

MECHANICAL

ME(H4DOTC)

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General Description

MECHANICAL

1. General Description

A: SPECIFICATION

Engine	Model			2.0 L	
	Cylinder arrangement			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
	Valve system mechanism			Chain driven, double overhead camshaft, 4-valve/cylinder	
	Bore × Stroke			mm (in)	86.0 × 86.0 (3.39 × 3.39)
	Displacement			cm ³ (cu in)	1,998 (121.92)
	Compression ratio				10.6
	Compression pressure (at 200 — 300 rpm)		kPa (kg/cm ² , psi)	Standard	1,350 — 1,750 (14 — 18, 196 — 254)
	Number of piston rings			Compression ring: 2 Oil ring: 1	
	Intake valve timing	Open	Max. retard	ATDC 26°	
			Min. advance	BTDC 42°	
		Close	Max. retard	ABDC 82°	
			Min. advance	ABDC 14°	
	Exhaust valve timing	Open	Max. retard	BBDC 11°	
			Min. advance	BBDC 66°	
		Close	Max. retard	ATDC 55°	
			Min. advance	ATDC 0°	
	Cam clearance	mm (in)		Intake	Standard
				Exhaust	Standard
	Idle rpm (select lever in "P" or "N" range)		rpm	No load	Standard
				A/C ON	Standard
	Ignition order			1 → 3 → 2 → 4	
	Ignition timing			BTDC/rpm	Standard

NOTE:

OS: Oversize US: Undersize

Camshaft	Bending			mm (in)	Limit	0.020 (0.00079)
	Cam lobe height	mm (in)	Intake	Valve drive section	Standard	40.77 — 40.87 (1.605 — 1.609)
				Fuel pump drive section	Standard	41.97 — 42.03 (1.652 — 1.655)
			Exhaust		Standard	40.72 — 40.82 (1.603 — 1.607)
	Cam base circle diameter			mm (in)	Standard	34.0 (1.339)
	Journal outer diameter			mm (in)	Standard	25.946 — 25.963 (1.0215 — 1.0222)
	Thrust clearance			mm (in)	Standard	0.068 — 0.116 (0.0027 — 0.0047)
Oil clearance			mm (in)	Standard	0.037 — 0.072 (0.0015 — 0.0028)	
Cylinder head	Warpage (mating surface with cylinder block)			mm (in)	Limit	0.035 (0.0014)
	Grinding limit			mm (in)		To 98.4 (3.874)
	Height			mm (in)	Standard	98.5 (3.878)

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Valve & valve guide	Valve overall length		mm (in)	Intake	103.3 (4.067)	
			Exhaust	95.45 (3.758)		
	Valve head edge thickness	mm (in)	Intake	Standard	0.8 — 1.2 (0.031 — 0.047)	
			Exhaust	Standard	1.0 — 1.4 (0.039 — 0.055)	
	Valve stem outer diameter	mm (in)	Intake	Standard	5.455 — 5.470 (0.2148 — 0.2154)	
			Exhaust	Standard	5.445 — 5.460 (0.2144 — 0.2150)	
	Valve guide inner diameter			mm (in)	Standard	5.500 — 5.512 (0.2165 — 0.2170)
Clearance between valve and valve guide	mm (in)	Intake	Standard	0.030 — 0.057 (0.0012 — 0.0022)		
		Exhaust	Standard	0.040 — 0.067 (0.0016 — 0.0026)		
Valve guide protrusion amount			mm (in)	Standard	11.4 — 11.8 (0.449 — 0.465)	
Valve & valve shim	Valve stem end outer diameter	mm (in)	Intake	Standard	5.455 — 5.470 (0.2148 — 0.2154)	
			Exhaust	Standard	5.445 — 5.460 (0.2144 — 0.2150)	
	Valve shim inner diameter		mm (in)	Standard	5.500 — 5.560 (0.2165 — 0.2189)	
	Clearance between valve and valve shim	mm (in)	Intake	Standard	0.030 — 0.105 (0.0012 — 0.0041)	
Exhaust			Standard	0.040 — 0.115 (0.0016 — 0.0045)		
Valve seat	Seating width between valve and valve seat	mm (in)	Intake	Standard	0.8 — 1.6 (0.031 — 0.063)	
			Exhaust	Standard	1.1 — 1.7 (0.043 — 0.067)	
	Seating angle between valve and valve seat				45°	
Seating position between valve and valve seat				Valve face center		
Valve spring	Free length			mm (in)	Standard	44.03 (1.733)
	Tension/spring height		N (kgf, lb)/mm (in)	Set	Standard	182 — 210 (18.56 — 21.41, 40.92 — 47.22)/ 33.0 (1.299)
				Lift	Standard	440 — 486 (44.87 — 49.56, 98.93 — 109.27)/ 22.0 (0.866)
	Squareness				Standard	2.5°, 1.9 mm (0.075 in) or less
Cylinder block & piston	Cylinder block warpage (Mating surface with cylinder head)			mm (in)	Limit	0.025 (0.00098)
	Grinding limit of cylinder block			mm (in)		To 204.9 (8.067)
	Height of cylinder block			mm (in)	Standard	205.0 (8.071)
	Inner diameter of cylinder liner	mm (in)	Cylinder bore size mark A		Standard	86.005 — 86.015 (3.3860 — 3.3864)
			Cylinder bore size mark B		Standard	85.995 — 86.005 (3.3856 — 3.3860)
	Cylindricity of cylinder liner			mm (in)	Limit	0.03 (0.0012)
	Out-of-roundness of cylinder liner			mm (in)	Limit	0.010 (0.0004)
	Piston grade point			mm (in)		40.0 (1.57)
	Piston outer diameter	mm (in)	Standard Size	Grade A	Standard	85.985 — 85.995 (3.3852 — 3.3856)
				Grade B	Standard	85.975 — 85.985 (3.3848 — 3.852)
			0.25 (0.0098) OS		Standard	86.225 — 86.245 (3.3947 — 3.3955)
			0.50 (0.0197) OS		Standard	86.475 — 86.495 (3.4045 — 3.4053)
	Clearance between cylinder liner and piston			mm (in)	Standard	0.010 — 0.030 (0.00039 — 0.00118)
Inner diameter of cylinder liner boring limit (diameter)			mm (in)		To 86.505 (3.4057)	
Piston and piston pin	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).	
	Clearance between piston and piston pin			mm (in)	Standard	0.004 — 0.008 (0.0002 — 0.0003)



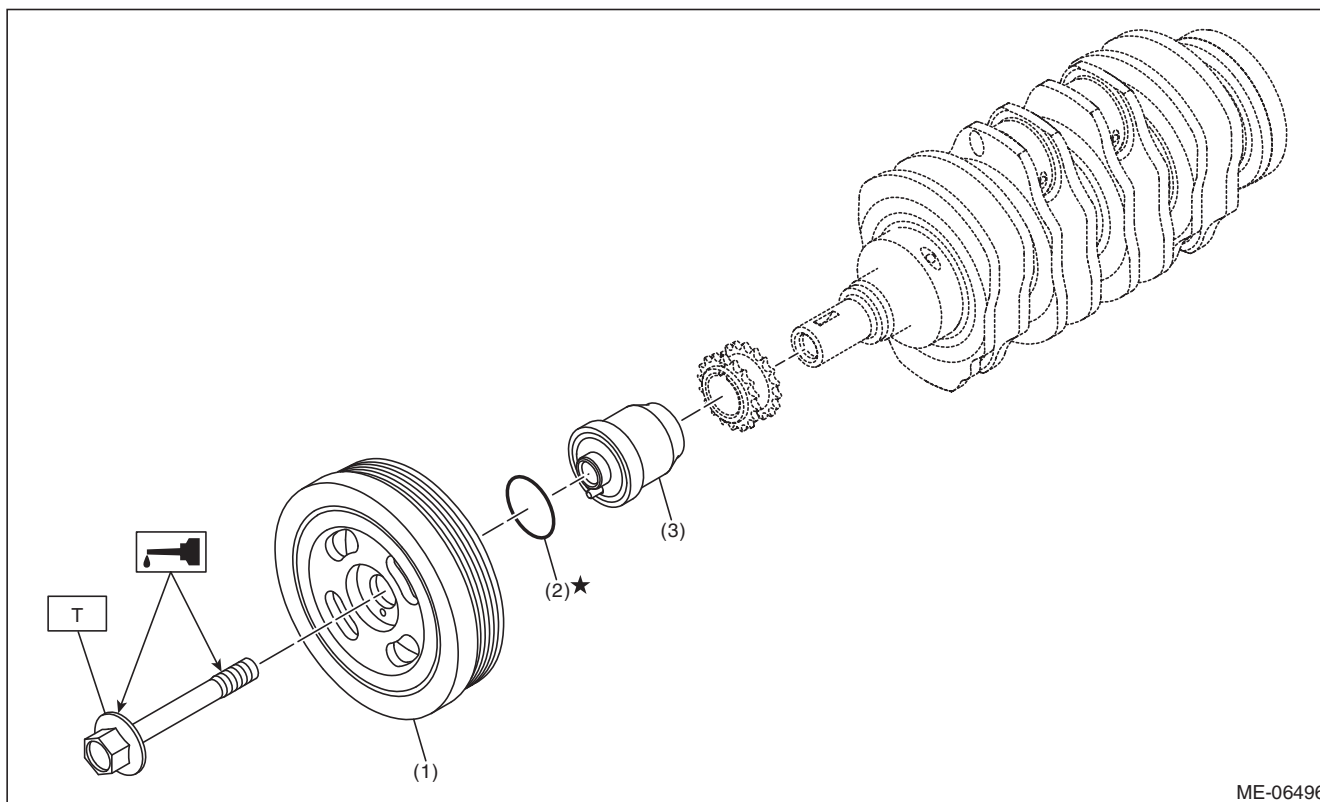
General Description

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Piston ring	Closed gap mm (in)	Compression ring	Top ring	Standard	0.20 — 0.25 (0.0079 — 0.0098)		
			Second ring	Standard	0.40 — 0.50 (0.0157 — 0.0197)		
		Oil ring (Upper rail and lower rail)		Standard	0.10 — 0.35 (0.0039 — 0.0138)		
	Clearance between compression ring and piston mm (in)		Top ring	Standard	0.040 — 0.080 (0.0016 — 0.0031)		
			Second ring	Standard	0.045 — 0.085 (0.0018 — 0.0033)		
Connect- ing rod and connect- ing rod bearing	Bend or twist per 100 mm (3.94 in) in length mm (in)			Limit	0.10 (0.0039)		
	Thrust clearance mm (in)			Standard	0.070 — 0.330 (0.0028 — 0.0130)		
	Connecting rod bearing thickness (at center) mm (in)	Standard size		Standard	1.492 — 1.508 (0.0587 — 0.0594)		
		0.03 (0.0012) US		Standard	1.511 — 1.515 (0.0595 — 0.0596)		
		0.05 (0.0020) US		Standard	1.521 — 1.525 (0.0599 — 0.0600)		
		0.25 (0.0098) US		Standard	1.621 — 1.625 (0.0638 — 0.0640)		
Oil clearance mm (in)			Standard	0.025 — 0.055 (0.0010 — 0.0022)			
Piston pin & connect- ing rod bushing	Clearance between piston pin and connecting rod bushing mm (in)			Standard	0.004 — 0.026 (0.0002 — 0.0010)		
Crank- shaft and crank- shaft bearing	Bending mm (in)			Limit	0.035 (0.0014)		
	Crankshaft pin	Cylindricity mm (in)		Limit	0.006 (0.0002)		
		Out-of-roundness mm (in)		Limit	0.005 (0.0002)		
		Grinding limit (dia.) mm (in)		To 49.726 (1.9577)			
		Crankshaft journal	Cylindricity mm (in)		Limit	0.006 (0.0002)	
	Out-of-roundness mm (in)		Limit	0.005 (0.0002)			
	Grinding limit (dia.) mm (in)		To 67.735 (2.6667)				
	Crankshaft pin outer diameter mm (in)		Standard size		Standard	49.976 — 50.000 (1.9676 — 1.9685)	
		0.03 (0.0012) US		Standard	49.946 — 49.970 (1.9664 — 1.9673)		
		0.05 (0.0020) US		Standard	49.926 — 49.950 (1.9656 — 1.9665)		
		0.25 (0.0098) US		Standard	49.726 — 49.750 (1.9577 — 1.9587)		
	Crankshaft journal outer diameter mm (in)	Standard size		Standard	67.985 — 68.009 (2.6766 — 2.6775)		
		0.03 (0.0012) US		Standard	67.955 — 67.979 (2.6754 — 2.6763)		
		0.05 (0.0020) US		Standard	67.935 — 67.959 (2.6746 — 2.6755)		
		0.25 (0.0098) US		Standard	67.735 — 67.759 (2.6667 — 2.6677)		
	Crankshaft bearing thick- ness (at center) mm (in)	#1, #2, #3, #4	Standard size		Standard	2.495 — 2.513 (0.0982 — 0.0989)	
			0.03 (0.0012) US		Standard	2.519 — 2.522 (0.0992 — 0.0993)	
			0.05 (0.0020) US		Standard	2.529 — 2.532 (0.0996 — 0.0997)	
			0.25 (0.0098) US		Standard	2.629 — 2.632 (0.1035 — 0.1036)	
		#5	Standard size		Standard	2.493 — 2.511 (0.0981 — 0.0989)	
			0.03 (0.0012) US		Standard	2.517 — 2.520 (0.0991 — 0.0992)	
			0.05 (0.0020) US		Standard	2.527 — 2.530 (0.0995 — 0.0996)	
			0.25 (0.0098) US		Standard	2.627 — 2.630 (0.1034 — 0.1035)	
			Thrust clearance mm (in)			Standard	0.130 — 0.308 (0.00512 — 0.01213)
			Oil clearance mm (in)			Standard	0.013 — 0.031 (0.00051 — 0.00122)

B: COMPONENT

1. CRANK PULLEY



(1) Crank pulley

(3) Crank pulley boss

(2) O-ring

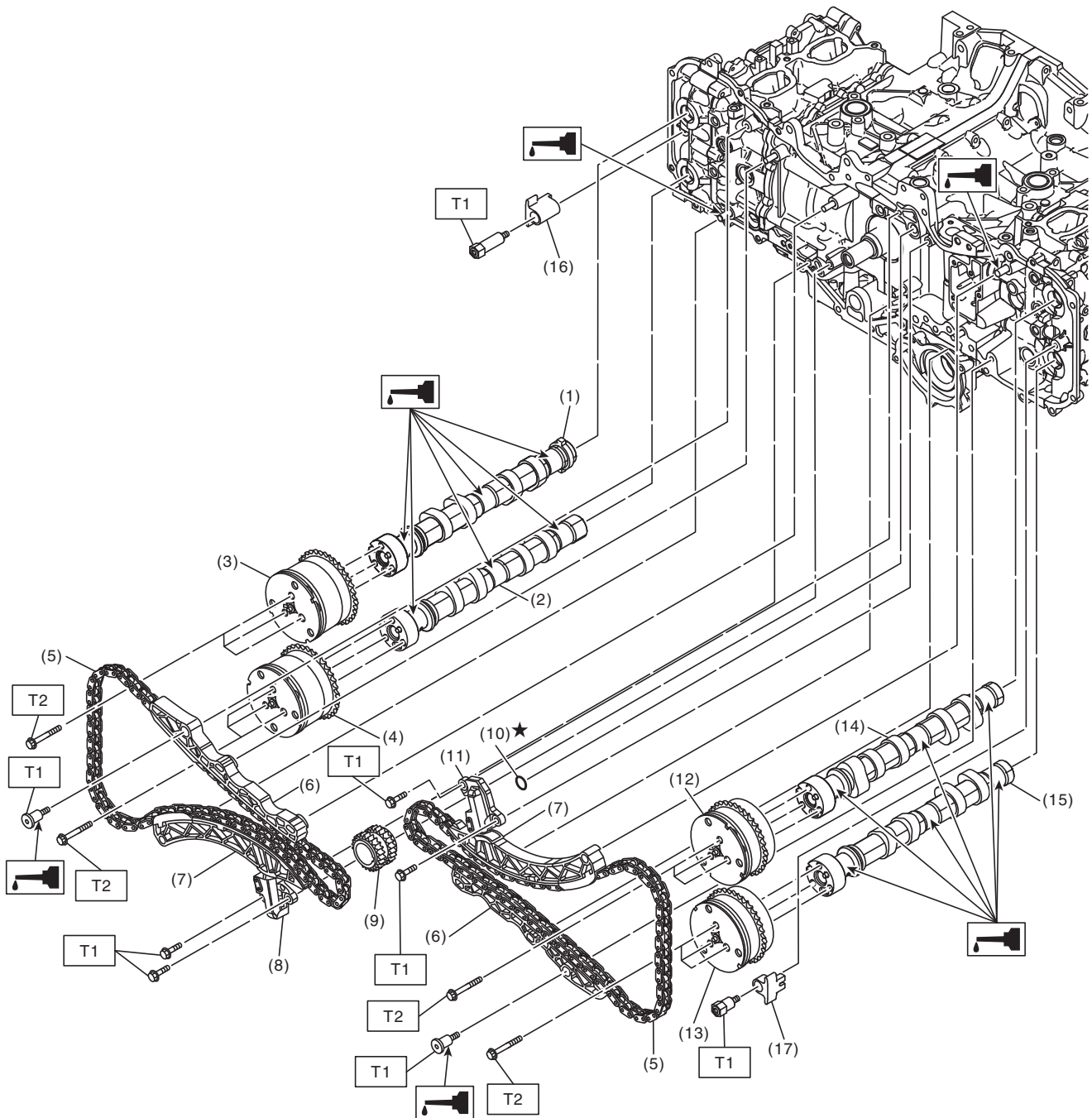
Tightening torque: N·m (kgf-m, ft-lb)

**T: <Ref. to ME(H4DOTC)-84,
INSTALLATION, Crank Pulley.>**

General Description

MECHANICAL

2. TIMING CHAIN & CAMSHAFT



ME-06622

- | | |
|-----------------------------|------------------------------|
| (1) Intake camshaft RH | (8) Chain tensioner RH |
| (2) Exhaust camshaft RH | (9) Crank sprocket |
| (3) Intake cam sprocket RH | (10) O-ring |
| (4) Exhaust cam sprocket RH | (11) Chain tensioner LH |
| (5) Timing chain | (12) Intake cam sprocket LH |
| (6) Chain guide A | (13) Exhaust cam sprocket LH |
| (7) Chain tension lever | (14) Intake camshaft LH |

- | |
|--------------------------|
| (15) Exhaust camshaft LH |
| (16) Chain guide B |
| (17) Chain guide C |

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)

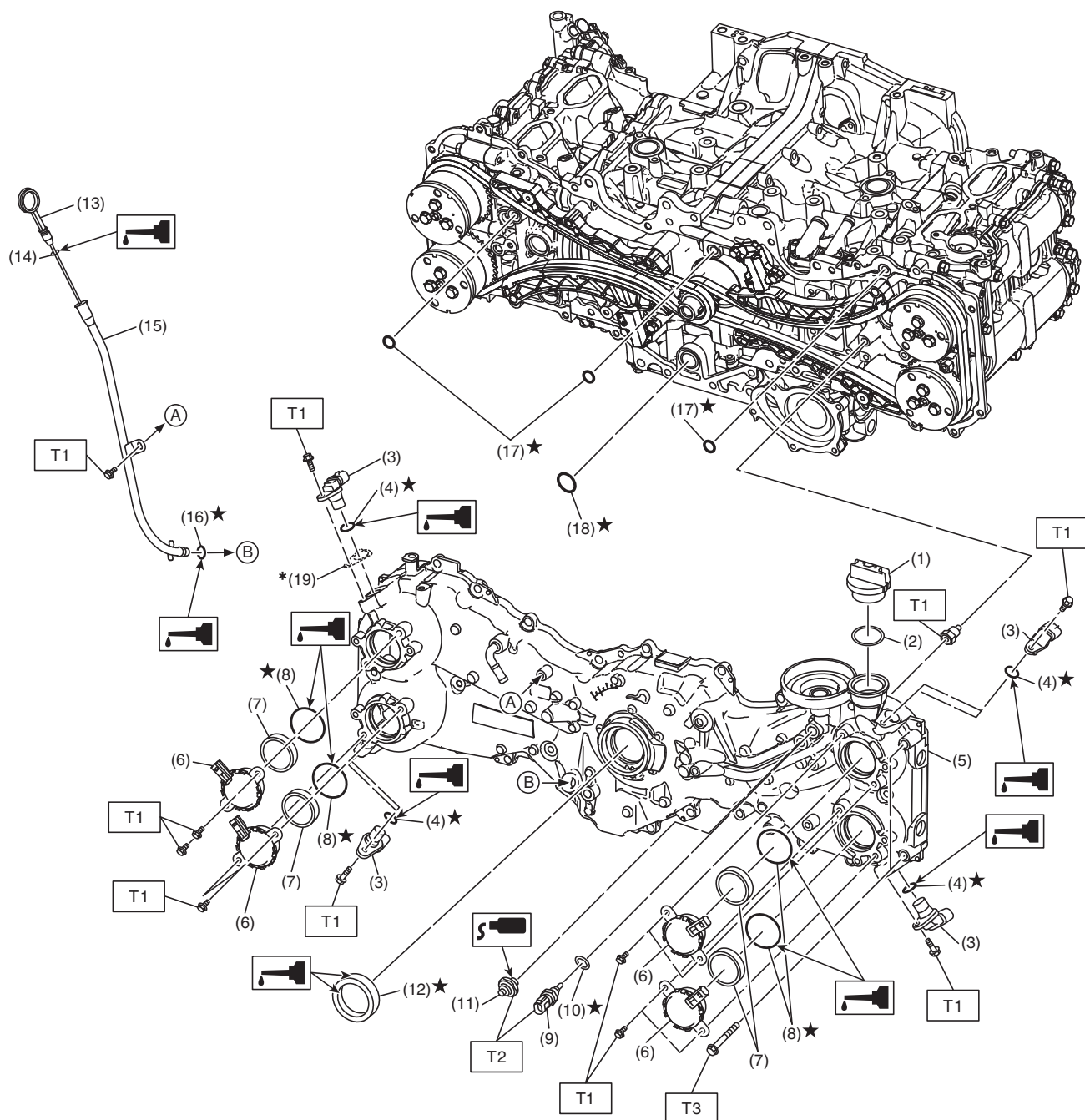
T2: 18 (1.8, 13.3)

ME(H4DOTC)-6

General Description

MECHANICAL

3. CHAIN COVER



ME-07694

ME(H4DOTC)-7

General Description

MECHANICAL

- | | | |
|------------------------------|-----------------------------------|-------------|
| (1) Oil filler cap | (9) Engine oil temperature sensor | (17) O-ring |
| (2) Gasket | (10) Gasket | (18) O-ring |
| (3) Camshaft position sensor | (11) Oil pressure switch | (19) Spacer |
| (4) O-ring | (12) Front oil seal | |
| (5) Chain cover | (13) Oil level gauge | |
| (6) Oil control solenoid | (14) O-ring | |
| (7) Back-up ring | (15) Oil level gauge guide | |
| (8) O-ring | (16) O-ring | |

Tightening torque: N·m (kgf-m, ft-lb)

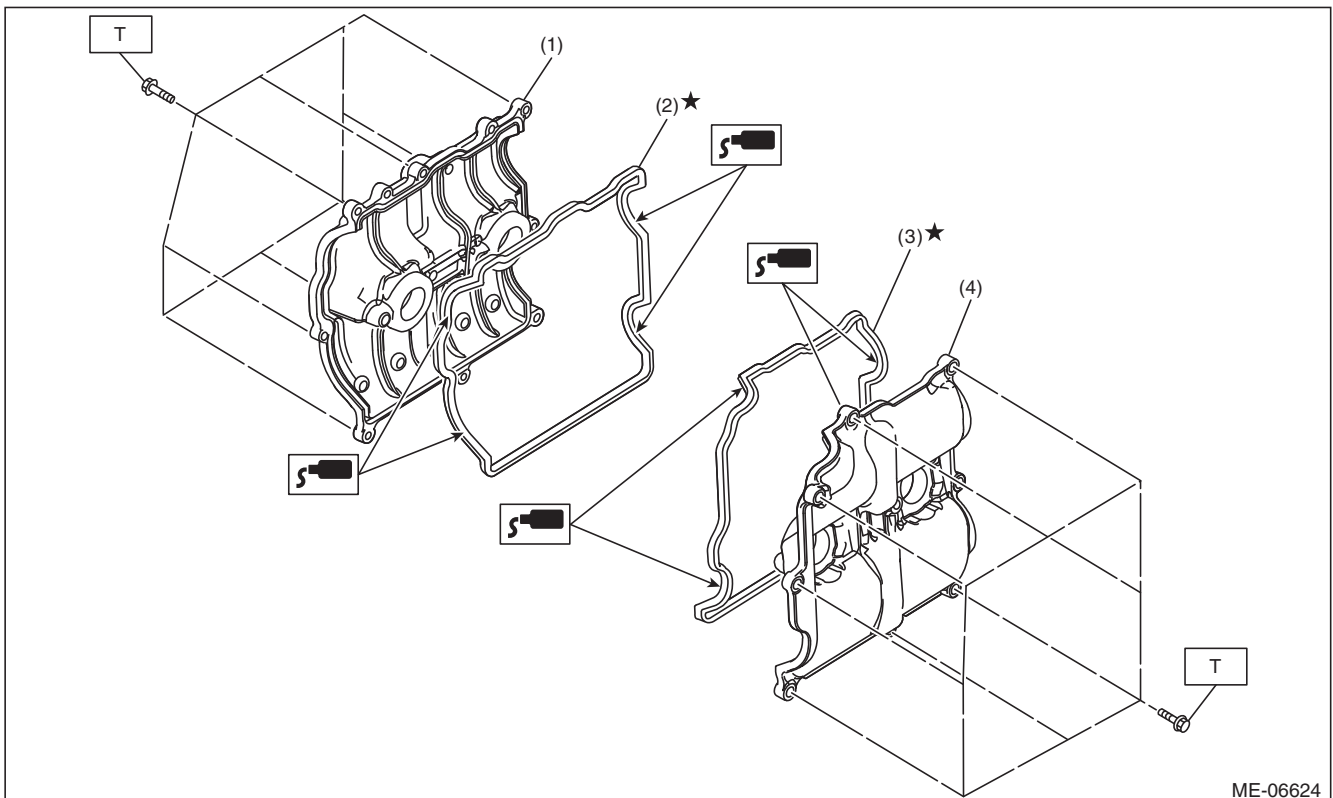
T1: 6.4 (0.7, 4.7)

T2: 18 (1.8, 13.3)

T3: <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

* Use one or no spacer to adjust the gap.

4. ROCKER COVER



- | | |
|----------------------------|----------------------------|
| (1) Rocker cover RH | (3) Rocker cover gasket LH |
| (2) Rocker cover gasket RH | (4) Rocker cover LH |

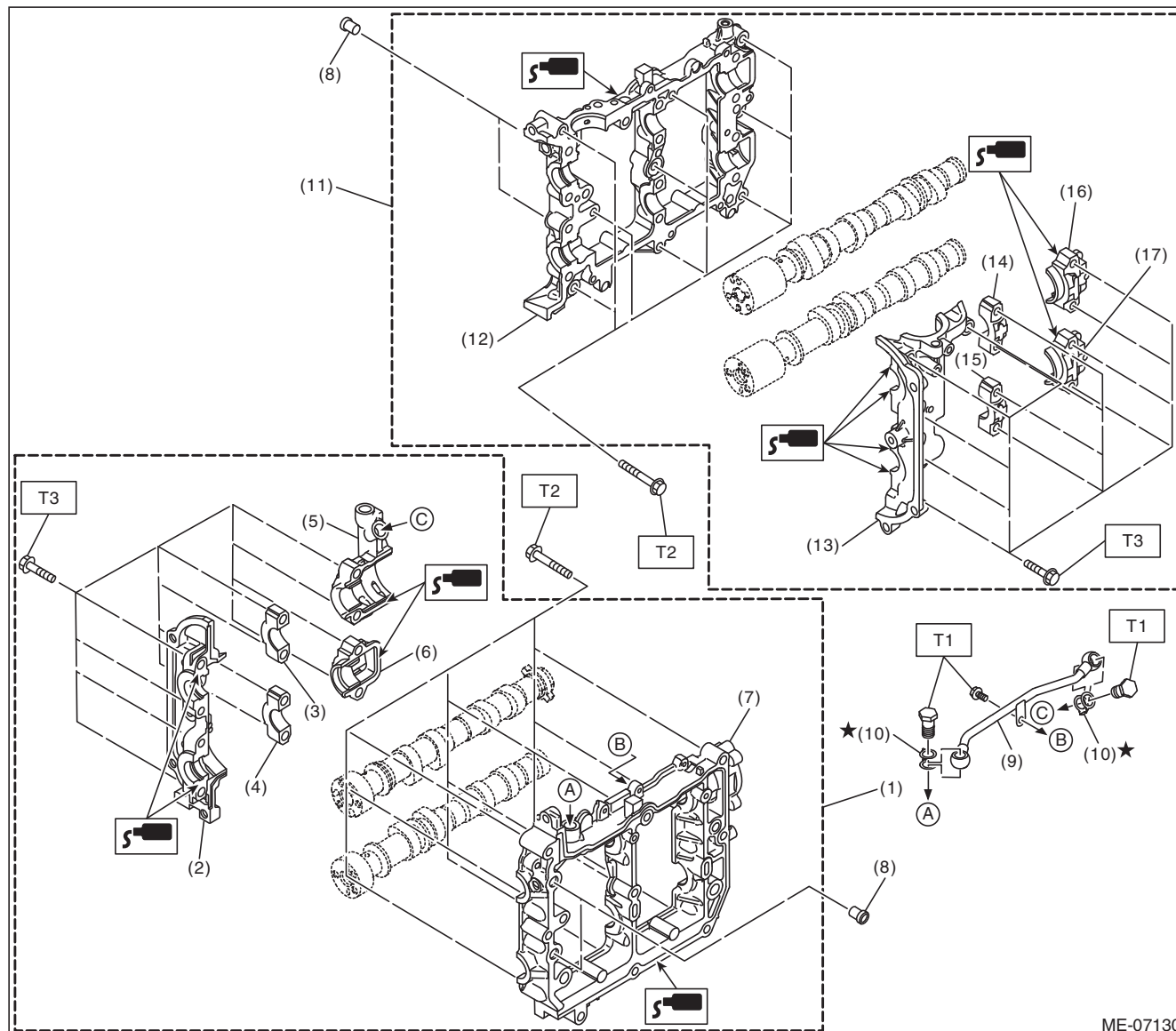
Tightening torque: N·m (kgf-m, ft-lb)

T: <Ref. to ME(H4DOTC)-159, INSTALLATION, Rocker Cover.>

General Description

MECHANICAL

5. CAM CARRIER



ME-07130

- (1) Cam carrier ASSY RH
- (2) Front camshaft cap RH
- (3) Intake center camshaft cap RH
- (4) Exhaust center camshaft cap RH

- (9) Oil pipe
- (10) Gasket
- (11) Cam carrier ASSY LH
- (12) Cam carrier LH

- (17) Exhaust rear camshaft cap LH

- (5) Intake rear camshaft cap RH
- (6) Exhaust rear camshaft cap RH

- (13) Front camshaft cap LH
- (14) Intake center camshaft cap LH

- (7) Cam carrier RH
- (8) Filter

- (15) Exhaust center camshaft cap LH
- (16) Intake rear camshaft cap LH

Tightening torque: N·m (kgf-m, ft-lb)

T1: <Ref. to ME(H4DOTC)-203, CAM CARRIER RH, ASSEMBLY, Cam Carrier.>

T2: <Ref. to ME(H4DOTC)-203, ASSEMBLY, Cam Carrier.>

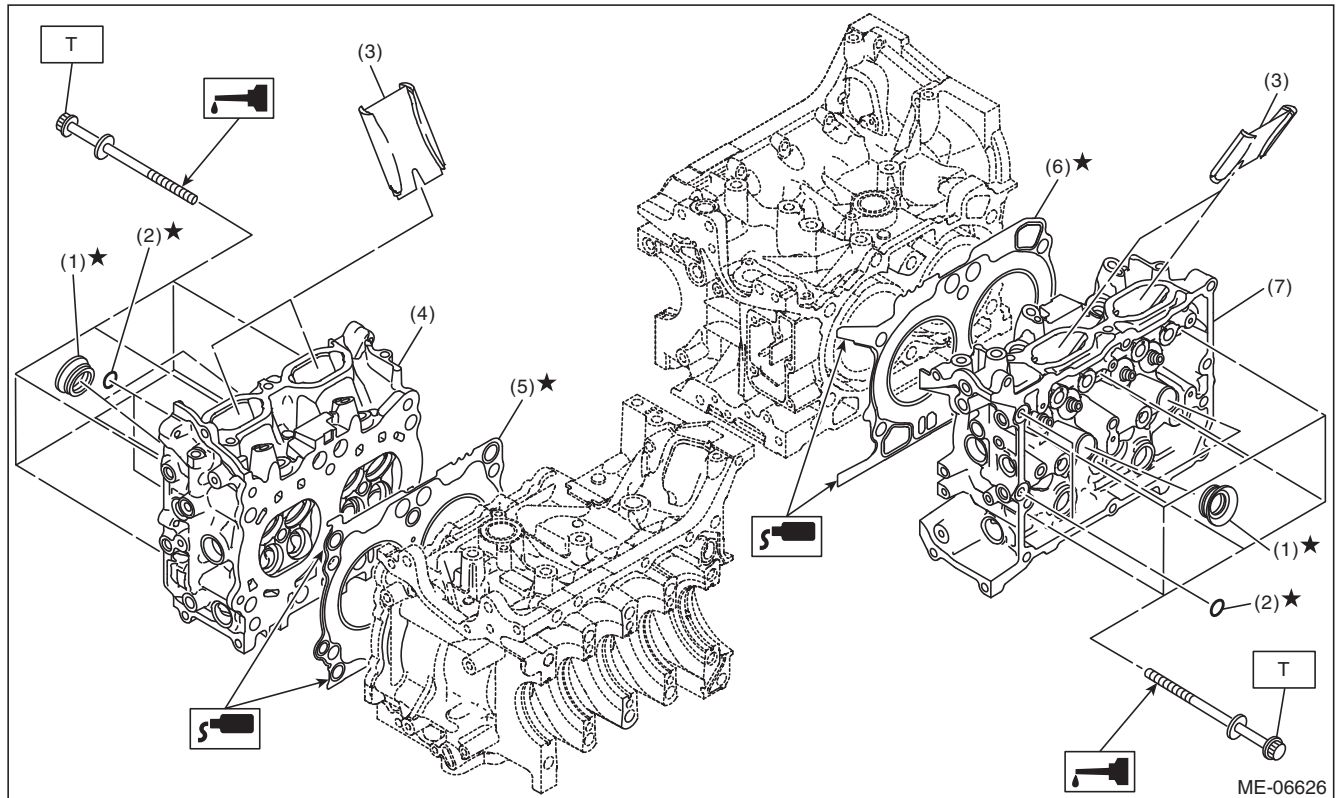
T3: <Ref. to ME(H4DOTC)-180, INSTALLATION, Cam Carrier.>

ME(H4DOTC)-9

General Description

MECHANICAL

6. CYLINDER HEAD



- | | |
|----------------------------|-----------------------------|
| (1) Spark plug pipe gasket | (5) Cylinder head gasket RH |
| (2) O-ring | (6) Cylinder head gasket LH |
| (3) Cylinder head plate | (7) Cylinder head LH |
| (4) Cylinder head RH | |

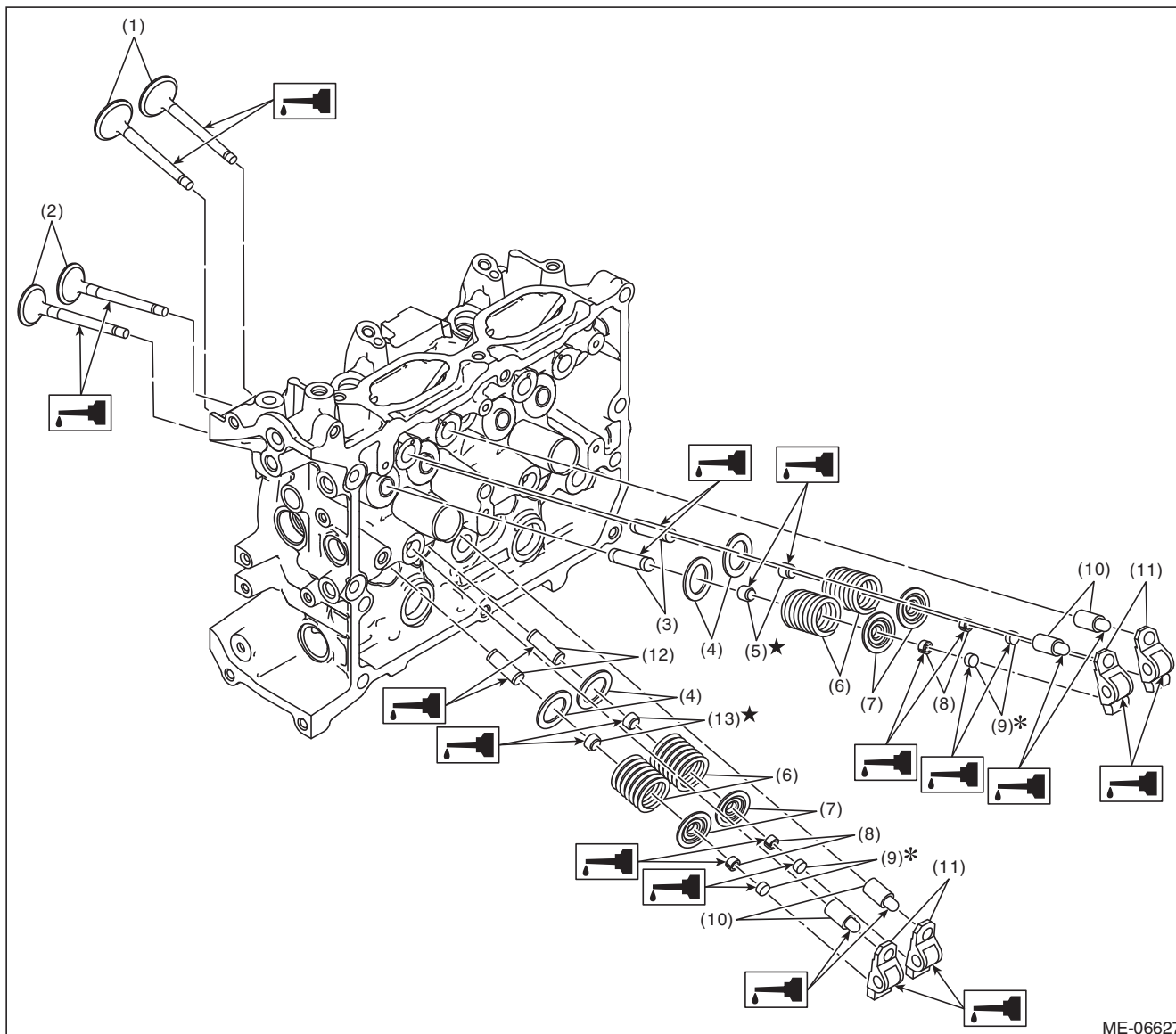
Tightening torque: N·m (kgf-m, ft-lb)

**T: <Ref. to ME(H4DOTC)-220,
INSTALLATION, Cylinder
Head.>**

General Description

MECHANICAL

7. VALVE ASSEMBLY



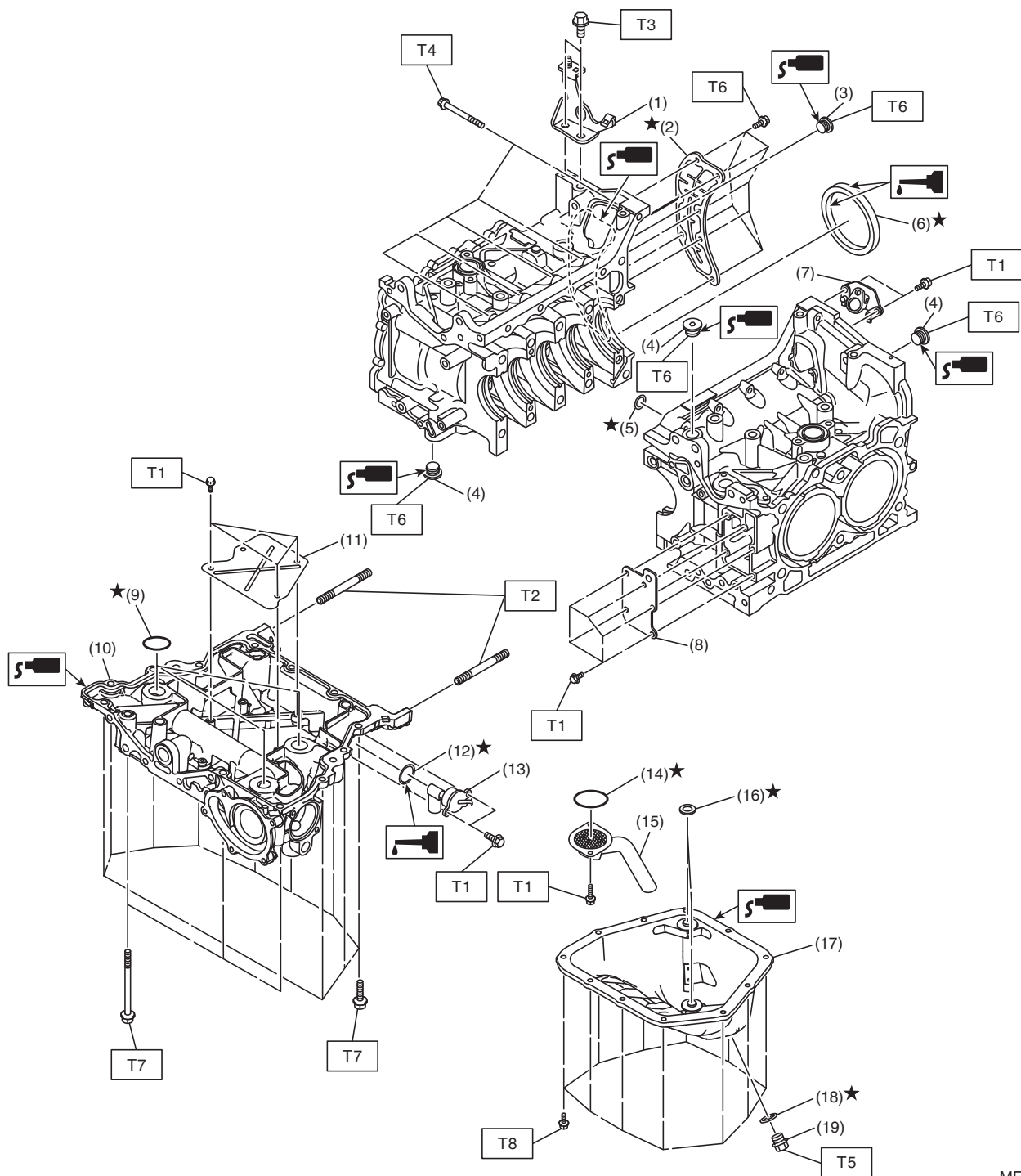
ME-06627

- | | | |
|---------------------------|------------------------------|-----------------------------|
| (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 | |

