SECTION 3

ENGINE

3

CONTENTS

NOTE:
In this section, the following systems and parts appear in some description or illustrations, but whether they are used in the particular vehicle or not depends on specifications or countries. Be sure to bear this in mind when performing inspection and service work.

- Thermostatically Controlled Air Cleaner (TCAC) System
  The parts of this system are installed in and on the air cleaner case.
- Charcoal Canister Storage System
  In the vehicle equipped with this system, the vacuum hose from the canister is connected to the bottom side of the carburetor.
- Exhaust Gas Recirculation System
  In the vehicle equipped with this system, EGR valve is installed on the intake manifold.

3-1. GENERAL DESCRIPTION

1) Engine

The engine is water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit with its S.O.H.C. (Single overhead camshaft) valve mechanism arranged for "V"-type valve configuration.
This single overhead camshaft is mounted over the cylinder head; it is driven from crankshaft through timing belt, and no push rods are provided in the valve train system.

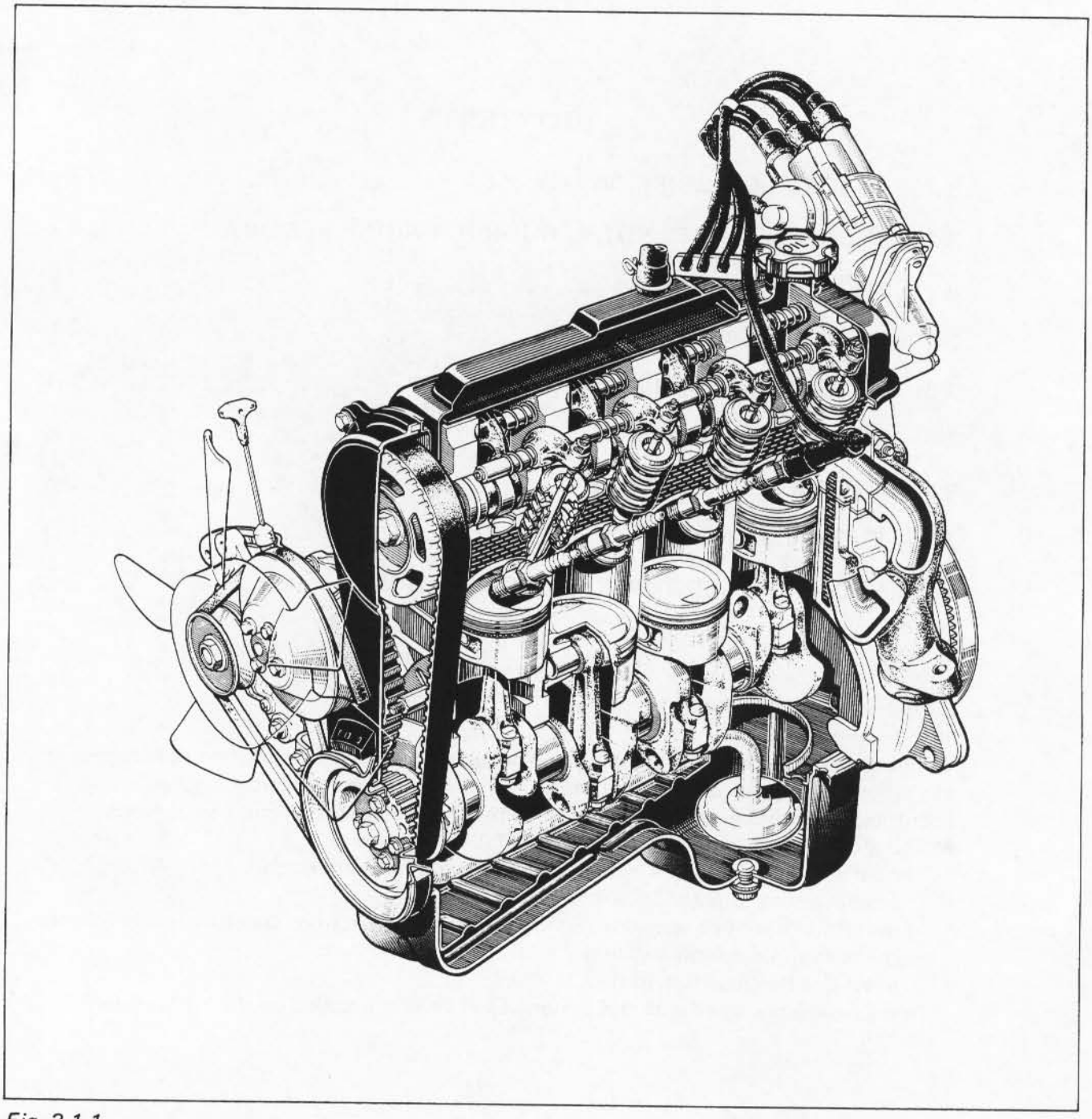


Fig. 3-1-1

2) Engine Lubrication

The oil pump is of a trochoid type, and mounted on the crankshaft at the crankshaft pulley side.
Oil is drawn up through the oil pump strainer and passed through the pump to the oil filter.
The filtered oil flows into two paths in cylinder block.
In one path, oil reaches the crankshaft journal bearings.
Oil from the crankshaft journal bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft, and then injected from a small hole provided on the big end of connecting rod to lubricate piston, rings, and cylinder wall.
In another path, oil goes up to the cylinder head and lubricates rocker arms, valves and camshaft, etc., after passing through the internal oilway of rocker arm shafts.

An oil relief valve is provided on the oil pump. This valve starts relieving oil pressure when the pressure comes over about 3.0 kg/cm^2 (42.7 psi, 300 kPa). Relieved oil drains back to the oil pan.

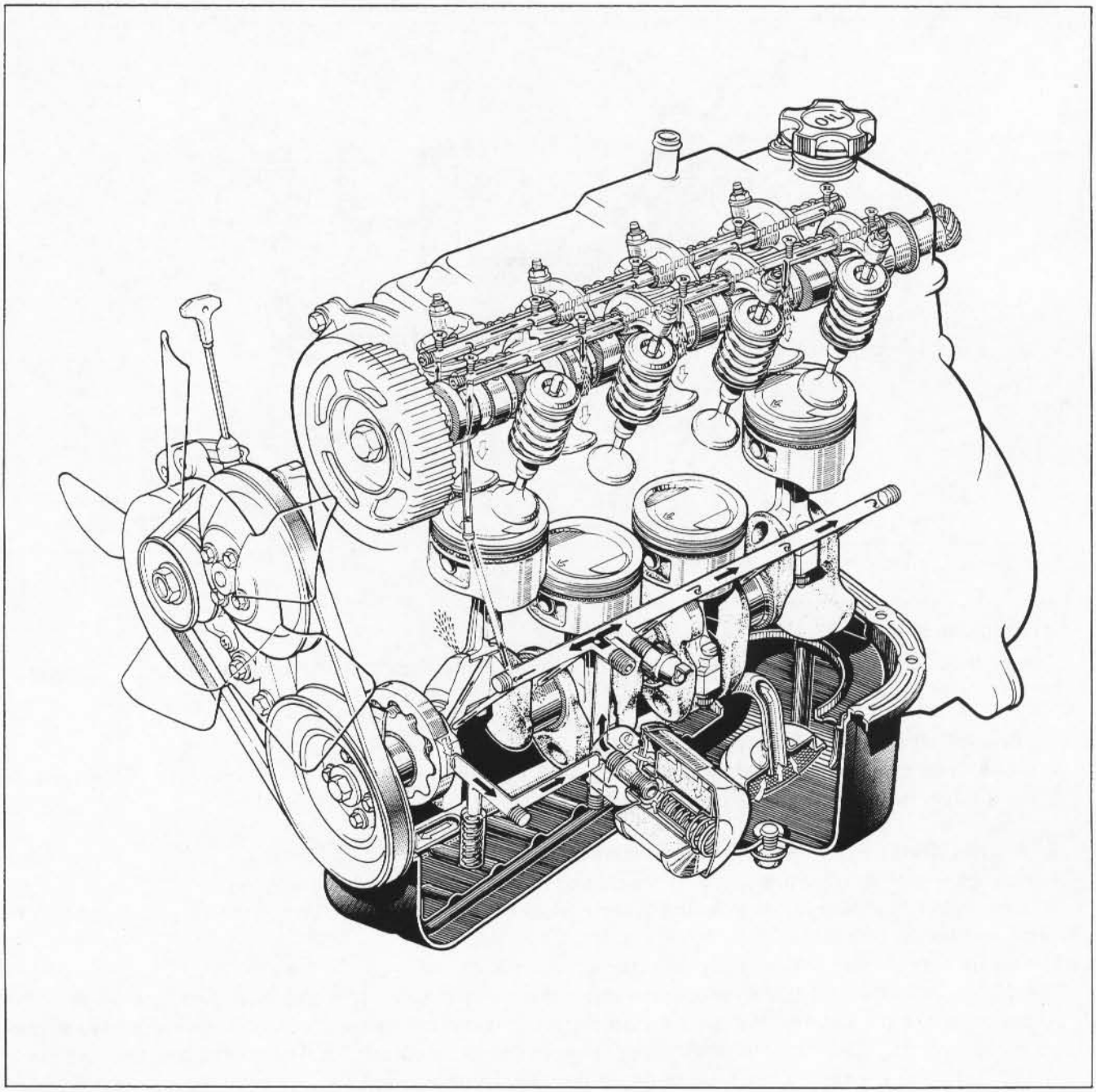


Fig. 3-1-2

3) Cylinder Head and Valve Train

The cylinder head is made of cast aluminum alloy and has four combustion chambers arranged in-line. Each combustion chamber has an intake and an exhaust ports.

Moreover, as shown in Figure 3-1-3, the air induction nozzle is provided near each intake valve. During intake stroke of the engine, air/fuel mixture enters into the combustion chamber from carburetor through intake manifold and intake valve. At the same time, air flows to the air induction nozzle through carburetor and air induction passage in the intake manifold, and jets into the combustion chamber.

The air jetted into the combustion chamber accelerates the mixture swirl to improve the combustion efficiency.

A single overhead camshaft driven by the crankshaft through the timing belt is mounted on the cylinder head. The camshaft has eight cams, and each cam operates the intake or exhaust valve through rocker arm. The valve lash can be adjusted by turning the adjusting screw on the rocker arm after loosening the lock nut.

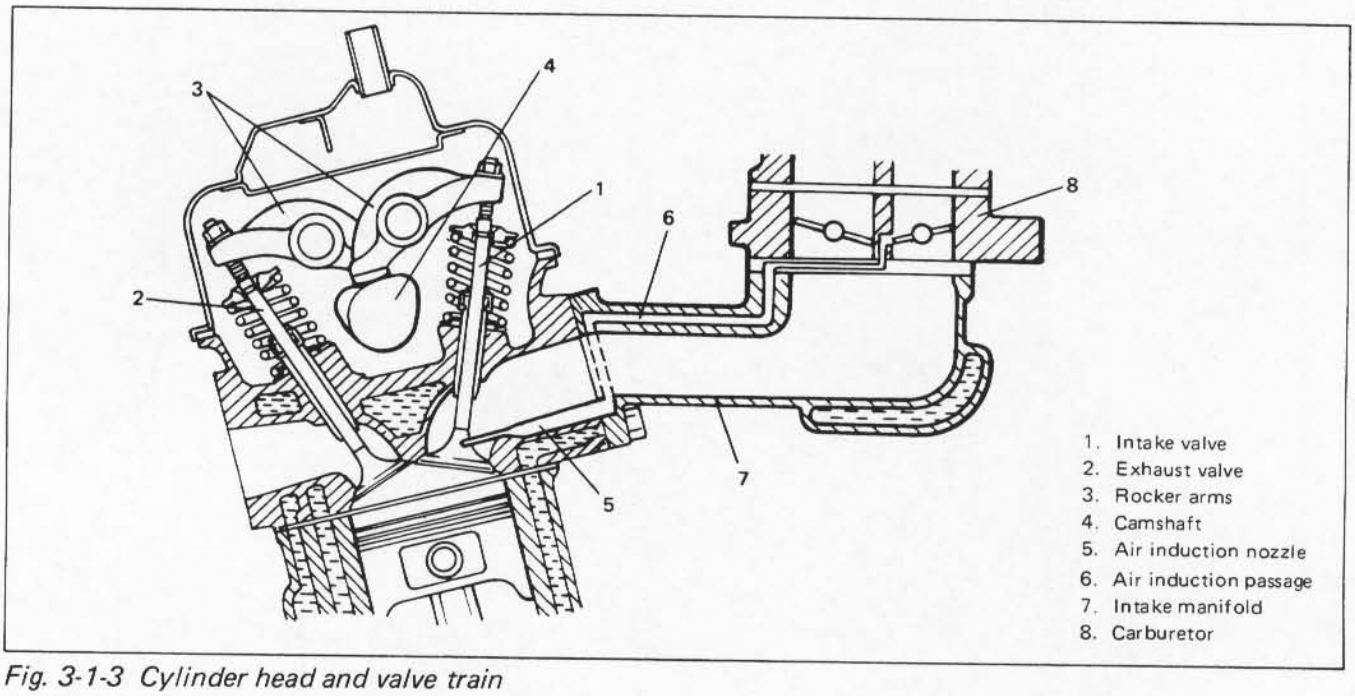


Fig. 3-1-3 Cylinder head and valve train

4) 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.

5) 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.

6) 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 top ring is plated 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 are chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit. The connecting rods are made of forged steel, and the rod bearings are of precision insert type.

3-2. ENGINE SERVICES NOT REQUIRING ENGINE REMOVAL

The following parts of components do not require engine removal to receive services (replacement, inspection or adjustment):

Part or Component	Nature of Service
1. Spark plug	Replacement or inspection
2. Distributor	Replacement, inspection or adjustment
3. Exhaust manifold	Replacement or inspection
4. Oil filter	Replacement
5. Oil pressure unit	Replacement
6. Cylinder head cover	Replacement
7. Rocker shaft	Replacement or inspection
8. Rocker-arm	Replacement or inspection
9. Rocker-arm spring	Replacement or inspection
10. Cam shaft	Replacement or inspection (Cylinder head removal required)
11 Cylinder head	Replacement or inspection
12. Radiator	Replacement or inspection (Cooling fan and fan shroud removal required)
13. Cooling fan	Replacement
14. Camshaft timing belt pulley	Replacement or inspection
15. Crankshaft timing belt pulley	Replacement or inspection
16. Timing belt	Replacement or inspection (Cooling fan and fan shroud removal required)
17. Fuel pump	Replacement
18. Carburetor	Replacement, inspection or adjustment
19. Intake manifold	Replacement
20. Alternator	Replacement or inspection
21. Starter motor	Replacement or inspection
22. Fan belt	Replacement, inspection or tension adjustment
23. Water pump	Replacement (Cooling fan and fan shroud removal required)
24. Pulleys (crank, generator, fan)	Replacement
25. Timing belt cover	Replacement (Cooling fan and fan shroud removal required)
26. Water hose	Replacement or inspection
27. Oil pan, oil strainer, and oil pump	Replacement or inspection
28. Piston and connecting rod	Replacement or inspection (Cylinder head and oil pan removal required)

3-3. ENGINE REMOVAL

1) Disconnect negative (–) and positive (+) cords from battery terminals.
2) From starter motor terminals, disconnect black/yellow lead wire and positive (+) battery cord.
3) Disconnect coupler and white lead wire from alternator terminals.
4) Disconnect lead wire from water temperature gauge. This gauge is on inlet manifold.
5) Disconnect coupler of carburetor solenoid coil lead wire.
6) Remove warm air hose.
7) Disconnect breather hose from air cleaner case.
8) Remove air inlet case from carburetor body and air inlet hose.
9) Disconnect accelerator cable from carburetor body.
10) Disconnect choke cable (no choke cable for automatic choke system) from carburetor body.
11) From fuel pump, disconnect two hoses leading to fuel tank.
12) Disconnect lead wire from oil pressure unit terminal.
13) Disconnect lead wire from back-up light switch.
14) Disconnect lead wires (brown/black and yellow) ignition coil.
15) Pull off high-tension cord from ignition coil.
16) Loosen radiator drain plug to drain cooling water.
17) Disconnect water hoses from thermostat cap and water inlet pipe.
    After removing cooling fan with fan shroud, remove radiator.

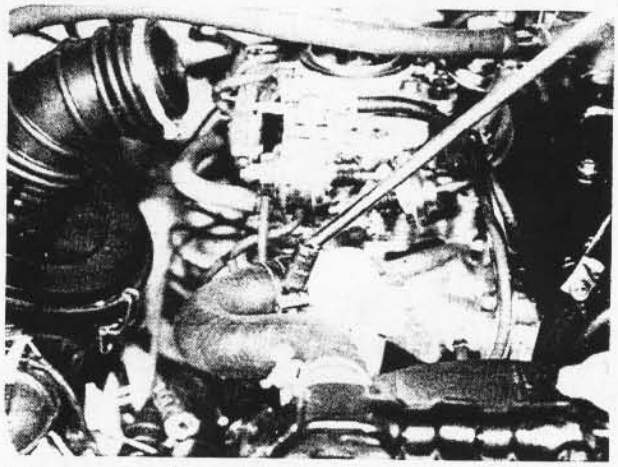


Fig. 3-3-1

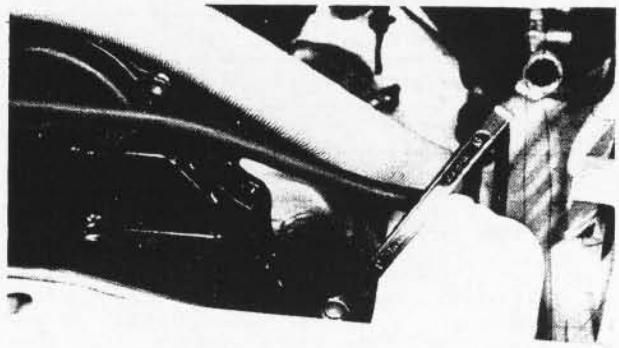


Fig. 3-3-2

18) Disconnect heater hoses (leading to car heater) from heater unit outlet pipe and intake manifold.

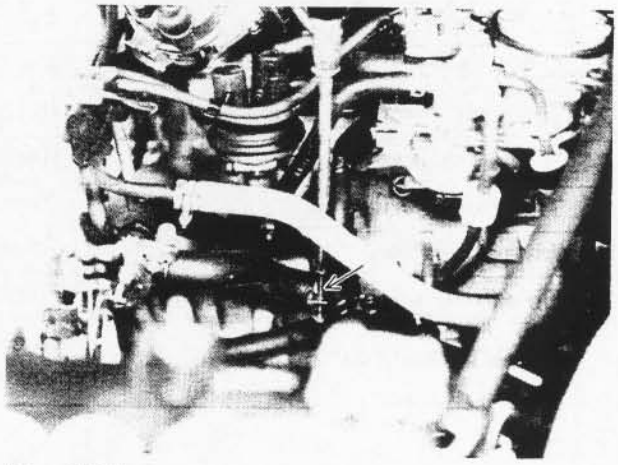


Fig. 3-3-3

19) Disconnect brake booster vacuum hose from pipe (If equipped with brake booster).
20) Disconnect coupler of lead wire (black) from distributor gear case.
21) Remove 4 bolts fastening gear shift lever boot No. 2 and move the boot upward.

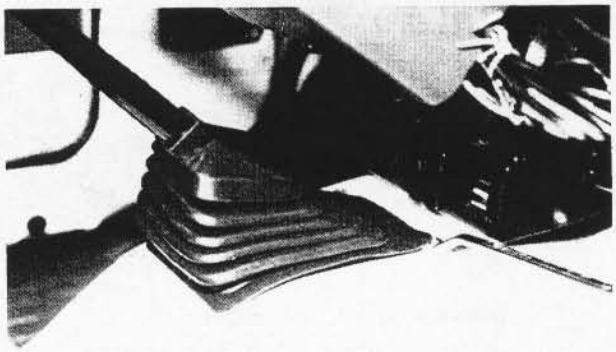


Fig. 3-3-4

22) Move gear shift lever boot No. 1 to upper side of shift lever.
23) Loosen 3 bolts tightening gear shift lever case cover and take shift lever out of lever case.

Fig. 3-3-5

24) Raise vehicle.
25) Sever exhaust manifold from muffler by undoing joint.
26) Disconnect clutch cable from engine mounting bracket and clutch release lever.
27) Loosen drain plug to drain transmission oil.
28) Remove propeller shaft interconnecting transmission case and transfer case.
29) By using a chain block, hold engine so that the engine is kept from falling.

NOTE:
To use a chain block for hoist, take hitch on engine at two hooks provided, one on inlet-manifold side and the other on exhaust-manifold side.

30) Remove 4 transmission mounting bolts.

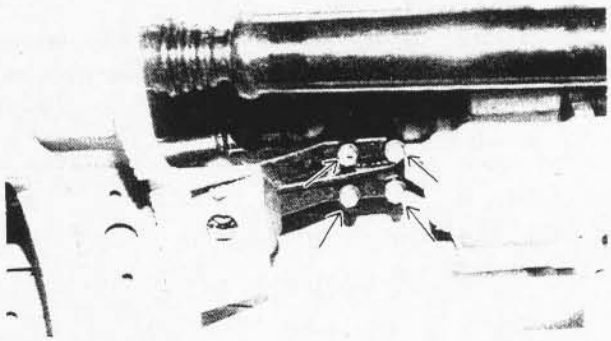


Fig. 3-3-6

31) Remove the pipe connected to chassis under the transmission case.

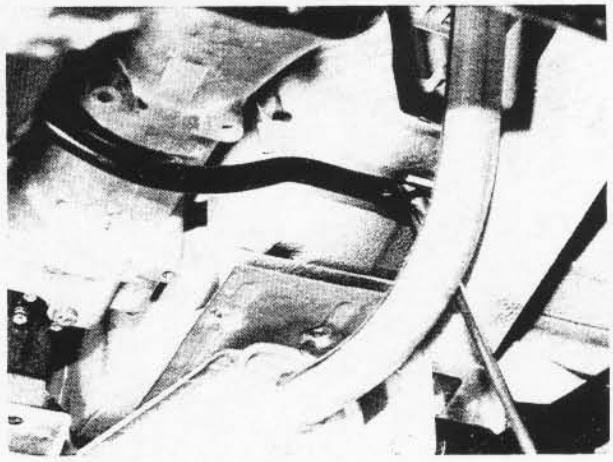


Fig. 3-3-7

32) Lower vehicle and remove 4 bolts securing right and left engine mounting brackets (body side).

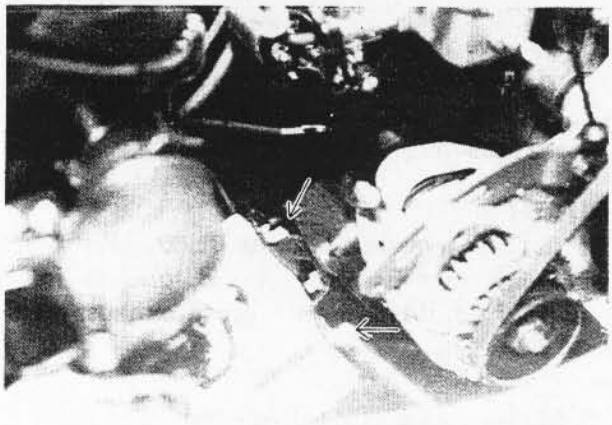


Fig. 3-3-8

CAUTION:
Before lifting engine and transmission, recheck to ascertain all hoses, electric wires and cables are disconnected from engine and transmission.

33) Take down engine by operating a hoisting means.

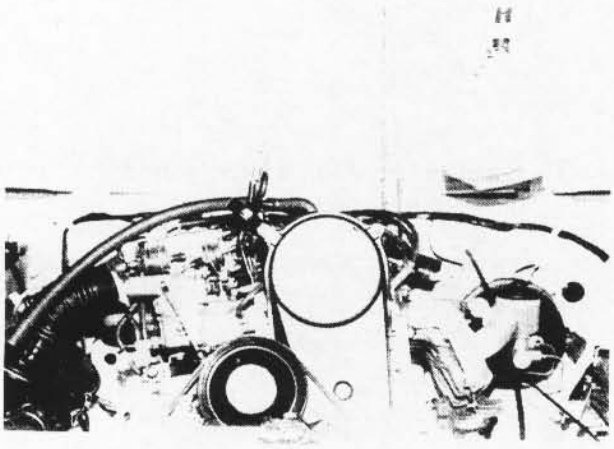


Fig. 3-3-9

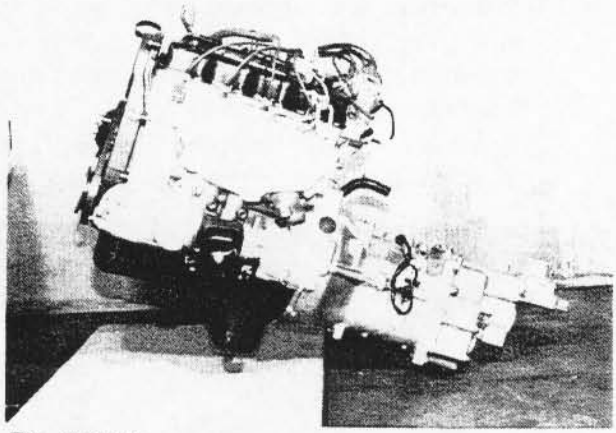


Fig. 3-3-10

34) Remove clutch lower plate.
35) Separate transmission from engine.

Throughout this MANUAL, 4 cylinders of engine are identified by numbers: No. 1, No. 2, No. 3 and No. 4 as counted from front end.

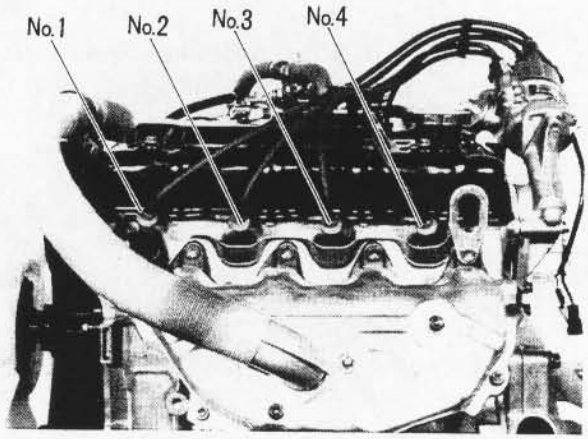


Fig. 3-3-11

3-4. ENGINE DISASSEMBLY

NOTE:

- **Observe critically before starting to remove a component or part by loosening bolts, nuts and the like. What you may find before and during disassembly is valuable information necessary for sucessful reassembly.**
- **Be careful in handling aluminum-alloy parts. They are softer than steel or cast-iron parts and their finished surfaces more easily take scratch marks.**
- **Have trays and pans ready for setting aside disassembled parts in an orderly manner. Place parts in trays and pans in such a way that they can be readily identified. Put match marks or tags on them, as necessary, so that they will go back to where they came from.**

Carry out engine disassembly in the following sequence:

1) Loosen drain plug and drain out engine oil.

