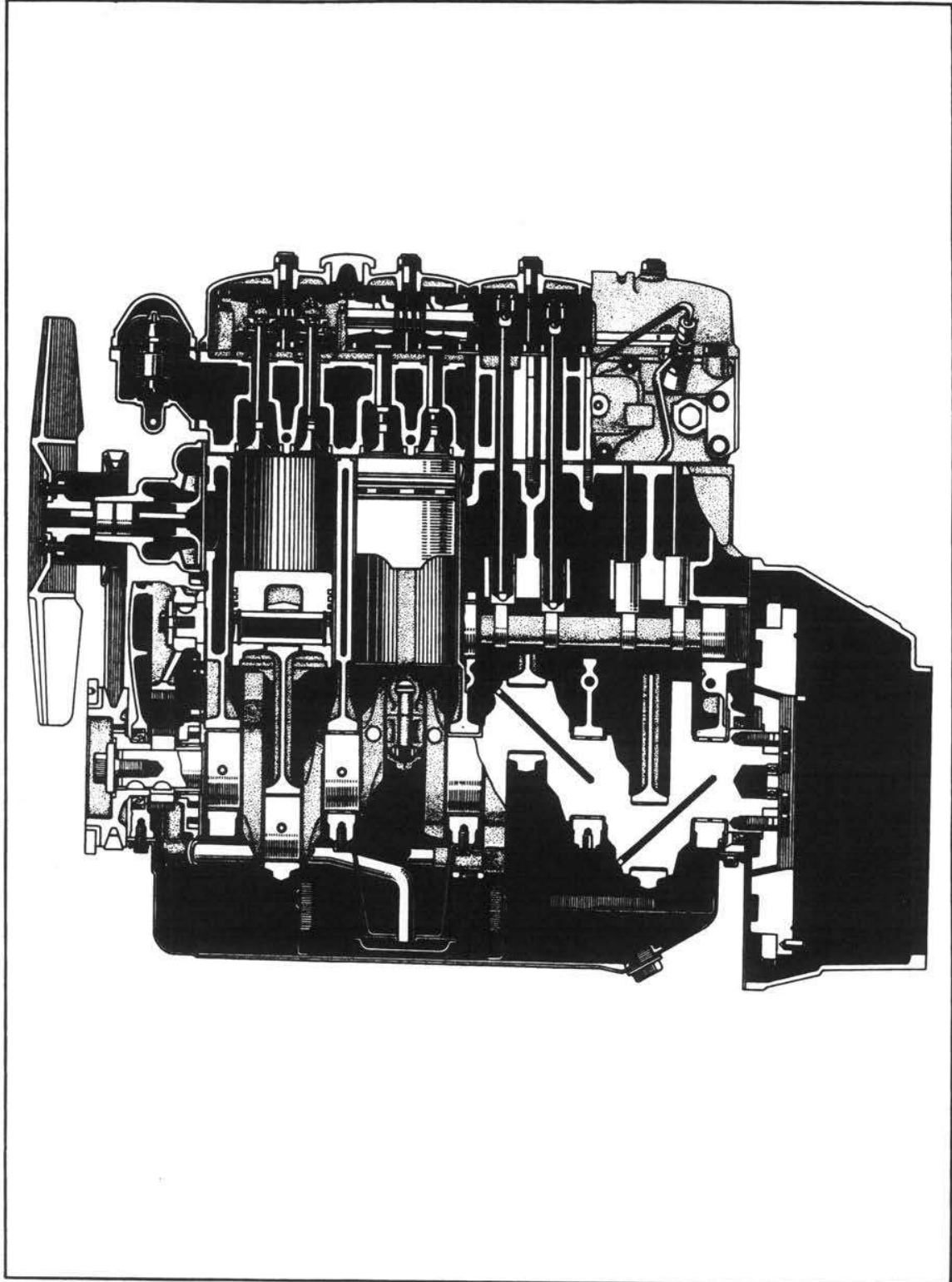
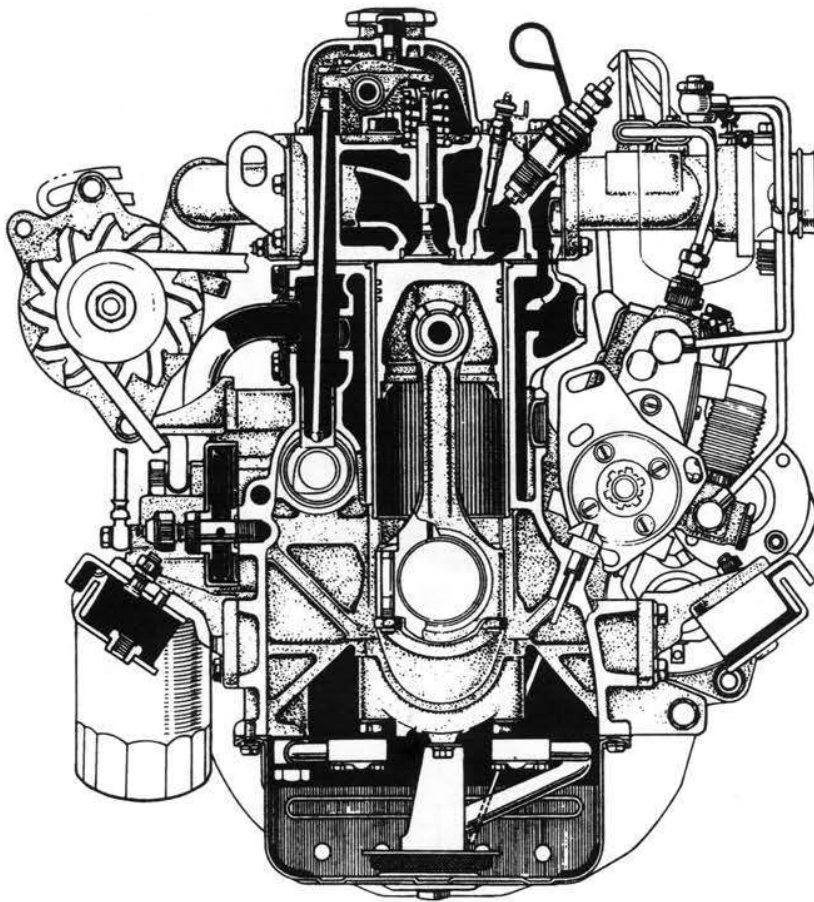


ENGINE SERVICE

	Page
CROSS SECTIONAL VIEW	3-2
CYLINDER HEAD	3-4
TIMING GEAR	3-22
CYLINDER BLOCK	3-33

3-2 ENGINE SERVICE — Cross Sectional View**CROSS SECTIONAL VIEW****Fig. 3-1**

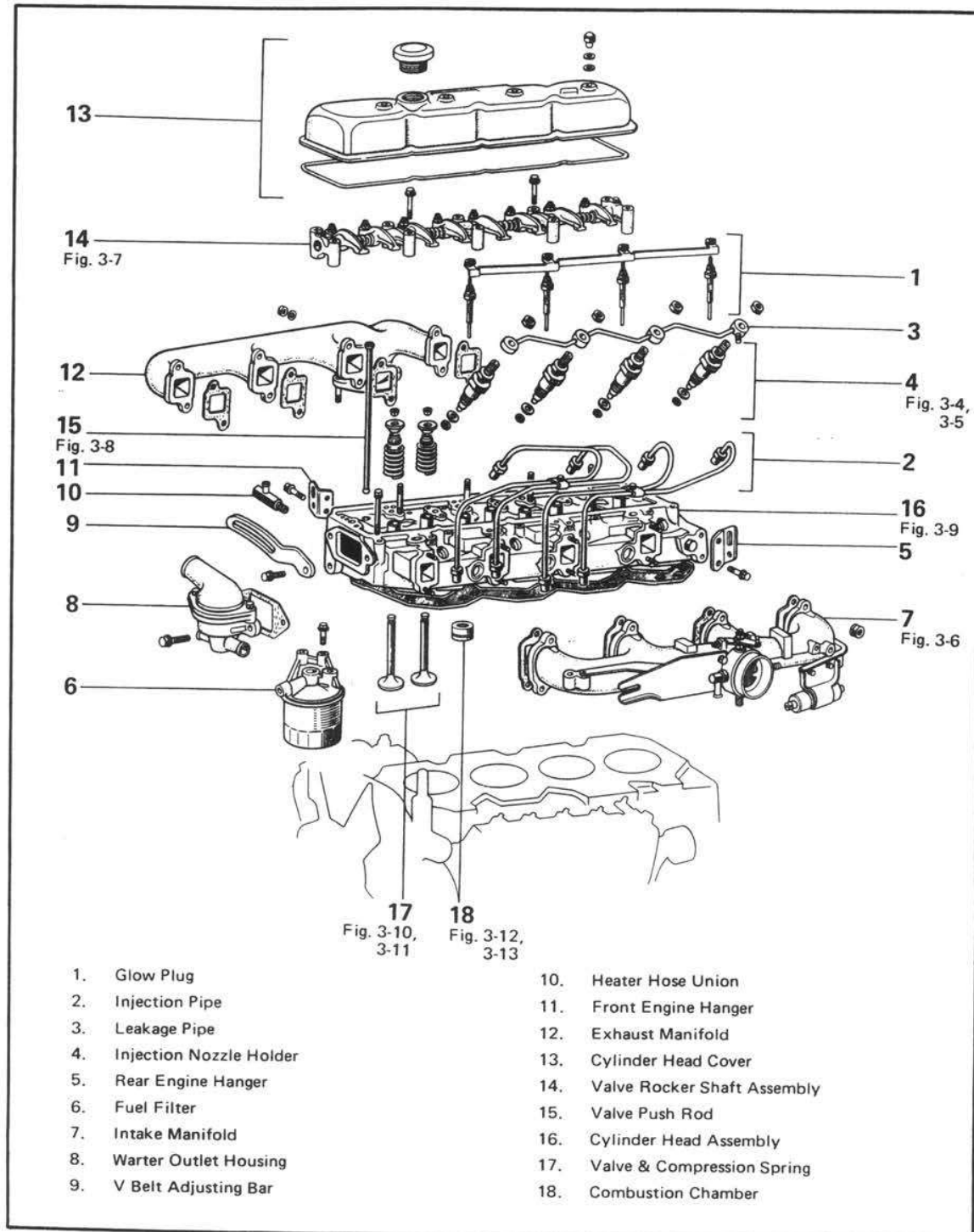
ENGINE SERVICE — Cross Sectional View 3-3**Fig. 3-2**

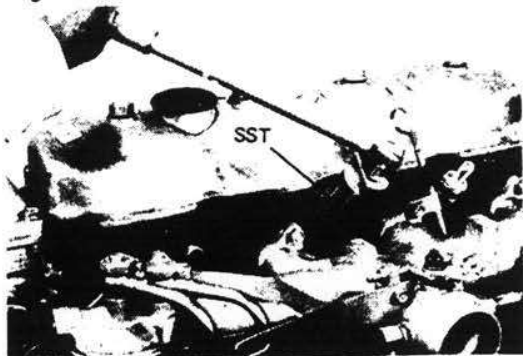
3-4 ENGINE SERVICE – Cylinder Head

CYLINDER HEAD**DISASSEMBLY**

Disassemble in numerical order.

Fig. 3-3

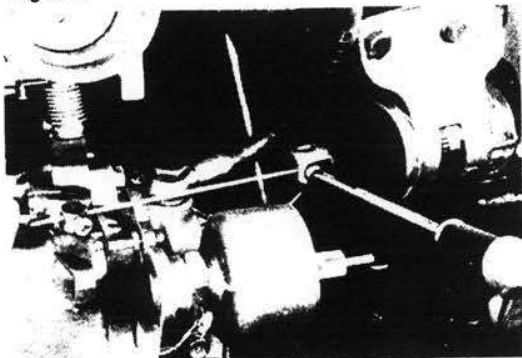


ENGINE SERVICE — Cylinder Head**3-5****Fig. 3-4**

Remove injection nozzle holders with SST [09268-46011].

Fig. 3-5

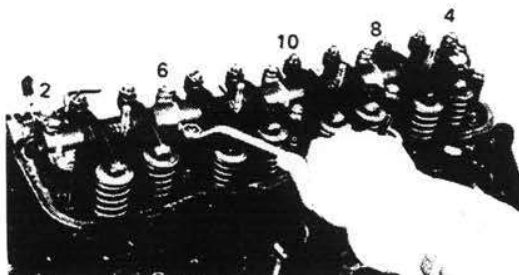
Keep the nozzle holders in correct order.

**Fig. 3-6**

Disconnect the overinjection magnet connecting wire, and remove the intake manifold.

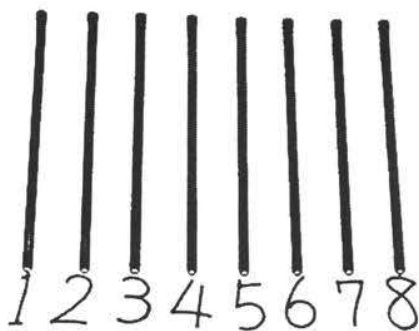
Fig. 3-7

Loosen valve rocker support bolts little by little in three or four steps in the specified numerical sequence.



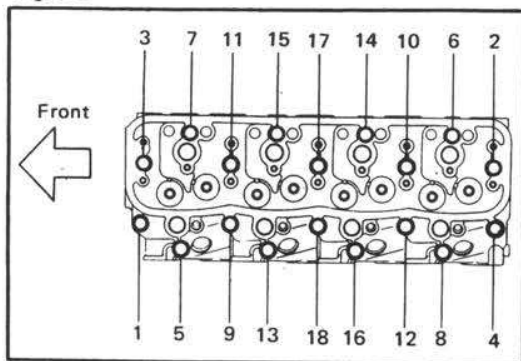
3-6 ENGINE SERVICE – Cylinder Head

Fig. 3-8



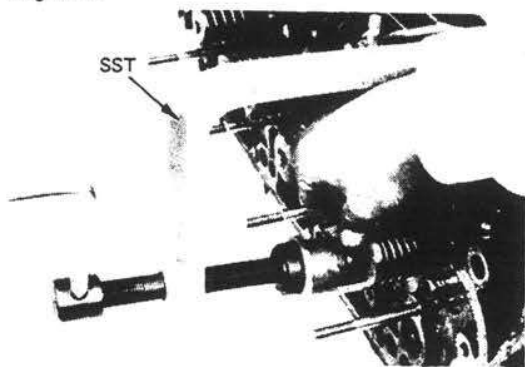
Keep push rods in correct order.

Fig. 3-9



Loosen cylinder head bolts little by little in two or three steps in the indicated numerical sequence.

Fig. 3-10



Compress the valve spring with SST[09202-43011] and remove the spring retainer locks.

Fig. 3-11



Keep valves and springs in correct order.

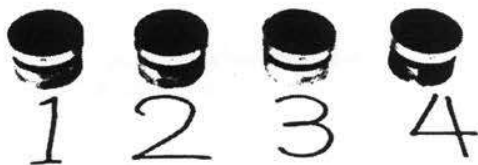
ENGINE SERVICE — Cylinder Head**3-7****Fig. 3-12**

Pull out the combustion chamber with SST
[09208-48010].

— **Caution** —
Be careful not to damage the hole.

Fig. 3-13

Keep combustion chambers in correct order.



3-8 ENGINE SERVICE – Cylinder Head

Fig. 3-14

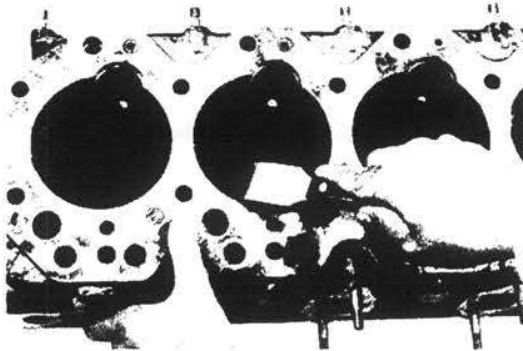


Fig. 3-15

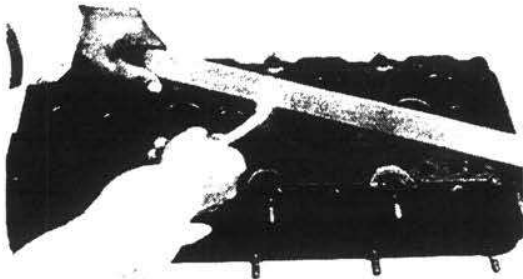


Fig. 3-16

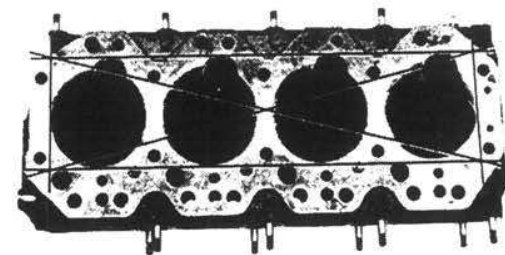
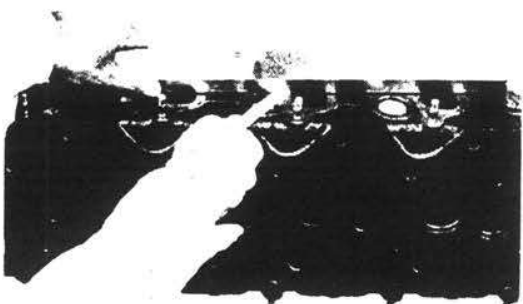


Fig. 3-17



INSPECTION & REPAIR



Cylinder Head

1. Clean and Check the cylinder head for cracks or scoring.



2. Check cylinder head underside surface for warpage with a precision straight edge and thickness gauge.

Underside surface warpage limit
0.05 mm (0.0020 in.)



3. Check surfaces along the indicated line for warpage.



4. Inspect the manifold mounting surface for warpage.

Manifold mounting surface warpage limit
0.2 mm (0.008 in.)

5. If the warpage exceeds the limit, either machine flat or replace cylinder head.

ENGINE SERVICE – Cylinder Head

3-9

Fig. 3-18

**Valve & Guide**

1. Clean and check the valves for wear, scores and bend.

2. Measure valve stem clearance.
 - (1) Measure inside diameter of valve guide.

Guide inside diameter (for both IN. and EX.)

