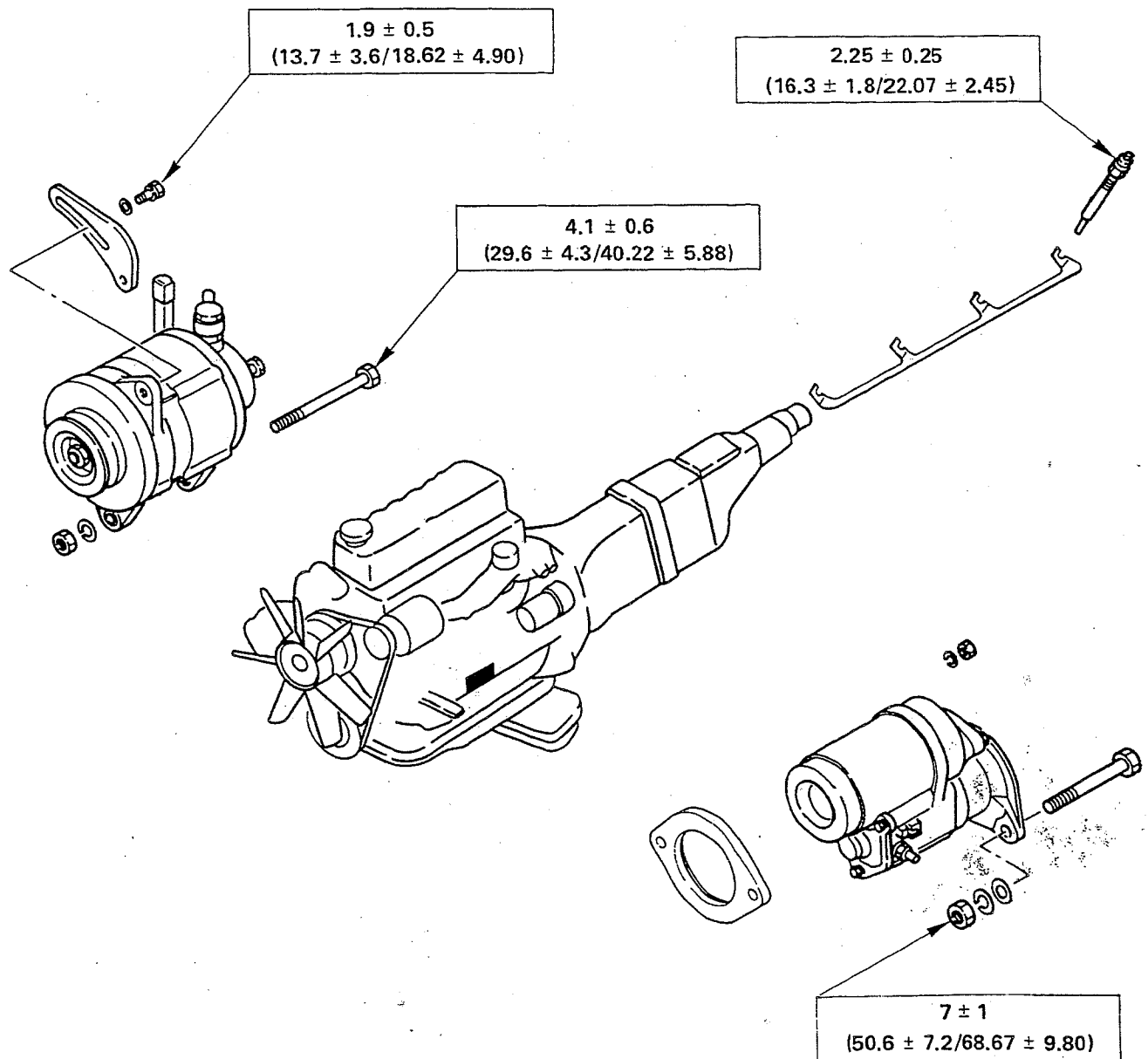


020407



Engine Electrical

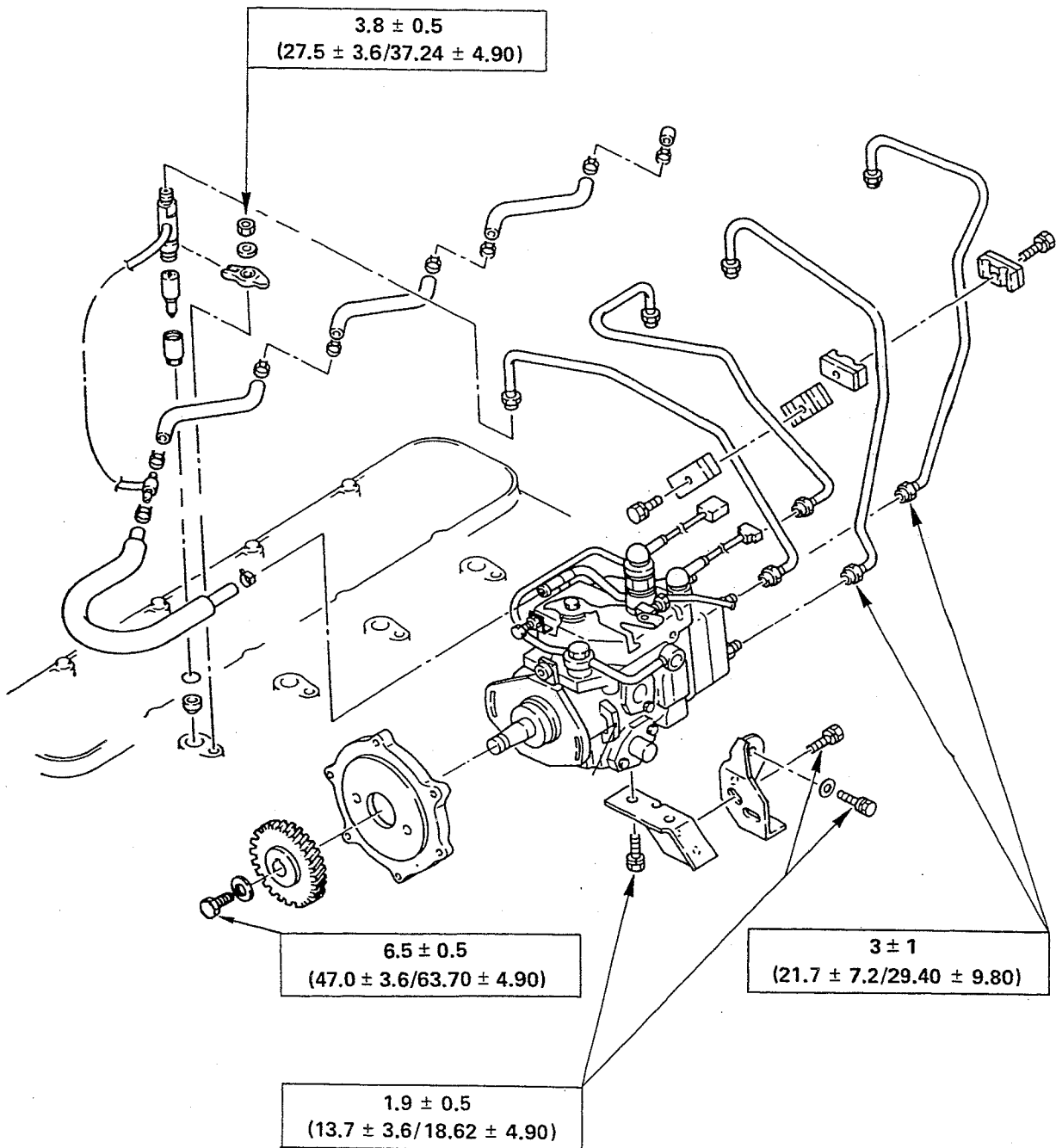
kg·m(lb.ft/N·m)





Fuel Injection System

kg-m(lb.ft/N-m)

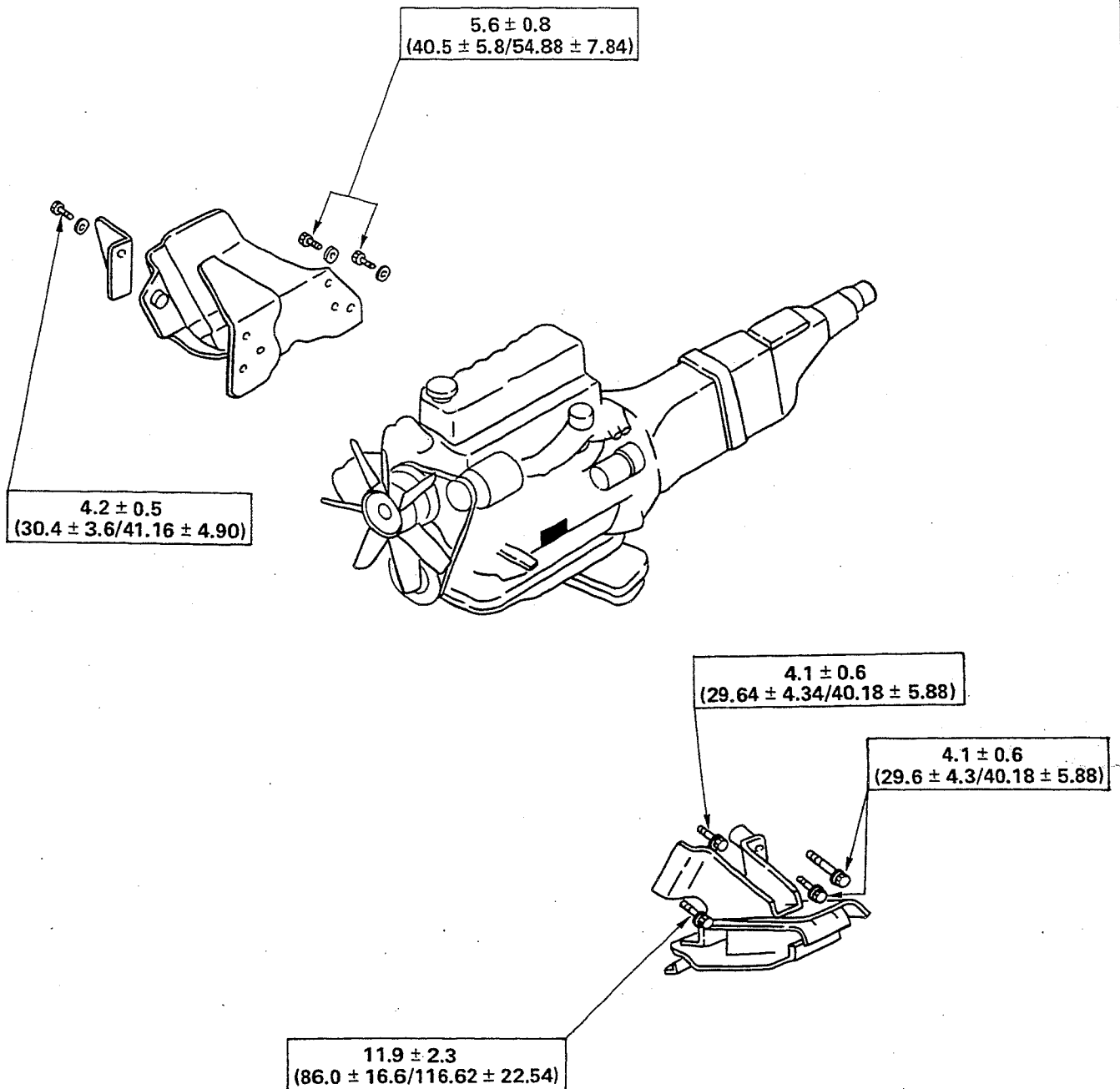


020410



Engine Mounting Bracket

kg·m(lb.ft/N·m)



RECOMMENDED LIQUID GASKET

Type	Brand Name	Manufacturer	Remarks
RTV* Silicon Base	ThreeBond 1207B ThreeBond 1207C	Three Bond Three Bond	
Water Base	ThreeBond 1141E	Three Bond	
Solvent	ThreeBond 1104 BelcoBond 4 BelcoBond 401 BelcoBond 402	Three Bond Isuzu Isuzu Isuzu	
Anerobic	LOCTITE 515 LOCTITE 518	Loctite Loctite	Recommended for transaxle repairs

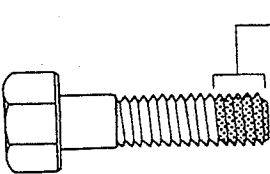
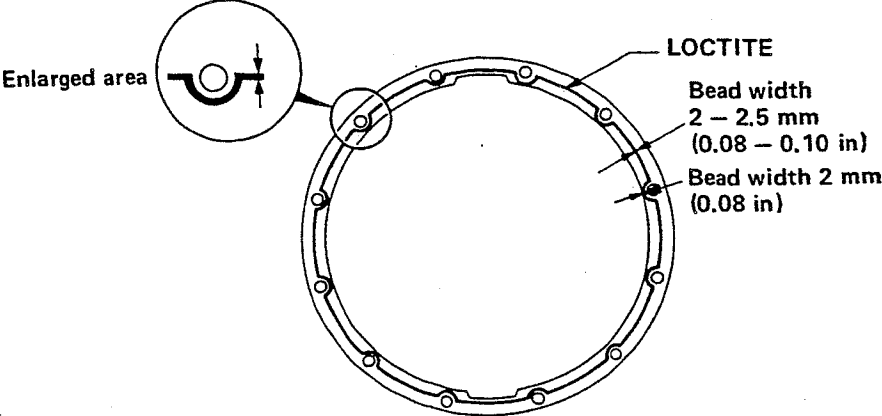
* RTV : Room Temperature Vulcanizer

Note:

1. It is very important that the liquid gaskets listed above or their exact equivalent be used on the vehicle.
2. Be careful to use the specified amount of liquid gasket.
Follow the manufacturer's instructions at all times.
3. Be absolutely sure to remove all lubricants and moisture from the connecting surfaces before applying the liquid gasket.
The connecting surfaces must be perfectly dry.
4. LOCTITE 515 and LOCTITE 518 harden upon contact with a metal surface.
Do not apply LOCTITE 515 or LOCTITE 518 between two metal surfaces having a clearance of greater than 0.25 mm (0.01 in). Poor adhesion will result.

1600

LOCTITE APPLICATION PROCEDURE

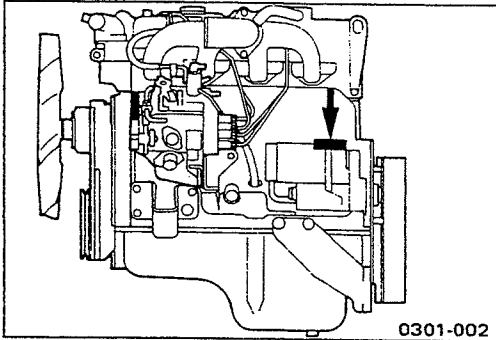
LOCTITE Type	LOCTITE Color	Application Steps
LOCTITE 242	Blue	1. Completely remove all lubricant and moisture from the bolts and the female threaded surfaces of the parts to be joined. The surfaces must be perfectly dry. 2. Apply LOCTITE to the bolts.  3. Tighten the bolts to the specified torque. 4. Wait at least one hour before continuing the installation procedure.
LOCTITE 262	Red	
LOCTITE 270	Green	
LOCTITE 271	Red	
LOCTITE 515	Violet	1. Completely remove lubricant and moisture from the connecting surfaces. The surfaces must be perfectly dry. 2. Apply a 2.0 — 2.5 mm bead of LOCTITE to one of the connecting surfaces. There must be no gaps in the bead.  3. Tighten the bolts to the specified torque. 4. Let the joined parts set for at least thirty minutes.

0300

SERVICING

Servicing refers to general maintenance procedures to be performed by qualified service personnel.

0301, 030101



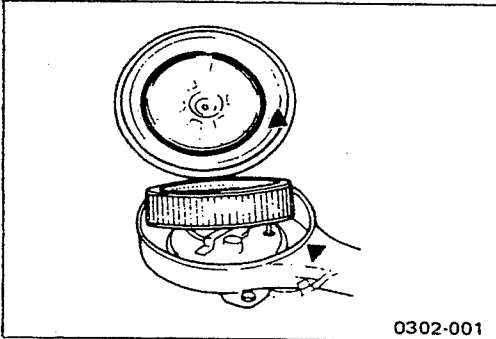
0301-002

MODEL IDENTIFICATION

Engine Serial Number

The engine number is stamped on the front left hand side of the cylinder body.

0302, 030201



0302-001

AIR CLEANER

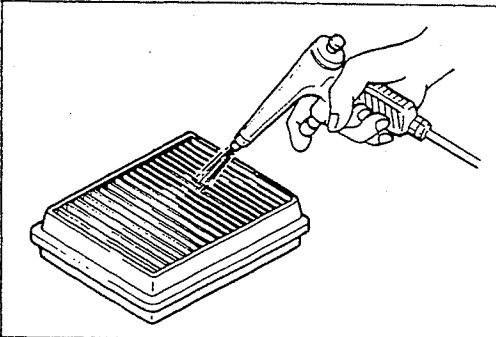
Oil Wetted (Viscous) Type Paper Element (For KB)

The air cleaner has an oil wetted paper element. No servicing is required until the replacement interval is reached.

Never attempt to clean the element, no matter how dirty it may appear. The element is designed to provide normal filtering efficiency until it becomes due for replacement.

Refer to the Item "Service and Maintenance" in the Owner's and Driver's Manual for general service information.

0302, 030201A



Dry Type Washable Paper Element (For KB)

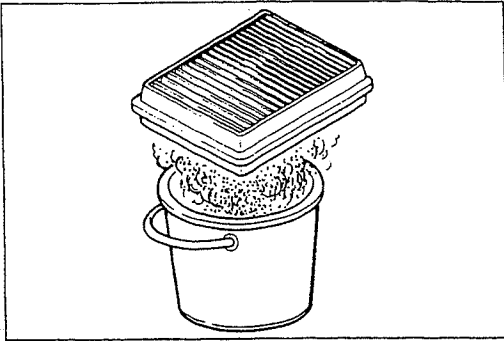
Element cleaning procedures will vary according to the condition of the element.

Dust Fouled Element

Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure must not exceed 7 kg/cm² (99.6 psi/686 kPa).

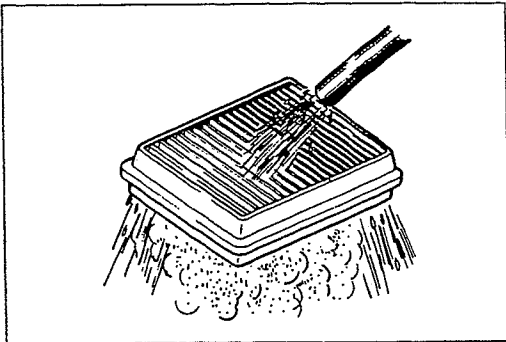
030202B



Carbon and Dust Fouled Element

1. Prepare a cleaning solution of Isuzu Genuine Element Cleaner (Donaldson D1400) diluted with water.
2. Submerge the element in the solution for twenty minutes.

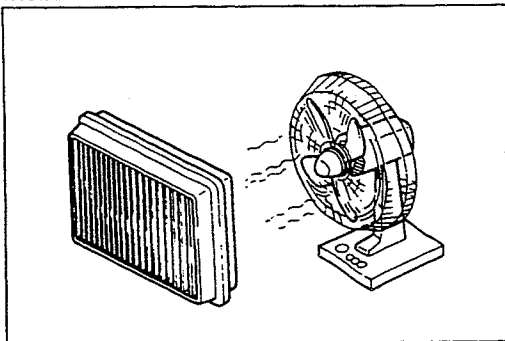
030202C



3. Remove the element from the solution and rinse it well with running water.

Water pressure must not exceed 2.8 kg/cm² (39.8 psi/274 kPa).

030202D



4. Dry the element in a well ventilated area.

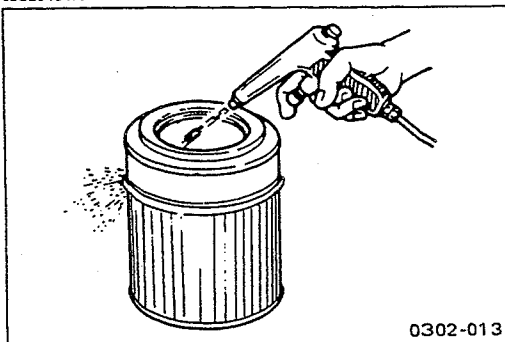
An electric fan will hasten drying.

Note:

Do not use compressed air or an open flame to dry the element quickly. Damage to the element will result.

It will usually take two or three days for the element to dry completely. Therefore, it is a good idea to have a spare on hand to use in the interim.

03020401A



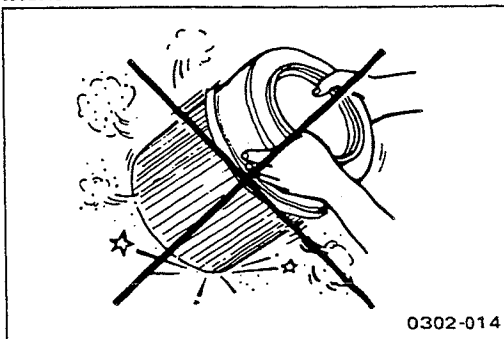
0302-013

Dry Type Paper Element (For UBS)

Apply compressed air to the inside of the element as you rotate it with your hand. This will blow the dust free.

Compressed Air Pressure	kg/cm ² (psi/kPa)
4 – 5	(56.9 – 71.1/392.26 – 490.33)

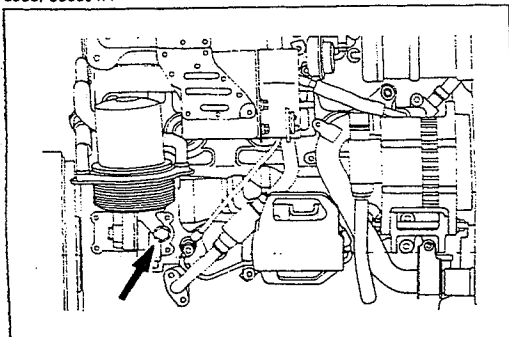
03020401B



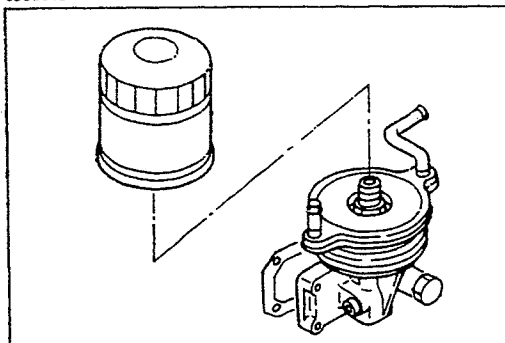
0302-014

Do not bang the element against another object in an attempt to clean it. Damage to the element will result.

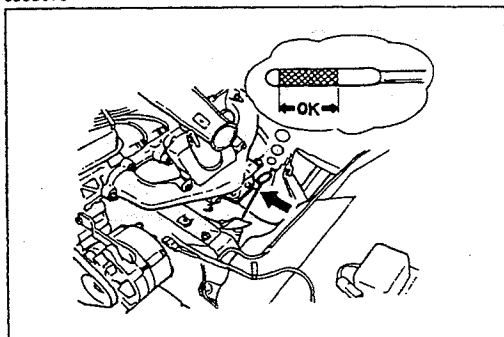
0303, 030301A



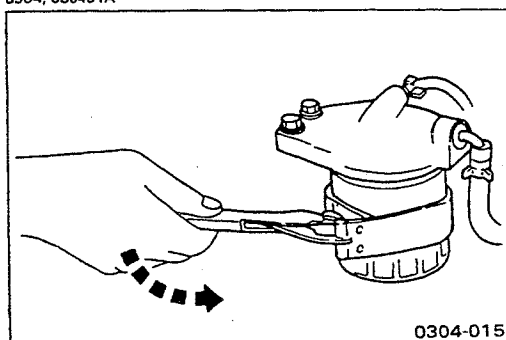
030301B



030301C

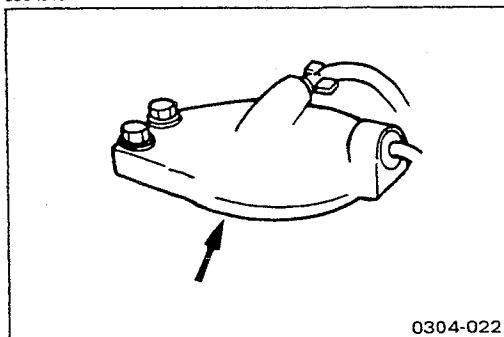


0304, 030401A



0304-015

030401B



0304-022



LUBRICATING SYSTEM

Main Oil Filter (Cartridge Type Paper Element)

Replacement Procedure

1. Loosen the drain plug to drain the engine oil.
2. Wait a few minutes and then retighten the drain plug.
3. Loosen the used oil filter by turning it counterclockwise with the filter wrench.



4. Clean the oil cooler fitting face.

This will allow the new oil filter to seat properly.



5. Apply a light coat of engine oil to the O-ring.



6. Turn in the new oil filter until the filter O-ring is fitted against the sealing face.

7. Use the filter wrench to turn in the filter an additional 1 and 1/4 turns.

Filter Wrench: 5-8840-0200-0 (For 4JB1)

5-8840-0201-0 (For 4JA1)



8. Check the engine oil level and replenish to the specified level if required.

Replenished Engine Oil	lit(US/UK gal)
0.7 (0.19/0.15)	

9. Start the engine and check for oil leakage from the main oil filter.



FUEL SYSTEM

Fuel Filter

Replacement Procedure

1. Loosen the used fuel filter by turning it counterclockwise with the filter wrench.

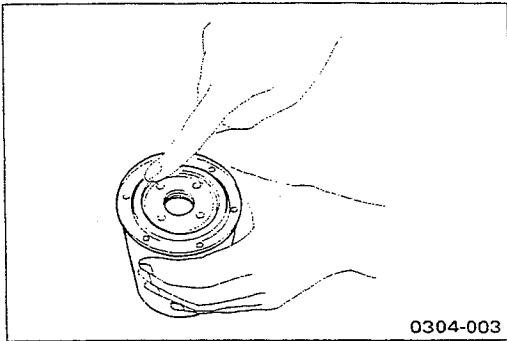
Filter Wrench: 5-8840-0253-0 (J-22700)



2. Clean the upper cover fitting face.

This will allow the new fuel filter to seat properly.

030401C



3. Apply a light coat of engine oil to the O-ring.
4. Supply fuel to the new fuel filter to facilitate bleeding.



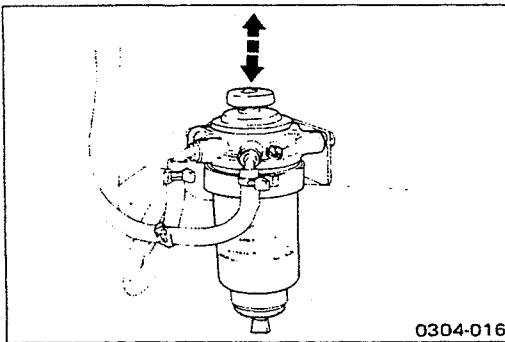
5. Turn in the new fuel filter until the filter O-ring is fitted against the sealing face.

Be very careful to avoid fuel spillage.

6. Use the filter wrench to turn in the fuel filter an additional 1/3 to 2/3 of a turn.

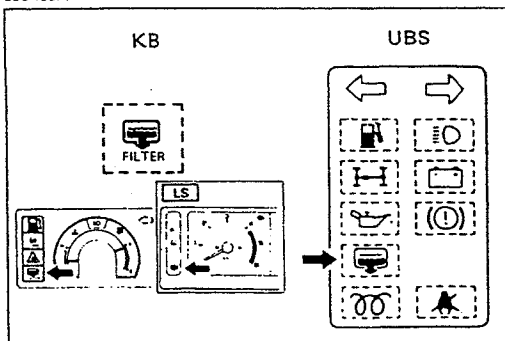
Filter Wrench: 5-8840-0253-0 (J-22700)

030401D



7. Loosen the bleeder screw on the injection pump overflow valve.
8. Operate the priming pump until fuel flows out of the bleeder screw.
9. Retighten the bleeder screw.
10. Operate the priming pump several times while checking for fuel leakage.

030403A

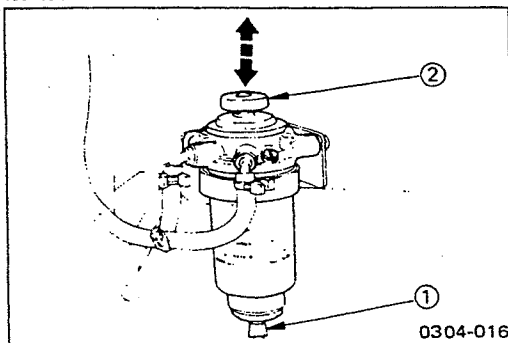


Water Separator (Water Sedimentor)

The indicator light will come on when the water level in the water separator exceeds the specified level.

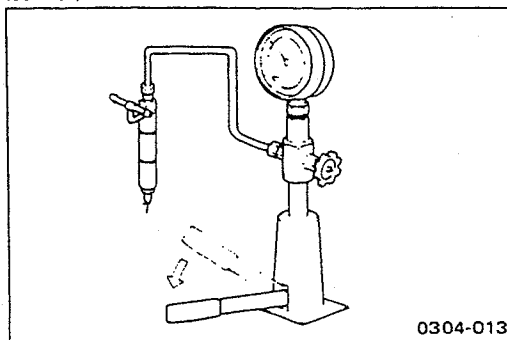
Drain the water and foreign material from the water separator with the following procedure.

030403B



1. Place the end of the vinyl hose (beneath the drain plug) in a container.
2. Loosen the drain plug ①.
3. Operate the priming pump ② several times to drain the water.
4. After draining the water, tighten the drain plug ①.
5. Operate the priming pump several times and check for fuel leakage.
6. Check the water separator indicator light. It should be off.

03040401, 0304040101A



Injection Nozzle (Single spring type)

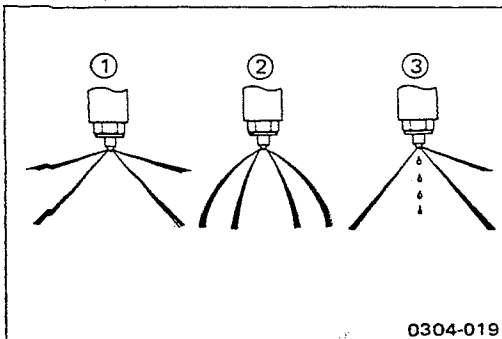
Injection Nozzle Inspection

Use a nozzle tester to check the injection nozzle opening pressure and the spray condition.

If the opening pressure is above or below the specified value, the injection nozzle must be replaced or adjusted.

Injection Nozzle Opening Pressure	kg/cm ² (psi/kPa)
185	(2,631/18,130)

0304040101B, 03040402B



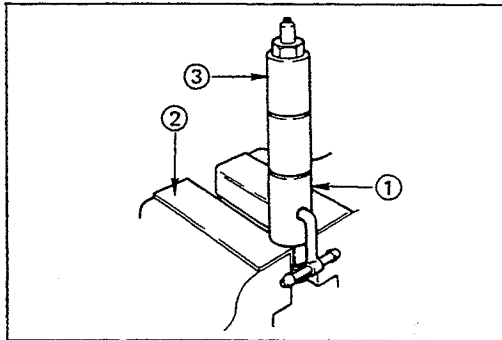
0304-019

If the spray condition is bad, the injection nozzle must be replaced or repaired.

Spray Condition

- ① Correct
- ② Incorrect (Restrictions in orifice)
- ③ Incorrect (Dripping)

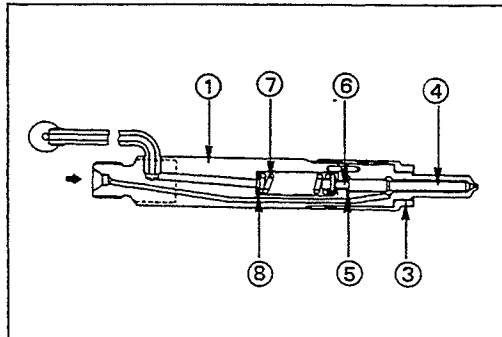
0304040001A



Injection Nozzle Adjustment

1. Clamp the injection nozzle holder ① in a vise ②.
2. Use a wrench to remove the injection nozzle retaining nut ③.

03040401B

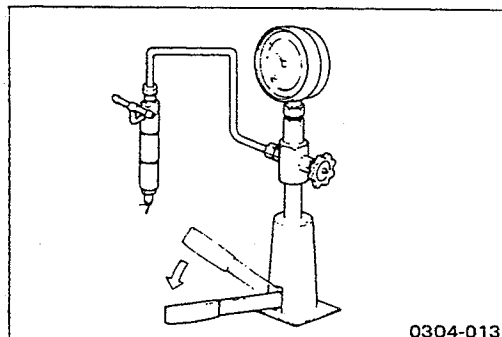


3. Remove the injection nozzle holder from the vise.
4. Remove the injection nozzle ④, the spacer ⑤, the spring seat ⑥, the spring ⑦ and the adjusting shim ⑧.
5. Install the new adjusting shim, the spring, the spring seat, the spacer, the injection nozzle, and the retaining nut.
6. Clamp the injection nozzle holder in the vise.
7. Tighten the injection nozzle holder retaining nut to the specified torque.

Injection Nozzle Holder Retaining Nut

Torque	kg·m(lb.ft/N·m)
4.5 ± 0.5 ($32.5 \pm 3.6/44.10 \pm 4.90$)	

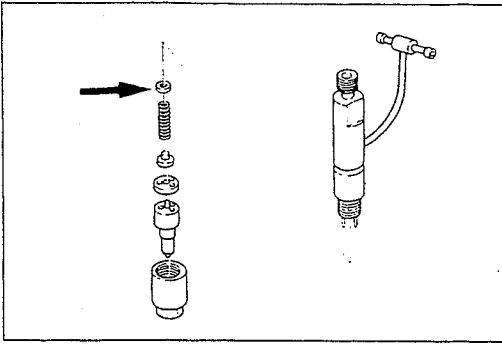
03040401D



0304-013

8. Remove the injection nozzle holder from the vise.
 9. Attach the injection nozzle holder to the injection nozzle tester.
 10. Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.
- If the injection nozzle does not open at the specified pressure, install or remove the appropriate number of adjusting shims to adjust it.

03040401E



(Reference)

Removing or installing one shim will increase or decrease the nozzle opening pressure approximately 3.77 kg/cm² (53.6 psi/370 kPa).

Adjusting Shim Availability

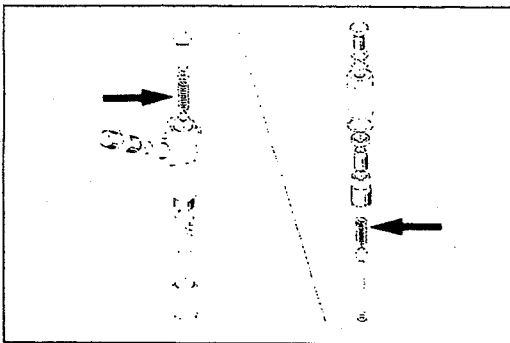
mm(in)

Range	0.5 — 1.5 (0.02 — 0.06)
Increment	0.025 (0.001)
Total No. of Shims	41

WARNING:

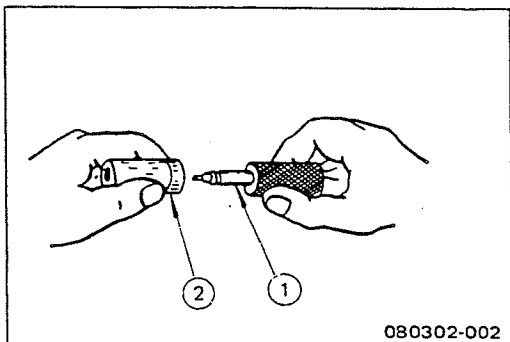
TEST FLUID FROM THE INJECTION NOZZLE WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PERSON'S SKIN. KEEP YOUR HANDS AWAY FROM THE INJECTION NOZZLE TESTER AT ALL TIMES.

030406

**Two Spring Type Injection Nozzle Adjustment**

Refer to "Injection Nozzle Adjustment" in the "FUEL SYSTEM" of this manual.

08030202



080302-002

**Nozzle Lapping Procedure**

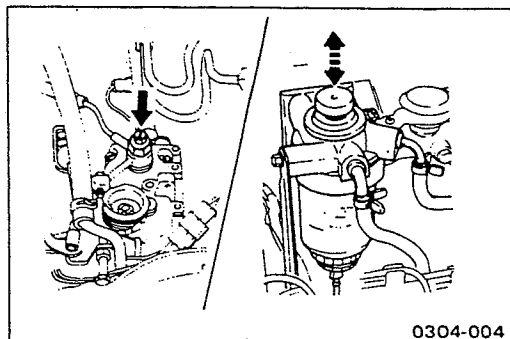
1. Lap the nozzle needle ① and the nozzle body ② by applying a compound of oxidized chrome and animal oil.

Note:

Do not apply an excessive amount of the oxidized chrome and animal oil compound to the injection needle valve seat area.

2. Carefully wash the needle valve and the nozzle body in clean diesel fuel after lapping.

030404E

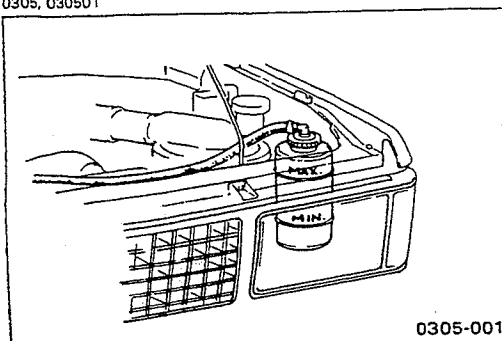


0304-004

Air Bleeding

1. Loosen the bleeder screw on the injection pump overflow valve.
2. Operate the priming pump until fuel flows from the bleeder screw.
3. Tighten the bleeder screw.
4. Operate the priming pump several times and check for fuel leakage.

0305, 030501



0305-001

COOLING SYSTEM

Coolant Level

Check the coolant level and replenish the radiator reserve tank as necessary.

If the coolant level falls below the "MIN" line, carefully check the cooling system for leakage. Then add enough coolant to bring the level up to the "MAX" line.

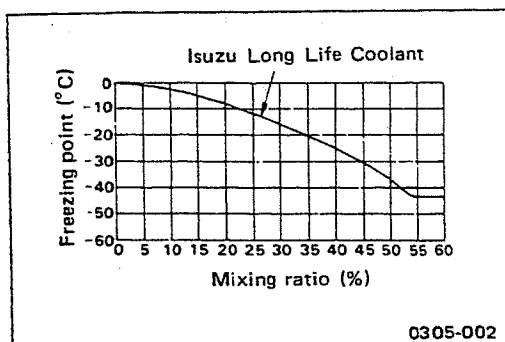
Note:

Do not overfill the reserve tank.

Remove the radiator filler cap only when absolutely necessary.

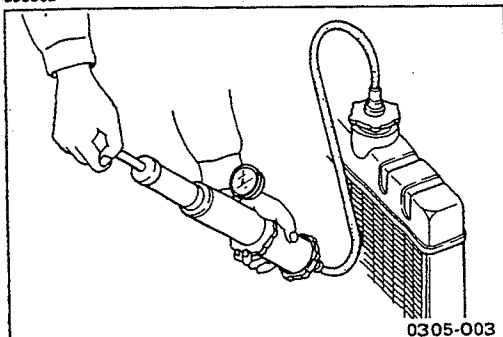
Always check the coolant level when the engine is cold.

Always refer to the chart at the left to determine the correct cooling water to antifreeze solution mixing ratio.



0305-002

030502



0305-003

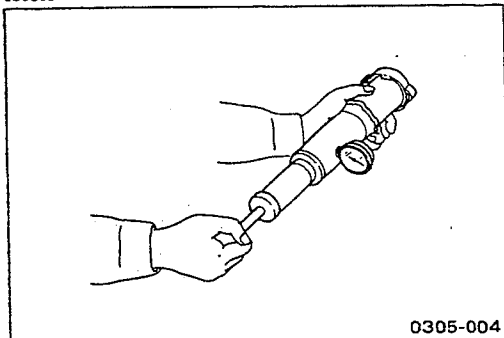


Cooling System Inspection

Install a radiator filler cap tester to the radiator. Apply testing pressure to the cooling system to check for leakage. The testing pressure must not exceed the specified pressure.

Testing Pressure	kg/cm ² (psi/kPa)
2	(28.45/196)

030503



0305-004



Radiator Cap Inspection

The radiator filler cap is designed to maintain coolant pressure in the cooling system at 1.05 kg/cm² (15 psi/ 103 kPa).

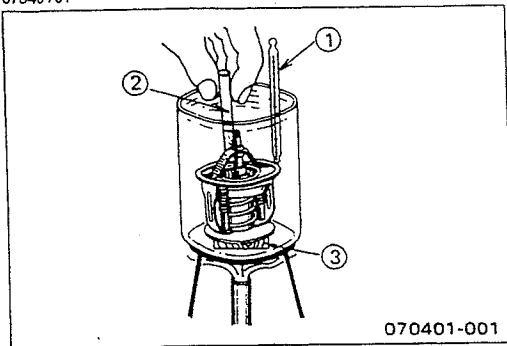
Check the radiator filler cap with a radiator filler cap tester. The radiator filler cap must be replaced if it fails to hold the specified pressure during the test procedure.

Radiator Filler Cap Pressure

Pressure Valve	kg/cm ² (psi/kPa)
0.9 - 1.2	(12.8 - 17.1/88 - 118)

Negative Valve (Reference)	kg/cm ² (psi/kPa)
0.01 - 0.04	(0.14 - 0.57/1.0 - 3.9)

07040101



070401-001

Thermostat Operating Test

1. Completely submerge the thermostat in water.
2. Heat the water.
Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the thermostat initial opening temperature.

Thermostat Initial Opening Temperature °C(°F)

Single Valve Type	82 (180)
Two Valve Type	Primary 85 (185)
	Secondary 88 (190)

4. Check the thermostat full opening temperature.

Thermostat Full Opening Temperature °C(°F)

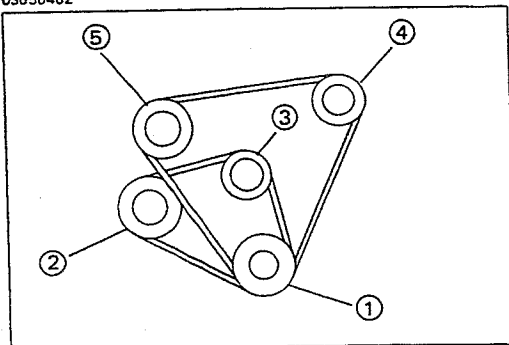
Single Valve Type	95 (203)
Two Valve Type	100 (212)

Valve Lift at Fully Open Position mm(in)

Single Valve Type	8 (0.31)
Two Valve Type	10 (0.39)

- ① Thermometer
- ② Agitating rod
- ③ Wooden piece

03050402

**Drive Belt Adjustment**

Check the drive belt tension.



Depress the drive belt mid-portion with a 10 kg (22 lb/ 98 N) force.

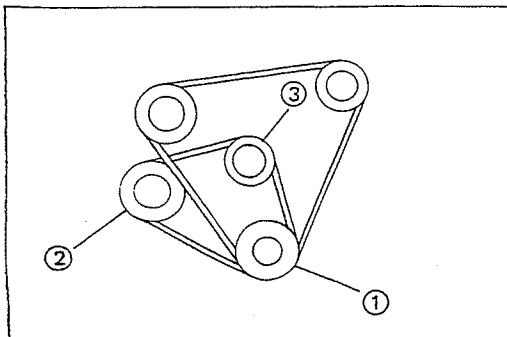
Drive Belt Deflection mm(in)

10 (0.39)

Check the drive belt for cracking and other damage.

- ① Crankshaft damper pulley
- ② Alternator pulley
- ③ Cooling fan pulley
- ④ Oil pump pulley or idler pulley
- ⑤ Compressor pulley or idler pulley

030505



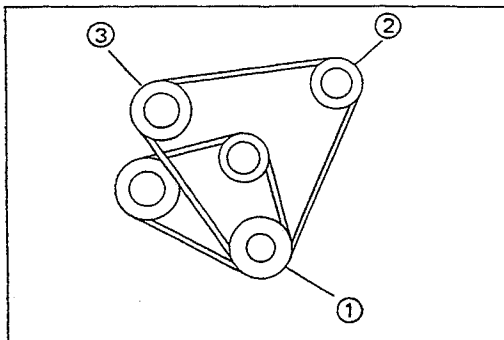
Cooling Fan Pulley Drive Belt

Fan belt tension is adjusted by moving the alternator.

Depress the drive belt mid-portion with a 10 kg (22 lb/ 98 N) force.

- ① Crankshaft damper pulley
- ② Alternator pulley
- ③ Cooling fan pulley

03050601



Compressor Pulley Drive Belt

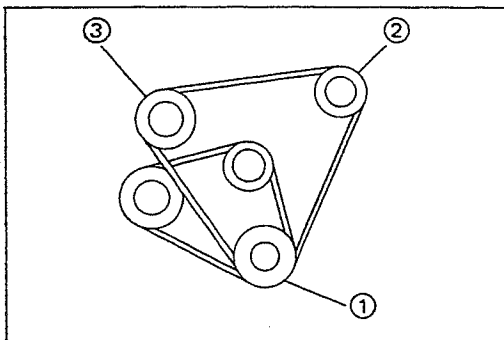
Move the idler pulley as required to adjust the compressor drive belt tension.

If the vehicle is equipped with power steering, move the oil pump as required.

Depress the drive belt mid-portion with a 10 kg (22 lb/ 98 N) force.

- ① Crankshaft damper pulley
- ② Oil pump pulley or idler pulley
- ③ Compressor pulley

03050701



Power Steering Oil Pump Pulley Drive Belt

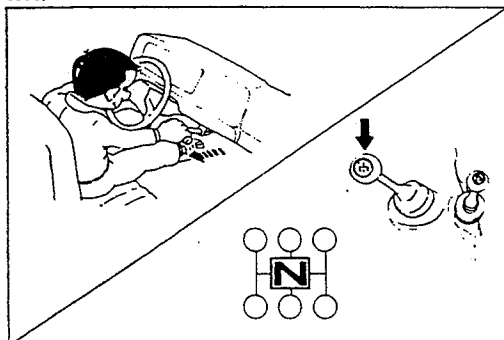
Move the oil pump as required to adjust the oil pump drive belt tension.

On air conditioner equipped models, both drive belts pulley must always be replaced as a set.

Depress the drive belt mid-portion with a 10 kg (22 lb/ 98 N) force.

- ① Crankshaft damper pulley
- ② Oil pump pulley
- ③ Compressor pulley or idler pulley

0306, 030603A



ENGINE CONTROL

Idling Speed Adjustment

1. Set the vehicle parking brake and chock the drive wheels.
2. Place the transmission in neutral.
3. Start the engine and allow it to warm up.

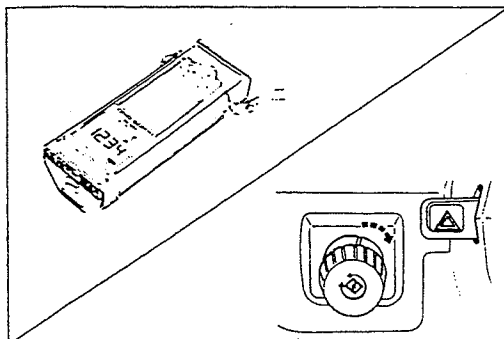
4. Disconnect the engine control cable from the control lever.
5. Set a tachometer to the engine.
6. Check the engine idling speed.

If the engine idling speed is outside the specified range, it must be adjusted.

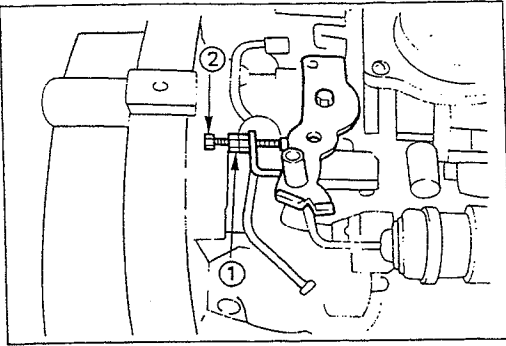
Engine Idling Speed rpm

750 — 790

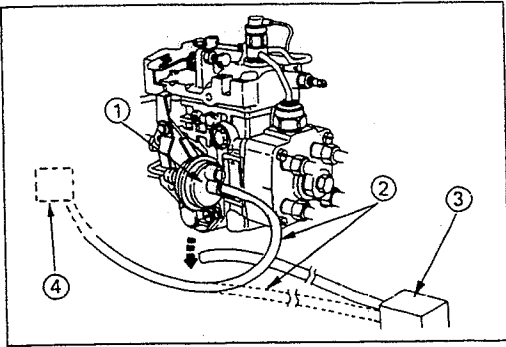
030603B



0306010103



030604A, C030604B

**Idling Speed Adjustment**

1. Loosen the idling set screw lock nut ① on the injection pump idling set bolt.
2. Adjust the idling speed to the specified range by turning the idling set bolt ②.
3. Lock the idling set bolt with the idling set screw lock nut.
4. Check that the idling control cable is tight (free of slack). If required, remove the slack from the cable.

**Fast Idling Speed Inspection**

1. Set tachometer to the engine.
2. Disconnect the vacuum hose from the fast idle actuator ① on the injection pump.
3. Disconnect the other vacuum hose ② from the vacuum switching valve ③ and connect it to the fast idle actuator ①.

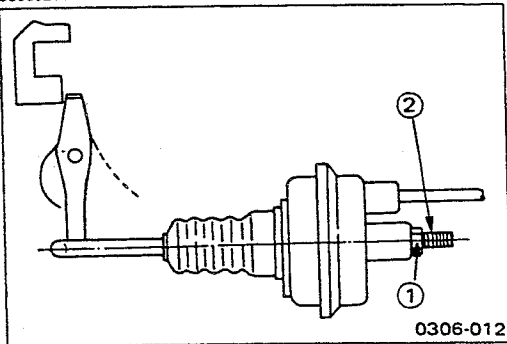
The vacuum line will now be connected directly from the vacuum pump ④ to the fast idle actuator.

4. Check the engine fast idling speed.

If the engine idling speed is outside the specified range, it must be adjusted.

Fast Idling Speed	rpm
	850 — 950

03060201

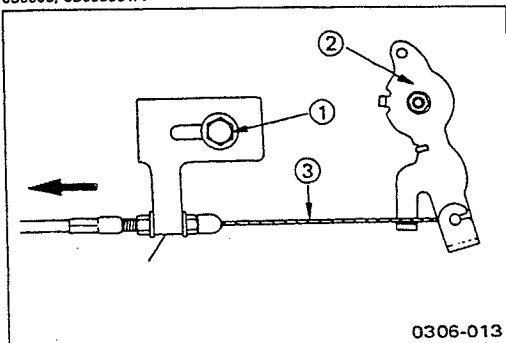


0306-012

**Fast Idling Speed Adjustment**

1. Loosen the fast idle actuator lock nut ①.
2. Adjust the fast idling speed by turning the adjusting screw ②.
3. Tighten the lock nut ①.
4. Connect the vacuum hose to the fast idle actuator.
5. Connect the other vacuum hose to the vacuum switching valve.

030605, 03060501A

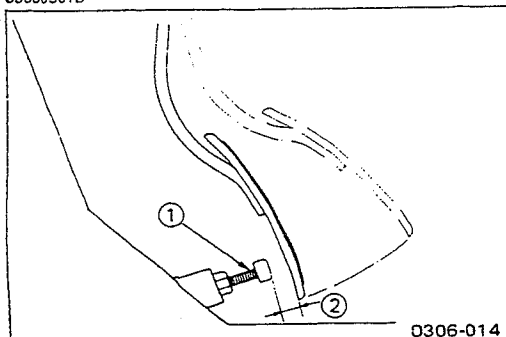


0306-013

**Accelerator Control****Accelerator Control Cable Adjustment**

1. Loosen the accelerator cable clamp bolt ①.
2. Check that the idling control knob on the instrument panel is in the engine idling position.
3. Hold the accelerator lever ② in the fully closed position and stretch the control cable ③ in the direction indicated by the arrow to remove any slack.

03060501B



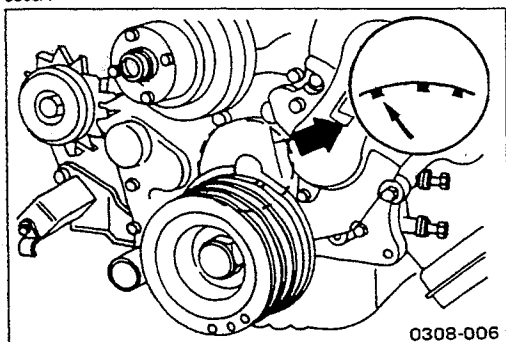
0306-014

**Accelerator Pedal Adjustment**

1. Depress the accelerator pedal and hold it.
2. Use the stopper bolt ① to adjust the clearance between the stopper bolt end and the accelerator pedal lower face ②.

Accelerator and Stopper Bolt Clearance	mm(in)
2 - 5 (0.08 - 0.20)	

0308A

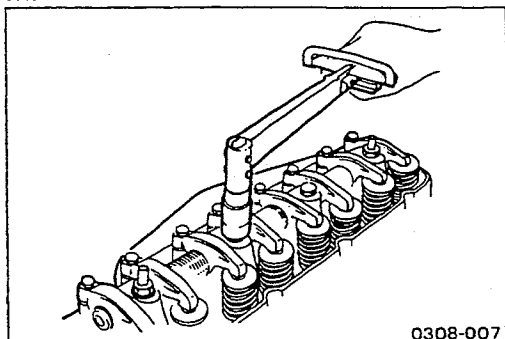


0308-006

**VALVE CLEARANCE ADJUSTMENT**

1. Bring the piston in either the No. 1 cylinder or the No. 4 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft damper pulley TDC line is aligned with the timing pointer.

0308B



0308-007



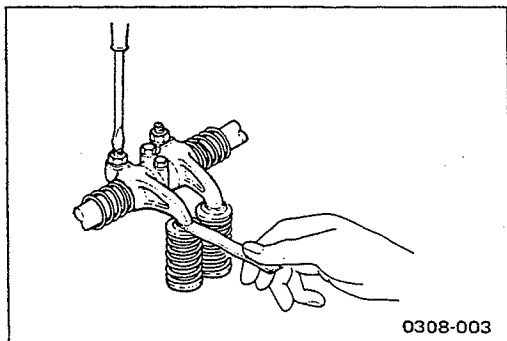
2. Check the rocker arm shaft bracket nuts for looseness.



Tighten any loose rocker arm shaft bracket nuts before adjusting the valve clearance.

Rocker Arm Shaft Bracket Nut Torque	kg·m(lb.ft/N·m)
5.5 ± 0.5 (39.8 ± 3.6/53.90 ± 4.90)	

0308C



0308-003

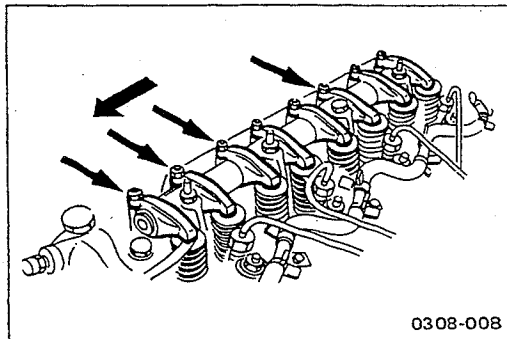


3. Check for play in the No. 1 intake and exhaust valve push rods.

If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.

If the No. 1 cylinder intake and exhaust valve push rods are depressed, the No. 4 piston is at TDC on the compression stroke.

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0308-008

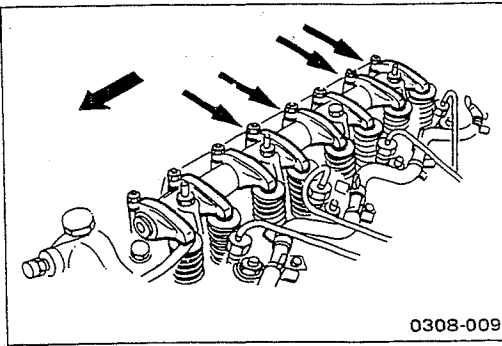


Adjust the No. 1 or the No. 4 cylinder valve clearances while their respective cylinders are at TDC on the compression stroke.

Valve Clearance (At Cold)	mm(in)
0.4 (0.016)	

4. Loosen each valve clearance adjusting screw as shown in the illustration.
5. Insert a feeler gauge of the appropriate thickness between the rocker arm and the valve stem end.

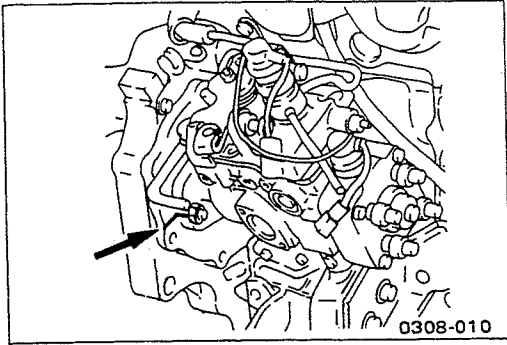
0308E



0308-009



6. Turn the valve clearance adjusting screw until a slight drag can be felt on the feeler gauge.
7. Tighten the lock nut securely.
8. Rotate the crankshaft 360°.
9. Realign the crankshaft damper pulley TDC notched line with the timing pointer.
10. Adjust the clearances for the remaining valves as shown in the illustration.

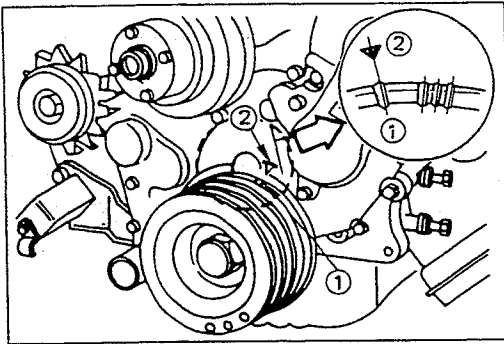


0308-010



INJECTION TIMING ADJUSTMENT

1. Check that the notched line on the injection pump flange is aligned with the front plate or the timing pulley housing or timing gear case notched line.



0308-011

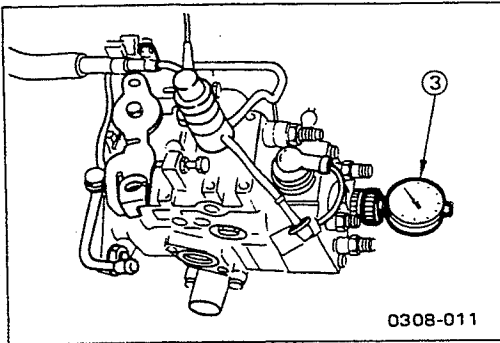


2. Bring the position in the No. 1 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft pulley TDC line ① is aligned with the timing mark ②.

Note:

Check for play in the No. 1 intake and exhaust valve push rods.

If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.



0308-012



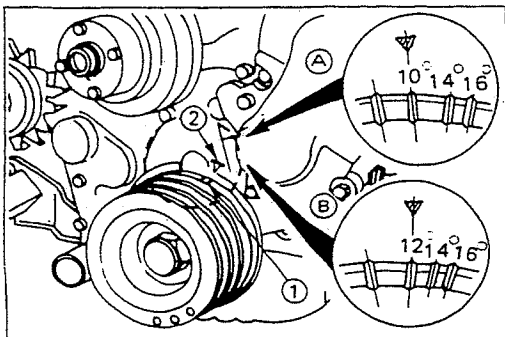
3. Disconnect the injection pipe from the injection pump.
4. Remove one bolt from the distributor head.
5. Install the static timing gauge ③.

The probe of the gauge should be depressed inward approximately 1 mm (0.039 in).

Static Timing Gauge: 5-8840-0145-0 (J-28827)



6. Rotate the crankshaft to bring the piston in the No. 1 cylinder to a point 30 – 40° BTDC.
7. Set the timing gauge needle to zero.
8. Move the crankshaft pulley slightly in both directions to check that the gauge indication is stable.



9. Turn the crankshaft clockwise and read the gauge indication when the crankshaft pulley timing mark is aligned with the pointer.

Plunger Life at Fuel Injection

Starting Timing	mm(in)
	0.5 (0.02)

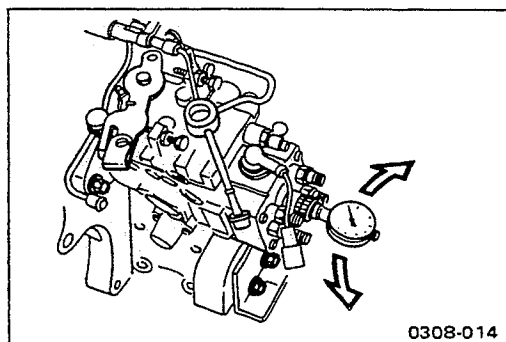
- ① Timing mark on the pulley
 ② Pointer
 ③ Ignition Timing (Deg)

(A) Belt drive	4JB1T	10
	4JB1TC	11
(B) Gear drive	4JA1, 4JB1 4JB1T	12

Note:

Belt drive and gear drive timing train systems use different crankshaft pulleys.

If the injection timing is outside the specified range, continue with the following steps.



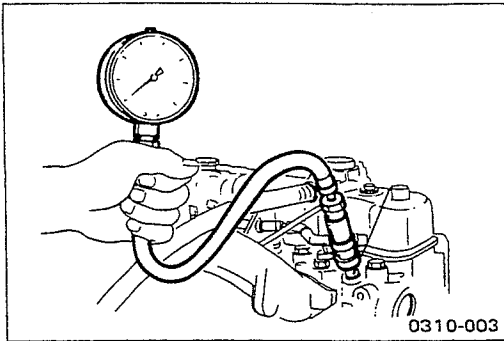
10. Loosen the injection pump fixing nuts and bracket bolts.
 11. Adjust the injection pump setting angle.

