TO INDEX

ENGINE MECHANICAL

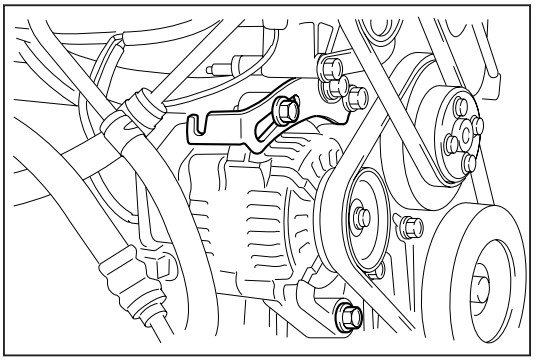
TIMING BELT

COMPONENTS

(Refer to the "CYLINDER HEAD" section.)

REMOVAL

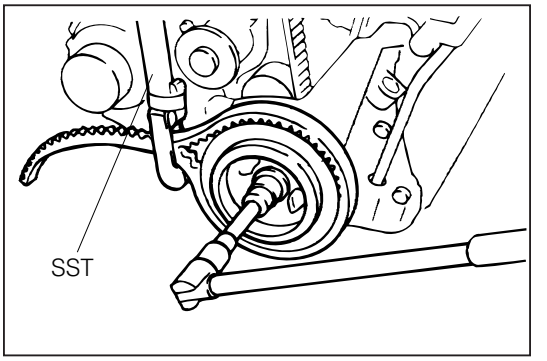
1. Loosen the all attaching bolts of the water pump pulley, utilizing the tension of the drive belt.
2. Remove the V belt. (Refer to the CH section.)
3. Remove the water pump pulley.



LEM00002-00001

4. Remove the crankshaft pulley from the crankshaft, while preventing the crankshaft pulley from being turned, using the following SST given below.
   SST: 09210-87701-000

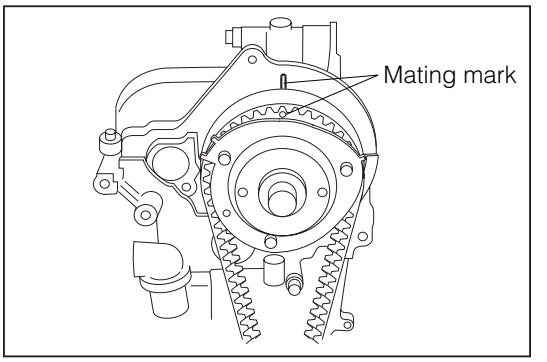
   [Reference]
   - When the crankshaft pulley is removed during the in-vehicle operation, use the SST 09213-87211-000.



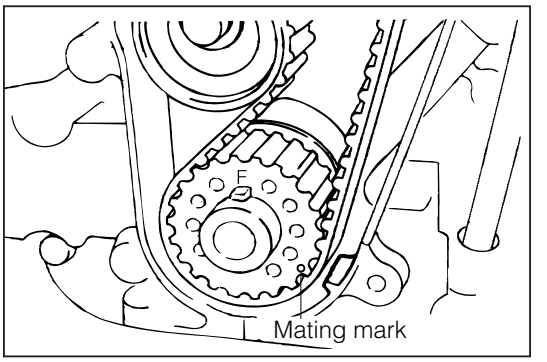
LEM00003-00002

5. Remove the timing belt cover.
6. Rotate the crankshaft, until the mating mark of the camshaft timing pulley is aligned with the mark of the cylinder head cover.
   CAUTION:
   - Perform the engine turning operation at the crankshaft side.

   NOTE:
   - Under this setting, ensure that the punched mark of the crankshaft timing belt pulley is aligned with the mating mark of the oil pump.
   - With the mating marks aligned with each other, the piston No. 1 is at the Top Dead Center under the compression stroke.



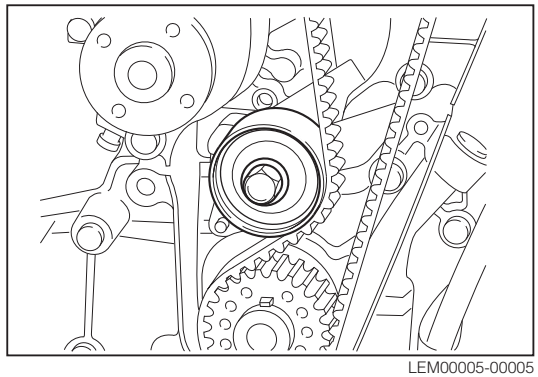
LEM00000-00202



LEM00004-00004

7. Remove the timing belt tensioner.
8. Remove the timing belt.
   CAUTION:
   - Do not try to pry the timing belt with a screwdriver or the like during the removal or installation.
   - Do not bend the belt at a sharp angle or turn the belt inside out.
   - Never turn the camshaft or crankshaft independently.

   NOTE:
   - Prior to the removal of the timing belt, put an arrow mark indicating the normal rotating direction on the belt, using a chalk or the like.
   - If the timing belt is to be re-used, ensure that the print line remains at the back side of the timing belt.
   - If the print line above wears out, the mating marks with the punched marks of the camshaft timing belt pulley and the crankshaft timing belt pulley should be put on the back side of the timing belt under a condition in which the piston No. 1 is set to the Top Dead Center under the compression stroke.

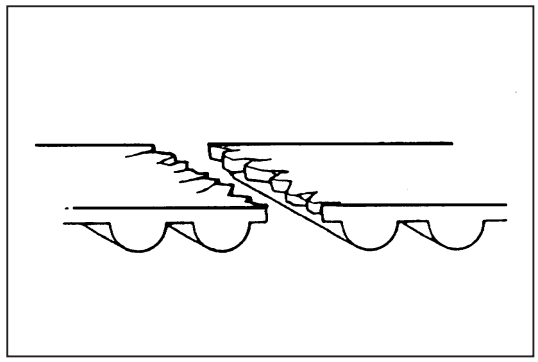

LEM00005-00005

INSPECTION

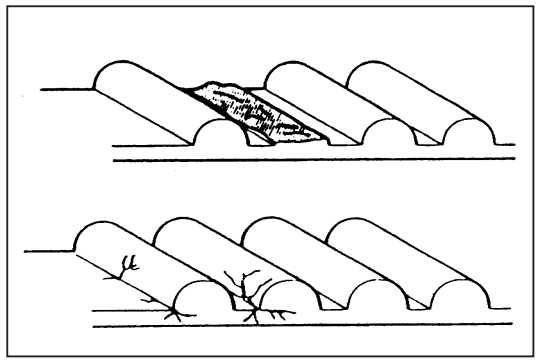
Timing belt

If there are defects, as shown in the figures, check the following points and replace the timing belt, If necessary.

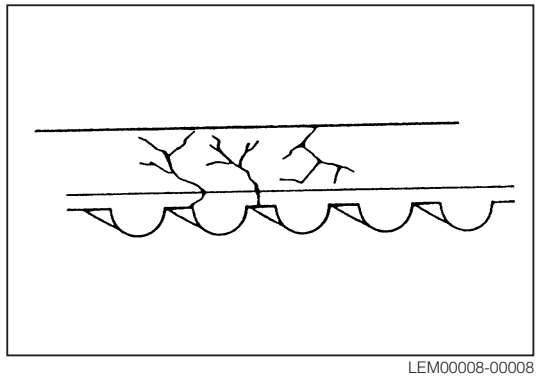
1. Premature separation
   Check for proper installation.
   Check the timing gear cover gaskets for damage and check for correct installation.


LEM00006-00006

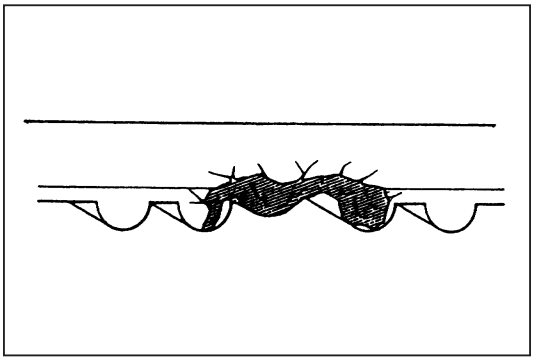
2. If the belt teeth are cracked or damaged, check to see if the camshaft is seized.


LEM00007-00007

3. If there is noticeable wear or cracks on the belt face, check to see if there are nicks on one side of the idler pulley lock.


LEM00008-00008

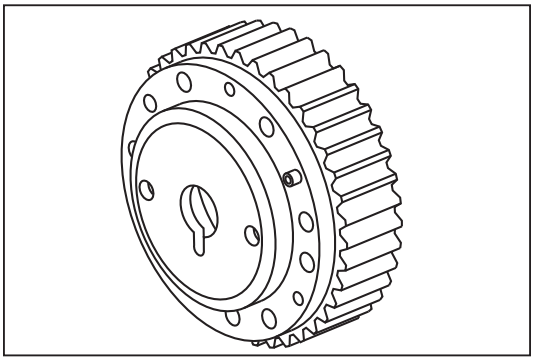
4. If there is wear or damage on only one side of the belt, check the pulley flange.



LEM00009-00009

Timing belt pulley (Crankshaft, Camshaft)

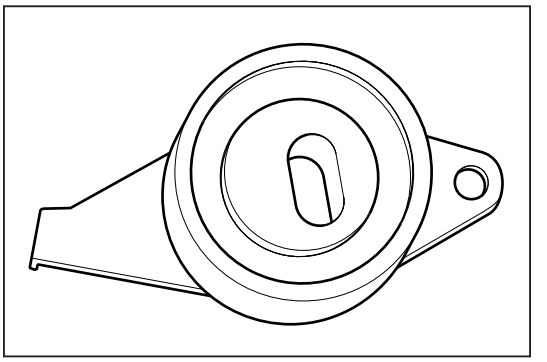
Visually inspect the timing belt pulleys for excessive wear. Replace them if they exhibit any excessive wear.
(For the replacement procedure for the camshaft timing belt pulley, refer to page "CYLINDER HEAD" section.)



LEM00215-00203

Timing belt tensioner

Turn the timing belt tensioner. Check to see if the bearing exhibits locking or emits abnormal noise. Also, check the contact surface with the belt for damage.
If any abnormality described above is present, replace the relative parts.



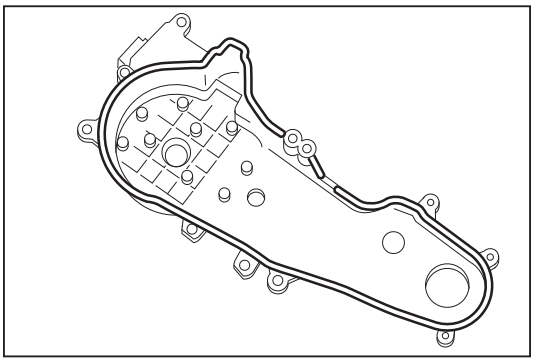
LEM00011-00011

Timing belt cover

Ensure that the gasket exhibits no damage.
If the gasket is damaged, replace it with a new one.
Affix the gasket onto the cover, using an adhesive agent.

NOTE:

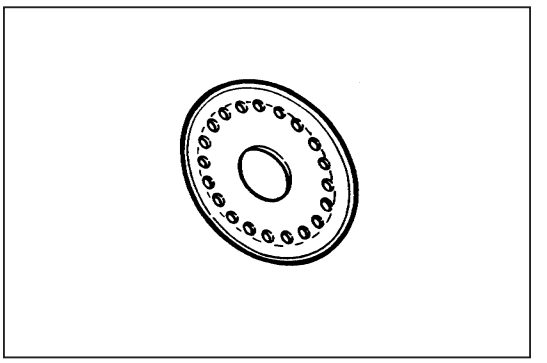
- Apply adhesive agent along the outer periphery of the timing belt cover, as indicated in the illustration.



LEM00216-00204

Crankshaft timing belt pulley flange

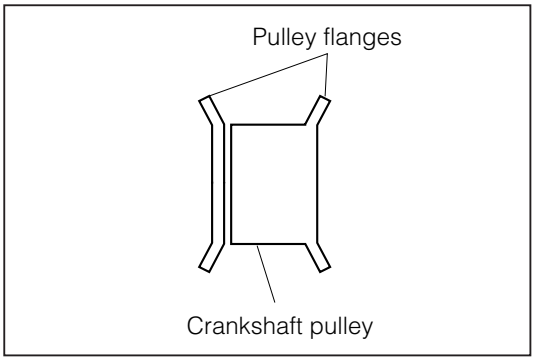
Check the crankshaft timing belt pulley flange for bend, damage and wear.
If necessary, replace the crankshaft timing belt pulley flange.



LEM00013-00013

INSTALLATION

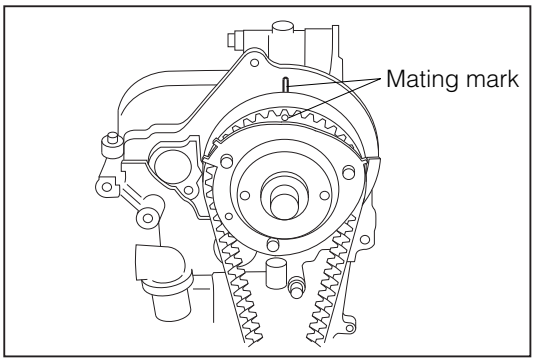
1. Install the crankshaft timing belt pulley with its flange attaching side facing toward the cylinder block.
2. Install the key to the key groove of the timing belt pulley.



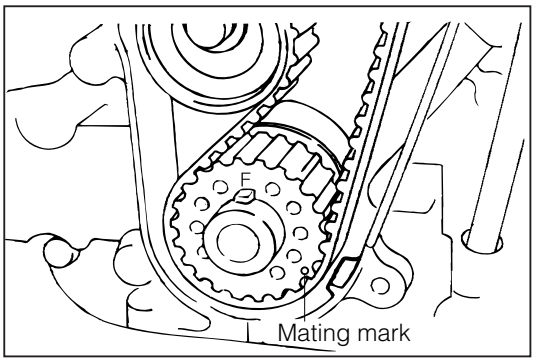
LEM00014-00014

3. Installation of timing belt
   CAUTION:
   - Do not try to pry the timing belt with a screwdriver or the like.
   - Do not bend the belt at a sharp angle or turn the belt inside out.
   - Perform the engine turning operation at the crankshaft side.
   - When the timing belt is reused, install the timing belt in such a way that the direction of the arrow put during the removal may match with the engine rotation direction.
   - Never turn the camshaft or crankshaft independently before the timing belt installation is completed.

   (1) Rotate the crankshaft, until the mating mark of the camshaft timing pulley aligns with the mark of the cylinder head cover.
   (2) Assemble the timing belt in such a way that the two mating marks on the timing belt may be aligned with the corresponding drilled marks on the crankshaft timing belt pulley and mating mark of the camshaft timing belt pulley.
   NOTE:
   - When the timing belt is reused, install the timing belt in such a way that there exist teeth of the belt between the drilled marks of the crankshaft timing belt pulley and the camshaft timing belt pulley.

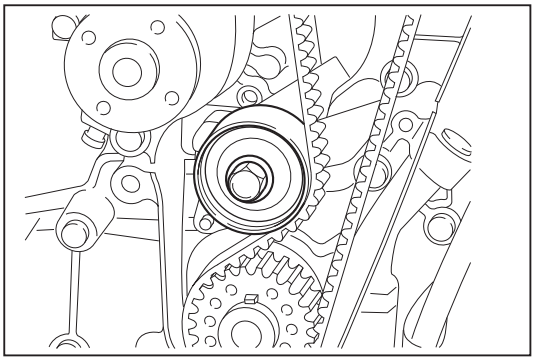


LEM00217-00205



LEM00016-00016

4. Adjustment of timing belt tension
   (1) Install the timing belt tensioner temporarily.
   NOTE:
   - Make sure that the tensioner moves freely.

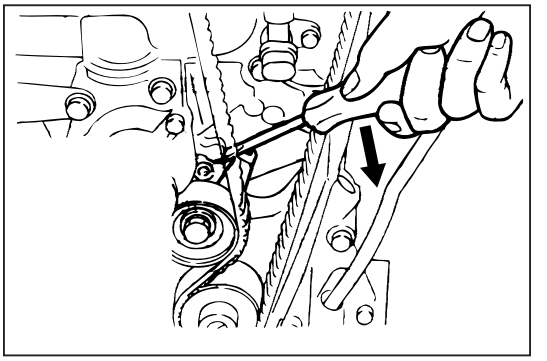

LEM00017-00017

(3) Tighten the crankshaft pulley bolt temporarily. Turn the crankshaft two turns in the engine rotating direction. Ensure that the respective mating marks of the camshaft timing belt pulley and the crankshaft timing belt pulley are aligned properly.

NOTE:

- If the crankshaft should be turned in a reversed direction, redo the operation.

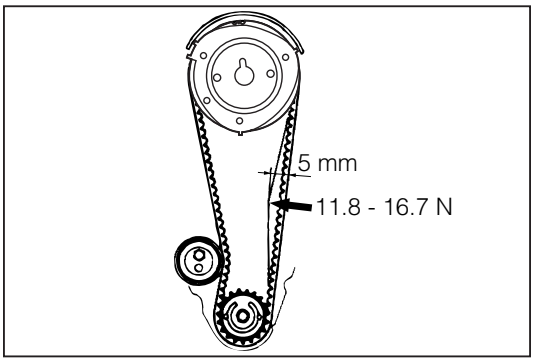
(4) Tighten the timing belt tensioner attaching bolt.
Tightening Torque: 39.0 ± 7.8 N·m



LEM00018-00018

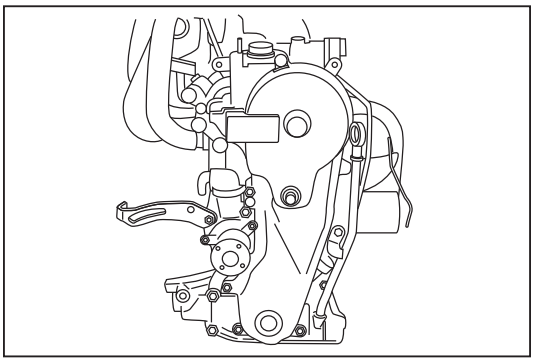
(6) Checking of timing belt tension
When the midpoint of the belt at the tension side is pushed 5 mm, ensure that the pushing force is 11.8 - 16.7 N.
Specified Pushing Force: 11.8 - 16.7 N

(When belt is deflected 5 mm)
If the amount of deflection of the timing belt is deviated, loosen the retaining bolt above of the timing belt tensioner. Readjust the gap.



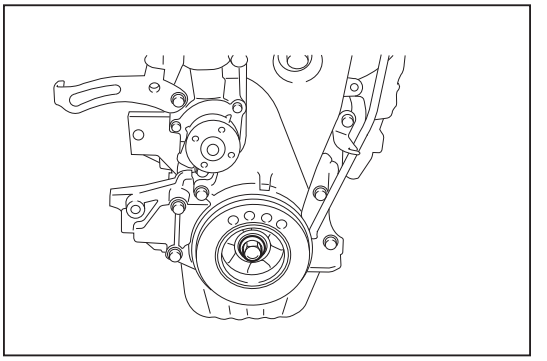
LEM00218-00206

5. Install the crankshaft timing belt pulley flange with its protruding side facing toward the timing belt pulley. (Refer to the page EM–5.)
6. Install the timing belt cover.
Tightening Torque: 5.5 ± 1.1 N·m



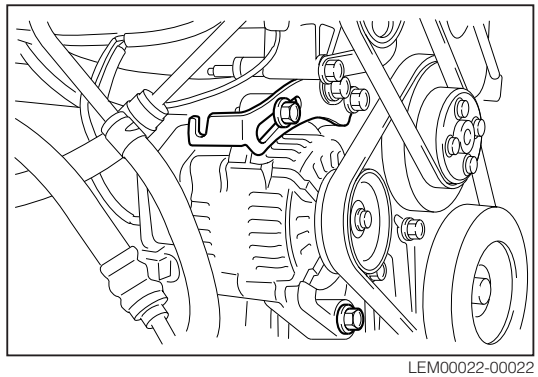
LEM00219-00207

7. Installation of crankshaft pulley set bolt
(1) Install the crankshaft pulley.
(2) Tighten the crankshaft pulley set bolt while preventing the crankshaft pulley from turning with the following SST.
SST: 09210-87701-000
Tightening Torque: 98.0 ± 10.0 N·m



LEM00021-00021

8. Temporarily install the water pump pulley with the four bolts.
9. Install the V-belt.
10. Adjust the V-belt tension.
    (Refer to the CH section.)
11. Tighten the water pump pulley attaching bolts.
    Tightening Torque: 9.5 ± 1.9 N·m

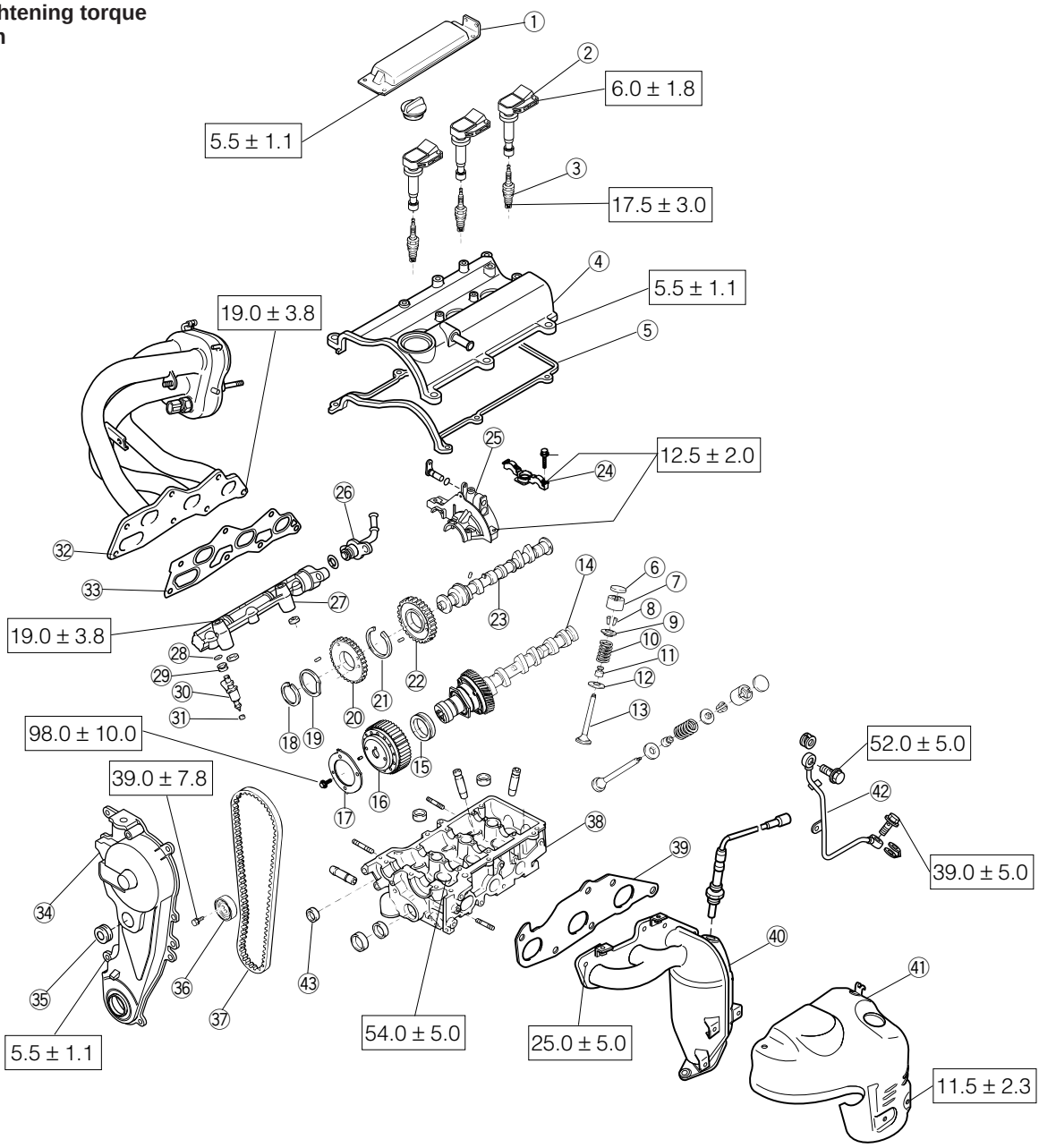


LEM00022-00022

CYLINDER HEAD

COMPONENTS

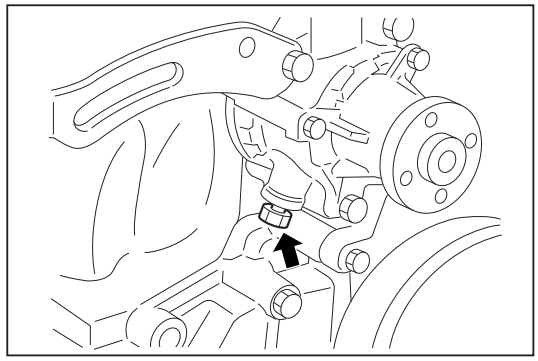
: Tightening torque
Unit : N·m



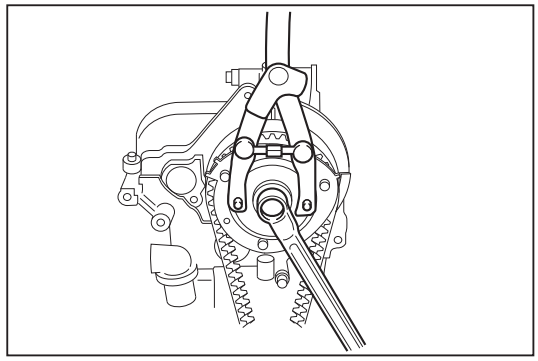
① Ignition coil cover
② Ignition coil
③ Spark plug
④ Cylinder head cover
⑤ Cylinder head cover gasket
⑥ Adjusting shim
⑦ Valve lifter
⑧ Valve spring retainer lock
⑨ Valve spring retainer
⑩ Valve spring
⑪ Valve stem oil seal
⑫ Valve seat
⑬ Valve
⑭ Camshaft No. 2
⑮ Oil seal
⑯ Camshaft timing belt pulley
⑰ Cam angle sensor rotor
⑱ Snap ring
⑲ Wave washer
⑳ Camshaft sub-gear
㉑ Camshaft gear spring
㉒ Camshaft gear
㉓ Camshaft No. 1
㉔ Camshaft bearing cap No. 2
㉕ Camshaft bearing cap No. 1
㉖ Fuel inlet tube
㉗ Fuel delivery pipe
㉘ O-ring
㉙ Grommet
㉚ Injector
㉛ Vibration insulator
㉜ Intake manifold
㉝ Intake manifold gasket
㉞ Timing belt cover
㉟ Grommet
㊱ Timing belt tensioner
㊲ Timing belt
㊳ Cylinder head
㊴ Exhaust manifold gasket
㊵ Exhaust manifold
㊶ Exhaust manifold heat insulator
㊷ Oil tube
㊸ Plug

REMOVAL

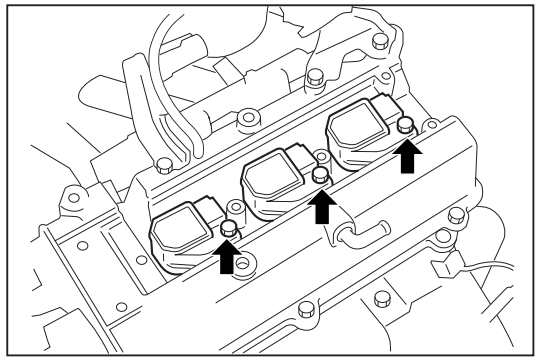
1. Remove the V-belt, water pump pulley and alternator. (Refer to the "TIMING BELT" section.)
2. Drain the engine coolant by removing the water pump drain plug.


LEM00024-00024

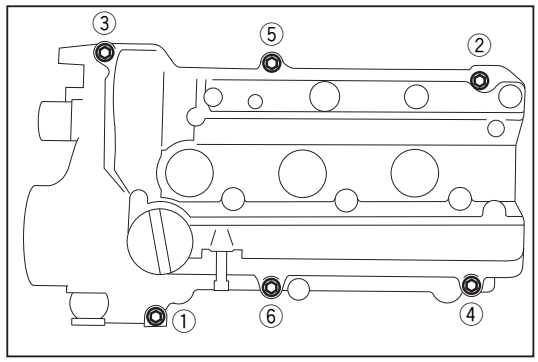
3. Remove the timing belt. (Refer to the "TIMING BELT" section.)
4. Remove the camshaft timing belt pulley, using the SST to prevent the turning of the camshaft.
   SST: 09504-87501-000


LEM00221-00209

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

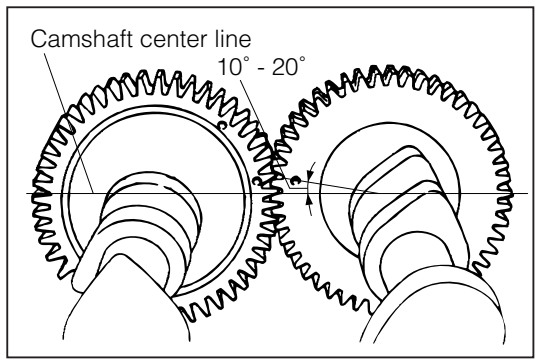

LEM00026-00026

6. Disconnect the vacuum hoses that are connected to the intake manifold and cylinder head cover.
7. Remove the surge tank stay from the cylinder head cover.
8. 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.



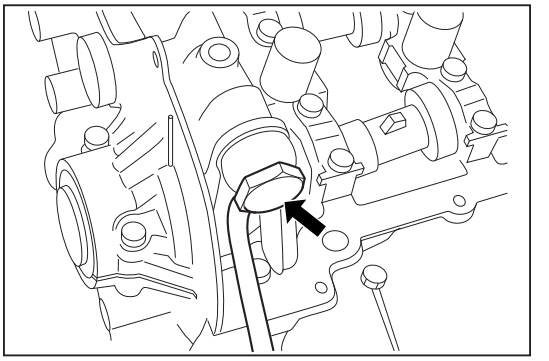
LEM00222-00210

9. 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.

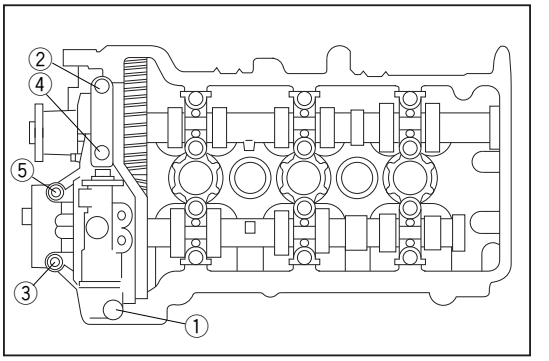


LEM00028-00028

(2) Loosen the oil pipe union bolt at the oil filter bracket side.
(3) Remove the oil pipe union bolt from the camshaft bearing cap No. 1.

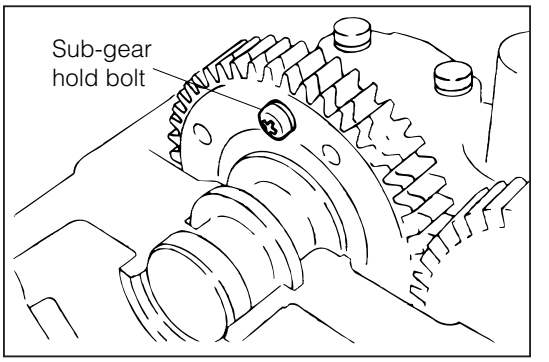

LEM00223-00211

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



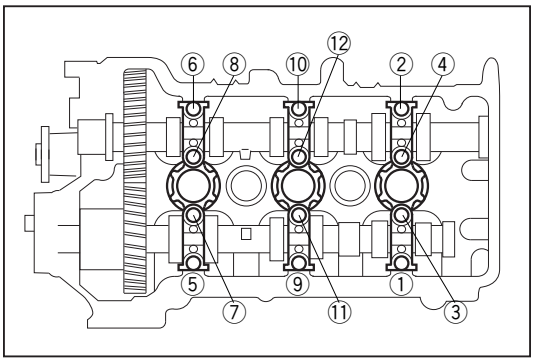
LEM00224-00222

(5) Secure the camshaft sub-gear to the gear section of the camshaft No. 2, using a bolt (M5 size with a 0.8 mm pitch).



LEM00030-00030

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



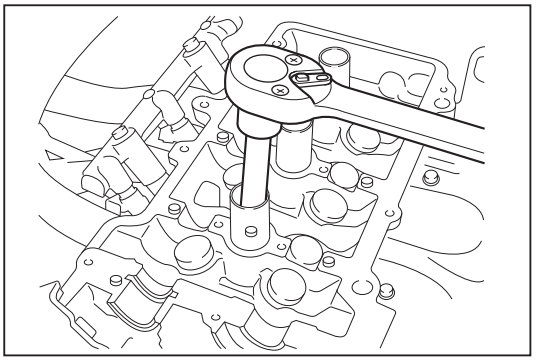
LEM00225-00223

(7) 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.)

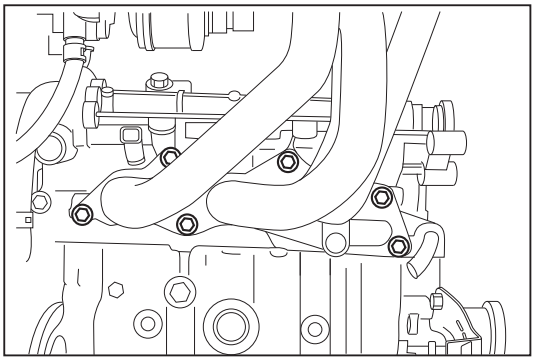
LEM00032-00000

10. Remove the spark plug from the cylinder head.



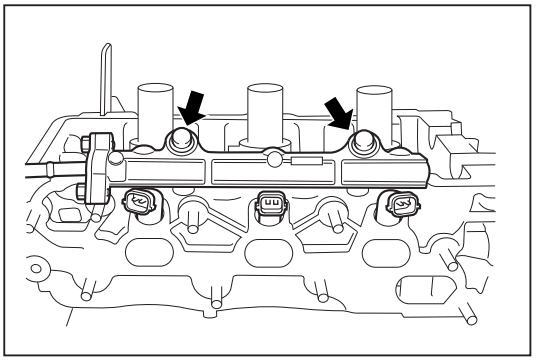
LEM00033-00032

11. Remove the intake manifold from the cylinder head.
12. Remove the intake manifold gasket from the cylinder head.
    CAUTION:
    - Never reuse the removed intake manifold gasket.



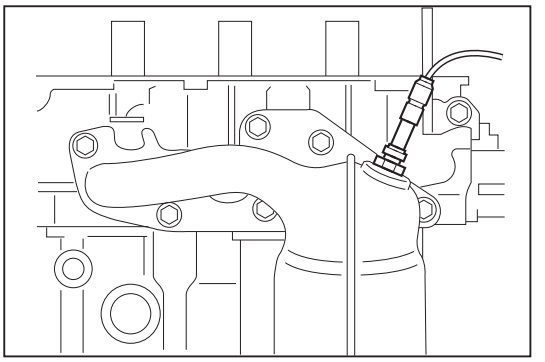
LEM00226-00224

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



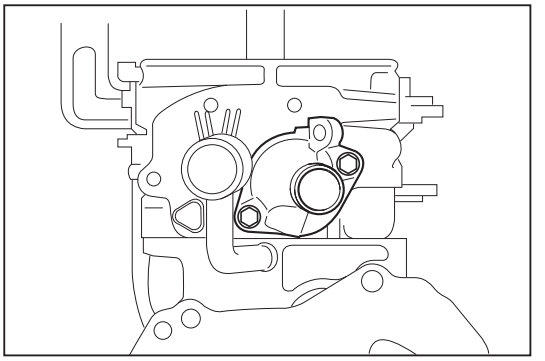
LEM00035-00034

15. Remove the O_2 sensor harness from the clamp.
16. Remove the exhaust manifold heat insulator from the exhaust manifold.
17. Remove the exhaust manifold from the cylinder head.
18. Remove the exhaust manifold gasket from the cylinder head.
    CAUTION:
    - Never reuse the removed exhaust manifold gasket.



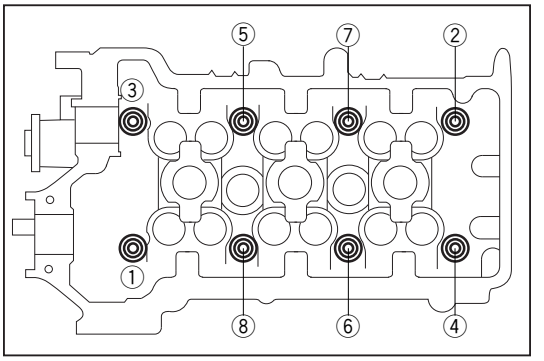
LEM00036-00035

19. Remove the water inlet from the cylinder head.
20. Remove the thermostat from the cylinder head.
21. Remove the water temperature switch.
22. Remove the cam position sensor from the cylinder head.



LEM00037-00036

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.

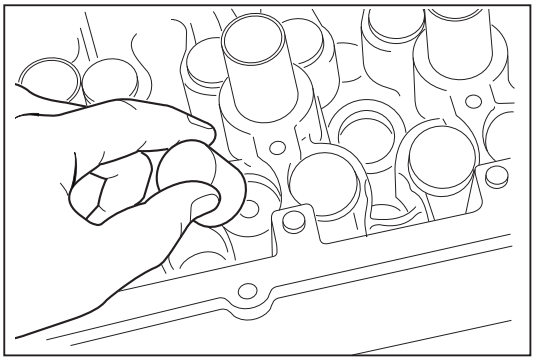


LEM00227-00225

DISASSEMBLY

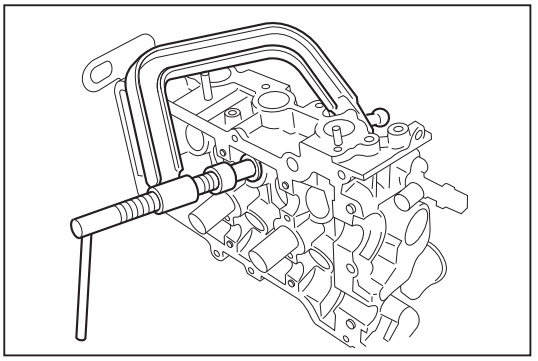
Cylinder head

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



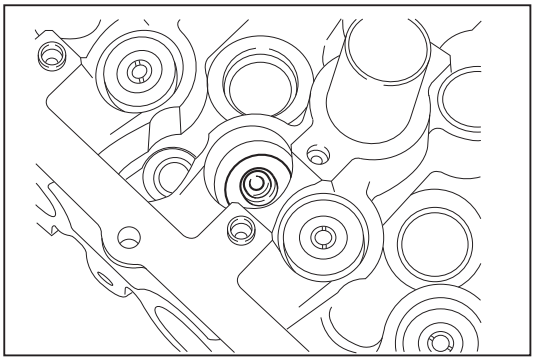
LEM00039-00038

2. Remove the valve spring retainer locks, using the following SSTs given below.
   SST: 09202-87002-000
   09202-87002-0A0



LEM00040-00039

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.



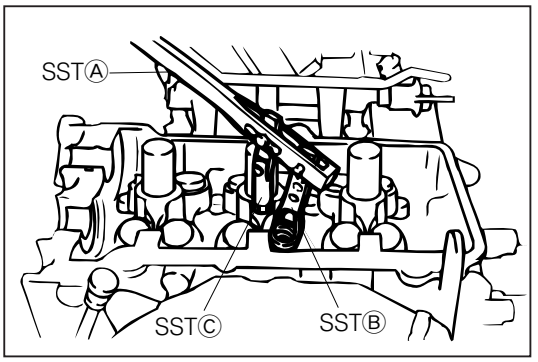
LEM00041-00040

[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.



LEM00042-00041

CAUTION:

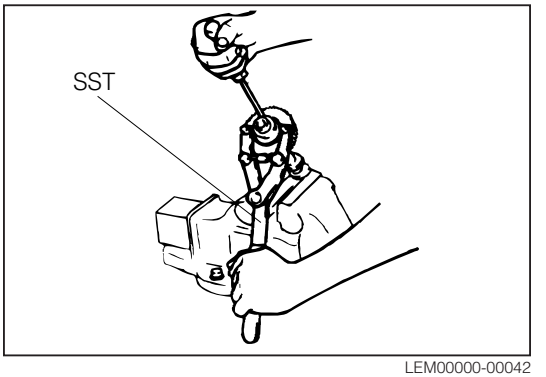
- When the valve spring retainer locks are removed, be sure to perform this removal with each piston set to the Top Dead Center, one cylinder at a time.
- Plug the oil return hole of the cylinder head with a cloth or the like so that the valve spring retainer lock may not be dropped inadvertently into the hole.
  SST: 09202-87702-000 (SSTⒶ)
  09202-87202-000 (SSTⒷ)
  09202-87203-000 (SSTⒸ)

Camshaft No. 1

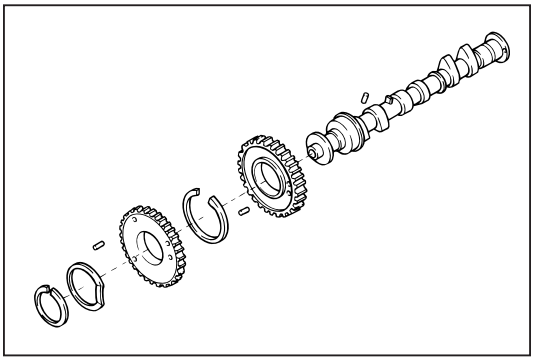
1. Secure the camshaft by clamping it in a vise.
   CAUTION:
   - Be very careful not to scratch the cam journal section.

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. Remove the wave washer, camshaft sub-gear and camshaft gear spring.



LEM00000-00042


LEM00043-00043

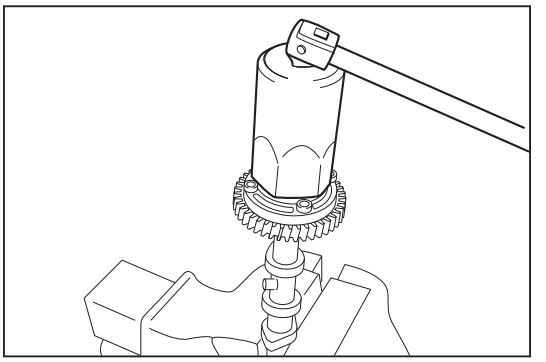
Camshaft No. 2

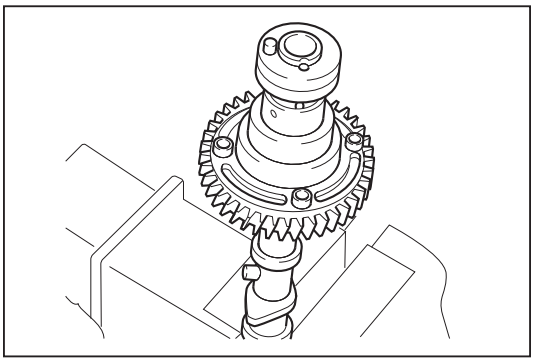
1. Secure the camshaft by clamping it in a vise.
   CAUTION:
   - Be very careful not to scratch the cam journal section.

2. Remove the nut, using the following SST.
   SST: 09607-87602-000

   NOTE:
   - It should be noted that this nut is inversely-threaded.

3. Remove the camshaft drive gear from the camshaft.


LEM00228-00226


LEM00229-00227

INSPECTION

Cylinder head

NOTE:

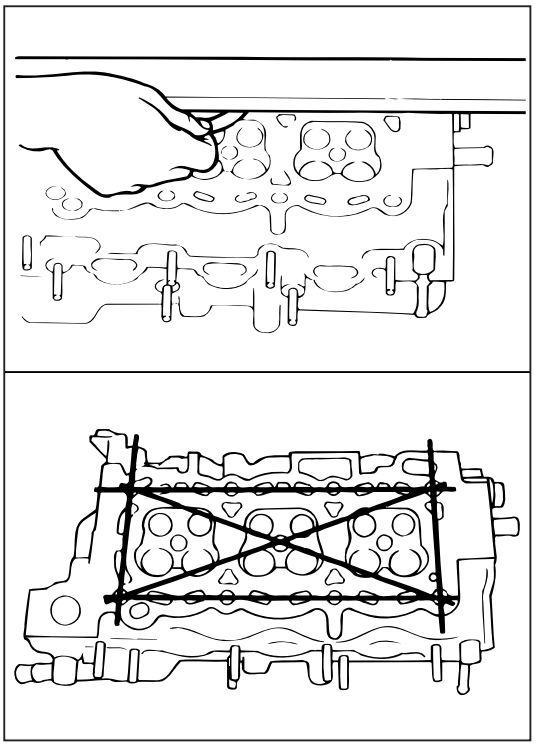
- Clean the cylinder head by removing the remaining gasket materials, carbon deposits, and so forth.
- Check the cylinder block for cracks, using a dye penetration or like.

LEM00044-00000

1. Check of cylinder head for flatness
   Using a precision straight edge and a feeler 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

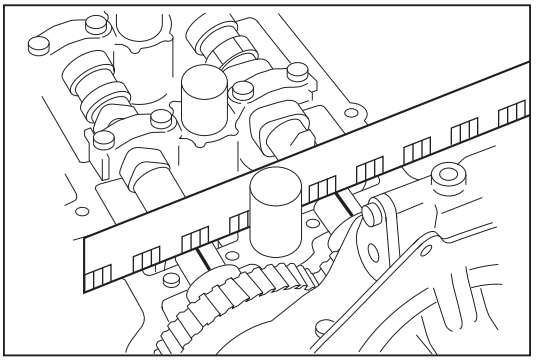


LEM00045-00044

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–20.)

(1) Measure the oil clearance between the camshaft and the camshaft bearing cap.
NOTE:
- For the tightening method of the camshaft bearing cap, refer to page EM–25.

Oil Clearance: 0.037 - 0.073 mm

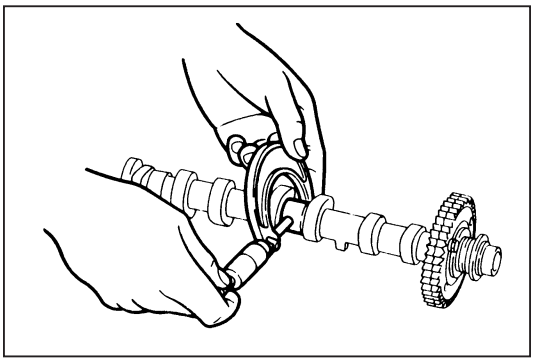

LEM00230-00228

If the oil clearance does not conform to the specification, measure the camshaft journals, camshaft bearing cap bore diameter.
Replace the any part which will not conform to the specifications.

(Reference)

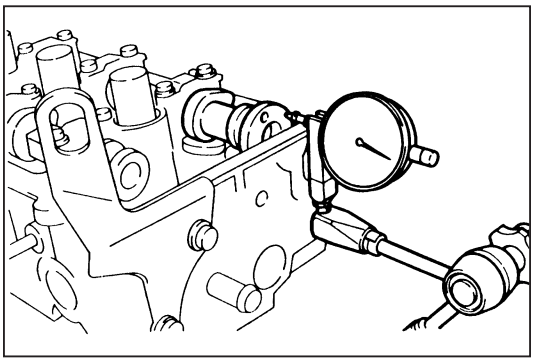
Camshaft Journal Outer Diameter
Intake side, Exhaust side:
No. 1 25.979 - 25.995 mm
No. 2, No. 3, No. 4 22.979 - 22.995 mm

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

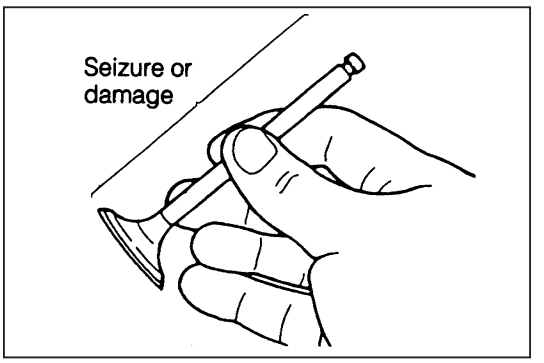

LEM00048-00047

3. Check of camshaft thrust clearance
Assemble the camshaft, referring to the assembling procedure of the camshaft in EM–25. Measure the thrust clearance.

Specified Thrust Clearance:
Intake Side 0.04 - 0.10 mm
Exhaust Side 0.04 - 0.10 mm

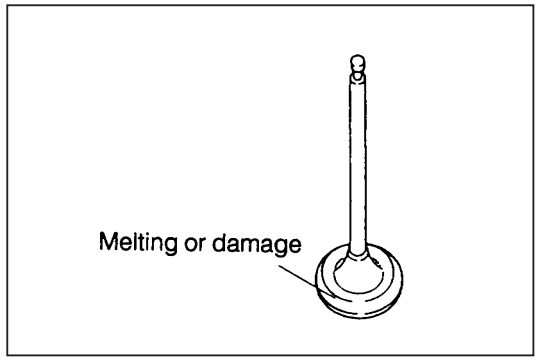

LEM00050-00048

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.



LEM00051-00049

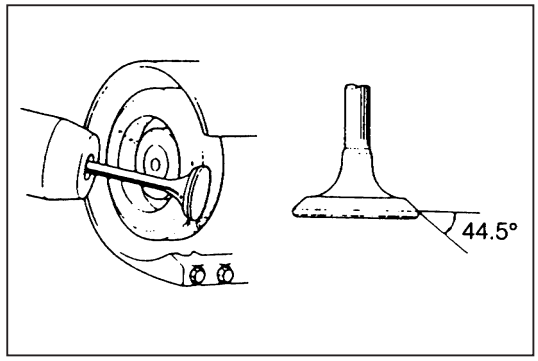
(2) Visually inspect the valve head for melting or damage.
If the valve head exhibits any melting or damage, replace the valve.
If the roughness on the contact surface can be corrected, grind the valve seat contact surface with a valve refacer.



LEM00052-00050

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

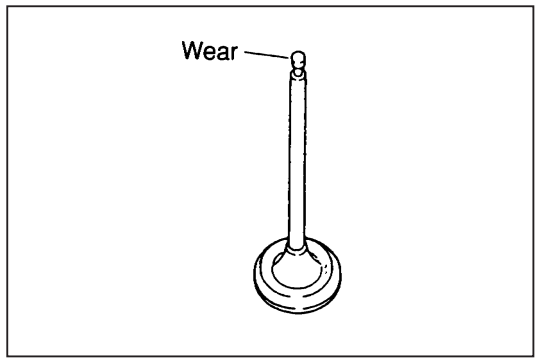
NOTE:
- Make sure the valves are ground to the correct valve face angle.



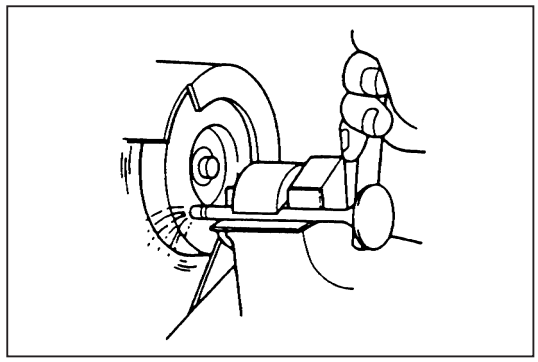
LEM00053-00051

(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

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

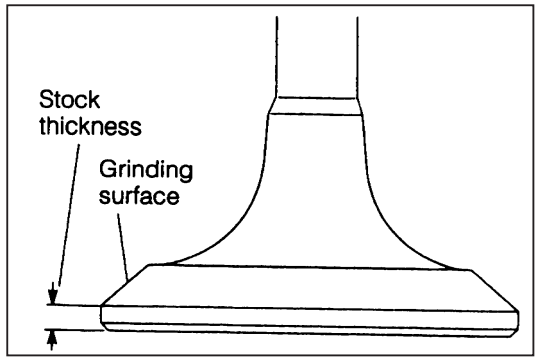


LEM00054-00052


LEM00000-00053

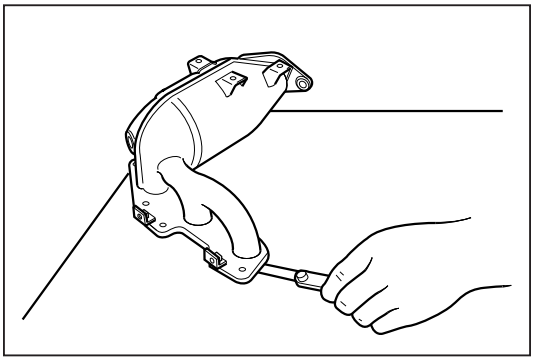
(5) Inspect the valve head for its stock thickness.
Minimum Stock Thickness:
Intake Valve: 1.0 ± 0.2 mm
Exhaust Valve: 1.0 ± 0.2 mm

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



LEM00055-00054

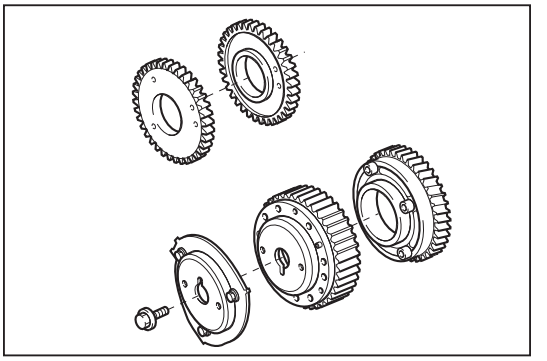
13. Check of manifold
    Check the cylinder head attaching surface of the intake manifold and exhaust manifold for warpage, using a straight edge and a thickness gauge.
    Maximum Warpage: 0.1 mm

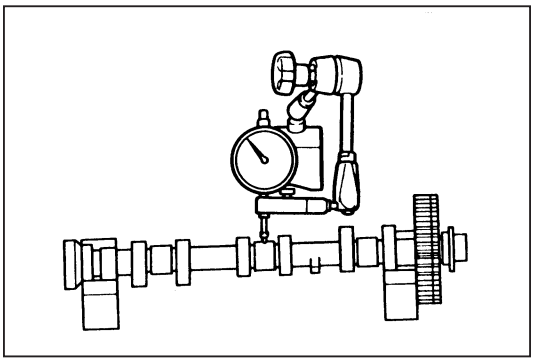

LEM00074-00073

Camshaft

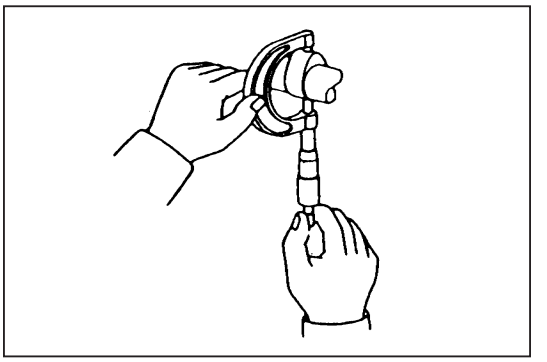
1. Check of gear
   Visually inspect the teeth for wear.
2. Check of shaft
   (1) Checking camshaft for runout
   Support the camshaft at its both ends with V-shaped blocks. Set a dial gauge to the mid-point of the center journal section of the camshaft. Turn the camshaft one turn, making sure that the 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.

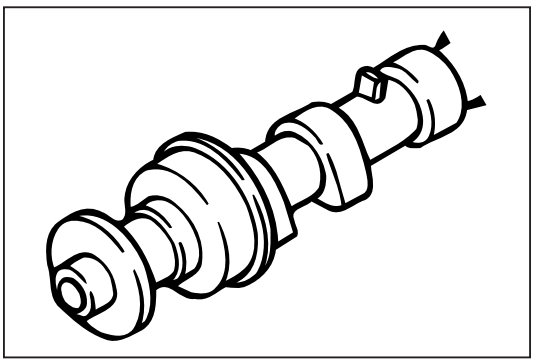

LEM00000-00229


LEM00075-00075

   (2) Checking of cam lobe height
   Measure the cam lobe height, using a micrometer.
   Specified Cam Lobe Height: 40.25 mm


LEM00076-00076

   (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.


LEM00077-00077

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

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

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

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

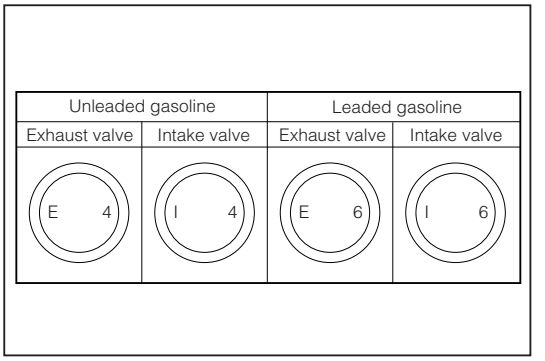
LEM00078-00000

ASSEMBLY

Cylinder head

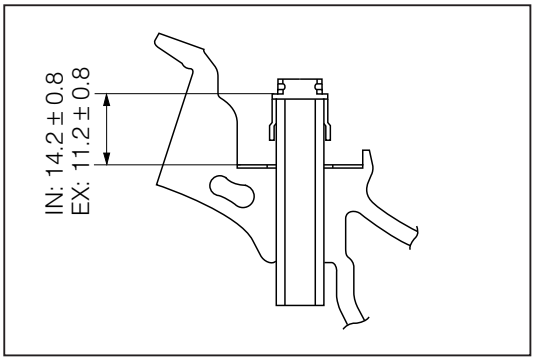
NOTE:
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new ones.

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



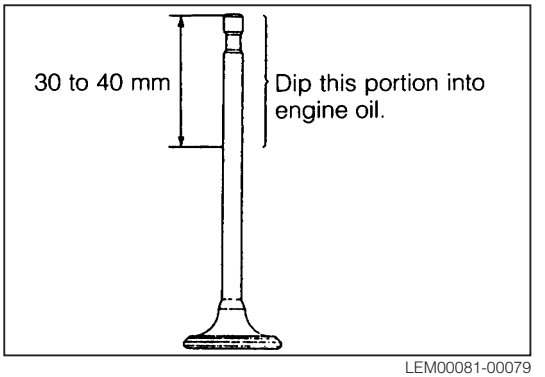
LEM00231-00230

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.



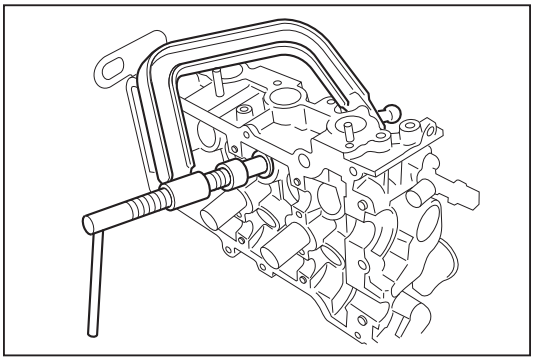
LEM00080-00078

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.

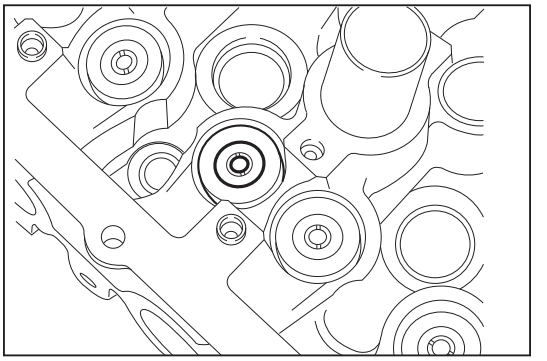


LEM00081-00079

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


LEM00083-00081

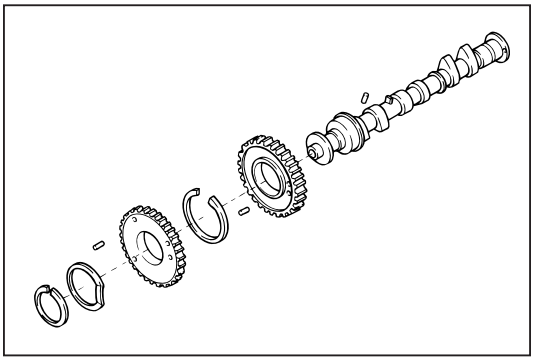
   (3) After installing the valve spring retainer lock, lightly tap the valve spring retainer with a plastic hammer or the like so as to ensure that the valve spring retainer locks are installed securely.


LEM00084-00082

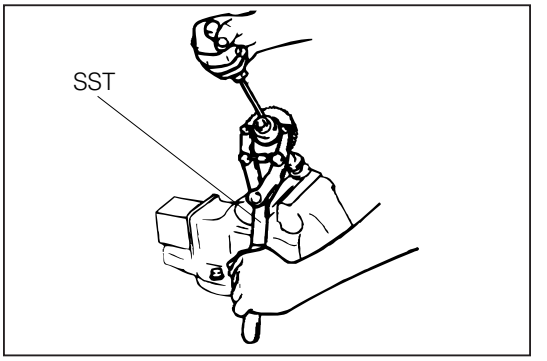
   WARNING:
   - During this operation, care must be exercised to ensure that the valve spring retainer or retainer locks may not jump out.
   - Protect your eyes with safety goggles during this operation.
   - Never tap the hole into which the valve lifter is inserted.

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


LEM00000-00083

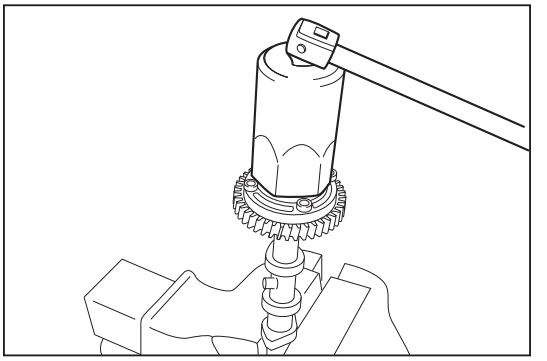
2. Turn the sub gear clockwise until the assembling auxiliary hole of the camshaft driven gear and also the teeth of the sub-gear and driven gear are aligned with each other. Install the sub gear retaining bolt (size: M5, pitch: 0.8 mm).
3. Install the camshaft rear springs, camshaft sub-gear and wave washer. Secure the components, using a shaft snap ring.



LEM00085-00084

Camshaft No. 2

1. Install the camshaft drive gear to the camshaft, using the following SST.
   SST: 09607-87602-000

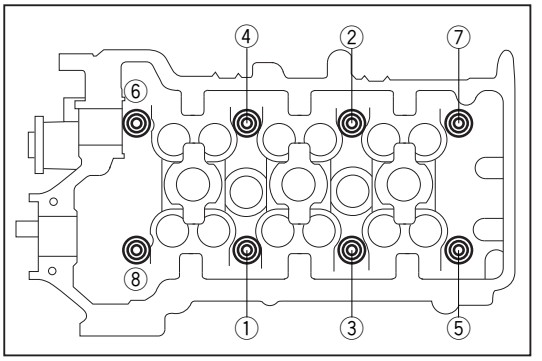

LEM000232-00231

2. Install the nut which secures the camshaft drive gear.
   CAUTION:
   - During assembling, it should be noted that this nut is inversely-threaded.
     Tightening Torque: 125 ± 7.0 N·m

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.

LEM00086-00000

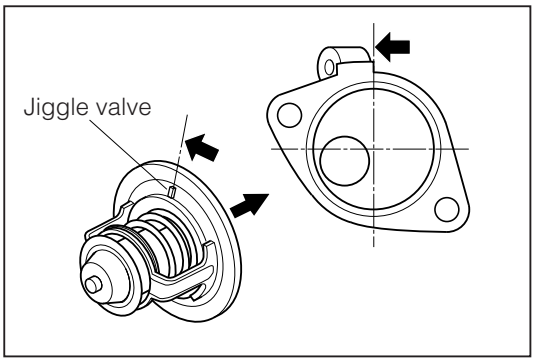


LEM00233-00232

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 ± 5.0 N·m

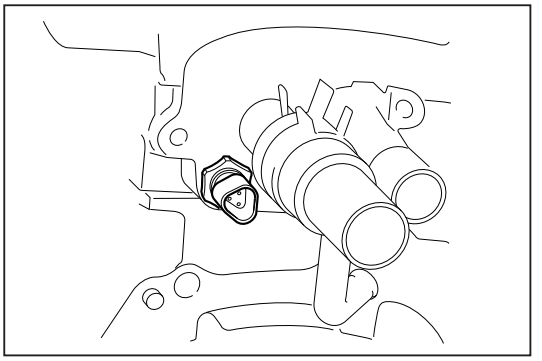
   NOTE:
   - Failure to tighten the bolts evenly may cause cracks and distortion of the cylinder head, even leading to engine seizure.
   - Make sure that all the bolts are tightened uniformly to a constant level as well as that they are tightened within the specified torque.

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 ± 3.8 N·m



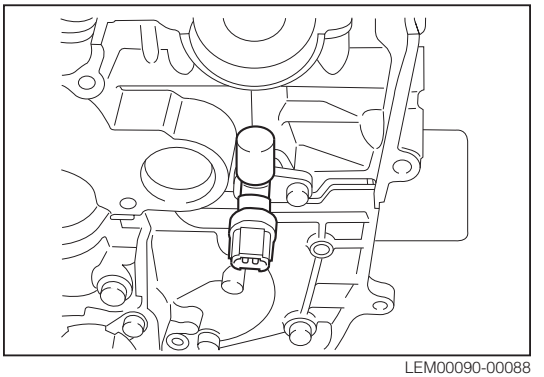
LEM00088-00086

7. Clean the threaded portion of the water 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 ± 4.8 N·m



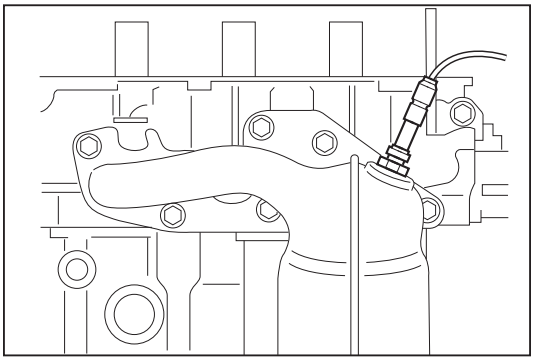
LEM00089-00087

8. Install the cam position sensor to the cylinder head.
   Tightening Torque: 8.0 ± 1.6 N·m


LEM00090-00088

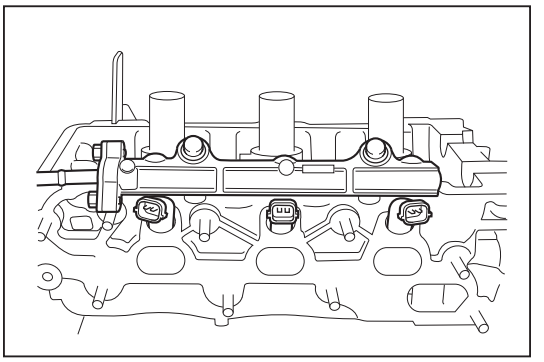
9. Install the exhaust manifold to the cylinder head with a new gasket interposed.
   Tightening Torque: 25.0 ± 5.0 N·m

10. Install the heat insulator to the exhaust manifold.
    Tightening Torque: 11.5 ± 2.3 N·m

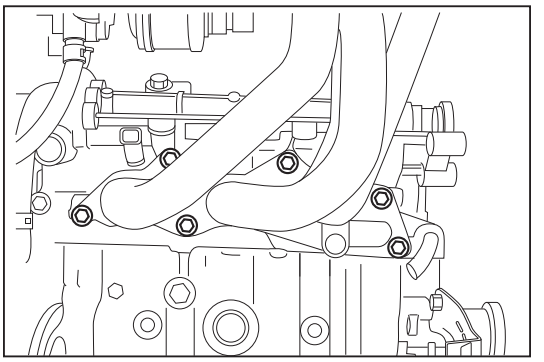

LEM00091-00089

11. Install the injector to the cylinder head in such a way that the connector faces toward the outside of the engine.
12. Apply lubrication oil to the O-ring of the injector.
13. Install the fuel delivery pipe to the cylinder head.
    Tightening Torque: 19.0 ± 3.8 N·m

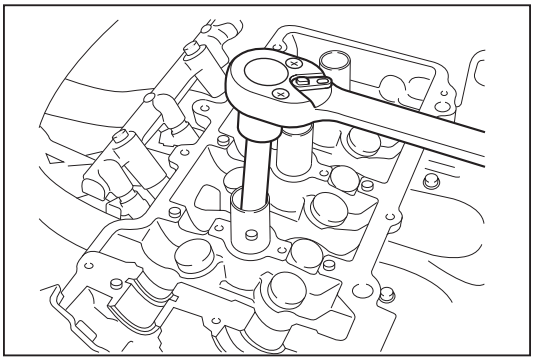
14. Turn the injector by your hand. Ensure that the injector turns smoothly, although you may feel a certain resistance.


LEM00092-00090

15. Install the intake manifold to the cylinder head with a new gasket interposed.
    Tightening Torque: 19.0 ± 3.8 N·m


LEM00234-00233

16. Install the spark plug to the cylinder head.
    Tightening Torque: 17.5 ± 3.0 N·m

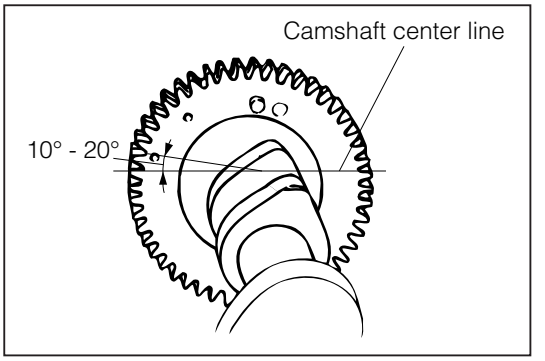

LEM00094-00092

17. 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.

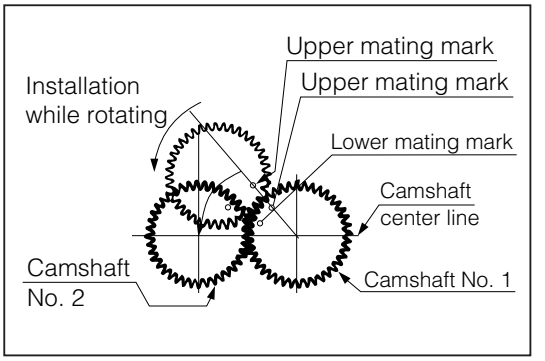
LEM00095-00000

(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.



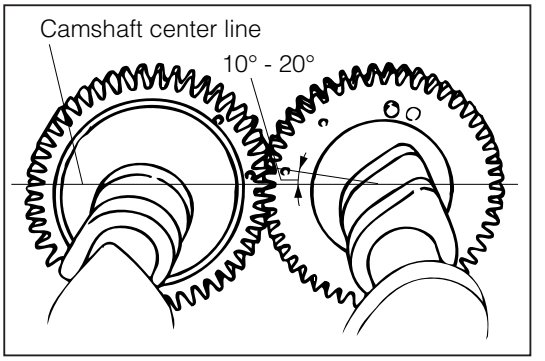
LEM00096-00093

(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.



LEM00097-00094

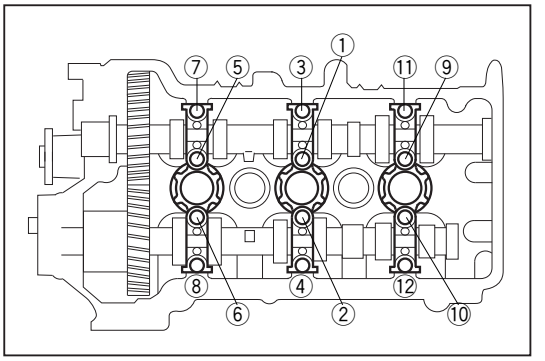
(6) While the camshaft No. 1 and camshaft No. 2 are in a set condition, ensure that the two mating marks at the back sides of the camshaft gears assume a relationship as indicated in the right figure.



LEM00098-00095

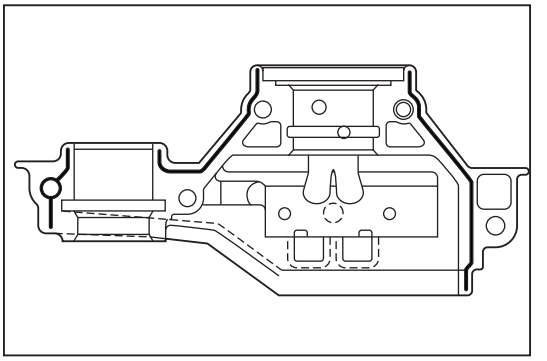
18. Install the camshaft No. 2 bearing cap, as indicated in the right figure. Tighten the attaching bolts to the specified tightening torque in a sequence specified in the right figure.
Tightening Torque: 12.5 ± 2.0 N·m

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

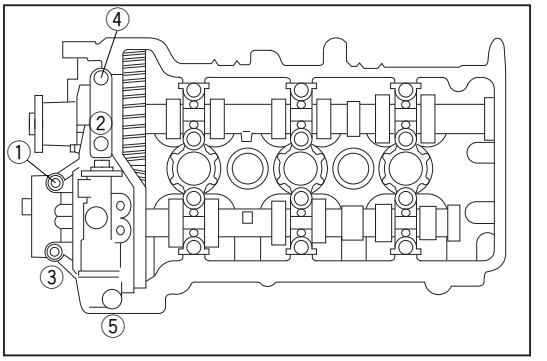


LEM00235-00234

20. 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

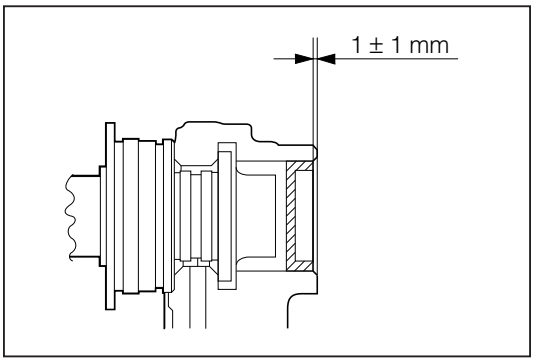

LEM00236-00235

    (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 ± 2.0 N·m



LEM00237-00236

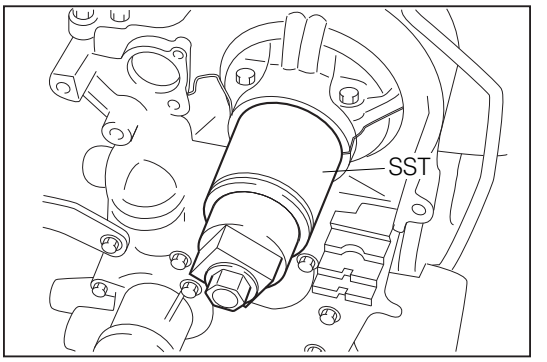
21. Press-fit the plug, using the following SST, so that the plug may assume the position shown in the figure.
    SST: 09237-87201-000



LEM00102-00099

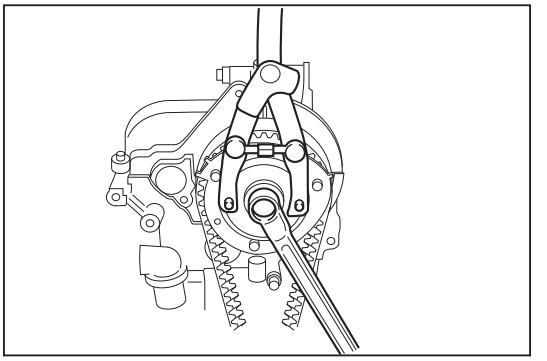
22. Apply engine oil to the lip surface of the type T oil seal. Press the oil seal into the cylinder head, until you can get a feeling of bottoming. For this installation, use the following SST in combination with a M12 bolt (whose nominal length is 80 to 90 mm).
    SST: 09707-87302-000

    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.

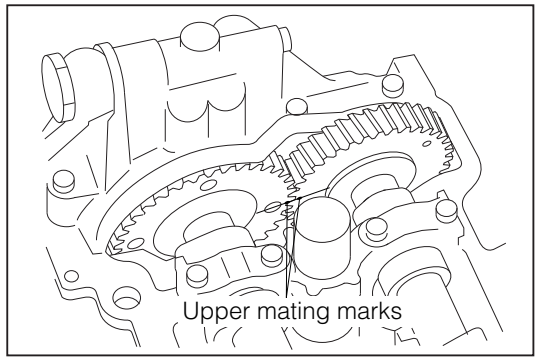


LEM00238-00237

23. 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

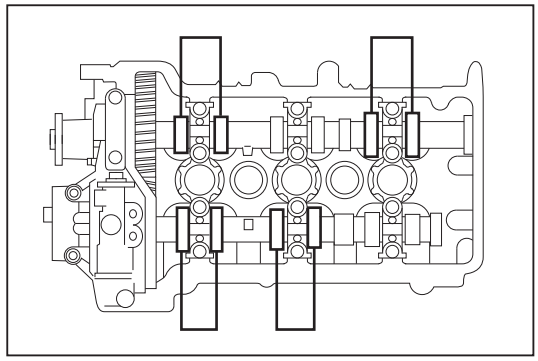

LEM00239-00238

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



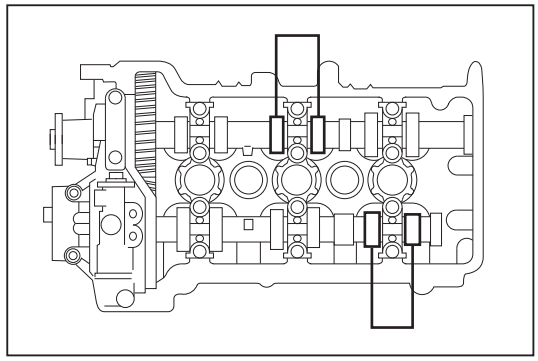
LEM00240-00239

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



LEM00241-00240

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



LEM00242-00241

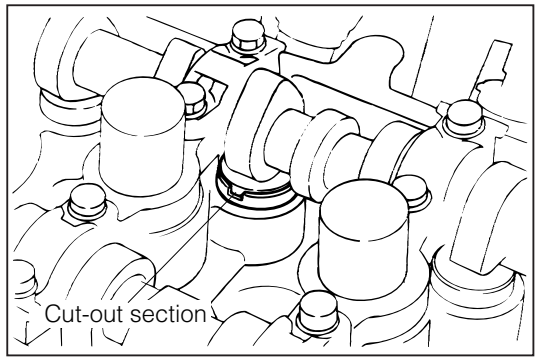
    (4) If the clearance deviates from the specified value, replace the shim in the following procedure and adjust it to the specified value.

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)

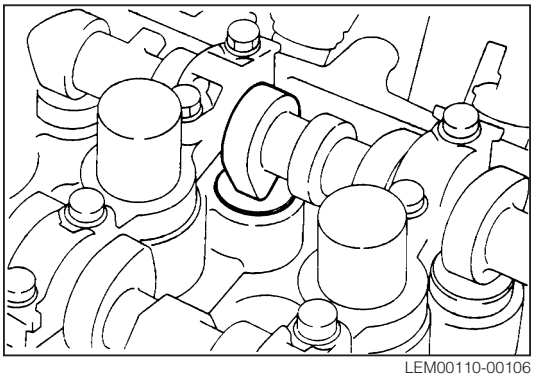
LEM00108-00000

    (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.

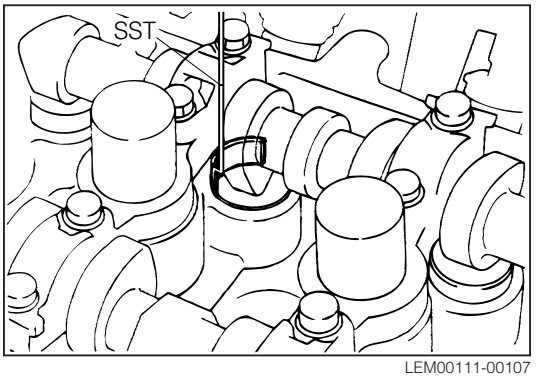


LEM00109-00105

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

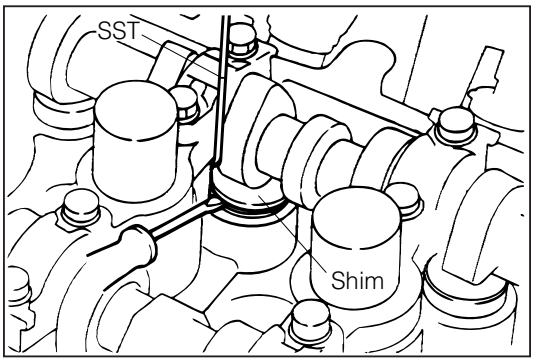

LEM00110-00106

(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



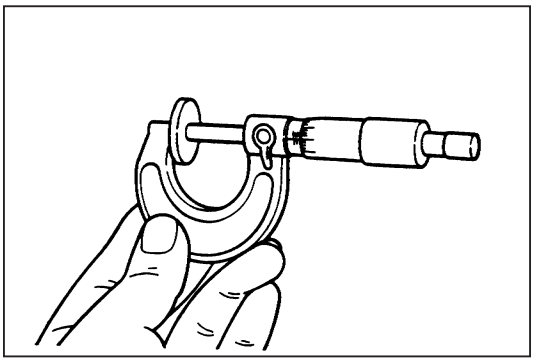
LEM00111-00107

(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.



LEM00112-00108

(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
(Thickness of shim to be selected)=(Thickness of removed shim) + [(measured clearance) - 0.18 mm]
Exhaust Valve
(Thickness of shim to be selected)=(Thickness of removed shim) + [(measured clearance) - 0.25 mm]


LEM00113-00109

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

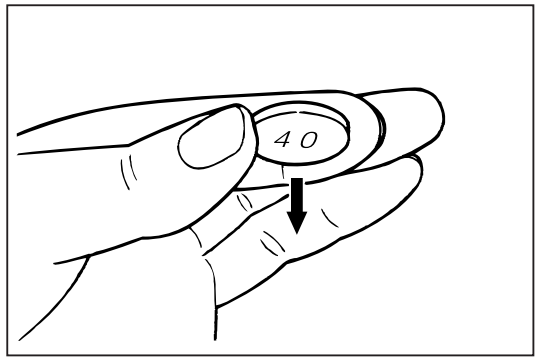
No.	Shim thickness (mm)	No.	Shim thickness (mm)	No.	Shim thickness (mm)	No.	Shim thickness (mm)
30	2.50	41	2.72	52	2.94	63	3.16
31	2.52	42	2.74	53	2.96	64	3.18
32	2.54	43	2.76	54	2.98	65	3.20
33	2.56	44	2.78	55	3.00	66	3.22
34	2.58	45	2.80	56	3.02	67	3.24
35	2.60	46	2.82	57	3.04	68	3.26
36	2.62	47	2.84	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		

LEM00114-00000

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

NOTE:

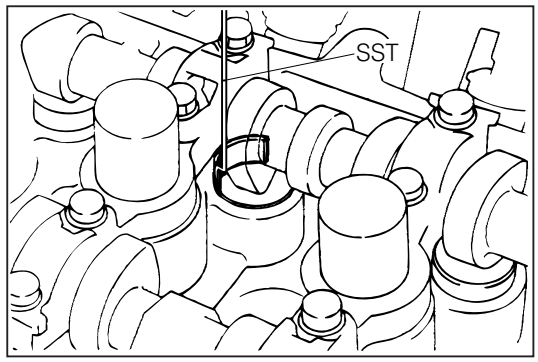
- Install the shim in such a way that the side bearing the identification number faces downward.



LEM00115-00110

(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).

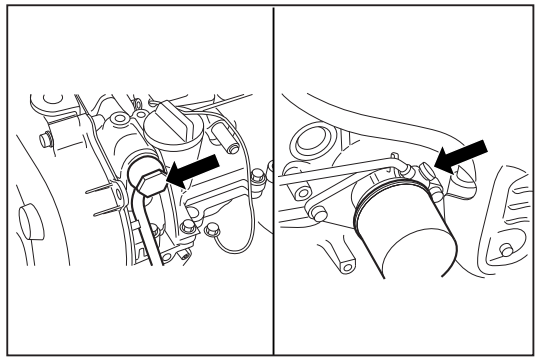


LEM00116-00111

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

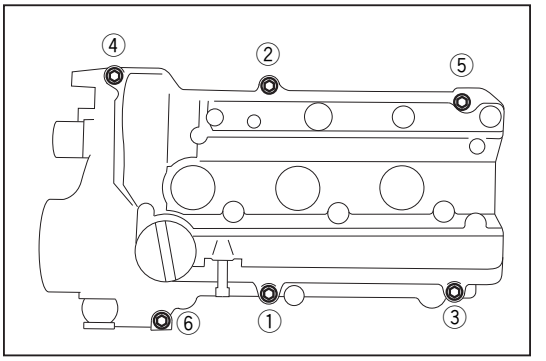
    NOTE:
    - Be sure to interpose the gasket.

27. Tighten the oil pipe union bolt at the oil filter bracket side that has been loosened.
    Tightening Torque: 39.0 ± 5.0 N·m



LEM00243-00242

28. 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 ± 1.1 N·m

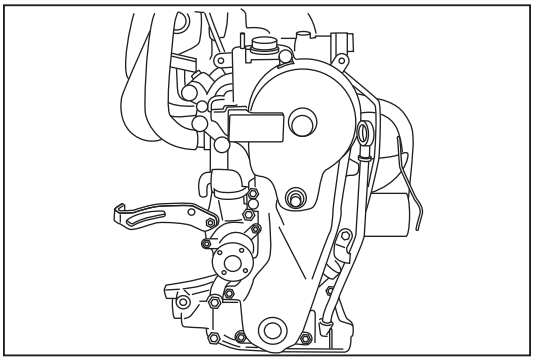


LEM00244-00243

29. Install the timing belt. (Refer to the "TIMING BELT" section.)
30. Install the timing belt cover. (Refer to the "TIMING BELT" section.)
31. Install the crankshaft pulley.
    Tightening Torque: 98.0 ± 10.0 N·m

32. Install the surge tank stay to the cylinder head cover.
    Tightening Torque: 9.0 ± 2.7 N·m

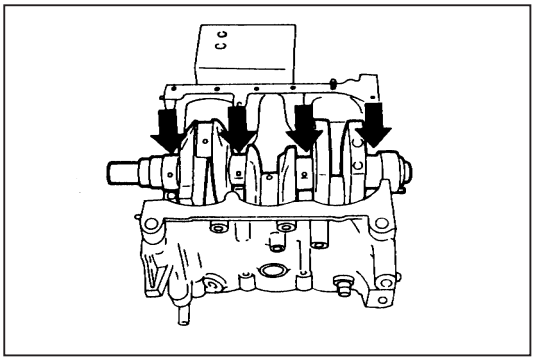
33. Connect the vacuum hose to the cylinder head and intake manifold.
34. Install the ignition coil to the cylinder head cover.
    Tightening Torque: 6.0 ± 1.8 N·m


LEM00245-00244

(5) Apply engine oil to the crankshaft main journal sections.

NOTE:

- Care must be exercised to ensure that no oil flows into the bearing cap attaching bolt holes.

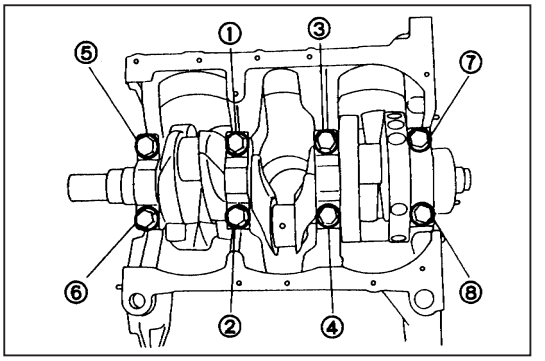


LEM00185-00173

(6) Install the crankshaft bearing caps with the arrow marks facing toward the oil pump side and also in the numerical sequence.

(7) Thinly apply engine oil to the crankshaft bearing cap bolts. Tighten the bolts to the specified torque over two or three stages in the sequence shown in the right figure.

Tightening Torque: 59.0 ± 6.0 N·m



LEM00186-00174

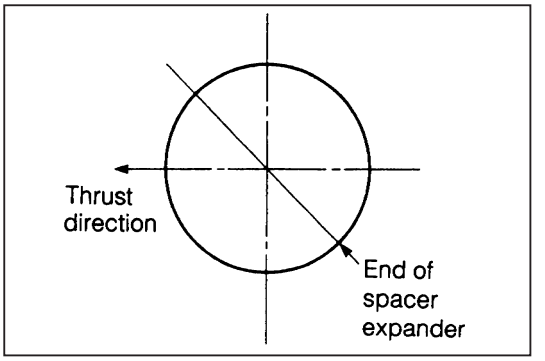
2. Assembly and installation of piston

Identification Color:

Compression ring No. 1:
Black (Leaded), Orange (Unleaded)

Compression ring No. 2:
Yellow (Leaded, Unleaded)

Oil ring spacer:
Red (Leaded), Pink (Unleaded)



LEM00187-00175

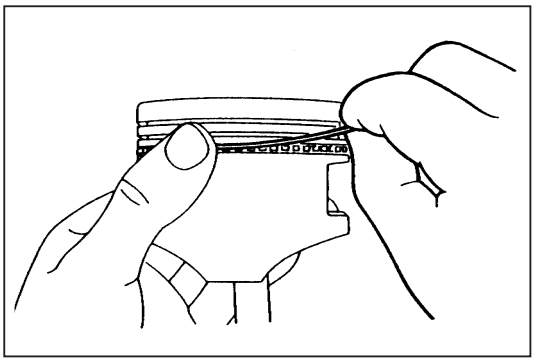
(1) Install the oil ring spacer expander in the oil ring groove.

Ensure that the expander end may not line up with the thrust direction nor with the axial direction.

NOTE:

- Do not expand the spacer expander to an extent that is more than necessary.

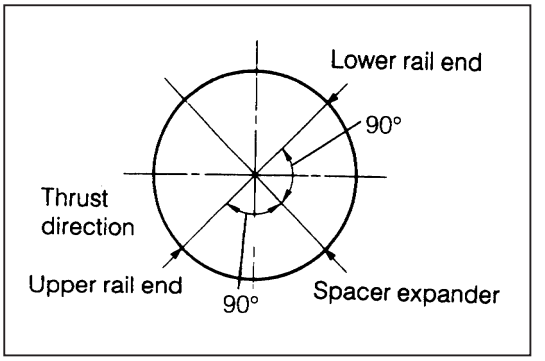
(2) Fit the upper rail into position in such a manner that it is wound up while pushing the edge section of the oil ring spacer expander with your thumb.



LEM00188-00176

NOTE:

- Ensure that the rail end is deviated 90 degrees to the left from the end of the oil ring spacer expander.
- Do not expand the rail to an extent that is more than necessary.



LEM00189-00177

ENGINE TUNE-UP

ENGINE COOLANT
Refer to the CO section.

RADIATOR CAP
Refer to the CO section.

DRIVE BELT
Refer to the CH section.

ENGINE OIL
Refer to the LU section.

SPARK PLUG
Refer to the IG section.

VALVE CLEARANCE
Refer to the EM–27.

IGNITION TIMING
Refer to the IG section.

BATTERY
Refer to the CH section.

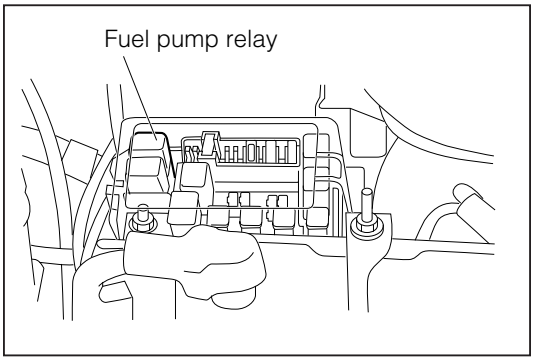
CHARCOAL CANISTER
Refer to the EC section.

FUEL LINE & CONNECTION
Refer to the EC section.

LEM00210-00000

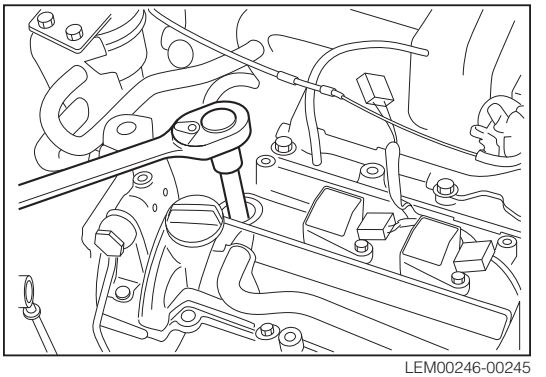
COMPRESSION CHECK
NOTE:
- After completion of the engine tune-up, if the engine exhibits lack of power, excessive oil consumption or poor fuel economy, measure the cylinder compression pressure.

1. Warm up the engine thoroughly.
2. Turn OFF the ignition key switch.
3. Remove the fuel pump relay from the relay box.



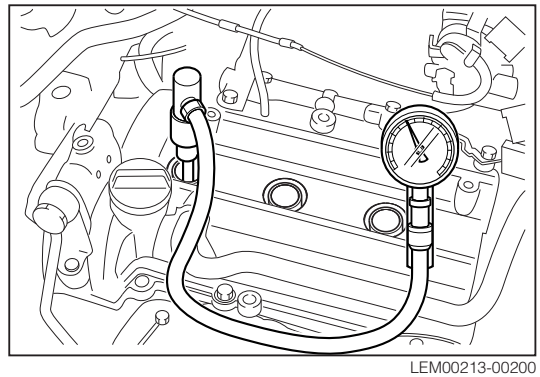
LEM00211-00198

4. Remove the spark plug from the cylinder head. (For removal procedure refer to the IG section.)
5. Measurement of cylinder compression pressure
   NOTE:
   - Perform the measurement in the shortest possible time.
   - Crank the engine for the same duration for each cylinder.
   - Always use a fully charged battery so that at least a revolution speed of 400 rpm is attained.

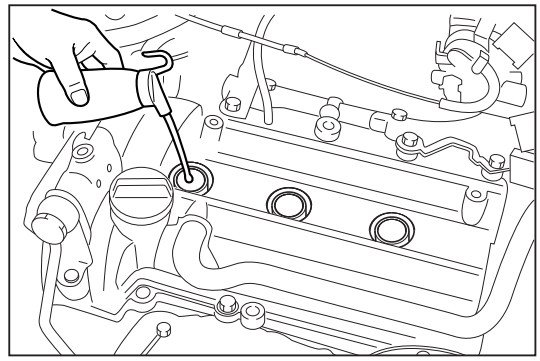


LEM00246-00245

(1) Insert a compression gauge into the spark plug hole.
(2) Depress the accelerator pedal fully.
(3) While cranking the engine, measure the compression pressure.
Compression Pressure:
1579 - 1755 kPa at 400 rpm
Difference Between Cylinders:
147 kPa at 400 rpm


LEM00213-00200

(4) Repeat the step (1) through (3) for each cylinder.
(5) If the compression of one or more cylinders is low, pour a small amount of engine oil into that cylinder through the spark plug hole and repeat the steps (1) through (3) for the cylinder with low compression.
- If adding oil helps the compression to improve, chances are that the piston rings and/or cylinder bores are worn or damaged.
- If the pressure remains low after the operation described in the step (5) has been performed, the valve may be sticking or seated improperly, or there may be leakage past the gasket.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6. Install the spark plug to the cylinder head, (Refer to the IG section.)
7. Install the fuel pump relay to the relay box.

SERVICE SPECIFICATIONS

Type				Petrol, 4 cycle
Cylinder No.				3-cylinder-in-line
Combustion chamber type				Pent roof type
Valve mechanism				DOHC, Directly driven by camshaft
Bore × stroke				72.0 mm × 81.0 mm
Total displacement				989 cc
Compression ratio				10.0 ± 0.3
Compression pressure				1579 - 1755 kPa (16.1 - 17.9 kg/cm^2) at 400 rpm
Maximum output				40.5/5200 (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°
			Close	ABCD 42.5°
		Exhaust	Open	BBDC 36.5°
			Close	ATDC 5.5°
Vale clearance		Intake (Cold)		0.18 ± 0.05 mm
		Exhaust (Cold)		0.25 ± 0.05 mm
Idring speed	M100 series	STD		850 ± 50 rpm
		AUS and tropical spec.		900 ± 50 rpm
	L700 series			850 ± 50 rpm
Blow-by gas recirculating system				Closed type

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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 position sensor	8.0 ± 1.6	0.8 ± 0.16	
Cylinder head × Water 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 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	
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	
Camshaft No. 2 nut	125 ± 7.0	12.3 ± 0.7	

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