General Description

MECHANICAL

8. CYLINDER BLOCK 1



ME-07381

ME(H4DOTC)-12

General Description

MECHANICAL

- | | |
|---------------------------------------|------------------------|
| (1) Engine rear hanger | (11) Baffle plate |
| (2) Oil separator cover | (12) O-ring |
| (3) Cylinder block plug | (13) Oil level switch |
| (4) Main gallery plug | (14) O-ring |
| (5) O-ring | (15) Oil strainer |
| (6) Rear oil seal | (16) Oil pan seal ring |
| (7) Crankshaft position sensor holder | (17) Oil pan |

- | | |
|--------------------------|------------------------|
| (8) Cylinder block plate | (18) Drain plug gasket |
|--------------------------|------------------------|

- | | |
|------------|-----------------|
| (9) O-ring | (19) Drain plug |
|------------|-----------------|

- (10) Oil pan upper

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)

T2: 10 (1.0, 7.4)

T3: 21 (2.1, 15.5)

T4: 25 (2.5, 18.4)

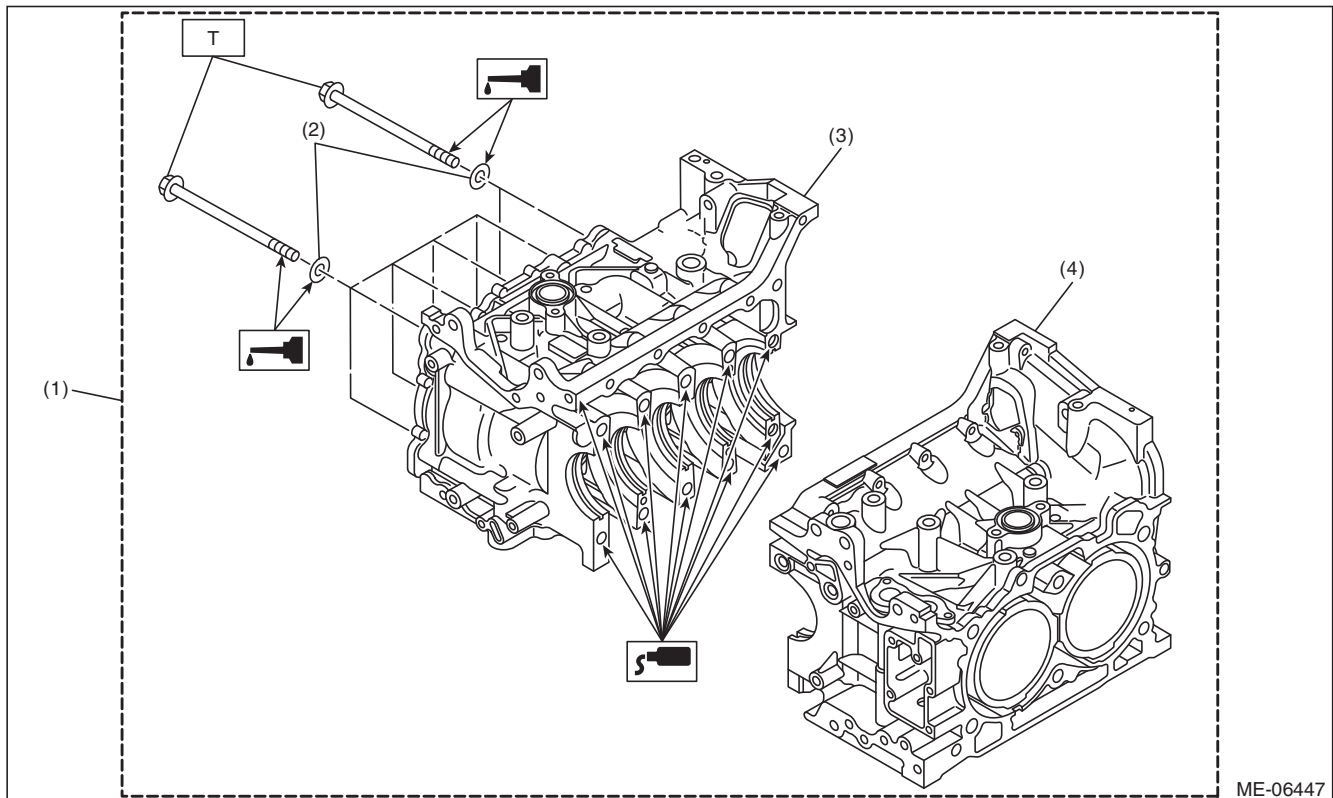
T5: 41.7 (4.3, 30.8)

T6: <Ref. to ME(H4DOTC)-311, CYLINDER BLOCK, ASSEMBLY, Cylinder Block.>

T7: <Ref. to ME(H4DOTC)-279, INSTALLATION, Cylinder Block.>

T8: <Ref. to LU(H4DO)-29, OIL PAN, INSTALLATION, Oil Pan and Strainer.>

9. CYLINDER BLOCK 2



- | | |
|-------------------------|-----------------------|
| (1) Cylinder block ASSY | (3) Cylinder block RH |
| (2) Washer | (4) Cylinder block LH |

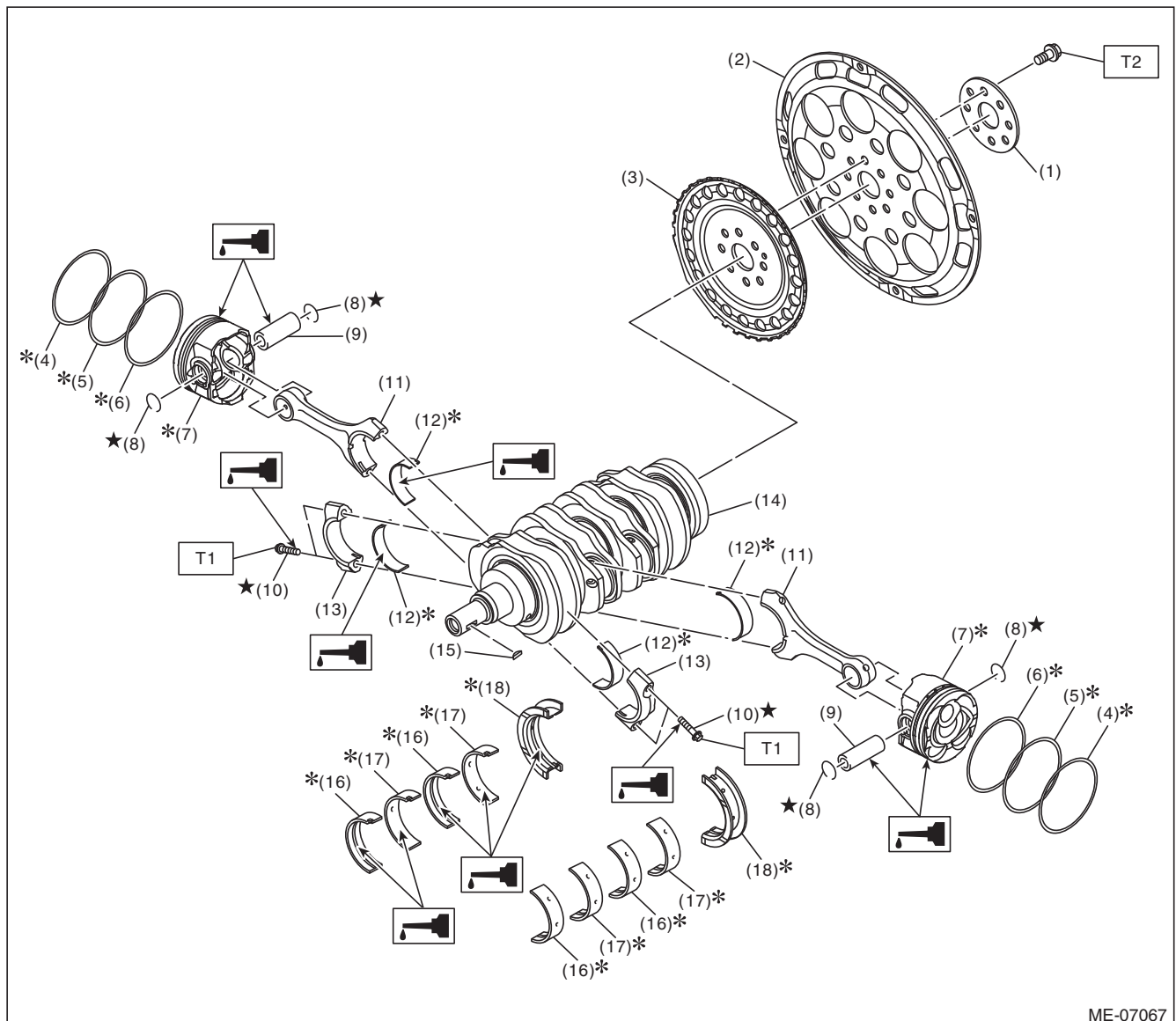
Tightening torque: N·m (kgf-m, ft-lb)

T: <Ref. to ME(H4DOTC)-279, INSTALLATION, Cylinder Block.>

General Description

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10. CRANKSHAFT AND PISTON



ME-07067

- (1) Reinforcement
- (2) Drive plate
- (3) Crankshaft position sensor plate
- (4) Top ring
- (5) Second ring
- (6) Oil ring
- (7) Piston
- (8) Circlip

- (9) Piston pin
- (10) Connecting rod cap bolt
- (11) Connecting rod
- (12) Connecting rod bearing
- (13) Connecting rod cap
- (14) Crankshaft
- (15) Woodruff key

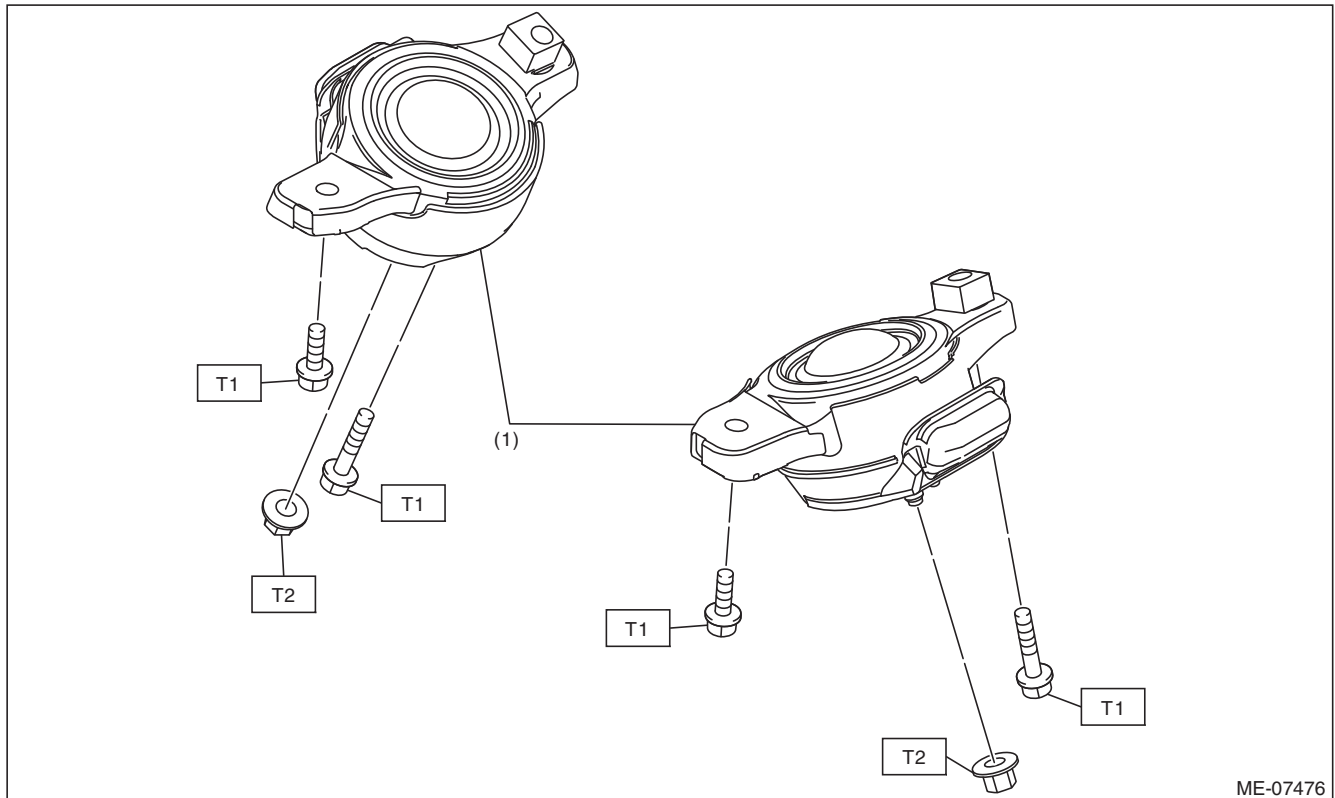
- (16) Crankshaft bearing #1, #3
- (17) Crankshaft bearing #2, #4
- (18) Crankshaft bearing #5

Tightening torque: N·m (kgf-m, ft-lb)

T1: <Ref. to ME(H4DOTC)-279, INSTALLATION, Cylinder Block.>

T2: <Ref. to CVT(TR690)-134, INSTALLATION, Drive Plate.>

11.ENGINE MOUNTING



(1) Front cushion rubber

Tightening torque: N·m (kgf-m, ft-lb)

T1: 35 (3.6, 25.8)

T2: 45 (4.6, 33.2)

C: CAUTION

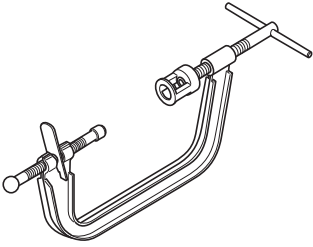
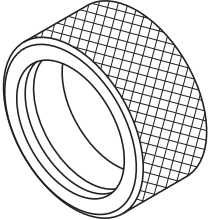
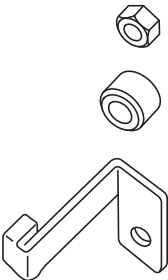
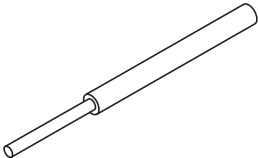
- Prior to starting work, pay special attention to the following:
 1. Always wear work clothes, a safety cap, protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
 2. Protect the vehicle using a seat cover, fender cover, etc.
 3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove or install the engine in an area where chain hoists, lifting devices, etc. are available for ready use. When lifting up the vehicle, make sure to support the vehicle at the jack-up points.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil when being assembled.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

General Description

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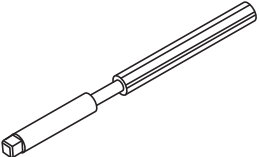
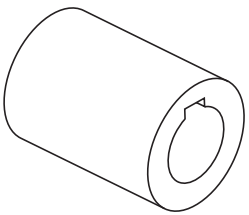
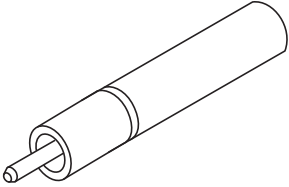
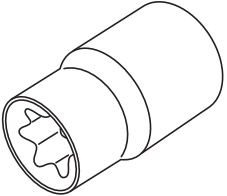
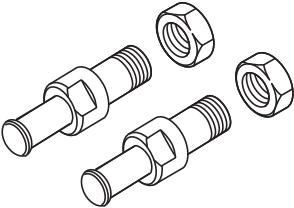
D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST0920287002000	0920287002000	REMOVER AND REPLACER	Used for removing and installing valve spring.
 ST-398437700	398437700	OIL SEAL INSTALLER	Used for installing the front oil seal of engine.
 ST-498277200	498277200	STOPPER SET	Used for preventing the torque converter from falling when removing and installing the engine.
 ST-499765700	499765700	VALVE GUIDE REMOVER AND INSTALLER	Used for removing and installing valve guide.

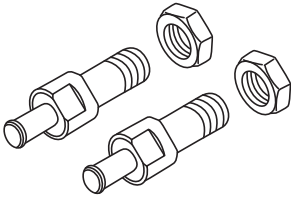
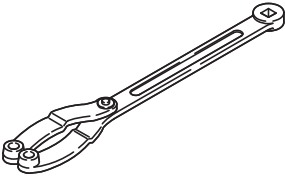
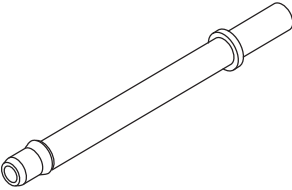
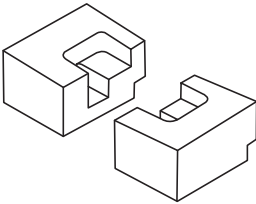
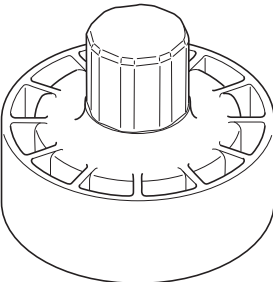
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499765900	499765900	VALVE GUIDE REAMER	Used for reaming valve guides.
 ST18252AA000	18252AA000	CRANKSHAFT SOCKET	Used for rotating crankshaft.
 ST18261AA010	18261AA010	VALVE OIL SEAL GUIDE	Used for press-fitting of intake valve oil seals and exhaust valve oil seals.
 ST18270AA020	18270AA020	SOCKET	Used for removing and installing connecting rod.
 ST18334AA000	18334AA000	PULLEY WRENCH PIN SET	• Used for removing and installing the crank pulley. • Used together with PULLEY WRENCH (18355AA000).

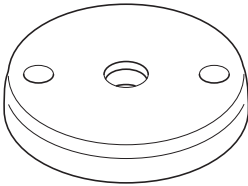
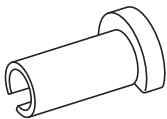
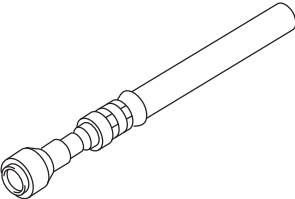
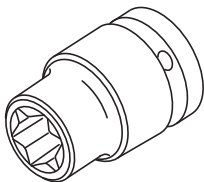
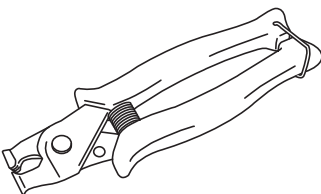
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18334AA030	18334AA030	PULLEY WRENCH PIN SET	- Used for removing and installing water pump pulley, intake cam sprocket and exhaust cam sprocket. - Used together with PULLEY WRENCH (18355AA000).
 ST18355AA000	18355AA000	PULLEY WRENCH	- Used for removing and installing the crank pulley. - Used for installing and removing the water pump pulley. - Used for removing and installing intake cam sprocket and exhaust cam sprocket. - Used together with PULLEY WRENCH PIN SET (18334AA000) or PULLEY WRENCH PIN SET (18334AA030).
 ST18471AA000	18471AA000	FUEL PIPE ADAPTER	Used for inspecting the fuel pressure.
 ST18632AA020	18632AA020	STAND ASSY	Used for removing and installing rocker cover.
 ST18657AA030	18657AA030	OIL SEAL INSTALLER	- Used for installing the rear oil seal of engine. - Used together with OIL SEAL GUIDE (18671AA020).

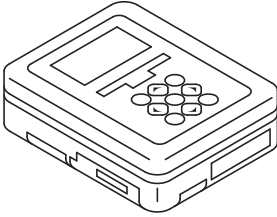
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18671AA020	18671AA020	OIL SEAL GUIDE	- Used for installing the rear oil seal of engine. - Used together with OIL SEAL INSTALLER (18657AA030).
 ST42099AE000	42099AE000	QUICK CONNECTOR RELEASE	Used for removing FUEL HOSE (42075AG690). NOTE: FUEL HOSE (42075AG690) is used for checking the fuel pressure.
 ST42075AG690	42075AG690	FUEL HOSE	Used for inspecting the fuel pressure. NOTE: This is the SUBARU genuine part.
 ST18270KA010	18270KA010	SOCKET	Used for installing and removing intake cam sprocket and exhaust cam sprocket.
 ST18353AA000	18353AA000	CLAMP PLIERS	- Used for removing and installing the PCV hose assembly. - This tool is made by the French company CAIL-LAU. (code) 54.0.000.205 To make it easier to obtain, it has been provided with a tool number.

General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST1B022XU0	1B022XU0	SUBARU SELECT MONITOR III KIT	Used for various inspections.

2. GENERAL TOOL

TOOL NAME	REMARKS
Compression gauge	Used for measuring compression.
Vacuum gauge	Used for measuring intake manifold vacuum.
Oil pressure gauge	Used for measuring engine oil pressure.
Fuel pressure gauge	Used for measuring fuel pressure.
Piston ring compressor	Used for installing the piston into the cylinder block.
Thickness gauge	Used for various inspections.
Angle gauge	Used for angle tightening.



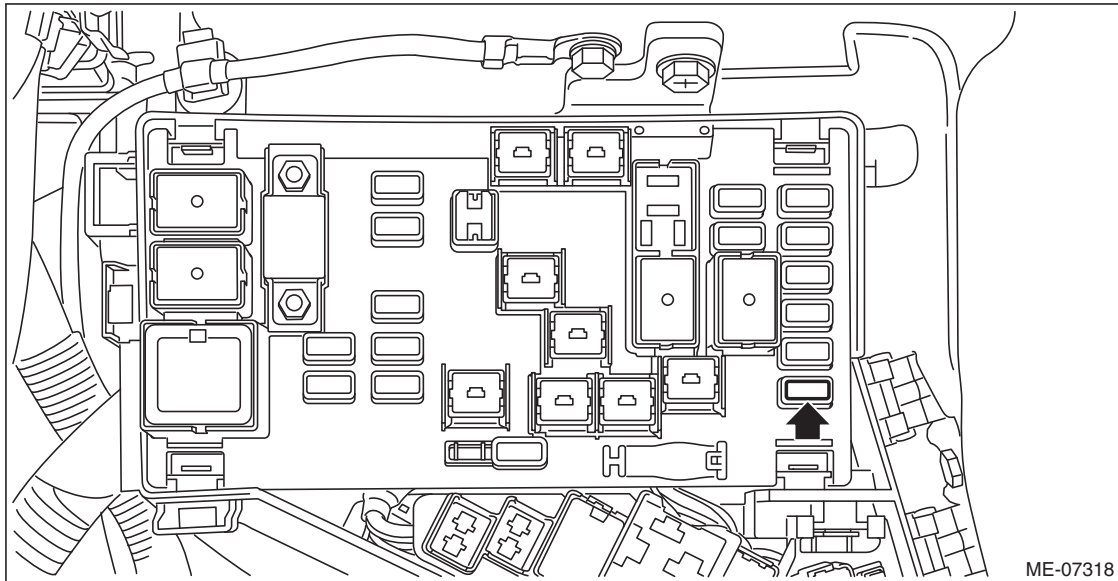
2. Compression

A: INSPECTION

CAUTION:

After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.

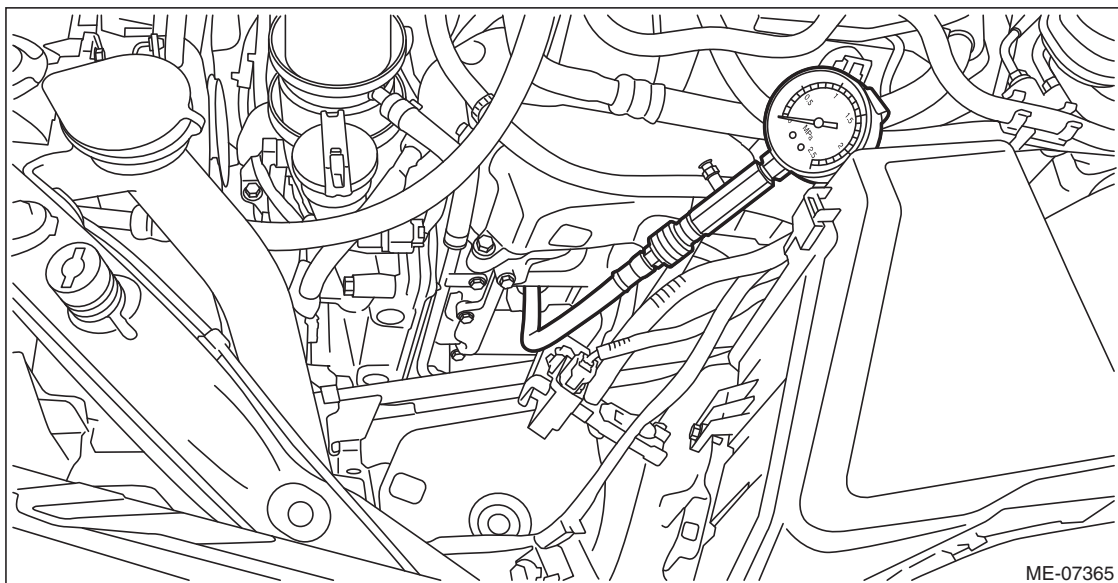
- 1) After warming-up the engine, turn the ignition switch to OFF.
- 2) Make sure that the battery is fully charged.
- 3) Check the starter motor for satisfactory performance and operation.
- 4) Remove the fuse of fuel pump from main fuse box.



- 5) Start the engine and run it until it stalls.
- 6) After the engine stalls, crank it for five more seconds.
- 7) Turn the ignition switch to OFF.
- 8) Remove all spark plugs. <Ref. to IG(H4DOTC)-4, REMOVAL, Spark Plug.>
- 9) Install the compression gauge to the spark plug hole.

NOTE:

When using a screw-in type compression gauge, the screw should be less than 25 mm (0.98 in) long.



Compression

MECHANICAL

- 10) Install the engine control module (ECM). <Ref. to FU(H4DOTC)-136, INSTALLATION, Engine Control Module (ECM).>
- 11) Install the battery. <Ref. to SC(H4DO)-63, INSTALLATION, Battery.>
- 12) Turn the ignition switch to ON.
- 13) Fully open the throttle valve.
- 14) Crank the engine by starter motor and read the value when the needle of the compression gauge becomes stable.

NOTE:

- Perform at least two measurements per cylinder, and make sure that the values are correct.
- If the compression pressure is out of standard, check or adjust the pistons, valves and cylinders.

Compression (fully open throttle):

Standard

1,350 — 1,750 kPa (14 — 18 kgf/cm², 196 — 254 psi)

Difference between cylinders

100 kPa (1 kgf/cm², 14 psi) or less

- 15) After inspection, install the related parts in the reverse order of removal.

NOTE:

When compression pressure is checked, the malfunction indicator light illuminates and DTC (P0087) may be stored in ECM. When the malfunction indicator light has illuminated, perform the Clear Memory Mode. <Ref. to EN(H4DOTC)(diag)-60, Clear Memory Mode.>



3. Idle Speed

A: INSPECTION

1) Before checking the idle speed, check the following item:

- (1) Check the air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and hoses are connected properly.
- (2) Check the malfunction indicator light does not illuminate.

2) Warm up the engine.

3) Read the engine idle speed using Subaru Select Monitor. <Ref. to EN(H4DOTC)(diag)-37, DISPLAY CURRENT ENGINE DATA, OPERATION, Subaru Select Monitor.>

NOTE:

- Idle speed cannot be adjusted manually, because the idle speed is automatically adjusted.
- If idle speed is out of standard, refer to the General Diagnosis Table under "Engine Control System". <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>
 - (1) Check the idle speed when no-loaded. (Headlight, blower fan, rear defroster, radiator fan, A/C and etc. are OFF)

Idle rpm (no load and select lever in "P" or "N" range):

Standard

700±100 rpm

- (2) Check the idle speed when loaded. (Turn the A/C switch to ON and operate the compressor for at least one minute before measurement.)

Idle speed (A/C ON and select lever in "P" or "N" range):

Standard

700 — 835±50 rpm



Ignition Timing

MECHANICAL

4. Ignition Timing

A: INSPECTION

CAUTION:

After warming-up, engine becomes very hot. Be careful not to burn yourself at measurement.

1) Before checking the ignition timing, check the following item:

(1) Check the air cleaner element is free from clogging, spark plugs are in good condition, and hoses are connected properly.

(2) Check the malfunction indicator light does not illuminate.

2) Warm up the engine.

3) Read the ignition timing using Subaru Select Monitor. <Ref. to EN(H4DOTC)(diag)-37, DISPLAY CURRENT ENGINE DATA, OPERATION, Subaru Select Monitor.>

NOTE:

If ignition timing is out of standard, check the ignition control system. Refer to "Engine Control System". <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>

Ignition timing [BTDC/rpm]:

Standard

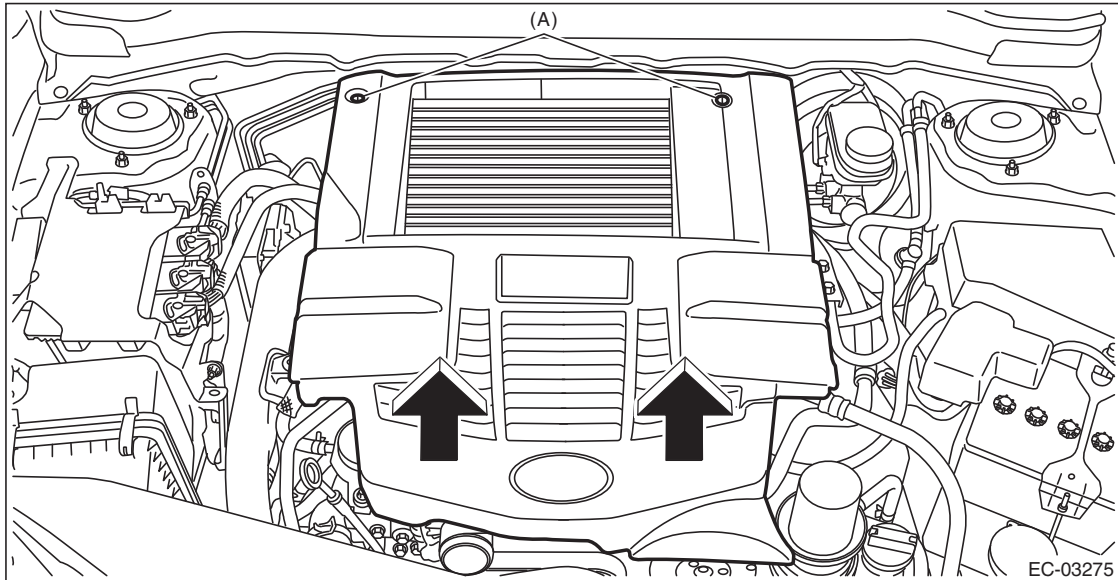
$10^{\circ} \pm 10^{\circ} / 700$



5. Intake Manifold Vacuum

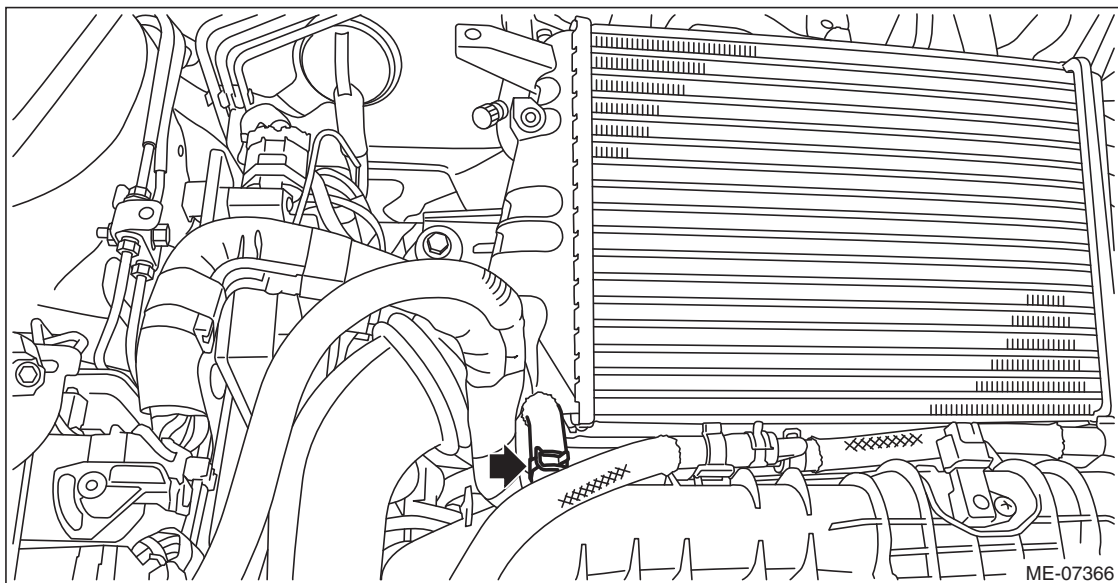
A: INSPECTION

1) Remove the clip (A), lift the front of the collector cover in the direction of arrow, and then remove the collector cover.



2) Warm up the engine.

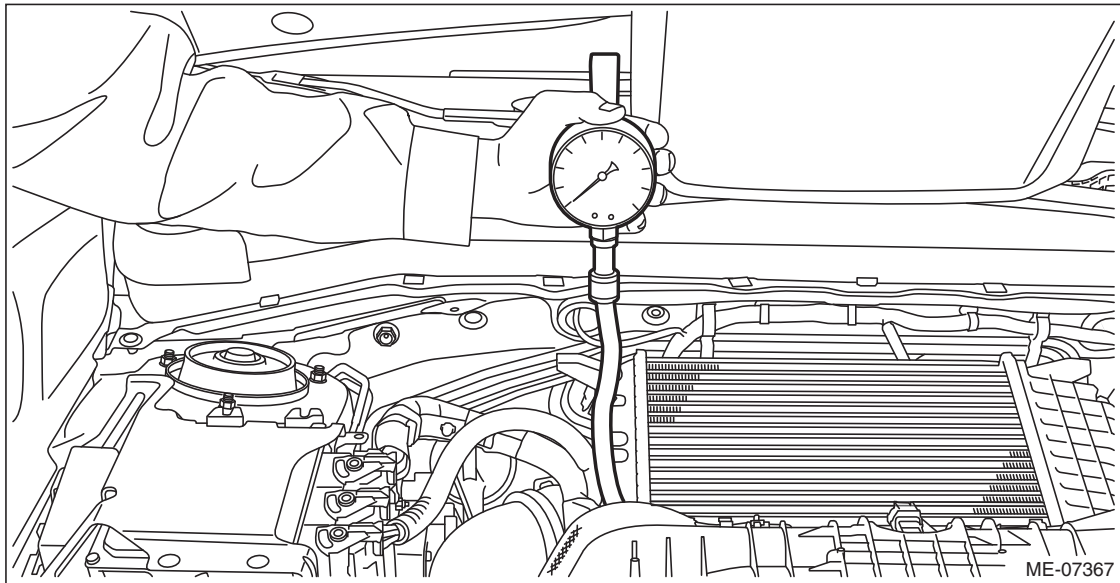
3) Disconnect the brake booster vacuum hose from the intake manifold.



Intake Manifold Vacuum

MECHANICAL

4) Connect the vacuum gauge to the intake manifold.



5) Keep the engine at idle speed and read the vacuum gauge indication.

NOTE:

Condition of engine inside can be diagnosed by observing the behavior of the vacuum gauge needle as described in table below.

Intake manifold vacuum (at idling, A/C OFF):

Standard

-60.0 kPa (-450 mmHg, -17.72 inHg) or more

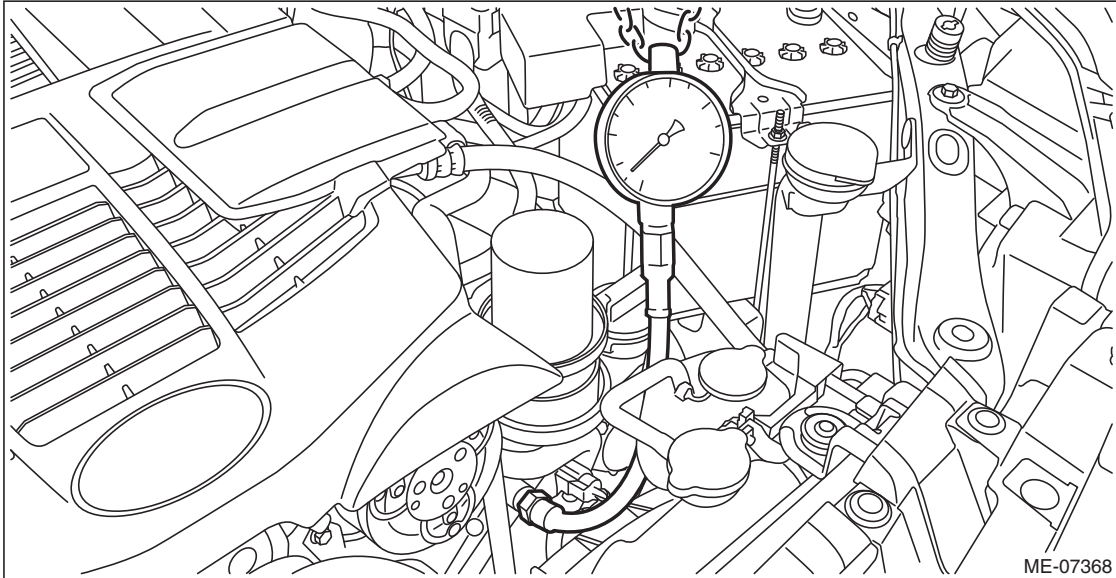
Diagnosis of engine condition by inspection of intake manifold vacuum	
Vacuum gauge needle behavior	Possible engine condition
1. Needle is steady but lower than standard value. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket, disconnection or damage of vacuum hose
2. Needle intermittently drops to position lower than standard value.	Leakage around cylinder
3. Needle drops suddenly and intermittently from standard value.	Sticky valve
4. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs
5. Needle vibrates above and below standard value in narrow range.	Defective ignition system

6) After inspection, install the related parts in the reverse order of removal.

6. Engine Oil Pressure

A: INSPECTION

- 1) Disconnect the ground cable from battery.
- 2) Remove the oil pressure switch. <Ref. to LU(H4DO)-42, REMOVAL, Oil Pressure Switch.>
- 3) Install the oil pressure gauge to the chain cover.



- 4) Connect the battery ground terminal.
- 5) Start the engine, and check the oil pressure.

NOTE:

- Standard value is based on an engine oil temperature of 80°C (176°F).
- If the oil pressure is out of specification, check oil pump, oil filter and lubrication line. <Ref. to LU(H4DO)-105, INSPECTION, Engine Lubrication System Trouble in General.>
- If the oil pressure warning light is ON and oil pressure is within standard, check the oil pressure switch. <Ref. to LU(H4DO)-105, INSPECTION, Engine Lubrication System Trouble in General.>

Engine oil pressure:

Standard

50 kPa (0.5 kgf/cm², 7 psi) or more (at 600 rpm)

350 kPa (3.6 kgf/cm², 51 psi) or more (at 6,000 rpm)

- 6) After inspection, install the related parts in the reverse order of removal.

