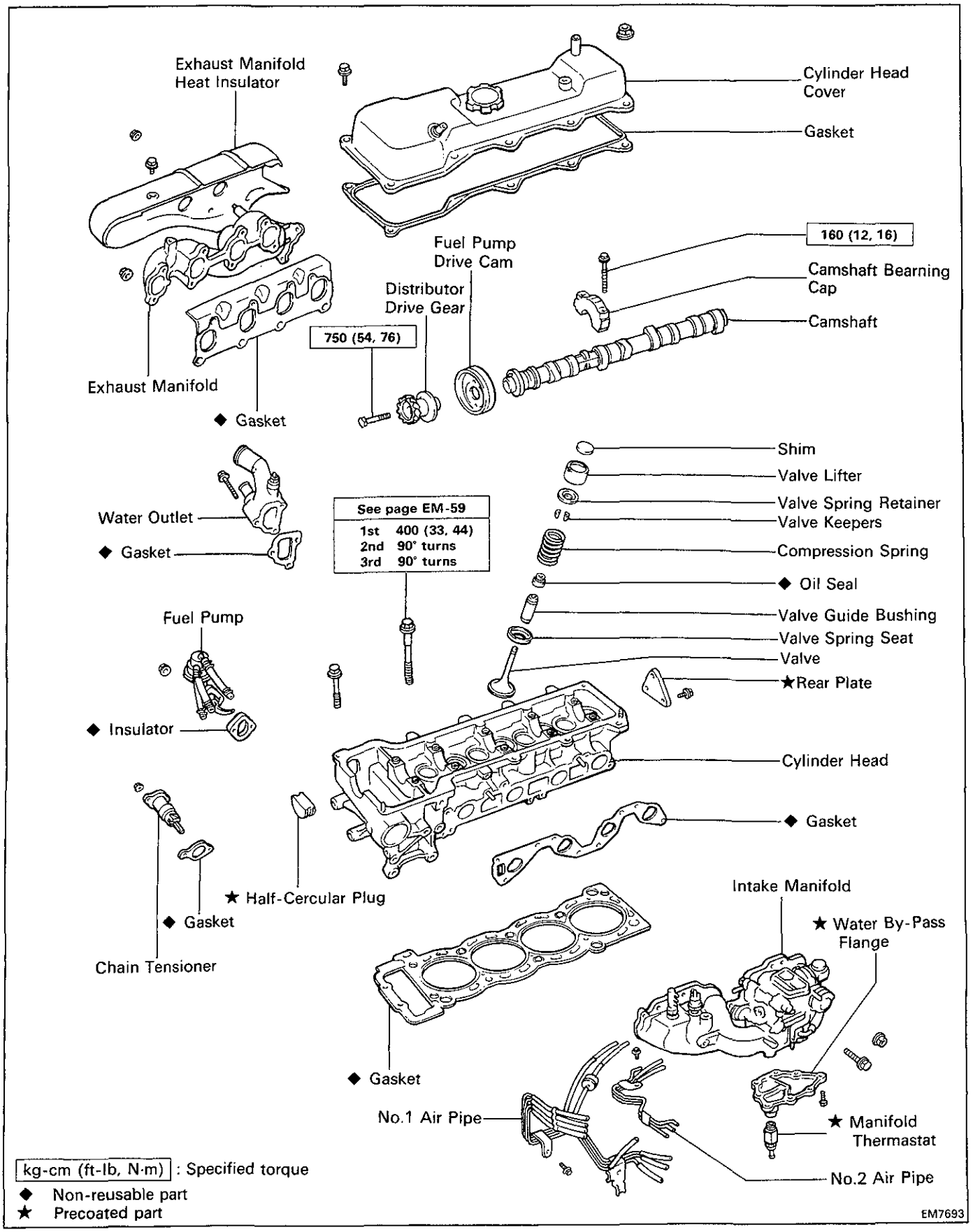
CYLINDER HEAD (1RZ AND 2RZ)

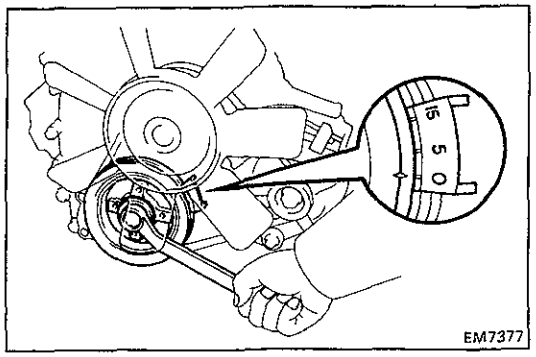
COMPONENTS



REMOVAL OF CYLINDER HEAD

(See page EM-38)

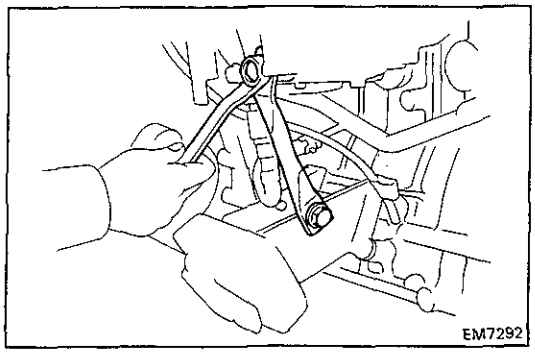
1. **REMOVE HIGH-TENSION CORDS AND SPARK PLUGS**
(See step 1 on page IG-8)
   (a) Remove the No.1 PCV hose.
   (b) Remove the high-tension cords and spark plugs.



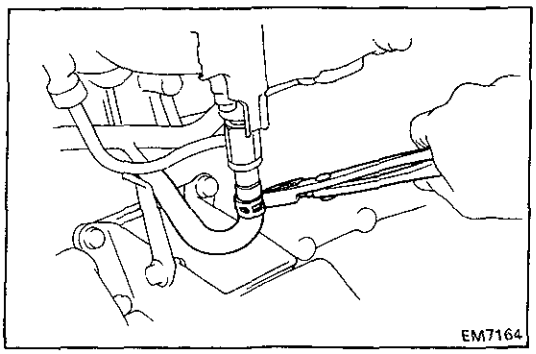
2. **SET NO.1 CYLINDER TO TDC/COMPRESSION**
   Turn the crankshaft pulley and align its groove with the "0" mark on the timing chain case.

3. **REMOVE CYLINDER HEAD COVER**
   (a) Remove the nine bolts and two nuts, and remove the cylinder head cover and gasket.
   (b) Remove the half-circular plug.

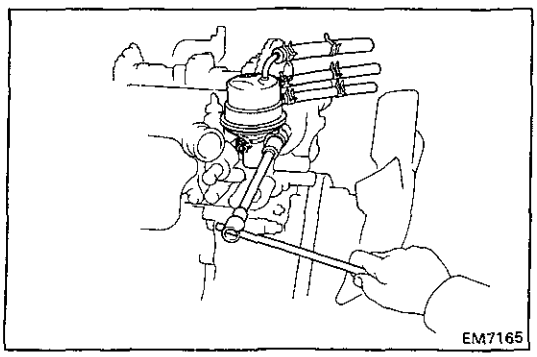
4. **REMOVE DISTRIBUTOR**
(See page IG-17 or 26)



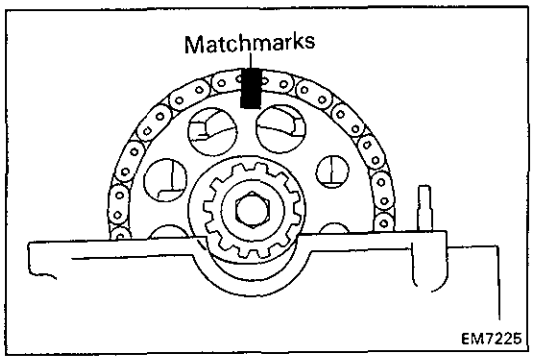
5. **REMOVE INTAKE MANIFOLD STAY**
   Remove the two bolts and intake manifold stay.



6. **DISCONNECT NO.1 WATER BY-PASS HOSE FROM MANIFOLD THERMOSTAT**

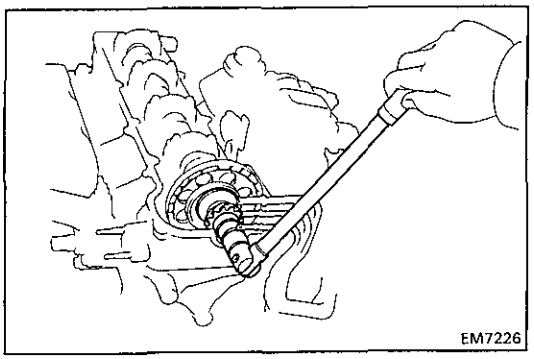


7. **REMOVE FUEL PUMP**
   (a) Disconnect the three fuel hoses from the fuel pipe.
   (b) Remove the two nuts, fuel pump and insulator.

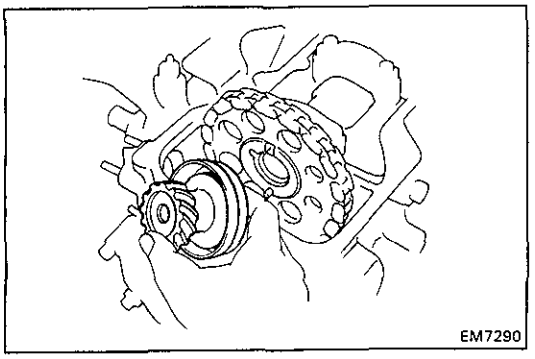


8. REMOVE CAM SPROCKET

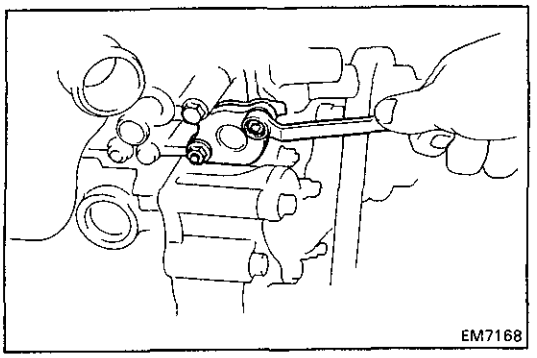
(a) Place matchmarks on the sprocket and chain.



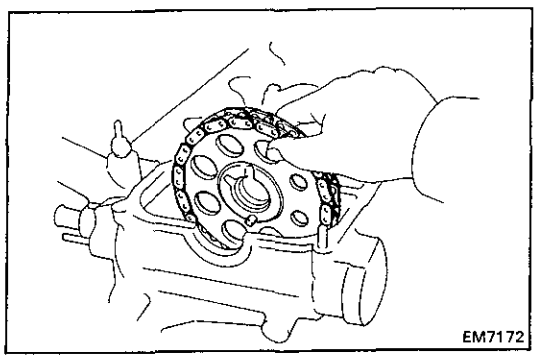
(b) Remove the cam sprocket bolt.



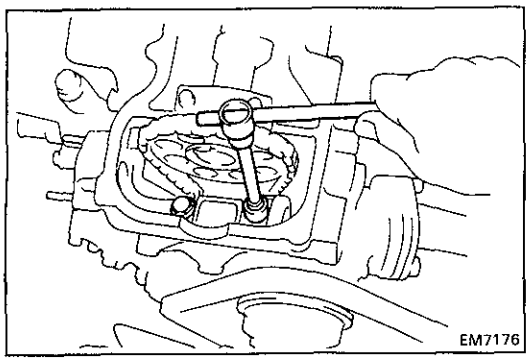
(c) Remove the distributor drive gear and fuel pump drive cam.



