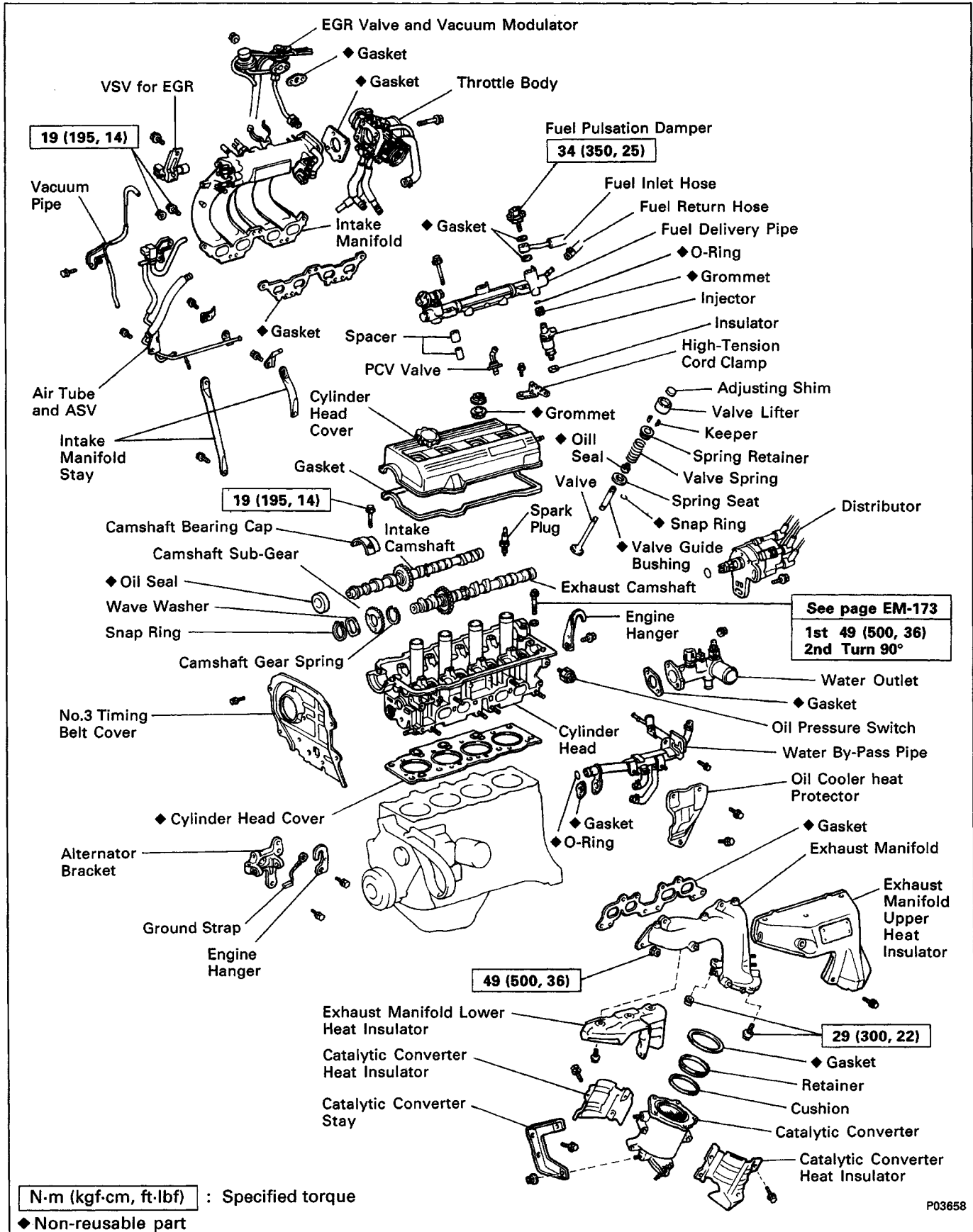


CYLINDER HEAD (5S-FE) COMPONENTS



REMOVAL OF CYLINDER HEAD

(See page [EM-150](#))

1. DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY

CAUTION: Work must be started after approx. 20 seconds or longer from the time the ignition switch is turned to the "LOCK" position and the negative (-) terminal cable is disconnected from the battery.

2. DRAIN ENGINE COOLANT (See page [CO-6](#))

3. (A/T)

.DISCONNECT THROTTLE CABLE FROM THROTTLE BODY

4. DISCONNECT ACCELERATOR CABLE FROM THROTTLE BODY

5. (w/ CRUISE CONTROL SYSTEM)

REMOVE CRUISE CONTROL ACTUATOR

(See step 11 on page [EM-270](#))

6. REMOVE AIR CLEANER CAP

(See step 6 on page [EM-269](#))

7. REMOVE ALTERNATOR (See page [CH-9](#))

8. REMOVE DISTRIBUTOR (See page [IG-30](#))

9. REMOVE ENGINE UNDER COVERS

10. REMOVE SUSPENSION LOWER CROSSMEMBER

(See step 28 on page [EM-274](#))

11. REMOVE FRONT EXHAUST PIPE

(See step 29 on page [EM-274](#))

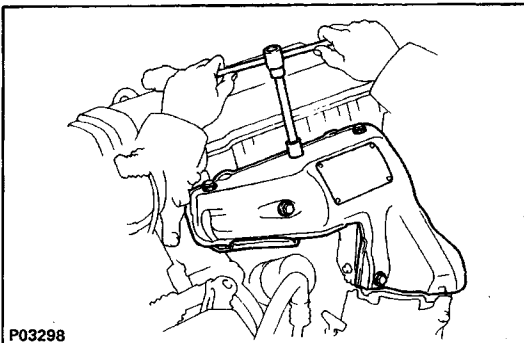
12. REMOVE OXYGEN SENSOR (MAIN)

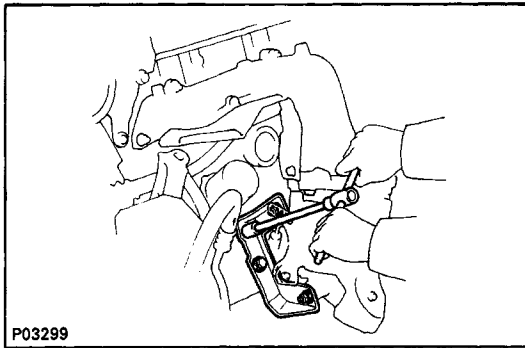
13. (CALIF. ONLY)

REMOVE SUB-OXYGEN SENSOR

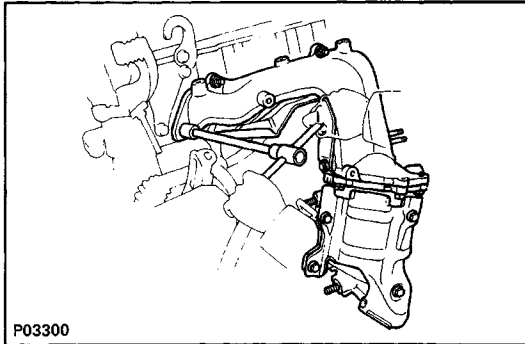
14. REMOVE EXHAUST MANIFOLD AND CATALYTIC CONVERTER ASSEMBLY

(a) Remove the six bolts and manifold upper heat insulator.

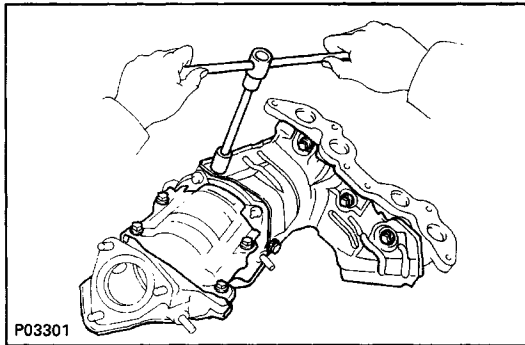




- (b) Remove the two bolts, two nuts and catalytic converter stay.

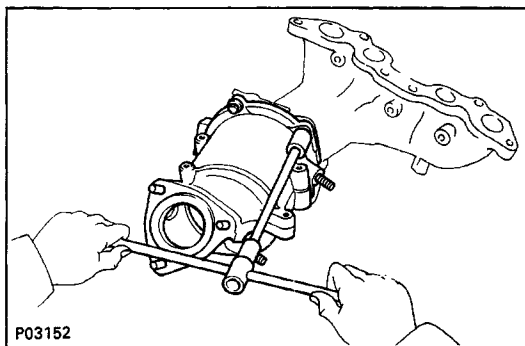


- (c) Remove the six nuts, the exhaust manifold and catalytic converter assembly.

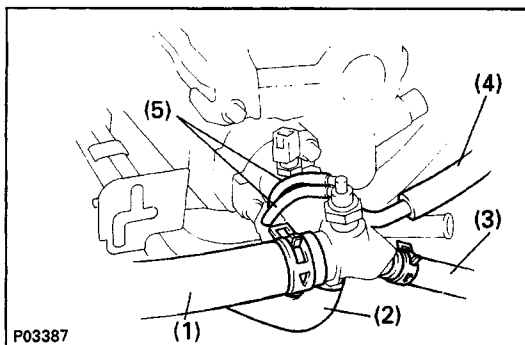


15. SEPARATE EXHAUST MANIFOLD AND CATALYTIC CONVERTER

- (a) Remove the five bolts and lower manifold heat insulator.
 (b) Remove the eight bolts and two catalytic converter heat insulator.

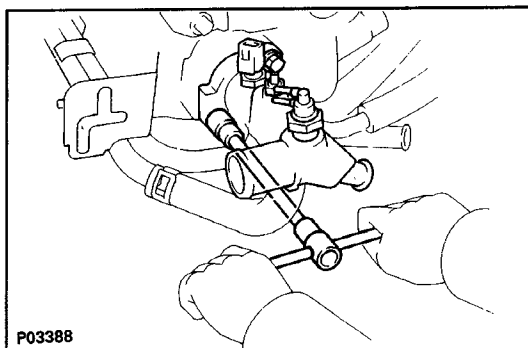


- (c) Remove the three bolts, two nuts, catalytic converter, gasket, retainer and cushion.

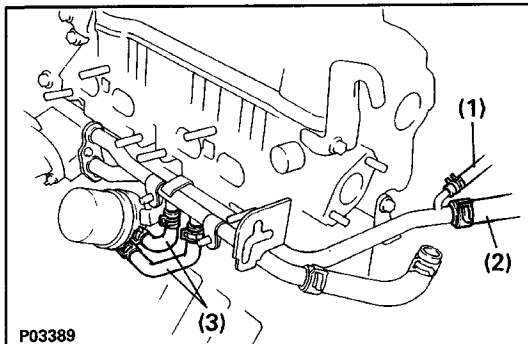


16. REMOVE WATER OUTLET

- (a) Disconnect the following connectors:
- Water temperature sender gauge connector
 - Water temperature sensor connector
- (b) Disconnect the following hoses:
- (1) Upper radiator hose
 - (2) Water by-pass pipe hose
 - (3) Heater water hose
 - (4) ISC water by-pass hose
 - (5) Two EVAP BVSV vacuum hoses

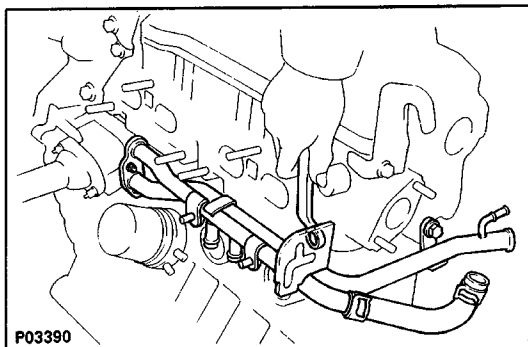


(c) Remove the two bolts, water outlet and gasket.



17. REMOVE WATER BY-PASS PIPE

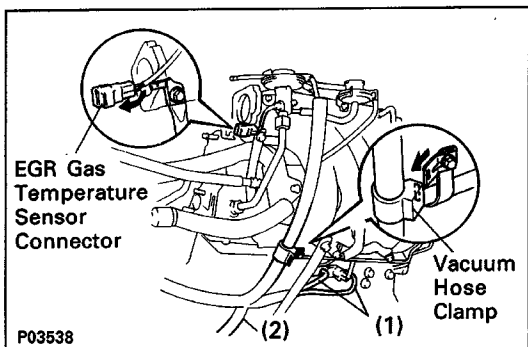
- (a) (w/ Oil Cooler)
Remove the water by-pass hose heat protector.
(See step 8 on page [LU-29](#))
- (b) Disconnect the following hoses:
- (1) ISC water by-pass hose
 - (2) Heater water hose
 - (3) (w/ Oil Cooler)
Two oil cooler water by-pass hoses



- (c) Remove the two bolts, two nuts, water by-pass pipe and gasket.
- (d) Remove the O-ring from the water by-pass hose.

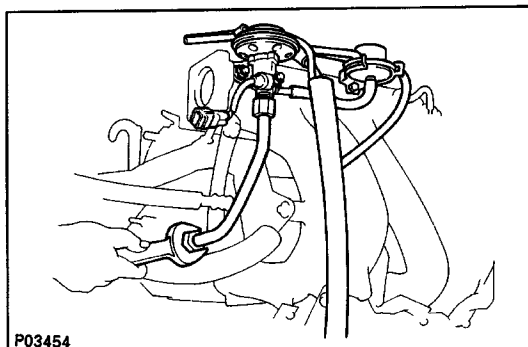
18. REMOVE THROTTLE BODY

(See steps 6 to 9 on pages [FI-201](#) and [202](#))

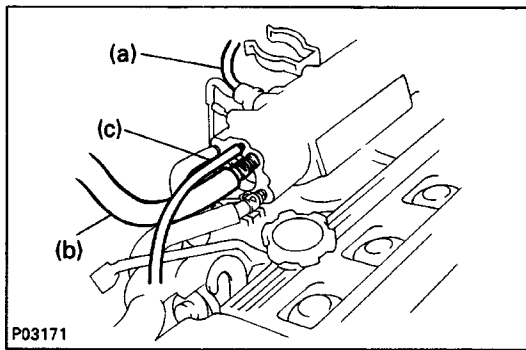


19. REMOVE EGR VALVE AND VACUUM MODULATOR

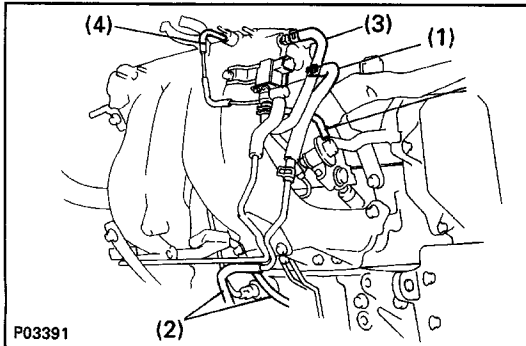
- (a) (CALIF. only)
Disconnect EGR gas temperature sensor connector, and disconnect the connector from the bracket.
- (b) Remove the following hoses:
- (1) Two vacuum hoses from EGR VSV
 - (2) Vacuum hose from charcoal canister
- (c) Disconnect the vacuum hose clamp from the bracket.



