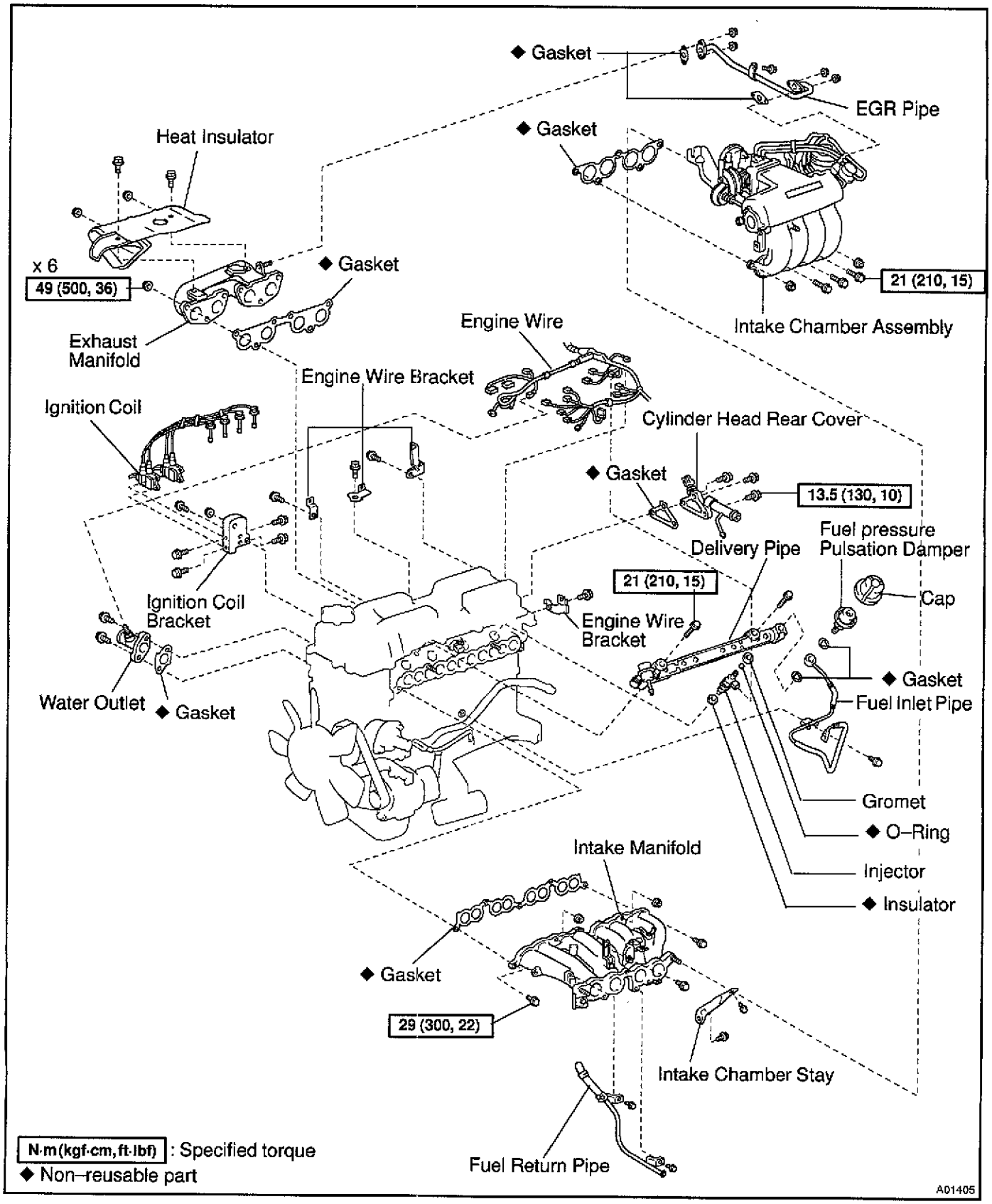
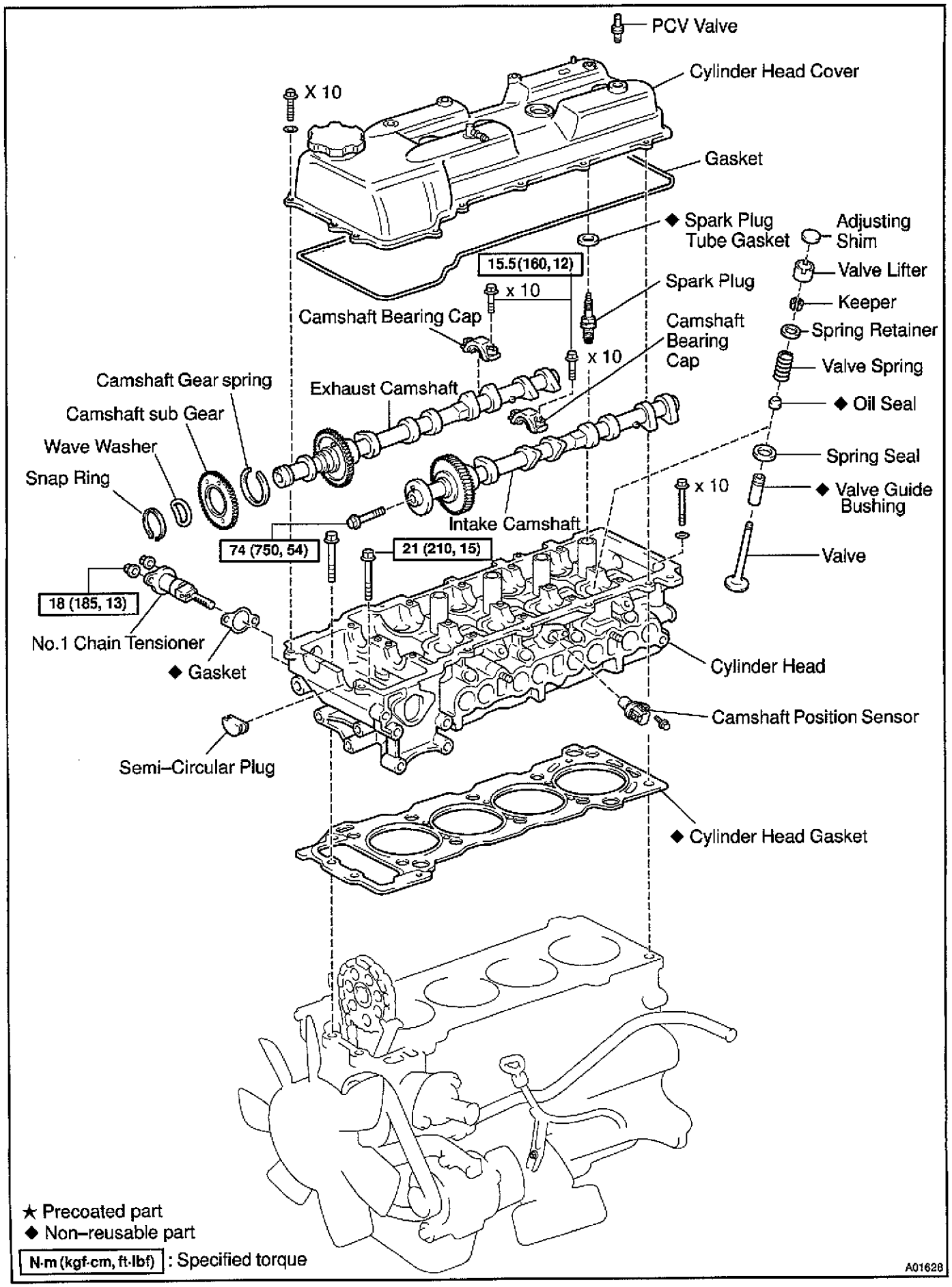
CYLINDER HEAD(2RZ–FE)

COMPONENTS

EM0694-01




PCV Valve
Cylinder Head Cover
X 10
Gasket
◆ Spark Plug Tube Gasket
Adjusting Shim
15.5(160, 12)
x 10
Spark Plug
Valve Lifter
Keeper
Camshaft Bearing Cap
Camshaft Bearing Cap
x 10
Spring Retainer
Valve Spring
Camshaft Gear spring
Exhaust Camshaft
Camshaft sub Gear
◆ Oil Seal
Wave Washer
Spring Seal
Snap Ring
x 10
◆ Valve Guide Bushing
Intake Camshaft
74 (750, 54)
21 (210, 15)
Valve
18 (185, 13)
No.1 Chain Tensioner
◆ Gasket
Cylinder Head
Camshaft Position Sensor
Semi–Circular Plug
◆ Cylinder Head Gasket
★ Precoated part
◆ Non–reusable part
N·m (kgf·cm, ft·lbf) : Specified torque
A01628

EM0GS-01

REMOVAL

1. REMOVE PCV HOSES

2. REMOVE IGNITION COILS

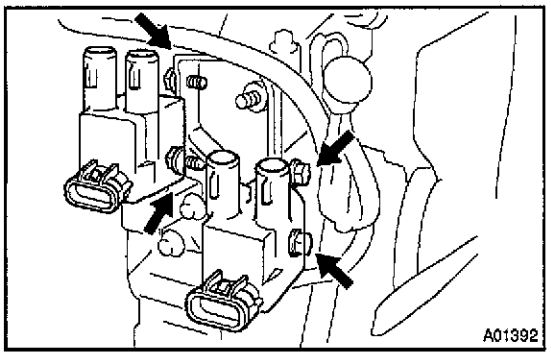
(a) Disconnect the 2 connectors from the ignition coils.

(b) Disconnect high–tension cords at rubber boot from the cylinder head.

(c) Disconnect the 4 high–tension cords from ignition coil.

(d) Remove the 4 bolts and 2 ignition coils from the bracket.

Torque: 10 N·m (100 kgf·cm, 7 ft·lbf)



HINT:

Arrange the ignition coils in correct order.

3. DISCONNECT ENGINE WIRE

(a) Remove the ignition coil bracket and ground.

(b) Disconnect these connectors and clamps:

(1) w/ A/C:
A/C compressor connector

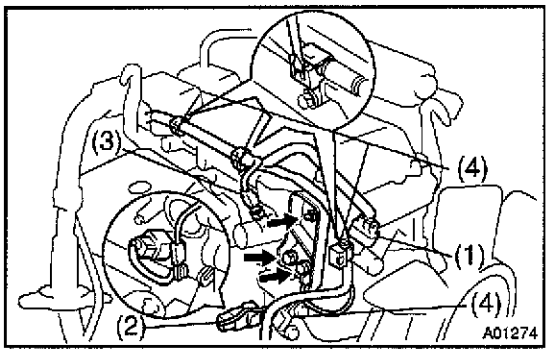
(2) Oil pressure sensor connector and clamp

(3) Engine coolant sender gauge connector

(4) 3 engine wire clamps and engine wire

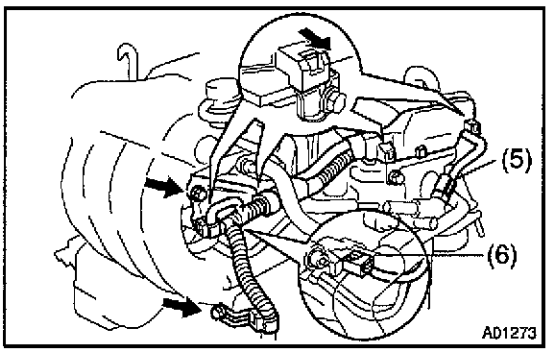
(5) ECT sensor connector

(6) VSV connector for EGR



(c) Disconnect the 4 engine wire clamps and engine wire.

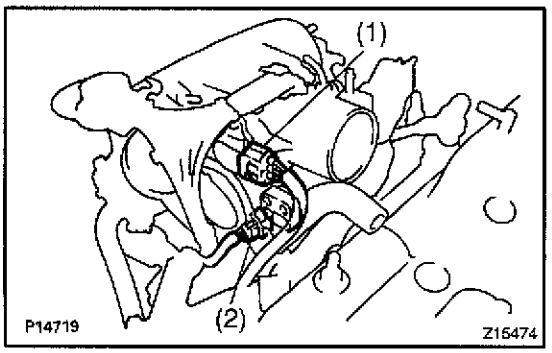
(d) Remove the engine wire braked from air intake chamber.



