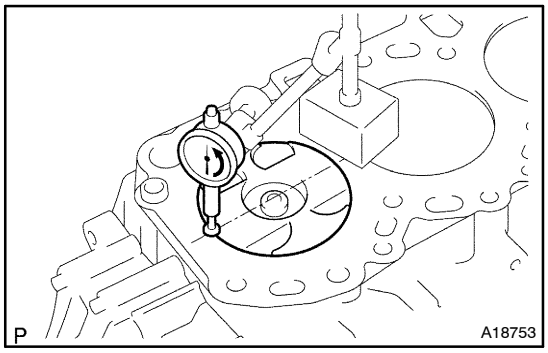
EM1MG–02

INSTALLATION

NOTICE:

When installing, clean up the seal surface of the injector, injection pipe, fuel inlet pipe, supply pump and common rail with clean light oil.



1. CHECK PISTON PROTRUSION AND SELECT CYLINDER HEAD GASKET

(a) Check the piston protrusions for each cylinder.

(1) Clean the cylinder block with solvent.

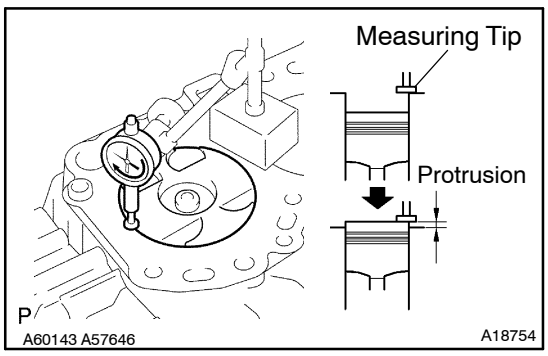
(2) Set the piston of the cylinder to be measured to slightly before TDC.

(3) Place a dial indicator on the cylinder block, set the measuring tip as shown in the illustration.

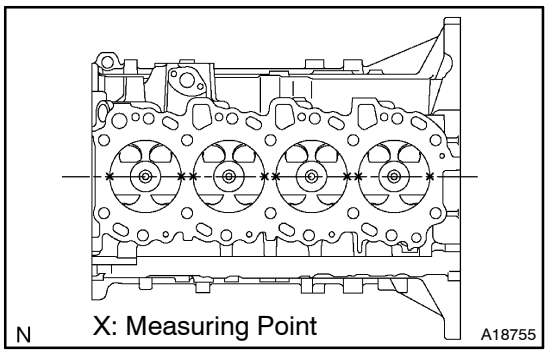
(4) Set the dial indicator at 0 mm (0 in.).

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.



(5) Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.



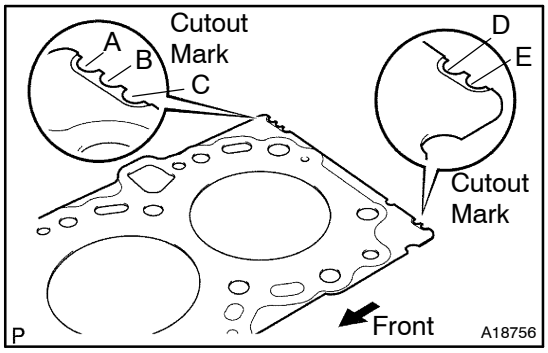
(6) Measure each cylinder at 2 places as shown in the illustration, making a total of 8 measurements.

(7) For the piston protrusion value of each cylinder, use the average of the 2 measurements of each cylinder.

Piston protrusion:

0.005 – 0.254 mm (0.0002 – 0.0100 in.)

HINT:
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 pages EM–66 and EM–82).



