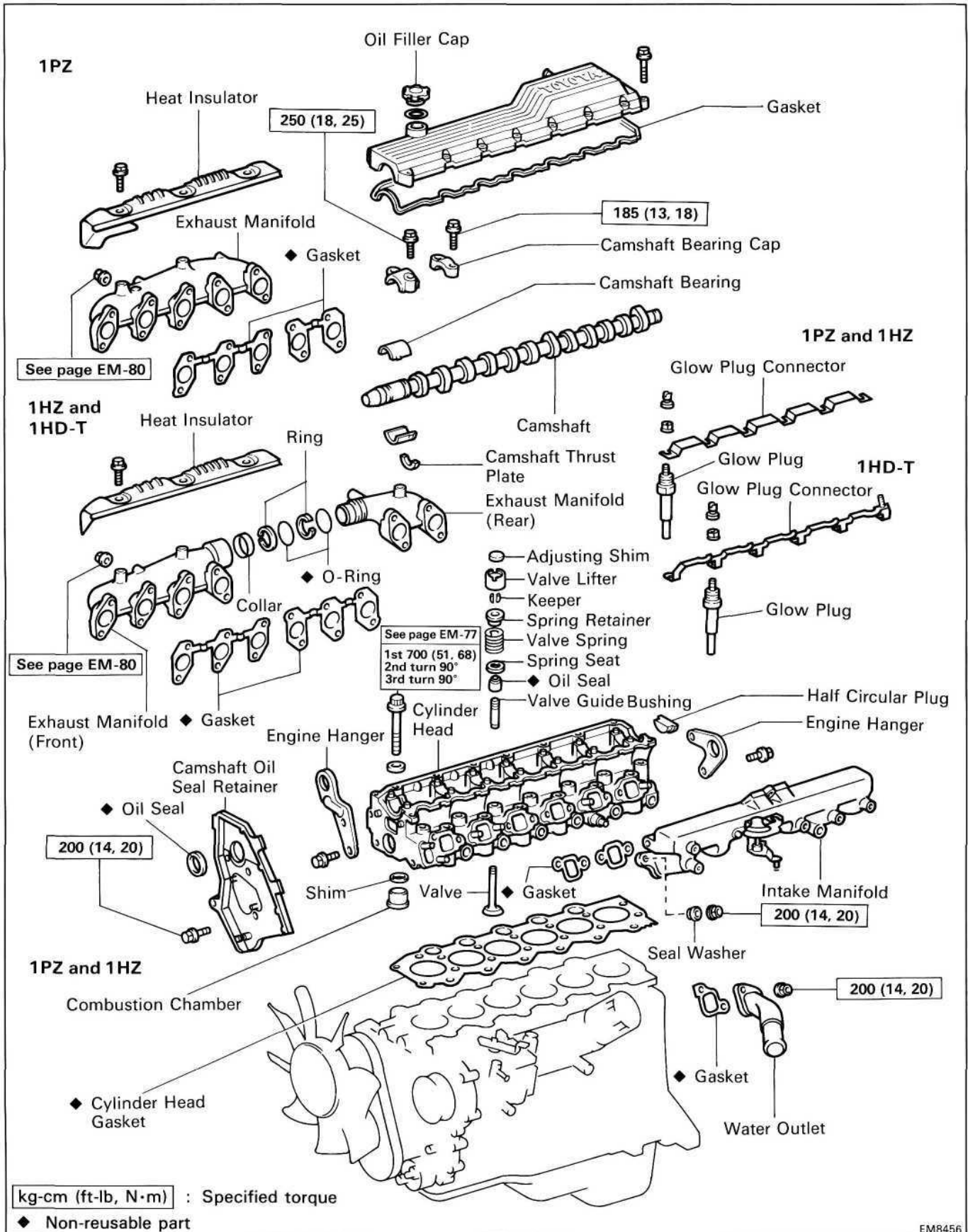


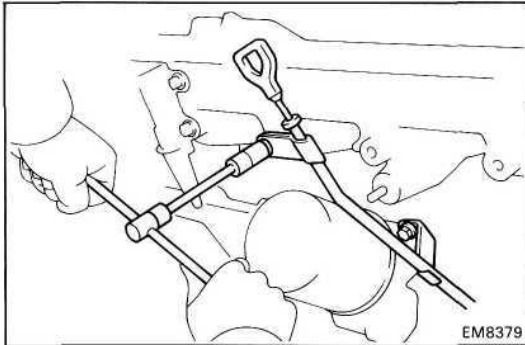
CYLINDER HEAD COMPONENTS



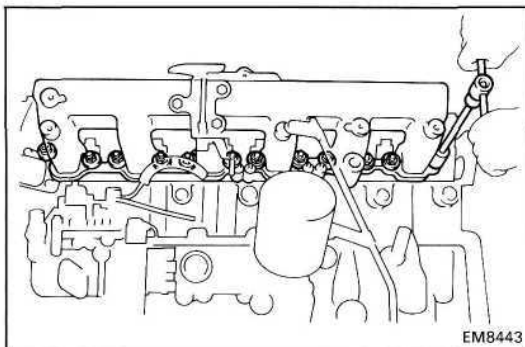
REMOVAL OF CYLINDER HEAD

(See page EM-54)

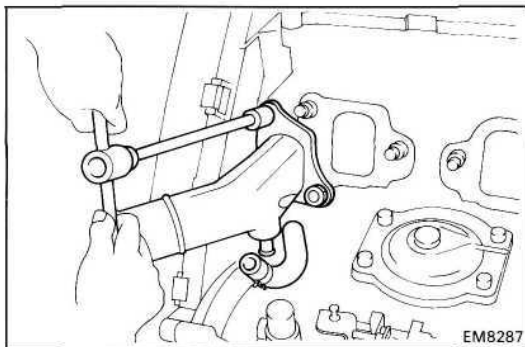
1. **DRAIN ENGINE COOLANT** (See page CO-4)
2. **REMOVE INTAKE PIPE**
(See step 6 on page EM-34)
3. **REMOVE INJECTION PIPES**
(See step 2 on page FU-9)
4. **REMOVE OIL DIPSTICK AND OIL DIPSTICK GUIDE**
 - (a) Remove the two bolts, and the oil dipstick guide assembly.
 - (b) Remove the O-ring from the oil dipstick guide.

**5. REMOVE INTAKE MANIFOLD**

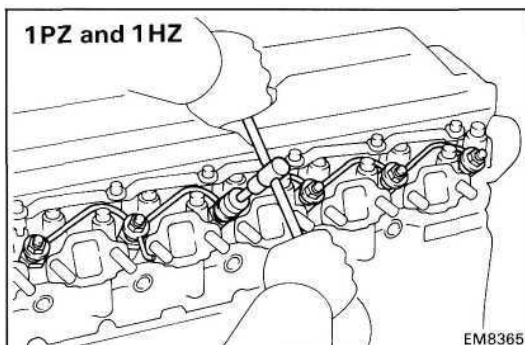
- (a) Disconnect the fuel hose from the nozzle leakage pipe.
- (b) (1PZ)
Remove the ten bolts, seal washers, intake manifold and five gaskets.
- (c) (1HZ and 1HD-T)
Remove the twelve bolts, seal washers, intake manifold and six gaskets.

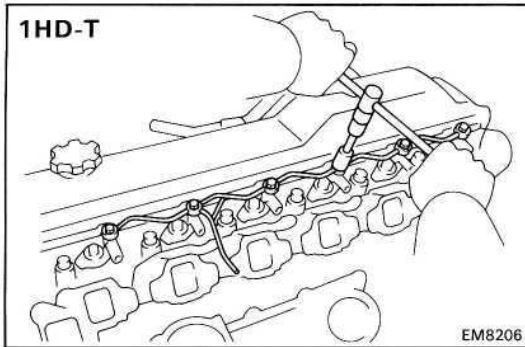
**6. REMOVE WATER OUTLET**

- (a) (1HD-T)
Disconnect the water by-pass hose.
- (b) Remove the two nuts, water outlet and gasket.

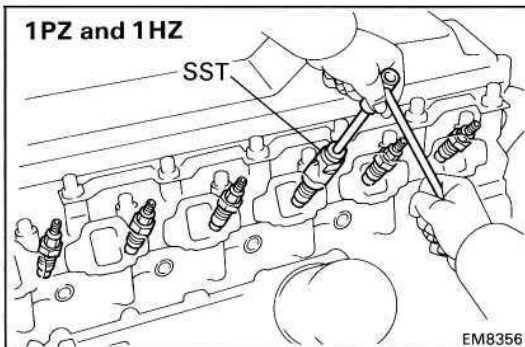
**7. REMOVE NOZZLE LEAKAGE PIPE (1PZ and 1HZ)**

- (a) (1PZ)
Remove the five union nuts, nozzle leakage pipe and five gaskets.
- (b) (1HZ)
Remove the six union nuts, nozzle leakage pipe and six gaskets.



**(1HD-T)**

Remove the six hollow bolts, nozzle leakage pipe and twelve gaskets.

**8. REMOVE INJECTION NOZZLES****(1PZ and 1HZ)****(a) (1PZ)**

Using SST, remove the five injection nozzles, seats and gaskets.

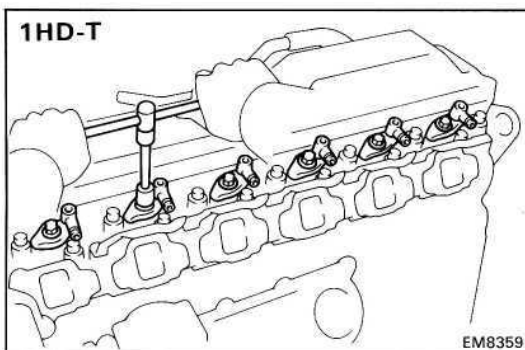
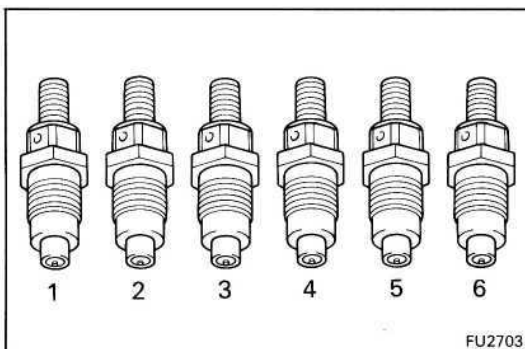
SST 09268-64010

(b) (1HZ)

Using SST, remove the six injection nozzles, seats and gaskets.

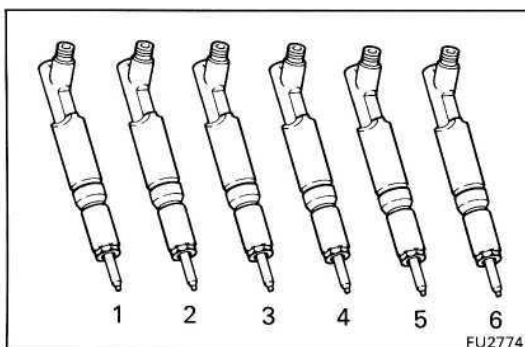
SST 09268-64010

HINT: Arrange the injection nozzles in correct order.

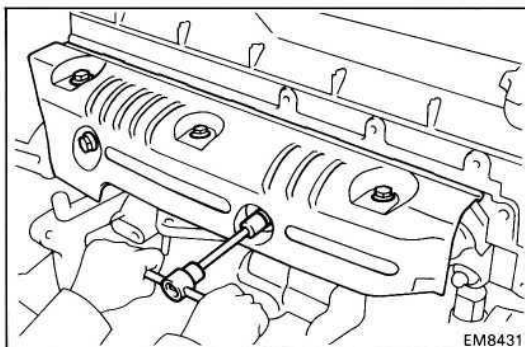
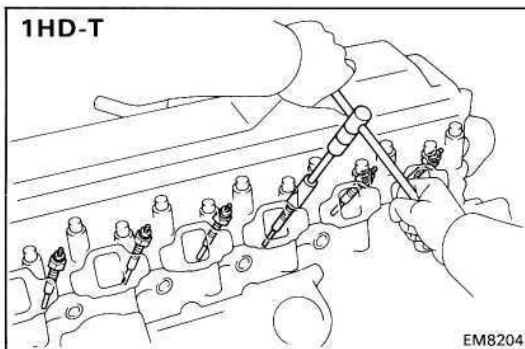
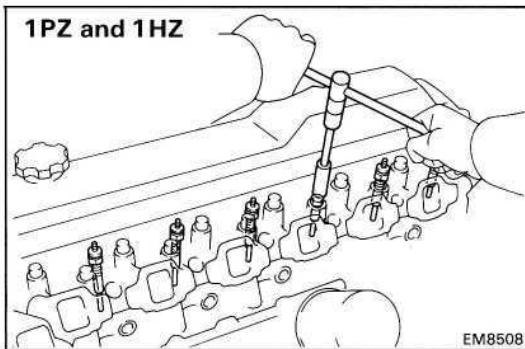
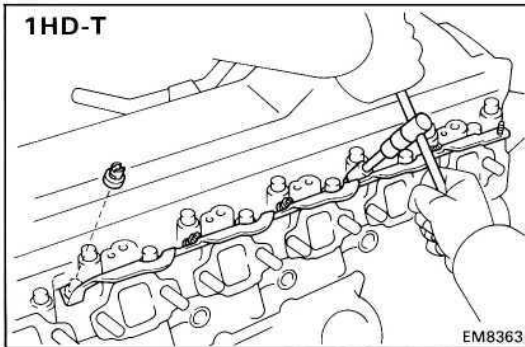
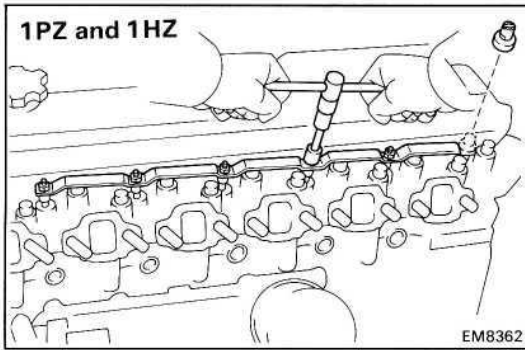
**(1HD-T)**

(a) Remove the bolt, washer, nozzle holder, injection nozzle and seat.

(b) Remove the O-ring from the injection nozzle.



HINT: Arrange the injection nozzles in correct order.



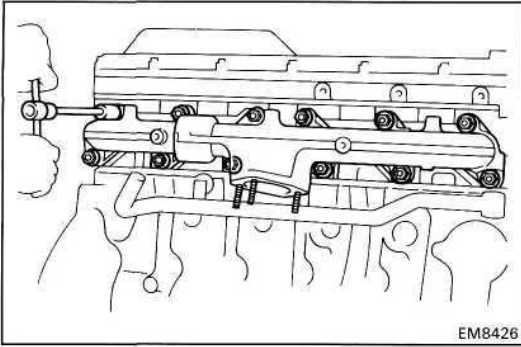
9. REMOVE GLOW PLUGS

- (a) Remove the five screw grommets (1 PZ) or six screw grommets (1 HZ and 1 HD-T).
- (b) Remove the five nuts (1PZ) or six nuts (1 HZ and 1HD-T) and glow plug connector.

- (c) Using a 12 mm deep socket wrench, remove the five glow plugs (1 PZ) or six glow plugs (1 HZ and 1 HD-T).

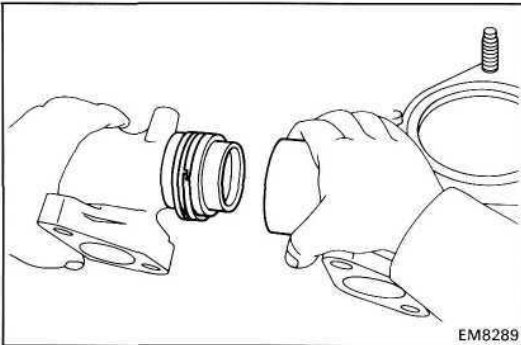
10. (1PZ and 1HZ) REMOVE EXHAUST MANIFOLD

- (a) Remove the four bolts (1 PZ) or five bolts (1 HZ) and heat insulator.

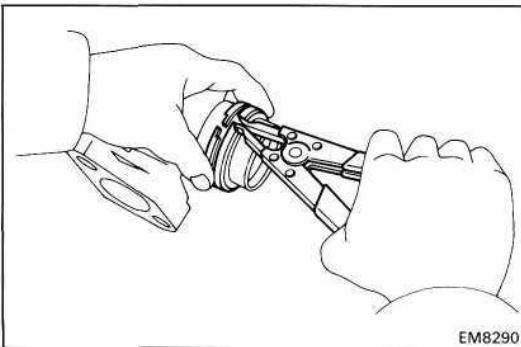


- (b) Remove the ten nuts (1 PZ) or twelve nuts (1HZ), exhaust manifold and two gaskets.

11. (1HD-T)
REMOVE TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY
(See steps 3 to 8 on pages TC-9, 10)

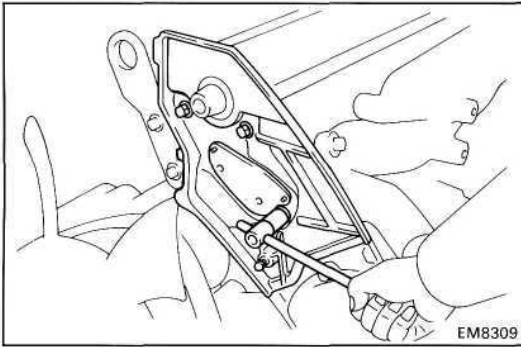


12. (1HZ and 1HD-T)
SEPARATE EXHAUST MANIFOLDS
(a) Separate the front and rear exhaust manifolds.

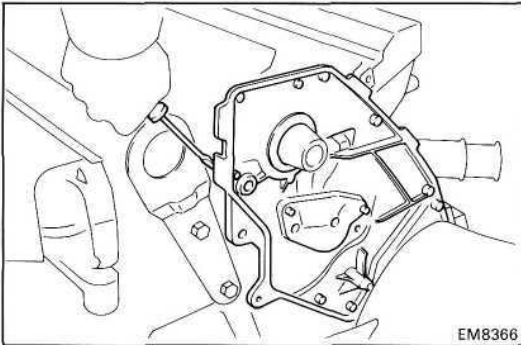


- (b) Using snap ring pliers, remove the two manifold rings.

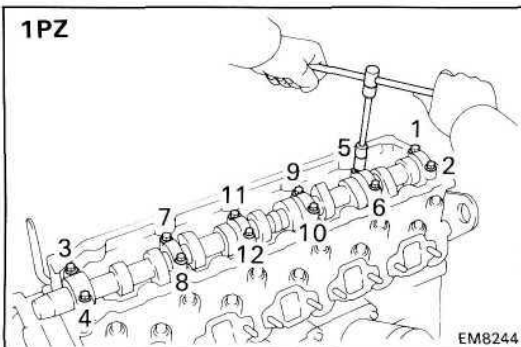
13. **REMOVE TIMING BELT AND PULLEYS**
(See steps 1 to 3 and 5 to 7 on pages EM-33 to 35)

**14. REMOVE CAMSHAFT OIL SEAL RETAINER**

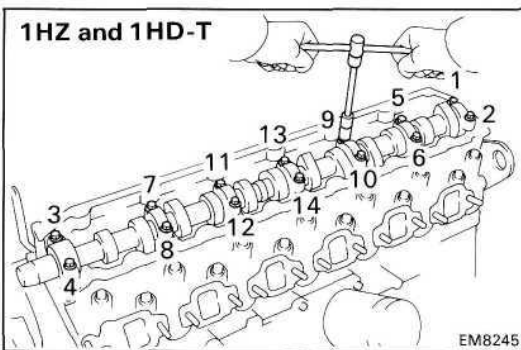
- (a) Remove the four bolts holding the camshaft oil seal retainer to the cylinder head.



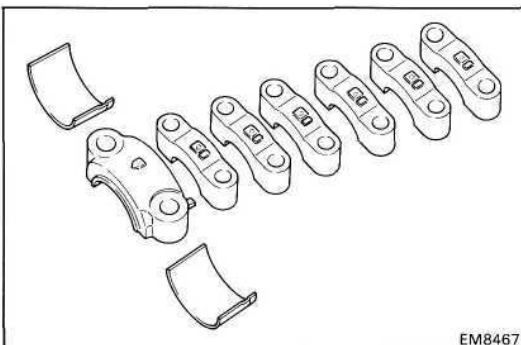
- (b) Pry out the camshaft oil seal retainer.

**15. REMOVE CAMSHAFT**

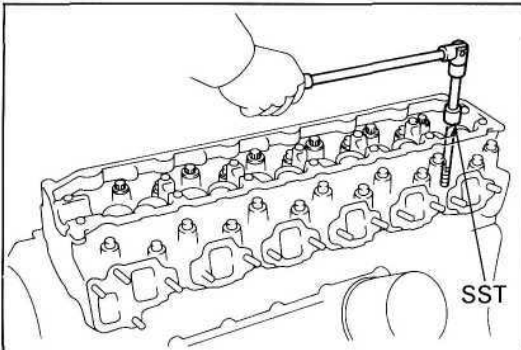
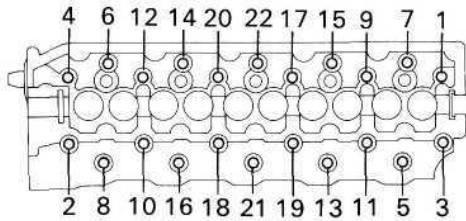
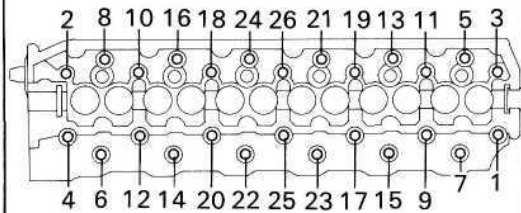
- (a) (1PZ)
Uniformly loosen and remove the twelve bearing cap bolts in several passes in the sequence shown.



- (b) (1 HZ and 1HD-T)
Uniformly loosen and remove the fourteen bearing cap bolts in several passes in the sequence shown.
- (c) Remove the six bearing caps (1 PZ) or seven bearing caps (1 HZ and 1 HD-T) and camshaft.
- (d) Remove the two bearings from the No.1 bearing cap and No.1 journal of the cylinder head.
- (e) Remove the camshaft thrust plate.



HINT: Arrange the bearing caps and bearings in correct order.

**1PZ****1HZ and 1HD-T**

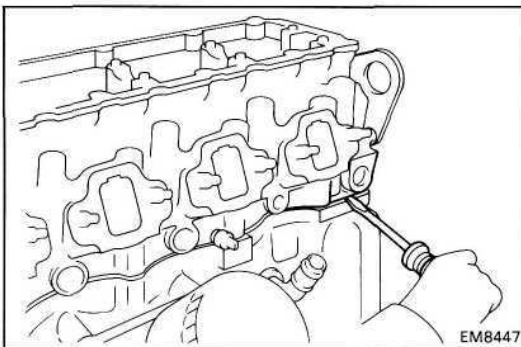
EM8324
EM8250
EM8249

16. REMOVE CYLINDER HEAD

- (a) Using SST, uniformly loosen and remove the twenty-two cylinder head bolts (1 PZ) or twenty-six cylinder head bolts (1 HZ and 1 HD-T) in several passes in the sequence shown.

SST 09011-381 21

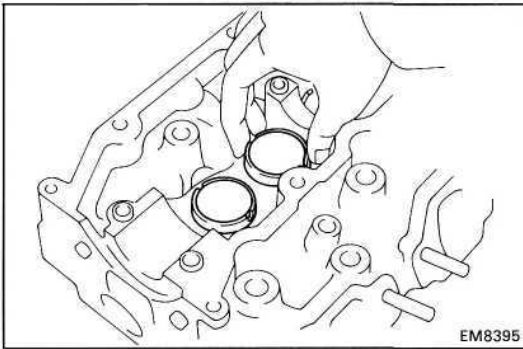
NOTICE: Head warpage or cracking could result from removing bolts in incorrect order.



- (b) Lift the cylinder head from the dowels on the cylinder block and place the head on wooden blocks on a bench.

HINT: If the cylinder head is difficult to lift off, pry with a screwdriver between the cylinder head and block.

NOTICE: Be careful not to damage the cylinder head and cylinder block surfaces of cylinder head gasket side.

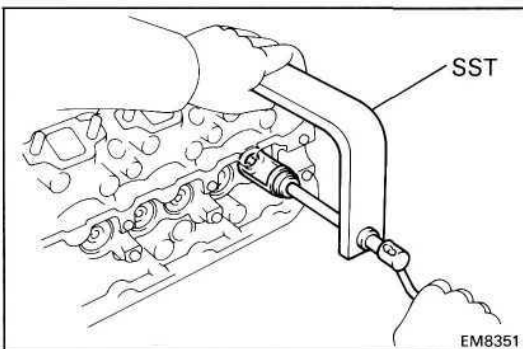
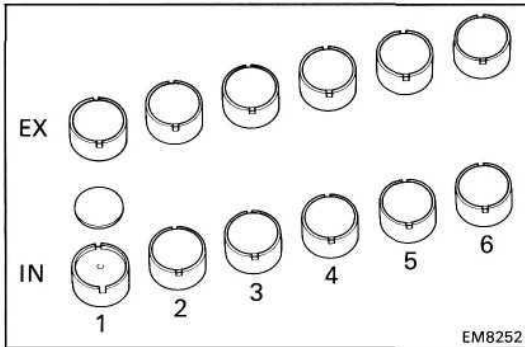


DISASSEMBLY OF CYLINDER HEAD

(See page EM-54)

1. REMOVE VALVE LIFTERS AND SHIMS

HINT: Arrange the valve lifters and shims in correct order.



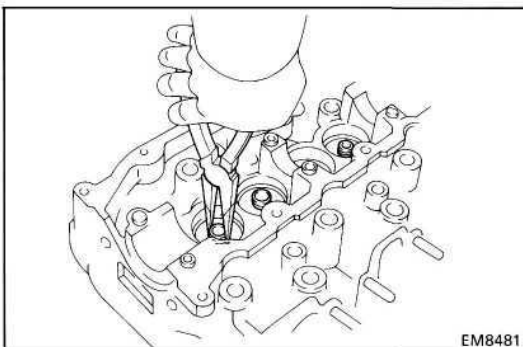
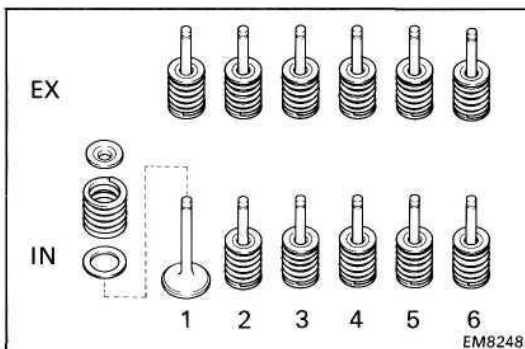
2. REMOVE VALVES

(a) Using SST, compress the valve spring and remove the two keepers.

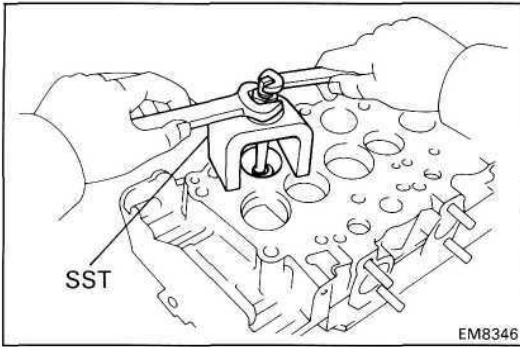
SST 09202-43013

(b) Remove the spring retainer, valve spring, valve and spring seat.

HINT: Arrange the valves, valve springs, spring seats and spring retainers in correct order.



(c) Using needle-nose pliers, remove the oil seal.



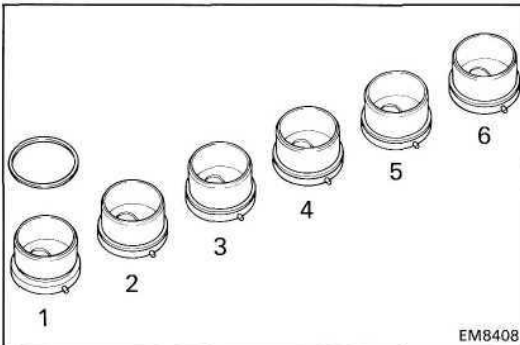
**3. (IPZ and 1HZ)
REMOVE COMBUSTION CHAMBERS**

Using SST, remove the five (1 PZ) and six (1 HZ) combustion chambers (and shims).

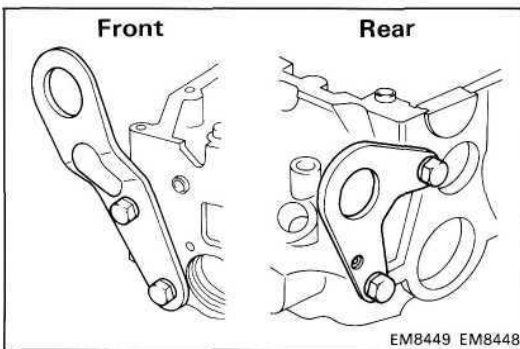
SST 09208-48010

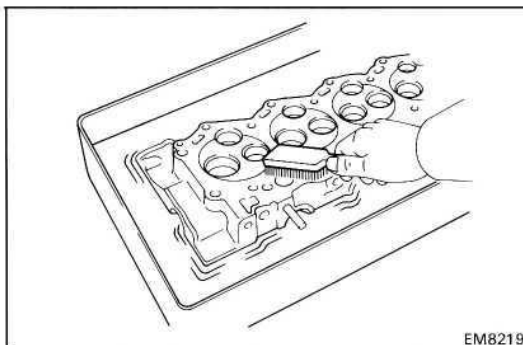
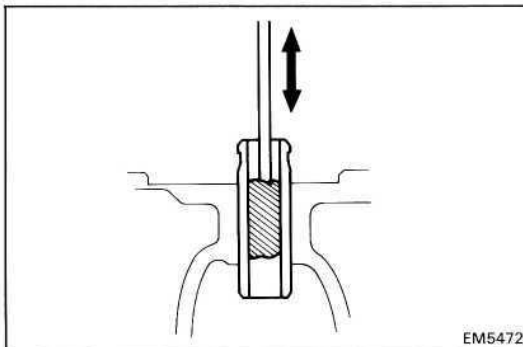
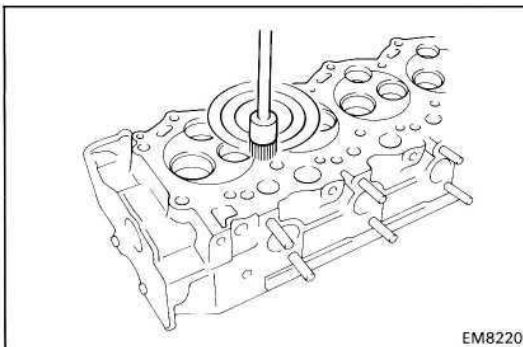
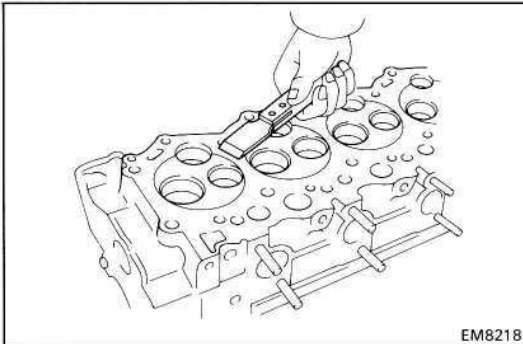
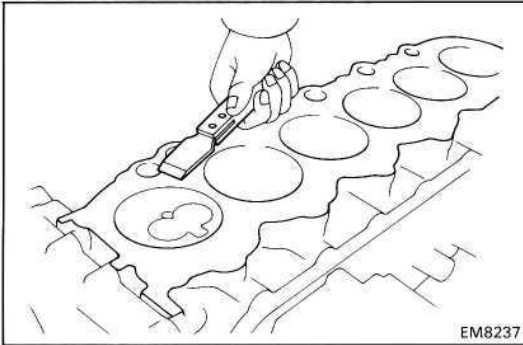
HINT: Arrange the combustion chambers (and shims) in correct order.

4. REMOVE HALF CIRCULAR PLUG



5. REMOVE FRONT AND REAR ENGINE HANGERS





INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF BLOCK

- (a) Turn the crankshaft and bring each piston to top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston top.
- (b) Remove all the gasket material from the top of the cylinder block.

NOTICE: Be careful not to scratch the surfaces.

- (c) Using compressed air, blow carbon and oil from the bolt holes.

CAUTION: Protect your eyes when using high pressure air.

2. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all the gasket material from the manifold and cylinder head surface.

NOTICE: Be careful not to scratch the surfaces.

3. CLEAN COMBUSTION CHAMBERS

Using a wire brush, remove all the carbon from the combustion chambers.

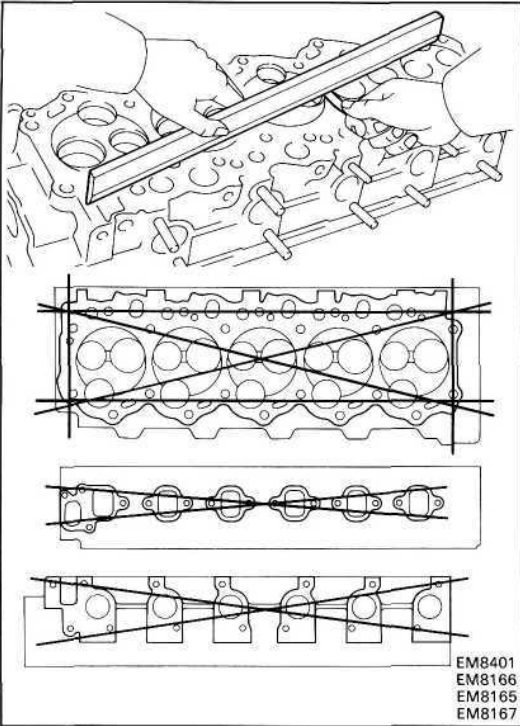
NOTICE: Be careful not to scratch the head gasket contact surface.

4. CLEAN VALVE GUIDE BUSHINGS

Using a valve guide bushing brush and solvent, clean all the guide bushings.

5. CLEAN CYLINDER HEAD

Using a soft brush and solvent, thoroughly clean cylinder heads.

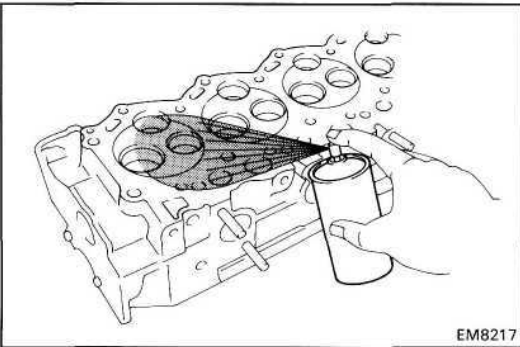


6. INSPECT CYLINDER HEAD FOR FLATNESS

Using a precision straight edge and thickness gauge, measure the surfaces contacting the cylinder block manifolds for warpage.

Maximum warpage: 0.20 mm (0.0079 in.)

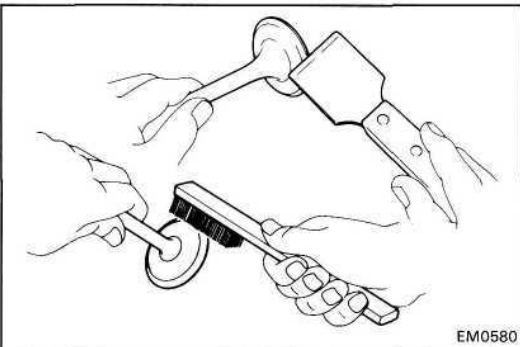
If warpage is greater than maximum, replace the cylinder head.



7. INSPECT CYLINDER HEAD FOR CRACKS

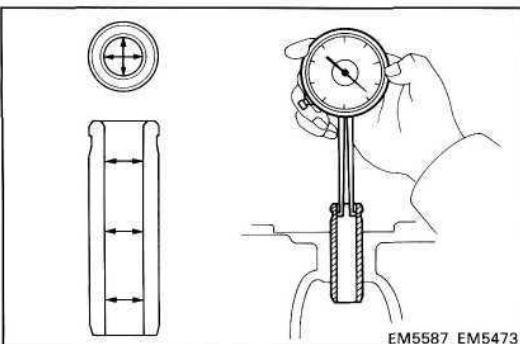
Using a dye penetrant, check the combustion chamber, intake and exhaust ports, head surface and the top of the head for cracks.

If cracked, replace the cylinder head.



8. CLEAN VALVES

- (a) Using a gasket scraper, chip any carbon from the valve head.
- (b) Using a wire brush, thoroughly clean the valve.

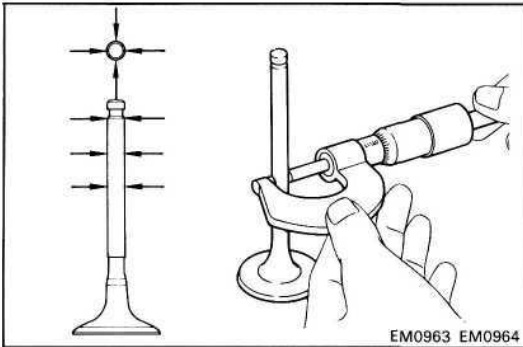


9. INSPECT VALVE STEMS AND GUIDE BUSHINGS

- (a) Using a caliper gauge, measure the inside diameter of the guide bushing.

Bushing inside diameter:

8.010-8.030 mm (0.3154-0.3161 in.)



- (b) Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter:

Intake	7.975-7.990 mm (0.3140-0.3146 in.)
Exhaust	7.960-7.975 mm (0.3134-0.3140 in.)

- (c) Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.

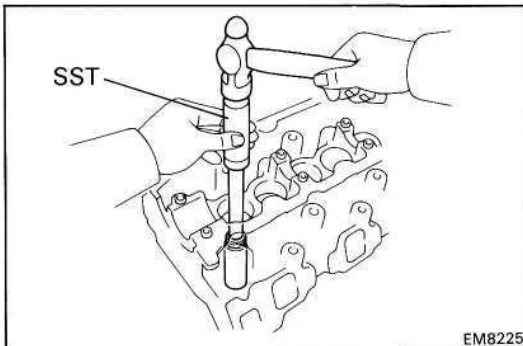
Standard oil clearance:

Intake	0.020-0.055 mm (0.0008-0.0022 in.)
Exhaust	0.035-0.070 mm (0.0014-0.0028 in.)

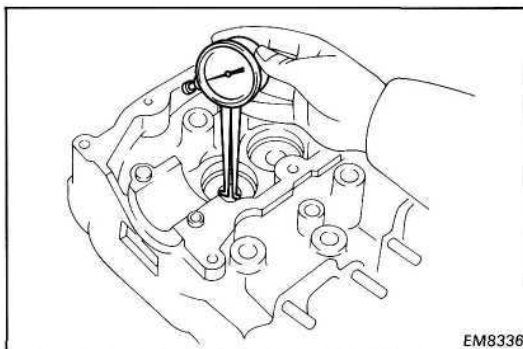
Maximum oil clearance:

Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

If the clearance is greater than maximum, replace the valve and guide bushing.

**10. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS**

- (a) Using SST and a hammer, tap out the guide bushing.
SST 09201-60011



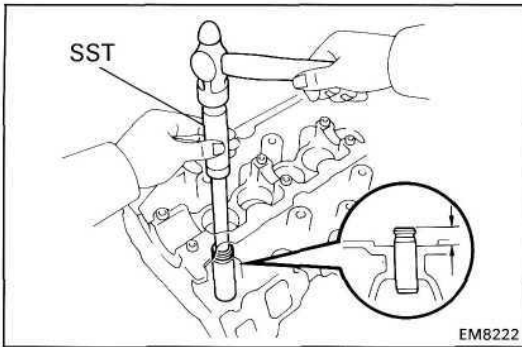
- (b) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.

Bushing bore diameter mm (in.)	Bushing size
13.004 – 13.025 (0.5112 – 0.5128)	Use STD
13.054 – 13.075 (0.5139 – 0.5148)	Use O/S 0.05

- (c) Select a new guide bushing (STD size or O/S 0.05). If the bushing bore diameter of the cylinder head is greater than 13.025 mm (0.5128 in.), machine the bushing bore to the following dimension:

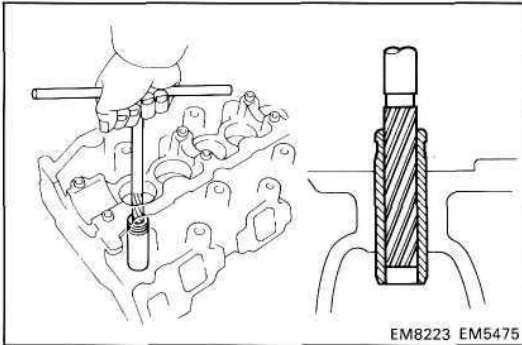
Rebored cylinder head bushing bore dimension:
13.054-13.075 mm (0.5139-0.5148 in.)

If the bushing bore diameter of the cylinder head is greater than 13.075 mm (0.5148 in.), replace the cylinder head.

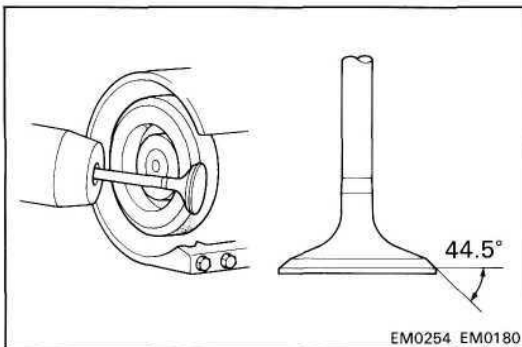


- (d) Using SST and a hammer, tap in a new guide bushing to where there is 11.8 - 12.2 mm (0.465 - 0.480 in.) protruding from the cylinder head.

SST 09201-60011



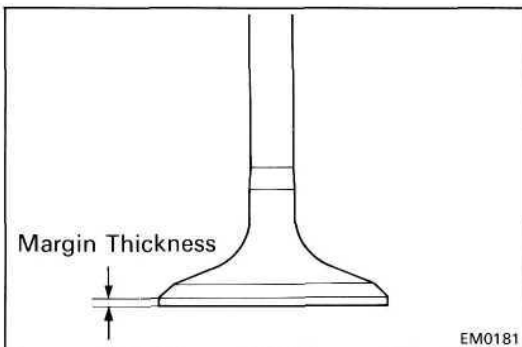
- (e) Using a sharp 8 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page EM-65) between the guide bushing and valve stem.



11. INSPECT AND GRIND VALVES

- (a) Grind the valve enough to remove pits and carbon.
 (b) Check that the valve is ground to the correct valve face angle.

Valve face angle: 44.5°



- (c) Check the valve head margin thickness.

Standard margin thickness:

Intake 1.6 mm (0.063 in.)

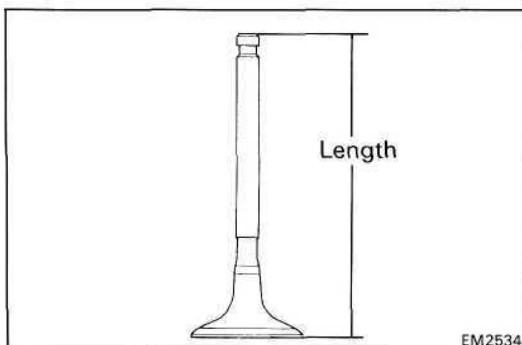
Exhaust 1.7 mm (0.067 in.)

Minimum margin thickness:

Intake 1.1 mm (0.043 in.)

Exhaust 1.2 mm (0.047 in.)

If the margin thickness is less than minimum, replace the valve.



- (d) Check the valve overall length.

Standard overall length:

Intake 103.29-103.69 mm

(4.0665-4.0823 in.)

Exhaust 103.14-103.54 mm

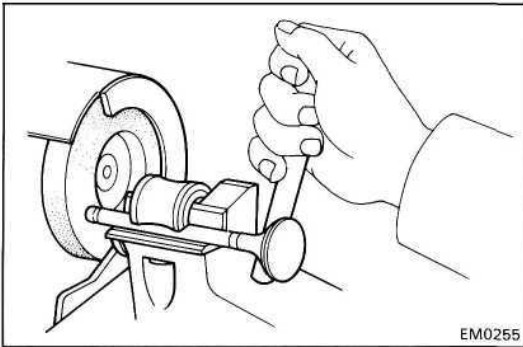
(4.0606-4.0764 in.)

Minimum overall length:

Intake 102.79 mm (4.0468 in.)

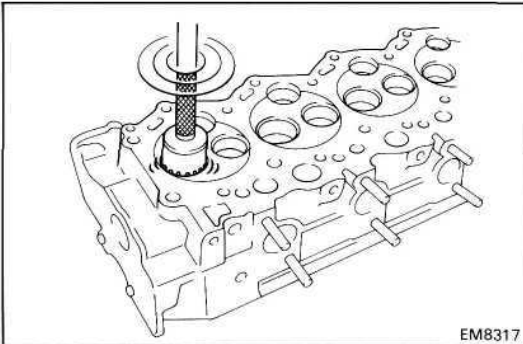
Exhaust 102.64 mm (4.0409 in.)

If the overall length is less than minimum, replace the valve.



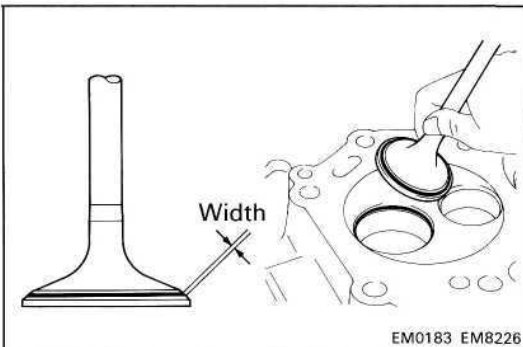
- (e) Check the surface of the valve stem tip for wear. If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

NOTICE: Do not grind off more than the minimum overall length.



12. INSPECT AND CLEAN VALVE SEATS

- (a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.



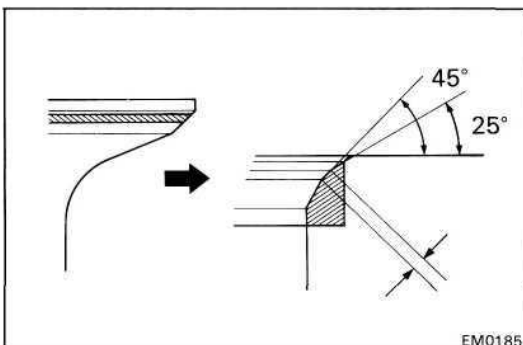
- (b) Check the valve seating position. Apply a thin coat of Prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate the valve.

- (c) Check the valve face and seat for the following:

- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is on the middle of the valve face with the following width:

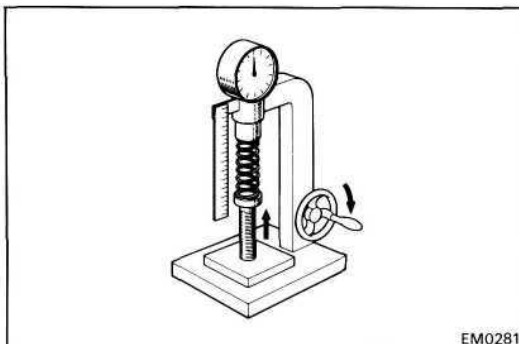
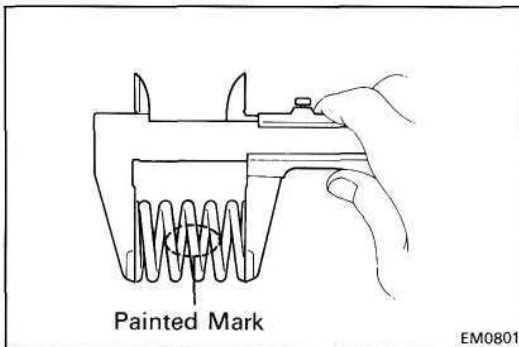
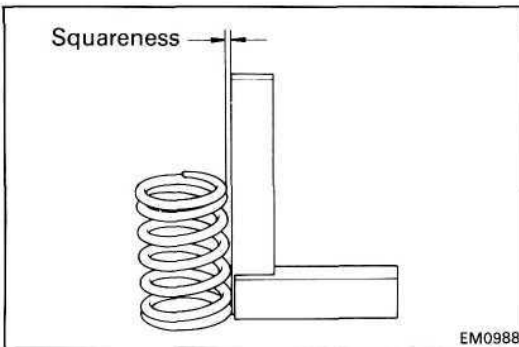
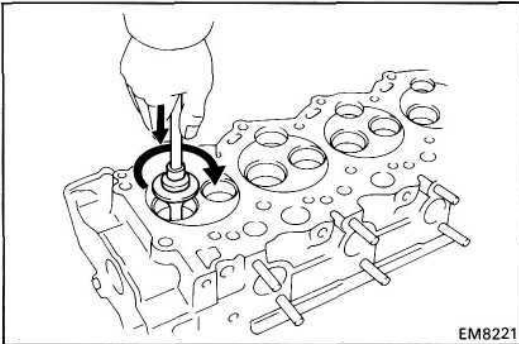
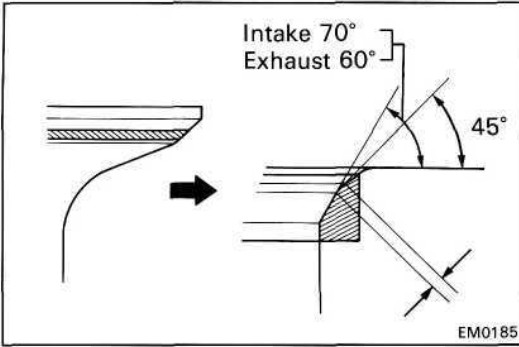
Intake 1.5-1.9 mm (0.059-0.075 in.)

Exhaust 1.8-2.2 mm (0.071 -0.087 in.)



If not, correct the valve seats as follows:

- (1) If the seating is too high on the valve face, use 25° and 45° cutters to correct the seat.



(2) (Intake)
If the seating is too low on the valve face, use 70° and 45° cutters to correct the seat.

(Exhaust)
If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.

(d) Hand-lap the valve and valve seat with an abrasive compound.

(e) After hand-lapping, clean the valve and valve seat.

13. INSPECT VALVE SPRINGS

(a) Using a steel square, measure the squareness of the valve spring.

Maximum squareness: 2.0 mm (0.075 in.)

If squareness is greater than maximum, replace the valve spring.

(b) Using vernier calipers, measure the free length of the valve spring.

Free length:

Yellow painted mark 46.20 mm (1.8189 in.)

Blue painted mark 49.14 mm (1.9346 in.)

If the free length is not as specified, replace the valve spring.

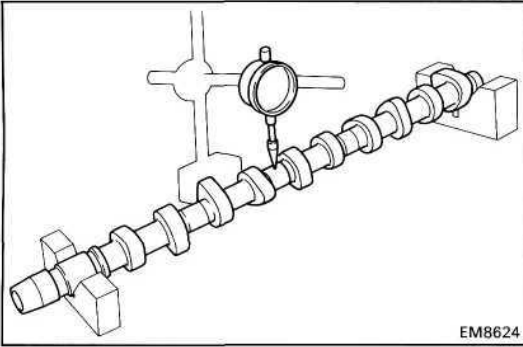
(c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

Installed tension:

30.7-33.9 kg (67.7-74.7 lb, 301 -332 N)

at 37.0 mm (1.457 in.)

If the installed tension is not as specified, replace the valve spring.



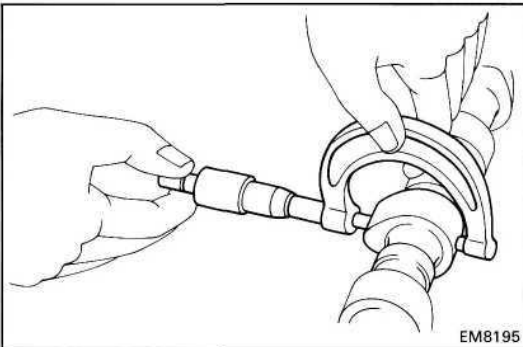
14. INSPECT CAMSHAFTS AND BEARINGS

A. Inspect camshaft for runout

- (a) Place the camshaft on V-blocks.
- (b) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.10 mm (0.0039 in.)

If the circle runout is greater than maximum, replace the camshaft.



B. Inspect cam lobes

Using a micrometer, measure the cam lobe height.

Standard cam lobe height:

Intake

1PZ and 1HZ 55.090-55.110 mm
(2.1689-2.1697 in.)

1HD-T 54.440-54.460 mm
(2.1433-2.1441 in.)

Exhaust 55.940 - 55.960 mm
(2.2024-2.2031 in.)

Minimum cam lobe height:

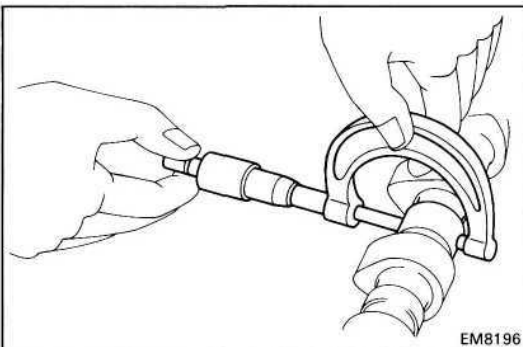
Intake

1PZ and 1HZ 54.59 mm (2.1492 in.)

1H-D 53.94 mm (2.1236 in.)

Exhaust 55.44 mm (2.1827 in.)

If the cam lobe height is less than minimum, replace the camshaft.



C. Inspect camshaft journals

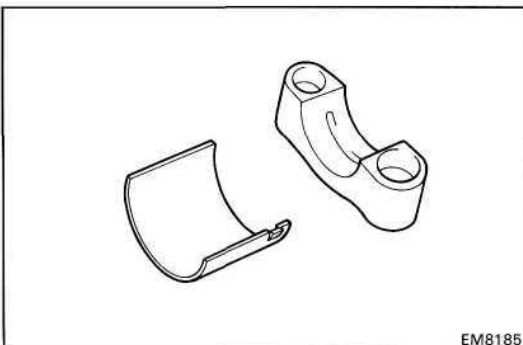
Using a micrometer, measure the journal diameter.

Journal diameter:

No.1 journal 34.969-34.985 mm
(1.3767-1.3774 in.)

Others 27.986-27.988 mm
(1.1018-1.1023 in.)

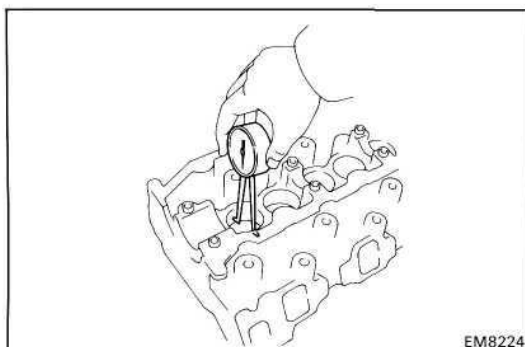
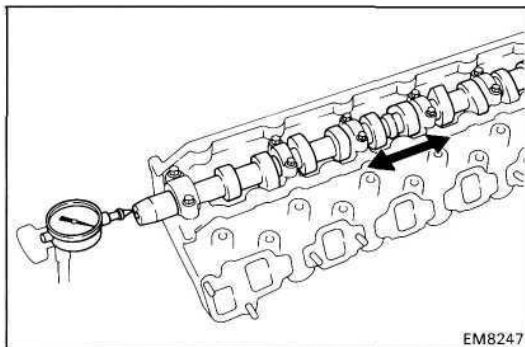
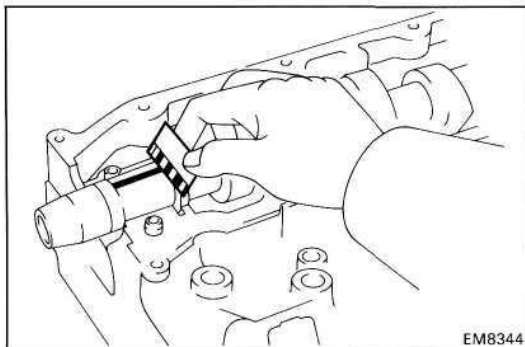
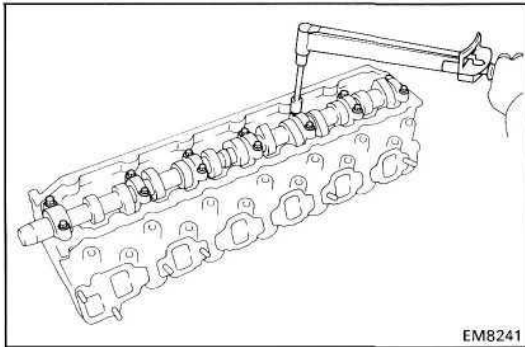
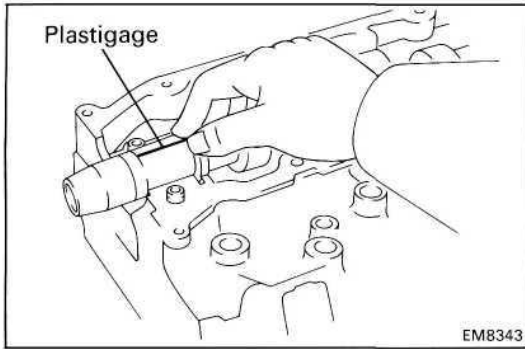
If the journal diameter is not as specified, check the oil clearance.



D. Inspect camshaft bearings

Check the bearings for flaking and scoring.

If the bearings are damaged, replace the bearings.



E. Inspect camshaft journal oil clearance

- (a) Install the camshaft bearings to the No.1 bearing cap and No.1 journal of the cylinder head.
(See step 4 (b) on page EM-78)
- (b) Clean the bearings and camshaft journals.
- (c) Place the camshaft on the cylinder head.
- (d) Lay a strip of Plastigage across each of the camshaft journals.

- (e) Install the bearing caps.
(See step 4 (c) to (e) on page EM-78)

Torque: 250 kg-cm (18 ft-lb, 25 N·m)

HINT: Do not turn the camshaft.

- (f) Remove the bearing caps.
- (g) Measure the Plastigage at its widest point.

Standard oil clearance:

No.1 journal	0.022-0.074 mm (0.0009-0.0029 in.)
Others	0.030-0.066 mm (0.0012-0.0026 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the bearings or camshaft. If necessary, replace the bearing caps and cylinder head.

- (h) Completely remove the Plastigage.

F. Inspect camshaft thrust clearance

- (a) Install the camshaft.
(See step 4 on page EM-78)
- (b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance: 0.10-0.20 mm
(0.0039-0.0079 in.)

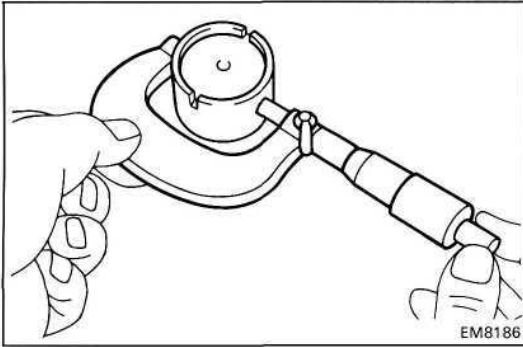
Maximum thrust clearance: 0.30 mm (0.0118 in.)

If the thrust clearance is greater than maximum, replace the thrust plate. If necessary, replace the camshaft.

15. INSPECT VALVE LIFTERS AND LIFTER BORES

- (a) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

Lifter bore diameter: 40.960—40.980 mm
(1.6126-1.6134 in.)



(b) Using a micrometer, measure the lifter diameter.

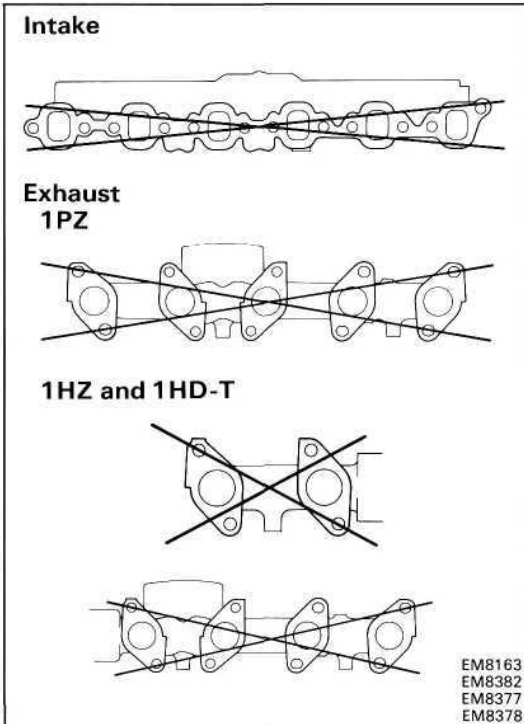
**Lifter diameter: 40.892-40.902 mm
(1.6099-1.6103 in.)**

(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

**Standard oil clearance: 0.058-0.083 mm
(0.0023-0.0033 in.)**

Maximum oil clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the lifter. If necessary, replace the cylinder head.

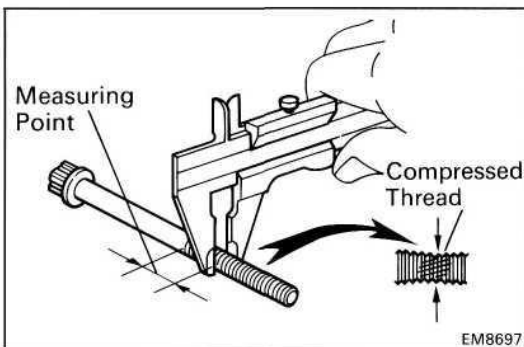


16. INSPECT INTAKE AND EXHAUST MANIFOLDS

Using a precision straight edge and thickness gauge, measure the surface contacting the cylinder head for warpage.

Maximum warpage: 0.40 mm (0.0157 in.)

If warpage is greater than maximum, replace the manifold.



17. INSPECT CYLINDER HEAD BOLTS

Using vernier calipers, measure the minimum outer diameter of the compressed thread at the measuring point.

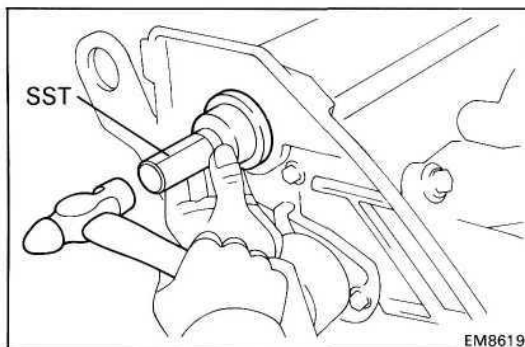
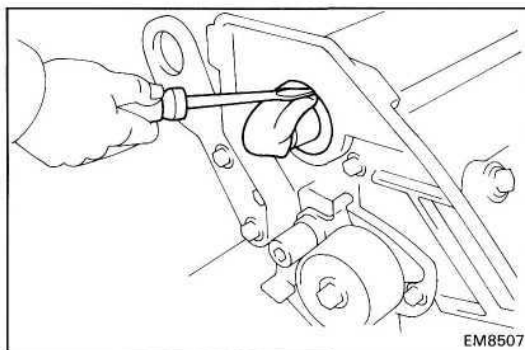
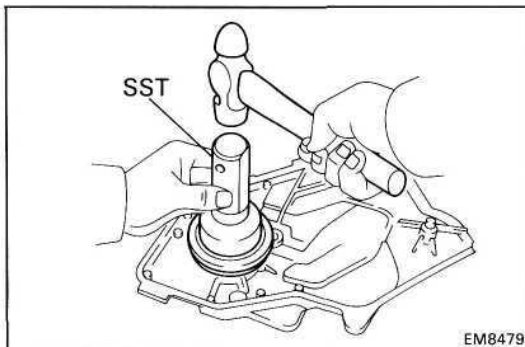
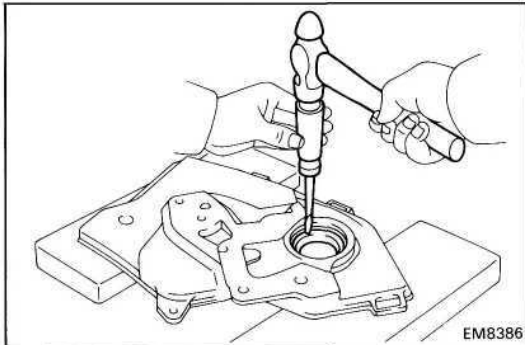
**Standard outer diameter: 10.800-11.000 mm
(0.4646-0.4724 in.)**

Minimum outer diameter: 10.55 mm (0.4154 in.)

If the outer diameter is less than minimum, replace the bolt.

REPLACEMENT OF CAMSHAFT OIL SEAL

HINT: There are two methods (A and B) to replace the oil seal as follows:



REPLACE CAMSHAFT OIL SEAL

A. If camshaft oil seal retainer is removed from cylinder head:

(a) Using a screwdriver and hammer, tap out the oil seal.

(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil seal retainer edge.

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(c) Apply MP grease to the oil seal lip.

B. If camshaft oil seal retainer is installed to the cylinder head:

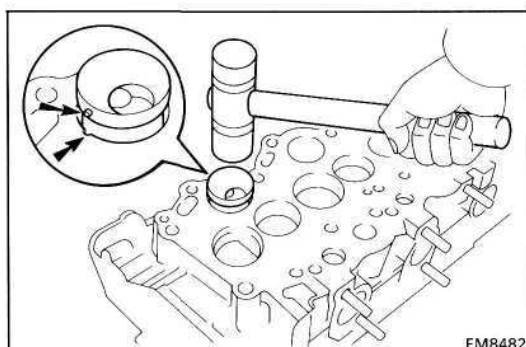
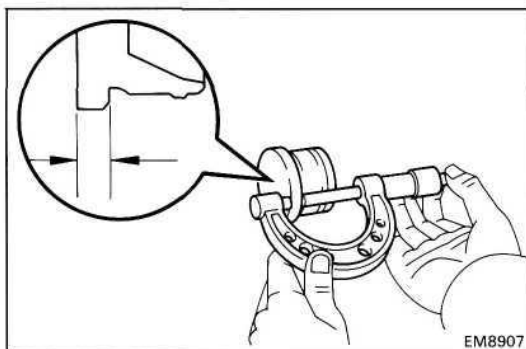
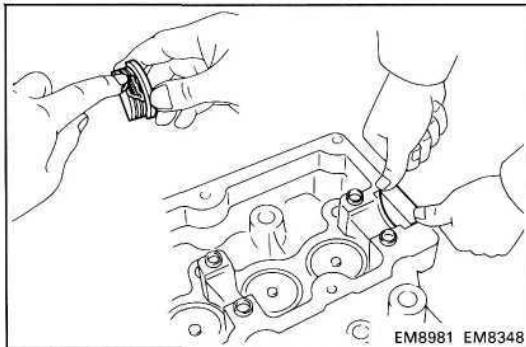
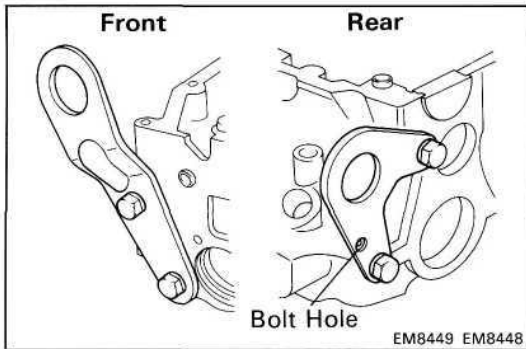
(a) Using a screwdriver, pry out the oil seal.

NOTICE: Be careful not to damage the camshaft. Tape the screwdriver tip.

(b) Apply MP grease to a new oil seal lip.

(c) Using SST and a hammer, tap in the oil seal until its surface is flush with the oil seal retainer edge.

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ASSEMBLY OF CYLINDER HEAD

(See page EM-54)

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new ones.

1. INSTALL FRONT AND REAR ENGINE HANGERS

Install the engine hangers as shown in the illustration.

2. INSTALL HALF CIRCULAR PLUG

- Remove any old packing (FIPG) material.
- Apply seal packing to the half circular plug as shown.
Seal packing: Part No. 08826-00080 or equivalent
- Install the half circular plug to the cylinder head.

3. SELECT COMBUSTION CHAMBER SHIM

A. If using new combustion chamber:

Using a micrometer, measure the thickness of each used combustion chamber at the position shown in the illustration, then select the number of shims to be used.

Combustion chamber thickness mm (in.)	No. of shims to be used
6.02 – 6.05 (0.2370 – 0.2382)	0
6.06 – 6.08 (0.2386 – 0.2394)	1
6.09 – 6.11 (0.2398 – 0.2406)	2

Shim thickness: 0.03 mm (0.0012 in.)

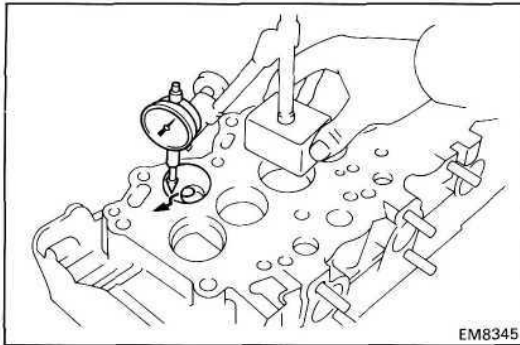
NOTICE: If combustion chamber shims were already being used, do not perform the above step; use the same number of shims as were used before.

B. If reusing combustion chamber:

Install the combustion chamber back in the same position it was originally at.

4. (1PZand1HZ) INSTALL COMBUSTION CHAMBERS

- Align the knock pin of the combustion chamber with the notch of the cylinder head.
- Using a plastic-faced hammer, tap in the (shim and) combustion chamber.



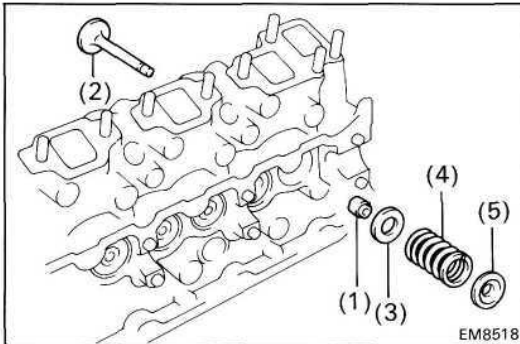
- (c) Using a dial indicator, measure the protrusion of the combustion chamber from the cylinder head.

**Protrusion: Minus 0.04-Plus 0.04 mm
(Minus 0.0016- Plus 0.0016 in.)**

If the protrusion is less than specified, adjust with shims.

Shim thickness: 0.03 mm (0.0012 in.)

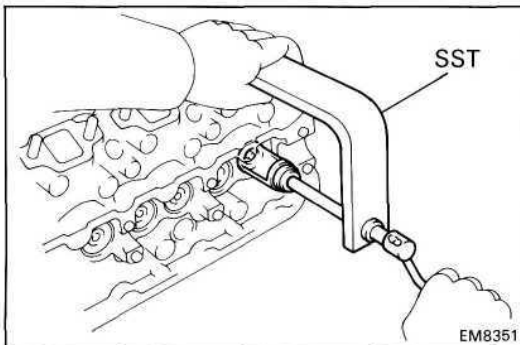
If the protrusion is greater than specification, replace the chamber and recheck the protrusion.



5. INSTALL VALVES

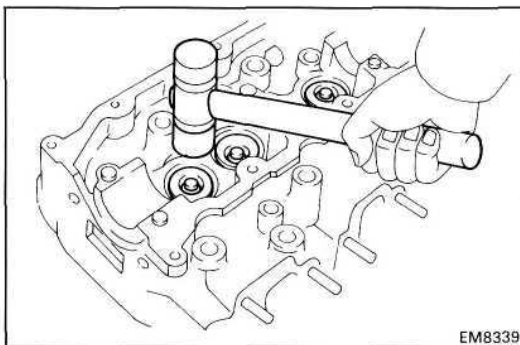
- (a) Install the following parts:

- (1) Oil seal
- (2) Valve
- (3) Spring seat
- (4) Valve spring
- (5) Spring retainer

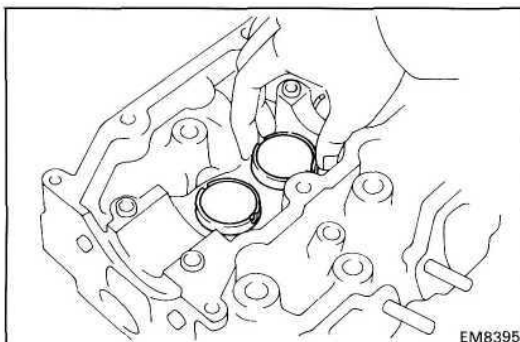


- (b) Using SST, compress the valve spring and place the two keepers around the valve stem.

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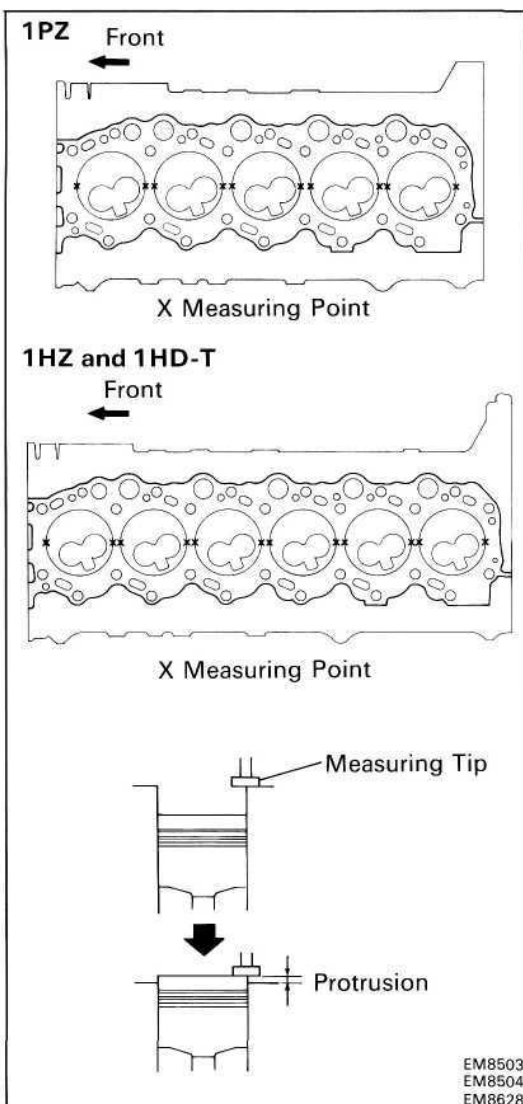
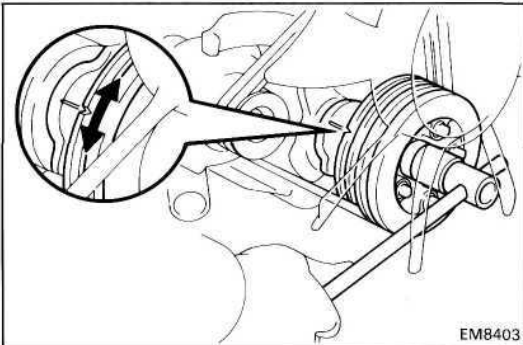
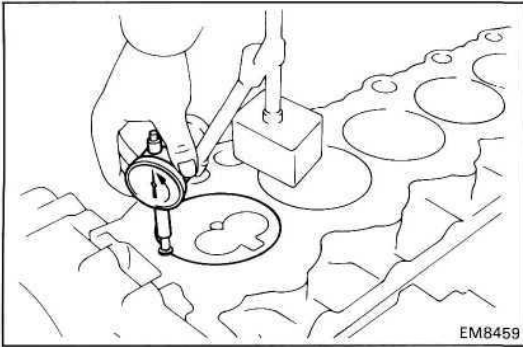


- (c) Using a plastic-faced hammer, lightly tap the valve stem tip to assure proper fit.



6. INSTALL VALVE LIFTERS AND SHIMS

Check the valve lifter rotates smoothly by hand.



INSTALLATION OF CYLINDER HEAD

(See page EM-54)

1. CHECK PISTON PROTRUSION AND SELECT CYLINDER HEAD GASKET

A. Check piston protrusions each cylinder

- Clean the cylinder block solvent.
- Set the piston of the cylinder to be measured to slightly before TDC.
- Place a dial indicator on the cylinder block, and set the dial indicator at 0 mm (0 in.)

HINT:

- Use a dial indicator measuring tip as shown in the illustration.
 - Make sure that the measuring tip is square to the cylinder block gasket surface and piston head when taking the measurements.
- Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.
 - Measure each cylinder at two places as shown in the illustration, making a total of ten measurements (1PZ) or twelve measurements (1HZ and 1HD-T).
 - For the piston protrusion value of each cylinder, use the average of the two measurements of each cylinder.

Protrusion:

IPZ and 1HZ

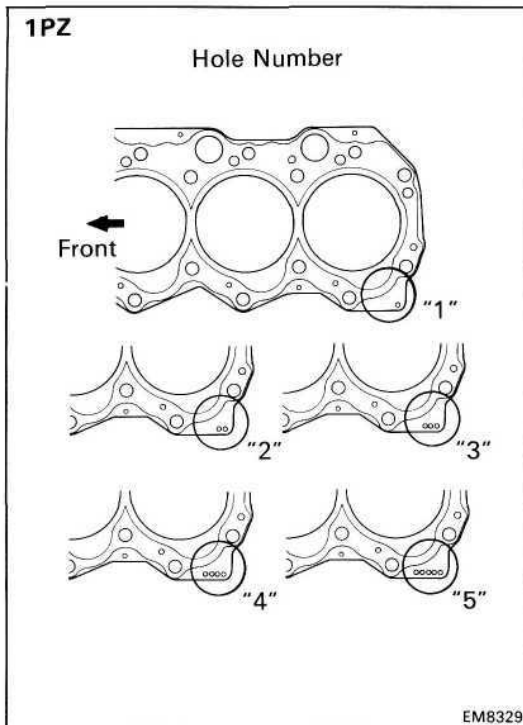
0.405-0.655 mm (0.0159-0.0258 in.)

1HD-T

0.475-0.725 mm (0.0187-0.0285 in.)

(When removing piston and connecting rod assembly)

If the protrusion is not as specified, remove the piston and connecting rod assembly (See page EM-86) and reinstall it (See page EM-108).



B. Select new cylinder head gasket (1PZ)

HINT: There are five types of cylinder head gasket (hole number 1 to 5) installed at factory, but only three types for supply parts (hole number "1", "3" and "5"), so when replacing the gasket select from one of three types above.

New cylinder head gasket thickness:

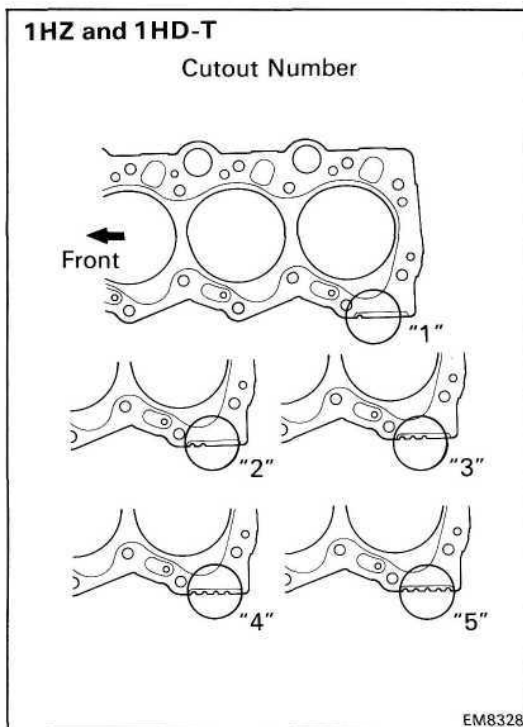
Hole number "1" 1.16-1.24 mm
(0.0457-0.0488 in.)

Hole number "3" 1.26-1.34 mm
(0.0496-0.0528 in.)

Hole number "5" 1.36-1.44 mm
(0.0535-0.0567 in.)

Select the largest piston protrusion value from the measurements made, then select the appropriate cylinder head gasket according to the table below.

Piston protrusion mm (in.)	Gasket size
0.455 (0.0179) or less	Use "1"
0.456 – 0.555 (0.0180 – 0.0219)	Use "3"
0.556 (0.0219) or more	User "5"



(1HZ and 1HD-T)

HINT: There are five types of cylinder head gasket (cutout number 1 to 5) installed at factory, but only three types for supply parts (cutout number "1", "3" and "5"), so when replacing the gasket select from one of three types above.

New cylinder head gasket thickness:

Cutout number "1" 1.15-1.25 mm
(0.0453-0.0492 in.)

Cutout number "3" 1.25-1.35 mm
(0.0492-0.0531 in.)

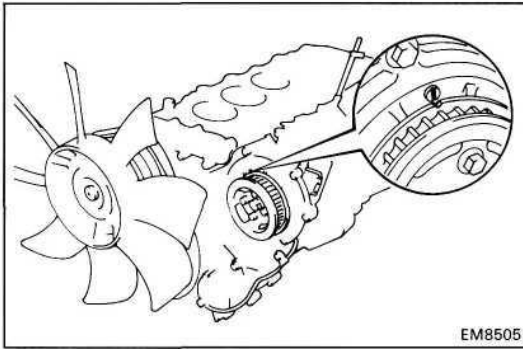
Cutout number "5" 1.35-1.45 mm
(0.0531 -0.0571 in.)

Select the largest piston protrusion value from the measurements made, then select the appropriate cylinder head gasket according to the table below.

1HZ

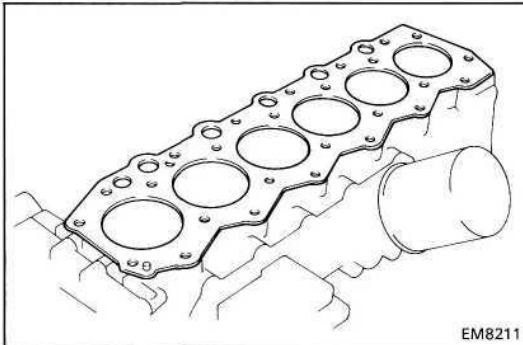
1HD-T

Poston protrusion mm (in.)	Gasket size	Piston protrusion mm (in.)	Gasket size
0.455 (0.0179) or less	Use "1"	0.525 (0.0207) or less	Use "1"
0.456 – 0.555 (0.0180 – 0.0219)	Use "3"	0.526 – 0.625 (0.0207 – 0.0246)	Use "3"
0.556 (0.0246) or more	Use "5"	0.626 (0.0246) or more	Use "5"



2. SET NO.1 CYLINDER TO BDC

Turn the crankshaft pulley, and align the BDC mark of the timing gear cover with the No.1 flange groove of the No.2 camshaft timing pulley.



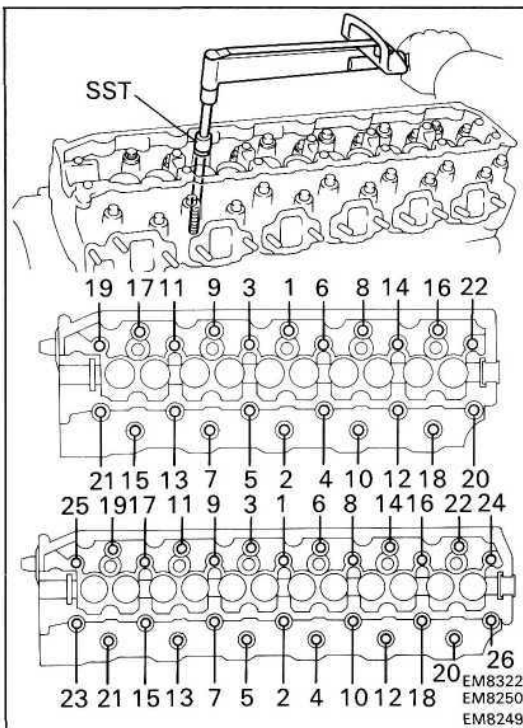
3. INSTALL CYLINDER HEAD

A. Place cylinder head on cylinder block

- (a) Place a new cylinder head gasket in position on the cylinder block.

NOTICE: Be careful of the installation direction.

- (b) Place the cylinder head in position on the cylinder head gasket.



B. Install cylinder head bolts

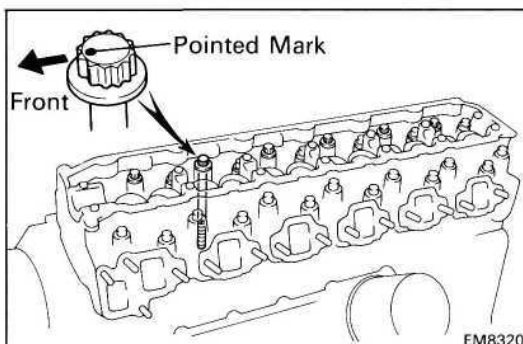
HINT:

- The cylinder head bolts are tightened in three progressive steps.
 - If any of bolts break or deform, replace them.
- (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
- (b) First, using SST, install and uniformly tighten the twenty-two cylinder head bolts (1 PZ) or twenty-six cylinder head bolts (1 HZ and 1HD-T) in several passes in the sequence shown.

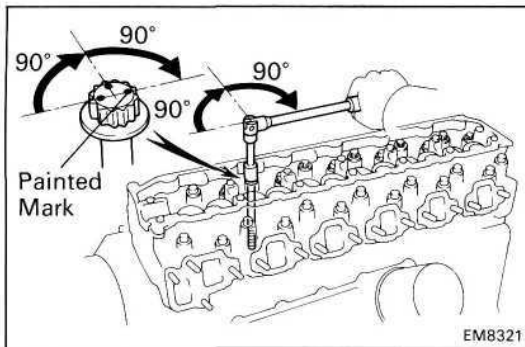
SST 09011 -38121

Torque: 700 kg-cm (51 ft-lb, 69 N·m)

If any one of the bolts does not meet the torque specification, replace the bolt.

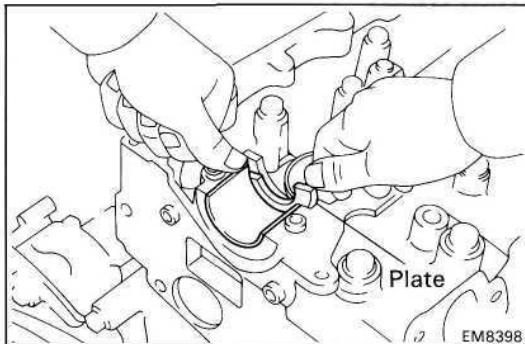


- (c) Mark the front of the cylinder head bolt head with paint.

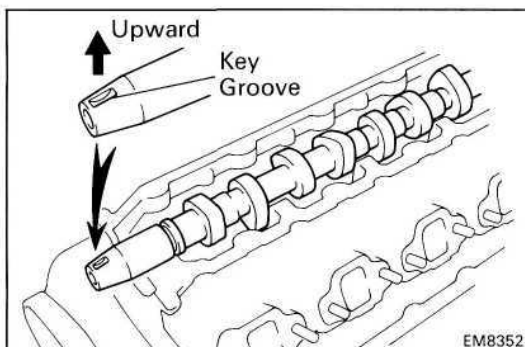


- (d) 2nd, retighten the cylinder head bolts 90° in the numerical order shown above.
- (e) 3rd, retighten cylinder head bolts by an additional 90°.
- (f) Check that the painted mark is now facing rearward.

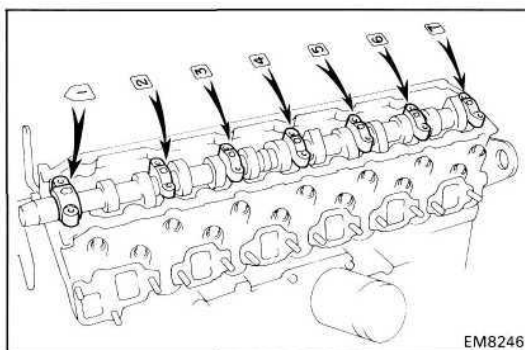
4. INSTALL CAMSHAFT



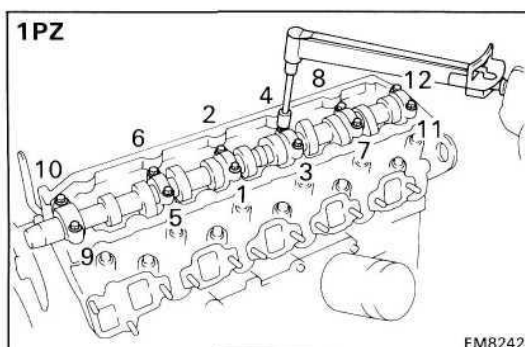
- (a) Install the camshaft thrust plate to the cylinder head.
- (b) Install the camshaft bearings to the No.1 bearing cap and No.1 journal of the cylinder head.



- (c) Place the camshaft on the cylinder head, facing the key groove upward.



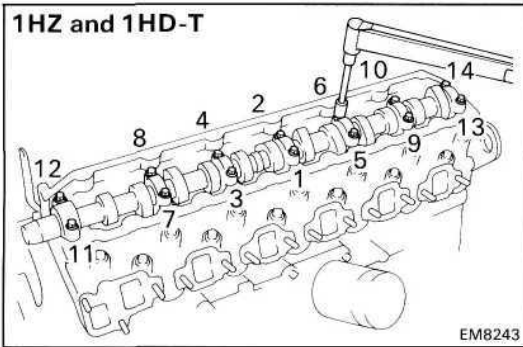
- (d) Install the six (1PZ) or seven (1 HZ and 1HD-T) bearing caps in their proper locations.



- (e) (1PZ)
Install and uniformly tighten the twelve bearing cap bolts in several passes in the sequence shown.

Torque:

No.1 journal	250 kg-cm (18 ft-lb, 25 N-m)
Others	185 kg-cm (13 ft-lb, 18 N-m)



- (f) (1HZ and 1HD-T)
Install and uniformly tighten the fourteen bearing cap bolts in several passes in the sequence shown.

Torque:

No.1 journal 250 kg-cm (18 ft-lb, 25 N-m)
Others 185 kg-cm (13 ft-lb, 18 N-m)

5. ADJUST VALVE CLEARANCE (See page EM-19)**Valve clearance (Cold):**

Intake 0.15-0.25 mm (0.006-0.010 in.)
Exhaust 0.35-0.45 mm (0.014-0.018 in.)

6. INSTALL CAMSHAFT OIL SEAL RETAINER

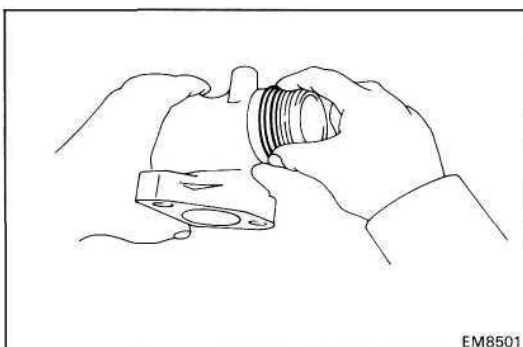
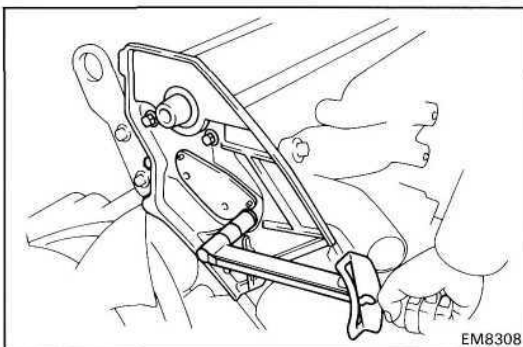
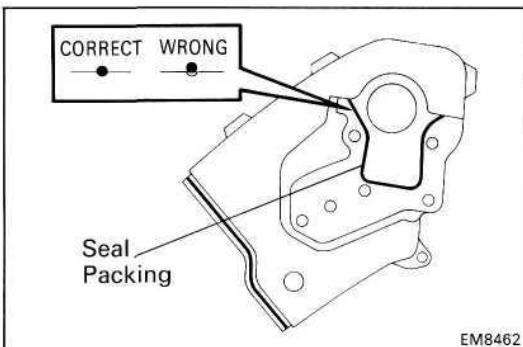
- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the camshaft oil seal retainer and cylinder head.
- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
 - Thoroughly clean all components to remove all the loose material.
 - Using a non-residue solvent, clean both sealing surfaces.
- (b) Apply seal packing to the camshaft oil seal retainer as shown in the illustration.

Seal packing: Part No.08826-00080 or equivalent

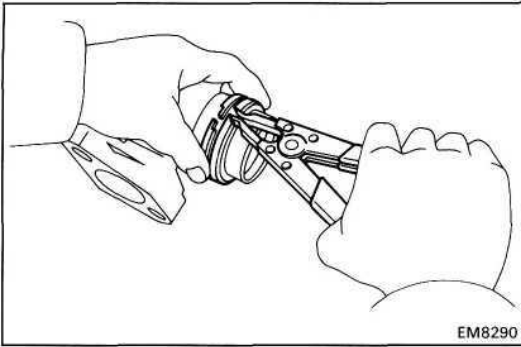
- Install a nozzle that has been cut to a 2 - 3 mm (0.08-0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

- (c) Install the retainer with the four bolts.

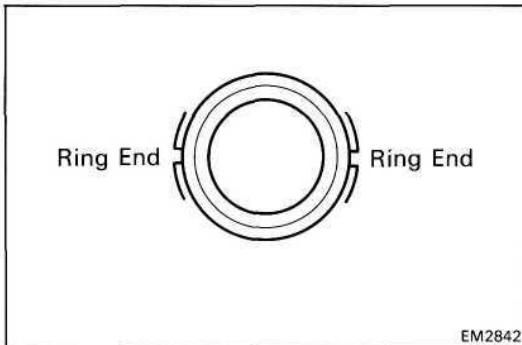
Torque: 200 kg-cm (14 ft-lb, 20 N-m)

7. INSTALL PULLEYS AND TIMING BELT (See steps 2 to 4 and 6 to 11 on pages EM-38 to 41)**8. (1HZ and 1HD-T) ASSEMBLY EXHAUST MANIFOLDS**

- (a) Remove all the O-ring material from the manifold grooves.
(b) Install new O-rings.

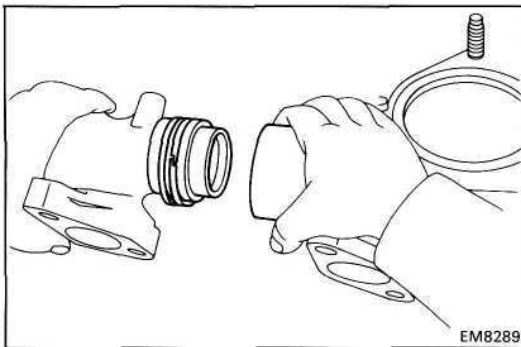


(c) Using snap ring pliers, install the two manifold rings.



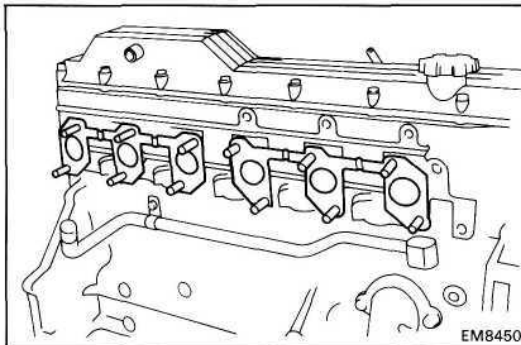
(d) Position the manifold rings so that the ring ends are as shown.

NOTICE: Do not align the ends.



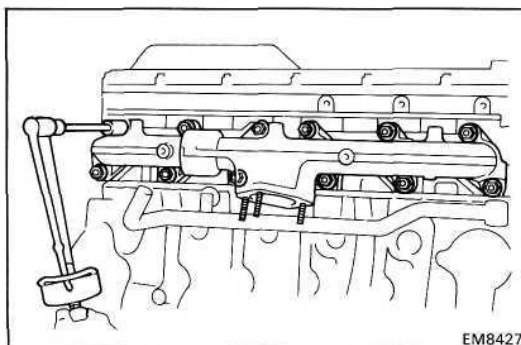
(e) Install the manifold collar.

(f) Assemble the front and rear manifolds.



9. (1PZ and 1HZ) INSTALL EXHAUST MANIFOLD

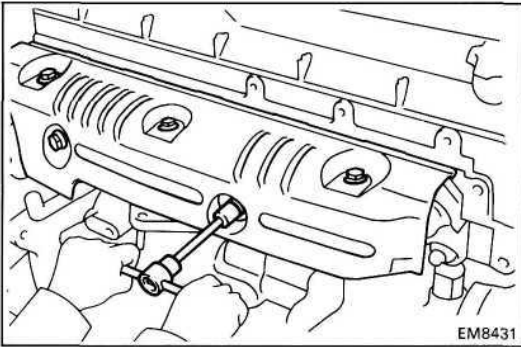
(a) Install new gaskets in direction as shown in the illustration.



(b) Install the exhaust manifold with the ten nuts (1PZ) or twelve nuts (1HZ).

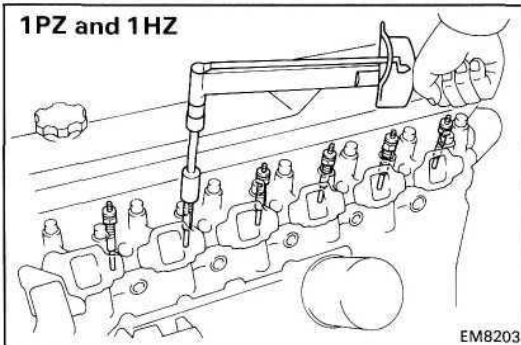
Torque: 400 kg-cm (29 ft-lb, 39 N-m)

HINT: Apply 330 kg-cm (24 ft-lb, 32 N-m) of torque when performing additional tightening of loosed nuts.



- (c) Install the heat insulator with the four bolts (1PZ) or five bolts (1HZ).

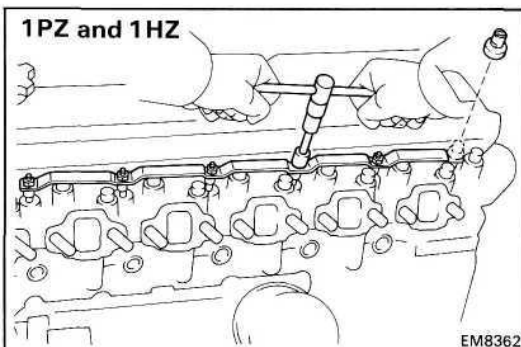
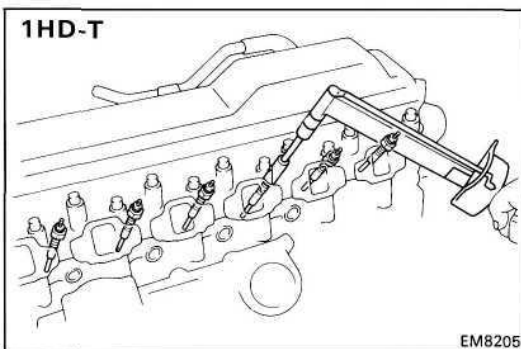
**10. (1HD-T)
INSTALL TURBOCHARGER AND EXHAUST MANIFOLD
(See steps 4 to 10 on pages TC-13 to 15)**



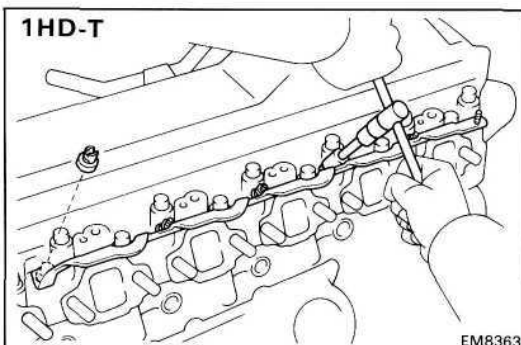
11. INSTALL GLOW PLUG

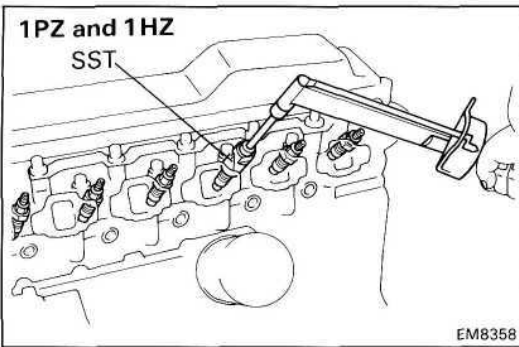
- (a) Using a 12 mm deep socket wrench, install the five glow plugs (1PZ) or six glow plugs (1HZ and 1HD-T).

Torque: 130 kg-cm (9 ft-lb, 13 N·m)



- (b) Install the glow plug connector with the five nuts (1 PZ) or six nuts (1 HZ and 1 HD-T).
- (c) Install the five screw grommets (1 PZ) and six screw grommets (1 HZ and 1 HD-T).



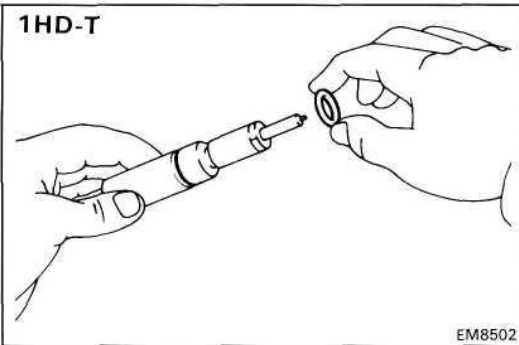


12. INSTALL INJECTION NOZZLES (1PZ and 1HZ)

- Place new gaskets and the nozzle seats into the injection nozzle holes of the cylinder head.
- Using SST, install the injection nozzles.
SST 09268-64010

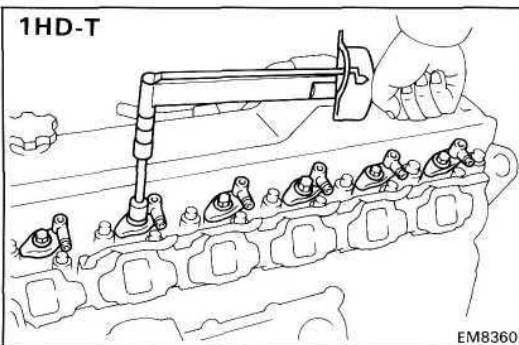
Torque: 650 kg-cm (47 ft-lb, 64 N·m)

NOTICE: Over torquing could cause nozzle deformation and needle adhesion or other defects.



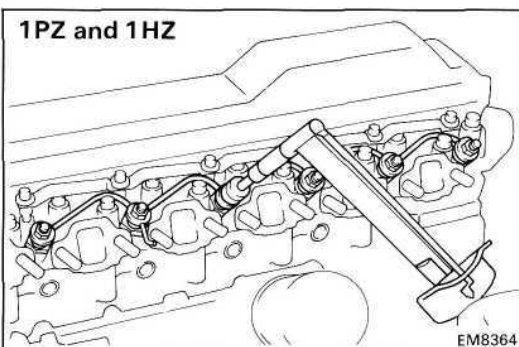
(1HD-T)

- Install a new O-ring to the injection nozzle.



- Place new nozzle seats into the injection nozzle holes of the cylinder head.
- Install the injection nozzles with the washer and bolt.

Torque: 400 kg-cm (29 ft-lb, 39 N·m)



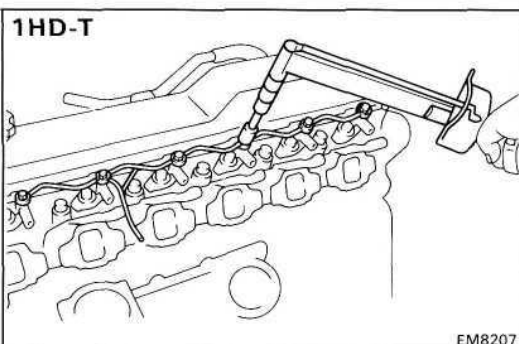
13. INSTALL NOZZLE LEAKAGE PIPE (1PZ and 1HZ)

- (1PZ)
Install five new gaskets and the leakage pipe with the five nuts.

Torque: 300 kg-cm (22 ft-lb, 29 N·m)

- (1HZ)
Install six new gaskets and the leakage pipe with the six nuts.

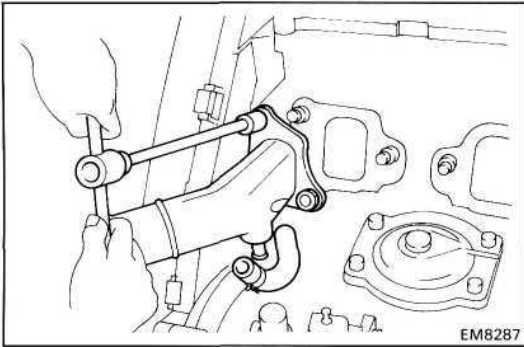
Torque: 300 kg-cm (22 ft-lb, 29 N·m)



(1HD-T)

- Install twelve new gaskets and the leakage pipe with the six hollow bolts.

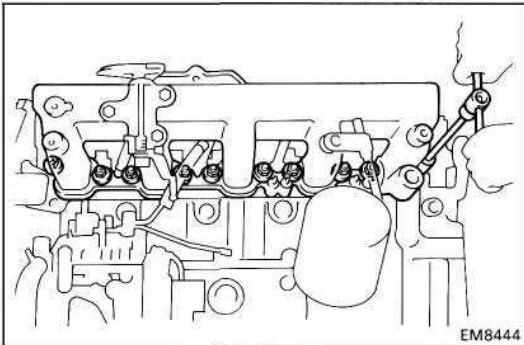
Torque: 125 kg-cm (9 ft-lb, 12 N·m)

**14. INSTALL WATER OUTLET**

- (a) Install a new gasket and water outlet with the two nuts.

Torque: 200 kg-cm (14 ft-lb, 20 Nm)

- (b) (1HD-T)
Connect the water by-pass hose.

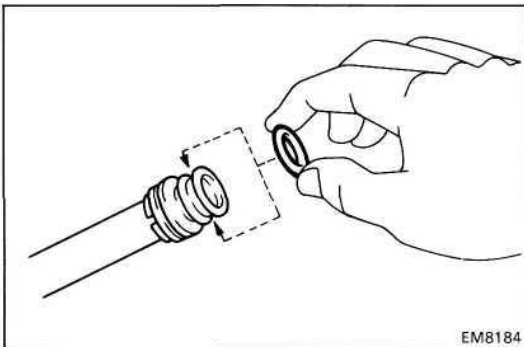
**15. INSTALL INTAKE MANIFOLD**

- (a) (1PZ)
Install five new gaskets and the intake manifold with the ten bolts and seal washers.

Torque: 200 kg-cm (14 ft-lb, 20 Nm)

- (b) (1 HZ and 1HD-T)
Install six new gaskets and the intake manifold with the twelve bolts and seal washers.

Torque: 200 kg-cm (14 ft-lb, 20 Nm)

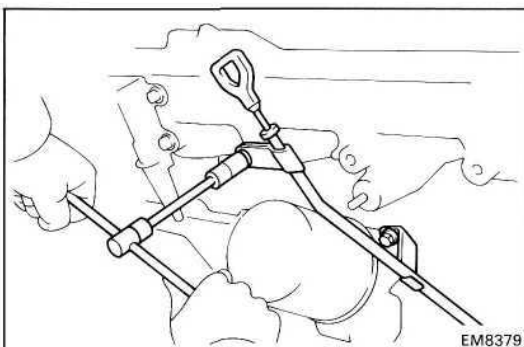
**16. INSTALL OIL DIPSTICK GUIDE AND OIL DIPSTICK**

- (a) Install a new O-ring to the dipstick guide.

- (b) Install the oil dipstick guide assembly with the two bolts.

Torque:

Intake manifold side
200 kg-cm (14 ft-lb, 20 Nm)
Oil cooler cover side
200 kg-cm (14 ft-lb, 20 Nm)

**17. INSTALL INJECTION PIPES**

(See step 3 on page FU-15)

Torque:

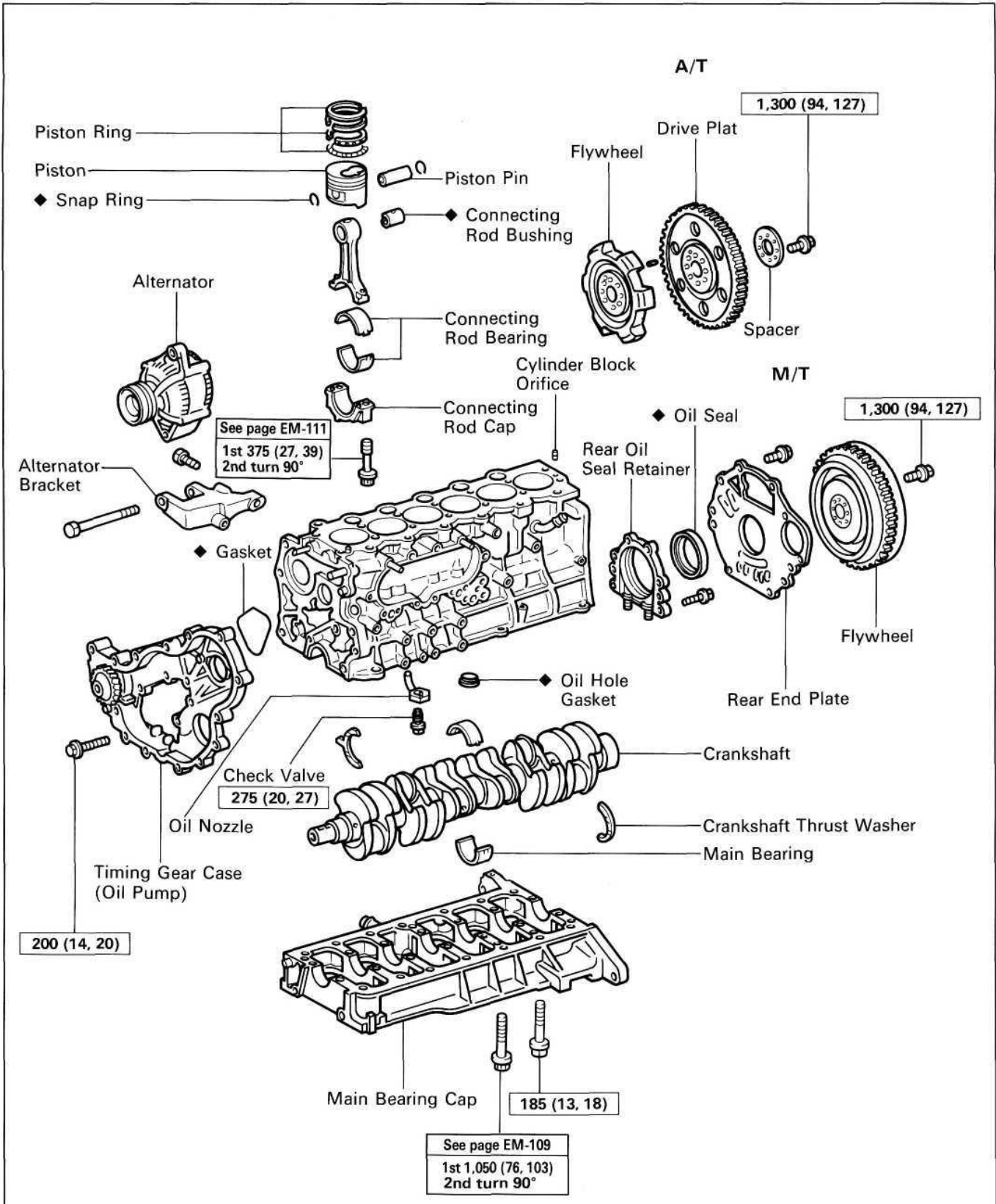
IPZ and iHZ 150 kg-cm (11 ft-lb, 15 Nm)
1HD-T 250 kg-cm (18 ft-lb, 25 Nm)

18. INSTALL INTAKE PIPE

(See step 2 on page EM-38)

19. FILL WITH ENGINE COOLANT (See page CO-5)**20. START ENGINE AND CHECK FOR LEAKS****21. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL**

CYLINDER BLOCK COMPONENTS

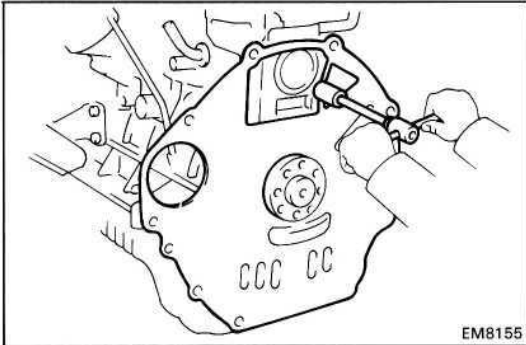


kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

PREPARATION FOR DISASSEMBLY

1. (M/T)
REMOVE CLUTCH COVER AND DISC
2. (M/T)
REMOVE FLYWHEEL
3. (A/T)
REMOVE DRIVE PLATE AND FLYWHEEL
Remove the drive plate rear spacer, drive plate and flywheel.
4. **REMOVE REAR END PLATE**
Remove the bolt, end plate and dust cover.



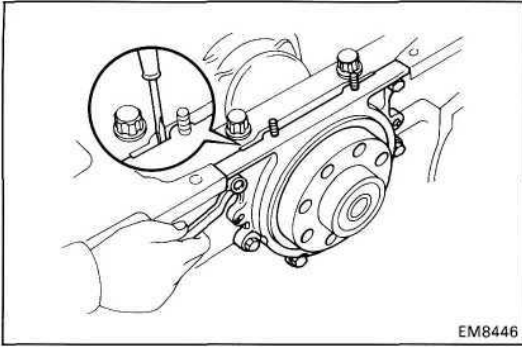
5. **INSTALL ENGINE TO ENGINE STAND FOR DISASSEMBLY**
6. **REMOVE TIMING BELT AND PULLEYS**
(See page EM-33)
7. **REMOVE CYLINDER HEAD** (See page EM-55)
8. **REMOVE WATER PUMP** (See page CO-6)
9. **REMOVE ALTERNATOR**
10. **REMOVE TIMING GEARS** (See page EM-43)
11. **REMOVE INJECTION PUMP** (See page FU-27)
12. **REMOVE OIL PAN AND TIMING GEAR CASE (OIL PUMP)**
(See page LU-8)
13. **REMOVE OIL COOLER** (See page LU-14)
14. **REMOVE WATER INLET AND THERMOSTAT**
15. **REMOVE ENGINE MOUNTING**

DISASSEMBLY OF CYLINDER BLOCK

(See page EM-84)

1. REMOVE REAR OIL SEAL RETAINER

Remove the six bolts and retainer.



EM8446

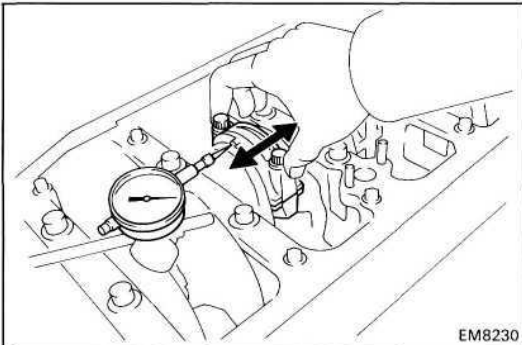
2. CHECK CONNECTING ROD THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance: 0.10-0.20 mm
(0.0038-0.0079 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

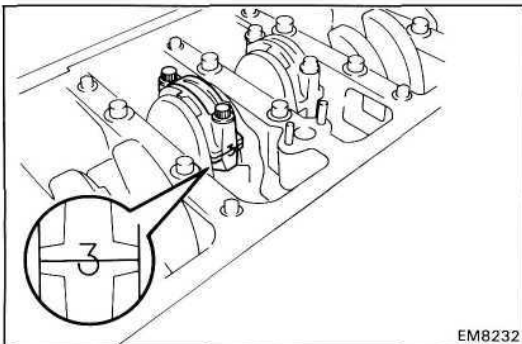
If the thrust clearance is greater than maximum, replace the connecting rod assembly. If necessary, replace the crankshaft.



EM8230

3. REMOVE CONNECTING ROD CAPS AND CHECK OIL CLEARANCE

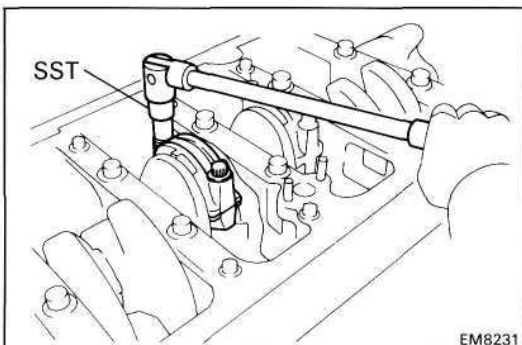
(a) Using paint, place the matchmarks on the connecting rod and cap to ensure correct reassembly.



EM8232

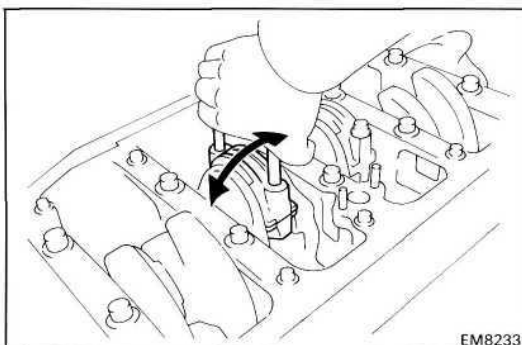
(b) Using SST, remove the connecting rod cap bolts.

SST 09011-381 21

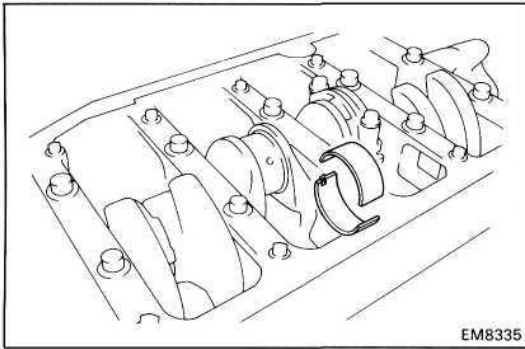


EM8231

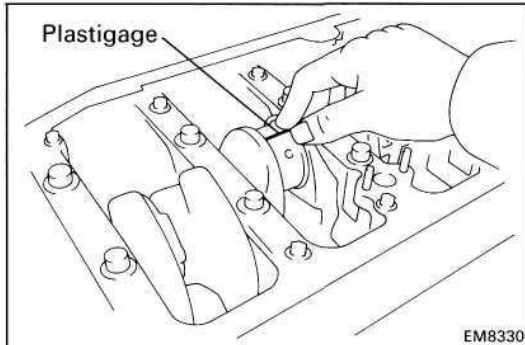
(c) Using the removed connecting rod cap bolts, pry the connecting rod cap back and forth, and remove the connecting cap.

HINT: Keep the lower bearing inserted with the connecting rod cap.

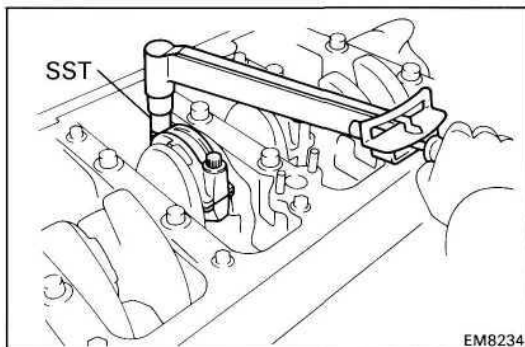
EM8233



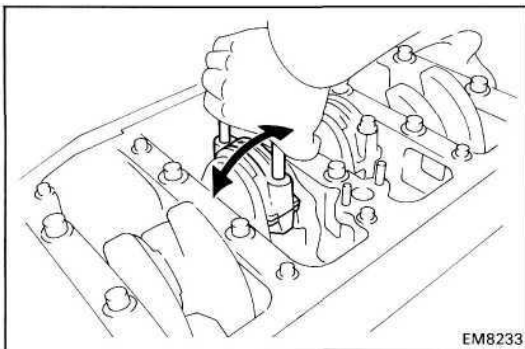
EM8335



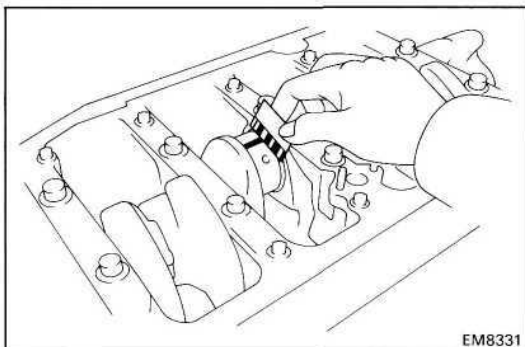
EM8330



EM8234



EM8233



EM8331

- (d) Clean crank pin and bearing.
- (e) Check the crank pin and bearing for pitting and scratches.

If the crank pin or bearing is damaged, replace the bearings. If necessary, grind or replace the crankshaft.

- (f) Lay a strip of Plastigage across the crank pin.

- (g) Install the connecting rod cap.
(See step 8 on page EM-111)

Torque: 1st 375 kg-cm (27 ft-lb, 37 Nm)
2nd turn 90°

HINT: Do not turn the crankshaft.

- (h) Remove the connecting rod cap.
(See procedure (b) and (c) above)

- (i) Measure the Plastigage at widest point.

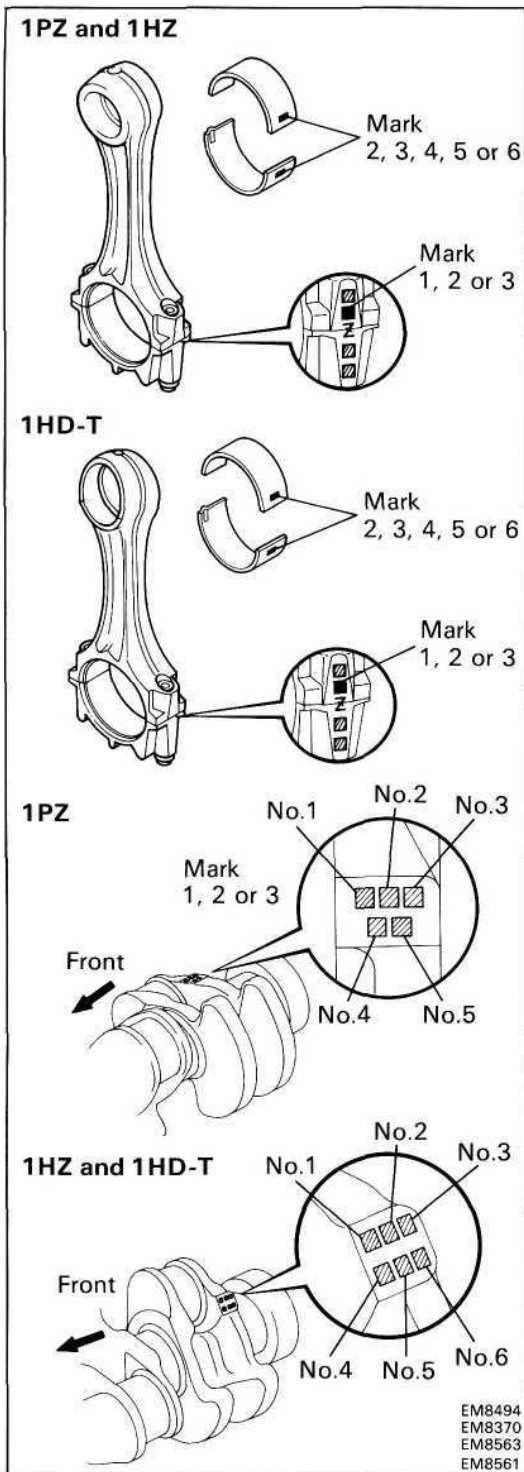
Standard oil clearance:

STD 0.036-0.054 mm
(0.0014-0.0021 in.)

U/S 0.25 and U/S 0.50
0.037 - 0.077 mm
(0.0015 - 0.0030 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.



HINT: If using a standard bearing, replace with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers inprinted on the crankshaft and connecting rod, then selecting the bearing with the same number as the total. There are five sizes of standard bearings, marked "2", "3", "4", "5" and "6" accordingly.

Connecting rod	Number marked								
	1			2			3		
Crankshaft	1	2	3	1	2	3	1	2	3
Bearing	2	3	4	3	4	5	4	5	6

EXAMPLE: Connecting rod "2" + Crankshaft "1"
= Total number (Use bearing "3")

(Reference)

Connecting rod big end inner diameter:

Mark "1" 62.014-62.020 mm
(2.4415-2.4417 in.)

Mark "2" 62.020-62.026 mm
(2.4417-2.4420 in.)

Mark "3" 62.026-62.032 mm
(2.4420-2.4422 in.)

Crankshaft pin diameter:

Mark "1" 58.994-59.000 mm
(2.3226-2.3228 in.)

Mark "2" 58.988 - 58.994 mm
(2.3224-2.3226 in.)

Mark "3" 58.982 - 58.988 mm
(2.3221-2.3224 in.)

Standard sized bearing center wall thickness:

Mark "2" 1.486-1.489 mm
(0.0585-0.0586 in.)

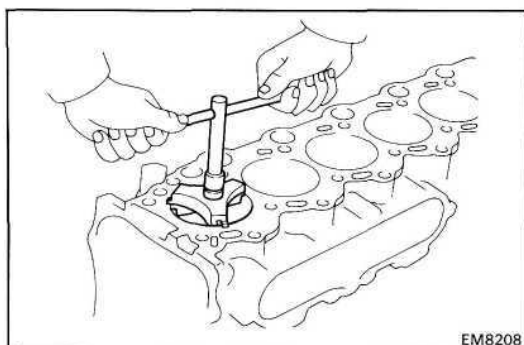
Mark "3" 1.489-1.492 mm
(0.0586-0.0587 in.)

Mark "4" 1.492-1.495 mm
(0.0587-0.0589 in.)

Mark "5" 1.495-1.498 mm
(0.0589-0.0590 in.)

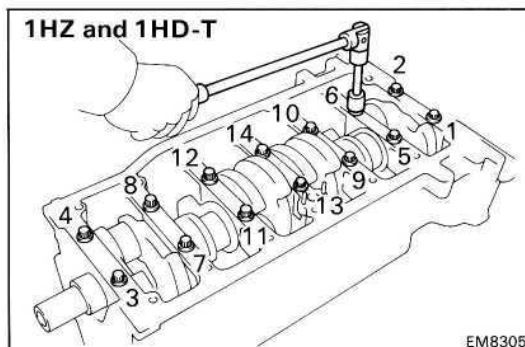
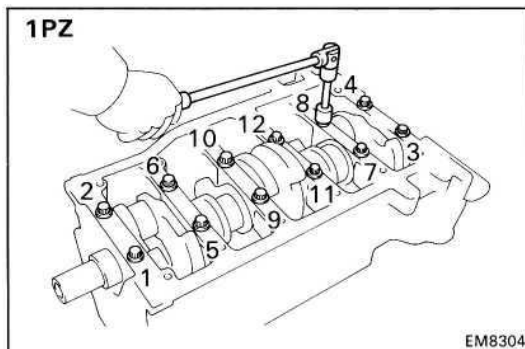
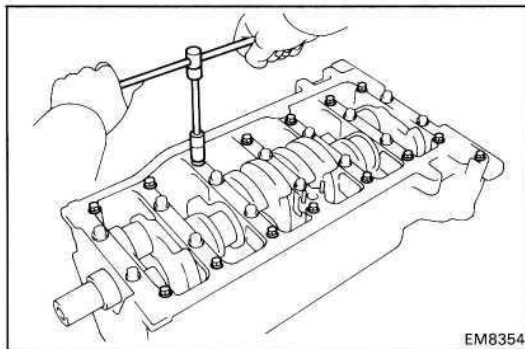
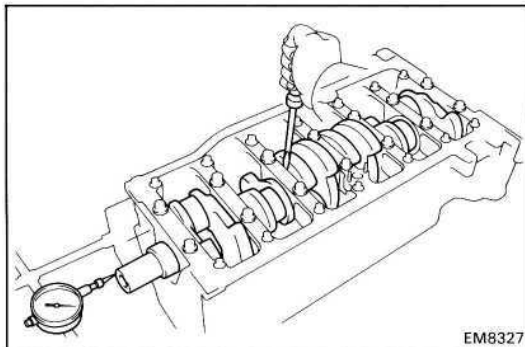
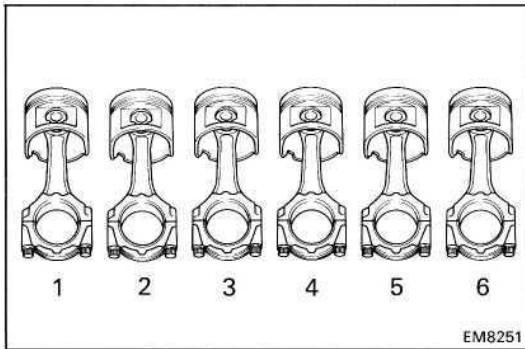
Mark "6" 1.498 -1.501 mm
(0.0590-0.0591 in.)

(j) Completely remove the Plastigage.



4. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES

- Remove the all carbon from the top of the cylinder.
- Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

**HINT:**

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in correct order.

5. CHECK CRANKSHAFT THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance: 0.04-0.24 mm
(0.0016-0.0094 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

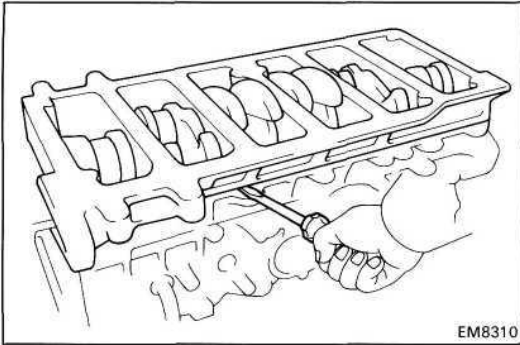
If the thrust clearance is greater than maximum, replace the thrust washers as a set.

Thrust washer thickness:
2.930-2.980 mm (0.1154-0.1173 in.)

6. REMOVE MAIN BEARING CAP AND CHECK OIL CLEARANCE

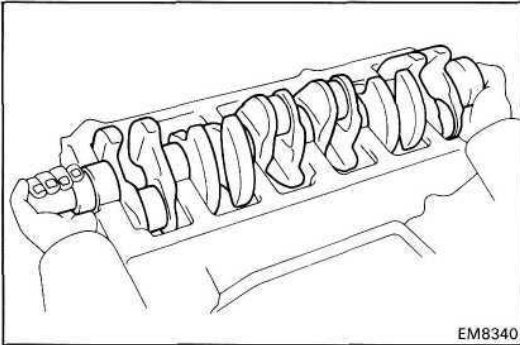
- (a) Remove the thirteen bolts (1 PZ) or fifteen bolts (1 HZ and 1HD-T).

- (b) Uniformly loosen and remove the main bearing cap bolts in several passes in the sequence shown.



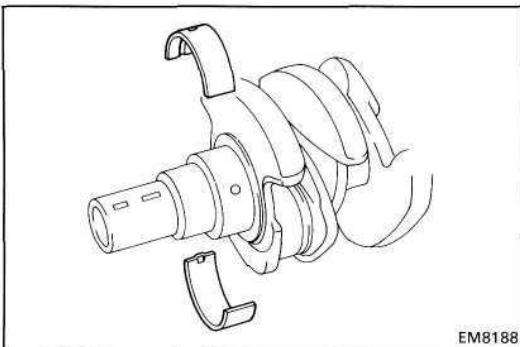
- (c) Using a screwdriver, pry out the main bearing cap.
 HINT: Keep the lower main bearings and main bearing cap together.

NOTICE: Do not scratch the surface which will be coated with FIPG.



- (d) Lift out the crankshaft.

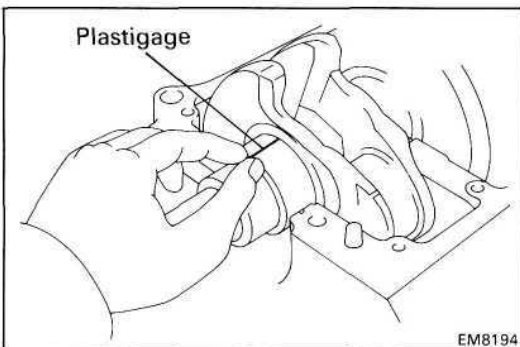
HINT: Keep the upper main bearings and thrust washers together with the cylinder block.



- (e) Clean each main journal and bearing.

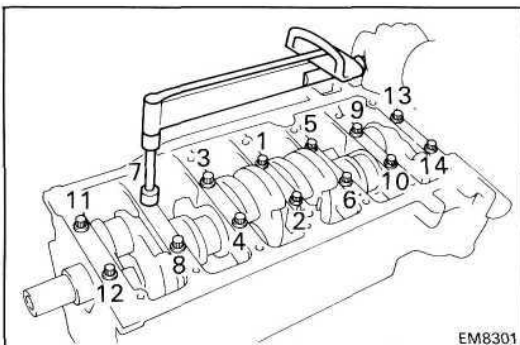
- (f) Check each main journal and bearing for pitting and scratches.

If the journal or bearing are damaged, replace the bearings. If necessary, grind or replace the crankshaft.



- (g) Place the crankshaft on the cylinder block,

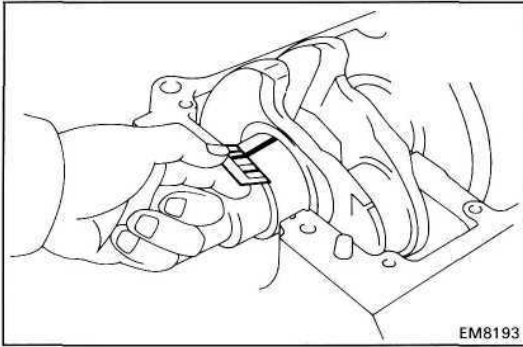
- (h) Lay a strip of Plastigage across each journal.



- (i) Install the main bearing cap with the bearings.
 (See step 6 on page EM-109)

**Torque: 1st 1,050 kg-cm (76 ft-lb, 103 N·m)
 2nd turn 90°**

HINT: Do not turn the crankshaft.



- (j) Remove the main bearing cap bolts and cap.
- (k) Measure the Plastigage at its widest point.

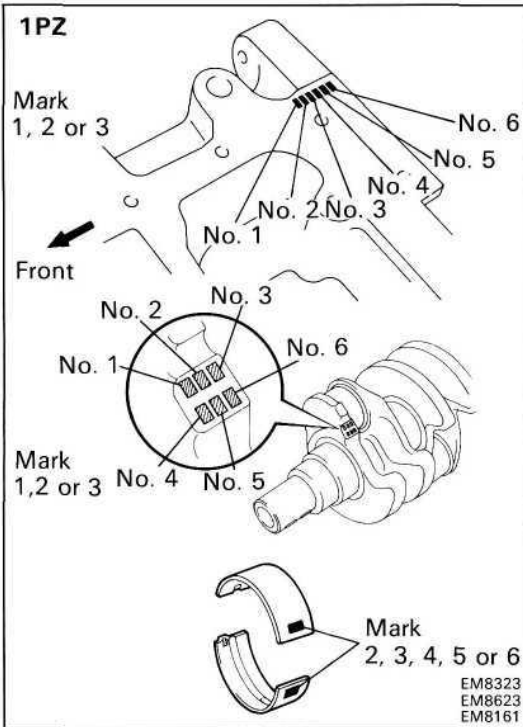
Standard clearance:

STD	0.036-0.054 mm (0.0014-0.0021 in.)
U/S 0.25 and U/S 0.50	0.037-0.077 mm (0.0015-0.0030 in.)

Maximum clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.

HINT: If using a standard bearing, replace with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers inprinted on the main bearing cap and crankshaft, then selecting the bearing with the same number as the total. There are five sizes of standard bearings, marked "2", "3", "4", "5" and "6" accordingly.



	Number marked								
	1			2			3		
Main bearing cap									
Crankshaft	1	2	3	1	2	3	1	2	3
Bearing	2	3	4	3	4	5	4	5	6

EXAMPLE: Main bearing cap "2" + Crankshaft "1"
= Total number (Use bearing "3")

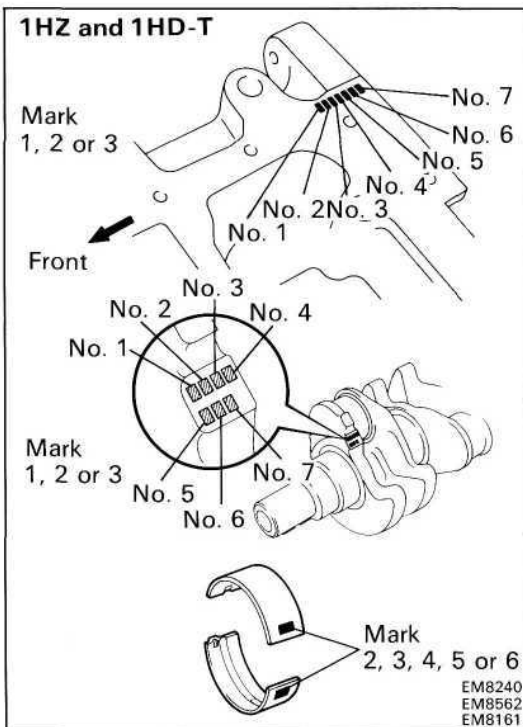
(Reference)

Cylinder block main journal bore diameter:

- Mark "1" 71.000 - 71.006 mm
(2.7953-2.7955 in.)
- Mark "2" 71.006 - 71.012 mm
(2.7955-2.7957 in.)
- Mark "3" 71.012-71.018 mm
(2.7957-2.7960 in.)

Crankshaft journal diameter:

- Mark "1" 66.994-67.000 mm
(2.6376-2.6378 in.)
- Mark "2" 66.988-66.994 mm
(2.6373-2.6376 in.)
- Mark "3" 66.982 - 66.988 mm
(2.6371-2.6373 in.)



(Reference) (Cont'd)

Standard sized bearing center wall thickness:

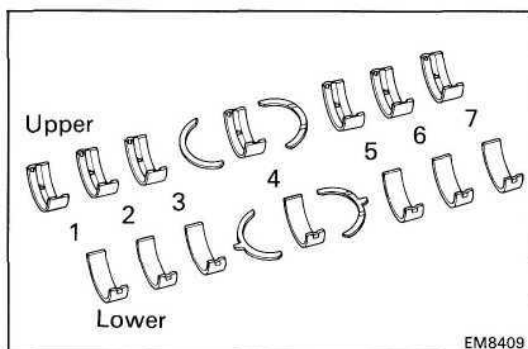
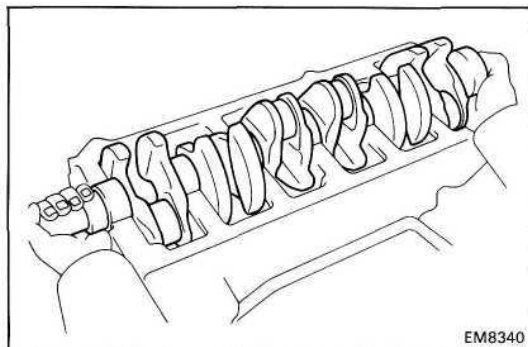
Mark "2"	1.979-1.982 mm (0.0779-0.0780 in.)
Mark "3"	1.982 -1.985 mm (0.0780-0.0781 in.)
Mark "4"	1.985 -1.988 mm (0.0781-0.0783 in.)
Mark "5"	1.988-1.991 mm (0.0783-0.0784 in.)
Mark "6"	1.991 -1.994 mm (0.0784-0.0785 in.)

(l) Completely remove the Plastigage.

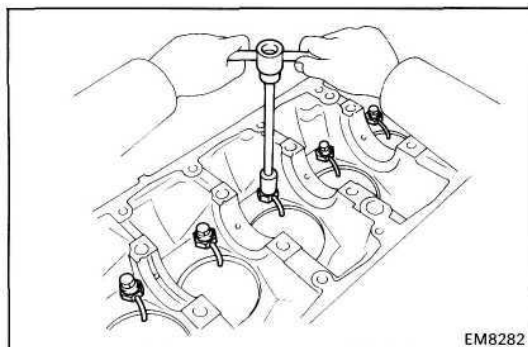
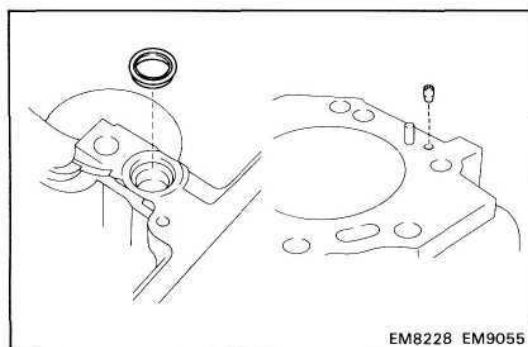
7. REMOVE CRANKSHAFT

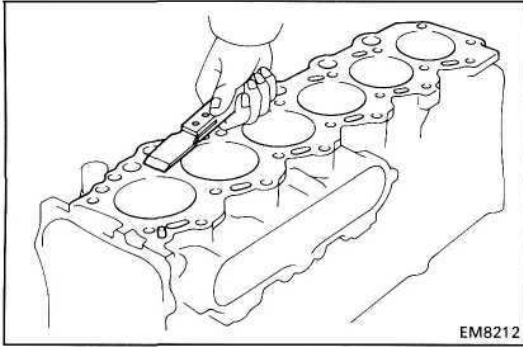
- (a) Lift out the crankshaft.
- (b) Remove the upper main bearings and thrust washers from the cylinder block.

HINT: Arrange the main bearings and thrust washers in correct order.

**8. REMOVE CHECK VALVES AND OIL NOZZLES**

Remove the five (1 PZ) or six (1 HZ and 1HD-T) check valves and oil nozzles.

**9. REMOVE CYLINDER BLOCK OIL HOLE GASKET****10. REMOVE CYLINDER BLOCK ORIFICE**



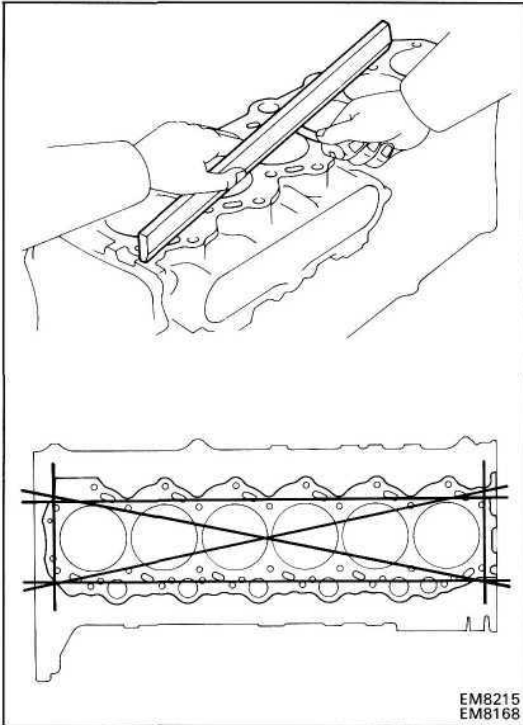
INSPECTION OF CYLINDER BLOCK

1. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all the gasket material from the cylinder block surface.

2. CLEAN CYLINDER BLOCK

Using a soft brush and solvent, clean the cylinder block.

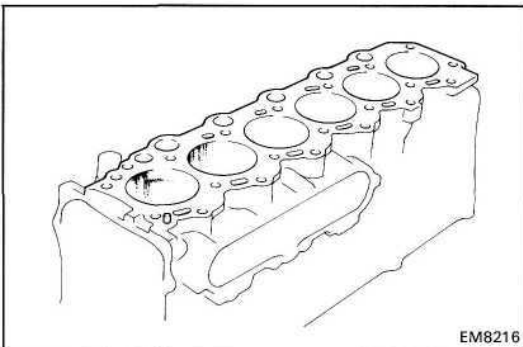


3. INSPECT TOP OF CYLINDER BLOCK FOR FLATNESS

Using a precision straight edge and thickness gauge, measure the surfaces contacting the cylinder head gasket for warpage.

Maximum warpage: 0.20 mm (0.0079 in.)

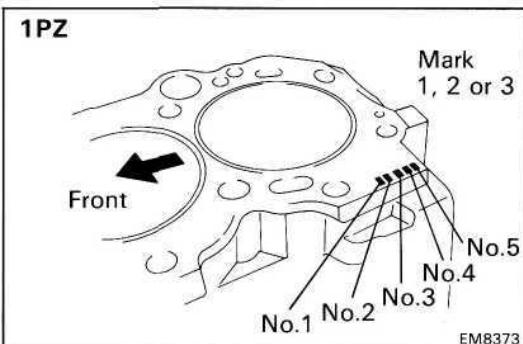
If warpage is greater than maximum, replace the cylinder block.



4. INSPECT CYLINDER FOR VERTICAL SCRATCHES

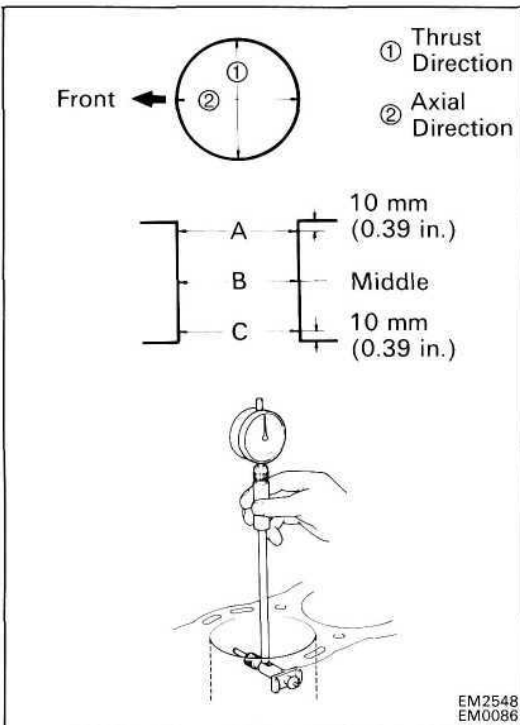
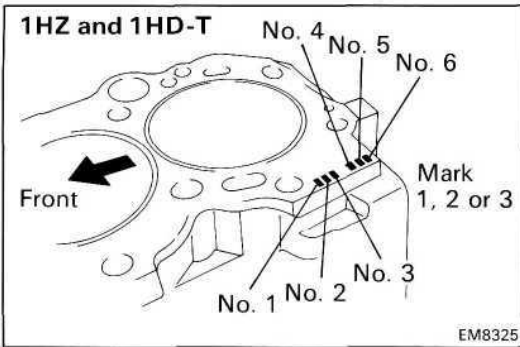
Visually check the cylinder for vertical scratches.

If deep scratches are present, rebore all five (1PZ) or six (1HZ and 1HD-T) cylinders. If necessary, replace the cylinder block.



5. INSPECT CYLINDER BORE DIAMETER

HINT: There are three sizes of the standard cylinder bore diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the upper left rear of the cylinder block.



Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust axial directions.

Standard diameter:

STD Mark "1" 94.000-94.010 mm
(3.7008-3.7012 in.)

Mark "2" 94.010-94.020 mm
(3.7012-3.7016 in.)

Mark "3" 94.020 - 94.030 mm
(3.7016-3.7020 in.)

Maximum diameter:

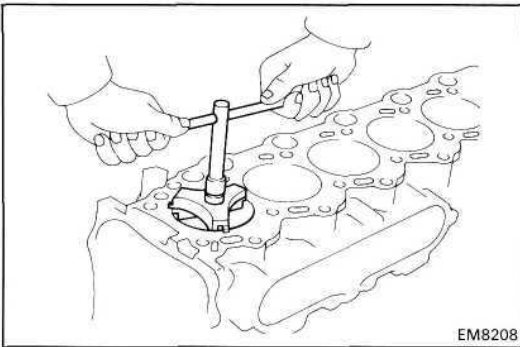
STD 94.23 mm (3.7098 in.)

O/S 0.50 94.73 mm (3.7295 in.)

If the diameter is greater than maximum, rebore all five (1 PZ) or six (1 HZ and 1 HD-T) cylinders. If necessary, replace the cylinder block.

6. REMOVE CYLINDER RIDGE

If the wear is less than 0.2 mm (0.008 in.), use a ridge reamer to machine the piston ring ridge at the top of the cylinder.



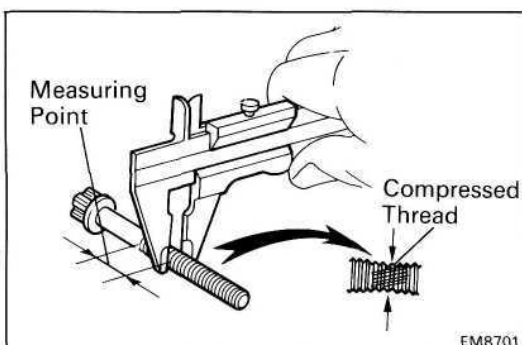
7. INSPECT MAIN BEARING CAP BOLTS

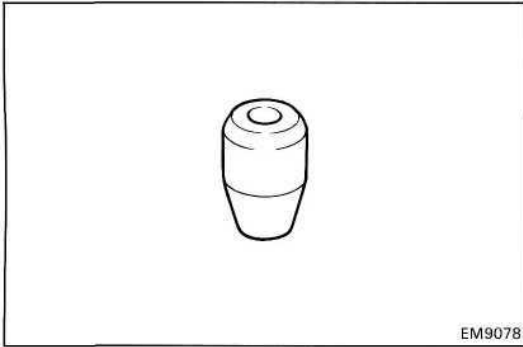
Using vernier calipers, measure the minimum diameter of the compressed thread at the measuring point.

Standard diameter: 11.800-12.000 mm
(0.4646-0.4724 in.)

Minimum diameter: 11.50 mm (0.4528 in.)

If the diameter is less than minimum, replace the bolt.





8. INSPECT CYLINDER BLOCK ORIFICE

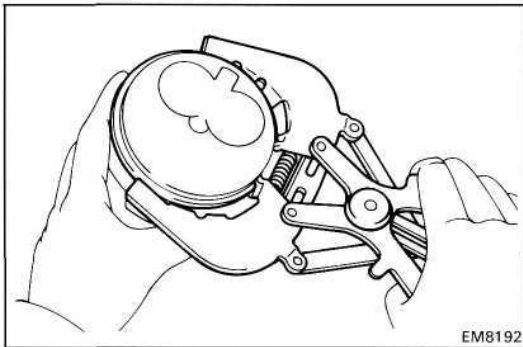
Check that the orifice is not clogged.



DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLIES

1. CHECK FIT BETWEEN PISTON AND PISTON PIN

Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and pin as a set.

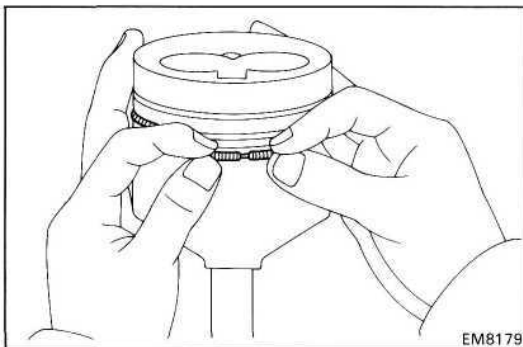


2. REMOVE PISTON RINGS

(a) Using a piston ring expander, remove the two compression rings and oil ring.

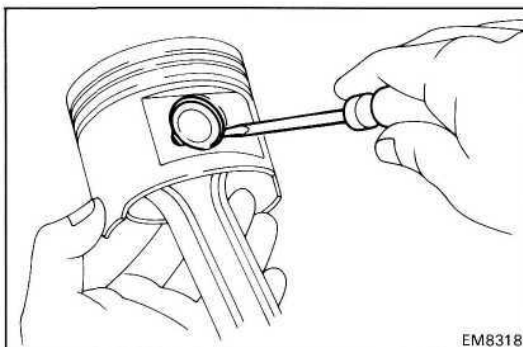
(b) Remove the coil by hand.

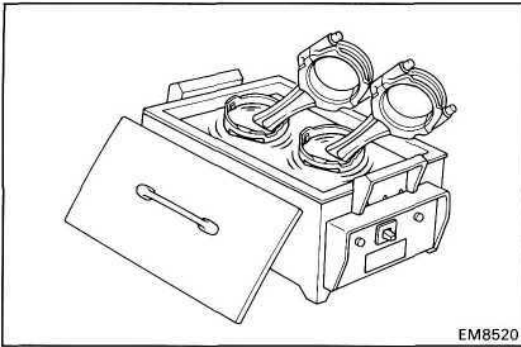
HINT: Arrange the rings in correct order only.



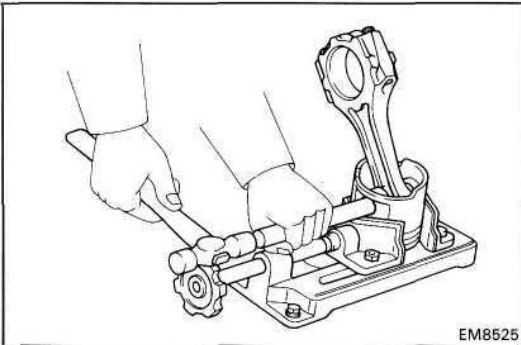
3. DISCONNECT CONNECTING ROD FROM PISTON

(a) Using a small screwdriver, remove the snap rings.

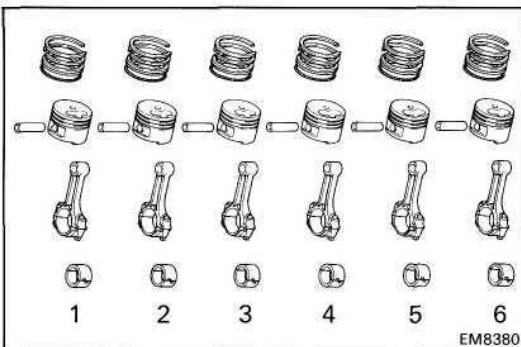




(b) Gradually heat the piston to approx. 80°C (176°F).

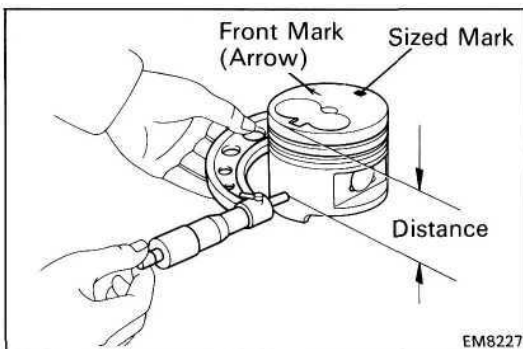
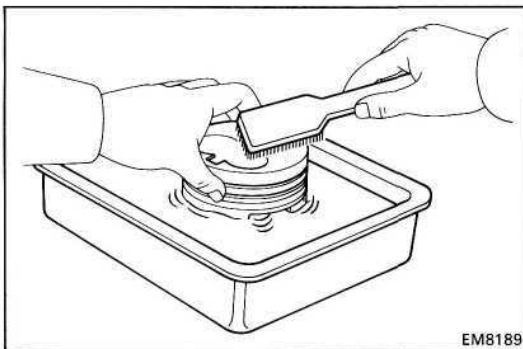
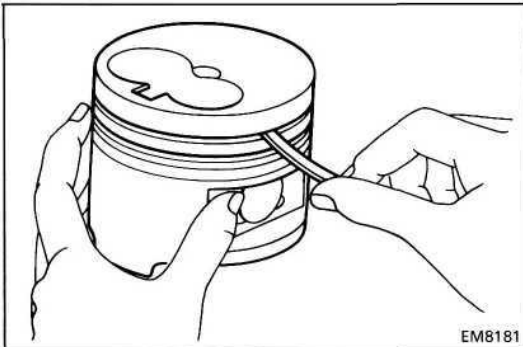
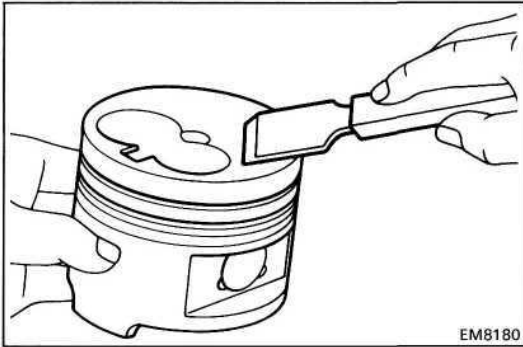


(c) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.



HINT:

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in correct order.



INSPECTION AND REPAIR OF PISTON AND CONNECTING ROD ASSEMBLIES

1. CLEAN PISTON

(a) Using a gasket scraper, remove the carbon from the piston top.

(b) Using a groove cleaning or broken ring, clean the piston ring grooves.

(c) Using solvent and a brush, thoroughly clean the piston.

NOTICE: Do not use a wire brush.

2. INSPECT PISTON DIAMETER AND OIL CLEARANCE

HINT: There are three sizes of the standard piston diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the top of the piston.

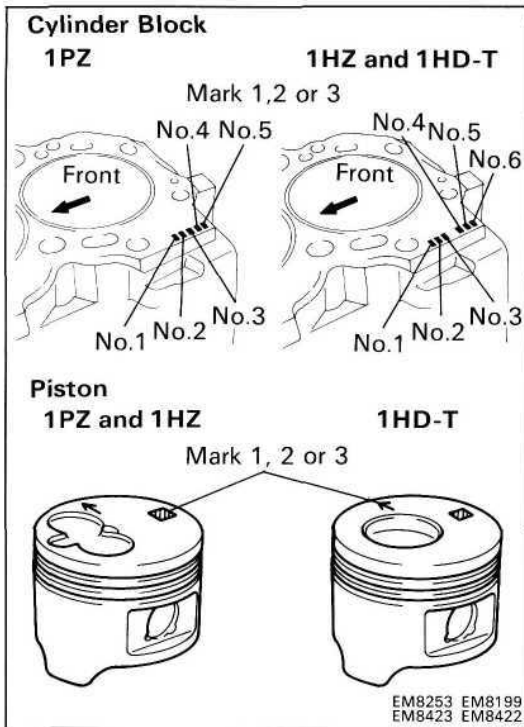
(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, at the indicated distance from the piston head.

Distance:

1PZ and 1 HZ	58.6 mm (2.3071 in.)
1HD-T	65.7 mm (2.5866 in.)

Piston diameter:

STD Mark "1"	93.95-93.96 mm (3.6988-3.6992 in.)
Mark "2"	93.96 - 93.97 mm (3.6992-3.7000 in.)
Mark "3"	93.97-93.98 mm (3.7000-3.7000 in.)
O/S 0.50	94.45 - 94.48 mm (3.7185-3.7197 in.)



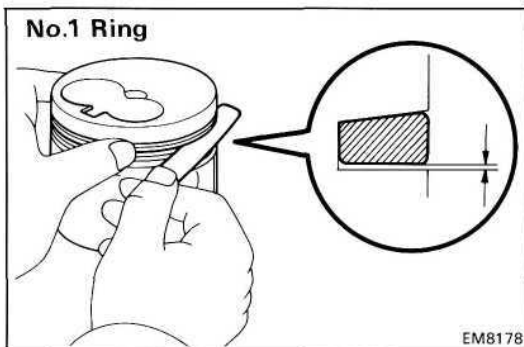
- (b) Measure the cylinder bore diameter in the thrust directions. (See step 5 on page EM-93)
- (c) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance: 0.04-0.06 mm (0.0016-0.0024 in.)

Maximum oil clearance: 0.14 mm (0.0055 in.)

If the oil clearance is greater than maximum, replace all five (1 PZ) or six (1 HZ and 1 HD-T) pistons and rebore all five (1 PZ) or six (1 HZ and 1 HD-T) cylinders. If necessary, replace the cylinder block.

HINT (Use cylinder block subassembly): When installing a standard piston, install one with the same number mark as the standard bore diameter mark on the cylinder block.



3. INSPECT CLEARANCE BETWEEN WALL OF RING GROOVE AND NEW PISTON RING (No.1 Ring)

Install new No.1 piston ring to the piston. Using a thickness gauge, measure the clearance between the piston ring and wall of the piston ring groove.

Ring groove clearance:

No.1 0.050-0.095 mm (0.0020-0.0037 in.)



(No.2 and Oil Rings)

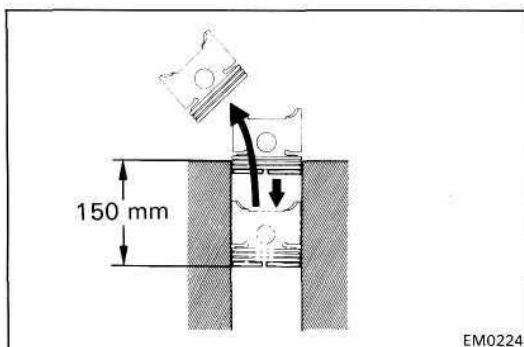
Using a thickness gauge, measure the clearance between new piston ring and the wall of the piston ring groove.

Ring groove clearance:

No.2 0.06-0.10 mm (0.0024-0.0039 in.)

Oil 0.03-0.07 mm (0.0012-0.0028 in.)

If the clearance is not as specified, replace the piston.



4. INSPECT PISTON RING END CAP

- (a) Insert the piston ring into the cylinderbore.
- (b) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 150 mm (5.91 in.) from the top of the cylinder block.

(c) Using a thickness gauge, measure the end gap.

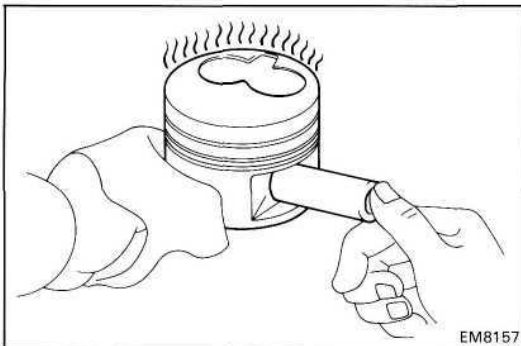
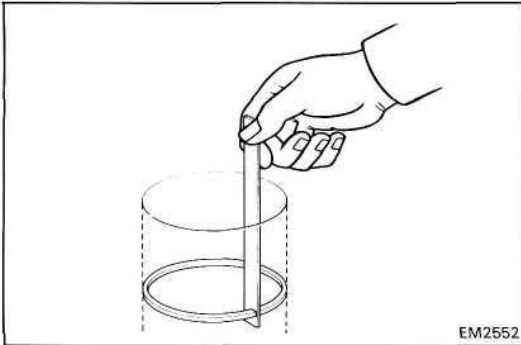
Standard end gap:

No.1	0.27-0.54 mm (0.0106-0.0213 in.)
No.2	0.40-0.62 mm (0.0157-0.0244 in.)
Oil	0.20-0.52 mm (0.0079-0.0205 in.)

Maximum end gap:

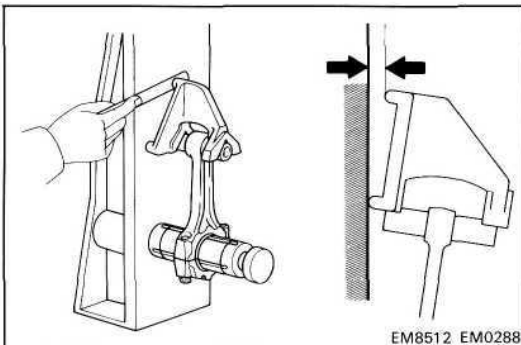
No.1	1.34 mm (0.0591 in.)
No.2	1.42 mm (0.0551 in.)
Oil	1.32 mm (0.0520 in.)

If the end gap is greater than maximum, replace the piston ring. If the end gap is greater than maximum, even with a new piston ring, rebores all five (1 PZ) or six (1 HZ and 1 HD-T) cylinders or replace the cylinder block.



5. INSPECT PISTON PIN FIT

At 80°C (176°F), you should be able to push the piston pin into the piston pin hole with your thumb.



6. INSPECT CONNECTING ROD

A. Inspect connecting rod alignment

Using a rod aligner, check the connecting rod alignment.

- Check for bending.

Maximum bending:

0.03 mm (0.0012 in.) per 100 mm (3.94 in.)

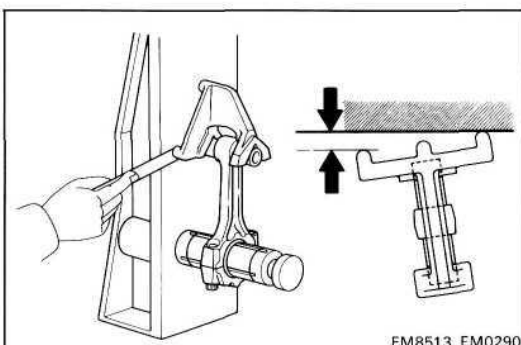
If bent is greater than maximum, replace the connecting rod assembly.

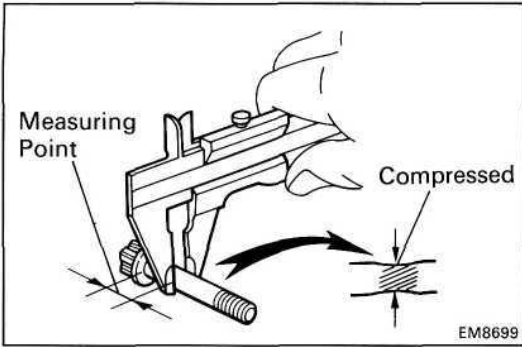
- Check for twist.

Maximum twist:

0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

If twist is greater than maximum, replace the connecting rod assembly.



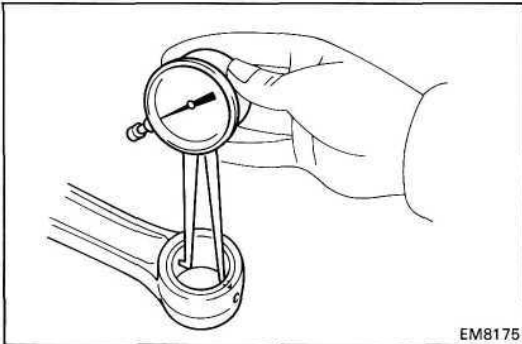
**B. Inspect connecting rod bolts**

Using vernier calipers, measure the minimum diameter of the compressed bolt at the measuring point.

Standard diameter: 8.300-8.400 mm
(0.3268-0.3307 in.)

Minimum diameter: 7.95 mm (0.3130 in.)

If the diameter is less than minimum, replace the connecting rod bolt.

**C. Inspect piston pin oil clearance**

(a) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

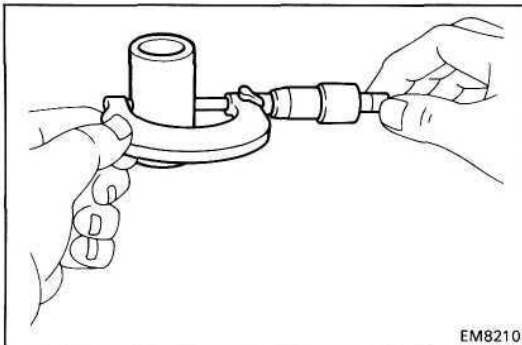
Bushing inside diameter:

1PZ and 1HZ

29.008-29.020 mm (1.1420-1.1425 in.)

1HD-T

33.008-33.020 mm (1.2995-1.3000 in.)



(b) Using a micrometer, measure the piston pin diameter.

Piston pin diameter:

1PZ and 1HZ

29.000-29.012 mm (1.1417-1.1422 in.)

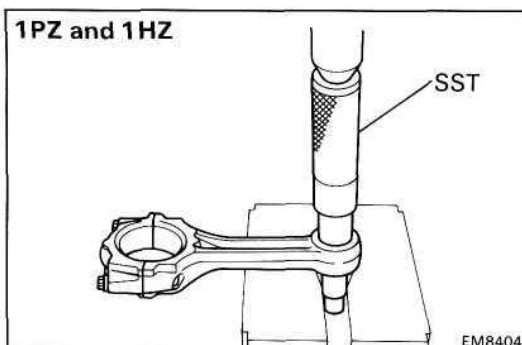
1HD-T

33.000-33.012 mm (1.2992-1.2997 in.)

(c) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.

Standard oil clearance: 0.004-0.012 mm
(0.0002-0.0005 in.)

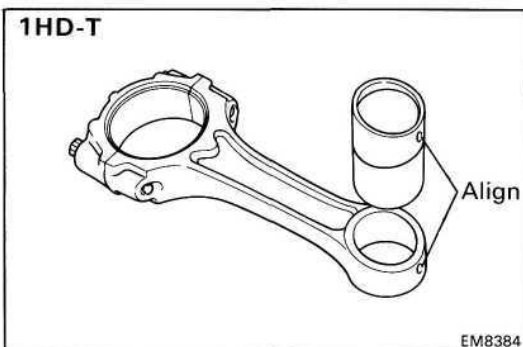
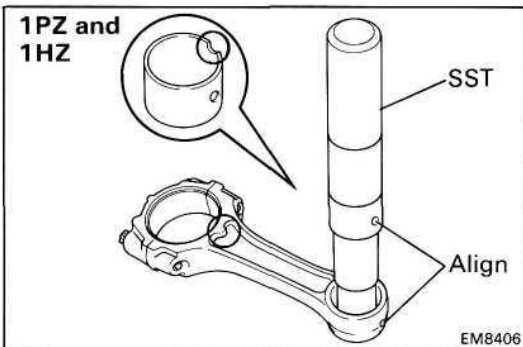
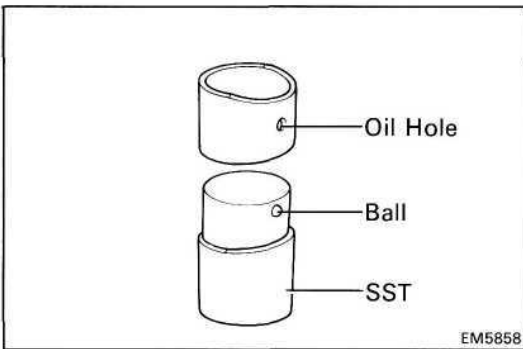
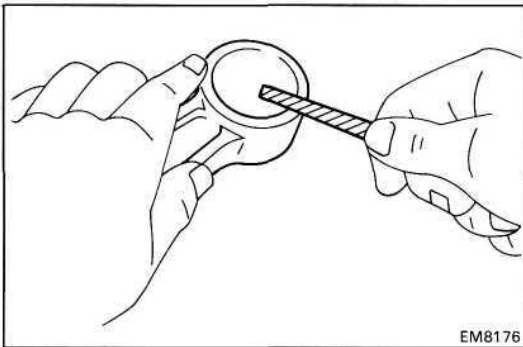
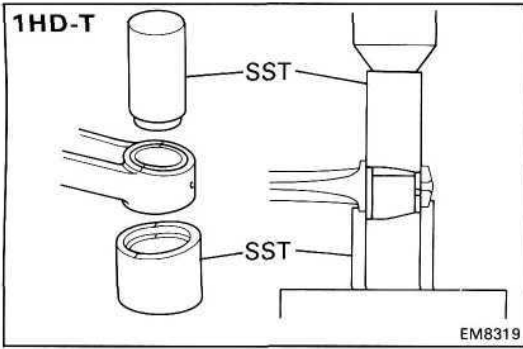
Maximum oil clearance: 0.03 mm (0.0012 in.)

**7. IF NECESSARY, REPLACE CONNECTING ROD BUSHINGS****A. Remove connecting rod bushings**

Using SST and a press, press out the bushing.

SST1PZand1HZ 09222-66010

1HD-T 09222-17010(09222-05020,
09222-05040)



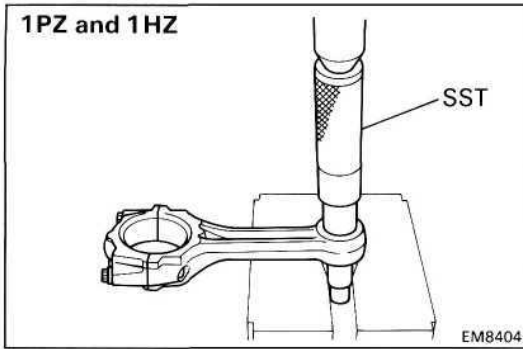
B. Install new connecting rod bushings

(a) Using a round file, lightly file off any roughness from the small end of the connecting rod.

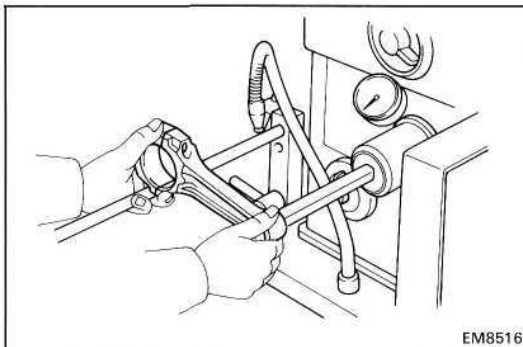
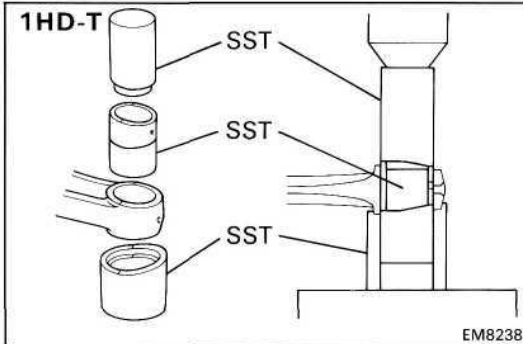
(b) (1HD-T)
Attach the bushing to SST with the ball of SST inside the oil hole of the bushing.

SST 09222-17010 (09222-05030)

(c) Align the oil holes of the bushing and connecting rod.

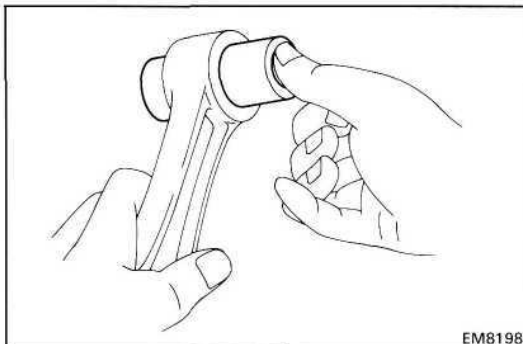


- (d) Using SST and a press, press in the bushing.
- | | |
|-----------------|---|
| SST 1PZ and 1HZ | 09222-66010 |
| 1HD-T | 09222-17010(09222-05020,
09222-05030, 09222-05040) |



C. Hone connecting rod bushing and check piston pin fit

- (a) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (see page EM-100) between the bushing and piston pin.



- (b) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.

BORING OF CYLINDERS

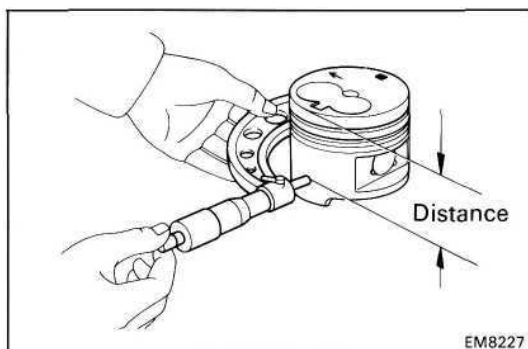
HINT:

- Bore all five (1 PZ) or six (1 HZ and 1 HD-T) cylinders for the oversized piston outside diameter.
- Replace the piston rings with ones to match the oversized pistons.

1. KEEP OVERSIZED PISTONS

Oversized piston diameter:

O/S0.50 94.45-94.48 mm
(3.7185-3.7197 in.)



2. CALCULATE AMOUNT TO BORE CYLINDER

- (a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, at the indicated distance from the piston head.

Distance:

1 PZ and 1 HZ 58.6 mm (2.3071 in.)
1 HD-T 65.7 mm (2.5866 in.)

- (b) Calculate the amount each cylinder is to be rebored as follows:

$$\text{Size to be rebored} = P + C - H$$

P = Piston diameter

C = Piston oil clearance

0.04-0.06 mm (0.0016-0.0024 in.)

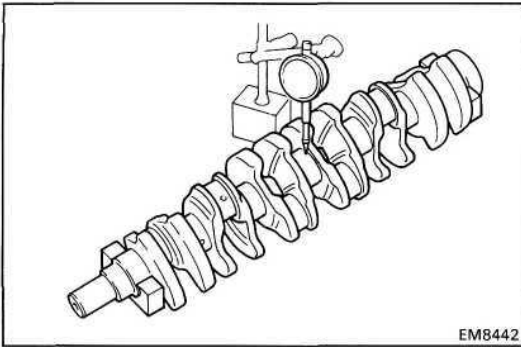
H = Allowance for honing

0.02 mm (0.0008 in.) or less

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

Maximum honing: 0.02 mm (0.0008 in.)

NOTICE: Excess honing will destroy the finished roundness.



INSPECTION AND REPAIR OF CRANKSHAFT

1. INSPECT CRANKSHAFT FOR RUNOUT

- (a) Place the crankshaft on V-blocks.
- (b) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.06 mm (0.0024 in.)

If the circle runout is greater than maximum, replace the crankshaft.

2. INSPECT MAIN JOURNALS AND CRANK PINS

- (a) Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter:

STD	66.982-67.000 mm (2.6371 -2.6378 in.)
U/S 0.25	66.745 - 66.755 mm (2.6278-2.6281 in.)
U/S 0.50	66.495 - 66.505 mm (2.6179-2.6183 in.)

Crank pin diameter:

STD	58.982-59.000 mm (2.3221-2.3228 in.)
U/S 0.25	58.745-58.755 mm (2.3128-2.3132 in.)
U/S 0.50	58.495-58.505 mm (2.3029-2.3033 in.)

If the diameter is not as specified, check the oil clearance (See pages EM-86 to 92).

- (b) Check each main journal and crank pin for taper and out-of-round as shown.

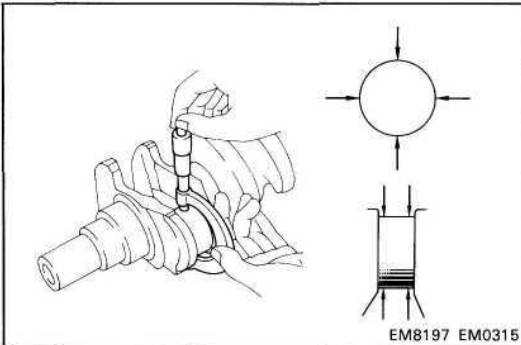
**Maximum taper and out-of-round: 0.02 mm
(0.0008 in.)**

If the taper or out-of-round is greater than maximum, grind or replace the crankshaft.

3. IF NECESSARY, GRIND AND HONE MAIN JOURNALS AND/OR CRANK PINS

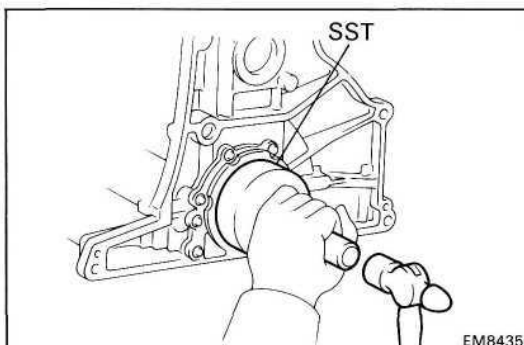
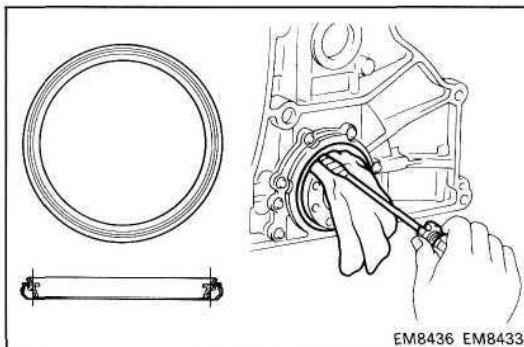
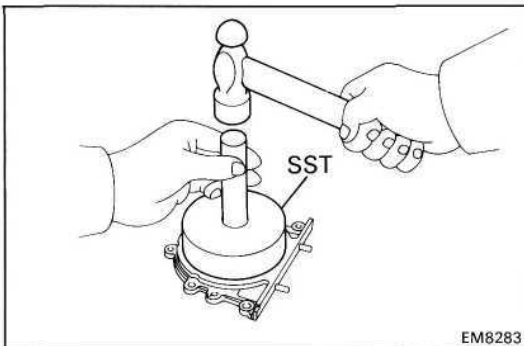
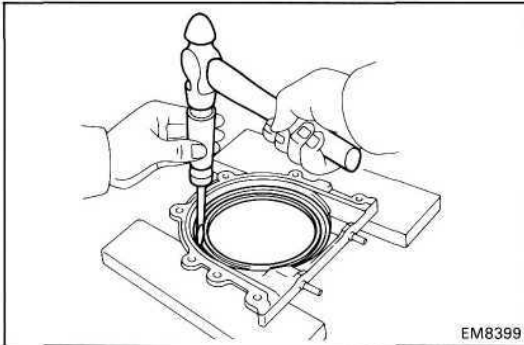
Grind and hone the main journals and/or crank pins to the finished undersized diameter (See procedure step 2).

Install new main journal and/or crank pin undersized bearings.



REPLACEMENT OF CRANKSHAFT OIL SEAL

HINT: There are two methods (A and B) to replace the oil seal as follows:



REPLACE CRANKSHAFT REAR OIL SEAL

A. If rear oil seal retainer is removed from cylinder block:

(a) Using a screwdriver and hammer, tap out the oil seal.

(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.

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(c) Apply MP grease to the oil seal lip.

B. If rear oil seal retainer is installed to cylinder block:

(a) Using a knife, cut off the oil seal lip.

(b) Using a screwdriver, pry out the oil seal.

NOTICE: Be careful not to damage the crankshaft. Tape the screwdriver tip.

(c) Apply MP grease to a new oil seal lip.

(d) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.

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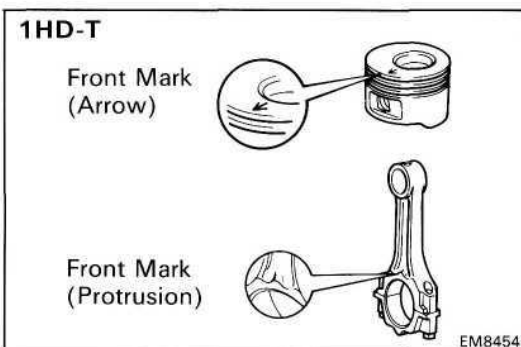
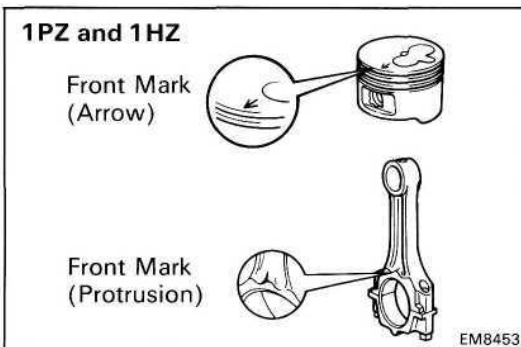
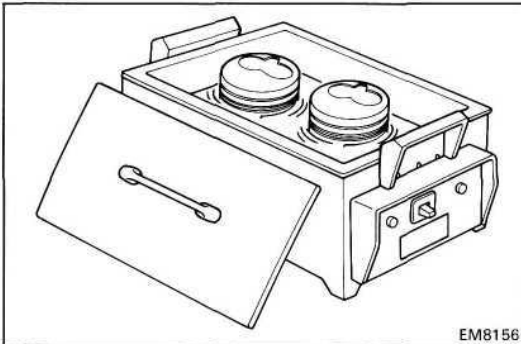
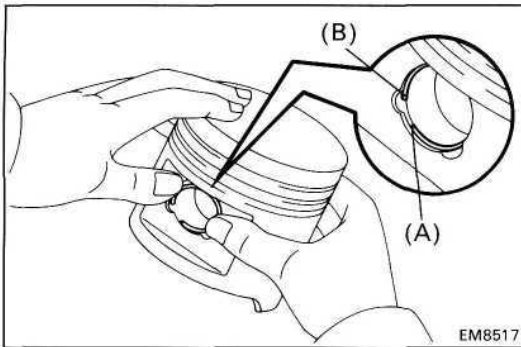
ASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLIES

1. ASSEMBLE PISTON AND CONNECTING ROD

- (a) Install a new snap ring on one side of the piston pin hole.
 - Position the snap ring so that end (B) of the snap ring is aligned with the hollow, then push the snap ring into the piston groove starting from end (A).

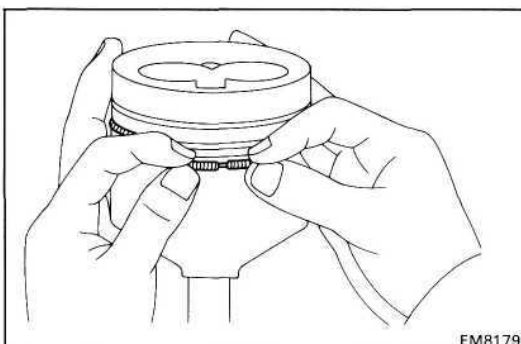
- (b) Gradually heat the piston to about 80°C (176°F).

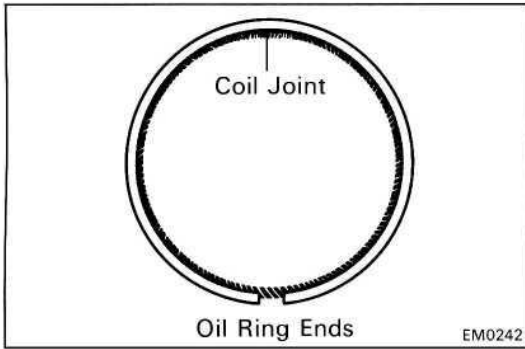
- (c) Apply a light coat of engine oil to the piston pin.
- (d) Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.
- (e) Install a new snap ring on the other side of the piston pin hole using the same method as in (a) above.



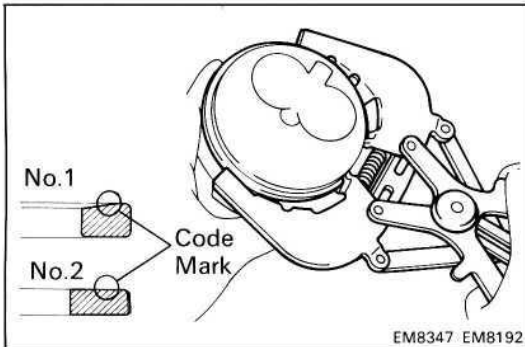
2. INSTALL PISTON RINGS

- (a) Install the coil by hand.
- (b) Using a piston ring expander, install the oil ring.



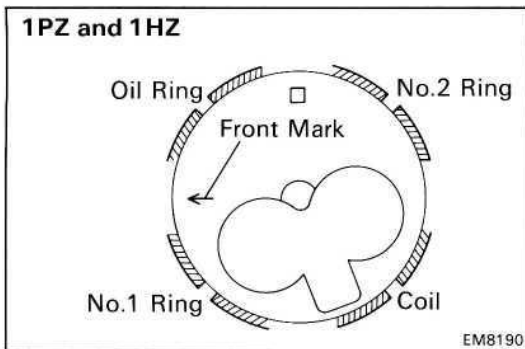


HINT: Face the end gap of the oil ring in the opposite direction of coil joint.



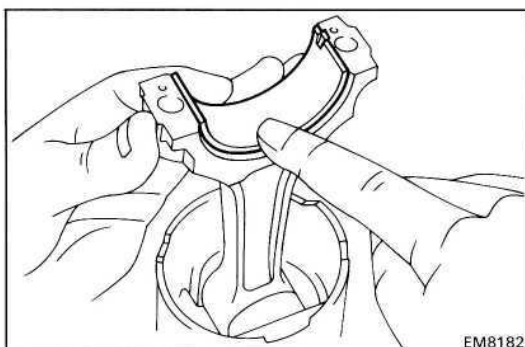
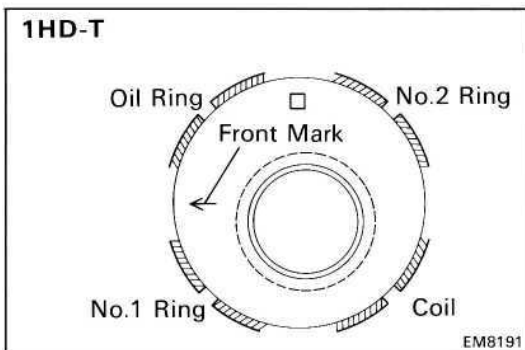
(c) Using a piston ring expander, install the two compression rings with the code mark facing upward.

Code mark: No.1 1T
No.2 2T



(d) Position the piston rings so that the ring ends are as shown.

NOTICE: Do not align the ring ends.



3. INSTALL BEARINGS

- Align the bearing claw with the claw groove of the connecting rod or connecting cap.
- Install the bearings in the connecting rod and connecting rod cap.

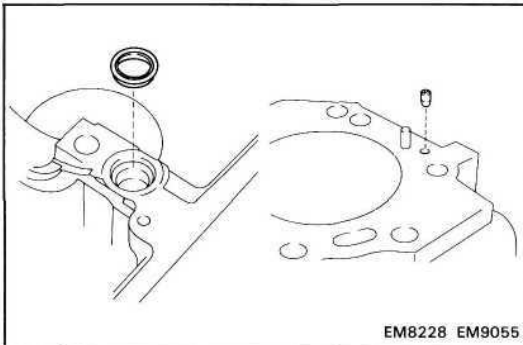
ASSEMBLY OF CYLINDER BLOCK

(See page EM-84)

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

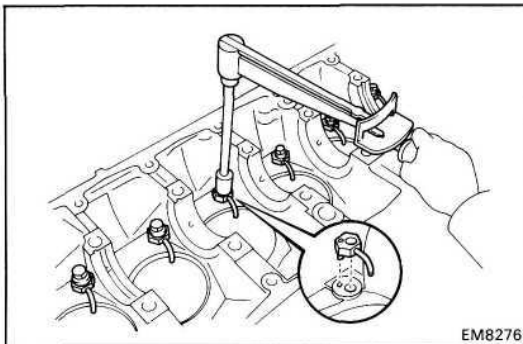
1. **INSTALL NEW CYLINDER BLOCK OIL HOLE GASKET**
2. **INSTALL CYLINDER BLOCK ORIFICE**



3. **INSTALL OIL NOZZLES AND CHECK VALVES**

- (a) Align the pin of the oil nozzle with the pin hole of the cylinder block.
- (b) Install the oil nozzle with the check valve. Install the five (1PZ) or six (1HZ and 1HD-T) oil nozzles and check valves.

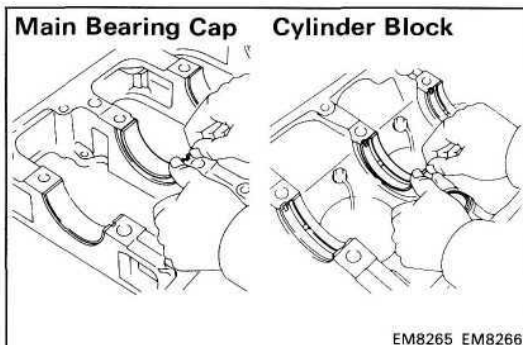
Torque: 275 kg-cm (20 ft-lb, 27 N·m)



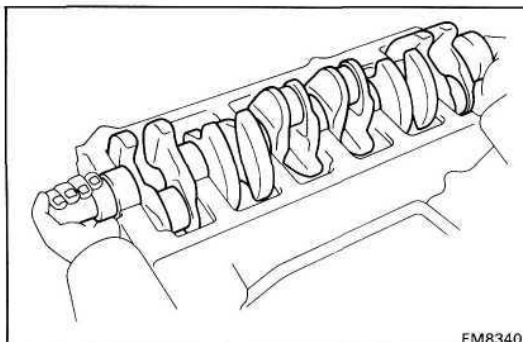
4. **INSTALL MAIN BEARINGS**

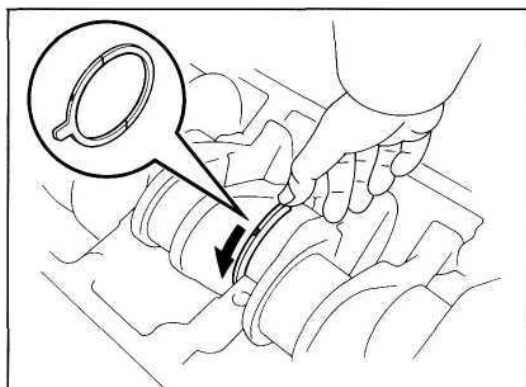
- (a) Align the bearing claw with the claw groove of the main bearing cap or cylinder block.
- (b) Install the bearings in the cylinder block and main bearing cap.

NOTICE: Install the bearing with the oil hole in the cylinder block.



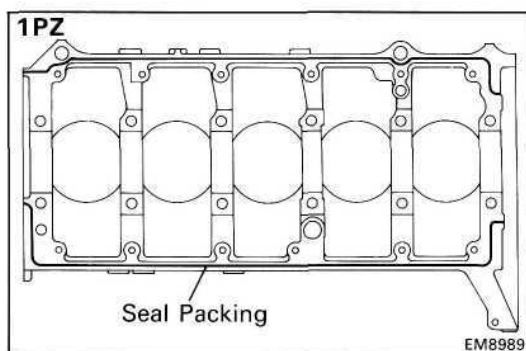
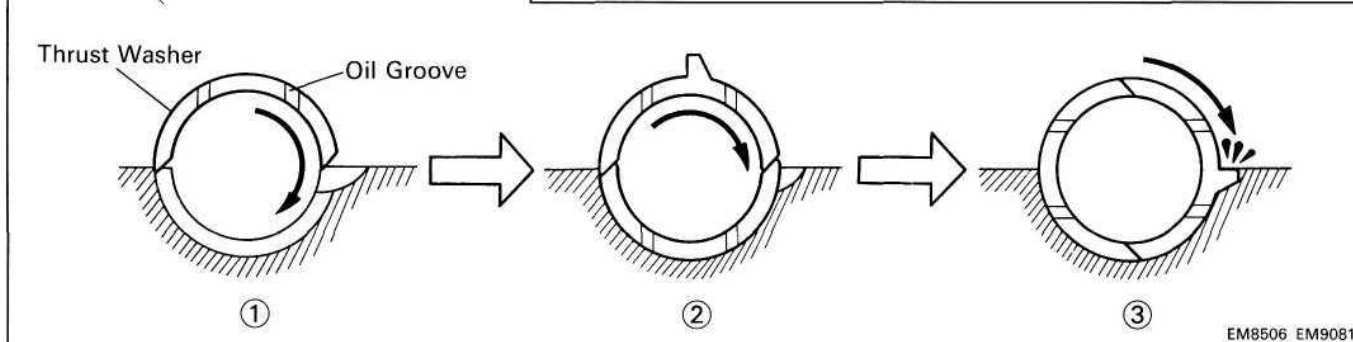
5. **PLACE CRANKSHAFT ON CYLINDER BLOCK**





6. INSTALL THRUST WASHERS

- (a) Push the crankshaft toward the front (rear) side.
- (b) Install the thrust washers to the No.4 main journal position of the cylinder block with the oil grooves facing outward.



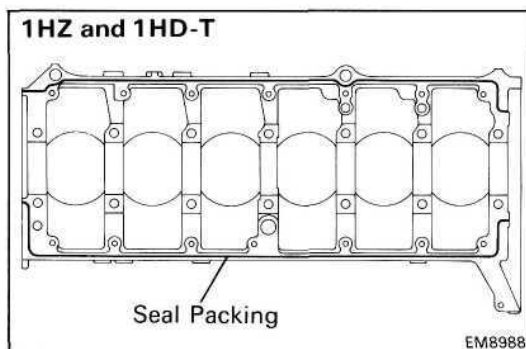
7. INSTALL MAIN BEARING CAP

A. Install main bearing cap on cylinder block

- (a) Remove any old packing (FIGP) material and be careful not to drop any oil the contact surfaces of the main bearing cap and cylinder block.
 - Thoroughly clean all components to remove all the loose material.
 - Using a non-residue solvent, clean both sealing surfaces.
- (b) Apply seal packing to the cylinder block as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

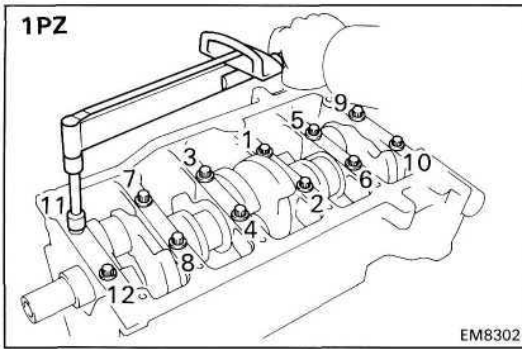
- Install a nozzle that has been cut to a 5 mm (0.20 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.



B. Install main bearing cap bolts

HINT:

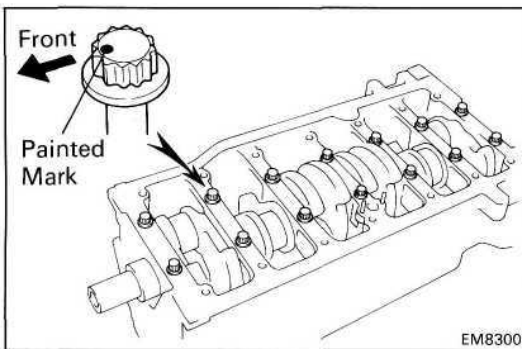
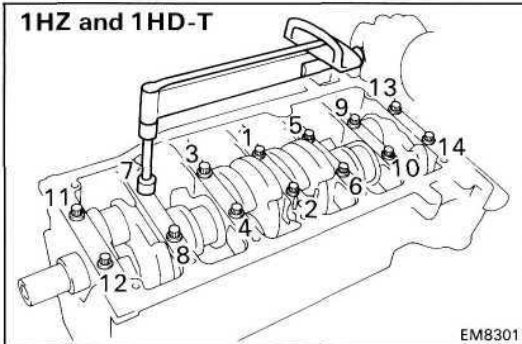
- The main bearing cap bolts are tightened in two progressive steps.
- If any of the main bearing bolts break or deform, replace them.



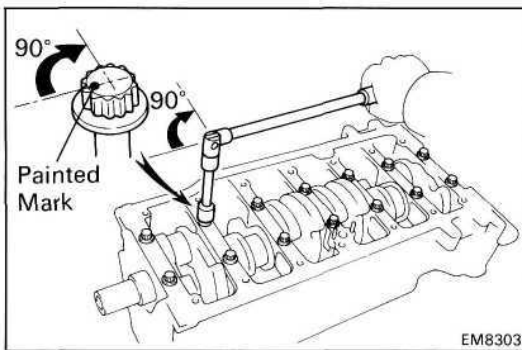
- (a) Apply a light coat of engine oil on the threads and under the heads of the main bearing cap bolts.
- (b) 1st, install and uniformly tighten the twelve (1 PZ) or fourteen (1 HZ and 1 HD-T) main bearing cap bolts in several passes in the sequence shown.

Torque: 1,050 kg-cm (76 ft-lb, 103 N·m)

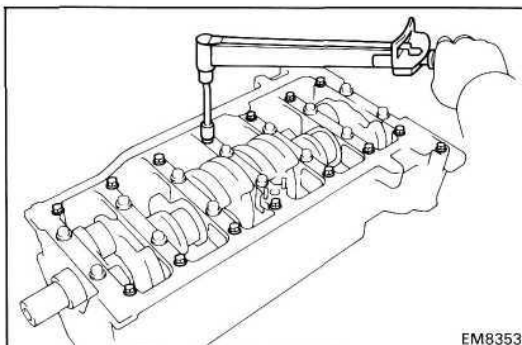
If any one of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.



- (c) Mark the front of the main bearing cap bolt head with paint.

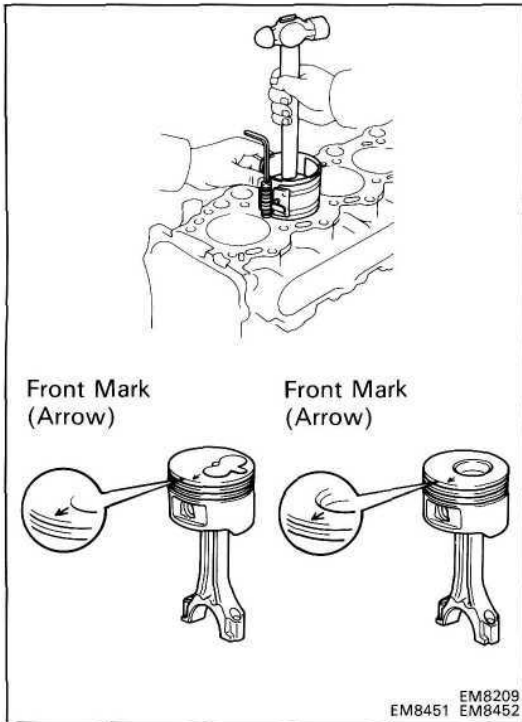


- (d) 2nd, retighten the main bearing cap bolts 90° in the numerical order shown above.
- (e) Check that the painted mark is now at a 90° angle to the front.
- (f) Check that the crankshaft turns smoothly.
- (g) Check the crankshaft thrust clearance.
(See step 5 on page EM-89)



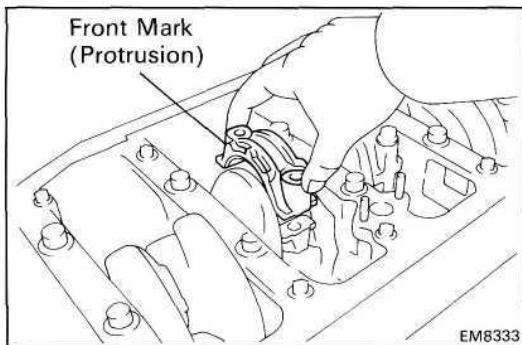
- (h) Install and torque the thirteen bolts (1 PZ) or fifteen bolts (1 HZ and 1 HD-T).

Torque: 185 kg-cm (13 ft-lb, 18 N·m)



8. INSTALL PISTON AND CONNECTING ROD ASSEMBLIES

Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward.



9. INSTALL CONNECTING ROD CAPS

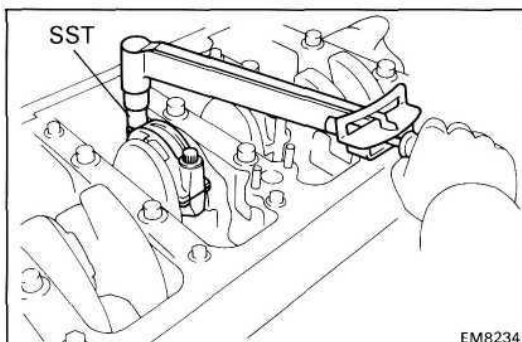
A. Place connecting rod cap on connecting rod

- Match the numbered connecting rod cap with the connecting rod.
- Install the connecting rod cap with the front mark facing forward.

B. Install connecting rod cap bolts

HINT:

- The connecting rod cap bolts are tightened in two progressive steps.
- If any of the connecting rod bolts break or deform, replace them.

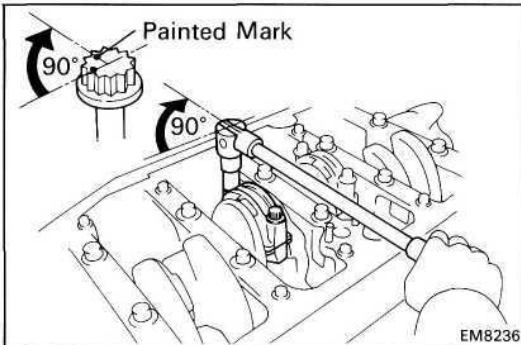
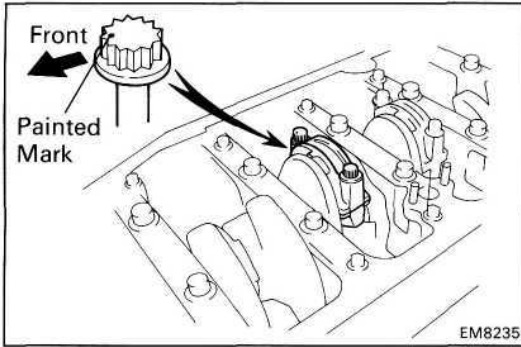


- Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.
- 1 st, using SST, install and alternately tighten the bolts of the connecting rod cap in several passes.

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Torque: 375 kg-cm (27 ft-lb, 37 N-m)

If any one of the connecting rod cap bolts does not meet the torque specification, replace the cap bolt.



(c) Mark the front of the connecting rod cap bolt with paint.

(d) 2nd, retighten the connecting rod cap bolts by an additional 90°.

(e) Check that the painted mark is now at a 90° angle to the front.

(f) Check that the crankshaft turns smoothly.

(g) Check the connecting rod thrust clearance.
(See step 2 on page EM-86)

10. INSTALL REAR OIL SEAL RETAINER

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the rear oil seal retainer and cylinder block.

- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
- Thoroughly clean all components to remove all the loose material.
- Using a non-residue solvent, clean both sealing surfaces.

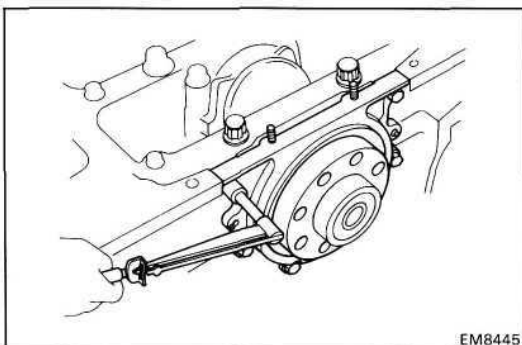
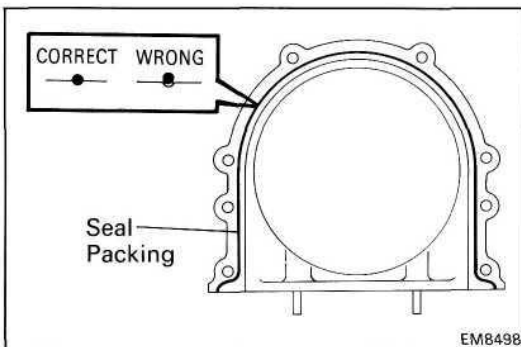
(b) Apply seal packing to the rear oil seal retainer as shown in the illustration.

Seal packing: Part No.08826-00080 or equivalent

- Install a nozzle that has been cut to a 2 - 3 mm (0.08-0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

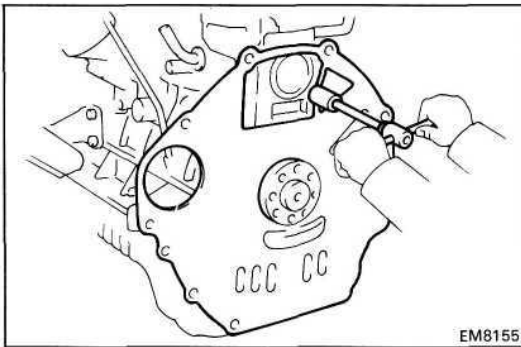
(c) Install the retainer with the six bolts.

Torque: 65 kg-cm (56 in.-lb, 6.4 N-m)



POST ASSEMBLY

1. **INSTALL ENGINE MOUNTING**
2. **INSTALL THERMOSTAT AND WATER INLET**
(See page CO-11)
3. **INSTALL OIL COOLER** (See page LU-18)
4. **INSTALL TIMING GEAR CASE (OIL PUMP) AND OIL PAN**
(See page LU-12)
5. **INSTALL INJECTION PUMP** (See page FU-93)
6. **INSTALL TIMING GEARS** (See page EM-50)
7. **INSTALL ALTERNATOR**
8. **INSTALL WATER PUMP** (See page CO-8)
9. **INSTALL CYLINDER HEAD** (See page EM-75)
10. **INSTALL PULLEYS AND TIMING BELT**
(See page EM-38)

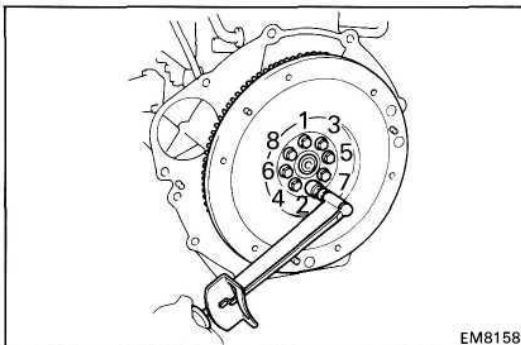


11. **REMOVE ENGINE STAND**

12. **INSTALL REAR END PLATE**

Install the end plate with the bolt.

Torque: 185 kg-cm (13 ft-lb, 18 N-m)



13. **(M/T)**
INSTALL FLYWHEEL

(a) Install the flywheel on the crankshaft.

(b) Install and uniformly tighten the eight mount bolts in several passes, in the sequence shown.

Torque: 1,300 kg-cm (94 ft-lb, 127 N-m)

14. **(A/T)**
INSTALL FLYWHEEL, DRIVE PLATE AND SPACER
(See procedure step 13)

Torque: 1,300 kg-cm (94 ft-lb, 127 N-m)

15. **(M/T)**
INSTALL CLUTCH DISC AND COVER