Fuel Pressure

MECHANICAL

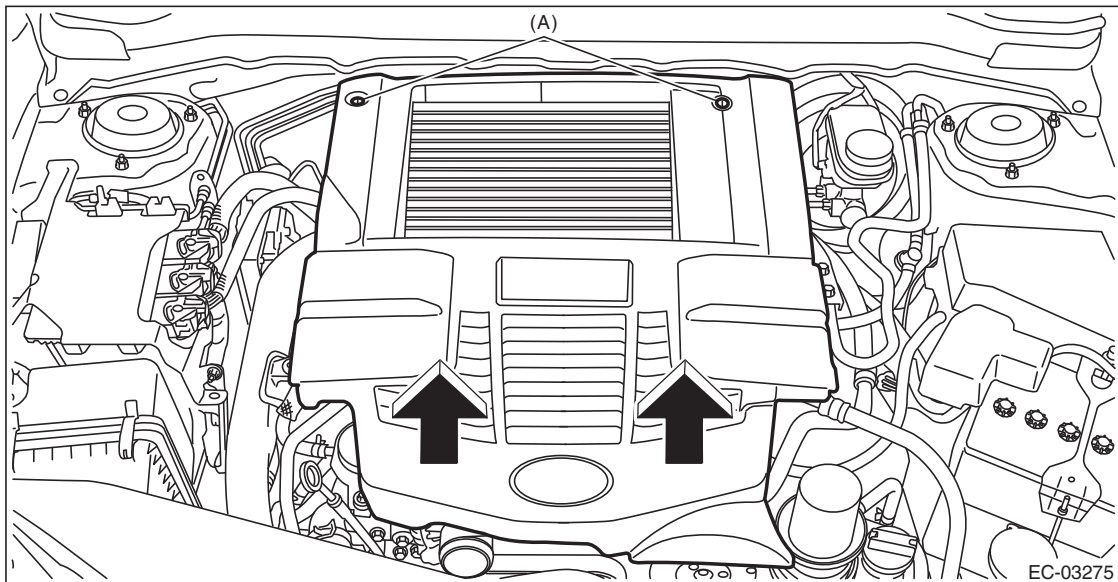
7. Fuel Pressure

A: INSPECTION

CAUTION:

- Be careful not to spill fuel.
- Catch the fuel from the tubes using a container or cloth.

1) Remove the clip (A), lift the front of the collector cover in the direction of arrow, and then remove the collector cover.



2) Release the fuel pressure. <Ref. to FU(H4DOTC)-151, RELEASING OF FUEL PRESSURE, PROCEDURE, Fuel.>

3) Open the fuel filler lid and remove the fuel filler cap.

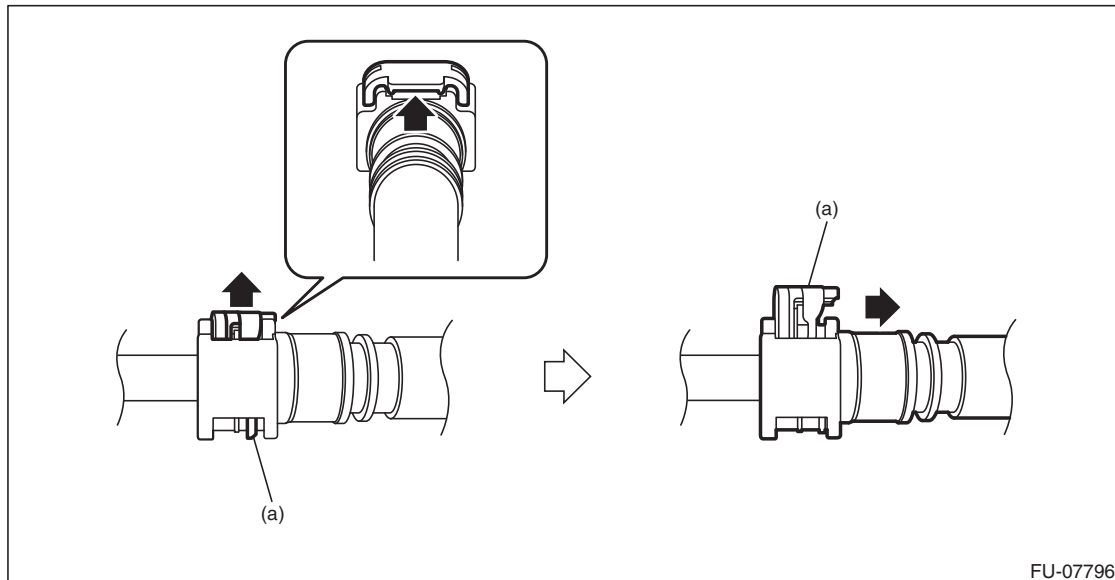
Fuel Pressure

MECHANICAL

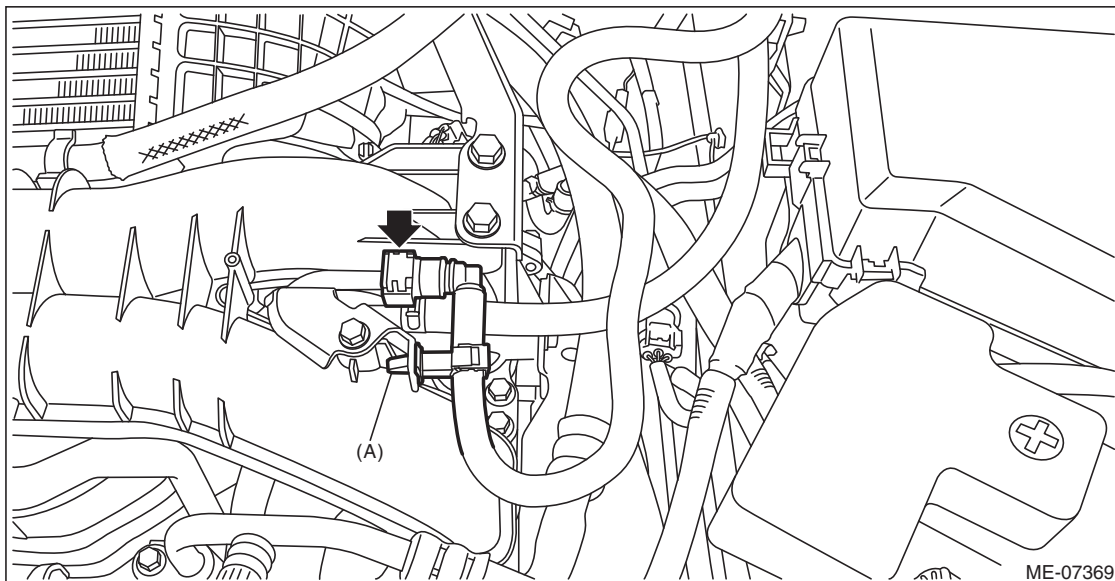
- 4) Disconnect the fuel delivery tube from the fuel delivery pipe, and connect the fuel pressure gauge.
(1) Disconnect the quick connector on the fuel delivery tube from the fuel pipe assembly, and remove the clip (A) securing the fuel delivery tube to the fuel pipe assembly.

NOTE:

Disconnect the quick connector as shown in the figure.



(a) Slider



Fuel Pressure

MECHANICAL

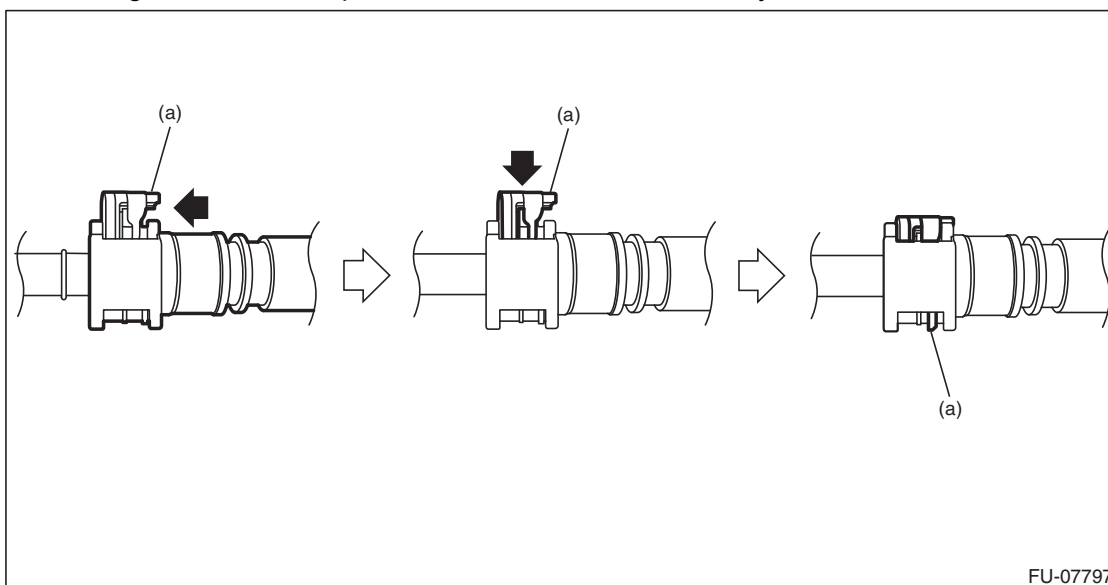
(2) Connect the fuel pressure gauge with ST1 and ST2.

CAUTION:

- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the ST2.
- When connecting the quick connector with slider, make sure to insert the pipe all the way in before locking the slider.
- When it is difficult to lock the slider, check that the pipe is fully inserted.
- Make sure that the quick connector is securely connected.

NOTE:

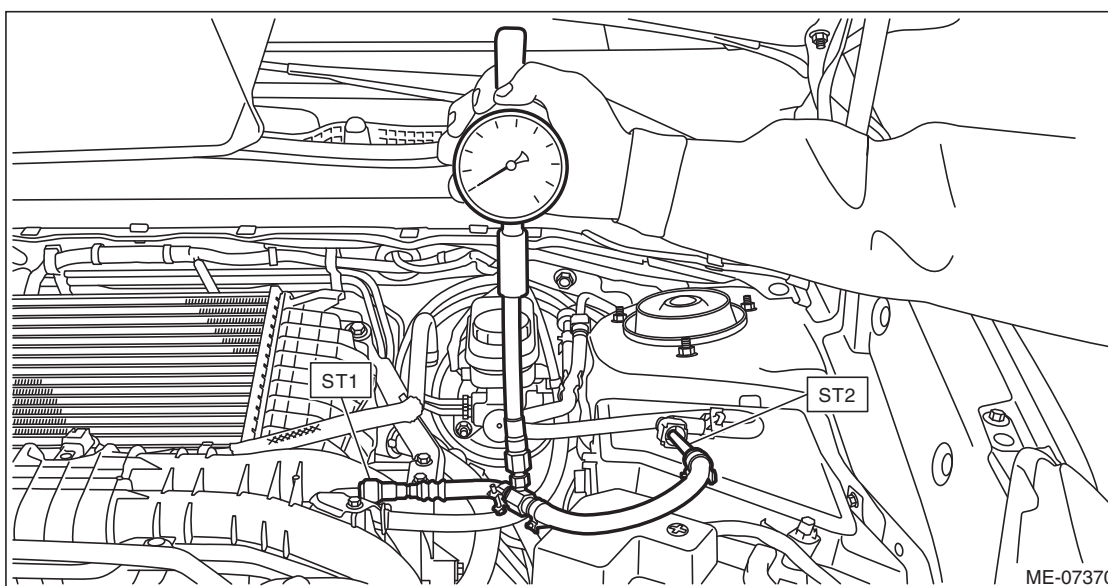
- ST1 is a SUBARU genuine part.
- When connecting the ST2 to the quick connector on the fuel delivery tube, connect as shown in the figure.



(a) Slider

ST1 42075AG690 FUEL HOSE

ST2 18471AA000 FUEL PIPE ADAPTER



5) Start the engine.

Fuel Pressure

MECHANICAL

6) Check the fuel pressure after warming up the engine.

NOTE:

- The fuel pressure gauge registers 10 to 20 kPa (0.1 to 0.2 kgf/cm², 1 to 3 psi) higher than standard values during high-altitude operations.
- Check or replace the fuel pump and fuel delivery line if the fuel pressure is out of the standard.

Fuel pressure:

Standard

340 — 400 kPa (3.5 — 4.1 kgf/cm², 49 — 58 psi)

7) After inspection, install the related parts in the reverse order of removal.

CAUTION:

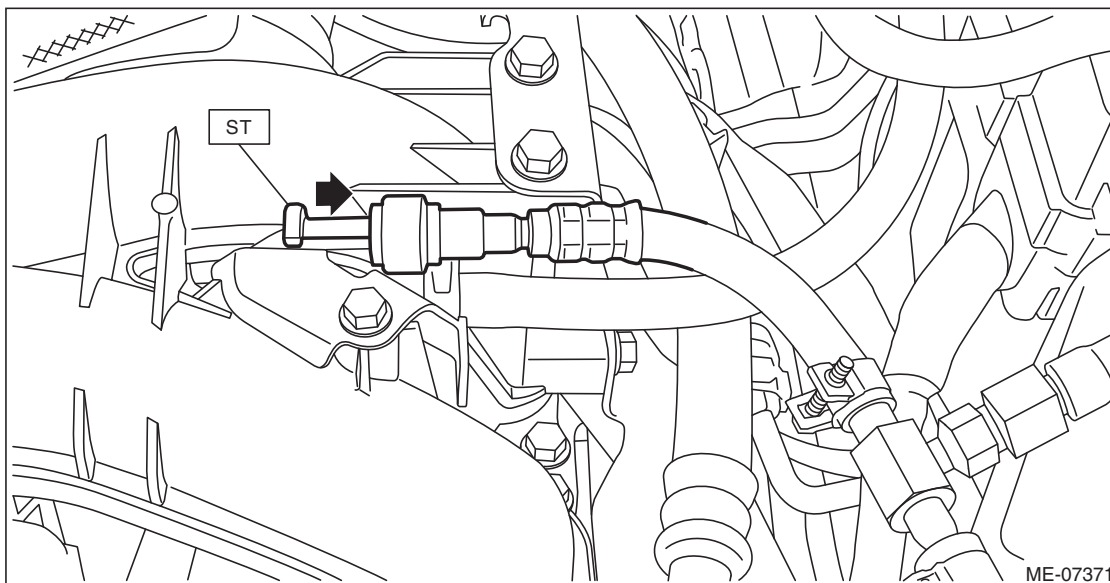
- Before removing the fuel pressure gauge, release the fuel pressure.
- Be careful not to spill fuel.
- Catch the fuel from hoses and tubes using a container or cloth.
- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector with slider, make sure to insert the pipe all the way in before locking the slider.
- When it is difficult to lock the slider, check that the pipe is fully inserted.
- Make sure that the quick connector is securely connected.

NOTE:

- When disconnecting the ST1, install the ST2 to the fuel pipe assembly, and press the ST2 in the direction of arrow to disconnect the quick connector on the ST1.

ST1 42075AG690 FUEL HOSE

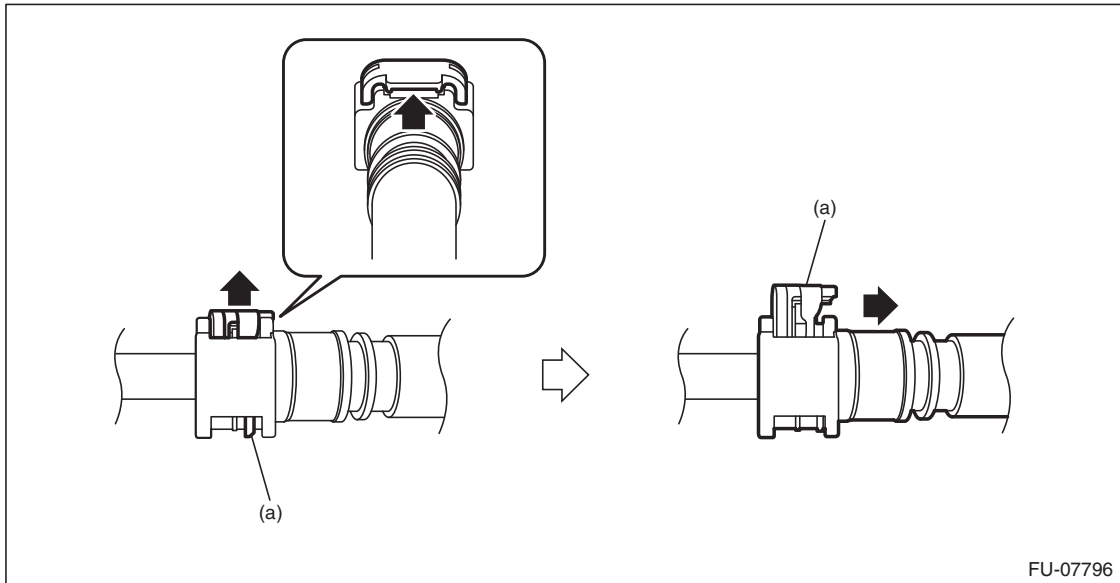
ST2 42099AE000 QUICK CONNECTOR RELEASE



Fuel Pressure

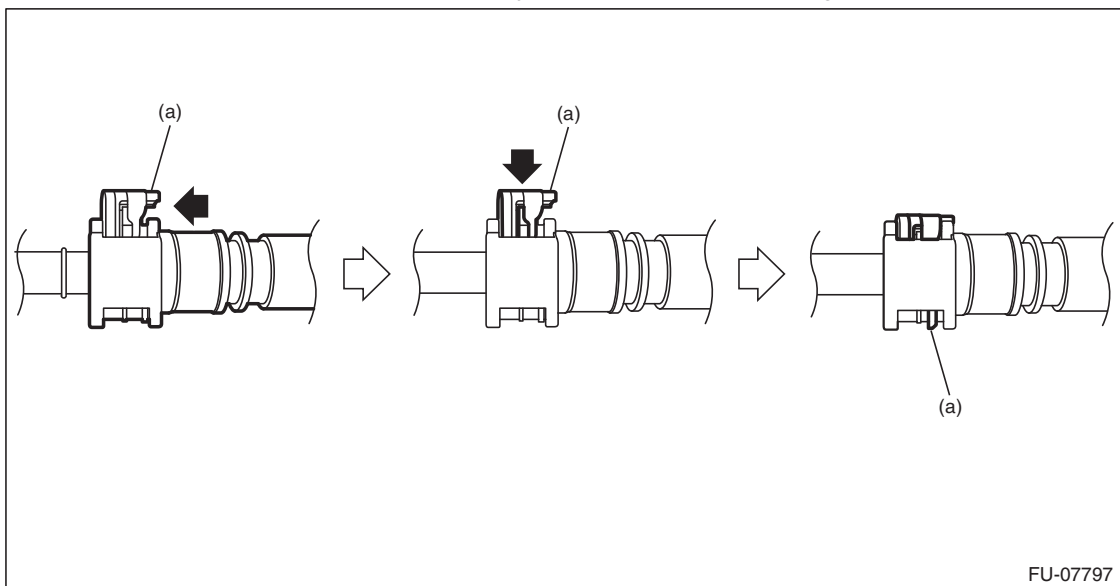
MECHANICAL

- Disconnect the quick connector on the fuel delivery tube as shown in the figure.



(a) Slider

- Connect the quick connector on the fuel delivery tube as shown in the figure.



(a) Slider

8. Cam Clearance

A: INSPECTION

1. WHEN TIMING CHAIN ASSEMBLY IS NOT REMOVED

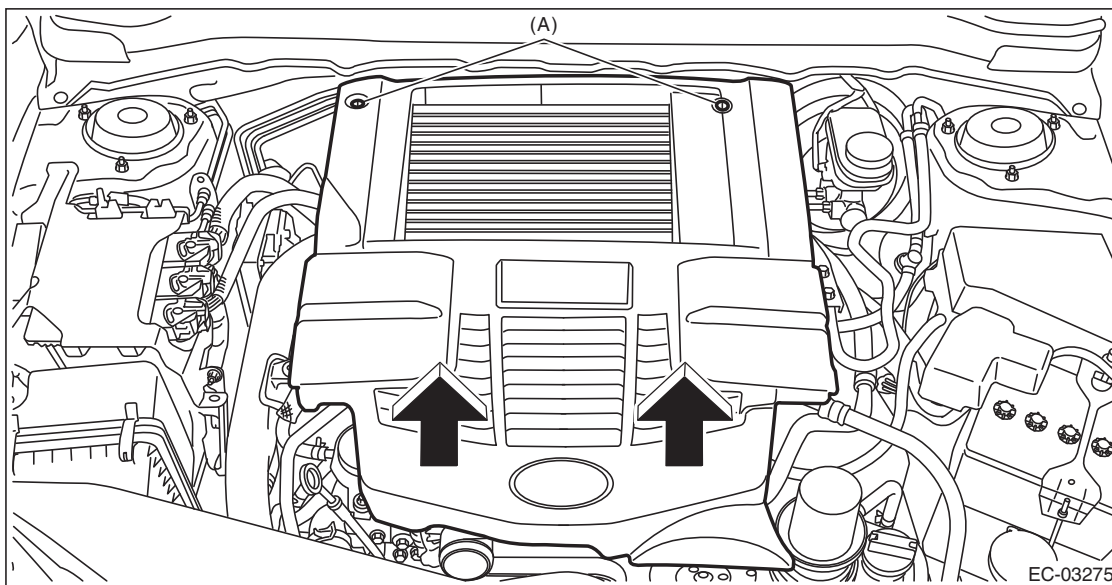
CAUTION:

When working on the vehicle, if engine oil is spilt onto the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.

NOTE:

- Inspection of cam clearance should be performed while engine is cold.
- If the engine is removed from vehicle, performing the step 1) is not necessary.

1) Remove the clip (A), lift the front of the collector cover in the direction of arrow, and then remove the collector cover.



2) Remove the V-belts. <Ref. to ME(H4DOTC)-75, REMOVAL, V-belt.>

Cam Clearance

MECHANICAL

3) When inspecting #1 and #3 cylinders

- (1) Remove the rocker cover RH. <Ref. to ME(H4DOTC)-147, ROCKER COVER RH, REMOVAL, Rocker Cover.>

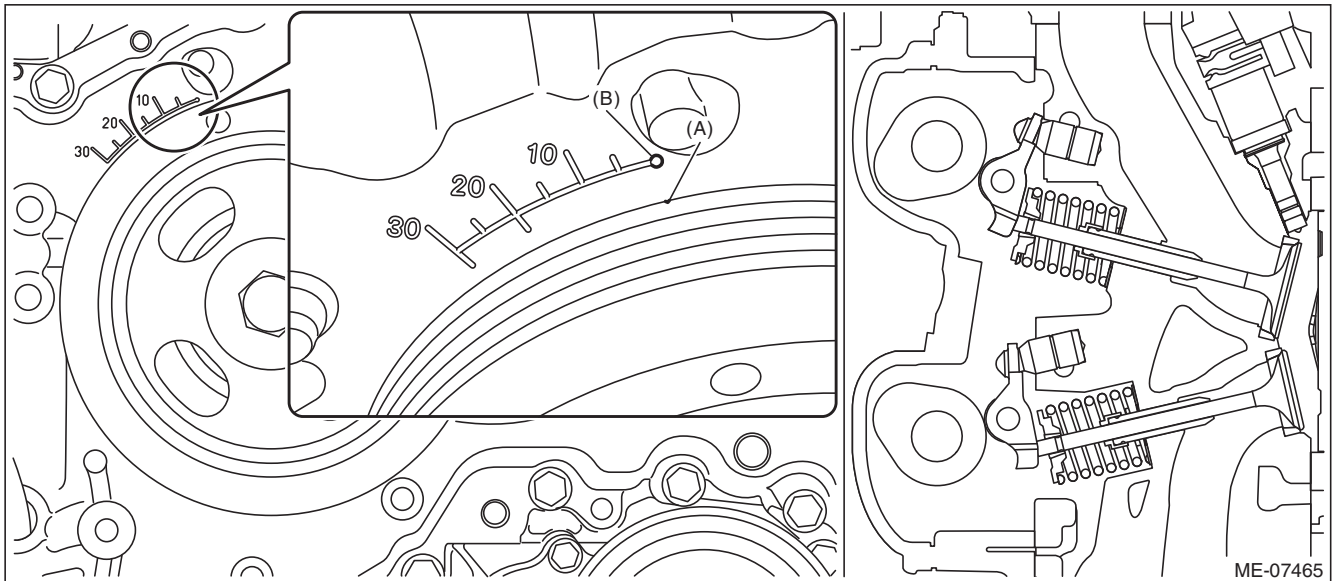
NOTE:

When working on the vehicle, place a suitable container under the vehicle.

- (2) Set #1 cylinder piston to top dead center of compression stroke by rotating the crank pulley clockwise using the socket wrench.

NOTE:

When the timing mark (A) on crank pulley is aligned to the 0° in timing gauge (B) on chain cover as shown in the figure, the #1 cylinder piston is located at TDC of compression stroke if the intake camshaft does not depress the #1 cylinder intake side roller rocker arm (intake valve) and exhaust side roller rocker arm (exhaust valve). If roller rocker arm (valve) is depressed, turn the crank pulley by 360° in order to make #1 cylinder piston at TDC of compression stroke.



Cam Clearance

MECHANICAL

(3) Check the cam clearance for #1 cylinder intake, #1 cylinder exhaust and #3 cylinder exhaust.

NOTE:

- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Intake

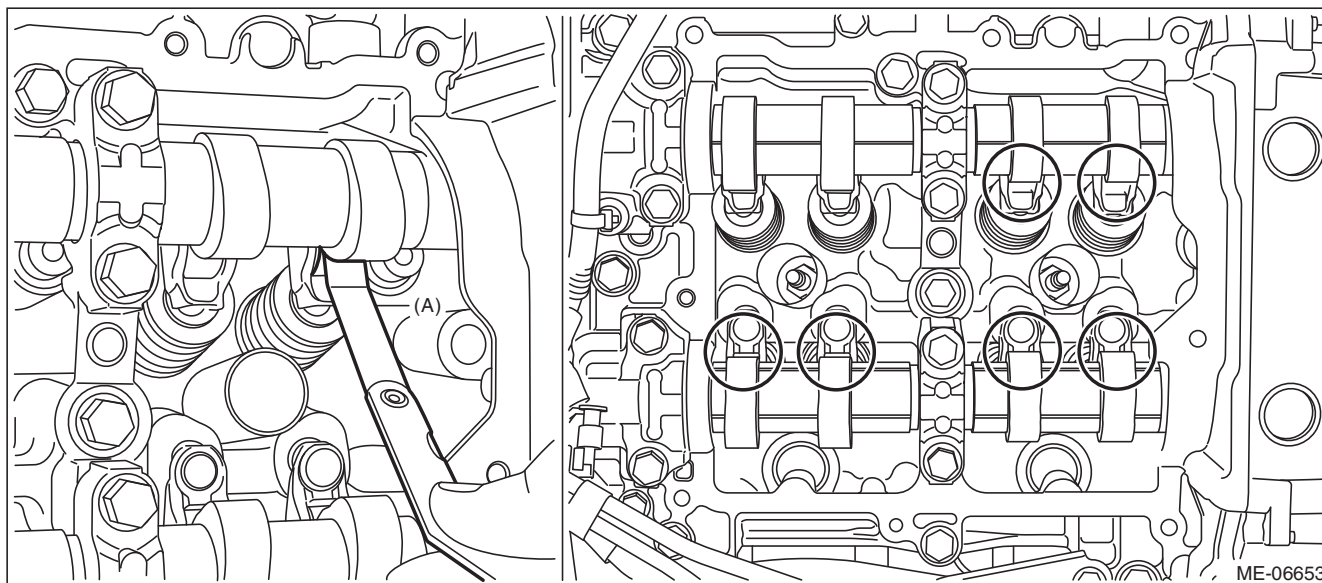
Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

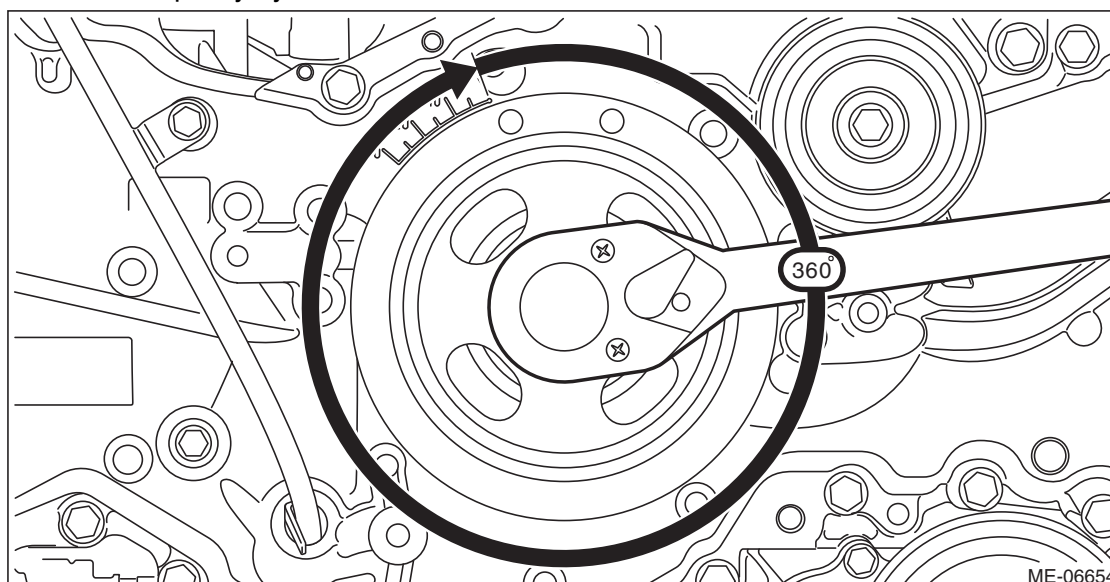
Exhaust

Standard

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)



(4) Turn the crank pulley by 360°.



Cam Clearance

MECHANICAL

- (5) Check the clearance of #3 cylinder intake.

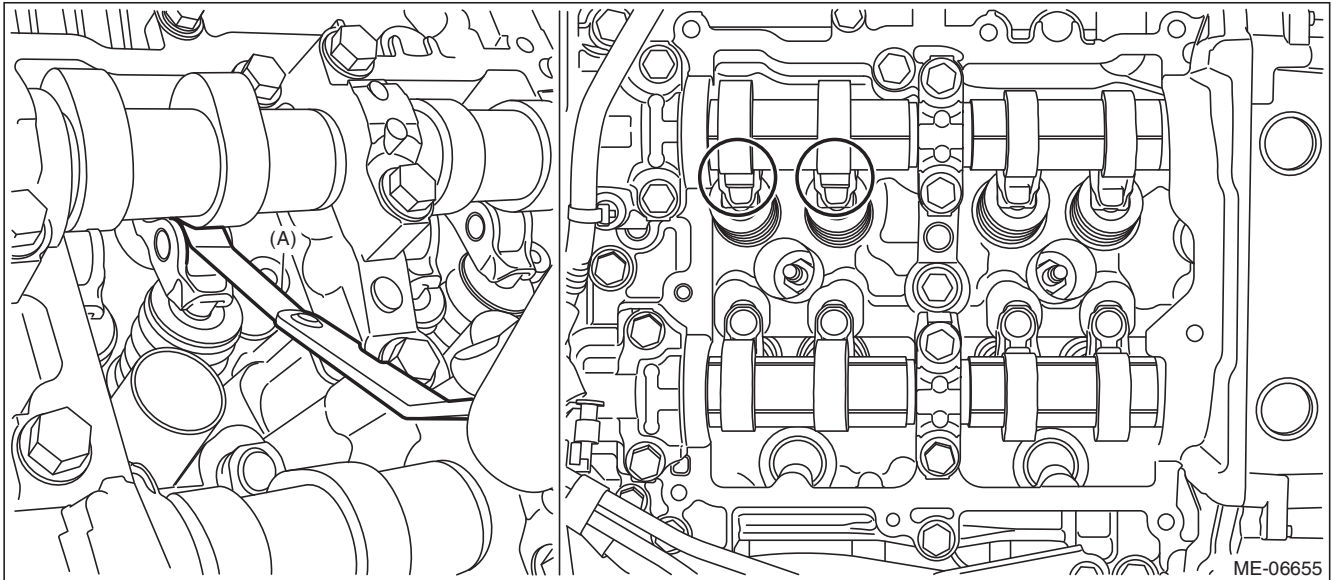
NOTE:

- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)



- 4) When inspecting #2 and #4 cylinders

- (1) Remove the rocker cover LH. <Ref. to ME(H4DOTC)-149, ROCKER COVER LH, REMOVAL, Rocker Cover.>

NOTE:

When working on the vehicle, place a suitable container under the vehicle.

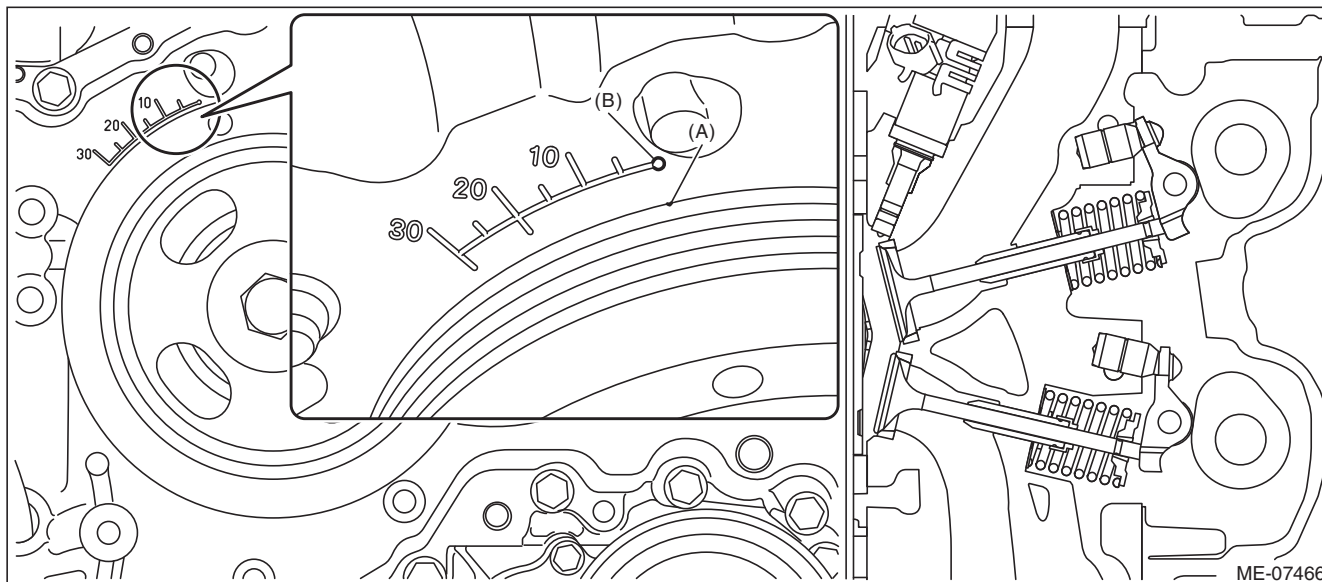
- (2) Set #2 cylinder piston to top dead center of compression stroke by rotating the crank pulley clockwise using the socket wrench.

Cam Clearance

MECHANICAL

NOTE:

When the timing mark (A) on crank pulley is aligned to the 0° in timing gauge (B) on chain cover as shown in the figure, the #2 cylinder piston is located at TDC of compression stroke if the intake camshaft and exhaust camshaft does not depress the #2 cylinder intake side roller rocker arm (intake valve) and exhaust side roller rocker arm (exhaust valve). If roller rocker arm (valve) is depressed, turn the crank pulley by 360° in order to make #2 cylinder piston at TDC of compression stroke.



(3) Check the cam clearance for #2 cylinder intake, #2 cylinder exhaust and #4 cylinder exhaust.

NOTE:

- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Intake

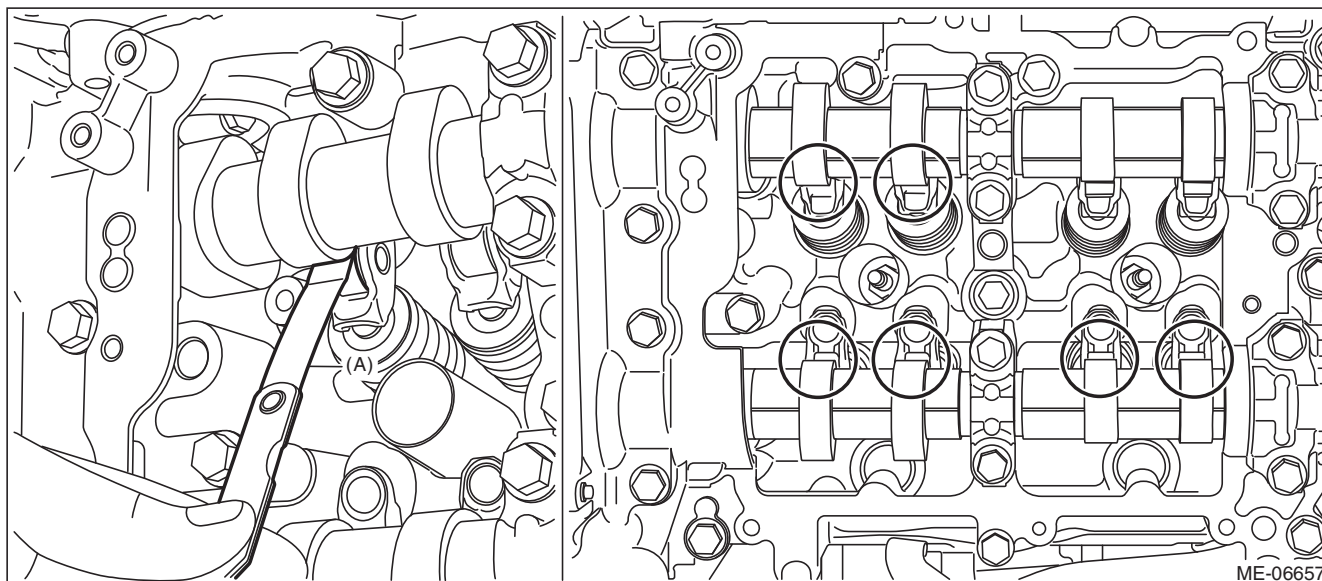
Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

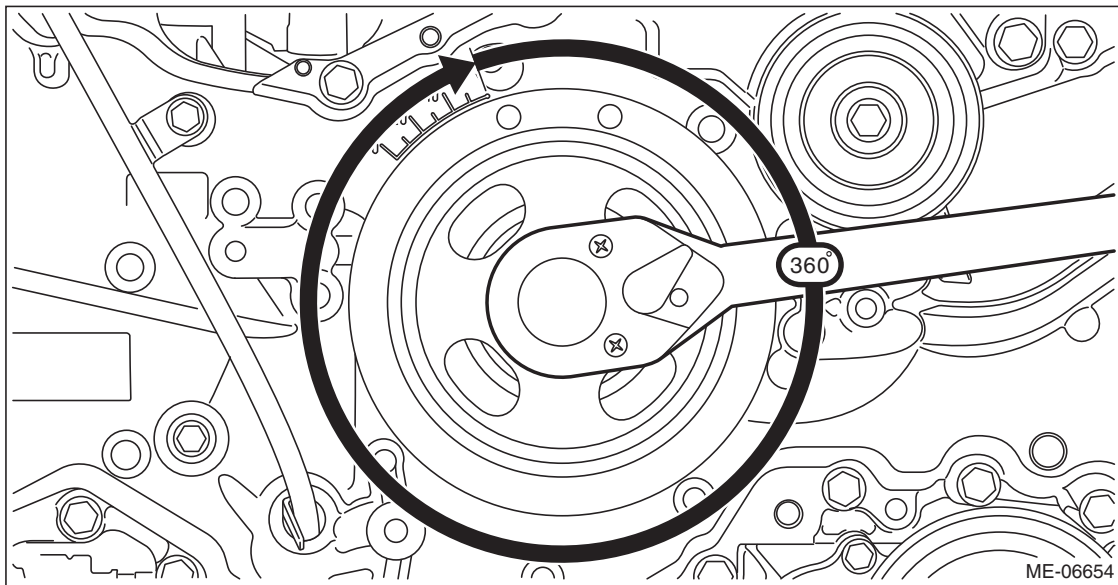
0.22 ± 0.02 mm (0.0087 ± 0.0008 in)



Cam Clearance

MECHANICAL

- (4) Turn the crank pulley by 360°.



- (5) Check the clearance of #4 cylinder intake.

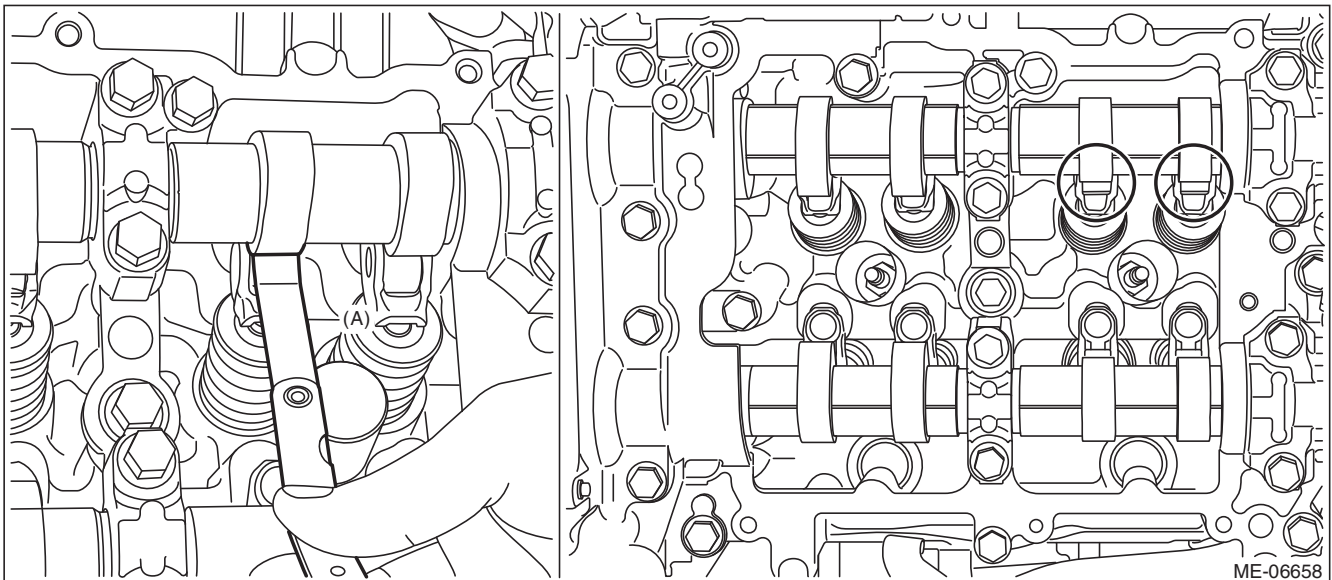
NOTE:

- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)



- 5) If necessary, adjust the cam clearance. <Ref. to ME(H4DOTC)-41, ADJUSTMENT, Cam Clearance.>
6) After inspection, install the related parts in the reverse order of removal.