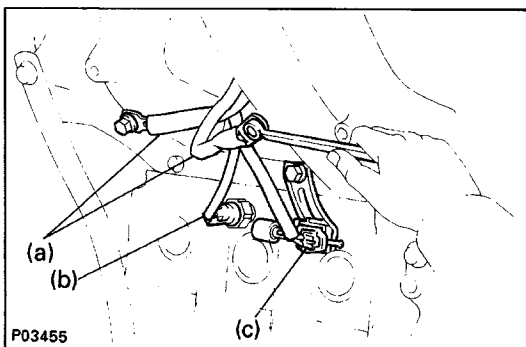
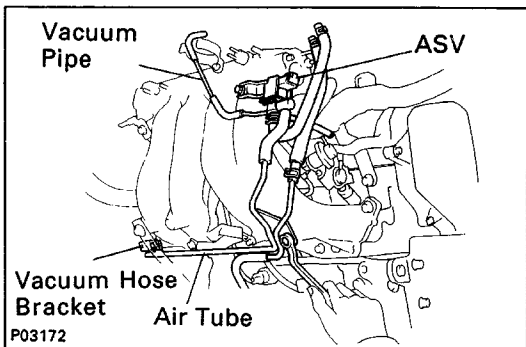
- (d) Loosen the union nut of the EGR pipe, and remove two nuts the EGR valve, vacuum modulator, vacuum hoses assembly and gasket.

**20. DISCONNECT VACUUM HOSES**

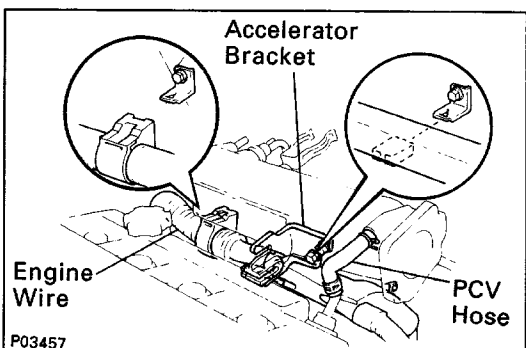
- (a) Vacuum sensor hose from gas filter
- (b) Brake booster vacuum hose from intake manifold
- (c) (w/ Cruise Control System (w/o ABS))
Actuator vacuum hose from intake manifold

**21. REMOVE AIR TUBE, ASV (FOR A/C) AND VACUUM PIPE**

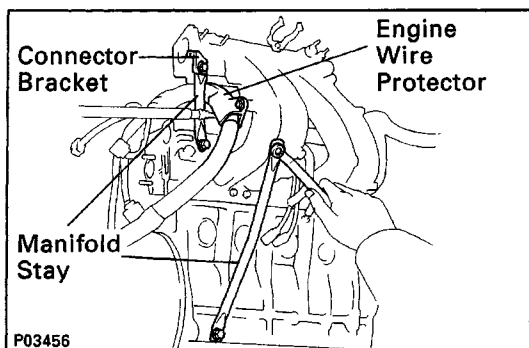
- (a) (w/ A/C)
Disconnect the ASV connector.
- (b) Disconnect the following hoses:
 - (1) PS air hose from intake manifold
 - (2) Two air hoses from air tube
 - (3) (w/ A/C)
Air- hose from intake manifold
 - (4) Vacuum hose from gas filter
 - (5) Vacuum hose from fuel pressure regulator
- (c) Remove the four bolts, vacuum hose bracket, the air tube and ASV assembly.
- (d) Remove the bolt and vacuum pipe.

**22. DISCONNECT ENGINE WIRE GROUND STRAPS AND CONNECTORS**

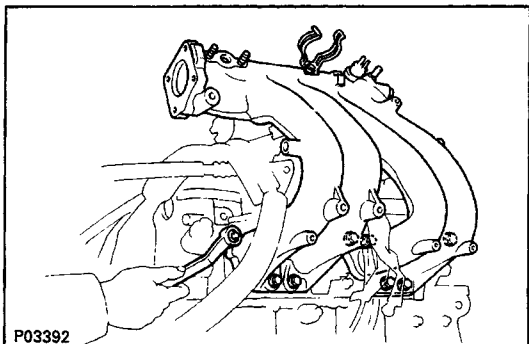
- (a) Two engine ground straps from intake manifold
- (b) Knock sensor connector
- (c) VSV connector for EGR

23. REMOVE VSV FOR EGR**24. REMOVE ACCELERATOR BRACKET****25. REMOVE INTAKE MANIFOLD**

- (a) Disconnect the PCV hose from the PCV valve.
- (b) Disconnect the two wire clamps from the wire brackets.



- (c) Remove the bolt, and disconnect the engine wire protector from the intake manifold.
- (d) Remove the four bolts, connector bracket (CALIF. only) and two manifold stays.



- (e) Remove the six bolts, two nuts, intake manifold and gasket.

26. REMOVE DELIVERY PIPE AND INJECTORS

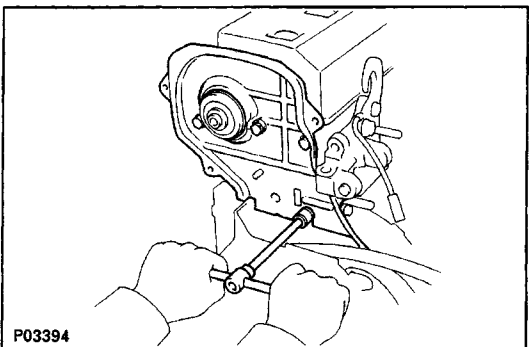
(See steps 16 and 17 on page [FI-173](#))

27. REMOVE CAMSHAFT TIMING PULLEY

(See steps 2 and 6 to 17 on pages [EM-67](#) to 70)

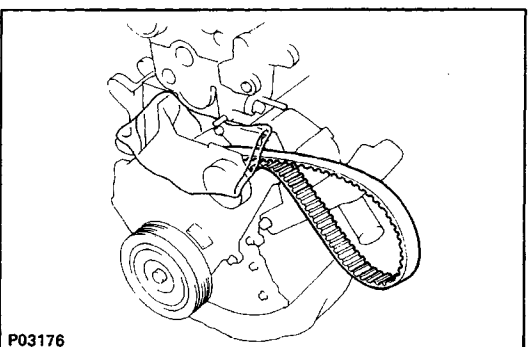
28. REMOVE NO.1 IDLER PULLEY AND TENSION SPRING

(See step 23 on page [EM-72](#))



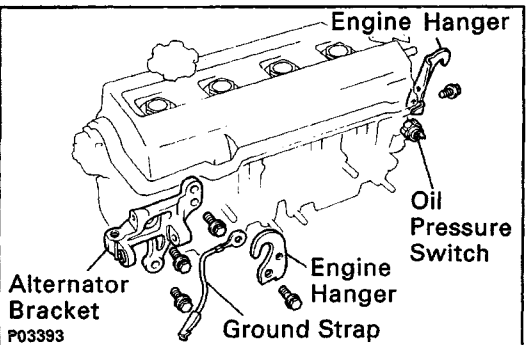
29. REMOVE NO.3 TIMING BELT COVER

Remove the four bolts and timing belt cover.



NOTICE:

- Support the timing belt, so the meshing of the crankshaft timing pulley and timing belt does not shift.
- Be careful not to drop anything inside the timing belt cover.
- Do not allow the belt to come into contact with oil, water or dust.



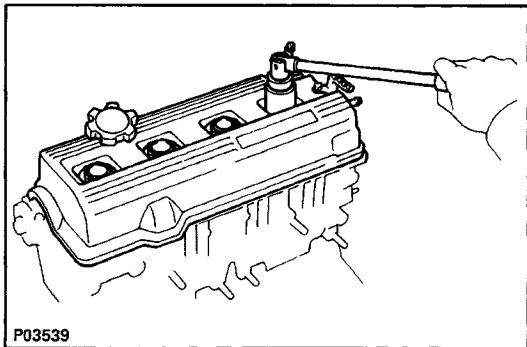
30. REMOVE ENGINE HANGERS

Remove the bolt and engine hanger. Remove the two engine hangers. Remove the ground strap.

31. REMOVE ALTERNATOR BRACKET

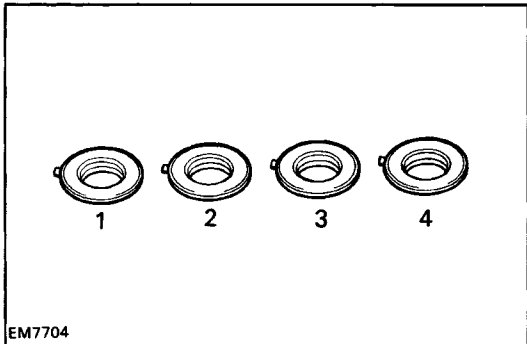
Remove the three bolts and alternator bracket.

32. REMOVE OIL PRESSURE SWITCH

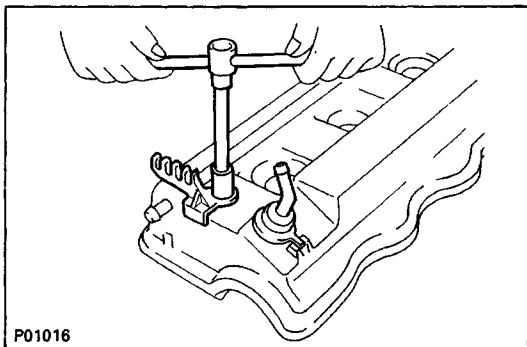


33. REMOVE CYLINDER HEAD COVER

Remove the four nuts, grommets, head cover and gasket.



HINT: Arrange the grommets in correct order, so that they can be reinstalled into their original positions. This minimizes any possibility of oil leakage due to reuse of grommets.



34. REMOVE HIGH-TENSION CORD CLAMP AND PCV VALVE FROM CYLINDER HEAD COVER

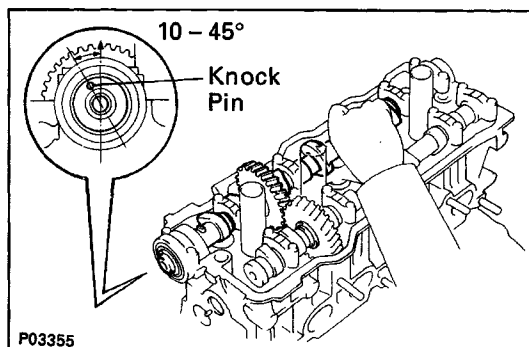
35. REMOVE CAMSHAFTS

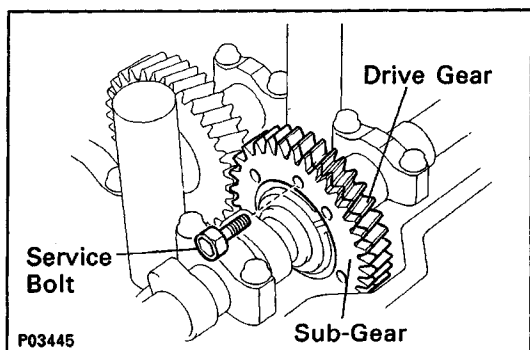
NOTICE: Since the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head receiving the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

A. Remove exhaust camshaft

(a) Set the knock pin of the intake camshaft at 10 –45° BTDC of camshaft angle.

HINT: The above angle allows No.2 and No.4 cylinder cam lobes of the exhaust camshaft to push their valve lifters evenly.





- (b) Secure the exhaust camshaft sub-gear to drive gear with a service bolt.

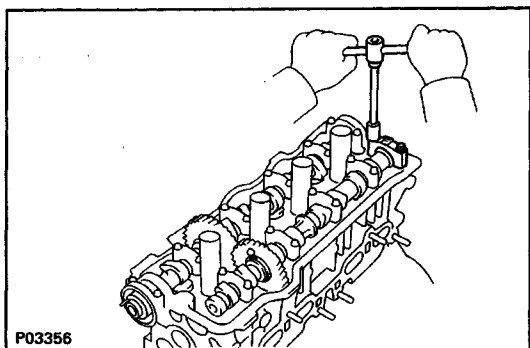
Recommended service bolt:

Thread diameter 6 mm

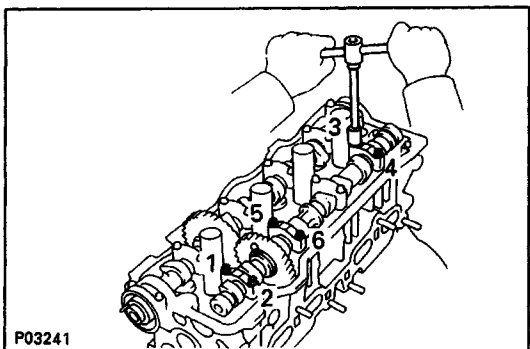
Thread pitch 1.0 mm

Bolt length 16 – 20 mm (0.63 – 0.79 in.)

HINT: When removing the camshaft, make sure that the torsional spring force of the sub-gear has been eliminated by the above operation.



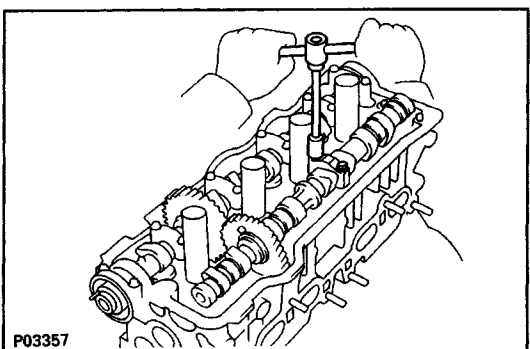
- (c) Remove the two bolts and rear bearing cap.



- (d) Uniformly loosen and remove the six bolts on the No.1, No.2 and No.4 bearing caps in several passes in the sequence shown.

NOTICE: Do not remove the No.3 bearing cap bolts at this stage.

- (e) Remove the No.1, No.2 and No.4 bearing caps.



- (f) Alternately loosen and remove the two bolts on the No.3 bearing cap.

HINT:

- As the two No.3 bearing cap bolts are loosened, make sure that the camshaft is lifted out straight and level.
- If the camshaft is not being lifted out straight and level, retighten the two No.3 bearing cap bolts. Then reverse the order of above steps from (f) to (a) and reset the knock pin of the intake camshaft at 10 – 45° BTDC, and repeat steps from (b) to (f) once again.

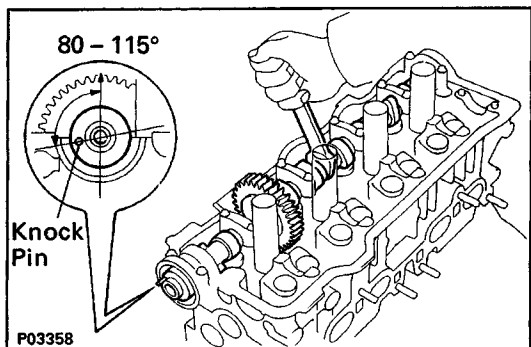
NOTICE: Do not pry on or attempt to force the camshaft with a tool or other object.

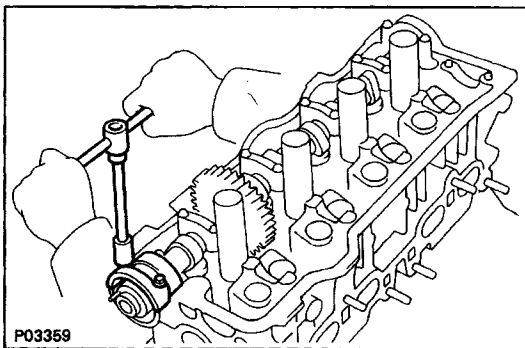
- (g) Remove the No.3 bearing cap and exhaust camshaft.