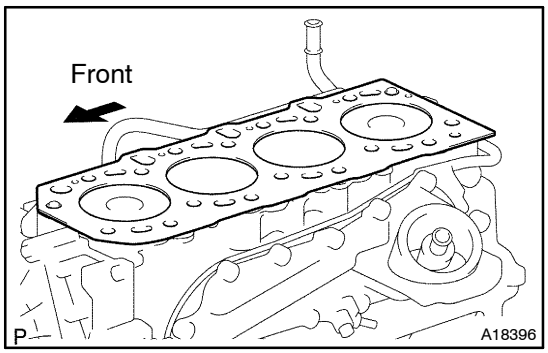
(b) Select a new cylinder head gasket.
HINT:
There are 5 sizes of new cylinder head gaskets, marked A, B, C, D or E accordingly.

New installed cylinder head gasket thickness:

A	0.80 – 0.90 mm (0.0315 – 0.0354 in.)
B	0.85 – 0.95 mm (0.0335 – 0.0374 in.)
C	0.90 – 1.00 mm (0.0354 – 0.0394 in.)
D	0.95 – 1.05 mm (0.0374 – 0.0413 in.)
E	1.00 – 1.10 mm (0.0394 – 0.0433 in.)

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

Piston protrusion	Gasket size
0.005 – 0.054 mm (0.0002 – 0.0021 in.)	Use A
0.055 – 0.104 mm (0.0022 – 0.0041 in.)	Use B
0.105 – 0.154 mm (0.0041 – 0.0061 in.)	Use C
0.155 – 0.204 mm (0.0061 – 0.0080 in.)	Use D
0.205 – 0.255 mm (0.0081 – 0.0100 in.)	Use E

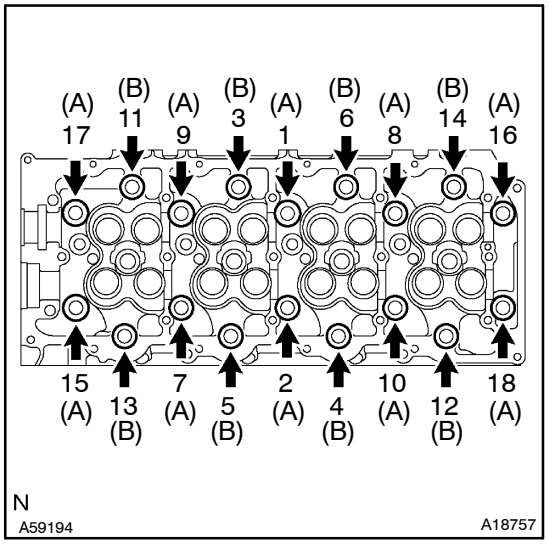


2. INSTALL CYLINDER HEAD

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

NOTICE:
Be careful of the installation direction.

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



(b) Install the cylinder head bolts.

HINT:

- The cylinder head bolts are tightened in 3 progressive steps (steps (2), (4) and (5)).
- If any bolts is broken or deformed, replace it.

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

(2) Install and uniformly tighten the 18 cylinder head bolts, in several passes, in the sequence shown.

Torque: 85 N·m (867 kgf·cm, 63 ft·lbf)

HINT:

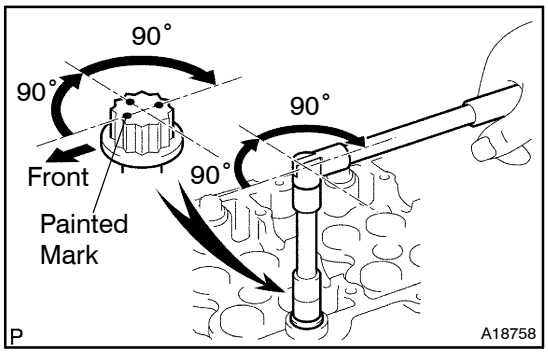
Each bolt length is indicated in the illustration.

Bolt length:

110 mm (4.33 in.) for A

167 mm (6.57 in.) for B

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

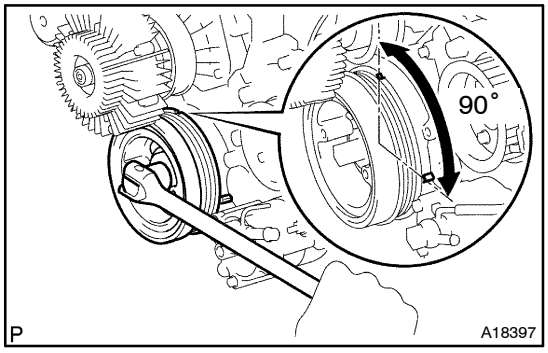


(3) Mark the front of the cylinder head bolt with paint.

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

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

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

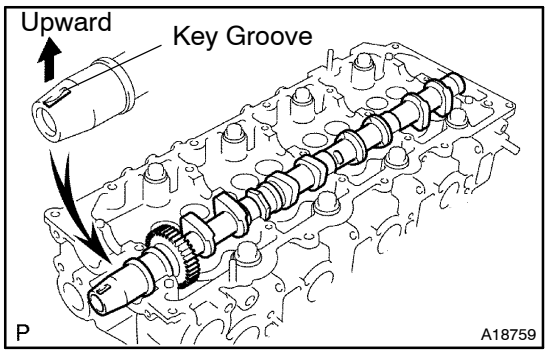


3. INSTALL CAMSHAFTS

(a) Turn the crankshaft pulley, and set the No. 1 cylinder to 90° BTDC/compression.

HINT:

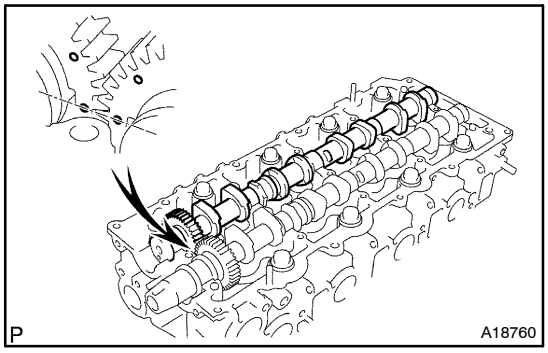
Set the No. 1 cylinder to 90° BTDC/compression to avoid interference with the piston top and valve head.



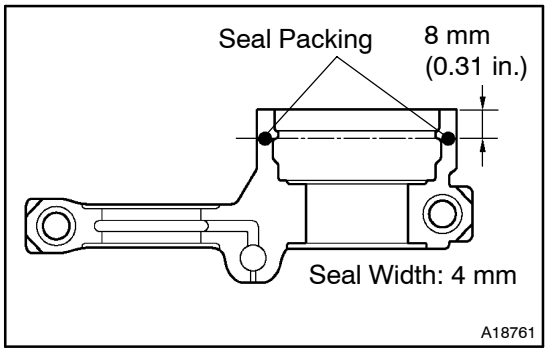
(b) Install the 2 camshafts.

(1) Apply MP grease to the thrust portion of the camshafts.

(2) Place the intake camshaft on the cylinder head, facing the key groove upward.



(3) Align the timing marks (1 dot mark) of the camshaft drive and driven main gears, and place the exhaust camshaft.



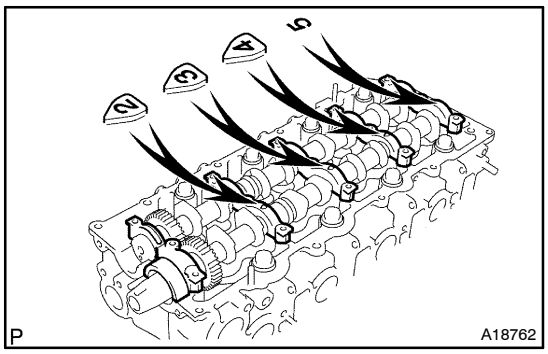
(4) Apply seal packing to the No. 1 bearing cap.

- Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the bearing cap and cylinder head.
  Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and groove.
  Thoroughly clean all components to remove all the loose material.
  Using a non–residue solvent, clean both sealing surfaces.
- Apply seal packing to the bearing cap as shown in the illustration.
  Install a nozzle that has been cut to a 4 mm (0.16 in.) opening.
  Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
  Immediately remove nozzle from the tube and reinstall cap.

