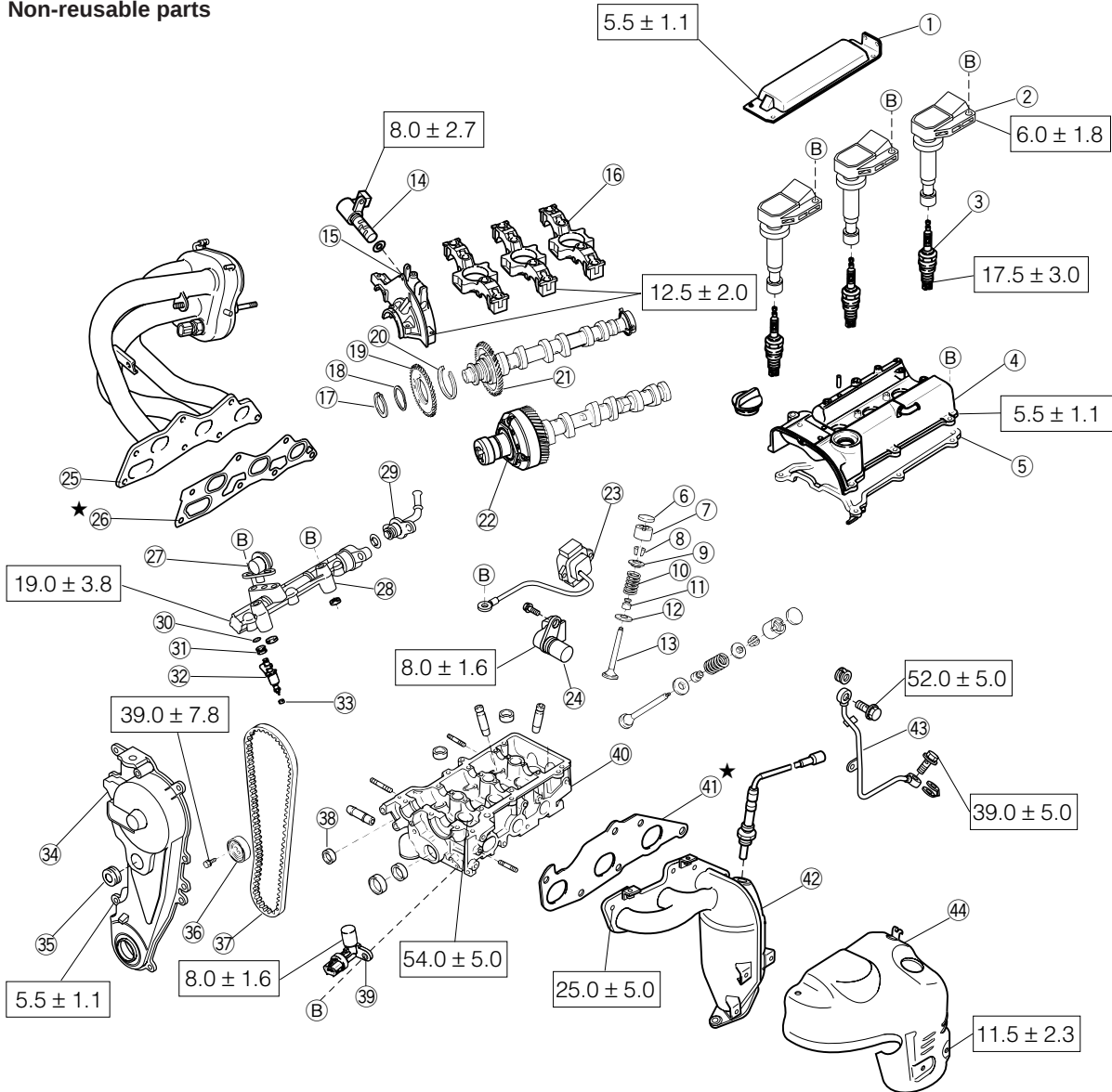


ENGINE MECHANICAL (EJ-VE)

CYLINDER HEAD	EM- 2
COMPONENTS	EM- 2
REMOVAL	EM- 3
DISASSEMBLY	EM- 7
INSPECTION	EM- 9
ASSEMBLY	EM-18
INSTALLATION	EM-19
SERVICE SPECIFICATIONS	EM-28
SSTs	EM-31
TIGHTENING TORQUE	EM-32

CYLINDER HEAD COMPONENTS

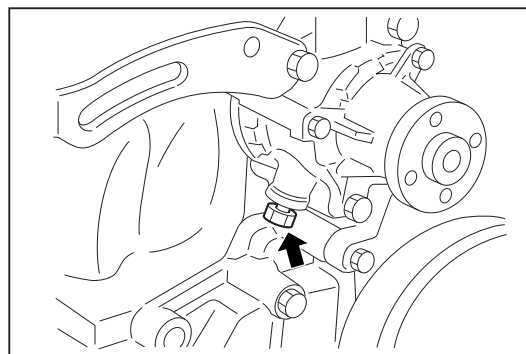
 : Tightening torque
 Unit : N·m
 ★ : Non-reusable parts



- | | | |
|------------------------------|-------------------------------|------------------------------------|
| ① Ignition coil cover | ①⑥ Camshaft bearing cap No. 2 | ③① Grommet |
| ② Ignition coil | ①⑦ Snap ring | ③② Injector |
| ③ Spark plug | ①⑧ Wave washer | ③③ Vibration insulator |
| ④ Cylinder head cover | ①⑨ Camshaft sub-gear | ③④ Timing belt cover |
| ⑤ Cylinder head cover gasket | ①⑩ Camshaft gear spring | ③⑤ Grommet |
| ⑥ Adjusting shim | ①⑪ Camshaft No. 1 | ③⑥ Timing belt tensioner |
| ⑦ Valve lifter | ①⑫ Camshaft No. 2 | ③⑦ Timing belt |
| ⑧ Valve spring retainer lock | ①⑬ Igniter unit | ③⑧ Plug |
| ⑨ Valve spring retainer | ①⑭ Cam angle sensor | ③⑨ Cam/crank angle sensor |
| ⑩ Valve spring | ①⑮ Intake manifold | ④① Cylinder head |
| ⑪ Valve stem oil seal | ①⑯ Intake manifold gasket | ④② Exhaust manifold gasket |
| ⑫ Valve seat | ①⑰ Pulsation damper | ④③ Exhaust manifold |
| ⑬ Valve | ①⑱ Fuel delivery pipe | ④④ Oil tube |
| ⑭ Oil control valve | ①⑲ Fuel inlet tube | ④⑤ Exhaust manifold heat insulator |
| ⑮ Camshaft bearing cap No. 1 | ①⑳ O-ring | |

REMOVAL

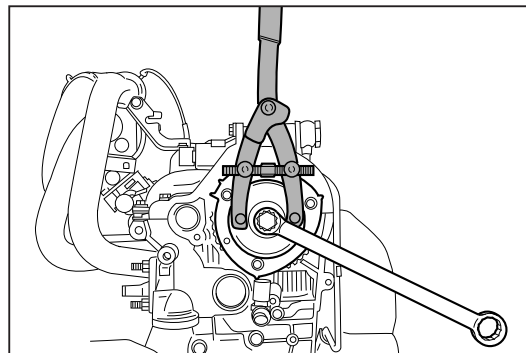
1. Remove the V-belt, water pump pulley and alternator.
(Refer to the "TIMING BELT" section.)
2. Drain the engine coolant by removing the water pump drain plug.



MEM00003-00002

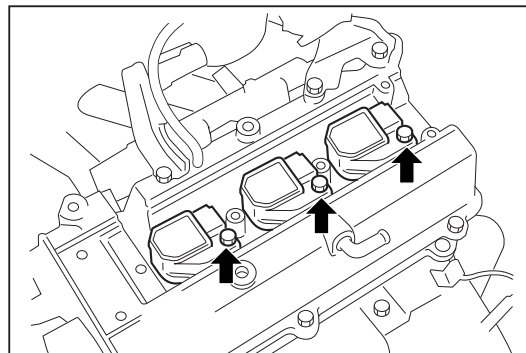
3. Remove the timing belt.
(Refer to the "TIMING BELT" section.)
4. Remove the camshaft timing belt pulley, using the SST to prevent the turning of the camshaft.

SST: 09504-87501-000



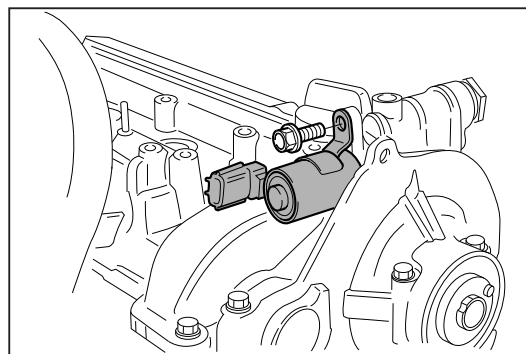
MEM00004-00003

5. Remove the ignition coil from the cylinder head cover.



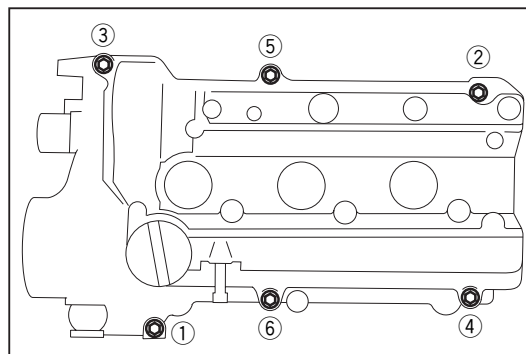
MEM00005-00004

6. Remove the oil control valve from the camshaft bearing cap No. 1.



MEM00006-00005

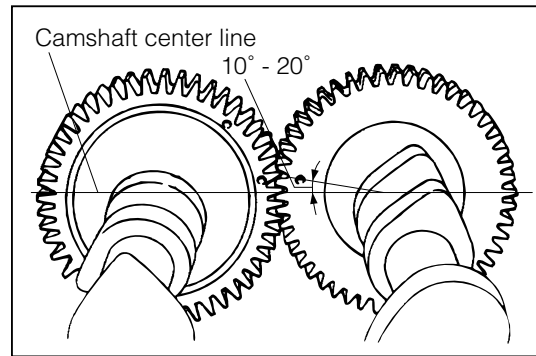
7. Disconnect the vacuum hoses that are connected to the intake manifold and cylinder head cover.
8. Remove the surge tank stay from the cylinder head cover.
9. Remove the cylinder head cover attaching bolts in the sequence as indicated in the right figure. Remove the cylinder head cover from the cylinder head.



MEM00007-00006

10. Removal of camshaft bearing cap No. 1 and camshaft bearing cap No. 2.

(1) Using the hexagonal section of the camshaft No. 2, set the mating marks of the camshaft gear sections to the relationship as indicated in the right figure.

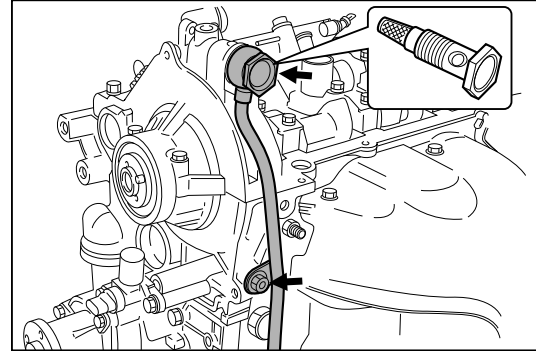


MEM00008-00007

(2) Loosen the oil pipe union bolt at the oil filter bracket side.

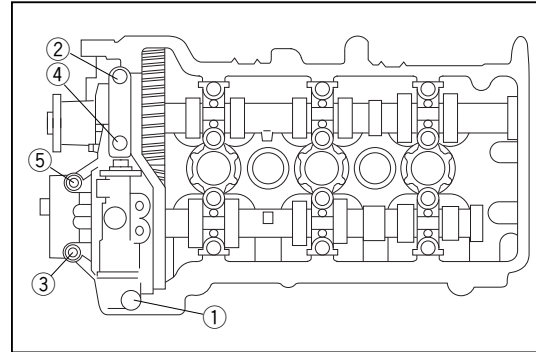
(3) Remove the oil pipe cramp bolt from the cylinder head.

(4) Remove the oil pipe union bolt with oil filter from the camshaft bearing cap No. 1.



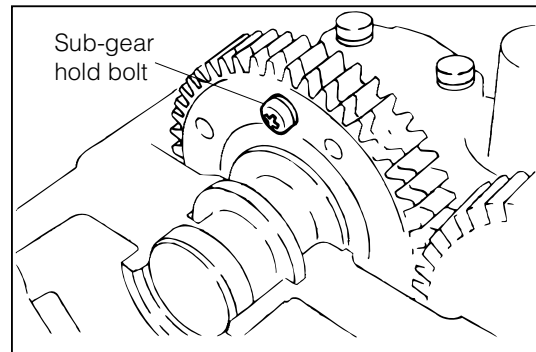
MEM00009-00008

(5) Remove the camshaft bearing cap No. 1 by removing the bolts in a sequence, as indicated in the right figure.



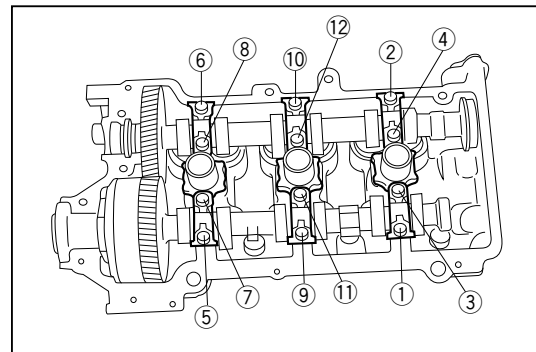
MEM00010-00009

(6) Secure the camshaft sub-gear to the gear section of the camshaft No. 1, using a bolt (M5 size with a 0.8 mm pitch).



MEM00011-00010

(7) Remove the camshaft bearing cap No. 2 by removing the bolts in a sequence, as indicated in the right figure.

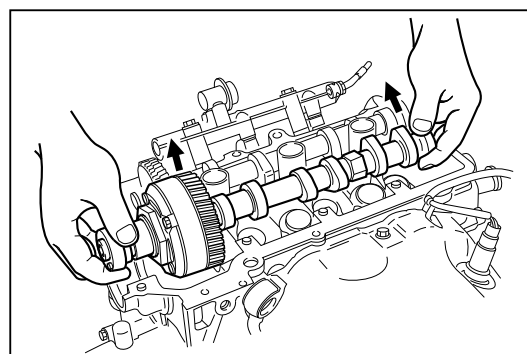


MEM00012-00011

- (8) Remove the camshaft No. 2 and camshaft No. 1 in this sequence.

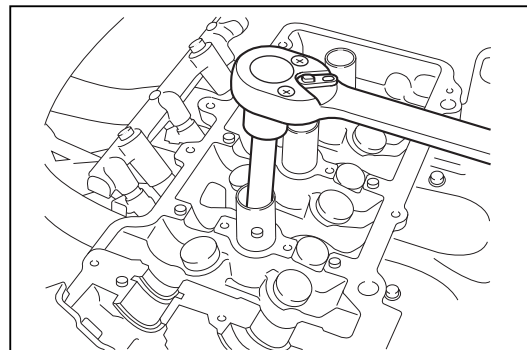
CAUTION:

- Be sure to hold the camshaft horizontally during the removal, for the camshaft thrust clearance has become smaller. (Failure to observe this caution may cause an undue force to be applied to the thrust section, resulting in scores.)



MEM00013-00012

10. Remove the spark plug from the cylinder head.

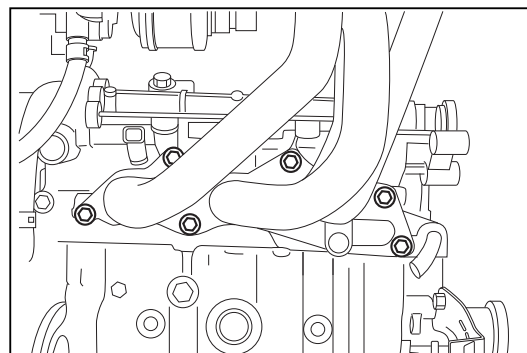


MEM00014-00013

11. Remove the intake manifold and gasket from the cylinder head.

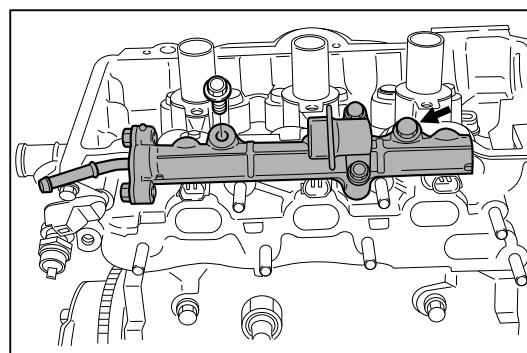
CAUTION:

- Never reuse the removed intake manifold gasket.



MEM00015-00014

12. Remove the fuel delivery pipe from the cylinder head.
13. Remove the injector from the cylinder head.

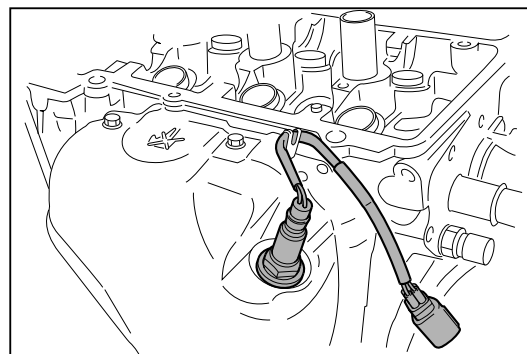


MEM00016-00015

14. Remove the oxygen sensor harness from the clamp.
15. Remove the exhaust manifold heat insulator from the exhaust manifold.
16. Remove the oxygen sensor from the exhaust manifold.

CAUTION:

- Care must be exercised so that no oil, grease and coolant may get to the oxygen sensor.
- Be very careful not to apply an undue force to the lead wires.



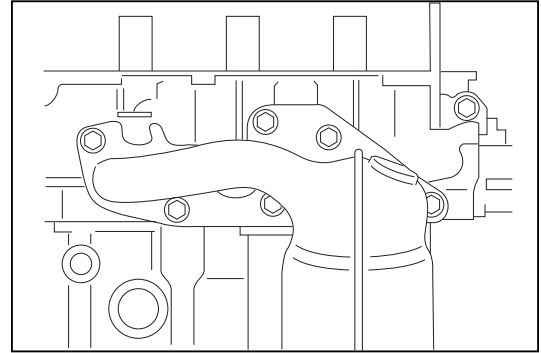
MEM00017-00016

EM-6

17. Remove the exhaust manifold and gasket from the cylinder head.

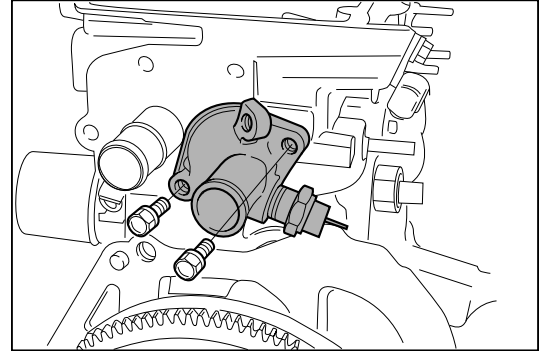
CAUTION:

- Never reuse the removed exhaust manifold gasket.



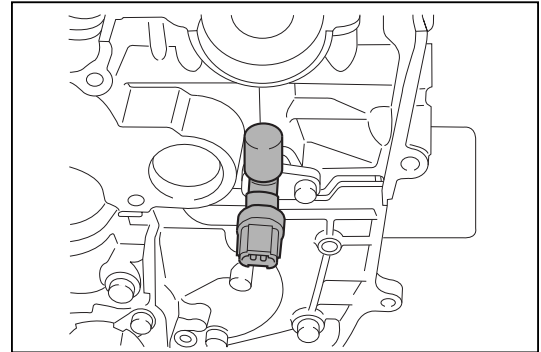
MEM00018-00017

18. Remove the water inlet from the cylinder head.
19. Remove the thermostat from the cylinder head.
20. Remove the engine coolant temperature sensor.



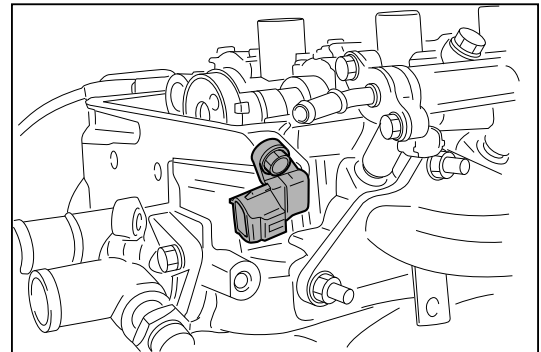
MEM00019-00018

21. Remove the cam/crank angle sensor from the cylinder head.



MEM00020-00019

22. Remove the cam angle sensor from the cylinder head.



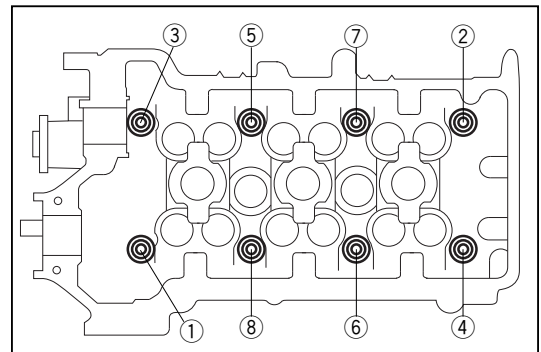
MEM00021-00020

23. Remove the cylinder head attaching bolts in the sequence as indicated in the right figure. Remove the cylinder head from the cylinder block.

24. Remove the cylinder head gasket from the cylinder block.

CAUTION:

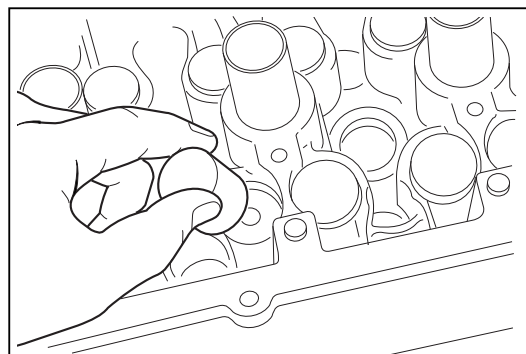
- Never reuse the cylinder head gasket.



MEM00022-00021

DISASSEMBLY**Cylinder head**

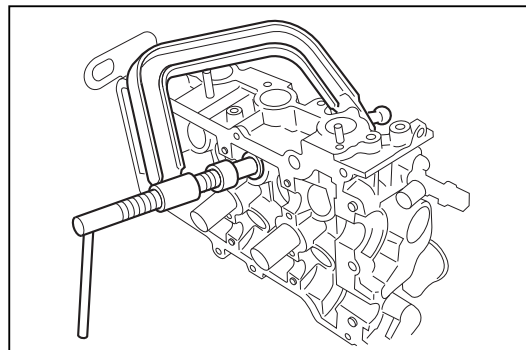
1. Remove the valve lifters from the cylinder head with the adjusting shims installed on each valve lifter.



MEM00023-00022

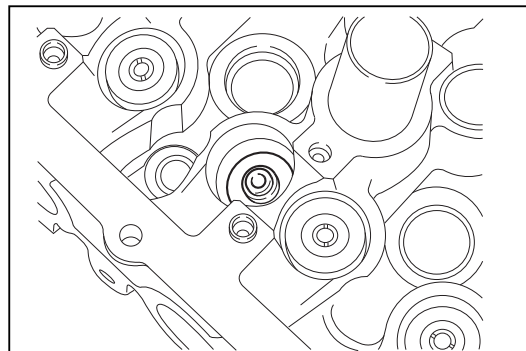
2. Remove the valve spring retainer locks, using the following SSTs.

SSTs: 09202-87002-000
09202-87002-0A0



MEM00024-00023

3. Remove the valve spring retainers, and valve springs.
4. Remove the valves from the cylinder head.
5. Remove the valve stem oil seals, using pliers or the like.
6. Remove the valve spring seats from the cylinder head.



MEM00025-00024

REFERENCE:

- When the SSTs specified above are employed, it is possible to perform replacements of the valve spring retainers, valve spring retainer locks and valve springs in the in-vehicle operation without removing the cylinder head from the cylinder block.

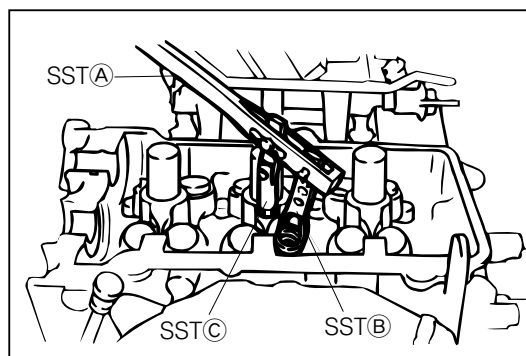
WARNING:

- Make sure to protect your eyes with safety goggles during this operation.
- Be very careful not to allow the spring, etc. to jump out.

CAUTION:

- When the valve spring retainer locks are removed, be sure to perform this removal with each piston set to the Top Dead Center, one cylinder at a time.
- Plug the oil return hole of the cylinder head with a cloth or the like so that the valve spring retainer lock may not be dropped inadvertently into the hole.

SST: 09202-87702-000 (SSTⒶ)
09202-87202-000 (SSTⒷ)
09202-87203-000 (SSTⒸ)



MEM00026-00025

EM-8

Camshaft No. 1

1. Secure the camshaft by clamping it in a vise.

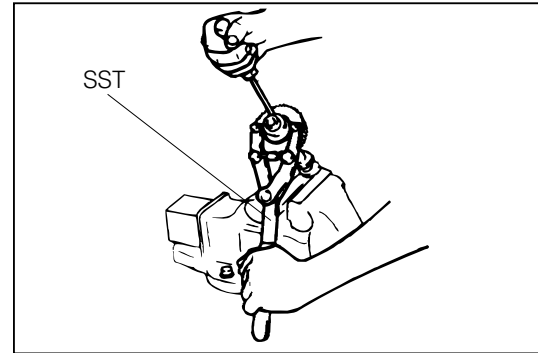
CAUTION:

- Be very careful not to scratch the cam journal section.

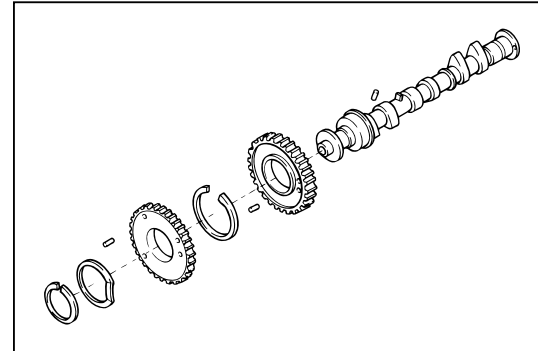
2. Remove the sub-gear attaching bolt (which was used in removing the camshaft from the cylinder head), using the SST to prevent the camshaft from being turned.

SST: 09504-87501-000

3. Using a snap ring expander, detach the shaft snap ring.
4. Remove the wave washer, camshaft sub-gear and camshaft gear spring.



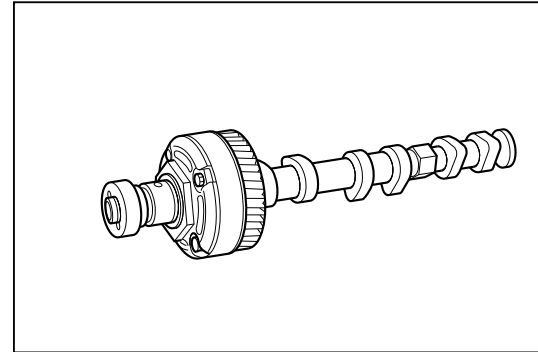
MEM00027-00026



MEM00028-00027

Camshaft No. 2

1. The camshaft No. 2 assembly cannot be disassembled, for the DVVT controller and camshaft drive gear are of an integral construction.



MEM00029-00028

INSPECTION

Cylinder head

NOTE:

- Clean the cylinder head by removing the remaining gasket materials, carbon deposits, and so forth.
- Check the cylinder block for cracks, using a dye penetration or like.

MEM00030-00000

1. Check of cylinder head for flatness
Using a precision straight edge and a thickness gauge, check the gasket surfaces contacting the cylinder head and manifolds for warpage.

Maximum Surface Warpage:

Cylinder Block Side: 0.10 mm

Intake Manifold Side: 0.10 mm

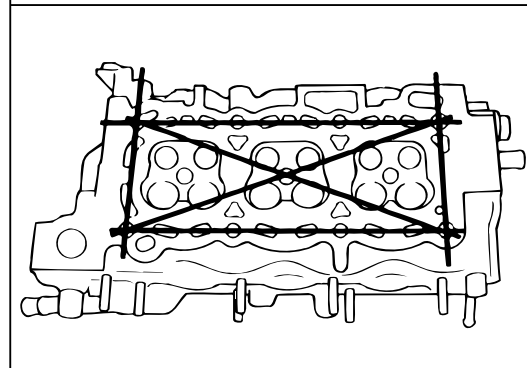
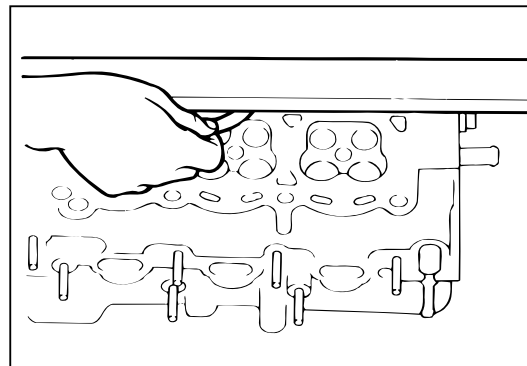
Exhaust Manifold Side: 0.10 mm

If surface warpage of the cylinder block side exceeds the maximum limit, reface or replace the cylinder head.

If surface warpage of the intake manifold and/or exhaust manifold side exceeds the maximum limit, replace the cylinder head.

If the cylinder head surface warpage at the cylinder block side exceeds the maximum warpage, reface the cylinder head within the minimum thickness limit.

Cylinder Head Height Limit: 103 mm

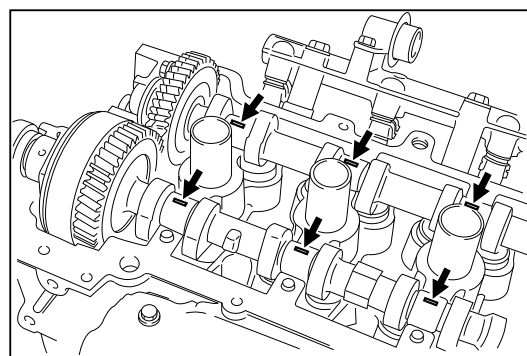


MEM00031-00029

2. Check of camshaft oil clearance

NOTE:

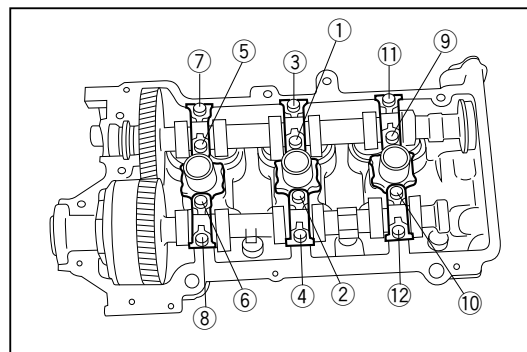
- Prior to this oil clearance check, the camshaft should be checked for bend in advance. (See page EM-16)
- (1) Install the camshaft to the cylinder head.
 - (2) Place a plastigauge on each bearing.



MEM00032-00030

- (3) Install the bearing caps. Tighten them to the specified torque.

Tightening Torque: $12.5 \pm 2.0 \text{ N}\cdot\text{m}$



MEM00033-00031

- (4) Remove the bearing caps and measure the oil clearance.

Clearance:

Specified Value: 0.037 - 0.073 mm

NOTE:

- After completion of the check, remove the plastigauges. Wash the camshaft and bearing caps in cleaning solvent.

Reference:

Camshaft Journal Outer Diameter

Intake Side, Exhaust Side:

No. 1: 25.979 - 25.995 mm

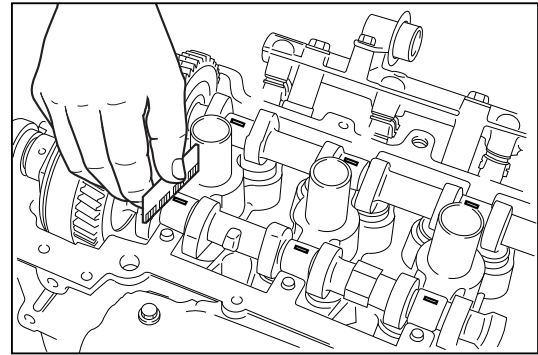
No. 2, No. 3, No. 4: 22.979 - 22.995 mm

Camshaft Bearing Cap Bore Diameter

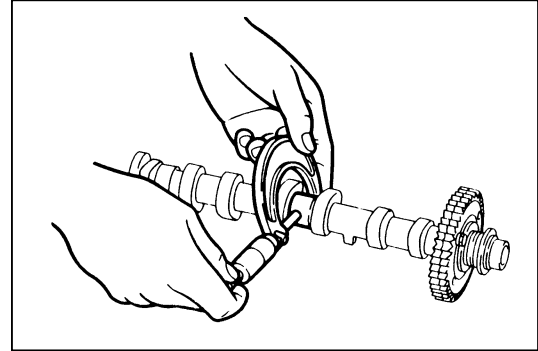
Intake Side, Exhaust Side:

No. 1: 26.032 - 26.052 mm

No. 2, No. 3, No. 4: 23.032 - 23.052 mm



MEM00034-00032



MEM00035-00033

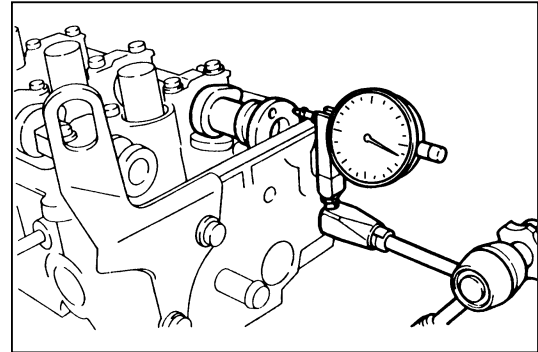
3. Check of camshaft thrust clearance

Assemble the camshaft, referring to the assembling procedure of the camshaft in EM-22. Measure the thrust clearance.

Specified Thrust Clearance:

Intake Side: 0.04 - 0.10 mm

Exhaust Side: 0.04 - 0.10 mm



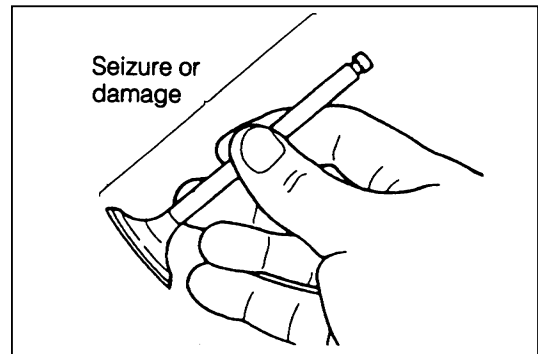
MEM00036-00034

4. Check and grinding of valves

- (1) Visually inspect the valve stem for seizure or damage.

NOTE:

- If seizure or damage is found, replace the valve and valve guide bush as a set.
- However, this replacement should be performed only after the checks for the valve seat, valve stem and valve guide bush have been finished.
- The valve guide bush hole must be used for refacing the valve seat. Hence, if the valve guide bush hole exhibits any roughness due to seizure, etc., rectify the hole with an adjustable reamer.

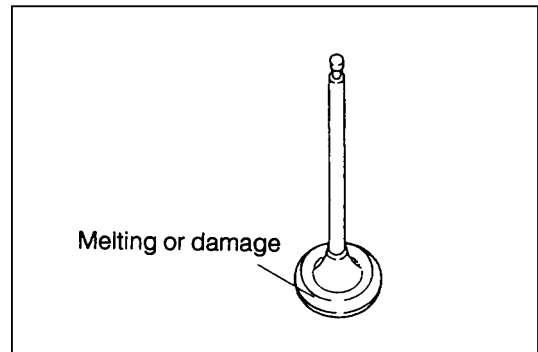


MEM00037-00035

- (2) Visually inspect the valve head for melting or damage.

If the valve head exhibits any melting or damage, replace the valve.

If the roughness on the contact surface can be corrected, grind the valve seat contact surface with a valve refacer.

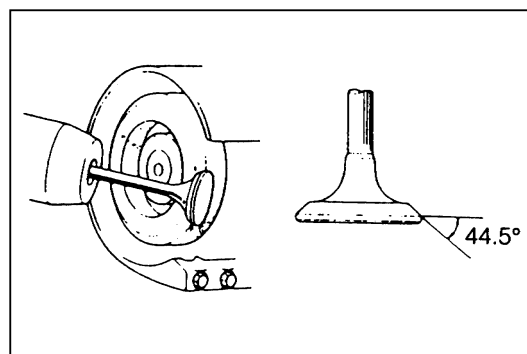


MEM00038-00036

- (3) Grind the valves only enough to obtain a smooth contact surface with the valve seat.
Valve Face Angle: 44.5°

NOTE:

- Make sure the valves are ground to the correct valve face angle.



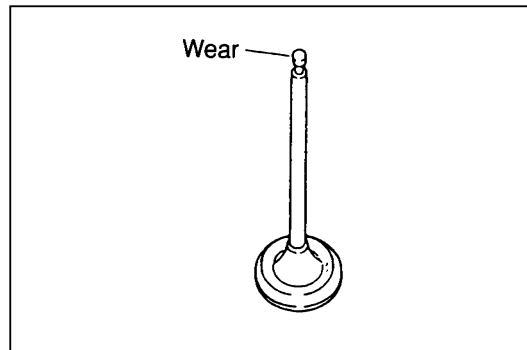
MEM00039-00037

- (4) Visually inspect the valve stem end for abnormal wear. If the valve stem end exhibits abnormal wear, correct the stem end with a valve refacer. However, this correction should be made within a limit of 0.2 mm from the standard length.

Reference:

Intake Valve: 79.4 mm

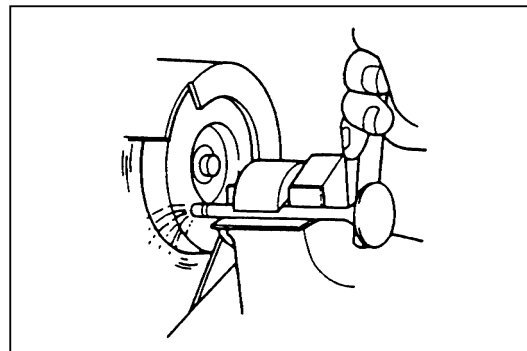
Exhaust Valve: 79.8 mm



MEM00040-00038

NOTE:

- Be very careful not to allow the valve to be overheated during grinding.



MEM00000-00039

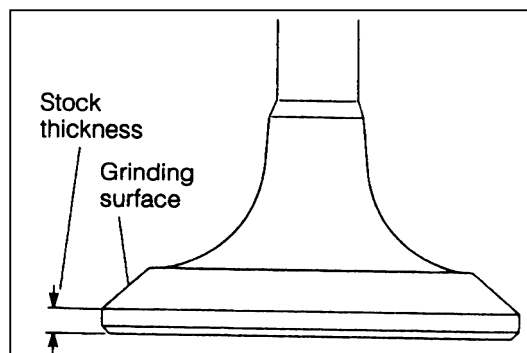
- (5) Inspect the valve head for its stock thickness.

Minimum Stock Thickness:

Intake Valve: 1.0 ± 0.2 mm

Exhaust Valve: 1.0 ± 0.2 mm

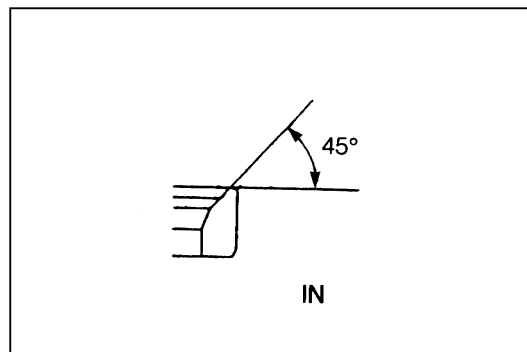
If the stock thickness of the valve head is less than the minimum stock thickness, replace it with a new one.



MEM00041-00040

5. Check and cleaning of valve seats

- (1) Using a 45-degree valve seat cutter, reface the valve seats. Remove only enough metal stock to clean the seats.
- (2) Apply a thin film of red lead (or white lead) to the valve seat.
- (3) Let the valve drop by its own weight onto the valve seat two or three times.
- (4) Take out the valve.



MEM00042-00041

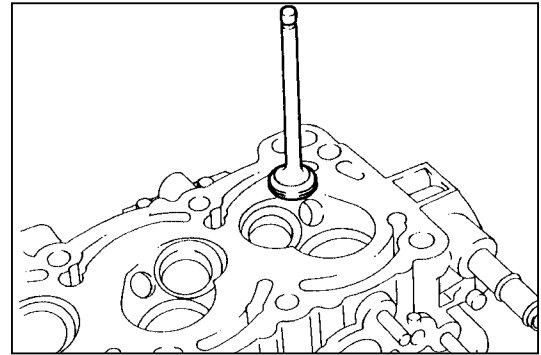
(5) Inspect the valve face and seat for the following items.

- ① Ensure that the valve seat contact surface of the valve is continuous over the whole circumference.
If not, replace the valve.
- ② Ensure that the valve contact surface of the valve seat is continuous over the whole circumference.
If not, reface the valve seat.

- ③ Measure the width of the contact surface of valve seat.

Contact Surface of Valve Seat: 1.4 ± 0.5 mm

If not, reface the valve seat.



MEM00043-00042



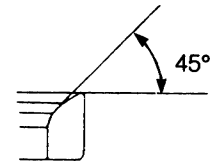
Center of valve
contact position

Seat contact width

MEM00044-00043

6. Refacing of valve seat

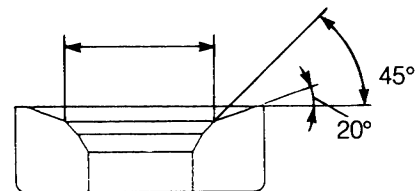
- (1) Using a 45-degree cutter, recondition the roughness on the valve-to-valve seat contact surface, only enough to obtain a smooth surface.



MEM00045-00044

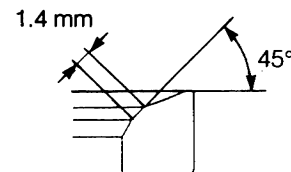
- (2) Using a 20-degree cutter, cut the valve seat in such a way that the circumference of the surface refaced by the 45-degree cutter may become the specified value.

Specified Value: IN: 23.0 ± 0.1 mm
EX: 20.0 ± 0.1 mm



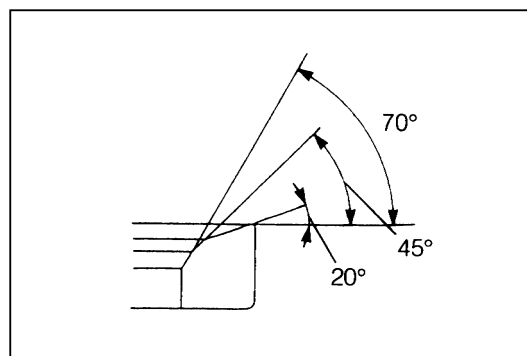
MEM00046-00045

- (3) Using a 70-degree cutter, cut the valve seat in such a way that the width of the surface refaced by the 45-degree cutter may become 1.4 mm.



MEM00047-00046

- (4) Using the 45-degree cutter, remove burrs produced during the refacing by the 20-degree and 70-degree cutters.



MEM00048-00047

7. Hand lapping of valves

- (1) Perform hand lapping of the valves and valve seats, using an abrasive compound.
- (2) Clean the valves and valve seats after the hand lapping of the valves.

MEM00049-00000

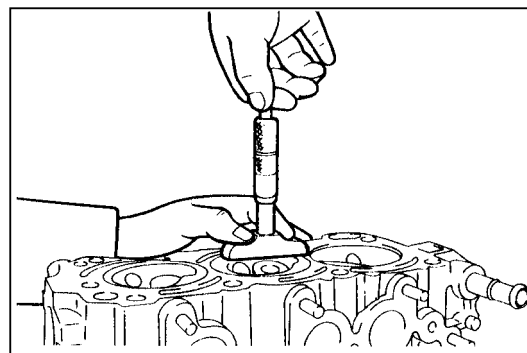
8. Check of valve recession

After the valve seat has been refaced, install the new valve.

Measure the distance between the cylinder block attaching surface of the cylinder head (attaching surface of the cylinder head gasket) and the upper most section of the valve.

Ensure that the distance does not exceed the following specified value.

Specified Value: Intake Valve: 3.07 mm
Exhaust Valve: 4.65 mm



MEM00050-00048

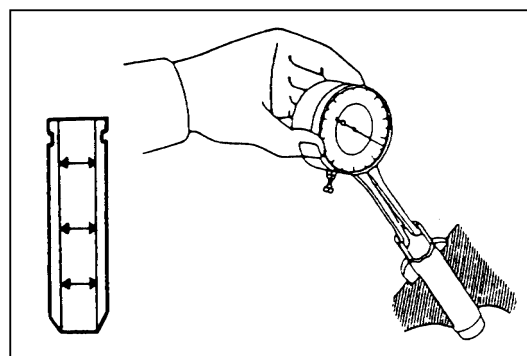
If the recession exceeds the maximum limit, replace the cylinder head.

9. Check of valve stem-to-valve guide bushing oil clearance

- (1) Using a caliper gauge, measure the inner diameter of the valve guide at six points. Record the measured values.

Reference:

Inner Diameter of the Valve Guide Bush:
IN, EX: 5.000 - 5.012 mm

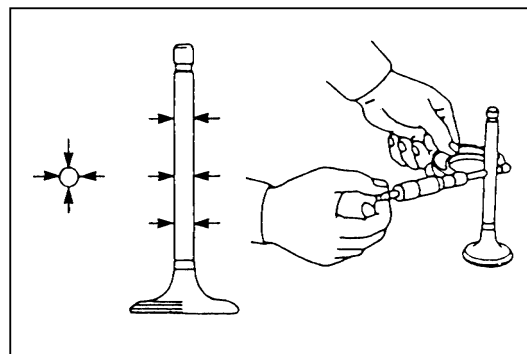


MEM00051-00049

- (2) Using a micrometer, measure the diameter of the valve stem at six points. Record the measured values.

Reference:

Outer Diameter of the Valve Stem:
Intake: 4.975 - 4.990 mm
Exhaust: 4.965 - 4.980 mm



MEM00052-00050

(3) Calculation of oil clearance

Calculate the oil clearance of each valve according to the following formula.

Oil clearance = Inner diameter of valve stem guide –
Outer diameter of valve stem

Specified Oil Clearance:

IN: 0.010 - 0.037 mm

EX: 0.020 - 0.047 mm

MEM00053-00000

10. Replacement of valve guide bush

(1) Drive out the valve guide bush from the combustion chamber side, using a suitable tool.

NOTE:

- Be very careful not to tap the cylinder head.

REFERENCE:

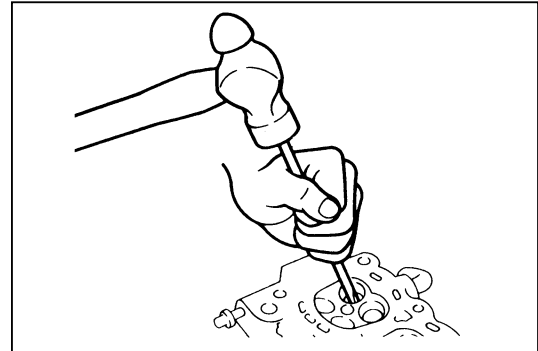
- As for this suitable tool, determine it, while referring to the inner diameter and outer diameter of the valve guide bush.

Valve Guide Bush Inner Diameter:

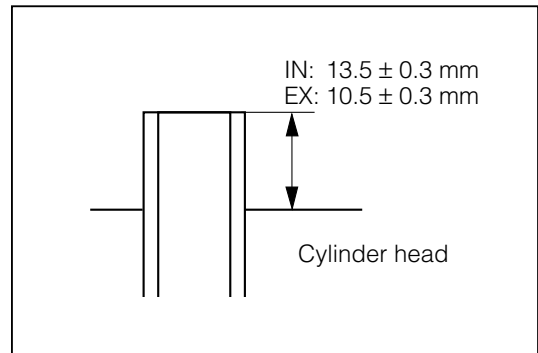
IN, EX: 9.727 - 9.738 mm

Valve Guide Bush Outer Diameter:

IN, EX: 5.000 - 5.012 mm



MEM00054-00051

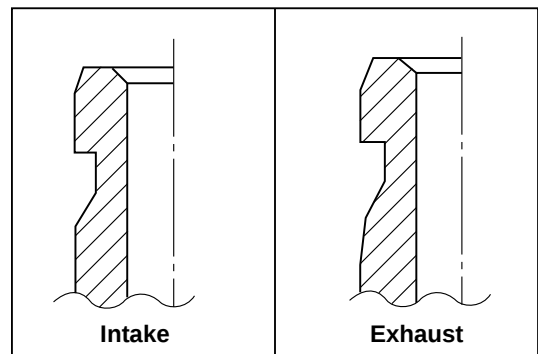


MEM00000-00052

(2) Drive a new valve guide bush into position, shown in the right figure, using a suitable tool.

CAUTION:

- Be very careful not to give an excessive impact during the installation. Failure to observe this caution will result in valve guide bush cracks.
- Care must be exercised as to the shape of the valve guide bush, for it differs between the intake side and the exhaust side.
- The exhaust valve guide bush has a two-stage taper, while the intake valve guide bush has a single-stage taper.



MEM00055-00053

(3) Using an adjustable reamer, ream the valve guide bush to remove any burr or the like.

NOTE:

- This reaming should be made only enough to remove the burr or the like.

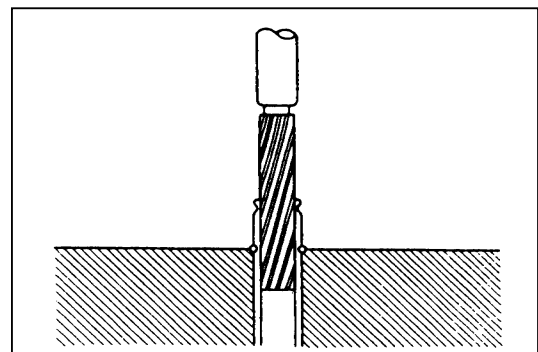
(4) Check of oil clearance

Ensure that the oil clearance meets the specifications.

Specified Oil Clearance:

IN: 0.010 - 0.037

EX: 0.020 - 0.047



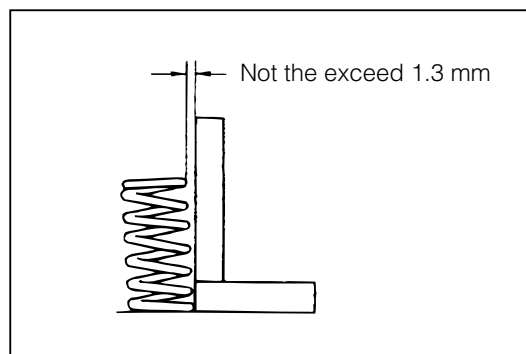
MEM00056-00054

11. Check of valve springs

- (1) Check the valve spring for squareness, using a steel square.

Maximum Squareness: 1.3 mm

If the squareness exceeds the maximum limit, replace the valve spring.



MEM00057-00055

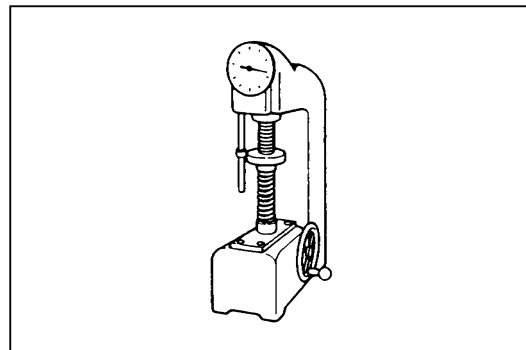
- (2) Measure the valve spring for free length and spring tension, using a spring tester.

Minimum Free Length: 37.1 mm

Minimum Tension/Installation Height:

123.17 ± 8.63 N/32.0 mm

If the minimum free length and/or minimum tension is less than the minimum limit, replace the valve spring.



MEM00058-00056

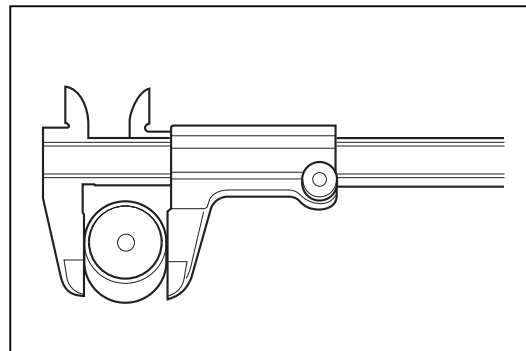
12. Check of valve lifter and cylinder head valve lifter bore oil clearance

- (1) Measure the outer diameter of the valve lifter.

Outer Diameter of Valve Lifter: 27.975 - 27.985 mm

- (2) Measure the inner diameter of the cylinder head valve lifter bore.

Bore Diameter: 28.000 - 28.021 mm

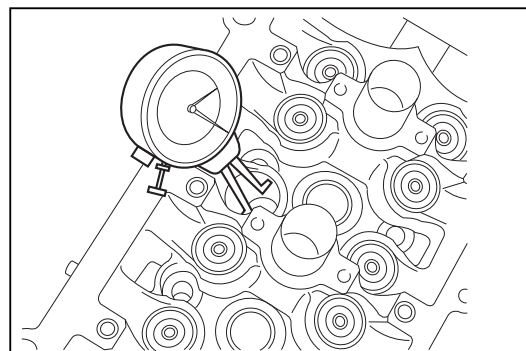


MEM00059-00057

- (3) Calculate the oil clearance, based on the results of the measurements (1) and (2). Check to see if the oil clearance is within the specification.

If the oil clearance does not conform to the specification, replace the valve lifter and/or cylinder head.

Specified Oil Clearance: 0.015 - 0.046 mm

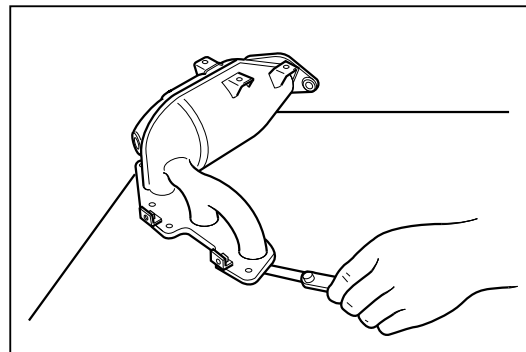


MEM00060-00058

13. Check of manifold

Check the cylinder head attaching surface of the intake manifold and exhaust manifold for warpage, using a straight edge and a thickness gauge.

Maximum Warpage: 0.1 mm



MEM00061-00059

EM-16

Camshaft

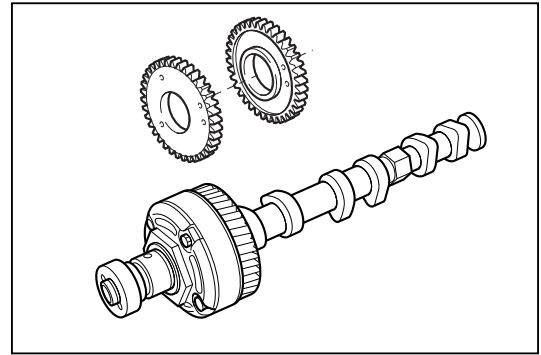
1. Check of gear
Visually inspect the teeth for wear.
2. Check of shaft

(1) Checking camshaft for runout

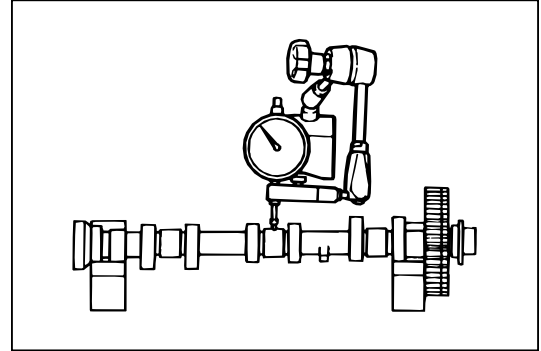
Support the camshaft at its both ends with V-shaped blocks. Set a dial gauge to the mid-point of the center journal section of the camshaft. Turn the camshaft one turn, making sure that the camshaft will not move in the axial direction. Take a reading on the dial gauge during the turning. Calculate the maximum runout, i.e. the difference between the maximum and minimum readings.

Maximum Runout: 0.03 mm

If the runout exceeds the maximum limit, replace the camshaft.



MEM00062-00060

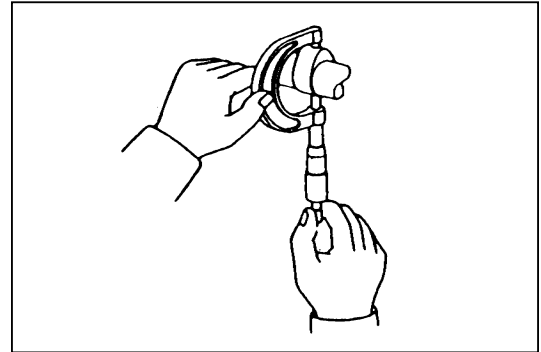


MEM00000-00061

(2) Checking of cam lobe height

Measure the cam lobe height, using a micrometer.

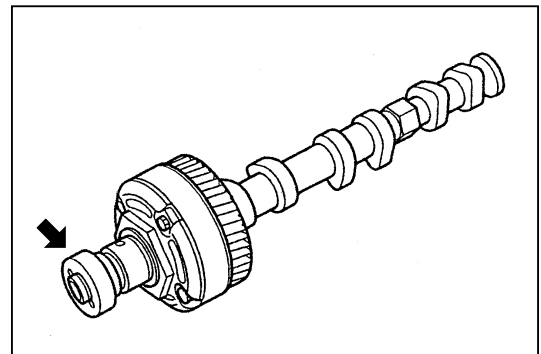
Specified Cam Lobe Height: 40.25 mm



MEM00063-00062

(3) Inspection of oil seal contact surface

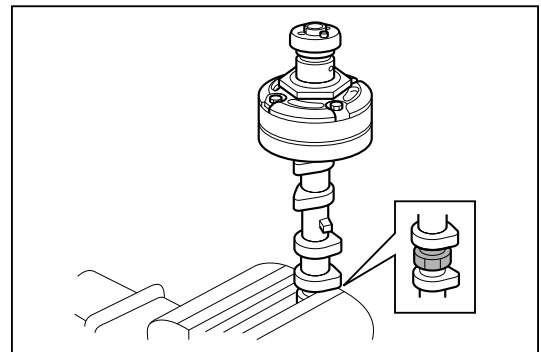
Inspect the oil seal contact surface for abnormal wear. Replace the camshaft if the contact surface exhibits any abnormal wear.



MEM00064-00063

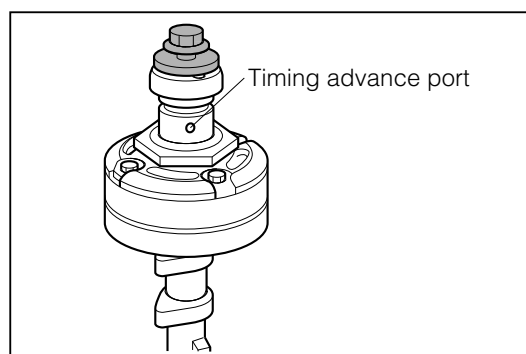
3. Check of DVVT actuator

- (1) Clamp the hexagonal section for servicing of the camshaft assembly No. 2 in a vice, etc.



MEM00065-00064

- (2) Temporarily tighten the attaching bolt at the timing belt pulley attaching bolt hole so as to plug the oil passage at the timing advance side.



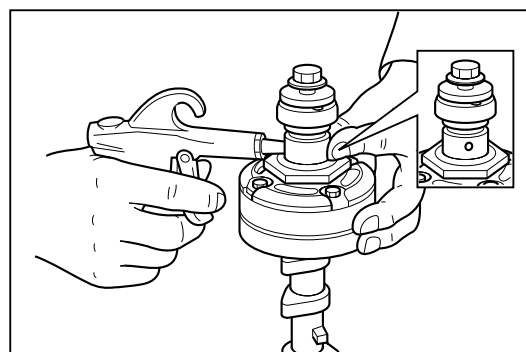
- (3) Hold one of the two timing advance ports (in the figure on the right) of the camshaft with your finger.
- (4) Apply compressed air to the other timing advance port, using an air tool.

CAUTION:

- Care must be exercised, for oil will splash.

NOTE:

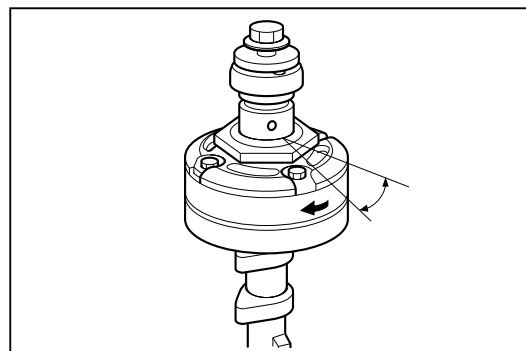
- The most retarded angle lock will be unlocked.



- (5) At this time, ensure that the most retarded angle lock of the actuator becomes unlocked and the actuator can be moved by your hand without binding within a range of approximately 30°.

NOTE:

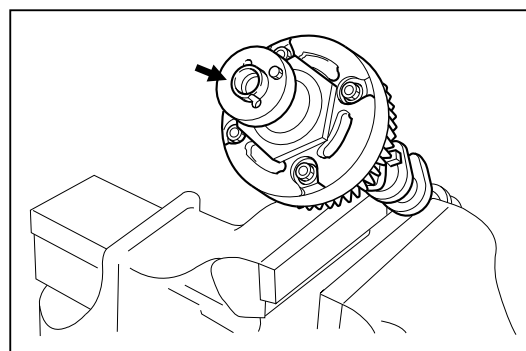
- The actuator will be locked when it comes to the most retarded angle position.



- (6) After completion of the check, lock the actuator at the most retarded angle position. Then, remove the timing pulley attaching bolt.

NOTE:

- After the bolt has been removed, be sure to wipe off any residual sealing material lodged at the screw hole of the camshaft. (Failure to perform this operation may result in malfunction of the DVVT after assembling.)



EM-18

Thermostat

For checking and replacement procedures, refer to the CO section.

Engine coolant temperature sensor

For checking procedure, refer to the EF section.

Cam/crank angle sensor

For checking and replacement procedures, refer to the IG section.

Cam angle sensor

For checking and replacement procedures, refer to the IG section.

Spark plug

For checking and replacement procedures, refer to the IG section.

MEM00070-00000

ASSEMBLY

Cylinder head

NOTE:

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

CAUTION:

- It should be noted that the valves for unleaded gasoline specifications differ from those for leaded gasoline specifications.

Identification Marks:

Unleaded Gasoline: IN = I4, EX = E4

Leaded Gasoline: IN = I6, EX = E6

1. Install the valve spring seat
2. Installation of valve stem oil seal
 - (1) Apply engine oil to the inner surface of the metal ring of the stem oil seal.
 - (2) Drive the valve stem oil seal into position.

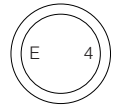
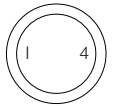
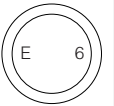
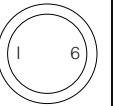
NOTE:

- Make sure that the stem oil seals will not tilt against the stem.

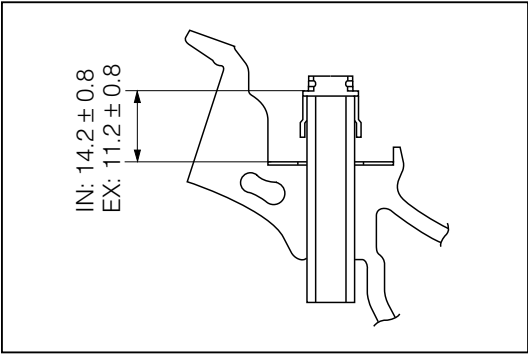
3. Dip the 30 to 40 mm long portion of the valve stem end into engine oil.
4. Install the valve to the cylinder head.

NOTE:

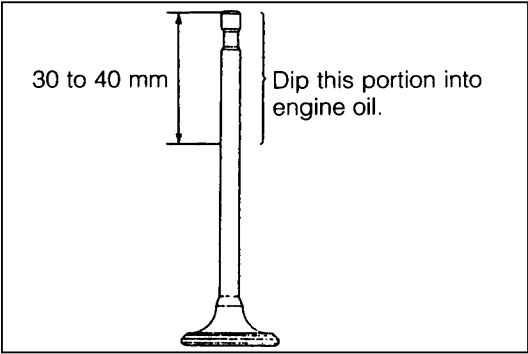
- Care must be exercised as to the installing position. Do not pull out the valve once it has been inserted.
- If the inserted valve should be pulled out, replace the valve stem oil seal with a new one.

Unleaded gasoline		Leaded gasoline	
Exhaust valve	Intake valve	Exhaust valve	Intake valve
			

MEM0071-00069

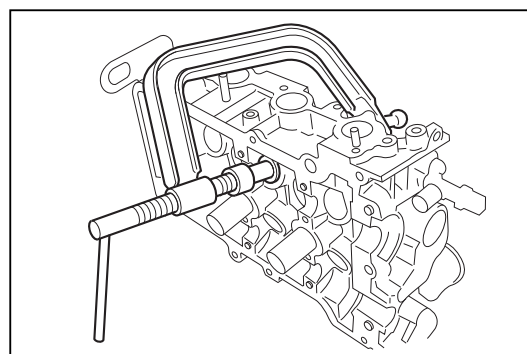


MEM00072-00070



MEM00073-00071

5. Assembly of valve springs, valve spring retainers and valve spring retainer locks
 - (1) Install the valve spring to the valve lifter inserting hole.
 - (2) Install the valve spring retainer to the valve spring. Install the valve spring retainer locks while compressing the valve spring retainer, using the following SST.
- SST: 09202-87002-000
09202-87002-0A0

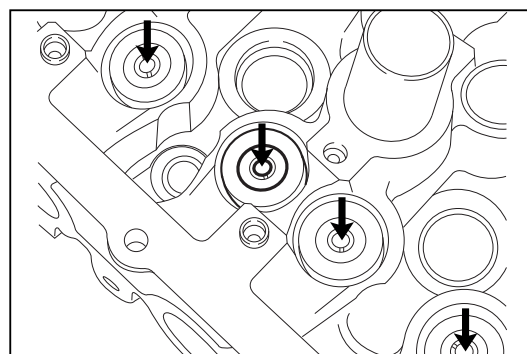


MEM00074-00072

- (3) After installing the valve spring retainer lock, lightly tap the valve spring retainer with a plastic hammer or the like so as to ensure that the valve spring retainer locks are installed securely.

WARNING:

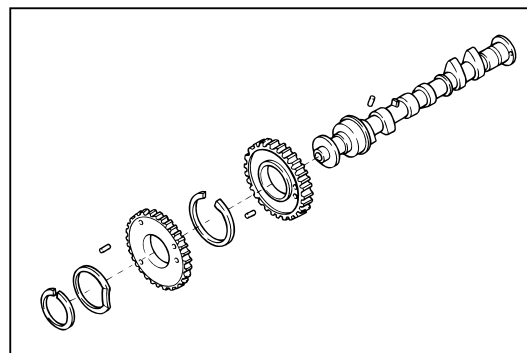
- During this operation, care must be exercised to ensure that the valve spring retainer or retainer locks may not jump out.
- Protect your eyes with safety goggles during this operation.
- Never tap the hole into which the valve lifter is inserted.



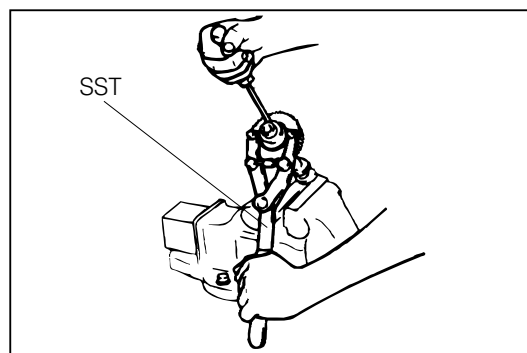
MEM00075-00073

Camshaft No. 1

1. Set the SST to the two 6 mm dia. holes of the camshaft sub gear using the following SST.
SST: 09504-87501-000
2. Turn the sub gear clockwise until the assembling auxiliary hole of the camshaft driven gear and also the teeth of the sub-gear and driven gear are aligned with each other. Install the sub gear retaining bolt (size: M5, pitch: 0.8 mm).
3. Install the camshaft rear springs, camshaft sub-gear and wave washer. Secure the components, using a shaft snap ring.



MEM00076-00074



MEM00000-00075

INSTALLATION

1. Clean the cylinder block upper gasket surface. Install the cylinder head gasket, while aligning it with the pin ring for locating use.
2. Temporarily install the crankshaft pulley bolt to the crankshaft.
3. Turn the crankshaft so that the crankshaft key groove may come at the top position.
4. Install the cylinder head to the cylinder block.

NOTE:

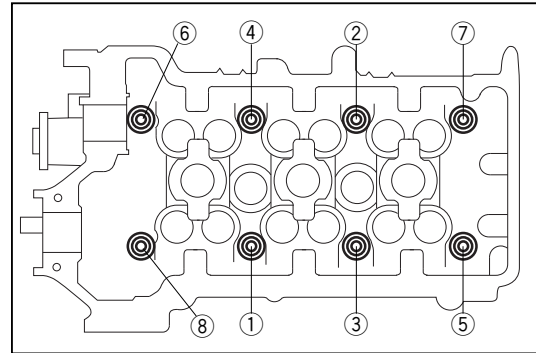
- Care must be exercised to ensure that no damage is made to the gasket surface of the cylinder head with the cylinder block.

MEM00077-00000

EM-20

5. Coat each cylinder head bolt with a thin film of engine oil. Using these bolts, install the cylinder head to the cylinder block. Tighten the bolts evenly over two or three stages, following the sequence shown in the right figure.

Tightening Torque: $54.0 \pm 5.0 \text{ N}\cdot\text{m}$



MEM00078-0076

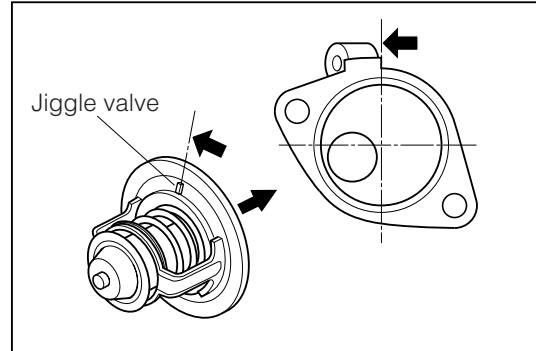
NOTE:

- Failure to tighten the bolts evenly may cause cracks and distortion of the cylinder head, even leading to engine seizure.
- Make sure that all the bolts are tightened uniformly to a constant level as well as that they are tightened within the specified torque.

6. Installation of water inlet

- (1) Install the thermostat to the water inlet, as shown in the illustration.
- (2) Apply soap water to the outer periphery of the thermostat grommet.
- (3) Install the water inlet to the cylinder head.

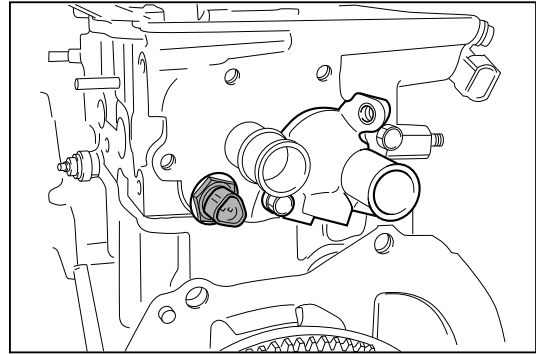
Tightening Torque: $19.0 \pm 3.8 \text{ N}\cdot\text{m}$



MEM00079-00077

7. Clean the threaded portion of the engine coolant temperature sensor. Wind seal tape around the threaded portion. Tighten the sensor to the cylinder head, using a long box wrench.

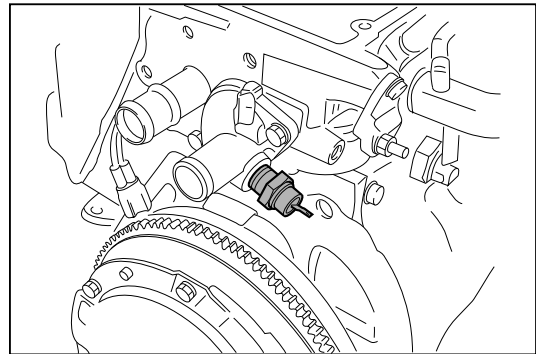
Tightening Torque: $24.0 \pm 4.8 \text{ N}\cdot\text{m}$



MEM00080-00078

8. Clean the threaded portion of the radiator thermo control switch. Wind seal tape around the threaded portion. Tighten the switch to the water inlet.

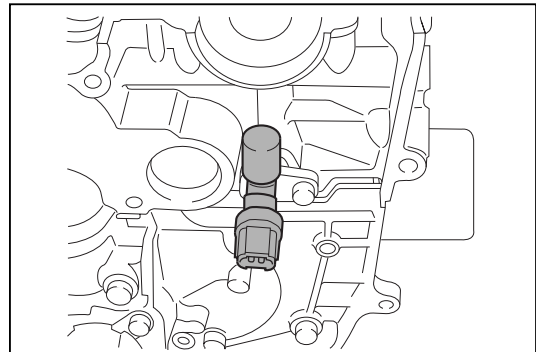
Tightening Torque: $24.0 \pm 4.8 \text{ N}\cdot\text{m}$



MEM00081-00079

9. Install the cam/crank angle sensor to the cylinder head.

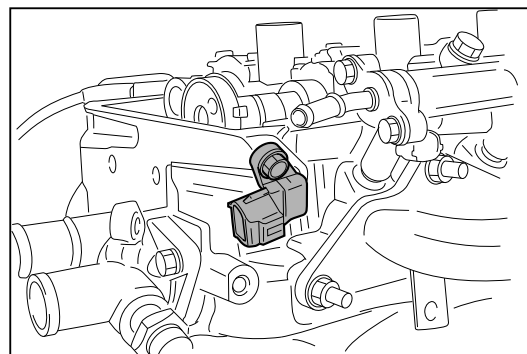
Tightening Torque: $8.0 \pm 1.6 \text{ N}\cdot\text{m}$



MEM00082-00080

10. Install the cam angle sensor to the cylinder head.

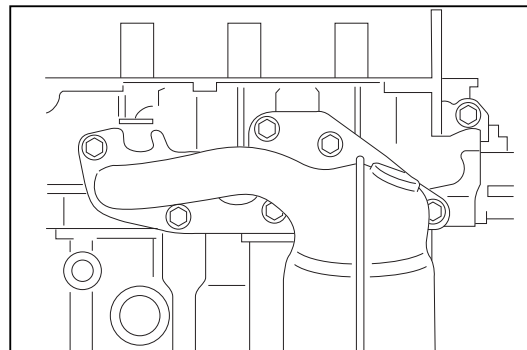
Tightening Torque: $8.0 \pm 1.6 \text{ N}\cdot\text{m}$



MEM00083-00081

11. Install the exhaust manifold to the cylinder head with a new gasket interposed.

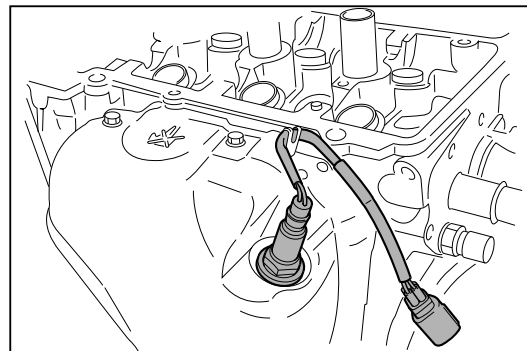
Tightening Torque: $25.0 \pm 5.0 \text{ N}\cdot\text{m}$



MEM00084-00082

12. Install the heat insulator to the exhaust manifold.

Tightening Torque: $11.5 \pm 2.3 \text{ N}\cdot\text{m}$



MEM00085-00083

14. Attach the oxygen sensor harness to the clamp.

CAUTION:

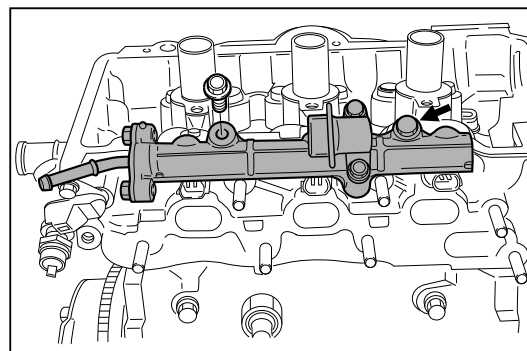
- Care must be exercised so that no oil, grease and coolant may get to the oxygen sensor.
- Be very careful not to apply an undue force to the lead wires.

15. Install the injector to the cylinder head in such a way that the connector faces toward the outside of the engine.

16. Apply lubrication oil to the O-ring of the injector.

17. Install the fuel delivery pipe to the cylinder head.

Tightening Torque: $19.0 \pm 3.8 \text{ N}\cdot\text{m}$

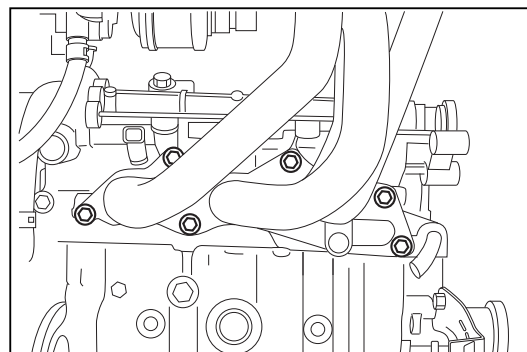


MEM00086-00084

18. Turn the injector by your hand. Ensure that the injector turns smoothly, although you may feel a certain resistance.

19. Install the intake manifold to the cylinder head with a new gasket interposed.

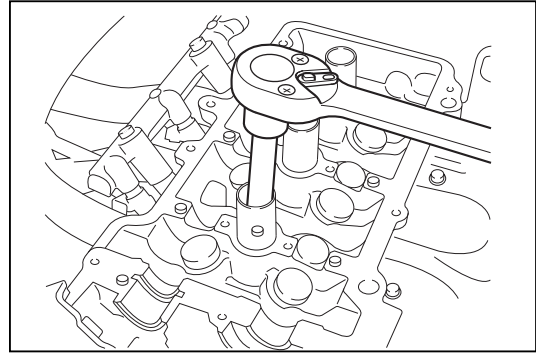
Tightening Torque: $19.0 \pm 3.8 \text{ N}\cdot\text{m}$



MEM00087-00085

20. Install the spark plug to the cylinder head.

Tightening Torque: $17.5 \pm 3.0 \text{ N}\cdot\text{m}$



MEM00088-00086

21. Installation of camshaft

CAUTION:

- Be sure to hold the camshaft horizontally during the installation, for the camshaft thrust clearance has become smaller. (Failure to observe this caution causes an undue force to be applied to the thrust section, resulting in scores.)

- (1) Apply engine oil to the cam section and gear section of the camshaft No. 1 and the journal section of the cylinder head.

- (2) Place the camshaft assembly No. 1 on the cylinder head in such a way that the sub-gear retaining bolt may face nearly upward.

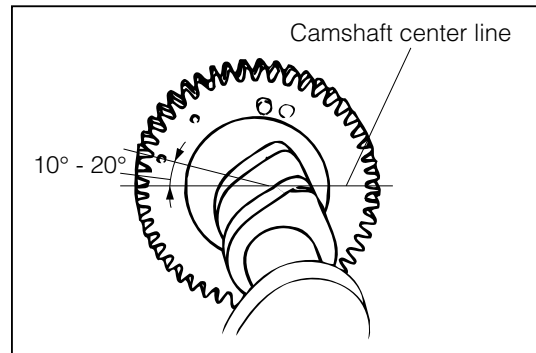
- (3) Turn the camshaft No. 1 so that the lower mating mark of the mating marks at the back sides of the gears may come within a range of about 10 degree to 20 degree from the line connecting the centers of the camshafts, as indicated in the right figure.

- (4) Apply engine oil to the cam section and gear section of the camshaft No. 2 and the journal section of the cylinder head.

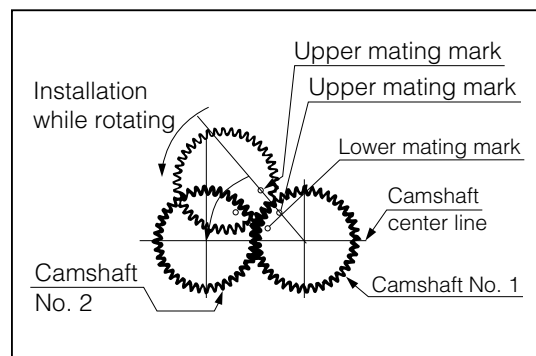
- (5) Of the two mating marks at the back sides of the camshaft driven gear and the camshaft drive gear, first align the upper marks each other. While the camshaft drive gear is being turned on the camshaft driven gear, install the camshaft No. 2.

- (6) While the camshaft No. 1 and camshaft No. 2 are in a set condition, ensure that the two mating marks at the back sides of the camshaft gears assume a relationship as indicated in the right figure.

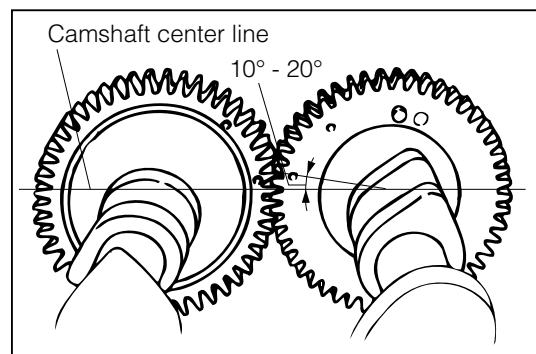
MEM00089-00000



MEM00090-00087



MEM00091-00088



MEM00092-00089

22. Install the camshaft No. 2 bearing cap, as indicated in the right figure. Tighten the attaching bolts to the specified tightening torque in a sequence specified in the right figure.

Tightening Torque: $12.5 \pm 2.0 \text{ N}\cdot\text{m}$

23. Remove the sub-gear retaining bolt of the camshaft No. 1.

24. Installation of camshaft No. 1 bearing cap

- (1) Apply liquid gasket to those points on the camshaft No. 1 bearing cap.

Liquid Gasket: Three bond 1207C or equivalent

- (2) Tighten the attaching bolts of the camshaft No. 1 bearing cap to the specified tightening torque in a sequence specified in the right figure.

Tightening Torque: $12.5 \pm 2.0 \text{ N}\cdot\text{m}$

25. Press-fit the plug, using the following SST, so that the plug may assume the position shown in the figure.

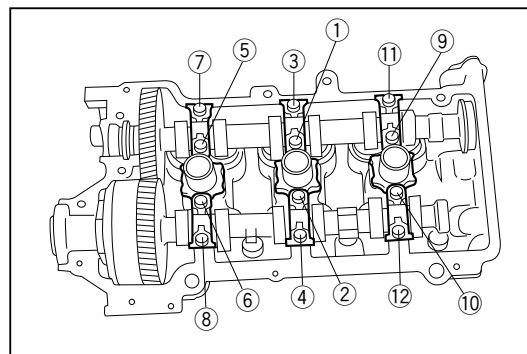
SST: 09237-87201-000

26. Apply engine oil to the lip surface of the type T oil seal. Press the oil seal into the cylinder head, until you can get a feeling of bottoming. For this installation, use the following SST in combination with a M12 bolt (whose nominal length is 80 to 90 mm).

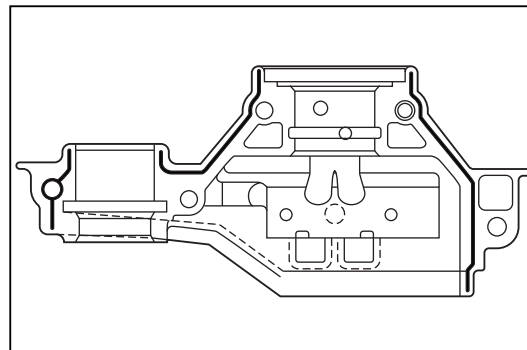
SST: 09707-87302-000

NOTE:

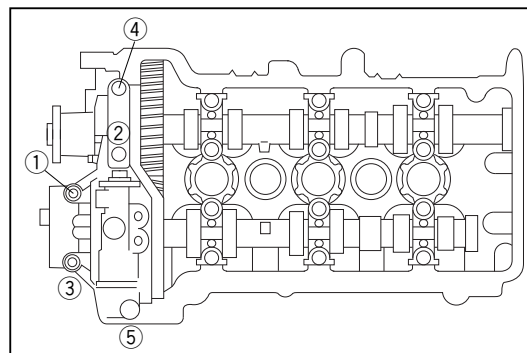
- If the oil seal is to be re-used, the press-fitting should be made after applying silicone bond.
- After the bolt has been removed, check the condition of the press-fitting by tapping the SST lightly with a hammer.



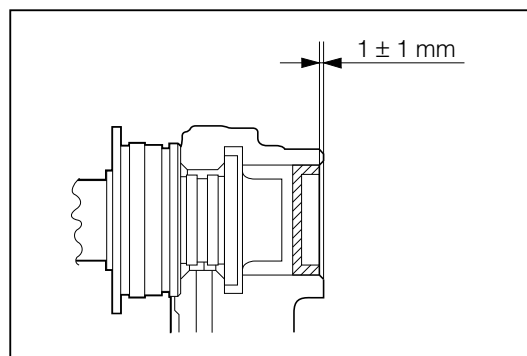
MEM00093-00090



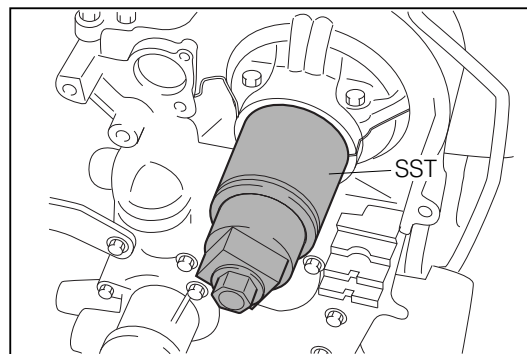
MEM00094-00091



MEM00095-00092



MEM00096-00093



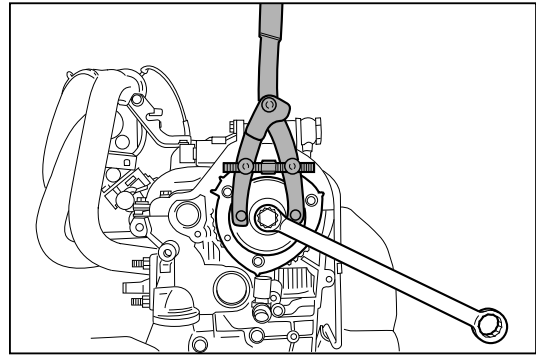
MEM00097-00094

EM-24

27. Install the camshaft timing belt pulley to the camshaft.
Tighten the bolt to the specified torque, while using the following SST to prevent the camshaft from being turned.

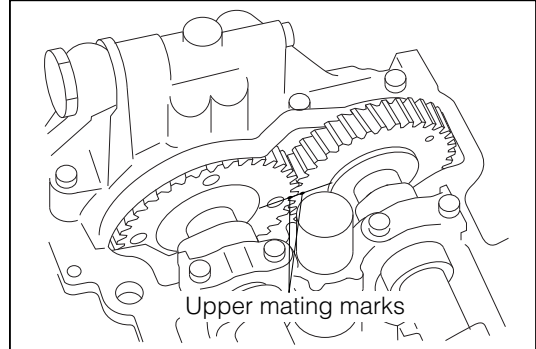
SST: 09504-87501-000

Tightening Torque: 98.0 ± 10.0 N·m



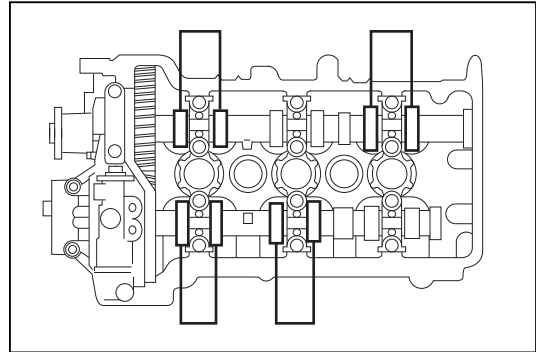
MEM00098-00095

28. Install the timing belt.
(Refer to the "TIMING BELT" section.)
29. Adjustment of valve clearance
(1) Align the upper mating marks of the drive gear and driven gear of the camshaft.



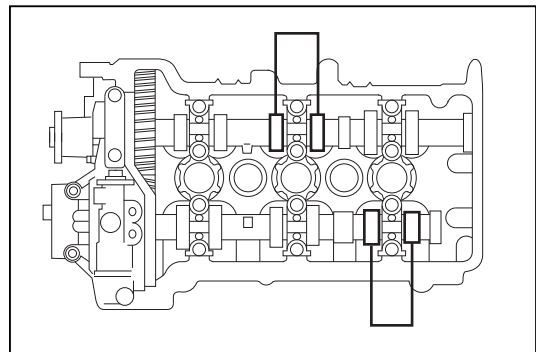
MEM00099-00096

- (2) Using a thickness gauge, check the valve clearances shown in the right figure.



MEM00100-00097

- (3) After turning the crankshaft one turn, check the valve clearances shown in the right figure.



MEM00101-00098

- (4) If the clearance deviates from the specified value, replace the shim in the following procedure and adjust it to the specified value.

NOTE:

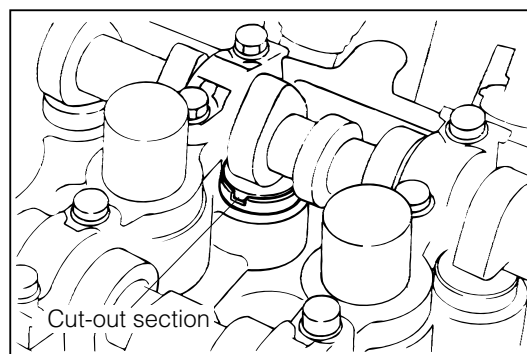
- Record the position of the valve where the clearance deviates from the specification, as well as the their measurement results.

Specified Value: IN: 0.18 ± 0.05 mm (Cold)

EX: 0.25 ± 0.05 mm (Cold)

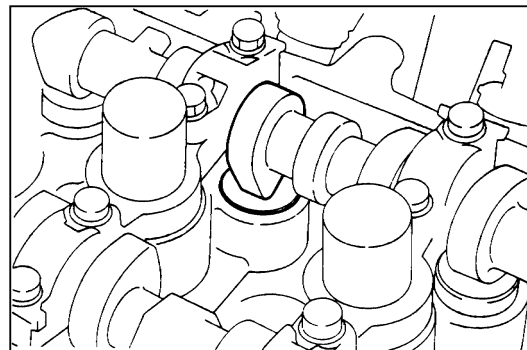
MEM00102-00000

- (5) Turn the crankshaft so that the cam nose of the cylinder where the clearance deviates from the specification points upward. Under this state, turn the valve lifter so that its cut-out section faces inward.



MEM00103-00099

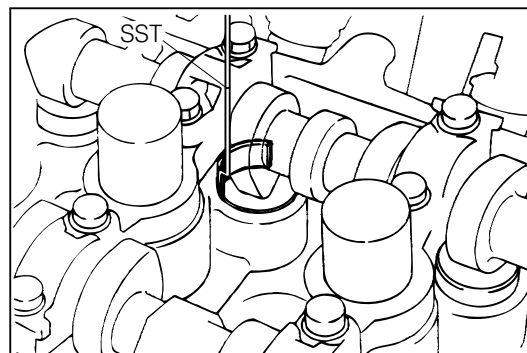
- (6) Turn the crankshaft so that the cam nose of the cylinder points downward and pushes down the valve lifter.



MEM00104-00100

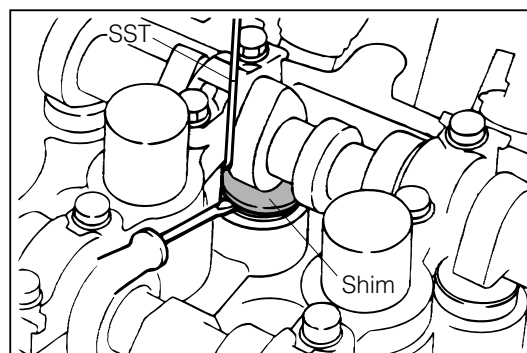
- (7) Place the SST on the upper circumference of the valve lifter from the inside of the cylinder head, as shown in the right figure. Turn the crankshaft so that the cam nose points approximately upward. In this way, retain the valve lifter in a pushed-down state by means of the SST.

SST: 09221-87208-000



MEM00105-00101

- (8) Raise the shim from the cut-out section, using a small-sized driver. Remove the shim toward the inside (spark plug side), using a magnet.



MEM00106-00102

- (9) Using a micrometer, measure the thickness of the shim that has been removed.
- (10) Select the shim, using the following formula given below, so that the valve clearance becomes the specified value.

Intake Valve:

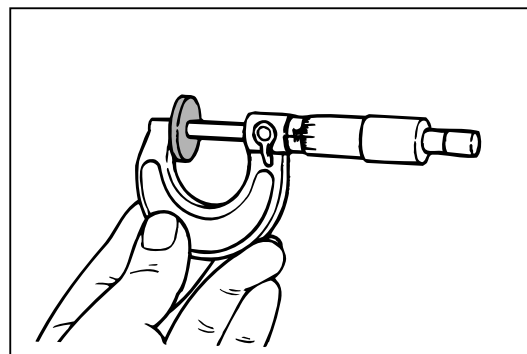
$$(\text{Thickness of shim to be selected}) = (\text{Thickness of removed shim}) + [(\text{measured clearance}) - 0.18 \text{ mm}]$$

Exhaust Valve:

$$(\text{Thickness of shim to be selected}) = (\text{Thickness of removed shim}) + [(\text{measured clearance}) - 0.25 \text{ mm}]$$

REFERENCE:

- As for a new shim, an identification number has been written with inerasable ink.



MEM00107-00103

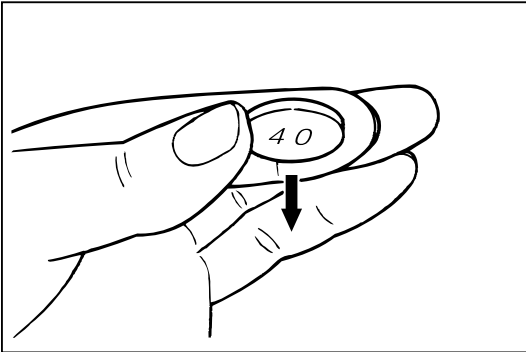
No.	Shim thickness (mm)	No.	Shim thickness (mm)	No.	Shim thickness (mm)	No.	Shim thickness (mm)
30	2.50	41	2.72	52	2.94	63	3.16
31	2.52	42	2.74	53	2.96	64	3.18
32	2.54	43	2.76	54	2.98	65	3.20
33	2.56	44	2.78	55	3.00	66	3.22
34	2.58	45	2.80	56	3.02	67	3.24
35	2.60	46	2.82	57	3.04	68	3.26
36	2.62	47	2.84	58	3.06	69	3.28
37	2.64	48	2.86	59	3.08	70	3.30
38	2.66	49	2.88	60	3.10		
39	2.68	50	2.90	61	3.12		
40	2.70	51	2.92	62	3.14		

MEM00108-00000

(11) Set the selected shim to the valve lifter.

NOTE:

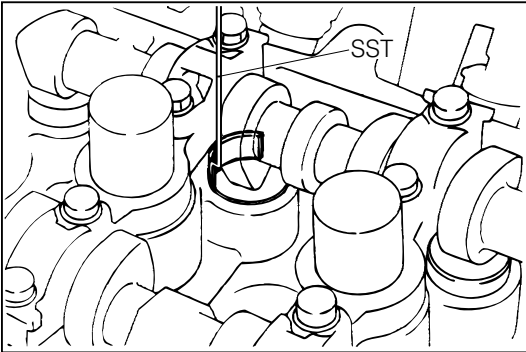
- Install the shim in such a way that the side bearing the identification number faces downward.



MEM00109-00104

(12) Turn the crankshaft so that the cam nose faces downward and pushes down the valve lifter. In this state, remove the SST.

(13) Turn the crankshaft two or three turns. Check the valve clearance. If it fails to meet the specification, repeat the steps from (5) through (13).



MEM00110-00105

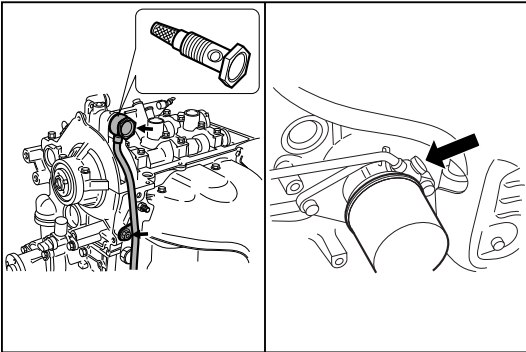
30. Install the oil pipe to the camshaft bearing cap No. 1.
Tightening Torque: 52.0 ± 5.0 N·m

NOTE:

- Be sure to interpose the gasket.

31. Install the oil pipe cramp bolt to the cylinder head.
32. Tighten the oil pipe union bolt at the oil filter bracket side that has been loosened.

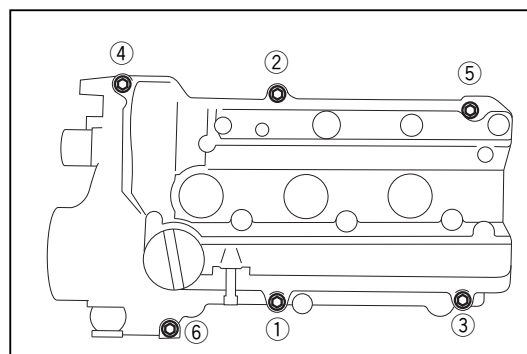
Tightening Torque: 39.0 ± 5.0 N·m



MEM00111-00106

33. Install the cylinder head cover to the cylinder head with the gasket interposed, following the sequence shown in the right figure.

Tightening Torque: $5.5 \pm 1.1 \text{ N}\cdot\text{m}$



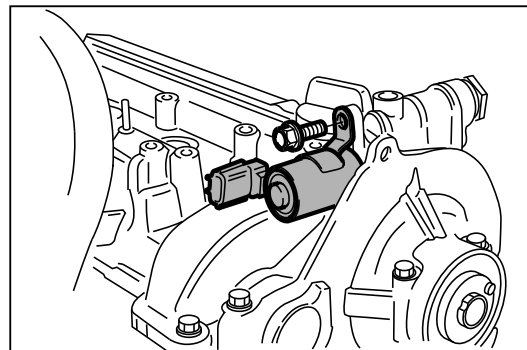
MEM00112-00107

34. Install the oil control valve to the camshaft bearing cap No. 1.

Tightening Torque: $8.0 \pm 2.7 \text{ N}\cdot\text{m}$

NOTE:

- Be sure to completely remove any foreign matter that may lodge at the installation hole or oil control valve.
- Apply engine oil to the O-ring section.



MEM00113-00108

35. Install the timing belt. (Refer to the "TIMING BELT" section.)
36. Install the timing belt cover. (Refer to the "TIMING BELT" section.)
37. Install the crankshaft pulley.

Tightening Torque: $98.0 \pm 10.0 \text{ N}\cdot\text{m}$

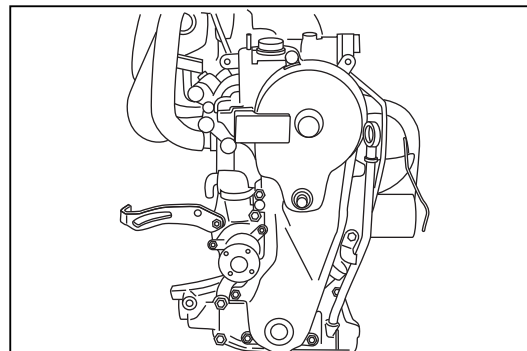
38. Install the surge tank stay to the cylinder head cover.

Tightening Torque: $9.0 \pm 2.7 \text{ N}\cdot\text{m}$

39. Connect the vacuum hose to the cylinder head and intake manifold.

40. Install the ignition coil to the cylinder head cover.

Tightening Torque: $6.0 \pm 1.8 \text{ N}\cdot\text{m}$



MEM00114-00109

SERVICE SPECIFICATIONS

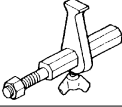
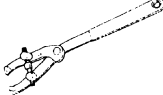
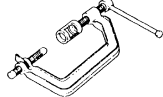
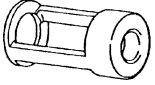
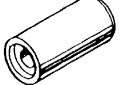
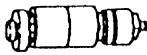
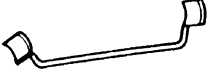
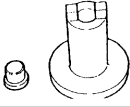
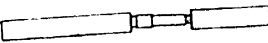
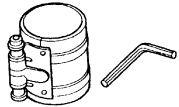
Engine type			EJ-DE	EJ-VE	
Type			Petrol, 4 cycle		
Cylinder No.			3-cylinder-in-line		
Combustion chamber type			Pent roof type		
Valve mechanism			DOHC	DOHC, DVVT	
Bore × Stroke			72.0 mm × 81.0 mm		
Total displacement			989 cc		
Compression ratio			10.0 ± 0.3		
Compression pressure			1579 - 1755 kPa at 400 rpm (16.1 - 17.9 kg/cm ²)	1363 - 1538 kPa at 400 rpm (13.9 - 15.7 kg/cm ²)	
Maximum output			40.5/5200 (kW/rpm)	43.0/6000 (kW/rpm)	
Maximum torque			88.3/3600 (N·m/rpm)		
Number of piston ring		Compression ring		2	
		Oil ring		1	
Valve timing		Intake	Open	BTDC 3.5°	BTDC 58° ~ -2°
			Close	ABDC 42.5°	ABDC 2° ~ 62°
		Exhaust	Open	BBDC 36.5°	BBDC 44°
			Close	ATDC 5.5°	ATDC 6°
Vale clearance		Intake (Cold)		0.18 ± 0.05 mm	
		Exhaust (Cold)		0.25 ± 0.05 mm	
Idling speed	M100 series	STD		850 ± 50 rpm	
		Tropical spec.		900 ± 50 rpm	
	M100 series	AUS		900 ± 50 rpm	—
	L700, L900 series		850 ± 50 rpm		—
	Blow-by gas recirculating system			Closed type	

Component	Item		EJ-DE	EJ-VE
Timing belt	Belt tension (When the midpoint of the belt at the tension side is pushed 5 mm)		11.8 - 16.7 N·m	
Camshaft	Camshaft journal outer dia. (IN, EX)	No. 1	25.979 - 25.995 mm	
		No. 2, No.3, No. 4	22.979 - 22.995 mm	
	Camshaft bearing cap inner dia. (IN, EX)	No. 1	26.032 - 26.052 mm	
		No. 2, No. 3, No. 4	23.032 - 23.052 mm	
	Oil clearance (IN, EX)	No. 1	0.037 - 0.073 mm	
		No. 2, No. 3, No. 4	0.037 - 0.073 mm	
	Camshaft thrust clearance (IN, EX)		0.04 - 0.10 mm	
	Cam lobe height (IN, EX)		40.25 mm	
	Camshaft for runout		0.03 mm	
Cylinder head	Warpage	Cylinder block side	0.1 mm	
		Intake manifold side	0.1 mm	
		Exhaust manifold side	0.1 mm	
	Cylinder head height		103.0 mm	
	Valve seat angle	IN	45°	
		EX	45°	
	Valve lifter outer dia.		27.975 - 27.985 mm	
	Inner dia. of the cylinder head valve lifter bore		28.000 - 28.021 mm	
	Valve lifter oil clearance		0.015 - 0.046 mm	
Valve	Valve stem dia.	IN	4.975 - 4.990 mm	
		EX	4.965 - 4.980 mm	
	Inner dia. of valve guide bush		5.000 - 5.012 mm	
	Valve stem oil clearance	IN	0.010 - 0.037 mm	
		EX	0.020 - 0.047 mm	
	Valve length	IN	79.4 mm	
		EX	79.8 mm	
	Valve face angle (IN, EX)		44.5°	
	Valve stock thickness (IN, EX)		1.0 ± 0.2 mm	
	Valve recession	IN	3.0 mm	
		EX	3.0 mm	
	Width of the contact surface of valve seat		1.4 ± 0.5 mm	
Valve spring	Valve stem oil seal installed position	IN	14.2 ± 0.8 mm	
		EX	11.2 ± 0.8 mm	
	Free length		37.1 mm	
	Valve spring for squareness		1.3 mm	
	Minimum tension/installation height		123.17 ± 8.63 N/32.0 mm	

EM-30

Component	Item		EJ-DE	EJ-VE
Cylinder block	Surface contacting the cylinder head gasket for warpage		0.1 mm	
	Cylinder block height		235.9 - 236.1 mm	
	Cylinder bore dia.		72.000 - 72.030 mm	
	Piston outer dia.		71.965 - 71.995 mm	
	Piston-to-cylinder bore oil clearance		0.025 - 0.045 mm	
	Crankshaft thrust clearance		0.02 - 0.22 mm	
	Connecting rod thrust clearance		0.15 - 0.25 mm	
	Width of big end of connecting rod in thrust direction		19.80 - 19.85 mm	
	Side width of crankpin journal		20.00 - 20.05 mm	
Connecting rod	Connecting rod big end bore dia.		43.000 - 43.024 mm	
	Crankpin dia.		39.076 - 40.000 mm	
	Oil clearance between the crankpin journal and the connecting rod cap		0.020 - 0.044 mm	
	Connecting rod for bend		0.05 mm	
	Connecting rod for twist		0.05 mm	
Crankshaft	Crankshaft main journal dia.		45.976 - 46.000 mm	
	Cylinder block main journal dia.		50.000 - 50.024 mm	
	Oil clearance between the crankshaft main journal and crankshaft bearing cap		0.004 - 0.028 mm	
	Crankshaft for runout		0.06 mm	
Piston	Piston pin outer dia.		17.994 - 17.997 mm	
	Piston pin hole of piston dia.		18.002 - 18.005 mm	
	Piston-to-piston pin oil clearance		0.005 - 0.011 mm	
	Connecting rod small end bore dia.		17.953 - 17.979 mm	
	Connecting rod-to-piston pin interference fit		0.015 - 0.044 mm	
	Piston ring groove side clearance	No. 1	0.03 - 0.07 mm	
		No. 2	0.02 - 0.06 mm	
	Piston ring end gap	No. 1	0.20 - 0.35 mm	
		No. 2	0.22 - 0.37 mm	
		Oil ring	0.15 - 0.50 mm	
Flywheel	Flywheel for runout		0.1 mm	

SSTs

Shape	Part number	Part name	Remarks
	09210-87701-000	Fly wheel holder	
	09504-87501-000	Differential side bearing adjusting nut wrench	
	09202-87002-000	Valve cotter remover & replacer	
	09202-87002-0A0	Valve cotter attachment	
	09202-87702-000	Valve spring replacer	
	09202-87202-000	Valve sprig replacer body	
	09202-87201-000	Valve spring replacer pivot	
	09237-87201-000	Replacer	
	09707-87302-000	Spring bush remover & replacer	
	09221-87208-000	Exchange attachment shim	
	09032-00100-000	Oil pan seal cutter	
	09221-87207-000	Piston pin body remover & replacer	
	09221-87206-000	Piston pin remover & replacer	
	09608-87302-000	Axle hub & drive pinion bearing tool set	
	09217-87001-000	Piston replacing guide	

TIGHTENING TORQUE

Components	N·m	kgf·m	Remarks
Cylinder head × Ignition coil	6.0 ± 1.8	0.6 ± 0.18	
Cylinder head × Spark plug	17.5 ± 3.0	1.8 ± 0.3	
Cylinder head × Cylinder head cover	5.5 ± 1.1	0.55 ± 0.11	
Cylinder head × Fuel delivery pipe	19.0 ± 3.8	1.95 ± 0.39	
Cylinder head × Intake manifold	19.0 ± 3.8	1.95 ± 0.39	
Cylinder head × Exhaust manifold	25.0 ± 5.0	2.6 ± 0.5	
Cylinder head × Water inlet	19.0 ± 3.8	1.95 ± 0.39	
Cylinder head × Cam/crank angle sensor	8.0 ± 1.6	0.8 ± 0.16	
Cylinder head × Cam angle sensor	8.0 ± 1.6	0.8 ± 0.16	
Cylinder head × Engine coolant temperature sensor	24.0 ± 4.8	2.5 ± 0.5	
Cylinder block × Cylinder head	54.0 ± 5.0	5.5 ± 0.5	
Cylinder block × Timing belt cover	5.5 ± 1.1	0.55 ± 0.11	
Cylinder block × Timing belt tensioner	39.0 ± 7.8	4.0 ± 0.8	
Cylinder block × Rear oil seal retainer	12.5 ± 2.5	1.3 ± 0.26	
Cylinder block × Rear end plate	21.0 ± 4.2	2.1 ± 0.42	
Cylinder block × Oil pan	8.0 ± 1.6	0.8 ± 0.16	
Cylinder block × Oil pump	19.0 ± 3.8	1.95 ± 0.39	
Oil pump × Oil strainer	8.0 ± 1.6	0.8 ± 1.6	
Oil pan drain plug	24.0 ± 4.8	2.5 ± 0.5	
Camshaft bearing cap No. 1, No. 2	12.5 ± 2.0	1.3 ± 0.2	
Surge tank stay × Cylinder head cover	9.0 ± 2.7	0.9 ± 0.27	
Water pump pulley × Water pump	9.5 ± 1.9	0.95 ± 0.19	
Camshaft timing belt pulley × Camshaft	98.0 ± 10.0	10.0 ± 1.0	
Exhaust manifold × Heat insulator	11.5 ± 2.3	1.15 ± 0.23	
Exhaust manifold × O ₂ sensor	34.0 ± 5.0	3.4 ± 0.5	Never use an impact wrench
Connecting rod cap nut	36.0 ± 6.0	3.7 ± 0.6	
Crankshaft bearing cap bolt	59.0 ± 6.0	6.0 ± 0.6	
Crankshaft pulley set bolt	98.0 ± 10.0	10.0 ± 1.0	
Crankshaft × Flywheel	25 - 34	2.5 - 3.5	Temporarily tightening
	44.0 ± 5.0	4.5 ± 0.5	
Oil filter bracket × Cylinder block	19.0 ± 3.8	1.95 ± 0.39	
Oil filter bracket × Oil pipe	39.0 ± 5.0	3.82 ± 0.49	
Oil pipe × Camshaft bearing cap No. 1	52.0 ± 5.0	5.1 ± 0.49	
Oil control valve × Cam shaft bearing cap No. 1	8.0 ± 2.7	0.8 ± 0.27	
Radiator thermo control switch × Water inlet	24.0 ± 4.8	2.4 ± 0.48	

MEM00118-00000