B. Remove intake camshaft

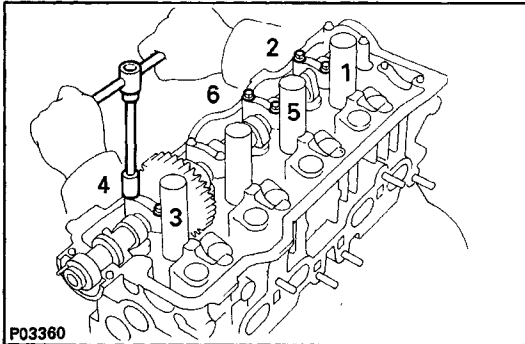
- (a) Set the knock pin of the intake camshaft at 80 – 115° BTDC of camshaft angle.

HINT: The above angle allows the No.1 and No.3 cylinder cam lobes of intake camshaft to push their valve lifters evenly.





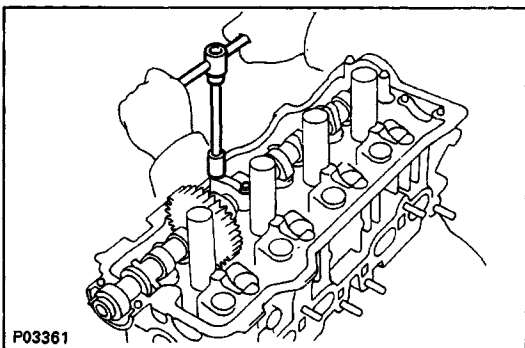
(b) Remove the two bolts, front bearing cap and oil seal.



(c) Uniformly loosen and remove the bolts on the No.1, No.3 and No.4 bearing caps in several passes in the sequence shown.

NOTICE: Do not remove the No.2 bearing cap bolts at this stage.

(d) Remove the No.1, No.3 and No.4 bearing caps.



(e) Alternately loosen and remove the two bolts on the No.2 bearing cap.

HINT:

- As the two No.2 bearing cap bolts are loosened, make sure that the camshaft is lifted out straight and level, after breaking adhesion on the front bearing cap.
- If the camshaft is not being lifted out straight and level, retighten the two No.2 bearing cap bolts. Reverse the order of above steps from (e) to (a) and reset the knock pin of the intake camshaft at 80 – 115° BTDC, and repeat steps from (b) to (e) once again.

NOTICE: Do not pry on or attempt to force the camshaft with a tool or other object.

(f) Remove the No.2 bearing cap and camshaft.

36. DISASSEMBLE EXHAUST CAMSHAFT

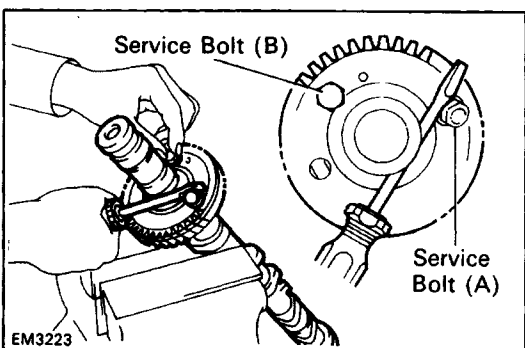
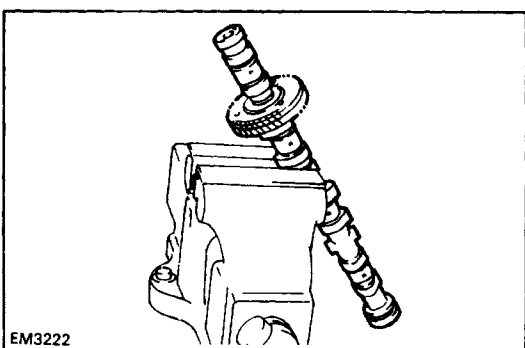
(a) Mount the hexagon wrench head portion of the camshaft in a vise.

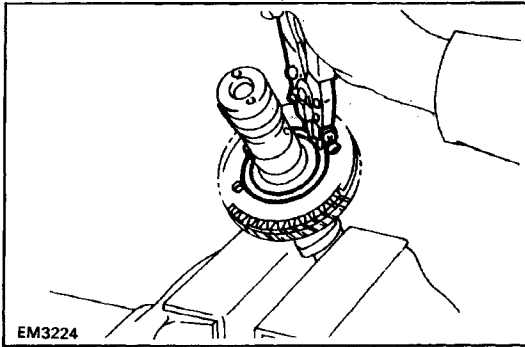
NOTICE: Be careful not to damage the camshaft.

(b) Insert a service bolt (A) into the service hole of the camshaft sub-gear.

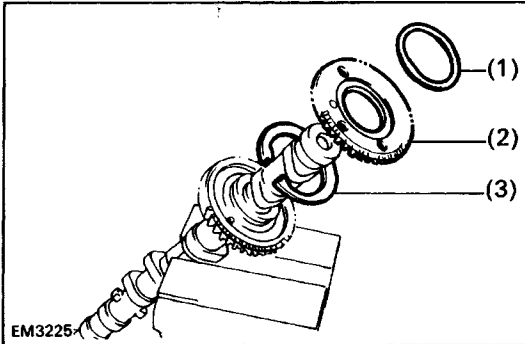
(c) Using a screwdriver, turn the sub-gear clockwise, and remove the service bolt (B).

NOTICE: Be careful not to damage the camshaft.



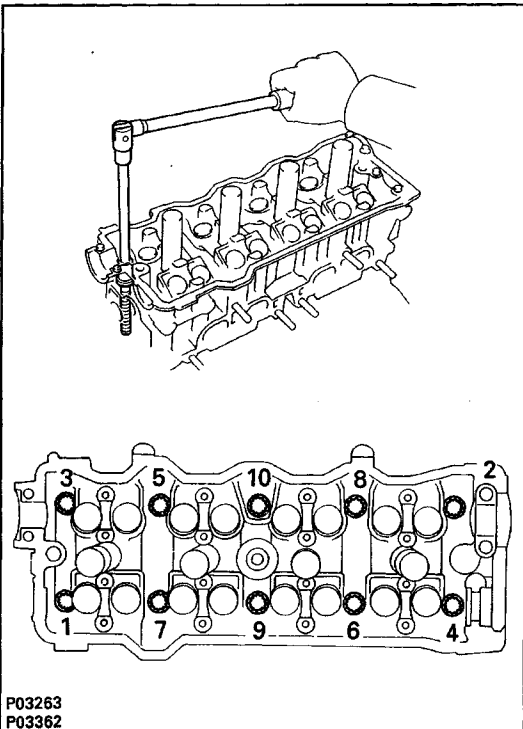


(d) Using snap ring pliers, remove the snap ring.



(e) Remove the following parts:

- (1) Wave washer
- (2) Camshaft sub-gear
- (3) Camshaft gear spring

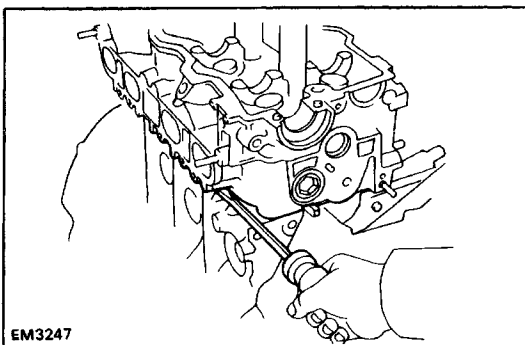


37. REMOVE CYLINDER HEAD

(a) Uniformly loosen and remove the ten cylinder head bolts in several passes in the sequence shown.

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

(b) Remove the ten plate washers.



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

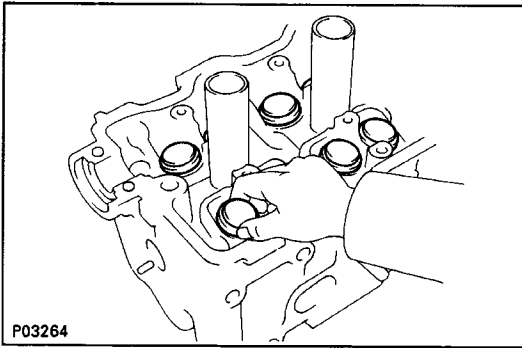
HINT: If the cylinder head is off, pry between the cylinder head and cylinder block with a screwdriver.

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

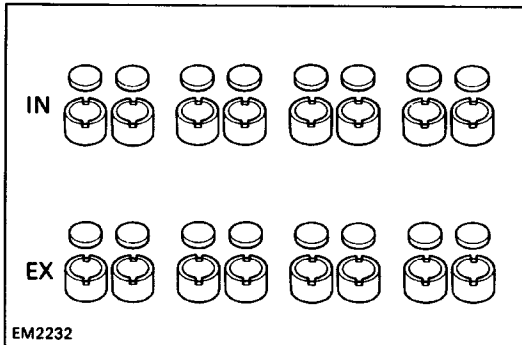
DISASSEMBLY OF CYLINDER HEAD

(See page [EM-150](#))

1. REMOVE VALVE LIFTERS AND SHIMS



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

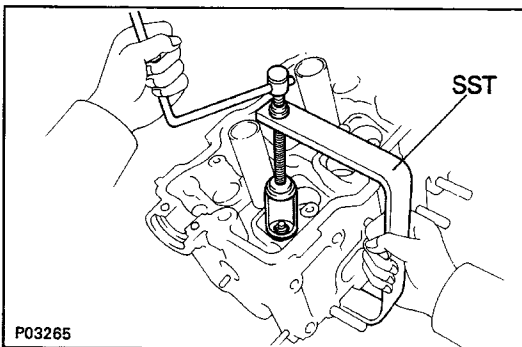


2. REMOVE VALVES

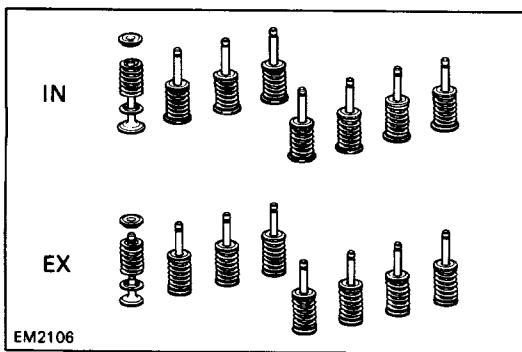
(a) Using SST, compress the valve spring and remove the two keepers.

SST 09202-70010

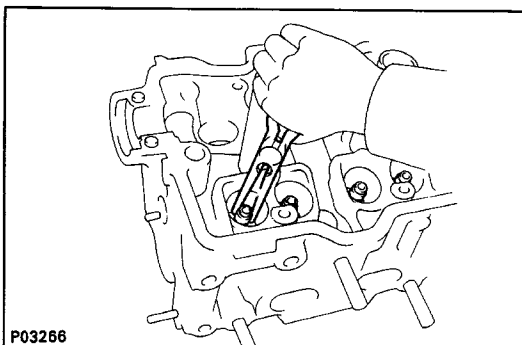
(b) Remove the spring retainer, valve spring, valve and spring seat.

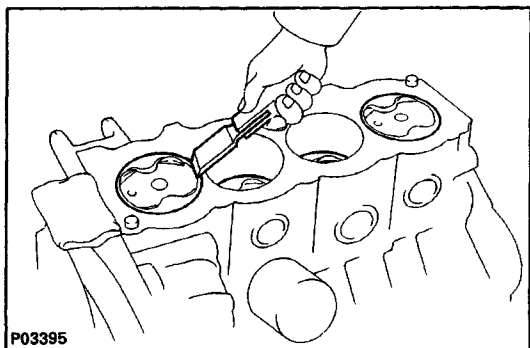


HINT: Arrange the valves, valve springs, spring seats and spring retainers in correct order.



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



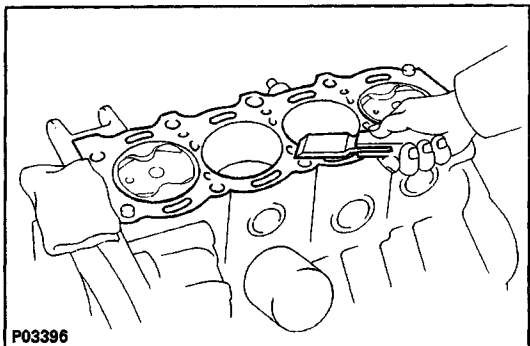


P03395

INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

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.

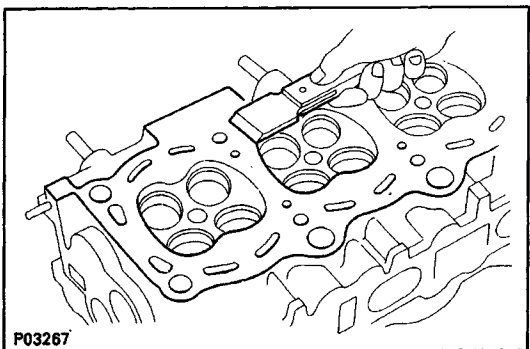


P03396

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

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

CAUTION: Protect your eyes when using high-compressed air.



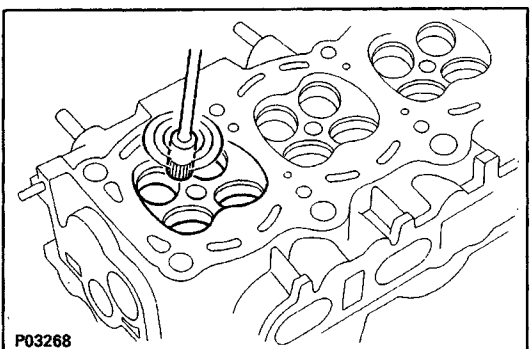
P03267

2. CLEAN CYLINDER HEAD

A. Remove gasket material

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

NOTICE: Be careful not to scratch the cylinder block contact surface.

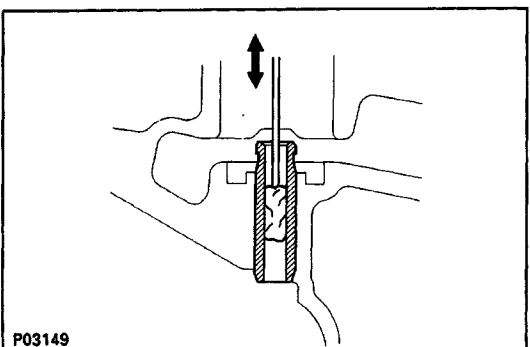


P03268

B. Clean combustion chambers

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

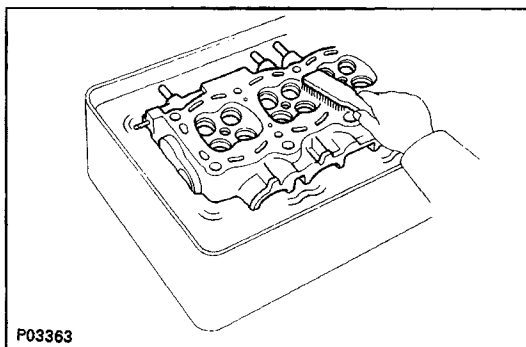
NOTICE: Be careful not to scratch the cylinder block contact surface.