9.01 – 9.03 mm
(0.3547 – 0.3555 in.)

- (2) Measure valve stem diameter.

Stem diameter

IN. 8.97 – 8.99 mm
(0.3531 – 0.3539 in.)

EX. 8.95 – 8.97 mm
(0.3524 – 0.3531 in.)

Oil clearance limit

IN. 0.10 mm
(0.0039 in.)

EX. 0.12 mm
(0.0047 in.)

Fig. 3-19

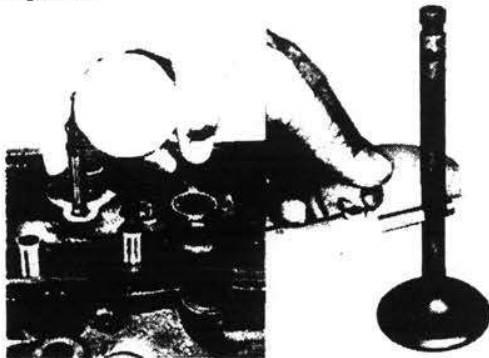


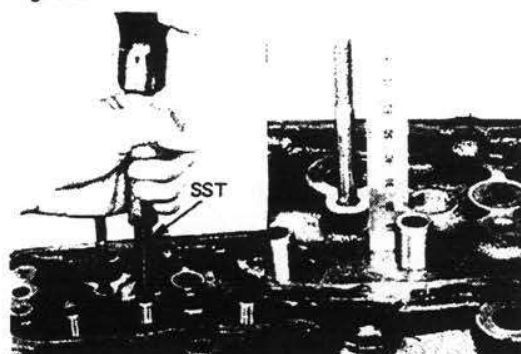
Fig. 3-20



3. If the oil clearance exceeds the limit, replace guides and valves.

- (1) Drive out valve guide from top end toward the combustion chamber with SST[09201-60011].

Fig. 3-21



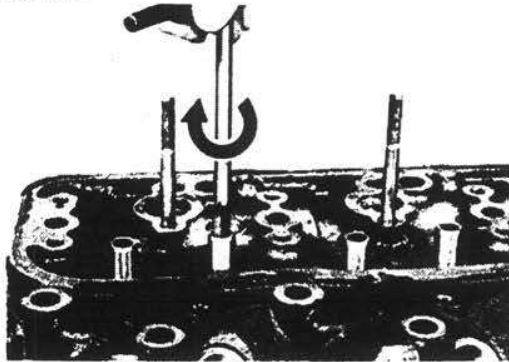
- (2) Drive in new valve guide until its end projects from the top of the cylinder head to the specified length below.

Projected length

16.6 – 17.4 mm
(0.654 – 0.685 in.)

3-10 **ENGINE SERVICE** — Cylinder Head

Fig. 3-22



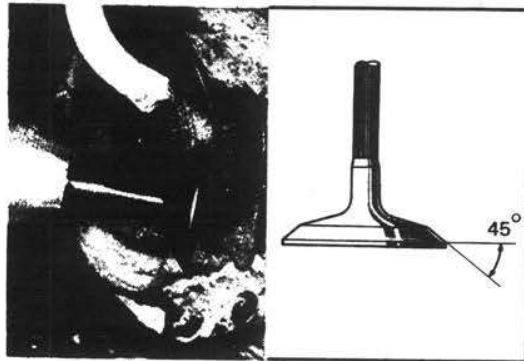
- (3) Ream valve guide to obtain specified clearance with a sharp reamer.

Oil clearance (STD)

IN. 0.02 – 0.06 mm
(0.0008 – 0.0024 in.)

EX. 0.04 – 0.08 mm
(0.0016 – 0.0031 in.)

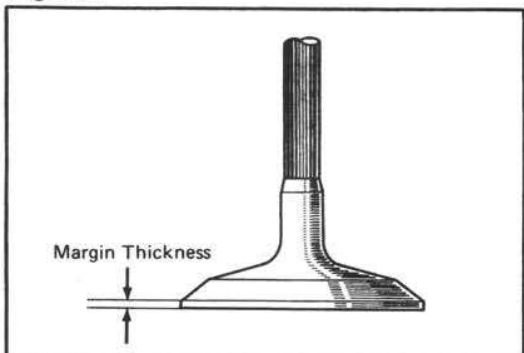
Fig. 3-23



4. Reface valve seating face with a valve refacer.

Valve face angle 45°

Fig. 3-24



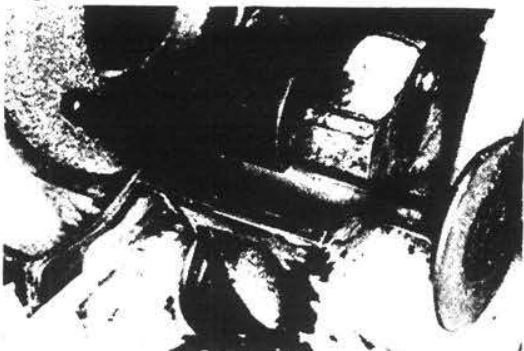
5. Check valve head margin thickness.

Margin thickness limit

IN. 0.9 mm (0.035 in.)

EX. 1.0 mm (0.039 in.)

Fig. 3-25



6. Resurface valve stem tip with a valve grinder.

Stem tip resurfacing limit

0.5 mm (0.020 in.)

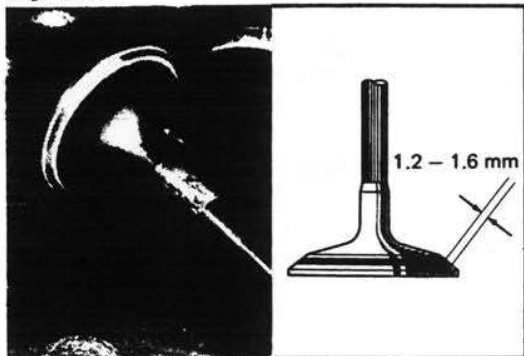
Overall length

IN. 127.95 mm (5.0374 in.)

EX. 127.75 mm (5.0295 in.)

ENGINE SERVICE – Cylinder Head

3-11

Fig. 3-26**Valve Seat**

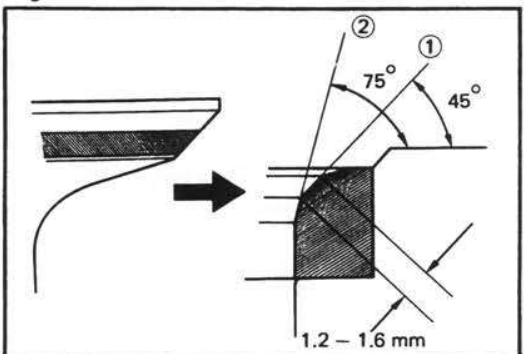
1. Check the position of valve contact with seat. Coat valve face with prussian blue or red lead. Locate contact point on valve by rotating valve against seat.

Contact width 1.2 – 1.6 mm
(0.047 – 0.063 in.)

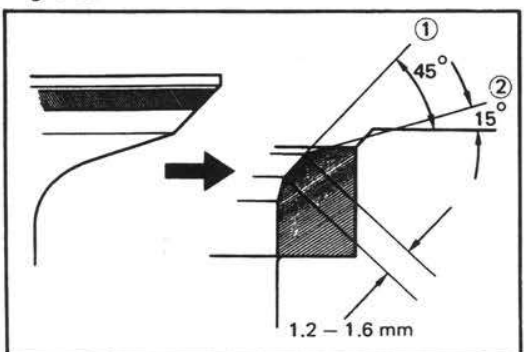
Contact position Middle of valve face

Fig. 3-27

2. Resurface valve seat with 45° cutter.

Fig. 3-28

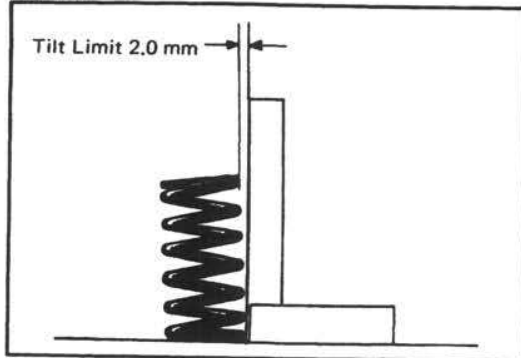
3. Correct seat position.
(1) If seat position is too high, use 45° and 75° cutters in the order indicated.

Fig. 3-29

- (2) If seat position is too low, use 45° and 15° cutters in the order indicated.

3-12 ENGINE SERVICE – Cylinder Head

Fig. 3-30

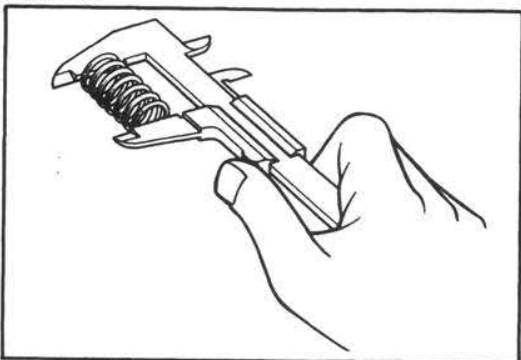


Valve Springs

1. Check squareness of valve spring with a square.

Tilt limit **2.0 mm (0.079 in.)**

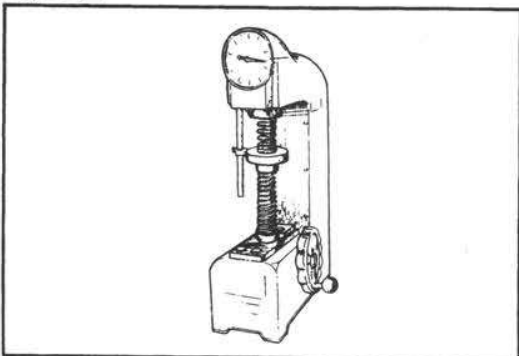
Fig. 3-31



2. Measure free height of valve springs.

Free height **45.5 mm (1.791 in.)**

Fig. 3-32



3. Using a spring tester, measure spring tension at the specified installed height.

Installed height

EX. **39.5 mm (1.555 in.)**

Installed tension

Limit **23.1 kg (50.9 lb)**

STD IN. **25.5 kg (56.2 lb)**

EX. **26.0 kg (57.3 lb)**

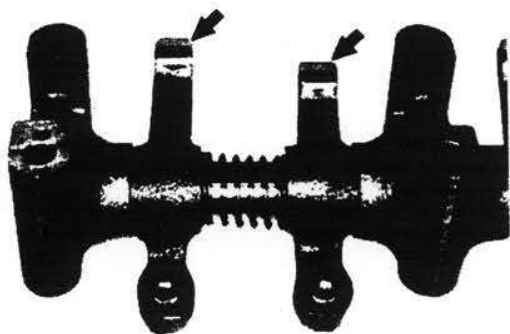
Fig. 3-33



Combustion Chamber

Clean and check combustion chamber for cracks and extreme damages.

Fig. 3-34

**Rocker Arms & Shaft**

1. Check the valve contacting surface of the rocker arm for wear. Correct or replace if necessary.

Fig. 3-35



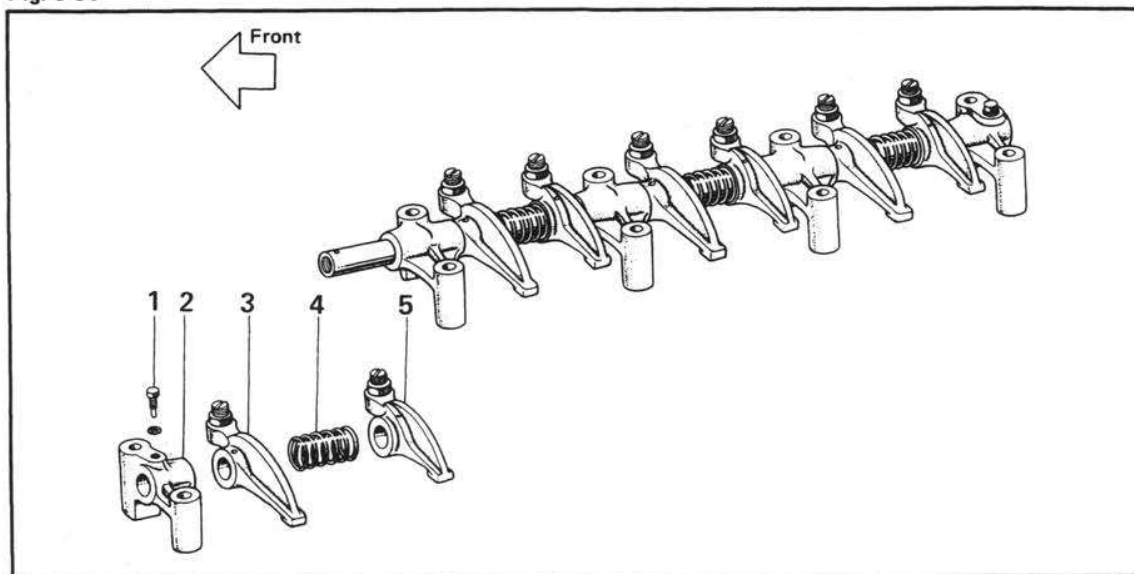
2. Check rocker arm-to-shaft clearance by moving each rocker arm as shown. Little or no movement should be possible. If movement is felt, disassemble and inspect.

3. Disassemble valve rocker shaft assembly in numerical order.

— Note —

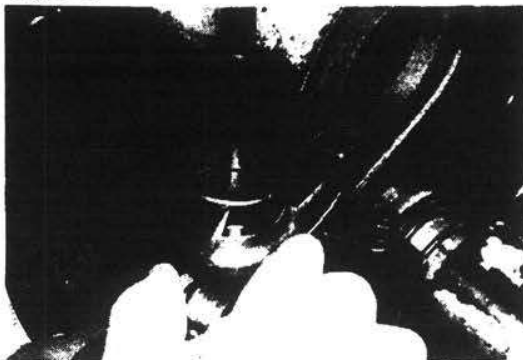
Keep rocker arms in correct order.

Fig. 3-36



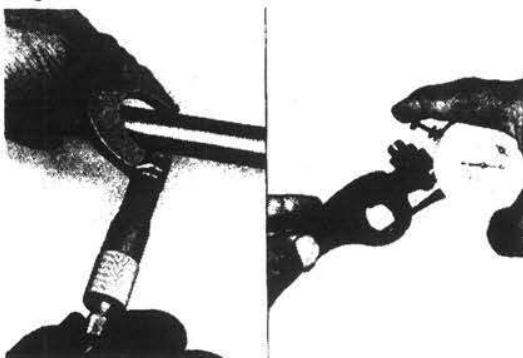
3-14 ENGINE SERVICE – Cylinder Head

Fig. 3-37



4. Correct the valve contacting surface of the rocker arm with a valve refacer and oil stone, if only a light ridged wear.

Fig. 3-38



5. Measure oil clearance between rocker arm to shaft.

Shaft diameter limit

18.44 mm (0.7260 in.)

Rocker arm bore limit

18.60 mm (0.7323 in.)

Oil clearance

Limit 0.1 mm (0.004 in.)

STD 0.02 – 0.06 mm
(0.0008 – 0.0024 in.)

6. Assemble valve rocker shaft assembly in numerical order.

– Note –

Align oil hole of the front rocker support with the shaft oil hole.

Fig. 3-39

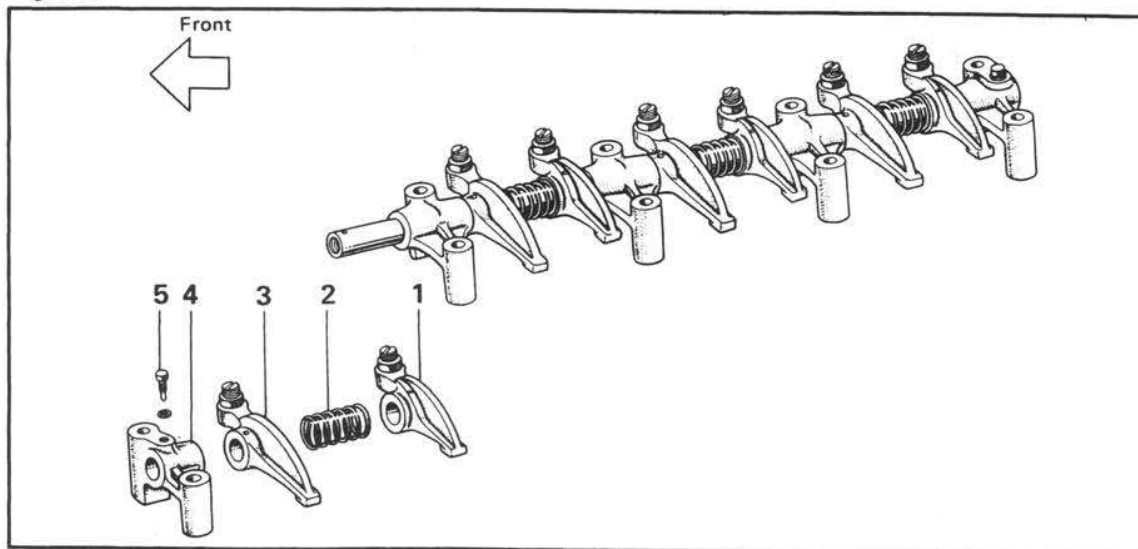
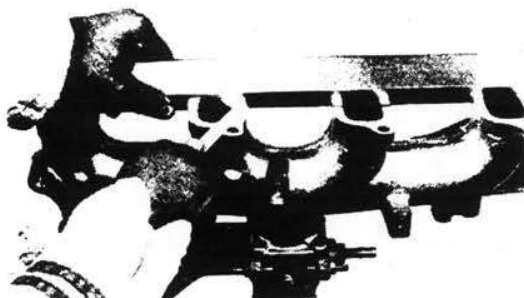
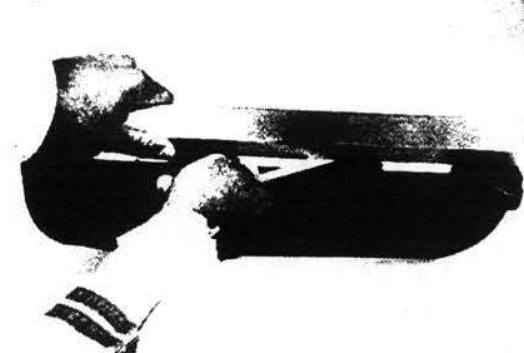


Fig. 3-40

**Manifold**

Using a precision straight edge and thickness gauge, inspect surfaces in contact with the cylinder head for warpage, and correct or replace if warped over the specified limit.

Fig. 3-41

**Warpage limit****0.4 mm (0.016 in.)**

3-16 ENGINE SERVICE – Cylinder Head

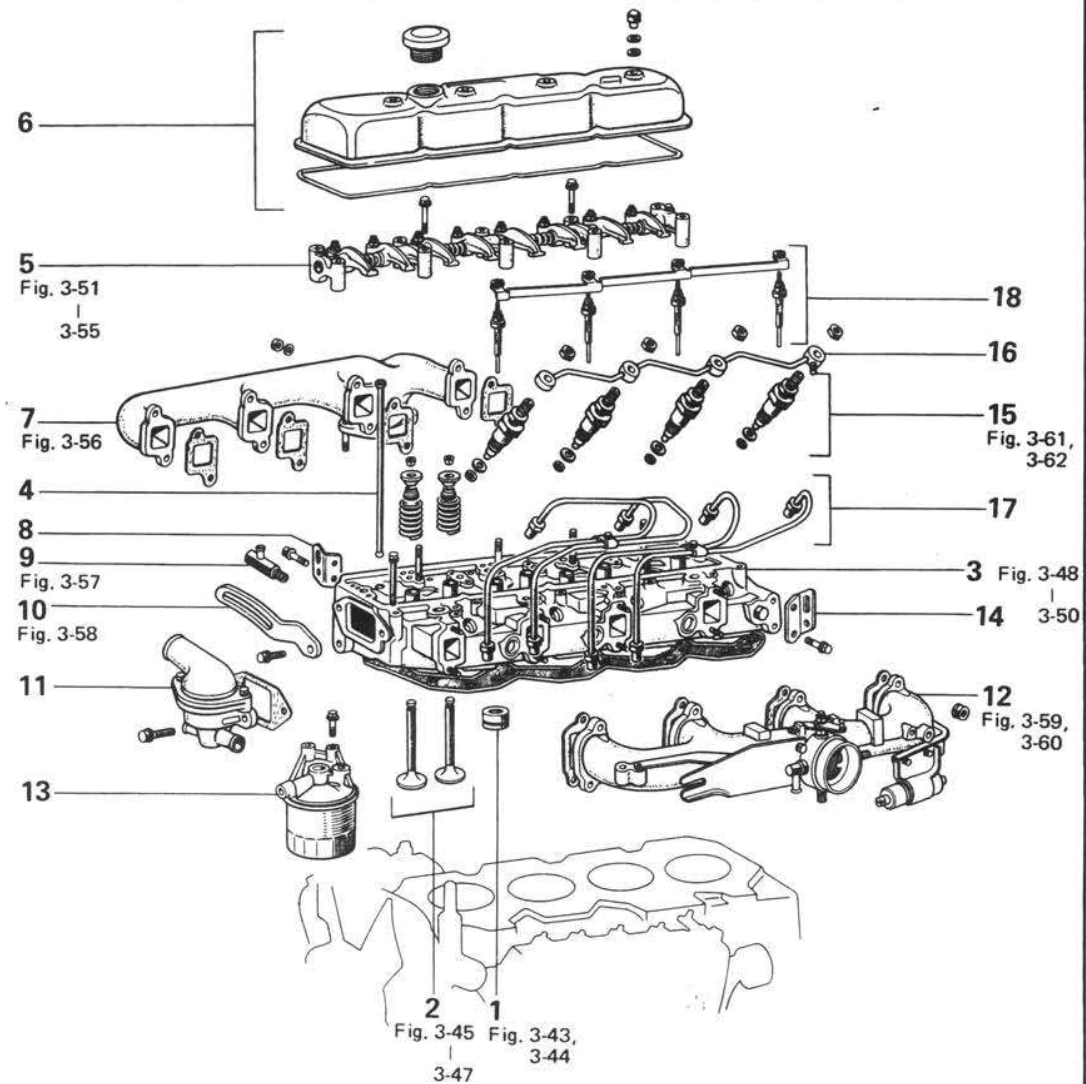
ASSEMBLY

Assemble in numerical order.

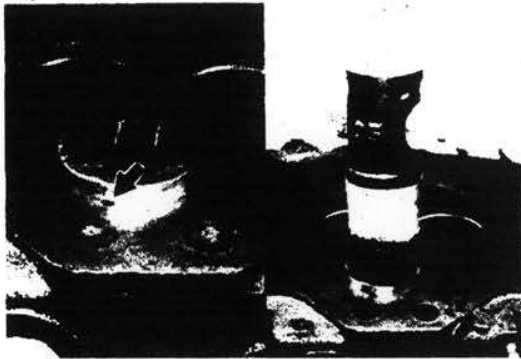
Fig. 3-42

Thoroughly clean all parts to be assembled.

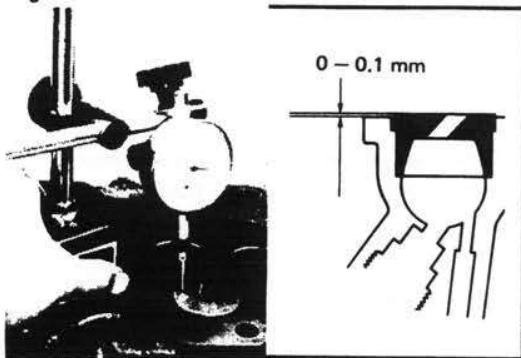
Apply clean engine oil to all sliding and rotating surfaces of the parts before assembly.



- | | |
|--------------------------------|-----------------------------|
| 1. Combustion Chamber | 10. V Belt Adjusting Bar |
| 2. Valve & Compression Spring | 11. Water Outlet Housing |
| 3. Cylinder Head Assembly | 12. Intake Manifold |
| 4. Valve Push Rod | 13. Fuel Filter |
| 5. Valve Rocker Shaft Assembly | 14. Rear Engine Hanger |
| 6. Cylinder Head Cover | 15. Injection Nozzle Holder |
| 7. Exhaust Manifold | 16. Leakage Pipe |
| 8. Front Engine Hanger | 17. Injection Pipe |
| 9. Heater Hose Union | 18. Glow Plug |

ENGINE SERVICE – Cylinder Head**3-17****Fig. 3-43**

Match the combustion chamber knock pin with the cylinder head notch, and drive in the combustion chamber.

Fig. 3-44

Check combustion chamber protrusion.

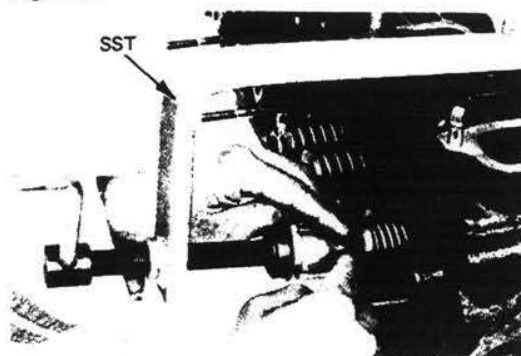
Combustion chamber protrusion
0 - 0.10 mm (0 - 0.0039 in.)

Fig. 3-45

Install oil seal before assembling the valve spring.

— Note —

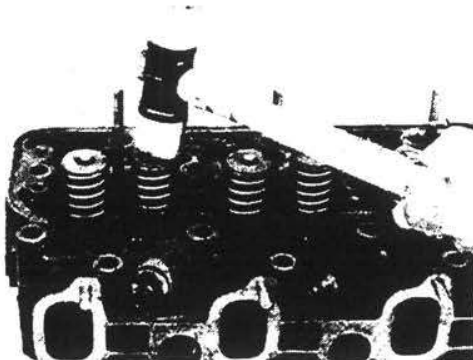
A new oil seal should be used whenever valve is disassembled.

Fig. 3-46

Compress the valve spring with SST[09202-43011] and insert the spring retainer locks.

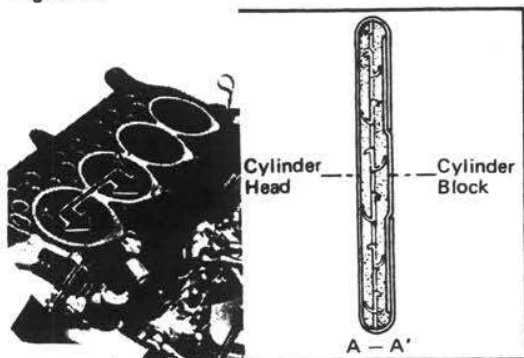
3-18 ENGINE SERVICE – Cylinder Head

Fig. 3-47



After installing the springs, lightly tap the stem ends and allow the springs to settle down snugly.

Fig. 3-48

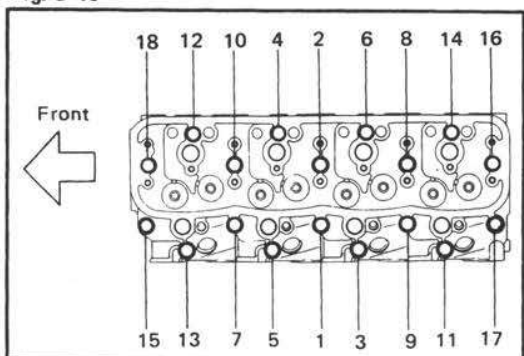


Put cylinder head gasket on the cylinder block, aligning the bolt holes as shown.

— Note —

Clean the cylinder block upper surface with a scraper before installing the head gasket.

Fig. 3-49



Tighten cylinder head bolts little by little in two or three steps in the specified numerical sequence.

— Note —

Apply a light coating of engine oil on the bolt threads and under the bolt head before installing.

Fig. 3-50



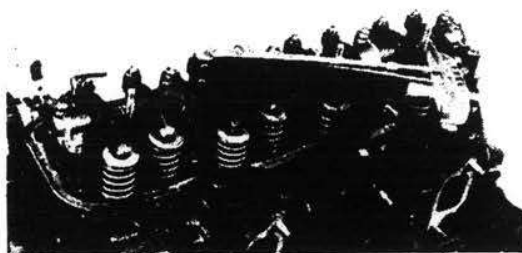
Tighten cylinder head bolts to specified torque.

Torque

**11.5 – 12.0 kg-m
(84 – 87 ft-lb)**

ENGINE SERVICE – Cylinder Head**3-19****Fig. 3-51**

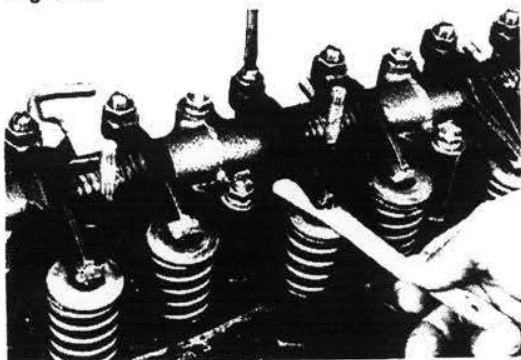
Tighten valve rocker support bolts little by little in three or four steps in the specified numerical sequence.

Fig. 3-52

Tighten valve rocker support bolts to specified torque.

Torque

**1.0 – 1.6 kg-m
(8 – 11 ft-lb)**

Fig. 3-53

Tentatively, adjust valve clearance.
1. Set No.1 cylinder to TDC/Compression.

Fig. 3-54

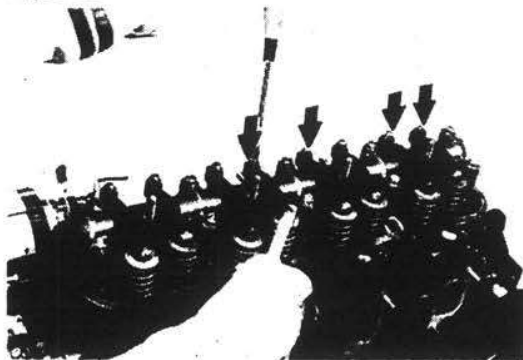
2. Adjust valve clearances indicated by arrows.

Valve clearance

IN.	0.20 mm (0.008 in.)
EX.	0.36 mm (0.014 in.)

3-20 ENGINE SERVICE — Cylinder Head

Fig. 3-55

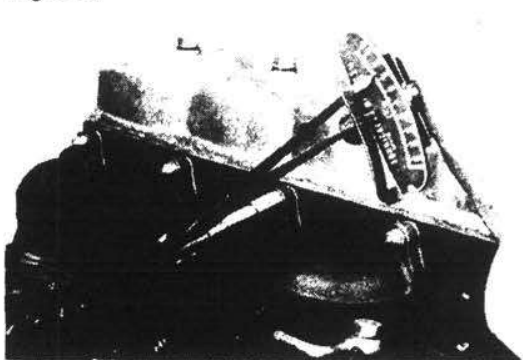


3. Rotate crankshaft one turn in normal direction.
4. Adjust remaining valves indicated by arrows.

Valve clearance

IN.	0.20 mm (0.008 in.)
EX.	0.36 mm (0.014 in.)

Fig. 3-56



Install exhaust manifold.

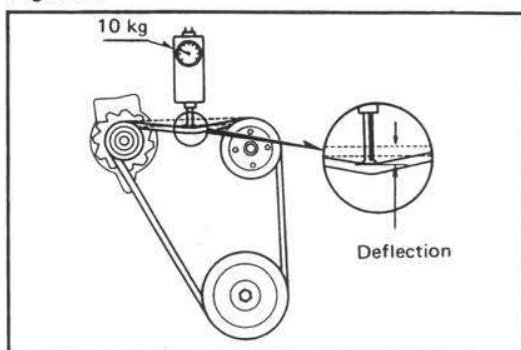
Torque	1.5 – 2.2 kg-m (11 – 15 ft-lb)
---------------	---

Fig. 3-57



Apply liquid sealer on the threads of the heater hose union, and assemble so that the union faces upward.

Fig. 3-58



Adjust the "V" belt tension.

Deflection at 10 kg (22 lb) force

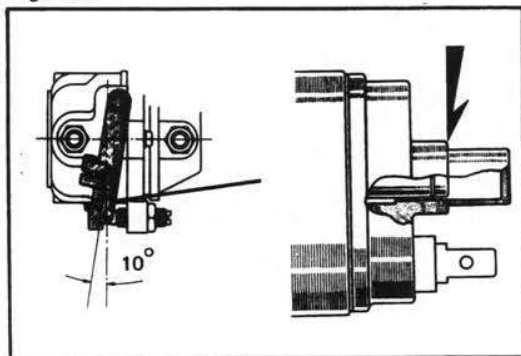
B engine	10 – 13 mm (0.4 – 0.5 in.)
2B engine	8 – 11 mm (0.3 – 0.4 in.)

ENGINE SERVICE – Cylinder Head

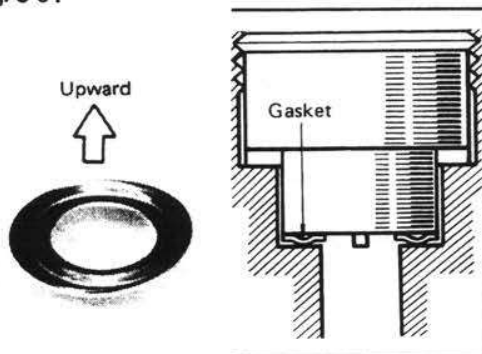
3-21

Fig. 3-59

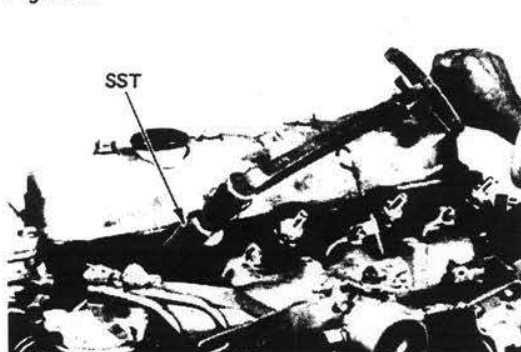
Install intake manifold.

Torque**1.5 – 2.2 kg-m
(11 – 15 ft-lb)****Fig. 3-60**

Connect and adjust the overinjection magnet connecting wire with the magnet core end surface positioned as shown.

Fig. 3-61

Note the orientation of the nozzle seat gasket as shown.

