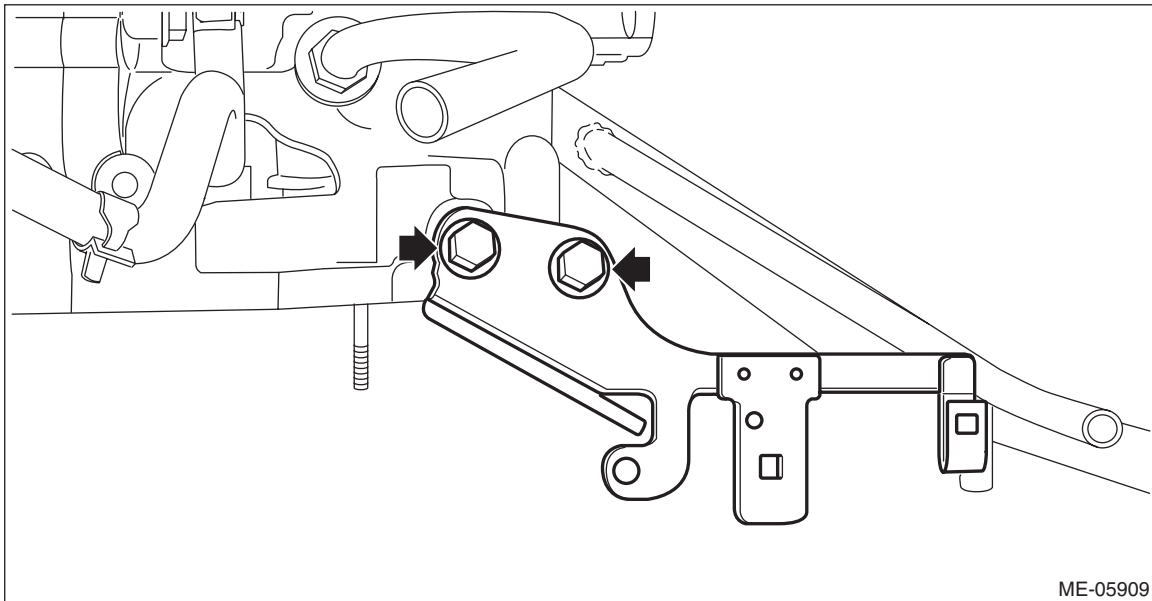


22.Cylinder Block

A: REMOVAL

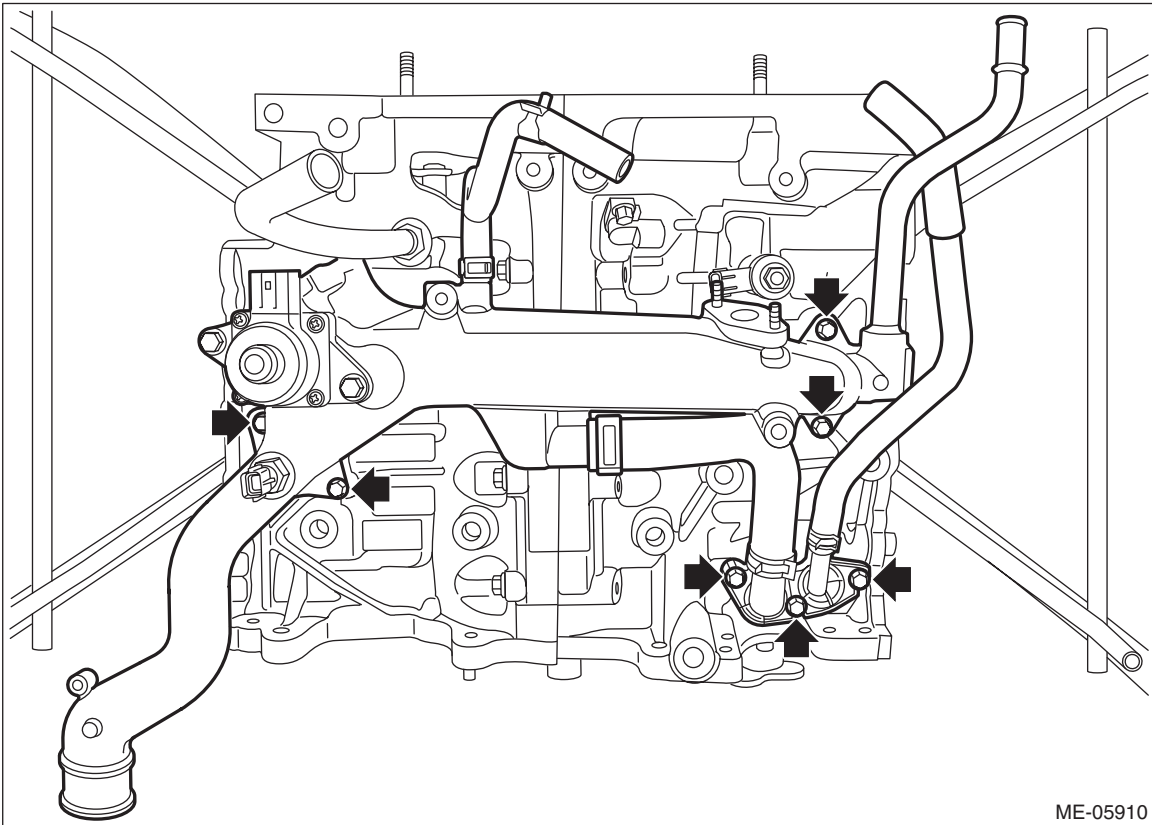
- 1) Remove the engine from the vehicle. <Ref. to ME(H4DO)-44, REMOVAL, Engine Assembly.>
- 2) Remove the intake manifold. <Ref. to FU(H4DO)-23, REMOVAL, Intake Manifold.>
- 3) Remove the tumble generator valve assembly. <Ref. to FU(H4DO)-85, REMOVAL, Tumble Generator Valve Assembly.>
- 4) Remove the chain cover. <Ref. to ME(H4DO)-97, REMOVAL, Chain Cover.>
- 5) Remove the rocker cover. <Ref. to ME(H4DO)-145, REMOVAL, Rocker Cover.>
- 6) Remove the cam carrier. <Ref. to ME(H4DO)-159, REMOVAL, Cam Carrier.>
- 7) Remove the cylinder head. <Ref. to ME(H4DO)-206, REMOVAL, Cylinder Head.>
- 8) Remove the crank sprocket. <Ref. to ME(H4DO)-143, REMOVAL, Crank Sprocket.>
- 9) Remove the engine rear hanger from cylinder block RH.



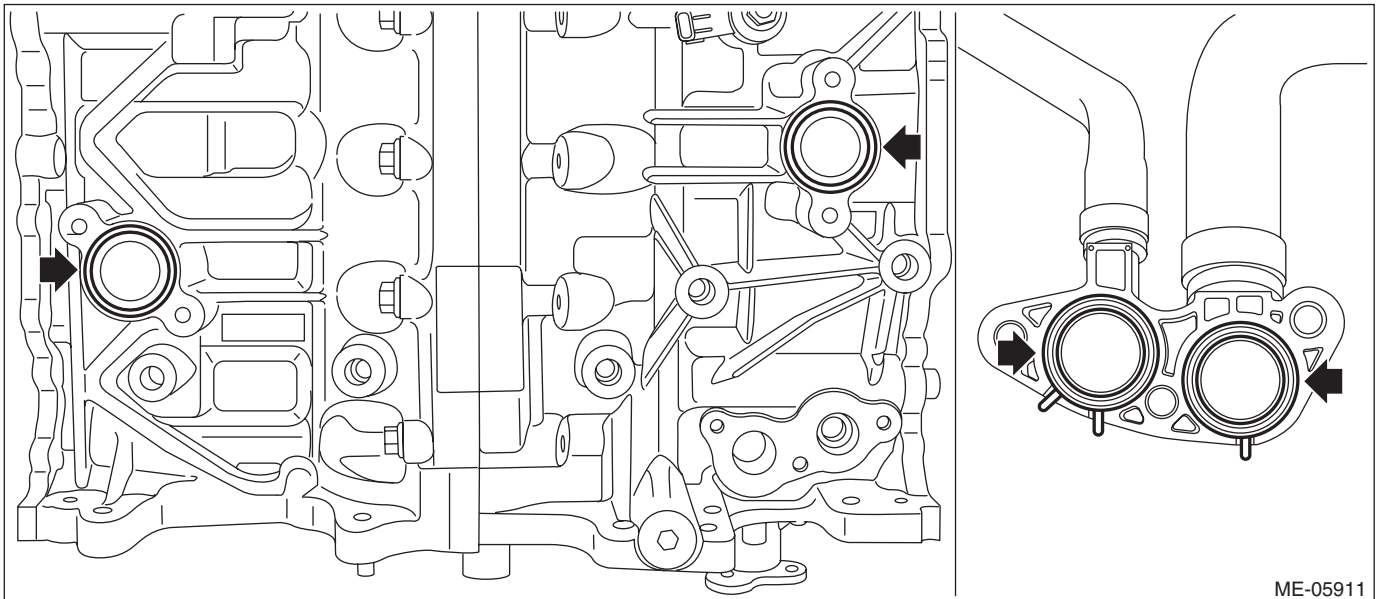
Cylinder Block

MECHANICAL

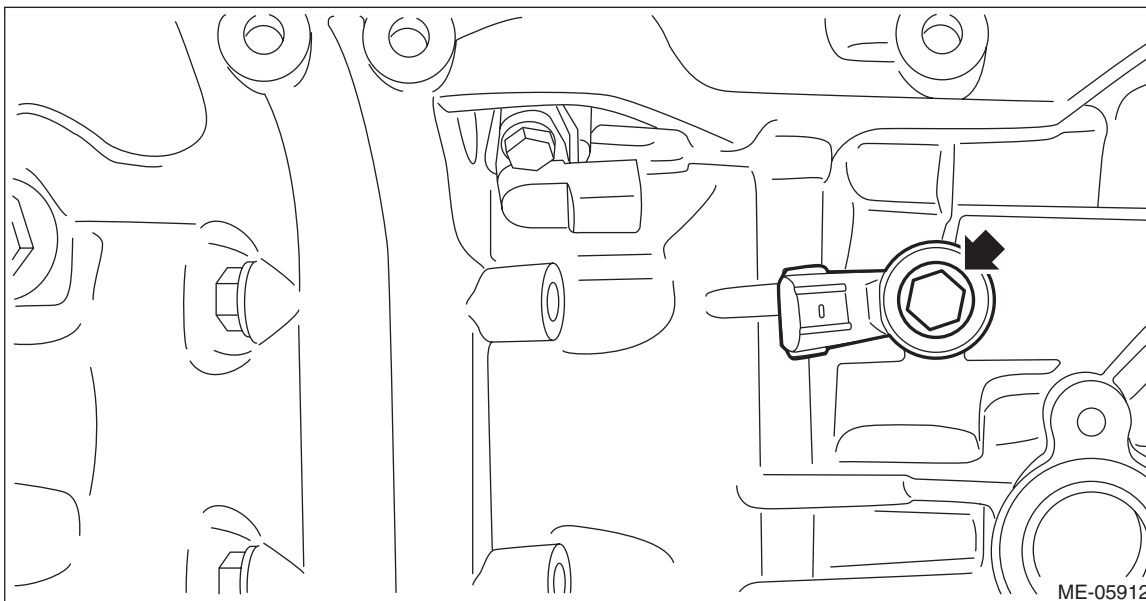
10) Remove the bolts securing the water pipe assembly and PCV connector to the cylinder block, and remove the water pipe assembly and PCV connector as a set from cylinder block.



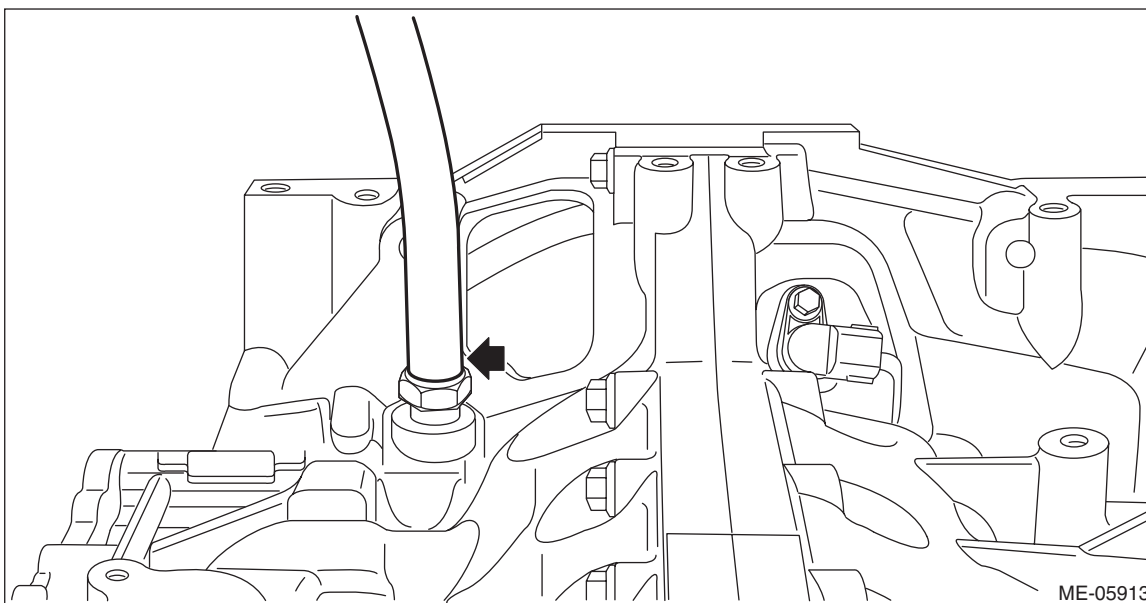
11) Remove the O-ring from the cylinder block and PCV connector.



12) Remove the knock sensor from cylinder block LH.



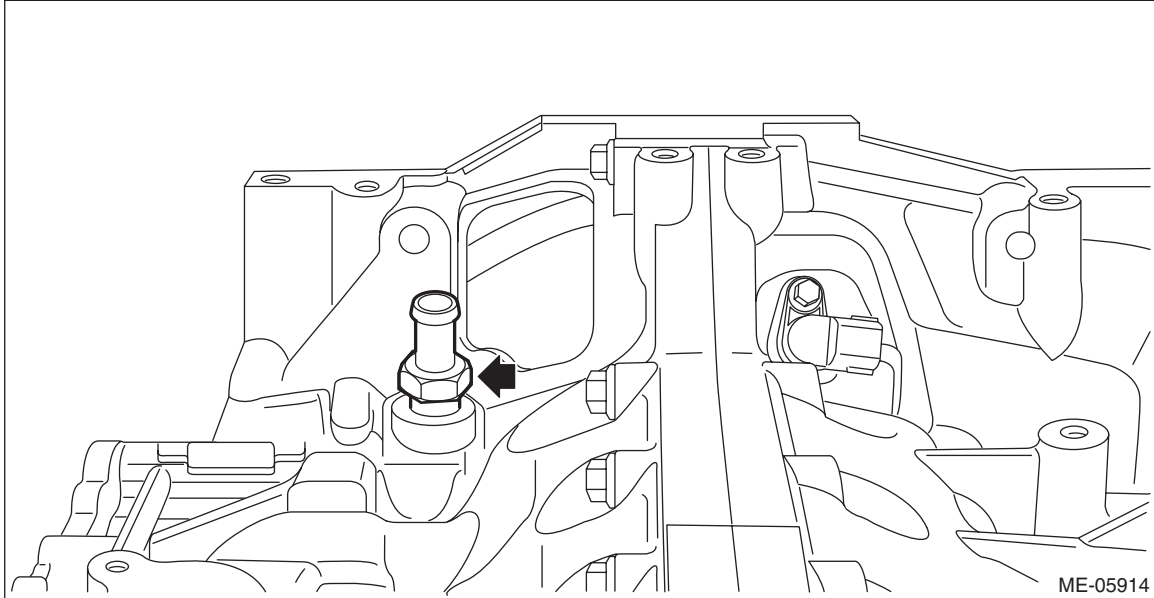
13) Remove the vacuum hose from the PCV valve.



Cylinder Block

MECHANICAL

14) Remove the PCV valve from the cylinder block RH.

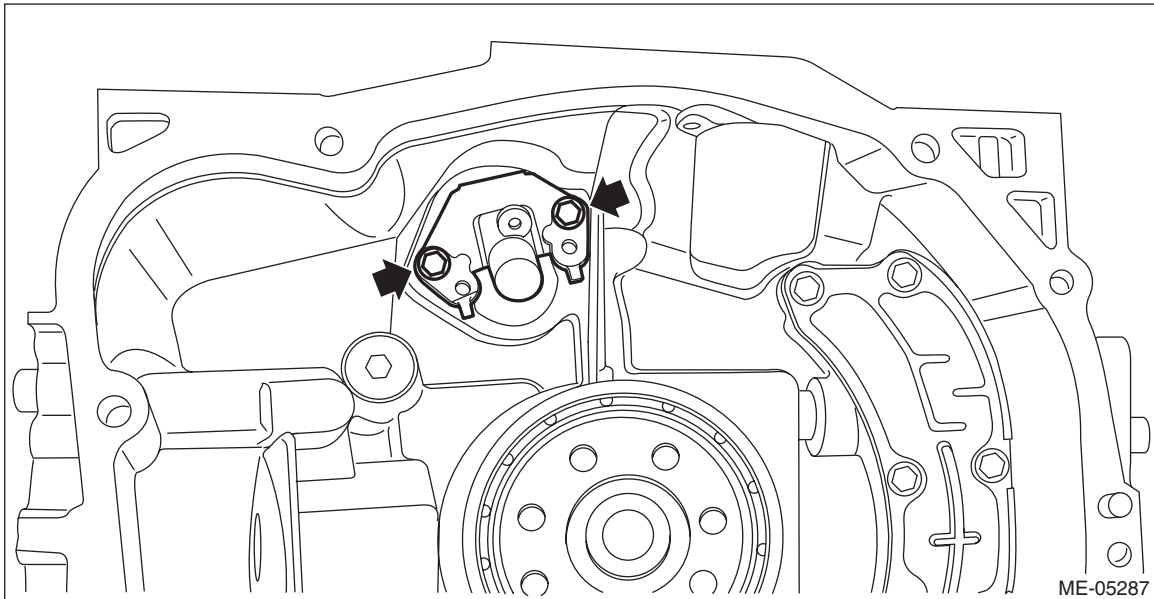


15) Remove the crankshaft position sensor plate with drive plate. (CVT model) <Ref. to CVT-150, REMOVAL, Drive Plate.>

16) Remove the clutch disc and cover. (MT model) <Ref. to CL-10, REMOVAL, Clutch Disc and Cover.>

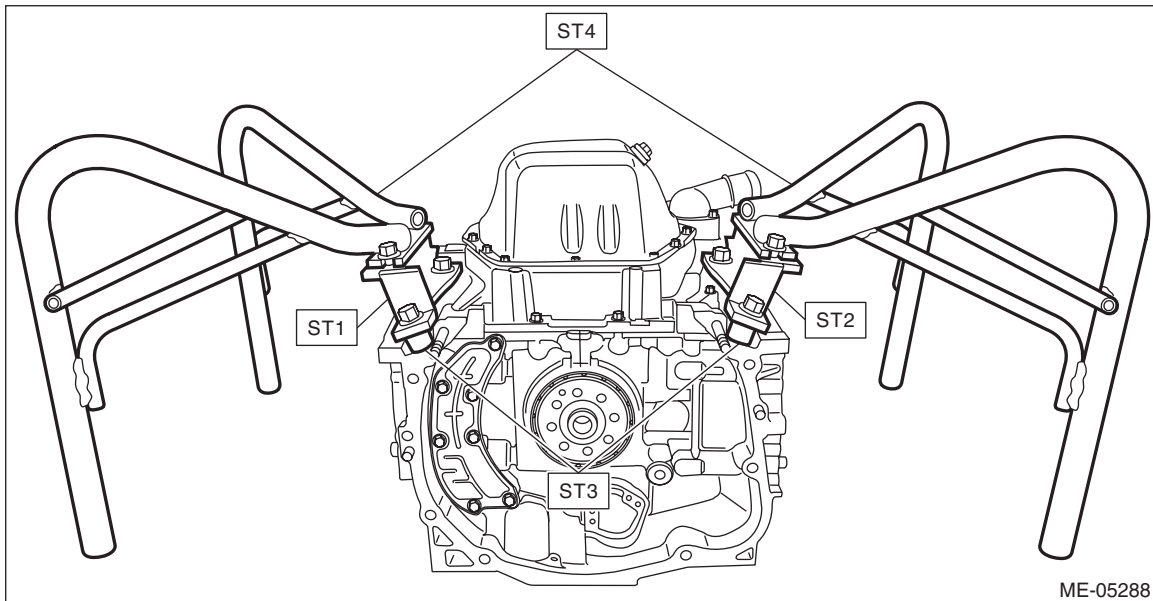
17) Remove the crankshaft position sensor plate with flywheel. (MT model) <Ref. to CL-13, REMOVAL, Flywheel.>

18) Remove the bolts securing the crankshaft position sensor holder from the cylinder block LH, and remove the crankshaft position sensor with crankshaft position sensor holder.

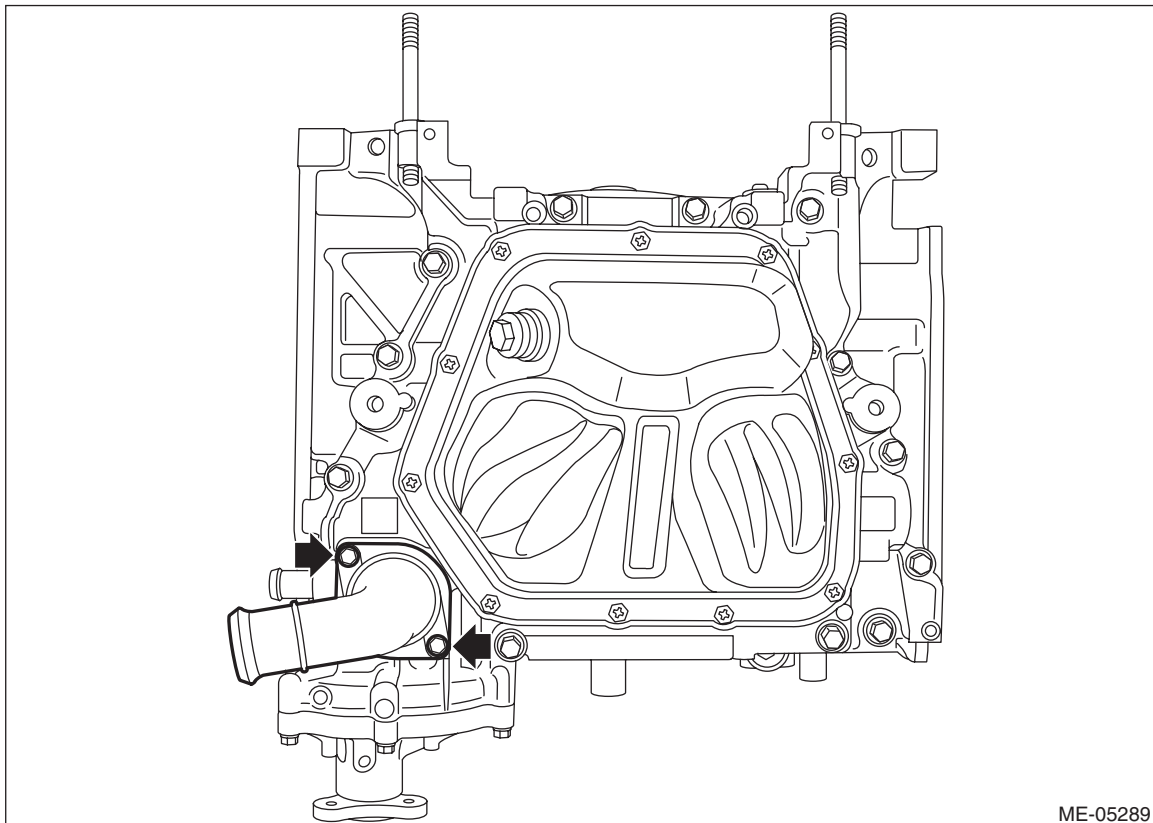


19) Set the cylinder block so that the oil pan is on the upper side, remove the ST1, ST2, ST3 and ST4 from cylinder block and oil pan upper.

ST1 498457000 ENGINE STAND ADAPTER RH
ST2 498457100 ENGINE STAND ADAPTER LH
ST3 18362AA020 ADAPTER
ST4 499817100 ENGINE STAND



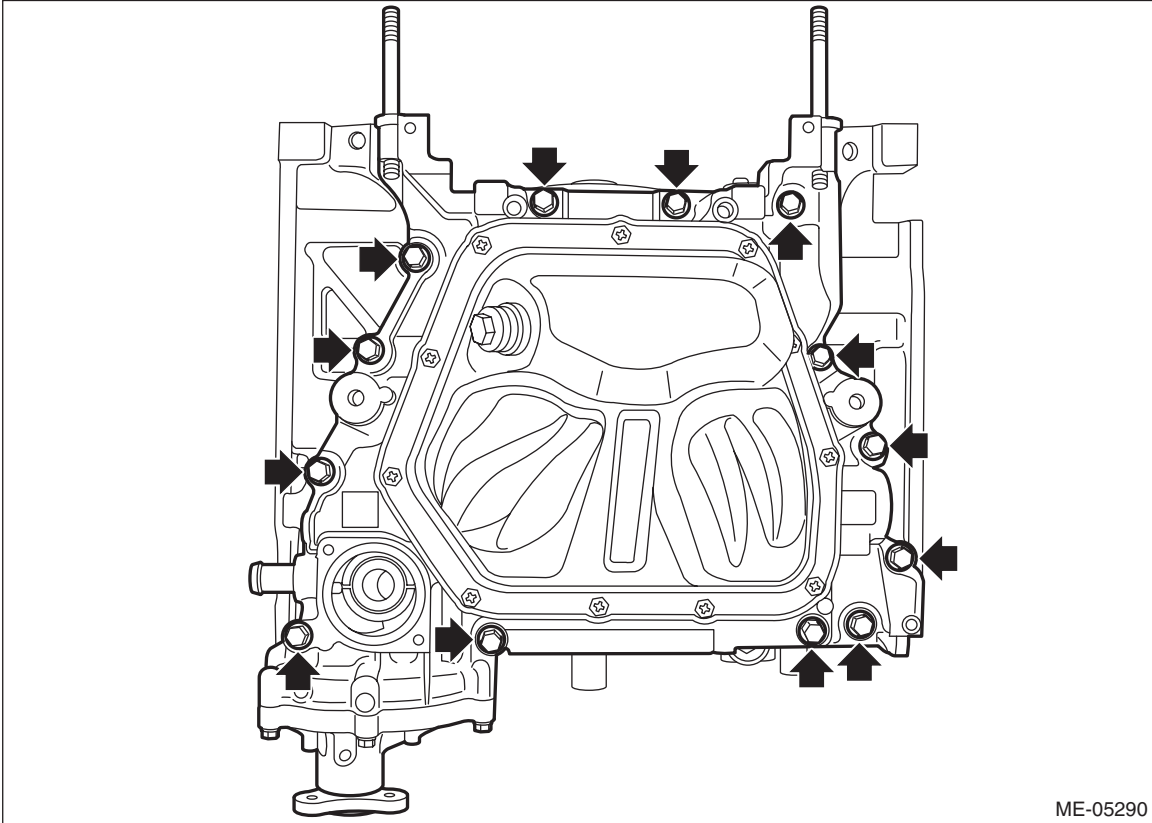
20) Remove the thermostat cover from oil pan upper, and then remove the thermostat.



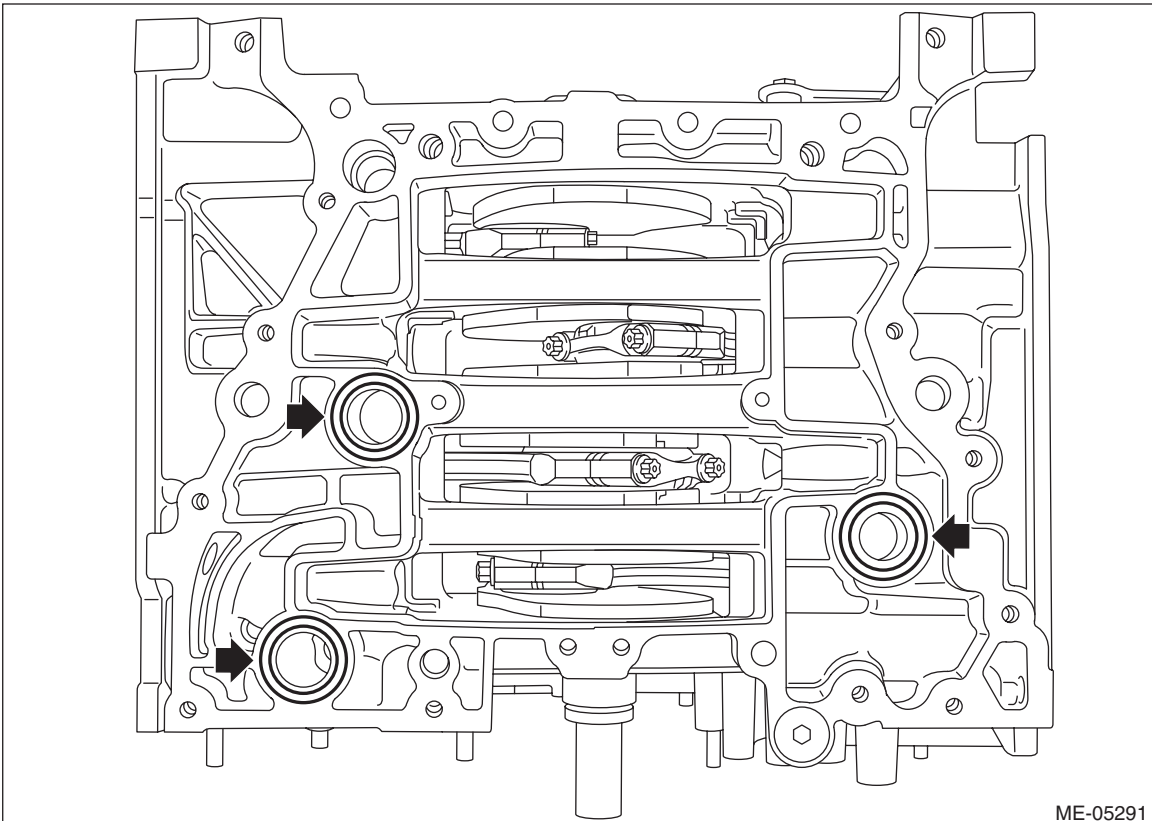
Cylinder Block

MECHANICAL

21) Remove the oil pan upper with oil pan from cylinder block.



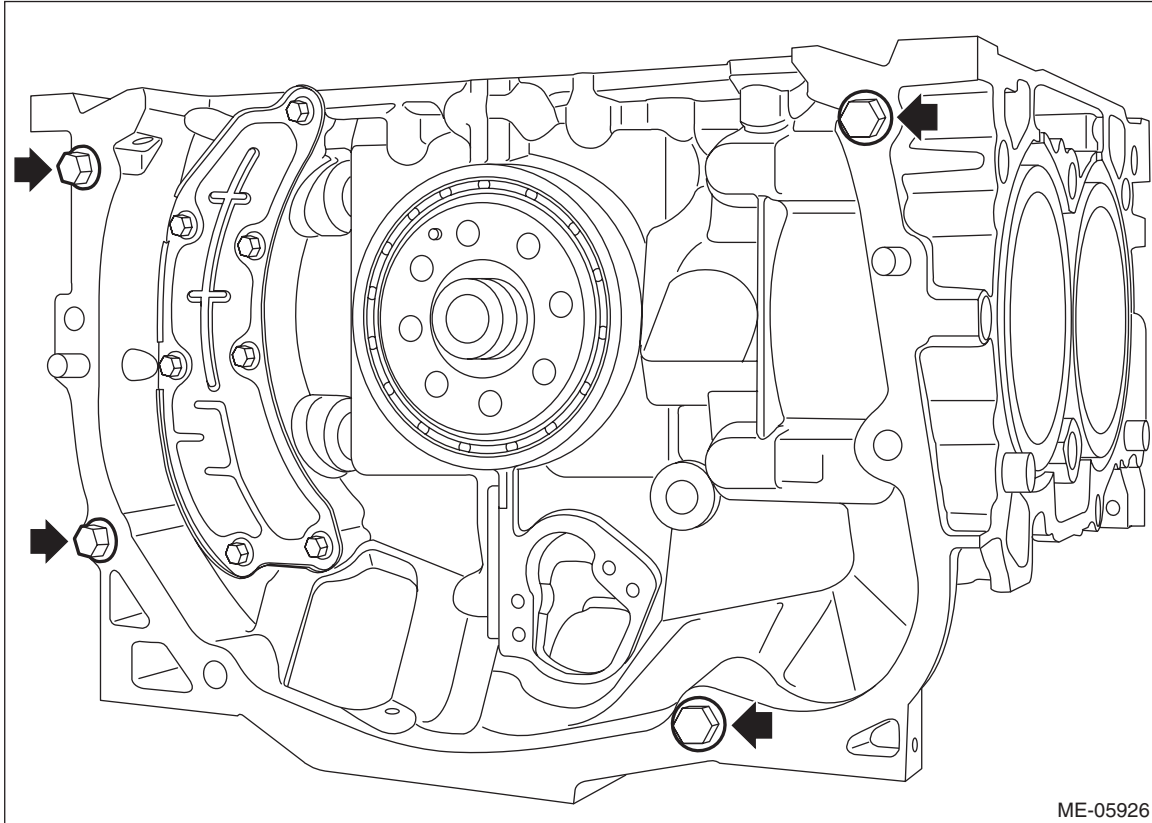
22) Remove the O-ring from the cylinder block.



23) Install the mounting bolts for the A/C compressor and the generator bracket at the locations shown in the figure.

NOTE:

- This procedure is required to prevent the knock pin damage when the cylinder block is raised in the next step.
- Use the same length bolt for the four bolts.



ME-05926

24) Raise the cylinder block so that the rear oil seal is on the lower side.

Cylinder Block

MECHANICAL

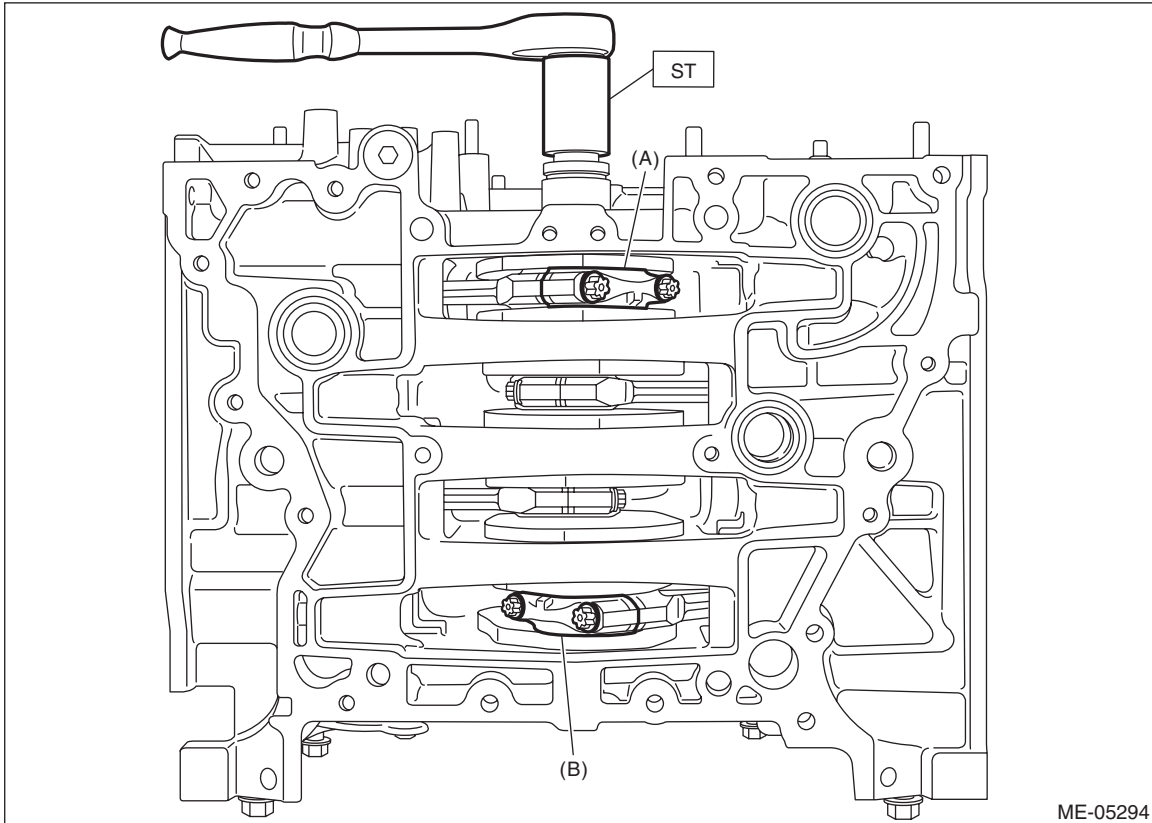
25) Remove the #1 and #4 connecting rod caps and pistons from the cylinder block.

NOTE:

Mark each connecting rod cap and piston with a cylinder number.

(1) Turn the crankshaft so that the #1 connecting rod cap (A) and #4 connecting rod cap (B) is located at the position shown in the figure using ST.

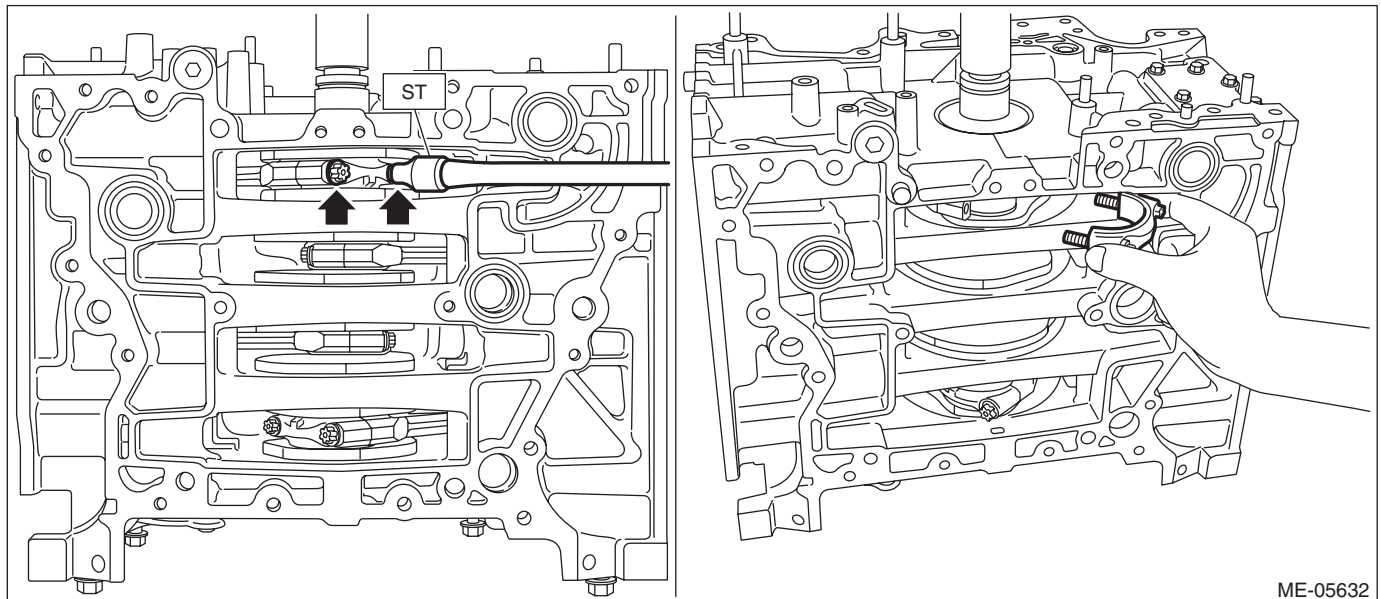
ST 18252AA000 CRANKSHAFT SOCKET



(2) Using ST, loosen the #1 connecting rod cap bolt, and remove the #1 connecting rod cap bolt and #1 connecting rod cap.

ST 18270AA010 SOCKET (when using TORX® E12)

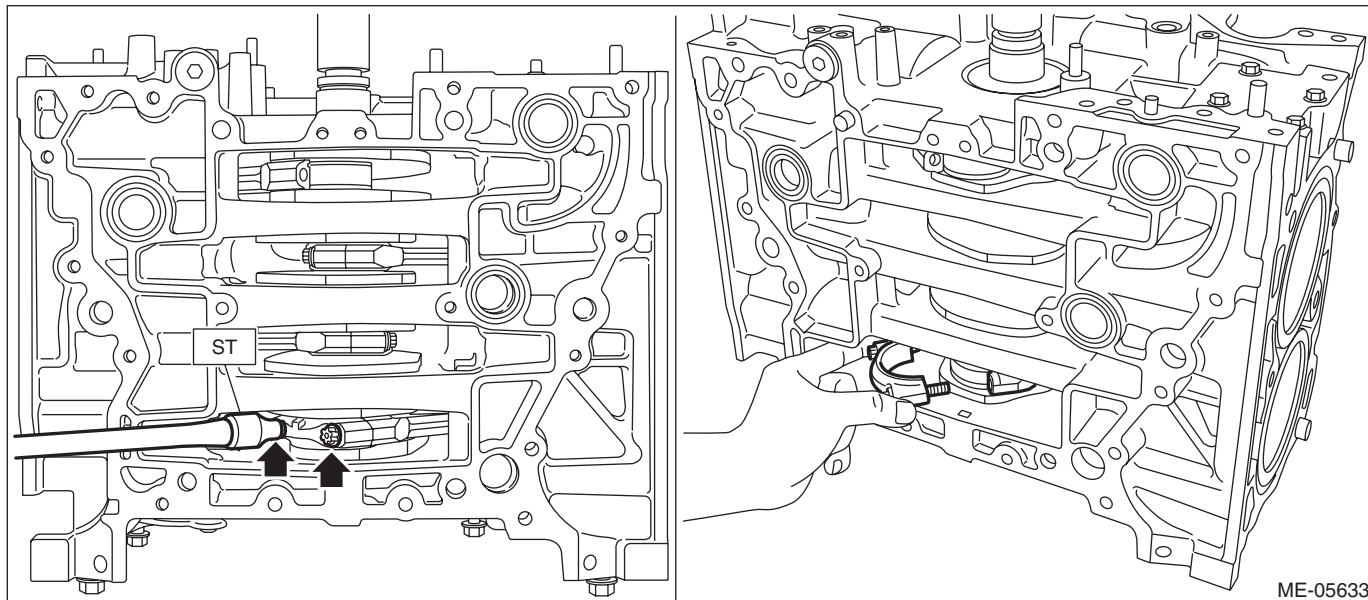
ST 18270AA020 SOCKET (when using TORX® E14)



(3) Using ST, loosen the #4 connecting rod cap bolt, and remove the #4 connecting rod cap bolt and #4 connecting rod cap.

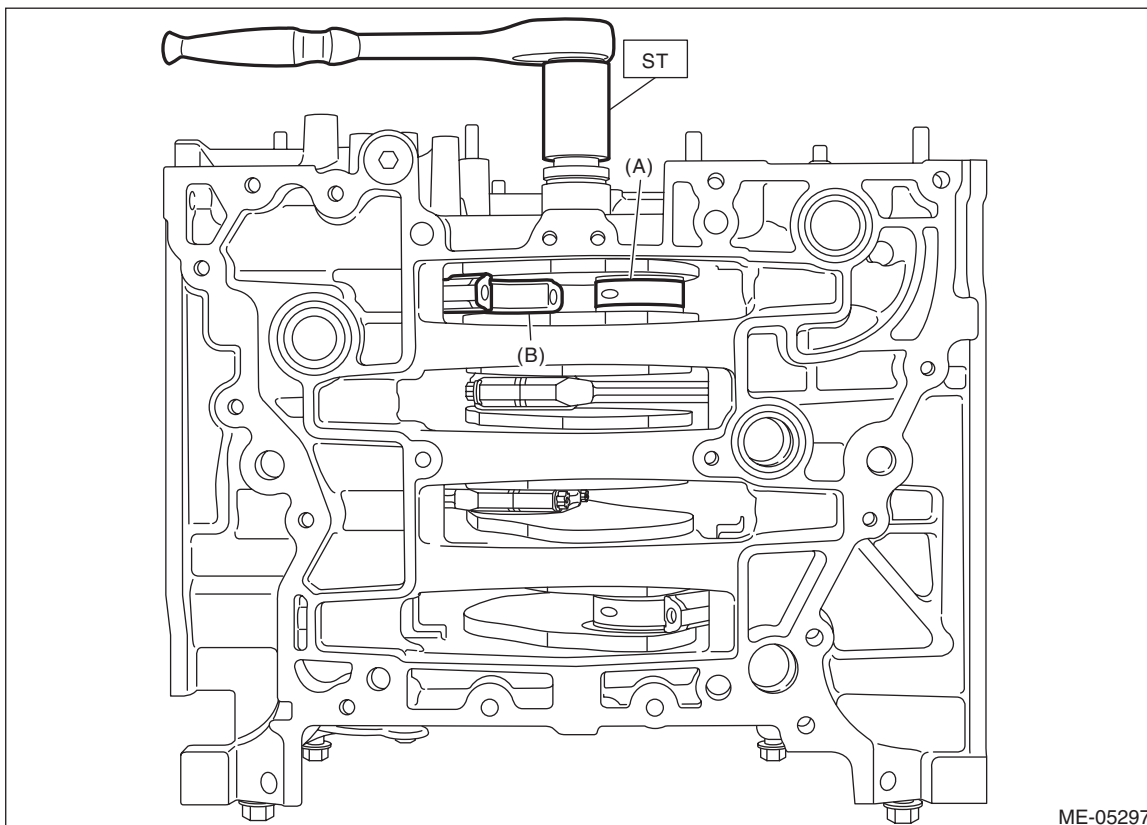
ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



(4) Using the ST, turn the crankshaft clockwise and separate the positions of the #1 pin (A) of crankshaft and the large end (B) of #1 connecting rod.

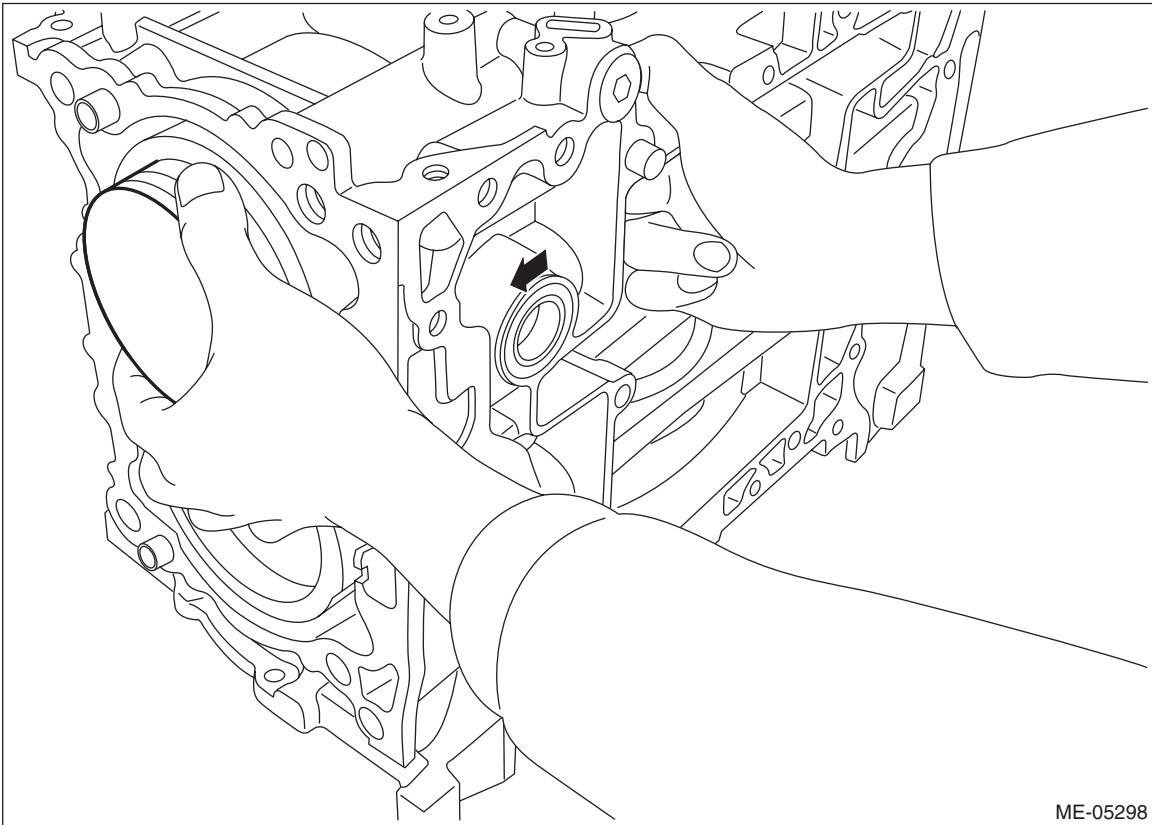
ST 18252AA000 CRANKSHAFT SOCKET



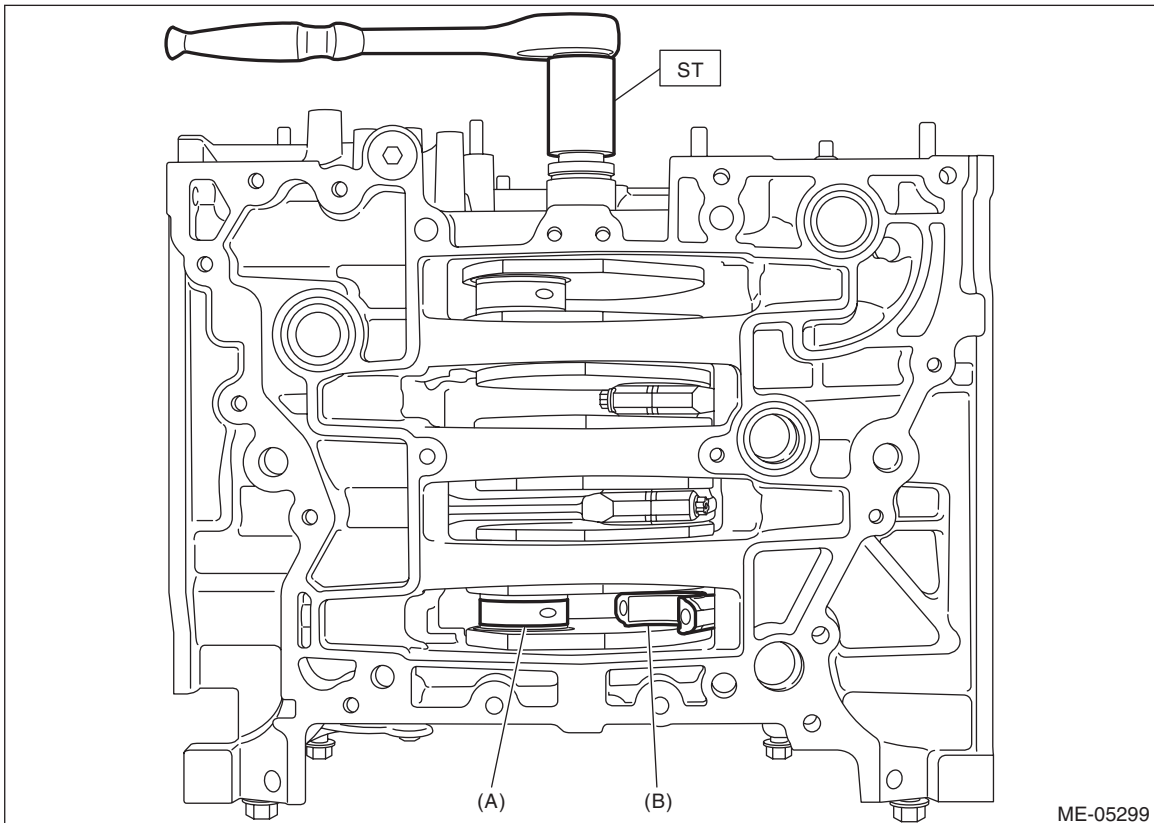
Cylinder Block

MECHANICAL

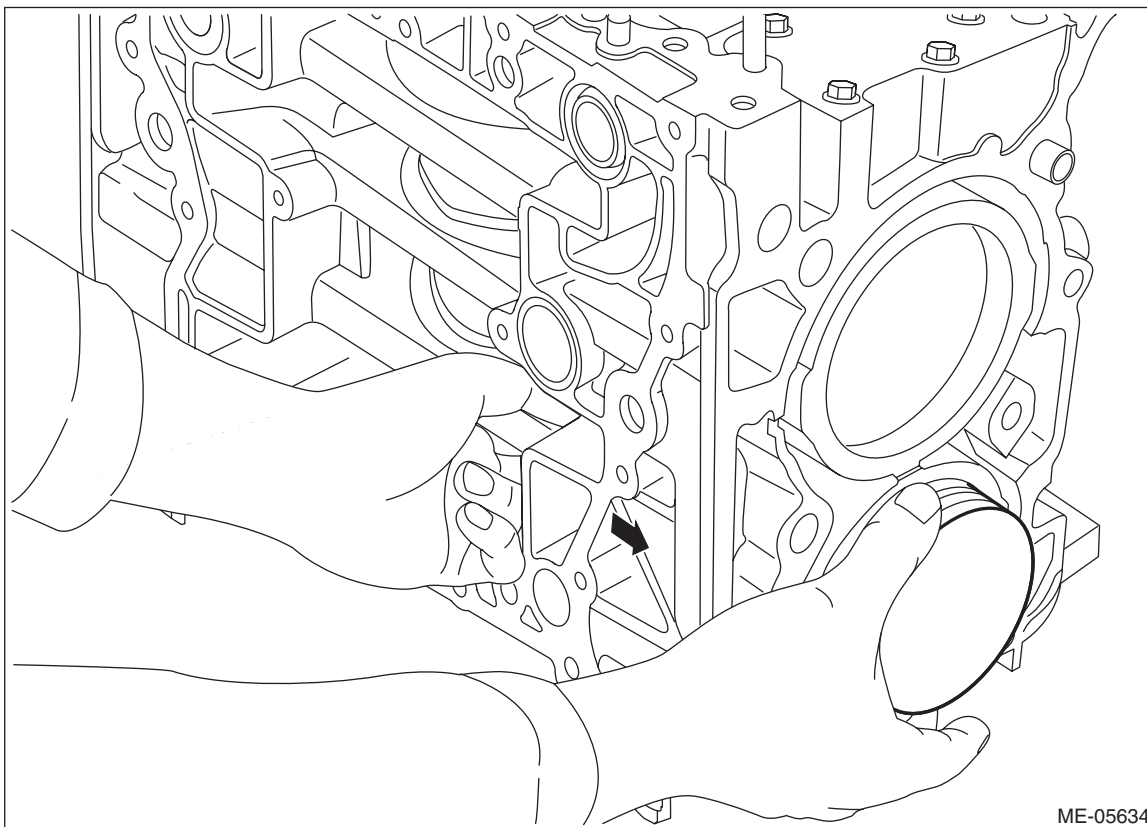
- (5) Push the #1 connecting rod in the direction of the arrow, and remove the #1 piston with #1 connecting rod from the cylinder block.



- (6) Using the ST, turn the crankshaft counterclockwise and separate the positions of the #4 pin (A) of crankshaft and the large end (B) of #4 connecting rod.
- ST 18252AA000 CRANKSHAFT SOCKET



(7) Push the #4 connecting rod in the direction of the arrow, and remove the #4 piston with #4 connecting rod from the cylinder block.



Cylinder Block

MECHANICAL

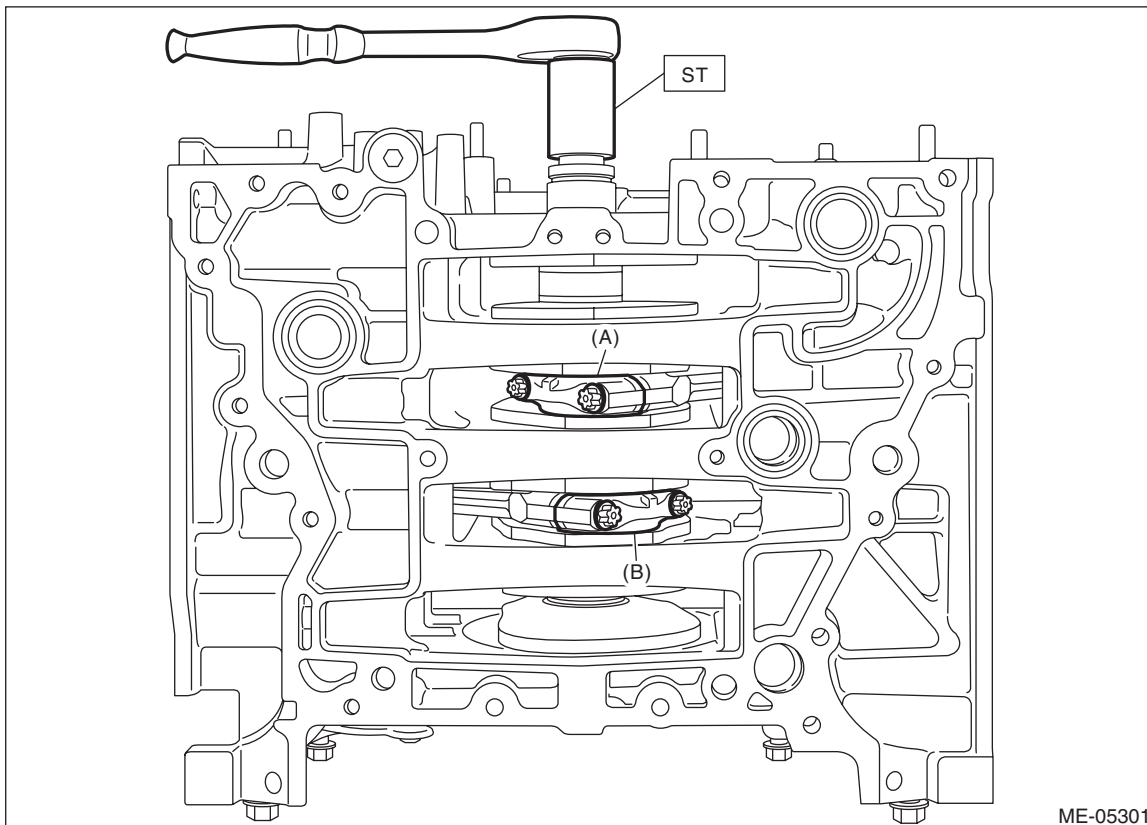
26) Remove the #2 and #3 connecting rod caps and pistons from the cylinder block.

NOTE:

Mark each connecting rod cap and piston with a cylinder number.

(1) Turn the crankshaft so that the #2 connecting rod cap (A) and #3 connecting rod cap (B) is located at the position shown in the figure using ST.

ST 18252AA000 CRANKSHAFT SOCKET

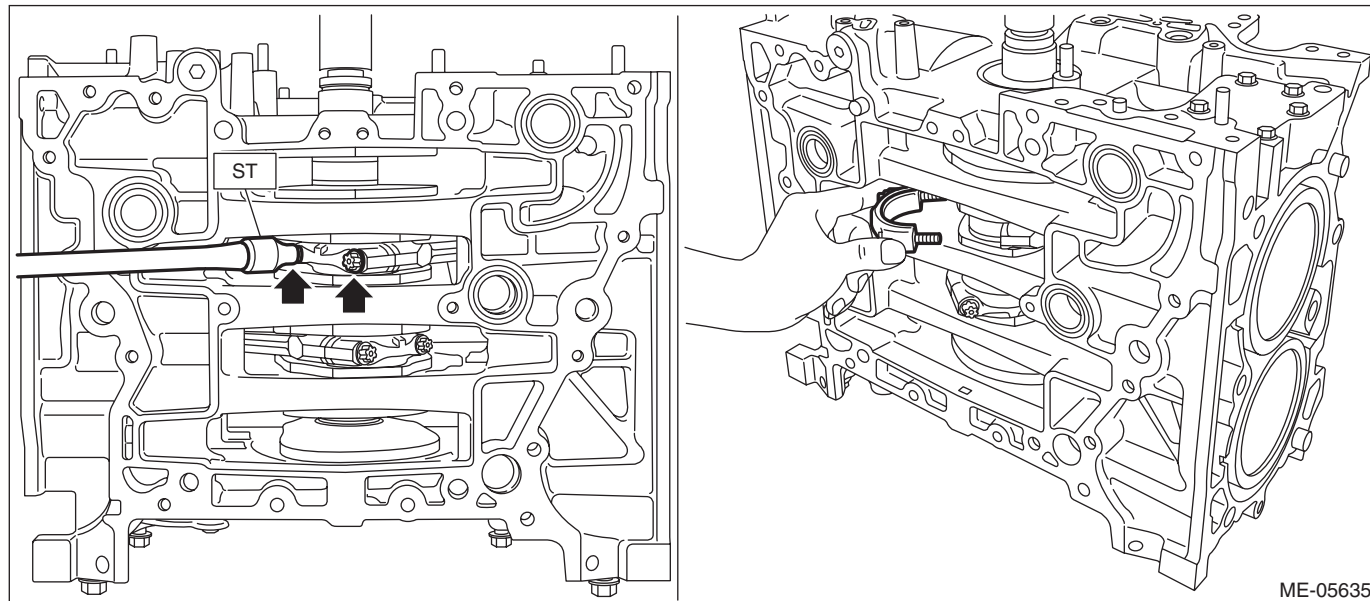


ME-05301

(2) Using ST, loosen the #2 connecting rod cap bolt, and remove the #2 connecting rod cap bolt and #2 connecting rod cap.

ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)

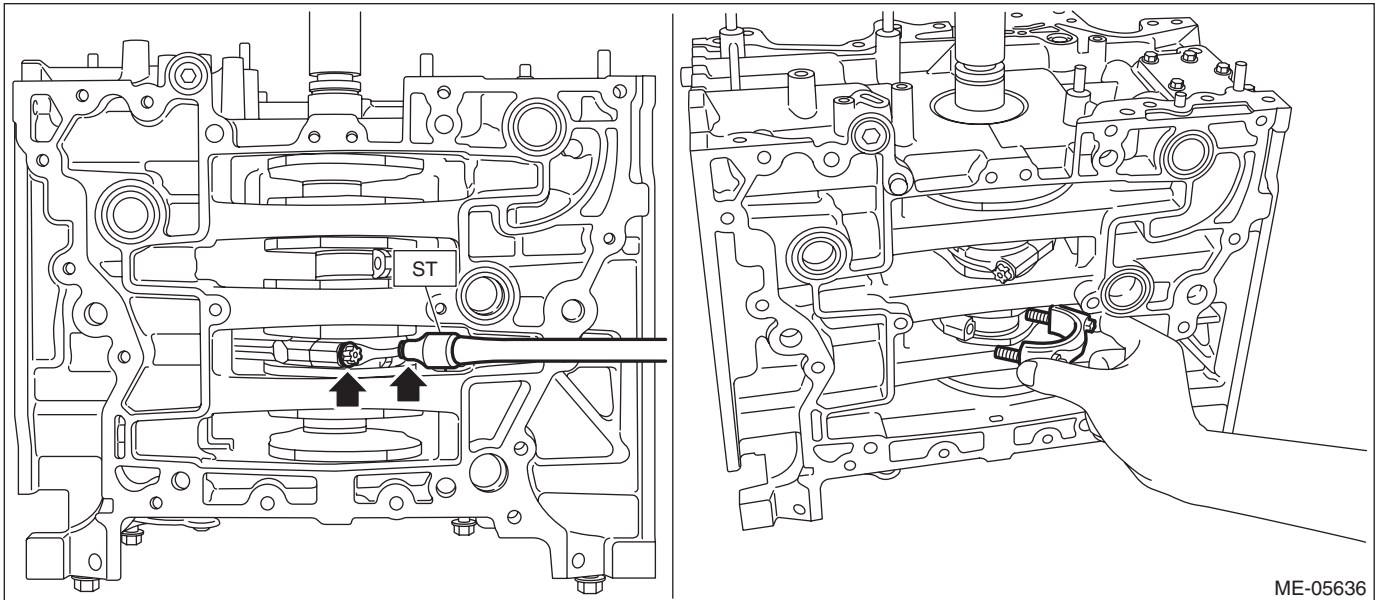


ME-05635

(3) Using ST, loosen the #3 connecting rod cap bolt, and remove the #3 connecting rod cap bolt and #3 connecting rod cap.

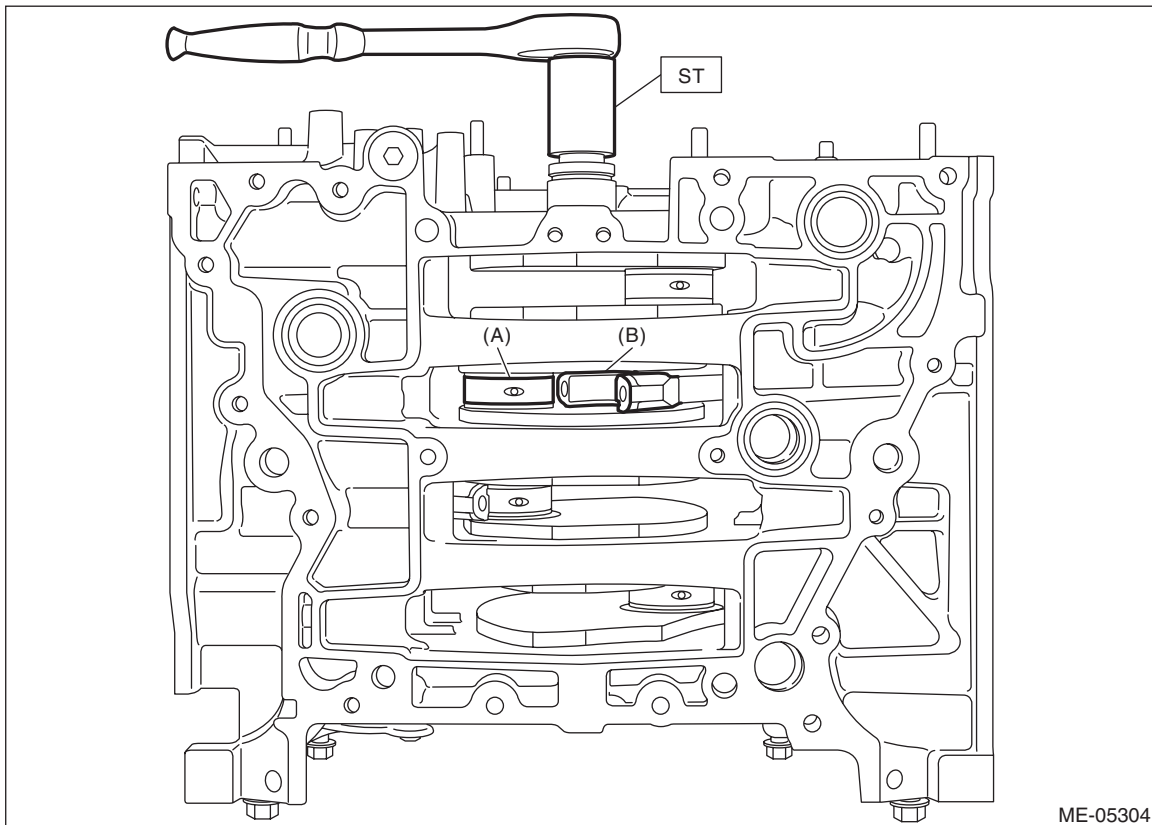
ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



(4) Using the ST, turn the crankshaft counterclockwise and separate the positions of the #2 pin (A) of crankshaft and the large end (B) of #2 connecting rod.

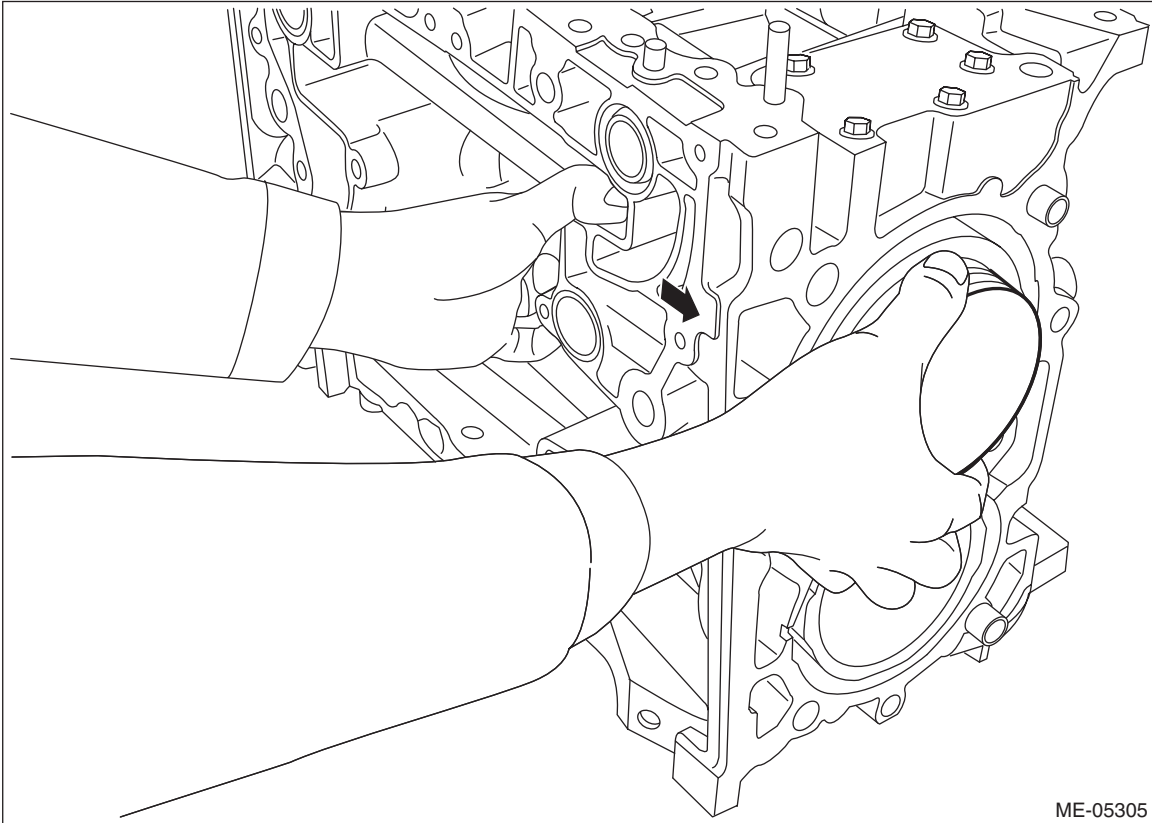
ST 18252AA000 CRANKSHAFT SOCKET



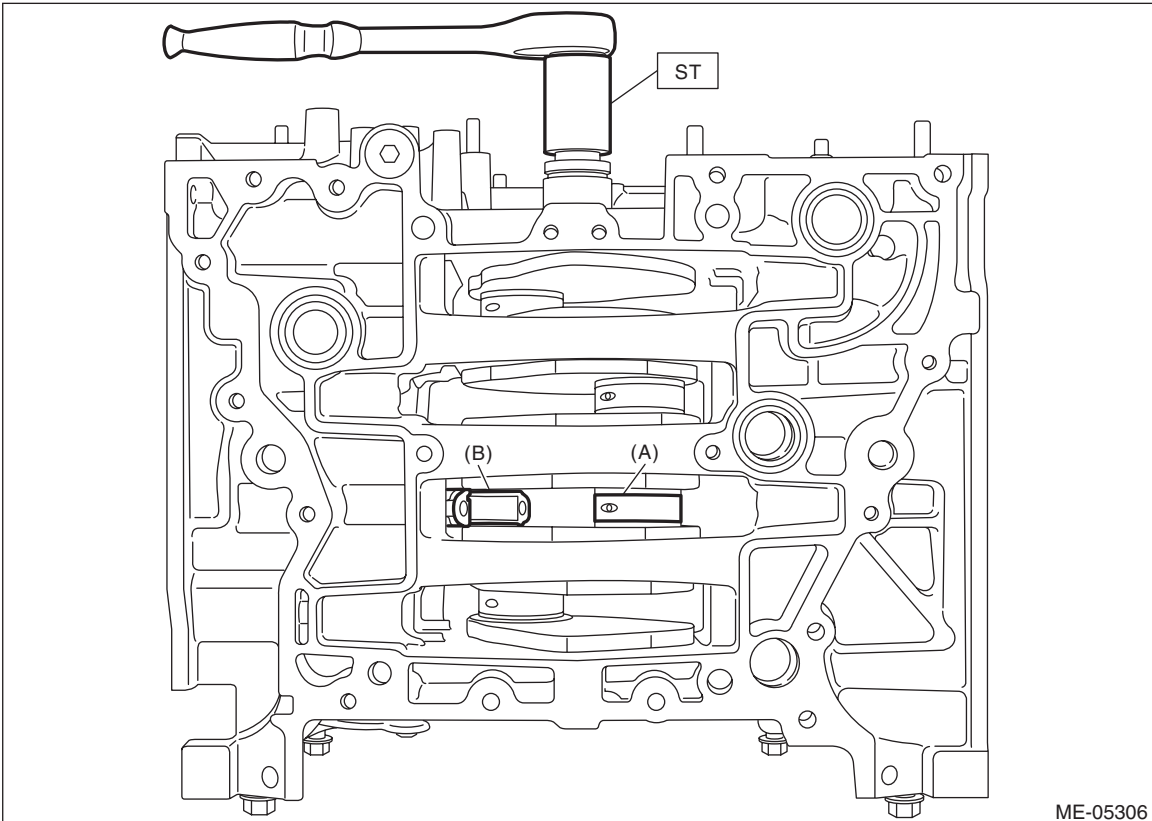
Cylinder Block

MECHANICAL

- (5) Push the #2 connecting rod in the direction of the arrow, and remove the #2 piston with #2 connecting rod from the cylinder block.



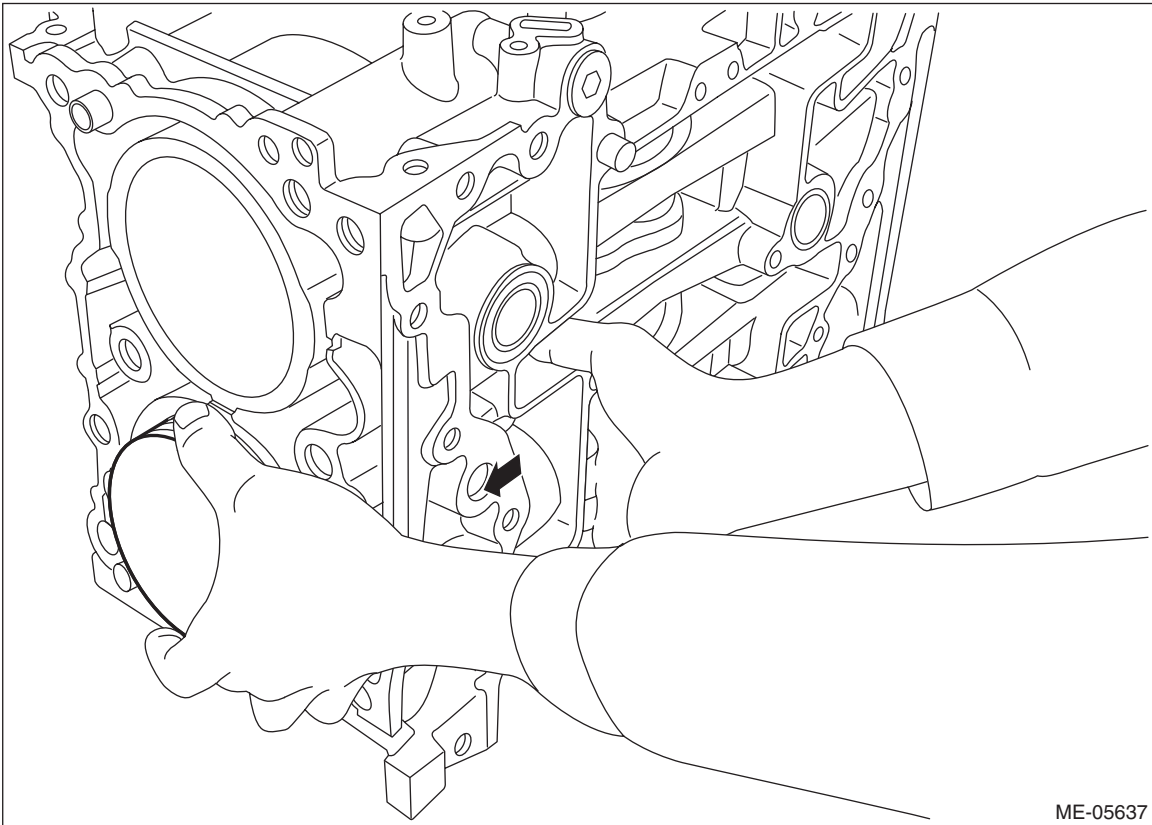
- (6) Using the ST, turn the crankshaft clockwise and separate the positions of the #3 pin (A) of crankshaft and the large end (B) of #3 connecting rod.
- ST 18252AA000 CRANKSHAFT SOCKET



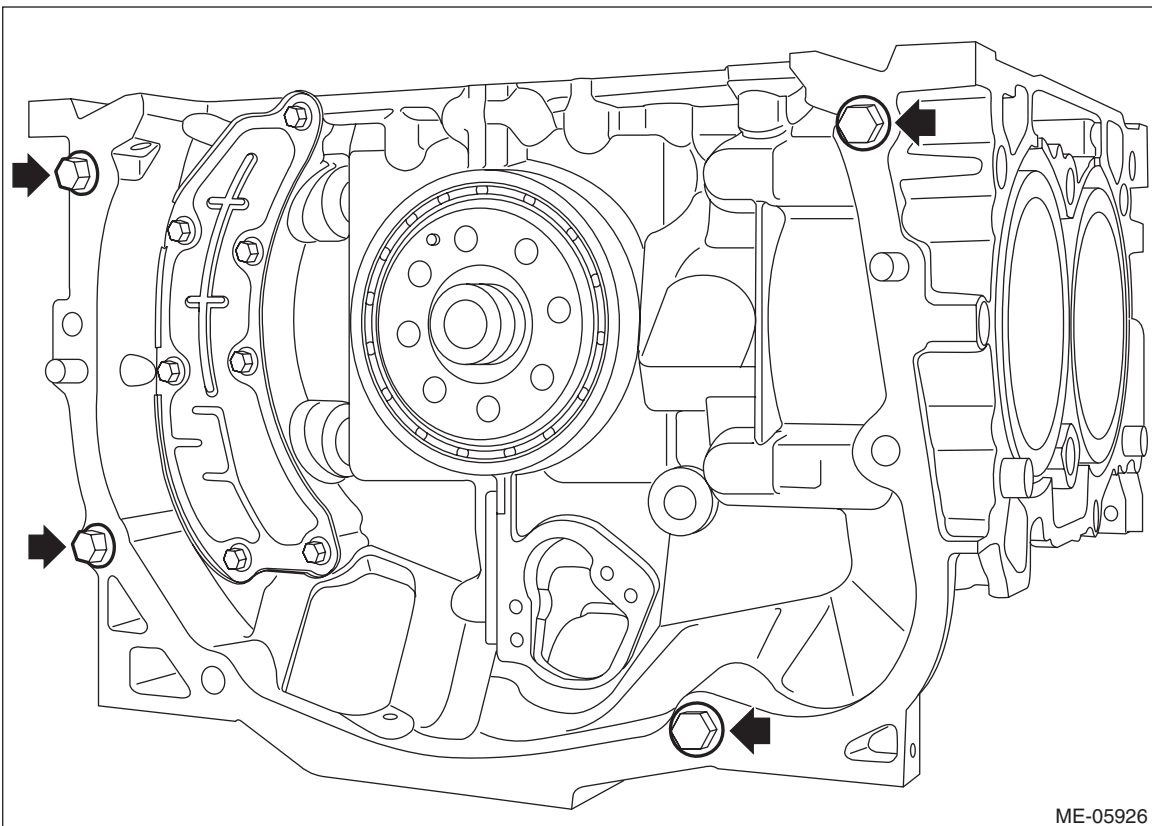
Cylinder Block

MECHANICAL

(7) Push the #3 connecting rod in the direction of the arrow, and remove the #3 piston with #3 connecting rod from the cylinder block.



27) Set the cylinder block so that the oil pan side faces upward, and remove the mounting bolts for A/C compressor and the generator bracket attached to the locations shown in the figure.



Cylinder Block

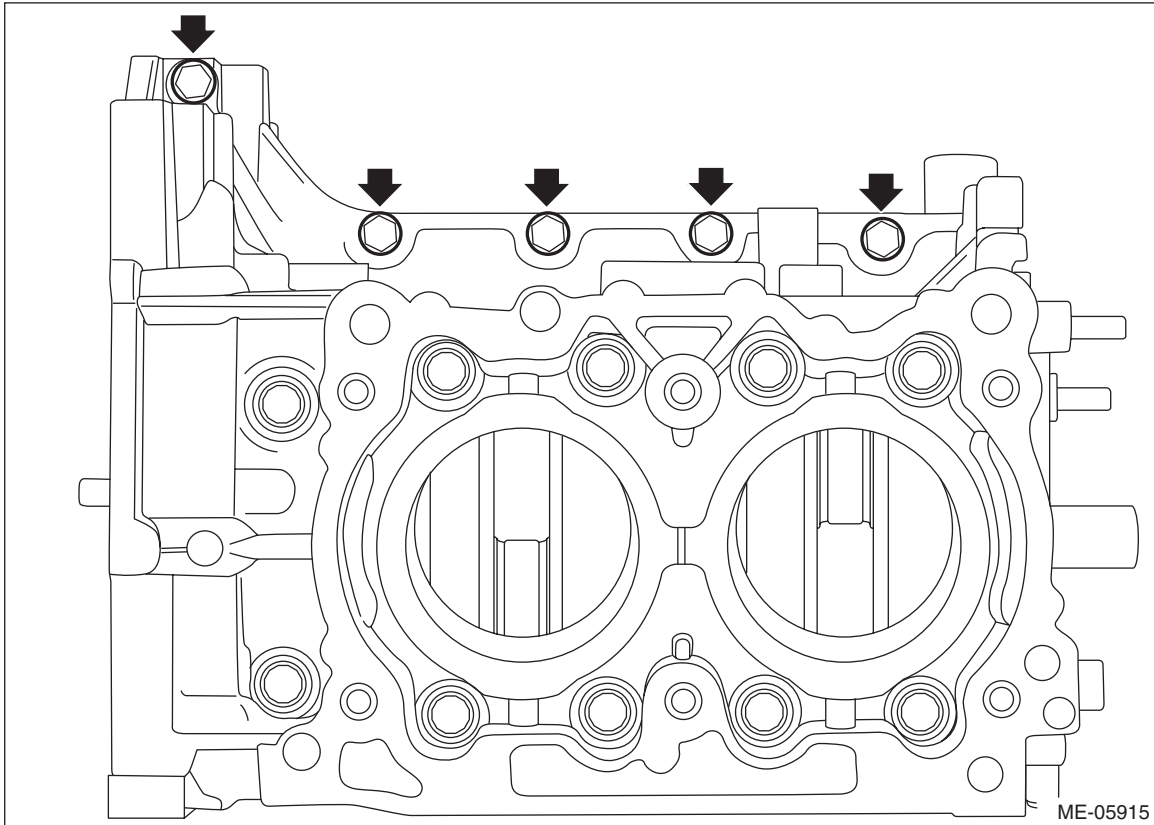
MECHANICAL

28) Set the part so that the cylinder block RH is on the upper side, and separate the cylinder block.

CAUTION:

- Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.
- Be careful not to scratch the mating surface of cylinder block during work.

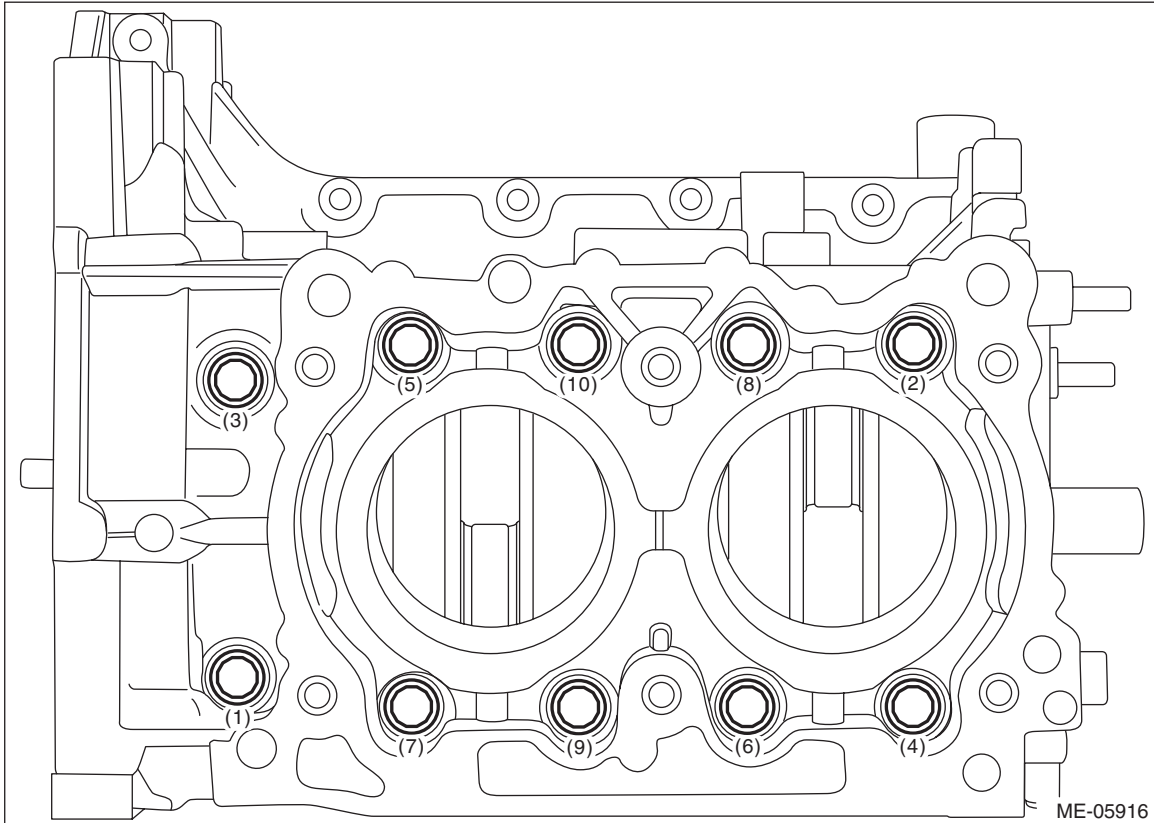
(1) Remove the bolt shown in the figure.



(2) Loosen the cylinder block mounting bolts in numerical order as shown in the figure, and separate the cylinder block RH and LH.

NOTE:

Lift the cylinder block RH slightly, and confirm that the crankshaft is remaining in the cylinder block LH. If the cylinder block RH is lifted carelessly when separating, the crankshaft may stick to cylinder block RH, then fall off.

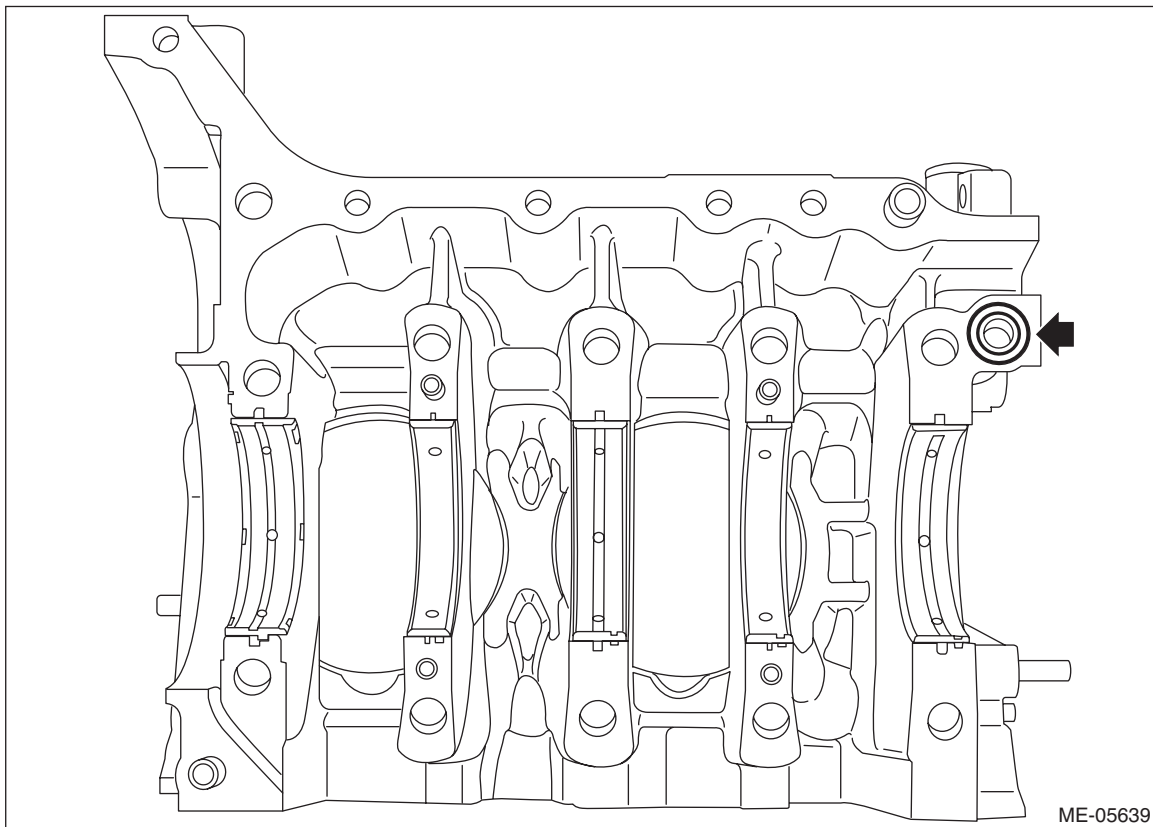


29) Remove the crankshaft from cylinder block LH, and remove the rear oil seal.

Cylinder Block

MECHANICAL

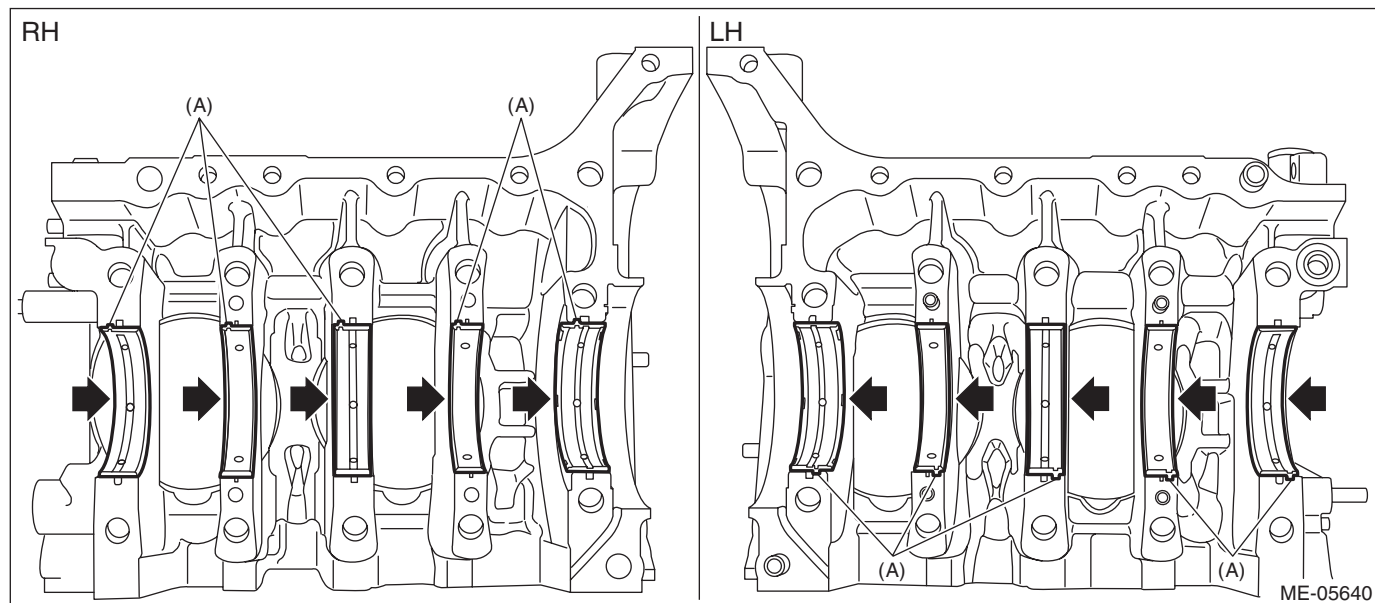
30) Remove the O-ring from the cylinder block LH.



31) Remove the crankshaft bearings from the cylinder block.

NOTE:

- Be careful not to confuse the crankshaft bearing combination.
- Press the bearing at the end opposite to locking lip (A).



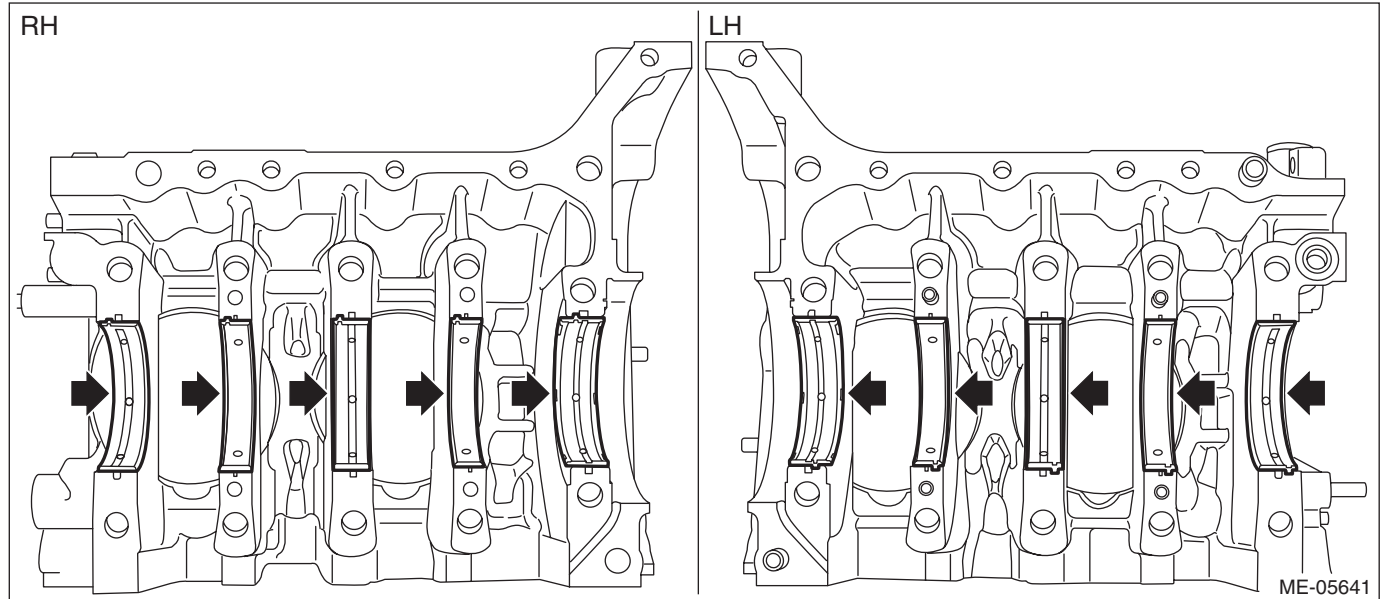
32) Remove the liquid gasket from cylinder block.

B: INSTALLATION

1) Apply engine oil to the crankshaft bearing, and install the crankshaft bearing to the cylinder block.

CAUTION:

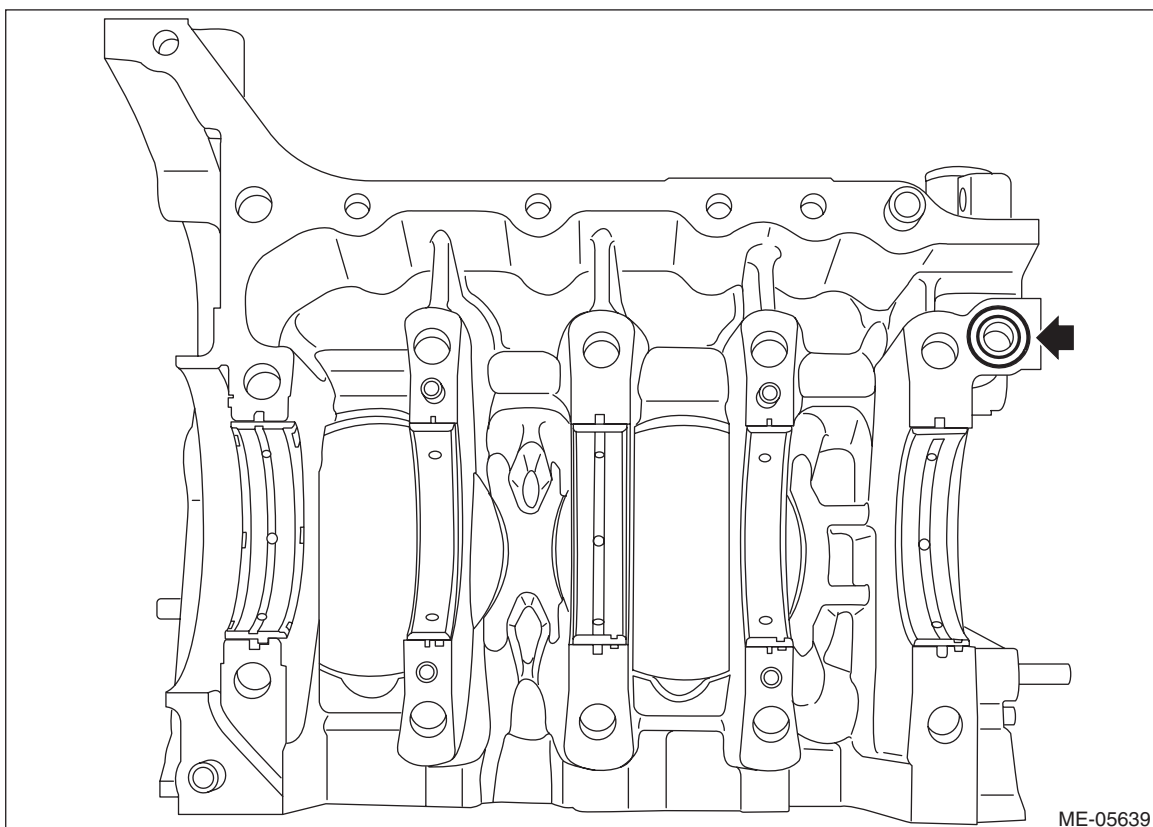
- Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.
- Be careful not to scratch the mating surface of cylinder block during work.



2) Install O-rings to the cylinder block LH.

NOTE:

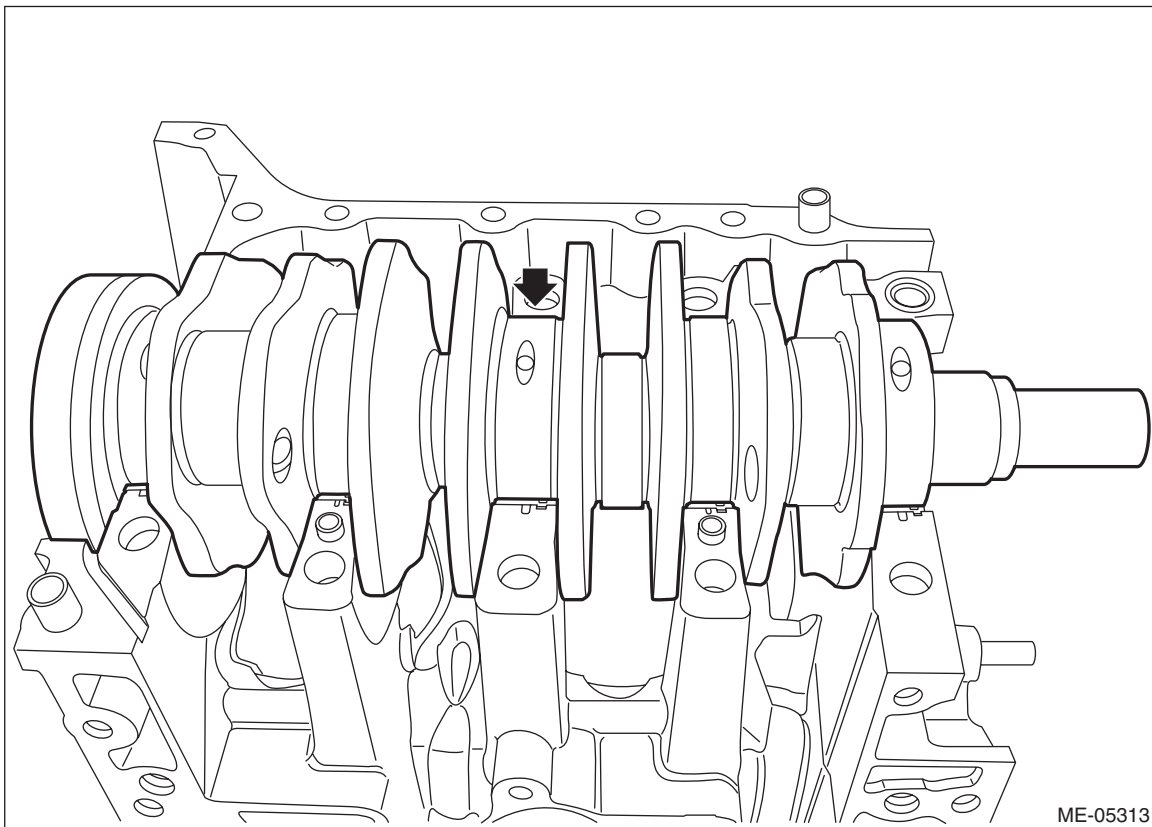
Use new O-rings.



Cylinder Block

MECHANICAL

3) Apply engine oil to the crankshaft journal, and set the crankshaft to cylinder block LH.



4) Apply liquid gasket to the mating surface of cylinder block RH as shown in the figure.

CAUTION:

Do not let the liquid gasket overflow to the oil passage and crankshaft bearing portions, because the engine seizure may result.

NOTE:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder block RH and cylinder block LH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

THREE BOND 1217G (Part No. K0877Y0100) or equivalent

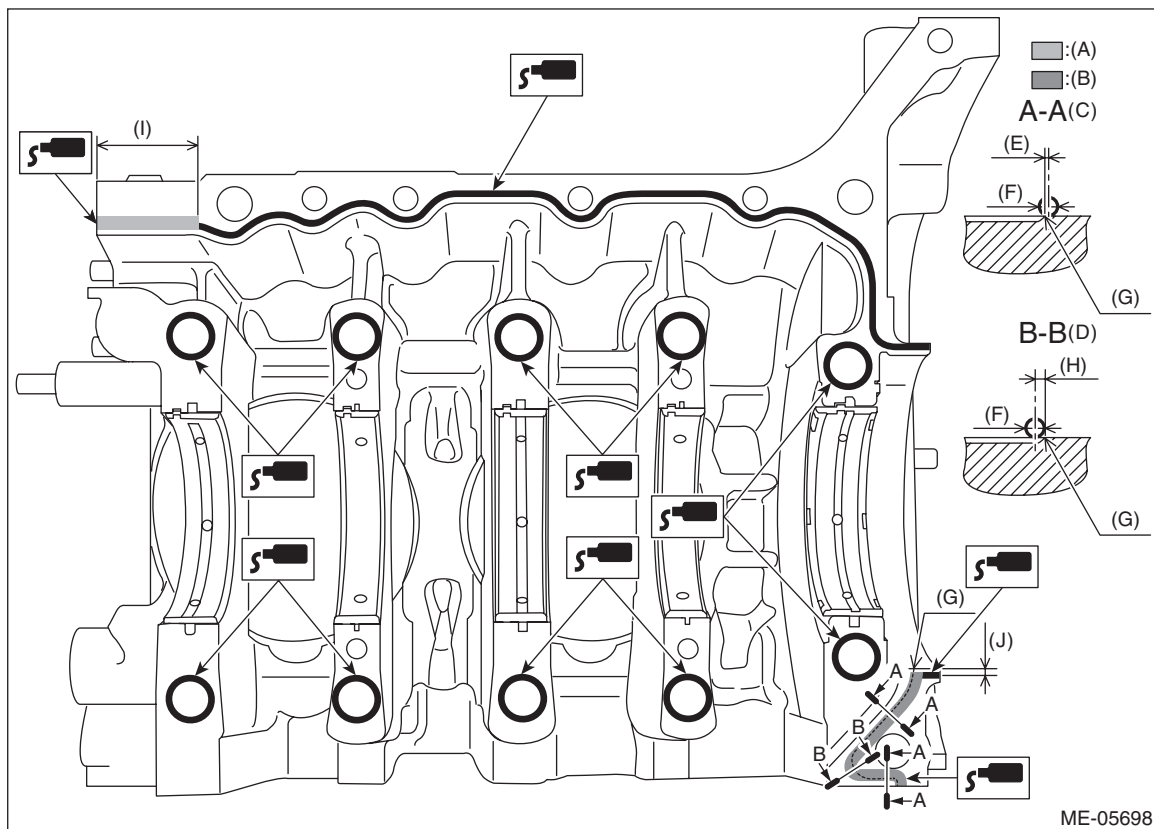
Liquid gasket applying diameter:

Mating surfaces other than ranges A and B

$1 \pm 0.5 \text{ mm (0.0394} \pm 0.0197 \text{ in)}$

Mating surfaces of ranges A and B

$4 \pm 0.5 \text{ mm (0.1575} \pm 0.0197 \text{ in)}$



- | | | |
|---|---|------------------------|
| (A) Range A | (E) 1 mm (0.0394 in) or less | (I) 36 mm (1.4173 in) |
| (B) Range B | (F) $4 \pm 0.5 \text{ mm (0.1575} \pm 0.0197 \text{ in)}$ | (J) 2.5 mm (0.0984 in) |
| (C) Liquid gasket applying position of mating surfaces (other than the edge) of range B | (G) Chamfer edge | |
| (D) Liquid gasket applying position of mating surfaces (the edge) of range B | (H) 2 mm (0.0787 in) | |

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

Cylinder Block

MECHANICAL

6) Join the cylinder blocks.

(1) Apply a coat of engine oil to the washers and cylinder block mounting bolt threads.

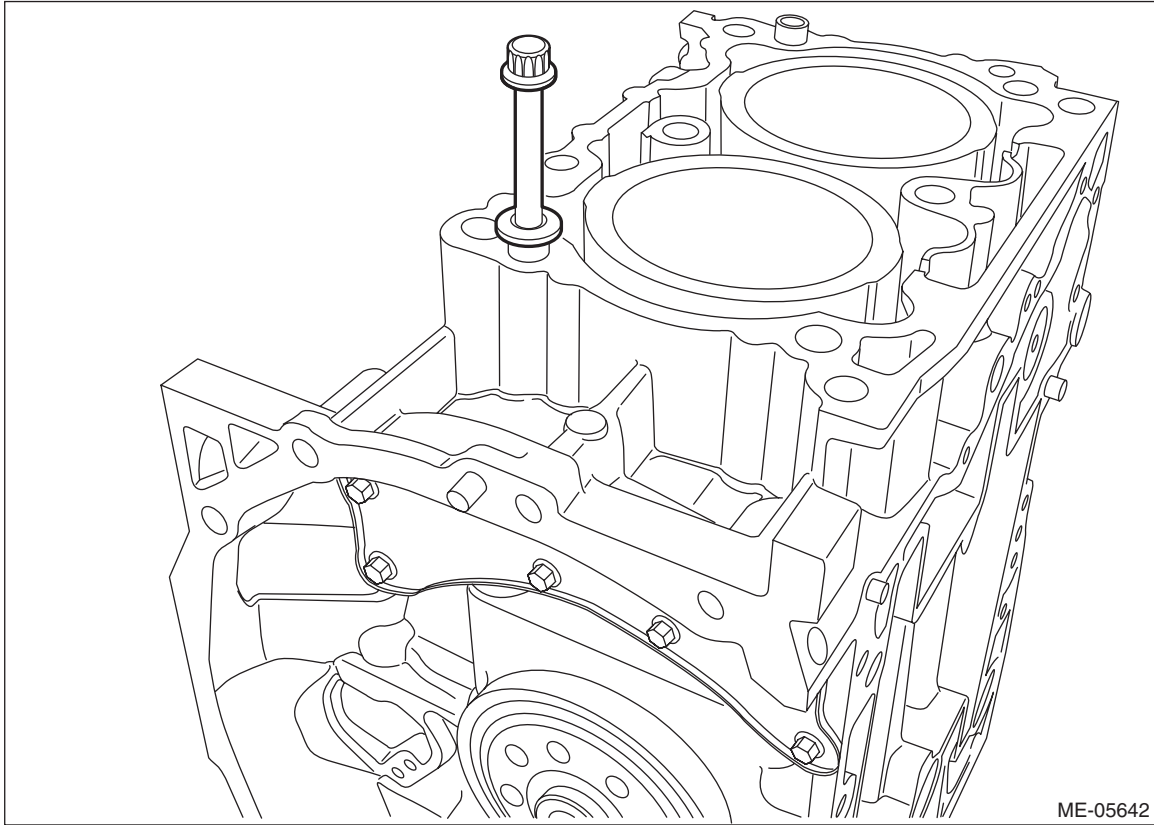
NOTE:

To prevent mixture of engine oil into the water jacket, do not apply a large amount.

(2) Install the cylinder head bolt at the locations shown in the figure.

NOTE:

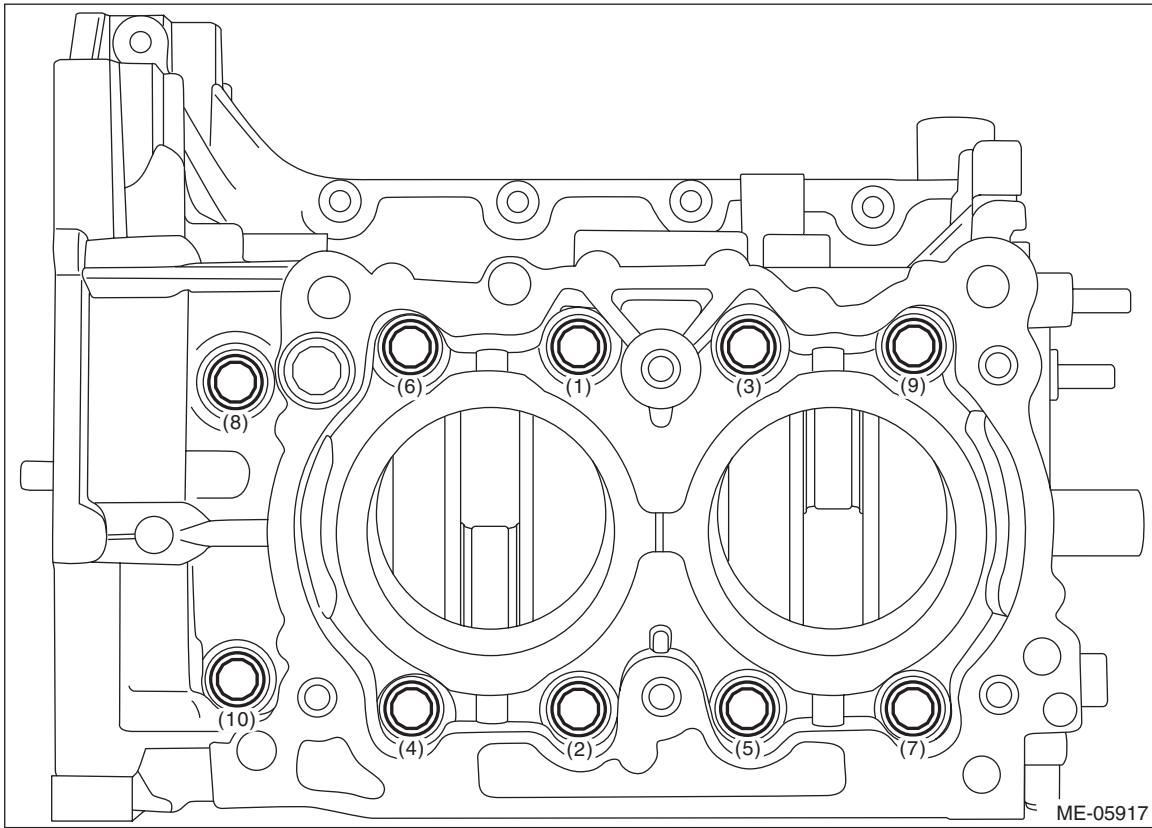
This procedure is required to tighten the cylinder block mounting bolts with specified angle using ST.



(3) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



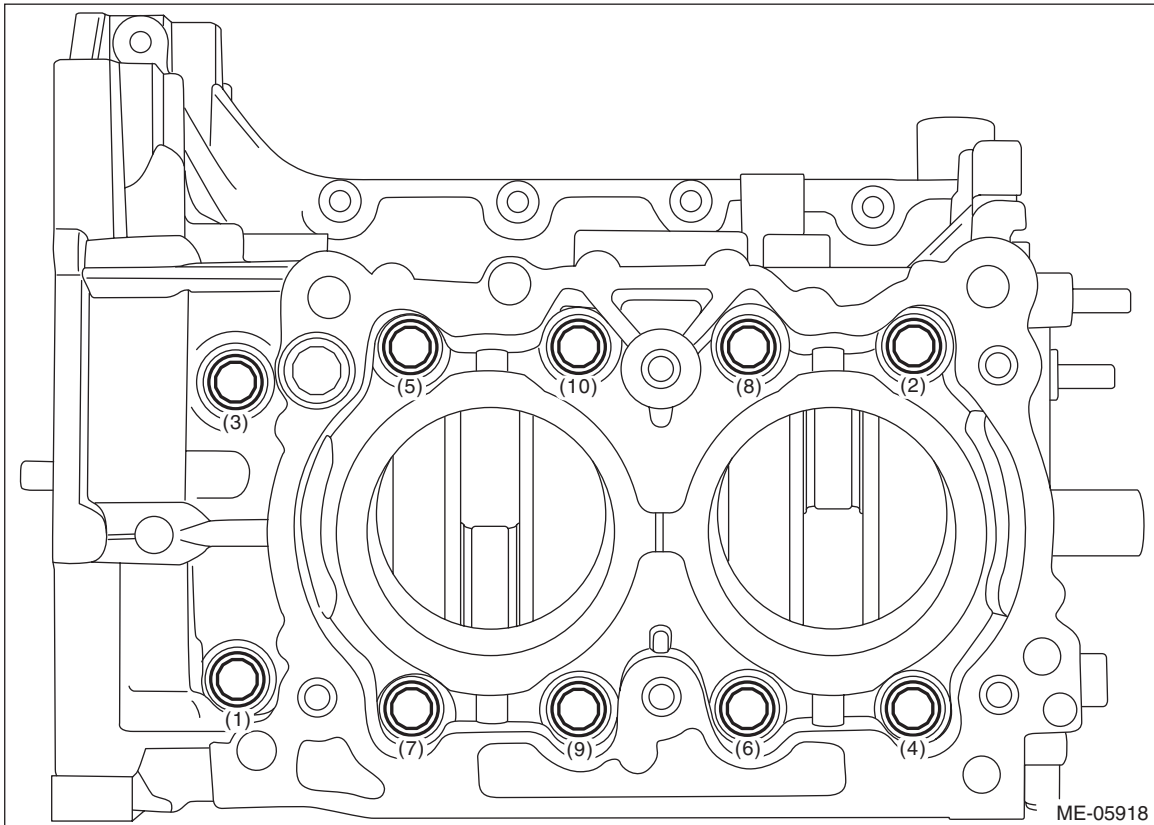
Cylinder Block

MECHANICAL

(4) Loosen all mounting bolts by 180° in numerical order as shown in the figure.

CAUTION:

When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



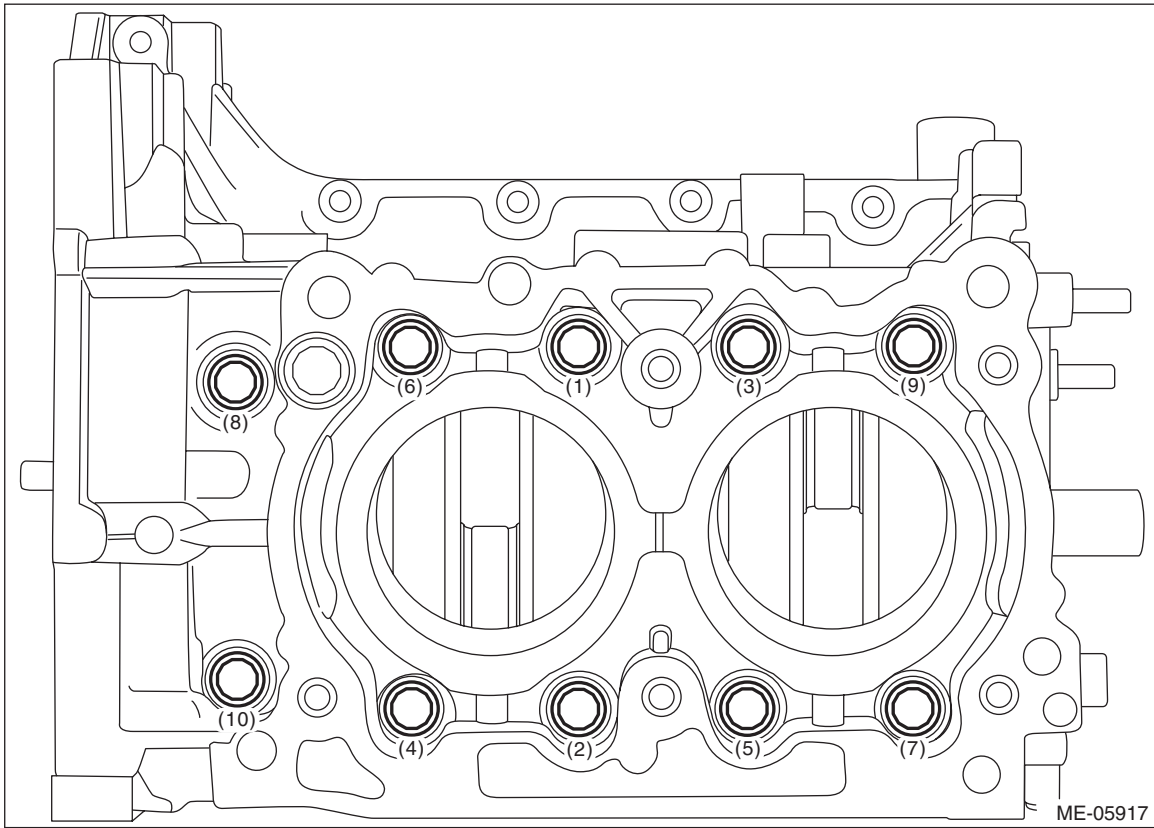
Cylinder Block

MECHANICAL

(5) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



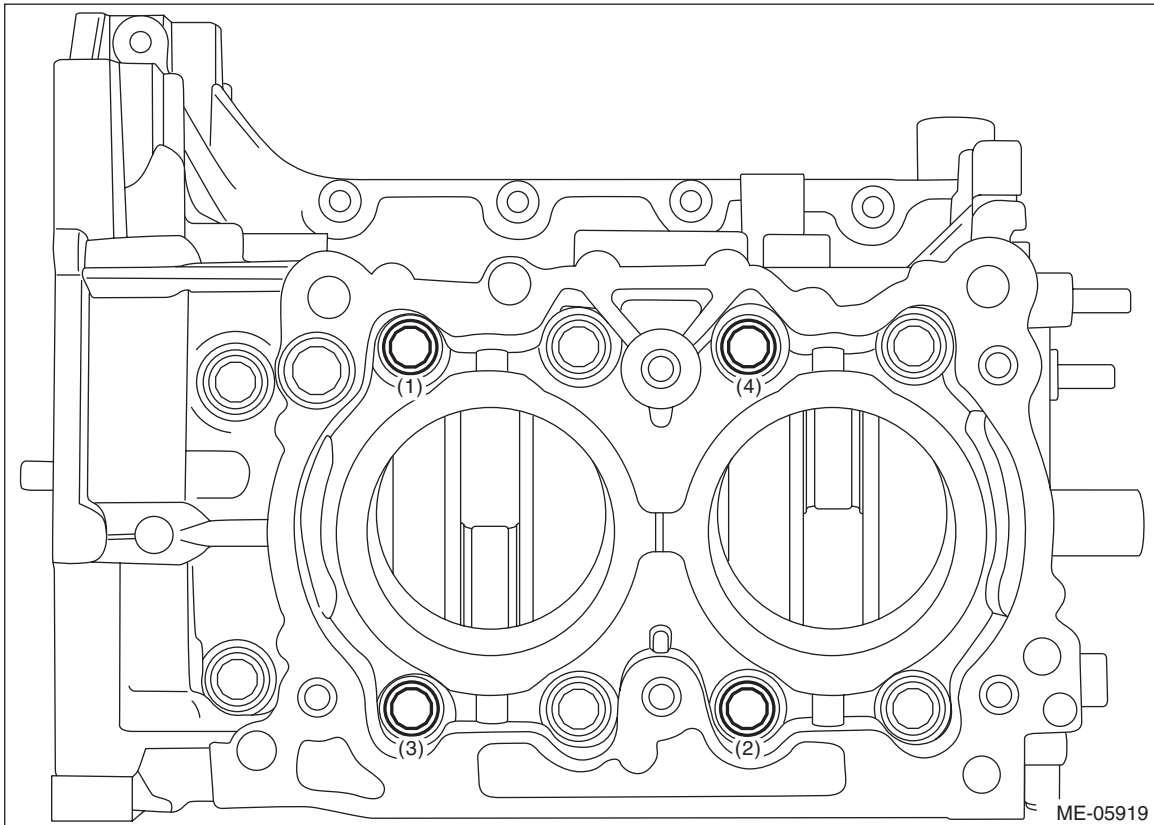
Cylinder Block

MECHANICAL

(6) Loosen the mounting bolts (4 places) by 180° in numerical order as shown in the figure.

CAUTION:

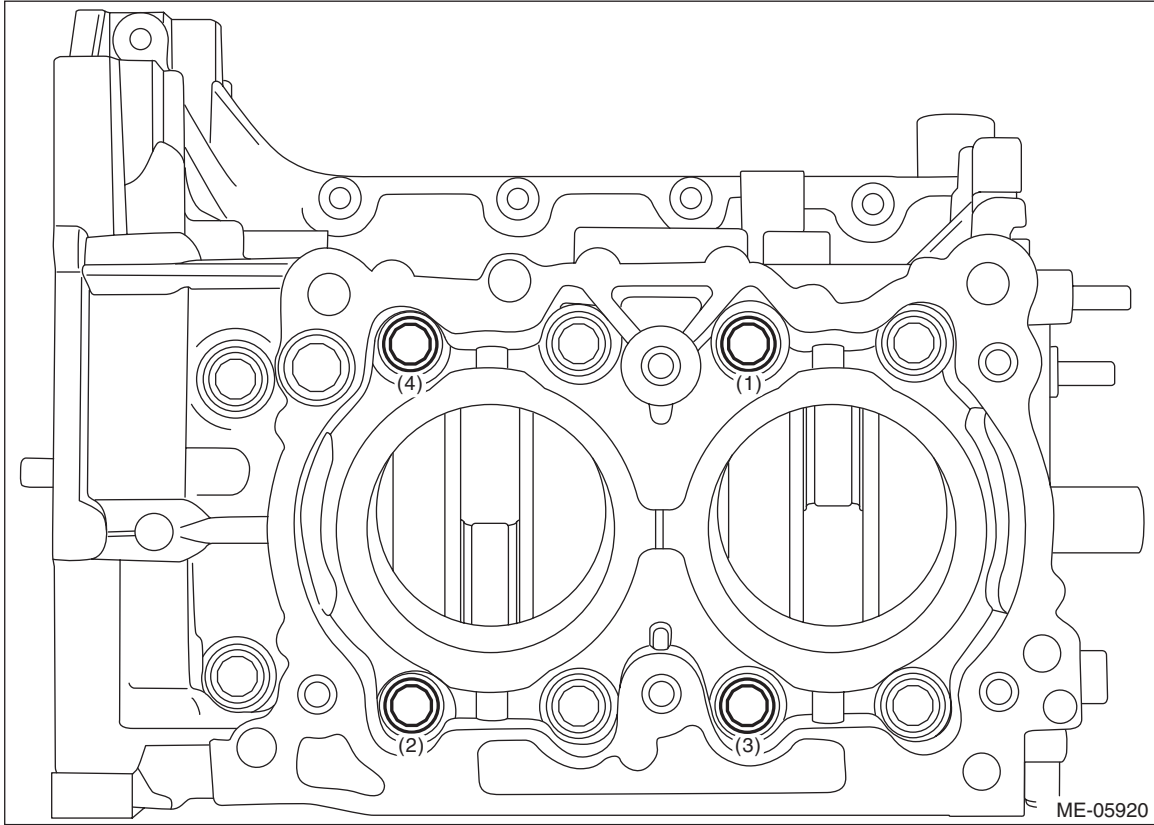
When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



(7) Tighten the mounting bolts (4 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



Cylinder Block

MECHANICAL

(8) Using ST, tighten the mounting bolts (4 places) with specified angle in numerical order as shown in the figure.

CAUTION:

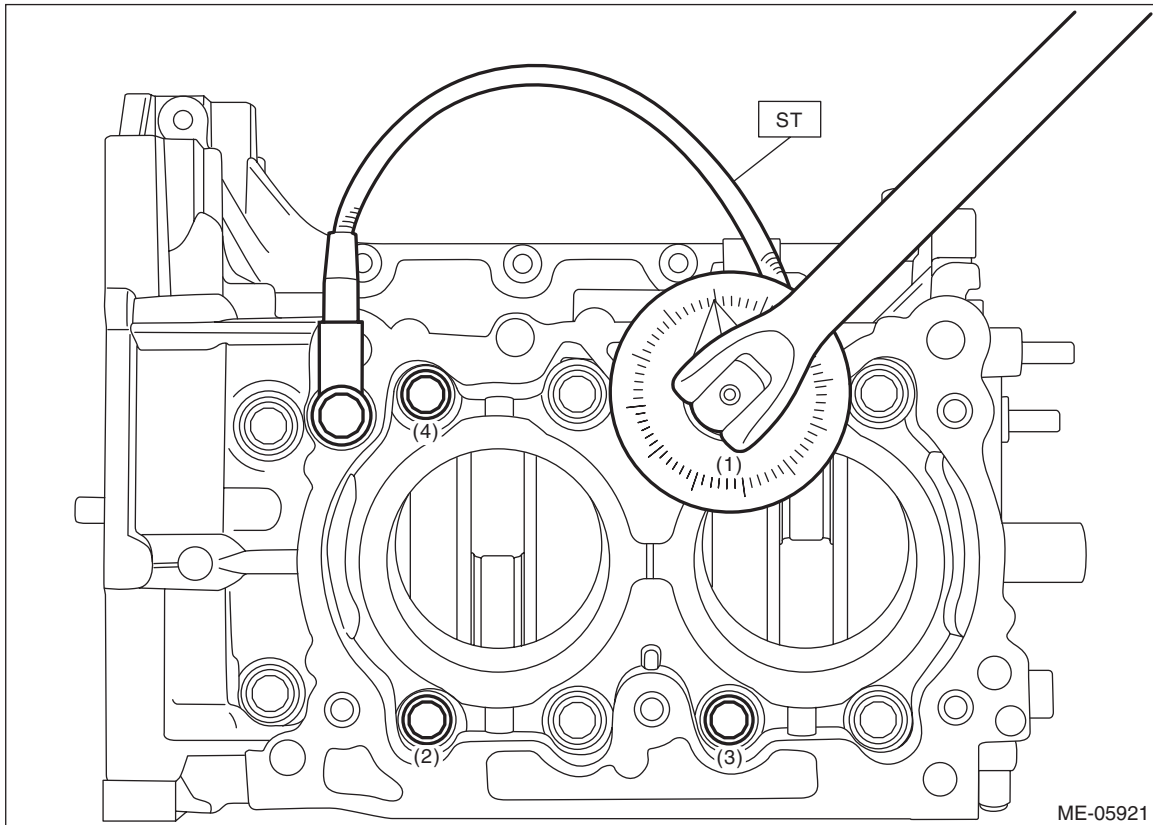
When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

NOTE:

Attach the magnet used for securing the ST (ANGLE GAUGE) to the cylinder head bolt attached in step (2).
ST 18854AA000 ANGLE GAUGE

Tightening angle:

$60^{\circ} \pm 2^{\circ}$



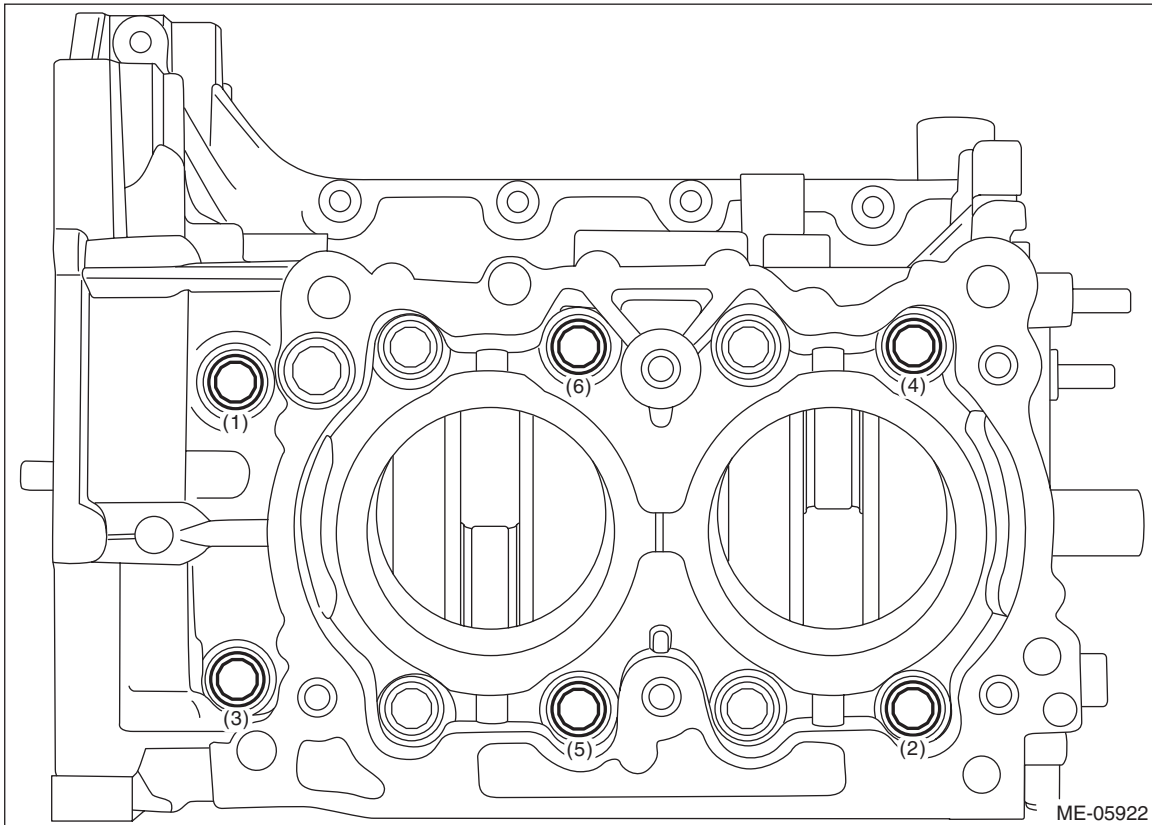
Cylinder Block

MECHANICAL

(9) Loosen the mounting bolts (6 places) by 180° in numerical order as shown in the figure.

CAUTION:

When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



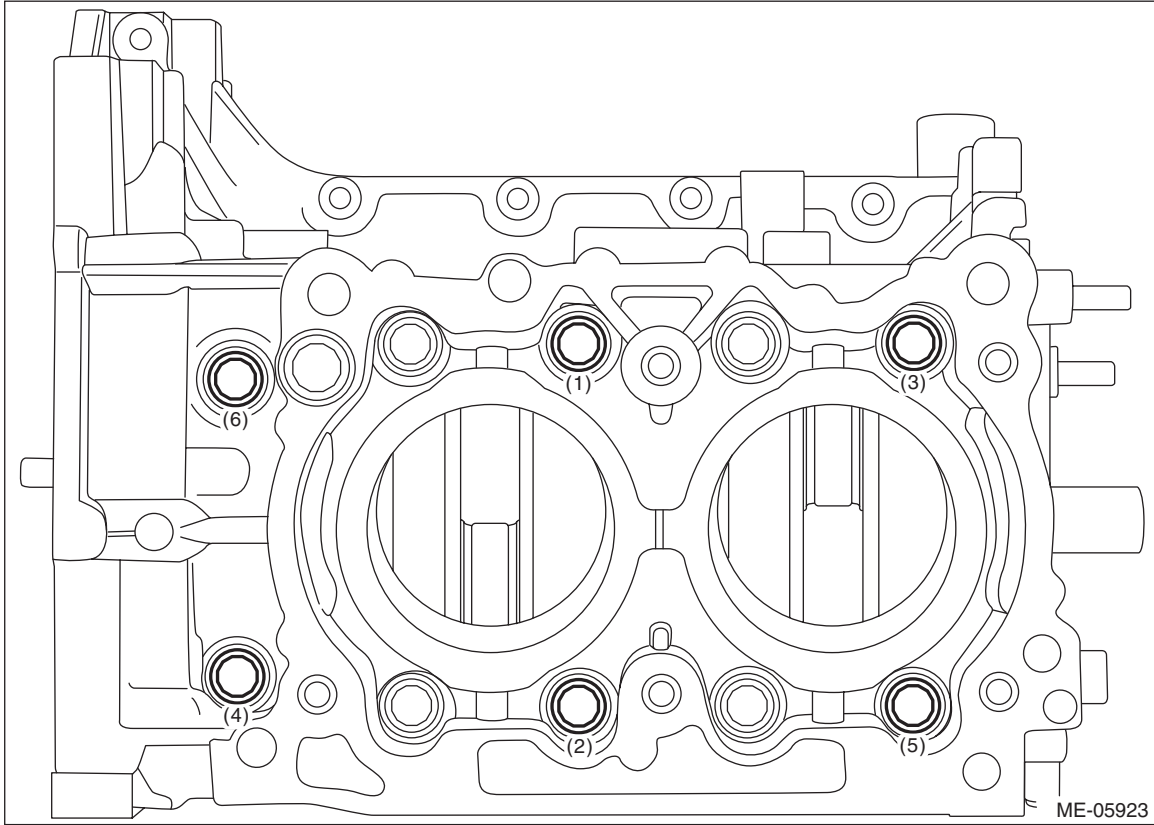
Cylinder Block

MECHANICAL

(10) Tighten the mounting bolts (6 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



(11) Using ST, tighten the mounting bolts (6 places) with specified angle in numerical order as shown in the figure.

CAUTION:

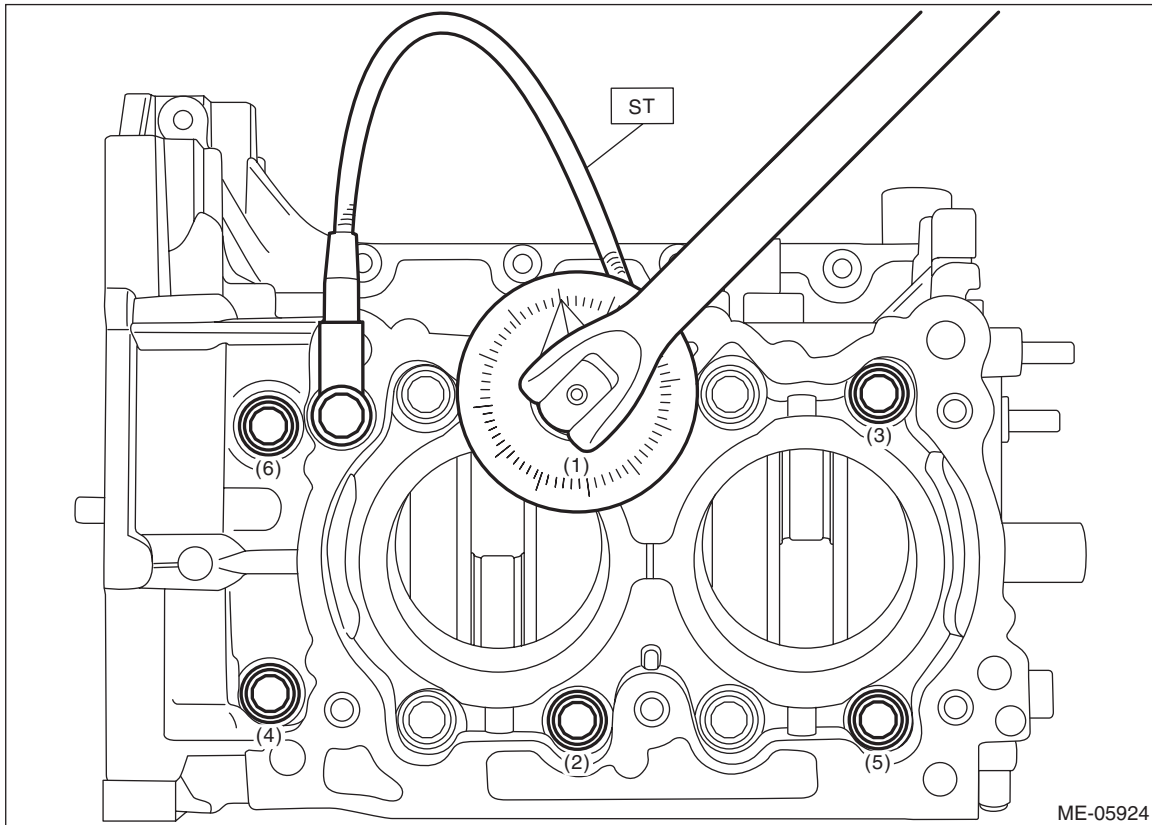
When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

NOTE:

Attach the magnet used for securing the ST (ANGLE GAUGE) to the cylinder head bolt attached in step (2).
ST 18854AA000 ANGLE GAUGE

Tightening angle:

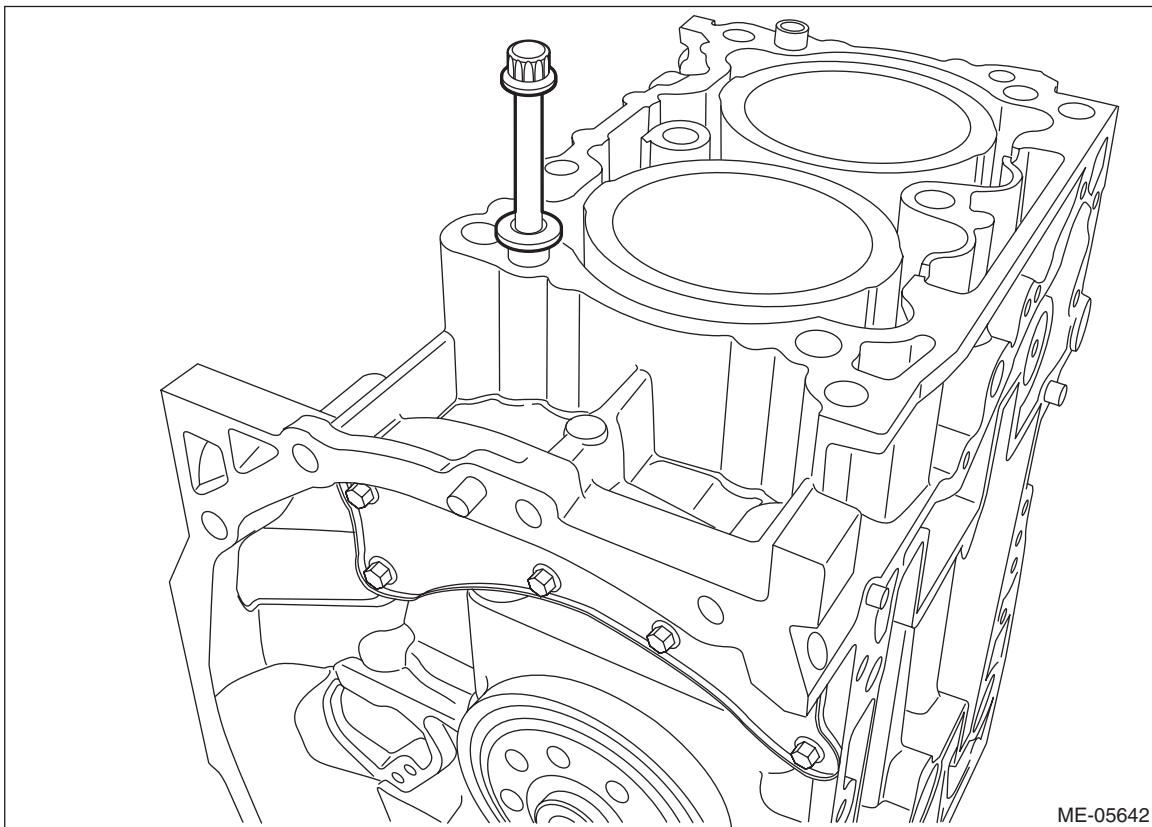
$60^{\circ} \pm 2^{\circ}$



Cylinder Block

MECHANICAL

(12) Remove the cylinder head bolt attached at the locations shown in the figure.



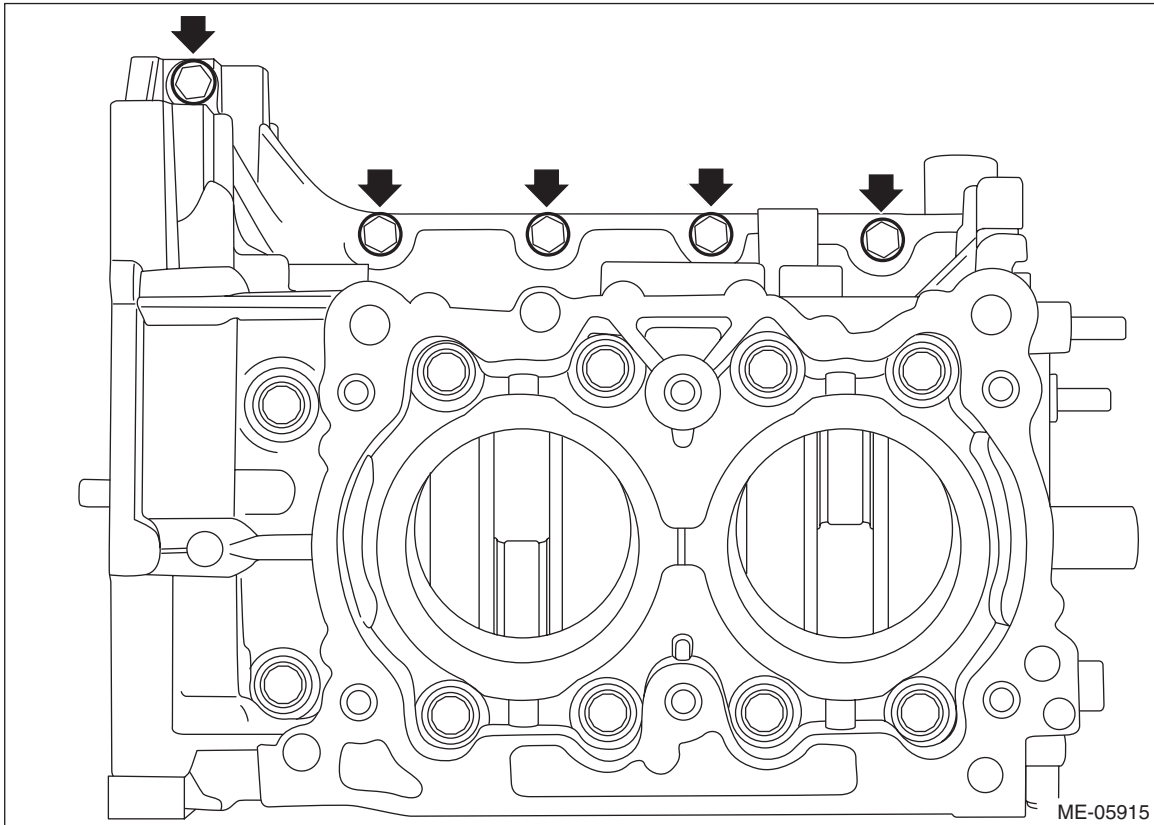
(13) Install the bolt shown in the figure.

NOTE:

After tightening, if the liquid gasket is squeezed out in the seal surface area of the chain cover and oil pan upper, completely remove any liquid gasket that is squeezed out. Any liquid gasket on the chamfer area, however, should not be removed.

Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)



7) Set the part so that the oil pan side of cylinder block is on the upper side.

Cylinder Block

MECHANICAL

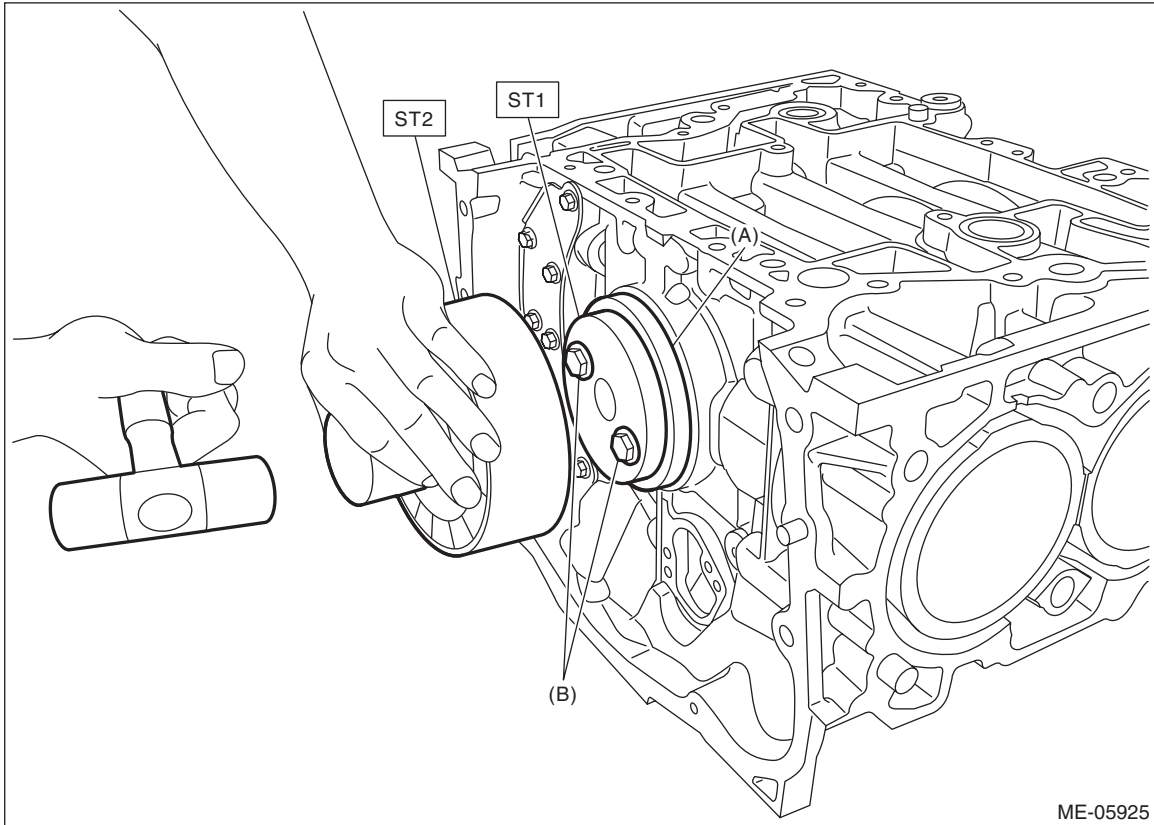
8) Apply a coat of engine oil to the oil seal inner periphery and outer periphery, and install the rear oil seal using ST1 and ST2.

NOTE:

Use a new rear oil seal.

ST1 18671AA020 OIL SEAL GUIDE

ST2 18657AA030 OIL SEAL INSTALLER



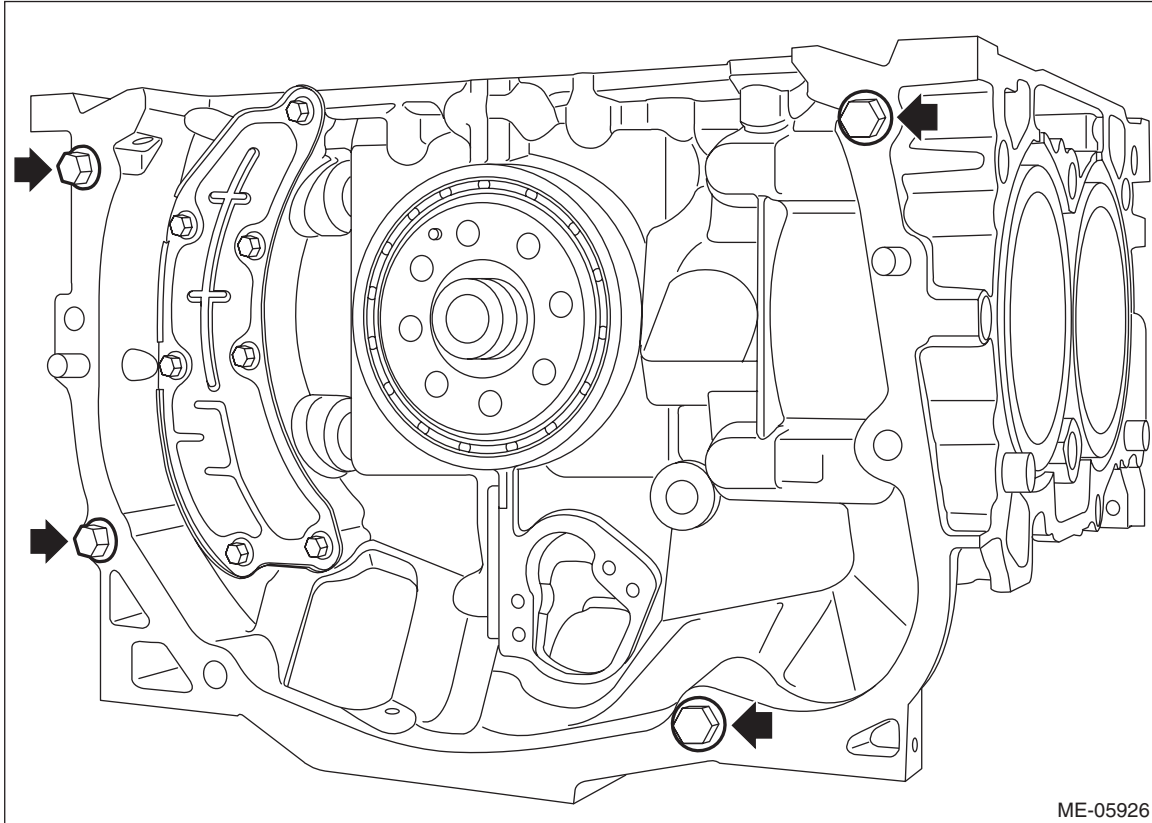
(A) Rear oil seal

(B) Drive plate or flywheel mounting bolt

9) Install the mounting bolts for the A/C compressor and the generator bracket at the locations shown in the figure.

NOTE:

- This procedure is required to prevent the knock pin damage when the cylinder block is raised in the next step.
- Use the same length bolt for the four bolts.



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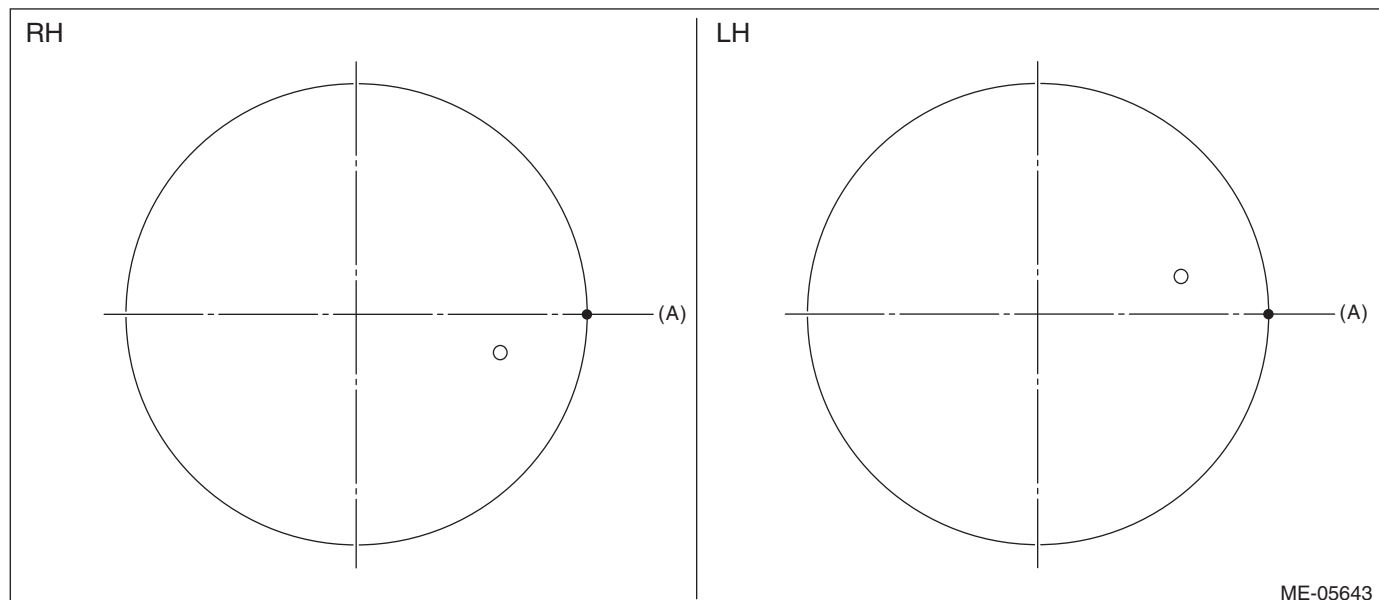
10) Raise the cylinder block so that the rear oil seal is on the lower side.

11) Adjust the positions of piston ring gap for each piston.

NOTE:

Check that the piston ring mark of compression ring faces the top side of the piston.

(1) Set the ring gap of the top ring to the position (A) in the figure.

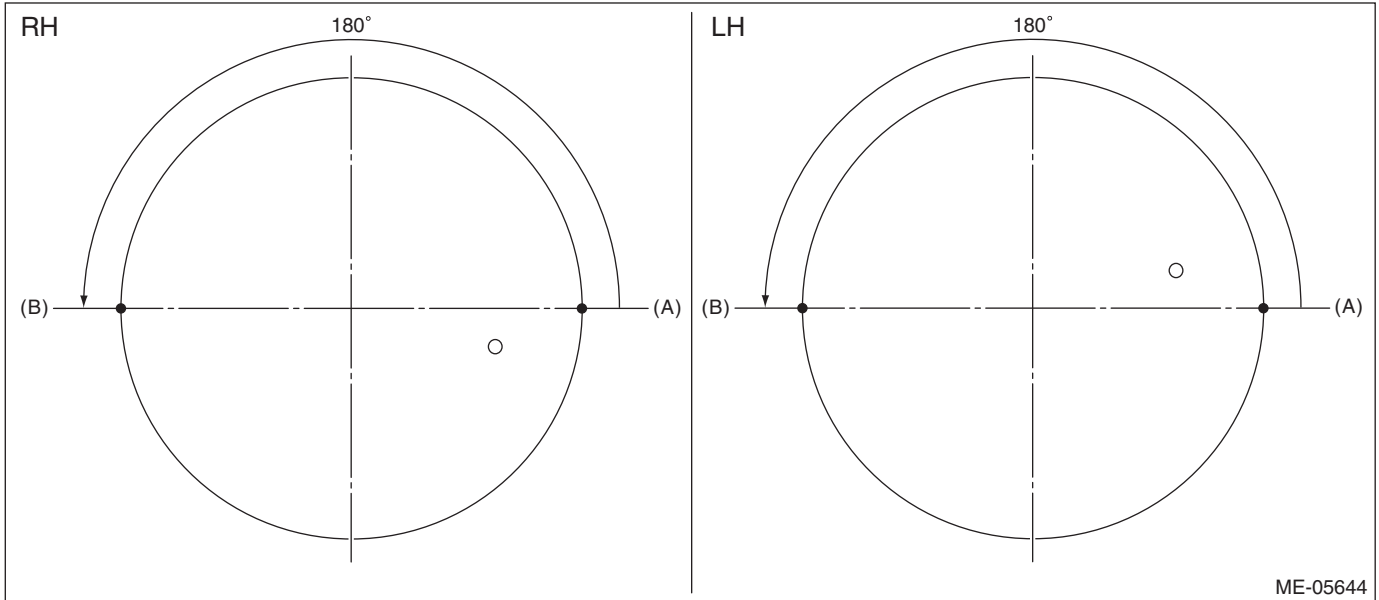


ME-05643

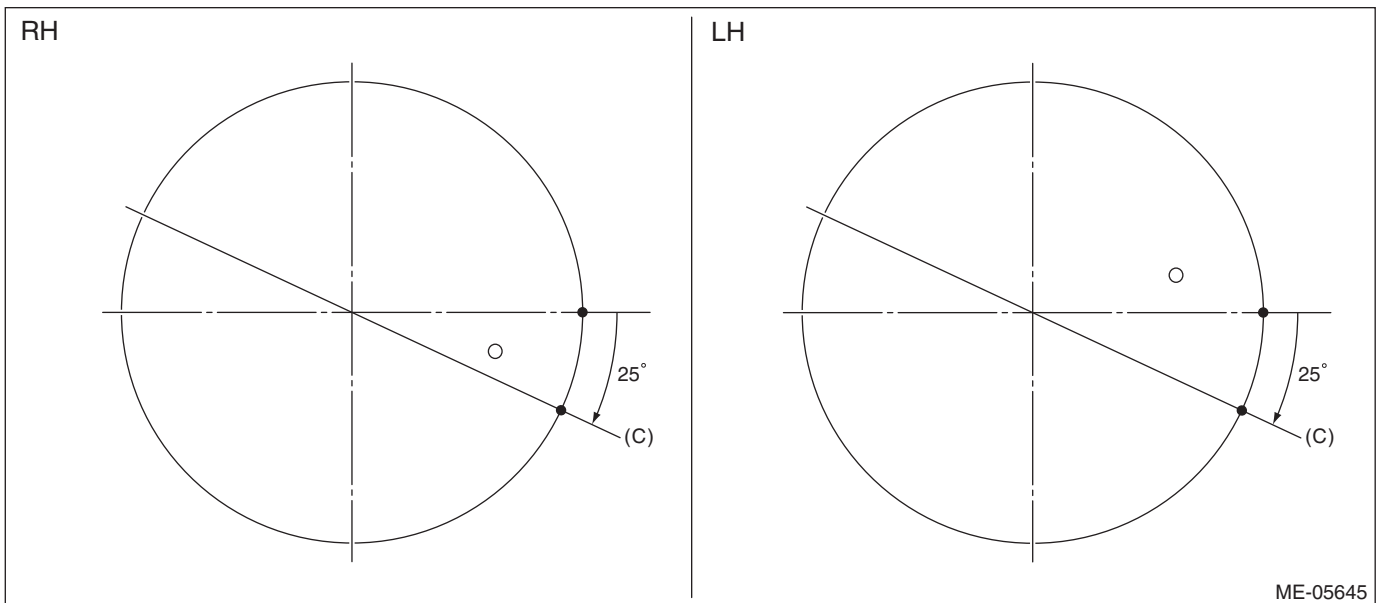
Cylinder Block

MECHANICAL

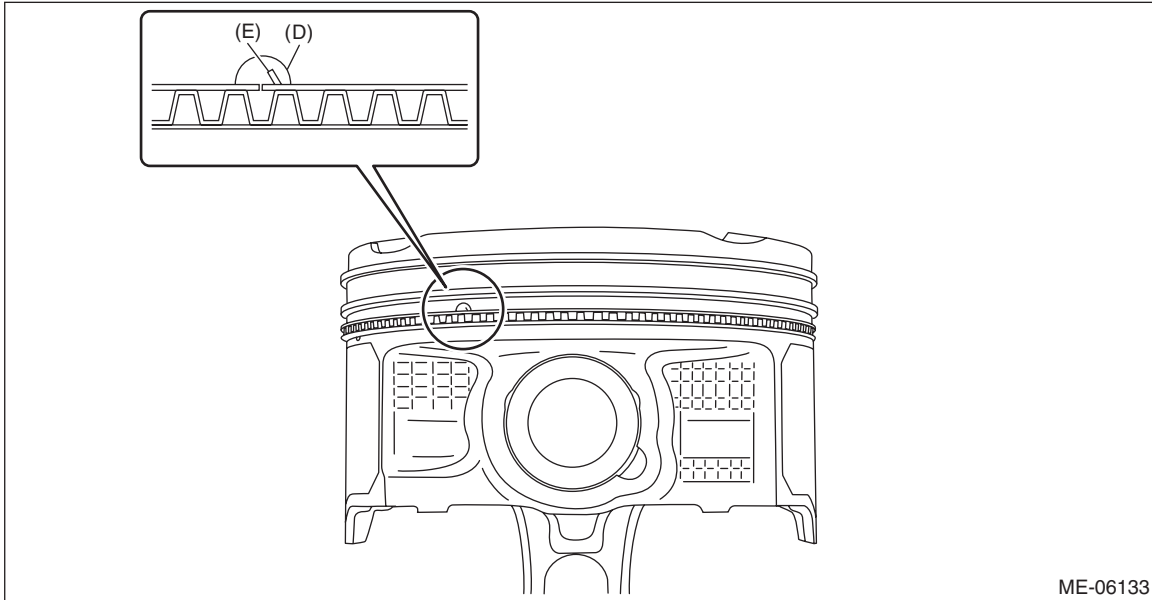
(2) Position the ring gap of second ring at (B) in the figure on the 180° opposite direction of (A).



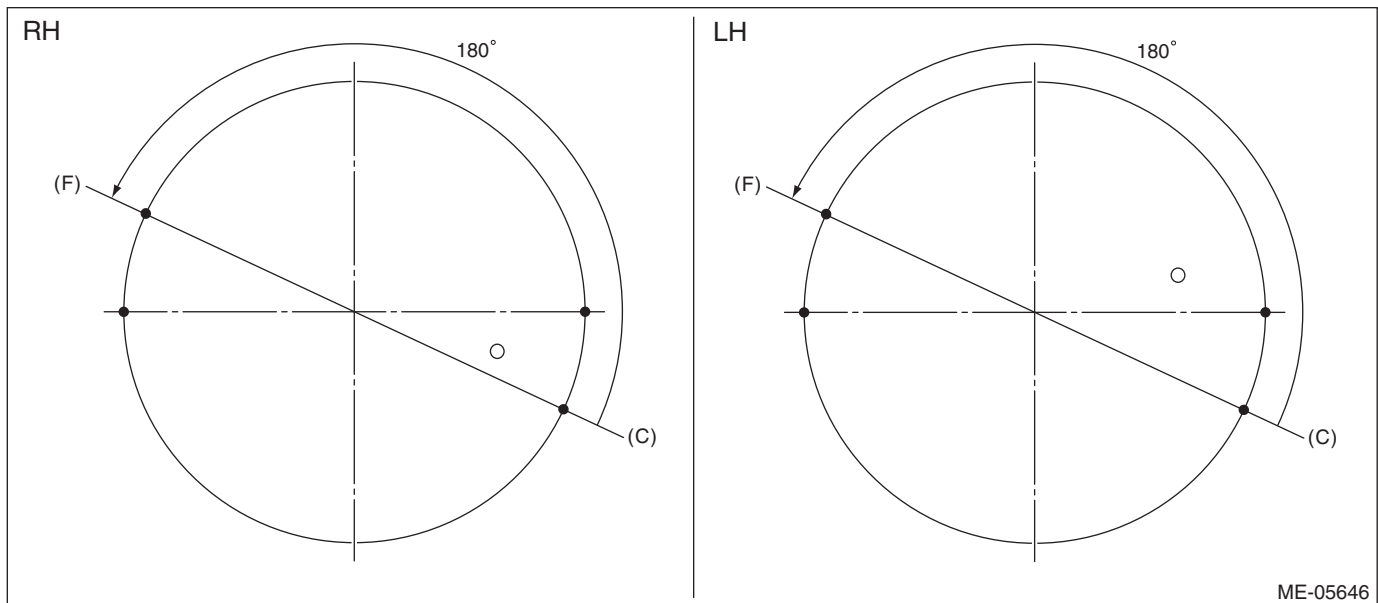
(3) Set the ring gap of the upper rail to the position (C) in the figure.



(4) Align the upper rail spin stopper (E) to the side hole (D) on the piston.



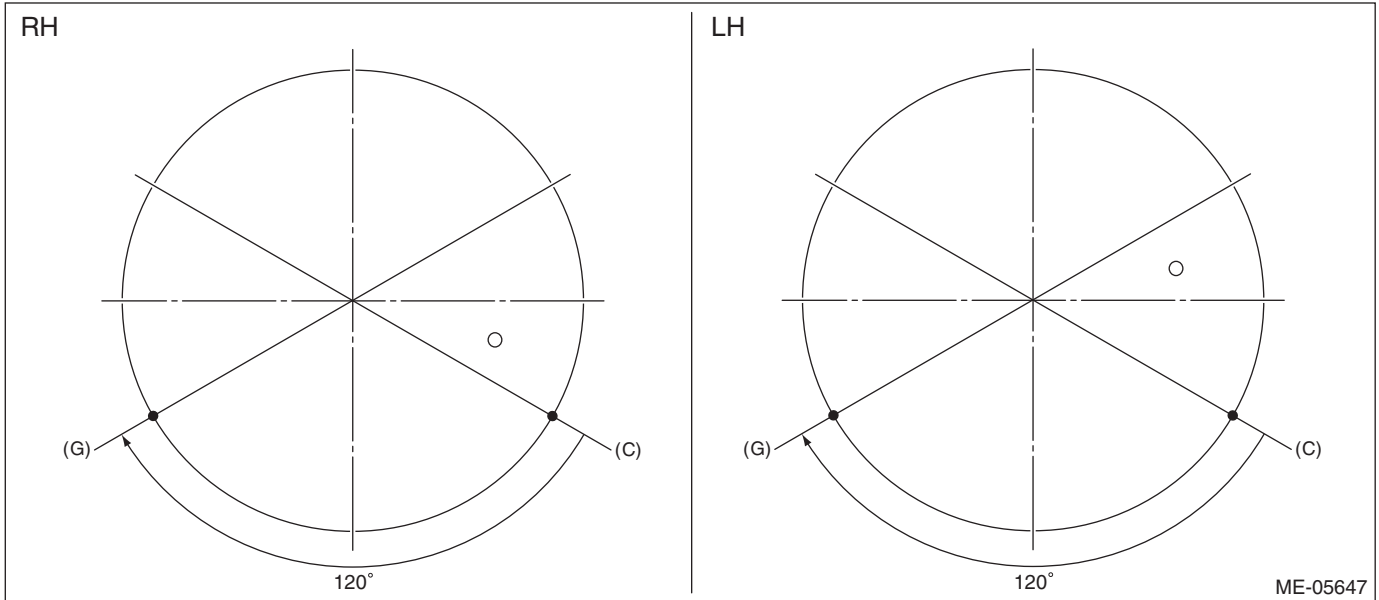
(5) Position the ring gap of expander at (F) in the figure on the 180° opposite direction of (C).



Cylinder Block

MECHANICAL

(6) Set the ring gap of lower rail at position (G), located 120° clockwise from (C) in the figure.



(7) Check that the positions of piston ring gap are properly adjusted.

NOTE:

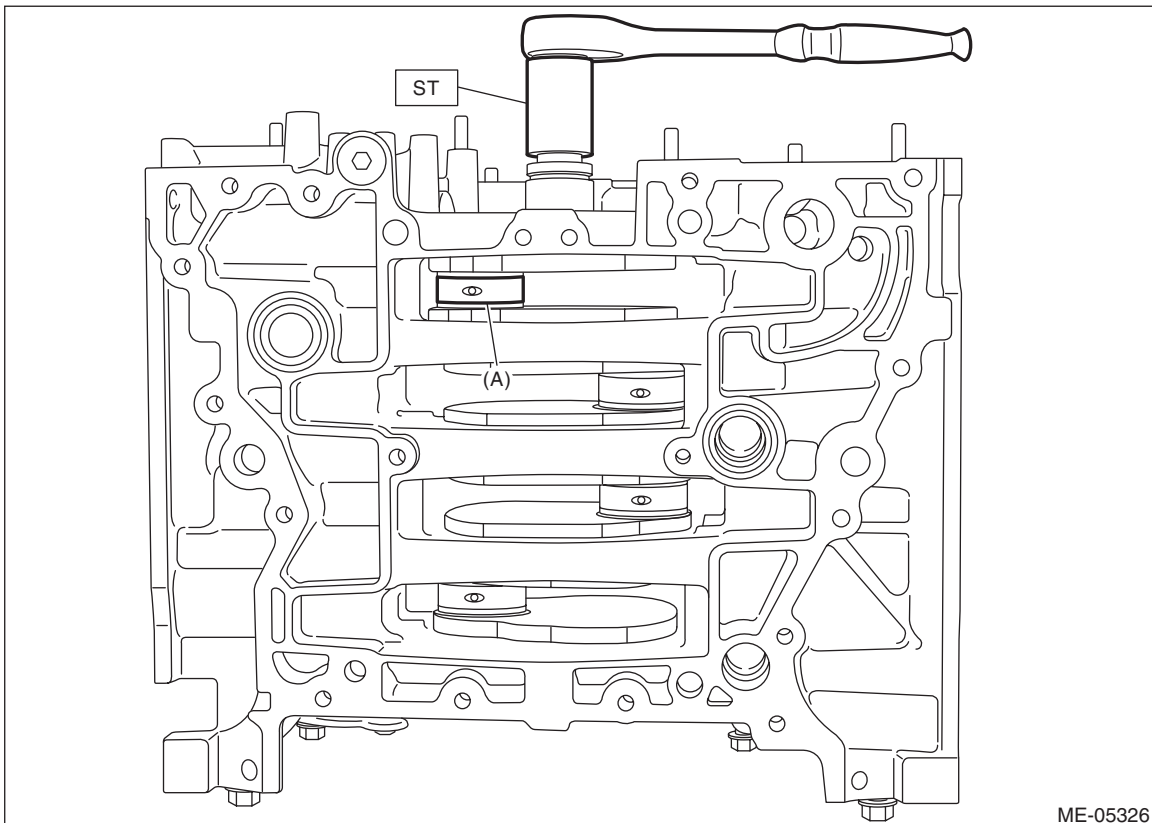
When checking the positions of piston ring gap, also check that the piston ring gaps are not positioned within the range of piston skirt extended line.

12) Install the piston and connecting rod to the cylinder block.

(1) Apply engine oil to the outer circumference of each piston, crankshaft pin, and in the cylinder block.

(2) Turn the crankshaft so that the #1 pin (A) of crankshaft is positioned at TDC using ST.

ST 18252AA000 CRANKSHAFT SOCKET



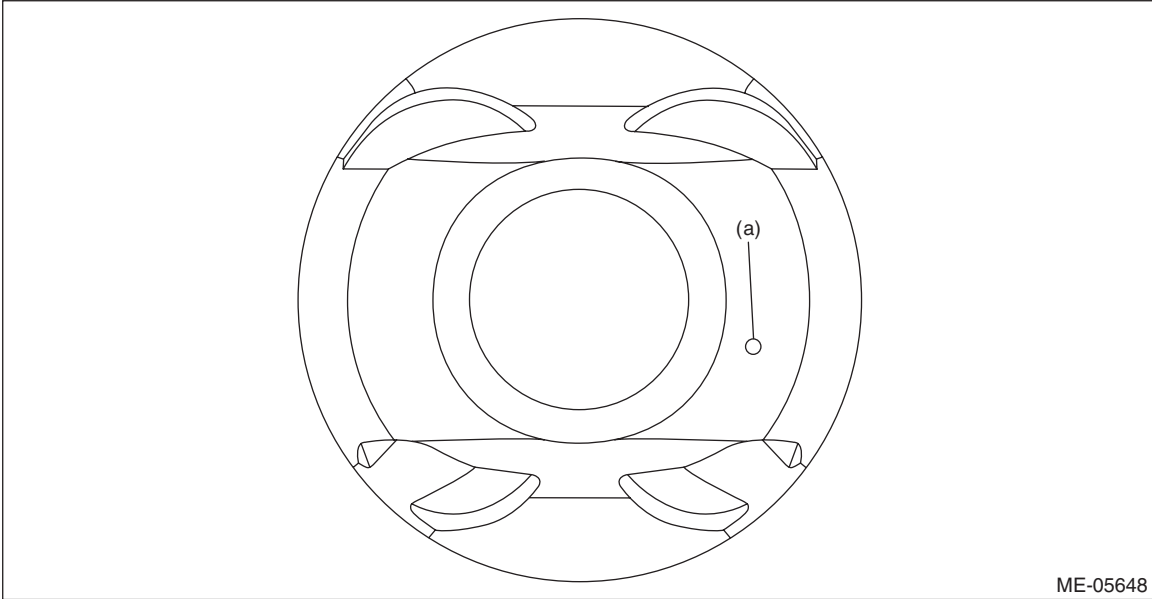
(3) Compress the piston ring using piston ring compressor, and insert the #1 connecting rod with #1 piston into cylinder block.

CAUTION:

- Be careful not to damage the cylinder liner and #1 pin of crankshaft by the #1 connecting rod large end.
- When inserting, be careful not to apply strong impact in order to prevent connecting rod bearing from falling off.

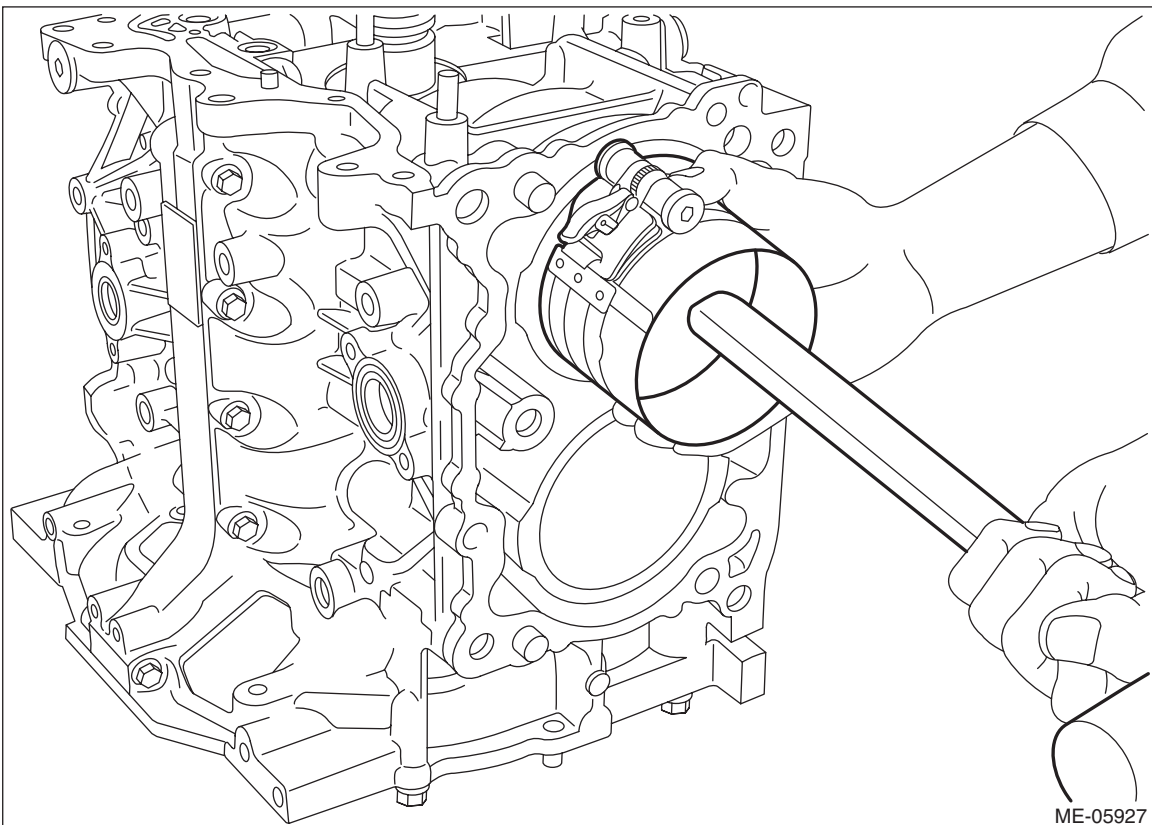
NOTE:

- Face the piston front mark (round mark) towards the front of the engine.



(a) Front mark

- Insert while lightly tapping the crown of the piston with the handle of a plastic hammer.



Cylinder Block

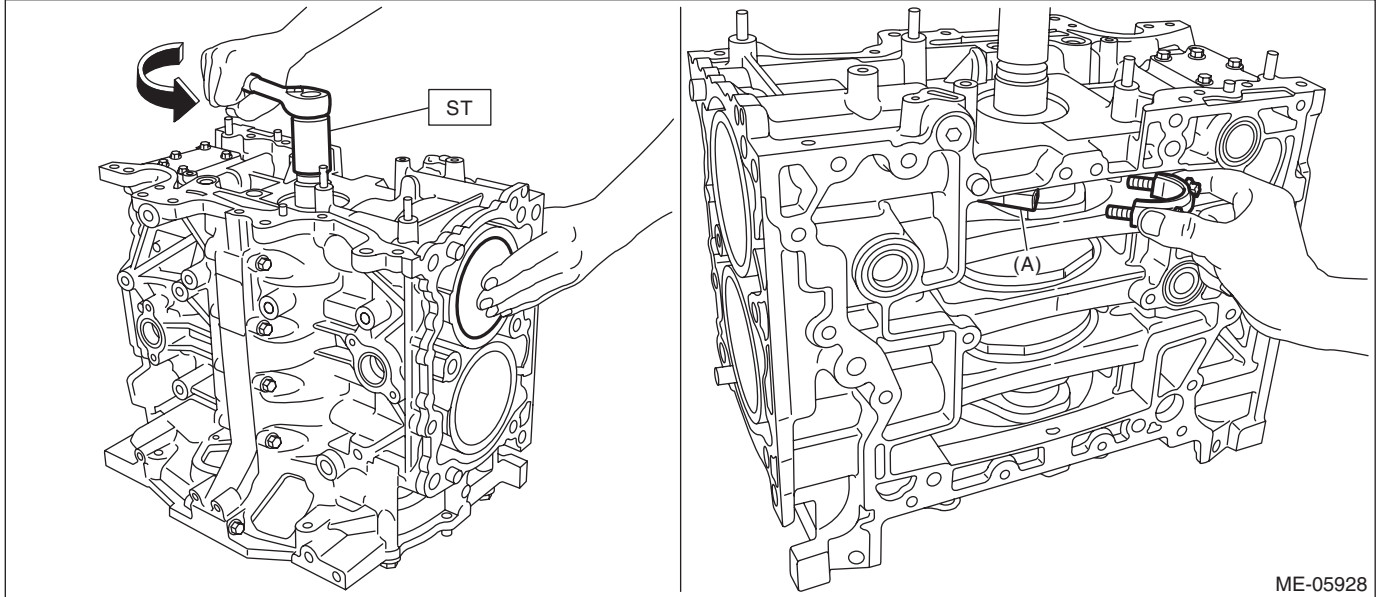
MECHANICAL

(4) Turn the crankshaft counterclockwise so that the #1 pin of crankshaft and the large end (A) of #1 connecting rod are positioned as shown in the figure using ST, while pressing the #1 piston crown, and then set the #1 connecting rod cap and #1 connecting rod cap bolt.

NOTE:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.
- Use a new connecting rod cap bolt.
- Apply a coat of engine oil to the #1 connecting rod cap seat and the connecting rod cap bolt threads.

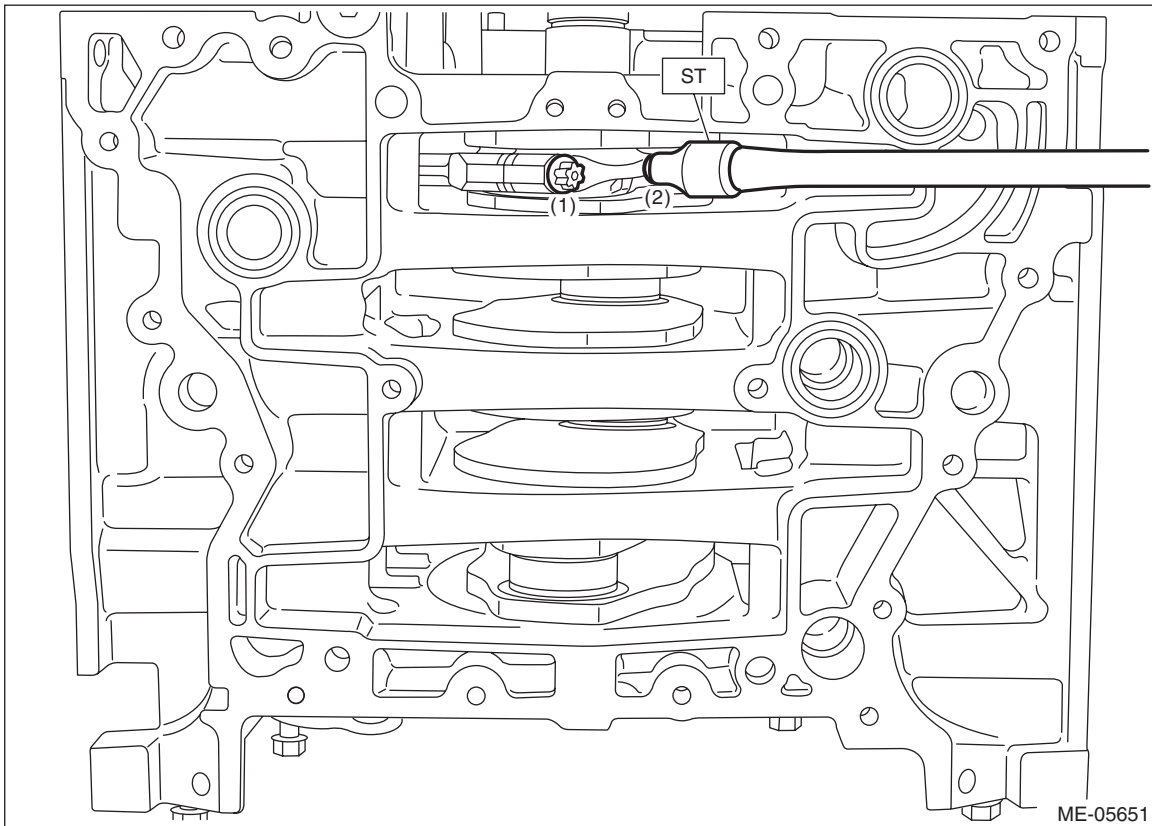
ST 18252AA000 CRANKSHAFT SOCKET



(5) Using ST, tighten the #1 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 22 N·m (2.2 kgf-m, 16.2 ft-lb) in numerical order as shown in the figure.

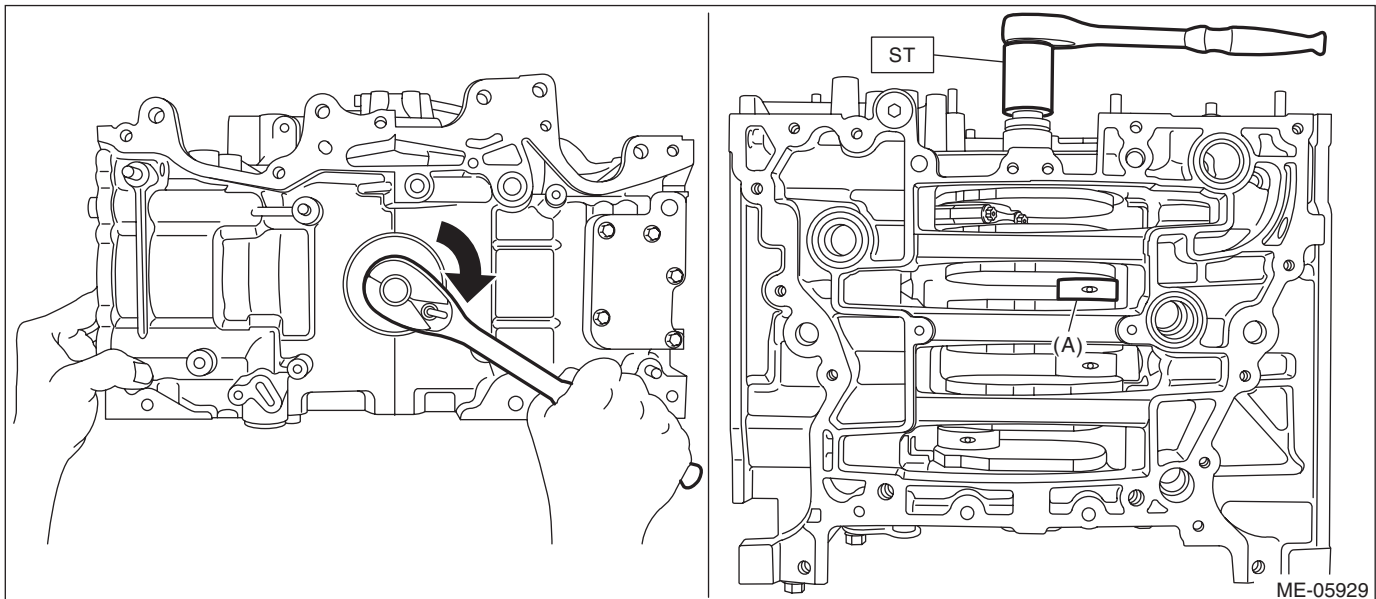
ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



(6) Turn the crankshaft clockwise so that the #2 pin (A) of crankshaft is positioned at TDC using ST.

ST 18252AA000 CRANKSHAFT SOCKET



Cylinder Block

MECHANICAL

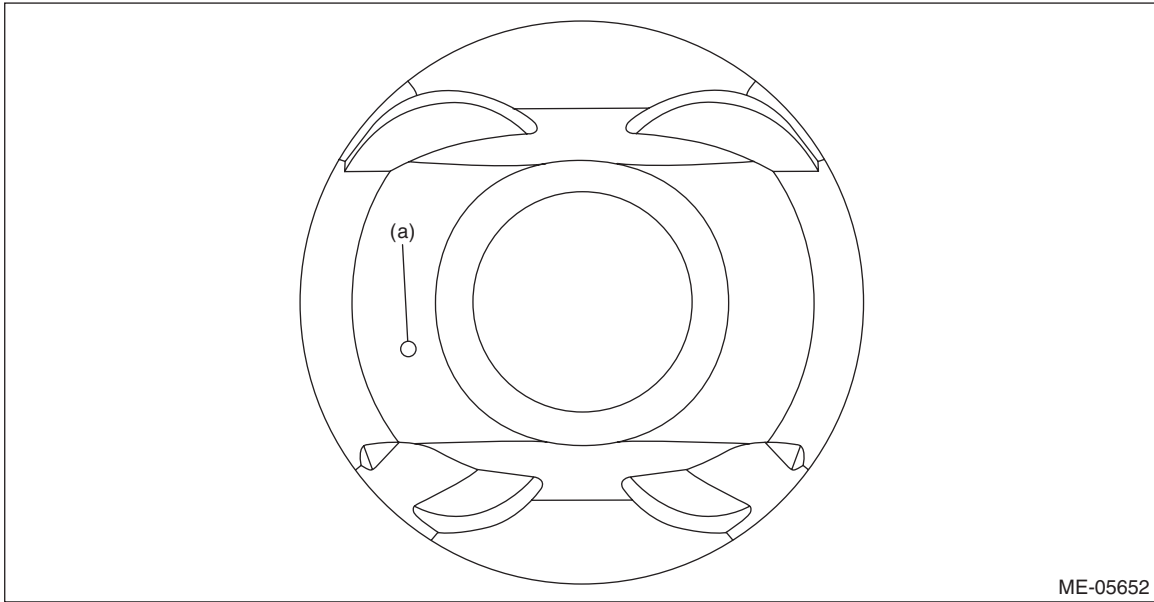
(7) Compress the piston ring using piston ring compressor, and insert the #2 connecting rod with #2 piston into cylinder block.

CAUTION:

- Be careful not to damage the cylinder liner and #2 pin of crankshaft by the #2 connecting rod large end.
- When inserting, be careful not to apply strong impact in order to prevent connecting rod bearing from falling off.

NOTE:

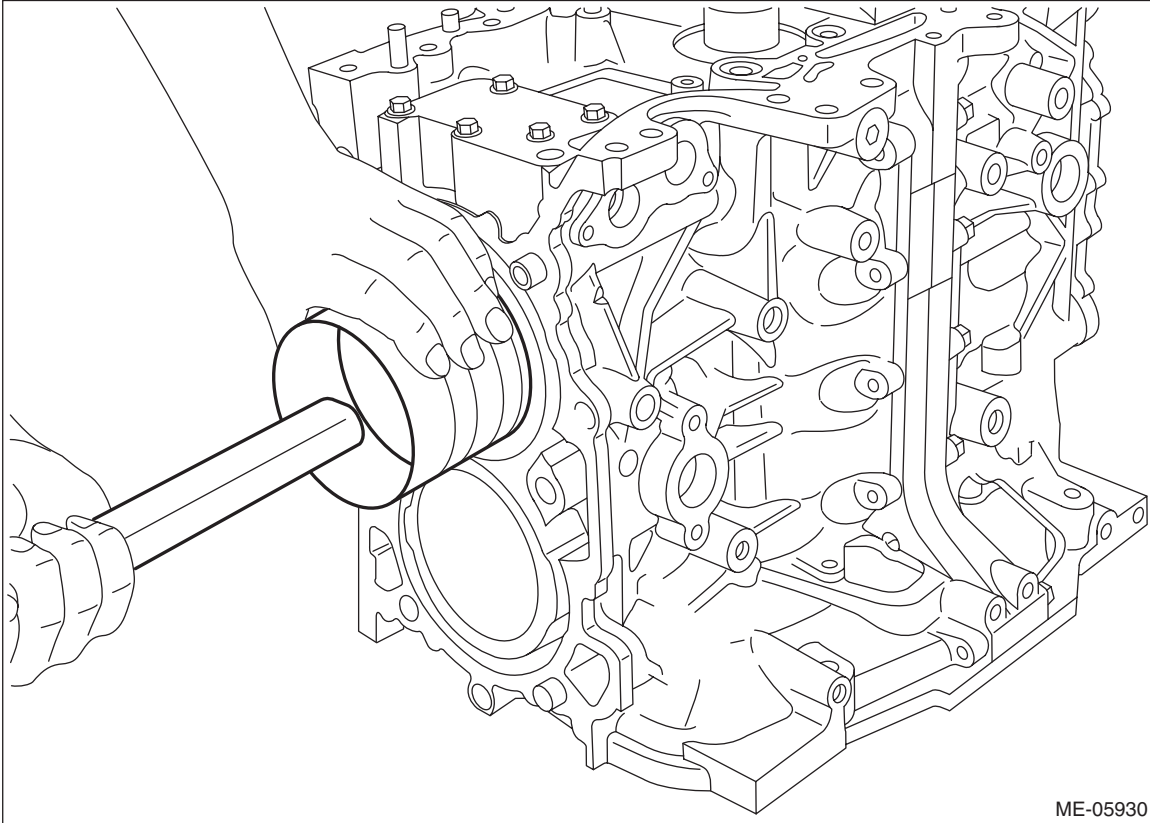
- Face the piston front mark (round mark) towards the front of the engine.



ME-05652

(a) Front mark

- Insert while lightly tapping the crown of the piston with the handle of a plastic hammer.

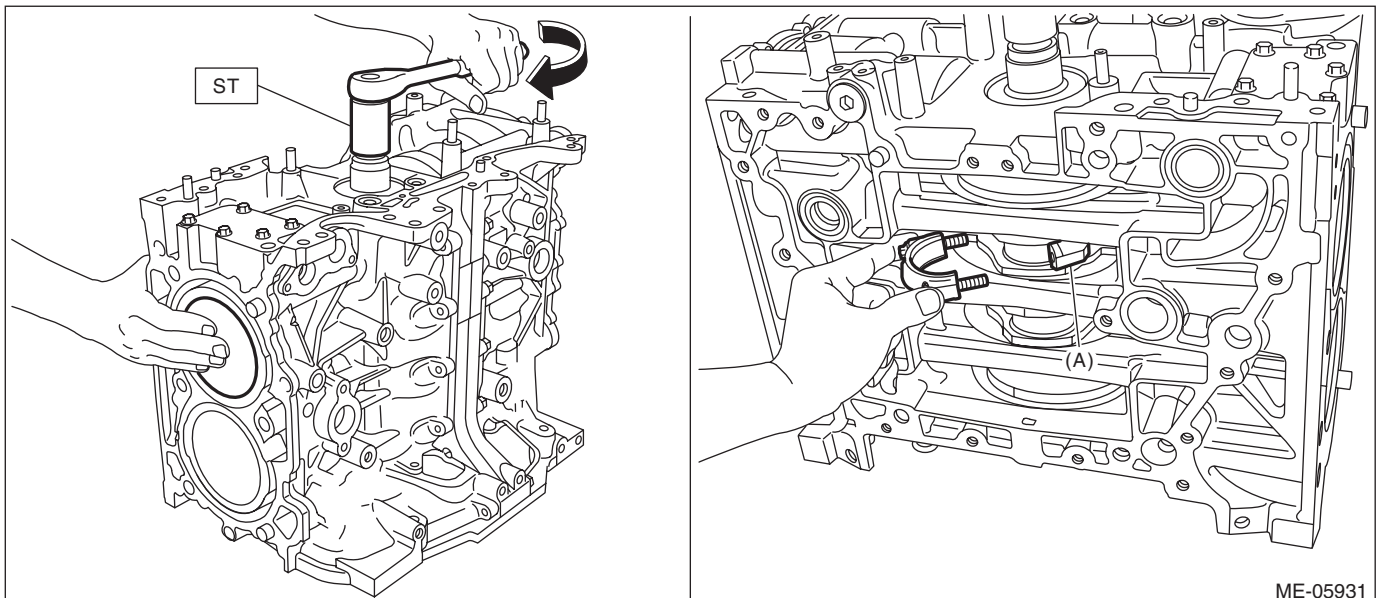


(8) Turn the crankshaft clockwise so that the #2 pin of crankshaft and the large end (A) of #2 connecting rod are positioned as shown in the figure using ST, while pressing the #2 piston crown, and then set the #2 connecting rod cap and #2 connecting rod cap bolt.

NOTE:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.
- Use a new connecting rod cap bolt.
- Apply a coat of engine oil to the #2 connecting rod cap seat and the connecting rod cap bolt threads.

ST 18252AA000 CRANKSHAFT SOCKET



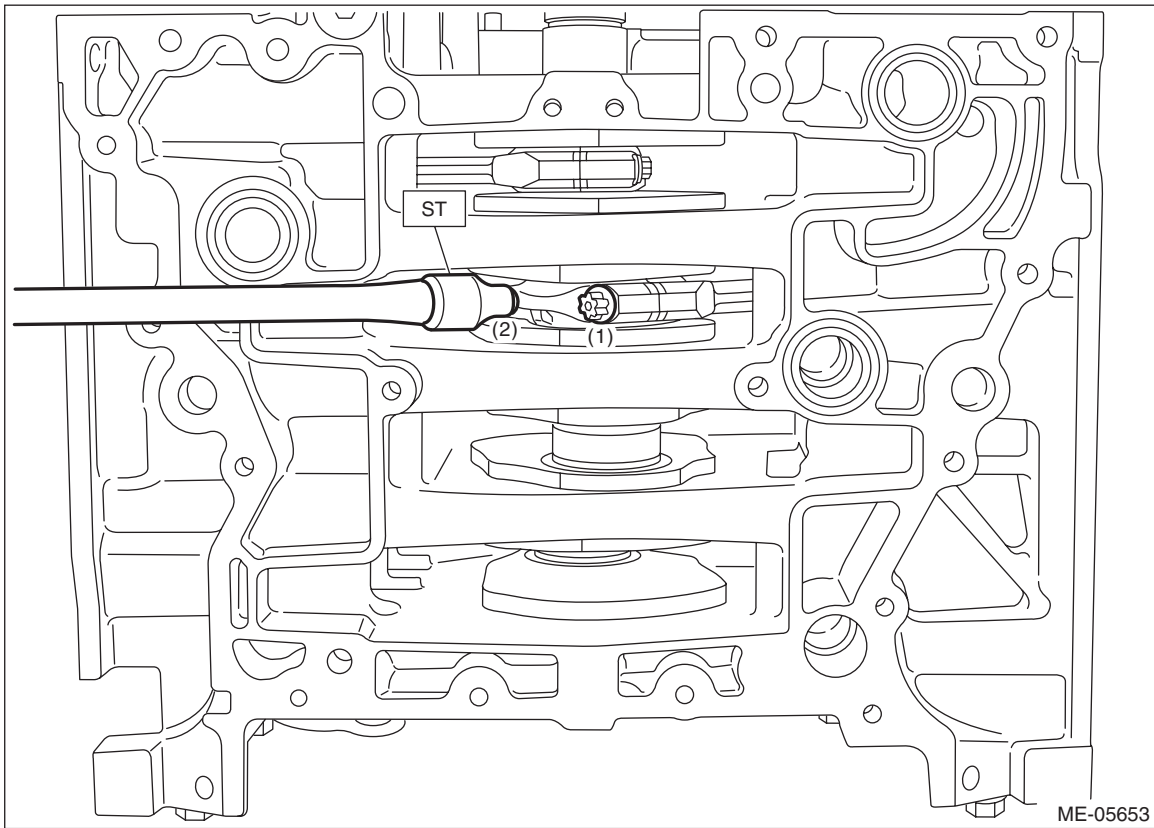
Cylinder Block

MECHANICAL

(9) Using ST, tighten the #2 connecting rod cap bolts to 10 N·m (1.0 kgf·m, 7.4 ft·lb) in numerical order as shown in the figure, then retighten the bolts to 22 N·m (2.2 kgf·m, 16.2 ft·lb) in numerical order as shown in the figure.

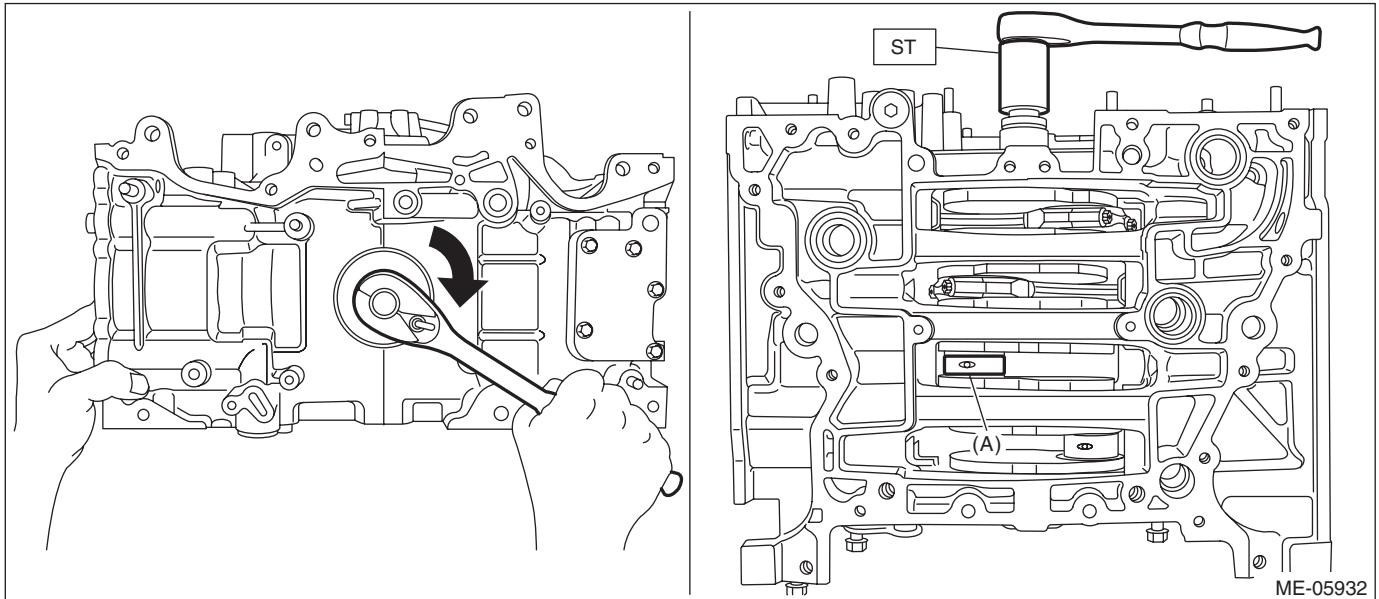
ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



(10) Turn the crankshaft clockwise so that the #3 pin (A) of crankshaft is positioned at TDC using ST.

ST 18252AA000 CRANKSHAFT SOCKET



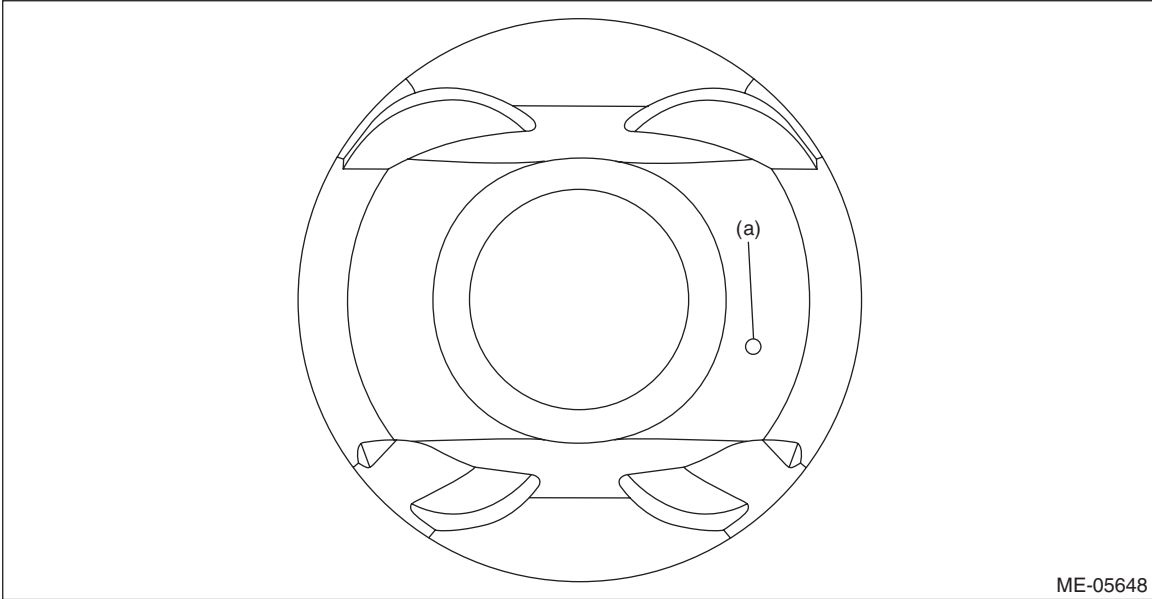
(11) Compress the piston ring using piston ring compressor, and insert the #3 connecting rod with #3 piston into cylinder block.

CAUTION:

- Be careful not to damage the cylinder liner and #3 pin of crankshaft by the #3 connecting rod large end.
- When inserting, be careful not to apply strong impact in order to prevent connecting rod bearing from falling off.

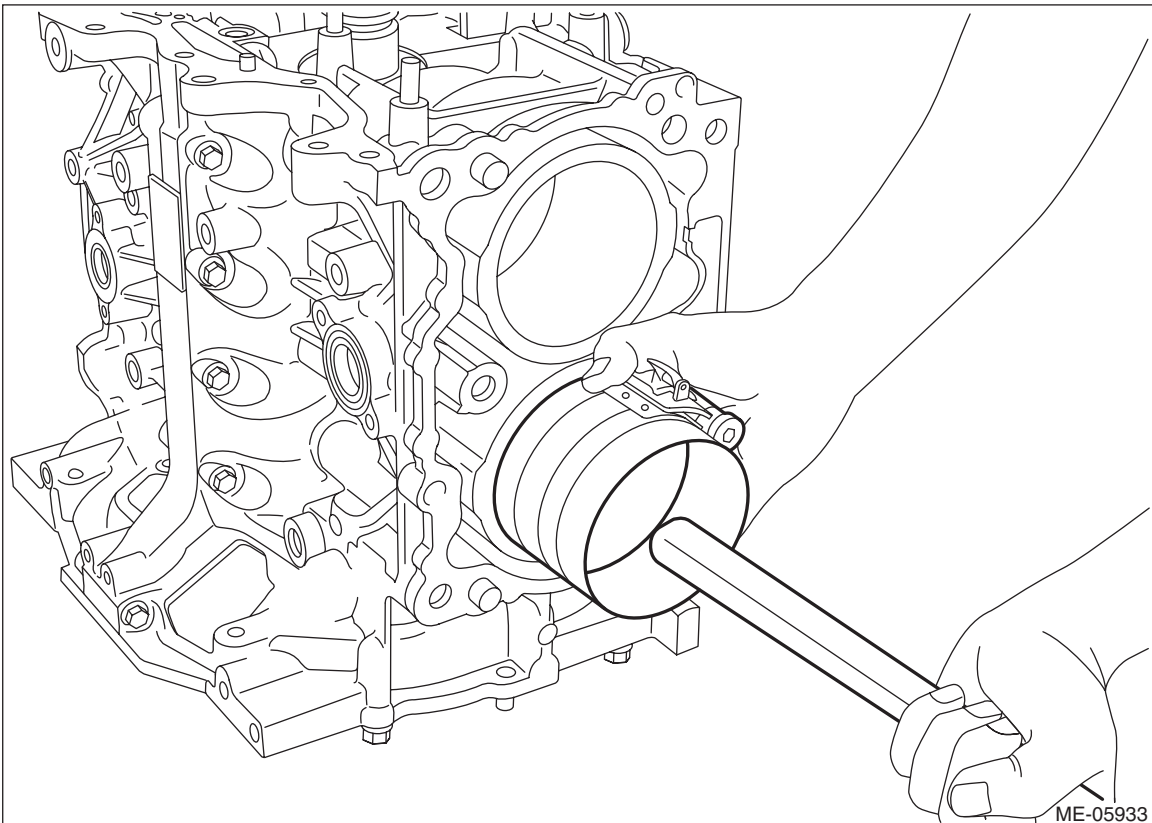
NOTE:

- Face the piston front mark (round mark) towards the front of the engine.



(a) Front mark

- Insert while lightly tapping the crown of the piston with the handle of a plastic hammer.



Cylinder Block

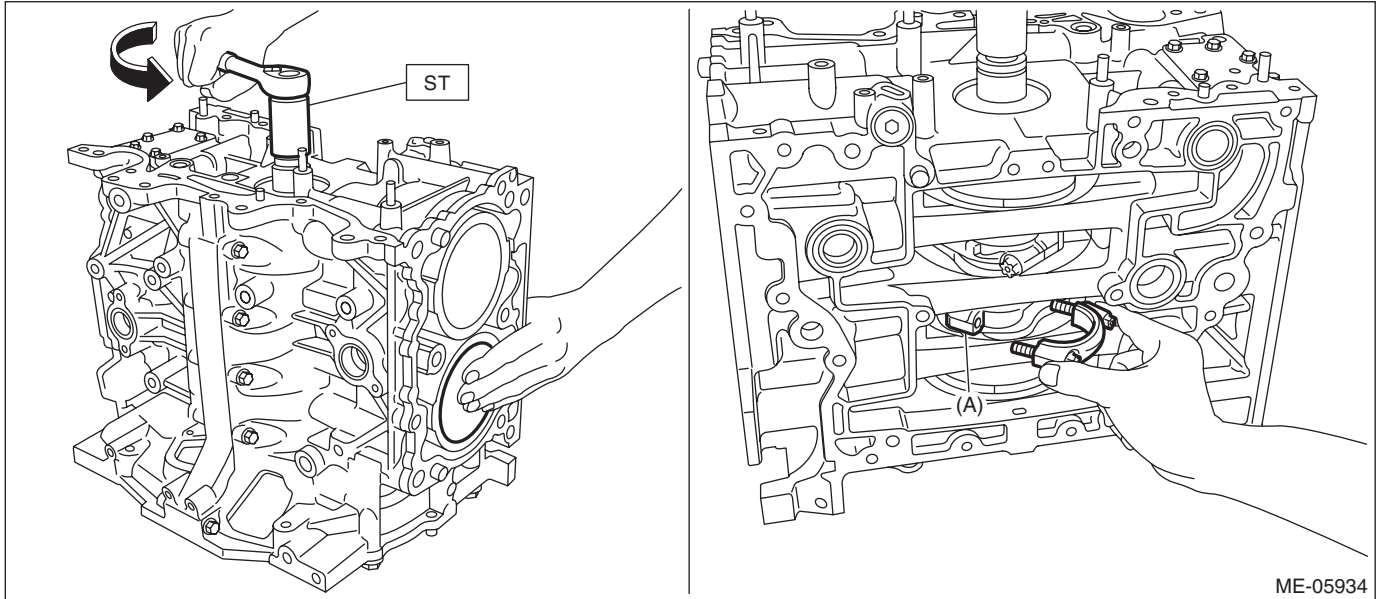
MECHANICAL

(12) Turn the crankshaft counterclockwise so that the #3 pin of crankshaft and the large end (A) of #3 connecting rod are positioned as shown in the figure using ST, while pressing the #3 piston crown, and then set the #3 connecting rod cap and #3 connecting rod cap bolt.

NOTE:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.
- Use a new connecting rod cap bolt.
- Apply a coat of engine oil to the #3 connecting rod cap seat and the connecting rod cap bolt threads.

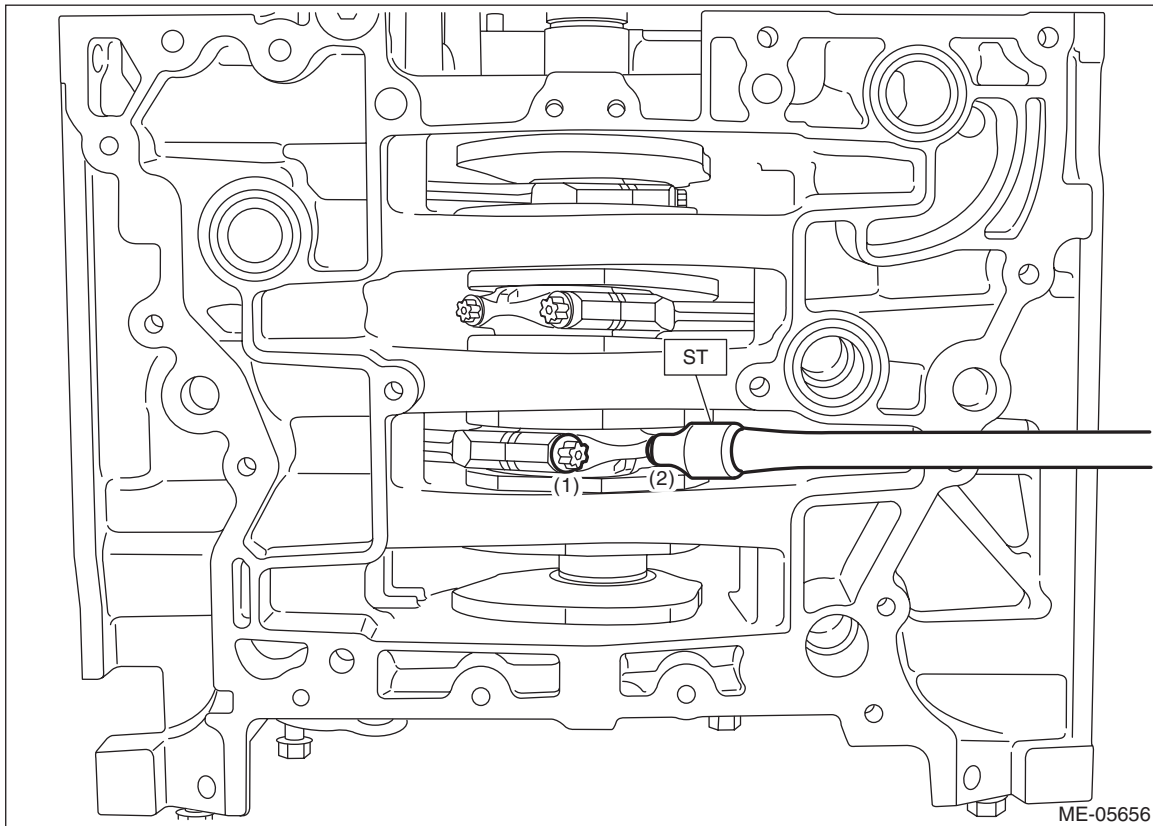
ST 18252AA000 CRANKSHAFT SOCKET



(13) Using ST, tighten the #3 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 22 N·m (2.2 kgf-m, 16.2 ft-lb) in numerical order as shown in the figure.

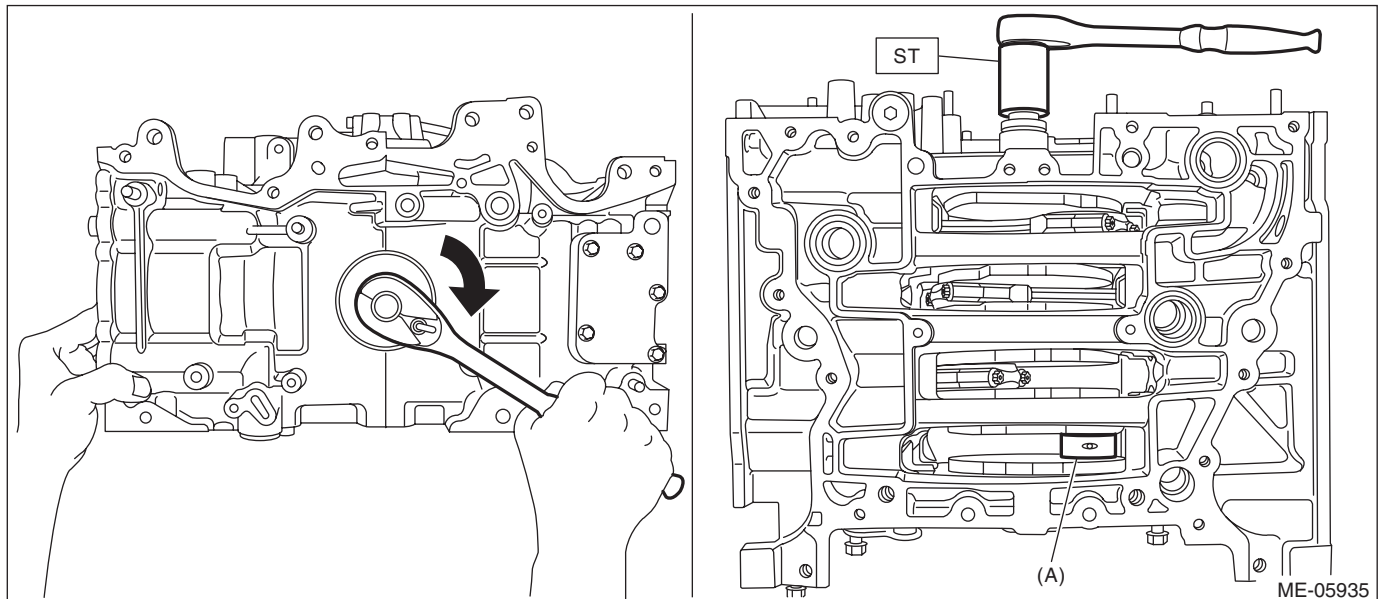
ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



(14) Turn the crankshaft clockwise so that the #4 pin (A) of crankshaft is positioned at TDC using ST.

ST 18252AA000 CRANKSHAFT SOCKET



Cylinder Block

MECHANICAL

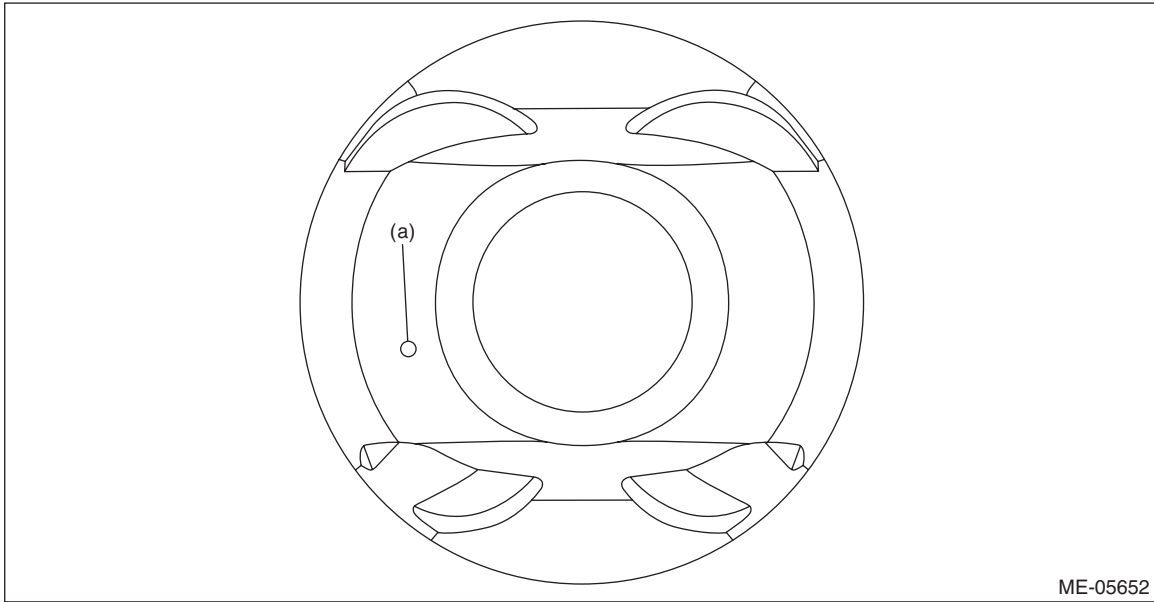
(15) Compress the piston ring using piston ring compressor, and insert the #4 connecting rod with #4 piston into cylinder block.

CAUTION:

- Be careful not to damage the cylinder liner and #4 pin of crankshaft by the #4 connecting rod large end.
- When inserting, be careful not to apply strong impact in order to prevent connecting rod bearing from falling off.

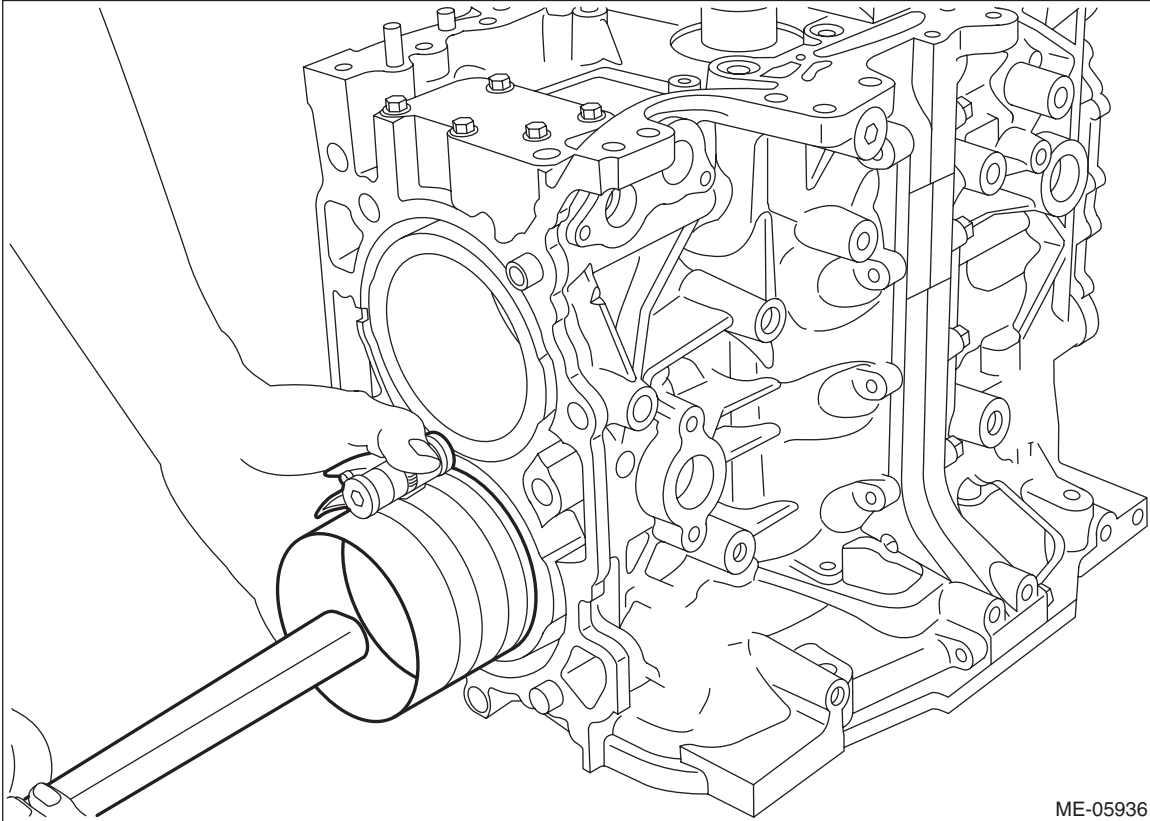
NOTE:

- Face the piston front mark (round mark) towards the front of the engine.



(a) Front mark

- Insert while lightly tapping the crown of the piston with the handle of a plastic hammer.

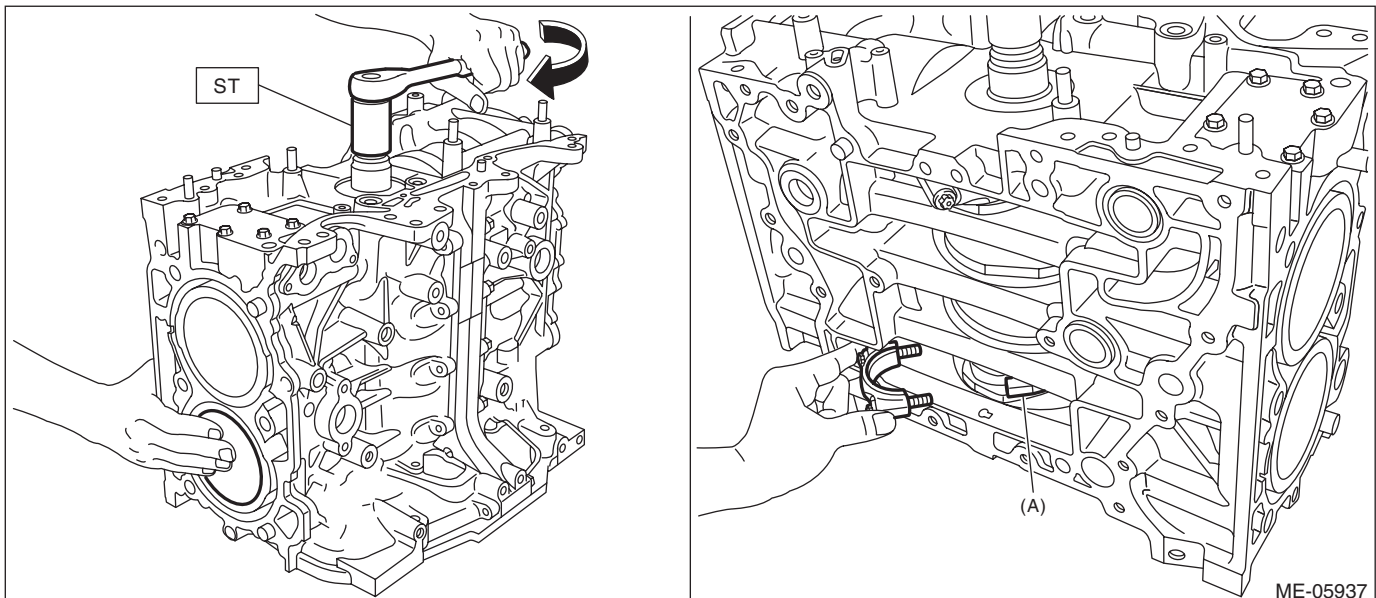


(16) Turn the crankshaft clockwise so that the #4 pin of crankshaft and the large end (A) of #4 connecting rod are positioned as shown in the figure using ST, while pressing the #4 piston crown, and then set the #4 connecting rod cap and #4 connecting rod cap bolt.

NOTE:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.
- Use a new connecting rod cap bolt.
- Apply a coat of engine oil to the #4 connecting rod cap seat and the connecting rod cap bolt threads.

ST 18252AA000 CRANKSHAFT SOCKET



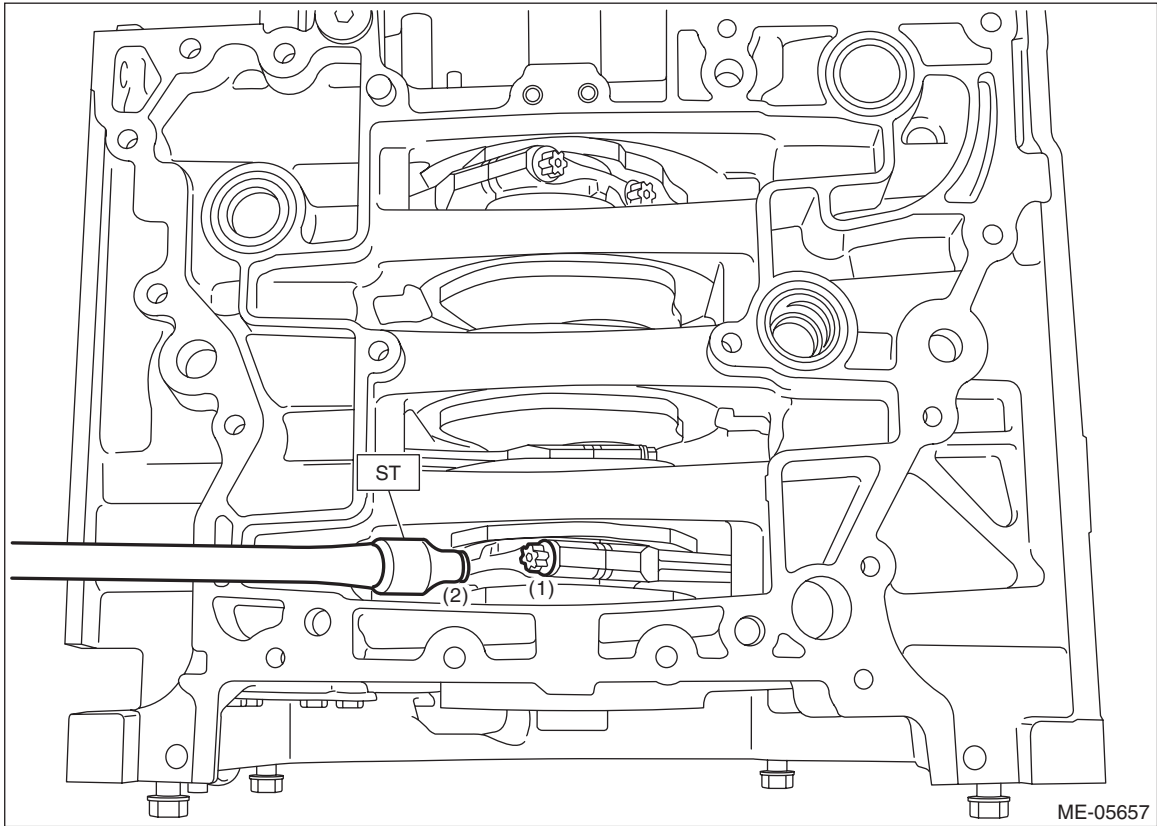
Cylinder Block

MECHANICAL

(17) Using ST, tighten the #4 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 22 N·m (2.2 kgf-m, 16.2 ft-lb) in numerical order as shown in the figure.

ST 18270AA010 SOCKET (when using TORX® E12)

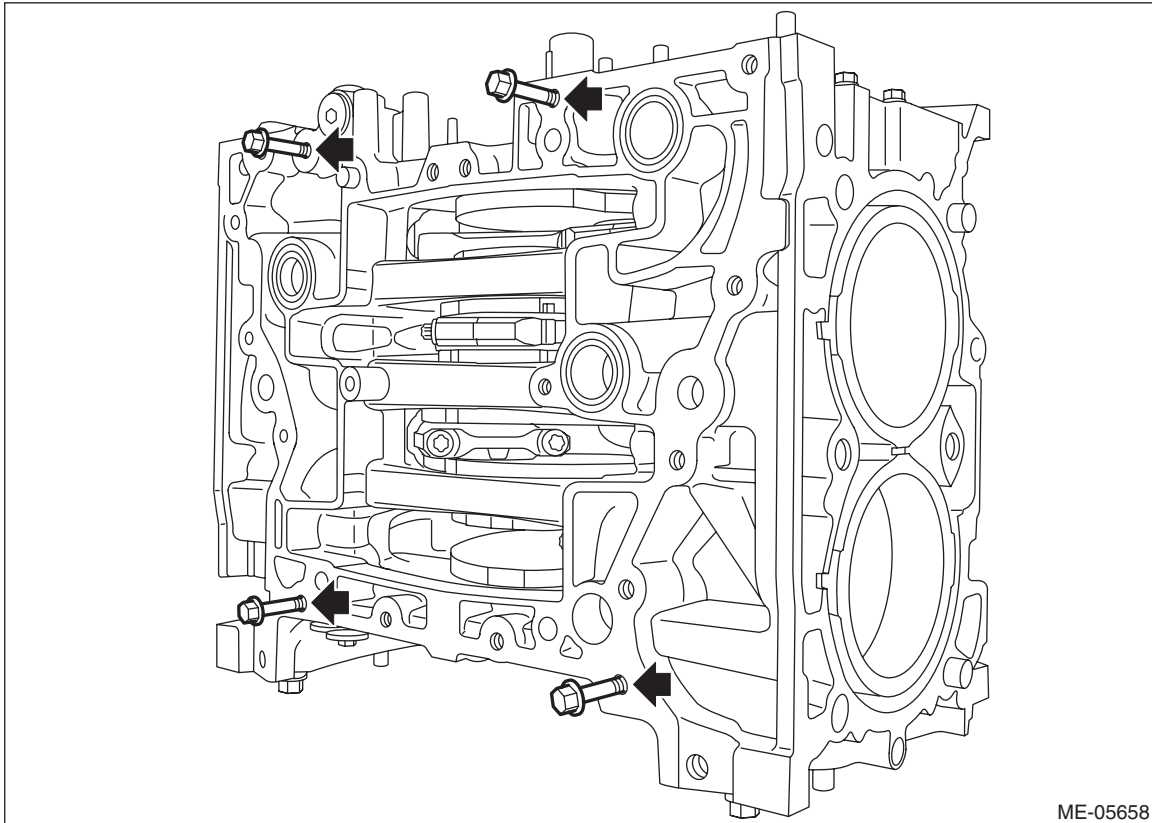
ST 18270AA020 SOCKET (when using TORX® E14)



(18) Install the cam carrier mounting bolts at the locations shown in the figure.

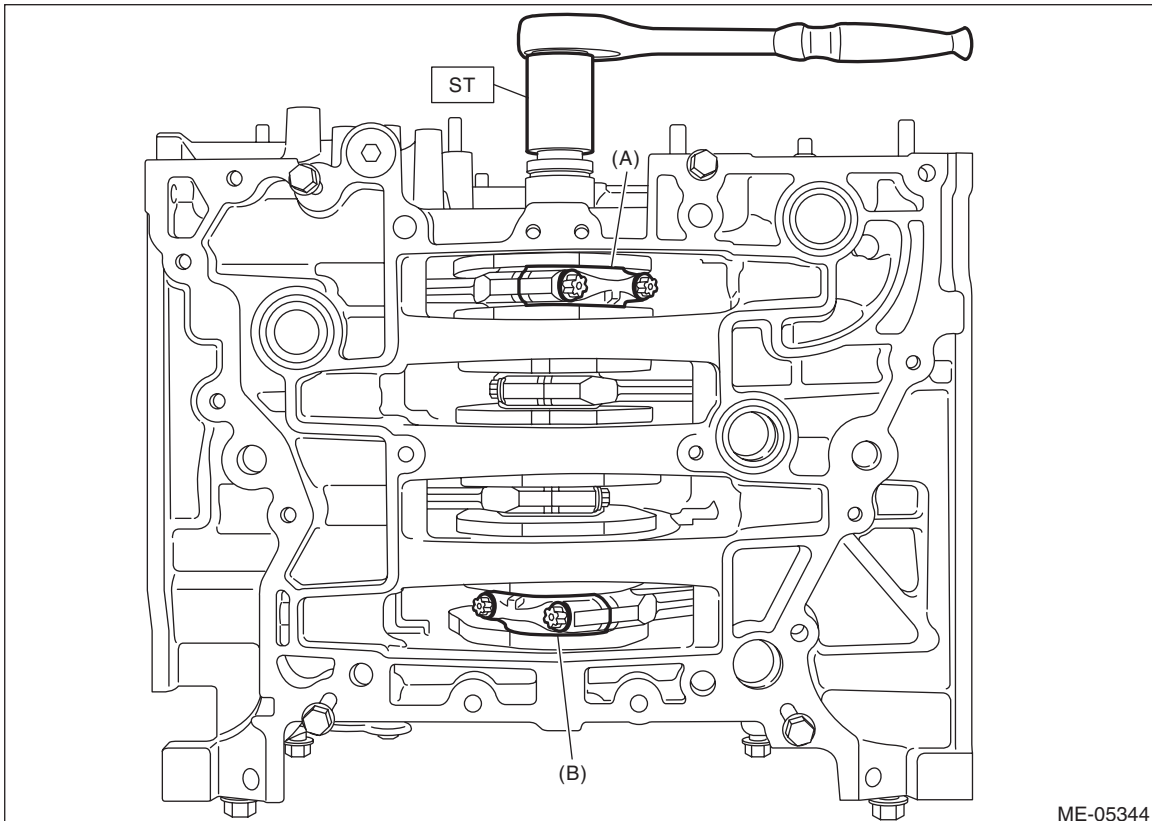
NOTE:

This procedure is required to tighten the connecting rod cap bolts with specified angle using ST.



(19) Turn the crankshaft so that the #1 connecting rod cap (A) and #4 connecting rod cap (B) is located at the position shown in the figure using ST.

ST 18252AA000 CRANKSHAFT SOCKET



Cylinder Block

MECHANICAL

(20) Using ST1 and ST2, tighten the #1 connecting rod cap bolts and #4 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

NOTE:

Attach the magnet used for securing the ST1 (ANGLE GAUGE) to the cam carrier mounting bolt attached in step (18).

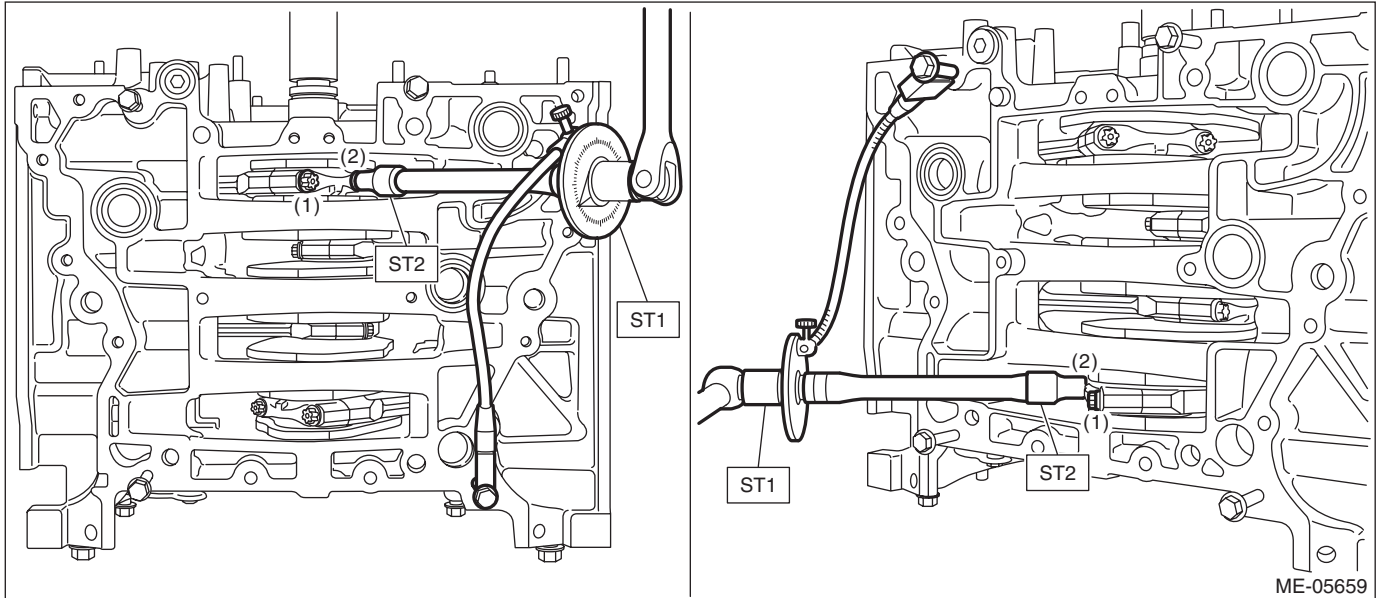
ST1 18854AA000 ANGLE GAUGE

ST2 18270AA010 SOCKET (when using TORX® E12)

ST2 18270AA020 SOCKET (when using TORX® E14)

Tightening angle:

137°±2°

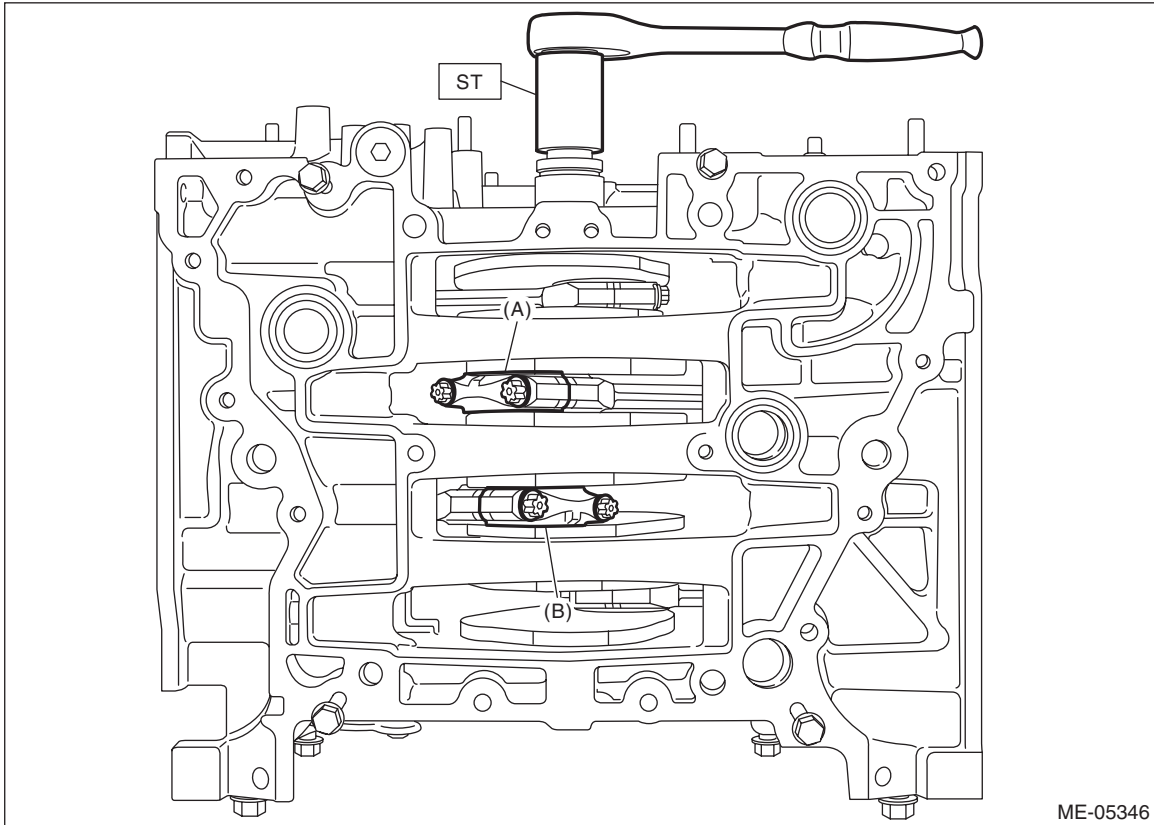


Cylinder Block

MECHANICAL

(21) Turn the crankshaft so that the #2 connecting rod cap (A) and #3 connecting rod cap (B) is located at the position shown in the figure using ST.

ST 18252AA000 CRANKSHAFT SOCKET



ME-05346

Cylinder Block

MECHANICAL

(22) Using ST1 and ST2, tighten the #2 connecting rod cap bolts and #3 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

NOTE:

Attach the magnet used for securing the ST1 (ANGLE GAUGE) to the cam carrier mounting bolt attached in step (18).

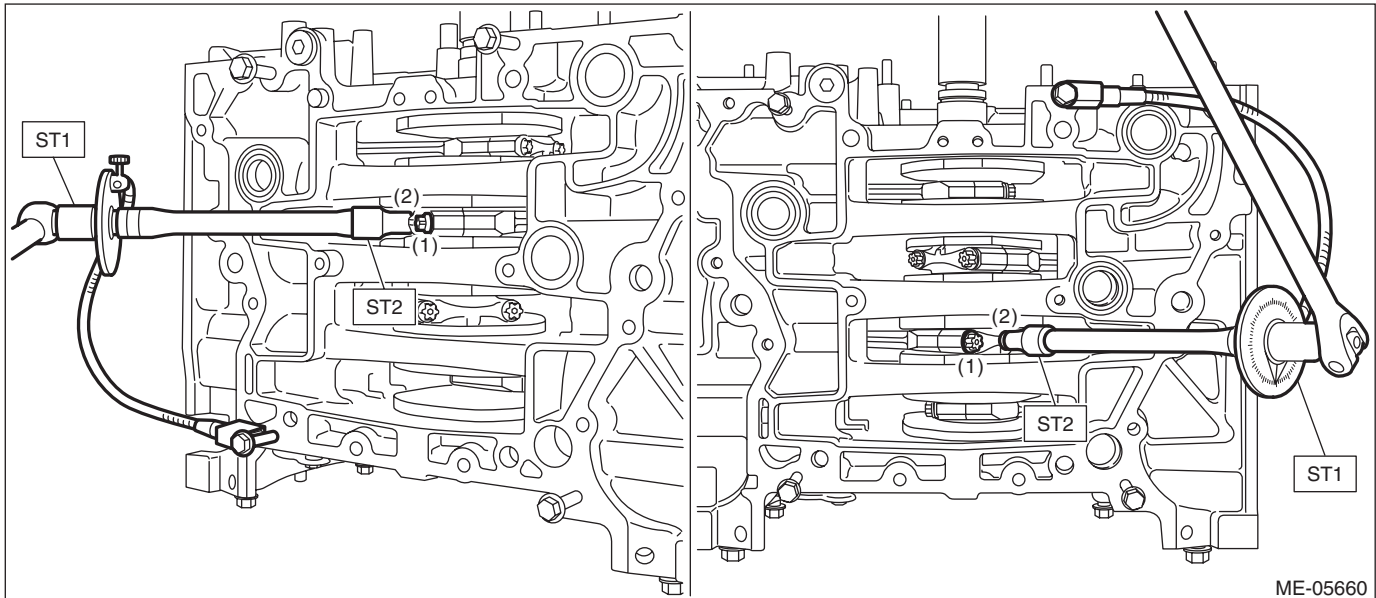
ST1 18854AA000 ANGLE GAUGE

ST2 18270AA010 SOCKET (when using TORX® E12)

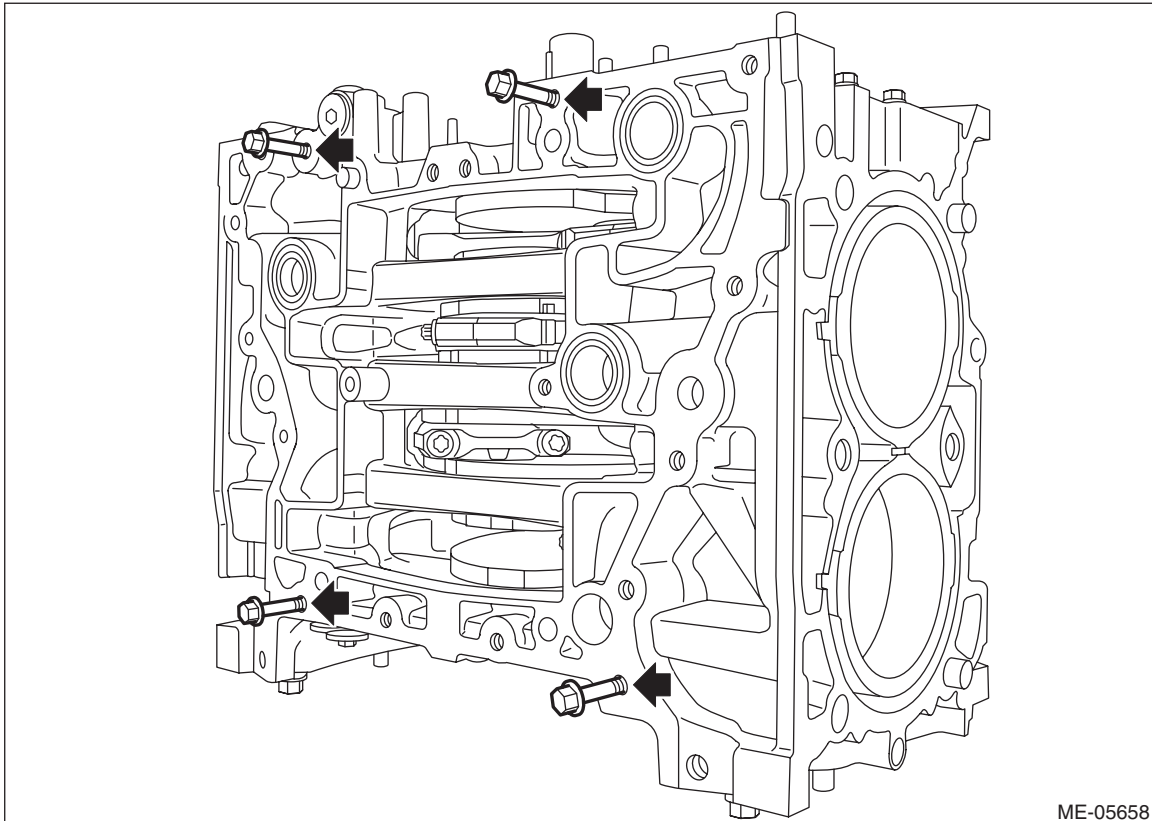
ST2 18270AA020 SOCKET (when using TORX® E14)

Tightening angle:

$137^{\circ} \pm 2^{\circ}$



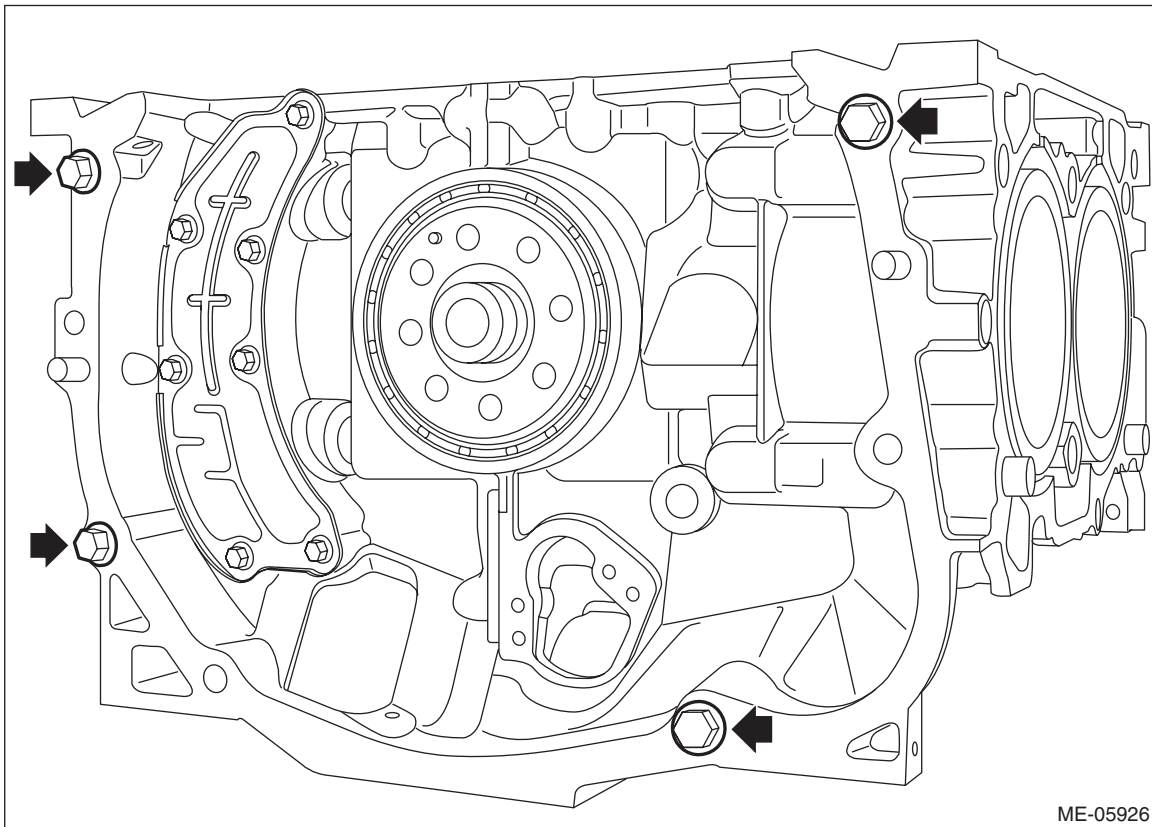
(23) Remove the cam carrier mounting bolts attached at the locations shown in the figure.



Cylinder Block

MECHANICAL

13) Set the cylinder block so that the oil pan side faces upward, and remove the mounting bolts for A/C compressor and the generator bracket attached to the locations shown in the figure.



ME-05926

Cylinder Block

MECHANICAL

14) Install the oil pan upper with oil pan to the cylinder block.

(1) Apply liquid gasket to the mating surface of oil pan upper as shown in the figure.

NOTE:

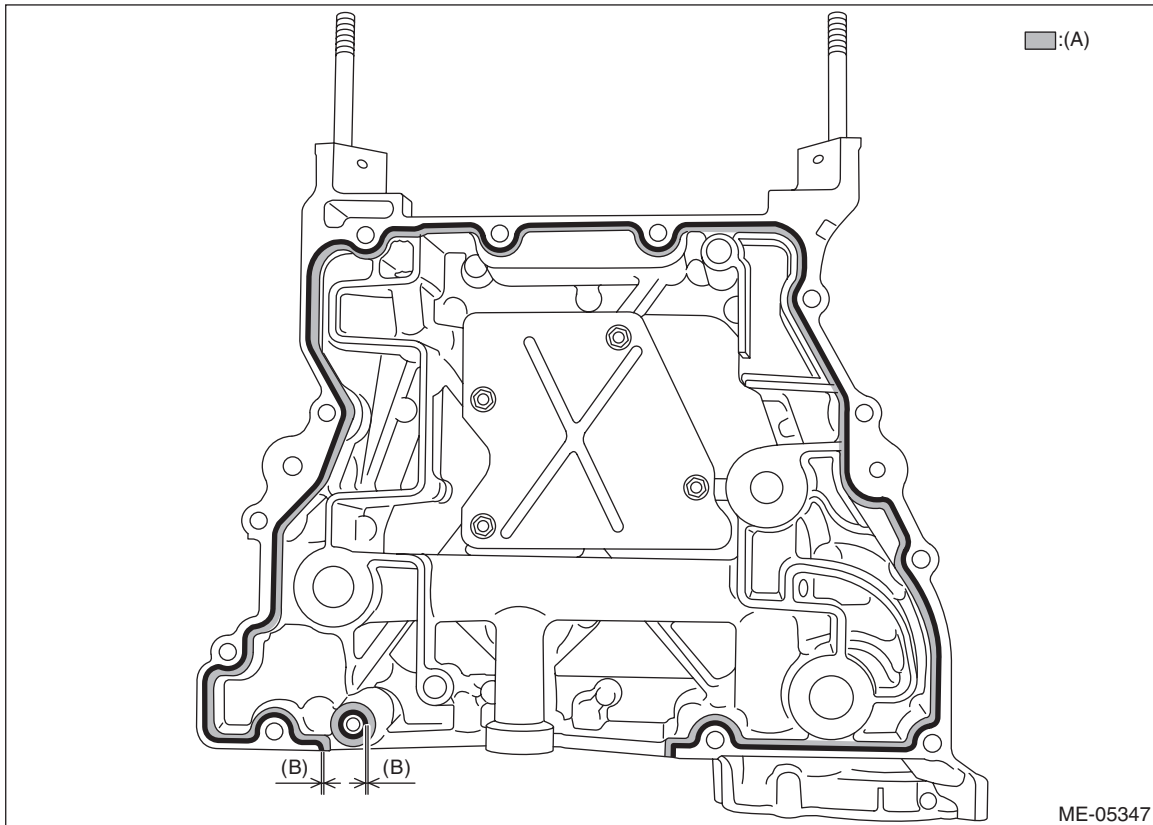
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder block and the oil pan upper.
- Install within 5 min. after applying liquid gasket.
- Apply liquid gasket 1.5 mm (0.0591 in) outside from the chamfer surface. However, application of liquid gasket on the chamfer surface around the bolt hole is allowed.

Liquid gasket:

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

Liquid gasket applying diameter:

5 ± 1 mm (0.1969 ± 0.0394 in)



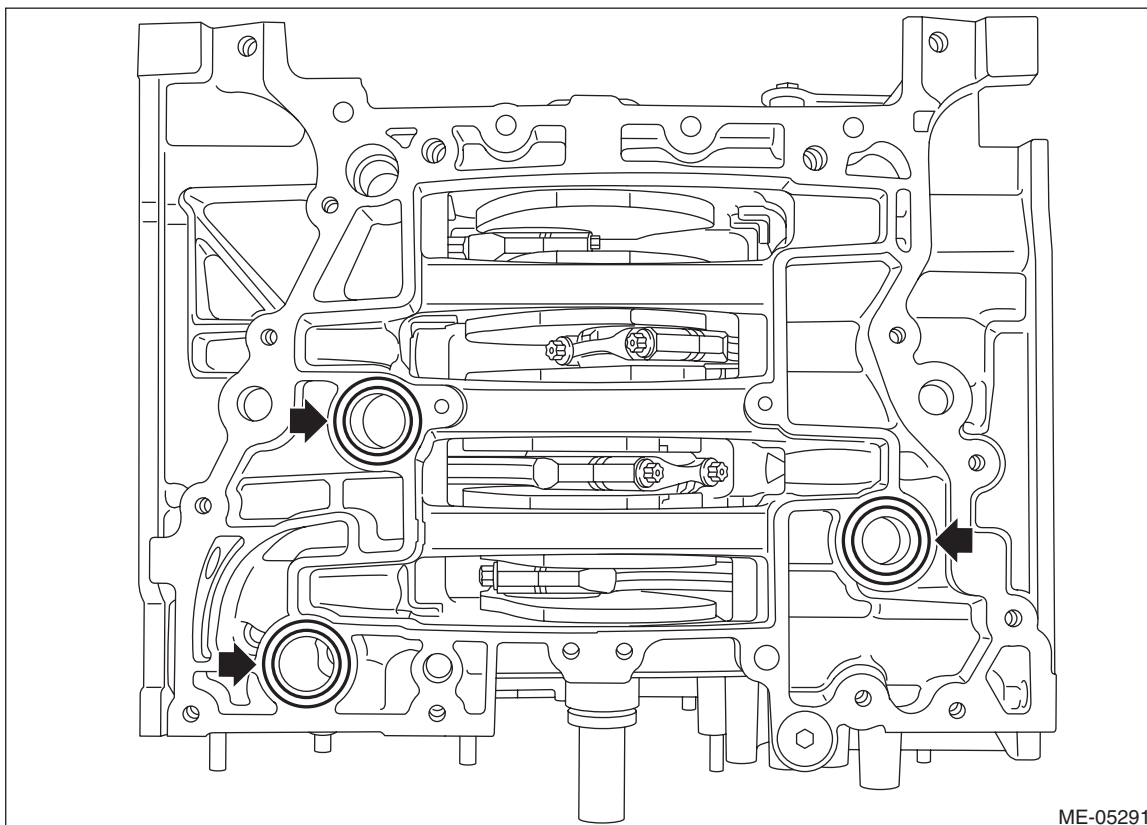
(A) Chamfer surface

(B) 1.5 mm (0.0591 in)

(2) Install the O-ring to the cylinder block.

NOTE:

Use new O-rings.



Cylinder Block

MECHANICAL

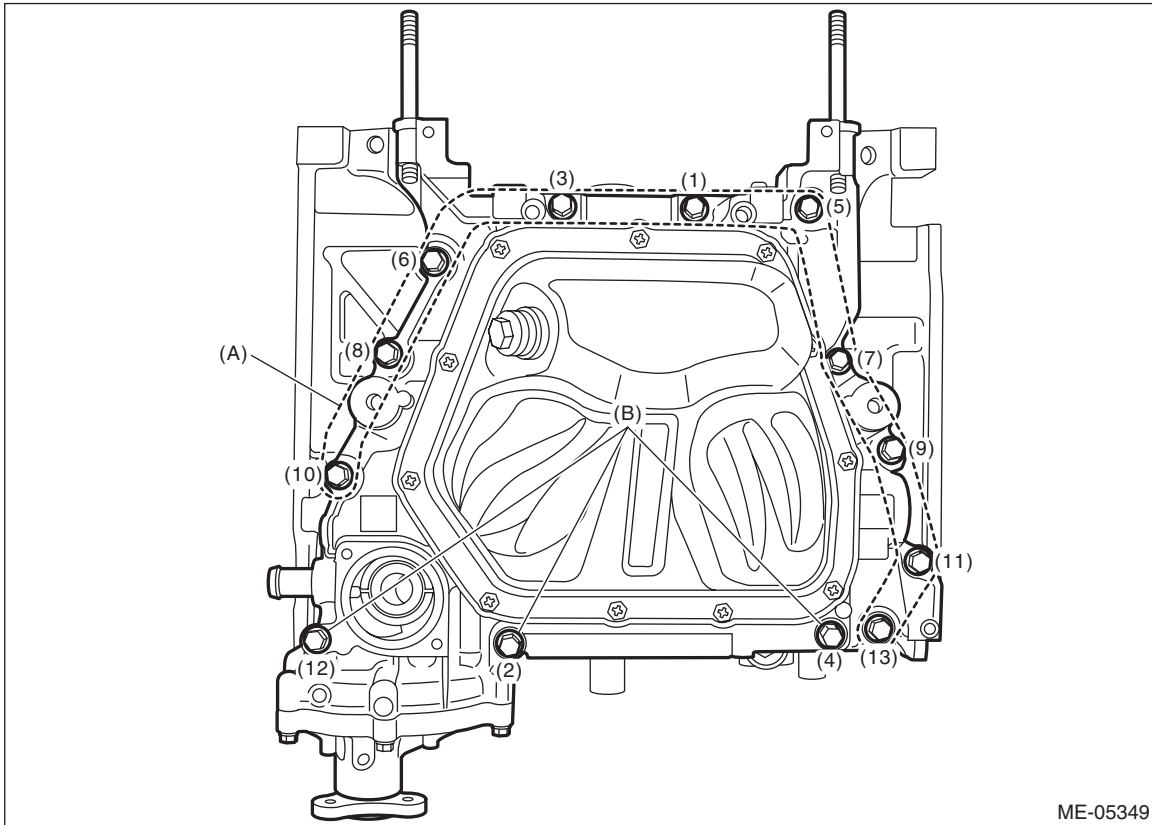
(3) Set the oil pan with oil pan upper to the cylinder block, and tighten the bolts in numerical order as shown in the figure.

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 torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



(A) M8 × 25

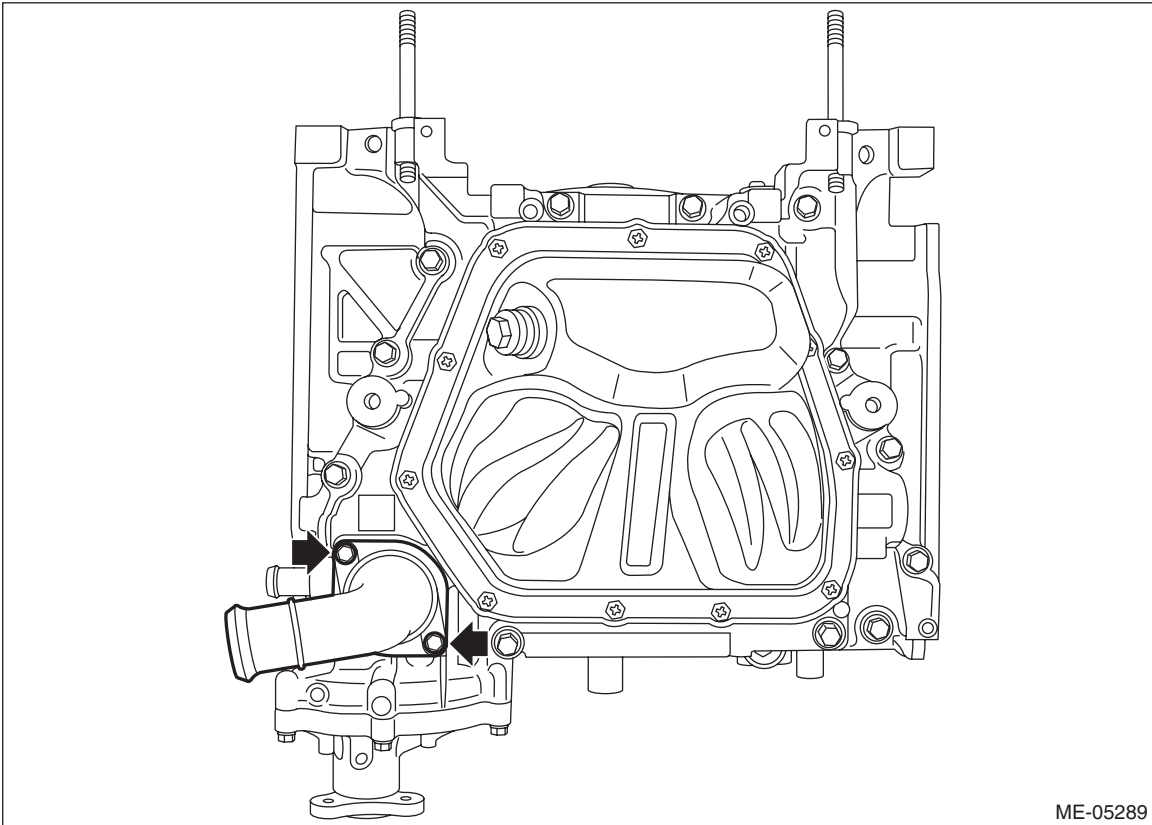
(B) M8 × 75

15) Set the thermostat to the oil pan upper, and install the thermostat cover.

NOTE:

Use a new gasket.

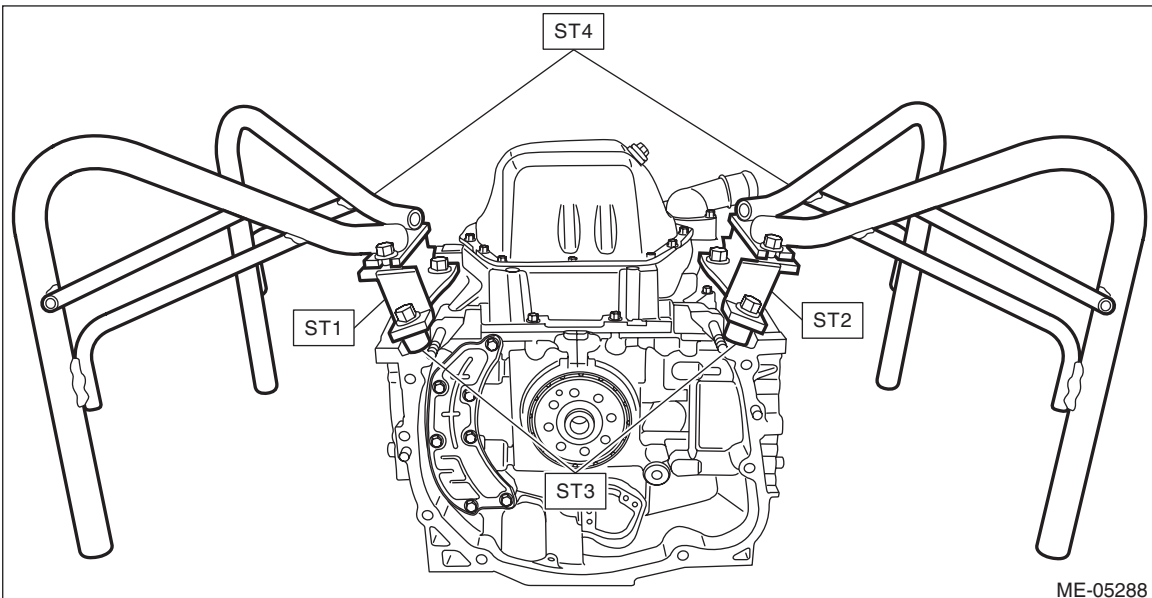
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



16) Install the ST1, ST2, ST3 and ST4 to the cylinder block and oil pan upper.

ST1 498457000 ENGINE STAND ADAPTER RH
ST2 498457100 ENGINE STAND ADAPTER LH
ST3 18362AA020 ADAPTER
ST4 499817100 ENGINE STAND

Tightening torque:
35 N·m (3.6 kgf-m, 25.8 ft-lb)



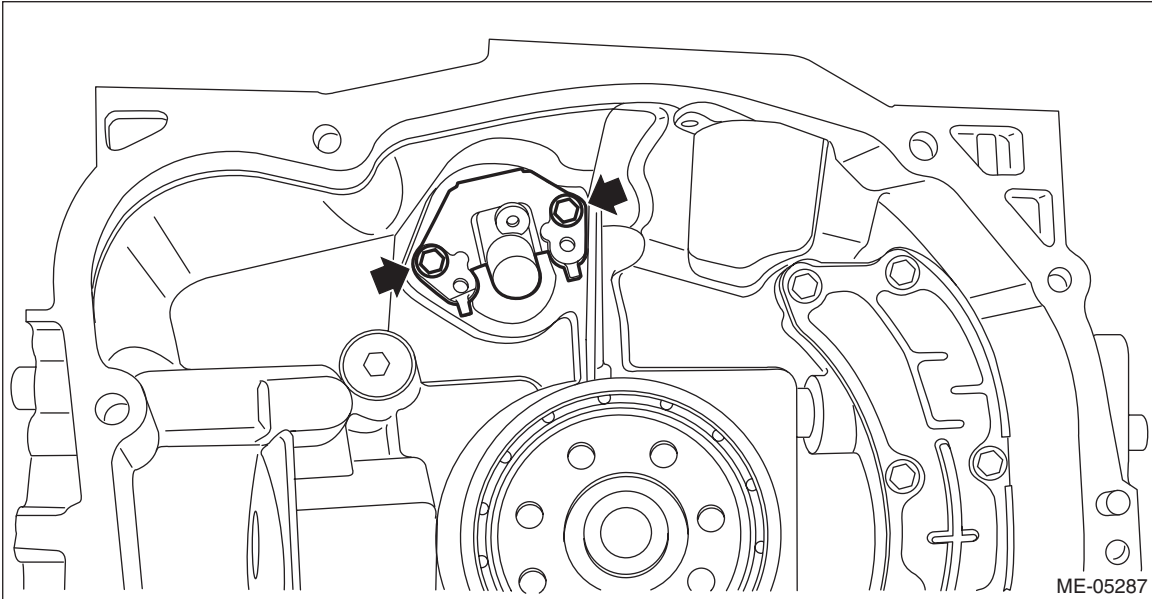
Cylinder Block

MECHANICAL

17) Install the crankshaft position sensor with crankshaft position sensor holder to the cylinder block LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



18) Install the crankshaft position sensor plate with drive plate. (CVT model) <Ref. to CVT-150, INSTALLATION, Drive Plate.>

19) Install the crankshaft position sensor plate with flywheel. (MT model) <Ref. to CL-13, INSTALLATION, Flywheel.>

20) Install the clutch disc and cover. (MT model) <Ref. to CL-10, INSTALLATION, Clutch Disc and Cover.>

21) Install the PCV valve onto the cylinder block RH.

NOTE:

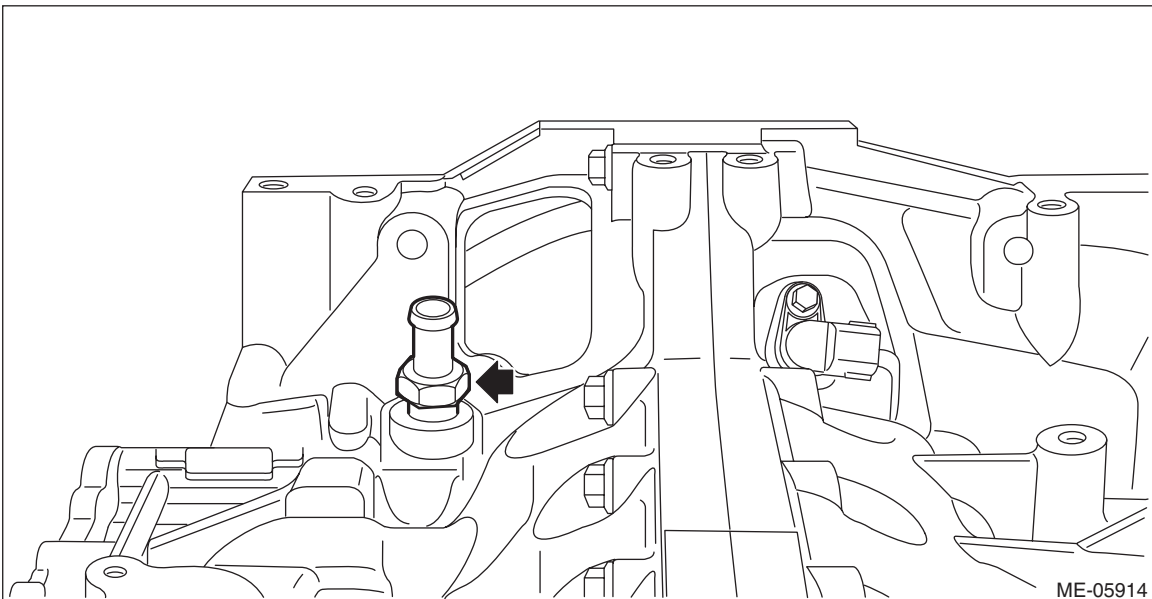
Apply liquid gasket to the bolt threads of PCV valve.

Liquid gasket:

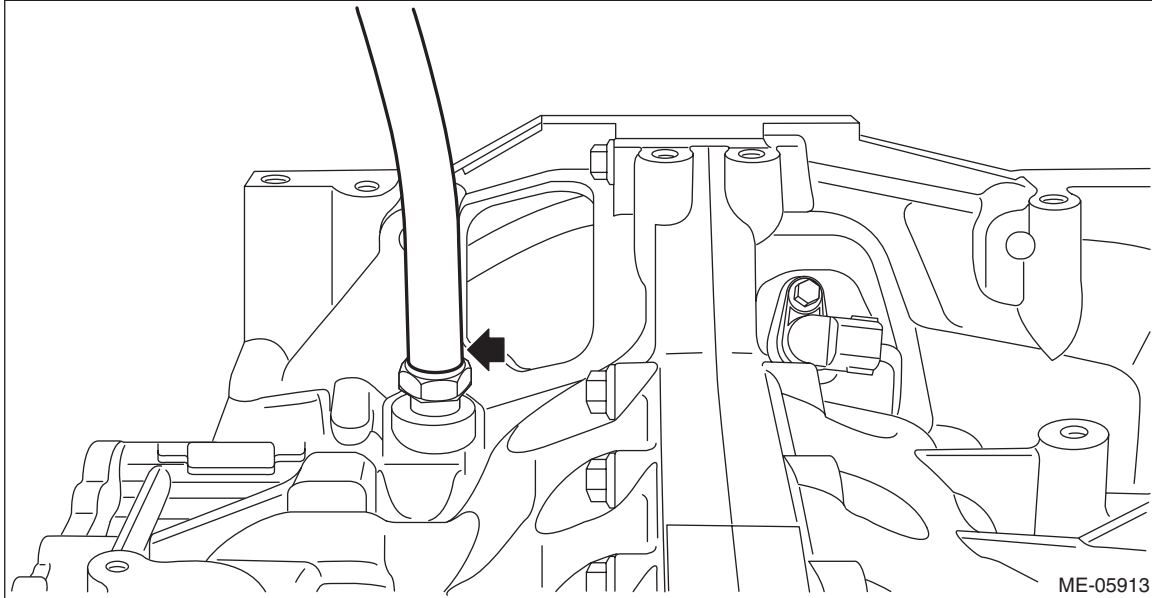
THREE BOND 1141G or equivalent

Tightening torque:

23 N·m (2.3 kgf-m, 17.0 ft-lb)



22) Install the vacuum hose to the PCV valve.



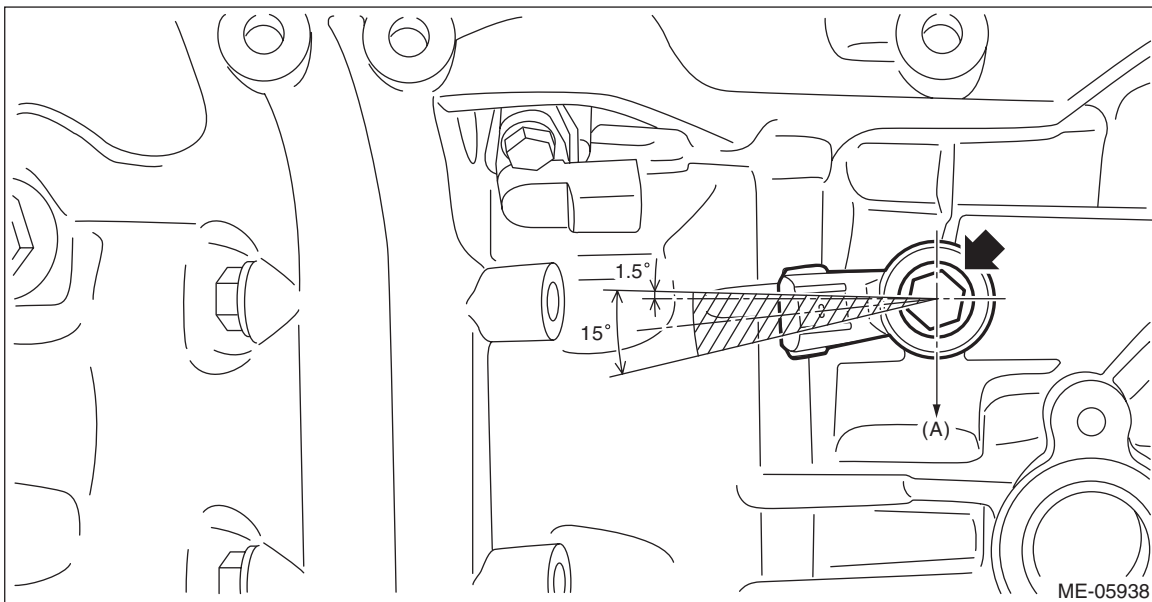
23) Install the knock sensor to the cylinder block LH.

NOTE:

Knock sensor must be positioned toward engine front so that the connector center position is within the range of 76.5 — 91.5° (shaded area).

Tightening torque:

24 N·m (2.4 kgf-m, 17.7 ft-lb)



(A) Front of engine

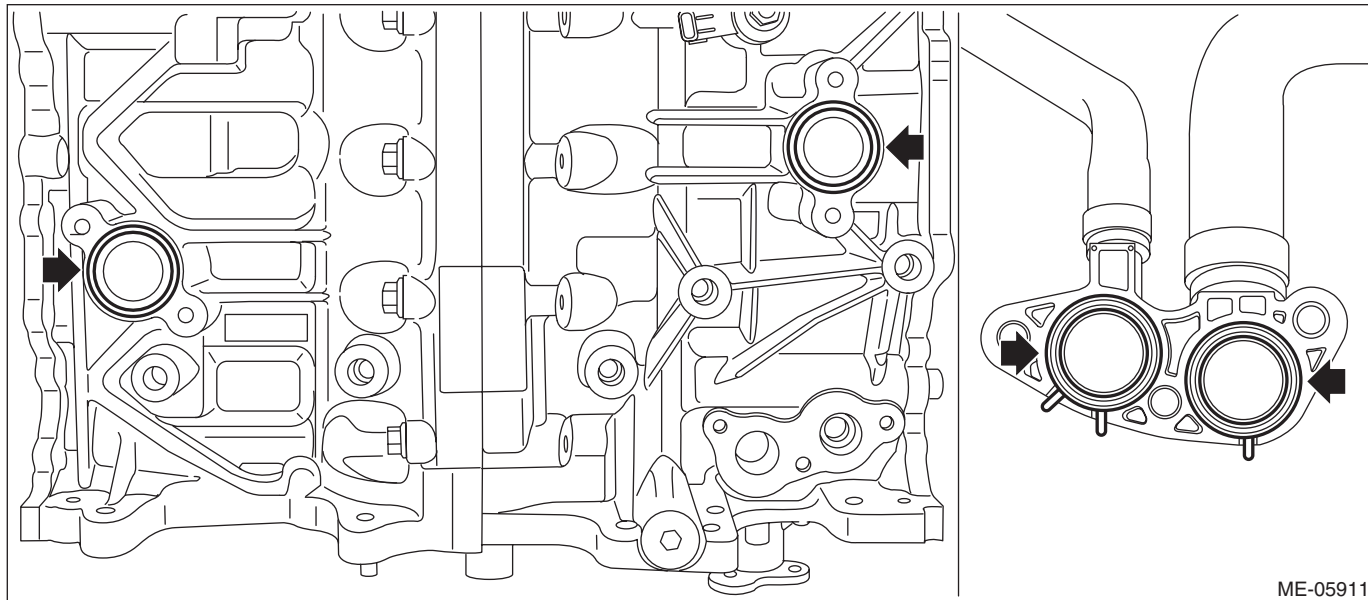
Cylinder Block

MECHANICAL

24) Install the O-ring to the cylinder block and PCV connector.

NOTE:

Use new O-rings.

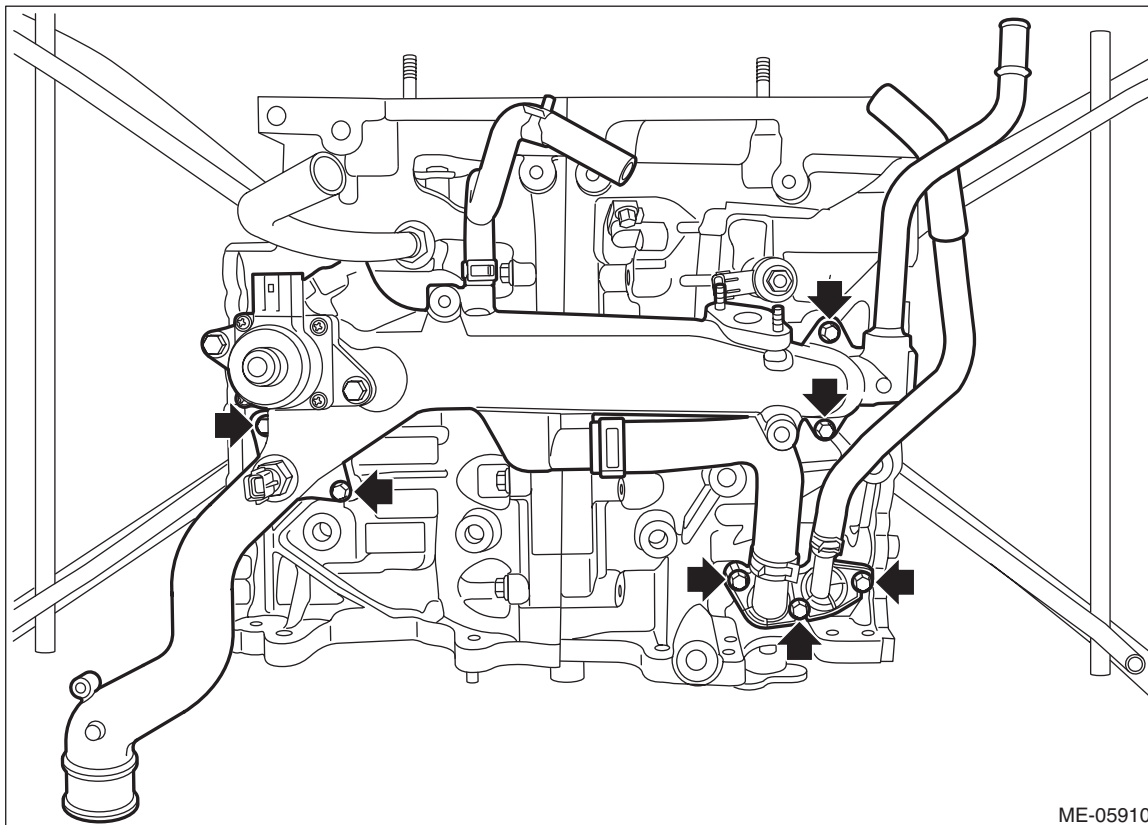


ME-05911

25) Install the water pipe assembly and PCV connector to the cylinder block.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

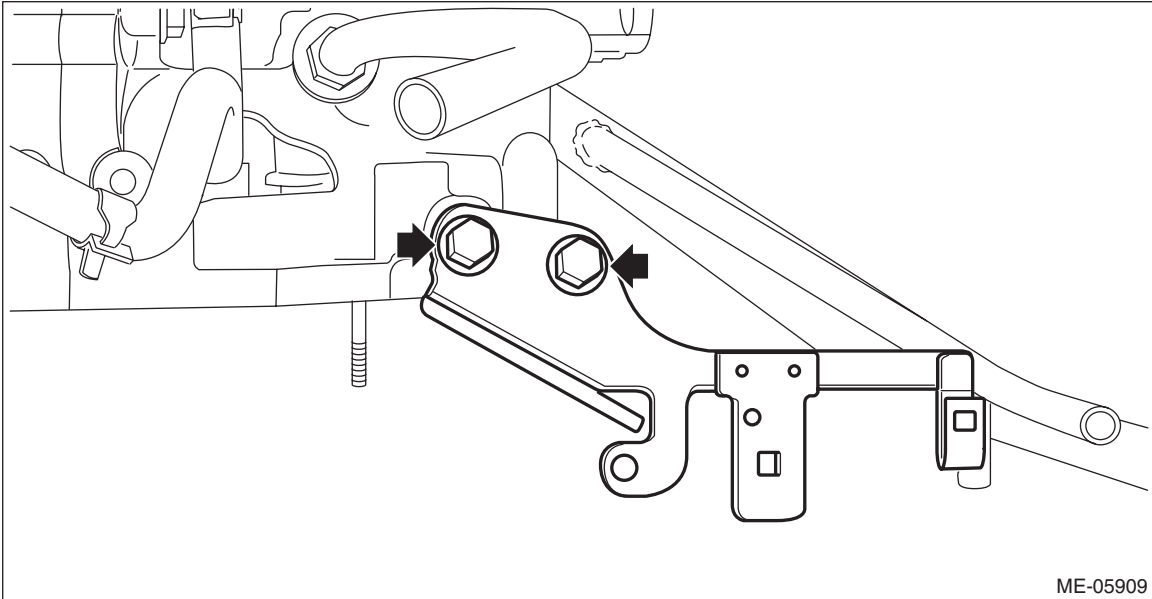


ME-05910

26) Install the engine rear hanger to the cylinder block RH.

Tightening torque:

21 N·m (2.1 kgf-m, 15.5 ft-lb)



27) Install the crank sprocket. <Ref. to ME(H4DO)-143, INSTALLATION, Crank Sprocket.>

28) Install the cylinder head. <Ref. to ME(H4DO)-208, INSTALLATION, Cylinder Head.>

29) Install the cam carrier. <Ref. to ME(H4DO)-170, INSTALLATION, Cam Carrier.>

30) Install the rocker cover. <Ref. to ME(H4DO)-151, INSTALLATION, Rocker Cover.>

31) Install the chain cover. <Ref. to ME(H4DO)-102, INSTALLATION, Chain Cover.>

32) Install the tumble generator valve assembly. <Ref. to FU(H4DO)-86, INSTALLATION, Tumble Generator Valve Assembly.>

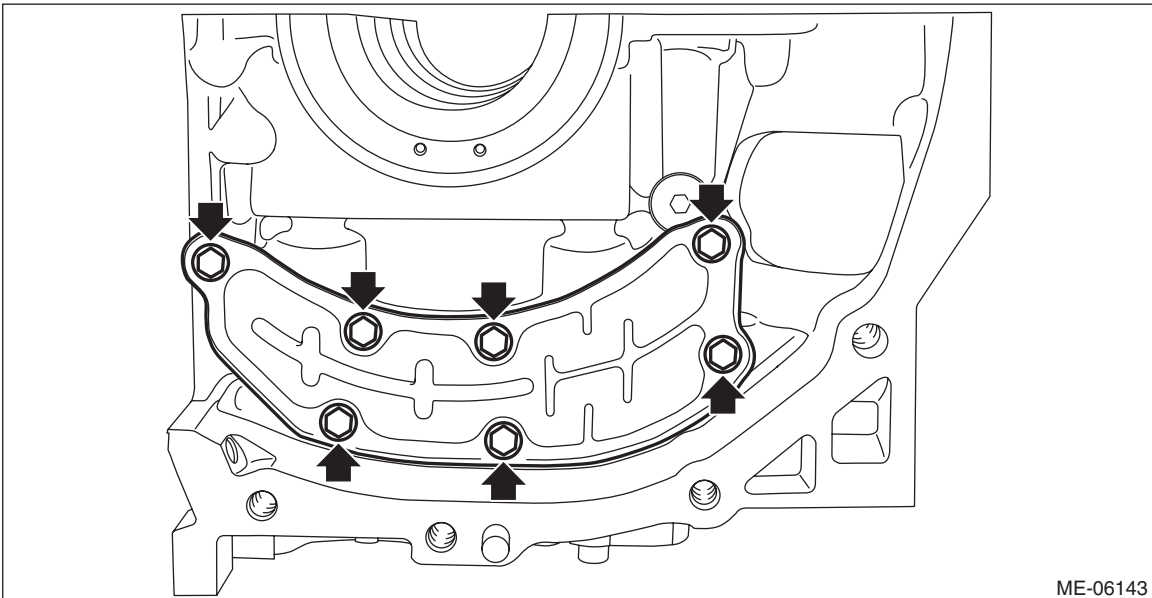
33) Install the intake manifold. <Ref. to FU(H4DO)-33, INSTALLATION, Intake Manifold.>

34) Install the engine to the vehicle. <Ref. to ME(H4DO)-60, INSTALLATION, Engine Assembly.>

C: DISASSEMBLY

1. CYLINDER BLOCK

1) Remove the oil separator cover from cylinder block RH.

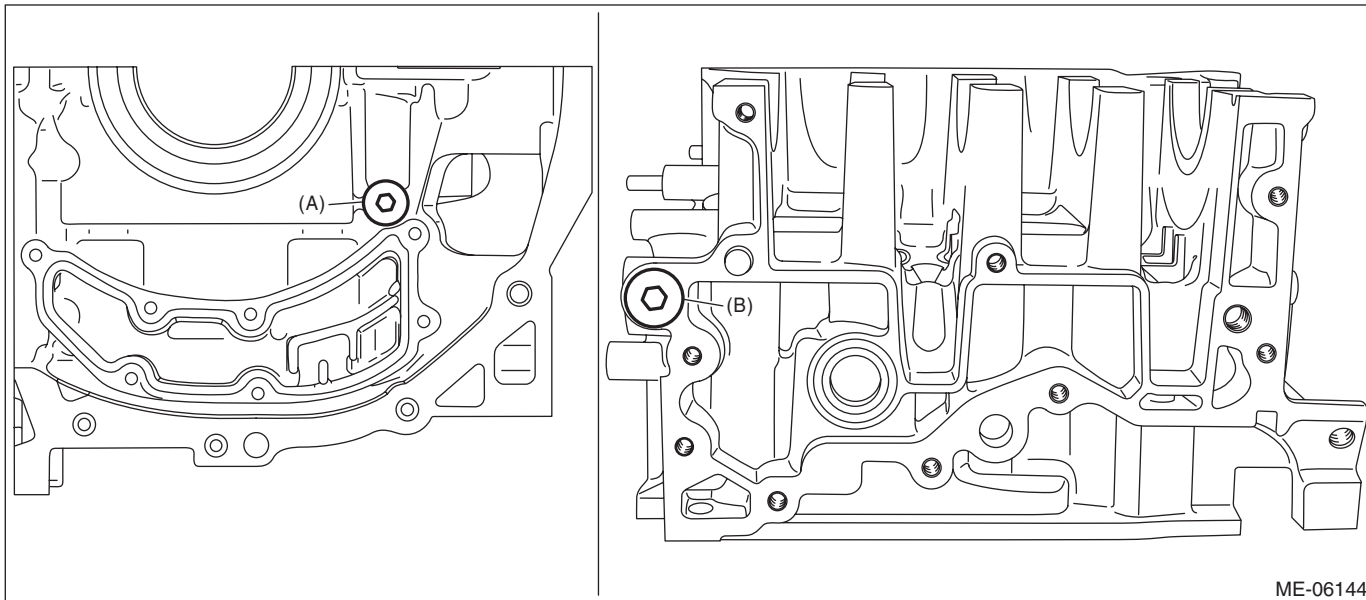


2) Remove the liquid gasket from cylinder block RH.

Cylinder Block

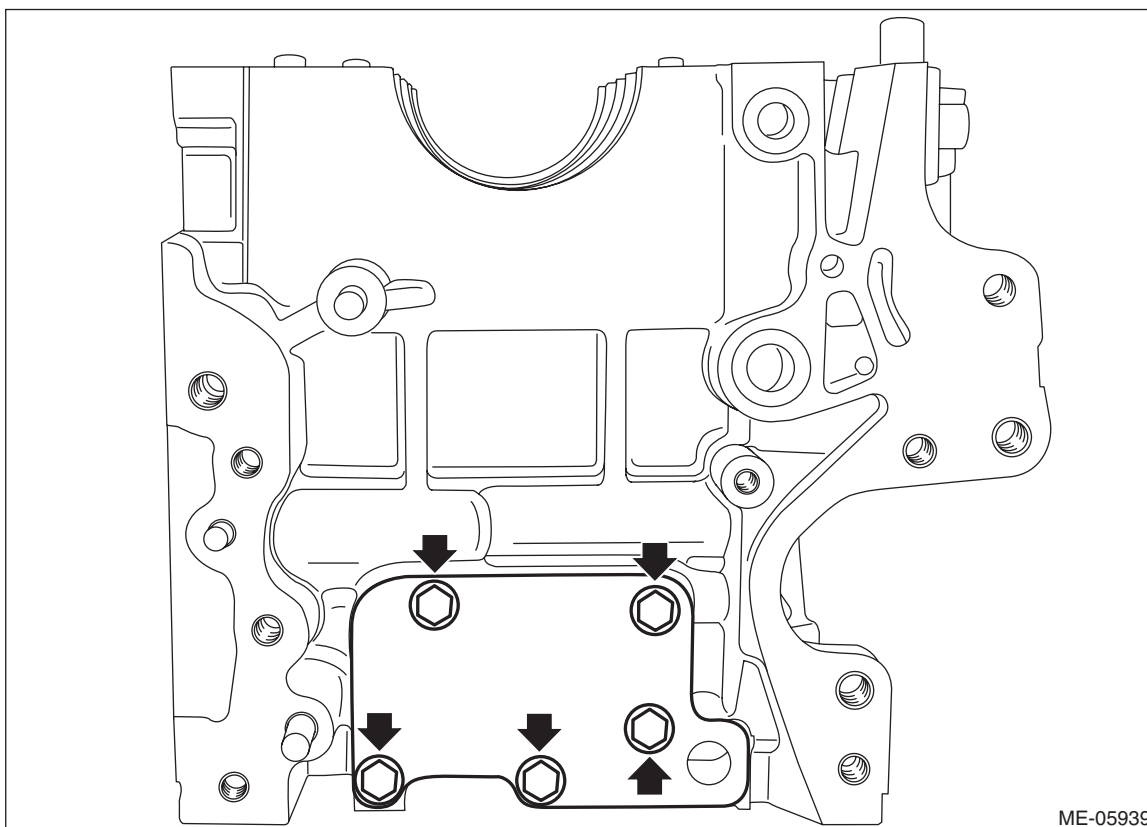
MECHANICAL

3) Remove the cylinder block plug (A) and the main gallery plug (B) from cylinder block RH.

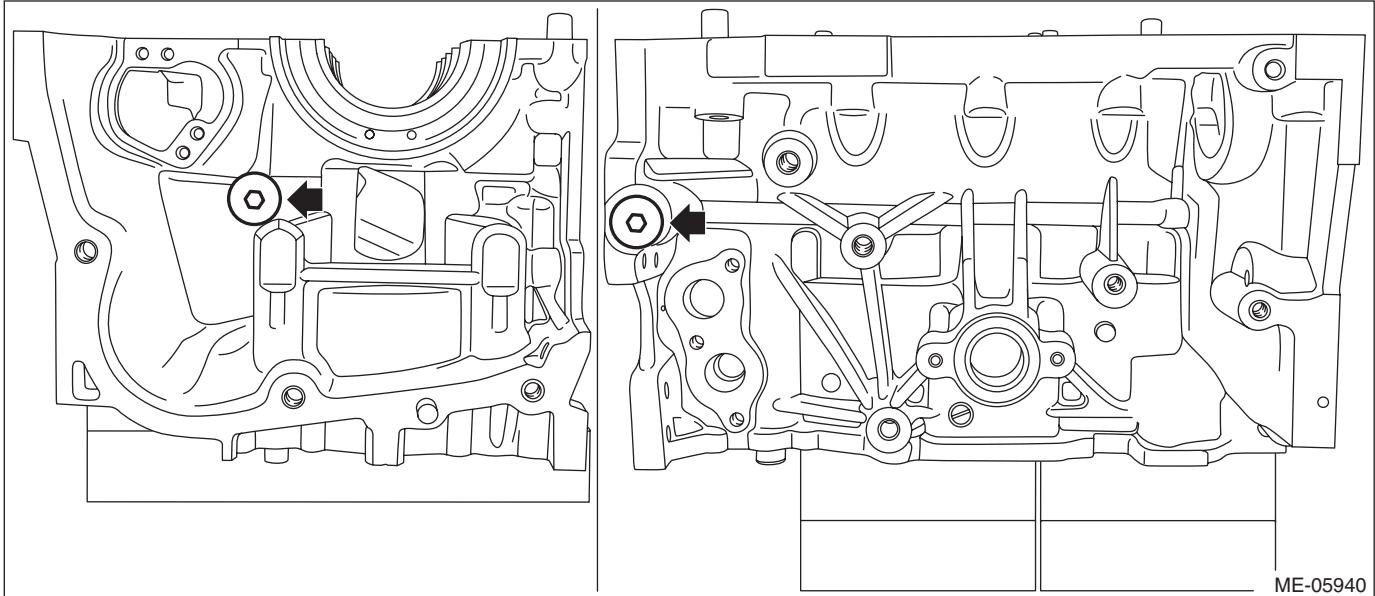


4) Remove the liquid gasket from the thread holes of the cylinder block RH, and from the threaded portions of cylinder block plug and main gallery plug.

5) Remove the cylinder block plate from cylinder block LH.

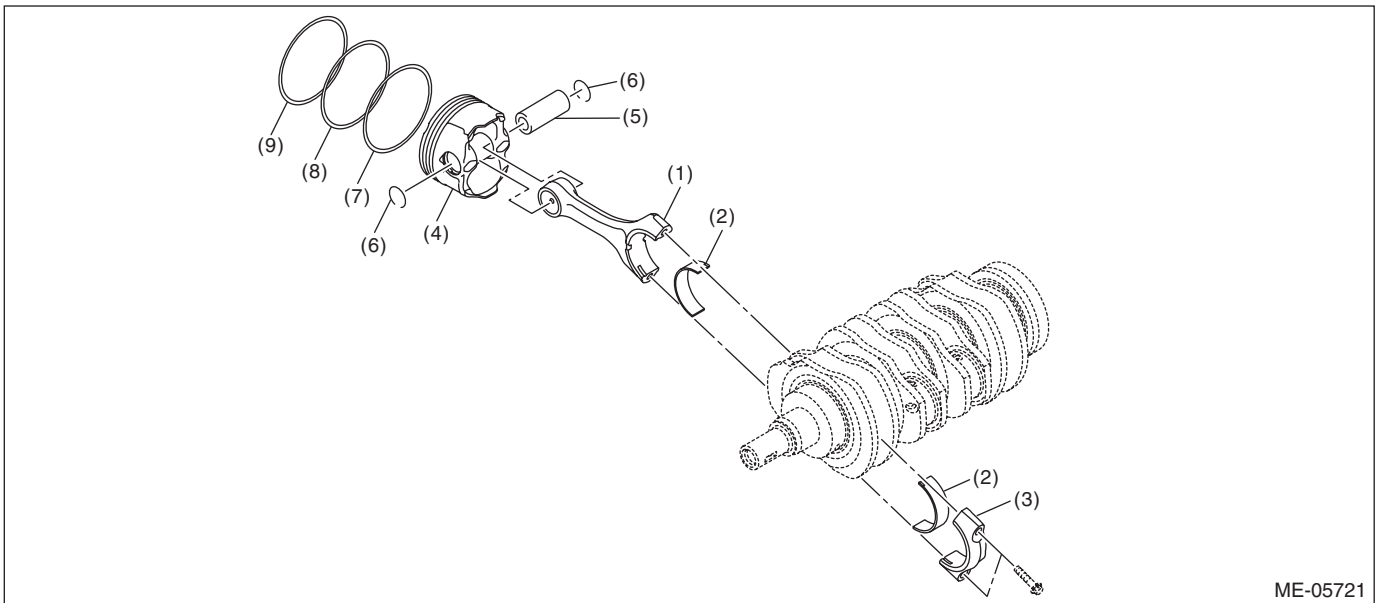


6) Remove the main gallery plug from cylinder block LH.



7) Remove the liquid gasket from the thread holes of the cylinder block LH and from the threaded portion of main gallery plug.

2. PISTON AND CONNECTING ROD



- | | | |
|----------------------------|----------------|-----------------|
| (1) Connecting rod | (4) Piston | (7) Oil ring |
| (2) Connecting rod bearing | (5) Piston pin | (8) Second ring |
| (3) Connecting rod cap | (6) Circlip | (9) Top ring |

NOTE:

To prevent confusion of various parts, mark each part.

1) Remove the connecting rod bearing from connecting rod and connecting rod cap.

2) Remove the piston rings from the piston.

NOTE:

Arrange the piston rings in order so that they can be installed in their original positions without confusion.

(1) Remove the compression rings in the order of top ring and second ring, using piston ring expander.

(2) Remove the oil rings in the order of upper rail, lower rail and expander by hand.

Cylinder Block

MECHANICAL

3) Remove the circlip on one end from the piston using a flat tip screwdriver.

NOTE:

Be careful not damage the piston and piston pin, by wrapping the tip of flat tip screwdriver with tape.

4) Remove the piston pin from piston, and remove the connecting rod from piston.

5) Remove the circlip on other end from the piston using a flat tip screwdriver.

NOTE:

Be careful not damage the piston and piston pin, by wrapping the tip of flat tip screwdriver with tape.

D: ASSEMBLY

1. CYLINDER BLOCK

1) Apply liquid gasket to the threaded portion of the main gallery plug, and install the main gallery plug to the cylinder block LH.

NOTE:

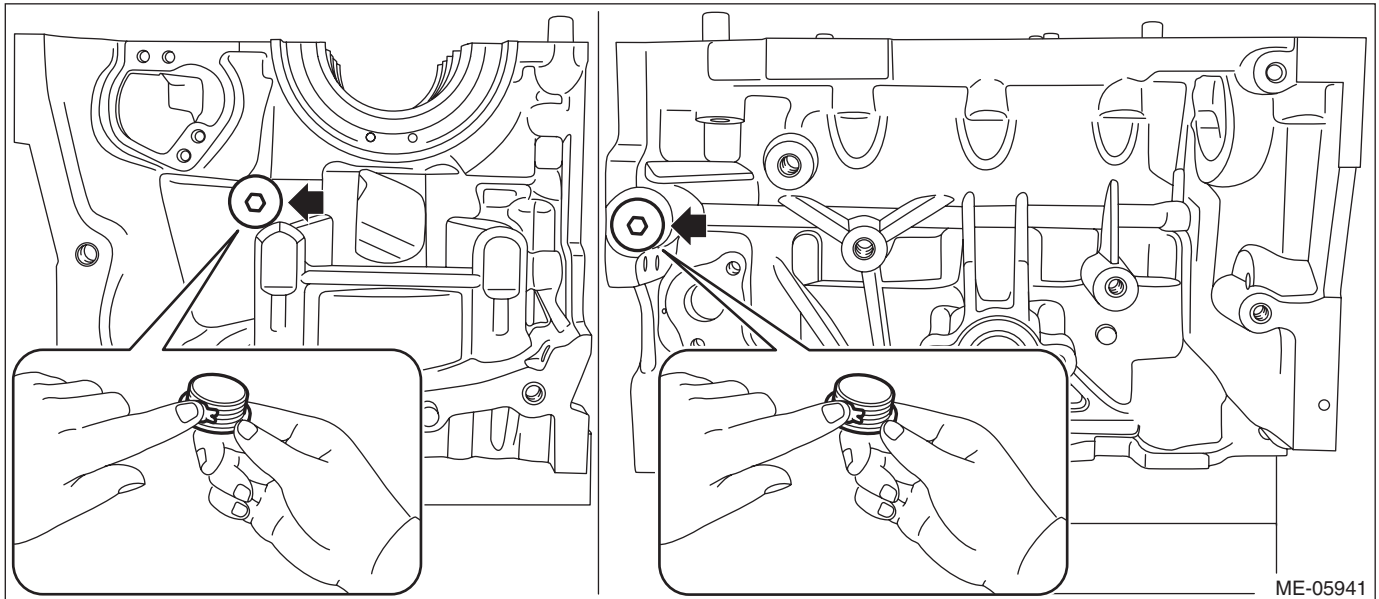
Before applying liquid gasket, degrease the thread holes of the cylinder block LH and the threaded portion of main gallery plug.

Liquid gasket:

THREE BOND 1105 (Part No. 004403010) or equivalent

Tightening torque:

37 N·m (3.8 kgf·m, 27.3 ft·lb)

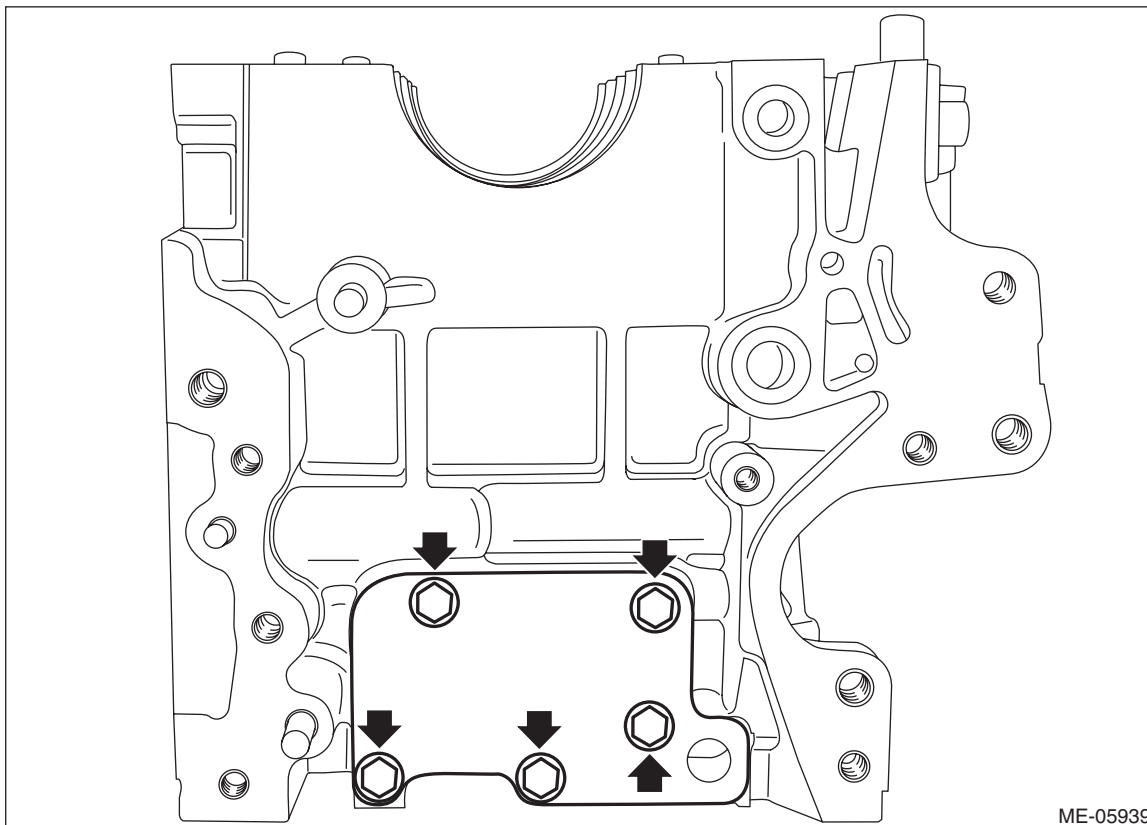


ME-05941

2) Install the cylinder block plate onto cylinder block LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Cylinder Block

MECHANICAL

3) Apply liquid gasket to the threaded portions of cylinder block plug and main gallery plug, and install the cylinder block plug (A) and main gallery plug (B) to cylinder block RH.

NOTE:

Before applying liquid gasket, degrease the thread holes of the cylinder block RH, and the threaded portions of cylinder block plug and main gallery plug.

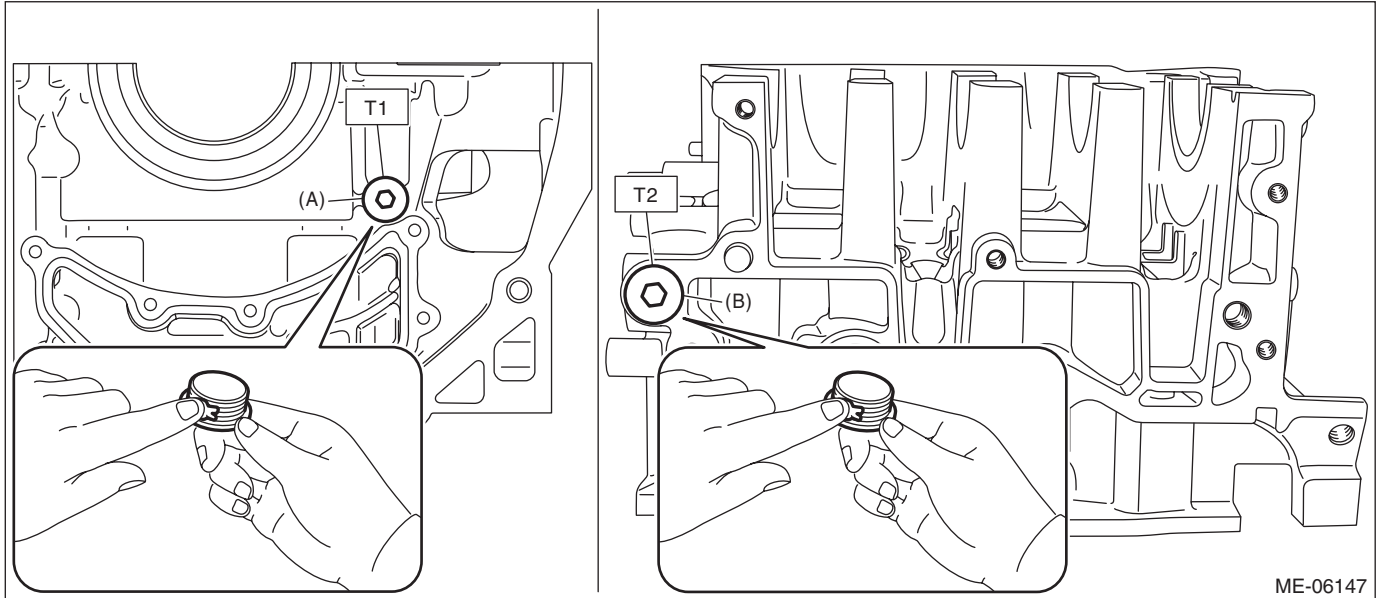
Liquid gasket:

THREE BOND 1105 (Part No. 004403010) or equivalent

Tightening torque:

T1: 16 N·m (1.6 kgf-m, 11.8 ft-lb)

T2: 37 N·m (3.8 kgf-m, 27.3 ft-lb)



- 4) Install the oil separator cover to the cylinder block RH.
 (1) Apply liquid gasket to the mating surfaces of oil separator cover.

NOTE:

- Use new oil separator cover.
- Before applying liquid gasket, degrease the old liquid gasket seal surface of cylinder block RH.
- Install within 5 min. after applying liquid gasket.

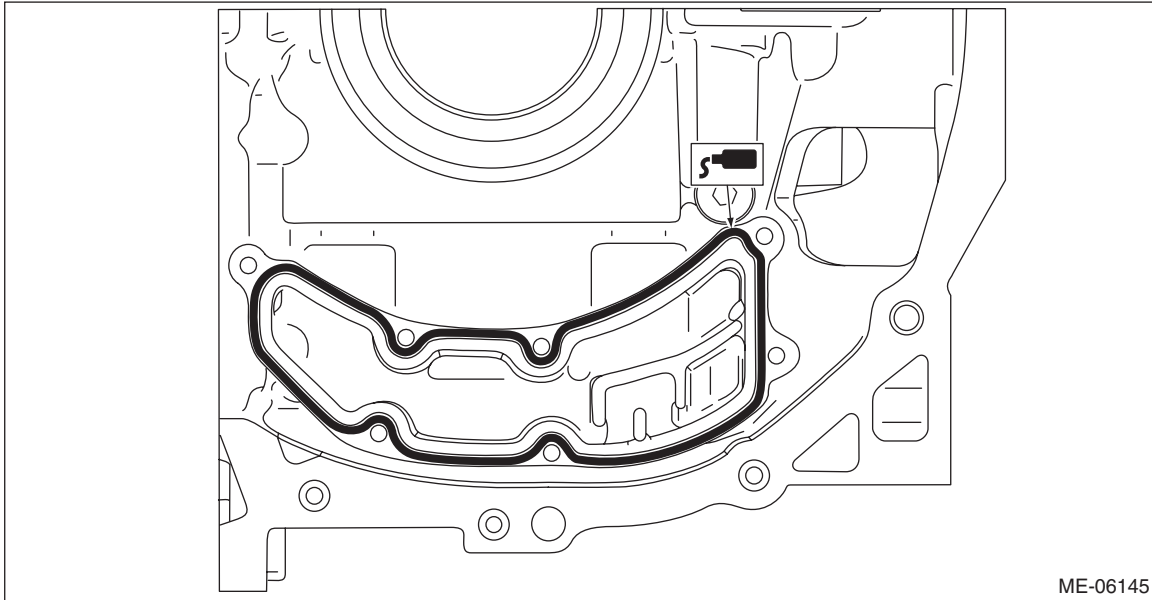
Liquid gasket:

Mating surface

THREE BOND 1217G (Part No. K0877Y0100) or equivalent

Liquid gasket applying diameter:

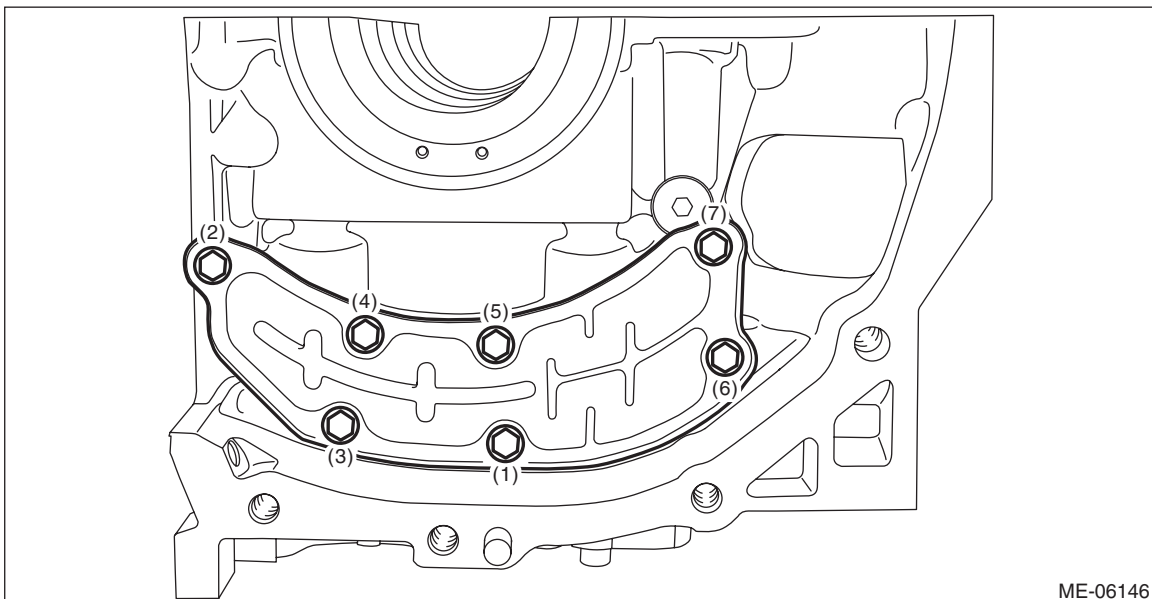
4 ± 1 mm (0.1772 ± 0.0197 in)



- (2) Install the oil separator cover to the cylinder block RH, and tighten the oil separator cover bolts in numerical order as shown in the figure.

Tightening torque:

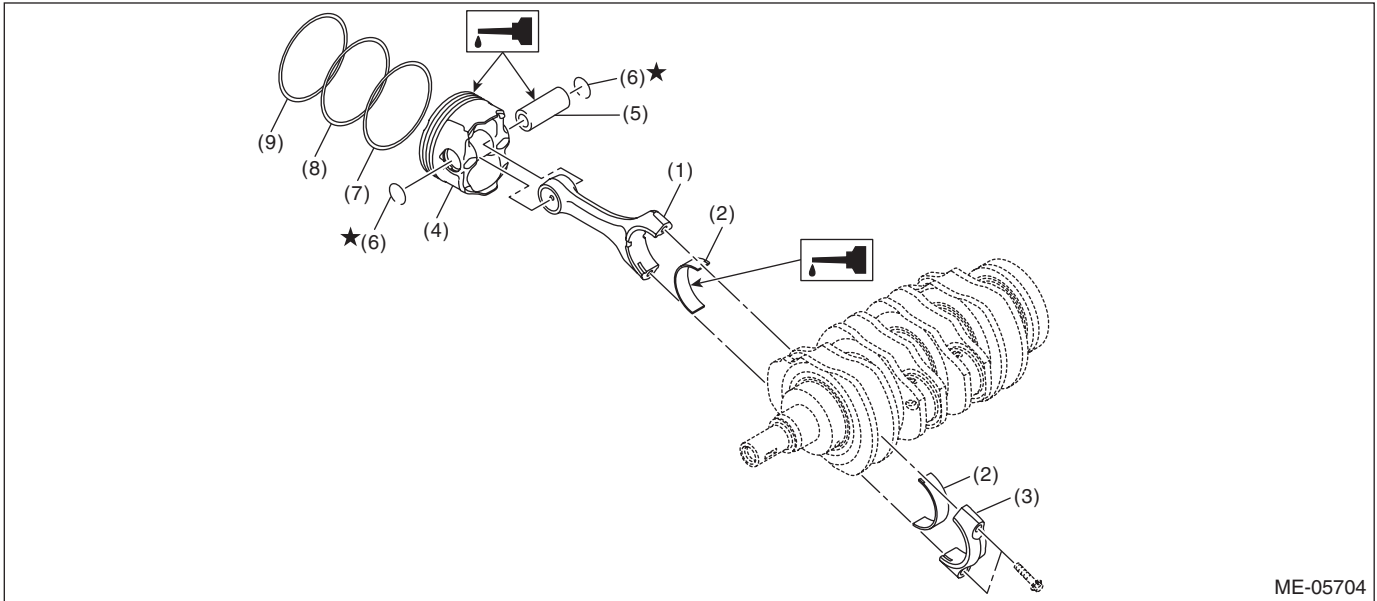
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Cylinder Block

MECHANICAL

2. PISTON AND CONNECTING ROD

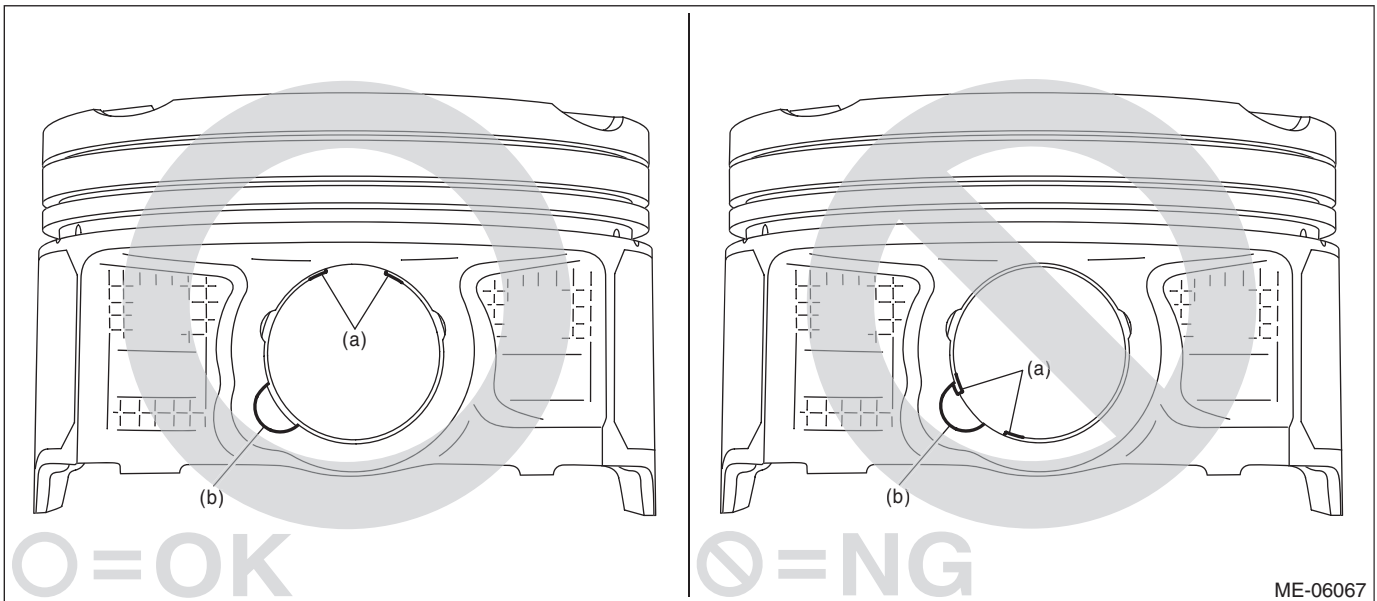


- | | | |
|----------------------------|----------------|-----------------|
| (1) Connecting rod | (4) Piston | (7) Oil ring |
| (2) Connecting rod bearing | (5) Piston pin | (8) Second ring |
| (3) Connecting rod cap | (6) Circlip | (9) Top ring |

- 1) Install the connecting rod bearing to the connecting rod and connecting rod cap.
- 2) Install the circlip on one end of the piston using a flat tip screwdriver.

NOTE:

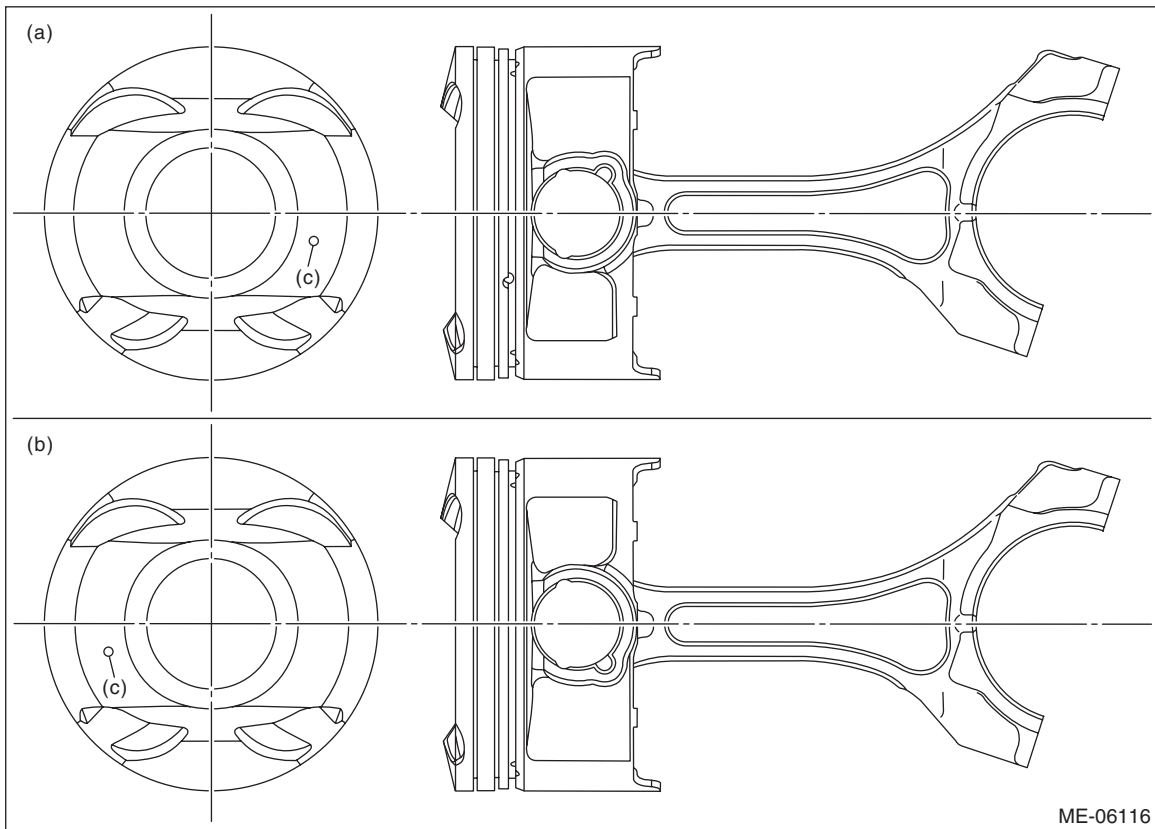
- Be careful not damage the piston, by wrapping the tip of flat tip screwdriver with tape.
- Make sure the circlip is firmly inserted into the circlip groove.
- After installing the circlip, rotate the circlip so that its end part (a) and the cutout portion of circlip groove (b) do not match.



- 3) Set the piston to the connecting rod.

NOTE:

Align the front mark of piston and the connecting rod direction correctly as shown in the figure.



(a) RH side (#1 and #3)

(b) LH side (#2 and #4)

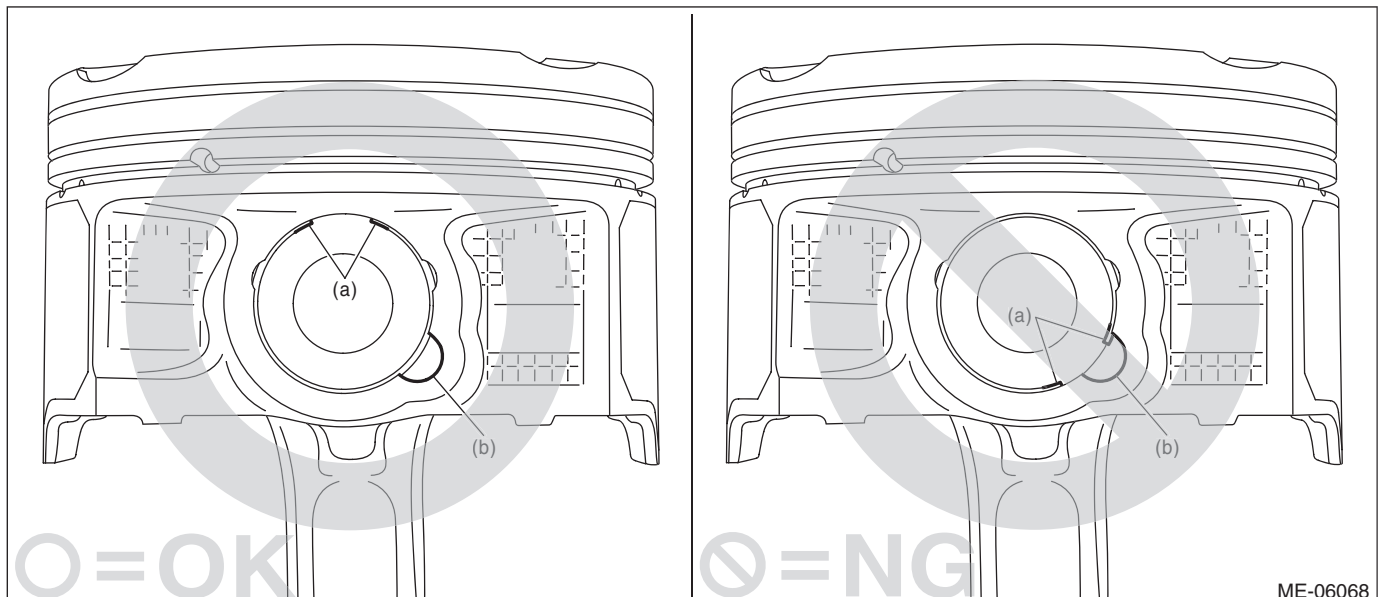
(c) Front mark

4) Apply engine oil to the piston pin, and attach the piston pin.

5) Install the circlip on the piston using a flat tip screwdriver.

NOTE:

- Be careful not damage the piston and piston pin, by wrapping the tip of flat tip screwdriver with tape.
- Make sure the circlip is firmly inserted into the circlip groove.
- After installing the circlip, rotate the circlip so that its end part (a) and the cutout portion of circlip groove (b) do not match.



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Cylinder Block

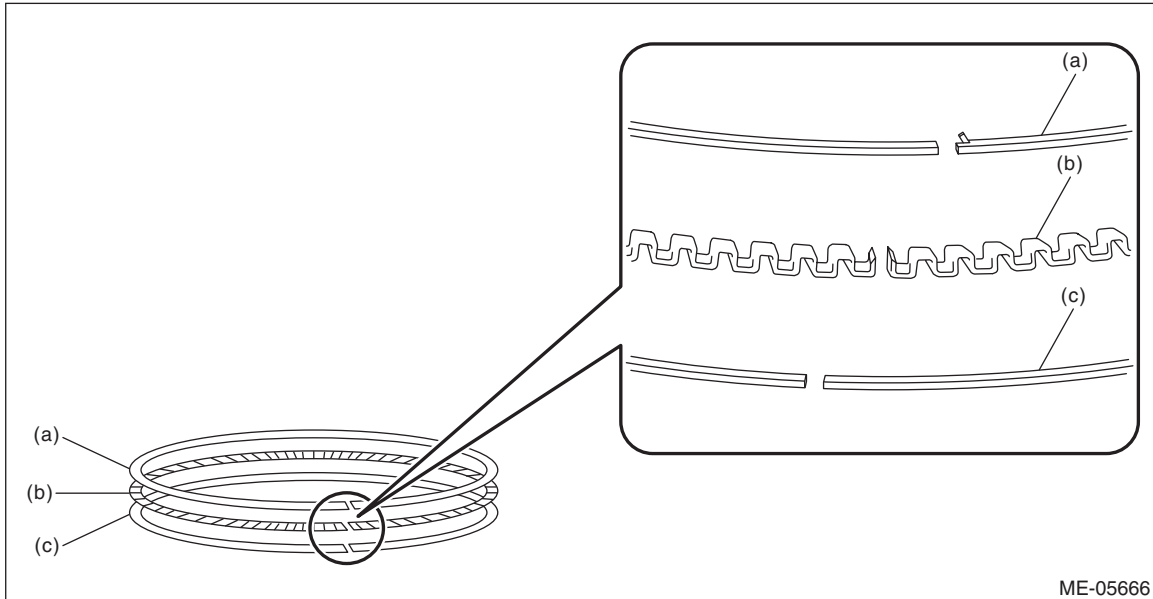
MECHANICAL

6) Install the piston rings onto the piston.

(1) Install the oil rings in the order of expander, lower rail and upper rail by hand.

NOTE:

Oil ring consists of the upper rail, expander and lower rail.



(a) Upper rail

(b) Expander

(c) Lower rail

(2) Install the compression rings in the order of second ring and top ring, using piston ring expander.

NOTE:

Install so that the compression ring mark faces the top side of the piston.

E: INSPECTION

1. CYLINDER BLOCK & PISTON

- 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 traces of gas leaking or water leaking on the gasket attachment surface.
- 4) Check the oil passages for clogging.
- 5) Check for warpage of mating surfaces of the cylinder block that contacts cylinder head using a straight edge and thickness gauge. If it exceeds the limit, correct the surface by grinding it with a surface grinder or replace the cylinder block.

NOTE:

Measurement should be performed at a temperature of 20°C (68°F).

Cylinder block warpage:

Limit

0.025 mm (0.00098 in)

Grinding limit of cylinder block :

To 204.9 mm (8.067 in)

Height of cylinder block:

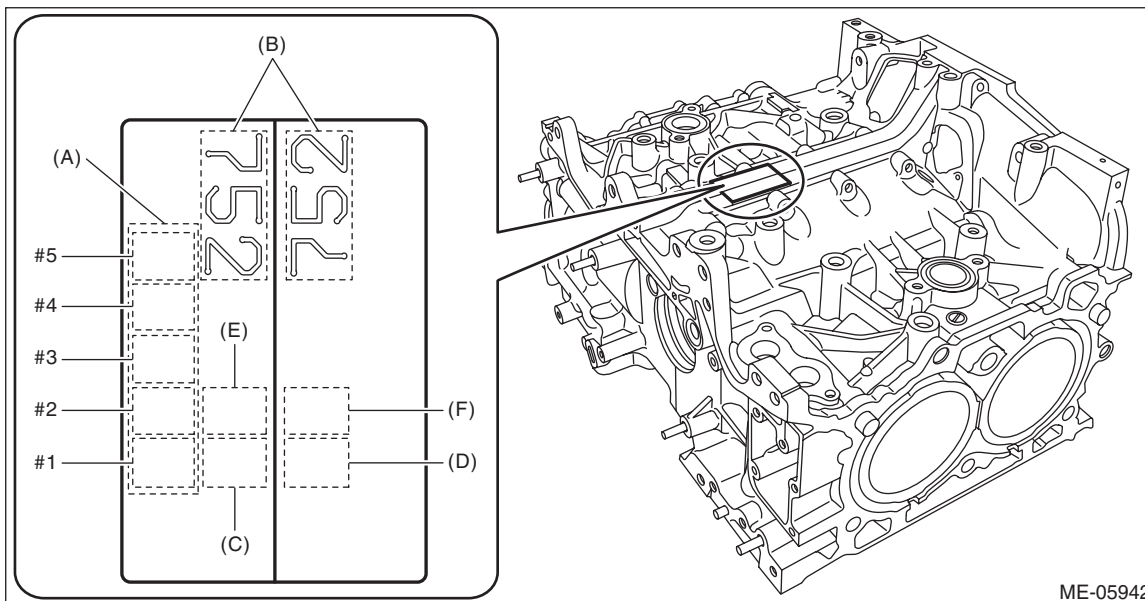
Standard

205.0 mm (8.071 in)

6) Using a cylinder bore gauge, check the inner diameter of cylinder liner, cylindricity, out-of-roundness. If it is not within the standard, perform boring and honing, or replace the cylinder block and piston as a set. For boring and honing procedure, refer to step 8).

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of each cylinder liner in both the thrust and piston pin directions at the heights as shown in the figure.
- The cylinder bore size mark is stamped on the upper face of the cylinder block.



- | | | |
|---|--------------------------------|--------------------------------|
| (A) Main journal size mark | (C) #1 cylinder bore size mark | (E) #3 cylinder bore size mark |
| (B) Cylinder block (RH) – (LH) combination mark | (D) #2 cylinder bore size mark | (F) #4 cylinder bore size mark |

Inner diameter of cylinder liner:

Cylinder bore size mark A

Standard

84.005 — 84.015 mm (3.3073 — 3.3077 in)

Cylinder bore size mark B

Standard

83.995 — 84.005 mm (3.3069 — 3.3073 in)

Cylindricity of cylinder liner:

Limit

0.015 mm (0.0006 in)

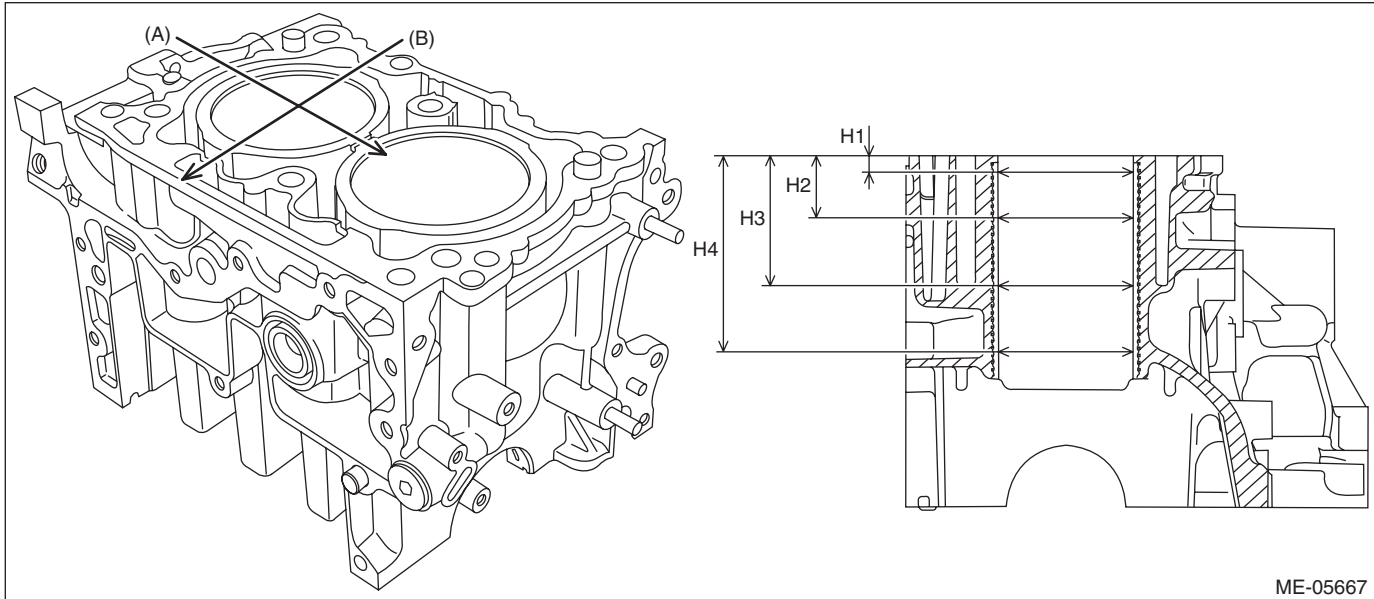
Cylinder Block

MECHANICAL

Out-of-roundness of cylinder liner:

Limit

0.010 mm (0.0004 in)



ME-05667

(A) Thrust direction

(B) Piston pin direction

H1: 10 mm (0.3937 in)

H2: 45 mm (1.7717 in)

H3: 80 mm (3.1496 in)

H4: 115 mm (4.5276 in)

7) Check the clearance between cylinder liner and piston. Check the clearance between cylinder liner and piston by measuring the inner diameter of cylinder liner and the outer diameter of piston respectively.

NOTE:

For the measurement of the inner diameter of cylinder liner, refer to step 6).

(1) Check the outer diameter of piston with a micrometer. If it is not within the standard, replace the piston.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of each piston in thrust direction at the height as shown in the figure.
- Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as guide lines in selecting a standard piston.
- If the piston is replaced, check the clearance between cylinder liner and piston in the step (2), and select a suitable sized piston.

Piston grade point H:

38.0 mm (1.50 in)

Piston outer diameter:

Standard size (grade A)

Standard

83.975 — 83.985 mm (3.3061 — 3.3065 in)

Standard size (grade B)

Standard

83.965 — 83.975 mm (3.3057 — 3.3061 in)

0.25 mm (0.0098 in) oversize

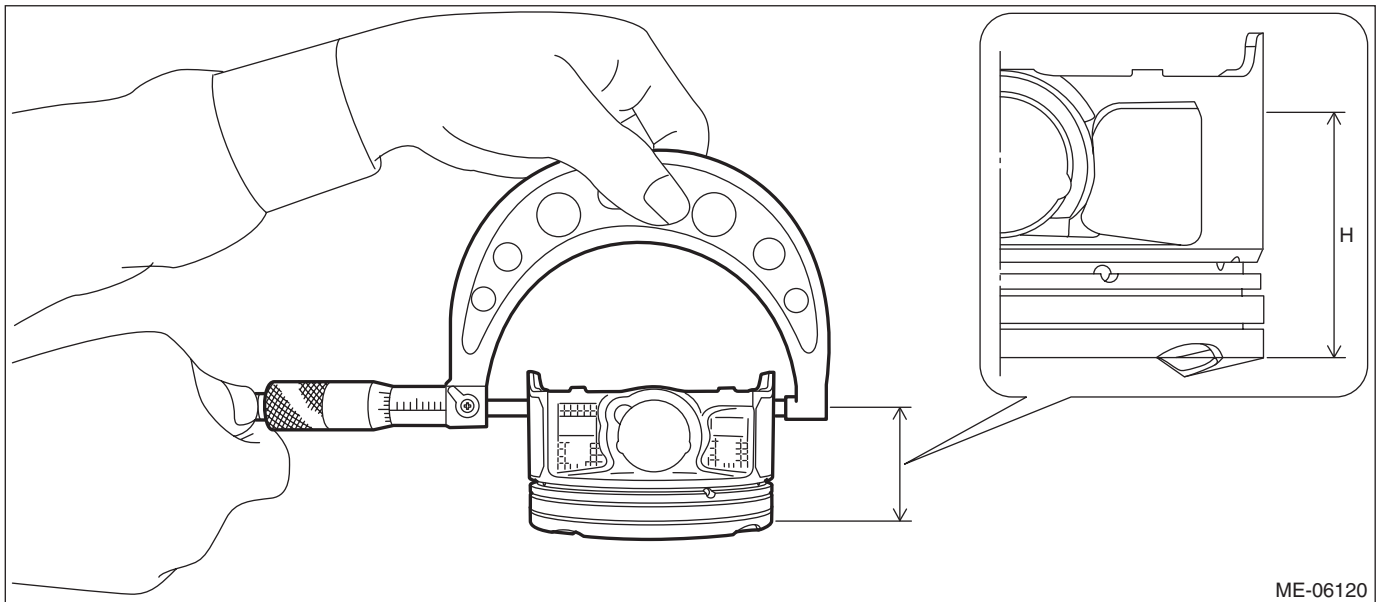
Standard

84.215 — 84.235 mm (3.3155 — 3.3163 in)

0.50 mm (0.0197 in) oversize

Standard

84.465 — 84.485 mm (3.3254 — 3.3262 in)



ME-06120

(2) Calculate the clearance between cylinder liner and piston. If it is not within the standard, perform boring and honing, or replace the cylinder block and piston as a set. For boring and honing procedure, refer to step 8).

Clearance between cylinder liner and piston:

Standard

0.020 — 0.040 mm (0.00079 — 0.00158 in)

8) Boring and honing

(1) If any of the inner diameter, cylindricity, out-of-roundness or clearance between cylinder liner and piston is out of standard or if there is any damage on the cylinder liner, rebores it to replace with an oversize piston.

CAUTION:

When any of the cylinder liner needs reboring, all other cylinder liners must be bored at the same time, and replaced with oversize pistons.

(2) If the inner diameter of cylinder liner exceeds the limit after boring and honing, replace the cylinder block and piston as a set.

NOTE:

- Immediately after reboring, the inner diameter of cylinder liner may differ from its real diameter due to temperature rise. Thus, when measuring the inner diameter of cylinder liner, wait until the temperature has cooled to 20°C (68°F).
- For the measurement of the inner diameter of cylinder liner, refer to step 6).

Inner diameter of cylinder liner boring limit (diameter):

To 84.505 mm (3.3270 in)

Cylinder Block

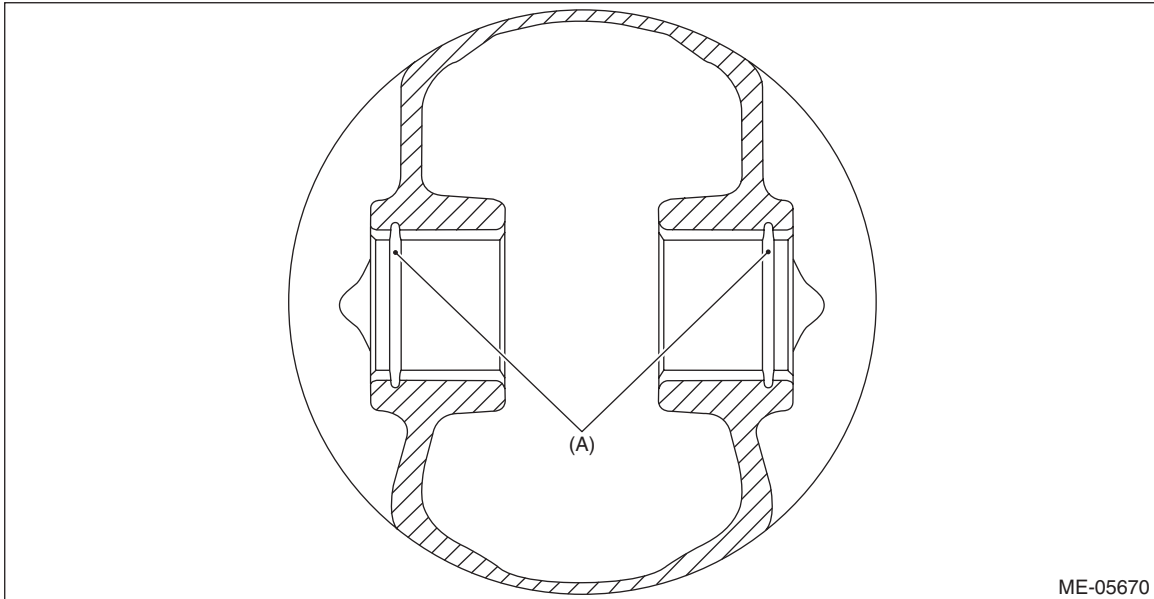
MECHANICAL

2. PISTON AND PISTON PIN

- 1) Check the piston and piston pin for wear or crack.
- 2) Check the snap ring for distortion or wear.
- 3) Check the piston ring groove for damage.
- 4) Check the circlip groove (A) for burr.

NOTE:

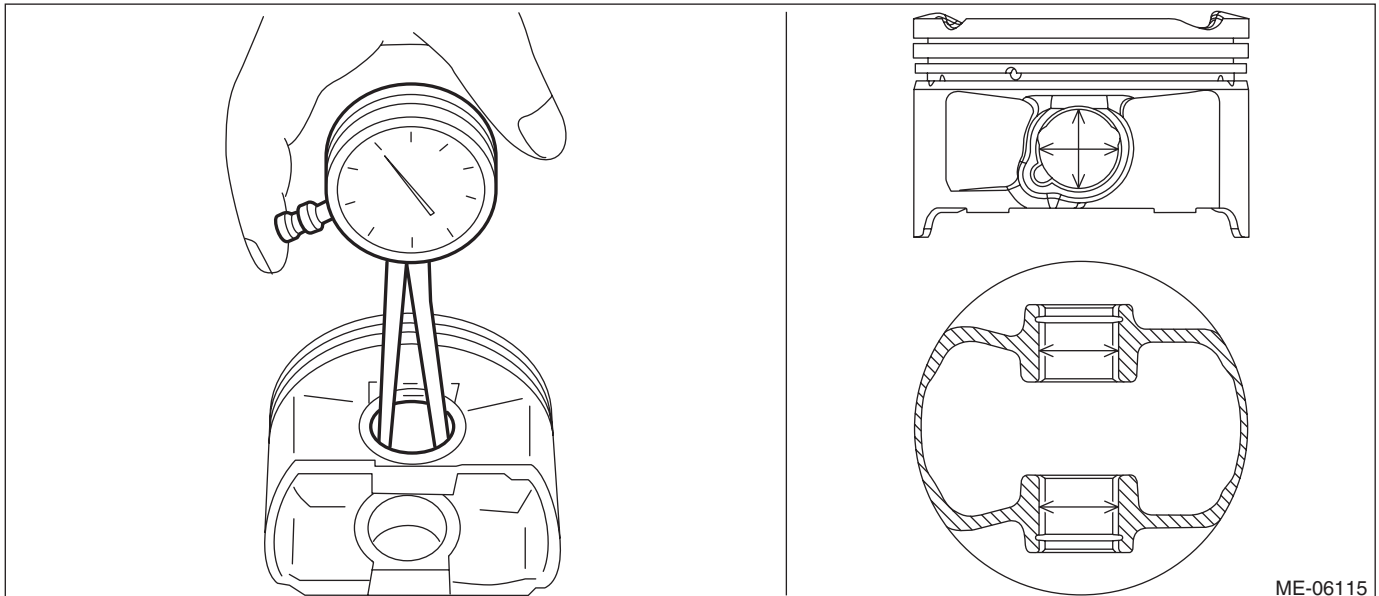
If the burr is found, remove the burr from groove.



- 5) Check that the piston pin can be inserted into the piston with a thumb at 20°C (68°F).
- 6) Check the clearance between piston and piston pin. Check the clearance between piston and piston pin by measuring the inner diameter of piston pin hole and the outer diameter of piston pin respectively.
 - (1) Using a caliper gauge, measure the inner diameter of piston pin hole.

NOTE:

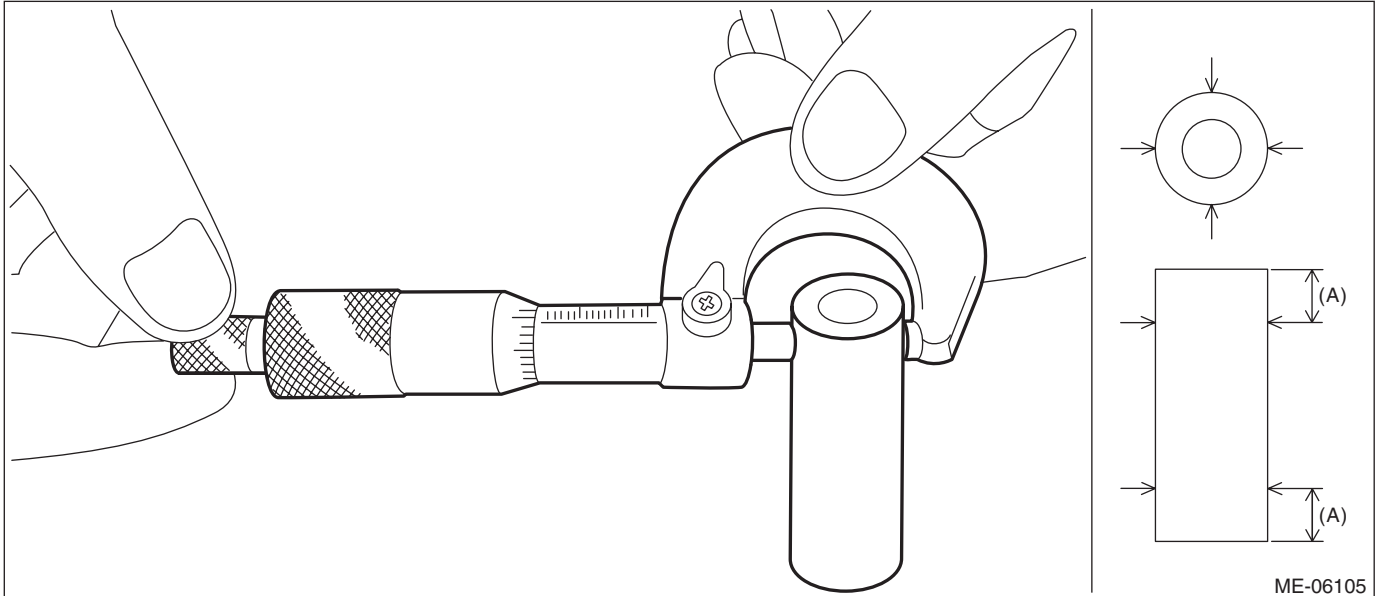
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the piston pin hole at the four locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



(2) Measure the outer diameter of piston pin with a micrometer.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the piston pin at the four locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



ME-06105

(A) 10 mm (0.394 in)

(3) Calculate the clearance between piston and piston pin. If it is not within the standard, replace the piston and piston pin as a set.

Clearance between piston and piston pin:

Standard

0.004 — 0.008 mm (0.0002 — 0.0003 in)

Cylinder Block

MECHANICAL

3. PISTON RING

- 1) Make sure the piston ring is not broken or damaged.
- 2) Using a cylindrical guide, insert the piston ring into the cylinder liner so that they are perpendicular to the cylinder wall, and check the piston ring gap using a thickness gauge. If it is not within the standard, replace the piston ring.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Use piston ring with same size as piston when replacing piston ring.

Piston ring gap:

Compression ring (top ring)

Standard

0.20 — 0.35 mm (0.0079 — 0.0138 in)

Compression ring (second ring)

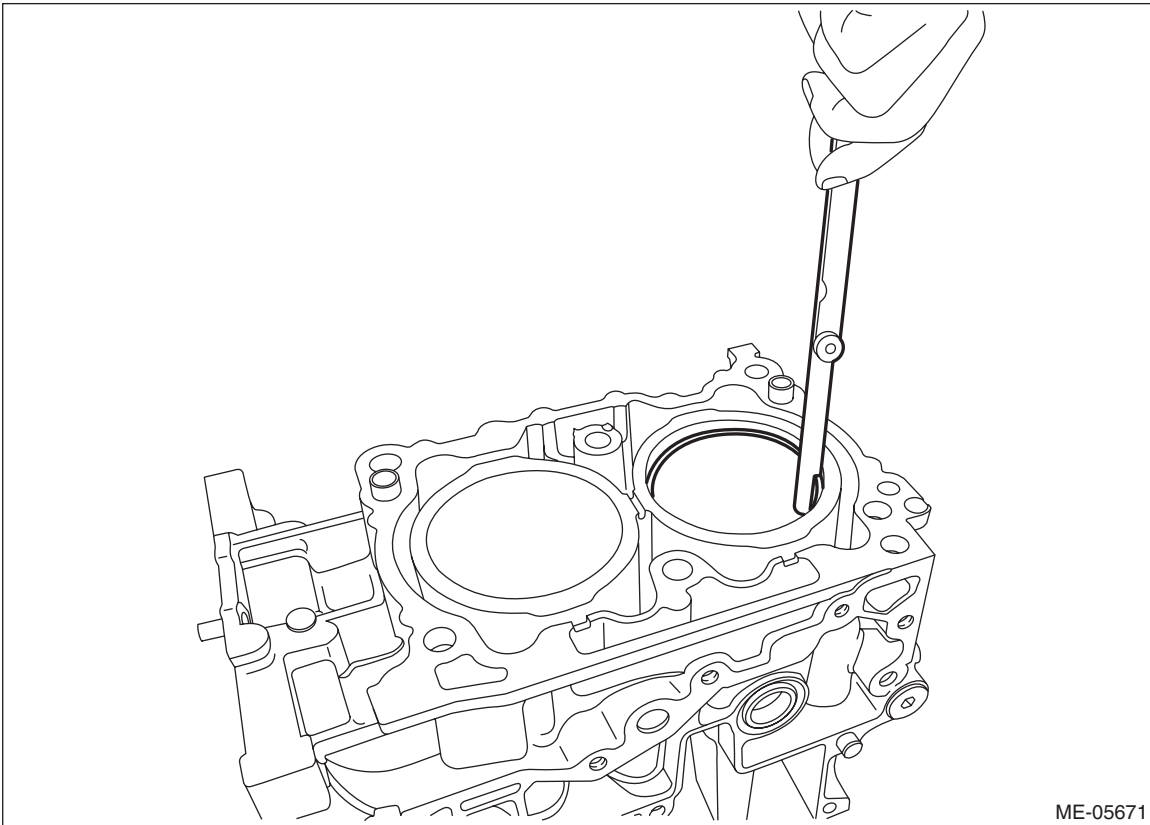
Standard

0.40 — 0.50 mm (0.0157 — 0.0197 in)

Oil ring (upper rail and lower rail)

Standard

0.20 — 0.50 mm (0.0079 — 0.0197 in)



- 3) Fit the compression ring straight into the piston ring groove, then check the clearance between compression ring and piston with a thickness gauge. If it is not within the standard, replace the compression ring.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Before inspecting the clearance, clean the piston ring groove and compression ring.
- Use compression ring with same size as piston when replacing compression ring.

Clearance between compression ring and piston:

Top ring

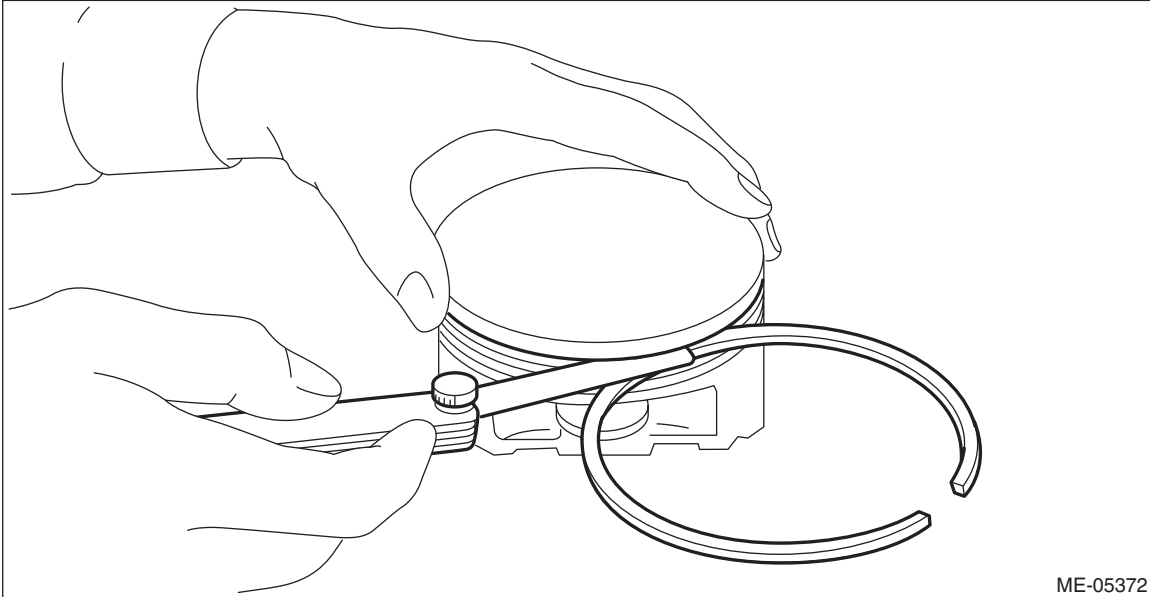
Standard

0.040 — 0.080 mm (0.0016 — 0.0031 in)

Second ring

Standard

0.030 — 0.070 mm (0.0012 — 0.0028 in)



4. CONNECTING ROD AND CONNECTING ROD BEARING

1) Check for bend or twist using a connecting rod aligner. If it exceeds the limit, replace the connecting rod.

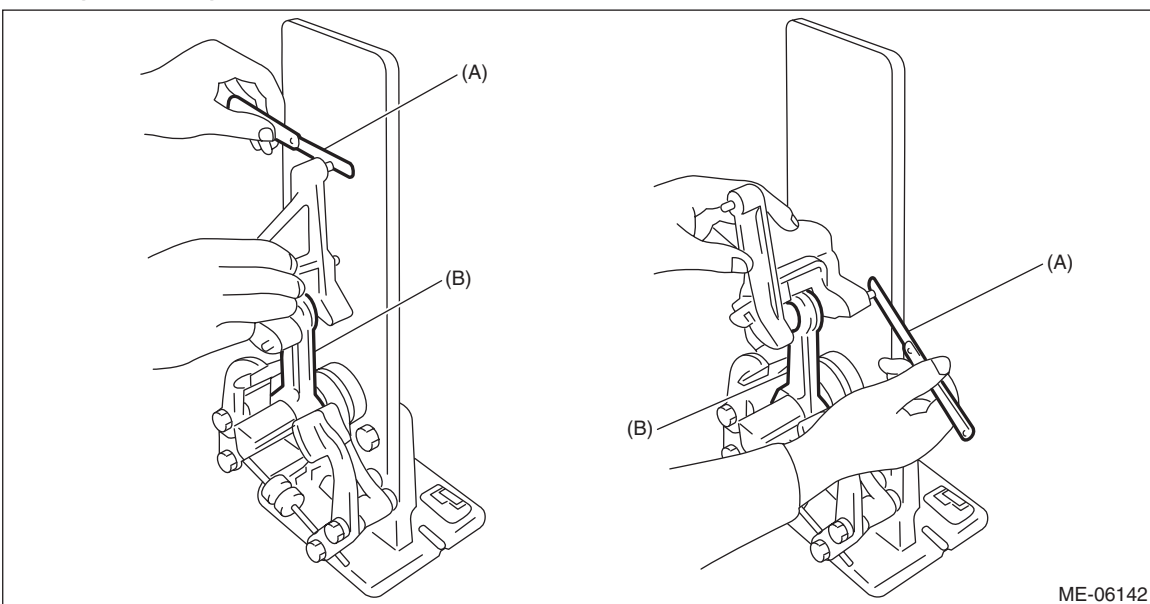
NOTE:

Measurement should be performed at a temperature of 20°C (68°F).

Bend or twist per 100 mm (3.94 in) in length:

Limit

0.10 mm (0.0039 in)



(A) Thickness gauge

(B) Connecting rod

Cylinder Block

MECHANICAL

- 2) Check that the large or small end thrust surface of each connecting rod is not damaged.
- 3) Check each connecting rod bearing for scar, peeling, seizure, melting or wear, etc.
- 4) Check the thrust clearance of each connecting rod using a thickness gauge.

NOTE:

Measurement should be performed at a temperature of 20°C (68°F).

- (1) Clean the #1 connecting rod bearing and the #1 pin of crankshaft, and apply engine oil to the #1 pin of crankshaft.
- (2) Set the #1 connecting rod bearing to the #1 connecting rod and #1 connecting rod cap.
- (3) Set the #1 connecting rod, #1 connecting rod cap and #1 connecting rod cap bolt to the #1 pin of crankshaft.

NOTE:

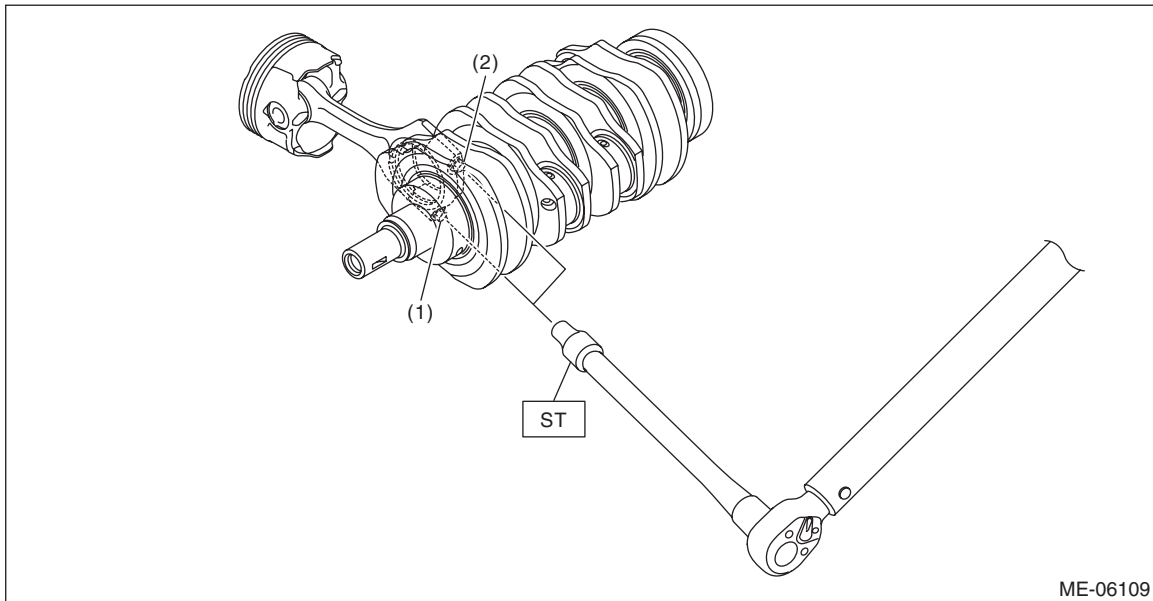
- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.
- Use a new connecting rod cap bolt.
- Apply a coat of engine oil to the #1 connecting rod cap bolt thread.
- (4) Using ST, tighten the #1 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 22 N·m (2.2 kgf-m, 16.2 ft-lb) in numerical order as shown in the figure.

CAUTION:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**

ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



- (5) Using ST1 and ST2, tighten the #1 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

CAUTION:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**

NOTE:

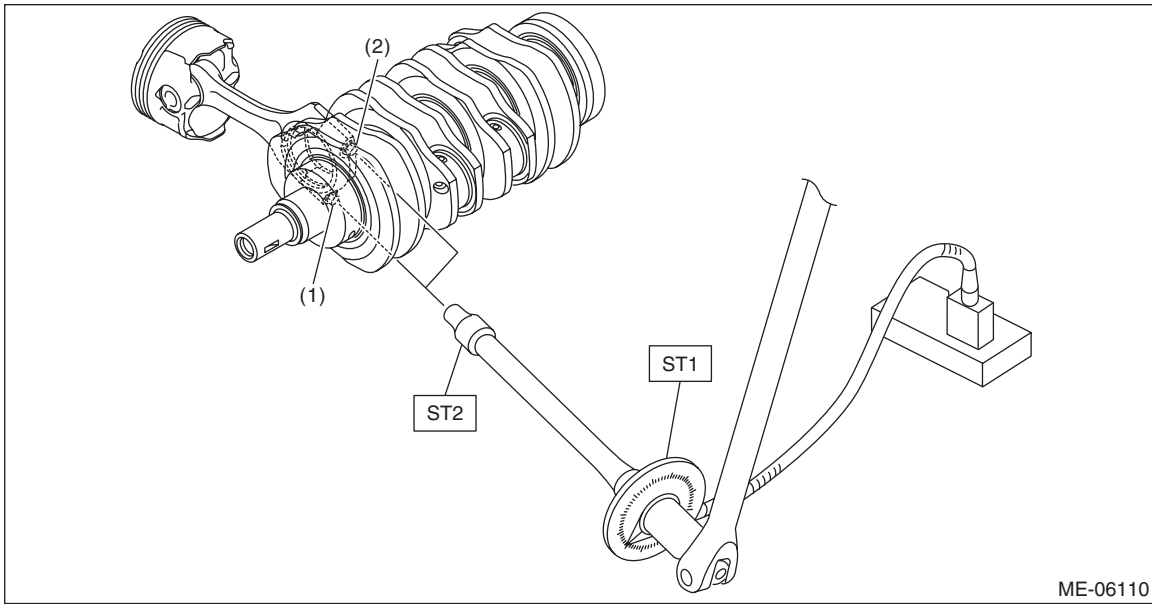
Attach the magnet used for securing the ST1 to V-block.

ST1 18854AA000 ANGLE GAUGE

ST2 18270AA010 SOCKET (when using TORX® E12)

ST2 18270AA020 SOCKET (when using TORX® E14)

Tightening angle:
 $137^{\circ} \pm 2^{\circ}$



ME-06110

(6) In the same manner, install the #2, #3 and #4 connecting rods.

(7) Check the thrust clearance of each connecting rod using a thickness gauge. If it is not within the standard, replace the connecting rod.

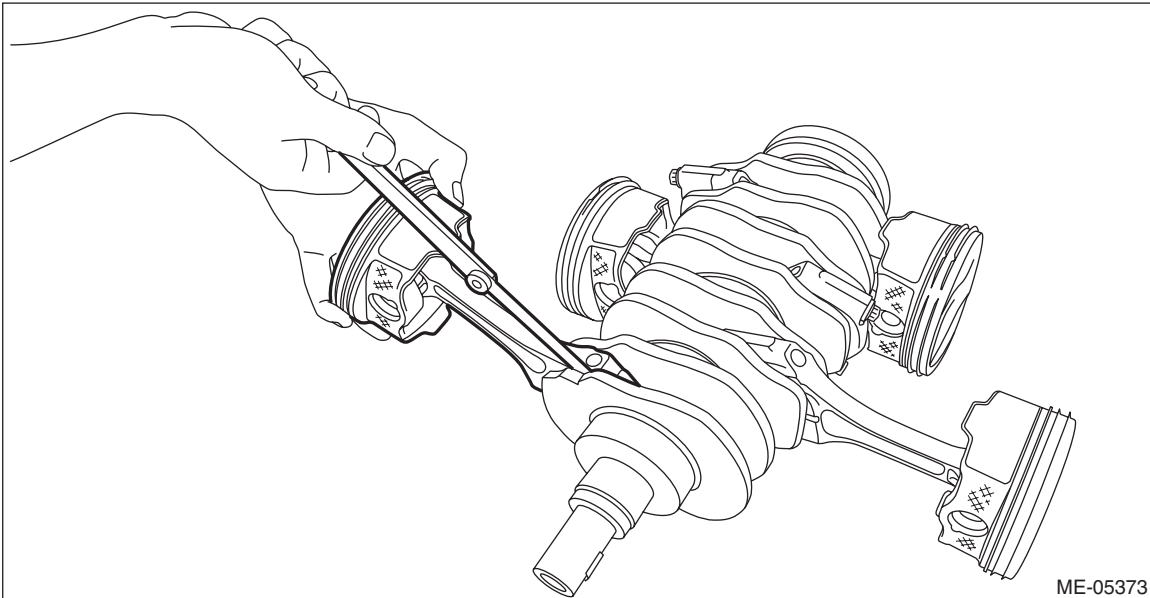
NOTE:

Measure the thrust clearance of each connecting rod at several points, and replace the connecting rod if there is uneven wear.

Connecting rod thrust clearance:

Standard

0.070 — 0.330 mm (0.0028 — 0.0130 in)



ME-05373

Cylinder Block

MECHANICAL

5) Check the oil clearance on each connecting rod bearing using plastigauge.

NOTE:

Measurement should be performed at a temperature of 20°C (68°F).

- (1) Clean the #1 connecting rod bearing and the #1 pin of crankshaft.
- (2) Set the #1 connecting rod bearing to the #1 connecting rod and #1 connecting rod cap.
- (3) Place a plastigauge across the #1 pin of crankshaft, and set the #1 connecting rod, #1 connecting rod cap and #1 connecting rod cap bolt to the #1 pin of crankshaft.

NOTE:

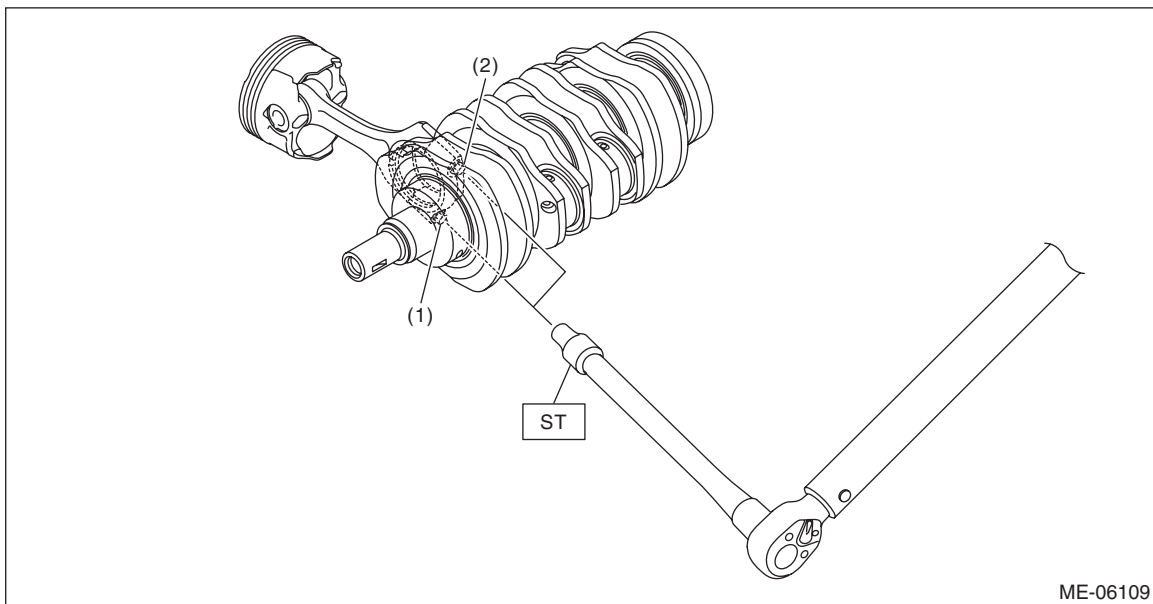
- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.
- Use a new connecting rod cap bolt.
- Apply a coat of engine oil to the #1 connecting rod cap bolt thread.
- (4) Using ST, tighten the #1 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 22 N·m (2.2 kgf-m, 16.2 ft-lb) in numerical order as shown in the figure.

CAUTION:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**
- **During tightening, be careful not to move the #1 connecting rod and the #1 connecting rod cap.**

ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



(5) Using ST1 and ST2, tighten the #1 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

CAUTION:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**
- **During tightening, be careful not to move the #1 connecting rod and the #1 connecting rod cap.**

NOTE:

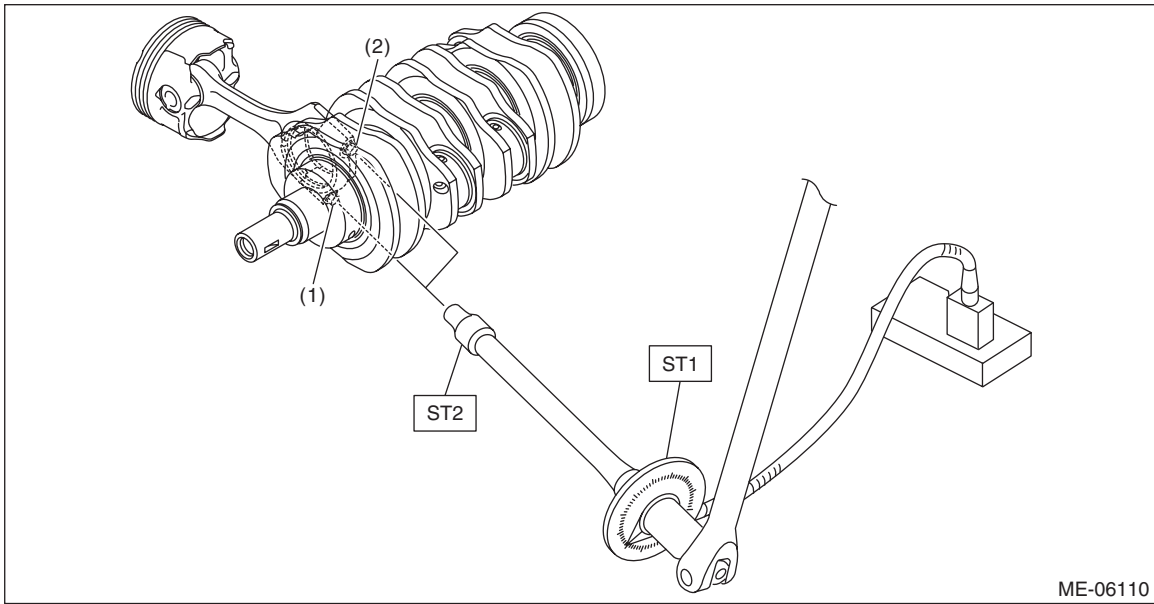
Attach the magnet used for securing the ST1 to V-block.

ST1 18854AA000 ANGLE GAUGE

ST2 18270AA010 SOCKET (when using TORX® E12)

ST2 18270AA020 SOCKET (when using TORX® E14)

Tightening angle:
 $137^{\circ} \pm 2^{\circ}$



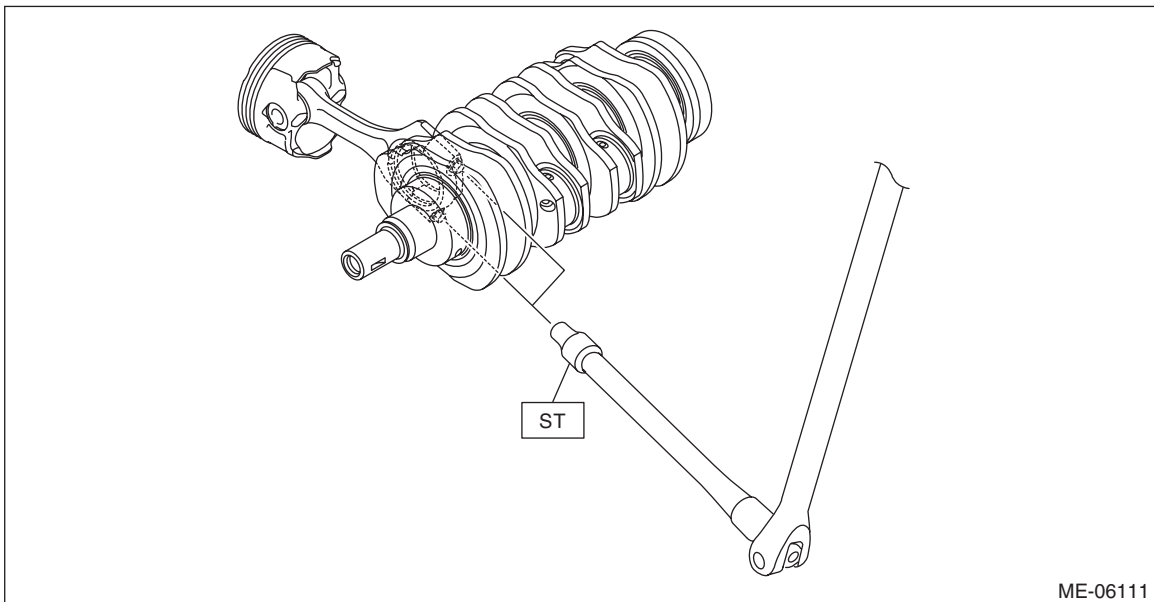
(6) Using ST, loosen the #1 connecting rod cap bolt, and remove the #1 connecting rod cap bolt and #1 connecting rod cap.

CAUTION:

- Make sure to hold the crankshaft securely during work.
- When holding the crankshaft, be careful not to damage the crankshaft.
- During removal, be careful not to move the #1 connecting rod and the #1 connecting rod cap.

ST 18270AA010 SOCKET (when using TORX® E12)

ST 18270AA020 SOCKET (when using TORX® E14)



Cylinder Block

MECHANICAL

(7) Determine oil clearance of the #1 connecting rod bearing by matching the widest point of the plastigauge on #1 pin of crankshaft against scale printed on a package of the plastigauge. If it is not within the standard, replace the #1 connecting rod bearing.

NOTE:

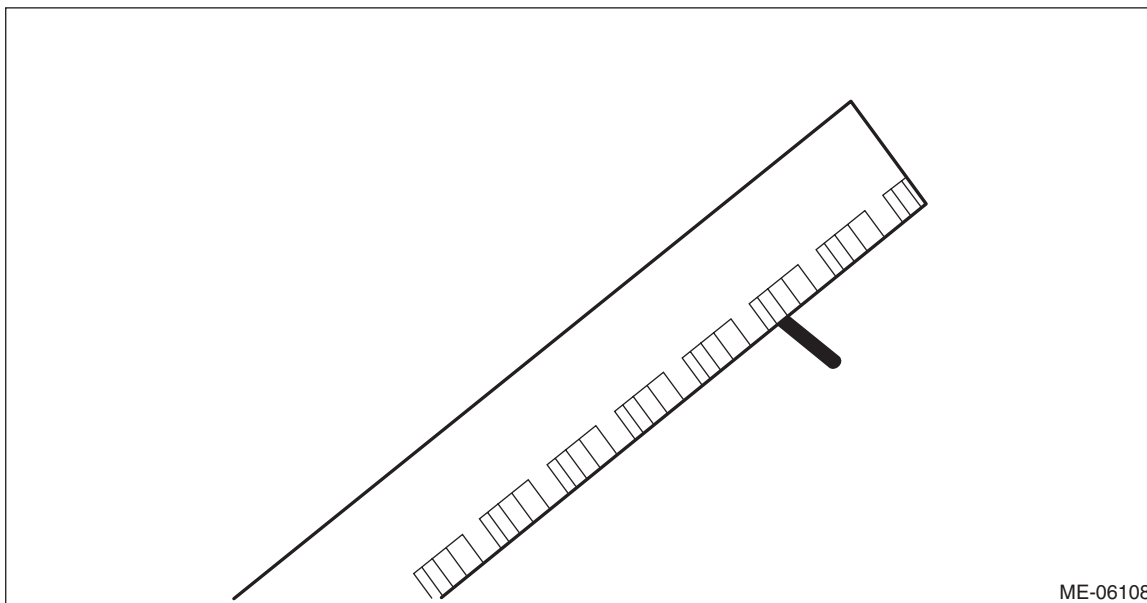
Measure the outer diameter of crankshaft pin using micrometer, and select the suitable size connecting rod bearing when replacing the connecting rod bearing.

Unit: mm (in)		
Bearing	Connecting rod bearing thickness (at center)	Crankshaft pin outer diameter
	Standard	Standard
Standard size	1.492 — 1.508 (0.0587 — 0.0594)	47.976 — 48.000 (1.8888 — 1.8898)
0.03 (0.0012) Undersize	1.511 — 1.515 (0.0595 — 0.0596)	47.946 — 47.970 (1.8876 — 1.8886)
0.05 (0.0020) Undersize	1.521 — 1.525 (0.0599 — 0.0600)	47.926 — 47.950 (1.8868 — 1.8878)
0.25 (0.0098) Undersize	1.621 — 1.625 (0.0638 — 0.0640)	47.726 — 47.750 (1.8790 — 1.8799)

Connecting rod bearing oil clearance:

Standard

0.017 — 0.047 mm (0.0007 — 0.0019 in)



(8) Completely remove the plastigauge.

(9) In the same manner, check oil clearance of the #2, #3 and #4 connecting rod bearings.

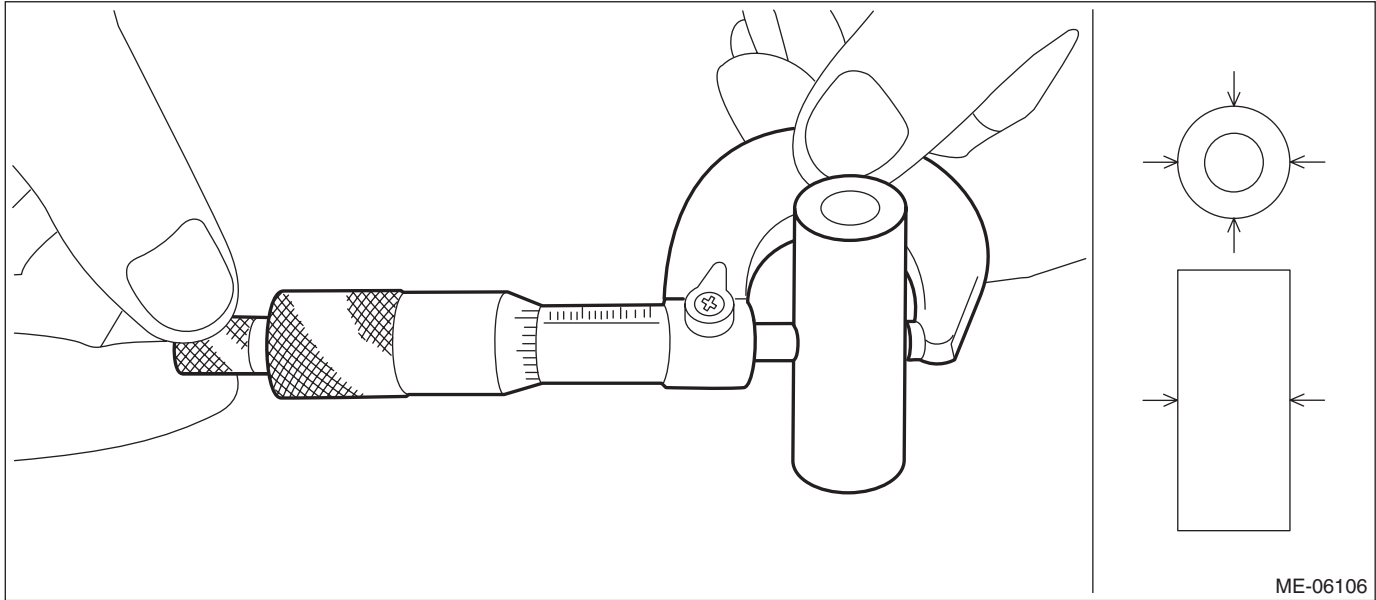
5. PISTON PIN & CONNECTING ROD BUSHING

- 1) Check the connecting rod bushing for damage.
- 2) Check the clearance between piston pin and connecting rod bushing. Check the clearance between piston pin and connecting rod bushing by measuring the outer diameter of piston pin and the inner diameter of connecting rod bushing respectively.

(1) Measure the outer diameter of piston pin with a micrometer.

NOTE:

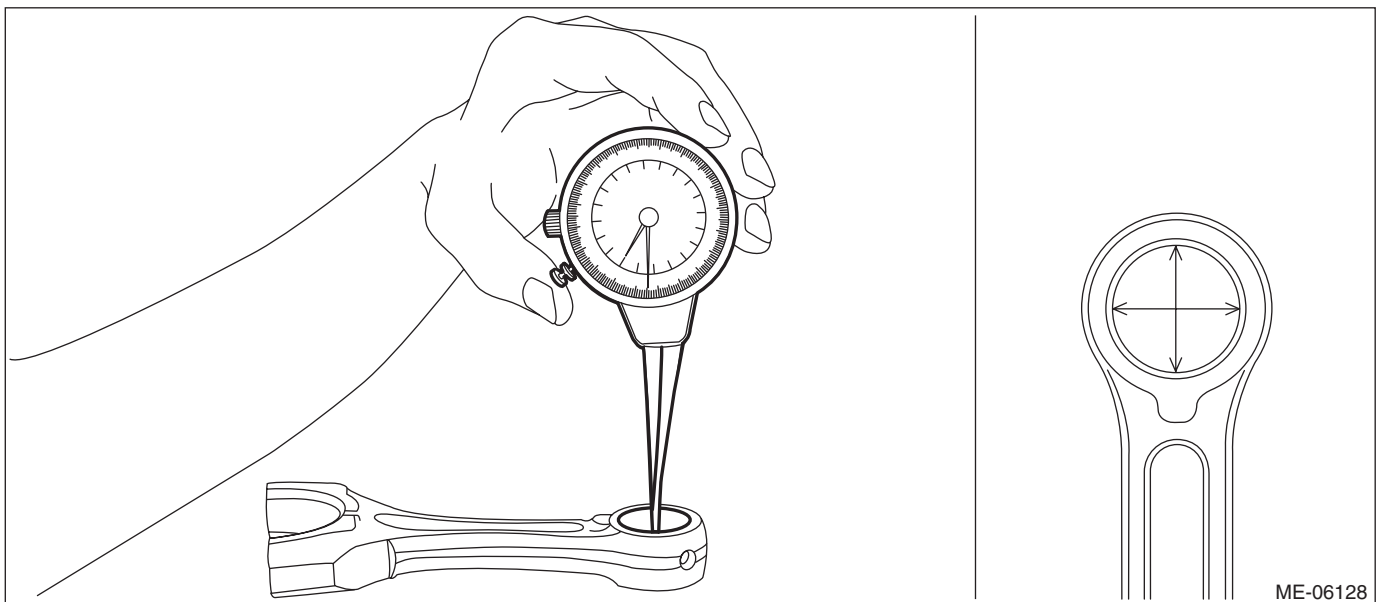
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the piston pin at the two locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



(2) Using a caliper gauge, measure the inner diameter of connecting rod bushing.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the connecting rod bushing at the two locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



Cylinder Block

MECHANICAL

- (3) Calculate the clearance between piston pin and connecting rod bushing.

Clearance between piston pin and connecting rod bushing:

Standard

0.004 — 0.026 mm (0.0002 — 0.0010 in)

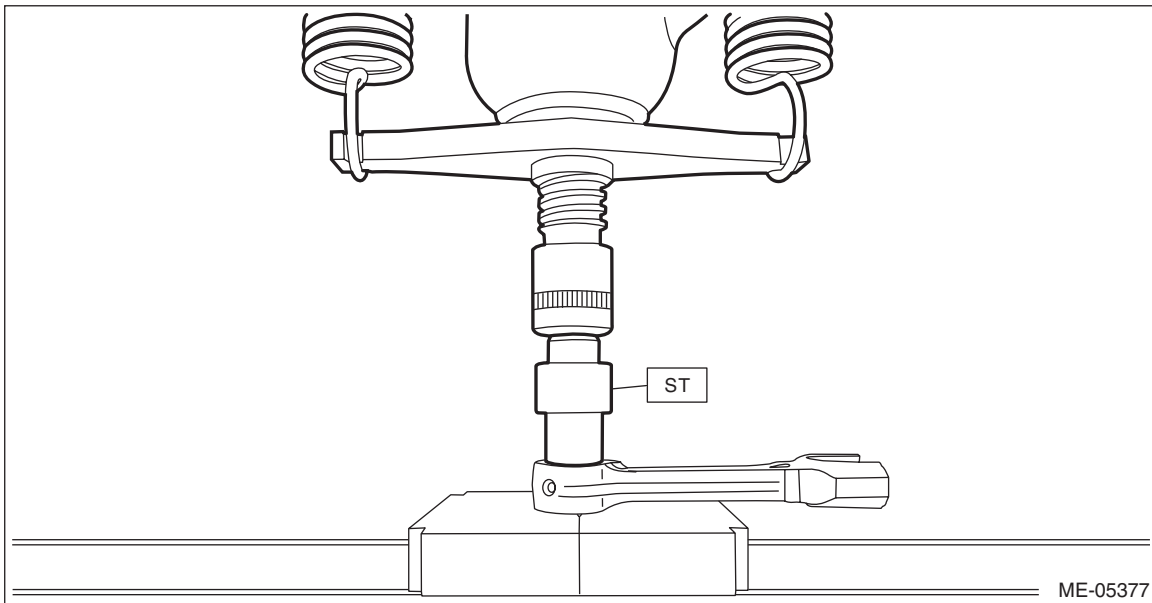
- 3) If the clearance between piston pin and connecting rod bushing is not within the standard, replace the connecting rod bushing and piston pin as a set. For replacement procedure of connecting rod bushing, refer to the following.

- (1) Remove the connecting rod bushing from connecting rod small end with ST and press.

NOTE:

Be careful not to confuse the direction of the ST, because it is used in opposite directions for extraction and press-fit.

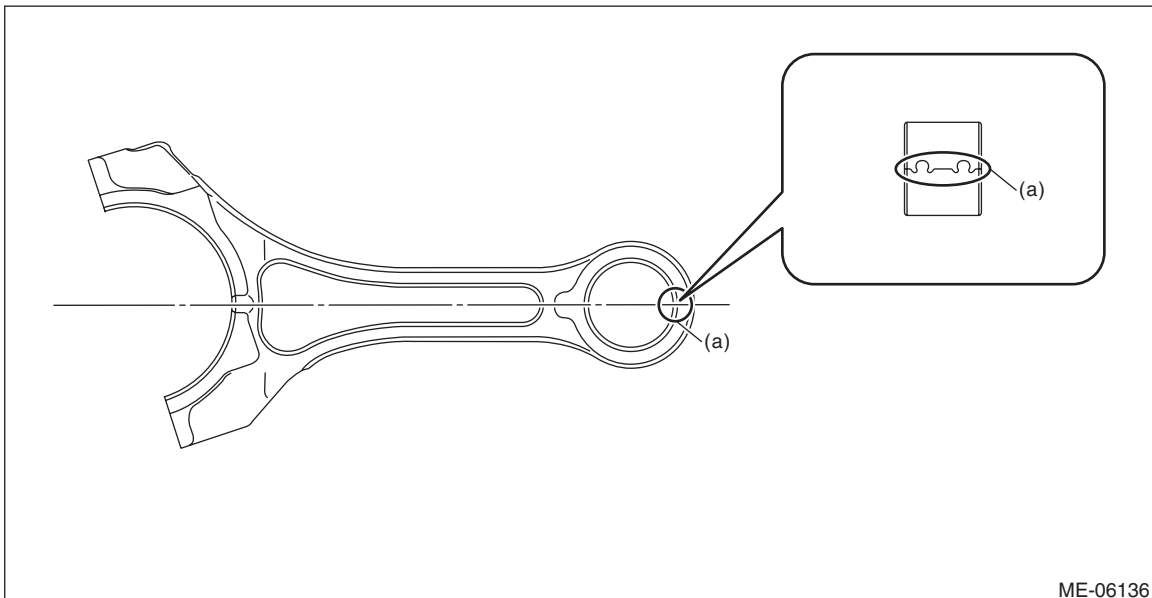
ST 18350AA000 CONNECTING ROD BUSHING REMOVER AND INSTALLER



- (2) Press the connecting rod bushing with ST and the press, after applying engine oil on the periphery of connecting rod bushing.

NOTE:

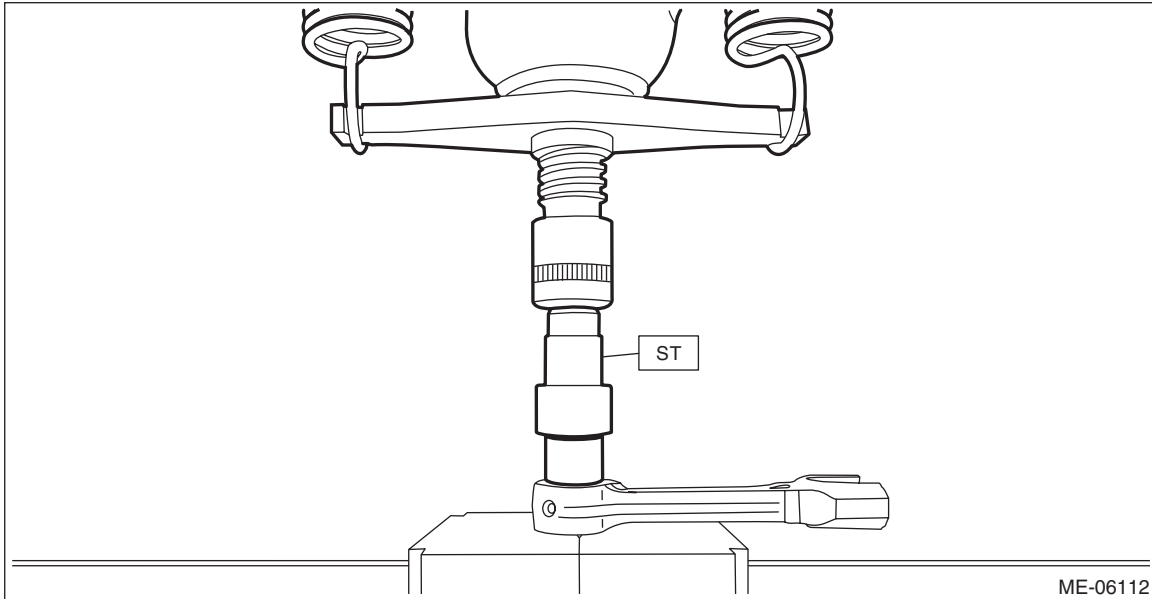
- Position the clinch portion of connecting rod bushing as shown in the figure.



- (a) Clinch portion of connecting rod bushing

- Be careful not to confuse the direction of the ST, because it is used in opposite directions for extraction and press-fit.

ST 18350AA000 CONNECTING ROD BUSHING REMOVER AND INSTALLER



(3) Make two 3 mm (0.12 in) holes in the pressed connecting rod bushing by aligning with the pre-manufactured holes on the connecting rod small end.

(4) Ream the inside of connecting rod bushing using the reamer. Insert the reamer in the connecting rod bushing, and turn slowly clockwise while pushing lightly. Bring the reamer back while rotating it clockwise.

NOTE:

- Use a $\phi 22$ reamer.
- Apply engine oil to the reamer.
- If the inner surface of valve guide is damaged, the edge of reamer should be slightly ground with oil stone.
- If the inner surface of connecting rod bushing becomes lustrous and the reamer does not chip, use a new reamer or remedy the reamer.

(5) After completion of reaming, clean the connecting rod bushing to remove chips.

Cylinder Block

MECHANICAL

6. CRANKSHAFT AND CRANKSHAFT BEARING

- 1) Clean the crankshaft completely, and check it for cracks using liquid penetrant tester.
- 2) Using a dial gauge, check the crankshaft bend. If it exceeds the limit, grind to correct the crankshaft journal or replace the crankshaft.

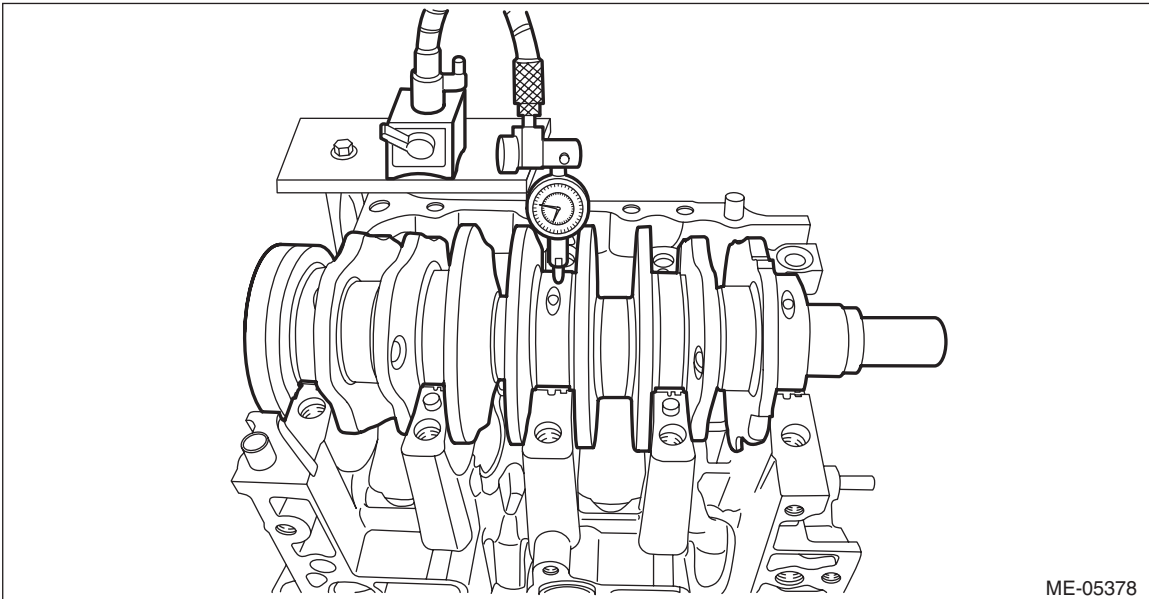
NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- If a suitable V-block is not available, using just the #1 and #5 crankshaft bearings on cylinder block, position the crankshaft on cylinder block. Then, measure the crankshaft bend using a dial gauge.
- When grinding to correct the crankshaft journal, refer to step 3).

Crankshaft bend:

Limit

0.035 mm (0.0014 in)



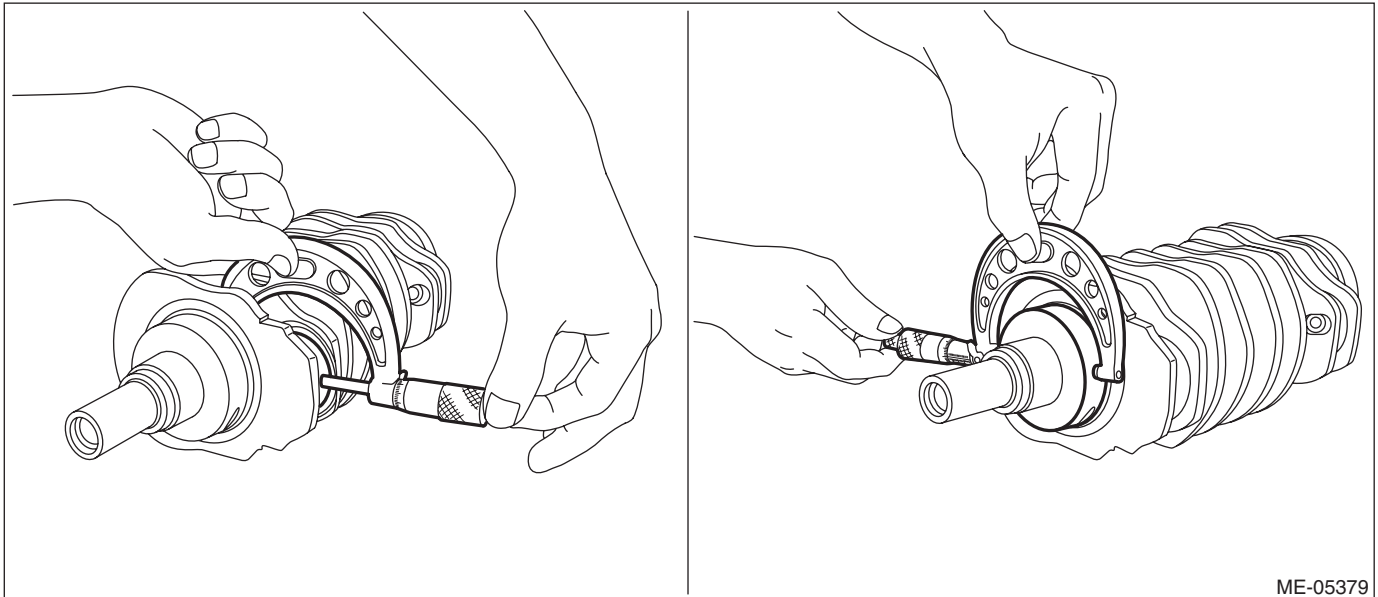
ME-05378

- 3) Using a micrometer, check the outer diameter of crankshaft pin, outer diameter of journal, cylindricity, and out-of-roundness. If it is not within the standard, replace the connecting rod bearing or crankshaft bearing, and grind to correct the crankshaft pin or journal or replace the crankshaft as required.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Select the suitable size connecting rod bearing or crankshaft bearing when replacing the connecting rod bearing or crankshaft bearing.
- When grinding to correct the crankshaft pin or journal, finish them to the suitable outer diameter as shown in the table below according to the undersize bearing to be used.

Unit: mm (in)						
Bearing	Connecting rod bearing thickness (at center)	Crankshaft pin outer diameter	Crankshaft bearing thickness (at center)		Crankshaft journal outer diameter	
			#1, #2, #3, #4	#5	#1, #2, #3, #4	#5
	Standard	Standard	Standard	Standard	Standard	Standard
Standard size	1.492 — 1.508 (0.0587 — 0.0594)	47.976 — 48.000 (1.8888 — 1.8898)	2.495 — 2.513 (0.0982 — 0.0989)	2.493 — 2.511 (0.0981 — 0.0989)	67.985 — 68.009 (2.6766 — 2.6775)	67.985 — 68.009 (2.6766 — 2.6775)
0.03 (0.0012) Undersize	1.511 — 1.515 (0.0595 — 0.0596)	47.946 — 47.970 (1.8876 — 1.8886)	2.519 — 2.522 (0.0992 — 0.0993)	2.517 — 2.520 (0.0991 — 0.0992)	67.955 — 67.979 (2.6754 — 2.6763)	67.955 — 67.979 (2.6754 — 2.6763)
0.05 (0.0020) Undersize	1.521 — 1.525 (0.0599 — 0.0600)	47.926 — 47.950 (1.8868 — 1.8878)	2.529 — 2.532 (0.0996 — 0.0997)	2.527 — 2.530 (0.0995 — 0.0996)	67.935 — 67.959 (2.6746 — 2.6755)	67.935 — 67.959 (2.6746 — 2.6755)
0.25 (0.0098) Undersize	1.621 — 1.625 (0.0638 — 0.0640)	47.726 — 47.750 (1.8790 — 1.8799)	2.629 — 2.632 (0.1035 — 0.1036)	2.627 — 2.630 (0.1034 — 0.1035)	67.735 — 67.759 (2.6667 — 2.6677)	67.735 — 67.759 (2.6667 — 2.6677)

Crankshaft pin:**Cylindricity****Limit****0.006 mm (0.0002 in)****Out-of-roundness****Limit****0.005 mm (0.0002 in)****Grinding limit (dia.)****To 47.726 mm (1.8790 in)****Crankshaft journal:****Cylindricity****Limit****0.006 mm (0.0002 in)****Out-of-roundness****Limit****0.005 mm (0.0002 in)****Grinding limit (dia.)****To 67.735 mm (2.6667 in)**

ME-05379

4) Inspect the crankshaft bearing for scar, peeling, seizure, melting or wear, etc.

Cylinder Block

MECHANICAL

5) Use a thickness gauge to check the thrust clearance of crankshaft at thrust of #5 crankshaft bearing. If it is not within the standard, replace the #5 crankshaft bearing.

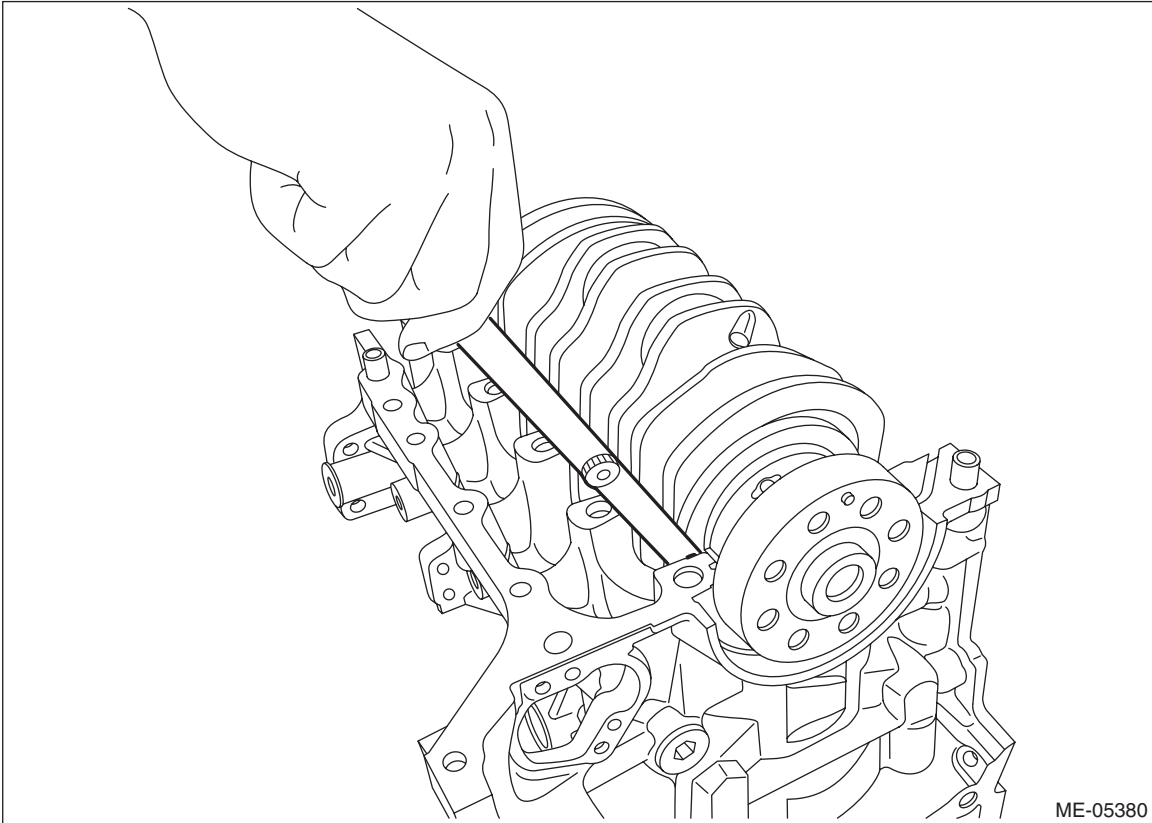
NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Set all the crankshaft bearings onto the cylinder block, then mount the crankshaft on the cylinder block, and use a thickness gauge to measure the thrust clearance of crankshaft.
- Select the #5 crankshaft bearing of suitable size by referring to step 3) when replacing #5 crankshaft bearing.

Crankshaft thrust clearance:

Standard

0.130 — 0.308 mm (0.00512 — 0.01213 in)



6) Check the oil clearance on each crankshaft bearing using plastigauge.

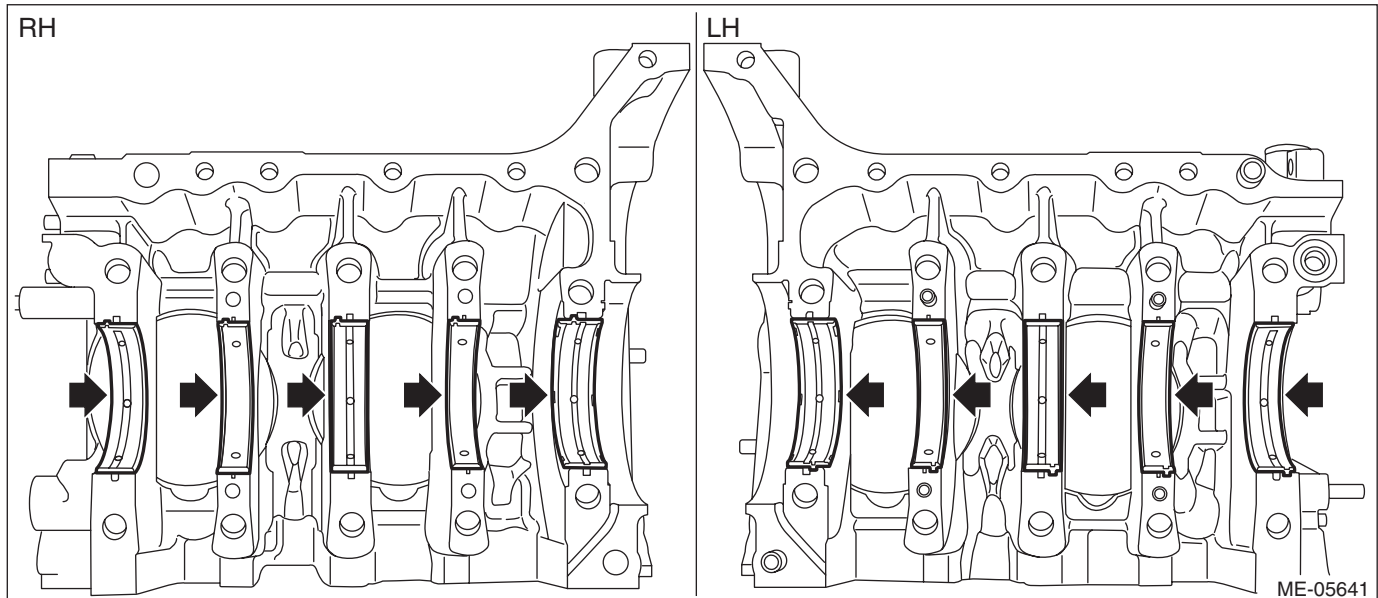
NOTE:

Measurement should be performed at a temperature of 20°C (68°F).

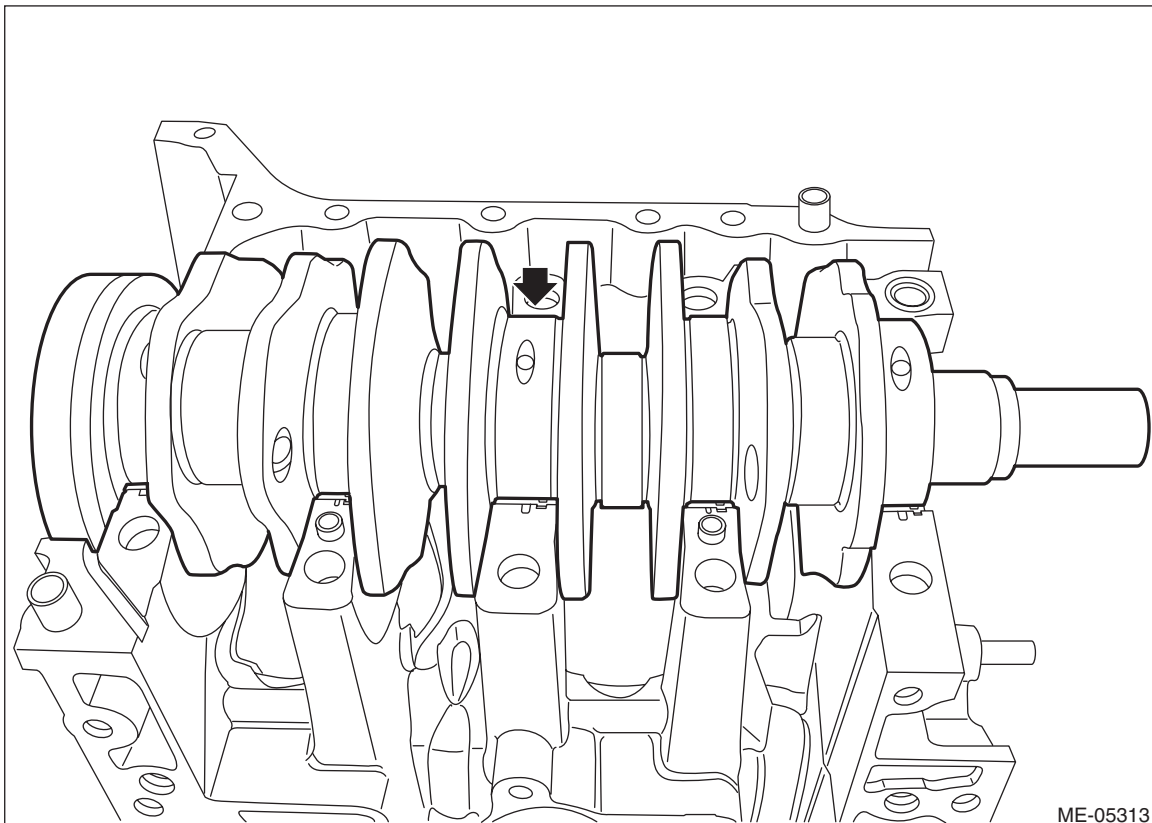
- (1) Remove the liquid gasket from cylinder block.
- (2) Clean each crankshaft bearing and crankshaft journal.
- (3) Set each crankshaft bearing to the cylinder block.

CAUTION:

- Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.
- Be careful not to scratch the mating surface of cylinder block during work.



(4) Set the crankshaft to the cylinder block LH.



Cylinder Block

MECHANICAL

(5) Place a plastigauge across the crankshaft journals and set the cylinder block RH to the cylinder block LH.

(6) Apply a coat of engine oil to the washers and cylinder block mounting bolt threads.

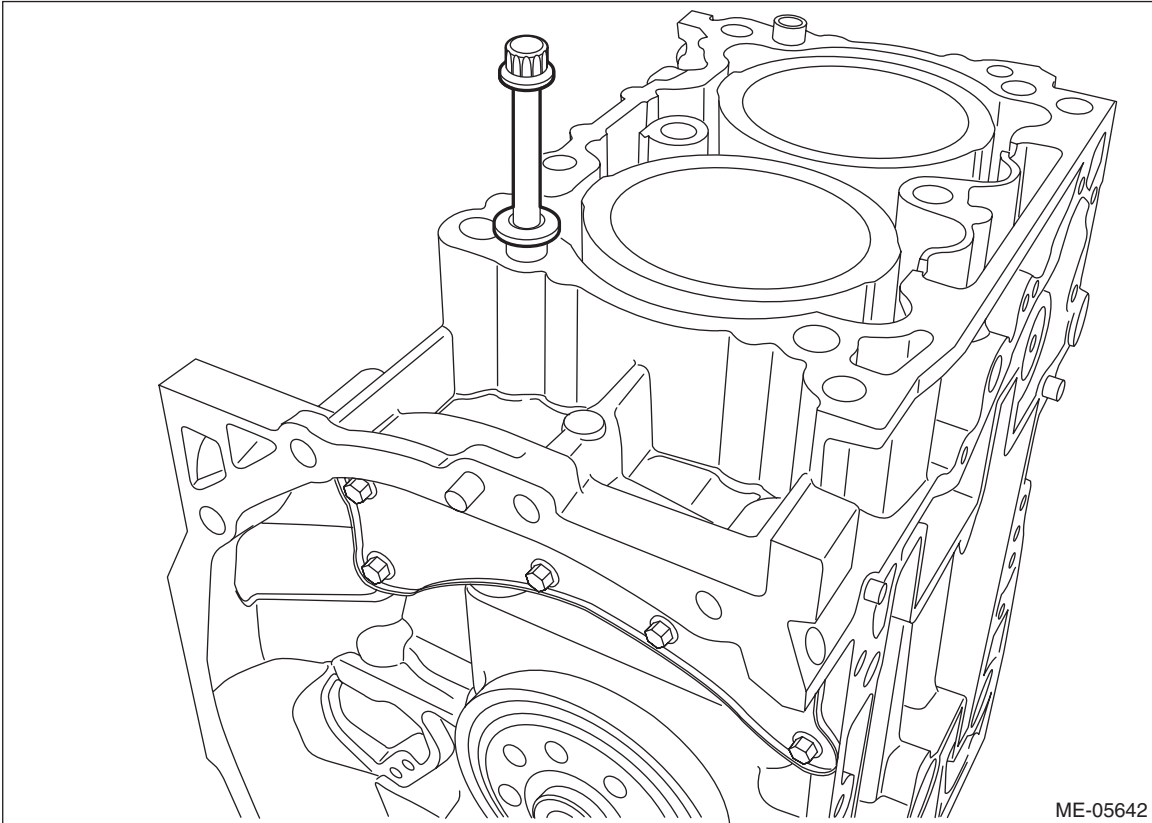
NOTE:

To prevent mixture of engine oil into the water jacket, do not apply a large amount.

(7) Install the cylinder head bolt at the locations shown in the figure.

NOTE:

This procedure is required to tighten the cylinder block mounting bolts with specified angle using ST.

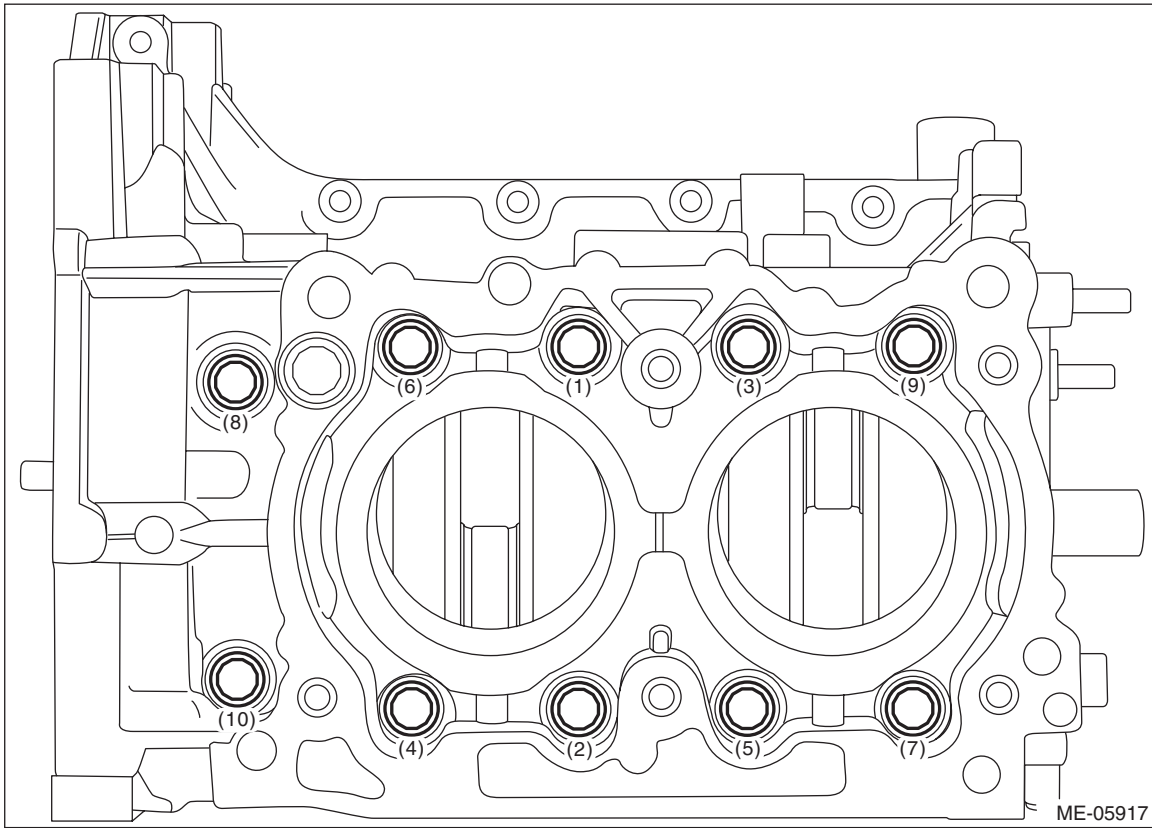


ME-05642

(8) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



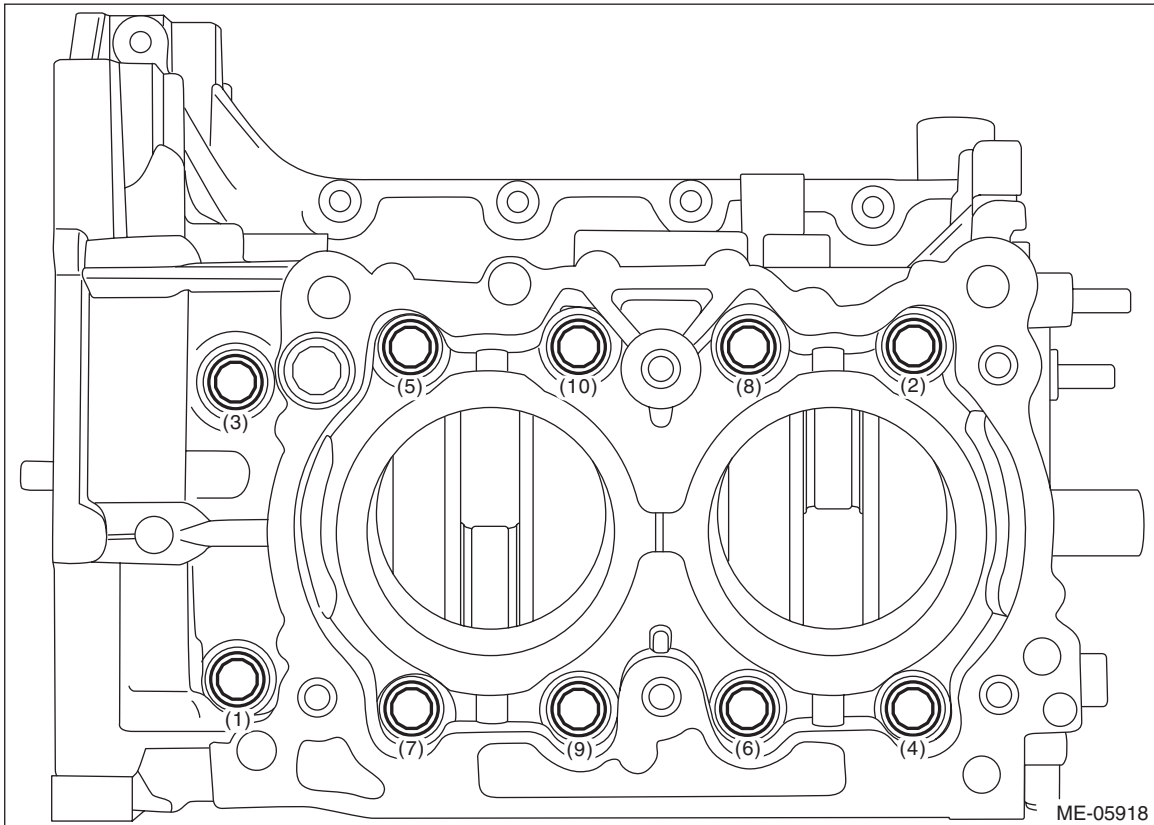
Cylinder Block

MECHANICAL

(9) Loosen all mounting bolts by 180° in numerical order as shown in the figure.

CAUTION:

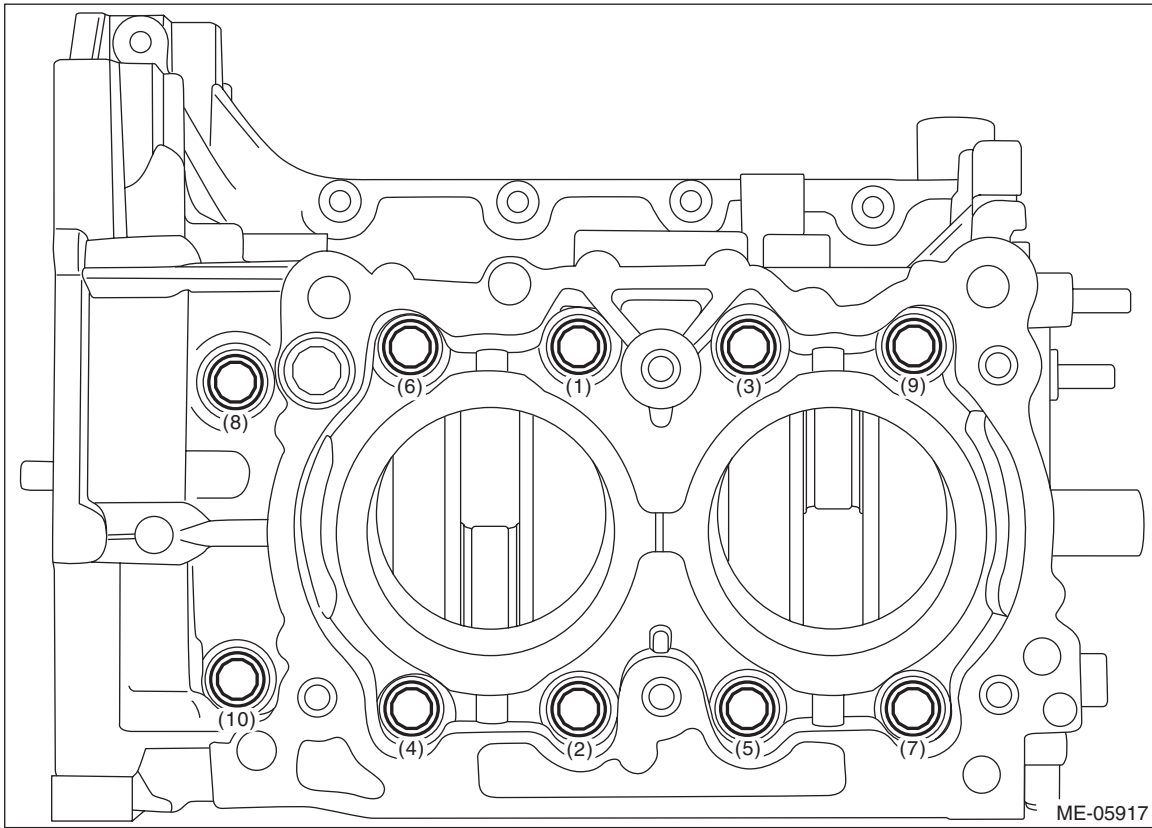
When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



(10) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



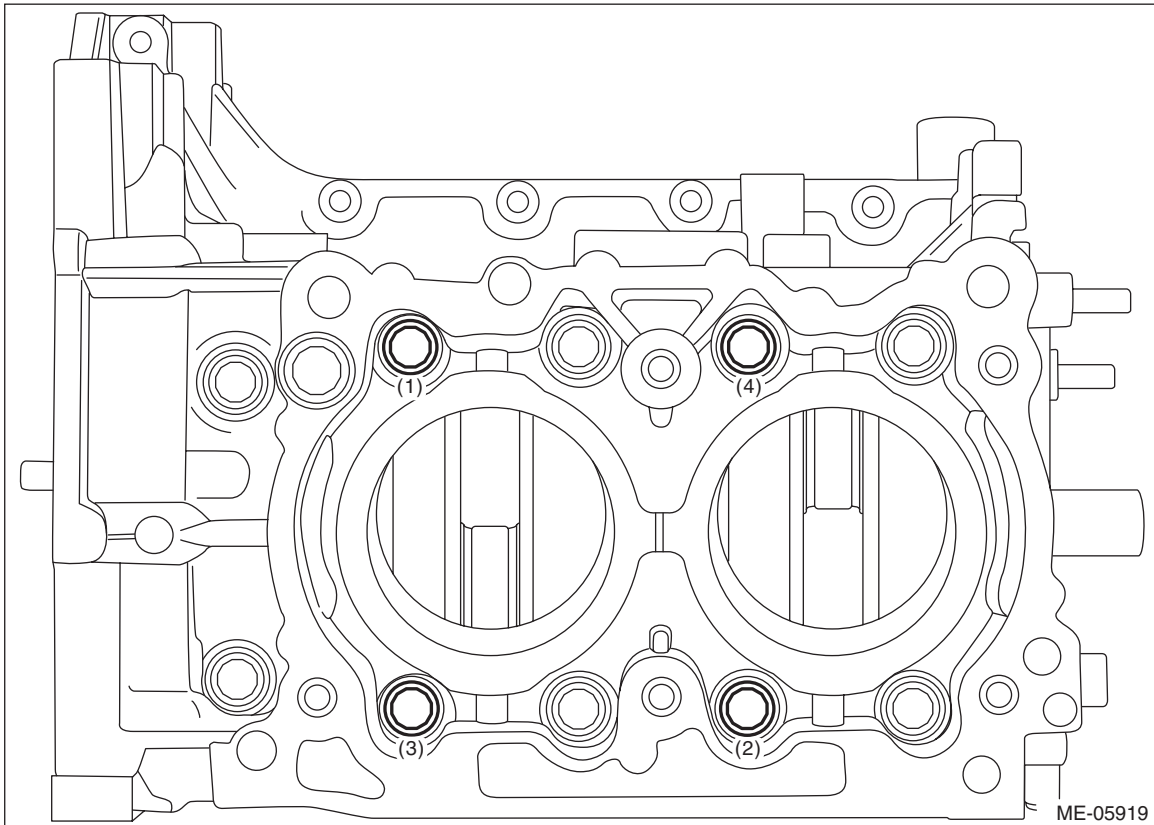
Cylinder Block

MECHANICAL

(11) Loosen the mounting bolts (4 places) by 180° in numerical order as shown in the figure.

CAUTION:

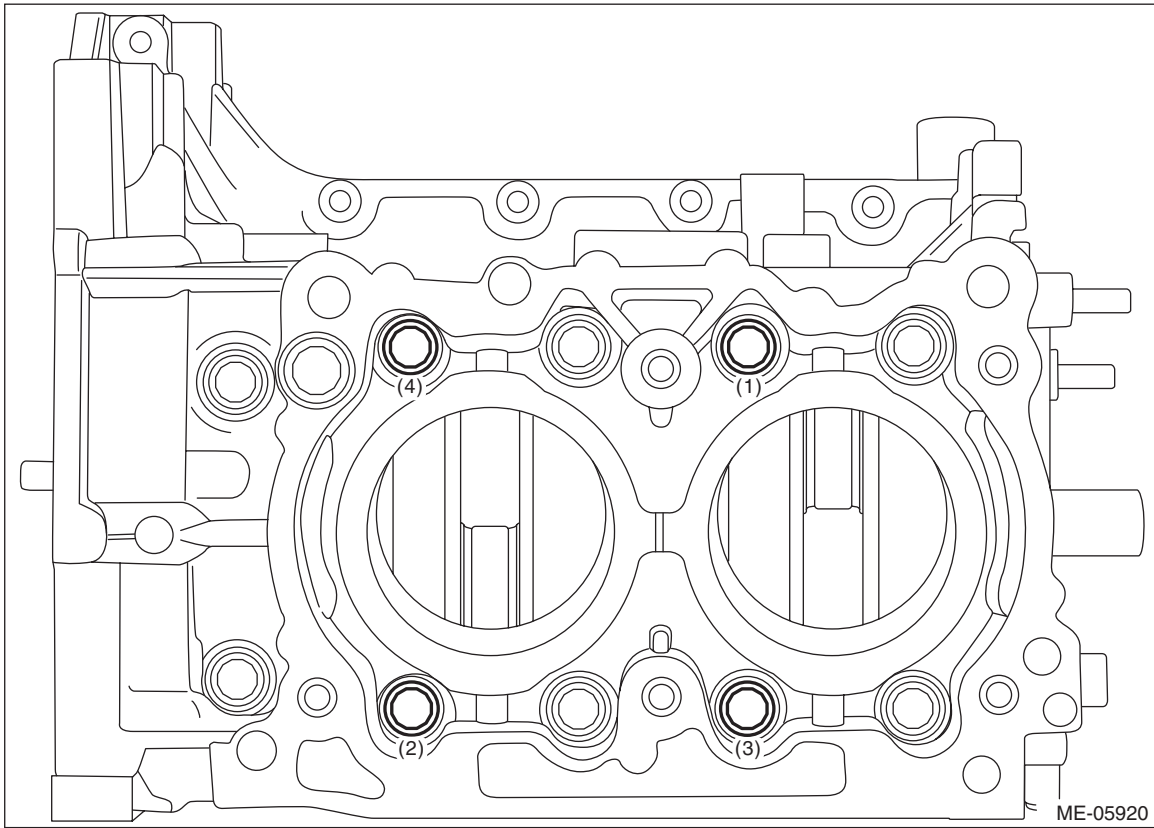
When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



(12) Tighten the mounting bolts (4 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



Cylinder Block

MECHANICAL

(13) Using ST, tighten the mounting bolts (4 places) with specified angle in numerical order as shown in the figure.

CAUTION:

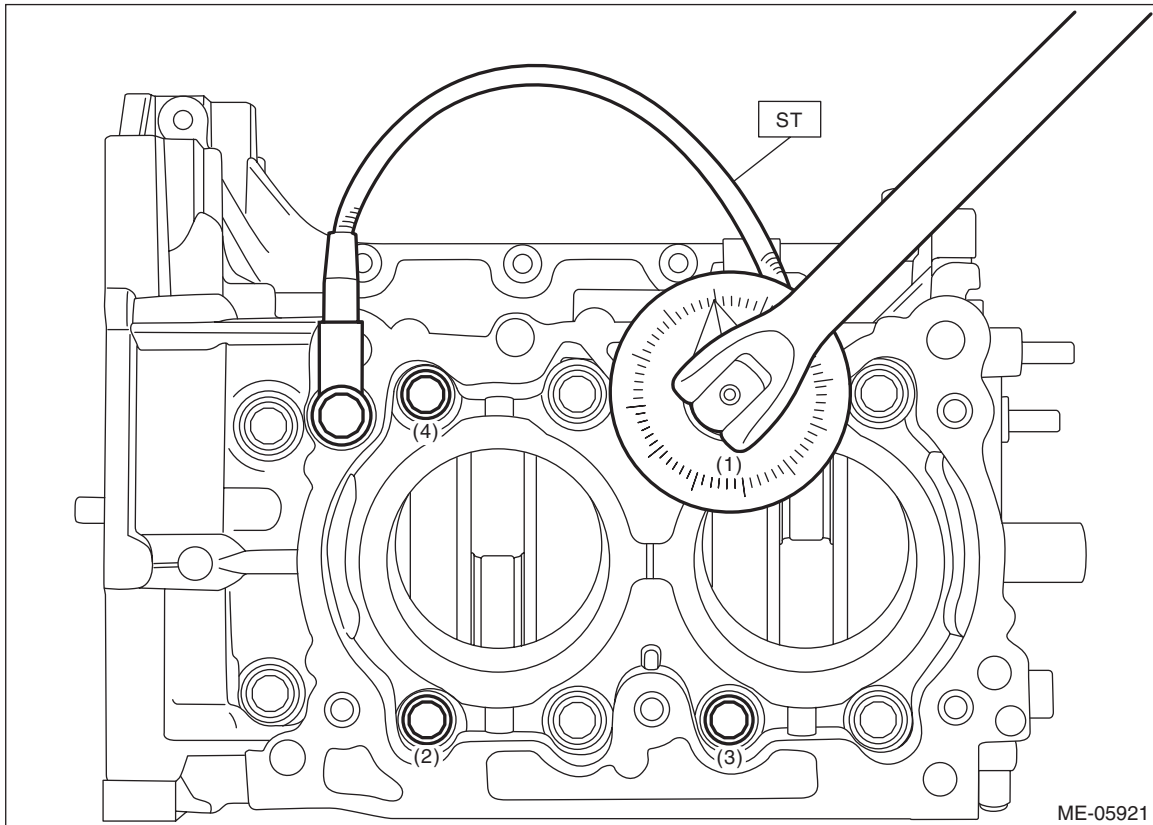
When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

NOTE:

Attach the magnet used for securing the ST (ANGLE GAUGE) to the cylinder head bolt attached in step (2).
ST 18854AA000 ANGLE GAUGE

Tightening angle:

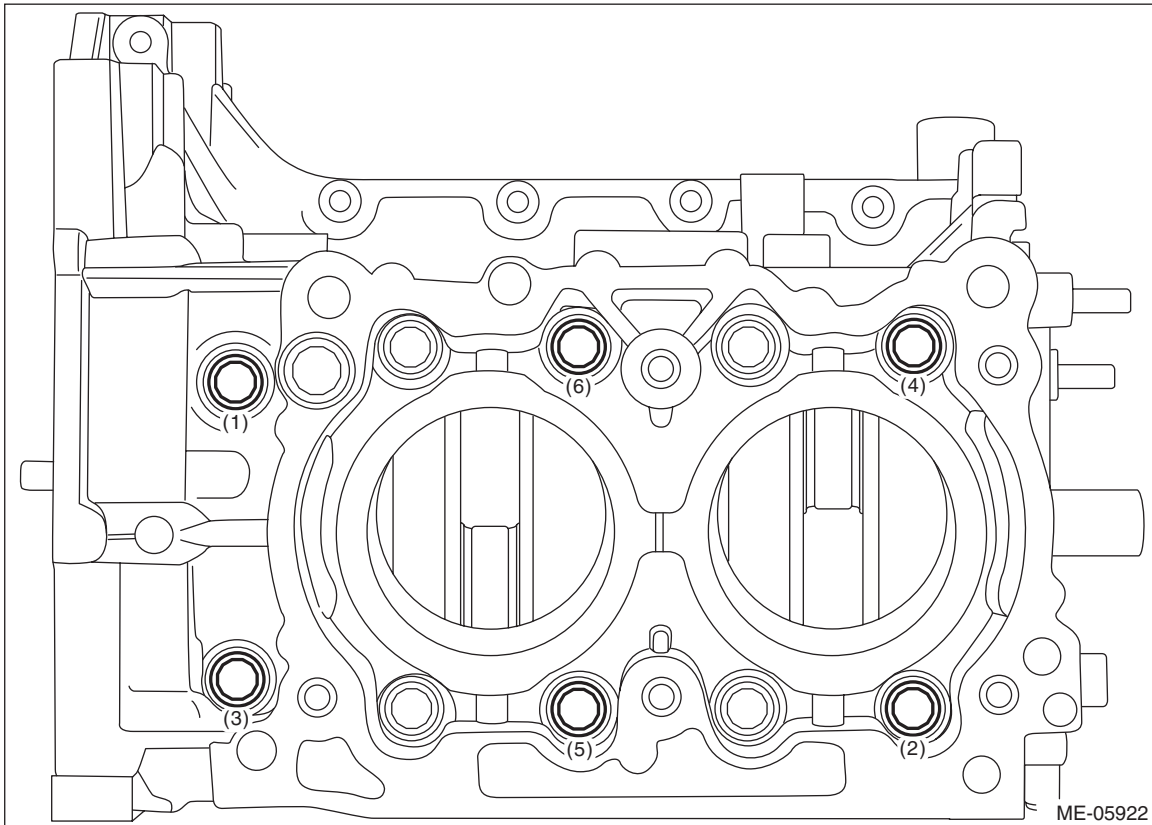
$60^{\circ} \pm 2^{\circ}$



(14) Loosen the mounting bolts (6 places) by 180° in numerical order as shown in the figure.

CAUTION:

When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



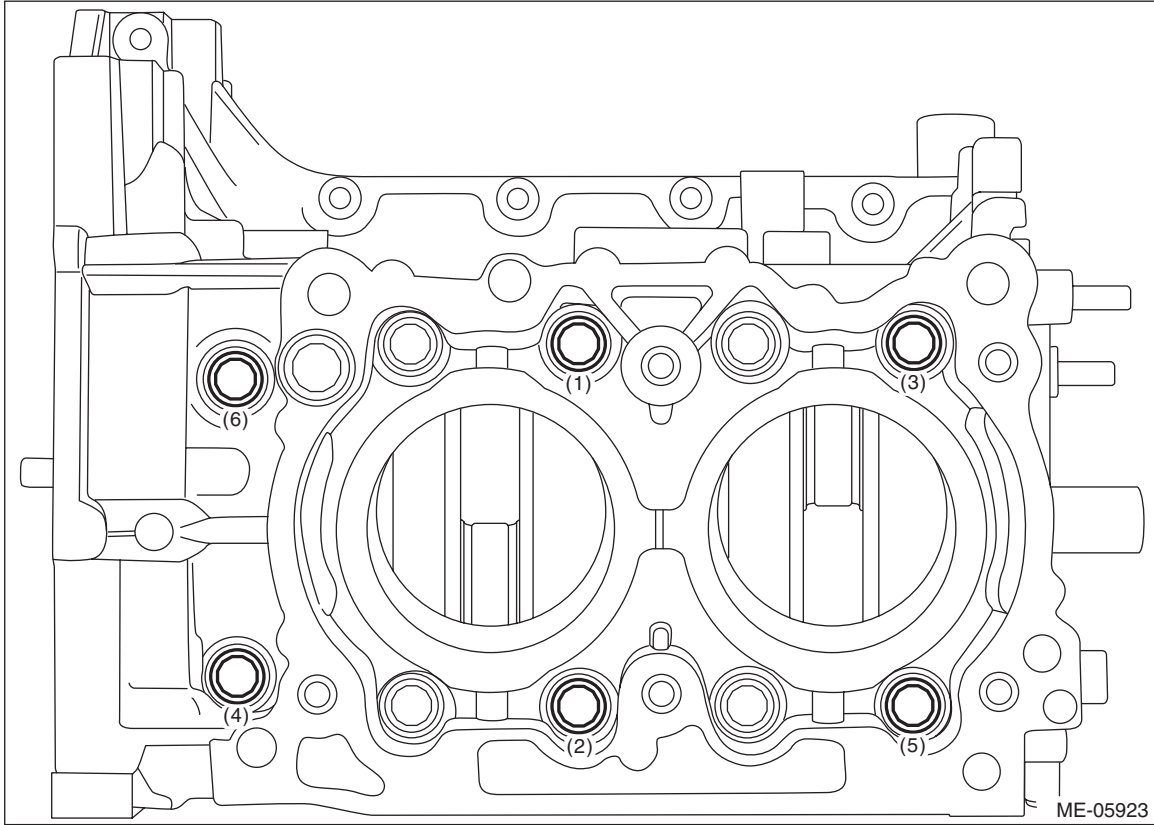
Cylinder Block

MECHANICAL

(15) Tighten the mounting bolts (6 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

CAUTION:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.



(16) Using ST, tighten the mounting bolts (6 places) with specified angle in numerical order as shown in the figure.

CAUTION:

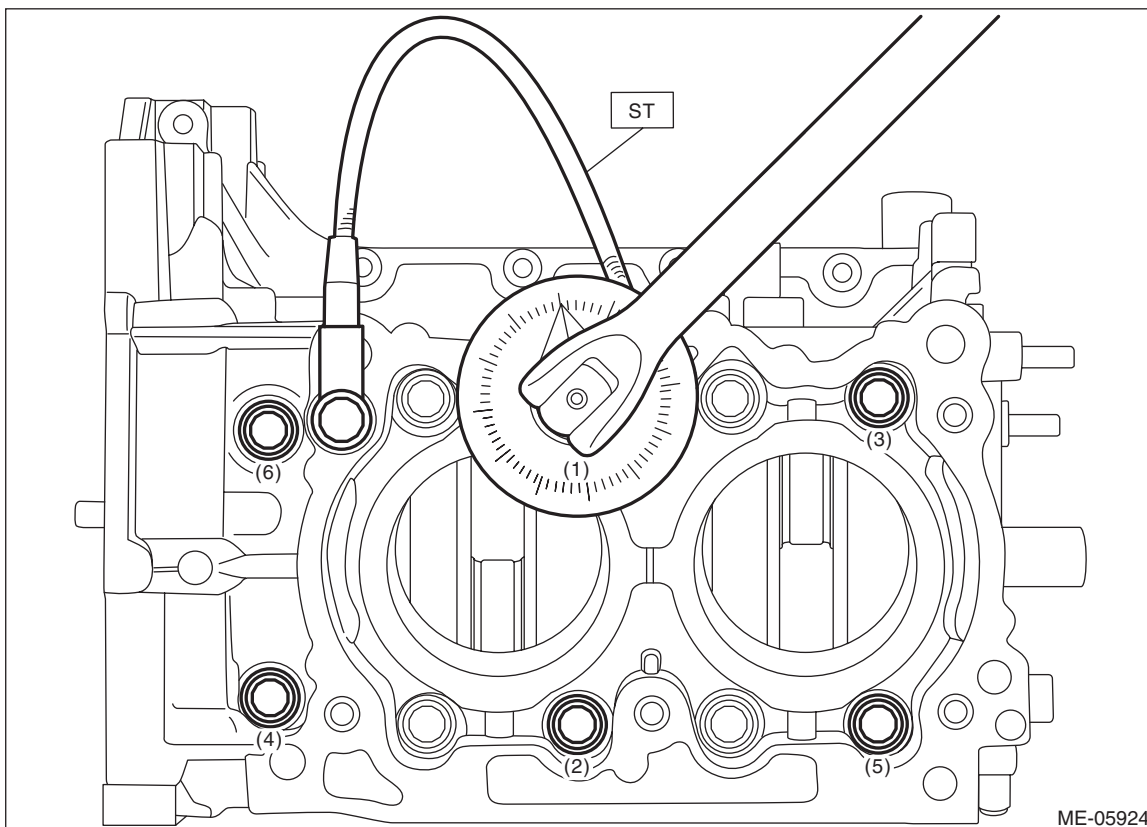
When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

NOTE:

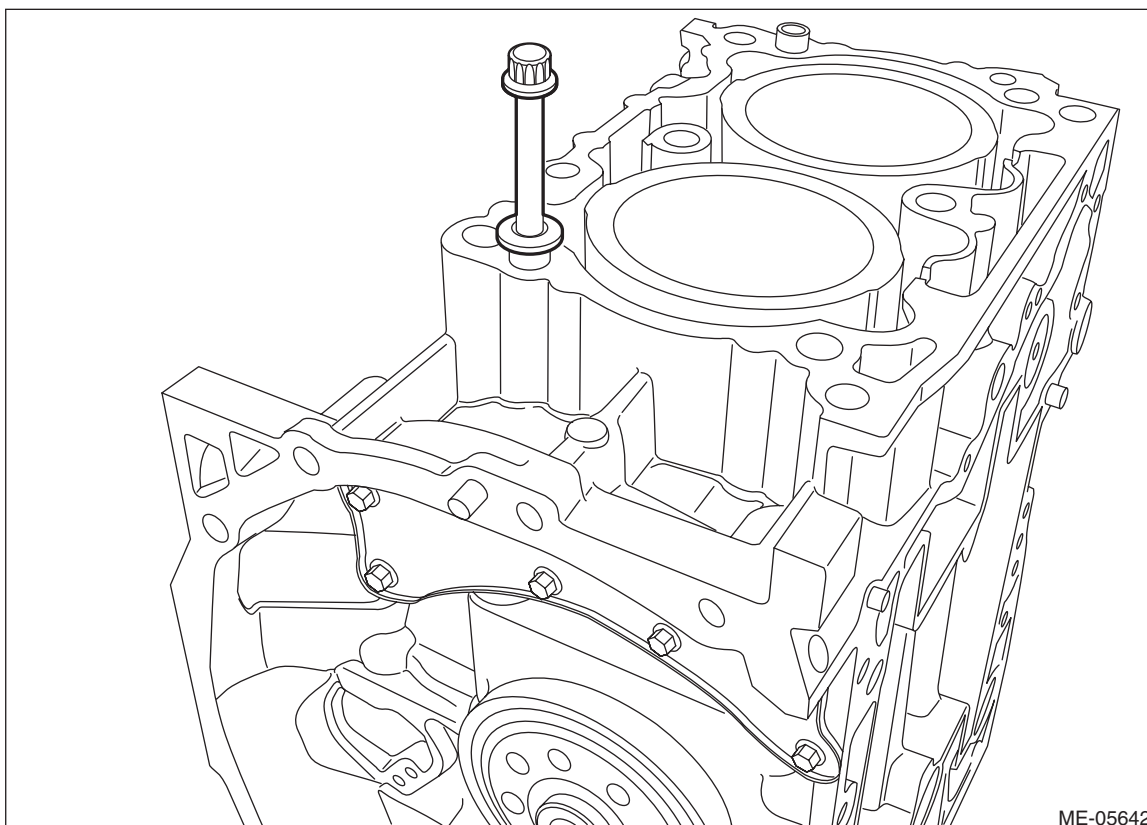
Attach the magnet used for securing the ST (ANGLE GAUGE) to the cylinder head bolt attached in step (2).

ST 18854AA000 ANGLE GAUGE

Tightening angle:
 $60^{\circ} \pm 2^{\circ}$



(17) Remove the cylinder head bolt attached at the locations shown in the figure.



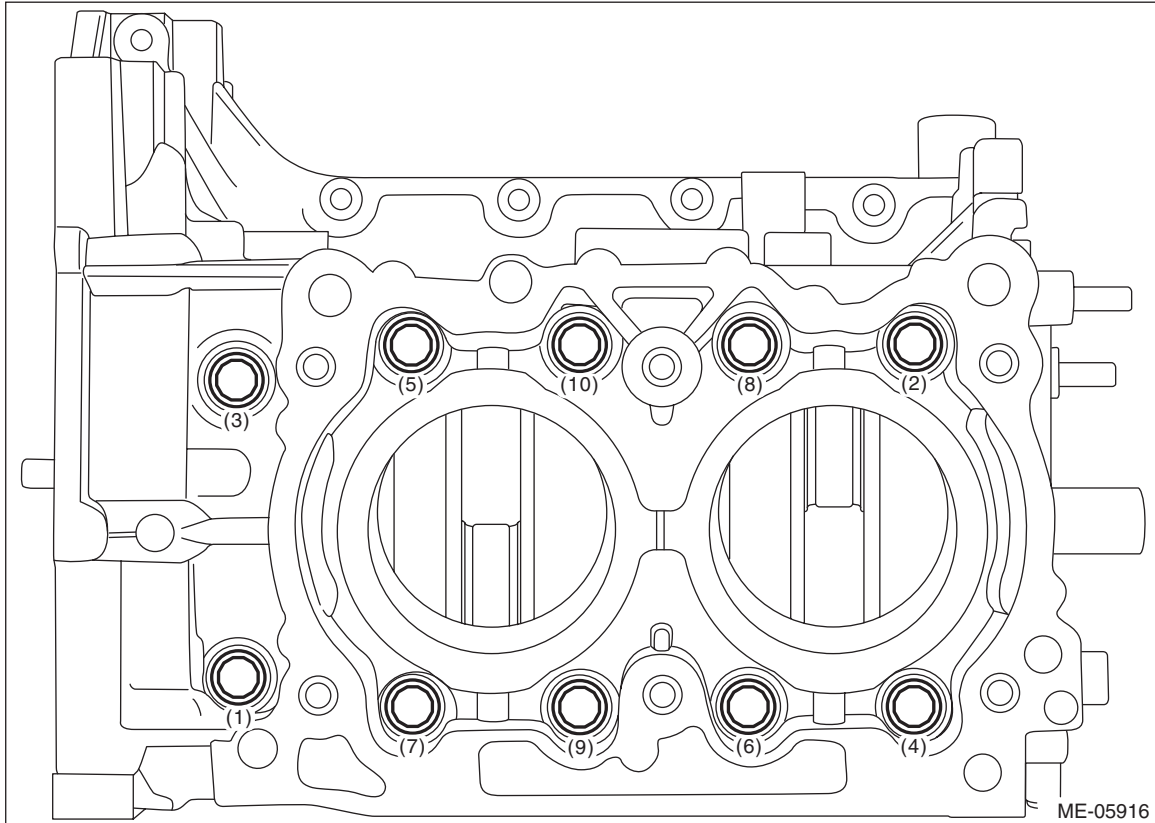
Cylinder Block

MECHANICAL

(18) Loosen the cylinder block mounting bolts in numerical order as shown in the figure, and separate the cylinder block RH and LH.

NOTE:

Lift the cylinder block RH slightly, and confirm that the crankshaft is remaining in the cylinder block LH. If the cylinder block RH is lifted carelessly when separating, the crankshaft may stick to cylinder block RH, then fall off.



(19) Determine the crankshaft oil clearance by matching the widest point of the plastigauge on each journal against scale printed on a package of the plastigauge. If it is not within the standard, replace the crankshaft bearing, and grind to correct the crankshaft journal or replace the crankshaft as required.

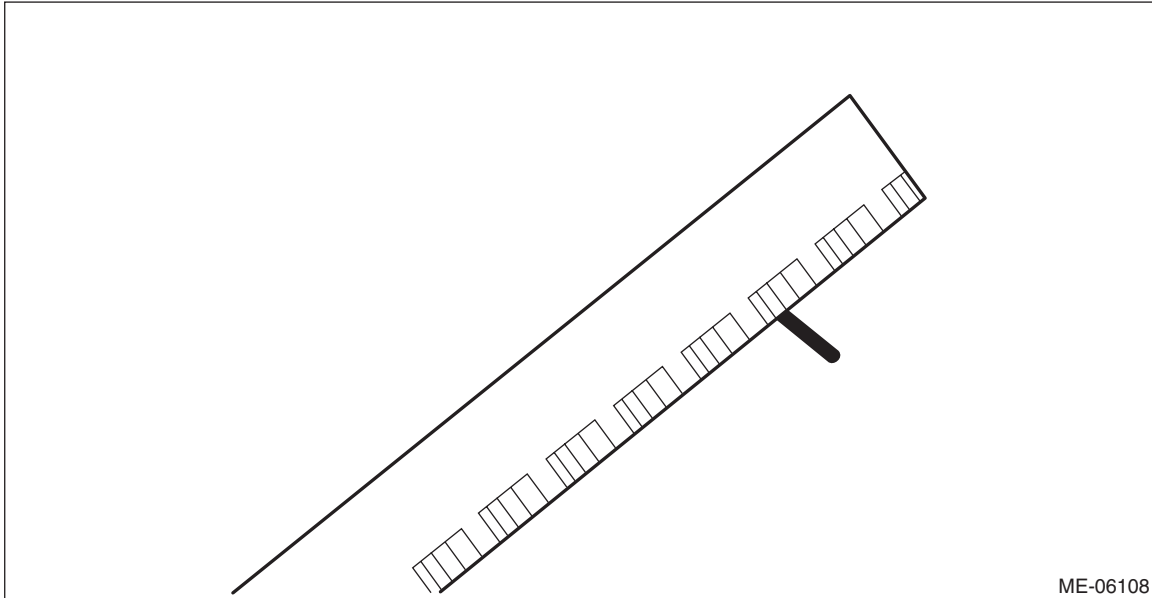
NOTE:

- Select the crankshaft bearing of suitable size by referring to step 3) when replacing crankshaft bearing.
- When grinding to correct the crankshaft journal, finish it to the suitable outer diameter by referring to step 3) according to the undersize bearing to be used.

Crankshaft oil clearance:

Standard

0.013 — 0.031 mm (0.00051 — 0.00122 in)



(20) Completely remove the plastigauge.