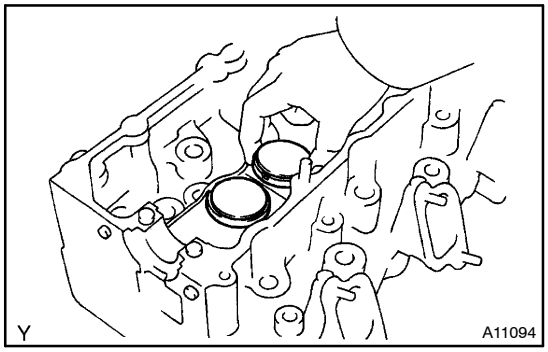
1410I–01

# OVERHAUL

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.

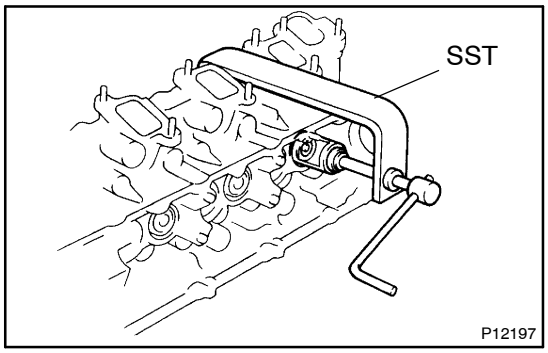



**1. REMOVE VALVE LIFTER**

(a) Remove the valve lifter and adjusting shim.

HINT:

Arrange the valve lifters and shims in correct order.



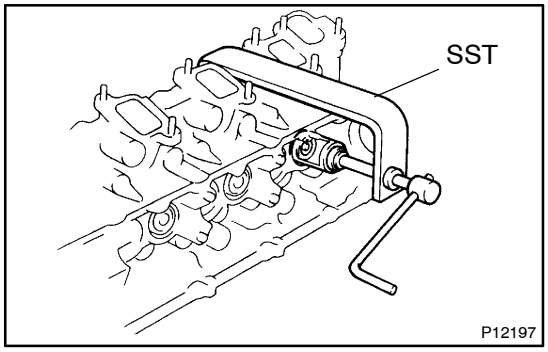

**2. REMOVE INTAKE VALVE**

(a) Using SST, compress the compression spring and remove the 2 keepers.
SST 09202–70020 (09202–00020)

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

HINT:

Arrange the valves, compression springs, spring seats and spring retainers incorrect order.



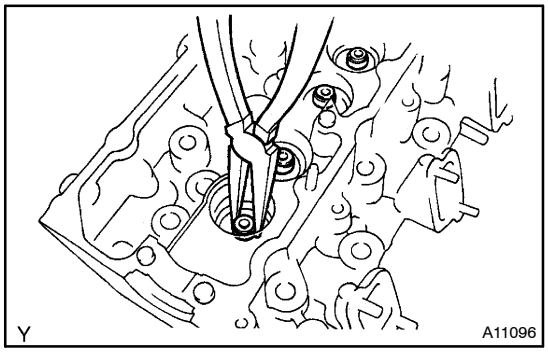

**3. REMOVE EXHAUST VALVE**

(a) Using SST, compress the compression spring and remove the 2 keepers.
SST 09202–70020 (09202–00020)

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

HINT:

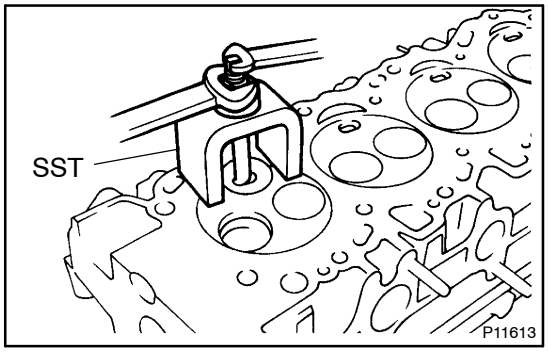
Arrange the valves, compression springs, spring seats and spring retainers incorrect order.




**4. REMOVE VALVE STEM OIL O SEAL OR RING**

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

**5. REMOVE SEMICIRCULAR PLUG**



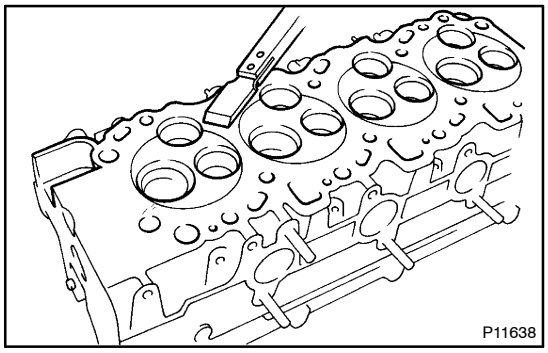

**6. REMOVE COMBUSTION CHAMBER SUB–ASSY**

(a) Using SST, remove the 4 combination chambers and 4 shims.

SST 09208–48010

HINT:

Arrange the combustion chambers in correct order.

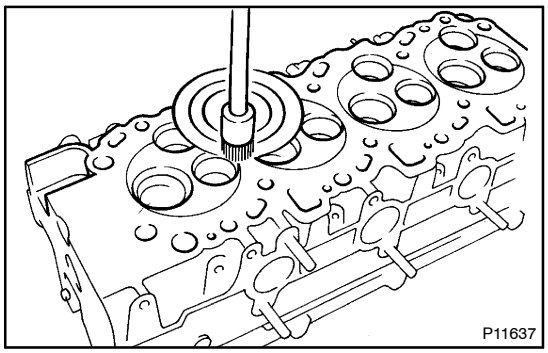



**7. CLEAN CYLINDER HEAD SUB–ASSY**

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

**NOTICE:**

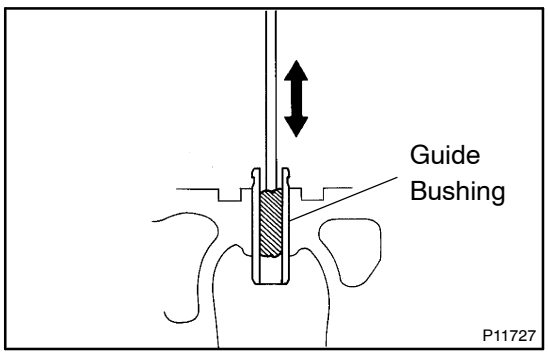
**Be careful not to scratch the cylinder block contact surface.**



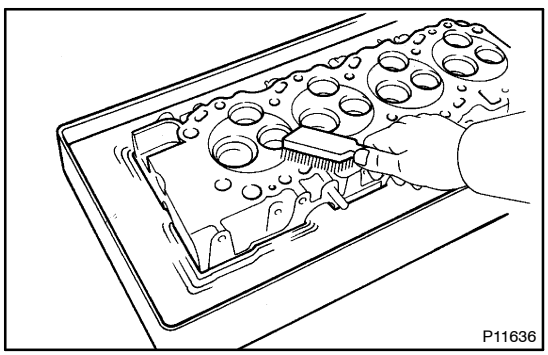

(b) Using a wire brush, remove all the carbon from the combustion chambers.

**NOTICE:**

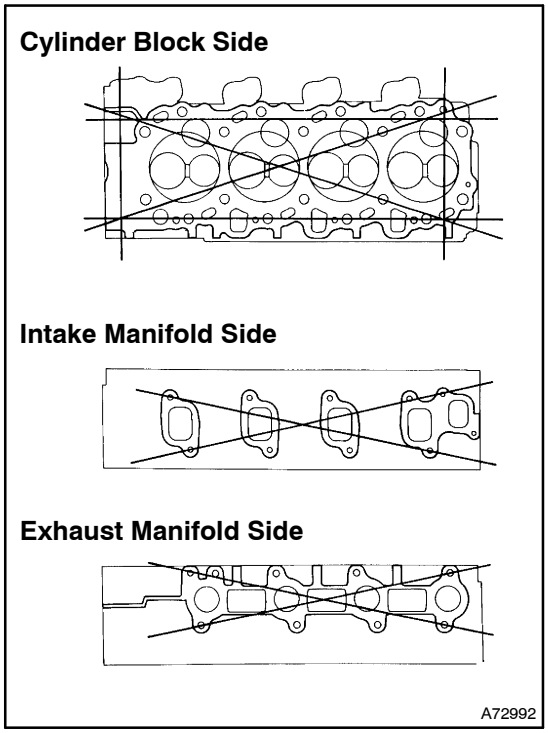
**Be careful not to scratch the cylinder block contact surface.**




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




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



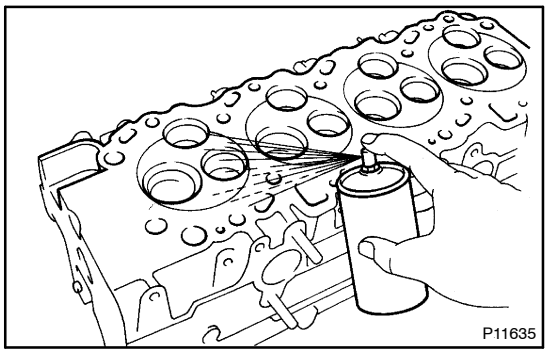

**8. INSPECT CYLINDER HEAD SUB–ASSY**

(a) Inspect for flatness.

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

**Maximum warpage: 0.15 mm (0.0059 in.)**

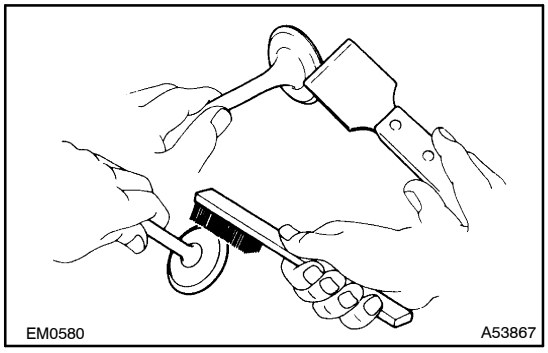
If warpage is greater than maximum, replace the cylinder head.




(b) Inspect for cracks.

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

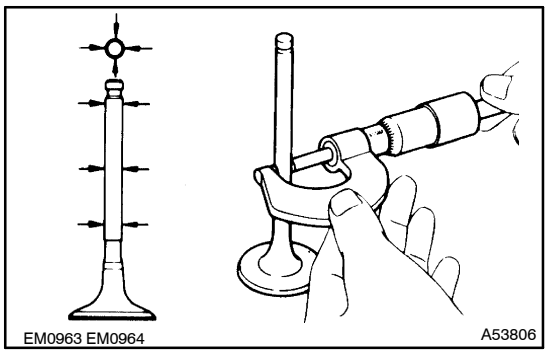
If cracked, replace the cylinder head.




**9. CLEAN INTAKE VALVE**

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

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

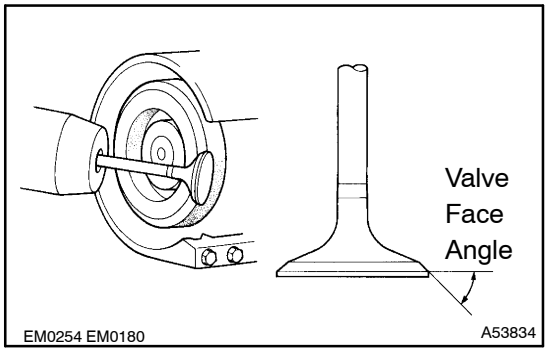



**10. INSPECT INTAKE VALVE**

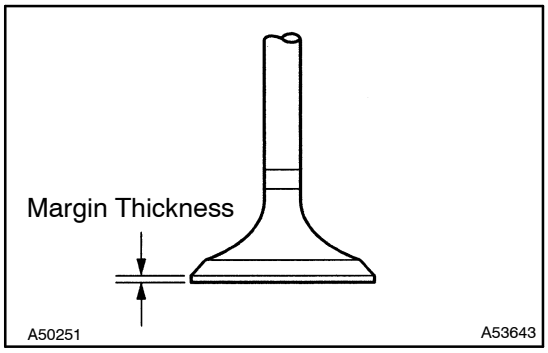
(a) Using a micrometer, measure the diameter of the valve stem.

**Valve stem diameter:**

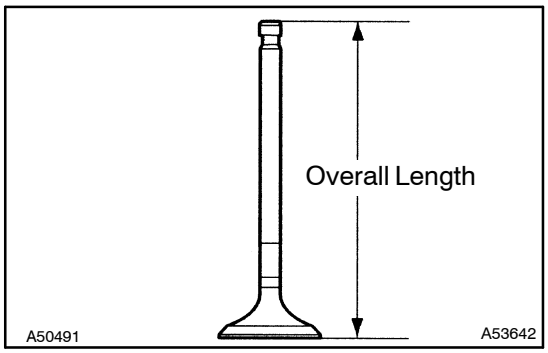
**7.975 – 7.990 mm (0.3140 – 0.3146 in.)**



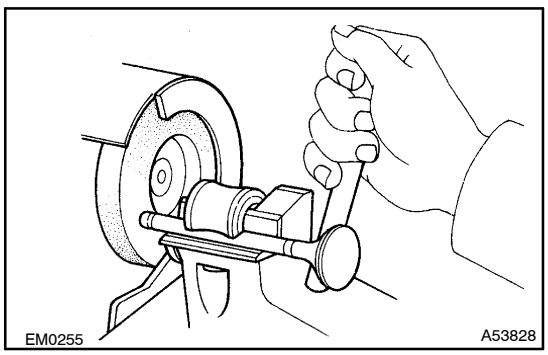

(b) Check the valve face angle.
(1) Grind the valve enough to remove pits and carbon.
(2) Check that the valve is ground to the correct valve face angle.
**Valve face angle: 44.5°**



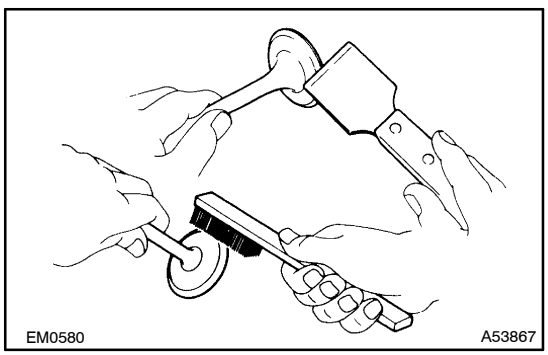

(c) Check the valve head margin thickness.
**Standard margin thickness: 1.6 mm (0.063 in.)**
**Minimum margin thickness: 1.1 mm (0.043 in.)**
If the margin thickness is less than minimum, replace the valve.



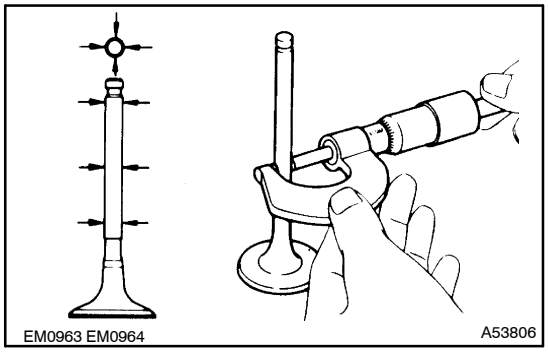

(d) Check the valve overall length.
**Standard overall length:**
**103.29 – 103.69 mm (4.0665 – 4.0823 in.)**
**Minimum overall length: 102.79 mm (4.0468 in.)**
If the overall length is less than minimum, replace the valve.




(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.**



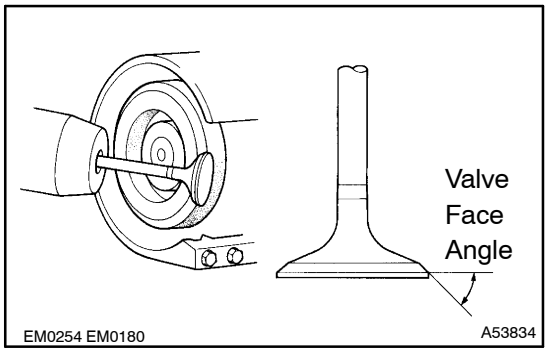

**11. CLEAN EXHAUST VALVE**
(a) Using a gasket scraper, chip off any carbon from the valve head.
(b) Using a wire brush, thoroughly clean the valve.




**12. INSPECT EXHAUST VALVE**

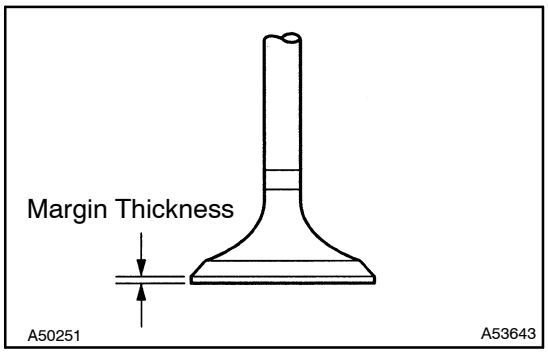
(a) Using a micrometer, measure the diameter of the valve stem.

**Valve stem diameter:**
**7.960 – 7.975 mm (0.3134 – 0.3140 in.)**



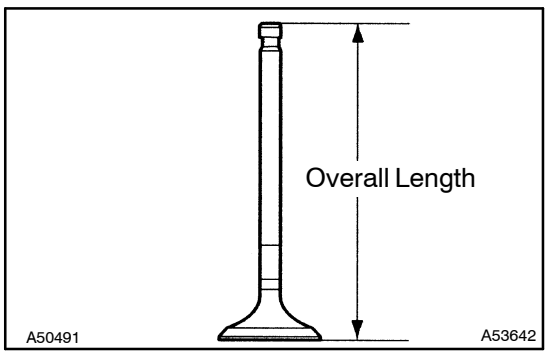

(b) Check the valve face angle.
(1) Grind the valve enough to remove pits and carbon.
(2) Check that the valve is ground to the correct valve face angle.

**Valve face angle: 44.5°**



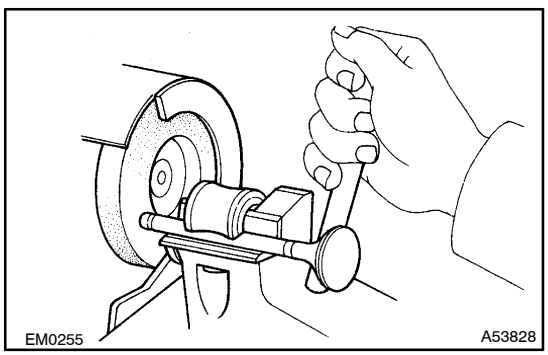

(c) Check the valve head margin thickness.
**Standard margin thickness: 1.7 mm (0.067 in.)**
**Minimum margin thickness: 1.2 mm (0.047 in.)**

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




(d) Check the valve overall length.
**Standard overall length:**
**103.29 – 103.69 mm (4.0665 – 4.0823 in.)**
**Minimum overall length: 102.79 mm (4.0468 in.)**

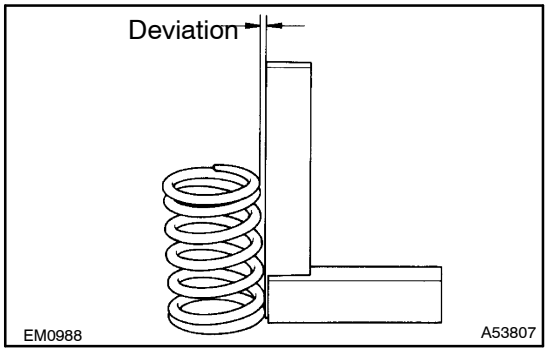
If the overall length is less than minimum, replace the valve.




(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.

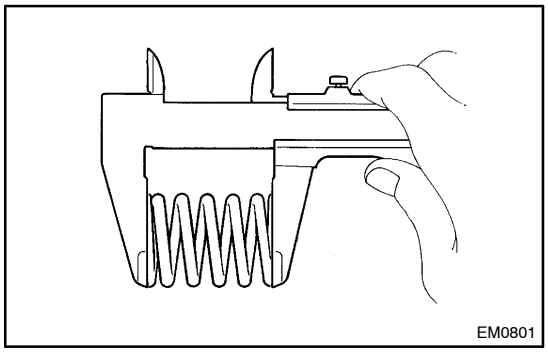
**NOTICE:**
**Do not grind off more than minimum.**




**13. INSPECT INNER COMPRESSION SPRING**

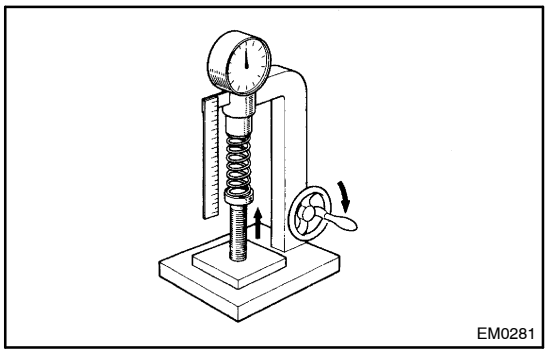
(a) Using a steel square, measure the deviation of the spring.
**Maximum deviation: 2.0 mm (0.079 in.)**

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



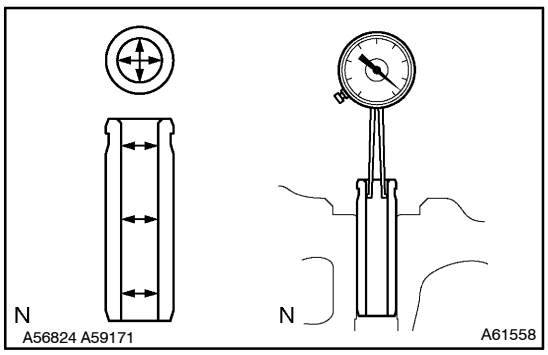

(b) Using vernier calipers, measure the free length of the spring.
**Free length: 48.54 mm (1.9110 in.)**

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




(c) Using a spring tester, measure the tension of the valve spring at the specified installed length.
**Installed tension:**
**301 – 332 N (30.7 – 33.9 kgf, 67.7 – 74.7 lbf)**
**at 37.0 mm (1.457 in.)**

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

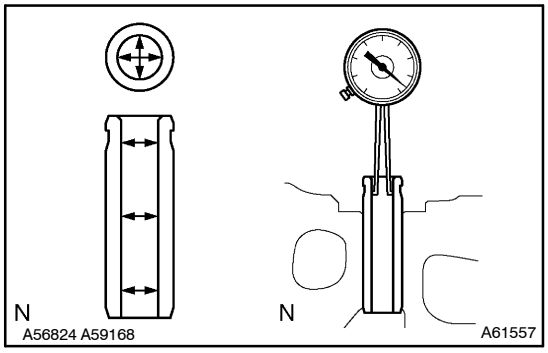



**14. INSPECT INTAKE VALVE GUIDE BUSH**

(a) Using a caliper gauge, measure the inside diameter of the guide bush.
**Bush inside diameter:**
**8.010 – 8.030 mm (0.3154 – 0.3161 in.)**

(b) Subtract the valve stem diameter measurement (See step 6) from the guide bush inside diameter measurement.
**Standard oil clearance:**
**0.020 – 0.055 mm (0.0008 – 0.0022 in.)**
**Maximum oil clearance: 0.08 mm (0.0031 in.)**

If the clearance is greater than maximum, replace the valve and guide bush (See steps 15 and 17).




**15. INSPECT EXHAUST VALVE GUIDE BUSH**

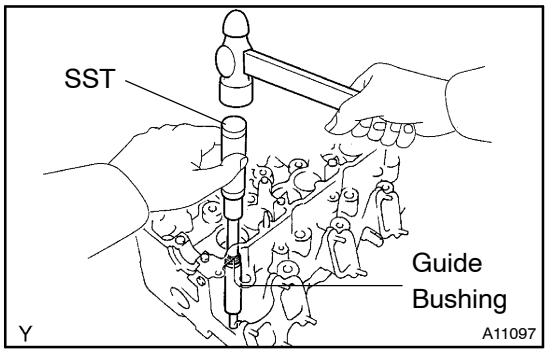
(a) Using a caliper gauge, measure the inside diameter of the guide bush.

**Bush inside diameter:**
**8.010 – 8.030 mm (0.3154 – 0.3161 in.)**

(b) Subtract the valve stem diameter measurement (See step 7) from the guide bush inside diameter measurement.

**Standard oil clearance:**
**0.035 – 0.070 mm (0.0014 – 0.0028 in.)**
**Maximum oil clearance: 0.10 mm (0.0039 in.)**

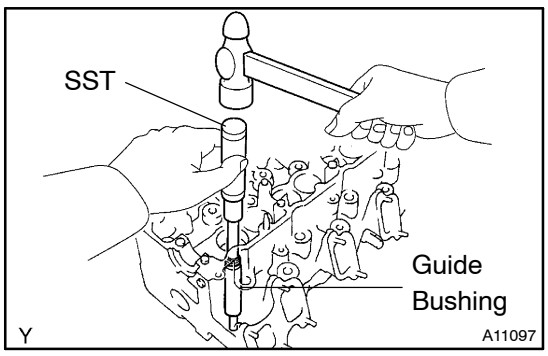
If the clearance is greater than maximum, replace the valve and guide bush (See steps 16 and 18).




**16. REMOVE INTAKE VALVE GUIDE BUSH**

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

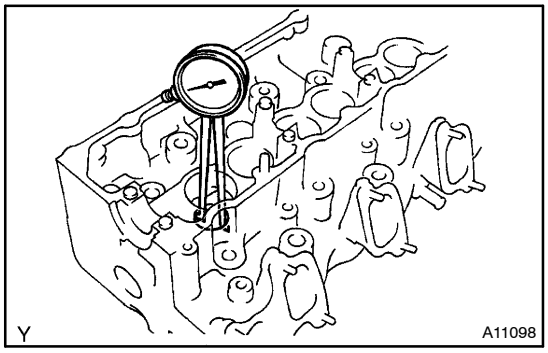
SST 09201–10000 (09201–01070), 09950–70010 (09951–07100)




**17. REMOVE EXHAUST VALVE GUIDE BUSH**

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

SST 09201–10000 (09201–01070), 09950–70010 (09951–07100)




**18. INSTALL INTAKE VALVE GUIDE BUSH**

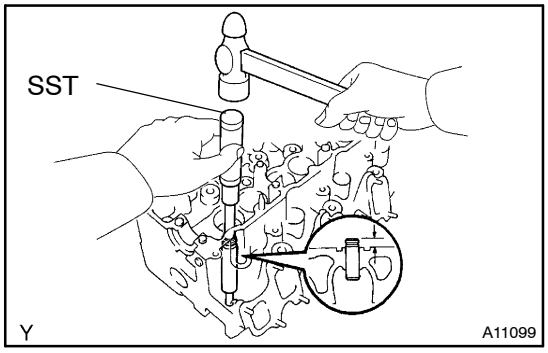
(a) Using a caliper gauge, measure the bush bore diameter of the cylinder head.

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

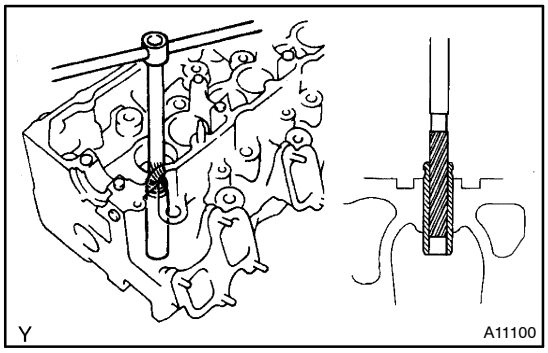
| Bush bore diameter | Bush size |
|---|---|
| 13.000 – 13.027 mm (0.5118 – 0.5129 in.) | Use STD |
| 13.050 – 13.077 mm (0.5134 – 0.5148 in.) | Use O/S 0.05 |

If the bush bore diameter of the cylinder head is greater than 13.027 mm (0.5129 in.), machine the bush bore to this dimension of 13.050 – 13.077 mm (0.5134 – 0.5148 in.).

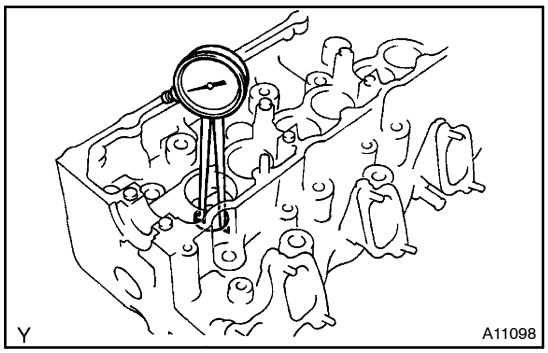
If the bush bore diameter of the cylinder head is greater than 13.077 mm (0.5148 in.), replace the cylinder head.




(c) Using SST and a hammer, tap in a new guide bush to the specified protrusion height.
SST 09201–10000 (09201–01070), 09950–70010 (09951–07100)
**Protrusion height: 12.8 – 13.2 mm (0.504 – 0.520 in.)**




(d) Using a sharp 8.0 mm reamer, ream the guide bush to obtain the standard specified clearance (See step 13) between the guide bush and valve stem.



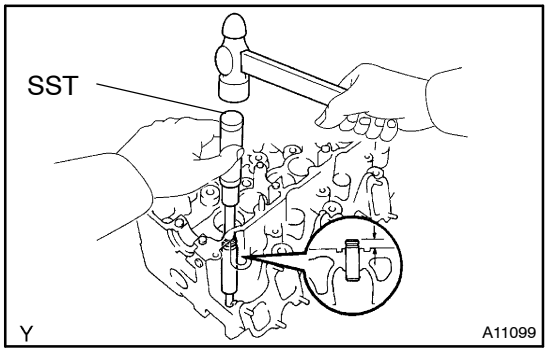

**19. INSTALL EXHAUST VALVE GUIDE BUSH**

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

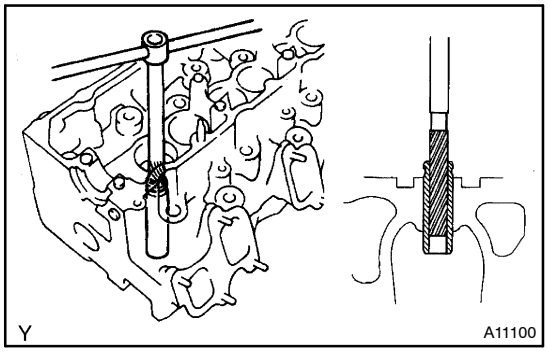
(b) Select a new guide bush (STD or O/S 0.05).

| Bush bore diameter | Bush size |
|---|---|
| 13.000 – 13.0527 mm (0.5118 – 0.5129 in.) | Use STD |
| 13.050 – 13.077 mm (0.5134 – 0.5148 in.) | Use O/S 0.05 |

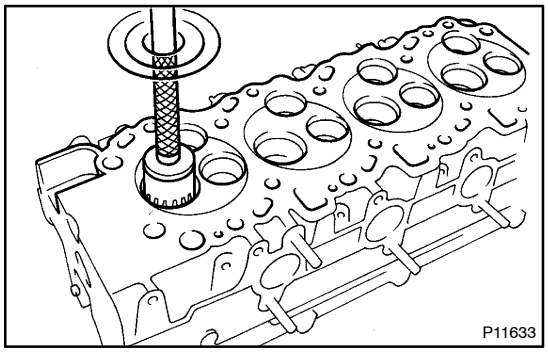
If the bush bore diameter of the cylinder head is greater than 13.027 mm (0.5129 in.), machine the bush bore to this dimension of 13.050 – 13.077 mm (0.5134 – 0.5148 in.).
If the bush bore diameter of the cylinder head is greater than 13.077 mm (0.5148 in.), replace the cylinder head.




(c) Using SST and a hammer, tap in a new guide bush to the specified protrusion height.
SST 09201–10000 (09201–01070), 09950–70010 (09951–07100)
**Protrusion height: 12.8 – 13.2 mm (0.504 – 0.520 in.)**

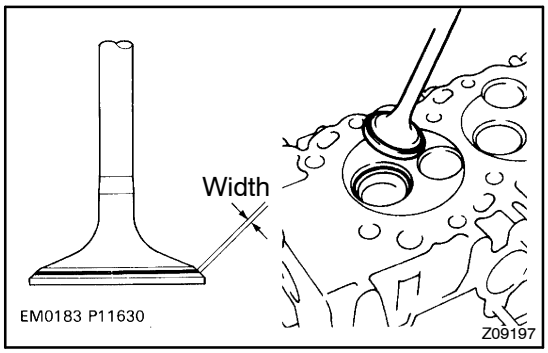



(d) Using a sharp 8.0 mm reamer, ream the guide bush to obtain the standard specified clearance (See step 13) between the guide bush and valve stem.




**20. INSPECT INTAKE VALVE SEATS**

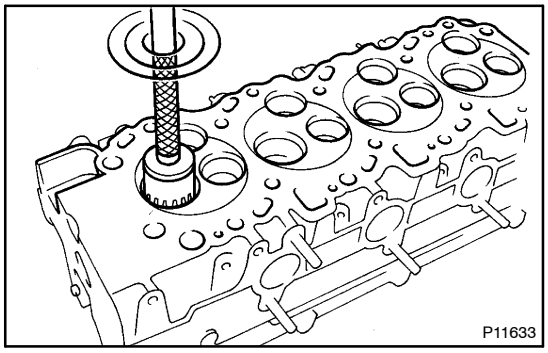
(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.




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

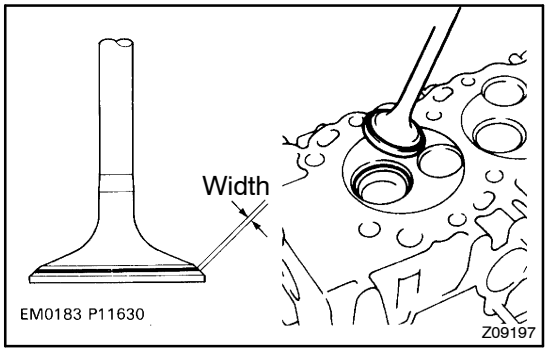
(c) Check the valve face and seat for the following:
  (1) If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
  (2) If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
  (3) Check that the seat contact is in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

**Width: 1.5 – 1.9 mm (0.059 – 0.075 in.)**




**21. INSPECT EXHAUST VALVE SEATS**

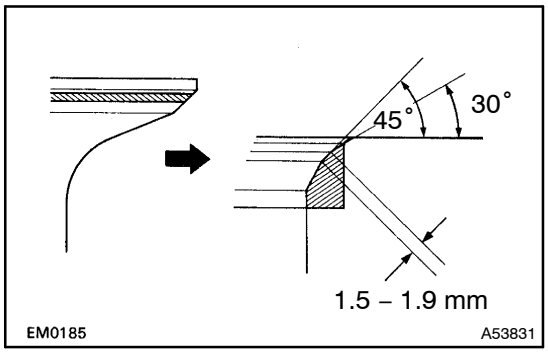
(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.




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

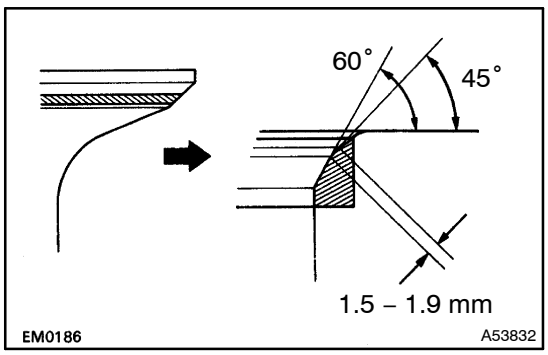
(c) Check the valve face and seat for the following:
  (1) If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
  (2) If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
  (3) Check that the seat contact is in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

**Width: 1.8 – 2.2 mm (0.071 – 0.087 in.)**

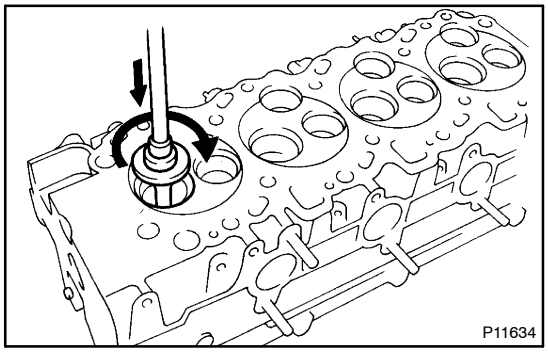



**22. REPAIR INTAKE VALVE SEATS**

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

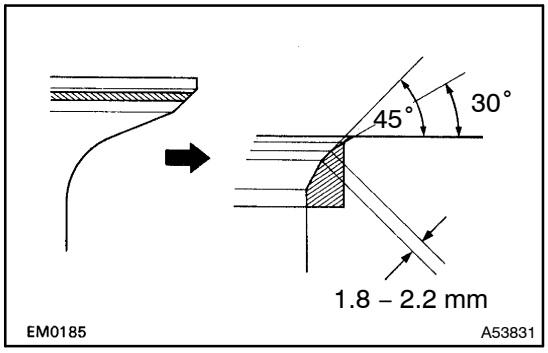



(b) If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



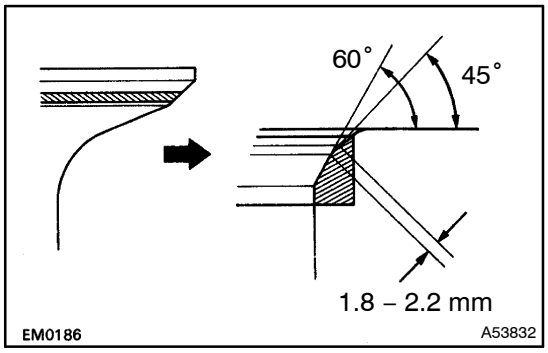

(c) Hand–lap the valve and valve seat with an abrasive compound.

(d) After hand–lapping, clean the valve and valve seat.

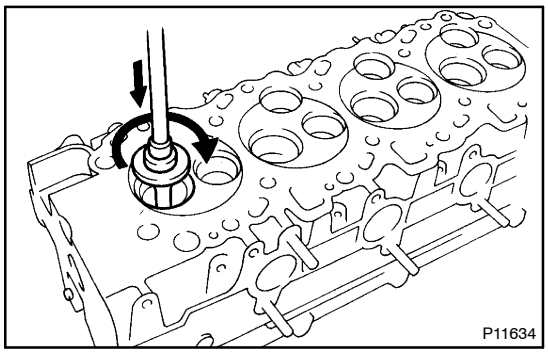



**23. REPAIR EXHAUST VALVE SEATS**

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

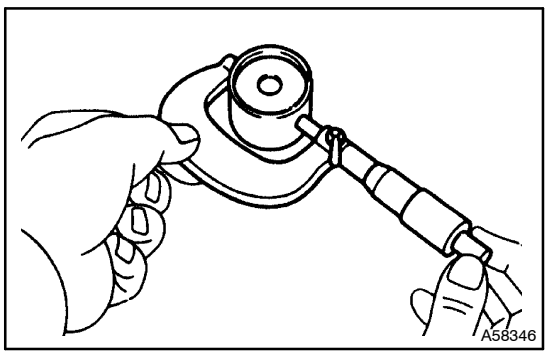



(b) If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



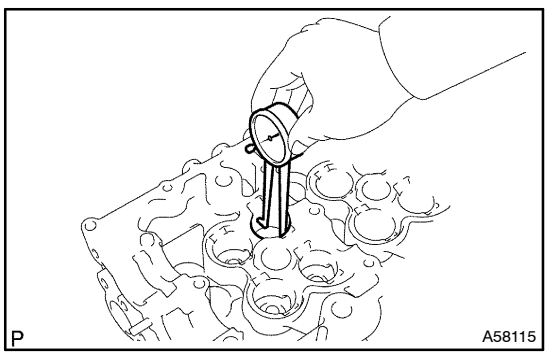

(c) Hand–lap the valve and valve seat with an abrasive compound.

(d) After hand–lapping, clean the valve and valve seat.




**24. INSPECT VALVE LIFTER**

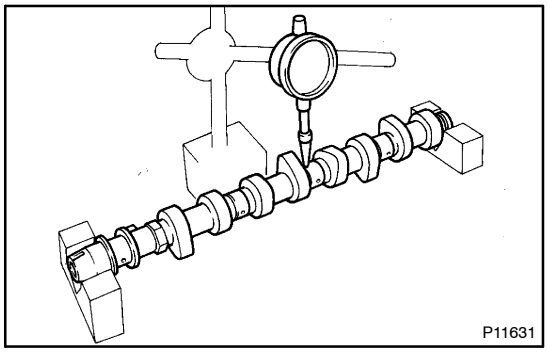
(a) Using a micrometer, measure the lifter diameter.
**Lifter diameter:**
**40.892 – 40.902 mm (1.6099 – 1.6103 in.)**




(b) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.
**Lifter bore diameter:**
**40.930 – 40.950 mm (1.6114 – 1.6122 in.)**

(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.
**Standard oil clearance:**
**0.038 – 0.063 mm (0.0015 – 0.0025 in.)**
**Maximum oil clearance: 0.08 mm (0.0031 in.)**

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




**25. INSPECT CAMSHAFT**

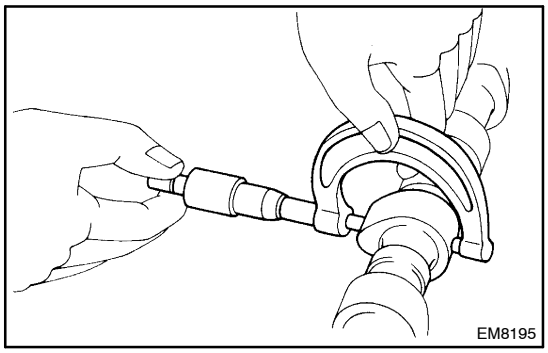
(a) Inspect the circle runout.

(1) Place the camshaft on V–blocks.

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

**Maximum circle runout: 0.06 mm (0.0024 in)**

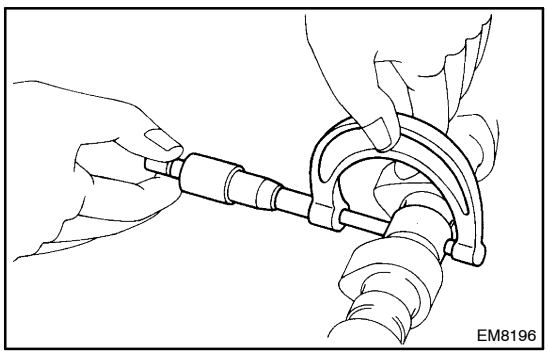
If the circle runout is greater than maximum, replace the camshaft.




(b) Using a micrometer, measure the cam lobe height.

**Standard cam lobe height:**
**54.810 – 54.910 mm (2.1579 – 2.1618 in.)**
**Minimum cam lobe height: 54.39 mm (2.1413 in.)**

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

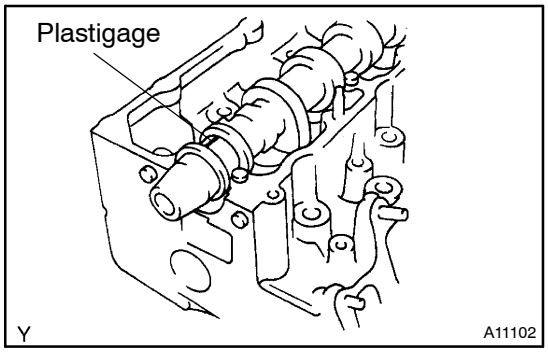



(c) Inspect the journal diameter of the camshaft.

(1) Using a micrometer, measure the journal diameter of the camshaft for the camshaft bearing.

**Journal diameter:**
**27.969 – 27.985 mm (1.1011 – 1.1018 in.)**

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




(d) Check the oil clearance.

(1) Clean the bearing caps and journals.

(2) Check that bearings for flaking and scoring.

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

(3) Install the bearings to the bearing caps and cylinder head.

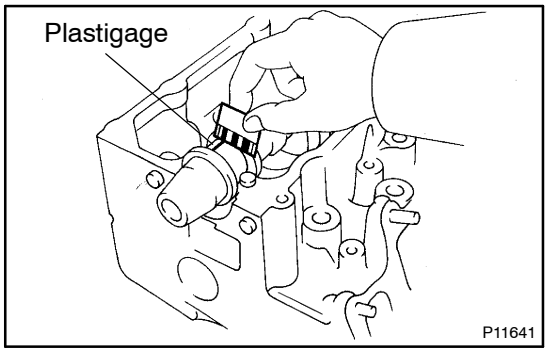
(4) Place the camshaft on the cylinder head.

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

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

**NOTICE:**
**Do not turn the camshaft.**

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

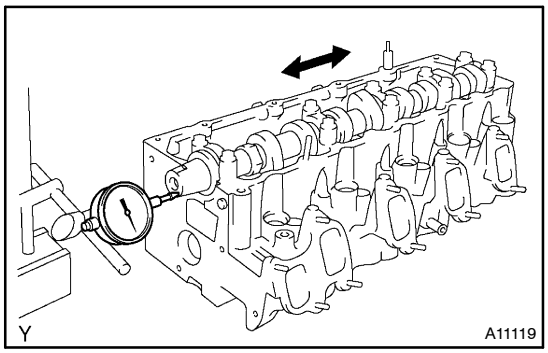



(8) Measure the Plastigage at its widest point.
**Standard oil clearance:**
**0.080 – 0.180 mm (0.0032 – 0.0071 in.)**
**Maximum oil clearance: 0.10 mm (0.0039 in.)**

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

(9) Completely remove the Plastigage.

(10) Remove the camshaft (See page 14–4).

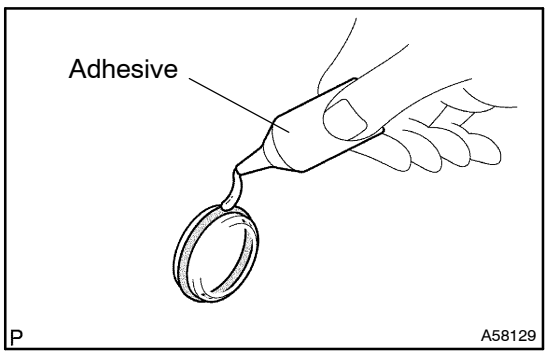



(e) Check the thrust clearance.

(1) Install the camshaft (See page 14–4).

(2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.
**Standard thrust clearance:**
**0.080 – 0.180 mm (0.0032 – 0.0071 in.)**
**Maximum thrust clearance: 0.25 mm (0.0098 in.)**

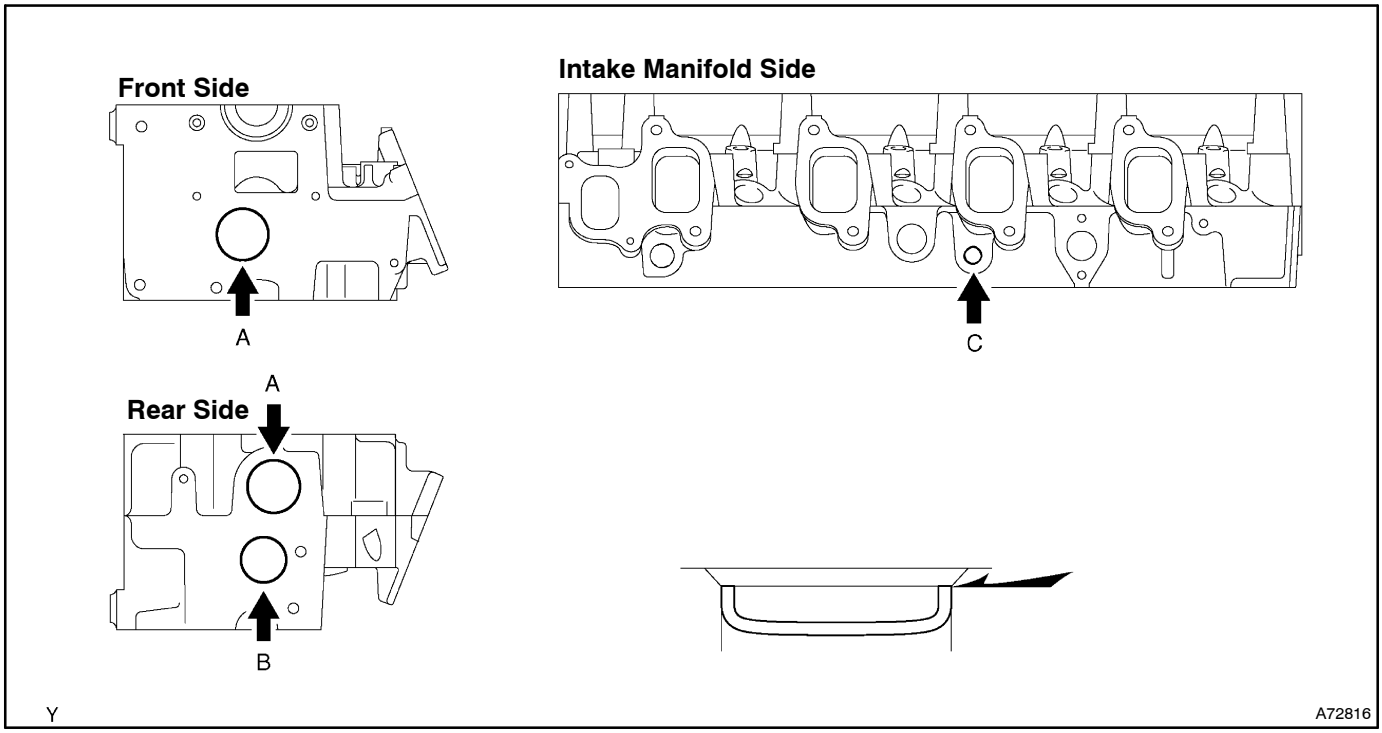
If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing cap and cylinder head as a set.



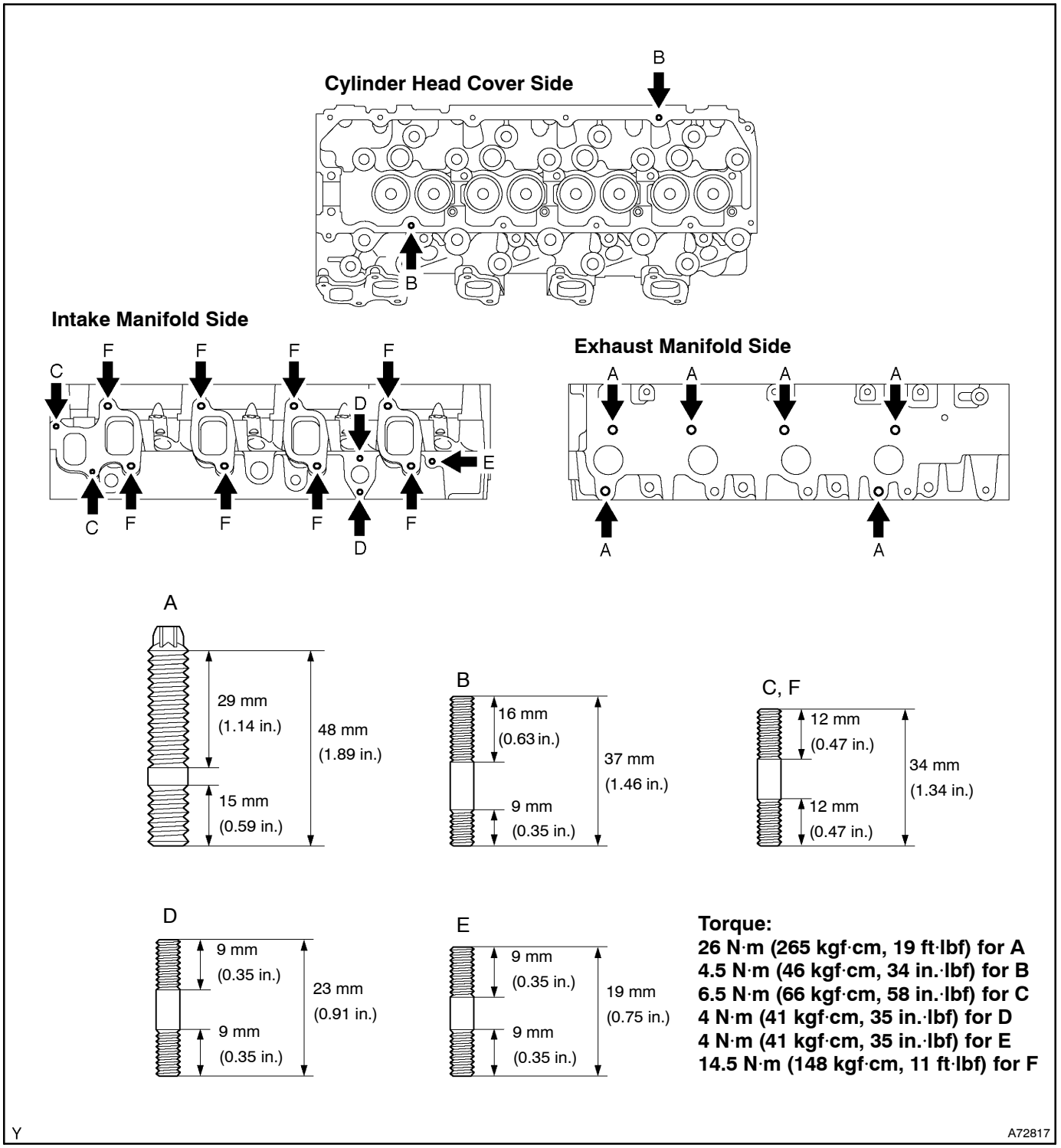

**26. INSTALL TIGHT PLUG**

(a) Apply adhesive to a new tight plug.
**Adhesive:**
**Part No. 08833–00070, THREE BOND 1324 or equivalent**

(b) Using SST and a hammer, tap in the tight plug as shown in the illustration.
SST Position A
09950–60010 (09951–00350), 09950–70010 (09951–07100)
SST Position B
09950–60010 (09951–00300), 09950–70010 (09951–07100)
SST Position C
09950–60010 (09951–00200), 09950–70010 (09951–07100)


Front Side
A
Intake Manifold Side
C
A
Rear Side
B
Y
A72816

## 27. INSTALL STUD BOLT

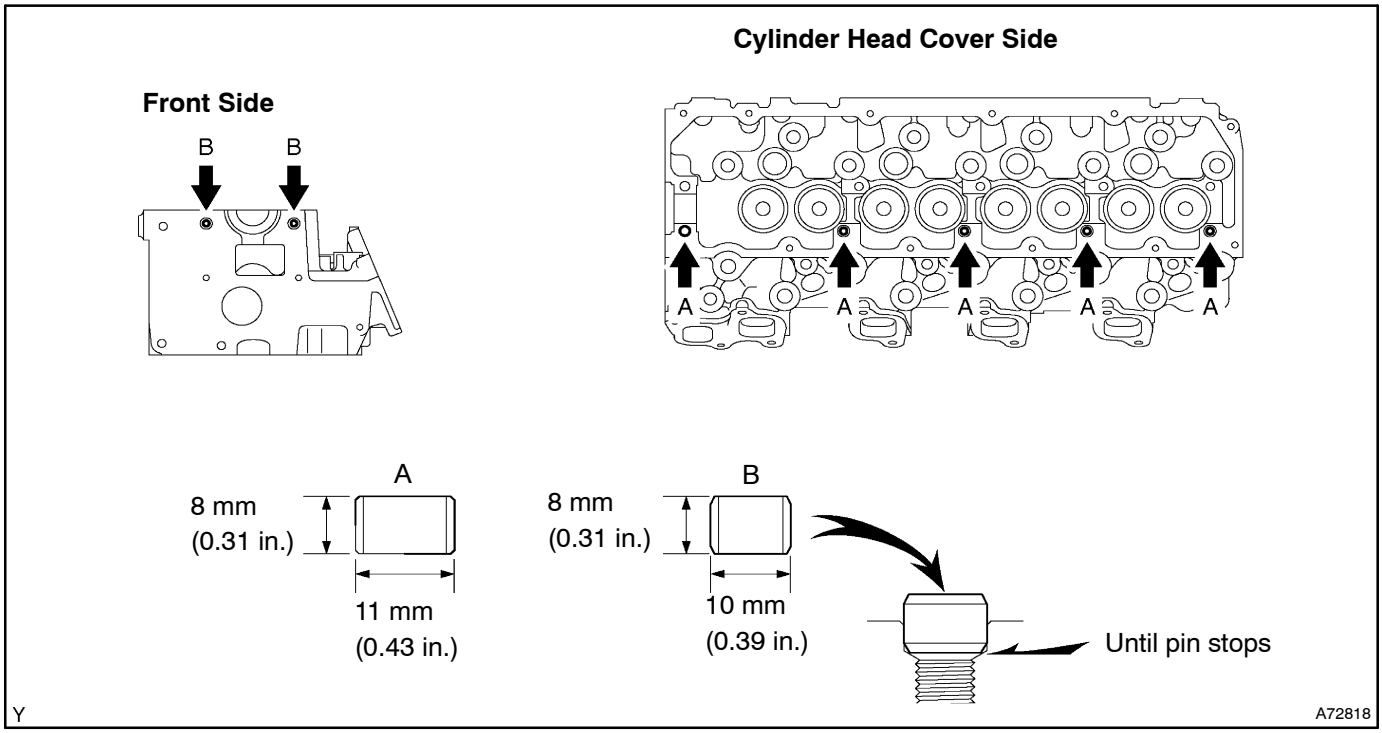



**Torque:**
**26 N·m (265 kgf·cm, 19 ft·lbf) for A**
**4.5 N·m (46 kgf·cm, 34 in.·lbf) for B**
**6.5 N·m (66 kgf·cm, 58 in.·lbf) for C**
**4 N·m (41 kgf·cm, 35 in.·lbf) for D**
**4 N·m (41 kgf·cm, 35 in.·lbf) for E**
**14.5 N·m (148 kgf·cm, 11 ft·lbf) for F**