(e) Disconnect these connectors:

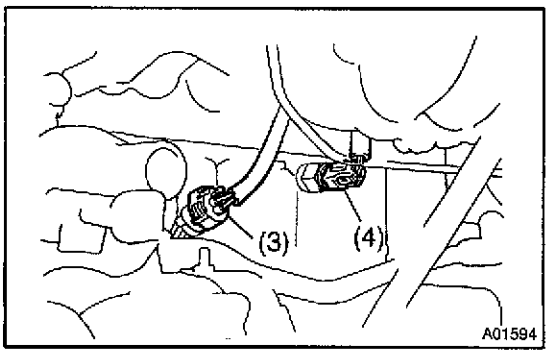
(1) Throttle position sensor connector

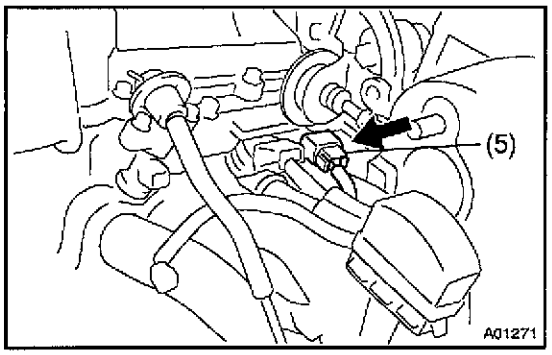
(2) ISC valve connector



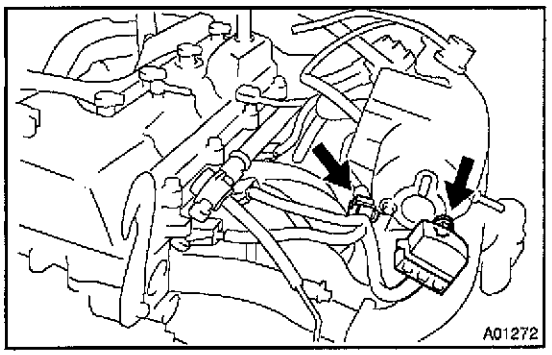
(3) Crankshaft position sensor connector

(4) Knock sensor connector



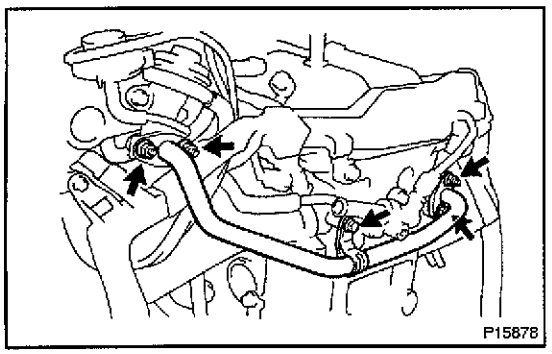


(5) Camshaft position sensor connector



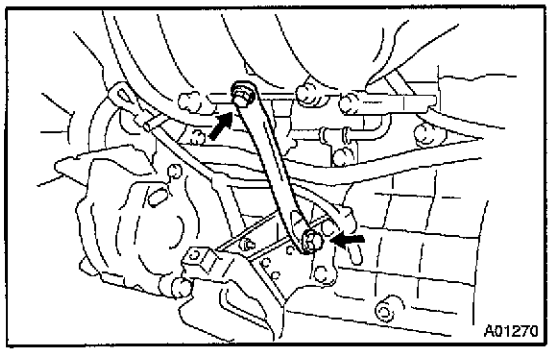
(f) Disconnect the check connector from the bracket.
(g) Disconnect the engine wire clamp.

4. DISCONNECT INJECTOR CONNECTORS



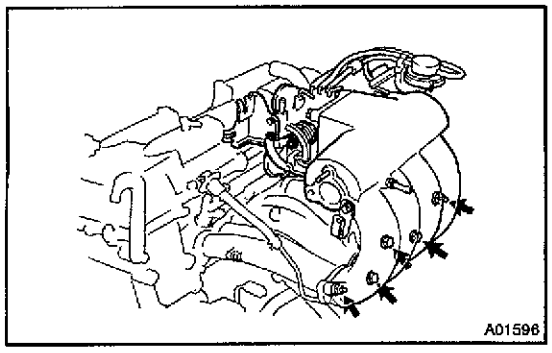
5. REMOVE EGR PIPE

Remove the 4 nuts, bolt, EGR pipe and 2 gasket.



6. REMOVE INTAKE CHAMBER STAY

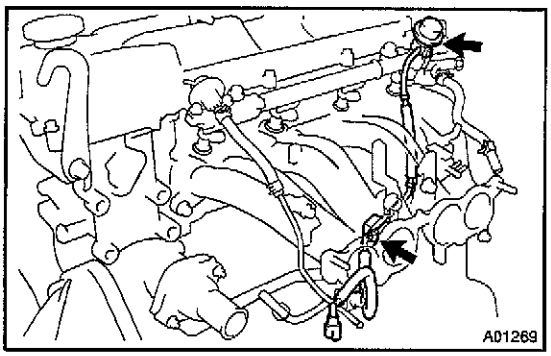
Remove the 2 bolts and intake chamber stay.



7. REMOVE AIR INTAKE CHAMBER ASSEMBLY

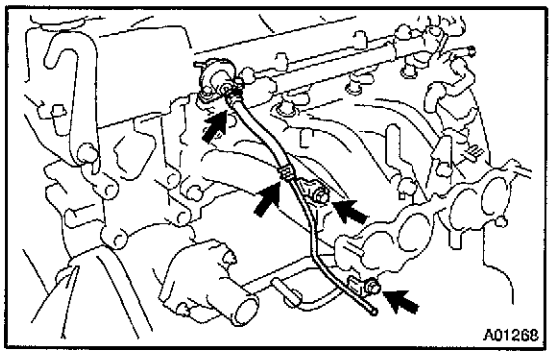
(a) Disconnect these hoses:
- EVAP hose from throttle body
- Brake booster vacuum hose from union
- Water bypass hose from water bypass pipe
- Water bypass hose from cylinder head rear cover

(b) Remove the 3 bolts, 2 nuts, air intake chamber assembly and gasket.



8. REMOVE FUEL INLET PIPE

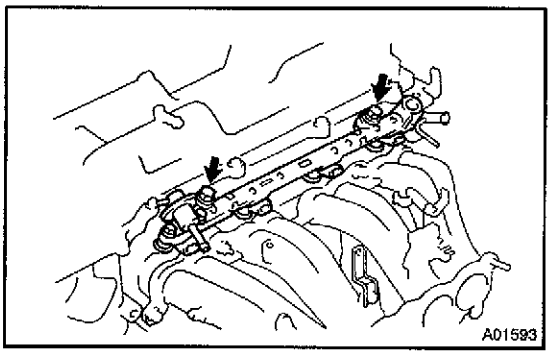
Remove the pulsation damper, 2 gaskets and fuel inlet pipe.



9. REMOVE FUEL RETURN PIPE

(a) Disconnect these hoses:
- Fuel return hose from fuel pressure regulator
- Fuel return hose from fuel return pipe

(b) Remove the 2 bolts and fuel return pipe.

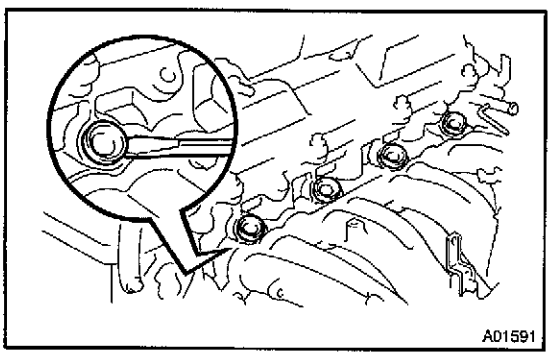


10. REMOVE DELIVERY PIPE AND INJECTORS

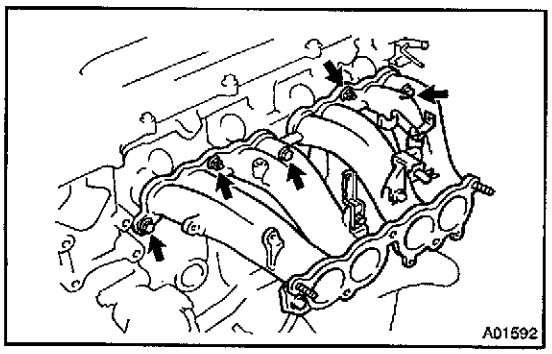
(a) Remove the 2 bolts and delivery pipe together with the 4 injectors.

NOTICE:

Be careful not to drop the injectors when removing the delivery pipe.

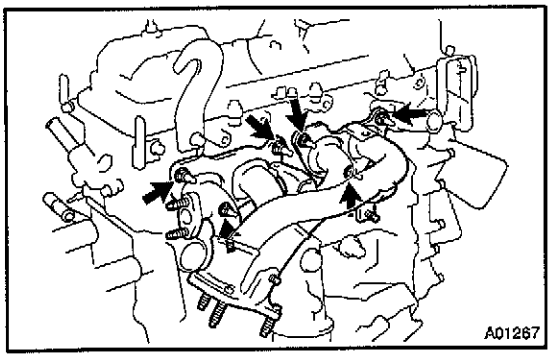


(b) Remove the 4 insulators from the 4 spacers.
(c) Pull out the 4 injectors from the delivery pipe.
(d) Remove the O–ring and grommet from each injector.
(e) Using a screwdriver, pry out the 4 spacers.



11. REMOVE INTAKE MANIFOLD

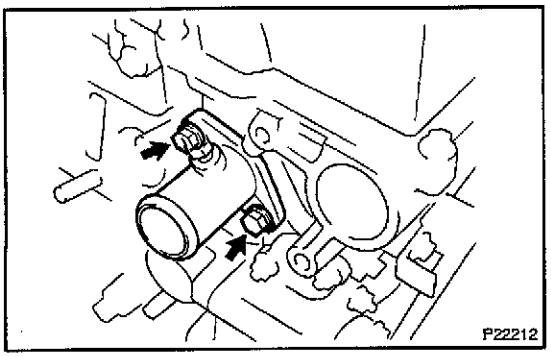
Remove the 3 bolts, 2 nuts, intake manifold and gasket.



12. REMOVE EXHAUST MANIFOLD

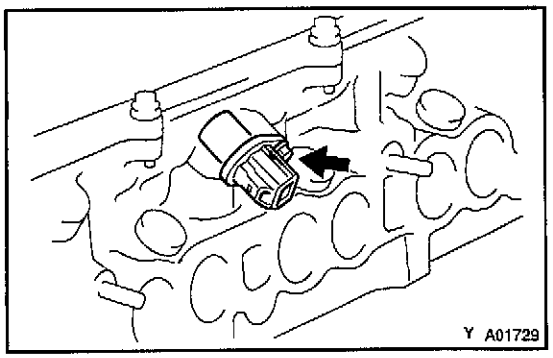
(a) Remove the 2 bolts, 2 nuts and heat insulator.

(b) Remove the 6 nuts, exhaust manifold and gasket.

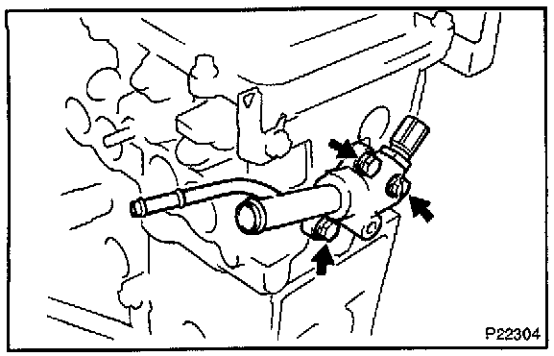


13. REMOVE WATER OUTLET

(a) Remove the 2 bolts, water outlet and gasket.



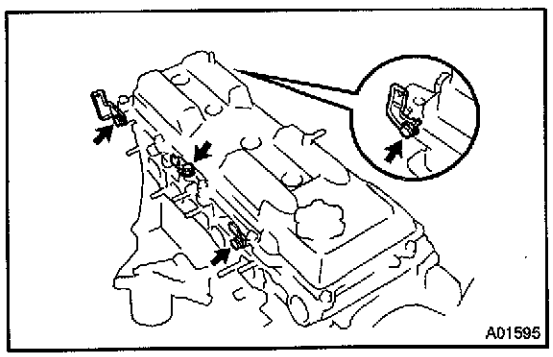
(b) Remove the camshaft position sensor.



14. REMOVE CYLINDER HEAD REAR COVER

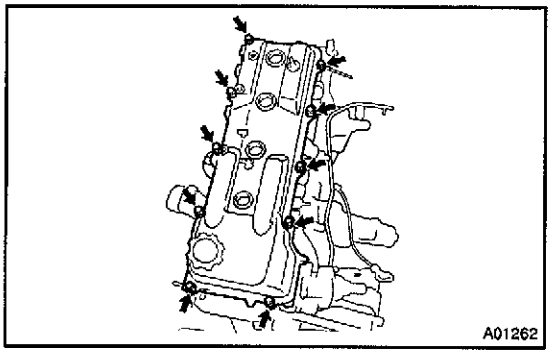
Remove the 3 bolts, cylinder head rear cover and gasket.

15. REMOVE SPARK PLUGS



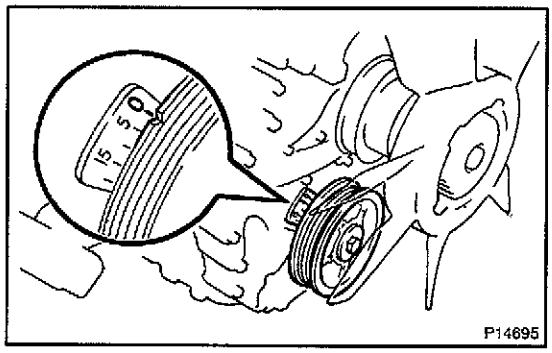
16. REMOVE ENGINE WIRE BRACKETS

Remove the 4 bolts, 4 wire brackets and ground strap.



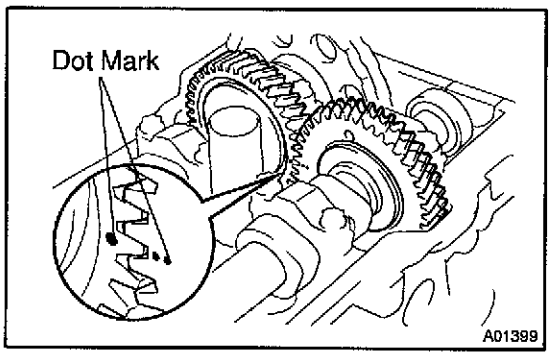
17. REMOVE CYLINDER HEAD COVER

Remove the 10 bolts, seal washers, cylinder head cover and gasket.

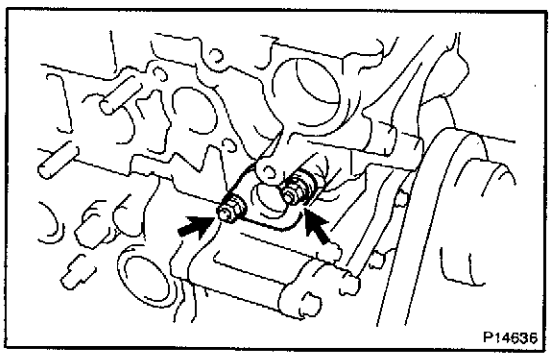


18. SET NO.1 CYLINDER TO TDC/COMPRESSION

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

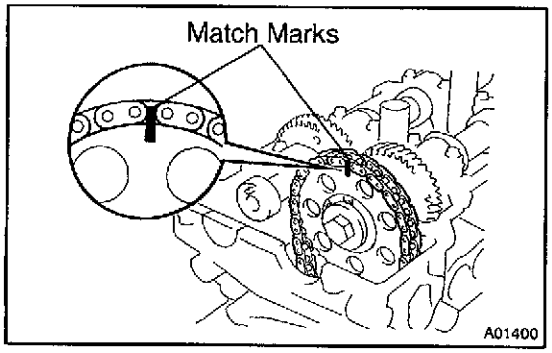


(b) Check that the timing marks (1 and 2 dots) of the camshaft drive and driven gears are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft 1 revolution (360°) and align the marks as above.



19. REMOVE CHAIN TENSIONER

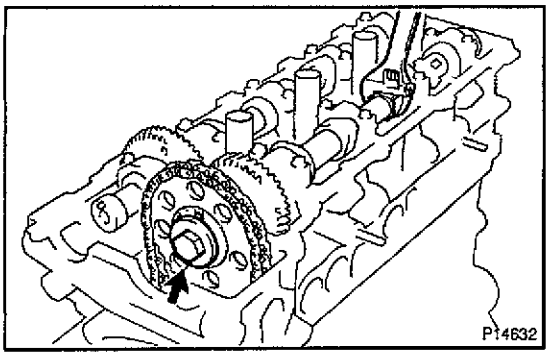
Remove the 2 nuts, chain tensioner and gasket.



20. REMOVE SEMI-CIRCULAR PLUGS

21. REMOVE CAMSHAFT TIMING GEAR

(a) Place the matchmarks on the camshaft timing gear and No.1 timing chain.



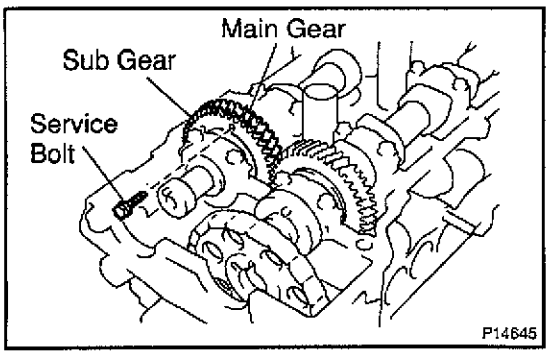
(b) Hold the intake camshaft with a wrench and remove the bolt.

(c) Remove the camshaft timing gear and chain from the intake camshaft and leave on the slipper and damper.

22. REMOVE CAMSHAFTS

NOTICE:

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



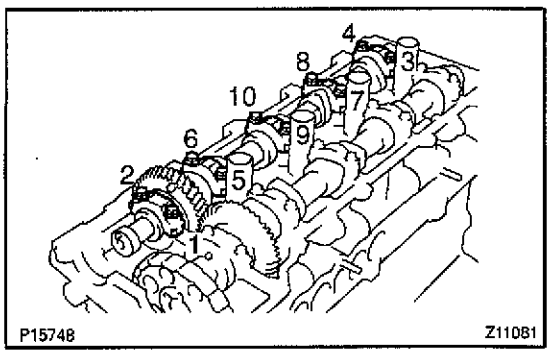
(a) Remove exhaust camshaft

(1) 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.

(2) Secure the exhaust camshaft sub–gear to the main gear with a service bolt.

Recommended service bolt:

Thread diameter	6 mm
Thread pitch	1.0 mm
Bolt length	16 – 20 mm (0.63 – 0.79 in.)

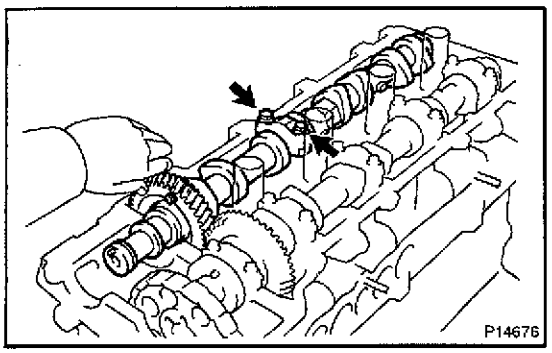


HINT:

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

(3) Uniformly loosen and remove the 10 bearing cap bolts, in several passes, in the sequence shown.

(4) Remove the 5 bearing caps and camshaft.

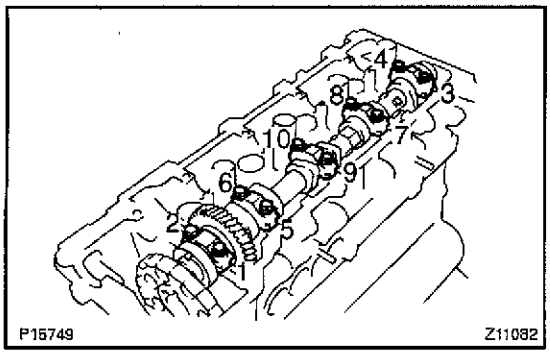


HINT:

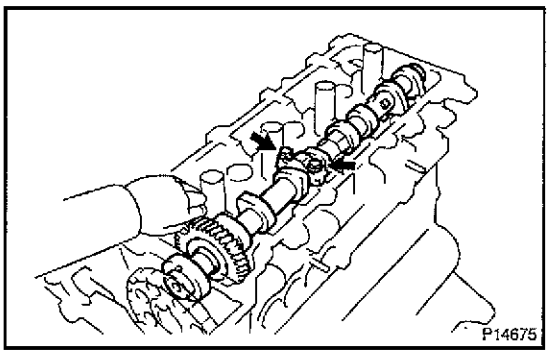
If the camshaft is not being lifted out straight and level, reinstall the No.3 bearing cap with the 2 bolts. Then alternately loosen and remove the bearing cap bolts with the camshaft gear pulled up.

NOTICE:

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

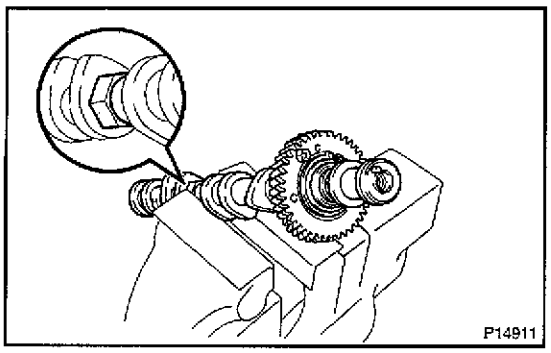


(b) Remove intake camshaft.
(1) Uniformly loosen and remove the 10 bearing cap bolts, in several passes, in the sequence shown.
(2) Remove the 5 bearing caps and camshaft.



HINT:
If the camshaft is not being lifted out straight and level, reinstall the No.3 bearing cap with the 2 bolts. Then alternately loosen and remove the 2 bearing cap bolts with the camshaft gear pulled up.

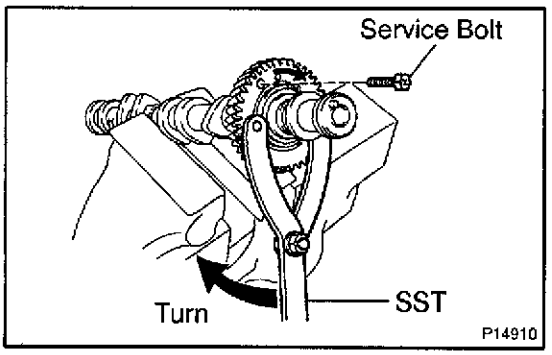
NOTICE:
Do not pry on or attempt to force the camshaft with a tool or other object.



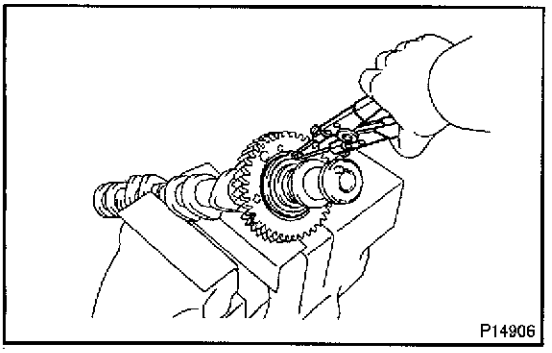
23. DISASSEMBLE EXHAUST CAMSHAFT

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

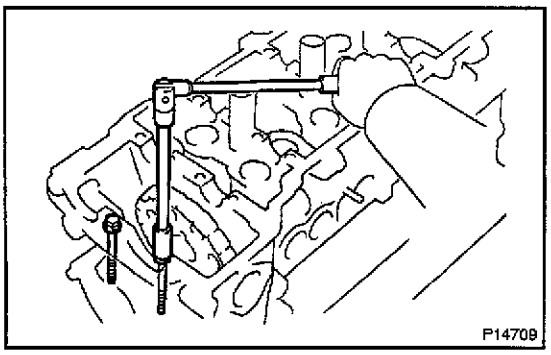
NOTICE:
Be careful not to damage the camshaft.



(b) Using SST, turn the sub–gear clockwise, and remove the service bolt.
SST 09960–10010 (09962–01000, 09963–00500)

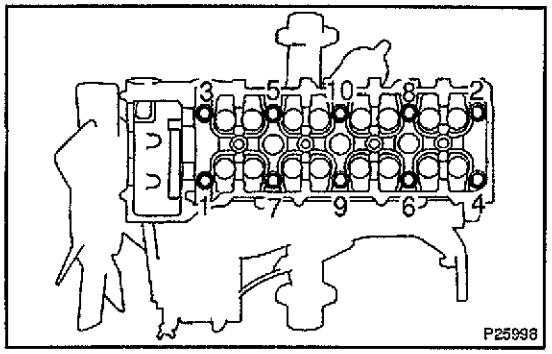


(c) Using snap ring pliers, remove the snap ring.
(d) Remove these parts:
- Wave washer
- Camshaft sub–gear
- Camshaft gear spring



24. REMOVE CYLINDER HEAD

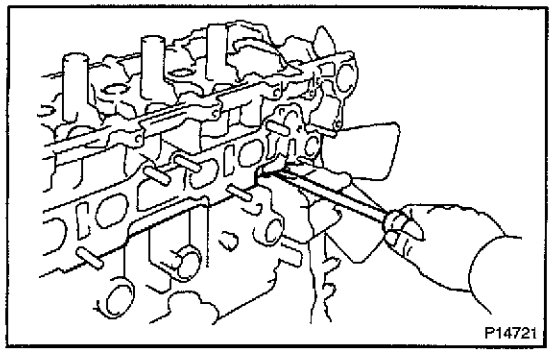
(a) Remove the 2 bolts in front of the head before the other head bolts are removed.



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

NOTICE:

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



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

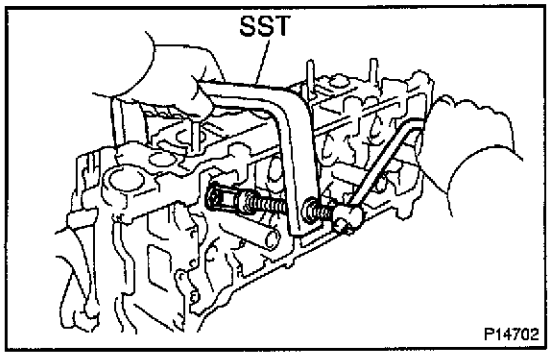
HINT:

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.

EM0S5–01



DISASSEMBLY

1. REMOVE VALVE LIFTERS AND SHIMS

HINT:

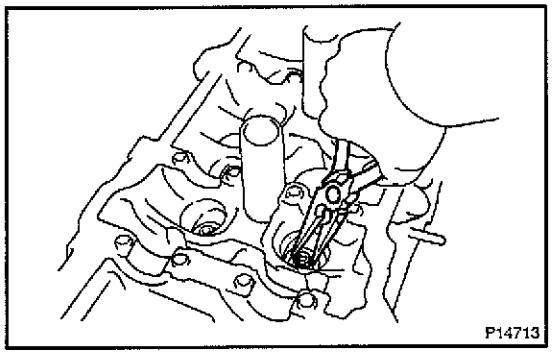
Arrange the valve lifters and shims in correct order.

2. REMOVE VALVES

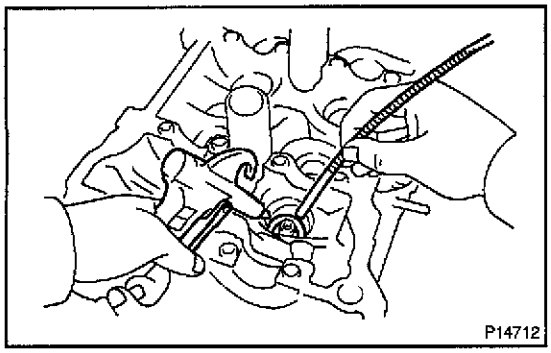
(a) Using SST, compress the valve spring and remove the 2 keepers.

SST 09202–70020 (09202–00010)

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



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



(d) Using compressed air and a magnetic finger, remove the spring seat by blowing air.

HINT:

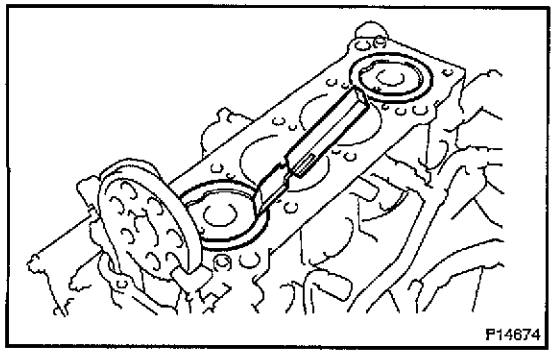
Arrange the valves, valve springs, spring seats and spring retainers in correct order.

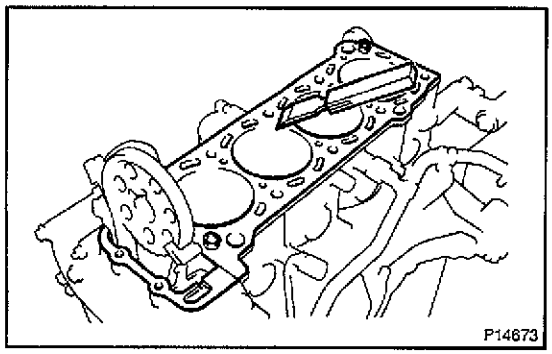
EM097–01

INSPECTION

1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

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





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

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

CAUTION:

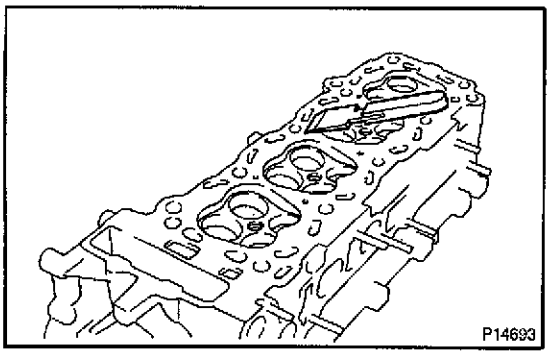
Protect your eyes when using high–compressed air.

2. REMOVE GASKET MATERIAL

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

NOTICE:

Be careful not to scratch the cylinder block contact surface.

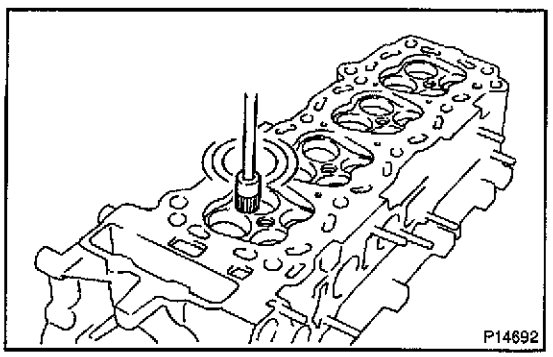


3. CLEAN COMBUSTION CHAMBERS

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

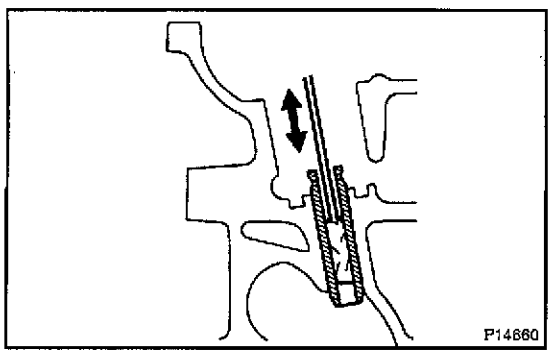
NOTICE:

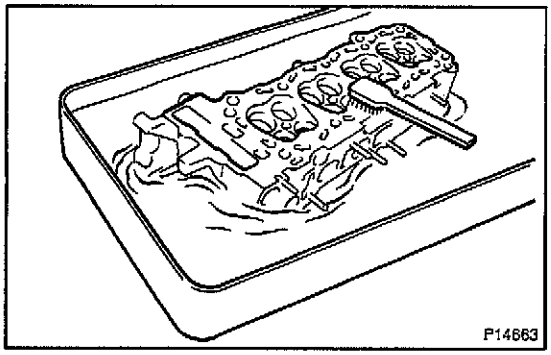
Be careful not to scratch the cylinder block contact surface.



4. CLEAN VALVE GUIDE BUSHINGS

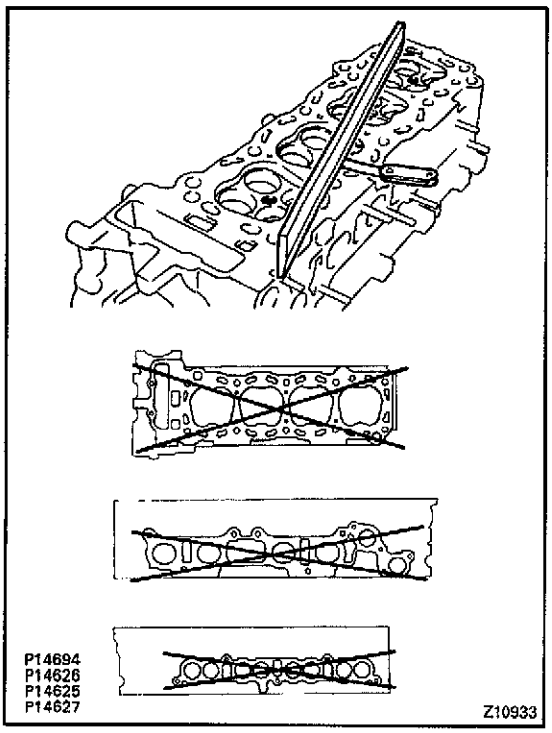
Using a valve guide bushing brush and solvent, clean all the guide bushings.





5. CLEAN CYLINDER HEAD

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

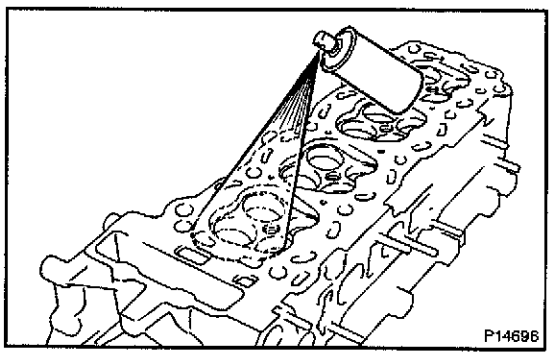


6. INSPECT FOR FLATNESS

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

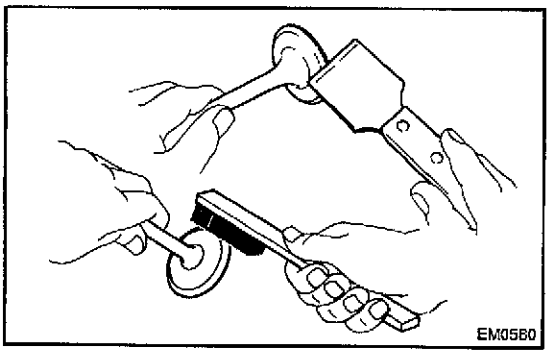
Maximum warpage:
Cylinder block side
0.05 mm (0.0020 in.)
Manifold side
0.10 mm (0.0039 in.)

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



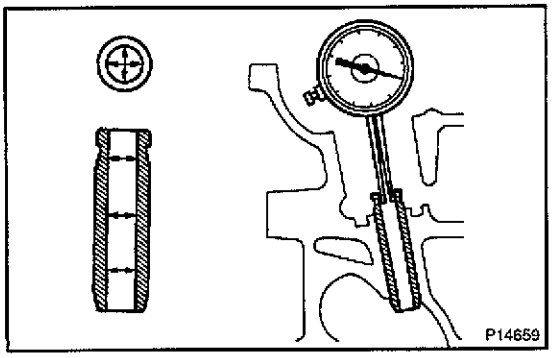
7. INSPECT FOR CRACKS

Using a dye penetrant, check the combustion chambers, intake ports, exhaust ports and cylinder block surface for cracks.
If cracked, replace the cylinder head.



8. CLEAN VALVES

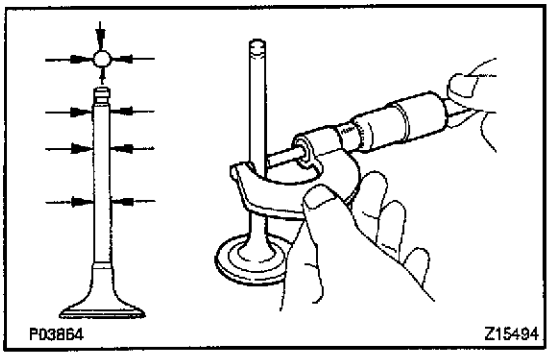
(a) Using a gasket scraper, chip off any carbon from the valve head.
(b) Using a wire brush, thoroughly clean the valve.



9. INSPECT VALVE STEMS AND GUIDE BUSHINGS

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

Bushing inside diameter:
6.010 – 6.030 mm (0.2366 – 0.2374 in.)



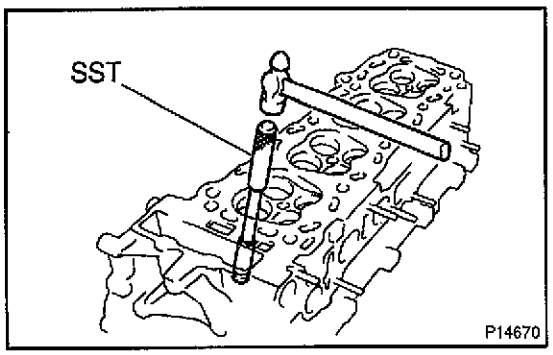
(b) Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter:
Intake
5.970 – 5.985 mm (0.2350 – 0.2356 in.)
Exhaust
5.965 – 5.980 mm (0.2348 – 0.2354 in.)

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

Standard oil clearance:
Intake
0.025 – 0.060 mm (0.0010 – 0.0024 in.)
Exhaust
0.030 – 0.065 mm (0.0012 – 0.0026 in.)
Maximum oil clearance:
Intake
0.08 mm (0.0031 in.)
Exhaust
0.10 mm (0.0039 in.)

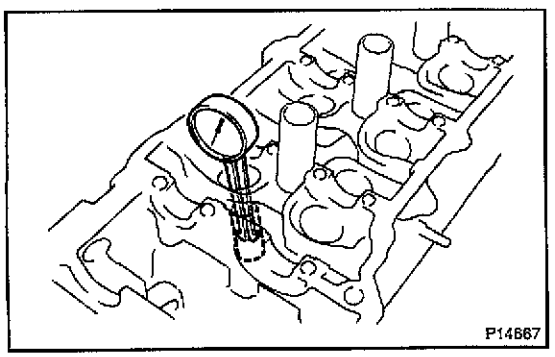
If the clearance is greater than maximum, replace the valve and guide bushing.



10. IF NECESSARY, REPLACE VALVE GUIDE BUSHINGS

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

(b) Using SST and a hammer, tap out the guide bushing.
SST 09201–10000 (09201–01060), 09950–70010 (09951–07150)



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

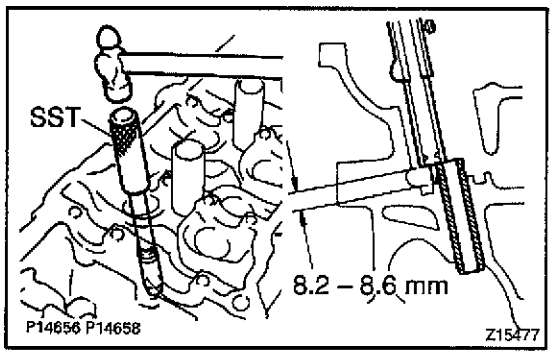
Both intake and exhaust

Bushing bor diameter mm (in.)	Bushing size
11.000 – 11.027 (0.4331 – 0.4341)	Use STD
11.050 – 11.077 (0.4350 – 0.4361)	Use O/S 0.05

(d) 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.), machine the bushing bore to these dimension:

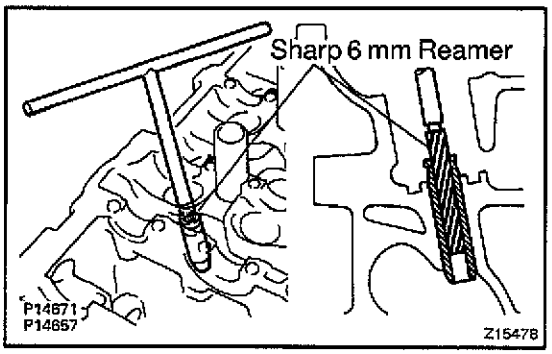
11.050 – 11.077 mm (0.4350 – 0.4361 in.)

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

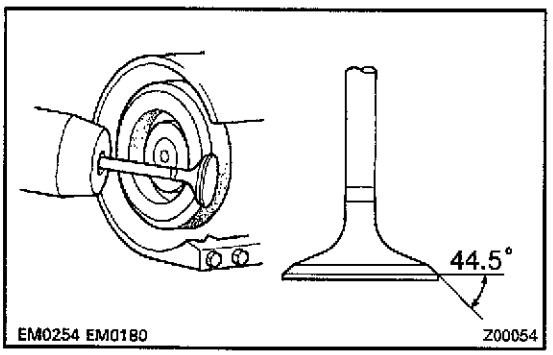


(e) Gradually heat the cylinder head to 80 – 100°C (176 – 212°F).

(f) Using SST and a hammer, tap in a new guide bushing to where there 8.2 – 8.6 mm (0.323 – 0.339 in.) protruding from the cylinder head.
SST 09201–10000 (09201–01060),
09950–70010 (09951–07150)



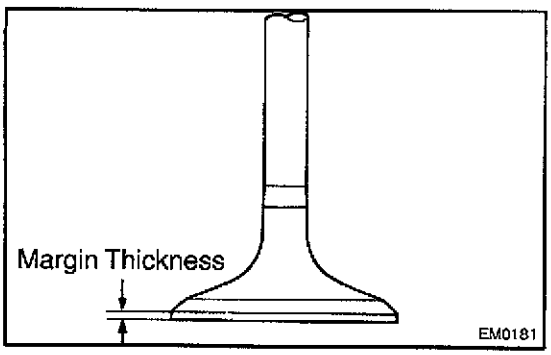
(g) Using a sharp 6 mm reamer, ream the guide bushing to obtain the standard specified clearance (See step 9 on the previous page) between the guide bushing and valve stem.



11. INSPECT AND GRIND VALVES

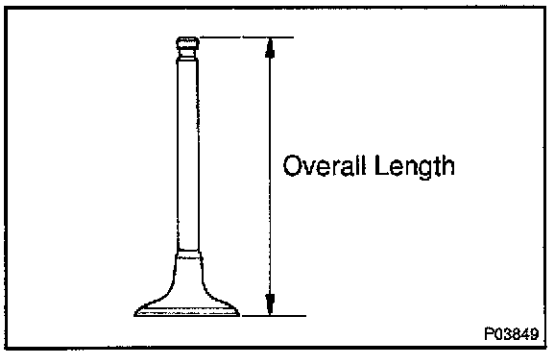
(a) Grind the valve enough to remove pits and carbon.

(b) Check that the valve is ground to the correct valve face angle.
Valve face angle:
44.5°

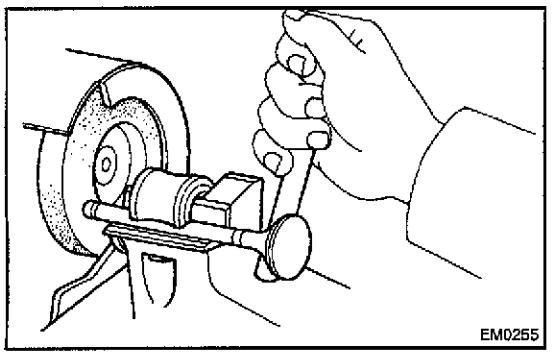


(c) Check the valve head margin thickness.
Standard margin thickness:
1.0 mm (0.039 in.)
Minimum margin thickness:
0.5 mm (0.020 in.)

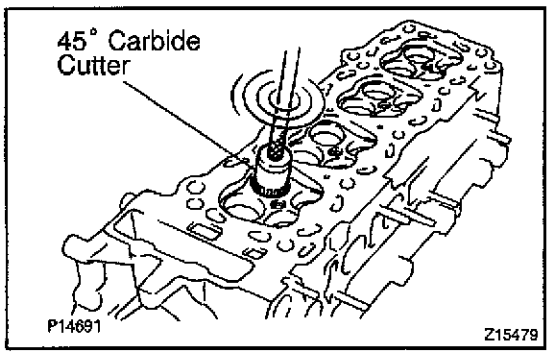
If the margin thickness is less than minimum, replace the valve.



(d) Check the valve overall length.
Standard overall length:
Intake: 103.45 mm (4.0728 in.)
Exhaust: 103.60 mm (4.0787 in.)
Minimum overall length:
Intake: 102.95 mm (4.0531 in.)
Exhaust: 103.10 mm (4.0590 in.)
If the overall length is less than minimum, replace the valve.



(e) Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.
NOTICE:
Do not grind off more than minimum.



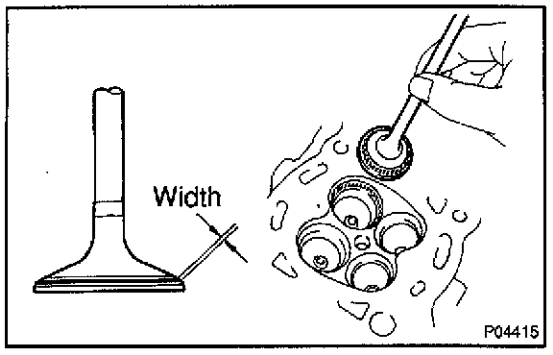
12. INSPECT AND CLEAN VALVE SEATS

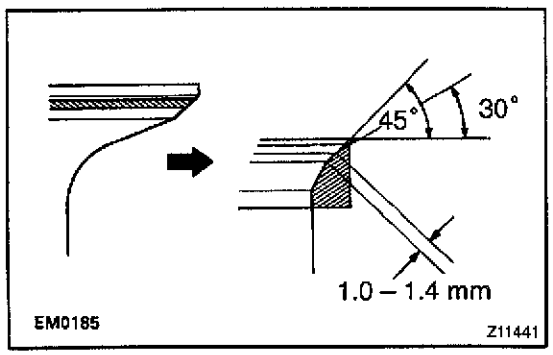
(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.

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

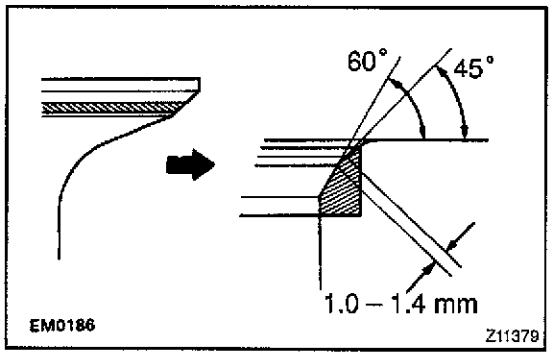
(c) Check the valve face and seat for these:
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is in the middle of the valve face with these width:

0.9 – 1.9 mm (0.035 – 0.075 in.)

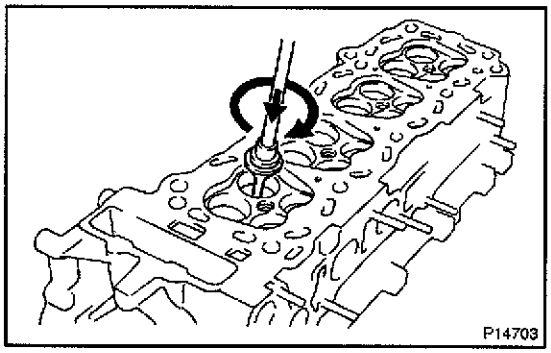




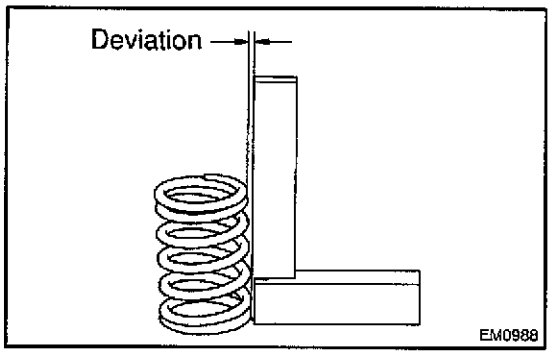
(d) If not, correct the valve seats as follows:
(1) Intake:
If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.



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



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

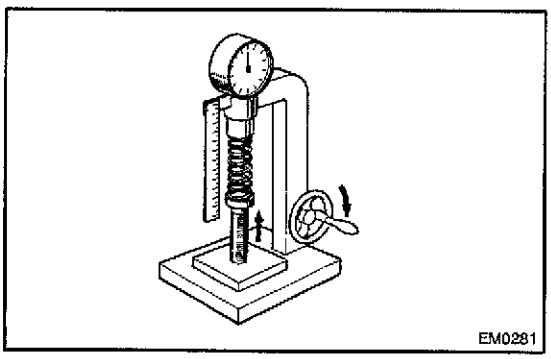


13. INSPECT VALVE SPRINGS

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

Maximum deviation:
2.0 mm (0.079 in.)

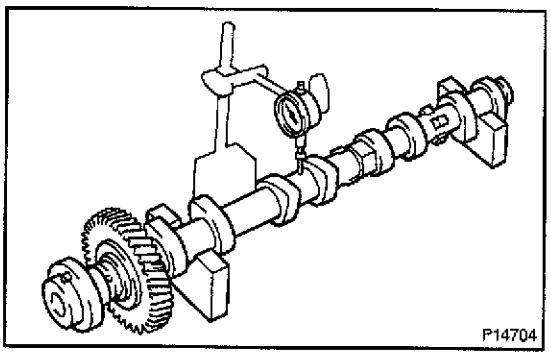
If the deviation is greater than maximum, replace the valve spring.



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

Installed tension:
162 – 190 N (16.5 – 19.4 kgf, 36.4 – 42.8 lbf)
at 40.3 mm (1.580 in.)

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

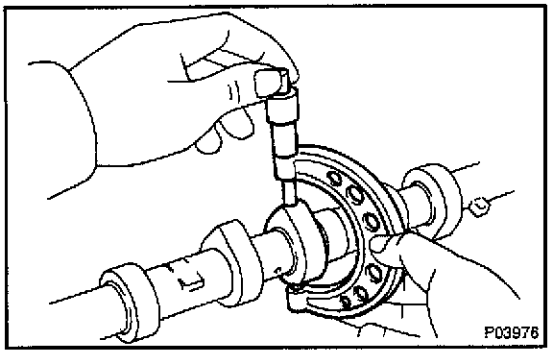


14. INSPECT CAMSHAFT FOR RUNOUT

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

Maximum circle runout:
0.06 mm (0.0024 in.)

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



15. INSPECT CAM LOBES

Using a micrometer, measure the cam lobe height.

Standard cam lobe height:

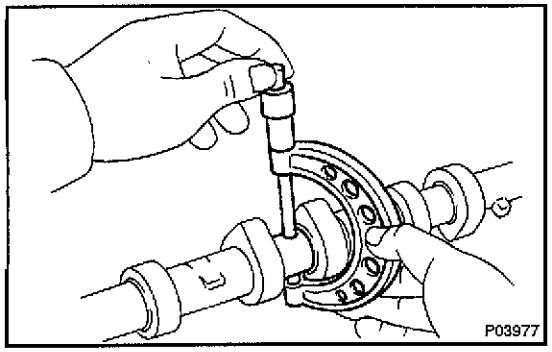
Intake

45.31 – 45.41 mm (1.7839 – 1.7878 in.)

Exhaust

45.06 – 45.16 mm (1.7740 – 1.7779 in.)

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



16. INSPECT CAMSHAFT JOURNALS

Using a micrometer, measure the journal diameter.

Journal diameter:

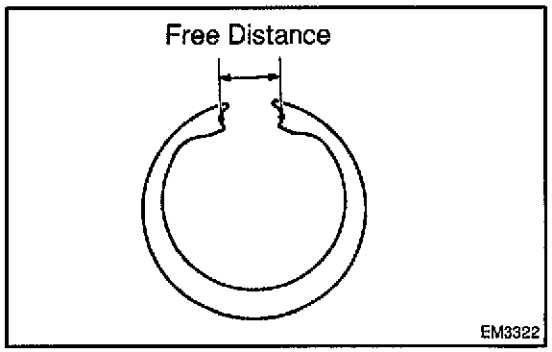
26.959 – 26.975 mm (1.0614 – 1.0620 in.)

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

17. 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.



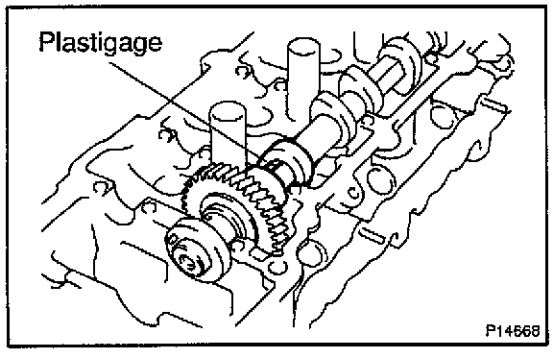
18. INSPECT CAMSHAFT GEAR SPRING

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

Free distance:

22.5 – 22.9 mm (0.886 – 0.902 in.)

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



19. 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 page EM–54)

Torque:15.5 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.

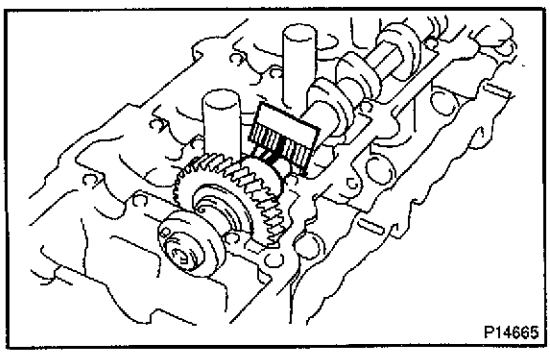
Standard oil clearance:

0.025 – 0.062 mm (0.0010 – 0.0024 in.)

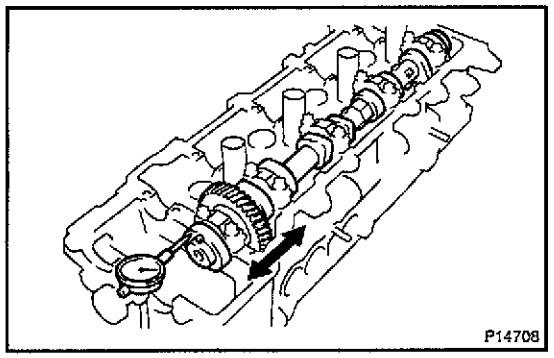
Maximum oil clearance:

0.08 mm (0.0031 in.)

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



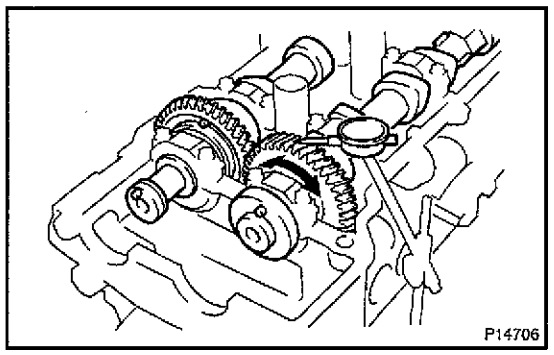
(g) Completely remove the Plastigage.


P14708

20. INSPECT CAMSHAFT THRUST CLEARANCE

(a) Install the camshaft.
(See page EM–54)

(b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.
Standard thrust clearance:
0.040 – 0.095 mm (0.0016 – 0.0037 in.)
Maximum thrust clearance:
0.12 mm (0.0047 in.)

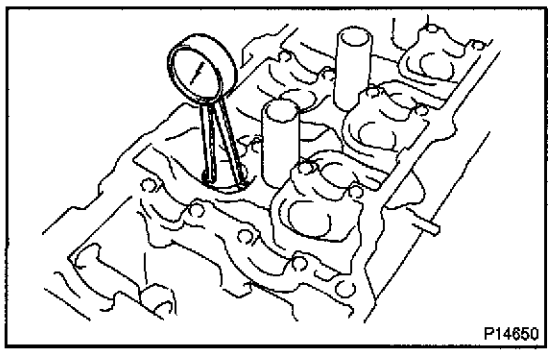

P14706

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

21. INSPECT CAMSHAFT GEAR BACKLASH

(a) Install the camshafts without installing the exhaust cam sub–gear.
(See page EM–54)

(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.)


P14650

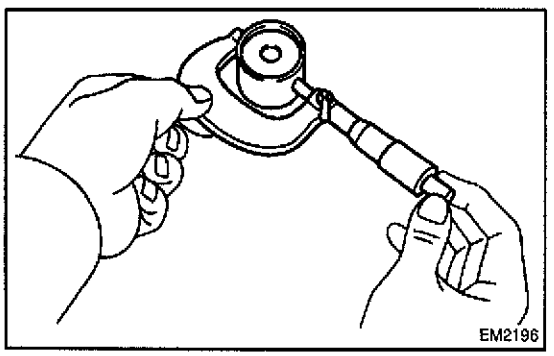
If the backlash is greater than maximum, replace the camshafts.

22. 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 (1.1578 – 1.2195 in.)

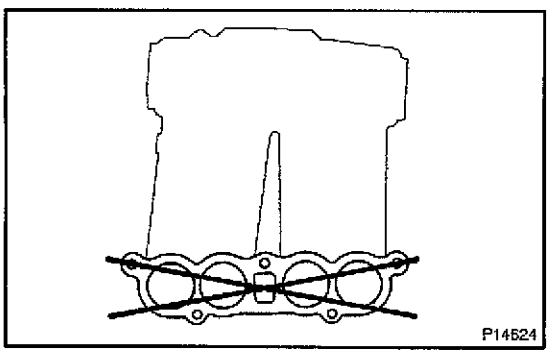
(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.
Standard oil clearance:
0.024 – 0.050 mm (0.0009 – 0.0020 in.)
Maximum oil clearance:
0.07 mm (0.0028 in.)


EM2196

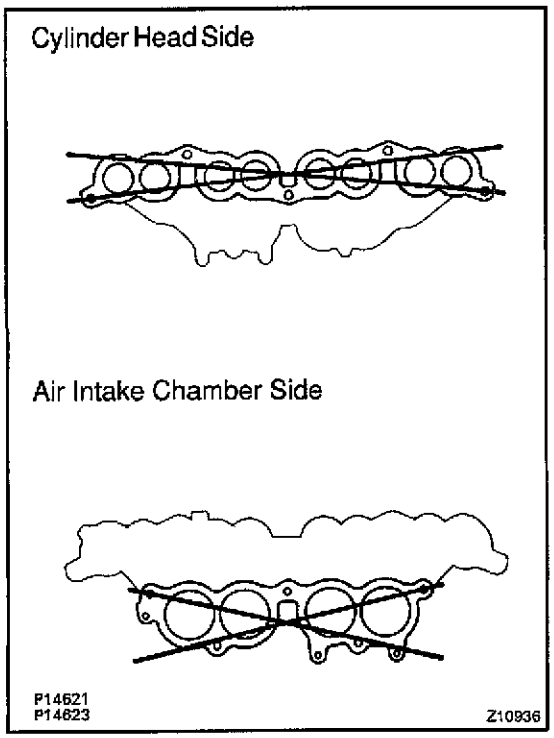
If the oil clearance is greater than maximum, replace the lifter. If necessary, replace the cylinder head.

23. INSPECT AIR INTAKE CHAMBER

Using a precision straight edge and thickness gauge, measure the surface contacting the intake manifold for warpage.
Maximum warpage:
0.20 mm (0.0078 in.)


P14524

If warpage is greater than maximum, replace the air intake chamber.

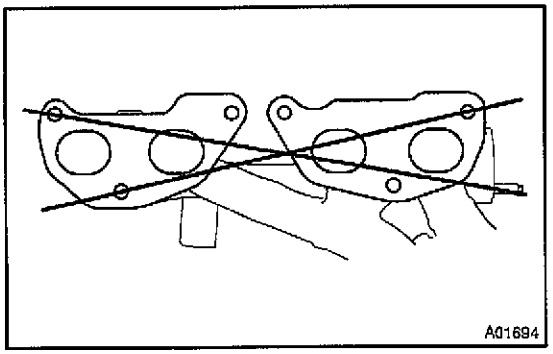


24. INSPECT INTAKE MANIFOLD

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

Maximum warpage:
0.20 mm (0.0078 in.)

If warpage is greater than maximum, replace the manifold.

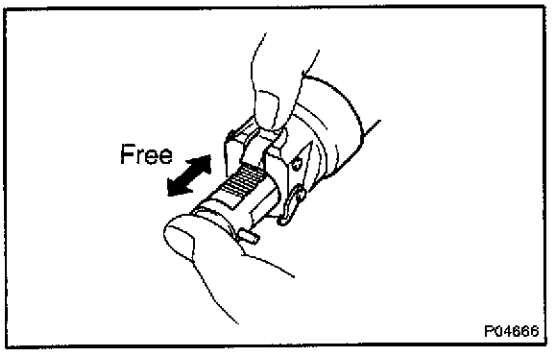


25. INSPECT EXHAUST MANIFOLD

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

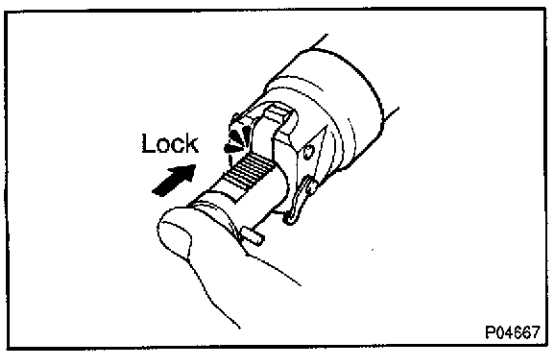
Maximum warpage:
0.50 mm (0.0197 in.)

If warpage is greater than maximum, replace the manifold.

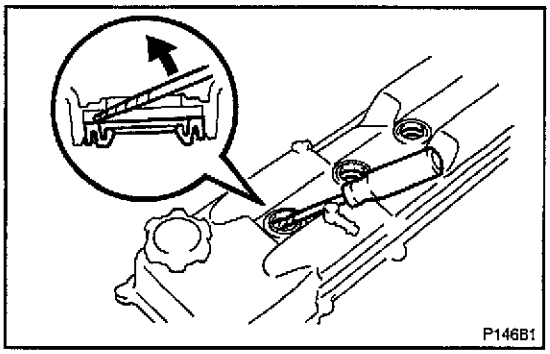


26. INSPECT CHAIN TENSIONER

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

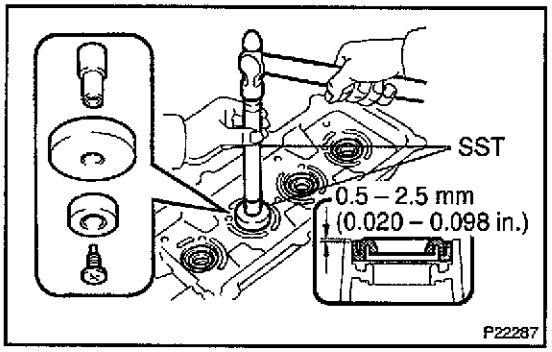


(b) Released the ratchet pawl and check that the plunger is locked in place by the ratchet pawl and does not move when pushed with your finger.



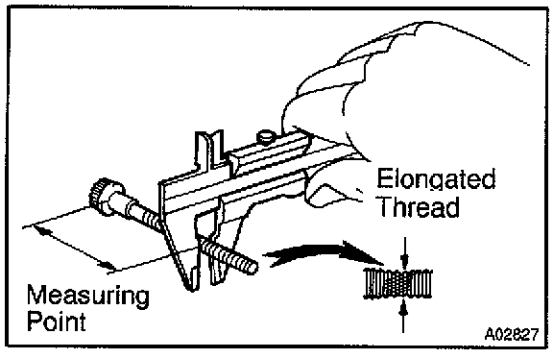
27. IF NECESSARY, REPLACE SPARK PLUG TUBE GASKETS

(a) Using a screwdriver, pry out the tube gasket.



(b) Using SST and a hammer, tap in a new tube gasket as shown in the illustration.
SST 09950–60010 (09951–00260, 09951–00490, 09952–06010), 09950–70010 (09951–07150)

(c) Apply a light coat of MP grease to the gasket lip.



28. INSPECT CYLINDER HEAD BOLTS

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

Standard outside diameter:
10.76 – 10.97 mm (0.4236 – 0.4319 in.)
Minimum outside diameter:
10.40 mm (0.4094 in.)

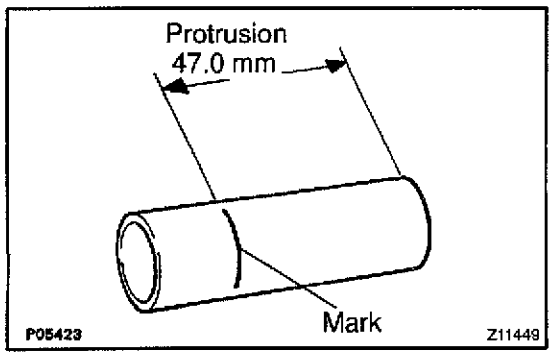
If the diameter is less than minimum, replace the bolt.

EM0S6-01

REASSEMBLY

HINT:

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



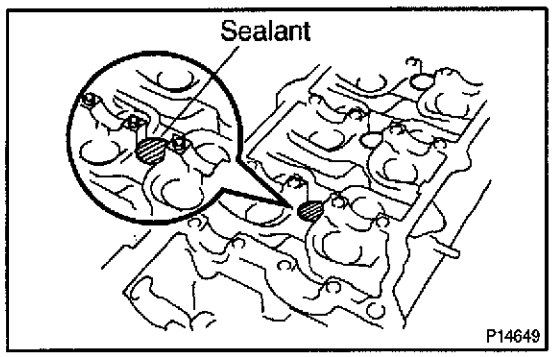
1. INSTALL SPARK PLUG TUBES

HINT:

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

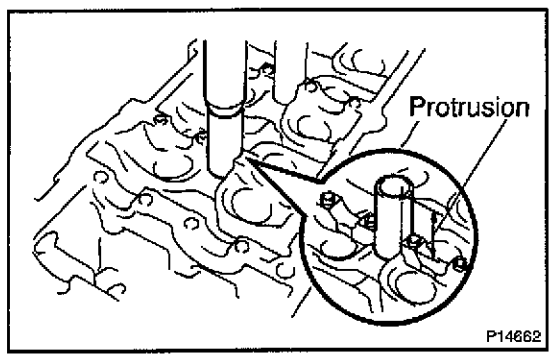
(a) Mark the standard position away from the edge, onto the spark plug tube.

Standard protrusion:
47.0 mm (1.850 in.)



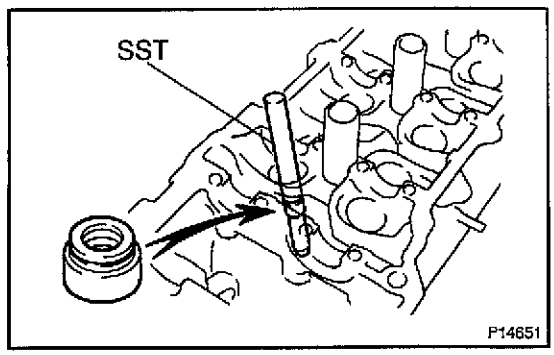
(b) Apply adhesive to the spark plug tube hole of the cylinder head.

Sealant:
Part No.08833–00070, Adhesive 1324, THREE BOND1324 or equivalent



(c) Using a press, press in a new spark plug tube until there is 47.0 mm (1.850 in.) protruding from the camshaft bearing cap installation surface of the cylinder head.

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



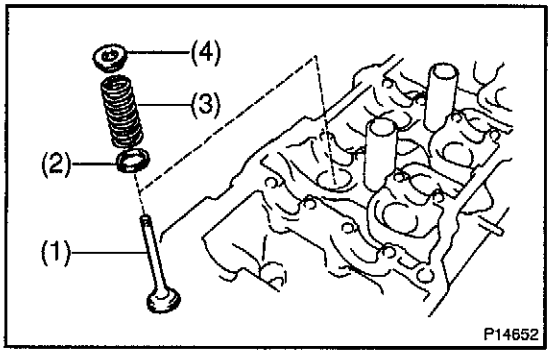
2. INSTALL VALVES

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

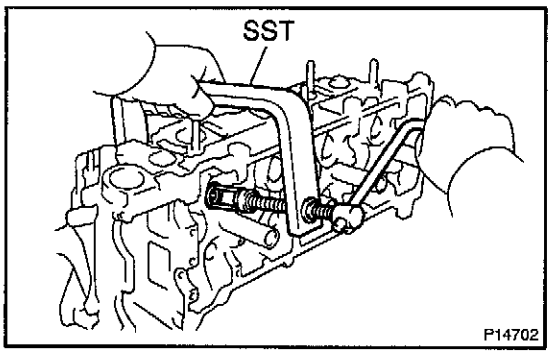
HINT:

Different oil seals are used for the intake and exhaust.

Code mark (Intake side only):
"H"



(b) Install these parts:
(1) Valve
(2) Spring seat
(3) Valve spring
(4) Spring retainer



(c) Using SST, compress the valve spring and place the 2 keepers around the valve stem.
SST 09202–70020 (09202–00010)

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

3. INSTALL VALVE LIFTERS AND SHIMS

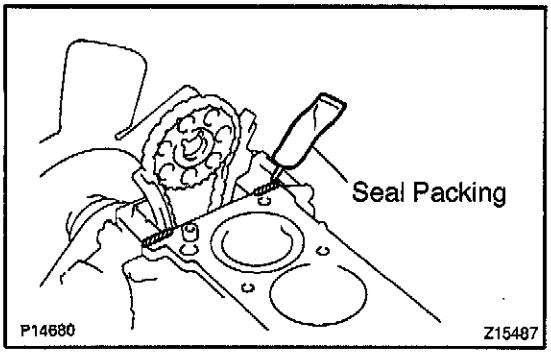
(a) Install the valve lifter and shim.

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

EM099–01

INSTALLATION

1. PLACE CYLINDER HEAD ON CYLINDER BLOCK

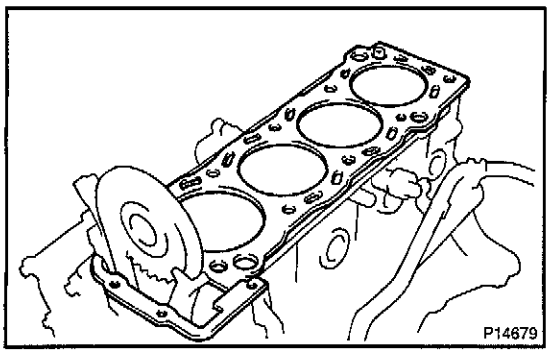


(a) Apply seal packing to the 2 locations as shown.

Seal packing:
Part No. 08826–00080 or equivalent

NOTICE:

Do not apply too much seal packing.



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

NOTICE:

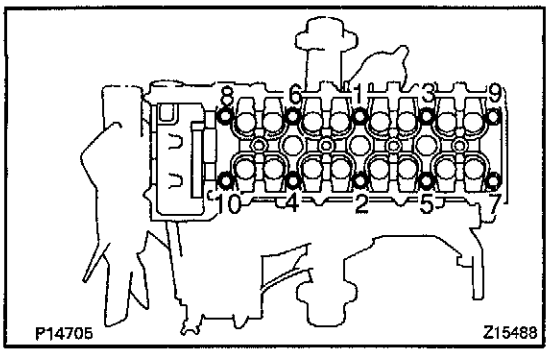
Be careful of the installation direction.

(c) Place the cylinder head in position on the cylinder head gasket.

2. INSTALL CYLINDER HEAD BOLTS

HINT:

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

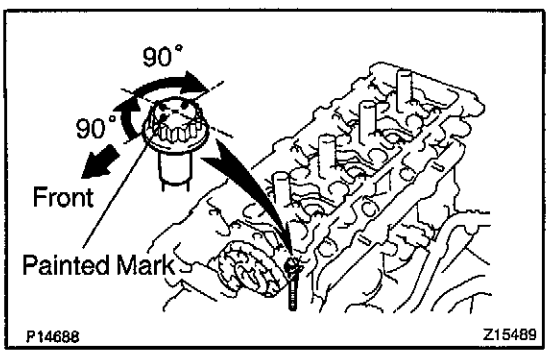


(a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.

(b) Install and uniformly tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

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

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

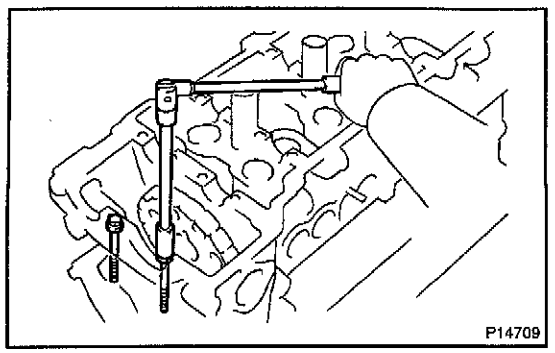


(c) Mark the front of the cylinder head bolt head with paint.

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

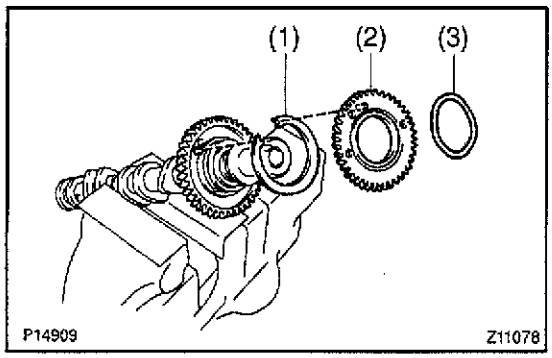
(e) Retighten the cylinder head bolts by an additional 90°.

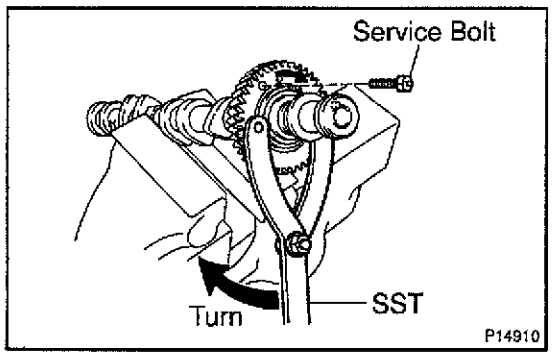
(f) Check that the painted mark is now facing rearward.

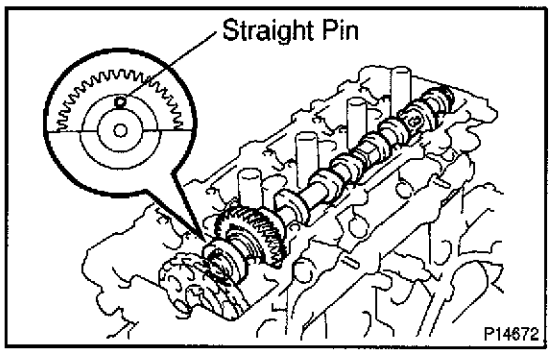


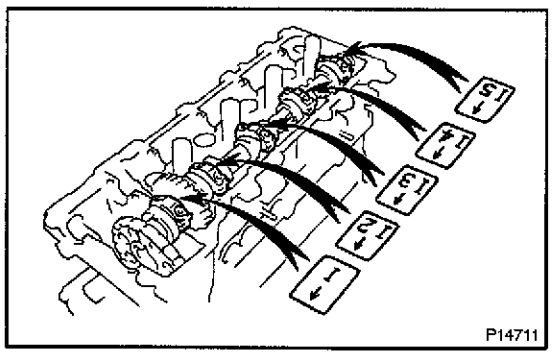
(g) Install and torque the 2 bolts.

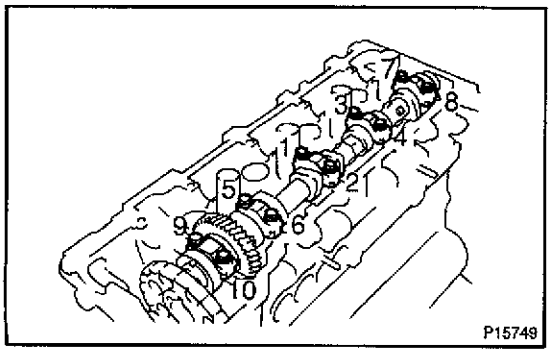
Torque: 21 N·m (210 kgf·cm, 15 ft·lbf)











3. ASSEMBLE EXHAUST CAMSHAFT

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

NOTICE:

Be careful not to damage the camshaft.

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

HINT:

Align the pins on the gears with the spring ends.

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

(d) Using SST, align the holes of the camshaft main gear and sub–gear by turning sub–gear clockwise, and install a service bolt.

SST 09960–10010 (09962–01000, 09963–00500)

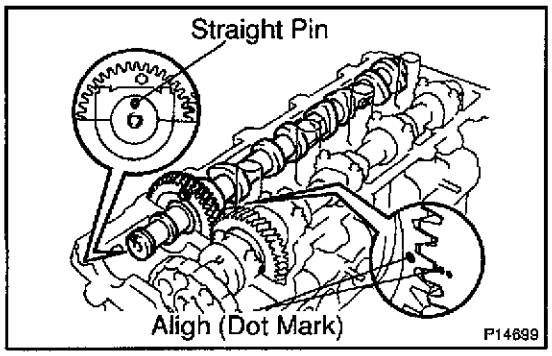
4. INSTALL CAMSHAFTS

NOTICE:

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

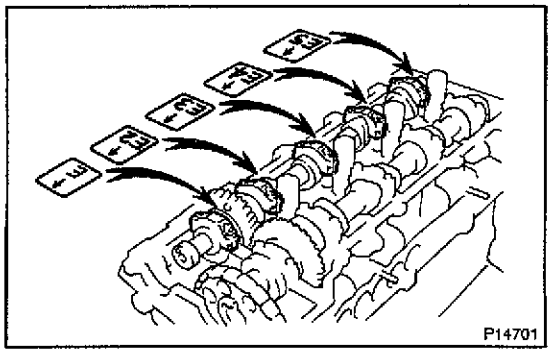
(a) Install intake camshaft.
- (1) Apply MP grease to the thrust portion of the intake camshaft.
- (2) Place the intake camshaft with knock pin facing upward of camshaft angle on the cylinder head.
- (3) Install the bearing caps in their proper locations.
- (4) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
- (5) Install and uniformly tighten the 10 bearing cap bolts in the sequence shown.

Torque: 15.5 N·m (160 kgf·cm, 12 ft·lbf)

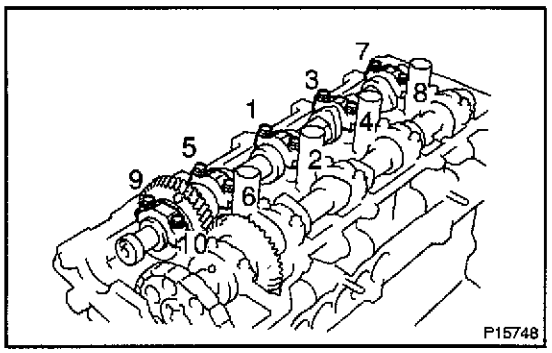


(b) Install exhaust camshaft.
(1) Apply MP grease to the thrust portion of the exhaust camshaft.
(2) Engage the exhaust camshaft gear to the intake camshaft gear by matching the timing marks (1 and 2 dots) on each gear.

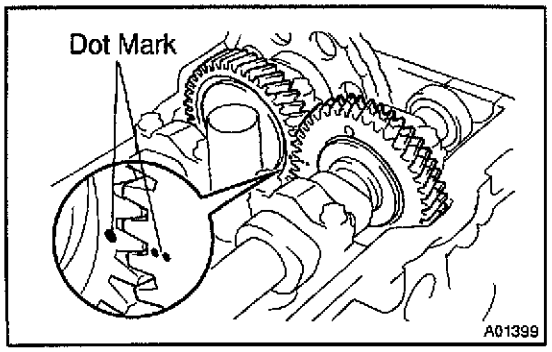
NOTICE:
There are also timing marks (for TDC) on each gear as shown in the illustration. Do not use these marks.



(3) Roll down the exhaust camshaft onto the bearing journals while engaging gears with each other.
(4) Install the bearing caps in their proper locations.
(5) Apply light coat of engine oil on the threads and under the heads of the bearing cap bolts.

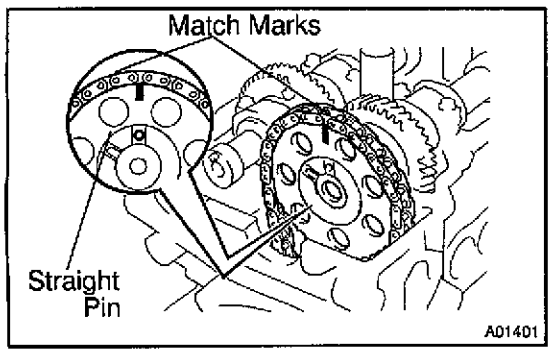


(6) Install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown.
Torque: 15.5 N·m (160 kgf·cm, 12 ft·lbf)
(7) Remove the service bolt.
(8) Check that the intake and exhaust camshafts turn smoothly.



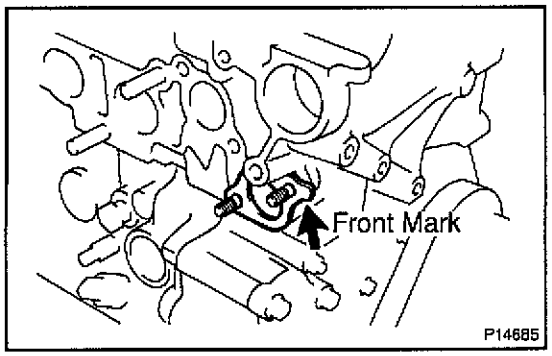
5. SET NO.1 CYLINDER TO TDC/COMPRESSION

(a) Turn the crankshaft pulley clockwise, and align its groove with the timing mark "0" of the timing chain cover.
(b) Turn the camshafts so that the timing marks with 1 and 2 dots will be in straight line on the cylinder head surface as shown in the illustration.



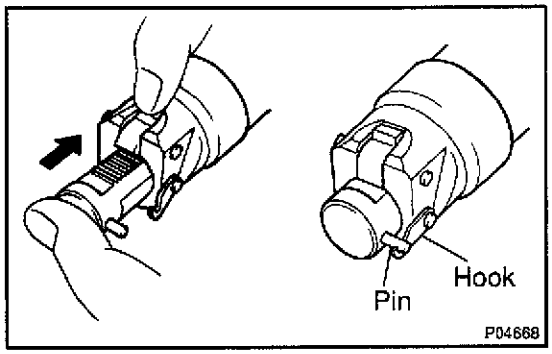
6. INSTALL CAMSHAFT TIMING GEAR

HINT:
Check that the matchmarks on the camshaft timing gear and timing chain are aligned.
(a) Place the gear over the straight pin of the intake camshaft.
(b) Hold the intake camshaft with a wrench, install and torque the bolt.
Torque: 73.5 N·m (750 kgf·cm, 54 ft·lbf)



7. INSTALL CHAIN TENSIONER

(a) Place a new gasket so that the front mark is toward the front side.

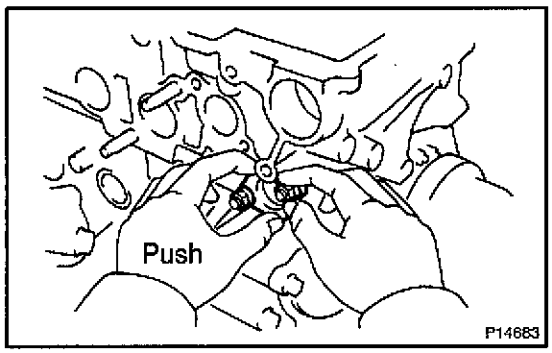


(b) Release the ratchet pawl, fully push in the plunger and apply the hook to the pin so that the plunger cannot spring out.

(c) Turn the crankshaft pulley clockwise to provide some slack for the chain on the tensioner side.

NOTICE:

Do not turn the pulley counterclockwise.



(d) Push the tensioner by hand until it touches the head installation surface, then install the 2 nuts.

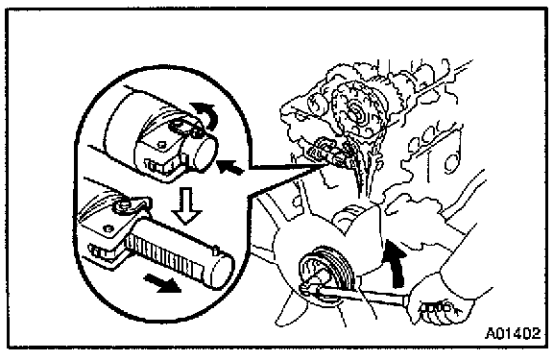
(e) Tighten the 2 nuts.

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

(f) Check that the hook of the tensioner is not released.

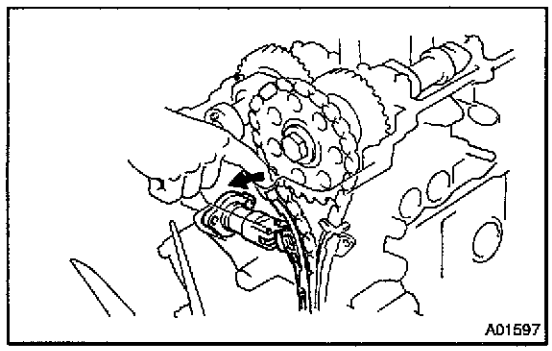
NOTICE:

If the plunger springs out during installation of the chain tensioner, repeat the operation in step (b) before installing the tensioner.



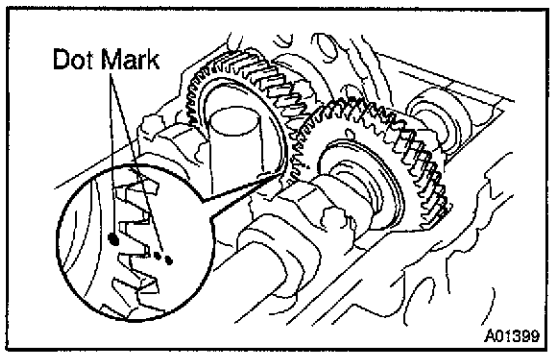
8. SET CHAIN TENSIONER

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



HINT:

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



9. CHECK VALVE TIMING

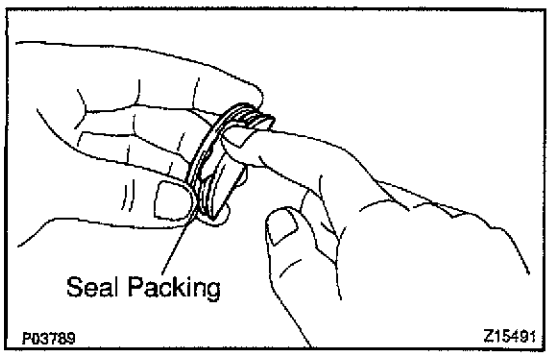
(a) Turn the crankshaft pulley, and align its groove with the timing mark "0" of the timing chain cover.

NOTICE:

Always turn the crankshaft clockwise.

(b) Check that the timing marks (1 and 2 dots) of the camshaft drive and driven gears are in straight line on the cylinder head surface as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.

10. CHECK AND ADJUST VALVE CLEARANCE
(See page EM–8)
Valve clearance (Cold):
Intake
0.15 – 0.25 mm (0.006 – 0.010 in.)
Exhaust
0.25 – 0.35 mm (0.010 – 0.014 in.)



11. INSTALL SEMI–CIRCULAR PLUGS

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

(b) Apply seal packing to the cylinder head installation surface of the semi–circular plugs.
Seal packing:
Part No. 08826–00080 or equivalent

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

12. INSTALL CYLINDER HEAD COVER

13. INSTALL ENGINE WIRE BRACKETS

14. INSTALL SPARK PLUGS

15. INSTALL CYLINDER HEAD REAR COVER

Install a new gasket and the rear cover with the 3 bolts.
Torque: 13.5 N·m (135 kgf·cm, 10 ft·lbf)

16. INSTALL WATER OUTLET

(a) Install a new gasket and the water outlet with the 2 bolts.
Torque: 20 N·m (200 kgf·cm, 14 ft·lbf)

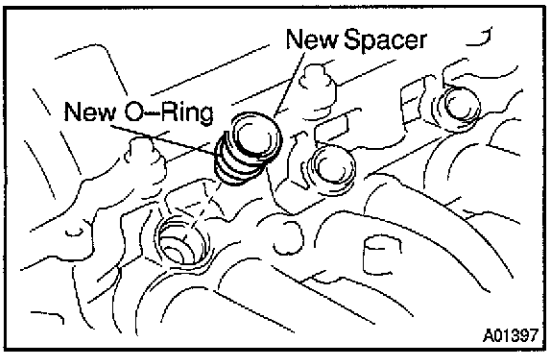
17. INSTALL EXHAUST MANIFOLD

(a) Install a new gasket and the exhaust manifold with the 6 nuts.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

(b) Install the heat insulator with the 2 bolts and 2 nuts.
Torque: 5.5 N·m (55 kgf·cm, 48 in.·lbf)

18. INSTALL INTAKE MANIFOLD

Install a new gasket and the intake manifold with the 3 bolts and 2 nuts.
Torque: 29 N·m (300 kgf·cm, 22 ft·lbf)



19. INSTALL INJECTORS AND DELIVERY PIPE
(See page FI–22)

HINT:
When using a new cylinder head, spacers must be installed. Apply a light coat of gasoline to a new O–ring and install it to a new spacer.

20. INSTALL FUEL RETURN PIPE
Torque:8.8 N·m (90 kgf·cm, 78 in·lbf)

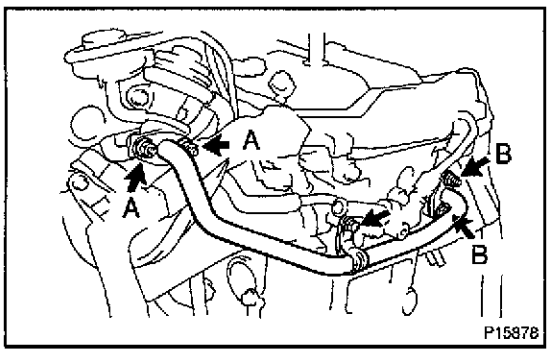
21. INSTALL FUEL INLET PIPE

22. INSTALL AIR INTAKE CHAMBER ASSEMBLY

(a) Install a new gasket and the air intake chamber assembly with the 3 bolts and 2 nuts.
Torque:21 N·m (210 kgf·cm, 15 ft·lbf)

(b) Connect these hoses:
- EVAP hose to throttle body
- Brake booster vacuum hose to union
- Water bypass hose to water bypass pipe
- Water bypass hose to cylinder head rear cover

23. INSTALL INTAKE CHAMBER STAY
Torque:20 N·m (200 kgf·cm, 15 ft·lbf)



24. INSTALL EGR PIPE

Install 2 new gaskets and EGR pipe with the bolt and 4 nuts.
Torque:
Bolt: 18 N·m (185 kgf·cm, 13 ft·lbf)
Nut A: 19 N·m (195 kgf·cm, 14 ft·lbf)
Nut B: 20 N·m (200 kgf·cm, 15 ft·lbf)

25. CONNECT INJECTOR CONNECTORS

26. CONNECT ENGINE WIRE

27. INSTALL IGNITION COILS

28. INSTALL PCV HOSES

29. FILL WITH ENGINE COOLANT

30. START ENGINE AND CHECK FOR LEAKS

31. VEHICLE ROAD TEST

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

32. RECHECK ENGINE COOLANT LEVEL