(d) Remove the two nuts, chain tensioner and gasket.

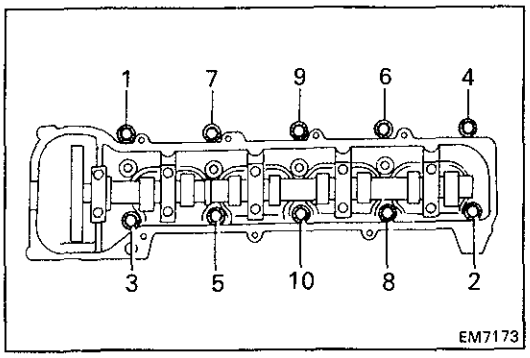


(e) Remove the cam sprocket and chain from the camshaft and leave on the slipper and damper.



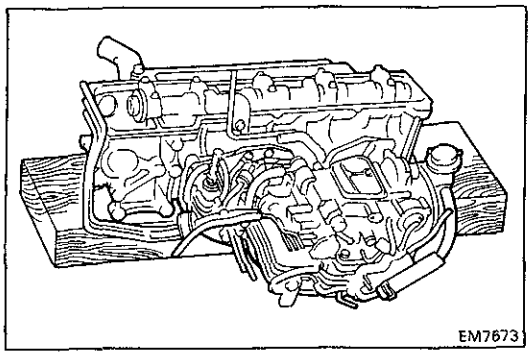
9. REMOVE CYLINDER HEAD

(a) Remove the two bolts in front of the head before the other head bolts are removed.



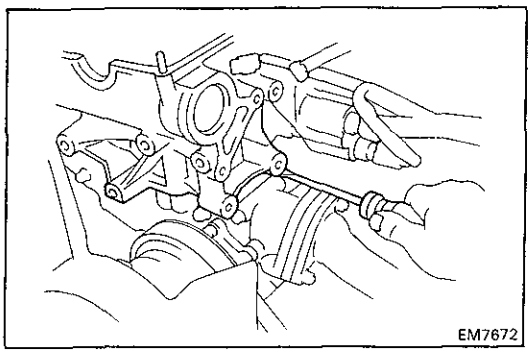
(b) Using a 12-sided socket wrench, remove the ten head bolts gradually in two or three passes and in the numerical order shown.

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



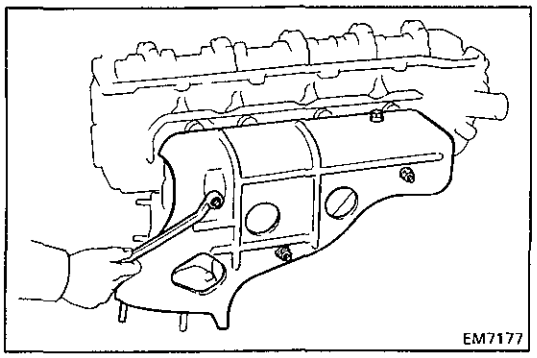
(c) Lift the cylinder head from the dowels on the cylinder block and place the head on wooden blocks on a bench.

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



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

(d) Remove the cylinder head gasket.

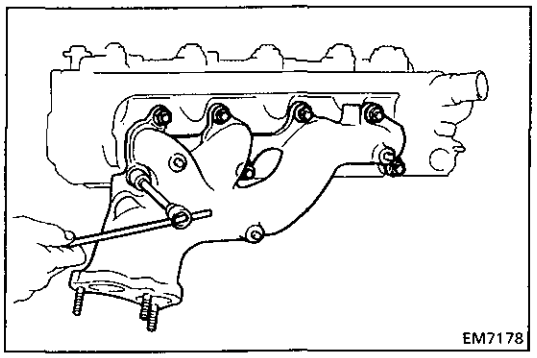


DISASSEMBLY OF CYLINDER HEAD

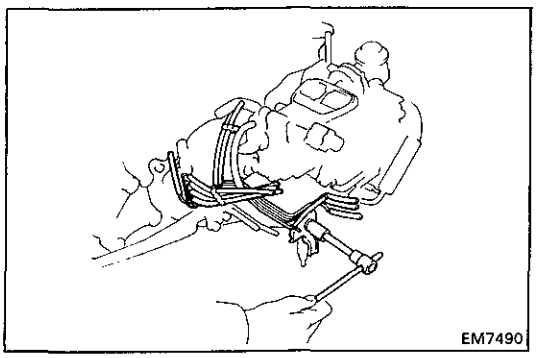
(See page EM-38)

1. REMOVE EXHAUST MANIFOLD

(a) Remove the three nuts, bolt and exhaust manifold heat insulator.

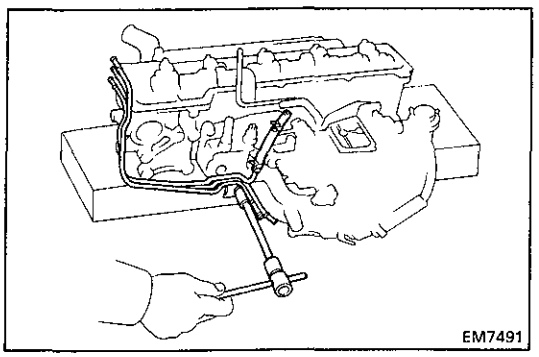


(b) Remove the eight nuts, exhaust manifold and gasket.



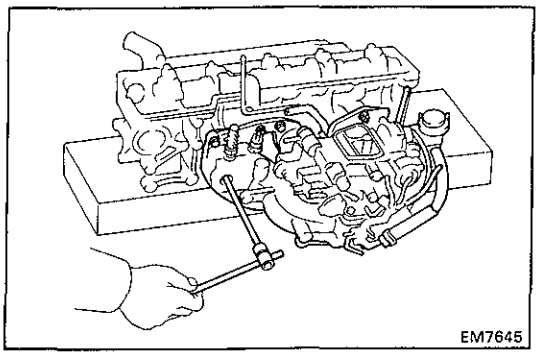
2. REMOVE INTAKE MANIFOLD

(a) Remove the two bolts and No.1 air pipe.

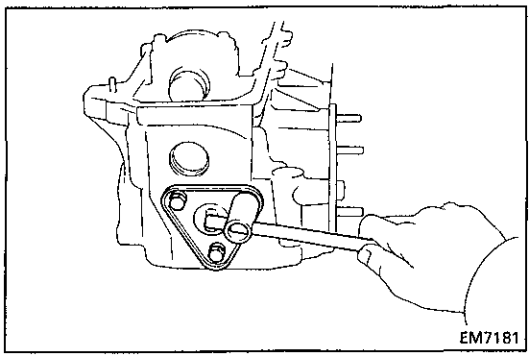


(b) Remove the two bolts and fuel pipe.

(c) Remove the No.2 PCV hose.

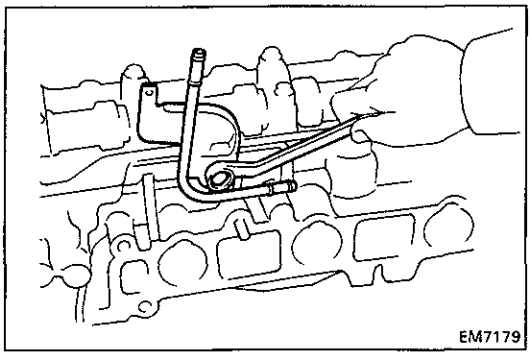


(d) Remove the seven bolts, two nuts, and remove the intake manifold and gasket.



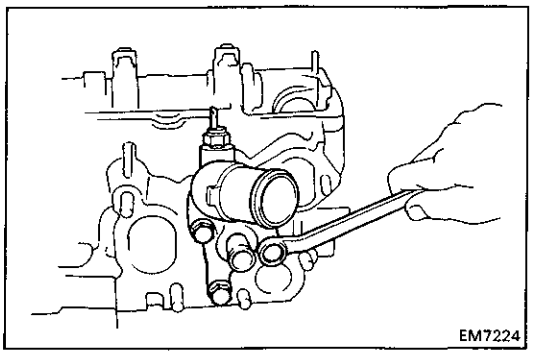
3. REMOVE CYLINDER HEAD REAR PLATE

Remove the three bolts and cylinder head rear plate.



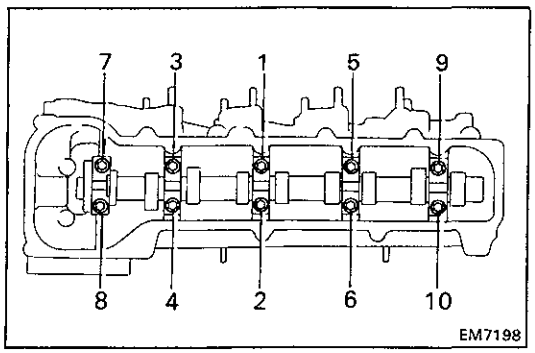
4. REMOVE PCV PIPE

Remove the bolt and PCV pipe.



5. REMOVE WATER OUTLET

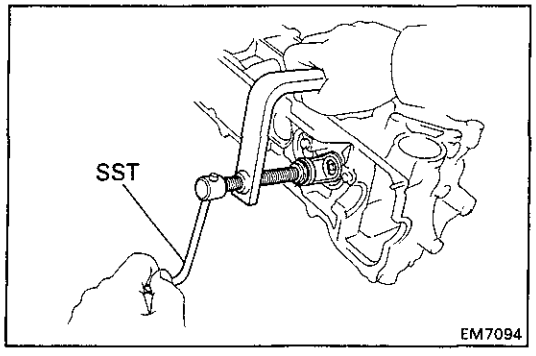
Remove the three bolts, water outlet and gasket.



6. REMOVE CAMSHAFT BEARING CAPS AND CAM SHAFT

(a) Loosen each bearing cap bolts little at a time and in the sequence shown in the figure.

(b) Remove the camshaft bearing caps and camshaft.



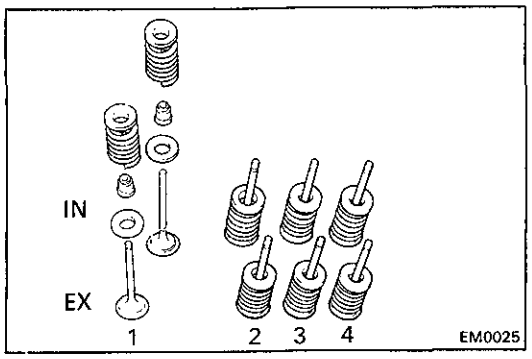
7. REMOVE VALVES

(a) Using SST, compress the valve retainer until the two keepers can be removed.

SST 09202-43013

(b) Remove the two keepers and SST.

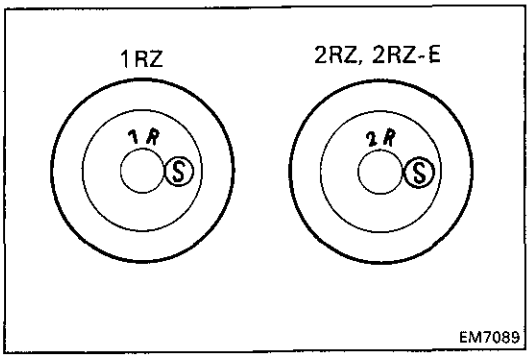
(c) Remove the retainer, spring and valve.



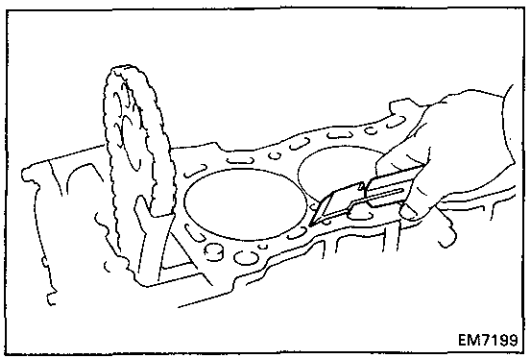
(d) Remove the oil seals.

(e) Using a small screwdriver or magnet, remove the spring seats.

(f) Arrange the disassembled parts in order.



HINT: There are two types of intake valve and two types of exhaust valve.
The 1RZ engine is marked "1R Ⓢ " and the 2RZ and 2RZ-E engines are marked "2R Ⓢ ".



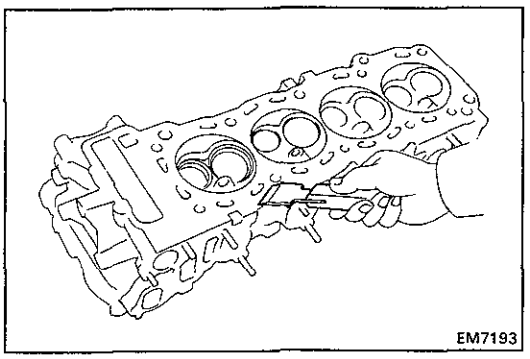
INSPECTION AND CLEANING COMPONENTS

1. CLEAN TOP OF PISTONS AND TOP OF CYLINDER BLOCK

(a) Turn the crankshaft and bring each piston to top dead center. Scrape the carbon from the piston top.

(b) Remove all gasket material from the top of the block. Blow carbon and oil from the bolt holes.

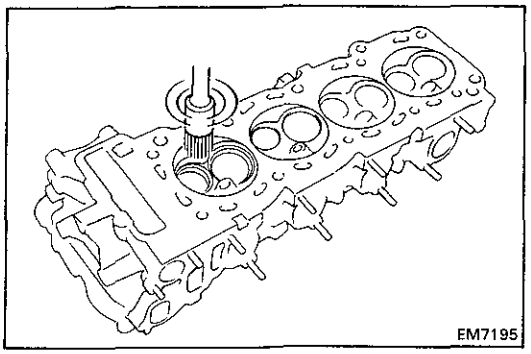
CAUTION: Protect your eyes when using compressed air.



2. REMOVE GASKET MATERIAL

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

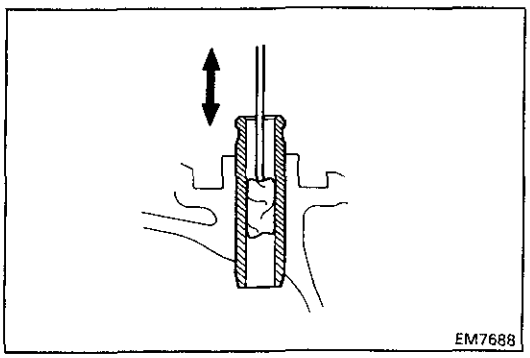
NOTICE: Do not scratch the surfaces.



3. CLEAN COMBUSTION CHAMBER

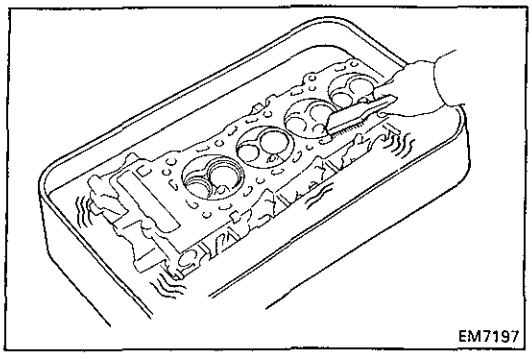
Using a wire brush, remove all the carbon from the combustion chambers.

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



4. CLEAN VALVE GUIDE BUSHINGS

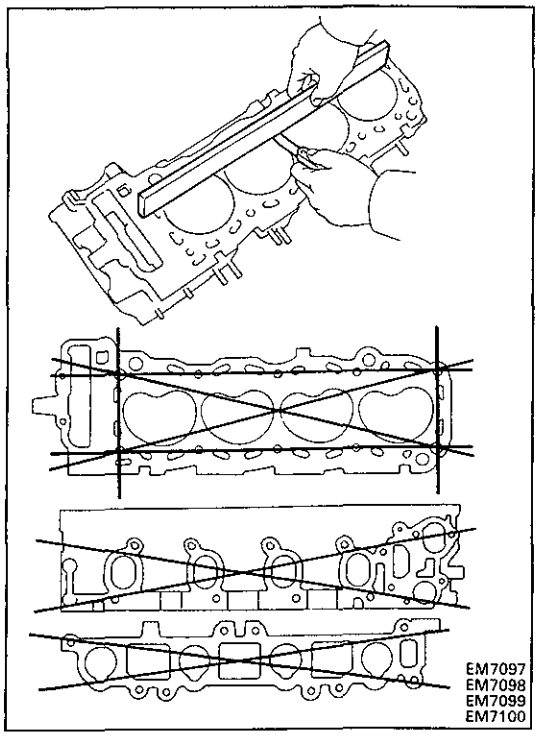
Using a valve guide brush and solvent, clean all valve guide bushings.



5. CLEAN CYLINDER HEAD

Using a soft brush and solvent, clean the head.

NOTICE: Do not clean the head in a hot tank as this will seriously damage it.



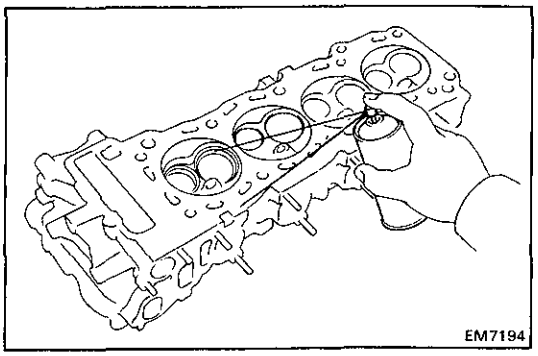
6. INSPECT CYLINDER HEAD FOR FLATNESS

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

Maximum warpage:

Head surface	**0.15 mm (0.0059 in.)**
Manifold surface	**0.20 mm (0.0079 in.)**

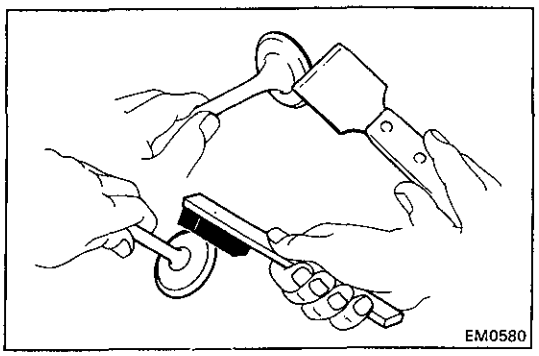
If warpage is greater than maximum, replace the head.



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 a crack is found, replace the head.

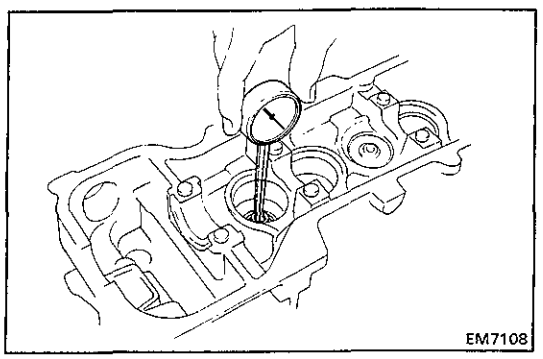


8. CLEAN VALVES

(a) Using a gasket scraper, chip any carbon from the valve.

(b) Using a wire brush, throughly clean the valve.

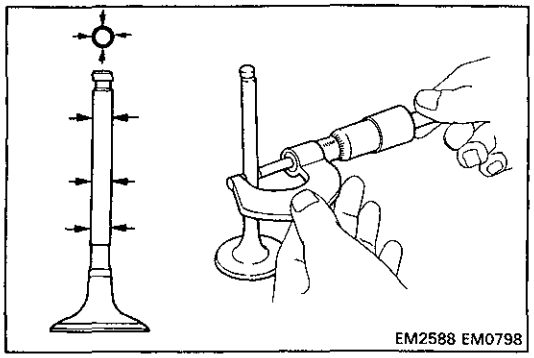
HINT: Be careful not to damage the seat valve surface.



9. INSPECT VALVE STEM GUIDE WEAR

(a) Using a dial gauge, measure the inside diameter.

Standard inside diameter: 8.01 – 8.03 mm (0.3154 – 0.3161 in.)



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

Standard valve stem diameter:

Intake	**7.970 – 7.985 mm (0.3138 – 0.3144 in.)**
Exhaust	**7.965 – 7.980 mm (0.3136 – 0.3142 in.)**

(c) Subtract the valve stem measurement from the valve guide measurement.

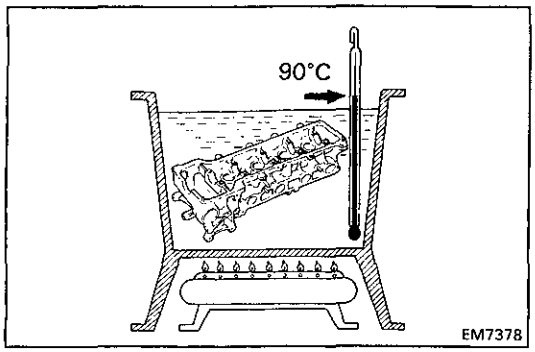
Standard oil clearance:

Intake	**0.025 – 0.060 mm (0.0010 – 0.0024 in.)**
Exhaust	**0.030 – 0.065 mm (0.0012 – 0.0026 in.)**

Maximum oil clearance:

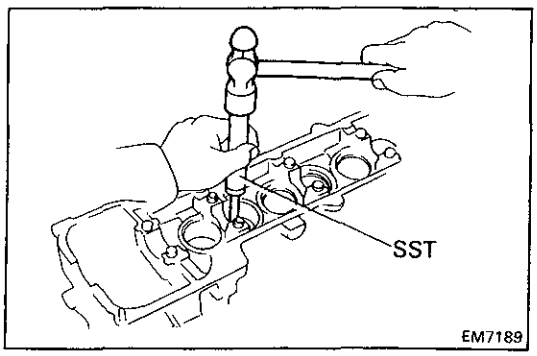
Intake	**0.08 mm (0.0031 in.)**
Exhaust	**0.10 mm (0.0039 in.)**

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



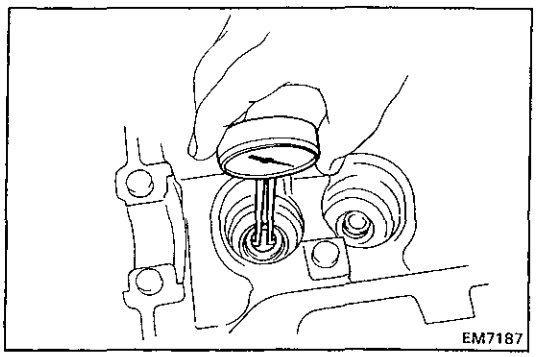
10. IF NECESSARY, REPLACE VALVE GUIDE BUSHING

(a) Heat the cylinder head to approx. 90°C (194°F).



(b) Using SST and a hammer, drive out the valve guide bushing.

SST 09201-60011



(c) Using a caliper gauge, measure the valve guide bushing bore of the cylinder head.

Standard valve guide bore at 20°C (68°F) :
12.992 – 13.019 mm (0.5115 – 0.5126 in.)

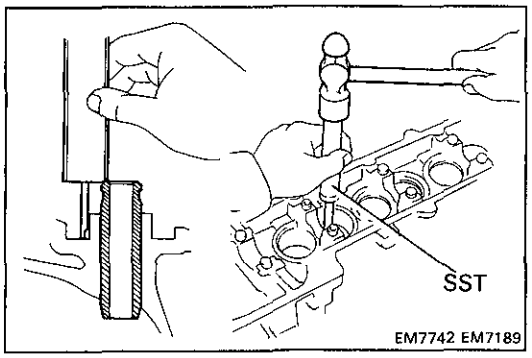
Bore intake and exhaust

Guide bore mm (in.)	Guide size
12.992 – 13.019 (0.5115 – 0.5126)	Use STD
Over 13.019 (0.5126)	Use O/S 0.05

(d) Select a new valve guide bushing.

If the valve guide bore of the cylinder head is more than 13.019 mm (0.5126 in.), machine the bore to the following dimension.

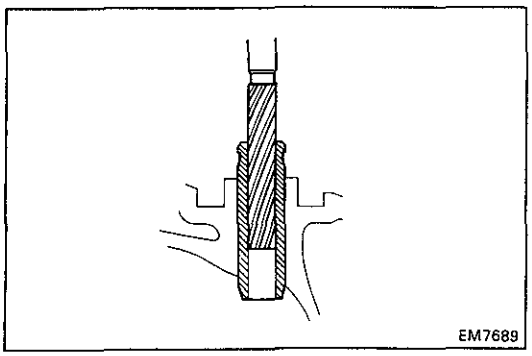
Rebored valve guide bushing bore dimension (cold):
13.042 – 13.069 mm (0.5135 – 0.5145 in.)



(e) Using SST and a hammer, drive in a new valve guide bushing to protrusion height.

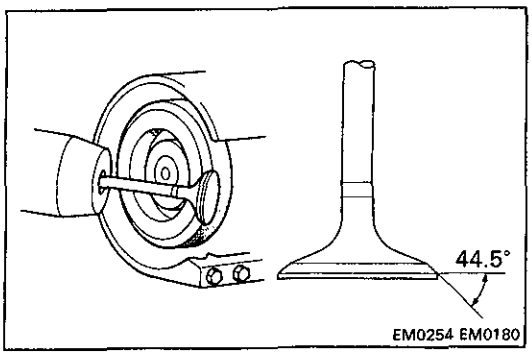
SST 09201-60011

Protrusion height: 18.2 – 18.6 mm (0.717 – 0.732 in.)



(f) Using a sharp 8 mm reamer, ream the valve guide bushing to obtain the specified clearance between the guide bushing and a new valve.

Standard oil clearance:
Intake 0.025 – 0.060 mm (0.0010 – 0.0024 in.)
Exhaust 0.030 – 0.065 mm (0.0012 – 0.0026 in.)

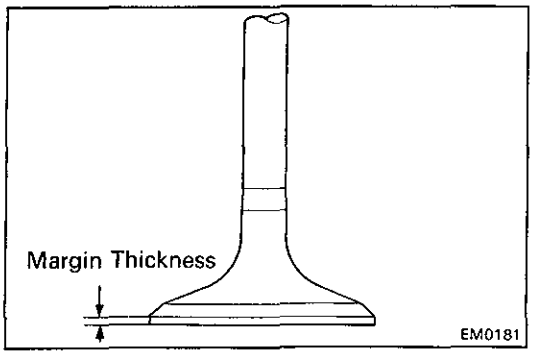


11. INSPECT AND GRIND VALVES

(a) Grind the valves only enough to remove pits and carbon.

(b) Check that the valves are ground at the correct valve face angle.

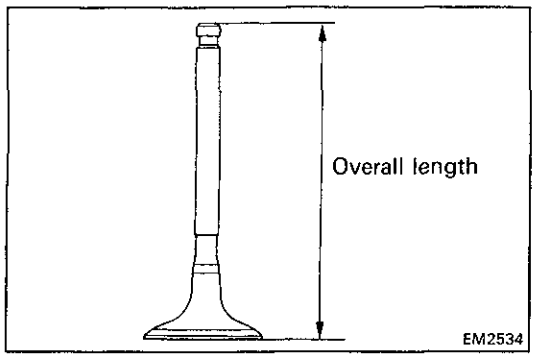
Valve face angle: 44.5°



(c) Check the valve head margin thickness.

Minimum margin thickness:
Intake 0.5 mm (0.020 in.)
Exhaust 0.8 mm (0.031 in.)

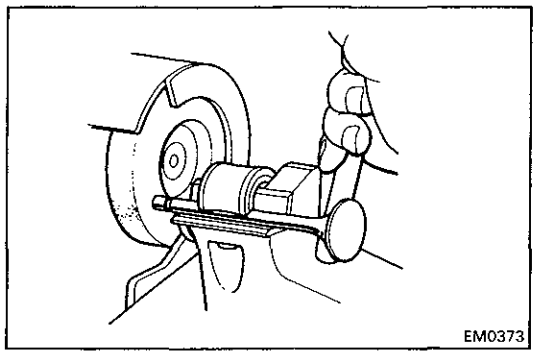
If the valve head margin thickness is less than minimum, replace the valve.



(d) Check the valve overall length.

Standard overall length:
Intake 102.00 mm (4.0157 in.)
Exhaust 102.25 mm (4.0256 in.)
Minimum overall length:
Intake 101.50 mm (3.9961 in.)
Exhaust 101.75 mm (4.0059 in.)

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

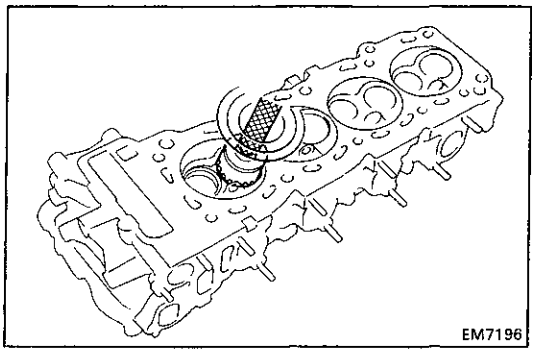


(e) Check the surface of the valve stem tip for wear.

If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

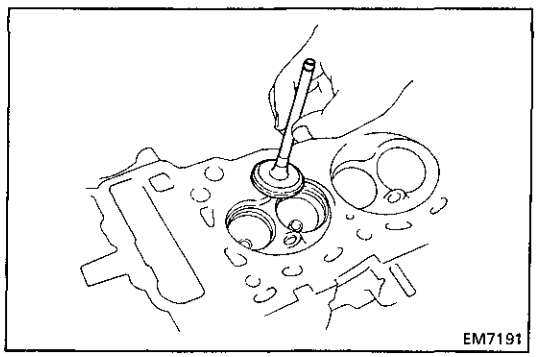
NOTICE: Do not grind off more than the minimum amount.

Minimum overall length:
Intake 101.50 mm (3.9961 in.)
Exhaust 101.75 mm (4.0059 in.)



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.

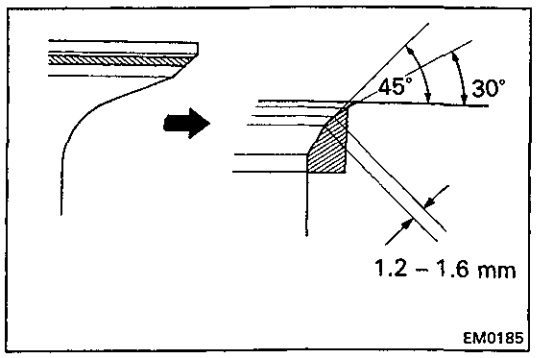
Apply a thin coat of prussian blue (or white lead) to the valve face. Install the valve.

Lightly press the valve against seat, Do not rotate the valve.

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

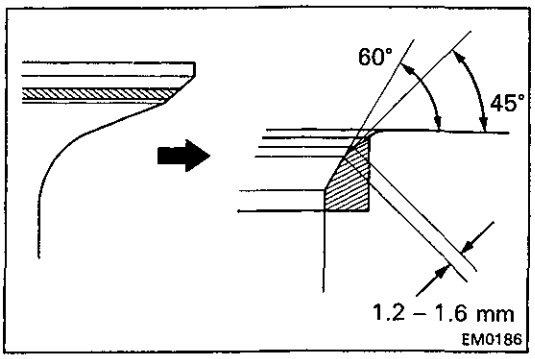
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and seat are concentric. If not, resurface the seat.
- Check that the seat contact is on the middle of the valve face with the following width:

1.2 – 1.6 mm (0.047 – 0.063 in.)

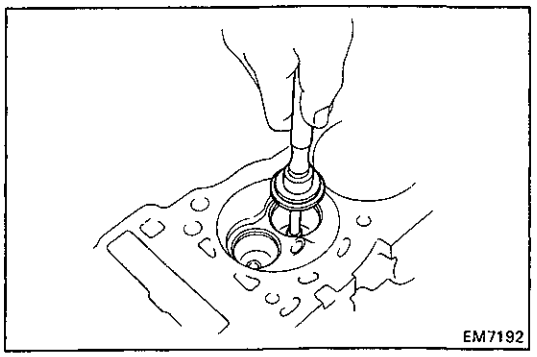


If not, correct the valve seat as follows:

- If seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

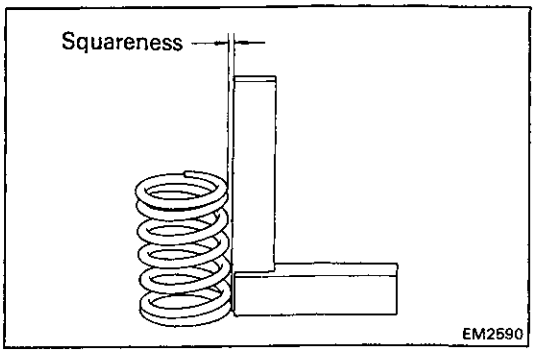


- If seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



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

(e) Clean the valve and valve seat after hand-lapping.

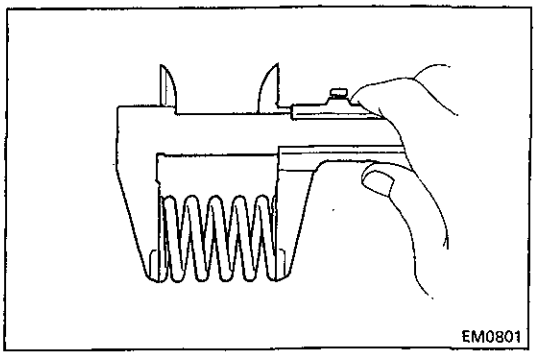


13. INSPECT VALVE SPRINGS

(a) Using a steel square, check the squareness of the valve springs.

Maximum allowable: 2.0 mm (0.079 in.)

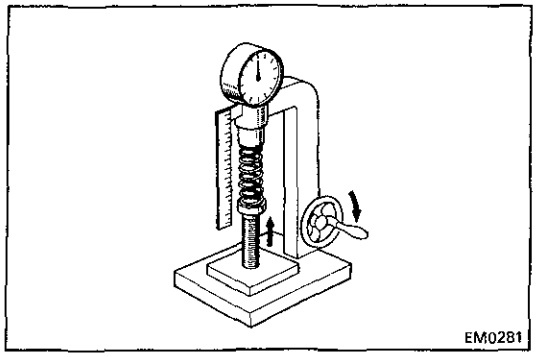
If squareness is greater than maximum, replace the spring.



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

Free length: 47.31 mm (1.8626 in.)

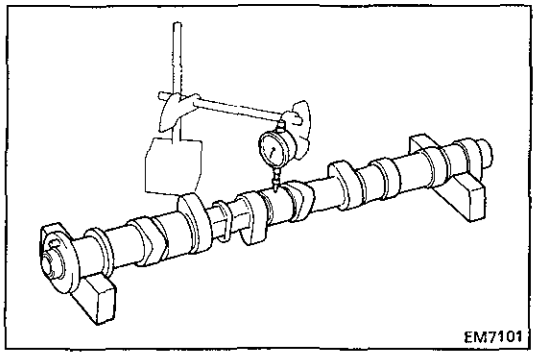
If not as specified, replace the valve spring.



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

Installed height: 40.3 mm (1.586 in.)
Standard installed tension: 27.0 kg (60.1 lb, 266 N)
Minimum installed tension: 24.3 kg (53.6 lb, 238 N)

If the installed tension is less than minimum, replace the spring.

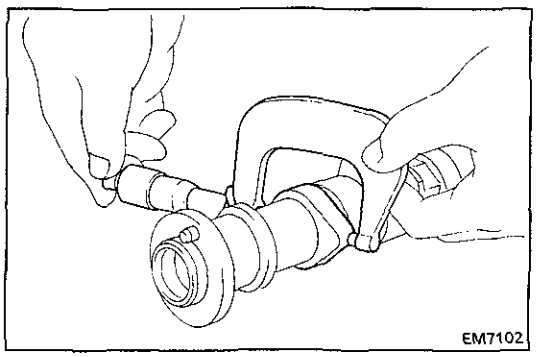


14. INSPECT CAMSHAFT

(a) Place the camshaft on V-blocks and measure the runout at the center journal.

Maximum circle runout: 0.06 mm (0.0024 in.)

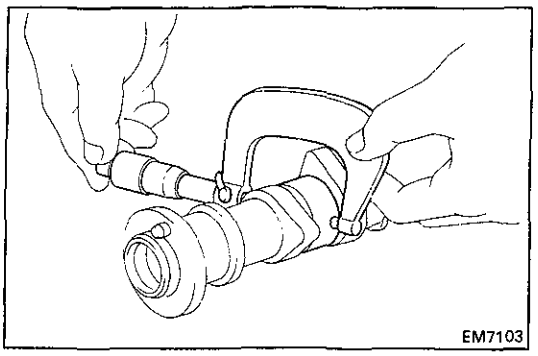
If the runout is greater than maximum, replace the camshaft.



(b) *Using a micrometer, measure the cam lobe height.*

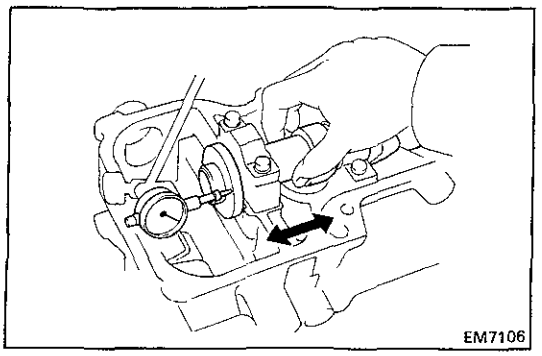
Standard cam lobe height: 47.84 – 47.94 mm (1.8835 – 1.8874 in.)

If the lobe height is less than standard allowable, the camshaft is worn and must be replaced.



(c) Using a micrometer, measure the journal diameter.

Standard diameter: 33.959 – 33.975 mm (1.3370 – 1.3376 in.)



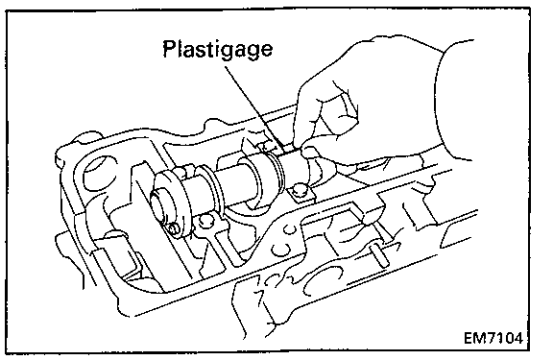
15. MEASURE CAMSHAFT THRUST CLEARANCE

(a) Clean and install the camshaft and bearing cap.

(b) Using a dial gauge, measure the camshaft thrust clearance while moving the camshaft back and forth.

Standard clearance: 0.08 – 0.18 mm (0.0031 – 0.0071 in.)
Maximum clearance: 0.25 mm (0.0098 in.)

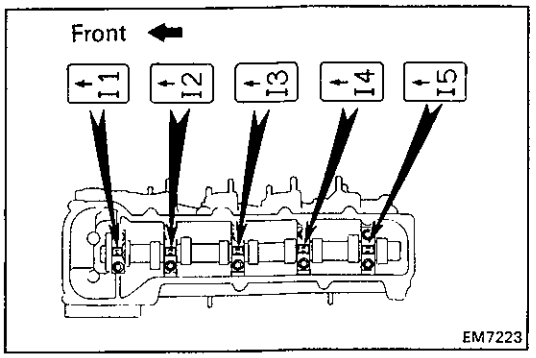
If clearance is greater than maximum, replace the head.



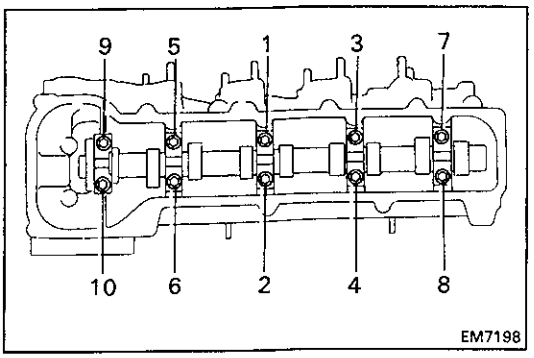
16. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the bearing caps and camshaft journal.

(b) Lay a strip of Plastigage across each journal.



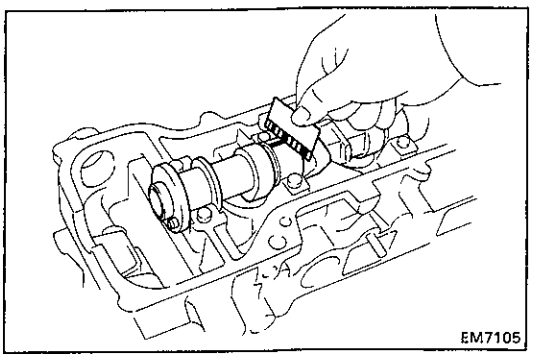
(c) Place the bearing caps with the top of the number on the cap pointing toward the front and in numerical order front side.



(d) Install and torque the bolts gradually from the inside in three passes.

Torque: 160 kg-cm (12 ft-lb, 16 N·m)

HINT: Do not turn the camshaft while the Plastigage is in plate.



(e) Remove the bearing caps.

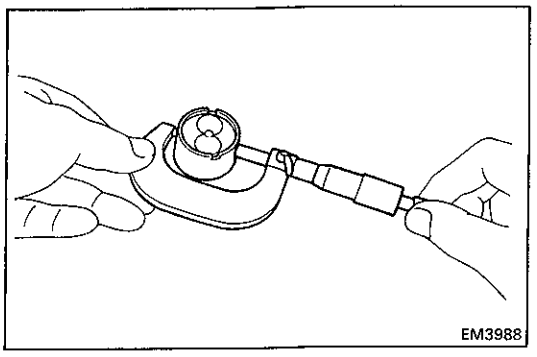
(f) Measure the Plastigage at its widest point.

Standard clearance: 0.025 – 0.066 mm (0.0010 – 0.0026 in.)

Maximum clearance: 0.10 mm (0.0039 in.)

If clearance is greater than maximum, replace the head and/or camshaft.

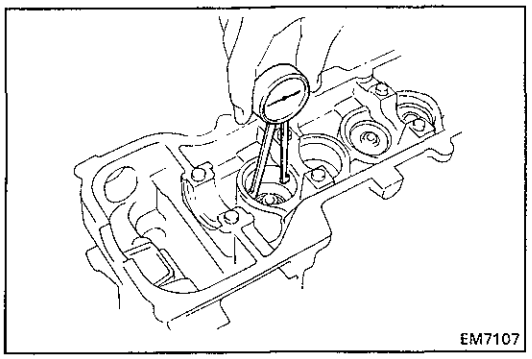
(g) Clean out the pieces of Plastigage from the bearings and journals.



17. MEASURE VALVE LIFTER OIL CLEARANCE

(a) Using a micrometer, measure the diameter of the valve lifter.

Standard diameter: 37.922 – 37.932 mm (1.4930 – 1.4934 in.)

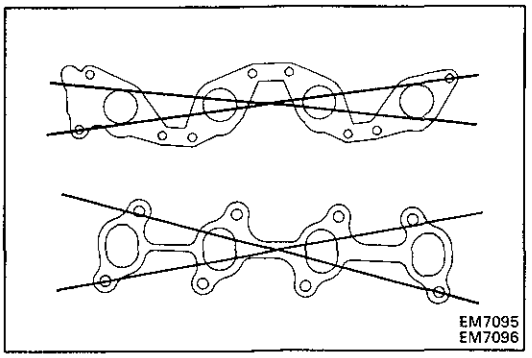

EM7107

(b) Using a dial indicator, measure the inside diameter of the cylinder head bore.

(c) Subtract the valve lifter measurement from the cylinder head above.

Standard oil clearance: **0.028 – 0.053 mm (0.0011 – 0.0021 in.)**
Maximum oil clearance: **0.1 mm (0.004 in.)**

If clearance is greater than maximum ,replace the cylinder head and/or valve lifter.

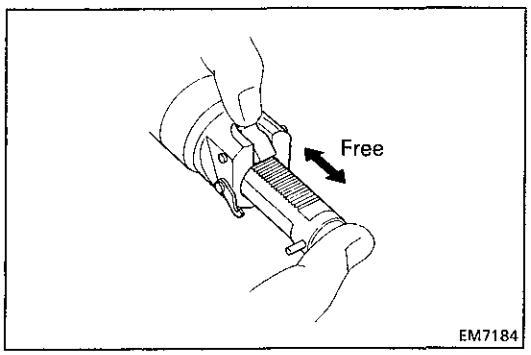

EM7095
EM7096

18. INSPECT INTAKE AND EXHAUST MANIFOLDS

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

Maximum warpage: **Intake 0.2 mm (0.008 in.)**
Exhaust 0.7 mm (0.028 in.)

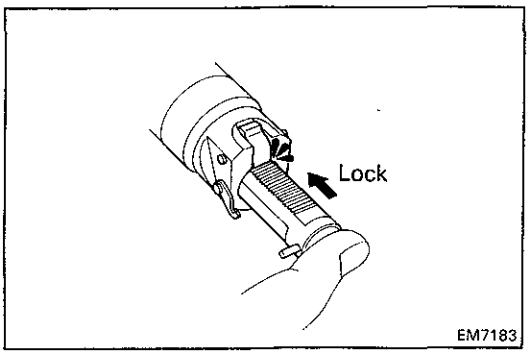
If warpage is greater than maximum, replace the manifold.



EM7184

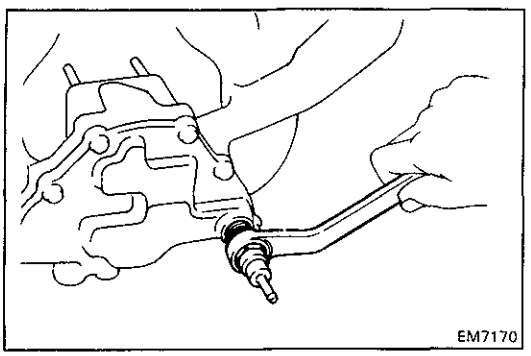
19. INSPECT CHAIN TENSIONER

(a) Check that the plunger moves smoothly when the ratchet pawl is raised with your finger.



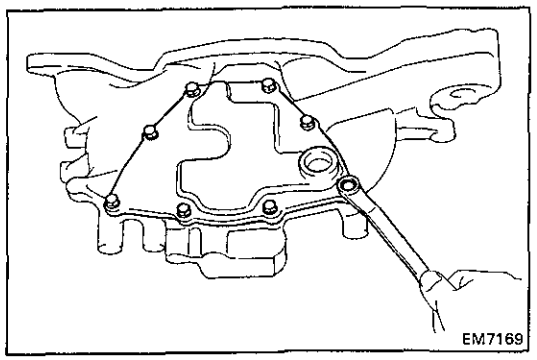
EM7183

(b) Release the ratchet pawl and check that the plunger is locked in place by the ratchet pawl and does not move when pushed with your finger.

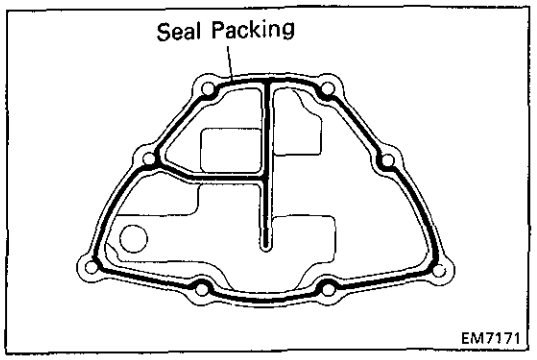

EM7170

20. IF NECESSARY, REMOVE MANIFOLD THERMOSTAT AND WATER BY-PASS FLANGE

(a) Remove the manifold thermostat.



(b) Remove the eight bolts and water by-pass flange.

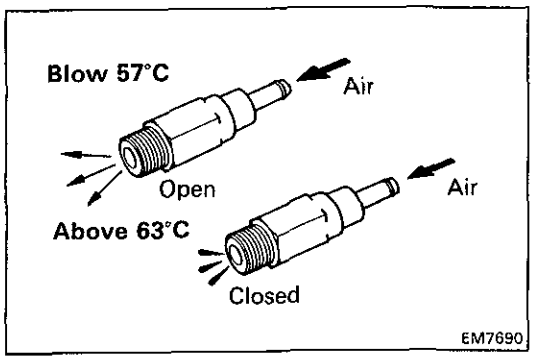


(c) Apply seal packing to the water by-pass flange as shown in the figure.

Seal packing: Part No. 08826-00100, Seal packing 1282B, THREE BOND 1282B, or equivalent

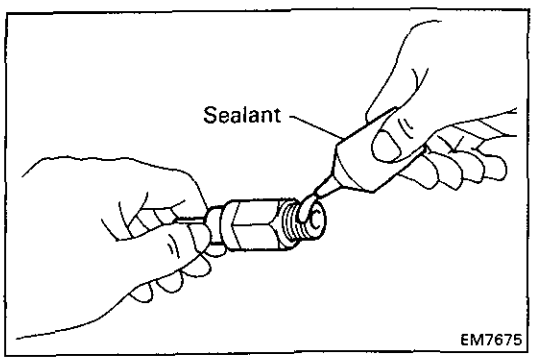
(d) Install the water by-pass flange with the eight bolts.

Torque: 80 kg-cm (69 in.-lb, 7.8 N·m)



(e) Inspect the manifold thermostat.

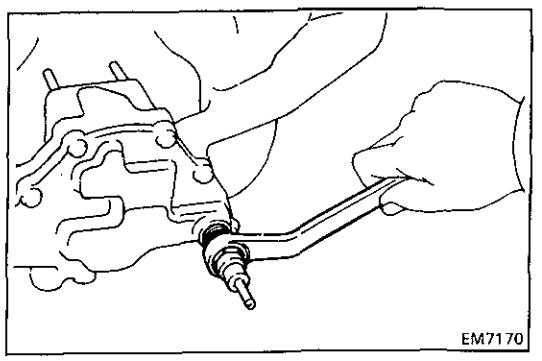
Check that when the temp is below 57°C (135°F), air flowing from the direetion of the arrow flows out the other end.



(f) Apply sealant to 2 or 3 threads of the manifold thermostat end.

Sealant: Part No. 08833-00070, adhesive 13244, THREE BOND 1324 or equivalent

HINT: This adhesive will not harden while exposed to air. It will act a sealant or binding agent only when applied to threads, etc., where air is cut off.



(g) Install and torque the manifold thermostat.

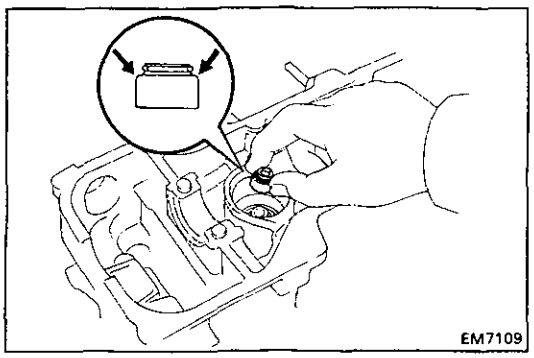
Torque: 250 kg-cm (18 ft-lb, 25 N·m)

ASSEMBLY OF CYLINDER HEAD

(See page EM-38)

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 parts.



1. INSTALL VALVES

(a) Install a new oil seals on the valve guide bushings.

HINT: Pushing down at the places shown in the illustration.

(b) Rotate the oil seal to check that it is firmly installed.

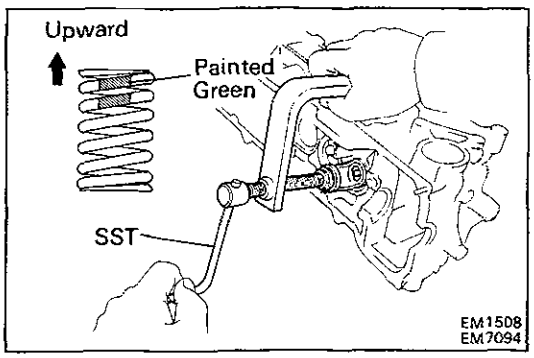
(c) Lubricate and insert valve in the valve guide bushing. Check that the valves are installed in correct order.

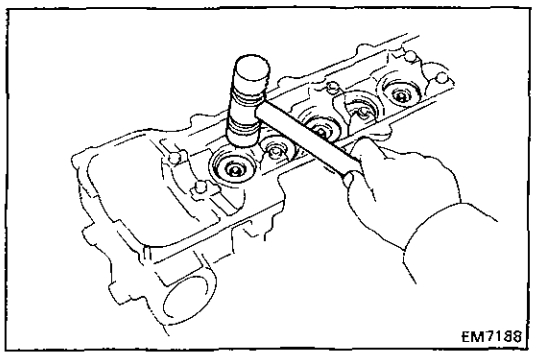
(d) Install spring seat, spring and spring retainer on the cylinder head.

(e) Using SST, compress valve retainer and place two keepers around the valve stem.

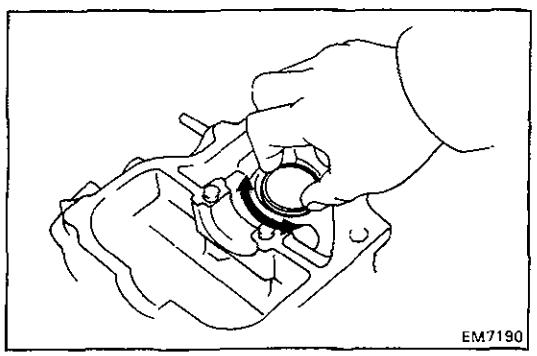
SST 09202-43013

(f) Unscrew the SST confirm proper fit of the keepers.



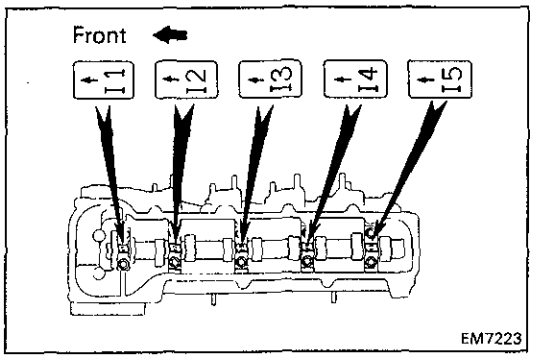


(g) Using a plastic-faced hammer, lightly tap the valve stem tip to assure proper fit.



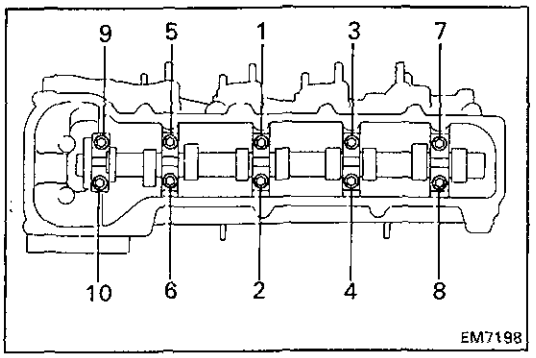
2. INSTALL VALVE LIFTERS WITH SHIMS

Make sure the valve lifters with their shims are installed in correct order.



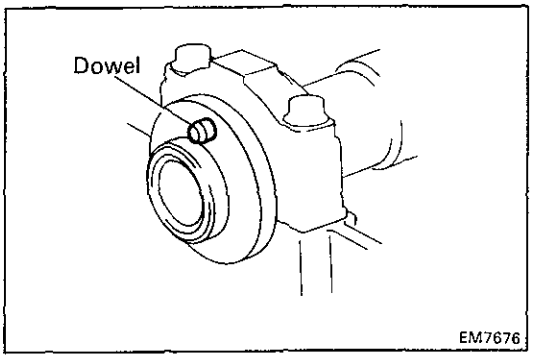
3. *INSTALL CAMSHAFT*

(a) Place the camshaft in the cylinder head and install the bearing caps in numbered order from the front with arrows pointing toward the front.

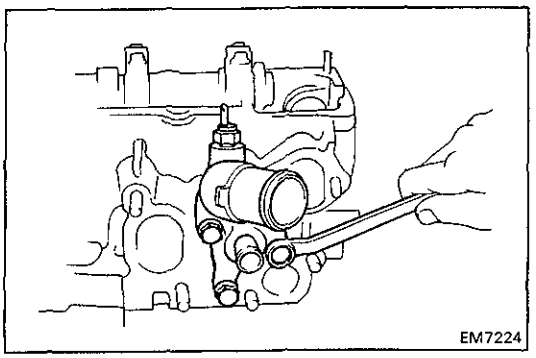


(b) Install and torque the cap bolts.

Torque: 160 kg-cm (12 ft-lb, 16 N·m)



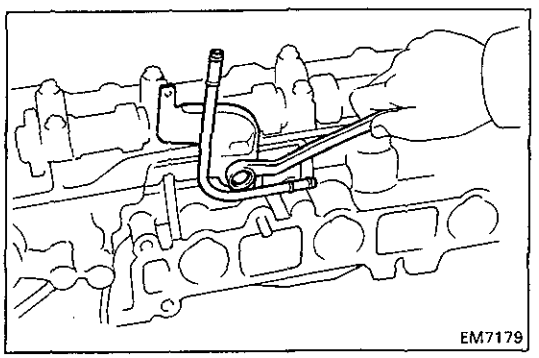
(c) Turn the camshaft to position the dowel at the top.



4. **INSTALL WATER OUTLET**

Install the water outlet and a new gasket with the three bolts.

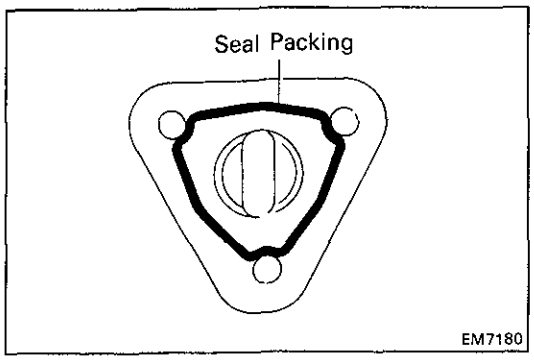
Torque: 200 kg-cm (14 ft-lb, 20 N·m)



5. *INSTALL PCV PIPE*

Install PCV pipe with the bolt.

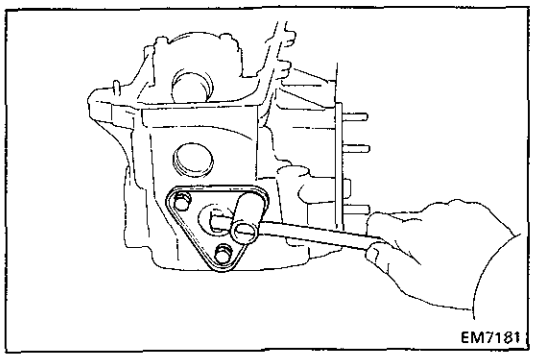
Torque: 200 kg-cm (14 ft-lb, 20 N·m)



6. INSTALL CYLINDER HEAD REAR PLATE

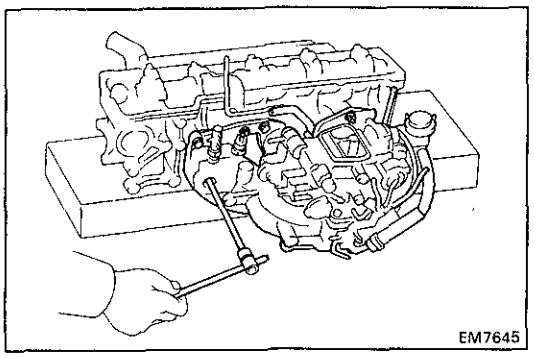
(a) Apply seal packing to the cylinder head rear plate as shown in the figure.

Seal packing: Part No. 08826-00100 , Seal packing, 1282B, THREE BOND 1282B or equivalent



(b) Install the cylinder head rear plate with the three bolts.

Torque: 185 kg-cm (13 ft-lb, 18 N·m)



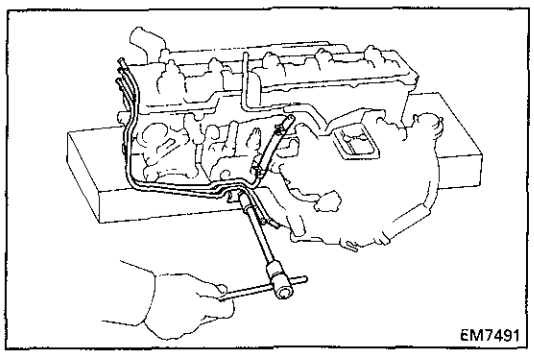
7. INSTALL INTAKE MANIFOLD

(a) Position a new gasket on the cylinder head.

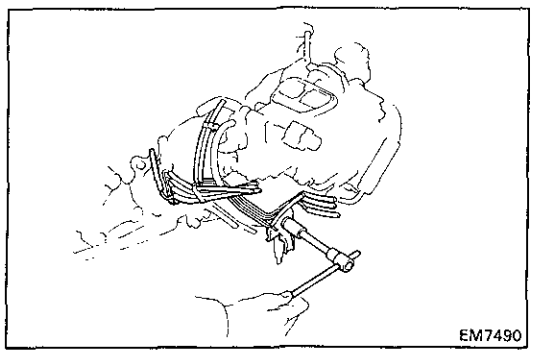
(b) Install the intake manifold with the seven bolts and two nuts

Torque: 210 kg-cm (15 ft-lb, 21 N·m)

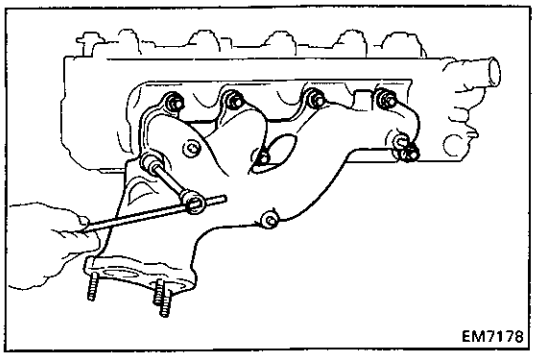
(c) Install the No.2 PCV hose.



(d) Install the fuel pipe with the two bolts.



(e) Install the No.1 air pipe with the two bolts.

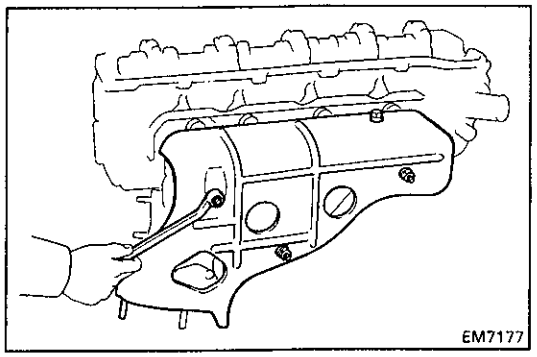


8. INSTALL EXHAUST MANIFOLD

(a) Position a new gasket on the cylinder head.

(b) Install the exhaust manifold with the eight nuts.

Torque: 500 kg-cm (35 ft-lb, 49 N·m)



(c) Install the exhaust manifold heat insulator with the three nuts and bolt.

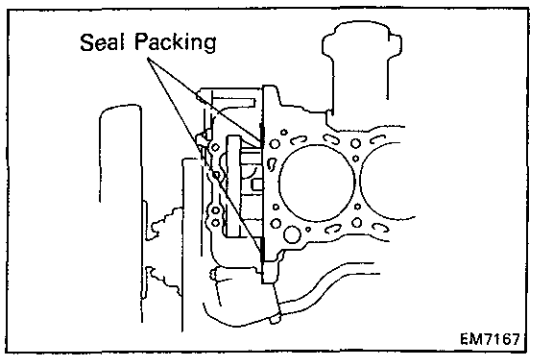
Torque: 115 kg-cm (8 ft-lb, 11 N·m)

INSTALLATION OF CYLINDER HEAD

(See page EM-38)

HINT:

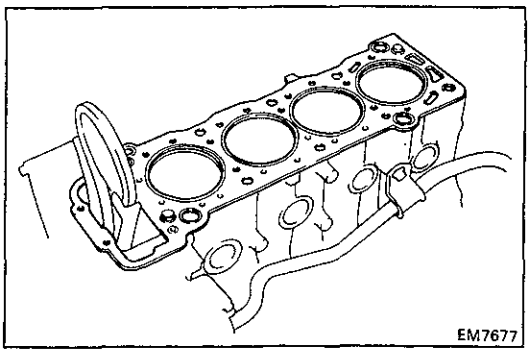
- The cylinder head bolts are tighten in three progressive steps.
- If any of the bolts break or deform, replace them.



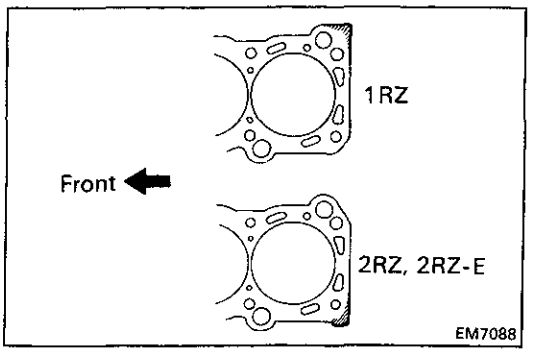
1. **INSTALL CYLINDER HEAD**

(a) Apply seal packing to two locations as shown.

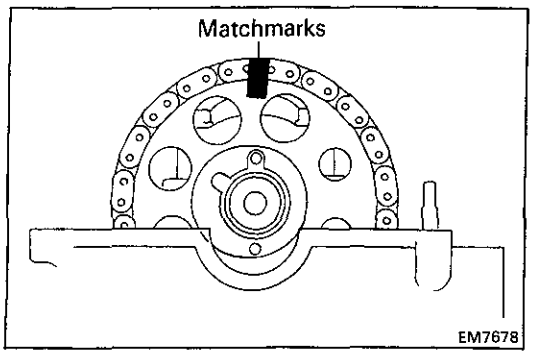
Seal packing: Part No.08826-00080 or equivalent



(b) Place a new head gasket over dowels on the cylinder block.



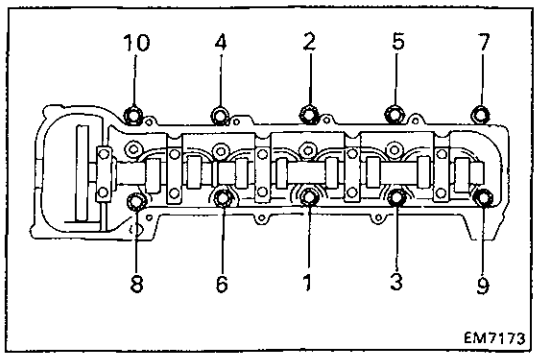
HINT: There are two types of cylinder head gasket as shown in the illustration.



(c) If the sprocket was removed, align the matchmarks placed on the sprocket and chain during removal.

(d) Position the cylinder head over dowels on the block.

NOTICE: Do not damage the timing chain or the sprocket.

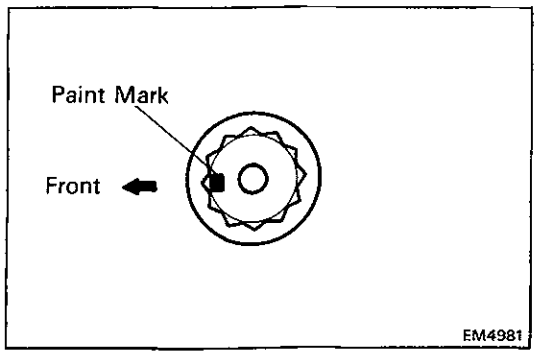


(e) Apply a light coat of the engine oil on the threads and under the cylinder head bolts.

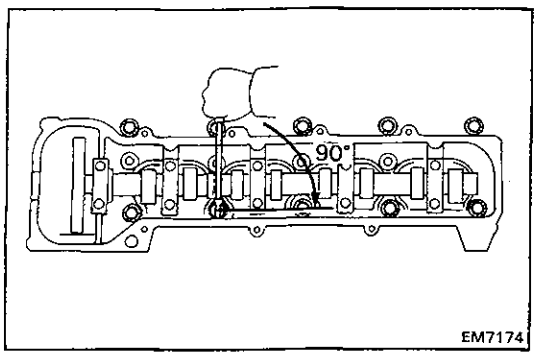
(f) Using a 12-sided socket wrench, first alternately torque the head bolts in several passes.