Y

A72817

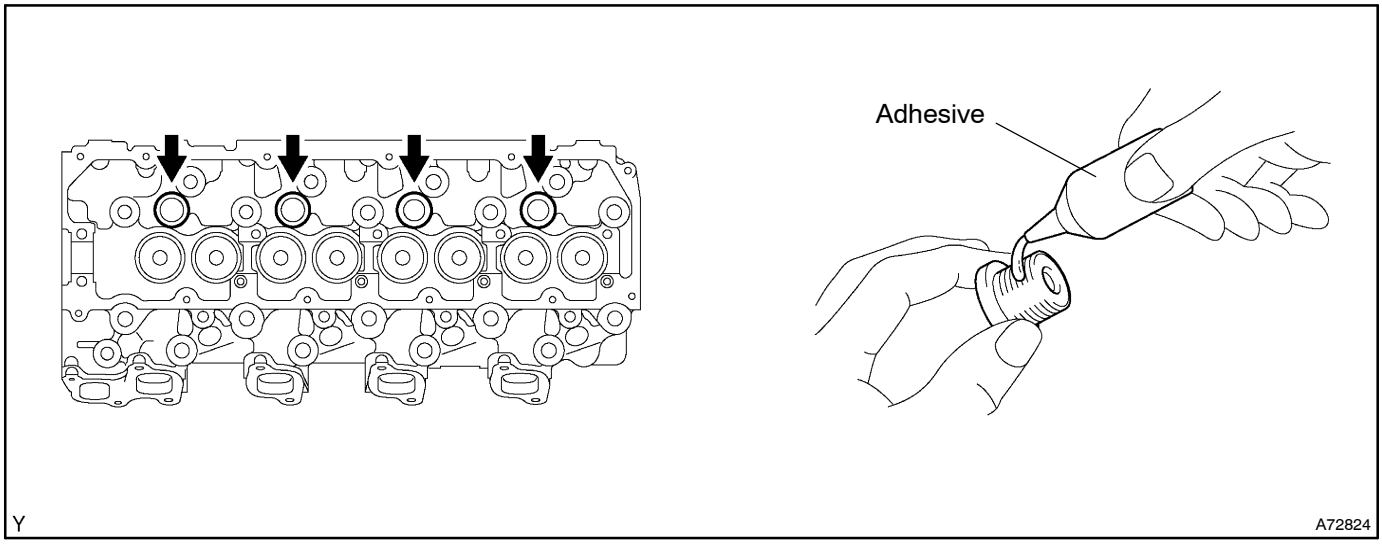
## 28. INSTALL RING PIN




## 29. INSTALL W/HEAD STRAIGHT SCREW PLUG NO.1

(a) Apply adhesive to the end of the screw plug.
**Adhesive: Part No. 08833–00070, THREE BOND 1324 or equivalent**

(b) Using a 10 mm hexagon wrench, install the screw plug.
**Torque: 40 N·m (408 kgf·cm, 30 ft·lbf)**

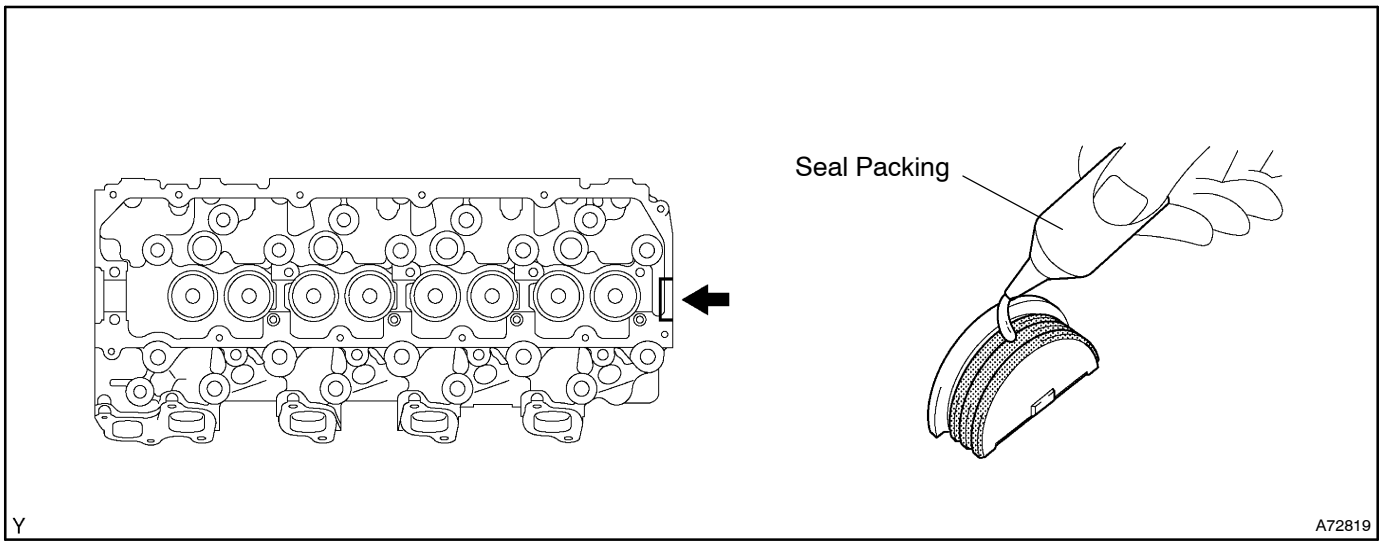


**30. INSTALL SEMICIRCULAR PLUG**

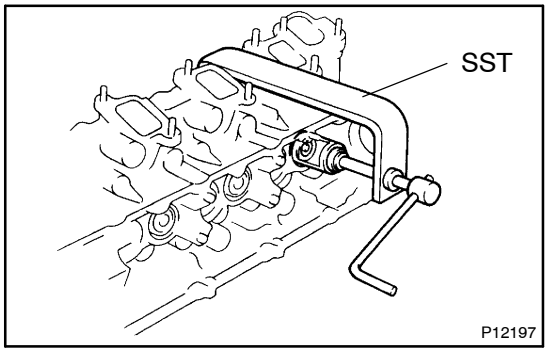
(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the semicircular plug and cylinder head.
  (1) Using a razor blade and gasket scraper, remove all the oil packing (FIPG) material from the gasket surfaces and sealing grooves.
  (2) Thoroughly clean all components to remove all the loose material.
  (3) Using a non–residue solvent, clean both sealing surfaces.

(b) Apply seal packing to the oil seal retainer as shown in the illustration.
**Seal packing: Part No. 08826–00080 or equivalent**
  (1) Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
  (2) Immediately remove nozzle from the tube and reinstall cap.

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



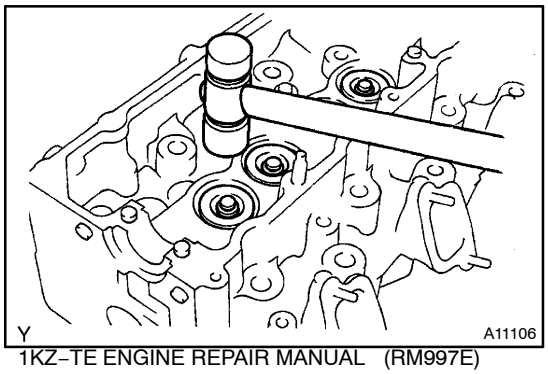

**31. INSTALL COMBUSTION CHAMBER SUB–ASSY**




**32. INSTALL INTAKE VALVE**

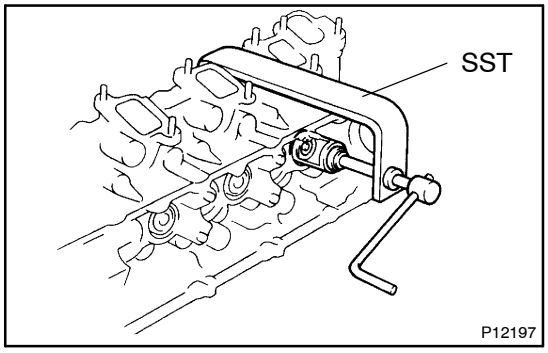
(a) Install the new oil seal, valve, spring seat, compression spring and spring retainer.

(b) Using SST, compress the compression spring and place the 2 keepers around the valve stem.
SST 09202–70020 (09202–00020)




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

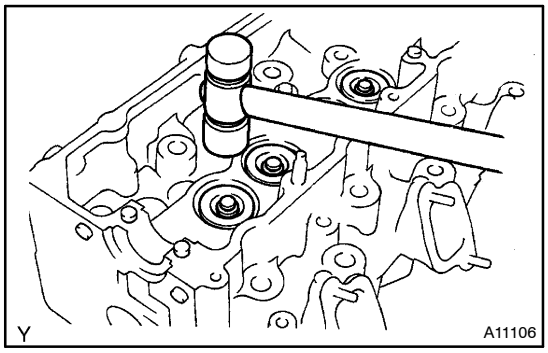
**NOTICE:**
**Be careful not do damage the valve stem tip.**




**33. INSTALL EXHAUST VALVE**

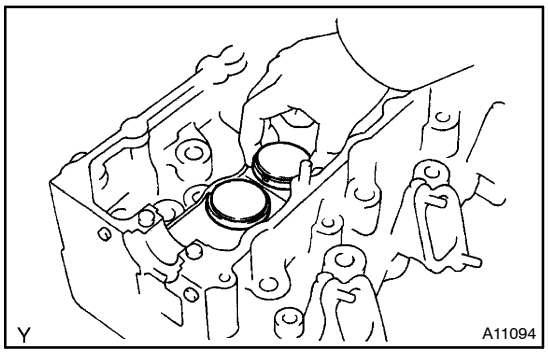
(a) Install the valve, spring seat, compression spring and spring retainer.

(b) Using SST, compress the compression spring and place the 2 keepers around the valve stem.
SST 09202–70020 (09202–00020)




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

**NOTICE:**
**Be careful not do damage the valve stem tip.**




**34. INSTALL VALVE LIFTER**

(a) Install the valve lifter and shim.

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