Cam Clearance

MECHANICAL

2. WHEN TIMING CHAIN ASSEMBLY IS REMOVED

NOTE:

Inspection of cam clearance should be performed while engine is cold.

1) When inspecting #1 and #3 cylinders

(1) Remove the rocker cover RH. <Ref. to ME(H4DOTC)-147, ROCKER COVER RH, REMOVAL, Rocker Cover.>

NOTE:

When working on the vehicle, place a suitable container under the vehicle.

(2) Check the #1 and #3 cylinder cam clearance.

CAUTION:

Intake and exhaust camshafts can be independently rotated with the timing chain removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero lift (cam base circle position) (in range where it can be turned lightly by hand).

NOTE:

- For cam clearance inspection, adjust the cam base circle position so that the thickness gauge (A) can be inserted easily by hand turning the camshaft (cam sprocket) to be measured.
- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Intake

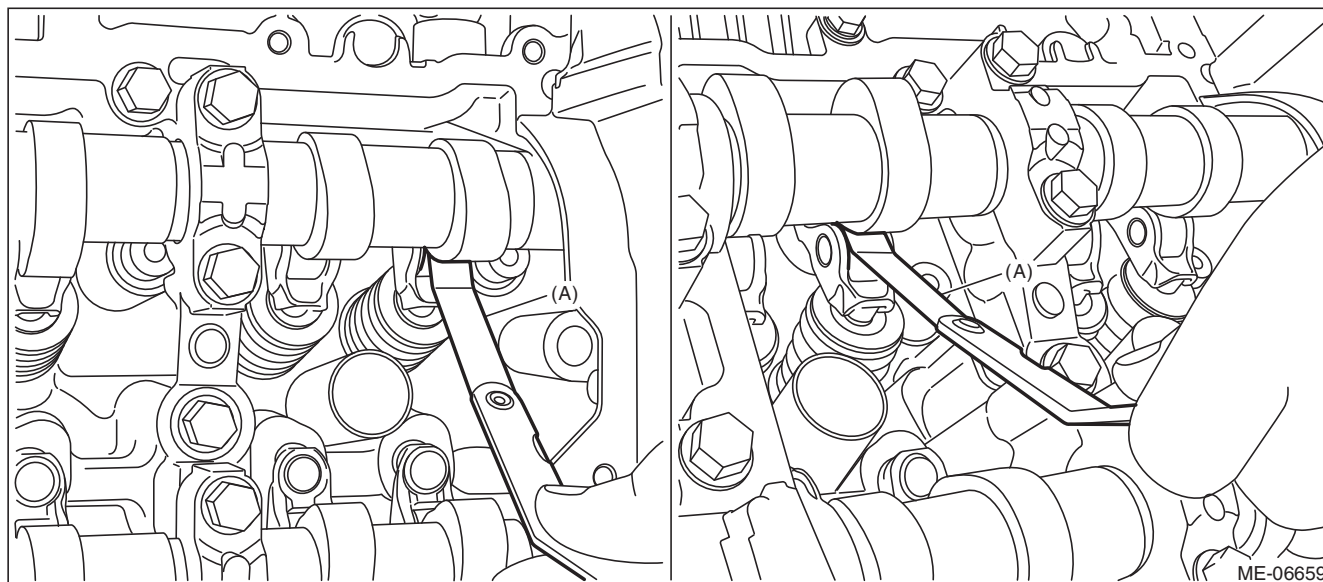
Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)



Cam Clearance

MECHANICAL

2) When inspecting #2 and #4 cylinders

(1) Remove the rocker cover LH. <Ref. to ME(H4DOTC)-149, ROCKER COVER LH, REMOVAL, Rocker Cover.>

NOTE:

When working on the vehicle, place a suitable container under the vehicle.

(2) Check the #2 and #4 cylinder cam clearance.

CAUTION:

Intake and exhaust camshafts can be independently rotated with the timing chain removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero lift (cam base circle position) (in range where it can be turned lightly by hand).

NOTE:

- Because the intake camshaft is pressurized by the high-pressure fuel pump, it is almost impossible to turn the intake camshaft lightly by hand. Since the zero-lift position is adjusted at the removal of the timing chain LH, measure the cam clearance at that position.
- For cam clearance inspection on exhaust side, adjust the cam base circle position so that the thickness gauge (A) can be inserted easily by hand turning the exhaust camshaft (cam sprocket).
- Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).
- If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.

Cam clearance:

Intake

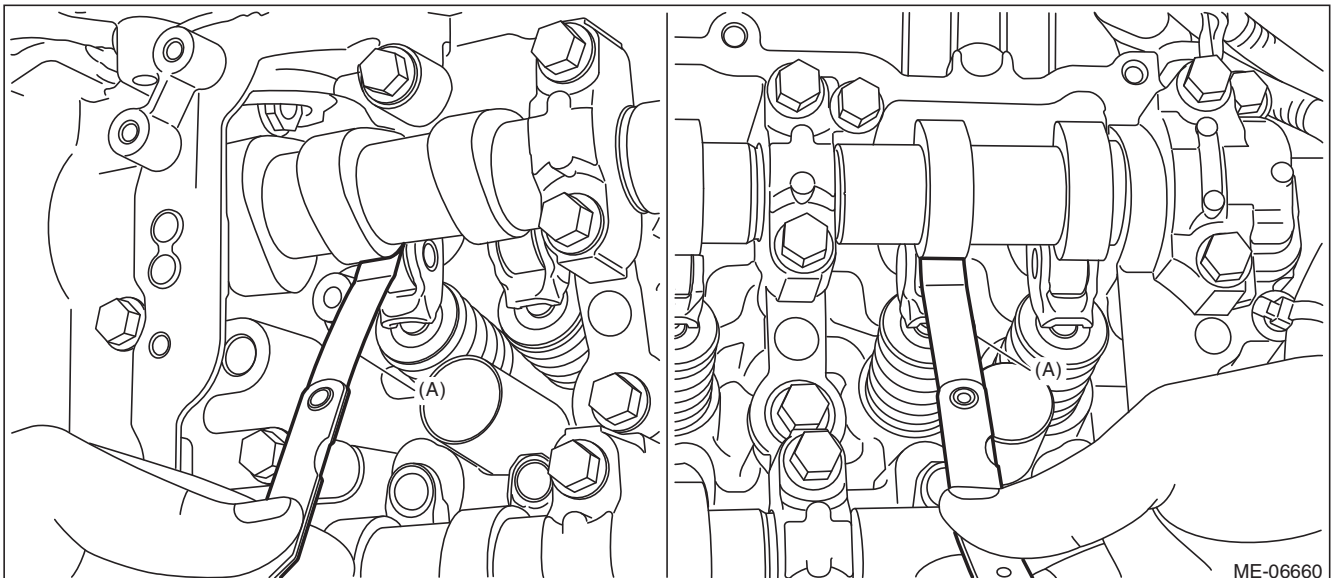
Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)



3) If necessary, adjust the cam clearance. <Ref. to ME(H4DOTC)-41, ADJUSTMENT, Cam Clearance.>

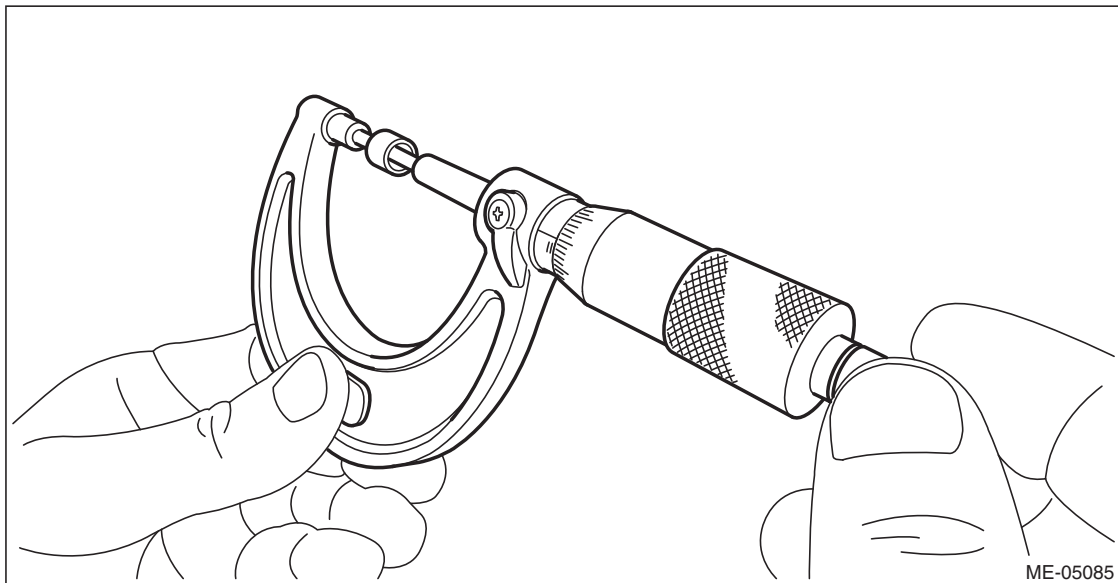
4) After inspection, install the related parts in the reverse order of removal.

B: ADJUSTMENT

- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-44, REMOVAL, Engine Assembly.>
- 2) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 3) When adjusting #1 and #3 cylinders
 - (1) Remove the timing chain RH. <Ref. to ME(H4DOTC)-111, TIMING CHAIN RH, REMOVAL, Timing Chain Assembly.>
 - (2) Remove the cam carrier RH. <Ref. to ME(H4DOTC)-172, CAM CARRIER RH, REMOVAL, Cam Carrier.>
 - (3) Measure the thickness of valve shim using micrometer.

NOTE:

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



- (4) Select a valve shim of suitable thickness using the measured cam clearance and valve shim thickness.

NOTE:

Use a new valve shim.

Intake side: $S = T + 1.54 \times (V - 0.13 \text{ mm (0.0051 in)})$
Exhaust side: $S = T + 1.69 \times (V - 0.22 \text{ mm (0.0087 in)})$

S: Valve shim thickness required

V: Measured cam clearance

T: Current valve shim thickness

- (5) Install the cam carrier RH. <Ref. to ME(H4DOTC)-180, CAM CARRIER RH, INSTALLATION, Cam Carrier.>

Cam Clearance

MECHANICAL

(6) Check all the cam clearance of RH side at this time. If the cam clearance is not within the standard value, repeat the procedure over again from step 2).

NOTE:

When the removing/installing of cam carrier RH has been performed, cam clearance may be outside the standard value. Checking of all cam clearance of RH side is necessary. Refer to INSPECTION of "Cam Clearance" for the cam clearance inspection. <Ref. to ME(H4DOTC)-39, WHEN TIMING CHAIN ASSEMBLY IS REMOVED, INSPECTION, Cam Clearance.>

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

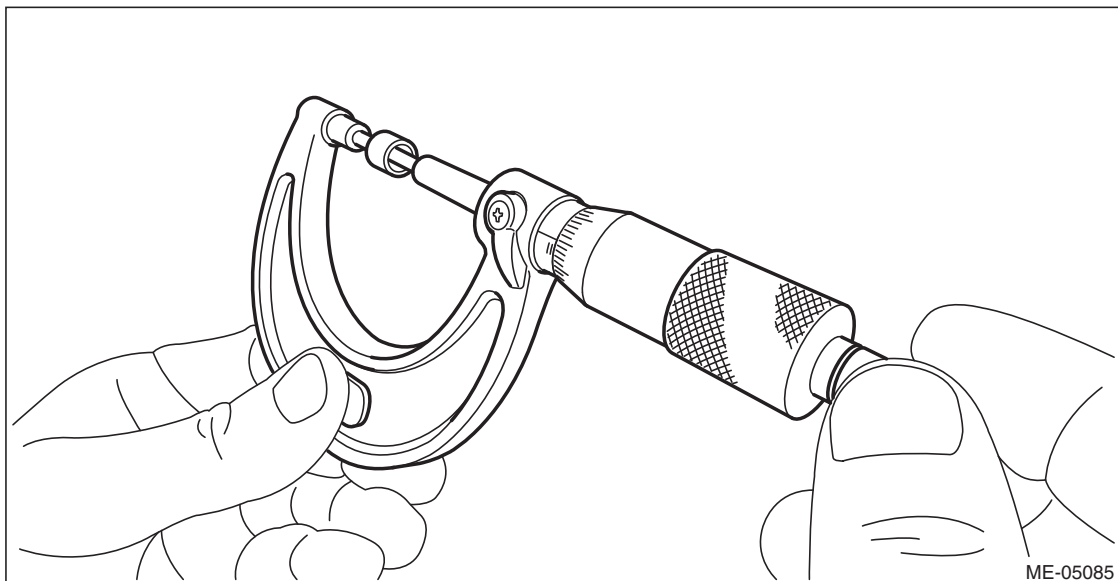
0.22 ± 0.02 mm (0.0087 ± 0.0008 in)

4) When adjusting #2 and #4 cylinders

- (1) Remove the timing chain LH. <Ref. to ME(H4DOTC)-114, TIMING CHAIN LH, REMOVAL, Timing Chain Assembly.>
- (2) Remove the intake manifold. <Ref. to FU(H4DOTC)-19, REMOVAL, Intake Manifold.>
- (3) Remove the cam carrier LH. <Ref. to ME(H4DOTC)-175, CAM CARRIER LH, REMOVAL, Cam Carrier.>
- (4) Measure the thickness of valve shim using micrometer.

NOTE:

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



(5) Select a valve shim of suitable thickness using the measured cam clearance and valve shim thickness.

NOTE:

Use a new valve shim.

Intake side: $S = T + 1.54 \times (V - 0.13 \text{ mm } (0.0051 \text{ in}))$
Exhaust side: $S = T + 1.69 \times (V - 0.22 \text{ mm } (0.0087 \text{ in}))$

S: Valve shim thickness required
V: Measured cam clearance
T: Current valve shim thickness

(6) Install the cam carrier LH. <Ref. to ME(H4DOTC)-189, CAM CARRIER LH, INSTALLATION, Cam Carrier.>

Cam Clearance

MECHANICAL

(7) Check all the cam clearance of LH side at this time. If the cam clearance is not within the standard value, repeat the procedure over again from step 3).

NOTE:

When the removing/installing of cam carrier LH has been performed, cam clearance may be outside the standard value. Checking of all cam clearance of LH side is necessary. Refer to INSPECTION of "Cam Clearance" for the cam clearance inspection. <Ref. to ME(H4DOTC)-39, WHEN TIMING CHAIN ASSEMBLY IS REMOVED, INSPECTION, Cam Clearance.>

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22 ± 0.02 mm (0.0087 ± 0.0008 in)

5) After adjustment, install the related parts in the reverse order of removal.



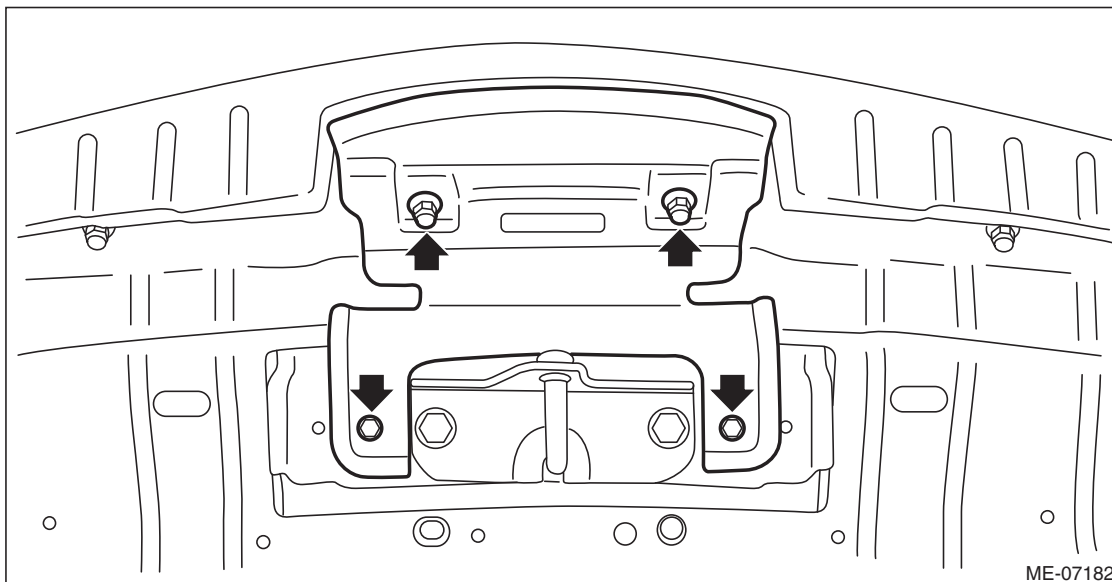
Engine Assembly

MECHANICAL

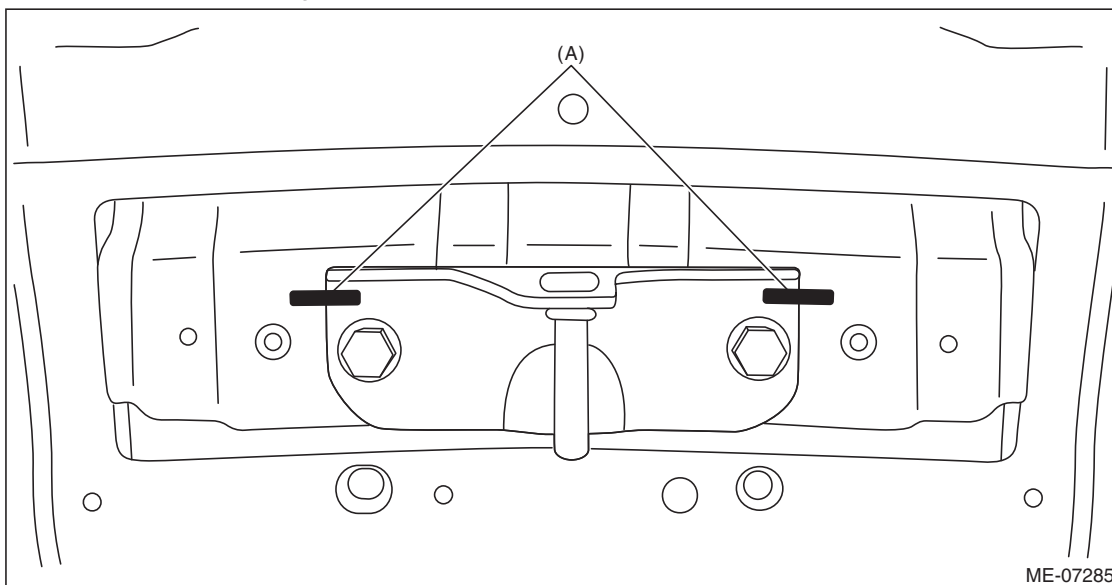
9. Engine Assembly

A: REMOVAL

1) Open the front hood, and remove the upper grille bracket from the front hood.



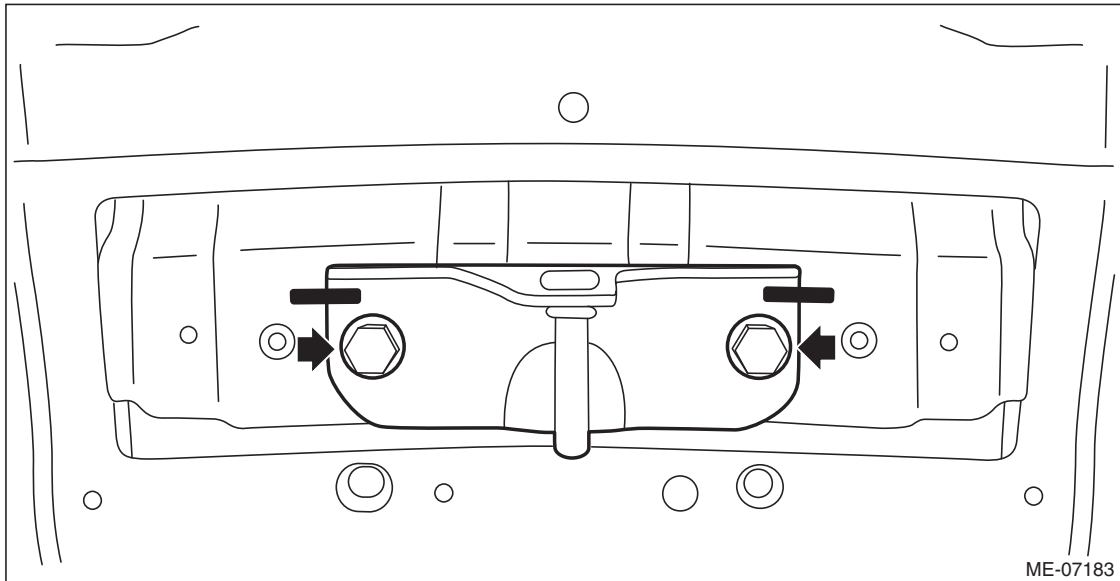
2) Using a marker pen, make alignment marks (A) on both the front hood and the front hood striker.



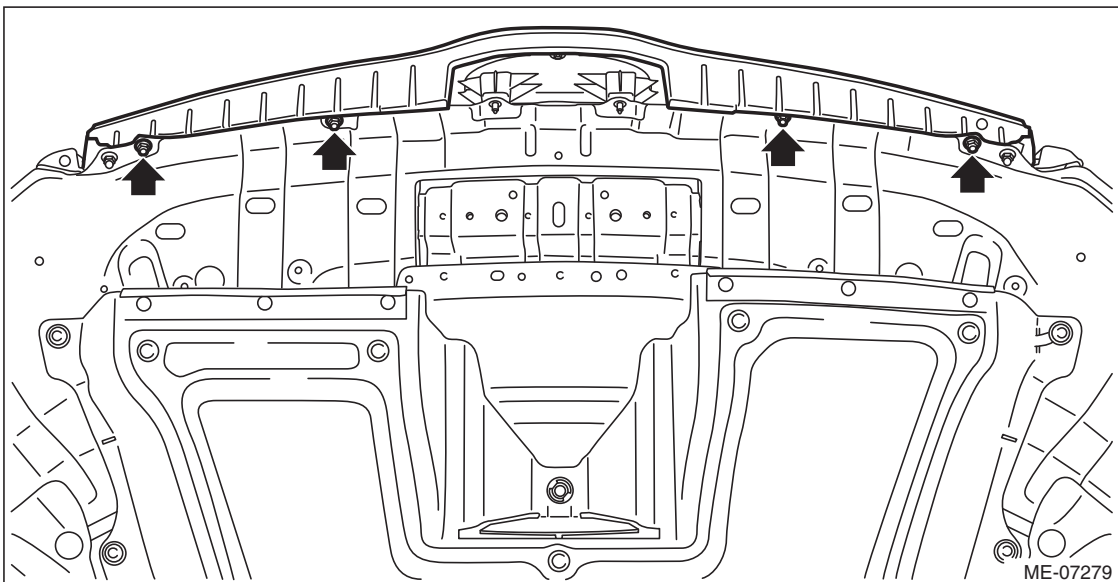
Engine Assembly

MECHANICAL

- 3) Remove the front hood striker from the front hood.



- 4) Remove the front center grille assembly from the front hood.



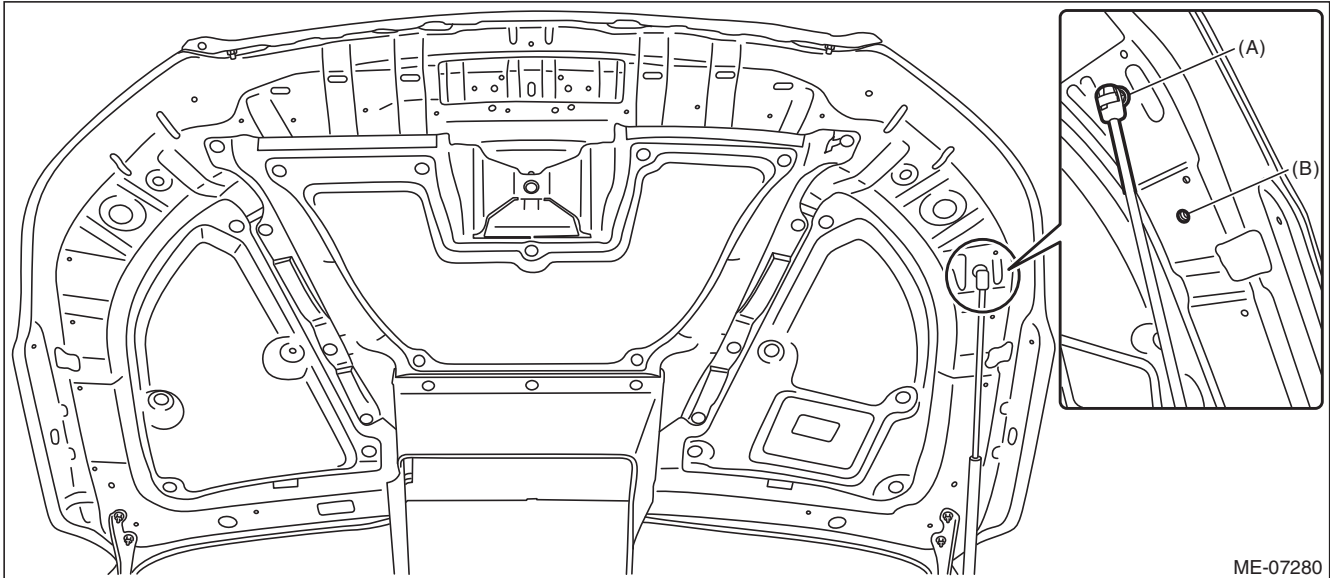
Engine Assembly

MECHANICAL

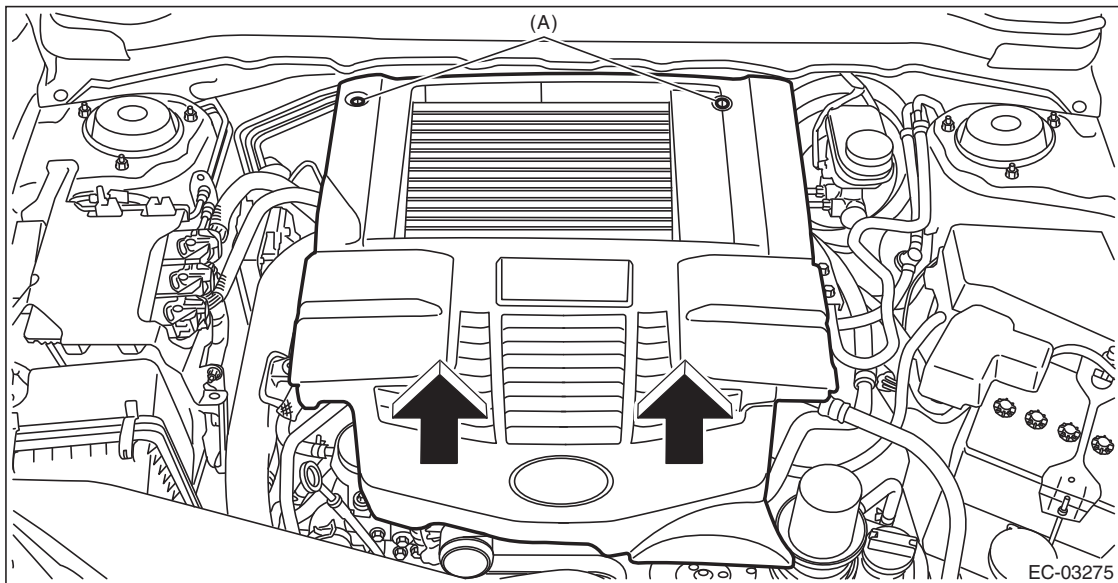
5) Change the front hood damper mounting position from (A) to (B), and completely open the front hood.

Tightening torque:

20 N·m (2.0 kgf-m, 14.8 ft-lb)



6) Remove the clip (A), lift the front of the collector cover in the direction of arrow, and then remove the collector cover.



7) Collect the refrigerant from A/C system. <Ref. to AC-26, Refrigerant Recovery Procedure.>

8) Release the fuel pressure. <Ref. to FU(H4DOTC)-151, RELEASING OF FUEL PRESSURE, PROCEDURE, Fuel.>

9) Disconnect the ground cable from battery.

10) Remove the air intake duct. <Ref. to IN(H4DOTC)-19, REMOVAL, Air Intake Duct.>

11) Remove the intercooler. <Ref. to IN(H4DOTC)-35, REMOVAL, Intercooler.>

12) Remove the intake duct No. 1 and intake duct No. 2. <Ref. to IN(H4DOTC)-20, INTAKE DUCT NO. 1, REMOVAL, Intake Duct.> <Ref. to IN(H4DOTC)-22, INTAKE DUCT NO. 2, REMOVAL, Intake Duct.>

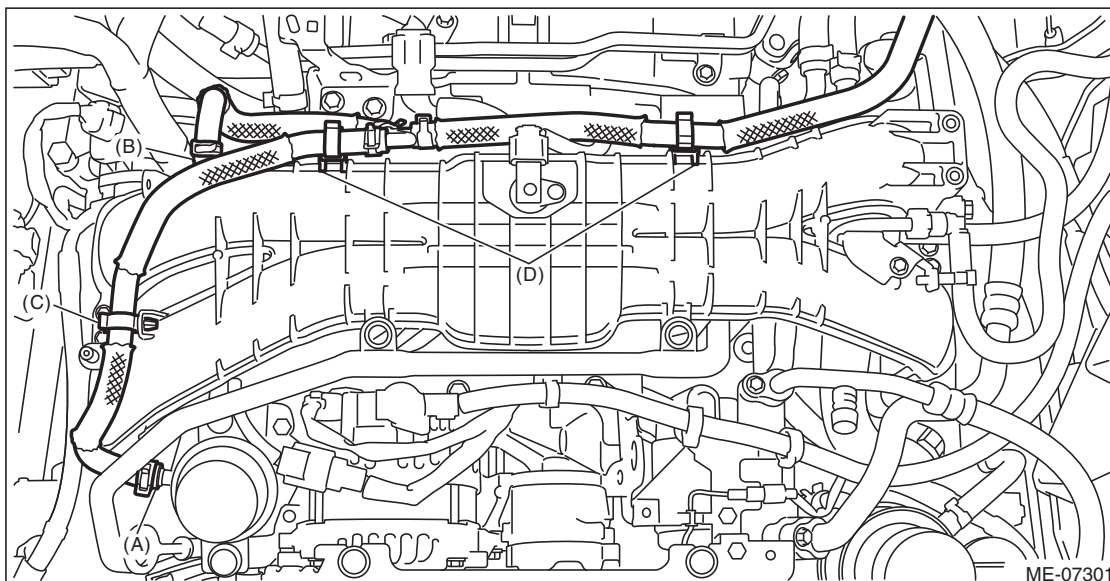
13) Remove the radiator. <Ref. to CO(H4DOTC)-39, REMOVAL, Radiator.>

14) Disconnect sections (A) and (B) of the brake booster vacuum hose from the brake vacuum pump and intake manifold, and remove the brake booster vacuum hose from the clip (C).

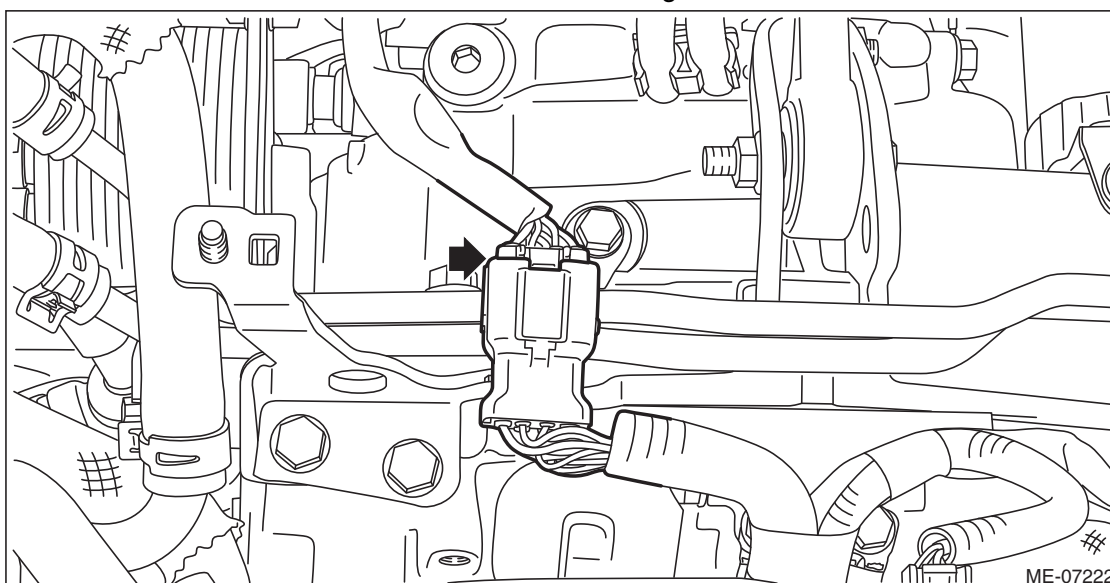
Engine Assembly

MECHANICAL

- 15) Remove the clip (D) securing the brake booster vacuum hose to the intake manifold, and move the brake booster vacuum hose at the locations that do not interfere operation.



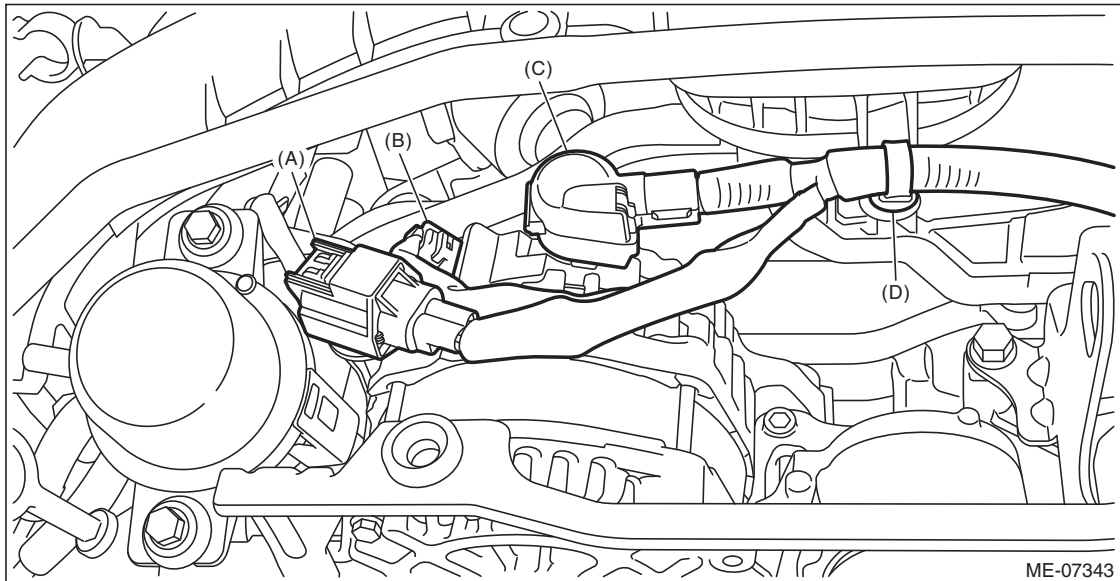
- 16) Disconnect the bulkhead harness connectors from the engine harness connectors.



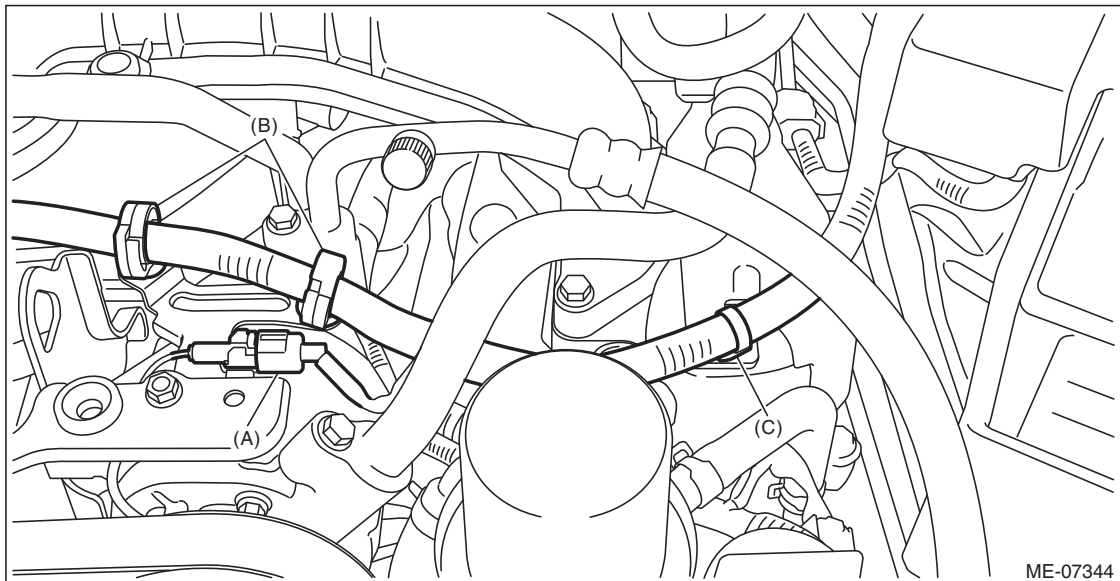
Engine Assembly

MECHANICAL

- 17) Disconnect the connector (A) from the brake vacuum pump.
- 18) Disconnect connector (B) and terminal (C) from the generator, and remove the clip (D) securing the generator cord to the intake manifold.



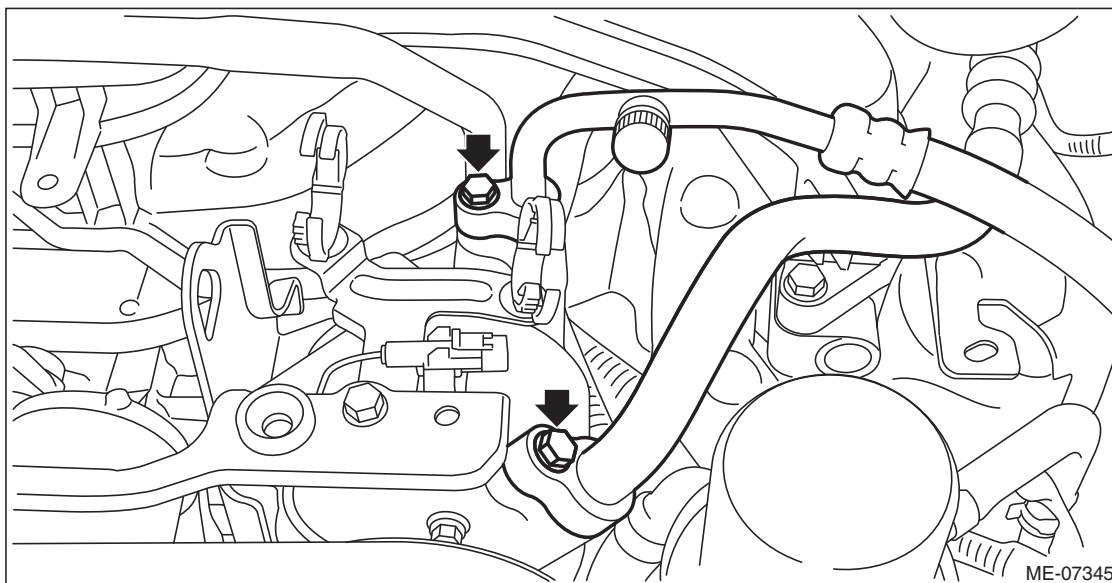
- 19) Disconnect connector (A) from A/C compressor, and remove the generator cord from clip (B).
- 20) Remove the clip (C) securing the generator cord to the fuel pipe protector, and move the generator cord to the left side wheel apron.