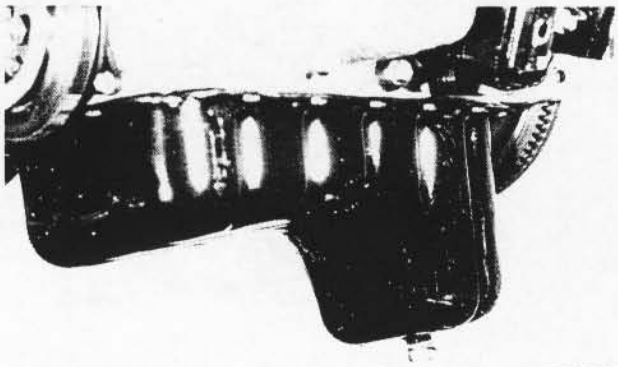


Fig. 3-4-1

2) Remove clutch cover and clutch disc.

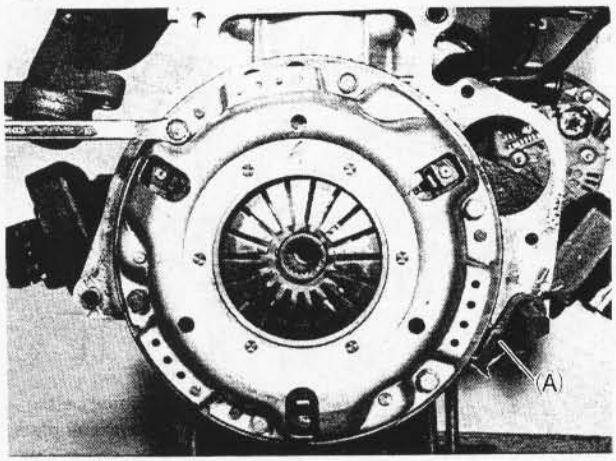


Fig. 3-4-2 (A) Flywheel holder (Special tool 09924-17810)

3) Remove distributor assembly.

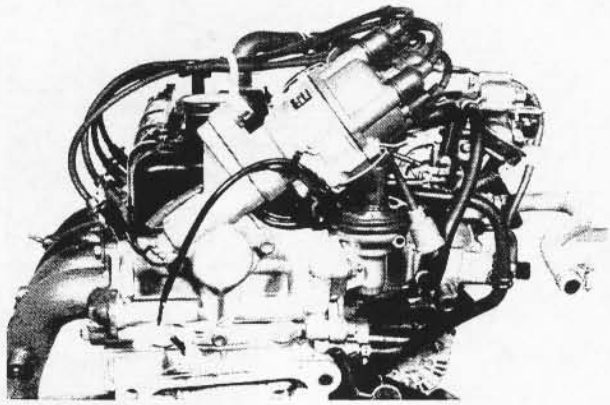


Fig. 3-4-3

4) Remove the fuel pump and rod.

NOTE:

When removing pump and distributor gear case, place waste or receiver under gear case.

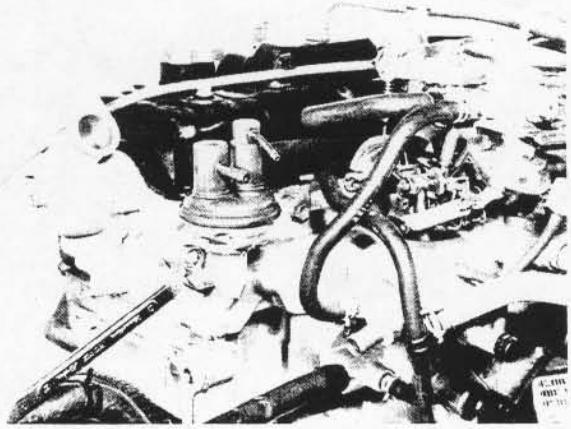


Fig. 3-4-4

5) Take down distributor case.

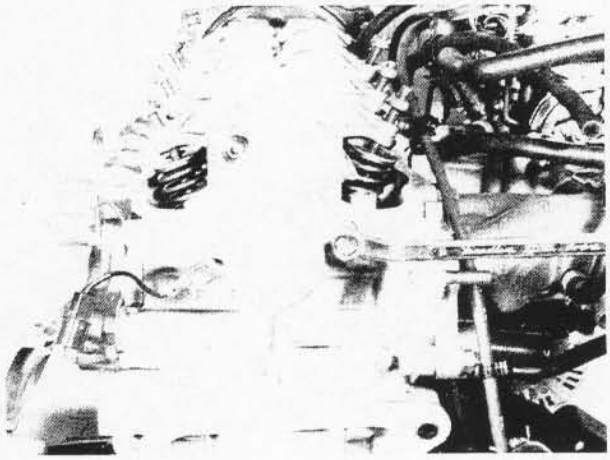


Fig. 3-4-5

6) Take down alternator and water pump pulley.

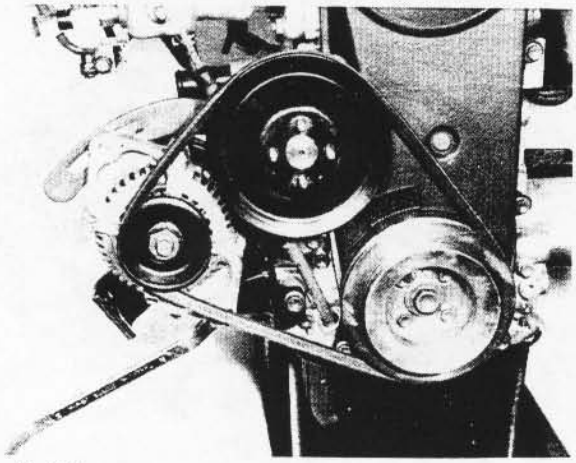


Fig. 3-4-6

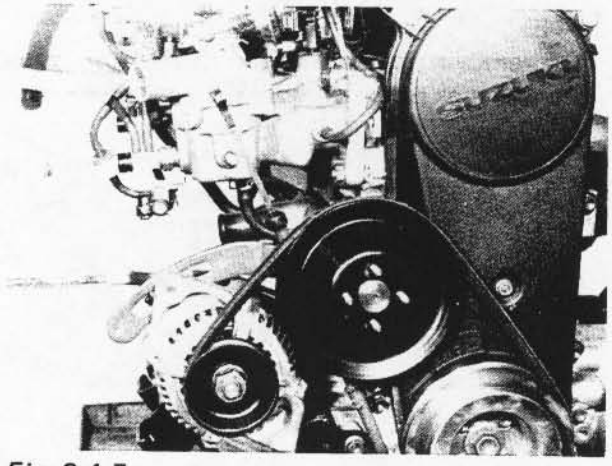
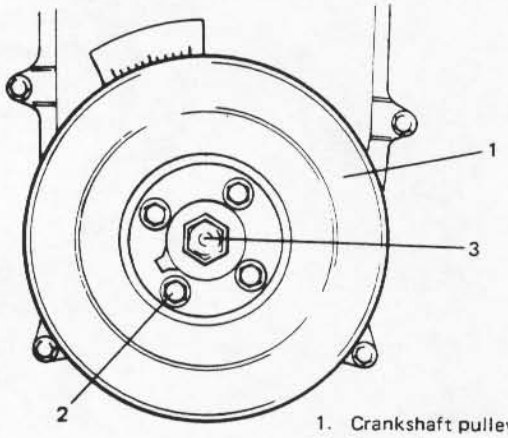


Fig. 3-4-7

7) Remove crankshaft pulley by removing 4 pulley bolts, with special tool (A) hitched to flywheel so that crankshaft will not turn.
The crank timing belt pulley bolt at the center needs not to be loosened.



1. Crankshaft pulley
2. Crankshaft pulley bolt
3. Crank timing belt pulley bolt

Fig. 3-4-8

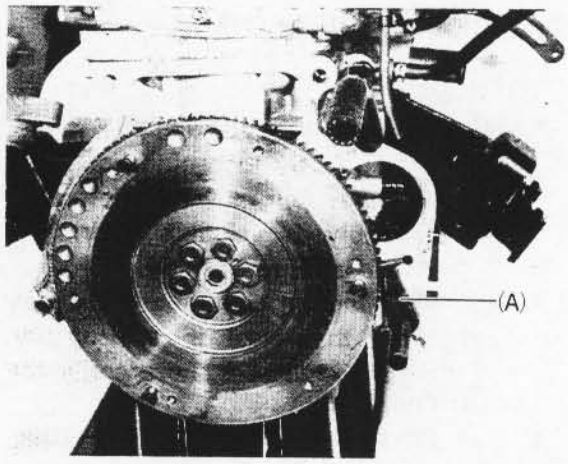


Fig. 3-4-9 (A) Flywheel holder (Special tool 09924-17810)

8) Remove outside cover on timing belt.

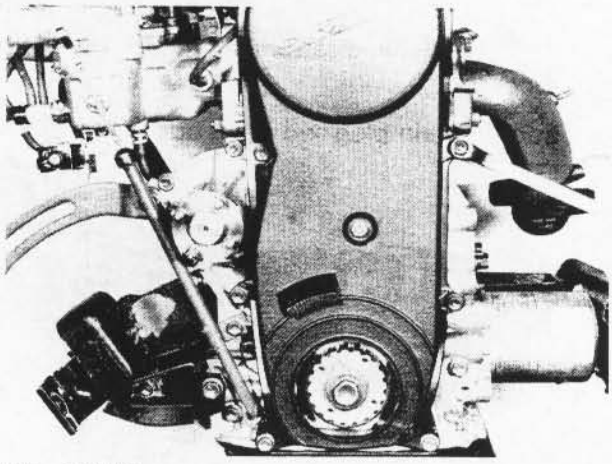
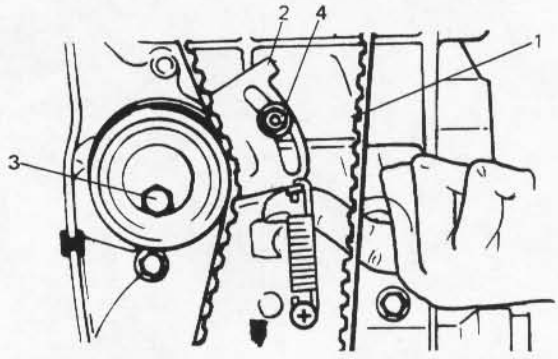


Fig. 3-4-10

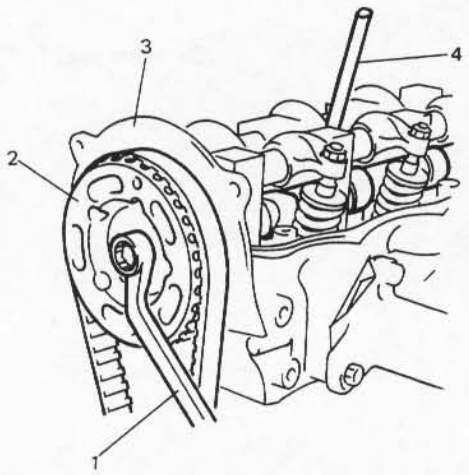
9) Loosen tensioner bolt and stud, and remove belt from crank timing belt pulley and camshaft pulley after pushing up tensioner plate fully by finger as shown in Figure 3-4-11.



1. Timing belt
2. Tensioner plate
3. Tensioner bolt
4. Tensioner stud

Fig. 3-4-11

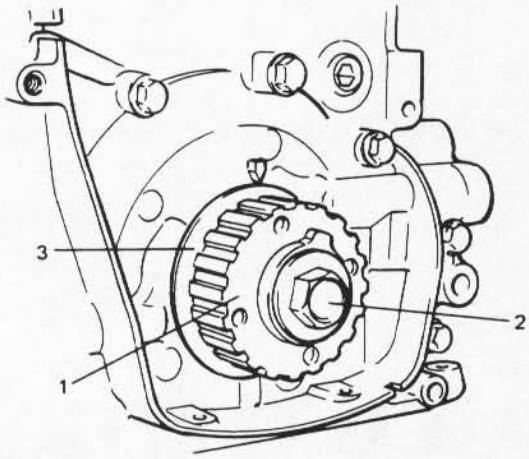
10) Remove timing belt tensioner, tensioner plate, and tensioner spring.
11) Remove camshaft timing belt pulley by locking camshaft (insert general rod into the camshaft hole) as shown below.



1. Wrench
2. Camshaft timing belt pulley
3. Timing belt inside cover
4. General rod

Fig. 3-4-12

12) Using flywheel holder (A) (Special tool), remove crankshaft timing belt pulley bolt, pulley and timing belt guide with crankshaft locked.



1. Crankshaft timing belt pulley
2. Pulley bolt
3. Timing belt guide

Fig. 3-4-13

13) Remove crankshaft timing belt pulley key.
14) Remove timing belt inside cover.

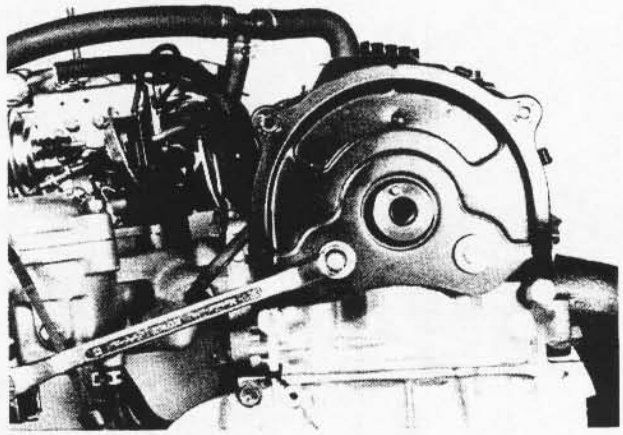


Fig. 3-4-14

15) Remove water pump.

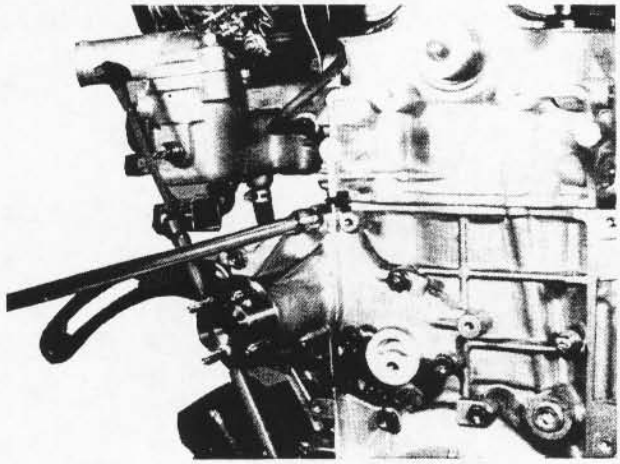


Fig. 3-4-15

16) Remove exhaust manifold cover.
17) Take off exhaust manifold and its gasket.

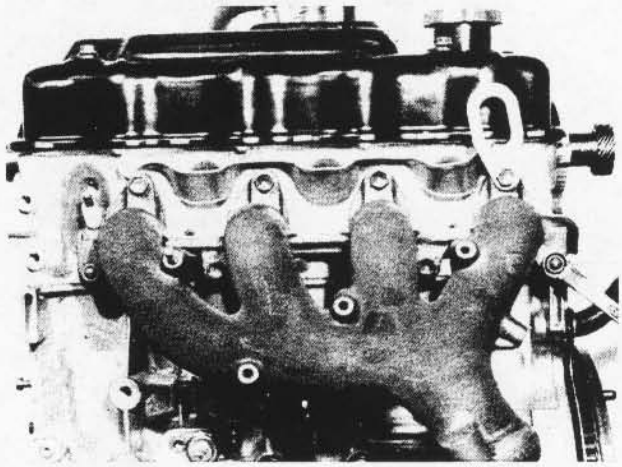


Fig. 3-4-16

18) Using special tool (C), remove oil filter.

NOTE:

Be careful not to spill oil when removing filter.

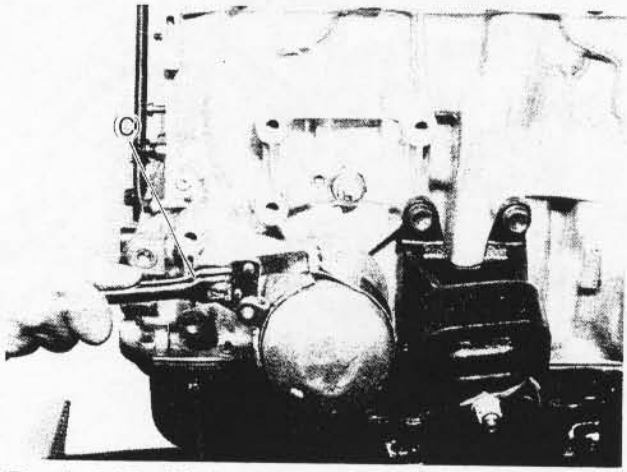


Fig. 3-4-17 (C) Oil filter wrench (09915-47310)

19) Draw water hoses off water pump inlet pipe.

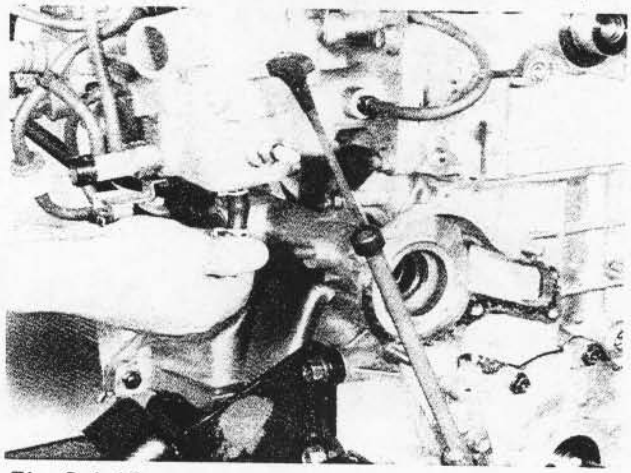


Fig. 3-4-18

20) Disconnect PCV (Positive crankcase ventilation valve) hose from cylinder head cover.

21) Take down intake manifold with carburetor.

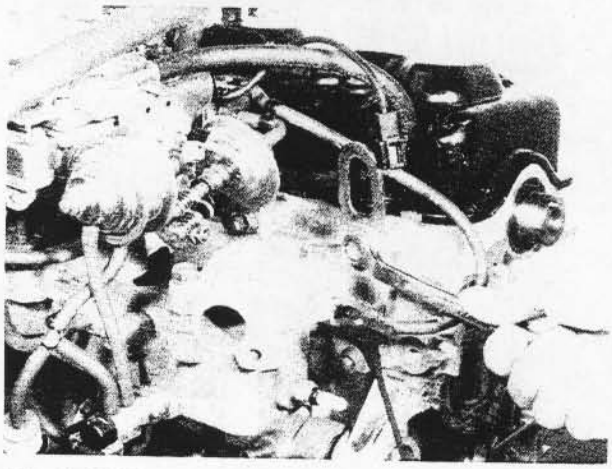


Fig. 3-4-19

22) Remove water inlet pipe.

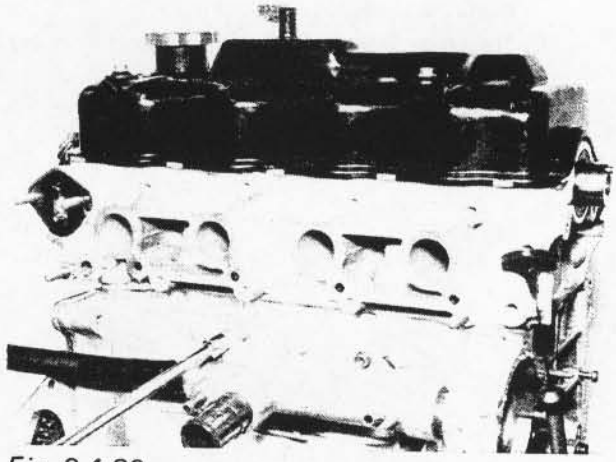


Fig. 3-4-20

23) Take off cylinder head cover.

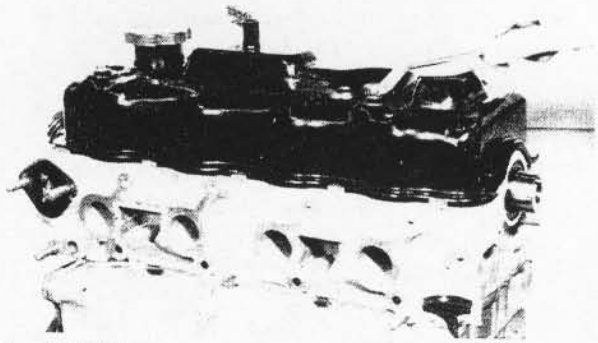


Fig. 3-4-21

24) Loosen 8 valve adjusting screws fully. Leave screws in place.

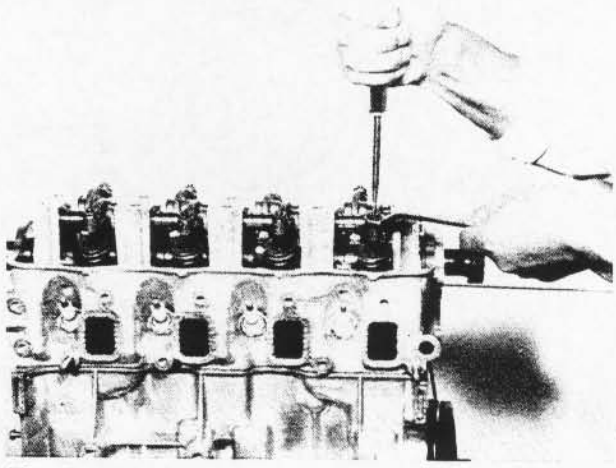


Fig. 3-4-22

25) Loosen rocker arm shaft securing screws (10 pcs).

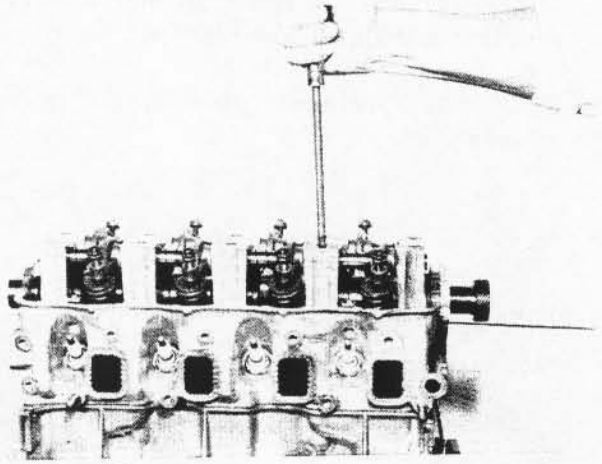


Fig. 3-4-23

26) While drawing out rocker arm shaft, separate valve rocker arms and rocker arm springs.

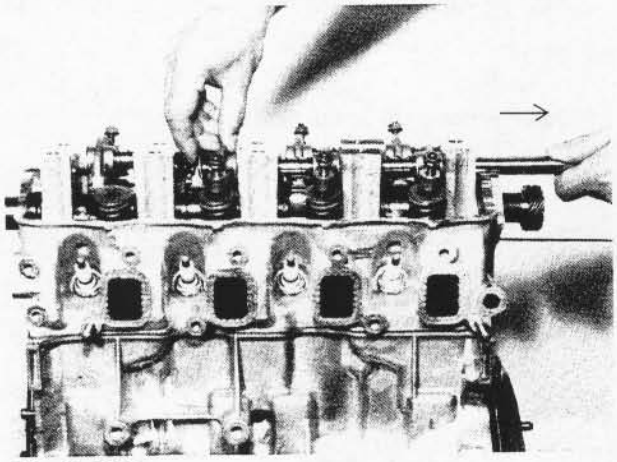


Fig. 3-4-24

27) Draw camshaft out toward rear end (transmission case side).

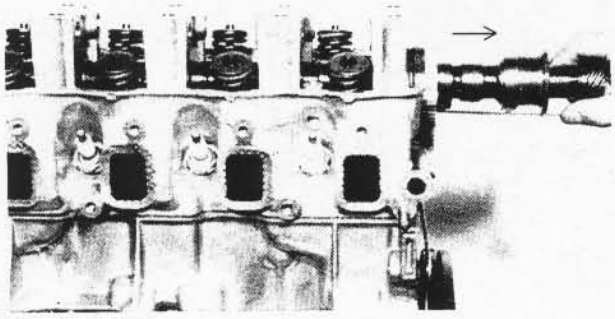


Fig. 3-4-25

28) Remove cylinder head.

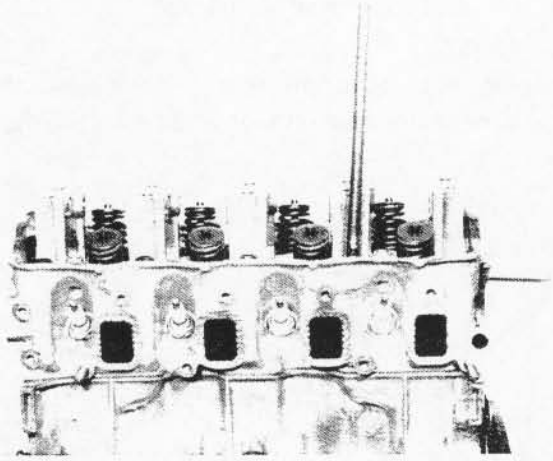
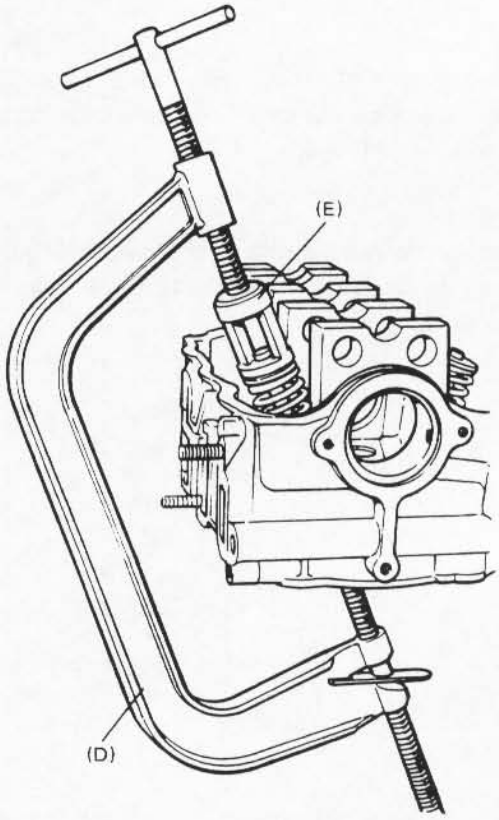


Fig. 3-4-26

a) Use valve lifter (D), (E) to compress valve spring in order to free valve cotter pieces for removal. In this way, remove valve spring and valves.



