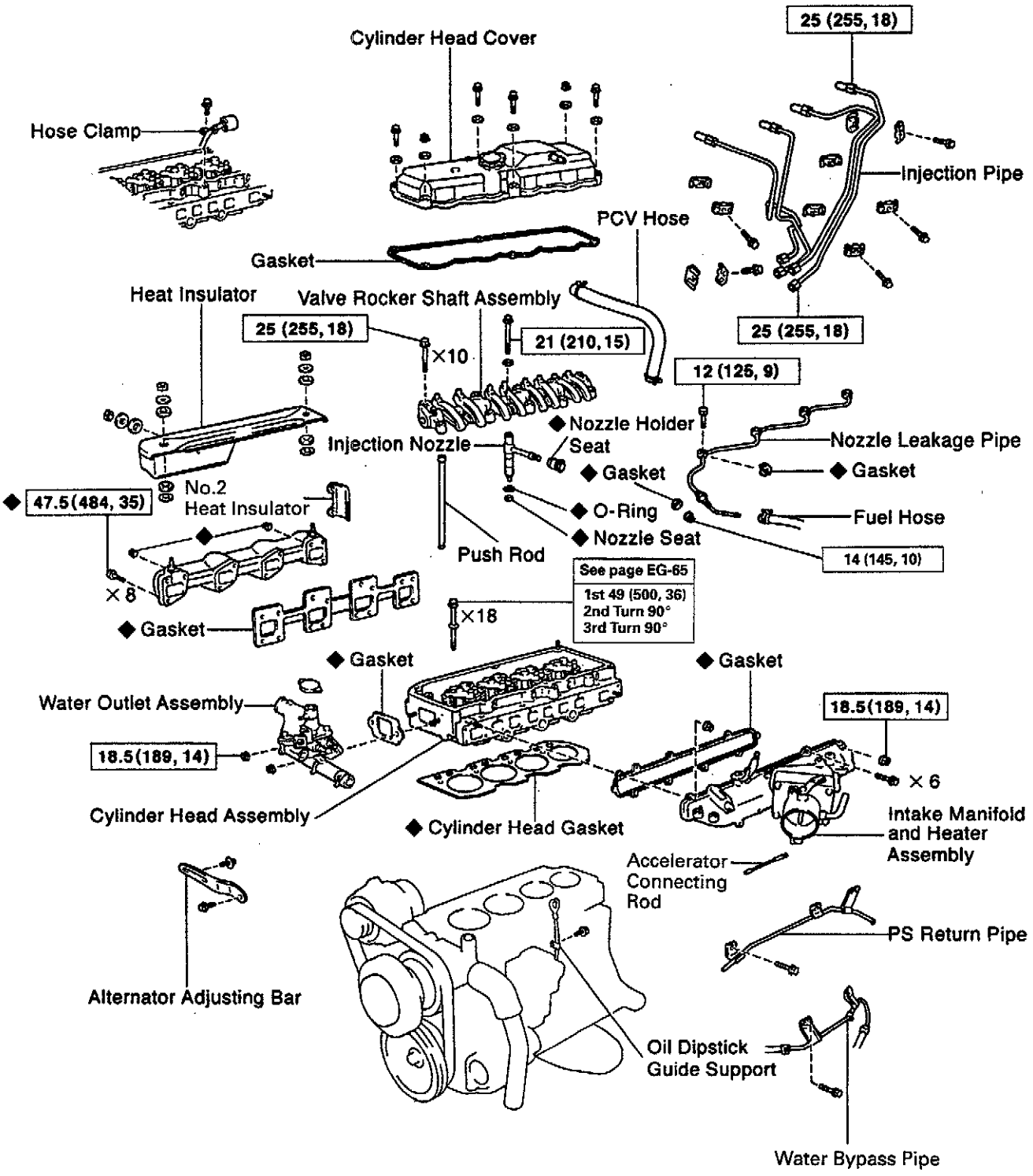
CYLINDER HEAD (15B−F, 15B−FT)

COMPONENTS FOR REMOVAL AND INSTALLATION

15B-F



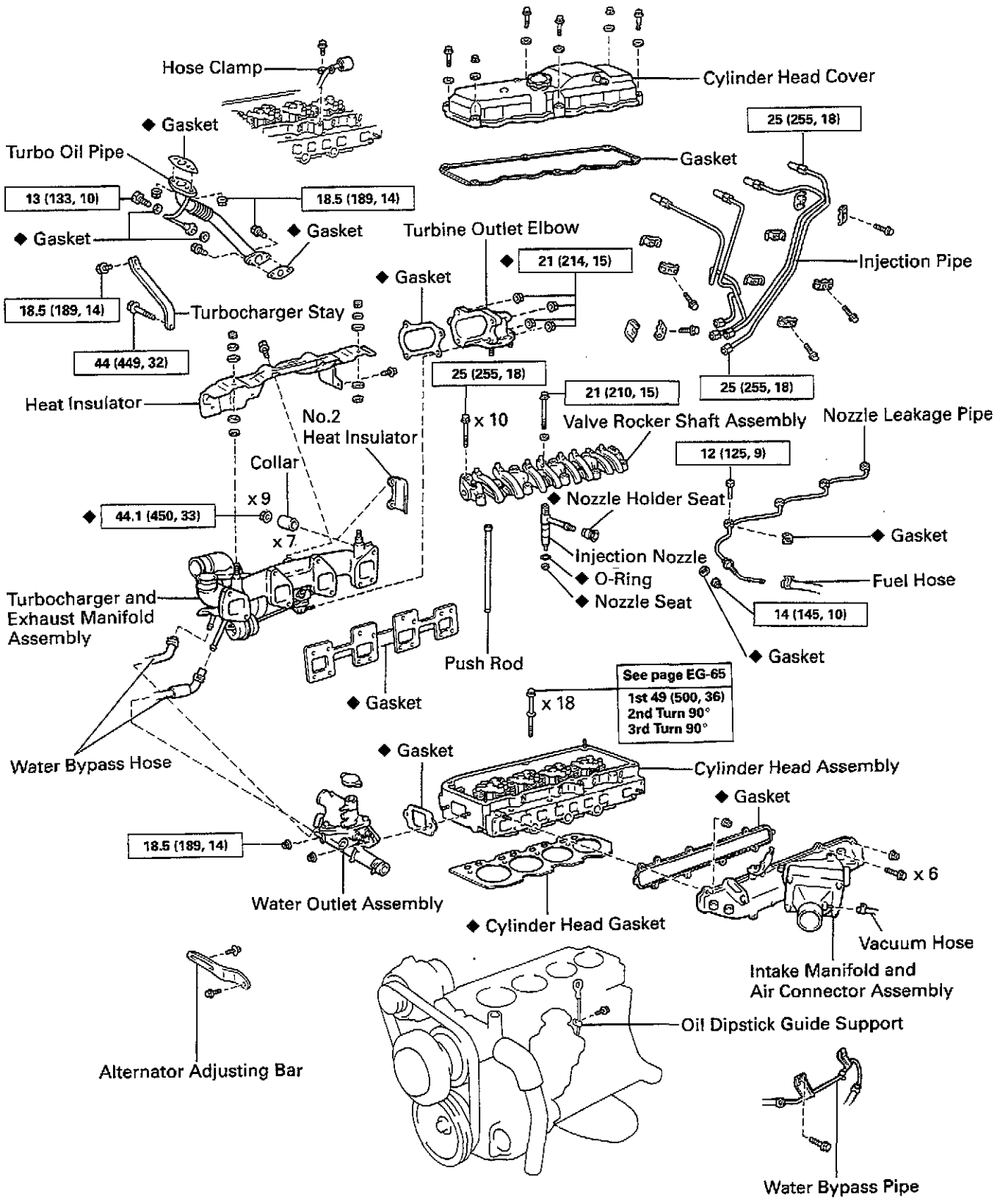
N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

P25012

EG

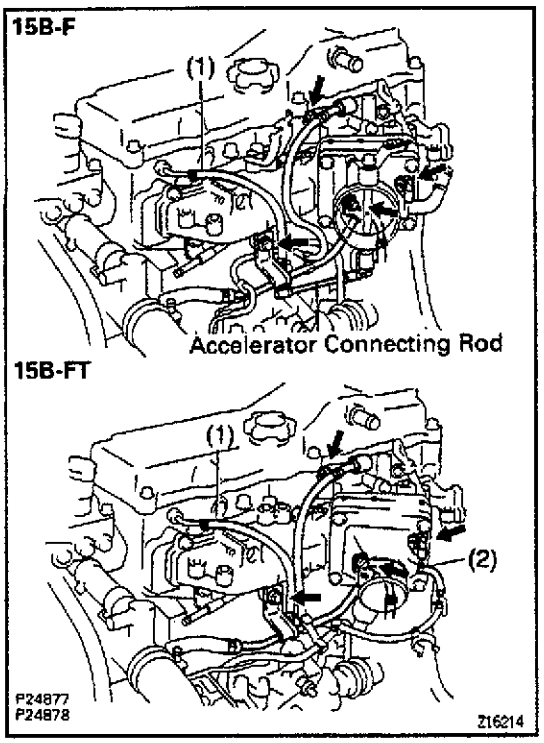
15B-FT



N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non-reusable part

P25037

CYLINDER HEAD REMOVAL



1. DRAIN ENGINE COOLANT

2. 15B–F:
REMOVE PCV HOSE

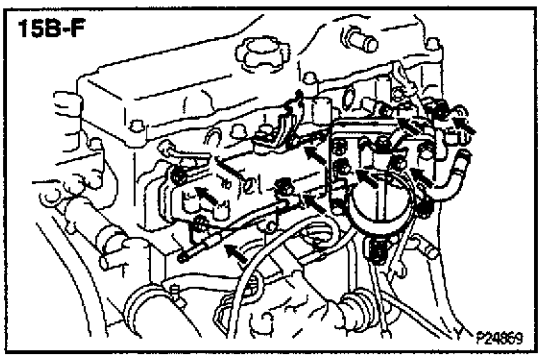
3. REMOVE INJECTION PIPES
(See step 3 in injection nozzles removal in Fuel System)