P03149

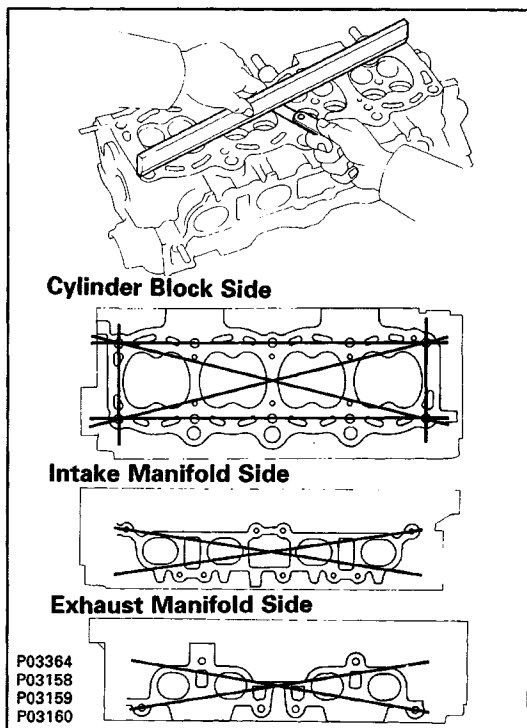
C. Clean valve guide bushings

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

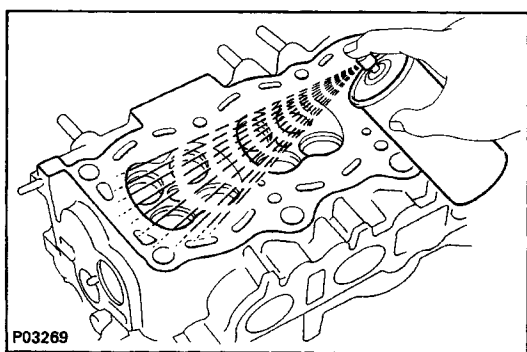
Using precision straight edge and feeler gauge, measure the surfaces contacting the cylinder block and manifold for warpage.

Maximum warpage:

Cylinder block side 0.05 mm (0.0020 in.)

Manifold side 0.08 mm (0.0031 in.)

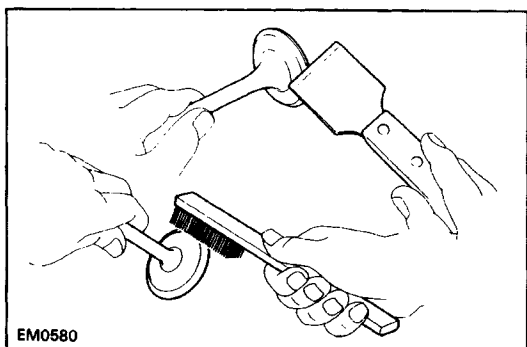
If warpage is greater than maximum, replace the cylinder head.



B. Inspect for cracks

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

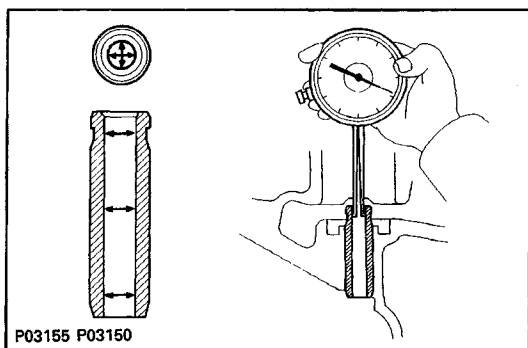
If cracked, replace the cylinder head.



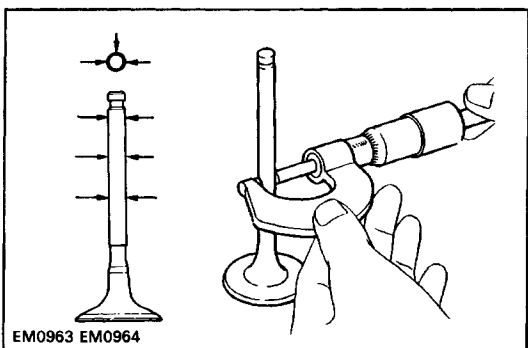
4. CLEAN VALVES

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

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



P03155 P03150



EM0963 EM0964

5. INSPECT VALVE STEMS AND GUIDE BUSHINGS

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

Bushing inside diameter:

6.010 – 6.030 mm (0.2366 – 0.2374 in.)

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

Valve stem diameter:

**Intake 5.970 – 5.985 mm
(0.2350 – 0.2356 in.)**

**Exhaust 5.965 – 5.980 mm
(0.2348 – 0.2354 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.)**

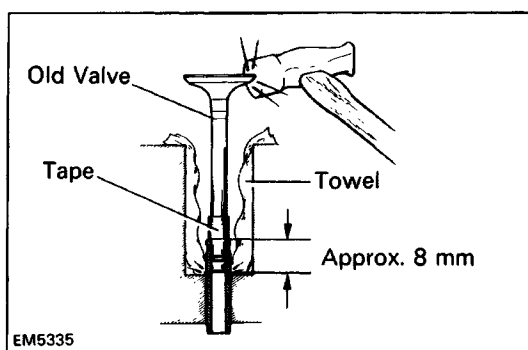
**Exhaust 0.030 – 0.065 mm
(0.0012 – 0.0026 in.)**

Maximum oil clearance:

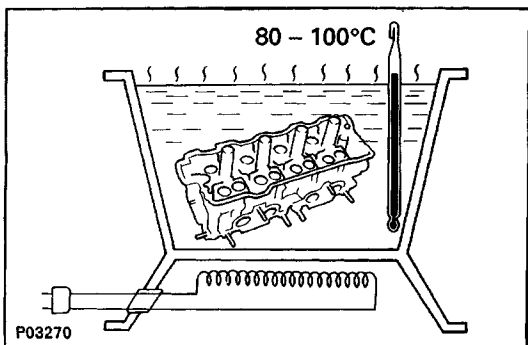
Intake 0.08 mm (0.0031 in.)

Exhaust 0.10 mm (0.0039 in.)

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



EM5335



P03270

6. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

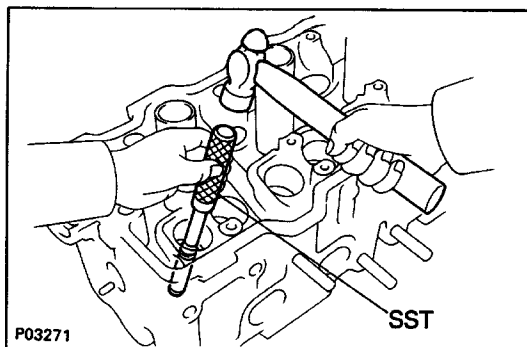
- (a) (Exhaust (w/ Snap Ring))

Insert an old valve wrapped with tape into the valve guide bushing, and break off the valve guide bushing by hitting it with a hammer. Remove the snap ring.

HINT: Wrap the tape approx. 8 mm (0.31 in.) from the valve stem end.

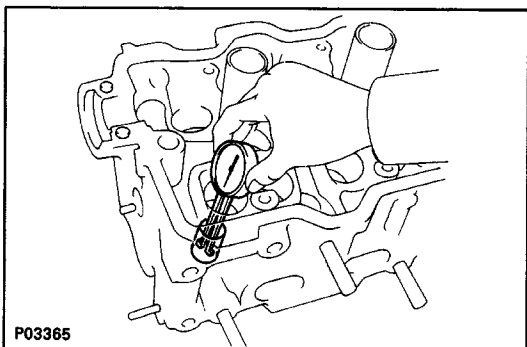
NOTICE: Be careful not to damage the valve lifter hole.

- (b) Gradually heat the cylinder head to 80–100°C (176–212°F).



(c) Using SST and a hammer, tap out the guide bushing.

SST 09201-70010



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

Both intake and exhaust

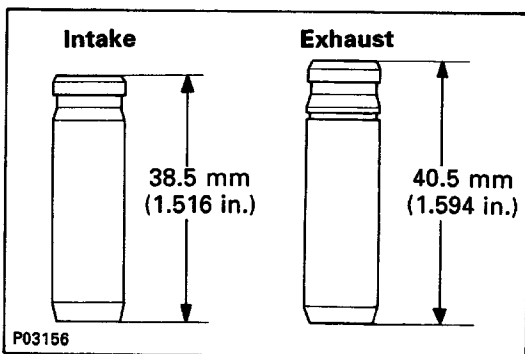
Bushing bore diameter mm (in.)	Bushing size
10.985 - 11.012 (0.4325 - 0.4335)	Use STD
11.035 - 11.062 (0.4344 - 0.4355)	Use O/S 0.05

(e) Select a new guide bushing (STD or O/S 0.05).

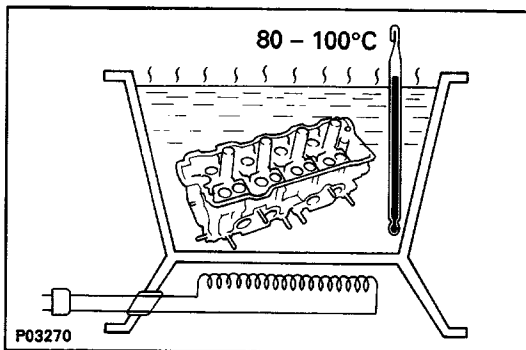
If the bushing bore diameter of the cylinder head is greater than 11.012 mm (0.04335 in.), machine the bushing bore to the following dimension:

11.035 - 11.062 mm (0.4344 - 0.4355 in.)

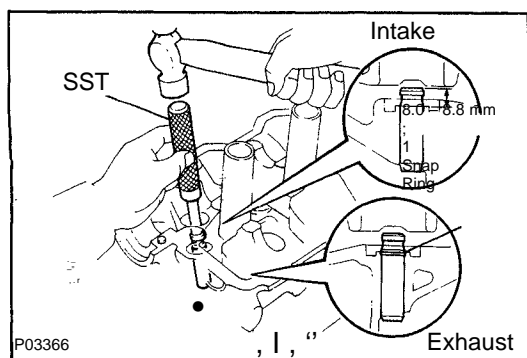
If the bushing bore diameter of the cylinder head is greater than 11.062 mm (0.4355 in.), replace the cylinder head.



HINT: Different the bushings are used for the intake and exhaust.



(f) Gradually heat the cylinder head to 80-100°C (176- 212°F).



(g) (Intake)

Using SST and a hammer, tap in a new guide bushing until there is 8.0 – 8.8 mm (0.315 – 0.346 in.) protruding from the cylinder head.

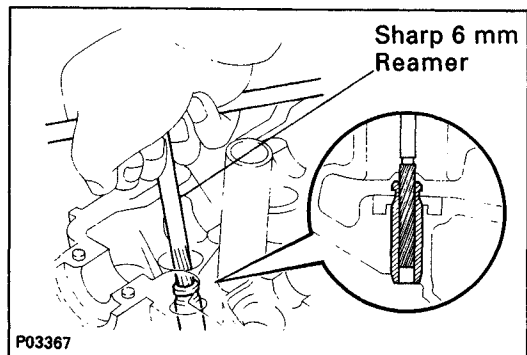
SST 09201-70010

(h) (Exhaust)

Using SST and a hammer, tap in a new guide bushing until the snap ring makes contact with the cylinder head.

SST 09201-70010

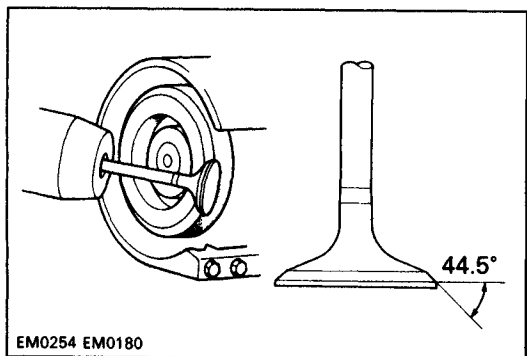
(h) Using a sharp 6 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page [EM-163](#)) between the guide bushing and valve stem.



7. INSPECT AND GRIND VALVES

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

Valve face angle: 44.5°



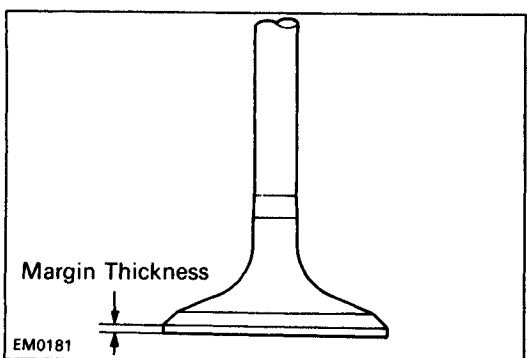
- Check the valve head margin thickness.

Standard margin thickness: 0.8 – 1.2 mm

(0.031 – 0.047 in.)

Minimum margin thickness: 0.5 mm (0.020 in.)

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



- Check the valve overall length.

Standard overall length:

Intake 97.60 mm (3.8425 in.)

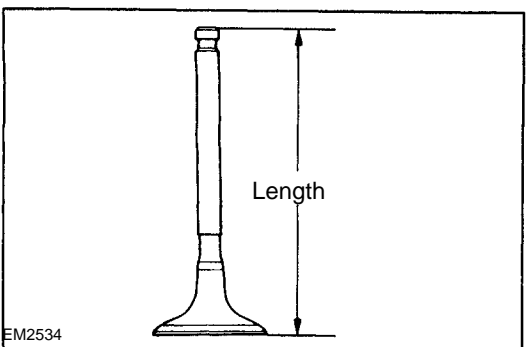
Exhaust 98.45 mm (3.8760 in.)

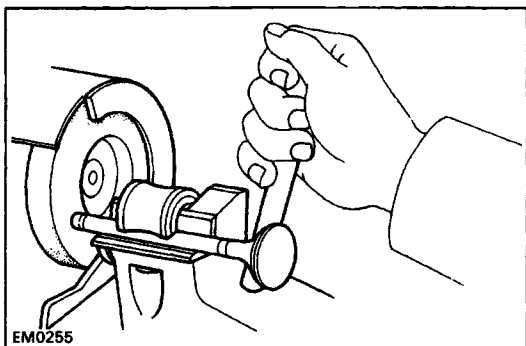
Minimum overall length:

Intake 97.1 mm (3.823 in.)

Exhaust 98.0 mm (3.858 in.)

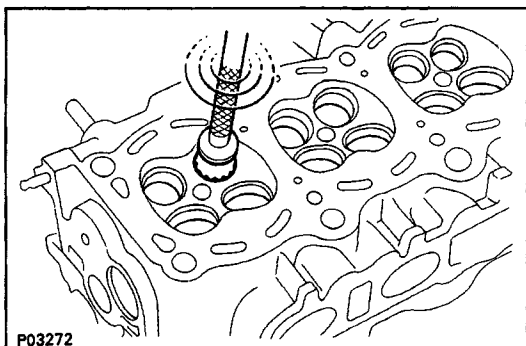
If the overall length is less than minimum, replace the valve.





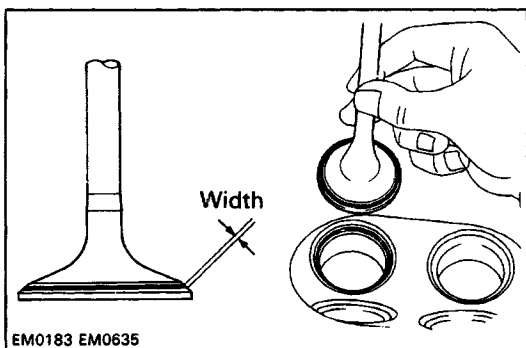
- (e) Check the surface of the valve stem tip for wear. If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

NOTICE: Do not grind off more than minimum.