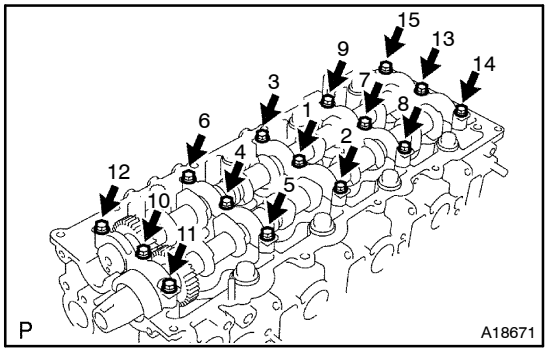
Seal packing: Part No. 08826–00080 or equivalent

NOTICE:

Do not apply seal packing to the front bearing cap grooves.



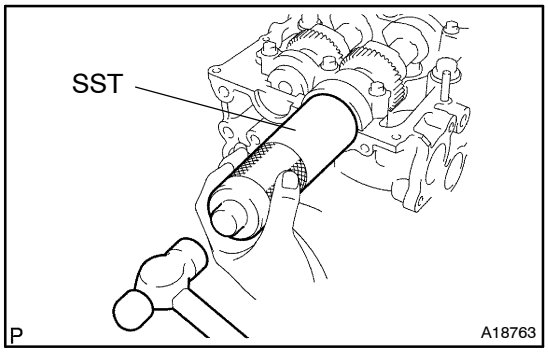
(5) Install the 5 bearing caps in their proper locations.



(6) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.

(7) Install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown.

Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)



(c) Install the camshaft oil seal.

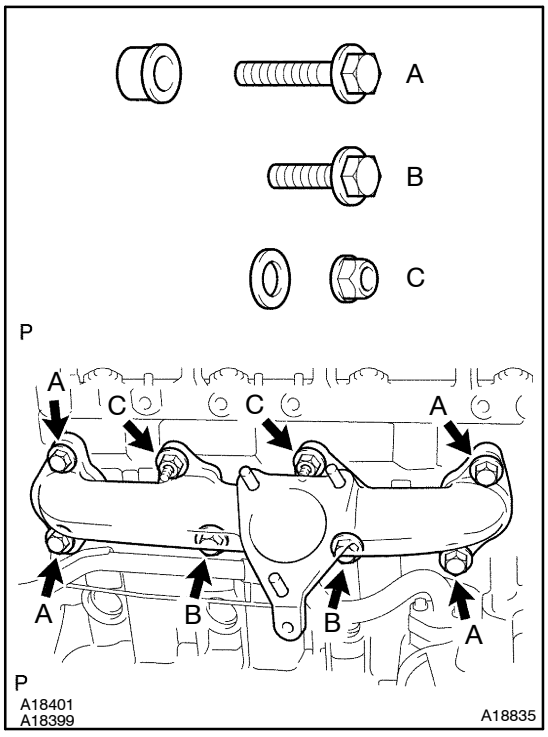
(1) Apply MP grease to a new oil seal lip.

(2) Using SST and a hammer, tap in the oil seal until its surface is flush with the oil seal retainer edge.

SST 09608–06041

4. CHECK AND ADJUST VALVE CLEARANCE (See page EM–6)

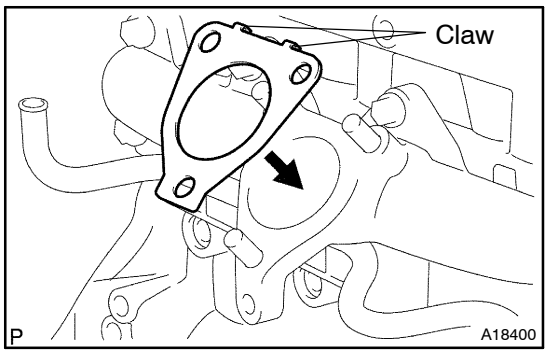
5. INSTALL INJECTORS (See page FU–8)



6. INSTALL EXHAUST MANIFOLD

Install a new gasket and the exhaust manifold with the 4 collars, 2 plate washers, 6 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)



7. INSTALL TURBOCHARGER ASSEMBLY

(a) Install a new gasket to the exhaust manifold.
Face the claws of a new gasket facing the exhaust manifold side.

