1412J–02

OVERHAUL

1. REMOVE W/HEAD STRAIGHT SCREW PLUG NO.1

(a) Using a socket hexagon wrench 14, remove the straight screw plug and gasket.

2. REMOVE VALVE ADJUSTING SHIM

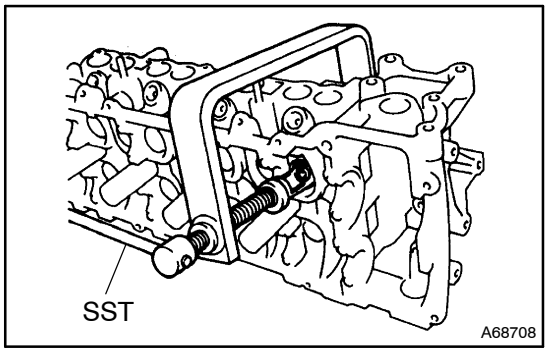
HINT:

Arrange the valve adjusting shim in correct order.

3. REMOVE VALVE LIFTER

HINT:

Arrange the valve lifter in correct order.



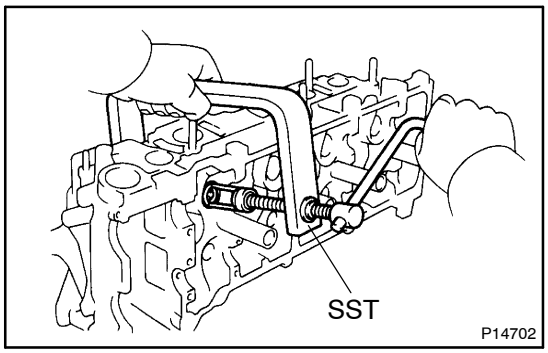
4. REMOVE INTAKE VALVE

(a) Using SST, compress the compression spring and remove the 2 valve spring retainer locks.
SST 09202–70020 (09202–00010)

(b) Remove the valve spring retainer, inner compression spring and intake valve.

HINT:

Arrange the valve spring retainers, inner compression springs and intake valves in correct order.



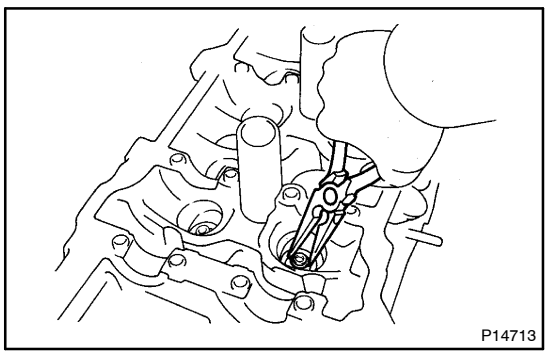
5. REMOVE EXHAUST VALVE

(a) Using SST, compress the compression spring and remove the 2 valve spring retainer locks.
SST 09202–70020 (09202–00010)

(b) Remove the valve spring retainer, inner compression spring and exhaust valve.

HINT:

Arrange the valve spring retainers, inner compression springs and exhaust valves in correct order.

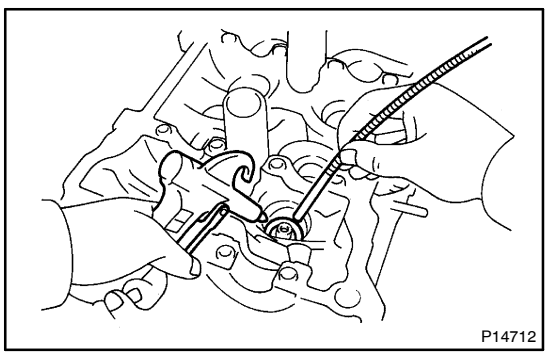


6. REMOVE VALVE STEM OIL O SEAL OR RING

(a) Using a needle–nose pliers, remove the 16 valve stem oil seals.

HINT:

Arrange the valve stem oil seals in correct order.

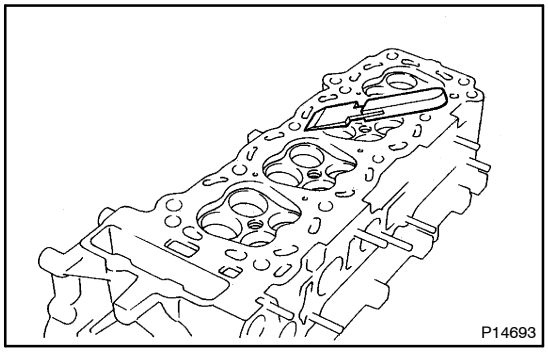


7. REMOVE VALVE SPRING SEAT

(a) Using compressed air and a magnetic finger, remove the 16 valve spring seats by blowing air.

HINT:

Arrange the valve spring seats in correct order.

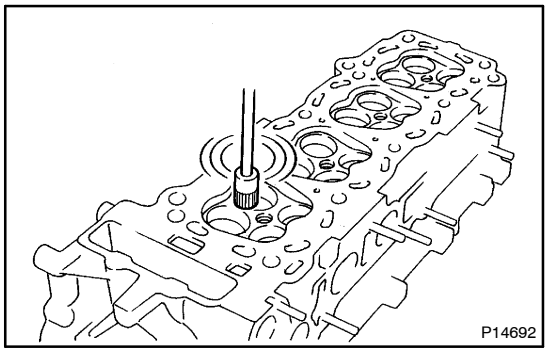


8. CLEAN CYLINDER HEAD SUB–ASSY

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

NOTICE:

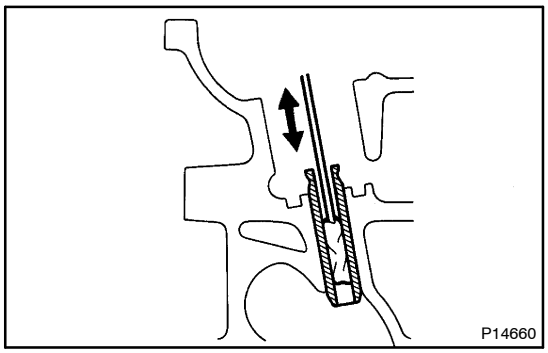
Be careful not to scratch the cylinder block contact surface.



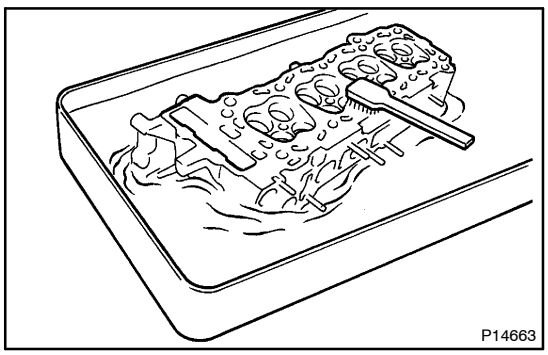
(b) Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE:

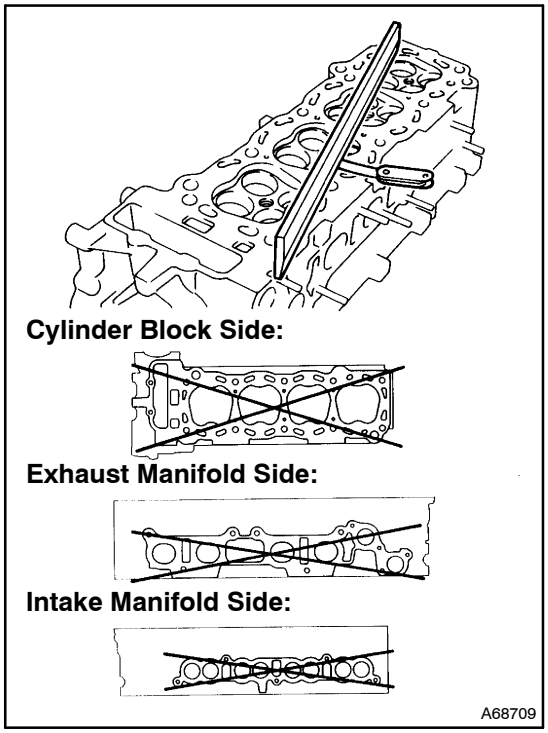
Be careful not to scratch the cylinder block contact surface.