4. 15B–F:
REMOVE ACCELERATOR CONNECTING ROD

5. REMOVE INTAKE MANIFOLD ASSEMBLY

(a) Disconnect these parts:
(1) Fuel hose from nozzle leakage pipe
(2) 15B–FT:
Vacuum hose from intake air connector

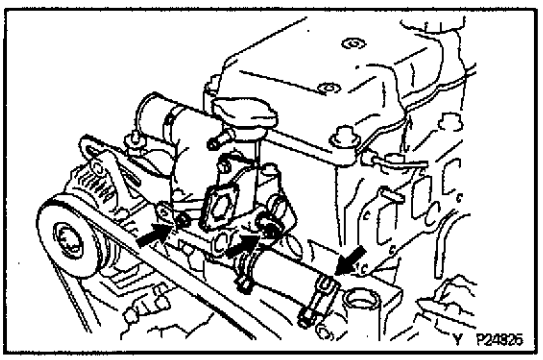
(b) Remove these holding bolts:
- Hose clamp to cylinder head
- Water bypass pipe to intake manifold
- Oil dipstick guide support to intake manifold



(c) Remove the 6 bolts, 2 nuts, intake manifold assembly, PS return pipe (15B–F) and gasket.

6. 15B–FT:
REMOVE TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY
(See steps 2 to 6 in turbocharger removal in Turbocharger System)

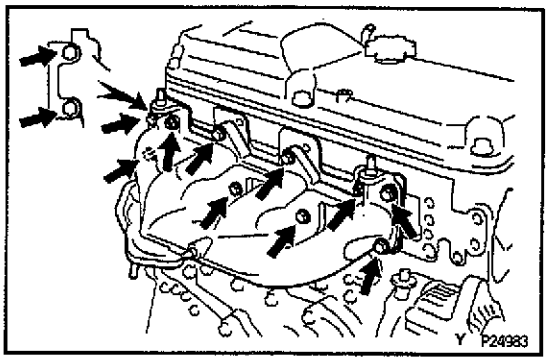
7. REMOVE DRIVE BELT ADJUSTING BAR



8. REMOVE WATER OUTLET ASSEMBLY

(a) Remove the 2 nuts holding the water outlet housing to the cylinder head.

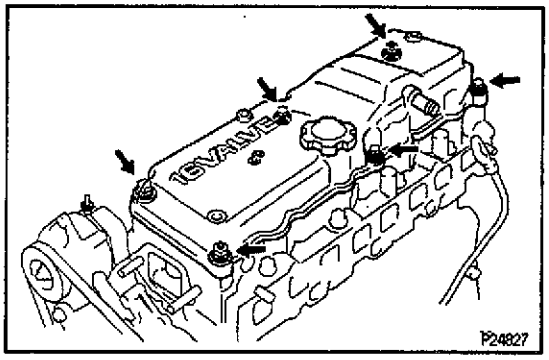
(b) Disconnect the water bypass hose from the water pump, and remove the water outlet assembly.



9. 15B—F:
REMOVE EXHAUST MANIFOLD

(a) Remove the 3 nuts, 6 plate washers, heat insulator and 6 spacers.

(b) Remove the 8 bolts, 2 nuts, exhaust manifold, No.2 heat insulator and gasket.

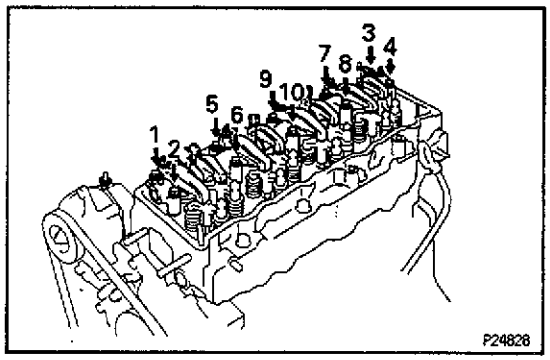


10. REMOVE CYLINDER HEAD COVER

Remove the 4 bolts, 2 nuts, 6 cushions, cylinder head cover and gasket.

11. REMOVE INJECTION NOZZLES

(See steps 2, 4 and 5 in injection nozzles removal in Fuel System)



12. REMOVE VALVE ROCKER SHAFT ASSEMBLY

(a) Loosen the lock nuts and adjusting screws.

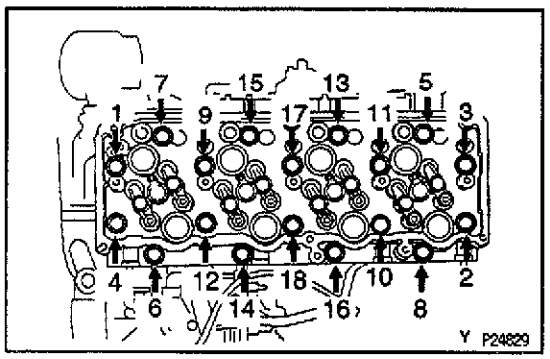
(b) Uniformly loosen and remove the 10 bolts, in several passes, in the sequence shown.

(c) Remove the rocker shaft assembly.

13. REMOVE PUSH RODS

Remove the 8 push rods in order, beginning from the No.1 push rod.

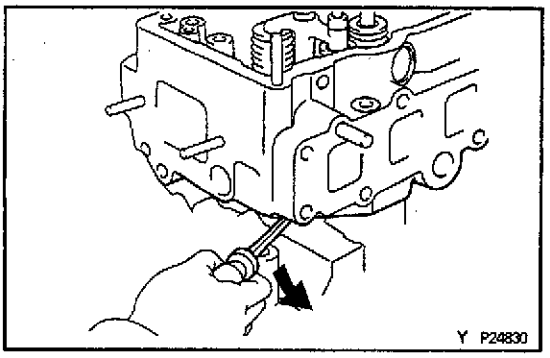
HINT: Arrange the push rods in correct order.



14. REMOVE CYLINDER HEAD ASSEMBLY

(a) Uniformly loosen and remove the 18 cylinder head bolts, in several passes, in the sequence shown.

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

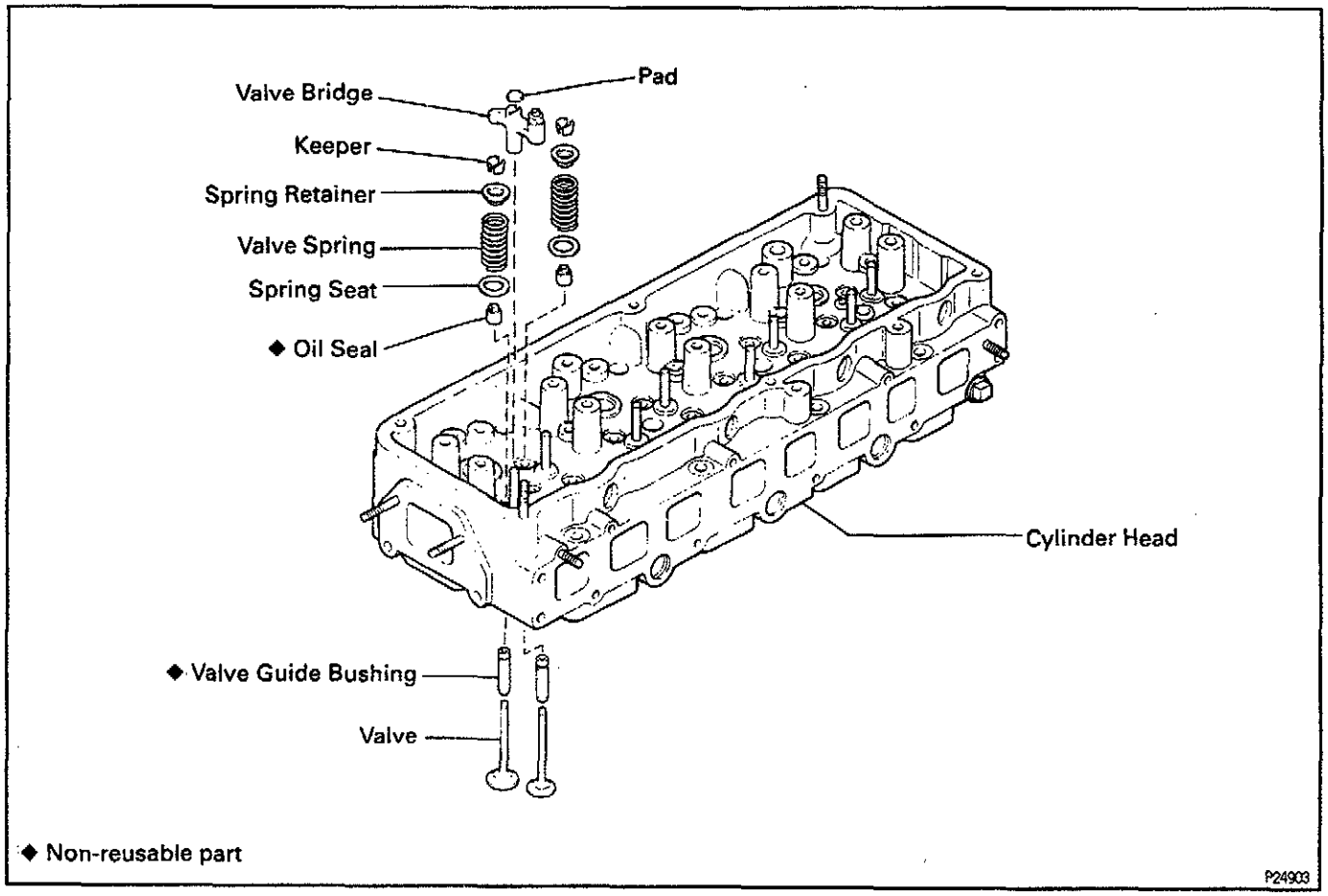


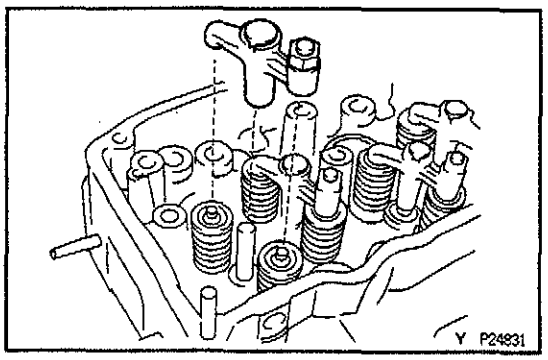
(b) Lift the cylinder head from the dowels on the cylinder block, and place the cylinder head on wooden blocks on a bench.

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

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

COMPONENTS FOR DISASSEMBLY AND ASSEMBLY

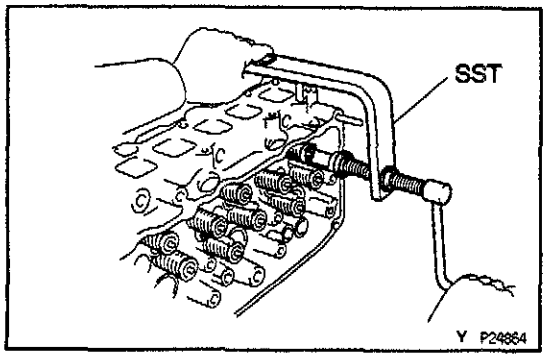




CYLINDER HEAD DISASSEMBLY

1. REMOVE VALVE BRIDGE AND PAD

HINT: Arrange the valve bridge in correct order.

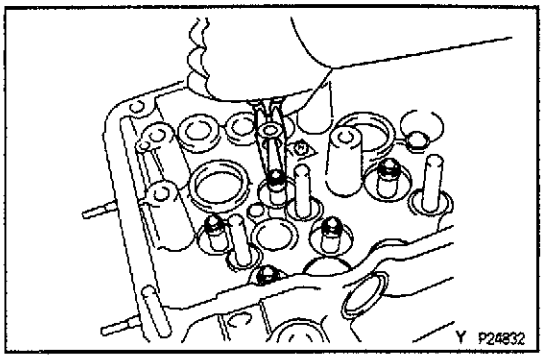


2. REMOVE VALVES

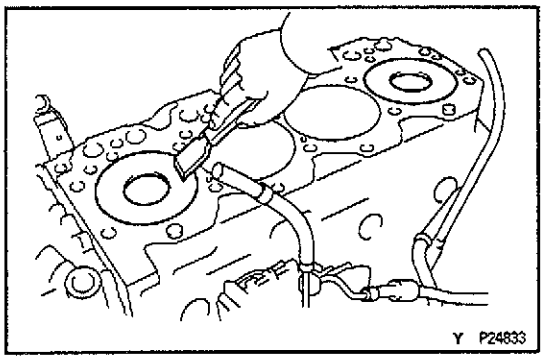
(a) Using SST, compress the valve spring and remove the 2 keepers.
SST 09202–70020 (09202–00010)

(b) Remove the spring retainer, valve spring, valve and spring seat.
HINT: Arrange the valves, valve springs, spring seats and spring retainers in correct order.

EG



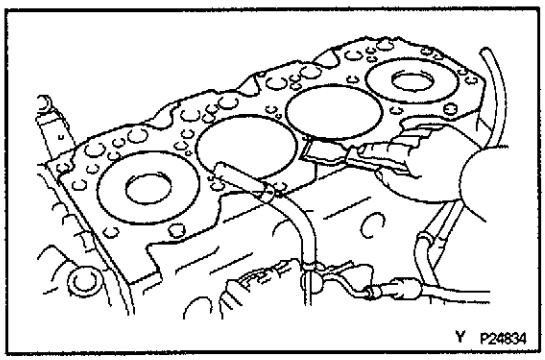
(c) Using needle—nose pliers, remove the oil seal.



CYLINDER HEAD COMPONENTS INSPECTION AND REPAIR

1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

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

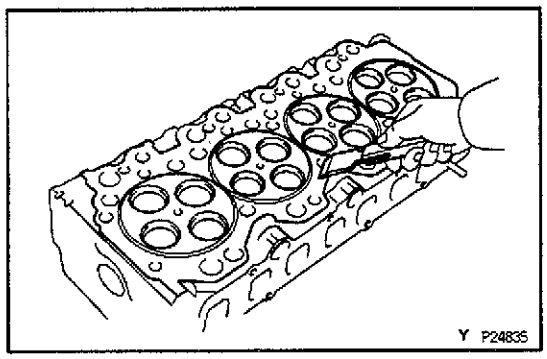


(b) Remove all the gasket material from the top of the cylinder block.

NOTICE: Be careful not to scratch the surfaces.

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

CAUTION: Protect your eyes when using high — compressed air.

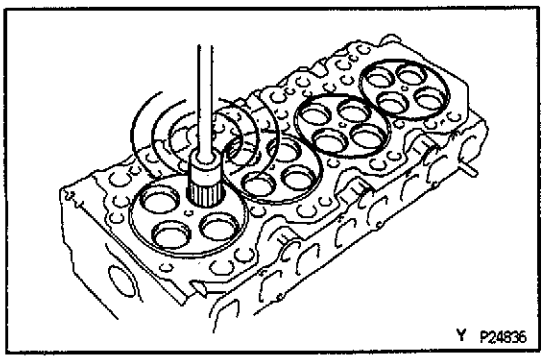


2. CLEAN CYLINDER HEAD

A. Remove gasket material

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

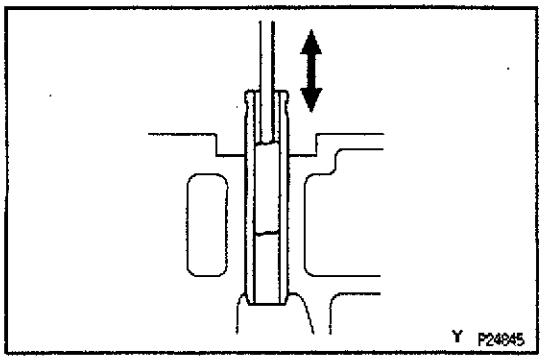
NOTICE: Be careful not to scratch the cylinder block contact surface.



B. Clean intake and exhaust ports

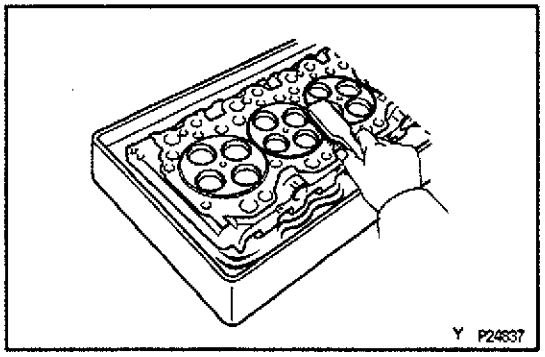
Using a wire brush, remove all the carbon from the intake and exhaust ports.

NOTICE: Be careful not to scratch the valve contact surface.



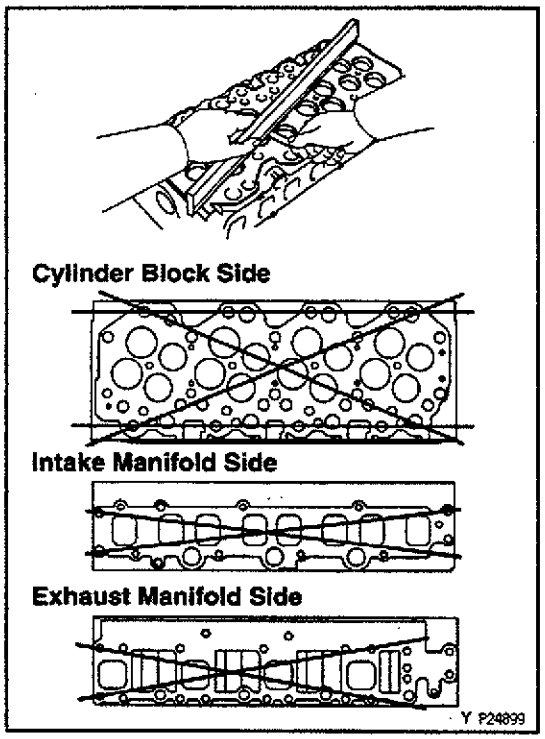
C. Clean valve guide bushings

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



D. Clean cylinder head

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



3. INSPECT CYLINDER HEAD

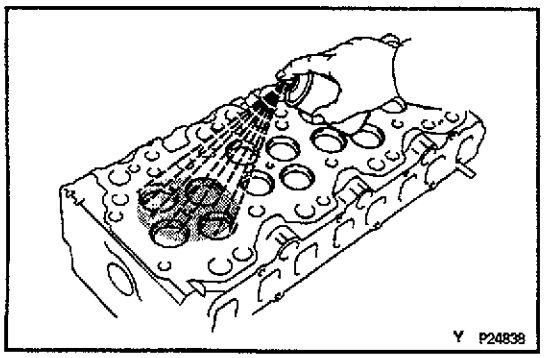
A. Inspect for flatness

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

Maximum warpage:

0.20 mm (0.0079 in.)

