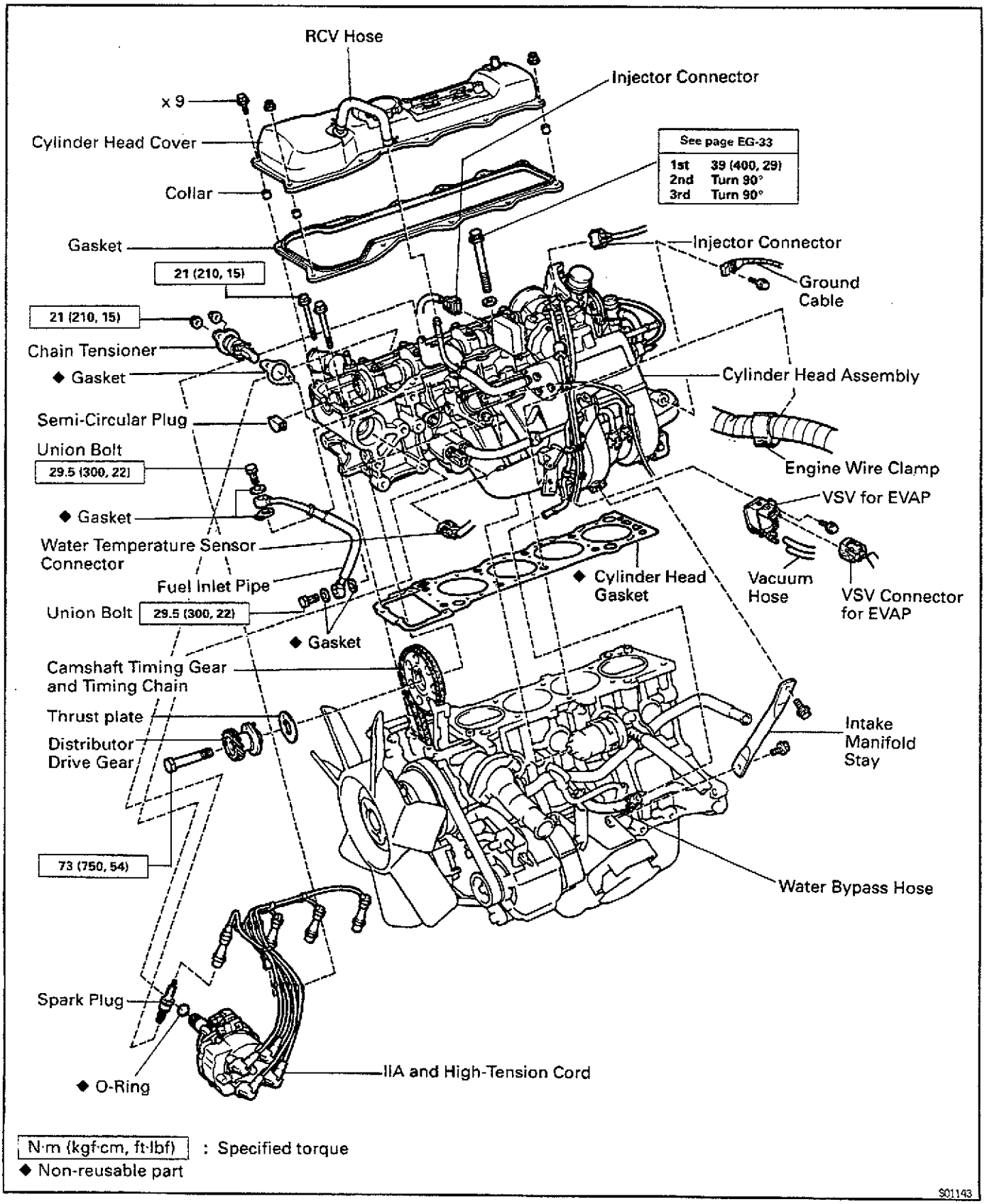
CYLINDER HEAD

COMPONENTS FOR REMOVAL AND INSTALLATION

50000-01

EG

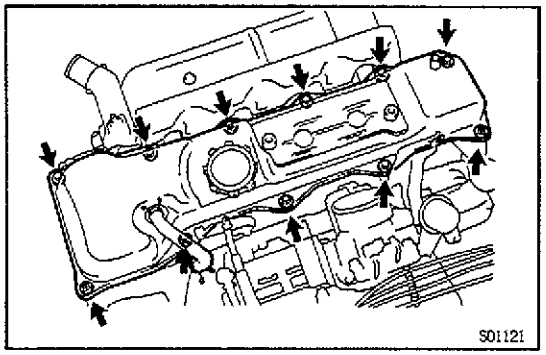


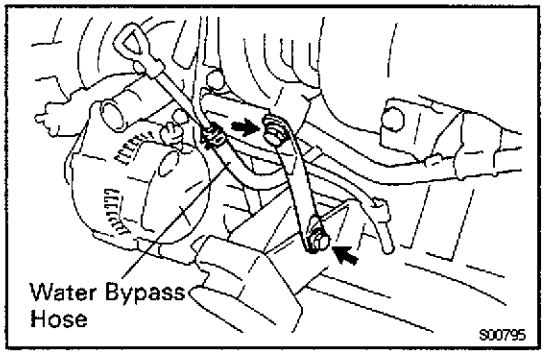
N·m (kgf·cm, ft·lbf) : Specified torque

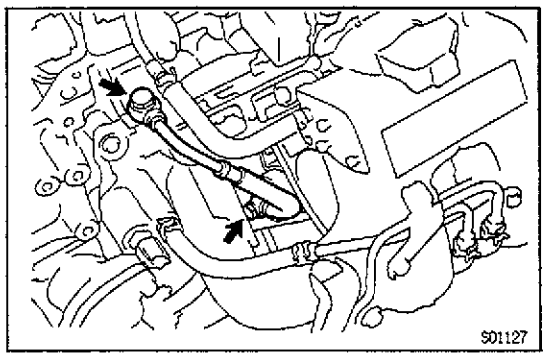
◆ Non-reusable part

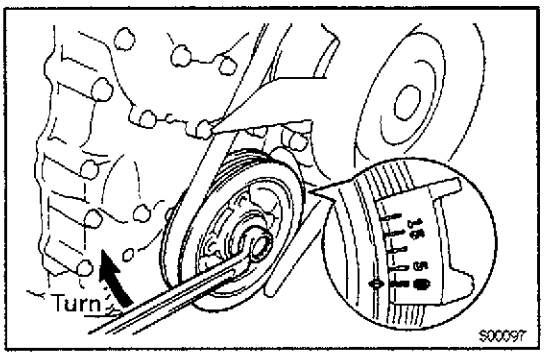
S01143

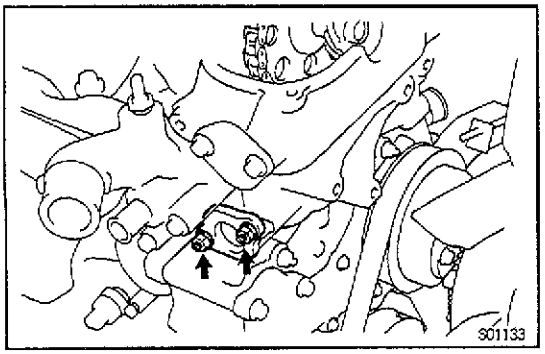
EG







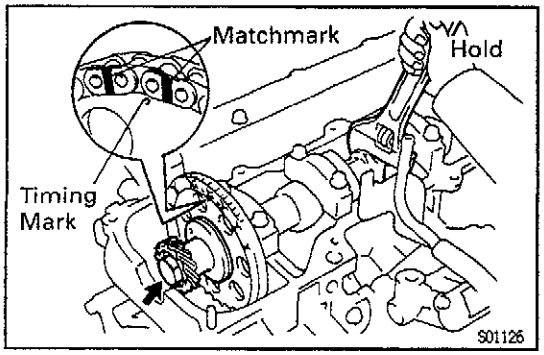




CYLINDER HEAD ASSEMBLY REMOVAL

EQ6GR–01

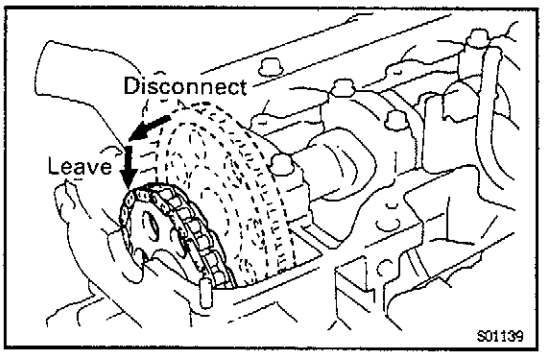
1. **DRAIN ENGINE COOLANT**
2. **DISCONNECT HIGH–TENSION CORDS FROM SPARK PLUGS**
3. **REMOVE CYLINDER HEAD COVER**
   Remove the 9 bolts, 2 nuts, cylinder head cover and gasket.
4. **REMOVE DISTRIBUTOR**
   (See distributor removal in Ignition System)
5. **REMOVE VSV FOR EVAP**
   (See components for removal and installation in EFI System)
6. **REMOVE INTAKE MANIFOLD STAY**
   Remove the 2 bolts and intake manifold stay.
7. **DISCONNECT WATER BYPASS HOSE FROM NO.2 WATER BYPASS PIPE**
8. **DISCONNECT ENGINE WIRE**
   Disconnect these connectors and clamp:
   - Water temperature sensor connector
   - Throttle position sensor connector
   - 4 injector connectors
   - Engine wire clamp from bracket on intake manifold
9. **REMOVE FUEL INLET PIPE**
   Remove the 2 union bolts, 4 gaskets and inlet pipe.
10. **REMOVE SPARK PLUGS**
11. **SET NO.1 CYLINDER TO TDC/COMPRESSION**
    (a) Turn the crankshaft pulley, and align its groove with timing mark "0" of the timing chain cover.
    (b) Check that the valve lifters on the No.1 cylinder are loose and valve lifters on the No.4 are tight.
    If not, turn the crankshaft one revolution (360°) and align the mark as above.
12. **REMOVE CHAIN TENSIONER**
    Remove the 2 nuts, chain tensioner and gasket.
13. **REMOVE SEMI–CIRCULAR PLUG**



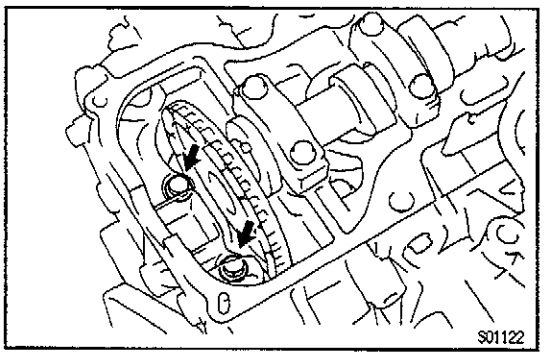
14. REMOVE CAMSHAFT TIMING GEAR

(a) Place the matchmarks on the timing chain to match the timing mark (dot mark) of the camshaft timing gear.