	If injection timing will be advanced	If injection timing will be retarded
Gear drive	B	A
Belt drive	A	B

A: Move the injection pump toward the engine.

B: Move the injection pump away from the engine.

03100101A



COMPRESSION PRESSURE MEASUREMENT

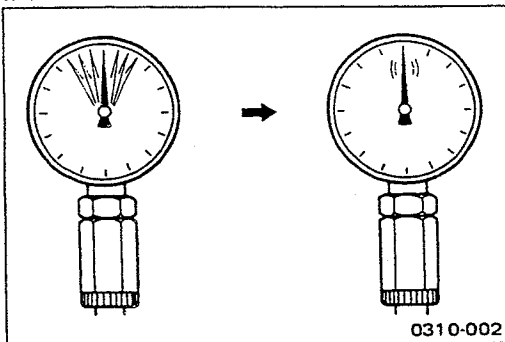


1. Start the engine and allow it to idle until the coolant temperature reaches 70 — 80°C (158 — 176°F).
2. Remove the following parts.
 - * Glow plugs
 - * Fuel cut solenoid connector
 - * QOS (Quick-On Start System) fusible link wire at the connector.
3. Set the adapter and compression gauge to the No. 1 cylinder glow plug hole.

Compression Gauge
(with Adapter): 5-8840-2008-0 (J-29762)

Adapter: 5-8531-7001-0

0310B

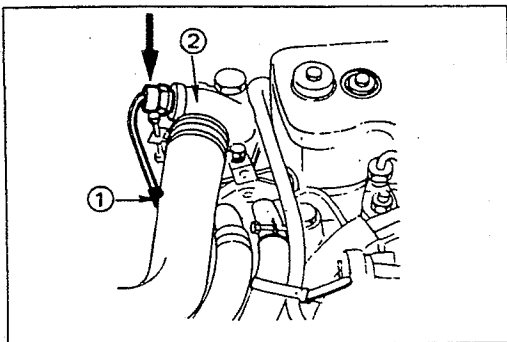


4. Turn the engine over with the starter motor and take the compression gauge reading.

Compression Pressure	kg/cm ² (psi/kPa) at 200 rpm
Standard	Limit
31 (441/3,038)	22 (313/2,156)

5. Repeat the procedure (Steps 3 and 4) for the remaining cylinders.

If the measured value is less than the specified limit, refer to "Trouble Shooting" in this Manual.



QUICK-ON START II SYSTEM

Quick-On Start II System Inspection Procedure

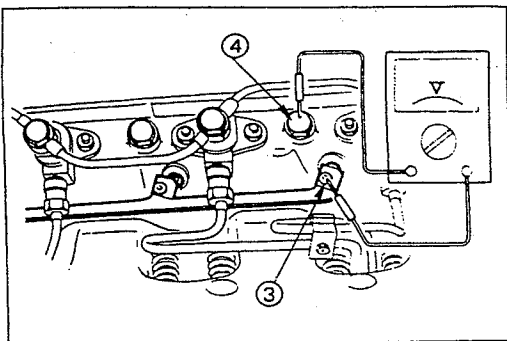
1. Disconnect the thermo-switch connector ① on the thermostat housing ②.
2. Connect the voltmeter between the glow plug ③ and the engine body earth ④.
3. Turn the starter switch to the "ON" position.

If the Quick-On Start II System is operating properly.

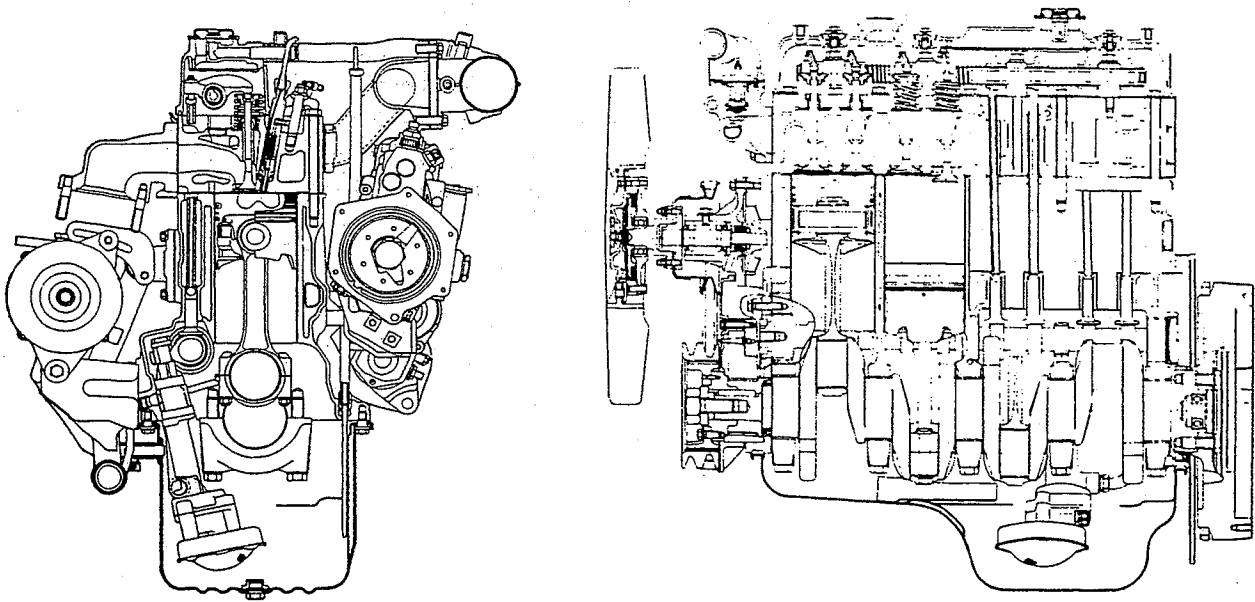
- 1) The glow indicator will light for 3.5 seconds.
- 2) The voltmeter will show the source voltage for approximately 18 seconds.

If the Quick-On Start II is not operating properly check the QOS timer, the glow relay, and the thermo switch.

If these parts are normal, check each glow plug.



ENGINE ASSEMBLY GENERAL DESCRIPTION



0501-002

The 4J Series of Isuzu Diesel Engines features the unique ISUZU toroidal square combustion chamber. This design provides superior fuel economy over a wide range of operating conditions.

4J Series engine power ratings vary with bore and stroke.

The 4JB1T engine and the 4JB1TC engine are turbocharger equipped.

The laminated steel sheet cylinder head gasket is very durable. This type of gasket eliminates cylinder head bolt retightening.

4JB1 engine cylinder heads use the angular tightening method.

Chrome plated dry type cylinder liners are used. This type of cylinder liner has a proven reputation for high durability.

Each piston has two compression rings and one oil ring.

4J Series engine crankshafts have been tufrided to provide a longer service life. Because the crankshaft is tufrided, it cannot be reground.

4J Series engines are equipped with a VE-type distributor injection pump. A fuel-cut solenoid is used to stop the engine.

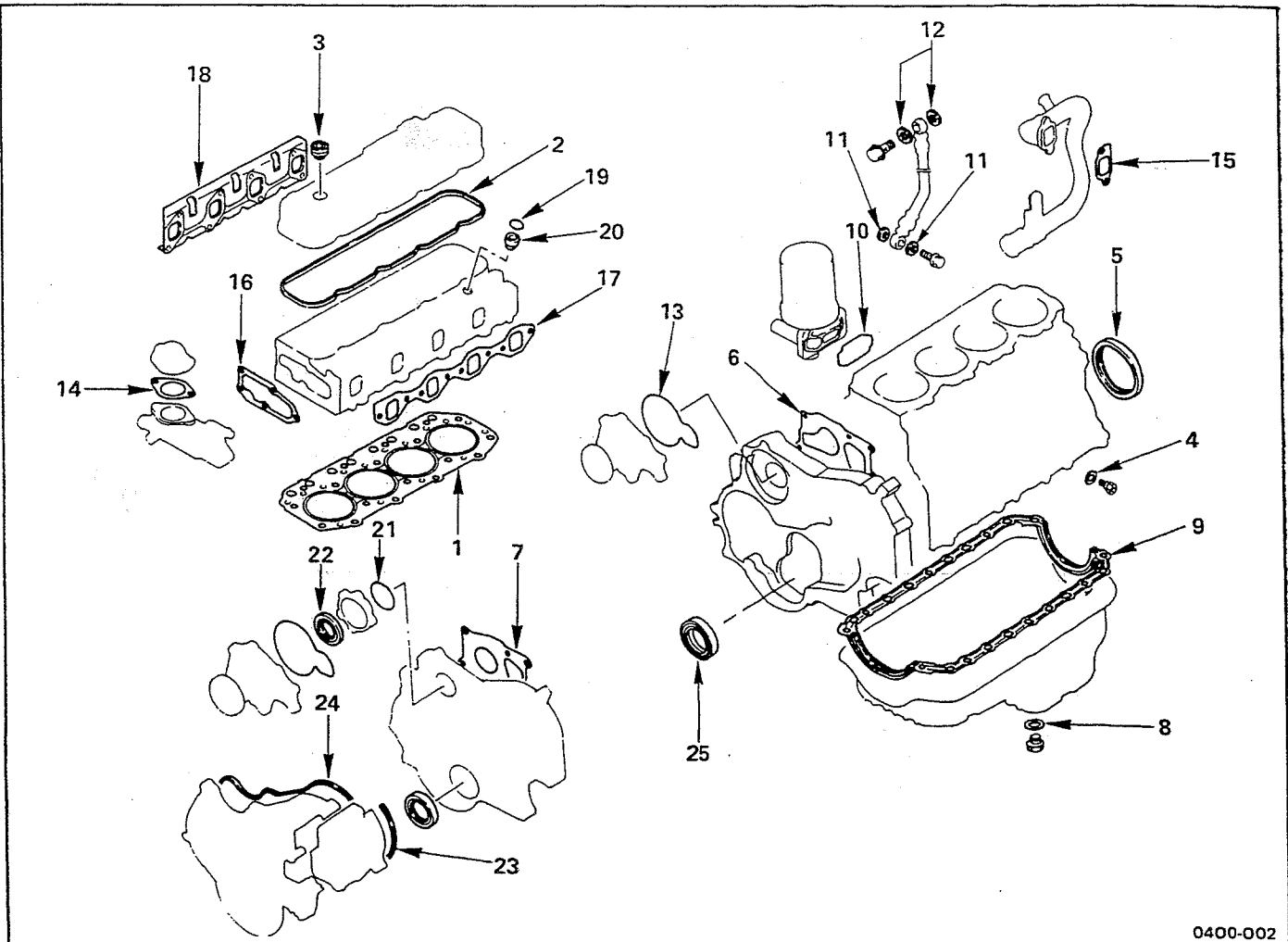
There are three systems available to ease cold-weather starting, speed engine warmup, and reduce engine operating noise,

1. Cold Start Device (CSD)
2. Quick-On-Start System (QOS)
3. Quick Warmup System (QWS)

Installation of these systems will vary with vehicle model and vehicle application.

ENGINE REPAIR KIT

All of the numbered parts listed below are included in the Engine Repair Kit.
The gaskets marked with an asterisk (*) are also included in the Top Overhaul Kit.



0400-002

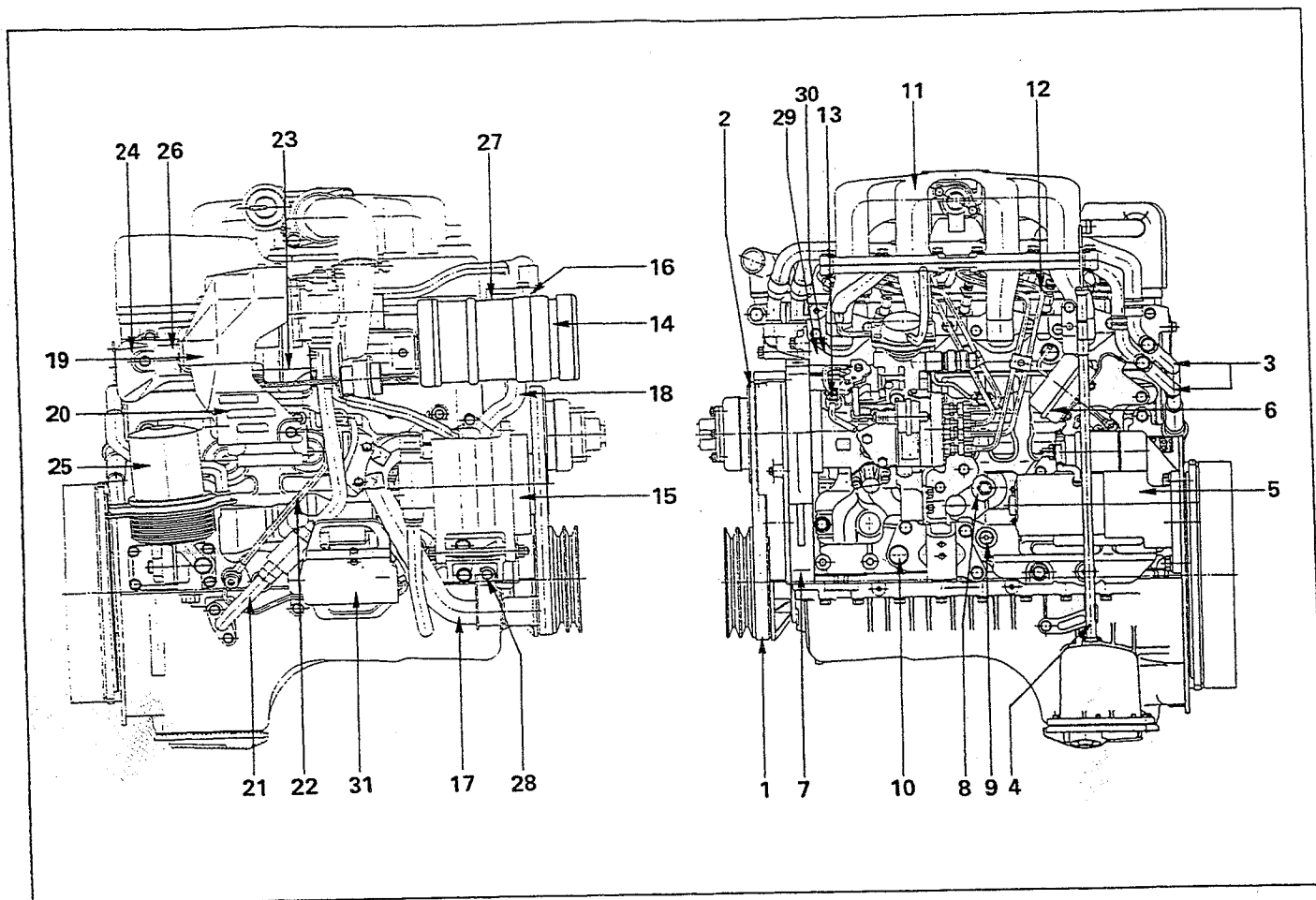
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- | | |
|--|---|
| <ul style="list-style-type: none"> * 1. Cylinder head gasket * 2. Head cover gasket * 3. Head cover cap nut gasket 4. Drain cock gasket 5. Crankshaft rear oil seal 6. Gear case gasket (Gear drive) 7. Gear case cover gasket (Belt drive) 8. Oil pan drain plug gasket 9. Oil pan gasket 10. Oil filter gasket 11. Joint bolt gasket 12. Vacuum pump gasket 13. Water pump O-ring | <ul style="list-style-type: none"> * 14. Water outlet pipe gasket * 15. Intake pipe gasket 16. Thermostat housing gasket * 17. Intake manifold gasket * 18. Exhaust manifold gasket * 19. Nozzle holder O-ring * 20. Nozzle holder gasket 21. Cam retainer O-ring (Belt drive) 22. Cam retainer oil seal (Belt drive) * 23. Dust cover upper gasket (Belt drive) * 24. Dust cover lower gasket (Belt drive) 25. Crankshaft front oil seal |
|--|---|

DISASSEMBLY

EXTERNAL PARTS

These disassembly steps are based on the 4JB1T engine.

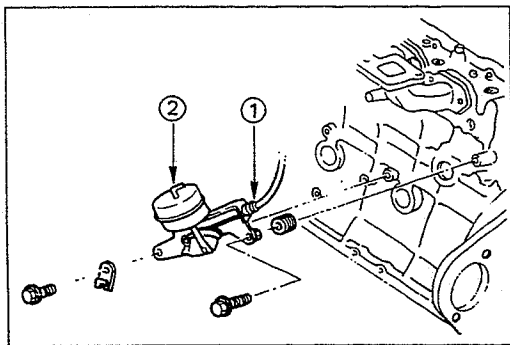


Disassembly Steps

1. Cooling fan drive belt
2. Cooling fan pulley
3. Heater pipe (Rear side)
4. Oil level gauge and guide tube
5. Starter motor
- ▲ 6. Exhaust actuator
7. Stiffener
8. Water drain cock
9. Oil pressure warning switch and nipple
10. Engine mounting bracket and mounting rubber
- ▲ 11. Upper intake manifold
- ▲ 12. Fuel injection pipe with clip
13. Fuel leak hose (leak off pipe to injection pump)
14. Compressor
15. Alternator and adjusting plate
16. Water by-pass hose
17. Water inlet pipe
18. Water inlet suction pipe
19. Turbocharger heat protector
20. Exhaust adapter
21. Turbocharger oil return pipe
22. Turbocharger oil feed pipe
- ▲ 23. Turbocharger
24. Exhaust manifold heat protector
25. Oil filter with oil cooler
26. Exhaust manifold
27. Compressor bracket
28. Alternator bracket
29. Power steering oil pump
30. Power steering oil pump bracket
31. Engine mounting bracket with mounting rubber

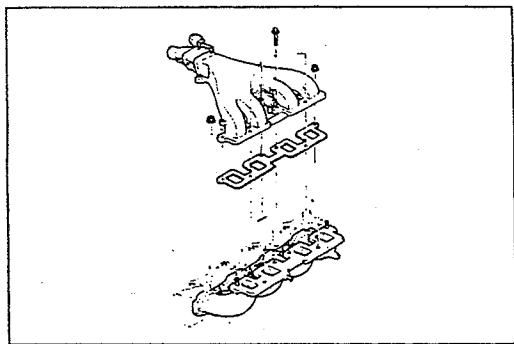


Important Operations



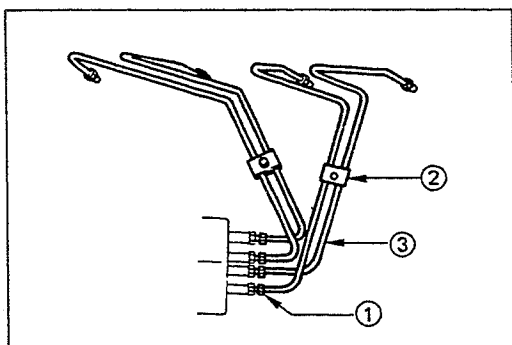
▲ Exhaust Actuator

- 1) Disconnect the control wire ① from the exhaust actuator.
- 2) Remove the actuator ② from the cylinder body.



▲ Upper Intake Manifold (4JB1T)

- 1) Disconnect the PCV hose from the cylinder head cover.
- 2) Disconnect the intake duct and intake rubber hose from the turbocharger.
- 3) Remove the upper intake manifold from the lower intake manifold with intake duct, and the PCV hose.

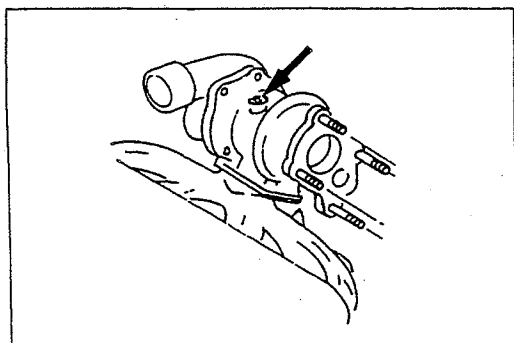


▲ Fuel Injection Pipe with Clip

- 1) Loosen the injection pipe sleeve nuts at the delivery valve side ①.
Do not apply excessive force to the injection pipes.
- 2) Loosen the injection pipe clips ②.
- 3) Remove the injection pipes ③.

Note:

Plug the delivery holder ports with the shipping caps to prevent the entry of foreign material.



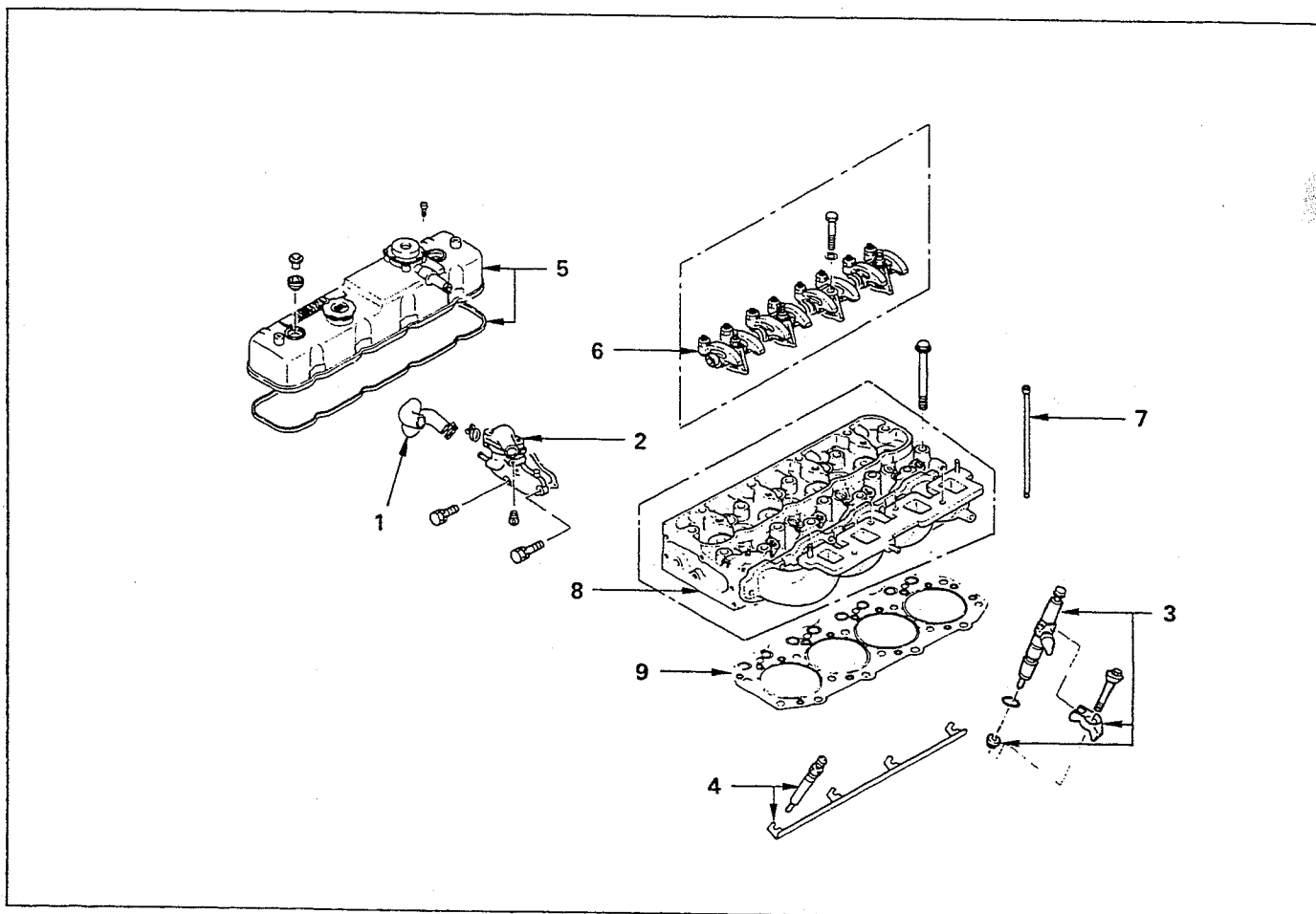
▲ Turbocharger

Plug the turbocharger body oil ports after removing the turbocharger assembly to prevent the entry of foreign material.



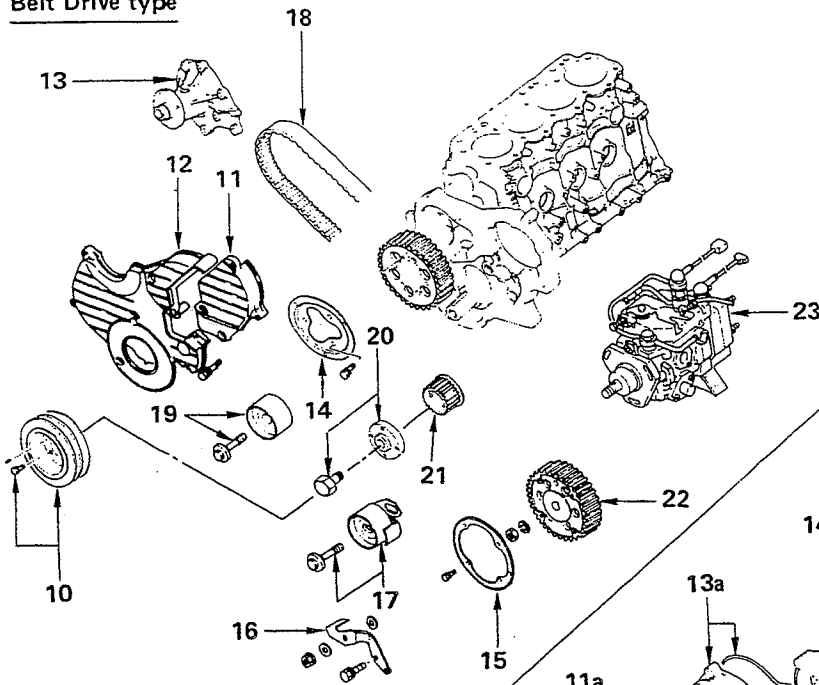
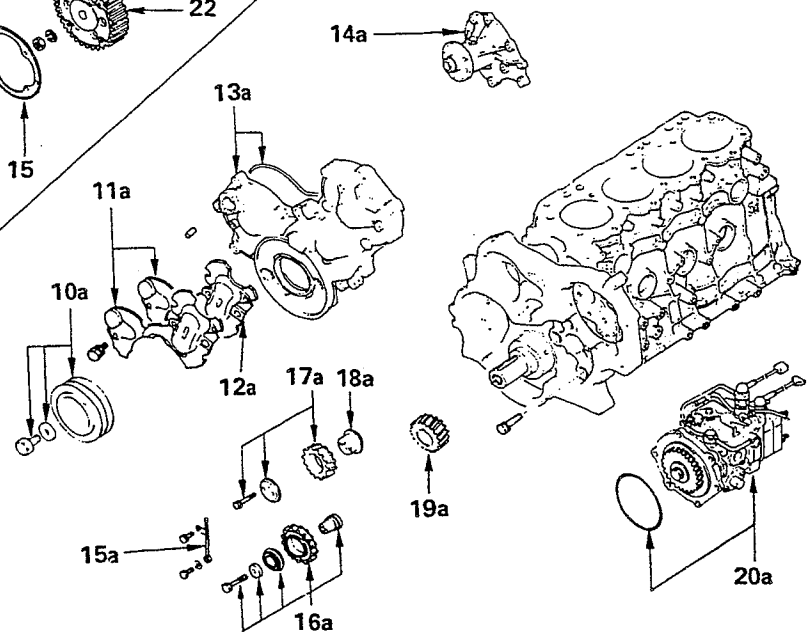
INTERNAL PARTS

MAJOR COMPONENTS



Disassembly Steps-1

- | | |
|--|--------------------------------------|
| 1. Water bypass pipe | 5. Cylinder head cover |
| 2. Thermostat housing with thermo switch | ▲ 6. Rocker arm shaft and rocker arm |
| ▲ 3. Injection nozzle holder | 7. Push rod |
| 4. Glow plug and glow plug connector | ▲ 8. Cylinder head |
| | 9. Cylinder head gasket |

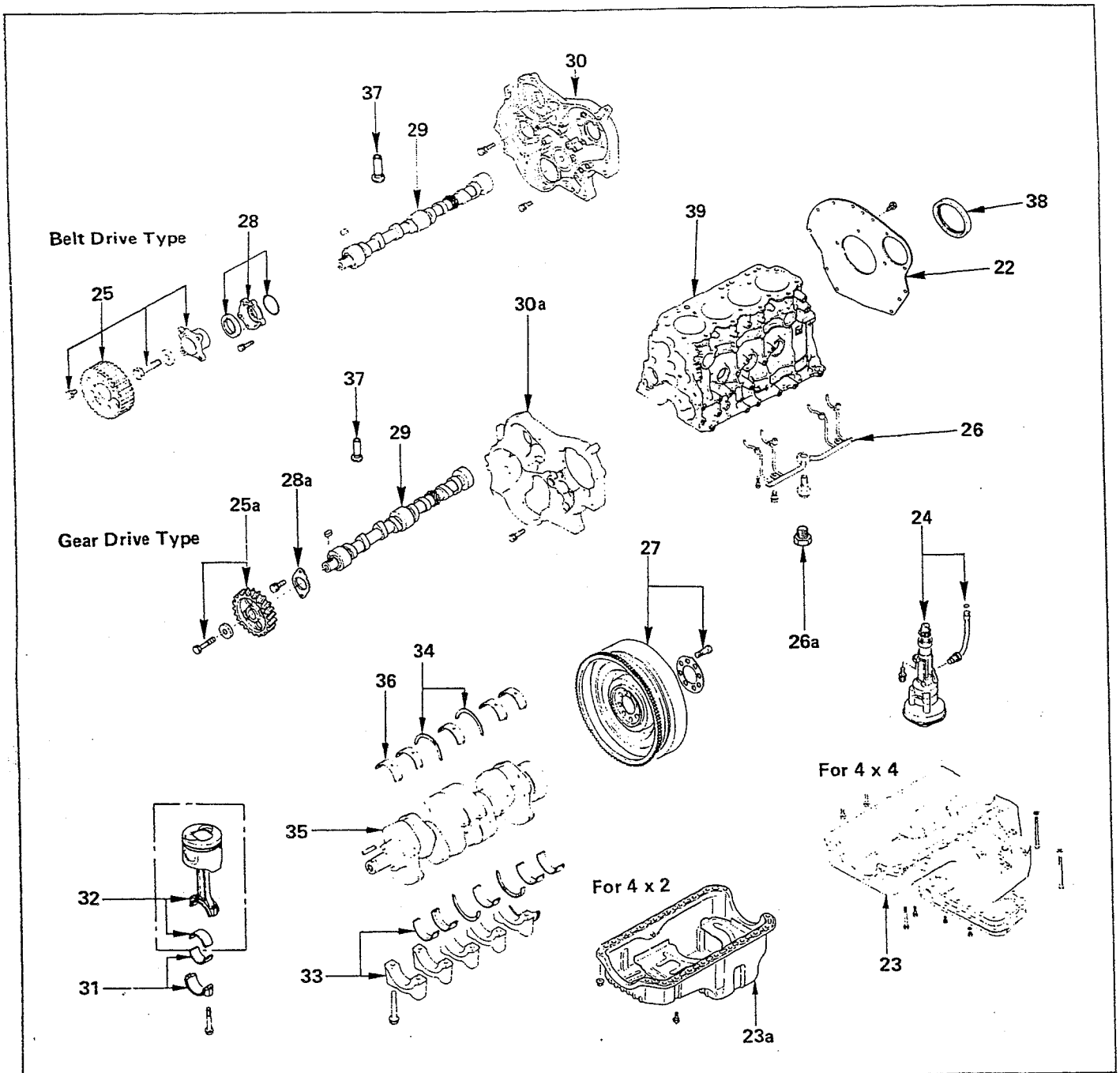
Belt Drive type**Gear Drive Type****Disassembly Steps-2****Belt Drive Type**

- ▲ 10. Crankshaft damper pulley
- 11. Timing pulley housing upper cover
- 12. Timing pulley housing lower cover
- 13. Water pump
- 14. Camshaft timing pulley flange
- 15. Injection pump timing pulley flange
- 16. Timing belt tension adjusting lever
- 17. Timing belt tensioner
- 18. Timing belt
- 19. Tension idler
- ▲ 20. Crankshaft timing pulley center
- ▲ 21. Crankshaft timing pulley
- ▲ 22. Injection pump timing pulley
- ▲ 23. Injection pump

Gear Drive Type

- ▲ 10a Crankshaft damper pulley
- 11a Gear case upper cover and lower cover
- 12a Space rubber
- 13a Timing gear case cover
- 14a Water pump
- 15a Timing gear oil pipe
- 16a Idler gear "B" and shaft
- ▲ 17a Idler gear "A"
- 18a Idler gear shaft
- 19a Crankshaft timing gear
- ▲ 20a Injection pump
- 21a —
- 22a —
- 23a —

Inverted Engine



Disassembly Steps-3

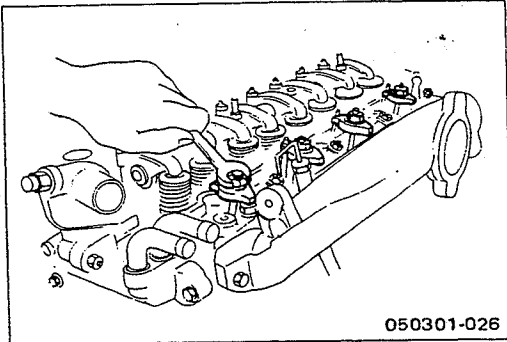
- | | |
|-------------------------------|---|
| 22. Cylinder body rear plate | 30a Timing gear case |
| 23. Oil pan | ▲ 31. Connecting rod bearing cap with lower bearing |
| 23a Oil pan (For 4JA1) | ▲ 32. Piston and connecting rod with upper bearing |
| 24. Oil pump with oil pipe | ▲ 33. Crankshaft bearing cap with lower bearing |
| ▲ 25. Camshaft timing pulley | 34. Crankshaft thrust bearing |
| ▲ 25a Camshaft timing gear | 35. Crankshaft |
| ▲ 26. Piston cooling oil pipe | ▲ 36. Crankshaft upper bearing |
| 26a Oil jet plug (For 4JB1) | ▲ 37. Tappet |
| ▲ 27. Flywheel | ▲ 38. Crankshaft rear oil seal |
| 28. Oil seal retainer | 39. Cylinder body |
| 28a Camshaft thrust plate | |
| ▲ 29. Camshaft | |
| 30. Timing pulley housing | |

05030601



Important Operations

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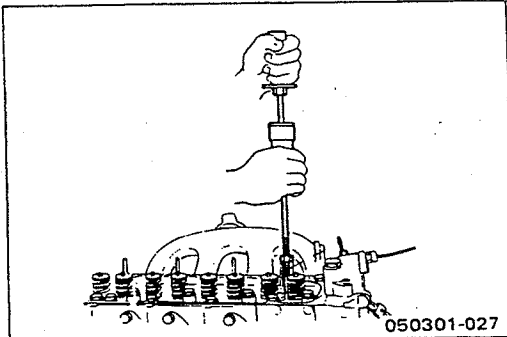


050301-026

▲ Injection Nozzle Holder

1. Remove the nozzle holder bracket nuts.

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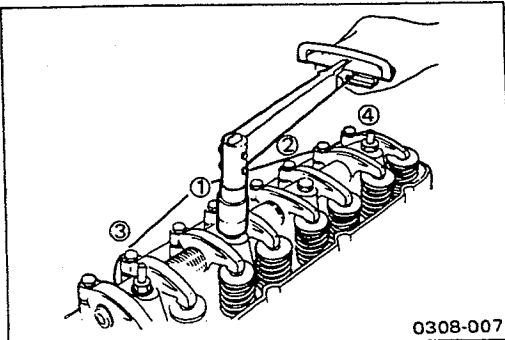
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2. Use the nozzle holder remover and the sliding hammer to remove the nozzle holder together with the holder bracket.

Nozzle Holder Remover: 5-8840-2034-0
Sliding Hammer: 5-8840-0019-0

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0308-007

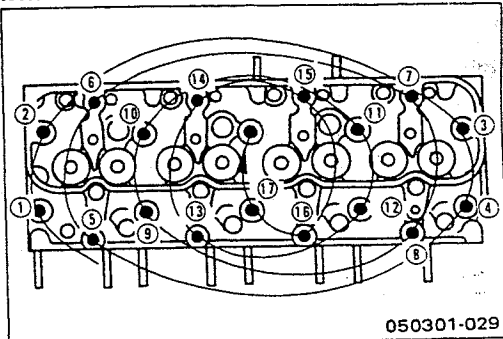
▲ Rocker Arm Shaft and Rocker Arm

Loosen the rocker arm shaft bracket bolts in numerical order a little at a time.

Note:

Failure to loosen the rocker arm shaft bracket bolts in numerical order a little at a time will adversely effect the rocker arm shaft.

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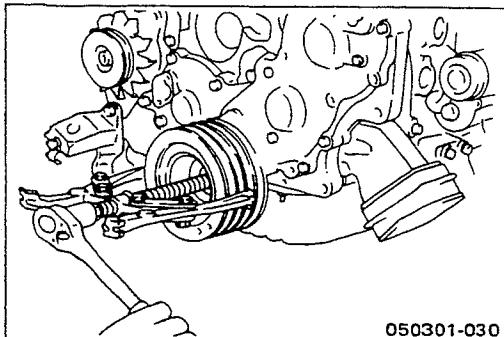
▲ Cylinder Head

Loosen the cylinder head bolts in numerical order a little at a time.

Note:

Failure to loosen the cylinder head bolts in numerical order a little at a time will adversely effect the cylinder head lower surface.

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▲ Crankshaft Damper Pulley

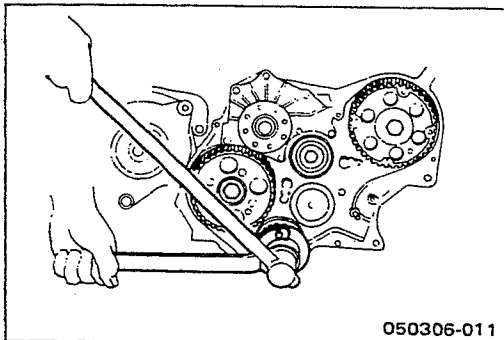
Use the damper pulley remover to remove the damper pulley.

Damper pulley Remover: 5-8840-0086-0

Note:

Hold the flywheel ring gear stationary to prevent the crankshaft from turning when removing the crankshaft pulley.

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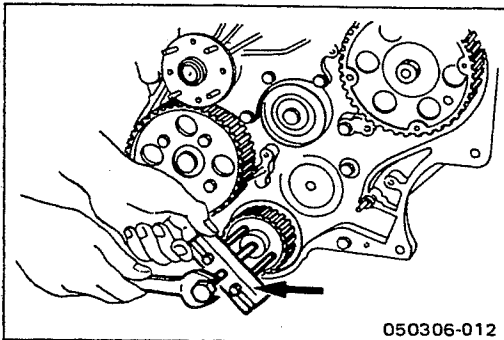
▲ Crankshaft Timing Pulley Center (For Belt Drive)

1. Use the fixing wrench to prevent the crankshaft from turning.

Fixing Wrench: 5-8840-0161-0

2. Remove the timing pulley center from the crankshaft.

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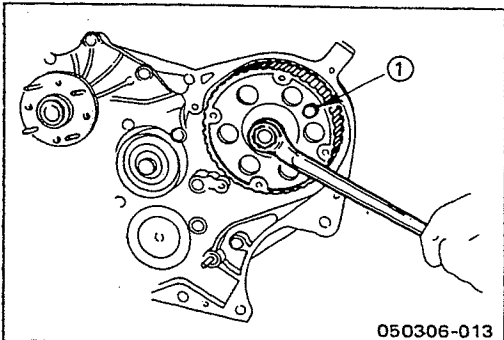


▲ Crankshaft Timing Pulley (For Belt Drive)

1. Block the crankshaft with a piece of hard wood.
2. Use the crankshaft timing pulley puller to remove the timing pulley.

Crankshaft Timing Pulley Puller: 5-8840-2035-0

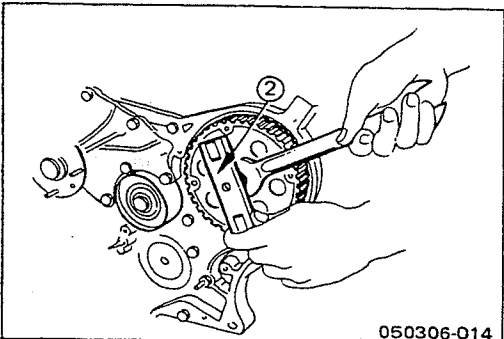
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▲ Injection Pump Timing Pulley (For Belt Drive)

1. Install the stopper bolt ① to the timing pulley to prevent it from turning.

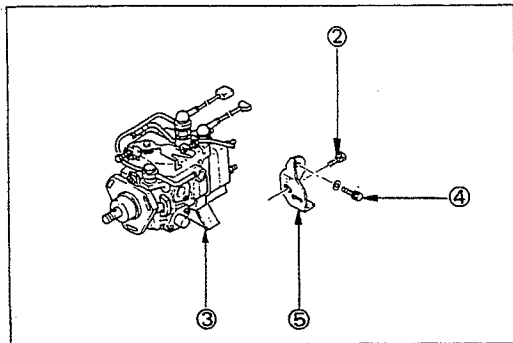
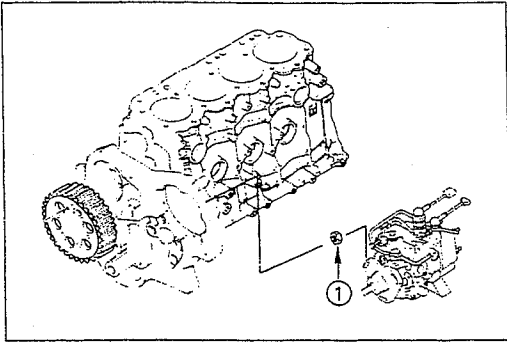
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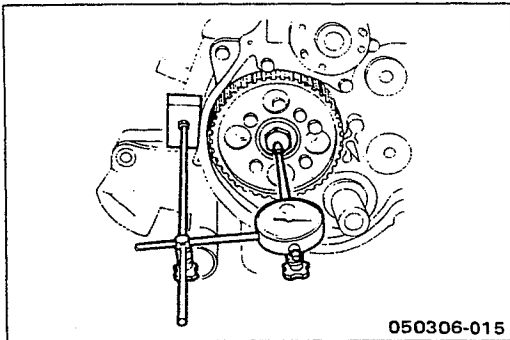
2. Use the timing pulley remover ② to remove the injection pump timing pulley.

Timing Pulley Puller: 5-8840-0086-0

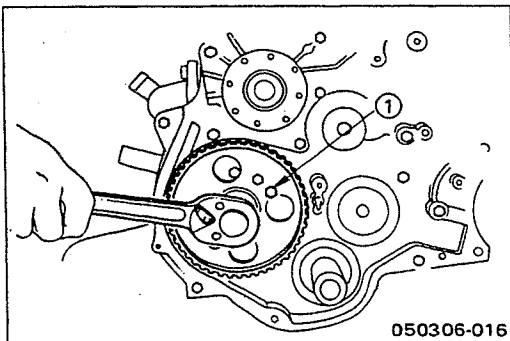
3. Remove the stopper bolt.



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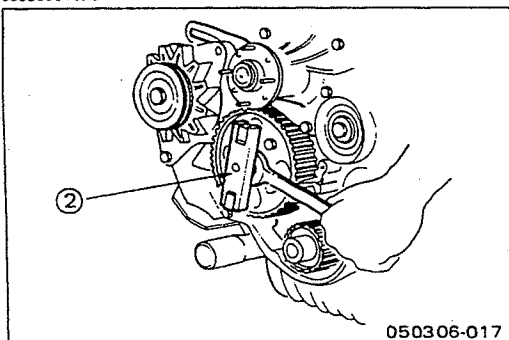


050306-015



050306-016

0503060107C



050306-017

▲ Injection Pump (For Belt Drive)

1. Remove the three injection pump bracket nuts ① at the rear of the timing pulley housing.
2. Remove the injection pump rear bracket bolts ② from the injection pump bracket ③.
3. Remove the injection pump rear bracket bolts ④ and the bracket ⑤ from the cylinder body.
4. Pull the injection pump free toward the rear of the engine.

Note:

Plug the injection pump delivery holder ports with the shipping caps (or the equivalent) to prevent the entry of foreign material.



▲ Oil Pump with Oil Pipe (For Belt Drive)

▲ Camshaft Timing Pulley (For Belt Drive)

1. Use a dial indicator to measure the camshaft end play.

This must be done before removing the oil pipe.

If the camshaft end play exceeds the specified limit, the camshaft and/or the driven gear must be replaced.

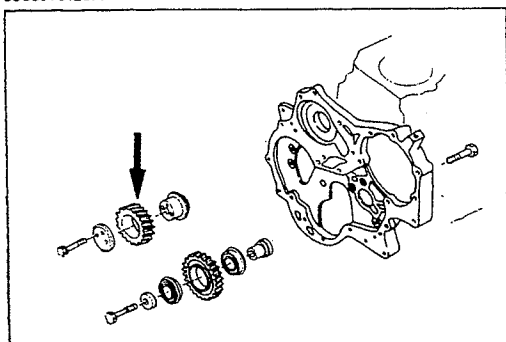
Camshaft End Play		mm(in)
Standard	Limit	
0.08 (0.003)	0.2 (0.008)	

2. Remove the oil pump with oil pipe.
3. Install the stopper bolt ① to the timing pulley to prevent it from turning.

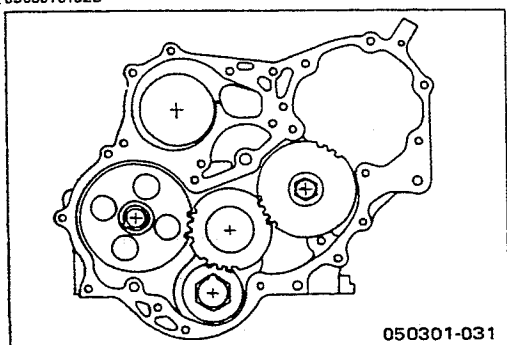


4. Use the timing pulley puller ② to remove the pulley.
Camshaft Timing Pulley Puller: 5-8840-0086-0
5. Remove the stopper bolt.

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0503010102B



050301-031

▲ Idler Gear "A" (For Gear Drive)

1. Measure the camshaft timing gear backlash and the crankshaft timing gear backlash before removing the idler gear.
2. Measure the idler gear end play before removing the idler gear.

Note:

Refer to the following items for details on the backlash and end play measurement procedures.

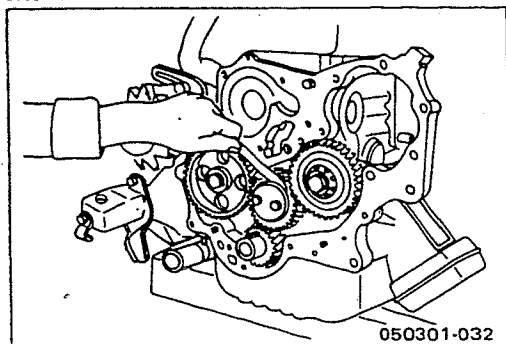


Timing Gear Backlash Measurement (For Gear Drive)

- 1) Set a dial indicator to the timing gear to be measured. Hold both the gear to be checked and the adjoining gear stationary.
- 2) Move the gear to be checked as far as possible to both the right and the left. Take the dial indicator reading. If the measured value exceeds the specified limit, the timing gear must be replaced.

Timing Gear Backlash		mm(in)
Standard	Limit	
0.10—0.17 (0.0039—0.0067)	0.30 (0.012)	

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050301-032



Idler Gear "A" End Play Measurement (For Gear Drive)

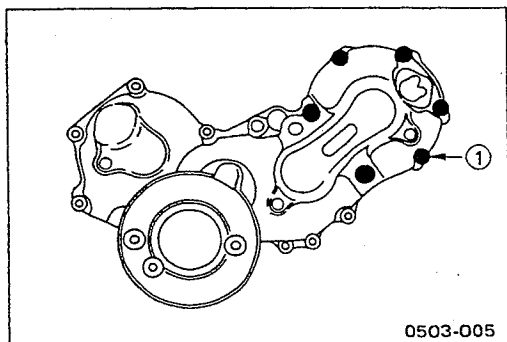
Insert a feeler gauge between the idler gear and the thrust collar to measure the gap and determine the idler gear end play.

If the measured value exceeds the specified limit, the thrust collar must be replaced.

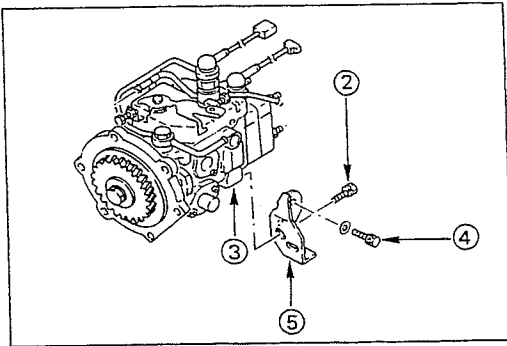
Idler Gear End Play		mm(in)
Standard	Limit	
0.07 (0.0028)	0.2 (0.0079)	

▲ Injection Pump (For Gear Drive)

1. Remove the six injection pump bracket bolts ① from the timing gear case.



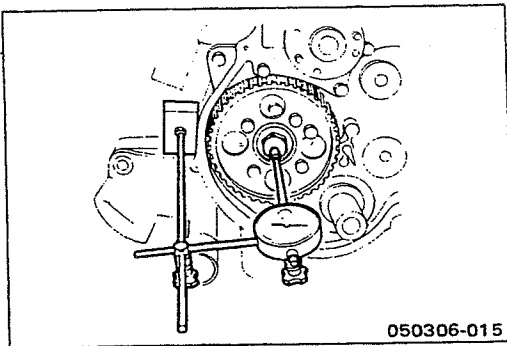
0503-005



2. Remove the injection pump rear bracket bolts ② from the injection pump bracket ③.
3. Remove the injection pump rear bracket bolts ④ and the bracket ⑤ from the cylinder body.
4. Pull the injection pump along with the injection pump timing gear free toward the rear of the engine.

Note:

Plug the injection pump delivery holder ports with the shipping caps (or the equivalent) to prevent the entry of foreign material.



▲ Camshaft Timing Gear (For Gear Drive)

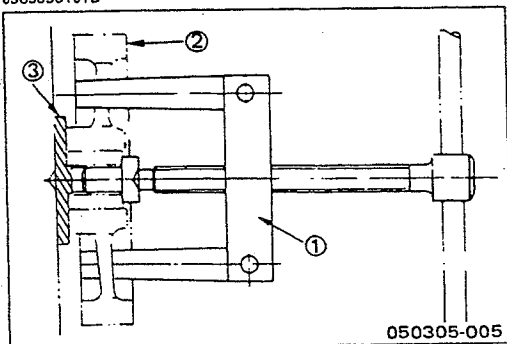
1. Use a dial indicator to measure the camshaft end play.

This must be done before removing the camshaft gear.

If the camshaft end play exceeds the specified limit, the thrust plate must be replaced.

Camshaft End Play		mm(in)
Standard	Limit	
0.050 — 0.114 (0.002 — 0.0044)	0.20 (0.008)	

0503050101B



2. Remove the camshaft timing gear bolt from the camshaft.

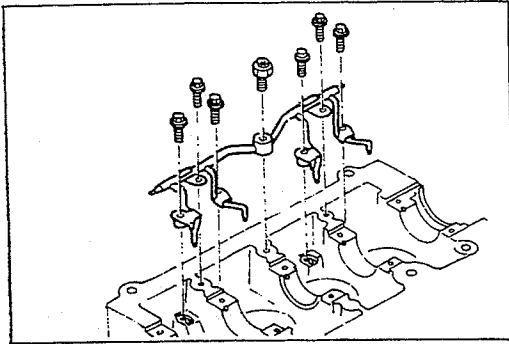
Note:

Hold the camshaft stationaly to prevent the camshaft from turning.

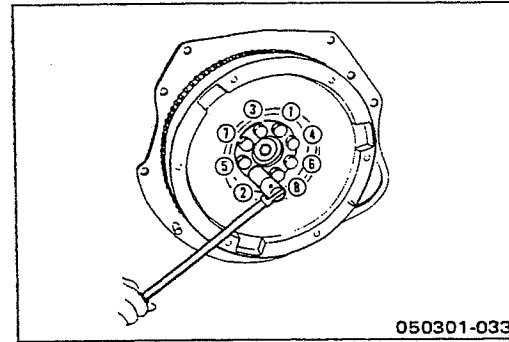
3. Use the universal puller ① to pull out the camshaft timing gear ②.

Universal Puller: 5-8521-0002-0

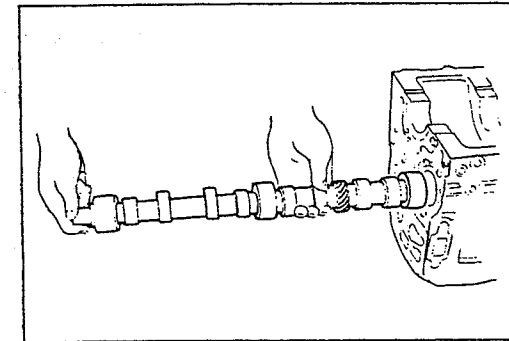
4. Remove the thrust plate ③.



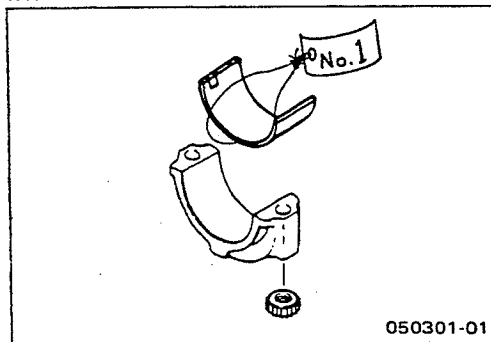
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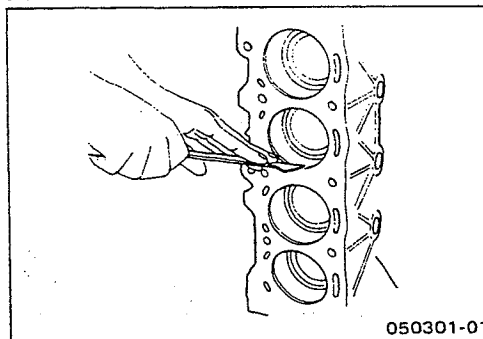


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0503010113A



050301-018

▲ Piston Cooling Oil Pipe (4JA1, 4JB1T, 4JB1TC)

The oiling jet uses thin steel tubing which is easily bent. Accidental contact between the oiling jet and the cylinder body, piston, or a tool will damage the oiling jet.

Never attempt to repair a damaged oiling jet. Replace it with a new one.

▲ Flywheel

Block the crankshaft with a piece of hard wood to prevent the flywheel from turning.

Loosen the flywheel bolts in numerical order a little at a time.

▲ Camshaft

Jiggle the camshaft with your hand as you pull it free from the front of the engine.

▲ Connecting Rod Bearing Cap with Lower Bearing

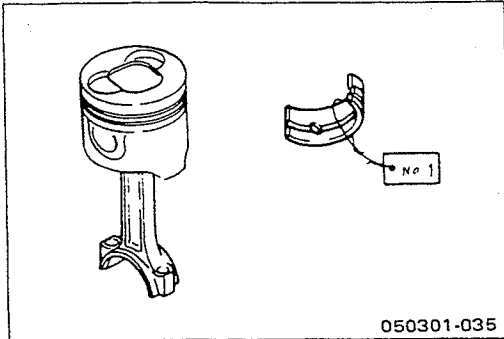
If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



▲ Piston and Connecting Rod with Upper Bearing

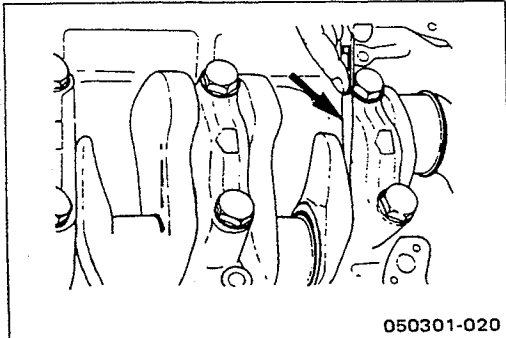
- 1) Remove carbon deposits from the upper portion of the cylinder wall with a scraper before removing the piston and connecting rod.
- 2) Move the piston to the top of the cylinder and tap it with a hammer grip or similar object from the connecting rod lower side to drive it out.

0503010113B



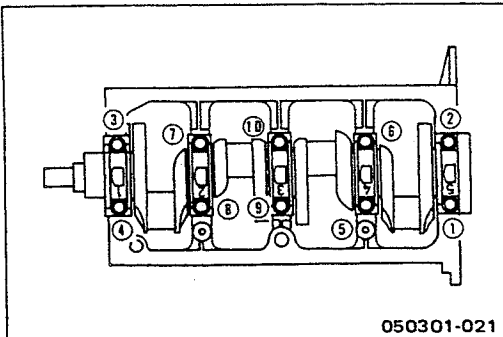
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0503010114A



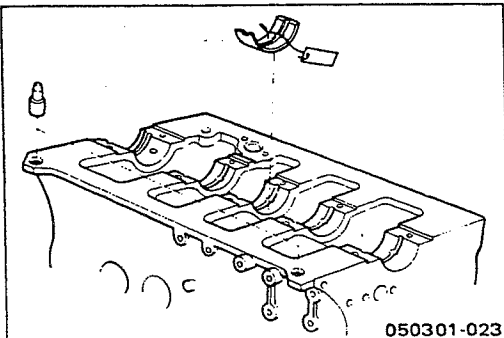
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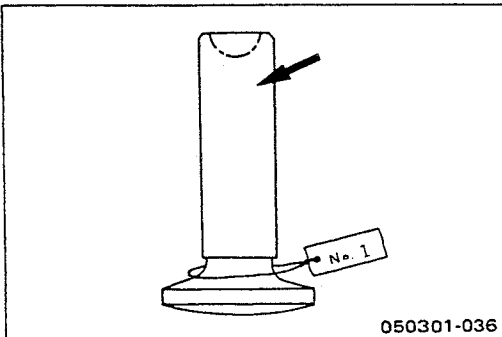
050301-021

0503010116



050301-023

050301011101



050301-036

If the connecting rod upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



▲ Crankshaft Bearing Cap with Lower Bearing

- 1) Measure the crankshaft end play at the center journal of the crankshaft.

Do this before removing the crankshaft bearing caps.

If the measured value exceeds the specified limit, the crankshaft thrust bearing must be replaced.

Crankshaft End Play		mm(in)
Standard	Limit	
0.10 (0.004)	0.30 (0.012)	

- 2) Loosen the crankshaft bearing cap bolts in numerical order a little at a time.

If the crankshaft bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

▲ Crankshaft Upper Bearing

If the crankshaft upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

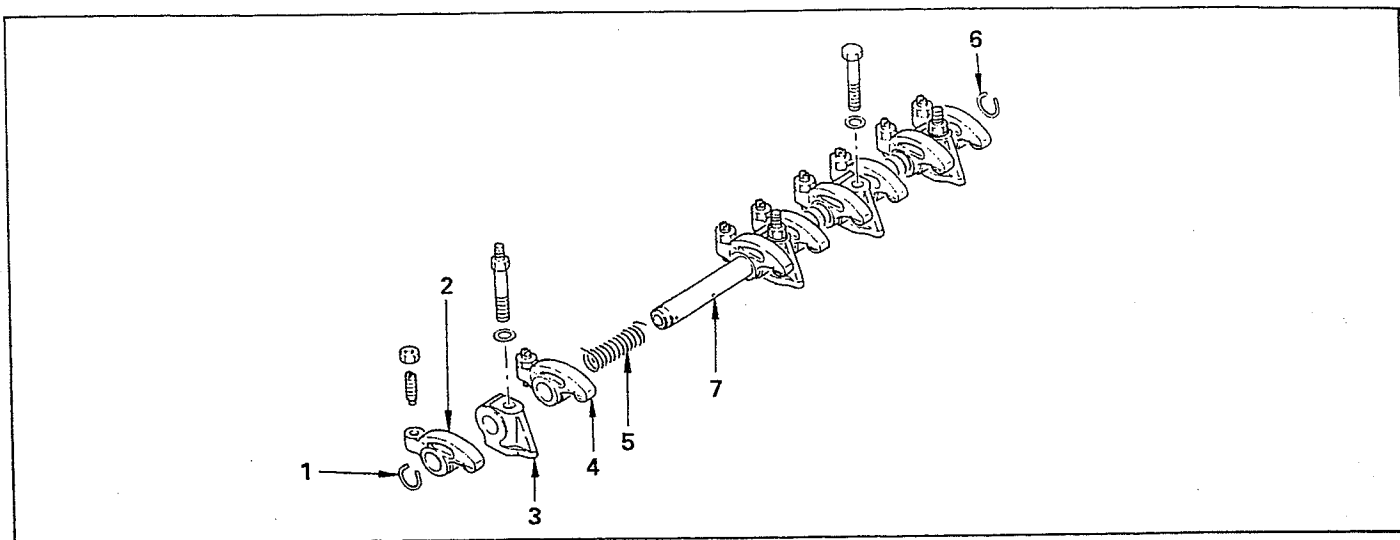
▲ Tappet

If the tappets are to be reinstalled, mark their fitting positions by tagging each tappet with the cylinder number from which it was removed.

▲ Crankshaft Rear Oil Seal

Be careful not to scratch the crankshaft rear oil seal fitting surfaces during the removal procedure.

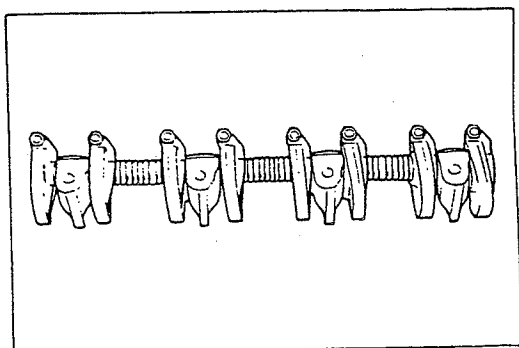
050302A

MINOR COMPONENTS**ROCKER ARM SHAFT AND ROCKER ARM**

050300002B

Disassembly Steps

- ▲ 1. Rocker arm shaft snap ring
- ▲ 2. Rocker arm
- ▲ 3. Rocker arm shaft bracket
- 4. Rocker arm
- 5. Rocker arm shaft spring
- 6. Rocker arm shaft snap ring
- 7. Rocker arm shaft

**Important Operations**

- ▲ Rocker Arm Shaft Snap Ring
- ▲ Rocker Arm
- ▲ Rocker Arm Shaft Bracket

- 1) Use a pair of pliers to remove the snap rings.
- 2) Remove the rocker arms.
- 3) Remove the rocker arm shaft brackets.

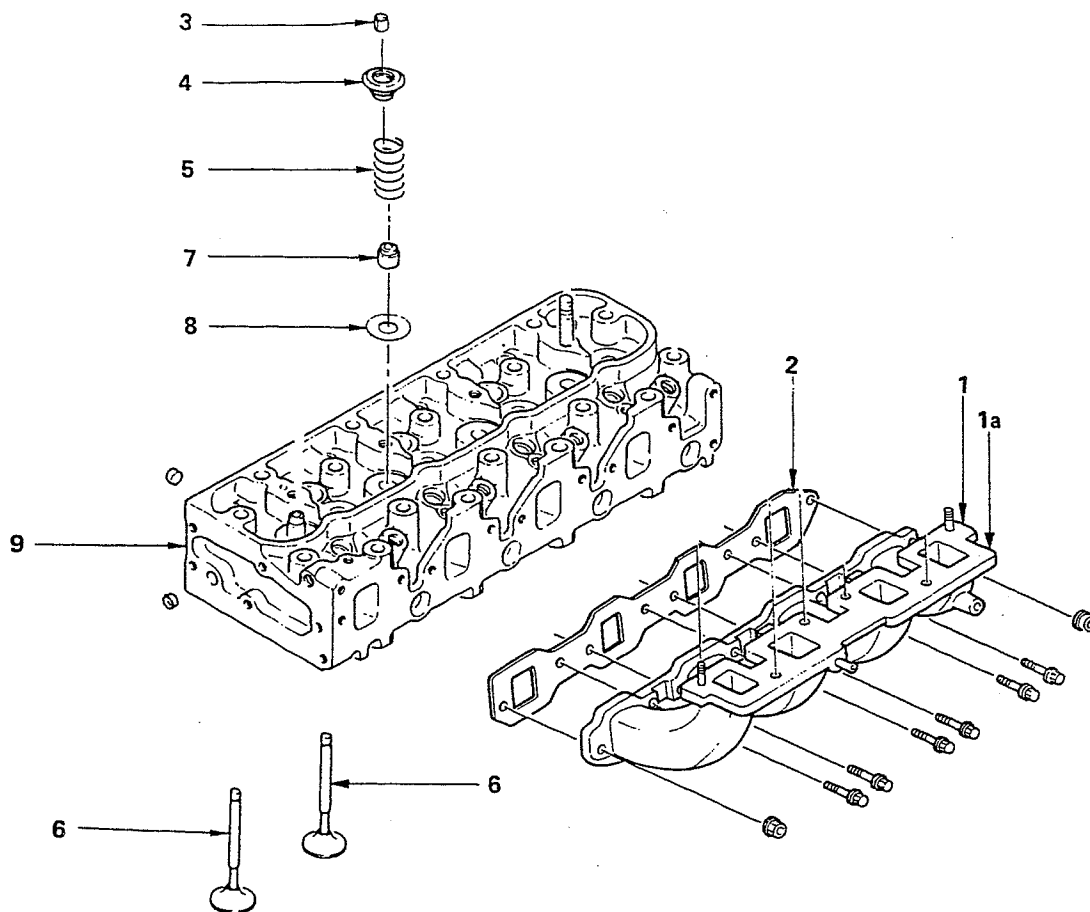
If the rocker arms and rocker arm shaft brackets are to be reinstalled, mark their installation positions by tagging each rocker arm and rocker arm shaft bracket with the cylinder number from which it was removed.

050303A



CYLINDER HEAD

This illustration is based on the 4JB1T engine.



050303B

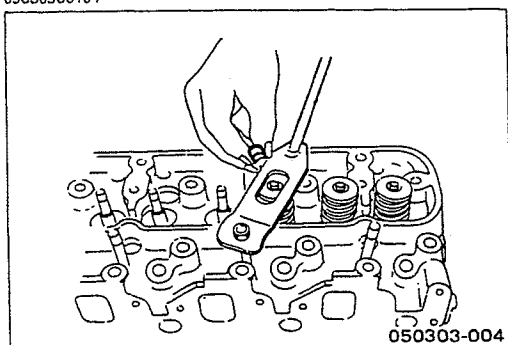
Disassembly Steps

- | | |
|-----------------------------------|--------------------------------|
| 1. Lower intake manifold (4JB1T) | 5. Valve spring |
| 1a Intake Manifold (Except 4JB1T) | ▲ 6. Intake and exhaust valves |
| 2. Intake manifold gasket | 7. Valve stem oil seal |
| ▲ 3. Split collar | 8. Valve spring lower seat |
| 4. Valve spring upper seat | 9. Cylinder head |

05030301

**Important Operations**

05030300101

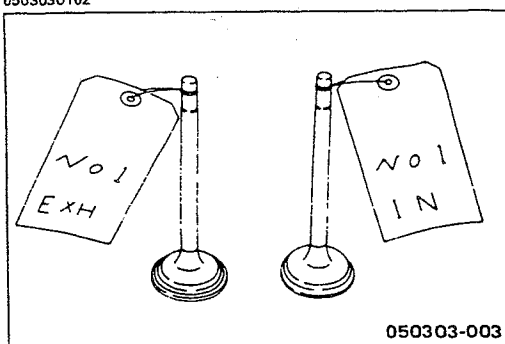
**▲ Split Collar**

- 1) Place the cylinder head on a flat wooden surface.
- 2) Use the spring compressor to remove the split collars.

Do not allow the valve to fall from the cylinder head.

Spring Compressor: 9-8523-1423-0 (J-29760)

0503030102

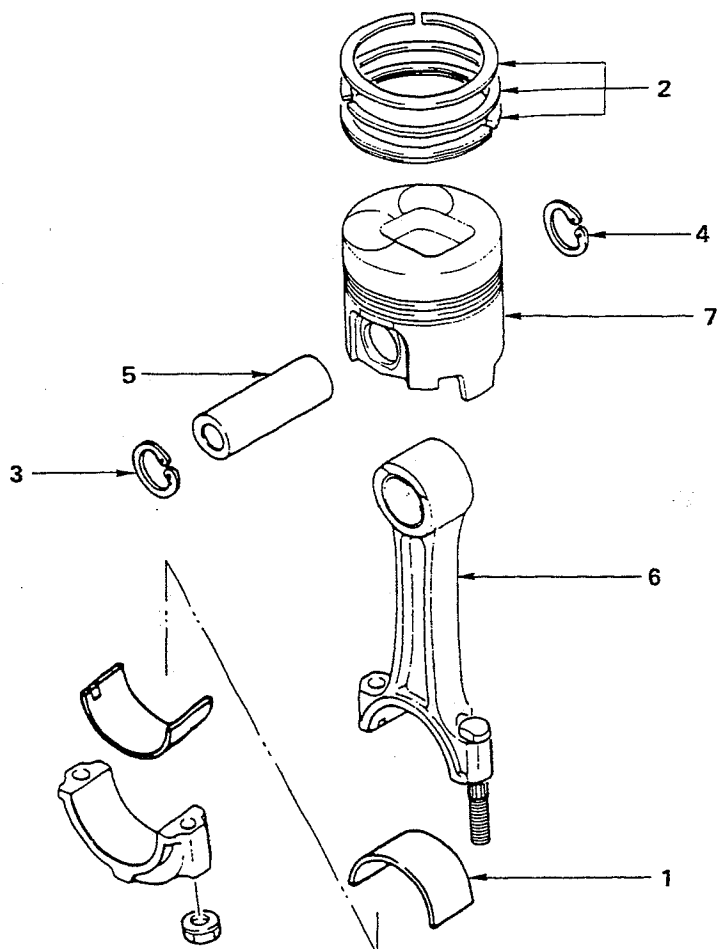
**▲ Intake and Exhaust Valve**

If the intake and exhaust valves are to be reinstalled, mark their installation positions by tagging each valve with the cylinder number from which it was removed.

If the intake and exhaust valves are to be replaced, the valve guides must also be replaced.



PISTON AND CONNECTING ROD



050304-006

050304B

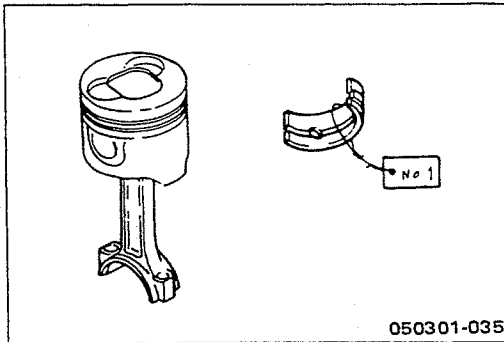
Disassembly Steps

- | | |
|-----------------------------|---------------------|
| ▲ 1. Connecting rod bearing | ▲ 5. Piston pin |
| ▲ 2. Piston ring | ▲ 6. Connecting rod |
| ▲ 3. Piston pin snap ring | ▲ 7. Piston |
| ▲ 4. Piston pin snap ring | |

05030401

**Important Operations**

0503040101

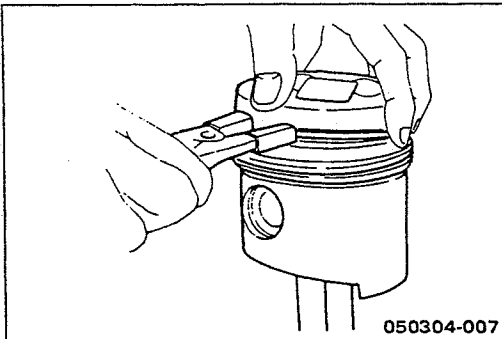


050301-035

▲ Connecting Rod Bearing

If the connecting rod bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

0503040102



050304-007

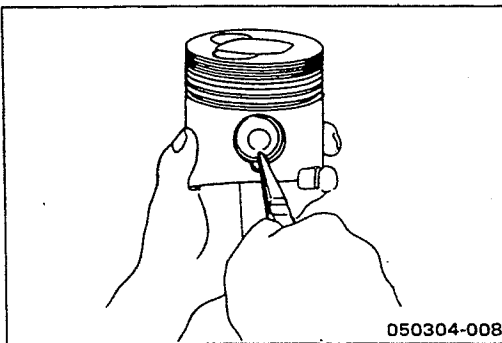
**▲ Piston Ring**

- 1) Clamp the connecting rod in a vise.
Take care not to damage the connecting rod.
- 2) Use a piston ring replacer to remove the piston rings.

Piston Ring Replacer

Do not attempt to use some other tool to remove the piston rings. Piston ring stretching will result in reduced piston ring tension.

0503040103

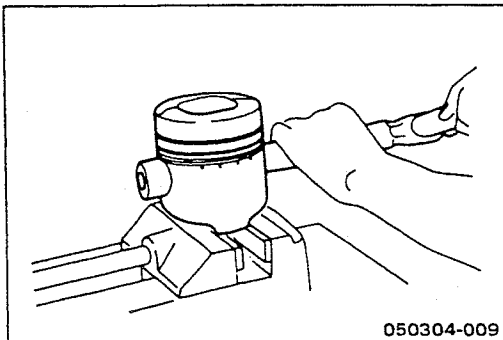


050304-008

**▲ Piston Pin Snap Ring**

Use a pair of snap ring pliers to remove the piston pin snap rings.

0503040104



050304-009

▲ Piston Pin**▲ Piston**

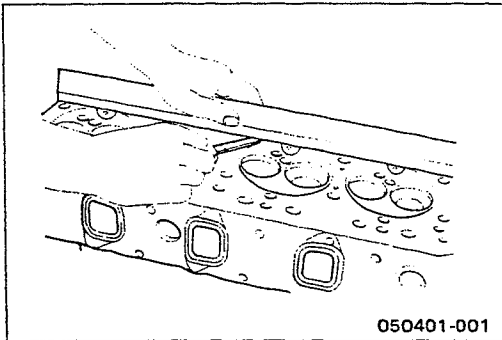
Tap the piston pin out with a hammer and a brass bar.
If the pistons and piston pins are to be reinstalled, mark their installation positions by tagging each piston and piston pin with the cylinder number from which it was removed.



INSPECTION AND REPAIR

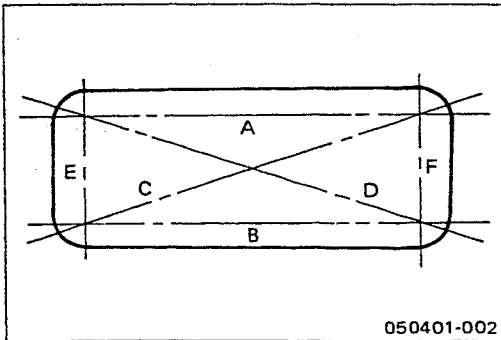
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

050401, 05040101A



050401-001

05040101B



050401-002



CYLINDER HEAD

Cylinder Head Lower Face Warpage

1. Use a straight edge and a feeler gauge to measure the four sides and the two diagonals of the cylinder head lower face.
2. Regrind the cylinder head lower face if the measured values are greater than the specified limit but less than the maximum grinding allowance.

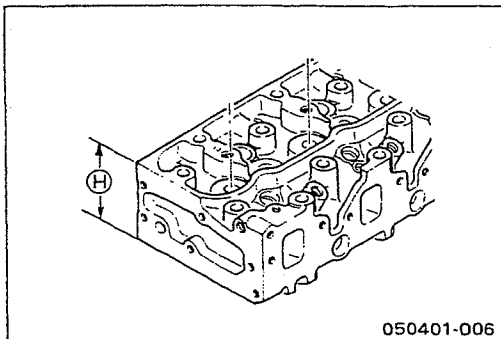
If the measured values exceed the maximum grinding allowance, the cylinder head must be replaced.

Cylinder Head Lower Face Warpage		mm(in)
Standard	Limit	Maximum Grinding Allowance
0.05 (0.002) or less	0.20 (0.008)	0.30 (0.012)

Note:

The 4JB1T and 4JB1TC cylinder head cannot be reground.

05040101C



050401-006



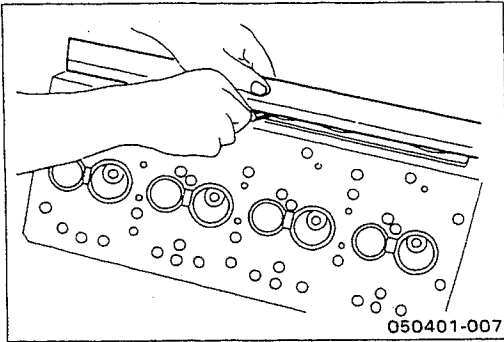
Cylinder Head Height (H) (Reference) mm(in)

Standard	Limit
91.95 — 92.05 (3.620 — 3.624)	91.55 (3.60)

Note:

If the cylinder head lower face is reground, valve depression must be checked.

05040102



Manifold Fitting Face Warpage

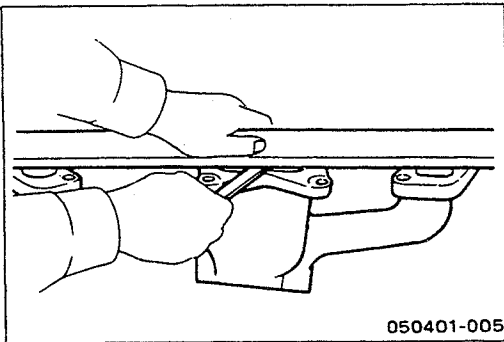
Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

Regrind the manifold cylinder head fitting surfaces if the measured values are greater than the specified limit but less than the maximum grinding allowance.

If the measured values exceed the maximum grinding allowance, the cylinder head must be replaced.

Manifold Fitting Face Warpage		mm(in)
Standard	Limit	Maximum Grinding Allowance
0.05 (0.002) or less	0.20 (0.008)	0.40 (0.016)

05040103



Exhaust Manifold Warpage

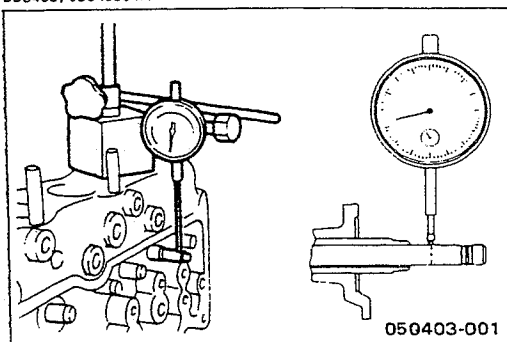
Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

Regrind the exhaust manifold cylinder head fitting surfaces if the measured values are between the specified limit and the standard.

If the measured values exceed the specified limit, the manifold must be replaced.

Exhaust Manifold Warpage		mm(in)
Standard	Limit	
0.05 (0.002) or less	0.20 (0.008)	

050403, 05040301A



VALVE GUIDE

Valve Stem and Valve Guide Clearance

Measuring Method-I

1. With the valve stem inserted in the valve guide, set the dial indicator needle to "0".
2. Move the valve head from side to side.

Read the dial indicator.

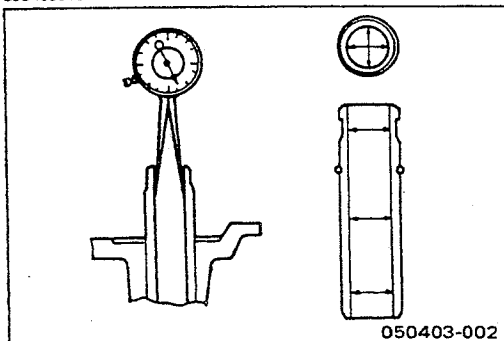
Note the highest dial indication.

If the measured values exceed the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Clearance mm(in)

	Standard	Limit
Intake Valve	0.039 – 0.069 (0.0015 – 0.0027)	0.200 (0.008)
Exhaust Valve	0.064 – 0.093 (0.0025 – 0.0037)	0.250 (0.0098)

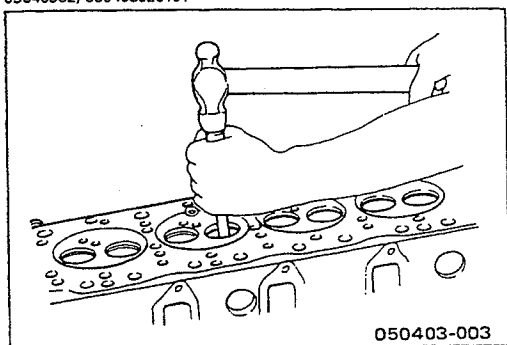
05040301B



Measuring Method-II

1. Measure the valve stem outside diameter.
Refer to the Item "Valve Stem Outside Diameter".
2. Use a caliper calibrator or a telescoping gauge to measure the valve guide inside diameter.
- 3.

05040302, 050403020101



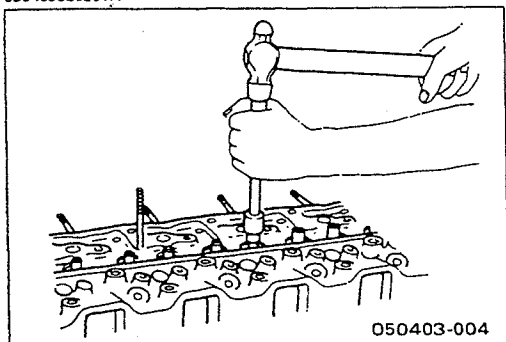
Valve Guide Replacement

Valve Guide Removal

Use a hammer and the valve guide replacer to drive out the valve guide from the cylinder head lower face.

Valve Guide Replacer: 9-8523-1212-0

050403020201A

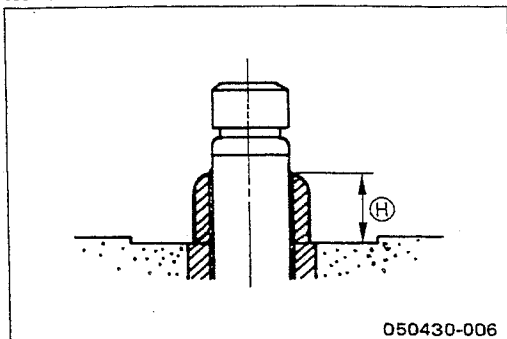


Valve Guide Installation

1. Apply engine oil to the valve guide outer circumference.
2. Attach the valve guide installer to the valve guide.
3. Use a hammer to drive the valve guide into position from the cylinder head upper face.

Valve Guide Installer: 9-8523-1212-0

0504030202B



050430-006



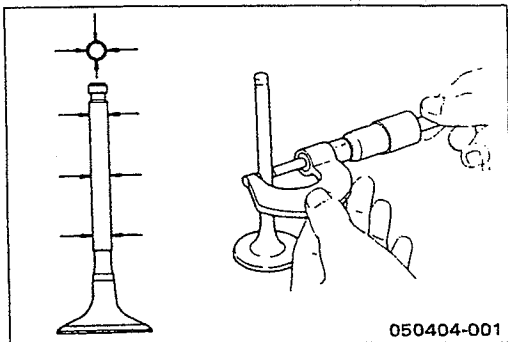
4. Measure the height of the valve guide upper end from the upper face of the cylinder head.

Valve Guide Upper End Height (H) (Reference)	mm(in)
13 (0.51)	

Note:

If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.

050404, 05040401



050404-001



VALVE AND VALVE SEAT INSERT

Valve Stem Outside Diameter

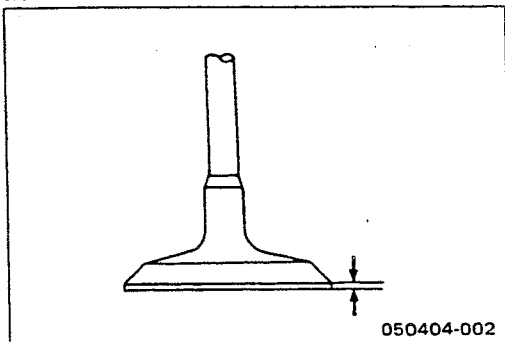
Measure the valve stem diameter at three points.

If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Outside Diameter mm(in)

	Standard	Limit
Intake Valve	7.946 – 7.961 (0.3128 – 0.3134)	7.880 (0.3102)
Exhaust Valve	7.921 – 7.936 (0.3119 – 0.3124)	7.850 (0.3090)

05040402



050404-002



Valve Thickness

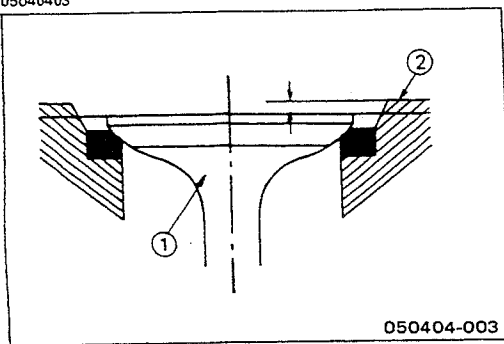
Measure the valve thickness.

If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Intake and Exhaust Valve Thickness mm(in)

Standard	Limit
1.8 (0.07)	1.5 (0.06)

05040403



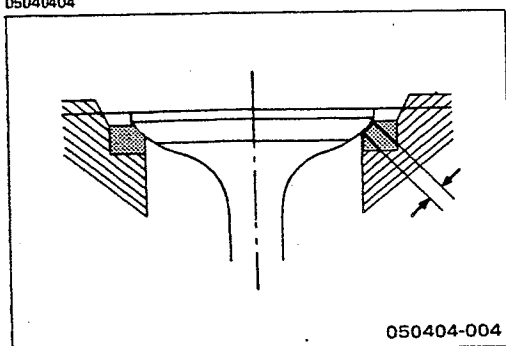
Valve Depression

1. Install the valve ① to the cylinder head ②.
2. Use a depth gauge or a straight edge with steel rule to measure the valve depression from the cylinder head lower surface.

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

Valve Depression		mm(in)
	Standard	Limit
Intake	0.73 (0.029)	1.28 (0.050)
Exhaust	0.70 (0.028)	1.20 (0.047)

05040404



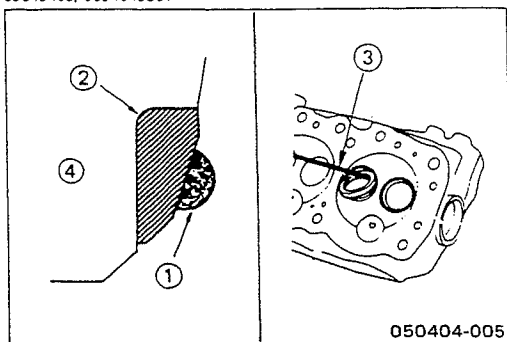
Valve Contact Width

1. Check the valve contact faces for roughness and unevenness. Make smooth the valve contact surfaces.
2. Measure the valve contact width.

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

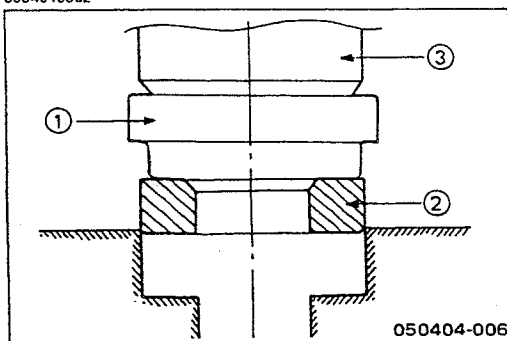
Valve Contact Width		mm(in)
	Standard	Limit
Intake	1.7 (0.067)	2.2 (0.087)
Exhaust	2.0 (0.079)	2.5 (0.078)

05040405, 0504040501

**Valve Seat Insert Replacement****Valve Seat Insert Removal**

1. Arc weld the entire inside circumference ① of the valve seat insert ②.
2. Allow the valve seat insert to cool for a few minutes.
This will invite contraction and make removal of the valve seat insert easier.
3. Use a screwdriver ③ to pry the valve seat insert free.
Take care not to damage the cylinder head ④.
4. Carefully remove carbon and other foreign material from the cylinder head insert bore.

0504040502

**Valve Seat Insert Installation**

1. Carefully place the attachment ① (having a smaller outside diameter than the valve seat insert) on the valve seat insert ②.

Note:

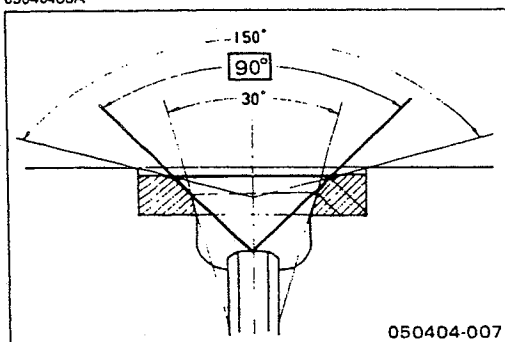
The smooth side of the attachment must contact the valve seat insert.

2. Use a bench press ③ to gradually apply pressure to the attachment and press the valve seat insert into place.

Note:

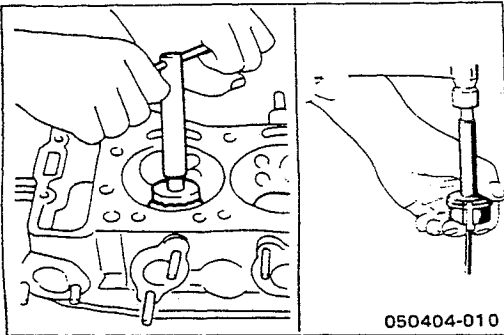
Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat insert will result.

05040406A

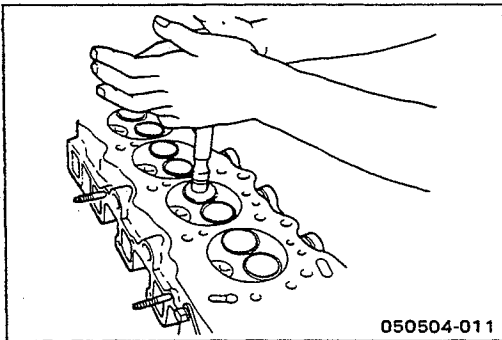
**Valve Seat Insert Correction**

1. Remove the carbon from the valve seat insert surface.
2. Use a valve cutter (15°, 45°, and 75° blades) to minimize scratches and other rough areas. This will bring the contact width back to the standard value.
Remove only the scratches and rough areas. Do not cut away too much. Take care not to cut away unblemished areas of the valve seat surface.

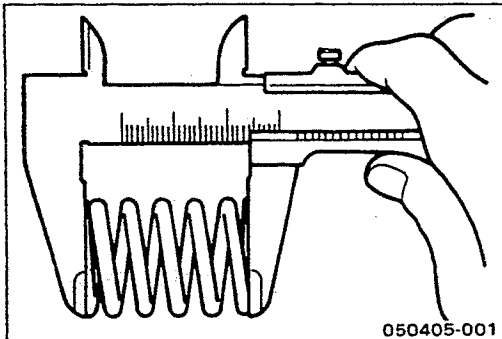
05040406B



05040406C



050405, 05040501



Valve Seat Angle	degree
45	

Note:

Use an adjustable valve cutter pilot.

Do not allow the valve cutter pilot to wobble inside the valve guide.

3. Apply abrasive compound to the valve seat insert surface.
4. Insert the valve into the valve guide.
5. Turn the valve while tapping it to fit the valve seat insert.
6. Check that the valve contact width is correct.
7. Check that the valve seat insert surface is in contact with the entire circumference of the valve.



VALVE SPRING

Valve Spring Free Height

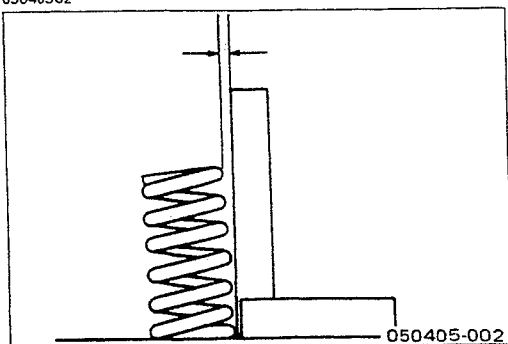
Use a vernier caliper to measure the valve spring free height.

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

Inner and Outer Spring Free Height mm(in)

		Standard	Limit
4JA1	Inner spring	45.3 (1.78)	44.4 (1.75)
	Outer spring	49.7 (1.96)	48.2 (1.90)
4JB1	Single spring	48.0 (1.89)	47.1 (1.85)

05040502



Valve Spring Squareness

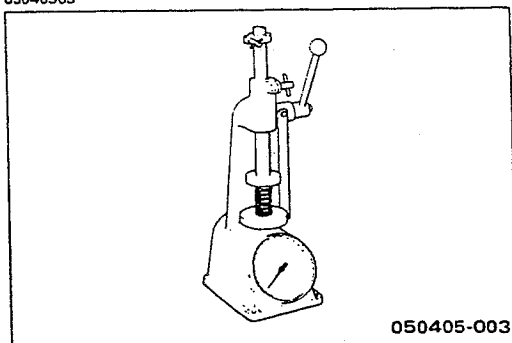
Use a surface plate and a square to measure the valve spring squareness.

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

Inner and Outer Spring Squareness mm(in)

		Limit
4JA1	Inner Spring	3.0 (0.120)
	Outer Spring	3.2 (0.126)
4JB1	Single Spring	1.7 (0.07)

05040503



Valve Spring Tension

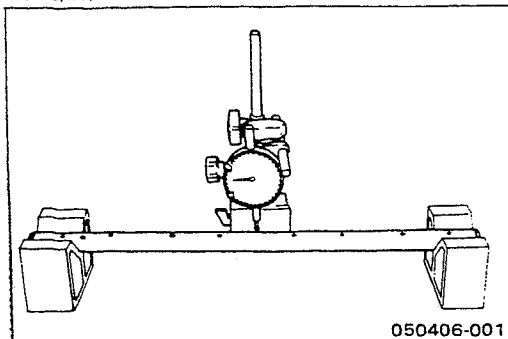
Use a spring tester to measure the valve spring tension.

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

Valve Spring Tension kg(lb/N)

		Compressed Height	Standard	Limit
4JA1	Inner Spring	37.0 mm (1.46 in)	5.9 (13.0/57.9)	5.0 (11.0/49.0)
	Outer Spring	39.0 mm (1.54 in)	20.9 (46.0/205.0)	18.1 (39.8/177.4)
4JB1	Single Spring	38.9 mm (1.53 in)	30.2 (66.4/296.0)	26.3 (57.9/257.7)

050406, 05040601



050406-001

**ROCKER ARM SHAFT AND ROCKER ARM****Rocker Arm Shaft Run-Out**

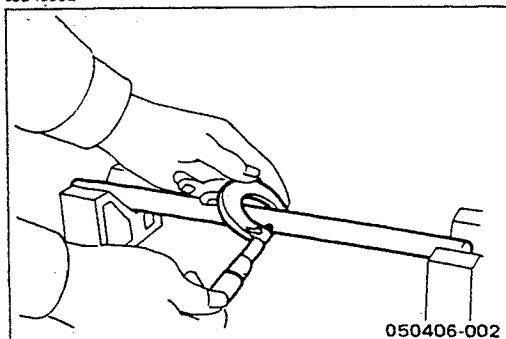
1. Place the rocker arm shaft on a V-block.
2. Use a dial indicator to measure the rocker arm shaft central portion run-out.

If the run-out is very slight, correct the rocker arm shaft run-out with a bench press. The rocker arm must be at cold condition.

If the measured rocker arm shaft run-out exceeds the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Run-Out	mm(in)
Limit	
0.3 (0.0012)	

05040602



050406-002

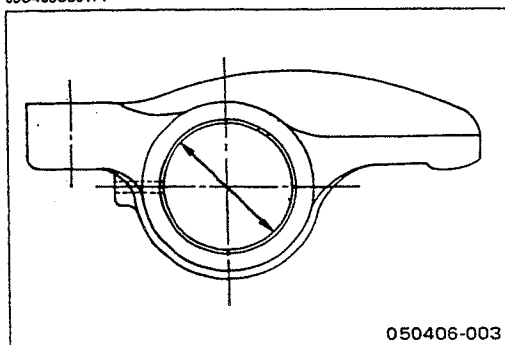
**Rocker Arm Shaft Outside Diameter**

Use a micrometer to measure the rocker arm fitting portion outside diameter.

If the measured value is less than the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Outside Diameter	mm(in)
Standard	Limit
18.98—19.00 (0.747—0.748)	18.90 (0.744)

0504060301A



050406-003

**Rocker Arm Shaft and Rocker Arm Clearance**

1. Use either a vernier caliper or a dial indicator to measure the rocker arm inside diameter.

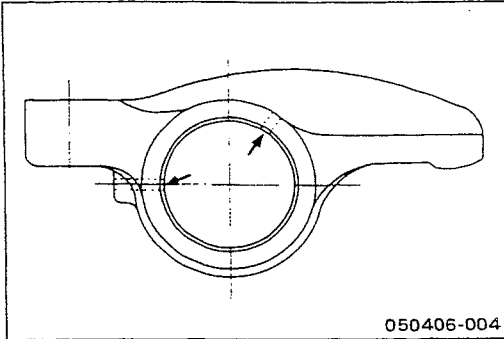
Rocker Arm Inside Diameter	mm(in)
Standard	Limit
19.036 — 19.060 (0.749 — 0.750)	19.100 (0.752)

2. Measure the rocker arm shaft outside diameter.

If the measured value exceeds the specified limit, replace either the rocker arm or the rocker arm shaft.

Rocker Arm Shaft and Rocker Arm Clearance	mm(in)
Standard	Limit
0.01 — 0.05 (0.0004 — 0.0020)	0.20 (0.008)

05040603B



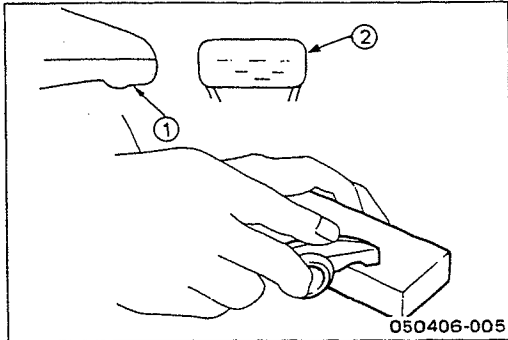
050406-004



3. Check that the rocker arm oil port is free of obstructions.

If necessary, use compressed air to clean the rocker arm oil port.

05040604



050406-005



Rocker Arm Correction

Inspect the rocker arm valve stem contact surfaces for step wear ① and scoring ②.

If the contact surfaces have light step wear or scoring, they may be honed with an oil stone.

If the step wear or scoring is severe, the rocker arm must be replaced.

050407, 0504070101A

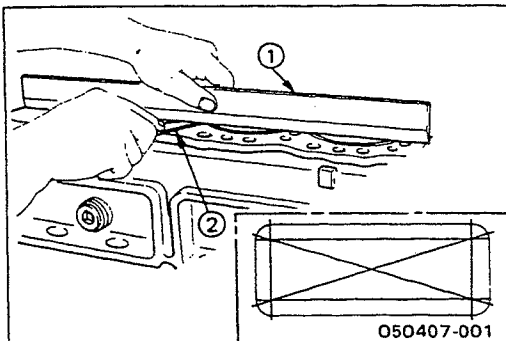
CYLINDER BODY

Cylinder Body Upper Face Warpage

1. Remove the cylinder body dowel.
2. Remove the cylinder liner.

Refer to "Cylinder Liner Replacement".

0504070101B



050407-001



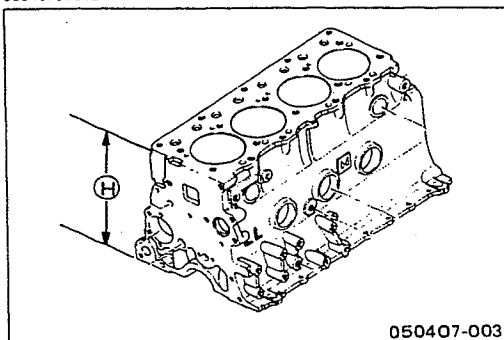
3. Use a straight edge ① and a feeler gauge ② to measure the four sides and the two diagonals of the cylinder body upper face.

If the measured values exceeds the limit, the cylinder body must be replaced.

Cylinder Body Upper Face Warpage mm(in)

Standard	Limit
0.05 (0.002) or less	0.20 (0.008)

0504070101D



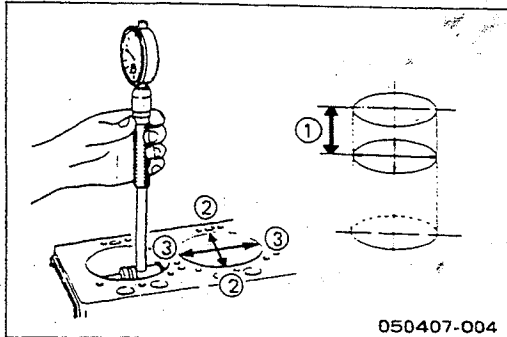
050407-003

Cylinder Body Height (H) (Reference) mm(in)

	Standard
4JA1	244.945 - 245.055 (9.6430 - 9.6478)
4JB1	269.945 - 270.055 (10.6277 - 10.6320)

5. Reinstall the cylinder liner.
Refer to "Cylinder Liner Replacement".
6. Reinstall the cylinder body dowel.

05040705A



050407-004

05040705B



Cylinder Liner Bore Measurement

Use a cylinder indicator to measure the cylinder bore at measuring point ① in the thrust ②—② and axial ③—③ directions of the crankshaft.

Measuring Point ① 20 mm (0.79 in)

If the measured value exceeds the specified limit, the cylinder liner must be replaced.

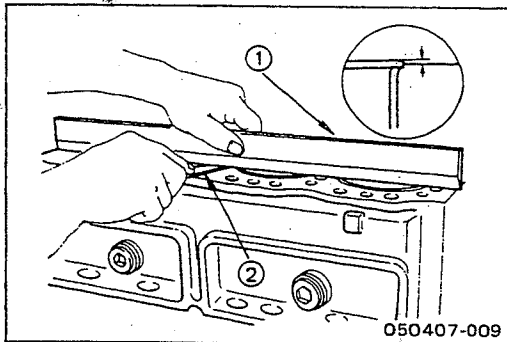
Cylinder Liner Bore		mm(in)
Standard		Limit
93.021 (3.662)		93.100 (3.665)

Note:

The inside of the dry type cylinder liner is chrome plated. It cannot be rebored or honed.

If the inside of the cylinder liner is scored or scorched, the cylinder liner must be replaced.

05040706



050407-009



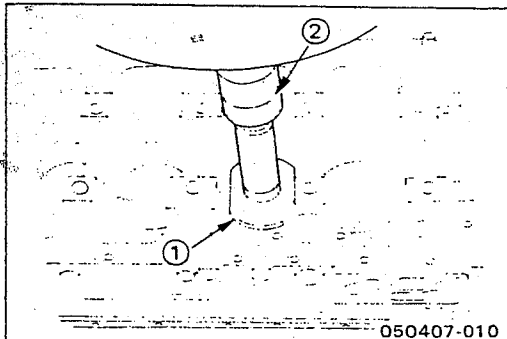
Cylinder Liner Projection Inspection

1. Hold a straight edge ① along the top edge of the cylinder liner to be measured.
2. Use a feeler gauge ② to measure each cylinder liner projection.

Cylinder Liner Projection		mm(in)
Standard		
0 — 0.1 (0 — 0.004)		

The difference in the cylinder liner projection height between any two adjacent cylinders must not exceed 0.03 mm (0.0012 in).

05040707, 0504070701



050407-010



Cylinder Liner Replacement

Cylinder Liner Removal

1. Insert the cylinder liner remover ① into the cylinder body (from the lower side of the cylinder body) until it makes firm contact with the cylinder liner.

Cylinder Liner Remover: 5-8840-2039-0

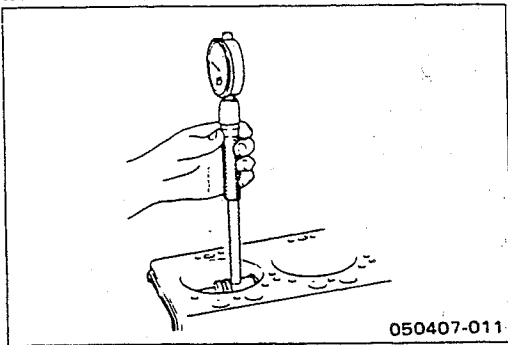
2. Use a bench press ② to slowly force the cylinder liner from the cylinder body.

Note:

Take care not to damage the cylinder body upper face during the cylinder liner removal procedure.

3. Measure the cylinder body upper face warpage.
Refer to "Cylinder Body Upper Face Warpage".

0504070702

**Cylinder Liner Grade Selection**

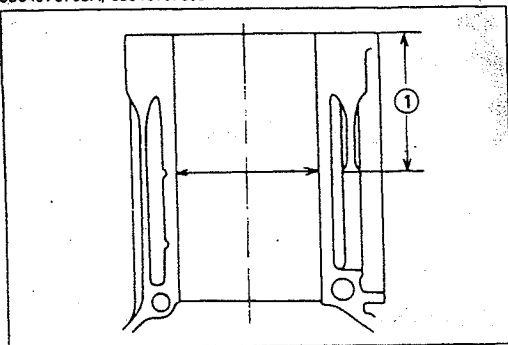
Measure the cylinder body inside diameter and select the appropriate cylinder liner grade.

Standard Fitting Interference	mm(in)
0.001 — 0.019 (0.0004 — 0.0007)	

If the cylinder liner fitting interference is too small, engine cooling efficiency will be adversely affected.

If the cylinder liner fitting interference is too large, it will be difficult to insert the cylinder liner into the cylinder body.

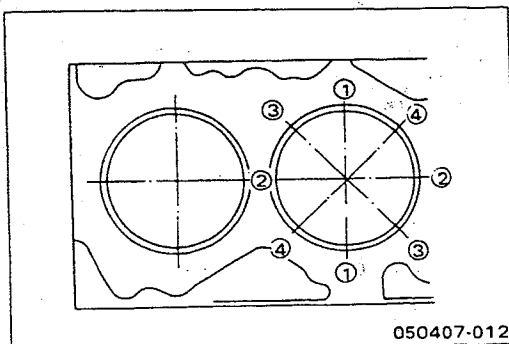
0504070703A, 0504070703B

**Cylinder Body Bore Measurement**

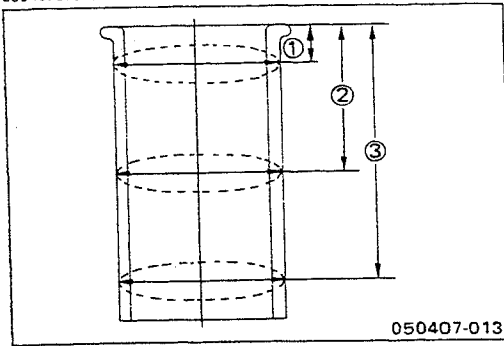
1. Take measurements at measuring point ① across positions ①—①, ②—②, ③—③, and ④—④.

Measuring Point ① 98 mm (3.86 in)

2. Calculate the average value of the four measurements to determine the correct cylinder grade.



050407070401C



Cylinder Liner Outside Diameter Measurement

1. Take two measurements at measuring points ①, ②, and ③.

Measuring Points ① 20 mm (0.79 in) all 4J models

Measuring Points ② 80 mm (3.15 in) 4JA1

90 mm (3.54 in) 4JB1

Measuring Points ③ 140 mm (5.50 in) 4JA1

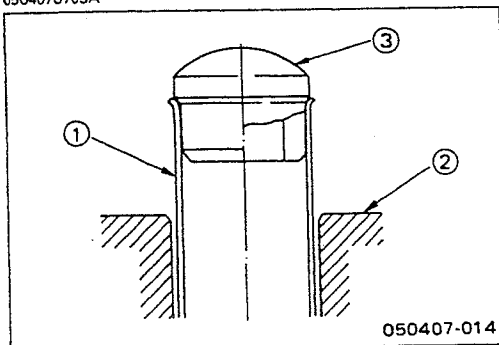
160 mm (6.30 in) 4JB1

2. Calculate the average value of the six measurements to determine the correct cylinder liner grade.

Cylinder Bore and Cylinder Liner Outside Diameter Combination

(Reference)	Cylinder Bore	Cylinder Liner Outside Diameter
1.	95.001 – 95.010 (3.74019 – 3.74055)	95.011 – 95.020 (3.74059 – 3.74094)
2.	95.011 – 95.020 (3.74059 – 3.74094)	95.021 – 95.030 (3.74098 – 3.74133)
3.	95.021 – 95.030 (3.74098 – 3.74133)	95.031 – 95.040 (3.74137 – 3.74173)

0504070705A



Cylinder Liner Installation

1. Cylinder Liner Installation Using The Special Tool

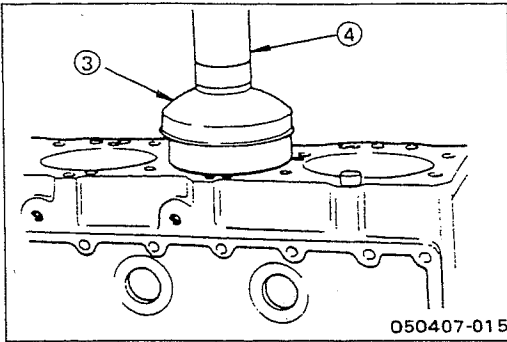
- 1) Use new kerosene or diesel oil to thoroughly clean the cylinder liners and bores.
- 2) Use compressed air to blow-dry the cylinder liner and bore surfaces.

Note:

All foreign material must be carefully removed from the cylinder liner and the cylinder bore before installation.

- 3) Insert the cylinder liner ① into the cylinder body ② from the top of the cylinder body.

0504070705B



- 4) Set the cylinder liner installer ③ to the top of the cylinder liner.

Cylinder Liner Installer: 5-8840-2040-0

- 5) Position the cylinder body so that the installer center ③ is directly beneath the bench press shaft center ④.

Note:

Check that the cylinder liner is set perpendicular to the bench press and that there is no wobble.

- 6) Use the bench press to apply a seating force of 500 kg (1,102.5 lb/4,900 N) to the cylinder liner.
- 7) Apply a force of 2,500 kg (5,512.5 lb/24,500 N) to fully seat the cylinder liner.
- 8) After installing the cylinder liner, measure the cylinder liner projection.

Refer to "Cylinder Liner Projection Inspection".

0504070705C

2. Cylinder Liner Installation Using Dry Ice

If the cylinder liner is a chrome plated dry type, it is advisable to use dry ice during the installation procedure.

Cooling the cylinder liner with dry ice will cause the cylinder liner to contract, thus making installation easier.

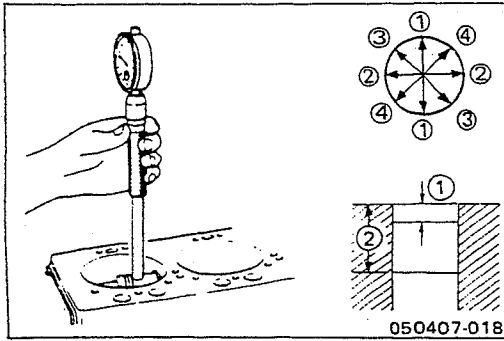
Note:

It is important that the cylinder liner be inserted to the cylinder body immediately after it has been cooled.

WARNING:

DRY ICE MUST BE USED WITH GREAT CARE. CARELESS HANDLING OF DRY ICE CAN RESULT IN SEVERE FROSTBITE.

0504070706A, 0504070706B



Piston Grade Selection

Measure the cylinder liner bore after installing the cylinder liner. Then select the appropriate piston grade for the installed cylinder liner.

1. Measure the cylinder liner bore.

Refer to "Cylinder Liner Bore Measurement".

Measuring Points ① 20 mm (0.79 in) for 4JA1 and 4JB1

② 140 mm (5.51 in) for 4JA1

160 mm (6.30 in) for 4JB1

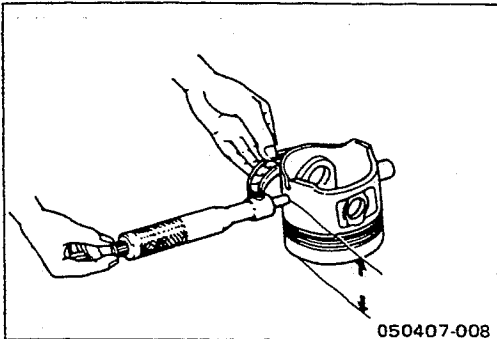
Cylinder Liner Bore mm(in)

Standard	Limit
93.021 – 93.060 (3.662 – 3.663)	93.100 (3.665)

Note:

It is most important that the correct piston grade be used. Failure to select the correct piston grade will result in engine failure. Always measure the cylinder bore and select the correct piston grade.

0504070706C



2. Measure the piston outside diameter.

Piston Measuring Point : 70 mm (3.13 in) for 4JA1

74 mm (2.91 in) for 4JB1

Piston Grade mm(in)

Grade	Size
Ⓐ	92.985 – 93.004 (3.660 – 3.662)
Ⓒ	93.005 – 93.024 (3.6616 – 3.6623)

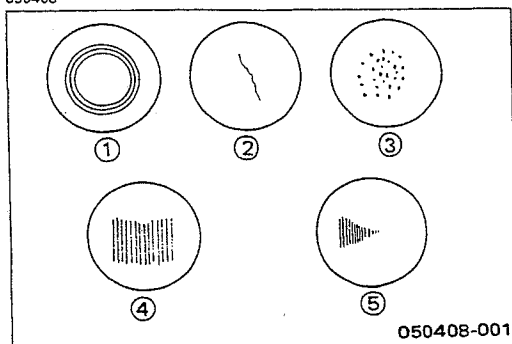
Cylinder Liner and Piston Clearance mm(in)

0.025 – 0.045 (0.0010 – 0.0018)

Note:

Cylinder liner kit clearances are preset. However, 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.

050408



TAPPET AND PUSH ROD

Visually inspect the tappet contact surfaces for pitting, cracking, and other abnormal conditions. The tappet must be replaced if any of these conditions are present.

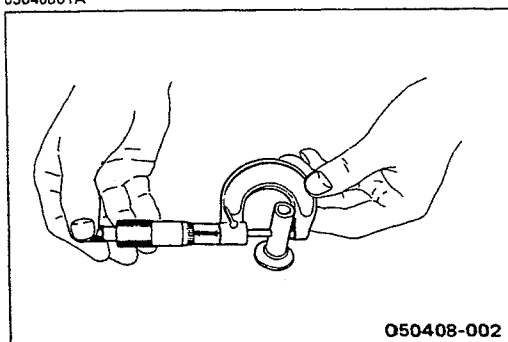
Refer to the illustration at the left.

- ① Normal contact
- ② Cracking
- ③ Pitting
- ④ Irregular contact
- ⑤ Irregular contact

Note:

The tappet surfaces are spherical. Do not attempt to grind them with an oil stone or similar tool in an effort to repair the tappet. If the tappet is damaged, it must be replaced.

05040801A

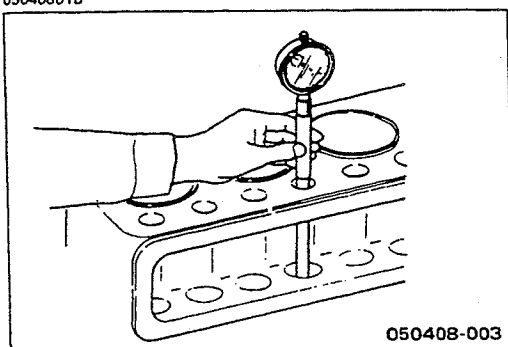


Tappet Outside Diameter

Measure the tappet outside diameter with a micrometer. If the measured value is less than the specified limit, the tappet must be replaced.

Tappet Outside Diameter		mm(in)
Standard	Limit	
12.97 — 12.99 (0.510 — 0.511)	12.95 (0.509)	

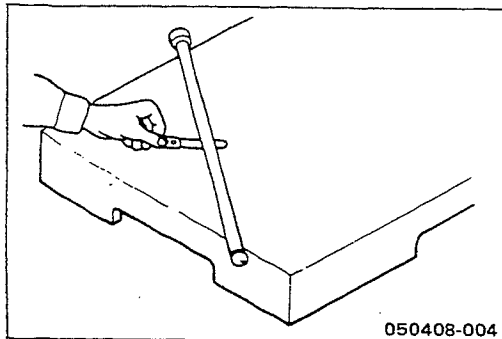
05040801B



Tappet and Cylinder Body Clearance

Tappet and Cylinder Body Clearance		mm(in)
Standard	Limit	
0.03 (0.001)	0.10 (0.004)	

05040802



050408-004

**Push Rod Curvature**

1. Lay the push rod on a surface plate.
2. Roll the push rod along the surface plate and measure the push rod curvature with a thickness gauge.
If the measured value exceeds the specified limit, the push rod must be replaced.

Push Rod Curvature	mm(in)
Limit	
0.3 (0.012)	



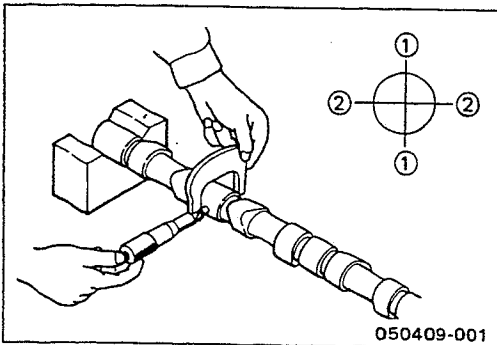
3. Visually inspect both ends of the push rod for excessive wear and damage. The push rod must be replaced if these conditions are discovered during inspection.

050409

**CAMSHAFT**

Visually inspect the journals, the cams, the oil pump drive gear, and the camshaft bearings for excessive wear and damage. The camshaft and the camshaft bearings must be replaced if these conditions are discovered during inspection.

05040901



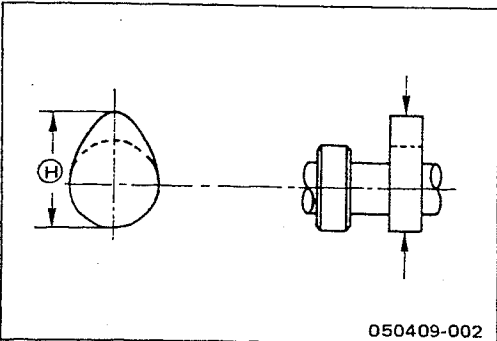
050409-001

**Camshaft Journal Diameter**

Use a micrometer to measure each camshaft journal diameter in two directions (① and ②). If the measured value is less than the specified limit, the camshaft must be replaced.

Camshaft Journal Diameter	mm(in)
Standard	Limit
49.945 — 49.975 (1.966 — 1.965)	49.60 (1.953)

05040902



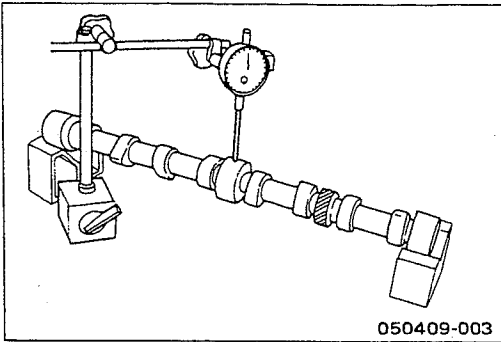
050409-002

**Cam Height**

Measure the cam height (H) with a micrometer. If the measured value is less than the specified limit, the camshaft must be replaced.

Cam Height (H)	mm(in)
Standard	Limit
42.08 (1.65)	41.65 (1.64)

05040903



050409-003

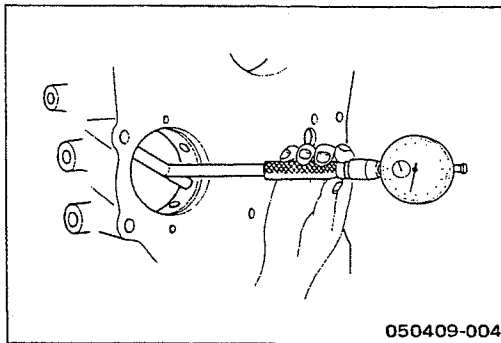
**Camshaft Run-Out**

1. Mount the camshaft on V-blocks.
2. Measure the run-out with a dial indicator.

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

Camshaft Run-Out		mm(in)
Standard	Limit	
0.02 (0.0008)	0.10 (0.004)	

05040904



050409-004

**Camshaft and Camshaft Bearing Clearance**

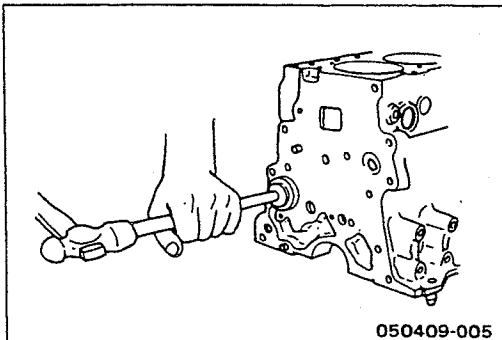
Use an inside dial indicator to measure the camshaft bearing inside diameter.

Crankshaft Bearing Inside Diameter		mm(in)
Standard	Limit	
50.00 – 50.03 (1.9685 – 1.9696)	50.08 (1.9716)	

If the clearance between the camshaft bearing inside diameter and the journal exceeds the specified limit, the camshaft bearing must be replaced.

Camshaft Bearing Clearance		mm(in)
Standard	Limit	
0.05 (0.002)	0.12 (0.005)	

05040905, 0504090501



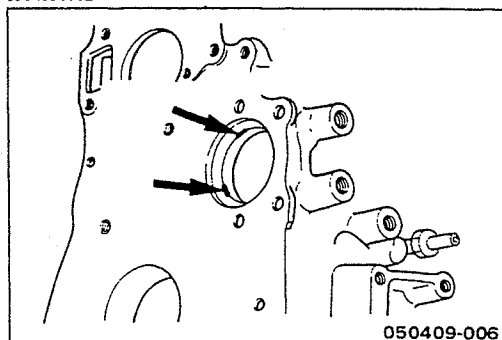
050409-005

**Camshaft Bearing Replacement****Camshaft Bearing Removal**

1. Remove the cylinder body plug plate.
2. Use the bearing replacer to remove the camshaft bearing.

Bearing Replacer: 5-8840-2038-0

0504090502



050409-006

**Camshaft Bearing Installation**

1. Align the bearing oil holes with the cylinder body oil holes.
2. Use the replacer to install the camshaft bearing.

Bearing Replacer: 5-8840-2038-0



CRANKSHAFT AND BEARING

Inspect the surface of the crankshaft journals and crankpins for excessive wear and damage.

Inspect the oil seal fitting surfaces for excessive wear and damage.

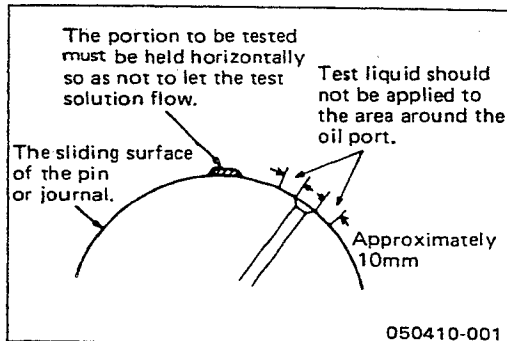
Inspect the oil ports for obstructions.

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.

05041001A



Crankshaft Tufftriding Inspection

1. Use an organic cleaner to thoroughly clean the crankshaft. There must be no traces of oil on the surfaces to be inspected.
2. Prepare a 5 — 10% solution of ammonium cuprous chloride (dissolved in distilled water).
3. Use a syringe to apply the solution to the surface to be inspected.

Hold the surface to be inspected perfectly horizontal to prevent the solution from running.

Note:

Do not allow the solution to come in contact with the oil ports and their surrounding area.

05041001B

**Judgment**

1. Wait for thirty to forty seconds.

If there is no discoloration after thirty or forty seconds, the crankshaft is usable.

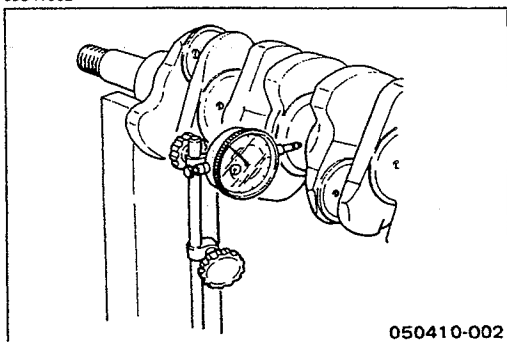
If discoloration appears (the surface being tested will become the color of copper), the crankshaft must be replaced.

2. Steam clean the crankshaft surface immediately after completing the test.

Note:

The ammonium cuprous chloride solution is highly corrosive. Because of this, it is imperative that the surfaces being tested be cleaned immediately after completing the test.

05041002

**Crankshaft Run-Out**

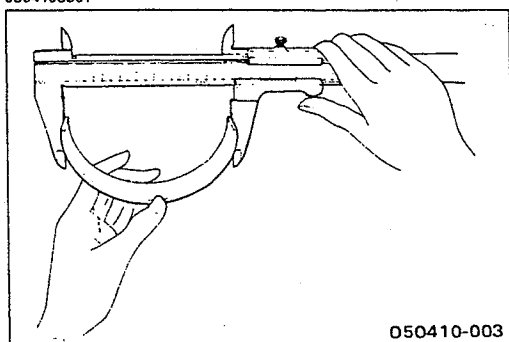
1. Set a dial indicator to the center of the crankshaft journal.
2. Gently turn the crankshaft in the normal direction of rotation.

Read the dial indicator as you turn the crankshaft.

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

Crankshaft Run-Out		mm(in)
Standard	Limit	
0.05 (0.02) or less	0.08 (0.003)	

0504100301

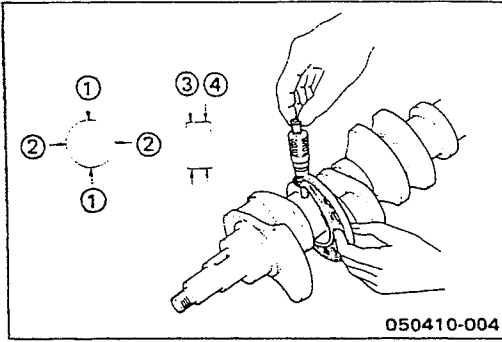
**Bearing Spread**

Use a vernier caliper to measure the bearing spread.

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

Bearing Spread		mm(in)
		Limit
Crankshaft Bearing	4JA1	64.5 (2.54)
	4JB1	74.5 (2.93)
Connecting Rod Bearing	56.5 (2.22)	

05041004A



050410-004

05041004B



Crankshaft Journal and Crankpin Diameter

1. Use a micrometer to measure the crankshaft journal diameter across points ① — ① and ② — ②.
2. Use the micrometer to measure the crankshaft journal diameter at the two points (③ and ④).
3. Repeat Steps ① and ② to measure the crankpin diameter.

If the measured values are less than the specified limit, the crankshaft must be replaced.

Crankshaft Journal Diameter mm(in)

	Standard	Limit
4JA1	59.92 — 59.93 (2.3591 — 2.3544)	59.91 (2.3587)
4JB1	69.92 — 69.93 (2.7526 — 2.7531)	69.91 (2.7524)

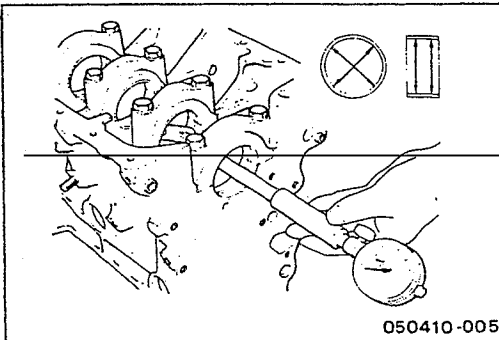
Crankpin Diameter mm(in)

Standard	Limit
52.92 — 52.93 (2.0833 — 2.0839)	52.90 (2.083)

Crankshaft Journal and Crankpin Uneven Wear mm(in)

Standard	Limit
0.05 (0.002) or less	0.08 (0.003)

05041005



050410-005



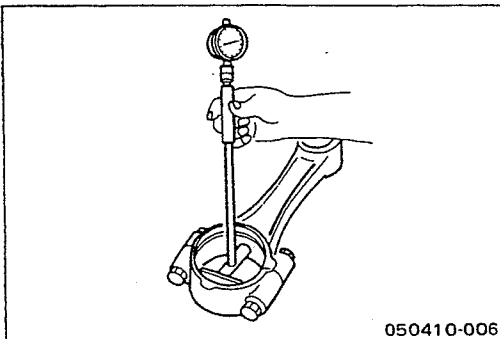
Crankshaft Journal and Bearing Clearance

If the clearance between the measured bearing inside diameter and the crankshaft journal diameter exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankshaft Journal and Bearing Clearance mm(in)

Standard	Limit
0.035 — 0.080 (0.0014 — 0.0036)	0.110 (0.0043)

05041006



050410-006



Connecting Rod Bearing Inside Diameter

1. Install the bearing to the connecting rod big end.
2. Tighten the bearing cap to the specified torque.

Connecting Rod Bearing Cap Bolt Torque

kg·m(lb.ft/N·m)
8.5 ± 0.5 (61.5 ± 3.6/83.40 ± 4.90)

3. Use an inside dial indicator to measure the connecting rod bearing inside diameter.

05041007

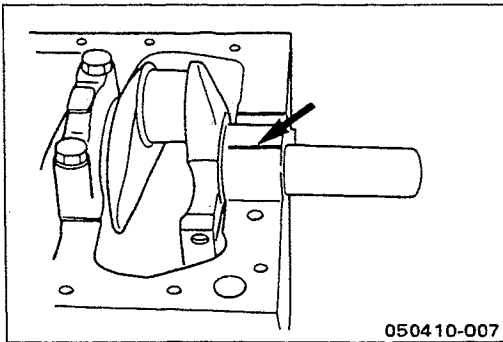


Crankpin and Bearing Clearance

If the clearance between the measured bearing inside diameter and the crankpin exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankpin and Bearing Clearance		mm(in)
Standard	Limit	
0.029 — 0.066 (0.0011 — 0.0026)	0.100 (0.0039)	

05041008, 0504100801A



050410-007

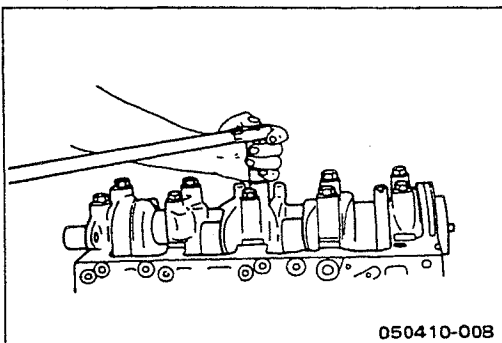


Clearance Measurements (With Plastigage)

Crankshaft Journal and Bearing Clearance

1. Clean the cylinder body, the journal bearing fitting surface, the bearing caps, and the bearings.
2. Install the bearings to the cylinder body.
3. Carefully place the crankshaft on the bearings.
4. Rotate the crankshaft approximately 30° to seat the bearing.
5. Place the Plastigage (arrow) over the crankshaft journal across the full width of the bearing.
6. Install the bearing caps with the bearing.

0504100801B



050410-008

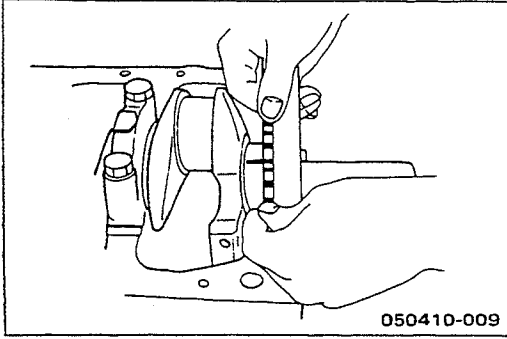


7. Tighten the bearing caps to the specified torque.

Crankshaft Bearing Cap Bolt Torque	kg·m(lb.ft/N·m)
17 ± 1 ($122.9 \pm 7.2/166.60 \pm 9.80$)	

Do not allow the crankshaft to turn during bearing cap installation and tightening.

8. Remove the bearing cap.



9. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

If the measured value exceeds the limit, perform the following additional steps.

- 1) Use a micrometer to measure the crankshaft outside diameter.
- 2) Use an inside dial indicator to measure the bearing inside diameter.

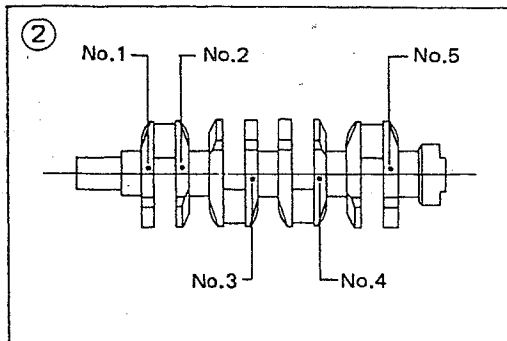
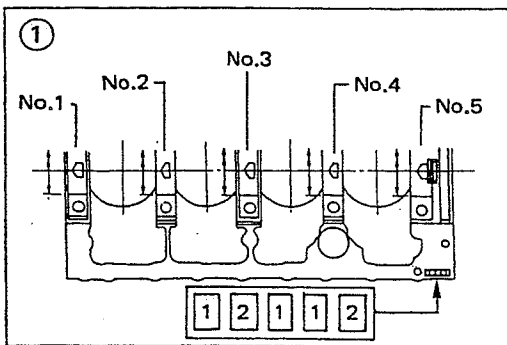
If the crankshaft journal and bearing clearance exceeds the limit, the crankshaft and/or the bearing must be replaced.

Crankshaft Journal and Bearing Clearance		mm(in)
Standard	Limit	
0.035 — 0.080 (0.0014 — 0.0036)	0.110 (0.0043)	

CRANKSHAFT BEARING SELECTION (REFERENCE)

Crankshaft bearing selection is based on the measured diameters of the crankshaft journals and the bearing inserts.

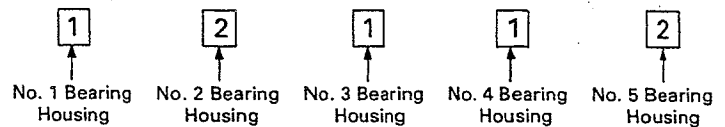
Match the crankshaft bearing housing grade marks and the crankshaft journal grade marks in the table below to determine the correct crankshaft bearing size.



Crankshaft Bearing Insert Grade Mark Position

Crankshaft bearing housing grade marks 1 or 2 are stamped on the rear right hand side of the cylinder body.

Example:

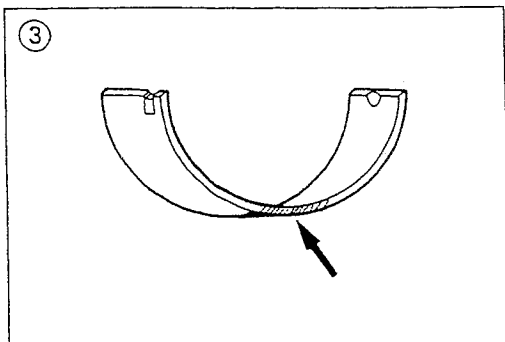


Crankshaft Journal Grade Mark Position

The crankshaft journal grade marks (1 or —) are stamped on each crankshaft journal wave.

The crankshaft journal and bearing clearance must be the same for each position after installation of the crankshaft and the crankshaft bearings.

Crankshaft Journal and Crankshaft Bearing Clearance	mm(in)
0.031 — 0.063 (0.0012 — 0.0025)	



Crankshaft Bearing Housing, Crankshaft Journal, and Crankshaft Bearing Combinations (Reference) mm(in)

Crankshaft Bearing ①		Crankshaft Journal ②		Crankshaft Bearing Size Color Code ③
Grade Mark	Diameter	Grade Mark	Diameter	
1	73.987—74.000 (2.9129—2.9134)	1 or —	69.927—69.932 (2.7530—2.7532)	Black
		2 or — —	69.922—69.927 (2.7528—2.7530)	Blue
		3 or — — —	69.917—69.922 (2.7556—2.7528)	
2	73.975—73.987 (2.9124—2.9129)	1 or —	69.927—69.932 (2.7530—2.7532)	Green
		2 or — —	69.922—69.927 (2.7528—2.7530)	
		3 or — — —	69.917—69.922 (2.7556—2.7528)	Black

0504100802A, 0504100802B, 0504100802C

**Crankpin and Bearing Clearance**

1. Clean the crankshaft, the connecting rod, the bearing cap, and the bearings.
2. Install the bearing to the connecting rod and the bearing cap.

Do not allow the crankshaft to move when installing the bearing cap.

3. Prevent the connecting rod from moving.
4. Attach the Plastigage to the crankpin.

Apply engine oil to the Plastigage to keep it from falling.



5. Install the bearing cap and tighten it to the specified torque.



Do not allow the connecting rod to move when installing and tightening the bearing cap.

Connecting Rod Bearing Cap Bolt

Torque	kg·m(lb.ft/N·m)
8.5 ± 0.5 ($61.5 \pm 3.6/83.30 \pm 4.90$)	

6. Remove the bearing cap.
7. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

If the measured value exceeds the specified limit, perform the following additional steps.

- 1) Use a micrometer to measure the crankpin outside diameter.

- 2) Use an inside dial indicator to measure the bearing inside diameter.

If the crank pin and bearing clearance exceeds the specified limit, the crankshaft and/or the bearing must be replaced.

Crankpin and Bearing Clearance		mm(in)
Standard	Limit	
0.029 – 0.066 (0.0011 – 0.0026)	0.100 (0.0039)	

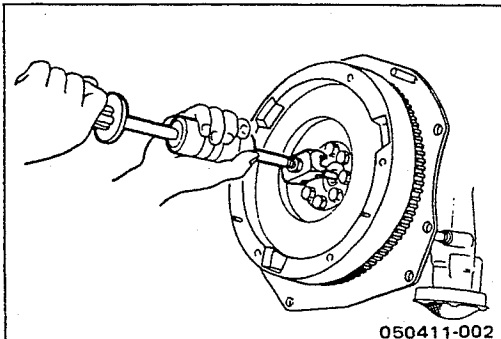
050411



CRANKSHAFT PILOT BEARING

Check the crankshaft pilot bearing for excessive wear and damage and replace it if necessary.

05041101, 0504110101



050411-002



Crankshaft Pilot Bearing Replacement

Crankshaft Pilot Bearing Removal

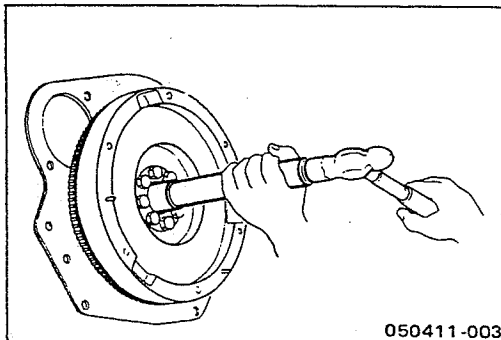


Use the pilot bearing remover to remove the crankshaft pilot bearing.

Pilot Bearing Remover: 5-8840-2000-0

Sliding Hammer: 5-8840-0019-0 (J-23907)

0504110102



050411-003



Crankshaft Pilot Bearing Installation



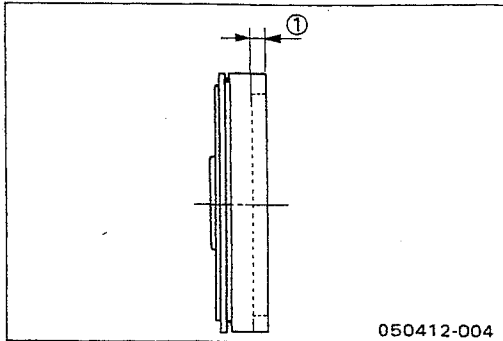
1. Place the crankshaft pilot bearing horizontally across the crankshaft bearing installation hole.
2. Tap around the edges of the crankshaft pilot bearing outer races with a brass hammer to drive the bearing into the crankshaft bearing installation hole.

Pilot Bearing Installer: 5-8522-0024-0

Note:

Strike only the crankshaft pilot bearing outer races with the hammer. Do not strike the bearing inner races. Bearing damage and reduced bearing service life will result.

050412, 05041201



050412-004



FLYWHEEL AND RING GEAR

Flywheel

1. Inspect the flywheel friction surface for excessive wear and heat cracks.
2. Measure the flywheel friction surface depth.
If the measured value is between the standard and the specified limit, the flywheel may be reground.
If the measured value exceeds the specified limit, the flywheel must be replaced.

Flywheel Friction Surface Depth ① mm(in)

	Standard	Limit
4JA1, 4JB1	20 (0.787)	21 (0.827)
4JB1T, 4JB1TC	14 (0.551)	15 (0.591)

Flywheel Friction Surface Roughness mm(in)

Less than 0.006 (0.00024)

05041202

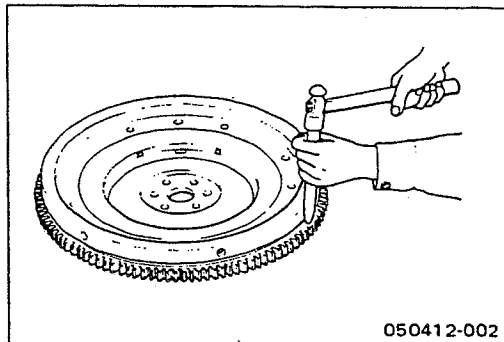


Ring Gear

Inspect the ring gear.

If the ring gear teeth are broken or excessively worn, the ring gear must be replaced.

05041203, 0504120301



050412-002

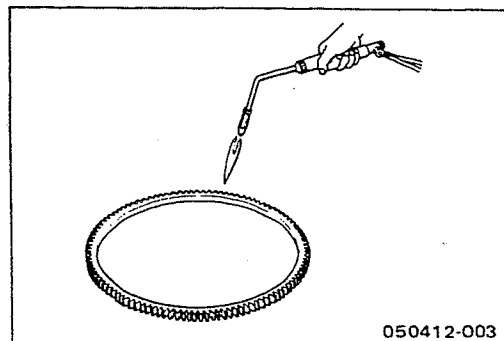


Ring Gear Replacement

Ring Gear Removal

Strike around the edges of the ring gear with a hammer and chisel to remove it.

0504120302



050412-003



Ring Gear Installation

1. Heat the ring gear evenly with a gas burner to invite thermal expansion.
Do not allow the temperature of the gas burner to exceed 200°C (390°F).
2. Install the ring gear when it is sufficiently heated.
The ring gear must be installed with the chamfer facing the clutch.

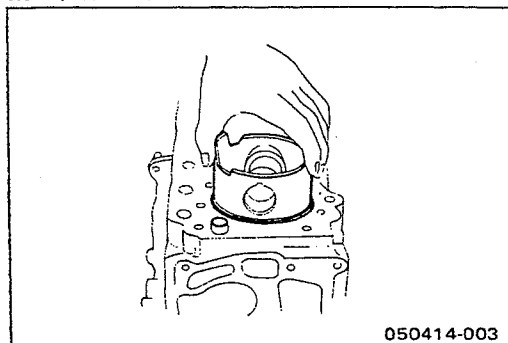


PISTON

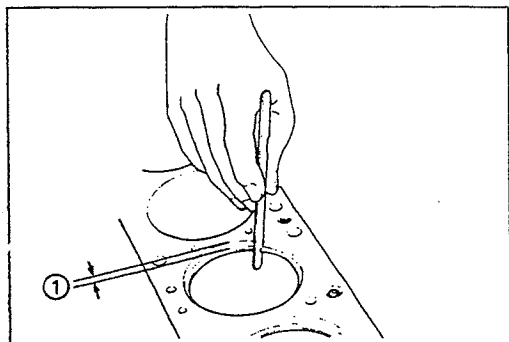
Piston Grade Selection and Cylinder Bore Measurement

Refer to the Section "CYLINDER BODY", Item "Cylinder Liner Bore Measurement" for details on piston grade selection and cylinder liner bore measurement.

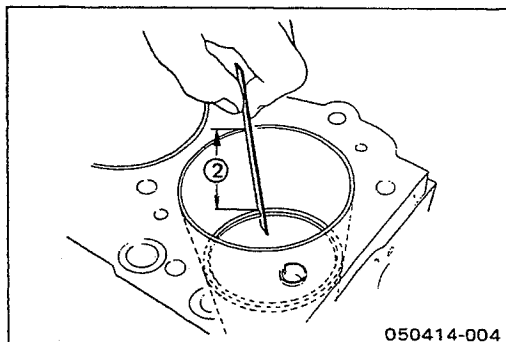
050414, 0504140101A



0504140101B



05041401C



PISTON RING

Piston Ring Gap

1. Insert the piston ring horizontally (in the position it would assume if it were installed to the piston) into the cylinder liner.

2. Push the piston ring into the cylinder bore until it reaches the measuring point ① where the cylinder liner bore is the smallest.

Do not allow the piston ring to slant to one side or the other. It must be perfectly horizontal.

Measuring Point ① 10 mm (0.39 in)

or

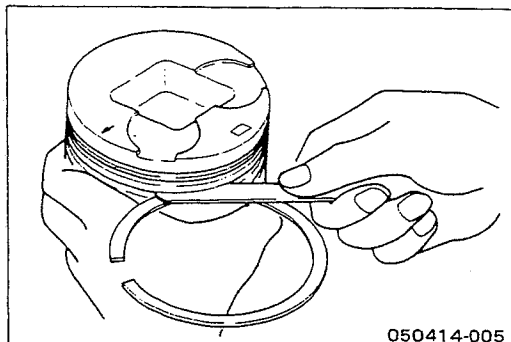
Measuring Point ② 120 mm (4.72 in)



3. Use a feeler gauge to measure the piston ring gap.
If the measured value exceeds the specified limit, the piston ring must be replaced.

Piston Ring Gap		mm(in)
	Standard	Limit
1st Compression Ring	0.2 – 0.4 (0.008 – 0.016)	1.5 (0.059)
2nd Compression Ring		
Oil Ring	0.1 – 0.3 (0.004 – 0.012)	

0504140201



050414-005



Piston Ring and Piston Ring Groove Clearance

Use a feeler gauge to measure the clearance between the piston ring and the piston ring groove at several points around the piston.

If the clearance between the piston ring and the piston ring groove exceeds the specified limit, the piston ring must be replaced.

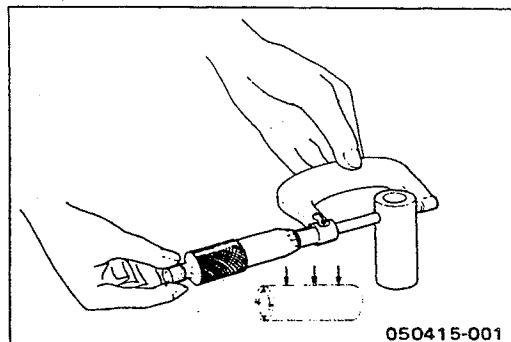
Piston Ring and Piston Ring Groove Clearance

		mm(in)
	Standard	Limit
1st Compression Ring	0.09—0.125 (0.0035—0.0049)	0.150 (0.006)
2nd Compression Ring	0.05—0.075 (0.002—0.003)	
Oil Ring	0.03—0.070 (0.0012—0.0028)	

4. Visually inspect the piston rings.

If a piston ring groove is damaged or distorted, the piston must be replaced.

050415, 05041501



050415-001



PISTON PIN

Piston Pin Diameter

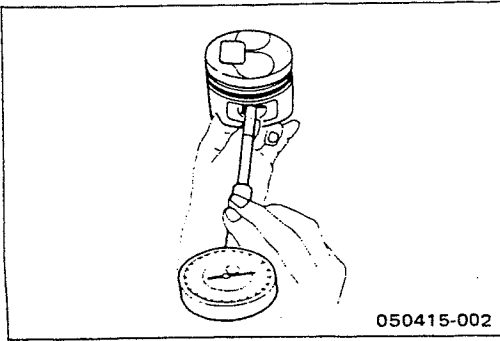
Use a micrometer to measure the piston pin diameter at several points.

If the measured value is less than the specified limit, the piston pin must be replaced.

Piston Pin Diameter

		mm(in)
	Standard	Limit
All 4JA1, 4JB1, and —'88 4JB1T	30.995 — 31.000 (1.2202 — 1.2204)	30.97 (1.219)
'89— 4JB1T and 4JB1TC	33.994 — 34.000 (1.3383 — 1.3386)	33.97 (1.337)

05041502A



050415-002



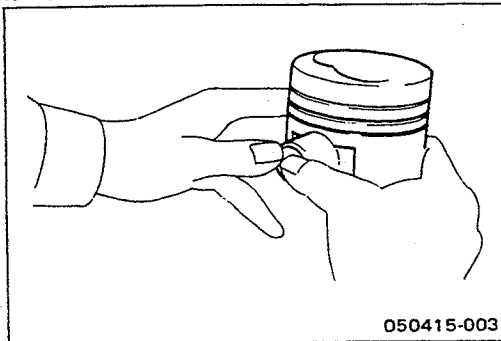
Piston Pin and Piston Clearance

Use an inside dial indicator to measure the piston pin hole (in the piston).

Piston Pin Hole	mm(in)
	Standard
All 4JA1, 4JB1, and —'88 4JB1T	31.002 — 31.010 (1.2206 — 1.2208)
'89— 4JB1T and 4JB1TC	34.002 — 34.010 (1.3387 — 1.3390) (1.3383 — 1.3386)

Piston Pin Clearance	mm(in)
	Standard
All Engine	0.002 — 0.015 (0.00008 — 0.0006)

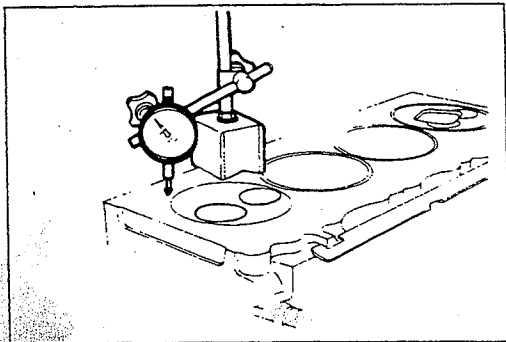
05041502B



050415-003

If an inside dial indicator is not available, use the following procedure.

1. Insert the piston pin into the piston.
Both the piston and the piston pin must be at room temperature.
2. Use your hand to forcefully push the piston pin in all directions.
You should feel a firm resistance to any movement.
If the piston pin moves loosely, both the piston and or the piston pin must be replaced.

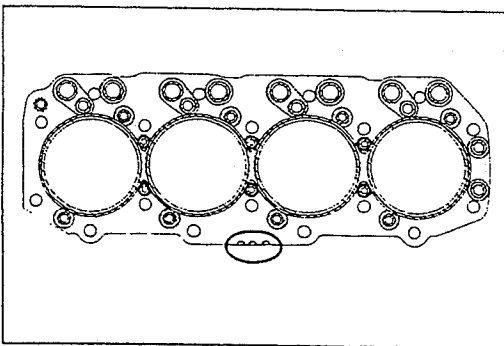
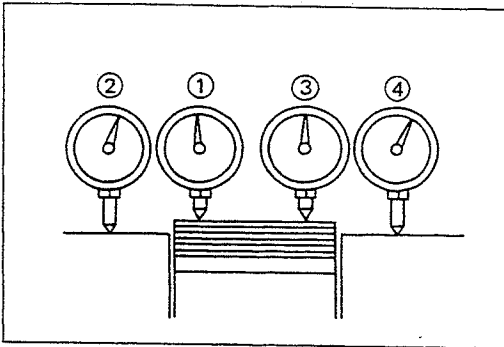
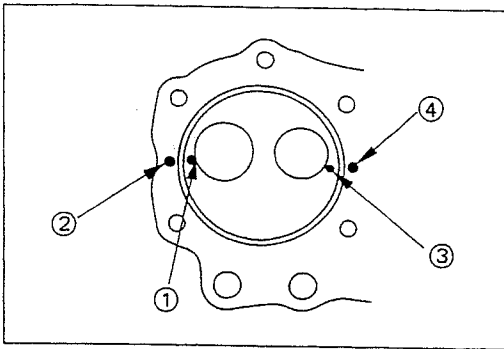


CYLINDER HEAD GASKET SELECTION (ALL 4JB1)

Cylinder head gasket is determined by the piston head projection from the cylinder body upper surface, in order to improve engine performance.

Three types of gasket are provided by the difference of thickness. Select the adequate one out of three grades of gasket, according to the following procedure.

Before measurement, clear off carbon from the piston head and cylinder body surface and also clean the place where a gasket was installed.



Piston Head Projection Measurement Point

1. Use a dial indicator to measure the piston projection amount.
2. Refer to the illustration for the piston head projection measuring positions.

All measuring positions should be as close as possible to the cylinder liner.



3. Measure the points ① ② ③ ④ and obtain two differences ①-② and ③-④ on each cylinder. Calculate the average value of the piston head projection on each cylinder.
4. Obtain the maximum value in the four cylinders.
5. Determine the gasket grade required to the maximum value described above in accordance with the following table.

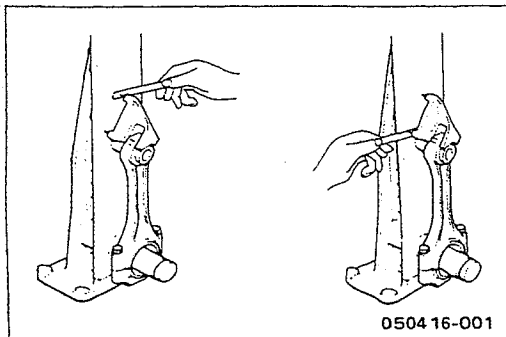
Cylinder Head Gasket Thickness mm(in)

Gasket Grade Mark	Piston Projection	Gasket Thickness (Reference)
①	0.758—0.813 (0.030—0.032)	1.50 (0.0591)
②	0.813—0.859 (0.032—0.034)	1.55 (0.0610)
③	0.859—0.914 (0.034—0.036)	1.60 (0.0630)

Note:

Difference of each piston projection and must be equal or within 0.1 mm (0.0039 in).

050416, 05041601



050416-001



CONNECTING ROD

Connecting Rod Alignment

Use a connecting rod aligner to measure the distortion and the parallelism between the connecting rod big end hole and the connecting rod small end hole.

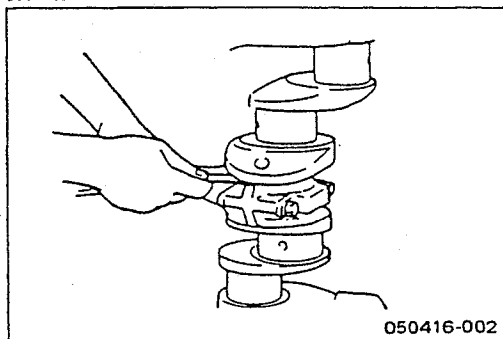
If either the measured distortion or parallelism exceed the specified limit, the connecting rod must be replaced.

Connecting Rod Alignment

Per Length of 100 mm (3.94 in) mm(in)

	Standard	Limit
Distortion	0.08 or Less (0.003)	0.20 (0.008)
Parallelism	0.05 or Less (0.002)	0.15 (0.006)

05041602



050416-002



Connecting Rod Side Face Clearance

1. Install the connecting rod to the crankpin.
2. Use a feeler gauge to measure the clearance between the connecting rod big end side face and the crankpin side face.

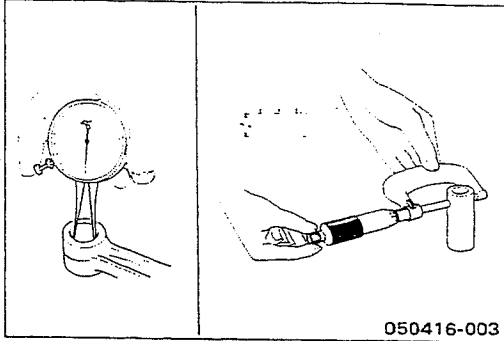
If the measured value exceeds the specified limit, the connecting rod must be replaced.

Connecting Rod Big End and Crankpin Side Face Clearance

mm(in)

Standard	Limit
0.23 (0.009)	0.35 (0.014)

05041603



050416-003



Piston Pin and Connecting Rod Small End Bushing Clearance

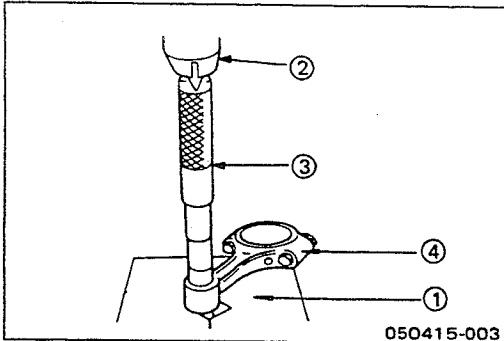
Use a caliper calibrator and a dial indicator to measure the piston pin and connecting rod small end bushing clearance.

If the clearance between the piston pin and the connecting rod small end bushing exceeds the specified limit, replace the piston pin and/or the connecting rod bushing.

Piston Pin and Connecting Rod Small End Bushing Clearance

mm(in)	
Standard	Limit
0.008 — 0.020 (0.0003 — 0.0008)	0.050 (0.002)

05041604, 050416040101A



050415-003



Connecting Rod Bushing Replacement

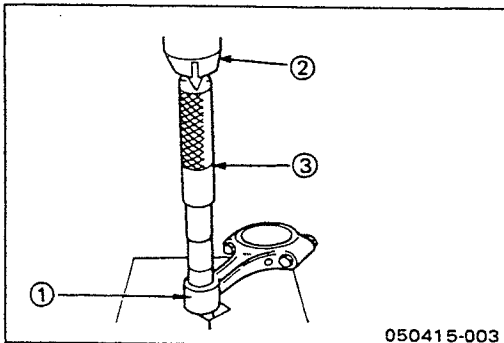
Connecting Rod Bushing Removal

1. Set the connecting rod small end to the bench press V-block ①.
2. Use the bench press ② and the bar ③ to slowly force the bushing from the connecting rod ④.

Note:

Take care not to damage the connecting rod with the bar when removing the bushing.

01018



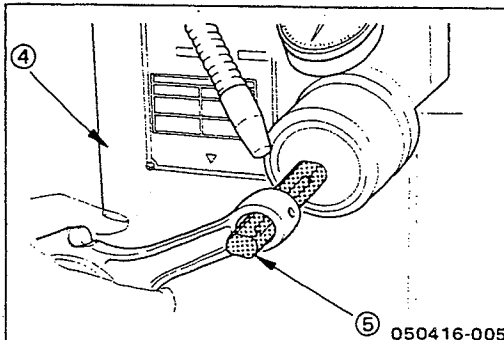
050415-003



Connecting Rod Bushing Installation

1. Set the connecting rod small end ① to the bench press V-block.
The connecting rod must be perfectly horizontal.
2. Use the bench press ② and the bar ③ to slowly force the bushing with oil hole into position.

01018

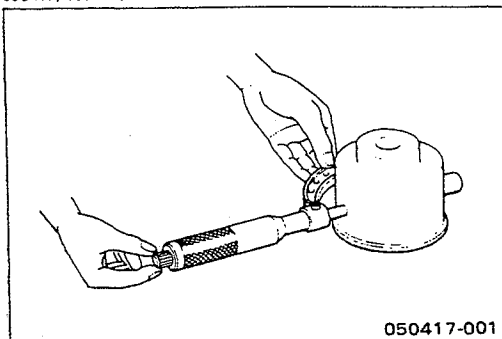


050416-005



3. Use a pin hole grinder ④ fitted with a reamer ⑤ to ream the piston pin hole.

050417, 05041701



050417-001



IDLER GEAR SHAFT AND IDLER GEAR (TIMING GEAR DRIVE)

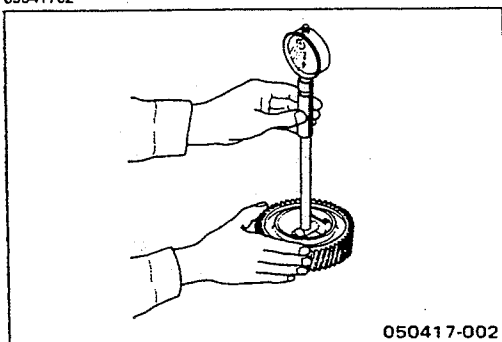
Idler Gear Shaft Outside Diameter

Use a micrometer to measure the idler gear shaft outside diameter.

If the measured value is less than the specified limit, the idler gear must be replaced.

Idler Gear Shaft Outside Diameter		mm(in)
Standard	Limit	
44.945 — 44.975 (1.769 — 1.770)	44.845 (1.766)	

05041702



050417-002



Idler Gear "A" Inside Diameter

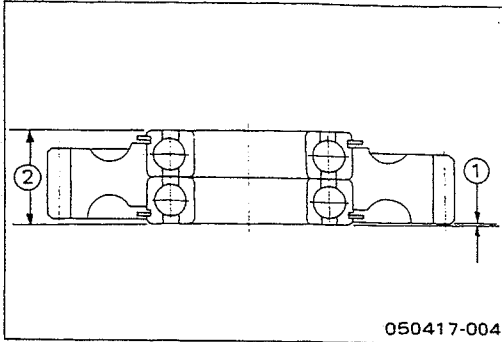
1. Use an inside dial indicator or an inside micrometer to measure the idler gear inside diameter.

Idler Gear Inside Diameter		mm(in)
Standard	Limit	
45.0 — 45.03 (1.7717 — 1.7718)	45.10 (1.7756)	

If the clearance between the idler gear shaft outside diameter and the idler gear inside diameter exceeds the limit, the idler gear must be replaced.

Idler Gear Shaft and Idler Gear Clearance		mm(in)
Standard	Limit	
0.025 — 0.085 (0.0010 — 0.0033)	0.200 (0.008)	

05041703



050417-004

**Idler Gear "B"****Bearing Replacement****Bearing Removal**

Use a bench press or a hammer and a bar to remove the bearing from the idler gear.

Bearing Installation

Use a bench press and bar to install the bearing into the idler gear.

Bearing Projection and Height

mm(in)

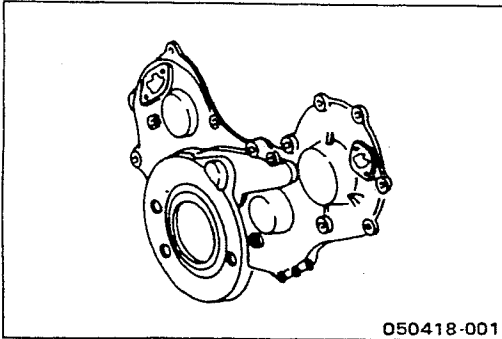
Projection①	0.4 – 0.6 (0.016 – 0.024)
Height ②	23.7 – 24.0 (0.933 – 0.945)

Note:

The bench press and bar should make contact only with the bearing outer races. Do not allow them to make contact with the bearing inner races.

Bearing damage and reduced bearing service life will result.

050418



050418-001

05041801, 050418010101

**TIMING GEAR CASE COVER
(TIMING GEAR DRIVE)**

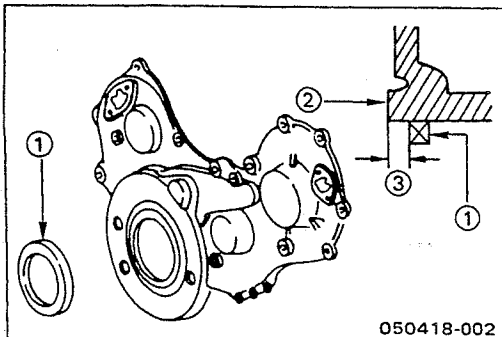
Replace the crankshaft front oil seal if it is excessively worn or damaged.

**Crankshaft Front Oil Seal Replacement****Oil Seal Removal**

Use a plastic hammer and a screwdriver to tap around the oil seal to free it from the gear case cover.

Take care not to damage the oil seal fitting surfaces.

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050418-002

**Oil Seal Installation**

Use the installer to install the front oil seal ① to the gear case cover ②.



Oil Seal Installer: 5-8840-2061-0

Note the oil seal installation depth ③ shown in the illustration.

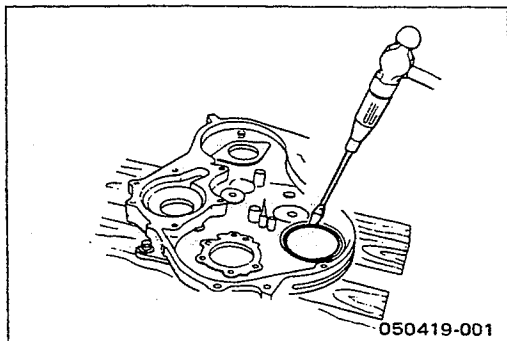
Depth ③ = 1 mm (0.039 in.)

TIMING PULLEY HOUSING (TIMING BELT DRIVE)

Replace the crankshaft front oil seal if it is worn or damaged.

Take care not to damage the oil seal fitting surfaces.

05041901, 050419010101



050419-001



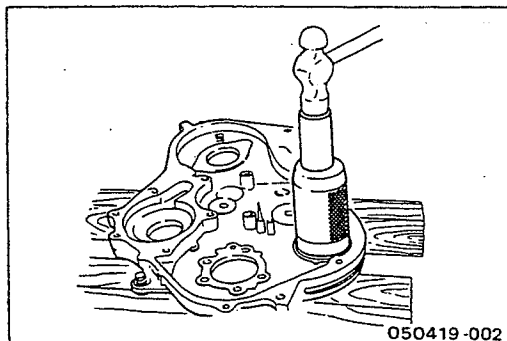
Crankshaft Front Oil Seal Replacement

Oil Seal Removal

1. Place two flat pieces of wood beneath the timing pulley housing.
Leave an open space beneath the oil seal.
2. Use a plastic hammer and a screwdriver to drive the oil seal out from the front side (lower side in the illustration) of the timing pulley housing.



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050419-002



Oil Seal Installation

1. Use an oil seal installer to install the oil seal to the timing pulley housing.
The oil seal must be flush with the pulley housing.
Oil Seal Installer: 5-8840-2036-0
Grip: 9-8522-1608-0
2. Apply engine oil to the oil seal lip.





INTERNAL PARTS

This diagram illustrates the assembly of a rear suspension component, likely a rear axle or shock absorber. The components are numbered as follows:

- 1**: A long, threaded rod or axle shaft.
- 2**: A small, curved metal bracket or clip.
- 3**: A small, curved metal bracket or clip, similar to 2.
- 4**: A small, curved metal bracket or clip, similar to 2 and 3.
- 5**: A small, curved metal bracket or clip, similar to 2, 3, and 4.
- 6**: A small, curved metal bracket or clip, similar to 2, 3, 4, and 5.
- 7**: A small, curved metal bracket or clip, similar to 2, 3, 4, 5, and 6.

The diagram shows the assembly of these components onto a central rod (1). The components are arranged in a line, with the rod passing through them. The components are shown in an exploded view, indicating their relative positions and the order of assembly.

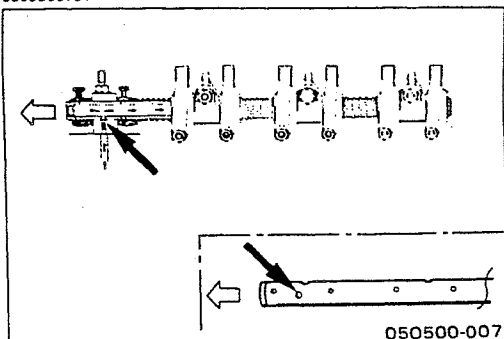
050500018

▲ 1. Rocker arm shaft
2. Rocker arm shaft snap ring
3. Rocker arm
4. Rocker arm shaft bracket
5. Rocker arm
6. Rocker arm shaft spring
7. Rocker arm shaft snap ring

05050001



0505000101

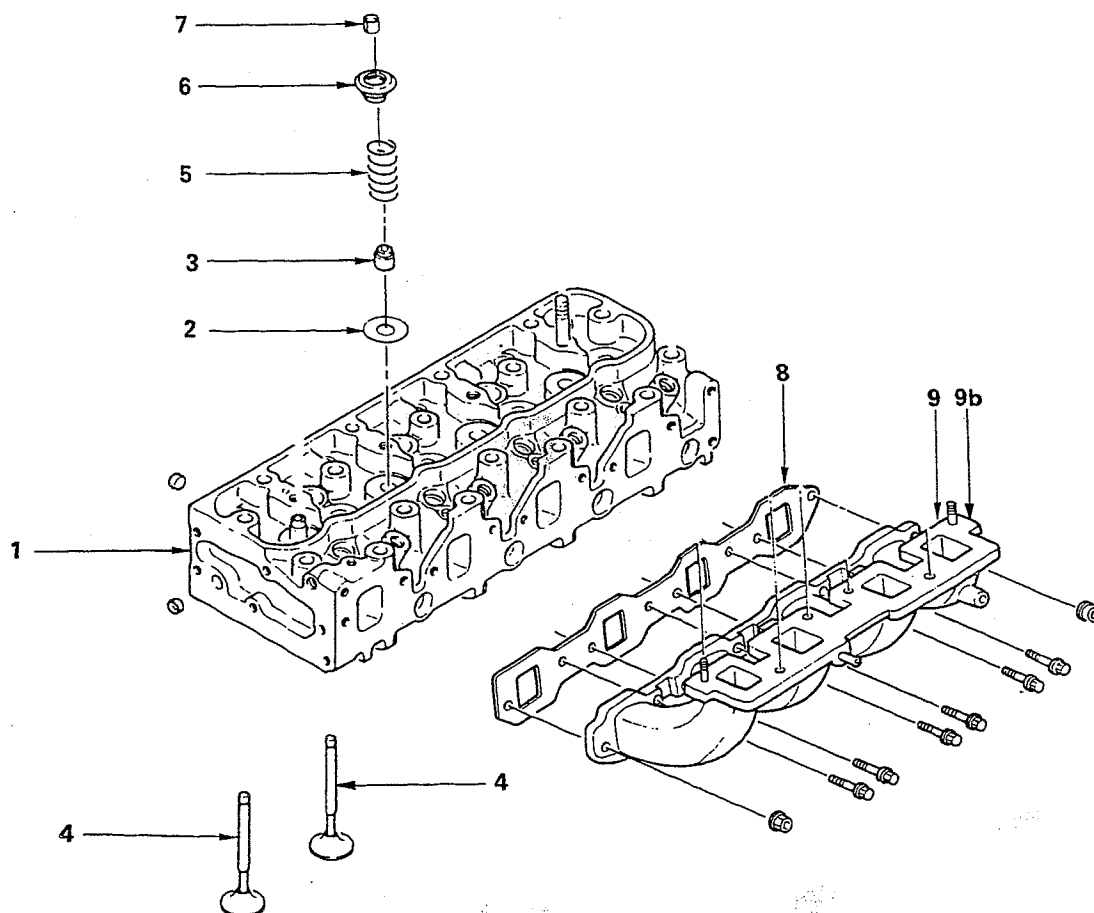


- 1) Position the rocker arm shaft with the large oil hole (4φ) facing the front of the engine.
- 2) Install the rocker arm shaft together with the rocker arm, the rocker arm shaft bracket, and the spring.



CYLINDER HEAD

This illustration is based on the 4JB1T engine.



050501B

Reassembly Steps

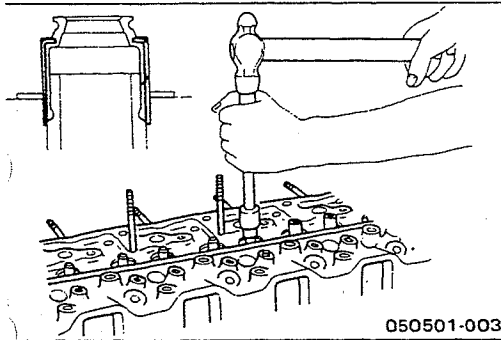
- | | |
|-------------------------------|-------------------------------------|
| 1. Cylinder head | 6. Valve spring upper seat |
| 2. Valve spring lower seat | ▲ 7. Split collar |
| ▲ 3. Valve stem oil seal | ▲ 8. Intake manifold gasket |
| ▲ 4. Intake and exhaust valve | ▲ 9. Lower intake manifold (4JB1T) |
| ▲ 5. Valve spring | ▲ 9a Intake manifold (Except 4JB1T) |

5050101



Important Operations

505010101



505010102



▲ Valve Stem Oil Seal

- 1) Apply a coat of engine oil to the oil seal inner face.
- 2) Use an oil seal installer to install the oil seal to the valve guide.

Oil Seal Installer: 5-8840-2033-0

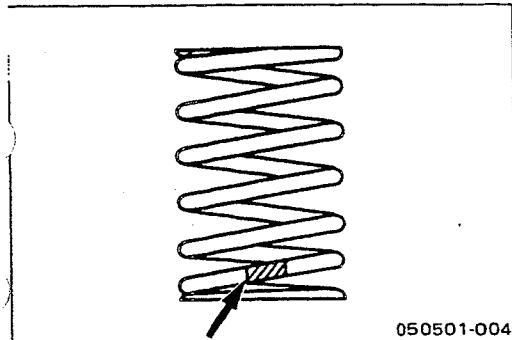


▲ Intake and Exhaust Valve

- 1) Apply a coat of engine oil to each valve stem before installation.
- 2) Install the intake and exhaust valves.
- 3) Turn the cylinder head up to install the valve springs.

Take care not to allow the installed valves to fall free.

0505010103

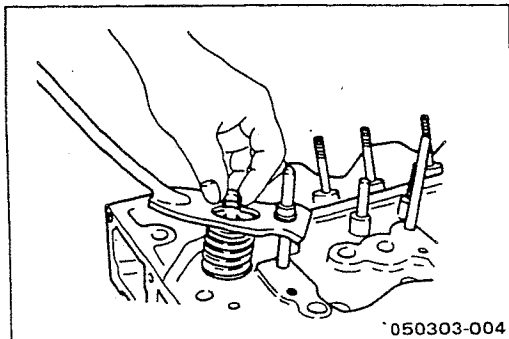


▲ Valve Spring

Install the inner and outer valve springs with their fine pitched end (painted) facing down. (For 4JA1)

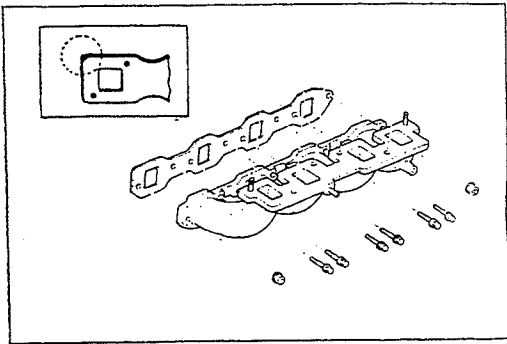
Install the valve springs with their fine pitched end (Painted) facing down. (For 4JB1)

0505010104



▲ Split Collar

- 1) Use the spring compressor to compress the valve spring into position.
Spring Compressor: 9-8523-1423-0 (J-29760)
- 2) Install the split collars to the valve stem.
- 3) Set the split collars by tapping around the head of the collar with a rubber hammer.



▲ Intake Manifold Gasket

▲ Lower Intake Manifold (4JB1T)



▲ Intake Manifold (Except 4JB1T)

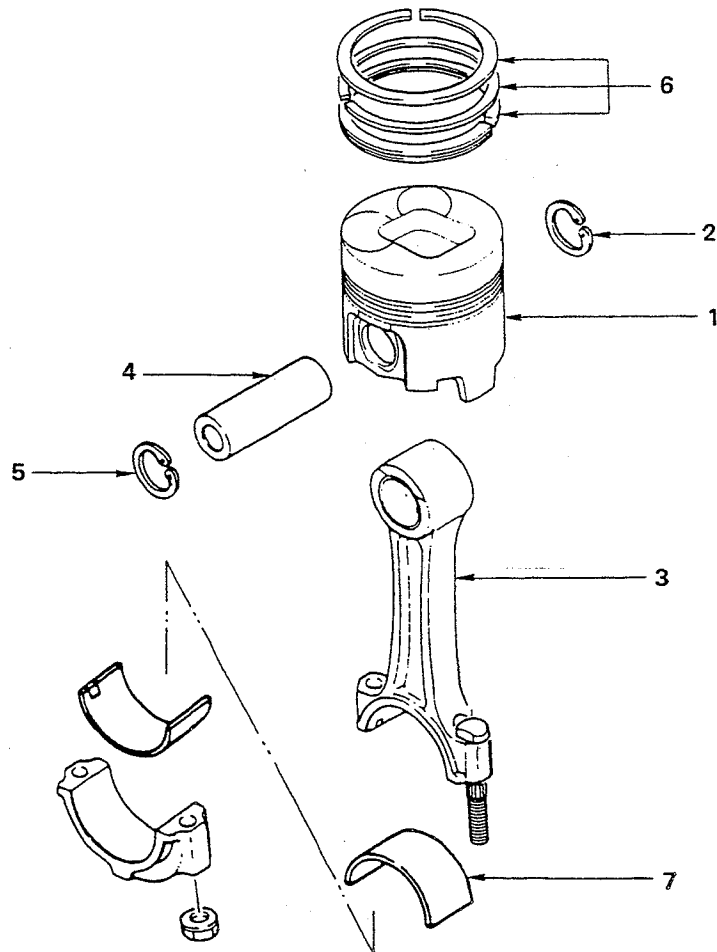
- 1) Install the manifold gasket with the end having the sharp corners facing the front of the engine.
- 2) Install the lower intake manifold to the cylinder head.
- 3) Tighten the manifold bolts to the specified torque.

Manifold Bolt Torque	kg·m(lb.ft/N·m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	

050502A



PISTON AND CONNECTING ROD



050502-007

050502B

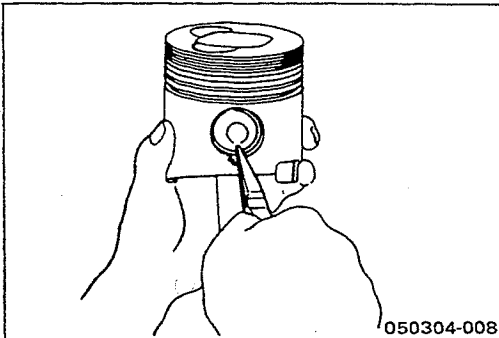
Reassembly Steps

- ▲ 1. Piston
- ▲ 2. Piston pin snap ring
- ▲ 3. Connecting rod
- ▲ 4. Piston pin
- ▲ 5. Piston pin snap ring
- ▲ 6. Piston ring
- ▲ 7. Connecting rod bearing



Important Operations

0505020101A



050304-008



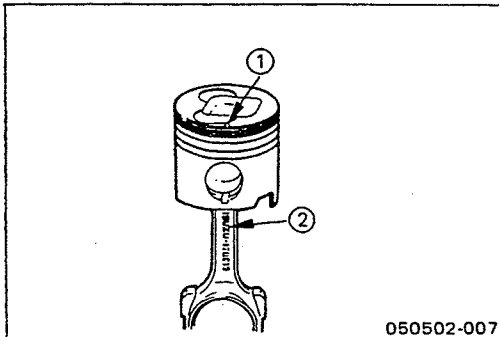
▲ Piston

▲ Piston Pin Snap Ring

▲ Connecting Rod

- 1) Clamp the connecting rod in a vise.
Take care not to damage the connecting rod.
- 2) Use a pair of pliers to install the piston pin snap ring to the piston.

0505020101B

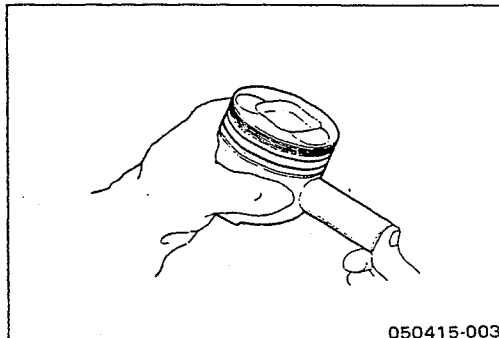


050502-007



Install the piston to the connecting rod so that the piston head front mark ① and the connecting rod "ISUZU" casting mark ② are facing in the same direction.

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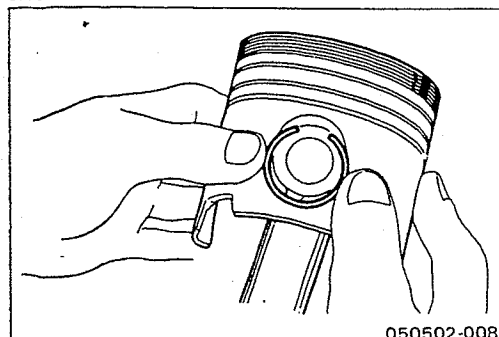
050415-003



▲ Piston Pin

- 1) Apply a coat of engine oil to the piston pin and the piston pin hole.
- 2) Use your fingers to force the piston pin into the piston until it makes contact with the snap ring.

050502010201B

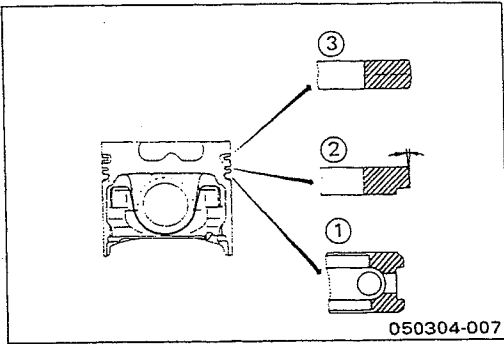


050502-008

▲ Piston Pin Snap Ring

- 1) Use your fingers to force the piston pin snap ring into the piston snap ring groove.
- 2) Check that the connecting rod moves smoothly on the piston pin.

0505020103A, 0505020103B



▲ Piston Ring

- 1) Use a piston ring replacer to install the three piston rings.

Piston Ring Replacer

Install the piston rings in the order shown in the illustration.

- ① Oil ring
- ② 2nd compression ring
- ③ 1st compression ring

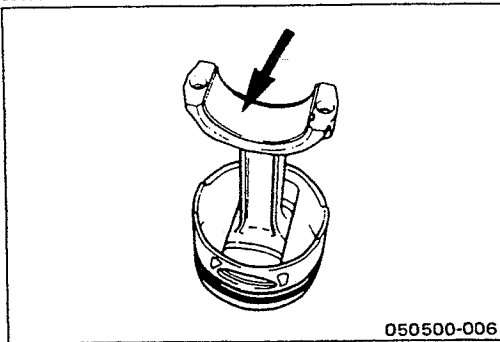
Note:

Install the compression rings with the stamped side facing up.

Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.

- 2) Apply engine oil to the piston ring surfaces.
- 3) Check that the piston rings rotate smoothly in the piston ring grooves.

0505020104



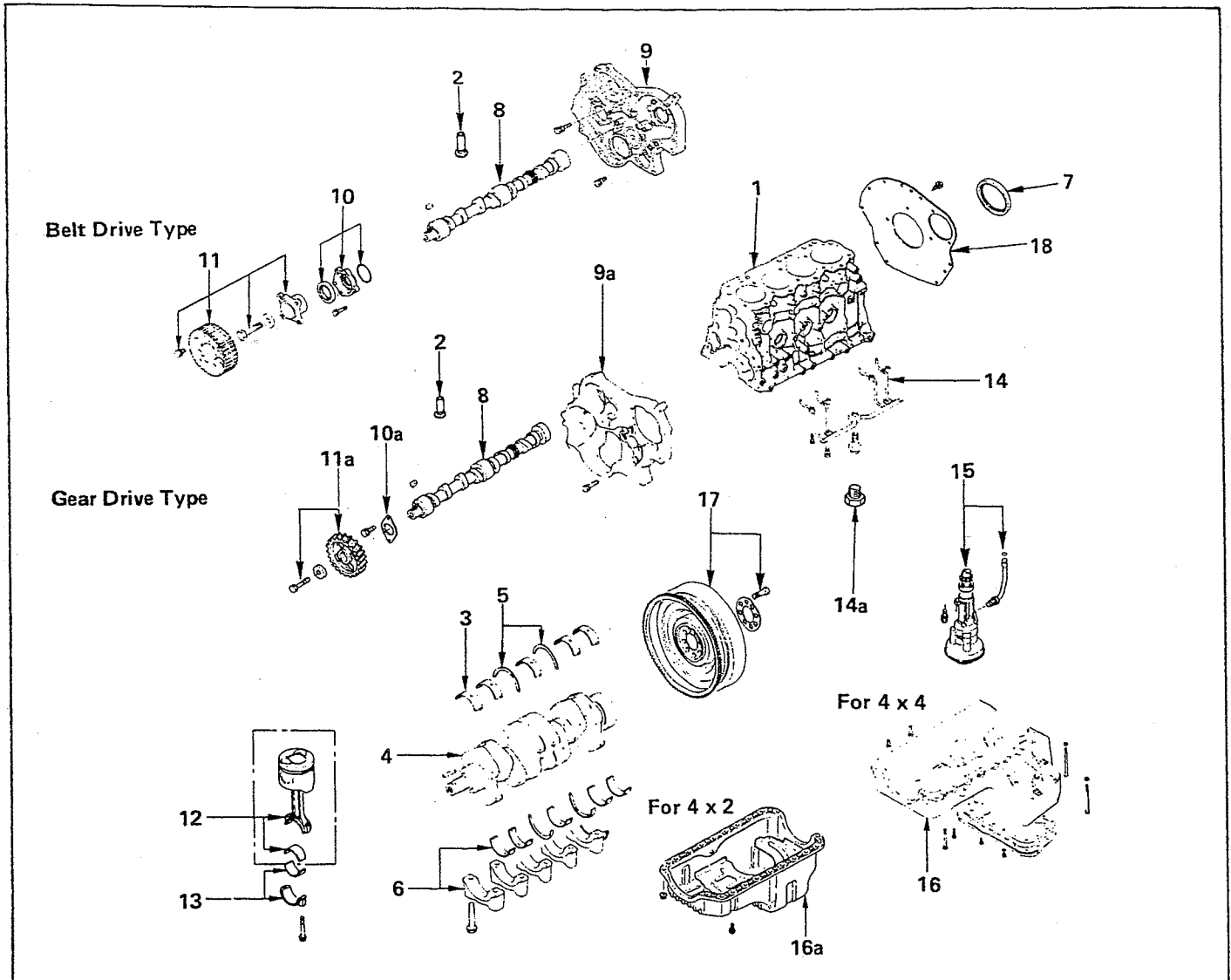
▲ Connecting Rod Bearing

Carefully wipe any oil or other foreign material from the connecting rod bearing back face and the connecting rod bearing fitting surface.



INTERNAL PARTS

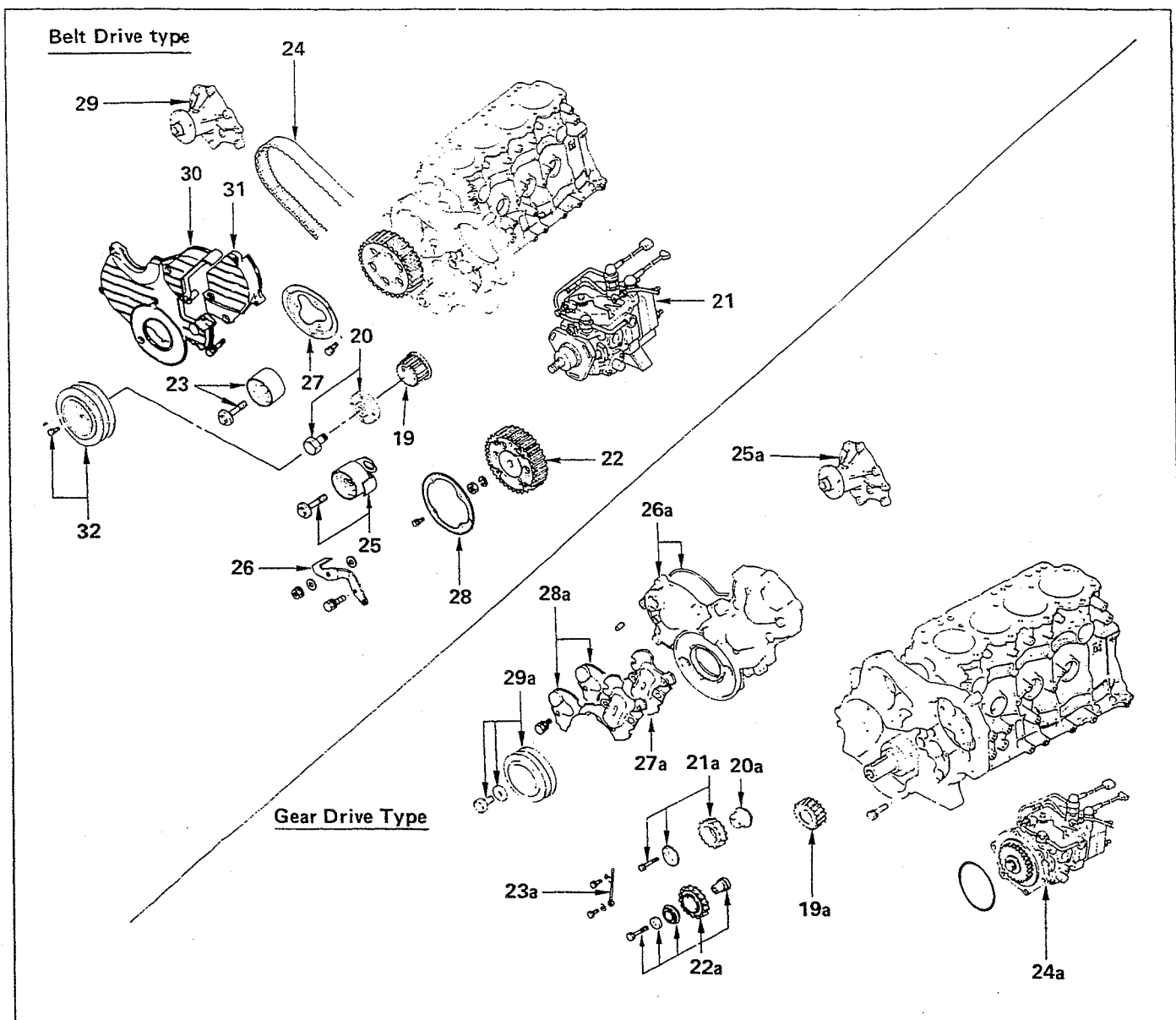
MAJOR COMPONENTS



Reassembly Steps-1

- ▲ 1. Cylinder body
- ▲ 2. Tappet
- ▲ 3. Crankshaft upper bearing
- ▲ 4. Crankshaft
- ▲ 5. Crankshaft thrust bearing
- ▲ 6. Crankshaft bearing cap with lower bearing
- ▲ 7. Crankshaft rear oil seal
- ▲ 8. Camshaft
- ▲ 9. Timing pulley housing (For belt drive)
- ▲ 9a Timing gear case (For gear drive)
- ▲ 10. Oil seal retainer (For belt drive)
- ▲ 10a Camshaft thrust plate (For gear drive)
- ▲ 11. Camshaft timing pulley (For belt drive)
- ▲ 11a Camshaft timing gear (For gear drive)
- ▲ 12. Piston and connecting rod with upper bearing
- ▲ 13. Connecting rod bearing cap with lower bearing
- ▲ 14. Piston cooling oil pipe
- ▲ 14a Oil jet plug (For 4JB1)
- ▲ 15. Oil pump with oil pipe
- ▲ 16. Oil pan (For 4JB1)
- ▲ 16a Oil pan (For 4JA1)
- ▲ 17. Flywheel
- ▲ 18. Cylinder body rear plate

Inverted Engine



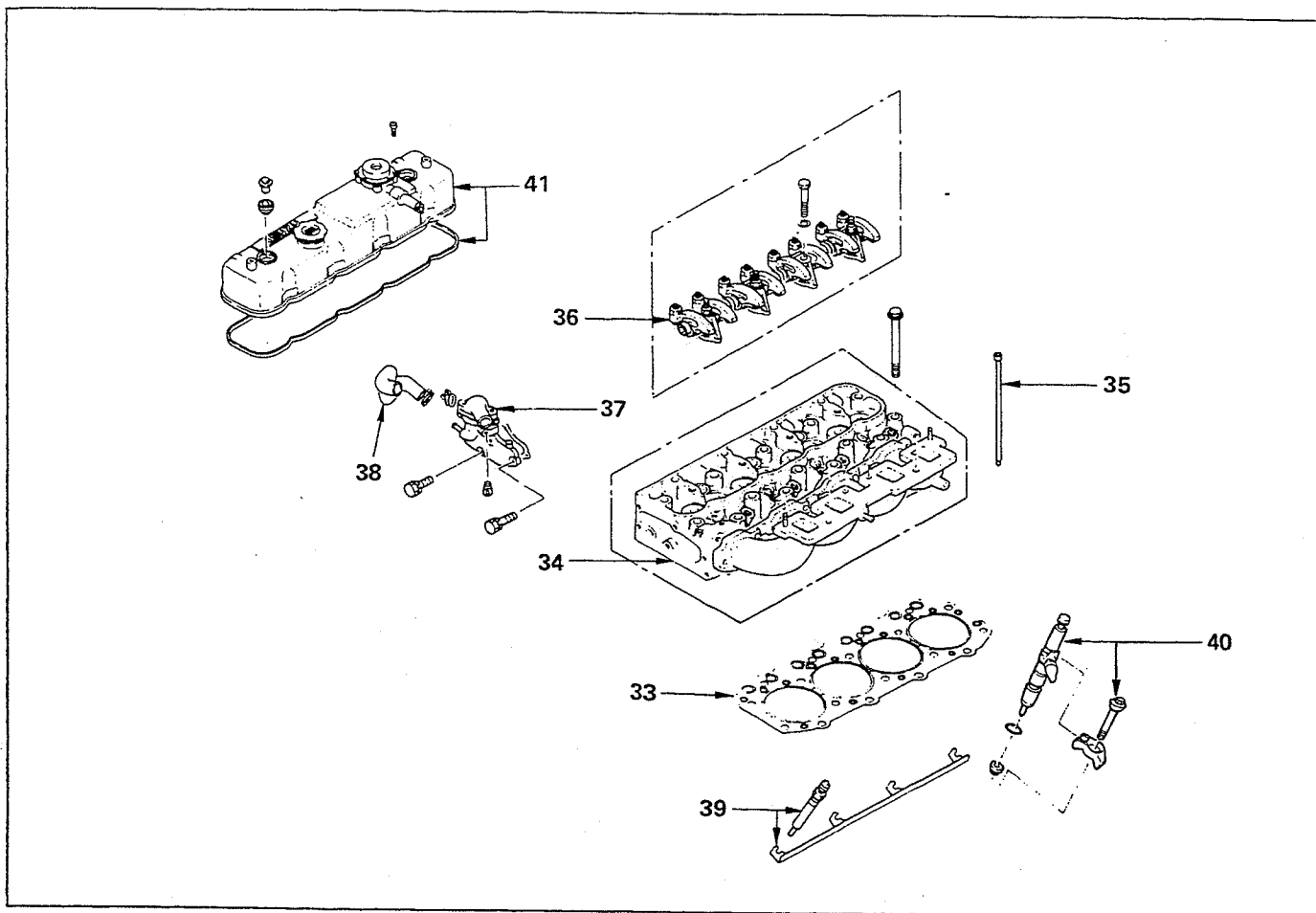
Reassembly Steps-2

Belt Drive Type

- ▲ 19. Crankshaft timing pulley
- ▲ 20. Crankshaft timing pulley center
- ▲ 21. Injection pump
- ▲ 22. Injection pump timing pulley
- ▲ 23. Tension idler
- ▲ 24. Timing belt
- ▲ 25. Timing belt tensioner
- ▲ 26. Timing belt tension adjusting lever
- ▲ 27. Camshaft timing pulley flange
- ▲ 28. Injection pump timing pulley flange
- ▲ 29. Water pump
- ▲ 30. Timing pulley housing lower cover
- ▲ 31. Timing pulley housing upper cover
- ▲ 32. Crankshaft damper pulley

Gear Drive Type

- ▲ 19a Crankshaft timing gear
- ▲ 20a Idler gear shaft
- ▲ 21a Idler gear "A"
- ▲ 22a Idler gear "B" and shaft
- ▲ 23a Timing gear oil pump
- ▲ 24a Injection pump
- ▲ 25a Water pump
- ▲ 26a Timing gear case cover
- 27a Space rubber
- 28a Gear case cover upper cover and lower cover
- ▲ 29a Crankshaft damper pulley
- 30. —
- 31. —
- 32. —



Reassembly Steps-3

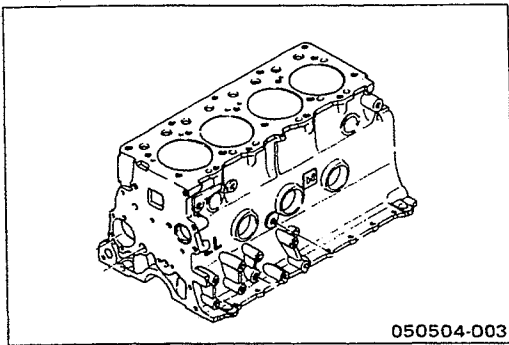
- | | |
|---|---|
| ▲ 33. Cylinder head gasket | 38. Water by-pass hose |
| ▲ 34. Cylinder head | ▲ 39. Glow plug and glow plug connector |
| 35. Push rod | ▲ 40. Injection nozzle holder |
| ▲ 36. Rocker arm shaft and rocker arm | ▲ 41. Cylinder head cover |
| ▲ 37. Thermostat housing with thermo switch | |

05050601



Important Operations

0505040101



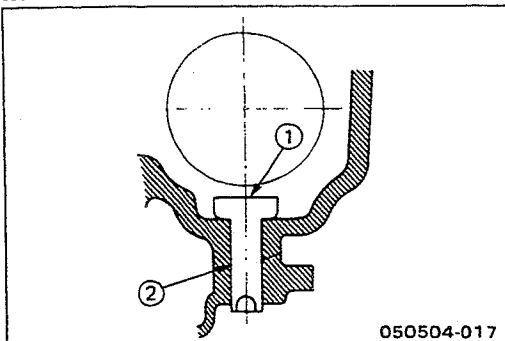
050504-003



▲ Cylinder Body

Use compressed air to thoroughly clean the inside and outside surfaces of the cylinder body, the oil holes, and the water jackets.

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050504-017



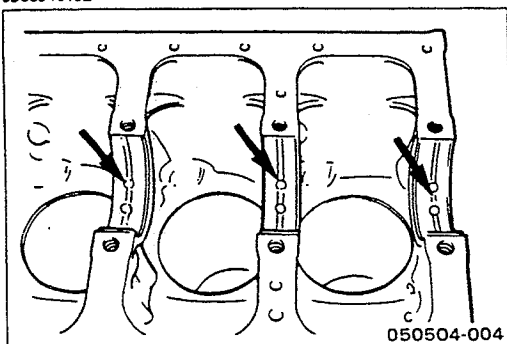
▲ Tappet

- 1) Apply a coat of engine oil to the tappet ① and the cylinder body tappet insert holes ②.
- 2) Locate the position mark applied at disassembly (if the tappet is to be reused).

Note:

The tappet must be installed before the camshaft.

0505040102



050504-004

▲ Crankshaft Upper Bearing

The crankshaft upper bearings have an oil hole and an oil groove. The lower bearings do not.

- 1) Carefully wipe any foreign material from the upper bearing.

Note:

Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surfaces.

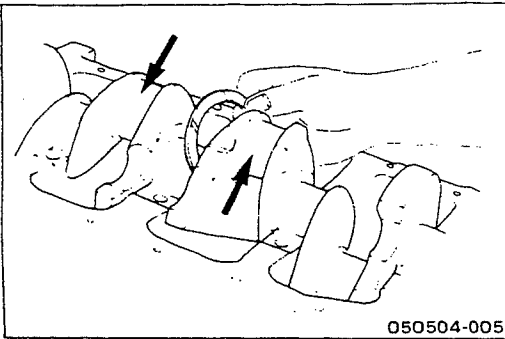
- 2) Locate the position mark applied at disassembly if the removed upper bearings are to be reused.

Note:

All 4JB1 engine (for UBS vehicles) bearings are selected according to cylinder body and crankshaft grade.

Refer to "INSPECTION AND REPAIR", "Crankshaft Bearing Selection".

0505060101



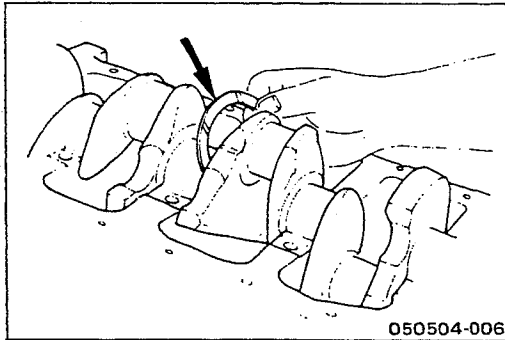
050504-005



▲ Crankshaft

Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft.

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050504-006



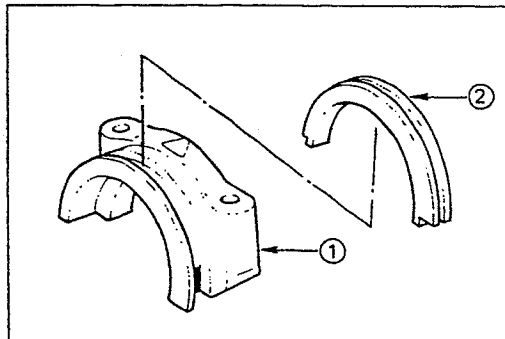
▲ Crankshaft Thrust Bearing

Apply an ample coat of engine oil to the thrust bearings before installation.



Install the thrust bearings to the crankshaft center journal.

The thrust bearing oil grooves must be facing the sliding faces.



▲ Crankshaft Bearing Cap with Lower Bearing

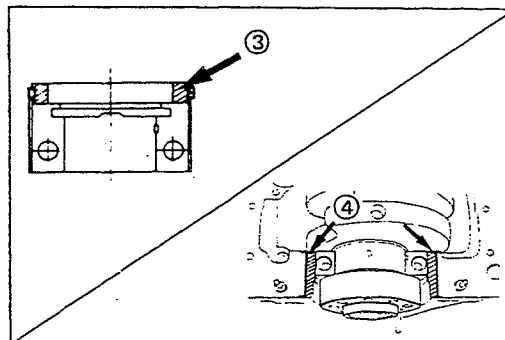
Install the selected bearing for all 4JB1 engines.

1) Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap ① as shown in the illustration.

2) Install the arch gasket ② to the No. 5 bearing cap.

Use your fingers to push the arch gasket into the bearing cap groove.

Take care not to scratch the arch gasket outer surface.

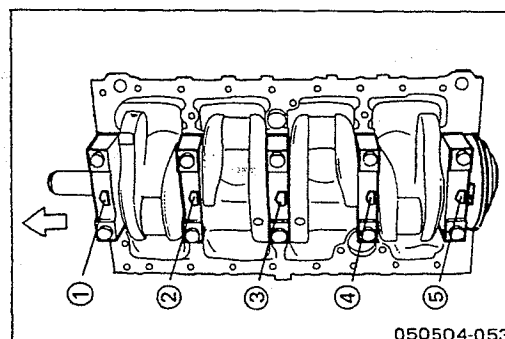


3) Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap cylinder body fitting surfaces at the points (③ and ④) shown in the illustration.

Note:

Be sure that the bearing cap fitting surface is completely free of oil before applying the liquid gasket.

Do not allow the liquid gasket to obstruct the cylinder thread holes and bearings.



050504-053



4) Install the bearing caps with the bearing cap head arrow mark facing the front of the engine.

The bearing cap numbers must be facing up.

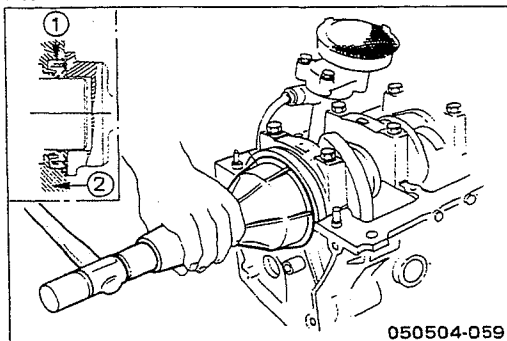


5) Apply engine oil to the crankshaft bearing cap bolts.

6) Temporarily tighten the bearing cap bolts.

The bolts will be tightened to the specified torque after the crankshaft rear oil seal is installed.

0505040106



050504-059



▲ Crankshaft Rear Oil Seal

- 1) Apply engine oil to the oil seal ① lip circumference and the oil seal inner circumference.
- 2) Use the oil seal installer to install the oil seal to the cylinder body ②.

There must be no step between the cylinder body and the oil seal.

Oil Seal Installer: 5-8840-0141-0



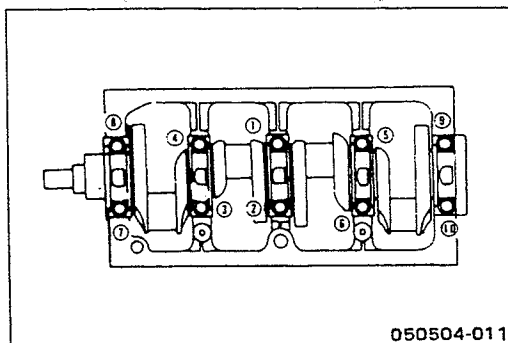
- 3) Tighten the crankshaft bearing cap bolts to the specified torque a little at a time in the sequence shown in the illustration.

Crankshaft Bearing Cap Torque kg·m(lb.ft/N·m)

17 ± 1 ($123.0 \pm 7.23/166.77 \pm 9.80$)

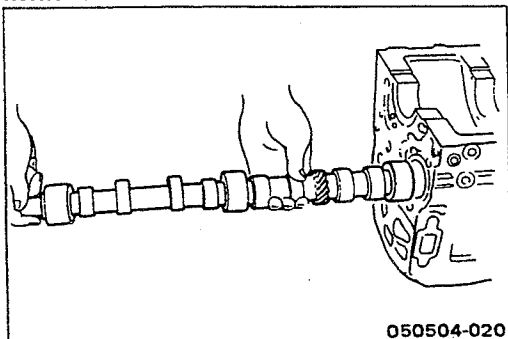


- 4) Check to see that the crankshaft turns smoothly by rotating it manually.



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050504-020



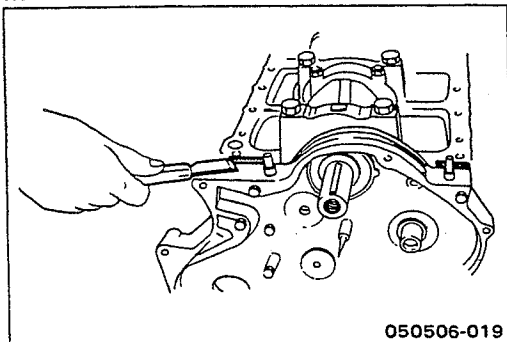
▲ Camshaft

- 1) Apply a coat of engine oil to the camshaft and the camshaft bearings.

Install the camshaft to the cylinder body.

Take care not to damage the camshaft bearings.

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050506-019



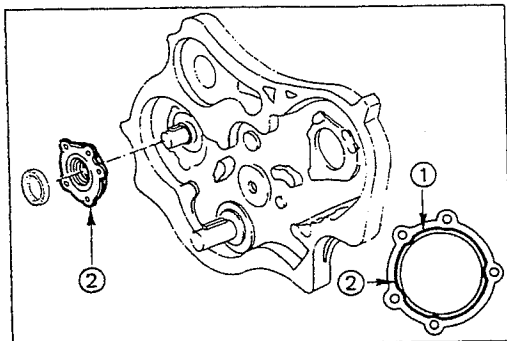
▲ Timing Pulley Housing (For Belt Drive)

- 1) Install the timing pulley housing to the cylinder body. Take care not to twist the front oil seal.
- 2) Tighten the timing pulley housing together with the timing pulley housing gasket to the specified torque.

Timing Pulley Housing Bolt Torque kg·m(lb.ft/N·m)

1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)

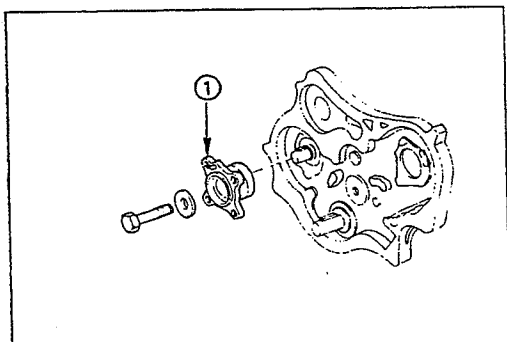
- 3) Cut away the flash from the gasket.



▲ Oil Seal Retainer (For Belt Drive)

- 1) Apply engine oil to the oil seal lip of the oil seal retainer.
- 2) Apply the recommended liquid gasket or its equivalent ① to the retainer ② at the position shown in the illustration.
Do not apply an excessive amount of liquid gasket.
- 3) Install the oil seal retainer ②.
- 4) Tighten the retainer bolts to the specified torque.

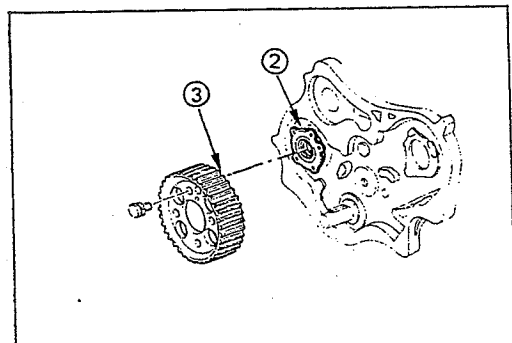
Oil Seal Retainer Bolt Torque	kg·m(lb.ft/N·m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	



▲ Camshaft Timing Pulley (For Belt Drive)

- 1) Align the timing pulley center ① with the camshaft key.
- 2) Tighten the timing pulley center bolts to the specified torque.
Prevent the camshaft from turning when tightening the timing center.

Timing Center Bolt Torque	kg·m(lb.ft/N·m)
6.5 ± 0.5 ($47.0 \pm 3.6/63.70 \pm 4.90$)	



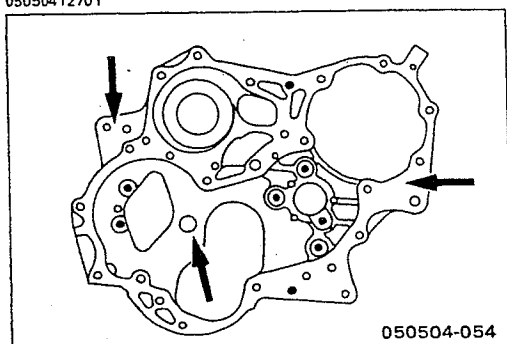
- 3) Align the timing pulley with the timing center knock pin ② and then install the timing pulley ③ to the center.

Install the stopper bolt to the camshaft timing pulley to prevent it from turning.

- 4) Tighten the timing pulley bolts to the specified torque.

Timing Pulley Bolt Torque	kg·m(lb.ft/N·m)
0.8 ± 0.2 ($5.8 \pm 1.4/7.84 \pm 1.96$)	

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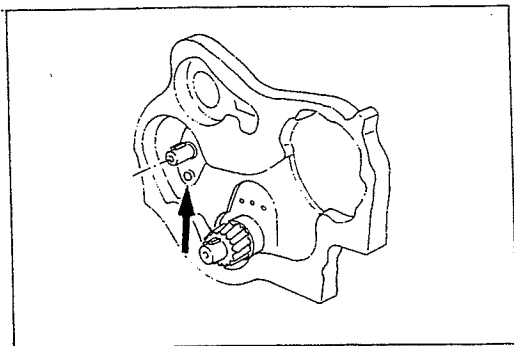
▲ Timing Gear Case (For Gear Drive)

- 1) Tighten the timing gear case with timing gear case gasket to the specified torque.

Timing Gear Case Bolt Torque	kg·m(lb.ft/N·m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.6 \pm 4.9$)	

- 2) Cut away the flash from the gasket.

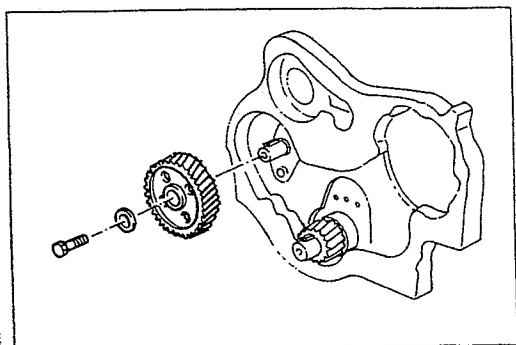
050504-054



▲ Camshaft Thrust Plate (For Gear Drive)

Install the thrust plate to the cylinder body and tighten the thrust plate bolts to specified torque.

Thrust Plate Bolt Torque	kg·m(lb.ft/N·m)
	1.8 ± 0.5 ($13.0 \pm 3.6/17.64 \pm 4.90$)



▲ Camshaft Timing Gear (For Gear Drive)

- 1) Install the camshaft timing gear to the camshaft.

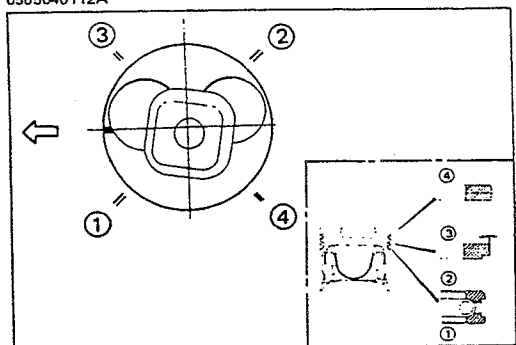
The timing gear mark ("Y - Y") must be facing outward.



- 2) Tighten the timing gear to the specified torque.

Timing Gear Bolt Torque	kg·m(lb.ft/N·m)
	6.5 ± 0.5 ($47.0 \pm 3.6/63.70 \pm 4.90$)

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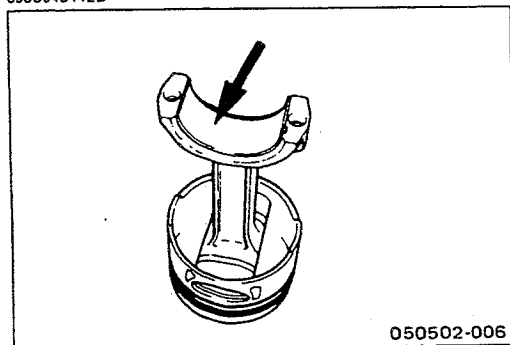
▲ Piston and Connecting Rod with Upper Bearing

▲ Connecting Rod Bearing Cap with Lower Bearing

- 1) Apply a coat of engine oil to the circumference of each piston ring and piston.
- 2) Position the piston ring gaps as shown in the illustration.

- ① Oil ring (Lower side)
- ② Oil ring (Upper side)
- ③ 2nd Compression ring
- ④ 1st Compression ring

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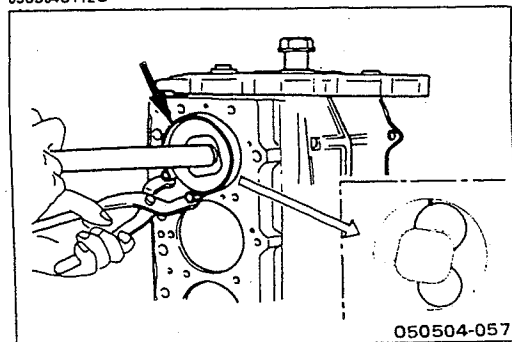
- 3) Apply a coat of molybdenum disulfide grease to the two piston skirts.

This will facilitate smooth break-in when the engine is first started after reassembly.



- 4) Apply a coat of engine oil to the upper bearing surfaces.
- 5) Apply a coat of engine oil to the cylinder wall.

0505040112C



- 6) Position the piston head front mark so that it is facing the front of the engine.

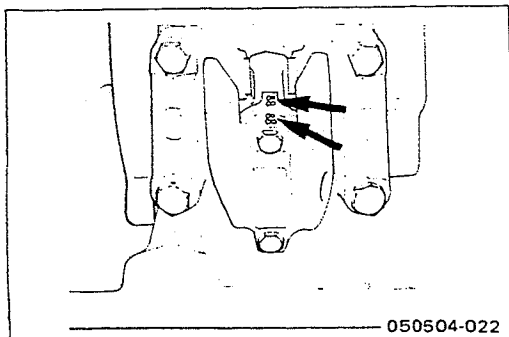


- 7) Use the piston ring compressor to compress the piston rings.

Piston Ring Compressor: 5-8840-9018-0 (J-8037)

- 8) Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.

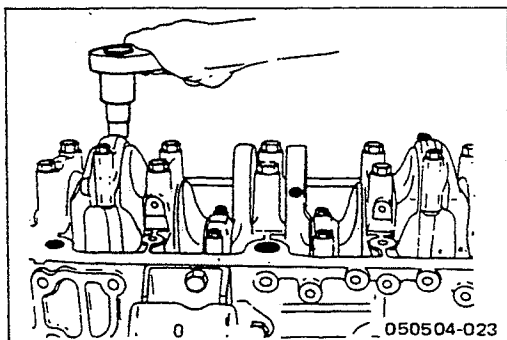
At the same time, rotate the crankshaft until the crankpin is at BDC.



- 9) Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.



The cylinder number marks must be turned toward the exhaust manifold.



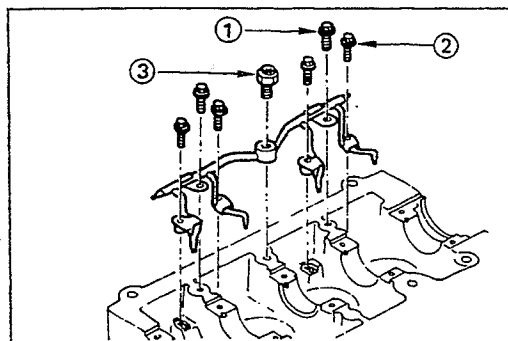
- 10) Apply a coat of engine oil to the threads and setting faces of each connecting rod cap bolt.



- 11) Tighten the connecting rod caps to the specified torque.

Connecting Rod Bearing Cap Bolt

Torque	kg·m(lb.ft/N·m)
	8.5 ± 0.5 ($61.5 \pm 3.6/83.30 \pm 4.90$)



▲ Piston Cooling Oil Pipe (Except 4JB1)

- 1) Install the piston cooling oil pipe to the cylinder body.
- 2) Tighten the oil pipe bolts and relief valve to the specified torque.

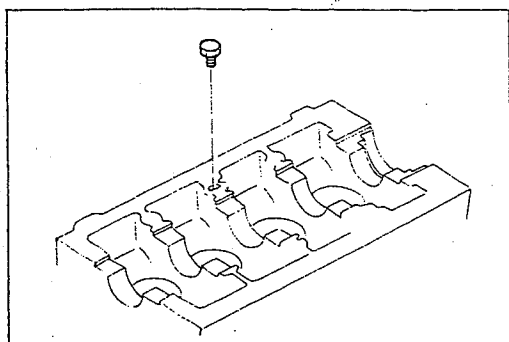
Oil Pipe Bolt Torque		kg · m(lb.ft/N · m)
① M8 × 1.25		1.9 ± 0.5 ($13.7 \pm 3.6/14.70 \pm 4.90$)
② M6 × 1.00		0.8 ± 0.2 ($5.1 \pm 1.4/7.84 \pm 1.96$)

Oil Pressure Regulating
Valve Torque

	kg·m(lb.ft/N·m)
③ M6 × 1.5	3.0 ± 0.5 ($21.7 \pm 3.6/29.40 \pm 4.90$)

Note:

Check that there is no interference between the piston and the oiling jet pipe by slowly rotating the crankshaft.



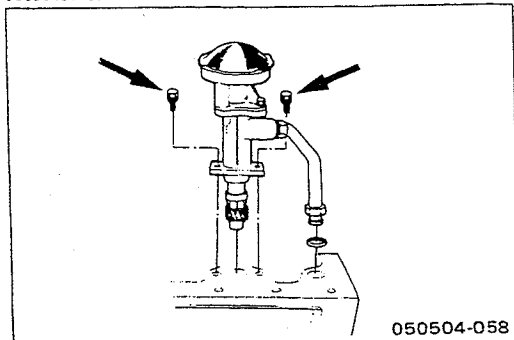
▲ Oil Jet Plug (For 4JB1)



- 1) Apply the recommended liquid gasket or its equivalent to the plug thread.
- 2) Tighten the oil jet plug to the specified torque.

Plug Torque	kg·m(lb.ft/N·m)
	5 ± 1 ($36.2 \pm 7.2/49.0 \pm 9.8$)

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▲ Oil Pump with Oil Pipe

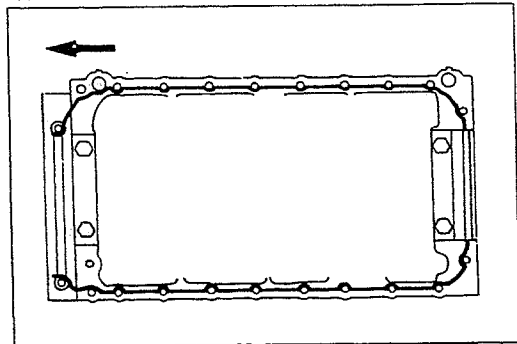
Install the oil pump with the oil pipe and tighten the bolts to the specified torque.

Oil Pump Bolt Torque	kg-m(lb.ft/N-m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	

Note:

Take care not to damage the O-rings when tightening the oil pipe bolts.

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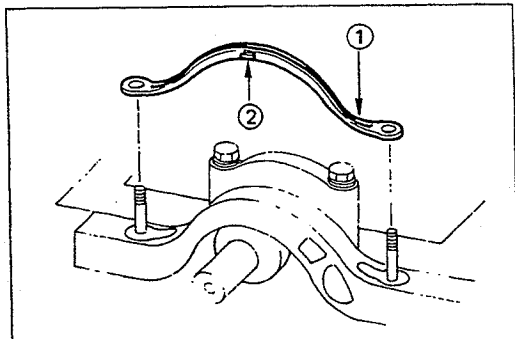
▲ Oil Pan

- 1) Apply the recommended liquid gasket or its equivalent to the cylinder body fitting faces and the No. 1 and No. 5 bearing cap arch gaskets at the positions shown in the illustration.
- 2) Apply the recommended liquid gasket or its equivalent to the cylinder body lower surface circumference shown in the illustration.

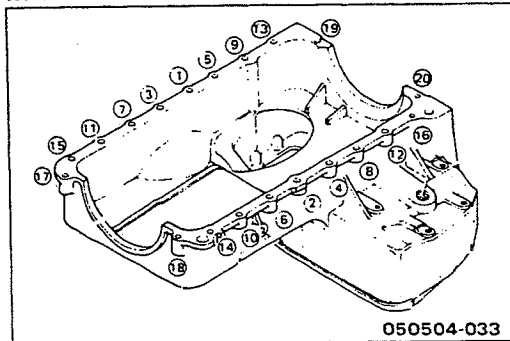


- 3) Install the oil pan front gasket ① to the timing pulley housing arches.

The gasket projection ② must be facing forward.



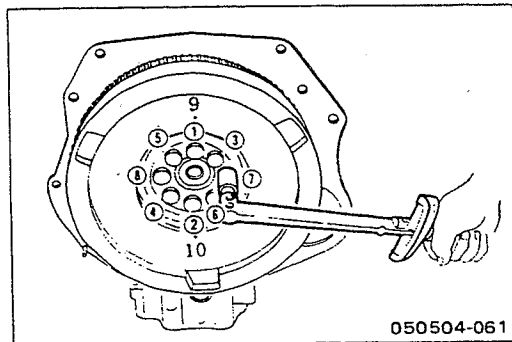
0505040116B



- 4) Install the oil pan to the cylinder body.

- 5) Tighten the oil pan bolts to the specified torque a little at a time in the sequence shown in the illustration.

Oil Pan Bolt Torque	kg-m(lb.ft/N-m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	



▲ Flywheel



- 1) Block the crankshaft with a piece of hard wood to prevent the flywheel from turning.



- 2) Apply a coat of engine oil to the threads of the flywheel bolts.

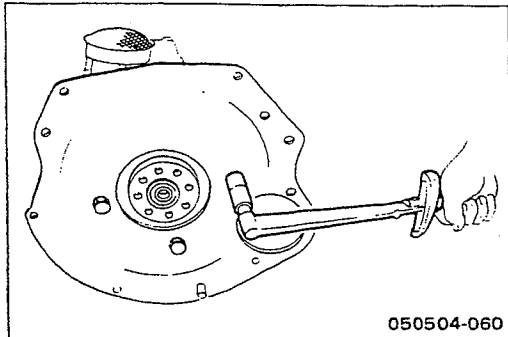


- 3) Align the flywheel with the crankshaft dowel pin.

- 4) Tighten the flywheel bolts to the specified torque in the numerical order shown in the illustration.

Flywheel Bolt Torque	kg-m(lb.ft/N-m)
12.0 ± 0.5 ($86.8 \pm 3.6/117.60 \pm 4.90$)	

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050504-060

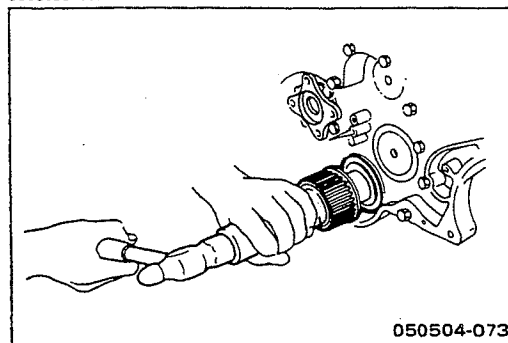


▲ Cylinder Body Rear Plate

- 1) Align the rear plate with the cylinder body knock pins.
- 2) Tighten the rear plate to the specified torque.

Rear Plate Torque	kg-m(lb.ft/N-m)
8.4 ± 0.8 ($60.7 \pm 5.8/82.32 \pm 7.84$)	

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050504-073

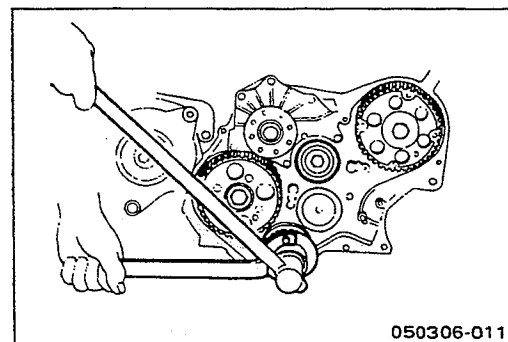


▲ Crankshaft Timing Pulley (For Belt Drive)

- 1) Install the timing pulley to the crankshaft.
- 2) Use the crankshaft timing pulley installer to install the timing pulley.

Crankshaft Timing Pulley Installer: 9-8522-0021-0

The timing pulley flange must be facing the cylinder body.



050306-011



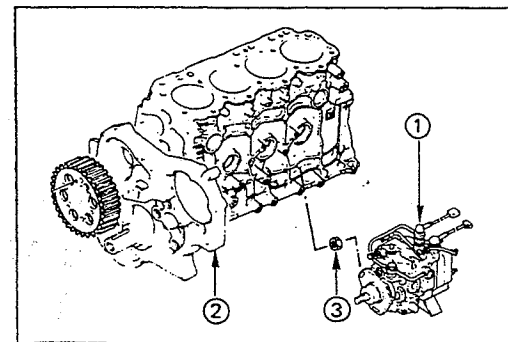
▲ Crankshaft Timing Pulley Center (For Belt Drive)

- 1) Install the crankshaft timing pulley center.
- 2) Use the fixing wrench to prevent the crankshaft from turning.
- 3) Tighten the crankshaft pulley center bolt to the specified torque.

Fixing Wrench: 5-8840-0161-0

Crankshaft Pulley Center Bolt Torque	kg-m(lb.ft/N-m)
19 ± 2 ($137.4 \pm 14.5/186.20 \pm 19.60$)	

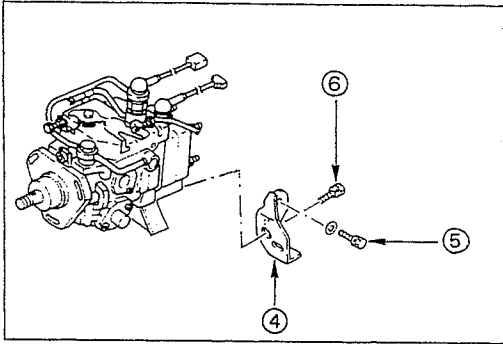
050504012201A



▲ Injection Pump (For Belt Drive)

- 1) Install the injection pump ① to the timing pulley housing ②.
- 2) Temporarily tighten the three injection pump nuts ③.

The injection pump nuts will be finally tightened after the injection pump rear bracket bolts.



- 3) Install the injection pump rear bracket ④ and the rear bracket bolts ⑤ to the cylinder body.
- 4) Install the rear bracket bolts ⑥ to the injection pump bracket.

Do not tighten the bolts.

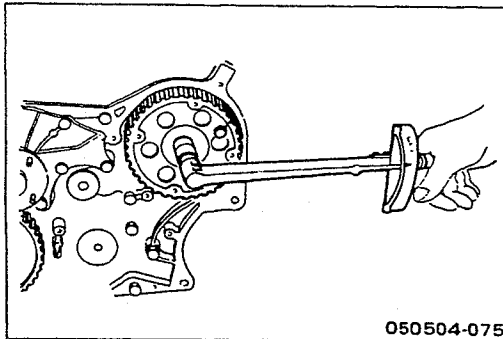
The rear bracket bolts ⑤ and ⑥ will be finally tightened to the specified torque after the injection pump nuts.

- 5) Tighten the injection pump nuts to the specified torque.

Injection Pump Nut and Bracket Bolt

Torque	kg·m(lb.ft/N·m)
1.5 ± 0.5 ($10.8 \pm 3.6/14.70 \pm 4.90$)	

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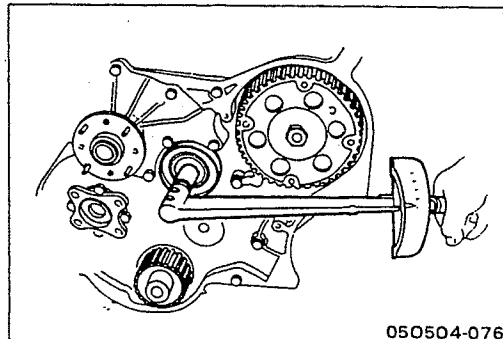
▲ Injection Pump Timing Pulley (For Belt Drive)

- 1) Align the timing pulley with the pump shaft key.
- 2) Install the stopper bolt to the timing pulley.
This will prevent the timing pulley from turning.
- 3) Tighten the timing pulley nut to the specified torque.

Injection Pump Timing Pulley Nut Torque	kg·m(lb.ft/N·m)
6.5 ± 0.5 ($47.0 \pm 3.6/63.77 \pm 4.90$)	

- 4) Remove the stopper bolt from the injection pulley.

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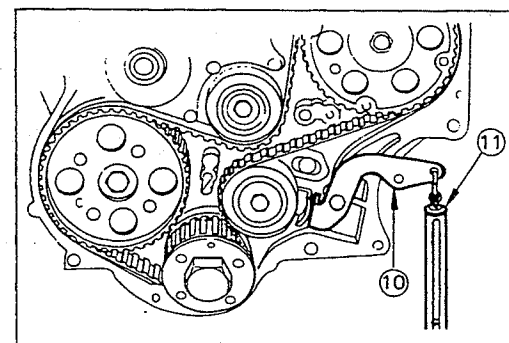
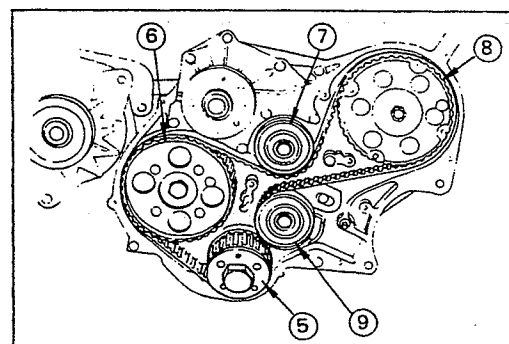
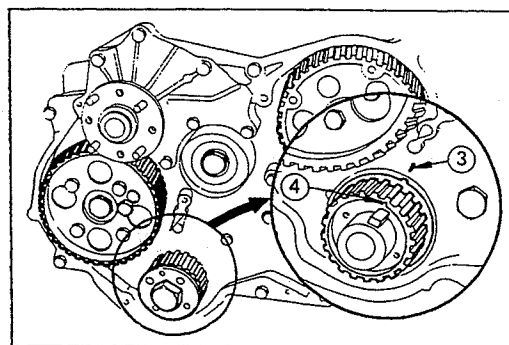
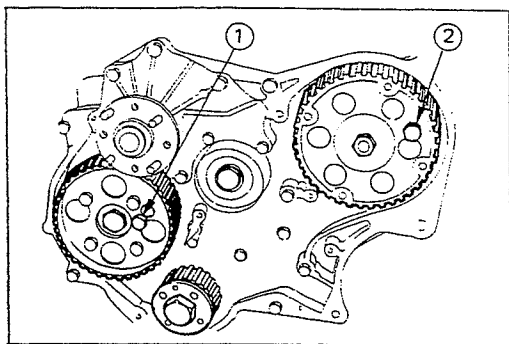


▲ Tension Idler (For Belt Drive)

- 1) Install the tensioner idler to the timing belt.
- 2) Tighten the tensioner idler to the specified torque.

Tensioner Idler Bolt Torque

7.7 ± 1.0 ($55.7 \pm 7.2/75$)



▲ Timing Belt (For Belt Drive)

▲ Timing Belt Tensioner (For Belt Drive)

▲ Timing Belt Tension Adjusting Lever (For Belt Drive)

- 1) Check that the stopper bolts are properly installed to the camshaft timing pulley ① and the injection pump timing pulley ②.

- 2) Check that the timing pulley housing mark ③ and the crankshaft timing pulley mark ④ are aligned.

The No. 1 cylinder should be at TDC on the compression stroke.

Rotate the crankshaft damper pulley clockwise to align the marks.

- 3) Install the timing belt to the crankshaft timing pulley ⑤, the camshaft timing pulley ⑥, the tensioner idler ⑦, and the injection timing pulley ⑧.

Follow the numerical order.

- 4) Install the timing belt tensioner ⑨ to the timing pulley housing.

- 5) Temporarily tighten the tensioner bolt.

The tensioner should move freely.

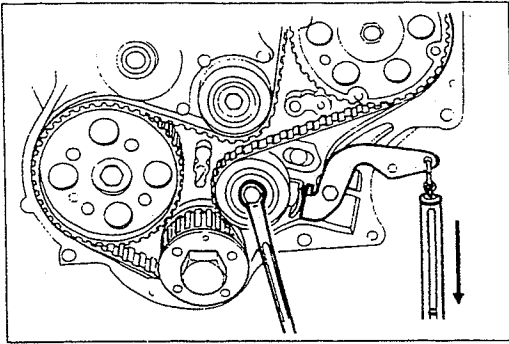
Note:

The timing belt is easily damaged. Be careful.

- 6) Set the tensioner adjusting lever ⑩ to the timing pulley housing.

- 7) Remove the stopper bolts from the camshaft timing pulley and the injection pump timing pulley.

- 8) Attach the spring balancer ⑪.



- 9) Adjust the timing belt tension by pulling straight down on the spring balancer with the specified force.

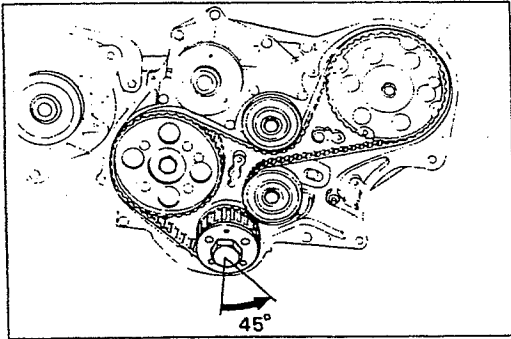
Tension Adjusting Lever Force	kg(lb/N)
10 - 12 (22.1 - 26.5/98.1 - 117.7)	

Note:

Timing belt tension must be adjusted.

Failure to adjust the timing belt tension will result in timing belt damage.

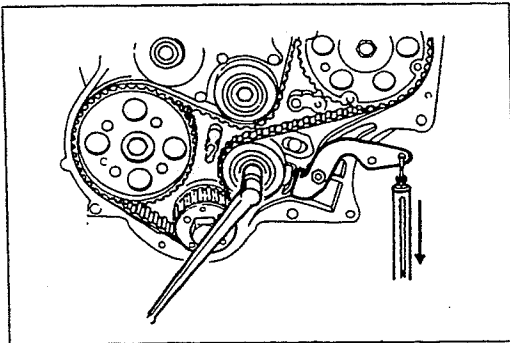
- 10) Tighten the tension bolt.



- 11) Rotate the crankshaft 45 degrees counterclockwise.

Note:

Never rotate the crankshaft clockwise when adjusting the timing belt.



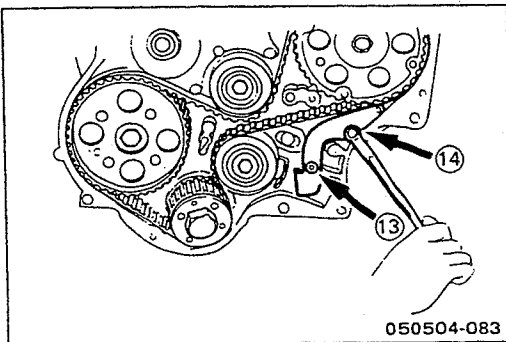
- 12) Readjust the timing belt tension.

Refer to Step 9

This will remove any remaining timing belt slack.

- 13) Tighten the tensioner bolt to the specified torque.

Tensioner Bolt Torque	kg·m(lb.ft/N·m)
7.7 ± 1.0 ($55.7 \pm 7.2/75.5 \pm 9.8$)	

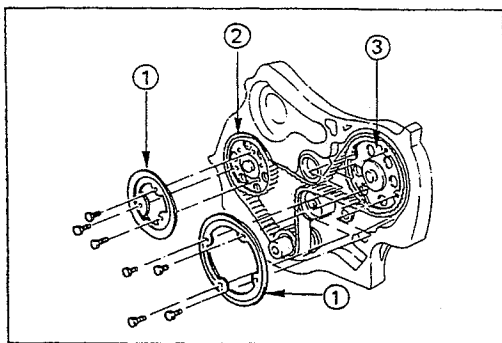


- 14) Tighten the tension adjusting lever nut ⑬ and bolt ⑭.

Note:

If on-vehicle timing belt replacement is performed, the crankshaft must not be allowed to turn.

If the crankshaft is allowed to turn, piston and valv damage will result.

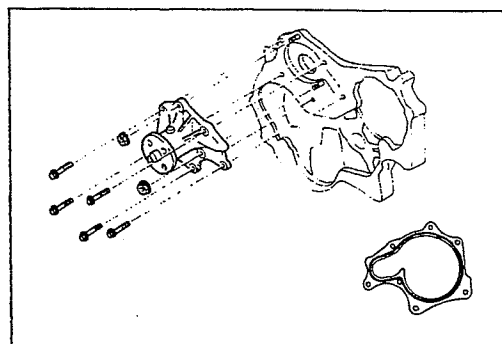


▲ Camshaft Timing Pulley Flange (For Belt Drive)

▲ Injection Pump Timing Pulley Flange (For Belt Drive)

- 1) Install the timing pulley flange ① to the camshaft ② and injection pump timing pulley ③.
- 2) Tighten the timing pulley flange bolts to the specified torque.

Timing Pulley Flange Bolt Torque	kg·m(lb.ft/N·m)
	1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)



▲ Water Pump

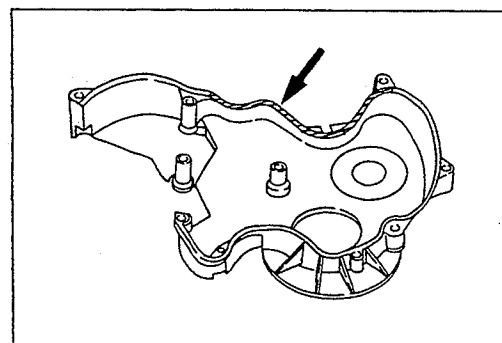


- 1) Apply the recommended liquid gasket or its equivalent to the water pump at the position shown in the illustration.

Do not apply an excessive amount of liquid gasket.

- 2) Tighten the water pump bolts to the specified torque.

Water Pump Bolt Torque	kg·m(lb.ft/N·m)
	2.0 ± 0.5 ($14.5 \pm 3.6/19.60 \pm 4.90$)



▲ Timing Pulley Housing Lower Cover (For Belt Drive)



▲ Timing Pulley Housing Upper Cover (For Belt Drive)

- 1) Apply the recommended liquid gasket or its equivalent to the timing pulley lower cover.
- 2) Install the lower cover ① to the timing pulley housing ②.

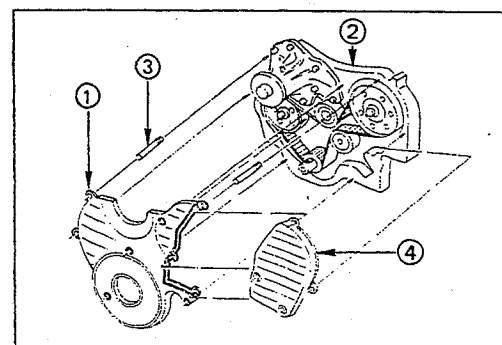
Use the lower cover guide bolts ③ to prevent the liquid gasket from running.

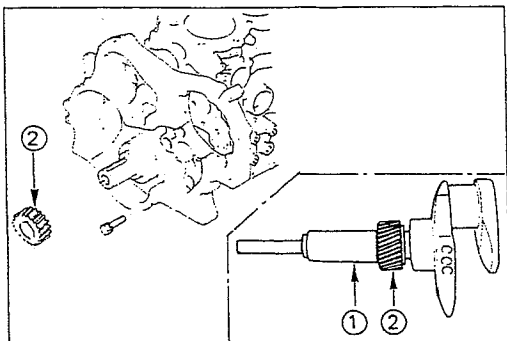
- 3) Install the upper cover ④ to the lower cover and pulley housing.
- 4) Tighten the timing cover bolts to the specified torque a little at a time in the sequence shown in the illustration.



Timing Pulley Cover Bolt Torque	kg·m(lb.ft/N·m)
	0.8 ± 0.2 ($5.8 \pm 1.4/7.84 \pm 1.96$)

- 5) Remove the lower cover guide pin.



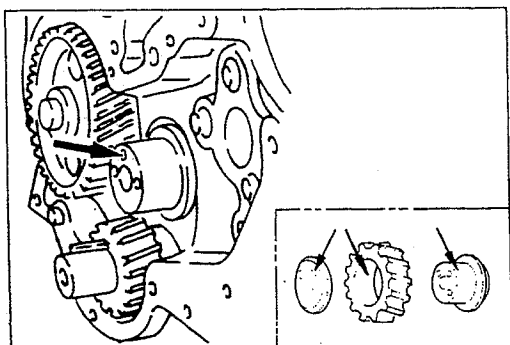


▲ Crankshaft Timing Gear (For Gear Drive)

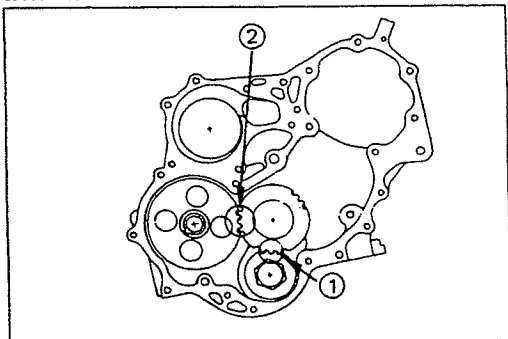
- 1) Install the crankshaft gear.
- 2) Use the crankshaft gear installer ① to install the crankshaft gear ②.

The crankshaft gear timing mark ("X-X") must be facing outward.

Crankshaft Gear Installer: 9-8522-0020-0



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▲ Idler Gear Shaft (For Gear Drive)

▲ Idler Gear "A" (For Gear Drive)

- 1) Apply engine oil to the idler gear and the idler gear shaft.

The idler gear shaft oil hole must be facing up.

- 2) Position the idler gear setting marks "X" and "Y" so that they are facing the front of the engine.

- 3) Align the idler gear "X" setting mark with the crankshaft timing gear ① "X-X" setting mark.

- 4) Align the idler gear "Y" setting mark with the camshaft timing gear ② "Y-Y" setting mark.

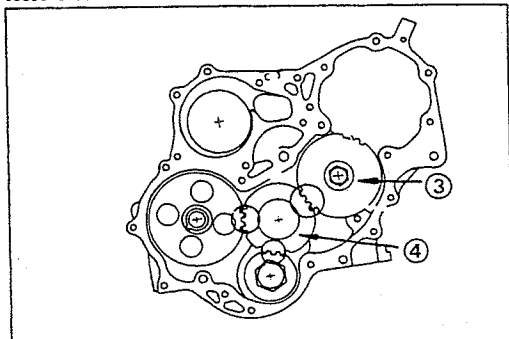
- 5) Install the thrust collar and bolts to the cylinder body through the shaft.

The thrust collar oil hole must be facing up, and the thrust collar chamfered must be outward.

- 6) Tighten the idler gear bolt to the specified torque.

Idler Gear "A" Bolt Torque	kg-m(lb.ft/N-m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	

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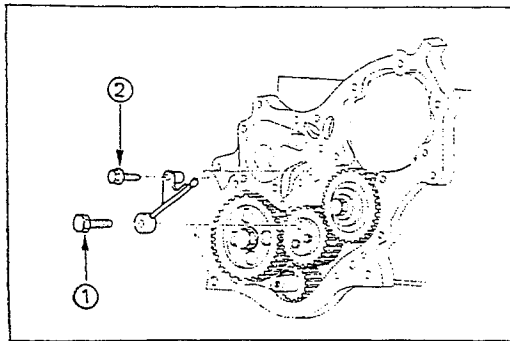
▲ Idler Gear "B" and Shaft (For Gear Drive)

- 1) Apply engine oil to the idler gear and the idler gear shaft.

- 2) Align the idler gear "B" ③ "Z" setting mark with the idler gear "A" ④ "Z-Z" setting mark.

- 3) Tighten the idler gear bolt to the specified torque.

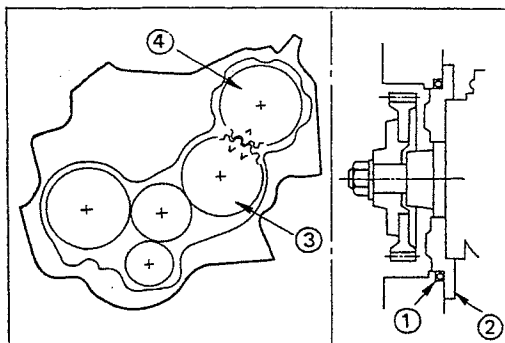
Idler Gear "B" Bolt Torque	kg-m(lb.ft/N-m)
7.7 ± 1.0 ($55.7 \pm 7.2/75.46 \pm 9.80$)	



▲ Timing Gear Oil Pipe (For Gear Drive)

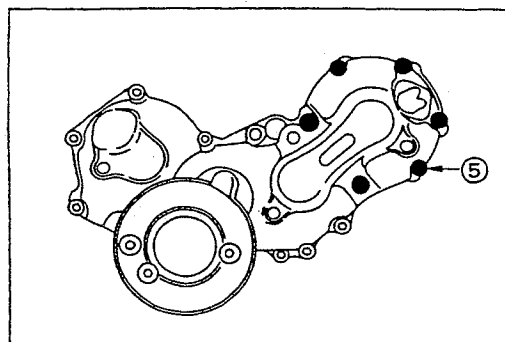
- 1) Install the oil pipe to the timing gear case and idler gear "A".
- 2) Tighten the oil pipe eye bolt ① and bolt ② to the specified torque.

Eye Joint and Bolt Torque	kg·m(lb.ft/N·m)
	1.25 ± 0.25 ($9.0 \pm 1.8/12.25 \pm 2.45$)

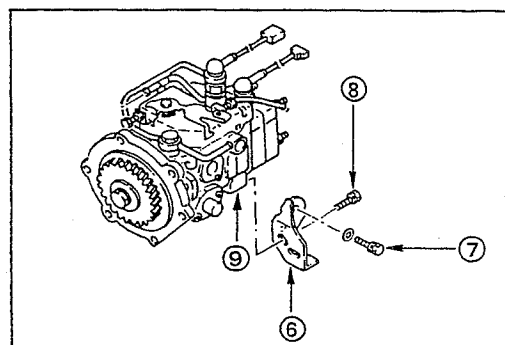


▲ Injection Pump (For Gear Drive)

- 1) Install the O-ring ① to the injection pump flange ②.
- 2) Install the injection pump to the timing gear case.
Align the idler gear "B" ③ "V—V" mark with the injection pump timing gear ④ "V" mark.

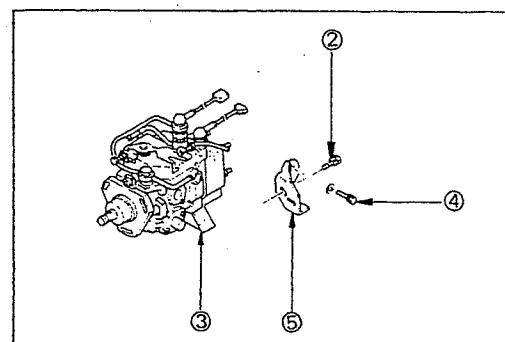


- 3) Temporarily tighten the six injection pump nuts ⑤.
The injection pump nuts will be finally tightened after the injection pump rear bracket bolts.



- 4) Install the injection pump rear bracket ⑥ and the rear bracket bolts ⑦ to the cylinder body.
- 5) Install the rear bracket bolts ⑧ to the injection pump bracket ⑨.
Do not tighten the bolts.

The rear bracket bolts ⑦ and ⑧ will be finally tightened to the specified torque after the injection pump nuts.

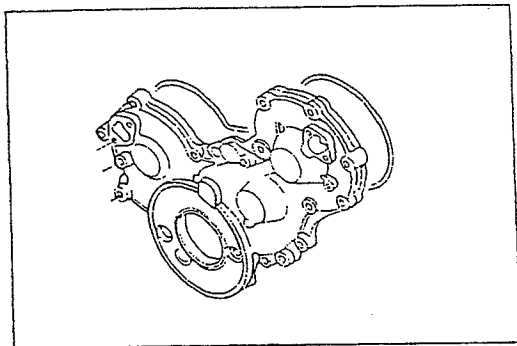


- 6) Tighten the injection pump nuts to the specified torque.

Injection Pump Nut Torque	kg·m(lb.ft/N·m)
	1.5 ± 0.5 ($10.8 \pm 3.6/14.70 \pm 4.90$)

- 7) Tighten the injection pump bracket bolts to the specified torque.

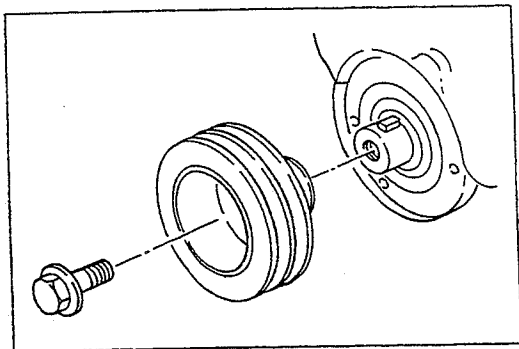
Injection Pump Bracket Bolt Torque	kg·m(lb.ft/N·m)
	1.5 ± 0.5 ($10.8 \pm 3.6/14.70 \pm 4.90$)



▲ Timing Gear Case Cover (For Gear Drive)

- 1) Align the gear case with the timing gear case knock pin and then install the timing gear case cover.
- 2) Tighten the gear case cover bolts to the specified torque.

Gear Case cover Bolt Torque	kg·m(lb.ft/N·m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	



▲ Crankshaft Damper Pulley (For Gear Drive)

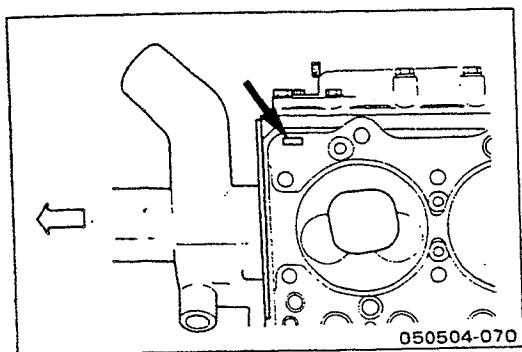
Tighten the crankshaft damper pulley bolt to the specified torque.

Note:

Hold the flywheel ring gear stationary to prevent the crankshaft from turning when tightening the damper pulley.

Crankshaft Damper Pulley Bolt Torque	kg·m(lb.ft/N·m)
19.0 ± 1.9 ($137.4 \pm 13.7/186.20 \pm 18.62$)	

Take care not to damage the crankshaft damper pulley boss.



▲ Cylinder Head Gasket

The cylinder head gasket "TOP" mark must be facing up.



Note:

For all 4JB1 engines, measure the piston head projection and select the appropriate head gasket.

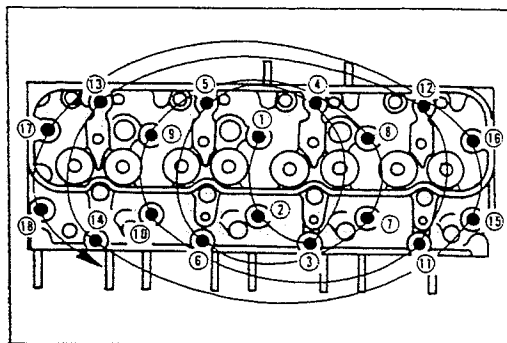
Refer to "INSPECTION AND REPAIR", "Cylinder Head Gasket Selection".



▲ Cylinder Head



- 1) Align the cylinder body dowels and the cylinder head dowel holes.
- 2) Carefully place the cylinder head on the cylinder head gasket.
- 3) Apply a coat of engine oil to the cylinder head bolt threads and setting faces.

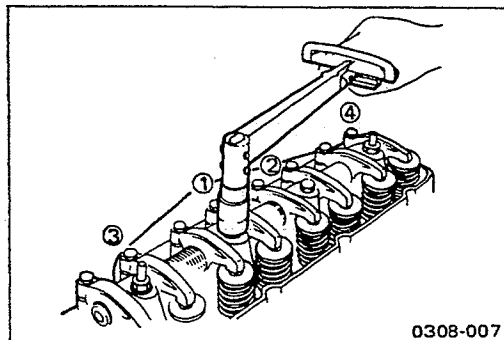


- 3) Tighten the cylinder head bolts in two steps using the Angular Tightening Method for all 4JB1. Follow the numerical sequence shown in the illustration.

Cylinder Head Bolt Torque		kg · m(lb.ft/N · m)
	1st Step	2nd Step
All 4JB1	5.0 ± 0.5 ($36.2 \pm 3.6/49.00 \pm 4.90$)	$120^\circ + 30^\circ$ $- 0^\circ$

Cylinder Head Bolt Torque		kg · m(lb.ft/N · m)
4JA1	New bolt	8.7 ± 0.5 ($62.9 \pm 3.6/85.26 \pm 4.90$)
	Used bolt	10.5 ± 0.5 ($75.9 \pm 3.6/102.90 \pm 4.90$)

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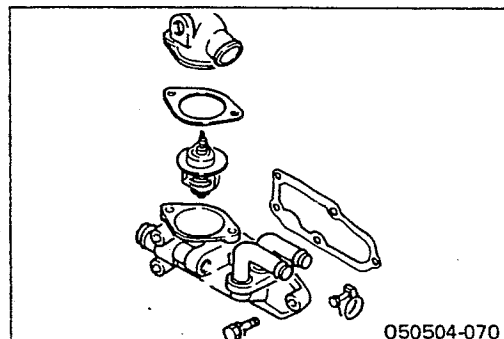


▲ Rocker Arm Shaft and Rocker Arm

Tighten the rocker arm shaft bracket bolts in the numerical order shown in the illustration.

Rocker Arm Shaft Bracket Bolt Torque		kg·m(lb.ft/N·m)
		5.5 ± 0.5 ($37.8 \pm 3.6/53.96 \pm 4.90$)

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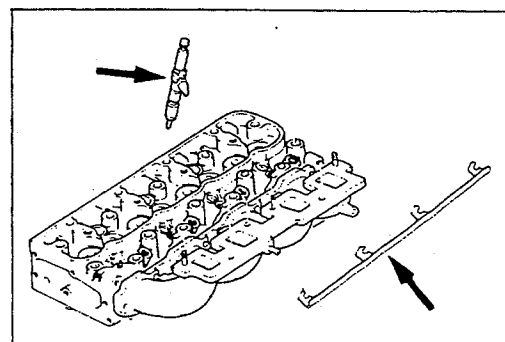
050504-070



▲ Thermostat Housing

- 1) Install the thermostat housing.
- 2) Tighten the thermostat housing bolts to the specified torque.

Thermostat Housing Bolt Torque		kg·m(lb.ft/N·m)
		1.9 ± 0.5 ($13.7 \pm 3.6/18.64 \pm 4.90$)



▲ Glow Plug and Glow Plug Connector

- 1) Install the glow plugs to the cylinder head.
- 2) Tighten the glow plugs to the specified torque.

Glow Plug Torque		kg·m(lb.ft/N·m)
		2.25 ± 0.25 ($16.3 \pm 1.8/22.07 \pm 2.45$)

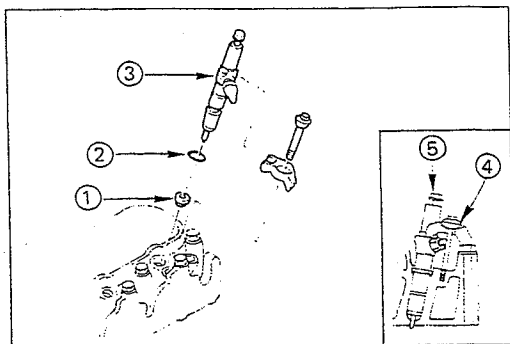
- 3) Install the glow plug connector.
- 4) Tighten the glow plug connector to the specified torque.

Glow Plug Connector Torque		kg·m(lb.ft/N·m)
		0.13 ± 0.2 ($0.94 \pm 1.4/1.27 \pm 1.96$)

Note:

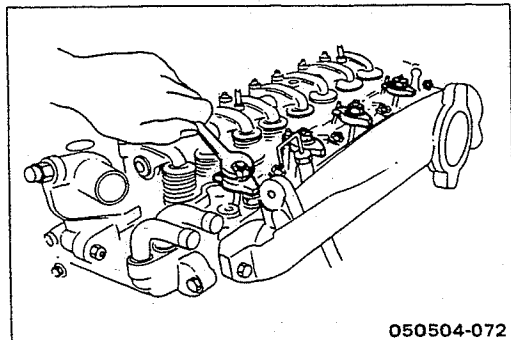
Glow plugs in good condition may be reused.

If glow plug replacement is required, the glow plugs must be replaced as a set. Never replace just one glow plug.



▲ Injection Nozzle Holder

- 1) Install the injection nozzle gasket ① and the O-ring ② to the injection nozzle holder ③.
Be sure that the O-ring fits snugly in the injection nozzle groove.
- 2) Apply engine oil to the cylinder head nozzle holder hole.
- 3) Install the nozzle holder together with the nozzle holder bracket ④ to the cylinder head.

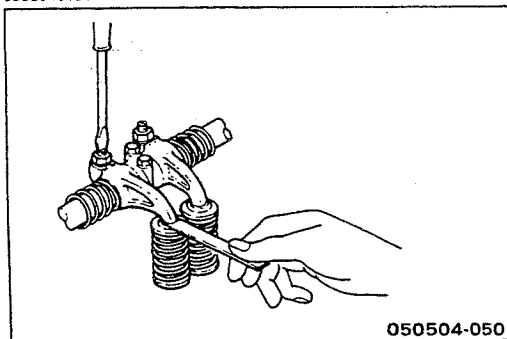


Nozzle Holder Bracket Bolt Torque	kg-m(lb.ft/N-m)
3.8 ± 0.6 ($27.5 \pm 4.3/37.24 \pm 5.88$)	

- 4) Tighten the holder nut with washer ⑤ to the specified torque.

Injection Nozzle Holder Nut Torque	kg-m(lb.ft/N-m)
3.8 ± 0.6 ($26.0 \pm 4.3/37.24 \pm 5.88$)	

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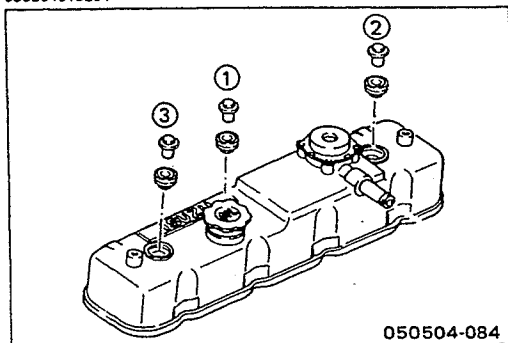
Note on Valve Clearance Adjustment

Valve clearances must be adjusted before the cylinder head cover is reinstalled.

Refer to "Valve Clearance Adjustment" in the "Servicing" Section of this Manual.

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▲ Cylinder Head Cover

- 1) Apply engine oil to the rocker arm and the valve spring.
- 2) Install the cylinder head cover gasket to the head cover.
Check to see that the head cover gasket has no loose areas.
- 3) Tighten the cylinder head cover nuts in the numerical order shown in the illustration.

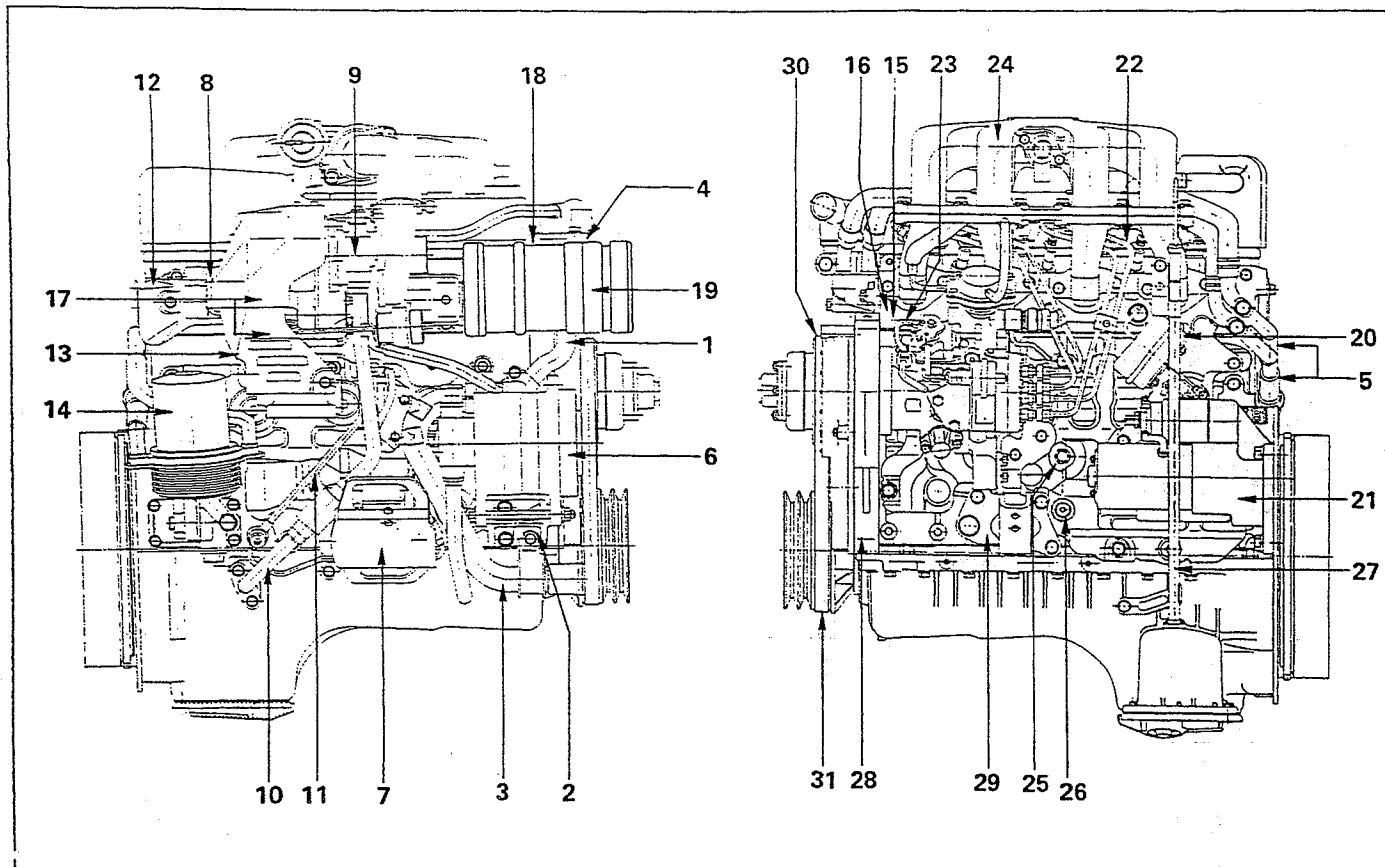


Cylinder Head Cover Bolt Torque	kg-m(lb.ft/N-m)
1.3 ± 0.5 ($9.4 \pm 3.6/12.74 \pm 4.90$)	



EXTERNAL PARTS

These reassembly steps are based on the 4JB1T engine.

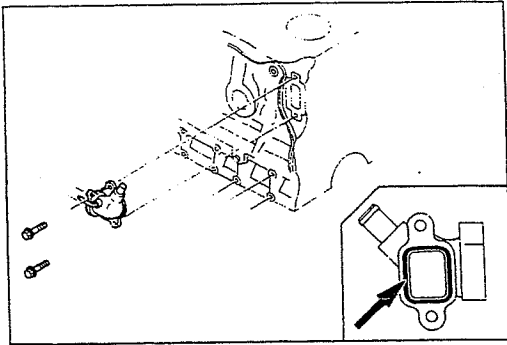


Reassembly Steps

- | | |
|---------------------------------------|---|
| ▲ 1. Water inlet suction pipe | ▲ 18. Compressor bracket |
| ▲ 2. Alternator bracket | ▲ 19. Compressor |
| ▲ 3. Water inlet pipe | ▲ 20. Exhaust actuator |
| 4. Water by-pass hose | ▲ 21. Starter motor |
| 5. Heater pipe (Rear side) | ▲ 22. Fuel injection pipe with clip |
| ▲ 6. Alternator and adjusting plate | 23. Fuel leak hose (leak off pipe to in- |
| ▲ 7. Engine mounting bracket with | jection pump) |
| mounting rubber | ▲ 24. Upper intake manifold |
| ▲ 8. Exhaust manifold | 25. Water drain cock |
| ▲ 9. Turbocharger | 26. Oil pressure warning switch and, |
| ▲ 10. Turbocharger oil return pipe | the nipple |
| ▲ 11. Turbocharger oil feed pipe | ▲ 27. Oil level gauge guide tube |
| 12. Exhaust manifold heat protector | ▲ 28. Stiffener (Housing — cylinder body) |
| ▲ 13. Exhaust adaptor | ▲ 29. Engine mounting bracket with |
| ▲ 14. Oil filter with oil cooler | mounting rubber |
| ▲ 15. Power steering oil pump bracket | ▲ 30. Cooling fan drive belt |
| ▲ 16. Power steering oil pump | ▲ 31. Cooling fan pulley |
| 17. Turbocharger heat protector upper | |
| and lower | |



Important Operations



▲ Water Inlet Suction Pipe

- 1) Apply the recommended liquid gasket or its equivalent to the suction pipe at the position shown in the illustration.

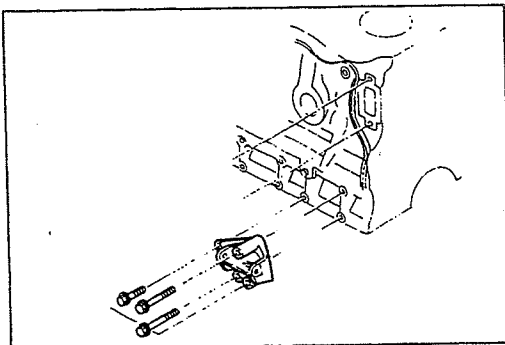
Do not apply an excessive amount of liquid gasket.

- 2) Tighten the suction pipe bolts to the specified torque.

Suction Pipe Bolt Torque	kg-m(lb.ft/N-m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	

▲ Heater Pipe (Rear Side)

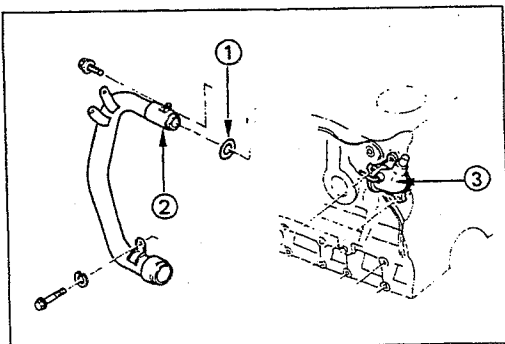
- 1) Install the heater pipe to the cylinder head.
- 2) Connect the oil cooler return hose and feed hose to the oil cooler.
- 3) Connect the water rubber hose to the heater pipe.



▲ Alternator Bracket

Install the alternator bracket to the cylinder body and tighten the bracket bolts to the specified torque.

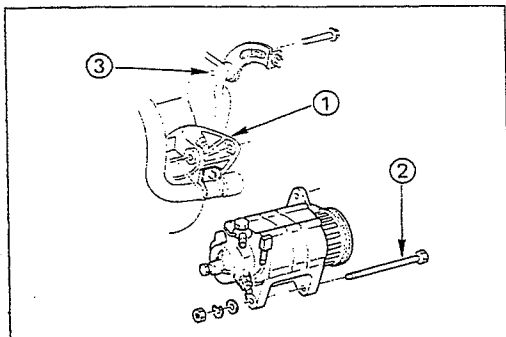
Bracket Bolt Torque	kg-m(lb.ft/N-m)
4.1 ± 0.6 ($29.7 \pm 4.3/40.18 \pm 5.88$)	



▲ Water Inlet Pipe

- 1) Install the O-ring ① to the inlet pipe O-ring groove ②.
- 2) Connect the inlet pipe to the suction pipe ③ and tighten the inlet pipe bolts to the specified torque.

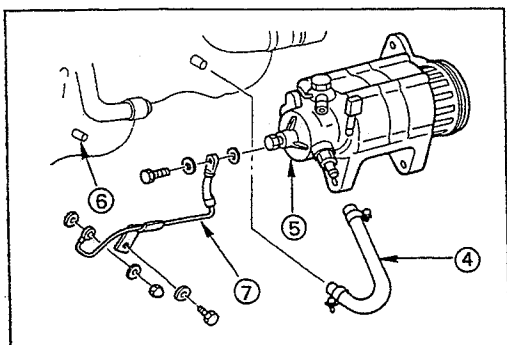
Inlet Pipe Bolt Torque	kg-m(lb.ft/N-m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	



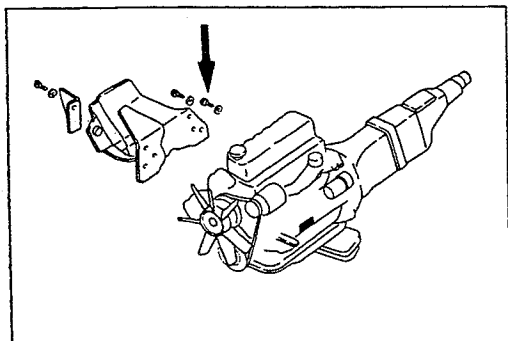
▲ Alternator and Adjusting Plate

- 1) Install the alternator to the bracket ①.
- 2) Temporarily tighten the alternator bolt ② and adjusting plate bolts ③.

The bolts will be finally tightened after installation of the cooling fan drive belt.



- 3) Connect the vacuum pump rubber hose ④ to the vacuum pump ⑤, and the oil pan ⑥.
- 4) Connect the vacuum oil pipe ⑦ to the vacuum pump, and the cylinder body.

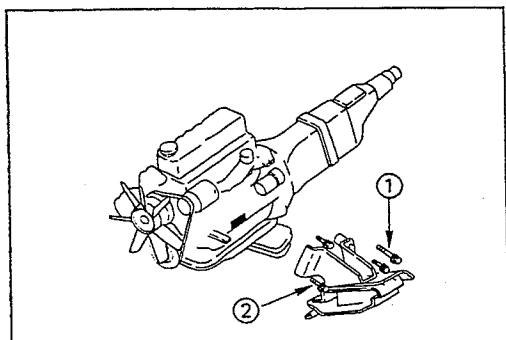


▲ Engine Mounting Bracket with Mounting Rubber

Install the engine mounting bracket to the cylinder body and tighten the bracket bolts to the specified torque.

Mounting Bracket Bolt Torque kg·m(lb.ft/N·m)

Right Side	M10×1.25 (9T)	$5.6^{+0.8}_{-0.9}$ ($40.5^{+5.8}_{-6.5}/54.88^{+7.84}_{-8.82}$)
Left Side	① M10×1.25 (7T)	4.1 ± 0.6 ($29.7 \pm 4.3/40.18 \pm 5.88$)
	② M14×1.50 (7T)	$11.9^{+2.3}_{-2.4}$ ($86.1^{+16.6}_{-17.4}/116.62^{+22.54}_{-23.52}$)

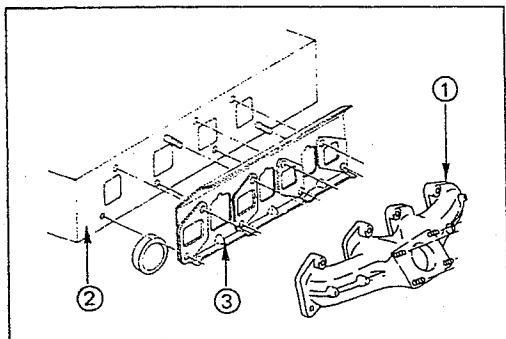


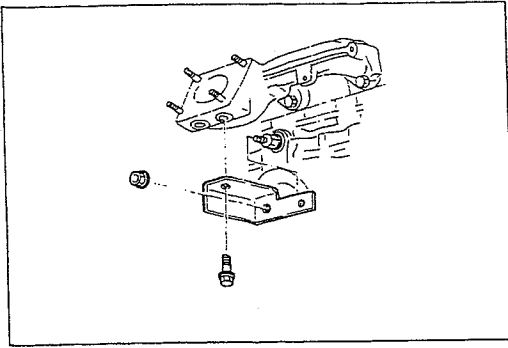
▲ Exhaust Manifold

- 1) Install the exhaust manifold ① to the cylinder head ② with the manifold gasket ③.
- 2) Tighten the exhaust manifold bolts to the specified torque a little at a time in the order shown in the illustration.

Exhaust Manifold Bolt Torque kg·m(lb.ft/N·m)

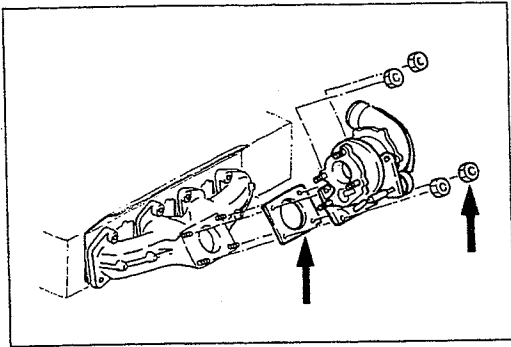
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)





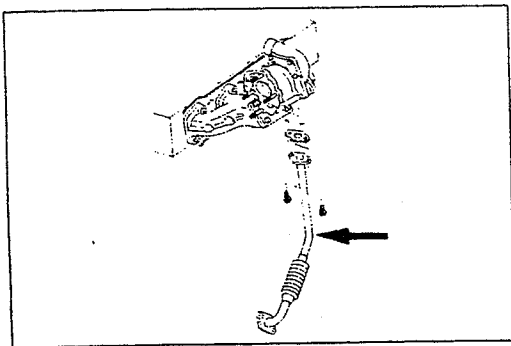
- 3) Install the exhaust manifold bracket to the manifold and the cylinder body.

Manifold Bracket Bolt Torque	kg-m(lb.ft/N-m)
1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)	



▲ Turbocharger

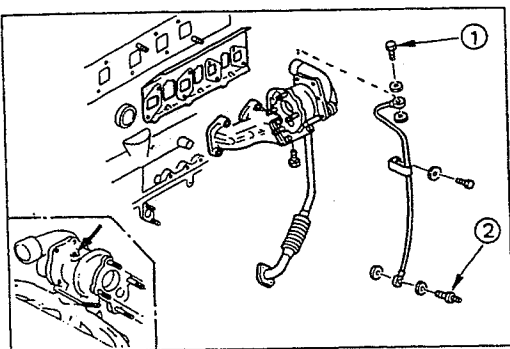
- 1) Install the turbocharger and the gasket.
 - 2) Temporarily tighten the turbocharger nuts at this time. They will be fully tightened after the installation of the turbocharger oil pipe.
- Always install new nuts and washers.



▲ Turbocharger Oil Return Pipe

- 1) Install the oil return pipe with gasket to the turbocharger.
- 2) Tighten the turbocharger oil return pipe to the specified torque.

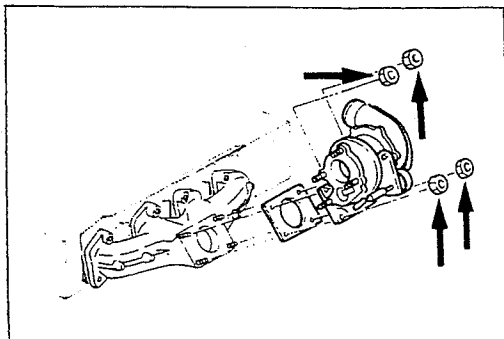
Turbocharger Oil Return Pipe Torque	kg-m(lb.ft/N-m)
0.8 ± 0.2 ($5.8 \pm 1.4/7.84 \pm 1.96$)	



▲ Turbocharger Oil Feed Pipe

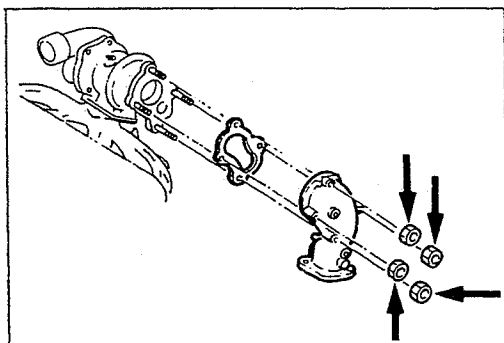
- 1) Before installing the oil feed pipe, supply 100 — 130 cm³ (6.1 — 7.9 in³) of clean engine oil to the turbocharger center housing through the oil feed opening.
- 2) Turn the rotating assembly with your hand to thoroughly lubricate the internal parts.
- 3) Tighten the oil feed pipe to the specified torque.

Turbocharger Oil Feed Pipe Joint Bolt Torque		kg-m(lb.ft/N-m)
① M10 × 1.5	2.25 ± 0.25 ($16.3 \pm 1.8/22.05 \pm 2.45$)	
② M14 × 1.5	3.0 ± 0.25 ($21.7 \pm 1.8/29.40 \pm 2.45$)	



- 4) Tighten the turbocharger nuts to the specified torque.

Turbocharger Nut Torque	kg·m(lb.ft/N·m)
	2.7 ± 0.5 ($19.5 \pm 3.6/26.46 \pm 4.90$)



▲ Exhaust Adapter

Install the exhaust adapter with gasket and tighten the adapter bolts to the specified torque.

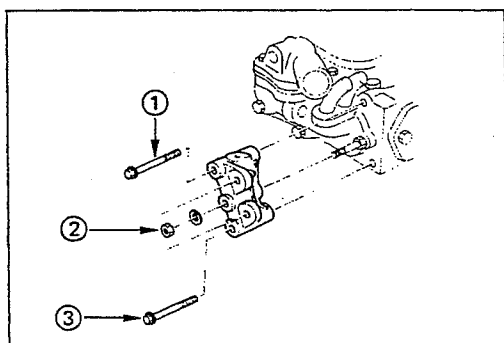
Adapter Bolt Torque	kg·m(lb.ft/N·m)
	2.7 ± 0.5 ($19.5 \pm 3.6/26.46 \pm 4.90$)



▲ Oil Filter and Oil Cooler

- 1) Install the O-ring to the oil filter flange groove.
- 2) Tighten the oil filter and oil cooler to the specified torque.

Oil Filter Flange Bolt Torque	kg·m(lb.ft/N·m)
	1.9 ± 0.5 ($13.7 \pm 3.6/18.62 \pm 4.90$)



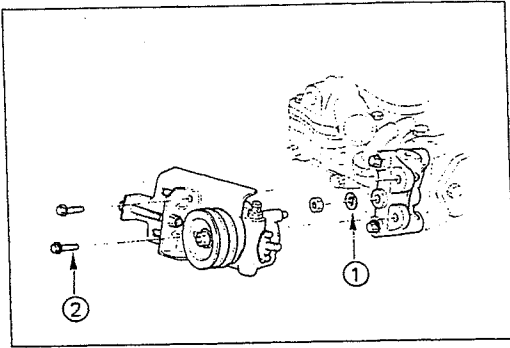
▲ Power Steering Oil Pump Bracket

▲ Power Steering Oil Pump

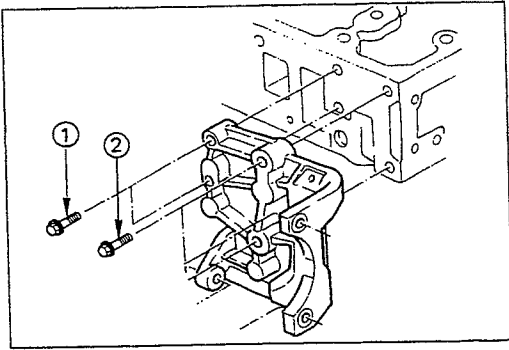
- 1) Install the oil pump bracket to the cylinder head.
- 2) Tighten the pump bracket nut and bolts to the specified torque.

Oil Pump Bracket Nut and Bolt Torque	kg·m(lb.ft/N·m)
--------------------------------------	-----------------

① M10 × 1.25 (7T)	3.75 ± 0.95 ($27.1 \pm 6.9/36.75 \pm 9.31$)
② M 8 × 1.25 (7T)	1.75 ± 0.55 ($12.7 \pm 4.0/17.75 \pm 5.39$)
③ M 8 × 1.25 (4T)	1.30 ± 0.50 ($9.4 \pm 3.6/12.74 \pm 4.90$)



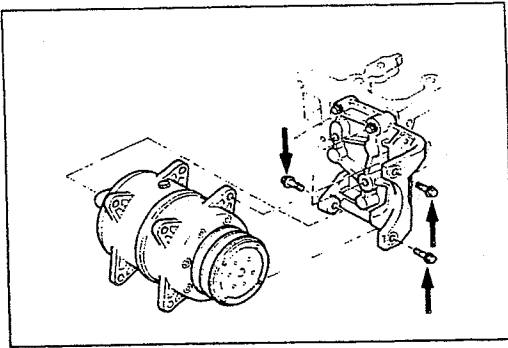
- 3) Install the oil pump to the bracket.
 - 4) Temporarily tighten the oil pump nut ① and bolts ②.
- The nut and bolts will be finally tightened after installation of the drive belt.



▲ Compressor Bracket

- 1) Install the compressor bracket to the cylinder head.
- 2) Tighten the bracket bolts to the specified torque.

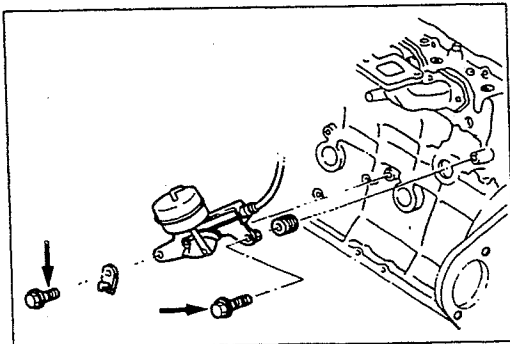
Bracket Bolt Torque		kg·m(lb.ft/N·m)
① M 8 × 1.25	1.9 ± 0.5 (13.7 ± 3.6/18.62 ± 4.90)	
② M10 × 1.25	3.8 ± 1.0 (27.5 ± 7.2/37.24 ± 9.80)	



▲ Compressor

- 1) Install the compressor to the compressor bracket.
- 2) Tighten the compressor bolts to the specified torque.

Compressor Bolt Torque		kg·m(lb.ft/N·m)
	3.8 ± 1.0 (27.5 ± 7.2/37.24 ± 9.80)	



▲ Exhaust Actuator

- 1) Install the exhaust actuator to the cylinder body.
- 2) Tighten the actuator bolts to the specified torque.

Actuator Bolt Torque		kg·m(lb.ft/N·m)
	2.7 ± 0.5 (19.5 ± 3.6/26.46 ± 4.90)	

- 3) Connect the control wire to the actuator.

0505070110

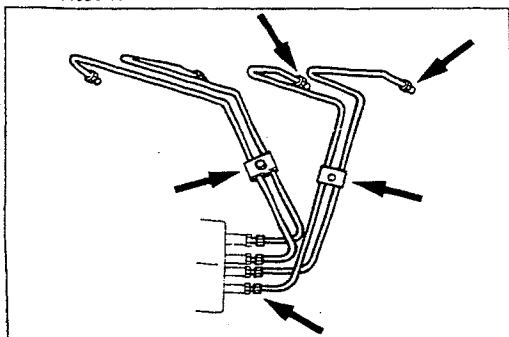


▲ Starter Motor

Tighten the starter motor bolts to the specified torque.

Starter Motor Bolt Torque		kg·m(lb.ft/N·m)
	7 ± 1 (50.6 ± 7.2/68.60 ± 9.80)	

050507010301A



▲ Fuel Injection pipe with Clip

- 1) Temporarily tighten the injection pipe sleeve nut.
- 2) Set the clip in the prescribed position.

Illustration ① : For Belt Drive

Illustration ② : For Gear Drive

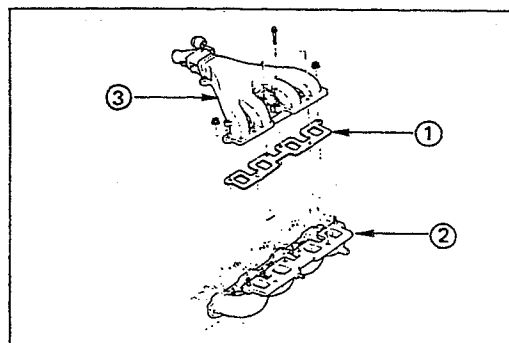
Note:

Make absolutely sure that the clip is correctly positioned.

An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

- 3) Tighten the injection pipe sleeve nut to the specified torque.

Injection Pipe Sleeve Nut Torque	kg-m(lb.ft/N-m)
3 ± 1 ($21.7 \pm 7.2/29.40 \pm 9.80$)	



▲ Upper Intake Manifold (4JB1T)

- 1) Install the manifold gasket ① to the lower intake manifold ②.
- 2) Connect the intake rubber hose to the turbocharger.
- 3) Install the upper intake manifold assembly ③ to the lower intake manifold.

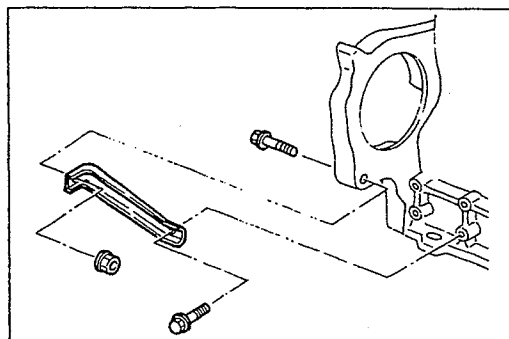
The upper intake manifold assembly consists of the intake pipe "B", the intake throttle assembly, the intake pipe "A", the PCV hose, the intake rubber hose, and the intake duct.

- 4) Tighten the intake manifold bolts and the flange nuts to the specified torque.

Intake Manifold Bolt Torque	kg-m(lb.ft/N-m)
1.9 ± 0.5 ($17.8 \pm 3.6/18.62 \pm 4.90$)	

Intake Manifold Flange Nut Torque	kg-m(lb.ft/N-m)
2.4 ± 0.5 ($17.8 \pm 3.6/23.52 \pm 4.90$)	

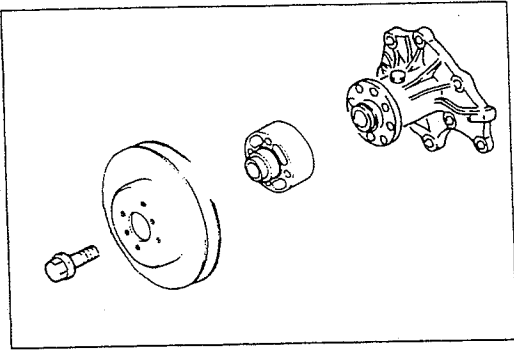
- 5) Connect the PCV hose to the cylinder head cover.



▲ Stiffener

- 1) Install the stiffener to the cylinder body and timing pulley housing or gear case.
- 2) Tighten the stiffener bolts to the specified torque.

Stiffener Bolt Torque	kg-m(lb.ft/N-m)
3.8 ± 1.0 ($27.5 \pm 7.2/37.24 \pm 9.80$)	

**▲ Cooling Fan Pulley**

- 1) Install the cooling fan pulley to the water pump with spacer.
- 2) Tighten the cooling fan pulley bolts to the specified torque.

Cooling Fan Pulley Bolt Torque	kg·m(lb.ft/N·m)
2.6 ± 0.5 ($18.8 \pm 3.6/25.48 \pm 4.90$)	

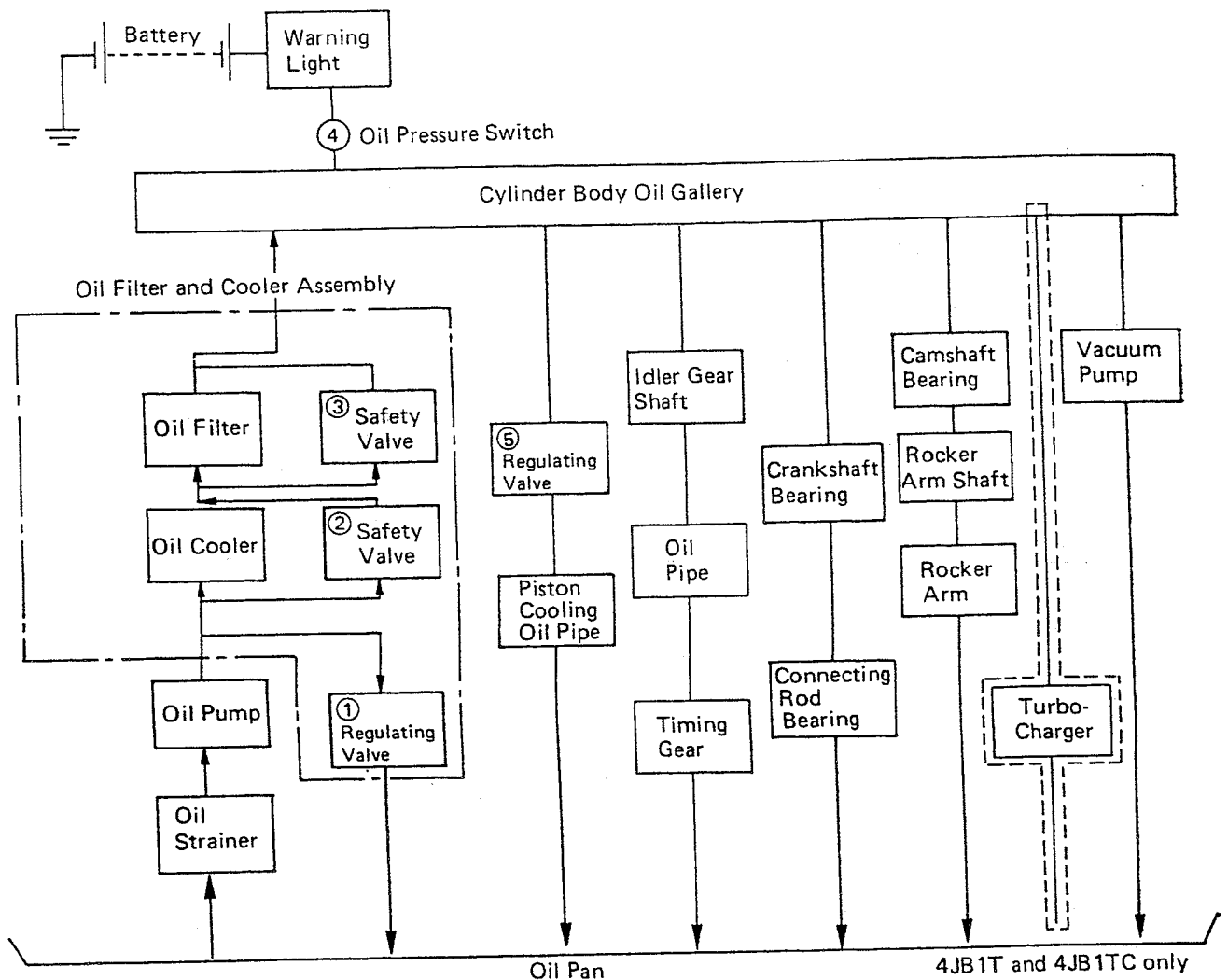
LUBRICATING SYSTEM

MAIN DATA AND SPECIFICATIONS

Engine model	4JA1	4JB1	4JB1T, 4JB1TC
Oil pump type	Gear	Trochoid	Gear
Delivery volume lit(US/UK gal)/min	19.9 (5.3/4.4)	13.0 (3.4/2.9)	19.9 (5.3/4.4)
Pump speed rpm		1000	
Delivery pressure kg/cm ² (psi/kPa)		4 (56.9/392.0)	
Oil temperature °C(°F)		48 — 52 (118 — 126)	
Engine oil		SAE 30	
Oil pressure switch operating pressure kg/cm ² (psi/kPa)		0.2 — 0.5 (2.8 — 7.1/19.6 — 49.0)	
Oil filter type	Full flow with cartridge paper element		
Relief valve opening pressure kg/cm ² (psi/kPa)	4.3 — 4.7 (61.1 — 66.8/421.4 — 460.6)		5.7 — 6.3 (82.5 — 89.5/ 558.6 — 617.4)
Safety valve opening pressure kg/cm ² (psi/kPa)		0.8 — 1.2 (11.38 — 17.07/78.9 — 117.6)	
Oil cooler type		Water-cooled	
Safety valve opening pressure kg/cm ² (psi/kPa)		2.3 — 2.7 (32.7 — 38.4/225.4 — 264.6)	

GENERAL DESCRIPTION

LUBRICATING OIL FLOW

Pressure Unit: kg/cm² (psi/kPa)

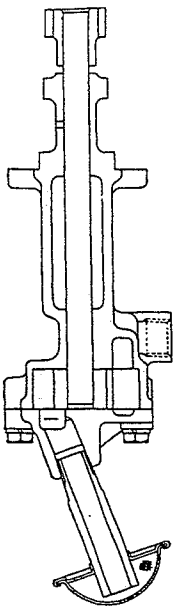
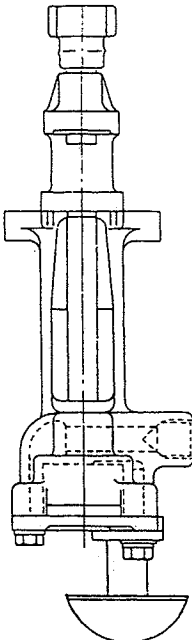
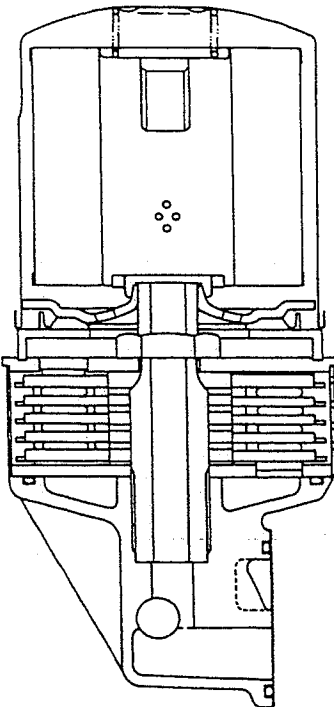
- ① Oil filter regulating valve opening pressure : 4.3—4.7 (61.1—66.8/421.4—460.6) for 4JA1, 4JB1
 5.7—6.3 (82.5—89.5/558.6—617.4) for 4JB1T, 4JB1TC
- ② Oil filter safety valve opening pressure : 0.8—1.2 (11.38—17.07/78.9—117.6)
- ③ Oil cooler safety valve opening pressure : 2.3—2.7 (32.7—38.4/225.4—264.6)
- ④ Oil pressure switch operating pressure : 0.2—0.5 (2.8—7.1/19.6—49.0)
- ⑤ Oil pressure regulating valve (Except 4JB1) : 2.3—2.7 (32.7—38.4/225.4—264.6)

The 4J Series engine lubricating system is a full flow type.

Lubricating oil is pumped from the oil pump to the cylinder body oil gallery through the oil cooler and the oil filter. It is then delivered to the vital parts of the engine from the cylinder body oil gallery.

Piston cooling oil pipes installed on the cylinder body spray engine oil to the piston inside faces to achieve maximum piston cooling effect.

060202
OIL PUMP AND OIL FILTER

TROCHOID TYPE	GEAR TYPE	OIL FILTER WITH BUILT-IN OIL COOLER
		

060202-004

4JB1 engines are equipped with a trochoid-type oil pump.

4JA1, 4JB1T, and 4JB1TC engines are equipped with a gear-type oil pump.

All 4J Series engines are equipped with a single unit oil filter with built-in oil cooler for the most effective engine oil cooling.

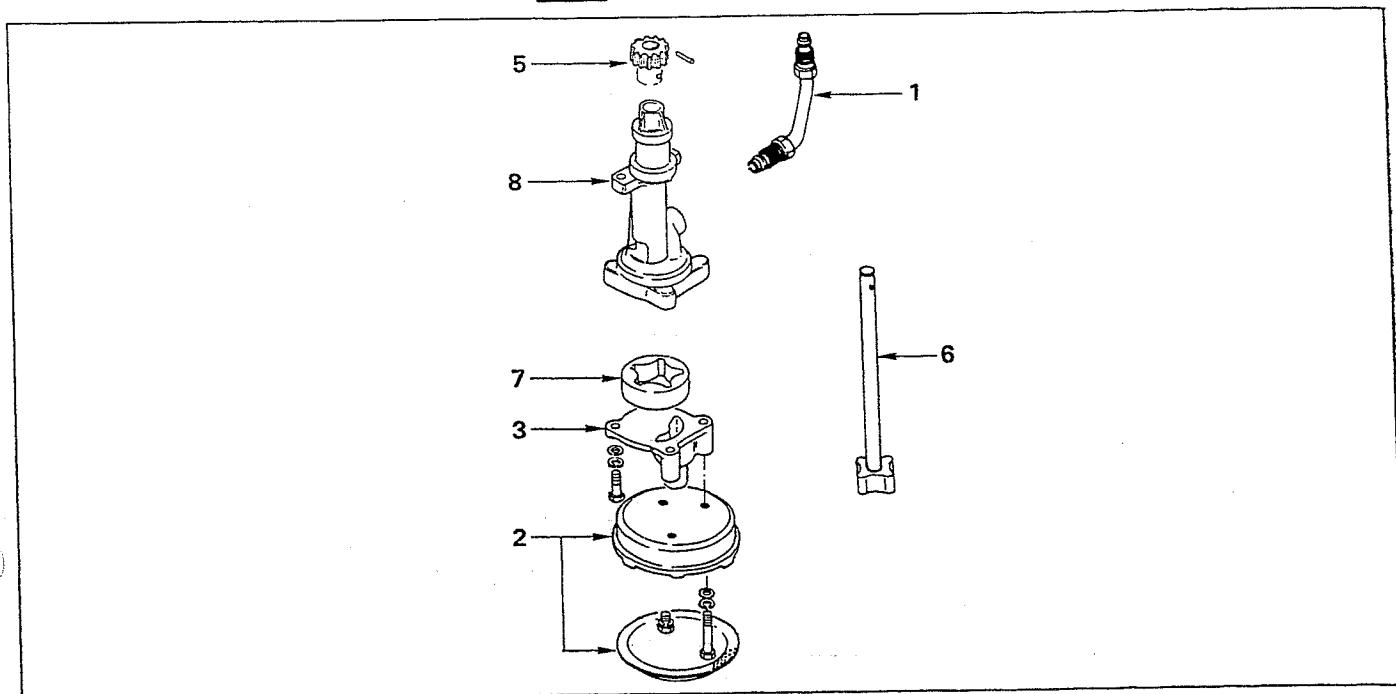
Exhaust gas recirculation system (EGR) equipped engines also have a bypass filter.

The bypass filter provides longer engine oil life.

060304

OIL PUMP (TROCHOID TYPE)

06030401A

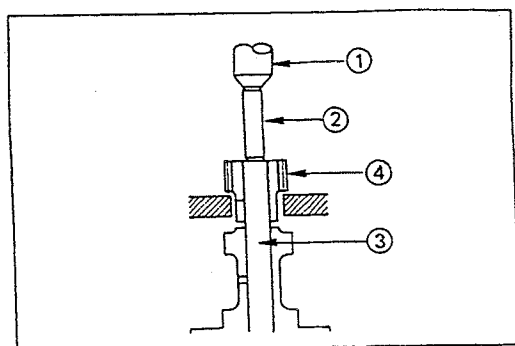
**DISASSEMBLY**

06030401B

Disassembly Steps

- | | |
|---------------|------------------|
| 1. Oil pipe | ▲ 5. Pinion gear |
| 2. Strainer | 6. Rotor shaft |
| 3. Pump cover | 7. Oil pump body |
| 4. Vane | |

06030402

**Important Operations****▲ Pinion Gear**

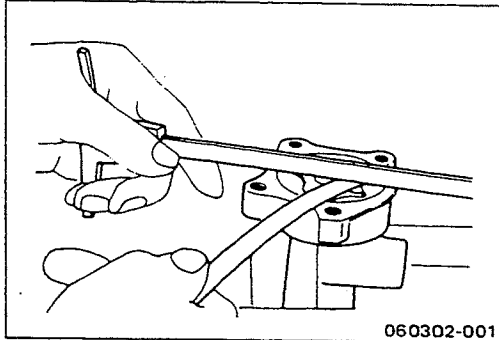
Use a bench press ① with brass bar ② to slowly force the rotor shaft ③ from the pinion gear ④.



INSPECTION AND REPAIR

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

06030201



060302-001

**Vane, Rotor, and Cover Clearance**

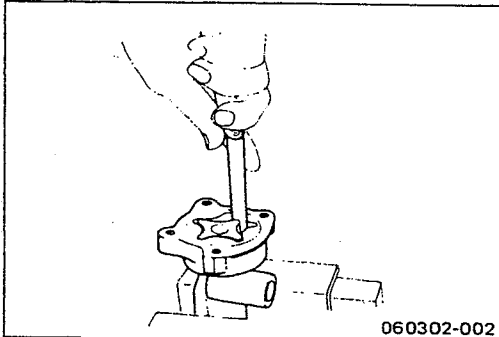
Use a feeler gauge to measure the clearance between the vane, the rotor, and the cover.

If the clearance between the vane, the rotor, and the cover exceeds the specified limit, the rotor set (pin, shaft, rotor, and vane) must be replaced.

Vane, Rotor, and Cover Clearance mm(in)

Standard	Limit
0.06 (0.0024)	0.15 (0.0059)

06030202



060302-002

**Rotor and Vane Clearance**

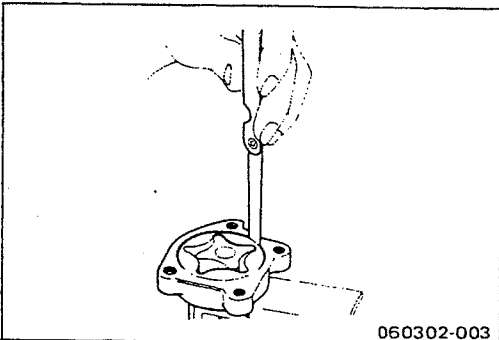
Use a feeler gauge to measure the clearance between the rotor and the vane.

If the clearance between the rotor and the vane exceeds the specified limit, the rotor set (pin, shaft, rotor, and vane) must be replaced.

Rotor and Vane Clearance mm(in)

Standard	Limit
0.14 (0.0055) or less	0.20 (0.0079)

06030203



060302-003

**Vane and Oil Pump Body Clearance**

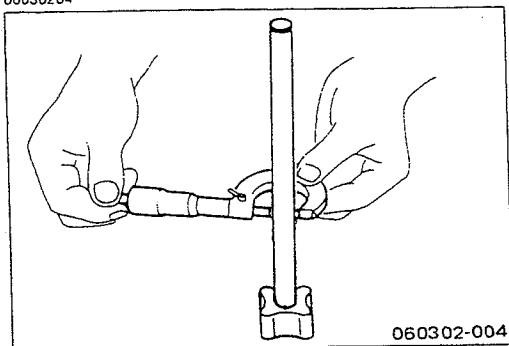
Use a feeler gauge to measure the clearance between the vane and the pump body.

If the clearance between the vane and the pump body exceeds the specified limit, the entire pump assembly must be replaced.

Vane and Pump Body Clearance mm(in)

Standard	Limit
0.26 (0.0102)	0.40 (0.016)

06030204

**Rotor Shaft and Oil Pump Body Clearance**

Use a micrometer to measure the rotor shaft outside diameter.

Use an inside dial indicator to measure the pump body inside diameter.

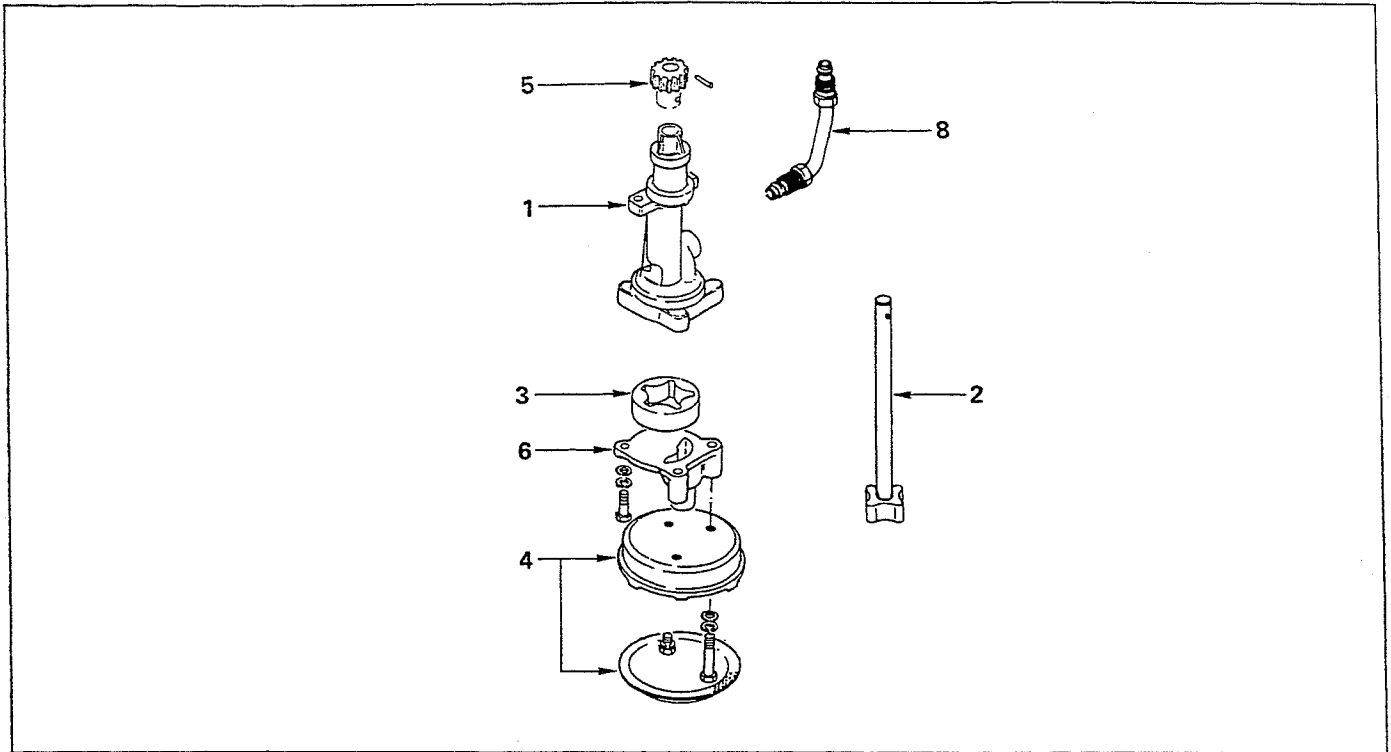
If the clearance between the rotor shaft and the pump body exceeds the specified limit, the entire pump assembly must be replaced.

Rotor Shaft and Pump Body Clearance mm(in)

Standard	Limit
0.05 (0.0020)	0.15 (0.0059)



REASSEMBLY



0603030001B

Reassembly Steps

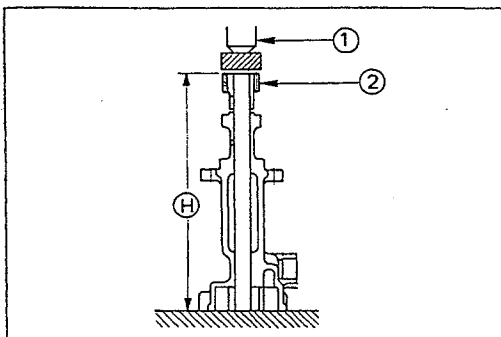
1. Oil pump body
2. Rotor shaft
3. Vane
4. Pump cover

- ▲ 5. Pinion gear
6. Strainer
7. Oil pipe

06030301



Important Operations



▲ Pinion Gear

Use a bench press ① to slowly force the pinion gear ② into place.

Note the installation distance (H) between the pinion gear upper face and the oil pump cover fitting face.

Pinion Gear and Pump Fitting Face

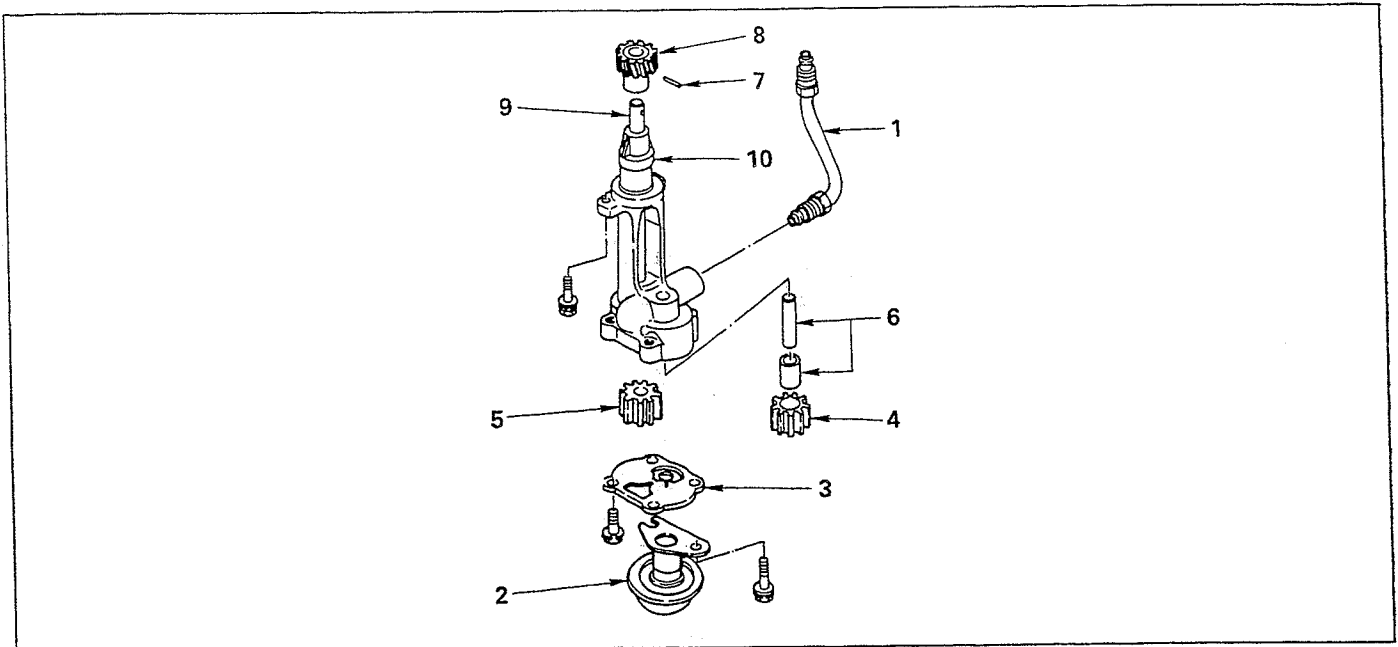
Distance (H) mm(in)

83.5 (3.41)

OIL PUMP (GEAR TYPE)



DISASSEMBLY



Disassembly Steps

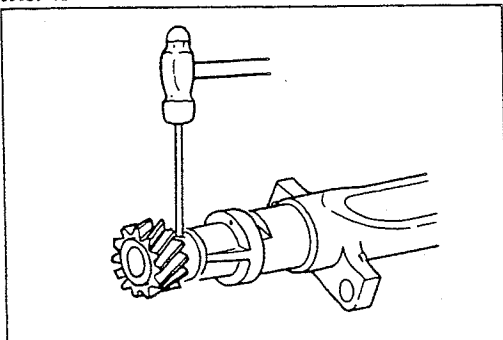
- | | |
|--------------------------|-------------------|
| 1. Oil pipe | 6. Driven shaft |
| 2. Strainer | ▲ 7. Pinion pin |
| 3. Pump cover | ▲ 8. Pinion gear |
| 4. Driven gear with bush | 9. Drive shaft |
| 5. Driven gear | 10. Oil pump body |

06030402



Important Operations

0603040201



▲ Pinion Pin

▲ Pinion Gear

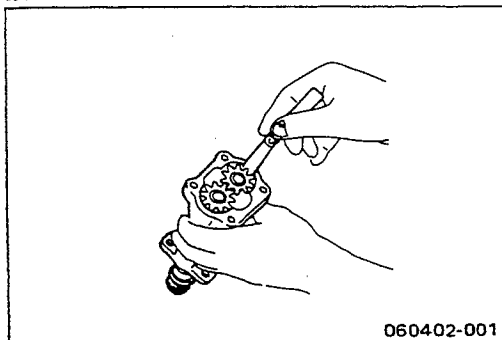
- 1) File off the caulked end of the pinion stopper pin.
- 2) Use a hammer and bar to drive the pinion pin free.
- 3) Remove the pinion.



INSPECTION AND REPAIR

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

06040201



060402-001

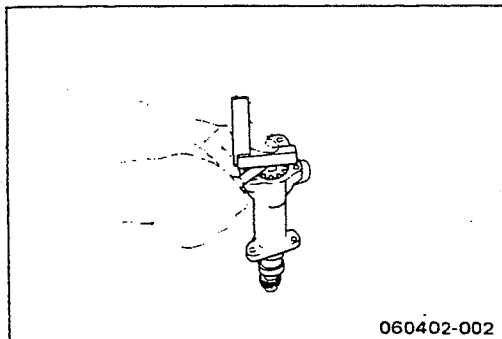
**Gear Teeth and Body Inner Wall Clearance**

Use a feeler gauge to measure the clearance between the gear teeth and the body inner wall.

If the clearance between the gear teeth and the body inner wall exceeds the specified limit, either the gear or the body must be replaced.

Gear Teeth and Body Inner Wall Clearance mm(in)	
Standard	Limit
0.14 (0.0055)	0.20 (0.0079)

06040202



060402-002

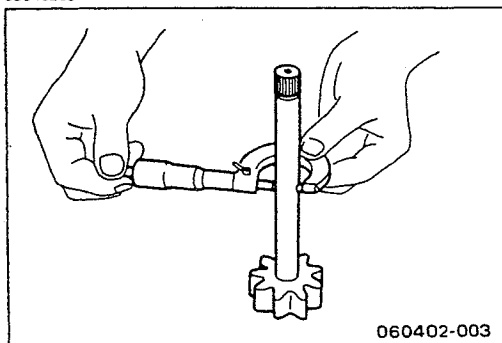
**Gear and Body Clearance**

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

If the clearance between the gear and the body exceeds the specified limit, the body must be replaced.

Gear and Body Clearance mm(in)	
Standard	Limit
0.06 (0.024)	0.15 (0.0059)

06040203



060402-003

**Drive Shaft and Oil Pump Body Clearance**

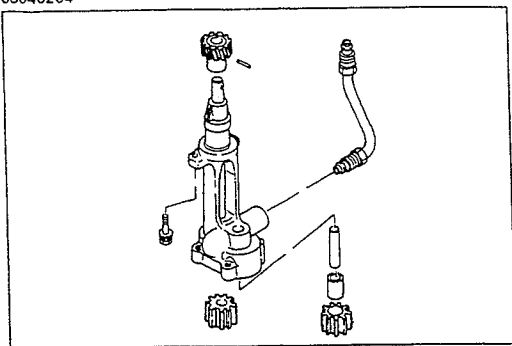
Use a micrometer to measure the drive shaft outside diameter.

Use an inside dial indicator to measure the pump body inside diameter.

If the clearance between the drive shaft and the oil pump body exceeds the specified limit, the oil pump assembly must be replaced.

Drive Shaft and Oil Pump Body Clearance mm(in)	
Standard	Limit
0.04 (0.0016)	0.20 (0.0079)

06040204



Driven Shaft and Bushing Clearance

Use a micrometer to measure the driven shaft outside diameter.

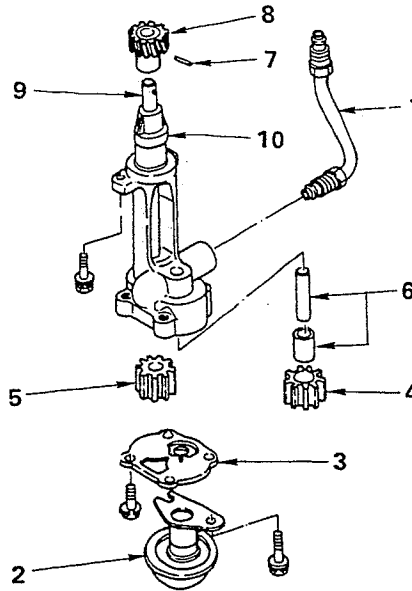
Use an inside dial indicator to measure the bushing inside diameter.

If the clearance between the driven shaft and the bushing exceeds the specified limit, the bushing must be replaced.

Driven Shaft and Bushing Clearance		mm(in)
Standard	Limit	
0.05 (0.0020)	0.15(0.0059)	



REASSEMBLY



Reassembly Steps

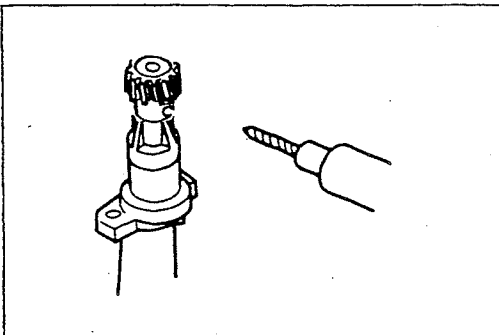
- | | |
|------------------|------------------|
| 1. Oil pump body | 6. Pump cover |
| 2. Drive shaft | ▲ 7. Pinion gear |
| 3. Driven shaft | ▲ 8. Pinion pin |
| 4. Driven gear | 9. Strainer |
| 5. Drive gear | 10. Oil pipe |

06D40301



Important Operations

06D4030101



▲ Pinion Gear

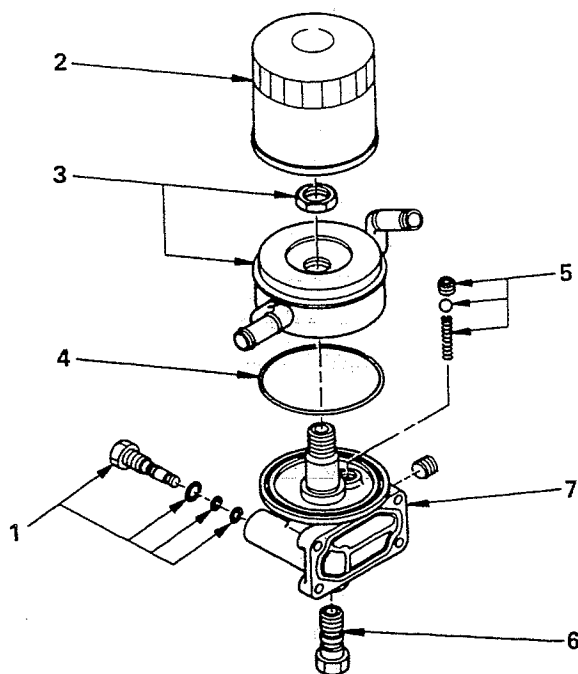
▲ Pinion Pin

- 1) Install the new drive shaft to the pump body.
- 2) Set the pinion gear to the drive shaft.
- 3) Use a 5 mm (0.20 in) drill to drill a hole through the pinion gear and the drive shaft.
- 4) Insert the pinion pin into the hole.
- 5) Caulk the pinion pin.

0605001

OIL FILTER WITH BUILT-IN OIL COOLER

060501

**DISASSEMBLY**

060501-002

Disassembly Steps

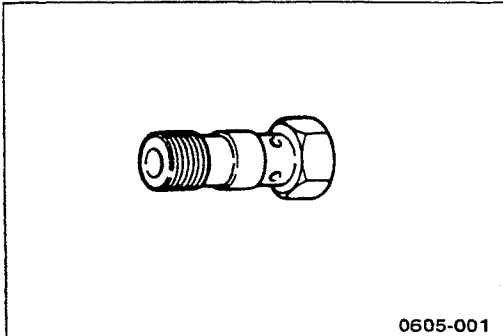
- | | |
|-------------------------|--------------------|
| 1. Drain plug | 5. Safety valve |
| 2. Cartridge oil filter | 6. Relief valve |
| 3. Oil cooler | 7. Oil filter body |
| 4. O-ring | |



INSPECTION AND REPAIR

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

06050201



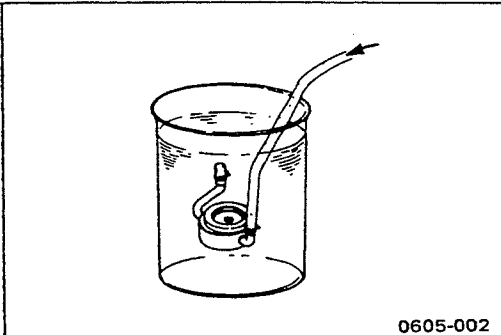
0605-001

Relief Valve

1. Attach an oil pressure gauge to the oil gallery near the oil filter.
2. Start the engine to check the relief valve opening pressure.

Relief Valve Opening Pressure		kg/cm ² (psi/kPa)
4JA1*4JB1		4.3—4.7 (61.1—66.8/421.4—460.6)
4JB1T*4JB1TC		5.7—6.3 (82.5—89.5/558.6—617.4)

06050202



0605-002

Oil Cooler

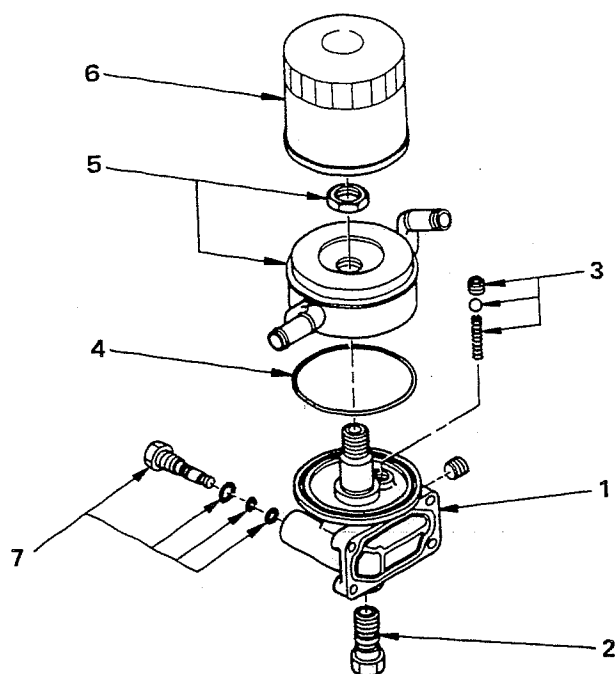
Water Leakage At Water Passage

1. Plug one side of the oil cooler water passage.
2. Submerge the oil cooler in water.
3. Apply compressed air (2 kg/cm² (28.4 psi/196 kPa)) to the other side of the oil cooler water passage.
If air bubbles rise to the surface, there is water leakage.

060503



REASSEMBLY



060503-007

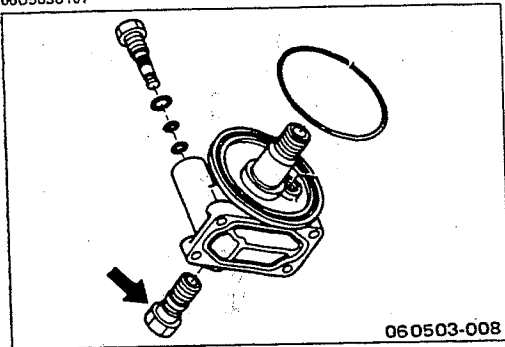
Reassembly Steps

- | | |
|--------------------|---------------------------|
| 1. Oil filter body | ▲ 5. Oil cooler |
| ▲ 2. Relief valve | ▲ 6. Oil filter cartridge |
| 3. Safety valve | ▲ 7. Drain plug |
| 4. O-ring | |



Important Operations

0605030101



060503-008

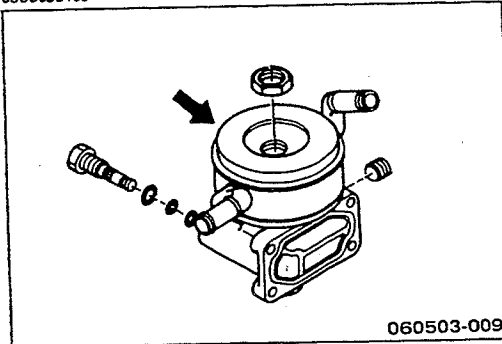


▲ Relief Valve

Tighten the relief valve to the specified torque.

Relief Valve Torque	kg·m(lb.ft/N·m)
2.0 ± 0.5	$(14.5 \pm 3.6/19.60 \pm 4.90)$

0605030103



060503-009

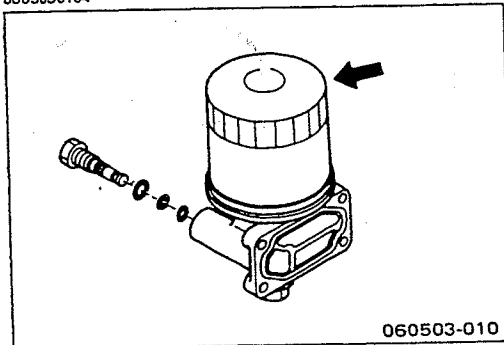


▲ Oil Cooler

- 1) Align the oil filter holes with the body knock pins at installation.
- 2) Tighten the oil cooler nut to the specified torque.

Oil Cooler Torque	kg·m(lb.ft/N·m)
3.0 ± 0.5	$(21.7 \pm 3.6/29.40 \pm 4.90)$

0605030104



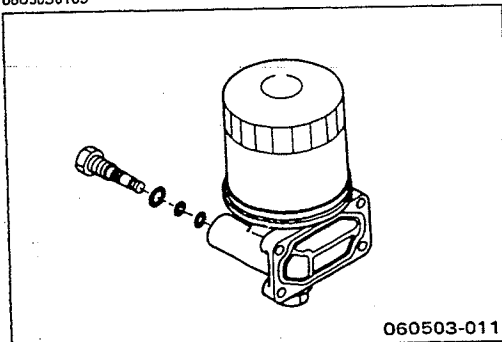
060503-010



▲ Oil Filter Cartridge

- 1) Apply engine oil to the O-ring.
- 2) Turn in the cartridge oil filter until the filter sealing face makes contact with the O-ring.
- 3) Turn in the cartridge oil filter an additional 1 and 1/4 turns.

0605030105



060503-011



▲ Drain Plug

Tighten the drain plug to the specified torque.

Drain Plug Torque	kg·m(lb.ft/N·m)
2.0 ± 0.5	$(14.5 \pm 3.6/19.60 \pm 4.90)$

0700

COOLING SYSTEM

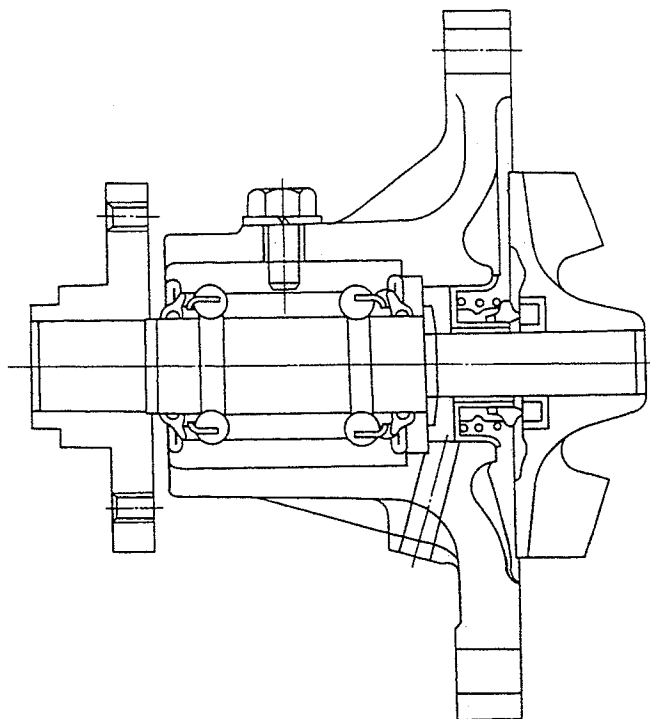
0701

MAIN DATA AND SPECIFICATIONS

Item	Description	
Water pump type	Centrifugal	
Pump to crankshaft speed ratio (To 1)	1.1	
*Delivery volume lit(US/UK gal)/min	100 (26.3/22.2)	
Pump bearing type	Double row shaft	
Thermostat type	Wax pellet with jiggle valve	
Valve initial opening temperature °C(°F)	82 (180)	Primary: 85 (185) Secondary: 88 (190)
Valve full opening temperature °C(°F)	95 (203)	100 (212)
Valve lift at fully open position mm(in)	8 (0.31)	10 (0.39)
Thermovalve		
Valve initial opening temperature °C(°F)	75 (167)	
Valve full opening temperature °C(°F)	90 (194)	
Valve lift at fully open position mm(in)	4.5 (0.18 or more)	

*Pump speed at 3,000 rpm and water temperature at 30°C (86°F)

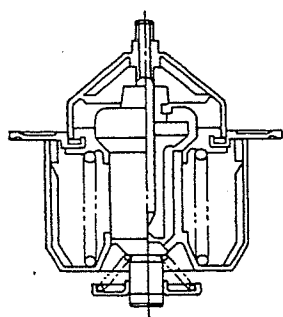
WATER PUMP



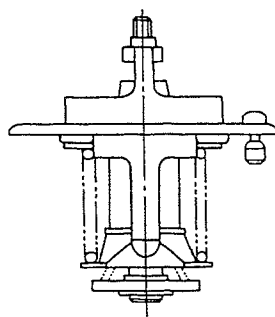
070202-003

070202B

THERMOSTAT



Single Valve



Two Valve

A centrifugal type water pump forcefully circulates the coolant through the cooling system.

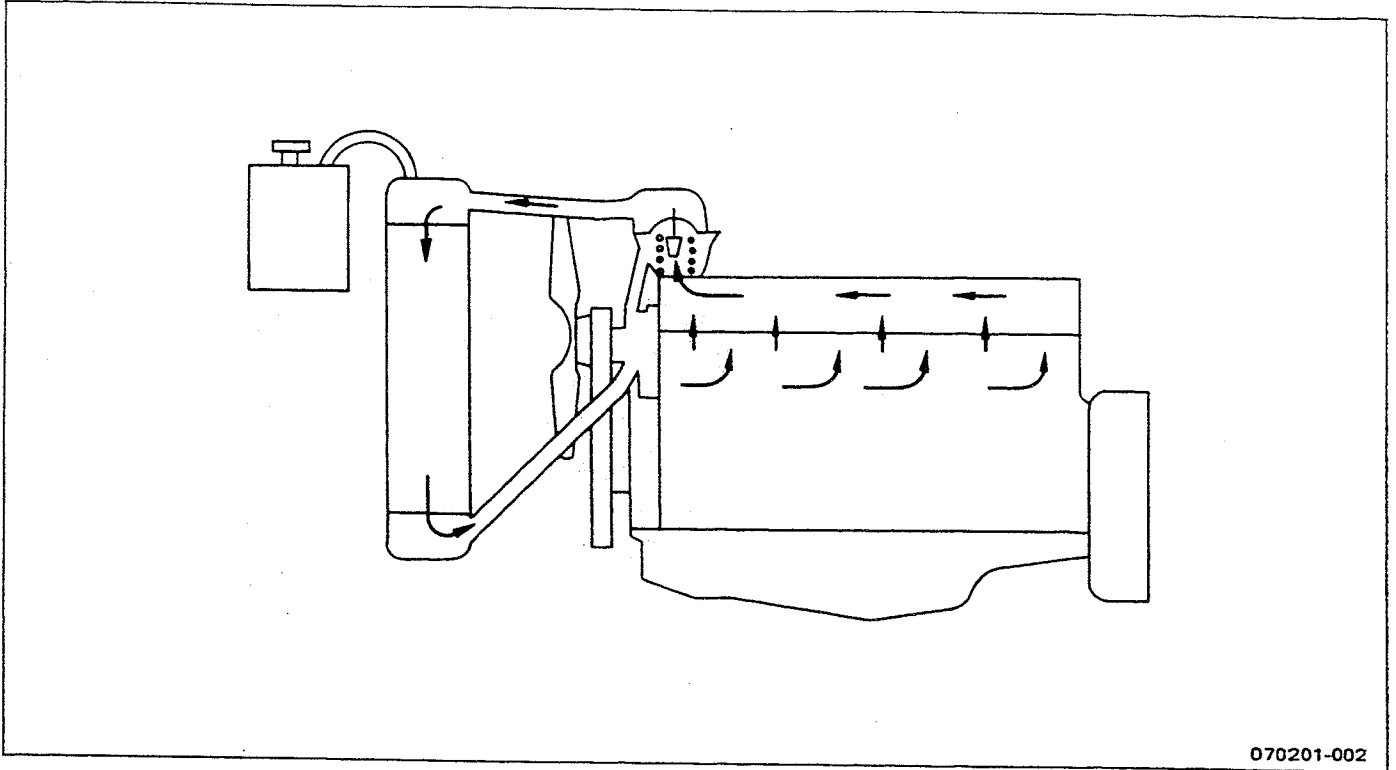
A wax pellet type thermostat is used.

The jiggle valve accelerates engine warmup.

GENERAL DESCRIPTION

070201

COOLANT FLOW



The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostat. Either a single valve type or a two-valve type thermostat is used. Installation depends upon engine and vehicle model.

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

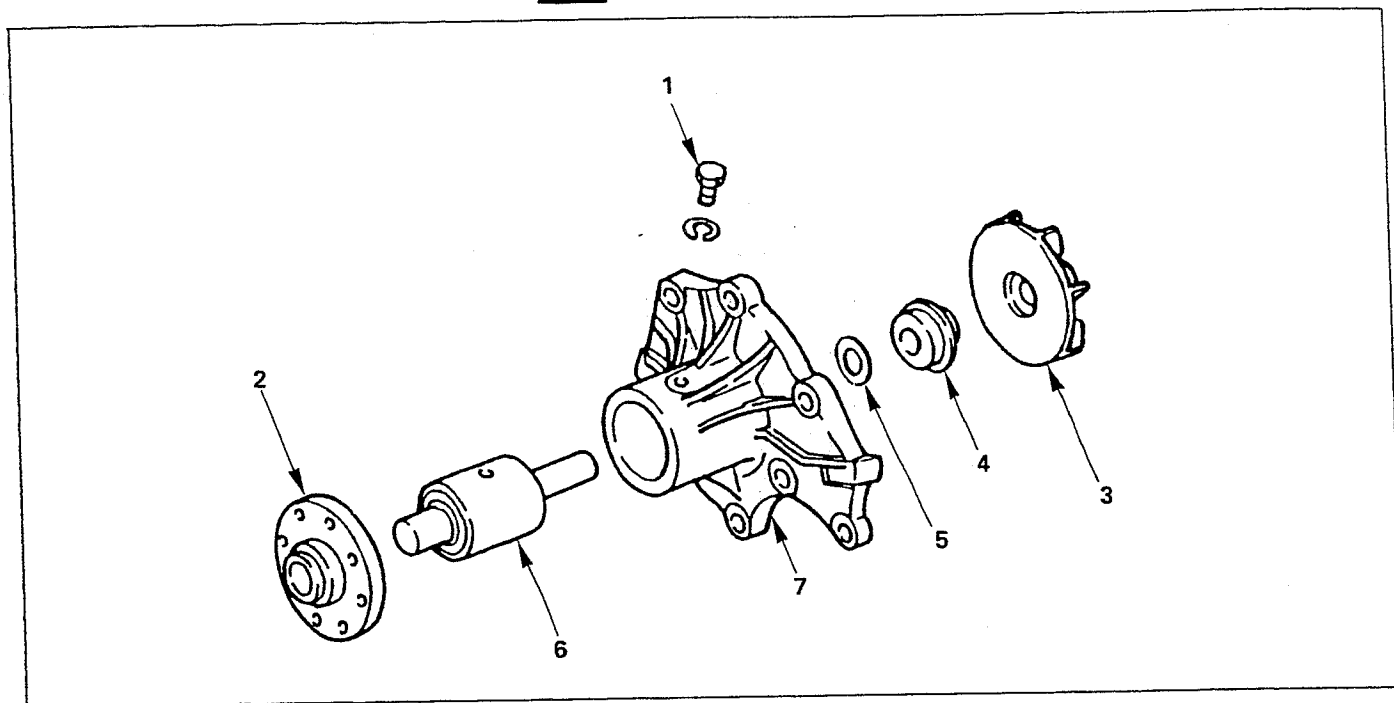
When the coolant temperature reaches the 82 — 85°C (180 — 185°F) range, the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.

The thermostat will be fully open when the coolant temperature reaches the 95 — 100°C (203 — 212°F). All of the coolant is now circulating through the radiator for effective engine cooling.

The Quick-Warming-Up System (QWS) is available as an option.

WATER PUMP

DISASSEMBLY

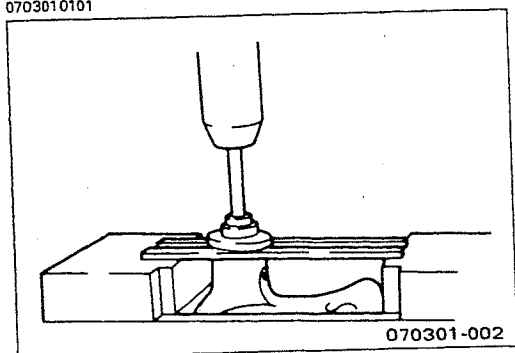


Disassembly Steps

- | | |
|-------------------------|--------------------|
| 1. Set screw | 5. Thrower |
| ▲ 2. Cooling fan center | 6. Bearing unit |
| ▲ 3. Impeller | 7. Water pump body |
| ▲ 4. Seal unit | |



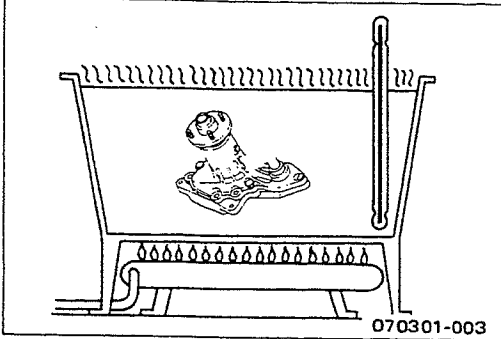
Important Operations



▲ Cooling Fan Center

Remove the fan center with a bench press and a bar.

0703010102A



070301-003

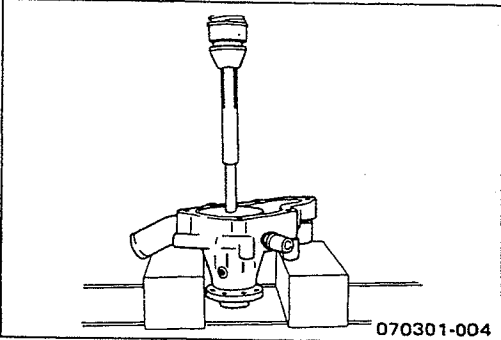
▲ Impeller (Aluminum Body Only)

▲ Seal Unit

▲ Bearing Unit

- 1) Heat the pump body in hot water (80 — 90°C/176 — 194°F).

0703010102B



070301-004



- 2) Remove the impeller, the seal unit, and the bearing unit with a bench press and bar.

Note:

Do not drive out the impeller with a hammer. Damage to the impeller will result.

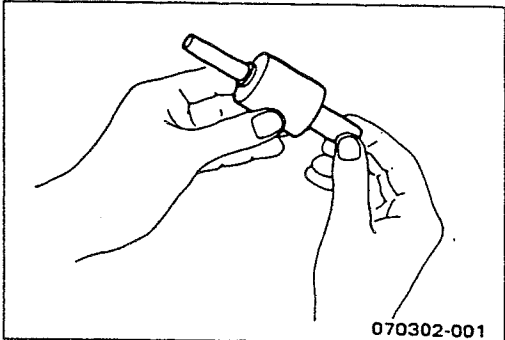
070302



INSPECTION AND REPAIR

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

07030201



070302-001

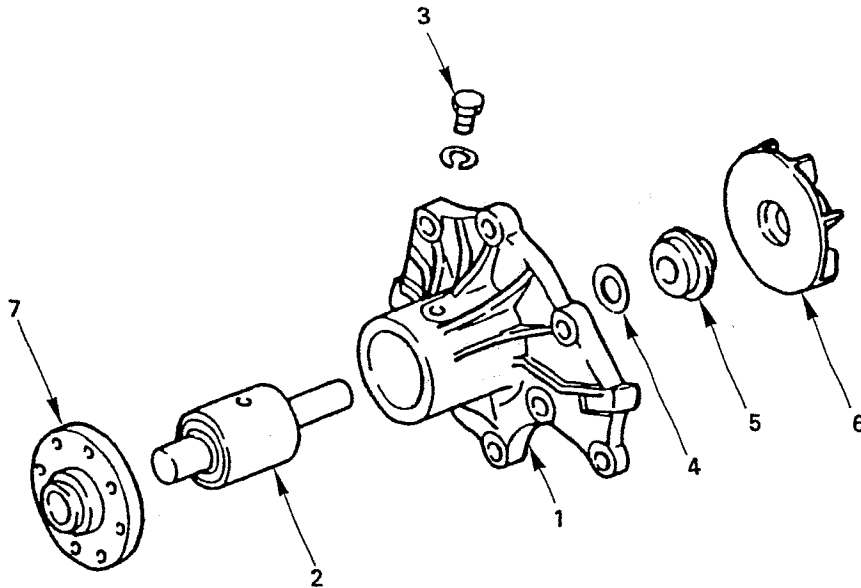


Bearing Unit

Check the bearing for abnormal noise, binding, and other abnormal conditions.



REASSEMBLY



Reassembly Steps

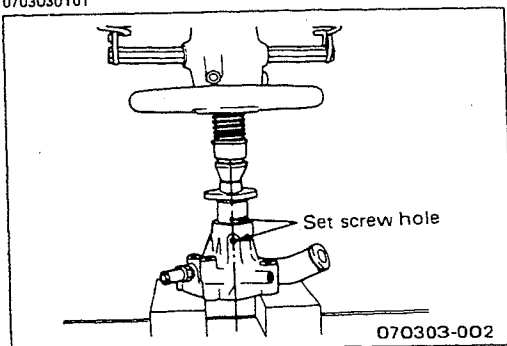
- | | |
|--------------------|-------------------------|
| 1. Water pump body | ▲ 5. Seal unit |
| ▲ 2. Bearing unit | ▲ 6. Impeller |
| ▲ 3. Set screw | ▲ 7. Cooling fan center |
| 4. Thrower | |

07030301



Important Operations

0703030101



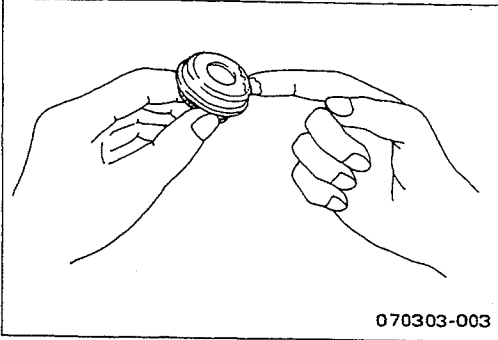
▲ Bearing Unit



▲ Set Screw

- 1) Align the bearing set screw hole with the pump body set screw hole.
- 2) Press the bearing unit into place.
- 3) Secure the bearing with the set screw.

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070303-003

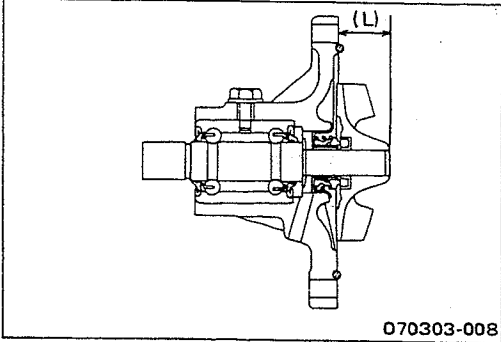


▲ Seal Unit

▲ Impeller

- 1) Apply a thin coat of liquid gasket to the seal unit outer periphery.
- 2) Install the seal unit.

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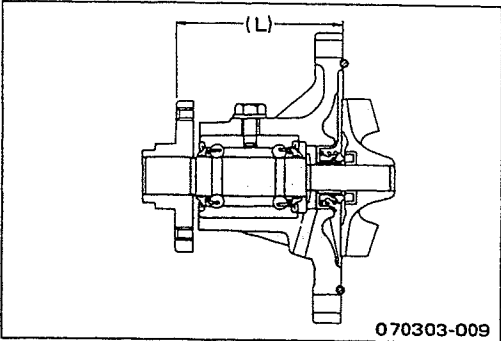
070303-008



- 3) Use a bench press to slowly force the impeller into place until the impeller installed distance from the water pump body face is equal to the specified value.

Impeller Projection (L) (Reference)	mm(in)
2.4 (0.94)	

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070303-009

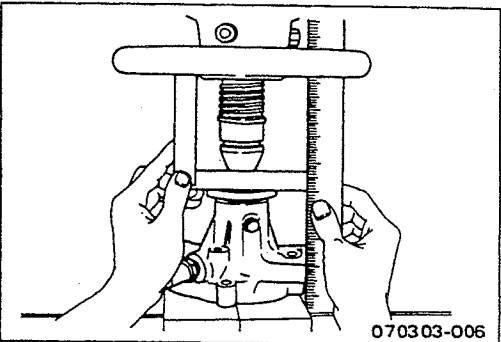


▲ Cooling Fan Center

Measure the distance between the cooling fan fitting face and the rear cover fitting face.

Cooling Fan Center Distance (L)	mm(in)
79.2-79.8 (3.12-3.14)	

0703030103B



070303-006

Notes:

1. The fan center and the impeller are installed to the water pump shaft with a press.
Never attempt to remove and reinstall the fan center and the impeller a second time. Replace the entire water pump assembly.
Removing and reinstalling the fan center and the impeller a second time may result in the breakdown of the water pump during engine operation and subsequent serious overheating problems.
2. The water pump assembly must be replaced whenever the fan center and impeller pressure force falls below 200 kg. (441 lb/1,960 N)
3. Do not attempt to strike the bearing into position with a hammer or similar object. Damage to the bearing will result.

FUEL SYSTEM

MAIN DATA AND SPECIFICATIONS

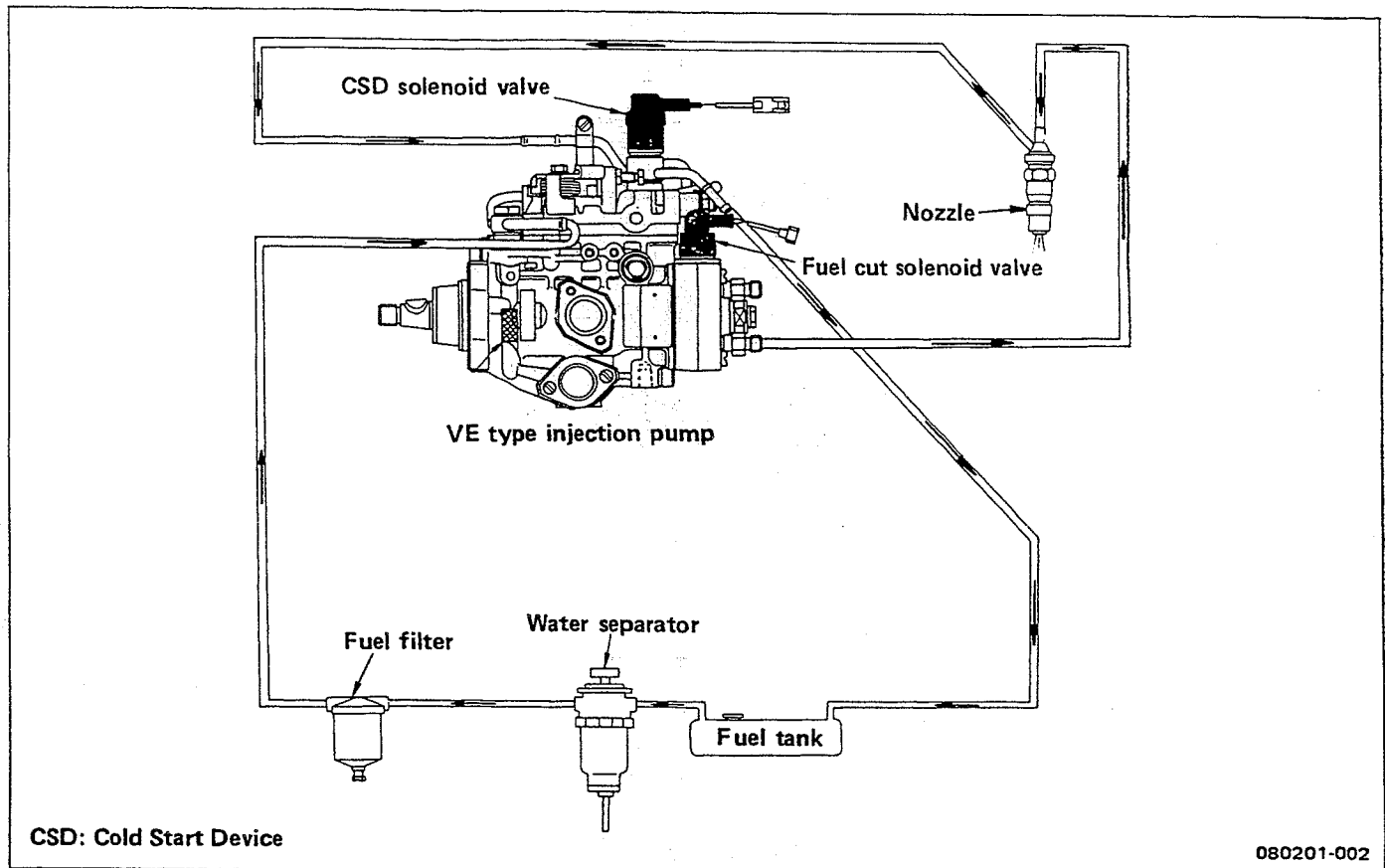
Item	4JA1, 4JB1, 4JB1T (For General Export)	4JB1T (For Europe)	4JB1TC (For Europe)
Injection pump type	Bosch Distributor		
Plunger outside diameter mm(in)	11 (0.43)		
Plunger lift mm(in)	2.2 (0.09)		
Governor type	Mechanical variable (Half all speed)		
Timer type	Oil pressure		
Fuel feed pump type	Vane with input shaft		
Injection nozzle type	Hole type		
Number of injection nozzle orifices	4		
Injection nozzle orifices mm(in) inside diameter	1 (0.04)		
Injection nozzle opening kg/cm ² (psi/kPa)	185 (2,631/18,143)		
Pressure (Design value)	Two spring type		
First:	170 (2,417/16,671)		
Second:	210 195 (2,986/20,593) (1,773/19,124)		
Main fuel filter type	Cartridge paper element and water separator		

0802

GENERAL DESCRIPTION

080201

FUEL FLOW



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

The fuel from the fuel tank passes through the water separator and the fuel filter where water particles and other foreign material are removed from the fuel.

Fuel, fed by the injection pump plunger, is delivered to the injection nozzle in the measured volume at the optimum timing for efficient engine operation.

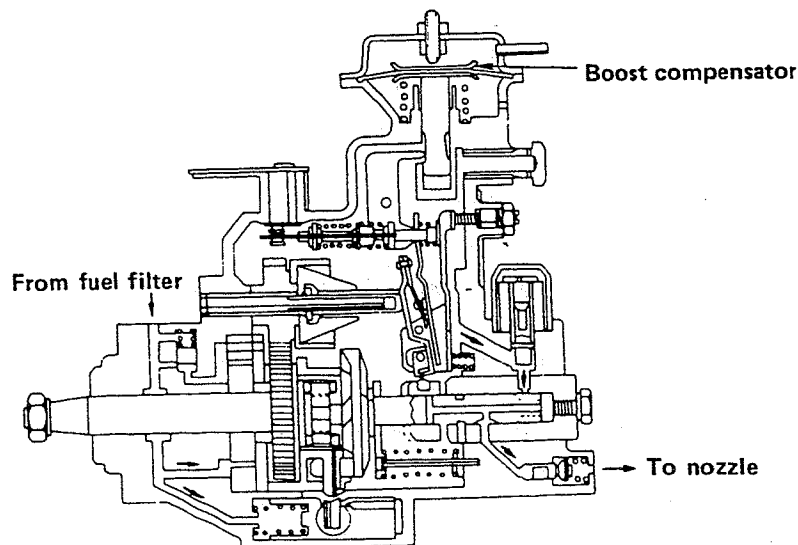
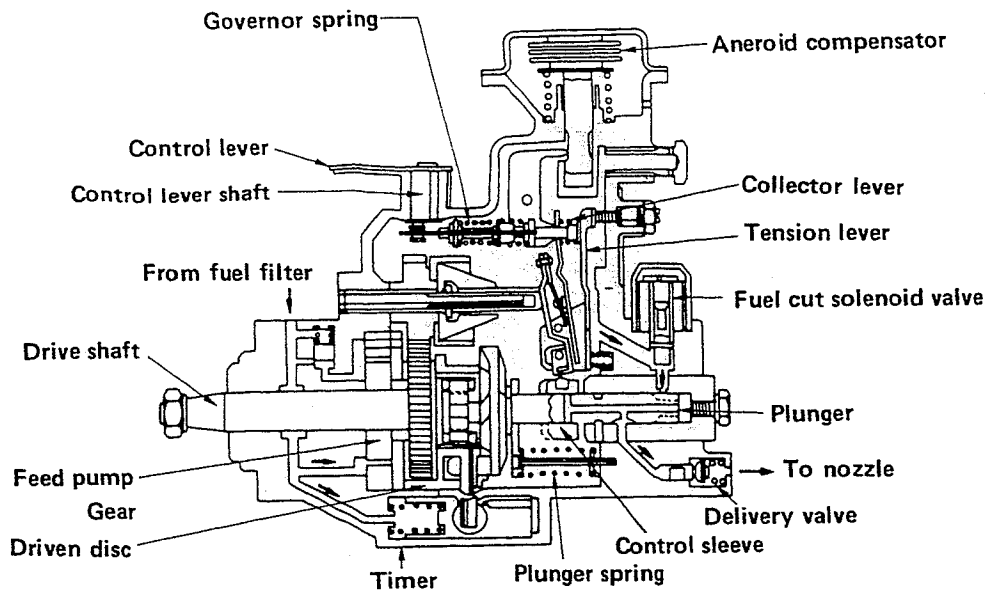
The CSD solenoid valve controls the injection pump internal pressure.

As the pressure rises, fuel injection timing is advanced.

The CSD solenoid valve is also called a "solenoid timer."

CSD solenoid valves are installed on engines equipped with cold weather starting systems.

INJECTION PUMP



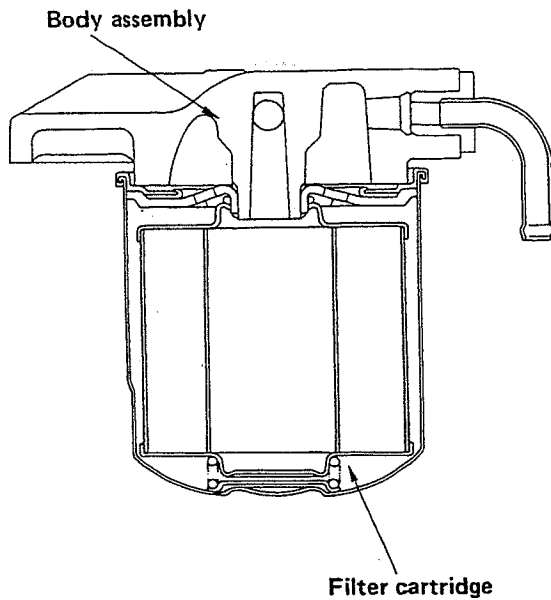
A Bosch Distributor Type Injection Pump is used. A single reciprocating/revolving plunger delivers the fuel uniformly to the injection nozzles, regardless of the number of cylinders.

The governor, the injection timer, and the feed pump are all contained in the injection pump housing. The injection pump is compact, light weight, and provides reliable high-speed operation.

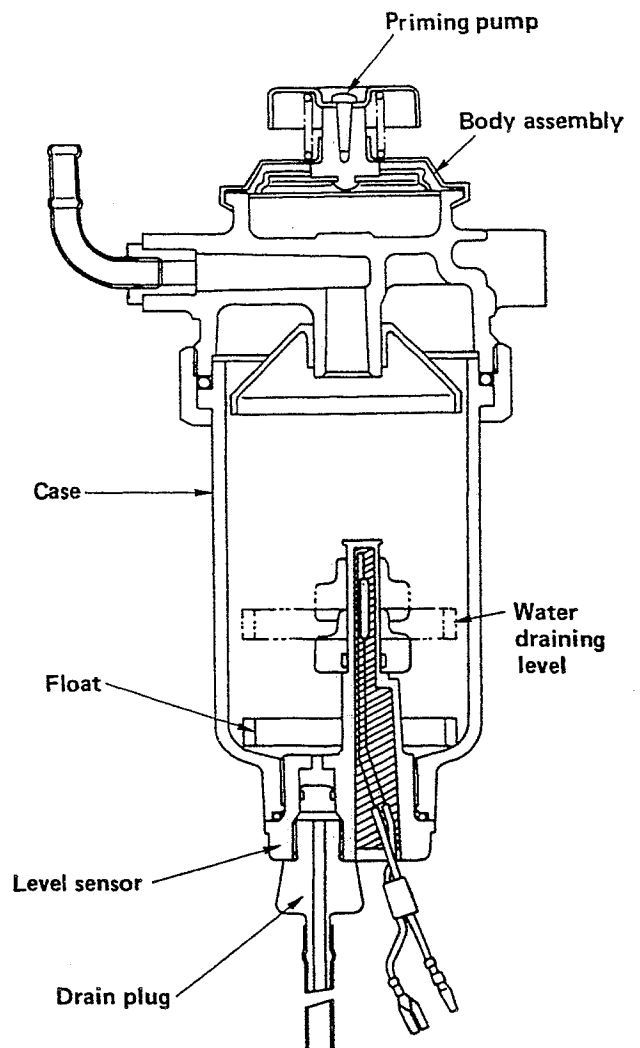
An aneroid compensator is available as an option for vehicles to be operated at high altitudes. It adjusts the fuel and air mixing ratio.

A boost compensator is installed on turbocharger equipped vehicles.

080203

FUEL FILTER AND WATER SEPARATOR

080203-001



080203-003

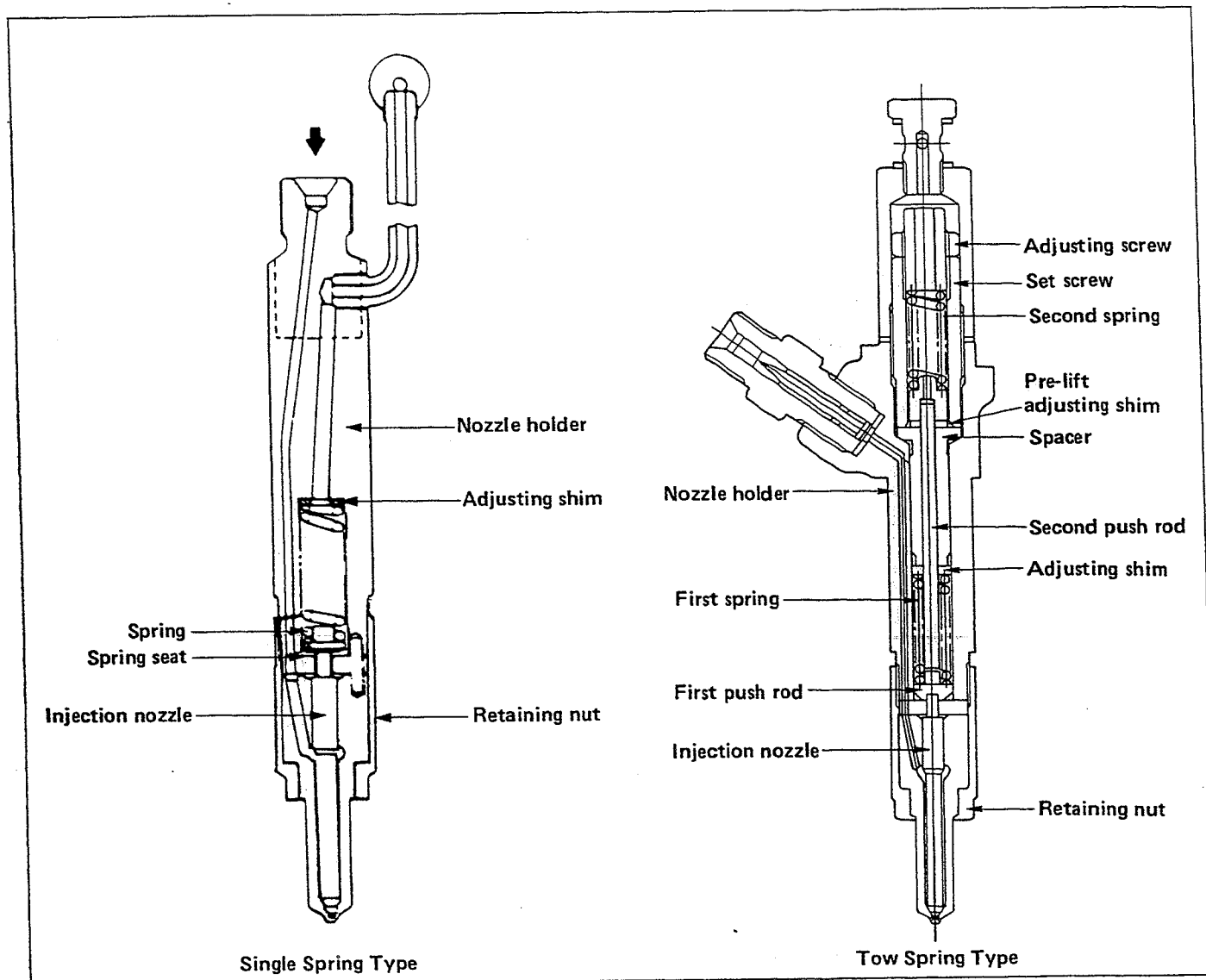
A cartridge type fuel filter and a water separator are used along with the VE type injection pump.

As the inside of the injection pump is lubricated by the fuel which it is pumping, the fuel must be perfectly clean. The fuel filter and the water separator remove water particles and other foreign material from the fuel before it reaches the injection pump.

The water separator has an internal float. When the float reaches the specified level, a warning light comes on to remind you to drain the water from the water separator.

A diaphragm type priming pump is installed at the top of the water separator. It is used during the water draining and the air bleeding procedures.

INJECTION NOZZLE



4J Series diesel engines are equipped with one of three types of injection nozzles, depending on engine and vehicle model.

The injection nozzle sprays pressurized fuel from the injection pump through the injection nozzle orifices and into the combustion chamber.

4J Series engines without turbocharger use a single spring hole type injection nozzle.

Turbocharged 4J series engines without an exhaust gas recirculation (EGR) system use a two spring hole type injection nozzle.

Turbocharged 4J series engines with the exhaust gas recirculation (EGR) system use a special two spring hole type injection nozzle.

Injection nozzle configurations for EGR equipped and EGR non-equipped engines are different. The nozzles are not interchangeable.

Two spring type injection nozzles have two independent springs and push rods.

First nozzle opening pressure is controlled by the first spring.

Second nozzle opening pressure must be adjusted with the adjusting screw when the injection nozzle is reassembled after major servicing.

Do not loosen the adjusting screw, lock nut, and set screw during ordinary servicing.

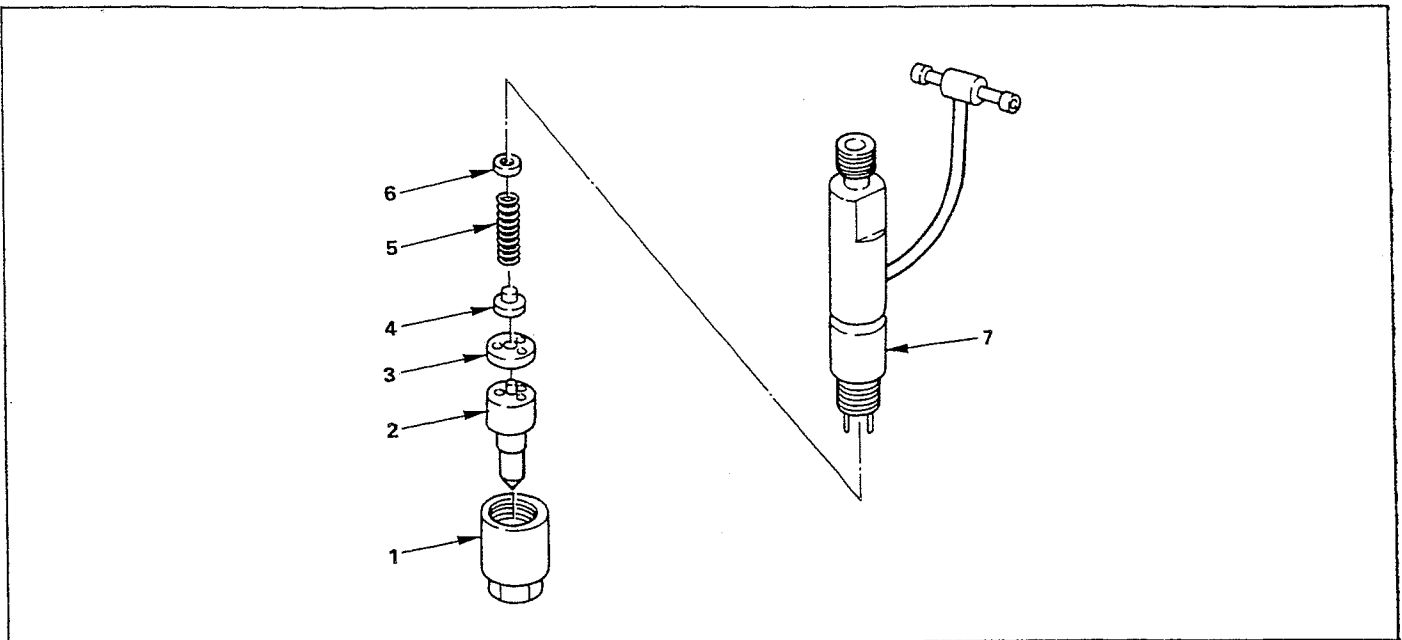
0803

INJECTION NOZZLE

0803010001A



DISASSEMBLY



Disassembly Steps

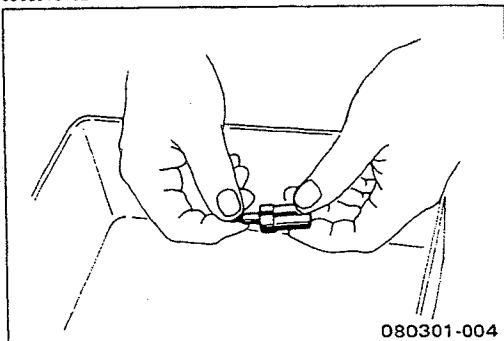
- | | |
|-----------------------|-------------------|
| 1. Retaining nut | 5. Spring |
| ▲ 2. Injection nozzle | 6. Adjusting shim |
| 3. Spacer | 7. Nozzle holder |
| 4. Spring seat | |

08030101



Important Operations

0803010102



▲ Injection Nozzle

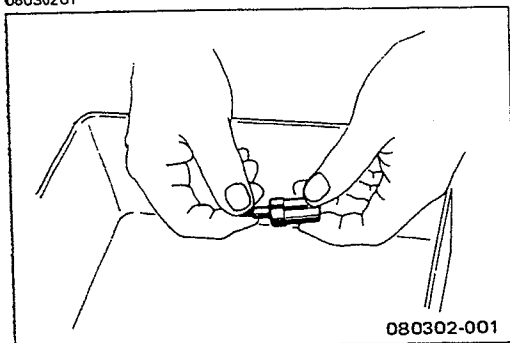
- 1) Remove the nozzle assemblies from the nozzle holders.
Tag the nozzle assemblies and the nozzle holders to ensure that they are reinstalled in their original positions.
The nozzle assembly and nozzle holder combinations must not be interchanged.
- 2) Immerse the injection nozzles in a tool tray filled with clean diesel oil to protect them from dust.



INSPECTION AND REPAIR

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

08030201



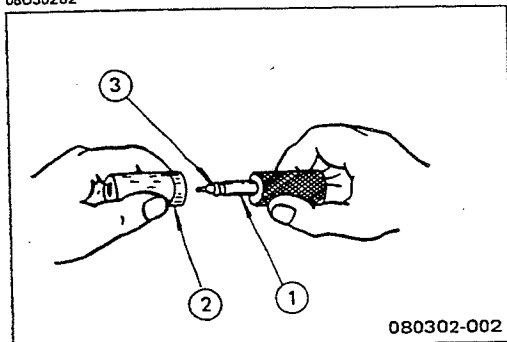
080302-001

Injection Nozzle Needle Inspection

1. Remove the nozzle needle from the nozzle body.
2. Carefully wash the nozzle needle and the nozzle body in clean diesel fuel.
3. Check that the nozzle needle moves smoothly inside the injection nozzle body.

If the nozzle needle does not move smoothly, it must be repaired (See "Nozzle Lapping Procedure" below).

08030202



080302-002

**Nozzle Lapping Procedure**

1. Lap the nozzle needle ① and the nozzle body ② by applying a compound of oxidized chrome and animal oil.

Note:

Do not apply an excessive amount of the oxidized chrome and animal oil compound to the injection needle valve seat area.

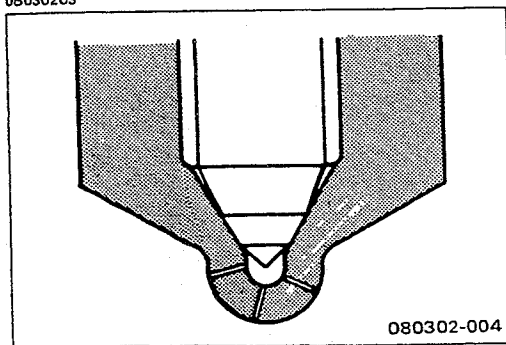
2. Carefully wash the needle valve and the nozzle body in clean diesel fuel after lapping.

Nozzle Body and Needle Valve Inspection

Check the nozzle body and the needle valve for damage and deformation.

The nozzle and body assembly must be replaced if either of these two conditions are discovered during inspection.

08030203

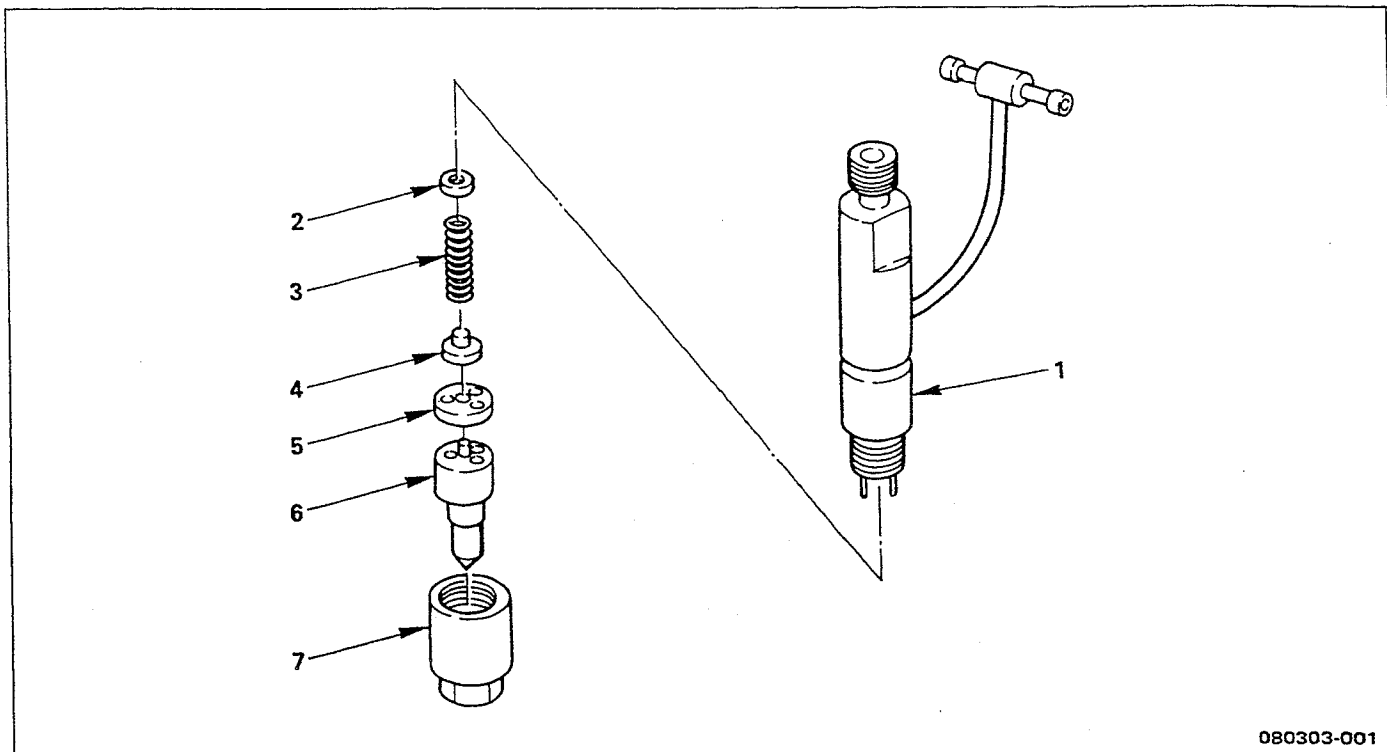


080302-004

08030301



REASSEMBLY



080303-001

Reassembly Steps

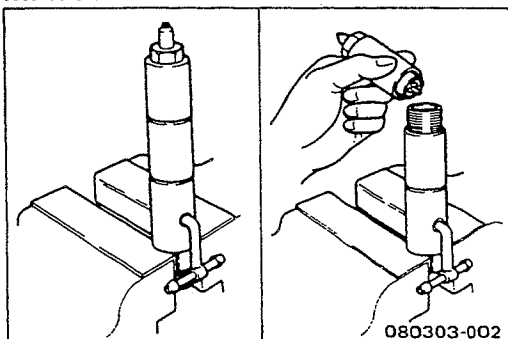
- | | |
|-------------------|---------------------|
| 1. Nozzle holder | 5. Spacer |
| 2. Adjusting shim | 6. Injection nozzle |
| 3. Spring | ▲ 7. Retaining nut |
| 4. Spring seat | |

0803030101



Important Operations

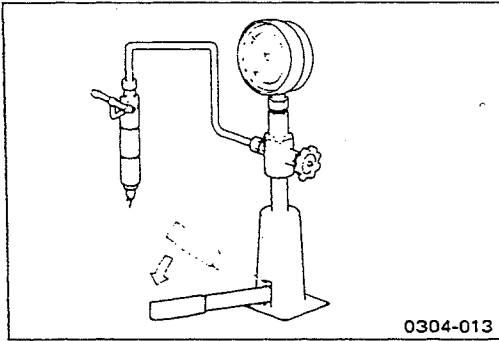
080303010101



▲ Retaining Nut

Tighten the retaining nut to the specified torque.

Retaining Nut Torque	kg·m(lb.ft/N·m)
4.5 ± 0.5 ($32.5 \pm 3.6/44.10 \pm 4.90$)	

**Injection Nozzle Adjustment**

- 1) Attach the injection nozzle holder to the injection nozzle tester.
- 2) Apply pressure to the nozzle tester to check that the injection nozzle opens at the specified pressure.

If the injection nozzle does not open at the specified pressure, install or remove the appropriate number of adjusting shims to adjust it.

Adjusting Shim Availability		mm(in)
Range	0.50 — 1.50	(0.02 — 0.06)
Increment		0.025 (0.001)
Total No. of Shims		41

Removing or installing one shim will increase or decrease the nozzle opening pressure approximately 3.77 kg/cm³ (53.6 psi/369.46 kPa).

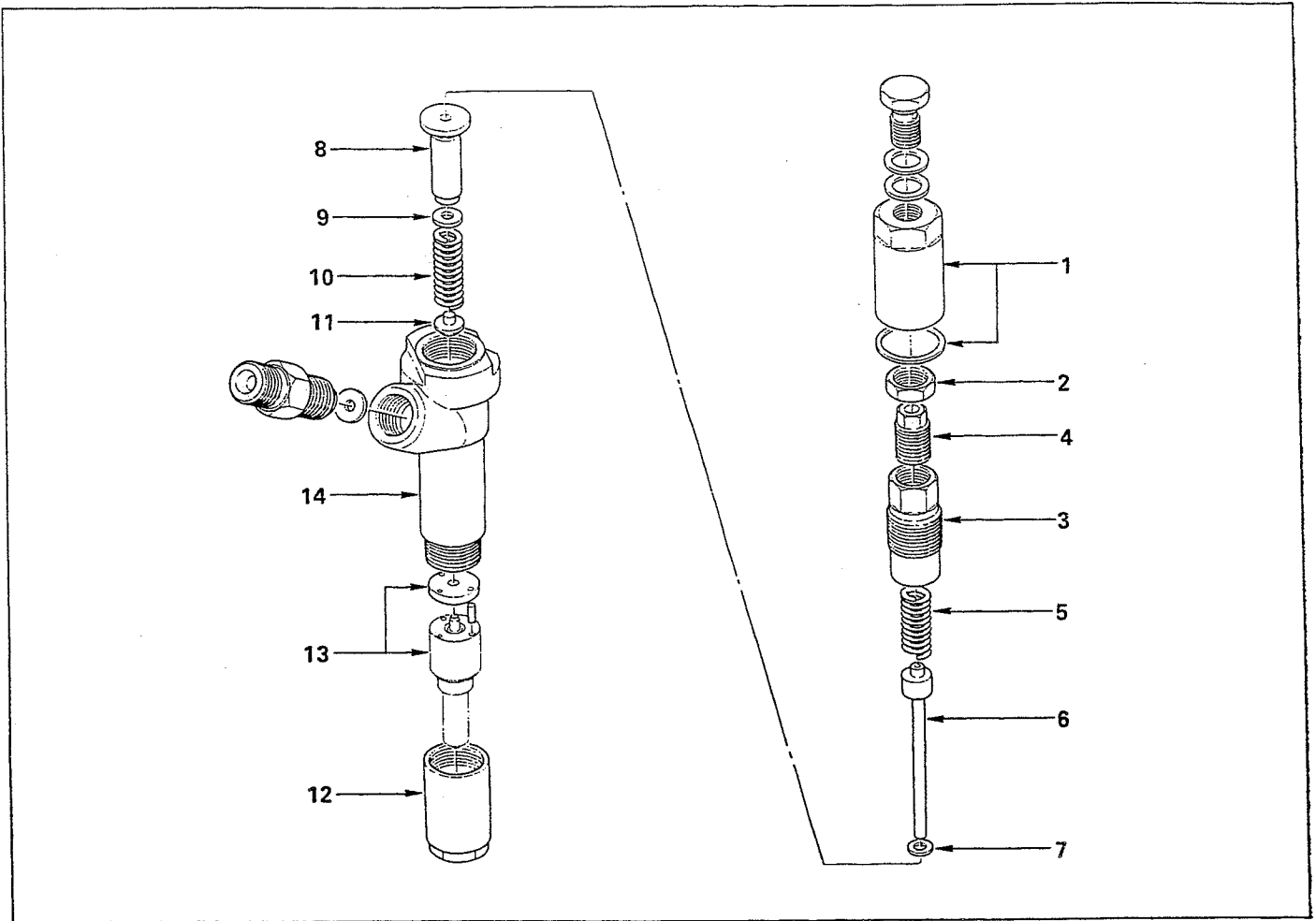
WARNING:

TEST FLUID FROM THE INJECTION NOZZLE WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PERSON'S SKIN. KEEP YOUR HANDS AWAY FROM THE INJECTION NOZZLE TESTER AT ALL TIMES.

INJECTION NOZZLE (TWO-SPRING TYPE)



DISASSEMBLY

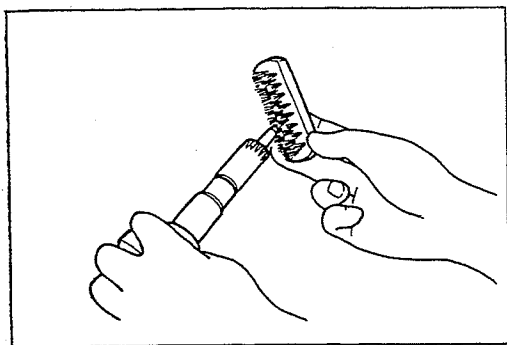


Disassembly Steps

- | | |
|------------------------------|-------------------------------|
| ▲ 1. Cap nut and gasket | ▲ 8. Spacer |
| ▲ 2. Lock nut | ▲ 9. Adjusting shim |
| ▲ 3. Set screw | ▲ 10. First spring |
| ▲ 4. Adjusting screw | ▲ 11. First push rod |
| ▲ 5. Second spring | ▲ 12. Retaining nut |
| ▲ 6. Second push rod | ▲ 13. Injection nozzle |
| ▲ 7. Pre-lift adjusting shim | ▲ 14. Injection nozzle holder |



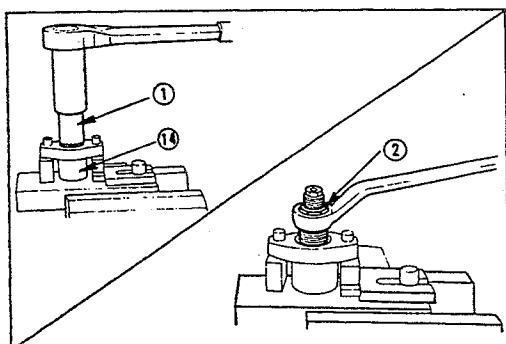
Important Operations



Injection Nozzle and Injection Nozzle Holder Assembly Cleaning

Clean the injection nozzle and the injector nozzle assembly before beginning the disassembly procedure.

- 1) Remove any carbon adhering to the injection nozzle tip.
- 2) Dip the nozzle holder assembly in a suitable cleaner to clean it.



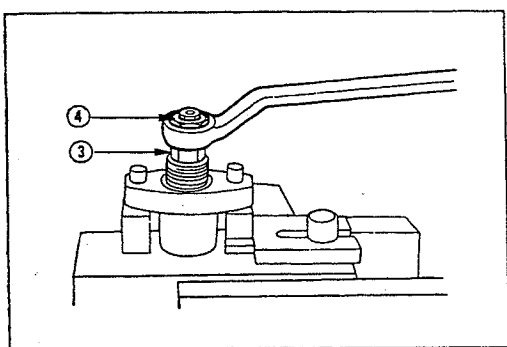
▲ Cap Nut and Gasket

▲ Lock Nut

- 1) Clamp the injection nozzle and injection nozzle holder assembly in a vise.

The cap nut and gasket must be facing up.

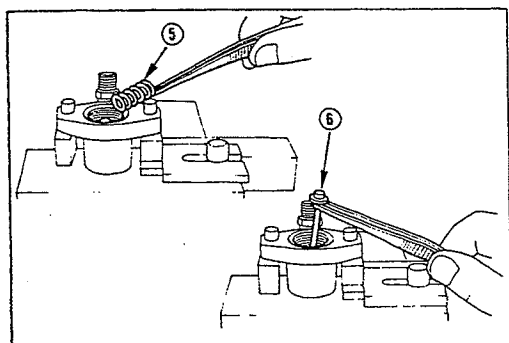
- 2) Remove the cap nut and gasket ①, the lock nut ② from the injection nozzle holder ⑭.



▲ Set Screw

▲ Adjusting Screw

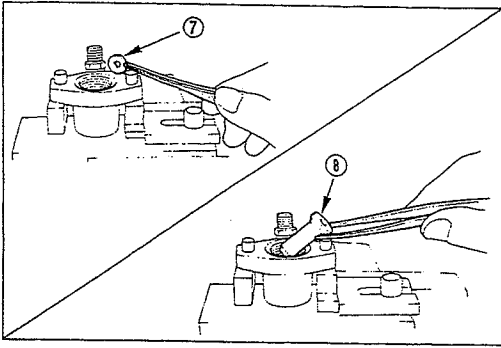
Remove the set screw ③, and the adjusting screw ④ from the injection nozzle holder.



▲ Second Spring

▲ Second Push Rod

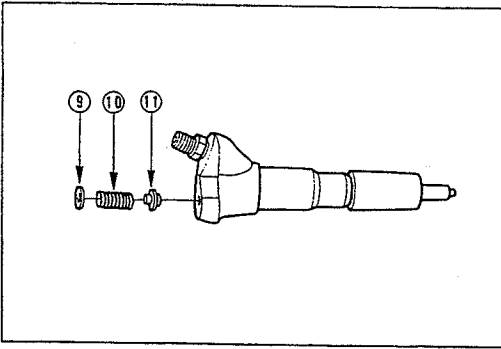
Remove the second spring ⑤, and the second push rod ⑥ from the injection nozzle holder.



▲ Pre-Lift Adjusting Shim

▲ Spacer

Remove the pre-lift adjusting shim ⑦, and the spacer ⑧ from the injection nozzle holder.

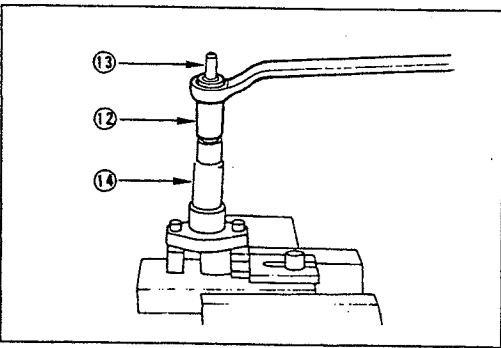


▲ Adjusting Shim

▲ First Spring

▲ First Push Rod

- 1) Remove the injection nozzle holder assembly from the vise.
- 2) Remove the adjusting shim ⑨, the first spring ⑩, and the first push rod ⑪ from the injection nozzle and injection nozzle holder.



▲ Retaining Nut

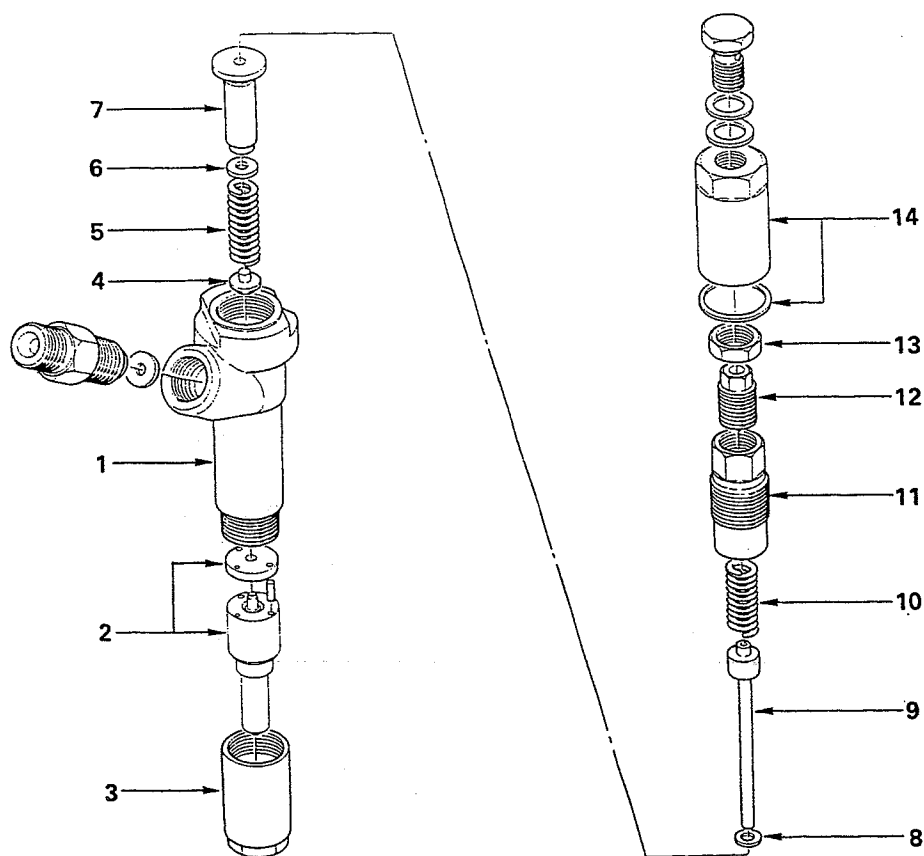
▲ Injection Nozzle

▲ Injection Nozzle Holder

- 1) Clamp the injection nozzle and injection nozzle assembly in a vise.
The retaining nut must be facing up.
- 2) Remove the retaining nut ⑫ from the injection nozzle holder.
- 3) Remove the injection nozzle ⑬ from the injection nozzle holder ⑭.



REASSEMBLY

**Reassembly Steps**

- | | |
|------------------------------|------------------------------|
| ▲ 1. Injection nozzle holder | ▲ 8. Pre-lift adjusting shim |
| ▲ 2. Injection nozzle | ▲ 9. Second push rod |
| ▲ 3. Retaining nut | ▲ 10. Second spring |
| ▲ 4. First push rod | ▲ 11. Set screw |
| ▲ 5. First spring | ▲ 12. Adjusting screw |
| ▲ 6. Adjusting shim | ▲ 13. Lock nut |
| ▲ 7. Spacer | ▲ 14. Cap nut and gasket |



Important Operations

The two-spring type injection nozzle assembly procedure is the reverse of the disassembly procedure.

Carefully follow the instructions to assemble and adjust the two-spring type injection nozzle.

Remember that the injection nozzle used with an EGR equipped engine is different from the injection nozzle used with an engine not equipped with an EGR system.

The two injection nozzle types are not interchangeable.

Be absolutely sure that you are installing the correct injection nozzle.



INJECTION NOZZLE ADJUSTMENT

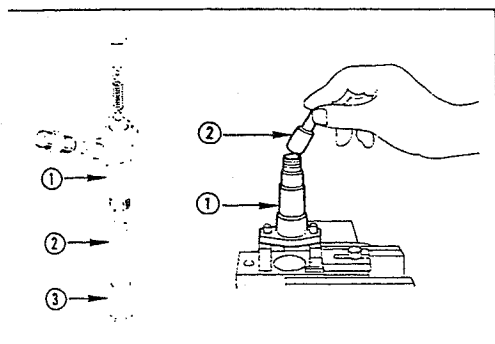


Injection nozzle adjustment must be performed during the assembly procedure.

Special measuring instruments and procedures are required to make the complicated and delicate adjustments. Carefully follow the instructions to adjust the injection nozzle.

Note the following:

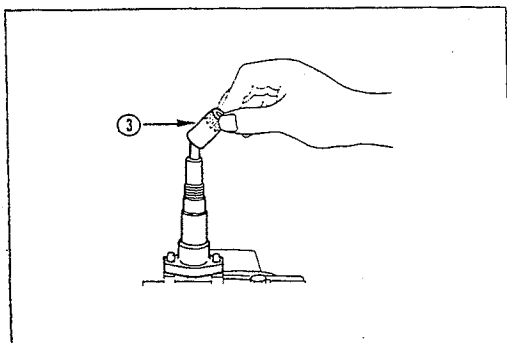
- * Assemble the injection nozzle near the nozzle tester. This will save time and effort when making adjustments.
- * The pre-lift measurement and adjustment must be made in increments of 0.01 mm (0.0004 in).
- * Each injection nozzle part must be carefully washed in diesel oil and wiped free of all foreign material before assembly.



INJECTION NOZZLE REASSEMBLY AND ADJUSTMENT PROCEDURE

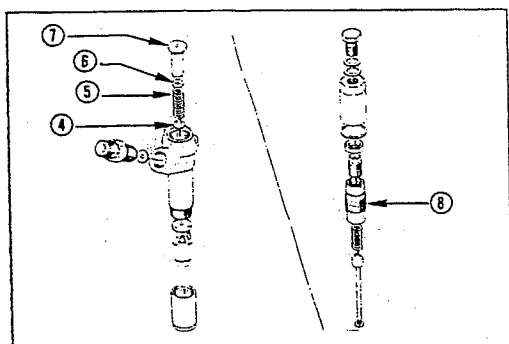
First Nozzle Opening Pressure Adjustment

1. Clamp the injection nozzle holder ① in a vise.
The nozzle holder cap must be facing down.
2. Align the injection nozzle ② knock pin with the nozzle holder knock pin hole.
Install the injection nozzle to the nozzle holder.

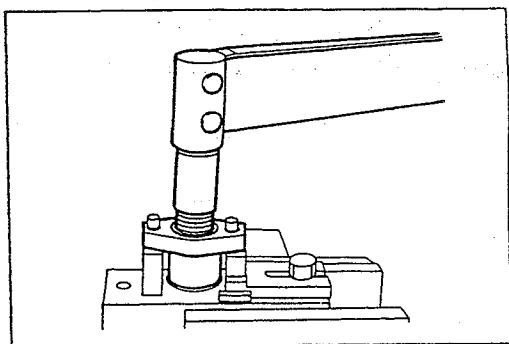


3. Install the retaining nut ③ to the nozzle holder.
4. Use a socket wrench to tighten the retaining nut to the specified torque.

Retaining Nut Torque	kg·m(lb.ft/N·m)
	3.5 ± 0.5 ($25.3 \pm 3.6/34.30 \pm 4.90$)



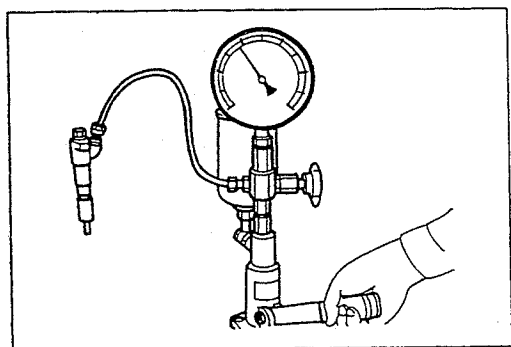
5. Reverse the position of the nozzle holder in the vise. The nozzle holder cap will now be facing up.
6. Install the first push rod ④, the first spring ⑤, the adjusting shim ⑥, and the spacer ⑦ to the nozzle holder.
7. Install the set screw ⑧ to the nozzle holder.



8. Use a socket wrench to tighten the set screw to the specified torque.

Set Screw Torque	kg·m(lb.ft/N·m)
	3.75 ± 0.25 ($27.1 \pm 1.8/36.75 \pm 2.45$)

9. Remove the nozzle holder from the vise.



10. Attach the nozzle holder to the injection nozzle tester.
11. Apply pressure to the nozzle tester.

The injection nozzle should open within the specified opening pressure range.

First Injection Nozzle Opening Pressure (Service Value)	kg/cm ² (psi/kPa)
4JB1T, 4JB1TC	180 ± 5 ($2,560 \pm 71/17,653 \pm 490$)

If the injection nozzle does not open within the specified range, the nozzle opening pressure must be adjusted.

Each shim thickness must be measured with a micrometer.

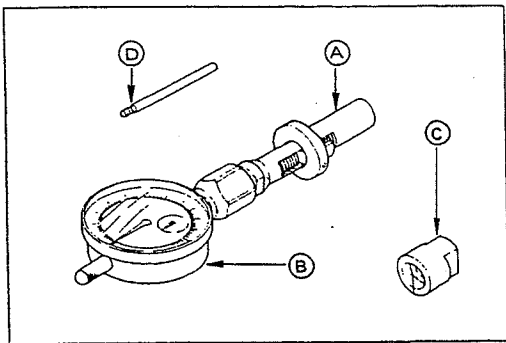
Adjust the opening pressure by installing shims of different thickness.

Installing a one-step larger or smaller shim will increase or decrease the nozzle opening pressure approximately 1.5 kg/cm² (21.3 psi/147 kPa).

Adjusting Shim Availability		mm(in)
Range		1.00 — 1.75 (0.04 — 0.07)
Increment		0.01 (0.0004)
Maximum Number of Shims		76

WARNING:

TEST FLUID FROM THE INJECTION NOZZLE WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PERSON'S SKIN. KEEP YOUR HANDS AWAY FROM THE INJECTION NOZZLE TESTER AT ALL TIMES.

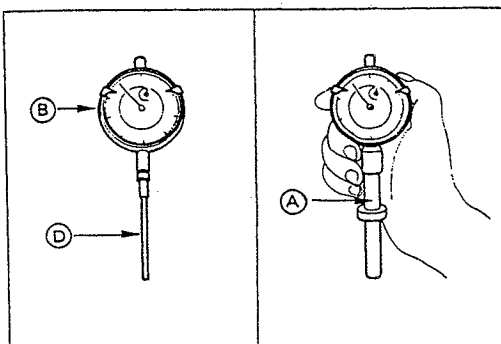
**Pre-Lift Adjusting Shim Selection**

The pre-lift adjusting shim selection must be done directly after "First Nozzle Opening Pressure Adjustment."

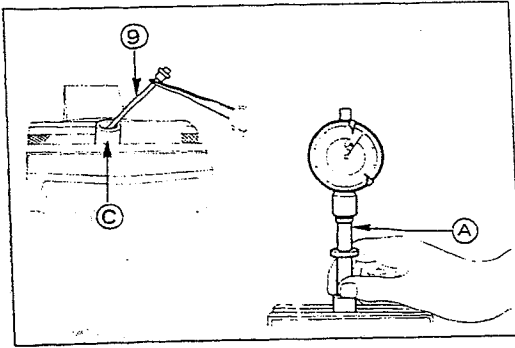
The following special tools are required for pre-lift adjustment shim selection.

Adjusting Device Kit: 5-8840-2138-0

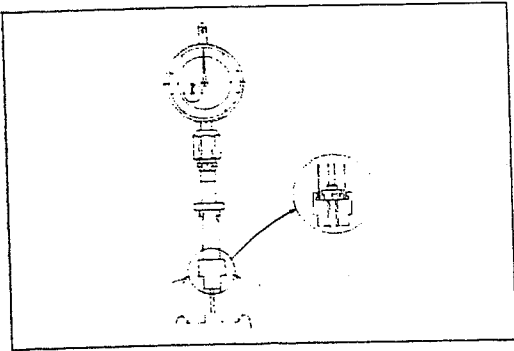
- (A) Adjusting Device : 5-8840-2139-0
- (B) Dial Indicator : 5-8840-2140-0
- (C) Base : 5-8840-2141-0
- (D) Pin : 5-8840-2142-0



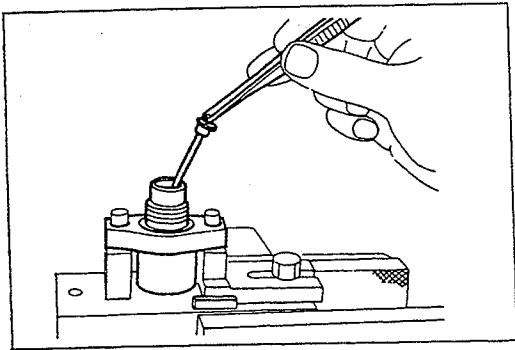
1. Insert the 60.4 mm (2.38 in) pin (D) to the dial indicator (B).
2. Set the dial indicator to the adjusting device (A).



3. Clamp the base (C) in a vise.
4. Insert the second push rod (9) into the base.
5. Set the adjusting device (A) to the base.

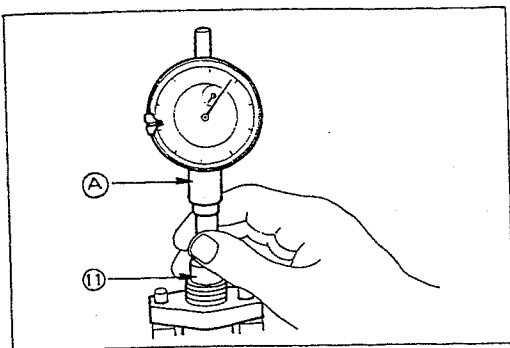


6. Hold the adjusting device down.
Set the dial indicator to "0".
Do this several times to be sure that the dial indicator is set correctly.
Handle the adjusting device (A) very carefully so as not to disturb the dial indicator setting.

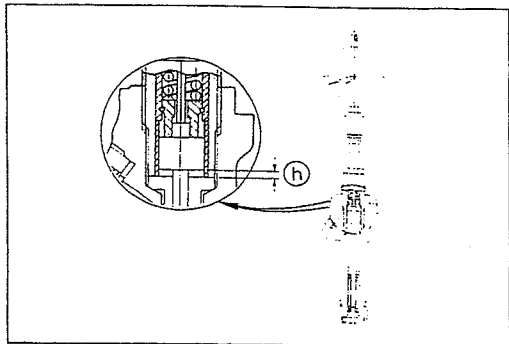


7. Clamp the nozzle holder in a vise and loosen the set screw.
The nozzle holder cap nut must be facing up.
8. Insert the second push rod to the nozzle holder.
Do not install the second spring and the pre-lift adjusting shim at this time.
9. Reinstall the set screw and tighten it to the specified torque.

Set Screw Torque	kg · m(lb.ft/N · m)
$3.75 \pm 0.25 (27.1 \pm 1.8/36.75 \pm 2.45)$	



10. Carefully insert the adjusting device (A) to the set screw (11).
11. Tighten the adjusting device at the intermediate position.
Check that the dial indicator moves smoothly.



12. Push the adjusting device down.

Note the pre-lift measurement (h) .

Measurement must be in increments of 0.01 mm (0.004 in).

13. Select the appropriate pre-lift adjusting shim.

$$t = l + h$$

t: Shim thickness (Measured value)

l: Pre-lift (Specified value)

h: (h) measurement (Step 12)

T: Actual selected shim thickness

$$(T = t \pm 0.015 \text{ mm (0.0006 in)})$$

Example:

If the (h) measurement is 0.98 mm (0.039 in)

$$t = 0.10\text{mm} + 0.98\text{mm} = 1.08\text{mm}$$

$$(t = 0.040\text{in} + 0.039\text{in} = 0.079\text{in})$$

$$T = 1.080\text{mm} \pm 0.015\text{mm} = 1.065\text{mm} - 1.095\text{mm}$$

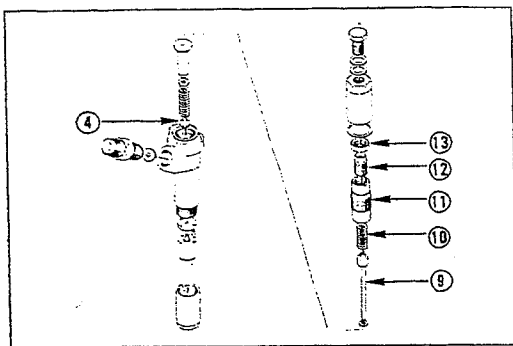
$$(T = 0.079\text{in} \pm 0.006\text{in} = 0.073\text{in} - 0.085\text{in})$$

A 1.08 mm (0.043 in) shim would be used.

14. Set the selected pre-lift adjustment shim aside.

Do not install the shim at this time.

15. Remove the adjusting device from the nozzle holder.



Second Nozzle Opening Pressure Adjustment

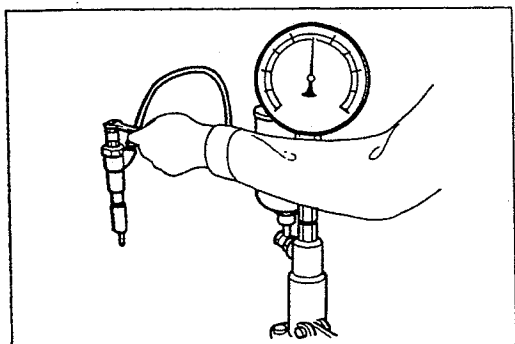
The second nozzle opening pressure adjustment must be done directly after "Pre-Lift Adjusting Shim Selection."

Second nozzle opening pressure cannot be adjusted after reassembly of the injection nozzle.

1. Install the second spring ⑩, the set screw ⑪, the adjusting screw ⑫, and the lock nut ⑬ to the nozzle holder.

The first push rod ④ must be making contact with the second push rod ⑨.

Do not install the pre-lift adjusting shim at this time.



2. Attach the nozzle holder to the injection nozzle tester.
3. Apply pressure to the nozzle tester.

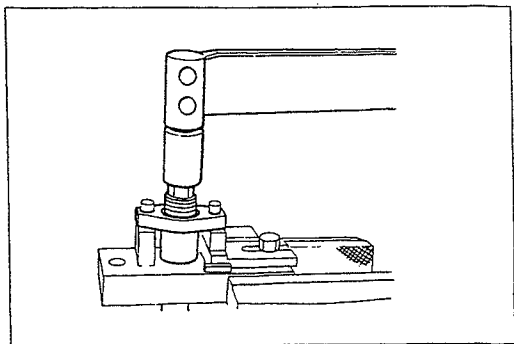
The injection nozzle should open within the specified opening pressure range.

Second Injection Nozzle Opening Pressure (Service Value)

	kg/cm ² (psi/kPa)
4JB1T	274.5 ± 3.5 (3,903 ± 50/26,920 ± 343)
4JB1TC (WITHOUT EGR)	274.5 ± 3.5 (3,903 ± 50/26,920 ± 343)
4JB1TC (WITH EGR)	224 ± 3.0 (3,185 ± 43/21,968 ± 294)

If the nozzle opening pressure is outside the specified range, adjust it with the adjusting screw.

Temporarily tighten the lock nut.

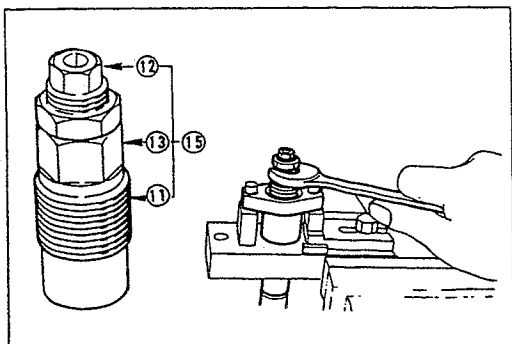


4. Remove the injection nozzle holder from the nozzle tester.
5. Clamp the nozzle holder in a vise.
6. Tighten the lock nut to the specified torque.

Lock Nut Torque	kg · m(lb.ft/N · m)
$2.25 \pm 0.25 (16.3 \pm 1.8/22.05 \pm 2.45)$	

7. Recheck the injection nozzle opening pressure (Step 2 and 3).

Nozzle opening pressure may change after the lock nut is tightened.

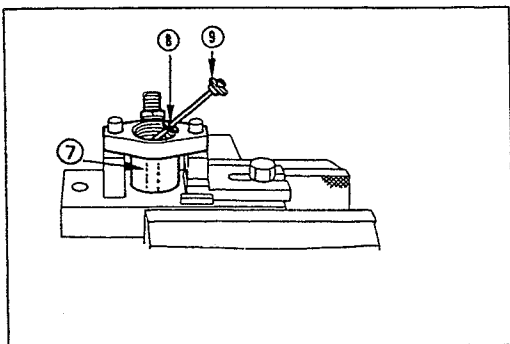


Pre-Lift Adjusting Shim Installation

Pre-lift adjusting shim installation must be done directly after "Second Nozzle Opening Pressure Adjustment."

1. Clamp the injection nozzle holder in a vise.
2. Remove the set screw assembly ⑮ (the adjusting screw ⑫, the lock nut ⑬, and the set screw ⑪) as a unit.

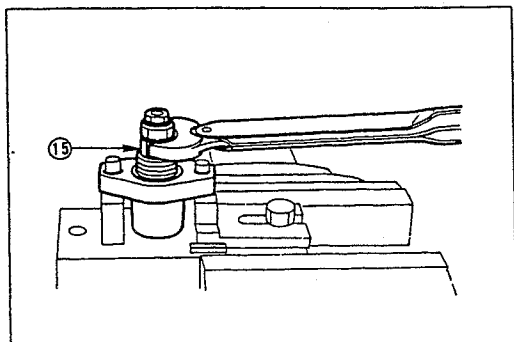
Do not remove or loosen the lock nut separately from the set screw. The adjusted second nozzle opening pressure will be affected.



3. Remove the second push rod ⑨ from the nozzle holder.
4. Install the pre-lift adjusting shim ⑧ selected earlier to the nozzle holder.

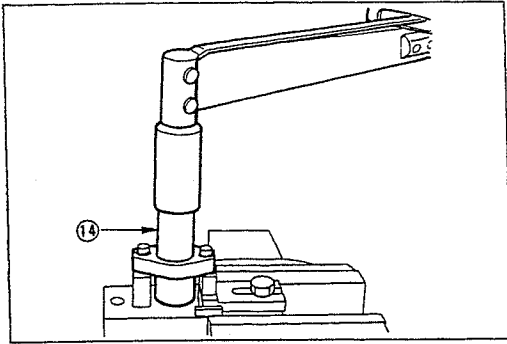
Be sure that the shim is clean and free of all foreign material.

5. Install the second push rod to the nozzle holder.
- The shim must be installed between the spacer ⑦ and the second push rod.



6. Install the set screw assembly ⑮ to the nozzle holder.
- Take care not to disturb the lock nut.
7. Tighten the set screw assembly to the specified torque.

Set Screw Torque	kg · m(lb.ft/N · m)
$3.75 \pm 0.25 (27.1 \pm 1.8/36.75 \pm 2.45)$	

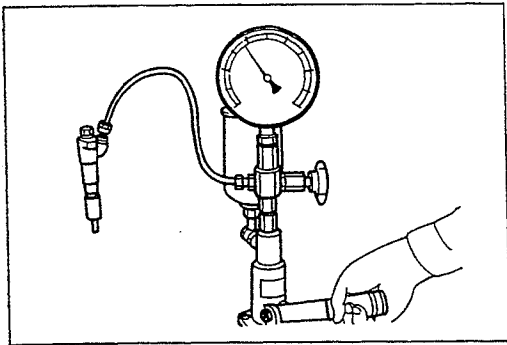


Final Inspection

1. Install the cap nut ⑭ with gasket to the set screw assembly.
2. Tighten the cap nut to the specified torque.

Cap Nut Torque	kg ·m(lb.ft/N ·m)
3.25 ± 0.25 ($23.5 \pm 1.8/31.85 \pm 2.45$)	

3. Remove the nozzle holder from the vise.



4. Attach the two-spring nozzle holder to the injection nozzle tester.
5. Check the first injection nozzle opening pressure and spray condition.

It is not possible to check the second injection nozzle opening pressure at this time. Check only the first injection nozzle opening pressure.

Check for abnormal noise and leakage.

If any abnormal conditions are discovered during inspection, the injection nozzle assembly must be readjusted or replaced.

0804

INJECTION PUMP DATA

08040101

4JA1/4JB1/4JB1T/4JB1TC INJECTION VOLUME ADJUSTMENT

0804010202

TEST CONDITION

Item	Condition
Injection Nozzle	DKKC Part No.: 105780-0000 Bosch Type No: DN12SD12T
Injection holder	DKKC Part No.: 105780-2080 Bosch Type No: EF8511/9
Injection nozzle opening pressure kg/cm ² (psi/kPa)	150 (2,133/14,700)
Injection line dimensions mm(in)	
Inside diameter	2.0 (0.079)
Outside diameter	6.0 (0.236)
Length	840 (33.1)
Fuel delivery pressure kg/cm ² (psi/kPa)	0.2 (2.84/19.6)
Test fuel	SAE Standard Test Diesel Fuel (SAE967D) ISO Standard Test Diesel Fuel (ISO4113)
Test fuel temperature °C(°F)	45 — 50 (113 — 122)
Identification numbers	104741-1313 104741-1401 104741-1740 104741-1322 104741-1410 104741-1741 104741-1332 104741-1421 104741-1750 104741-1342 104741-1430 104741-1751 104741-1370 104741-1480 104741-6352

08040102

MAKER%.	894225	2471
ASS'Y NO.		
INJ.PUMP		
ASS'Y NO.	104748-1010	

080401-001

IDENTIFICATION PLATE AND NUMBER

Use the data following the injection pump identification number to adjust the injection volume.

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers: 104741-1332

Test Fuel: Standard Diesel Fuel SAE J967D or ISO 4113

1.	Item	Pump speed (rpm)	Settings	Charge air Press (mmHg)	Delivery difference (cc)
1.1	Timing device travel	1600	4.8 — 5.2 mm		
1.2	Supply pump pressure	1600	5.3 — 5.7 kg/cm ²		
1.3	Full load delivery without charge-air pressure	1000	41.3 — 42.4 cc/1000st		3.5
1.4	Idle speed regulation	385	5.7 - 9.7 cc/1000st		2.0
1.5	Start	100	Above 65.0 cc/1000st		
1.6	Full-load speed regulation	2250	13.1 — 19.1 cc/1000st		4.5
1.7	Aneroid compensator adjustment	1000	Decrease 6.3 — 8.8 cc/1000st	-161 ~ -167	

2. Test Specifications					
2.1	Timing device	rpm mm	1200 1.4 — 2.2	1600 4.7 — 5.3	2000 7.4 — 8.2
2.2	Supply pump	rpm kg/cm ²	500 Above 1.1	1200 4.0 — 4.6	1600 5.3 — 5.7
2.3	Overflow delivery	rpm cc/10s	1600 50.0 — 93.0		2000 6.5 — 7.1
2.4 Fuel delivery					
Speed control lever		Pump speed (rpm)	Fuel delivery (cc/1000st)	Charge air press (mmHg)	
End stop		1000	40.8 — 42.9		
		700	32.6 — 38.6		
		500	30.3 — 38.3		
		1600	43.1 — 49.1		
		2000	38.0 — 44.1		
		2250	12.6 — 19.6		
		2350	Below 12.0		
		1000	Decrease 5.6 — 9.5		
Switch-off		385	0	-161 ~ -167	
Idle stop		300	9.5 — 15.5		
		385	5.7 — 9.7		
		450	Below 5.0		
Partial load					
2.5	Solenoid	Maximum cut-in voltage (V) Test voltage (V)	8 12 — 14		

3. Dimensions (For assembly and adjustment)							
Designation							
Identification numbers	K (mm)	KF (mm)	MS (mm)	α (deg)	A (mm)	β (deg)	B (mm)
104741-1332	2.7 — 2.9	4.9 — 5.1	0.9 — 1.1	14 — 22	11.3 — 14.8	32 — 42	10.1 — 13.6

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers: 104741-1342

Test Fuel: Standard Diesel Fuel SAE J967D or ISO 4113

1.	Item	Pump speed (rpm)	Settings	Charge air press (mmHg)	Delivery difference (cc)
1.1	Timing device travel	1600	4.8 — 5.2 mm		
1.2	Supply pump pressure	1600	5.3 — 5.7 kg/cm ²		
1.3	Full load delivery without charge-air pressure	1000	41.3 — 42.4 cc/1000st		3.5
1.4	Idle speed regulation	385	5.7 — 9.7 cc/1000st		2.0
1.5	Start		Above 65.0 cc/1000st		
1.6	Full-load speed regulation	2250	13.1 — 19.1 cc/1000st		4.5
1.7	Aneroid compensator adjustment	1000	Decrease 6.3 — 8.8 cc/1000st		

2. Test Specifications		Solenoid timer ON		OFF	
2.1	Timing device	rpm mm	1200 1.4 — 2.2	1600 4.7 — 5.3	2000 7.4 — 8.2
2.2	Supply pump	rpm kg/cm ²	500 Above 1.1	1200 4.0 — 4.6	1600 5.3 — 5.7
2.3	Overflow delivery	rpm cc/10s	1600 50.0 — 93.0		2000 6.5 — 7.1
2.4	Fuel delivery				
	Speed control lever	Pump speed (rpm)	Fuel delivery (cc/1000st)	Charge air press (mmHg)	
	End stop	1000 700 500 1600 2000 2250 2350 1000	40.8 — 42.9 32.6 — 38.6 30.3 — 38.3 43.1 — 49.1 38.0 — 44.1 12.6 — 19.6 Below 12.0 Decrease 5.6 — 9.5	-161 ~ -167	
	Switch-off	385	0		
	Idle stop	300 385 450	9.5 — 15.5 5.7 — 9.7 Below 5.0		
	Partial load				
2.5	Solenoid	Maximum cut-in voltage (V) Test voltage (V)	8 12 — 14		

3. Dimensions (For assembly and adjustment)							
Designation							
Identification numbers	K (mm)	KF (mm)	MS (mm)	α (deg)	A (mm)	β (deg)	B (mm)
104741-1342	2.7 — 2.9	4.9 — 5.1	0.9 — 1.1	14 — 22	11.3 — 14.8	32 — 42	10.1 — 13.6

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers: 104741-1741, 104741-1751

Test Fuel: Standard Diesel Fuel SAE J967D or ISO 4113

1.	Item	Pump speed (rpm)	Settings	Charge air press (mmHg)	Delivery difference (cc)
1.1	Timing device travel	1700	5.0 — 5.4 mm	590 — 610	
1.2	Supply pump pressure	1700	5.2 — 5.6 kg/cm ²	590 — 610	
1.3	Full load delivery without charge-air pressure	*1250 (Full) 900 (BCS)	63.2 — 64.2 cc/1000st 50.9 — 51.9	590 — 610 340 — 360	3.5 4.5
1.4	Idle speed regulation	385	3.1 - 7.1 cc/1000st	0	2.0
1.5	Start	100	60 — 100 cc/1000st	0	
1.6	Full-load speed regulation	2300	19.3 — 25.4 cc/1000st	590 — 610	4.5
1.7			cc/1000st		

2.	Test Specifications	Solenoid timer					
		ON		OFF			
2.1	Timing device (590 — 610 mmHg)	rpm mm	550 Above 0.5	1450 2.1 — 2.9	1700 4.9 — 5.5	1850 5.8 — 6.5	
2.2	Supply pump (590 — 610 mmHg)	rpm kg/cm ²	500 4.0 — 6.0	500 Above 0.8	1450 4.3 — 4.9	1700 5.2 — 5.6	1850 5.8 — 6.2
2.3	Overflow delivery (590 — 610 mmHg)	rpm cc/10s			1700 73 — 150		
2.4	Fuel delivery						
	Speed control lever	Pump speed (rpm)		Fuel delivery (cc/1000st)		Charge air press (mmHg)	
	End stop	1250(Full) 600 750 900(BCS) 1800 2300 2500		62.7 — 64.7 33.1 — 41.1 38.7 — 42.7 50.4 — 52.4 54.6 — 61.6 18.8 — 25.8 Below 5.0		590 — 610 90 — 110 170 — 190 340 — 360 590 — 610 590 — 610 590 — 610	
	Switch-off	385		0			
	Idle stop	385 500 If there is no designation in the specification for the solenoid timers "ON—OFF" position, then the position should be regarded as "OFF".		3.1 — 7.1 Below 3.0		Observations: • Conform the end of the BCS stroke at the point. • Attach the timer's measuring device at the low pressure side.	
	Partial load						
2.5	Solenoid	Maximum cut-in voltage (V) Test voltage (V)		8 12 — 14			

3. Dimensions (For assembly and adjustment)							
Designation							
Identification numbers	K (mm)	KF (mm)	MS (mm)	α (deg)	A (mm)	β (deg)	B (mm)
104741-1741 104741-1751	2.7 — 2.9	5.7 — 5.9	0.8 — 1.0	14 — 22	11.3 — 14.7	32 — 42	10.1 — 13.6

INJECTION VOLUME AND GOVERNOR PERFORMANCE DIAGRAM

Identification Numbers: 104741-6352

Test Fuel: Standard Diesel Fuel SAE J967D or ISO 4113

1.	Item	Pump speed (rpm)	Settings	Charge air press (mmHg)	Delivery difference (cc)
1.1	Timing device travel	1500	4.9 — 5.3 mm	590 — 610	
1.2	Supply pump pressure	1500	4.7 — 5.1 kg/cm ²	590 — 610	
1.3	Full load delivery without charge-air pressure	1250	68.1 — 69.1 cc/1000st	590 — 610	3.5
		800	47.7 — 48.7 cc/1000st	295 — 315	4.5
1.4	Idle speed regulation	385	6.1 — 10.1 cc/1000st	0	2.0
1.5	Start	100	80 — 90 cc/1000st	0	
1.6	Full-load speed regulation	2300	16.6 — 22.6 cc/1000st	590 — 610	4.5

2.	Test Specifications	Solenoid timer ON		OFF		
2.1	Timing device (590 — 610 mmHg)	rpm mm		1500 4.9 — 5.3	1700 6.7 — 7.5	1900 8.3 — 9.0
2.2	Supply pump (590 — 610 mmHg)	rpm kg/cm ²		1500 4.7 — 5.1		1900 5.8 — 6.4
2.3	Overflow delivery (590 — 610 mmHg)	rpm cc/10s	1500 57 — 100	1500 65 — 108		
2.4	Fuel delivery					
	Speed control lever	Pump speed (rpm)		Fuel delivery (cc/1000st)	Charge air press (mmHg)	
Max. speed		1250		47.6 — 54.6	0	
		1250		67.6 — 69.6	590 — 610	
		400		36.5 — 47.5	0	
		600		34.7 — 40.7	130 — 150	
		800		47.2 — 49.2	295 — 315	
		1900		66.5 — 75.5	590 — 610	
		2300		16.1 — 23.1	590 — 610	
		2400		Below 12.0	590 — 610	
Switch-off		385	0	0		
Idle stop		385	6.1 — 10.1	0		
		500	Below 3.0			
Partial load						
2.5	Solenoid	Maximum cut-in voltage (V) Test voltage (V)		8 12 — 14		

3. Dimensions (For assembly and adjustment)								
Designation								
Identification numbers	K (mm)	KF (mm)	MS (mm)	BCS (mm)	α (deg)	A (mm)	β (deg)	B (mm)
104741-6352	2.7 – 2.9	5.4 – 5.6	0.9 – 1.1	3.8 – 4.0	20 – 28	—	43 – 53	—

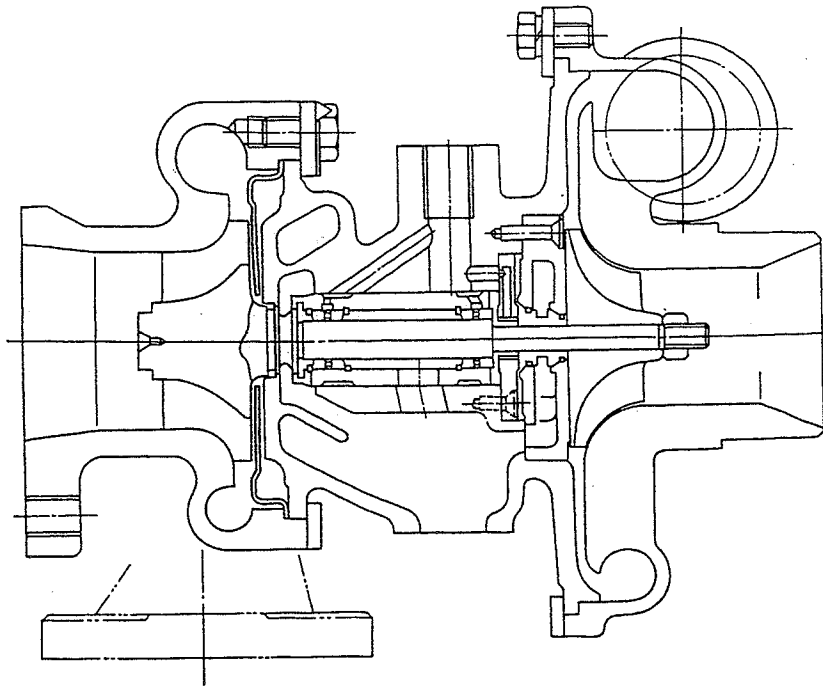
TURBOCHARGER

MAIN DATA AND SPECIFICATIONS

Item	—'88 4JB1T Engine	4JB1TC and '89— 4JB1T
Model	IHI RHB52	
Turbine type	Radial-inflow	
Compressor type	Radial-outflow	
Maximum permissible speed rpm	172,000	
Wastegate opening pressure mmHg(inHg)	600 (23.62)	660 (25.98)
Weight kg(lb)	4.6 (10.1)	

IHI : Ishikawajima-Harima Heavy Industries., Ltd.

GENERAL DESCRIPTION



090201B

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.

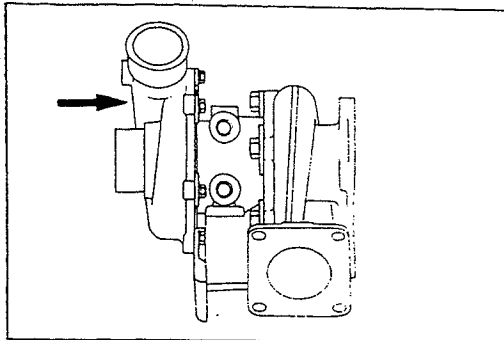
The turbocharger increases air intake efficiency. This results in increased engine power, reduced fuel consumption, and minimal engine noise.

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.

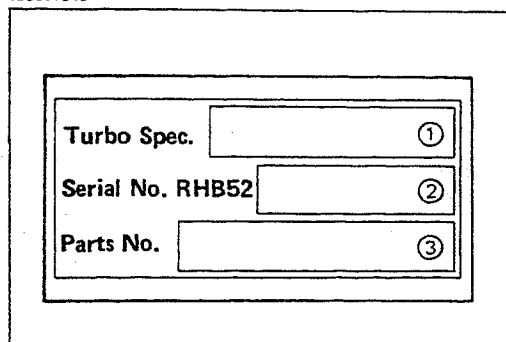
0903, 090301A



IDENTIFICATION OF UNIT

The turbocharger nameplate gives the date of manufacture and other important information required to identify the unit when service inquiries are made.

09030101B



The turbocharger nameplate has the following information stamped on it.

- ① Turbo Specification Number, Production Year and Month
- ② Production Date, Daily Serial Number
- ③ ISUZU Parts Number

0904



INSPECTION AND REPAIR

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

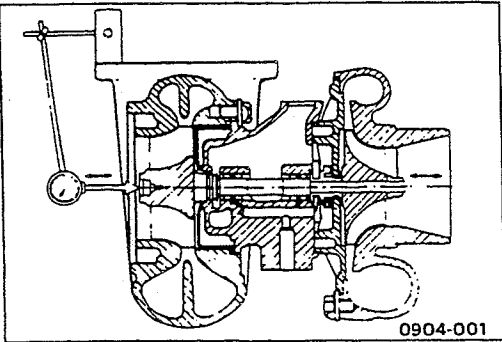
09040101B

Contact the "ISUZU MOTORS LIMITED" Dealer service department for major repairs and maintenance.

090401B

Important wheel shaft end play and bearing clearance standards and limits are included below for your reference.

090402

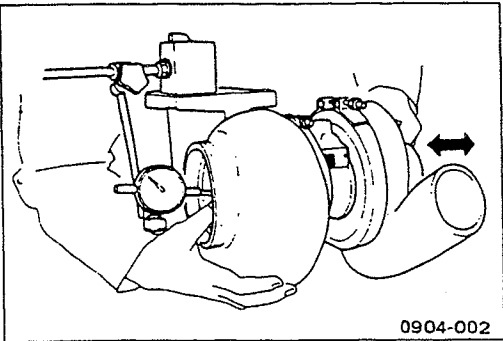


Wheel Shaft End Play

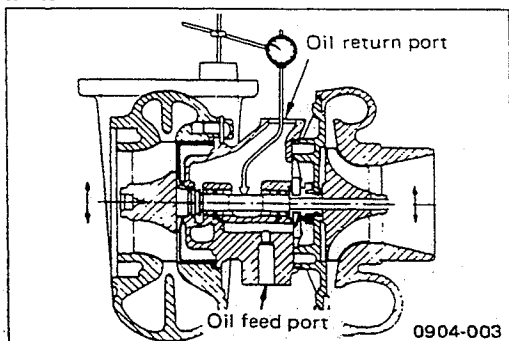
Use a dial indicator to measure the wheel shaft end play.

Apply a force of 1.2 kg (2.6 lb/11.76N) alternately to the compressor wheel end and the turbine wheel end.

Wheel Shaft End Play		mm(in)
Standard	Limit	
0.03–0.06 (0.0012–0.0024)	0.09 (0.0035)	



090403



Wheel Shaft and Bearing Clearance

Use a dial indicator to measure the wheel shaft and bearing clearance.

Wheel Shaft and Bearing Clearance		mm(in)
Standard	Limit	
0.056—0.127 (0.002—0.005)	0.127 (0.005)	