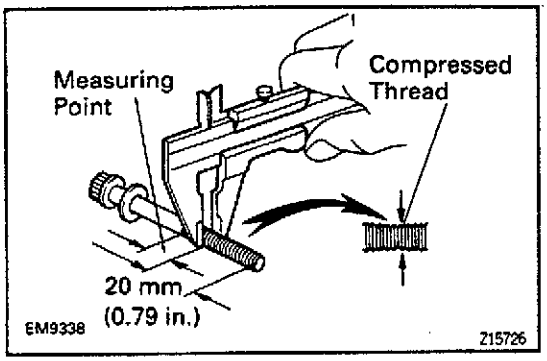
If warpage is greater than maximum, replace the cylinder head.



B. Inspect for cracks

Using a dye penetrant, check the intake ports, exhaust ports and surface contacting the cylinder block.

If cracked, replace the cylinder head.



EG

C. Inspect cylinder head bolts

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

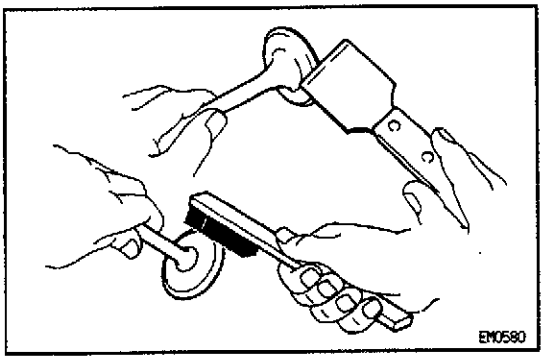
Standard outer diameter:

11.800 — 12.000 mm (0.4646 — 0.4724 in.)

Minimum outer diameter:

11.60 mm (0.4567 in.)

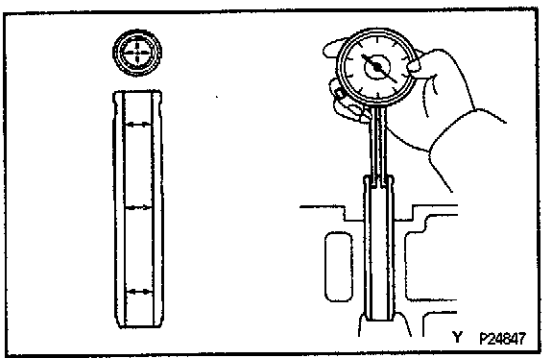
If the outer diameter is less than minimum, replace the bolt.



4. CLEAN VALVES

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

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

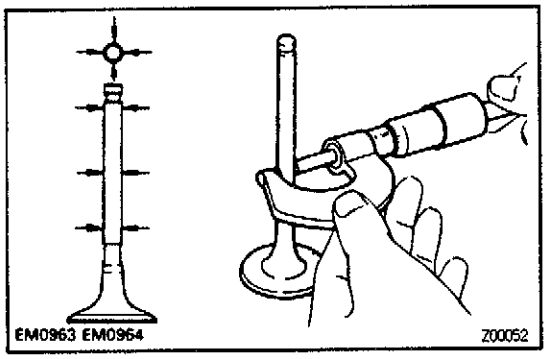


5. INSPECT VALVE STEMS AND GUIDE BUSHINGS

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

Bushing inside diameter:

7.010 — 7.030 mm (0.2760 — 0.2768 in.)



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

Valve stem diameter:

Intake

6.970 — 6.985 mm (0.2744 — 0.2750 in.)

Exhaust

6.955 — 6.970 mm (0.2738 — 0.2744 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

0.040 — 0.075 mm (0.0016 — 0.0030 in.)

Maximum oil clearance:

Intake

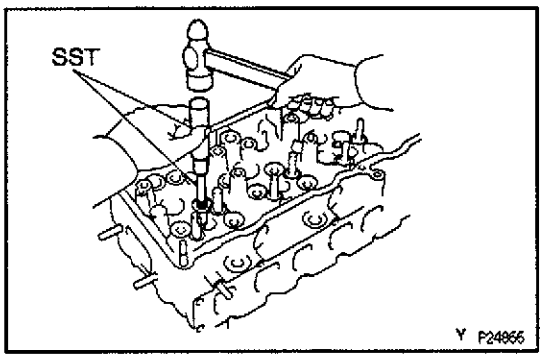
0.08 mm (0.0031 in.)

Exhaust

0.10 mm (0.0039 in.)

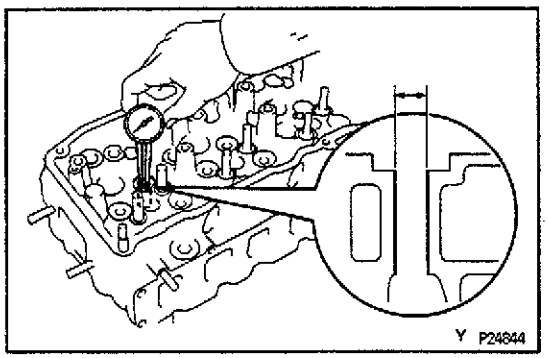
If the clearance is greater than maximum, replace the valve and guide bushing.

EG

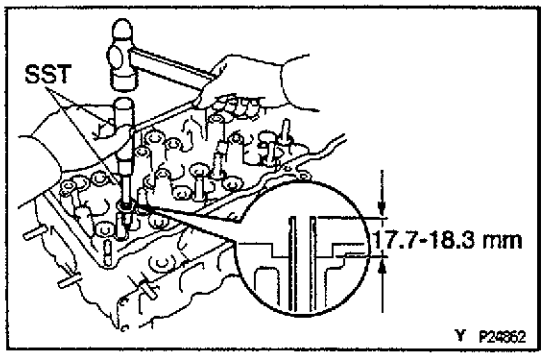


6. IF NECESSARY, REPLACE VALVE GUIDE BUSHING

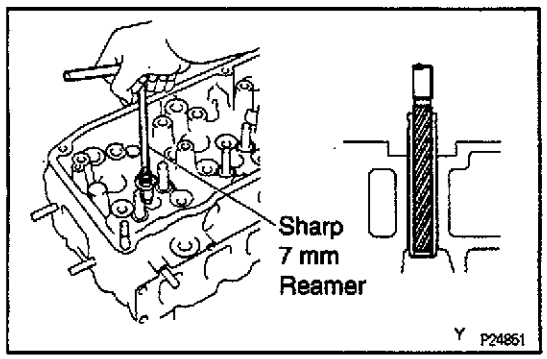
(a) Using SST and a hammer, tap out the valve guide bushing.
SST 09201 – 10000 (09201 – 01070),
09950 – 70010 (09951 – 07100)



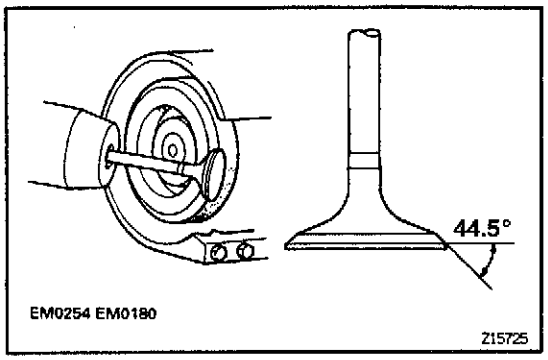
(b) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.
If the bushing bore diameter of cylinder head is more than 11.525 mm (0.4537 in.), replace the cylinder head.



(c) Using SST and a hammer, drive in a new valve guide bushing to where there is 17.7 – 18.3 mm (0.697 – 0.720 in.) protruding from the cylinder head.
SST 09201 – 10000 (09201 – 01070),
09950 – 70010 (09951 – 07100)



(d) Using a sharp 7.0 mm reamer, ream the valve guide bushing to obtain the standard specified clearance (See step 5 above) between the valve guide bushing and new valve stem.



EG

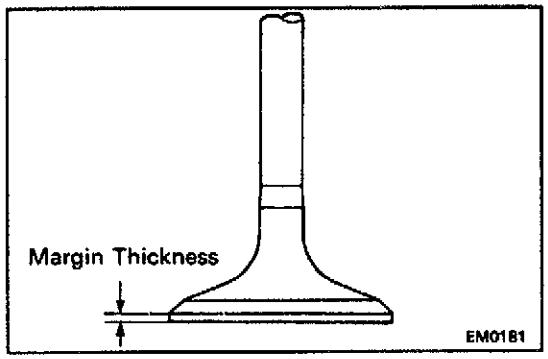
7. INSPECT AND GRIND VALVES

(a) Grind the valve only 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:

Intake

1.26 mm (0.0496 in.)

Exhaust

0.97 mm (0.0382 in.)

Minimum margin thickness:

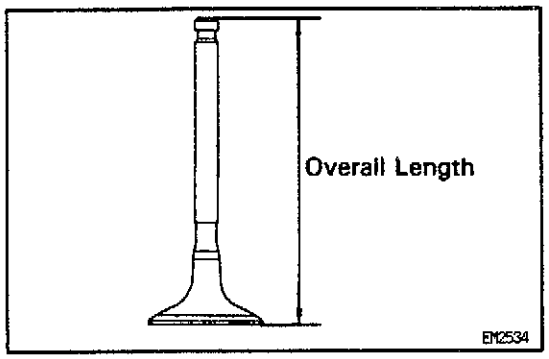
Intake

0.76 mm (0.0299 in.)

Exhaust

0.47 mm (0.0185 in.)

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



(d) Check the valve overall length.

Standard overall length:

Intake

126.30 – 126.70 mm (4.9724 – 4.9882 in.)

Exhaust

126.25 – 126.65 mm (4.9705 – 4.9862 in.)

Minimum overall length:

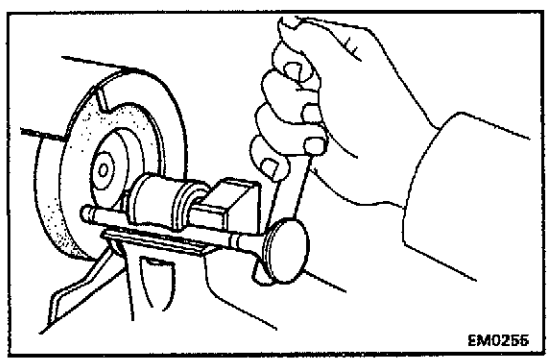
Intake

126.00 mm (4.9606 in.)

Exhaust

125.95 mm (4.9587 in.)

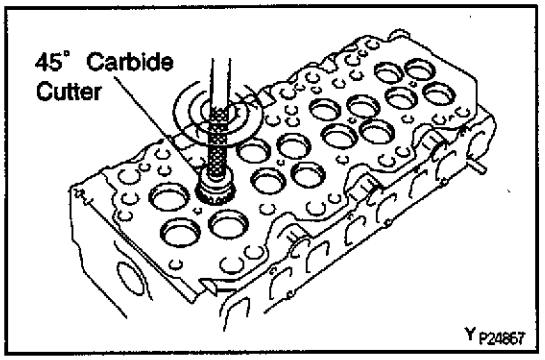
If the overall length is less than minimum, replace the valve.



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

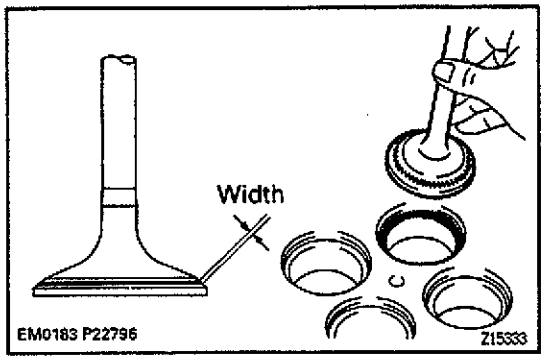
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

NOTICE: Do not grind off more than minimum.



8. 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:

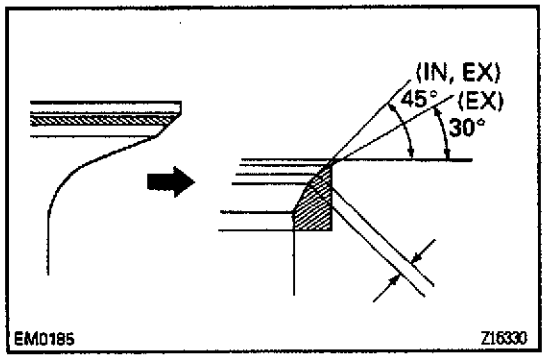
- If blue appears 360° around the valve face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is in the middle of the valve face with the following width:

Intake

1.3 – 1.9 mm (0.051 – 0.075 in.)

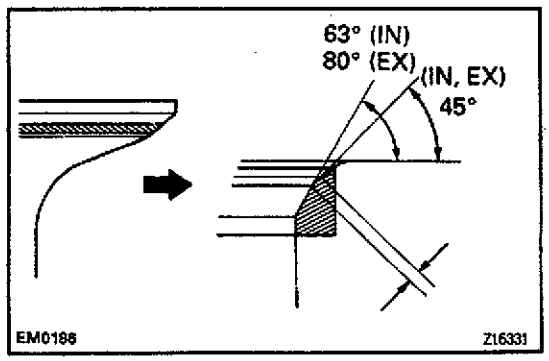
Exhaust

1.6 – 2.4 mm (0.063 – 0.094 in.)

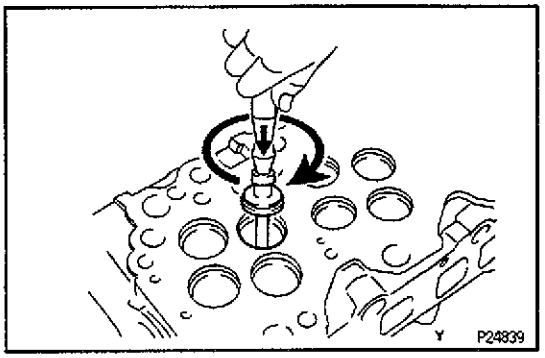


If not, correct the valve seats as follows:

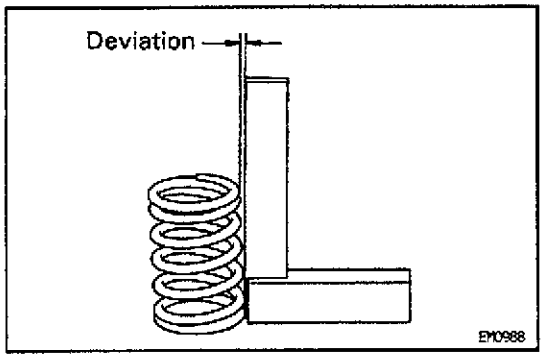
(1) If the seating is too high on the valve face, use 30° cutter (EX) and 45° cutter (IN, EX) to correct the seat.



(2) If the seating is too low on the valve face, use 63° (IN) or 80° (EX) cutter and 45° cutter (IN, EX) to correct the seat.

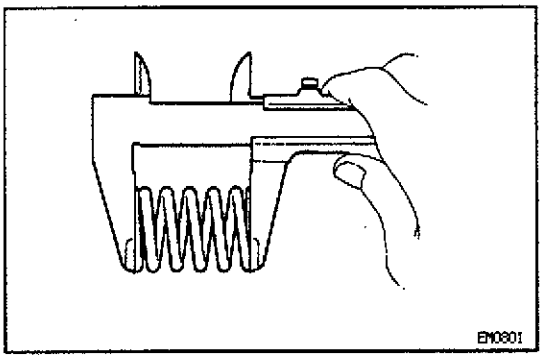


(d) Hand–lap the valve and valve seat with an abrasive compound.
(e) After hand–lapping, clean the valve and valve seat.

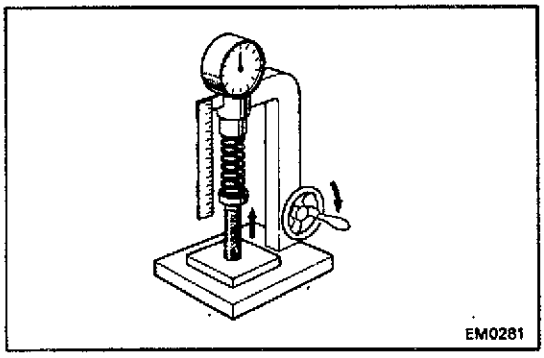


9. INSPECT VALVE SPRINGS

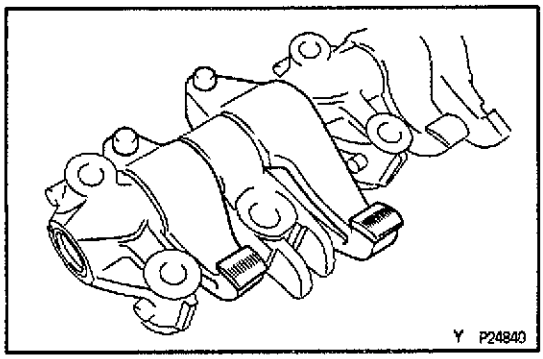
(a) Using a steel square, measure the deviation of the valve spring.
Maximum deviation:
2.0 mm (0.079 in.)
If the deviation is greater than maximum, replace the valve spring.



(b) Using vernier calipers, measure the free length of the valve spring.
Free length:
51.83 – 54.16 mm (2.0406 – 2.1323 in.)
If the free length is not as specified, replace the valve spring.

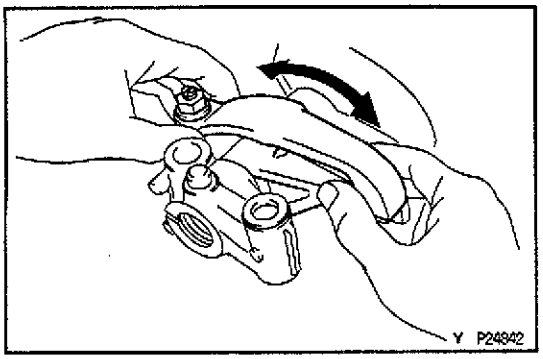


(c) Using a spring tester, measure the tension of the valve spring at the specified installed length.
Installed tension:
245 – 315 N (25.0 – 32.1 kgf, 55.1 – 70.8 lbf)
at 41.3 mm (1.626 in.)
If the installed tension is not as specified, replace the valve spring.