8. INSPECT AND CLEAN VALVE SEATS

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



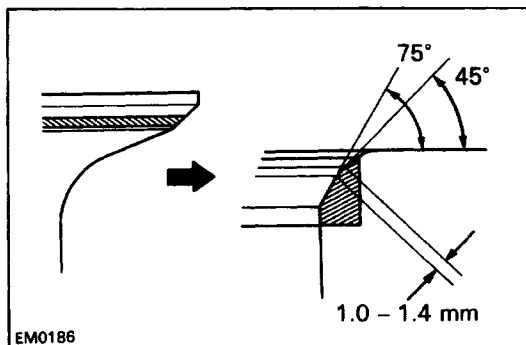
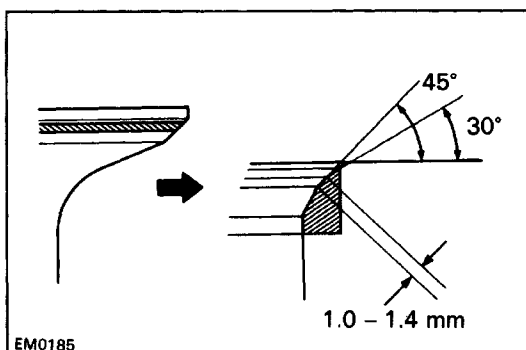
- (b) Check the valve seating position. Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate valve.

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

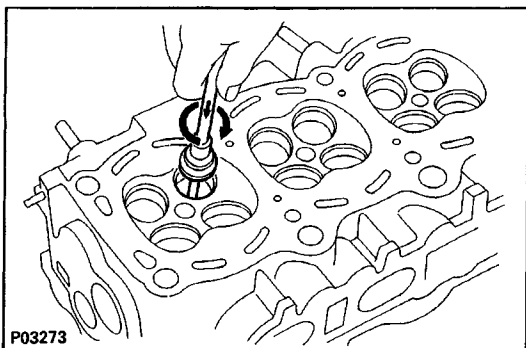
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is in the middle of the valve face with the following width:
1.0 – 1.4 mm (0.039 – 0.055 in.)

If not, correct the valve seats as follows:

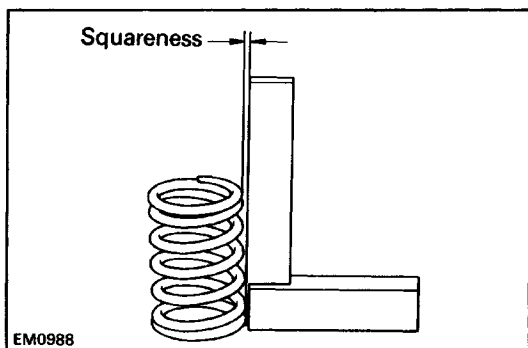
- (1) If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.



- (2) If the seating is too low on the valve face, use 75° 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.

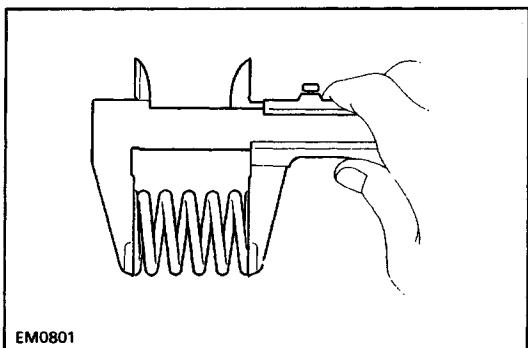


9. INSPECT VALVE SPRINGS

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

Maximum squareness: 2.0 mm (0.079 in.)

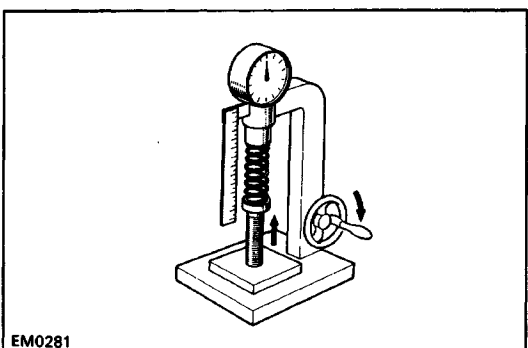
If the squareness is greater than maximum, replace the valve spring.



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

Free length: 41.96 – 41.99 mm (1.6520 – 1.6531 in.)

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



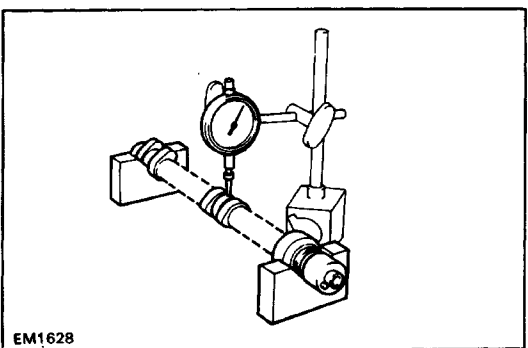
- (c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

Installed tension:

164 – 189 N (16.7 – 19.3 kgf, 36.8 – 42.5 lbf)

at 34.7 mm 0.366 in.)

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



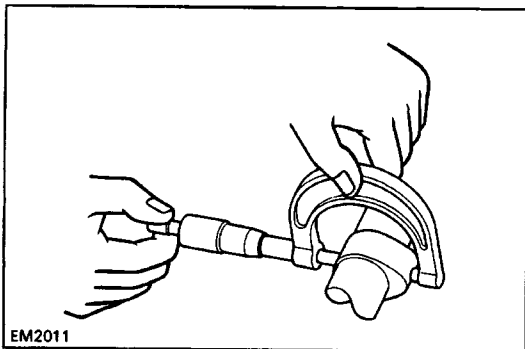
10. INSPECT CAMSHAFTS AND BEARINGS

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: 0.04 mm (0.0016 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 42.010 – 42.110 mm
(1.6539 – 1.6579 in.)

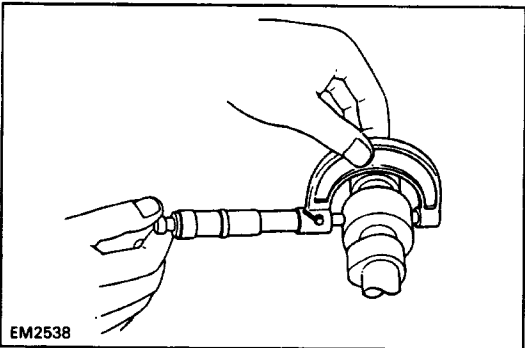
Exhaust 40.060 – 40.160 mm
(1.5772 – 1.5811 in.)

Minimum cam lobe height:

Intake 41.90 mm (1.6496 in.)

Exhaust 39.95 mm (1.5728 in.)

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

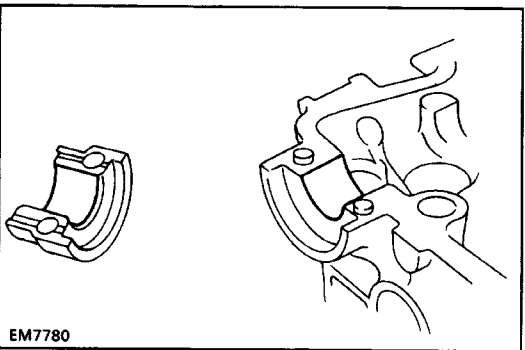


C. Inspect camshaft journals

Using a micrometer, measure the journal diameter.

Journal diameter: 26.959 – 26.975 mm
(1.0614 – 1.0620 in.)

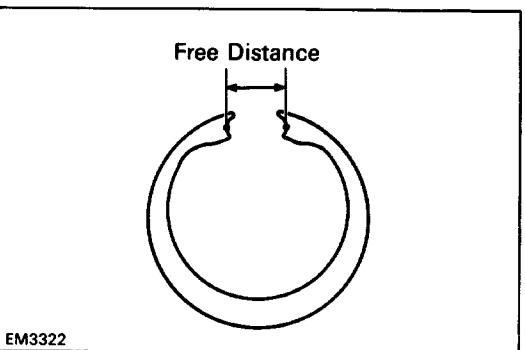
If the journal diameter is not as specified, check the oil clearance.



D. Inspect camshaft bearings

Check the bearings for flaking and scoring.

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

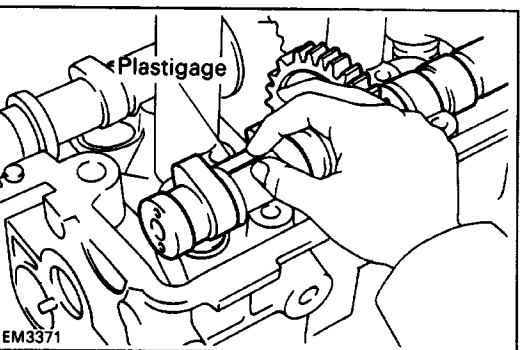


E. Inspect camshaft gear spring

Using a vernier caliper, measure the free distance between the spring ends.

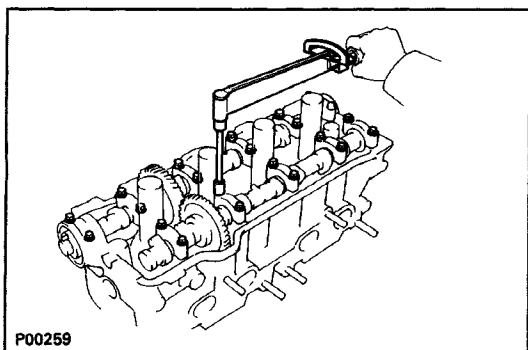
Free distance: 22.5 – 22.9 mm (0.886 – 0.902 in.)

If the free distance is not as specified, replace the gear spring.



F. Inspect camshaft journal oil clearance

- Clean the bearing caps and camshaft journals.
- Place the camshafts on the cylinder head.
- Lay a strip of Plastigage across each of the camshaft journals.

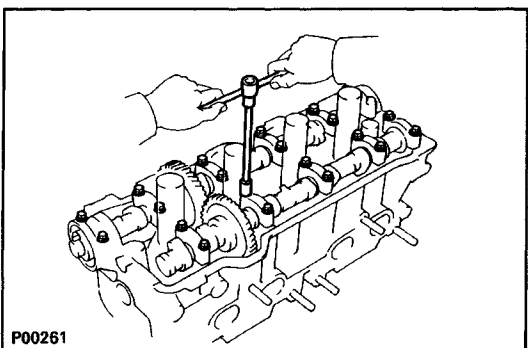


(d) Install the bearing caps.

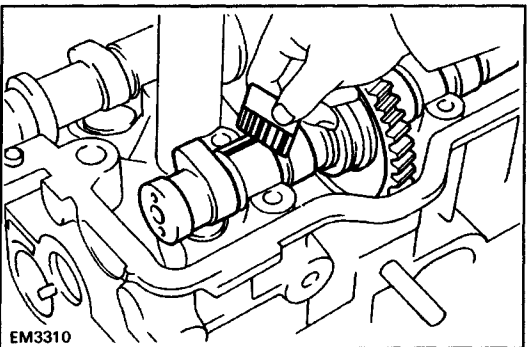
(See step 4 on pages [EM-175](#) to 177)

Torque: 19 N·m (190 kgf·cm, 94 ft·lbf)

NOTICE: Do not turn the camshaft.



(e) Remove the bearing caps.



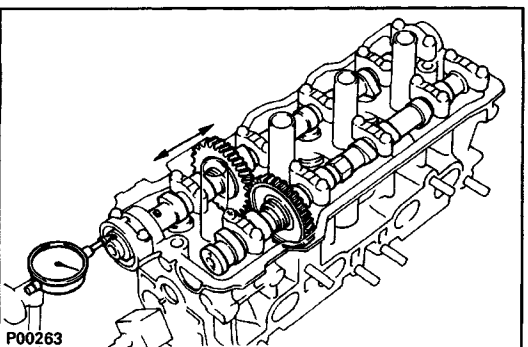
(f) Measure the Plastigage at its widest point.

**Standard oil clearance: 0.025 – 0.062 mm
(0.0010 – 0.0024 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.



G. Inspect camshaft thrust clearance

(a) Install the camshafts.

(See step 4 on pages [EM-175](#) to 177)

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

Standard thrust clearance:

**Intake 0.045 – 0.100 mm
(0.0018 – 0.0039 in.)**

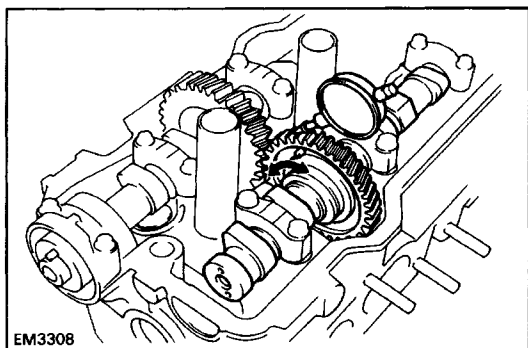
**Exhaust 0.030 – 0.085 mm
(0.0012 – 0.0033 in.)**

Maximum thrust clearance:

Intake 0.12 mm (0.0047 in.)

Exhaust 0.10 mm (0.0039 in.)

If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.



H. Inspect camshaft gear backlash

- (a) Install the camshafts without installing the exhaust cam sub-gear.

(See step 4 on pages EM-175 to 177)

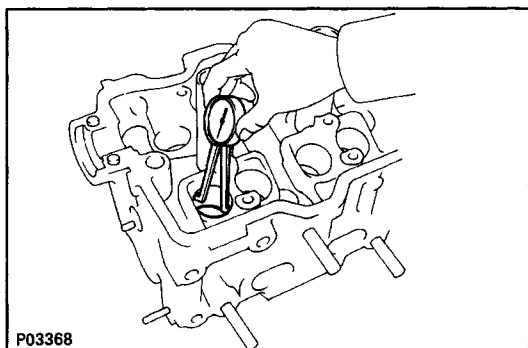
- (b) Using a dial indicator, measure the backlash.

Standard backlash: 0.020 – 0.200 mm

(0.0008 – 0.0079 in.)

Maximum backlash: 0.30 mm (0.0188 in.)

If the backlash is greater than maximum, replace the camshafts.

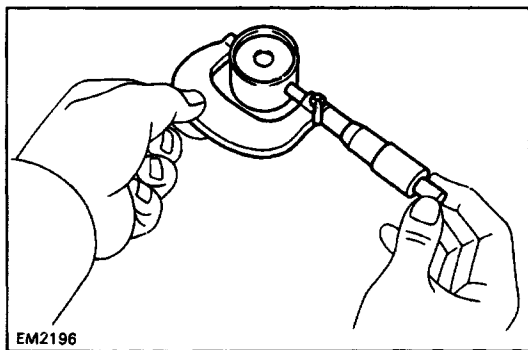


11. INSPECT VALVE LIFTERS AND LIFTER BORES

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

Lifter bore diameter: 31.000 – 31.018 mm

(1.2205 – 1.2213 in.)



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

Lifter diameter: 30.966 – 30.976 mm

(1.2191 – 1.2195 in.)