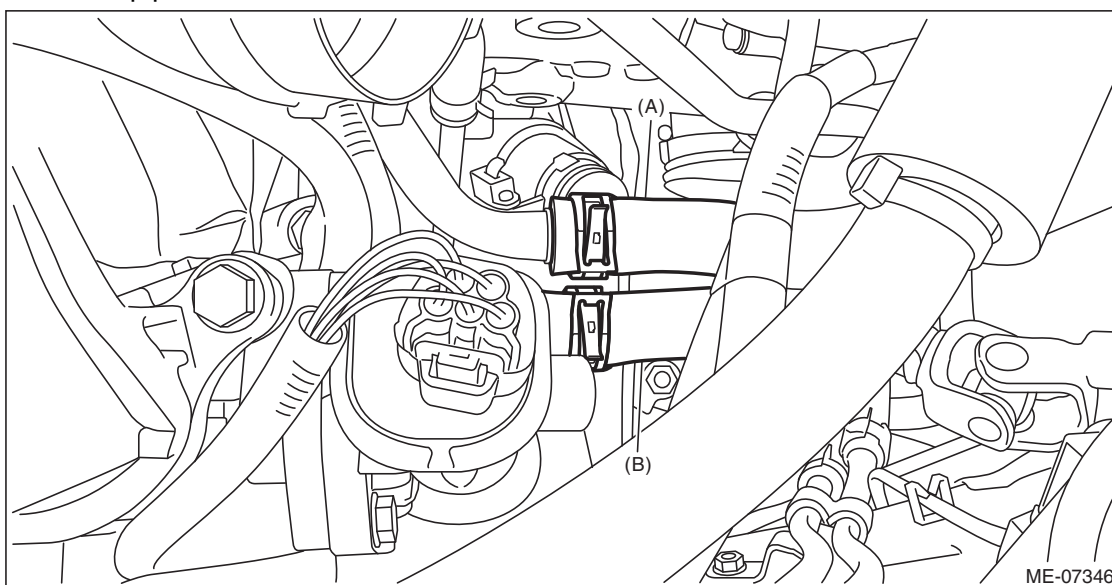
Engine Assembly

MECHANICAL

21) Disconnect the A/C pressure hoses from A/C compressor. <Ref. to AC-70, REMOVAL, Hose and Pipe.>



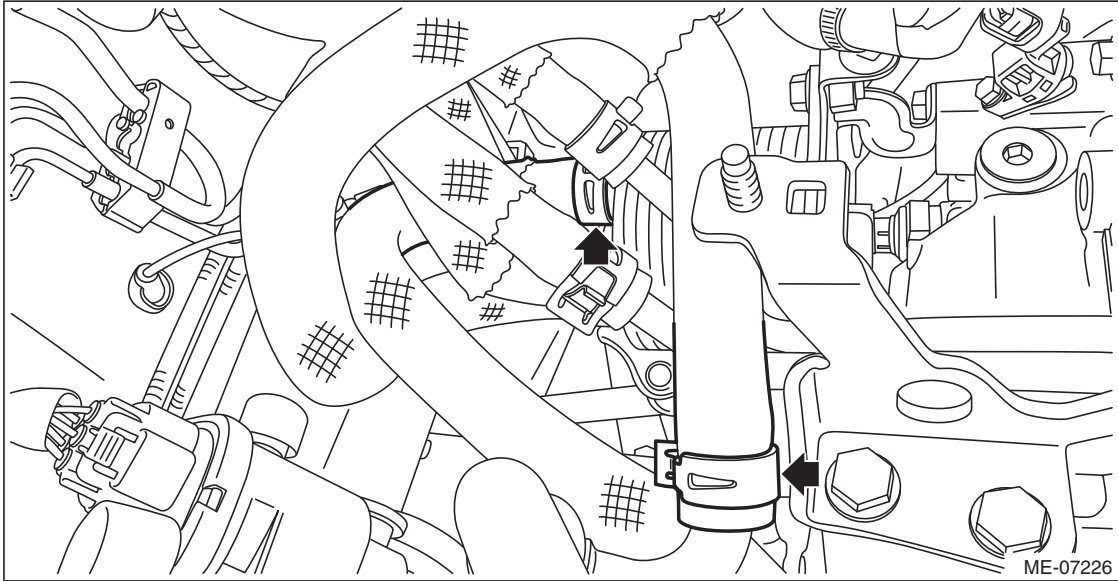
22) Disconnect the heater inlet hose (A) from the water pipe assembly, and disconnect the heater outlet hose (B) from the water pipe LH.



Engine Assembly

MECHANICAL

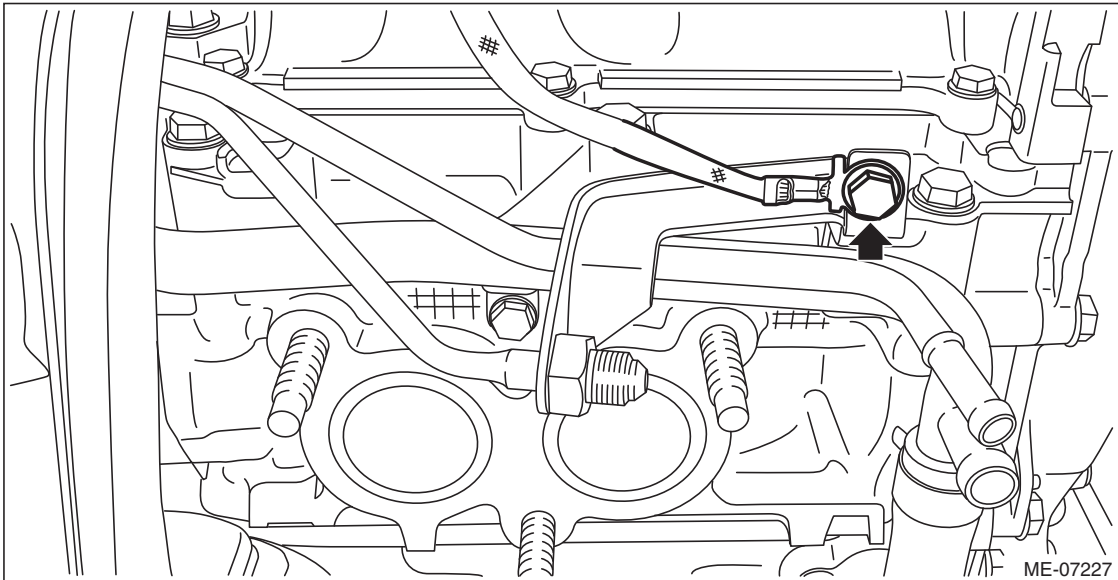
23) Disconnect the engine coolant inlet hose and engine coolant outlet hose from the CVTF cooler (with warmer feature) and EGR cooler.



24) Remove the front exhaust pipe. <Ref. to EX(H4DOTC)-7, REMOVAL, Front Exhaust Pipe.>

25) Lift up the vehicle.

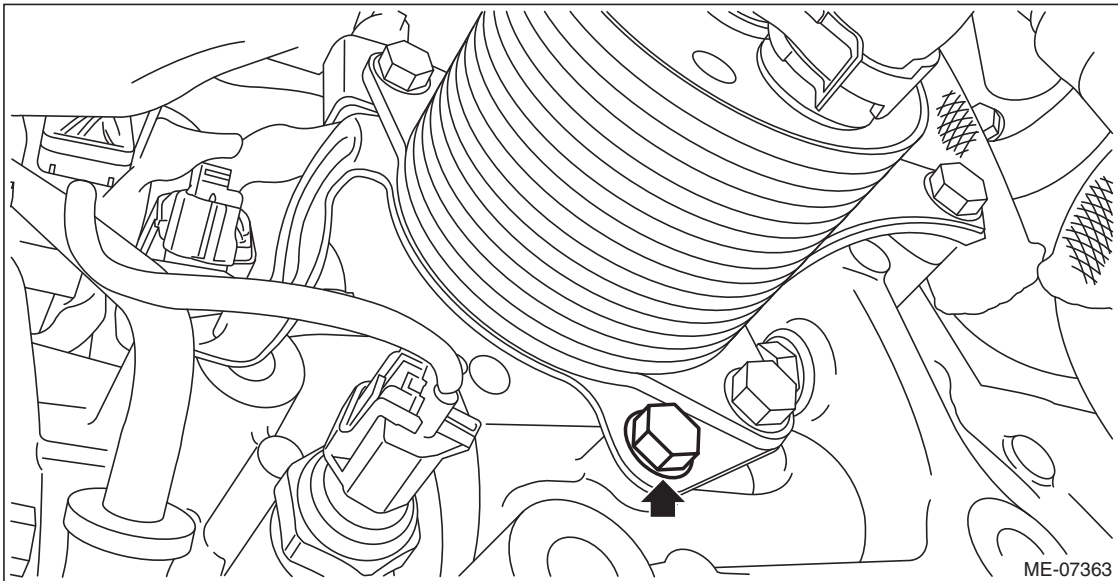
26) Disconnect the ground cable from the oil pipe assembly.



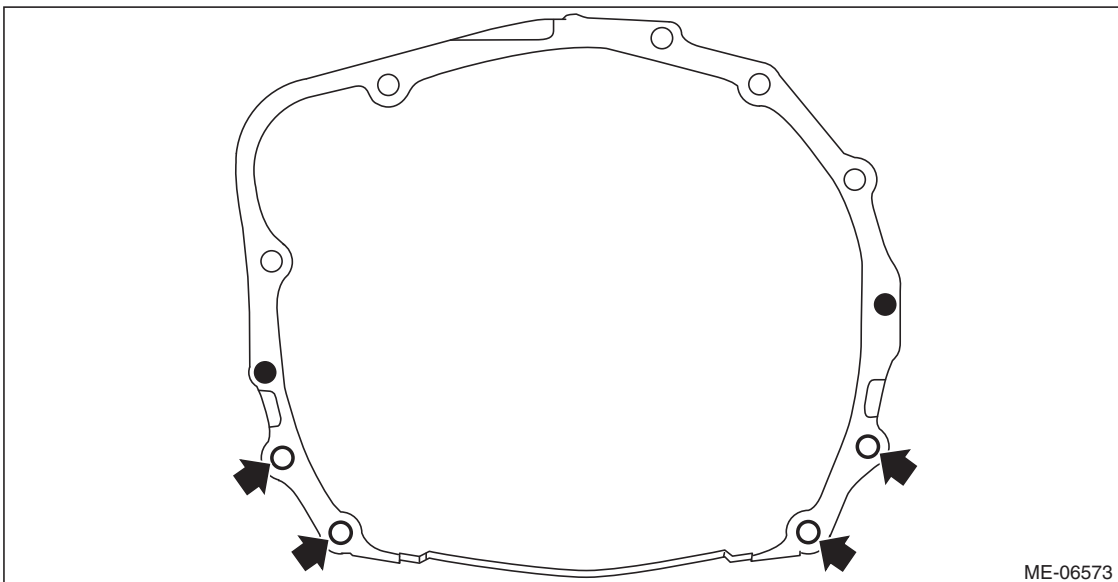
Engine Assembly

MECHANICAL

- 27) Remove the lower bolt securing the CVTF cooler (with warmer feature) to the CVT.



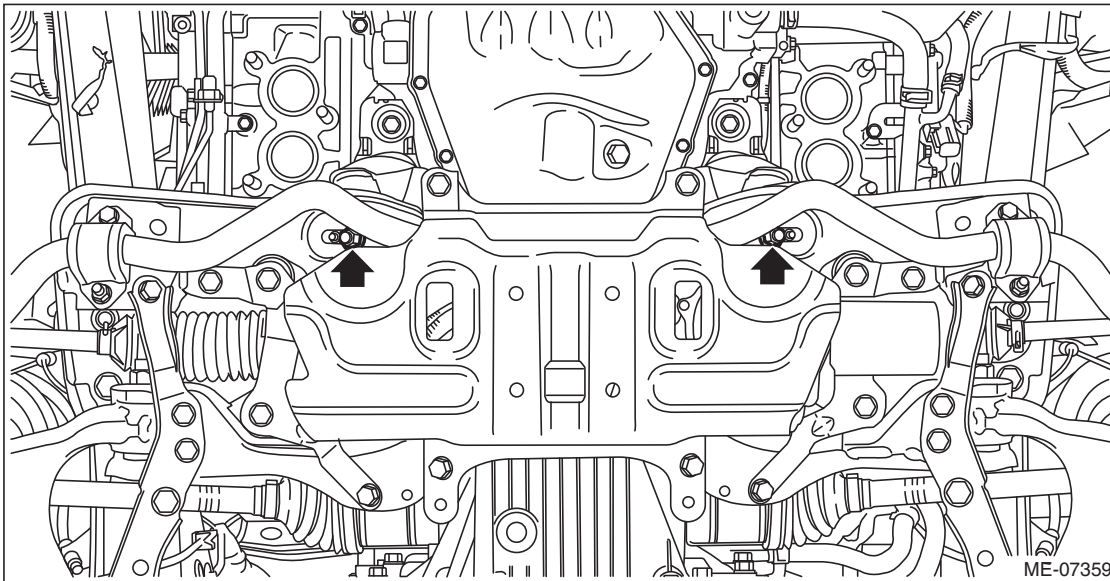
- 28) Remove the bolts and nuts which hold the lower side of transmission to the engine.



Engine Assembly

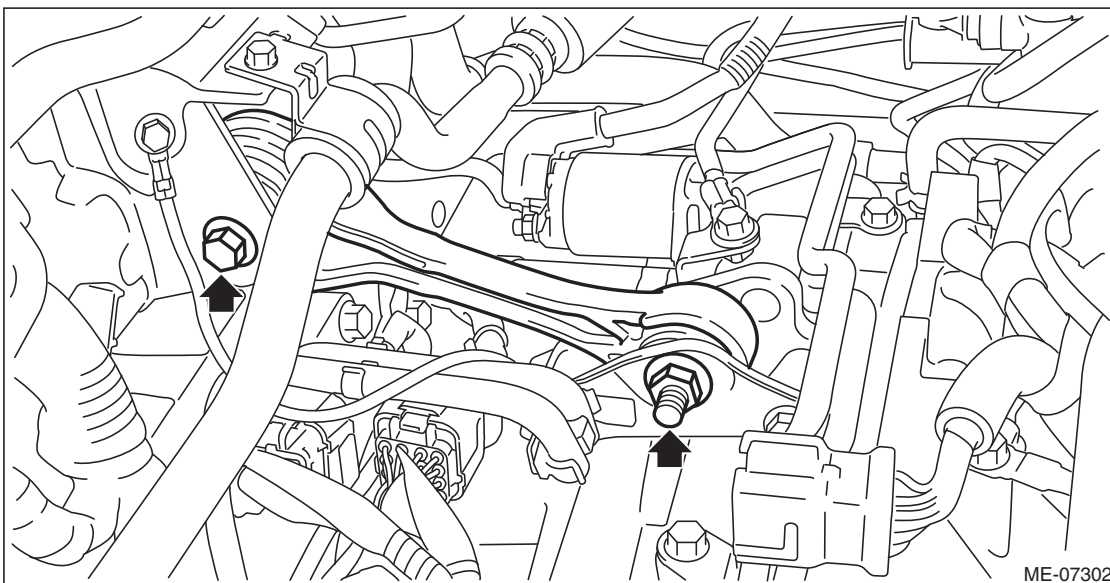
MECHANICAL

29) Remove the nuts which secure the engine mounting to the front crossmember.

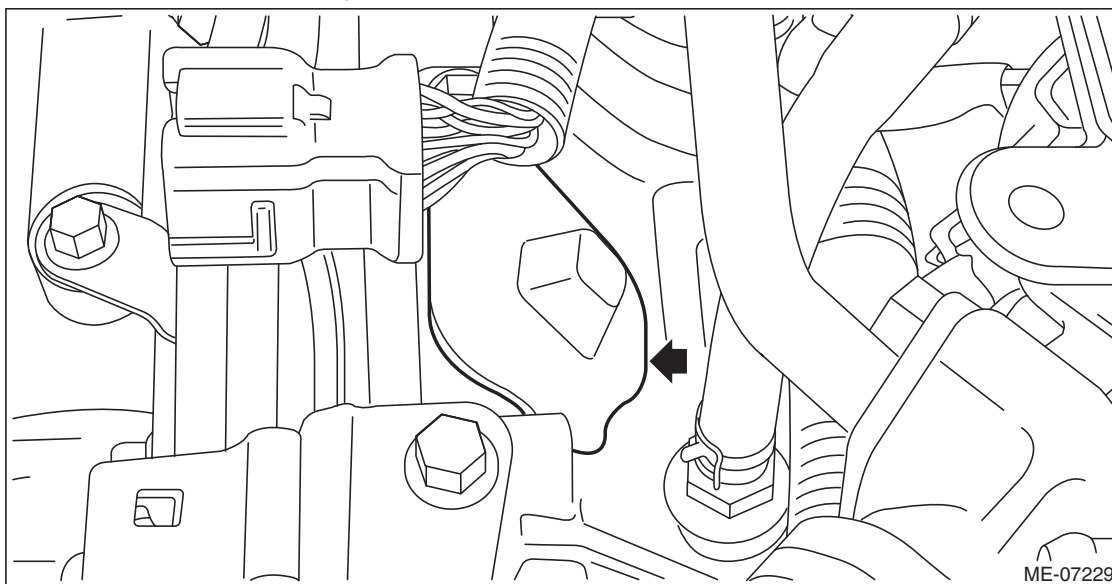


30) Lower the vehicle.

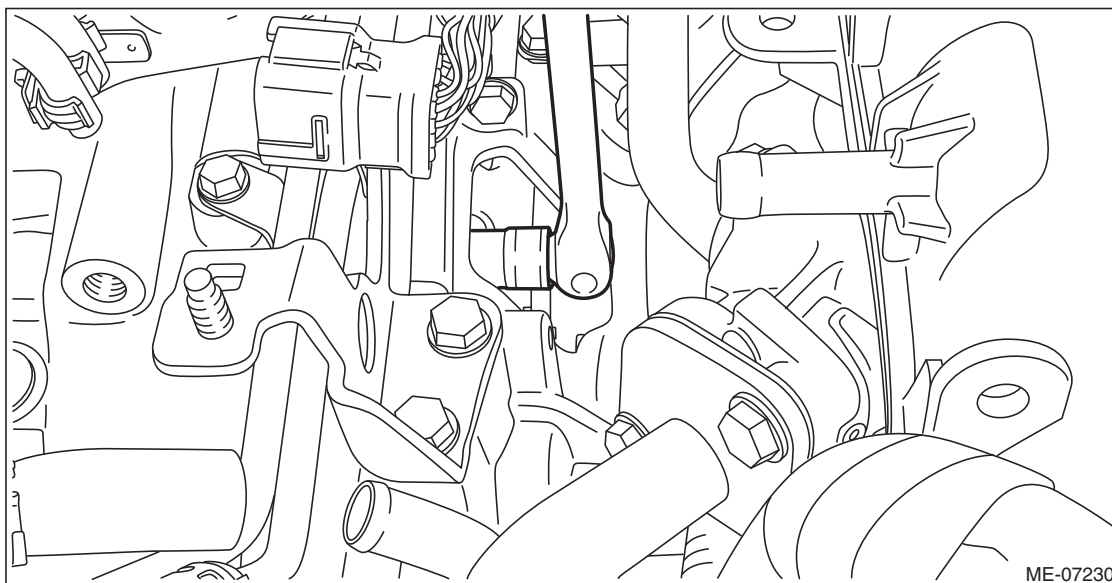
31) Remove the pitching stopper.



- 32) Separate the torque converter clutch from the drive plate.
(1) Remove the starter. <Ref. to SC(H4DO)-8, REMOVAL, Starter.>
(2) Remove the service hole plug.



- (3) Insert the wrench into the crank pulley bolt and rotate the crank pulley to remove the bolts which hold torque converter clutch to drive plate.

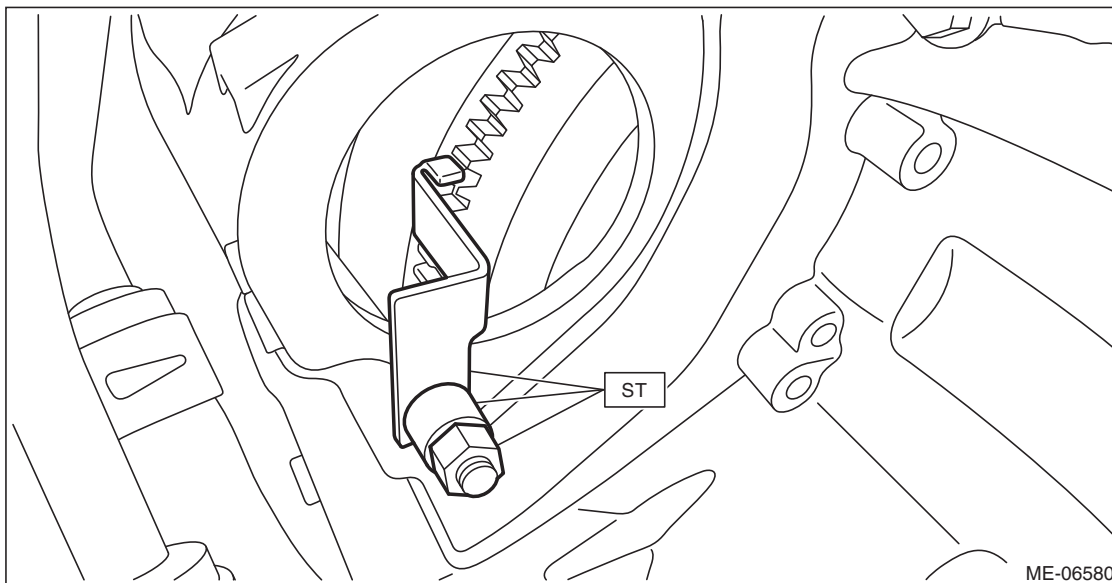


Engine Assembly

MECHANICAL

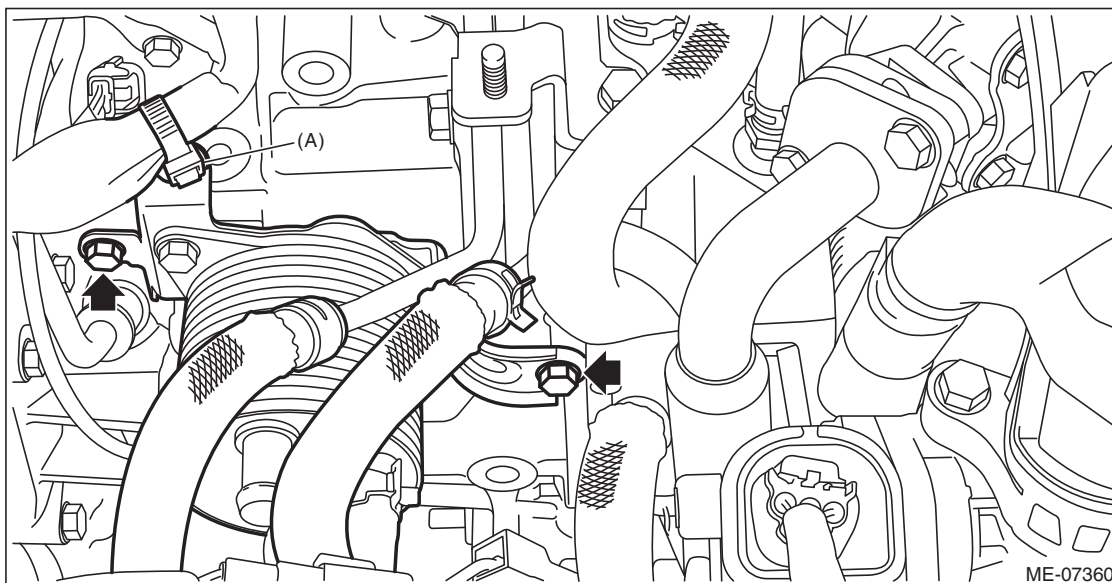
(4) Attach the ST to the torque converter clutch case.

ST 498277200 STOPPER SET



33) Remove the clip (A) securing the bulkhead harness to the CVTF cooler (with warmer feature).

34) Remove the upper bolt securing the CVTF cooler (with warmer feature) to the CVT, and move the CVTF cooler (with warmer feature) at the locations that do not interfere operation.



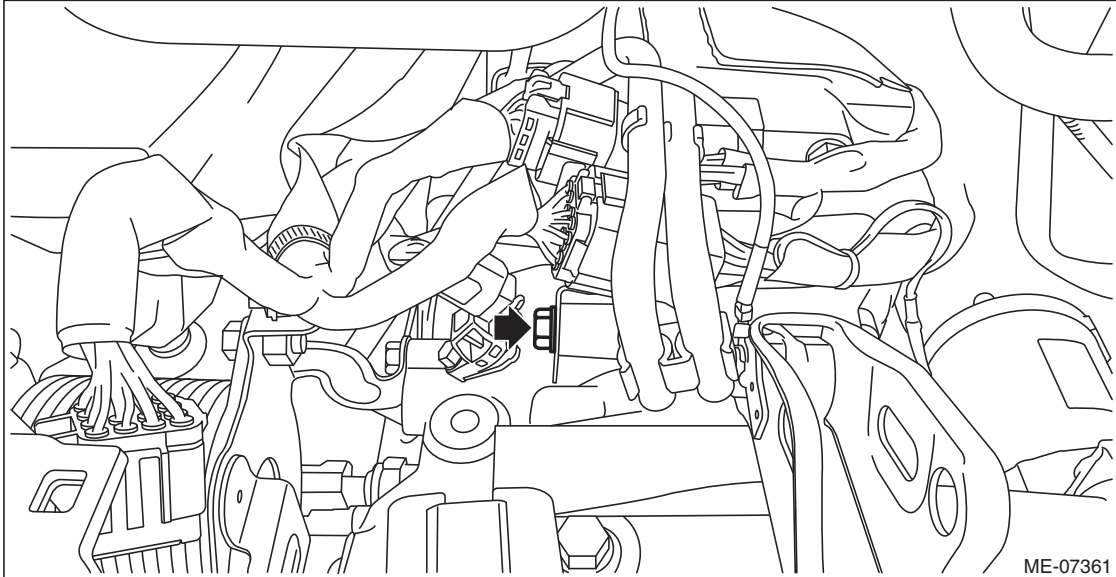
Engine Assembly

MECHANICAL

35) Remove the bolt securing the transmission harness stay to the CVT.

NOTE:

This procedure is required to prevent the transmission connector from touching the A/C pressure hose during engine removal/installation.



Engine Assembly

MECHANICAL

36) Disconnect the fuel delivery tube and evaporation hose.

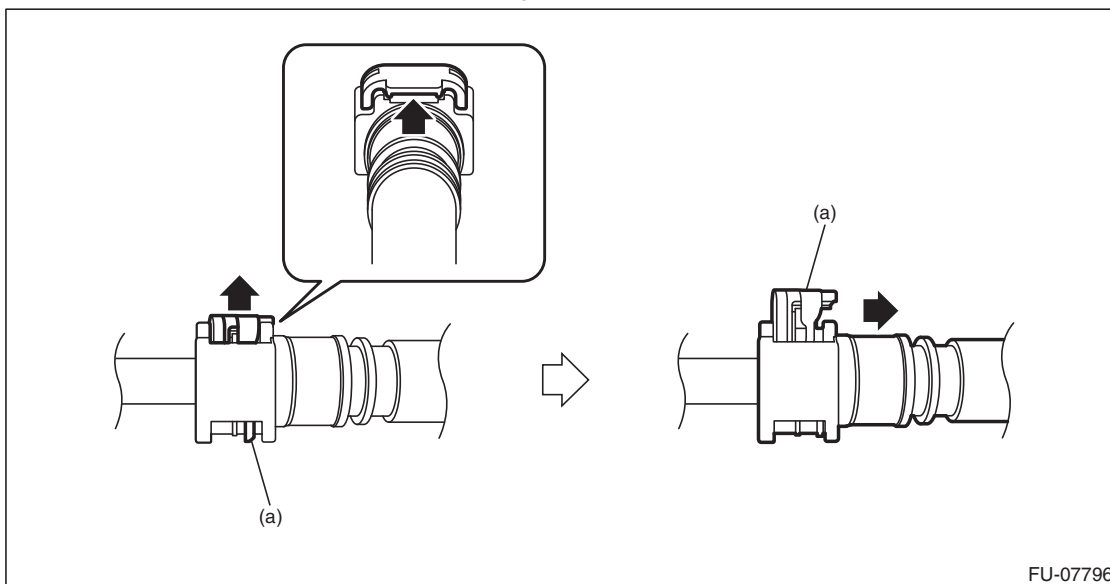
CAUTION:

- Be careful not to spill fuel.
- Catch the fuel from the tubes using a container or cloth.

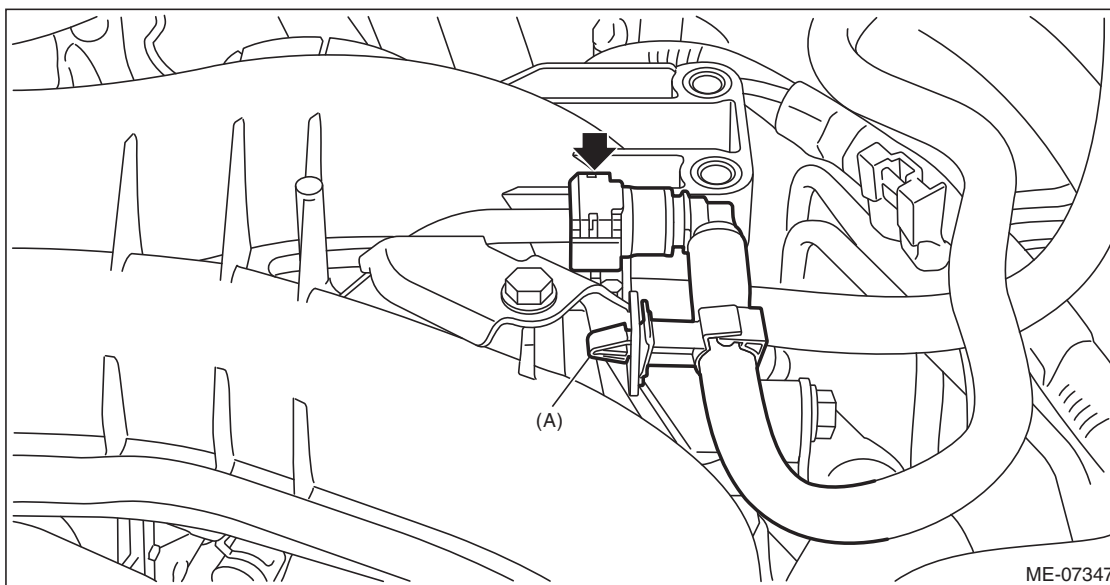
(1) Disconnect the quick connector on the fuel delivery tube from the fuel pipe assembly, and remove the clip (A) securing the fuel delivery tube.

NOTE:

Disconnect the quick connector as shown in the figure.



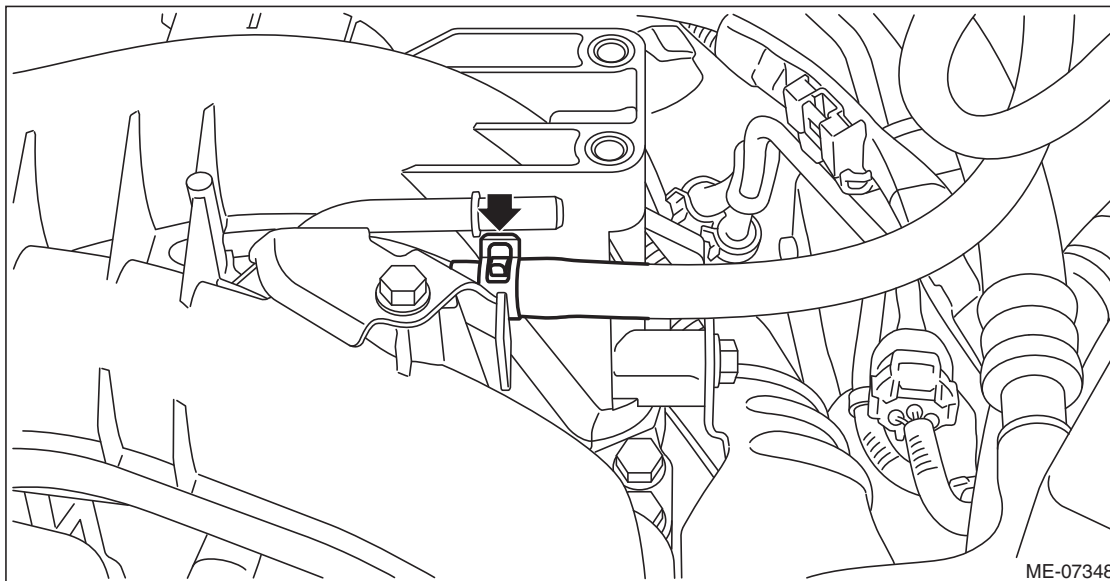
(a) Slider



Engine Assembly

MECHANICAL

- (2) Disconnect the evaporation hose from the fuel pipe assembly.

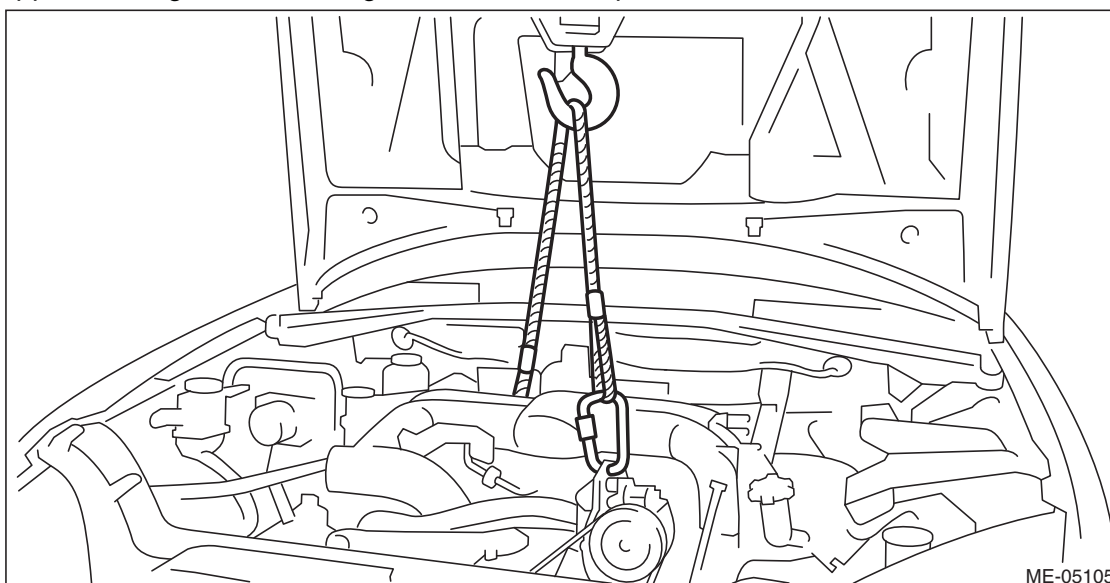


- 37) Separate the engine and transmission.

CAUTION:

Before removing the engine away from transmission, check to be sure no work has been overlooked.

- (1) Support the engine with a lifting device and wire ropes.



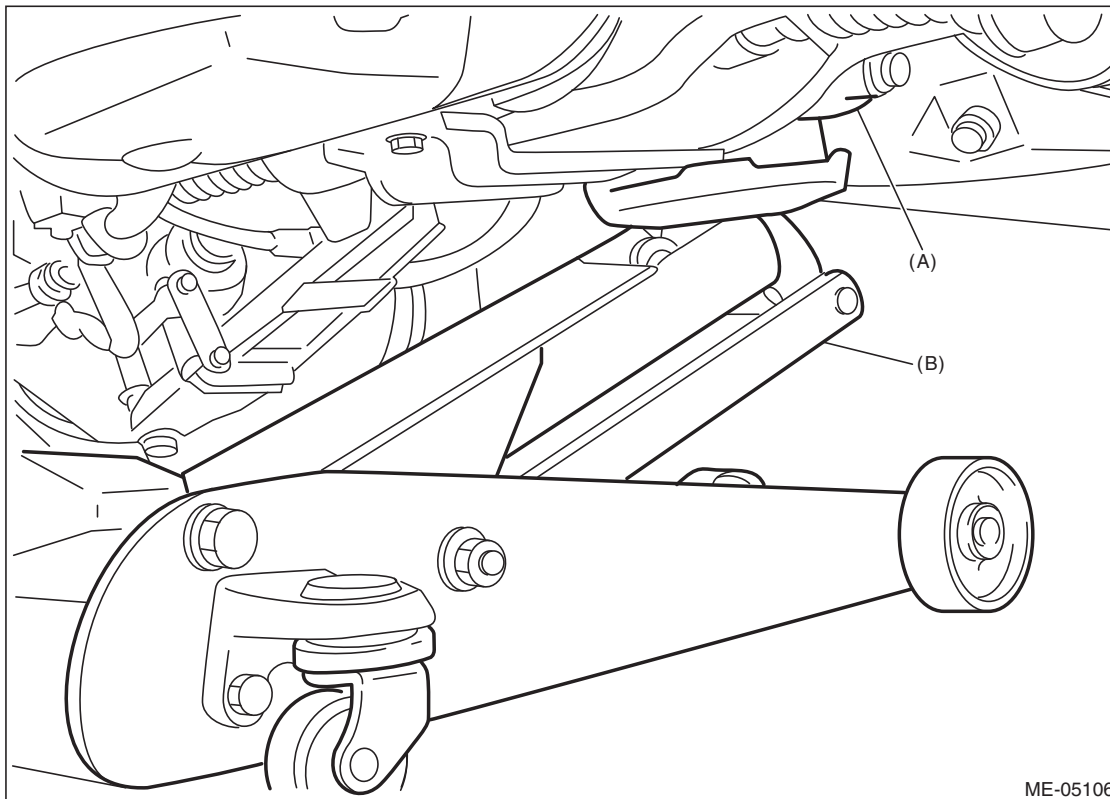
Engine Assembly

MECHANICAL

(2) Support the transmission with a garage jack.

CAUTION:

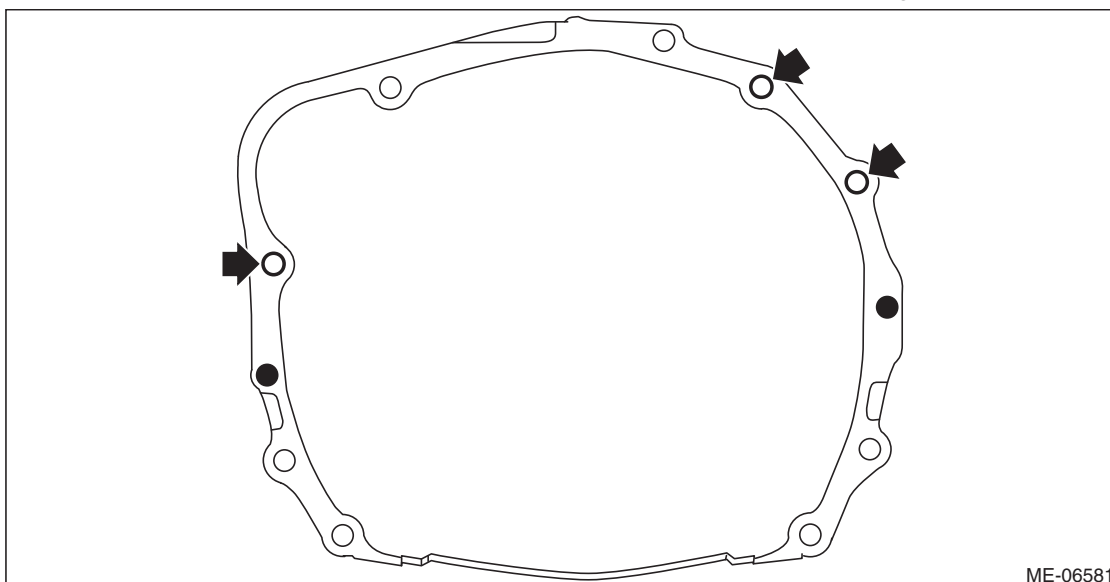
Be sure to perform this procedure to prevent the transmission from lowering by its own weight.



(A) Transmission

(B) Garage jack

(3) Remove the bolts which hold the upper side of the transmission to the engine.



38) Remove the engine from the vehicle.

NOTE:

Be careful not to damage adjacent parts or body panels with crank pulley, oil level gauge, etc.

(1) Move the engine horizontally until engine is withdrawn from transmission.

(2) Slowly move the engine away from engine compartment.

39) Remove the engine mounting from the engine.

B: INSTALLATION

1) Install the engine mounting onto the engine.

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

2) Position the engine in engine compartment and align it with transmission.

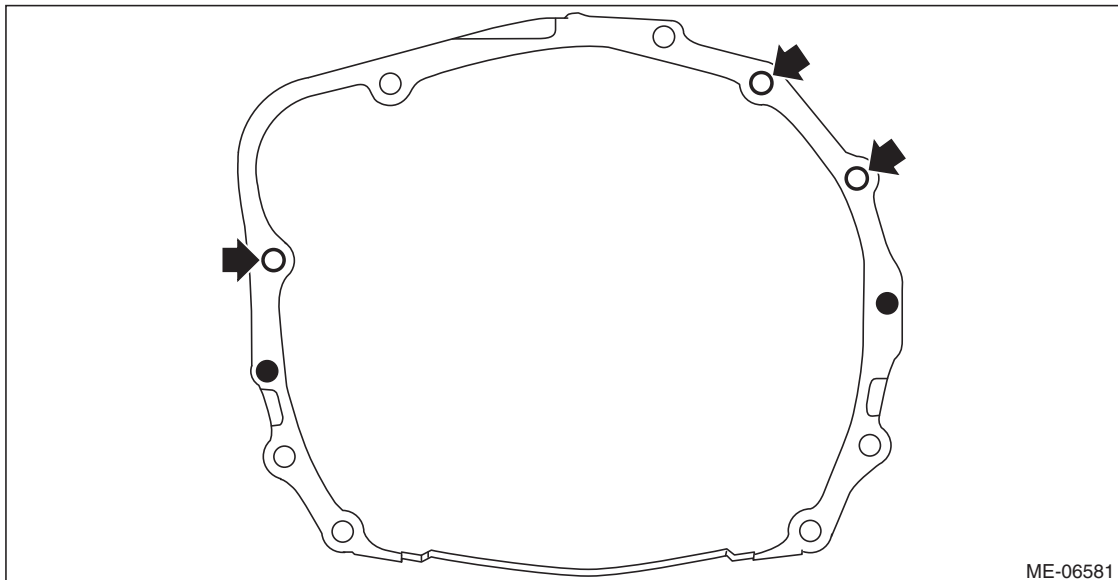
NOTE:

Be careful not to damage adjacent parts or body panels with crank pulley, oil level gauge, etc.

3) Install the bolts which hold upper side of transmission to engine.