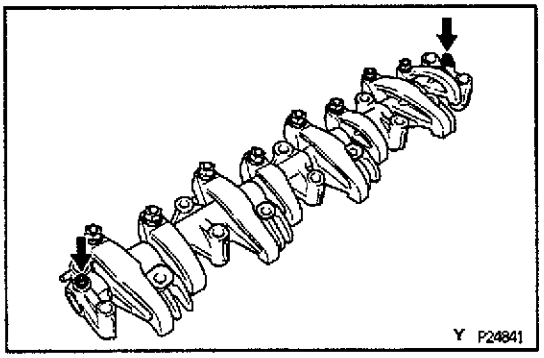


10. INSPECT VALVE ROCKER ARM AND SHAFT

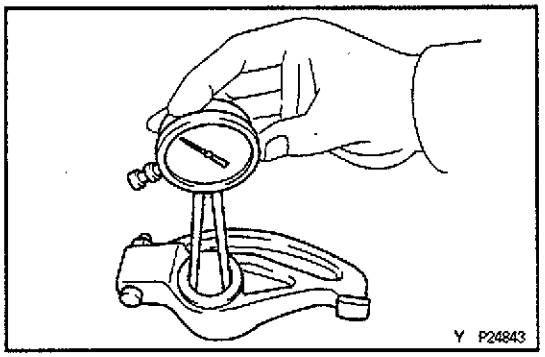
(a) Check the pad valve bridge contacting surface of the rocker arm for wear.
If the pad valve bridge contact surface is worn, disassemble and replace the rocker arm.



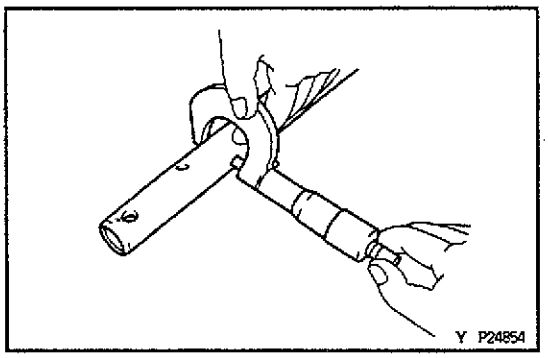
(b) Check that each rocker arm turns smoothly.
If movement is felt, disassemble and check the oil clearance.



(c) Using a 5 mm hexagon wrench, remove the 2 bolts and washers, and disassemble the parts.
HINT: Arrange the disassembled parts in correct order.



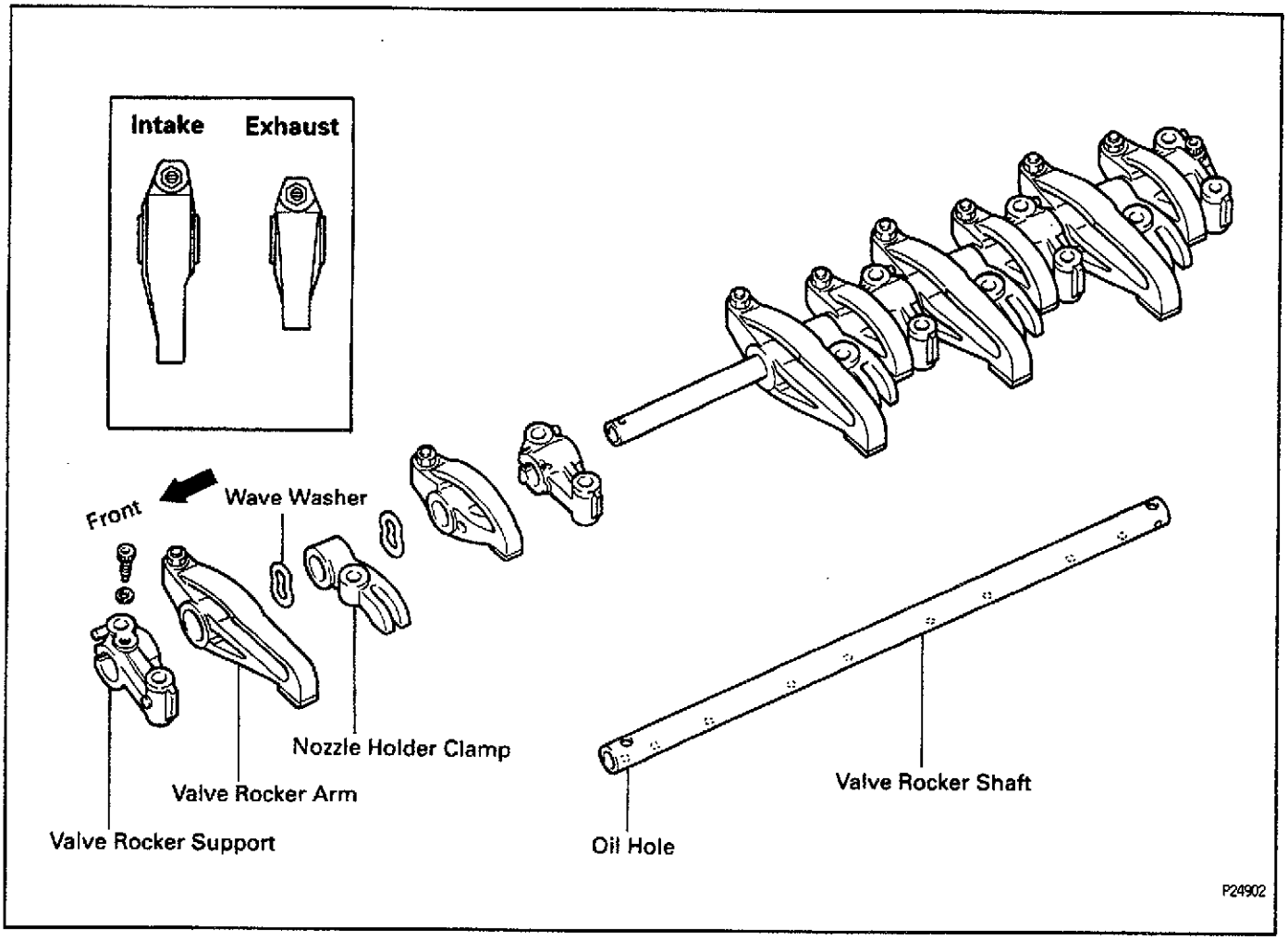
(d) Using a caliper gauge, measure the inside diameter of the rocker arm.
Rocker arm inside diameter:
18.512 – 18.533 mm (0.7288 – 0.7296 in.)

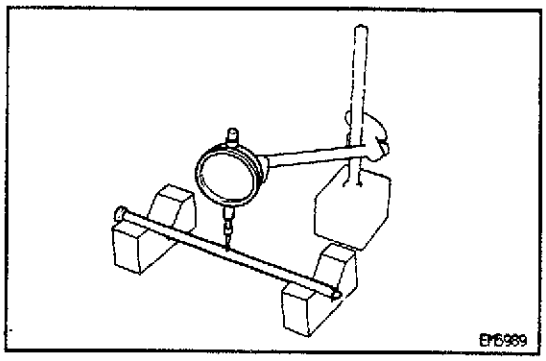


(e) Using a micrometer, measure the diameter of the rocker arm shaft.
Shaft diameter:
18.472 – 18.493 mm (0.7272 – 0.7281 in.)

(f) Subtract the rocker arm shaft measurement from the rocker arm measurement.
Standard oil clearance:
0.019 – 0.061 mm (0.0007 – 0.0024 in.)
Maximum oil clearance:
0.10 mm (0.0039 in.)
If the clearance is greater than maximum, replace the rocker shaft and shaft.

(g) Assemble the parts as shown in the illustration.





11. INSPECT PUSH RODS

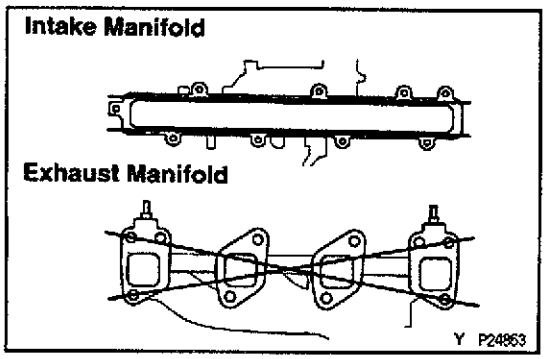
(a) Place the push rod on V–blocks.

(b) Using a dial indicator, measure the circle runout at the center of the push rod.

Maximum circle runout:

0.50 mm (0.0197 in.)

If the circle runout is greater than maximum, replace the push rod.



12. INSPECT INTAKE AND EXHAUST MANIFOLDS

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

Maximum warpage:

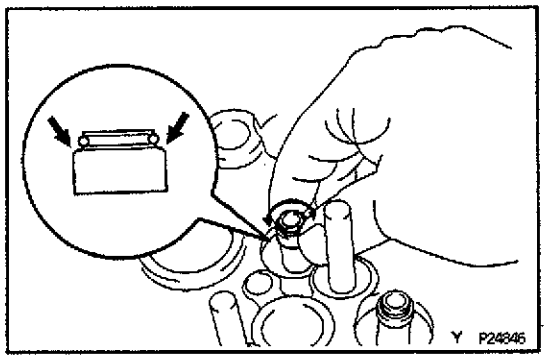
0.20 mm (0.0079 in.)

If warpage is greater than maximum, replace the manifold.

CYLINDER HEAD ASSEMBLY

HINT:

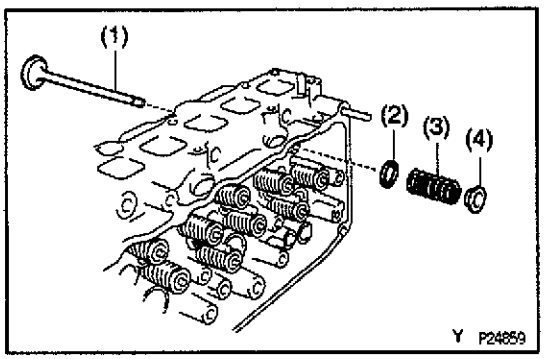
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new ones.



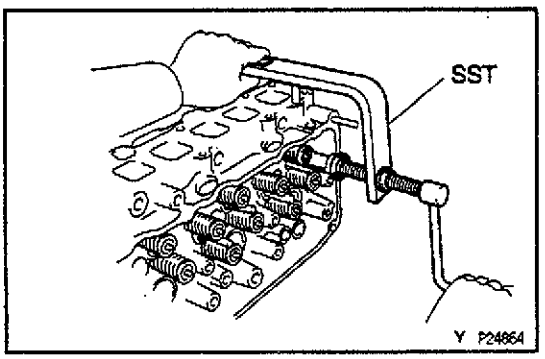
1. INSTALL VALVES

(a) Install new oil seals on the valve guide bushings.
HINT: Pushing down at the places shown in the illustration.

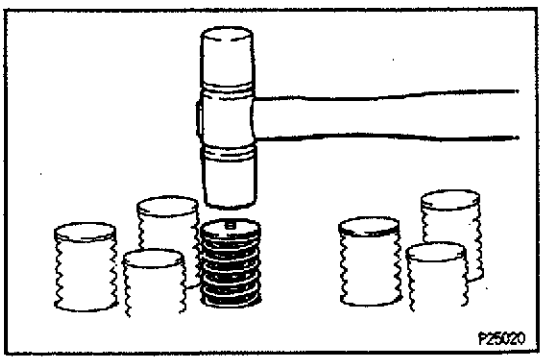
(b) Rotate the oil seal to check that it is firmly installed.



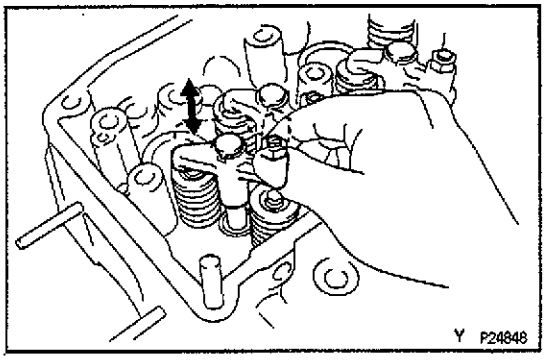
(c) Install these parts:
(1) Valve
(2) Spring seat
(3) Valve spring
(4) Spring retainer



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



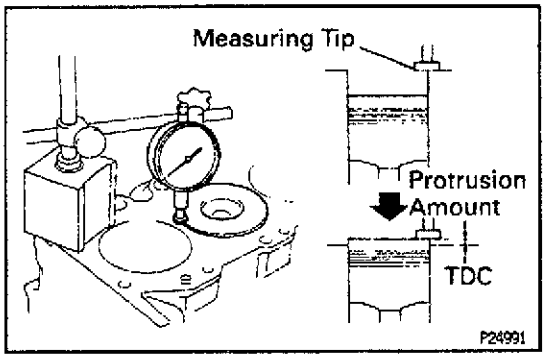
(e) Using a plastic—faced hammer, lightly tap the valve stem tip to assure a proper fit.



EG

2. INSTALL VALVE BRIDGES AND PAD

(a) Install the valve bridge and pad.
(b) Check that the valve bridge rotates smoothly.

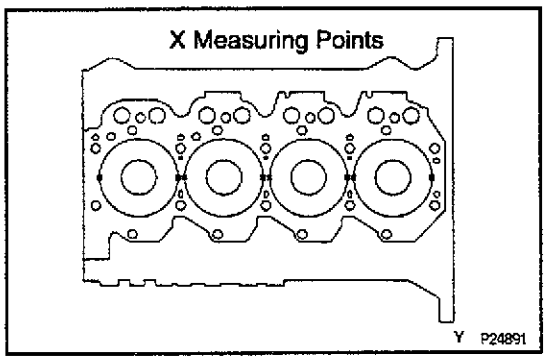


CYLINDER HEAD INSTALLATION

1. CHECK PISTON PROTRUSION AND SELECT CYLINDER HEAD GASKET

A. Check piston protrusions for each cylinder

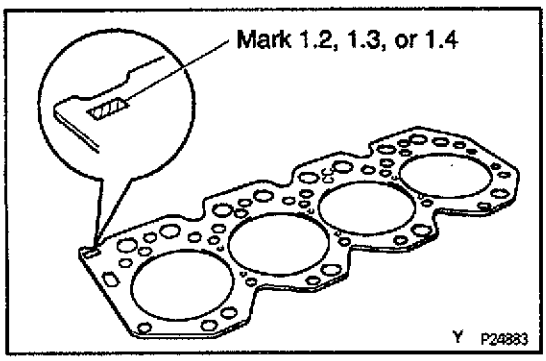
(a) Clean the cylinder block with solvent.
(b) Set the piston of the cylinder to be measured to slightly before TDC.
(c) Place a dial indicator on the cylinder block, and set the dial indicator at 0 mm (0 in.).
HINT:
- Use a dial indicator measuring tip as shown in the illustration.
- Make sure that the measuring tip is square to the cylinder block gasket surface and piston head when taking the measurements.



(d) Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.
(e) Measure each cylinder at 2 places as shown in the illustration, making a total of 8 measurements.
(f) For the piston protrusion value of each cylinder, use the average of the 2 measurements of each cylinder.
Protrusion:
0.255 – 0.705 mm (0.0100 – 0.0278 in.)
When removing piston and connecting rod assembly:
If the protrusion is not as specified, remove the piston and connecting rod assembly and reinstall it.
(See cylinder block disassembly and assembly)

B. Select new cylinder head gasket

HINT: There are 3 sizes of new cylinder head gaskets, marked "1.2", "1.3" or "1.4" accordingly.
New installed cylinder head gasket thickness:

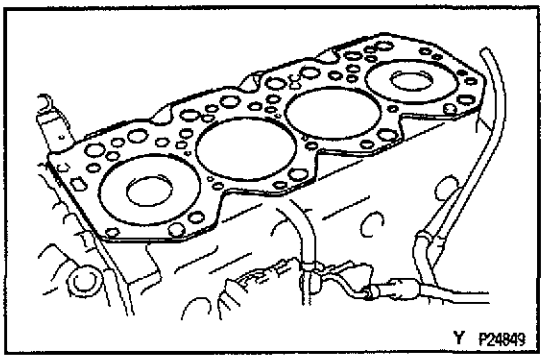


Mark "1.2"	1.17 – 1.23 mm (0.0461 – 0.0484 in.)
Mark "1.3"	1.27 – 1.33 mm (0.0500 – 0.0524 in.)
Mark "1.4"	1.37 – 1.43 mm (0.0539 – 0.0563 in.)

Select the largest piston protrusion value from the measurements made, then select a new appropriate gasket according to the table below.

Piston protrusion mm (in.)	Gasket size
0.255 – 0.505 (0.0100 – 0.0199)	Use "1.2"
0.505 – 0.605 (0.0199 – 0.0238)	Use "1.3"
0.605 – 0.705 (0.0238 – 0.0278)	Use "1.4"

EG



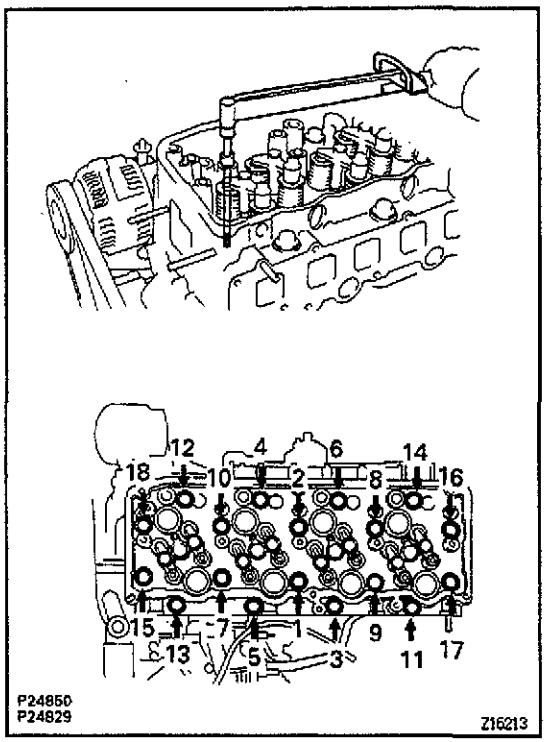
2. INSTALL CYLINDER HEAD

A. Place cylinder head on cylinder block

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

NOTICE: Be careful of the installation direction.

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



B. Install cylinder head bolts

HINT:

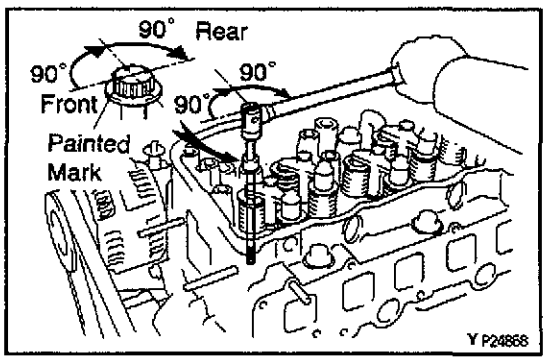
- The cylinder head bolts are tightened in 3 progressive steps (steps (b), (d) and (e)).
- If any bolts is broken or deformed, replace it.

(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 18 cylinder head bolts, in several passes, in the sequence shown.

Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

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

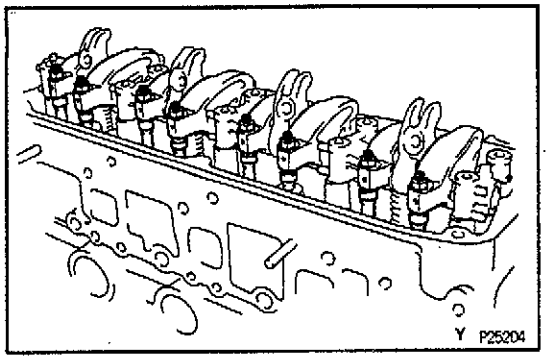


(c) Mark the front of the cylinder head bolt with paint.

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

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

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

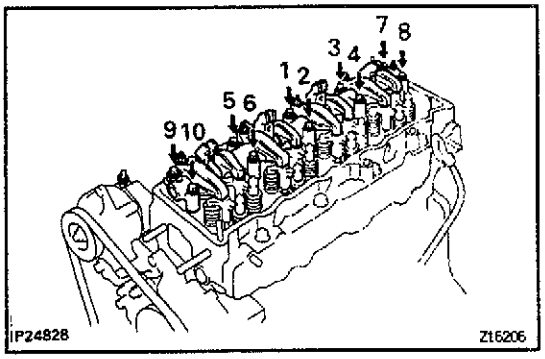


3. INSTALL PUSH RODS

4. INSTALL VALVE ROCKER SHAFT ASSEMBLY

(a) Place the rocker shaft assembly on the cylinder head.

(b) Align the rocker arm adjusting screws with the heads of the push rods.

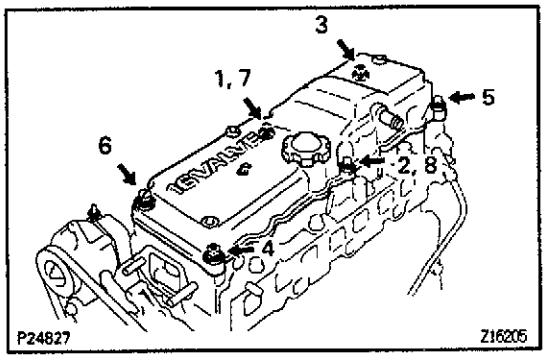


(c) Install and uniformly tighten the 10 bolts, in several passes, in the sequence shown.
Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)

5. INSTALL INJECTION NOZZLES
(See steps 1, 2 and 4 in injection nozzles installation in Fuel System)

6. ADJUST VALVE CLEARANCE
(See step 5 in valve clearance inspection and adjustment)
Reference
Valve clearance (Cold):

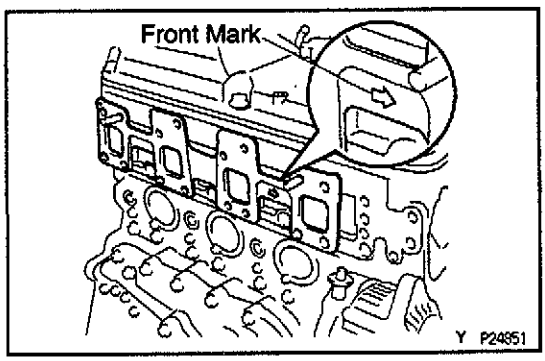
Intake	**0.25 mm (0.010 in.)**
Exhaust	**0.40 mm (0.016 in.)**



7. INSTALL CYLINDER HEAD COVER

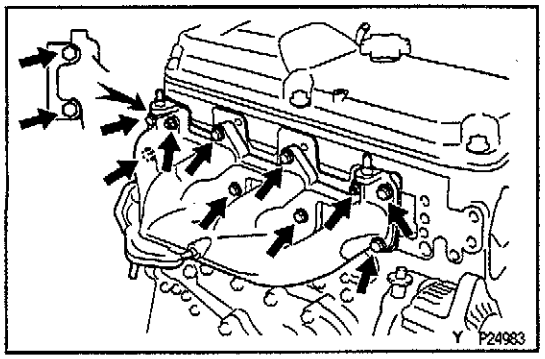
(a) Install the gasket to the cylinder head cover.

(b) Install and uniformly tighten the cylinder head cover with the 6 cushions, 4 bolts and 2 nuts, in several passes, in the sequence shown.
Torque: 10.5 N·m (107 kgf·cm, 8 ft·lbf)

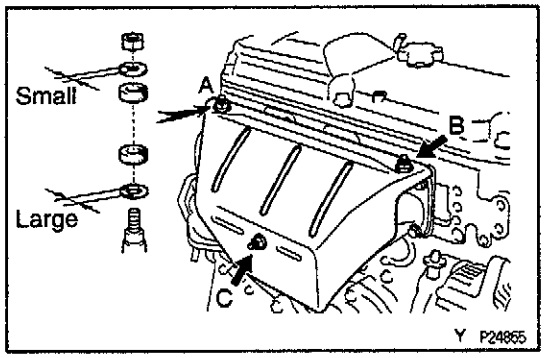


8. 15B—F:
INSTALL EXHAUST MANIFOLD

(a) Install a new gasket to the cylinder head as shown.
NOTICE: Be careful of the installation direction.



(b) Install the exhaust manifold and No.2 heat insulator with the 8 bolts and new 2 nuts. Uniformly tighten the bolts and nuts in several passes.
Torque: 47.5 N·m (484 kgf·cm, 35 ft·lbf)



(c) Install the 3 plate washers and 3 spacers to the stud bolts on the exhaust manifold.
HINT: Install the plate washers with large inside diameter.

(d) Install the heat insulator with the 3 spacers, 3 plate washers and 3 nuts.
HINT: Install the plate washers with small inside diameter.

(e) Install and tighten the 3 nuts with these order.
First, temporarily tighten nuts A and B. Then fully tighten nuts C, A and B.
Torque: 18.5 N·m (189 kgf·cm, 14 ft·lbf)

9. INSTALL WATER OUTLET ASSEMBLY

(a) Install a new gasket to the intake manifold.

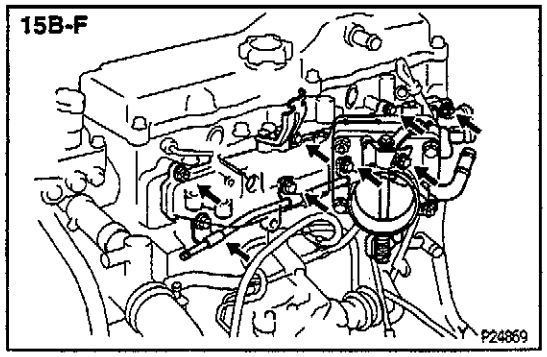
(b) Connect the water bypass hose to the water pump.

(c) Install the water outlet assembly with the 2 nuts.
Torque: 18.5 N·m (189 kgf·cm, 14 ft·lbf)

10. INSTALL DRIVE BELT ADJUSTING BAR
Torque: 44 N·m (449 kgf·cm, 32 ft·lbf)

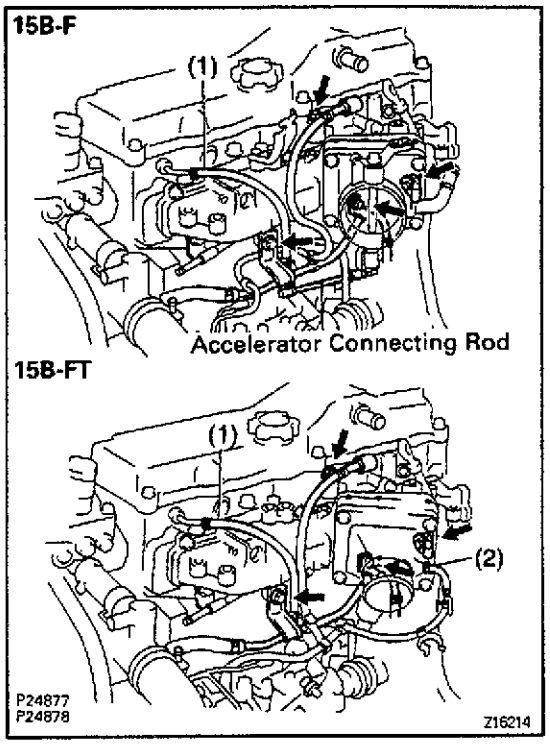
11. 15B—FT:
INSTALL TURBOCHARGER AND EXHAUST MANIFOLD ASSEMBLY
(See steps 5 to 9 in turbocharger installation in Turbocharger System)

12. ADJUST DRIVE BELT(S)
Torque:
Adjusting bolt
18.5 N·m (189 kgf·cm, 14 ft·lbf)
Pivot bolt
37.5 N·m (382 kgf·cm, 28 ft·lbf)



13. INSTALL INTAKE MANIFOLD ASSEMBLY

(a) Install a new gasket, the intake manifold assembly and PS return pipe (15B—F) with the 6 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.
Torque: 18.5 N·m (189 kgf·cm, 14 ft·lbf)



(b) Install these holding bolts:
- Hose clamp to cylinder head
- Water bypass pipe to intake manifold
- Oil dipstick guide support to intake manifold

(c) Connect these parts:
(1) Fuel hose to nozzle leakage pipe
(2) 15B—FT:
Vacuum hose to intake air connector

14. 15B—F:
INSTALL ACCELERATOR CONNECTING ROD

15. INSTALL INJECTION PIPES
(See step 3 in injection nozzles installation in Fuel System)

16. 15B—F:
INSTALL PCV HOSE

17. FILL WITH ENGINE COOLANT

18. START ENGINE AND CHECK FOR LEAKS

19. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL

20. READJUST VALVE CLEARANCE
(See valve clearance inspection and adjustment)

21. READJUST DRIVE BELT
(See step 3 in on—vehicle inspection in Charging System)