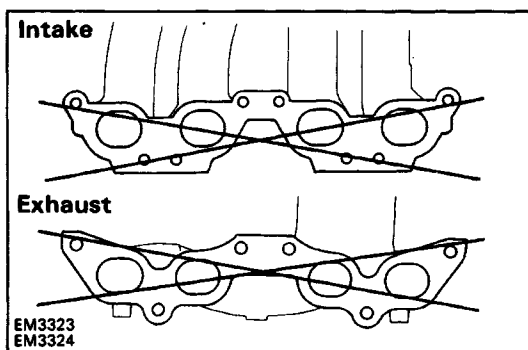
- (c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance: 0.024 – 0.052 mm

(0.0009 – 0.0020 in.)

Maximum oil clearance: 0.07 mm (0.0028 in.)

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



12. INSPECT MANIFOLDS

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

Maximum warpage: 0.30 mm (0.0118 in.)

If warpage is greater than maximum, replace the manifold.

ASSEMBLY OF CYLINDER HEAD

(See page [EM-150](#))

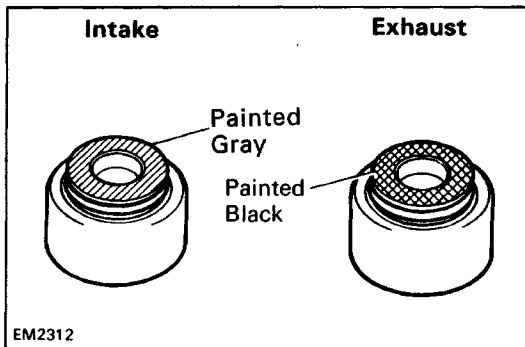
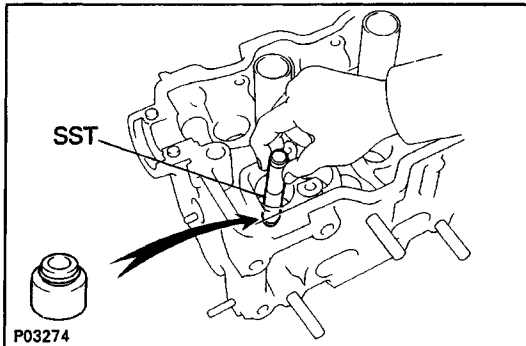
HINT:

- 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.

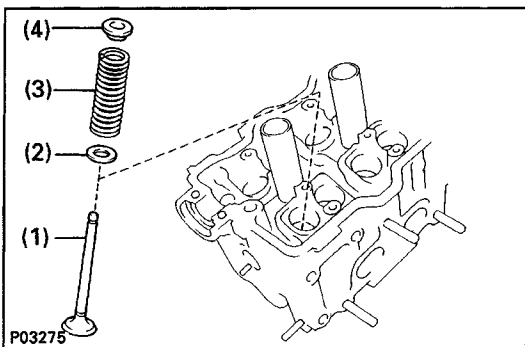
1. INSTALL VALVES

(a) Using SST, push in a new oil seal.

SST 09201-41020

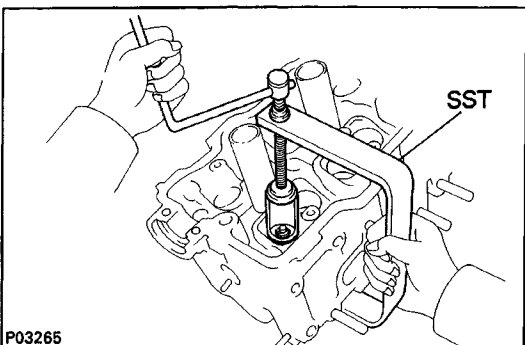


HINT: The intake valve oil seal is brown and the exhaust valve oil seal is black.



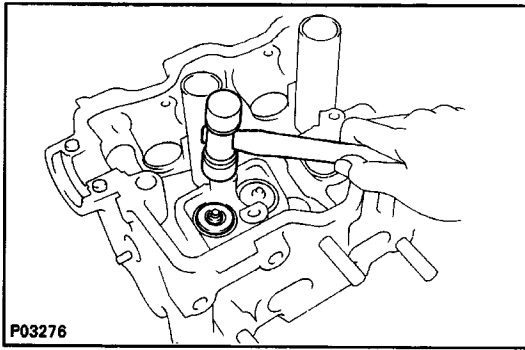
(b) Install the following parts:

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

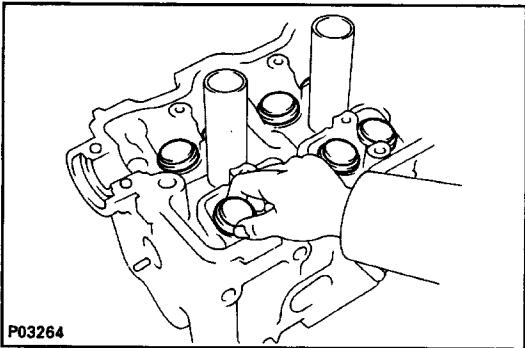


(c) Using SST, compress the valve spring and place the two keepers around the valve stem.

SST 09202-70010

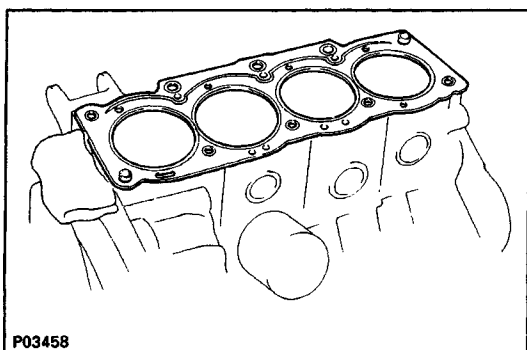


- (d) Using a plastic-faced hammer, lightly tap the valve stem tip to assure proper fit.



2. INSTALL VALVE LIFTERS AND SHIMS

- (a) Install the valve lifter and shim.
(b) Check that the valve lifter rotates smoothly by hand.



INSTALLATION OF CYLINDER HEAD

(See page EM-150)

1. 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.

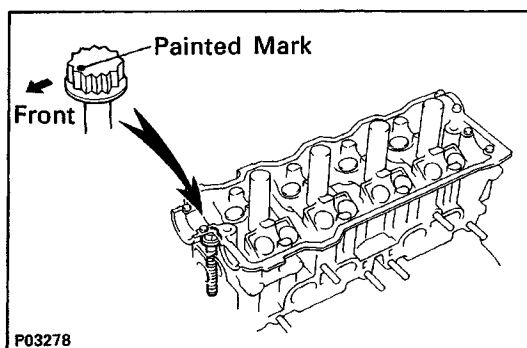
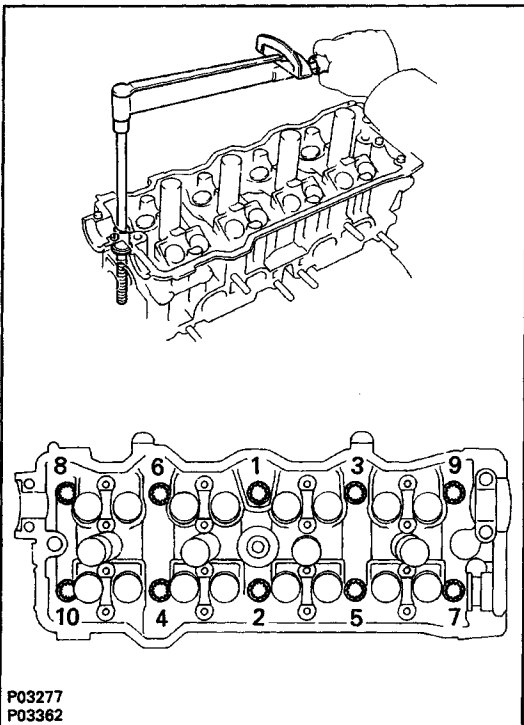
B. Install cylinder head bolts

HINT:

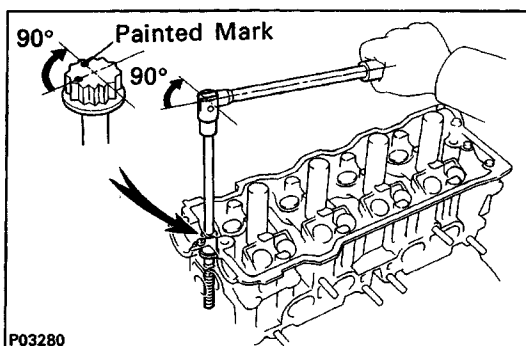
- The cylinder head bolts are tightened in two progressive steps (steps (b) and (d)).
 - If any cylinder head bolt is broken or deformed, replace it.
- (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
- (b) Install the plate washer to each cylinder head bolt.
- (c) Install and uniformly tighten the ten cylinder head bolts in several passes in the sequence shown.

Torque: 49 N-m (500 kgf-cm, 36 ft-lbf)

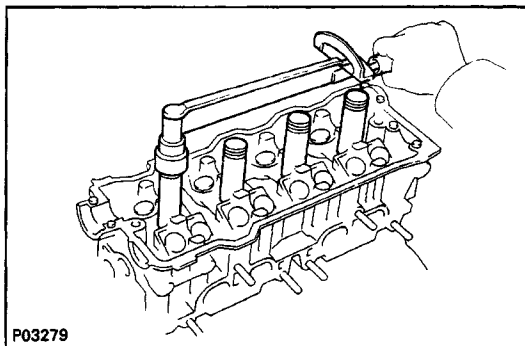
If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.



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



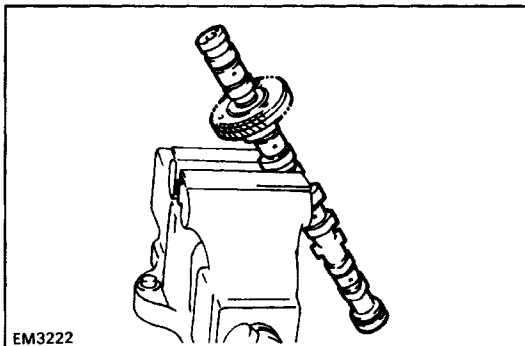
- (e) Retighten the cylinder head bolts 90° in the numerical order shown.
- (f) Check that the painted mark is now at a 90° angle to front.



2. INSTALL SPARK PLUG TUBES

- (a) Clean the cylinder head tube holes of any residual adhesive, oil or foreign particles. Remove any oil with kerosene or gasoline.
- (b) Screw the threads of the spark plug tube coated with adhesive into the cylinder head.
- (c) Using the spark plug tube nut and a 30 mm socket wrench, tighten the spark plug tubes.

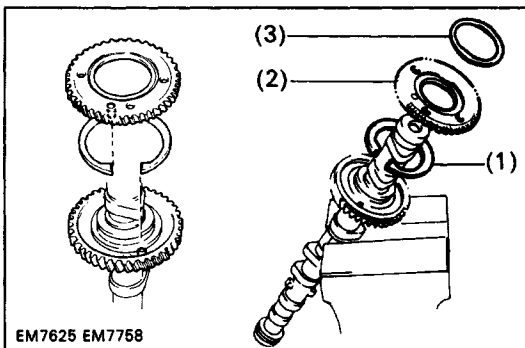
Torque: 39 N-m (400 kgf-cm, 29 ft-lbf)



3. ASSEMBLE EXHAUST CAMSHAFT

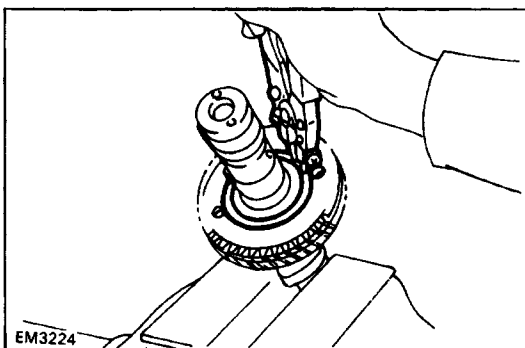
- (a) Mount the hexagon wrench head portion of the camshaft in a vise.

NOTICE: Be careful not to damage the camshaft.

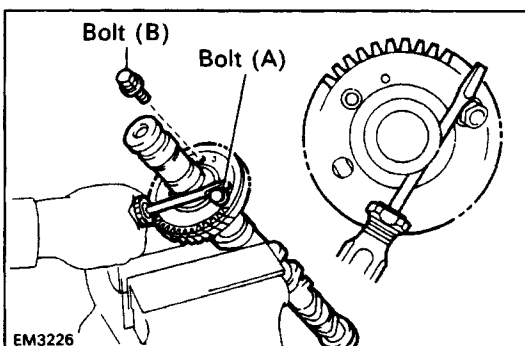


- (b) Install the following parts:
 - (1) Camshaft gear spring
 - (2) Camshaft sub-gear
 - (3) Wave washer

HINT: Align the pins on the gears with the spring ends.



- (c) Using snap ring pliers, install the snap ring.

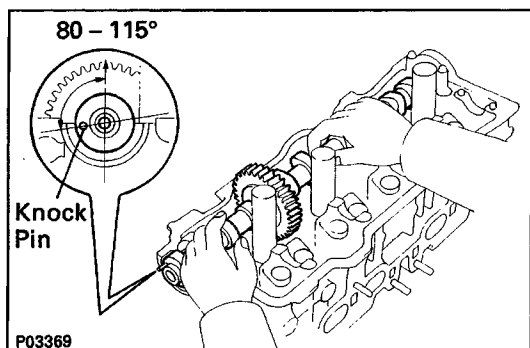


- (d) Insert a service bolt (A) into the service hole of the camshaft sub-gear.
- (e) Using a screwdriver, align the holes of the camshaft drive gear and sub-gear by turning camshaft sub-gear clockwise, and install a service bolt (B).

NOTICE: Be careful not to damage the camshaft.

4. INSTALL CAMSHAFTS

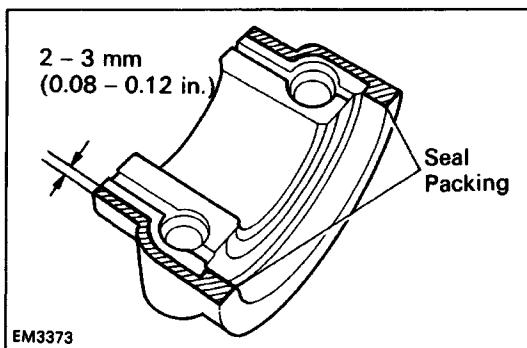
NOTICE: Since the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head receiving the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.



A. Install intake camshaft

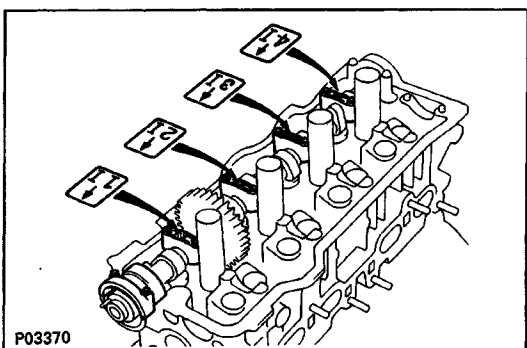
- Apply MP grease to the thrust portion of the camshaft.
- Place the intake camshaft at 80 - 115° BTDC of camshaft angle on the cylinder head.

HINT: The above angle allows the No.1 and No.3 cylinder cam lobes of the intake camshaft to push their valve lifters evenly.

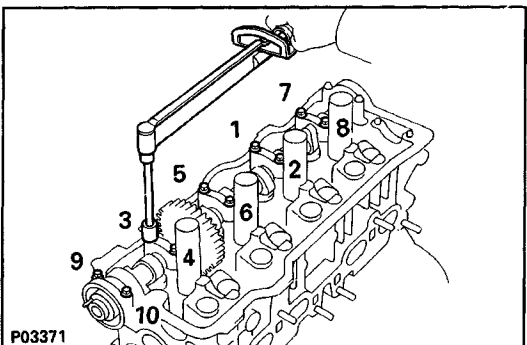


- Apply seal packing to the No.1 bearing cap as shown.

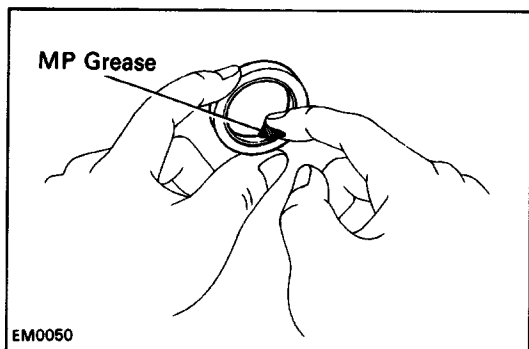
Seal packing: Part No. 08826-00080 or equivalent



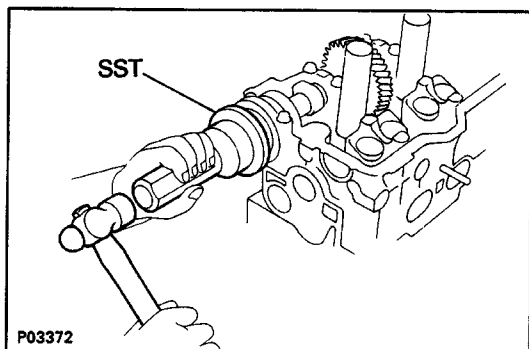
- Install the bearing caps in their proper locations.



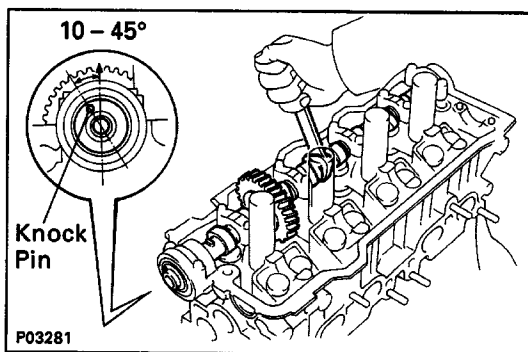
- Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
 - Install and uniformly tighten the ten bearing cap bolts in several passes in the sequence shown.
- Torque: 19 N-m (190 kgf-cm, 14 ft-lbf)**



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



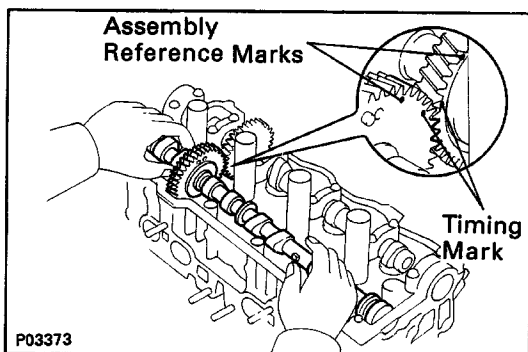
(h) Using SST, tap in the oil seal.
SST 09223-46011



B. Install exhaust camshaft

(a) Set the knock pin of the intake camshaft at 10 -45* BTDC of camshaft angle.

HINT: The above angle allows the No.2 and No.4 cylinder cam lobes of the exhaust camshaft to push their valve lifters evenly.



(b) Apply MP grease to the thrust portion of the camshaft.

(c) Engage the exhaust camshaft gear to the intake camshaft gear by matching the timing marks on each gear.

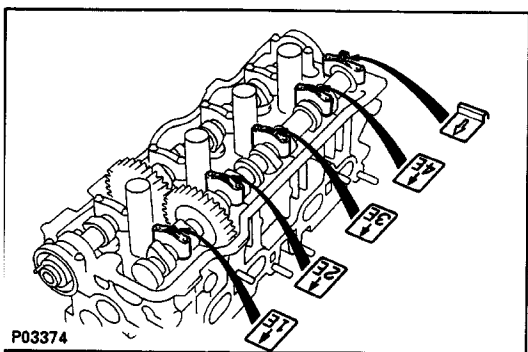
(d) Roll down the exhaust camshaft onto the bearing journals while engaging gears with each other.

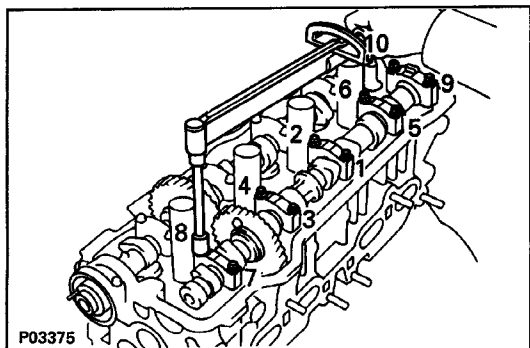
NOTICE: There are also assembly reference marks on each gear as shown in the illustration. Do not use these marks.

(e) Turn the intake camshaft clockwise or counter-clockwise little by little until the exhaust camshaft sits in the bearing journals evenly without rocking the camshaft on the bearing journals.

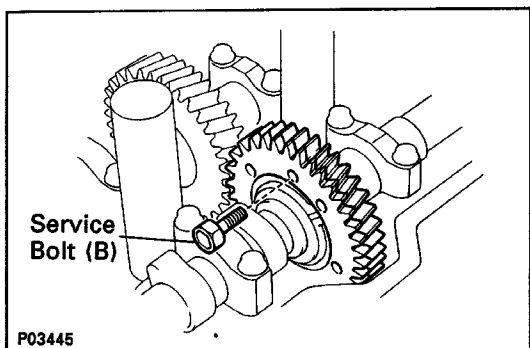
NOTICE: It is very important to replace the camshaft in the bearing journals evenly while tightening bearing caps in the subsequent steps.

(f) Install the bearing caps in their proper locations.





- (g) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
 - (h) Install and uniformly tighten the ten bearing cap bolts in several passes in the sequence shown.
- Torque: 19 N-m (190 kgf-cm, 14 ft-lbf)**



- (i) Remove the service bolt (B).

5. CHECK AND ADJUST VALVE CLEARANCE

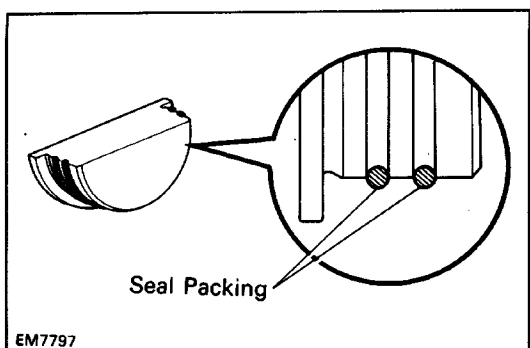
(See page [EM-22](#))

Turn the camshaft and position the cam lobe upward, and check and adjust the valve clearance.

Valve clearance (Cold):

Intake 0.19 – 0.29 mm (0.007 – 0.011 in.)

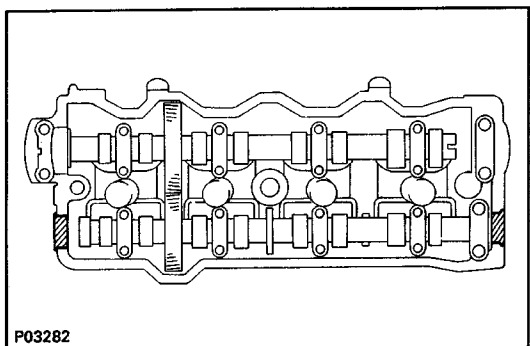
Exhaust 0.28 – 0.38 mm (0.011 – 0.015 in.)



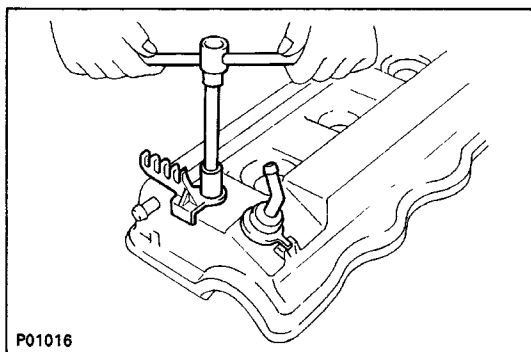
6. INSTALL SEMI-CIRCULAR PLUGS

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the semi-circular plug grooves.

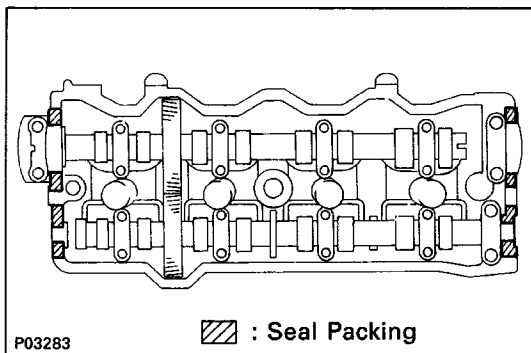
Seal packing: Part No. 08826-00080 or equivalent



- (c) Install the two semi-circular plugs to the cylinder head.



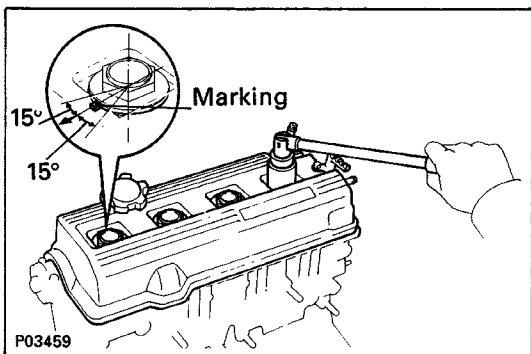
7. INSTALL HIGH-TENSION CORD CLAMP AND PCV VALVE



8. INSTALL CYLINDER HEAD COVER

- Remove any old packing (FIPG) material.
- Apply seal packing to the cylinder head as shown in the illustration.

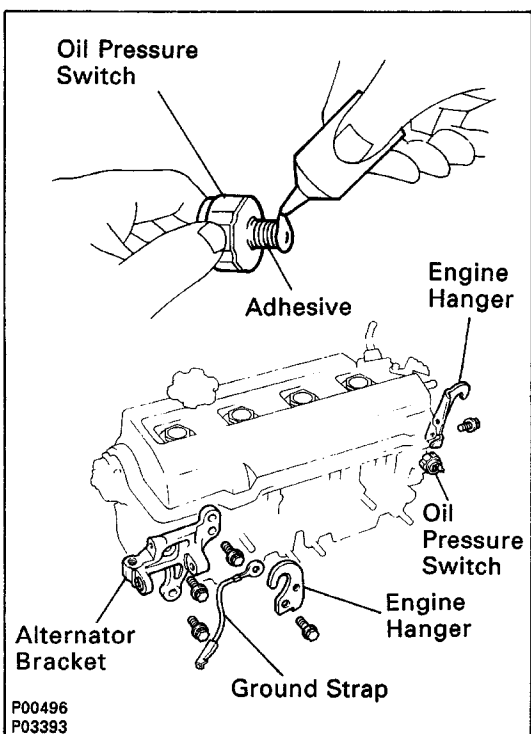
Seal packing: Part No. 08826-00080 or equivalent



- Install the gasket to the head cover.
- Install the head cover with the four grommets and nuts. Uniformly tighten the nuts in several passes.

Torque: 23 N-m (230 kgf-cm, 17 ft-lbf)

HINT: Install the grommets so that its markings are as shown in the illustration. Then install the grommet to its original position.



9. INSTALL OIL PRESSURE SWITCH

Apply adhesive to two or three threads.

Adhesive: Part No. 08833-00080, THREE BOND 1324 or equivalent

10. INSTALL ALTERNATOR BRACKET

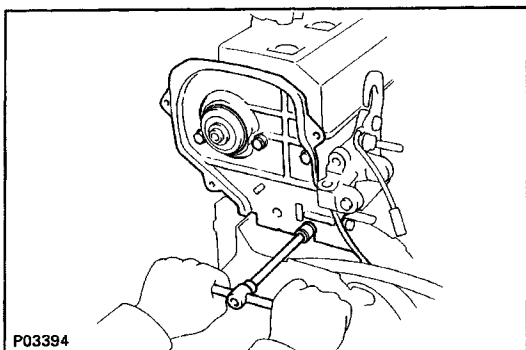
Install the alternator bracket with the three bolts.

Torque: 42 N-m (425 kgf-cm, 31 ft-lbf)

11. INSTALL ENGINE HANGERS

Install the engine hanger with the bolt. Install the two engine hangers. Install the ground strap.

Torque: 25 N-m (250 kgf-cm, 18 ft-lbf)

**12. INSTALL No.3 TIMING BELT COVER**

Install the timing belt cover with the four bolts.

Torque: 7.8 N-m (80 kgf-cm, 69 in-lbf)

13. INSTALL NO.1 IDLER PULLEY AND TENSION SPRING

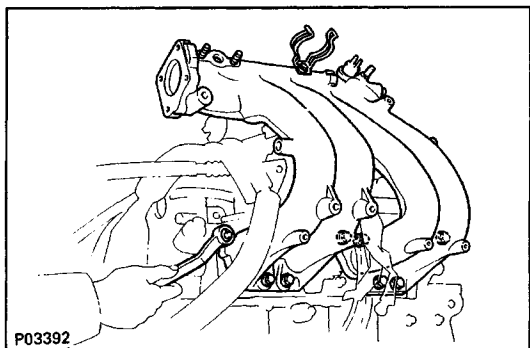
(See step 4 on page [EM-75](#))

14. INSTALL CAMSHAFT TIMING PULLEY

(See steps 9 to 21 and 24 on pages [EM-76](#) to 80)

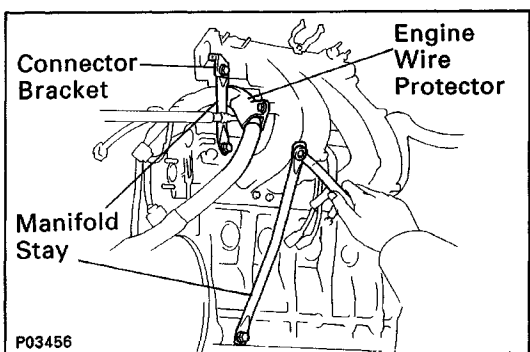
15. INSTALL INJECTOR AND DELIVERY PIPE

(See steps 1 and 2 on pages [FI-175](#) and 176)

**16. INSTALL INTAKE MANIFOLD**

(a) Install a new gasket and the intake manifold with the six bolts and two nuts. Uniformly tighten the bolts and nuts in several passes.

Torque: 19 N-m (195 kgf-cm, 14 ft-lbf)



(b) Install the two manifold stays with the four bolts.

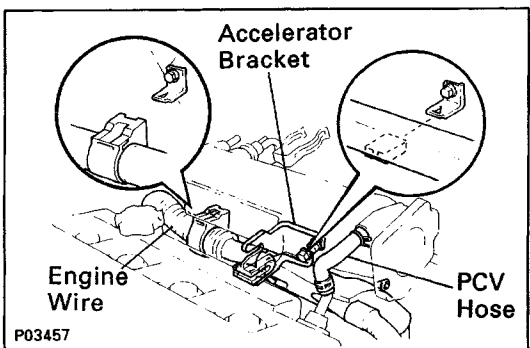
Alternately tighten the bolts. Install the connector bracket (CALIF. only).

Torque:

12 mm. head bolt 22 N-m (220 kgf-cm, 16 ft-lbf)

14 mm head bolt 42 N-m (425 kgf-cm, 31 ft-lbf)

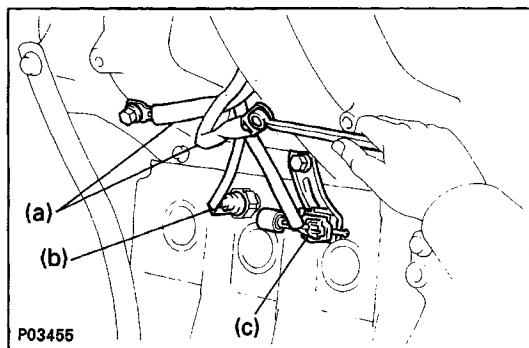
(c) Install the engine wire protector with the bolt.



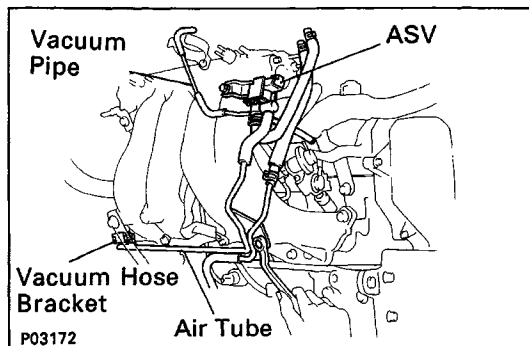
(d) Connect the two wire clamps to the wire brackets.

(e) Connect the PCV hose to the PVC valve.

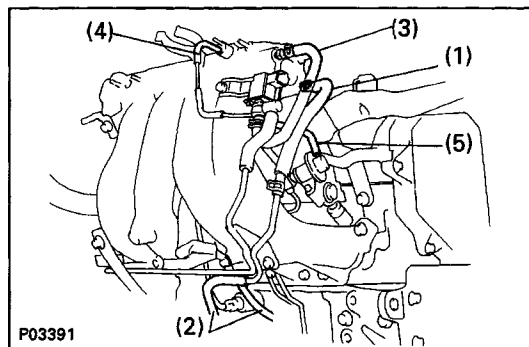
17. INSTALL ACCELERATOR BRACKET

**18. INSTALL VSV FOR EGR****19. CONNECT ENGINE WIRE GROUND STRAPS AND CONNECTORS**

- (a) Two engine ground straps to intake manifold
- (b) Knock sensor connector
- (c) VSV connector for EGR

**20. INSTALL AIR TUBE, ASV (FOR A/C) AND VACUUM PIPE**

- (a) Install the air tube, ASV assembly and the vacuum hose bracket with the four bolts.
- (b) Install the vacuum pipe with the bolt.

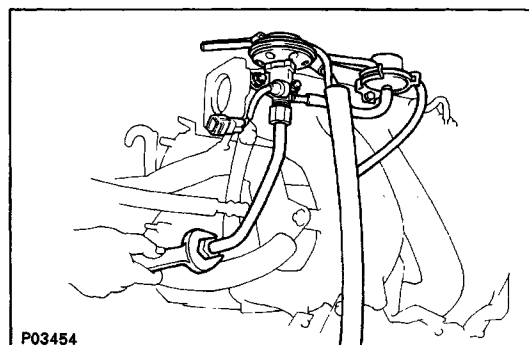
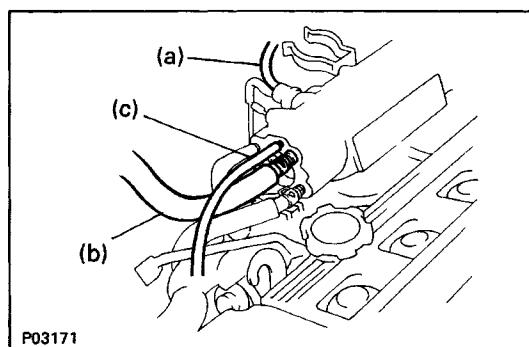


- (c) Connect the following hoses:
 - (1) PS air hose to intake manifold
 - (2) Two air hoses to air tube
 - (3) (w/ A/C)
 - Air hose to intake manifold
 - (4) Vacuum hose to gas filter
 - (5) Vacuum hose to fuel pressure regulator
- (d) (w/ A/C)

Connect the ASV connector.

21. CONNECT VACUUM HOSES

- (a) Vacuum sensor hose to gas filter
- (b) Brake booster vacuum hose to intake manifold
- (c) (w/ Cruise Control System (w/o ABS))
 - Actuator vacuum hose to intake manifold

**22. INSTALL EGR VALVE AND VACUUM MODULATOR**

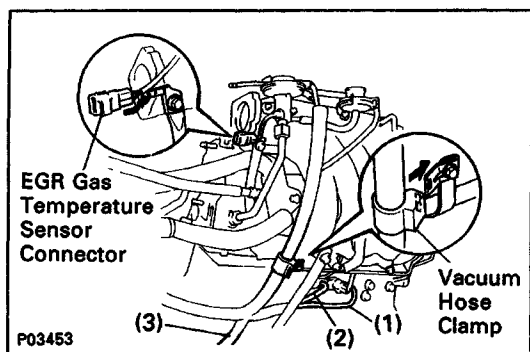
- (a) Install a new gasket and the EGR valve with the union nut and two nuts.

Torque:

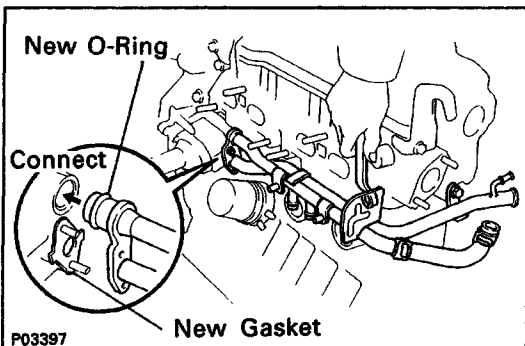
Union nut 59 N-m (600 kgf-cm, 43 ft-lbf)

Bolt 13 N-m (130 kgf-cm, 9 ft-lbf)

- (b) Install the EGR modulator- to the clamp.



- (c) Connect the following hoses:
- (1) Vacuum hose (from port Q of EGR vacuum modulator) to port G of VSV for EGR
 - (2) Vacuum hose (from EGR valve) to port E of VSV for EGR
 - (3) Vacuum hose to charcoal canister
- (d) Install the vacuum hose clamp to the bracket.
- (e) (CALIF. only)
Install the connector to the bracket. Connect the EGR gas temperature sensor connector.



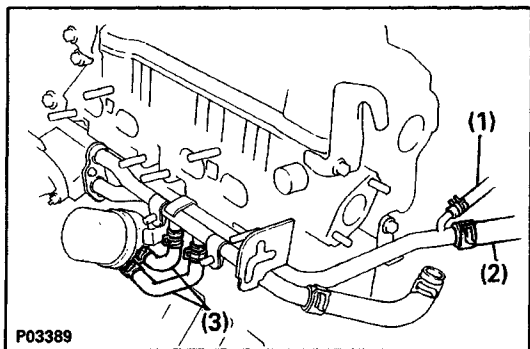
23. INSTALL THROTTLE BODY

(See steps 2 to 5 on pages [FI-204](#) and [205](#))

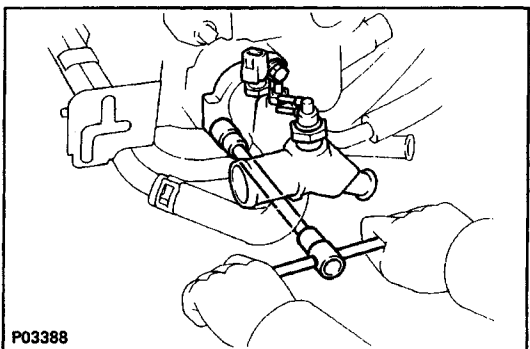
24. INSTALL WATER BY-PASS PIPE

- (a) Install a new O-ring to the by-pass pipe.
- (b) Apply soapy water on the O-ring.
- (c) Install a new gasket and the by-pass pipe with the two nuts and two bolts.

Torque(Nut): 9.3 N-m (95 kgf-cm, 82 in-lbf)



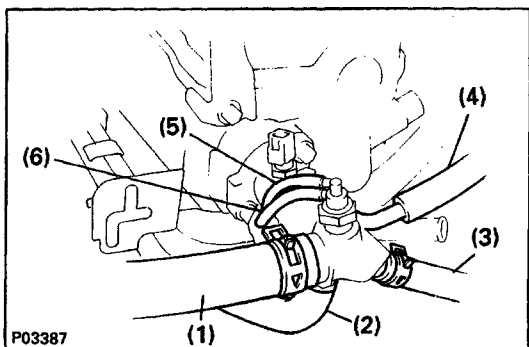
- (d) Connect the following hoses:
- (1) ISC water by-pass hose
 - (2) Heater water hose
 - (3) (w/ Oil Cooler)
Two oil cooler water by-pass hoses
- (e) (w / Oil Cooler)
Install the water by-pass hose heat protector.
(See step 3 on page [LU-30](#))



25. INSTALL WATER OUTLET

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

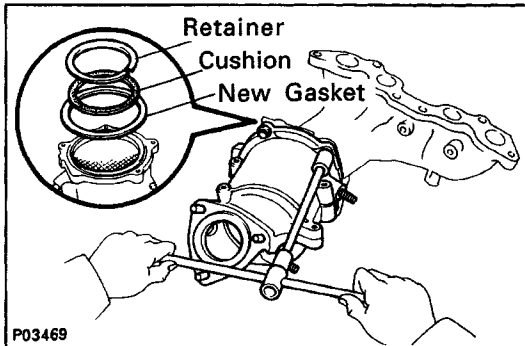
Torque: 15 N-m (150 kgf-cm, 11 ft-lbf)



- (b) Connect the following hoses:
- (1) Upper radiator hose
 - (2) Water by-pass pipe hose
 - (3) Heater water hose
 - (4) ISC water by-pass hose
 - (5) EVAP BSVV vacuum hose (from port P of throttle body)
 - (6) EVAP BSVV vacuum hose (from charcoal canister)

(c) Connect the following connectors:

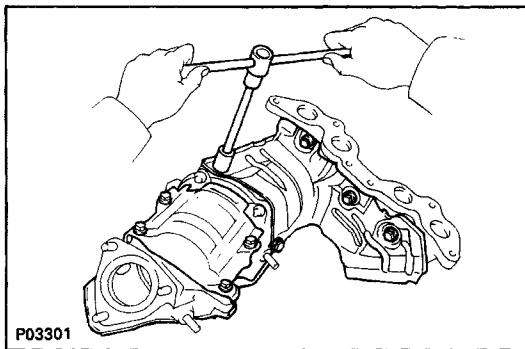
- Water temperature sender gauge connector
- Water temperature sensor connector



26. ASSEMBLE EXHAUST MANIFOLD AND CATALYTIC CONVERTER

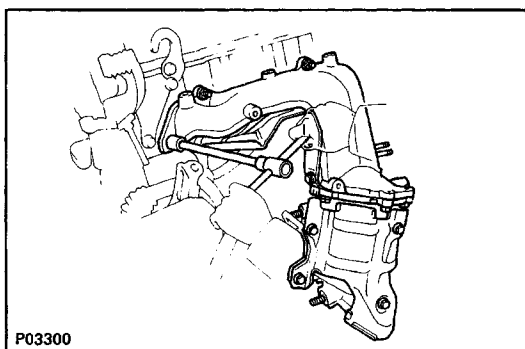
- Place the cushion, retainer and a new gasket on the catalytic converter.
- Install the catalytic converter to the exhaust manifold with the three bolts and two nuts.

Torque: 29 N-m (300 kgf-cm, 22 ft-lbf)



(c) Install the lower manifold head insulator with the five bolts.

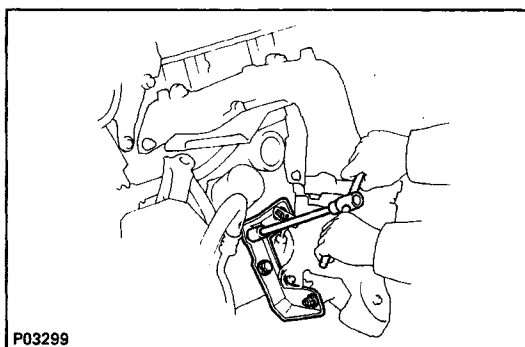
(d) Install the two catalytic converter heat insulators with the eight bolts.



27. INSTALL EXHAUST MANIFOLD AND CATALYTIC CONVERTER ASSEMBLY

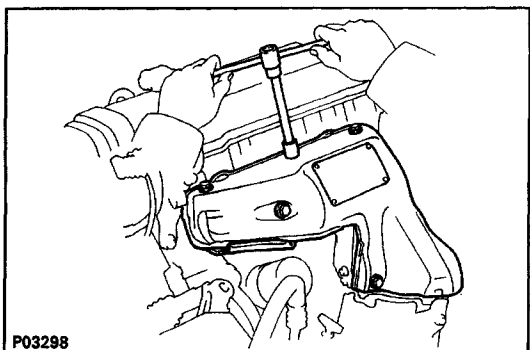
- Install a new gasket, the exhaust manifold and catalytic converter assembly with the six new nuts. Uniformly tighten the nuts in several passes.

Torque: 49 N-m (500 kgf-cm, 36 ft-lbf)



- Install the catalytic converter stay with the two bolts and two new nuts. Alternately tighten the bolts and nut.

Torque: 42 N-m (425 kgf-cm, 31 ft-lbf)



- (c) Install the manifold upper heat insulator with the six bolts.

28. (CALIF. ONLY)
INSTALL SUB-OXYGEN SENSOR
29. INSTALL OXYGEN SENSOR (MAIN)
10. INSTALL FRONT EXHAUST PIPE
(See step 15 on page [EM-305](#))
31. INSTALL SUSPENSION LOWER CROSSMEMBER
(See page 16 on page [EM-306](#))
32. INSTALL ENGINE UNDER COVERS
33. INSTALL DISTRIBUTOR (See page [IG-35](#))
34. INSTALL ALTERNATOR (See page [CH-24](#))
35. INSTALL AIR CLEANER CAP AND HOSE
(See step 38 on page [EM-310](#))
36. (w/ CRUISE CONTROL SYSTEM)
INSTALL CRUISE CONTROL ACTUATOR
(See step 33 on page [EM-309](#))
37. INSTALL ACCELERATOR CABLE, AND ADJUST IT
38. (A/T)
CONNECT THROTTLE CABLE, AND ADJUST IT
39. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY
40. FILL WITH ENGINE COOLANT (See page [CO-6](#))
Capacity (w/ Heater):
M/T 6.2 liters (6.6 US qts, 5.5 Imp. qts)
A/T 6.1 liters (6.4 US qts, 5.4 Imp. qts)
41. START ENGINE AND CHECK FOR LEAKS
42. ADJUST IGNITION TIMING (See page [IG-37](#))
Ignition timing:
10° BTDC, idle
(w/ Terminals TE1 and E1 connected)
43. PERFORM ROAD TEST
Check for abnormal noise, shock, slippage, correct shift points and smooth operation.
44. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL