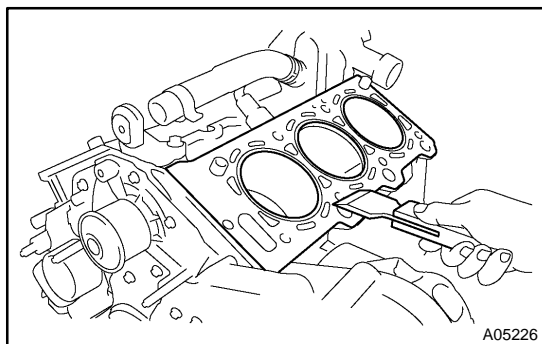


## INSPECTION

### 1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

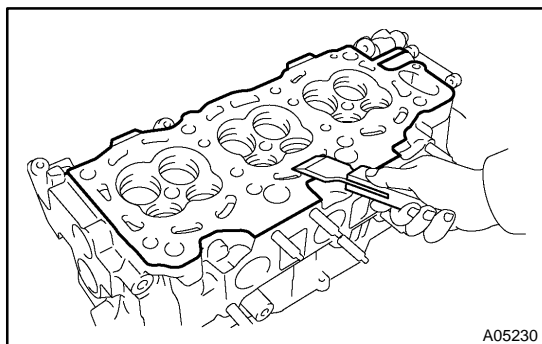
- (a) Turn the crankshaft, and bring each piston to top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston top surface.



- (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 pressure compressed air.

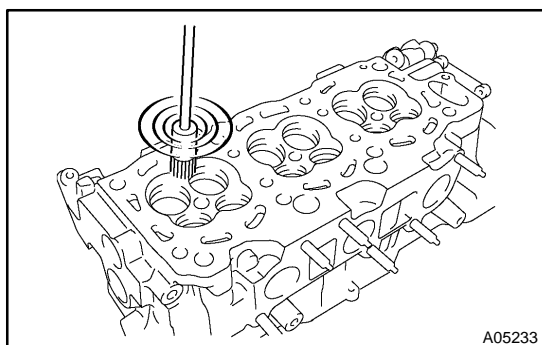


### 2. REMOVE GASKET MATERIAL

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.

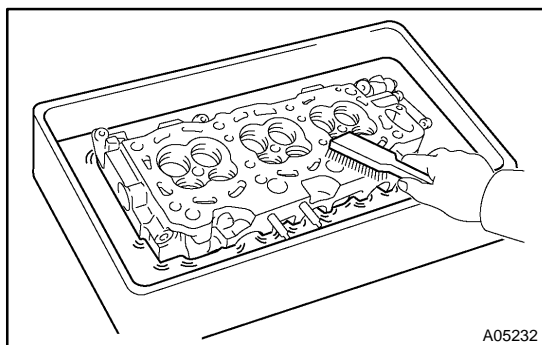


### 3. CLEAN COMBUSTION CHAMBERS

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

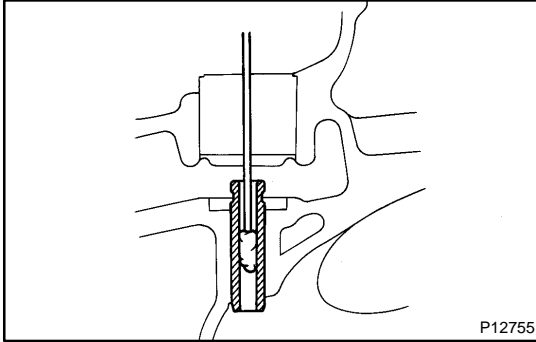
#### NOTICE:

Be careful not to scratch the cylinder block contact surface.



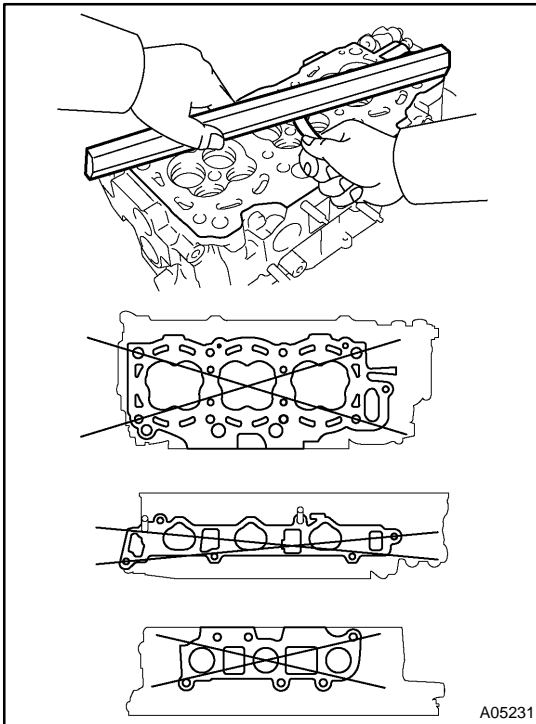
### 4. CLEAN CYLINDER HEADS

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



### 5. CLEAN VALVE GUIDE BUSHINGS

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

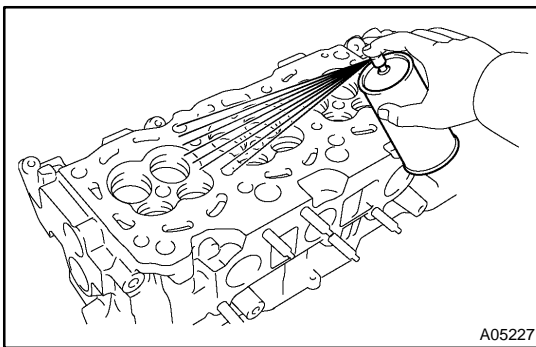


### 6. INSPECT FOR FLATNESS

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

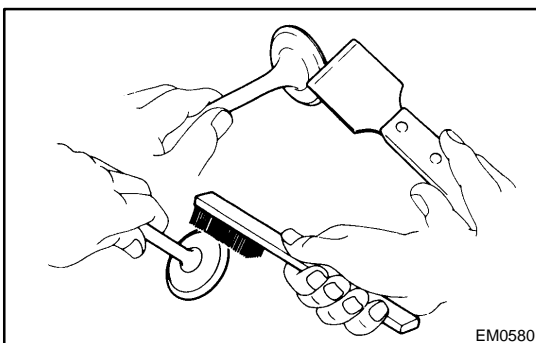
**Maximum warpage: 0.10 mm (0.0039 in.)**

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



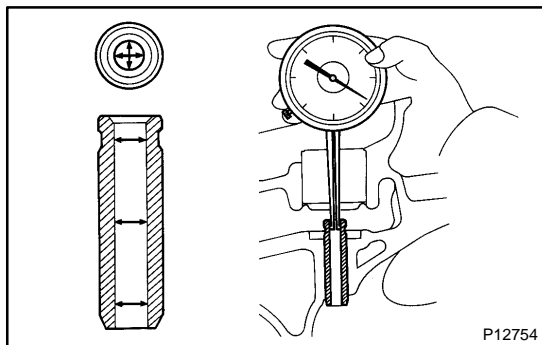
### 7. INSPECT FOR CRACKS

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



### 8. CLEAN VALVES

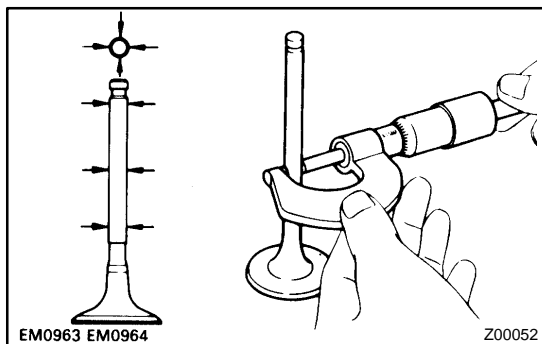
- (a) Using a gasket scraper, chip off any carbon from the valve head.
- (b) Using a wire brush, thoroughly clean the valve.

**9. INSPECT VALVE STEMS AND GUIDE BUSHINGS**

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

**Bushing inside diameter:**

**5.510 – 5.530 mm (0.2169 – 0.2177 in.)**



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

**Valve stem diameter:**

Intake	5.470 – 5.485 mm (0.2154 – 0.2159 in.)
Exhaust	5.465 – 5.480 mm (0.2152 – 0.2157 in.)

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

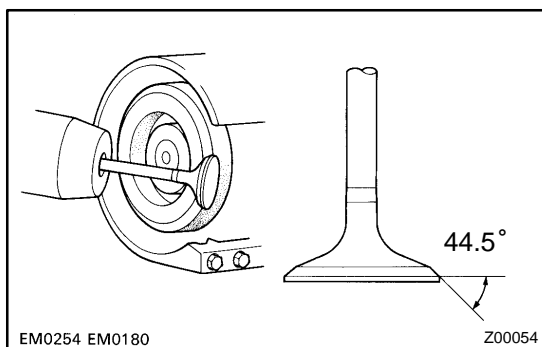
**Standard oil clearance:**

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:**

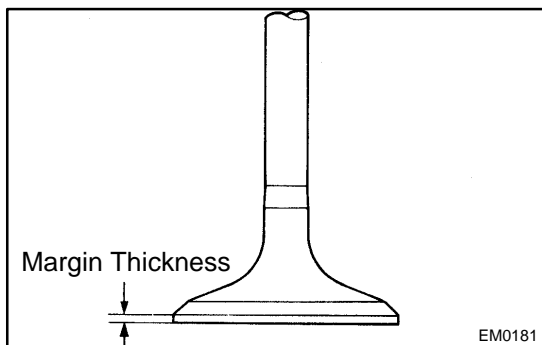
Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

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

**10. 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°**

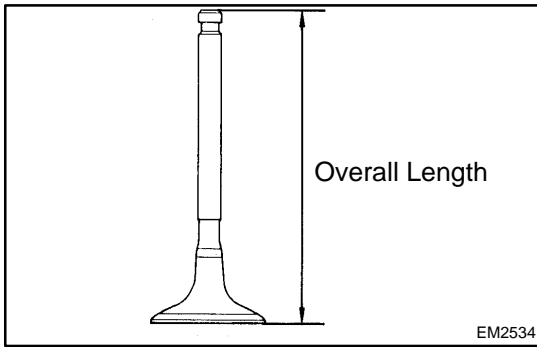


- (c) Check the valve head margin thickness.

**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.

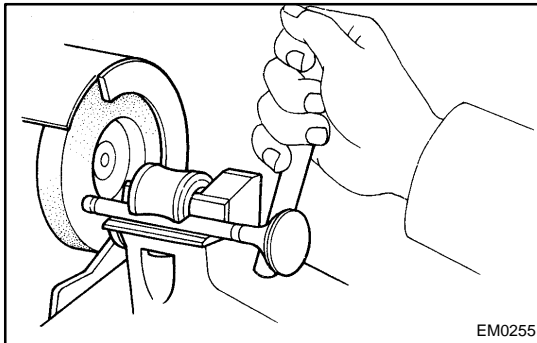
**Standard overall length:**

Intake	95.45 mm (3.5779 in.)
Exhaust	95.40 mm (3.7559 in.)

**Minimum overall length:**

Intake	94.95 mm (3.7382 in.)
Exhaust	94.90 mm (3.7362 in.)

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

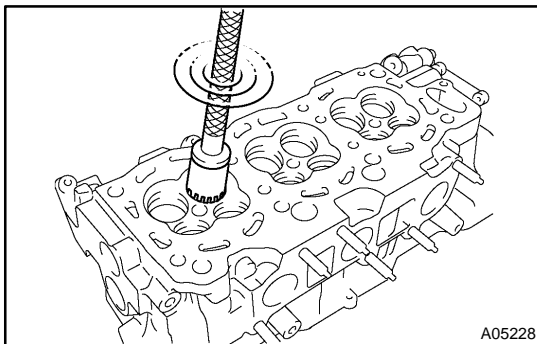


- (e) Check the surface of the valve stem tip for wear.

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

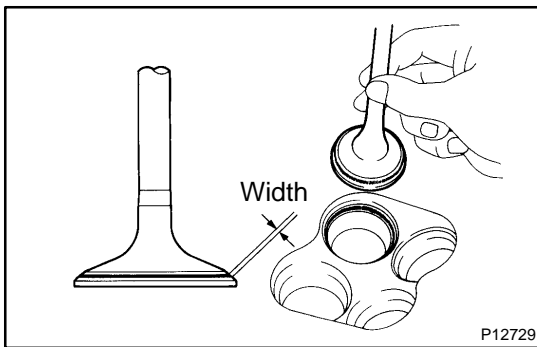
**NOTICE:**

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



**11. INSPECT AND CLEAN VALVE SEATS**

- (a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.
- (b) Check the valve seating position. Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate valve.



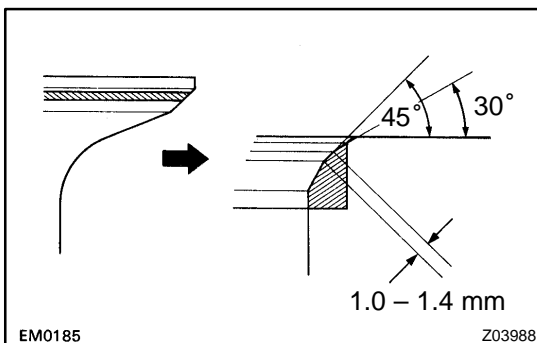
- (c) Check the valve face and seat for the following:

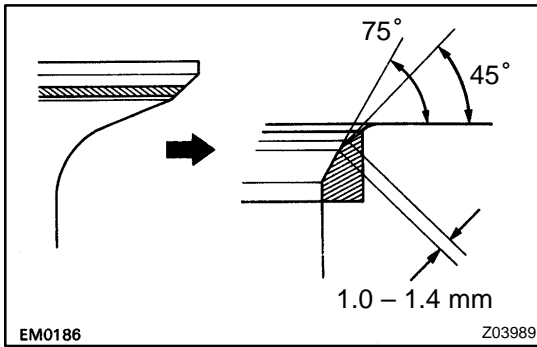
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is in the middle of the valve face with the following width:

**1.0 – 1.4 mm (0.039 – 0.055 in.)**

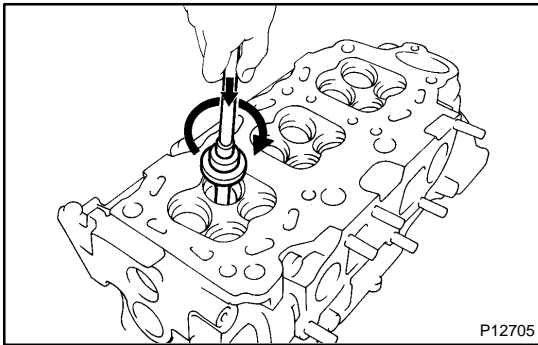
If not, correct the valve seats as follows:

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

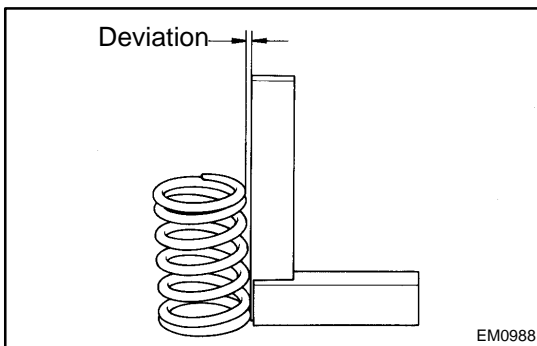




- (2) If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.



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

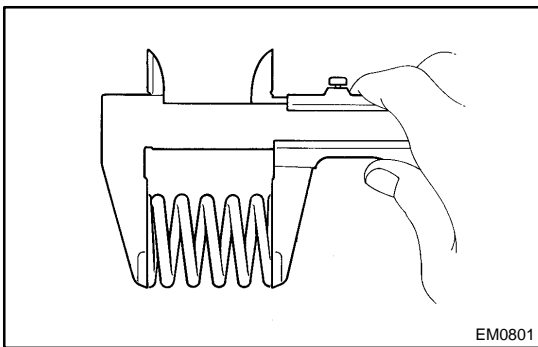


## 12. INSPECT VALVE SPRINGS

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

**Maximum deviation: 2.0 mm (0.079 in.)**

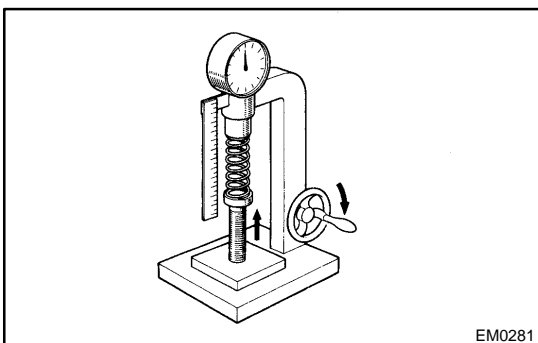
If the deviation is greater than maximum, replace the valve spring.



