

ENGINE MECHANICAL

TIMING BELT	EM- 2	ENGINE TUNE-UP	EM-54
COMPONENTS	EM- 2	ENGINE COOLANT	EM-54
REMOVAL	EM- 2	RADIATOR CAP	EM-54
INSPECTION	EM- 3	DRIVE BELT	EM-54
INSTALLATION	EM- 5	ENGINE OIL	EM-54
CYLINDER HEAD	EM- 8	SPARK PLUG	EM-54
COMPONENTS	EM- 8	VALVE CLEARANCE	EM-54
REMOVAL	EM- 9	IGNITION TIMING	EM-54
DISASSEMBLY	EM-12	BATTERY	EM-54
INSPECTION	EM-13	CHARCOAL CANISTER	EM-54
ASSEMBLY	EM-21	FUEL LINE & CONNECTION	EM-54
INSTALLATION	EM-23	COMPRESSION CHECK	EM-54
CYLINDER BLOCK	EM-31	CHECKING OF A/F (Air/Fuel)	
COMPONENTS	EM-31	CONTROL SYSTEM	EM-56
DISASSEMBLY	EM-32	SERVICE SPECIFICATIONS	EM-57
INSPECTION	EM-39	SSTs	EM-60
ASSEMBLY	EM-46	TIGHTENING TORQUE	EM-61

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.
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.

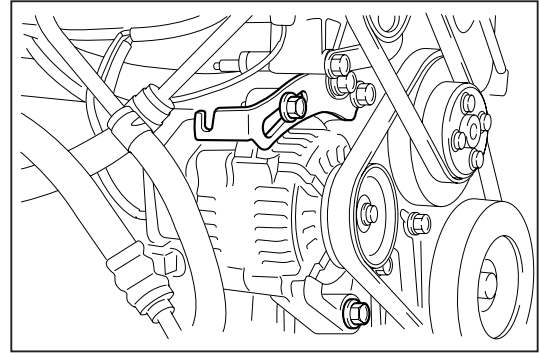
5. Remove the timing belt cover.
6. Rotate the crankshaft, until the mating mark of the camshaft timing pulley is aligned with the mark of the cylinder head cover.

CAUTION:

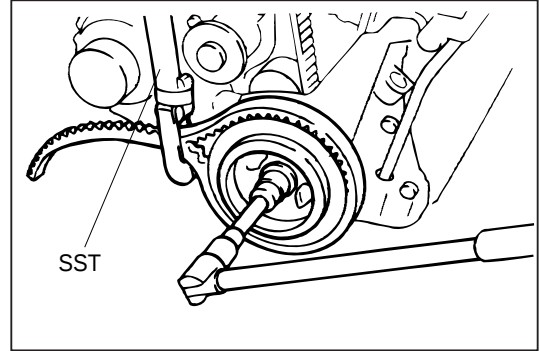
- Perform the engine turning operation at the crankshaft side.

NOTE:

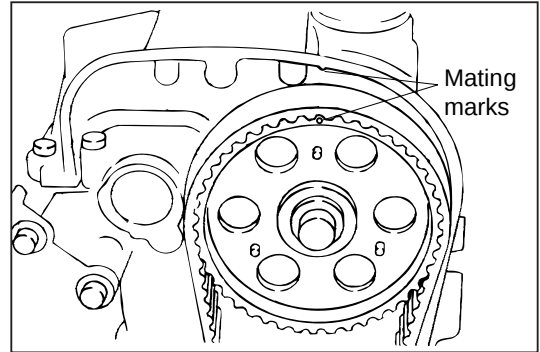
- Under this setting, ensure that the punched mark of the crankshaft timing belt pulley is aligned with the mating mark of the oil pump.
- With the mating marks aligned with each other, the piston No. 1 is at the Top Dead Center under the compression stroke.



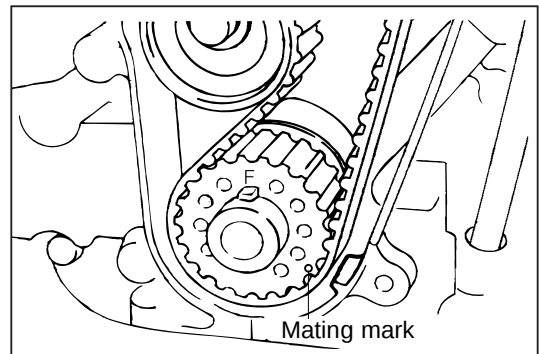
MEM00002-00001



MEM00003-00002



MEM00000-00003



MEM00004-00004

7. Remove the timing belt tensioner.

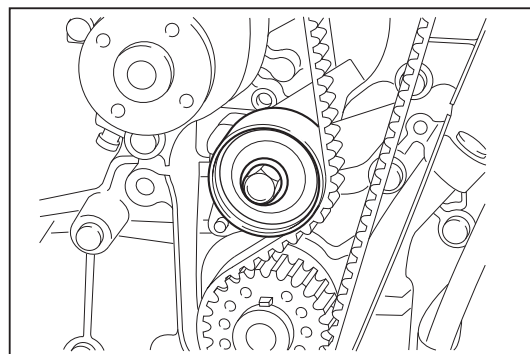
8. Remove the timing belt.

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.



INSPECTION

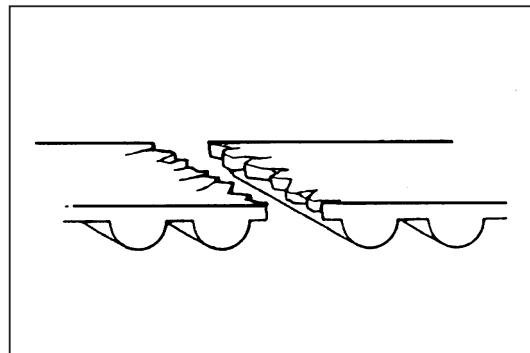
Timing belt

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

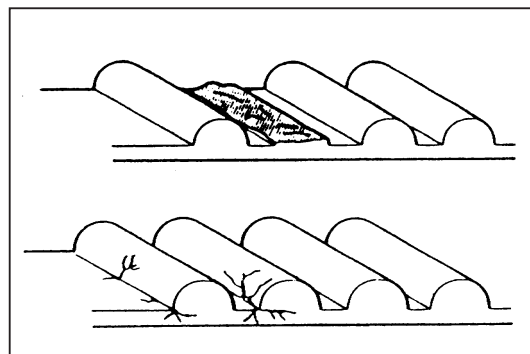
1. Premature separation

Check for proper installation.

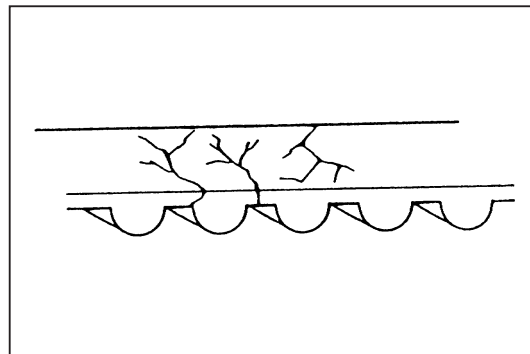
Check the timing gear cover gaskets for damage and check for correct installation.



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



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.



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

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.)

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.

Timing belt cover

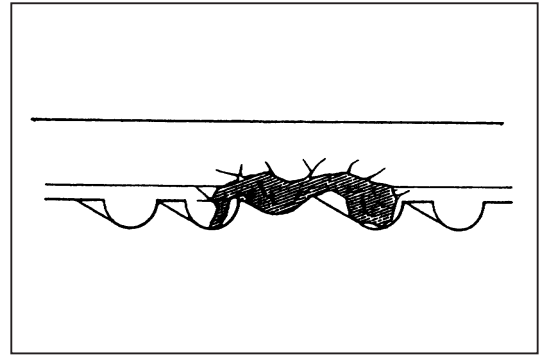
Ensure that the gasket exhibits no damage. If the gasket is damaged, replace it with a new one. Affix the gasket onto the cover, using an adhesive agent.

NOTE:

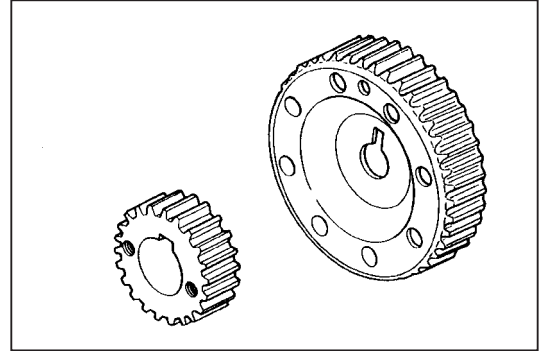
- Apply adhesive agent along the outer periphery of the timing belt cover, as indicated in the illustration.

Crankshaft timing belt pulley flange

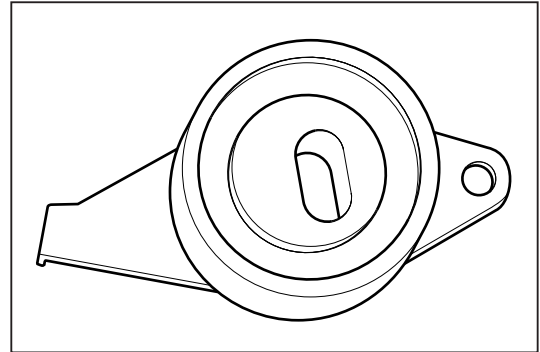
Check the crankshaft timing belt pulley flange for bend, damage and wear. If necessary, replace the crankshaft timing belt pulley flange.



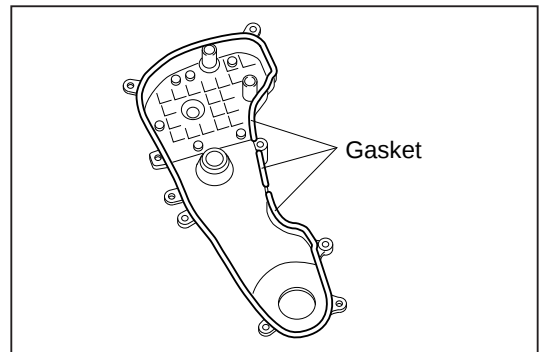
MEM00009-00009



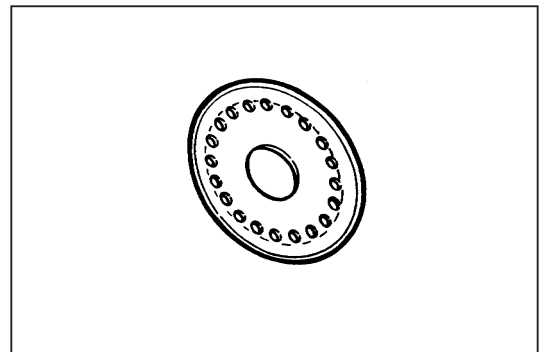
MEM00010-00010



MEM00011-00011



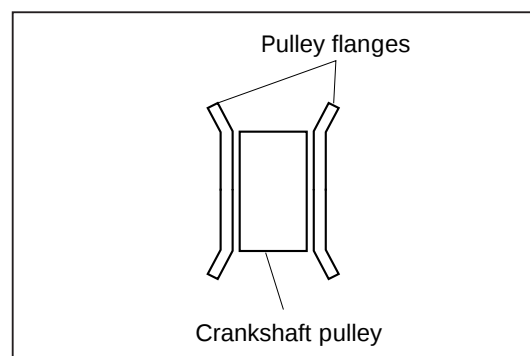
MEM00012-00012



MEM00013-00013

INSTALLATION

1. Install the crankshaft timing belt pulley flange with its protruding side facing toward the timing belt pulley.
2. Install the crankshaft timing belt pulley on the crankshaft by aligning it with the key groove.



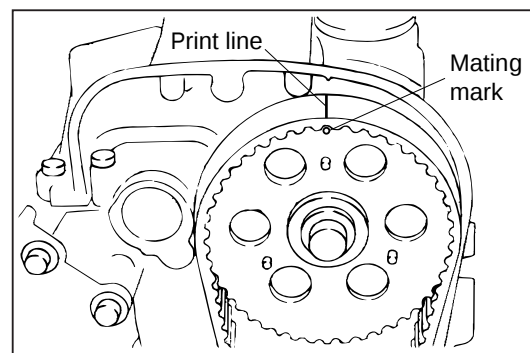
MEM00014-00014

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.

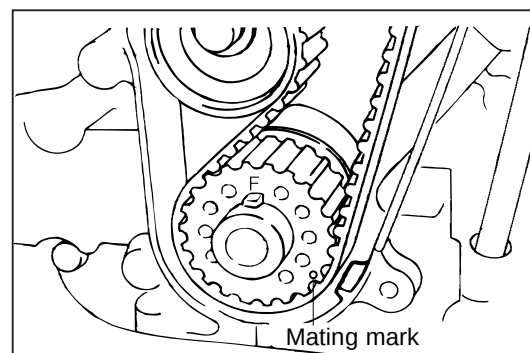
- (1) Rotate the crankshaft, until the mating mark of the camshaft timing pulley aligns with the mark of the cylinder head cover. (Refer to the page EM-2.)
- (2) Assemble the timing belt in such a way that the two mating marks on the timing belt may be aligned with the corresponding drilled marks on the crankshaft timing belt pulley and mating mark of the camshaft timing belt pulley.



MEM00015-00015

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.



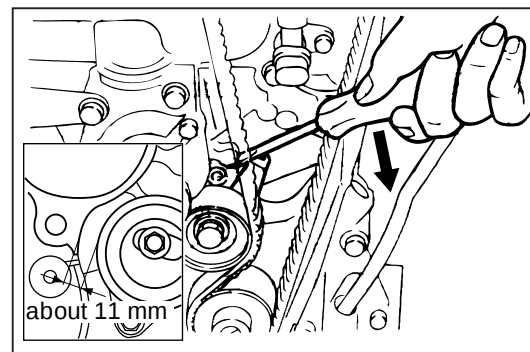
MEM00016-00016

4. Adjustment of timing belt tension

- (1) Install the timing belt tensioner temporarily.

NOTE:

- Make sure that the tensioner moves freely.
- (2) Using a common screwdriver, move the timing belt tensioner in a right direction so that the gap indicated in the figure may become approximately 11 mm (to such an extent that a M8 bolt may be inserted smoothly). Proceed to tighten the tensioner retaining bolt temporarily.



MEM00017-00017

- (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.

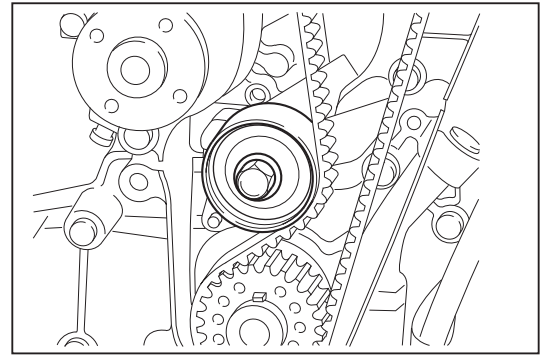
NOTE:

- 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

- (5) Ensure that the gap indicated in the right figure is approximately 11 mm (an extent that a M8 bolt may be inserted smoothly).



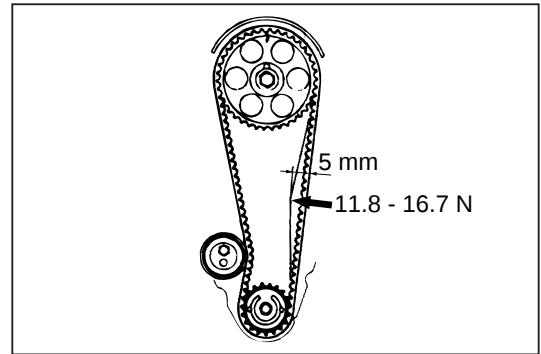
- (6) Checking of timing belt tension

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)

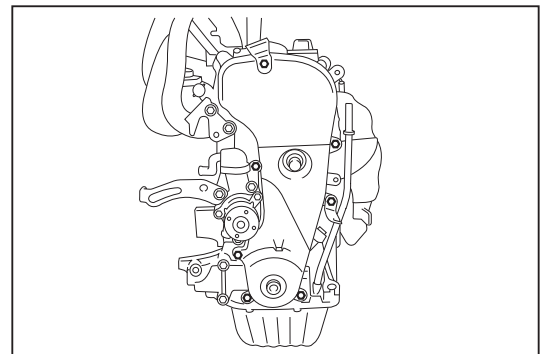
If the amount of deflection of the timing belt is deviated, loosen the retaining bolt above of the timing belt tensioner. Readjust the gap.



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



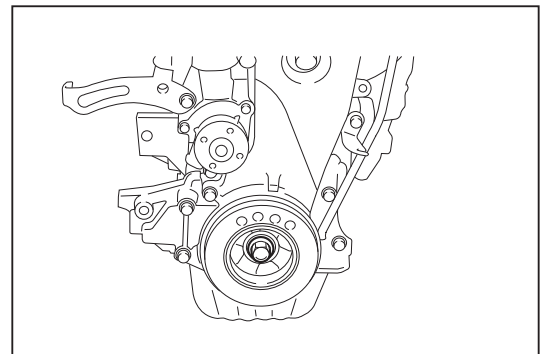
7. Installation of crankshaft pulley set bolt

- (1) Install the crankshaft pulley.

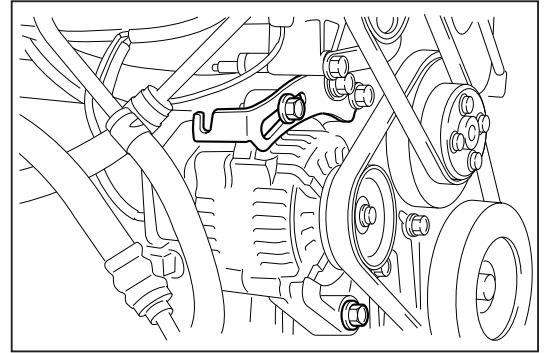
- (2) Tighten the crankshaft pulley set bolt while preventing the crankshaft pulley from turning with the following SST.

SST: 09210-87701-000

Tightening Torque: 98.0 ± 10.0 N·m



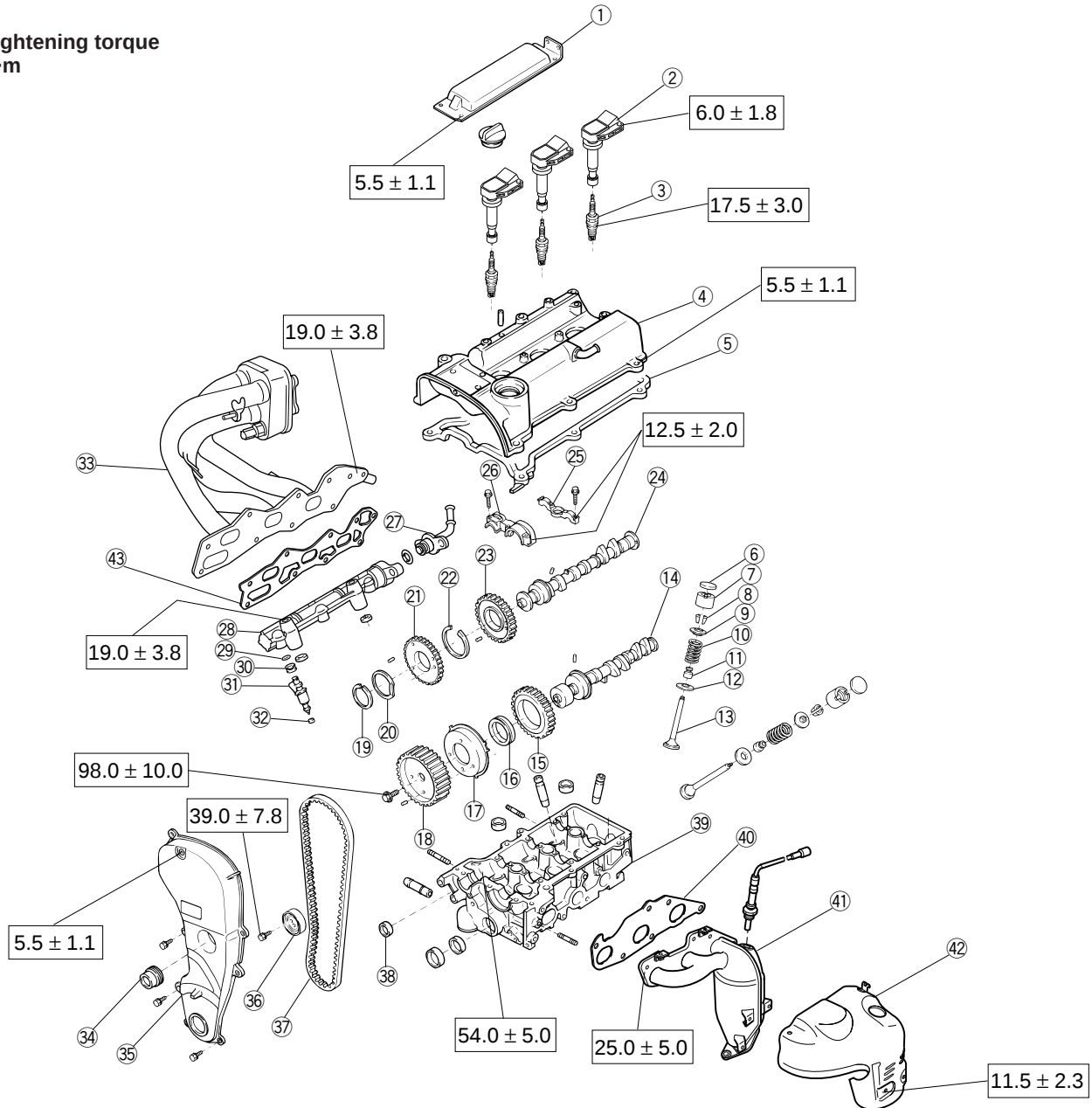
8. Temporarily install the water pump pulley with the four bolts.
9. Install the V-belt.
10. Adjust the V-belt tension.
(Refer to the CH section.)
11. Tighten the water pump pulley attaching bolts.
Tightening Torque: 9.5 ± 1.9 N·m



MEM00022-00022

CYLINDER HEAD COMPONENTS

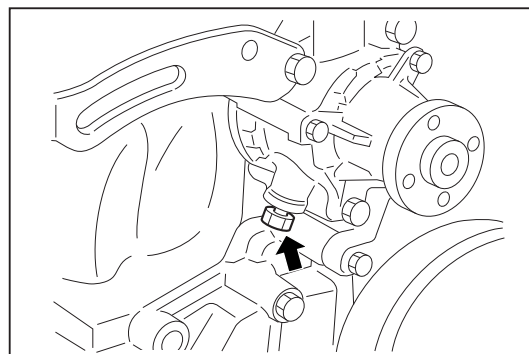
□ : Tightening torque
Unit : N·m



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

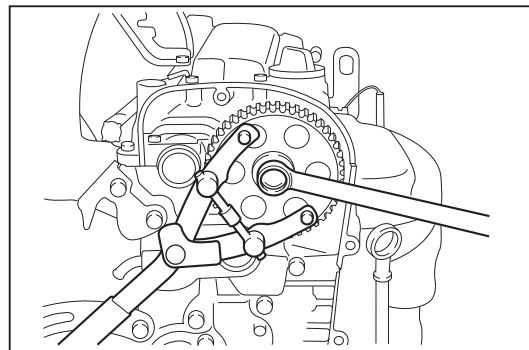
REMOVAL

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.



MEM00024-00024

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

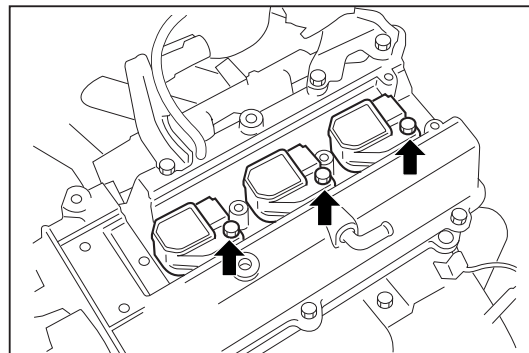


MEM00025-00025

NOTE:

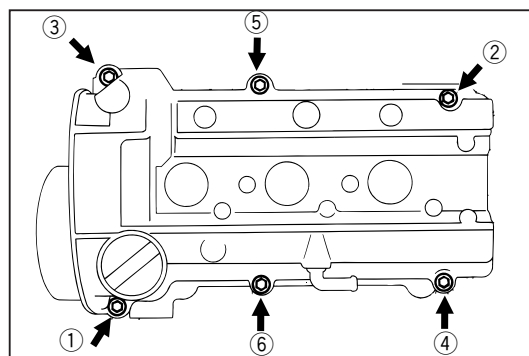
- When the bolts are removed, care must be exercised, for the oil starts to flowing from the camshaft.

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



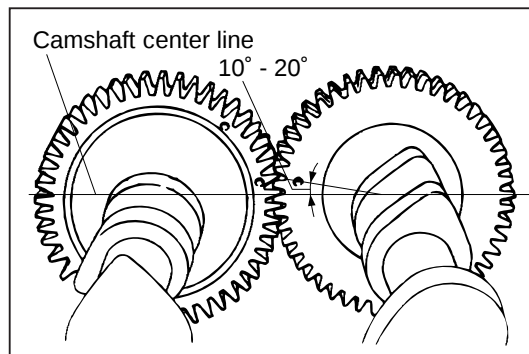
MEM00026-00026

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.



MEM00027-00027

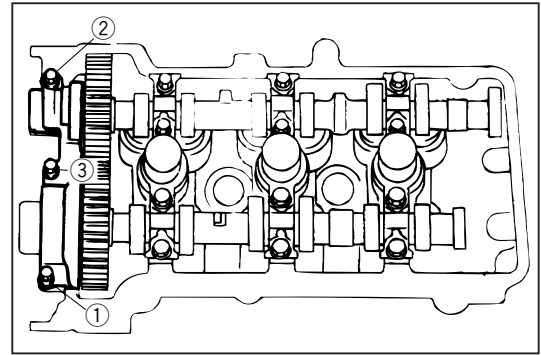
9. Removal of camshaft bearing cap No. 1 and camshaft bearing cap No. 2.
(1) Using the hexagonal section of the camshaft No. 2, set the mating marks of the camshaft gear sections to the relationship as indicated in the right figure.



MEM00028-00028

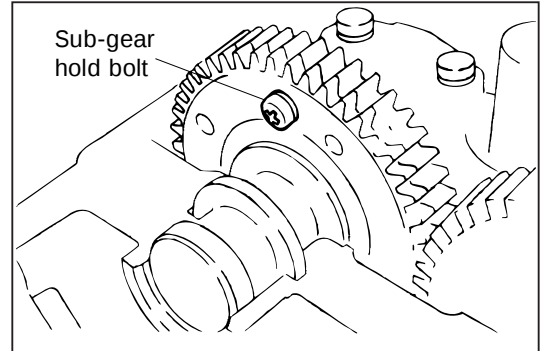
EM-10

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



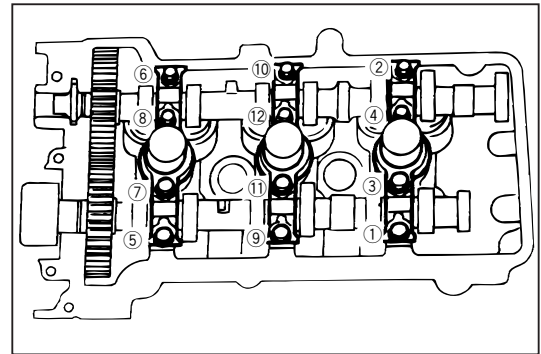
MEM00029-00029

- (3) 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).



MEM00030-00030

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



MEM00031-00031

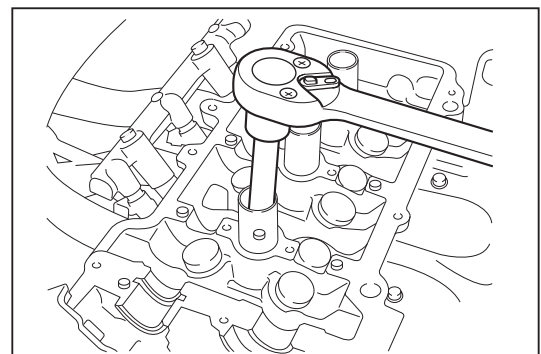
- (5) Remove the camshaft No. 2 and camshaft No. 1 in this sequence.

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.)

MEM00032-00000

10. Remove the spark plug from the cylinder head.

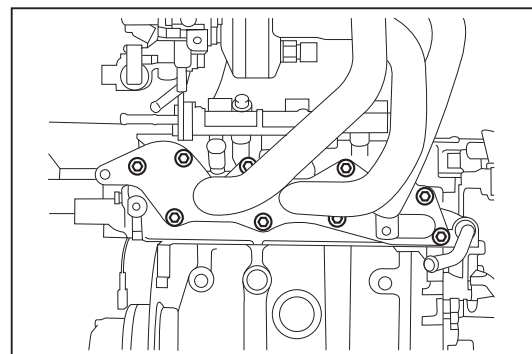


MEM00033-00032

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

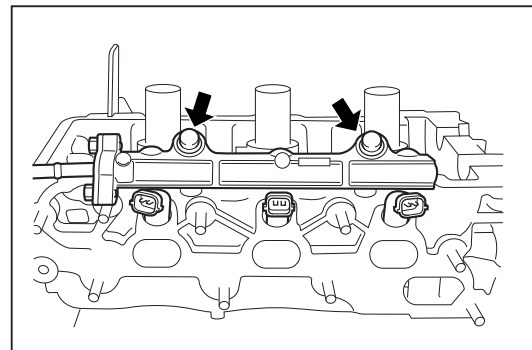
CAUTION:

- Never reuse the removed intake manifold gasket.



MEM00034-00033

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

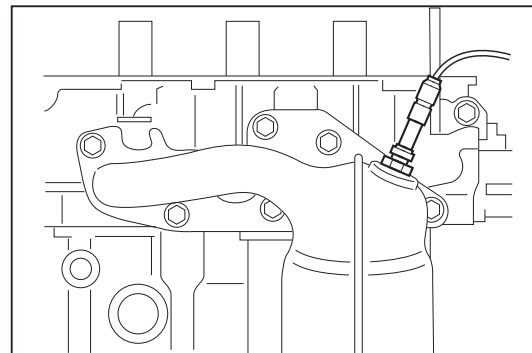


MEM00035-00034

15. Remove the O₂ 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.

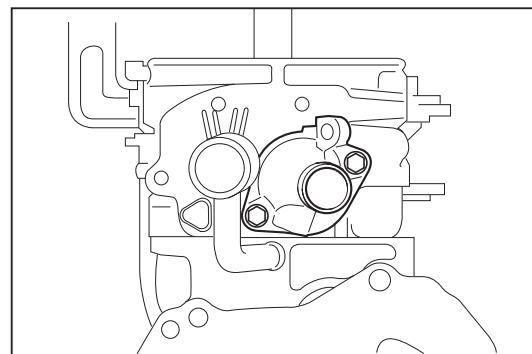
CAUTION:

- Never reuse the removed exhaust manifold gasket.



MEM00036-00035

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.

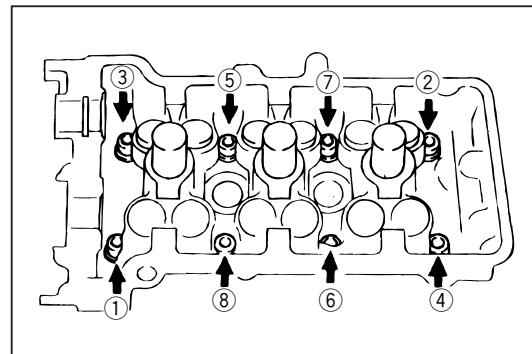


MEM00037-00036

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.



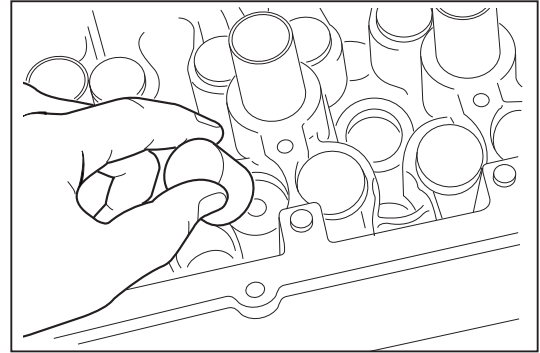
MEM00038-00037

EM-12

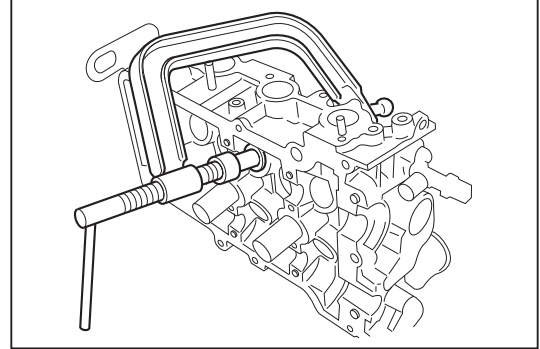
DISASSEMBLY

Cylinder head

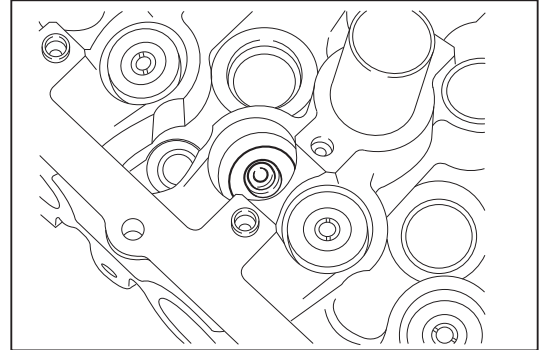
1. Remove the valve lifters from the cylinder head with the adjusting shims installed on each valve lifter.
2. Remove the valve spring retainer locks, using the following SSTs given below.
SST: 09202-87002-000
09202-87002-0A0
3. Remove the valve spring retainers, and valve springs.
4. Remove the valves 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.



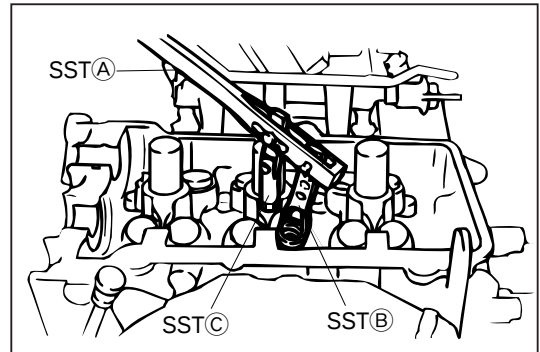
MEM00039-00038



MEM00040-00039



MEM00041-00040



MEM00042-00041

[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.

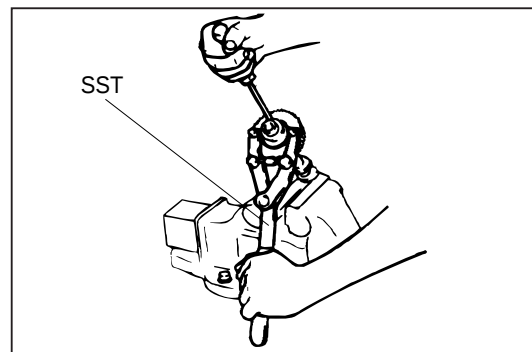
CAUTION:

- 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.

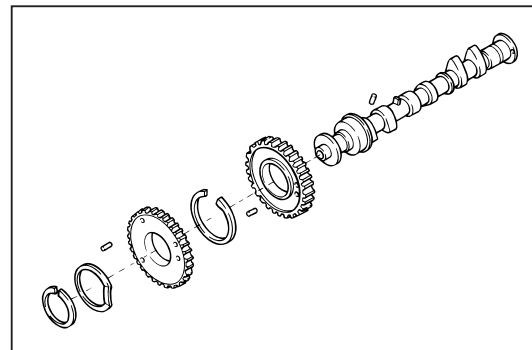
SST: 09202-87702-000 (SST A)
09202-87202-000 (SST B)
09202-87201-000 (SST C)

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.



MEM00000-00042



MEM00043-00043

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.

MEM00044-00000

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:

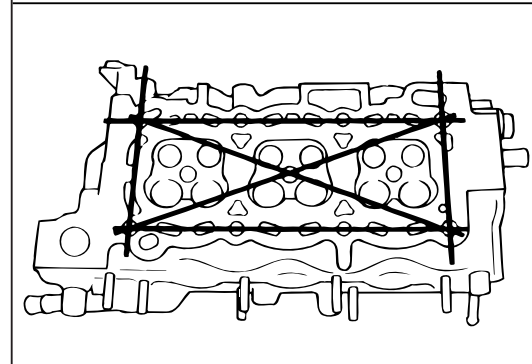
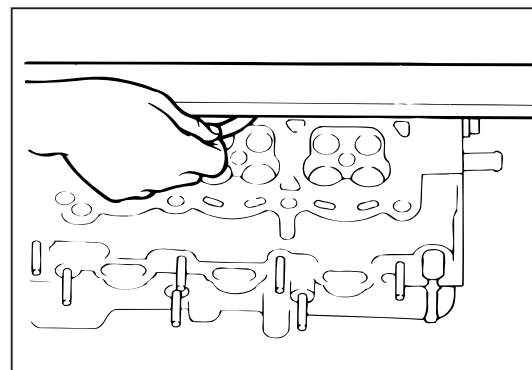
Cylinder Block Side: 0.10 mm
Intake Manifold Side: 0.10 mm
Exhaust Manifold Side: 0.10 mm

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



MEM00045-00044

EM-14

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

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:

Intake side, Exhaust side:

No. 1 25.979 - 25.995 mm

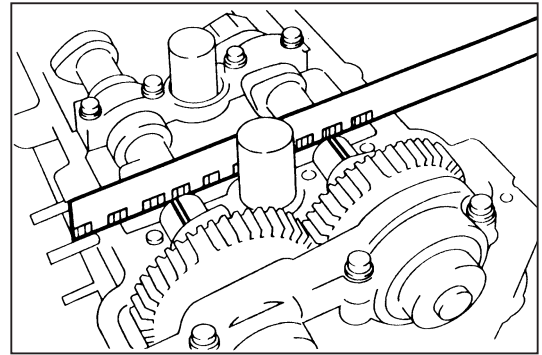
No. 2, No. 3, No. 4 22.979 - 22.995 mm

Camshaft bearing Cap Bore Diameter

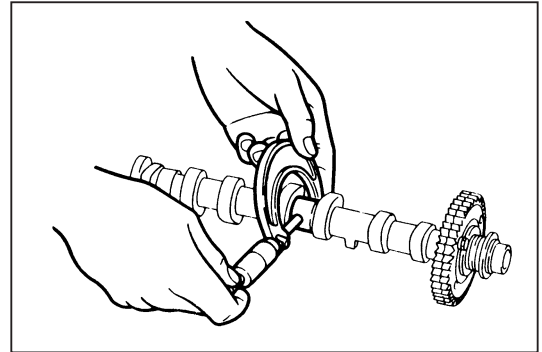
Intake side, Exhaust side:

No. 1 26.032 - 26.052 mm

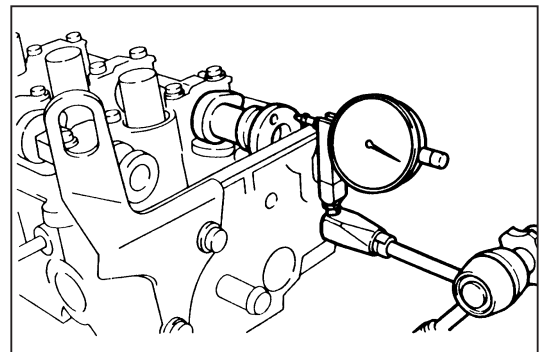
No. 2, No. 3, No. 4 23.032 - 23.052 mm



MEM00047-00046



MEM00048-00047



MEM00050-00048

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

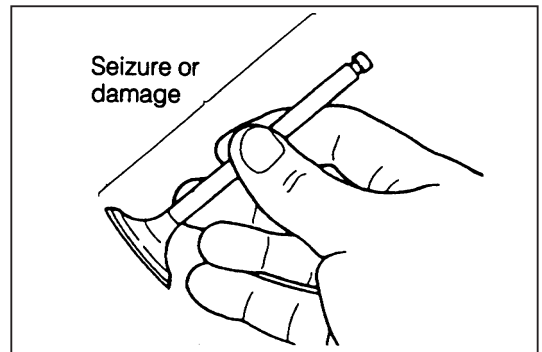
Exhaust Side 0.04 - 0.10 mm

4. Check and grinding of valves

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

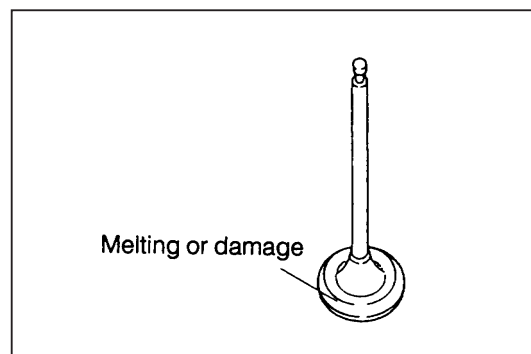
NOTE:

- 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.



MEM00051-00049

- (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.

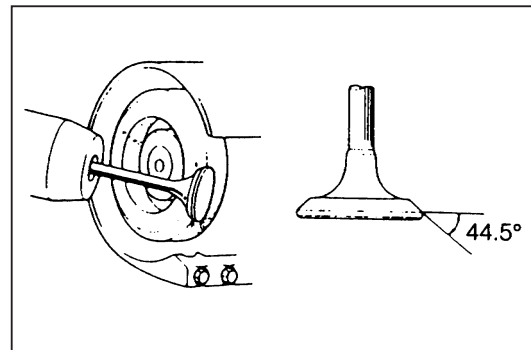


MEM00052-00050

- (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.



MEM00053-00051

- (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.

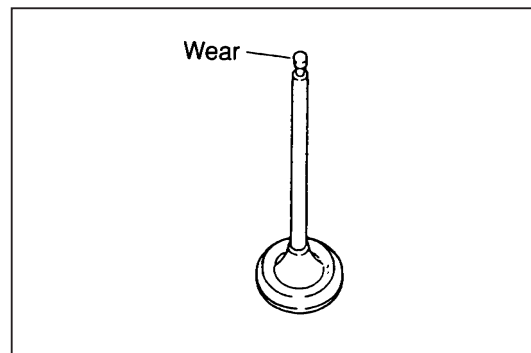
[Reference]

Intake Valve: 79.4 mm

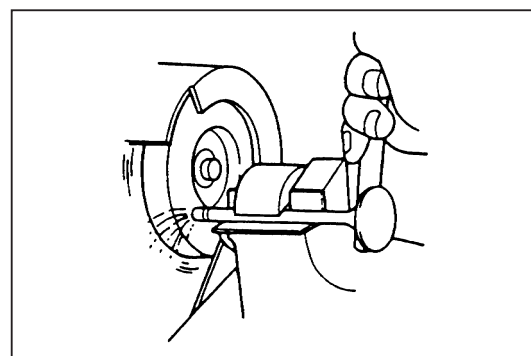
Exhaust Valve: 79.8 mm

NOTE:

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



MEM00000-00052



MEM00054-00053

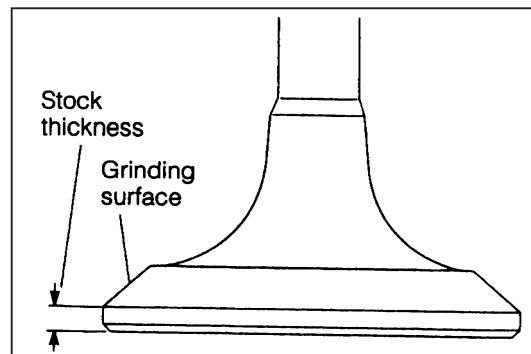
- (5) Inspect the valve head for its stock thickness.

Minimum Stock Thickness:

Intake Valve: 1.0 ± 0.2 mm

Exhaust Valve: 1.0 ± 0.2 mm

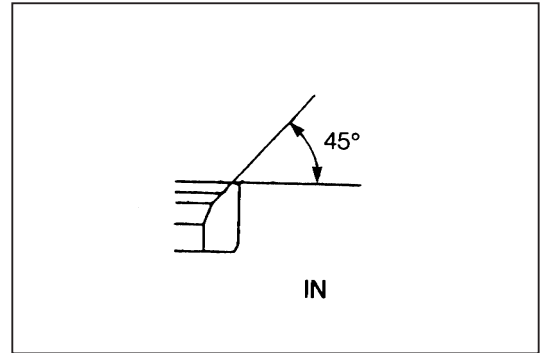
If the stock thickness of the valve head is less than the minimum stock thickness, replace it with a new one.



MEM00055-00054

5. Check and cleaning of valve seats

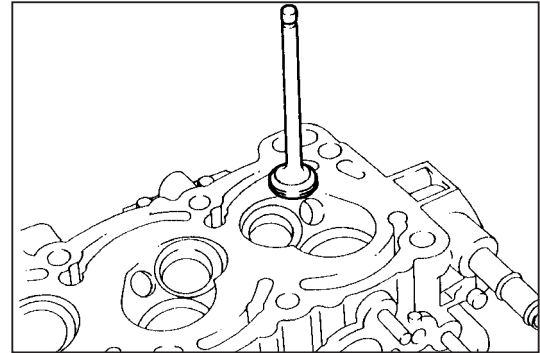
- (1) Using a 45-degree valve seat cutter, reface the valve seats. Remove only enough metal stock to clean the seats.
- (2) Apply a thin film of red lead (or white lead) to the valve seat.
- (3) Let the valve drop by its own weight onto the valve seat two or three times.
- (4) Take out the valve.



MEM00056-00055

(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.

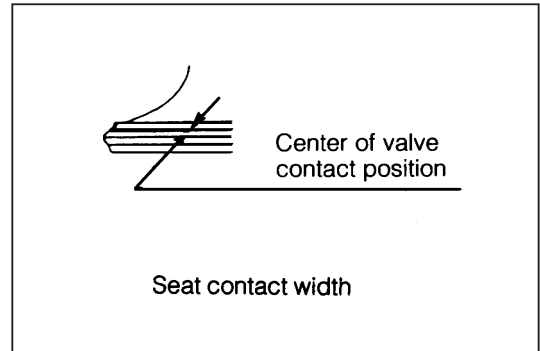


MEM00057-00056

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

Contact Surface of Valve Seat: 1.4 ± 0.5 mm

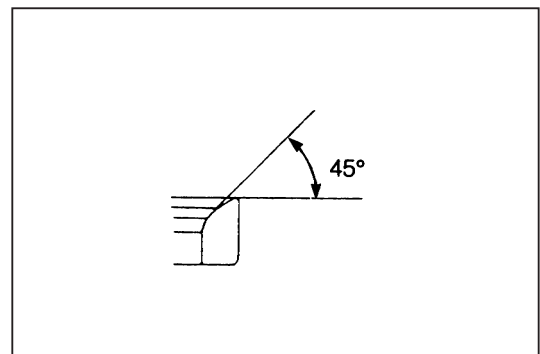
If not, reface the valve seat.



MEM00058-00057

6. Refacing of valve seat

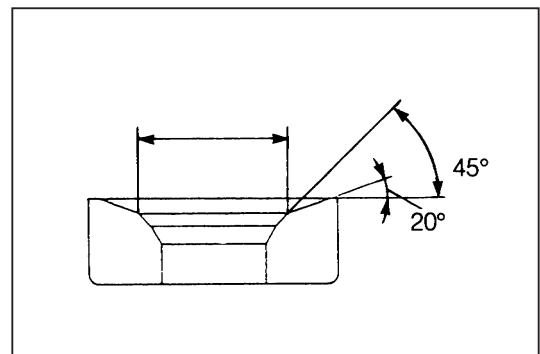
- (1) Using a 45-degree cutter, recondition the roughness on the valve-to-valve seat contact surface, only enough to obtain a smooth surface.



MEM00059-00058

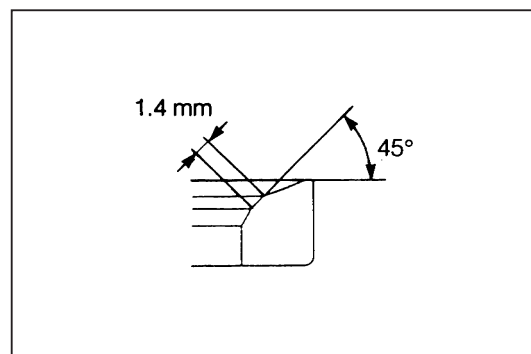
- (2) Using a 20-degree cutter, cut the valve seat in such a way that the circumference of the surface refaced by the 45-degree cutter may become the specified value.

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



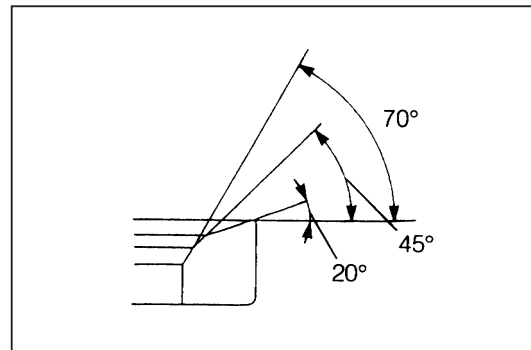
MEM00060-00059

- (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.



MEM00061-00060

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



MEM00062-00061

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.

MEM00063-00000

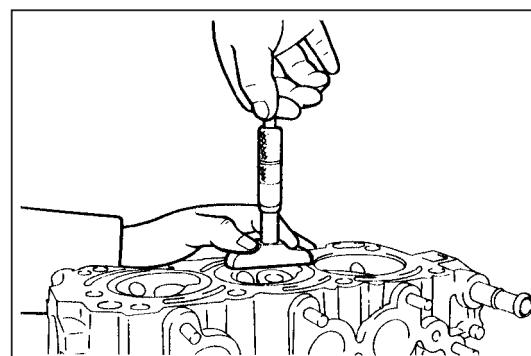
8. Check of valve recession

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



MEM00064-00062

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

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

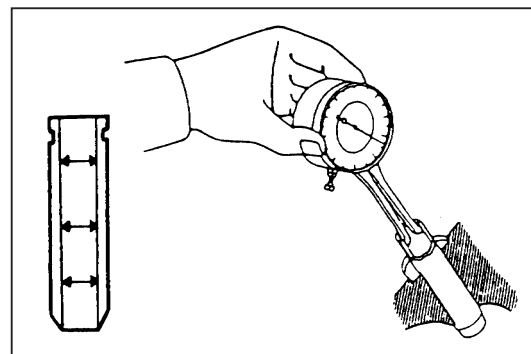
- (1) Using a caliper gauge, measure the inner diameter of the valve guide at six points.

Record the measured values.

[Reference]

Inner Diameter of the Valve Guide Bush:

IN, EX 5.000 - 5.012 mm



MEM00065-00063

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

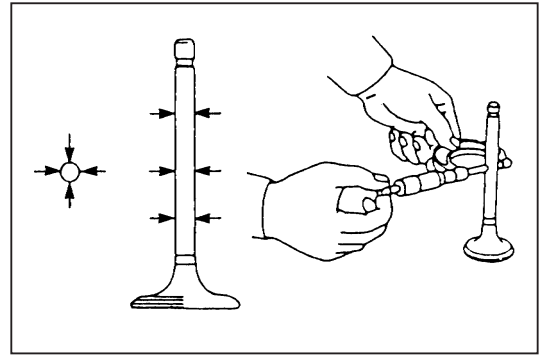
Record the measured values.

[Reference]

Outer Diameter of the Valve Stem:

Intake 4.975 - 4.990 mm

Exhaust 4.965 - 4.980 mm



MEM00066-00064

- (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

MEM00067-00000

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]

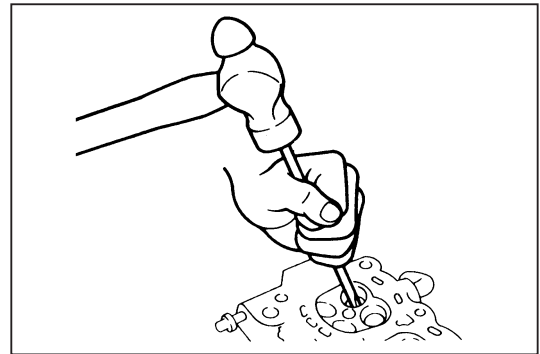
- As for this suitable tool, determine it, while referring to the inner diameter and outer diameter of the valve guide bush.

Valve Guide Bush Inner Diameter:

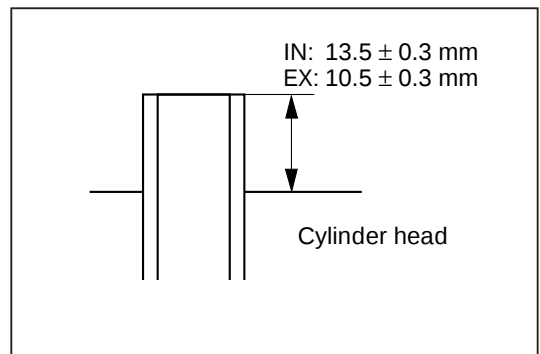
IN, EX 9.727 - 9.738 mm

Valve Guide Bush Outer Diameter:

N, EX 5.000 - 5.012 mm



MEM00068-00065



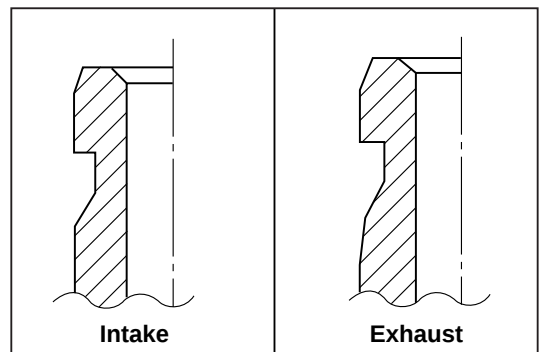
MEM00000-00066

- (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.



MEM00068-00067

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

NOTE:

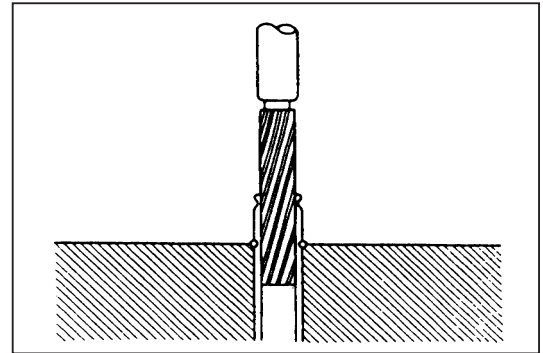
- This reaming should be made only enough to remove the burr or the like.

- (4) Check of oil clearance

Ensure that the oil clearance meets the specifications.

Oil Clearance:

Specified Value: See page EM-18.



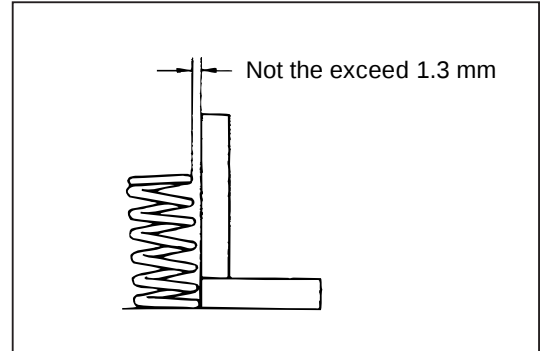
MEM00069-00068

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.



MEM00070-00069

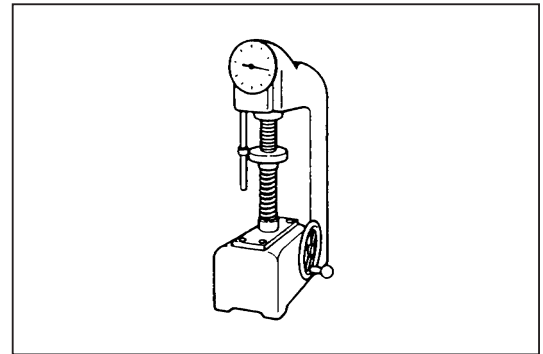
- (2) Measure the valve spring for free length and spring tension, using a spring tester.

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.



MEM00071-00070

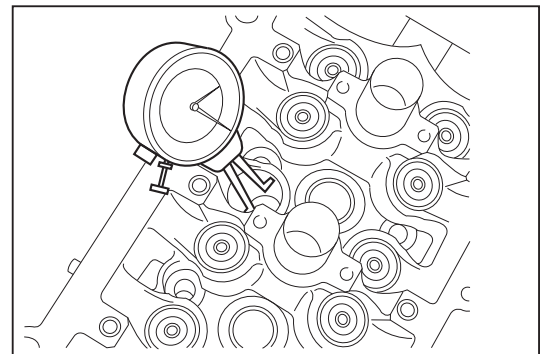
12. Check of valve lifter and cylinder head valve lifter bore oil clearance

- (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

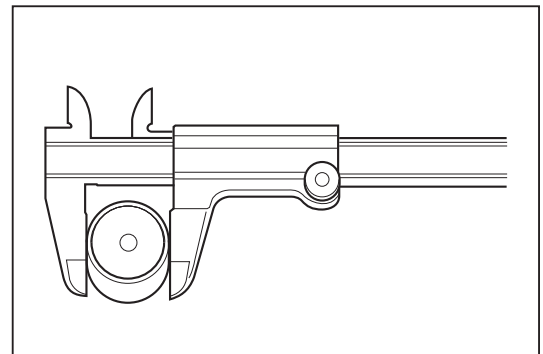


MEM00072-00071

- (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

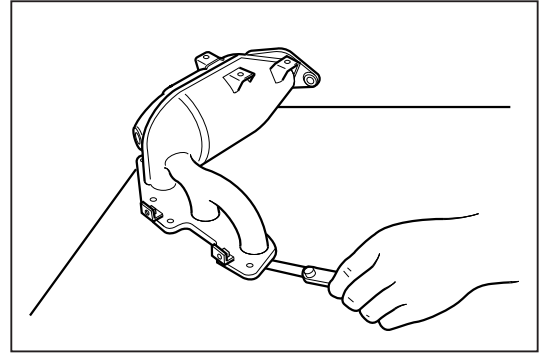


MEM00073-00072

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



MEM00074-00073

Camshaft

1. Check of gear

Visually inspect the teeth for wear.

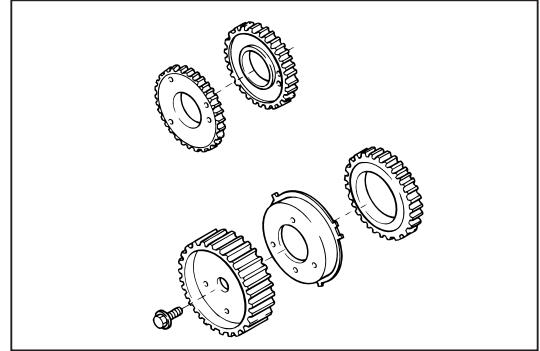
2. Check of shaft

(1) Checking camshaft for runout

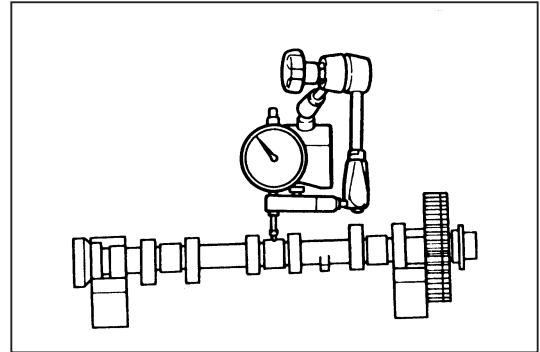
Support the camshaft at its both ends with V-shaped blocks. Set a dial gauge to the mid-point of the center journal section of the camshaft. Turn the camshaft one turn, making sure that the camshaft will not move in the axial direction. Take a reading on the dial gauge during the turning. Calculate the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



MEM00000-00074

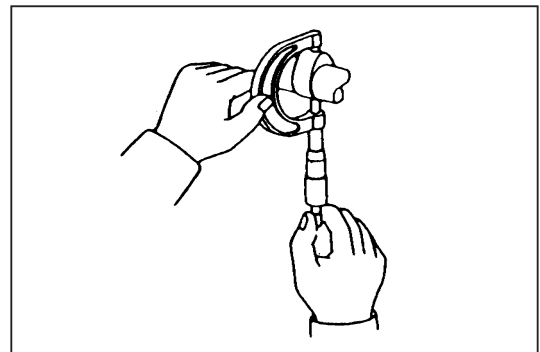


MEM00075-00075

(2) Checking of cam lobe height

Measure the cam lobe height, using a micrometer.

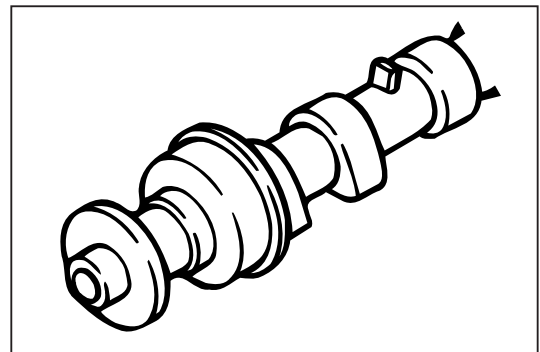
Specified Cam Lobe Height: 40.25 mm



MEM00076-00076

(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.



MEM00077-00077

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.

MEM00078-00000

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.

MEM00079-00000

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.

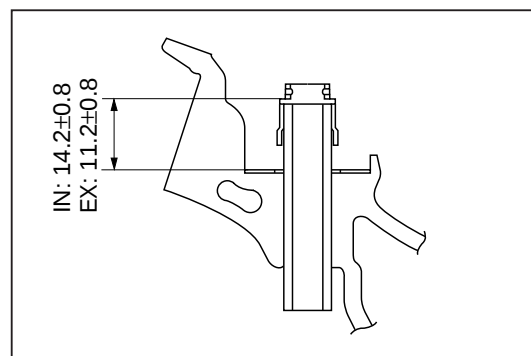
NOTE:

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

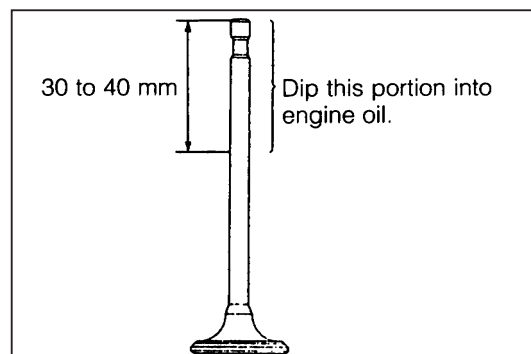
3. Dip the 30 to 40 mm long portion of the valve stem end into engine oil.
4. Install the valve to the cylinder head.

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.



MEM00080-00078



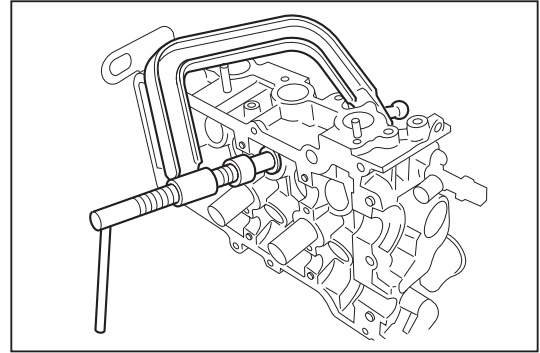
MEM00081-00079

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

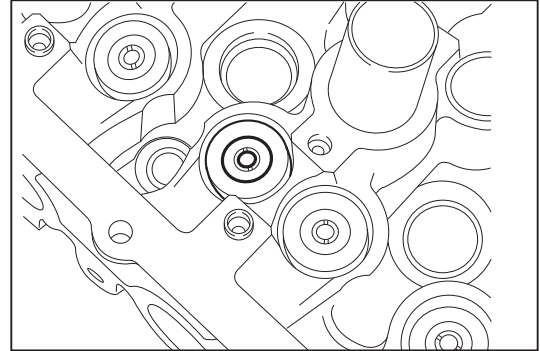
09202-87002-0A0



- (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.



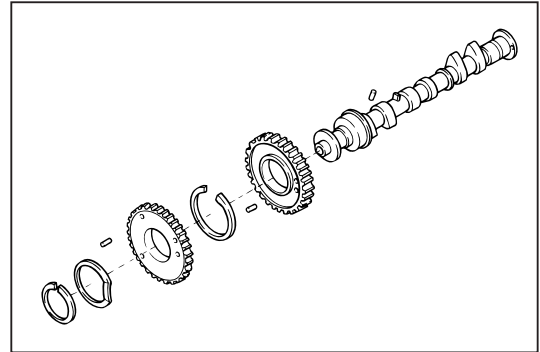
MEM00084-00082

Camshaft

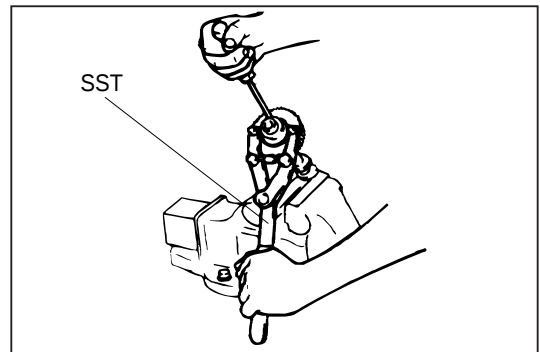
1. Set the SST to the two 6 mm dia. holes of the camshaft sub gear using the following SST.

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.



MEM00000-00083



MEM00085-00084

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.

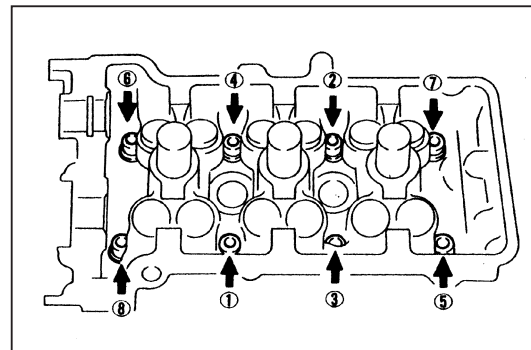
5. Coat each cylinder head bolt with a thin film of engine oil. Using these bolts, install the cylinder head to the cylinder block. Tighten the bolts evenly over two or three stages, following the sequence shown in the right figure.

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

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.

MEM00086-00000

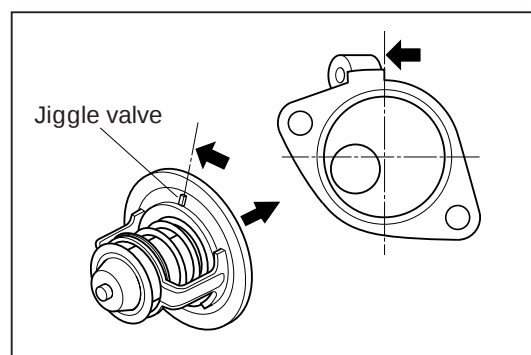


MEM00087-00085

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.

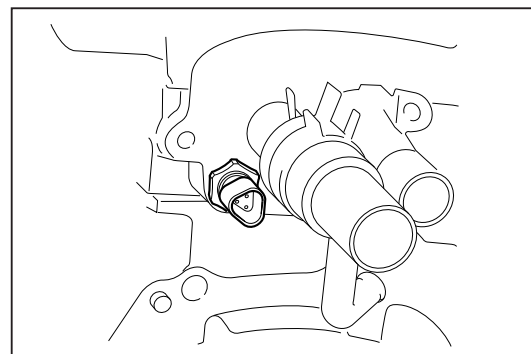
Tightening Torque: $19.0 \pm 3.8 \text{ N}\cdot\text{m}$



MEM00088-00086

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.

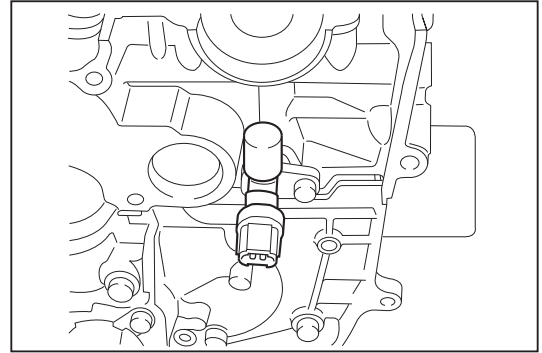
Tightening Torque: $24.0 \pm 4.8 \text{ N}\cdot\text{m}$



MEM00089-00087

EM-24

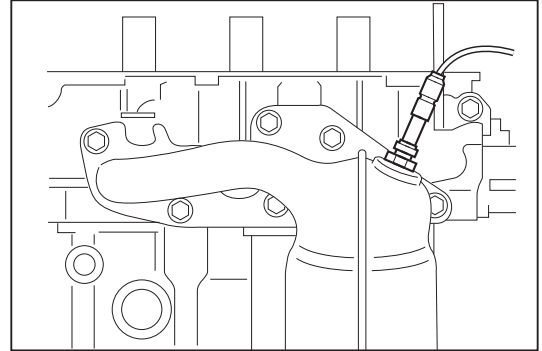
8. Install the cam position sensor to the cylinder head.
Tightening Torque: $8.0 \pm 1.6 \text{ N}\cdot\text{m}$



MEM00090-00088

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

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



MEM00091-00089

10. Install the heat insulator to the exhaust manifold.

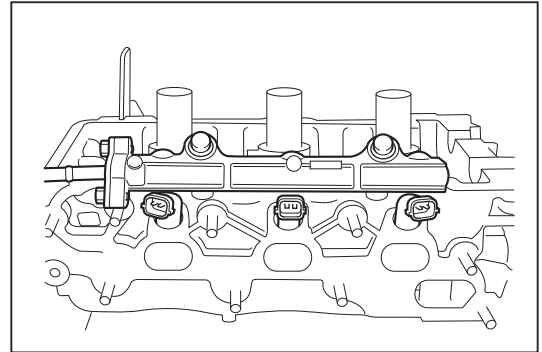
Tightening Torque: $11.5 \pm 2.3 \text{ N}\cdot\text{m}$

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.

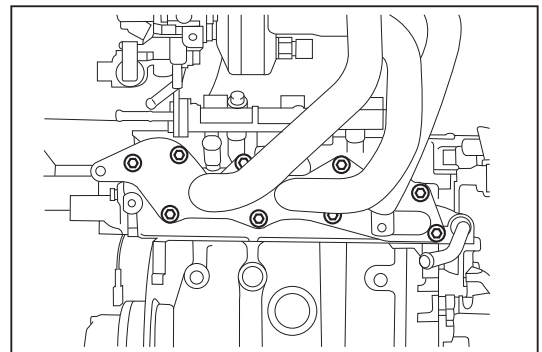
Tightening Torque: $19.0 \pm 3.8 \text{ N}\cdot\text{m}$



MEM00092-00090

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

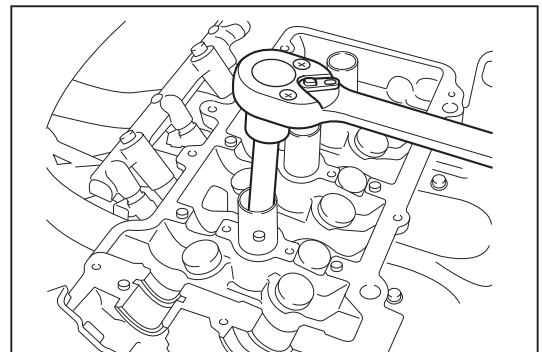
Tightening Torque: $19.0 \pm 3.8 \text{ N}\cdot\text{m}$



MEM00093-00091

16. Install the spark plug to the cylinder head.

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



MEM00094-00092

17. Installation of camshaft

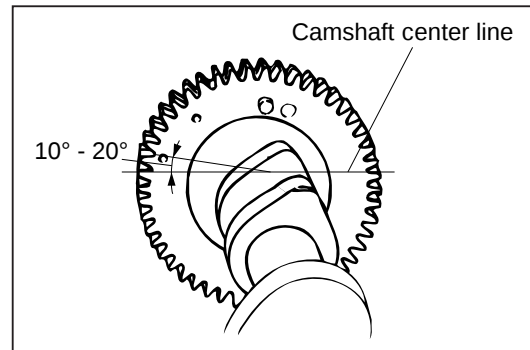
CAUTION:

- 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.)

- Apply engine oil to the cam section and gear section of the camshaft No. 1 and the journal section of the cylinder head.
- Place the camshaft assembly No. 1 on the cylinder head in such a way that the sub-gear retaining bolt may face nearly upward.

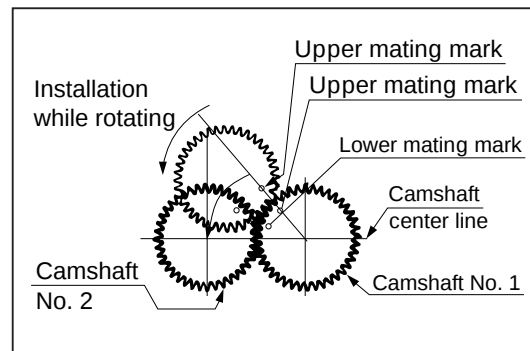
MEM00095-00000

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



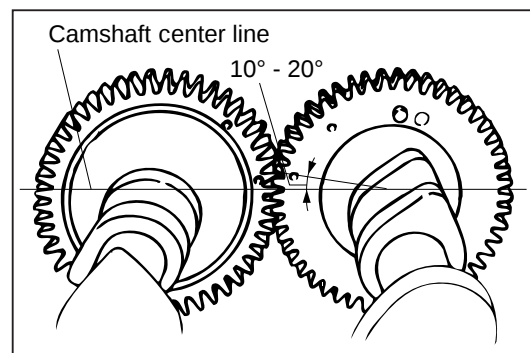
MEM00096-00093

- 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.



MEM00097-00094

- 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.

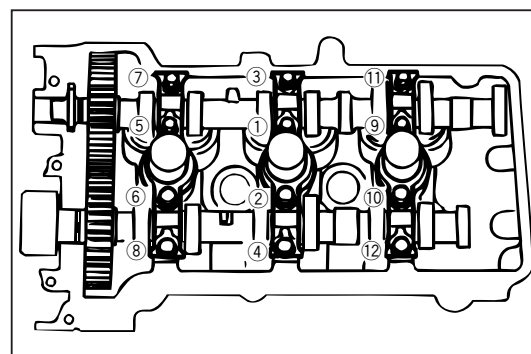


MEM00098-00095

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

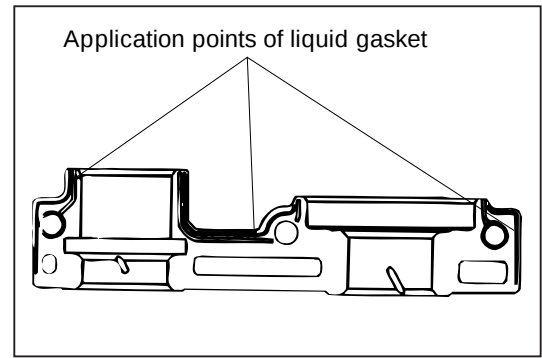
- Remove the sub-gear retaining bolt of the camshaft No. 1.



MEM00099-00096

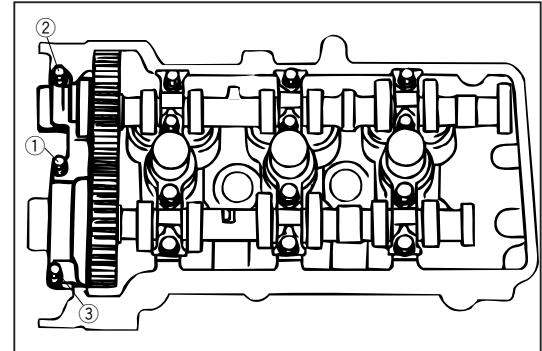
EM-26

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



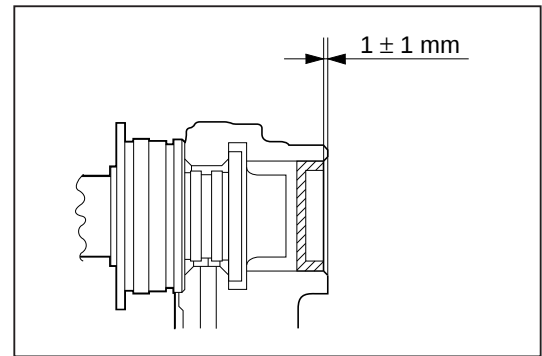
MEM00100-00097

- (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



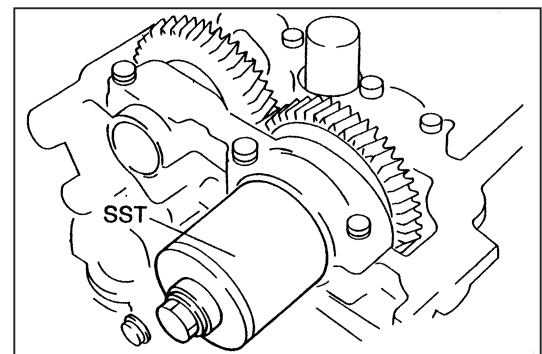
MEM00101-00098

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



MEM00102-00099

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

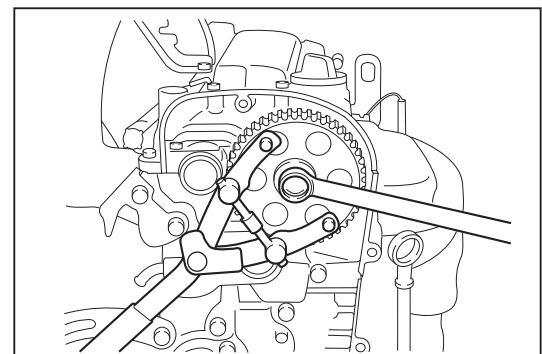


MEM00103-00100

NOTE:

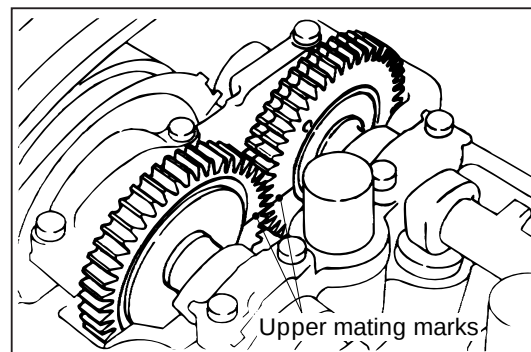
- If the oil seal is to be re-used, the press-fitting should be made after applying silicone bond.
- After the bolt has been removed, check the condition of the press-fitting by tapping the SST lightly with a hammer.

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



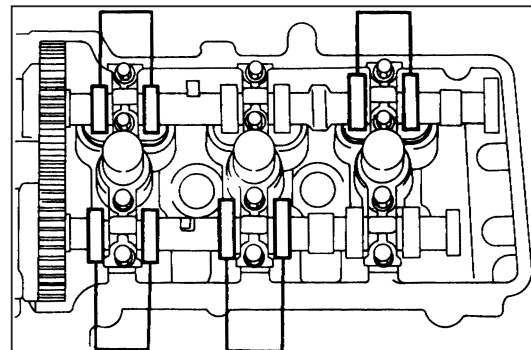
MEM00104-00101

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.



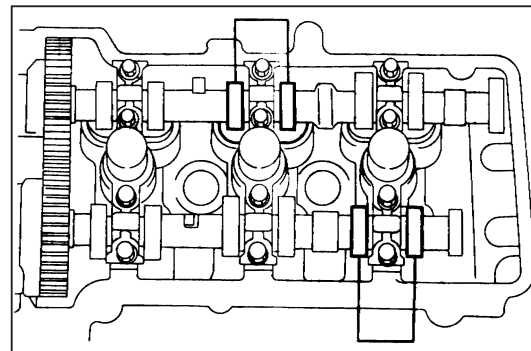
MEM00105-00102

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



MEM00106-00103

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



MEM00107-00104

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

NOTE:

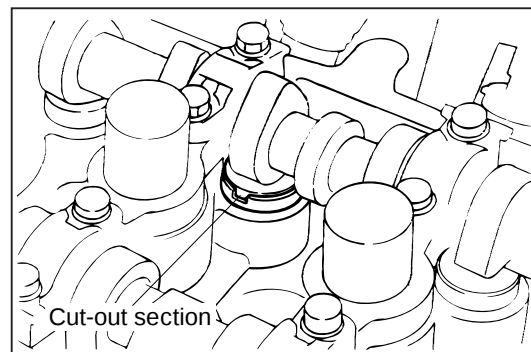
- Record the position of the valve where the clearance deviates from the specification, as well as the their measurement results.

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

EX: 0.25 ± 0.05 mm (Cold)

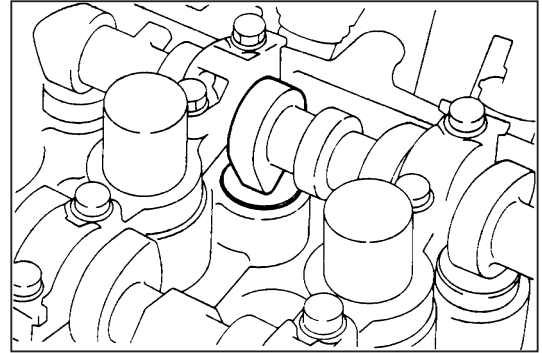
MEM00108-00000

- (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.



MEM00109-00105

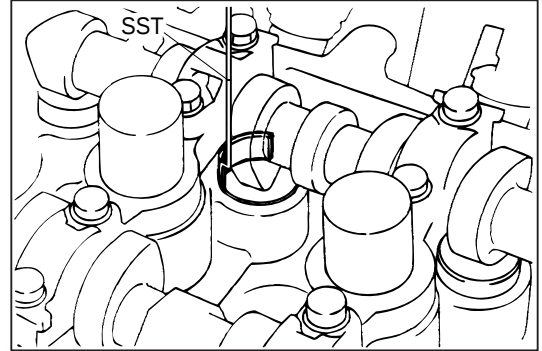
- (6) Turn the crankshaft so that the cam nose of the cylinder points downward and pushes down the valve lifter.



MEM00110-00106

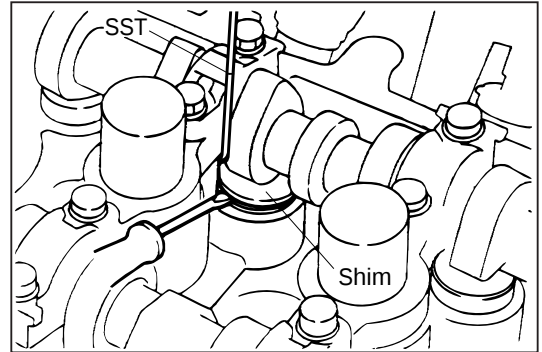
- (7) Place the SST on the upper circumference of the valve lifter from the inside of the cylinder head, as shown in the right figure. Turn the crankshaft so that the cam nose points approximately upward. In this way, retain the valve lifter in a pushed-down state by means of the SST.

SST: 09221-87208-000



MEM00111-00107

- (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.



MEM00112-00108

- (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

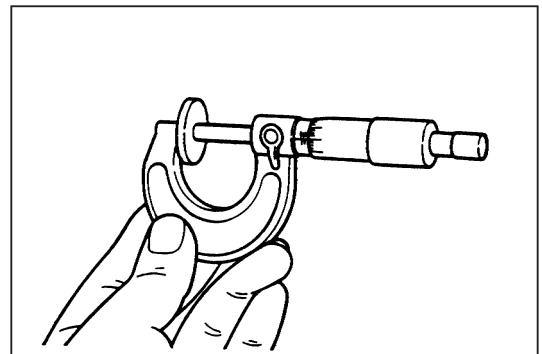
(Thickness of shim to be selected) = (Thickness of removed shim) + [(measured clearance) - 0.18 mm]

Exhaust Valve

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

[Reference]

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



MEM00113-00109

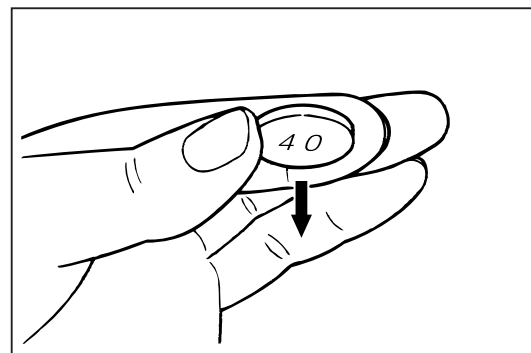
No.	Shim thickness (mm)	No.	Shim thickness (mm)	No.	Shim thickness (mm)	No.	Shim thickness (mm)
30	2.50	41	2.72	52	2.94	63	3.16
31	2.52	42	2.74	53	2.96	64	3.18
32	2.54	43	2.76	54	2.98	65	3.20
33	2.56	44	2.78	55	3.00	66	3.22
34	2.58	45	2.80	56	3.02	67	3.24
35	2.60	46	2.82	57	3.04	68	3.26
36	2.62	47	2.84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

MEM00114-00000

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

NOTE:

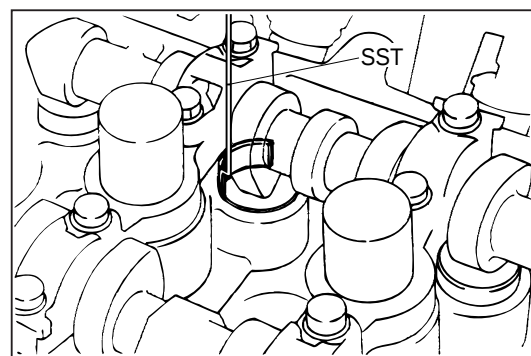
- Install the shim in such a way that the side bearing the identification number faces downward.



MEM00115-00110

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

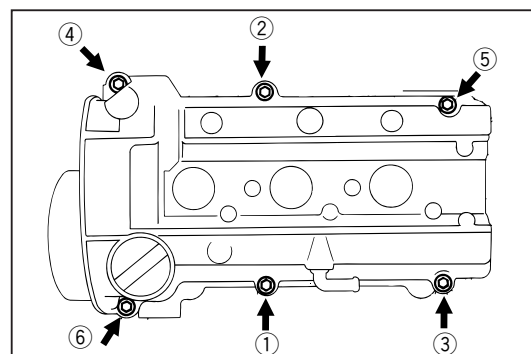
(13) Turn the crankshaft two or three turns. Check the valve clearance. If it fails to meet the specification, repeat the steps from (5) through (13).



MEM00116-00111

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

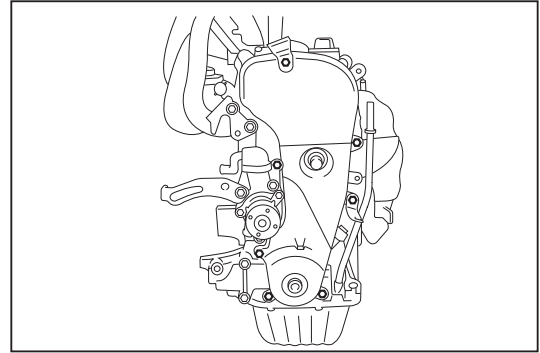
Tightening Torque: $5.5 \pm 1.1 \text{ N}\cdot\text{m}$



MEM00117-00112

EM-30

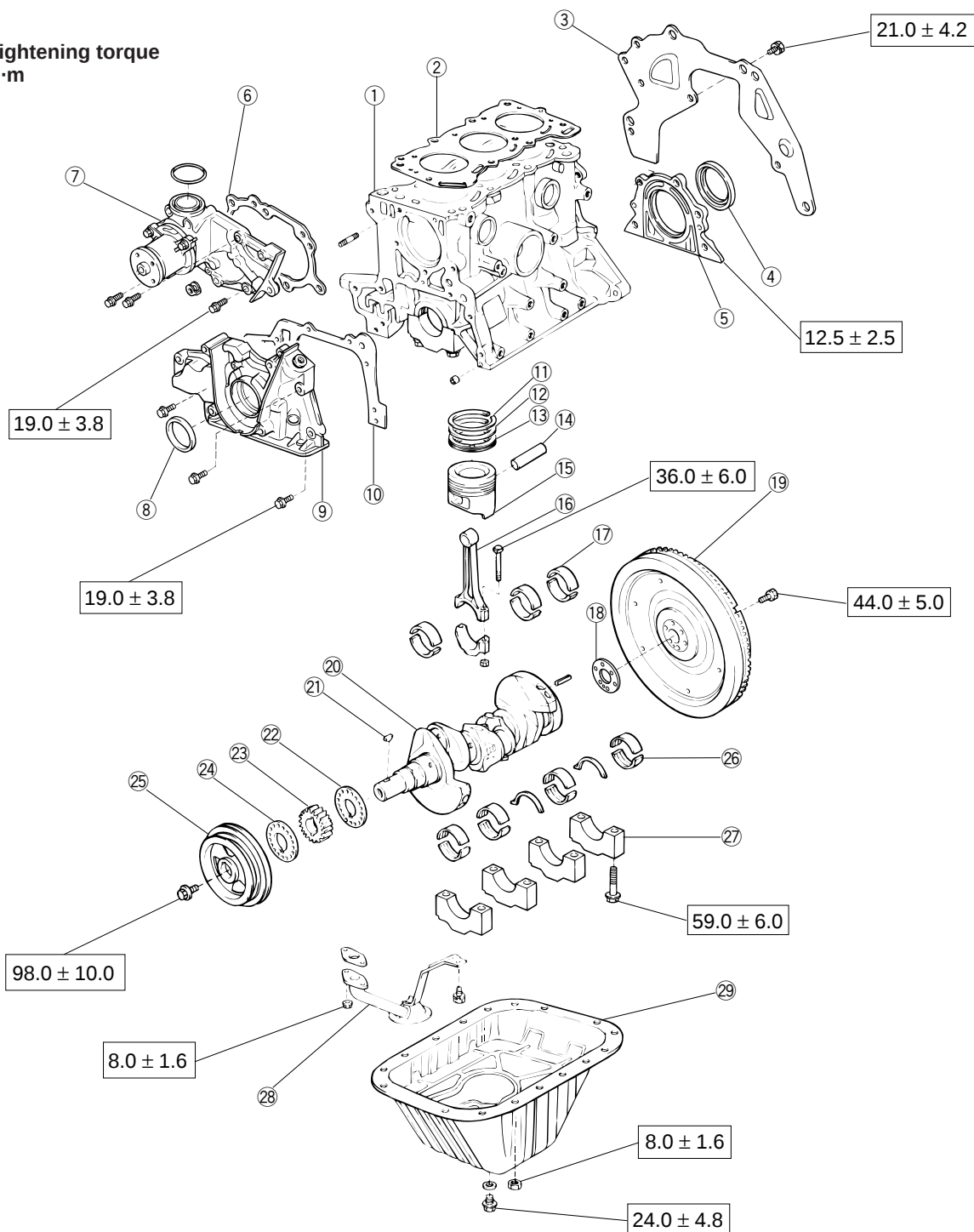
27. Install the timing belt. (Refer to the “TIMING BELT” section.)
28. Install the timing belt cover. (Refer to the “TIMING BELT” section.)
29. Install the crankshaft pulley.
Tightening Torque: 98.0 ± 10.0 N·m
30. Install the surge tank stay to the cylinder head cover.
Tightening Torque: 9.0 ± 2.7 N·m
31. Connect the vacuum hose to the cylinder head and intake manifold.
32. Install the ignition coil to the cylinder head cover.
Tightening Torque: 6.0 ± 1.8 N·m



MEM00118-00113

CYLINDER BLOCK COMPONENTS

□ : Tightening torque
Unit : N·m



- ① Cylinder block
- ② Cylinder head gasket
- ③ Rear end plate
- ④ Rear oil seal
- ⑤ Rear oil seal retainer
- ⑥ Water pump gasket
- ⑦ Water pump
- ⑧ Front oil seal
- ⑨ Oil pump
- ⑩ Oil pump gasket

- ⑪ Piston ring No. 1
- ⑫ Piston ring No. 2
- ⑬ Oil ring
- ⑭ Piston pin
- ⑮ Piston
- ⑯ Connecting rod
- ⑰ Connecting rod bearing
- ⑱ Spacer
- ⑲ Flywheel
- ⑳ Crankshaft

- ㉑ Key
- ㉒ Spacer
- ㉓ Crankshaft timing belt pulley
- ㉔ Spacer
- ㉕ Crankshaft pulley
- ㉖ Crankshaft bearing
- ㉗ Crankshaft bearing cap
- ㉘ Oil strainer
- ㉙ Oil pan

DISASSEMBLY

1. Drain the engine oil by removing the drain plug of the oil pan.
2. Drain the engine coolant by removing the drain plug of the water pump.

3. Remove the timing belt. (For removal procedure, refer to the "TIMING BELT" section.)
4. Remove the cylinder head. (For removal procedure, refer to the "CYLINDER HEAD" section.)
5. Remove the pressure plate and clutch disc.

NOTE:

- Prevent the pressure plate from turning, using the following SST.

SST: 09210-87701-000

6. Remove the water pump.

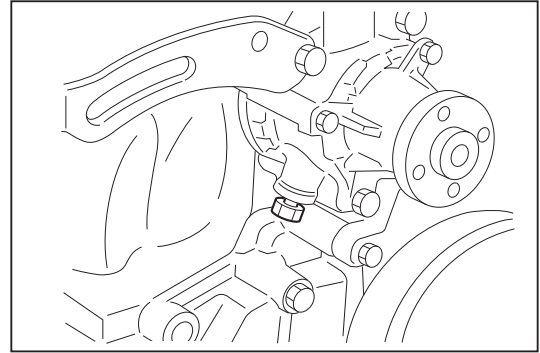
7. Check of flywheel (drive plate) for runout

NOTE:

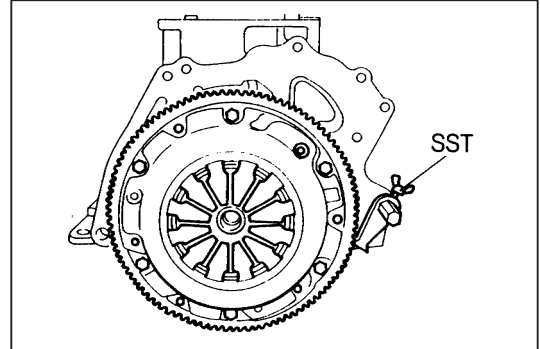
- If the runout does not conform to the specification, confirm the tightening torque of the flywheel (drive plate). Only in the case where the tightening torque conforms to the specified value, replace the flywheel (drive plate).

Specified Runout Limit: Less than 0.1 mm

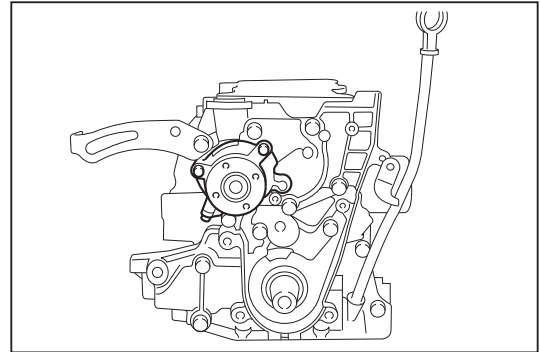
8. Loosen the attaching bolts of the flywheel (drive plate) in the sequence as indicated in the right figure. Remove the flywheel (drive plate).



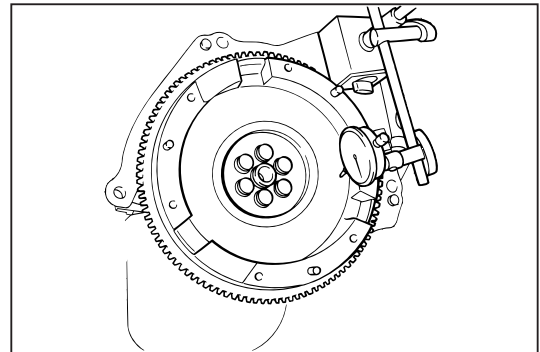
MEM00120-00115



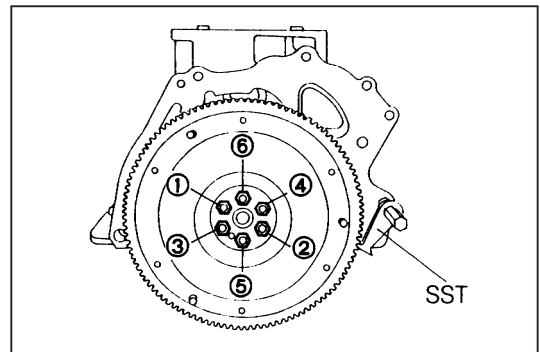
MEM00121-00116



MEM00122-00117



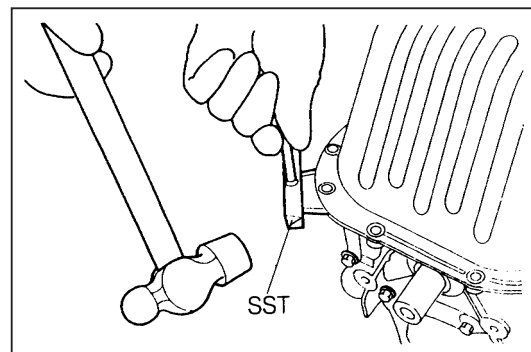
MEM00123-00118



MEM00124-00119

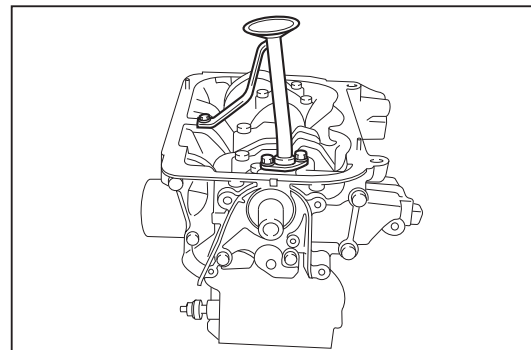
9. Remove the rear end plate.
10. Removal of oil pan
 - (1) Loosen the attaching bolts and nuts of the oil pan over two or three stages. Pull out the bolts and nuts.
 - (2) Separate the oil pan from the cylinder block by driving the following SST into between the cylinder block and the oil pan.

SST: 09032-00100-000



MEM00125-00120

11. Remove the oil strainer.
12. Remove the oil strainer gasket from the oil pump.
13. Remove the oil pump from the cylinder block.
(For the disassembly and inspection of the oil pump, refer to the LU section.)
14. Remove the oil pump gasket from the cylinder block.
15. Remove the rear oil seal retainer.



MEM00126-00121

16. Measurement of connecting rod thrust clearance
Measure the thrust clearance between the connecting rod and the crankshaft, using a thickness gauge.

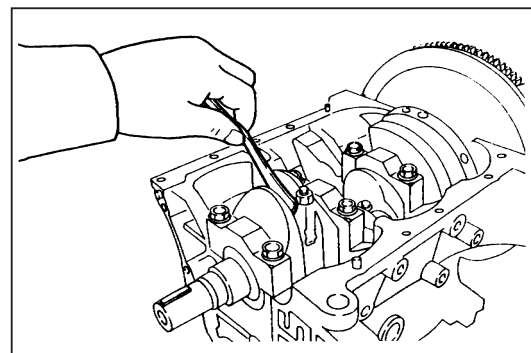
Thrust Clearance:

Specified Value: 0.15 - 0.25 mm

Maximum Limit: 0.3 mm

NOTE:

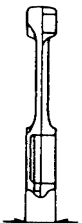
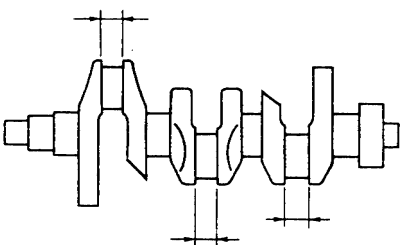
- The thrust clearance should be measured while the connecting rod is being pushed against either side of the crankshaft in the axial direction. Measure the thrust clearance at the opposite side.



MEM00127-00122

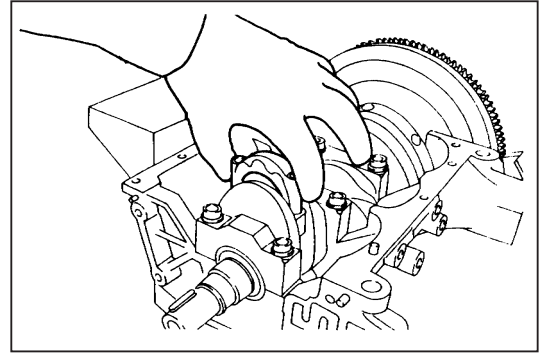
If the clearance exceeds the specified value, replace the connecting rod or the crankshaft, or both of them, referring to the width of the big end of the connecting rod in the thrust direction and the side width of the crankpin journal.

[Reference]

Width of big end of connecting rod in thrust direction	Side width of crankpin journal
19.80 - 19.85 mm	20.00 - 20.05 mm
Connecting rod 	Crankshaft 

MEM00128-00123

17. Loosen the connecting rod bearing cap nuts evenly over two or three stages. Then, remove the nut.
18. Remove the connecting rod bearing cap.



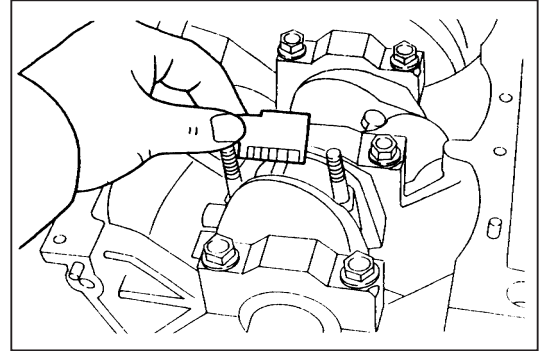
MEM00129-00124

19. Measure the oil clearance between the crankpin journal and the connecting rod bearing cap.
(For the tightening method of the connecting rod cap nuts, refer to page EM-50.)

Oil Clearance:

STD: 0.020 - 0.044 mm

Maximum Limit: 0.07 mm



MEM00130-00125

NOTE:

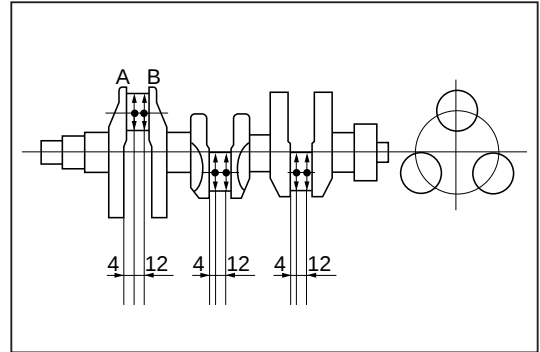
- If the oil clearance does not conform to the specification, measure the crankshaft pin journal and connecting rod big end bore, following the procedure given. If both meet the specifications, replace the bearing according to the classification.

Measurement of crankpin diameter

1. Measure the crankpin diameter of the crankshaft in four directions for each crankshaft pin, 90 degrees spaced, at those points indicated in the right figure.
2. The greatest value among the measured diameters is regarded as the crankpin journal diameter.

Specified Crankpin Journal Diameter:

39.076 - 40.000 mm



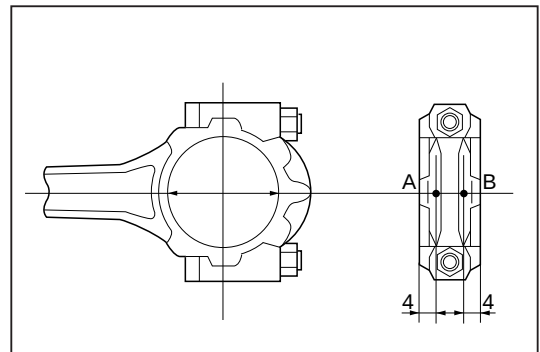
MEM00131-00126

Measurement of connecting rod big end bore diameter

1. Perform measurement at the two points indicated in the figure.
2. The smaller value among the measured diameters is regarded as the connecting rod big end bore diameter.

Specified Connecting Rod Big End Bore:

43.000 - 43.024 mm



MEM00132-00127

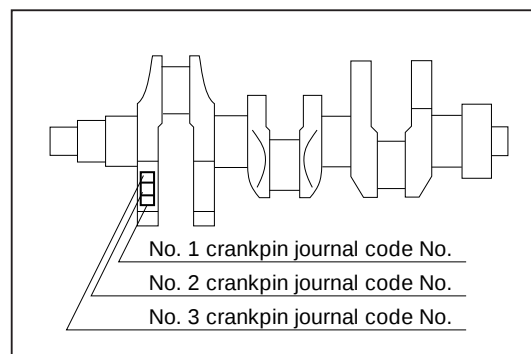
CAUTION:

- If the classification that has been determined by the measured value differs from the code attached to the part, be sure to carefully select the bearing.
- Since undersized bearings are available, the crank pin journals of a crankshaft which will not meet the specification can be machined according to the undersized bearing. In this case, perform machining of the crank pin journals, referring to the table below.
- When some parts only are replaced, the replacement should be done only when the classification matches with each other.

MEM00133-00000

Crankshaft pin code No.

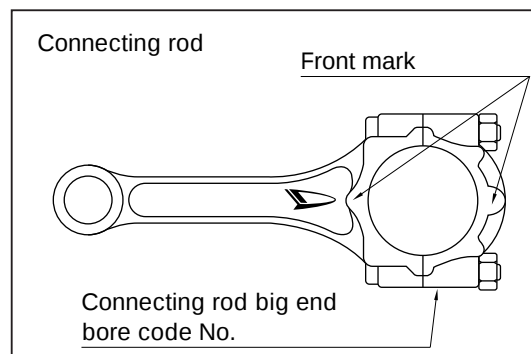
Crankshaft pin code No.	Crankshaft pin diameter (mm)
1	39.976 - 39.984
2	39.985 - 39.992
3	39.993 - 40.000



MEM00134-00128

Connecting rod big end bore code No.

Connecting rod big end bore code No.	Connecting rod big end bore diameter (mm)
4	43.000 - 43.008
5	43.009 - 43.016
6	43.017 - 43.024



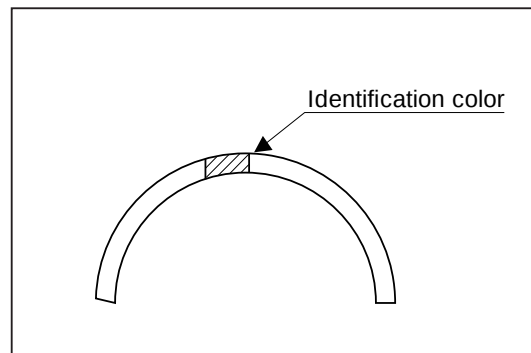
MEM00135-00129

Connecting rod bearing code No.

Connecting rod bearing code No. (Identification color)	Connecting rod bearing center thickness (mm)
1 (Yellow)	1.486 - 1.490
2 (Green)	1.491 - 1.494
3 (Brown)	1.495 - 1.498
4 (Black)	1.499 - 1.502
5 (Blue)	1.503 - 1.506

Connecting rod bearing selection

		Crankshaft		
		Crankshaft pin code No.		
Connecting rod	Connecting rod big end bore code No.	1	2	3
		4	3	2
		5	4	3
		6	5	4



MEM00136-00130

Specified crankshaft pin diameter

Kind of bearing	Crankshaft pin diameter (mm)
U/S 0.25	39.726 - 39.750
U/S 0.50	39.476 - 39.500

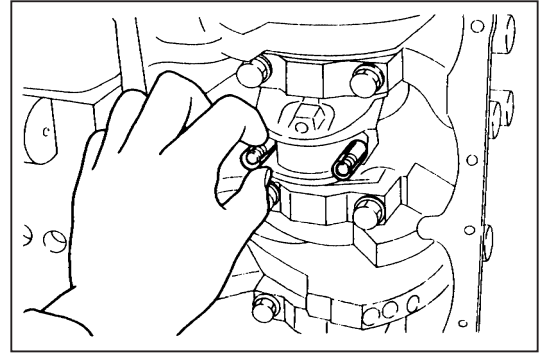
MEM00137-00000

20. Removal of piston

- (1) Cover each connecting rod bolt with a short piece of hose to protect the crankpin journal from damage.
- (2) Push out the piston and connecting rod assembly and the upper bearing through the top of the cylinder block.

NOTE:

- Arrange the removed pistons and connecting rods so that their installation positions may be identified readily.
- Care should be exercised so as not to damage the bearings.



MEM00138-00131

21. Checking procedure of crankshaft thrust clearance

NOTE:

- Measure the thrust clearance, using a dial gauge.

Thrust Clearance:

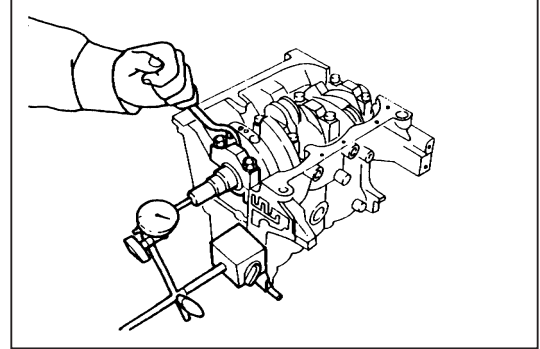
Specified Value: 0.02 - 0.22 mm

Maximum Limit: 0.30 mm

If the thrust clearance exceeds the specified value, measure the width of the crankshaft thrust washer contact surface. If the measure value is less than 22.63 mm, replace the thrust washer with a standard thrust washer or a suitable oversize thrust washer. If the measured value exceeds 22.63 mm, replace the crankshaft and thrust washer.

[Reference]

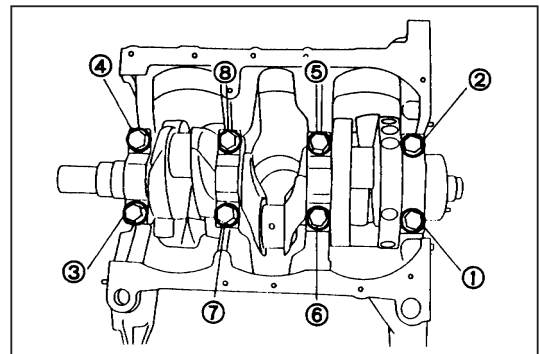
- The oversize thrust washer comes in two thicknesses of 0.125 mm and 0.25 mm. However, this figure represents the amount of oversize for each thrust washer.



MEM00139-00132

22. Removal of crankshaft

- (1) Gradually loosen the main bearing cap bolts over three stages in the numerical sequence shown in the figure. Remove the bearing cap bolts.

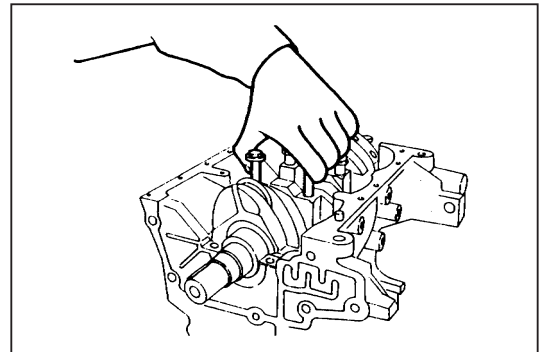


MEM00140-00133

- (2) With the main bearing cap bolts inserted into the bolt holes of the main bearing cap, wiggle the bearing cap back and forth. Remove the bearing cap together with the lower bearing.

NOTE:

- Keep the lower bearing fitted to the main bearing cap. Arrange the removed main bearing caps in order.



MEM00141-00134

- (3) Lift off the crankshaft.
- (4) Remove the upper bearing.

NOTE:

- Be very careful not to allow the main bearings to be mixed with the bearings of other cylinders.
- Remove the thrust washer.

23. Measure the oil clearance between the crankshaft main journal and the crankshaft bearing cap.

NOTE:

- For the tightening method of the crankshaft bearing cap, refer to page EM-50.)

Oil Clearance:

STD: 0.004 - 0.028 mm

NOTE:

- If the oil clearance does not conform to the specification, measure the crankshaft main journals, cylinder block main journal diameters and crankshaft bearing center thickness, following the procedure given below. Replace any part which will not conform to the specifications.

As an alternative method, when undersized bearings are available as replacement parts, machine the crank pin journal in such a way that the following formula given below may be satisfied.

Measured cylinder block main journal diameter – (Measured crank pin journal diameter + Undersized bearing center thickness to be used $\times$ 2) = 0.004 - 0.028 mm

Measurement of crankshaft main journal diameter

1. Measure the crankshaft main journal diameter of the crankshaft in four directions for each crankshaft pin, 90 degrees spaced, at those points indicated in the right figure.
2. The greatest value among the measured diameters is regarded as the crankshaft main journal diameter.

Specified Crankshaft Main Journal Diameter:

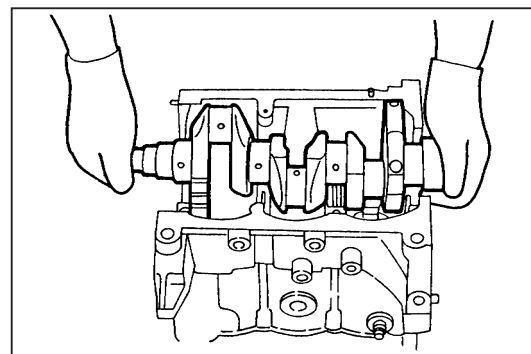
45.976 - 46.000 mm

Measurement of cylinder block main journal diameter

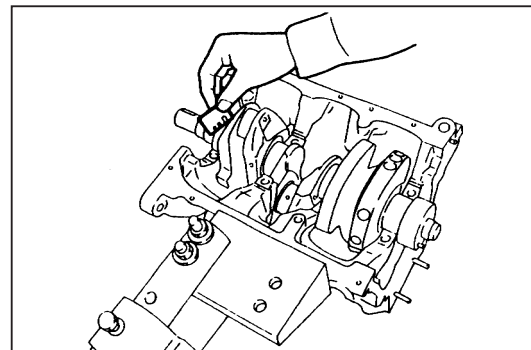
1. Perform the measurement at the two points shown in the figure.
2. The smaller value among the measured diameters is regarded as the connecting rod big end bore diameter.

Specified Cylinder Block Main Journal Diameter:

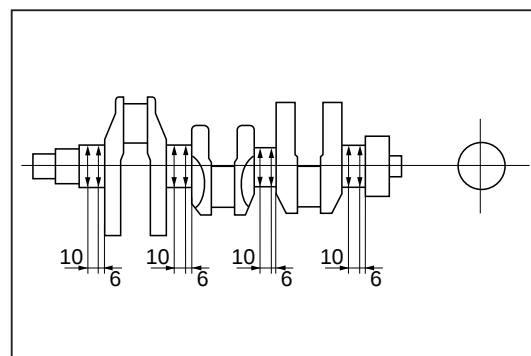
50.000 - 50.024 mm



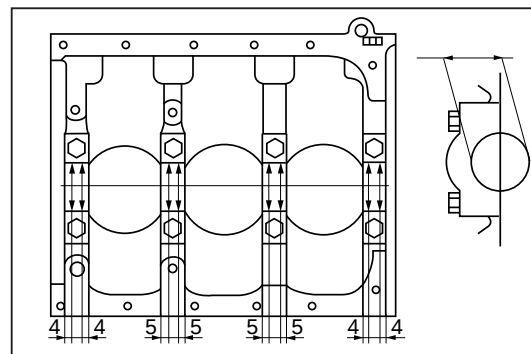
MEM00142-00135



MEM000143-00136



MEM00144-00137



MEM00145-00138

CAUTION:

- If the classification that has been determined by the measured value differs from the code attached to the part, be sure to carefully select the bearing.
- Since undersized bearings are available, the crank pin journals of a crankshaft which will not meet the specification can be machined according to the undersized bearing. In this case, perform machining of the crank pin journals, referring to the table below.
- When some parts only are replaced, the replacement should be done only when the classification matches with each other.

Crankshaft main journal code No.

Crankshaft main journal code No.	Crankshaft main journal diameter (mm)
1	45.976 - 45.984
2	45.985 - 45.992
3	45.993 - 46.000

Cylinder block main journal code No.

Cylinder block main journal code No.	Cylinder block main journal bore diameter (mm)
4	50.000 - 50.008
5	50.009 - 50.016
6	50.017 - 50.024

Crankshaft bearing code No.

Crankshaft bearing code No. (Identification color)	Crankshaft main journal bearing center thickness (mm)
3 (Green)	1.994 - 1.998
4 (Brown)	1.999 - 2.002
5 (Black)	2.003 - 2.006
6 (Blue)	2.007 - 2.010
7 (Pink)	2.011 - 2.014

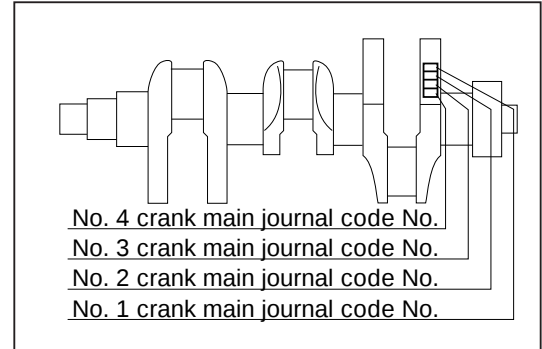
Crankshaft bearing selection code No.

Crankshaft		Crankshaft main journal code No.		
Cylinder block	Cylinder block main journal bore code No.	1	2	3
		4	5	4
		5	6	5
		6	7	6

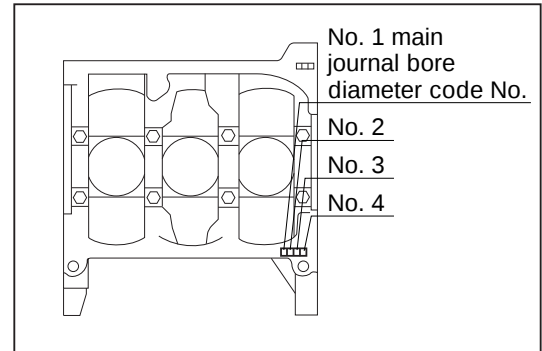
Specified crankshaft main journal diameter

Kind of bearing	Crankshaft main journal diameter (mm)
U/S 0.25	45.726 - 45.750
U/S 0.50	45.746 - 45.500

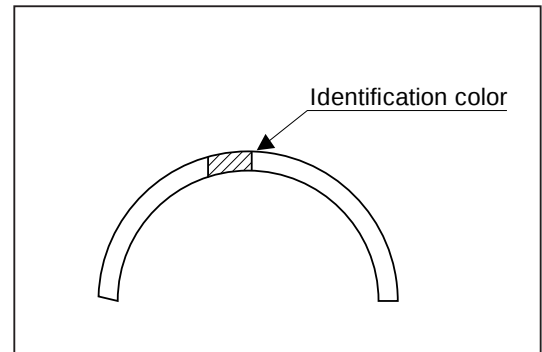
MEM00146-00000



MEM00147-00139



MEM00148-00140



MEM00149-00141

MEM00150-00000

INSPECTION

Crank shaft

1. Check the main journals and bearings for pitting or scratches.

If the main journals exhibits damage, repair or replace the crankshaft.

If the main journal bearings are damaged, replace the main journal bearings.

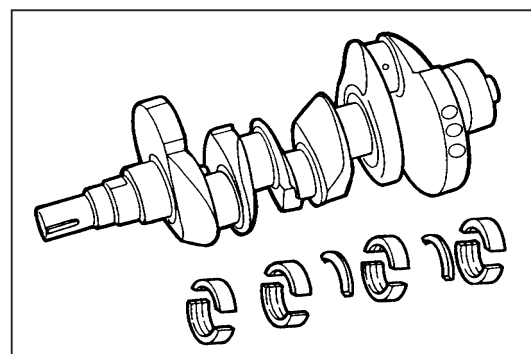
2. Support the both ends of the crankshaft with a V-block. Measure the crankshaft runout with a dial gauge at No. 3 journal.

Allowable Limit of Runout: 0.06 mm

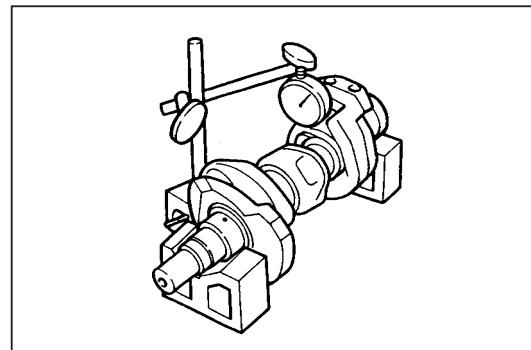
NOTE:

- The allowable limit of bend is 0.03 mm

If the runout exceeds the allowable limit, replace the crankshaft.



MEM00150-00142

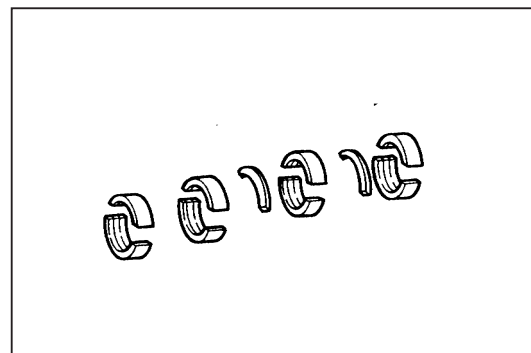


MEM00151-00143

Crankshaft bearing & Connecting rod bearing

Check the bearings for pitting or scratches.

If the bearings exhibits damage, replace the bearing.



MEM00152-00144

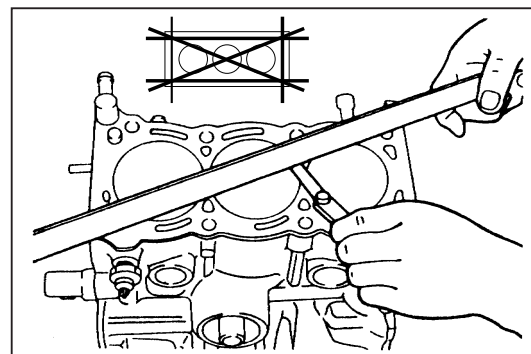
Cylinder block

1. Inspection of top surface of cylinder block

Using a precision straightedge and a thickness gauge, check the surface contacting the cylinder head gasket for warpage in the six directions as shown in the figure.

Maximum Warpage: 0.08 mm

If the warpage exceeds the allowable limit, replace the cylinder block or reface the upper gasket surface of the cylinder block, referring to the following cylinder block height as a limit.



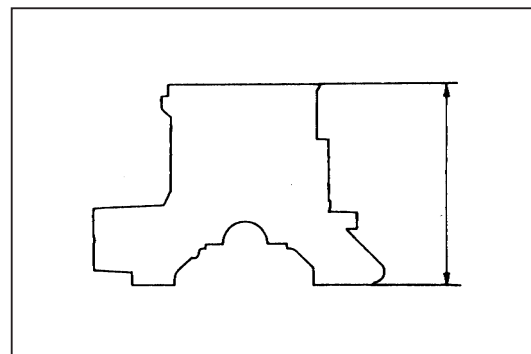
MEM00153-00145

Cylinder Block Minimum Height: 235.8 mm

(Reference)

Cylinder Block Height:

STD: 235.9 - 236.1 mm



MEM00154-00146

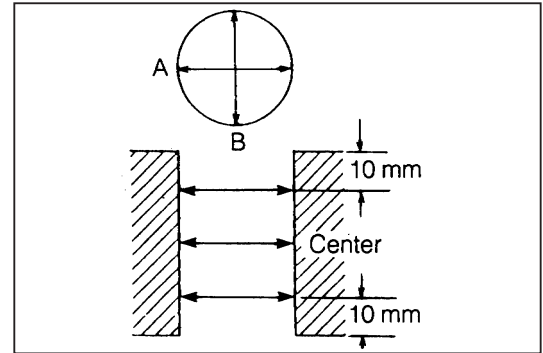
EM-40

2. Measurement of cylinder bores

- (1) Measure the bore diameter of each cylinder at the six points shown in the right figure. Ensure that the difference between the maximum and minimum bore diameters of each cylinder is within 0.03 mm.

Specified Cylinder Bore Diameter:
72.000 - 72.030 mm

If the difference between the maximum and minimum values exceeds 0.03 mm, perform boring and/or honing for the cylinder bore in accordance with the oversized piston.



MEM00155-00147

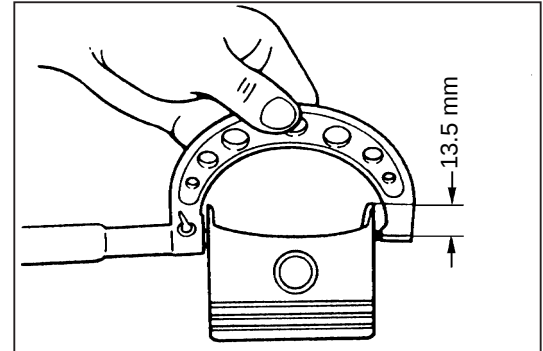
3. Inspection of piston-to-cylinder bore clearance

- (1) Calculate the piston-to-cylinder bore clearance based on the cylinder bore diameter and the piston outer diameter that were measured in Step 2.

- (2) Measurement of piston diameter

Measure the piston outer diameter horizontally at a point 13 mm from the lower end of the piston at right angles to the piston pin.

Specified Piston Outer Diameter:
71.965 - 71.995 mm



MEM00156-00148

- (3) Calculation of piston-to-cylinder bore clearance

Subtract the measured piston outer diameter from the measured cylinder bore diameter.

Piston-to-Cylinder Bore Clearance:

Specified Value: 0.025 - 0.045 mm

If the piston-to-cylinder bore clearance exceeds the allowable limit, perform boring and/or honing for the cylinder bore in accordance with the oversized piston.

4. Boring and honing of cylinder bore

NOTE:

- When the cylinder is bored, all cylinders should be bored at the same time.
- As for piston and piston rings, use oversized piston and piston rings.

- (1) Determining cylinder finishing diameter

- ① Measure the diameter of the oversized piston to be used, using a micrometer.

- ② Calculate the finishing dimension, as follows.

A: Piston diameter

B: Piston-to-cylinder bore clearance

C: Honing allowance 0.02 mm

D: Finishing diameter

$$D = A + B - C$$

(2) Hone the cylinder after the boring.

① Bore the cylinder, leaving a honing allowance of 0.02 mm.

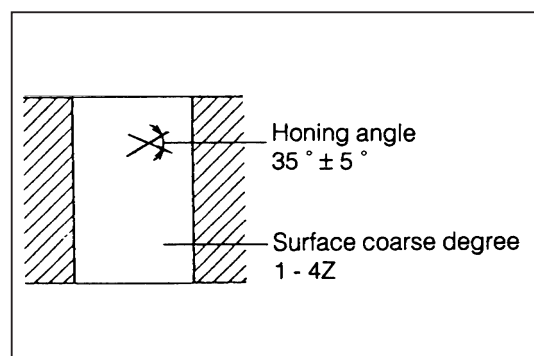
② Hone the cylinder.

Honing Angle: $35^\circ \pm 5^\circ$

Surface Coarse Degree: 1 - 4Z

[Reference]

- The table below shows the cylinder bore diameter when oversized pistons are used.
- However, after the diameter of the replacement piston has been measured, perform the finishing in accordance with the piston diameter.



MEM00157-00149

(mm)

Kind	Piston outer diameter	Cylinder bore
STD	72.000 - 72.030	71.965 - 71.995
0.25	72.250 - 72.280	72.215 - 72.245
0.50	72.500 - 72.530	72.465 - 72.495
0.75	72.750 - 72.780	72.715 - 72.745
1.00	73.000 - 73.030	72.965 - 72.995

Piston & Connecting rod

CAUTION:

- The piston and piston pin are available only as a set so that the oil clearance may become the specified value. Therefore, if you replace a piston or a piston pin, be sure to replace them as a set. Moreover, the piston and piston pin should be handled at all times as a set. Care must be exercised so that no piston nor piston pin may be mixed with other ones.

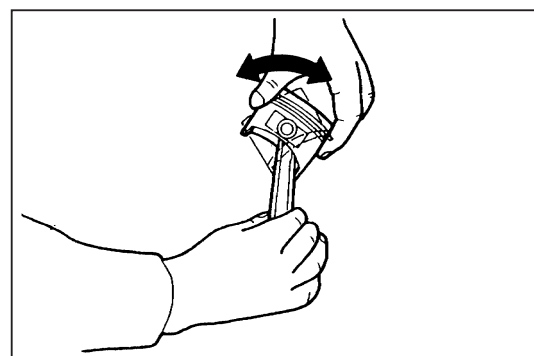
MEM00158-00000

1. Inspection of fit between piston and piston pin

Try to move the piston back and forth on the piston pin. If any movement is felt, inspect the piston and piston pin clearance.

NOTE:

- When the piston is moved back and forth on the piston pin, you may encounter hard movement. However, if the piston moves smoothly without any binding, this fitting of the piston is normal.



MEM00159-00150

EM-42

2. Measurement of oil clearance

NOTE:

- The oil clearance can be measured, following the procedure given below.

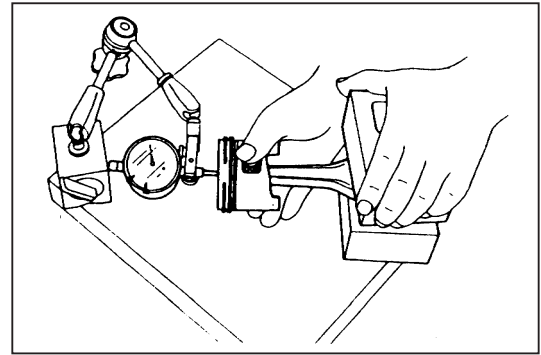
- (1) When measuring oil clearance without disassembling: Interpose the big end of the connecting rod between V-block on a surface plate. Measure the play while moving the piston, as indicated in the right figure.

Piston Pin-to-piston Clearance:

STD: 0.005 - 0.011 mm

Limit: 0.05 mm

If the oil clearance does not conform to the specification, replace the piston and piston pin. (There are no replacement parts for the piston only nor the piston pin only.)

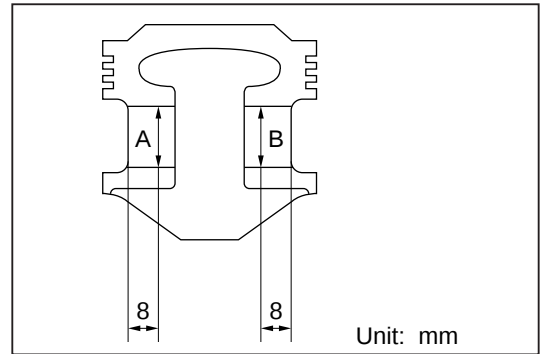


MEM00160-00151

- (2) When measuring oil clearance after disassembling (For disassembling procedure refer to the page EM-43.)

- ① Measure the diameter of the whole circumference at the positions A and B indicated in the right figure. The minimum dimension should be the piston pin hole diameter.

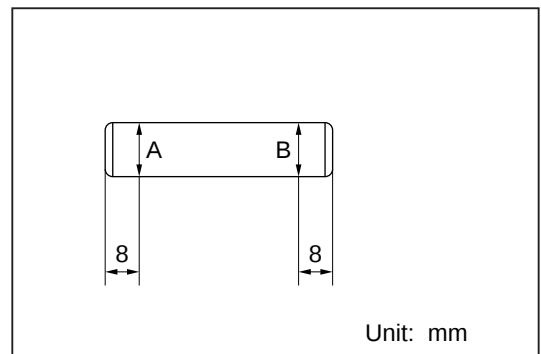
Specified Value: 18.002 - 18.005 mm



MEM00161-00152

- ② Measure the diameter of the whole circumference at the positions A and B indicated in the right figure. The maximum dimension should be the piston pin outer diameter.

Specified Value: 17.994 - 17.997 mm



MEM00162-00153

- ③ Calculate the oil clearance.

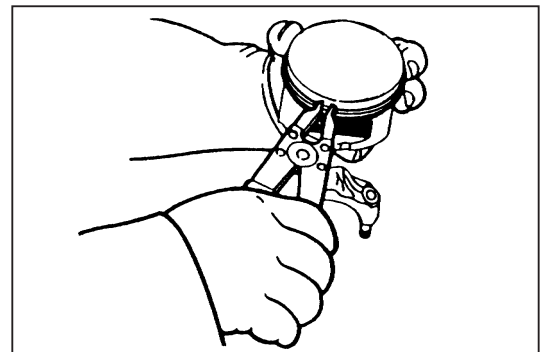
If the oil clearance does not conform to the specification, replace the piston and piston pin. (There are no replacement parts for the piston only nor the piston pin only.)

3. Removal of piston rings

NOTE:

- Arrange the removed piston rings in order so that their installation positions may be known readily.
- Do not expand the piston ring unnecessarily beyond the required extent.

- (1) Remove the piston rings No. 1 and No. 2 using a piston ring expander.
- (2) Remove the oil ring side rails by hand.
- (3) Remove the oil ring expander by hand.



MEM00163-00154

4. Inspection of piston ring groove side clearance
Measure the side clearances of the piston rings No. 1 and No. 2 over the entire periphery of each groove, using a thickness gauge.

The maximum measured value is regarded as the piston ring side clearance.

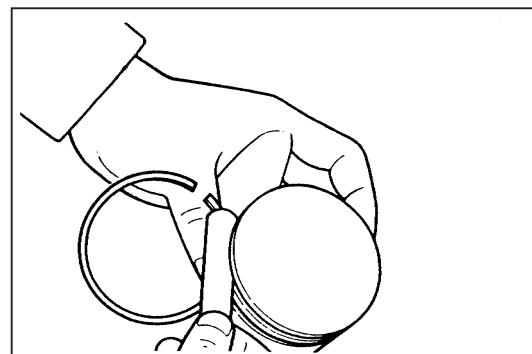
Piston ring side clearance (mm)

	Specified value	Allowable limit
Compression ring No. 1	0.03 - 0.07	0.12
Compression ring No. 2	0.02 - 0.06	0.11

Replace the piston ring and/or piston so that the piston ring side clearance may become less than the allowable limit.

NOTE:

- When replacing the piston rings, a set of piston rings for one cylinder should be replaced.

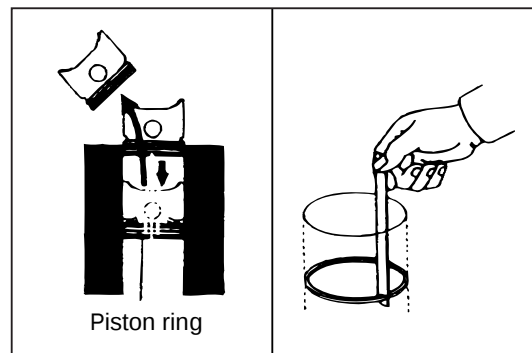


MEM00164-00155

5. Inspection of piston ring end gap
- (1) Apply engine oil to the cylinder walls.
 - (2) Insert the piston rings into the cylinder bore.
 - (3) Using a piston, push down the piston ring to a point 45 mm from the cylinder block upper surface.
 - (4) Measure the piston ring end gap, using a thickness gauge or a feeler gauge.

Piston ring end gap (mm)

	Specified value	Allowable limit
Compression ring No. 1	0.20 - 0.35	0.65
Compression ring No. 2	0.22 - 0.37	0.65
Oil ring (Side rail)	0.15 - 0.50	1.0

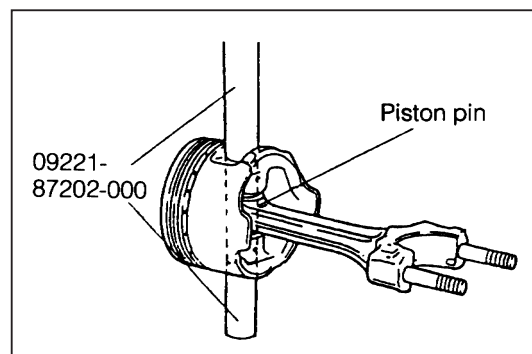


MEM00165-00156

If the piston ring end gap exceeds the allowable limit, a set of piston rings for one cylinder should be replaced.

6. Disassembly of piston and connecting rod
Use the following SSTs for the disassembling operation.
SST: 09221-87202-000
09221-87207-000

- (1) Set the SST to the piston as shown in the right figure.



MEM00166-00157

NOTE:

- Prior to this operation, remove the spacer 09221-87202-000 in advance.

- (2) Install the connecting rod in the following SST as shown in the right figure.

NOTE:

- Be sure to insert the shorter SST into the base side.
SST: 09221-87207-000

- (3) Press off the piston pin, using a hydraulic press.

7. Inspection of connecting rods

- (1) Visually inspect the connecting rods for damage or cracks.
- (2) Check the connecting rod for bend and twist, using a connecting rod aligner.
Maximum Bend: 0.05 mm
Maximum Twist: 0.05 mm

If the bend and/or twist is greater than the maximum limit, replace the connecting rod assembly.

8. Inspection of piston pin-to-connecting rod interference fit

- (1) Measure the outer diameter of the piston pin contacting with the connecting rod, using a micrometer.
Specified Piston Pin Diameter: 17.994 - 17.997 mm

- (2) Measure the inner diameter of the connecting rod, using a bore dial gauge.
Specified Connecting Rod Inner Diameter: 17.953 - 17.979 mm

- (3) Determine the interference fit by subtracting the outer diameter of the piston pin from the inner diameter of the connecting rod.
Interference Fit: 0.015 - 0.044 mm

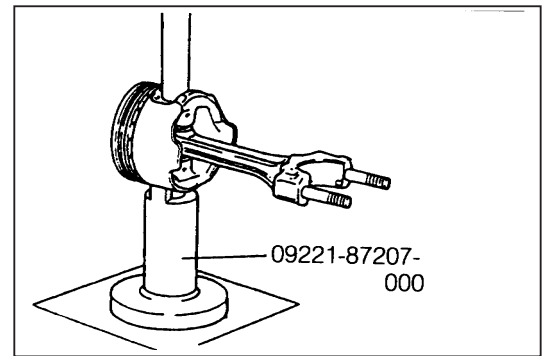
If the interference fit does not conform to the specification, replace the connecting rod or piston. (There are no replacement parts for the piston pin only.)

9. Assembly of piston and connecting rod

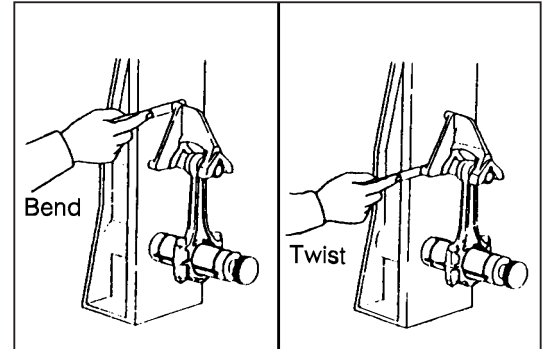
Use the following SSTs for the assembling operation.

SST: 09221-87202-000
09221-87207-000

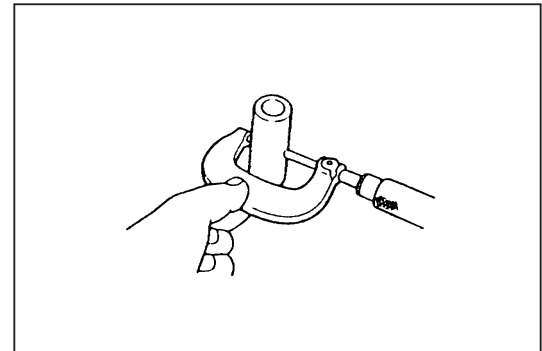
- (1) Install the piston pin to the following SST in a way shown in the right figure.
SST: 09221-87202-000



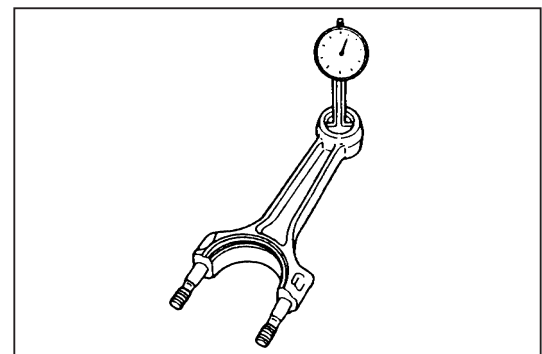
MEM00167-00158



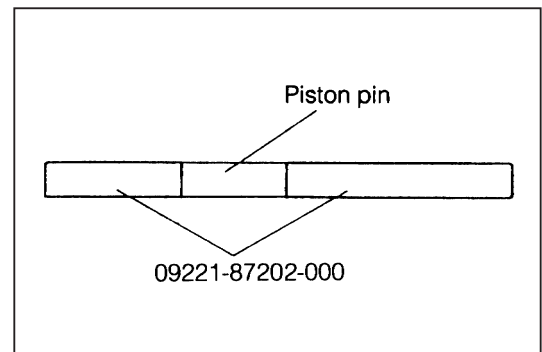
MEM00168-00159



MEM00169-00160



MEM00170-00161



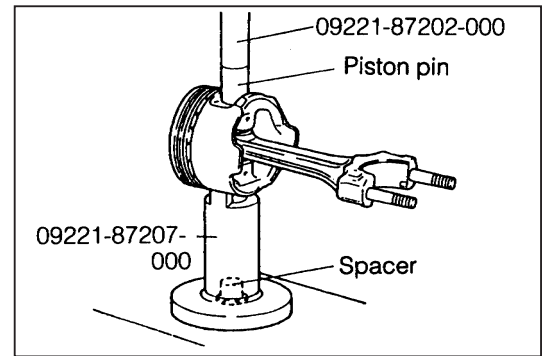
MEM00171-00162

- (2) Install the piston and connecting rod in the SST in a way shown in the right figure. Insert the SST with the piston pin installed into the piston pin hole.

NOTE:

- The piston and connecting rod should be assembled in such a way that the piston front mark and connecting rod front mark come in the same direction.
- Prior to this operation, install the spacer 09221-87207-000 in advance.

- (3) Press the piston pin into the piston and connecting rod, using a hydraulic press.
- (4) Remove the piston and connecting rod assembly from the SST. Remove the SST from the piston pin.



MEM00172-00163

Rear oil seal retainer

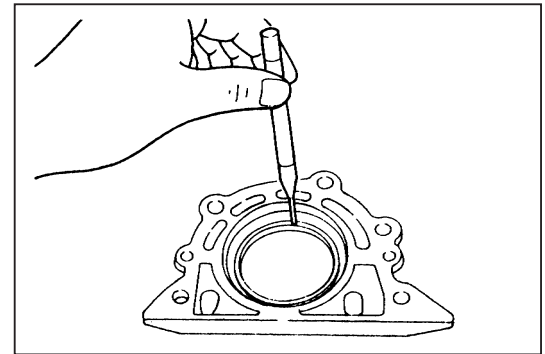
Replacement of rear oil seal

1. Removal of rear oil seal

Remove the rear oil seal from the rear oil seal retainer, using a pin punch.

NOTE:

- Be very careful not to damage the oil seal retainer.



MEM00173-00164

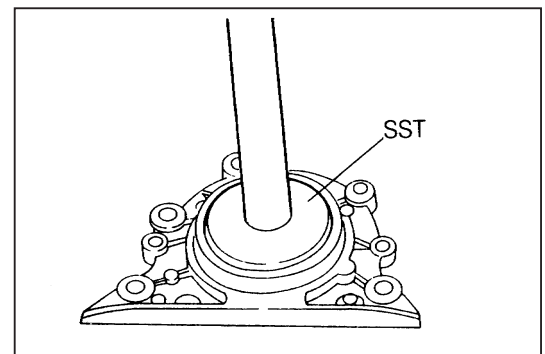
2. Installation of rear oil seal

Drive a new rear oil seal into position, using the following SST.

SST: 09608-87302-000

NOTE:

- Care must be exercised to ensure that the oil seal is not driven in a tilted state.

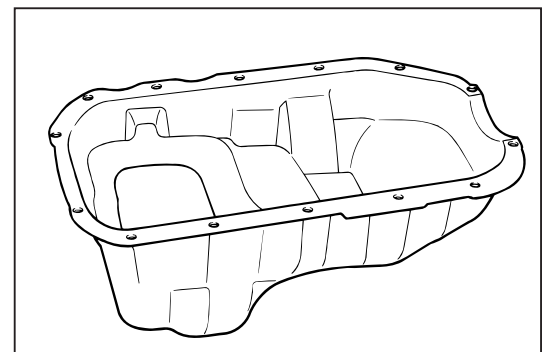


MEM00174-00165

Oil pan

Visually inspect the oil pan for damage or cracks.

Replace the oil pan, as required.



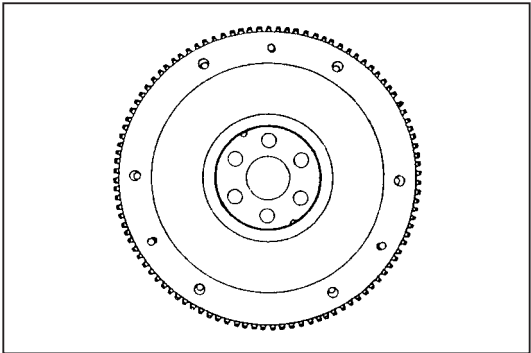
MEM00175-00166

Flywheel

Inspect the flywheel for cracks or damage.
Inspect the ring gear for damage.
Replace the flywheel if it exhibits defects.

CAUTION:

- Never disassemble the flexible type flywheel by removing the flex-plate from the flywheel subassembly. If the flywheel has undergone disassembling, it would cause breakage of the flywheel due to unbalanced flywheel mass, while the engine is running.
- Never expose the flexible type flywheel to flame of a burner, etc. If the flywheel is exposed to flame of a burner, for example, at the time of replacement of the ring gear, the quenched state of the flex-plate will be weakened. This may lead to breakage during the engine running.



MEM00176-00167

Oil pressure switch

For checking and replacement procedure, refer to the LU section.

Knocking sensor

For checking and replacement procedure, refer to the EF section.

Oil filter

For checking and replacement procedure, refer to the LU section.

MEM00177-00000

ASSEMBLY

NOTE:

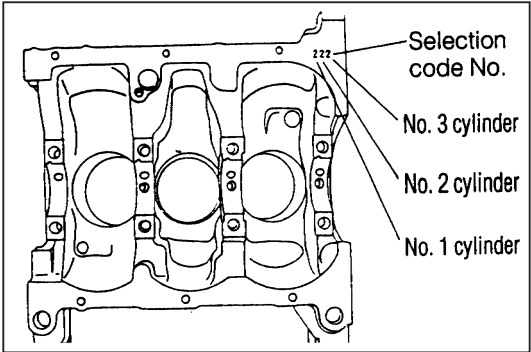
- The cylinder block is furnished along with the pistons as a set.
- Hence, make sure that each piston is installed in the mated cylinder bore.

[Reference]

- Those numerals stamped at the positions as indicated in the right figure are the piston selection code No. for each cylinder.

The table below indicates those sizes corresponding to each selection code No.

at 20°C (mm)		
Code	Cylinder bore diameter	Piston outer diameter
1	72.000 - 72.010	71.965 - 71.975
2	72.011 - 72.020	71.976 - 71.985
3	72.021 - 72.030	71.986 - 71.995



MEM00178-00000

MEM00179-00168

[Reference]

- Select the crankshaft bearing, connecting rod bearing and piston, as required, referring to the table on page EM-35, EM-38, EM-46.

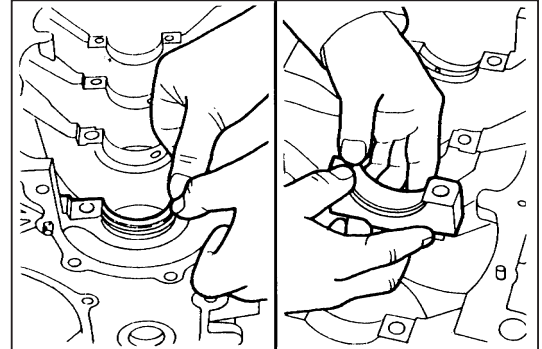
MEM00180-00000

1. Installation of crankshaft

- (1) Install the crankshaft bearings to the cylinder block and crankshaft bearing caps.

NOTE:

- Do not touch the front and back surfaces of each bearing.
- Be sure to hold the bearing at its edge surfaces.

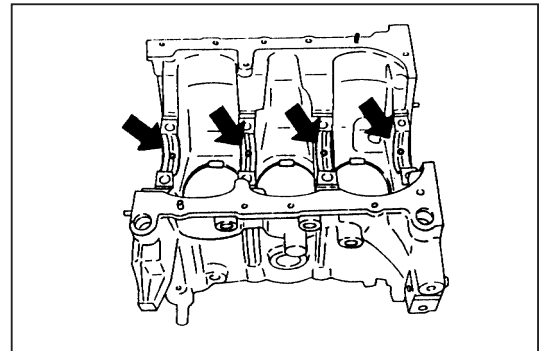


MEM00181-00169

- (2) Lubricate the surface of each bearing with engine oil.

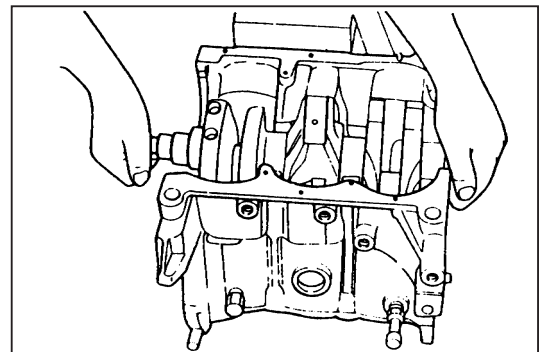
NOTE:

- Never apply engine oil to the crankshaft bearing caps.



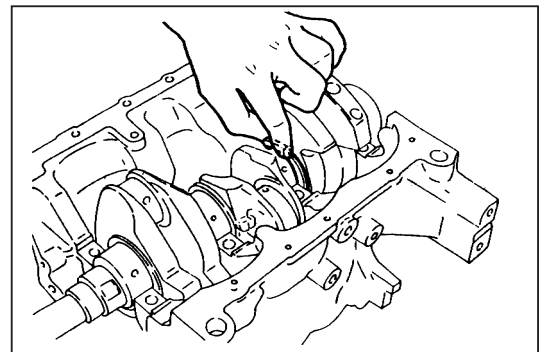
MEM00182-00170

- (3) Install the crankshaft in the cylinder block.



MEM00183-00171

- (4) Apply engine oil to the thrust washers. With the side having the oil groove facing toward the crankshaft side, insert each thrust washer between the crankshaft main journal No. 3 and the cylinder block.



MEM00184-00172

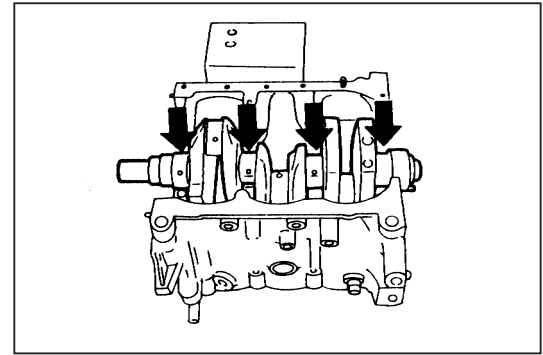
- (5) Apply engine oil to the crankshaft main journal sections.

NOTE:

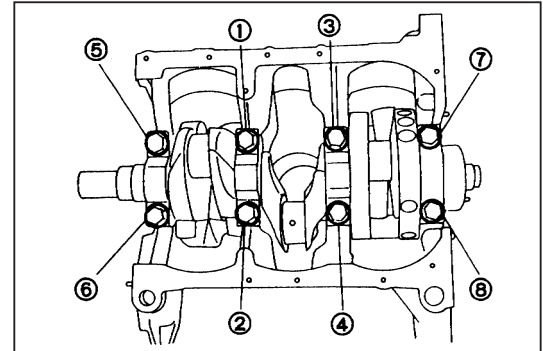
- Care must be exercised to ensure that no oil flows into the bearing cap attaching bolt holes.

- (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: $59.0 \pm 6.0 \text{ N}\cdot\text{m}$



MEM00185-00173



MEM00186-00174

2. Assembly and installation of piston

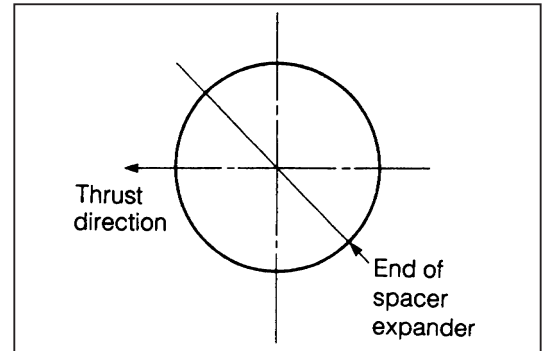
Identification Color:

- Compression ring No. 1: Black
 Compression ring No. 2: Yellow
 Oil ring spacer: Red

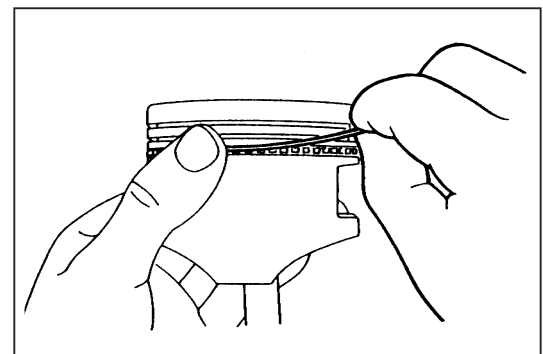
- (1) Install the oil ring spacer expander in the oil ring groove.
 Ensure that the expander end may not line up with the thrust direction nor with the axial direction.

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.



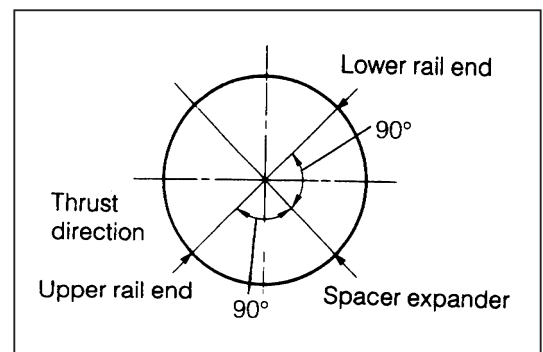
MEM00187-00175



MEM00188-00176

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.

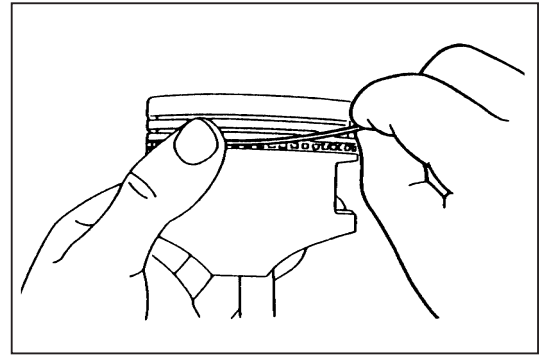


MEM00189-00177

- (3) Fit the lower rail into position in such a manner that it is wound up.

NOTE:

- Ensure that the rail end is deviated 90 degrees to the right from the end of the oil ring spacer expander.
- Do not expand the rail to an extent that is more than necessary.
- Make sure that the oil ring can be rotated smoothly.

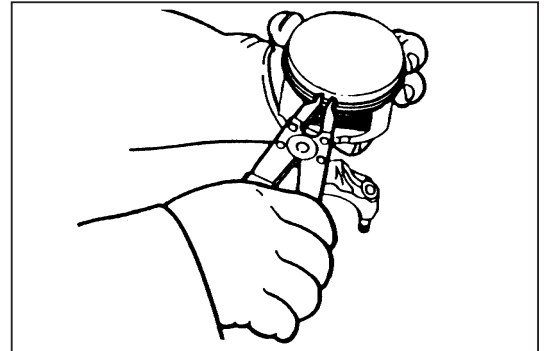


MEM00190-00178

- (4) Install the compression ring No. 2 with the stamped mark facing upward, using a piston ring expander.

NOTE:

- Do not expand the piston ring to an extent that is more than necessary.



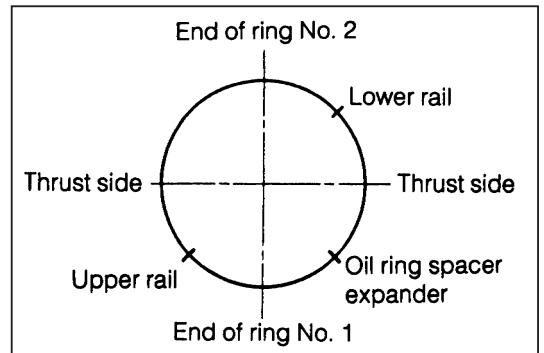
MEM00191-00179

- (5) Install the compression ring No. 1 with the stamped mark facing upward, using a piston ring expander.

- (6) Position the piston rings so that each ring end may come at the respective points as indicated in the right figure.

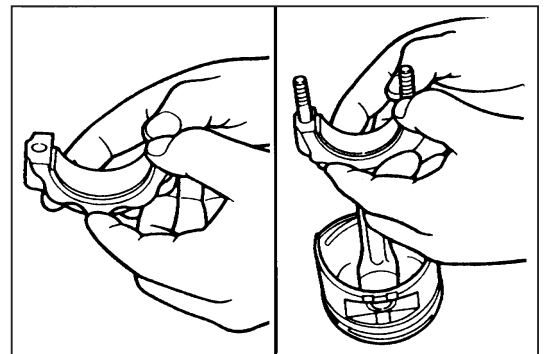
NOTE:

- It is not necessarily required to follow strictly the right figure. However, be sure that the ring end is not lined up with the thrust direction. Also, each ring should be deviated about 120 to 180 degrees from the adjacent ring.



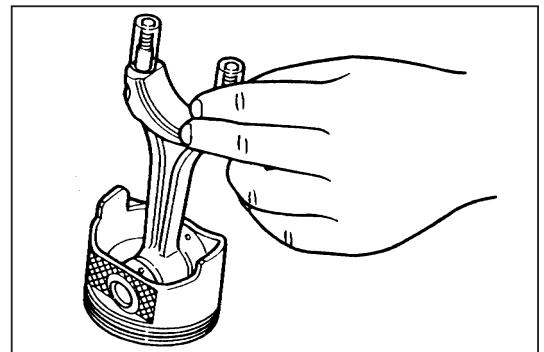
MEM00192-00180

- (7) Install the connecting rod bearings on the connecting rod and connecting rod cap, making sure that your fingers will not touch the front and back surfaces of the bearings.



MEM00193-00181

- (8) Cut an appropriate vinyl hose to a suitable length. Fit the vinyl hose to each connecting rod bolt sections.

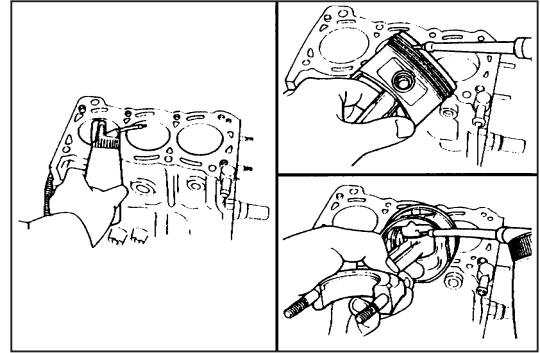


MEM00194-00182

- (9) Apply engine oil to the piston rings, piston pins, connecting rod bearings, cylinder walls and crankpin journals.

NOTE:

- Apply a small amount of engine oil to each cylinder bore.
- Apply a small amount of engine oil to each piston ring section.



MEM00195-00183

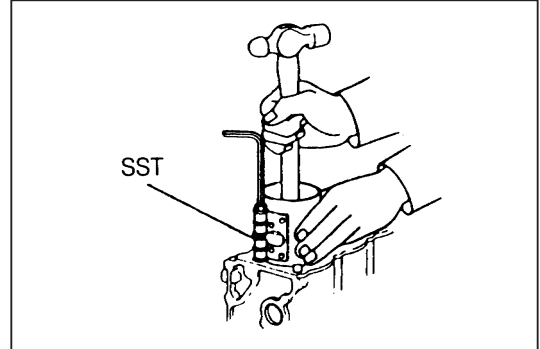
- (10) Compress the piston rings by means of the piston ring compressor SST, making sure that the piston ring ends will not move during the installation.

SST: 09217-87001-000

- (11) Push the piston by hand into the cylinder bore with the front mark facing toward the oil pump side.

NOTE:

- Be very careful to avoid damaging the connecting rod bearings during the installation.
- Care must be exercised to ensure that the crankpin journal is not scratched by the connecting rod.



MEM00196-00184

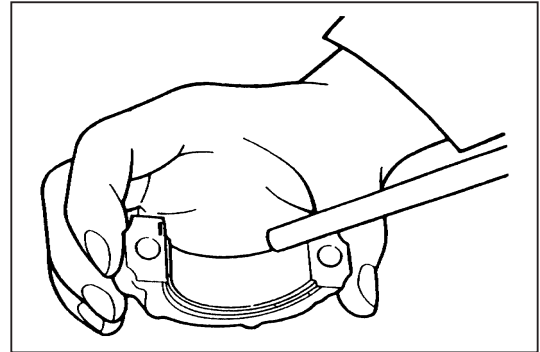
- (12) Push the piston with a suitable tool, until the connecting rod reaches the crankpin journal.

- (13) Apply engine oil to the bearing surface of each connecting rod bearing.

NOTE:

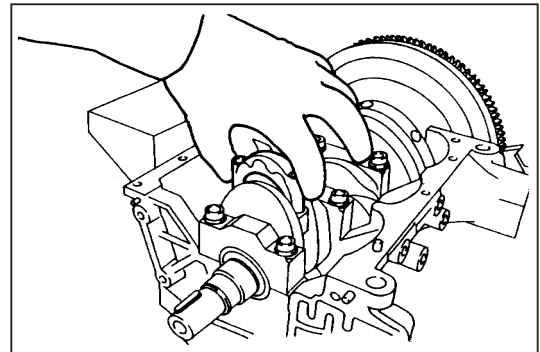
- Do not touch the bearing front surface.

- (14) Remove the vinyl hoses which were attached to the connecting rod bolt sections.



MEM00197-00185

- (15) Install the connecting rod cap with the front mark facing toward the oil pump side.



MEM00198-00186

- (16) Thinly apply engine oil to the connecting rod cap attaching nuts. Tighten the nuts to the specified torque evenly over two or three stages.

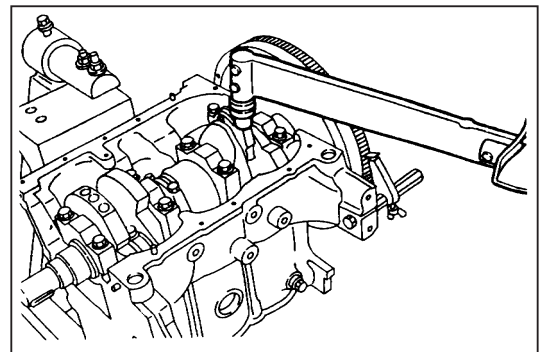
Tightening Torque: 36.0 ± 6.0 N·m

NOTE:

- Prevent the crankshaft from turning, using the following SST.

SST: 09210-87701-000

- (17) Perform the operations described in the steps (1) through (16) for each cylinder.



MEM00199-00187

3. Installation of oil pump

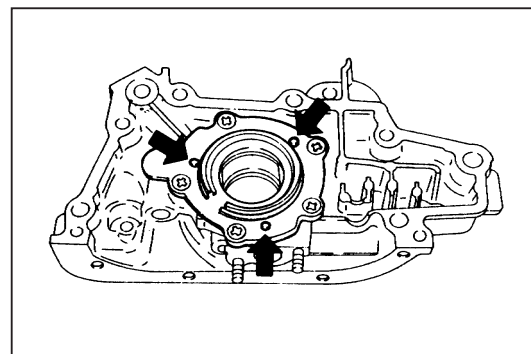
- (1) Turn the crankshaft, until the No. 1 cylinder is set to the top dead center.
- (2) Apply engine oil to the inner surface of the oil seal.
- (3) Insert a new O-ring into the groove section of the pump cover. Secure the O-ring by holding it at the three projection sections at the cover side.

NOTE:

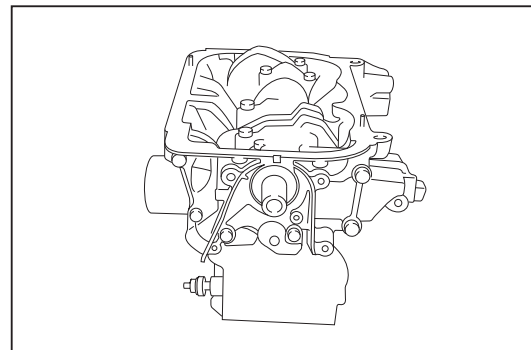
- Embossed marks having a 5 mm diameter have been provided at the holding positions.

- (4) With the crankshaft's two-flat sections for driving the oil pump aligned with the oil pump, install the oil pump to the cylinder block with a new gasket interposed.
- (5) Tighten the oil pump attaching bolt and nuts to the specified torque.

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



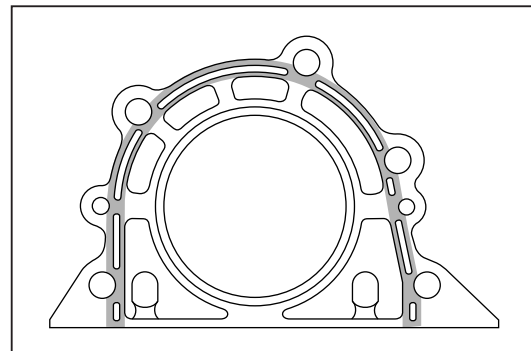
MEM00200-00188



MEM00201-00189

4. Installation of rear oil seal retainer

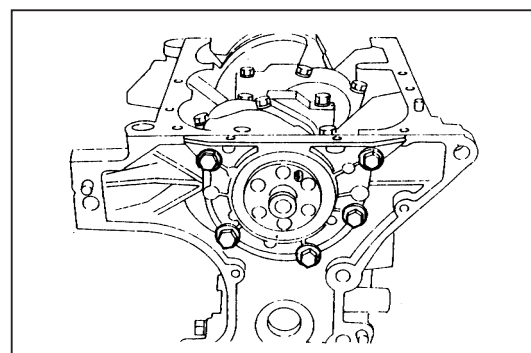
- (1) Apply engine oil to the inner surface of the oil seal.
- (2) Apply Three Bond 1207F or equivalent to the flange surface in such a way that the sealing may be formed without any discontinued spot, in a size equivalent to a 3 mm to 4 mm diameter, following the procedure given in the right figure.



MEM00202-00190

- (3) With the rear oil seal retainer aligned with the knock pin, install the rear oil seal retainer to the cylinder block with a new gasket interposed.
- (4) Tighten the attaching bolt to the specified torque.

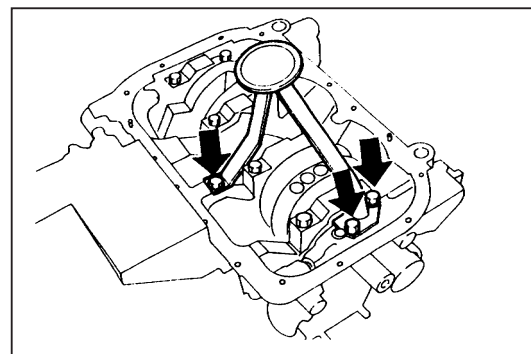
Tightening Torque: $12.5 \pm 2.5 \text{ N}\cdot\text{m}$



MEM00203-00203

5. Install the oil pump strainer with a new gasket interposed.

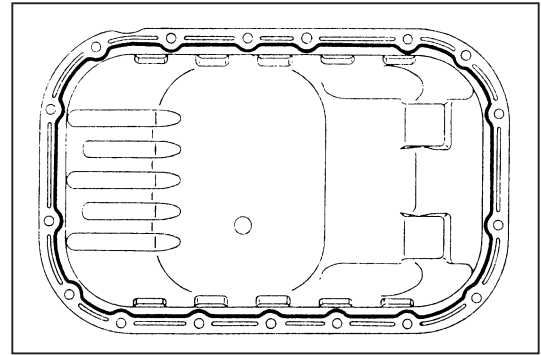
Tightening Torque: $8.0 \pm 1.6 \text{ N}\cdot\text{m}$



MEM00204-00192

6. Installation of oil pan

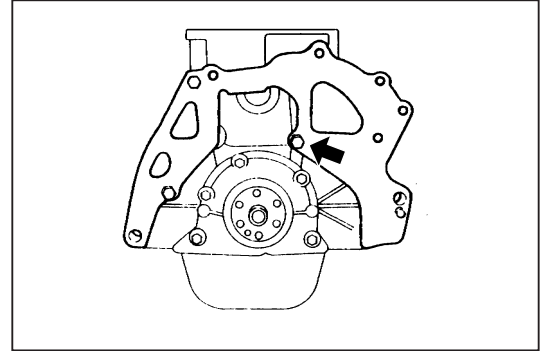
- (1) Thoroughly remove any foreign matters (grease and water, etc.) from both the oil pan attaching surface of the cylinder block and the cylinder block attaching surface of the oil pan.
- (2) Apply Three Bond 1207F or equivalent to the flange surface in such a way that the sealing may be formed without any discontinued spot, in a size equivalent to a 3 mm to 4 mm diameter, following the procedure given in the right figure.



MEM00000-00193

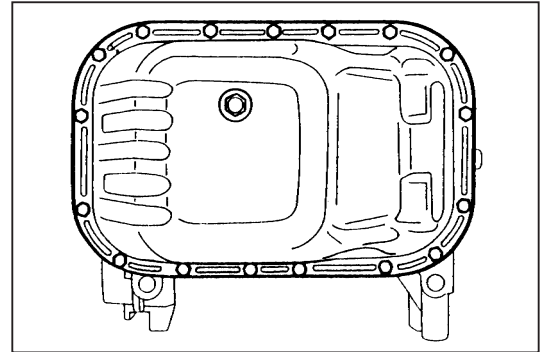
7. Install the rear end plate.

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



MEM00221-00191

- (3) Install the oil pan to the cylinder block.
 - (4) Tighten the oil pan attaching nuts and bolts to the specified torque over two or three stages.
- Tightening Torque: $8.0 \pm 1.6 \text{ N}\cdot\text{m}$



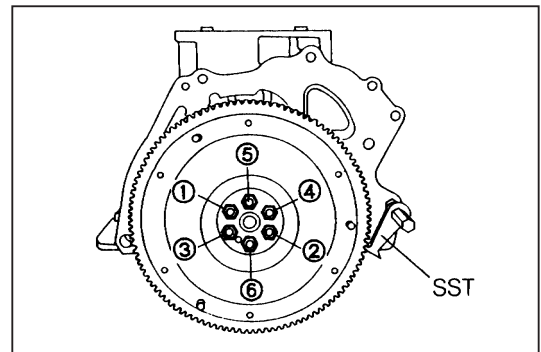
MEM00206-00194

8. Installation of flywheel (drive plate)

- (1) Assemble the flywheel (drive plate), aligning it with the knock pin of the crankshaft.
 - (2) Temporarily tighten the flywheel (drive plate) attaching bolts to the following torque in the sequence indicated in the next step.
- Tightening Torque: $25 - 34 \text{ N}\cdot\text{m}$

NOTE:

- Prevent the crankshaft from turning at the ring gear section, using the following SST.
- SST: 09210-87701-000



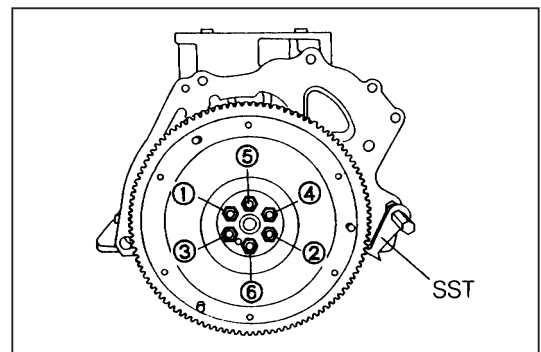
MEM00207-00195

- (3) Tighten the flywheel (drive plate) attaching bolts to the specified torque in the sequence indicated in the right figure.

Tightening Torque: $44.0 \pm 5.0 \text{ N}\cdot\text{m}$

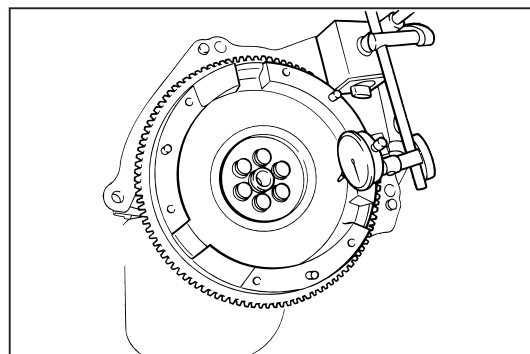
NOTE:

- Prevent the crankshaft from turning at the ring gear section, using the following SST.
- SST: 09210-87701-000



MEM00208-00196

9. Check the flywheel runout. (For checking procedure, refer to the page EM-32.)
10. Install the cylinder head. (For installation procedure, refer to the "CYLINDER HEAD" section.)
11. Install the timing belt. (For installation procedure, refer to the page EM-5.)



MEM00209-00197

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.

MEM00210-00000

COMPRESSION CHECK

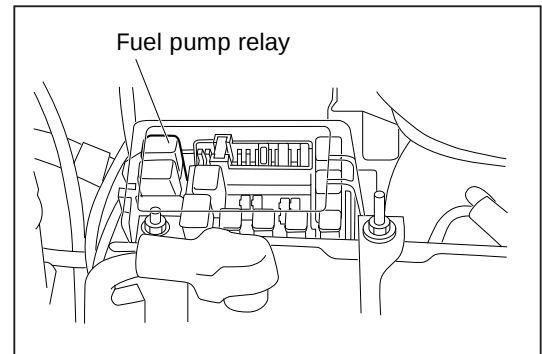
NOTE:

- 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.

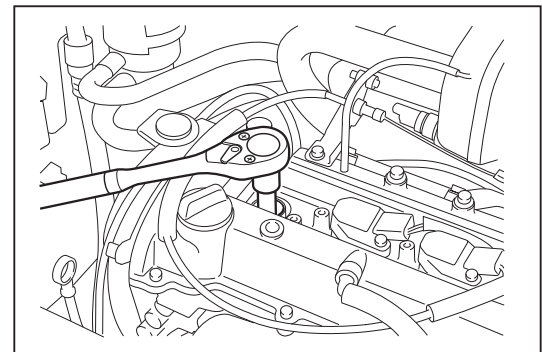
1. Warm up the engine thoroughly.
2. Turn OFF the ignition key switch.
3. Remove the fuel pump relay from the relay box.
4. Remove the spark plug from the cylinder head. (For removal procedure refer to the IG section.)
5. Measurement of cylinder compression pressure

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.



MEM00211-00198



MEM00212-00199

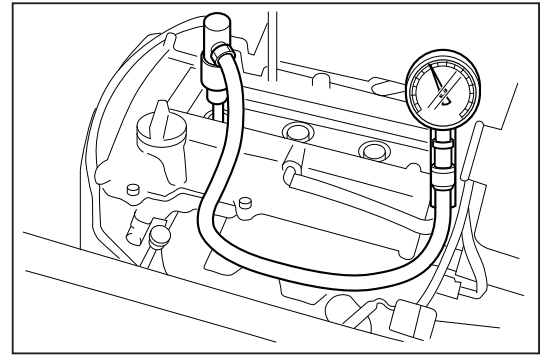
- (1) Insert a compression gauge into the spark plug hole.
- (2) Depress the accelerator pedal fully.
- (3) While cranking the engine, measure the compression pressure.

Compression Pressure:

1579 - 1755 kPa at 400 rpm

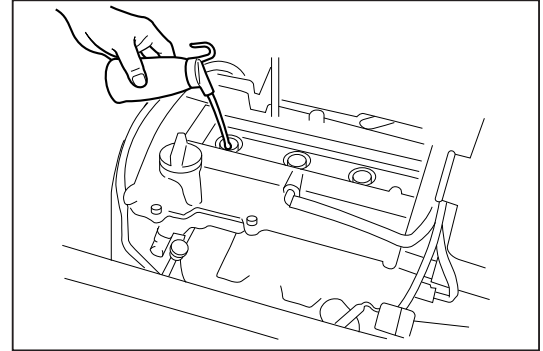
Difference Between Cylinders:

147 kPa at 400 rpm



MEM00213-00200

- (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.



MEM00214-00201

6. Install the spark plug to the cylinder head, (Refer to the IG section.)
7. Install the fuel pump relay to the relay box.

MEM00215-00000

CHECKING OF CO/HC CONCENTRATIONS

Preparation to be made prior to check of CO/HC concentrations.

- Apply the parking brake fully.
- Check the ignition timing.
- Check the idle speed.
- Warm up the engine thoroughly. (continue engine warm-up for another 10 minutes after the fan motor has started its operation.)
- All accessory switches are turned OFF.
- The air cleaner element is installed.
- All pipes and vacuum hose are connected.
- Ensure that the intake system exhibits no air leakage.
- Ensure that the exhaust system exhibits no gas leakage.
- On the automatic transmission vehicle, the shift lever is placed in the [N] or [[P] range.
- On the manual transmission vehicle, the shift lever is placed in the neutral position.
- Position the steering wheel to straight-ahead direction.
- Prior to the use, be sure to prepare the CO/HC meter, following the instructions of the manufacturer.

NOTE:

- This check is only for determining whether or not the idle HC/CO emission complies with the specified values.

Specified Values:

CO less than: 0.5 %

HC less than: 400 ppm

If the CO/HC concentrations will not conform to the specified values, check the A/F control system and/or replace the exhaust manifold.

MEM00216-00000

CHECKING OF A/F (Air/Fuel) CONTROL SYSTEM

NOTE:

- Since the A/F adjustment is performed by a computer, you are not able to perform this adjustment. Your check ensures that the computer control is being properly performed. Your check is not for performing the adjustment.
1. Connect the test terminal and the ground terminal with a jumper wire of the diagnosis connector.
 2. While keeping the engine revolution speed at a speed in excess of 1200 rpm (aiming at a speed of around 3000 rpm), measure the voltage between the terminal VF of the diagnosis connector and the body.
 3. Check that the measured value changes between 0 V and 5 V.
 4. If the voltage described in Step 3 above is not obtained, it means that the computer control is not functioning properly. Perform the check of EFI ECU, referring to the EF section.

MEM00217-00000

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	STD		850 ± 50 rpm
	AUS and tropical spec.		900 ± 50 rpm
Blow-by gas recirculating system			Closed type

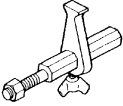
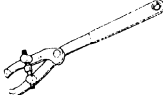
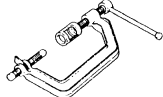
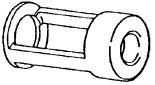
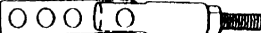
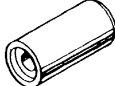
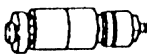
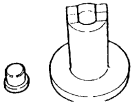
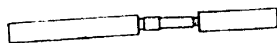
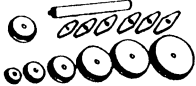
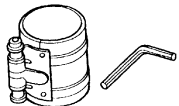
MEM00218-00000

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
Cylinder head	Camshaft for runout		0.03 mm
	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 stem oil seal installed position	IN	14.2 ± 0.8 mm
		EX	11.2 ± 0.8 mm
Valve spring	Free length		37.1 mm
	Valve spring for squareness		1.3 mm
	Minimum fension/installation height		123.17 ± 8.63 N/32.0 mm

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

EM-60

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 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	

MEM00221-00000