Torque: 400 kg-cm (33 ft-lb, 44 N·m)

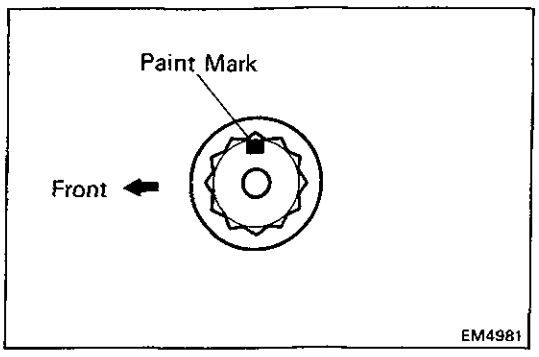
If any one of the bolts does not meet the torque specification, replace the bolt.



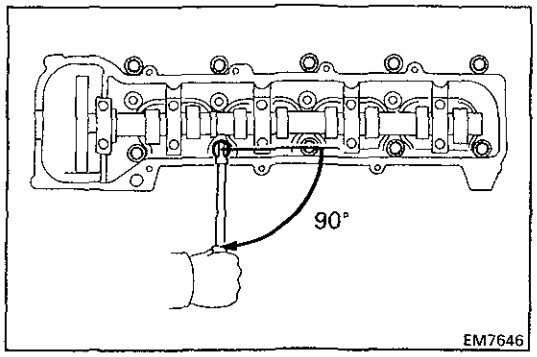
(g) Mark the front side of the top of bolt with paint.



(h) Second, uniformly torque the bolts by an additional 90°.

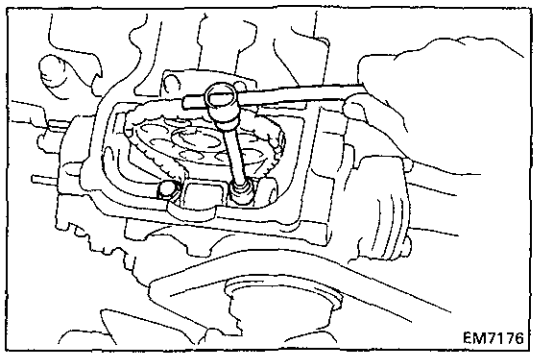


(i) Check that the paint mark is now facing sideward.



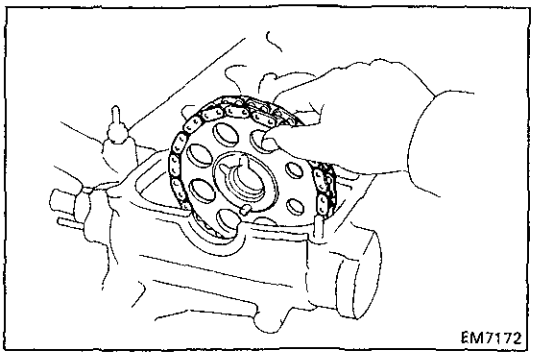
(j) Third, uniformly torque the bolts by an additional 90°.

(k) Check that the paint mark is now facing rearward.



(l) Install and torque the two bolts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

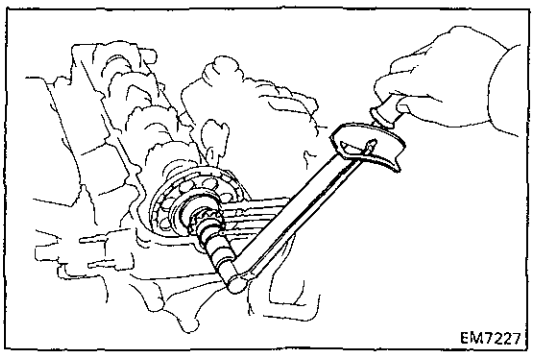


2. INSTALL CAM SPROCKET

(a) While holding up on the sprocket and chain.

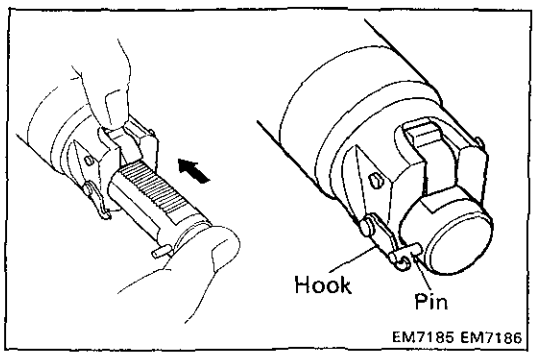
(b) Place the chain sprocket over the camshaft dowel.

HINT: If the chain does not seem long enough, turn the crankshaft back and forth while pulling up on the chain and sprocket.



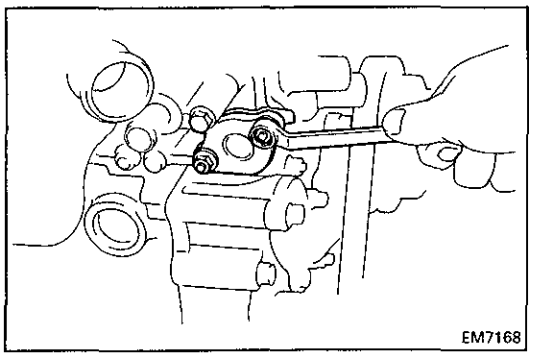
(c) Place the fuel pump drive cam and distributor drive gear over the chain sprocket. Install and torque the bolt.

Torque: 750 kg-cm (54 ft-lb, 74 N·m)



3. INSTALL CAIN TENSIONER

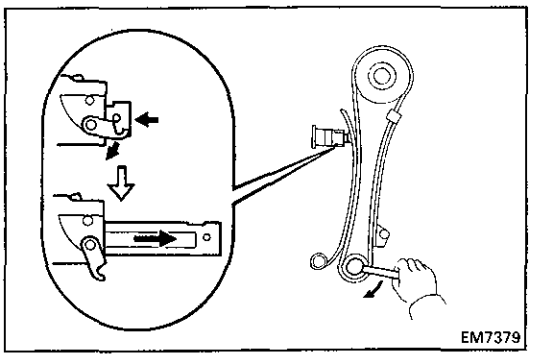
(a) Release the ratchet pawl, fully push in the plunger and apply the hook to the pin so that the plunger cannot spring out.



(b) Install the chain tensioner and a new gasket with the two nuts.

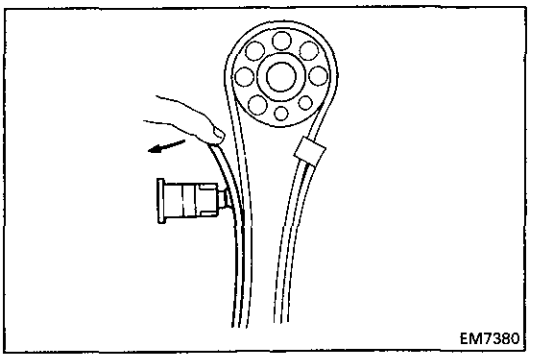
Torque: 210 kg-cm (15 ft-lb, 21 N·m)

***CAUSTION:* If the plunger springs out during installation of the chain tension, repeat the operation in 3. (a) on the previous page before installing the tensioner.**



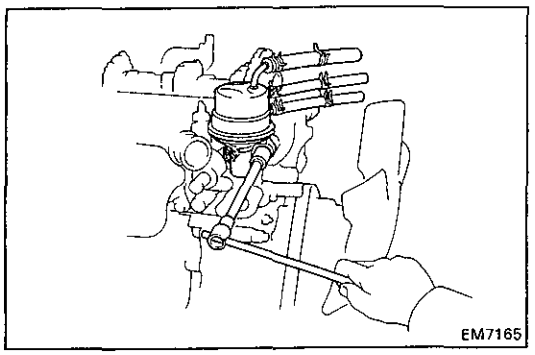
4. SET CHAIN TENSION

Turn the crankshaft to the right so that the hook of the chain tensioner is released from the pin of the plunger, causing the plunger to spring out and the slipper to be pushed into the chain.



HINT: If the plunger does not spring out, press the slipper into the chain tensioner with a screwdriver or your finger so that the hook is released and the plunger springs out.

5. ADJUST VALVE CLEARANCE
(See pages EM-12 to 23)

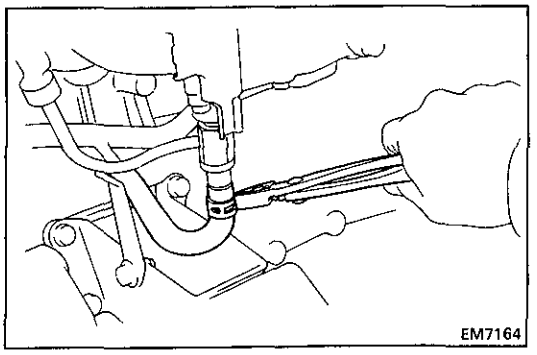


6. *INSTALL FUEL PUMP*

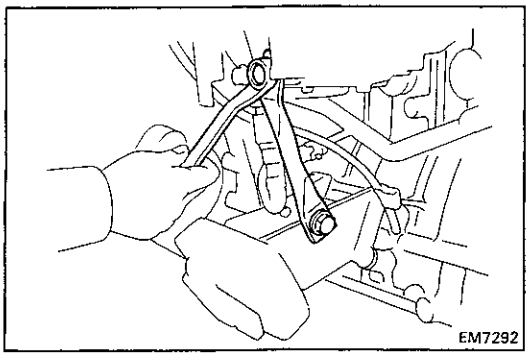
(a) Install a new insulator and fuel pump with the two nuts.

Torque: 200 kg-cm (14 ft-lb, 20 N·m)

(b) Connect the three fuel hoses to the fuel pipe.



7. CONNECT NO.1 WATER BY-PASS HOSE TO MANIFOLD THERMOSTAT

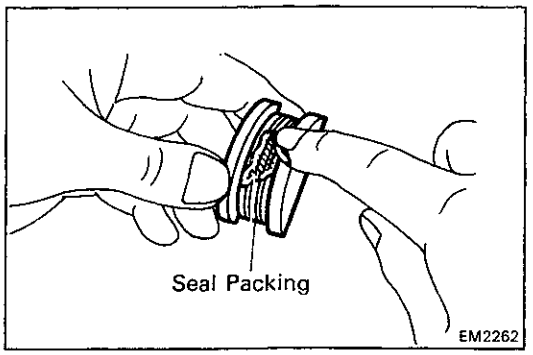


8. **INSTALL INTAKE MANIFOLD STAY**

Install the intake manifold stay with the two bolts.

Torque: 380 kg-cm (27 ft-lb, 37 N·m)

9. **INSTALL DISTRIBUTOR**
(See page IG-24 or 34)

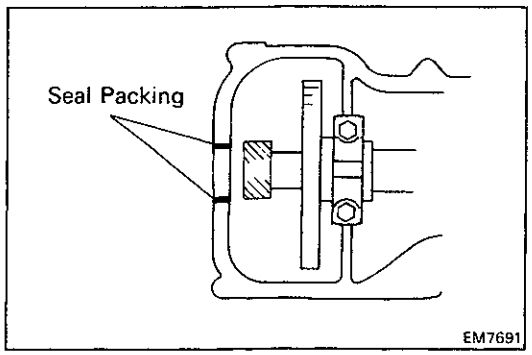


10. **INSTALL CYLINDER HEAD COVER**

(a) Apply seal packing to the cylinder head installation surface of the half-circular plug.

Seal packing: Part No. 08826-00080 or equivalent

(b) Install the half-circular plug to the cylinder head.



(c) Apply seal packing to two location shown.

Seal packing: Part No. 08826-00080 or equivalent

(d) Install the cylinder head cover and gasket with the nine bolts and two nuts.

Torque: 55 kg-cm (48 in.-lb, 5.4 N·m)

11. **INSTALL SPARK PLUGS**
(See step 1 on page IG-8)

(a) Install the spark plugs and high-tension cords.

(b) Install the No.1 PCV hose.