(c) Using a valve guide bushing brush and solvent, clean all the valve guide bushes.



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



9. INSPECT CYLINDER HEAD SUB–ASSY

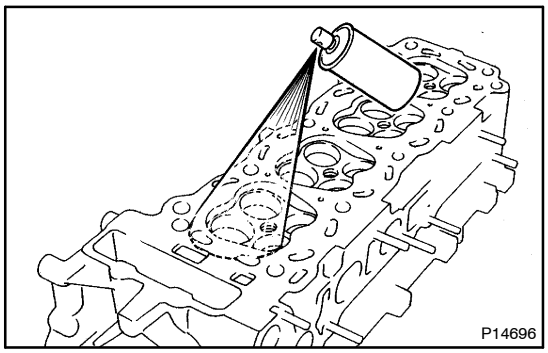
(a) Inspect for flatness.

(1) Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder block and manifolds for warpage.

Maximum warpage:

Cylinder block side	0.05 mm (0.0020 in.)
Exhaust manifold side	0.10 mm (0.0039 in.)
Intake manifold side	0.10 mm (0.0039 in.)

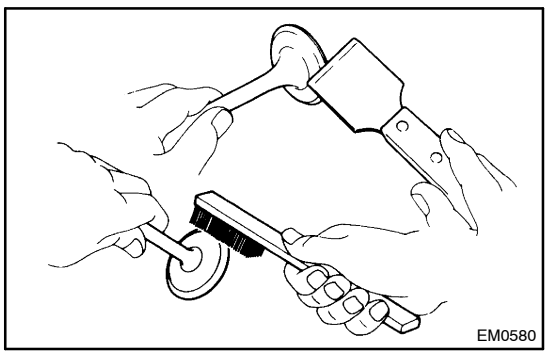
If warpage is greater than maximum, replace the cylinder head.



(b) Inspect for cranks.

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

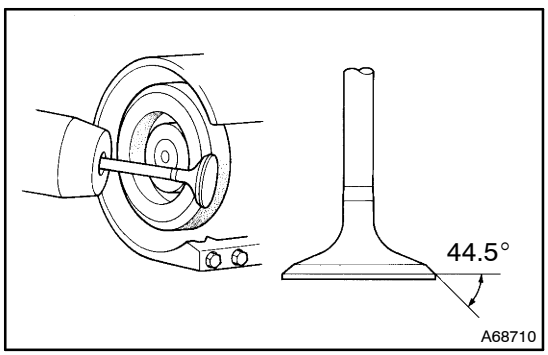
If cracked, replace the cylinder head.



10. CLEAN INTAKE VALVE

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

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

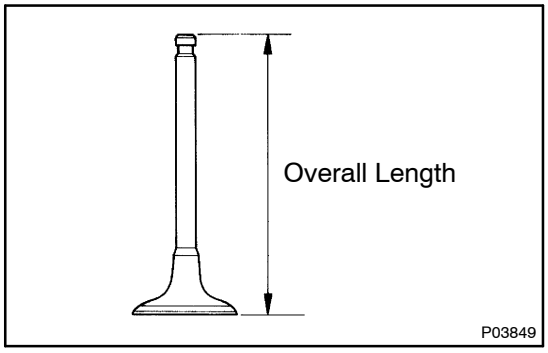


11. INSPECT INTAKE VALVE

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

(b) Check the intake valve is ground to the correct valve face angle.

Valve face angle: 44.5°



(c) Inspect for overall length.

(1) Using vernier calipers, measure the valve overall length.

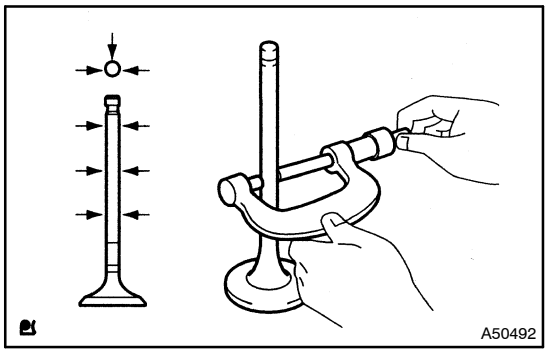
Standard overall length:

Leaded	103.95 mm (4.0925 in.)
Unleaded	103.45 mm (4.0728 in.)

Minimum overall length:

Leaded	103.65 mm (4.0807 in.)
Unleaded	103.15 mm (4..0610 in.)

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

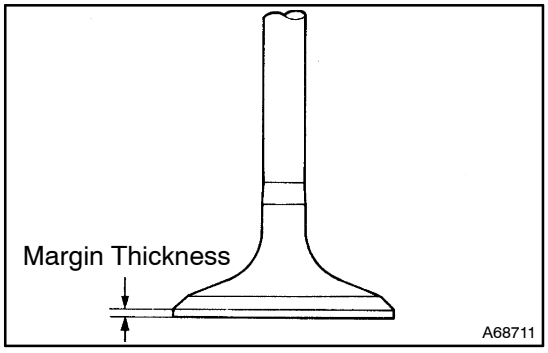


(d) Inspect for valve stem diameter.

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

Valve stem diameter:

5.970 – 5.985 mm (0.2350 – 0.2356 in.)



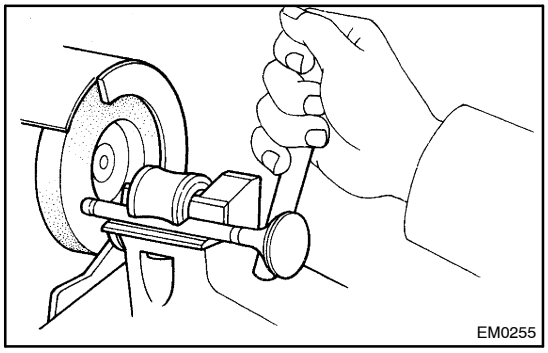
(e) Inspect for valve head margin thickness.

(1) Using vernier calipers, measure the valve head margin thickness.

Standard margin thickness:

Leaded	1.55 – 1.95 mm (0.0610 – 0.0768 in.)
Unleaded	1.05 – 1.45 mm (0.0413 – 0.0571 in.)

If the margin thickness is not as standard, replace the intake valve.

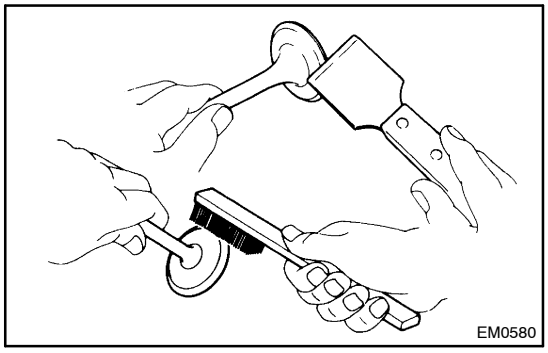


(f) Check the surface of the valve stem tip for wear.

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

NOTICE:

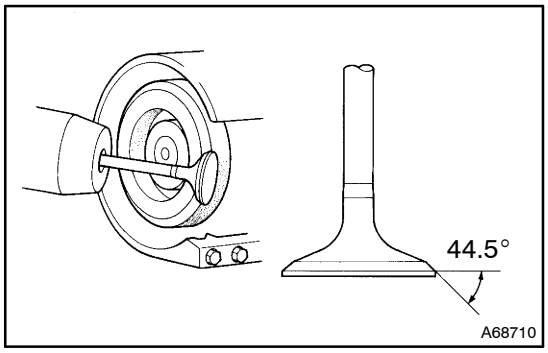
Do not grind off than minimum.



12. CLEAN EXHAUST VALVE

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

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

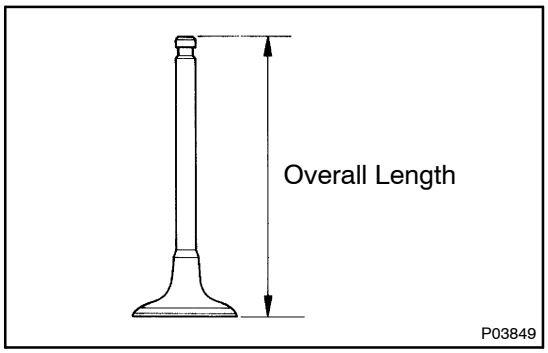


13. INSPECT EXHAUST VALVE

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

(b) Check the intake valve is ground to the correct valve face angle.

Valve face angle: 44.5°



(c) Inspect for overall length.

(1) Using vernier calipers, measure the valve overall length.

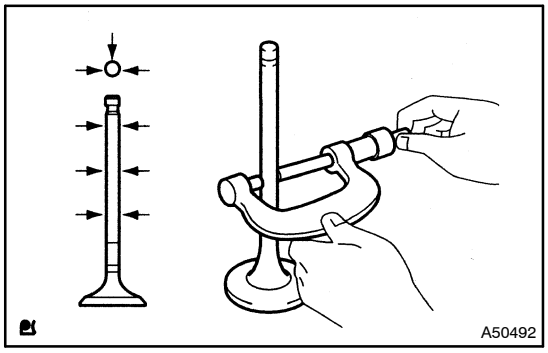
Standard overall length:

Leaded	103.90 mm (4.0906 in.)
Unleaded	103.60 mm (4.0787 in.)

Minimum overall length:

Leaded	103.60 mm (4.0787 in.)
Unleaded	103.30 mm (4.0669 in.)

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

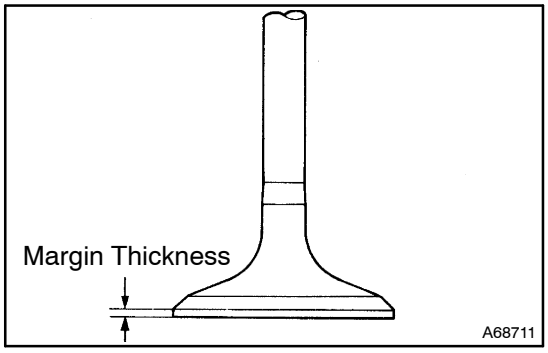


(d) Inspect for valve stem diameter.

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

Valve stem diameter:

5.970 – 5.985 mm (0.2350 – 0.2356 in.)

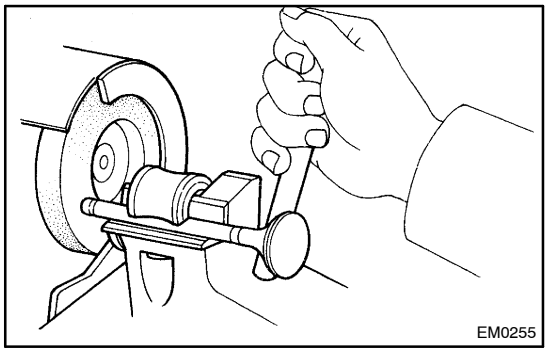


(e) Inspect for valve head margin thickness.
(1) Using vernier calipers, measure the valve head margin thickness.

Standard margin thickness:

Leaded	1.50 – 1.90 mm (0.0591 – 0.0748 in.)
Unleaded	1.20 – 1.60 mm (0.0472 – 0.0630 in.)

If the margin thickness is not as standard, replace the exhaust valve.

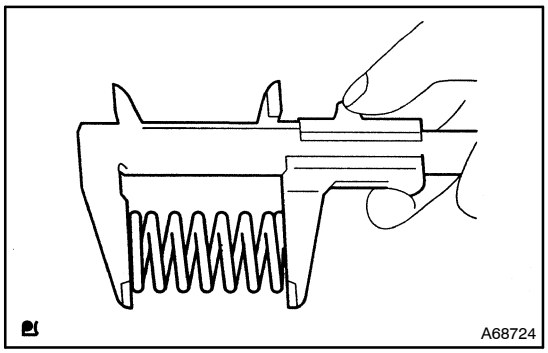


(f) Check the surface of the valve stem tip for wear.

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

NOTICE:

Do not grind off more than minimum.

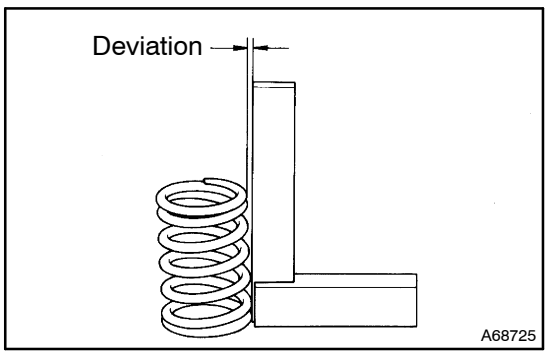


14. INSPECT INNER COMPRESSION SPRING

(a) Inspect for free length.
(1) Using vernier calipers, measure the free length of the compression spring.

Free length: 47.7 mm (1.878 in.)

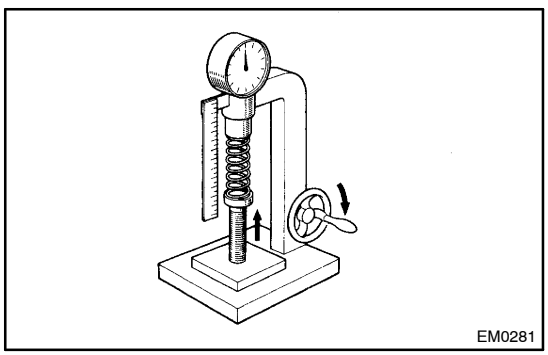
If the free length is not as specified, replace the compression spring.



(b) Inspect for deviation.
(1) Using a steel square, measure the deviation of the compression spring.

Maximum deviation: 2.0 mm (0.079 in.)

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

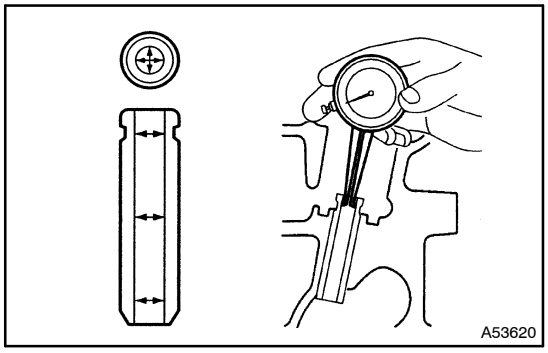


(c) Inspect for installed tension.
(1) Using a spring tester, measure the tension of the compression spring at the specified installed length.

Installed length:

162 – 190 N (16.6 – 19.4 kgf, 36.6 – 42.8 lbf) at 35.7 mm (1.406 in.)

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



15. INSPECT INTAKE VALVE GUIDE BUSHING

(a) Inspect for oil clearance.

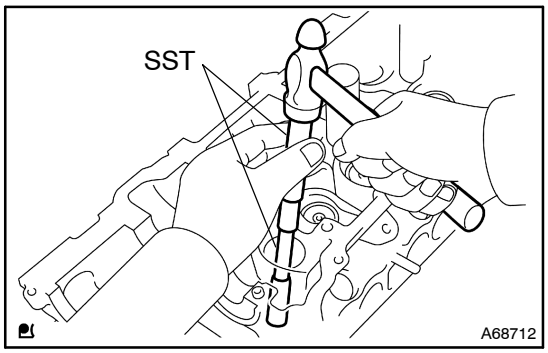
(1) Using a caliper gauge, measure the bush inside diameter of the valve guide bush.

Bush inside diameter:
6.01 – 6.03 mm (0.2366 – 0.2374 in.)

(2) Subtract the valve stem diameter measurement from the bush inside diameter measurement.

Standard oil clearance:
0.025 – 0.060 mm (0.0010 – 0.0024 in.)
Maximum oil clearance:
0.08 mm (0.0031 in.)

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

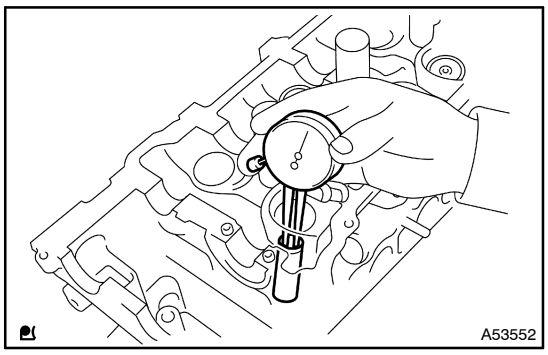


16. REMOVE INTAKE VALVE GUIDE BUSHING

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

(b) Using SST, tap out the intake valve guide bush.

SST 09201–10000 (09201–01060), 09950–70010 (09951–07100)



17. INSTALL INTAKE VALVE GUIDE BUSHING

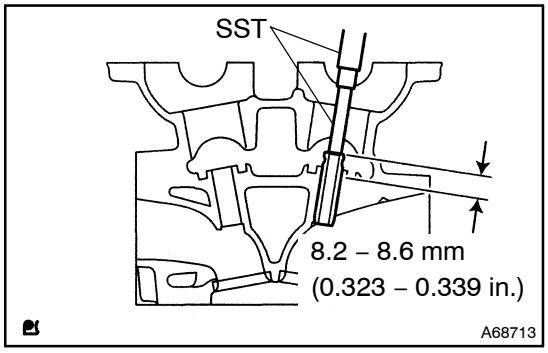
(a) Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Bush bore diameter:
10.985 – 11.006 mm (0.4325 – 0.4333 in.)

(b) Select a new valve guide bush (STD size or O/S 0.05).

Bush bore diameter	Bush size
11.033 – 11.044 mm (0.4344 – 0.4348 in.)	Use STD
11.083 – 11.094 mm (0.4363 – 0.4368 in.)	Use O/S 0.05

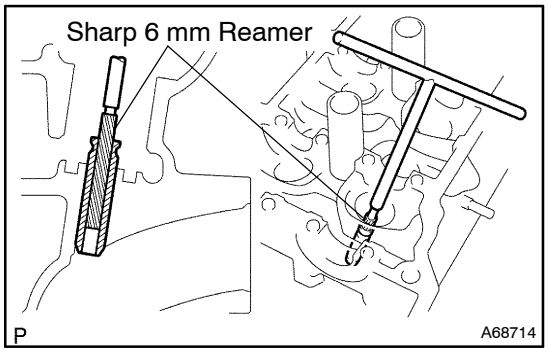
- If the bush bore diameter of the cylinder head is greater than 11.044 mm (0.4348 in.), machine the bushing bore to these dimension of 11.083 – 11.094 mm (0.4363 – 0.4368 in.) to install a over size valve guide bush.
- If the bush bore diameter of the cylinder head is greater than 11.094 mm (0.4368 in.), replace the cylinder head.



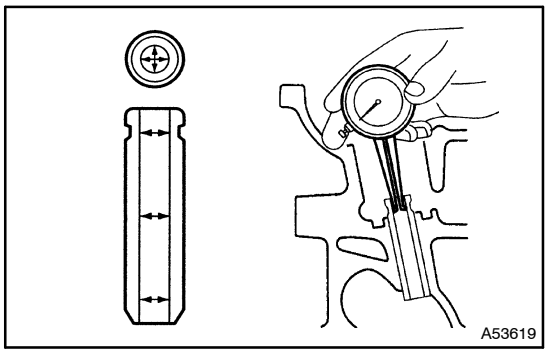
(c) Gradually heat the cylinder head to 80 – 100°C (176 – 212°F)

(d) Using SST, tap in a new intake valve guide bush to where there is 8.2 – 8.6 mm (0.323 – 0.339 in.) protruding from the cylinder head.

SST 09201–10000 (09201–01060), 09950–70010 (09951–07100)



(e) Using a sharp 6 mm reamer, ream the intake valve guide bush to obtain the standard specified clearance 6.010 – 6.030 mm (0.2366 – 0.2374 in.) between the intake valve guide bush and valve stem.



18. INSPECT EXHAUST VALVE GUIDE BUSHING

(a) Inspect for oil clearance.

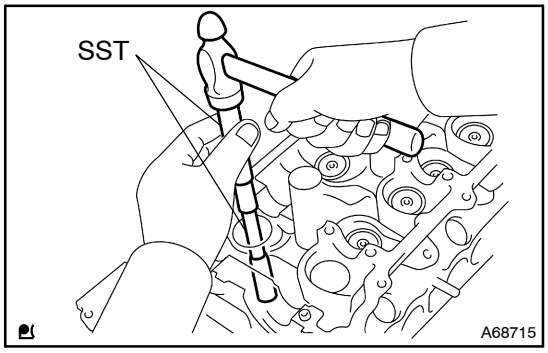
(1) Using a caliper gauge, measure the bush inside diameter of the valve guide bush.

Bush inside diameter:
6.01 – 6.03 mm (0.2366 – 0.2374 in.)

(2) Subtract the valve stem diameter measurement from the bush inside diameter measurement.

Standard oil clearance:
0.030 – 0.065 mm (0.0012 – 0.0026 in.)
Maximum oil clearance:
0.10 mm (0.0039 in.)

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

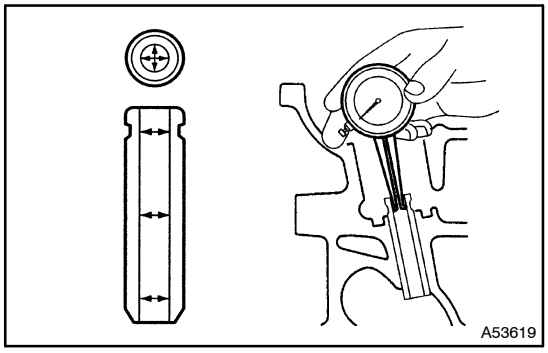


19. REMOVE EXHAUST VALVE GUIDE BUSHING

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

(b) Using SST, tap out the intake valve guide bush.

SST 09201–10000 (09201–01060), 09950–70010 (09951–07100)



20. INSTALL EXHAUST VALVE GUIDE BUSHING

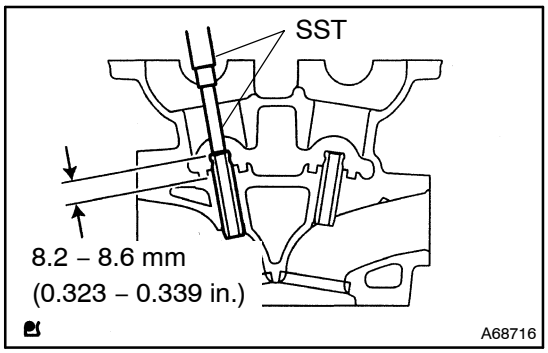
(a) Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Bush bore diameter:
10.985 – 11.006 mm (0.4325 – 0.4333 in.)

(b) Select a new valve guide bush (STD size or O/S 0.05).

Bush bore diameter	Bush size
11.033 – 11.044 mm (0.4344 – 0.4348 in.)	Use STD
11.083 – 11.094 mm (0.4363 – 0.4368 in.)	Use O/S 0.05

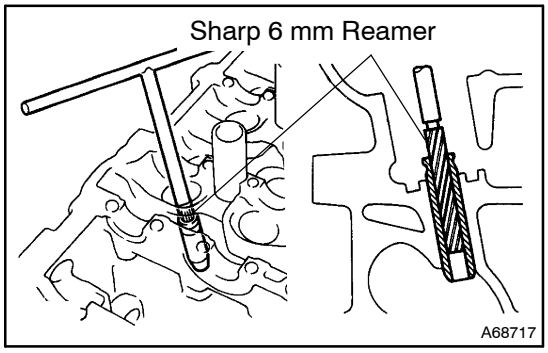
- If the bush bore diameter of the cylinder head is greater than 11.044 mm (0.4348 in.), machine the bushing bore to these dimension of 11.083 – 11.094 mm (0.4363 – 0.4368 in.) to install a over size valve guide bush.
- If the bush bore diameter of the cylinder head is greater than 11.094 mm (0.4368 in.), replace the cylinder head.



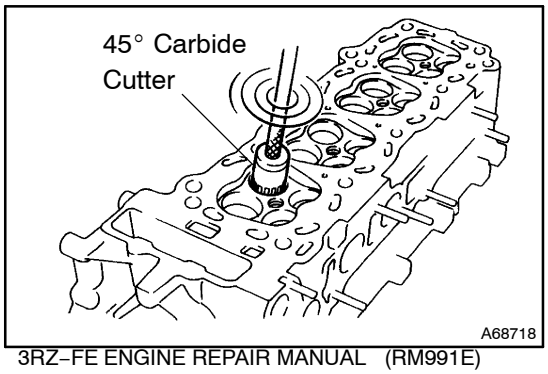
(c) Gradually heat the cylinder head to 80 – 100°C (176 – 212°F)

(d) Using SST, tap in a new intake valve guide bush to where there is 8.2 – 8.6 mm (0.323 – 0.339 in.) protruding from the cylinder head.

SST 09201–10000 (09201–01060), 09950–70010 (09951–07100)



(e) Using a sharp 6 mm reamer, ream the intake valve guide bush to obtain the standard specified clearance 6.010 – 6.030 mm (0.2366 – 0.2374 in.) between the intake valve guide bush and valve stem.



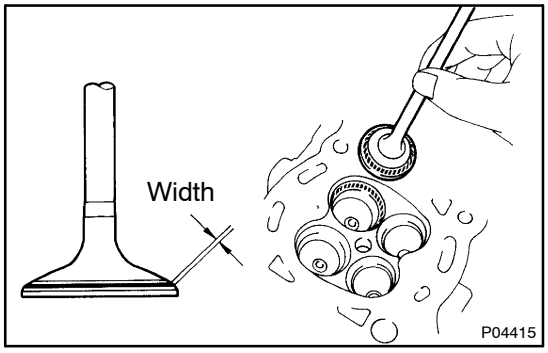
21. INSPECT INTAKE VALVE SEAT

(a) Using a 45° carbide cutter, resurface the intake valve seat.

(1) Remove only enough metal to clean the intake valve seat.

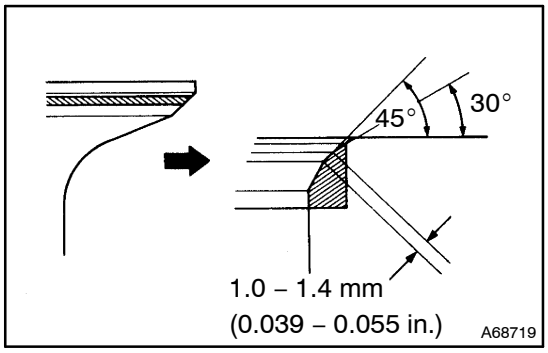
(b) Check the valve seating position.

(1) 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.

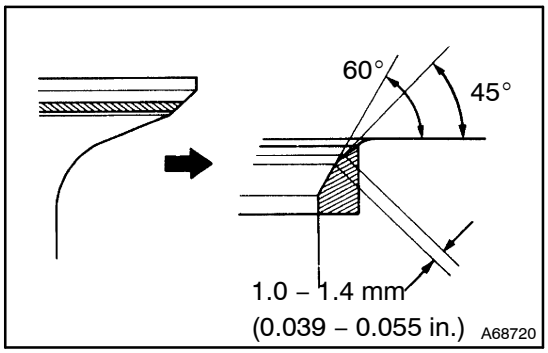


(c) Check the valve face and seat for these:
(1) If blue appears 360° around the face, the valve is concentric. If not, replace the intake valve.
(2) If blue appears 360° around the intake valve seat, the guide and face are concentric. If not, resurface the seat.
(3) Check that the seat contact is in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

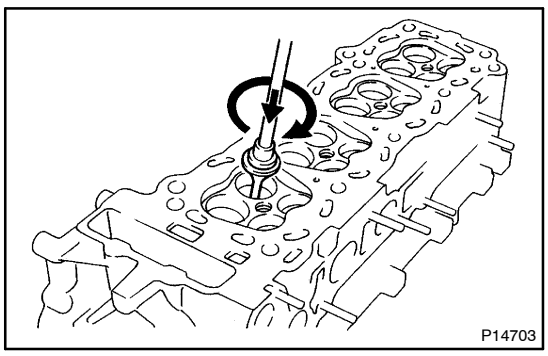
Width: 1.0 – 1.4 mm (0.039 – 0.055 in.)



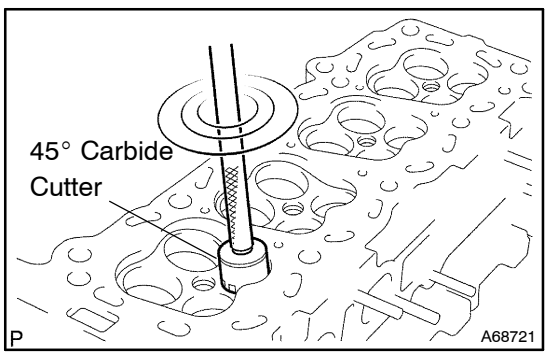
(d) If not, correct the intake valve seat as follows:
(1) If the seating is too high on the valve face, use 30° and 45° cutters to correct the intake valve seat.



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



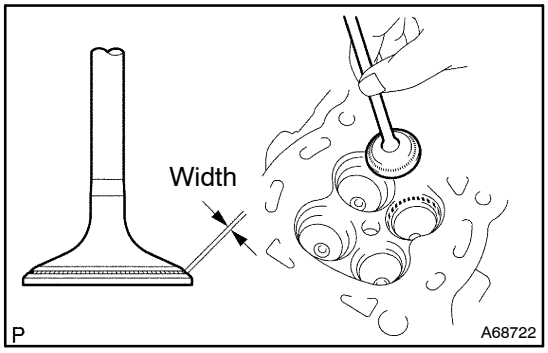
(3) Hand–lap the intake valve and intake valve seat with an abrasive compound.
(4) After hand–lapping, clean the intake valve and intake valve seat.



22. INSPECT EXHAUST VALVE SEAT

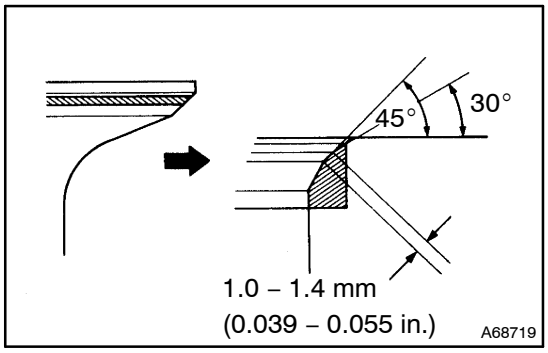
(a) Using a 45° carbide cutter, resurface the exhaust valve seat.
(1) Remove only enough metal to clean the exhaust valve seat.

(b) Check the valve seating position.
(1) 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.

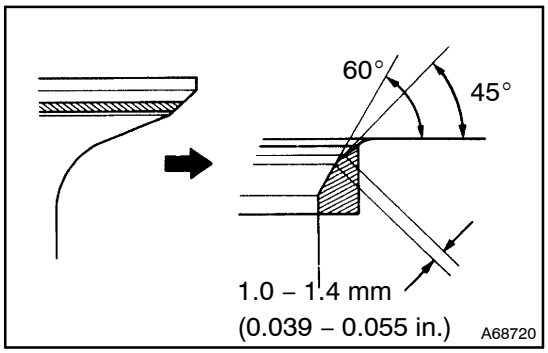


(c) Check the valve face and seat for these:
(1) If blue appears 360° around the face, the exhaust valve is concentric. If not, replace the exhaust valve.
(2) If blue appears 360° around the exhaust valve seat, the guide and face are concentric. If not, resurface the seat.
(3) Check that the seat contact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

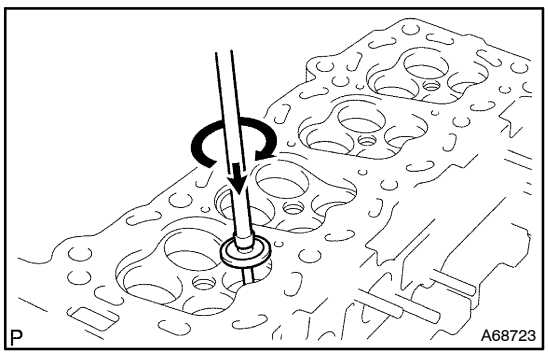
Width: 1.0 – 1.4 mm (0.039 – 0.055 in.)



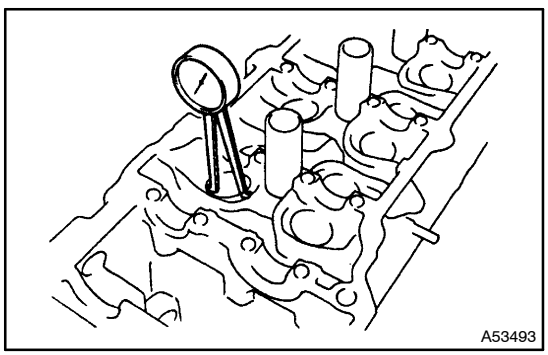
(d) If not, correct the exhaust valve seat as follows:
(1) If the seating is too high on the valve face, use 30° and 45° cutters to correct the exhaust valve seat.



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



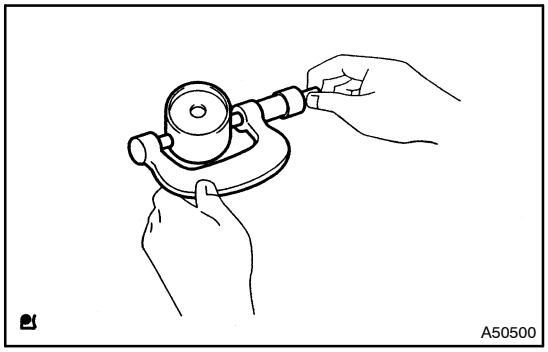
(3) Hand–lap the exhaust valve and exhaust valve seat with an abrasive compound.
(4) After hand–lapping, clean the valve and valve seat.



23. INSPECT VALVE LIFTER

(a) Inspect for oil clearance.
(1) 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.)



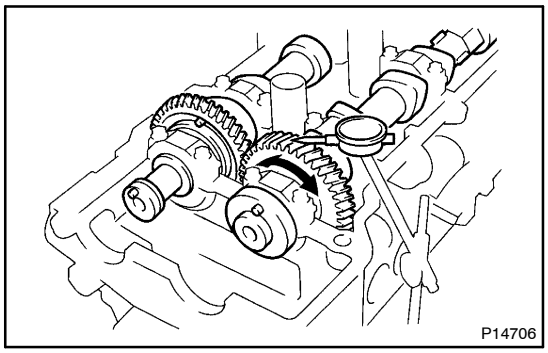
(2) Using a micrometer, measure the valve lifter diameter.

Valve lifter diameter:
30.966 – 30.976 mm (1.1578 – 1.2195 in.)

(3) Subtract the valve 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 valve lifter. If necessary, replace the cylinder head.



24. INSPECT CAMSHAFT

(a) Inspect for backlash.

(1) Install the camshafts without installing the camshaft sub gear.

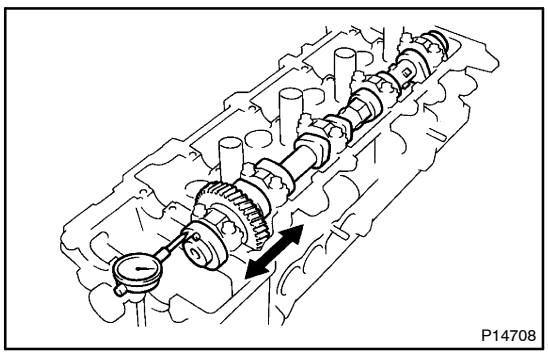
(2) Install the camshaft bearing caps.
(See page 14–4)

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

(3) 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.



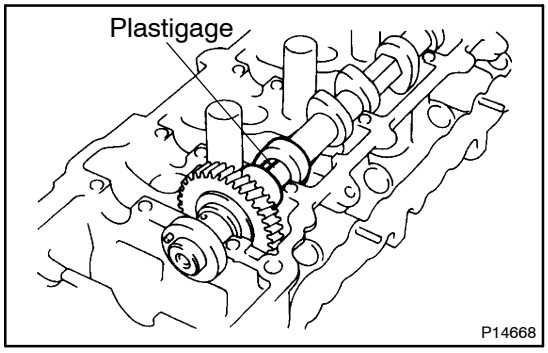
(b) Inspect for thrust clearance.

(1) Remove the camshaft bearing caps and camshaft No. 2.
(See page 14–4)

(2) 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.)

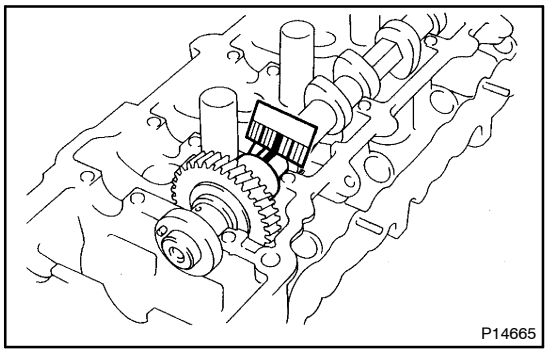
If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the camshaft bearing caps and cylinder head as a set.



(c) Inspect for oil clearance.
(1) Remove the camshaft bearing caps.
(See page 14–4)
(2) Clean the camshaft bearing caps camshaft journals.
(3) Place the camshaft on the cylinder head.
(4) Lay a strip of Plastigage across each of the camshaft journals.
(5) Install the camshaft bearing caps.
(See page 14–4)
Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

NOTICE:
Do not turn the camshafts.

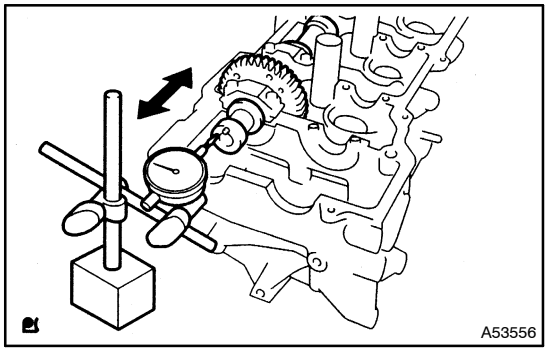
(6) Remove the camshaft bearing caps.
(See page 14–4)



(7) 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 camshaft bearing caps and cylinder head as a set.

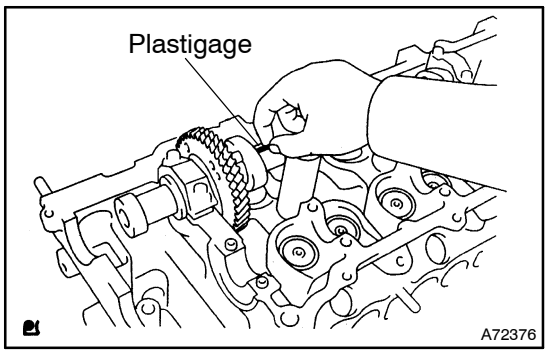
(d) Completely remove the plastigage.



25. INSPECT NO.2 CAMSHAFT

(a) Inspect for thrust clearance.
(1) Install the camshaft.
(2) Install the camshaft bearing caps.
(See page 14–4)
Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)
(3) 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.)

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

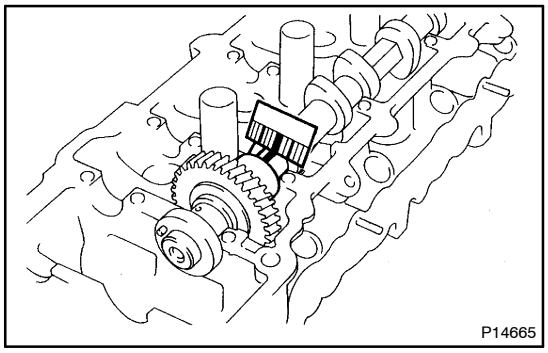


(b) Inspect for oil clearance.
(1) Remove the camshaft bearing caps.
(See page 14–4)
(2) Clean the camshaft bearing caps camshaft journals.
(3) Place the camshaft on the cylinder head.
(4) Lay a strip of Plastigage across each of the camshaft journals.

(5) Install the camshaft bearing caps.
(See page 14–4)
Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

NOTICE:
Do not turn the camshafts.

(6) Remove the camshaft bearing caps.
(See page 14–4)



(7) 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.)

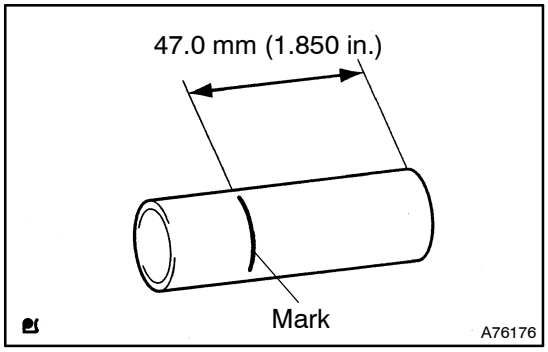
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the camshaft bearing caps and cylinder head as a set.

(c) Completely remove the plastigage.

26. INSPECT CAMSHAFT BEARING CAP

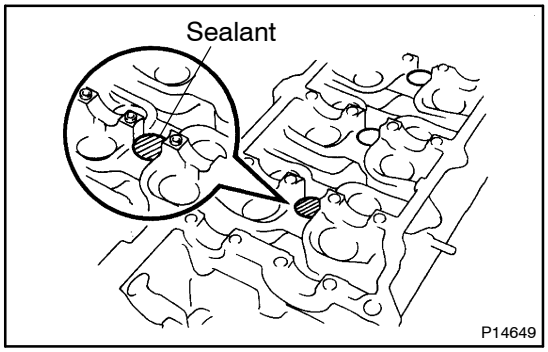
(a) Check that the camshaft bearing caps for flanking and scoring.

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



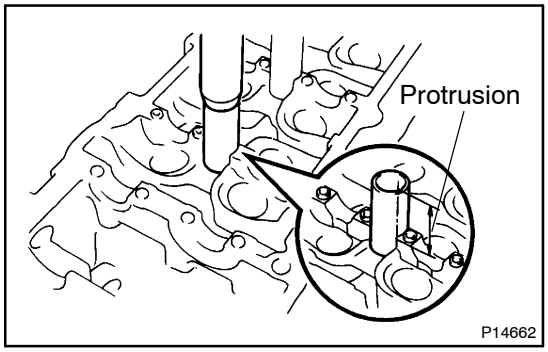
27. INSTALL TUBE, SPARK PLUG

(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 BOND 1324 or equivalent.

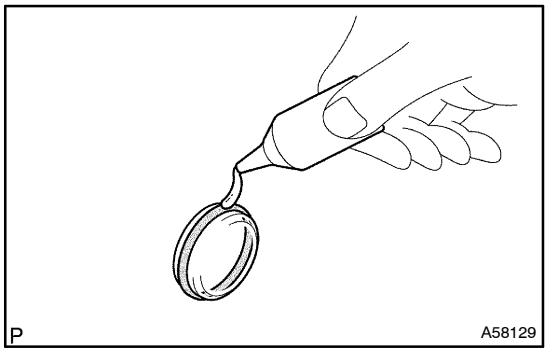
NOTICE:
- **Remove any oil from the contact surface**
- **Install the spark plug tube 5 minutes after applying adhesive.**
- **Do not put into the engine oil within 1 hours after installing.**



(c) Using a press, press in a 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 spark plug tube in too far by measuring the amount of protrusion while pressing.



28. INSTALL TIGHT PLUG

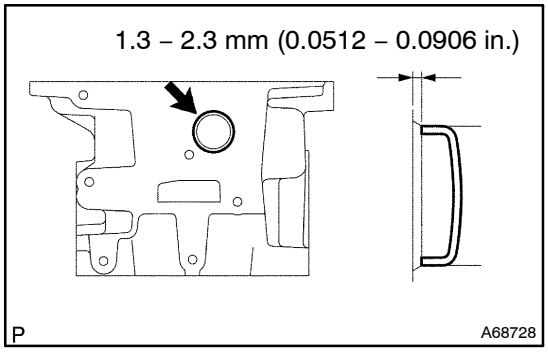
(a) Apply adhesive to a new tight plug.

Adhesive:

Part No. 08833–00070, THREE BOND 1324 or equivalent

NOTICE:

- **Remove any oil from the contact surface**
- **Install the tight plug 5 minutes after applying adhesive.**
- **Do not put into the engine oil within 1 hours after installing.**



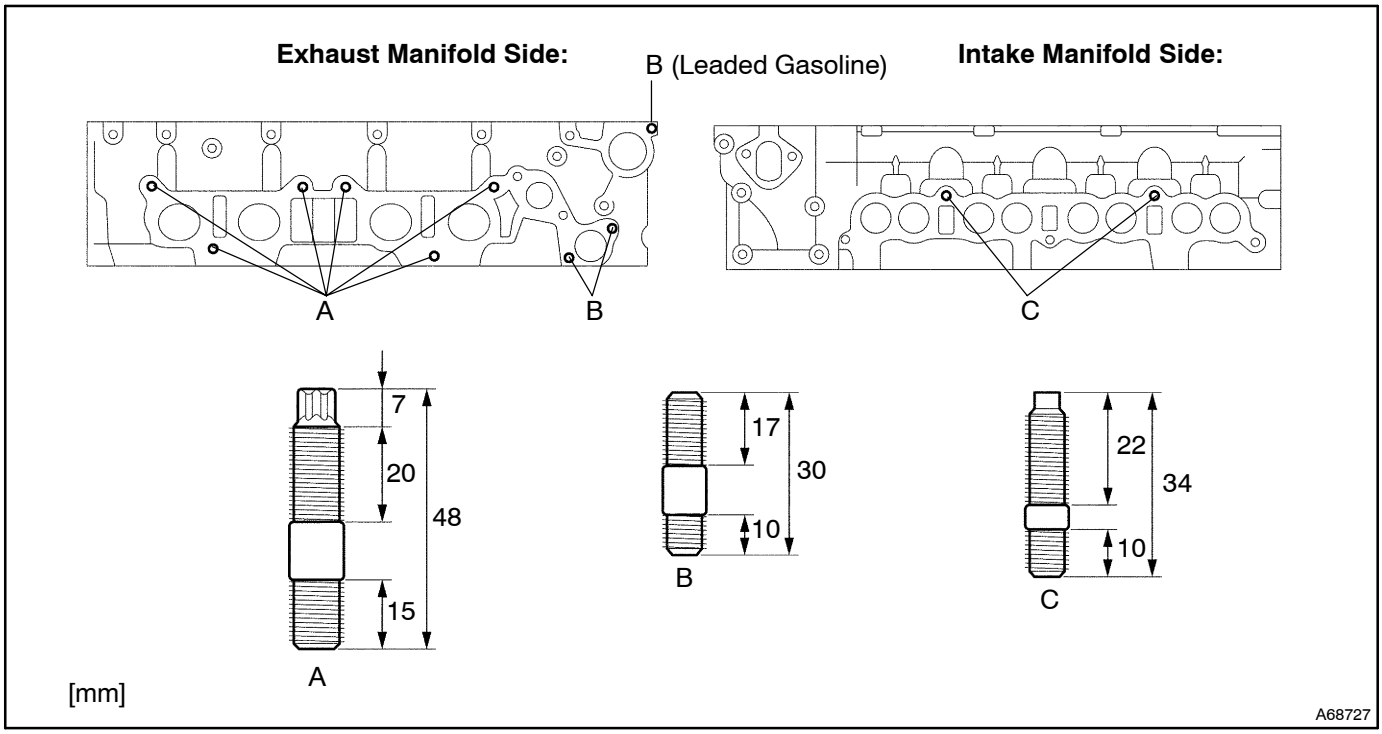
(b) Using SST, tap in a new tight plug to the cylinder head.

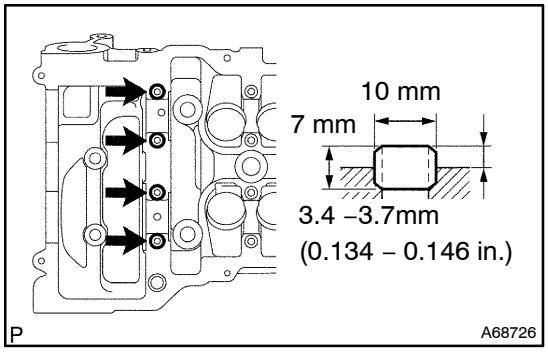
SST 09950–60010 (09951–00290), 09950–70010 (09951–07100)

29. INSTALL STUD BOLT

(a) Using a torx socket E10, install the stud bolts .

Torque:
15 N·m (150 kgf·cm, 11 ft·lbf) for stud bolt A
7.5 N·m (75 kgf·cm, 65 in.·lbf) for stud bolt B and C

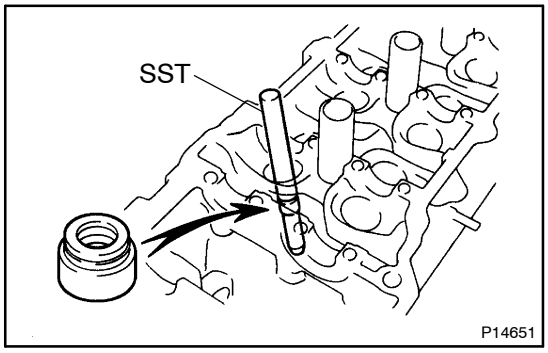




30. INSTALL RING PIN

(a) Using a plastic hammer, tap in the 2 new ring pins to the cylinder head.

31. INSTALL VALVE SPRING SEAT



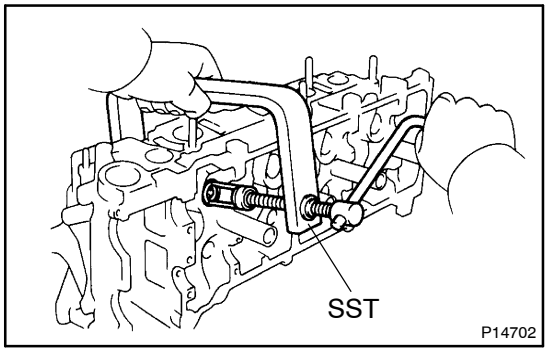
32. INSTALL VALVE STEM OIL O SEAL OR RING

(a) Using SST, push in the new O seals.
SST 09236–00101 (09236–15010)

HINT:

Different O seals are used for the intake and exhaust.

Cord mark (Intake side only): ”H”



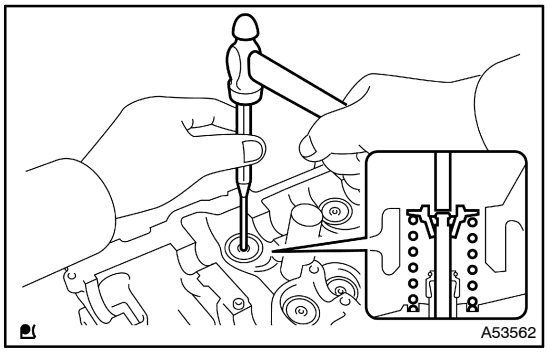
33. INSTALL EXHAUST VALVE

(a) Apply a light coat of engine oil to the exhaust valve.

(b) Install the exhaust valve, inner compression spring and valve spring retainer.

(c) Using SST, compress the inner compression spring and place the 2 valve spring retainer locks around the valve stem.

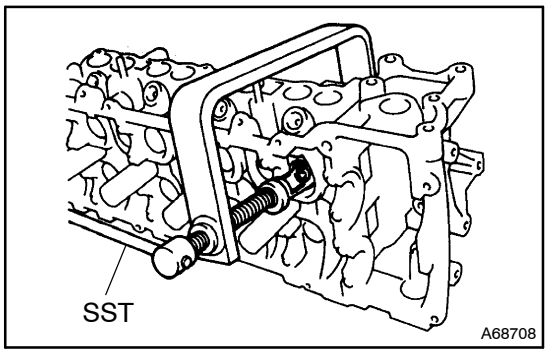
SST 09202–70020 (09202–00010)



(d) Using a pin punch, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the valve stem tip.



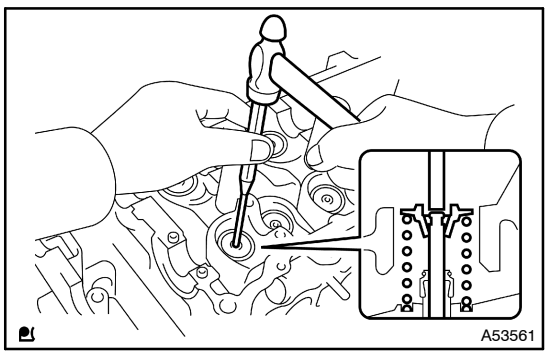
34. INSTALL INTAKE VALVE

(a) Apply a light coat of engine oil to the intake valve.

(b) Install the intake valve, inner compression spring and valve spring retainer.

(c) Using SST, compress the inner compression spring and place the 2 valve spring retainer locks around the valve stem.

SST 09202–70020 (09202–00010)



(d) Using a pin punch, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the valve stem tip.

35. INSTALL VALVE LIFTER

(a) Apply the engine oil to the valve lifter.

(b) Install the valve lifter.

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

36. INSTALL VALVE ADJUSTING SHIM

37. INSTALL W/HEAD STRAIGHT SCREW PLUG NO.1

(a) Using a socket hexagon wrench 14, install a new gasket and the straight screw plug.

Torque: 83 N·m (850 kgf·cm, 62 ft·lbf)