(b) Hold the hexagon wrench head portion of the camshaft with a wrench, remove the bolt, thrust plate and distributor gear.

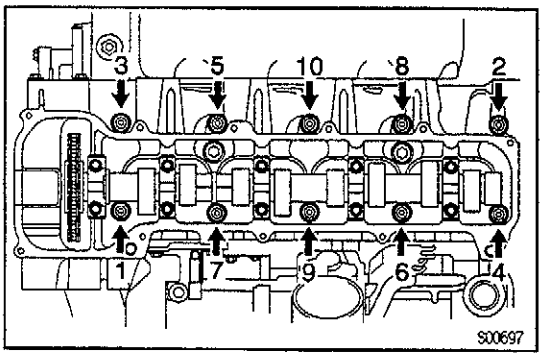


(c) Disconnect the camshaft timing gear and chain from the camshaft, and leave on the slipper and damper.



15. REMOVE CYLINDER HEAD ASSEMBLY

(a) Remove the 2 cylinder head bolts (6 pointed head).



(b) Uniformly loosen and remove the 10 cylinder head bolts (12 pointed head) in several passes, in the sequence shown.

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

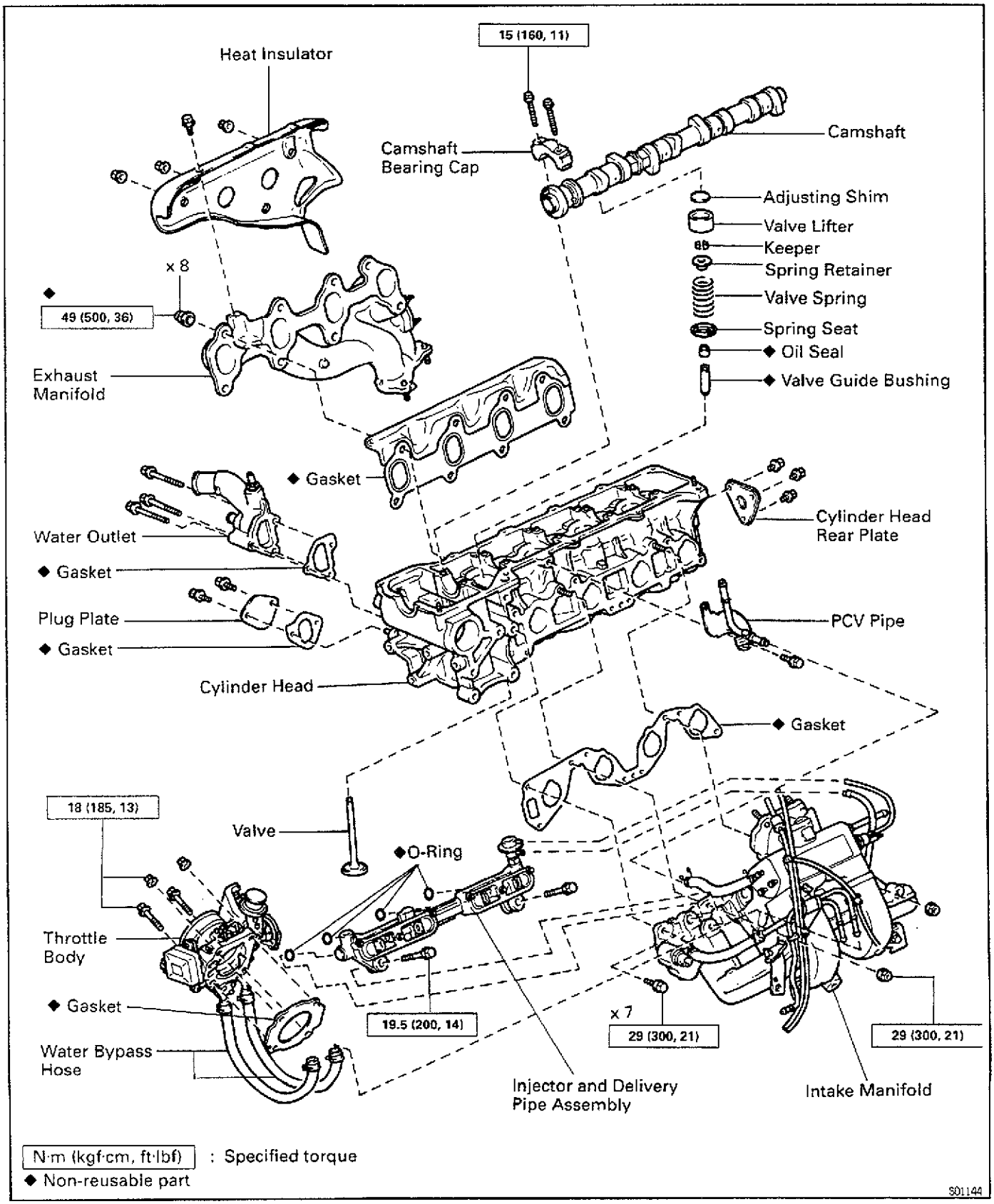
(c) Lift the cylinder head assembly from the dowels on the cylinder block, and place the cylinder head assembly on wooden blocks on a bench.

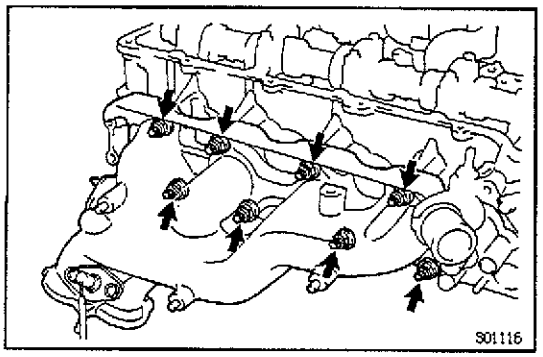
HINT: If the cylinder head is difficult to lift off, pry between the cylinder head and cylinder block with a screwdriver.

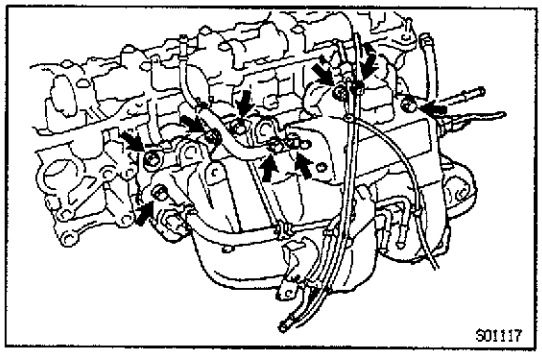
NOTICE: Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

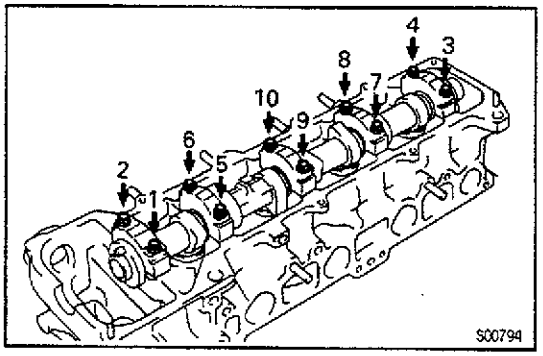
EG60J-01

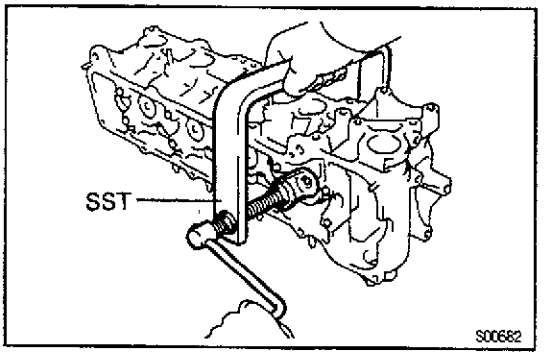
COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

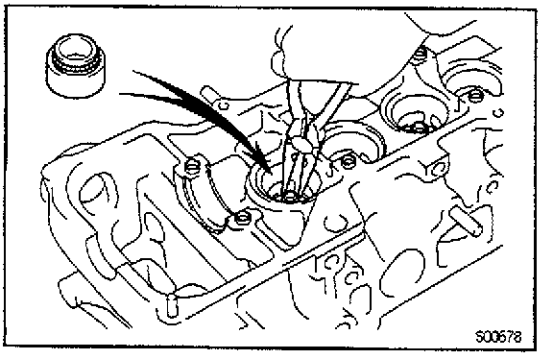












CYLINDER HEAD DISASSEMBLY

1. **REMOVE EXHAUST MANIFOLD**

(a) Remove the bolt, 3 nuts and heat insulator.

(b) Remove the 8 nuts, exhaust manifold and gasket.

2. **REMOVE THROTTLE BODY**

(See steps 3 to 5 in throttle body removal in EFI System)

3. **REMOVE INJECTORS AND DELIVERY PIPE ASSEMBLY**

(See step 2 in injectors and delivery pipe assembly installation in EFI System)

4. **REMOVE INTAKE MANIFOLD**

(a) Disconnect the PCV hose from the PCV pipe.

(b) Remove the 7 bolts, 2 nuts, intake manifold and gasket.

5. **REMOVE WATER OUTLET**

Remove the 3 bolts, water outlet and gasket.

6. **REMOVE PLUG PLATE**

Remove the 2 bolts, plug plate and gasket.

7. **REMOVE CYLINDER HEAD REAR PLATE**

Remove the 3 bolts, rear plate and gasket.

8. **REMOVE PCV PIPE**

Remove the bolt and PCV pipe.

9. **REMOVE CAMSHAFT**

Uniformly loosen and remove the 10 bearing cap bolts in several passes, in the sequence shown, and remove the 5 bearing caps and camshaft.

10. **REMOVE VALVE LIFTERS AND SHIMS**

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

11. **REMOVE VALVES**

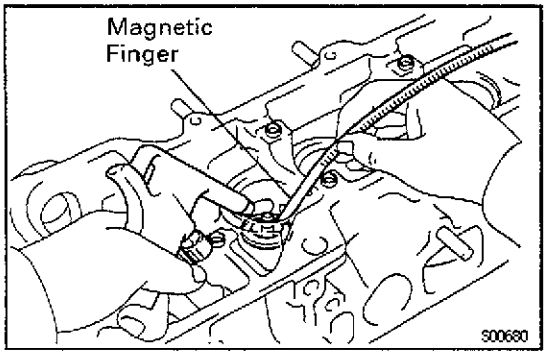
(a) Using SST, compress the valve spring and remove the 2 keepers.

SST 09202—70020 (09202—00030)

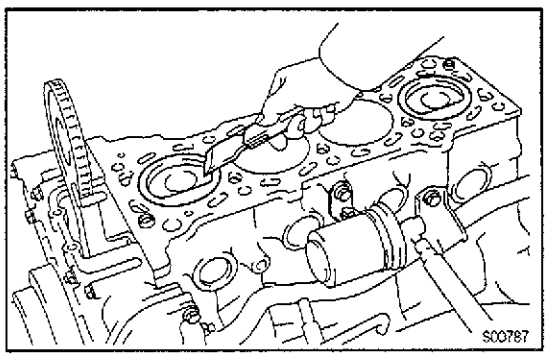
(b) Remove the spring retainer, valve spring and valve.

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

EG



(d) Using compressed air and a magnetic finger, remove the spring seat by blowing air.
HINT: Arrange the valves, valve springs, spring seats and spring retainers in correct order.

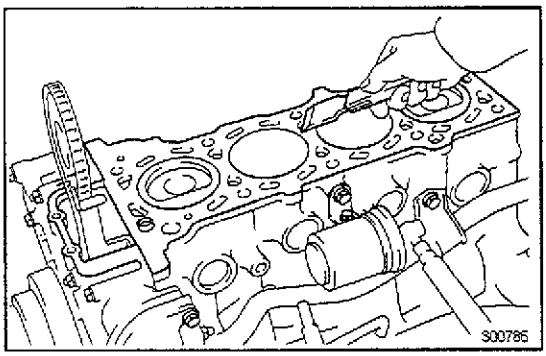


EG60X-01

CYLINDER HEAD COMPONENTS INSPECTION AND REPAIR

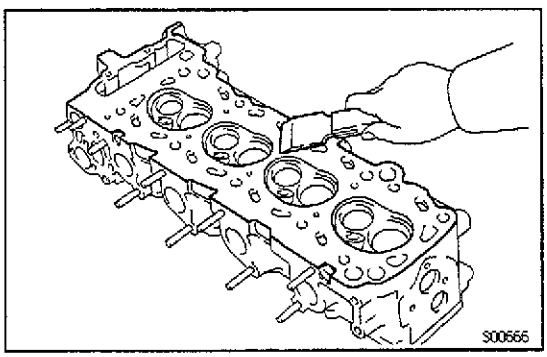
1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

(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 surface.



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

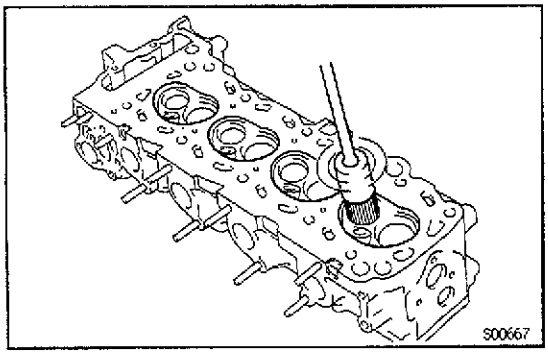
(c) Using compressed air, blow carbon and oil from the bolt holes.
CAUTION: Protect your eyes when using high—pressure compressed air.



2. CLEAN CYLINDER HEAD

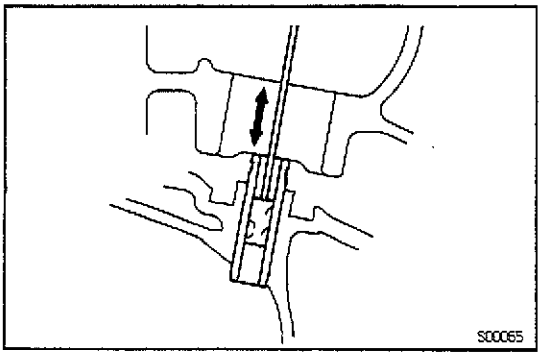
A. Remove gasket material

Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.
NOTICE: Be careful not to scratch the cylinder block contact surface.



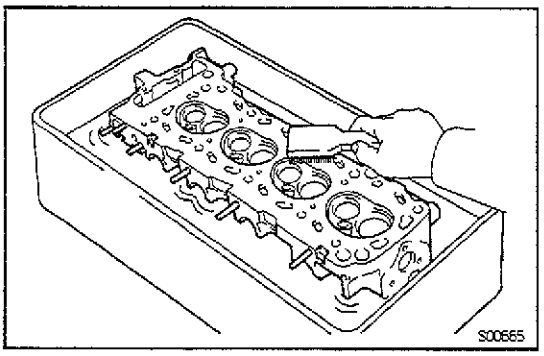
B. Clean combustion chambers

Using a wire brush, remove all the carbon from the combustion chamber.
NOTICE: Be careful not to scratch the cylinder block contact surface.



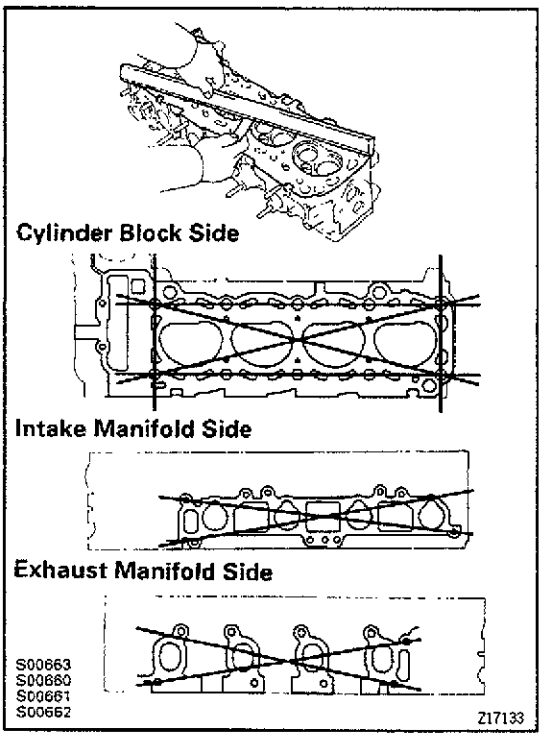
C. Clean valve guide bushings

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



D. Clean cylinder head

Using a soft brush and solvent, thoroughly clean the cylinder head.



3. INSPECT CYLINDER HEAD

A. Inspect for flatness

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

Maximum warpage:

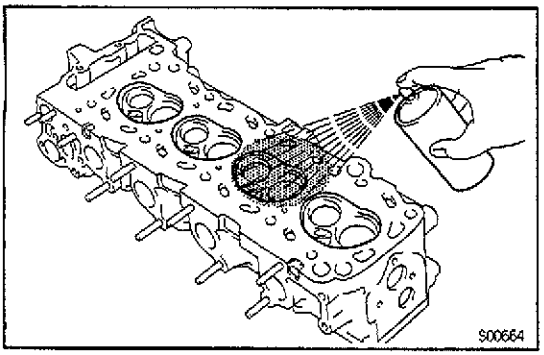
Cylinder block side

0.15 mm (0.0059 in.)

Manifold side

0.20 mm (0.0079 in.)

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

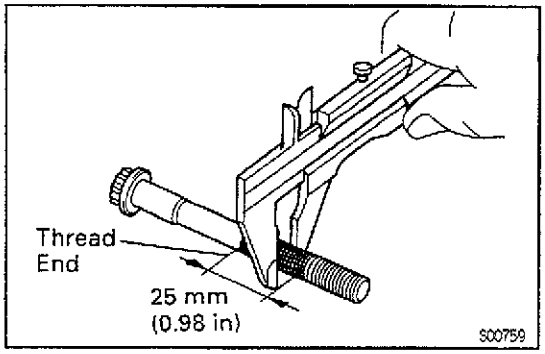


B. Inspect for cracks

Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.

If cracked, replace the cylinder head.

EG



C. Inspect cylinder head bolts

Using vernier calipers, measure the thread outside diameter at the measuring point.

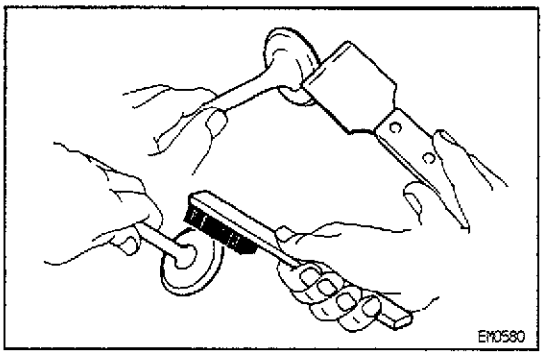
Standard outer diameter:

10.760 – 10.970 mm (0.4236 – 0.4319 in.)

Minimum outer diameter:

10.40 mm (0.4094 in.)

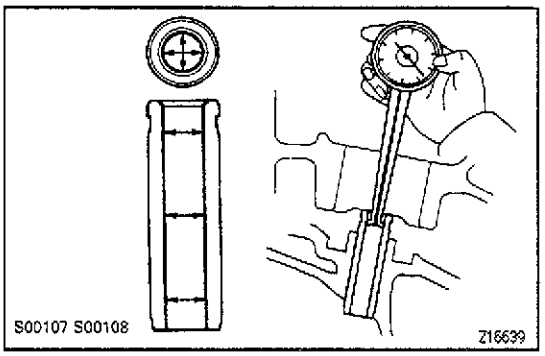
If the outer diameter is less than minimum, replace the bolt.



4. CLEAN VALVES

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

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

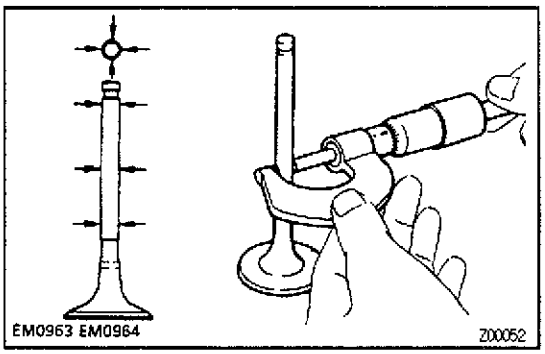


5. INSPECT VALVE STEMS AND GUIDE BUSHINGS

(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

7.970 – 7.985 mm (0.3138 – 0.3144 in.)

Exhaust

7.965 – 7.980 mm (0.3136 – 0.3142 in.)

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

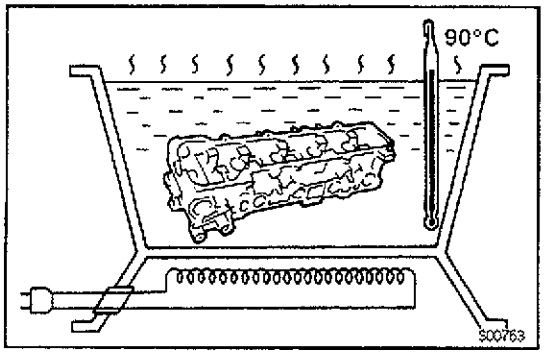
Maximum oil clearance:

Intake

0.08 mm (0.0031 in.)

Exhaust

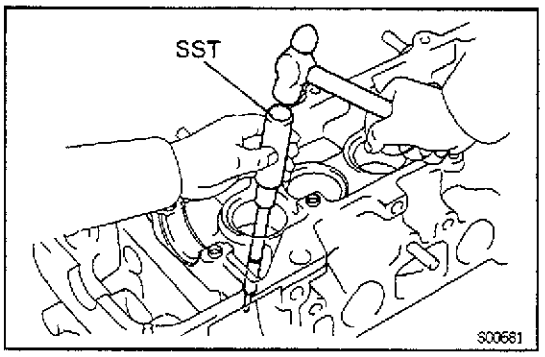
0.10 mm (0.0039 in.)



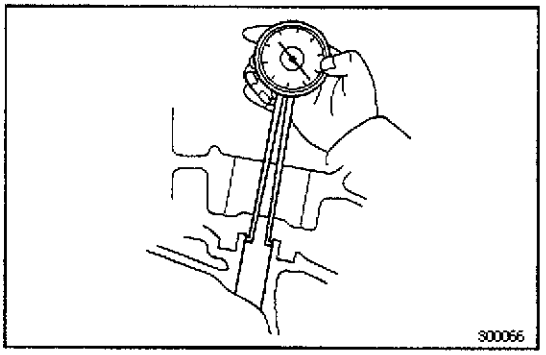
If the clearance is greater than maximum, replace the valve and guide bushing.

6. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

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



(b) Using SST and a hammer, tap out the guide bushing.
SST 09201 – 10000 (09201 – 01080),
09950 – 70010 (09951 – 07100)



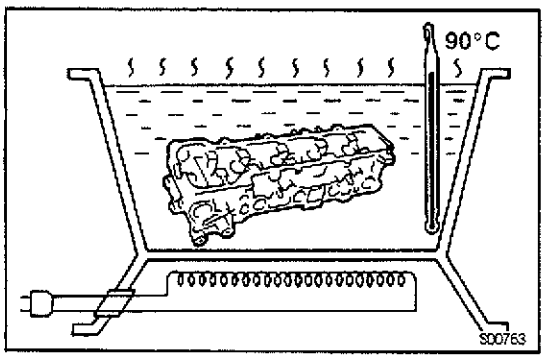
(c) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.

Both intake and exhaust

Bushing bore diameter mm (in.)	Bushing size
12.992 – 13.019 (0.5115 – 0.5126	Use STD
13.042 – 13.069 (0.5135 – 0.5145)	Use O/S 0.05

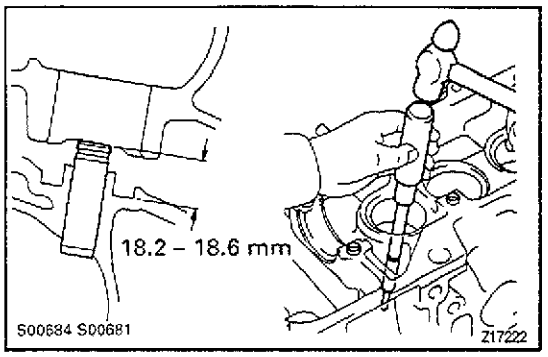
V07340

(d) Select a new guide bushing (STD or O/S 0.05).
If the bushing bore diameter of the cylinder head is greater than 13.019 mm (0.5126 in.), machine the bushing bore to the following dimension:
13.042 – 13.069 mm (0.5135 – 0.5145 in.)
If the bushing bore diameter of the cylinder head is greater than 13.069 mm (0.5145 in.), replace the cylinder head.

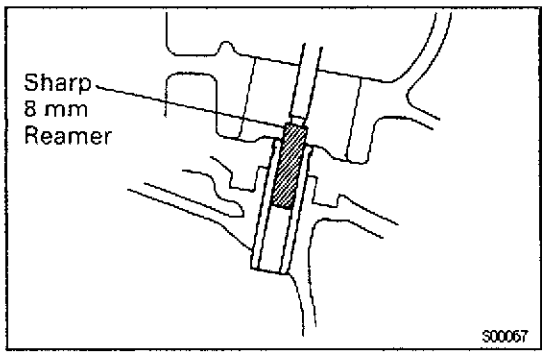


(e) Gradually heat the cylinder head to approx. 90°C (194°F).

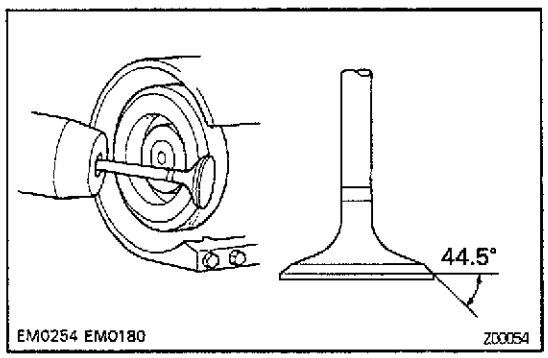
EG



(f) Using SST and a hammer, tap in a new guide bushing until there is 18.2 — 18.6 mm (0.717 — 0.732 in.) protruding from the cylinder head.
SST 09201—10000 (09201—01060),
09950—70010 (09951—07100)



(g) Using a sharp 6 mm reamer, ream the guide bushing to obtain the standard specified clearance (See step 5 above) between the guide bushing and valve stem.



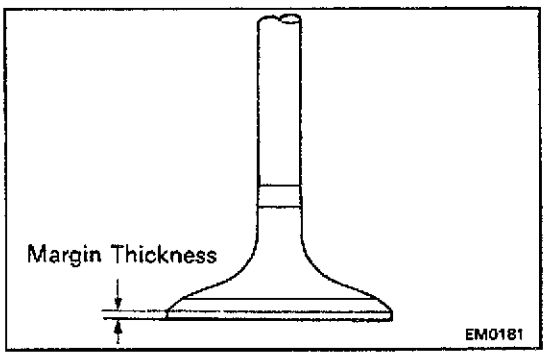
7. INSPECT AND GRIND VALVES

(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

1.00 — 1.40 mm (0.0394 — 0.0551 in.)

Exhaust

1.30 — 1.70 mm (0.0512 — 0.0669 in.)

Minimum margin thickness:

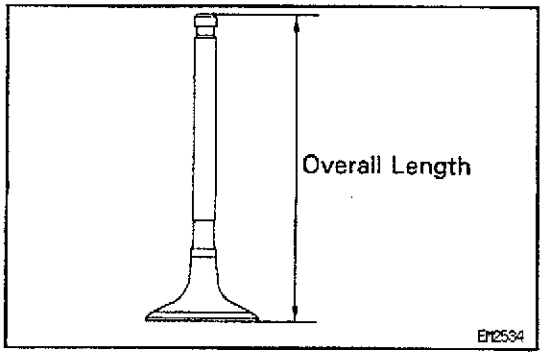
Intake

0.70 mm (0.0276 in.)

Exhaust

1.00 mm (0.0394 in.)

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



(d) Check the valve overall length.

Standard overall length:

Intake

101.70 — 102.30 mm (4.0039 — 4.0278 in.)

Exhaust

102.05 — 102.45 mm (4.0177 — 4.0335 in.)

Minimum overall length:

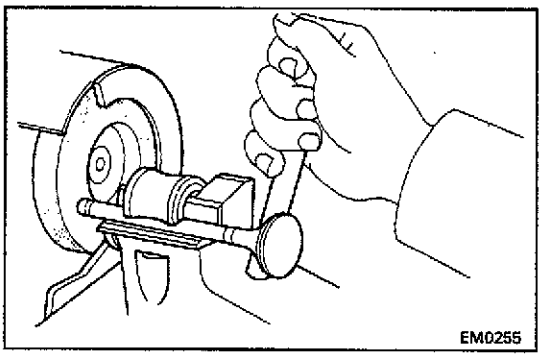
Intake

101.50 mm (3.9961 in.)

Exhaust

101.75 mm (4.0059 in.)

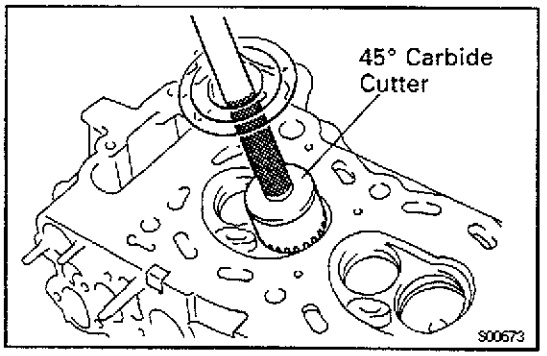
If the overall length is less than minimum, replace the valve.



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

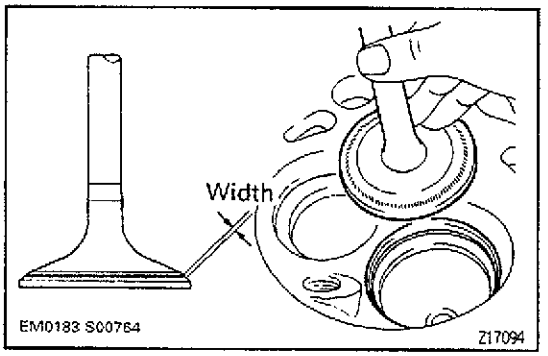
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

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



8. INSPECT AND CLEAN VALVE SEATS

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



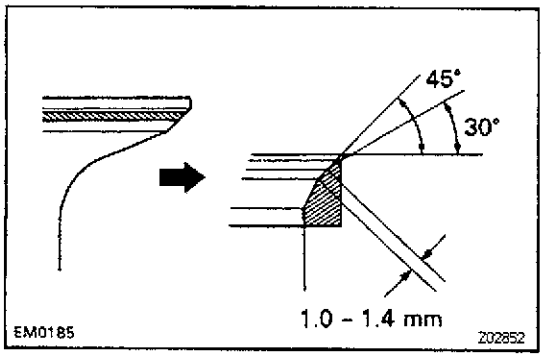
(b) Check the valve seating position.

Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate 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 in the middle of the valve face with the following width:

  1.0 — 1.4 mm (0.039 — 0.055 in.)

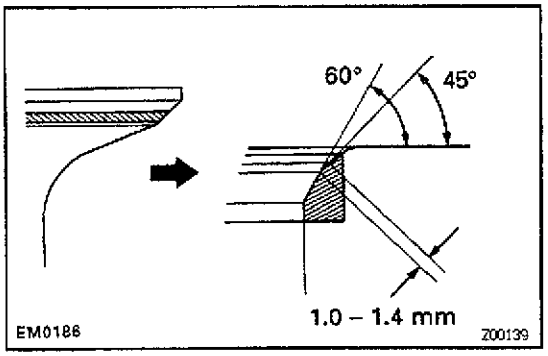


If not, correct the valve seats as follows:

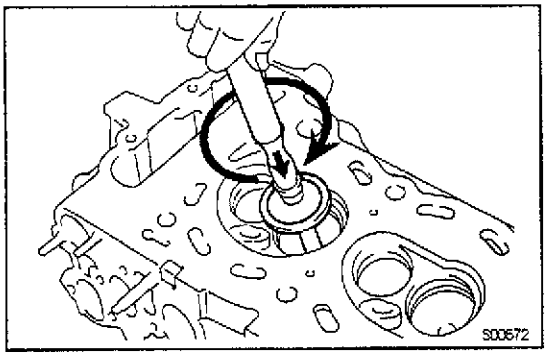
(1) If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

EG

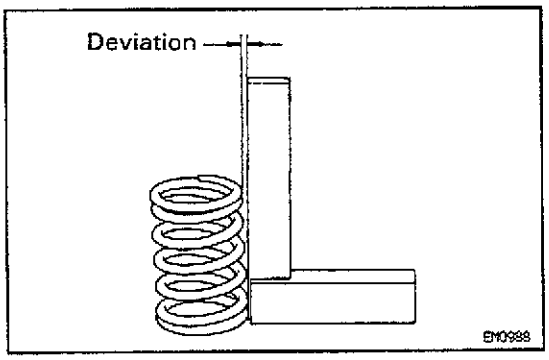
EG



(2) 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.



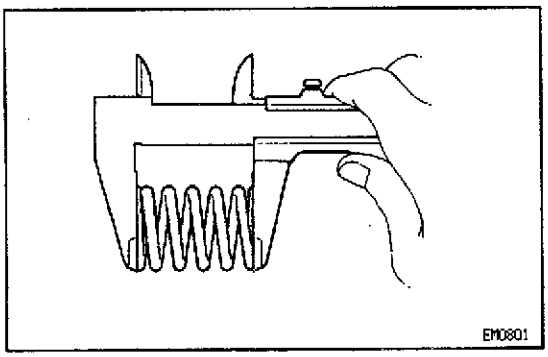
9. INSPECT VALVE SPRINGS

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

Maximum deviation:

2.0 mm (0.079 in.)

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

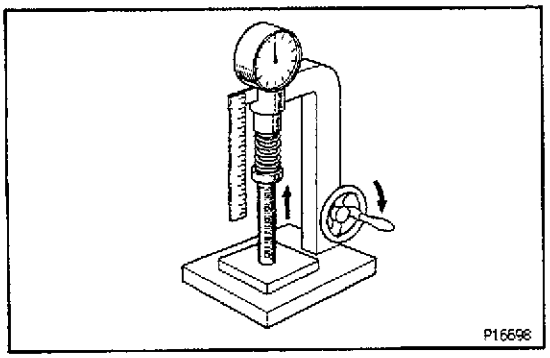


(b) Using a vernier caliper, measure the free length of the valve spring.

Free length:

47.70 mm (1.8779 in.)

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

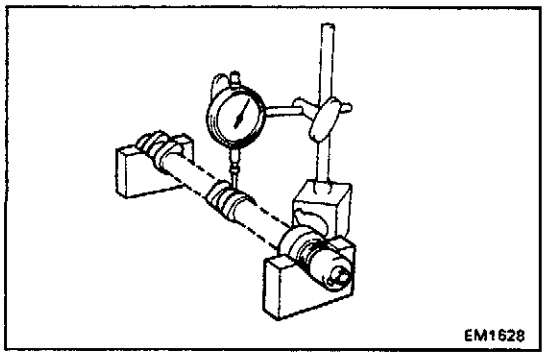


(c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

Installed tension (at 40.30 mm (1.5866 in.)):

252 – 278 N (25.7 – 28.4 kgf, 56.7 – 62.6 lbf)

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



10. INSPECT CAMSHAFTS AND BEARINGS

A. Inspect camshaft for runout

(a) Place the camshaft on V—blocks.

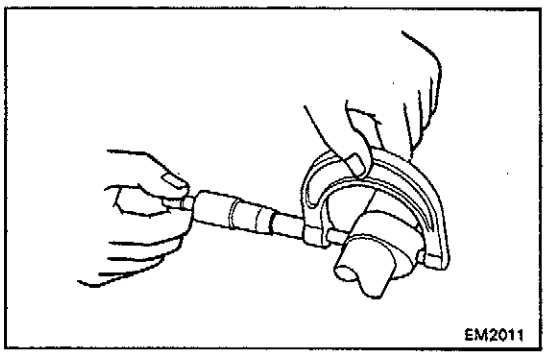
(b) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout:

0.03 mm (0.0012 in.)

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

EG



B. Inspect cam lobes

Using a micrometer, measure the cam lobe height.

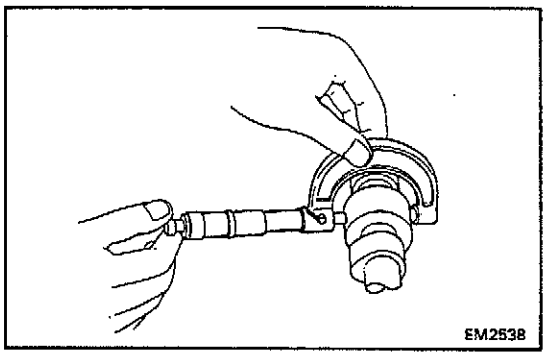
Standard cam lobe height:

47.840 — 47.940 mm (1.8835 — 1.8874 in.)

Minimum cam lobe height:

47.44 mm (1.8677 in.)

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



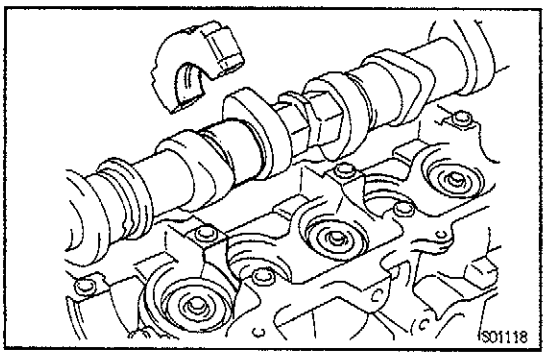
C. Inspect camshaft journals

Using a micrometer, measure the journal diameter.

Journal diameter:

33.959 — 33.975 mm (1.3370 — 1.3376 in.)

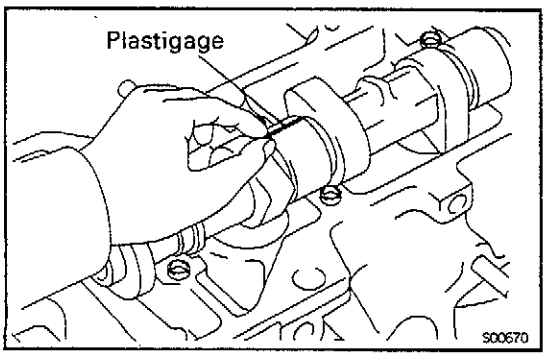
If the journal diameter is not as specified, check the oil clearance.



D. Inspect camshaft bearings

Check that bearings and journals for flaking and scoring.

If the bearings are damaged, replace the bearing caps and cylinder head as a set.



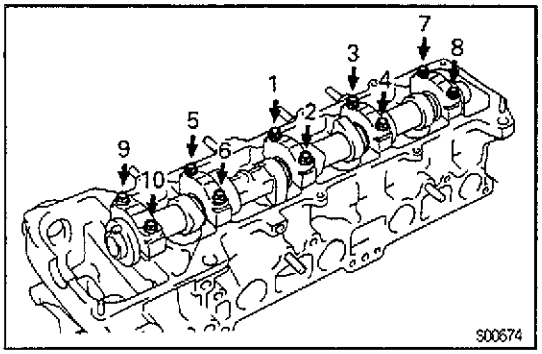
E. Inspect camshaft journal oil clearance

(a) Clean the bearing caps and camshaft journals.

(b) Place the camshafts on the cylinder head.

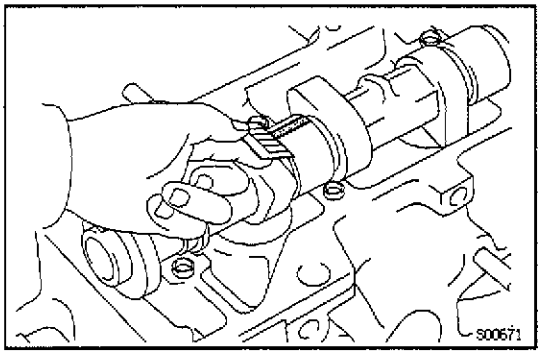
(c) Lay a strip of Plastigage across each of the camshaft journals.

EG



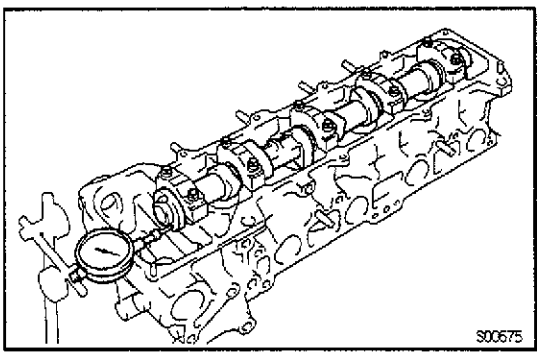
(d) Install the bearing caps.
(See step 3 in cylinder head assembly)
NOTICE: Do not turn the camshaft.

(e) Remove the bearing caps.



(f) Measure the Plastigage at its widest point.
Standard oil clearance:
0.025 — 0.066 mm (0.0010 — 0.0026 in.)
Maximum oil clearance:
0.10 mm (0.0039 in.)
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

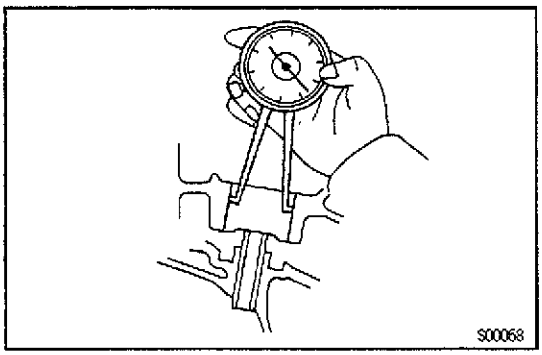
(g) Completely remove the Plastigage.



F. Inspect camshaft thrust clearance

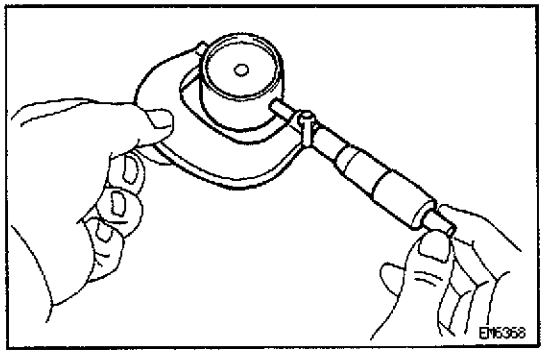
(a) Install the camshaft.
(See step 3 in cylinder head assembly)

(b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.
Standard thrust clearance:
0.080 — 0.155 mm (0.0031 — 0.0061 in.)
Maximum thrust clearance:
0.25 mm (0.0098 in.)
If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.



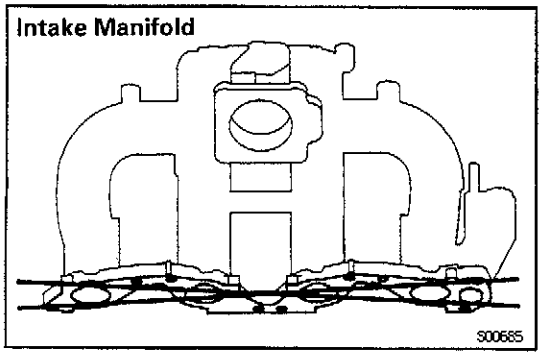
11. INSPECT VALVE LIFTERS AND LIFTER BORES

(a) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.
Lifter bore diameter:
37.960 — 37.975 mm (1.4945 — 1.4951 in.)



(b) Using a micrometer, measure the lifter diameter.
Lifter diameter:
37.922 — 37.932 mm (1.4930 — 1.4934 in.)

(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.
Standard oil clearance:
0.028 — 0.053 mm (0.0011 — 0.0021 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.

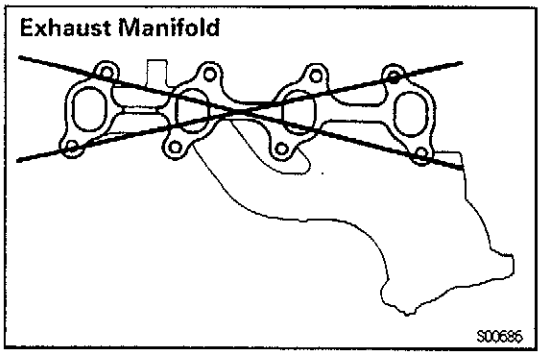
12. INSPECT INTAKE MANIFOLD

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

Maximum warpage:

0.20 mm (0.0079 in.)

If warpage is greater than maximum, replace the manifold.



13. INSPECT EXHAUST MANIFOLD

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

Maximum warpage:

0.70 mm (0.0276 in.)

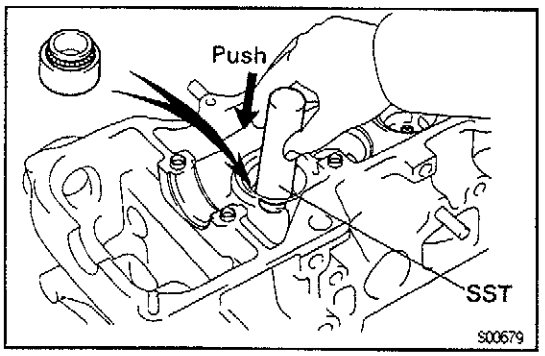
If warpage is greater than maximum, replace the manifold.

CYLINDER HEAD ASSEMBLY

EG6QL–01

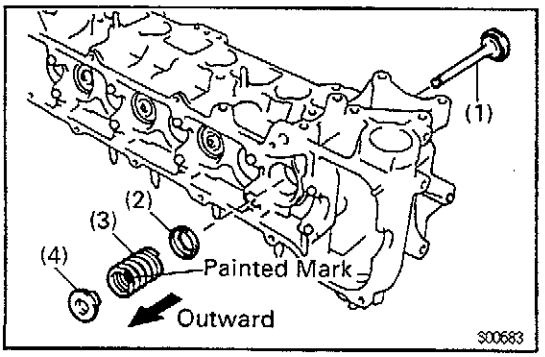
HINT:

- 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.



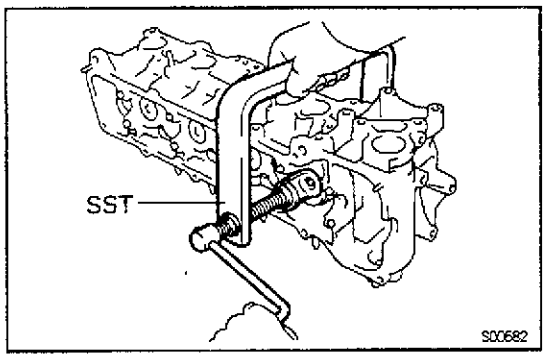
1. INSTALL VALVES

(a) Using SST, push in a new oil seal.
SST 09236–00101 (09236–15010)

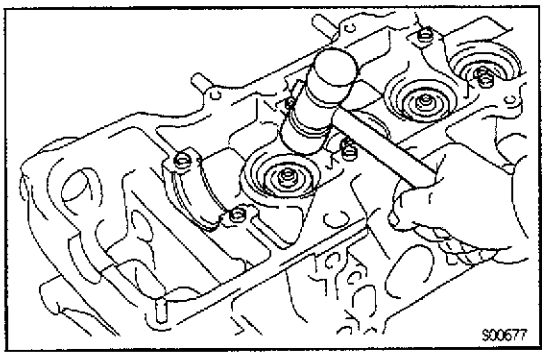


(b) Install these parts:
(1) Valve
(2) Spring seat
(3) Valve spring
HINT: Install the valve spring, facing the green painted mark outward.
(4) Spring retainer

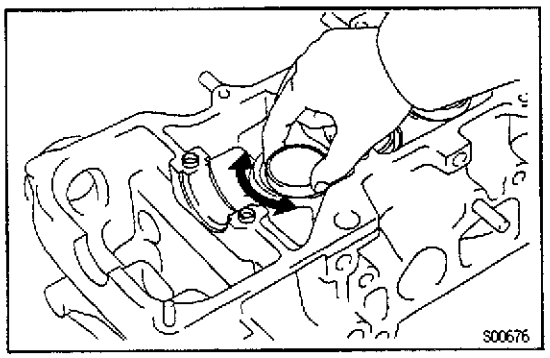
EG



(c) Using SST, compress the valve spring and place the 2 keepers around the valve stem.
SST 09202—70020 (09202—00030)



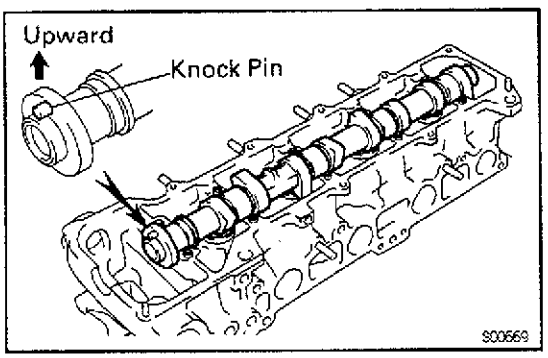
(d) Using a plastic—faced hammer, lightly tap the valve stem tip to assure a proper fit.



2. INSTALL ADJUSTING SHIMS AND VALVE LIFTERS

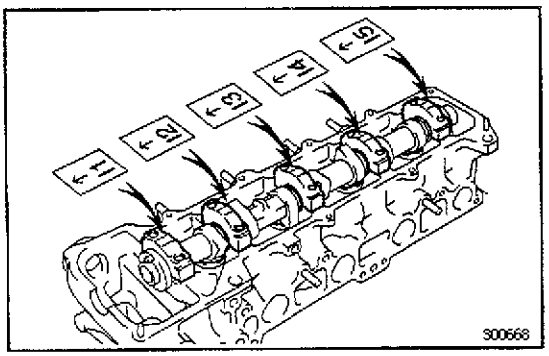
(a) Install the valve lifter and adjusting shim.

(b) Check that the valve lifter rotates smoothly by hand.

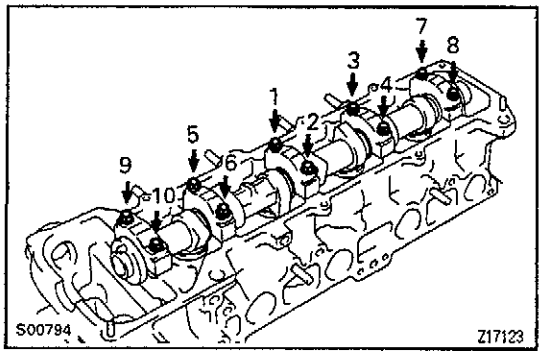


3. INSTALL CAMSHAFT

(a) Place the camshaft on the cylinder head, facing the knock pin upward.



(b) Install the bearing caps in their proper locations.
HINT: Each bearing cap has a number and front mark.



(c) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.

(d) Install and uniformly tighten the 10 bearing cap bolts in several passes, in the sequence shown.

Torque: 15 N·m (160 kgf·cm, 11 ft·lbf)

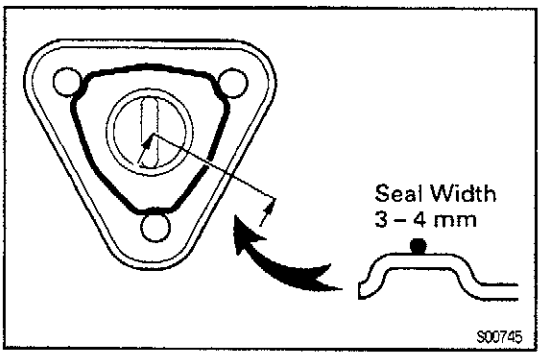
4. INSTALL PCV PIPE

Install the PCV pipe with the bolt.

5. INSTALL CYLINDER HEAD REAR PLATE

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the rear plate 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 rear plate as shown in the illustration.

Seal packing:

Part No. 08826–00100 or equivalent

- Install a nozzle that has been cut to a 3 – 4 mm (0.12 – 0.16 in.) opening.

HINT: Avoid applying an excessive amount to the surface.

- 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

(c) Install the rear plate with the 3 bolts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

6. INSTALL PLUG PLATE

Install a new gasket and the plug plate with the 2 bolts.

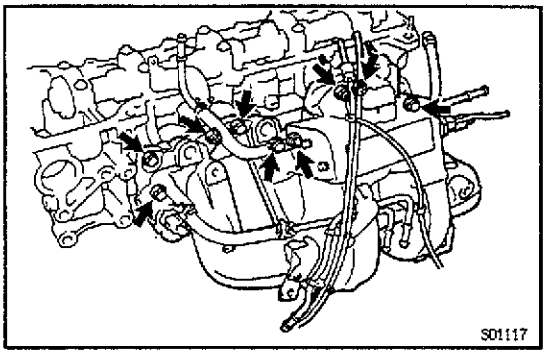
Torque: 20 N·m (200 kgf·cm, 15 ft·lbf)

7. INSTALL WATER OUTLET

Install a new gasket and the water outlet with the 3 bolts.

Torque: 20 N·m (200 kgf·cm, 15 ft·lbf)

EG



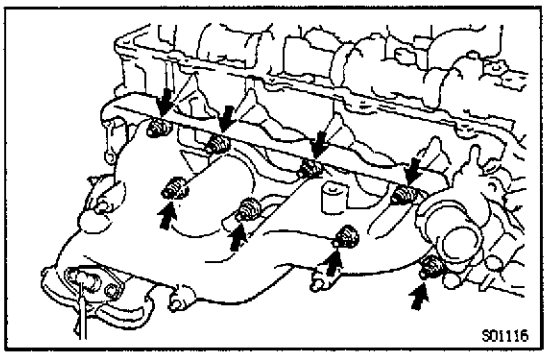
8. INSTALL INTAKE MANIFOLD

(a) Install a new gasket and the intake manifold with the 7 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.
Torque: 29 N·m (300 kgf·cm, 21 ft·lbf)

(b) Connect the PCV hose to the PCV pipe.

9. INSTALL INJECTORS AND DELIVERY PIPE ASSEMBLY
(See step 1 in injectors and delivery pipe assembly installation in EFI System)

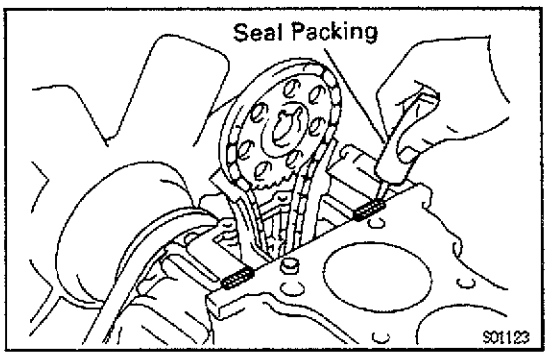
10. INSTALL THROTTLE BODY
(See steps 1 to 3 in throttle body installation in EFI System)

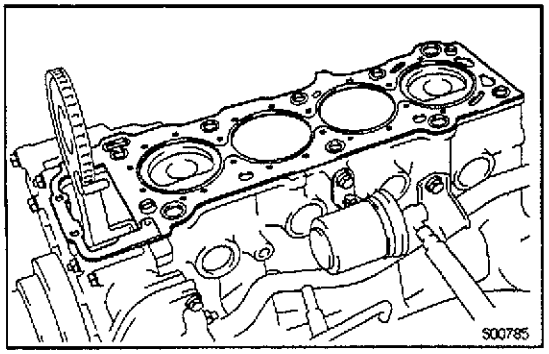


11. INSTALL EXHAUST MANIFOLD

(a) Install a new gasket and the exhaust manifold with 8 new nuts. Uniformly tighten the nuts in several passes.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

(b) Install the heat insulator with the bolt and 3 nuts.





CYLINDER HEAD ASSEMBLY INSTALLATION

1. INSTALL CYLINDER HEAD ASSEMBLY

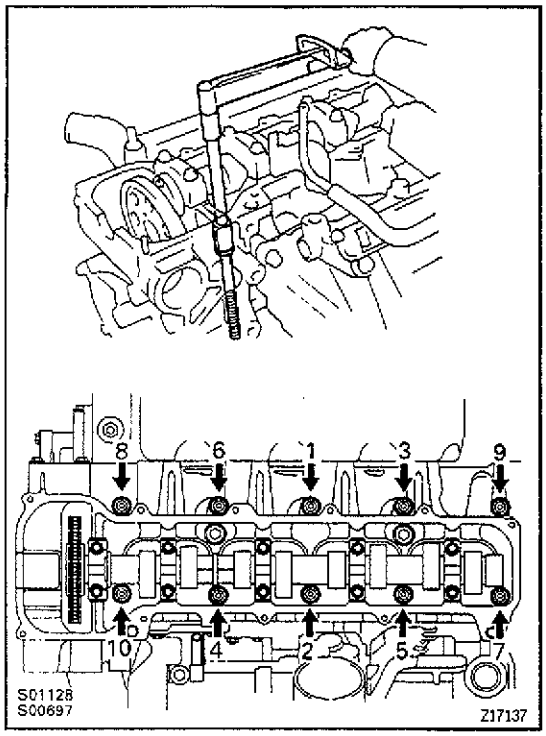
A. Place cylinder head on assembly cylinder block

(a) Remove the any old packing (FIPG) material.

(b) Apply seal packing to the positions as shown in the illustration.
Seal packing:
Part No. 08826—00080 or equivalent
NOTICE: Do not apply too much seal packing

(b) Place a new cylinder head gasket on the cylinder block.
NOTICE: Be careful of the installation direction.

(c) Place the cylinder head assembly on the cylinder head gasket.



B. Install cylinder head bolts (12 pointed head)

HINT:

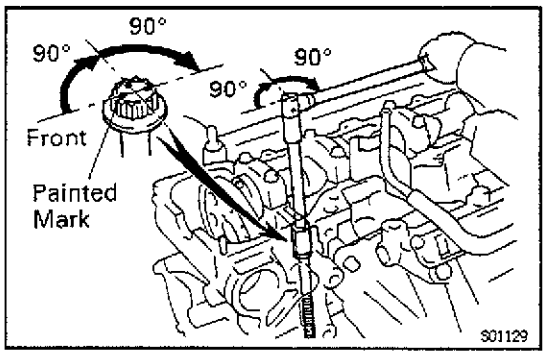
- The cylinder head bolts are tightened in 3 progressive steps (steps (b), (d) and (e)).
- If any cylinder head bolt is broken or deformed, replace it.

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

(b) Install and uniformly tighten the 14 cylinder head bolts and plate washers in several passes, in the sequence shown.

Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

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

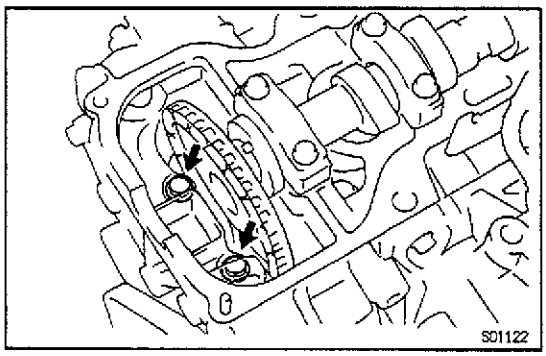


(c) Mark the front of the cylinder head bolt head with paint.

(d) Retighten the cylinder head bolts by 90° in the numerical order shown.

(e) Retighten the cylinder head bolts by an additional 90°.

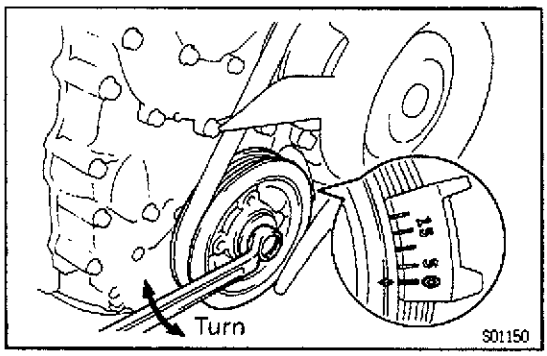
(f) Check that the painted mark is now facing rearward.



C. Install cylinder head bolts (6 pointed head)

Install the 2 cylinder head bolts.

Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)

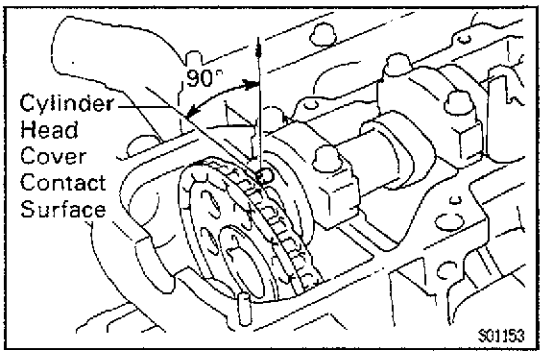


2. SET NO.1 CYLINDER TO TDC/COMPRESSION

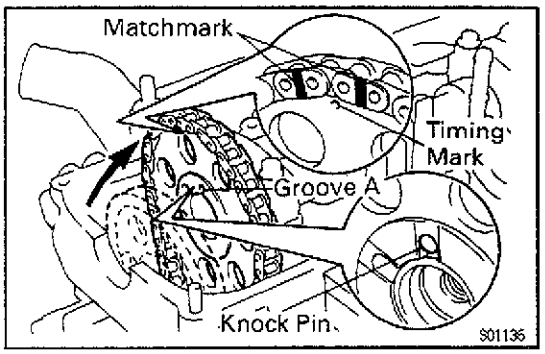
(a) Turn the crankshaft pulley, and align its groove with timing mark "0" of the timing chain cover.

EG

EG



(b) Check the knock pin position of the camshaft as shown in the illustration.

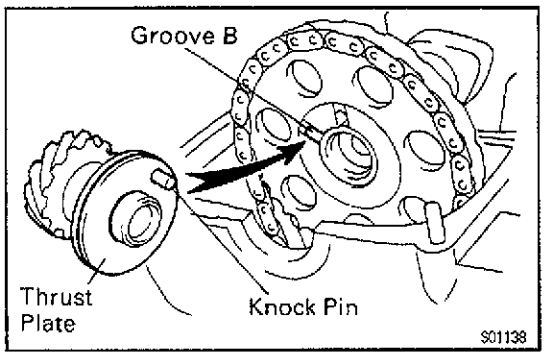


3. INSTALL CAMSHAFT TIMING GEAR AND TIMING CHAIN

HINT: Check that the matchmarks on the timing chain is aligned with the timing mark of the timing gear.

(a) Align knock pin groove A of the timing gear with the knock pin of the camshaft.

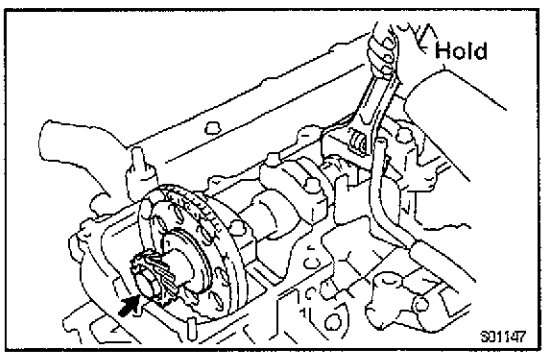
(b) Slide the timing gear on the camshaft.



(c) Install the thrust plate to the distributor gear.

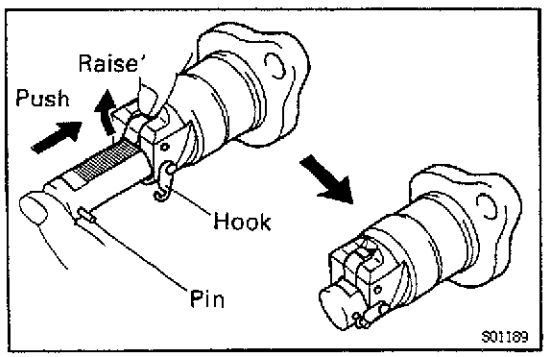
(d) Align the knock pin of the distributor gear with knock pin groove B of the camshaft gear.

(e) Temporarily install the bolt.



(f) Hold the hexagon wrench portion of the intake camshaft with a wrench, tighten the bolt.

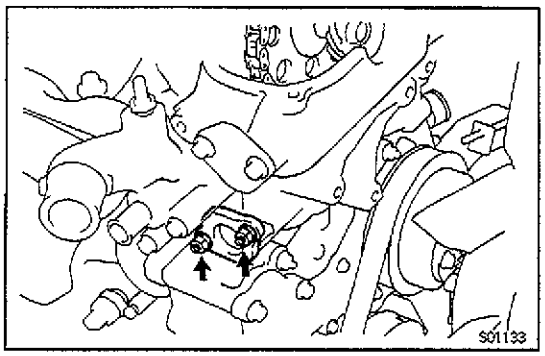
Torque: 73 N·m (750 kgf·cm, 54 ft·lbf)



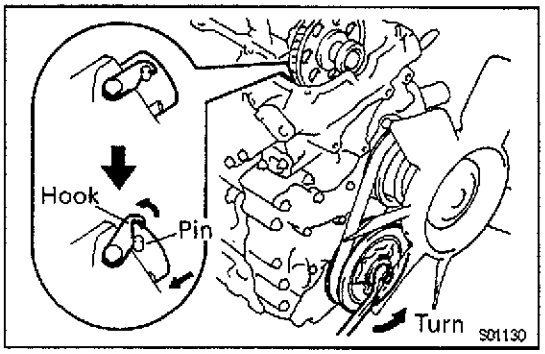
4. INSTALL CHAIN TENSIONER

(a) Check the chain tensioner.
(See step 3 in timing chain components inspection)

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

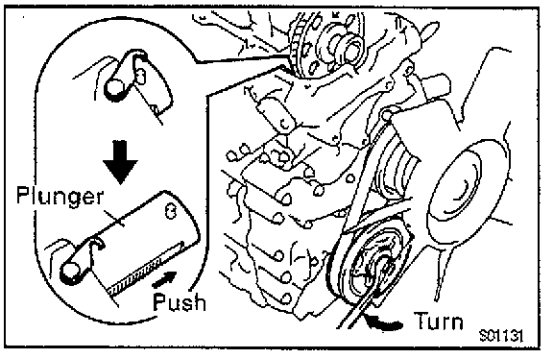


(c) Install the chain tensioner with a new gasket and the 2 nuts.
Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)
NOTICE: If the plunger springs out during installation of the chain tensioner, repeat the operation in 6. (a) on the previous page before installation the tensioner.

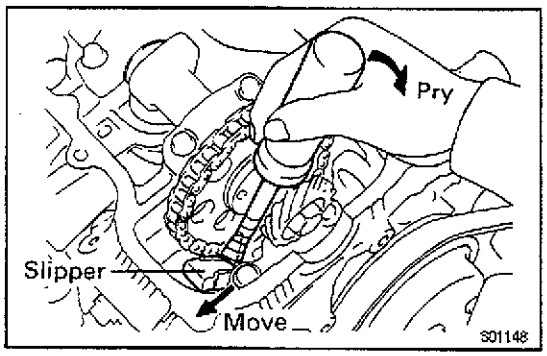


5. SET CHAIN TENSION

(a) Turn the crankshaft counterclockwise, and disconnect the plunger knock pin from the hook.



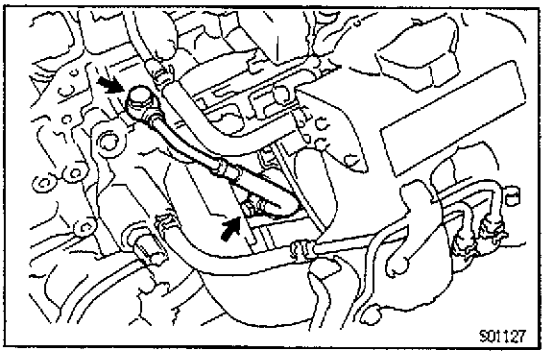
(b) Turn the crankshaft clockwise, and check that the slipper is pushed by the plunger.



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 from the knock pin and the plunger springs out.

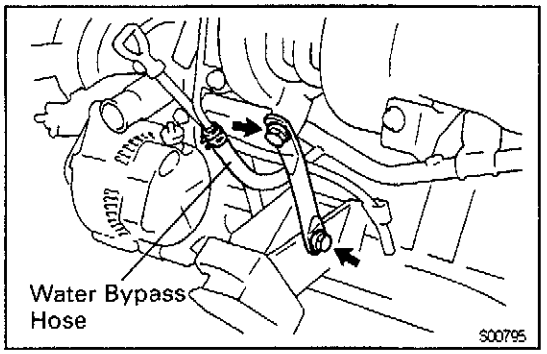
6. CHECK AND ADJUST VALVE CLEARANCE
(See steps 2 to 4 in valve clearance inspection and adjustment)

7. INSTALL SPARK PLUGS



8. CONNECT FUEL INLET PIPE
Install the fuel inlet pipe to the fuel filter with 4 new gaskets and the 2 union bolts.
Torque: 29.5 N·m (300 kgf·cm, 22 ft·lbf)

9. CONNECT ENGINE WIRE
Connect these connectors:
- Water temperature sensor connector
- Throttle position sensor connector
- 4 injector connectors



- Engine wire clamp to bracket on intake manifold

10. INSTALL INTAKE MANIFOLD STAY

Install the intake manifold stay with the 2 bolts.

Torque: 37 N·m (380 kgf·cm, 27 ft·lbf)

11. CONNECT WATER BYPASS HOSE TO NO.2 WATER BYPASS PIPE

12. INSTALL VSV FOR EVAP

(See components for removal and installation in EFI System)

13. INSTALL DISTRIBUTOR

(See distributor installation in Ignition System)

14. INSTALL SEMI–CIRCULAR PLUG

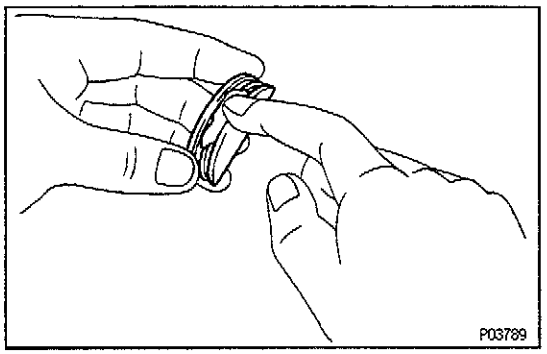
(a) Remove any old packing (FIPG) material.

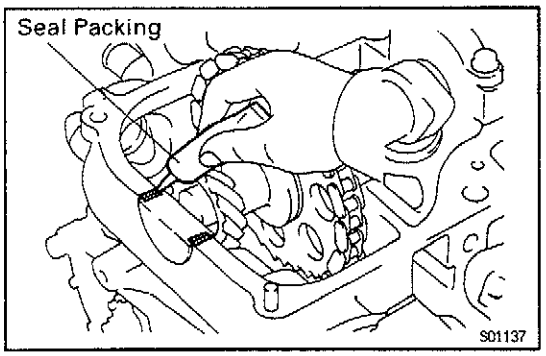
(b) Apply seal packing to the cylinder head installation surface of the semi–circular plug.

Seal packing:

Part No. 08826–00080 or equivalent

(c) Install the semi–circular plug to the cylinder head.





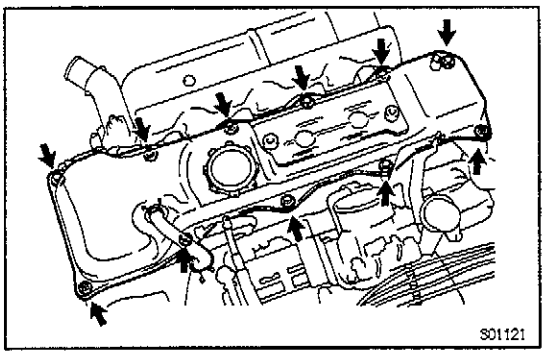
15. INSTALL CYLINDER HEAD COVER

(a) Remove any old packing (FIPG) material.

(b) Apply seal packing to the positions as shown in the illustration.

Seal packing:

Part No. 08826–00080 or equivalent



(c) Install the gasket to the cylinder head cover.

(d) Install the cylinder head cover with the 9 bolts and 2 nuts.

Torque: 5.0 N·m (55 kgf·cm, 44 in.·lbf)

16. CONNECT HIGH–TENSION CORDS TO SPARK PLUGS

17. FILL WITH ENGINE COOLANT

18. START ENGINE AND CHECK FOR LEAKS

19. ADJUST IGNITION TIMING

(See ignition timing inspection and adjustment)

20. RECHECK ENGINE COOLANT LEVEL