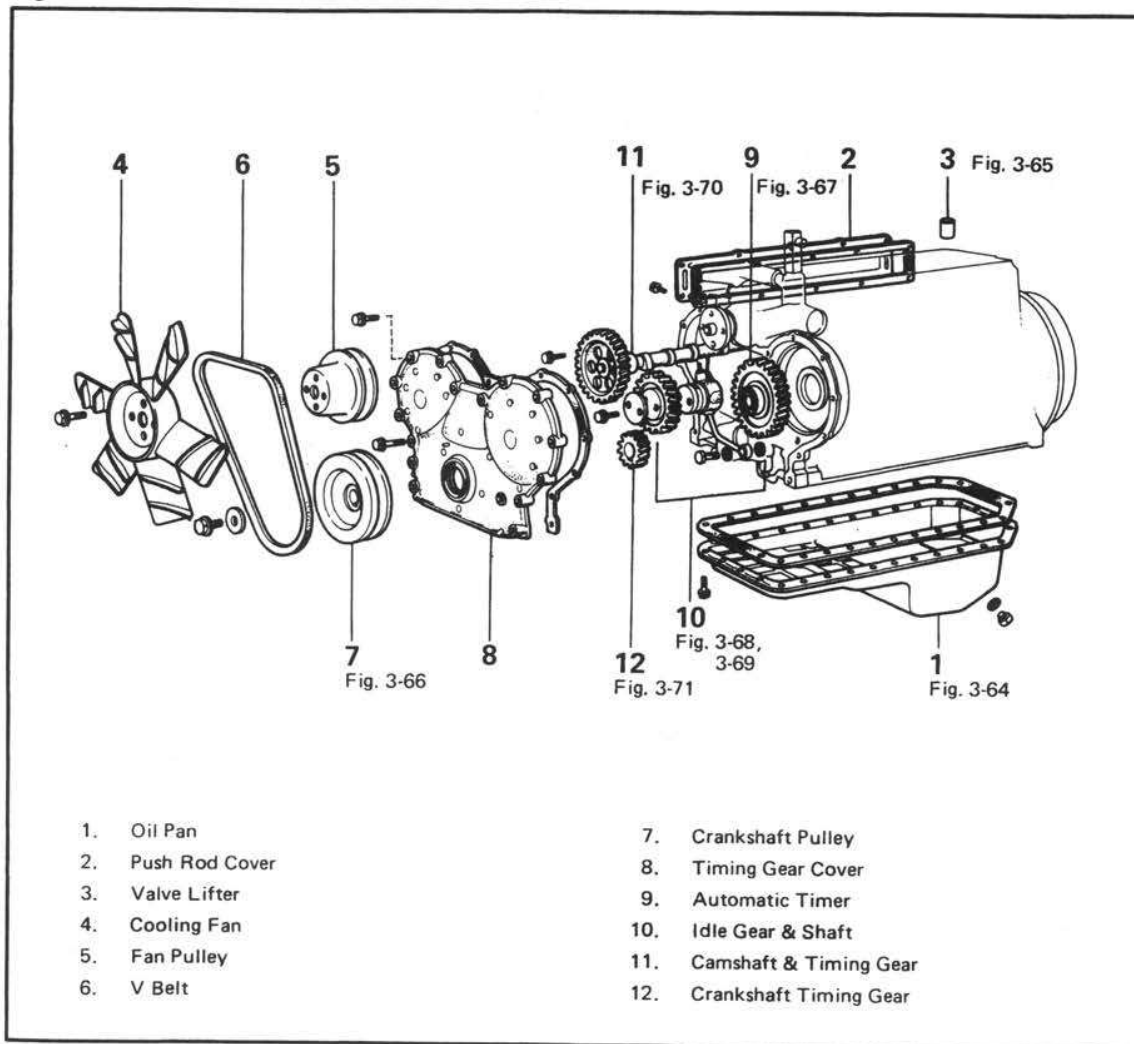
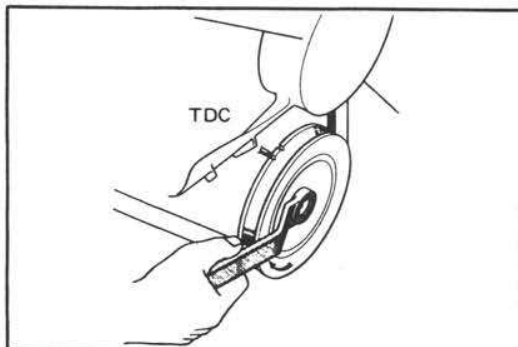
Fig. 3-62

Tighten nozzle holder with SST [09260-46011].

Torque**6.0 – 8.0 kg-m
(44 – 57 ft-lb)**

3-22 **ENGINE SERVICE – Timing Gear****TIMING GEAR****DISASSEMBLY**

Disassemble in numerical order.

Fig. 3-63**Fig. 3-64**

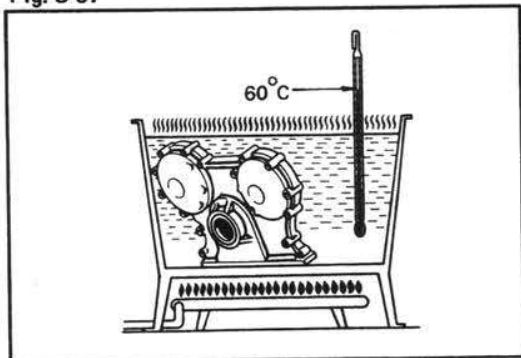
Before starting work, set No.1 cylinder piston at TDC/Compression.

ENGINE SERVICE – Timing Gear**3-23****Fig. 3-65**

Keep valve lifters in correct order.

**Fig. 3-66**

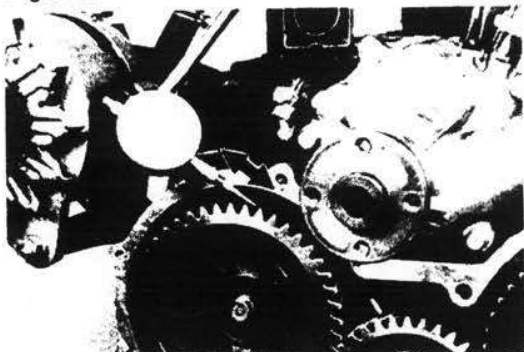
Pull out the crankshaft pulley with SST[09213-31021].

Fig. 3-67

Remove the automatic timer from the timing gear cover after heating the cover to about 60°C (140°F).

— Note —

For disassembly and assembly of the automatic timer, refer to "FUEL SYSTEM" section.

Fig. 3-68

Install the automatic timer to the injection pump spline shaft, and measure the timing gear backlashes.

Back lash**Camshaft, Timer to idle gear**

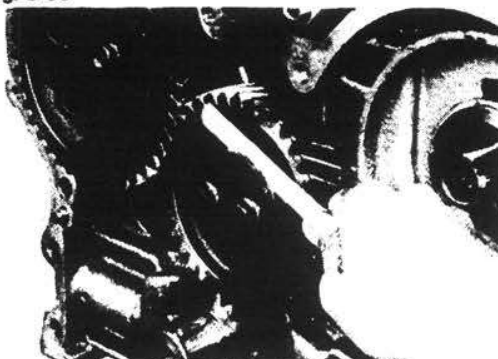
Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.09 mm (0.0024 – 0.0035 in.)

Crankshaft to idle gear

Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.10 mm (0.0024 – 0.0039 in.)

3-24 ENGINE SERVICE – Timing Gear

Fig. 3-69

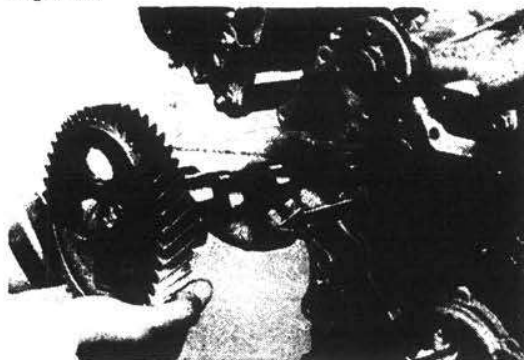


Measure idle gear thrust clearance.

Thrust clearance

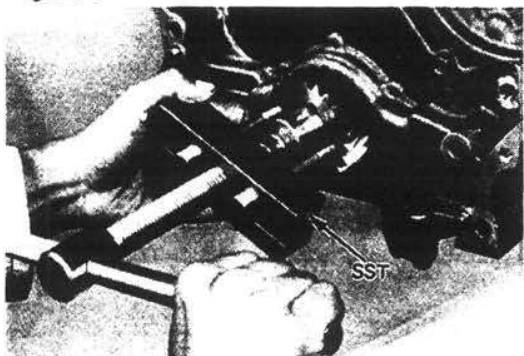
Limit	0.3 mm (0.012 in.)
STD	0.08 – 0.20 mm (0.0031 – 0.0079 in.)

Fig. 3-70

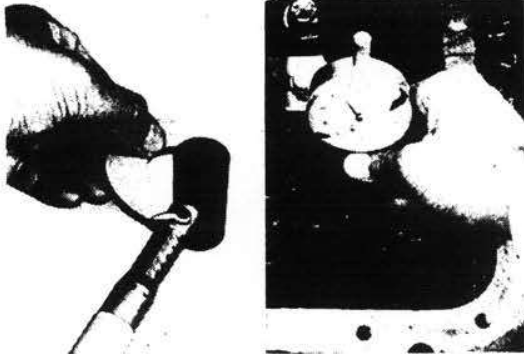


Pull out camshaft using care not to damage the camshaft bearings.

Fig. 3-71



Pull out crankshaft timing gear with SST [09213 -60015].

ENGINE SERVICE – Timing Gear**3–25****Fig. 3-72****INSPECTION & REPAIR****Valve Lifter**

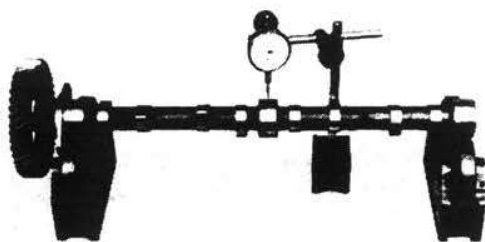
Inspect lifters and lifter bores for wear or damage.

Oil clearance

Limit	0.1 mm (0.004 in.)
STD	0.02 – 0.06 mm (0.0008 – 0.0024 in.)

Fig. 3-73**Timing Gears**

Inspect gears for cracks, wear and chipped teeth. If damaged, replace both timing gears.

Fig. 3-74**Camshaft**

1. Inspect camshaft for straightness, damage or wear.
2. Measure the run out.

Run out limit 0.04 mm (0.0016 in.)

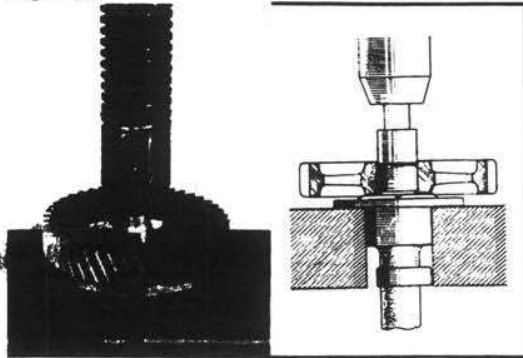
Fig. 3-75

3. Measure camshaft thrust clearance.

Thrust clearance

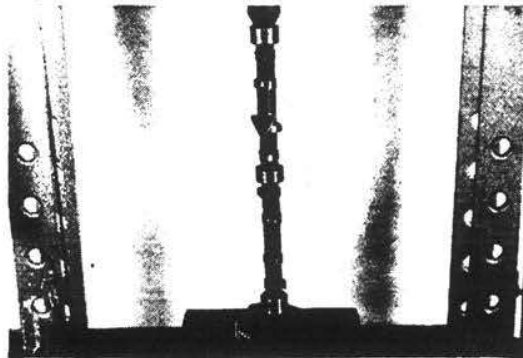
Limit	0.3 mm (0.012 in.)
STD	0.06 – 0.13 mm (0.0024 – 0.0051 in.)

3-26

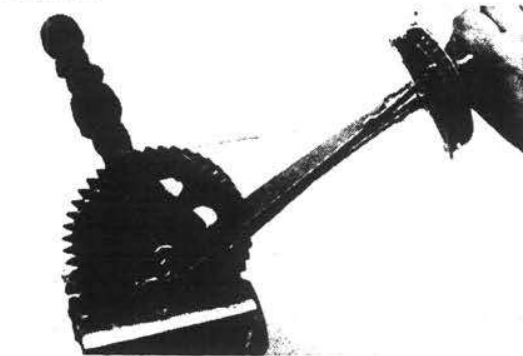
ENGINE SERVICE – Timing Gear**Fig. 3-76**

4. Replace thrust plate if the thrust clearance exceeds the limit.

- (1) Using a press and a spacer, press out the timing gear from the camshaft.

Fig. 3-77

- (2) Using a press, press in the timing gear.

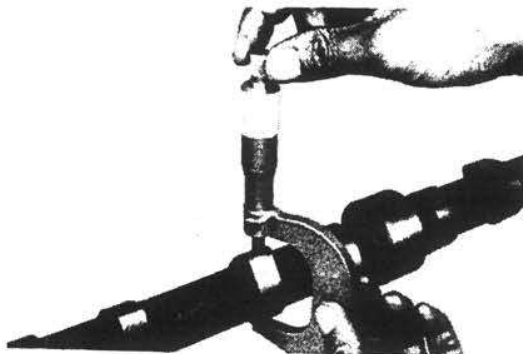
Fig. 3-78

- (3) Tighten retaining bolt.

**Torque 3.0 – 4.5 kg-m
(22 – 32 ft-lb)**

– Note –

Apply a light coating of engine oil on the bolt threads and under the bolt head before installing.

Fig. 3-79

5. Measure cam height.

Cam Height (for both IN. and EX.)
Limit 39.0 mm (1.535 in.)
STD 39.47 – 39.56 mm
(1.5539 – 1.5575 in.)

ENGINE SERVICE — Timing Gear**3-27****Fig. 3-80**

6. Measure journal oil clearance.
(1) Measure camshaft journal diameter.

Journal diameter (STD)

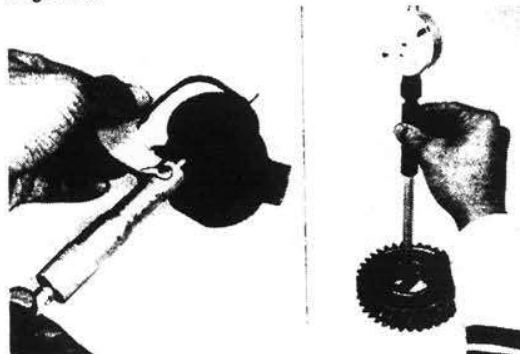
No.1	47.16 – 47.18 mm (1.8567 – 1.8575 in.)
No.2	46.96 – 46.98 mm (1.8488 – 1.8496 in.)
No.3	46.76 – 46.78 mm (1.8409 – 1.8417 in.)

Fig. 3-81

- (2) Measure bearing inner diameter, referring to "CYLINDER BLOCK" section.

Oil clearance

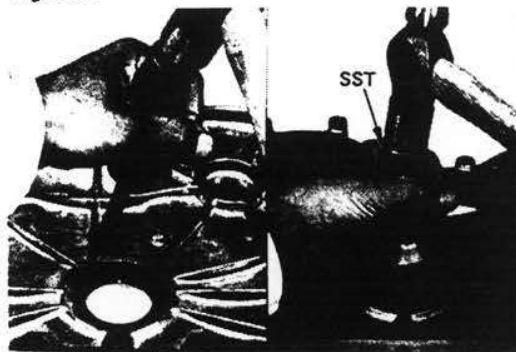
Limit	0.1 mm (0.004 in.)
STD	0.03 – 0.07 mm (0.0012 – 0.0028 in.)

Fig. 3-82**Idle Gear**

Measure idle gear oil clearance.

Oil clearance

Limit	0.3 mm (0.012 in.)
STD	0.04 – 0.09 mm (0.0016 – 0.0035 in.)

Fig. 3-83**Crankshaft Front Oil Seal**

1. Check oil seal for wear or damage.
2. Replace oil seal with SST [09223-46010].



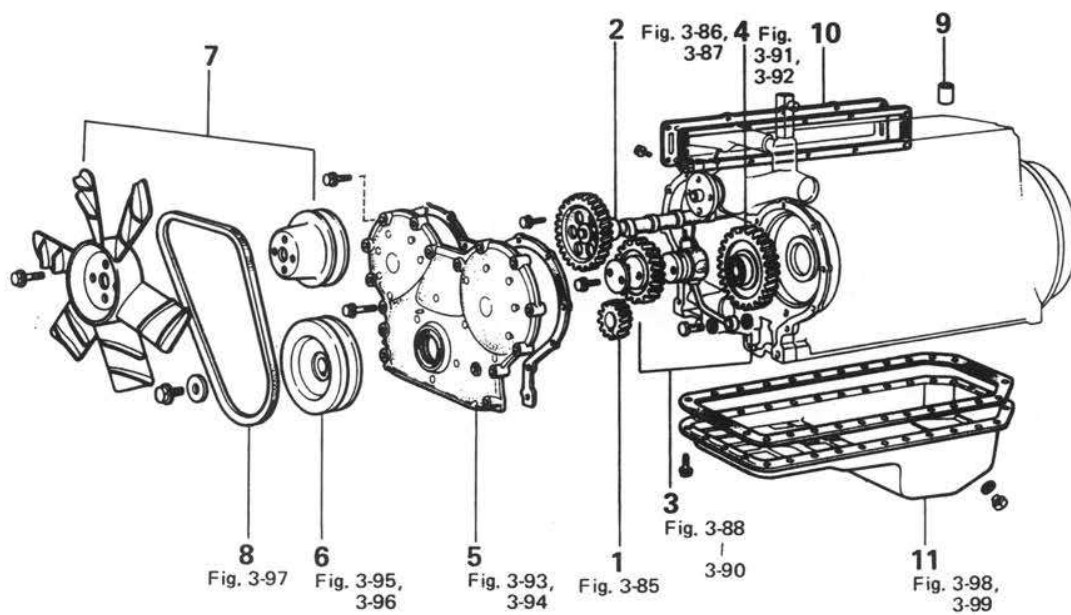
3-28 ENGINE SERVICE – Timing Gear

ASSEMBLY

Assemble in numerical order.

Fig. 3-84

Thoroughly clean all parts to be assembled.
Apply clean engine oil to all sliding and rotating surfaces of the parts before assembly.

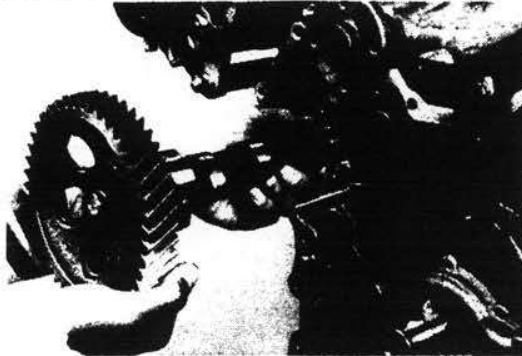


- | | |
|---------------------------|-----------------------------|
| 1. Crankshaft Timing Gear | 7. Cooling Fan & Fan Pulley |
| 2. Camshaft & Timing Gear | 8. V Belt |
| 3. Idle Gear & Shaft | 9. Valve Lifter |
| 4. Automatic Timer | 10. Push Rod Cover |
| 5. Timing Gear Cover | 11. Oil Pan |
| 6. Crankshaft Pulley | |

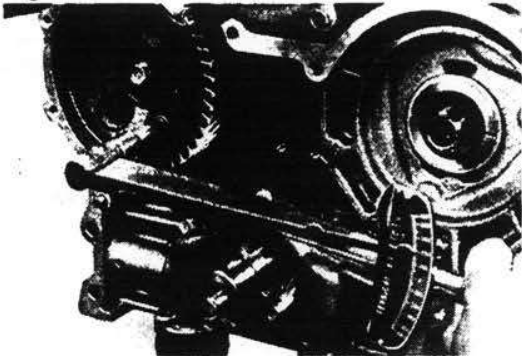
Fig. 3-85



Drive in crankshaft timing gear with SST [09214-60010].