(b) Temporarily install the turbocharger assembly with 3 new nuts and the 2 bolts.

(c) Temporarily install the turbo oil pipe with 2 new gaskets, union bolt and 2 bolts.

(d) Tighten the 3 nuts holding the turbocharger to the exhaust manifold.

Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

(e) Tighten the 2 bolts holding the turbocharger stay to the cylinder block.

Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)

(f) Tighten the 2 bolts holding the turbo oil pipe to the cylinder block.

Torque: 12 N·m (122 kgf·cm, 9 ft·lbf)

(g) Tighten the union bolt holding the turbo oil pipe to the cylinder block.

Torque: 26 N·m (265 kgf·cm, 19 ft·lbf)

8. INSTALL EXHAUST MANIFOLD STAY

Install the exhaust manifold stay with the 2 bolts.

Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)

9. INSTALL NO. 1 WATER BYPASS PIPE

Install the bypass pipe with the 2 bolts.

Torque: 18 N·m (184 kgf·cm, 13 ft·lbf)

10. INSTALL NO. 1 ENGINE HANGER

Install the engine hanger with the bolt.

Torque: 47 N·m (479 kgf·cm, 35 ft·lbf)

11. INSTALL WATER OUTLET

(a) Install a new gasket to the water outlet.

(b) Install the water outlet with the 2 bolts.

Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)

12. INSTALL GLOW PLUGS

(a) Install the 4 glow plugs.

Torque: 13 N·m (133 kgf·cm, 10 ft·lbf)

(b) Install the glow plug connector with the 4 nuts.

Torque: 2.2 N·m (22 kgf·cm, 20 in.·lbf)

(c) Install the 4 screw grommets.

13. INSTALL INTAKE MANIFOLD

Install a new gasket and the intake manifold with the 4 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque: 29 N·m (296 kgf·cm, 21 ft·lbf)

14. INSTALL COMMON RAIL

Install the common rail with the 3 bolts. Uniformly tighten the bolts in several passes.

Torque: 38 N·m (387 kgf·cm, 28 ft·lbf)

15. INSTALL NO. 2 NOZZLE LEAKAGE PIPE

Install the leakage pipe with 3 new gaskets, the check valve, 2 union bolts and bolt.

Torque:
21 N·m (214 kgf·cm, 15 ft·lbf) for check valve
12.7 N·m (130 kgf·cm, 9 ft·lbf) for union bolt

16. INSTALL FUEL INLET PIPE (See page FU–17)

17. INSTALL E–VRV

(a) Install the E–VRV with the 2 bolts.

(b) Connect the vacuum hose to the No. 2 vacuum transmitting pipe.

18. INSTALL EGR CONTROL VALVE

(a) Install a new gasket and the control valve.

(b) Connect the vacuum hose to the E–VRV.

19. INSTALL EGR PIPE

Install 2 new gaskets EGR pipe with the 2 bolts and 2 nuts.

Torque: 13 N·m (133 kgf·cm, 10 ft·lbf)

20. INSTALL OIL DIPSTICK GUIDE AND DIPSTICK

(a) Install a new O–ring to the dipstick guide.

(b) Apply soapy water to the O–ring.

(c) Push in the dipstick guide end into the guide hole of the cylinder block.

(d) Install the dipstick guide with the bolt.

(e) Install the dipstick.

21. INSTALL INTAKE MANIFOLD STAY

Install the intake manifold stay with the 2 bolts.

Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)

22. INSTALL OIL FILTER (See page LU–2)

23. INSTALL NO. 2 TIMING BELT COVER (See page EM–30)

24. INSTALL PULLEYS AND TIMING BELT (See page EM–18)

25. FILL WITH ENGINE COOLANT

26. START ENGINE AND CHECK FOR LEAKS

27. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL