

## SECTION 6A1

# ENGINE MECHANICAL (G13B, 1-CAM 16-VALVES ENGINE)

**WARNING:**

For vehicles equipped with Supplement Restraint (Air Bag) System:

- Service on and around the air bag system components or wiring must be performed only by an authorized SUZUKI dealer. Refer to “Air Bag System Components and Wiring Location View” under “General Description” in air bag system section in order to confirm whether you are performing service on or near the air bag system components or wiring. Please observe all WARNINGS and “Service Precautions” under “On-Vehicle Service” in air bag system section before performing service on or around the air bag system components or wiring. Failure to follow WARNINGS could result in unintentional activation of the system or could render the system inoperative. Either or these two conditions may result in severe injury.
- Technical service work must be started at least 90 seconds after the ignition switch is turned to the “LOCK” position and the negative cable is disconnected from the battery. Otherwise, the system may be activated by reserve energy in the Sensing and Diagnostic Module (SDM).

6A1

## CONTENTS

<b>GENERAL DESCRIPTION</b> .....	6A1- 2
Engine .....	6A1- 2
Engine Lubrication .....	6A1- 3
Cylinder Block .....	6A1- 4
Crankshaft and Main Bearings .....	6A1- 4
Pistons, Rings, Piston Pins and Connecting Rods .....	6A1- 4
Cylinder Head and Value Train .....	6A1- 4
<b>ON VEHICLE SERVICE</b> .....	6A1- 5
Compression Check .....	6A1- 5
Engine Vacuum Check .....	6A1- 6
Oil Pressure Check .....	6A1- 7
Valve Lash (Clearance) .....	6A1- 9
Air Cleaner Element .....	6A1-11
Air Cleaner Outlet Hose .....	6A1-12
Cylinder Head Cover .....	6A1-13
Throttle Body and Intake Manifold .....	6A1-14
Exhaust Manifold .....	6A1-17
Timing Belt and Belt Tensioner .....	6A1-19
Oil Pan and Oil Pump Strainer .....	6A1-25
Oil Pump .....	6A1-28
Rocker Arms, Rocker Arm Shaft and Camshaft .....	6A1-33
Valves and Cylinder Head .....	6A1-41
Piston, Piston Rings, Connecting Rods and Cylinders .....	6A1-54
<b>UNIT REPAIR OVERHAUL</b> .....	6A1-64
Engine Assembly .....	6A1-64
Main Bearings, Crankshaft and Cylinder Block .....	6A1-68
<b>SPECIAL TOOLS</b> .....	6A1-80
<b>REQUIRED SERVICE MATERIALS</b> .....	6A1-81
<b>TIGHTENING TORQUE SPECIFICATIONS</b> .....	6A1-82

**NOTE:**

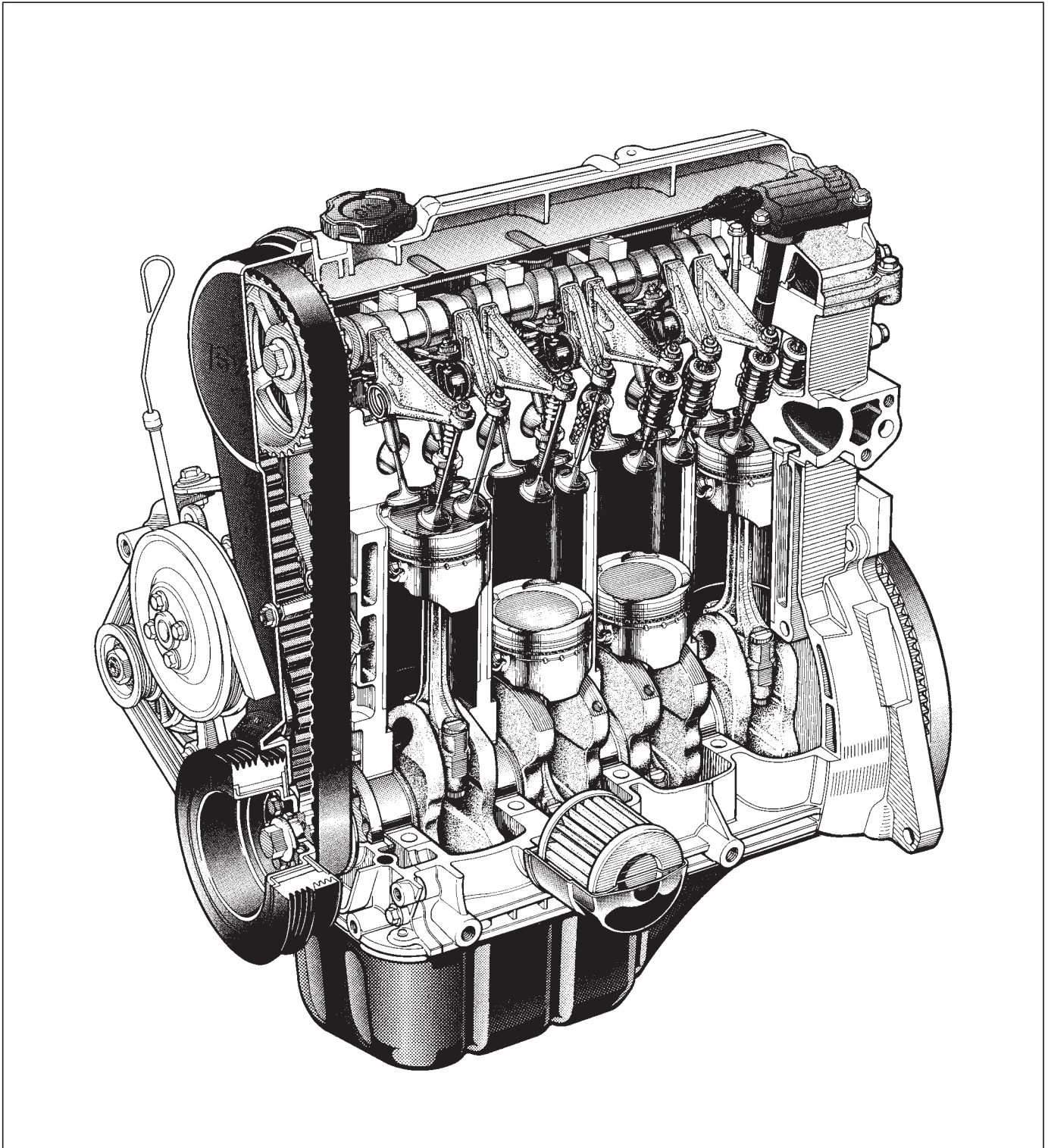
For what each abbreviation stands for (i.e., full term), refer to SECTION 0A.

## GENERAL DESCRIPTION

### ENGINE

The engine is a water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit equipped with its S.O.H.C. (Single Overhead Camshaft) valve mechanism arranged for "V"-type valve configuration and 16 valves (IN 2 and EX 2/one cylinder).

The single overhead camshaft is mounted over the cylinder head: it is driven from crankshaft through timing belt and opens and closes its valves via the rocker arms.



## ENGINE LUBRICATION

The oil pump is of a trochoid type, and mounted on crankshaft at crankshaft pulley side.

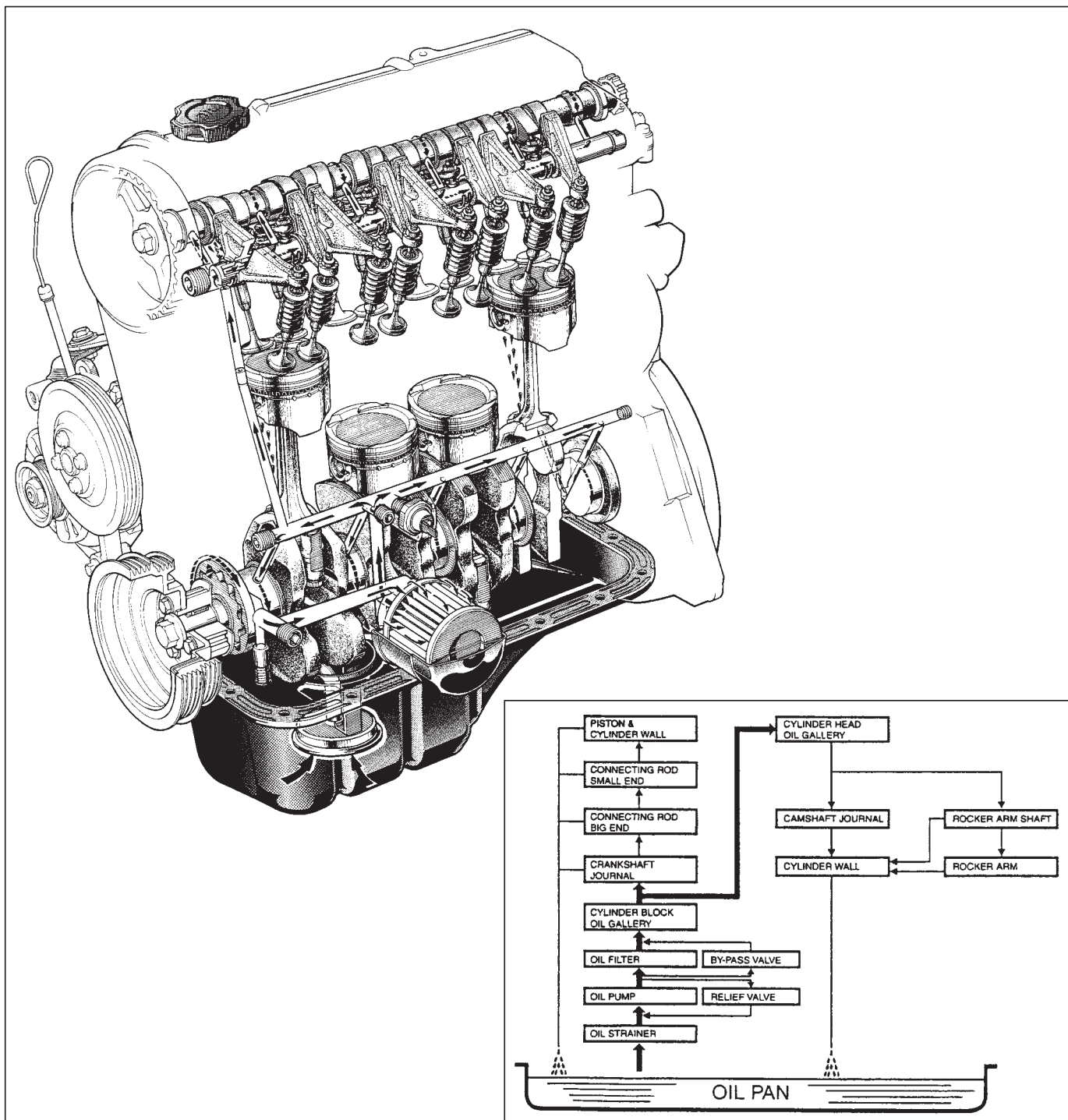
Oil is drawn up through oil pump strainer and passed through pump to oil filter.

The filtered oil flows into two paths in cylinder block. In one path, oil reaches crankshaft journal bearings.

Oil from crankshaft journal bearings is supplied to connecting rod bearings by means of intersecting passages drilled in crankshaft, and then injected from a small hole provided on big end of connecting rod to lubricate piston, rings, and cylinder wall.

In another path, oil goes up to cylinder head and lubricates camshaft journals, rocker arms, camshaft, etc., passing through oil gallery in rocker arm shaft.

An oil relief valve is provided on oil pump. This valve starts relieving oil pressure when the pressure comes over about 400 kPa (4.0 kg/cm<sup>2</sup>, 56.9 psi). Relieved oil drains back to oil pan.



## CYLINDER BLOCK

The cylinder block is made of cast aluminum alloy and has 4 cylinders arranged "In-Line". A cylindrical cast iron sleeve is installed in each cylinder.

## CRANKSHAFT AND MAIN BEARINGS

A monoblock casting crankshaft is supported by 5 main bearings which are of precision insert type. Four crank pins on the crankshaft are positioned 180° apart.

## PISTONS, RINGS, PISTON PINS AND CONNECTING RODS

The piston is cast aluminum alloy, and has two compression rings and one oil ring.

Among two compression rings (top and 2nd rings), the outer surface of the top ring is treated with hard chromium for improvement in abrasion resistance.

The oil ring consists of two rails and one spacer. The piston pin is offset 0.5 mm towards the major thrust side.

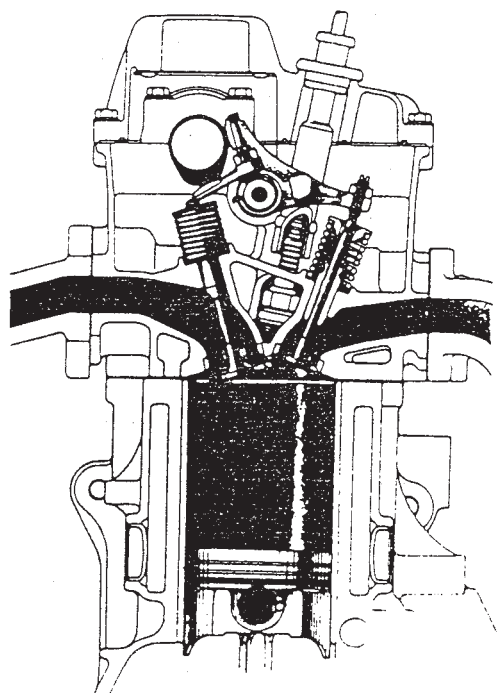
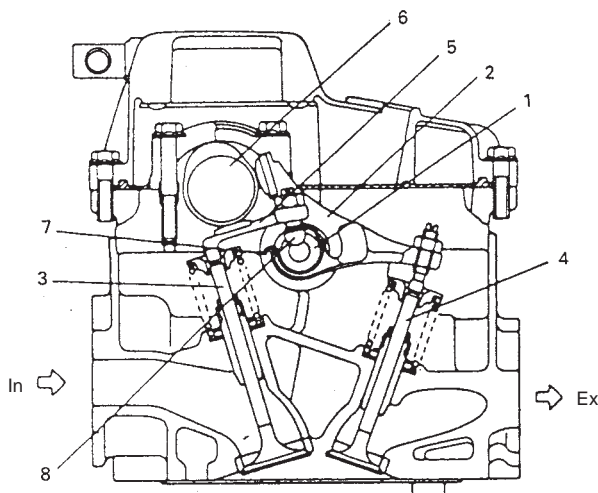
This allows a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins, made of chromium steel, have a floating fit in the pistons and in the connecting rods. The connecting rods are made of forged steel, and the rod bearings are of precision insert type.

## CYLINDER HEAD AND VALVE TRAIN

The cylinder head is made of aluminum casting. The supporting part of the camshaft is an independent cap type. The combustion chamber has 4 valves and uses the center plug type pent roof shape for higher intake and exhaust efficiency.

As the intake side rocker arm is end pivot type, it swings according to the camshaft movement to open and close the intake valve.

On the other hand, the exhaust side rocker arm is see-saw type. It swings with the rocker arm shaft as its supporting point and according to the camshaft movement to open and close the exhaust valve.



- |                     |                    |
|---------------------|--------------------|
| 1. Rocker arm shaft | 5. Rocker arm (IN) |
| 2. Rocker arm (EX)  | 6. Camshaft        |
| 3. Intake valve     | 7. Clip            |
| 4. Exhaust valve    | 8. Pivot           |

## ON-VEHICLE SERVICE

### COMPRESSION CHECK

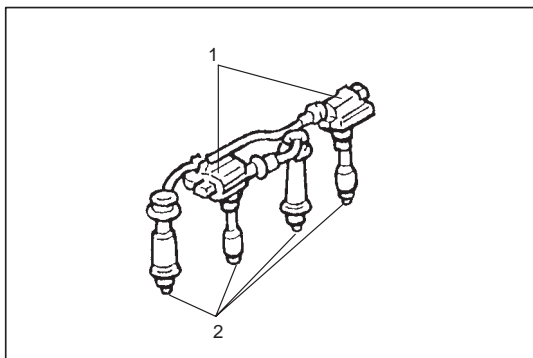
Check compression pressure on all four cylinders as follows:

- 1) Warm up engine.
- 2) Stop engine after warming up.

#### NOTE:

After warming up engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

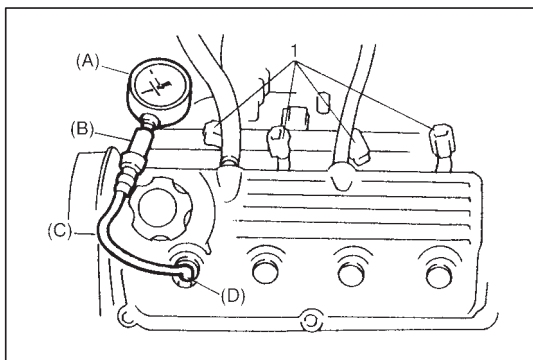
- 3) Remove ignition coil assemblies (1) and all spark plugs (2) referring to Section 6F.



#### WARNING:

Failure in disconnecting couplers from ignition coil assemblies can cause spark to occur in engine room possibly resulting in a dangerous explosion.

- 4) Disconnect fuel injector wire harness at couplers (2).
- 5) Install special tools (Compression gauge) into spark plug hole.



#### Special Tool

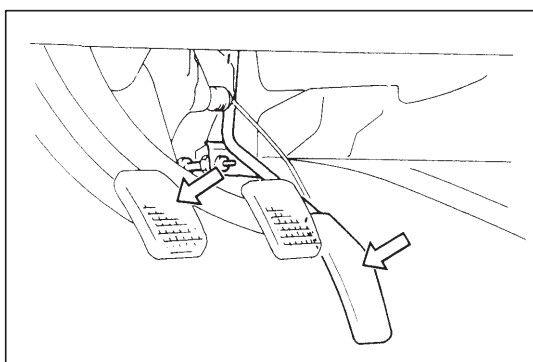
(A): 09915-64510-001

(B): 09915-64510-002

(C): 09915-64530

(D): 09915-67010

- 6) Disengage clutch (to lighten starting load on engine) for M/T model, and depress accelerator pedal all the way to make throttle valve full-open.
- 7) Crank engine with fully charged battery, and read the highest pressure on compression gauge.



	Compression pressure
Standard	1400 kPa (14.0 kg/cm <sup>2</sup> , 199.0 psi)
Limit	1100 kPa (11.0 kg/cm <sup>2</sup> , 156.4 psi)
Max. difference between any two cylinders	100 kPa (1.0 kg/cm <sup>2</sup> , 14.2 psi)

- 8) Carry out steps 5) through 7) on each cylinder to obtain four readings.
- 9) After checking, connect couplers to fuel injectors securely and install spark plugs and ignition coil assemblies.

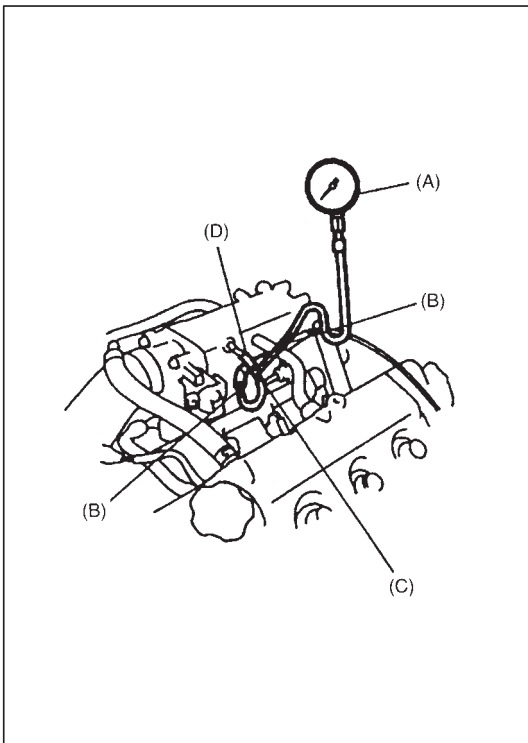
## ENGINE VACUUM CHECK

The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows:

- 1) Warm up engine to normal operating temperature.

**NOTE:**

After warming up engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.



- 2) With engine stopped, disconnect EVAP canister purge valve hose from intake manifold and connect 3-way joint, hoses and special tools (vacuum gauge and joint) between intake manifold and vacuum hose disconnected.

**Special Tool**

(A): 09915-67311

(B): 09918-08210

**SUZUKI GENUINE PARTS**

(C): Hose 09343-03087

(D): 3-way joint 09367-04002

- 3) Run engine at specified idle speed, and read vacuum gauge. Vacuum should be within the following specification.

**Vacuum specification (at sea level):**

**52.6 – 65.8 kPa (40 – 50 cm·Hg, 15.7 – 19.7 in.Hg) at specified idling speed**

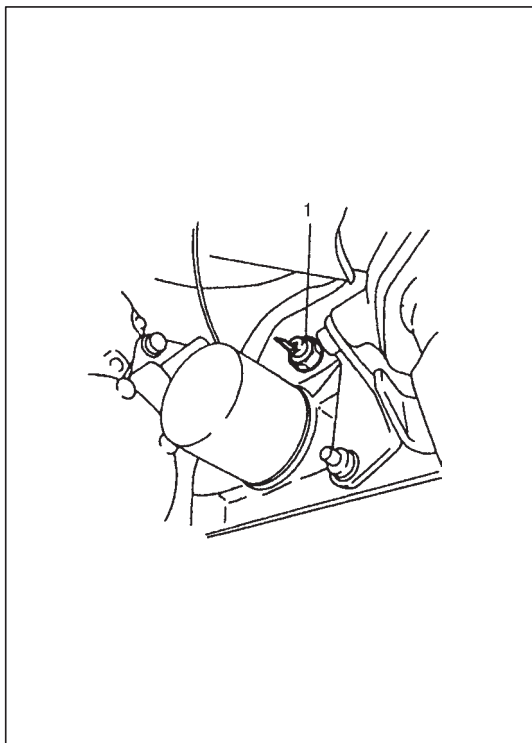
- 4) After checking, connect vacuum hose to intake surge tank.

## OIL PRESSURE CHECK

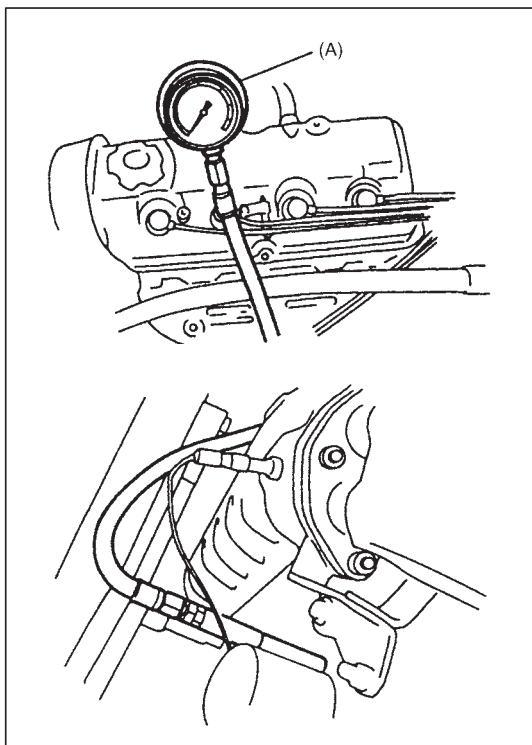
### NOTE:

Prior to checking oil pressure, check the following items.

- Oil level in oil pan.  
If oil level is low, add oil up to Full level mark on oil level gauge.
- Oil quality.  
If oil is discolored, or deteriorated, change it.  
For particular oil to be used, refer to the table in Section 0B.
- Oil leaks.  
If leak is found, repair it.



- 1) Remove oil pressure switch (1) from cylinder block.



- 2) Install special tool (Oil pressure gauge) to vacated threaded hole.

### Special Tool

(A): 09915-77311

- 3) Start engine and warm it up to normal operating temperature.

### NOTE:

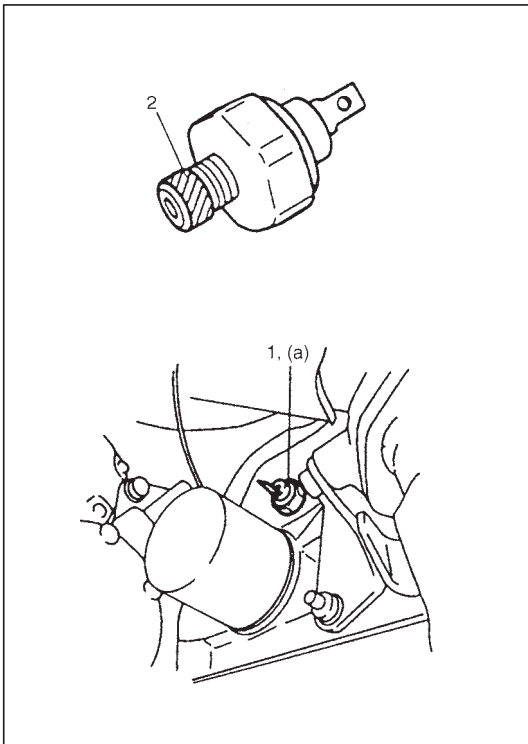
Be sure to place transmission gear shift lever in “Neutral” (shift selector lever to “P” range for A/T model), and set parking brake and block drive wheels.

- 4) After warming up, raise engine speed to 4,000 r/min and measure oil pressure.

### Oil pressure specification:

360 – 440 kPa (3.6 – 4.4 kg/cm<sup>2</sup>, 51.2 – 62.6 psi) at 4,000 r/min (rpm)

- 5) Stop engine and remove oil pressure gauge.



- 6) Before reinstalling oil pressure switch (1), be sure to wrap its screw threads with sealing tape (2) and tighten switch to specified torque.

**NOTE:**

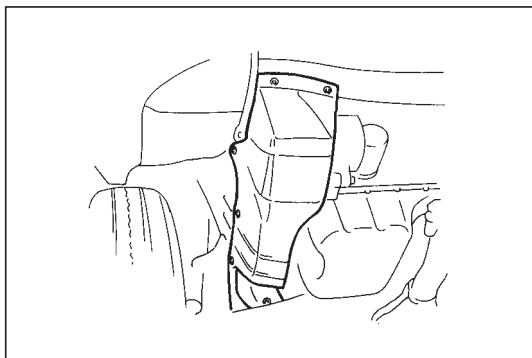
If sealing tape edge is bulged out from screw threads of switch, cut it off.

**Tightening Torque**

(a): 13 N·m (1.3 kg·m, 9.5 lb·ft)

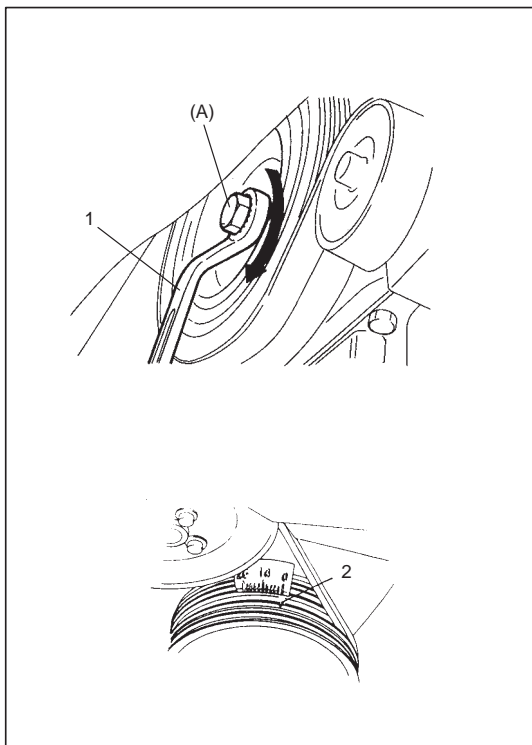
- 7) Start engine and check oil pressure switch for oil leakage.





## VALVE LASH (CLEARANCE)

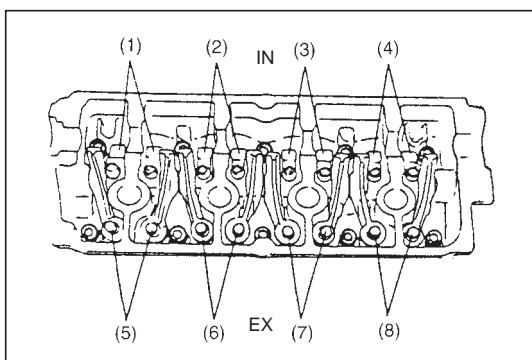
- 1) Remove negative cable at battery.
- 2) Remove cylinder head cover referring to item "Cylinder Head cover".
- 3) Remove engine under cover of right side from body.



- 4) Using special tool and wrench (1), turn crankshaft pulley clockwise until "V" mark (2) (in white paint) on pulley aligns with "0" (zero) calibrated on timing belt cover.

### Special Tool

(A): 09919-16020

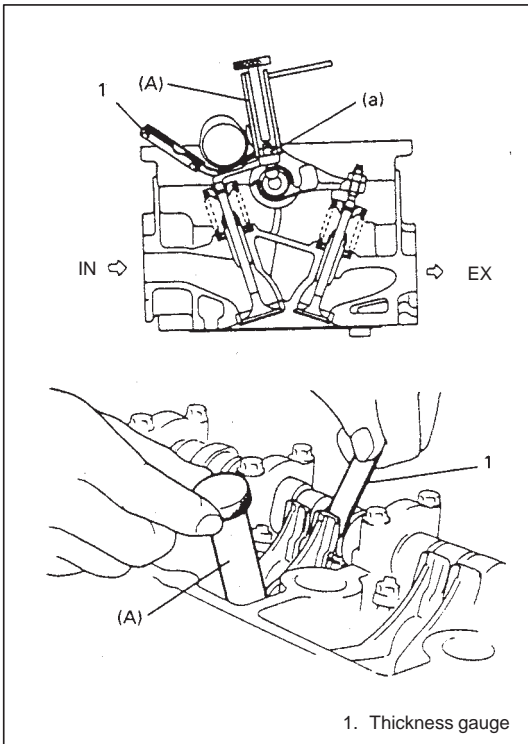


- 5) See if the rocker arms of No.1 cylinder are off the respective cam lobes (of camshaft); if so, valves (1), (2), (5) and (7) in figure are ready for clearance checking and adjustment. Check valve lashes at valves (1), (2), (5) and (7).

If the rocker arms of No.4 cylinder are off the respective cam lobes, check valve lashes at valves (3), (4), (6) and (8).

### NOTE:

**When checking valve clearance, insert thickness gauge between camshaft and cam-riding face of rocker arm.**

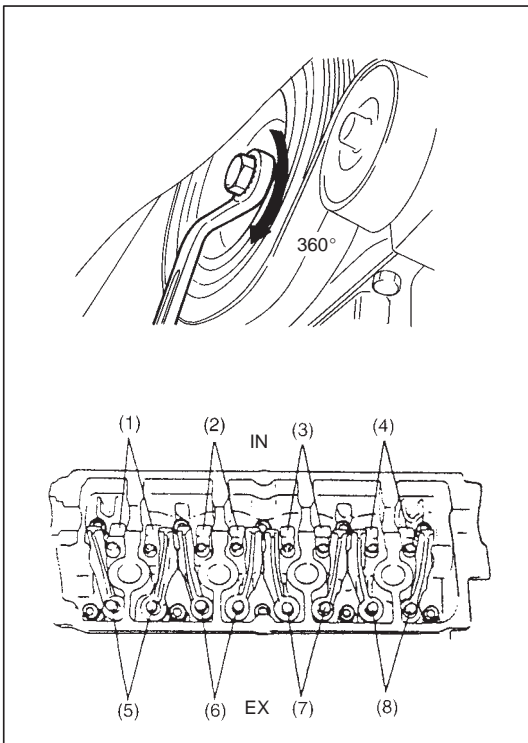


- 6) If valve lash is out of specification, adjust it to specification by turning adjusting screw after loosening lock nut. After adjustment, tighten lock nut to specified torque while holding adjusting screw stationary, and then make sure again that valve lash is within specification.

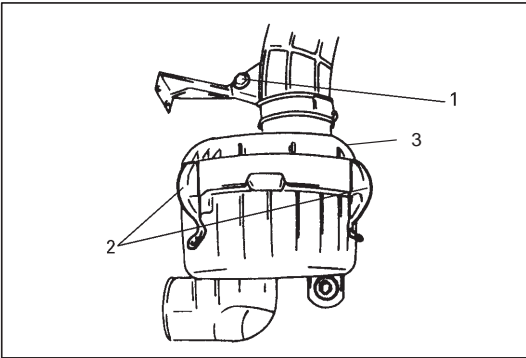
Valve clearance specification		When cold (Coolant temperature is 15 – 25°C or 59 – 77°F)	When hot (Coolant temperature is 60 – 68°C or 140 – 154°F)
		Intake	0.13 – 0.17 mm (0.005 – 0.007 in.)
Exhaust		0.23 – 0.27 mm (0.009 – 0.011 in.)	0.28 – 0.32 mm (0.011 – 0.013 in.)

**Special Tool**  
**(A): 09917-18211**

**Tightening Torque**  
**(a): 12 N·m (1.2 kg·m, 9.0 lb·ft)**



- 7) After checking and adjusting valve lashes at valves (1), (2), (5) and (7), (or (3), (4), (6) and (8)) rotate crankshaft exactly one full turn (360°) and check the same at valves (3), (4), (6) and (8) (or (1), (2), (5) and (7)). Adjust them as necessary.
- 8) After checking and adjusting all valves, reverse removal procedure for installation.



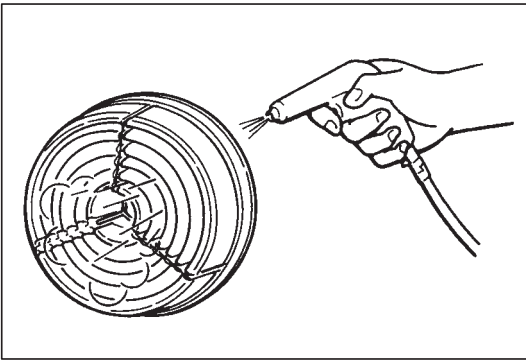
## AIR CLEANER ELEMENT

### REMOVAL

- 1) Disconnect air cleaner outlet hose from case after loosening its clamp (2) and removing bolt (1) shown in figure.
- 2) Remove air cleaner cap (3) from case by unhooking its clamps, then take out air cleaner element.

### INSPECTION

Check air cleaner element for dirt. Replace excessively dirty element.

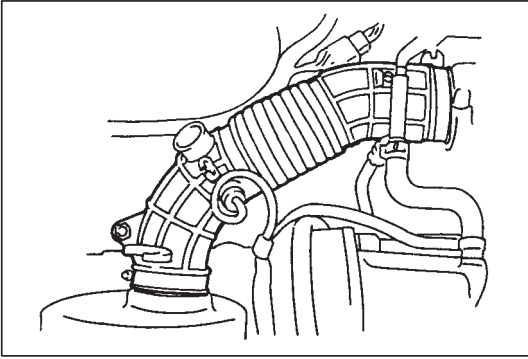


### CLEAN

Blow off dust by compressed air from air outlet side of element.

### INSTALLATION

Reverse removal procedure for installation.



## AIR CLEANER OUTLET HOSE

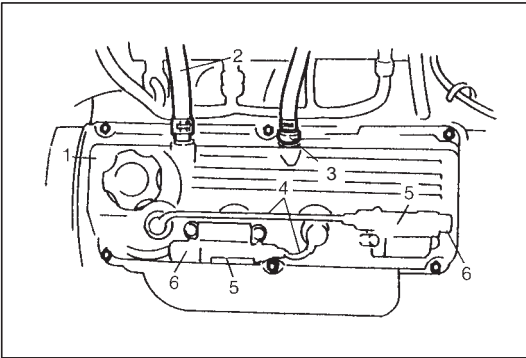
### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Disconnect resonator after loosening its clamp.
- 3) Disconnect breather hose from air cleaner outlet hose.
- 4) Disconnect IAT sensor wire at coupler.
- 5) Remove bolt and then air cleaner outlet hose after loosening its clamps.

### INSTALLATION

Reverse removal procedure for installation, noting the following.

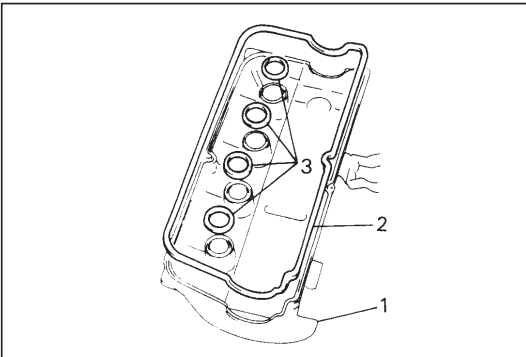
- Clamp each hose securely.



## CYLINDER HEAD COVER

### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Disconnect breather hose (2) and PCV valve (3) from head cover.
- 3) Disconnect ignition coil couplers (6).
- 4) Remove ignition coil assemblies (5) with high-tension cord (4).
- 5) Remove cylinder head cover (1) with cylinder head cover gasket and O-rings.

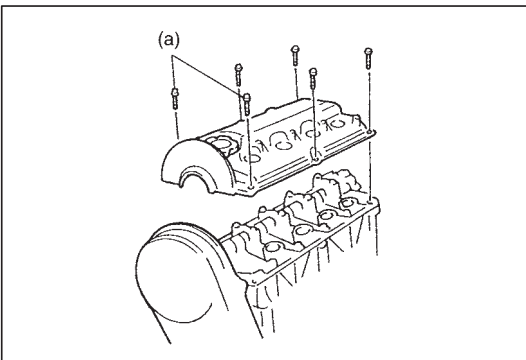


### INSTALLATION

- 1) Install O-rings (3) and cylinder head cover gasket (2) to cylinder head cover (1).

#### NOTE:

**Be sure to check each of these parts for deterioration or any damage before installation and replace if found defective.**



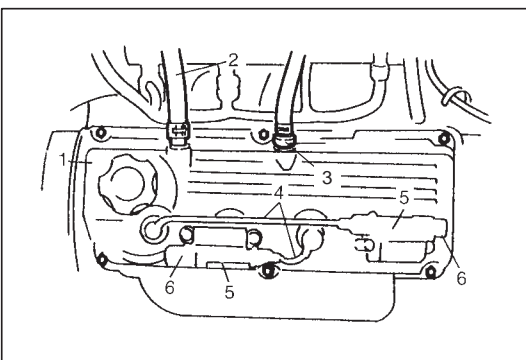
- 2) Install cylinder head cover to cylinder head and tighten cover bolts to specified torque.

#### Tightening Torque

**(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)**

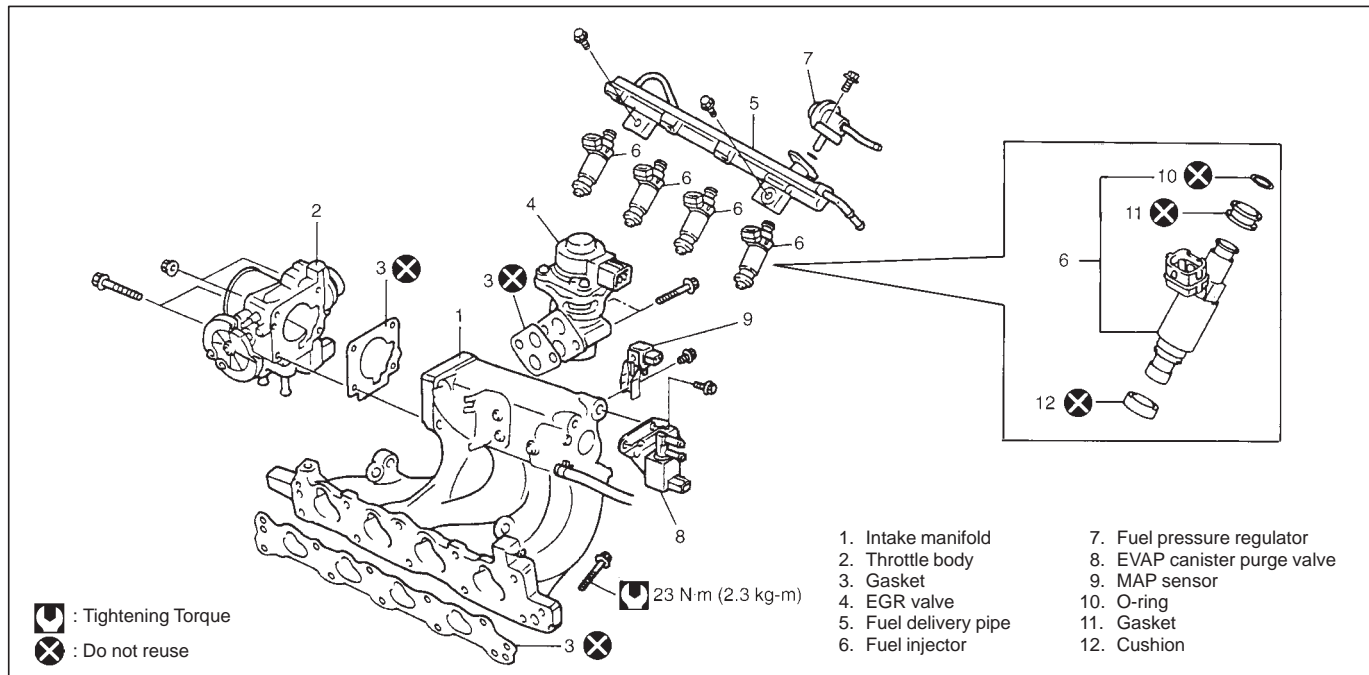
#### NOTE:

**When installing cylinder head cover, use care so that cylinder head cover gasket or O-rings will not get out of place or fall off.**



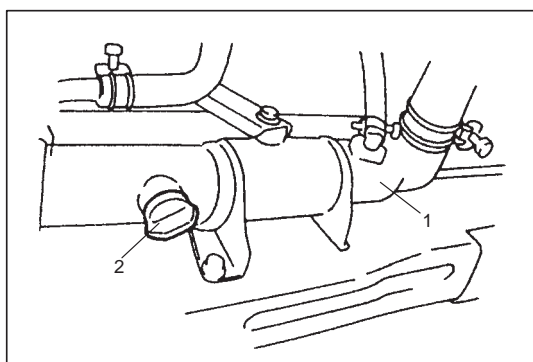
- 3) Install ignition coil assemblies (5) with high-tension cord (4).
- 4) Connect ignition coil couplers (6).
- 5) Connect breather hose (2) and PCV valve (3) to head cover (1).
- 6) Connect negative cable at battery.

## THROTTLE BODY AND INTAKE MANIFOLD



### REMOVAL

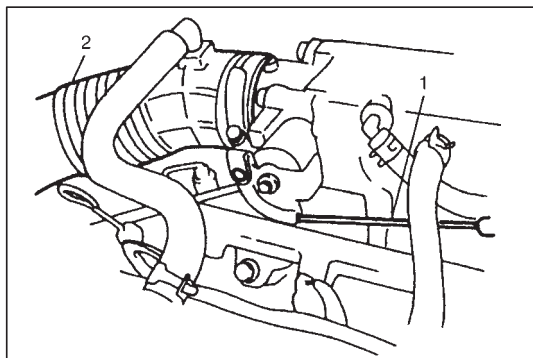
- 1) Relieve fuel pressure according to procedure described in Section 6.
- 2) Disconnect negative cable at battery.



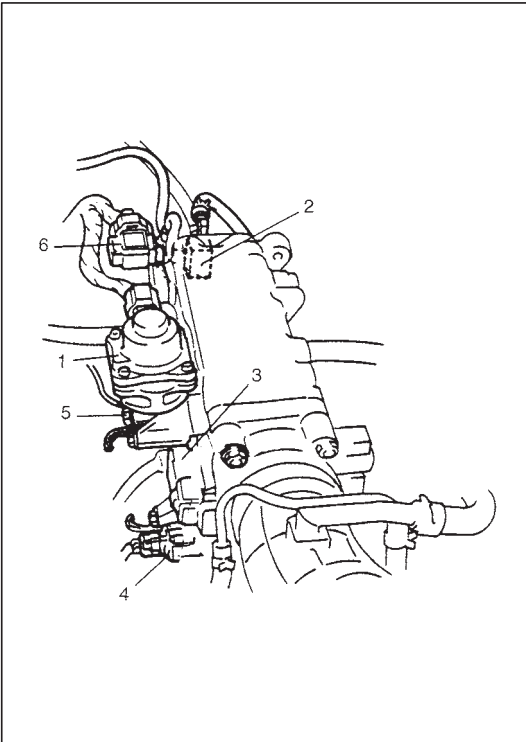
- 3) Drain cooling system.

#### WARNING:

To help avoid danger of being burned, do not remove drain plug (2) and radiator cap while engine and radiator (1) are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.

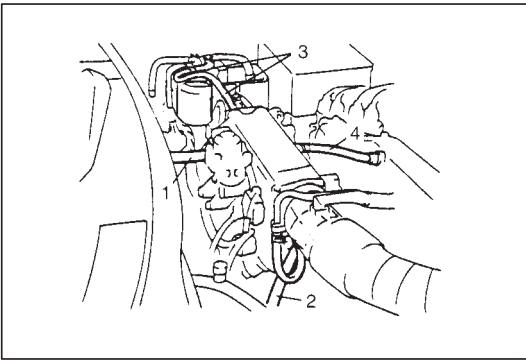


- 4) Disconnect IAT sensor at coupler.
- 5) Remove air cleaner outlet hose (2) with resonator.
- 6) Disconnect accelerator cable (1) from throttle body.



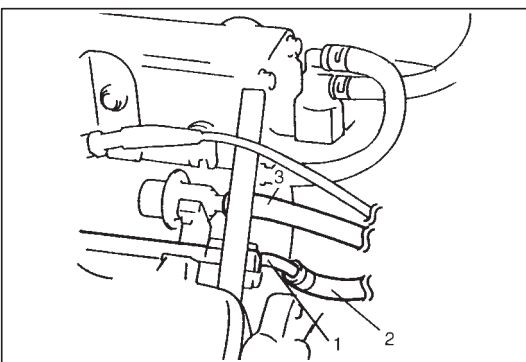
7) Disconnect the following electric lead wires and release clamp:

- Ground wires (5) from intake manifold
- TP sensor (3)
- IAC valve (4)
- Fuel injectors
- EVAP canister purge valve (2)
- MAP sensor (6)
- EGR valve (1)

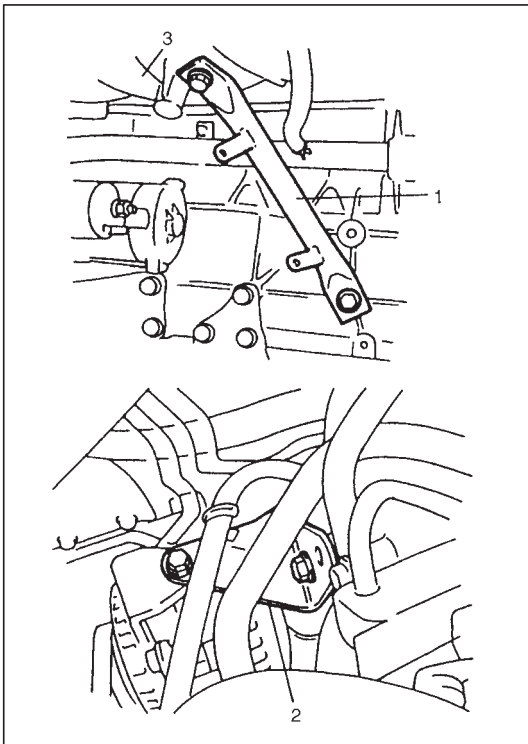


8) Disconnect the following hoses:

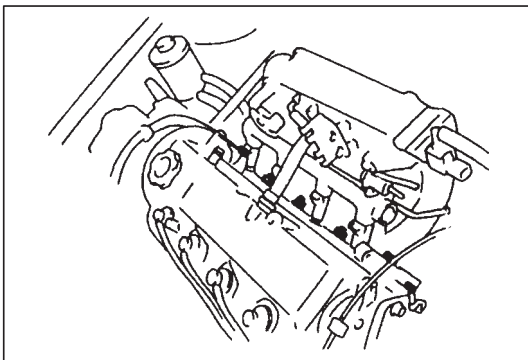
- Brake booster hose (1) from intake manifold
- Canister purge hose (3) from EVAP canister purge valve
- Engine cooling water (coolant) hose (2) from IAC valve
- PCV hose (4)
- Breather hose from cylinder head



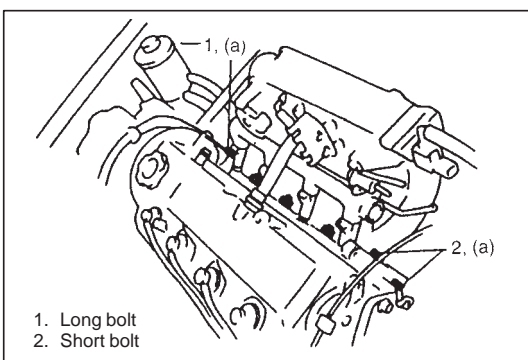
9) Disconnect fuel feed hose (2) from pipe (1), and disconnect fuel return hose (3) from fuel pressure regulator.



10) Remove intake manifold rear stiffener (1) and generator adjust arm reinforcement (2) from intake manifold (3).



11) Remove intake manifold with throttle body from cylinder head, and then its gasket.



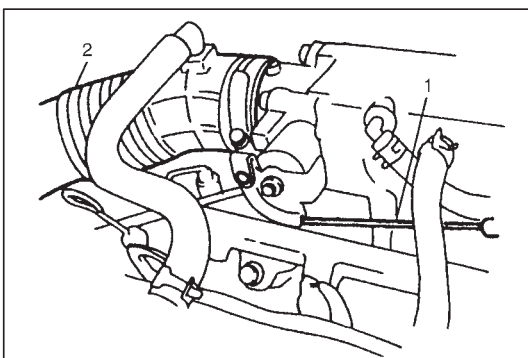
### INSTALLATION

Reverse removal procedure for installation noting the followings.

- Use new intake manifold gasket.
- When installing intake manifold, install clamps securely.

### Tightening Torque

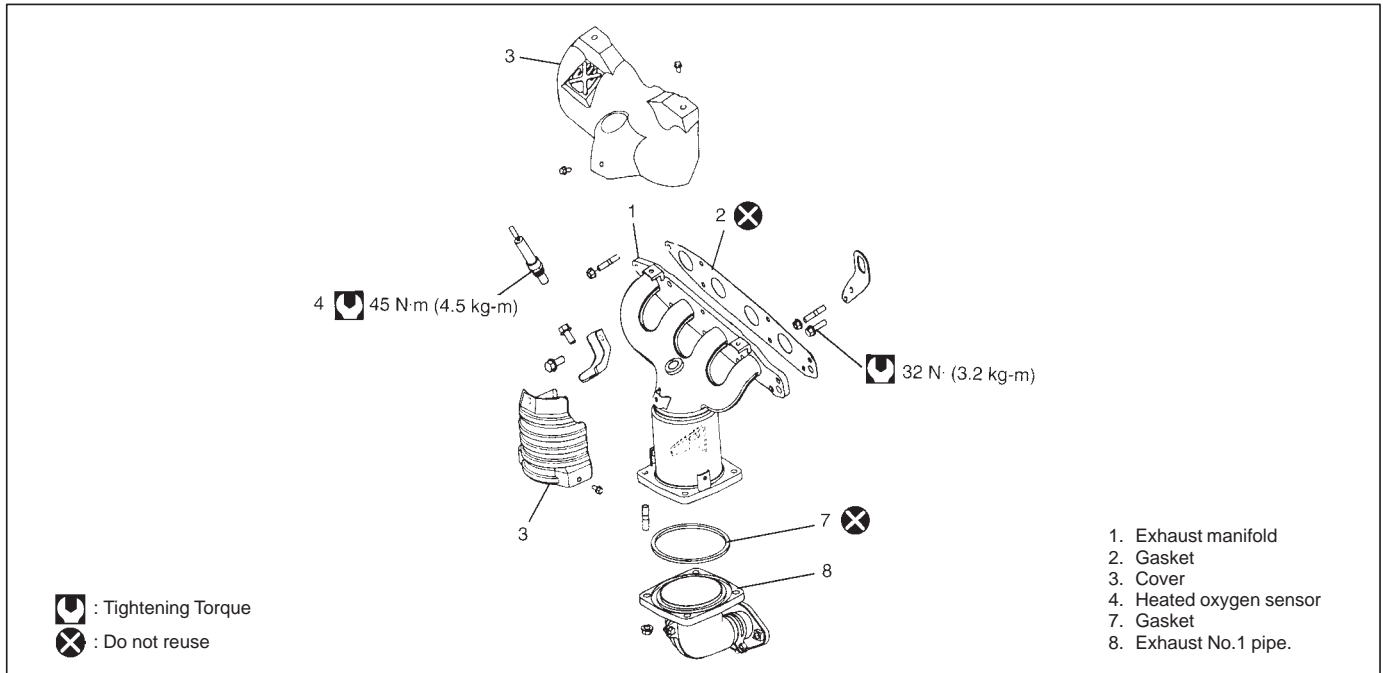
(a): 23 N·m (2.3 kg-m, 17.0 lb-ft)



- Adjust accelerator cable play, referring to Section 6E.
- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Refill cooling system referring to Section 6B.
- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.



## EXHAUST MANIFOLD



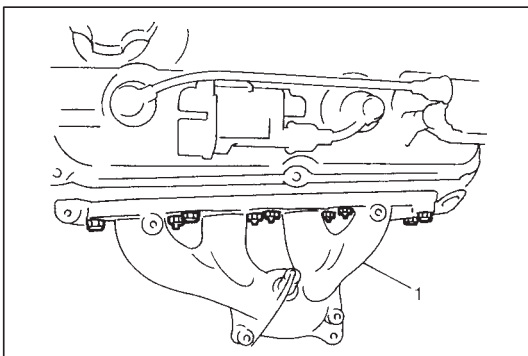
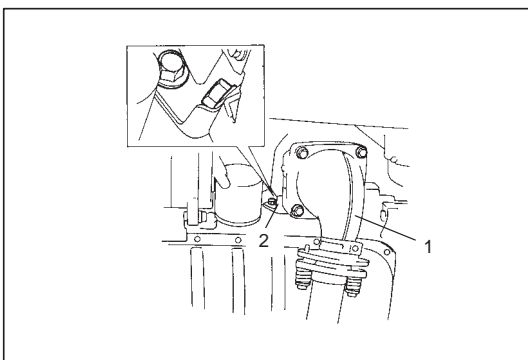
### WARNING:

To avoid danger of being burned, do not service exhaust system while it is still hot.

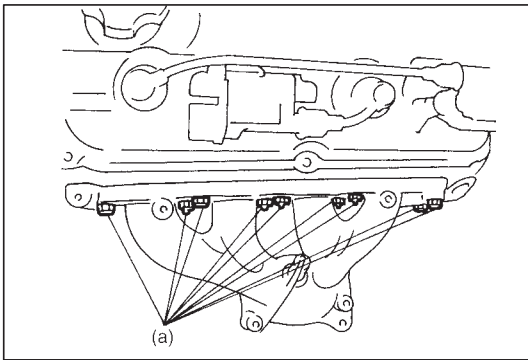
Service should be performed after system cools down.

### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Disconnect heated oxygen sensor coupler.  
Release its wire from clamps.
- 3) Disconnect exhaust No.1 pipe (1) from WU-TWC.
- 4) Remove WU-TWC stiffener (2) (if equipped).



- 5) Remove exhaust manifold (1) and its gasket from cylinder head.

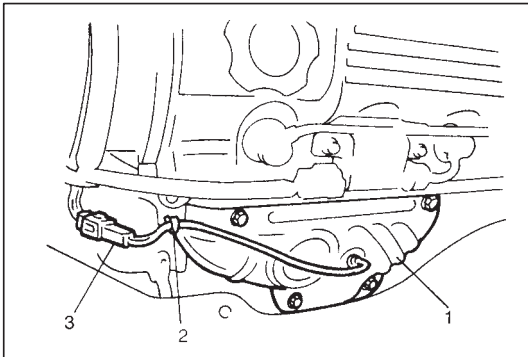


### INSTALLATION

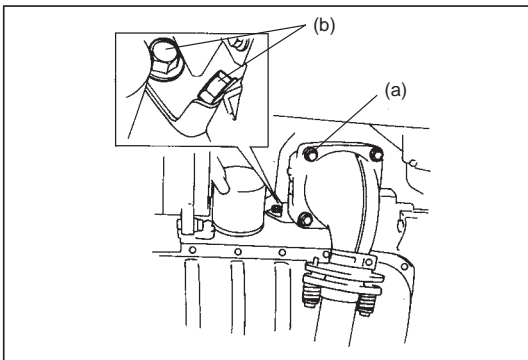
- 1) Install new gaskets to cylinder head.
- 2) Install exhaust manifold.  
Tighten bolts and nuts to specified torque.

#### Tightening Torque

**(a): 32 N·m (3.2 kg-m, 23.5 lb-ft)**



- 3) Install exhaust manifold cover(s) (1).
- 4) Connect oxygen sensor coupler (3) and clamp (2) its wire securely.



- 5) Tighten exhaust No.1 pipe to manifold nuts and exhaust manifold stiffener bolt.

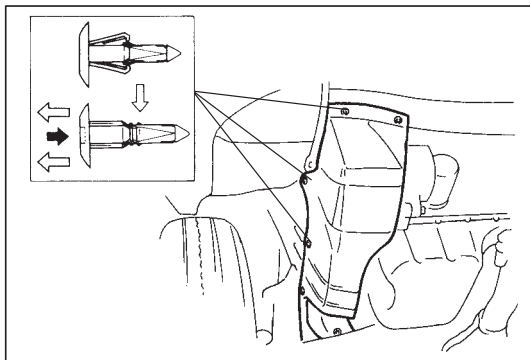
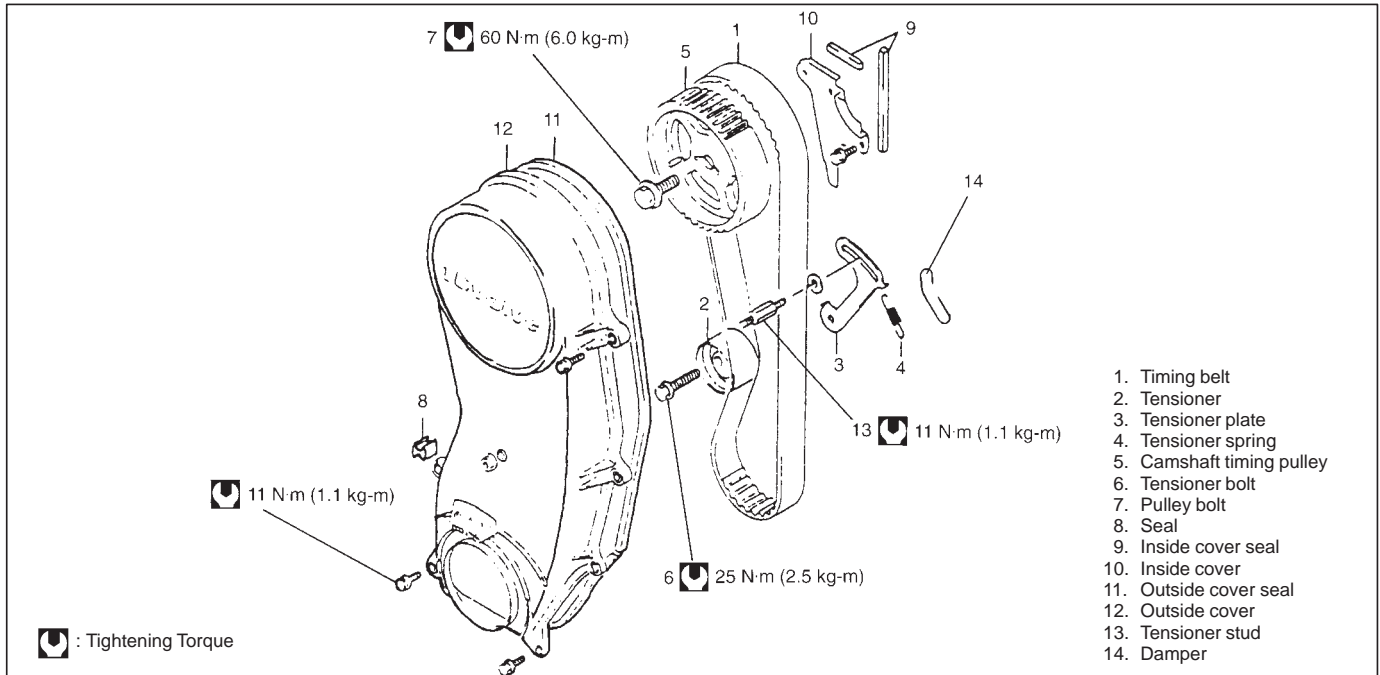
#### Tightening Torque

**(a): 50 N·m (5.0 kg-m, 36.5 lb-ft)**

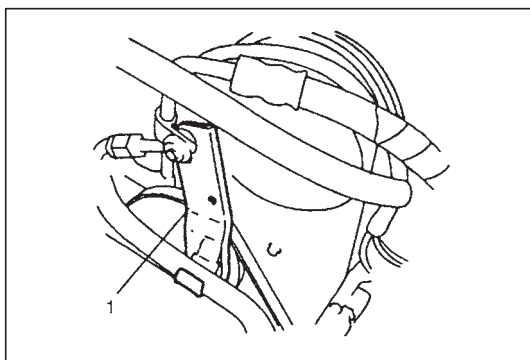
**(b): 50 N·m (5.0 kg-m, 36.5 lb-ft)**

- 6) Connect negative cable at battery.
- 7) Check exhaust system for exhaust gas leakage.

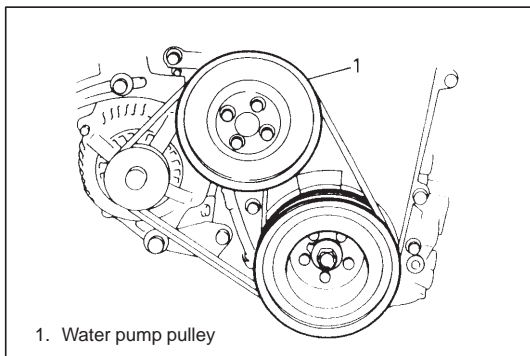
## TIMING BELT AND BELT TENSIONER

**REMOVAL**

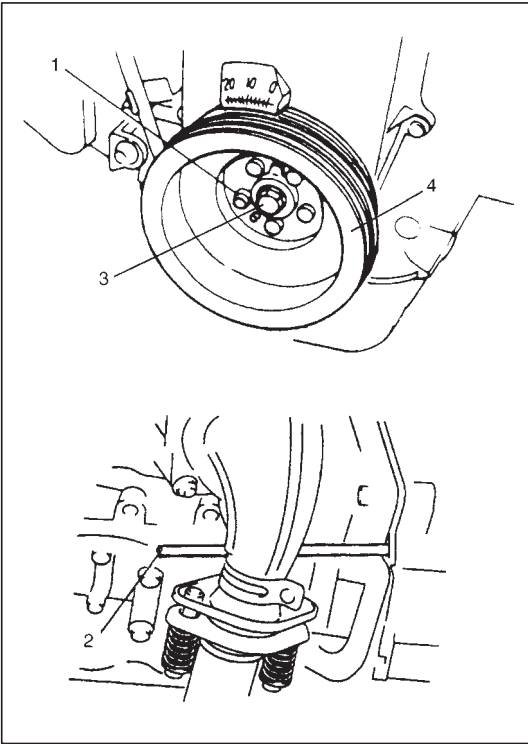
- 1) Disconnect negative cable at battery.
- 2) Remove right side of engine under cover.
- 3) Remove power steering pump belt or A/C compressor belt, if equipped.
- 4) Disconnect IAT sensor at coupler.
- 5) Remove air cleaner case with air cleaner outlet hose.



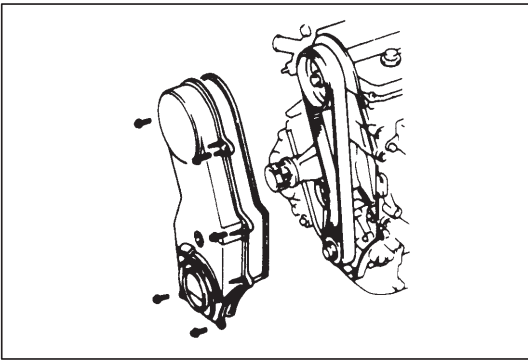
- 6) Remove power steering hose stay (1) (if equipped).



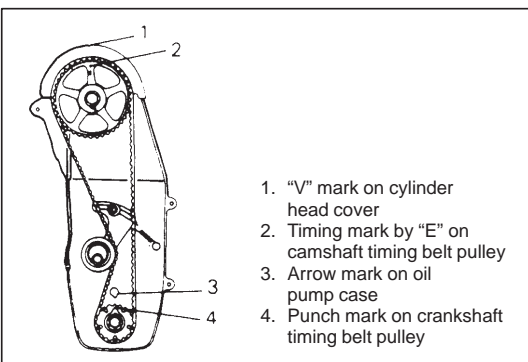
- 7) Remove water pump pulley and drive belt.



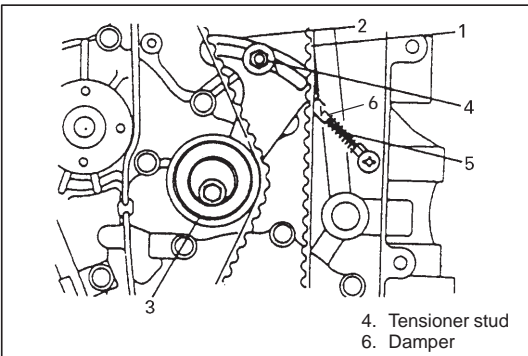
- 8) Lock crankshaft inserting flat end rod or the like (2) between fly-wheel ring gear and transmission case, after removing clutch housing (torque converter housing for A/T) lower plate. With crankshaft locked, remove crankshaft timing belt pulley bolt (3).
- 9) Remove crankshaft pulley bolts (1).
- 10) Remove crankshaft pulley (4).
- 11) Install crankshaft timing belt pulley bolt temporarily to turn crankshaft.



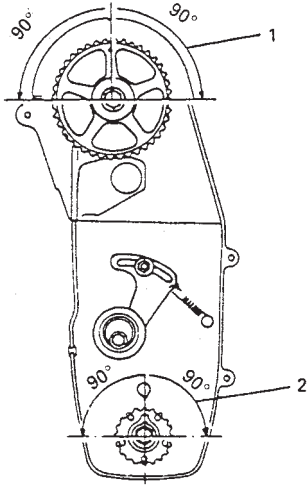
- 12) Release harness clamps.
- 13) Remove timing belt outside cover.



- 14) For installation of timing belt, align 4 timing marks as shown in figure by turning crankshaft.



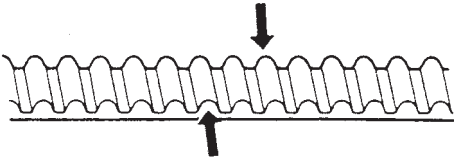
- 15) Remove timing belt tensioner (3), tensioner plate (2), tensioner spring (5) and timing belt (1).



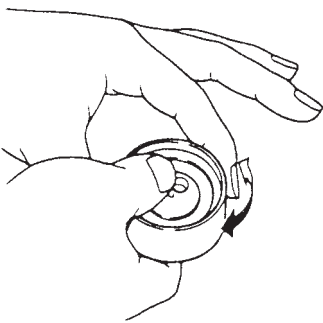
1. Camshaft allowable turning range - - - By timing mark, within 90° from "V" mark on head cover on both right and left.
2. Crankshaft allowable turning range - - - By punch mark, within 90° from arrow mark on oil pump case on both right and left.

**CAUTION:**

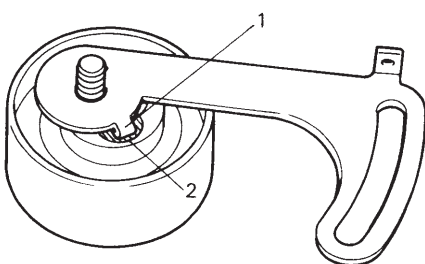
- After timing belt is removed, never turn camshaft and crankshaft independently more than such an extent as shown in figure. If turned, interference may occur among piston and valves, and parts related to piston and valves may be damaged.
- Never bend timing belt.

**INSPECTION**

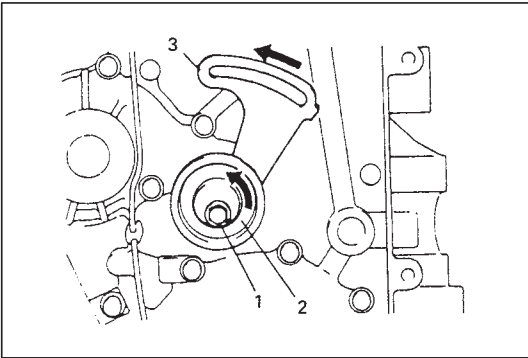
- Inspect timing belt for wear or crack.  
Replace it as necessary.



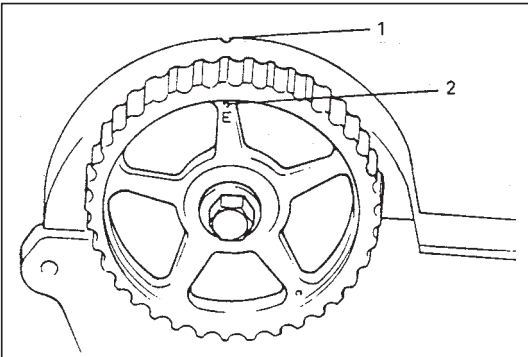
- Inspect tensioner for smooth rotation.

**INSTALLATION**

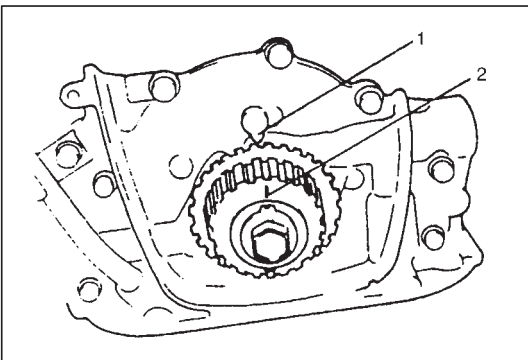
- 1) Install tensioner plate to tensioner.  
Insert lug (1) of tensioner plate into hole (2) in tensioner.



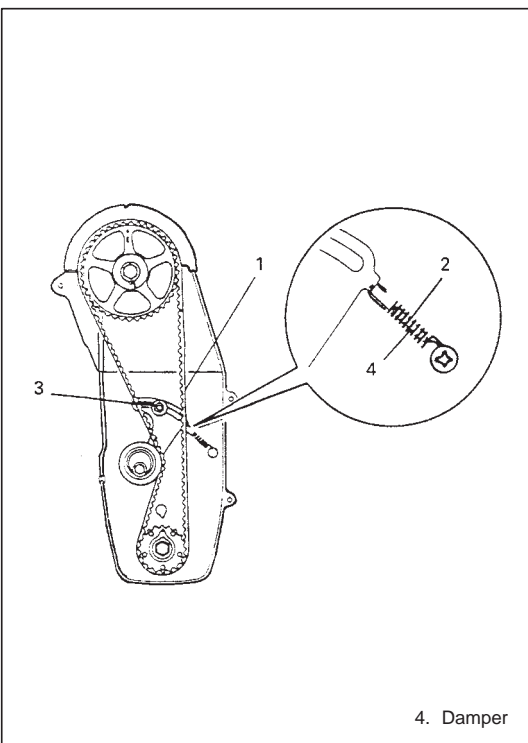
- 2) Install tensioner (2) and tensioner plate (3):  
Do not tighten tensioner bolt (1) with wrench yet. Hand tighten only at this time.  
Check to ensure that plate movement in arrow direction as shown in figure causes tensioner to move in the same direction. If no associated movement between plate and tensioner occurs, remove tensioner and plate again and reinsert plate lug into tensioner hole.



- 3) Check that timing mark (2) on camshaft timing belt pulley is aligned with "V" mark (1) on cylinder head cover. If not, align two marks by turning camshaft but be careful not to turn it more than its allowable turning range which is described on previous page.



- 4) Check that timing mark (2) on crankshaft timing belt pulley is aligned with arrow mark (1) on oil pump case. If not, align two marks by turning crankshaft but be careful not to turn it more than its allowable turning range which is described on previous page.

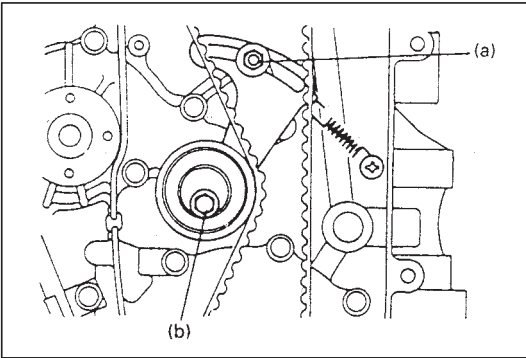


- 5) Install timing belt and tensioner spring (2).  
With two sets of marks aligned and tensioner plate pushed up, install timing belt on two pulleys in such a way that drive side (1) of belt is free from any slack.  
And then install tensioner spring as shown in figure, and hand-tighten tensioner stud (3).

**NOTE:**

- When installing timing belt, match arrow mark ( ⇨ ) on timing belt with rotating direction of crankshaft.
- In this state, No. 4 piston is at top dead center of compression stroke.

4. Damper

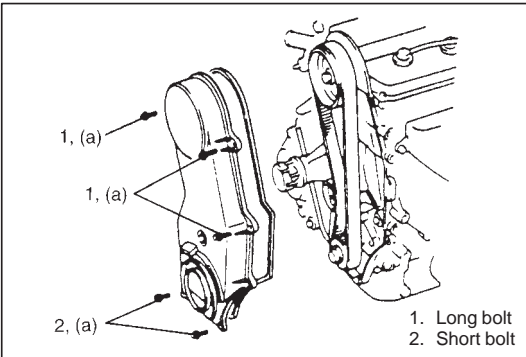


- 6) To take up slack of timing belt, turn crankshaft two rotations clockwise after installing it. After making sure that belt is free from slack, tighten tensioner stud first and then tensioner bolt to each specified torque.  
Then confirm again that two sets of marks are aligned respectively.

#### Tightening Torque

(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

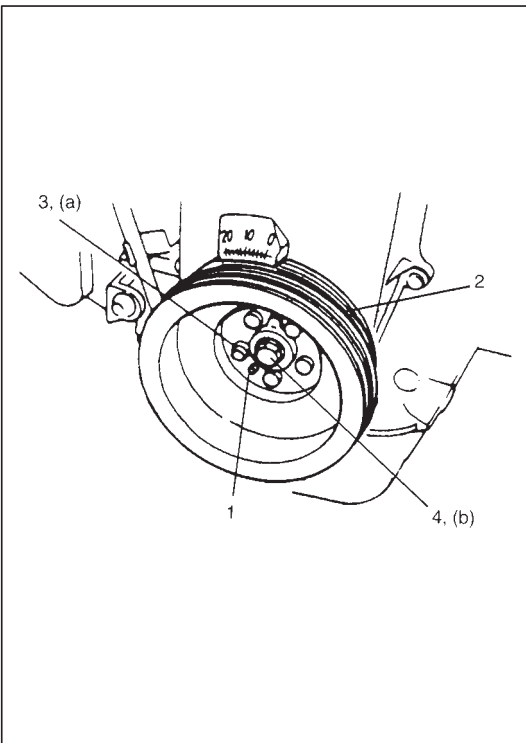
(b): 25 N·m (2.5 kg-m, 18.0 lb-ft)



- 7) Install timing belt outside cover.  
Before installing, make sure that seal is between water pump and oil pump case.

#### Tightening Torque

(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



- 8) With crankshaft locked, remove crankshaft timing belt pulley bolt (4).  
9) Install crankshaft pulley (2).  
Fit hole of pulley to pin (1) on crankshaft timing belt pulley, and tighten pulley bolts (3) to specified torque.

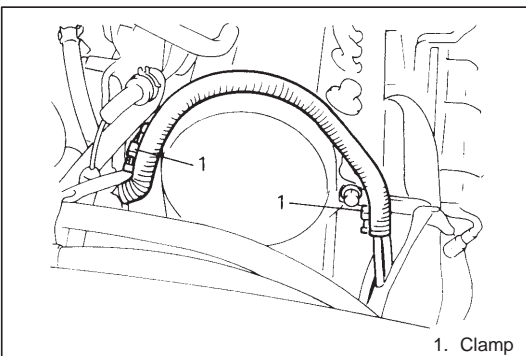
#### Tightening Torque

(a): 16 N·m (1.6 kg-m, 11.5 lb-ft)

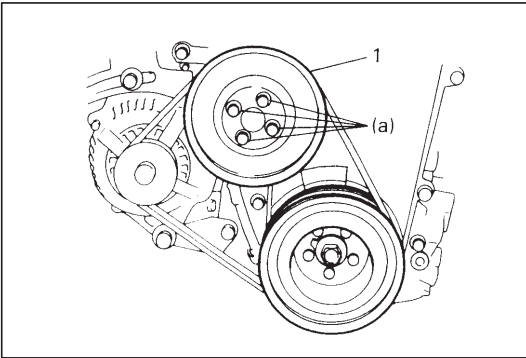
- 10) With crankshaft locked using flat end rod or the like, tighten crankshaft timing belt pulley bolt (4).

#### Tightening Torque

(b): 130 N·m (13.0 kg-m, 94.0 lb-ft)



- 11) Clamp harness securely.



- 12) Install water pump pulley (1) and drive belt.

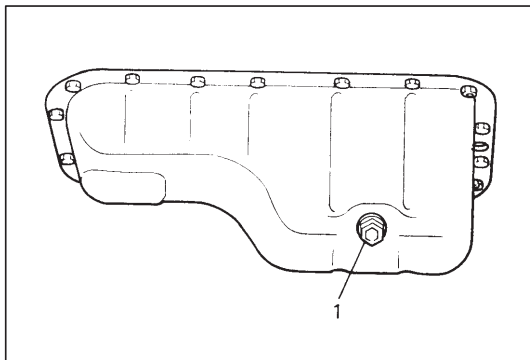
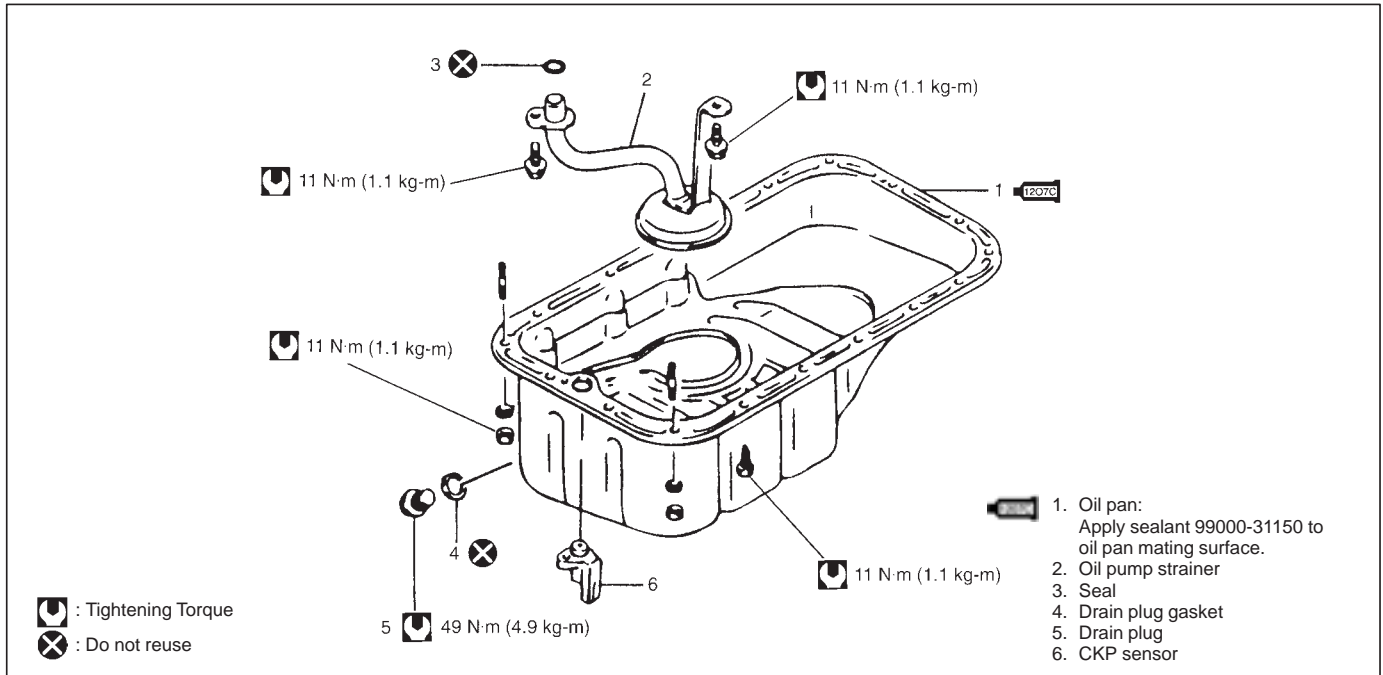
**Tightening Torque**

**(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)**

- 13) Adjust drive belt tension referring to Section 6B.
- 14) Adjust power steering pump belt tension or A/C compressor belt tension, if equipped.  
Refer to Section 0B.
- 15) Install P/S hose stay (if equipped).
- 16) Install air cleaner case with air cleaner outlet hose.
- 17) Install right side of engine under cover.
- 18) Install clutch housing (torque converter housing for A/T) lower plate.
- 19) Connect negative cable at battery.

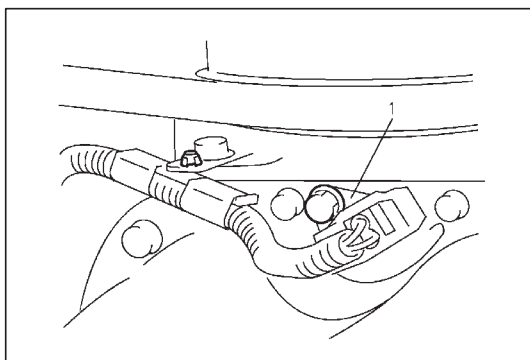


## OIL PAN AND OIL PUMP STRAINER

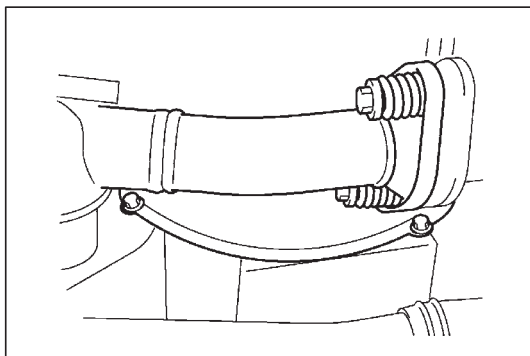


## REMOVAL

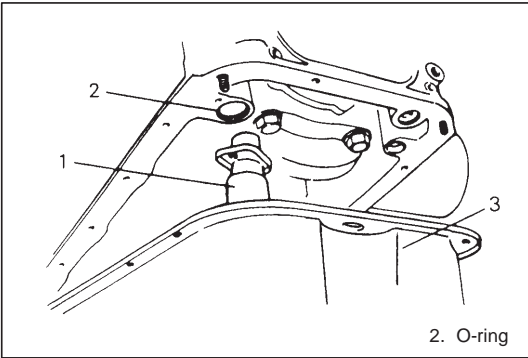
- 1) Raise vehicle.
- 2) Drain engine oil by removing drain plug (1).
- 3) Remove right side of engine under cover.



- 4) Disconnect CKP sensor coupler and remove CKP sensor (1) by removing its bolt. Then remove CKP sensor wire harness from clamp.



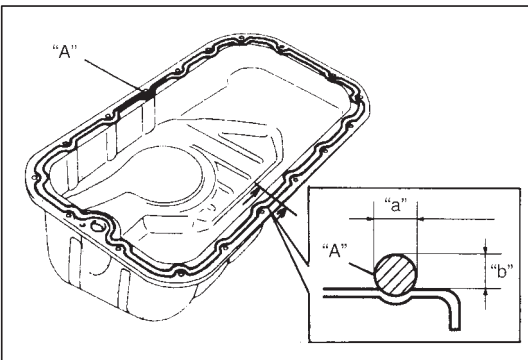
- 5) Remove clutch housing (torque converter housing for A/T) lower plate.



6) Remove oil pan (3) and then oil pump strainer (1).

### CLEANING

- Clean mating surfaces of oil pan and cylinder block.  
Remove oil, old sealant, and dusts from mating surfaces and oil pan inside.
- Clean oil pump strainer screen.



### INSTALLATION

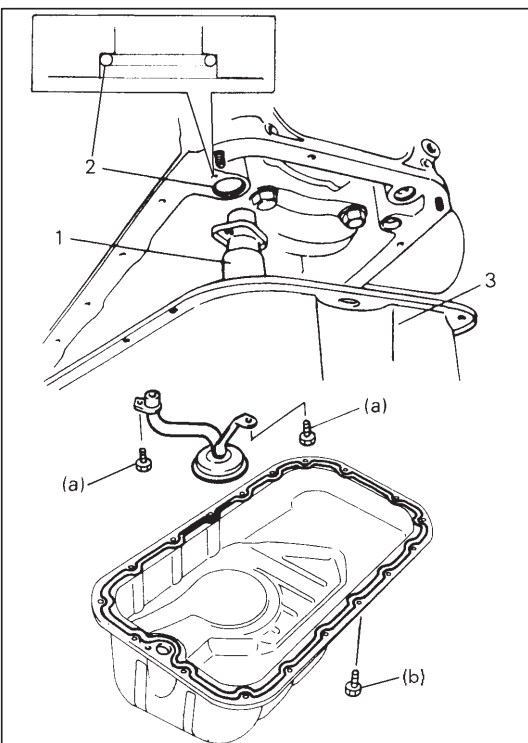
1) Apply sealant to oil pan mating surface continuously as shown in figure.

**"A" Sealant: 99000-31150**

#### Sealant amount

**Width "a": 4 mm, 0.16 in.**

**Height "b": 2 mm, 0.08 in.**



2) Install O-ring (2) into cylinder block securely as shown in figure. Install oil pump strainer (1) to cylinder block. Tighten strainer bolt first and then bracket bolt to specified torque.

#### Tightening Torque

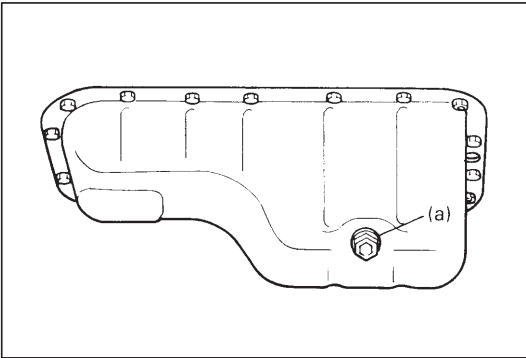
**(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)**

After fitting oil pan (3) to cylinder block, run in securing bolts and start tightening at the center: move wrench outward, tightening one bolt at a time.

Tighten bolts to specified torque.

#### Tightening Torque

**(b): 11 N·m (1.1 kg-m, 8.0 lb-ft)**

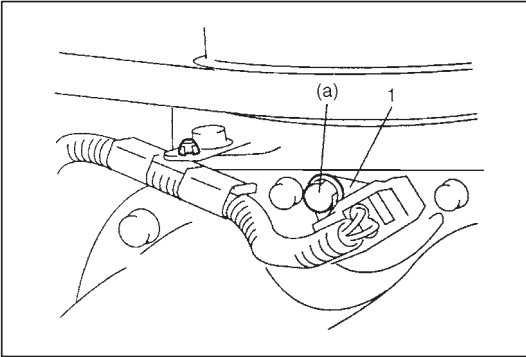


- 3) Install new gasket and drain plug to oil pan.  
Tighten drain plug to specified torque.

**Tightening Torque**

**(a): 50 N·m (5.0 kg·m, 36 lb·ft)**

- 4) Install clutch (torque converter) housing lower plate.



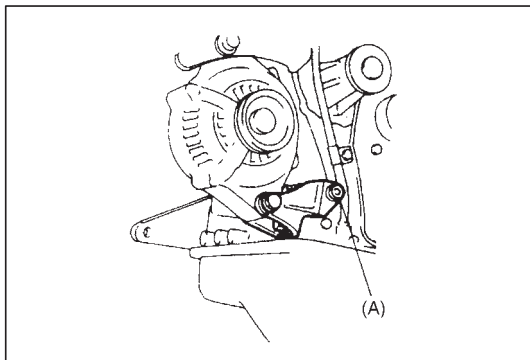
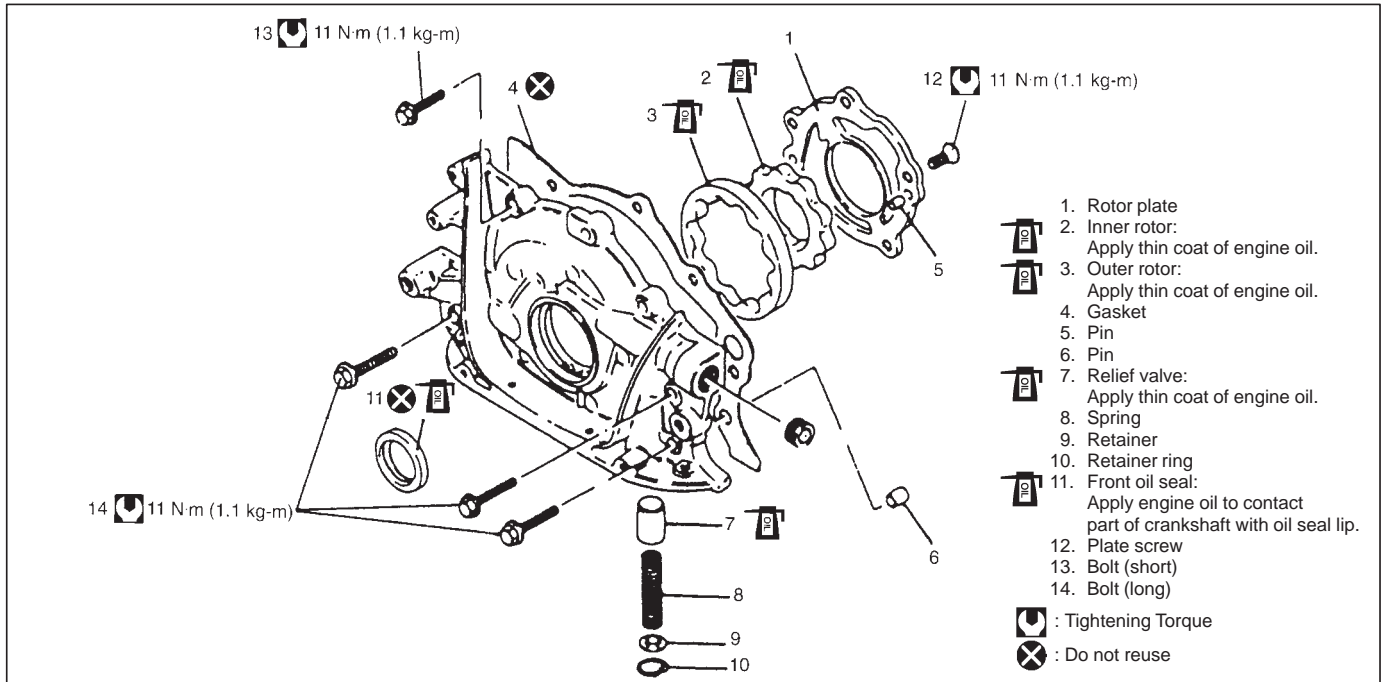
- 5) Install CKP sensor (1) and connect its coupler, then clamp its harness.

**Tightening Torque**

**(a): 10 N·m (1.0 kg·m, 7.5 lb·ft)**

- 6) Install right side of engine under cover.
- 7) Refill engine with engine oil referring to "ENGINE OIL CHANGE" in Section 0B.

## OIL PUMP

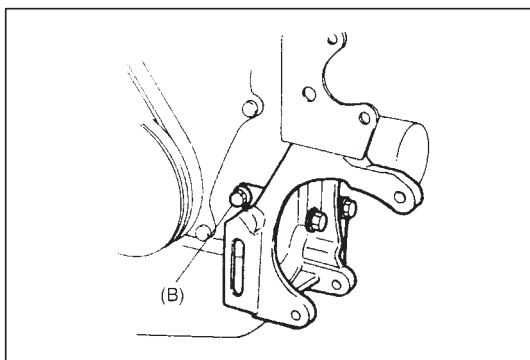


### REMOVAL

- 1) Disconnect negative cable at battery.
- 2) Remove timing belt as previously outlined.
- 3) Remove generator and its bracket.

#### NOTE:

**When installing bracket, fasten nut (A) first.**

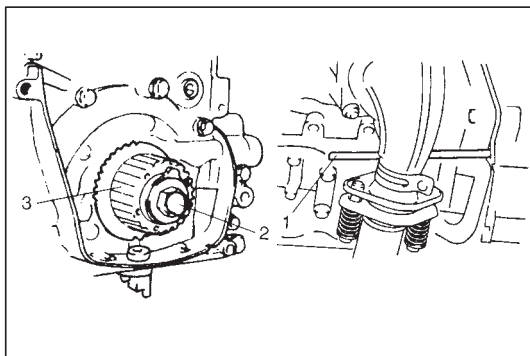


- 4) Remove power steering pump bracket or A/C compressor bracket, if equipped.

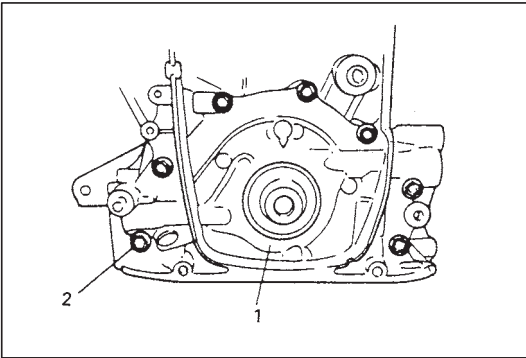
#### NOTE:

**When installing bracket, fasten bolt (B) first.**

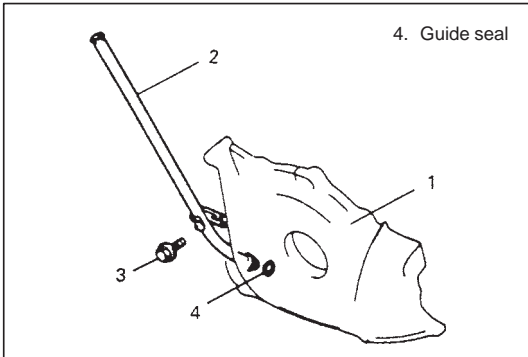
- 5) Remove oil pan and oil pump strainer as previously outlined.



- 6) Remove crankshaft timing belt pulley (3).  
 Lock crankshaft inserting flat end rod or the like (1) between fly-wheel ring gear and transmission case.  
 With crankshaft locked, remove crankshaft timing belt pulley bolt (2).

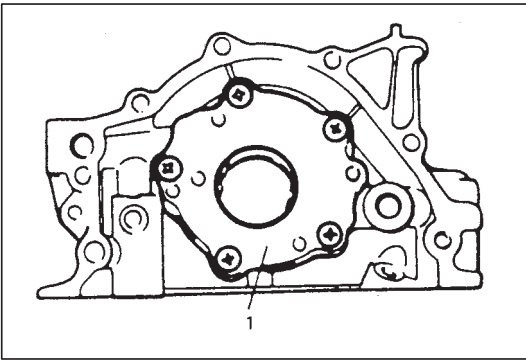


7) Remove oil pump assembly (1) after removing bolts (2).

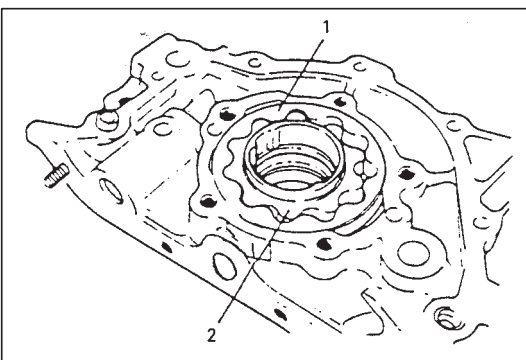


#### DISASSEMBLY

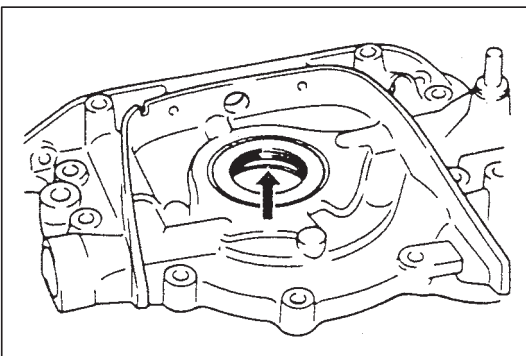
1) Remove oil level gauge guide bolt (3) and pull out guide (2) from oil pump (1).



2) Remove rotor plate (1).

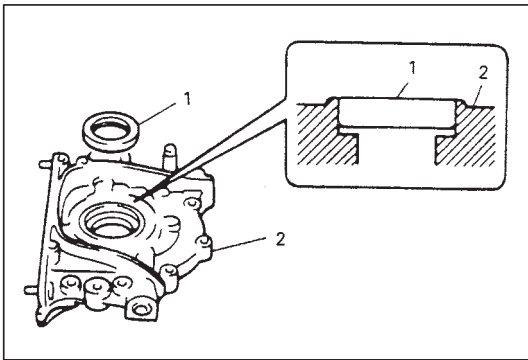


3) Remove outer rotor (1) and inner rotor (2).

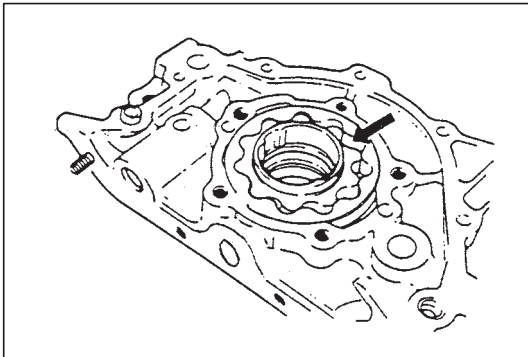


#### INSPECTION

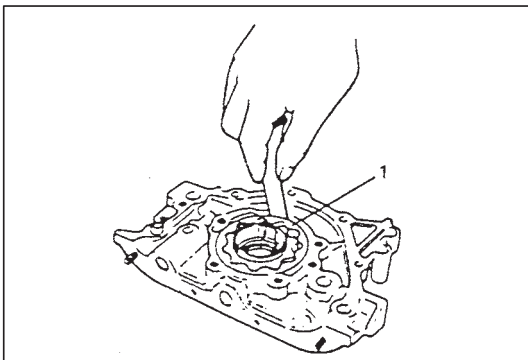
- Check oil seal lip for fault or other damage. Replace as necessary.

**NOTE:**

When installing oil seal (1), press-fit it till its end face is flush with oil pump case (2) end face.



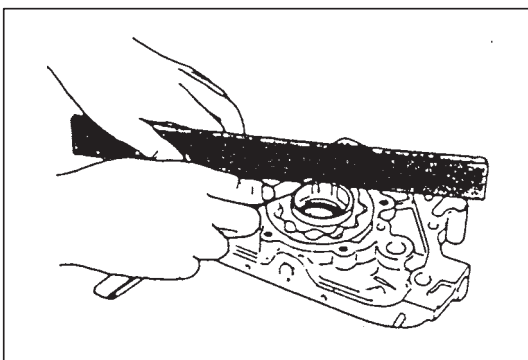
- Check outer and inner rotors, rotor plate, and oil pump case for excessive wear or damage.

**MEASUREMENT**● **Radial clearance**

Check radial clearance between outer rotor (1) and case, using thickness gauge.

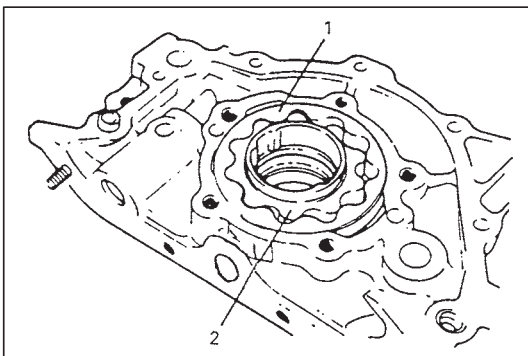
If clearance exceeds its limit, replace outer rotor or case.

**Limit on radial clearance between outer rotor and case:  
0.200 mm (0.079 in.)**

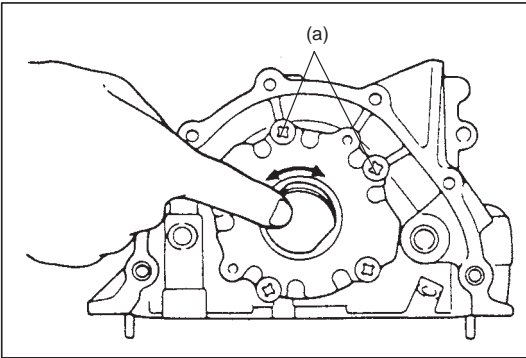
● **Side clearance**

Using straight edge and thickness gauge, measure side clearance.

**Limit on side clearance: 0.10 mm (0.0039 in.)**

**ASSEMBLY**

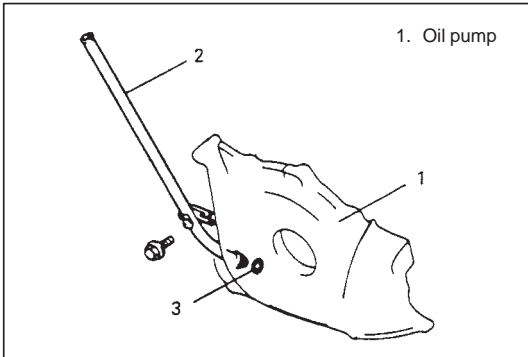
- 1) Wash, clean and then dry all disassembled parts.
- 2) Apply thin coat of engine oil to inner (2) and outer rotors (1), oil seal lip portion, and inside surfaces of oil pump case and plate.
- 3) Install outer and inner rotors to pump case.



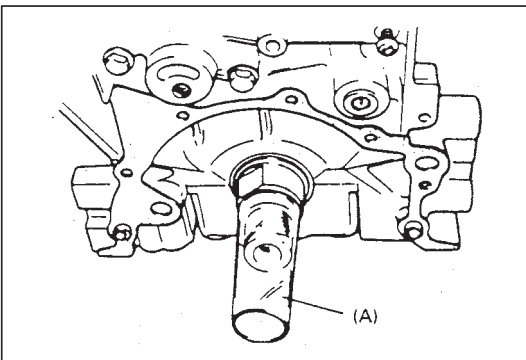
- 4) Install rotor plate. Tighten 5 screw securely.  
After installing plate, check to be sure that gears turn smoothly by hand.

#### Tightening Torque

(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



- 5) Apply engine oil to guide seal (3) and install guide seal and guide (2).

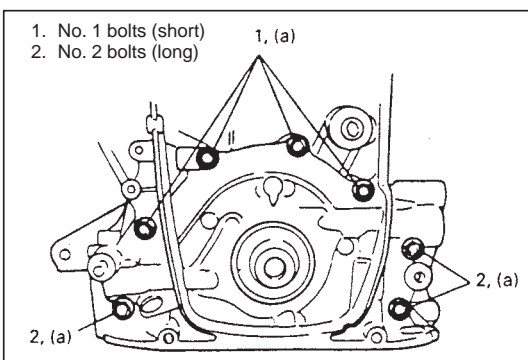


#### INSTALLATION

- 1) Install two oil pump pins and oil pump gasket to cylinder block. Use a new gasket.
- 2) To prevent oil seal lip from being damaged or upturned when installing oil pump to crankshaft, fit special tool (Oil seal guide) to crankshaft, and apply engine oil to special tool.

#### Special Tool

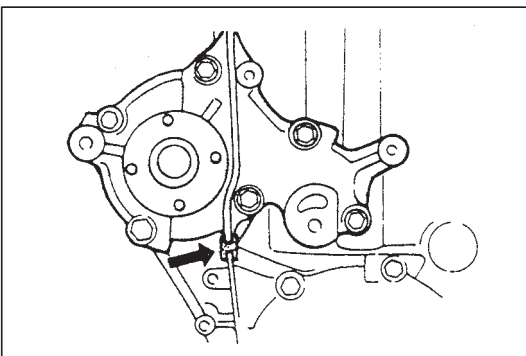
(A): 09926-18210



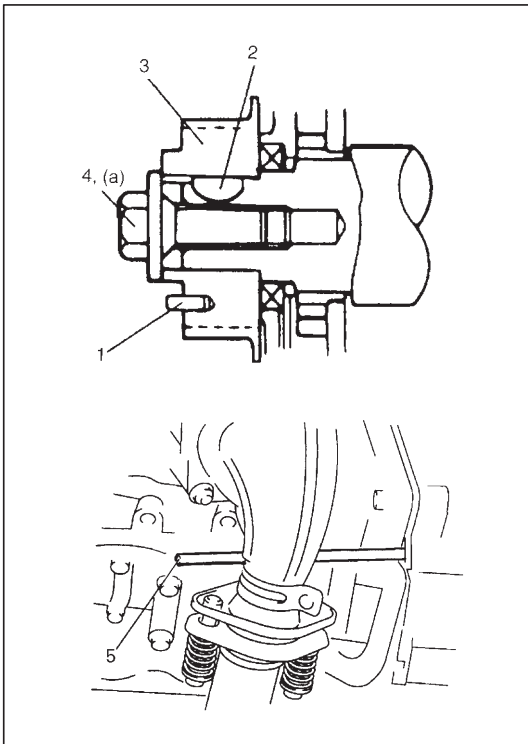
- 3) Install oil pump to cylinder block.  
As there are 2 types of oil pump bolts, refer to figure for their correct use and tighten them to specified torque.

#### Tightening Torque

(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



- 4) Install rubber seal between oil pump and water pump.



- 5) Install timing pulley key (2) and crank timing belt pulley (3) and crankshaft pulley pin (1). Refer to figure for proper installation of these parts.

With crankshaft locked using flat end rod or the like (5), tighten crank timing belt pulley bolt (4) to specified torque.

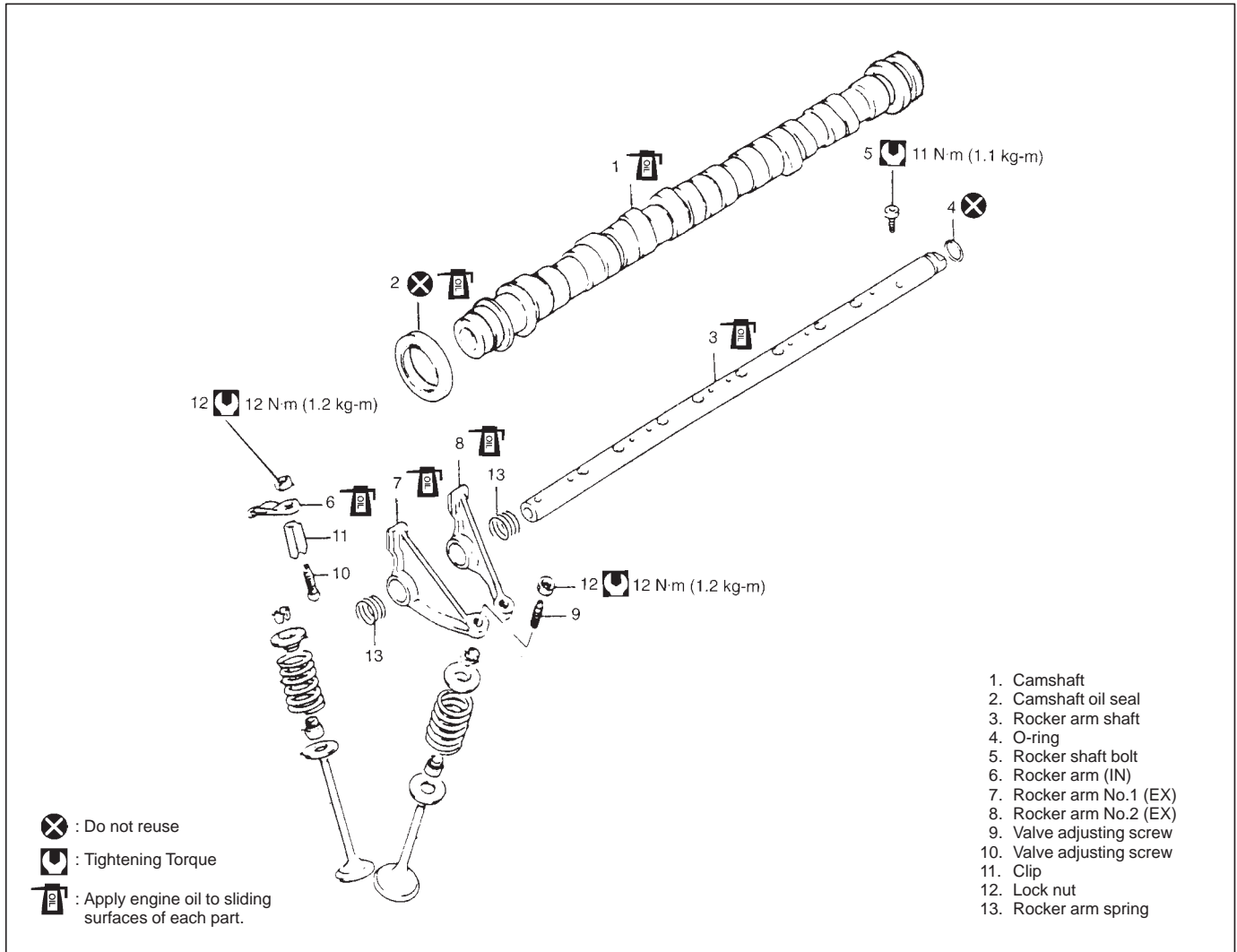
#### **Tightening Torque**

**(a): 130 N·m (13.0 kg·m, 94.0 lb·ft)**

- 6) Install timing belt, tensioner, oil pump strainer, oil pan and other parts as previously outlined.
- 7) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- 8) Adjust water pump drive belt tension referring to Section 6B.
- 9) Adjust power steering pump belt tension or A/C compressor belt tension, if equipped.  
Refer to Section 0B.
- 10) Refill engine with engine oil referring to "ENGINE OIL CHANGE" in Section 0B.
- 11) Connect negative cable at battery.
- 12) After completing installation, check oil pressure by running engine.

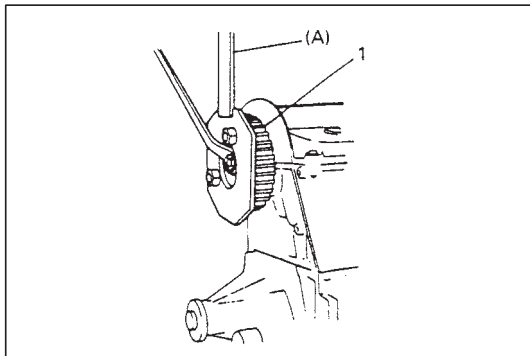


## ROCKER ARMS, ROCKER ARM SHAFT AND CAMSHAFT



### REMOVAL

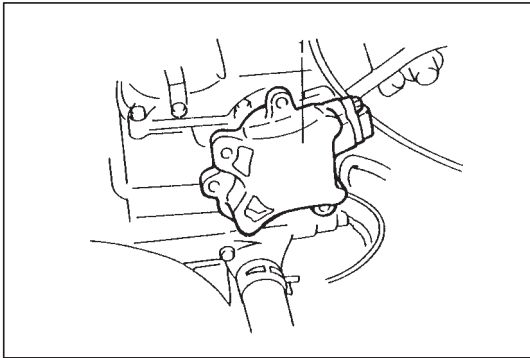
- 1) Disconnect negative cable at battery.



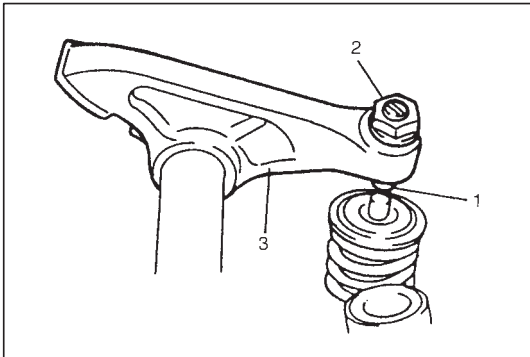
- 2) Remove timing belt as previously outlined and remove camshaft timing belt pulley (1) by using special tool.

**Special Tool**  
**(A): 09917-68221**

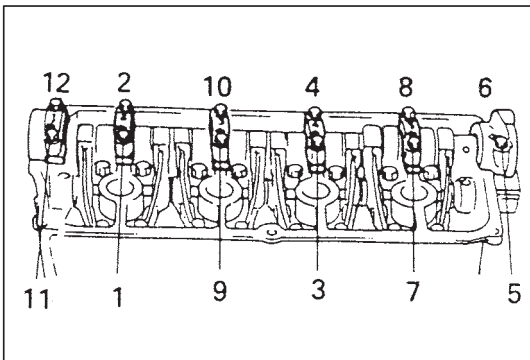
- 3) Remove cylinder head cover as previously outlined.



- 4) Disconnect CMP sensor coupler from CMP sensor.
- 5) Remove CMP sensor case (1) from cylinder head. Place a container or rag under CMP sensor case, for a small amount of oil flows out during removal of case.



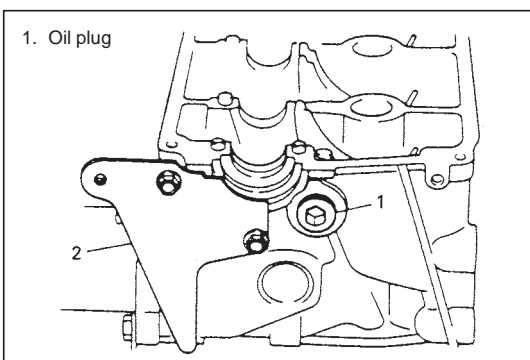
- 6) After loosening all valve adjusting screw lock nuts (2), turn adjusting screws (1) back all the way to allow all rocker arms (3) to move freely.



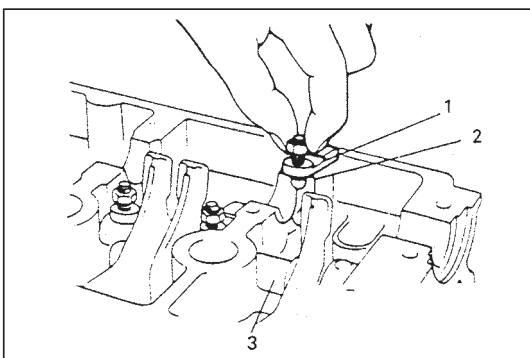
- 7) Remove camshaft housing and camshaft.

**NOTE:**

To remove camshaft housing bolts, loosen them in such order as indicated in figure, a little at a time.



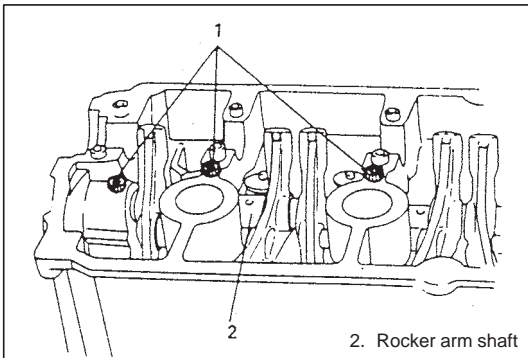
- 8) Remove timing belt inside cover (2).



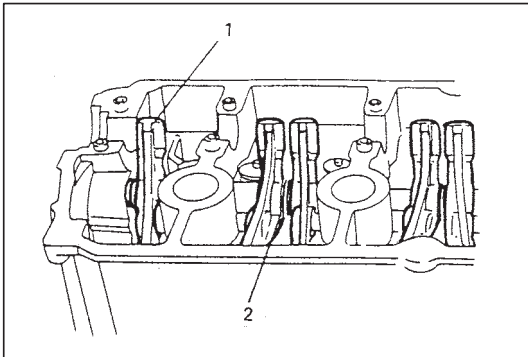
- 9) Remove intake rocker arm (1) with clip (2) from rocker arm shaft (3).

**NOTE:**

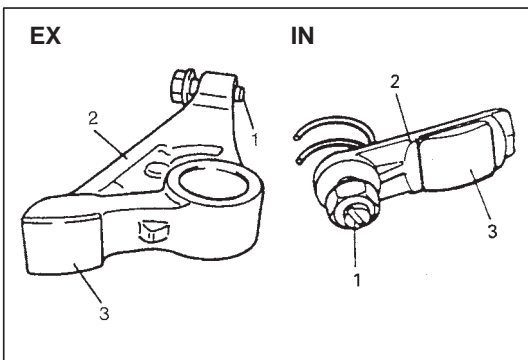
Do not bend clip when removing intake rocker arm.



10) Remove rocker arm shaft bolts (1).



11) Remove exhaust rocker arms (1) and rocker arm spring (2) by pulling out rocker arm shaft to battery side after removing battery.

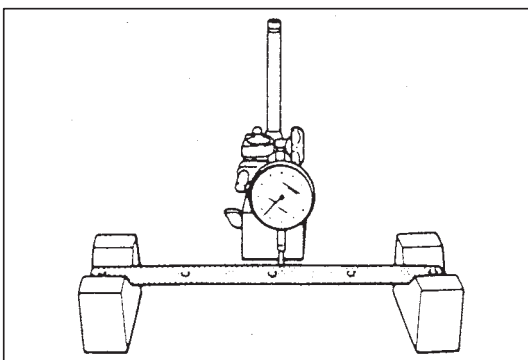


### INSPECTION

#### Adjusting Screw and Rocker Arm

If tip of adjusting screw (1) is badly worn, replace it.

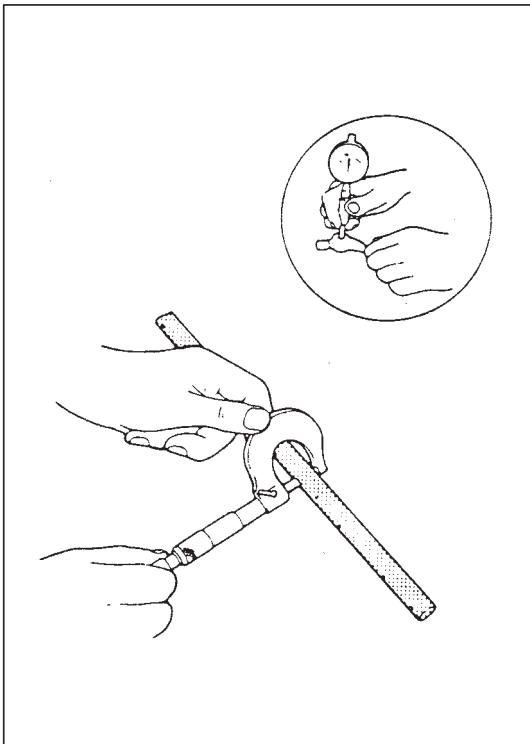
Rocker arm (2) must be replaced if its cam-riding face (3) is badly worn.



#### Rocker Arm Shaft Runout

Using "V" blocks and dial gauge, check runout. If runout exceeds its limit, replace rocker arm shaft.

**Runout limit: 0.10 mm (0.004 in.)**



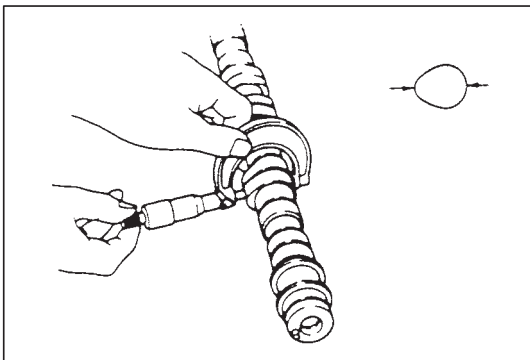
### Rocker Arm-to-Rocker Arm Shaft Clearance

Using a micrometer and a bore gauge, measure rocker shaft dia. and rocker arm I.D.

Difference between two readings is arm-to-shaft clearance on which a limit is specified.

If limit is exceeded, replace shaft or arm, or both.

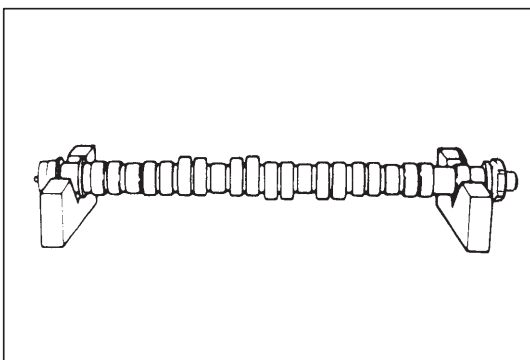
Item	Standard	Limit
Rocker arm I.D.	15.996 – 16.014 mm (0.629 – 0.630 in.)	—
Rocker arm shaft dia.	15.969 – 15.984 mm (0.6287 – 0.6293 in.)	—
Arm-to-shaft clearance	0.012 – 0.045 mm (0.0005 – 0.0018 in.)	0.09 mm (0.0035 in.)



### Cam Wear

Using a micrometer, measured height of cam. If measured height is below limit, replace camshaft.

Cam height	Standard	Limit
Intake cam	36.184 – 36.344 mm (1.4246 – 1.4309 in.)	36.084 mm (1.4206 in.)
Exhaust cam	35.900 – 36.060 mm (1.4134 – 1.4197 in.)	35.800 mm (1.4094 in.)

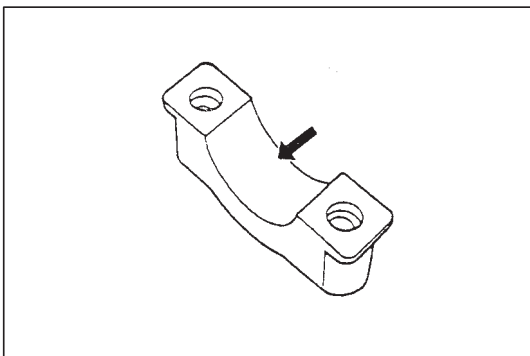


### Camshaft Runout

Hold camshaft between two "V" blocks, and measure runout by using a dial gauge.

If runout exceeds the limit, replace camshaft.

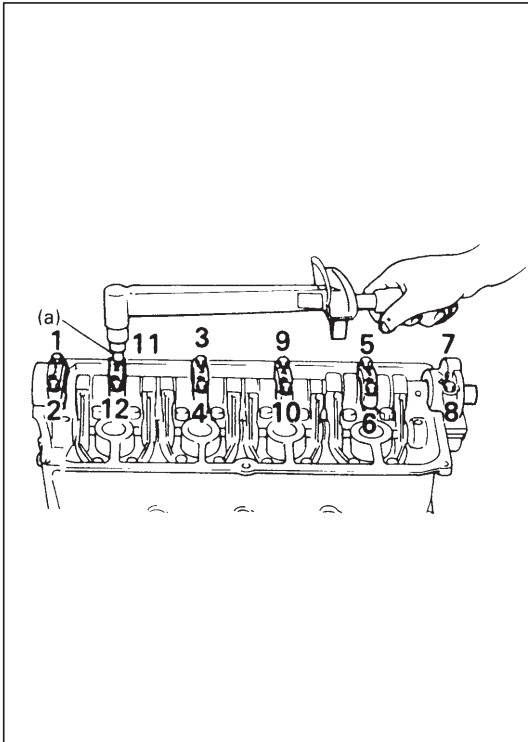
**Runout limit: 0.10 mm (0.0039 in.)**



### Camshaft Journal Wear

Check camshaft journals and camshaft housings for pitting, scratches, wear or damage.

If any malcondition is found, replace camshaft or cylinder head with housing. Never replace cylinder head without replacing housing.



Check clearance by using gaging plastic.

The procedure is as follows.

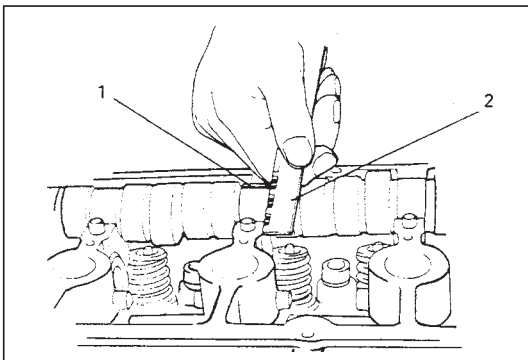
- 1) Clean housing and camshaft journals.
- 2) Install camshaft to cylinder head.
- 3) Place a piece of gaging plastic the full width of journal of camshaft (parallel to camshaft).
- 4) Install camshaft housing referring to "INSTALLATION" of the following page.
- 5) Tighten camshaft housing bolts in such order as indicated in figure a little at a time till they are tightened to specified torque.

**Tightening Torque**

**(a): 11 N·m (1.1kg-m, 8.0 lb-ft)**

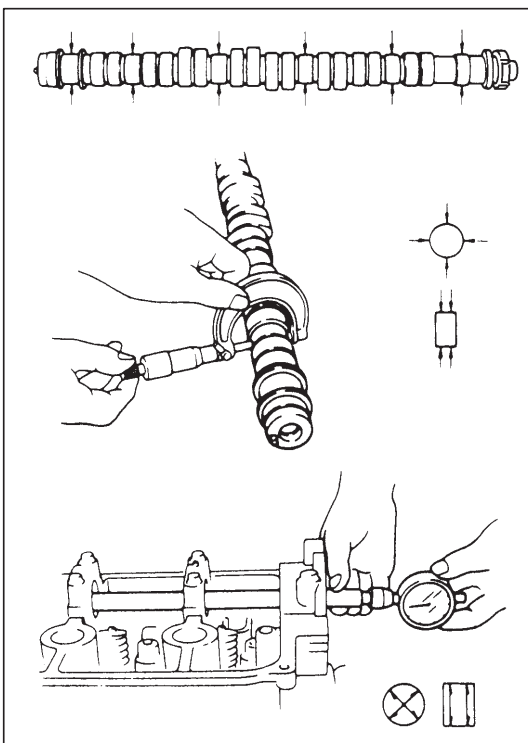
**NOTE:**

**Do not rotate camshaft while gaging plastic is installed.**



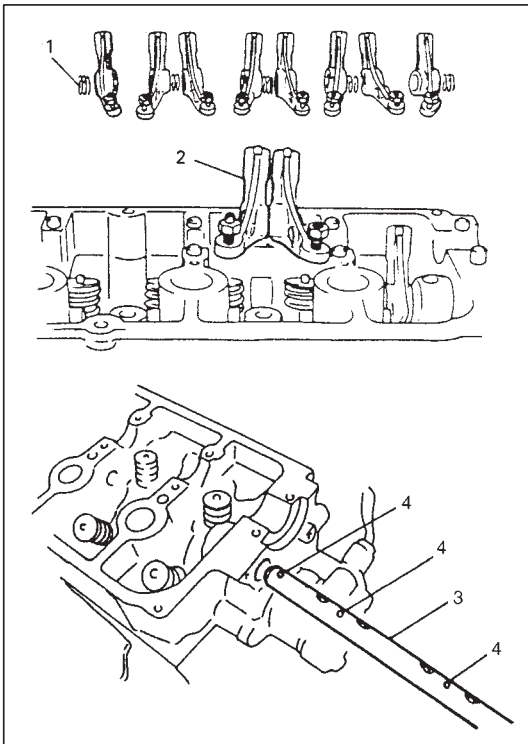
- 6) Remove housing and using scale (2) on gaging plastic (1) envelope, measure gaging plastic width at its widest point.

	Standard	Limit
Journal clearance	0.040 – 0.082 mm (0.0016 – 0.0032 in.)	0.12 mm (0.0047 in.)



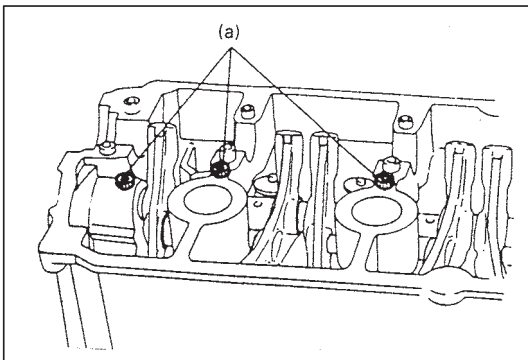
If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Item	Standard
Camshaft Journal bore dia.	28.000 – 28.021 mm (1.1024 – 1.1031 in.)
Camshaft journal O.D.	27.939 – 27.960 mm (1.1000 – 1.1008 in.)



## INSTALLATION

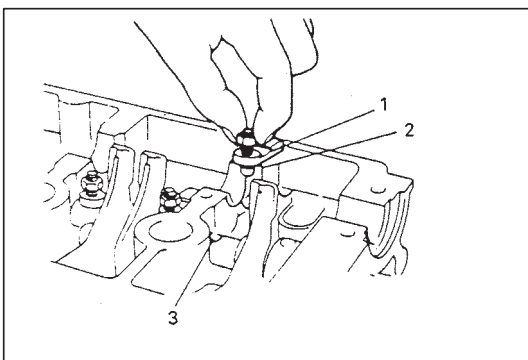
- 1) Apply engine oil to rocker arm shaft and rocker arms.
- 2) Check O-ring for damage or deterioration. Install O-ring to rocker arm shaft.
- 3) Install rocker arm shaft (3) with shaft bolt holes (4) facing up, rocker arm (exhaust side) (2) and rocker arm spring (1).



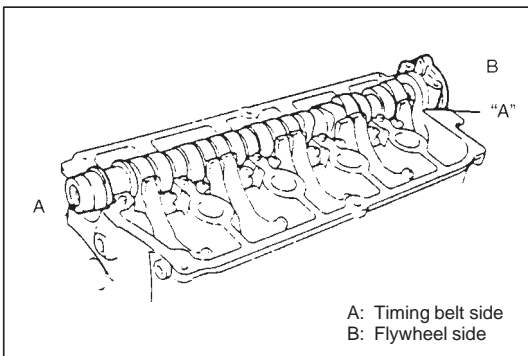
- 4) Install rocker arm shaft bolts and tighten them to specified torque.

### Tightening Torque

(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)



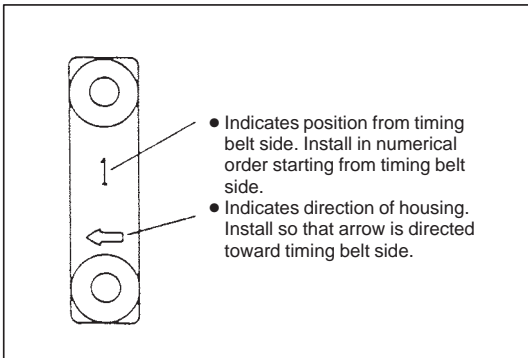
- 5) Fill small amount of engine oil into arm pivot holding part (3) of rocker arm shaft. Install rocker arm (intake side) (1) with clips (2) to rocker arm shaft.



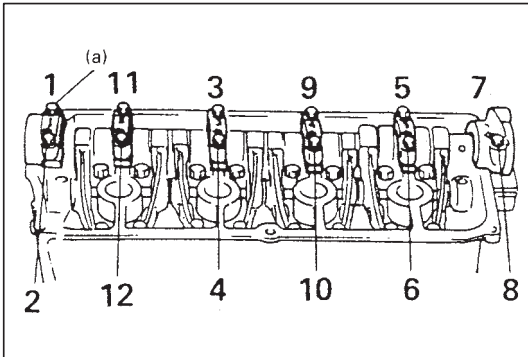
- 6) Apply engine oil to cams and journals on camshaft and put camshaft on cylinder head. Install camshaft housing to camshaft and cylinder head.

- Apply engine oil to sliding surface of each housing against camshaft journal.
- Apply sealant to mating surface of No.6 housing which will mate with cylinder head.

**“A” Sealant: 99000-31110**



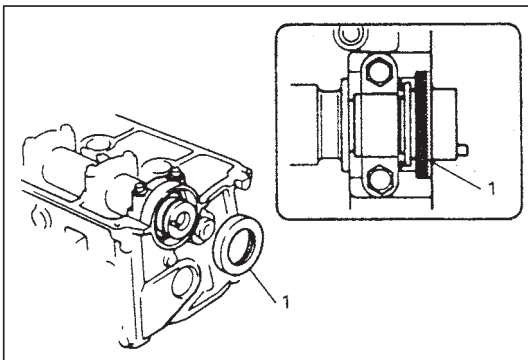
- Embossed marks are provided on each camshaft housing, indicating position and direction for installation. Install housing as indicated by these marks.
- As camshaft housing No. 1 retains camshaft in proper position as to thrust direction, make sure to first fit No. 1 housing to No. 1 journal of camshaft securely.



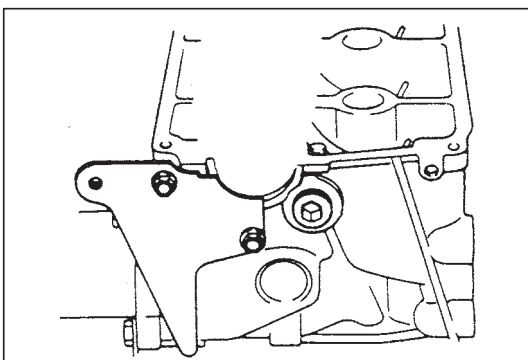
- After applying engine oil to housing bolts, tighten them temporarily first. Then tighten them by the following sequence as indicated in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence three to four times before they are tightened to specified torque.

#### Tightening Torque

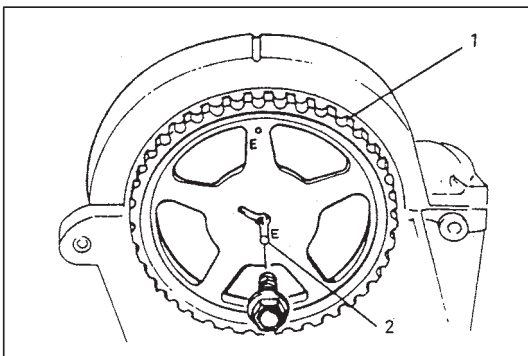
(a): 11 N·m (1.1 kg·m, 8.0 lb-ft)



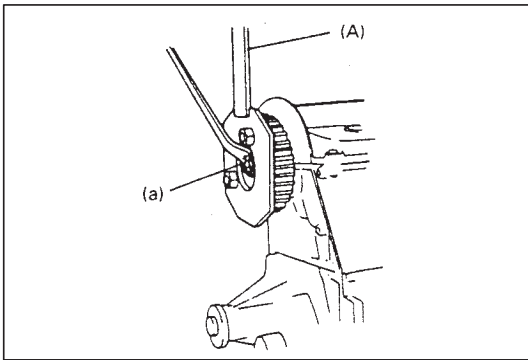
- 7) Install camshaft oil seal (1).  
After applying engine oil to oil seal lip, press-fit camshaft oil seal till oil seal surface becomes flush with housing surface.



- 8) Install timing belt inside cover.



- 9) Install camshaft timing belt pulley (1) to camshaft while fitting pin (2) on camshaft into slot at "E" mark.



- 10) Using special tool, tighten pulley bolt to specified torque.

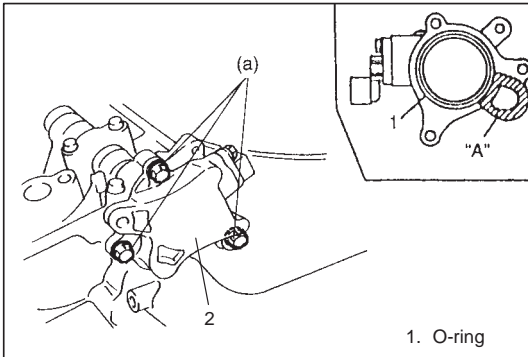
**Tightening Torque**

**(a): 60 N·m (6.0 kg-m, 43.5 lb-ft)**

**Special Tool**

**(A): 09917-68221**

- 11) Install belt tensioner, timing belt, outside cover, crankshaft pulley and water pump belt as previously outlined.



- 12) After applying sealant to part "A" as shown in figure, install CMP sensor case (2) (Distributorless ignition coil case) to cylinder head and tighten its fixing bolts to specified torque.

**"A" Sealant: 99000-31110**

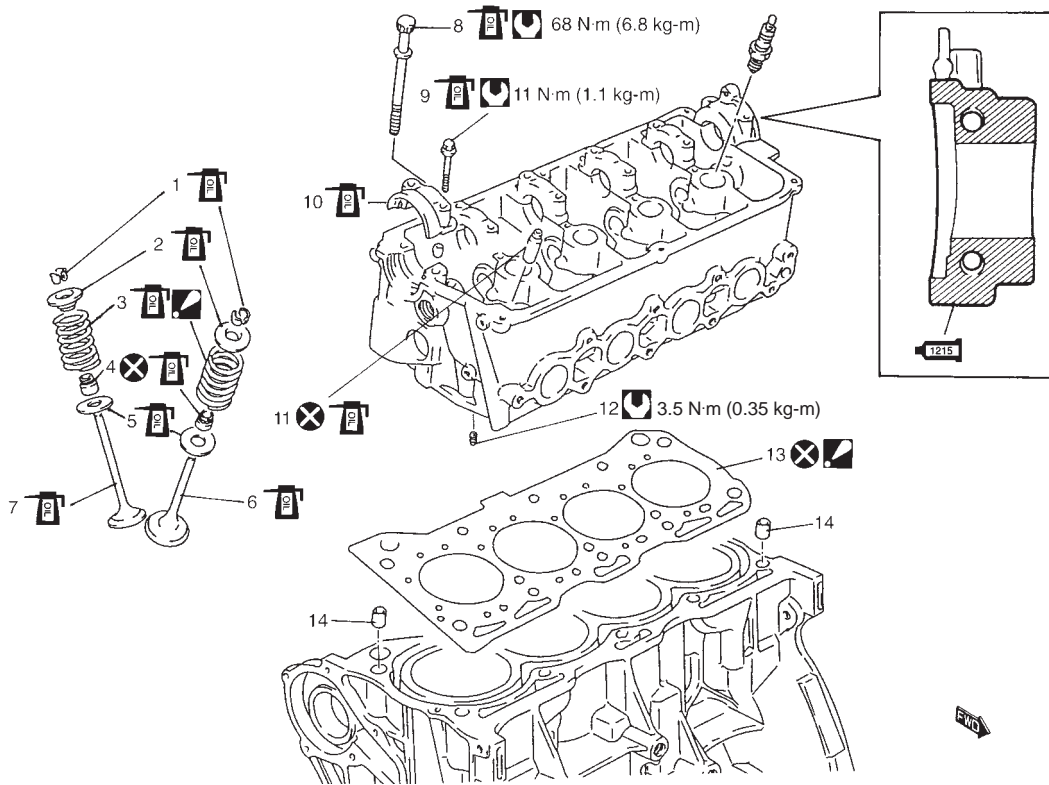
**Tightening Torque**

**(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)**

- 13) Adjust valve clearance as previously outlined.
- 14) Install cylinder head cover and air cleaner outlet hose.
- 15) Check to ensure that the following parts are back in place:
- Ignition coil assemblies
  - High tension cords
  - CMP sensor coupler
  - Couplers to ignition coil assembly
  - Other removed parts which have not been reinstalled
- 16) Connect negative cable at battery.
- 17) Confirm that ignition timing is within specification referring to Section 6F.

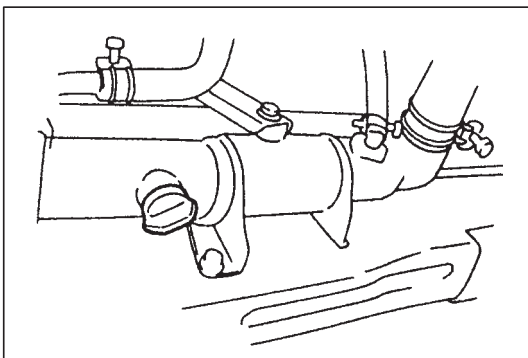


## VALVES AND CYLINDER HEAD



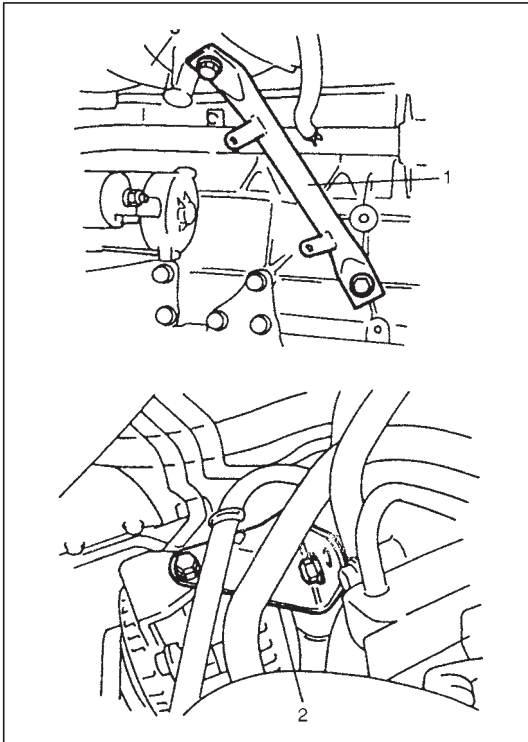
- 1. Valve cotter pins
- 2. Valve spring retainers
- 3. Valve spring: be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).
- 4. Valve stem seal
- 5. Valve spring seat
- 6. Exhaust valve
- 7. Intake valve
- 8. Cylinder head bolt
- 9. Camshaft housing bolt

- 10. Camshaft housing: Apply sealant to mating surface of No.1 and No.6 housings.
- 11. Valve guide
- 12. Oil venturi plug
- 13. Cylinder head gasket: "TOP" mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).
- 14. Dowel pin
- ⊗ : Do not reuse
- ⊖ : Tightening Torque
- 🔧 : Apply engine oil to sliding surfaces of each part.



### REMOVAL

- 1) Relieve fuel pressure according to procedure described in Section 6.
- 2) Disconnect negative cable at battery.
- 3) Drain cooling system.
- 4) Remove air cleaner outlet hose as previously outlined.

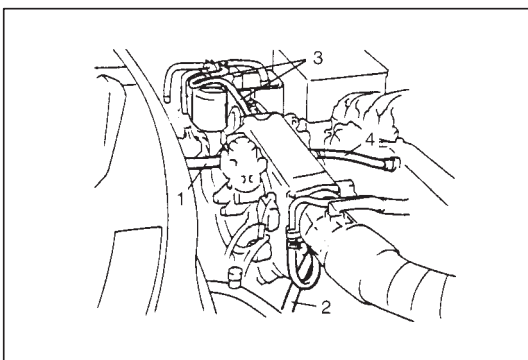


5) Remove intake manifold rear stiffener (1) and generator adjust arm reinforcement (2) from intake manifold.

6) Disconnect the following electric wires:

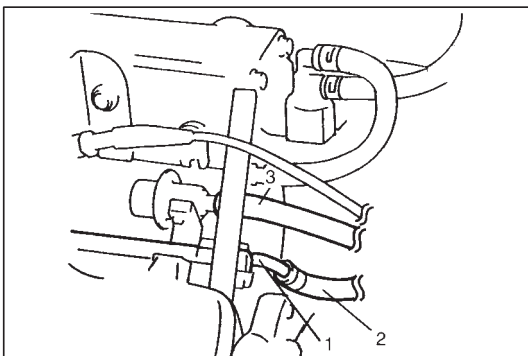
- Ignition coil assembly
- Ground wires from intake manifold
- EVAP canister purge valve
- ECT sensor
- Injectors, TP sensor and IAC valve wires at the coupler
- Heated oxygen sensor 1
- MAP sensor

and then release above wire harnesses from clamps.

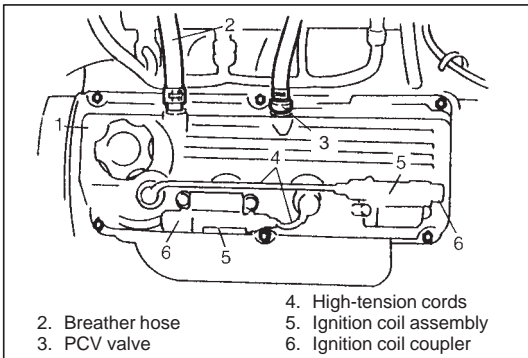


7) Disconnect the following hoses:

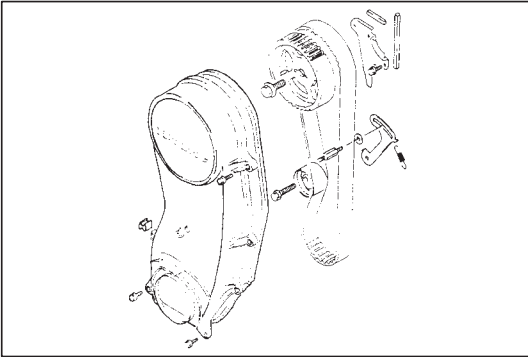
- Brake booster hose (1)
- EVAP canister purge hose (3) from purge valve
- Radiator inlet hose
- Heater inlet hose
- IAC valve outlet (2)



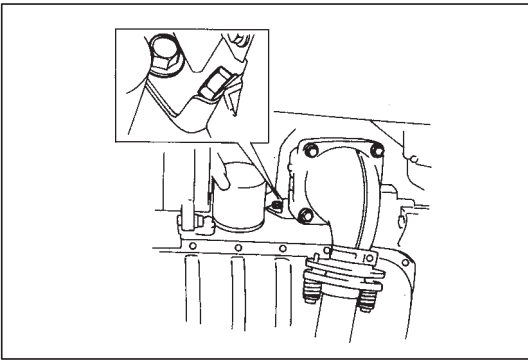
8) Disconnect fuel feed (2) and return hoses (3) from fuel delivery pipe (1).



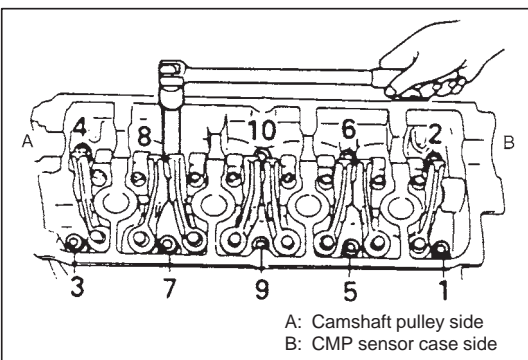
- 9) Remove cylinder head cover (1) as previously outlined. Loosen all valve lash adjusting screws fully.



- 10) Remove timing belt and camshaft as previously outlined.

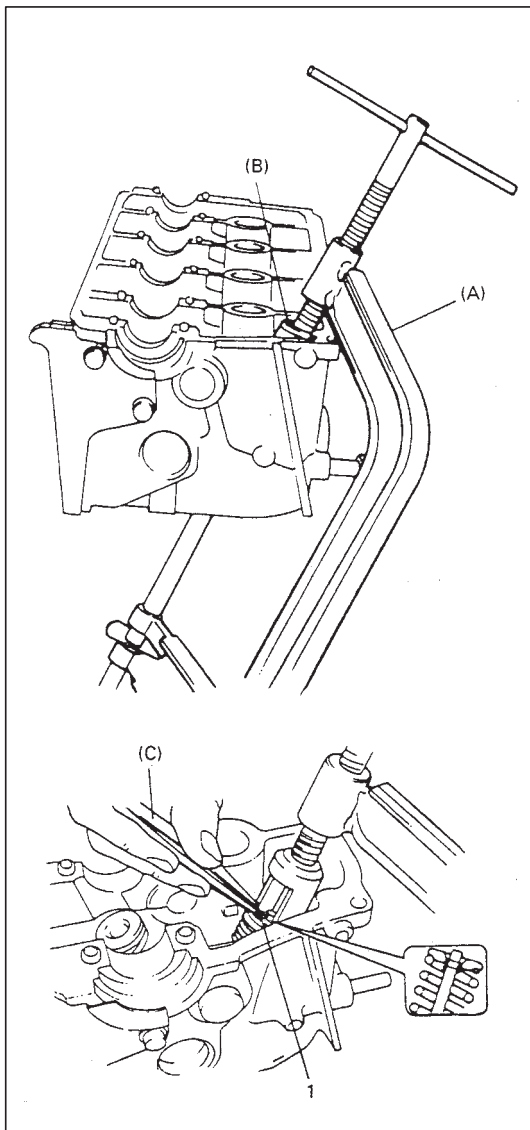


- 11) Disconnect exhaust pipe from exhaust manifold and remove exhaust manifold stiffener (if equipped).



- 12) Loosen cylinder head bolts in such order as indicated in figure and remove them.  
13) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.

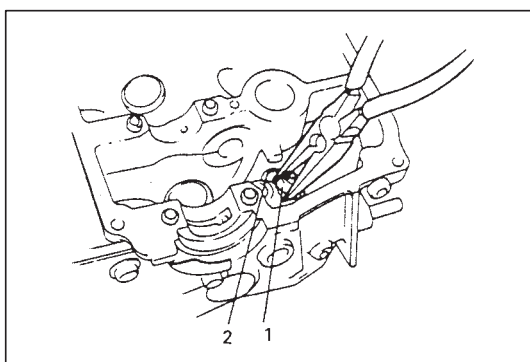
- 14) Remove cylinder head with intake manifold, exhaust manifold CMP sensor case, using lifting device if necessary.

**DISASSEMBLY**

- 1) For ease in servicing cylinder head, remove CMP sensor case, intake manifold with throttle body and exhaust manifold from cylinder head.
- 2) Remove rocker arms and washers by pulling its shaft out to transmission side.
- 3) Using special tools (Valve lifter), compress valve springs and then remove valve cotters (1) by using special tool (Forceps) as shown.

**Special Tool****(A): 09916-14510****(B): 09916-14910****(C): 09916-84511**

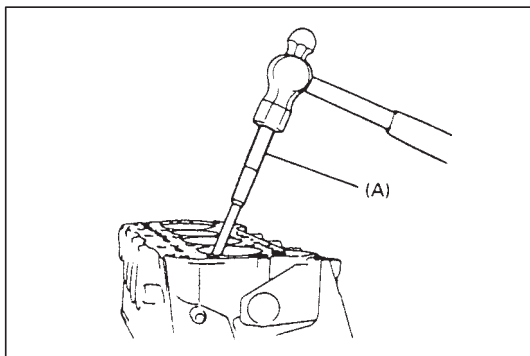
- 4) Release special tool, and remove spring retainer and valve spring.
- 5) Remove valve from combustion chamber side.



- 6) Remove valve stem oil seal (1) from valve guide, and then valve spring seat (2).

**NOTE:**

**Do not reuse oil seal once disassembled. Be sure to use new oil seal when assembling.**

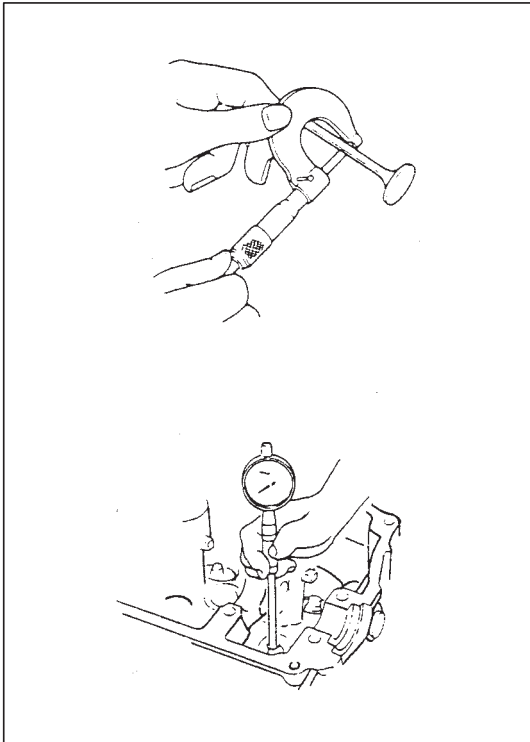


- 7) Using special tool (Valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

**Special Tool****(A): 09916-44910****NOTE:**

**Do not reuse valve guide once disassembled. Be sure to use new valve guide (Oversize) when assembling.**

- 8) Place disassembled parts except valve stem seal and valve guide in order, so that they can be installed in their original position.



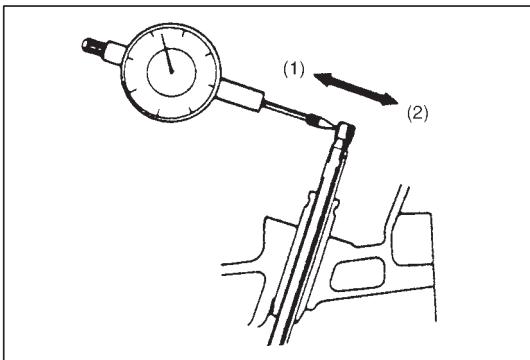
**INSPECTION**

**Valve Guides**

Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance. Be sure to take reading at more than one place along the length of each stem and guide.

If clearance exceeds limit, replace valve and valve guide.

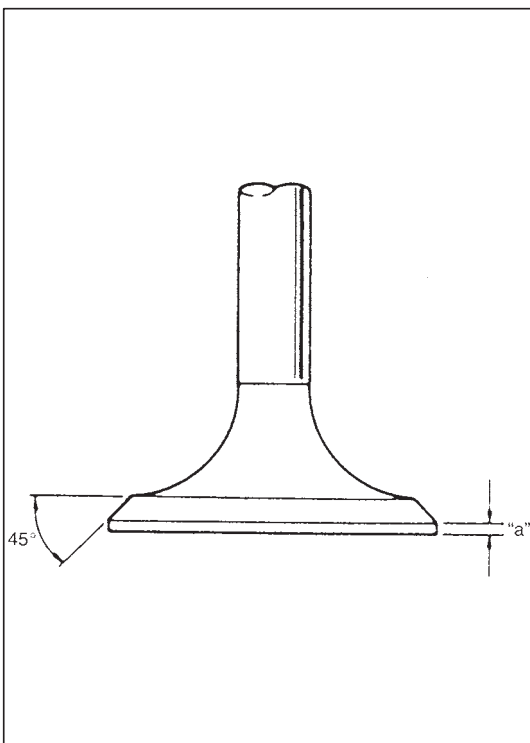
Item		Standard	Limit
Valve stem diameter	In	5.465 – 5.480 mm (0.2152 – 0.2157 in.)	–
	Ex	5.440 – 5.455 mm (0.2142 – 0.2148 in.)	–
Valve guide I.D.	In	5.500 – 5.512 mm	–
	Ex	(0.2166 – 0.2170 in.)	
Stem-to-guide clearance	In	0.020 – 0.047 mm (0.0008 – 0.0018 in.)	0.07 mm (0.0027 in.)
	Ex	0.045 – 0.072 mm (0.0018 – 0.0028 in.)	0.09 mm (0.0035 in.)



If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.

Move stem end in directions (1) and (2) to measure end deflection. If deflection exceeds its limit, replace valve stem and valve guide.

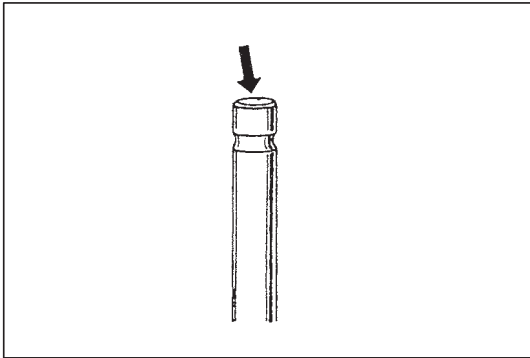
Valve stem end deflection limit	In	0.14 mm (0.005 in.)
	Ex	0.18 mm (0.007 in.)



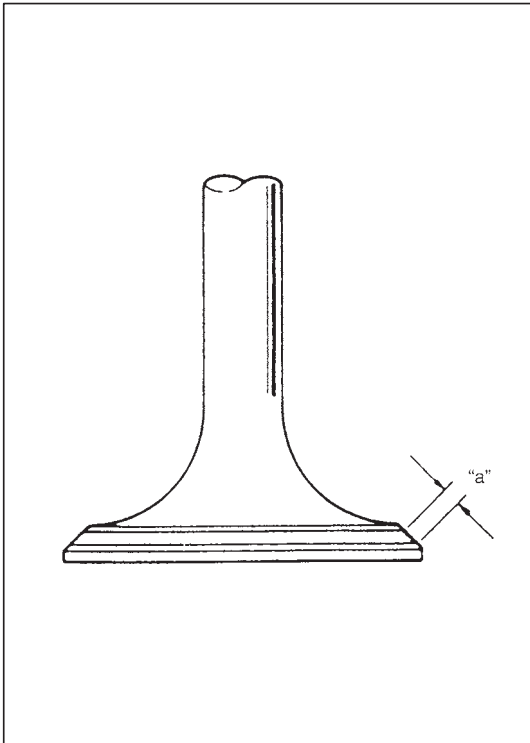
**Valves**

- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem and, as necessary, replace it.
- Measure thickness “a” of valve head. If measured thickness exceeds limit, replace valve.

Valve head thickness		
	Standard	Limit
In	0.8 – 1.2 mm	0.6 mm (0.024 in.)
Ex	(0.03 – 0.047 in.)	



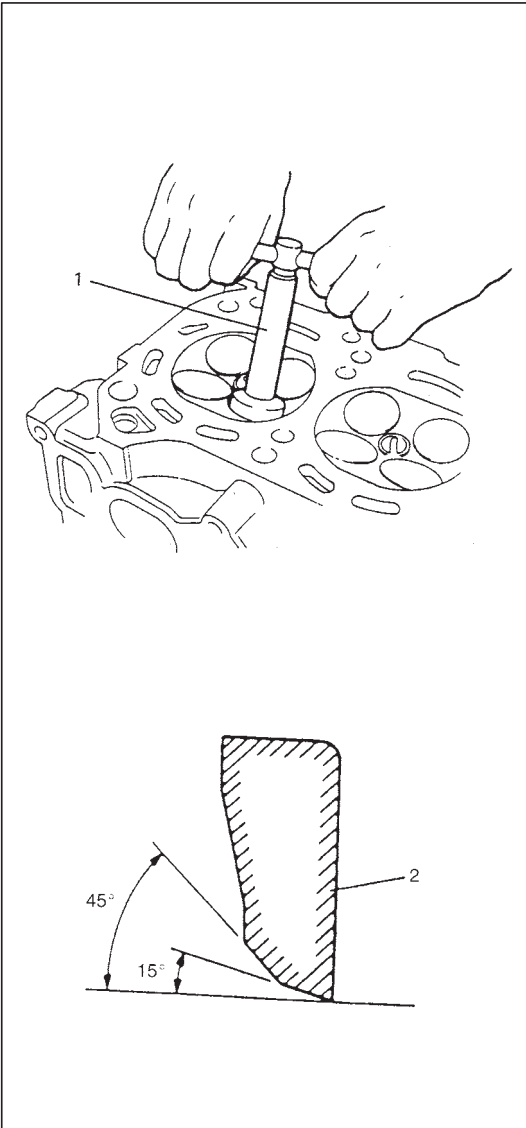
- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not so much as to grind off its chamfer. When it is worn so much that its chamfer is gone, replace valve.



- Seating contact width:  
Create contact pattern on each valve in the usual manner, i.e., by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.

Pattern produced on seating face of valve must be a continuous ring without any break, and the width "a" of pattern must be within specified range.

Standard seating width revealed by contact pattern on valve face	In	1.1 – 1.3 mm (0.0433 – 0.0512 in.)
	Ex	



- Valve seat repair:

A valve seat (2) not producing a uniform contact with its valve or showing width of seating contact that is out of specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

- 1) EXHAUST VALVE SEAT: Use valve seat cutters (1) to make two cuts as illustrated in figure. Two cutters must be used: the first for making 15° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

**Seat width for exhaust valve seat:**

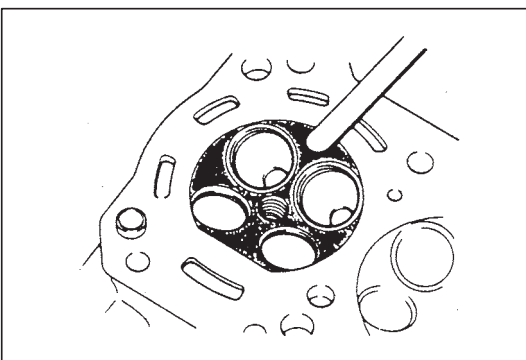
**1.1 – 1.3 mm (0.0433 – 0.0512 in.)**

- 2) INTAKE VALVE SEAT: Cutting sequence is the same as for exhaust valve seats.

**Seat width for intake valve seat:**

**1.1 – 1.3 mm (0.0433 – 0.0512 in.)**

- 3) VALVE LAPPING: Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine-size compound, each time using valve lapper according to usual lapping method.



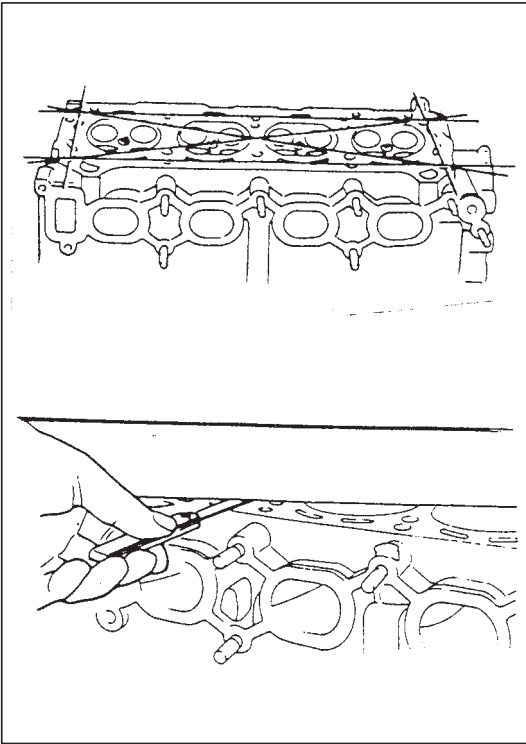
### Cylinder Head

- Remove all carbon from combustion chambers.

**NOTE:**

**Do not use any sharp-edged tool to scrape off carbon. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.**

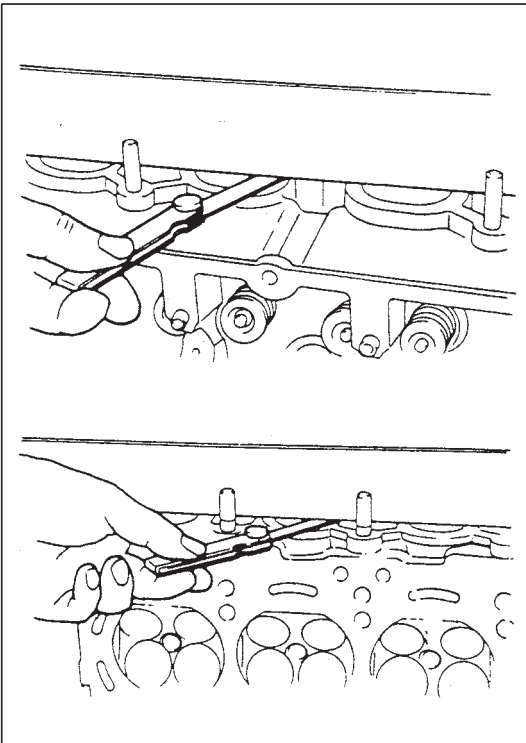
- Check cylinder head for cracks in intake and exhaust ports, combustion chambers, and head surface.



- Flatness of gasketed surface:

Using a straightedge and thickness gauge, check surface at a total of 6 locations. If distortion limit, given below, is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head. Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

**Limit of distortion: 0.05 mm (0.002 in.)**

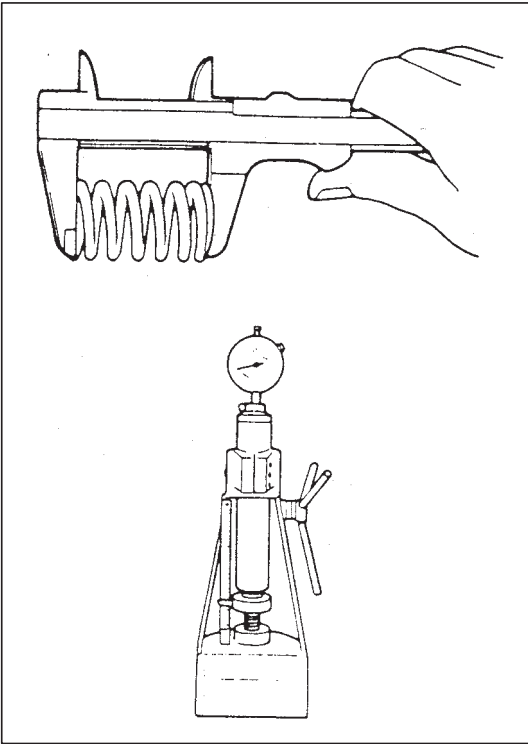


- Distortion of manifold seating faces:

Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

**Limit of distortion: 0.10 mm (0.004 in.)**

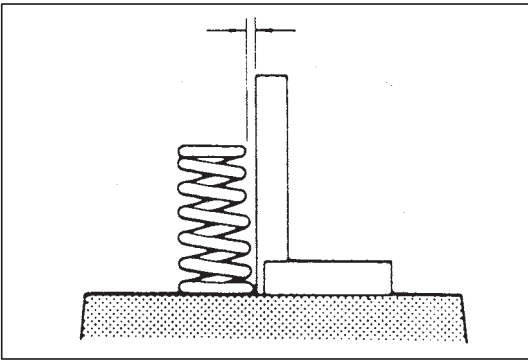




### Valve Springs

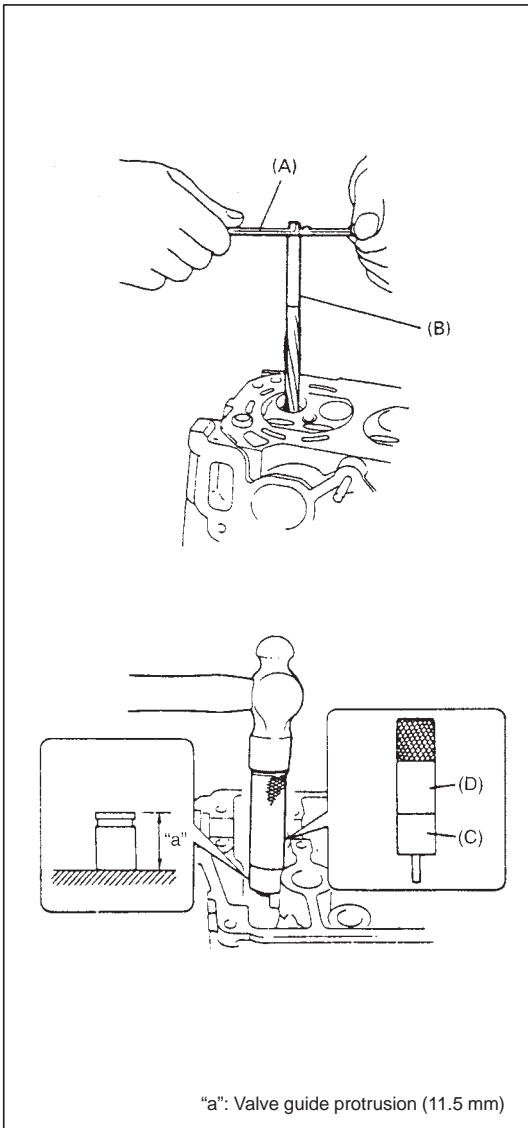
- Referring to data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Item	Standard	Limit
Valve spring free length	36.83 mm (1.4500 in.)	35.67 mm (1.4043 in.)
Valve spring preload	10.7 – 12.5 kg for 31.5 mm (23.6 – 27.5 lb/1.24 in.)	9.3 kg for 31.5 mm (20.5 lb/1.24 in.)



- Spring squareness:  
Use a square and surface plate to check each spring for squareness in terms of clearance between end of valve spring and square. Valve springs found to exhibit a larger clearance than limit given below must be replaced.

**Valve spring squareness limit: 1.6 mm (0.063 in.)**

**ASSEMBLY**

- 1) Before installing valve guide into cylinder head, ream guide hole with special tool (11 mm reamer) to remove burrs and make it truly round.

**Special Tool****(A): 09916-34542****(B): 09916-38210**

- 2) Install valve guide to cylinder head.

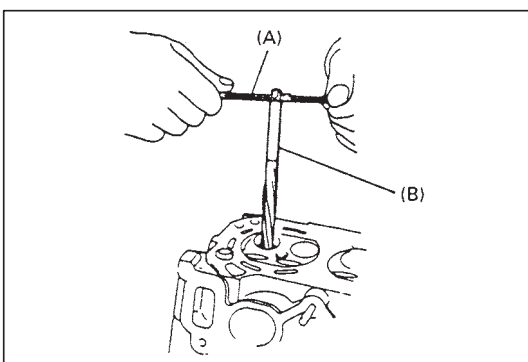
Heat cylinder head uniformly at a temperature of 80 to 100°C (176 to 212°F) so that head will not be distorted, and drive new valve guide into hole with special tools. Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head. After installing, make sure that valve guide protrudes by 11.5 mm (0.45 in.) from cylinder head.

**Special Tool****(C): 09916-56011****(D): 09916-58210****NOTE:**

- Do not reuse valve guide once disassembled. Install new valve guide (Oversize).
- Intake and exhaust valve guides are identical.

**Valve guide oversize: 0.03 mm (0.0012 in.)**

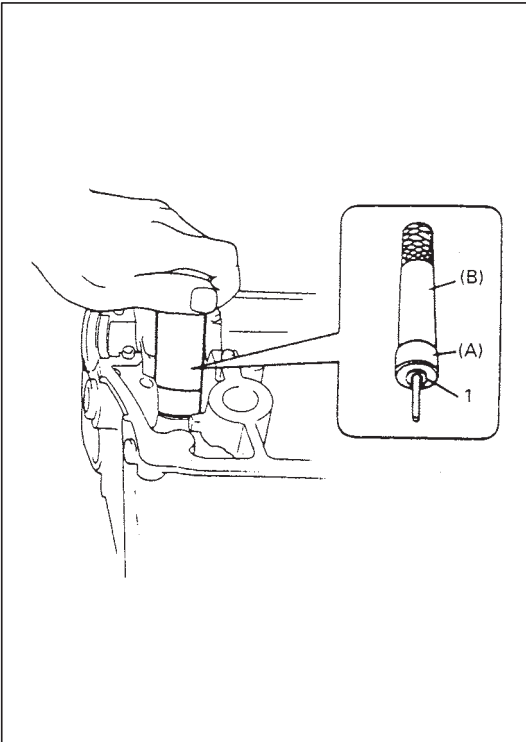
**Valve guide protrusion (In and Ex): 11.5 mm (0.45 in.)**



- 3) Ream valve guide bore with special tool (5.5 mm reamer). After reaming, clean bore.

**Special Tool****(A): 09916-34542****(B): 09916-34550**

- 4) Install valve spring seat to cylinder head.



- 5) Install new valve stem seal (1) to valve guide.  
 After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.  
 After installing, check to be sure that seal is properly fixed to valve guide.

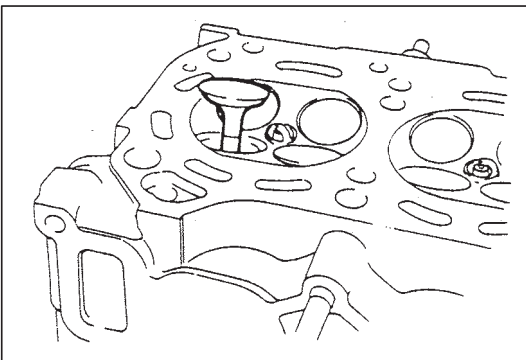
#### Special Tool

(A): 09917-98221

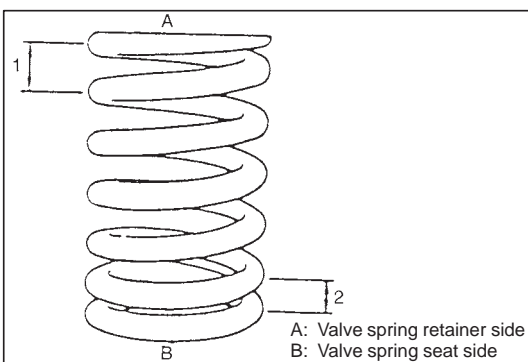
(B): 09916-58210

#### NOTE:

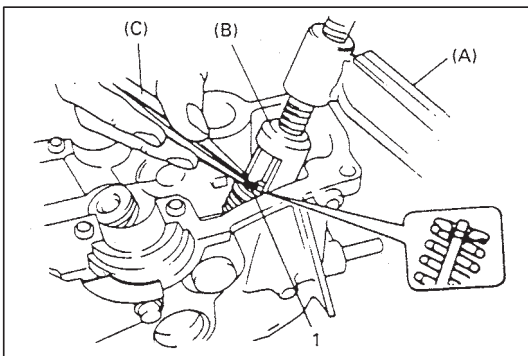
- Do not reuse seal once disassembled. Be sure to install new seal.
- When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.



- 6) Install valve to valve guide.  
 Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore, and valve stem.



- 7) Install valve spring and spring retainer.  
 Each valve spring has top end (large-pitch (1) end) and bottom end (small-pitch (2) end). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).



- 8) Using special tools (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

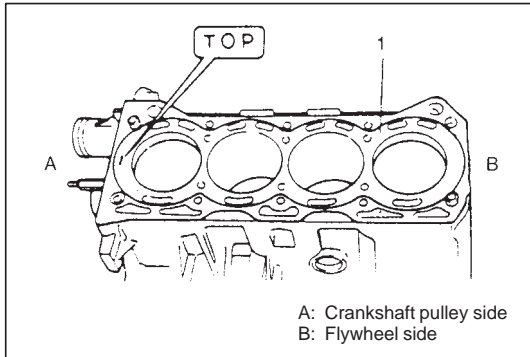
#### Special Tool

(A): 09916-14510

(B): 09916-14910

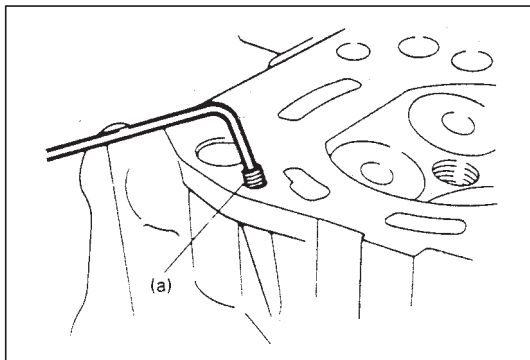
(C): 09916-84511

- 9) Install rocker arms, washers, rocker arm shaft and camshaft as previously outlined.
- 10) Install CMP sensor case, intake manifold and exhaust manifold.



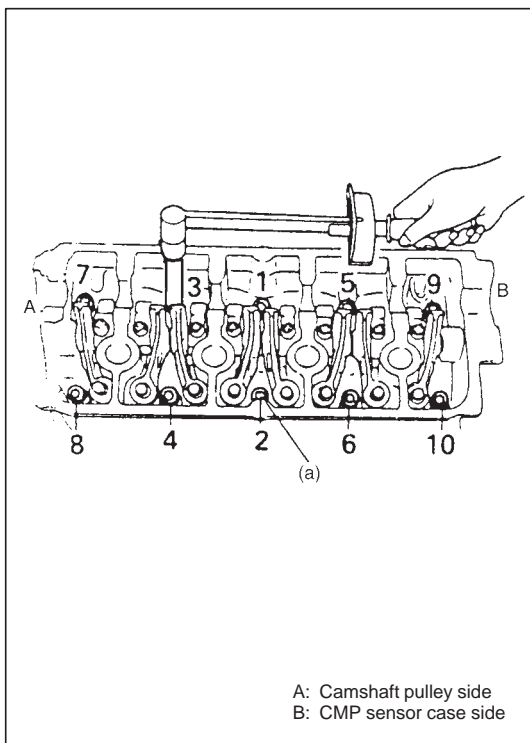
**INSTALLATION**

- 1) Remove oil gasket and oil on mating surfaces and install new head gasket (1) as shown in figure, that is, "TOP" mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).



- 2) Check to make sure that oil jet (venturi plug) is installed and if it is, that it is not clogged. When installing it, be sure to tighten to specified torque.

**Tightening Torque**  
**(a): 3.5 N·m (0.35 kg-m, 2.5 lb-ft)**

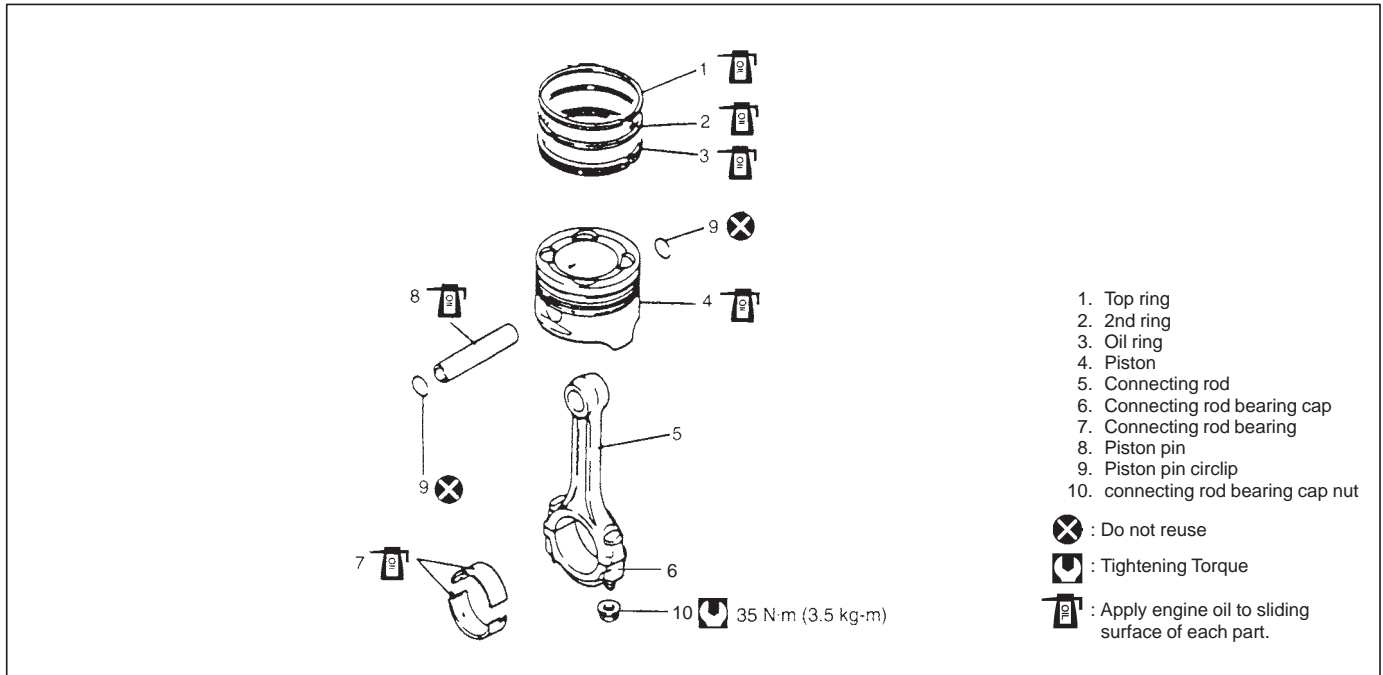


- 3) Apply engine oil to cylinder head bolts and tighten them gradually as follows.
  - a) Tighten all bolts to 35 N·m (3.5 kg-m, 25.0 lb-ft) according to numerical order in figure.
  - b) In the same manner as in a), tighten them to 55 N·m (5.5 kg-m, 40.0 lb-ft).
  - c) Loosen all bolts until tightening torque is reduced to 0 (zero) in reverse order of tightening.
  - d) In the same manner as in a), tighten them to 35 N·m (3.5 kg-m, 25.0 lb-ft).
  - e) In the same manner as in a) again, tighten them to specified torque.

**Tightening Torque**  
**(a): 68 N·m (6.8 kg-m, 49.5 lb-ft)**

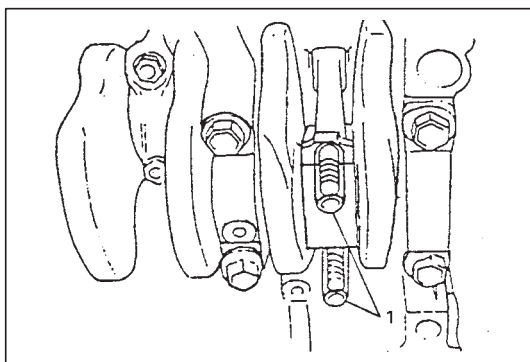
- 4) Reverse removal procedure for installation.
- 5) Adjust water pump drive belt tension by referring to "ENGINE COOLING" section.
- 6) Adjust power steering pump belt tension or A/C compressor belt tension, if equipped.  
Refer to Section 0B.
- 7) Adjust intake and exhaust valve lashes as previously outlined.
- 8) Adjust accelerator cable play.  
Refer to Section 6E.
- 9) Check to ensure that all removed parts are back in place.  
Reinstall any necessary parts which have not been reinstalled.
- 10) Refill cooling system referring to Section 6B.
- 11) Connect negative cable at battery.
- 12) Confirm that ignition timing is within specification.
- 13) Verify that there is no fuel leakage, coolant leakage and exhaust gas leakage at each connection.

## PISTON, PISTON RINGS, CONNECTING RODS AND CYLINDERS



### REMOVAL

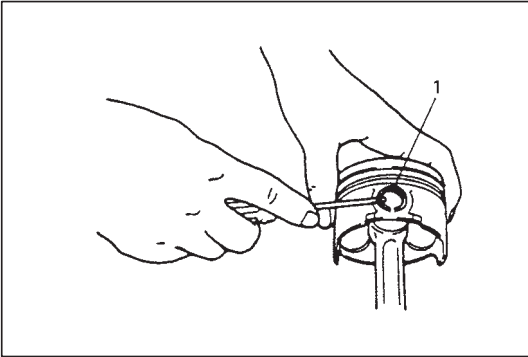
- 1) Remove cylinder head from cylinder block as previously outlined.
- 2) Drain engine oil.
- 3) Remove oil pan and oil pump strainer as previously outlined.
- 4) Mark cylinder number on all pistons, connecting rods and rod bearing caps, using silver pencil or quick drying paint.



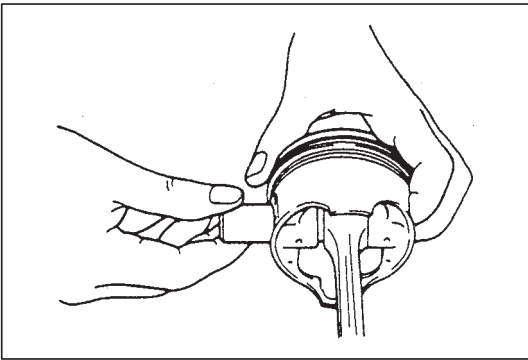
- 5) Remove rod bearing caps.
- 6) Install guide hose (1) over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads when removing connecting rod.
- 7) Decarbon top of cylinder bore before removing piston from cylinder.
- 8) Push piston and connecting rod assembly out through the top of cylinder bore.

**DISASSEMBLY**

- 1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.



- 2) Remove piston pin from connecting rod.
  - Ease out piston pin circlips (1), as shown.



- Force piston pin out.

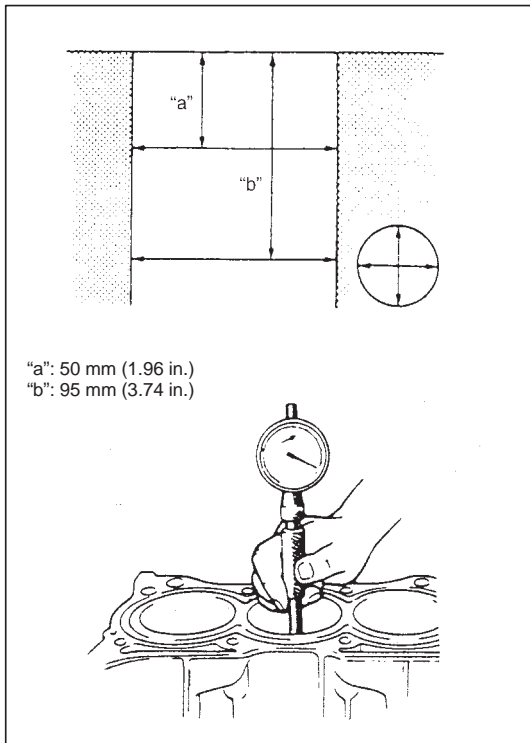
**CLEANING**

Clean carbon from piston head and ring grooves, using a suitable tool.

## INSPECTION

### Cylinders

- Inspect cylinder walls for scratches, roughness, or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched, or ridged, rebore cylinder and use oversize piston.



- Using a cylinder gauge, measure cylinder bore in thrust and axial directions at two positions as shown in figure.

If any of the following conditions is noted, rebore cylinder.

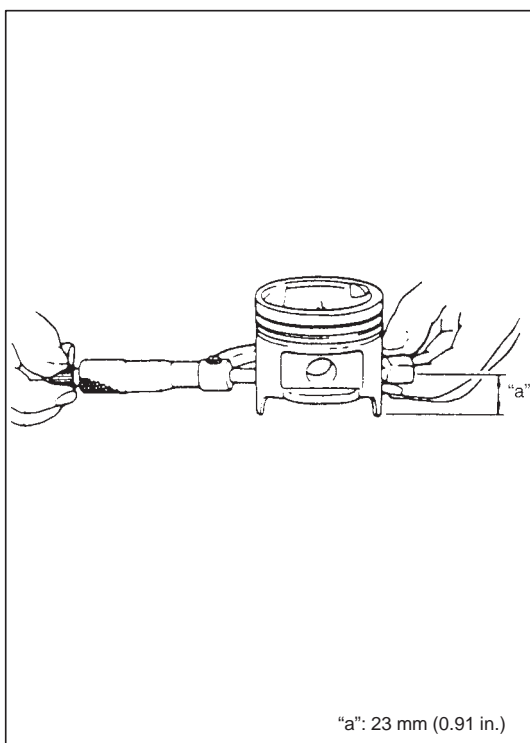
- 1) Cylinder bore dia. exceeds limit.
- 2) Difference of measurements at two positions exceeds taper limit.
- 3) Difference between thrust and axial measurements exceeds out-of-round limit.

**Cylinder bore dia. limit: 74.15 mm (2.9196 in.)**

**Tapper and out-of-round limit: 0.10 mm (0.0039 in.)**

#### NOTE:

**If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.**



### Pistons

- Inspect piston for faults, cracks or other damaged.

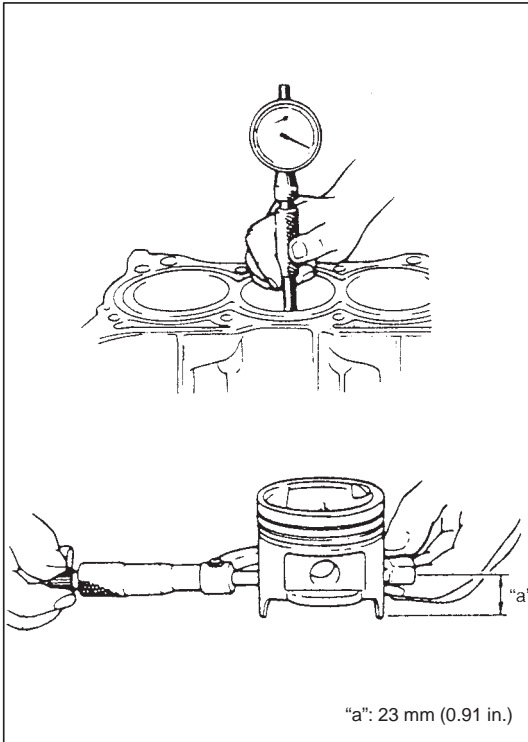
Damaged or faulty piston should be replaced.

- Piston diameter:

As indicated in figure, piston diameter should be measured at a position 23 mm (0.91 in.) from piston skirt end in the direction perpendicular to piston pin.

Piston diameter	Standard	73.970 – 73.990 mm (2.9122 – 2.9130 in.)
	Oversize: 0.25 mm (0.0098 in.)	74.220 – 74.230 mm (2.9220 – 2.9224 in.)
	0.50 mm (0.0196 in.)	74.470 – 74.480 mm (2.9319 – 2.9323 in.)





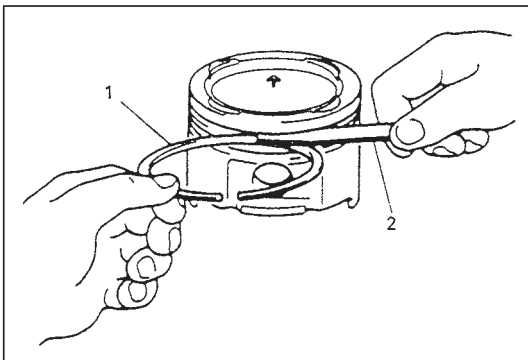
- **Piston clearance:**

Measure cylinder bore diameter and piston diameter to find their difference which is piston clearance. Piston clearance should be within specification as given below. If it is out of specification, re-bore cylinder and use oversize piston.

**Piston clearance: 0.02 – 0.04 mm (0.0008 – 0.0015 in.)**

**NOTE:**

**Cylinder bore diameters used here are measured in thrust direction at two positions.**



- **Ring groove clearance:**

Before checking, piston grooves must be clean, dry and free of carbon.

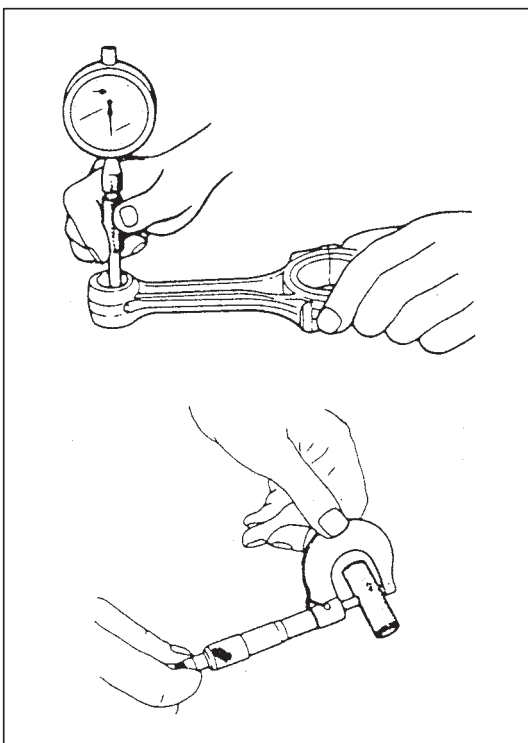
Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2).

If clearance is out of specification, replace piston.

**Ring groove clearance:**

**Top: 0.03 – 0.07 mm (0.0012 – 0.0027 in.)**

**2nd: 0.02 – 0.06 mm (0.0008 – 0.0023 in.)**



**Piston Pin**

- Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod or piston.

- **Piston pin clearance:**

Check piston pin clearance in small end. Replace connecting rod if its small end is badly worn or damaged or if measured clearance exceeds limit.

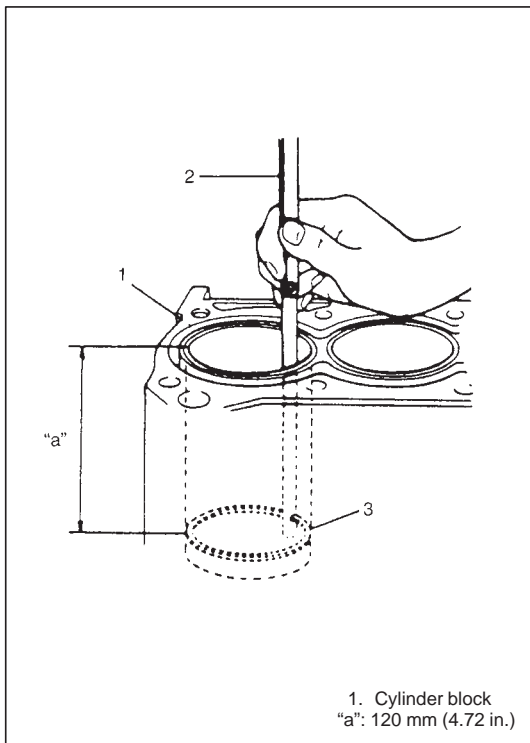
Item	Standard	Limit
Piston clearance in small end	0.003 – 0.016 mm (0.0001 – 0.0006 in.)	0.05 mm (0.0020 in.)

**Small-end bore:**

**19.003 – 19.011 mm (0.7482 – 0.7486 in.)**

**Piston pin dia.:**

**18.995 – 19.000 mm (0.7478 – 0.7480 in.)**



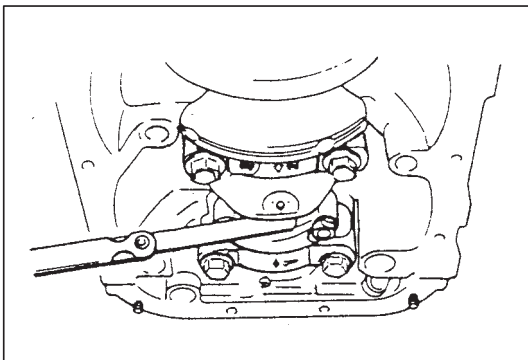
### Piston Rings

To measure end gap, insert piston ring (3) into cylinder bore and then measure the gap by using thickness gauge (2).  
If measured gap is out of specification, replace ring.

#### NOTE:

**Decarbon and clean top of cylinder bore before inserting piston ring.**

Item		Standard	Limit
Piston ring end gap	Top ring	0.15 – 0.30 mm (0.0059 – 0.0118 in.)	0.7 mm (0.0275 in.)
	2nd ring	0.2 – 0.35 mm (0.0079 – 0.0137 in.)	0.7 mm (0.0275 in.)
	Oil ring	0.2 – 0.7 mm (0.0079 – 0.0275 in.)	1.7 mm (0.0669 in.)



### Connecting Rod

#### ● Big-end side clearance:

Check big-end of connecting rod for side clearance, with rod fitted and connected to its crank pin in the normal manner. If measured clearance is found to exceed its limit, replace connecting rod.

Item	Standard	Limit
Big-end side clearance	0.10 – 0.20 mm (0.0039 – 0.0078 in.)	0.35 mm (0.0137 in.)

#### ● Connecting rod alignment:

Mount connecting rod on aligner to check it for bow and twist and, if limit is exceeded, replace it.

**Limit on bow: 0.05 mm (0.0020 in.)**

**Limit on twist: 0.10 mm (0.0039 in.)**

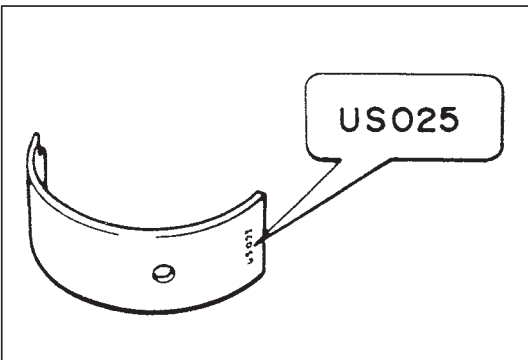


### Crank Pin and Connecting Rod Bearings

- Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged, or out-of-round or taper is out of limit, replace crankshaft or regrind crank pin to undersize and use undersize bearing.

Connecting rod bearing size	Crank pin diameter
Standard	41.982 – 42.000 mm (1.6528 – 1.6535 in.)
0.25 mm (0.0098 in.)	41.732 – 41.750 mm (1.6430 – 1.6437 in.)

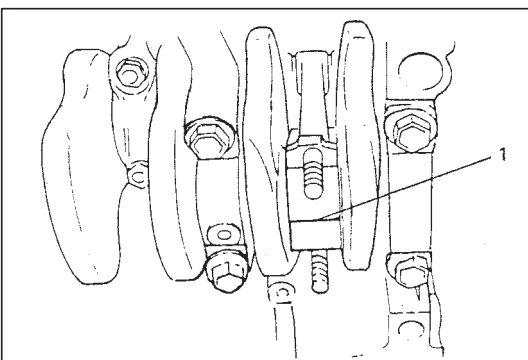
**Out-of-round and taper limit: 0.01 mm (0.0004 in.)**



- Rod bearing:

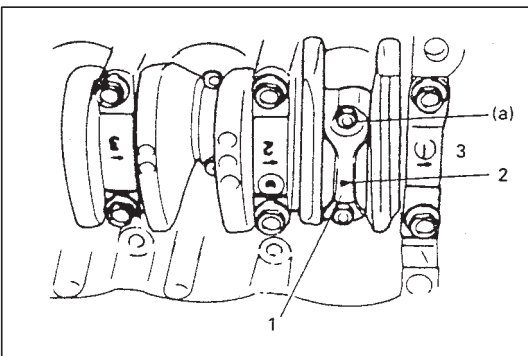
Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.

Two kinds of rod bearing are available; standard size bearing and 0.25 mm undersize bearing. To distinguish them, 0.25 mm undersize bearing has the stamped number (US025) on its backside as indicated in figure, but standard size one has no number.



- Rod bearing clearance:

- 1) Before checking bearing clearance, clean bearing and crank pin.
- 2) Install bearing in connecting rod and bearing cap.
- 3) Place a piece of gaging plastic (1) to full width of crankpin as contacted by bearing (parallel to crankshaft), avoiding oil hole.

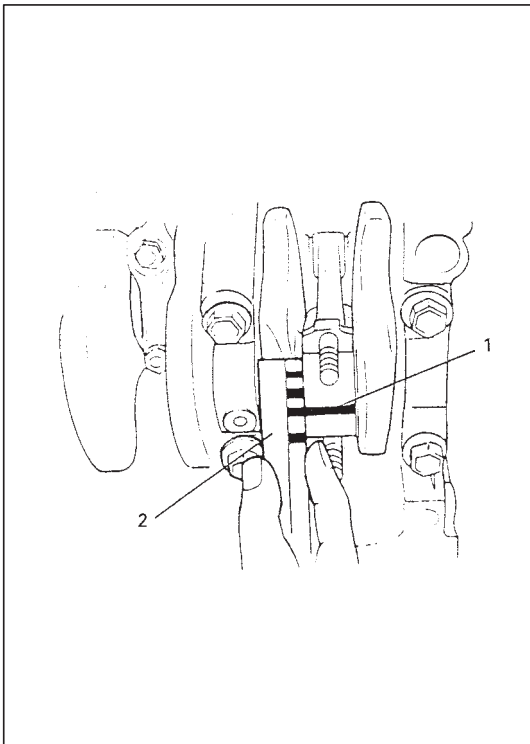


- 4) Install rod bearing cap (1) to connecting rod.

When installing cap, be sure to point arrow mark (2) on cap to crankshaft pulley side (3), as shown in figure. After applying engine oil to rod bolts, tighten cap nuts to specified torque. DO NOT turn crankshaft with gaging plastic installed.

### Tightening Torque

**(a): 35 N·m (3.5 kg·m, 25.5 lb·ft)**

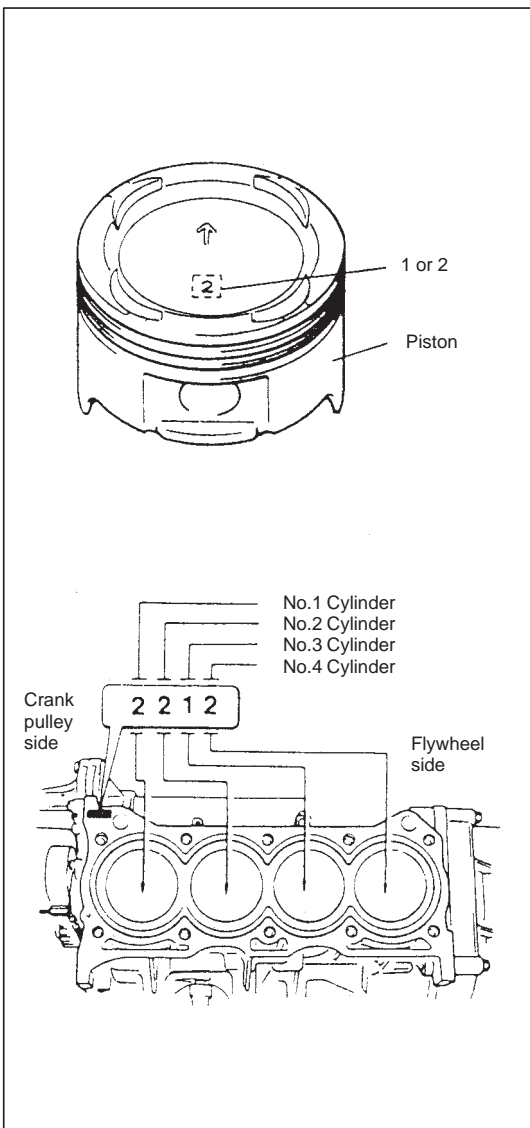


5) Remove cap and using a scale (2) on gaging plastic (1) envelope, measure gaging plastic width at the widest point (clearance).

If clearance exceeds its limit, use a new standard size bearing and remeasure clearance.

Item	Standard	Limit
Bearing clearance	0.020 – 0.050 mm (0.0008 – 0.0019 in.)	0.080 mm (0.0031 in.)

6) If clearance can not be brought to within its limit even by using a new standard size bearing, regrind crankpin to undersize and use 0.25 mm undersize bearing.

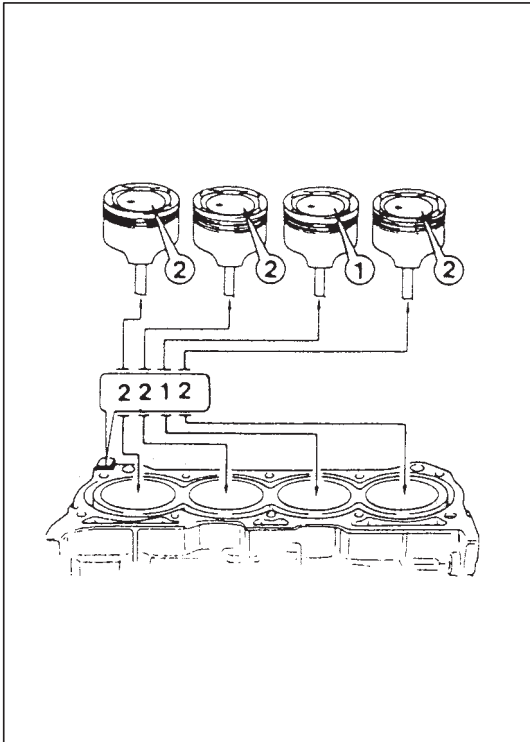


### ASSEMBLY

#### NOTE:

Two sizes of piston are available as standard size spare part so as to ensure proper piston-to-cylinder clearance. When installing a standard size piston, make sure to match piston with cylinder as follows.

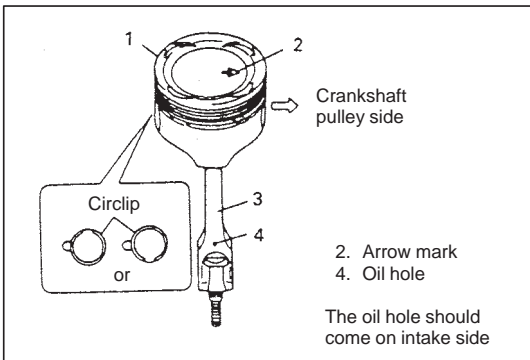
- Each piston has stamped number 1 or 2 as shown. It represents outer diameter of piston.
- There are also stamped numbers of 1 and 2 on the cylinder block as shown. The first number represents inner diameter of No.1 cylinder, the second number of No.2 cylinder, the third number of No.3 cylinder and the fourth number of No.4 cylinder.



c) Stamped number on piston and that on cylinder block should correspond. That is, install number 2 stamped piston to cylinder which is identified with number 2 and a number 1 piston to cylinder with number 1.

Number at the top (mark)	Piston		Cylinder		Piston-to-cylinder clearance
	Outer diameter	Number (mark)	Bore diameter		
1	73.98 – 73.99 mm (2.9126 – 2.9130 in.)	1	74.01 – 74.02 mm (2.9138 – 2.9141 in.)		0.02 – 0.04 mm (0.0008 – 0.0015 in.)
2	73.97 – 73.98 mm (2.9122 – 2.9126 in.)	2	74.00 – 74.01 mm (2.9134 – 2.9138 in.)		0.02 – 0.04 mm (0.0008 – 0.0015 in.)

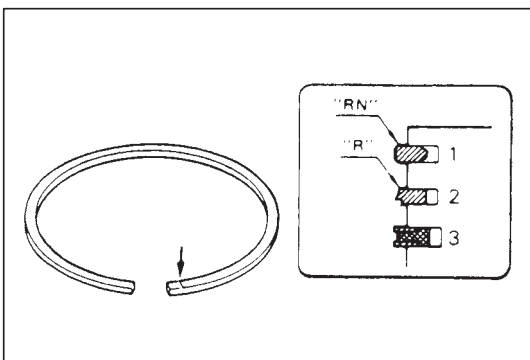
Also, a letter A, B or C is stamped on piston head but ordinarily it is not necessary to discriminate each piston by this letter.



1) Install piston pin to piston (1) and connecting rod (3):  
After applying engine oil to piston pin and piston pin holes in piston and connecting rod, fit connecting rod to piston as shown in figure and insert piston pin to piston and connecting rod, and install piston pin circlips.

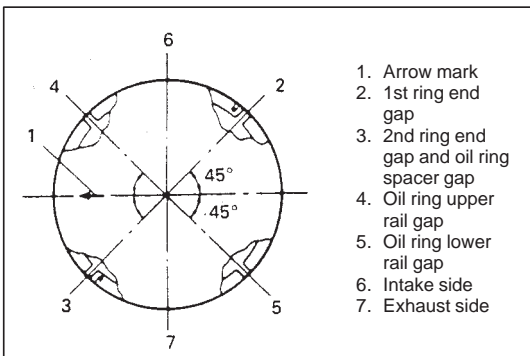
**NOTE:**

**Circlip should be installed with its cut part facing either up or down as shown in figure.**



2) Install piston rings to piston:  

- As indicated in figure, 1st and 2nd rings have "RN" or "R" mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
- 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall. Distinguish 1st ring from 2nd ring by referring to figure.
- When installing oil ring (3), install spacer first and then two rails.



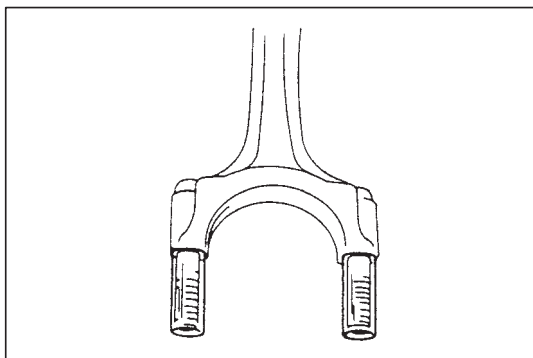
3) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

**INSTALLATION OR CONNECTION**

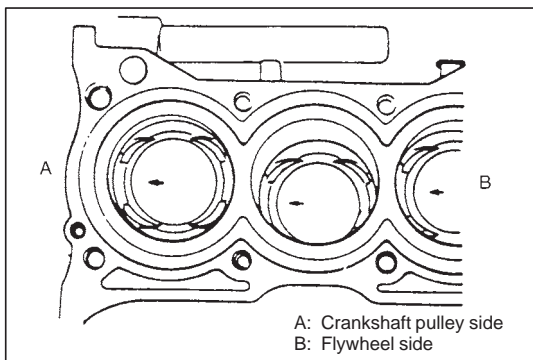
- 1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crankpins.

**NOTE:**

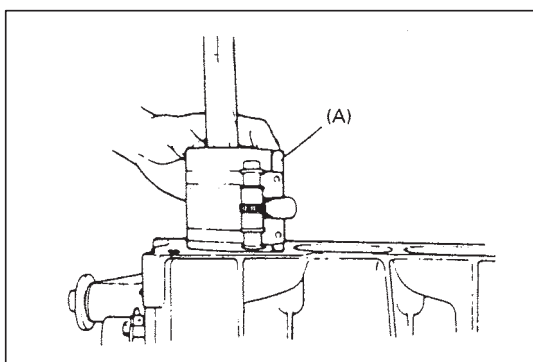
**Do not apply oil between connecting rod and bearing or between bearing cap and bearing.**



- 2) Install guide hoses over connecting rod bolts. These guide hoses protect crankpin and threads of rod bolt from damage during installation of connecting rod and piston assembly.



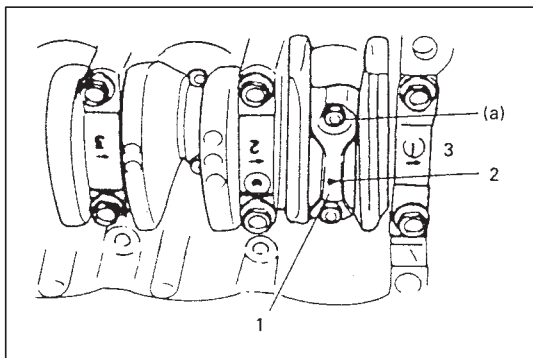
- 3) When installing piston and connecting rod assembly into cylinder bore, point arrow mark on piston head to crankshaft pulley side.



- 4) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft. Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

**Special Tool**

**(A): 09916-77310**



- 5) Install bearing cap (1): Point arrow mark (2) on cap to crankshaft pulley side (3). Tighten cap nuts to specification.

**Tightening Torque**

**(a): 35 N·m (3.5 kg·m, 25.5 lb-ft)**

- 6) Reverse removal procedure for installation, as previously outlined.
- 7) Adjust water pump drive belt tension referring to Section 6B.
- 8) Adjust power steering pump belt tension or A/C compressor belt tension, if equipped.  
Refer to Section 0B.
- 9) Adjust accelerator cable play.  
Refer to Section 6E.
- 10) Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- 11) Refill engine with engine oil by referring to item "ENGINE OIL CHANGE" in Section 0B.
- 12) Refill cooling system referring to Section 6B.
- 13) Connect negative cable at battery.
- 14) Check ignition timing referring to Section 6F.
- 15) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

## UNIT REPAIR OVERHAUL

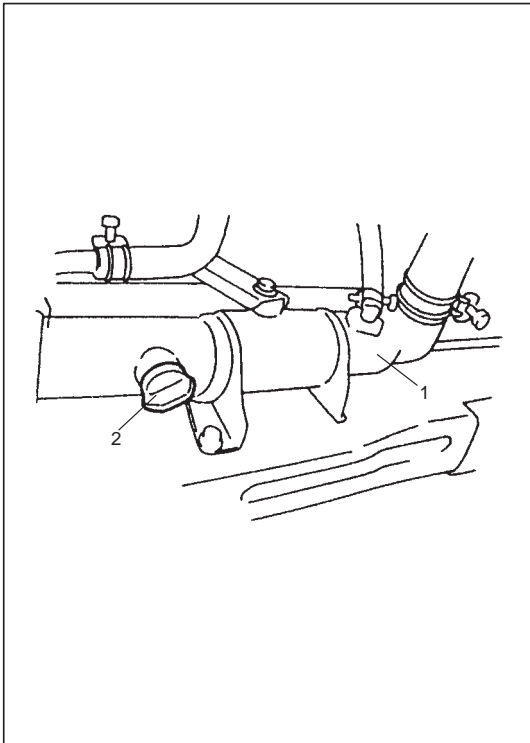
### ENGINE ASSEMBLY

#### REMOVAL

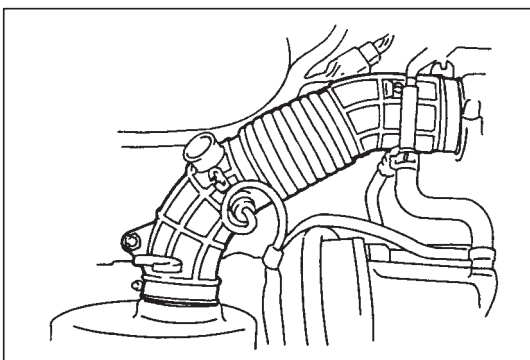
- 1) Release fuel pressure in fuel feed line by referring to Section 6.
- 2) Remove battery.
- 3) Remove engine hood after disconnecting windshield washer hose.
- 4) Drain cooling system.

#### WARNING:

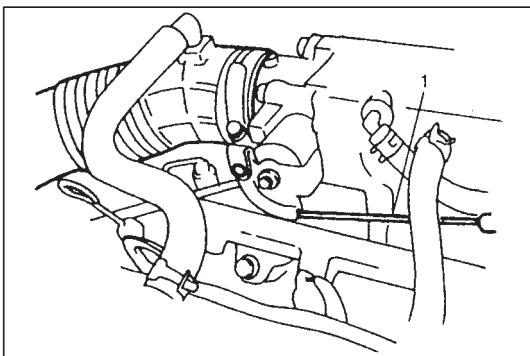
To help avoid danger of being burned, do not remove drain plug (2) and radiator cap while engine and radiator (1) are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.



- 5) Disconnect coupler of cooling fan motor.
- 6) Disconnect radiator inlet hose from thermostat case.
- 7) Disconnect A/T fluid hoses from A/T fluid pipes (for A/T model)
- 8) Remove outlet hose from water inlet pipe and radiator.
- 9) Remove radiator referring to Section 6B.



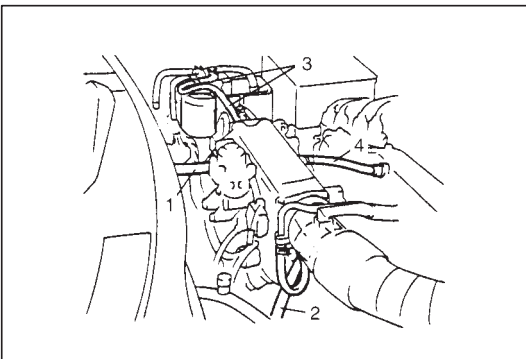
- 10) Remove air cleaner case and air cleaner outlet hose as previously outlined.



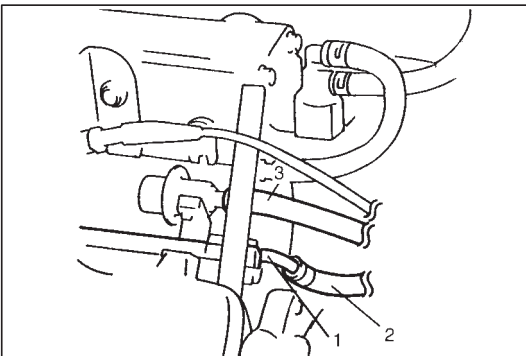
- 11) Disconnect the following cables.
  - Accelerator cable (1) from throttle body.
  - A/T throttle pressure control cable from A/T.
  - Clutch cable from transmission (M/T).
  - Gear select cable from transmission (A/T).
  - Speedometer cable



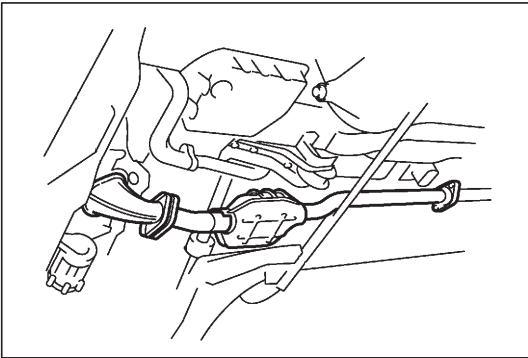
- 12) Disconnect the following electric wires:
- Ignition coil assembly
  - Ground wires from intake manifold
  - Engine oil pressure switch
  - EVAP canister purge valve (if equipped)
  - Engine coolant temp. sensor
  - Fuel injectors
  - Power steering pressure switch (if equipped)
  - Oxygen sensor-1
  - Back-up light switch (M/T)
  - Transmission range switch (A/T)
  - A/T vehicle speed sensor (A/T)
  - Solenoid coupler (A/T)
  - Generator
  - Starter
  - Battery negative cable from transmission
  - TP sensor
  - IAC valve
  - CMP sensor
  - MAP sensor
- and then release wire harnesses from clamps.



- 13) Disconnect the following hoses:
- Canister purge hose (2) from EVAP canister purge valve
  - Brake booster hose (1) from intake manifold
  - Radiator outlet hose from inlet pipe
  - Heater inlet and outlet hose from heater unit



- 14) Disconnect fuel feed (2) and return hoses (3) from fuel delivery pipe (1).



- 15) Remove exhaust No.1 pipe.
- 16) Remove right and left engine under covers.
- 17) Remove gear shift control shaft from transmission and remove extension rod (M/T).
- 18) Drain engine and transmission oil.
- 19) Disconnect drive shaft joints from differential gears of transmission or center bearing support referring to Section 4. In this case, it is not necessary to disconnect drive shafts from steering knuckle.
- 20) With hoses connected, detach A/C compressor and/or P/S pump with bracket from cylinder block, if equipped.

**NOTE:**

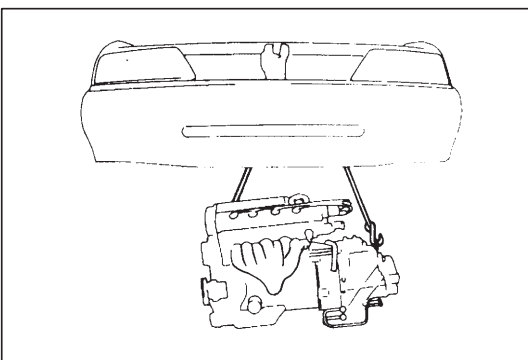
**Suspend removed compressor and/or pump at a place where no damage will be caused during removal and installation of engine with transmission.**

- 21) Disconnect P/S hose from P/S oil pump. (if equipped)

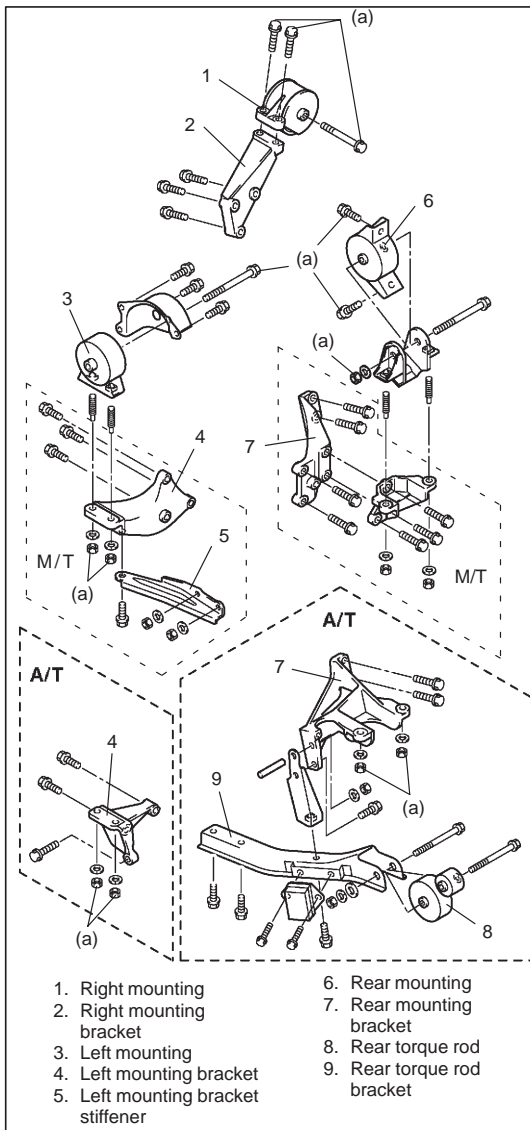
**NOTE:**

**Plug pipe, hose and pump port.**

- 22) Install support device.
- 23) Remove rear mounting from body. (For M/T model)  
Remove rear torque rod (For A/T model).
- 24) Remove engine left mounting from body.
- 25) Remove engine right mounting from right mounting bracket and stiffener.



- 26) Before removing engine with transmission from body, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transmission.
- 27) Lower engine with transmission from body.



## INSTALLATION

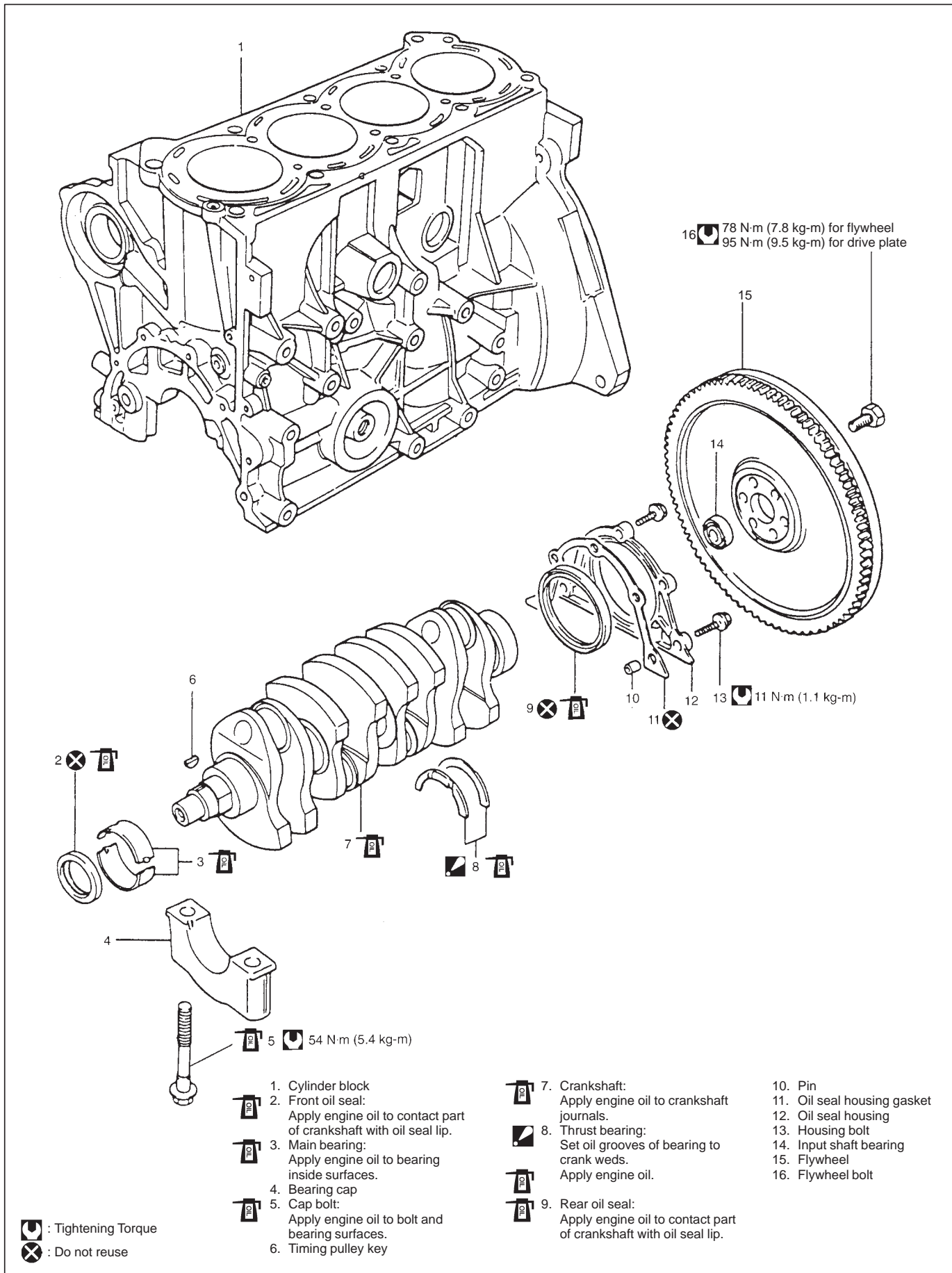
- 1) Lift engine with transmission into engine compartment, but do not remove support device.
- 2) Install engine right mounting to right mounting bracket and stiffener.
- 3) Install engine left mounting to body.
- 4) Install rear mounting to body (For M/T model)  
Install torque rod (For A/T model)
- 5) Tighten bolts and nuts of all parts installed in above steps 2), 3) and 4) or 5) to specified torque.

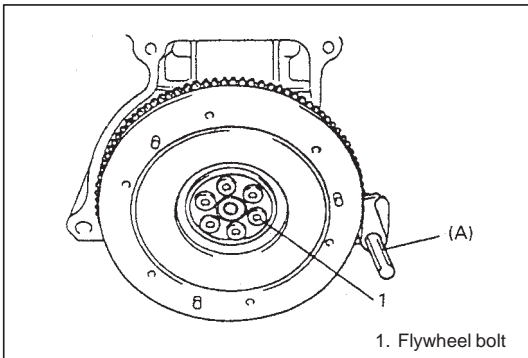
### Tightening Torque

**(a): 55 N·m (5.5 kg·m, 40.0 lb·ft)**

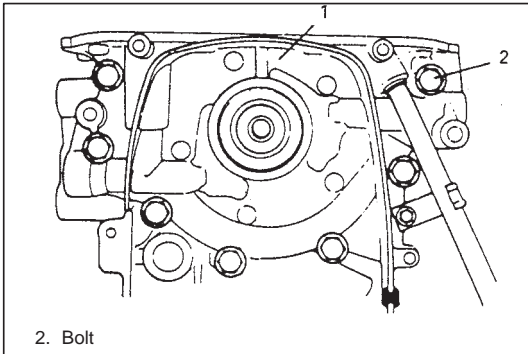
- 6) Remove support device.
- 7) Reverse removal procedures for installation of remainder.
  - Push in each drive shaft joint fully so that snap ring engages with differential gear or center bearing support.  
Use care not to damage oil seal lip when inserting.
  - Clamp electric wire securely.
- 8) Adjust clutch pedal free travel by referring to Section 7C. (M/T)  
Adjust gear select cable and A/T throttle pressure control cable, referring to Section 7B. (A/T)
- 9) Adjust gear shift control lever by referring to Section 7A. (M/T)
- 10) Adjust accelerator cable play by referring to Section 6E.
- 11) Refill transmission with gear oil. (A/T fluid for A/T model) by referring to Section 0B.
- 12) Refill engine with engine oil by referring to Section 0B.
- 13) Refill cooling system by referring to Section 6B.
- 14) Adjust A/C compressor and/or P/S pump drive belt referring to Section 0B. (if equipped)
- 15) Check P/S fluid level by referring to Section 3B1. (if equipped)
- 16) Upon completion of installation, verify that there is no fuel leakage, coolant leakage, transmission oil leakage or exhaust gas leakage at each connection.

# MAIN BEARINGS, CRANKSHAFT AND CYLINDER BLOCK

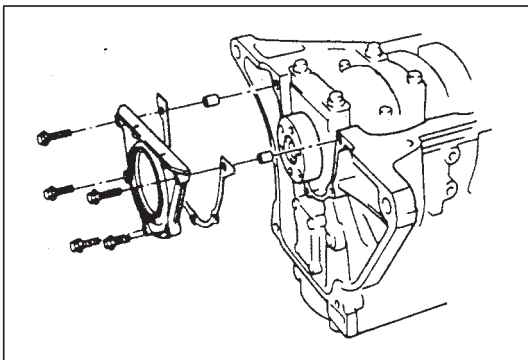


**REMOVAL**

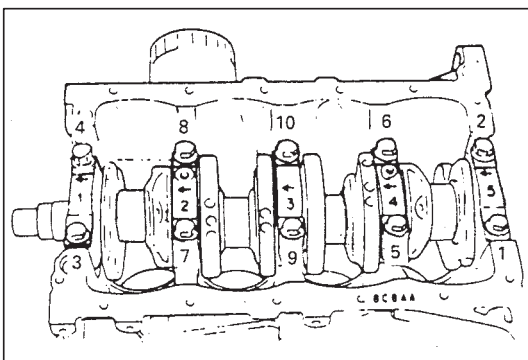
- 1) Remove engine assembly from body as previously outlined.
- 2) Remove clutch cover, clutch disc and flywheel (drive plate for A/T).

**Special Tool****(A): 09924-17810**

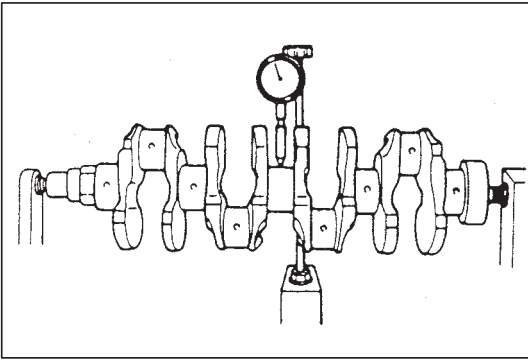
- 3) Remove crankshaft pulley, timing belt and crankshaft timing pulley.
- 4) Remove cylinder head assembly.
- 5) Remove oil pan and oil pump strainer.
- 6) Remove oil pump (1).



- 7) Remove oil seal housing.
- 8) Remove connecting rod bearing caps.



- 9) Loosen crankshaft bearing cap bolts in such order as indicated in figure a little at a time and remove bearing caps.
- 10) Remove crankshaft from cylinder block.



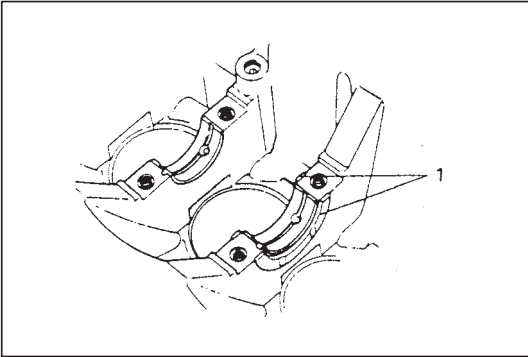
## INSPECTION

### Crankshaft

#### Crankshaft runout

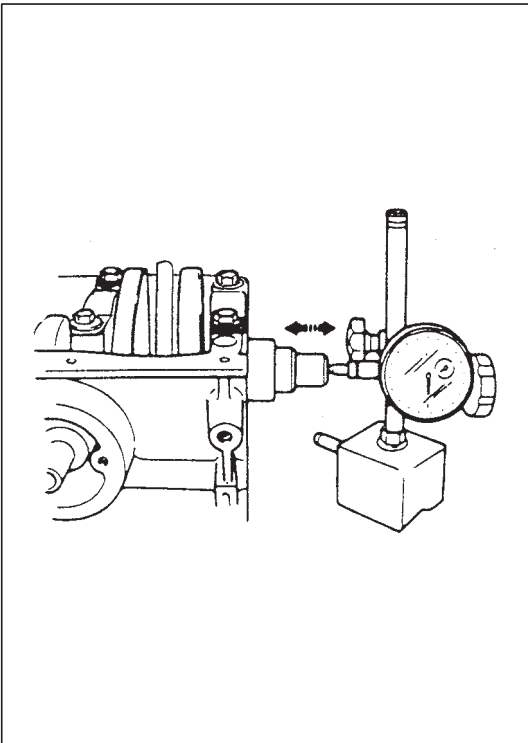
Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

**Limit on runout: 0.06 mm (0.0023 in.)**



#### Crankshaft thrust play

Measure this play with crankshaft set in cylinder block in the normal manner, that is, with thrust bearing (1) and journal bearing caps installed.

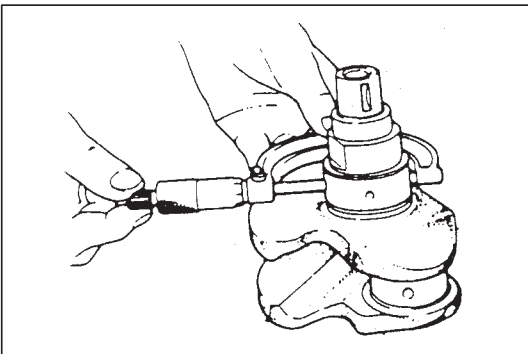


Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.

If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Item	Standard	Limit
Crankshaft thrust play	0.11 – 0.31 mm (0.0044 – 0.0122 in.)	0.38 mm (0.0149 in.)

Thickness of crankshaft thrust bearing	Standard	
		2.500 mm (0.0984 in.)
Oversize:	0.125 mm (0.0049 in.)	2.563 mm (0.1009 in.)

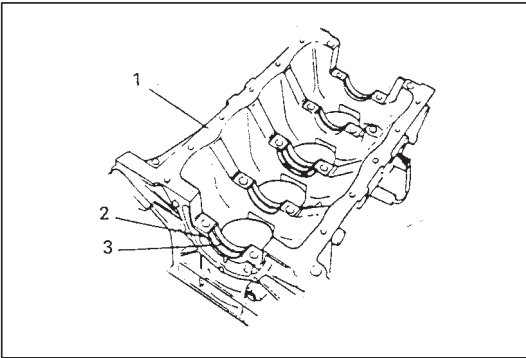


#### Out-of-round and taper (uneven wear) of journals

An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings.

If any one of journals is badly damaged or if amount of uneven wear in the sense explained above exceeds its limit, regrind or replace crankshaft.

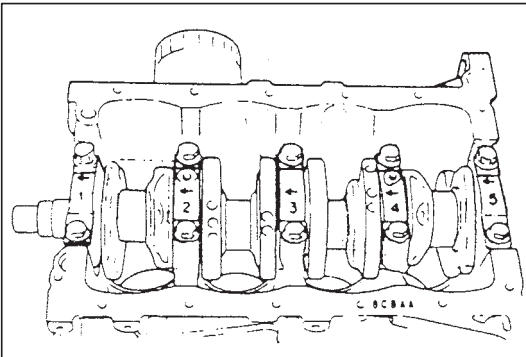
**Limit on out-of-round and taper: 0.01 mm (0.0004 in.)**



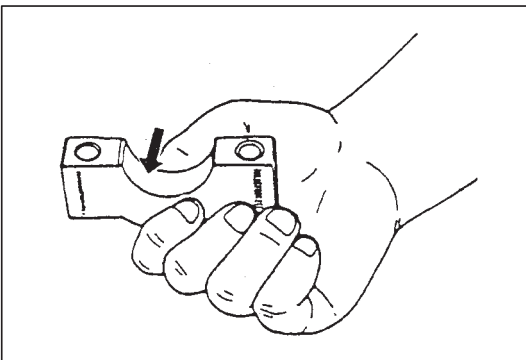
## Main Bearings

### General information

- Service main bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and each of them has 5 kinds of bearings differing in tolerance.
- Upper half of bearing (2) has oil groove (3) as shown in figure. Install this half with oil groove to cylinder block (1).

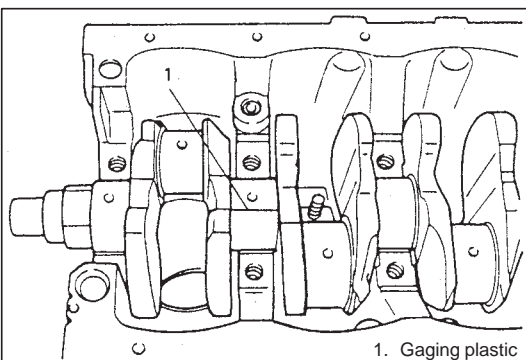


- On each main bearing cap, arrow mark and number are embossed as shown in figure. When installing each bearing cap to cylinder block, point arrow mark toward crankshaft pulley side and install each cap from that side to flywheel side in ascending order of numbers "1", "2", "3", "4" and "5". Tighten cap bolts to specified torque.



### Inspection

Check bearings for pitting, scratches, wear or damage. If any malcondition is found, replace both upper and lower halves. Never replace one half without replacing the other half.



### Main bearing clearance

Check clearance by using gaging plastic (1) according to the following procedure.

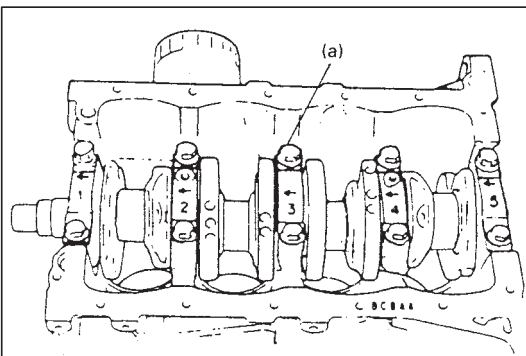
- 1) Remove bearing caps.
- 2) Clean bearings and main journals.
- 3) Place a piece of gaging plastic to full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.
- 4) Install bearing cap as previously outlined and evenly torque cap bolts to specified torque. Bearing cap **MUST** be torqued to specification in order to assure proper reading of clearance.

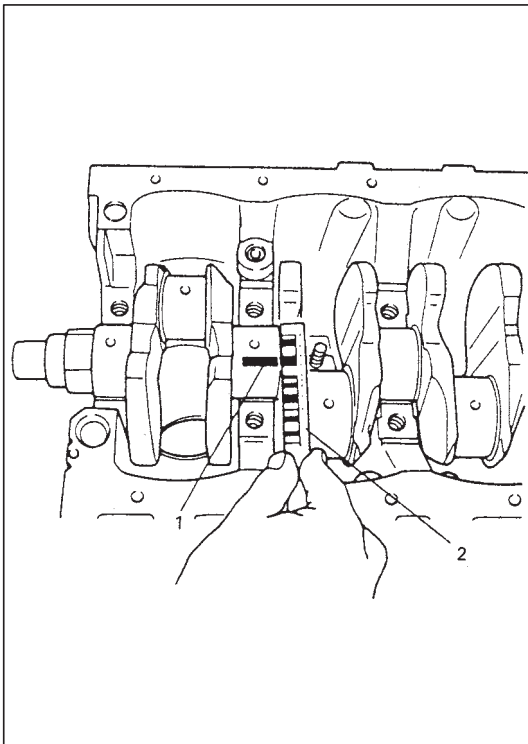
### Tightening Torque

(a): 54 N·m (5.4 kg·m, 39.0 lb·ft)

### NOTE:

Do not rotate crankshaft while gaging plastic is installed.



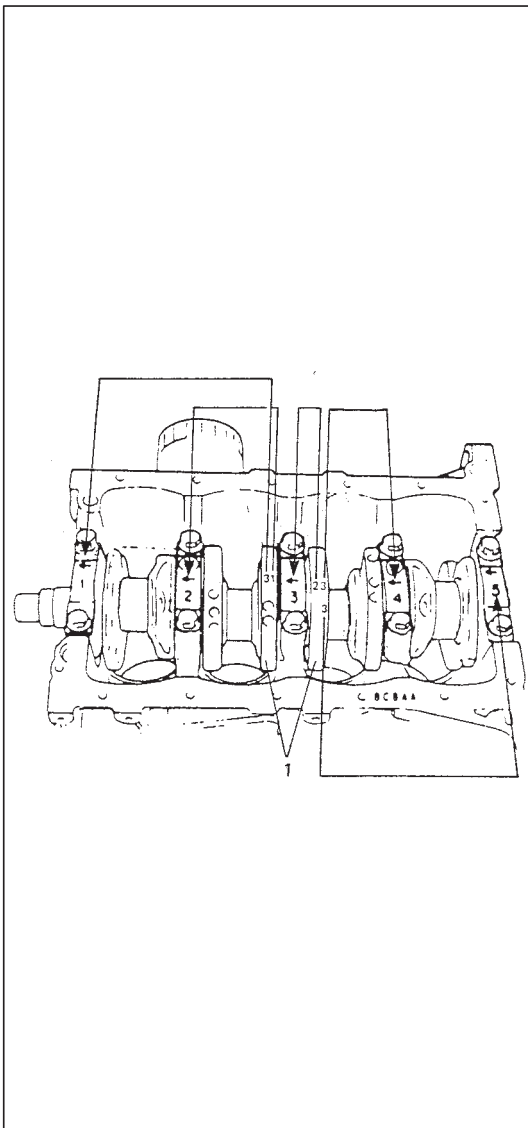


- Remove cap and using scale (2) on gaging plastic (1) envelope, measure gaging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.

A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.

After selecting new bearing, recheck clearance.

	Standard	Limit
Bearing clearance	0.020 – 0.040 mm (0.0008 – 0.0016 in.)	0.060 mm (0.0023 in.)



**Selection of main bearings**

**STANDARD BEARING:**

If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.

- First check journal diameter by using the following procedure. As shown in figure, crank webs (1) of No.2 and No.3 cylinders have five stamped numerals.

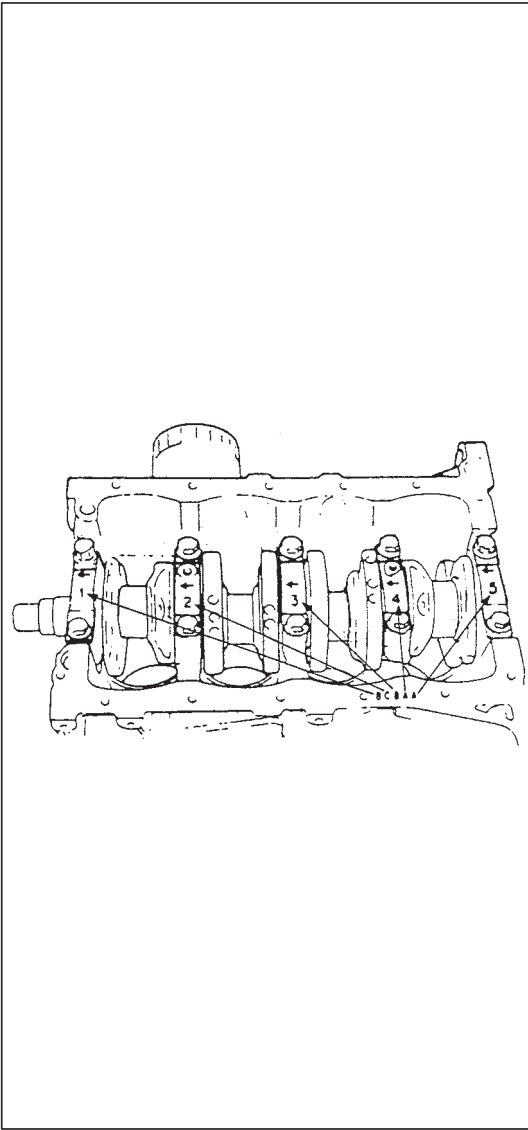
Three kinds of numerals (“1”, “2” and “3”) represent the following journal diameters.

Numeral stamped	Journal diameter
1	44.994 – 45.000 mm (1.7714 – 1.7716 in.)
2	44.988 – 44.994 mm (1.7712 – 1.7714 in.)
3	44.982 – 44.988 mm (1.7709 – 1.7712 in.)

The first, second, third, fourth and fifth (left to right) stamped numerals represent journal diameters at bearing caps “1”, “2”, “3”, “4” and “5” respectively.

For example, in figure, the first (leftmost) numeral “3” indicates that journal dia. at bearing cap “1” is within 44.982 – 44.988 mm, and second one “1” indicate that journal dia. at cap “2” is within 44.994 – 45.000 mm.





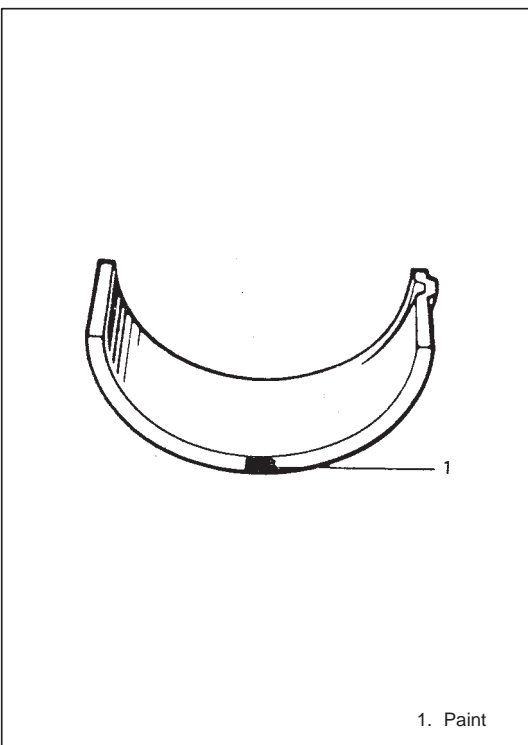
2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, four alphabets are stamped as shown in figure.

Three kinds of alphabets (“A”, “B” and “C”) represent the following cap bore diameters.

Alphabet stamped	Bearing cap bore diameter (without bearing)
A	49.000 – 49.006 mm (1.9291 – 1.9294 in.)
B	49.006 – 49.012 mm (1.9294 – 1.9296 in.)
C	49.012 – 49.018 mm (1.9296 – 1.9298 in.)

The first, second, third, fourth and fifth (left to right) stamped alphabets represent cap bore diameters of bearing caps “1”, “2”, “3”, “4” and “5”, respectively.

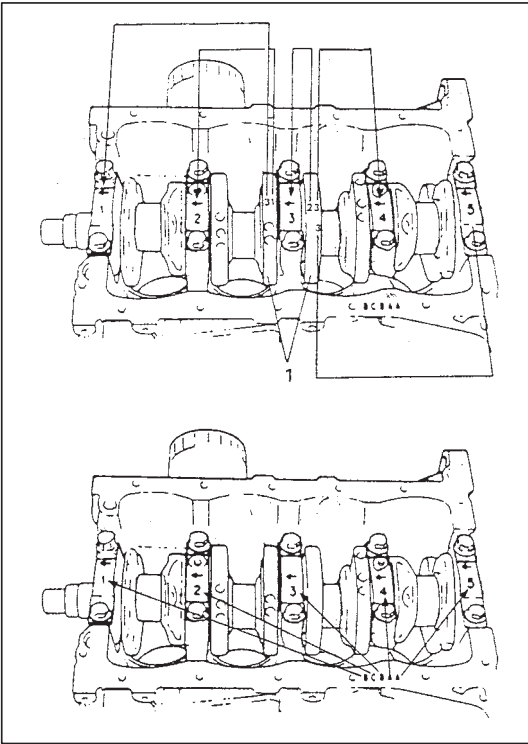
For example, in figure, the first (leftmost) alphabet “B” indicates that cap bore dia. of bearing cap “1” is within 49.006 – 49.012 mm, and the fifth (rightmost) alphabet “A” indicates that cap bore dia. of cap “5” is within 49.000 – 49.006 mm.



3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in figure.

Each color indicates the following thickness at the center of bearing.

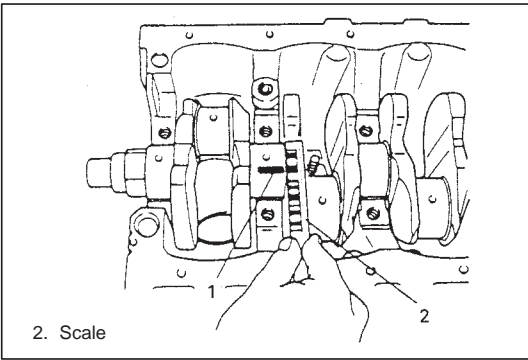
Color painted	Bearing thickness
Green	1.996 – 2.000 mm (0.0786 – 0.0787 in.)
Black	1.999 – 2.003 mm (0.0787 – 0.0788 in.)
Colorless (no paint)	2.002 – 2.006 mm (0.0788 – 0.0789 in.)
Yellow	2.005 – 2.009 mm (0.0789 – 0.0790 in.)
Blue	2.008 – 2.012 mm (0.0790 – 0.0791 in.)



4) From numerals stamped on crank webs (1) of No.2 and No.3 cylinders and the alphabets stamped on mating surface of cylinder block, determine new standard bearing to be installed to journal, by referring to table given below.

For example, if numeral stamped on crank web is "1" and alphabet stamped on mating surface is "B", install a new standard bearing painted in "Black" to its journal.

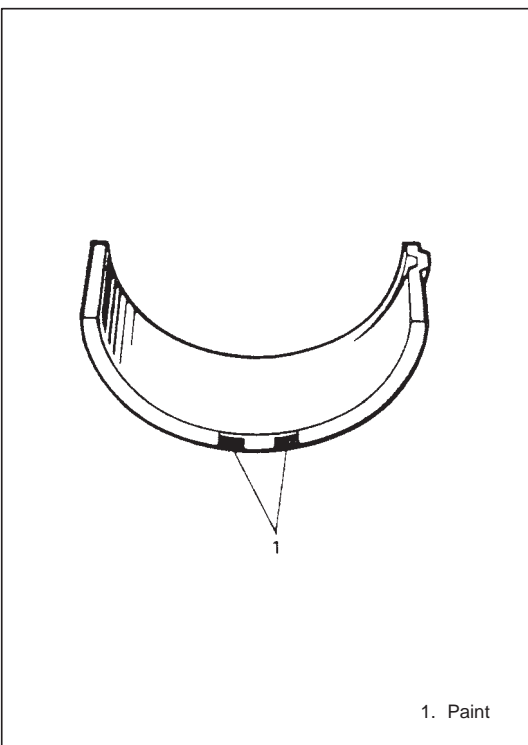
		Numeral stamped on crank web (Journal diameter)		
		1	2	3
Alphabet stamped on mating surface (Bearing cap bore dia.)	A	Green	Black	Colorless
	B	Black	Colorless	Yellow
	C	Colorless	Yellow	Blue
New standard bearing to be installed.				



5) Using gaging plastic (1), check bearing clearance with newly selected standard bearing.

If clearance still exceeds its limit, use next thicker bearing and recheck clearance.

6) When replacing crankshaft or cylinder block due to any reason, select new standard bearings to be installed by referring to numerals stamped on new crankshaft or alphabets stamped on mating surface of new cylinder block.



**UNDERSIZE BEARING (0.25 mm):**

● 0.25 mm undersize bearing is available, in five kinds varying in thickness.

To distinguish them, each bearing is painted in the following colors at such position as indicated in figure.

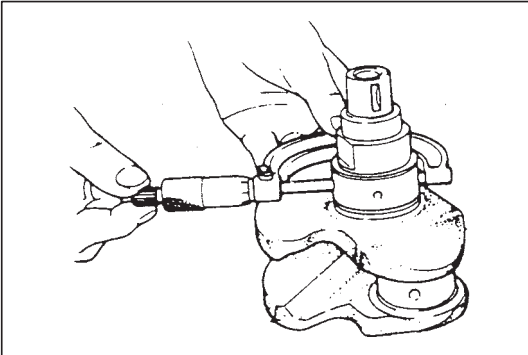
Each color represents the following thicknesses at the center of bearing.

Color painted	Bearing thickness
Green & Red	2.121 – 2.125 mm (0.0835 – 0.0836 in.)
Black & Red	2.124 – 2.128 mm (0.0836 – 0.0837 in.)
Red only	2.127 – 2.131 mm (0.0837 – 0.0838 in.)
Yellow & Red	2.130 – 2.134 mm (0.0838 – 0.0839 in.)
Blue & Red	2.133 – 2.137 mm (0.0839 – 0.0840 in.)

- If necessary, regrind crankshaft journal and select under-size bearing to use with it as follows.

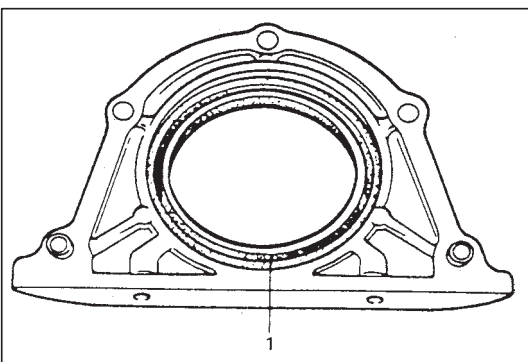
1) Regrind journal to the following finished diameter.

**Finished diameter: 44.732 – 44.750 mm  
(1.7611 – 1.7618 in.)**



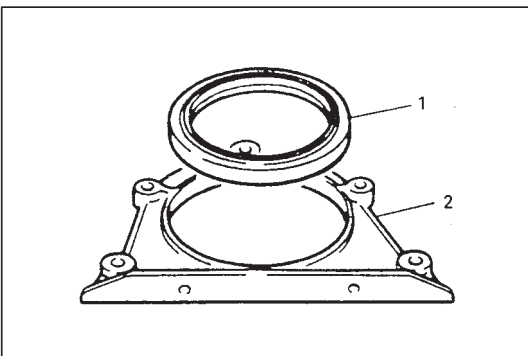
- 2) Using micrometer, measure reground journal diameter. Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
- 3) Using journal diameter measured above and alphabets stamped on mating surface of cylinder block, select an under-size bearing by referring to table given below. Check bearing clearance with newly selected undersize bearing.

		Measured journal diameter		
		44.744 – 44.750 mm (1.7616 – 1.7618 in.)	44.738 – 44.744 mm (1.7613 – 1.7616 in.)	44.732 – 44.738 mm (1.7611 – 1.7613 in.)
Alphabets stamped on mating surface of cylinder block	A	Green & Red	Black & Red	Red only
	B	Black & Red	Red only	Yellow & Red
	C	Red only	Yellow & Red	Blue & Red
Undersize bearing to be installed				

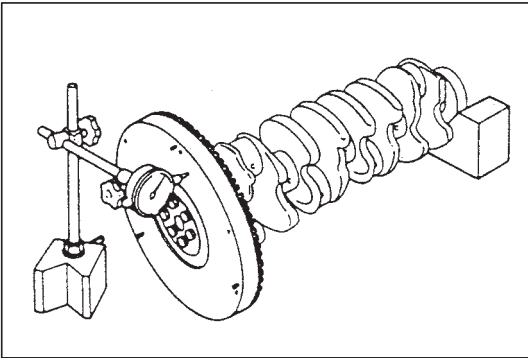


**Rear Oil Seal**

Carefully inspect oil seal (1) for wear or damage. If its lip is worn or damaged, replace it.



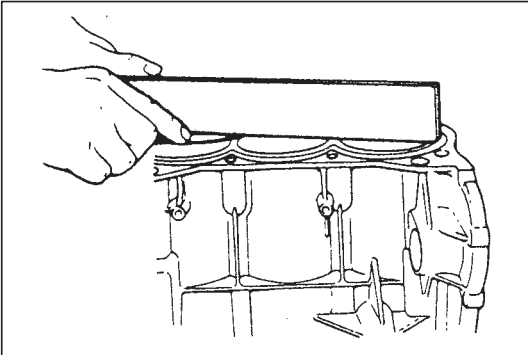
For oil seal installation, press-fit rear oil seal (1) so that oil seal housing (2) end face is flush with oil seal end face.



**Flywheel**

- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.
- Check flywheel for face runout with dial gauge. If runout exceeds its limit, replace flywheel.

**Limit on runout: 0.2 mm (0.0078 in.)**



**Cylinder Block**

**Distortion of gasketed surface**

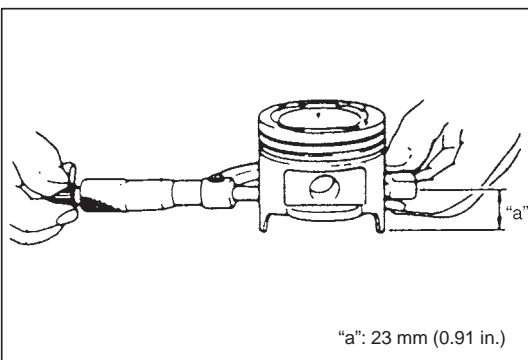
Using straightedge and thickness gauge, check gasketed surface for distortion and, if flatness exceeds its limit, correct it.

Item	Standard	Limit
Flatness	0.03 mm (0.0012 in.)	0.06 mm (0.0024 in.)

**Honing or reboring cylinders**

- 1) When any cylinder needs reboring, all other cylinders must also be rebored at the same time.
- 2) Select oversized piston according to amount of cylinder wear.

Size	Piston diameter
O/S 0.25	74.220 – 74.230 mm (2.9220 – 2.9224 in.)
O/S 0.50	74.470 – 74.480 mm (2.9319 – 2.9323 in.)



- 3) Using micrometer, measure piston diameter.

- 4) Calculate cylinder bore diameter to be rebored.

$$D = A + B - C$$

D: Cylinder bore diameter to be rebored.

A: Piston diameter as measured.

B: Piston clearance = 0.02 – 0.04 mm  
(0.0008 – 0.0015 in.)

C: Allowance for honing = 0.02 mm (0.0008 in.)

5) Rebore and hone cylinder to calculated dimension.

**NOTE:**

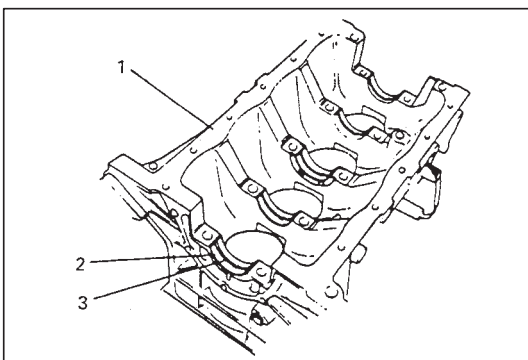
**Before reboring, install all main bearing caps in place and tighten to specification to avoid distortion of bearing bores.**

6) Measure piston clearance after honing.

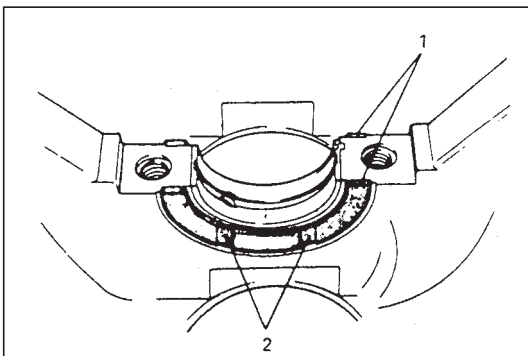
**INSTALLATION**

**NOTE:**

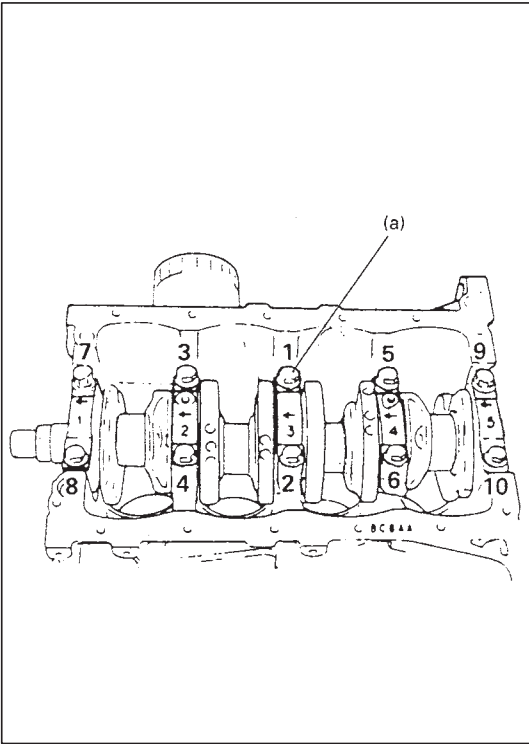
- All parts to be installed must be perfectly clean.
- Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.
- Journal bearings, bearing caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.



- 1) Install main bearings to cylinder block. One of two halves of main bearing (2), has an oil groove (3). Install it to cylinder block (1), and the other half without oil groove to bearing cap. Make sure that two halves are painted in the same color.



- 2) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.



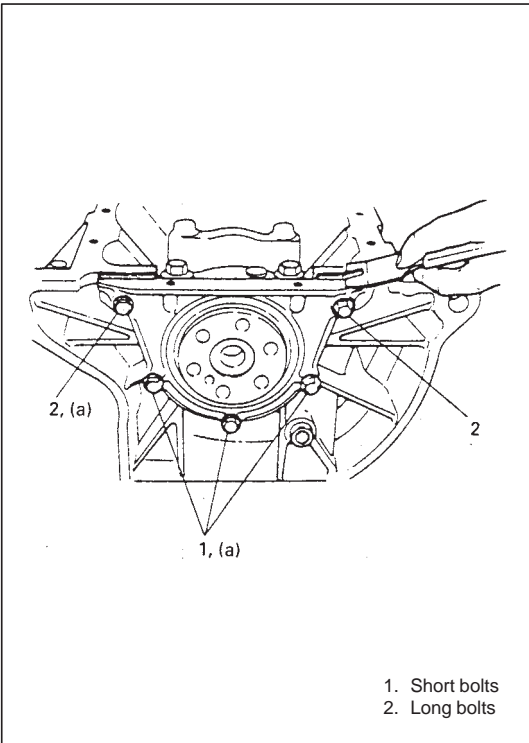
- 3) Install crankshaft to cylinder block.
- 4) Install bearing cap to cylinder block, making sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side. After installing bearing cap stiffeners, tighten bearing cap bolts in such order as shown in figure a little at a time and repeat it till they are tightened to specified torque.

**Tightening Torque**

(a): 54 N·m (5.4 kg-m, 39.0 lb-ft)

**NOTE:**

After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 8.0 N·m (0.8 kg-m, 5.8 lb-ft) torque or below.



- 5) Install new gasket and oil seal housing. Do not reuse gasket removed in disassembly. Apply engine oil to oil seal lip before installation. Tighten housing bolts to specification.

**Tightening Torque**

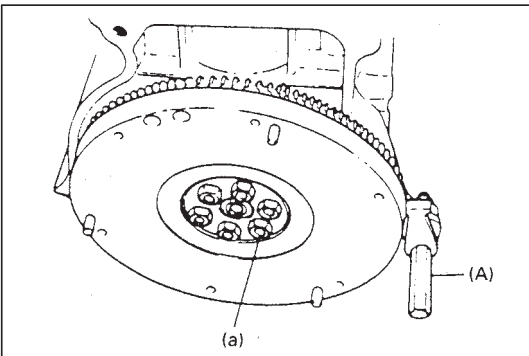
(a): 11 N·m (1.1 kg-m, 8.0 lb-ft)

**NOTE:**

As there are 2 types of housing bolts, refer to figure for their correct use.

After installing oil seal housing, gasket edges might bulge out; if so, cut them off to make them flush with cylinder block and oil seal housing.

- 6) Install oil pump. Refer to item "Oil pump" for installation of oil pump.



- 7) Install flywheel (M/T model) or drive plate (A/T model). Using special tool, lock flywheel or drive plate, and torque its bolts to specification.

**Special Tool**

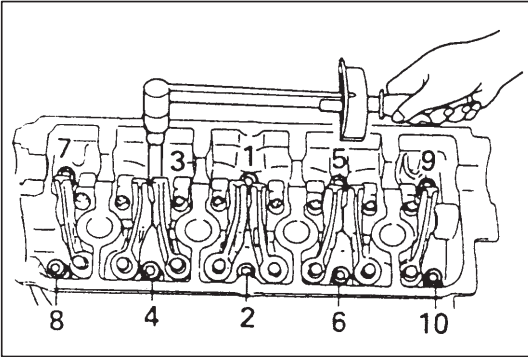
(A): 09924-17810

**Tightening Torque**

(a): 78 N·m (7.8 kg-m, 56.5 lb-ft) (Flywheel bolts)

(a): 95 N·m (9.5 kg-m, 69.0 lb-ft) (Drive plate bolts)

- 8) Install pistons and connecting rods as previously outlined.
- 9) Install oil pump strainer and oil pan as previously outlined.

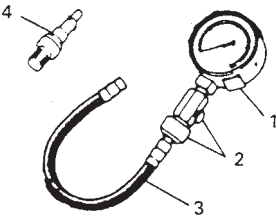
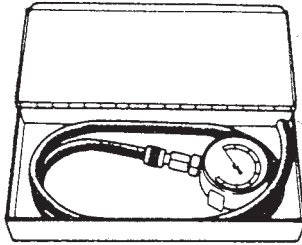
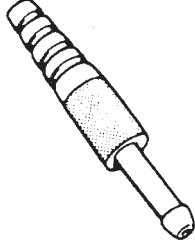
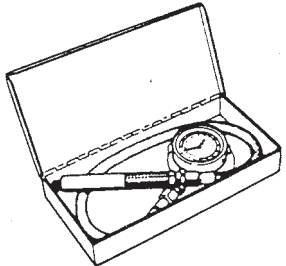
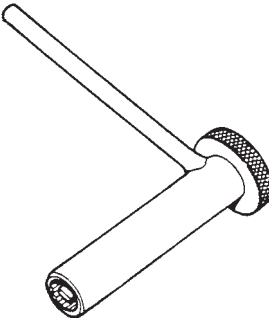

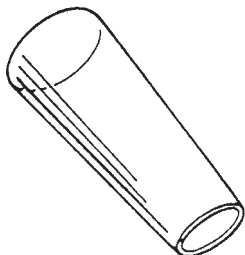
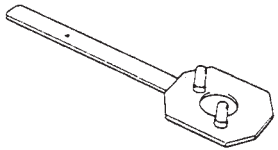
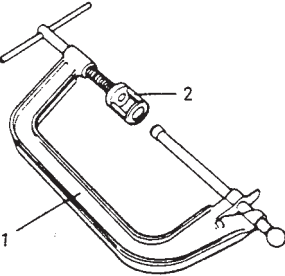
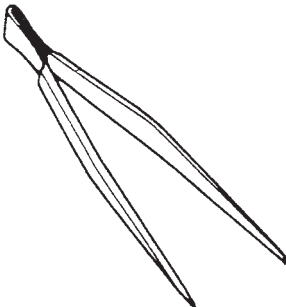
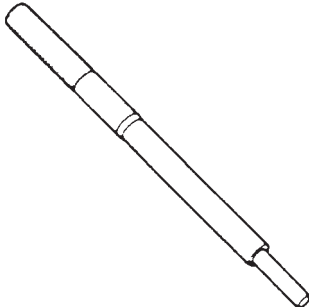
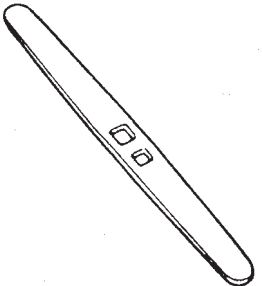
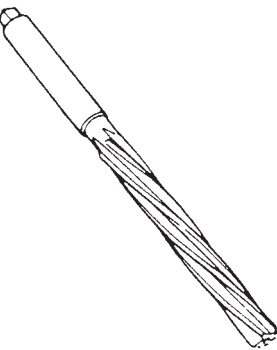
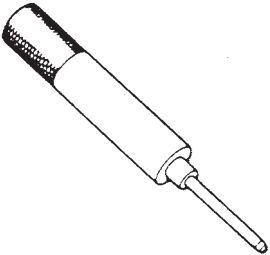
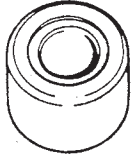
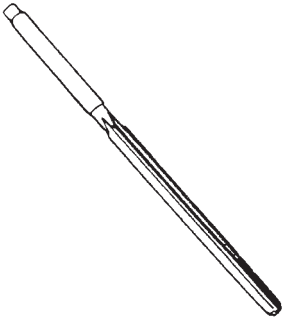


- 10) Install cylinder head assembly to cylinder block as previously outlined.


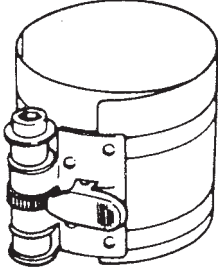
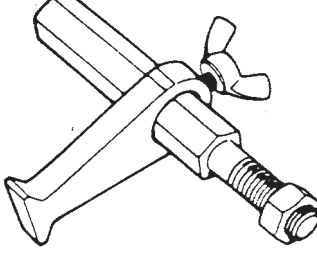
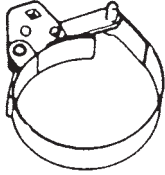
- 11) Install camshaft, crankshaft timing belt pulley, timing belt, crankshaft pulley, water pump pulley, etc., as previously outlined.
- 12) Install clutch to flywheel (for M/T vehicle). For clutch installation, refer to "CLUTCH" section.

- 13) Install engine mountings and brackets.  
Refer to tightening torque for INSTALLATION of "ENGINE ASSEMBLY" in this section.
- 14) Install engine with transmission to vehicle as previously outlined.

## SPECIAL TOOLS

 <p>1. 09915-64510-001 Compression gauge 2. 09915-64510-002 Connector 3. 09915-64530 Hose 4. 09915-67010 Attachment</p>	 <p>09915-67311 Vacuum gauge</p>	 <p>09918-08210 Vacuum gauge hose joint</p>	 <p>09915-77311 Oil pressure gauge</p>
 <p>09917-18211 Tappet adjuster wrench</p>	 <p>09919-16020 17 mm socket</p>	 <p>09926-18210 Oil seal guide (Vinyl resin)</p>	 <p>09917-68221 Camshaft pulley holder</p>
 <p>1. 09916-14510 Valve lifter 2. 09916-14910 Valve lifter attachment</p>	 <p>09916-84511 Forceps</p>	 <p>09916-44910 Valve guide remover</p>	 <p>09916-34542 Reamer handle</p>
 <p>09916-38210 Reamer (11 mm)</p>	 <p>09916-58210 Valve guide installer handle</p>	 <p>09916-56011 Valve guide installer attachment</p>	 <p>09916-34550 Reamer (5.5 mm)</p>



 <p>09917-98221 Valve stem seal installer</p>	 <p>09916-77310 Piston ring compressor</p>	 <p>09924-17810 Flywheel holder</p>	 <p>09915-47330 Oil filter wrench</p>
--	---	---	--

## REQUIRED SERVICE MATERIALS

MATERIALS	RECOMMENDED SUZUKI PRODUCT	USE
Sealant	SUZUKI BOND NO.1207C (99000-31150)	<ul style="list-style-type: none"> <li>● Mating surfaces of cylinder block and oil pan.</li> </ul>
Sealant	SUZUKI BOND NO.1215 (99000-31110)	<ul style="list-style-type: none"> <li>● Mating surfaces of camshaft housings (No.6).</li> <li>● Mating surfaces of CMP sensor case and cylinder block.</li> </ul>

## TIGHTENING TORQUE SPECIFICATIONS

FASTENING PARTS	TIGHTENING TORQUE		
	N·m	kg·m	lb·ft
Oil pressure switch	13	1.3	9.5
Valve adjusting screw lock nuts	12	1.2	9.0
Cylinder head cover bolts	11	1.1	8.0
Intake manifold bolts and nuts	23	2.3	17.0
Timing belt tensioner stud	11	1.1	8.0
Timing belt tensioner bolt	25	2.5	18.0
Timing belt cover bolts and nut	11	1.1	8.0
Exhaust manifold bolts and nuts	32	3.2	23.5
Crankshaft pulley bolt	16	1.6	11.5
Crankshaft timing belt pulley bolt	130	13.0	94.0
Exhaust pipe nuts and bolts	50	5.0	36.5
Exhaust manifold stiffener nut			
Oil pump strainer bolt and stay bolt	11	1.1	8.0
Oil pan bolts and nuts			
CKP sensor bolt	10	1.0	7.5
Oil pan drain plug	50	5.0	36.0
Oil pump rotor plate screws	11	1.1	8.0
Oil pump case bolts			
Camshaft housing bolts	11	1.1	8.0
Rocker arm shaft bolts			
Camshaft timing belt pulley bolt	60	6.0	43.5
Cylinder head venturi plug	3.5	0.35	2.5
Cylinder head bolts	68	6.8	49.0
Connecting rod bearing cap nuts	35	3.5	25.5
Crankshaft main bearing cap bolts	54	5.4	39.0
Flywheel bolts	78	7.8	56.5
Drive plate bolts	95	9.5	69.0
Engine mounting & bracket bolts and nuts	Refer to INSTALLATION of ENGINE ASSEMBLY in this section.		