ENGINE SERVICE – Timing Gear**3-29****Fig. 3-86**

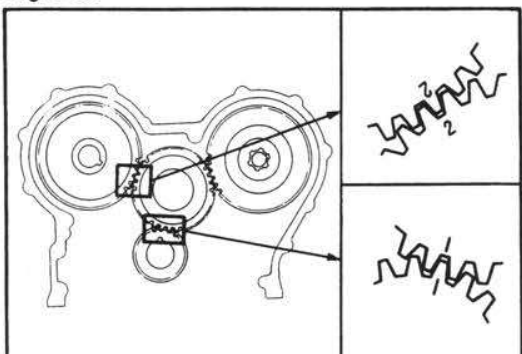
Insert camshaft using care not to damage the camshaft bearings.

Fig. 3-87

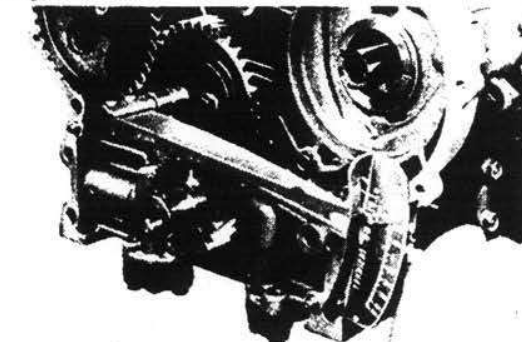
Tighten camshaft thrust plate.

Torque

**1.0 – 1.6 kg-m
(8 – 11 ft-lb)**

Fig. 3-88

Set idle gear aligning marks "1" and "2" respectively against crankshaft gear mark "1" and camshaft gear mark "2".

Fig. 3-89

Tighten the idle gear and shaft.

Torque

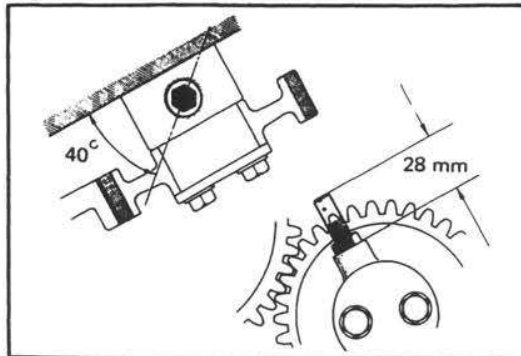
**4.0 – 5.5 kg-m
(29 – 39 ft-lb)**

— Note —

Apply a light coating of engine oil on the bolt threads and under head (thrust plate contacting surface) before installing the bolts.

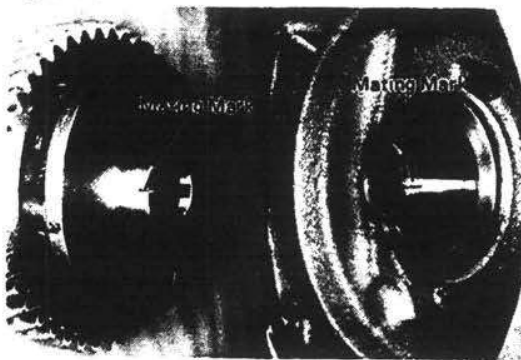
3-30 ENGINE SERVICE – Timing Gear

Fig. 3-90



Oil injection hole should face the side where the camshaft and idle gears are engaged.

Fig. 3-91

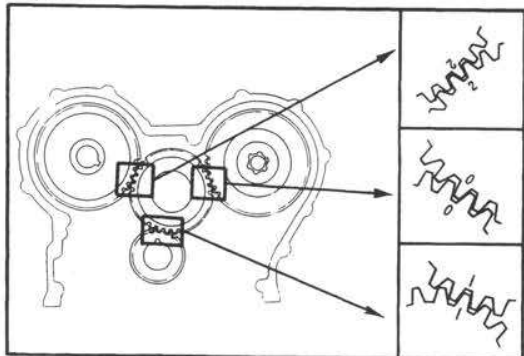


Align the mating marks on injection pump spline shaft and timer drive shaft when installing the automatic timer.

— Note —

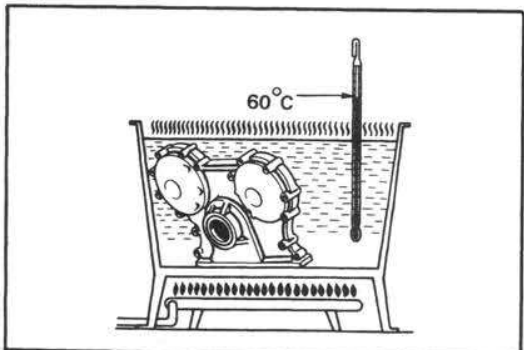
Coat the splines and bearing with MP grease.

Fig. 3-92



Align the idle gear mark "O" against the timer drive gear mark "O".

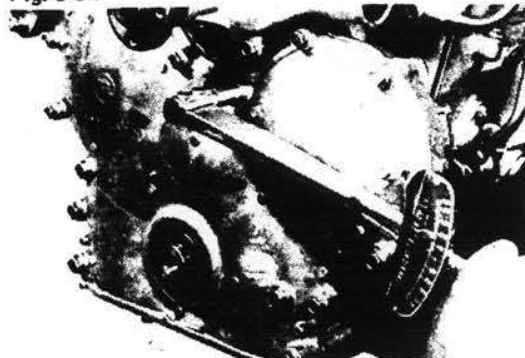
Fig. 3-93



Heat the timing gear cover to about 60°C (140°F) before installing.

ENGINE SERVICE – Timing Gear

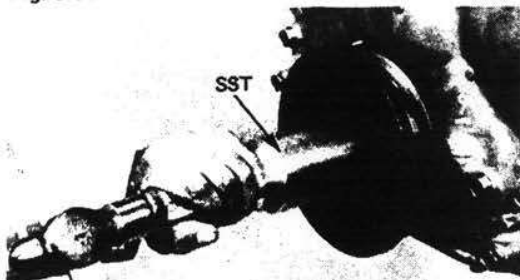
3-31

Fig. 3-94

Tighten timing gear cover.

Torque

8 mm bolt	1.5 – 2.2 kg-m (11 – 15 ft-lb)
10 mm bolt	3.0 – 4.5 kg-m (22 – 32 ft-lb)

Fig. 3-95

Drive in the crankshaft pulley with SST [09214-60010].

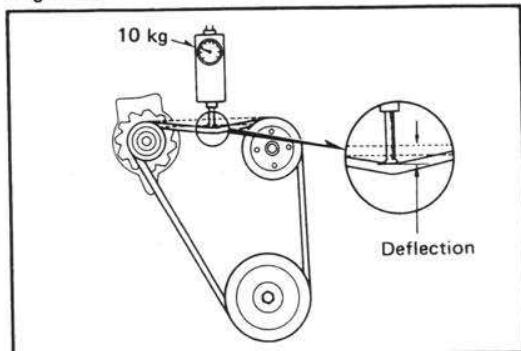
Fig. 3-96

Tighten retaining bolt.

Torque	20.0 – 24.0 kg-m (145 – 173 ft-lb)
---------------	---

– Note –

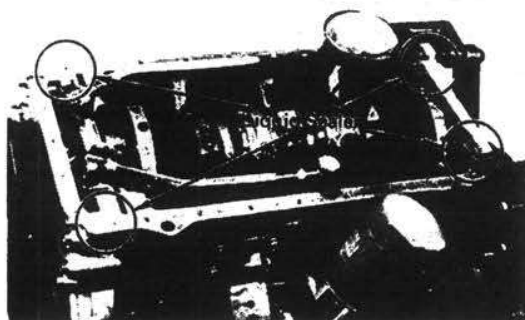
Apply a light coating of engine oil on the bolt threads and under the bolt head before installing.

Fig. 3-97

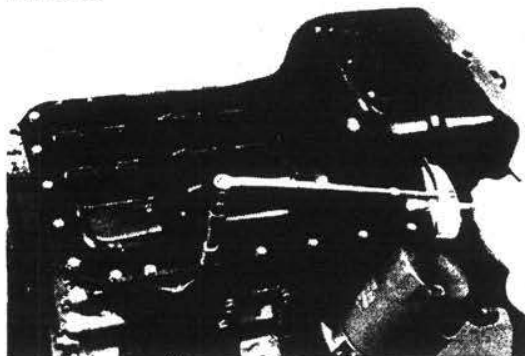
Adjust "V" belt tension.

Deflection at 10 kg (22 lb) force

B engine	10 – 13 mm (0.4 – 0.5 in.)
2B engine	8 – 11 mm (0.3 – 0.4 in.)

3-32 ENGINE SERVICE – Timing Gear**Fig. 3-98**

Apply liquid sealer to the cylinder block and gear cover as shown.

Fig. 3-99

Install oil pan.

Torque

**0.5 – 1.0 kg-m
(4 – 7 ft-lb)**

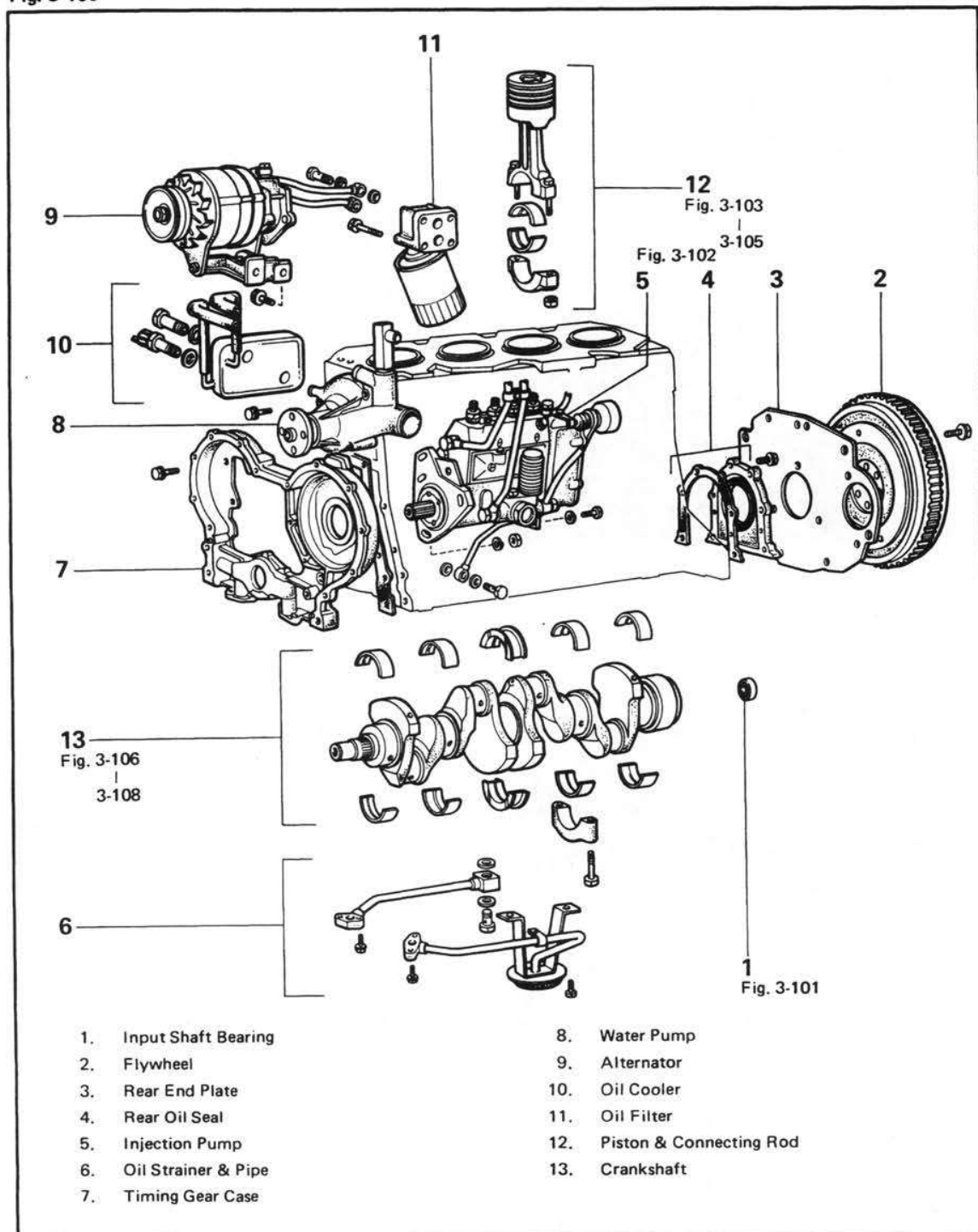
ENGINE SERVICE — Cylinder Block

3-33

CYLINDER BLOCK**DISASSEMBLY**

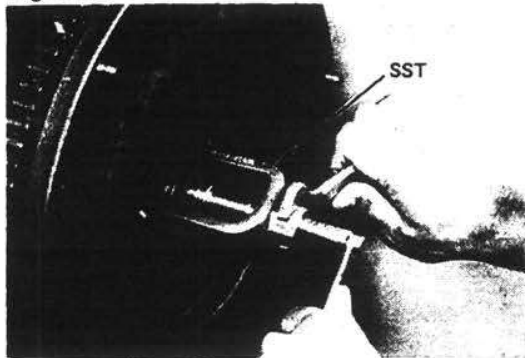
Disassemble in numerical order.

Fig. 3-100



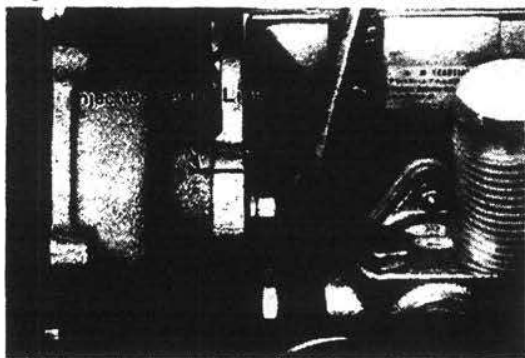
3-34 **ENGINE SERVICE** — Cylinder Block

Fig. 3-101



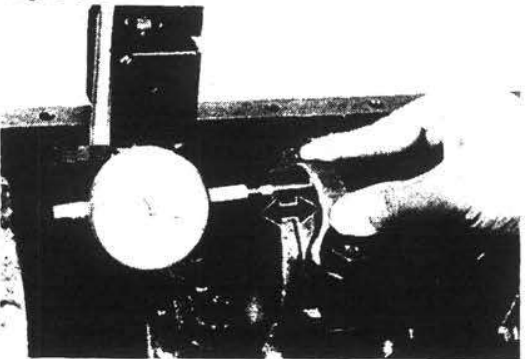
Remove input shaft bearing with SST[09303-35010].

Fig. 3-102



Check the position of injection period line before removing injection pump.

Fig. 3-103

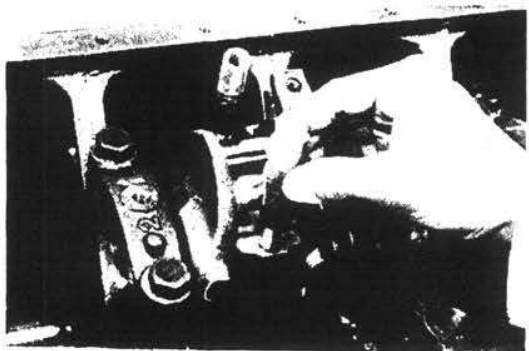


Measure connecting rod thrust clearance. If it exceeds the limit, replace connecting rod.

Thrust clearance

Limit	0.3 mm (0.012 in.)
STD	0.08 – 0.20 mm (0.0031 – 0.0079 in.)

Fig. 3-104



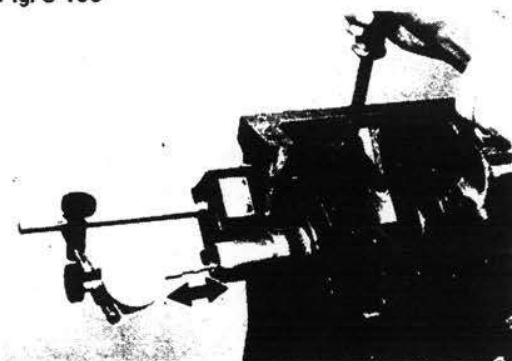
Cover rod bolts with a short hose to protect crankshaft pins from damage.

ENGINE SERVICE – Cylinder Block**3-35****Fig. 3-105**

Keep connecting rods and bearings in correct order.

**Fig. 3-106**

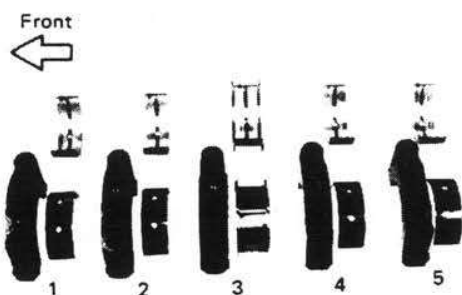
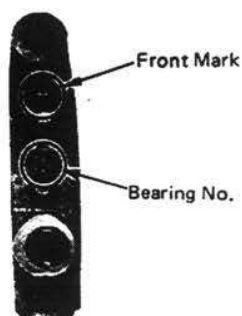
Measure crankshaft thrust clearance.
If it exceeds the limit, replace bearings as a set.

**Thrust clearance**

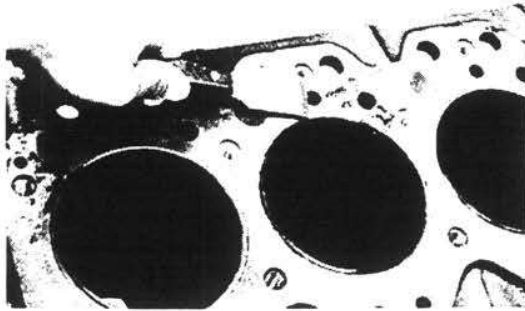
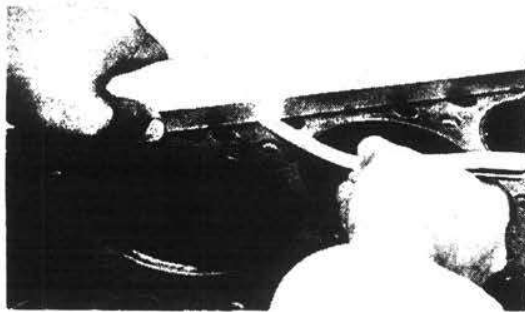
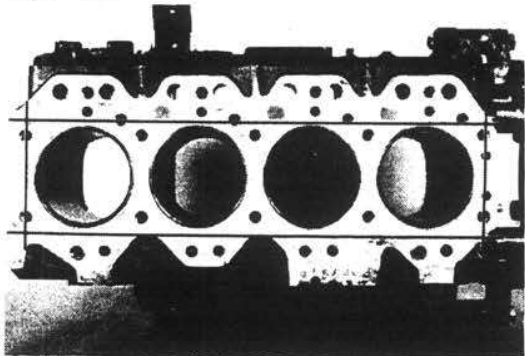
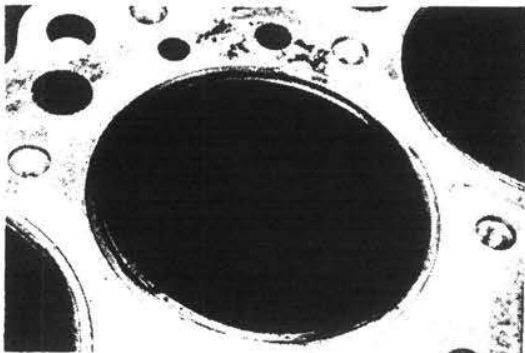
Limit	0.3 mm (0.012 in.)
STD	0.07 – 0.18 mm (0.0028 – 0.0071 in.)
U/S bearing type	0.25, 0.50, 1.00

Fig. 3-107

Keep crankshaft bearings and caps in correct order.

**Fig. 3-108**

3-36

ENGINE SERVICE — Cylinder Block**Fig. 3-109****Fig. 3-110****Fig. 3-111****Fig. 3-112****INSPECTION & REPAIR****Cylinder Block & Liner**

1. Clean and check cylinder block for cracks or scores.



2. Using a precision straight edge and thickness gauge, inspect the cylinder block topside surface for warpage.

Topside surface warpage limit
0.05 mm (0.0020 in.)



3. Inspect for warpage at the indicated lines shown in left.



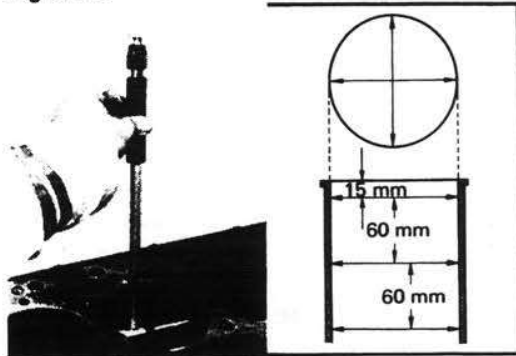
4. Visually inspect cylinders for vertical scratches. If there are deep scratches, the cylinder liner must be rebored.

— Note —

When reboring cylinder, rebore all cylinders to the same size.

ENGINE SERVICE – Cylinder Block

3-37

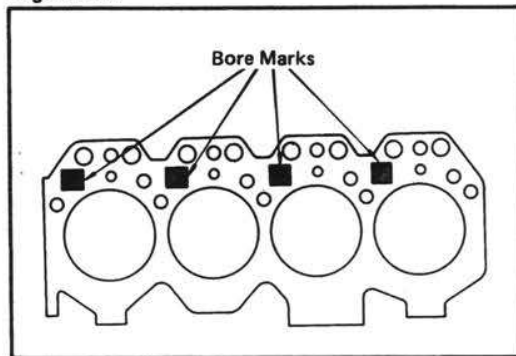
Fig. 3-113

5. Measure cylinder bores at top, middle and bottom as shown. If the bore exceeds the limit, it must be rebored.

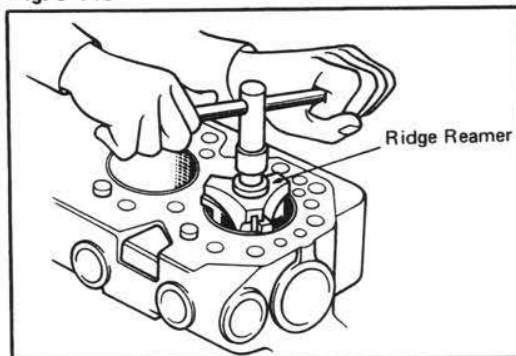
Wear limit 0.3 mm (0.012 in.)

Standard Bore

Mark	Size	
	B Engine	2B Engine
1	95.00 – 95.01 mm (3.7402 – 3.7405 in.)	98.00 – 98.01 mm (3.8583 – 3.8587 in.)
2	95.01 – 95.02 mm (3.7405 – 3.7409 in.)	98.01 – 98.02 mm (3.8587 – 3.8590 in.)
3	95.02 – 95.03 mm (3.7409 – 3.7413 in.)	98.02 – 98.03 mm (3.8590 – 3.8594 in.)

Fig. 3-114**– Note –**

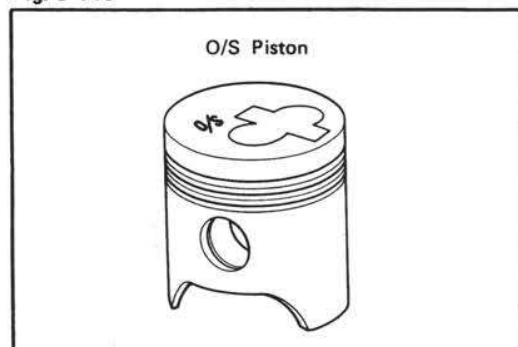
The bore marks are stamped on cylinder block topside surface as shown.

Fig. 3-115

6. If the wear is less than 0.3 mm (0.012 in.), machine piston ring ridge at the top of bore with a ridge reamer.

– Note –

If this step is not performed prior to removing pistons the piston ring lands will be damaged.

Fig. 3-116

7. Use oversize pistons when cylinder liners are rebored.

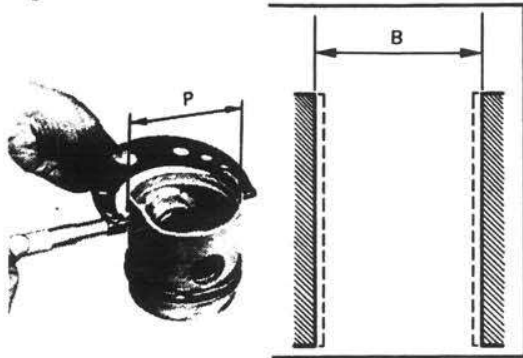
Oversize piston diameter, O/S 1.00

**B engine 95.88 – 95.91 mm
(3.7748 – 3.7760 in.)**

**2B engine 98.88 – 98.91 mm
(3.8929 – 3.8941 in.)**

3-38 ENGINE SERVICE — Cylinder Block

Fig. 3-117



8. Use following equation to determine reboring finished diameter.

$$B = P + C - H$$

Where **B**: Reboring finished diameter

P: O/S piston diameter

C: Piston clearance

0.11 – 0.13 mm

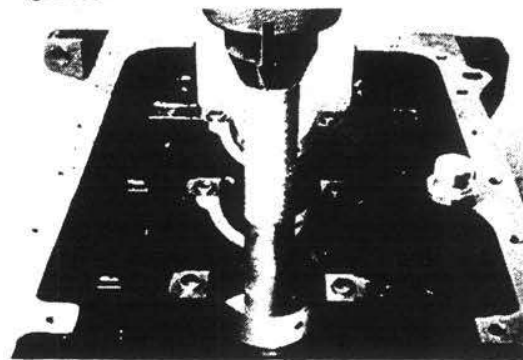
(0.0043 – 0.0051 in.)

H: Honing allowance

Less than 0.02 mm

(0.0008 in.)

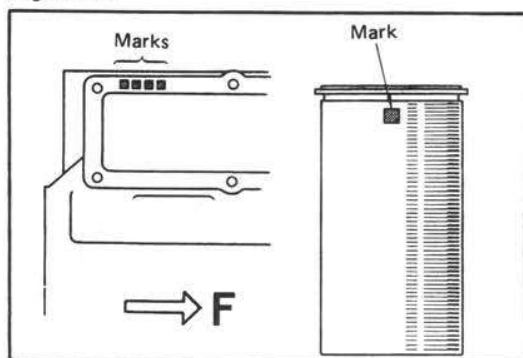
Fig. 3-118



9. Replace cylinder liner if the bore damage is excessive, or if the bore is worn so much that O/S 1.00 piston cannot be used.

(1) Press out cylinder liner with SST [09218-56010].

Fig. 3-119



- (2) Select the liner having the same mark with the cylinder block, "A" or "B".

Fig. 3-120

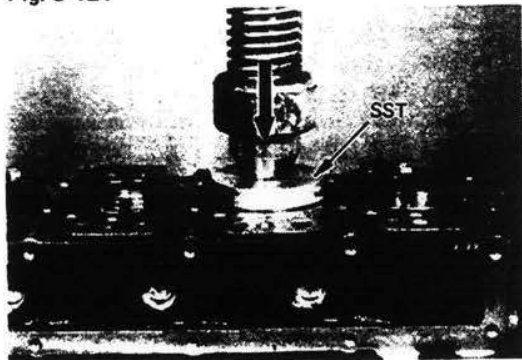


- (3) Lubricate outside surface of the liner with engine oil before installing.

ENGINE SERVICE — Cylinder Block

3-39

Fig. 3-121



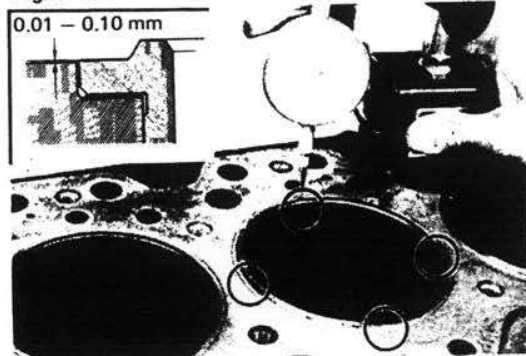
- (4) Press in the liner with SST[09218-56010].

Pressing force
5,000 kg (11,000 lb)

— Note —

After pressing in the liner, rebore and hone the liner bore to fit STD piston.

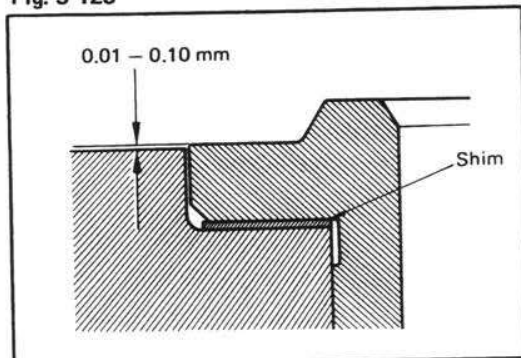
Fig. 3-122



10. Measure protrusion of cylinder liner above cylinder block topside surface at four positions.

Protrusion 0.01 - 0.10 mm
(0.0004 - 0.0039 in.)

Fig. 3-123



11. Adjust protrusion of cylinder liner with cylinder liner shims.

Cylinder liner shim thickness
0.05, 0.10 mm (0.002, 0.004 in.)

Fig. 3-124

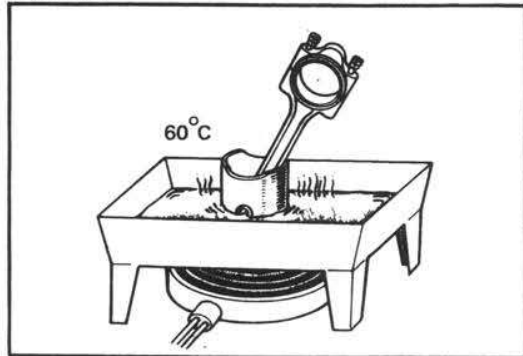


Piston Pin & Connecting Rod

1. Check pin fit by rocking piston at right angle to pin.
If any movement is felt, replace piston and pin.

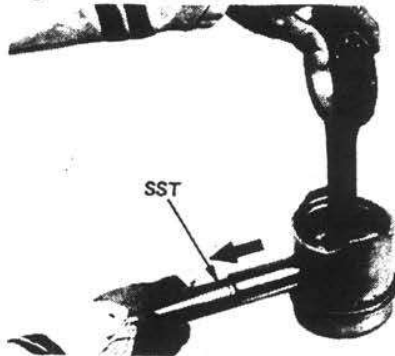
3-40 ENGINE SERVICE – Cylinder Block

Fig. 3-125



2. Heat piston in a piston heater to about 60°C (140°F) before removing piston pin.

Fig. 3-126



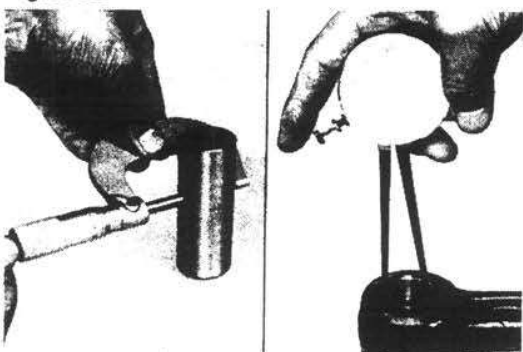
3. Remove piston pin with SST [09221-46010].

Fig. 3-127



4. Check piston pin fitness. Heat piston to about 60°C (140°F), and coat pin with engine oil. It should then be possible to push the pin into the piston hole with thumb pressure.

Fig. 3-128



5. Measure oil clearance between bushing and piston pin.

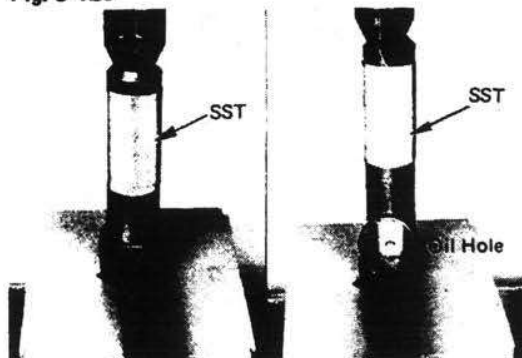
Oil clearance

Limit	0.05 mm (0.0020 in.)
STD	0.004 – 0.012 mm (0.0002 – 0.0005 in.)

ENGINE SERVICE — Cylinder Block

3-41

Fig. 3-129



6. Replace bushing with SST [09222-66010].



— Note —

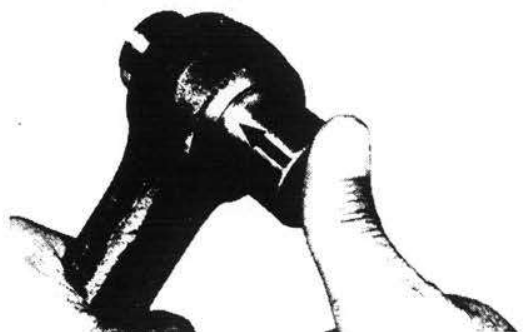
Align the bushing oil hole with the connecting rod oil hole.

Fig. 3-130



7. After installing the bushing, finish bushing bore with a pin hole grinder.

Fig. 3-131



8. The fitting between bushing and pin should be such that the pin, when coated with engine oil, can be pushed in with the thumb at normal temperature.

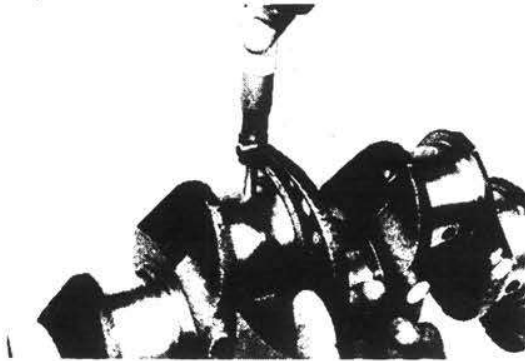
Fig. 3-132

**Crankpin Bearing**

1. Check bearings for flaking or scoring. If damaged, replace.

3-42 **ENGINE SERVICE** — Cylinder Block

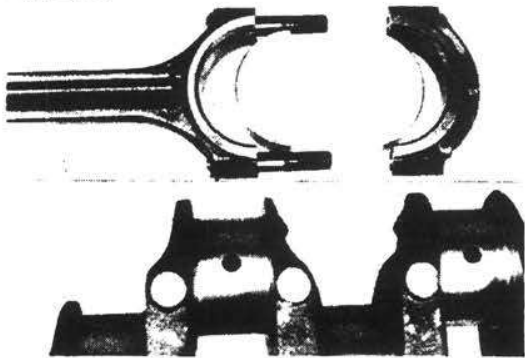
Fig. 3-133



2. Measure crankpin diameter.
If wear is excessive, crankshaft must be reground or replaced.

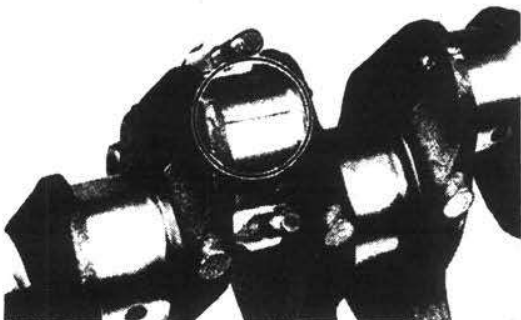
Crankpin diameter (STD)**58.98 – 59.00 mm****(2.3220 – 2.3228 in.)**

Fig. 3-134



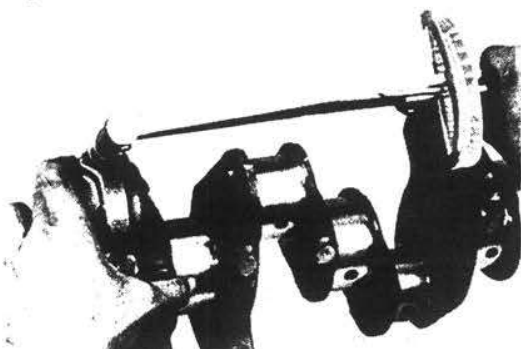
3. Measure crankpin oil clearance.
(1) Clean crankshaft pin, connecting rod, cap and bearings.

Fig. 3-135



- (2) Lay strip of plastigage across pin.

Fig. 3-136



- (3) Tighten cap nuts to specified torque.

Torque 6.5 – 7.5 kg-m
(48 – 54 ft-lb)**— Caution —****Do not turn connecting rod or crankshaft.**

Fig. 3-137



- (4) Measure plastigage at its widest point.
If clearance is not within specification, replace bearings.

Oil clearance

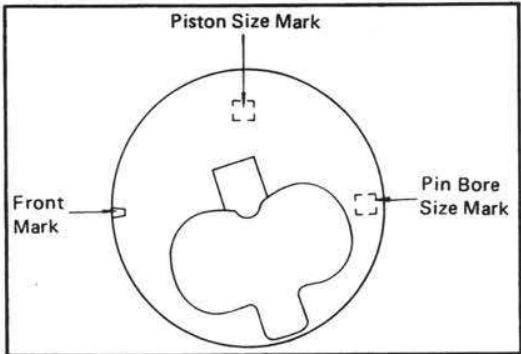
Limit	0.1 mm (0.004 in.)
STD	0.03 – 0.07 mm (0.0012 – 0.0028 in.)
U/S bearing type	0.25, 0.50, 1.00

Fig. 3-138



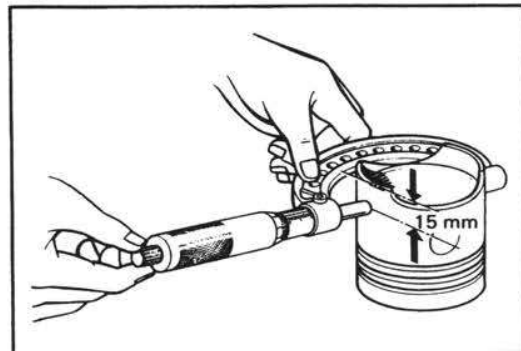
- Piston**
1. Check piston for wear and damage, especially in the piston ring grooves and ring lands.

Fig. 3-139



- Note –
At the piston top surface there is a mark indicating the front side, and stamped codes indicating piston diameter and piston pin bore.

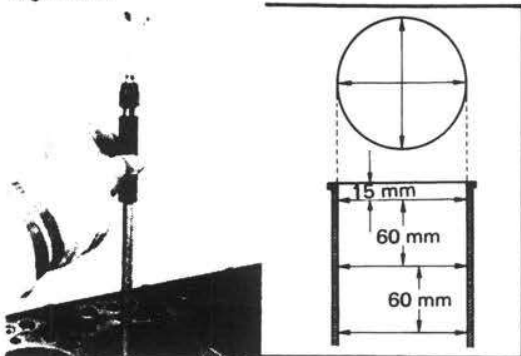
Fig. 3-140



2. Check piston clearance.
- (1) Measure piston diameter, in the thrust direction about 15 mm (0.59 in.) up from skirt bottom edge. Measurement must be made at normal temperature 20°C (68°F).

Mark	Piston Size	
	B Engine	2B Engine
1	94.88 – 94.89 mm (3.7354 – 3.7358 in.)	97.88 – 97.89 mm (3.8535 – 3.8539 in.)
2	94.89 – 94.90 mm (3.7358 – 3.7362 in.)	97.89 – 97.90 mm (3.8539 – 3.8543 in.)
3	94.90 – 94.91 mm (3.7362 – 3.7366 in.)	97.90 – 97.91 mm (3.8543 – 3.8547 in.)

3-44

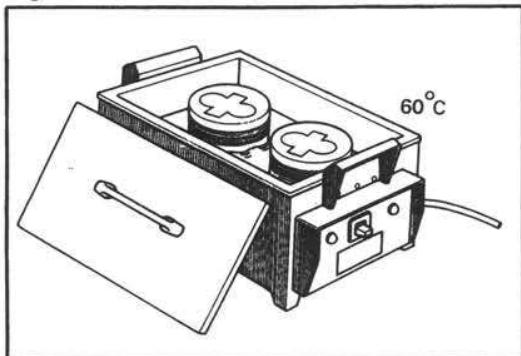
ENGINE SERVICE – Cylinder Block**Fig. 3-141**

- (2) Measure cylinder bore and subtract piston size.

Mark	Cylinder Size	
	B Engine	2B Engine
1	95.00 – 95.01 mm (3.7402 – 3.7405 in.)	98.00 – 98.01 mm (3.8583 – 3.8587 in.)
2	95.01 – 95.02 mm (3.7405 – 3.7409 in.)	98.01 – 98.02 mm (3.8587 – 3.8590 in.)
3	95.02 – 95.03 mm (3.7409 – 3.7413 in.)	98.02 – 98.03 mm (3.8590 – 3.8594 in.)

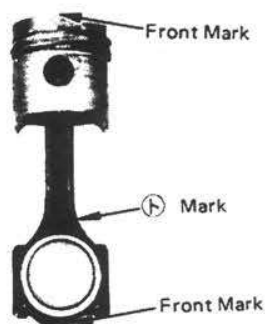
Piston clearance

0.11 – 0.13 mm
(0.0043 – 0.0051 in.)

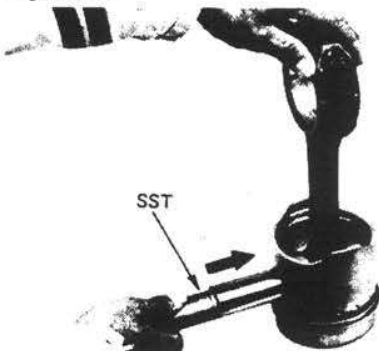
Fig. 3-142

- 3 Assemble piston and connecting rod as follows.

- (1) Heat piston to about 60°C (140°F) before installing piston pin.

Fig. 3-143

- (2) Align front mark of the piston and "Ⓟ" mark of the connecting rod as shown.

Fig. 3-144

- (3) Install piston pin with SST[09221-46010].

ENGINE SERVICE – Cylinder Block

3-45

Fig. 3-145



(4) Install snap ring on both side.

– Caution –

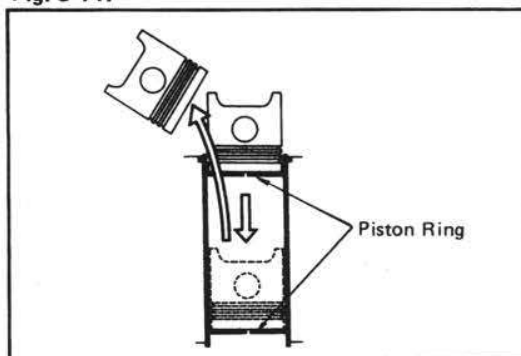
Make sure snap ring is completely in place.

Fig. 3-146

**Piston Ring**

1. Remove piston ring with a piston ring expander.

Fig. 3-147

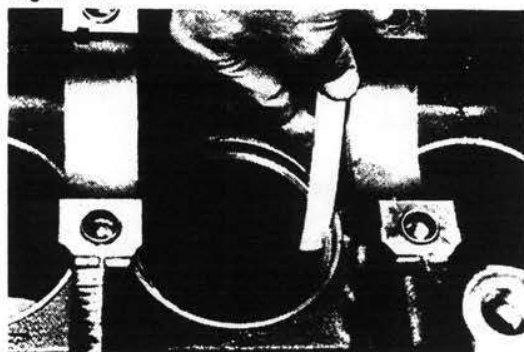


2. Measure piston ring end gap with the ring at the lower part of the cylinder bore Where the wear is least.

– Note –

Use correct size rings to match the piston size.

Fig. 3-148



3. Measure end gap.

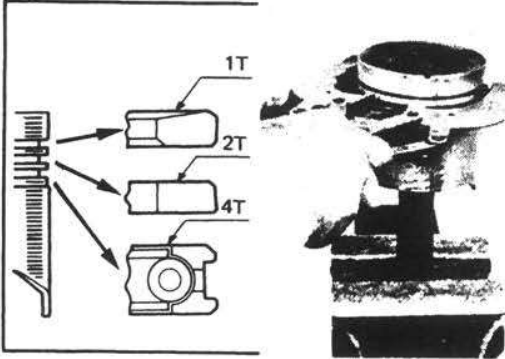
End Gap

Ring	B Engine	2B Engine
No.1	0.35 – 0.55 mm (0.0138 – 0.0217 in.)	0.40 – 0.60 mm (0.0157 – 0.0236 in.)
No.2	0.30 – 0.50 mm (0.0118 – 0.0197 in.)	←
Oil Ring	0.30 – 0.50 mm (0.0118 – 0.0197 in.)	←

3-46

ENGINE SERVICE – Cylinder Block**Fig. 3-149**

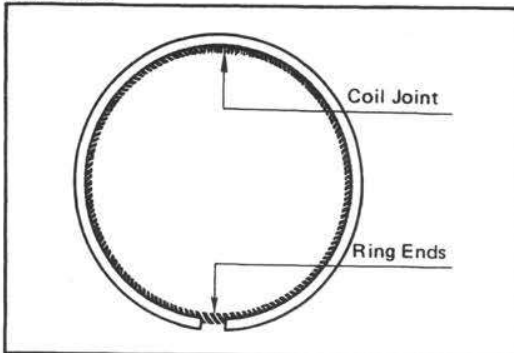
4. Clean ring grooves with groove cleaning tool or broken ring.

Fig. 3-150

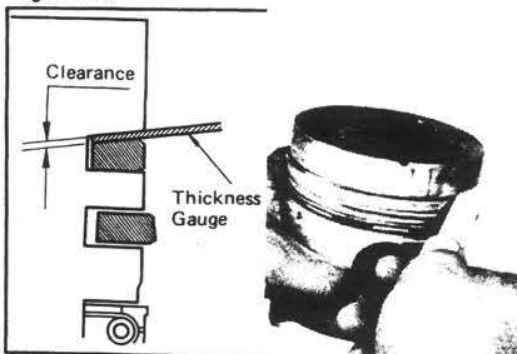
5. Install piston ring with the piston ring expander.

– Note –

1. Always install the rings with code marks facing up.

Fig. 3-151

2. To assemble the oil ring and expander coil, insure that expander coil joint is at the opposite side of the ring ends.

Fig. 3-152

6. With a thickness gauge, measure the clearance between No.1 ring and ring groove when ring is flush with piston surface.

No.1 ring to groove clearance
0.03 – 0.07 mm
(0.0012 – 0.0028 in.)

ENGINE SERVICE – Cylinder Block

3-47

Fig. 3-153

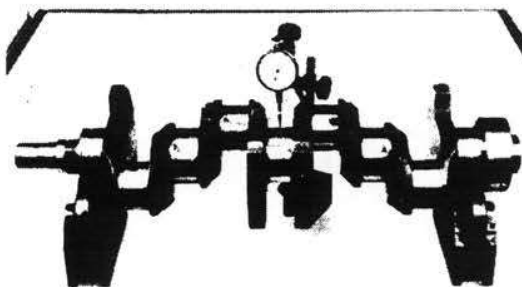


7. Measure No.2 and oil ring groove clearance. If it exceeds specification, replace ring and/or piston.

Ring to groove clearance

No.2	0.04 – 0.08 mm (0.0016 – 0.0031 in.)
Oil ring	0.03 – 0.07 mm (0.0012 – 0.0028 in.)

Fig. 3-154

**Crankshaft & Bearing**

1. Check crankshaft for run out and if it exceeds limit, replace.

Run out limit 0.06 mm (0.0024 in.)

Fig. 3-155

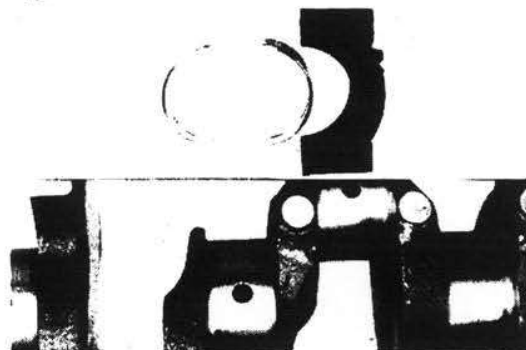


2. Measure crankshaft main journal. If wear is excessive, crankshaft must be reground or replaced.

Main journal diameter (STD)

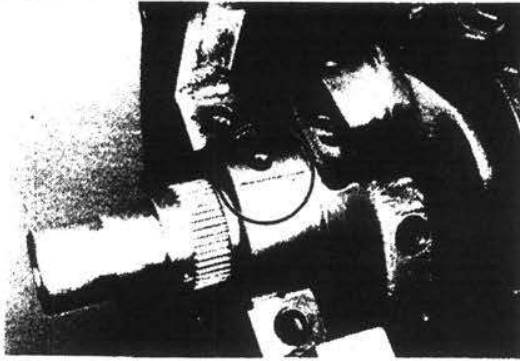
69.98 – 70.00 mm
(2.7551 – 2.7559 in.)

Fig. 3-156

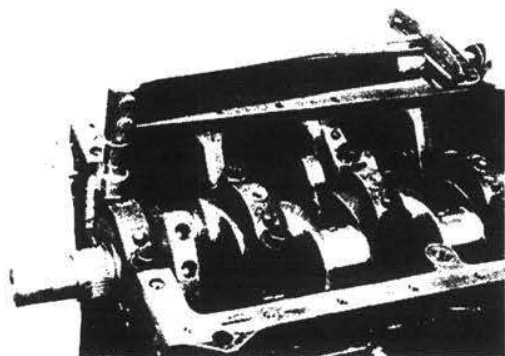


3. Measure main journal oil clearance.
(1) Clean journal, cap and bearing.

3-48

ENGINE SERVICE – Cylinder Block**Fig. 3-157**

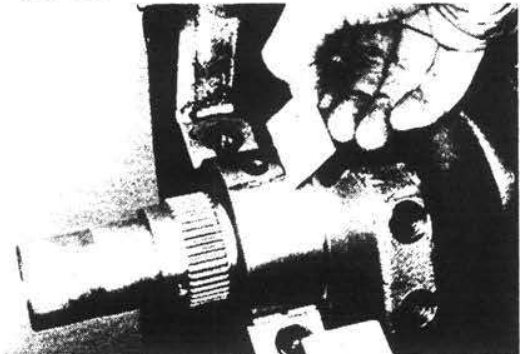
- (2) Lay a strip of plastigage across journal.

Fig. 3-158

- (3) Tighten cap bolts to specified torque.

Torque **9.8 – 11.2 kg-m**
 (71 – 81 ft-lb)

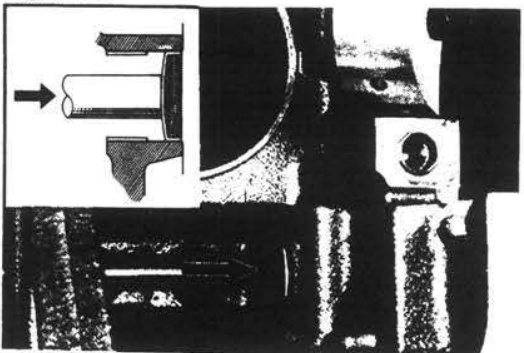
— **Caution** —
Do not turn crankshaft.

Fig. 3-159

- (4) Measure plastigage at its widest point. If clearance is not within specification, replace bearings.

Oil clearance

Limit **0.1 mm (0.004 in.)**
STD **0.03 – 0.07 mm**
 (0.0012 – 0.0028 in.)
U/S bearing type 0.25, 0.50, 1.00

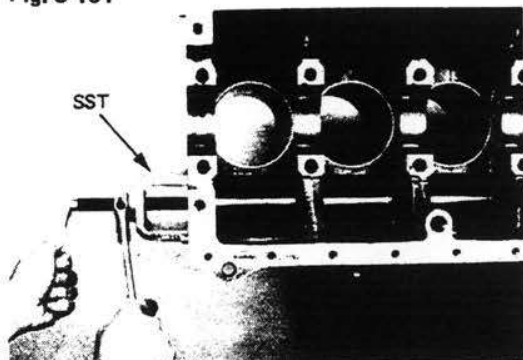
Fig. 3-160**Camshaft Bearing**

1. Remove camshaft rear expansion plug.

ENGINE SERVICE – Cylinder Block

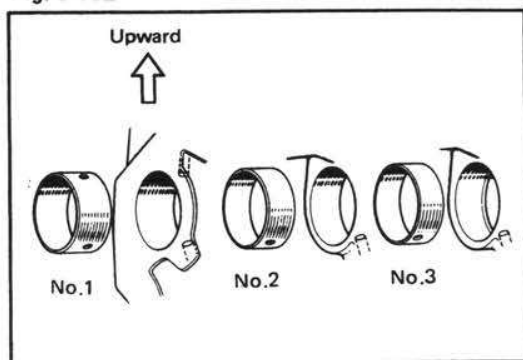
3-49

Fig. 3-161



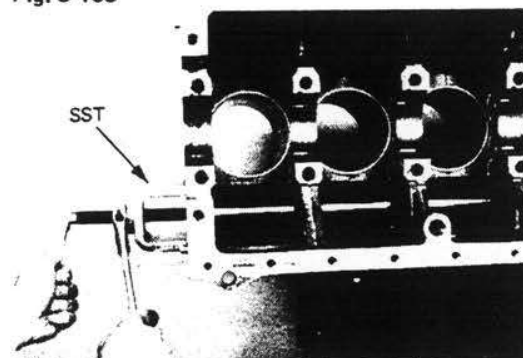
2. Remove camshaft bearings with SST[09210-56010].