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

**Free length: 45.50 mm (1.7913 in.)**

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



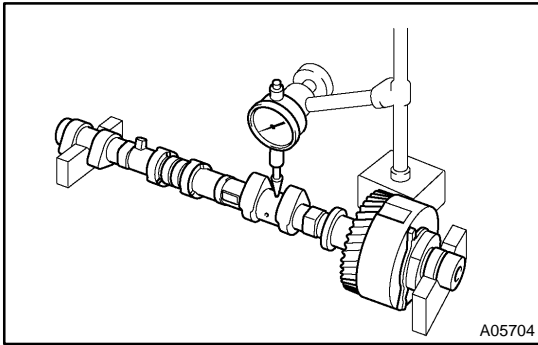
- (c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

**Installed tension:**

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

**at 33.8 mm (1.331 in.)**

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

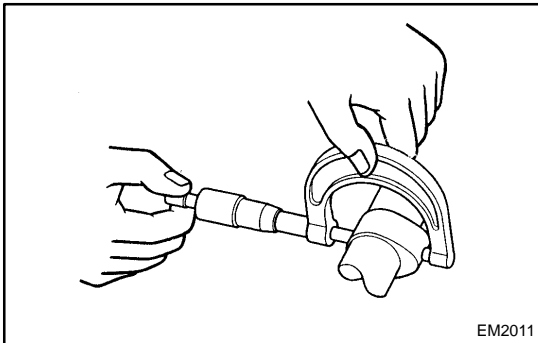


### 13. INSPECT CAMSHAFT FOR RUNOUT

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

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

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



### 14. INSPECT CAM LOBES

Using a micrometer, measure the cam lobe height.

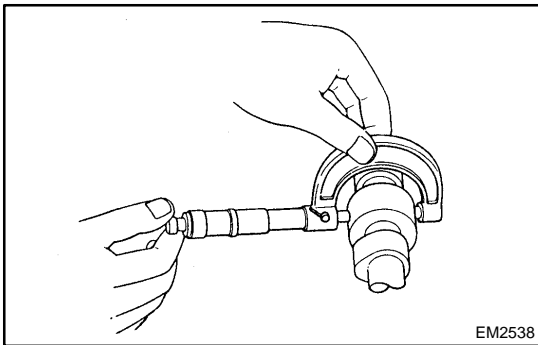
**Standard cam lobe height:**

Intake	42.932 – 43.032 mm (1.6902 – 1.6942 in.)
Exhaust	42.764 – 42.864 mm (1.6836 – 1.6876 in.)

**Minimum cam lobe height:**

Intake	42.78 mm (1.6842 in.)
Exhaust	42.61 mm (1.6776 in.)

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



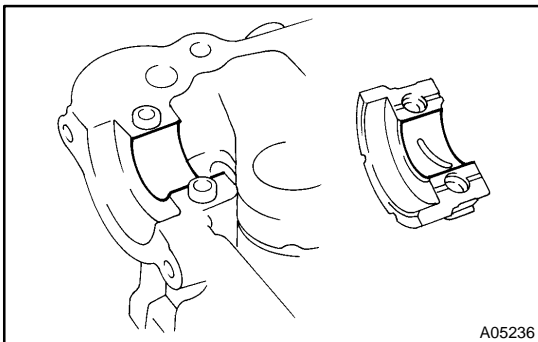
### 15. INSPECT CAMSHAFT JOURNALS

Using a micrometer, measure the journal diameter.

**Journal diameter:**

**26.959 – 26.975 mm (1.0613 – 1.0620 in.)**

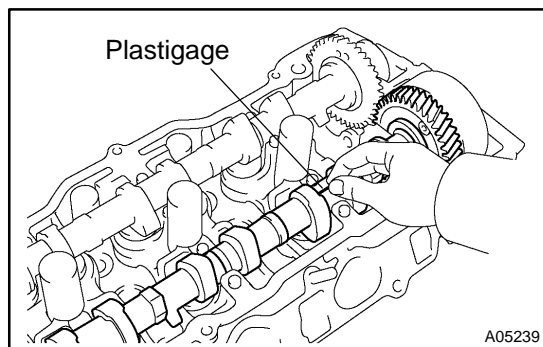
If the journal diameter is not as specified, check the oil clearance.



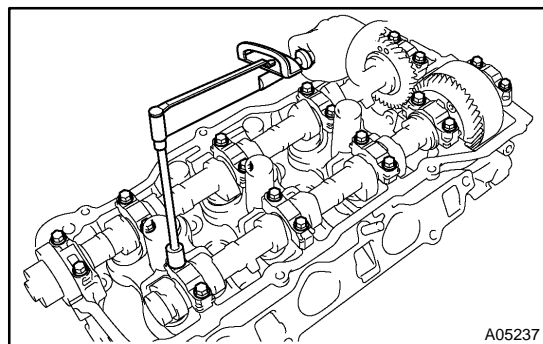
### 16. INSPECT CAMSHAFT BEARINGS

Check that bearings for flaking and scoring.

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

**17. 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 journal.

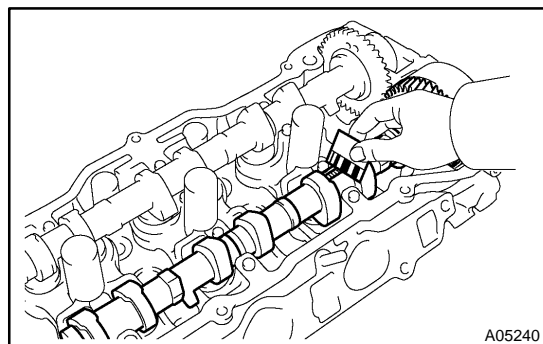


- (d) Install the bearing caps. (See page [EM-59](#))  
**Torque: 16 N·m (160 kgf-cm, 12 ft-lbf)**

**NOTICE:**

**Do not turn the camshaft.**

- (e) Remove the bearing caps.



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

**Standard oil clearance:**

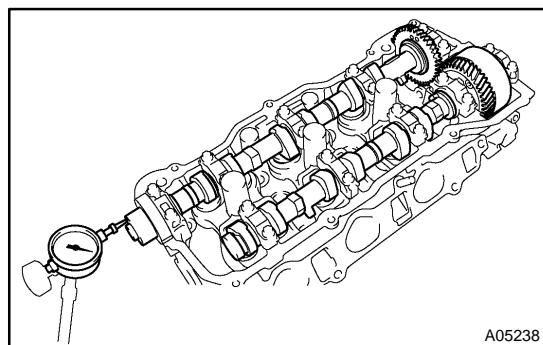
Intake	0.035 – 0.072 mm (0.0014 – 0.0028 in.)
Exhaust	0.025 – 0.062 mm (0.0010 – 0.0024 in.)

**Maximum oil clearance:**

Intake	0.10 mm (0.0039 in.)
Exhaust	0.09 mm (0.0035 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.
- (h) Remove the camshafts.

**18. INSPECT CAMSHAFT THRUST CLEARANCE**

- (a) Install the camshafts. (See page [EM-59](#))
- (b) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

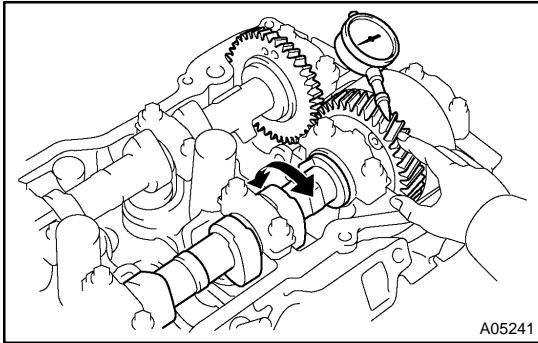
**Standard thrust clearance:**

**0.040 – 0.090 mm (0.0016 – 0.0035 in.)**

**Maximum thrust clearance: 0.12 mm (0.0047 in.)**

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

- (c) Remove the camshafts.



### 19. INSPECT CAMSHAFT GEAR BACKLASH

- (a) Install the camshafts without installing the exhaust cam sub-gear. (See page EM-59)
- (b) Using a dial indicator, measure the backlash.

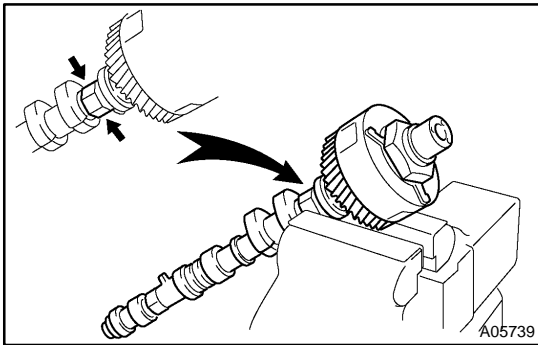
**Standard backlash:**

**0.020 – 0.200 mm (0.0008 – 0.0079 in.)**

**Maximum backlash: 0.30 mm (0.0188 in.)**

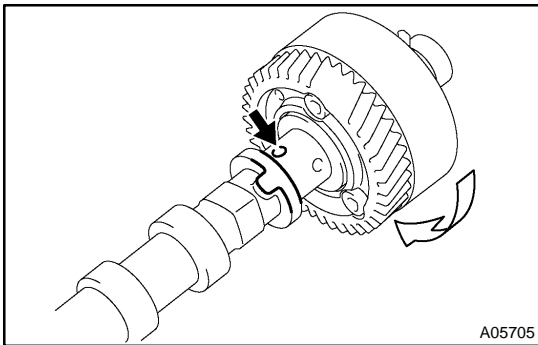
If the backlash is greater than maximum, replace the camshafts.

- (c) Remove the camshafts.



### 20. INSPECT CAMSHAFT TIMING GEAR (VVT-i)

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



- (b) Check that VVT-i will not turn.
- (c) Cover the port except the port on the advance angle side (nearest to the convex portion) shown in the illustration with the vinyl tape.
- (d) Using the air gun, apply about 100 kPa (1 kgf/cm<sup>3</sup>, 14 psi) of air pressure to the port on the advance side shown in the illustration.

#### NOTICE:

**When the oil is splashed, wipe it off with a shop lug and the likes.**

#### HINT:

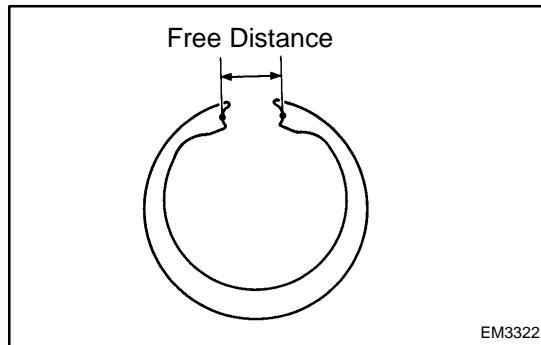
Perform this in order to release the lock pin for the maximum delay angle locking.

**Standard: Must turn**

#### HINT:

Depending on the air pressure, VVT-i will turn to the advance angle side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.

- (e) Under the condition of (d), turn VVT-i to the advance angle side (the white arrow marked direction in the illustration) with your hand.
- (f) Except the position where the lock pin meets at the maximum delay angle, let VVT-i turn back and forth and check the movable range and that there is no disturbance.  
**Standard: Movable smoothly in the range about 30°**
- (g) Turn VVT-i with your hand and lock it at the maximum delay angle position.

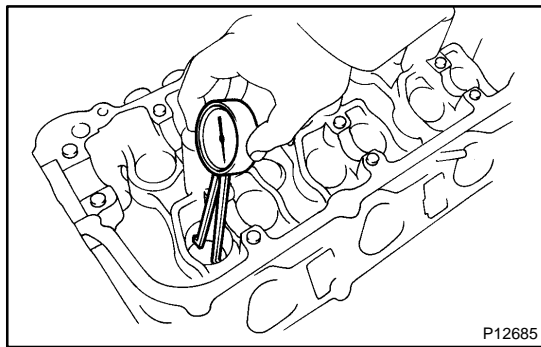


## 21. INSPECT CAMSHAFT GEAR SPRING

Using vernier calipers, measure the free distance between the spring ends.

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

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

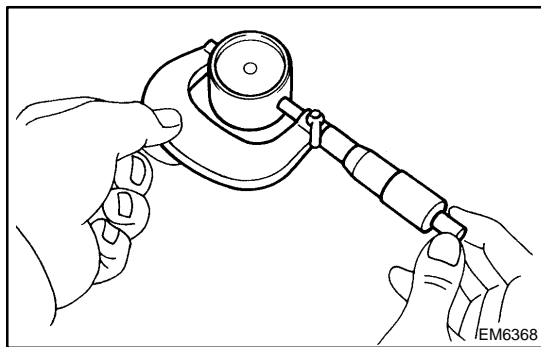


## 22. INSPECT VALVE LIFTERS AND LIFTER BORES

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

**Lifter bore diameter:**

**31.000 – 31.018 mm (1.2205 – 1.2212 in.)**



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

**Lifter diameter:**

**30.966 – 30.976 mm (1.2191 – 1.2195 in.)**

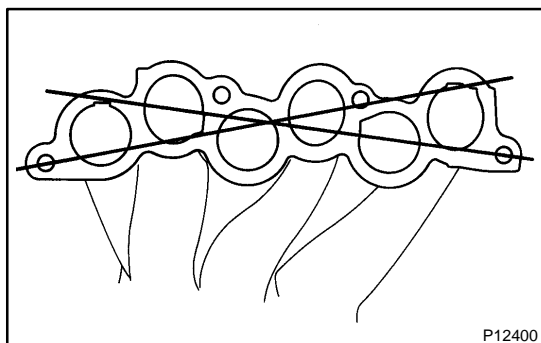
- (c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

**Standard oil clearance:**

**0.024 – 0.050 mm (0.0009 – 0.0020 in.)**

**Maximum oil clearance: 0.07 mm (0.0028 in.)**

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



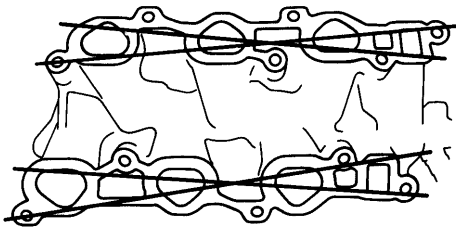
## 23. INSPECT AIR INTAKE CHAMBER

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

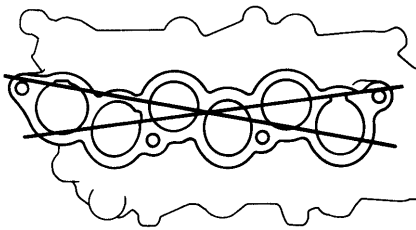
**Maximum warpage: 0.10 mm (0.0039 in.)**

If warpage is greater than maximum, replace the chamber.

Cylinder Head Side



Air Intake Chamber Side



P12396  
P12397

Z09167

#### 24. INSPECT INTAKE MANIFOLD

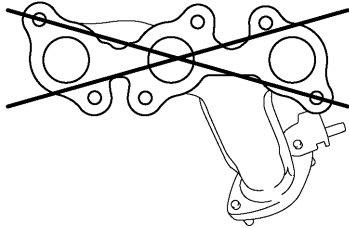
Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head and air intake chamber for warpage.

**Maximum warpage:**

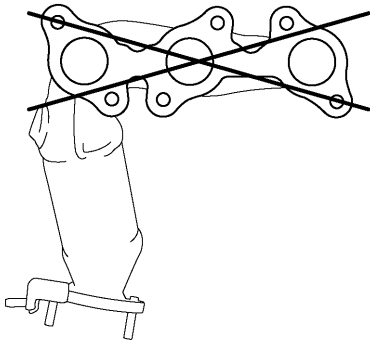
Air intake chamber side	0.15 mm (0.0059 in.)
Cylinder head side	0.08 mm (0.0031 in.)

If warpage is greater than maximum, replace the manifold.

RH Side



LH Side



Y

A07443

#### 25. INSPECT EXHAUST MANIFOLDS

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

**Maximum warpage: 0.50 mm (0.0196 in.)**

If warpage is greater than maximum, replace the manifold.

#### 26. INSPECT 12 POINTED HEAD CYLINDER HEAD BOLTS

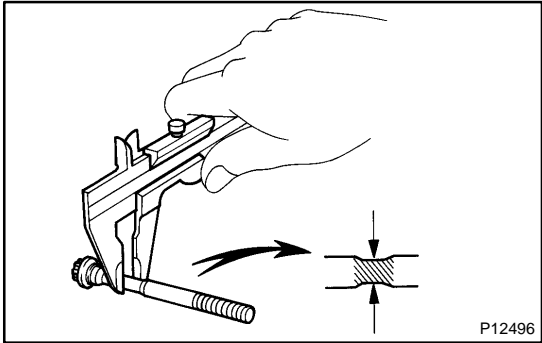
Using vernier calipers, measure the tension portion diameter of the bolt.

**Standard outside diameter:**

**8.95 – 9.05 mm (0.3524 – 0.3563 in.)**

**Minimum outside diameter: 8.75 mm (0.3445 in.)**

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



P12496