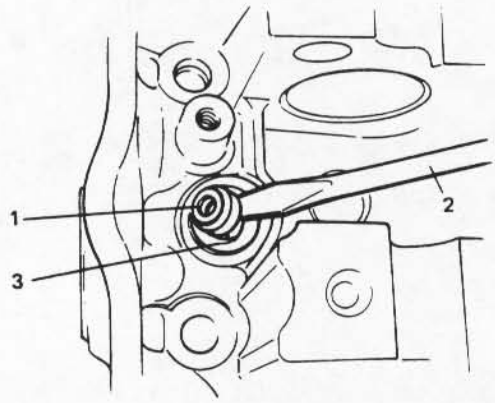
(D) Valve lifter
(Special tool 09916-14510)

(E) Valve lifter attachment
(Special tool 09916-48210)

Fig. 3-4-27

b) Remove valve stem oil seal from valve guide, and then valve spring seat.

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

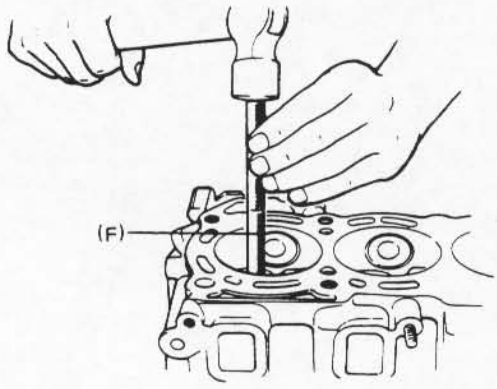


1. Valve stem oil seal
2. Blade screw driver
3. Valve spring seat

Fig. 3-4-28

c) Using special tool (F), drive valve guide out from combustion chamber side to valve spring side (Figure 3-4-29).

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



(F) Valve guide remover (Special tool 09916-44511)

Fig. 3-4-29

NOTE:
Place disassembled parts except valve stem seal and valve guide in order, so that they can be installed in their original positions.

29) Remove flywheel, using special tool (A) as shown.

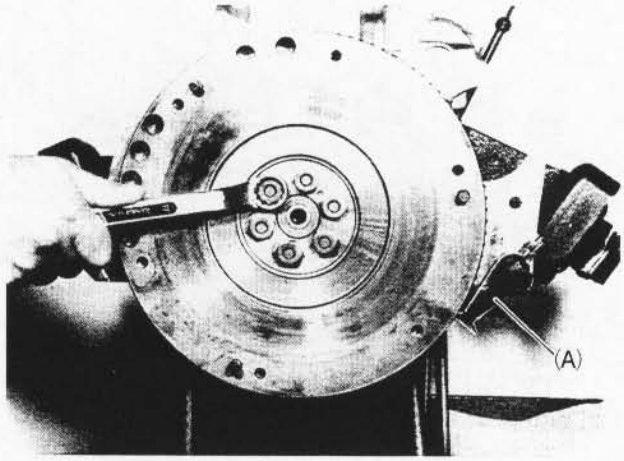


Fig. 3-4-30 (A) Flywheel holder (Special tool 09924-17810)

30) Remove oil level gauge guide from oil pump.

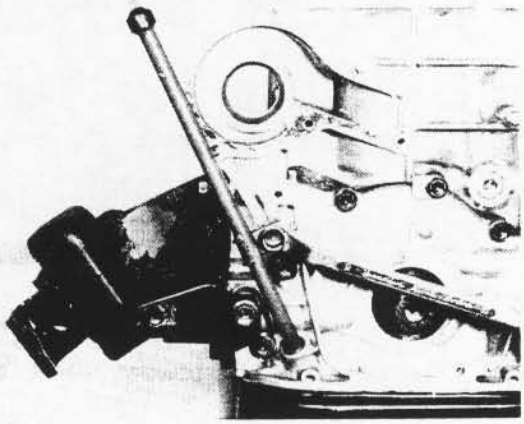


Fig. 3-4-31

31) Take down oil pan.

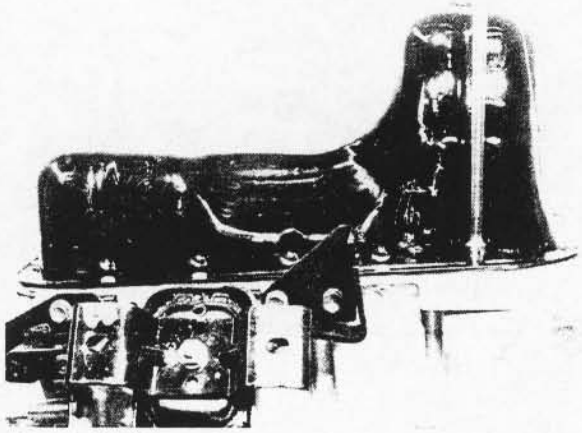


Fig. 3-4-32

32) Remove oil pump strainer.

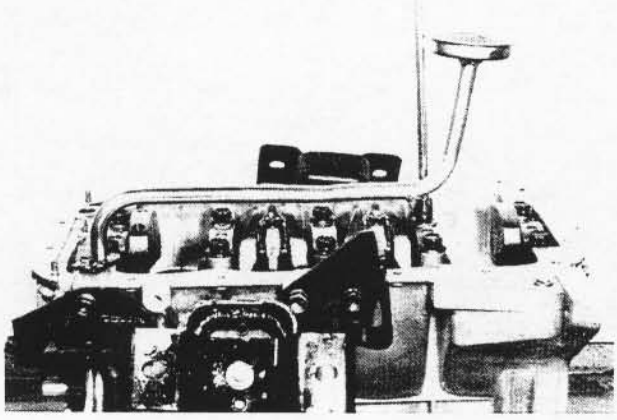


Fig. 3-4-33

33) Remove connecting rod bearing caps.

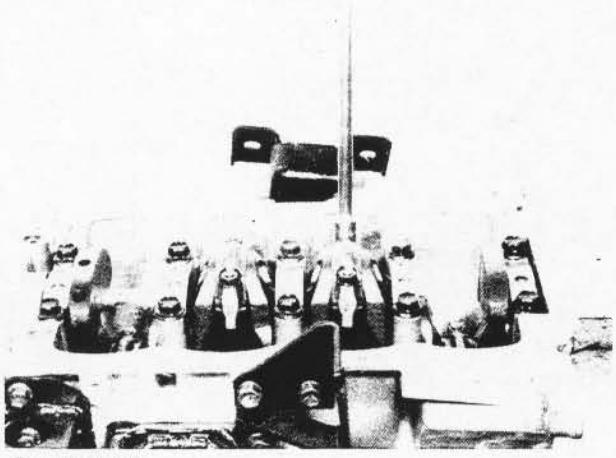
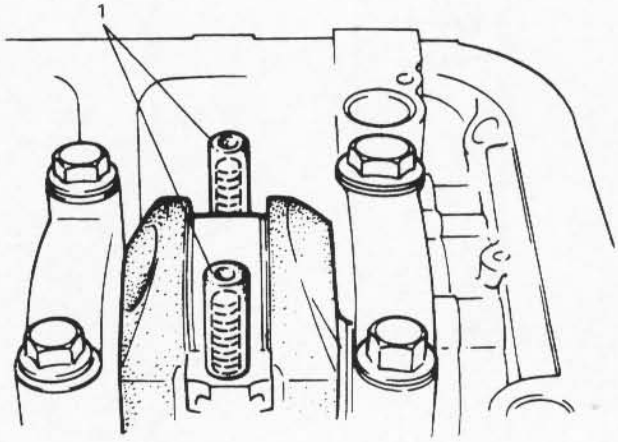


Fig. 3-4-34

34) Install guide hose over threads of rod bolts. This is to prevent damage to bearing journal and cylinder wall when removing connecting rod.



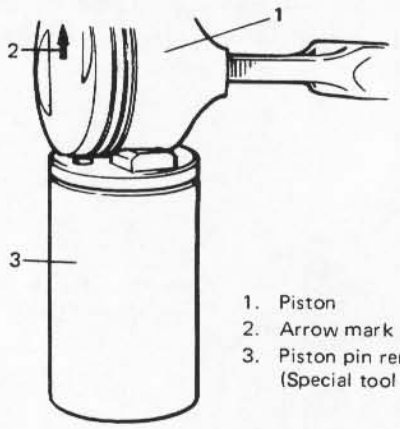
1. Guide hoses

Fig. 3-4-35

35) Decarbon top of cylinder bore, before removing piston from cylinder.
36) Push piston and connecting rod assembly out through the top of cylinder bore.

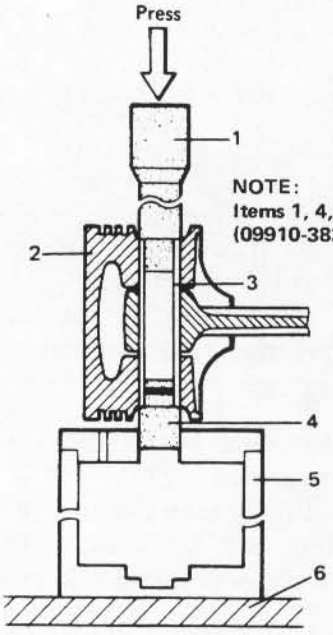
CAUTION:
- **Before pulling piston out, scribe cylinder number on its crown.**
- **Be sure to identify each bearing cap for its connecting rod by using cylinder number. Set cap and rod aside in combination.**

a) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
b) Remove piston pin from connecting rod.
Fit piston and connecting rod assembly to special tool (Fig. 3-4-36), and then press piston pin out of connecting rod by using arbor press (Fig. 3-4-37).



1. Piston
2. Arrow mark
3. Piston pin remover and installer (Special tool 09910-38210)

Fig. 3-4-36



1. Driver handle
2. Piston
3. Piston pin
4. Piston pin guide
5. Base
6. Support

NOTE:
Items 1, 4, and 5 are in Special tool (09910-38210).

Fig. 3-4-37

37) Remove oil pump assembly.

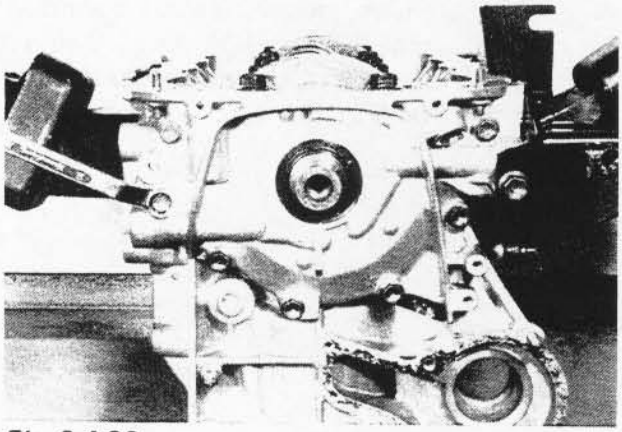
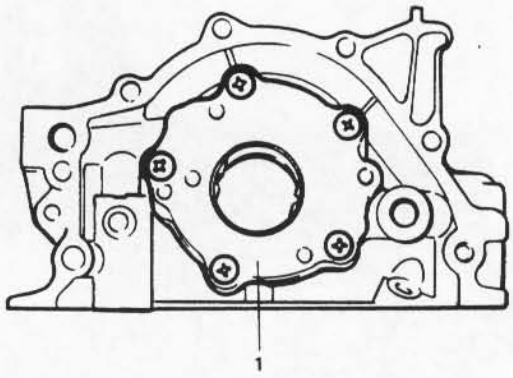


Fig. 3-4-38

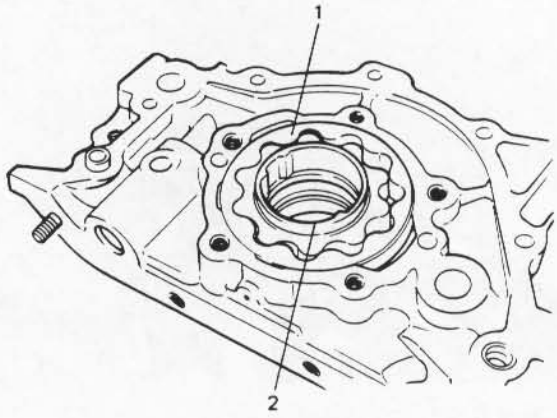
a) Remove oil pump rotor plate.



1. Rotor plate

Fig. 3-4-39

b) Remove outer rotor and inner rotor.



1. Outer rotor
2. Inner rotor

Fig. 3-4-40

38) Remove oil seal housing.

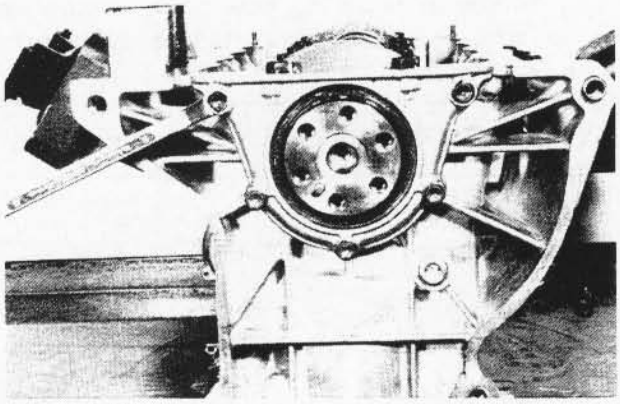


Fig. 3-4-41

39) Remove crankshaft bearing caps, and take out crankshaft.

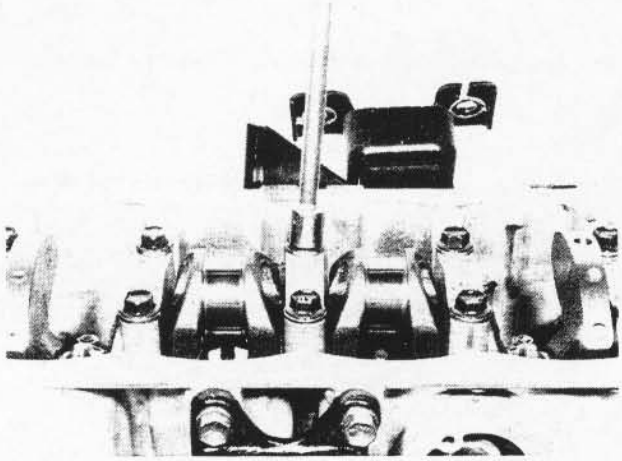


Fig. 3-4-42

3-5. INSPECTION OF ENGINE COMPONENTS

NOTE:

- **During and immediately after disassembly, inspect cylinder block and head for evidence of water leakage or damage and, after washing them clean, inspect more closely.**
- **Wash all disassembled parts clean, removing grease, slime, carbon and scales, before inspecting them to determine whether repair is necessary or not. Be sure to de-scale water jackets.**
- **Use compressed air to clear internal oil holes and passages.**
- **Do not disturb set combinations of valves, bearings and bearing caps, etc. Have the sets segregated and identified.**

Cylinder Head

- Remove all carbon from combustion chambers.

NOTE:

Do not use any sharp-edged tool to scrape off the carbon. Be careful not to scuff or nick metal surfaces when de-carboning. This applies to valves and valve seats, too.

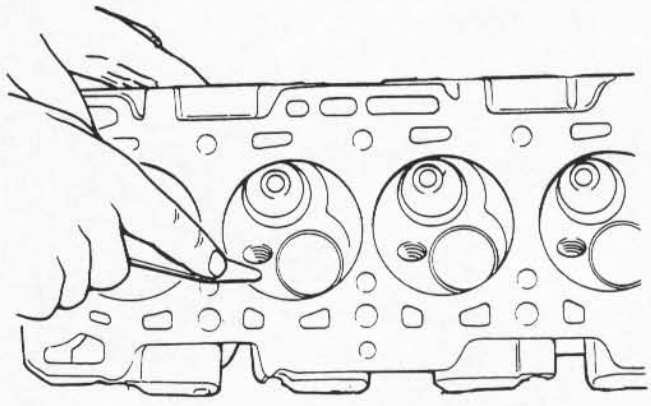


Fig. 3-5-1

- 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 the limit stated 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 the limit, replace cylinder head.
  Leakage of combustion gases from this gasketed joint is often due to a warped gasketed surface; such leakage results in reduced power output.

Limit of distortion	0.05 mm (0.002 in.)

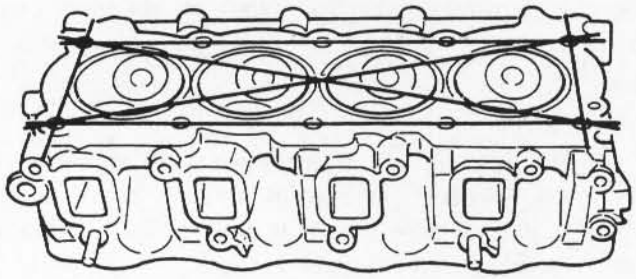


Fig. 3-5-2

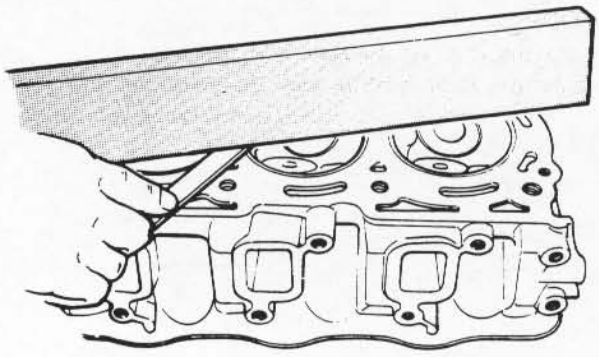


Fig. 3-5-3

- 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.)

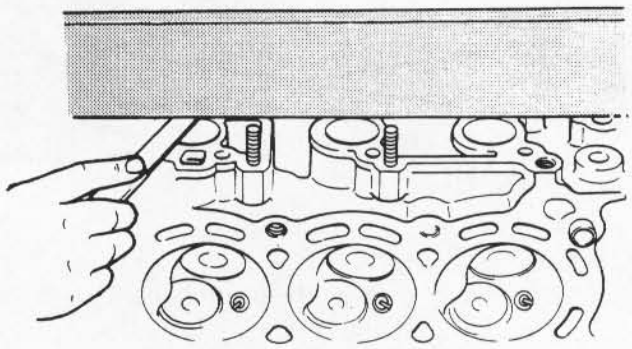


Fig. 3-5-4 Intake manifold seating face

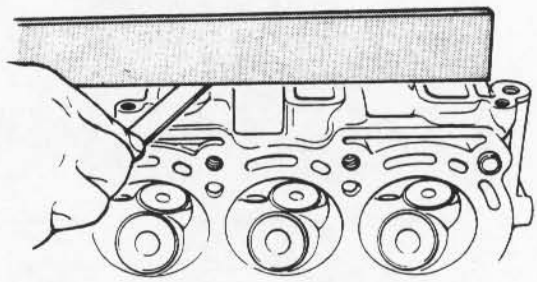


Fig. 3-5-5 Exhaust manifold seating face

Rocker-Arm Shaft and Rocker Arms

- Shaft-to-arm clearance (IN & EX):
  Using a micrometer and a bore gauge, measure rocker shaft dia. and rocker arm I.D..
  The difference between two readings is the arm-to-shaft clearance on which limit is specified.
  If the limit is exceeded, replace shaft or arm, or both.

Item	Standard	Limit
Rocker arm I.D.	16.000 – 16.018 mm (0.629 – 0.630 in.)	—
Rocker arm Shaft dia.	15.973 – 15.988 mm (0.628 – 0.629 in.)	—
Arm-to-Shaft clearance	0.012 – 0.045 mm (0.0005 – 0.0017 in.)	0.09 mm (0.0035 in.)

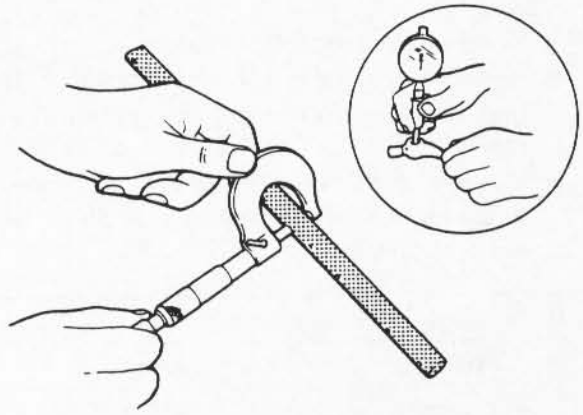


Fig. 3-5-6

- Runout of rocker-arm shaft:
  Using "V" blocks and dial gauge, check runout. If runout exceeds the limit, replace rocker arm shaft.

Runout limit	0.12 mm (0.004 in.)

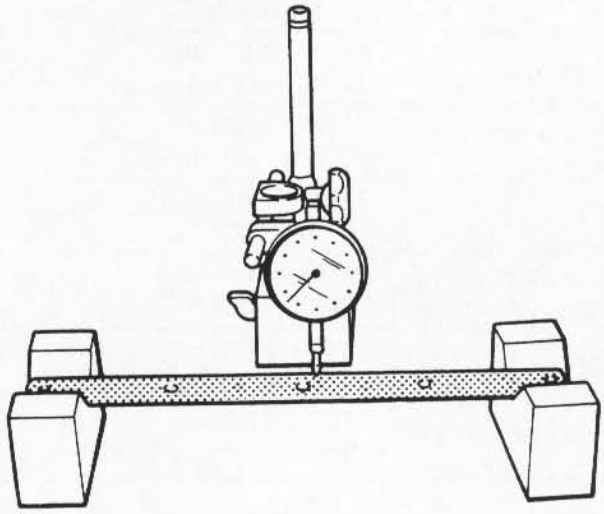
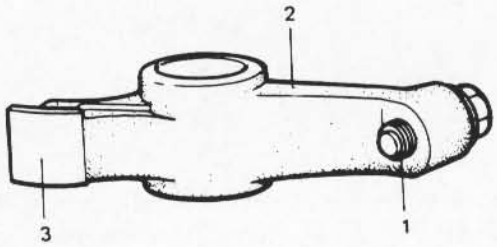


Fig. 3-5-7

- Wear of rocker-arm and adjusting screw:
  If the tip ① of adjusting screw is badly worn, replace screw. Arm must be replaced if its cam-riding face ③ is badly worn.



1. Adjusting screw
2. Rocker arm
3. Cam-riding face

Fig. 3-5-8

Valve Guides

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

Item		Standard	Limit
Valve stem diameter	In	6.965 – 6.980 mm (0.2742 – 0.2748 in.)	———
	Ex	6.950 – 6.965 mm (0.2737 – 0.2742 in.)	———
Valve guide I.D.	In	7.000 – 7.015 mm (0.2756 – 0.2761 in.)	———
	Ex.	7.000 – 7.015 mm (0.2756 – 0.2761 in.)	———
Stem-to-guide clearance	In	0.020 – 0.050 mm (0.0008 – 0.0019 in.)	0.07 mm (0.0027 in.)
	Ex	0.035 – 0.065 mm (0.0014 – 0.0025 in.)	0.09 mm (0.0035 in.)

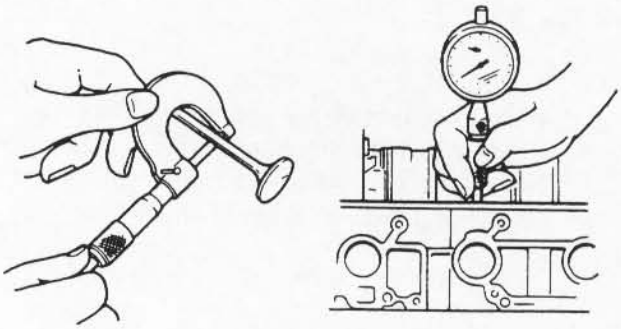


Fig. 3-5-9

If bore gauge is not available, check end deflection of the valve stem in place with a dial gauge rigged.
Move stem end in the 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.)

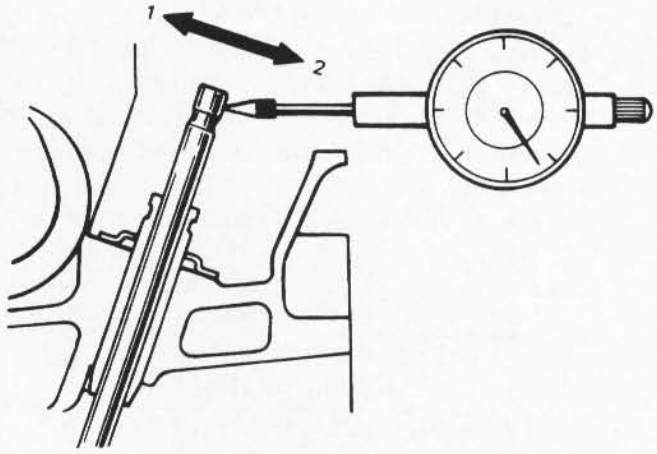
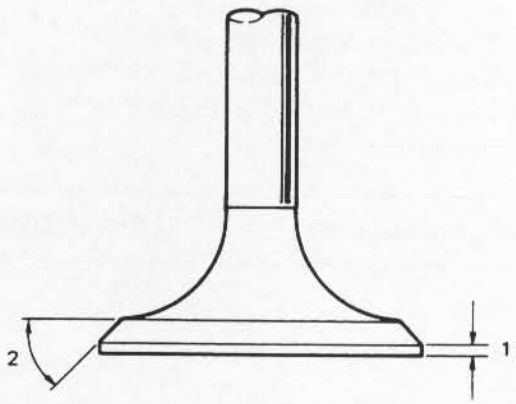


Fig. 3-5-10

Valves

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

Valve head thickness		
Standard	Limit	
1.0 mm (0.039 in.)	In	0.6 mm (0.023 in.)
	Ex	0.7 mm (0.027 in.)



1. Valve head thickness
2. 45°

Fig. 3-5-11

- Check end face of each valve stem for wear. This face meets rocker arm intermittently in operation, and might become concaved or otherwise irregular. As necessary, smoothen the end face with an oil stone and, if this grinding removes the end stock by as much as 0.5 mm (0.0196 in.) (as measured from the original face), replace the valve.

Limit on stock allowance of valve stem end face	0.5 mm (0.0196 in.)

- Check each valve for radial runout with a dial gauge and "V" block. To check runout, rotate valve slowly. If runout exceeds limit, replace valve.

Limit on valve head radial runout	0.08 mm (0.003 in.)

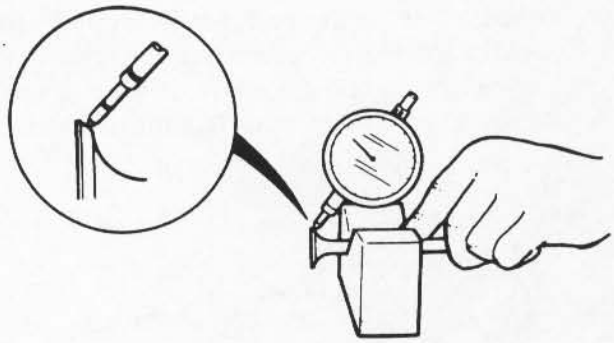


Fig. 3-5-12

Valve Seats

CAUTION:
Valves to be checked and serviced for seating width and contact pattern must be those found satisfactory in regard to stem clearance in the guide and also requirements stated on preceding page under valves.

- Seating contact width:
  Produce contact pattern on each valve in the usual manner, namely, 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.

The pattern produced on seating face of valve must be a continuous ring without any break, and width Ⓦ of pattern must be within stated range as follows.

Ⓦ Standard seating width revealed by contact pattern on valve face	Intake	1.3 – 1.5 mm (0.0512 – 0.0590 in.)
	Exhaust	

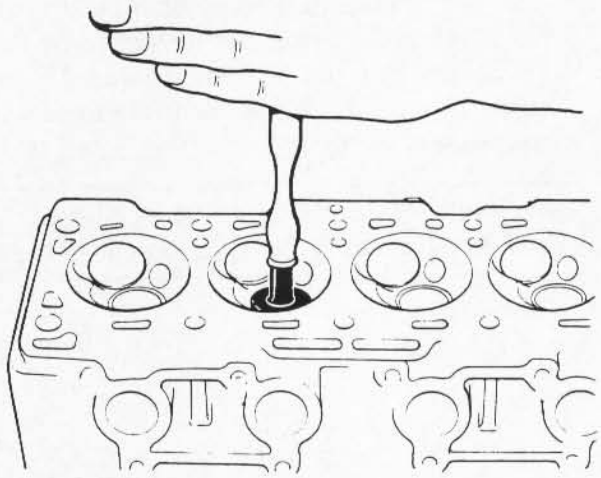
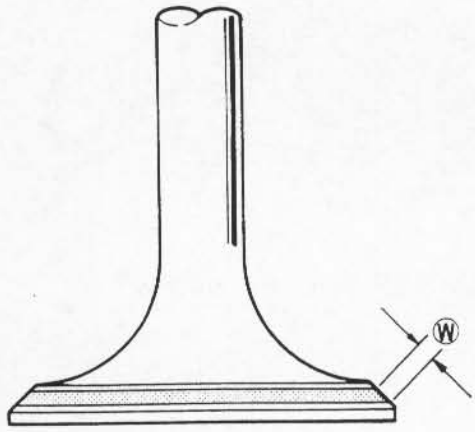


Fig. 3-5-13



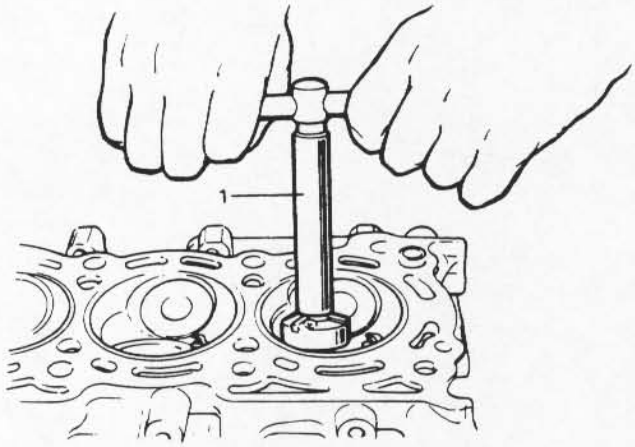
Ⓦ Valve seat contact width

Fig. 3-5-14

- Valve seat repair:
  Valow seat not producing uniform contact with its valve or showing width Ⓦ of seating contact that is off the specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

1) EXHAUST VALVE SEAT: Use a valve seat cutter to make three cuts as illustrated in Fig. 3-5-16. Three cutters must be used: the first for making 15° angle, the second for making 75° angle and the last for making 45° seat angle. The third cut must be made to produce desired seat width Ⓦ.

Seat width Ⓦ for exhaust valve seat	1.3 – 1.5 mm (0.0512 – 0.0590 in.)



1. Valve seat cutter

Fig. 3-5-15 Valve seat cutting

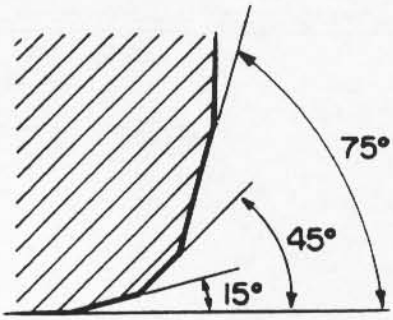


Fig. 3-5-16 Valve seat angles for exhaust valve

2) INLET VALVE SEAT: Cutting sequence is the same as for exhaust valve seats but the second angle is (60°).

Seat width Ⓦ for inlet valve seat	1.3 – 1.5 mm (0.0512 – 0.0590 in.)

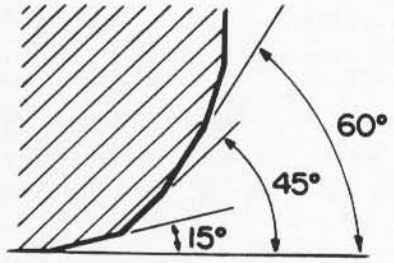


Fig. 3-5-17 Valve seat angles for intake valve

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

Fig. 3-5-18 Applying lapping compound to valve face

NOTE:

- **After lapping, wipe compound off valve face and seat, and produce contact pattern with marking compound. Check to be sure that contact is centered widthwise on valve seat and that there is no break in contact pattern ring.**
- **Be sure to check and, as necessary, adjust valve clearance after re-installing cylinder head and valve mechanism.**

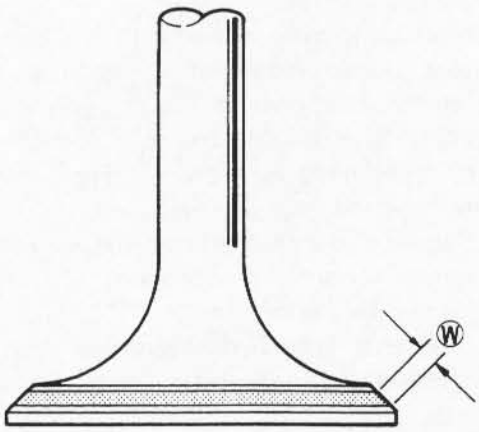


Fig. 3-5-19 Contact pattern Ⓦ uniform in width

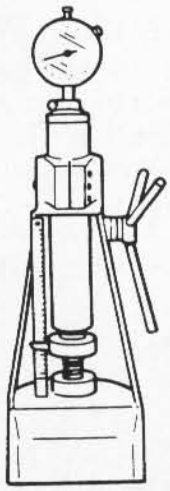


Fig. 3-5-21 Measuring spring preload

Valve Springs

- Referring to the criterion-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 be the cause of chatter, not to mention the possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Item	Standard	Limit
Valve spring free length	49.3 mm (1.9409 in.)	48.1 mm (1.8937 in.)
Valve spring preload	24.8 – 29.2 kg for 41.5 mm (54.7 – 64.3 lb/ 1.63 in.)	22.8 kg for 41.5 mm (50.2 lb/ 1.63 in.)

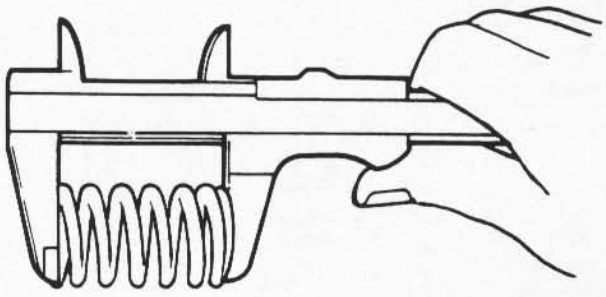


Fig. 3-5-20 Measuring free length of spring

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

Valve springs squareness limit	2.0 mm (0.079 in.)

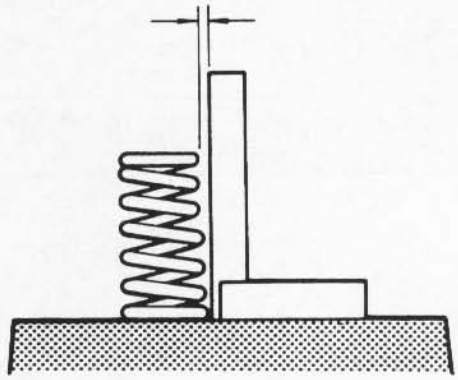


Fig. 3-5-22 Measuring spring squareness

Camshaft

- Runout of camshaft:
  Hold camshaft between two "V" blocks, and measure runout by using a dial gauge.
  If runout exceeds its limit, replace camshaft.

Runout limit	0.10 mm (0.0039 in.)

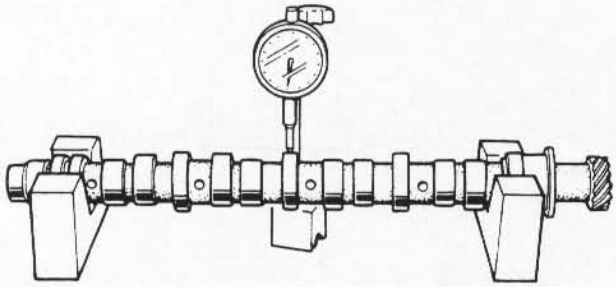


Fig. 3-5-23

- Cam wear:
  Using a micrometer, measure height (H) of cam (lobe). If measured height is less than respective limits, replace camshaft.

Cam height	Standard	Limit
Intake cam	37.500 mm (1.4763 in.)	37.400 mm (1.4724 in.)
Exhaust cam	37.500 mm (1.4763 in.)	37.400 mm (1.4724 in.)
Fuel pump drive cam	40.000 mm (1.5748 in.)	39.600 mm (1.5590 in.)

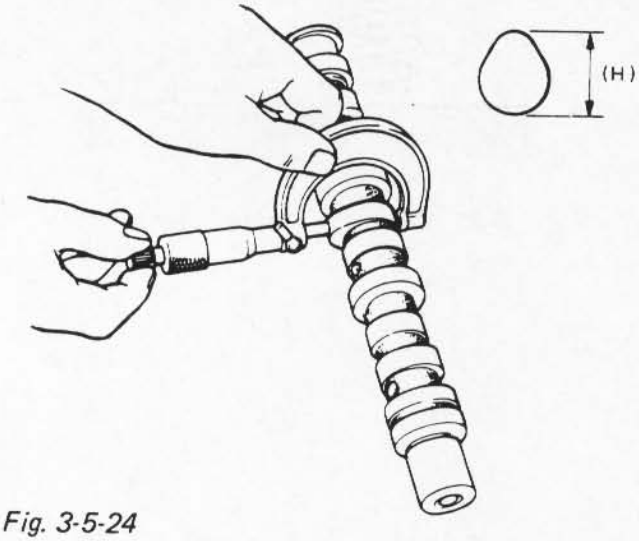


Fig. 3-5-24

- Journal wear:
  Measure journal diameter in two directions at two places (total of 4 readings) on each journal as shown in Fig. 3-5-25, and also by using bore gauge, measure journal bore in cylinder head as shown in Fig. 3-5-26 (i.e. 4 readings on each journal).
  Subtract journal diameter measurement from journal bore measurement to determine journal clearance.
  If journal clearance exceeds its limit, replace camshaft, and as necessary, cylinder head, too.

	Standard	Limit
Journal clearance limit	0.050 – 0.091 mm (0.0020 – 0.0036 in.)	0.15 mm (0.0059 in.)

Camshaft journal dia.	Journal bore dia.
Ⓐ 44.125 – 44.150 mm (1.7372 – 1.7381 in.)	44.200 – 44.216 mm (1.7402 – 1.7407 in.)
Ⓑ 44.325 – 44.350 mm (1.7451 – 1.7460 in.)	44.400 – 44.416 mm (1.7480 – 1.7486 in.)
Ⓒ 44.525 – 44.550 mm (1.7530 – 1.7539 in.)	44.600 – 44.616 mm (1.7560 – 1.7565 in.)
Ⓓ 44.725 – 44.750 mm (1.7609 – 1.7618 in.)	44.800 – 44.816 mm (1.7638 – 1.7644 in.)
Ⓔ 44.925 – 44.950 mm (1.7687 – 1.7697 in.)	45.000 – 45.016 mm (1.7716 – 1.7723 in.)

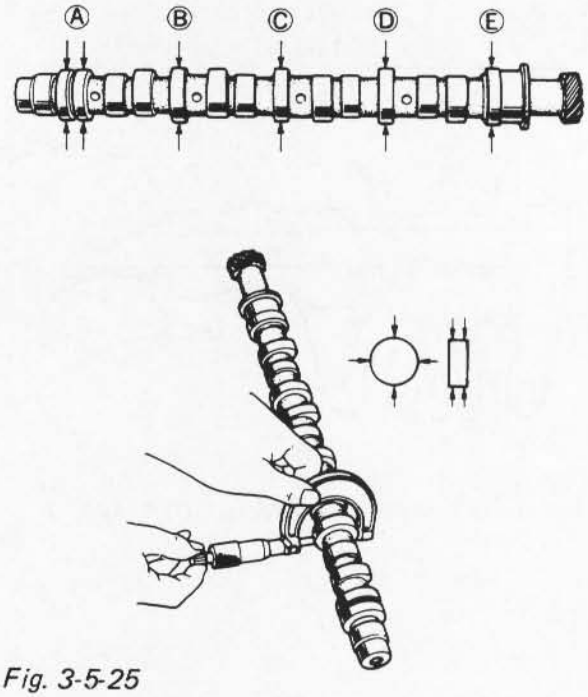


Fig. 3-5-25

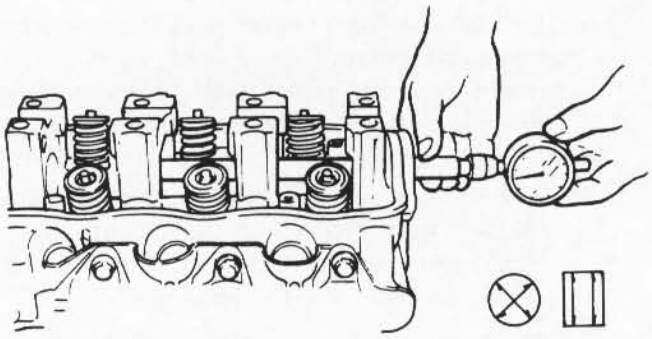


Fig. 3-5-26

Cylinder Block

- Distortion of gasketed surface:
  Using a straightedge and a thickness gauge, check gasketed surface for distortion and, if result exceeds specified limit, correct it.

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

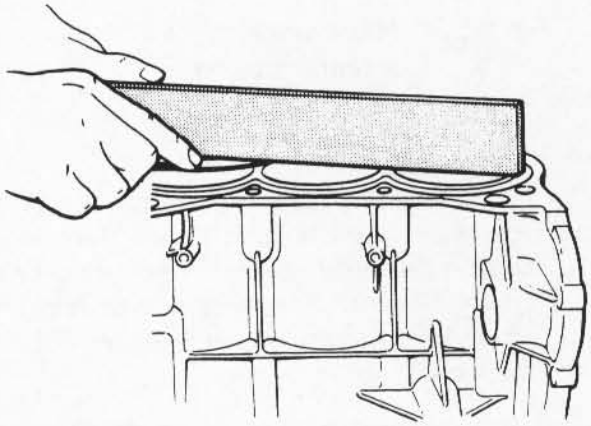


Fig. 3-5-27

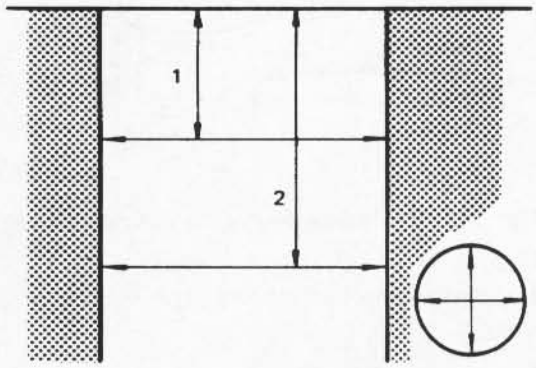
- Cylinder bore:

1) 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.
2) Using a cylinder gauge, measure cylinder bore in thrust and axial directions at two positions as shown in Fig. 3-5-28.
   If any of the following conditions exists, rebore cylinder.

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

Cylinder bore dia. limit	74.15 mm (2.9193 in.)
Taper 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.



1. 50 mm (1.96 in.)
2. 95 mm (3.74 in.)

Fig. 3-5-28 Positions to be measured

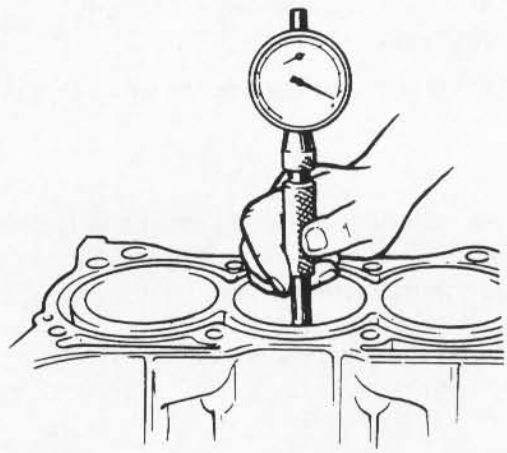


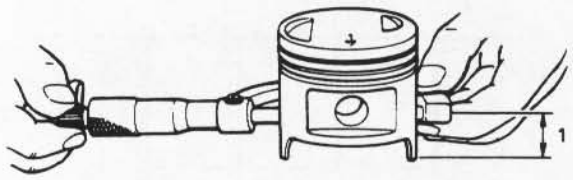
Fig. 3-5-29 Measuring cylinder bore with cylinder gauge

- Honing or reboring cylinders:

1) When any cylinder needs reboring, all other cylinders must also be rebored at 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 (2.9318 – 2.9322 in.)

3) Using micrometer, measure piston diameter.



1. 15 mm (0.59 in.)

Fig. 3-5-30 Measuring 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 horning = 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.

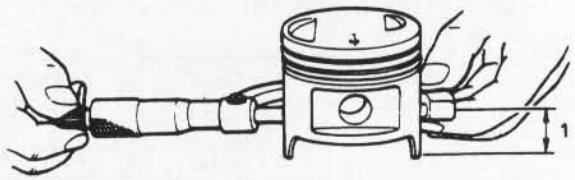
6) Measure piston clearance after honing.

Piston and Piston Rings

Clean carbon from piston head and ring grooves, using a suitable tool.
Inspect piston for faults, cracks or other damage. Damaged or faulty piston should be replaced.

- Piston diameter:
  As indicated in Fig. 3-5-31, piston diameter should be measured at the height of 15 mm (0.59 in) from piston skirt end in the direction perpendicular to piston pin.

Piston diameter	Standard	73.970 – 73.990 mm (2.9122 – 2.9129 in.)
	Oversize: 0.25 mm (0.0098 in.)	74.220 – 74.230 mm (2.9220 – 2.9224 in.)
	0.50 mm (0.0196 in.)	74.47 – 74.48 mm (2.9319 – 2.9322 in.)



1. 15 mm (0.59 in)

Fig. 3-5-31 Measuring piston diameter with micrometer

- Piston clearance:
  To calculate piston clearance, measure cylinder bore diameter and piston diameter. The piston clearance is difference between cylinder bore diameter and piston diameter. Piston clearance should be within specification as follows.

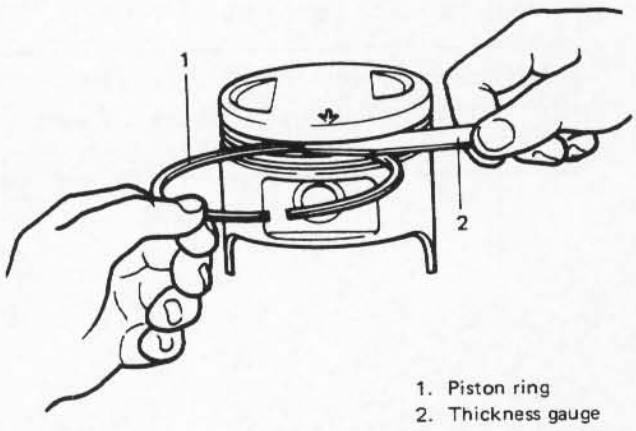
If it is out of specification, rebore cylinder and use oversize piston.

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

NOTE:
Cylinder bore diameters measured in thrust direction at two positions as shown in Fig. 3-5-28 should be used for calculation of piston clearance.

- Ring groove clearance:
  Before checking, piston grooves must be clean, dry and free from carbon.
  Fit new piston ring into piston groove, and measure clearance between ring and ring land by using thickness gauge.
  If the 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.)



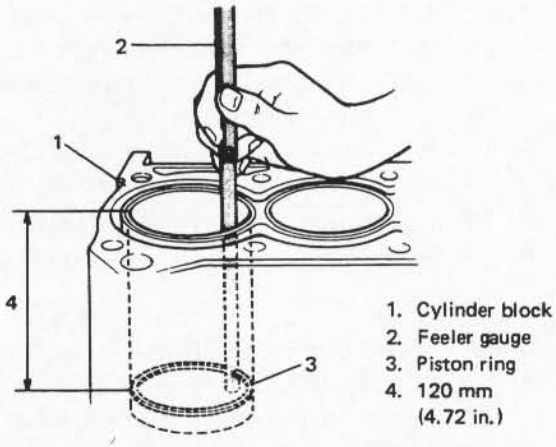
1. Piston ring
2. Thickness gauge

Fig. 3-5-32 Measuring ring groove clearance

- Piston ring end gap:
  To measure end gap, insert piston ring into cylinder bore, locating it at the lowest part of bore and holding it true and square; then use a feeler gauge to measure gap. If the gap exceeds its limit, replace ring.

NOTE:
Decarbon and clean top of cylinder bore, before inserting piston ring.

Item		Standard	Limit
Piston ring end gap	Top ring	0.20 – 0.33 mm (0.0079 – 0.0129 in.)	0.7 mm (0.0275 in.)
	2nd ring	0.20 – 0.35 mm (0.0079 – 0.0137 in.)	0.7 mm (0.0275 in.)
	Oil ring	0.20 – 0.70 mm (0.0079 – 0.0275 in.)	1.8 mm (0.0708 in.)



1. Cylinder block
2. Feeler gauge
3. Piston ring
4. 120 mm (4.72 in.)

Fig. 3-5-33 Measuring piston ring end gap

Piston Pins

- Piston pin must be fitted into piston bore with an easy finger push at normal room temperature.
- Check piston pin and piston bore for wear or damage. If pin or piston bore is badly worn or damaged, replace pin or piston, or both.

Connecting Rods

- 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 clearance measured 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.)

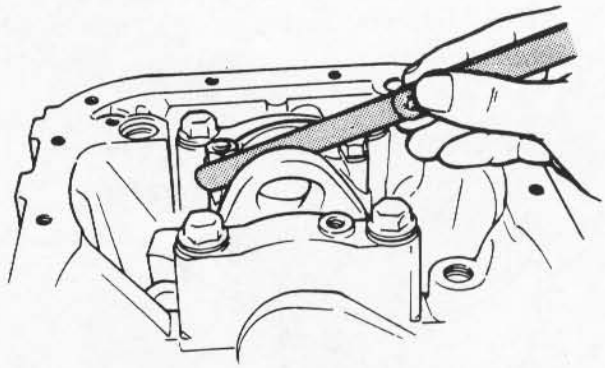


Fig. 3-5-34 Measuring side clearance

- Connecting rod alignment:
  Mount connecting rod on aligner to check it for bow and twist and, if either 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 (1.6529 – 1.6535 in.)
0.25 mm (0.0098 in.) undersize	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 stamped number (US025) on its backside as indicated in Fig. 3-5-35, but standard size one has no such number.

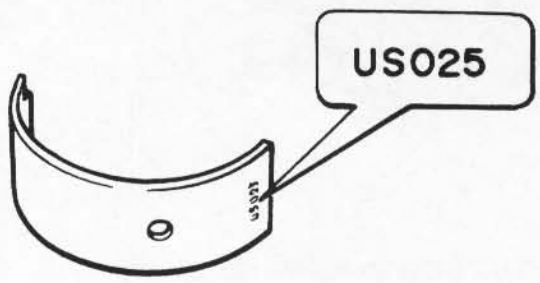
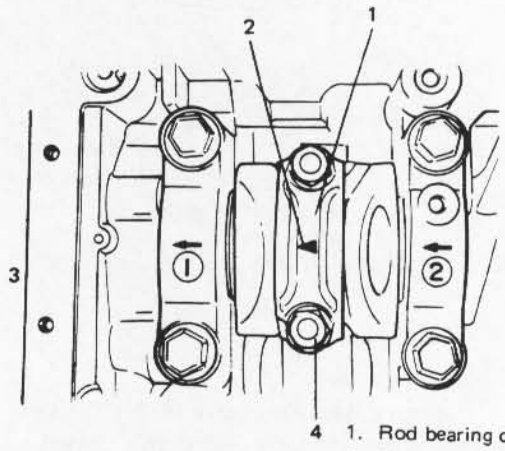


Fig. 3-5-35 0.25 mm undersize bearing

- 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 to full width of the crankpin as contacted by bearing (parallel to the crankshaft), avoiding the oil hole.
4) Install rod bearing cap to connecting rod. When installing cap, be sure to point arrow mark on cap to crankshaft pulley side, as indicated in Fig. 3-5-36. Tighten the cap nuts to the specified torque. DO NOT turn crankshaft with gaging plastic installed.

Tightening torque for rod bearing cap nuts	33 – 37 N·m 3.3 – 3.7 kg-m 24.0 – 26.5 lb-ft

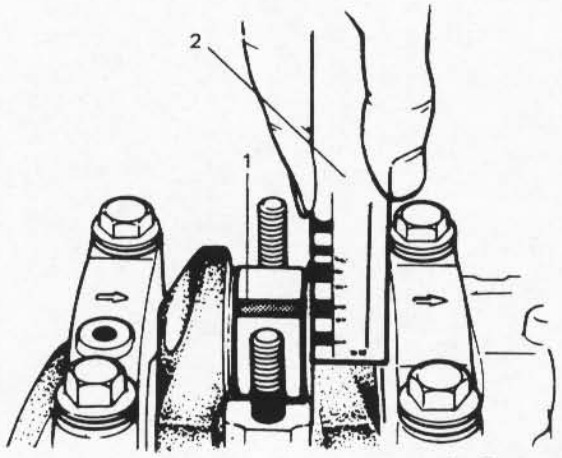


1. Rod bearing cap
2. Arrow mark
3. Crankshaft pulley side
4. Cap nut

Fig. 3-5-36 Installing bearing cap

5) Remove cap and using scale on gaging plastic envelope, measure gaging plastic width at the widest point.
If the clearance exceeds its limit, use a new standard size bearing and remeasure clearance.

	Standard	Limit
Bearing clearance	0.030 – 0.050 mm (0.0012 – 0.0019 in.)	0.080 mm (0.0031 in.)



1. Gaging plastic
2. Scale

Fig. 3-5-37 Measuring rod bearing clearance

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

Crankshaft

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

Limit on runout	0.06 mm (0.0023 in.)

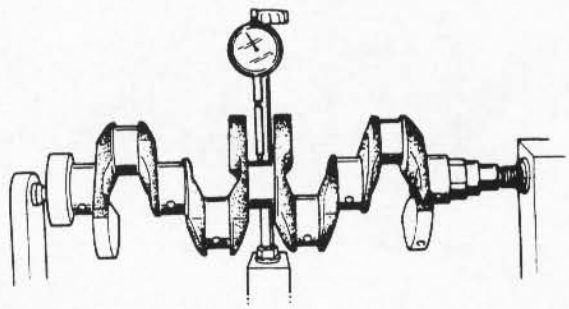


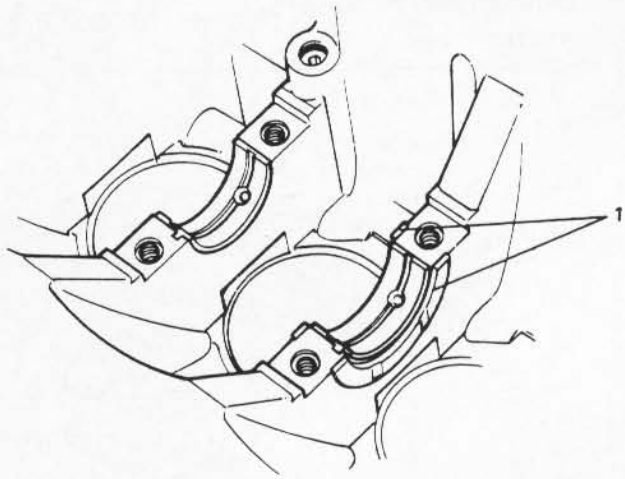
Fig. 3-5-38 Measuring runout

- Crankshaft thrust play:
  Measure this play with crankshaft set in cylinder block in the normal manner, that is, with thrust bearing fitted and journal bearing caps installed. Tighten bearing cap bolts to specified torque.
  Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.
  If the limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

Tightening torque for main bearing cap bolts	50 – 57 N·m 5.0 – 5.7 kg-m 36.5 – 41.0 lb-ft

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	2.50 mm (0.0984 in.)
	Oversize 0.125 mm (0.0049 in.)	2.563 mm (0.1009 in.)



1. Thrust bearing

Fig. 3-5-39 Thrust bearings

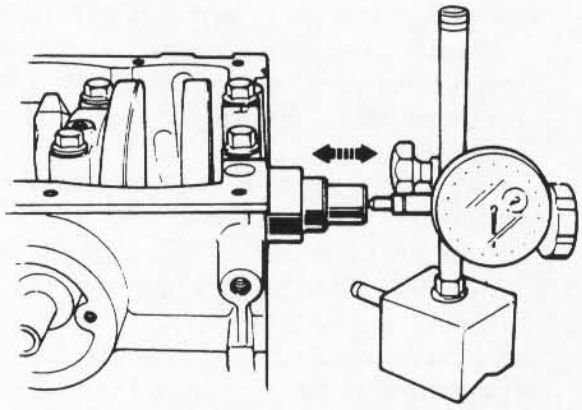


Fig. 3-5-40 Measuring thrust play of crankshaft

- Out-of-round and taper (uneven wear):
  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 to be determined from micrometer readings.
  If any of journals is badly damaged or if the amount of uneven wear in the sense explained above exceeds its limit, regrind or replace the crankshaft.

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

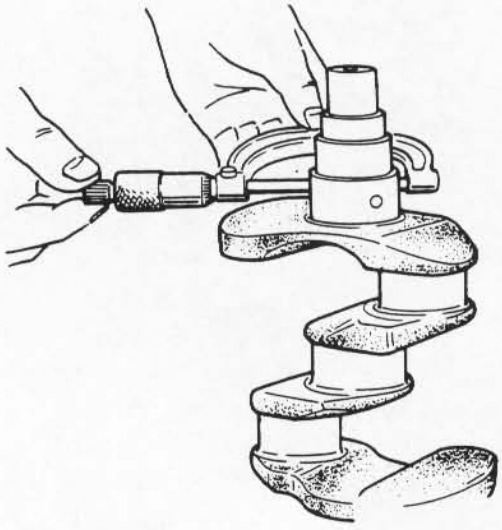
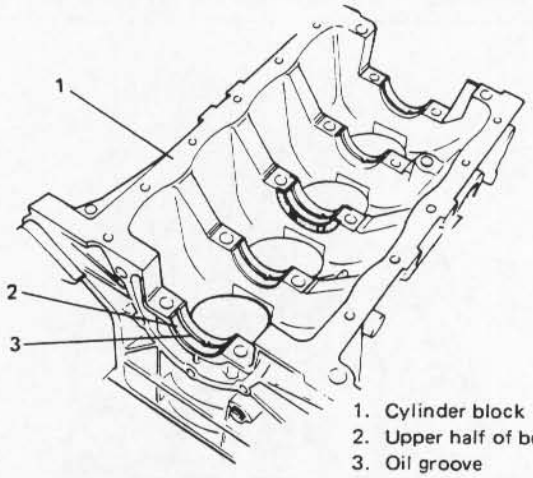


Fig. 3-5-41 Checking uneven wear

Crankshaft Main (Journal) Bearings

General informations:

- 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.
- The upper half of bearing has oil groove as indicated in Fig. 3-5-42. Install this half with oil groove to cylinder block.

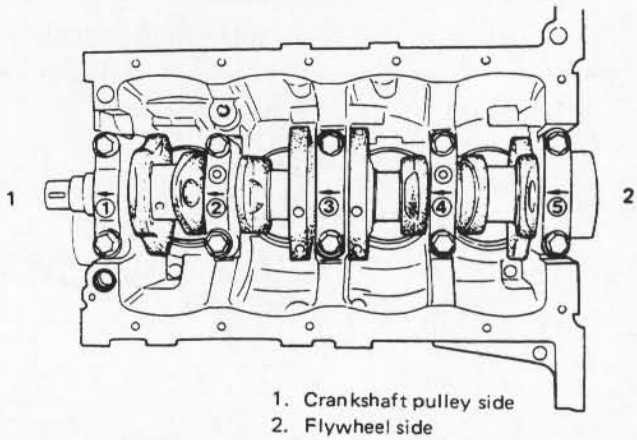


1. Cylinder block
2. Upper half of bearing
3. Oil groove

Fig. 3-5-42 Upper half of bearing installation

- On each main bearing cap, arrow mark and number are embossed as indicated in Fig. 3-5-43.
  When installing each bearing cap to cylinder block, point arrow mark toward crankshaft pulley side and install each cap from crankshaft pulley side to flywheel side in ascending order of numbers ①, ②, ③, ④ and ⑤. Tighten cap bolts to specified torque.

Tightening torque for main bearing cap bolt	50 – 57 N·m 5.0 – 5.7 kg-m 36.5 – 41.0 lb-ft



1. Crankshaft pulley side
2. Flywheel side

Fig. 3-5-43 Bearing caps installation

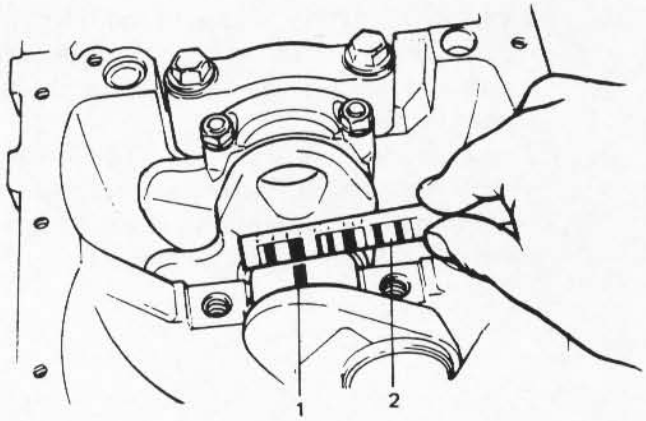
Inspect:
Check bearings for pitting, scratches, wear or damage. If any malcondition is found, replace both upper and lower halves. Never replace one half without replacing the other half.

Main bearing clearance:
Check clearance by using gaging plastic according to following procedure.
1) Remove bearing caps.
2) Clean bearings and main journals.
3) Place a piece of gaging plastic to full width of the bearing (parallel to the 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.

NOTE:
Do not rotate crankshaft while gaging plastic is installed.

5) Remove cap, and using scale on gaging plastic envelop, 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.)



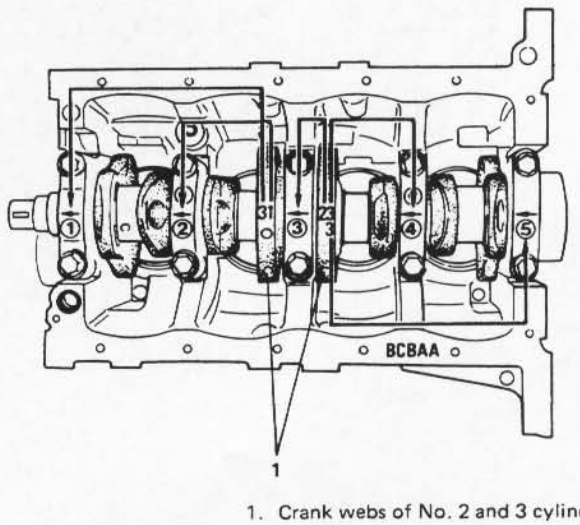
1. Gaging plastic
2. Scale

Fig. 3-5-44 Measuring main bearing clearance

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.
1) First check journal diameter as follows.
   As shown in Fig. 3-5-45, crank webs of No. 2 and No. 3 cylinders have five stamped numerals.
   Three kinds of numerals (1, 2 and 3) represent following journal diameters respectively.

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 (1.7710 – 1.7712 in.)

The first, second, third, fourth and fifth (left to right) stamped numerals indicate the journal diameters at bearing caps "1", "2", "3" "4" and "5" respectively.
For example, in Fig. 3-5-45, the first (leftmost) numeral "3" indicates that journal dia. at bearing cap ① is within 44.982 – 44.988 mm, and second one "1" indicates that journal dia. at cap ② is within 44.994 – 45.000 mm.



1. Crank webs of No. 2 and 3 cylinder

Fig. 3-5-45 Stamped numerals on crank webs of No. 2 and No. 3 cylinders

2) Next, check bearing cap bore diameter without bearing.
On mating surface of cylinder block, five alphabets are stamped as shown in Fig. 3-5-46.
Three kinds of alphabets ("A", "B" and "C") represent following cap bore diameters.

Alphabet stamped	Bearing cap bore diameter (without bearing)
A	49.000 – 49.006 mm) (1.9292 – 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 indicate the cap bore diameter of bearing caps "1", "2", "3", "4" and "5" respectively.
For example, in Fig. 3-5-46, the first (leftmost) alphabet "B" indicates that the cap bore dia. of bearing cap ① is within 49.006 – 49.012 mm, and the fifth (rightmost) alphabet "A" indicates that the cap bore dia. of cap ⑤ is within 49.000 – 49.006 mm.

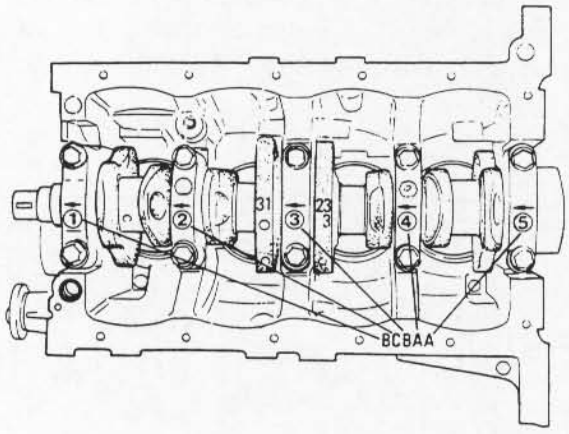
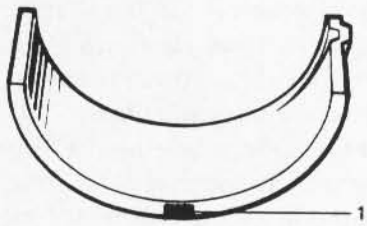


Fig. 3-5-46 Stamped alphabets on cylinder block

3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in following colors at the position indicated in Fig. 3-5-47.
Each color indicates the following thicknesses at 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.)



1. Paint

Fig. 3-5-47 Paint on standard bearing

4) From the numeral stamped on crank webs 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 the journal, by referring to the table shown below.
For example, if numeral stamped on crank web is "1" and alphabet stamped on mating surface is "B", install new standard bearing painted in "Black" to its journal.

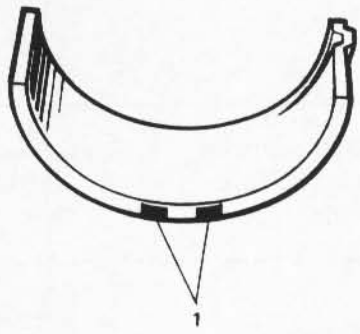
		Numerals stamped on crank webs (Journals diameter)		
		1	2	3
Alphabets stamped on mating surface	A	Green	Black	Colorless
	B	Black	Colorless	Yellow
	C	Colorless	Yellow	Blue
	New standard bearing to be installed.			

5) Using gaging plastic, check bearing clearance with new standard bearing selected.
   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 the numerals stamped on new crankshaft or the alphabets stamped on the mating surface of new cylinder block.

UNDERSIZE BEARING (0.25 mm):

- 0.25 mm undersize bearing is available in 5 kinds differing in thickness.
  To distinguish them, each bearing is painted in following colors at position indicated in Fig. 3-5-48.
  Each color indicates following thickness at 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.)



1. Paint

Fig. 3-5-48 Paints on undersize bearing

- If crankshaft journal is necessary to be reground to undersize, regrind the journal and select undersize bearing to be used as follows.

1) Regrind journal to following finished diameter.

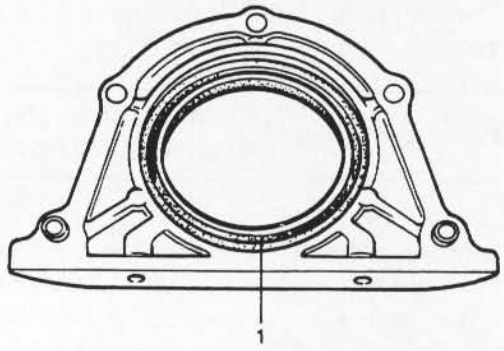
Finished diameter	44.732 – 44.750 mm (1.7612 – 1.7618 in.)

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

		Measured journal diameter		
		44.744 – 44.750 mm (1.7616 – 1.7618 in.)	44.738 – 44.744 mm (1.7614 – 1.7616 in.)	44.732 – 44.738 mm (1.7612 – 1.7614 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 for wear or damage. If its lip is worn or damaged, replace oil seal.



1. Rear oil seal

Fig. 3-5-49 Rear oil seal

Flywheel

- If ring gear is damaged, cracked or worn, replace flywheel.
- If surface contacting clutch disc is damaged, or excessibly worn, replace flywheel.
- Check flywheel for face runout with a dial gauge.
  If runout is out of limit, replace flywheel.

Limit on runout	0.2 mm (0.0078 in.)

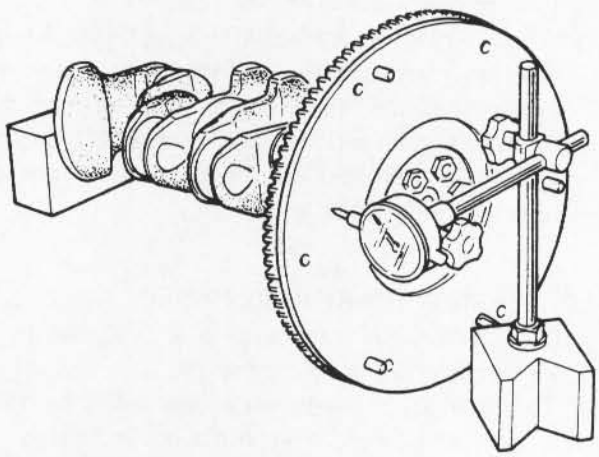


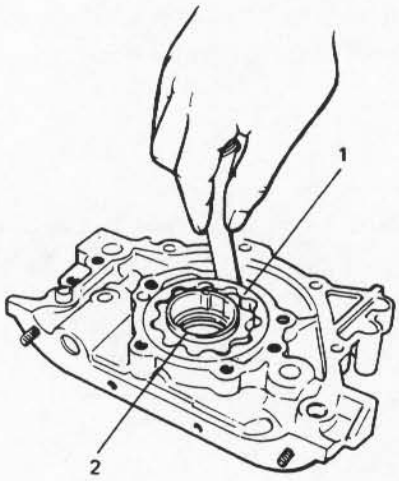
Fig. 3-5-50 Measuring runout

Oil Pump

1) Inspect oil seal lip for fault or other damage. Replace as necessary.
2) Inspect outer and inner rotors, rotor plate, and oil pump case for excessive wear or damage.

- Radial clearance:
  Check radial clearance between outer rotor and case, using thickness gauge.
  If clearance exceeds its limit, replace outer rotor or case.

Radial clearance between:	Limit on radial clearance
Outer rotor and case	0.310 mm (0.0122 in.)



1. Outer rotor
2. Inner rotor

Fig. 3-5-51 Radial clearances

- Side clearance:
  Using straight edge and thickness gauge, measure side clearance.

Limit on side clearance	0.15 mm (0.0059 in.)

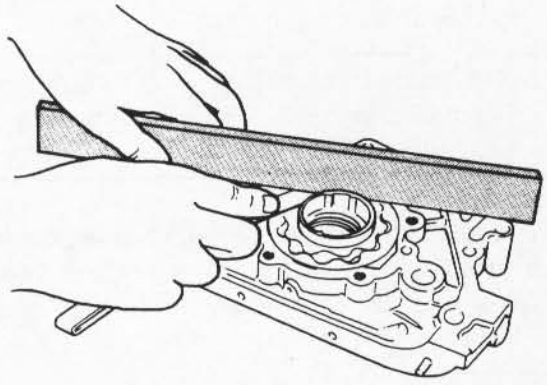


Fig. 3-5-52 Side clearance measurement

Timing Belt and Tensioner

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

3-6. ENGINE REASSEMBLY

NOTE:

- **All parts to be used in reassembly must be perfectly clean.**
- **Oil sliding and rubbing surfaces of engine parts just before using them in reassembly. Use engine oil (Refer to page 1-7).**
- **Have liquid packing ready for use. SUZUKI BOND NO. 1215 is specified for it. Use it wherever its use is specified in order to ensure leak-free (oil and water) workmanship of reassembly.**
- **There are many running clearances. During the course of engine reassembly, be sure to check these clearances, one after another, as they form.**
- **Gaskets, "O" rings and similar sealing members must be in perfect condition. For these members, use replacement parts in stock.**
- **Tightening torque is specified for important fasteners – mainly bolts and nuts –of the engine and other components. Use torque wrenches and constantly refer to the specified values given on p. 3-58.**
- **Do not disregard match marks provided on parts. Some of them are those given at the time of disassembly.**
- **There are many sets of parts. Crankshaft bearings, connecting rods, pistons, etc., are in combination sets. Do not disturb such combinations and make sure that each part goes back to where it came from.**

Engine reassembly is the reverse of engine disassembly as far as sequence is concerned, but there are many reassembling steps that involve measures necessary for restoring engine as close to factory-assembled condition as possible. Only those steps will be dealt with here.

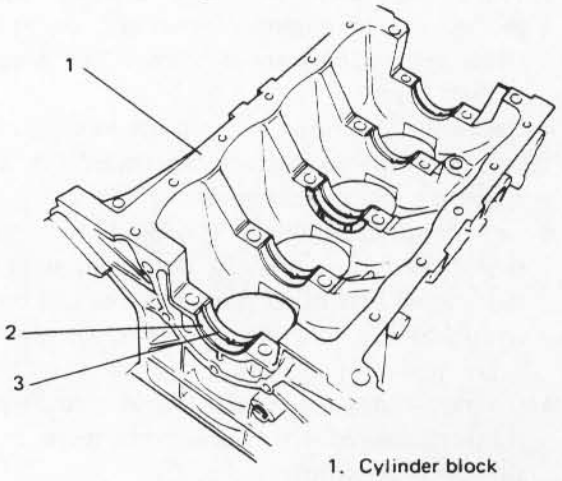
Crankshaft

1) Install main bearings to cylinder block.

NOTE:

If main bearing replacement is necessary, select such bearing as to allow proper clearance as described on p. 3-30 and install it in place.

Between two halves of main bearing, one side has oil groove. Install this half with oil groove to cylinder block, and another half without oil groove to bearing cap.
Make sure that two halves are painted with same color.



1. Cylinder block
2. Upper half of bearing
3. Oil groove

Fig. 3-6-1 Installing bearing half with oil groove

2) Be sure to oil crankshaft journal bearings as shown.

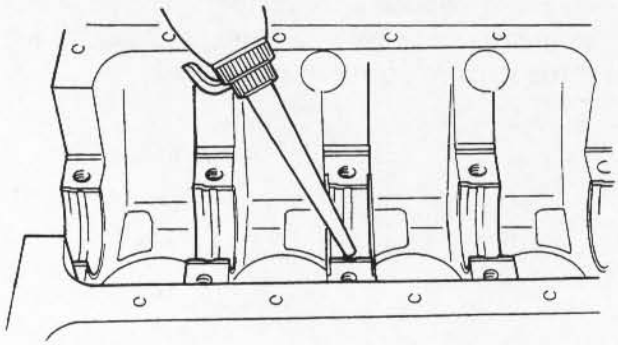
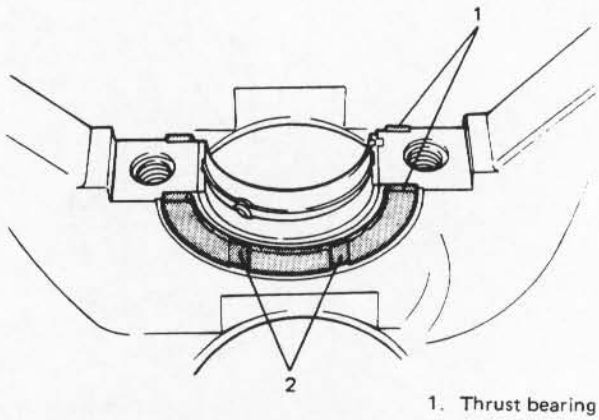


Fig. 3-6-2

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



1. Thrust bearing
2. Oil groove

Fig. 3-6-3 Installing thrust bearing

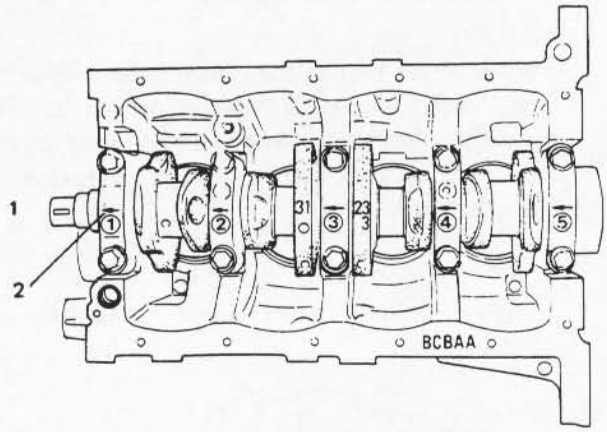
4) Install crankshaft to cylinder block.
5) Oil crankshaft journals.
6) When fitting bearing caps to journals after setting crankshaft in place, be sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side.

Tightening torque for main bearing cap bolts	50 – 57 N·m 5.0 – 5.7 kg-m 36.5 – 41.0 lb-ft

Gradual and uniform tightening is important for bearing cap bolts. Make sure that five caps become tight equally and uniformly specified torque.

NOTE:

After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turned by hand.



1. Crankshaft pulley side
2. Arrow mark

Fig. 3-6-4 Installing main bearing caps

Oil Seal Housing

Install oil seal housing and its gasket.

Install new gasket. Do not reuse gasket removed in disassembly. Apply oil to oil seal lip before installing. Tighten housing bolts to specification.

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

Tightening torque for housing bolts	10 – 13 N·m 1.0 – 1.3 kg-m 7.5 – 9.0 lb-ft

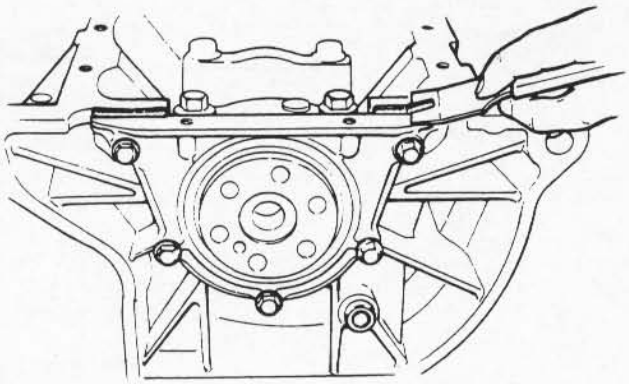


Fig. 3-6-5 Cutting off edges of gasket

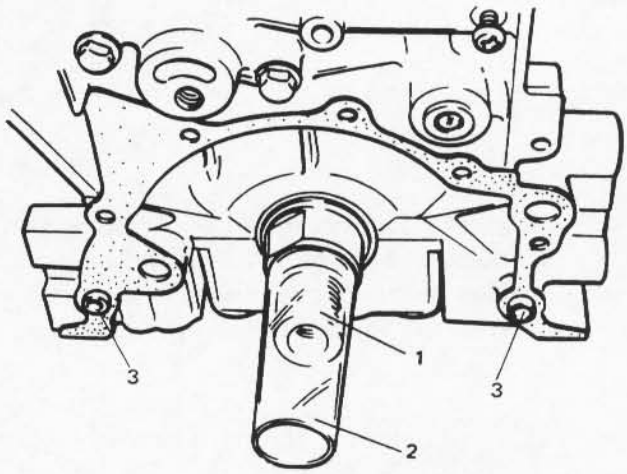
Oil Pump

NOTE:

Reassemble components of oil pump assembly according to following procedure, if disassembled.

a) Wash, clean and then dry all disassembled parts.
b) Apply thin coat of engine oil to inner and outer rotors, oil seal lip portion, and inside surfaces of oil pump case and plate.
c) Install outer and inner rotors to pump case.
d) Install gear plate. Tighten 5 screws securely.
e) After installing plate, check to be sure that gears turn smoothly by hand.

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

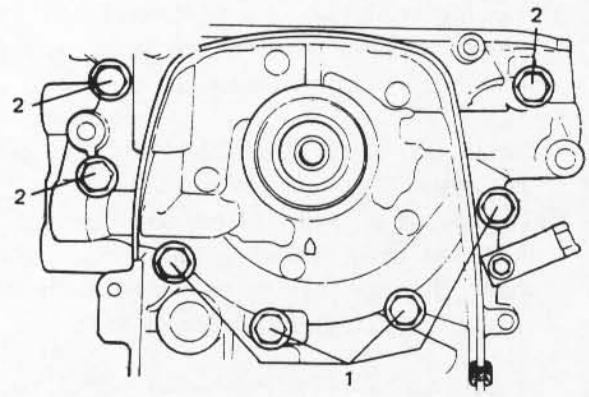


1. Crankshaft
2. Oil seal guide (Vinyl resin) (Special tool 09926-18210)
3. Oil pump pin

Fig. 3-6-6 Special tool (Oil seal guide) installation

3) Install oil pump to crankshaft and cylinder block. Install No. 1 and No. 2 bolts as shown in Fig. 3-6-7, and tighten them to specified torque.
After installing oil pump, check to be sure that oil seal lip is not upturned, and then remove special tool.

Tightening torque for No. 1 and No. 2 bolts	9 – 12 N·m 0.9 – 1.2 kg-m 7.0 – 8.5 lb-ft



1. No. 1 bolts (short)
2. No. 2 bolts (long)

Fig. 3-6-7

4) Edge of oil pump gasket might bulge out: if it does, cut bulge off with a sharp knife, making edge smooth and flush with end faces of the pump case and cylinder block.

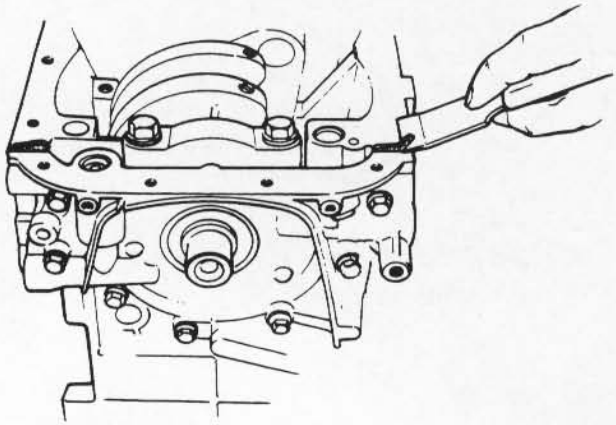


Fig. 3-6-8 Cutting the edge of gasket

Piston, Connecting Rod and Piston Rings

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.

a) Each piston has a stamped number 1 or 2 as shown depending on its outer diameter.

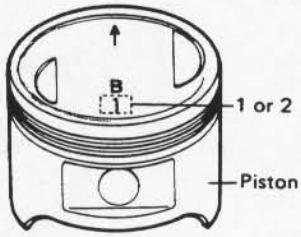


Fig. 3-6-9

b) There are also stamped numbers of 1 and 2 on cylinder block as shown below. First number indicates inner diameter of No. 1 cylinder, second number of No. 2 cylinder, third number of No. 3 cylinder and fourth number of No. 4 cylinder.

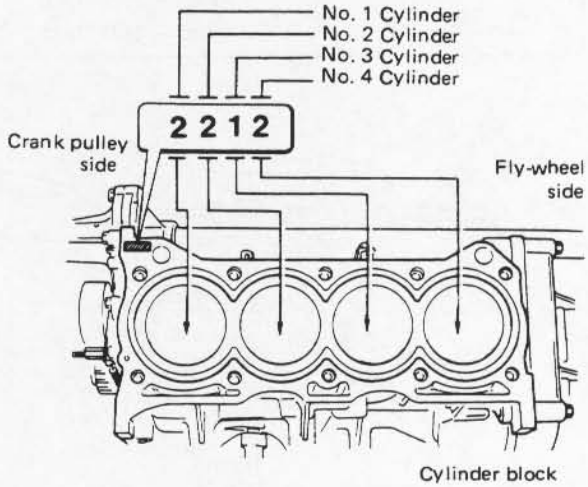


Fig. 3-6-10

c) Use a number 2 stamped piston for installation if cylinder is identified with number 2 and a number 1 piston for cylinder with number 1.

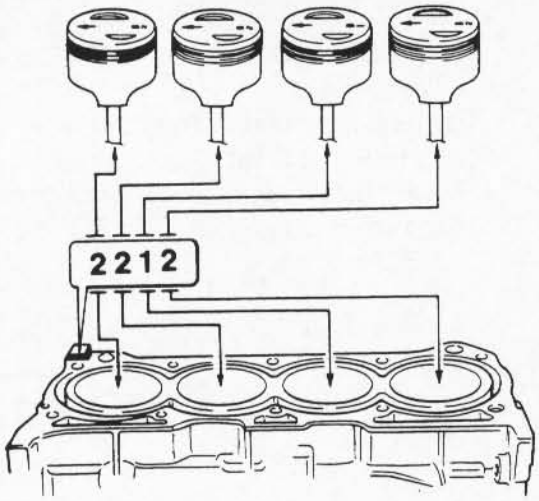


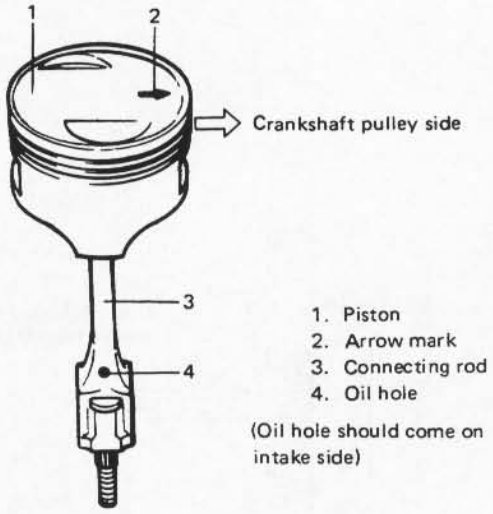
Fig. 3-6-11

Piston		Cylinder		Piston-to-cylinder clearance
Number at the top (mark)	Outside diameter	Number (mark)	Bore diameter	
1	73.98 - 73.99mm (2.9126 - 2.9130in.)	1	74.01 - 74.02mm (2.9138 - 2.9142in.)	0.02 - 0.04mm (0.0008 - 0.0015in.)
2	73.97 - 73.98mm (2.9122 - 2.9126in.)	2	74.00 - 74.01 mm (2.9134 - 2.9138in.)	0.02 - 0.04mm (0.0008 - 0.0015in.)

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

1) Install connecting rod to piston.

① After applying engine oil to piston pin holes in piston and connecting rod, fit connecting rod to piston as prescribed in Fig. 3-6-12.

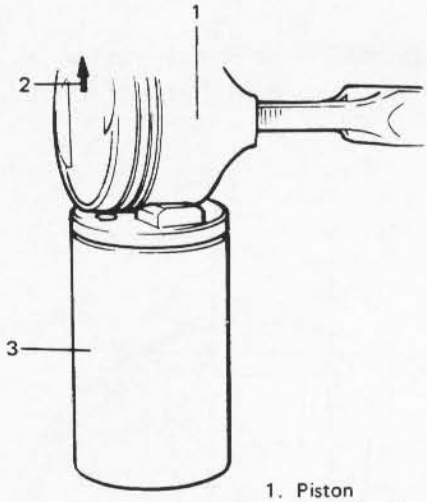


1. Piston
2. Arrow mark
3. Connecting rod
4. Oil hole

(Oil hole should come on intake side)

Fig. 3-6-12 Fitting connecting rod to piston

② Place piston on piston pin remover and installer (special tool) as indicated in Fig. 3-6-13, and press piston pin into piston and connecting rod (Fig. 3-6-14).



1. Piston
2. Arrow mark
3. Piston pin remover and installer (Special tool 09910-38210)

Fig. 3-6-13 Fitting piston to special tool

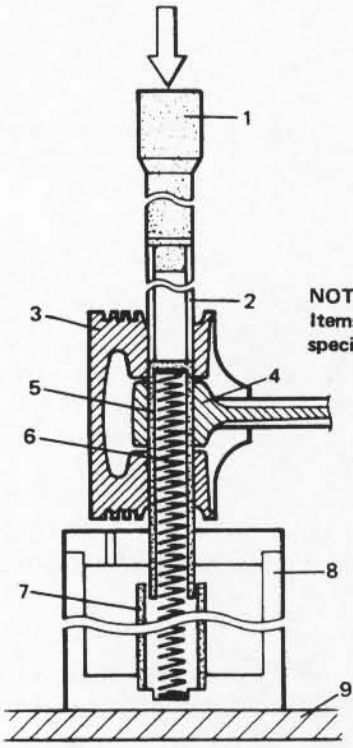


Fig. 3-6-14 Installing piston pin

③ Press piston pin until line marked on driver handle is flush with flat surface of piston (Fig. 3-6-15).

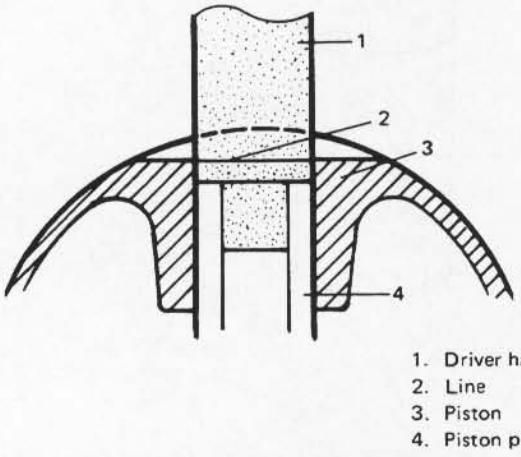


Fig. 3-6-15 Line marked on driver handle

2) Install piston rings to piston.

- As indicated in Fig. 3-6-16, 1st and 2nd rings have "R" or "T" mark. Installing these piston rings to piston with marked side of each ring faced foward top of piston.
- 1st ring differs from 2nd ring in thickness, shape and color of the surface contacting cylinder wall.
  Distinguish 1st ring from 2nd ring by referring to Fig. 3-6-16.
- When installing oil ring, install spacer first and then two rails.

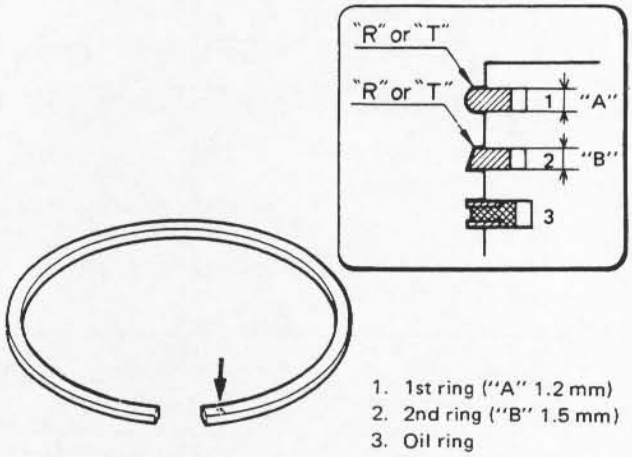


Fig. 3-6-16 Piston rings installation

- After installing 3 rings (1st, 2nd and oil rings), distribute their end gaps as shown in Fig. 3-6-17.

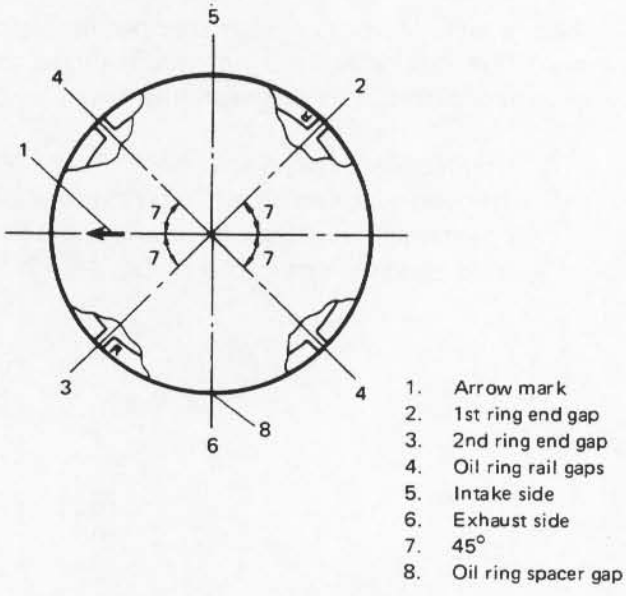
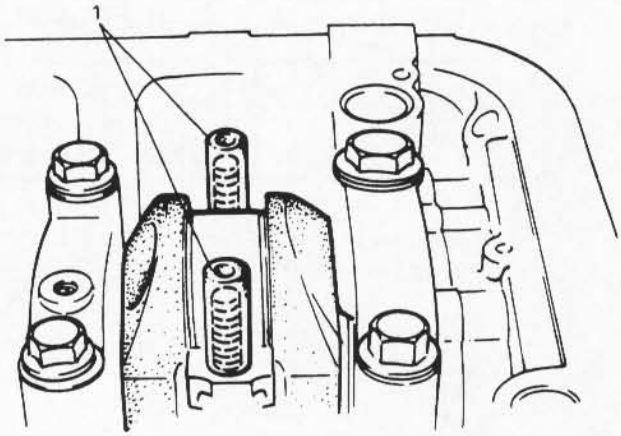


Fig. 3-6-17 Piston ring end gaps positions

3) Install piston and connecting rod assembly into cylinder bore.

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

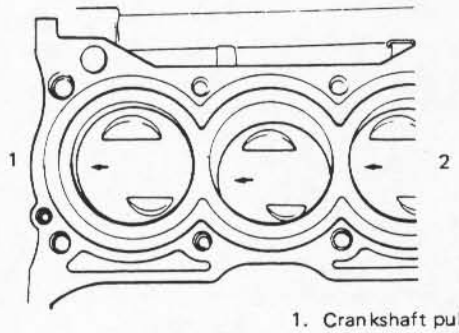
② Put guide hoses over connecting rod bolts as shown in Fig. 3-6-18. These guide hoses protect crankpin and thread of rod bolt from damage during installation of connecting rod and piston assembly.



1. Guide hoses

Fig. 3-6-18 Guide hoses installation

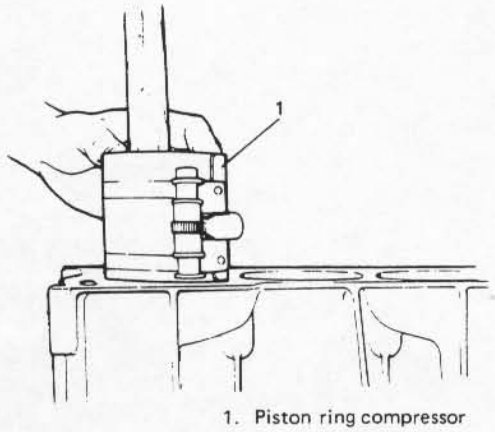
③ When installing piston and connecting rod assembly into cylinder bore, point arrow mark on each piston head to crankshaft pulley side.



1. Crankshaft pulley side
2. Flywheel side

Fig. 3-6-19 Direction of arrow mark on piston head

④ Use piston ring compressor (Special tool) to compress rings. Guide connecting rod into place on the 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.

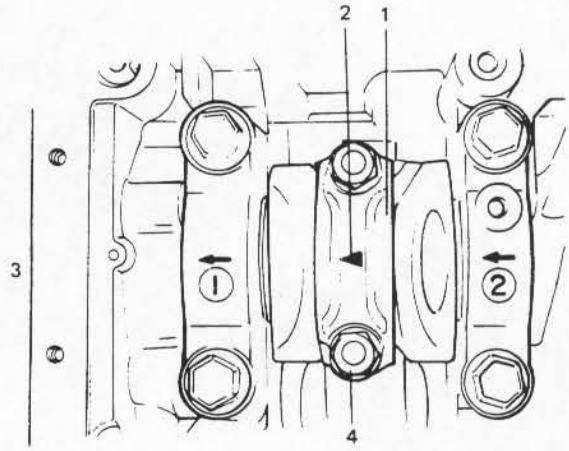


1. Piston ring compressor (Special tool 09916-77310)

Fig. 3-6-20 Installing piston to cylinder

4) Install connecting rod bearing cap.
When installing cap to rod, point arrow mark on cap to crankshaft pulley side.
Tighten cap nuts to specification.

Tightening torque for rod bearing cap nuts	33 – 37 N·m 3.3 – 3.7 kg-m 24.0 – 26.5 lb-ft



1. Bearing cap
2. Arrow mark
3. Crankshaft pulley side
4. Cap nut

Fig. 3-6-21 Installing bearing cap

Oil Pump Strainer

Install seal in the position shown in Fig. 3-6-22. Tighten strainer bolt first and bracket bolt to specified torque.

Tightening torque for bolts	9 – 12 N·m 0.9 – 1.2 kg-m 6.5 – 8.5 lb-ft

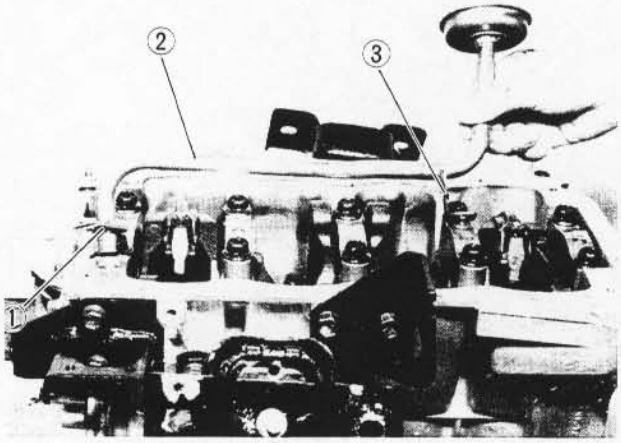
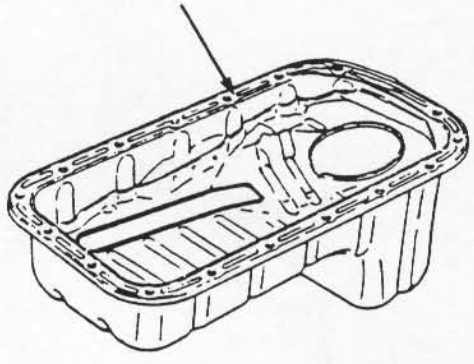


Fig. 3-6-22 Installing seal

1. Seal
2. Strainer
3. Bracket

Oil Pan

1) Clean mating surfaces of oil pan and cylinder block. Remove oil, old sealant, and dusts from mating surfaces.
   After cleaning, apply silicon type sealant to oil pan mating surface continuously as shown in Fig. 3-6-23.



Sealant (99000-31150)

Fig. 3-6-23 Applying sealant to oil pan

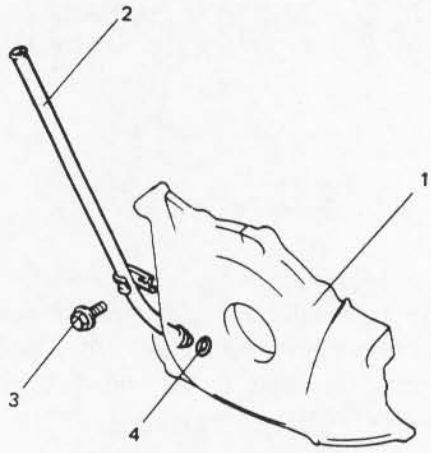
2) Install oil pan to cylinder block.
   After fitting oil pan to block, run in securing bolts and start tightening at the center: move wrench outward, tightening one bolt at a time.
   Tighten bolts to specified torque.

Tightening torque for oil pan bolts	9 – 12 N·m 0.9 – 1.2 kg-m 7.0 – 8.5 lb-ft

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

Tightening torque for drain plug	30 – 40 N·m 3.0 – 4.0 kg-m 22.0 – 28.5 lb-ft

4) Install guide seal to pump case and then oil level gauge guide.



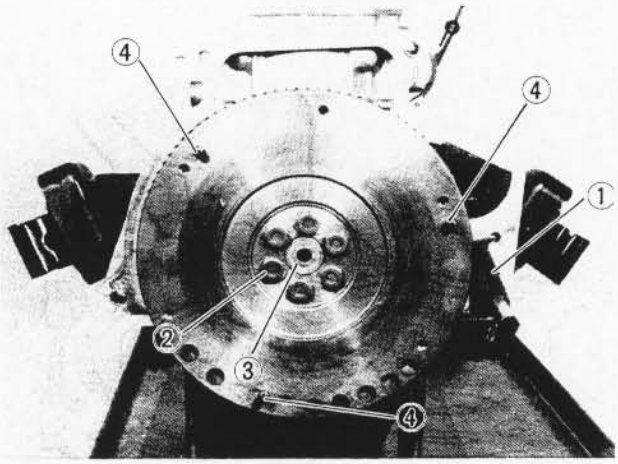
1. Oil pump
2. Oil level gauge guide
3. Guide bolt
4. Guide seal

Fig. 3-6-24 Oil level gauge guide

Flywheel

Install flywheel to crankshaft.
Using special tool, lock flywheel, and tighten flywheel bolts to specification.

Tightening torque for flywheel bolts	57 – 65 N·m 5.7 – 6.5 kg-m 41.5 – 47 lb-ft



1. Flywheel holder (Special tool 09924-17810)
2. Flywheel bolts
3. Input shaft end bearing
4. Locating pin

Fig. 3-6-25

Cylinder Head

NOTE:

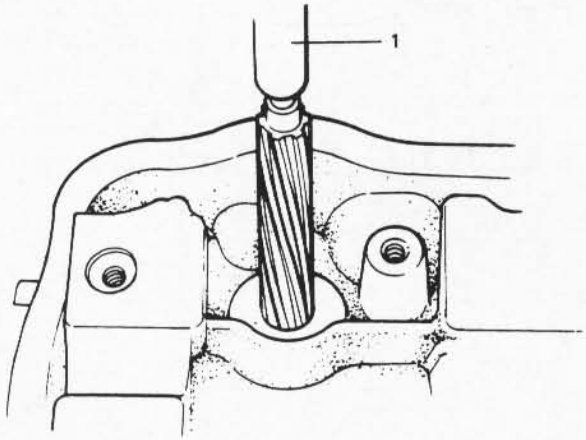
- **Do not reuse valve guide once disassembled. Install new valve guide (Oversize).**
- **Intake and exhaust valve guides are identical.**

Valve guide oversize	0.03 mm (0.0012 in.)
Valve guide protrusion (In and Ex)	14 mm (0.55 in.)

1) Install new valve guide into cylinder head.

a) Before installing new valve guide into cylinder head, ream guide hole with 12 mm reamer (Special tool) to remove burrs, making sure that guide hole diameter after reaming comes within specified range.

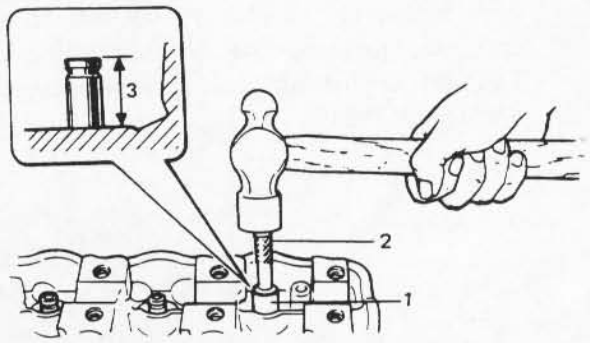
Valve guide hole Dia. (In & Ex)	12.030 – 12.048 mm (0.4736 – 0.4743 in.)



1. 12 mm reamer (Special tool 09916-37310)

Fig. 3-6-26 Reaming guide hole

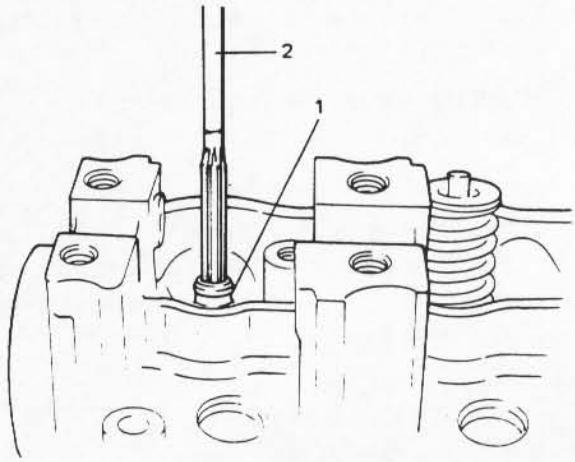
b) Install valve guide to cylinder head.
Heat cylinder head uniformly at a temperature of 80 to 100°C (176 to 212°F), using care not to distort head, and drive new valve guide into hole with special tools. Refer to Fig. 3-6-27.
Drive in new valve guide until valve guide installer (Special tool) contacts cylinder head. After installation, make sure that valve guide protrudes by 14 mm from cylinder head (Fig. 3-6-27).



1. Valve guide installer attachment (Special tool 09917-88210)
2. Valve guide installer handle (Special tool 09916-57321)
3. Valve guide protrusion (14 mm)

Fig. 3-6-27 Valve guide installation

c) Ream valve guide bore with 7 mm reamer (Special tool).
After reaming, clean bore.



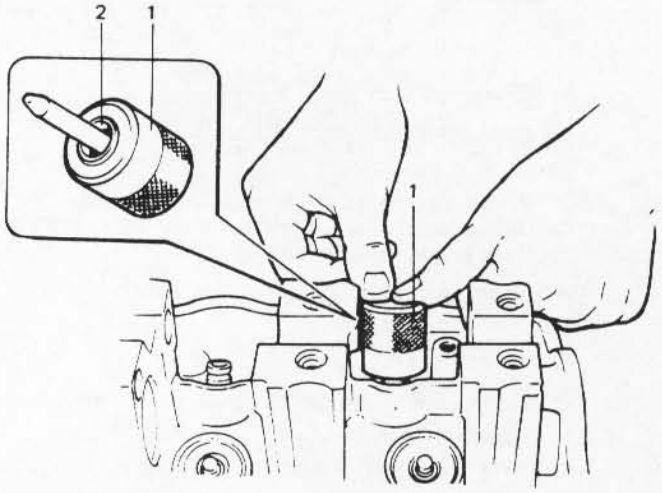
1. Valve guide
2. 7 mm reamer (Special tool 09916-34520)

Fig. 3-6-28 Reaming valve guide bore

2) Install valve spring seat to cylinder head.
3) Install new valve stem seal to valve guide.
After applying engine oil to seal and spindle of valve stem seal installer (special tool), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.
After installation, check to be sure that seal is properly fixed to valve guide.

NOTE:

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



1. Valve stem seal installer (Special tool 09917-98210)
2. Valve stem seal

Fig. 3-6-29 Valve stem seal installation

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

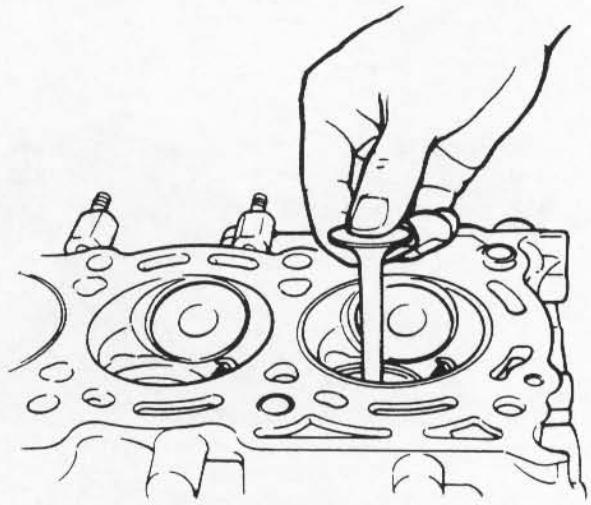
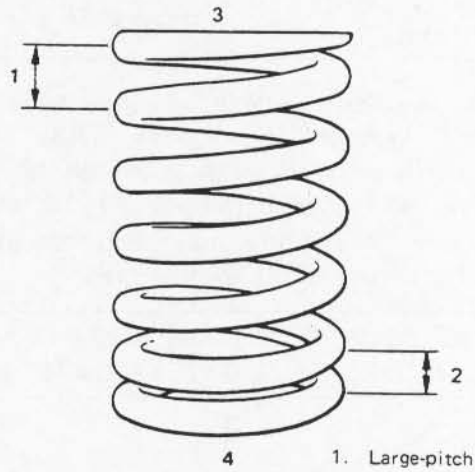


Fig. 3-6-30 Valve installation

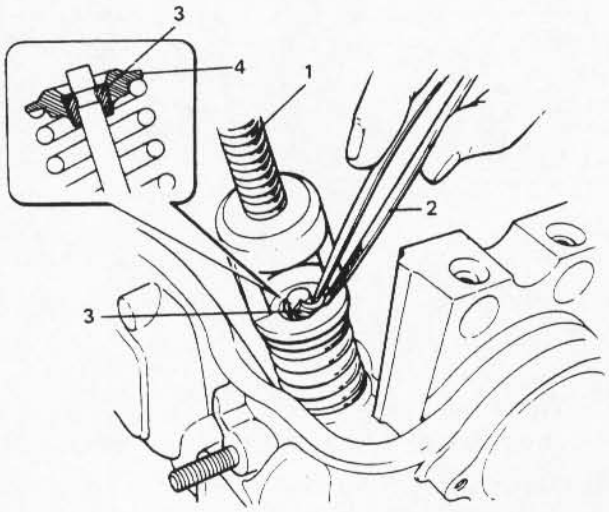
5) Install valve spring and spring retainer. Each valve spring has top end (large-pitch end) and bottom end (small-pitch end). Be sure to position spring in place with its bottom end (small-pitch end) down to valve spring seat side.



1. Large-pitch
2. Small-pitch
3. Valve spring retainer side
4. Valve spring seat side

Fig. 3-6-31 Valve spring installation

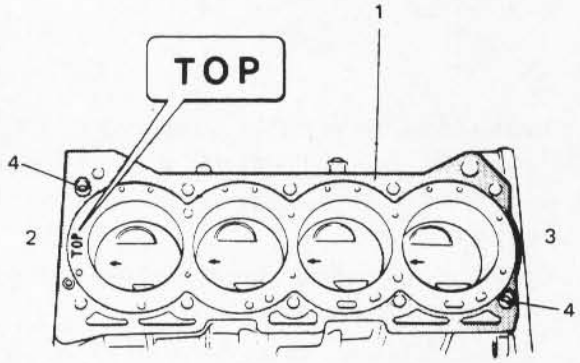
6) Using special tool (Valve lifter), compress valve spring and fit two valve cotters to groove provided in valve stem.



1. Valve lifter (Special tool)
2. Forceps (Special tool)
3. Valve cotters
4. Valve spring retainer

Fig. 3-6-32 Valve cotters installation

7) Be sure that locating pins ④ are in place and then install new head gasket as shown in Fig. 3-6-33, namely in such a way that "TOP" mark provided on the gasket comes on top side (toward cylinder head side) and on crankshaft pulley side.



1. Cylinder head gasket
2. Crankshaft pulley side
3. Flywheel side
4. Locating pin

Fig. 3-6-33 Cylinder head gasket installation

8) Install cylinder head onto cylinder block. Tighten cylinder head bolts gradually with a torque wrench, following sequence in Fig. 3-6-34. Finally tighten bolts to specified torque.

Tightening torque for cylinder head bolts	63 – 70 N·m 6.3 – 7.0 kg-m 46.0 – 50.5 lb-ft

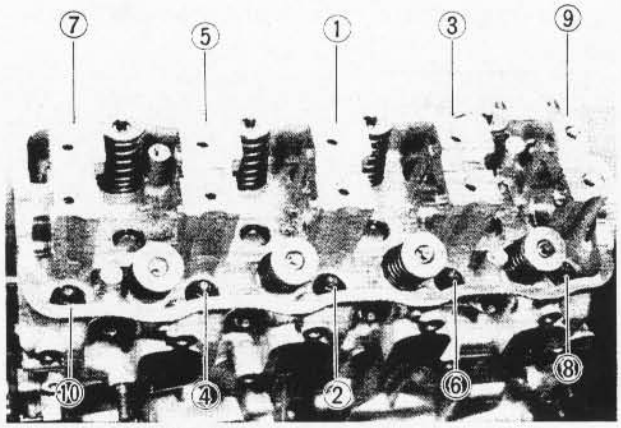


Fig. 3-6-34 Tightening sequence of cylinder head bolts

Camshaft

1) Apply engine oil to cams and journals on camshaft, and oil seal on cylinder head.
2) Install to cylinder head from transmission case side.

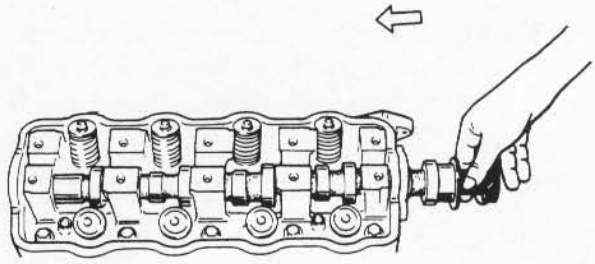
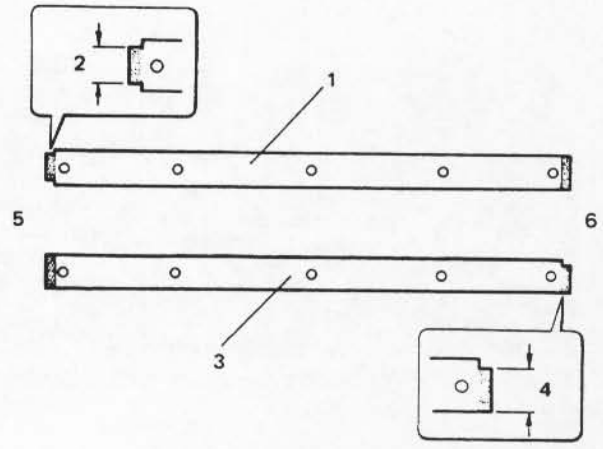


Fig. 3-6-35 Camshaft installation

Rocker-Arm Shafts

1) Apply engine oil to rocker arms and rocker arm shafts.
2) Install rocker arms, springs and rocker arm shafts.
   The two rocker arm shafts are not identical. To distinguish between the two, dimensions of their stepped ends differ as shown in Fig. 3-6-36. Install intake rocker arm shaft, facing its stepped end to camshaft pulley side, and exhaust rocker arm shaft, facing its stepped end to distributor side (rear side).



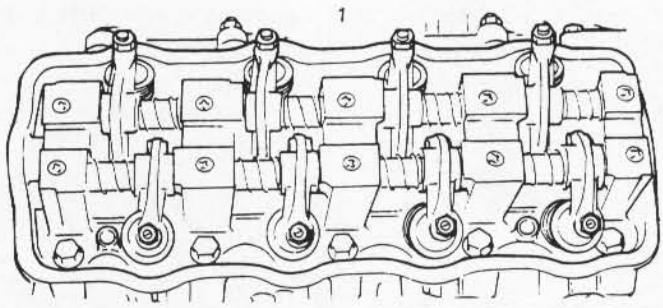
1. Intake rocker arm shaft
2. 14 mm (0.55 in)
3. Exhaust rocker arm shaft
4. 15 mm (0.59 in)
5. Camshaft pulley side
6. Distributor side

Fig. 3-6-36 Rocker arm shafts installation

3) After installing rocker arms, springs, and rocker arm shafts as shown in Fig. 3-6-37, tighten rocker arm shaft screws to specified torque.

Tightening torque for rocker arm shaft screws	9 – 12 N·m 0.9 – 1.2 kg-m 7.0 – 8.5 lb-ft

NOTE:
Valve clearance is adjusted after all parts are assembled. So it is not adjusted at this point. Leave rocker arm adjusting screw as loose as can be.



1. Intake side
2. Exhaust side

Fig. 3-6-37

Water Inlet Pipe

Install water inlet pipe to cylinder block.

Make sure to fit seal ring ①(O-ring) to inlet pipe before installation.

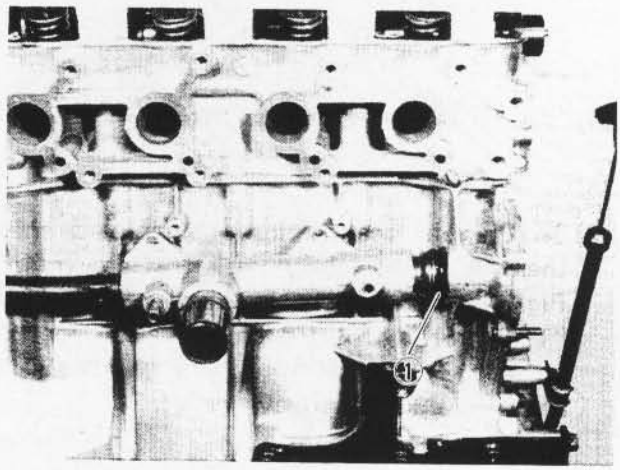


Fig. 3-6-38

Intake Manifold and Carburetor

1) Install intake manifold gasket to cylinder head. Use new gasket.

NOTE:
Clean cylinder head mating surface with gasket before installation.

2) Install intake manifold with carburetor to cylinder head.
3) Tighten manifold bolts and nuts to specified torque.

Tightening torque for manifold bolts and nuts	N·m	kg-m	lb-ft
	18 – 28	1.8 – 2.8	13.5–20.0

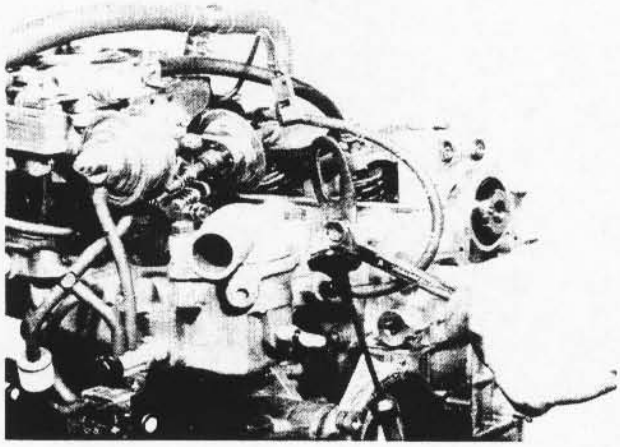


Fig. 3-6-39

4) Connect water hoses to water inlet pipe and clamp each hose.

Oil Filter

Install oil filter.

> **CAUTION:**
> **For oil filter installation, refer to P. 1-6 of this manual.**

Exhaust Manifold and Cover

1) Install exhaust manifold gasket to cylinder head.
   Use new gasket.

NOTE:

Clean cylinder head mating surface with gasket before installation.

2) Install exhaust manifold to cylinder head.
3) Tighten bolts and nuts to specified torque.

Tightening torque for bolts and nuts	N·m	kg-m	lb-ft
	18 – 28	1.8 – 2.8	13.5 – 20.0

4) Install exhaust manifold cover.

Water pump

1) Install water pump gasket to cylinder block.
   Use new gasket.

NOTE:

Clean cylinder block mating surface with gasket before installation.

2) Install water pump to cylinder block.
3) Tighten bolts and nuts to specified torque.

Tightening torque for water pump bolts and nuts	N·m	kg-m	lb-ft
	9 – 12	0.9 – 1.2	7.0 – 8.5

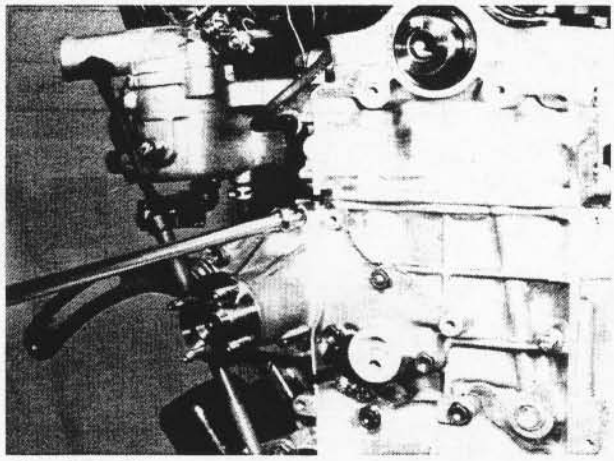


Fig. 3-6-40

4) Install rubber seats ① one between oil pump and water pump and the other between water pump and cylinder head.

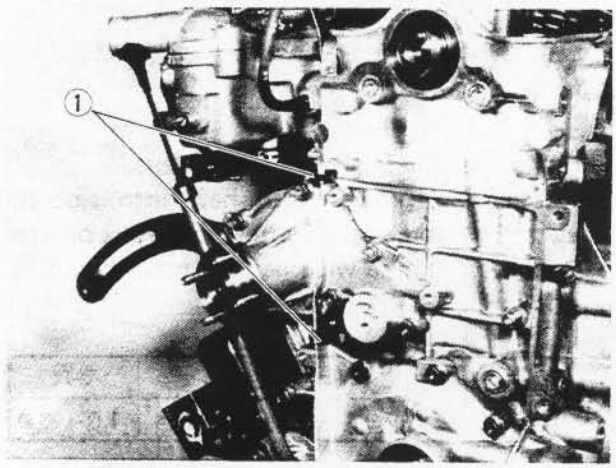
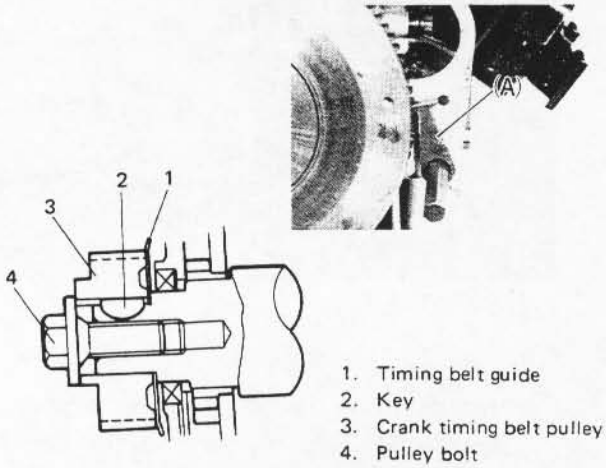


Fig. 3-6-41

Timing Belt Inside Cover, Belt Pulleys, Tensioner, Timing Belt and Outside Cover

1) Install timing belt inside cover to cylinder head.
2) Install crankshaft timing belt guide, key and pulley.
   Refer to Fig. 3-6-42 for proper installation of these parts.
   Install timing belt guide in such a way that its concave side faces oil pump.
   Tighten crankshaft timing belt pulley bolt to specified torque by using flywheel holder A (Special tool).

Tightening torque for timing belt pulley bolt	N·m	kg-m	lb-ft
	65 – 75	6.5 – 7.5	47.5–54.0



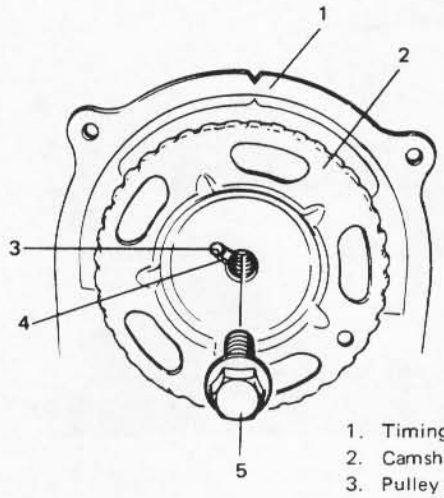
1. Timing belt guide
2. Key
3. Crank timing belt pulley
4. Pulley bolt

(A) Flywheel holder (09924-17810)

Fig. 3-6-42 Installing guide, key and pulley

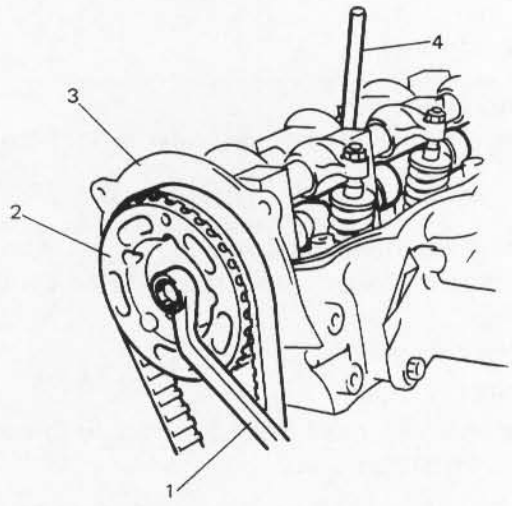
3) Install camshaft timing belt pulley.
   Fit pulley pin on camshaft into slot in camshaft pulley. Tighten pulley bolt to specified torque with general rod applied as shown in Fig. 3-6-44.

Tightening torque for pulley bolt	N·m	kg-m	lb-ft
	56 – 64	5.6 – 6.4	41.0–46.0



1. Timing belt inside cover
2. Camshaft pulley
3. Pulley pin
4. Slot
5. Pulley bolt

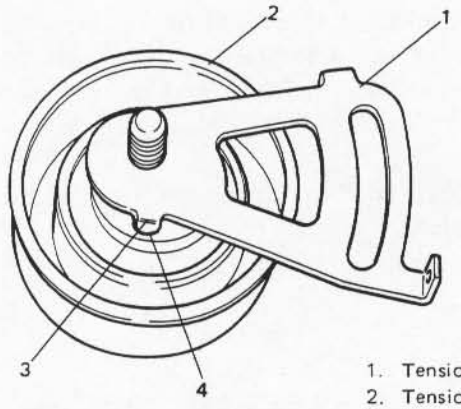
Fig. 3-6-43 Pulley pin, slot and pulley bolt



1. Wrench
2. Camshaft timing belt pulley
3. Timing belt inside cover
4. General rod

Fig. 3-6-44

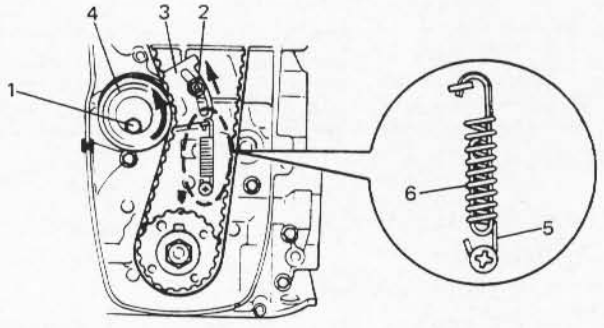
4) Install timing belt tensioner plate to tensioner.
Insert lug of tensioner plate into hole of tensioner.



1. Tensioner plate
2. Tensioner
3. Lug
4. Hole

Fig. 3-6-45 Lug and hole

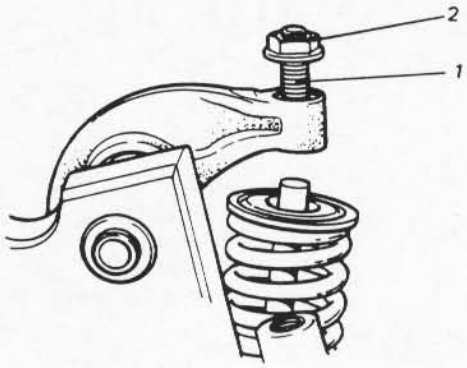
5) Install timing belt tensioner, tensioner plate and spring.
Do not tighten tensioner bolt and stud with wrench yet.
Hand tighten only at this time.
Be sure that plate movement in arrow direction as shown in Fig. 3-6-46 causes the same directional movement of tensioner. If no associated movement between plate and tensioner occurs, remove tensioner and plate again and reinsert plate lug into tensioner hole.



1. Tensioner bolt
2. Tensioner stud
3. Tensioner plate
4. Tensioner
5. Spring
6. Spring dumper

Fig. 3-6-46 Tensioner installation

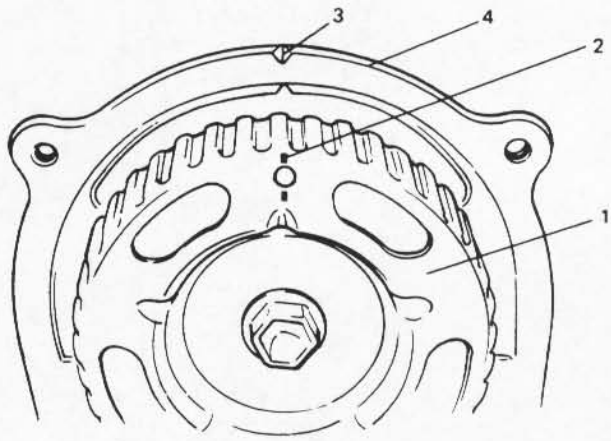
6) Before installing timing belt to camshaft pulley and crankshaft timing belt pulley, loosen all valve adjusting screws of intake and exhaust rocker arms fully, or check to ensure they are loose.
This is to permit free rotation of camshaft for the following reason; when installing timing belt to both pulleys, belt should be correctly tensed by tensioner spring force. If camshaft does not rotate freely, belt will not be correctly tensed by tensioner.



1. Valve adjusting screw
2. Lock nut

Fig. 3-6-47 Valve adjusting screw and lock nut

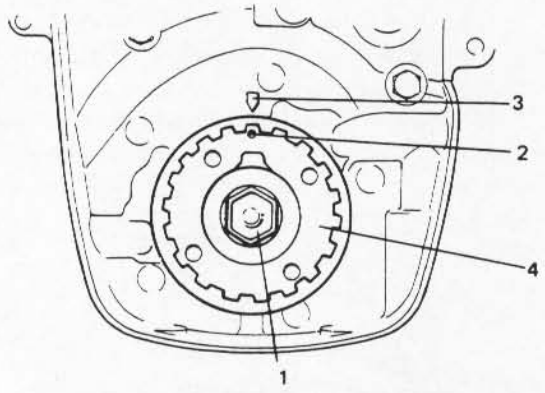
7) After loosening all valve adjusting screws all the way, turn camshaft pulley clockwise and align timing mark on camshaft pulley with "V" mark on belt inside cover as shown in Fig. 3-6-48.



1. Camshaft timing pulley
2. Timing mark
3. "V" mark
4. Belt inside cover

Fig. 3-6-48 Timing marks

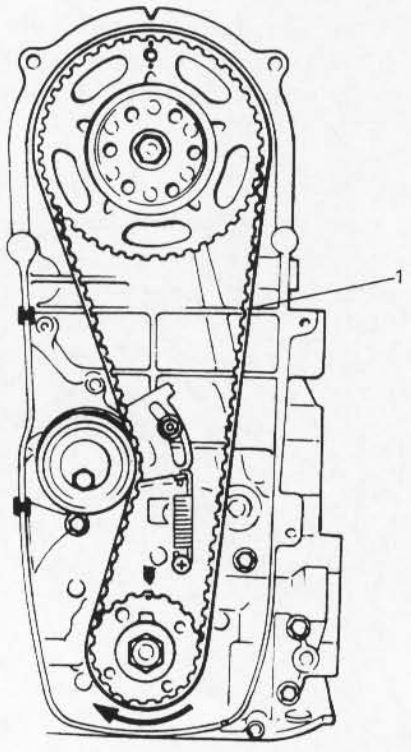
8) Turn crankshaft clockwise, fitting 17 mm wrench to crankshaft timing belt pulley bolt, and align punch mark on timing belt pulley with arrow mark on oil pump as shown in Fig. 3-6-49.



1. Crankshaft timing belt pulley bolt
2. Punch mark
3. Arrow mark
4. Crankshaft timing belt pulley

Fig. 3-6-49 Timing marks

9) With 4 marks aligned, install timing belt on two pulleys in such a way that drive side of belt is free from any slack, and with tensioner plate pushed up by finger.



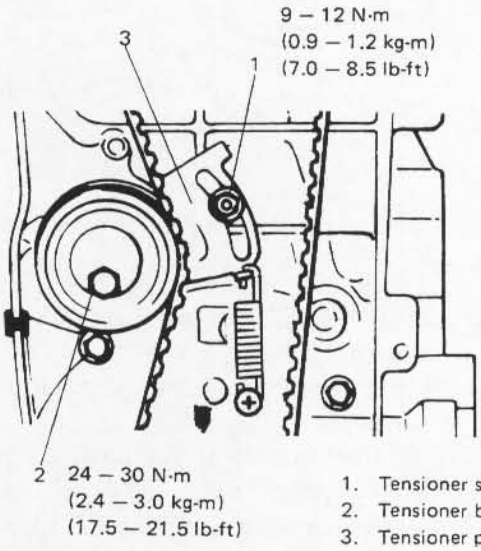
Direction of crankshaft

1. Drive side of belt

Fig. 3-6-50 Installing timing belt

NOTE:
When installing timing belt, match arrow mark (⇨) on timing belt with rotating direction of crankshaft.

10) To allow belt to be free of any slack, turn crankshaft clockwise fully twice after installing belt. After removing belt slack, tighten tensioner stud first and then tensioner bolt to 24 – 30 N·m (2.4 – 3.0 kg-m, 17,5 – 21.5 lb-ft).
Then confirm again that 4 marks are matched.



1. Tensioner stud
2. Tensioner bolt
3. Tensioner plate

Fig. 3-6-51 Tensioner bolt and nut

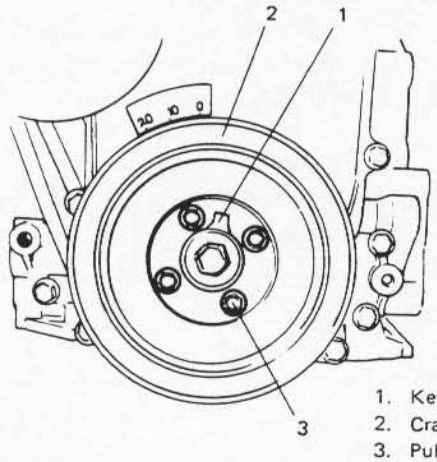
11) Install timing belt outside cover.

Tightening torque for outside cover bolts and nuts	N·m	kg-m	lb-ft
	9 – 12	0.9 – 1.2	7.0 – 8.5

Crankshaft Pulley, Water Pump Pulley and Alternator

1) Install crankshaft pulley.
Fit keyway on pulley to key of crankshaft timing belt pulley, and tighten 4 bolts to specification, with flywheel holder (special tool 09924-17810) hitched to flywheel so that crankshaft will not turn.

Tightening torque for pulley bolts	N·m	kg-m	lb-ft
	10 – 13	1.0 – 1.3	7.5 – 9.0



1. Key
2. Crankshaft pulley
3. Pulley bolt

Fig. 3-6-52 Installing crankshaft pulley

2) Install alternator assembly.
   Tighten alternator ass'y securing bolts (3pcs) only to the extent to allow alternator to be moved by hand. Don't torque them tight.

NOTE:
Adjust water pump belt tension to specification upon completion of installing engine ass'y to body and then cooling fan and water pump pulley. Make sure to refer to p. 1-4 of this manual for adjusting procedure.

Distributor Case

1) Install distributor case O-ring to cylinder head.
2) Install distributor case.
3) Tighten bolts to specified torque.

Tightening torque for case bolts	N·m	kg-m	lb-ft
	8 – 12	0.8 – 1.2	6.0 – 8.5

CAUTION:
After tightening case bolts, fill distributor case with about 30cc (1.02/1.06 US/Imp oz) engine oil.

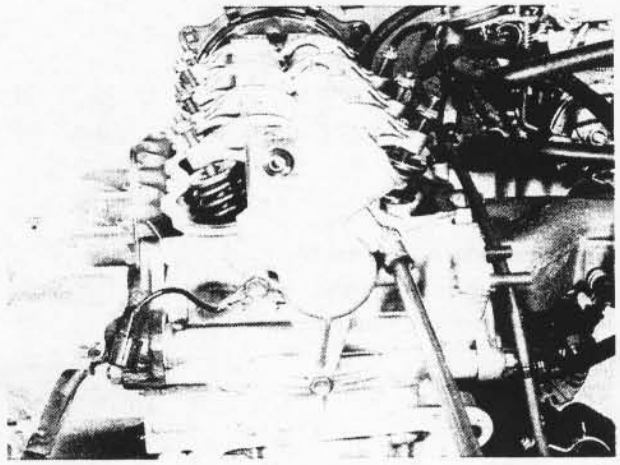


Fig. 3-6-53

Fuel Pump

Install fuel pump rod, gasket and fuel pump to cylinder head.
Apply engine oil to rod ① before installation.
Use new gasket.

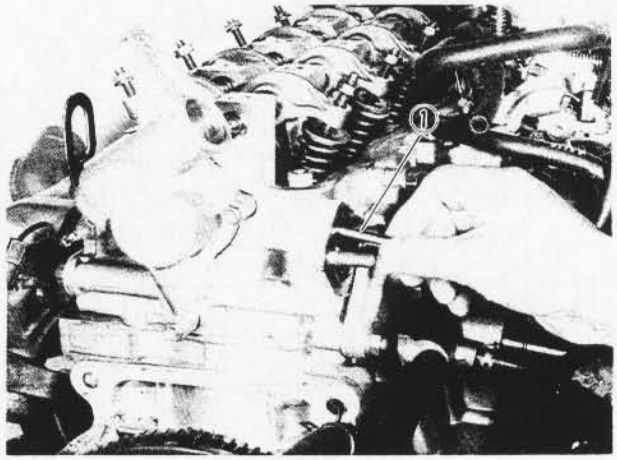


Fig. 3-6-54 Fuel pump rod installation

Clutch Disc and Cover

Install clutch disc and cover.

For installation, refer to p. 11-7 of SECTION 11 CLUTCH in this manual and torque each bolt to specification.

Transmission Assembly

1) Check to make sure that 2 pins ① are fitted to cylinder block.

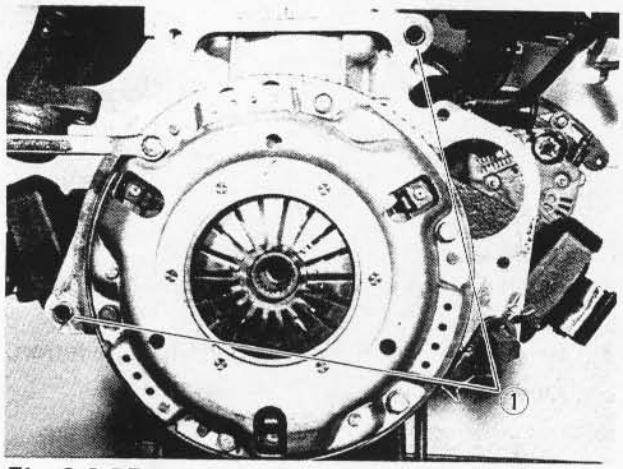


Fig. 3-6-55

2) Attach transmission assembly to engine cylinder block and tighten bolts and nuts to specified torque.

Tightening torque for transmission case bolts and nuts	N·m	kg-m	lb-ft
	22 – 35	2.2 – 3.5	16.0 – 25.0

Distributor

1) Install distributor to case.

For installation, be sure to refer to SECTION 8 IGNITION SYSTEM in this manual.

NOTE:

Check and adjust ignition timing with engine installed to car body and after installing and connecting all necessary parts. For procedure, refer to p. 8-9 of SECTION 8 IGNITION SYSTEM in this manual.

Valve Lash (Clearance) Adjustment

Adjust valve lash of all intake and exhaust valves to specification, referring to description on valve lash on p. 3-53 of this manual.

Cylinder Head Cover

Install cover to cylinder head and tighten bolts to specified torque.

Tightening torque for cylinder head cover bolts	N·m	kg-m	lb-ft
	4 – 5	0.4 – 0.5	3.0 – 3.5

3-7. ENGINE INSTALLATION

1) Lower engine with transmission into vehicle, but do not remove lifting device.
2) Tighten engine mounting bracket bolts (right and left) and transmission mounting bolts to specification. Refer to p. 3-58.
3) Remove lifting device.
4) Reverse removal procedures for installation of remainder.
5) Adjust accelerator cable play and clutch cable play.
6) Tighten bolts and nuts to specified torque. For individual specification, refer to each section.
7) Fill specified amount of specified transmission oil and engine oil. For the detail, refer to SECTION 1 PERIODIC MAINTENANCE SERVICE of this manual.
8) After adjusting water pump belt tension to specification, fill specified amount of engine cooling water.
9) Before starting engine, check again to ensure that all parts once disassembled or disconnected are back in place securely.
10) Start engine and check ignition timing. If it is not to specified timing, adjust it, referring to SECTION 8 of this manual.
11) After engine is started, check for oil leak, abnormal noise and other malcontion. Also, check each part for operation.

3-8. ENGINE MAINTENANCE SERVICE

Fan Belt
Adjust belt tension as outlined in SECTION 6 ENGINE COOLING SYSTEM (p. 1-4).

Ignition Timing
Refer to IGNITION TIMING, Page 8-8.

Carburetor
Adjustments to be made are detailed in SECTION 4 (p. 4-17).

Valve Lash (Clearance)
Valve lash specifications:
Valve lash refers to gap between rocker arm adjusting screw and valve stem. Use a thickness gauge to measure this gap Ⓐ.

		When cold (Coolant temperature is 15 – 25°C or 59 – 77°F)	When hot (Coolant temperature is 60 – 68°C or 140 – 154°F)
Valve lash (gap A) specification	Intake	0.13 - 0.17 mm (0.0051 - 0.0067 in)	0.23 - 0.27 mm (0.009 - 0.011 in)
	Exhaust	0.16 - 0,20 mm (0.0063 - 0.0079 in)	0.26 - 0.30 mm (0.0102 - 0.0118 in)

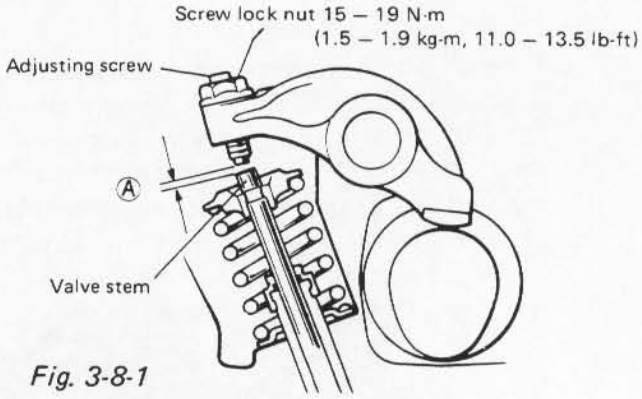


Fig. 3-8-1

Checking and adjusting procedures:

NOTE:
- **Refer to Fig. 3-3-11 of SECTION 3 for cylinder numbers (No. 1, No. 2, No. 3 and No. 4) mentioned in this section.**
- **When adjustment becomes necessary in step 4), loosen adjusting screw lock nut and then make adjustment by turning adjusting screw. After adjustment, tighten lock nut to specified torque while holding adjusting screw stationary with straight headed screwdriver, and then make sure again that gap Ⓐ is within specification.**

1) Remove cylinder head cover.
2) Remove ignition timing check window rubber plug from clutch housing of transmission case.
3) Turn crankshaft clockwise (viewing from crankshaft pulley side) to the extent that line ② above "T" mark punched on flywheel is aligned with match mark ① on transmission case as shown below, i.e. No. 1 cylinder piston reaches TDC position.

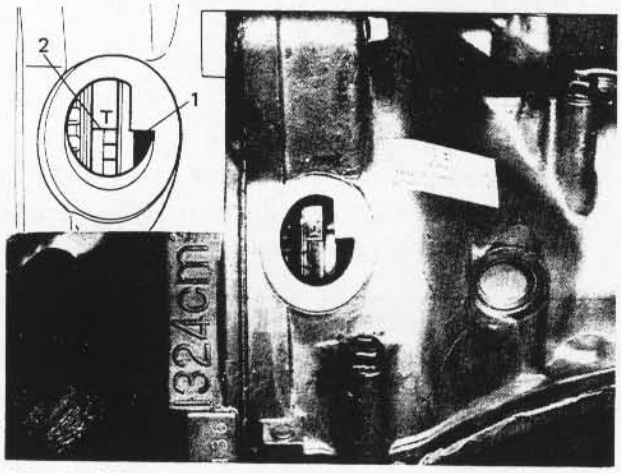


Fig. 3-8-2 1. Match mark 2. "T" (TDC) mark

4) Remove distributor cap and check that rotor is positioned as shown in figure. If rotor is out of place, turn crankshaft clockwise once (360°). In this state, check valve lashes at valves ①, ②, ⑤ and ⑦. Rotate crankshaft exactly one turn, and check the same at valves ③, ④, ⑥ and ⑧.

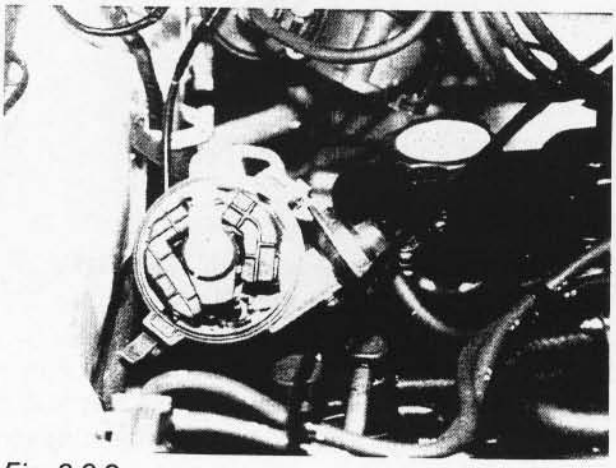


Fig. 3-8-3

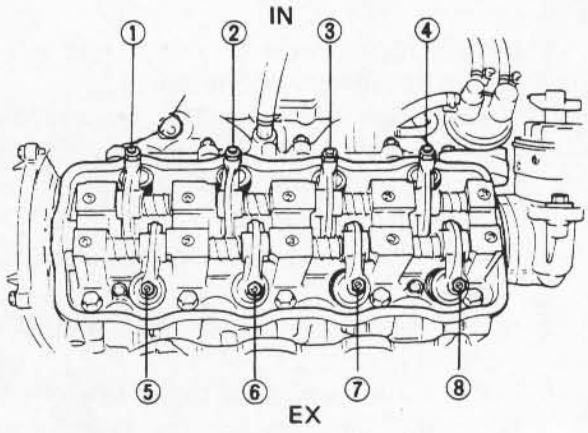


Fig. 3-8-4

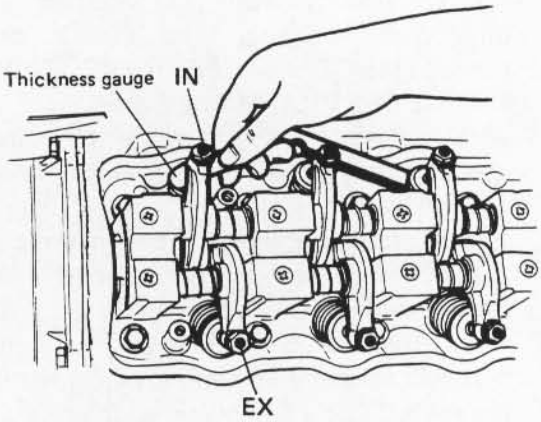


Fig. 3-8-5 Measuring valve lashes

5) Upon completion of check and adjustment, install cylinder head cover and torque bolts to specification.

Tightening torque for cylinder head cover bolts	N·m	kg-m	lb-ft
	4 – 5	0.4 – 0.5	3.0 – 3.5

6) Install distributor cap and connect blow-by gas hose to cylinder head cover.

Camshaft Timing Belt
For checking procedures of damage, wear and tension of camshaft timing belt, refer to SECTION 1 (p. 1-4) of this manual.

Engine Oil
Refer to SECTION 1 (p. 1-6) of this manual.

Engine Oil Filter
For removal and installation of filter, refer to SECTION 1 (p. 1-6) of this manual.

Engine Coolant

This subject is covered in SECTION 6 ENGINE COOLING SYSTEM.

Exhaust Line and Muffler

Inspect each exhaust line connection for tightness, and examine muffler and other parts for evidence of breakage and leakage of gases. Repair or replace defective parts, if any.

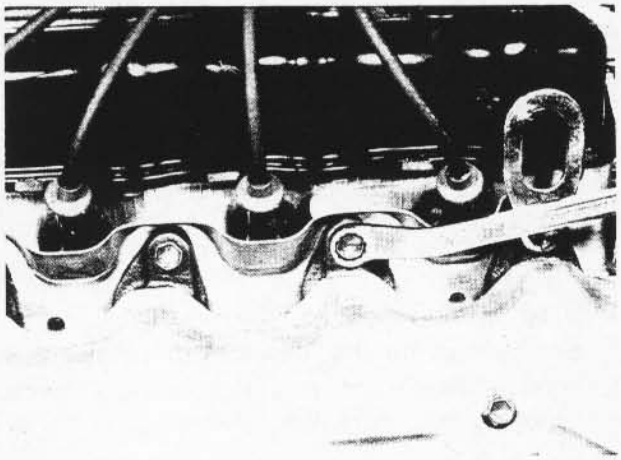
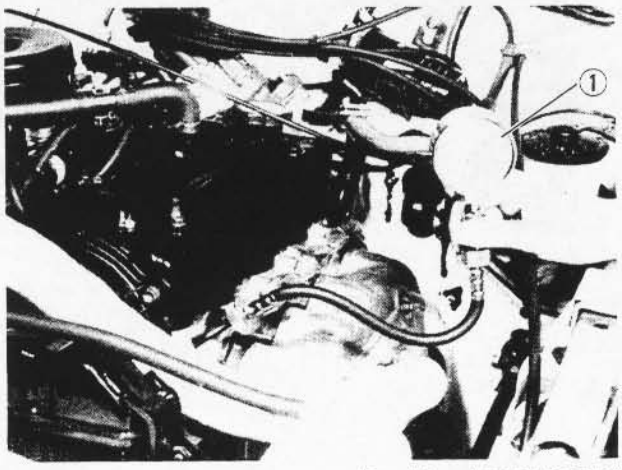


Fig. 3-8-6

Compression Pressure Measurement

Check compression pressure on all four cylinders as follows:

1) Warm up engine.
2) Stop engine after warming up.
3) Remove all spark plugs and disconnect high tension cord from ignition coil.
4) Install compression gauge (special tool) into spark plug hole.



1. Compression gauge (Special tool 09915-64510)

Fig. 3-8-7 Installing compression gauge

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

	Compression pressure
Standard	14.0 kg/cm² (199.0 psi) 400 r/min
Limit	12.0 kg/cm² (170.0 psi) 400 r/min
Max. difference between any two cylinders	1.0 kg/cm² (14.2 psi), 400 r/min

7) Carry out steps 4) through 6) on each cylinder to obtain four readings.

NOTE:
Compression pressure value is measured by using compression gauge (Special tool 09915-64510).

Oil Pump Discharge Pressure Measurement

NOTE:
Prior to checking oil pressure, check the following.

- **Oil level in oil pan.**
  If level is low, add oil up to Full level hole on oil level gauge.
- **Oil quality.**
  If oil is discolored, or deteriorated, change oil. For particular oil to be used, refer to table on p 1-6 of SECTION 1.
- **Oil leak.**
  If leak is found, repair it.

1) Disconnect lead wire from oil pressure switch.
2) Remove oil pressure switch from cylinder block.

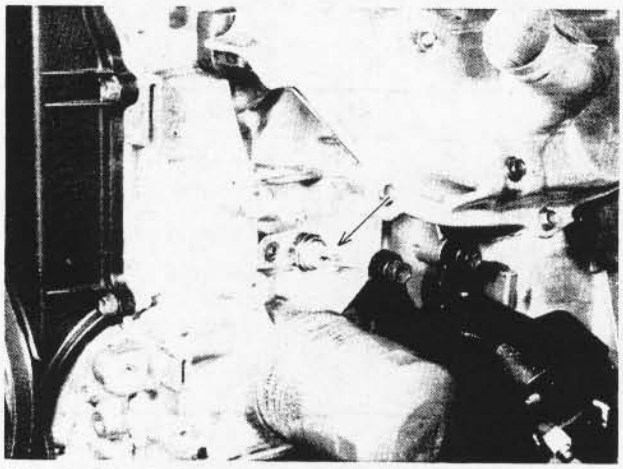
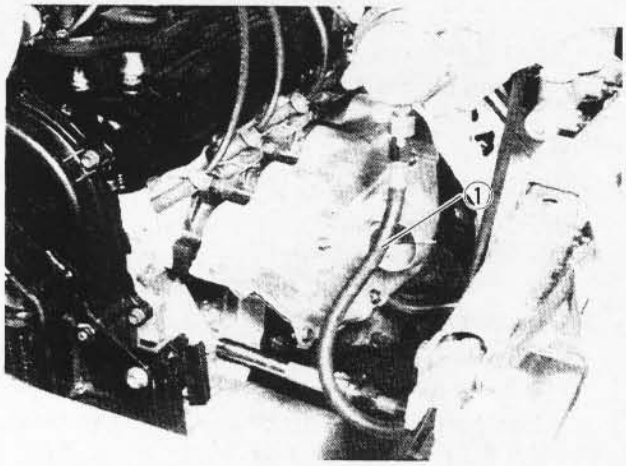


Fig. 3-8-8 Oil pressure switch

3) Install oil pressure gauge (special tool) to vacated threaded hole.



1. Oil pressure gauge (Special tool 09915-77310)

Fig. 3-8-9 Oil pressure gauge installation

4) Start engine and warm it up to normal operating temperature.
5) After warming up, raise engine speed to 3,000 r/min and measure oil pressure.

Oil pressure specification	3.0 – 4.2 kg/cm^2 42.7 – 59.7 psi at 3,000 r/min (rpm)

6) After checking oil pressure, stop engine and remove oil pressure gauge.
7) Before reinstalling oil pressure switch, be sure to wrap its screw threads with sealing tape and tighten switch to specified torque.

Tightening torque for oil pressure switch	12 – 15 N·m 1.2 – 1.5 kg-m 9.0 – 10.5 lb-ft

NOTE:
- **If sealing tape edge is bulged out from screw threads of switch, cut off edge.**

8) After installing oil pressure switch, start engine and check switch for oil leakage.

Vacuum Measurement

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

1) Warm up engine to normal operating temperature.
2) Install vacuum gauge Ⓐ (09915-67310), as shown in Fig. 3-8-10. Install engine tachometer.

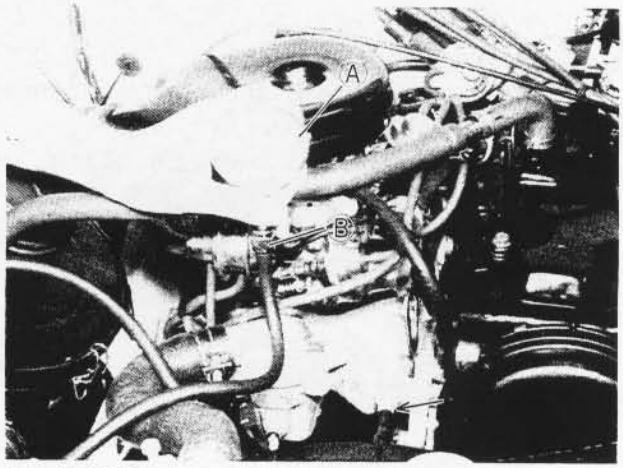


Fig. 3-8-10

3) Run engine at specified idling speed and, under this running condition, read vacuum gauge. Vacuum should not be lower than 45 cm Hg (17.7 in. Hg).

A low vacuum reading means that any combination of following malconditions is the cause, which must be corrected before releasing machine to customer:

(a) Leaky cylinder head gasket
(b) Leaky inlet manifold gasket
(c) Leaky valves
(d) Weakened valve springs
(e) Maladjusted valve clearance
(f) Valve timing out of adjustment
(g) Ignition mistimed
(h) Carburetor improperly adjusted

NOTE:
Should indicating hand of the vacuum gauge oscillate violently, turn adjusting nut Ⓑ to steady it.

Standard vacuum (sea level)	45 – 55 cm Hg (17.7 – 21.6 in. Hg)
Idling speed specification	850 ± 50 r/min (rpm) (Take vacuum reading at this speed.)

4) After checking, remove vacuum gauge.
5) Before reinstalling vacuum checking plug, be sure to wrap its screw threads with sealing tape and tighten plug.

Oil Filler Cap

The cap has a packing. Be sure that packing is in good condition, free of any damage and signs of deterioration, and is tight in place: it is replaceable.

3-9. RECOMMENDED TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
1. Cylinder head bolt	63 – 70	6.3 – 7.0	46.0 – 50.5
2. Cylinder head cover bolt	4 – 5	0.4 – 0.5	3.0 – 3.5
3. Spark plug	20 – 30	2.0 – 3.0	14.5 – 21.5
4. Distributor gear case	8 – 12	0.8 – 1.2	6.0 – 8.5
5. Rocker arm shaft screw	9 – 12	0.9 – 1.2	7.0 – 8.5
6. Valve adjusting screw lock nut	15 – 19	1.5 – 1.9	11.0 – 13.5
7. Crankshaft main bearing cap bolt	50 – 57	5.0 – 5.7	36.5 – 41.0
8. Oil filter stand	20 – 25	2.0 – 2.5	14.5 – 18.0
9. Oil filter Ass'y	12 – 16	1.2 – 1.6	9.0 – 11.5
10. Oil pressure switch	12 – 15	1.2 – 1.5	9.0 – 10.5
11. Oil drain plug	30 – 40	3.0 – 4.0	22.0 – 28.5
12. Oil pan bolt and nut	9 – 12	0.9 – 1.2	7.0 – 8.5
13. Oil pump strainer bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
14. Water pump bolt and nut	9 – 12	0.9 – 1.2	7.0 – 8.5
15. Cooling fan nut	8 – 12	0.8 – 1.2	6.0 – 8.5
16. Flywheel bolt	57 – 65	5.7 – 6.5	41.5 – 47.0
17. Oil seal housing bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
18. Connecting rod bearing cap nut	33 – 37	3.3 – 3.7	24.0 – 26.5
19. Crankshaft pully bolt	10 – 13	1.0 – 1.3	7.5 – 9.0
20. Crankshaft timing belt pulley bolt	65 – 75	6.5 – 7.5	47.5 – 54.0
21. Timing belt cover bolt and nut	9 – 12	0.9 – 1.2	7.0 – 8.5
22. Camshaft timing pully bolt	56 – 64	5.6 – 6.4	41.0 – 46.0
23. Timing belt tension bolt	24 – 30	2.4 – 3.0	17.5 – 21.5
24. Timing belt tensioner stud	9 – 12	0.9 – 1.2	7.0 – 8.5
25. Oil pump case bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
26. Oil pump rotor plate screw	9 – 12	0.9 – 1.2	7.0 – 8.5
27. Inlet & exhaust manifold nut	18 – 28	1.8 – 2.8	13.5 – 20.0
28. Fuel pump nut	10 – 16	1.0 – 1.6	7.0 – 11.5
29. Engine mounting bracket frame side bolt	40 – 60	4.0 – 6.0	29.0 – 43.0
30. Engine mounting bracket engine side bolt	50 – 60	5.0 – 6.0	36.5 – 43.0
31. Engine mounting nut	40 – 50	4.0 – 5.0	29.0 – 36.0
32. Transmission mounting bracket bolt	18 – 28	1.8 – 2.8	13.5 – 20.0
33. Transmission mounting bolt	18 – 28	1.8 – 2.8	13.5 – 20.0
34. Transmission mounting and frame bolt	18 – 28	1.8 – 2.8	13.5 – 20.0
35. Propeller shaft flange bolt and nut	23 – 30	2.3 – 3.0	17.0 – 21.5

NOTE: If specified tightening torque for particular bolt or nut is not included here, refer to p 0-12 of this manual.