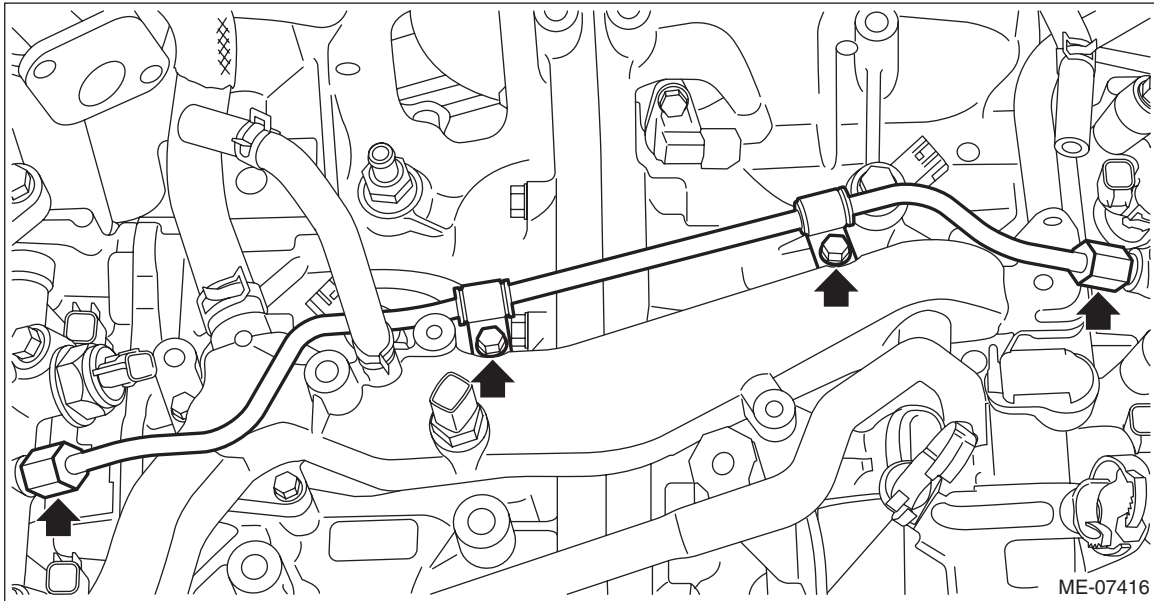


21.Cylinder Head

A: REMOVAL

1. CYLINDER HEAD RH

- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-46, REMOVAL, Engine Assembly.>
- 2) Remove the intake manifold. <Ref. to FU(H4DOTC)-19, REMOVAL, Intake Manifold.>
- 3) Remove the engine wiring harness. <Ref. to FU(H4DOTC)-88, REMOVAL, Engine Wiring Harness.>
- 4) Remove the chain cover. <Ref. to ME(H4DOTC)-92, REMOVAL, Chain Cover.>
- 5) Remove the rocker cover RH. <Ref. to ME(H4DOTC)-149, ROCKER COVER RH, REMOVAL, Rocker Cover.>
- 6) Remove the cam carrier RH. <Ref. to ME(H4DOTC)-174, CAM CARRIER RH, REMOVAL, Cam Carrier.>
- 7) Remove the high-pressure fuel delivery pipe assembly from the water pipe assembly and fuel injector pipe.



Cylinder Head

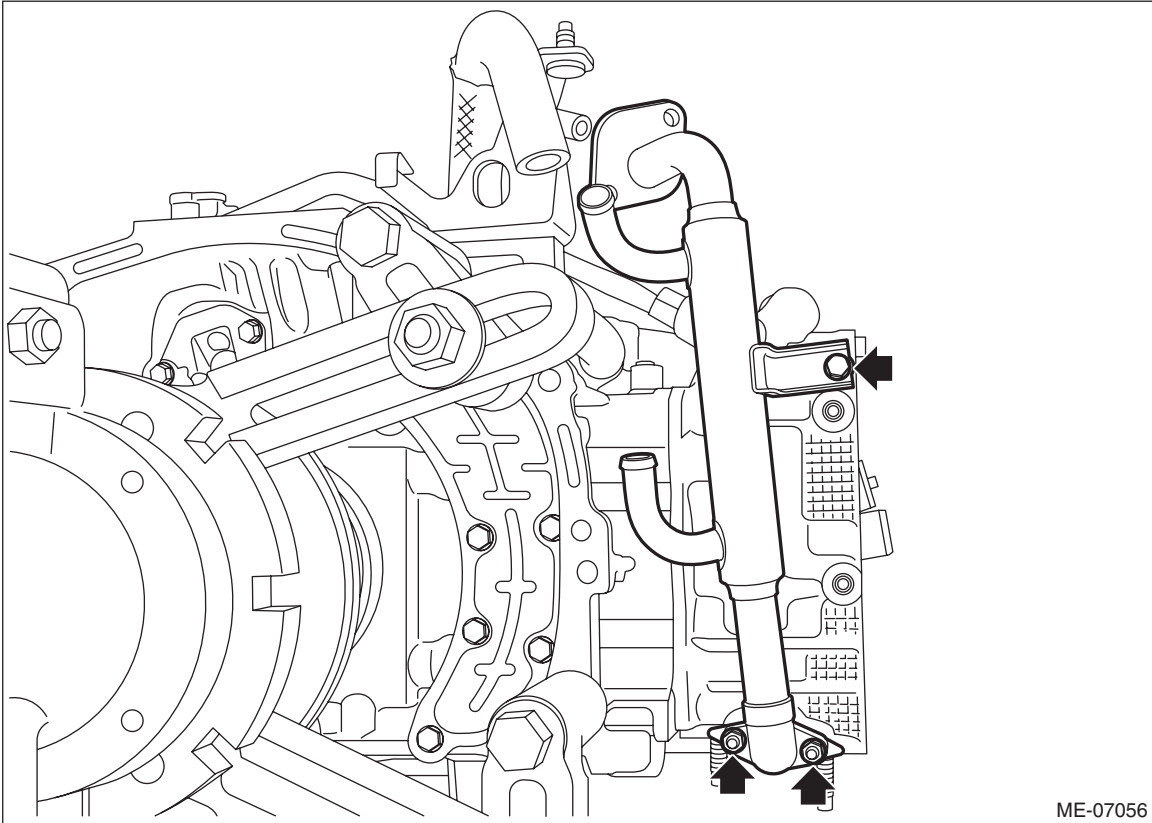
MECHANICAL

8) Disassemble the cylinder head RH.

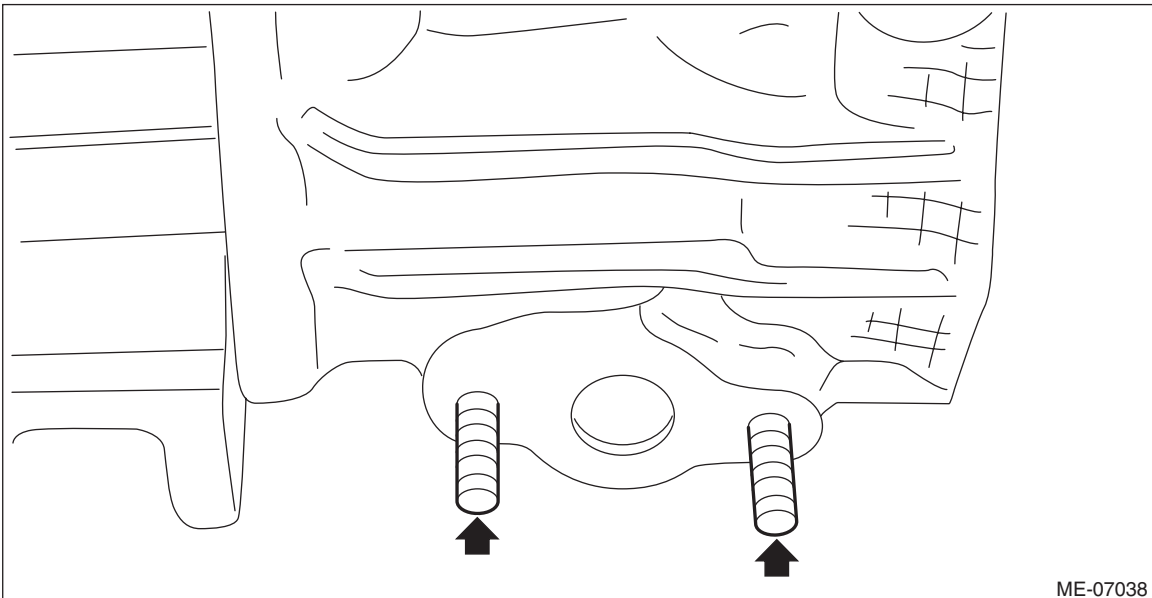
NOTE:

When disassembling the cylinder head RH, perform the following steps also.

- (1) Remove the tumble generator valve assembly RH. <Ref. to FU(H4DOTC)-44, REMOVAL, Tumble Generator Valve Assembly.>
- (2) Remove the fuel injector RH. <Ref. to FU(H4DOTC)-52, FUEL INJECTOR RH, REMOVAL, Fuel Injector.>
- (3) Remove the EGR cooler from the cylinder head RH.

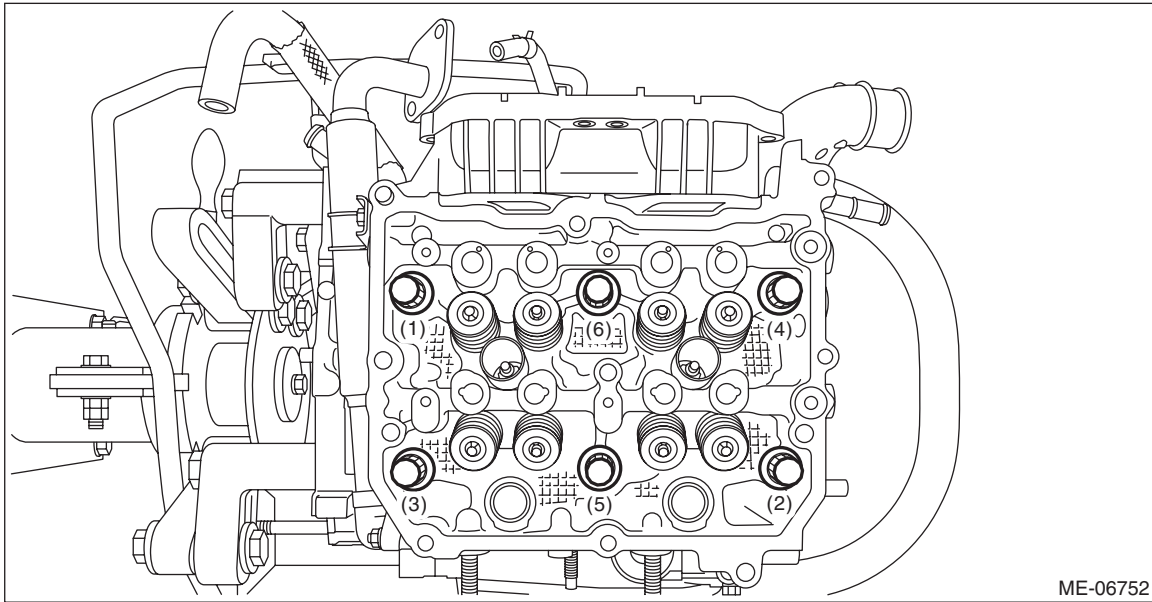


(4) Remove the stud bolt from the cylinder head RH.



9) Set the part so that the cylinder head RH is on the upper side.

10) Loosen the bolts securing the cylinder head RH equally, a little at a time in numerical sequence as shown in the figure and remove the cylinder head bolt.



11) While tapping the cylinder head RH with a plastic hammer, separate to remove it from the cylinder block RH.

12) Remove the cylinder head gasket RH.

CAUTION:

Be careful not to scratch the mating surface of cylinder head and cylinder block.

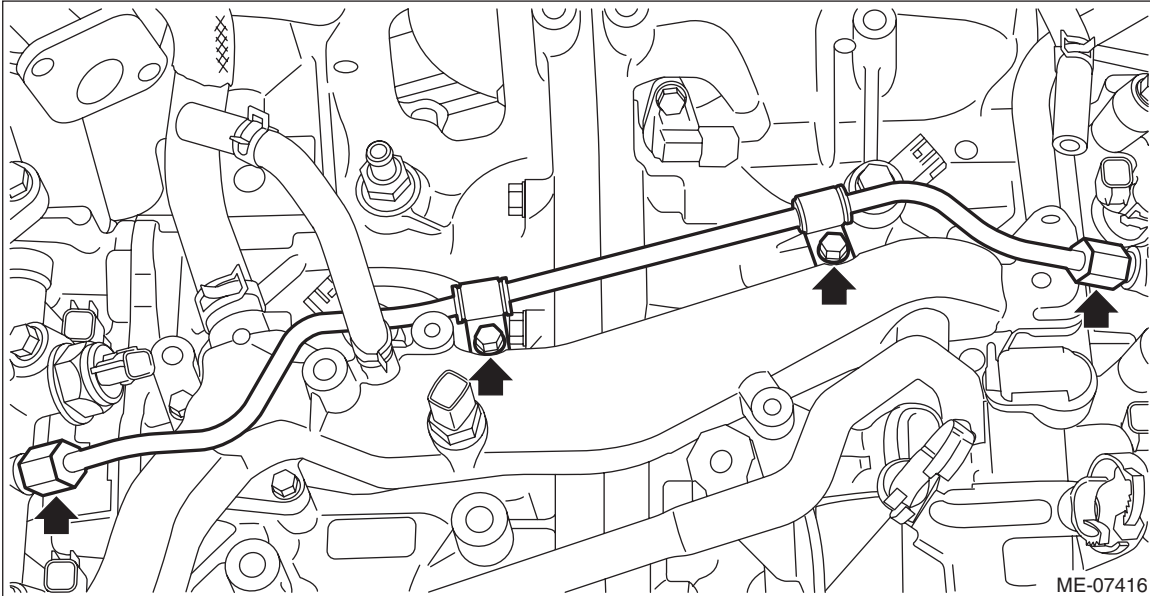
13) Remove the liquid gasket from the cylinder head RH and cylinder block RH.

Cylinder Head

MECHANICAL

2. CYLINDER HEAD LH

- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-46, REMOVAL, Engine Assembly.>
- 2) Remove the intake manifold. <Ref. to FU(H4DOTC)-19, REMOVAL, Intake Manifold.>
- 3) Remove the engine wiring harness. <Ref. to FU(H4DOTC)-88, REMOVAL, Engine Wiring Harness.>
- 4) Remove the chain cover. <Ref. to ME(H4DOTC)-92, REMOVAL, Chain Cover.>
- 5) Remove the rocker cover LH. <Ref. to ME(H4DOTC)-151, ROCKER COVER LH, REMOVAL, Rocker Cover.>
- 6) Remove the cam carrier LH. <Ref. to ME(H4DOTC)-177, CAM CARRIER LH, REMOVAL, Cam Carrier.>
- 7) Remove the high-pressure fuel delivery pipe assembly from the water pipe assembly and fuel injector pipe.



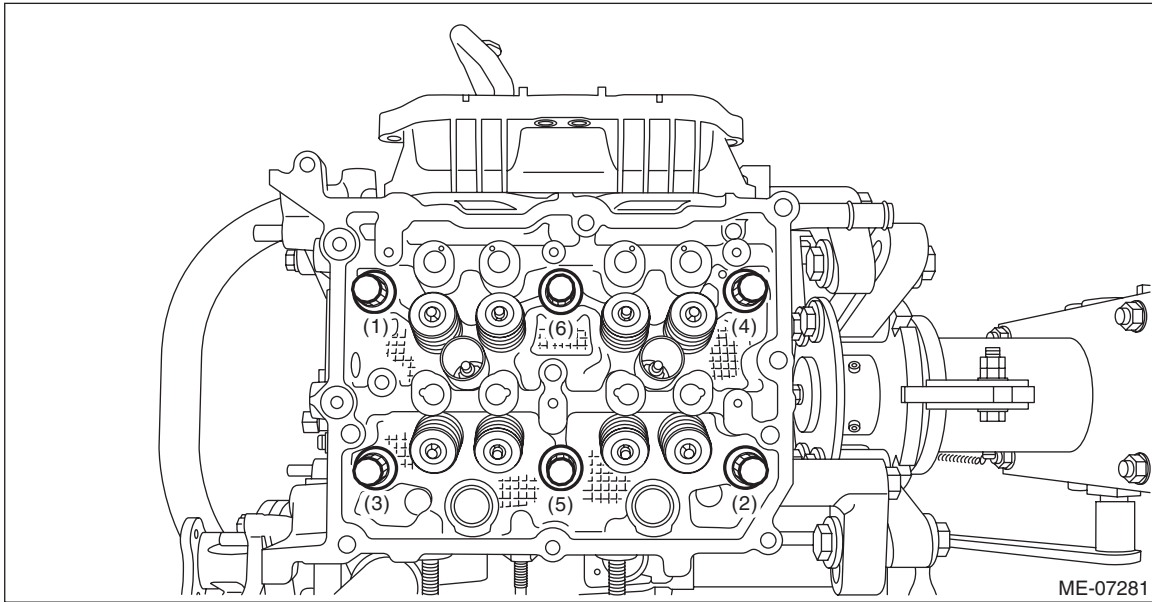
- 8) Remove the A/C compressor. <Ref. to AC-54, REMOVAL, Compressor.>
- 9) When disassembling the cylinder head LH

NOTE:

When disassembling the cylinder head LH, perform the following steps also.

- (1) Remove the tumble generator valve assembly LH. <Ref. to FU(H4DOTC)-44, REMOVAL, Tumble Generator Valve Assembly.>
 - (2) Remove the fuel injector LH. <Ref. to FU(H4DOTC)-56, FUEL INJECTOR LH, REMOVAL, Fuel Injector.>
- 10) Set the part so that the cylinder head LH is on the upper side.

11) Loosen the bolts securing the cylinder head LH equally, a little at a time in numerical sequence as shown in the figure and remove the cylinder head bolt.



12) While tapping the cylinder head LH with a plastic hammer, separate to remove it from the cylinder block LH.

13) Remove the cylinder head gasket LH.

CAUTION:

Be careful not to scratch the mating surface of cylinder head and cylinder block.

14) Remove the liquid gasket from cylinder head LH and cylinder block LH.

B: INSTALLATION

1. CYLINDER HEAD RH

1) Set the part so that the cylinder block RH is on the upper side.

2) Clean the bolt holes in the cylinder block RH.

CAUTION:

To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.

3) Apply liquid gasket to both sides of the cylinder head gasket RH as shown in the figure.

NOTE:

- Use a new cylinder head gasket RH.
- Before applying liquid gasket, degrease the mating surface of cylinder blocks RH and cylinder head RH.
- Install within 5 min. after applying liquid gasket.

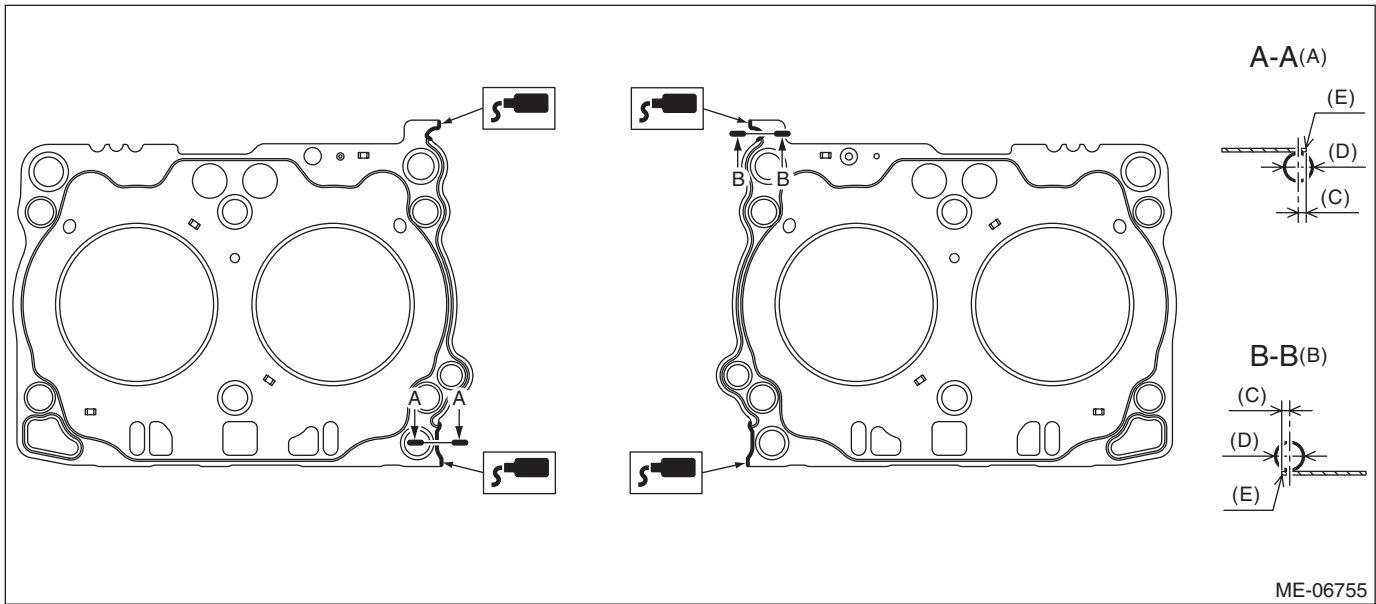
Liquid gasket:

THREE BOND 1217G (Part No. 0877Y0100) or equivalent

Cylinder Head

MECHANICAL

Liquid gasket applying diameter:
 3 ± 1 mm (0.1181 ± 0.0394 in)



- | | | |
|--|---|-------------------------------|
| (A) Liquid gasket applying position to the cylinder head side | (C) 1 mm (0.0394 in) or less | (E) Cylinder head gasket edge |
| (B) Liquid gasket applying position to the cylinder block side | (D) $\phi 3\pm 1$ mm (0.1181 ± 0.0394 in) | |

4) Attach the cylinder head gasket RH.

NOTE:

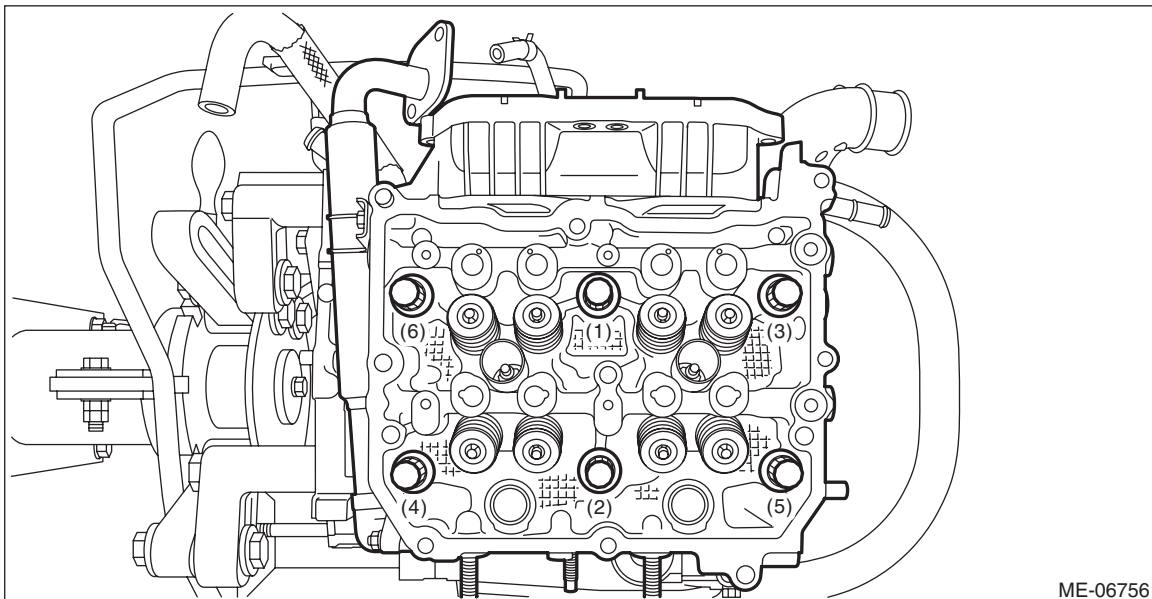
Check that liquid gasket RH is squeezed out from the cylinder head gasket.

5) Install the cylinder head RH to the cylinder block RH.

CAUTION:

Be careful not to scratch the mating surface of cylinder head RH and cylinder block RH.

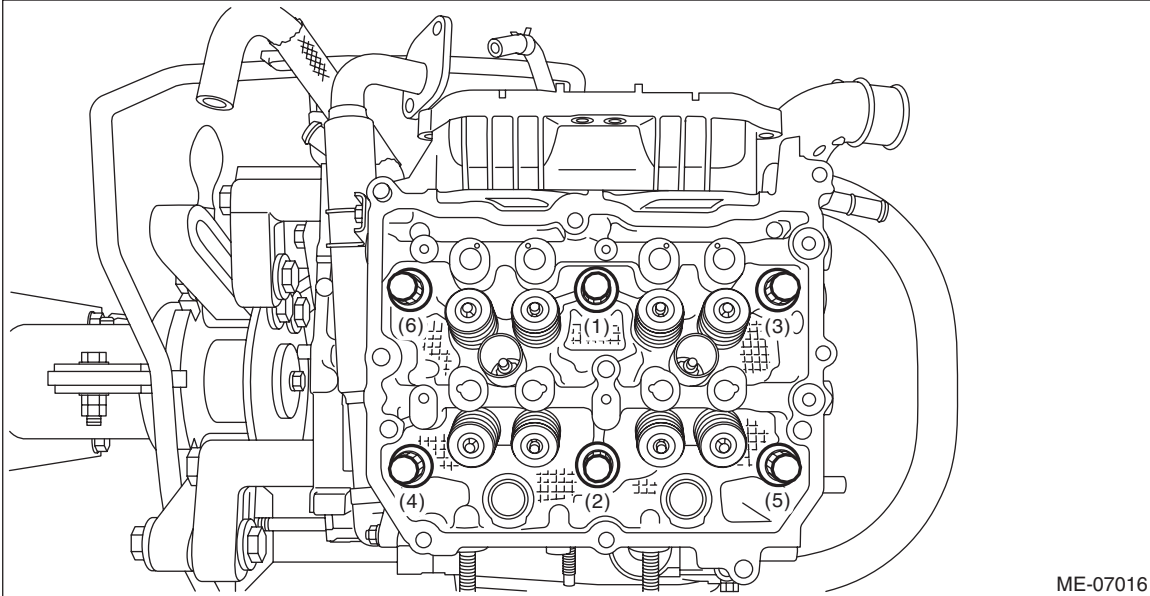
- (1) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolts threads.
- (2) Mount the cylinder head RH onto the cylinder block RH, and tighten all bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.



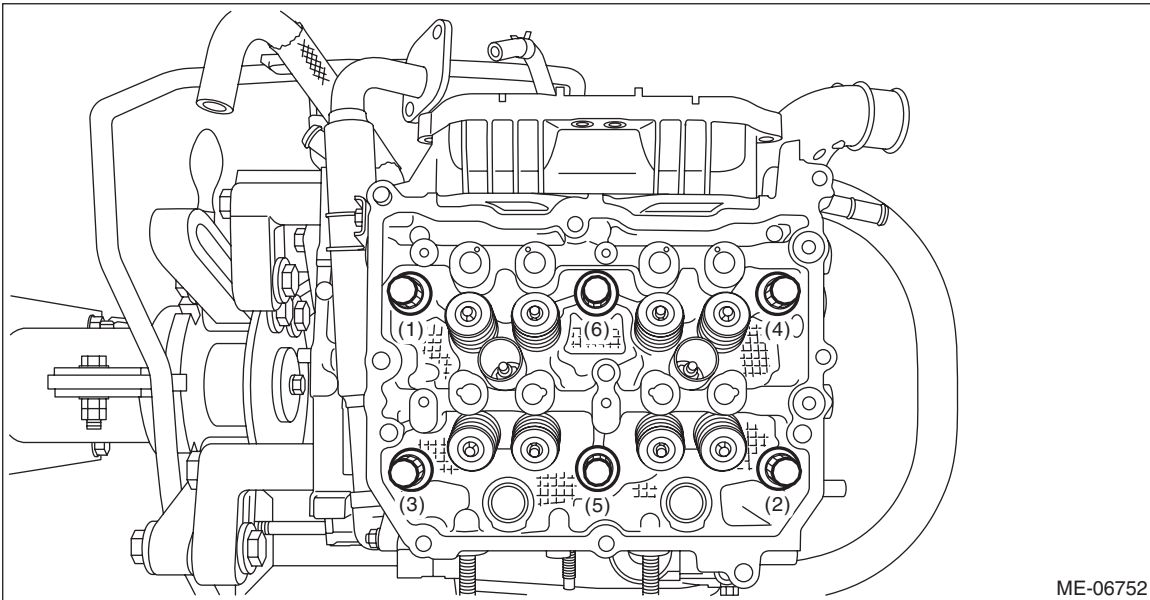
- (3) Tighten all cylinder head bolts further with a torque of 100 N·m (10.2 kgf-m, 73.8 ft-lb) in numerical order as shown in the figure.

CAUTION:

If the bolt makes stick-slip sound during tightening, repeat the procedure from step 1). In that case, the cylinder head gasket RH can be reused. But it is necessary to remove liquid gasket completely from cylinder block RH, cylinder head RH and cylinder head gasket RH and re-apply to them.



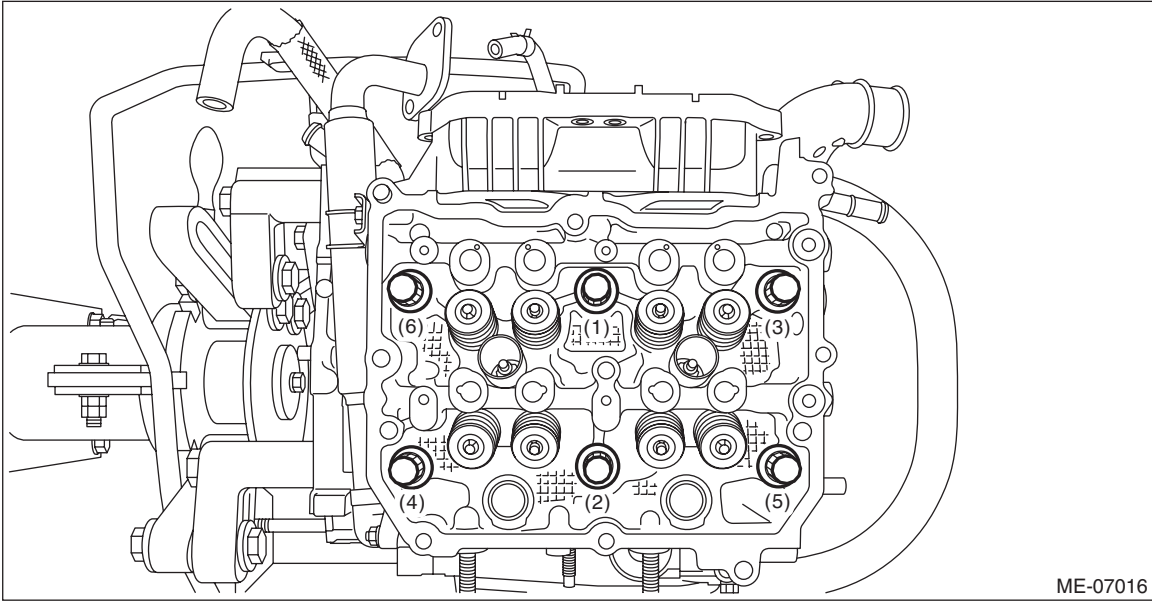
- (4) Loosen all cylinder head bolts by 360° in the numerical order as shown in the figure.



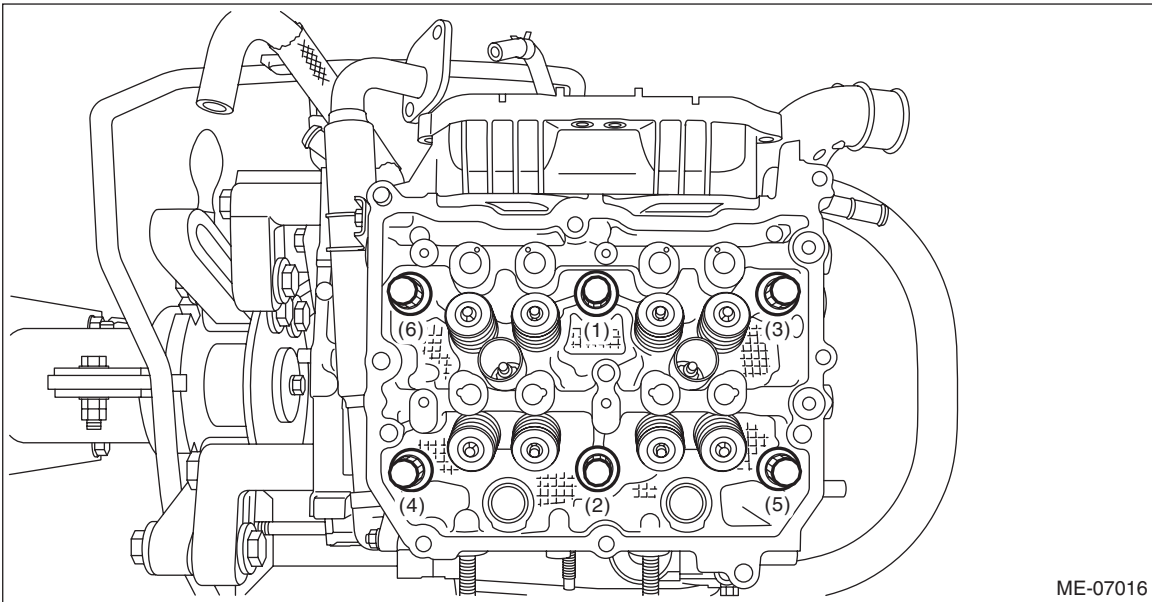
Cylinder Head

MECHANICAL

(5) Tighten all bolts with torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical sequence as shown in the figure.

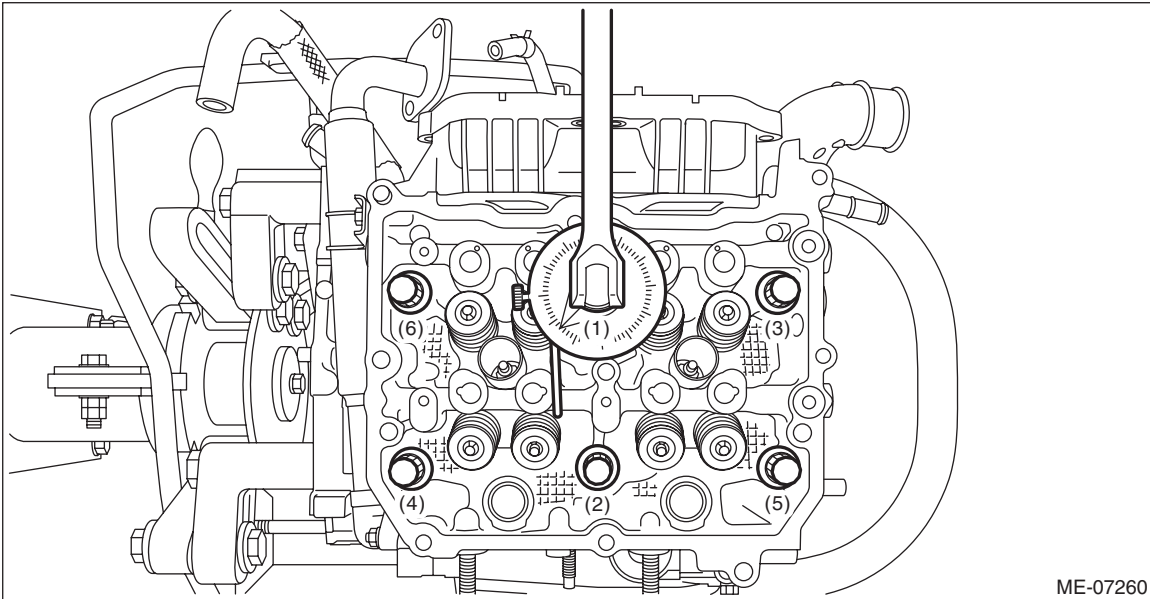


(6) Tighten all cylinder head bolts with a torque of 42 N·m (4.3 kgf-m, 31.0 ft-lb) in numerical order as shown in the figure.



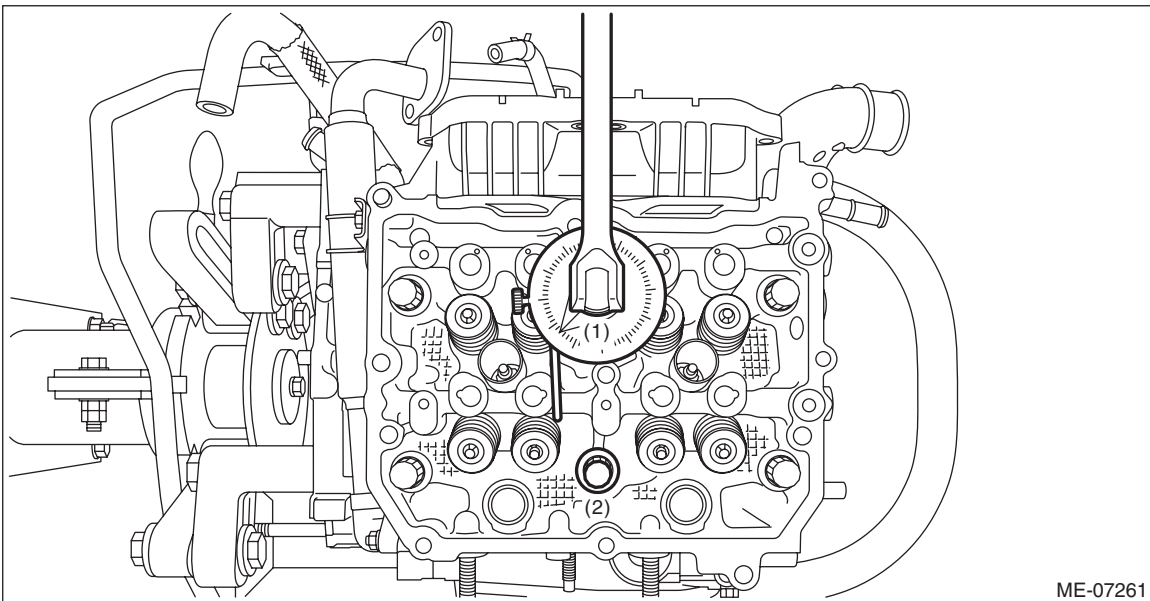
(7) Using angle gauge, tighten all cylinder head bolts with specified angle in numerical order as shown in the figure.

Tightening angle:
 $100^{\circ} \pm 2^{\circ}$



(8) Using angle gauge, tighten the cylinder head bolts (2 places) with specified angle in numerical order as shown in the figure.

Tightening angle:
 $100^{\circ} \pm 2^{\circ}$



Cylinder Head

MECHANICAL

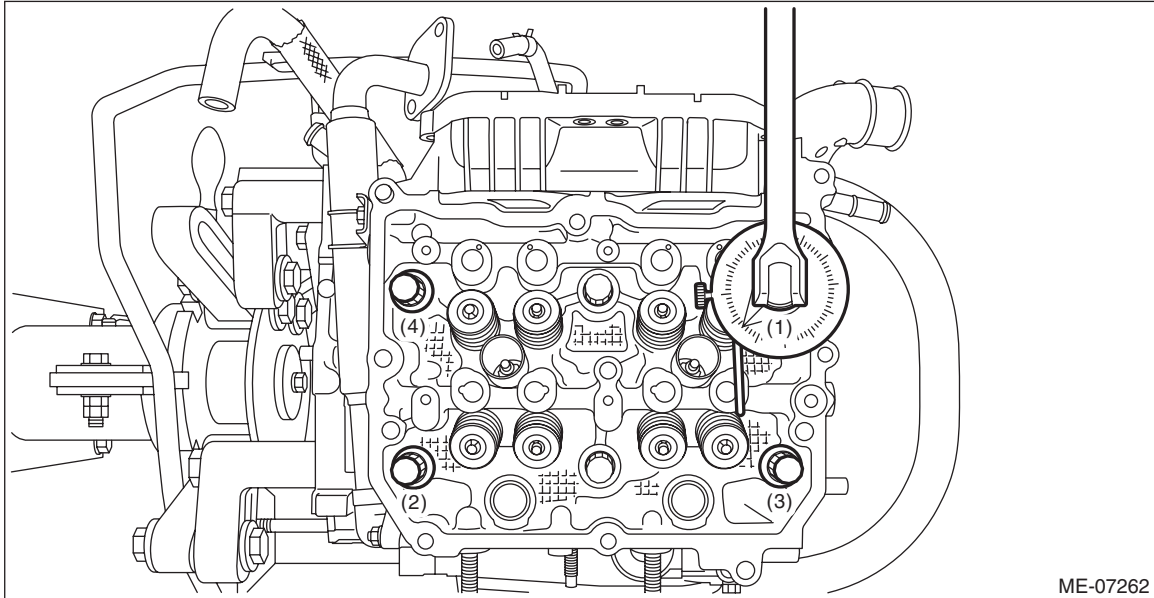
(9) Using angle gauge, tighten the cylinder head bolts (4 places) with specified angle in numerical order as shown in the figure.

NOTE:

After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.

Tightening angle:

$50^{\circ} \pm 2^{\circ}$



6) Set the part so that the installation surface of the intake manifold is on the upper side.

7) When the cylinder head RH has been disassembled

NOTE:

When the cylinder head RH has been disassembled, perform the following steps also.

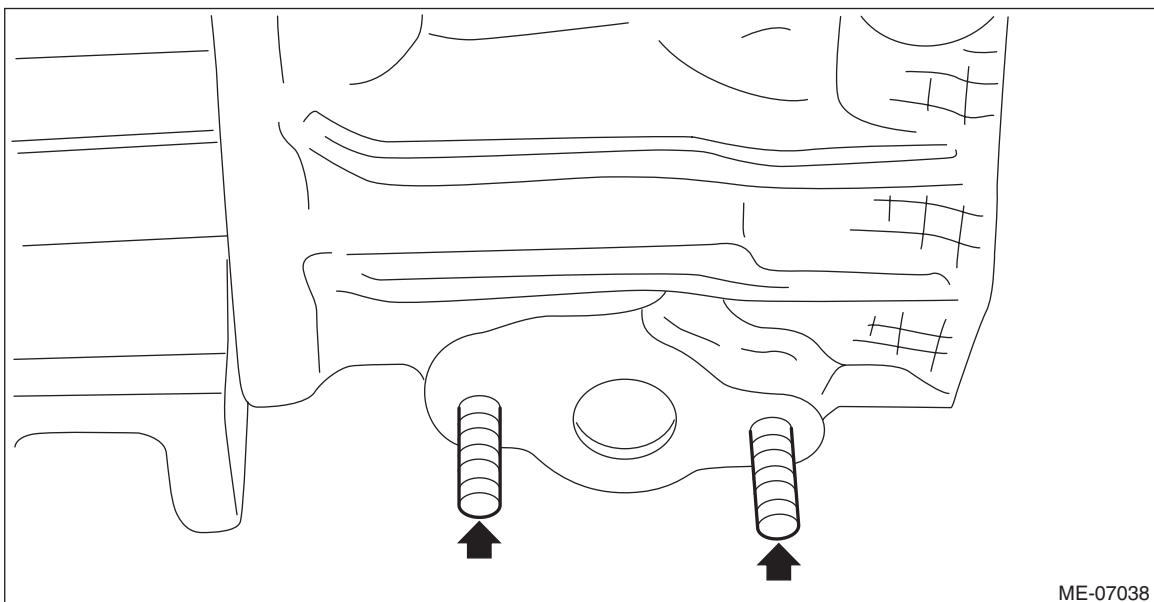
(1) Install the stud bolts to the cylinder head RH.

NOTE:

Use a new stud bolt.

Tightening torque:

$6.4 \text{ N}\cdot\text{m}$ (0.7 kgf-m, 4.7 ft-lb)

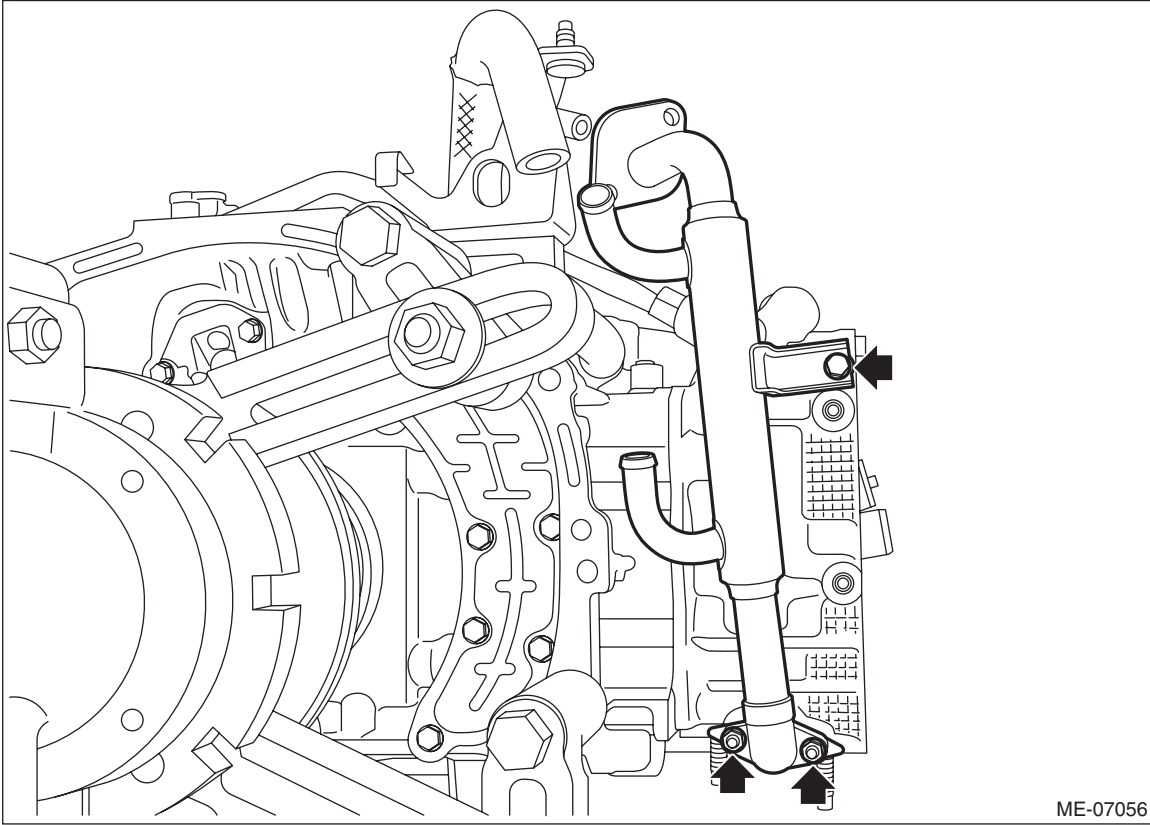


(2) Install the EGR cooler to the cylinder head RH.

1. Set the EGR cooler to the cylinder head RH, and temporarily tighten the bolt and nut which secures the EGR cooler to the cylinder head RH.

NOTE:

Use a new gasket.



ME-07056

Cylinder Head

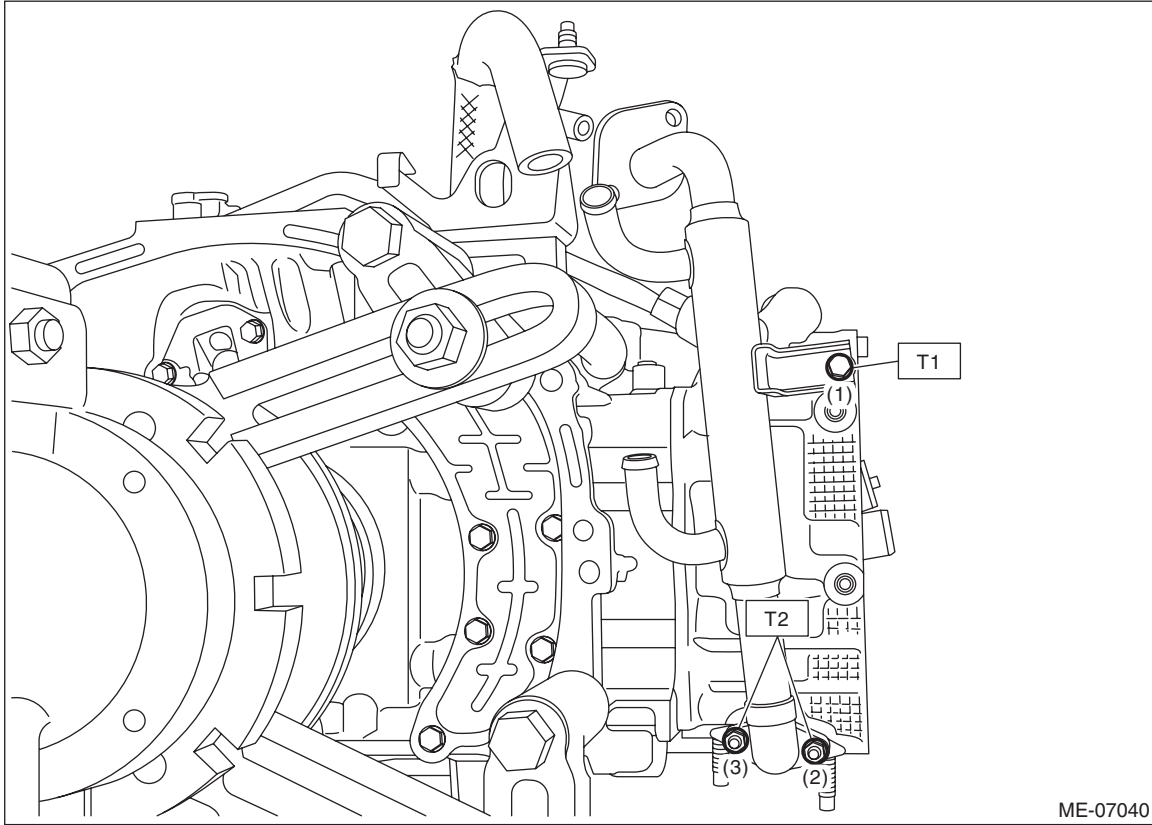
MECHANICAL

2. Tighten the bolts and nuts which secure the EGR cooler to the cylinder head RH in numerical order as shown in the figure.

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 9 N·m (0.9 kgf-m, 6.6 ft-lb)

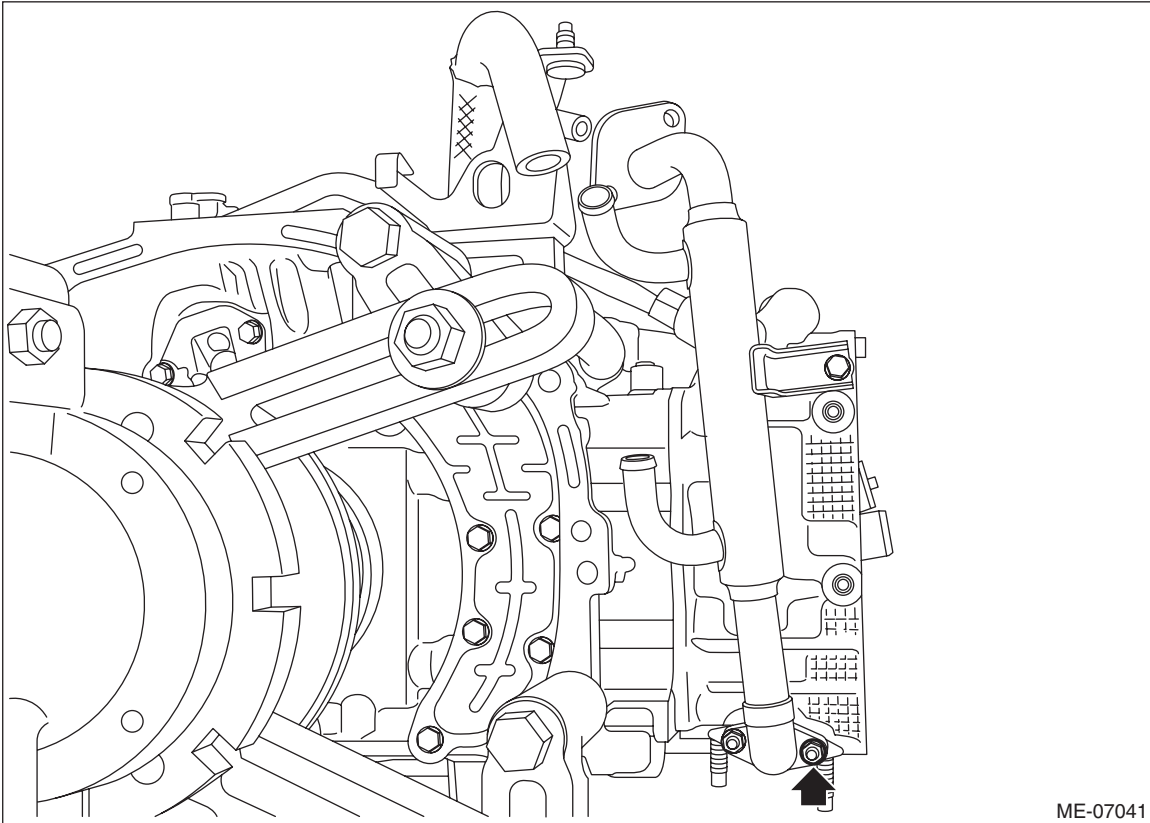


ME-07040

3. Retighten the nut shown in the figure.

Tightening torque:

9 N·m (0.9 kgf-m, 6.6 ft-lb)



(3) Install the fuel injector RH.<Ref. to FU(H4DOTC)-60, FUEL INJECTOR RH, INSTALLATION, Fuel Injector.>

(4) Install the tumble generator valve assembly RH.<Ref. to FU(H4DOTC)-45, INSTALLATION, Tumble Generator Valve Assembly.>

Cylinder Head

MECHANICAL

8) Install the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe.

CAUTION:

Always use a new high-pressure fuel delivery pipe assembly.

- (1) Temporarily tighten the flare nut (A) to the fuel injector pipe by hand until it is seated, and secure the high-pressure fuel delivery pipe assembly to the water pipe assembly using bolts (B).

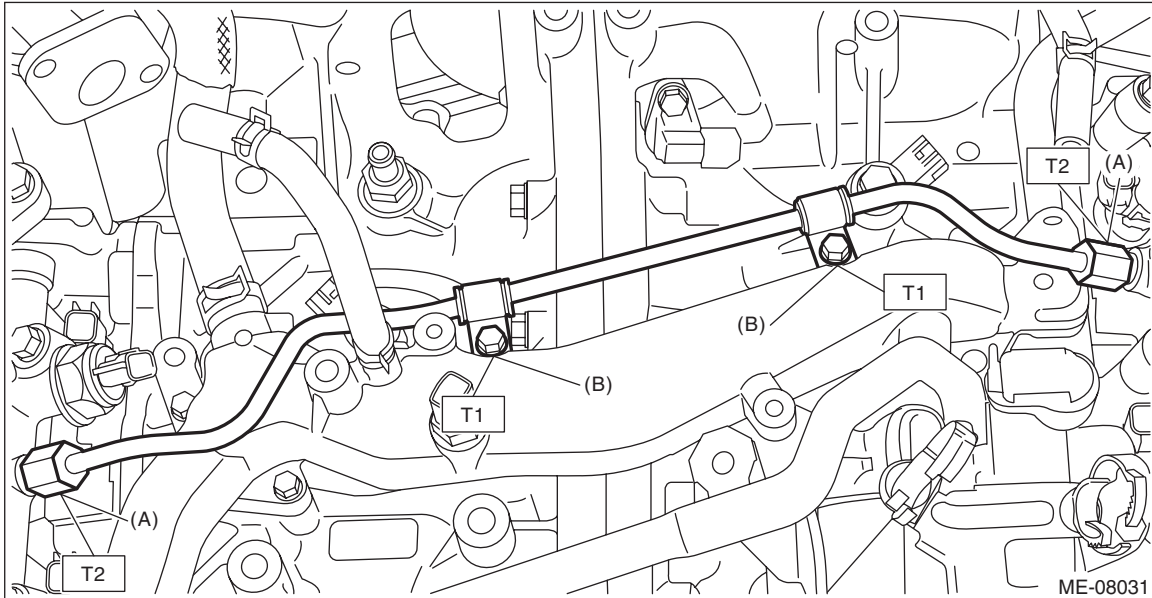
Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

- (2) Tighten the flare nuts (A).

Tightening torque:

T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)



9) Install the cam carrier RH.<Ref. to ME(H4DOTC)-182, CAM CARRIER RH, INSTALLATION, Cam Carrier.>

10) Install the rocker cover RH.<Ref. to ME(H4DOTC)-161, ROCKER COVER RH, INSTALLATION, Rocker Cover.>

11) Install the chain cover.<Ref. to ME(H4DOTC)-99, INSTALLATION, Chain Cover.>

12) Install the engine wiring harness.<Ref. to FU(H4DOTC)-92, INSTALLATION, Engine Wiring Harness.>

13) Install the intake manifold.<Ref. to FU(H4DOTC)-30, INSTALLATION, Intake Manifold.>

14) Install the engine to the vehicle.<Ref. to ME(H4DOTC)-61, INSTALLATION, Engine Assembly.>

2. CYLINDER HEAD LH

- 1) Set the part so that the cylinder block LH is on the upper side.
- 2) Clean the bolt holes in the cylinder block LH.

CAUTION:

To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.

- 3) Apply liquid gasket to both sides of the cylinder head gasket LH as shown in the figure.

NOTE:

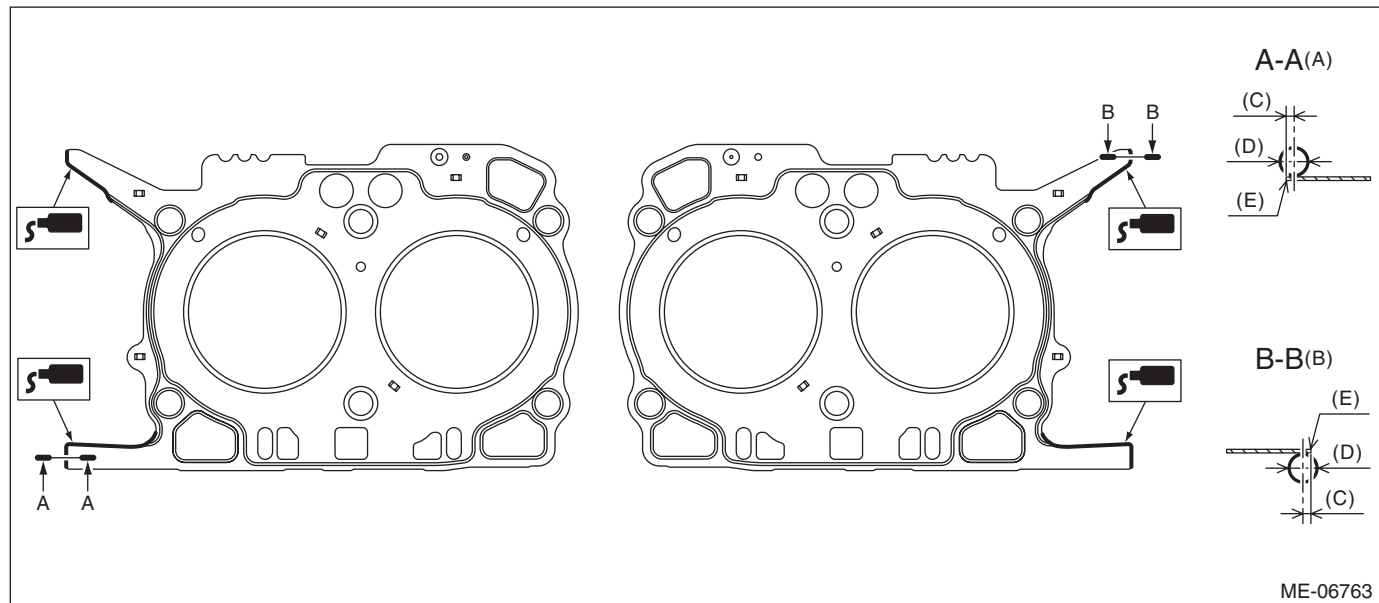
- Use a new cylinder head gasket LH.
- Before applying liquid gasket, degrease the mating surface of cylinder blocks LH and cylinder head LH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

THREE BOND 1217G (Part No. 0877Y0100) or equivalent

Liquid gasket applying diameter:

3 ± 1 mm (0.1181 ± 0.0394 in)



- | | | |
|--|---|-------------------------------|
| (A) Liquid gasket applying position to the cylinder head side | (C) 1 mm (0.0394 in) or less | (E) Cylinder head gasket edge |
| (B) Liquid gasket applying position to the cylinder block side | (D) $\phi 3 \pm 1$ mm (0.1181 ± 0.0394 in) | |

- 4) Attach the cylinder head gasket LH.

NOTE:

Check that liquid gasket is squeezed out from the cylinder head gasket LH.

Cylinder Head

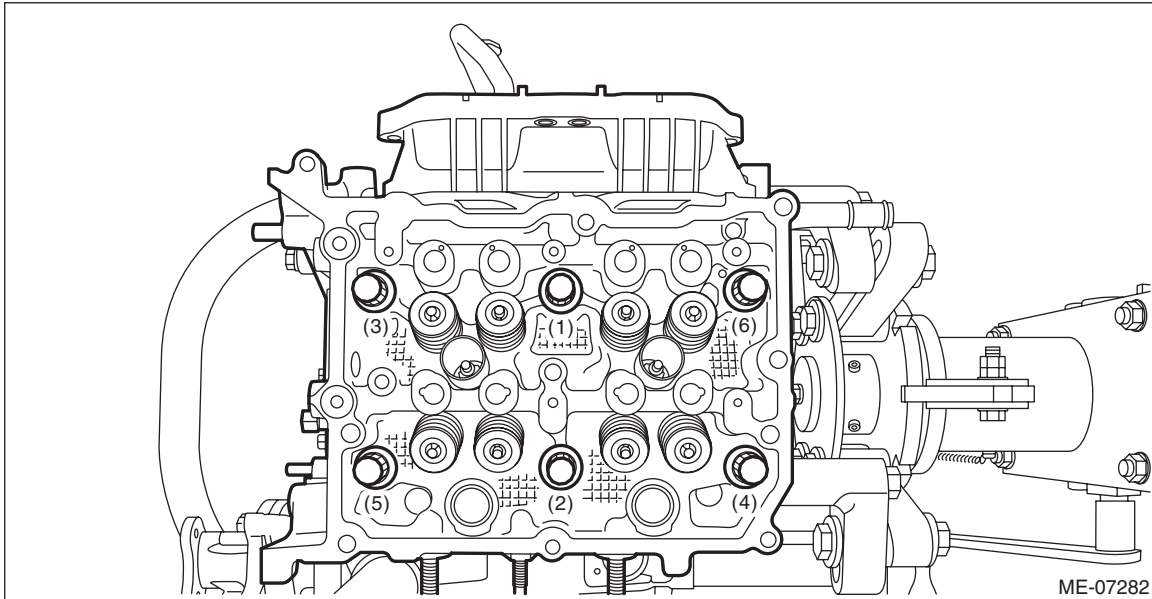
MECHANICAL

5) Install the cylinder head LH to the cylinder block LH.

CAUTION:

Be careful not to scratch the mating surface of cylinder head LH and cylinder block LH.

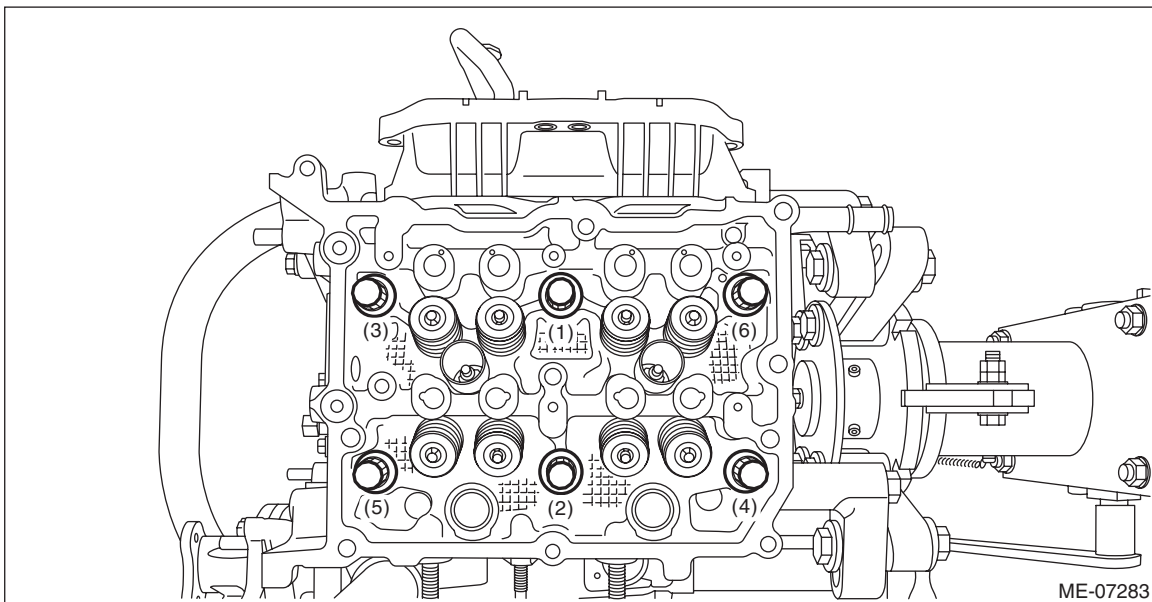
- (1) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolts threads.
- (2) Set the cylinder head LH to the cylinder block LH, then tighten all bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.



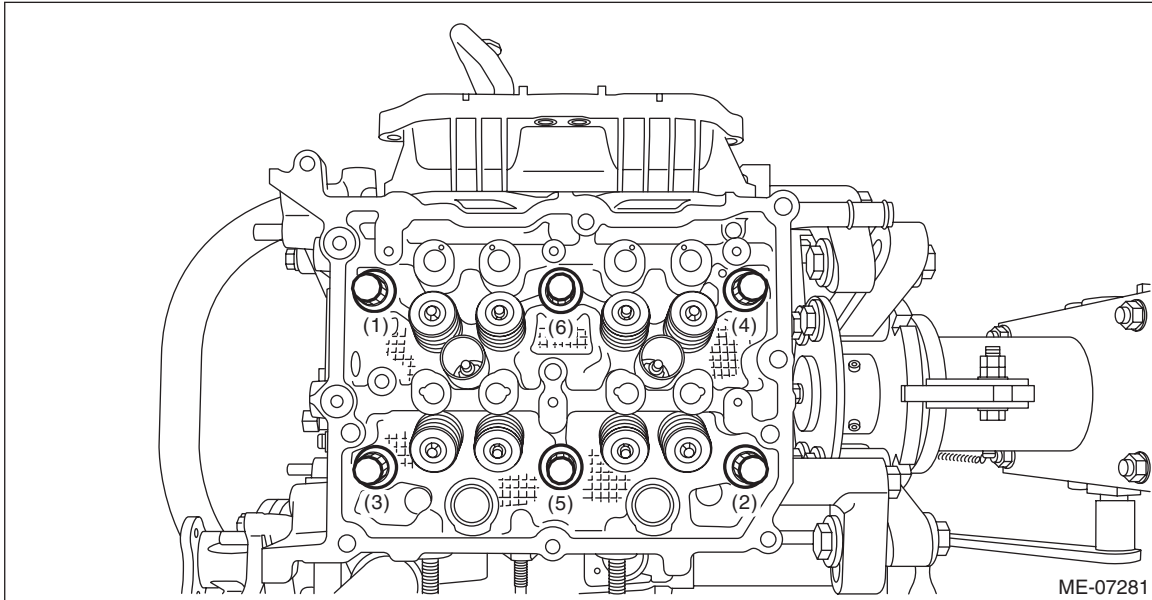
- (3) Tighten all cylinder head bolts further with a torque of 100 N·m (10.2 kgf-m, 73.8 ft-lb) in numerical order as shown in the figure.

CAUTION:

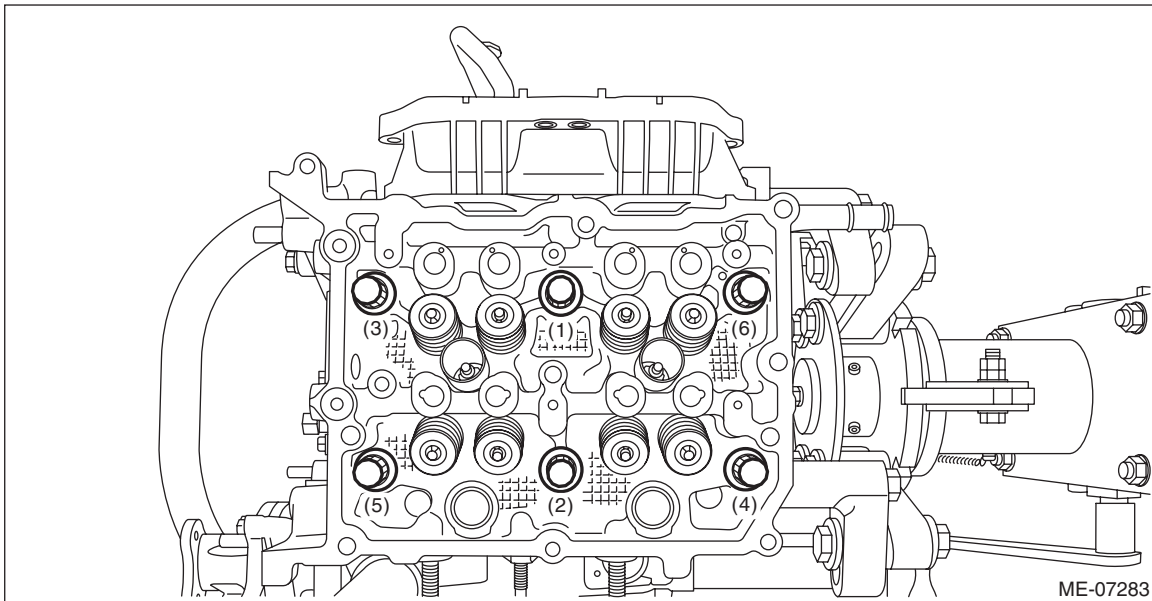
If the bolt makes stick-slip sound during tightening, repeat the procedure from step 1). In that case, the cylinder head gasket LH can be reused. But it is necessary to remove liquid gasket completely from cylinder block LH, cylinder head LH and cylinder head gasket LH and re-apply to them.



- (4) Loosen all cylinder head bolts by 360° in the numerical order as shown in the figure.



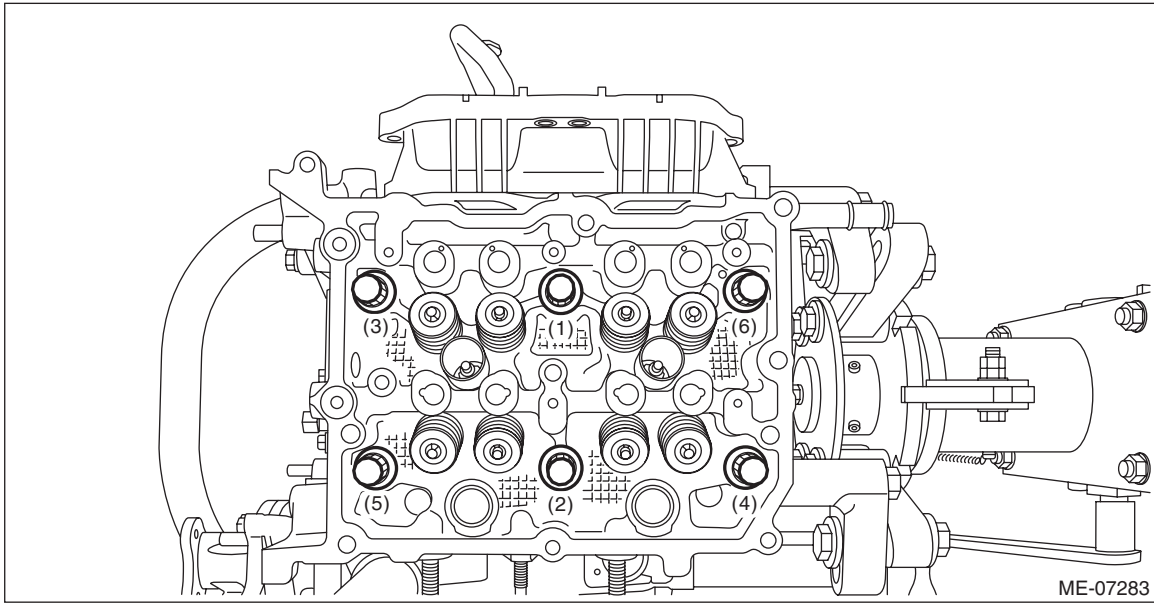
- (5) Tighten all bolts with torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical sequence as shown in the figure.



Cylinder Head

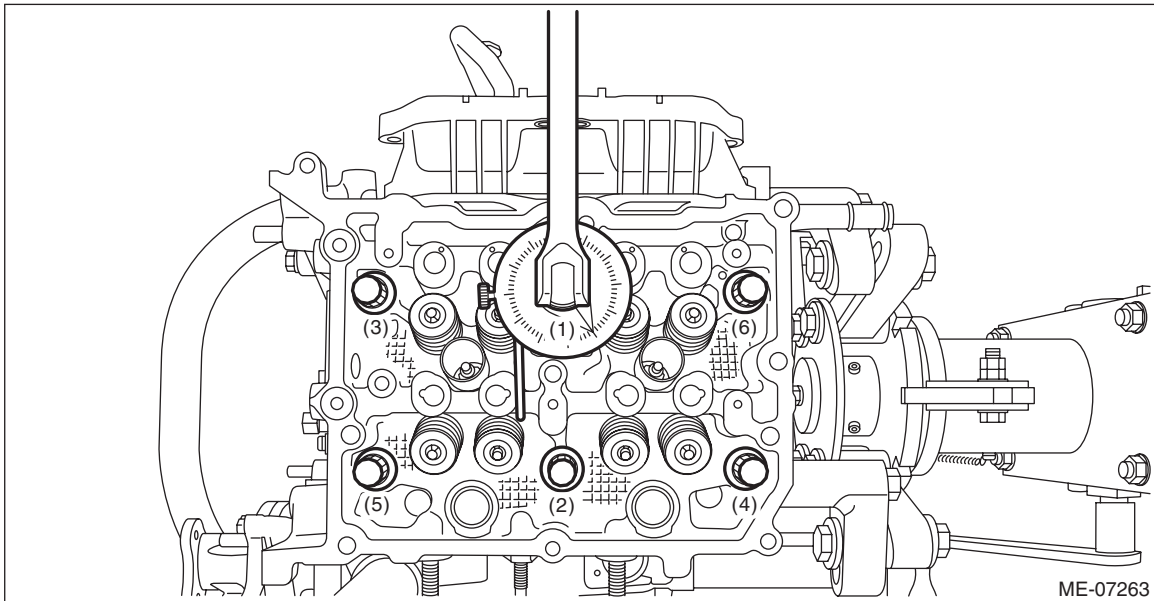
MECHANICAL

(6) Tighten all cylinder head bolts with a torque of 42 N·m (4.3 kgf-m, 31.0 ft-lb) in numerical order as shown in the figure.



(7) Using angle gauge, tighten all cylinder head bolts with specified angle in numerical order as shown in the figure.

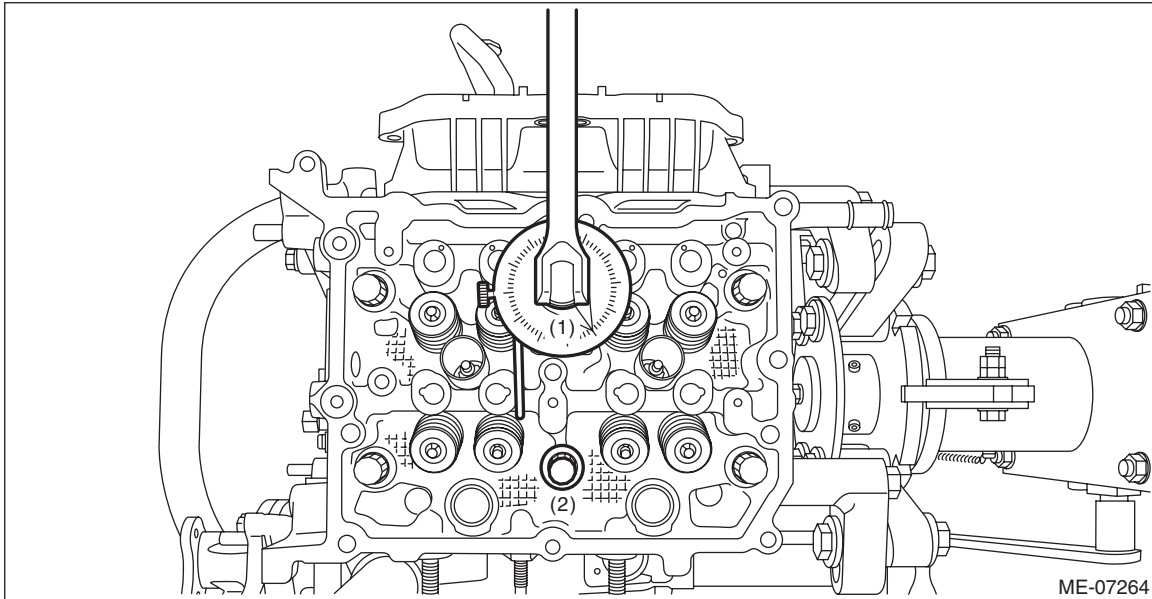
Tightening angle:
 $100^{\circ} \pm 2^{\circ}$



(8) Using angle gauge, tighten the cylinder head bolts (2 places) with specified angle in numerical order as shown in the figure.

Tightening angle:

$100^{\circ} \pm 2^{\circ}$



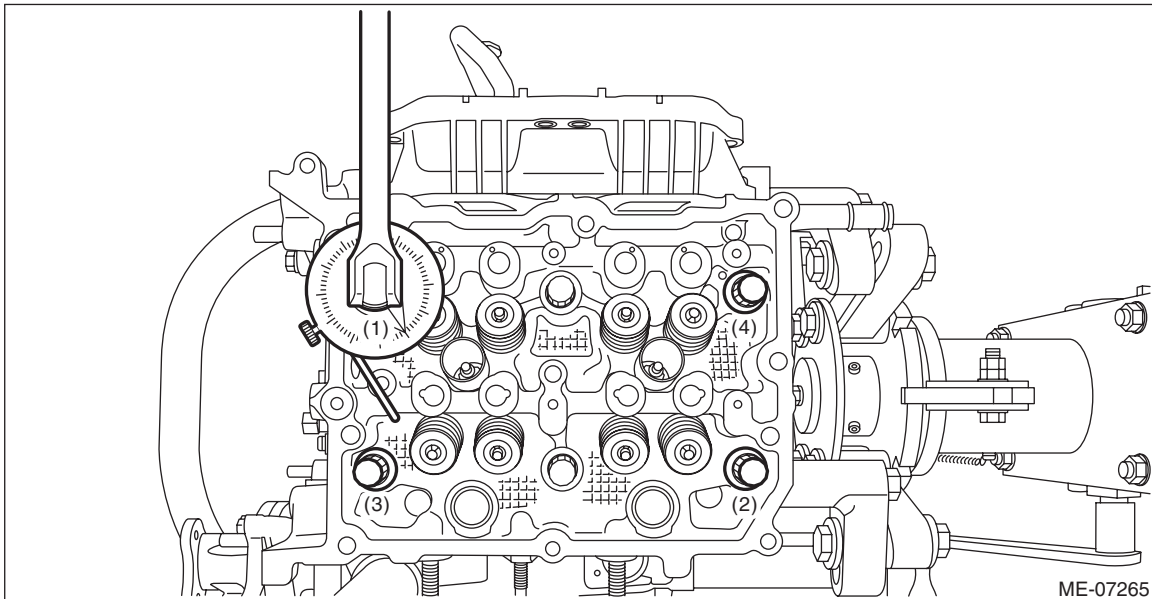
(9) Using angle gauge, tighten the cylinder head bolts (4 places) with specified angle in numerical order as shown in the figure.

NOTE:

After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.

Tightening angle:

$50^{\circ} \pm 2^{\circ}$



6) Set the part so that the installation surface of the intake manifold is on the upper side.

Cylinder Head

MECHANICAL

7) When the cylinder head LH has been disassembled

NOTE:

When the cylinder head LH has been disassembled, perform the following steps also.

- (1) Install the fuel injector LH.<Ref. to FU(H4DOTC)-63, FUEL INJECTOR LH, INSTALLATION, Fuel Injector.>
- (2) Install the tumble generator valve assembly LH.<Ref. to FU(H4DOTC)-45, INSTALLATION, Tumble Generator Valve Assembly.>
- 8) Install the A/C compressor.<Ref. to ME(H4DOTC)-191, CAM CARRIER LH, INSTALLATION, Cam Carrier.>
- 9) Install the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe.

CAUTION:

Always use a new high-pressure fuel delivery pipe assembly.

- (1) Temporarily tighten the flare nut (A) to the fuel injector pipe by hand until it is seated, and secure the high-pressure fuel delivery pipe assembly to the water pipe assembly using bolts (B).

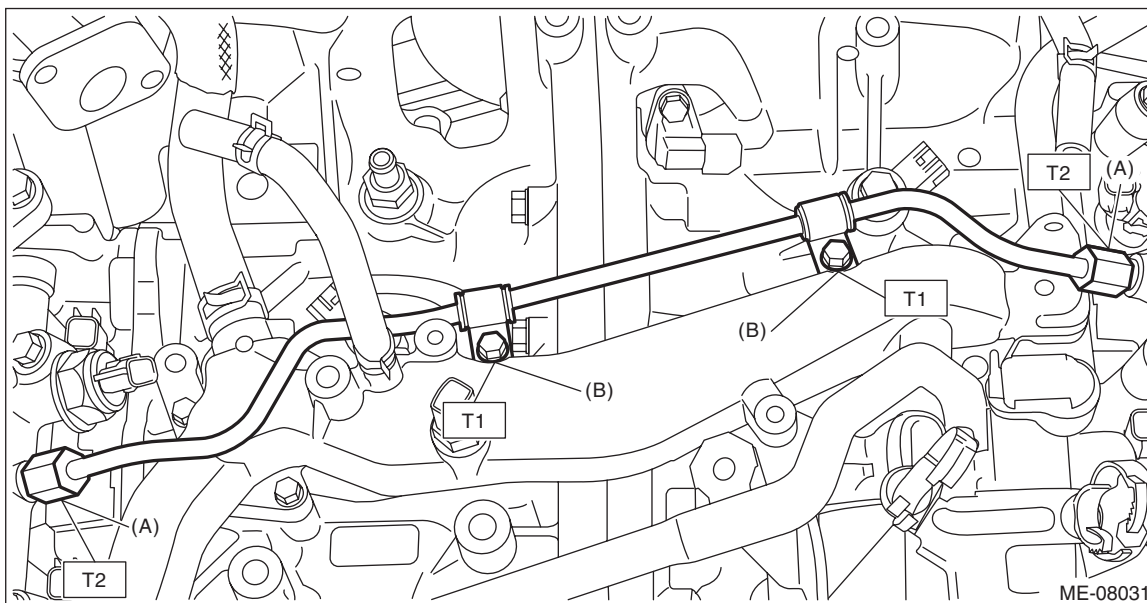
Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

- (2) Tighten the flare nuts (A).

Tightening torque:

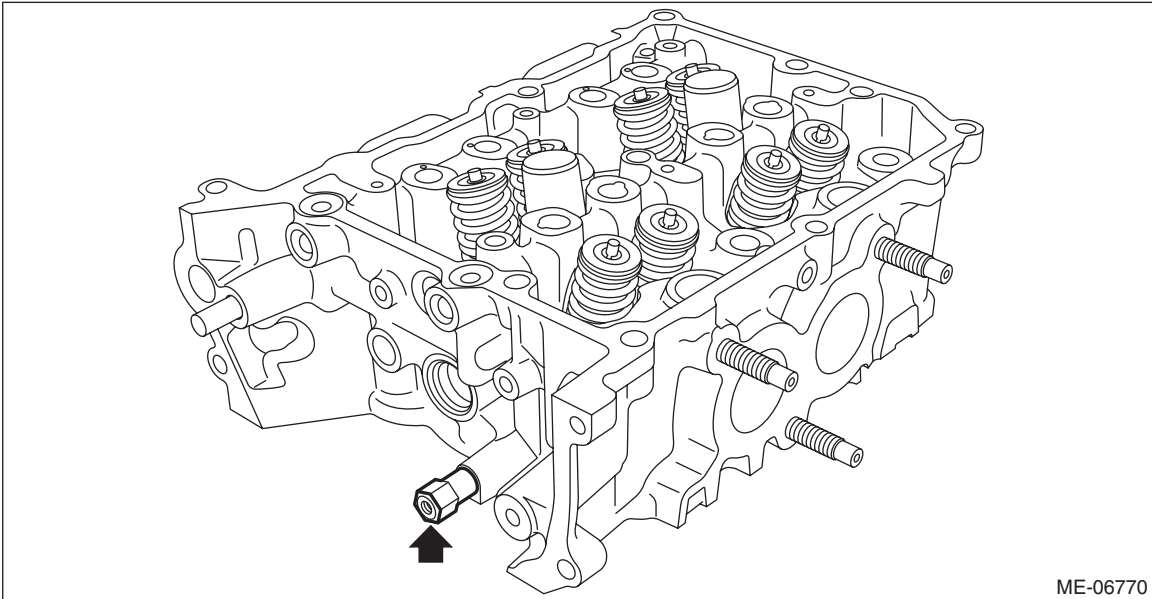
T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)



- 10) Install the cam carrier LH.<Ref. to ME(H4DOTC)-191, CAM CARRIER LH, INSTALLATION, Cam Carrier.>
- 11) Install the rocker cover LH.<Ref. to ME(H4DOTC)-163, ROCKER COVER LH, INSTALLATION, Rocker Cover.>
- 12) Install the chain cover.<Ref. to ME(H4DOTC)-99, INSTALLATION, Chain Cover.>
- 13) Install the engine wiring harness.<Ref. to FU(H4DOTC)-92, INSTALLATION, Engine Wiring Harness.>
- 14) Install the intake manifold.<Ref. to FU(H4DOTC)-30, INSTALLATION, Intake Manifold.>
- 15) Install the engine to the vehicle.<Ref. to ME(H4DOTC)-61, INSTALLATION, Engine Assembly.>

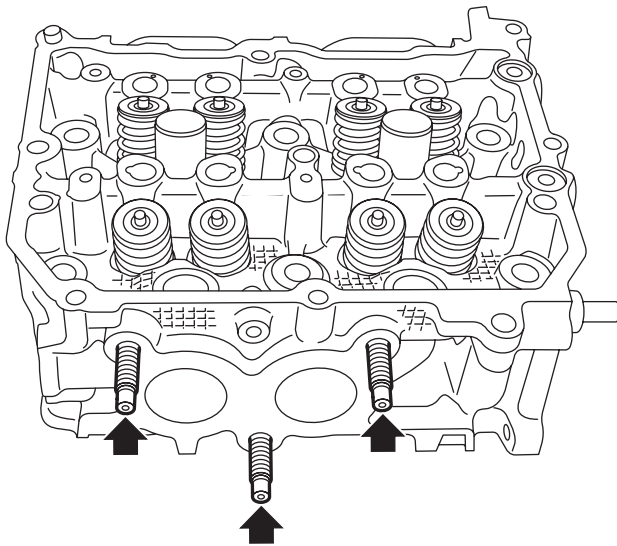
C: DISASSEMBLY

- 1) Remove the chain cover securing bolt from the cylinder head LH.

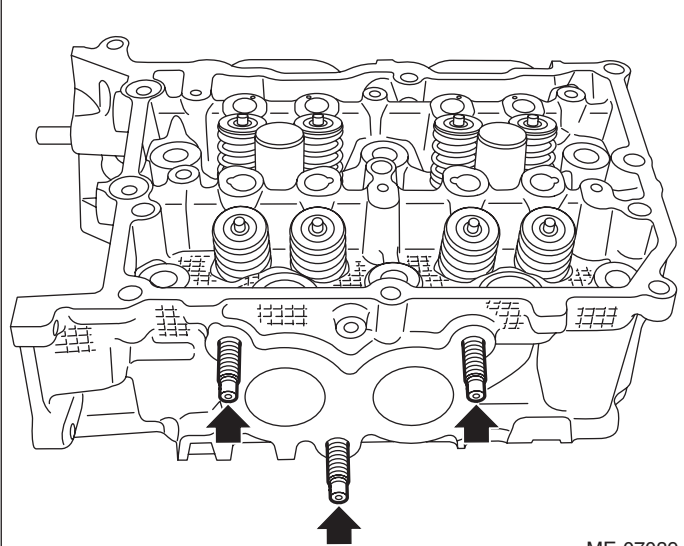


- 2) Remove the stud bolts from the cylinder head.

RH



LH



Cylinder Head

MECHANICAL

3) Remove the valve collet, valve, valve spring retainer, valve spring and valve spring seat from the cylinder head RH.

WARNING:

Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm "DISPOSAL". <Ref. to ME(H4DOTC)-264, DISPOSAL, Cylinder Head.>

CAUTION:

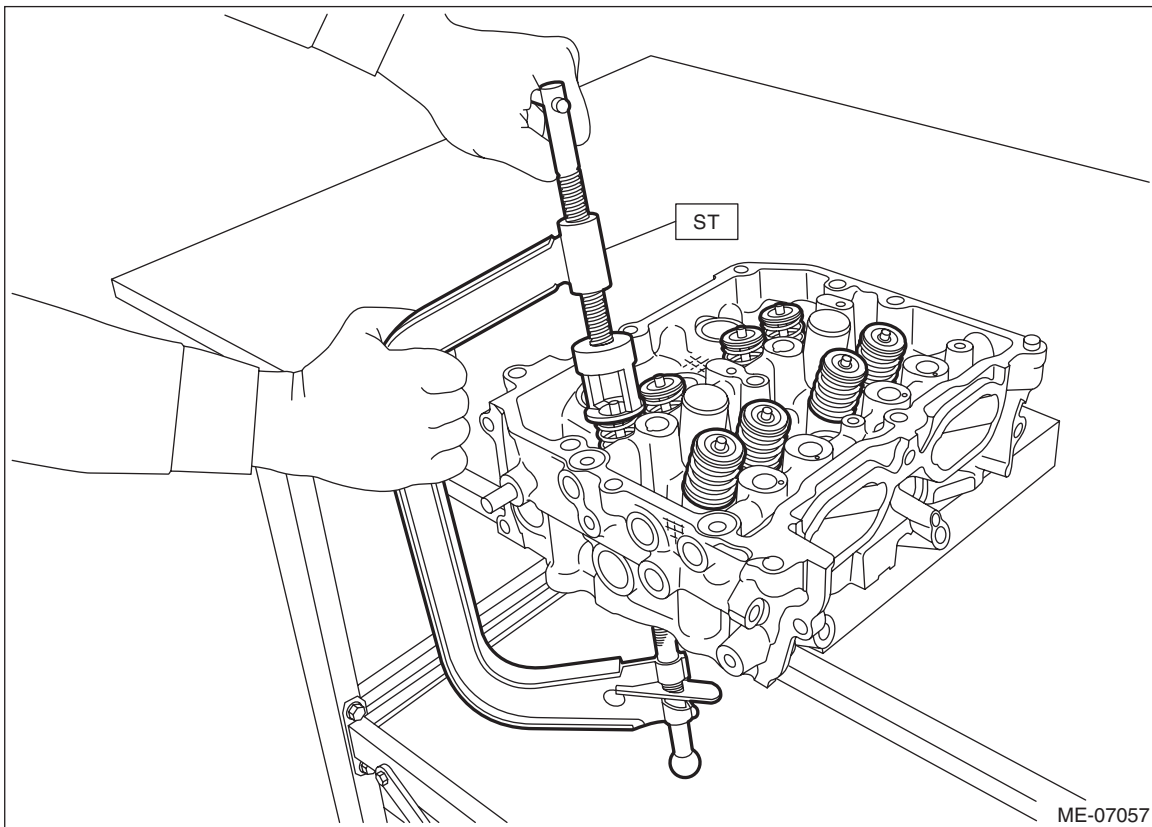
During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.

NOTE:

- Mark each part to prevent confusion.
- Keep all the removed parts in order for re-installing in their original positions.

(1) Compress the valve spring and remove the valve collet using ST.

ST 0920287002000 REMOVER AND REPLACER



ME-07057

(2) Remove valve, valve spring retainer, valve spring and valve spring seat.

4) Remove the valve collet, valve, valve spring retainer, valve spring and valve spring seat from the cylinder head LH.

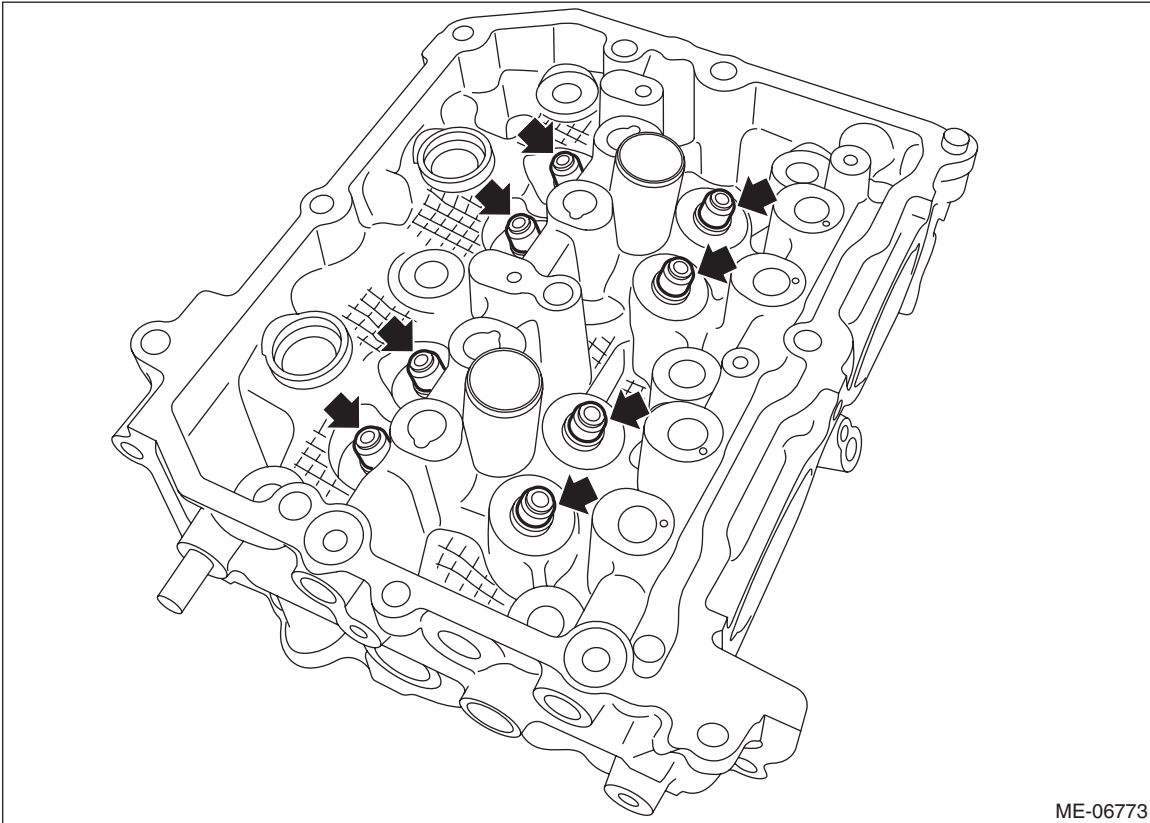
5) Remove the valve oil seals from valve guides of cylinder head RH.

CAUTION:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.
- Use special care not to damage the cylinder head RH and guide during work.

NOTE:

For removal of valve guide, refer to INSPECTION. <Ref. to ME(H4DOTC)-245, VALVE & VALVE GUIDE, INSPECTION, Cylinder Head.>



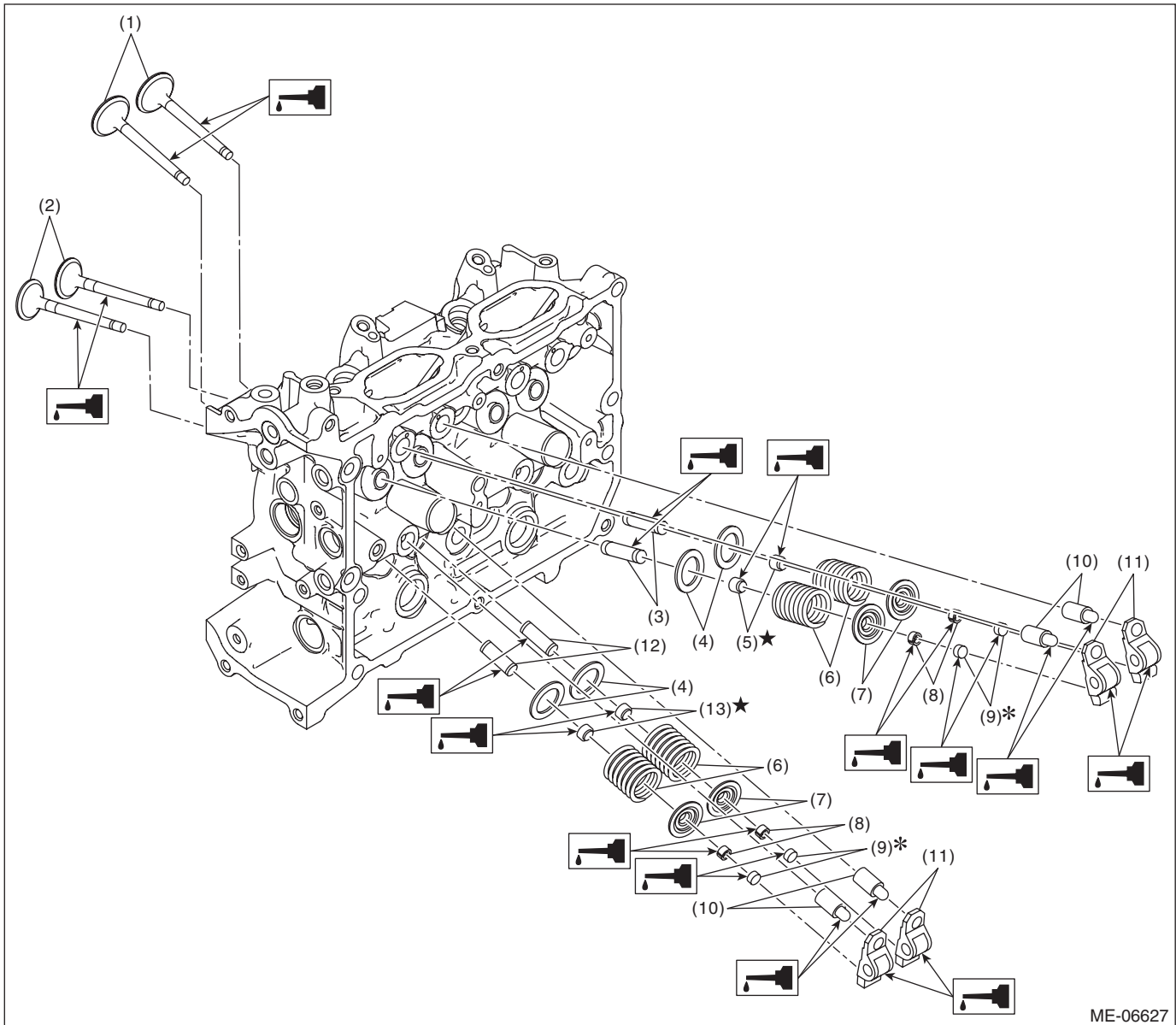
ME-06773

6) For cylinder head LH, remove the valve oil seal in the same manner.

Cylinder Head

MECHANICAL

D: ASSEMBLY



ME-06627

- | | | |
|---------------------------|------------------------------|-----------------------------|
| (1) Exhaust valve | (6) Valve spring | (11) Roller rocker arm |
| (2) Intake valve | (7) Valve spring retainer | (12) Exhaust valve guide |
| (3) Intake valve guide | (8) Valve collet | (13) Exhaust valve oil seal |
| (4) Valve spring seat | (9) Valve shim | |
| (5) Intake valve oil seal | (10) Roller rocker arm pivot | |

1) Using the ST, install the valve oil seals to valve guides of cylinder head RH.

CAUTION:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.
- Use special care not to damage the cylinder head RH and guide during work.
- When installing the valve oil seal, press the ST with hands to install it and never drive the ST with a plastic hammer, otherwise the valve oil seal can be damaged.

NOTE:

- Use a new valve oil seal.
- Apply engine oil to valve oil seal before installing.
- The intake valve oil seals and exhaust valve oil seals are distinguished by their colors.

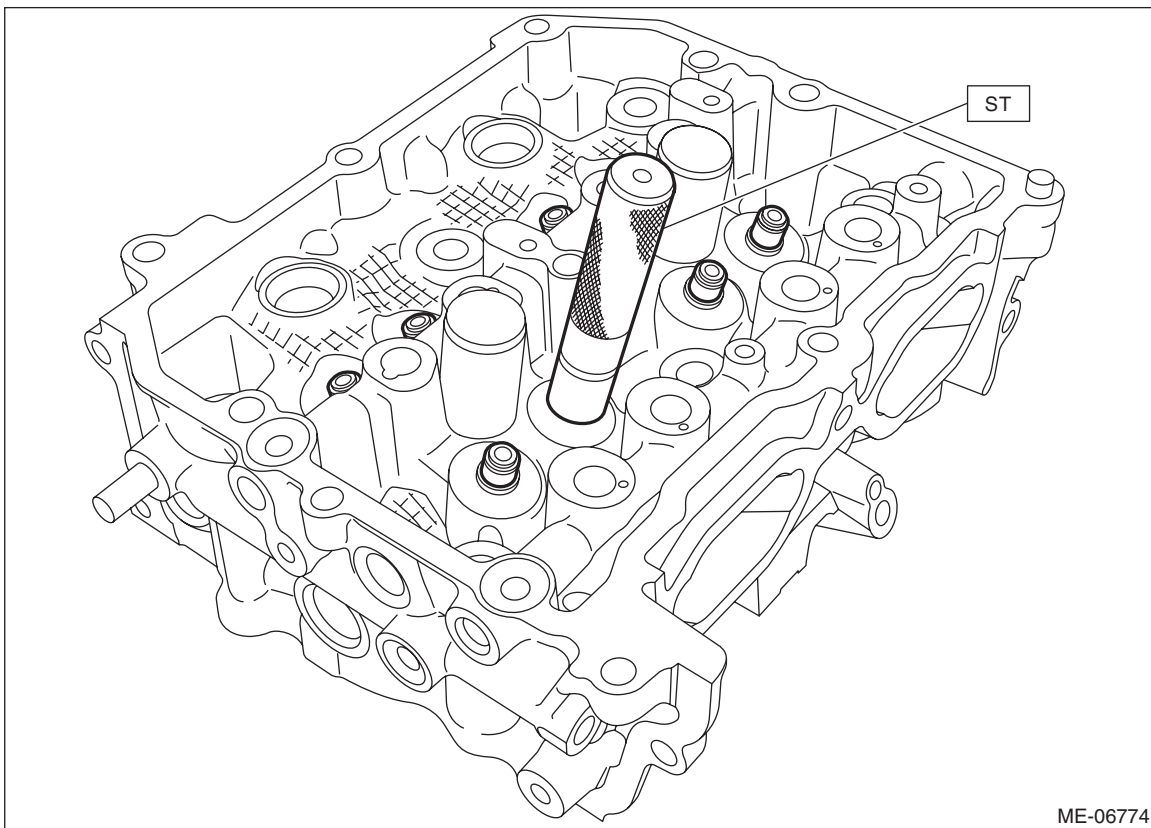
Identification colors:

Intake [Gray]

Exhaust [Green]

- For installation of valve guide, refer to INSPECTION. <Ref. to ME(H4DOTC)-245, VALVE & VALVE GUIDE, INSPECTION, Cylinder Head.>

ST 18261AA010 VALVE OIL SEAL GUIDE



ME-06774

2) For cylinder head LH, install the valve oil seal in the same manner.

3) Install the valve spring seat, valve spring, valve spring retainer, valve and valve collet to the cylinder head RH.

CAUTION:

During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.

(1) Set the valve spring seat, valve spring and valve spring retainer onto the cylinder head RH.

NOTE:

Be sure to install the valve spring with its close-coiled end facing the cylinder head side.

(2) Coat the valve stem of each valve with engine oil and insert the valve into valve guide.

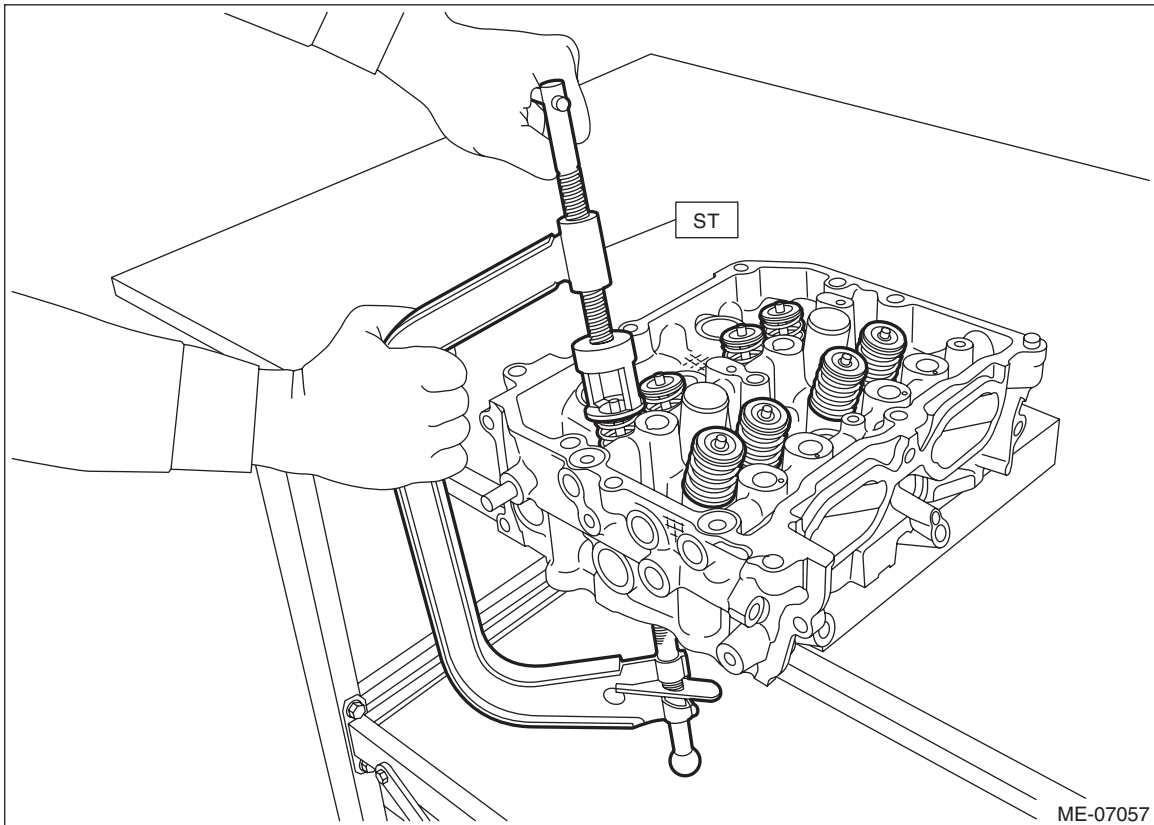
NOTE:

When inserting the valve into valve guide, use special care not to damage the oil seal lip.

Cylinder Head

MECHANICAL

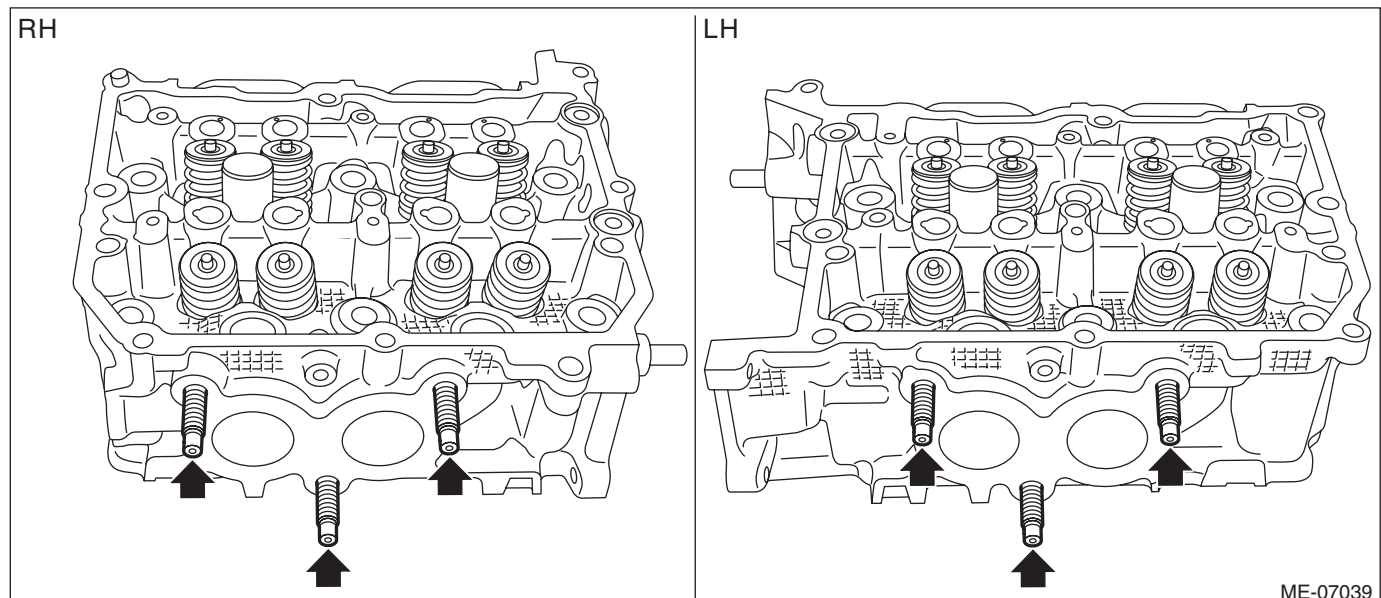
- (3) Compress the valve spring and install the valve collet using ST.
ST 0920287002000 REMOVER AND REPLACER



- 4) Install the valve spring seat, valve spring, valve spring retainer, valve and valve collet to the cylinder head LH.
5) Lightly tap the valve spring retainer with a plastic hammer, and make sure that the valve collet is securely attached.
6) Install the stud bolts onto cylinder heads.

Tightening torque:

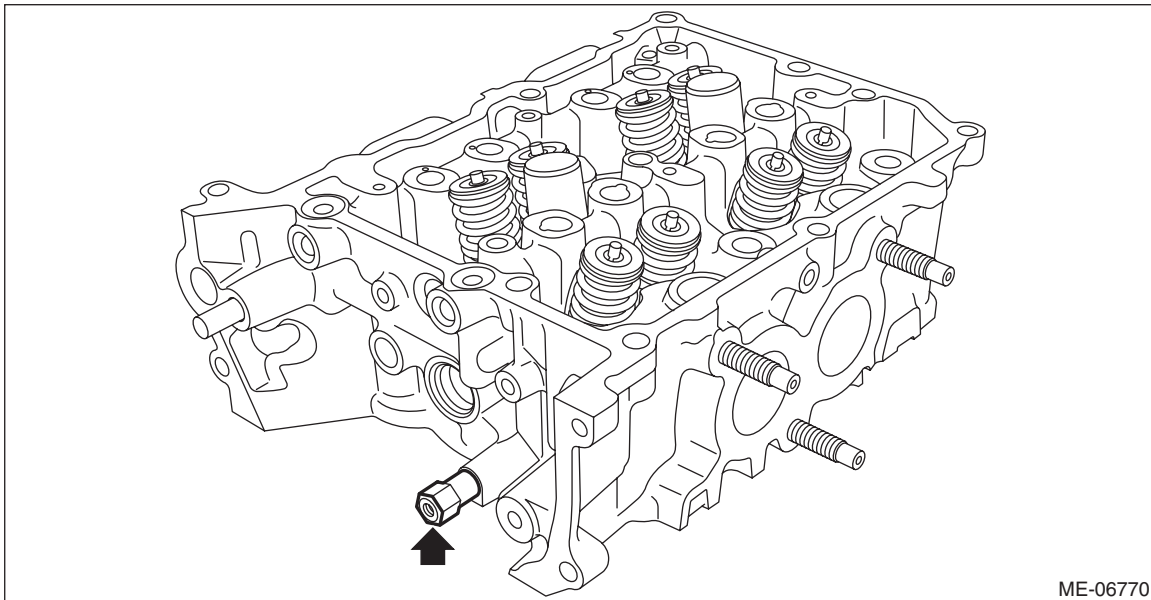
18 N·m (1.8 kgf-m, 13.3 ft-lb)



7) Install the chain cover securing bolt to the cylinder head LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



E: INSPECTION

1. CYLINDER HEAD

- 1) Visually inspect to make sure that there are no cracks, scratches or other damage.
- 2) Use liquid penetrant tester on the important sections to check for fissures.
- 3) Check that there are no marks of gas leaking or water leaking on gasket attachment surface.
- 4) Check the warpage of the cylinder head mating surface that mates with cylinder block at the locations shown in the figure using a straight edge (A) and thickness gauge (B). If it exceeds the limit, correct the surface by grinding it with a surface grinder or replace the cylinder head.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- If there is warpage on the cylinder head mating surface, the cylinder head bolt tightening torque and angle tightening may be improper. When installing the cylinder head, make sure that tightening torque and angle tightening work is performed precisely according to the operation procedures.
- When the cylinder head is replaced, lap each valve. Refer to "VALVE SEAT" for lapping. <Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>

Cylinder head warpage:

Limit

0.035 mm (0.0014 in)

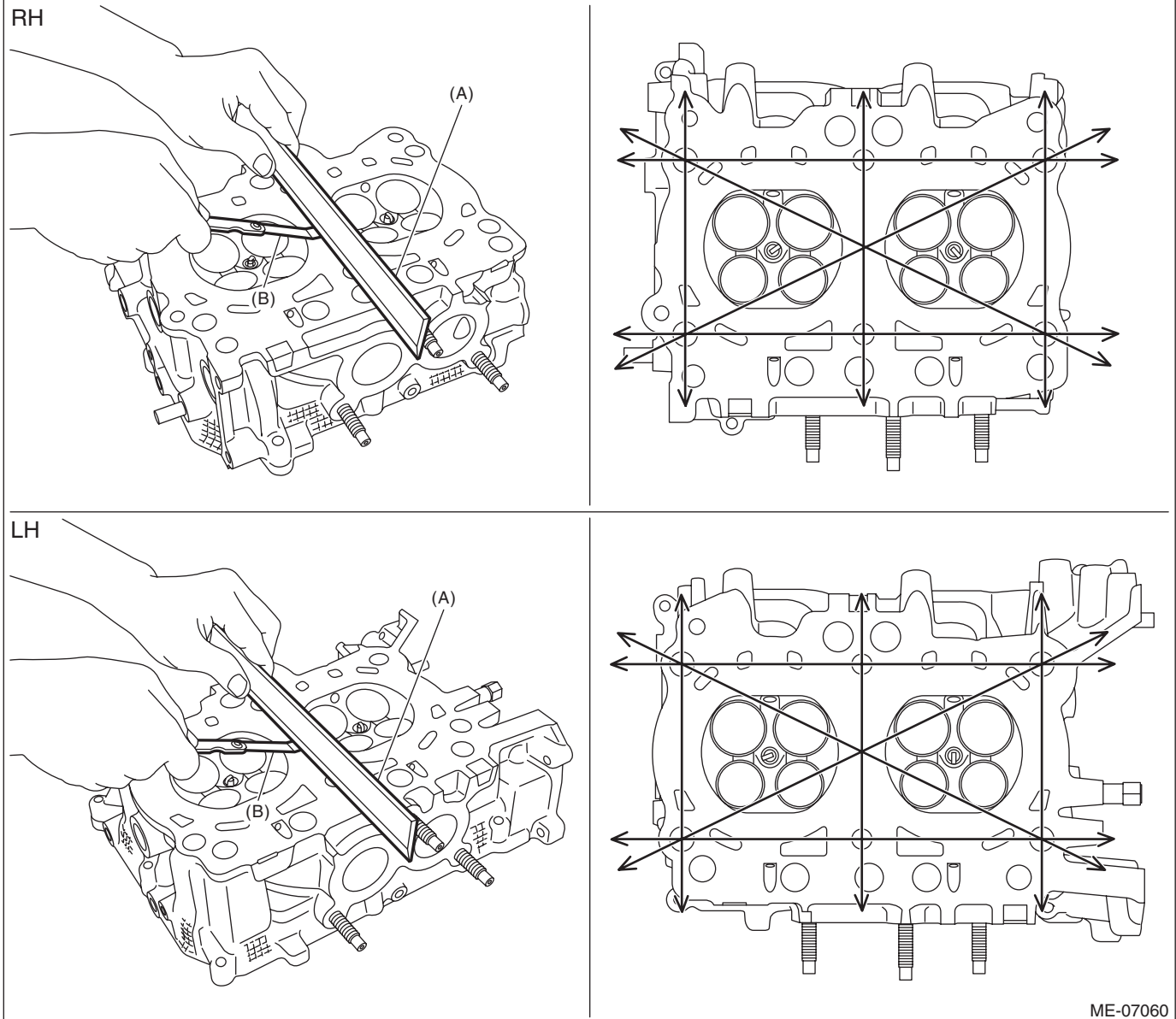
Cylinder head grinding limit:

To 98.4 mm (3.874 in)

Cylinder Head

MECHANICAL

Cylinder head height:
Standard
98.5 mm (3.878 in)



2. VALVE & VALVE GUIDE

WARNING:

Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm “DISPOSAL”.<Ref. to ME(H4DOTC)-264, DISPOSAL, Cylinder Head.>

- 1) Check the valve flange and stem for damage, wear or deformation.
- 2) Measure the thickness “H” of valve head edge as shown in the figure using a caliper gauge. If it is not within the standard, replace the valve.

NOTE:

- It is possible to differentiate between the intake valve and the exhaust valve by their overall length.

Valve overall length:

Intake

104.95 mm (4.132 in)

Exhaust

97.9 mm (3.854 in)

- When the valve is replaced, lap the valve. Refer to “VALVE SEAT” for lapping.<Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>

Valve head edge thickness H:

Intake (A)

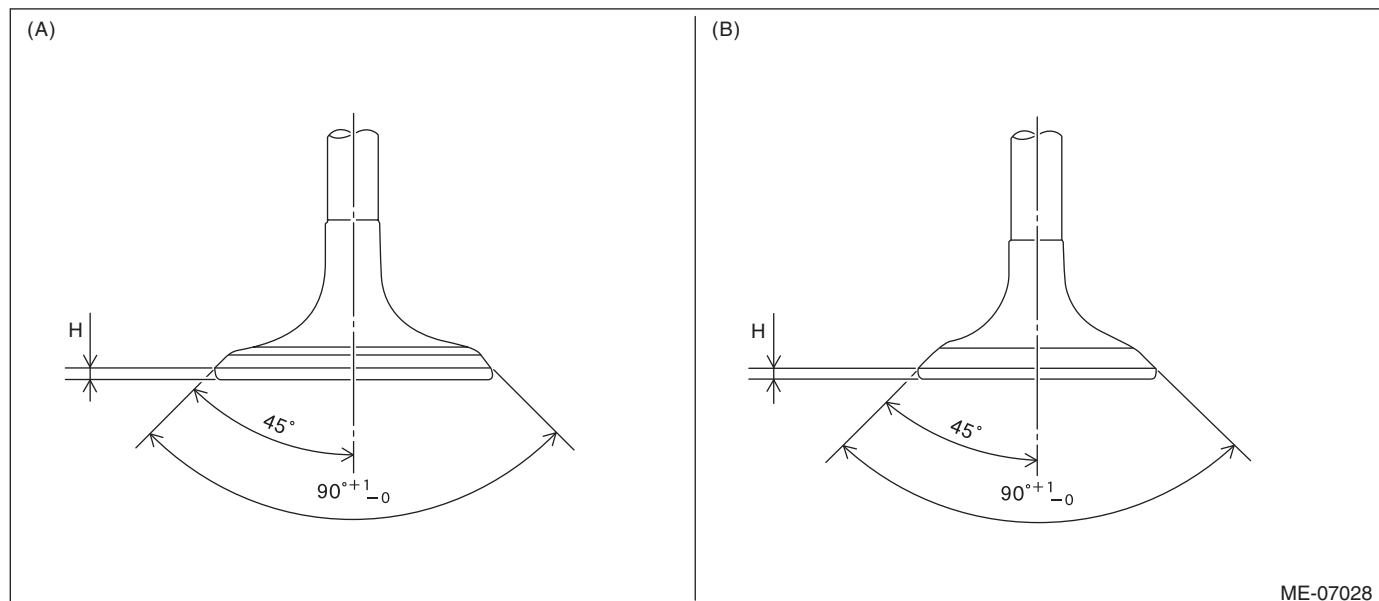
Standard

0.8 — 1.2 mm (0.031 — 0.047 in)

Exhaust (B)

Standard

1.0 — 1.4 mm (0.039 — 0.055 in)



Cylinder Head

MECHANICAL

3) Check the clearance between valve and valve guide. Check the clearance between valve and valve guide by measuring the outer diameter of valve stem and the inner diameter of valve guide respectively.

(1) Measure the outer diameter of valve stem with a micrometer. If it is not within the standard, replace the valve.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the valve stem at the six locations as shown in the figure, and read the value of most worn location.
- When the valve is replaced, lap the valve. Refer to “VALVE SEAT” for lapping.<Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>

Valve stem outer diameter:

Intake

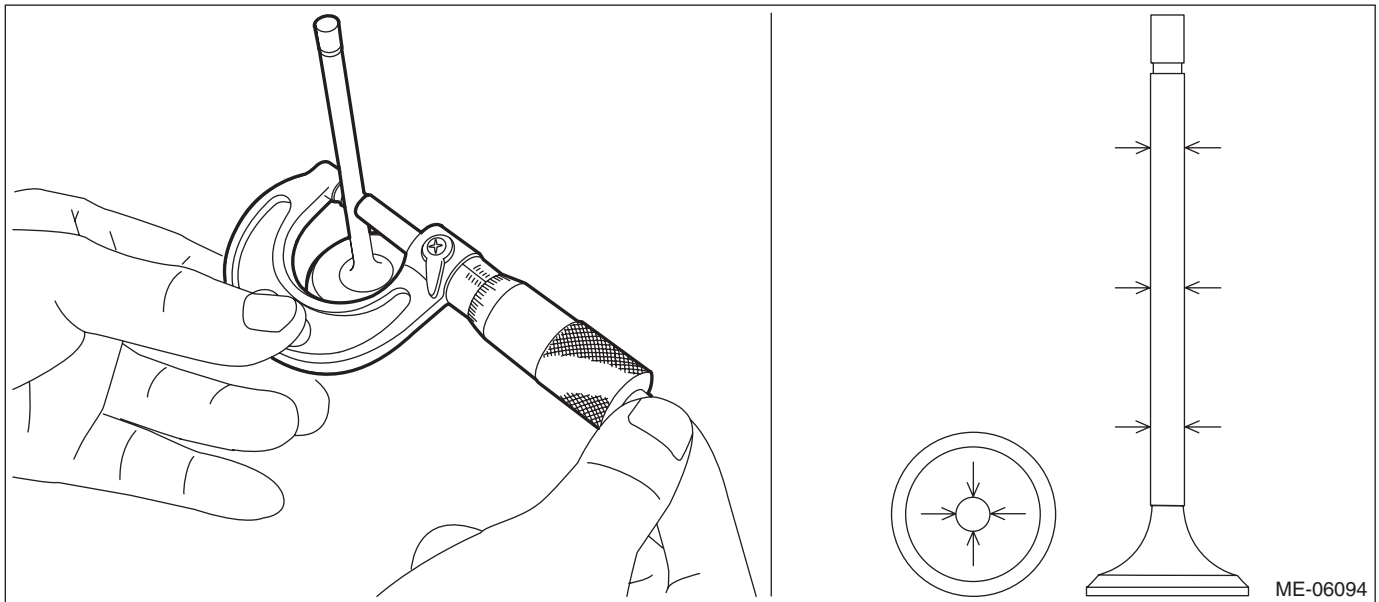
Standard

5.455 — 5.470 mm (0.2148 — 0.2154 in)

Exhaust

Standard

5.445 — 5.460 mm (0.2144 — 0.2150 in)



(2) Using a caliper gauge, measure the inner diameter of valve guide. If it is not within the standard, replace the valve guide. For replacement procedure, refer to step 4).

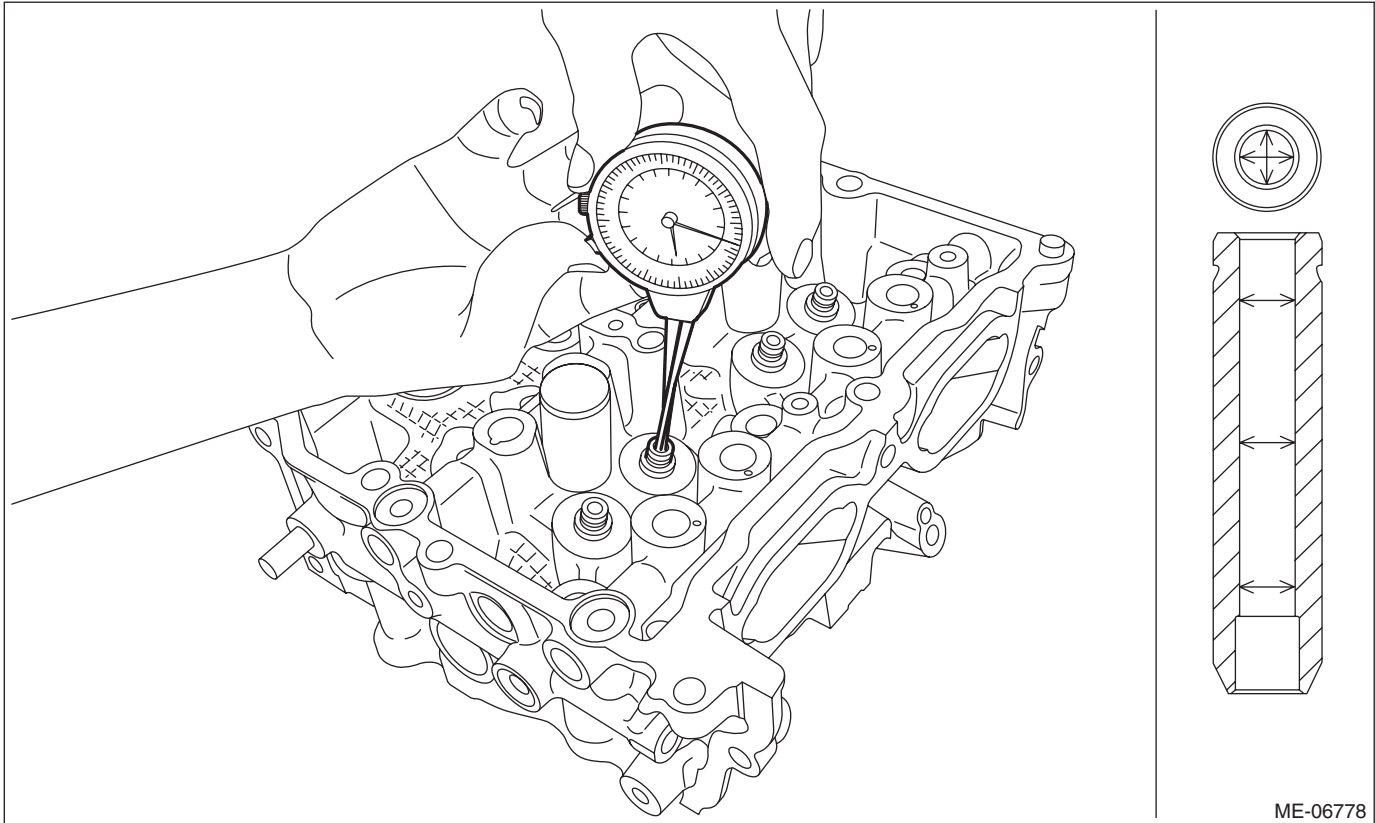
NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the valve guide at the six locations as shown in the figure, and read the value of most worn location.

Valve guide inner diameter:

Standard

5.500 — 5.512 mm (0.2165 — 0.2170 in)



ME-06778

(3) Calculate the clearance between valve and valve guide.

Clearance between valve and valve guide:

Intake

Standard

0.030 — 0.057 mm (0.0012 — 0.0022 in)

Exhaust

Standard

0.040 — 0.067 mm (0.0016 — 0.0026 in)

Cylinder Head

MECHANICAL

4) If the clearance between valve and valve guide exceeds the standard, replace the valve or valve guide, whichever shows the greater amount of wear or damage. For replacement procedure of valve guide, refer to the following.

NOTE:

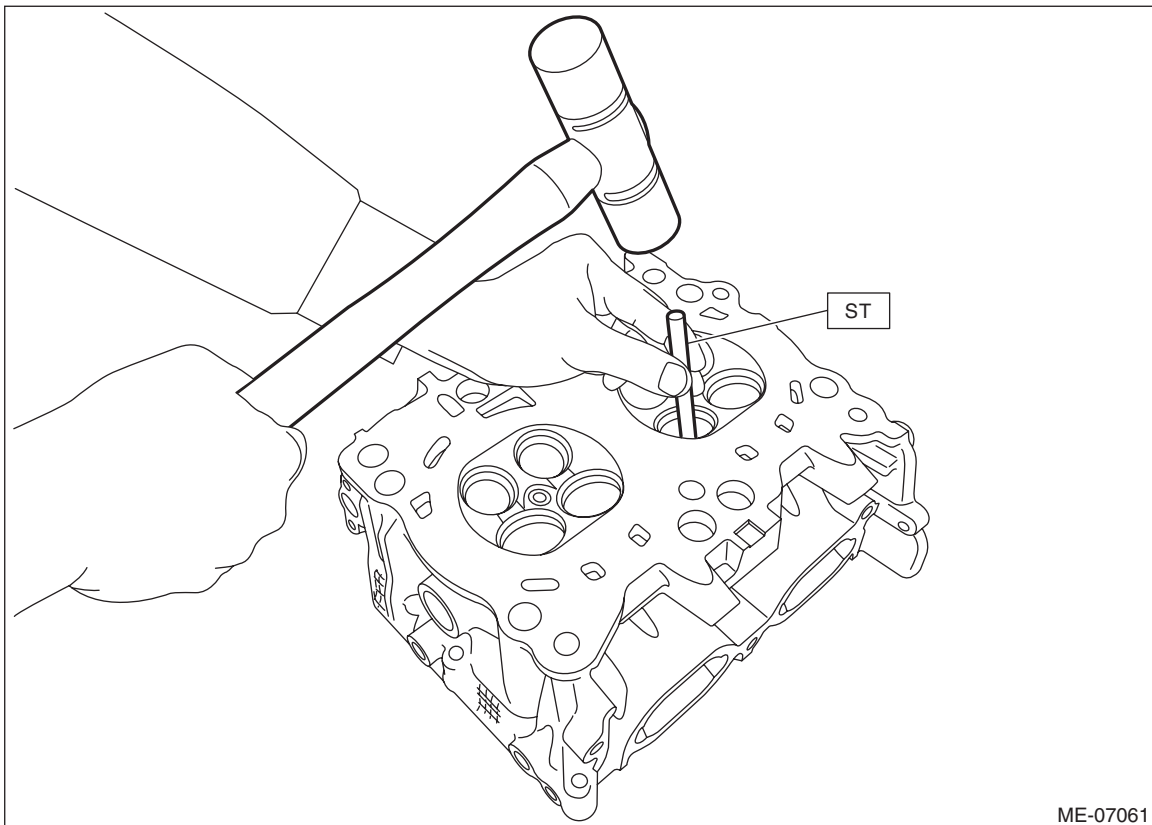
When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping.<Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>

(1) Insert ST into the valve guide with the combustion chamber upward and remove the valve guide using plastic hammer.

CAUTION:

- Place a wood board wrapped with a waste cloth to stabilize the cylinder head before work.
- Use special care not to damage the cylinder head during work.
- Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.

ST 499765700 VALVE GUIDE REMOVER AND INSTALLER



ME-07061

(2) Before installing the valve guide, make sure that neither scratches nor damages exist on the inner surface of valve guide installation holes of cylinder head.

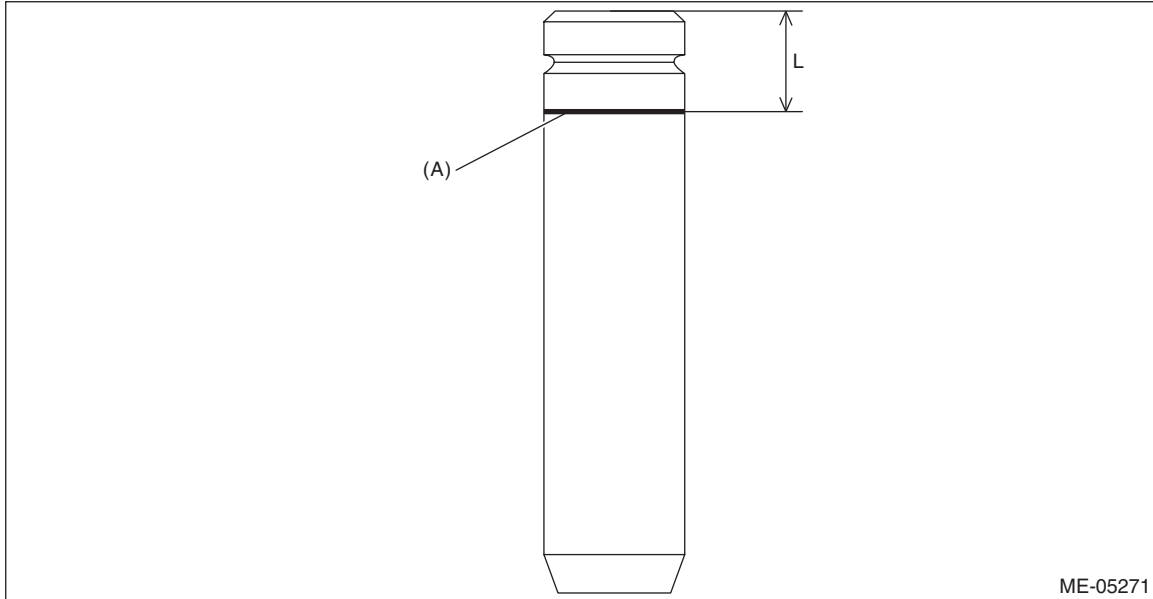
(3) Draw a reference line (A) for insert on the valve guide using a marker as shown in the figure.

NOTE:

- Use a new valve guide.
- A reference line for insert is used as a guide when tapping-in the valve guide.

Valve guide inserting reference line position L:

15 mm (0.5906 in)



ME-05271

(4) Apply a enough coat of engine oil to the valve guide, and set the valve guide on the cylinder head with the combustion chamber downward.

Cylinder Head

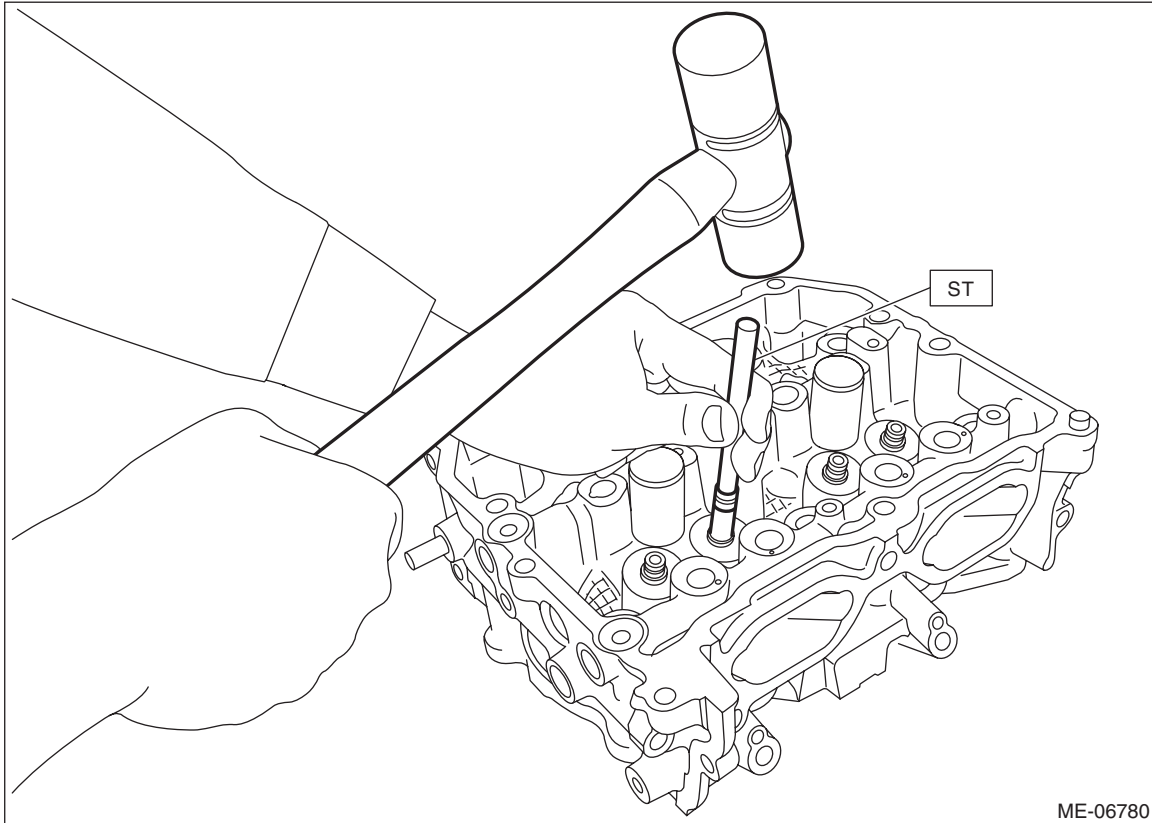
MECHANICAL

(5) Insert the ST into the valve guide, and tap-in the valve guide to the reference line (A) for insert using plastic hammer.

CAUTION:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head.
- Use special care not to damage the cylinder head during work.
- Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.

ST 499765700 VALVE GUIDE REMOVER AND INSTALLER



(6) Measure the valve guide protrusion amount “L” as shown in the figure using a caliper gauge. Insert the ST into the valve guide again, and tap-in the valve guide so that it is positioned within standard by referring to the measured value using plastic hammer.

CAUTION:

- During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head.
- Use special care not to damage the cylinder head during work.
- Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.

NOTE:

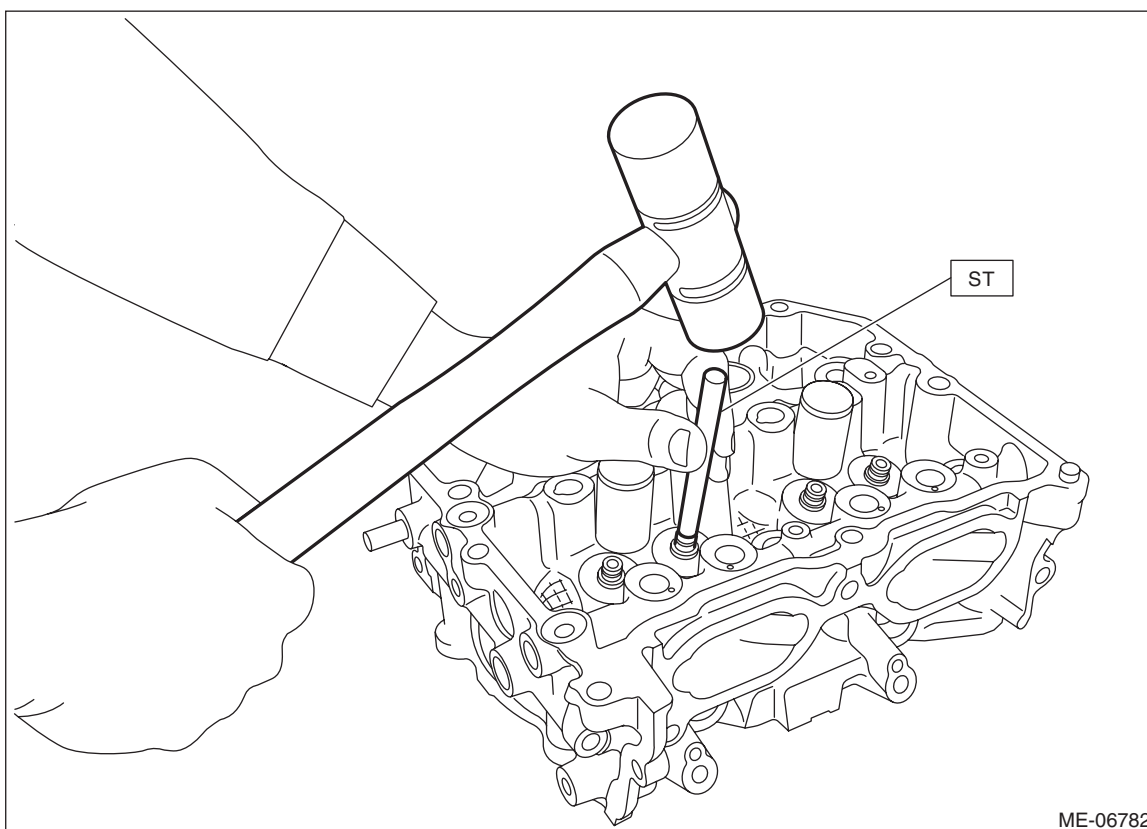
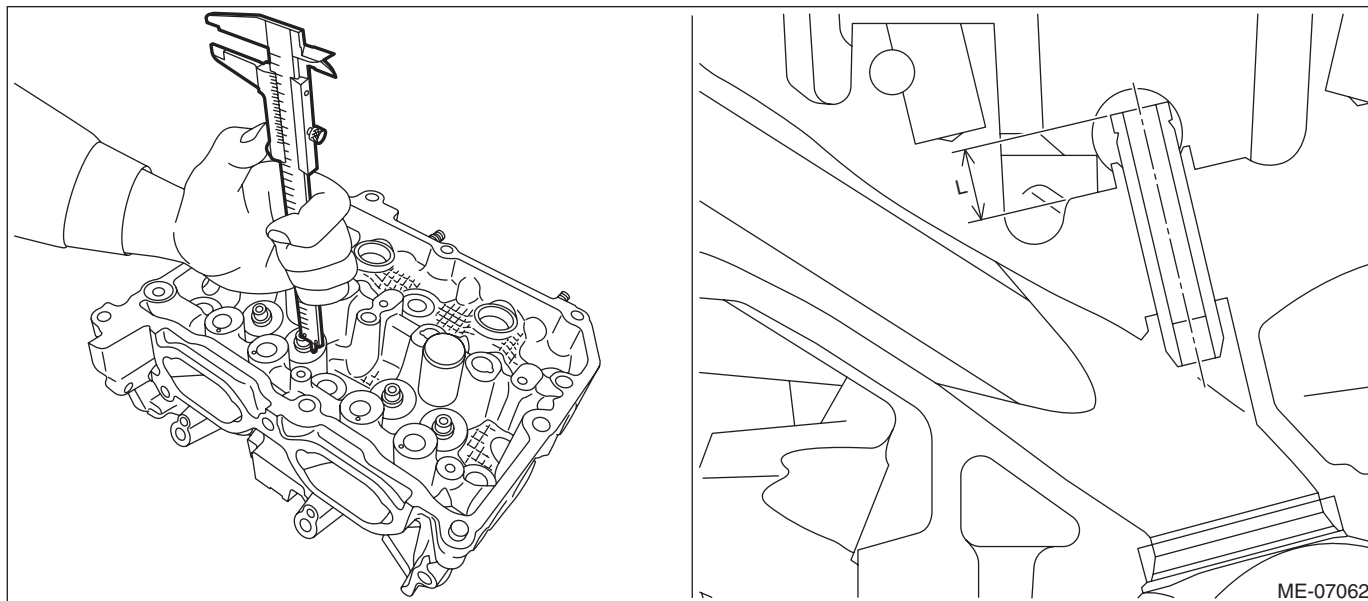
Be careful not to tap-in excessively by repeating the steps of Tapping-in → Measurement → Tapping-in → Measurement ... when installing the valve guide.

ST 499765700 VALVE GUIDE REMOVER AND INSTALLER

Valve guide protrusion amount L:

Standard

11.4 — 11.8 mm (0.449 — 0.465 in)



Cylinder Head

MECHANICAL

(7) Ream the inside of valve guide with the combustion chamber upward using the ST. Put the ST in valve guide, and rotate the ST slowly clockwise while pushing it lightly. Bring the ST back while rotating it clockwise.

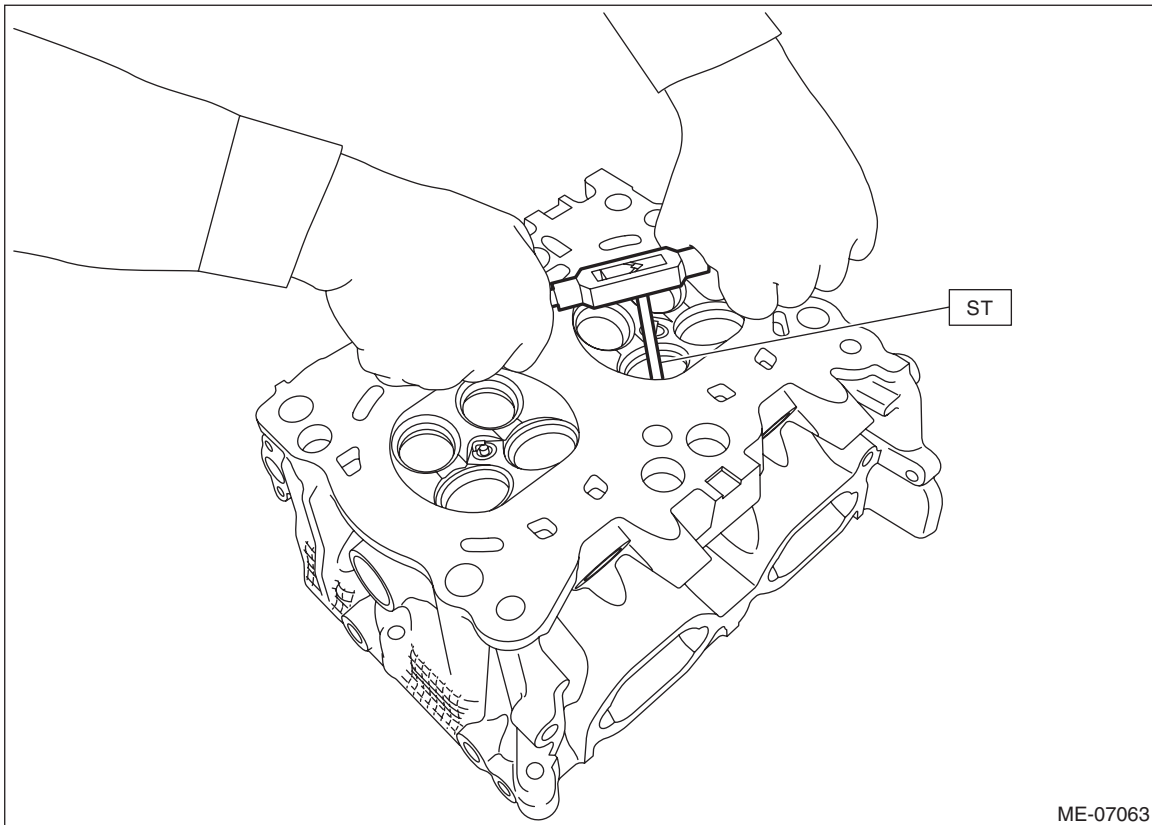
CAUTION:

- Place a wood board wrapped with a waste cloth to stabilize the cylinder head before work.
- Use special care not to damage the cylinder head during work.

NOTE:

- Apply engine oil to the ST.
- If the inner surface of valve guide is damaged, the edge of ST should be slightly ground with oil stone.
- If the inner surface of valve guide becomes lustrous and the ST does not chip, use a new ST or remedy the ST.

ST 499765900 VALVE GUIDE REAMER



(8) After reaming, clean the valve guide to remove chips.

(9) Check the seating width between valve and valve seat.<Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>

3. VALVE & VALVE SHIM

WARNING:

Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm “DISPOSAL”. <Ref. to ME(H4DOTC)-264, DISPOSAL, Cylinder Head.>

- 1) Visually check the valve shim for damage.
- 2) Check the clearance between valve and valve shim. Check the clearance between valve and valve shim by measuring the outer diameter of valve stem end and the inner diameter of valve shim respectively.
 - (1) Measure the outer diameter of valve stem end with a micrometer. If it is not within the standard, replace the valve.

NOTE:

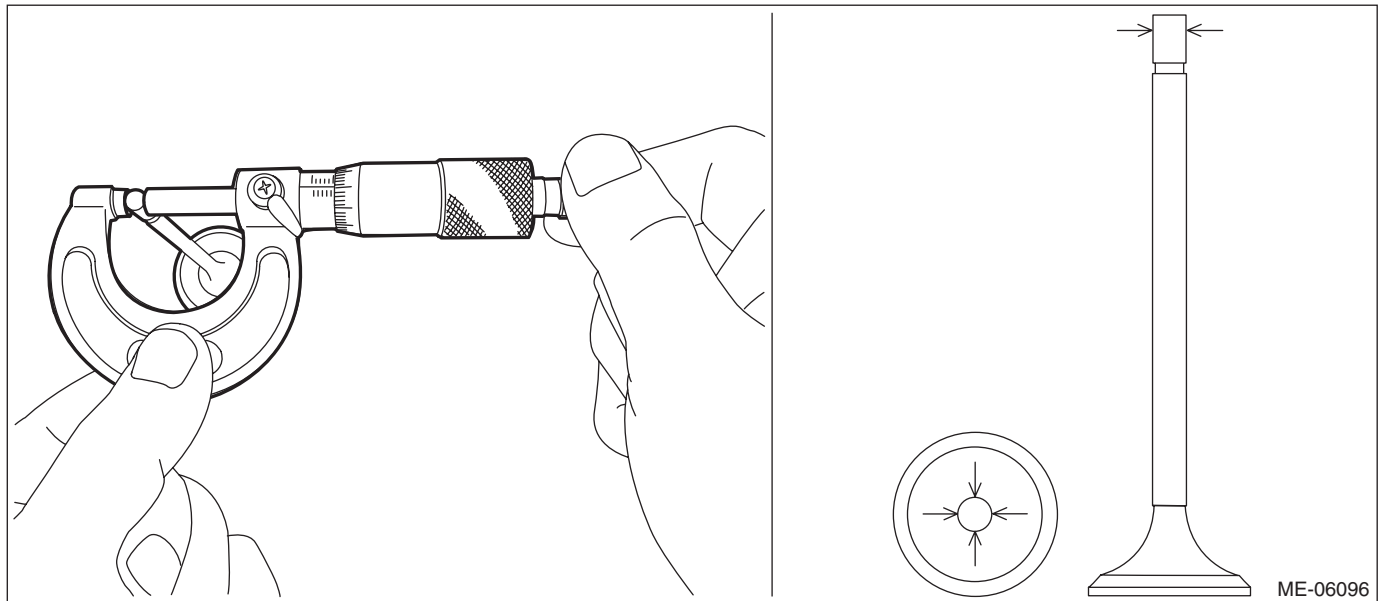
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the valve stem end at the two locations as shown in the figure, and read the value of most worn location.
- When the valve is replaced, lap the valve. Refer to “VALVE SEAT” for lapping. <Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>

Valve stem end outer diameter:**Intake****Standard**

5.455 — 5.470 mm (0.2148 — 0.2154 in)

Exhaust**Standard**

5.445 — 5.460 mm (0.2144 — 0.2150 in)



Cylinder Head

MECHANICAL

(2) Using a caliper gauge, measure the inner diameter of valve shim. If it is not within the standard, replace the valve shim.

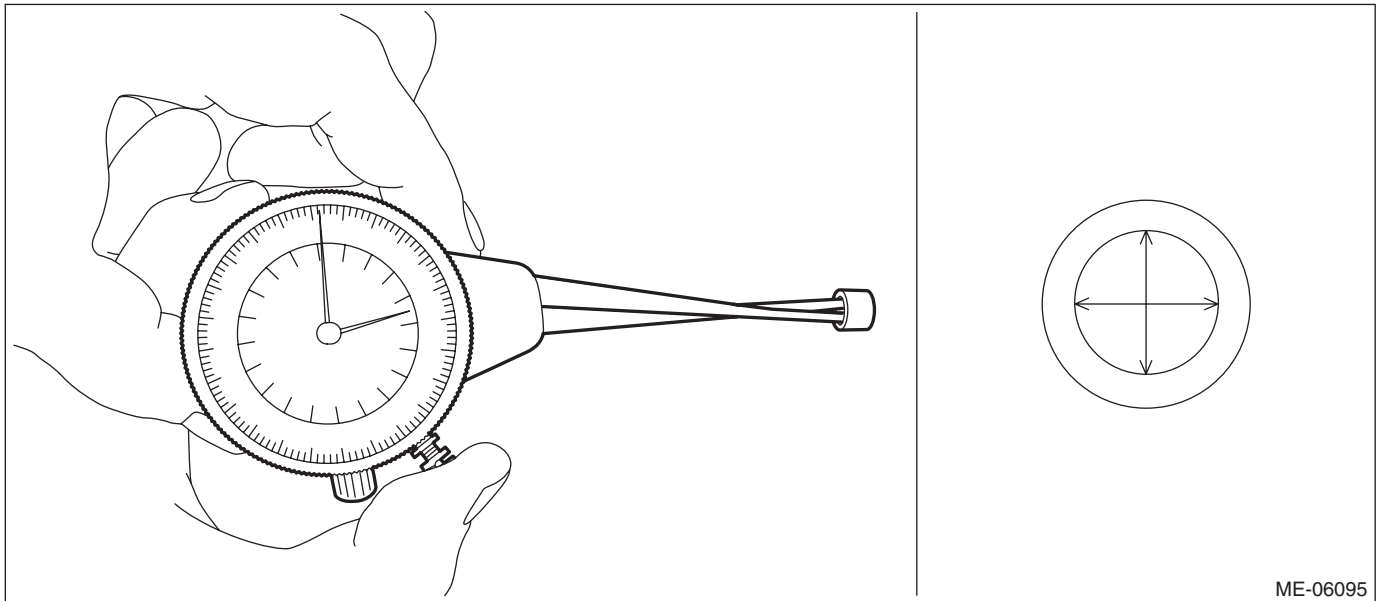
NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the valve shim at the two locations as shown in the figure, and read the value of most worn location.
- If the valve shim has to be replaced, check the cam clearance and replace with the suitable valve shim. <Ref. to ME(H4DOTC)-41, WHEN TIMING CHAIN ASSEMBLY IS REMOVED, INSPECTION, Cam Clearance.>

Valve shim inner diameter:

Standard

5.500 — 5.560 mm (0.2165 — 0.2189 in)



ME-06095

(3) Calculate the clearance between valve and valve shim. If the clearance exceeds the standard, replace the valve or valve shim, whichever shows the greater amount of wear or damage.

NOTE:

- When the valve is replaced, lap the valve. Refer to “VALVE SEAT” for lapping. <Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>
- If the valve shim has to be replaced, check the cam clearance and replace with the suitable valve shim. <Ref. to ME(H4DOTC)-41, WHEN TIMING CHAIN ASSEMBLY IS REMOVED, INSPECTION, Cam Clearance.>

Clearance between valve and valve shim:

Intake

Standard

0.030 — 0.105 mm (0.0012 — 0.0041 in)

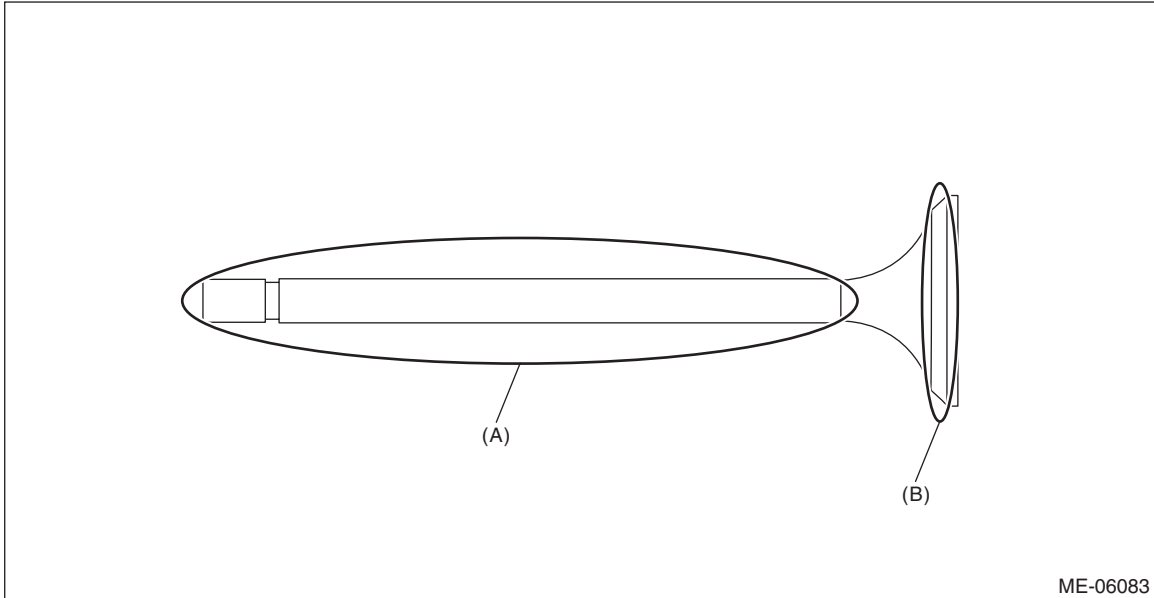
Exhaust

Standard

0.040 — 0.115 mm (0.0016 — 0.0045 in)

4. VALVE SEAT

- 1) Check the valve seat for damage and deformation.
- 2) Check the seating width and seating position between valve and valve seat for the intake valve seat and exhaust valve seat.
 - (1) Clean the valve and valve seat.
 - (2) Coat the stem (A) of the valve lightly with engine oil and apply red dye evenly on the valve face (B).



- (3) Using the valve lapper, slowly insert the valve with red dye applied into the valve guide. Lightly press the valve against the valve seat without turning the valve, and then slowly pull out the valve.
- (4) Check the seating width "W" of valve seat as shown in the figure, using a caliper gauge. Check the seating width "W" between valve and valve seat by measuring the width of red dye on the seating surface of valve seat. If the seating width "W" between valve and valve seat is out of the standard, correct the seating surface of valve seat using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3).

Cylinder Head

MECHANICAL

NOTE:

- When the red dye does not appear seamlessly on the valve seat seating surface, lap the valve. For lapping procedure, refer to step 4).
- When the red dye does not appear seamlessly on the valve seat seating surface even after lapping the valve, correct the valve seat seating surface using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3).

Seating width *W* between valve and valve seat:

Intake

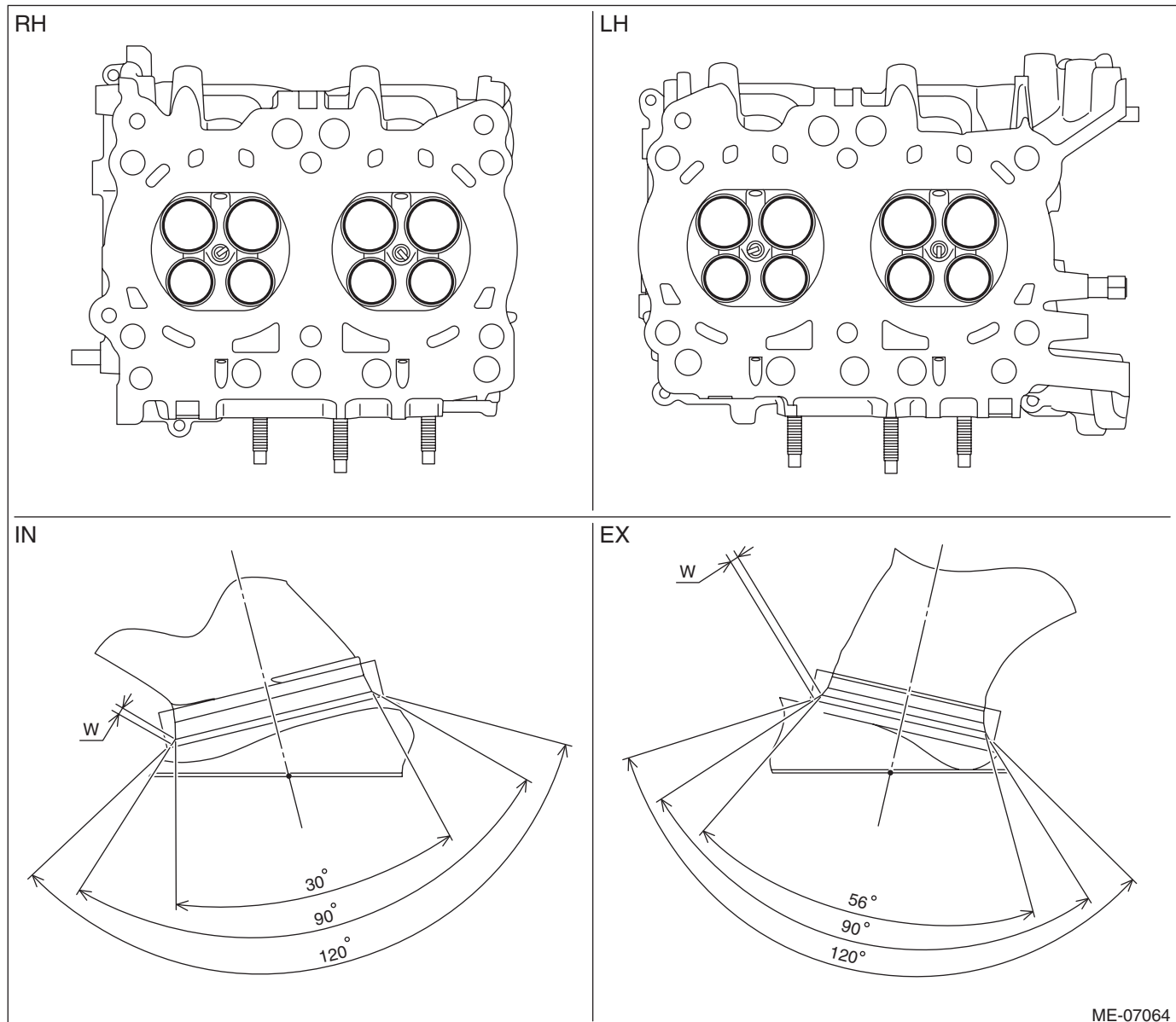
Standard

0.8 — 1.6 mm (0.031 — 0.063 in)

Exhaust

Standard

1.1 — 1.7 mm (0.043 — 0.067 in)



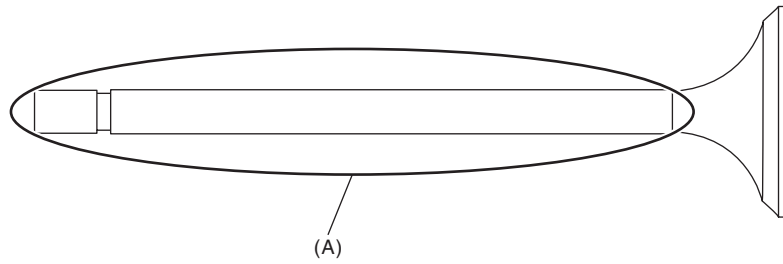
ME-07064

(5) Wipe off the red dye on the valve and valve seat completely.

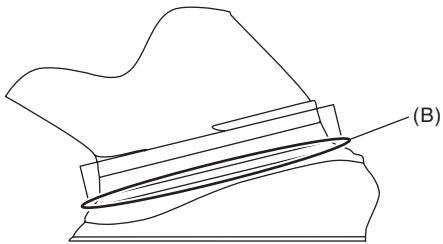
Cylinder Head

MECHANICAL

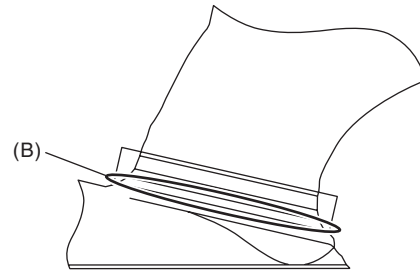
- (6) Coat the stem (A) of the valve lightly with engine oil and apply red dye evenly on the seating surface (B) between valve and valve seat.



IN



EX



ME-06785

Cylinder Head

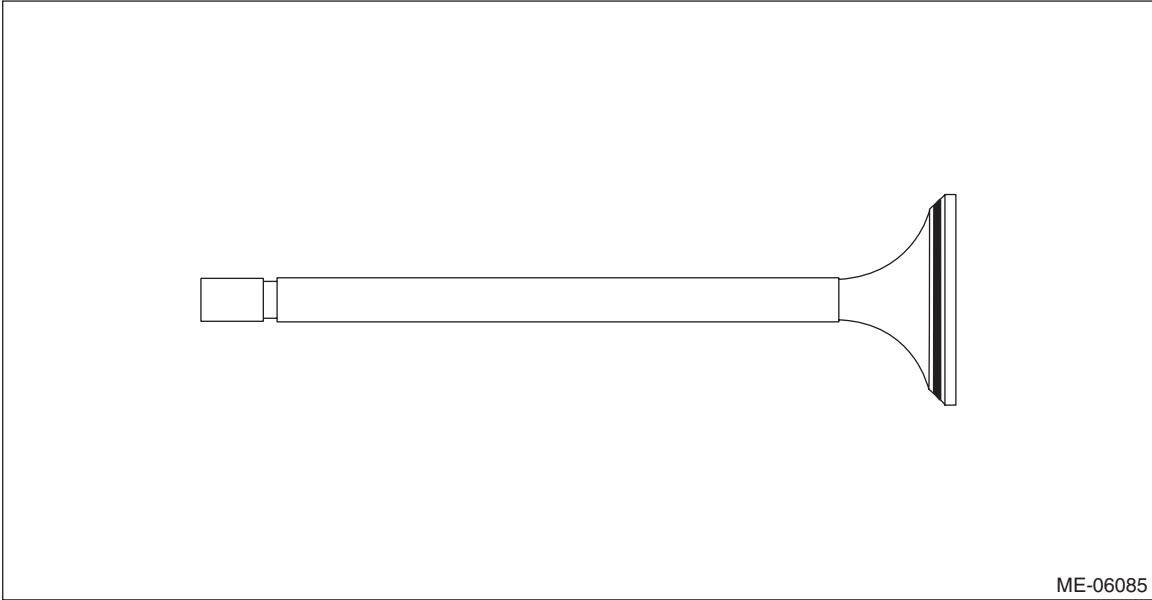
MECHANICAL

(7) Using the valve lapper, slowly insert the valve into the valve guide. Lightly press the valve against the valve seat without turning the valve, and then slowly pull out the valve.

(8) Check the seating position between valve and valve seat. Check the seating position between valve and valve seat by checking the position of red dye on the valve face. If the seating position between valve and valve seat is not at the center of valve face, correct the seating surface of valve seat using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3).

Seating position between valve and valve seat:

Valve face center



(9) After inspection, wipe off the red dye completely.

3) When correcting the seating surfaces of valve seat

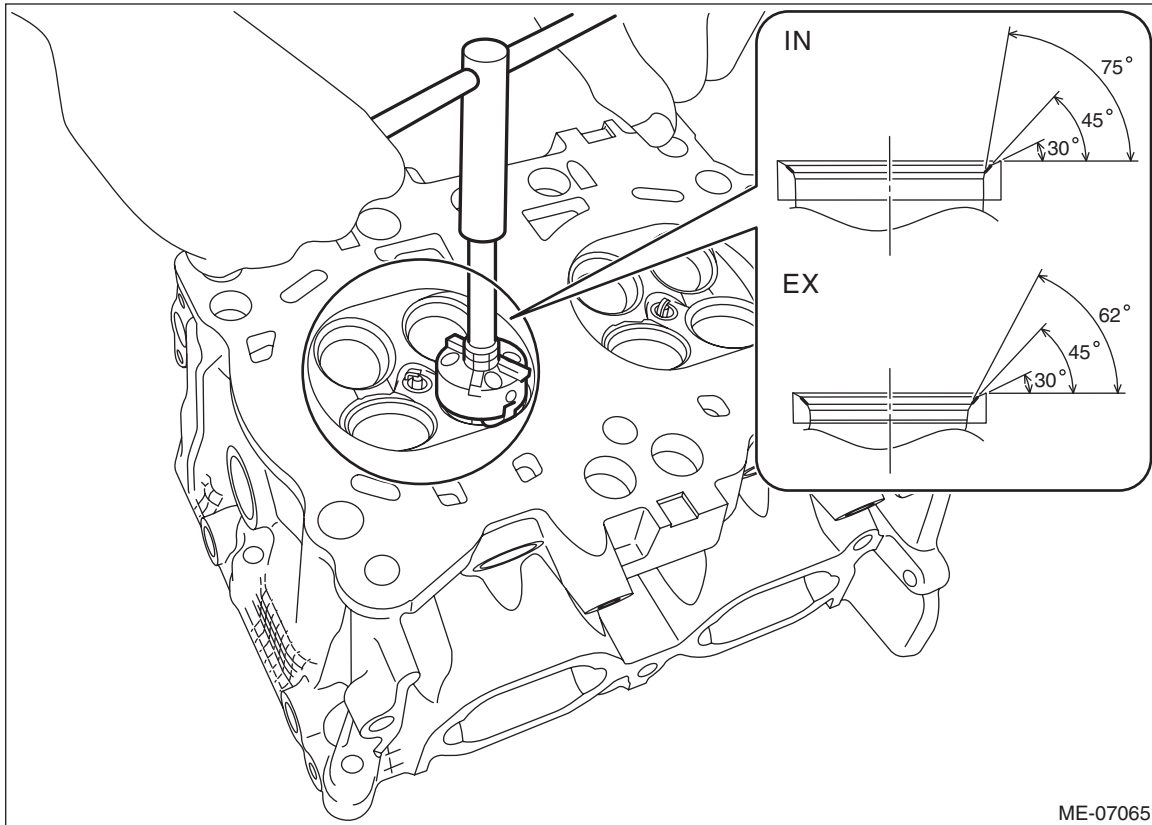
(1) Correct the seating angle between valve and valve seat using the 45° valve seat cutter.

NOTE:

- Select the size of the valve seat cutter by referring to the outer diameters of the intake valve and exhaust valve.

Valve outer diameter:**Intake****Standard****33.9 — 34.1 mm (1.335 — 1.343 in)****Exhaust****Standard****28.9 — 29.1 mm (1.138 — 1.146 in)**

- Grind the seating surface so that the seating width between valve and valve seat becomes slightly larger than the standard value.
- Gradually reduce pressure at the end of grinding process in order to avoid creating a gap on the valve seat correcting surface.

Seating angle between valve and valve seat:**45°**

ME-07065

(2) Lap the valve. For lapping procedure of the valve, refer to step 4).

(3) Check the seating position between valve and valve seat. For inspection of the seating position between valve and valve seat, refer to step 2).

NOTE:

This procedure is necessary to select a seat cutter to be used in step (4).

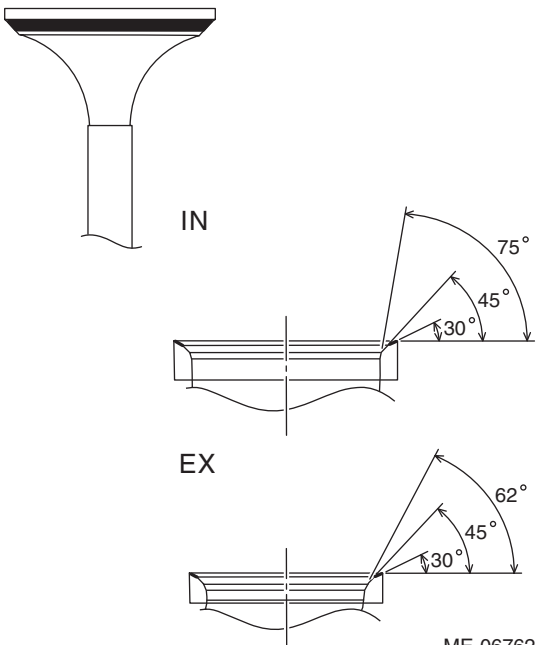
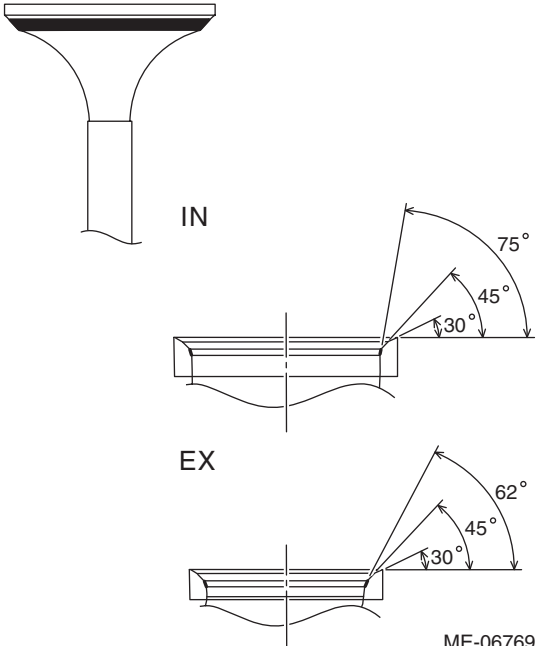
Cylinder Head

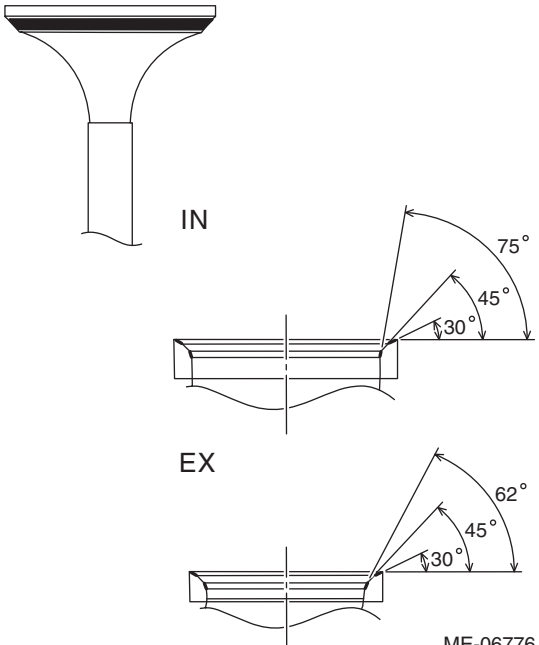
MECHANICAL

(4) Using the 30°, 75° (IN) or 62° (EX) seat cutter, correct the valve seat so that the seating width between valve and valve seat becomes the standard value.

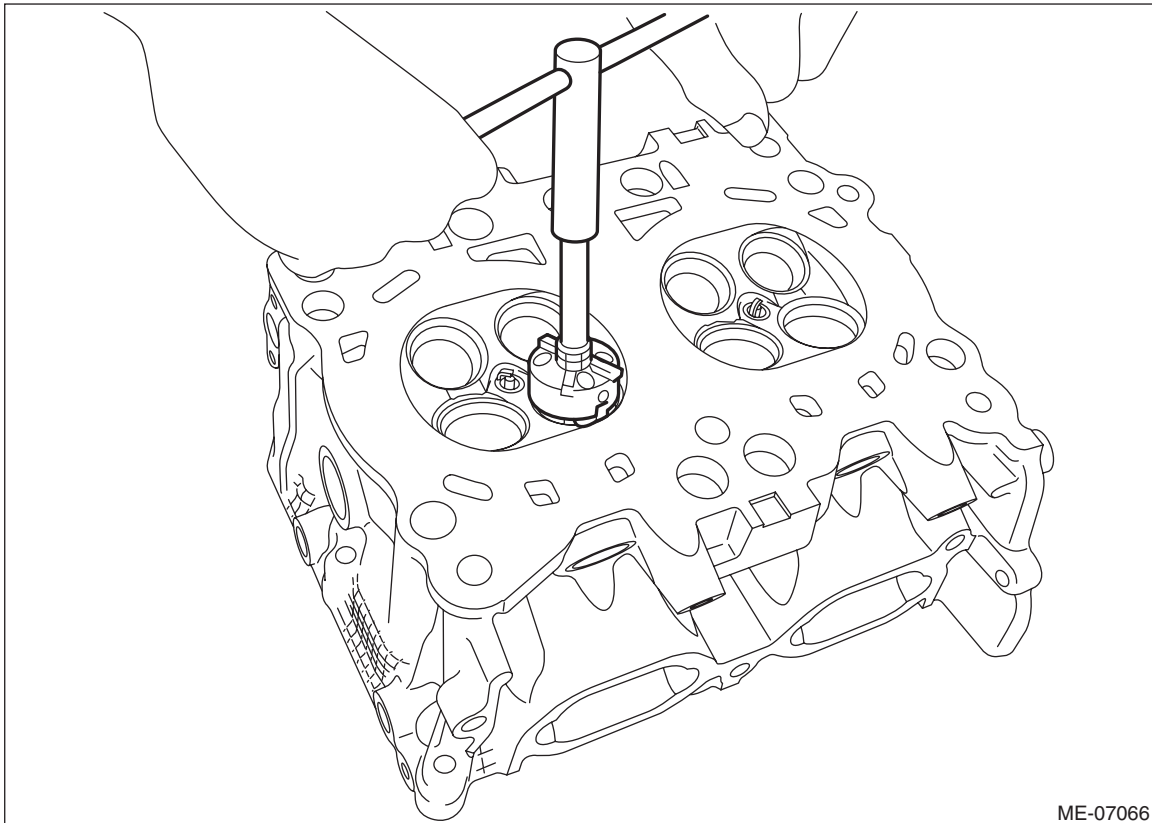
NOTE:

- Select a proper valve seat cutter according to the following table.

Seating position between valve and valve seat	Seat cutter selection
 IN EX ME-06762	When the seating position of valve face is high, grind the surface using the 30° seat cutter until seating width between valve and valve seat becomes the standard value.
 IN EX ME-06769	When the seating position of valve face is low, grind the surface using the 75° (IN) or 62° (EX) seat cutter until seating width between valve and valve seat becomes the standard value.

Seating position between valve and valve seat	Seat cutter selection
 IN EX ME-06776	When the seating position of valve face is at center, grind the surface evenly using the 30° and 75° (IN) or 62° (EX) seat cutters until seating width between valve and valve seat becomes the standard value.

- Gradually reduce pressure at the end of grinding process in order to avoid creating a gap on the valve seat correcting surface.



ME-07066

(5) Lap the valve. For lapping procedure of the valve, refer to step 4).

Cylinder Head

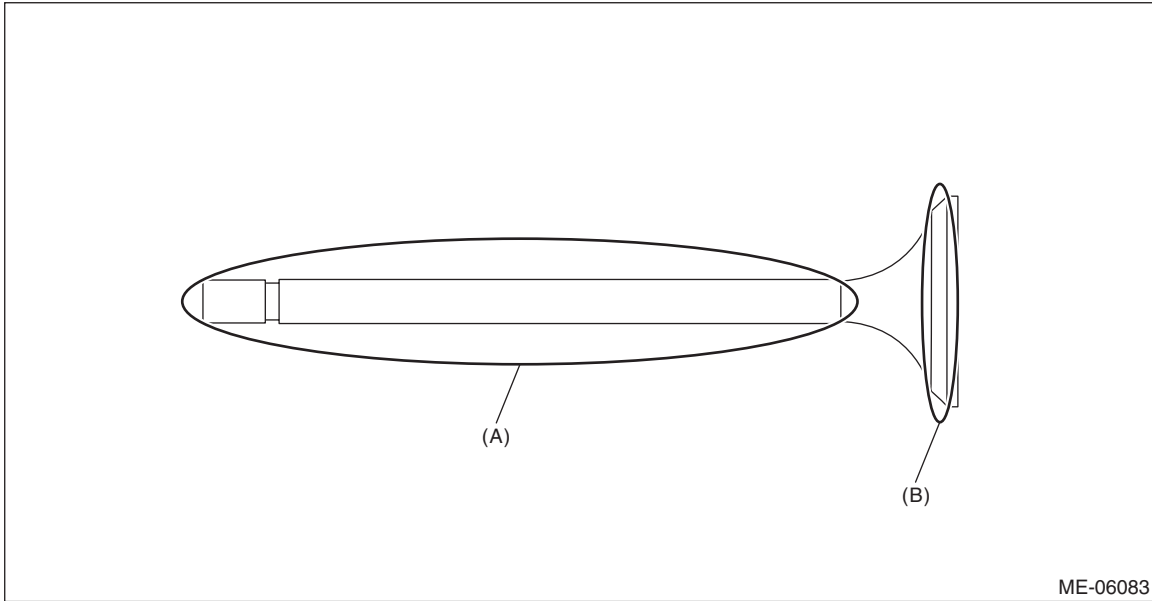
MECHANICAL

4) When lapping the valve

- (1) Coat the stem (A) of the valve lightly with engine oil and put a small amount of valve compound evenly on the valve face (B).

NOTE:

- Be careful not to put the valve compound more than necessary.
- To avoid damaging the valve guide and valve stem, be careful not to let the valve compound contact the valve stem.



- (2) Using the valve lapper, slowly insert the valve with the valve compound applied into the valve guide, and lap the seating surface between valve and valve seat. First, lift the valve and strike it against the valve seat twice, and then slightly turn the valve once. Repeat these steps as one set.

NOTE:

- To prevent the seating width between valve and valve seat from exceeding the standard value, be careful not to keep turning the valve while pressing it against the valve seat during lapping.
- Be careful not to lift the valve too far during lapping in order to prevent the valve from coming off the valve guide.

- (3) Wipe off the valve compound on the valve and valve seat completely after lapping.

NOTE:

Be careful not to leave any valve compound in order to avoid malfunction.

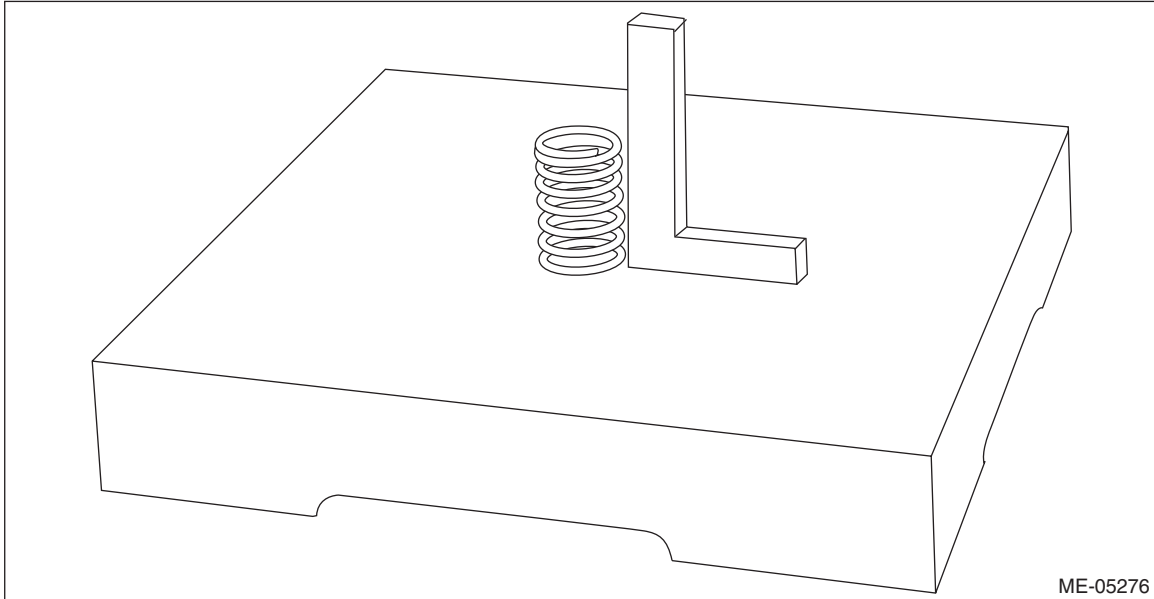
- (4) Check the seating width and seating position between valve and valve seat.

5. VALVE SPRING

- 1) Check the valve spring for damage and deformation.
- 2) Using a caliper gauge, valve spring tester, surface plate and try square, check the valve spring free length, tension/spring height and squareness. If it is not within the standard, replace the valve spring.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- To check the squareness of the valve spring, stand the valve spring on a surface plate and check its deflection at the top of the valve spring using a try square.



Valve spring free length:

Standard

44.03 mm (1.733 in)

Valve spring tension/spring height:

Set

Standard

182 — 210 N (18.56 — 21.41 kgf, 40.92 — 47.22 lbf)/33.0 mm (1.299 in)

Lift

Standard

440 — 486 N (44.87 — 49.56 kgf, 98.93 — 109.27 lbf)/22.0 mm (0.866 in)

Valve spring squareness:

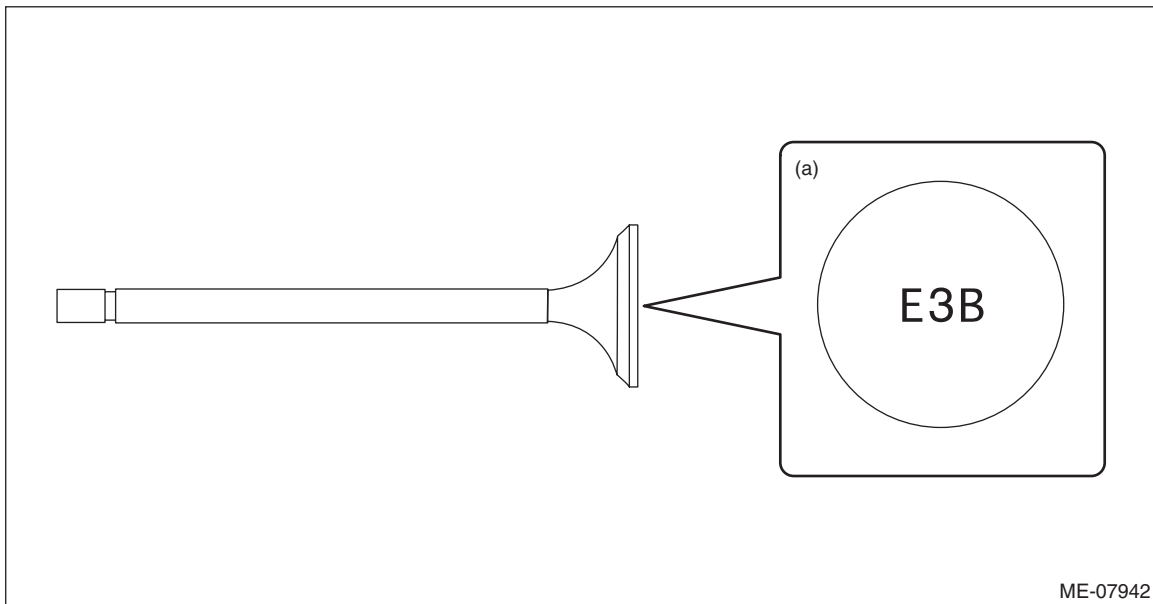
Standard

2.5°, 1.9 mm (0.075 in) or less

F: DISPOSAL

WARNING:

- Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and poses a risk of causing a severe chemical reaction. Use great care when handling and disposing it.
- If the metallic sodium gets into your eyes, you may lose your sight. If it touches the skin, you may get burned severely or if it touches flame, fire may be caused by chemical reaction. Therefore, do not disassemble the exhaust valve.
- It is safe when the metallic sodium encapsulated in the exhaust valve is not exposed to the air.
- When the exhaust valve is broken, remove the broken exhaust valve, and dispose of the metallic sodium.
- Do not intentionally break the exhaust valve and take out the metallic sodium.
- Identify the exhaust valve in which the metallic sodium is encapsulated with the embossed mark.



(a) Embossed mark (Identification: E3B)

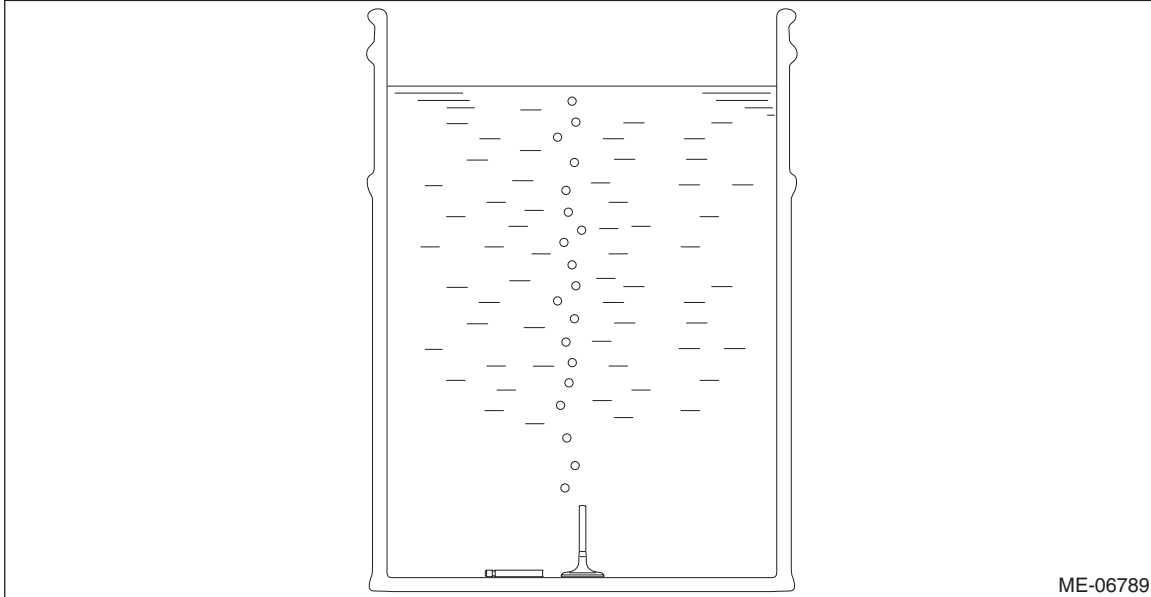
CAUTION:

- When disposing of the exhaust valve that is not broken, entrust the disposal processing to the industrial waste disposer in charge of dissolution treatment.
- When the exhaust valve is broken, remove it from the cylinder head, perform appropriate processing in the same manner as the general steel material.
- When performing processing, be careful of the following.
 1. Prepare the fire extinguisher nearby.
 2. Wear the protective goggles.
 3. Wear rubber gloves.

- 1) Wear rubber gloves and remove the broken exhaust valve from the cylinder head.
- 2) Prepare large container (bucket or oil can) in well-ventilated place, and fill the container with water (10 L or more).
- 3) Using a pair of large tweezers or pliers, immerse the broken exhaust valve in the water vertically.

CAUTION:

- Completely immerse the broken exhaust valve in the water.
- Hydrogen gas is produced by the chemical reaction. Therefore, always keep the container away from open flames such as sparks.
- Because the severe chemical reaction is developed, keep at least 2 to 3 m away from the container.



- 4) After completion of chemical reaction (after the elapse of 4 to 5 hours), carefully take out the exhaust valve using a pair of large tweezers or pliers, and dispose of the exhaust valve according to the same disposal procedure as other parts.

CAUTION:

- Concerning the liquid waste disposal of the liquid (sodium hydrate) produced in a chemical reaction, follow all governmental regulations and local regulations related to the liquid waste disposal.
- If the liquid produced in a chemical reaction (sodium hydrate) should touch the skin, immediately wash it away with plenty water.