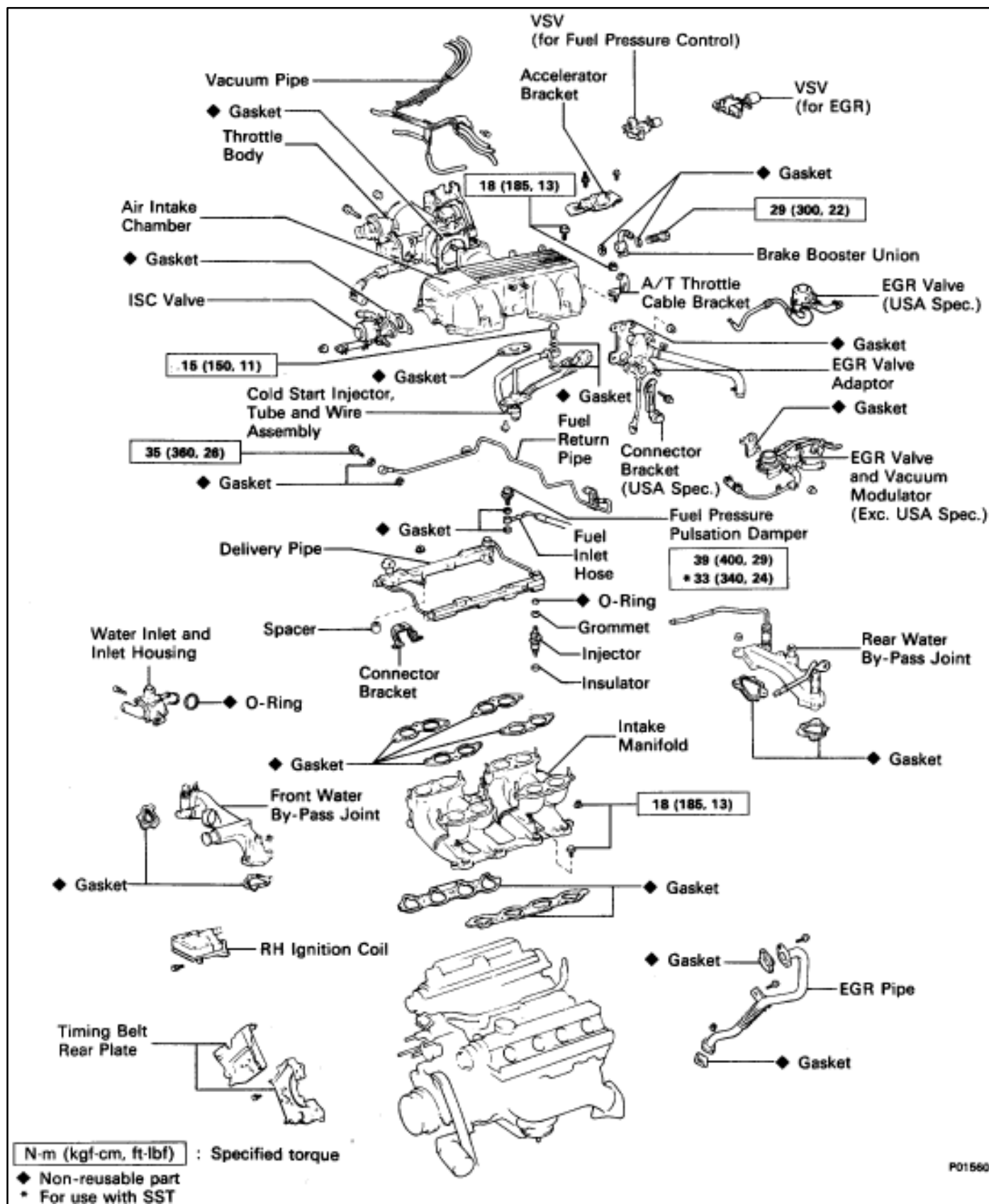


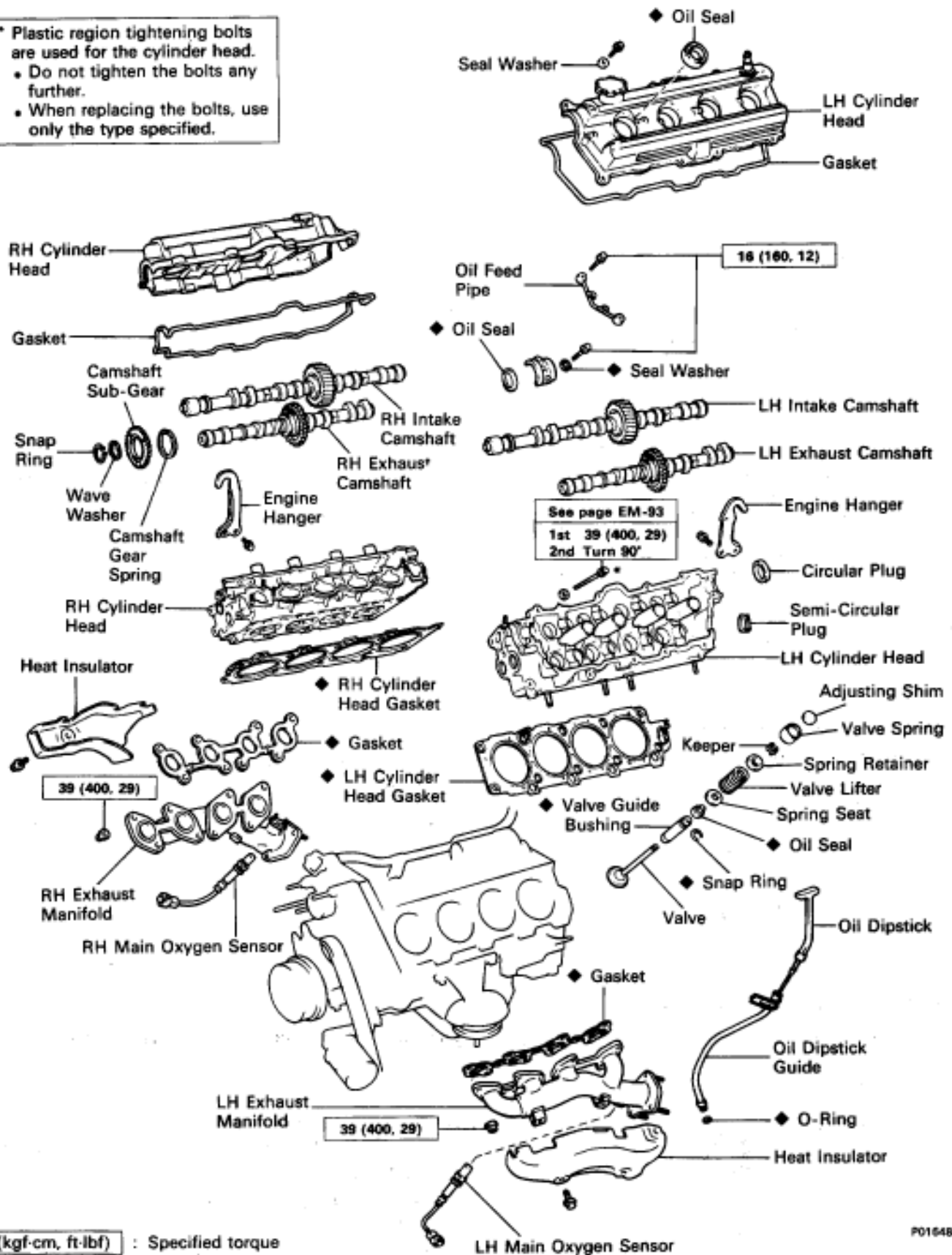
CYLINDER HEADS

COMPONENTS FOR REMOVAL AND INSTALLATION



COMPONENTS FOR REMOVAL AND INSTALLATION (Cont'd)

- Plastic region tightening bolts are used for the cylinder head.
- Do not tighten the bolts any further.
- When replacing the bolts, use only the type specified.



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

◆ Non-reusable part

P01648

REMOVAL OF CYLINDER HEADS

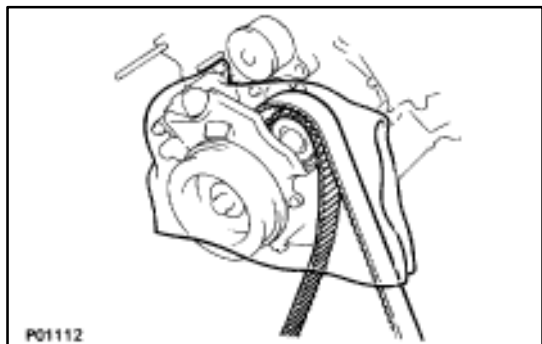
(See Components on pages EM-58 and 59)

1. DISCONNECT TIMING BELT FROM CAMSHAFT TIMING PULLEYS

(See steps 1 to 28 on pages EM-35 to 42)

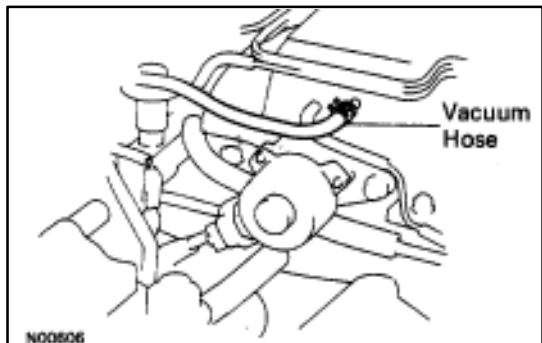
2. REMOVE CAMSHAFT TIMING PULLEYS AND HYDRAULIC PUMP

(See steps 29 and 31 on pages EM-42 and 43)



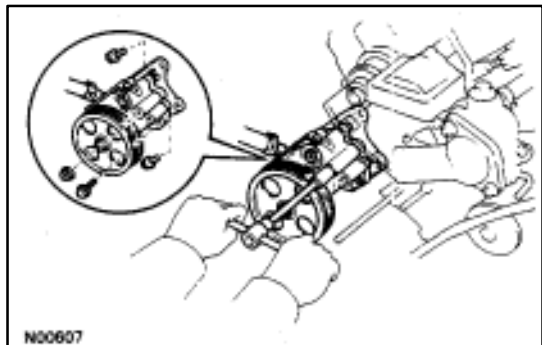
HINT:

- Be careful not to drop anything inside the timing belt cover.
- Do not allow the timing belt to come into contact with oil, water or dust.



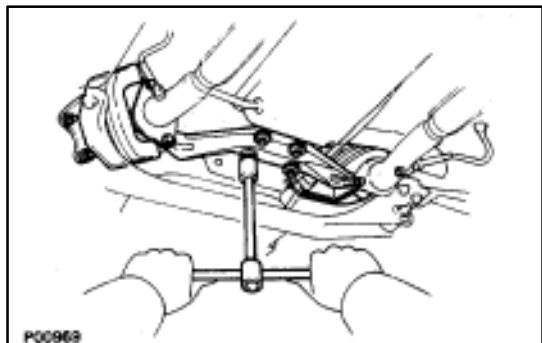
3. DISCONNECT PS PUMP FROM LH CYLINDER HEAD

- (a) Disconnect the vacuum hose from the air intake chamber.



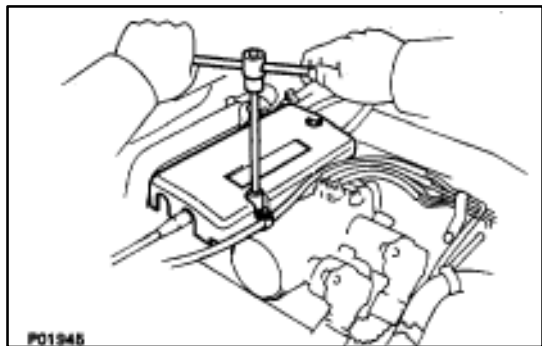
- (b) Remove the three bolts and nut, and disconnect the PS pump.

HINT: Put aside the PS pump, and suspend it.

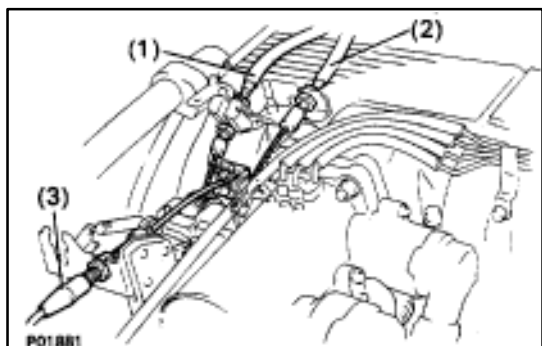


4. REMOVE CATALYTIC CONVERTERS (MAIN)

- (a) Remove the four bolts holding the pipe support bracket to the transmission.
- (b) Remove the four bolts and nuts holding the catalytic converters to the front exhaust pipe. Remove the pipe support bracket.
- (c) Disconnect the front exhaust pipe from the catalytic converter, and remove the two gaskets.
- (d) Remove the three nuts, catalytic converter and gasket. Remove the two catalytic converters.

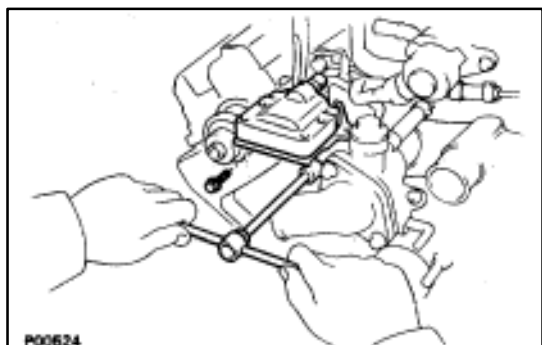
**5. REMOVE THROTTLE BODY COVER**

- (a) Remove the mounting cap nut.
- (b) Loosen the two bolts, and remove the throttle body cover.

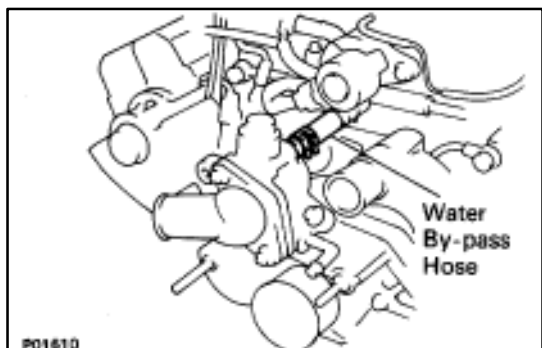
**6. DISCONNECT CONTROL CABLES FROM THROTTLE BODY**

Disconnect the following cables:

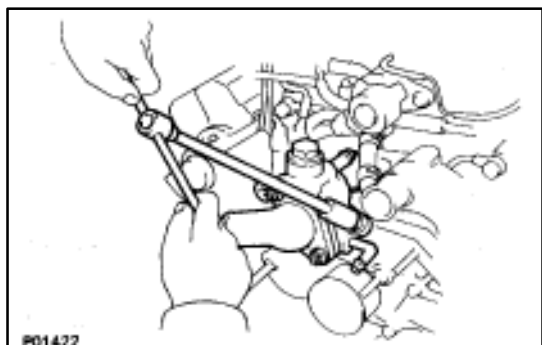
- (1) Accelerator cable
- (2) A/T throttle control cable
- (3) (w/ Cruise Control System)
Cruise control actuator cable

**7. REMOVE RH IGNITION COIL**

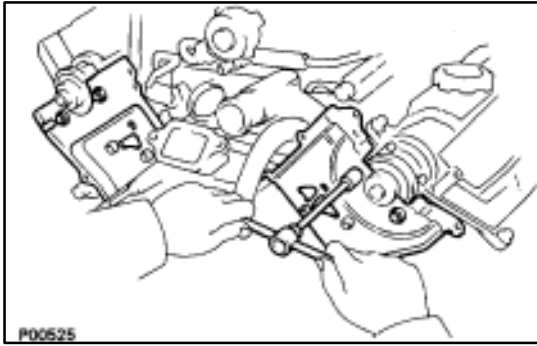
Remove the two bolts and ignition coil.

**8. REMOVE WATER INLET AND INLET HOUSING**

- (a) Disconnect the water by-pass hose from the ISC valve.

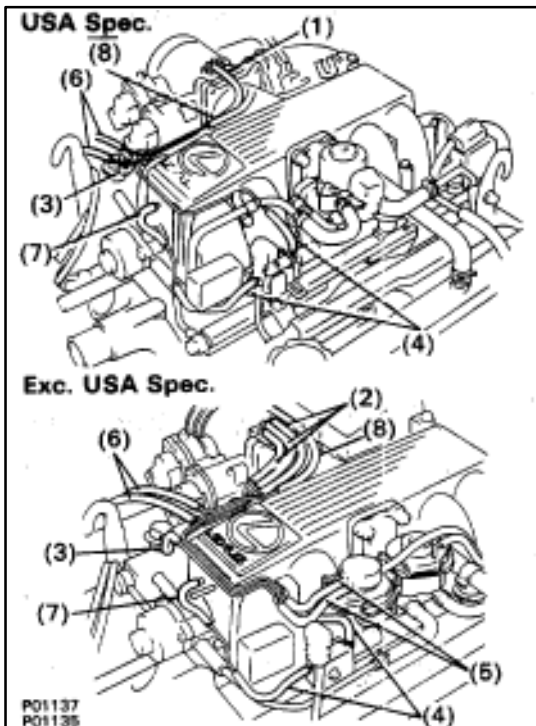


- (b) Remove the two bolts holding the water inlet housing to the water pump.
- (c) Pull out the water inlet and inlet housing assembly.
- (d) Remove the O-ring from the water inlet housing.



9. REMOVE TIMING BELT REAR PLATES

Remove the two bolts and rear plate. Remove the two rear plates.

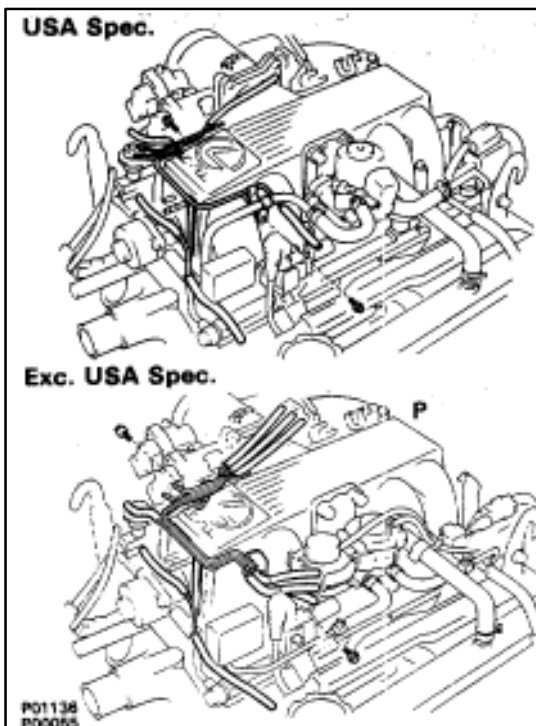


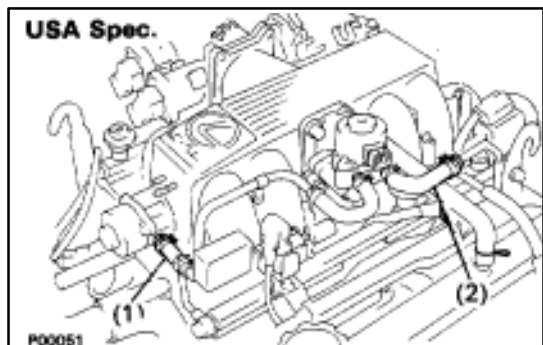
10. REMOVE VACUUM PIPE

(a) Disconnect the following hoses:

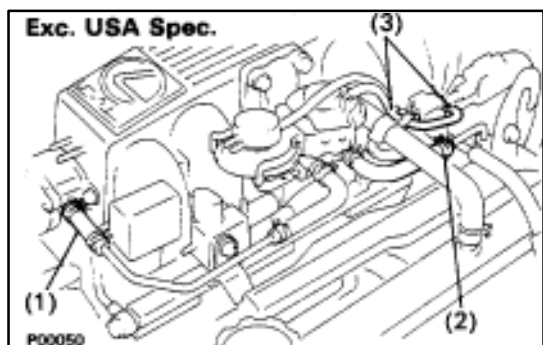
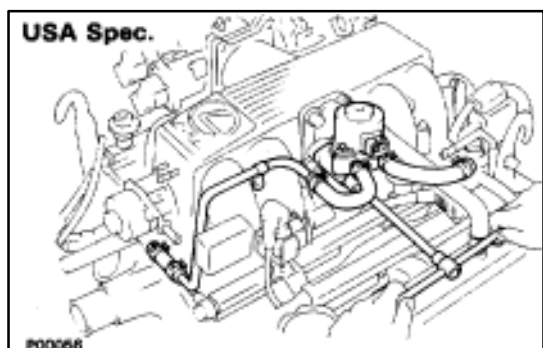
- (1) (USA Spec.)
Vacuum hose from throttle body
- (2) (Exc. USA Spec.)
Three vacuum hoses from throttle body
- (3) Vacuum hose from fuel pressure regulator
- (4) Two vacuum hoses from VSV for fuel pressure control system
- (5) (Exc. USA Spec.)
Two vacuum hoses from EGR vacuum modulator
- (6) Two vacuum hoses (from VSV for EVAP system) from vacuum pipe
- (7) Vacuum hose (from VSV for fuel pressure control system) from air intake chamber
- (8) Vacuum hose (from charcoal canister) from vacuum pipe.

(b) Remove the two bolts, the vacuum pipe and vacuum hoses assembly.

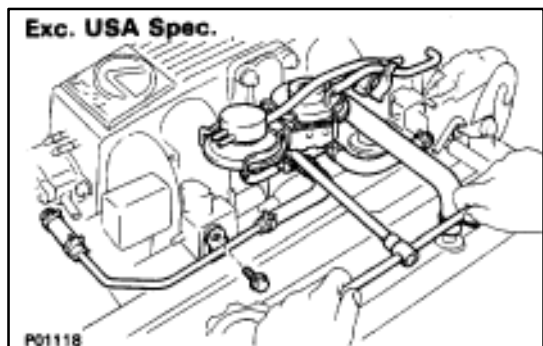


**11. (USA Spec.)****REMOVE EGR VALVE**

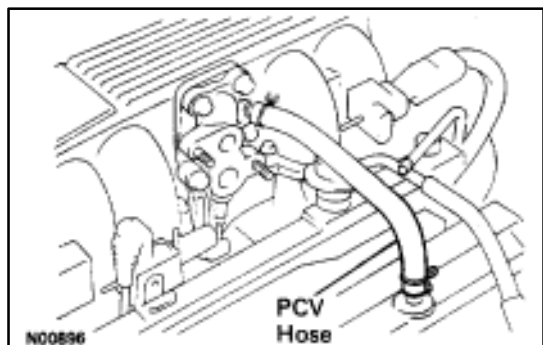
- (a) Disconnect the EGR valve connector.
- (b) Disconnect the following hoses:
 - (1) Water by-pass pipe hose from ISC valve
 - (2) Water by-pass hose from water by-pass pipe (from rear water by-pass joint)
- (c) Remove the two nuts, EGR valve and gasket.

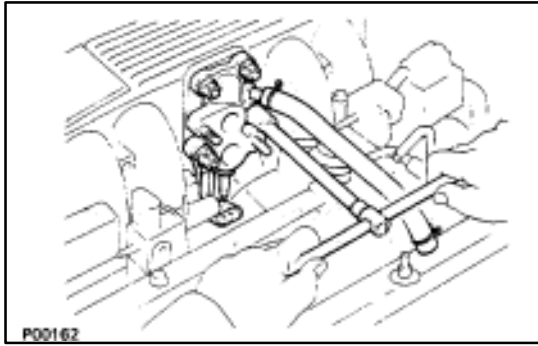
**12. (Exc. USA Spec.)****REMOVE EGR VALVE AND VACUUM MODULATOR**

- (a) Disconnect the hose clamp (A) from the PCV hose.
- (b) Disconnect the following hoses:
 - (1) Water by-pass pipe hose from ISC valve
 - (2) Water by-pass hose from water by-pass pipe (from rear water by-pass joint)
 - (3) Two vacuum hoses from VSV for EGR system
- (c) Remove the bolt, two nuts, the EGR valve, vacuum modulator assembly and gasket.

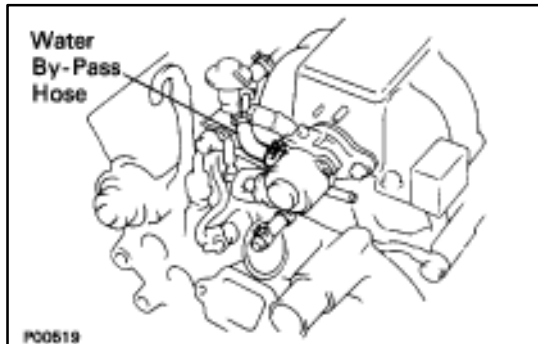
**13. REMOVE EGR VALVE ADAPTOR**

- (a) Disconnect the PCV hose from the cylinder head.



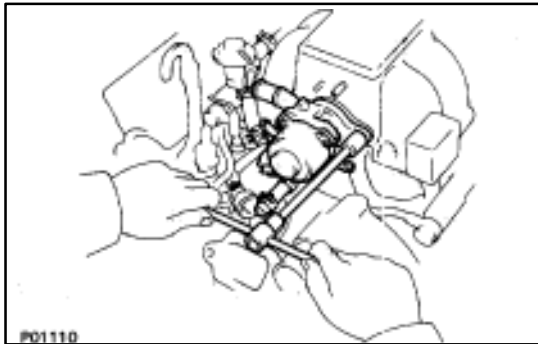


- (b) Remove the two bolts, two nuts, adaptor and gasket.
- (c) (USA Spec. only)
Disconnect the EGR gas temperature sensor connector.

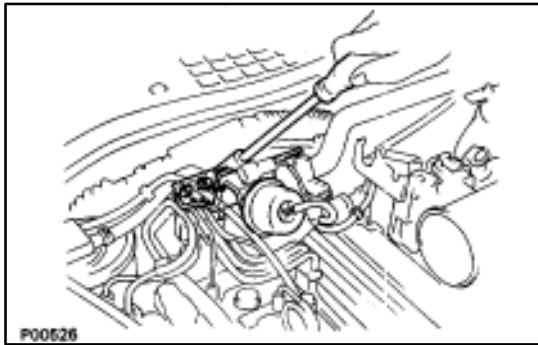


14. REMOVE ISC VALVE

- (a) Disconnect the ISC valve connector.
- (b) Disconnect the water by-pass hose from the ISC valve.

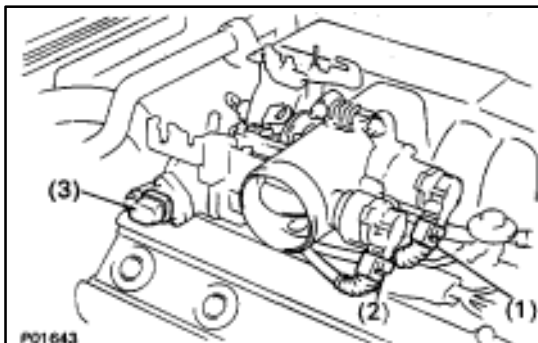


- (c) Remove the two nuts, ISC valve and gasket.



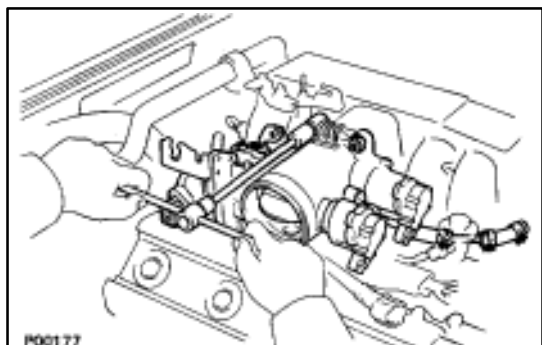
15. DISCONNECT HEATER WATER VALVE FROM BODY

- (a) Disconnect the VSV connector.
- (b) Remove the bolt holding the engine wire clamp to the water valve bracket.
- (c) Remove the two bolts, and disconnect the water valve and bracket assembly.

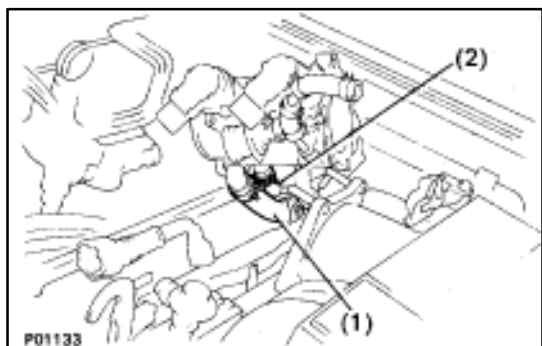


16. REMOVE THROTTLE BODY

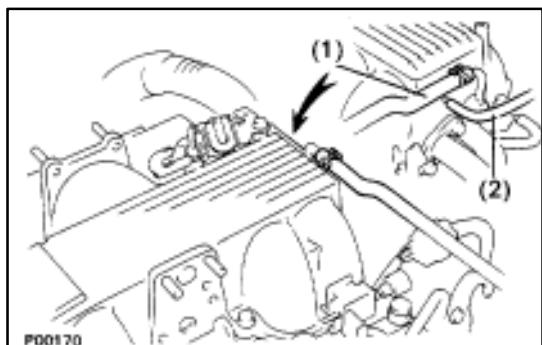
- (a) Disconnect the following connectors:
 - (1) Throttle position sensor connector
 - (2) (w/ TRAC)
Sub-throttle position sensor connector
 - (3) (w/ TRAC)
Sub-throttle actuator connector



- (b) Remove the two mounting bolts and two mounting nuts, and disconnect the throttle body from the air intake chamber.



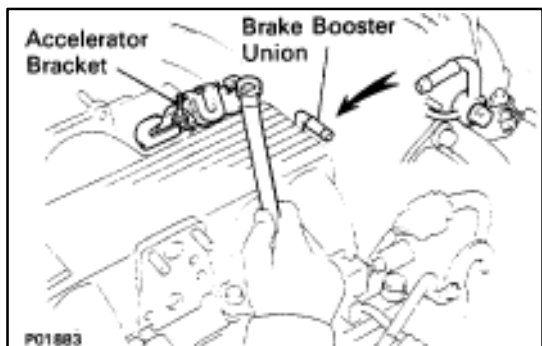
- (c) Disconnect the following hoses, and remove the throttle body:
- (1) PCV hose from throttle body
 - (2) Water by-pass hose from throttle body
- (d) Remove the throttle body gasket.



17. DISCONNECT VACUUM HOSES

Disconnect the following hoses:

- (1) Vacuum hose from brake booster union
- (2) Vacuum hose (from VSV for heater water valve) from air intake chamber

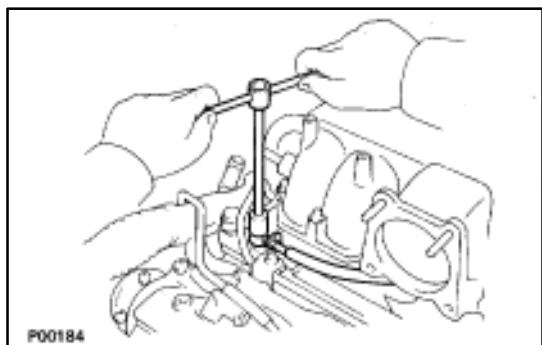


18. REMOVE ACCELERATOR BRACKET

Remove the bolt, stud bolt and bracket.

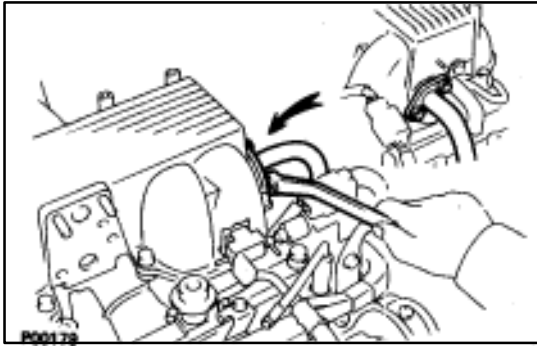
19. REMOVE BRAKE BOOSTER UNION

Remove the union bolt, union and two gaskets.

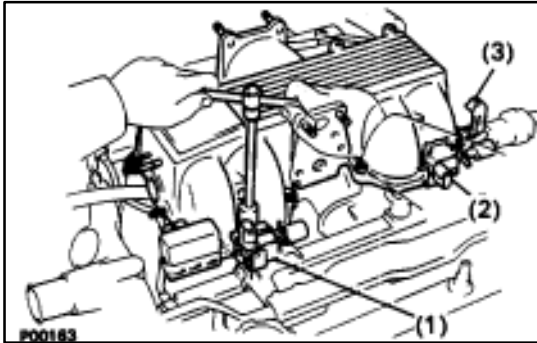


20. REMOVE AIR INTAKE CHAMBER

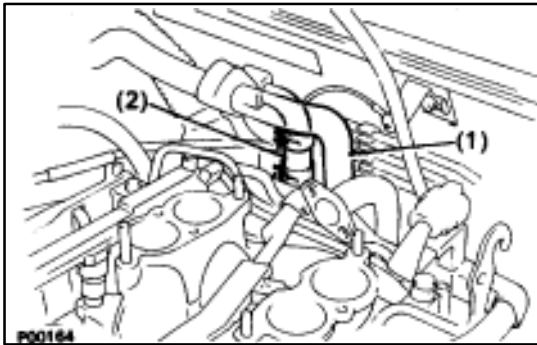
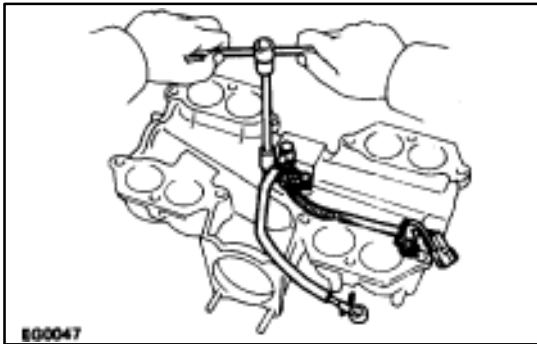
- (a) Disconnect the following connectors:
- Cold start injector connector
 - VSV connector for fuel pressure control system
 - (Exc. USA Spec.) VSV connector for EGR system
- (b) Remove the union bolt and two gaskets, and disconnect the cold start injector tube from the RH delivery pipe.



- (c) Remove the two bolts and gaskets, and disconnect the EGR pipe from the air intake chamber.



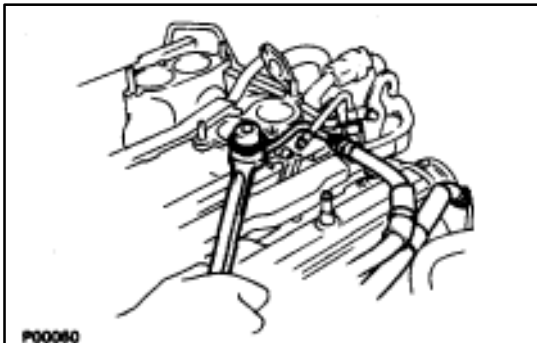
- (d) Remove the four mounting bolts, eight mounting nuts and following parts:
- (1) VSV for fuel pressure control system
 - (2) (Exc. USA Spec.)
VSV for EGR system
 - (3) A/T throttle cable bracket
- (e) Disconnect the check ("DIAGNOSIS") connector from the intake chamber.
- (f) Remove the air intake chamber and four gaskets.
- (g) Remove the three bolts, the cold start injector, tube, lead wire assembly and gasket.



21. DISCONNECT HEATER WATER HOSES

Disconnect the following hoses:

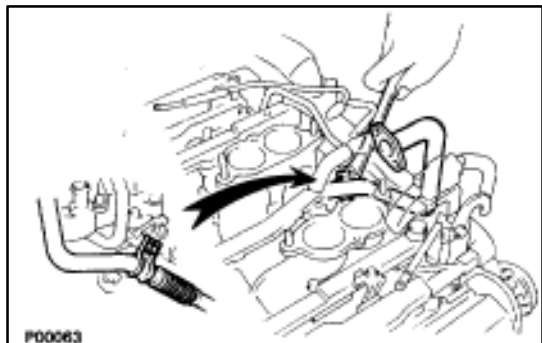
- (1) Water hose from water by-pass pipe
- (2) Water hose from rear water by-pass joint



22. DISCONNECT FUEL INLET HOSE FROM LH DELIVERY PIPE

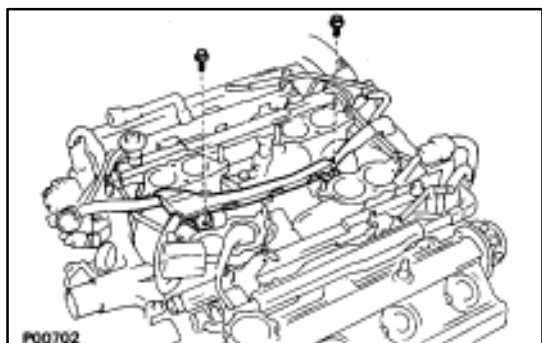
Remove the pulsation damper and two gaskets, and disconnect the inlet hose.

23. DISCONNECT FUEL RETURN HOSE FROM FUEL RETURN PIPE



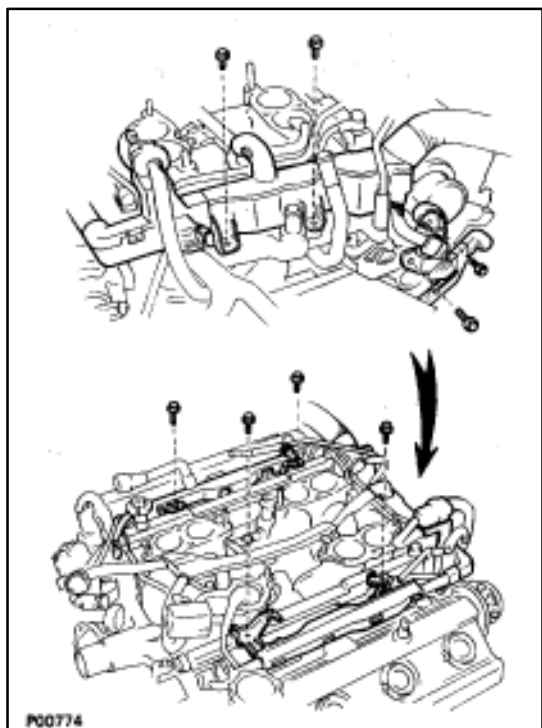
24. DISCONNECT EGR PIPE FROM RH CYLINDER HEAD

Remove the bolt holding the EGR pipe to the RH cylinder head, and disconnect the EGR pipe.



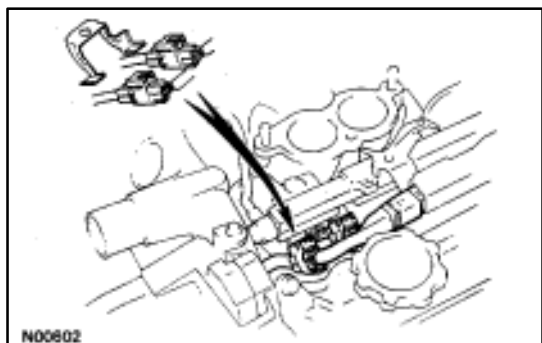
25. DISCONNECT ENGINE WIRE FROM INTAKE MANIFOLD

Remove the two bolts, and disconnect the engine wire.

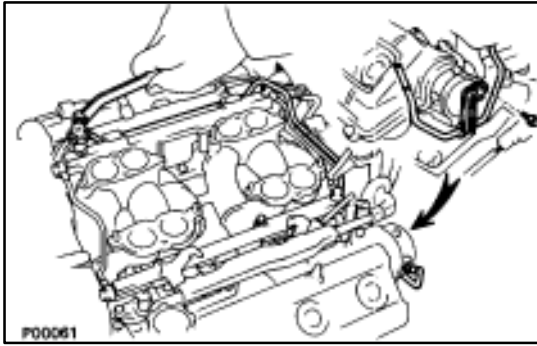


26. DISCONNECT ENGINE WIRE FROM DELIVERY PIPES, REAR WATER BY-PASS JOINT AND RH CYLINDER HEAD

- (a) Remove the four bolts holding the engine wire to the delivery pipes, and disconnect the engine wire from the delivery pipes.
- (b) Remove the two bolts holding the engine wire to the rear water by-pass joint, and disconnect the engine wire from the rear water by-pass joint.
- (c) Remove the two bolts holding the engine wire to the rear side of the RH cylinder head, and disconnect the engine wire from the engine wire RH cylinder head.

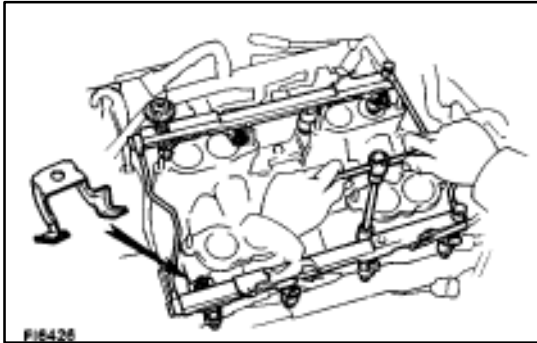


- (d) Disconnect the two engine wire connectors from the connector bracket on the front side of the LH delivery pipe.
- (e) Disconnect the eight injector connectors.



27. REMOVE FUEL RETURN PIPE

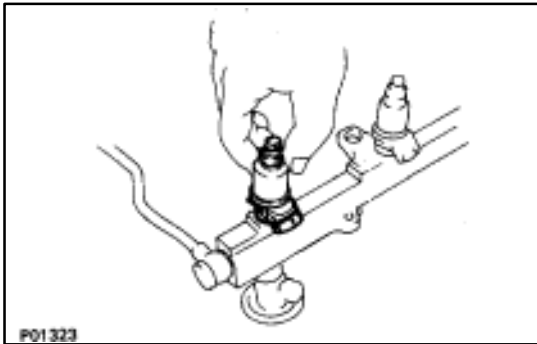
- (a) Remove the bolt holding the fuel return pipe to the rear side of the LH cylinder head.
- (b) Remove the union bolt, two gaskets and return pipe.



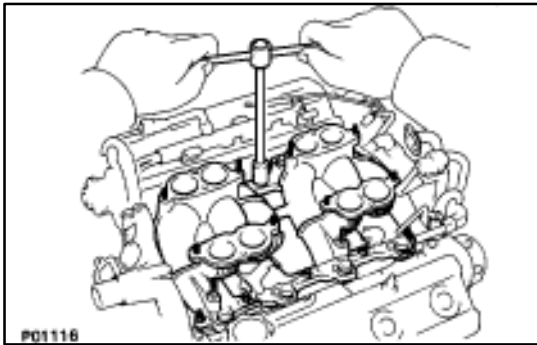
28. REMOVE DELIVERY PIPES AND INJECTORS

- (a) Remove the four nuts holding the delivery pipe to the intake manifold.
- (b) Remove the connector bracket, the two delivery pipes, eight injectors assembly, four spacers and eight insulators.

NOTICE: Be careful not to drop the injectors.

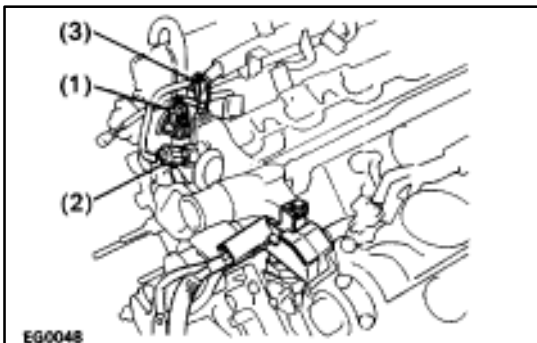


- (c) Remove the eight injectors from the delivery pipes.
- (d) Remove the O-ring and grommet from each injector.



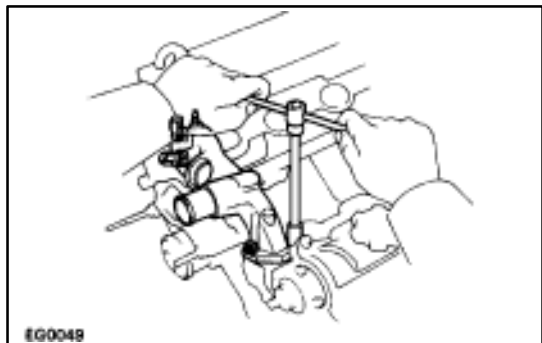
29. REMOVE INTAKE MANIFOLD

Remove the six bolts, four nuts, intake manifold and two gaskets.

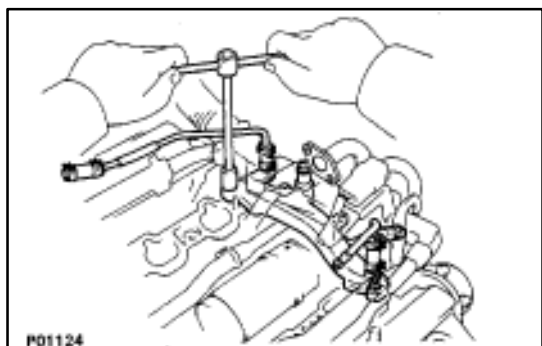


30. REMOVE FRONT WATER BY-PASS JOINT

- (a) Disconnect the following connectors:
 - (1) Water temperature sensor connector
 - (2) Cold start injector time switch connector
 - (3) Water temperature sender gauge connector
- (b) Remove the bolt, and disconnect the engine wire clamp from the water by-pass joint.

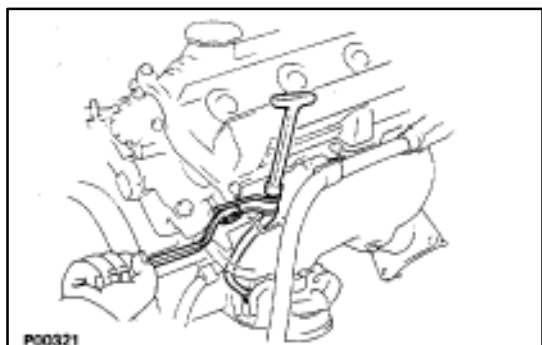


- (c) Remove the four nuts, water by-pass joint and two gaskets.



31. REMOVE REAR WATER BY-PASS JOINT

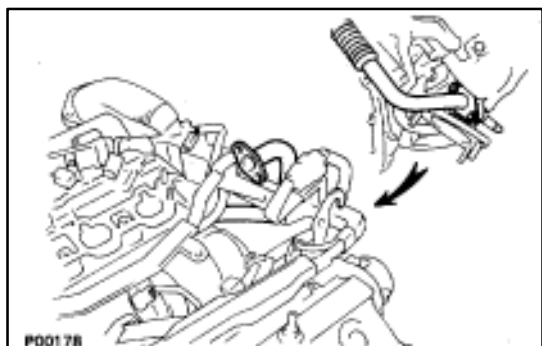
- (a) Remove the bolt holding the water by-pass pipe to the engine hanger.
 (b) Remove the four nuts, water by-pass joint and two gaskets.



32. REMOVE OIL DIPSTICK AND GUIDE FOR ENGINE

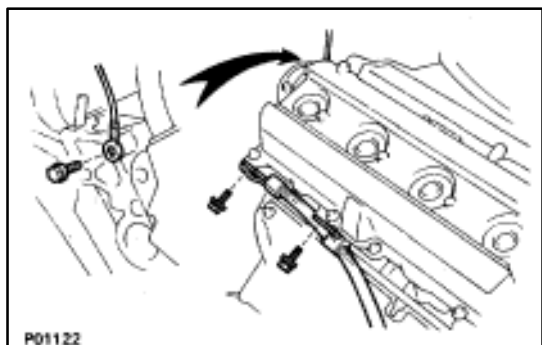
- (a) Remove the mounting bolt.
 (b) Pull out the dipstick guide together with the dipstick.
 (c) Remove the O-ring from the dipstick guide.

33. REMOVE OIL DIPSTICK AND GUIDE FOR A/T



34. REMOVE EGR PIPE

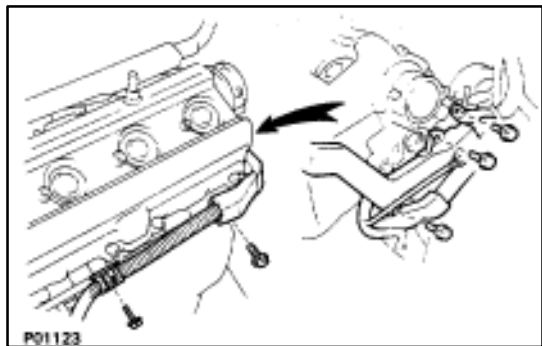
- (a) Remove the two nuts holding the EGR pipe to the RH exhaust pipe.
 (b) Remove the EGR pipe and gasket.



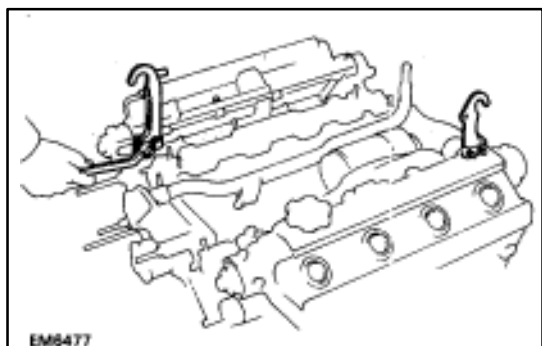
35. DISCONNECT GROUND STRAP FROM RH CYLINDER HEAD

36. DISCONNECT ENGINE WIRE FROM RH CYLINDER HEAD

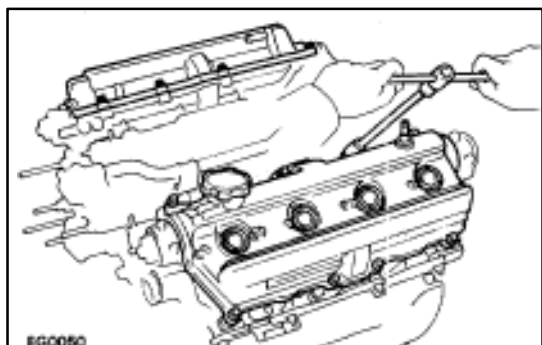
Remove the two bolts, and disconnect the engine wire.

**37. DISCONNECT ENGINE WIRE FROM LH CYLINDER HEAD**

Remove the five bolts, and disconnect the engine wire.

**38. REMOVE ENGINE HANGERS**

Remove the two bolts and engine hanger. Remove the two engine hangers.

**39. REMOVE CYLINDER HEAD COVERS**

Remove the eight bolts, seal washers, cylinder head cover and gasket. Remove the two cylinder head covers.

40. IF NECESSARY, REMOVE SEMI-CIRCULAR PLUGS**41. REMOVE CAMSHAFTS**

NOTICE: Since the thrust clearance of the camshaft is small, the camshaft must be held 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 due the camshaft to seize or break. To avoid this, the following steps should be carried out.

A. Remove exhaust camshaft from RH cylinder head

- (a) Bring the service bolt hole of the driven sub-gear upward by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.
- (b) Secure the exhaust camshaft sub-gear to the driven gear with a service bolt.

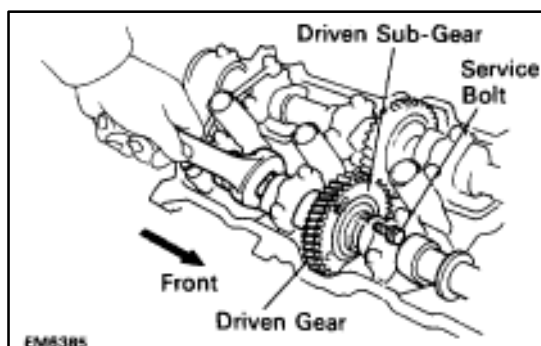
Recommended service bolt:

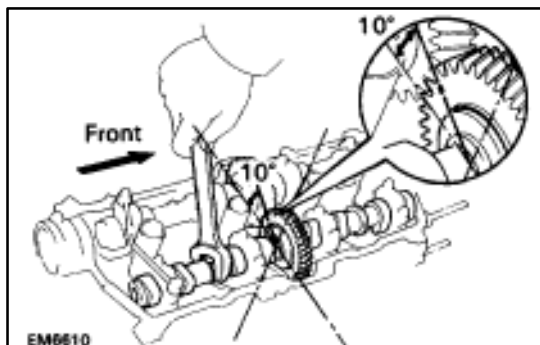
Thread diameter 6 mm

Thread pitch 1.0 mm

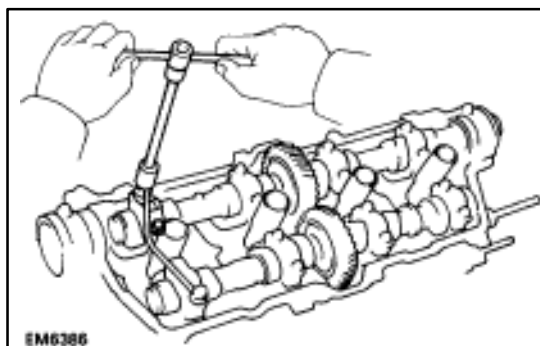
Bolt length 16–20 mm (0.63–0.79 in.)

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

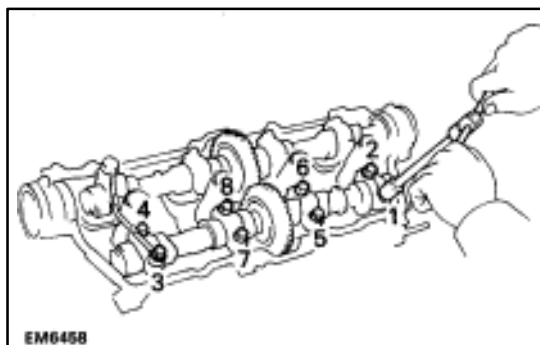




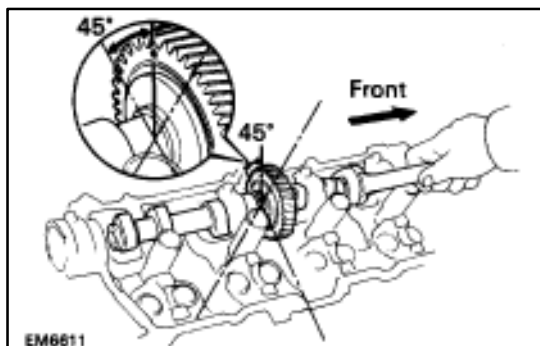
- (c) Set the timing mark (one dot mark) of the camshaft driven gear at approx. 105 angle by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.



- (d) Alternately loosen and remove the two bearing cap bolts holding the intake camshaft side of the oil feed pipe to the cylinder head.

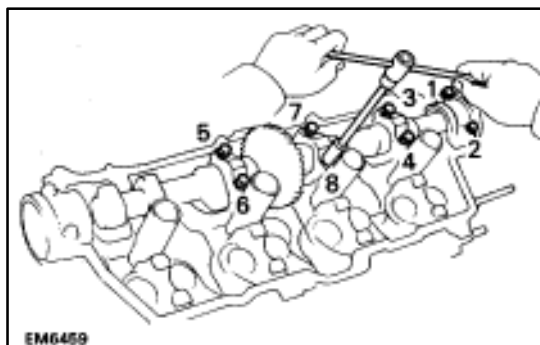


- (e) Uniformly loosen and remove the eight bearing cap bolts in several passes in the sequence shown.
 (f) Remove the oil feed pipe, four bearing caps and exhaust camshaft.

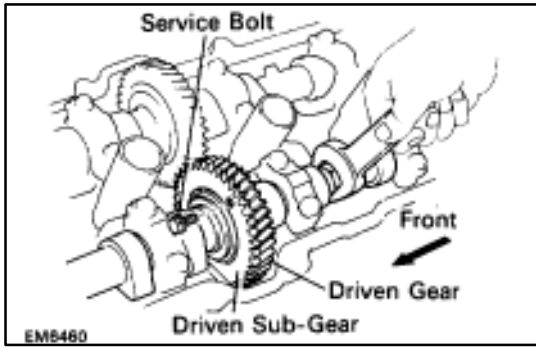


B. Remove intake camshaft from RH cylinder head

- (a) Remove the rear bearing cap.
 (b) Set the timing mark (one dot mark) of the camshaft drive gear at approx. 455 angle by turning the hexagon wrench head portion of the intake camshaft with a wrench.



- (c) Uniformly loosen and remove the eight bearing cap bolts in several passes in the sequence shown.
 (d) Remove the four bearing caps, oil seal and intake camshaft.



C. Remove exhaust camshaft from LH cylinder head

- (a) Bring the service bolt hole of the driven sub-gear upward by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.
- (b) Secure the exhaust camshaft sub-gear to the driven gear with a service bolt.

Recommended service bolt:

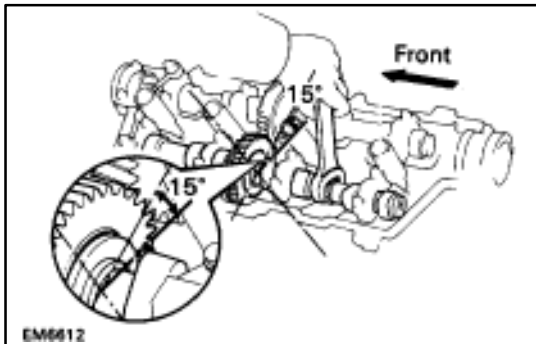
Thread diameter 6 mm

Thread pitch 1.0 mm

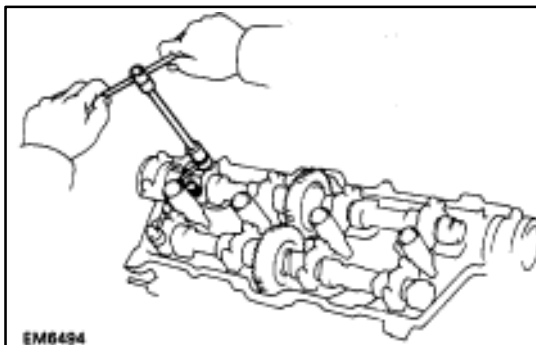
Bolt length 16–20 mm (0.63–0.79 in.)

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

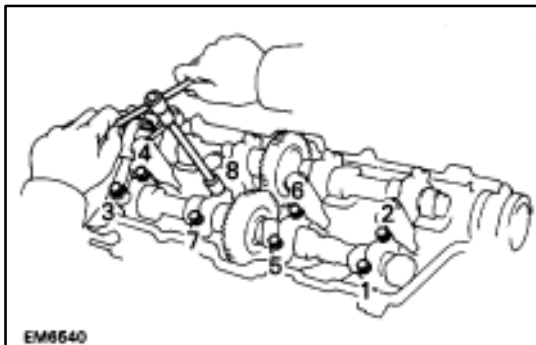
- (c) Set the timing mark (two dot marks) of the camshaft driven gear at approx. 155 angle by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.



- (d) Alternately loosen and remove the two bearing cap bolts holding the intake camshaft side of the oil feed pipe to the cylinder head.

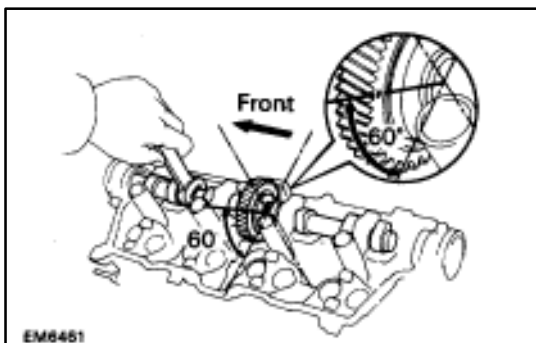


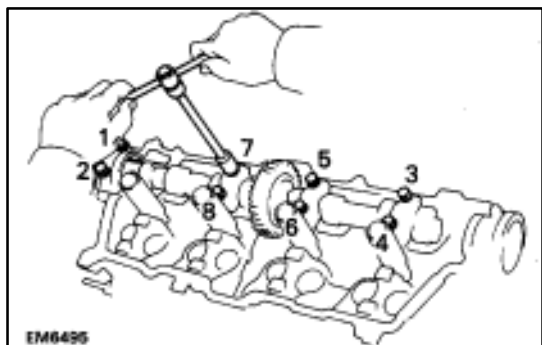
- (e) Uniformly loosen and remove the eight bearing cap bolts in several passes in the sequence shown.
- (f) Remove the oil feed pipe, four bearing caps and exhaust camshaft.



D. Remove intake camshaft from LH cylinder head

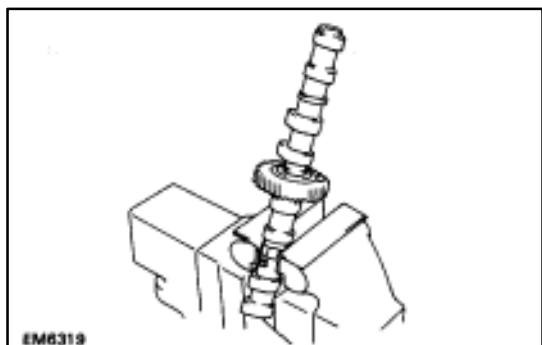
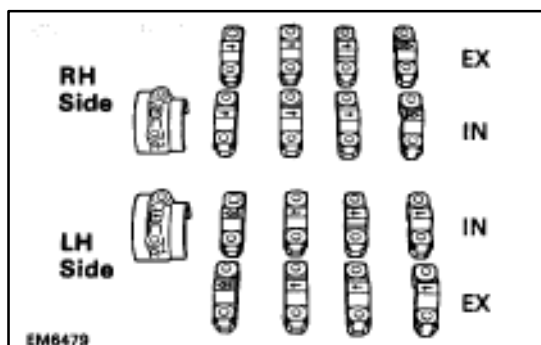
- (a) Remove the front bearing cap.
- (b) Set the timing mark (one dot mark) of the camshaft drive gear at approx. 60° angle by turning the hexagon wrench head portion of the intake camshaft with a wrench.





- (c) Uniformly loosen and remove the eight bearing cap bolts in several passes in the sequence shown.
- (d) Remove the four bearing caps, oil seal and intake camshaft.

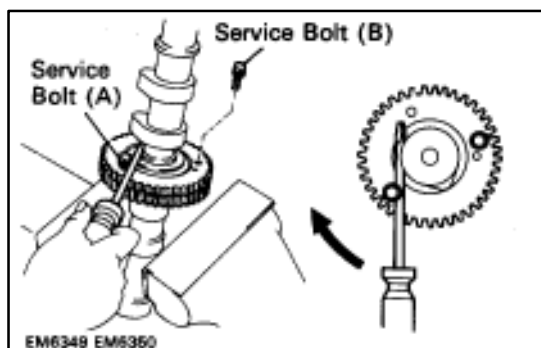
HINT: Arrange the bearing caps in correct order.



42. DISASSEMBLE EXHAUST CAMSHAFTS

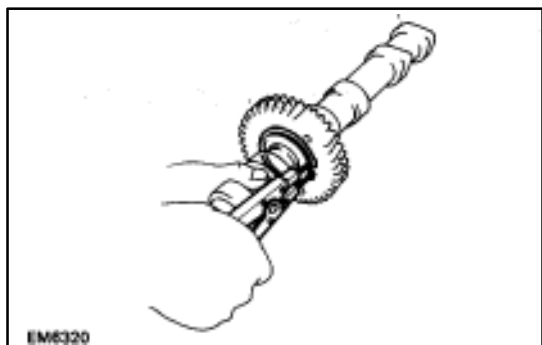
- (a) Mount the hexagon wrench head portion of the camshaft in a vise.

NOTICE: Be careful not to damage the camshaft.

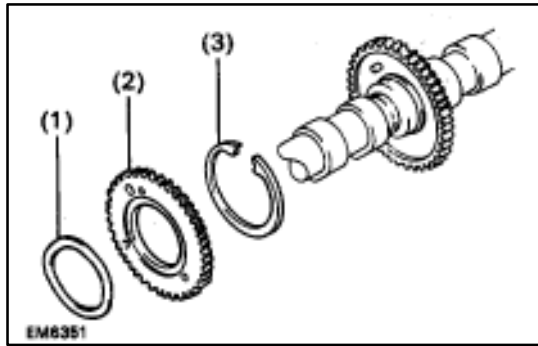


- (b) Insert a service bolt (A) into the service hole of the camshaft sub-gear.
- (c) Using a screwdriver, turn the sub-gear clockwise, and remove the service bolt (B).

NOTICE: Be careful not to damage the camshaft.



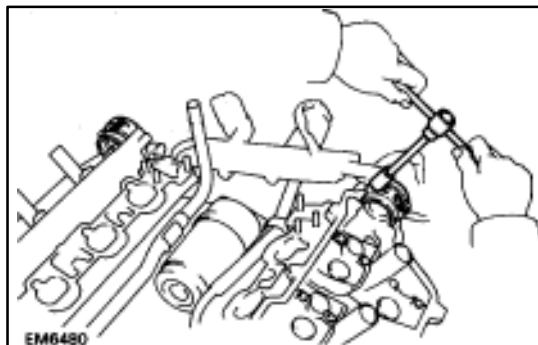
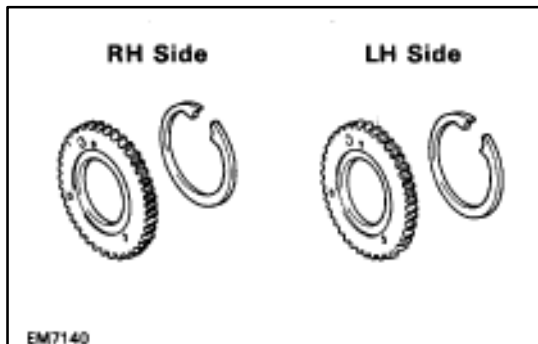
- (d) Using snap ring pliers, remove the snap ring.



(e) Remove the following parts:

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

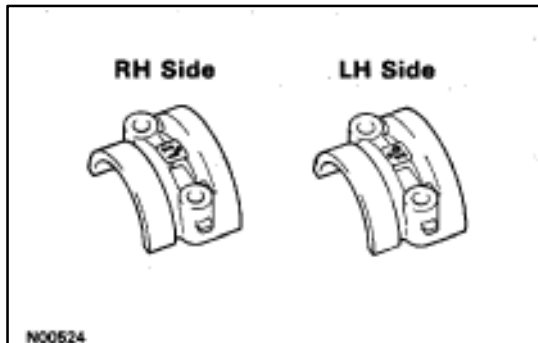
HINT: Arrange the camshaft sub-gears and gear springs (RH side and LH side).



43. REMOVE CIRCULAR PLUGS

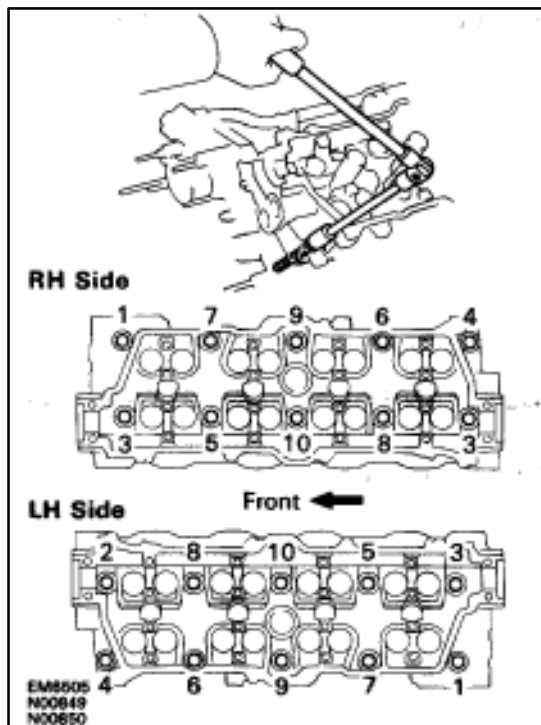
Remove the two bolts, seal washers, bearing cap and circular plug. Remove the two circular plugs.

HINT: Arrange the bearing caps (RH side and LH side).



44. DISCONNECT MAIN OXYGEN SENSOR CONNECTORS

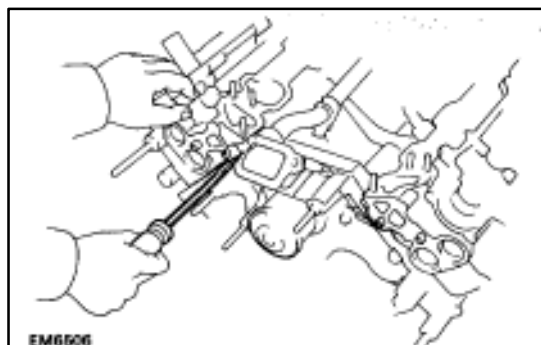
Disconnect the RH and LH oxygen sensor connector.



45. REMOVE CYLINDER HEADS

- (a) Uniformly loosen the ten cylinder head bolts on one side of each cylinder head in several passes in the sequence shown, then do the other side as shown. Remove the twenty cylinder head bolts and plate washers.

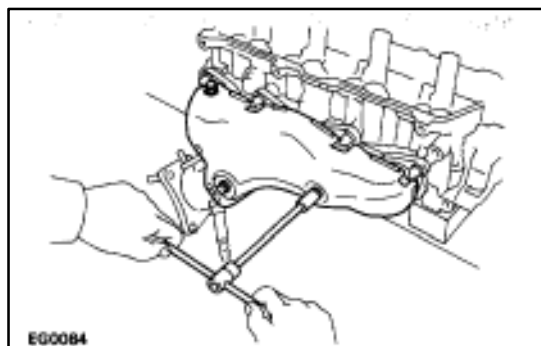
NOTICE: Head warpage or cracking could result from removing bolts in an incorrect order.



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

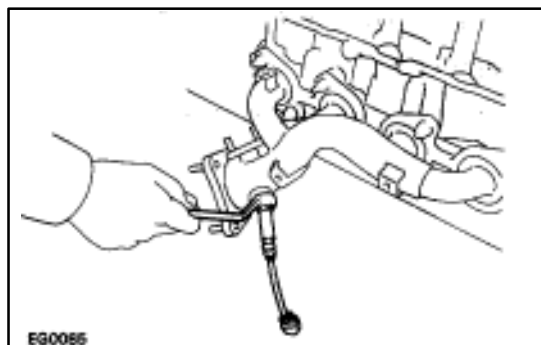
HINT: If the cylinder head is difficult to lift off, pry between the cylinder head and cylinder block with a screwdriver.

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

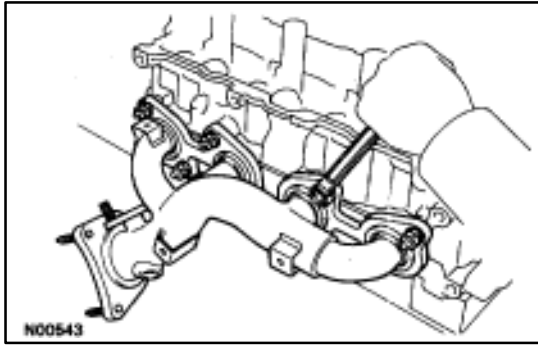


46. REMOVE EXHAUST MANIFOLD FROM RH CYLINDER HEAD

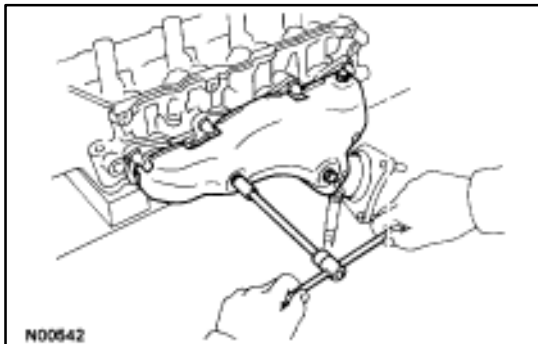
- (a) Remove the three bolts and heat insulator.



- (b) Remove the main oxygen sensor.

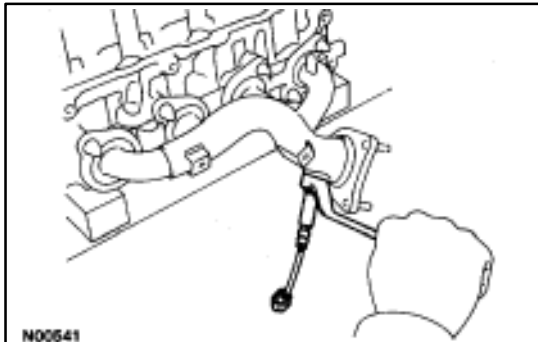


(c) Remove the eight nuts, exhaust manifold and gasket.

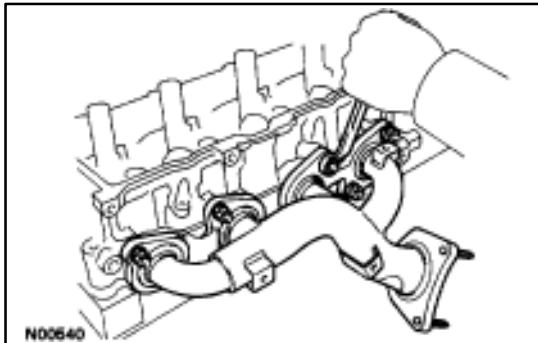


47. REMOVE EXHAUST MANIFOLD FROM LH CYLINDER HEAD

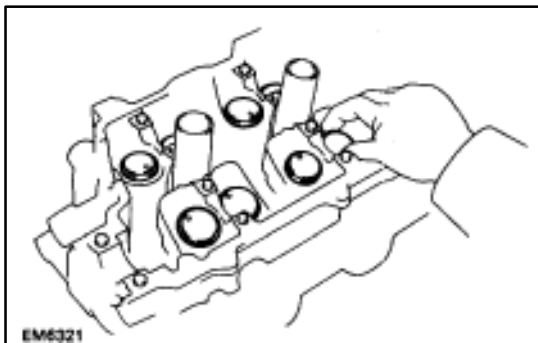
(a) Remove the three bolts and heat insulator.



(b) Remove the main oxygen sensor.



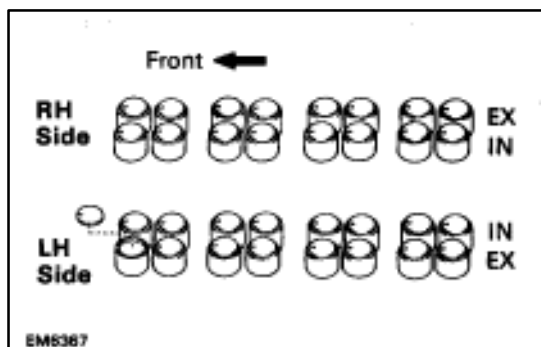
(c) Remove the eight nuts, exhaust manifold and gasket.



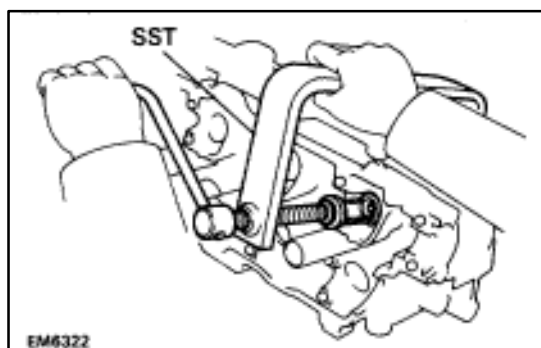
DISASSEMBLY OF CYLINDER HEADS

(See Components on page [EM-59](#))

1. REMOVE VALVE LIFTERS AND ADJUSTING SHIMS



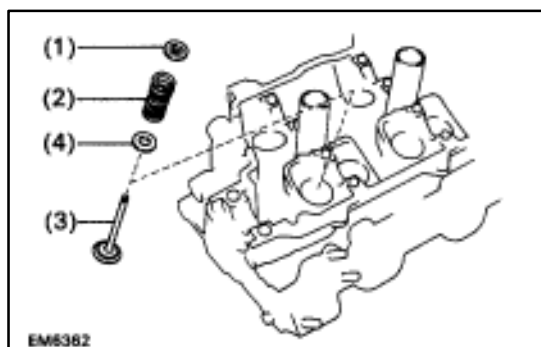
HINT: Arrange the valve lifters and adjusting shims in correct order.



2. REMOVE VALVES

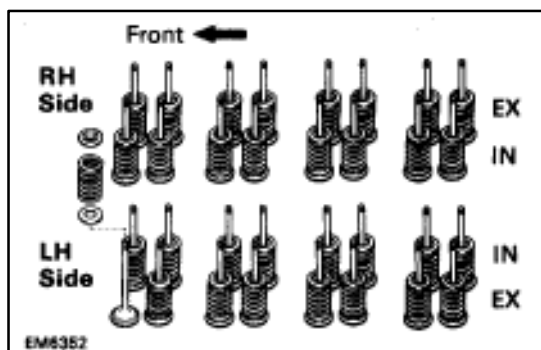
(a) Using SST, compress the valve spring and remove the two keepers.

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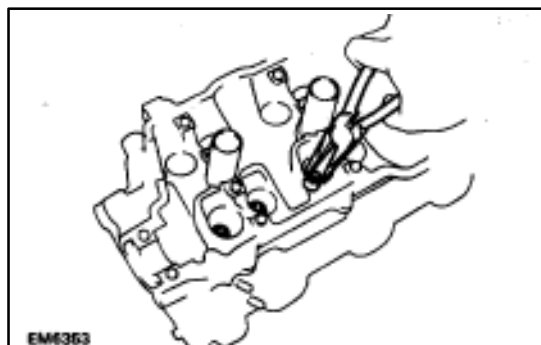


(b) Remove the following parts:

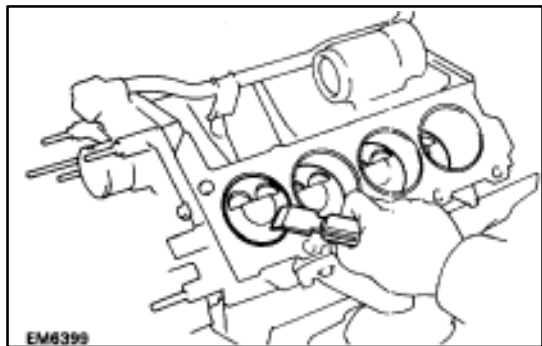
- (1) Spring retainer
- (2) Valve spring
- (3) Valve
- (4) Spring seat



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



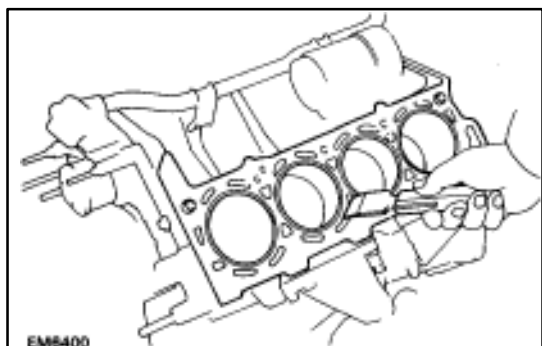
(c) Using needle-nose pliers, remove the oil seal.



INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

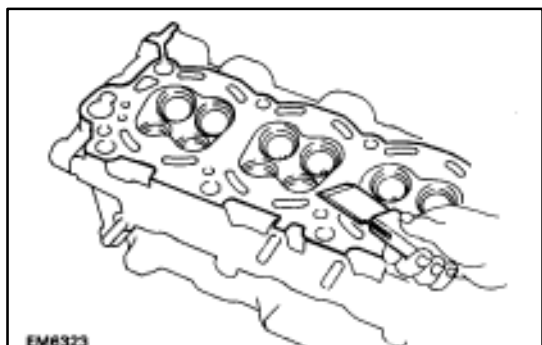
- (a) Turn the crankshaft and bring each piston to top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston top surfaces.



- (b) Using a gasket scraper, remove all the gasket material from the top surfaces of the cylinder block.

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

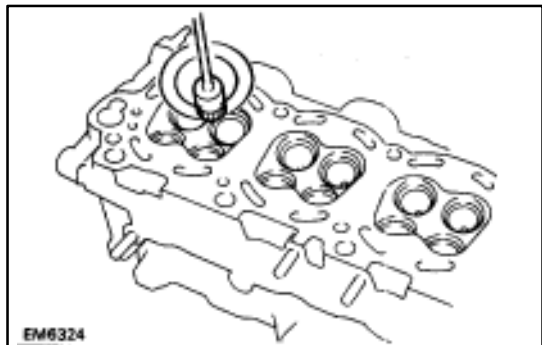
CAUTION: Protect your eyes when using high-pressure compressed air.



2. CLEAN CYLINDER HEADS

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

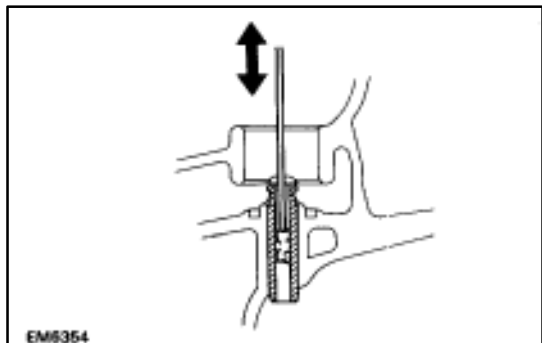
NOTICE: Be careful not to scratch the cylinder block contact surface.



- B. Clean combustion chambers

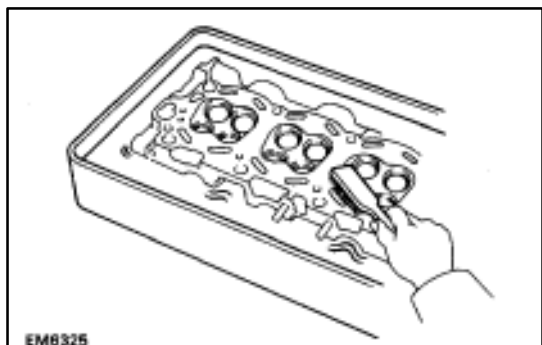
Using a wire brush, remove all the carbon from the combustion chambers.

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



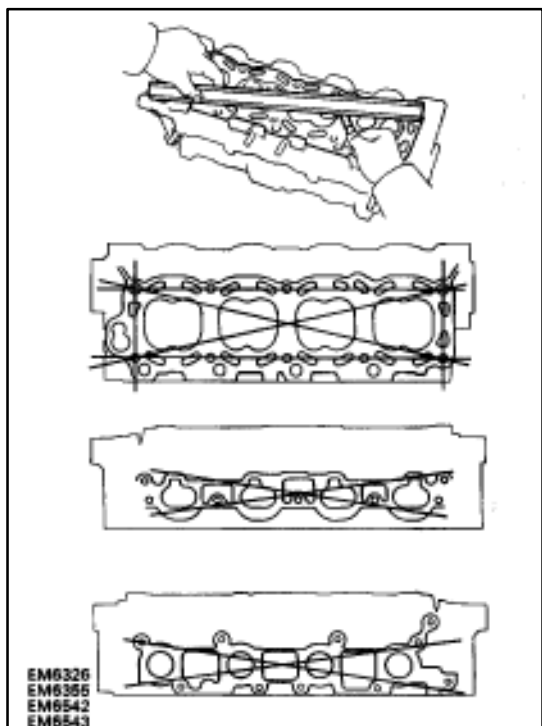
- C. Clean valve guide bushings

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



D. Clean cylinder heads

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



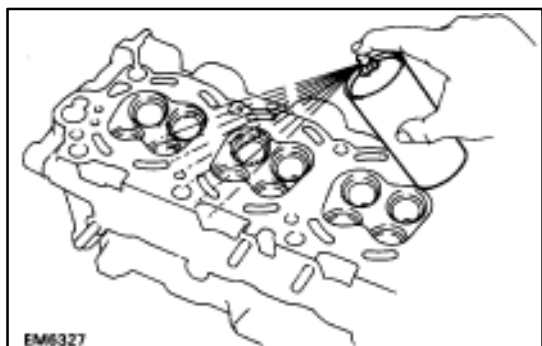
3. INSPECT CYLINDER HEADS

A. Inspect for flatness

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

Maximum warpage: 0.10 mm (0.0039 in.)

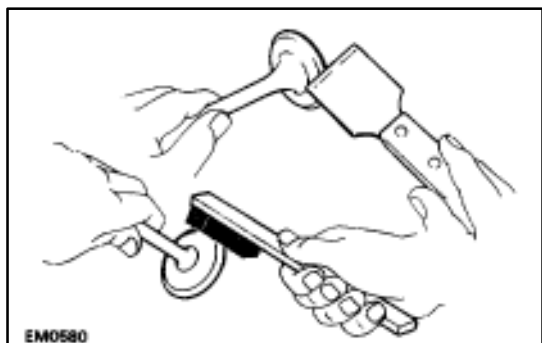
If warpage is greater than maximum, replace the cylinder head.



B. Inspect for cracks

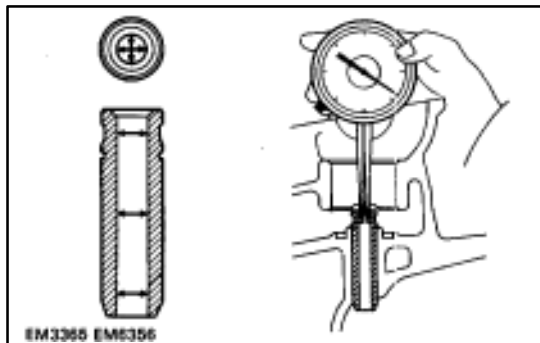
Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.

If cracked, replace the cylinder head.



4. CLEAN VALVES

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

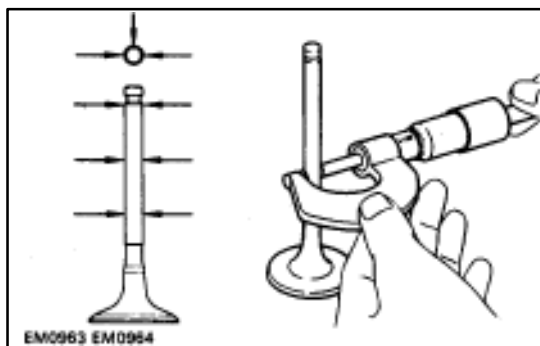


5. INSPECT VALVE STEMS AND GUIDE BUSHINGS

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

Bushing inside diameter:

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 diameter measurement of the valve stem from the inside diameter measurement of the guide bushing.

Standard oil clearance:

Intake 0.025–0.060 mm

(0.0010–0.0024 in.)

Exhaust 0.030–0.065 mm

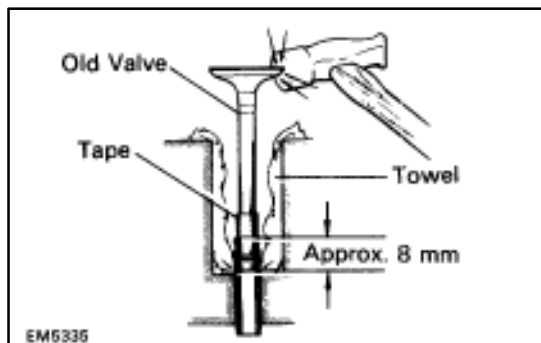
(0.0012–0.0026 in.)

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.

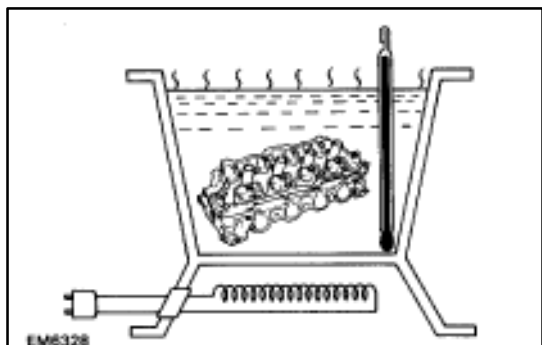


6. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

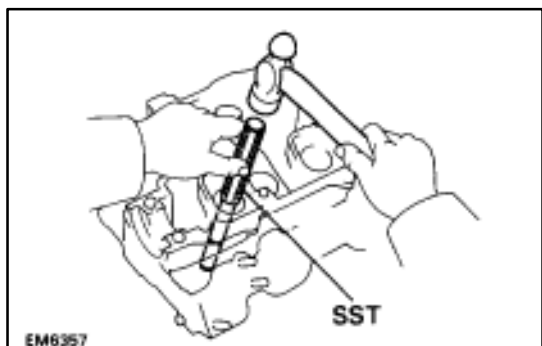
- (a) Insert an old valve wrapped with tape into the valve guide bushing, and break off the valve guide bushing by hitting it with a hammer. Remove the snap ring.

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

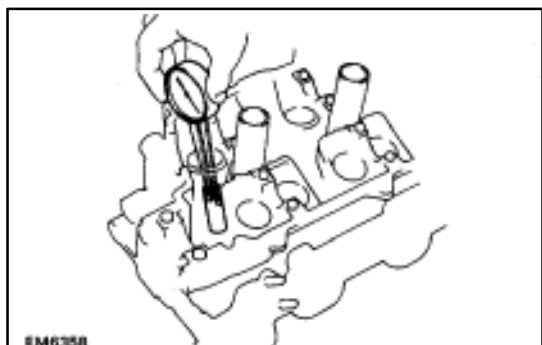
NOTICE: Be careful not to damage the valve lifter hole.



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



- (c) Using SST and a hammer, tap out the guide bushing.
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- (d) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.

Both intake and exhaust

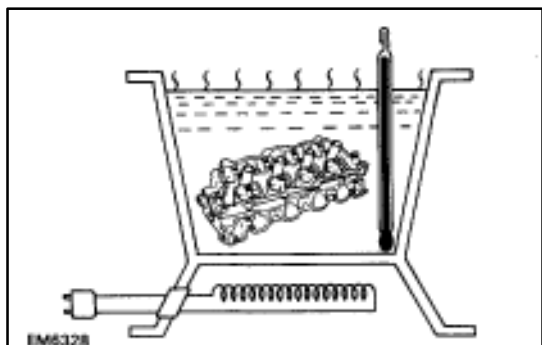
Bushing bore diameter mm (in.)	Bushing size
11.000–11.027 (0.4331–0.4342)	Use STD
11.050–11.077 (0.4350–0.4361)	Use O/S 0.05

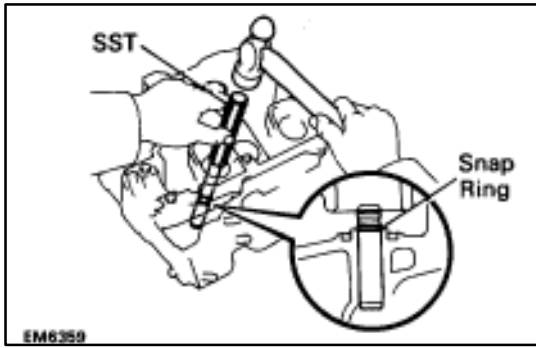
- (e) Select a new guide bushing (STD size or O/S 0.05).
If the bushing bore diameter of the cylinder head is greater than 11.027 mm (0.4341 in.), grind the bushing bore to the following dimension:

11.050–11.077 mm (0.4350–0.4361 in.)

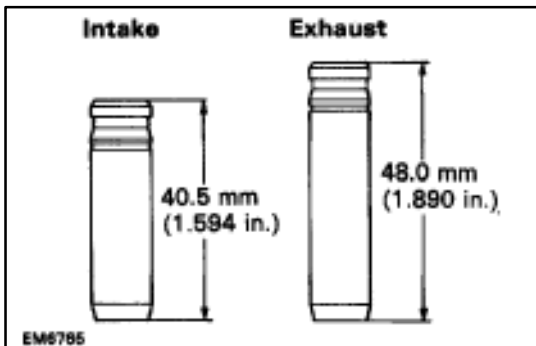
If the bushing bore diameter of the cylinder head is greater than 11.077 mm (0.4361 in.), replace the cylinder head.

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

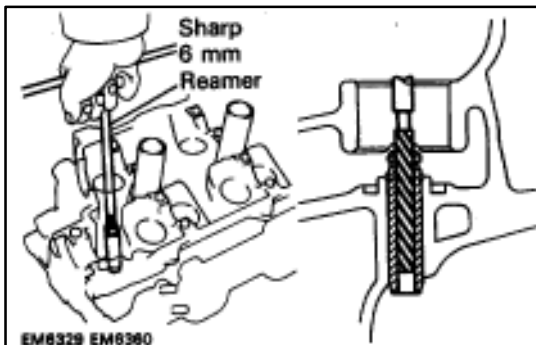




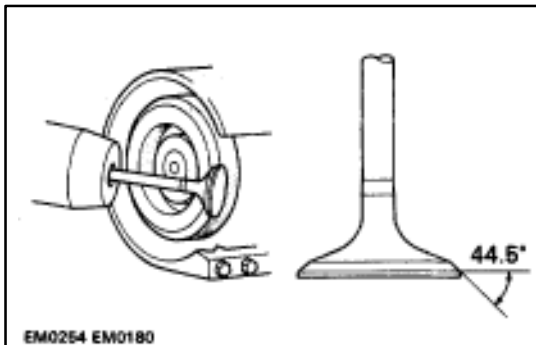
- (g) Using SST and a hammer, tap in a new guide bushing until the snap ring makes contact with the cylinder head.
SST 09201-70010



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



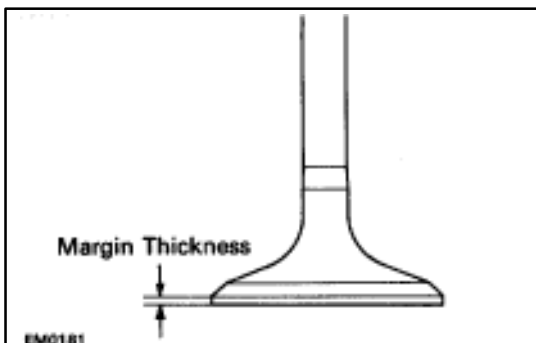
- (h) Using a sharp 6 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page [EM-80](#)) between the guide bushing and valve stem.



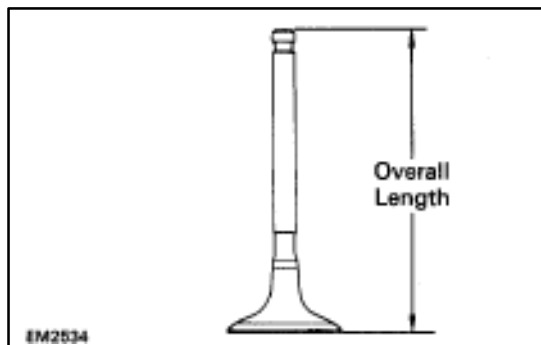
7. INSPECT AND GRIND VALVES

- (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: 1.0 mm (0.039 in.)
Minimum margin thickness: 0.5 mm (0.020 in.)
If the margin thickness is less than minimum, replace the valve.



(d) Check the valve overall length.

Standard overall length:

Intake 94.95 mm (3.7382 in.)

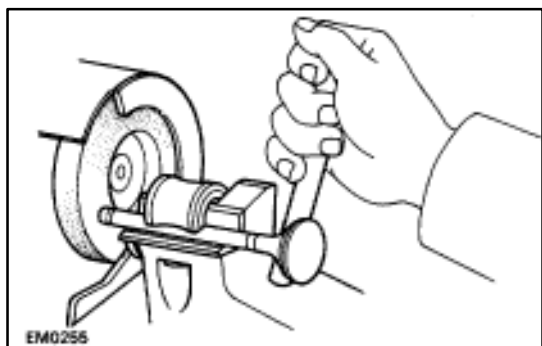
Exhaust 96.90 mm (3.8150 in.)

Minimum overall length:

Intake 94.45 mm (3.7185 in.)

Exhaust 96.40 mm (3.7953 in.)

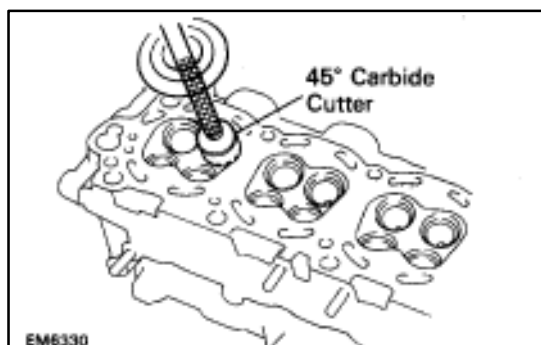
If the overall length is less than minimum, replace the valve.



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

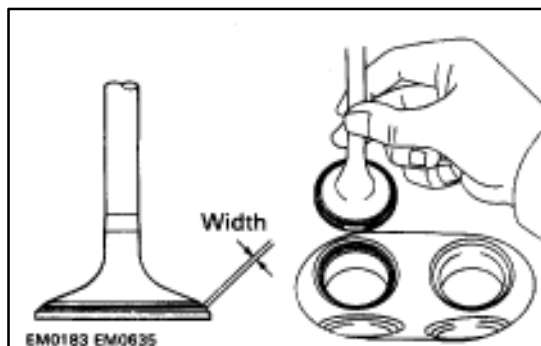
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

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



8. INSPECT AND CLEAN VALVE SEATS

(a) Using a 455 carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.



(b) Check the valve seating position.

Apply a thin coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate the valve.

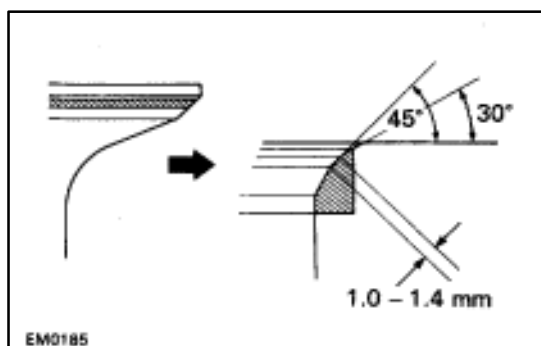
(c) Check the valve face and seat for the following:

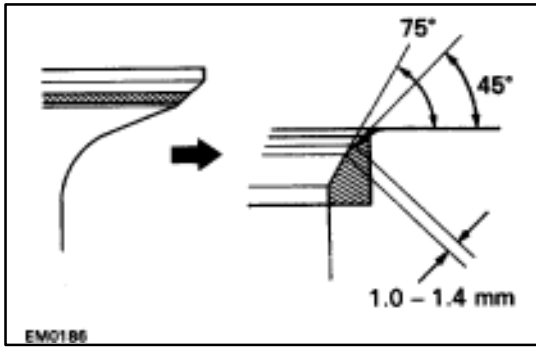
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is on the middle of the valve face with the following width:

1.0–1.4 mm (0.039–0.055 in.)

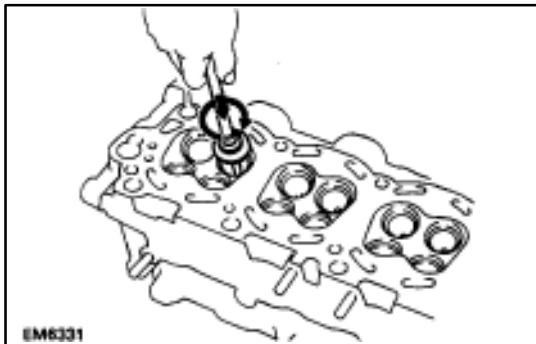
If not, correct the valve seats as follows:

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

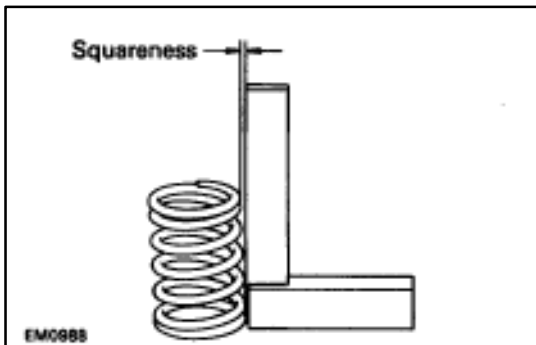




- (2) If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.



- (d) Hand-lap the valve and valve seat with an abrasive compound.
(e) After hand-lapping, clean the valve and valve seat.

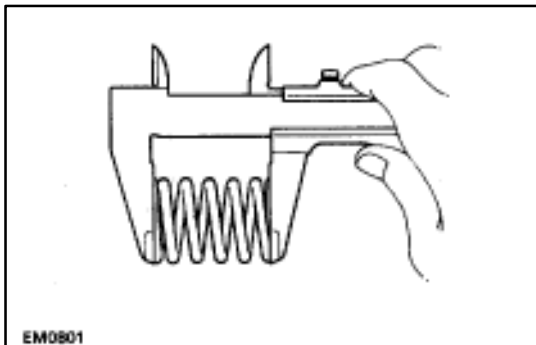


9. INSPECT VALVE SPRINGS

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

Maximum squareness: 2.0 mm (0.079 in.)

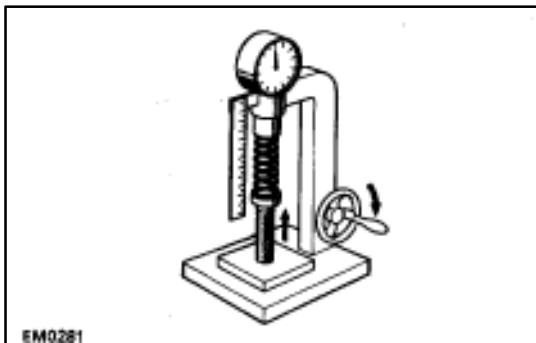
If squareness is greater than maximum, replace the valve spring.



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

Free length: 43.6 mm (1.717 in.)

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

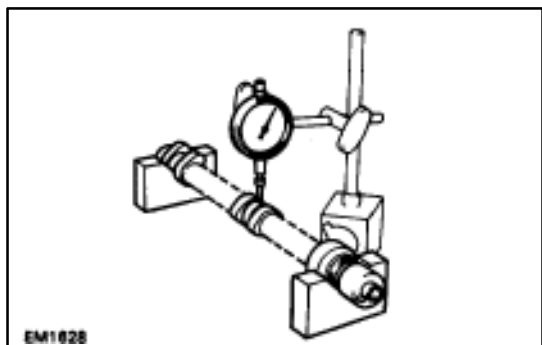


- (c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

Installed tension (at 32.9 mm (1.295 in.):

186–206 N (19.0–21.0 kgf, 41.9–46.3 lbf)

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



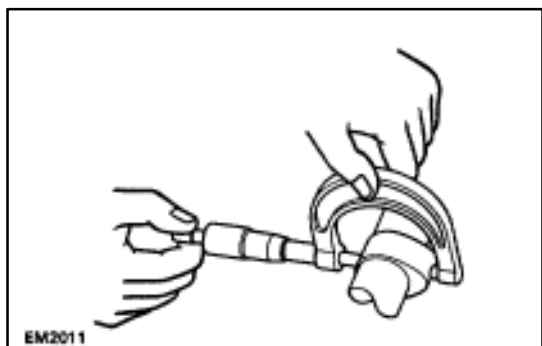
10. INSPECT CAMSHAFTS AND BEARINGS

A. Inspect camshaft for runout

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

Maximum circle runout: 0.08 mm (0.0031 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 41.710–41.810 mm

(1.6421–1.6461 in.)

Exhaust 41.910–42.010 mm

(1.6500–1.6539 in.)

Minimum cam lobe height:

Intake 41.56 mm (1.6362 in.)

Exhaust 41.76 mm (1.6441 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:

Exhaust camshaft thrust portion (A)

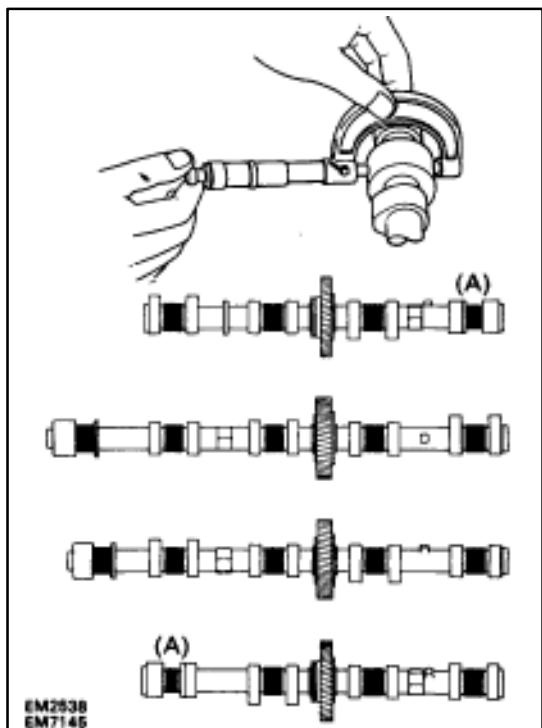
23.959–23.975 mm

(0.9433–0.9439 in.)

Others 26.954–26.970 mm

(1.0612–1.0618 in.)

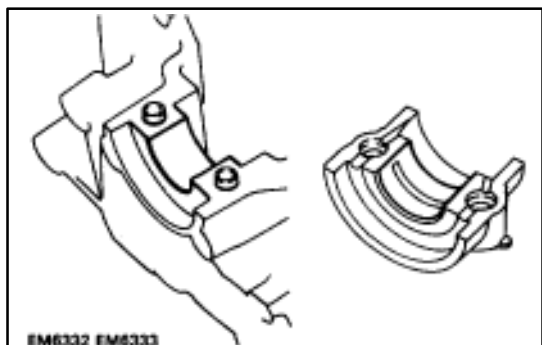
If the journal diameter is not as specified, check the oil clearance.

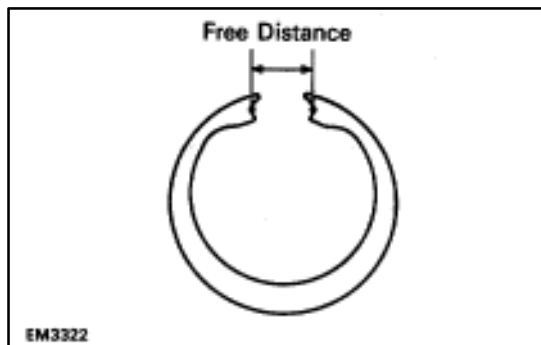


D. Inspect camshaft bearings

Check the bearings for flaking and scoring.

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



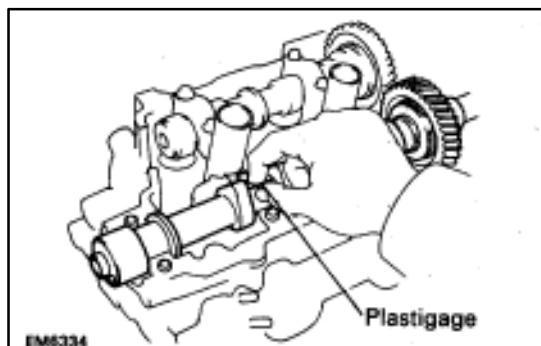


E. Inspect camshaft gear spring

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

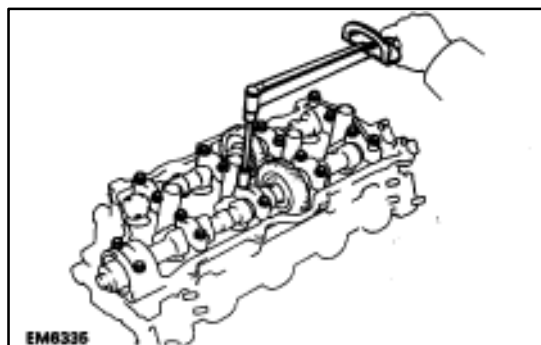
Free distance: 18.2–18.8 mm (0.712–0.740 in.)

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



F. 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.

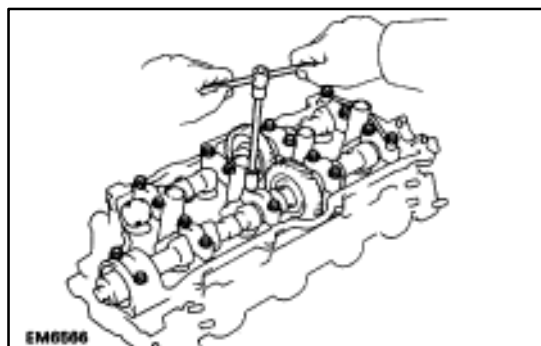


- (d) Install the bearing caps.

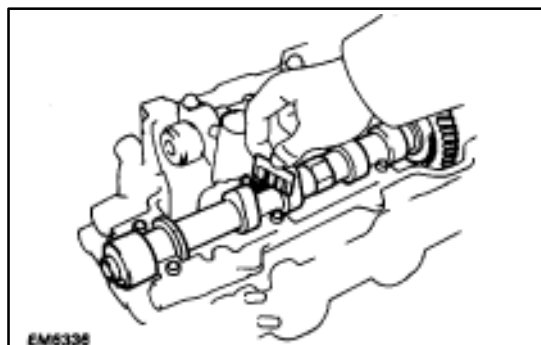
(See step 7 on pages [EM-95](#) to 101)

Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

NOTICE: Do not turn the camshaft.



- (e) Remove the bearing caps.



- (f) Measure the Plastigage at its widest point.

Standard oil clearance:

Exhaust camshaft thrust portion

0.025–0.061 mm

(0.0010–0.0024 in.)

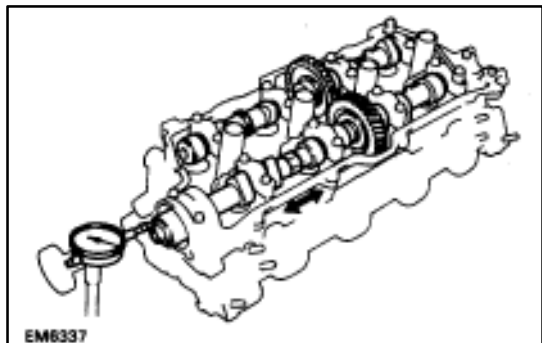
Others 0.030–0.067 mm

(0.0012–0.0026 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

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

- (g) Completely remove the Plastigage.



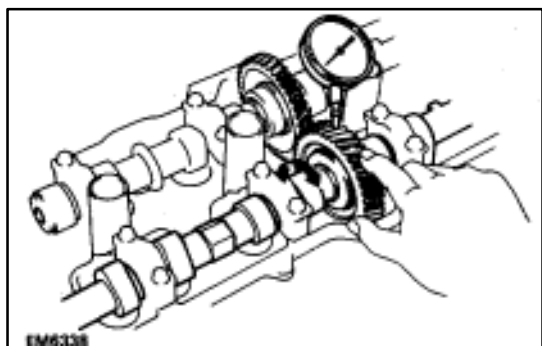
G. Inspect camshaft thrust clearance

- (a) Install the camshafts.
(See step 7 on pages [EM-95](#) to 101)
- (b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance: 0.040–0.090 mm
(0.0016–0.0035 in.)

Maximum thrust clearance: 0.12 mm (0.0047 in.)

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



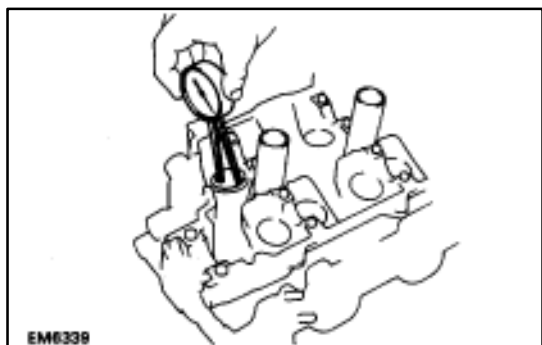
H. Inspect camshaft gear backlash

- (a) Install the camshafts without installing the exhaust camshaft sub-gear.
(See step 7 on pages [EM-95](#) to 101)
- (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.)

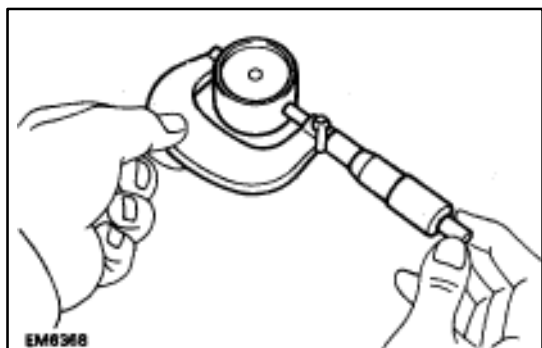
If the backlash is greater than maximum, replace the camshafts.



11. INSPECT VALVE LIFTERS AND LIFTER BORES

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

Lifter bore diameter: 31.000–31.016 mm
(1.2205–1.2211 in.)



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

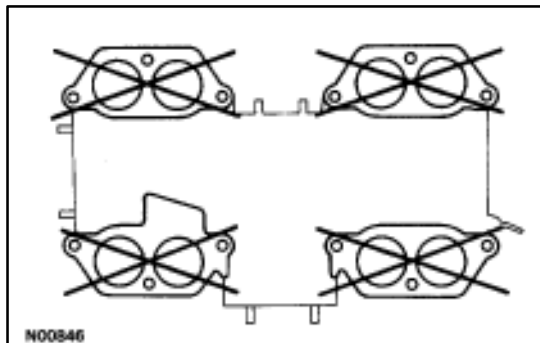
Lifter diameter: 30.966–30.976 mm
(1.2191–1.2195 in.)

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

Standard oil clearance: 0.024–0.050 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.

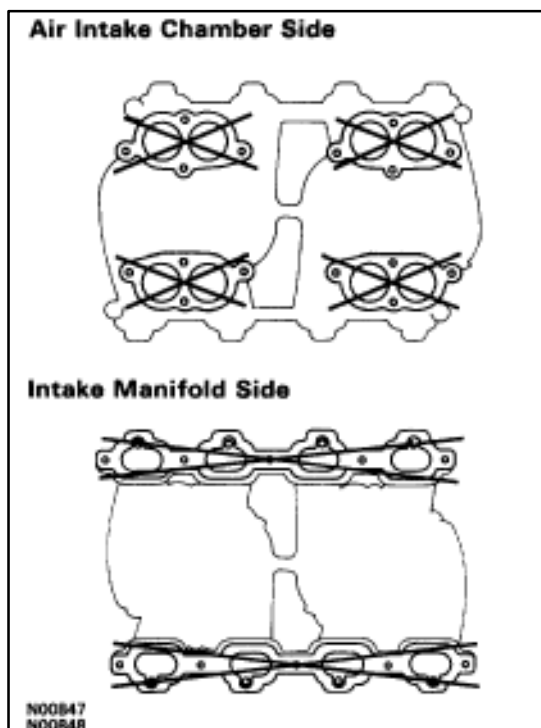


12. INSPECT AIR INTAKE CHAMBER

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

Maximum warpage: 0.15 mm (0.0059 in.)

If warpage is greater than maximum, replace the chamber.

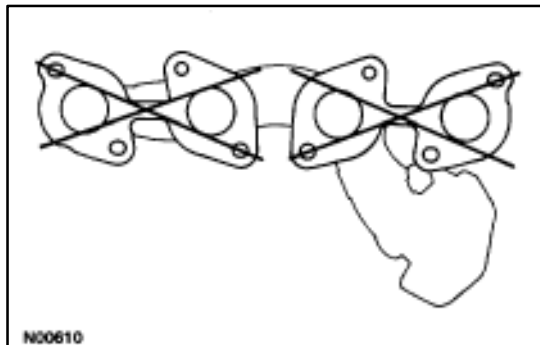


13. INSPECT INTAKE MANIFOLD

Using a precision straight edge and feeler gauge, measure the surfaces contacting the cylinder head and air intake chamber for warpage.

Maximum warpage: 0.15 mm (0.0059 in.)

If warpage is greater than maximum, replace the manifold.

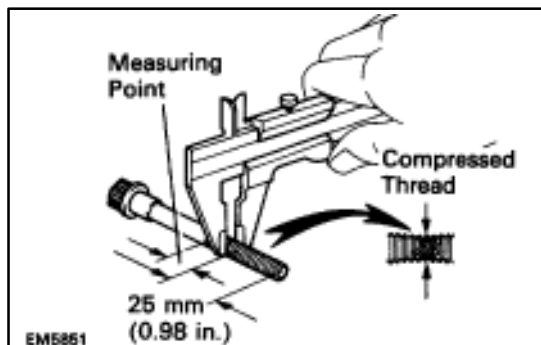


14. INSPECT EXHAUST MANIFOLD

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

Maximum warpage: 1.00 mm (0.0394 in.)

If warpage is greater than maximum, replace the manifold.



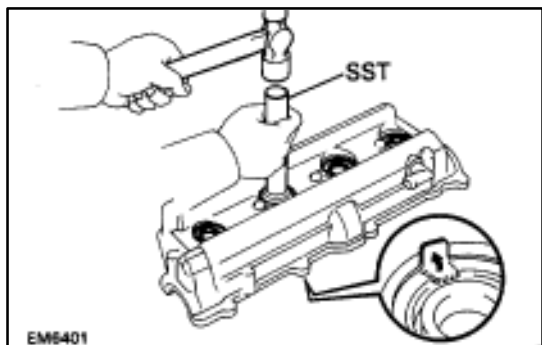
15. INSPECT CYLINDER HEAD BOLTS

Using a vernier caliper, measure the thread outside diameter of the bolt.

**Standard outside diameter: 9.770–9.960 mm
(0.3846–0.3921 in.)**

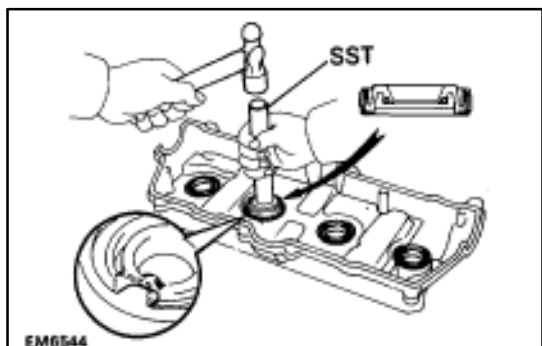
Minimum outside diameter: 9.60 mm (0.3780 in.)

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



16. IF NECESSARY, REPLACE SPARK PLUG TUBE GASKETS

- (a) Bend the ventilation case claw installed on the cylinder head cover to an angle of 90° or more.
- (b) Using SST and a hammer, tap out the gasket.
SST 09550-10012 (09552-10010, 09560-10010)



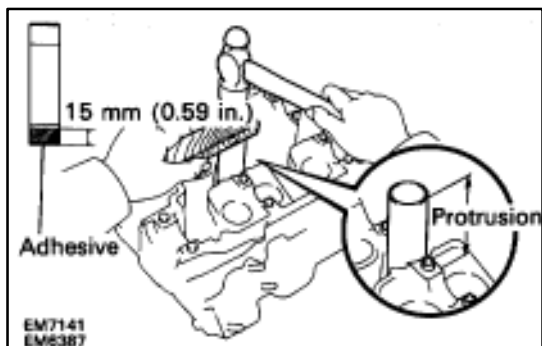
- (c) Using SST and a hammer, tap in a new gasket until its surface is flush with the upper edge of the cylinder head cover.
SST 09550-10012 (09552-10010, 09560-10010)
- (d) Apply a light coat of MP grease to the gasket lip.
- (e) Return the ventilation case claw to its original position.

ASSEMBLY OF CYLINDER HEADS

(See Components on page [EM-59](#))

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 SPARK PLUG TUBES

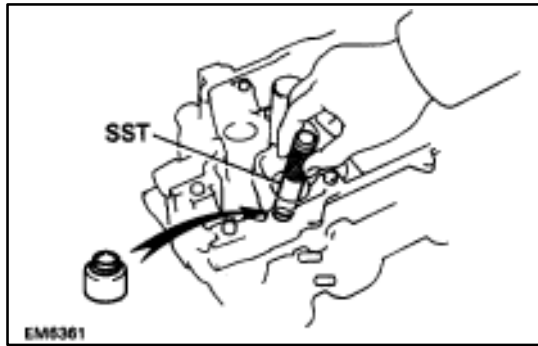
HINT: When using a new cylinder head, spark plug tubes must be installed.

- (a) Apply adhesive to the end of the spark plug tube.

Adhesive: Part No.08833-00070, THREE BOND 1324 or equivalent

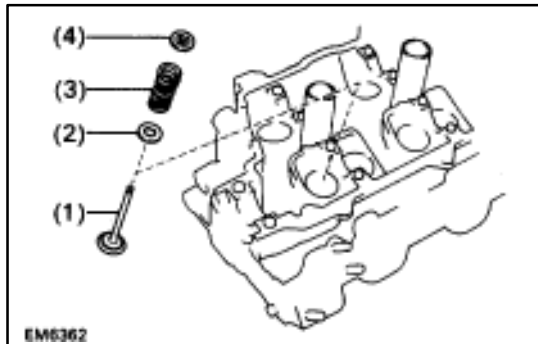
- (b) Using a wooden block and hammer, tap in a new spark plug tube until there is 48.7–49.3 mm (1.917 –1.941 in.) protruding from the camshaft bearing cap installation surface of the cylinder head.

NOTICE: Avoid tapping a new spark plug tube in too far by measuring the amount of protrusion while tapping.

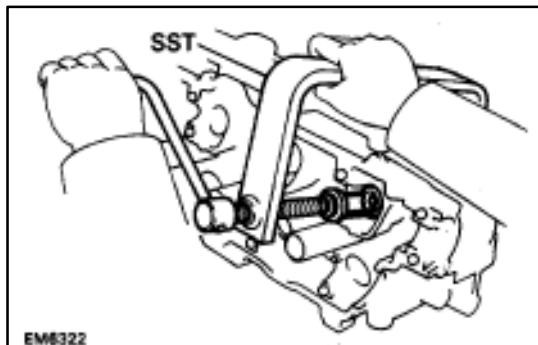


2. INSTALL VALVES

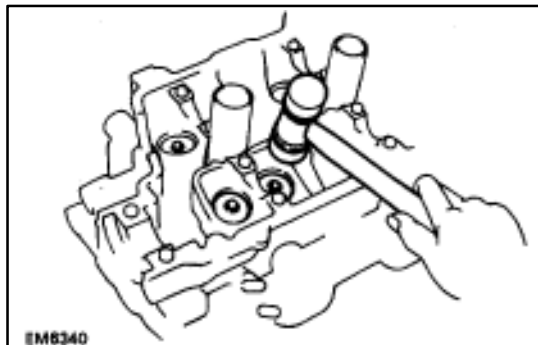
- (a) Using SST, push in a new oil seal.
SST 09201-41020



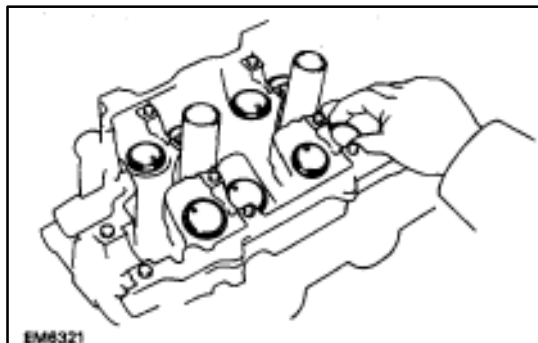
- (b) Install the following parts:
- (1) Valve
 - (2) Spring seat
 - (3) Valve spring
 - (4) Spring retainer



- (c) Using SST, compress the valve spring and place the two keepers around the valve stem.
SST 09202-70010

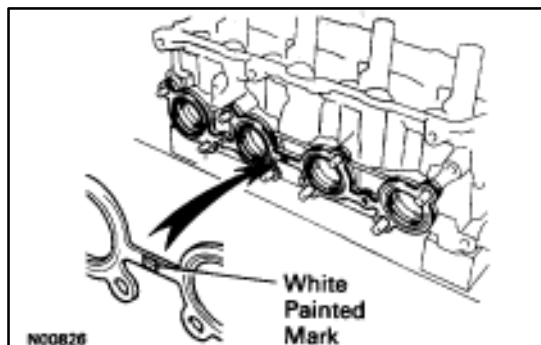


- (d) Using a plastic-faced hammer, lightly tap the valve stem tip to assure proper fit.



3. INSTALL VALVE LIFTERS AND SHIMS

Check the valve lifter rotates smoothly by hand.



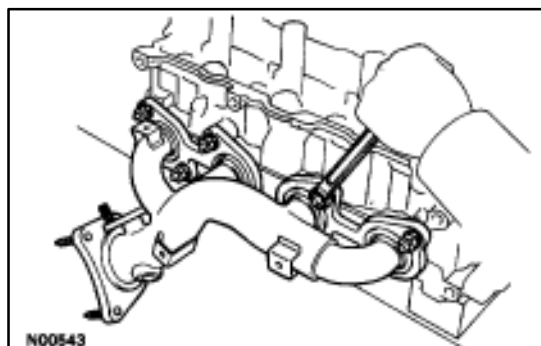
INSTALLATION OF CYLINDER HEADS

(See Components on pages [EM-58](#) and [59](#))

1. INSTALL RH EXHAUST MANIFOLD TO RH CYLINDER HEAD

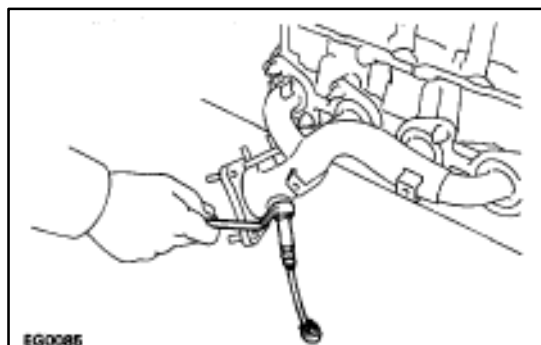
- (a) Place a new gasket on the cylinder head with the white painted marks facing the manifold side.

NOTICE: Be careful of the installation direction.



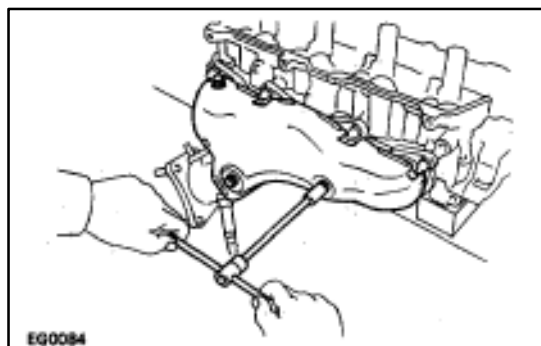
- (b) Install the exhaust manifold with the eight new nuts. Uniformly tighten the nuts in several passes.

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

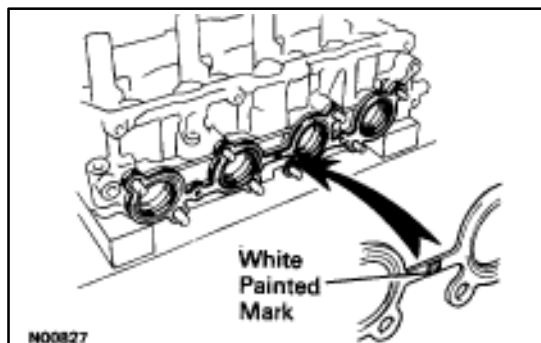


- (c) Install the main oxygen sensor.

Torque: 44 N·m (450 kgf·cm, 33 ft·lbf)



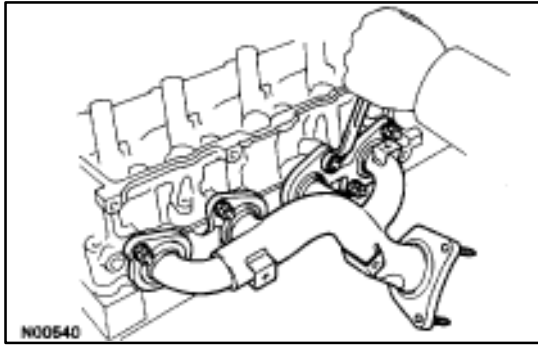
- (d) Install the heat insulator with the three bolts.



2. INSTALL LH EXHAUST MANIFOLD TO LH CYLINDER HEAD

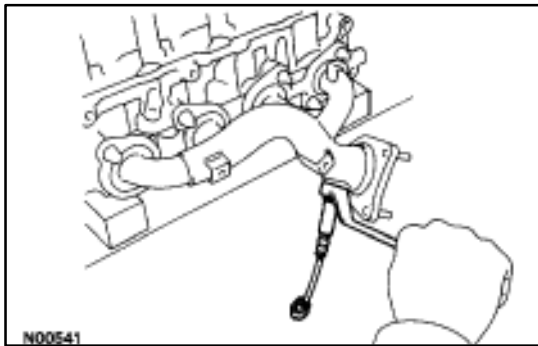
- (a) Place a new gasket on the cylinder head with the white painted marks facing the manifold side.

NOTICE: Be careful of the installation direction.



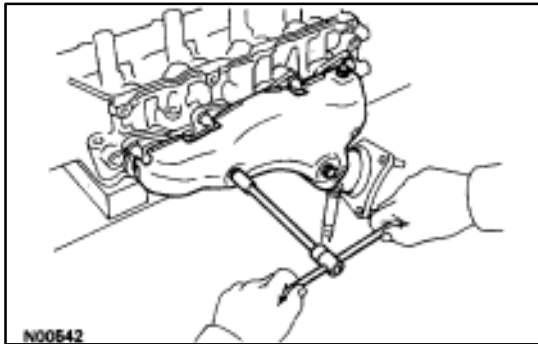
- (b) Install the exhaust manifold with the eight new nuts. Uniformly tighten the nuts in several passes.

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

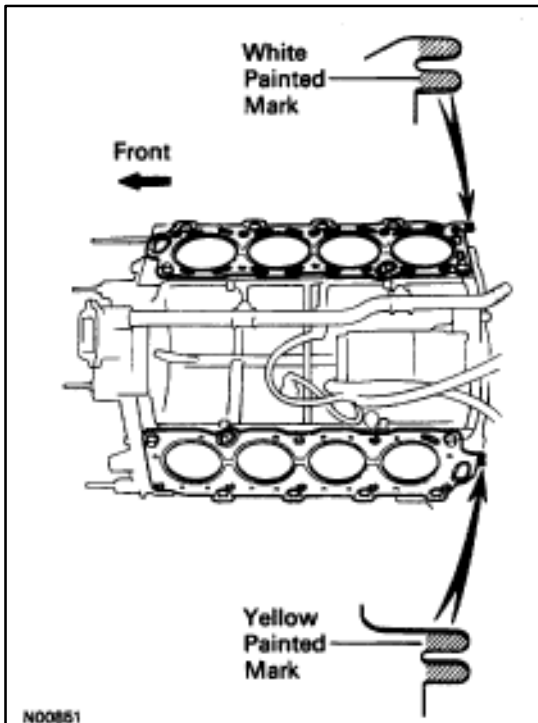


- (c) Install the main oxygen sensor.

Torque: 44 N·m (450 kgf·cm, 33 ft·lbf)



- (d) Install the heat insulator with the three bolts.



3. INSTALL CYLINDER HEADS

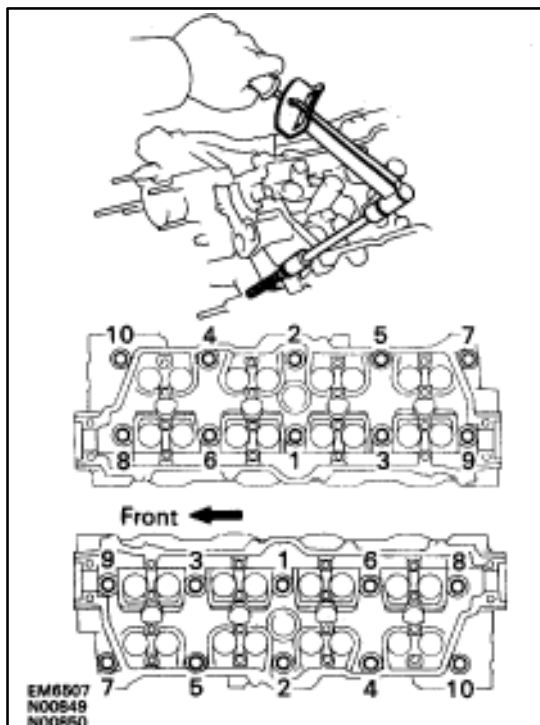
A. Place cylinder heads on cylinder block

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

HINT: On the rear side of the cylinder head gasket are painted marks to distinguish the LH and RH banks, a white painted mark for the RH bank and a yellow painted mark for the LH bank.

NOTICE: Be careful of the installation direction.

- (b) Place the two cylinder heads in position on the cylinder head gaskets.



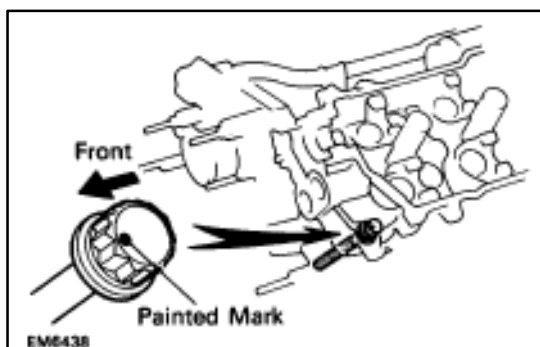
B. Install cylinder head bolts

HINT:

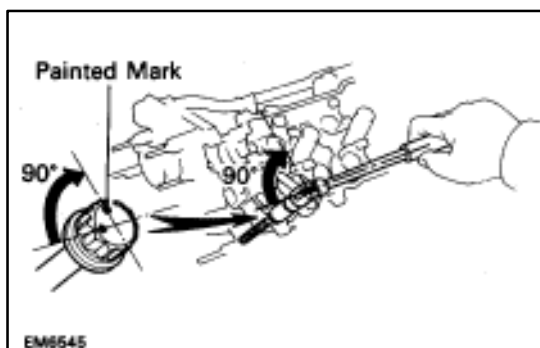
- The cylinder head bolts are tighten in two progressive steps (steps (c) and (e)).
 - If any one of the cylinder head bolts broken or deformed, replace it.
- (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
 - (b) Temporarily install the twenty plate washers and cylinder head bolts.
 - (c) Uniformly tighten the ten cylinder head bolts on one side of the cylinder head in several passes in the sequence shown, then do the other side as shown.

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

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



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



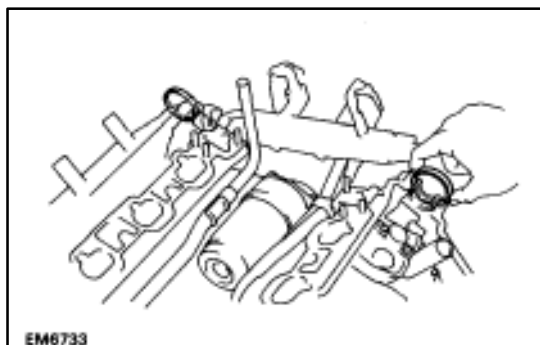
- (e) Retighten the cylinder head bolts 90° in the numerical order shown.
- (f) Check that the painted mark is now at a 90° angle to front.

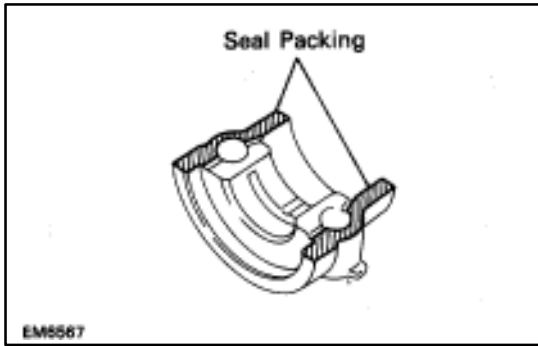
4. CONNECT MAIN OXYGEN SENSOR CONNECTORS

Connect the RH and LH oxygen sensor connector.

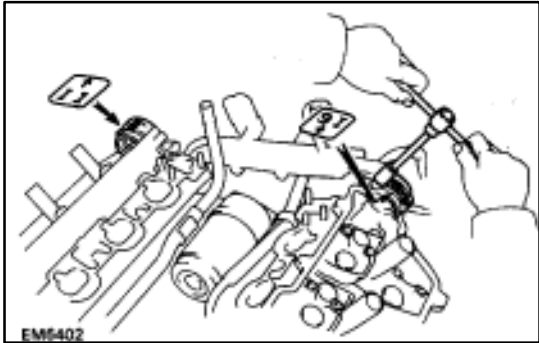
5. INSTALL CIRCULAR PLUGS

- (a) Place two new circular plugs in position on the cylinder heads, facing the cup side forward.

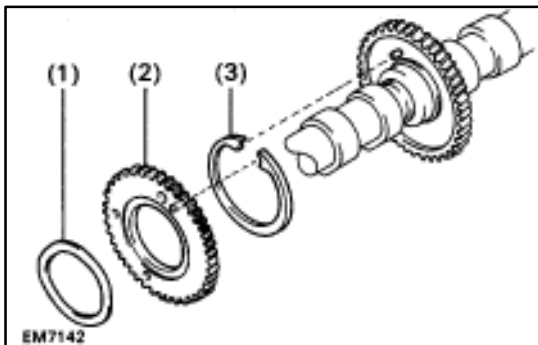




- (b) Remove any old packing (FIPG) material.
- (c) Apply seal packing to the bearing caps as shown.
Seal packing: Part No. 08826-00080 or equivalent

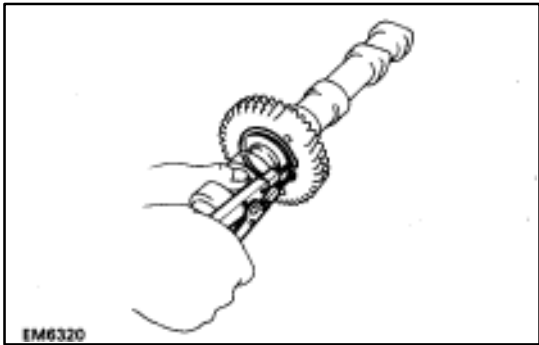


- (d) (RH Cylinder Head)
Install the bearing cap (mark "11") in position with the arrow mark facing rearward.
- (e) (LH Cylinder Head)
Install the bearing cap (mark "16") in position with the arrow mark facing forward.
- (f) Install a new seal washer to the bearing cap bolt.
- (g) Apply a light of engine oil on the threads of the bearing cap bolt.
- (h) Install the four bearing cap bolts.
Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)
HINT: Use silver colored bolts 38 mm (1.50 in.) in length.

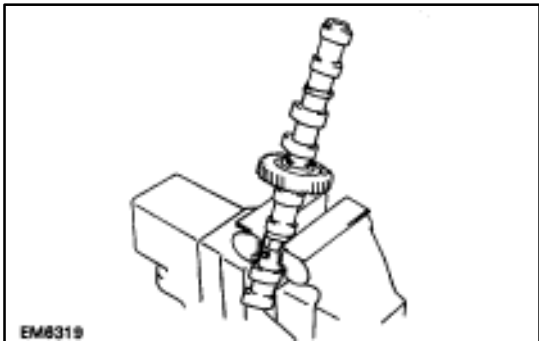


6. ASSEMBLE EXHAUST CAMSHAFTS

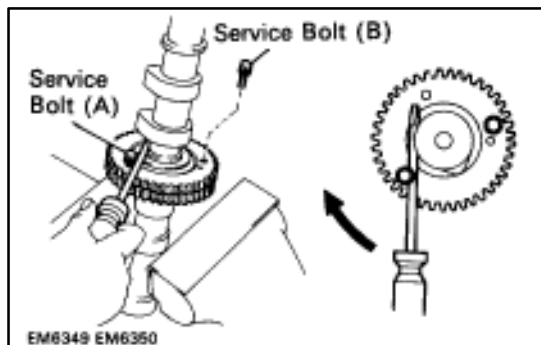
- (a) Install the following parts:
 - (1) Camshaft gear spring
 - (2) Camshaft sub-gear
 - (3) Wave washer



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



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



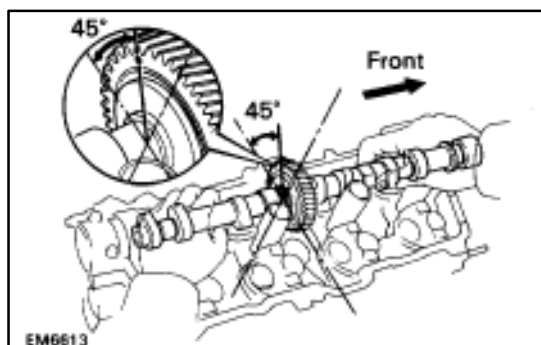
- (d) Insert a service bolt (A) into the service hole of the camshaft sub-gear.
- (e) Using a screwdriver, align the service holes and teeth of the camshaft driven gear and sub-gear by turning camshaft sub-gear clockwise, and install a service bolt (B).

NOTICE: Be careful not to damage the camshaft.

- (f) Remove the service bolt (A).

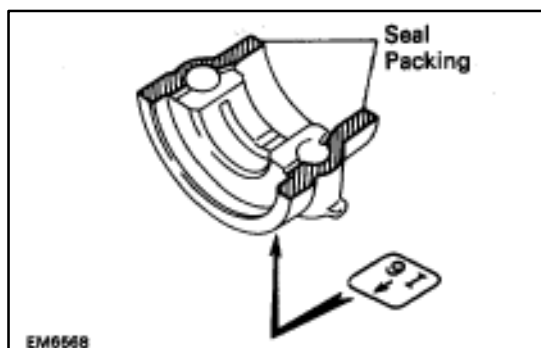
7. INSTALL CAMSHAFTS

NOTICE: Since the thrust clearance of the camshaft is small, the camshaft must be held 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.



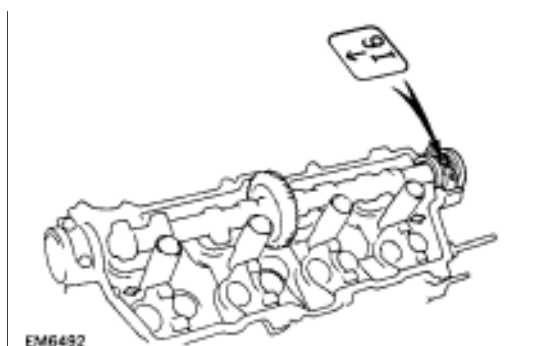
A. Install intake camshaft to RH cylinder head

- (a) Apply MP grease to the thrust portion of the camshaft.
- (b) Place the intake camshaft at 45° angle of the timing mark (one dot mark) on the cylinder head.



- (c) Remove any old packing (FIPG) material.
- (d) Apply seal packing to the bearing cap (mark "16") as shown.

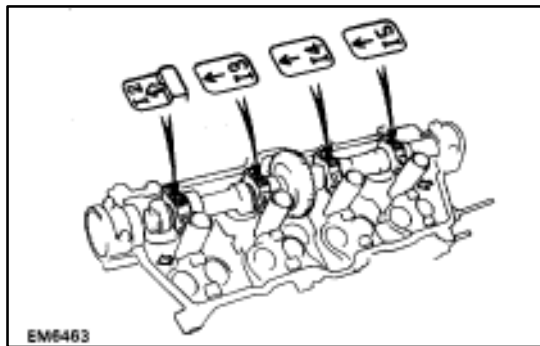
Seal packing: Part No. 08826-00080 or equivalent



- (e) Install the front bearing cap (mark "16") with the arrow mark facing rearward.

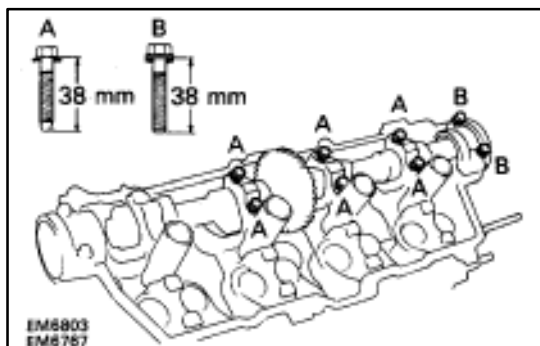
HINT:

- Installing the front bearing cap will determine the thrust position of the camshaft.
- Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



- (f) Install the other bearing caps in the sequence shown with the arrow mark facing rearward.

HINT: Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



- (g) Apply a light coat of engine oil on the threads and under the heads (A only) of the bearing cap bolts.

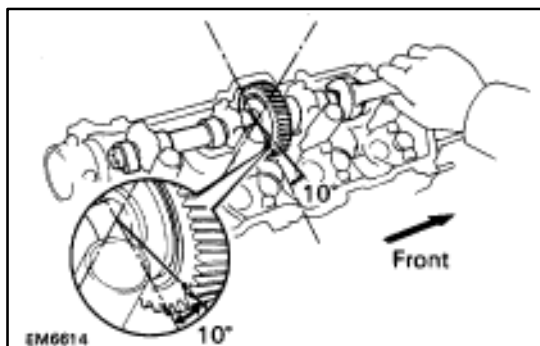
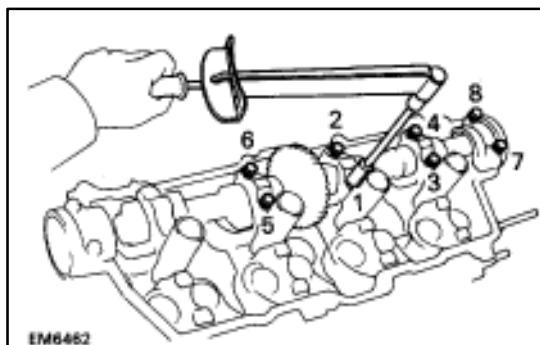
HINT: Do not apply engine oil under the heads of the bearing cap bolts (B).

- (h) Install a new seal washer to the bearing cap bolt (B). Install the eight bearing cap bolts as shown.

HINT:

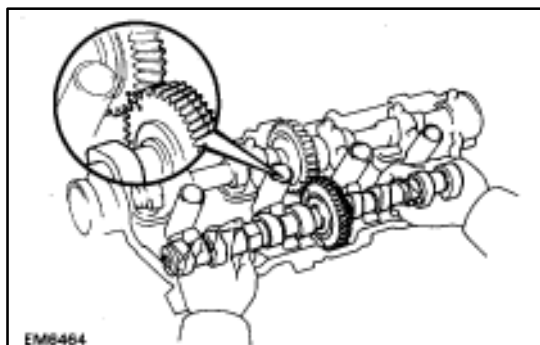
- Use bearing cap bolts 38 mm (1.50 in.) in length. The bolts are black (A) or silver (B) in color. Install the two silver bolts to the front bearing cap. Install the six black bolts to the other positions.
 - After installing the oil feed pipe, install the two bolts to the rear bearing cap as directed in step B (i).
- (i) Uniformly tighten the eight bearing cap bolts in several passes in the sequence shown.

Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

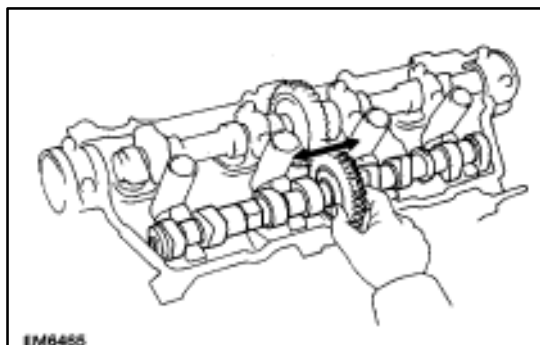


B. Install exhaust camshaft to RH cylinder head

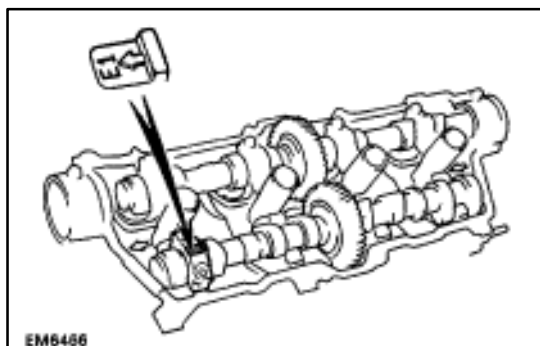
- (a) Set the timing mark (one dot mark) of the camshaft drive gear at 105 angle by turning the hexagon wrench head portion of the intake camshaft with a wrench.



- (b) Apply MP grease to the thrust portion of the exhaust camshaft.
- (c) Align the timing marks (one dot mark) of the camshaft drive and driven gears.
- (d) Place the exhaust camshaft on the cylinder head.



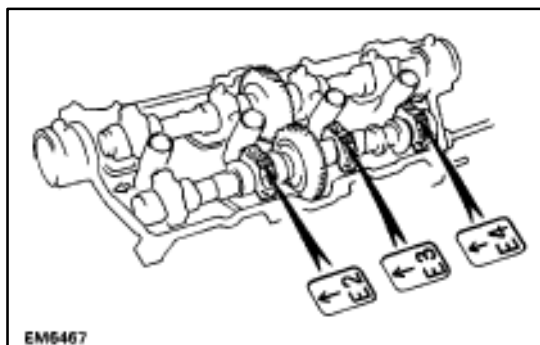
- (e) Check that the exhaust camshaft moves smoothly in the thrust direction.



- (f) Install the rear bearing cap with the arrow mark facing rearward.

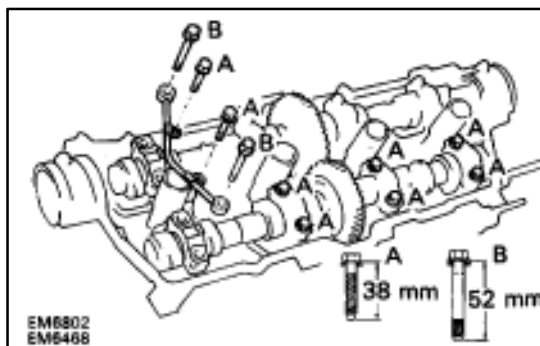
HINT:

- Installing the rear bearing cap will determine the thrust position of the camshaft.
- Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



- (g) Install the other bearing caps in the sequence shown with the arrow mark facing rearward.

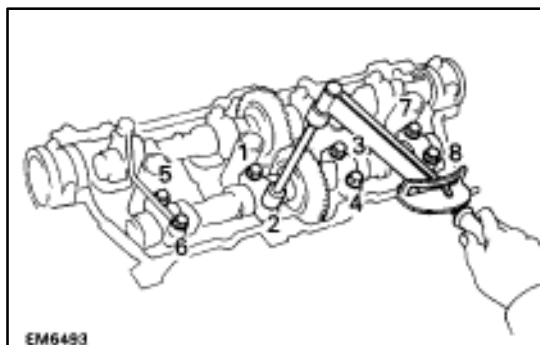
HINT: Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



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

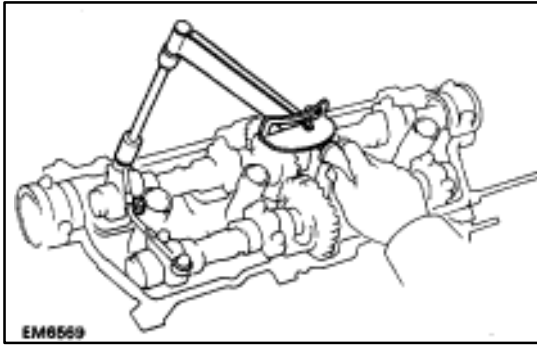
- (i) Install the oil feed pipe and ten bolts.

HINT: Use bearing cap bolts 38 mm (1.50 in.) and 52 mm (2.05 in.) in length. Use black colored 38 mm (1.50 in.) bolts. Install the two 52 mm (2.05 in.) bolts in outside positions of the oil pipe. Install the eight 38 mm (1.50 in.) bolts in the other positions.

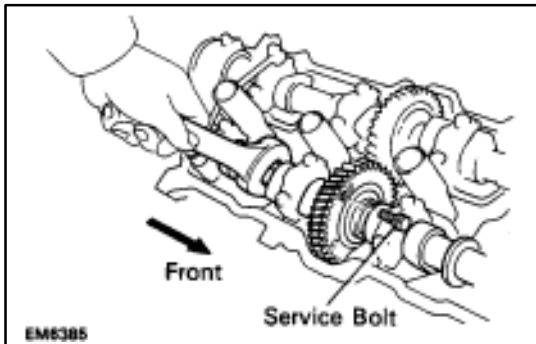


- (j) Uniformly tighten the eight bearing cap bolts on the bearing caps of the exhaust camshaft in several passes in the sequence shown.

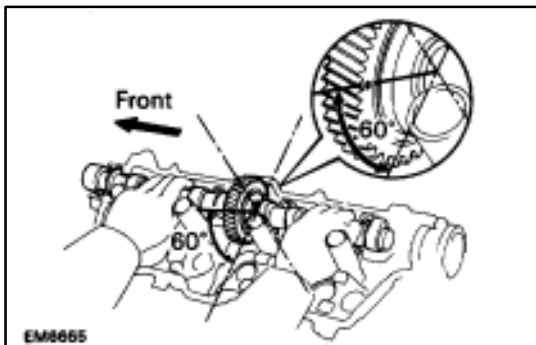
Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)



- (k) Alternately tighten the two bearing cap bolts on the rear bearing cap of the intake camshaft in several passes.
Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

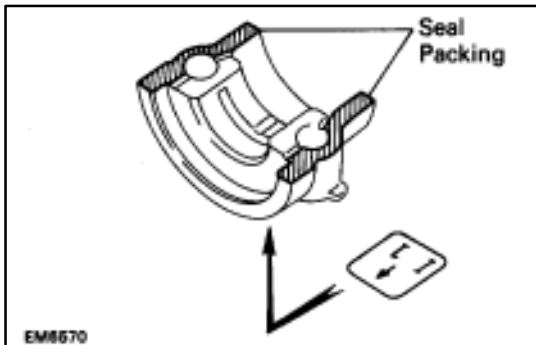


- (l) Bring the service bolt installed in the driven subgear upward by turning the hexagon wrench head portion of the camshaft with a wrench.
 (m) Remove the service bolt.



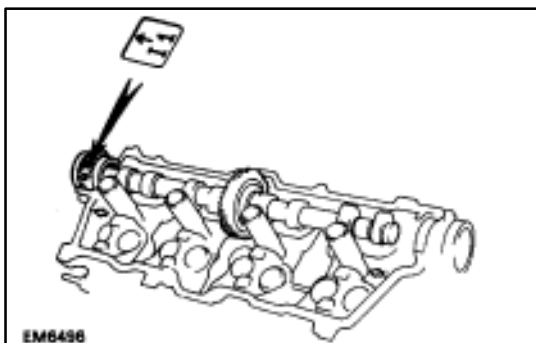
C. Install intake camshaft to LH cylinder head

- (a) Apply MP grease to the thrust portion of the camshaft.
 (b) Place the intake camshaft at 60° angle of the timing mark (one dot mark) on the cylinder head.



- (c) Remove any old packing (FIPG) material.
 (d) Apply seal packing to the bearing cap (mark "I1") as shown.

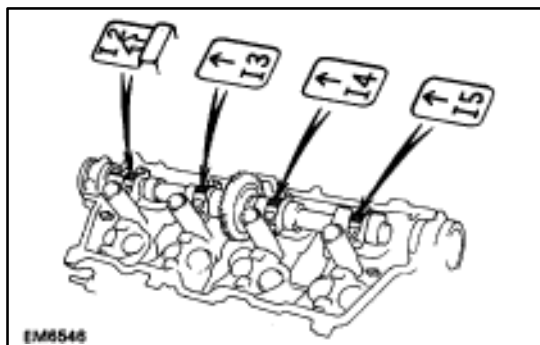
Seal packing: Part No. 08826-00080 or equivalent



- (e) Install the front bearing cap (mark "I1") with the arrow mark facing forward.

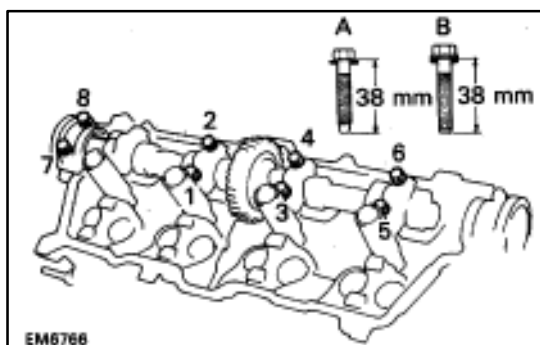
HINT:

- Installing the front bearing cap will determine the thrust position of the camshaft.
- Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



- (f) Install the other bearing caps in the sequence shown with the arrow mark facing forward.

HINT: Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



- (g) Apply a light coat of engine oil on the threads and under the heads (A only) of the bearing cap bolts.

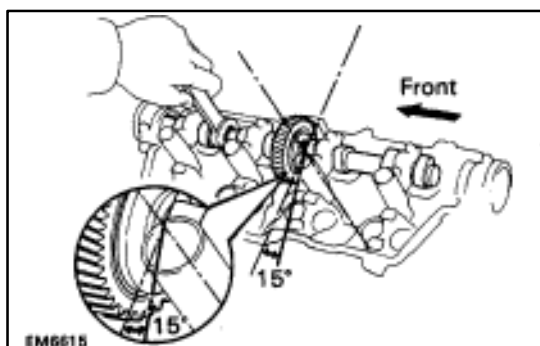
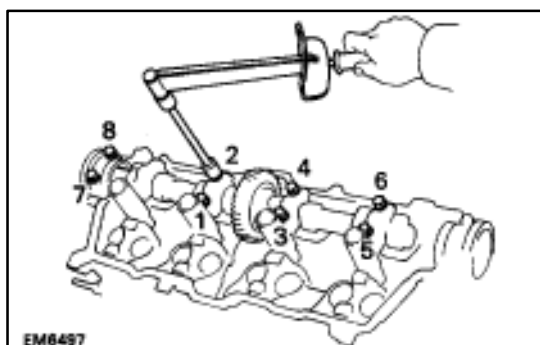
HINT: Do not apply engine oil under the heads of the bearing cap bolts (B).

- (h) Install a new seal washer to the bearing cap bolt (B). Install the eight bearing cap bolts as shown.

HINT:

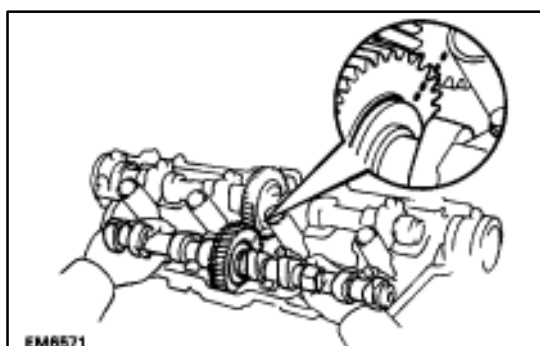
- Use bearing cap bolts 38 mm (1.50 in.) in length. The bolts are black (A) or silver (B) in color. Install the two silver bolts to the front bearing cap. Install the six black bolts to the other positions.
 - After installing the oil feed pipe, install the two bolts to the bearing cap second from the front as directed in step D (i).
- (i) Uniformly tighten the eight bearing cap bolts in several passes in the sequence shown.

Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

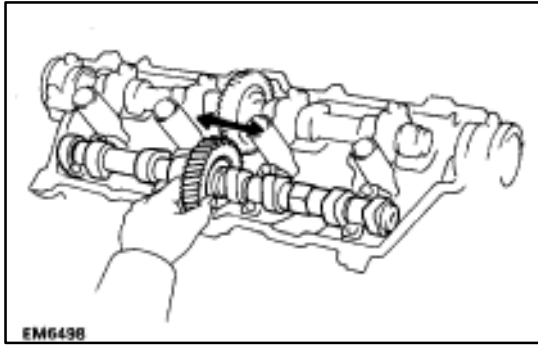


D. Install exhaust camshaft to LH cylinder head

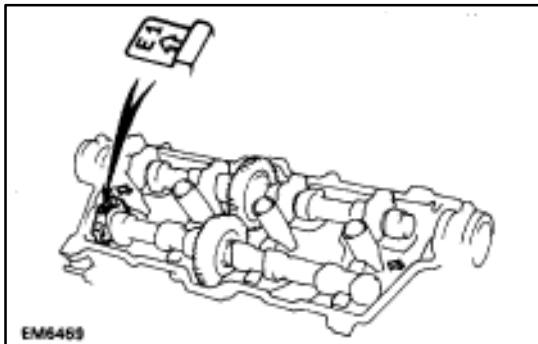
- (a) Set the timing mark (two dot marks) of the camshaft drive gear at 15° angle by turning the hexagon wrench head portion of the intake camshaft with a wrench.



- (b) Apply MP grease to the thrust portion of the exhaust camshaft.
- (c) Align the timing marks (two dot marks) of the camshaft drive and driven gears.
- (d) Place the exhaust camshaft on the cylinder head.



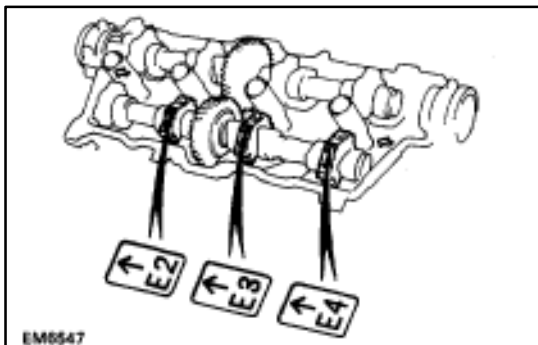
- (e) Check that the exhaust camshaft moves smoothly in the thrust direction.



- (f) Install the front bearing cap with the arrow mark facing forward.

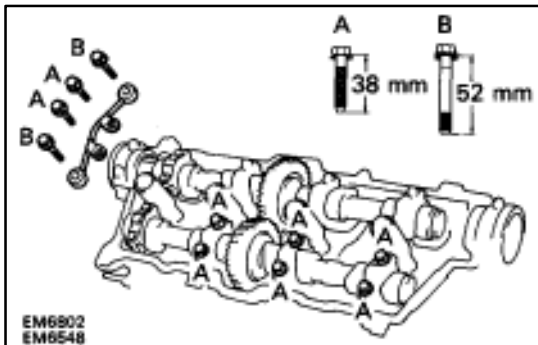
HINT:

- Installing the front bearing cap will determine the thrust position of the camshaft.
- Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



- (g) Install the other bearing caps in the sequence shown with the arrow mark facing forward.

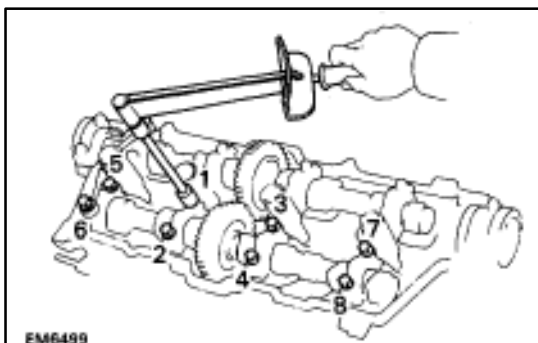
HINT: Align the arrow marks at front and rear of the cylinder head with the mark on the bearing cap.



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

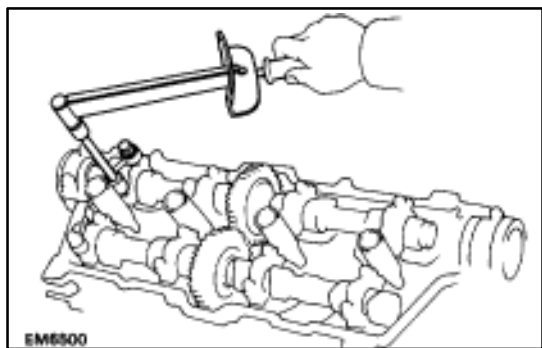
- (i) Install the oil feed pipe and ten bolts.

HINT: Use bearing cap bolts 38 mm (1.50 in.) and 52 mm (2.05 in.) in length. Use black colored 38 mm (1.50 in.) bolts. Install the two 52 mm (2.05 in.) bolts in outside positions of the oil pipe. Install the eight 38 mm (1.50 in.) bolts in the other positions.



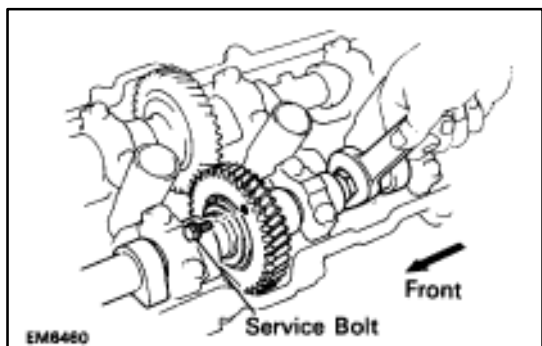
- (j) Uniformly tighten the eight bearing cap bolts on the bearing caps of the exhaust camshaft in several passes in the sequence shown.

Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)



- (k) Alternately tighten the two bearing cap bolts on the bearing cap of the intake camshaft second from the front in several passes.

Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)



- (l) Bring the service bolt installed in the driven subgear upward by turning the hexagon wrench head portion of the camshaft with a wrench.

- (m) Remove the service bolt.

8. CHECK AND ADJUST VALVE CLEARANCE

(See steps 19 to 23 on pages [EM-15](#) to 22)

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

Valve clearance:

Intake 0.15–0.25 mm (0.006–0.010 in.)

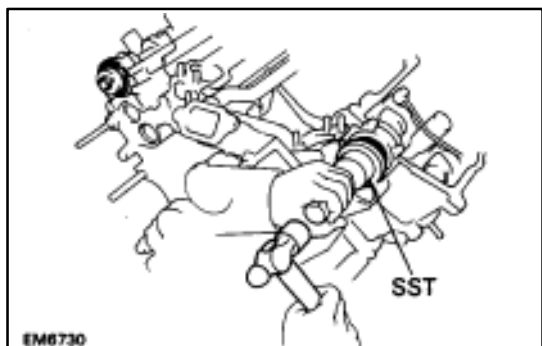
Exhaust 0.25–0.35 mm (0.010–0.014 in.)

9. INSTALL CAMSHAFT OIL SEALS

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



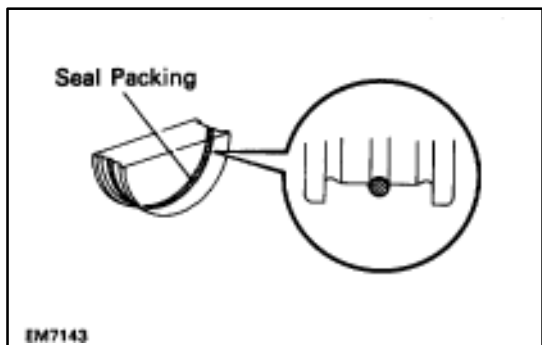
- (b) Using SST and a hammer, tap in the two oil seals.
SST 09223-46011

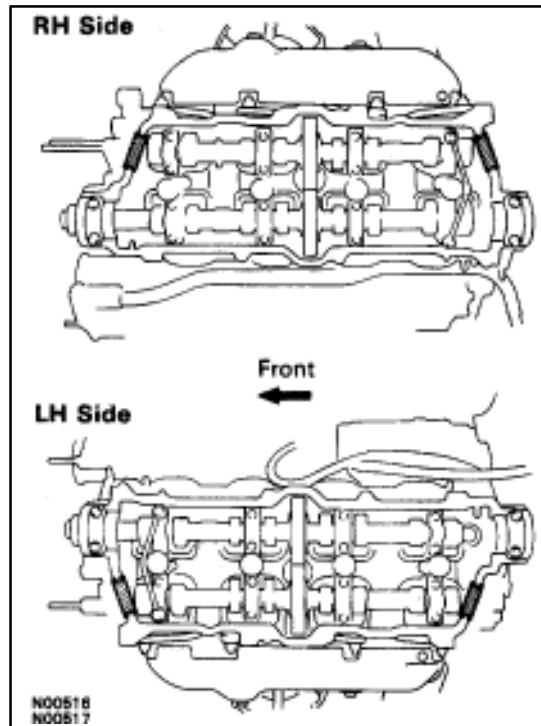


10. INSTALL SEMI-CIRCULAR PLUGS

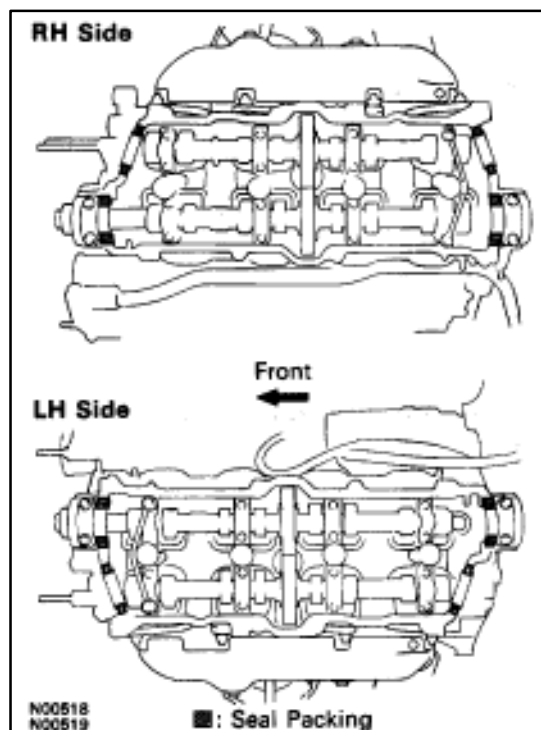
- (a) Remove any oil packing (FIPG) material.
(b) Apply seal packing to the semi-circular plug groove.

Seal packing: Part No. 08826-00080 or equivalent





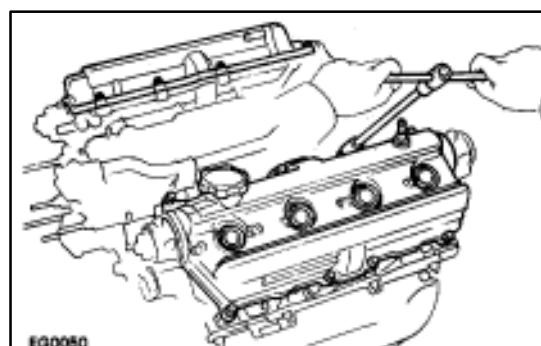
- (c) Install the four semi-circular plugs.



11. INSTALL CYLINDER HEAD COVERS

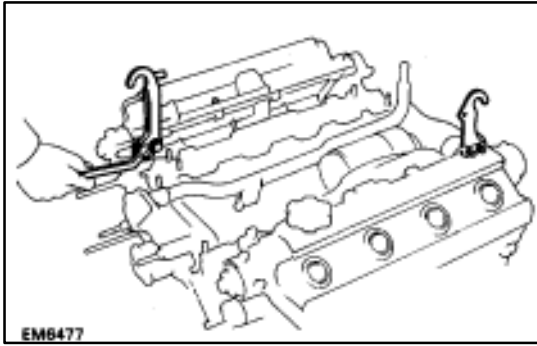
- (a) Remove any oil packing (FIPG) material.
 (b) Apply seal packing to the cylinder heads as shown in the figure.

Seal packing: Part No.08826-00080 or equivalent



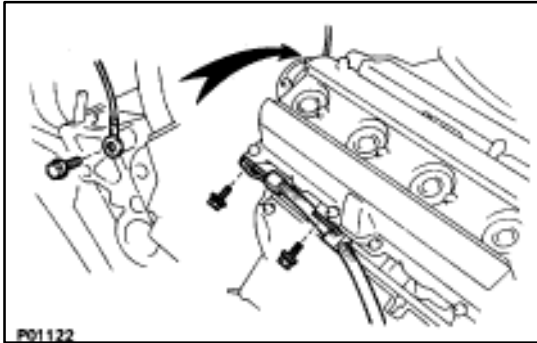
- (c) Install the gasket to the cylinder head cover.
 (d) Install the seal washer to the bolt. Install the cylinder head cover with the eight bolts. Uniformly tighten the bolts. Install the two cylinder head covers

Torque: 5.9 N·m (60 kgf·cm, 52 in·lbf)

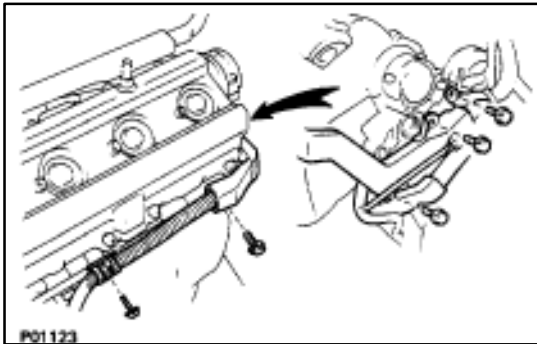
**12. INSTALL ENGINE HANGERS**

Install the engine hanger with the two bolts.
Install the two engine hangers.

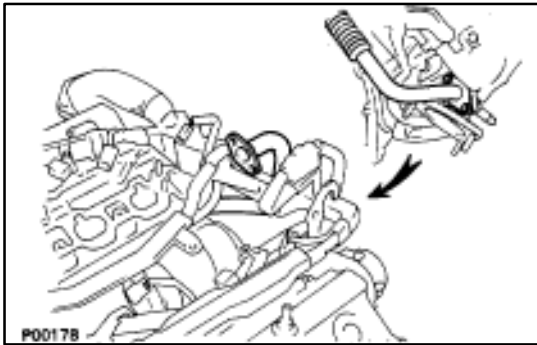
Torque: 37 N·m (380 kgf·cm, 27 ft·lbf)

**13. CONNECT GROUND STRAP TO RH CYLINDER HEAD****14. INSTALL ENGINE WIRE TO RH CYLINDER HEAD**

Install the engine wire with the two bolts.

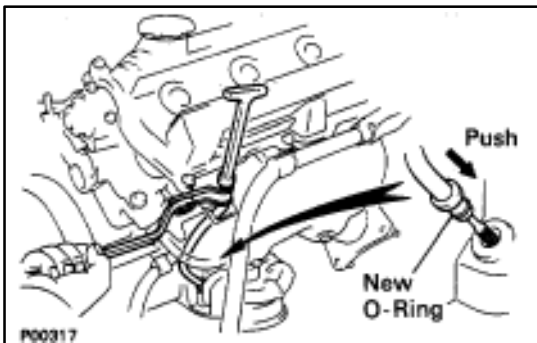
**15. INSTALL ENGINE WIRE TO LH CYLINDER HEAD**

Install the engine wire with the five bolts.

**16. INSTALL EGR PIPE TO RH EXHAUST MANIFOLD**

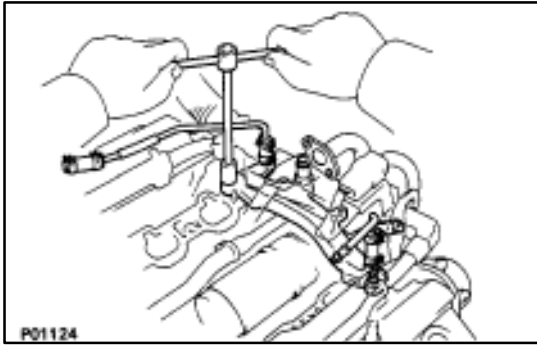
Install a new gasket and the EGR pipe with the two new nuts.

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

**17. INSTALL OIL DIPSTICK AND GUIDE FOR ENGINE**

- (a) Install a new O-ring to the dipstick guide.
- (b) Apply a light of engine oil on the O-ring.
- (c) Push in the dipstick guide into the guide hole of the No.1 oil pan.
- (d) Install the dipstick guide with the bolt.
- (e) Install the oil dipstick.

18. INSTALL OIL DIPSTICK AND GUIDE FOR A/T

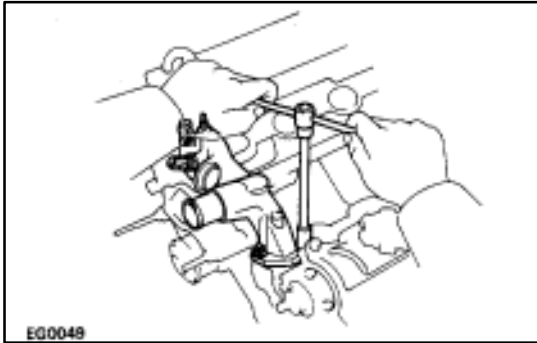


19. INSTALL REAR WATER BY-PASS JOINT

- (a) Install two new gaskets and the water by-pass joint with the four nuts. Alternately tighten the nuts.

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

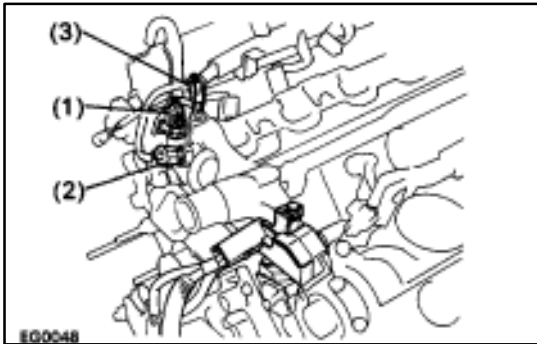
- (b) Install the bolt holding the water by-pass pipe to the engine hanger.



20. INSTALL FRONT WATER BY-PASS JOINT

- (a) Install two new gaskets and the water by-pass joint with the four nuts. Alternately tighten the nuts.

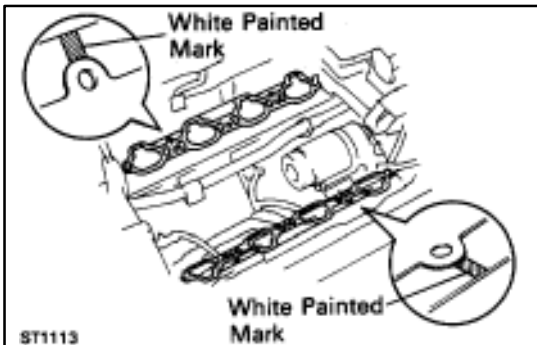
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)



- (b) Install the engine wire clamp with the bolt.

- (c) Connect the following connectors:

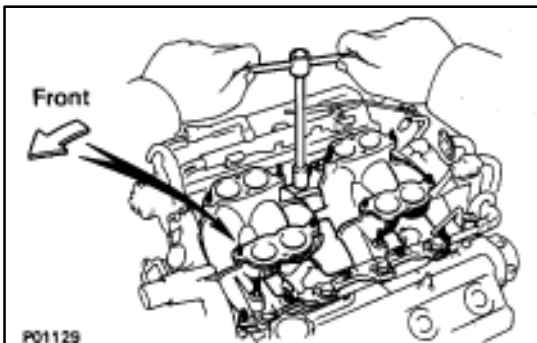
- (1) Water temperature sensor connector
- (2) Cold start injector time switch connector
- (3) Water temperature sender gauge connector



21. INSTALL INTAKE MANIFOLD

- (a) Place two new gaskets on the cylinder heads with the white painted mark facing upward.

NOTICE: Align the port holes of the gasket and cylinder head. Be careful of the installation direction.



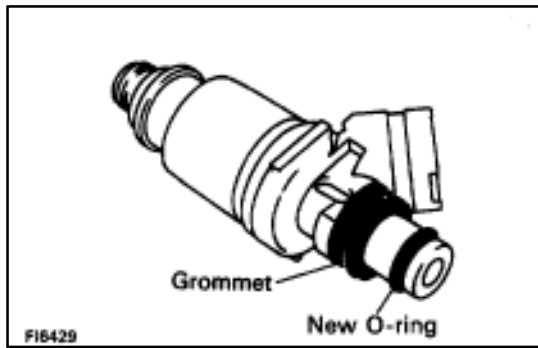
- (b) Place the intake manifold in position on the cylinder head with the arrow mark facing forward.

NOTICE: Be careful of the installation direction.

- (c) Install and uniformly tighten the six mounting bolts and four mounting nuts.

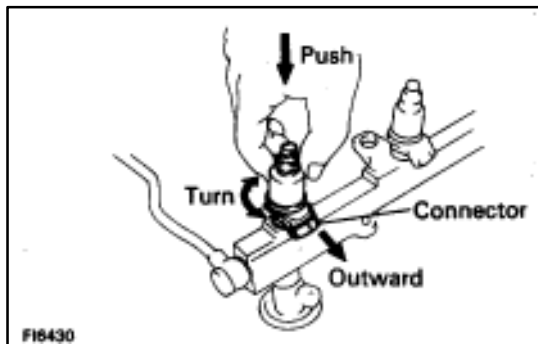
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

HINT: Use bolts 30 mm (1.18 in.) in length.

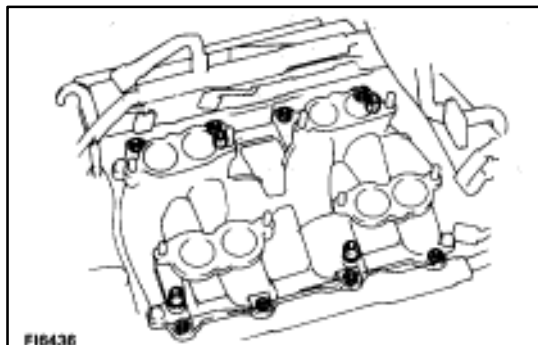


22. INSTALL DELIVERY PIPES AND INJECTORS

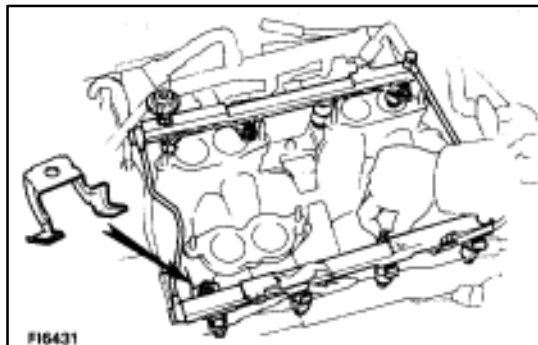
- (a) Install the grommet and a new O-ring to each injector.



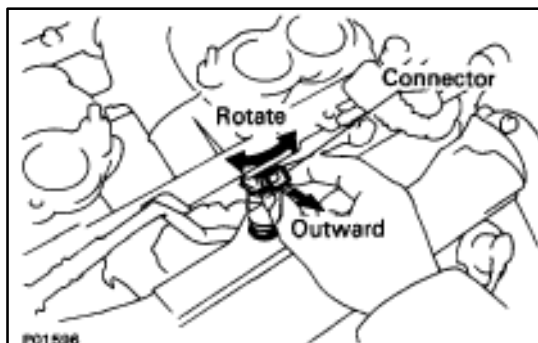
- (b) While turning the Injector clockwise and counterclockwise, push it to delivery pipe. Install the eight injectors.
- (c) Position the injector connector outward.



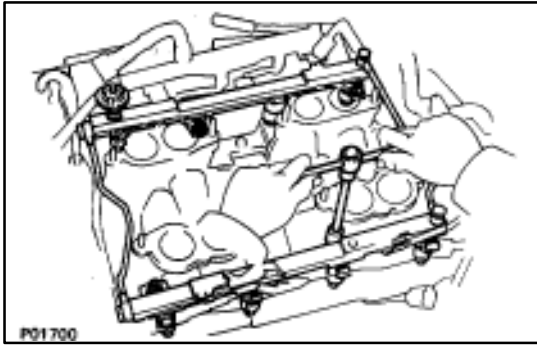
- (d) Place the eight insulators and four spacers in positions on the intake manifold.



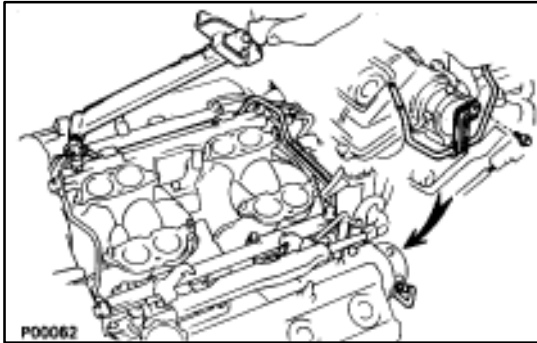
- (e) Place the eight injectors and two delivery pipes assembly in position on the intake manifold.
- (f) Temporarily install the connector bracket and four mounting nuts.



- (g) Check that the injectors rotates smoothly.
- (h) Position the injector connectors outward.



- (i) Tighten the four mounting nuts.
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

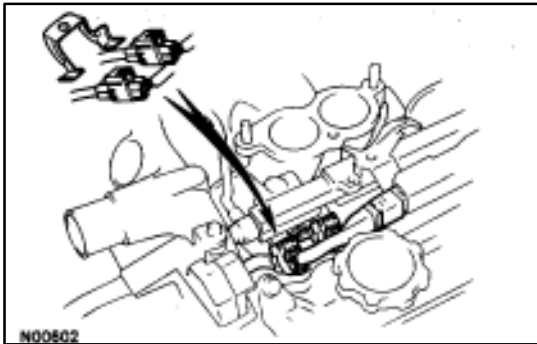


23. INSTALL FUEL RETURN PIPE

- (a) Temporarily install the return pipe with the bolt, two new gaskets and union bolt.
 (b) Tighten the union bolt holding the return pipe to the fuel pressure regulator.

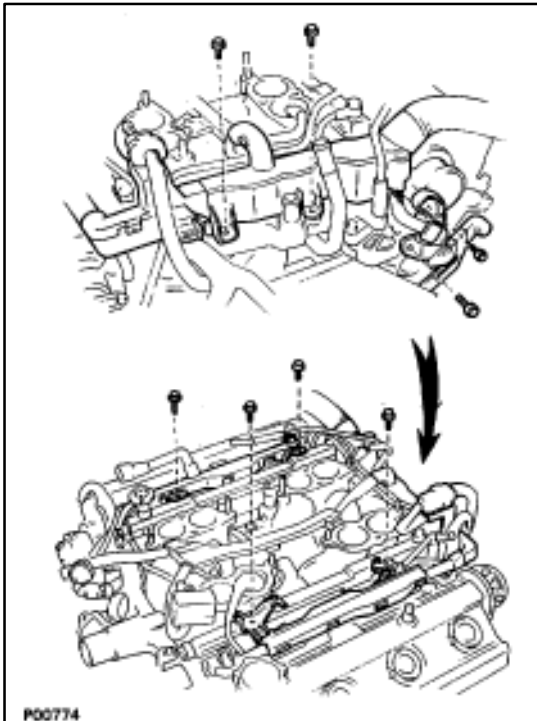
Torque: 35 N·m (360 kgf·cm, 26 ft·lbf)

- (c) Tighten the bolt holding the return pipe to the LH cylinder head.

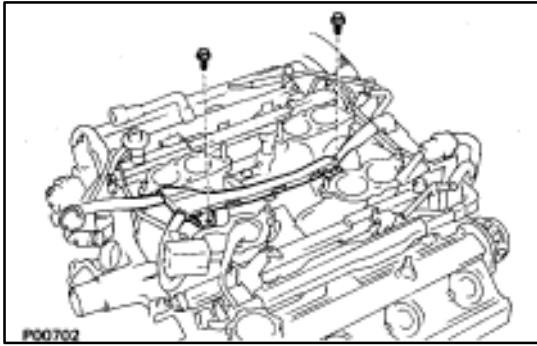


24. INSTALL ENGINE WIRE TO DELIVERY PIPES, REAR WATER BY-PASS JOINT AND RH CYLINDER HEAD

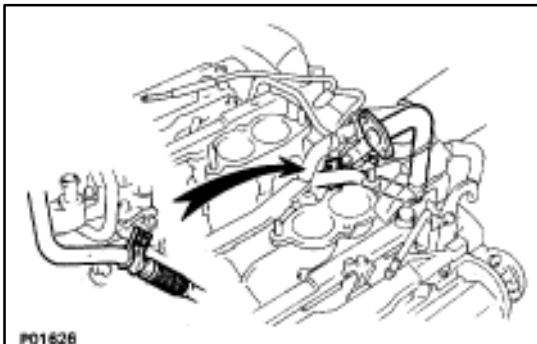
- (a) Connect the eight injector connectors.
 (b) Install the two engine wire connectors to connectors bracket on the LH delivery pipe.



- (c) Install the engine wire to the RH cylinder head with the two bolts.
 (d) Install the engine wire to the rear water by-pass joint with the two bolts.
 (e) Install the engine wire to the delivery pipes with the four bolts.

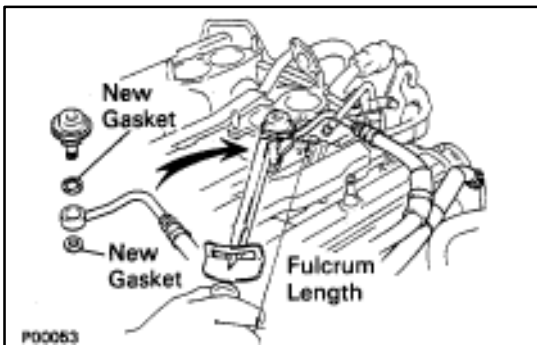
**25. INSTALL ENGINE WIRE TO INTAKE MANIFOLD**

Install the engine wire with the two bolts.

**26. TEMPORARILY INSTALL EGR PIPE TO RH CYLINDER HEAD**

Temporarily install a new gasket and the EGR pipe with the two bolts.

HINT: Use bolt 25 mm (0.98 in.) in length.

**27. CONNECT FUEL RETURN HOSE TO FUEL RETURN PIPE****28. CONNECT FUEL INLET HOSE TO LH DELIVERY PIPE**

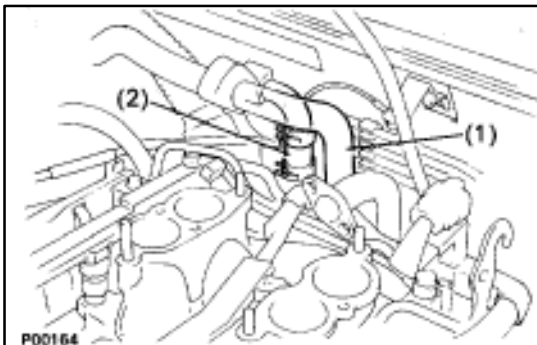
Connect the inlet hose with two new gaskets and the pulsation damper.

SST 09612-24012 (09617-24011)

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

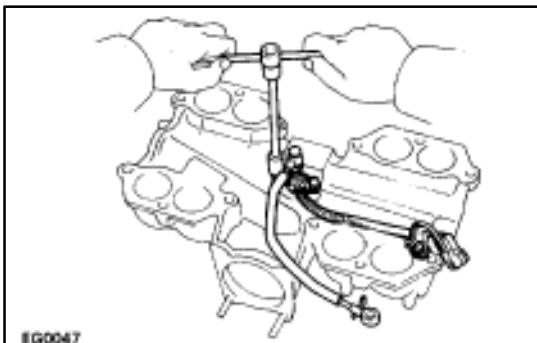
33 N·m (340 kgf·cm, 24 ft·lbf) for SST

HINT: Use a torque wrench with a fulcrum length of 30 cm (11.81 in.).

**29. CONNECT HEATER WATER HOSES**

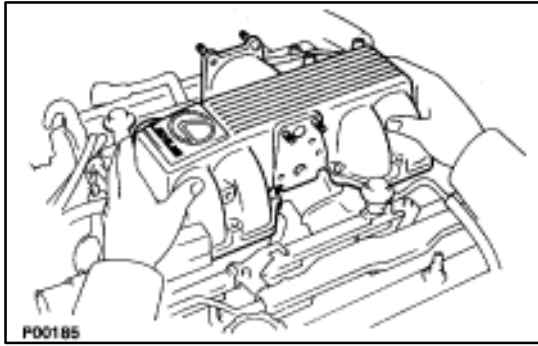
Connect the following hoses:

- (1) Water hose to water by-pass pipe
- (2) Water hose to rear water by-pass joint

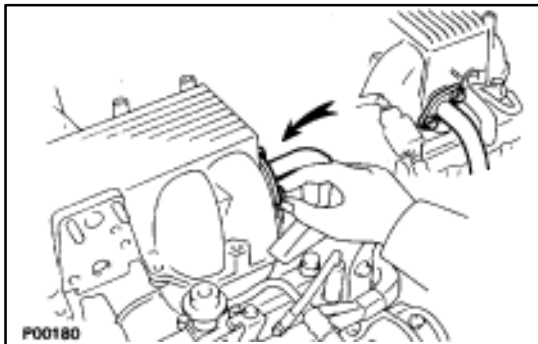
**30. INSTALL AIR INTAKE CHAMBER**

- (a) Install the cold start injector, tube and wire assembly with the three bolts.

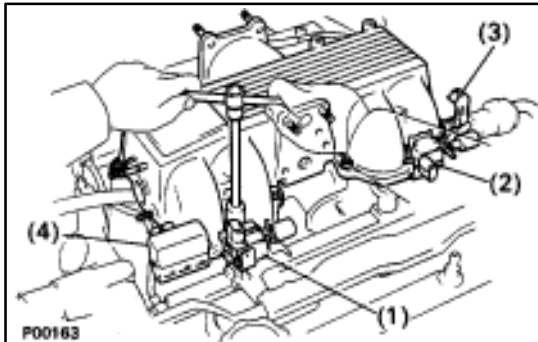
Torque: 7.8 N·m (80 kgf·cm, 69 in·lbf)



- (b) Place four new gaskets on the intake manifold.
 HINT: Gaskets can only be used twice before being replaced.
 (c) Place the air intake chamber on the intake manifold.



- (d) Temporarily connect the EGR pipe to the air intake chamber with a new gasket and the two bolts.
 HINT: Use bolts 20 mm (0.79 in.) in length.



- (e) Temporarily install the air intake chamber and following parts with the four bolts and eight nuts:
 (1) VSV for fuel pressure control system
 (2) (Exc. USA Spec.)
 VSV for EGR system
 (3) A/T throttle cable bracket
 (4) Check connector ("DIAGNOSIS") connector
 (f) Uniformly tighten the bolts and nuts in several passes.

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

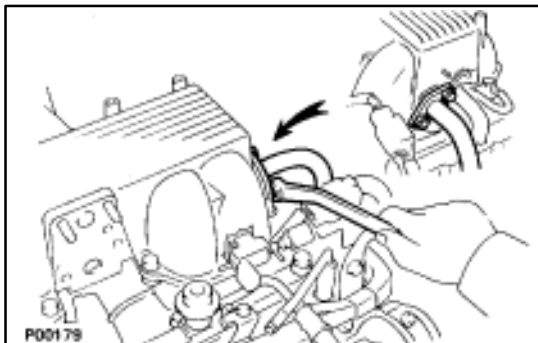
HINT: Use bolts 40 mm (1.57 in.) in length.

- (g) Tighten the two bolts holding the EGR pipe to the air intake chamber.

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

- (h) Tighten the two bolts holding the EGR pipe to the RH cylinder head.

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

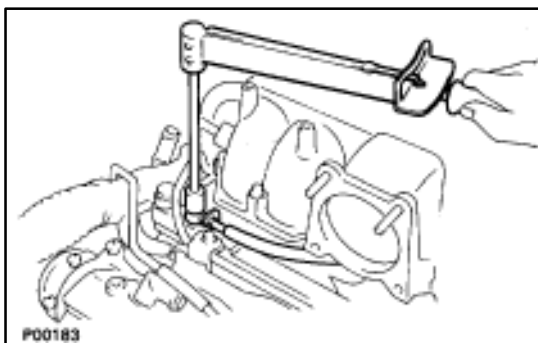


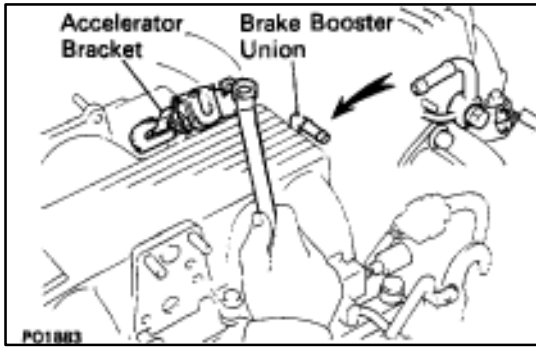
- (i) Connect the cold start injector tube to the RH delivery pipe with the two new gaskets and the union bolt.

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

- (j) Connect the following connectors:

- Cold start injector connector
- SV connector for fuel pressure control system
- (Exc. USA Spec.)
 VSV connector for EGR system



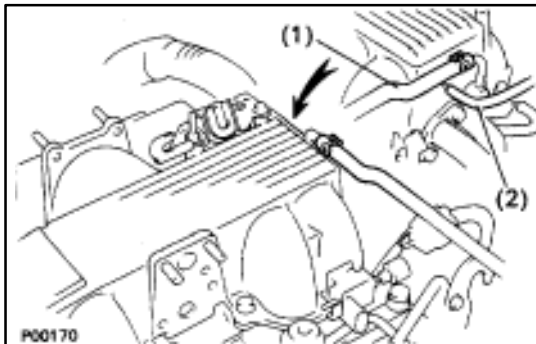
**31. INSTALL ACCELERATOR BRACKET**

Install the bracket with the bolt and stud bolt.

32. INSTALL BRAKE BOOSTER UNION

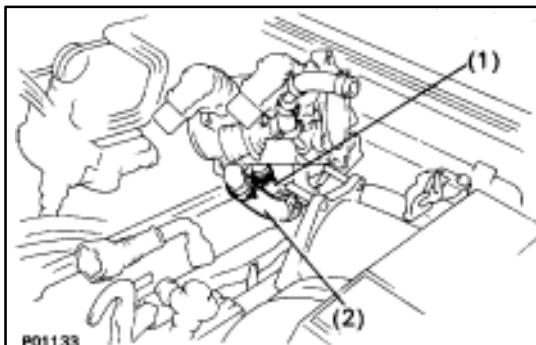
Install the union with two new gaskets and the union bolt.

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

**33. CONNECT VACUUM HOSES**

Connect the following hoses:

- (1) Vacuum hose to brake booster union
- (2) Vacuum hose (from VSV for heater water valve) to air intake chamber

**34. INSTALL THROTTLE BODY**

(a) Connect the following hoses:

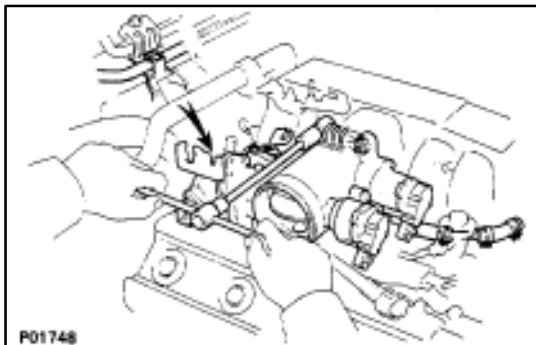
- (1) Water by-pass hose to throttle body
- (2) PCV hose to throttle body

(b) Install a new gasket and throttle body with the two bolts and two nuts.

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

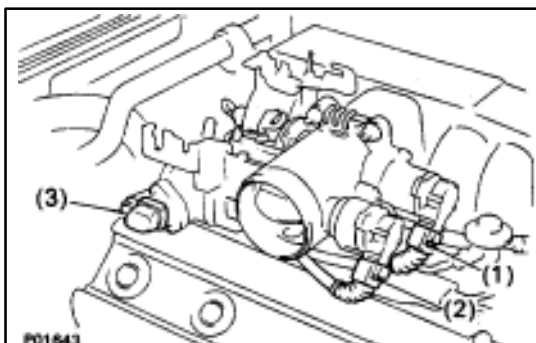
HINT: Use bolts 40 mm (1.57 in.) in length.

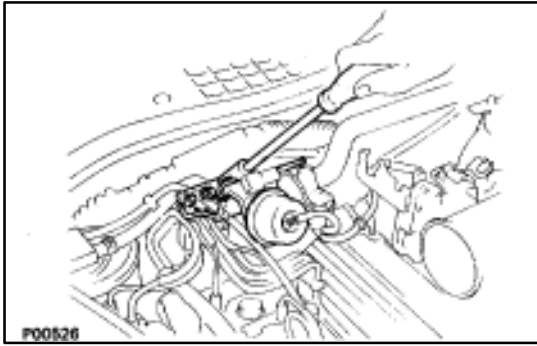
(c) Install the water by-pass pipe (from rear water bypass joint) to the clamp on the engine wire cover.



(d) Connect the following connectors:

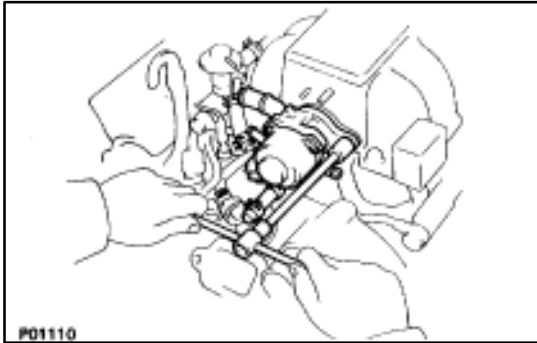
- (1) Throttle position sensor connector
- (2) (w/ TRAC)
Sub-throttle position sensor connector
- (3) (w/ TRAC)
Sub-throttle actuator connector





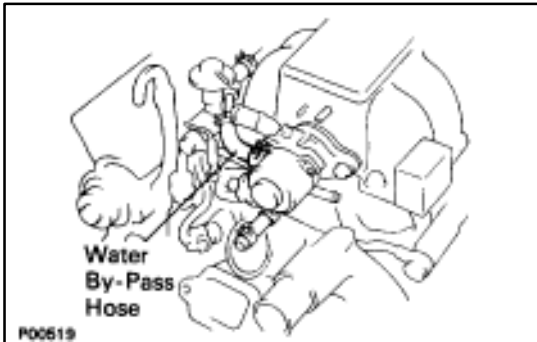
35. INSTALL HEATER WATER VALVE

- (a) Install the water valve and bracket assembly with the two bolts.
- (b) Install the engine wire clamp with the bolt.
- (c) Connect the VSV connector.

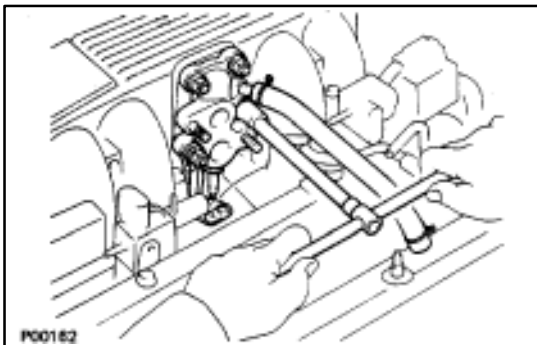


36. INSTALL ISC VALVE

- (a) Install a new gasket and the ISC valve with the two nuts.
- Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)**



- (b) Connect the water by-pass hose (from throttle body) to the ISC valve.
- (c) Connect the ISC valve connector.



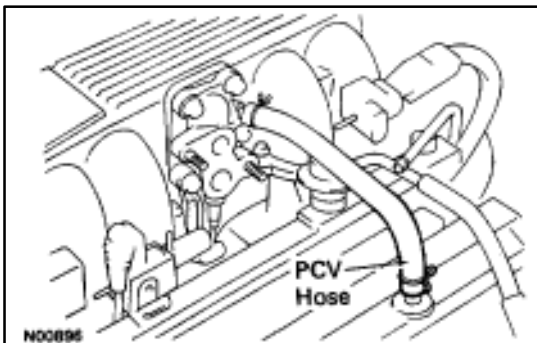
37. INSTALL EGR VALVE ADAPTOR

- (a) Install a new gasket, the adaptor and connector bracket (USA spec. only) with the two bolts and two nuts.

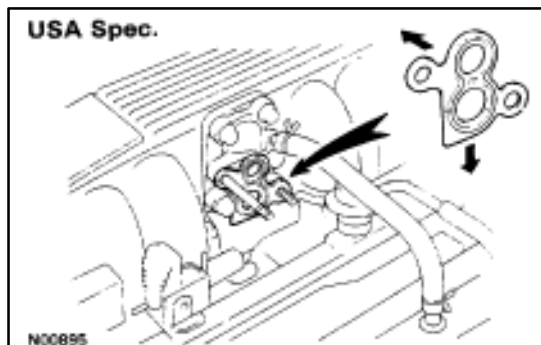
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

HINT: Use bolts 20 mm (1.79 in.) in length.

NOTICE: Do not touch the air intake chamber and adaptor surfaces of the gasket with your hand.



- (b) Connect the PCV hose to cylinder head.
- (c) (USA Spec. only)
Connect the EGR gas temperature sensor connector.

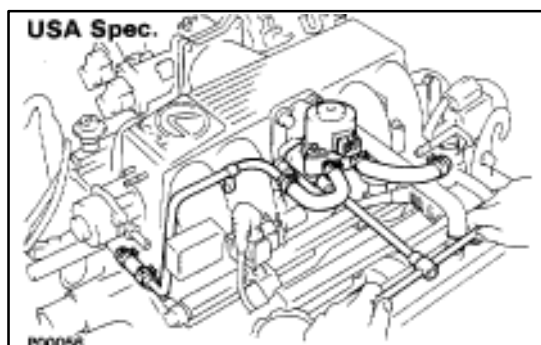


38. (USA Spec.) INSTALL EGR VALVE

- (a) Place a new gasket on the EGR valve adaptor.

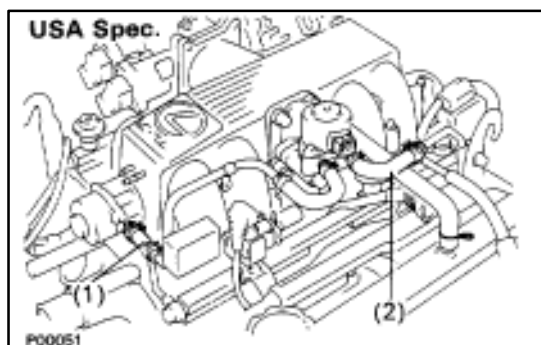
NOTICE:

- Do not touch the adapter and EGR valve surfaces of the gasket with your hand.
- Align the port holes of the gasket and adaptor. Be careful of the installation direction.

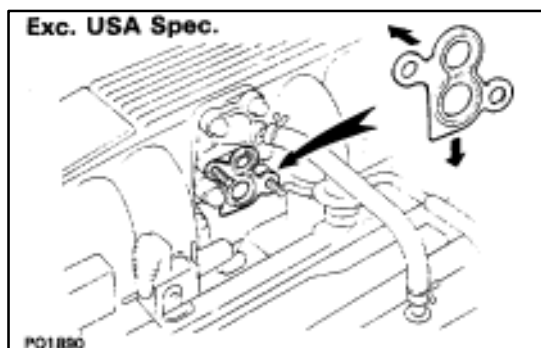


- (b) Install the EGR valve with the two nuts.

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



- (c) Connect the following hoses:
- (1) Water by-pass pipe hose to ISC valve
 - (2) Water by-pass pipe hose to water by-pass pipe (from rear water by-pass joint)
- (d) Connect the EGR valve connector.

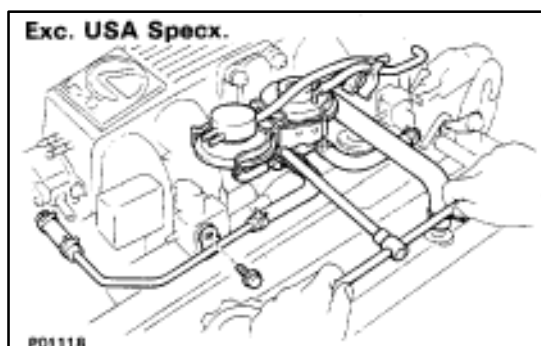


39. (Exc. USA Spec.) INSTALL EGR VALVE AND VACUUM MODULATOR

- (a) Place a new gasket on the EGR valve adaptor.

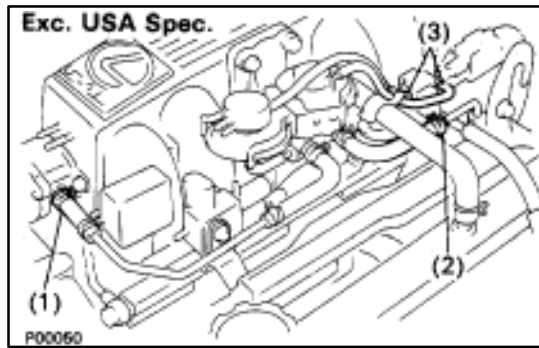
NOTICE:

- Do not touch the adapter and EGR valve surfaces of the gasket with your hand.
- Align the port holes of the gasket and adaptor. Be careful of the installation direction.

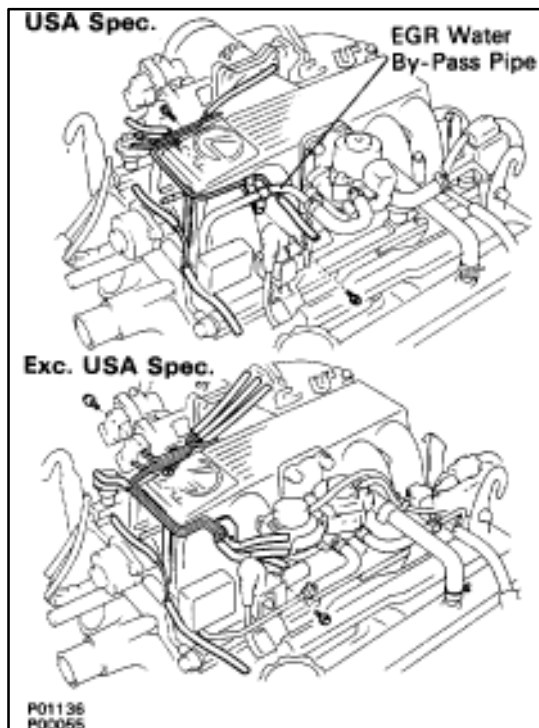


- (b) Install the EGR valve and vacuum and modulator assembly with the two nuts and bolt.

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

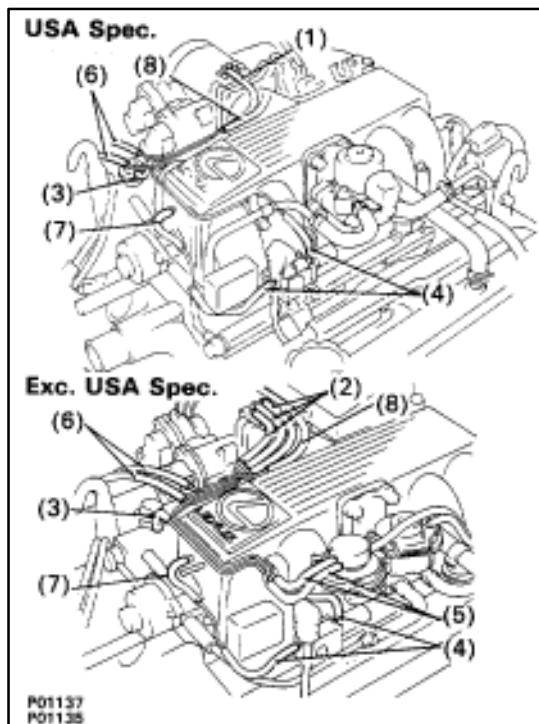


- (c) Connect the following hoses:
- (1) Water by-pass pipe hose to ISC valve
 - (2) Water by-pass pipe hose to water by-pass pipe (from rear water by-pass joint)
 - (3) Two vacuum hoses to VSV for EGR system

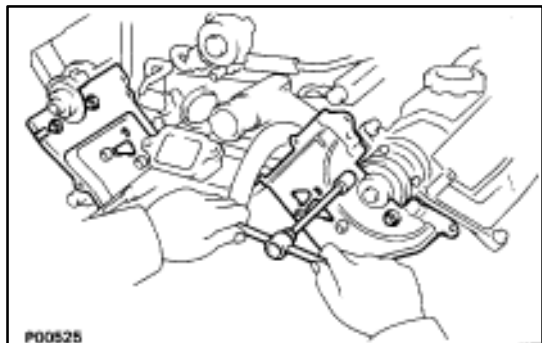


40. INSTALL VACUUM PIPE

- (a) Install the vacuum pipe, vacuum hoses assembly and EGR water by-pass pipe (USA spec. only) with the two bolts.



- (b) Connect the following hoses:
- (1) (USA Spec.)
Vacuum hose to throttle body
 - (2) (Exc. USA Spec.)
Three vacuum hoses to throttle body
 - (3) Vacuum hose to fuel pressure regulator
 - (4) Two vacuum hoses to VSV for fuel pressure control system
 - (5) (Exc. USA Spec.)
Two vacuum hoses to EGR vacuum modulator
 - (6) Two vacuum hoses (from VSV for EVAP system) to vacuum pipe
 - (7) Vacuum hose (from VSV for fuel pressure control system) to air intake chamber
 - (8) Vacuum hose (from charcoal canister) to vacuum pipe



41. INSTALL TIMING BELT REAR PLATES

Install the rear plate with the two bolts. Install the two rear plates.

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

42. INSTALL WATER INLET AND INLET HOUSING

- (a) Remove any old packing (FIPG) material.
 - Using a razor blade and gasket scraper, remove all the old packing (FIPG) materials from the gasket surfaces and sealing groove.
 - Thoroughly clean all components to remove all the loose materials.
 - Using a non-residue solvent, clean both sealing surfaces.
- (b) Apply seal packing to the sealing groove of the water inlet housing as shown in the illustration.

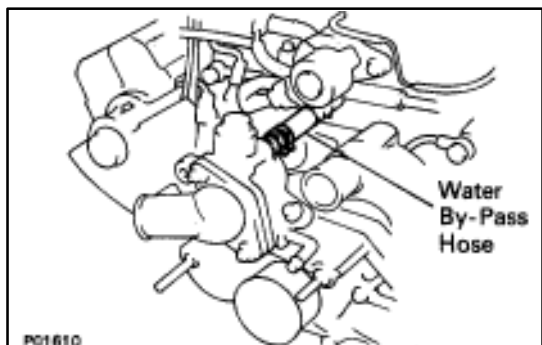
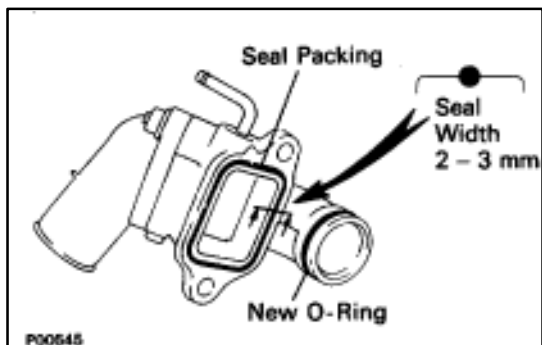
Seal packing: Part No.08826-00100 or equivalent

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

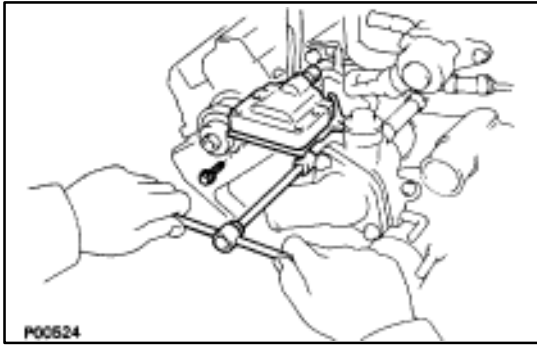
- (c) Install a new O-ring to the water inlet housing.
- (d) Apply soapy water to the O-ring.
- (e) Push the water inlet housing end into the water pump hole.
- (f) Install the water inlet and housing assembly with the two bolts. Alternately tighten the bolts.

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

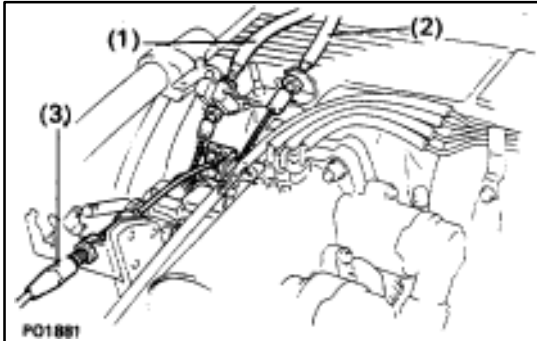
HINT: Use bolts 25 mm (0.98 in.) in length.



- (g) Connect the water by-pass hose to the ISC valve.

**43. INSTALL RH IGNITION COIL**

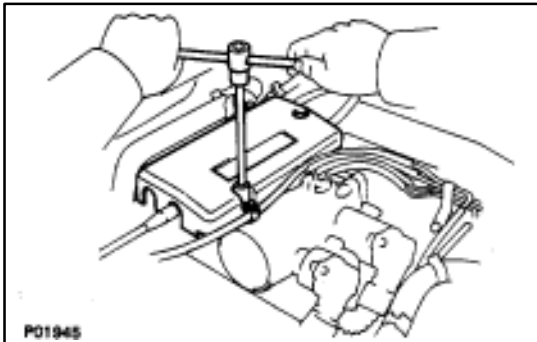
Install the ignition coil with the two bolts.

**44. CONNECT CONTROL CABLES TO THROTTLE BODY**

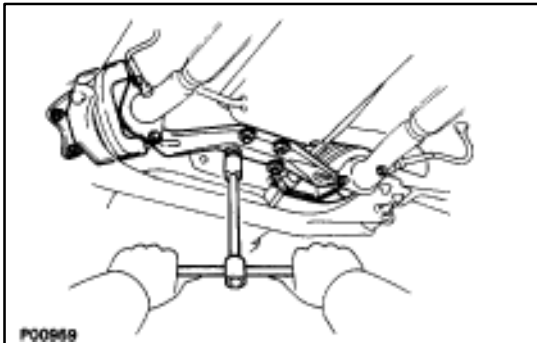
Connect the following cables:

- (1) Accelerator cable
- (2) A/T throttle cable
- (3) (w/ Cruise Control System)

Cruise control actuator cable

**45. INSTALL THROTTLE BODY COVER**

Install the throttle body cover and hose clamp with the two bolts and cap nut.

**46. INSTALL CATALYTIC CONVERTERS (MAIN)**

- (a) Install a new gasket and the catalytic converter to the exhaust manifold with the three new bolts. Install the two catalytic converters.

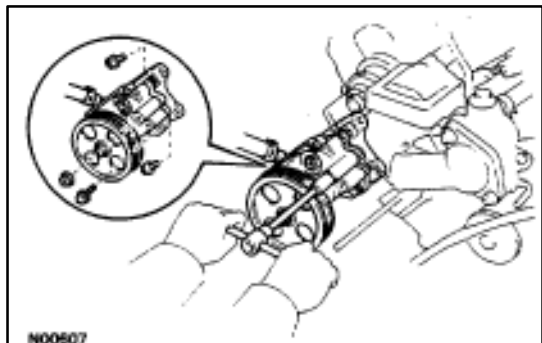
Torque: 62 N·m (630 kgf·cm, 46 ft·lbf)

- (b) Install a new gasket to each front end of the front exhaust pipe.
- (c) Connect the front exhaust pipe to the catalytic converters.
- (d) Temporarily install the four bolts holding the pipe support bracket to the transmission.
- (e) Install the four bolts and nuts holding the catalytic converters to the front exhaust pipe.

Torque: 43 N·m (440 kgf·cm, 32 ft·lbf)

- (f) Tighten the four bolts holding the pipe support bracket to the transmission.

Torque: 43 N·m (440 kgf·cm, 32 ft·lbf)

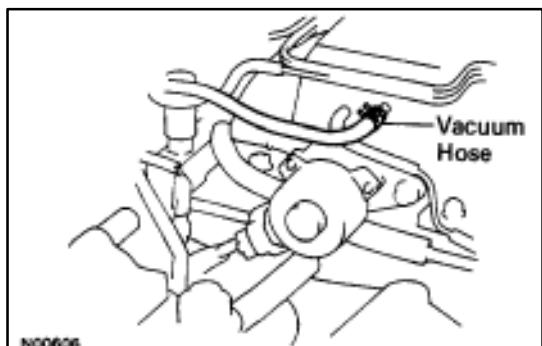
**47. INSTALL PS PUMP**

- (a) Install the PS pump with the three bolts and nut. Alternately tighten the bolts and nut.

Torque:

Bolt 39 N·m (400 kgf·cm, 29 ft·lbf)

Nut 43 N·m (440 kgf·cm, 32 ft·lbf)



- (b) Connect the vacuum hose to the vacuum pipe.

48. INSTALL HYDRAULIC PUMP AND CAMSHAFT TIMING PULLEYS

(See steps 8, 10 and 11 on pages [EM-48](#) to 49)

49. INSTALL HYDRAULIC PUMP AND CAMSHAFT TIMING PULLEYS

(See steps 12 to 43 on pages [EM-49](#) to 57)

50. PERFORM ROAD TEST

Check for abnormal noise, shock, slippage, correct shift points and smooth operation.