Fig. 3-162



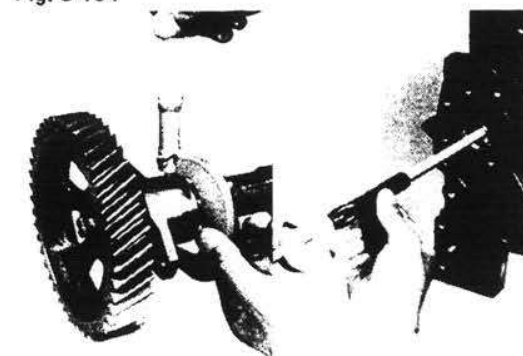
3. Align the bearing oil holes.

Fig. 3-163



4. Install new bearings with SST[09210-56010].

Fig. 3-164

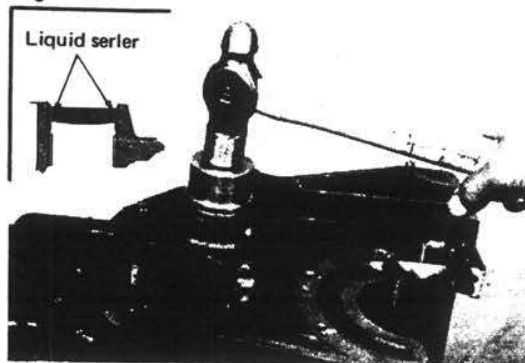


5. Check bearing oil clearance.

Oil clearance

Limit	0.1 mm (0.004 in.)
STD	0.03 – 0.07 mm (0.0012 – 0.0028 in.)

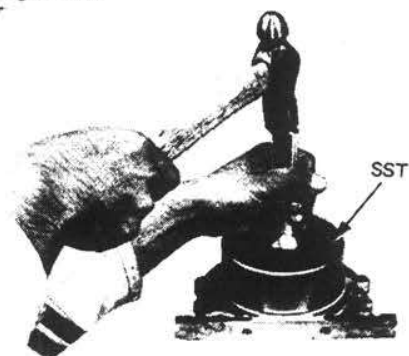
3-50

ENGINE SERVICE – Cylinder Block**Fig. 3-165**

6. Install new expansion plug with liquid sealer.

Fig. 3-166**Crankshaft Rear Oil Seal**

1. Remove oil seal.

Fig. 3-167

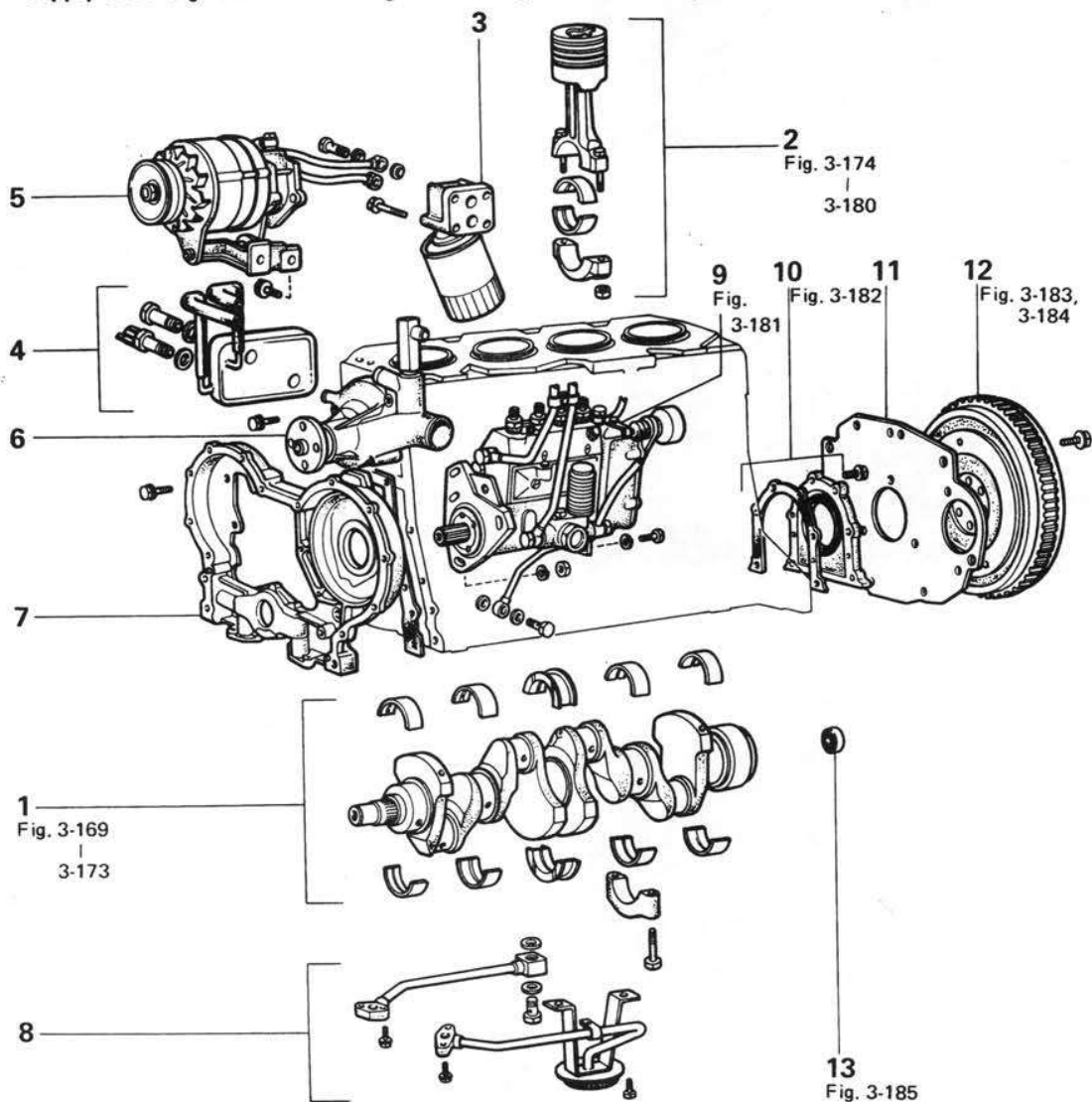
2. Install new oil seal with SST[09223-56010].

ENGINE SERVICE – Cylinder Block

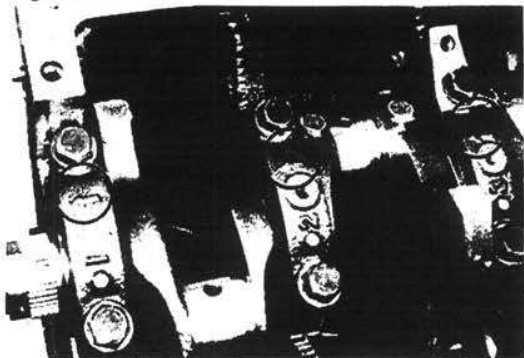
3-51

ASSEMBLY

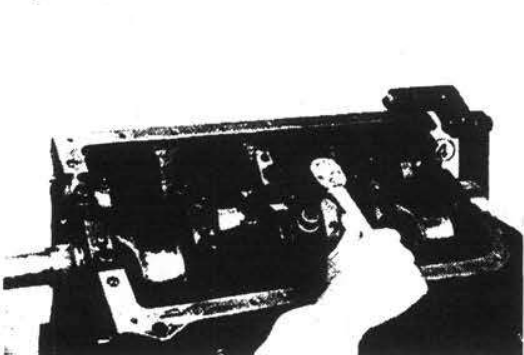
Assemble in numerical order.

Fig. 3-168**Thoroughly clean all parts to be assembled.****Apply clean engine oil to all sliding and rotating surfaces of the parts before assembly.**

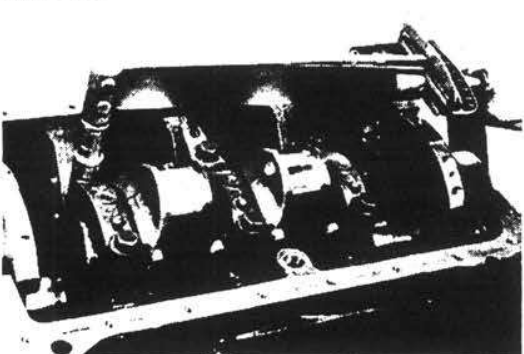
3-52

ENGINE SERVICE – Cylinder Block**Fig. 3-169**

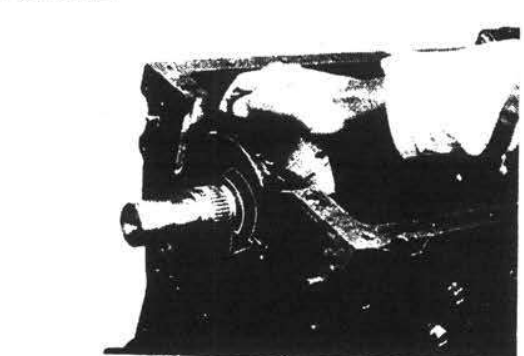
Face arrow mark toward the front.

Fig. 3-170

Tighten bearing cap bolts little by little in two or three steps in the specified numerical sequence.

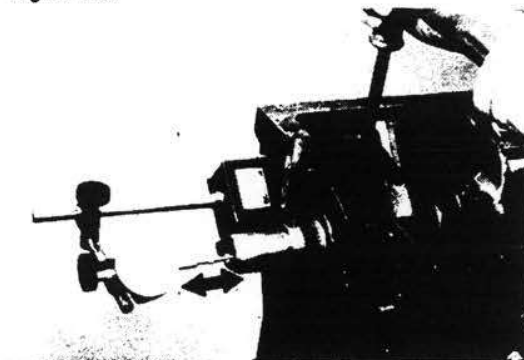
Fig. 3-171

Tighten bearing caps to specified torque.

Torque **9.8 – 11.2 kg-m (71 – 81 ft-lb)****Fig. 3-172**

— Note —

Check for tightness of crankshaft rotation after each tightening of bearing.

ENGINE SERVICE — Cylinder Block**3—53****Fig. 3-173**

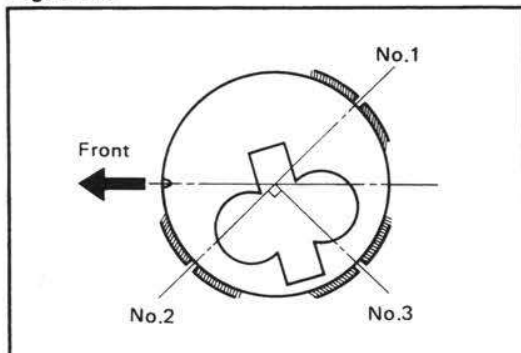
Measure crankshaft thrust clearance.

Thrust clearance

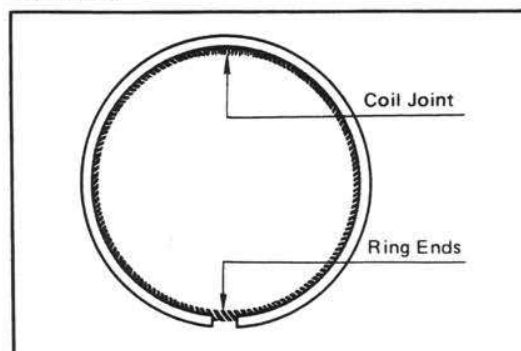
Limit	0.3 mm (0.012 in.)
STD	0.07 – 0.18 mm (0.0028 – 0.0071 in.)

Fig. 3-174

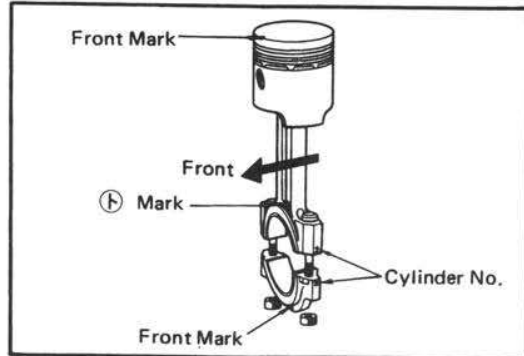
Cover rod bolts with a hose to protect crankpins from damage.

Fig. 3-175

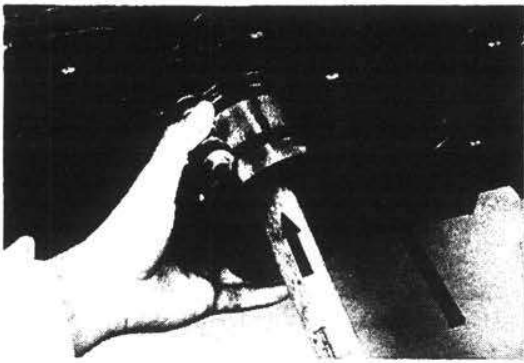
Position ring gap in the direction shown.

Fig. 3-176

The oil ring ends should be at the opposite side of the expander coil joint.

3-54 **ENGINE SERVICE – Cylinder Block****Fig. 3-177**

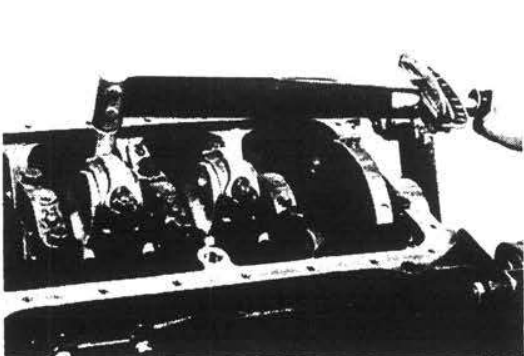
Assemble correctly numbered piston/rod assembly with the notch on piston and the "Ⓣ" mark on connecting rod facing the front.

Fig. 3-178

Insert piston into cylinder while compressing rings with a piston ring compressor.

— Caution —

Use care not to break piston ring.

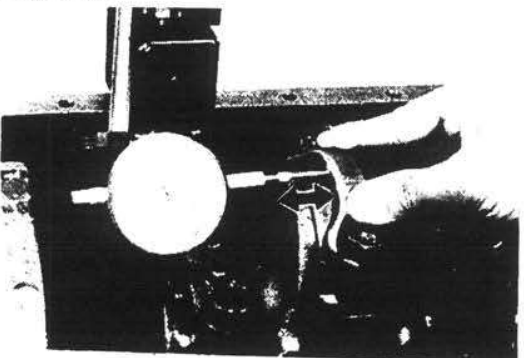
Fig. 3-179

Tighten connecting rod cap to specified torque.

Torque 6.5 – 7.5 kg-m (48 – 54 ft-lb)

— Note —

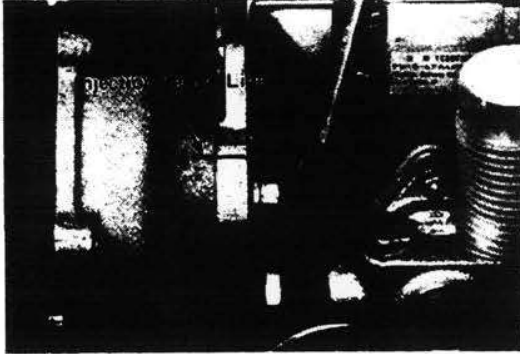
Check for tightness of crankshaft rotation after each tightening of bearing.

Fig. 3-180

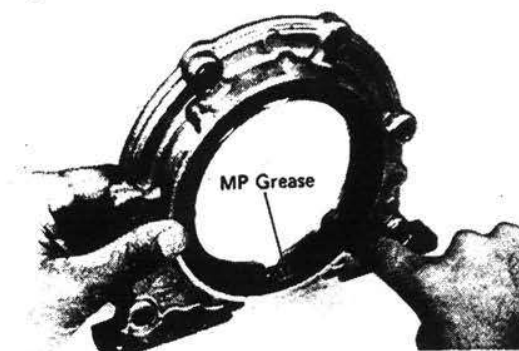
Check connecting rod thrust clearance.

Thrust clearance

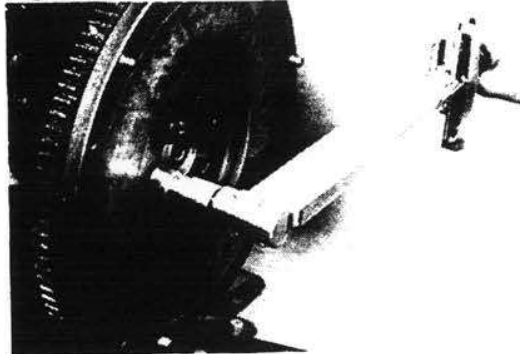
Limit	0.3 mm (0.012 in.)
STD	0.08 – 0.20 mm (0.0031 – 0.0079 in.)

ENGINE SERVICE – Cylinder Block**3-55****Fig. 3-181**

Set the injection period line back to the former position.

Fig. 3-182

Apply MP grease on oil seal lip before assembling.

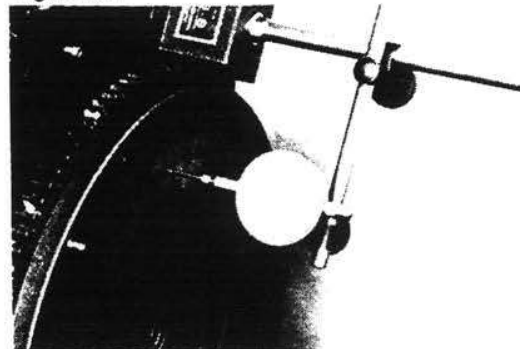
Fig. 3-183

Tighten bolts to specified torque.

Torque 11.5 – 12.5 kg-m (84 – 90 ft-lb)

– Note –

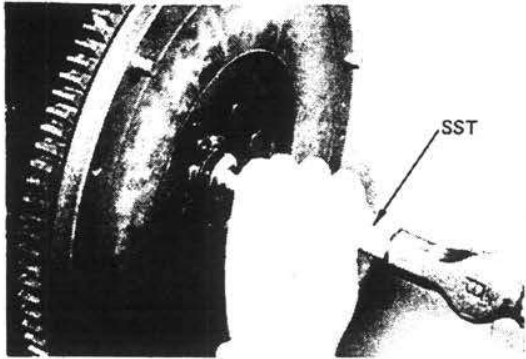
Apply a light coating of engine oil on the bolt threads and under head before installing.

Fig. 3-184

Check flywheel for run out.

Run out limit
0.2 mm (0.008 in.)

3-56 ENGINE SERVICE – Cylinder Block

Fig. 3-185

Drive in input shaft bearing with SST[09304-30012].