Tightening torque:

50 N·m (5.1 kgf-m, 36.9 ft-lb)

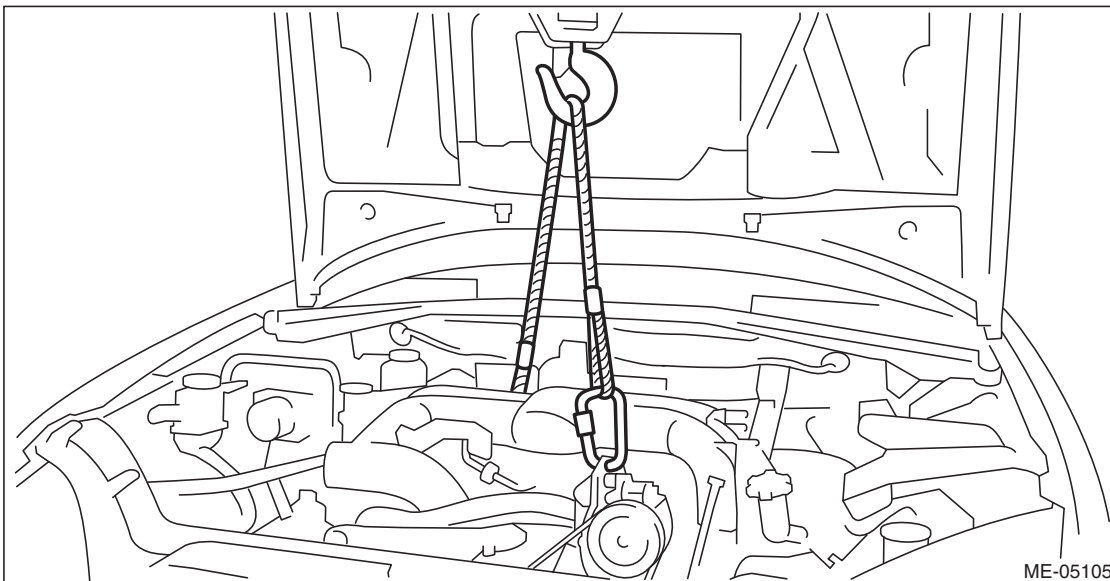


ME-06581

Engine Assembly

MECHANICAL

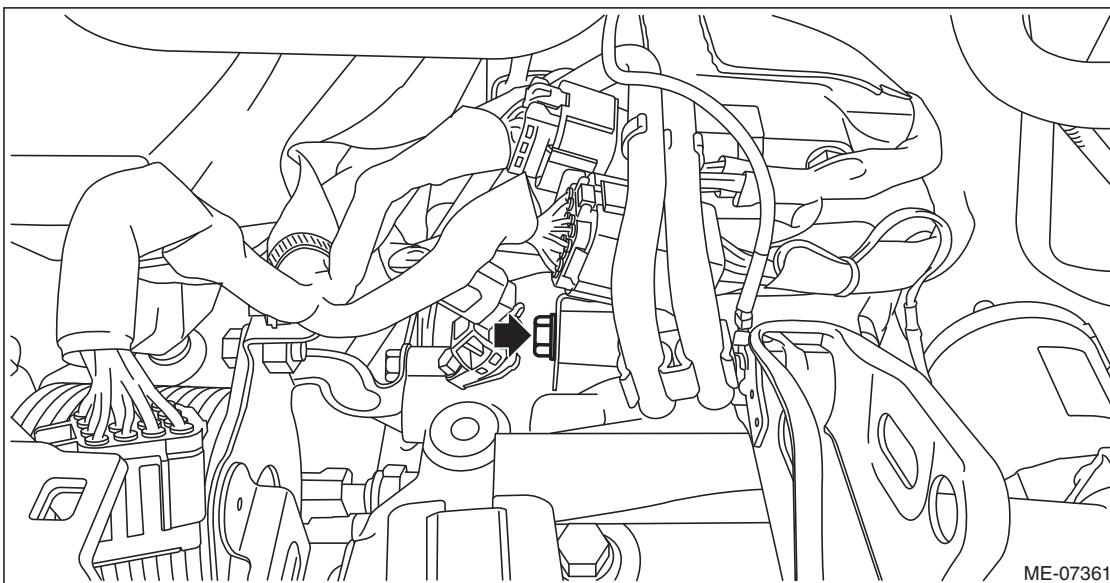
- 4) Remove the lifting device and wire ropes.



- 5) Remove the garage jack.
6) Install the bolt which secures the transmission harness stay to the CVT.

Tightening torque:

15 N·m (1.6 kgf-m, 11.8 ft-lb)

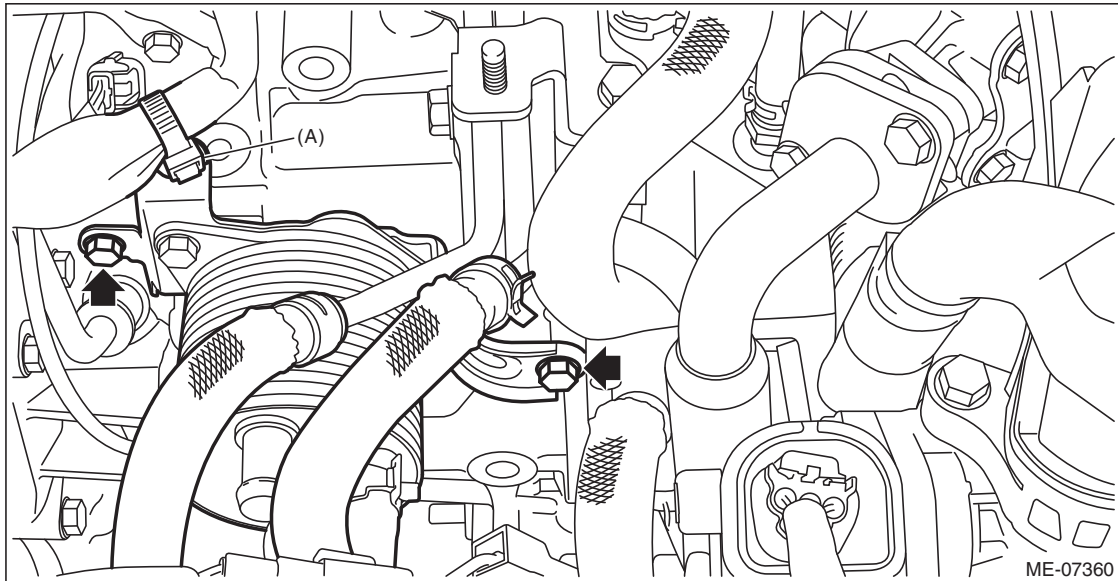


Engine Assembly

MECHANICAL

7) Install the CVTF cooler (with warmer feature) to the CVT.

- (1) Temporarily tighten the upper bolt which secures the CVTF cooler (with warmer feature) to the CVT.
- (2) Using clip (A), fix the bulkhead harness to the CVTF cooler (with warmer feature).

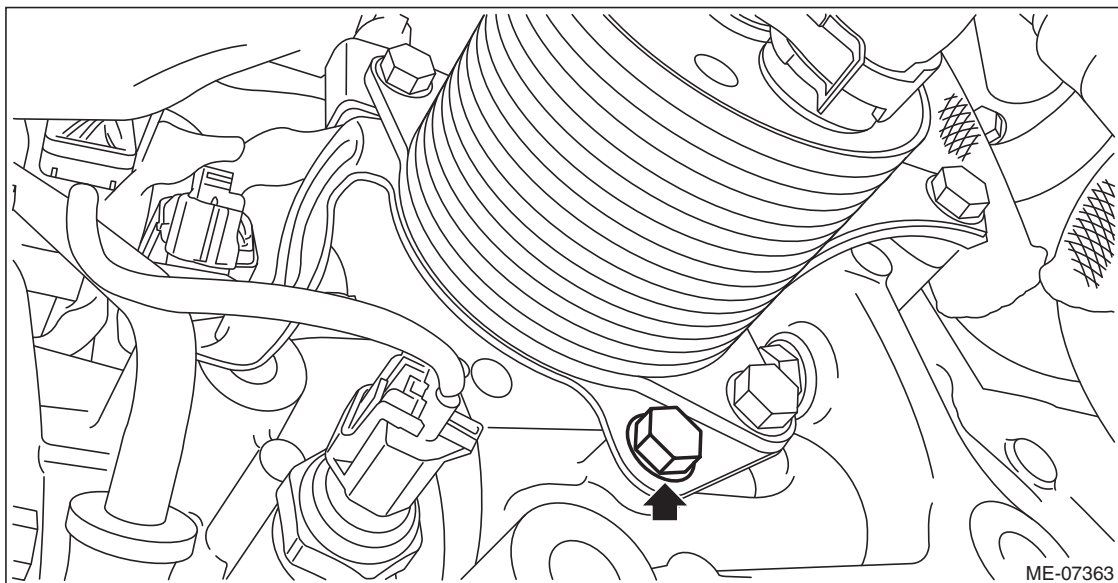


(3) Lift up the vehicle.

(4) Install the lower bolt which secures CVTF cooler (with warmer feature) to the CVT.

Tightening torque:

23 N·m (2.3 kgf-m, 17.0 ft-lb)



(5) Lower the vehicle.

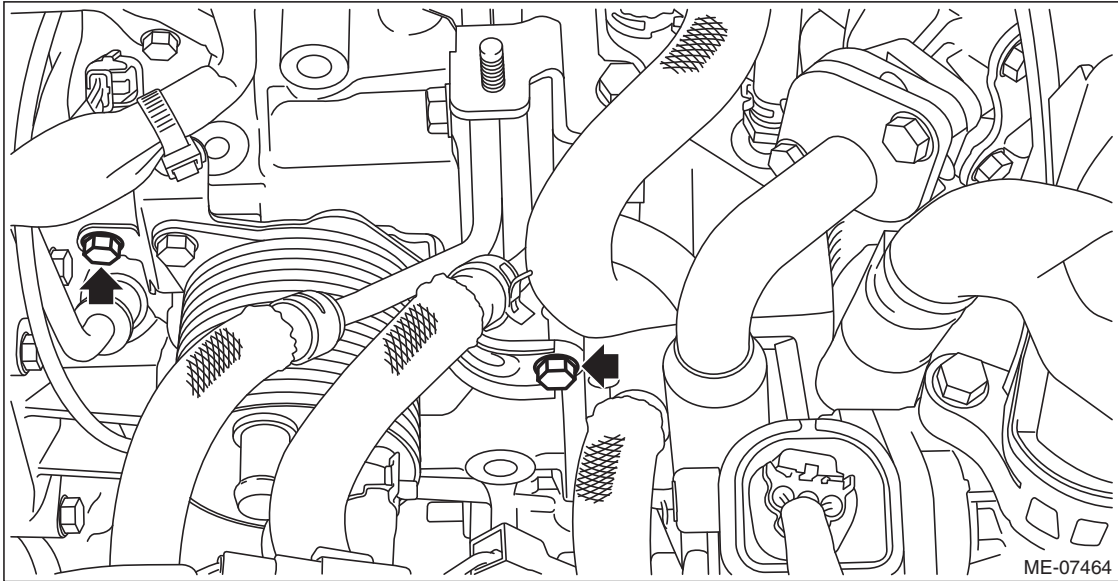
Engine Assembly

MECHANICAL

- (6) Tighten the upper bolt which secures the CVTF cooler (with warmer feature) to the CVT.

Tightening torque:

23 N·m (2.3 kgf-m, 17.0 ft-lb)



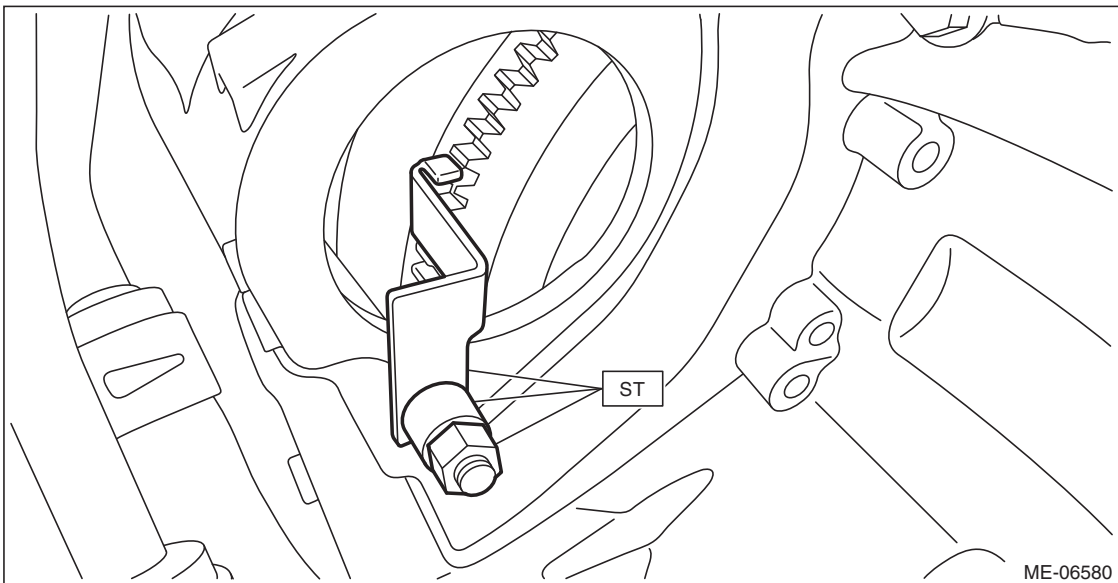
- 8) Install the torque converter clutch to drive plate.

- (1) Remove the ST from torque converter clutch case.

NOTE:

Be careful not to drop the ST into the torque converter clutch case when removing the ST.

ST 498277200 STOPPER SET



Engine Assembly

MECHANICAL

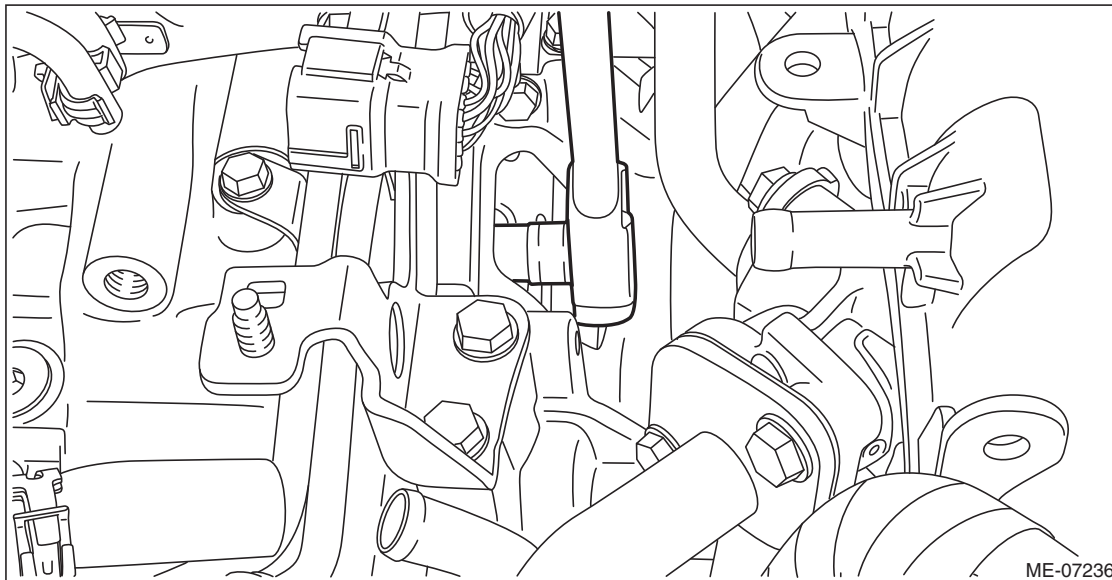
- (2) Insert the wrench into the crank pulley bolt and rotate the crank pulley to install the bolts which hold torque converter clutch to drive plate.

NOTE:

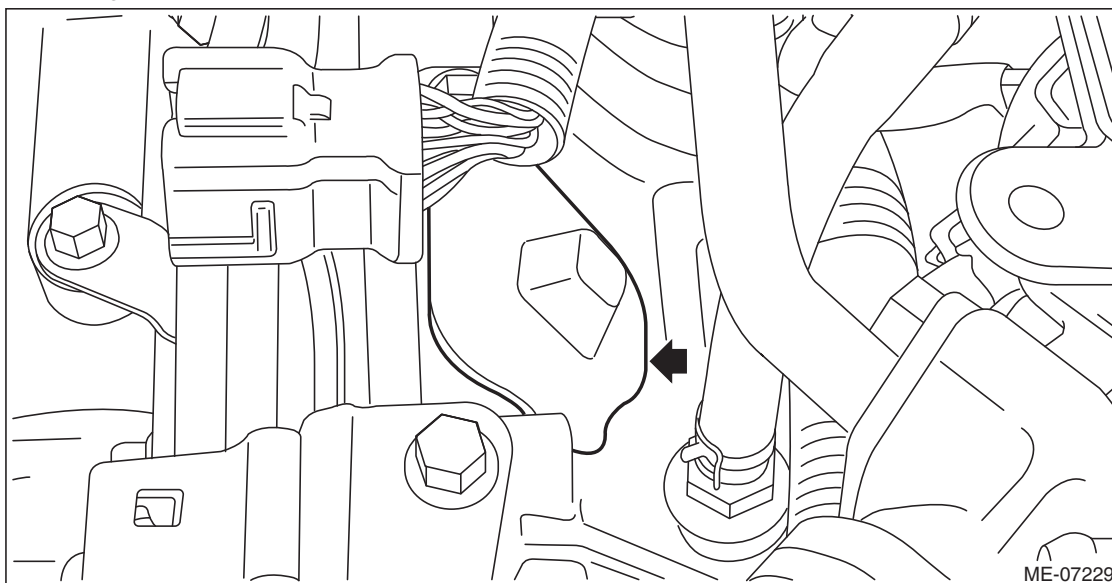
Be careful not to drop bolts into the torque converter clutch case.

Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)



- (3) Fit the plug to service hole.



- (4) Install the starter. <Ref. to SC(H4DO)-12, INSTALLATION, Starter.>

Engine Assembly

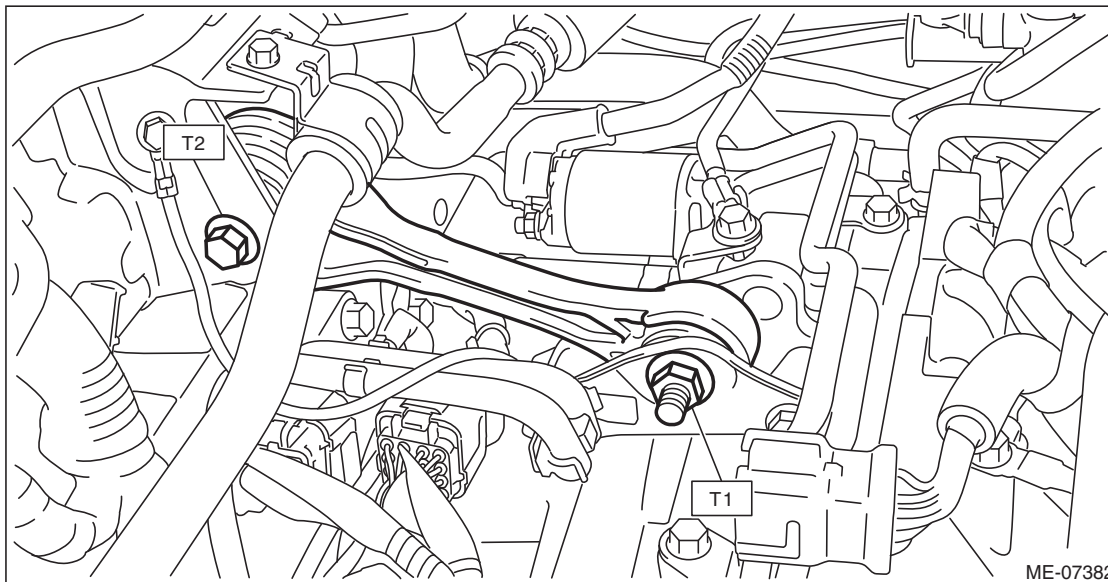
MECHANICAL

9) Install the pitching stopper.

Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)

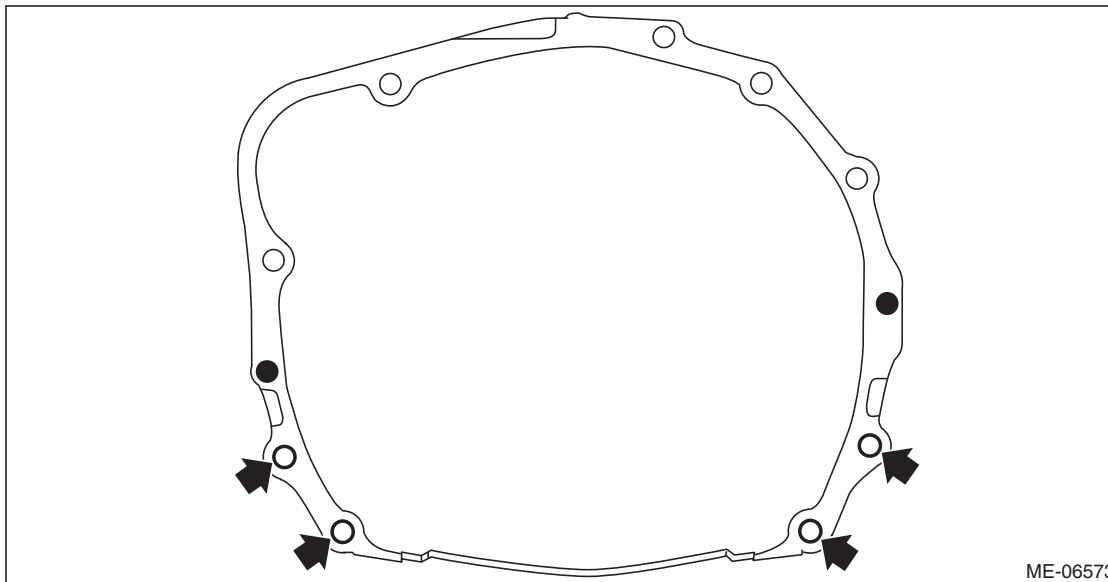


10) Lift up the vehicle.

11) Install the bolts and nuts which hold lower side of the transmission to engine.

Tightening torque:

50 N·m (5.1 kgf-m, 36.9 ft-lb)



Engine Assembly

MECHANICAL

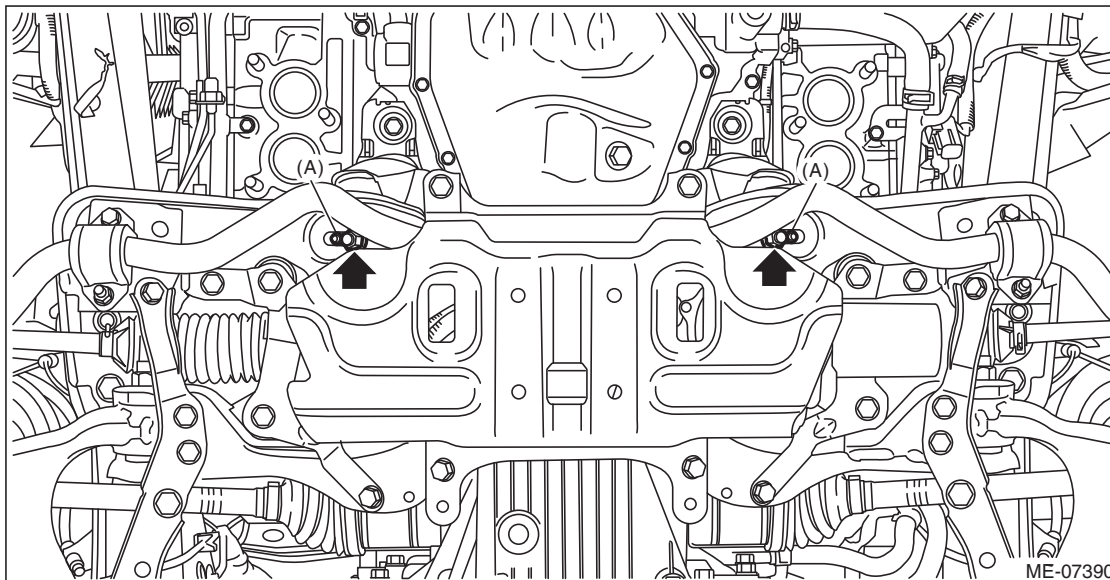
12) Install the nuts which hold the engine mounting to the crossmember.

NOTE:

Make sure that locators (A) of the engine mounting are securely inserted.

Tightening torque:

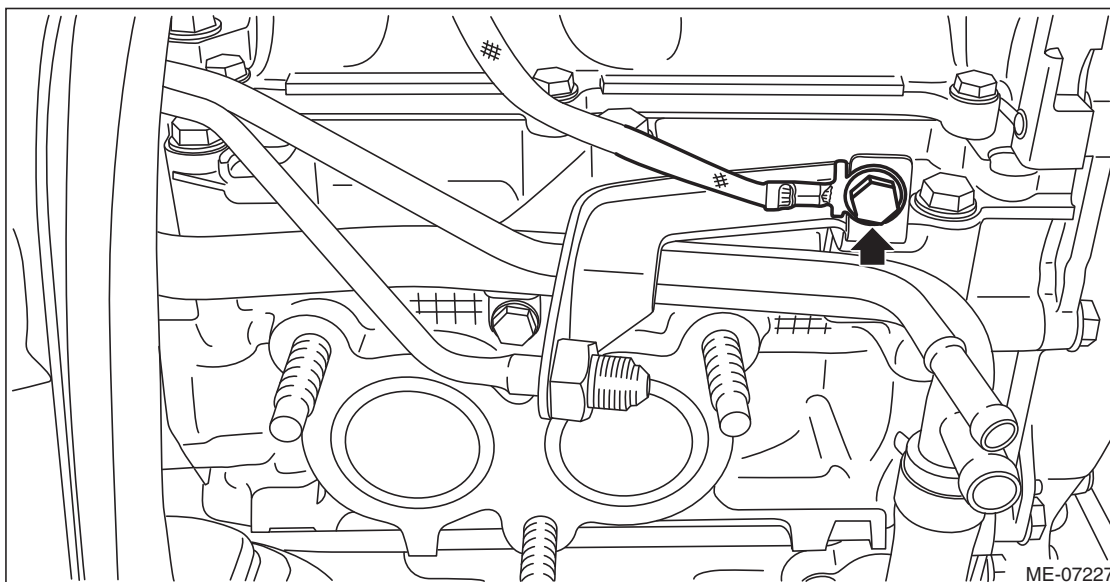
45 N·m (4.6 kgf-m, 33.2 ft-lb)



13) Connect the ground cable to the oil pipe assembly.

Tightening torque:

7 N·m (0.7 kgf-m, 5.2 ft-lb)

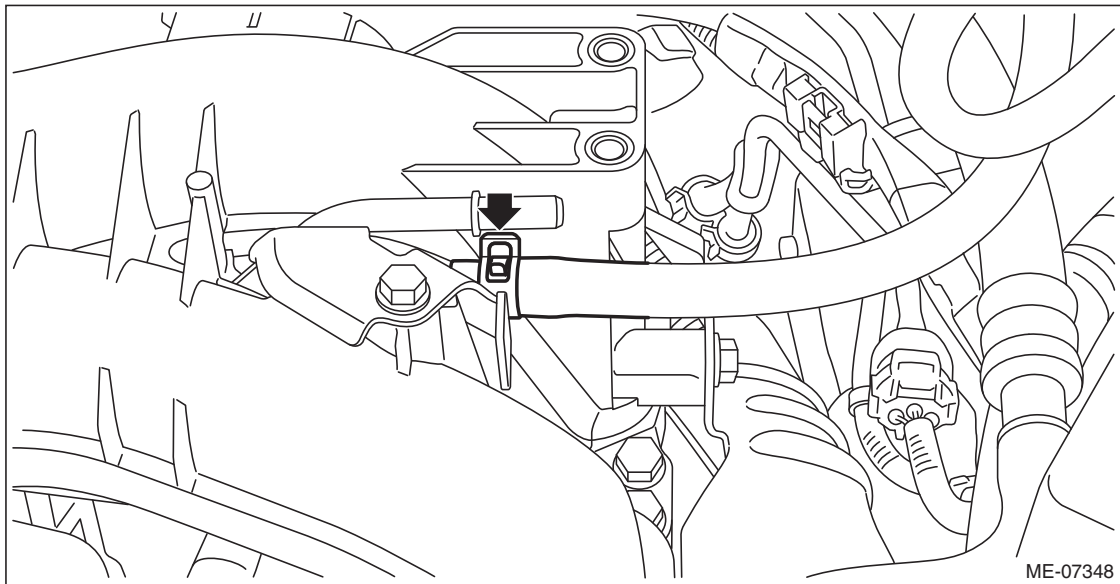


14) Install the front exhaust pipe. <Ref. to EX(H4DOTC)-15, INSTALLATION, Front Exhaust Pipe.>

Engine Assembly

MECHANICAL

- 15) Connect the fuel delivery tube and evaporation hose.
(1) Connect the evaporation hose to fuel pipe assembly.



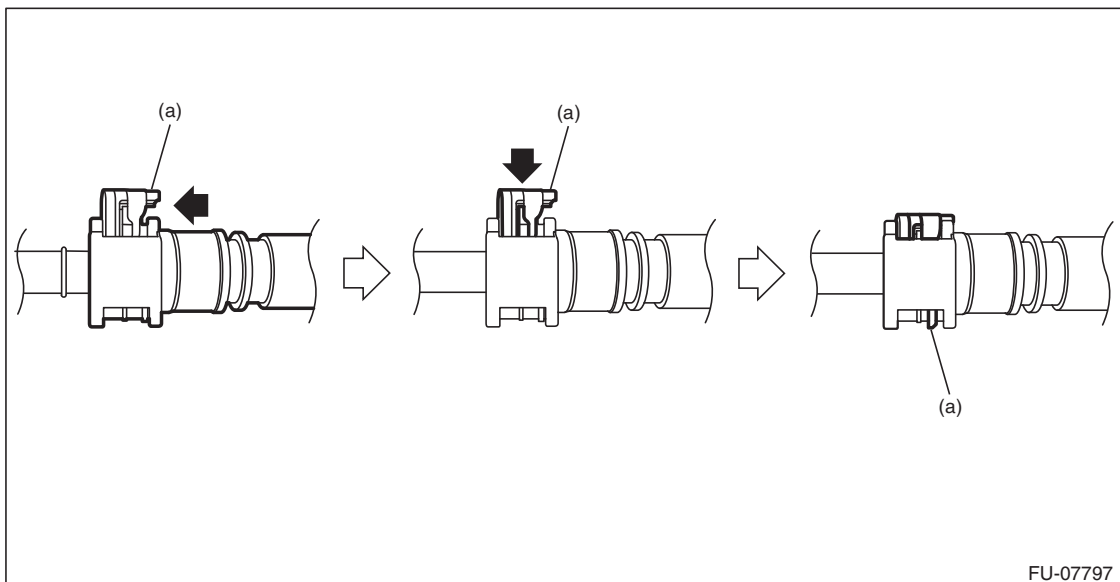
- (2) Connect the quick connector on the fuel delivery tube to the fuel pipe assembly, and fix the fuel delivery tube using clip (A).

CAUTION:

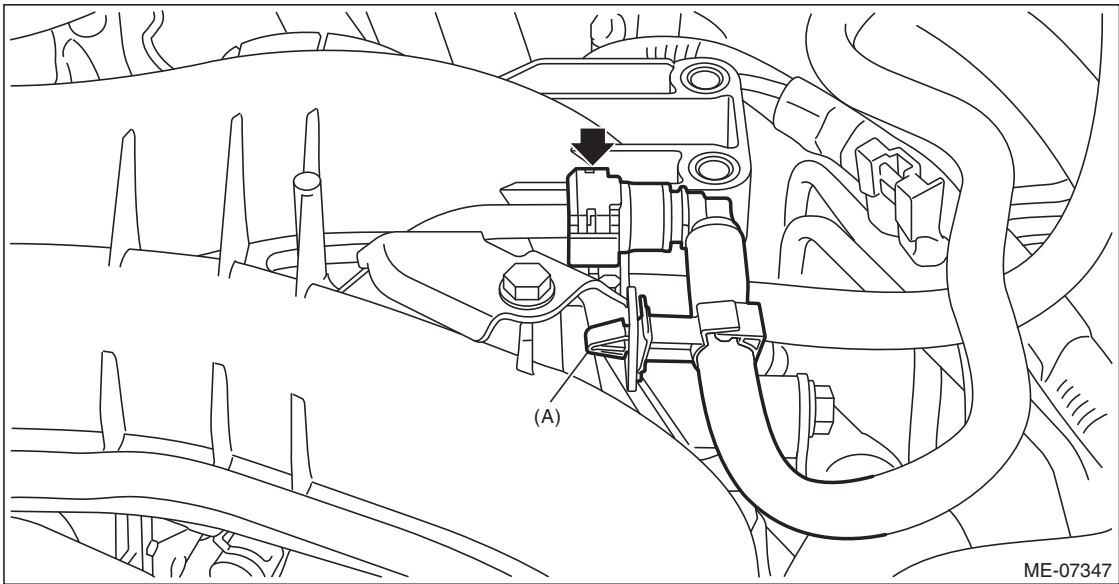
- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector, make sure to insert the pipe all the way in before locking the slider.
- When it is difficult to lock the slider, check that the pipe is fully inserted.
- Make sure that the quick connector is securely connected.

NOTE:

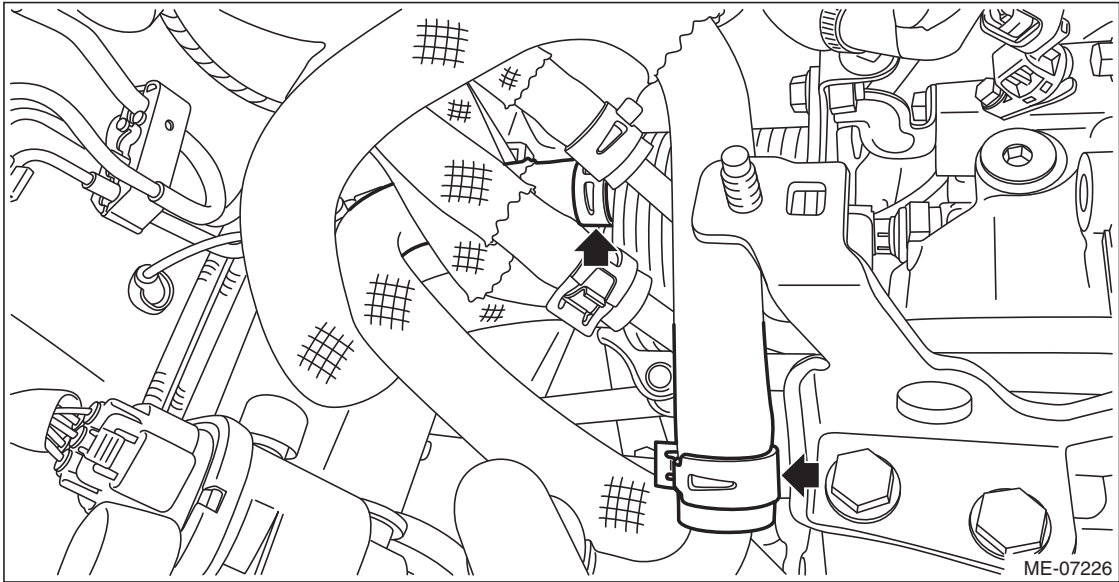
Connect the quick connector as shown in the figure.



(a) Slider



16) Connect the engine coolant inlet hose and engine coolant outlet hose to the CVTF cooler (with warmer feature) and EGR cooler.



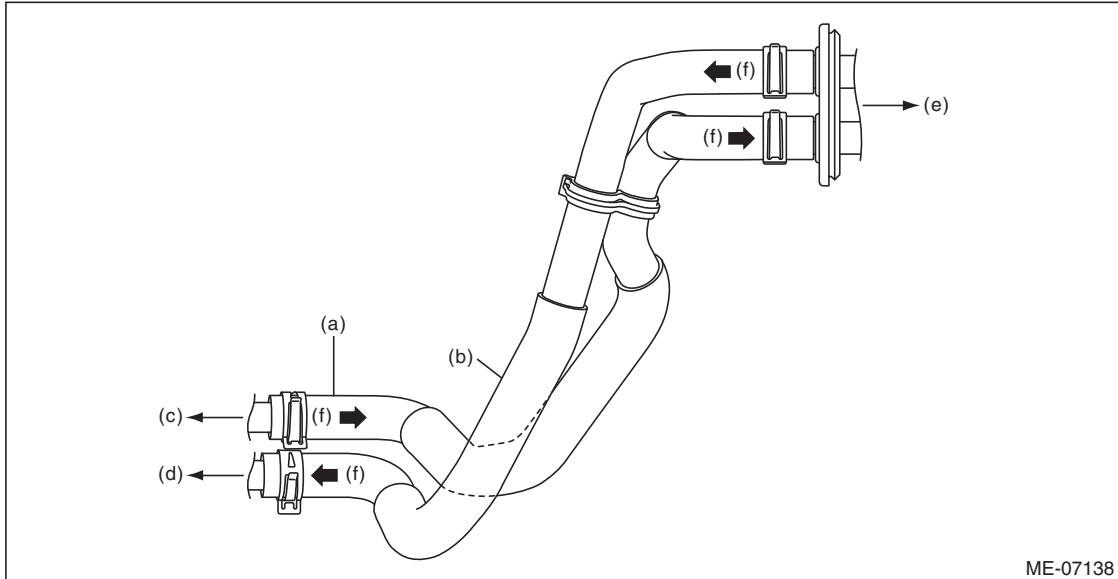
Engine Assembly

MECHANICAL

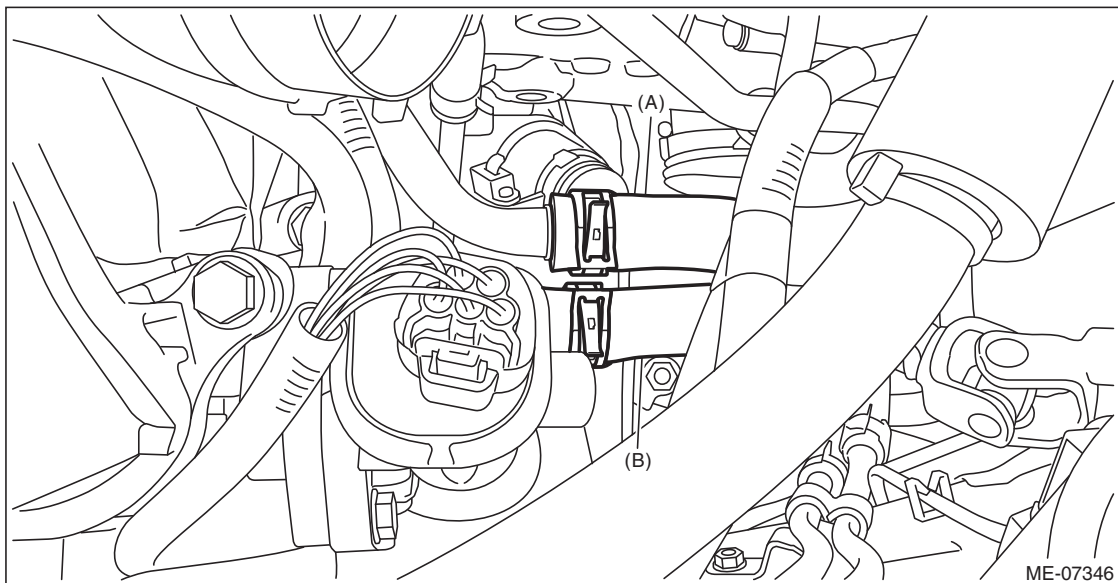
17) Connect the heater inlet hose (A) to the water pipe assembly, and connect the heater outlet hose (B) to the water pipe LH.

NOTE:

Be careful not to mix up the heater inlet hose and the heater outlet hose when connecting them.



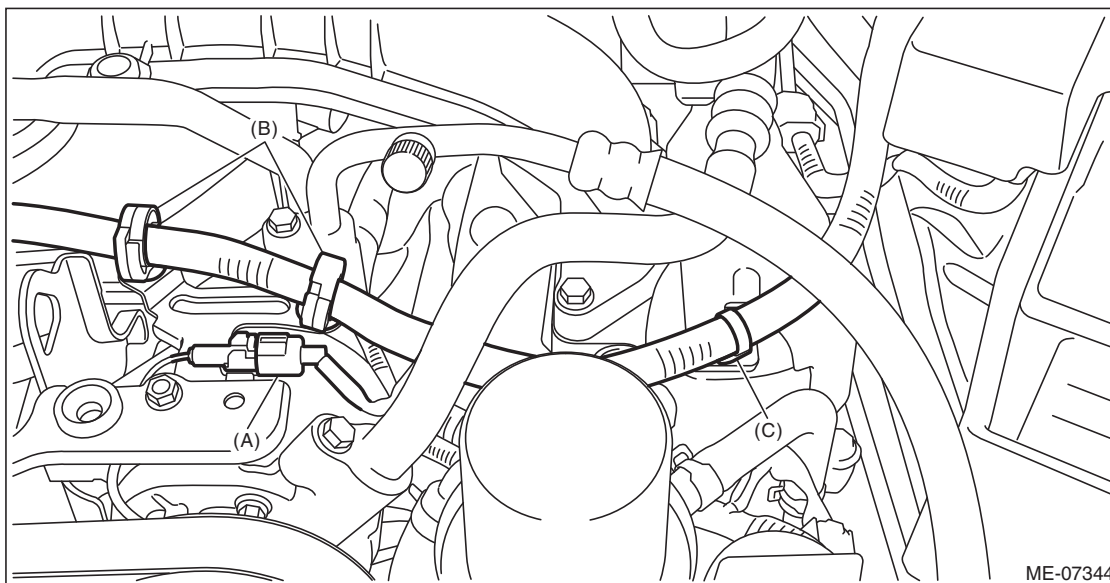
- | | | |
|------------------------|------------------------|-------------------------|
| (a) Heater inlet hose | (c) To water pipe ASSY | (e) To heater core ASSY |
| (b) Heater outlet hose | (d) To water pipe LH | (f) Engine coolant flow |



18) Connect the A/C pressure hose to A/C compressor. <Ref. to AC-70, INSTALLATION, Hose and Pipe.>

19) Set the generator cord, and fix the generator cord to the fuel pipe protector using clip (C).

20) Install the generator cord to clip (B), and connect the connector (A) to A/C compressor.

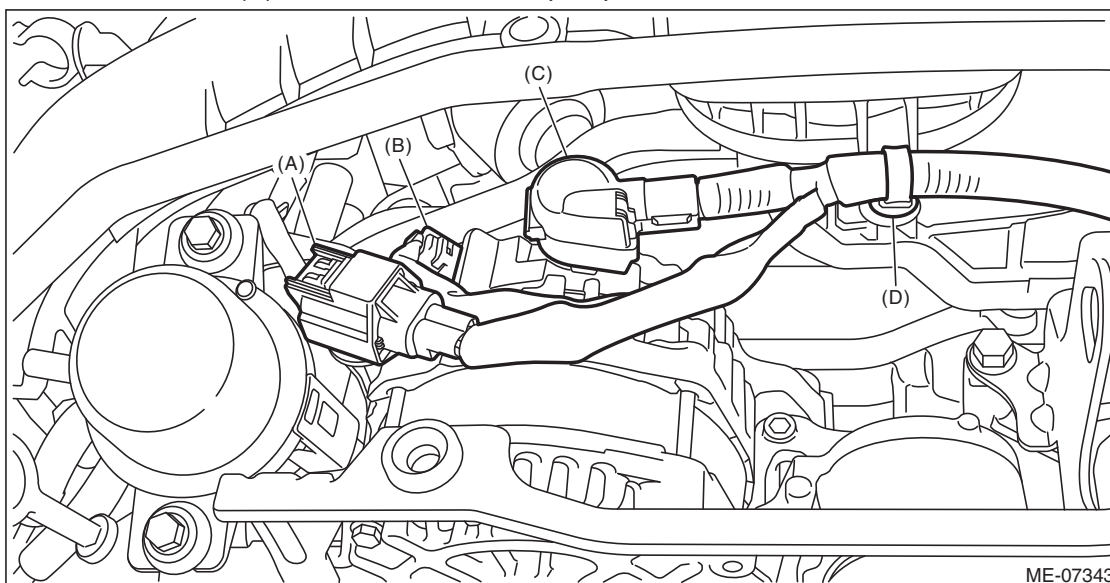


21) Using clip (D), fix the generator cord to the generator cord stay, and connect the connector (B) and the terminal (C) to the generator.

Tightening torque:

15 N·m (1.5 kgf-m, 11.1 ft-lb)

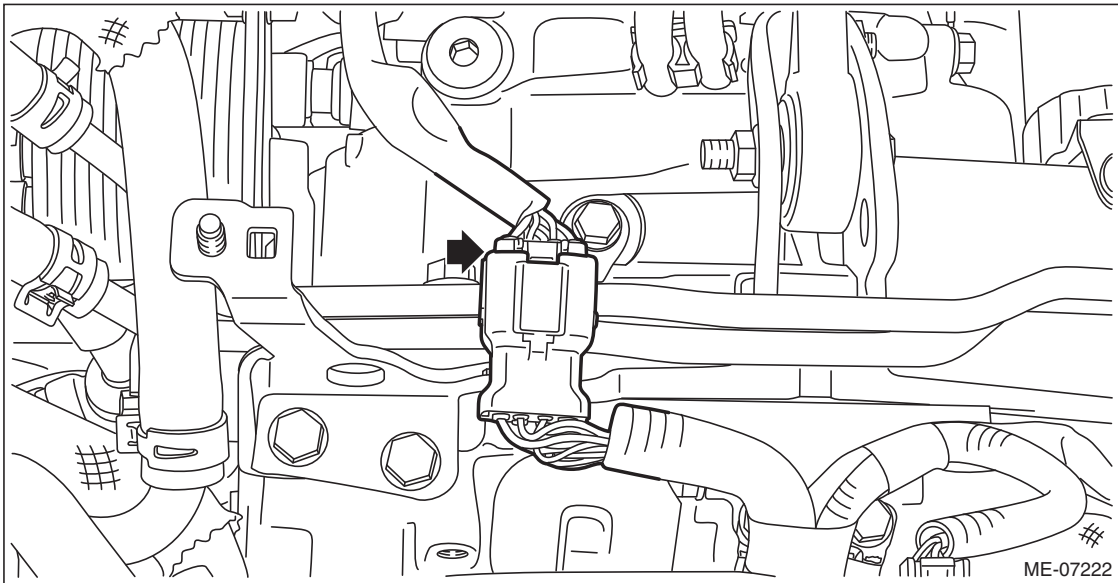
22) Connect the connector (A) to the brake vacuum pump.



Engine Assembly

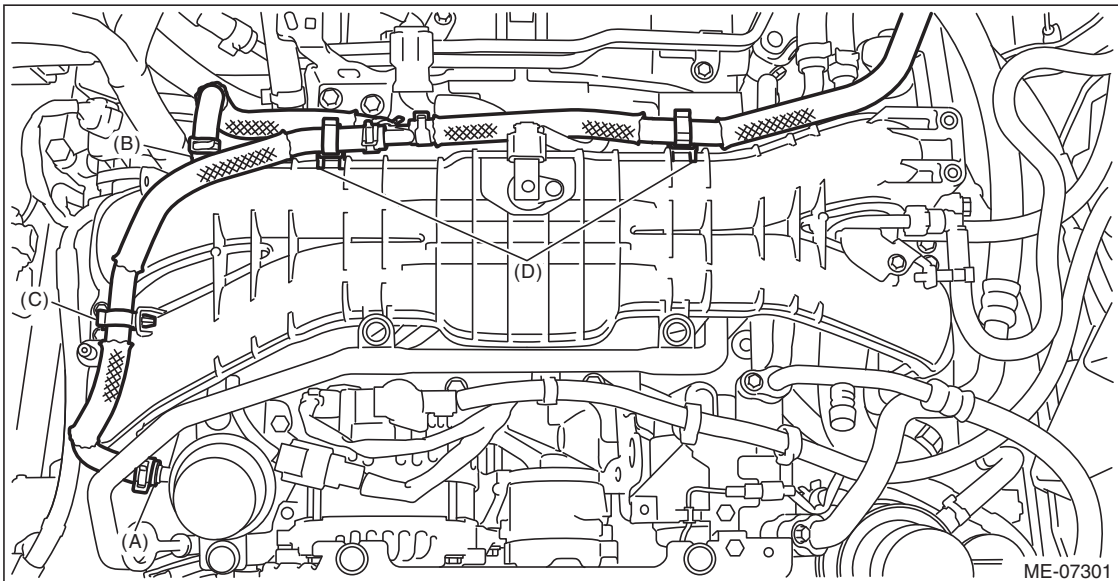
MECHANICAL

23) Connect the bulkhead harness connector to the engine harness connector.



24) Using clip (D), fix the brake booster vacuum hose to the intake manifold.

25) Connect sections (A) and (B) of the brake booster vacuum hose to the brake vacuum pump and intake manifold, and install the brake booster vacuum hose to the clip (C).



26) Install the radiator. <Ref. to CO(H4DOTC)-44, INSTALLATION, Radiator.>

27) Install the intake duct No. 1 and intake duct No. 2. <Ref. to IN(H4DOTC)-26, INTAKE DUCT NO. 1, INSTALLATION, Intake Duct.> <Ref. to IN(H4DOTC)-29, INTAKE DUCT NO. 2, INSTALLATION, Intake Duct.>

28) Install the intercooler. <Ref. to IN(H4DOTC)-37, INSTALLATION, Intercooler.>

29) Install the air intake duct. <Ref. to IN(H4DOTC)-19, INSTALLATION, Air Intake Duct.>

30) Connect the battery ground terminal.

31) Fill engine coolant. <Ref. to CO(H4DOTC)-14, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

32) Check the CVTF level and replenish it if necessary. <Ref. to CVT(TR690)-36, ADJUSTMENT, CVTF.>

33) Charge the A/C system with refrigerant. <Ref. to AC-27, PROCEDURE, Refrigerant Charging Procedure.>

34) Install the collector cover.

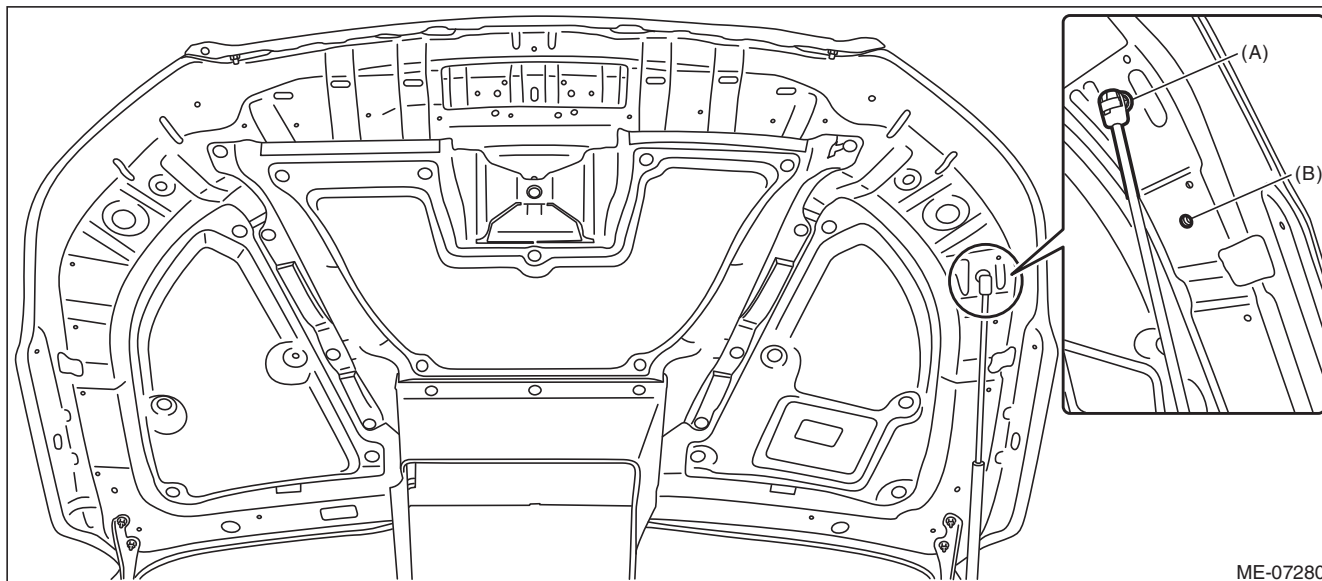
Engine Assembly

MECHANICAL

35) Change the installation position of the front hood damper from (B) to (A).

Tightening torque:

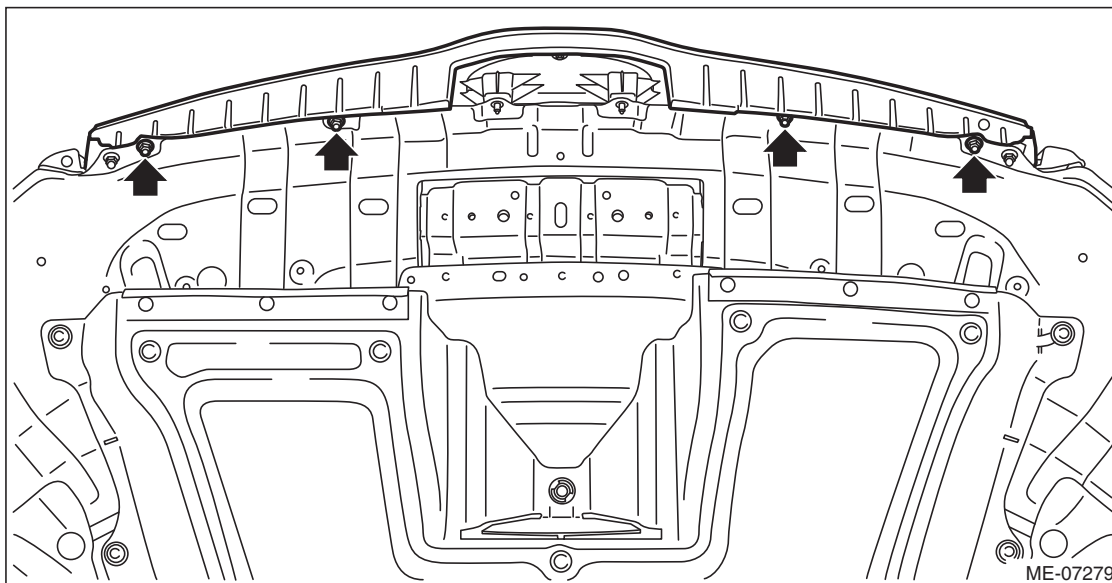
20 N·m (2.0 kgf-m, 14.8 ft-lb)



36) Install the front center grille assembly to the front hood.

Tightening torque:

4.5 N·m (0.5 kgf-m, 3.3 ft-lb)



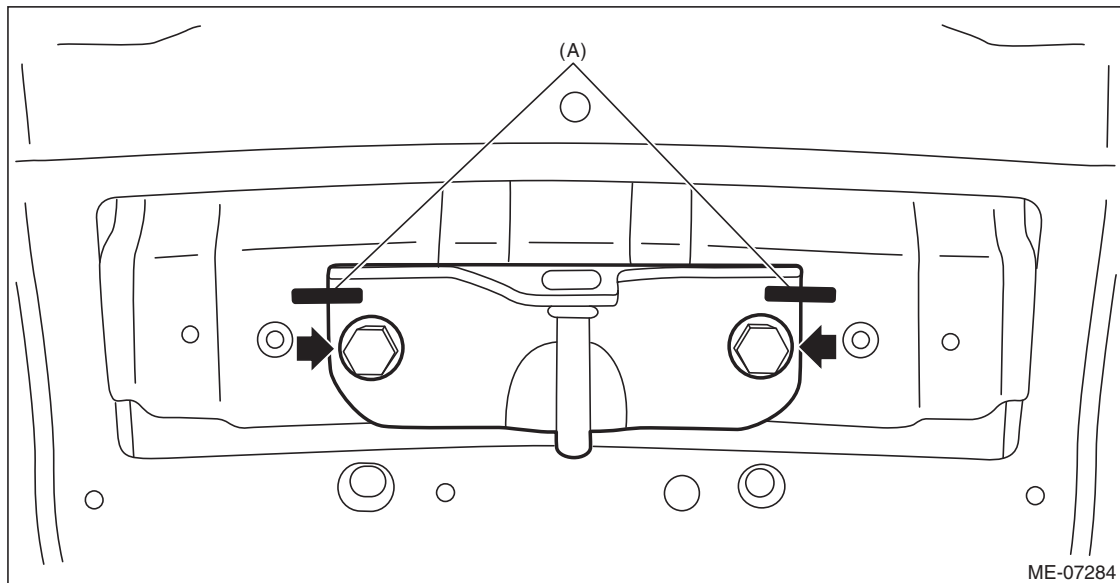
Engine Assembly

MECHANICAL

37) Align the alignment marks (A), and install the front hood striker to the front hood.

Tightening torque:

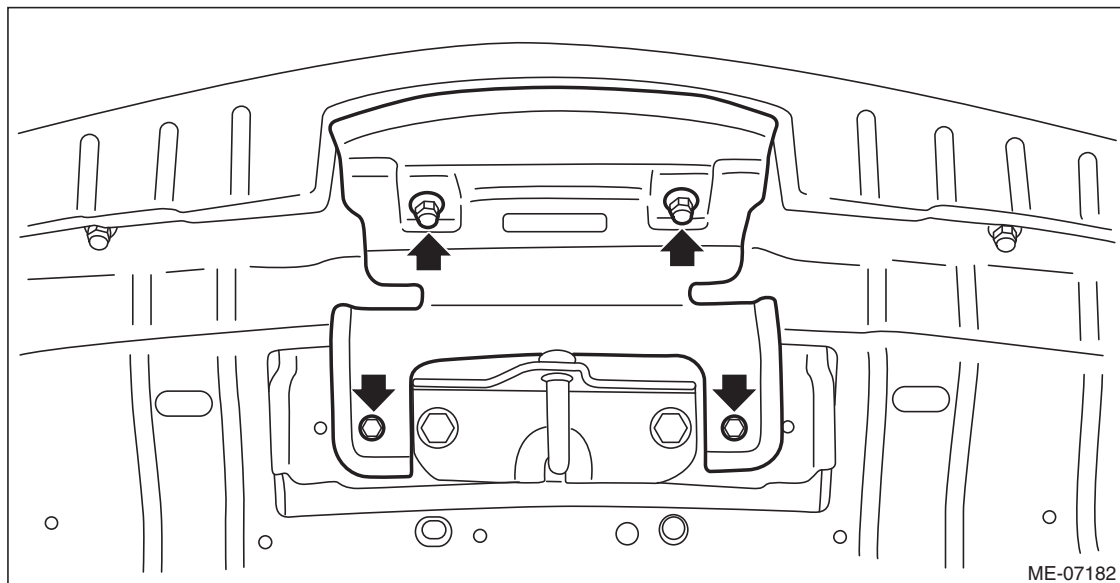
33 N·m (3.4 kgf-m, 24.3 ft-lb)



38) Install the upper grille bracket to the front hood, and close the front hood.

Tightening torque:

4.5 N·m (0.5 kgf-m, 3.3 ft-lb)



C: INSPECTION

- 1) Check that pipes, hoses, connectors and clamps are installed firmly.
- 2) Check the engine coolant is at specified level.
- 3) Check CVTF is at the specified level.
- 4) Start the engine and check for exhaust gas, engine coolant, leaks of fuel, etc. Also check for noise and vibrations.

10.Engine Mounting

A: REMOVAL

- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-44, REMOVAL, Engine Assembly.>
- 2) Remove the engine mounting from the engine.

B: INSTALLATION

Install in the reverse order of removal.

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

C: INSPECTION

Make sure that there are no cracks or other damages.

Preparation for Overhaul

MECHANICAL

11. Preparation for Overhaul

A: PROCEDURE

1) After engine has been removed from the vehicle, mount the engine to the engine stand while being careful of the following.

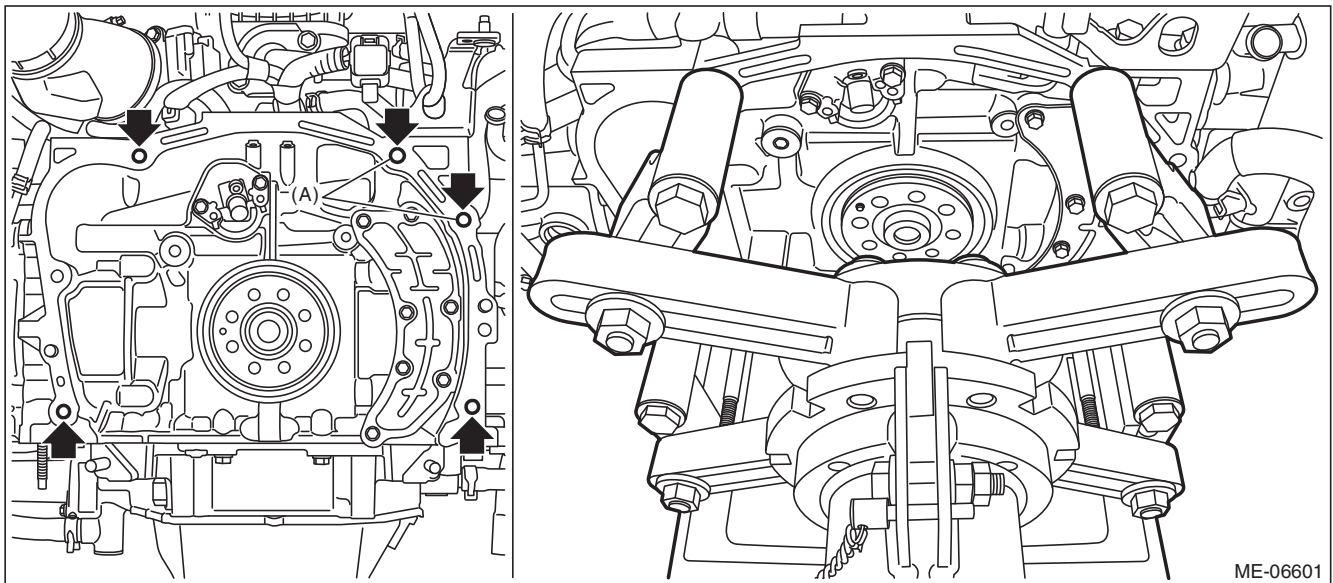
- (1) When mounting the engine stand, follow the instructions of engine stand used.
- (2) When disassembling the cylinder block, remove the crankshaft position sensor plate together with the drive plate first, and then mount the engine stand. <Ref. to CVT(TR690)-133, REMOVAL, Drive Plate.>
- (3) Mount the engine stand using the points shown by the arrows in the figure.

CAUTION:

Be sure to mount the engine stand at four points. Otherwise, the engine damage may occur.

NOTE:

- For points (A), either of them can be used for mounting the engine stand.
- The engine stand shown in the figure is just for reference.



2) In this section the procedures described under each index are all connected and stated in order. The procedure for overhauling of the engine will be completed when you go through all steps in the process. Therefore, in this section, to conduct the particular procedure within the flow of a section, you need to go back and conduct the procedure described previously in order to do that particular procedure.

12.V-belt

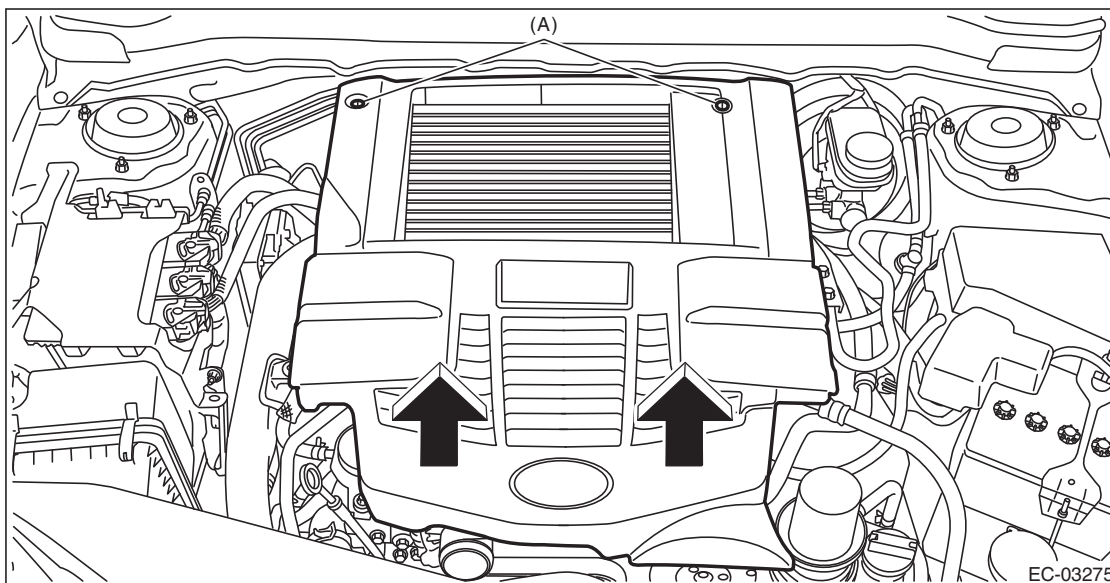
A: REMOVAL

NOTE:

When replacing a single part, perform the work with the engine assembly installed to body.

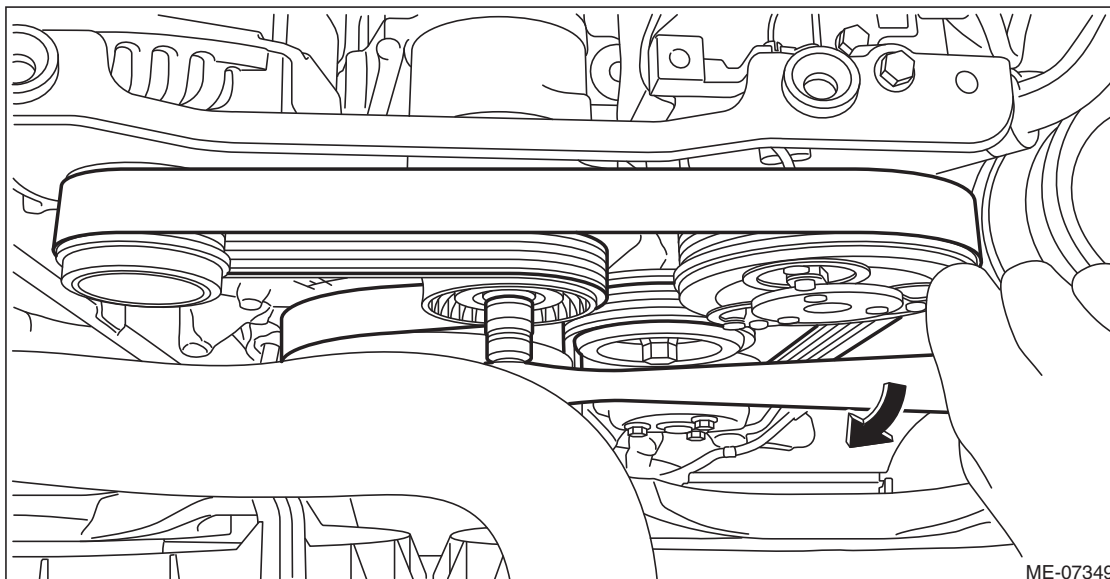
1. V-BELT

1) Remove the clip (A), lift the front of the collector cover in the direction of arrow, and then remove the collector cover.



2) Remove the air intake duct (rear). <Ref. to IN(H4DOTC)-19, REMOVAL, Air Intake Duct.>

3) Attach the tool to the V-belt tensioner assembly, and rotate the tool clockwise to loosen and remove the V-belt.

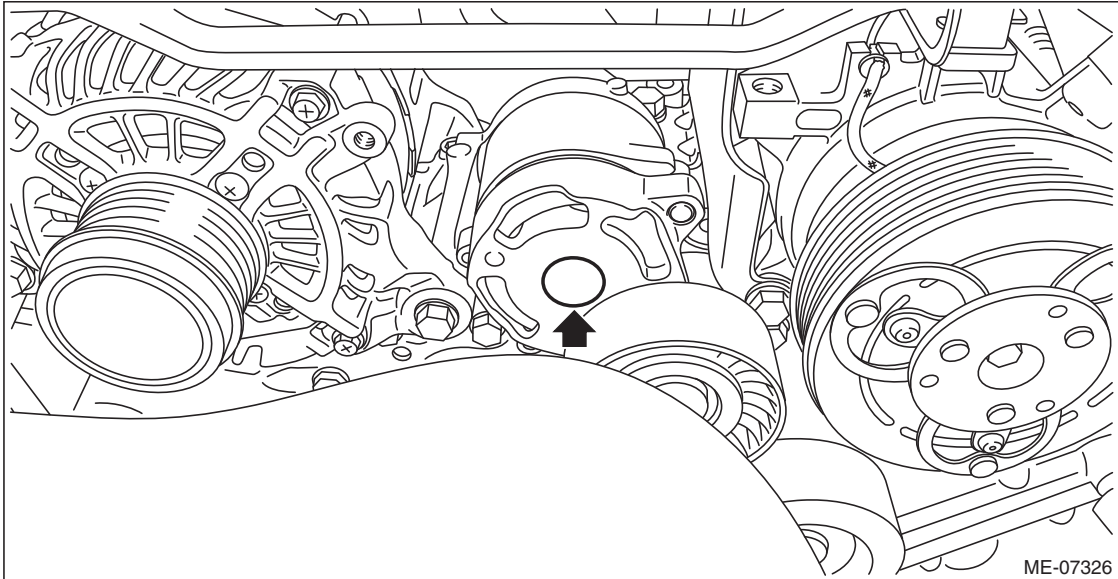


V-belt

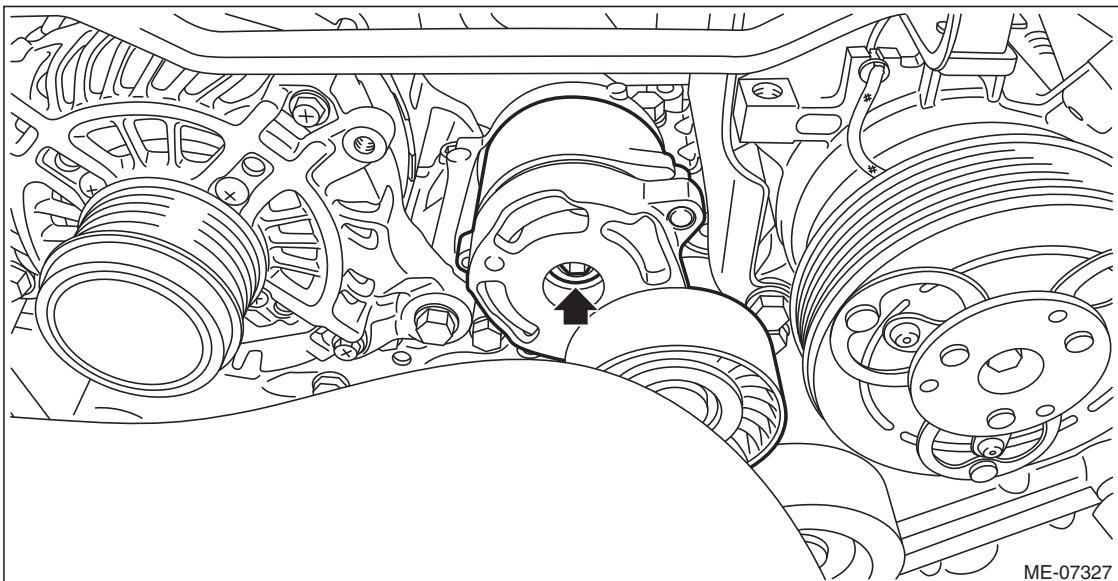
MECHANICAL

2. V-BELT TENSIONER ASSEMBLY

- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-75, V-BELT, REMOVAL, V-belt.>
- 2) Remove the cap from V-belt tensioner assembly.

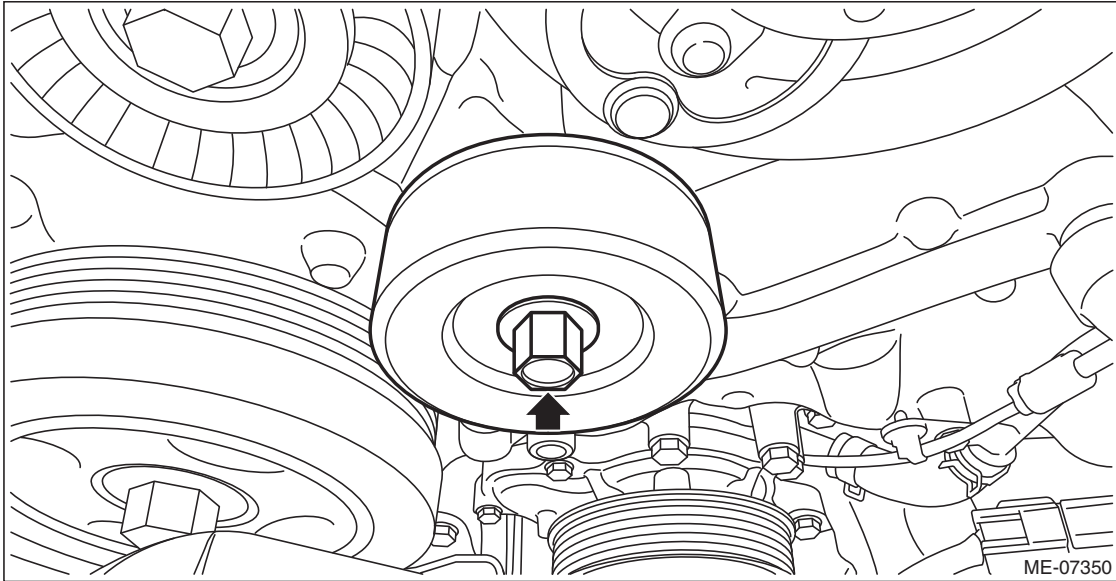


- 3) Remove the bolt securing the V-belt tensioner assembly to the generator bracket, and remove the V-belt tensioner assembly.



3. IDLER PULLEY

- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-75, V-BELT, REMOVAL, V-belt.>
- 2) Remove the bolts which secure the idler pulley to the chain cover, and remove the idler pulley.



V-belt

MECHANICAL

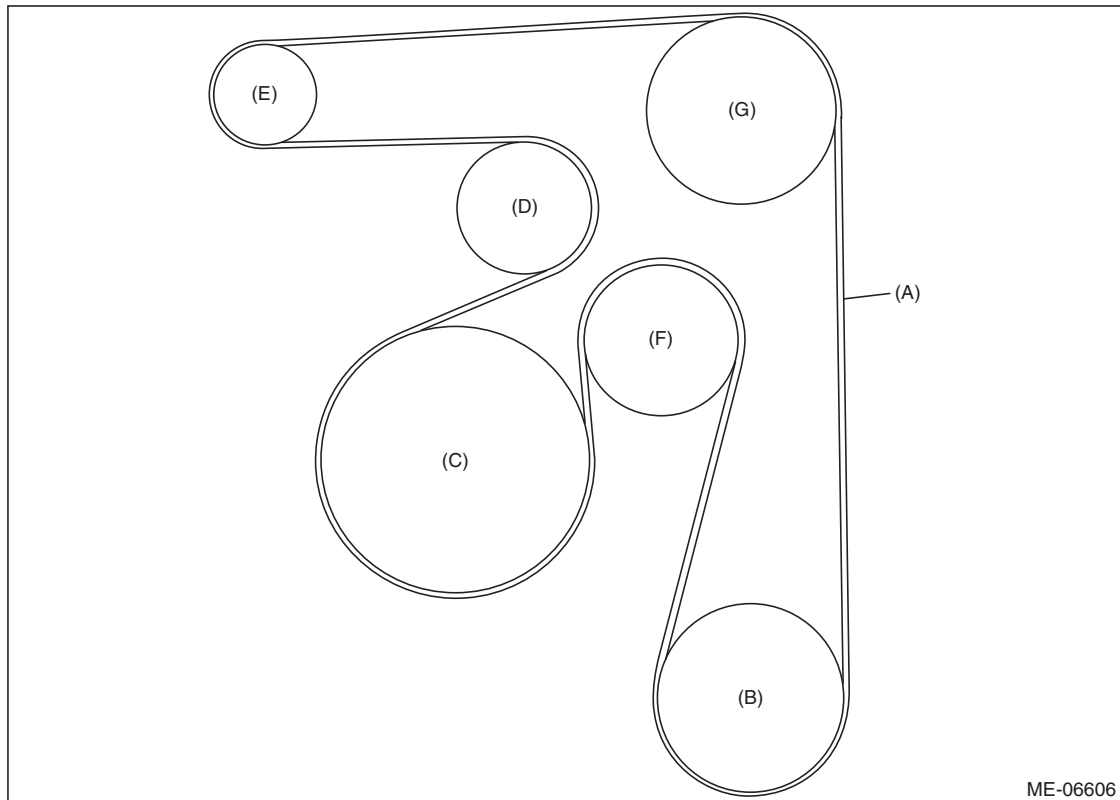
B: INSTALLATION

1. V-BELT

Install in the reverse order of removal.

CAUTION:

- When reusing the V-belt, wipe off dust and water with cloth.
- Do not use the V-belt if there is any oil, grease or coolant on the belt.
- Be careful not to rub the V-belt end surface with bare hands; exposed core may cause injury.
- Wipe off any dust, oil and water on the groove of each pulley with cloth.



- | | | |
|-----------------------|---------------------------|---------------------------|
| (A) V-belt | (D) V-belt tensioner ASSY | (G) A/C compressor pulley |
| (B) Water pump pulley | (E) Generator pulley | |
| (C) Crank pulley | (F) Idler pulley | |

V-belt

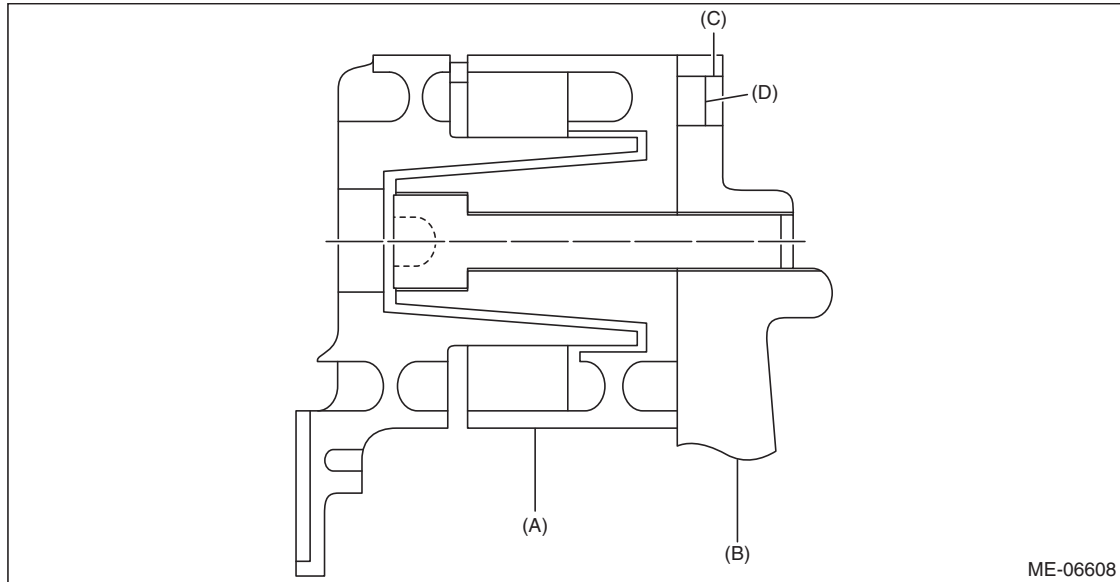
MECHANICAL

2. V-BELT TENSIONER ASSY

Install in the reverse order of removal.

NOTE:

When installing the V-belt tensioner assembly, insert the protrusion of V-belt tensioner assembly into the hole for preventing rotation at the generator bracket.



(A) V-belt tensioner ASSY

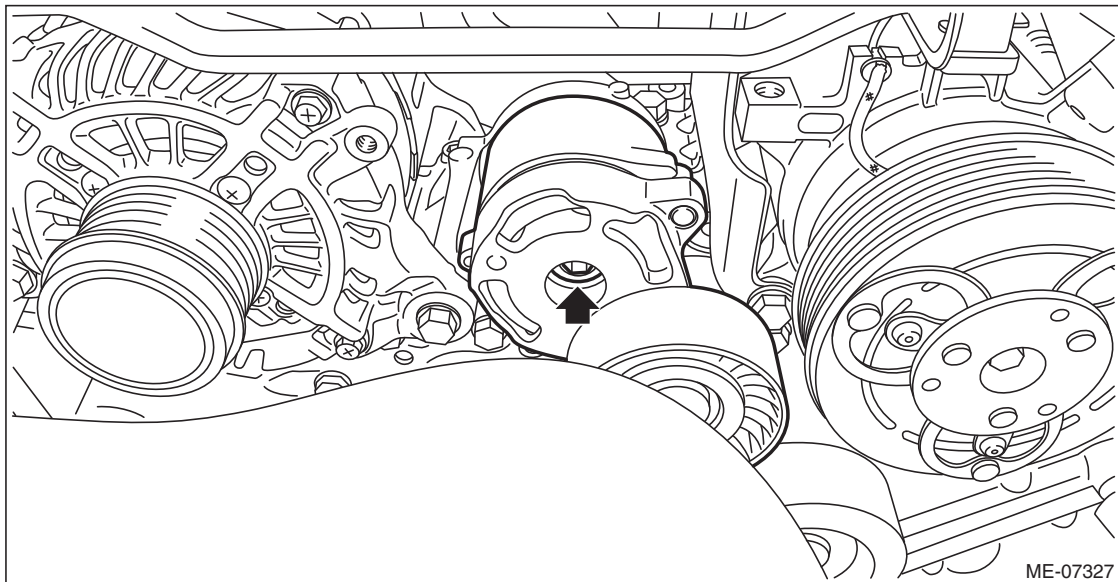
(C) Hole to prevent rotation

(D) Protrusion portion

(B) Generator bracket

Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)



V-belt

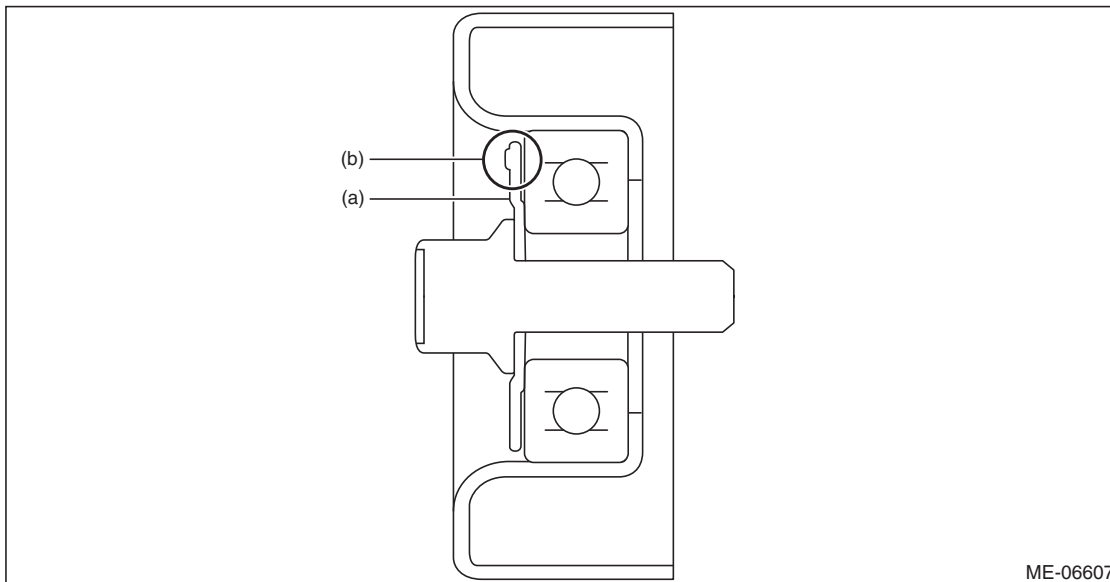
MECHANICAL

3. IDLER PULLEY

Install in the reverse order of removal.

NOTE:

When installing the idler pulley, be careful of the idler pulley cover direction.



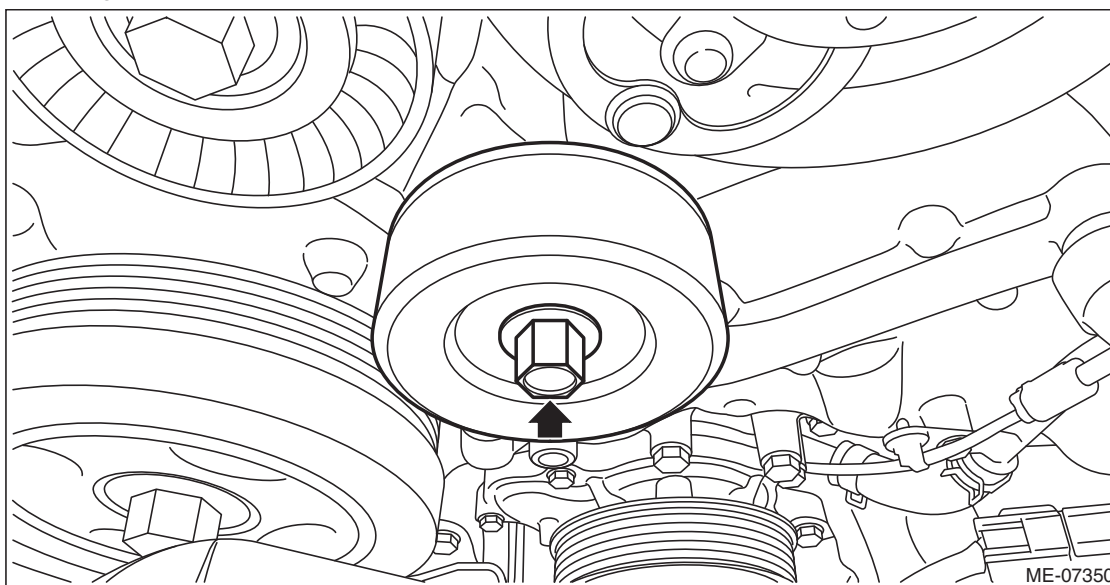
ME-06607

(a) Idler pulley cover

(b) Protrusion (3 places)

Tightening torque:

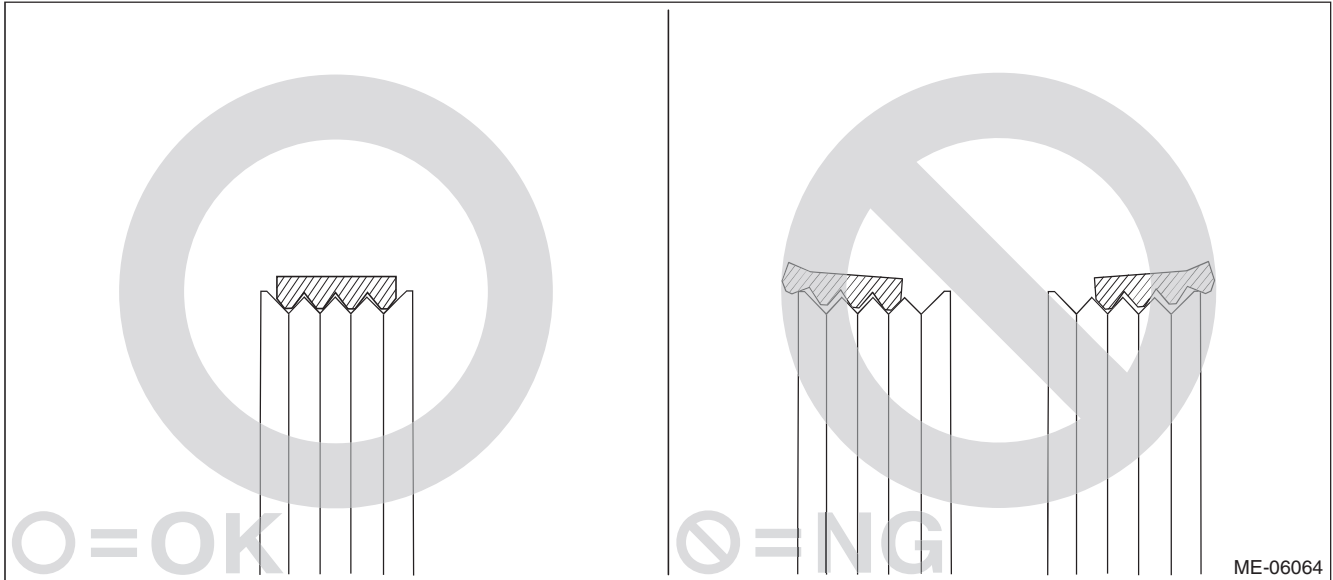
36 N·m (3.7 kgf-m, 26.6 ft-lb)



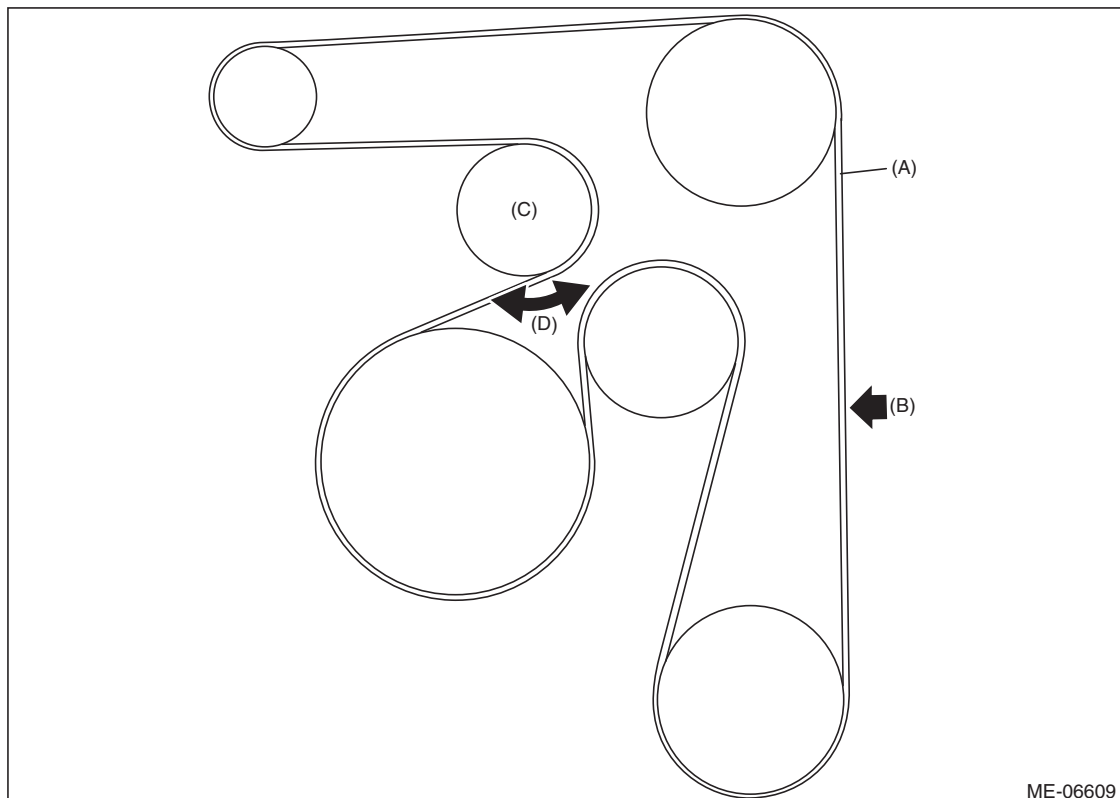
ME-07350

C: INSPECTION

- 1) Check the V-belt for cracks, tear or wear.
- 2) Check the V-belt tensioner assembly and idler pulley for deformation, cracks or other damages.
- 3) Check that the V-belt ribs are securely placed on the rib grooves for each pulleys.



- 4) Check that the V-belt tensioner assembly (C) moves in the direction of arrow (D), when the V-belt (A) is pushed and released by the area indicated by the arrow (B).



Crank Pulley

MECHANICAL

13.Crank Pulley

A: REMOVAL

NOTE:

When replacing a single part, perform the work with the engine assembly installed to body.

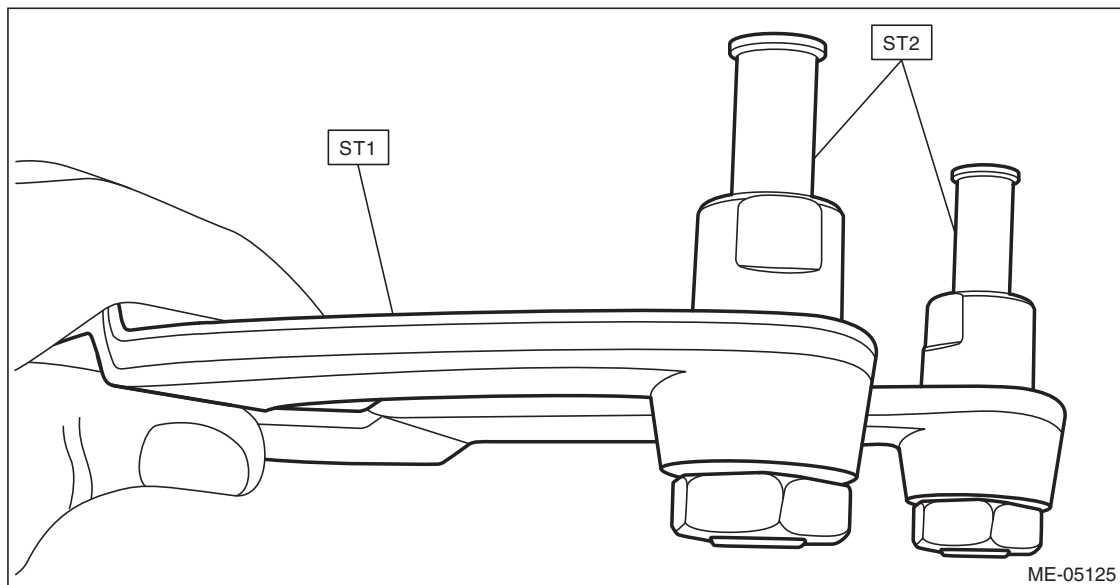
- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-75, V-BELT, REMOVAL, V-belt.>
- 2) Remove the radiator main fan & fan motor assembly and radiator sub fan & fan motor assembly. <Ref. to CO(H4DOTC)-52, REMOVAL, Radiator Main Fan and Fan Motor.> <Ref. to CO(H4DOTC)-55, REMOVAL, Radiator Sub Fan and Fan Motor.>
- 3) Use the ST to lock the crank pulley, and remove the crank pulley bolt.

NOTE:

To prevent damaging ST1, attach the ST2 onto the ST1 as shown.

ST1 18355AA000 PULLEY WRENCH

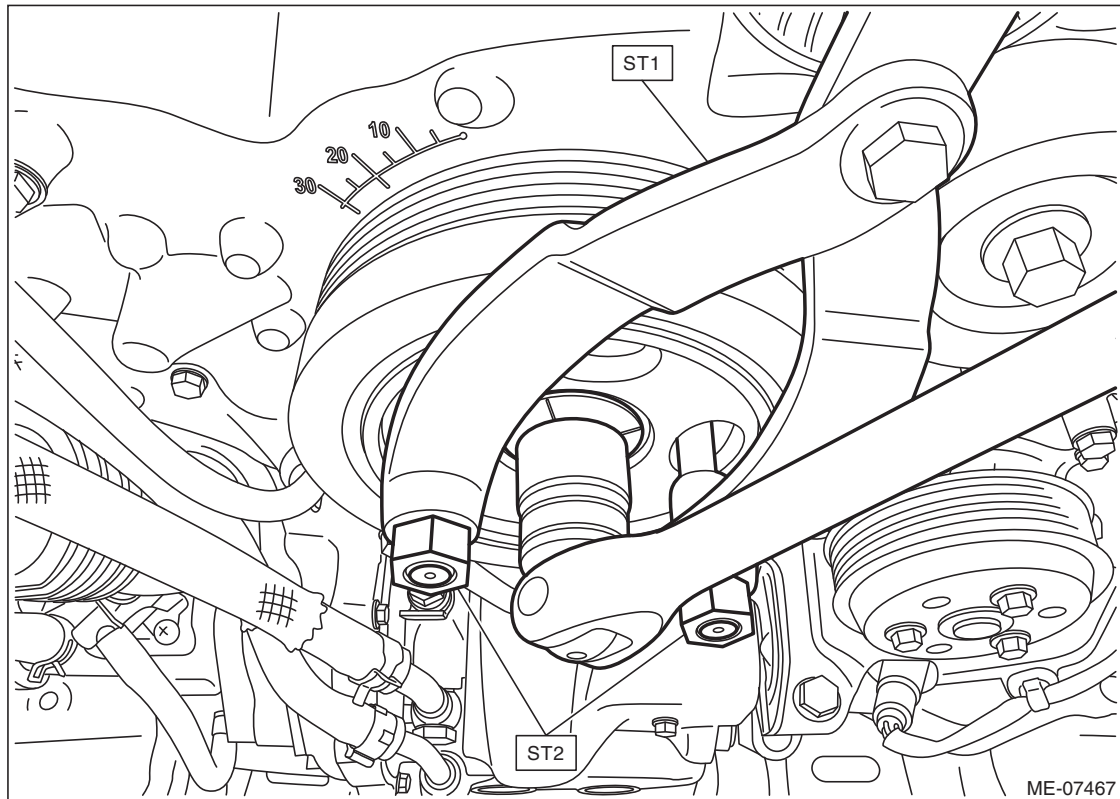
ST2 18334AA000 PULLEY WRENCH PIN SET



Crank Pulley

MECHANICAL

ST1 18355AA000 PULLEY WRENCH
ST2 18334AA000 PULLEY WRENCH PIN SET



4) Remove the crank pulley.

Crank Pulley

MECHANICAL

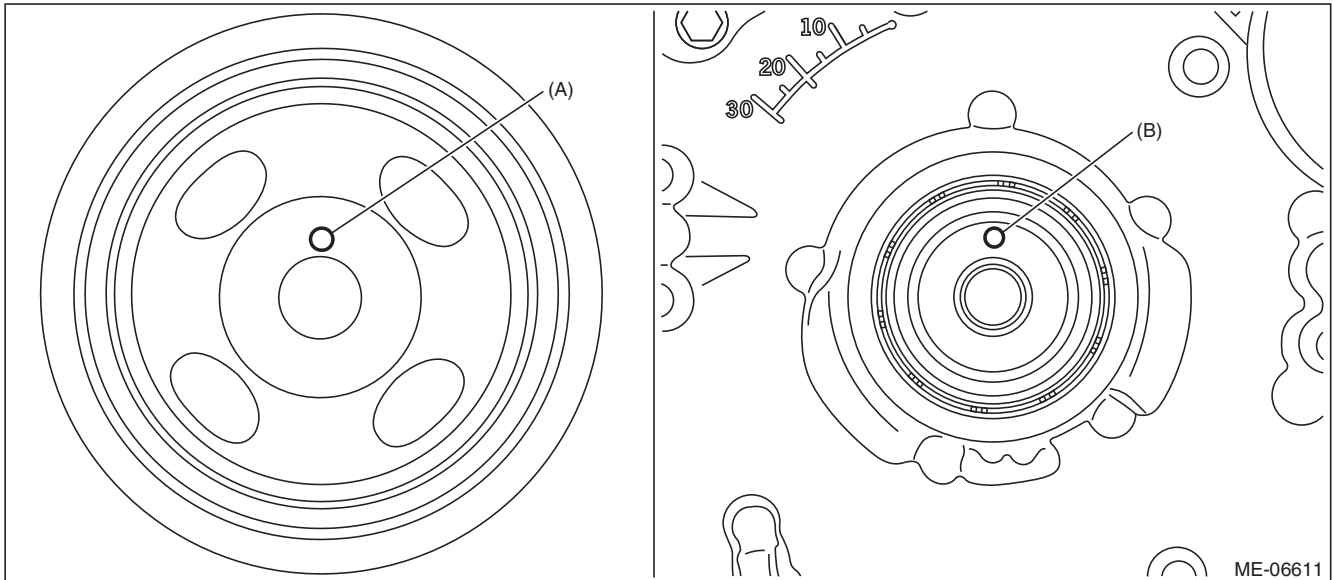
B: INSTALLATION

- 1) Clean the crankshaft thread using compressed air.
- 2) Apply engine oil to the crank pulley bolt seat and thread.
- 3) Install the crank pulley.

- (1) Install the crank pulley to the crank pulley boss.

NOTE:

- Use new O-rings.
- Install the crank pulley by aligning the crank pulley knock hole (A) and crank pulley boss knock pin (B).



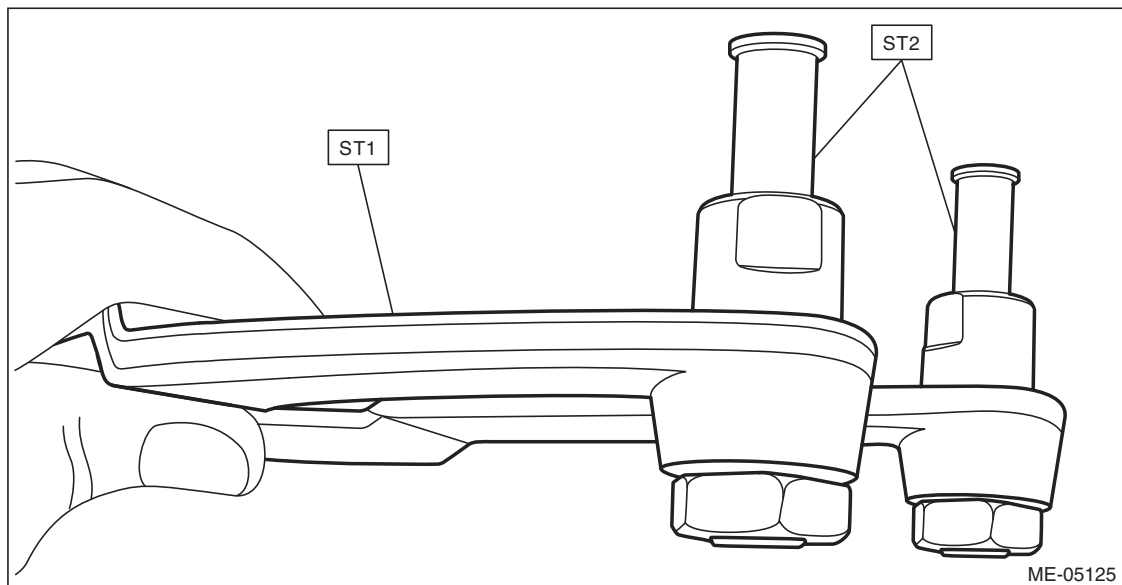
- (2) Use the ST to lock the crank pulley, and temporarily tighten the crank pulley bolt.

NOTE:

To prevent damaging ST1, attach the ST2 onto the ST1 as shown.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA000 PULLEY WRENCH PIN SET

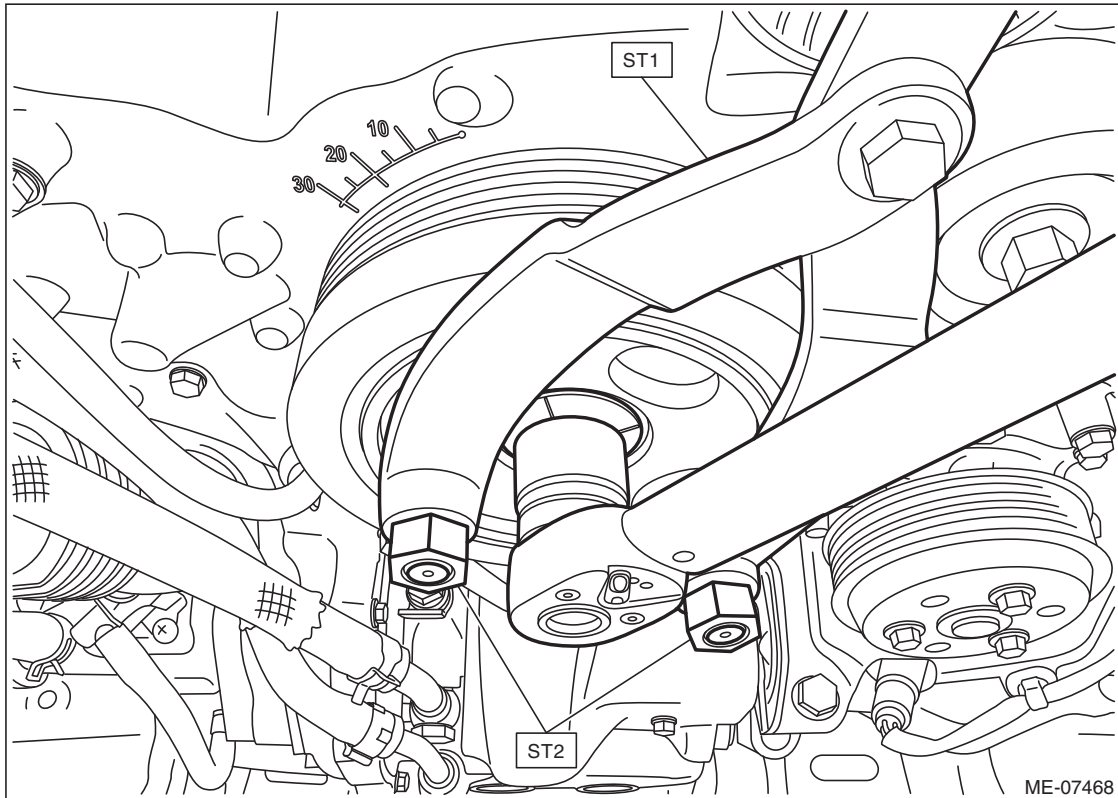


Crank Pulley

MECHANICAL

ST1 18355AA000 PULLEY WRENCH
ST2 18334AA000 PULLEY WRENCH PIN SET

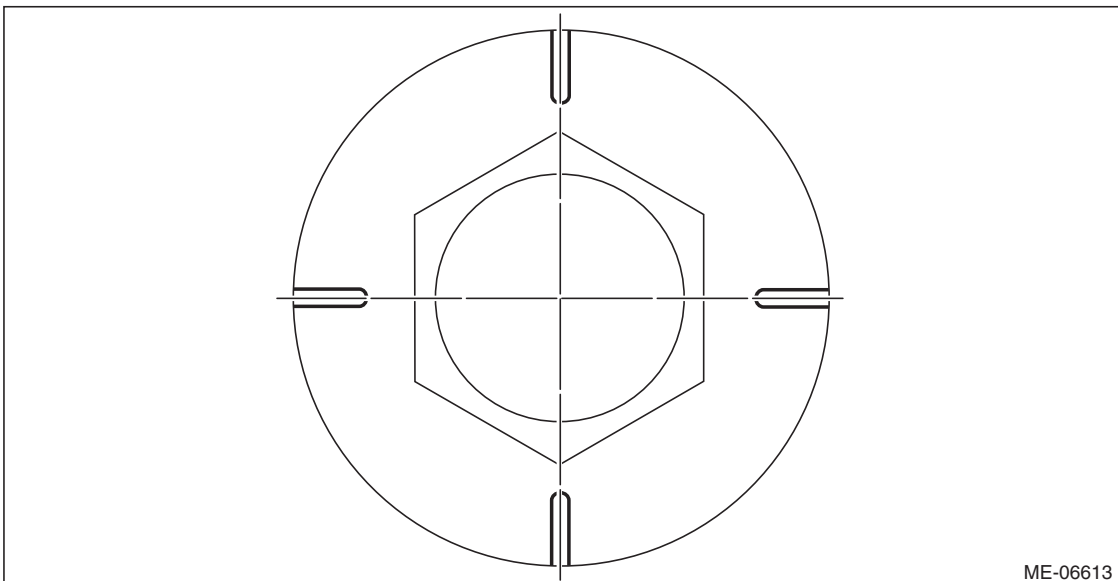
Tightening torque:
20 N·m (2.0 kgf-m, 14.8 ft-lb)



(3) Use the marker as shown in the figure, draw the reference line (A) on the crank pulley bolt according to the indented line on the crank pulley bolt head, and draw the end line (B) on the crank pulley.

NOTE:

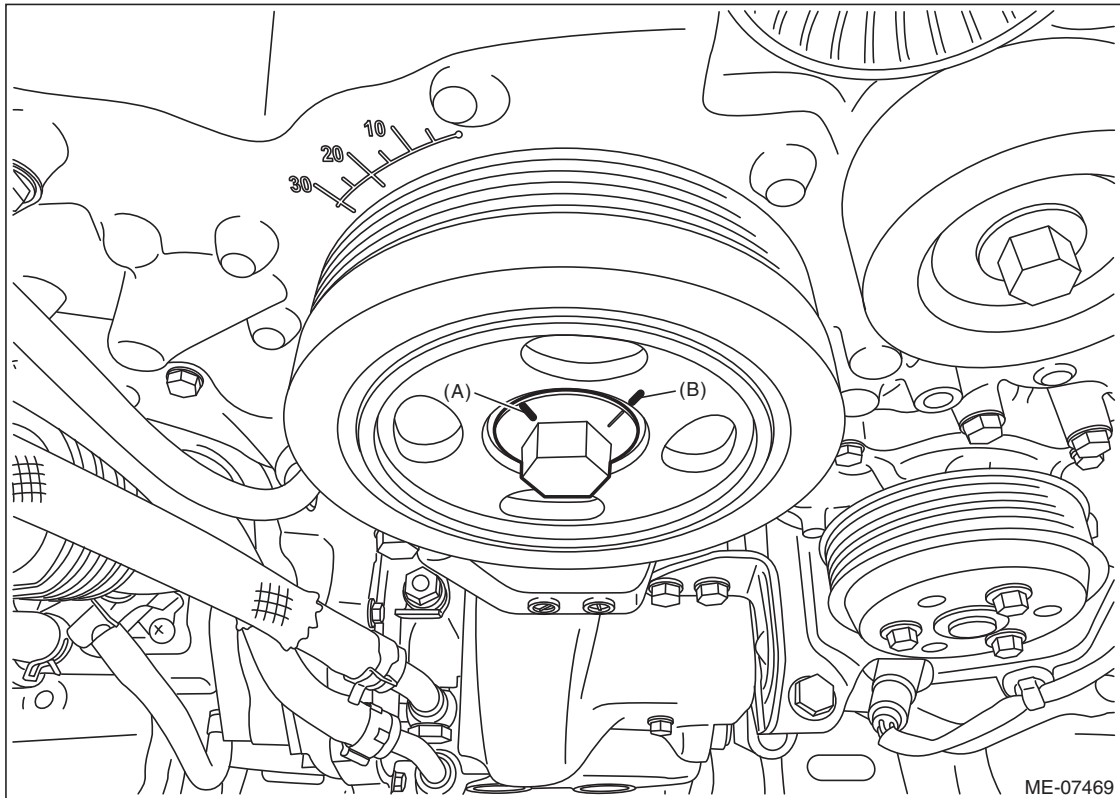
- Four lines are indented by 90° on the crank pulley bolt head.



Crank Pulley

MECHANICAL

- Reference line is drawn for better visibility.



Crank Pulley

MECHANICAL

- (4) Use the ST to lock the crank pulley, and tighten the crank pulley bolt to the angle where reference line (A) and end line (B) are aligned.

NOTE:

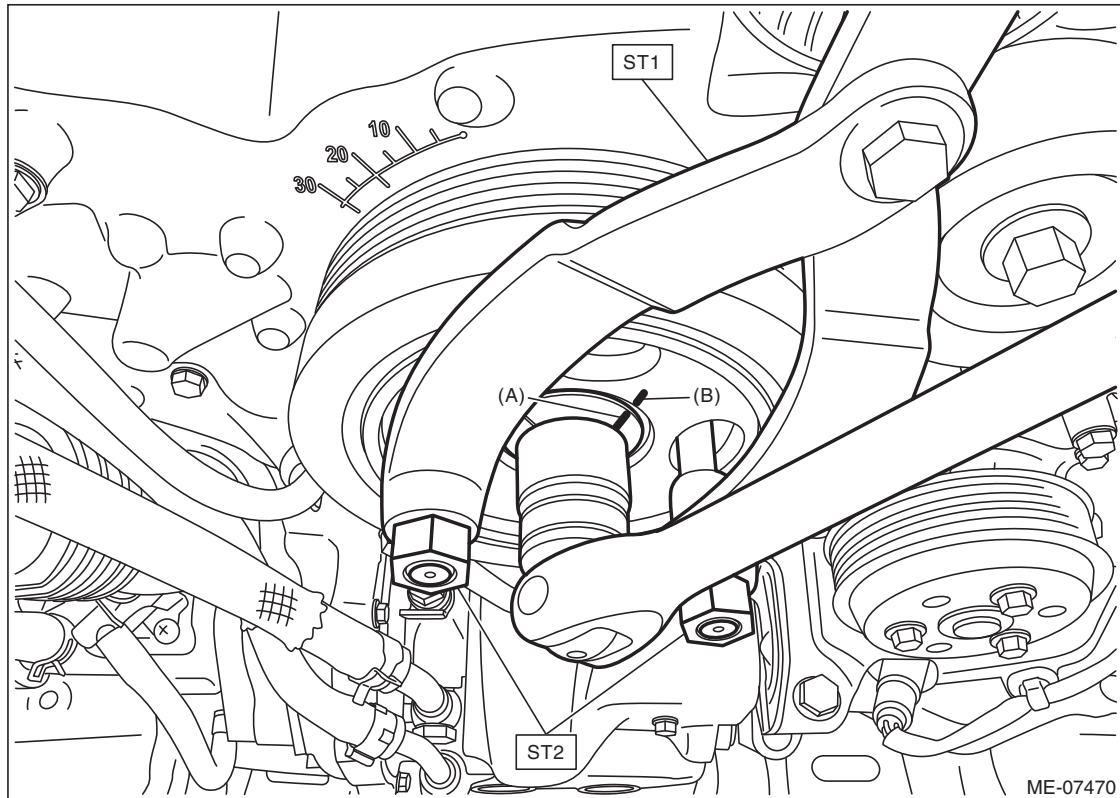
It should be approx. 90° when reference line (A) and end line (B) are aligned.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA000 PULLEY WRENCH PIN SET

Tightening angle:

$90^{\circ} \pm 5^{\circ}$



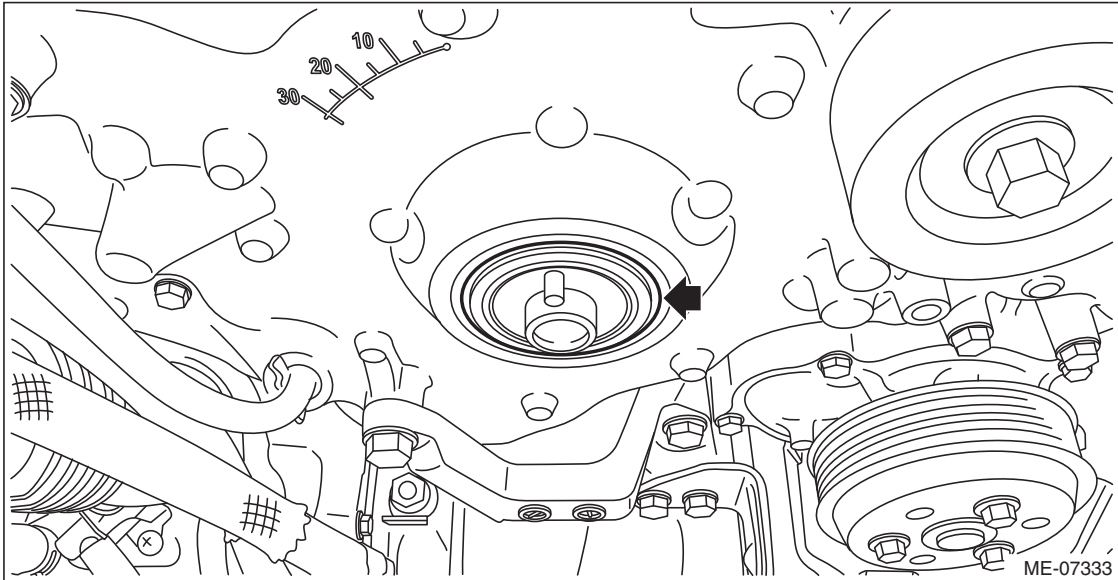
- 4) Install the radiator main fan & fan motor assembly and radiator sub fan & fan motor assembly. <Ref. to CO(H4DOTC)-52, INSTALLATION, Radiator Main Fan and Fan Motor.> <Ref. to CO(H4DOTC)-55, INSTALLATION, Radiator Sub Fan and Fan Motor.>
- 5) Install the V-belts. <Ref. to ME(H4DOTC)-78, V-BELT, INSTALLATION, V-belt.>

Crank Pulley

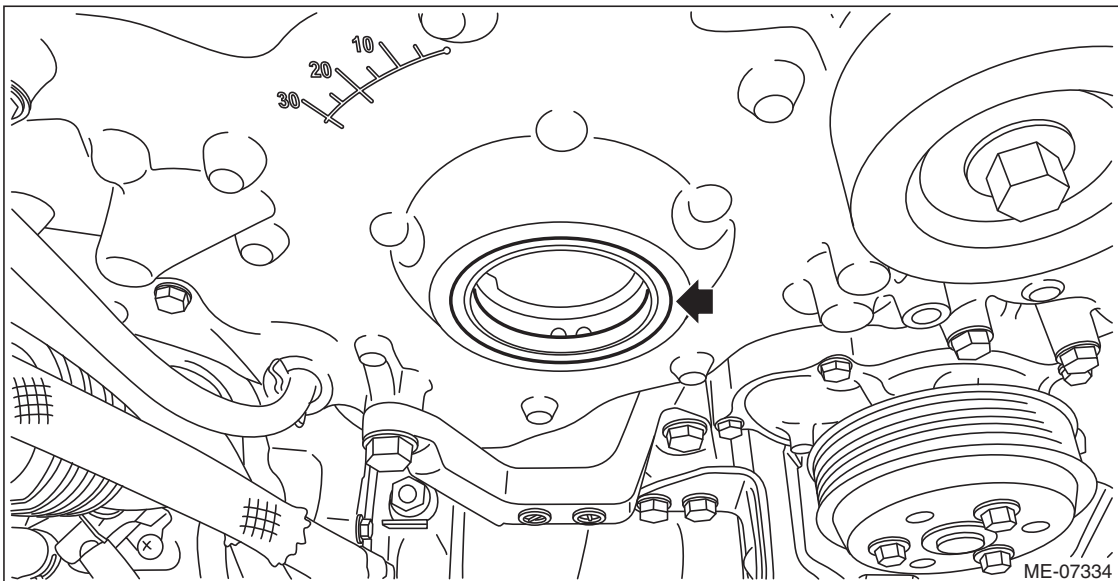
MECHANICAL

C: INSPECTION

- 1) Check that the crank pulley and crank pulley boss have no deformation, cracks or other damages.
- 2) Inspect for oil leakage from the front oil seal. If there is an oil leak, replace the front oil seal with a new part according to the following procedures.
 - (1) Remove the crank pulley. <Ref. to ME(H4DOTC)-82, REMOVAL, Crank Pulley.>
 - (2) Remove the crank pulley boss from the chain cover.



- (3) Remove the front oil seal from the chain cover.



Crank Pulley

MECHANICAL

(4) Apply a light coat of engine oil to the front oil seal inner periphery and outer periphery, and install the front oil seal to the chain cover using ST.

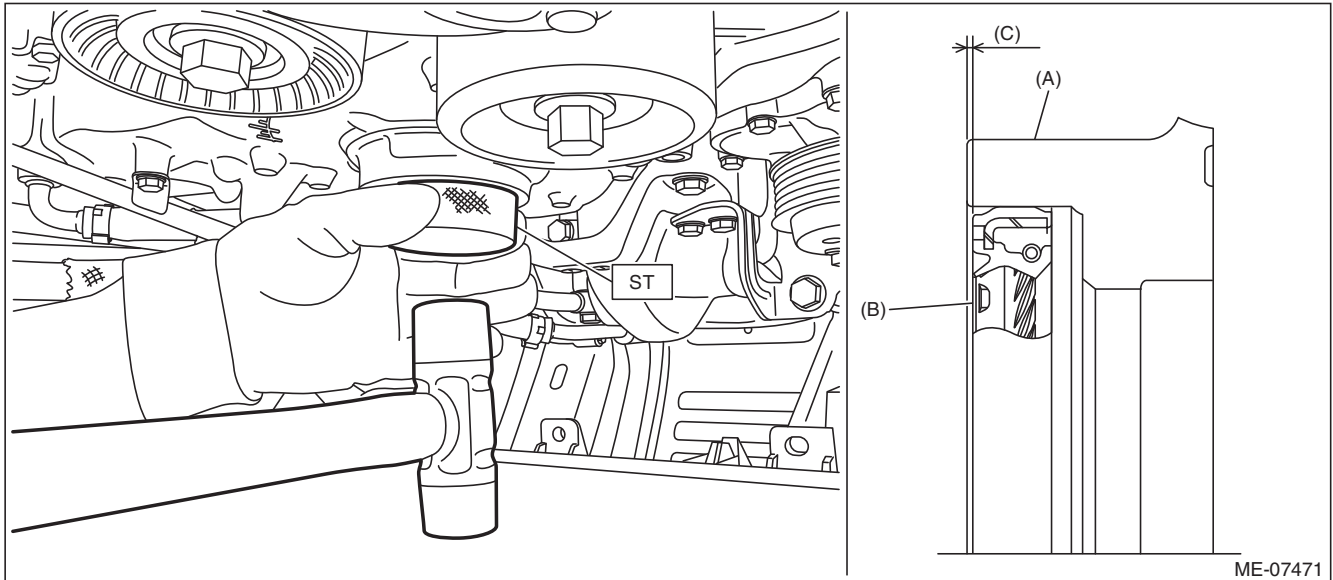
NOTE:

When tapping the front oil seal in, protect the radiator fin with cardboards etc. so as not to damage the radiator fin by the plastic hammer.

ST 398437700 OIL SEAL INSTALLER

Front oil seal press-fit position:

1^{+0}_{-1} mm ($0.0039^{+0}_{-0.0039}$ in) position from chain cover end face



(A) Chain cover

(B) Oil seal

(C) Front oil seal press-fit position
 1^{+0}_{-1} mm ($0.0039^{+0}_{-0.0039}$ in)
position from chain cover end
face)

3) Install in the reverse order of removal after replacement.

Chain Cover

MECHANICAL

14.Chain Cover

A: REMOVAL

NOTE:

When replacing a single part, perform the work with the engine assembly installed to body.

1) When working on the vehicle

NOTE:

When working on the vehicle, perform the following steps also.

- (1) Remove the intercooler. <Ref. to IN(H4DOTC)-35, REMOVAL, Intercooler.>
- (2) Remove the intake duct No. 1 and intake duct No. 2. <Ref. to IN(H4DOTC)-20, INTAKE DUCT NO. 1, REMOVAL, Intake Duct.> <Ref. to IN(H4DOTC)-22, INTAKE DUCT NO. 2, REMOVAL, Intake Duct.>
- (3) Remove the radiator. <Ref. to CO(H4DOTC)-39, REMOVAL, Radiator.>
- (4) Remove the front exhaust pipe. <Ref. to EX(H4DOTC)-7, REMOVAL, Front Exhaust Pipe.>
- 2) Drain the engine oil. <Ref. to LU(H4DO)-14, REPLACEMENT, Engine Oil.>
- 3) Remove the V-belts. <Ref. to ME(H4DOTC)-75, V-BELT, REMOVAL, V-belt.>
- 4) Remove the generator. <Ref. to SC(H4DO)-37, REMOVAL, Generator.>
- 5) Remove the water pump pulley. <Ref. to CO(H4DOTC)-16, WATER PUMP, REMOVAL, Water Pump.>
- 6) Remove the crank pulley. <Ref. to ME(H4DOTC)-82, REMOVAL, Crank Pulley.>
- 7) Remove the engine oil cooler. <Ref. to LU(H4DO)-46, REMOVAL, Engine Oil Cooler.>
- 8) Remove the front engine oil cooler pipe assembly. <Ref. to LU(H4DO)-48, FRONT ENGINE OIL COOLER PIPE, REMOVAL, Engine Oil Cooler Pipe.>
- 9) When working on the engine unit only

NOTE:

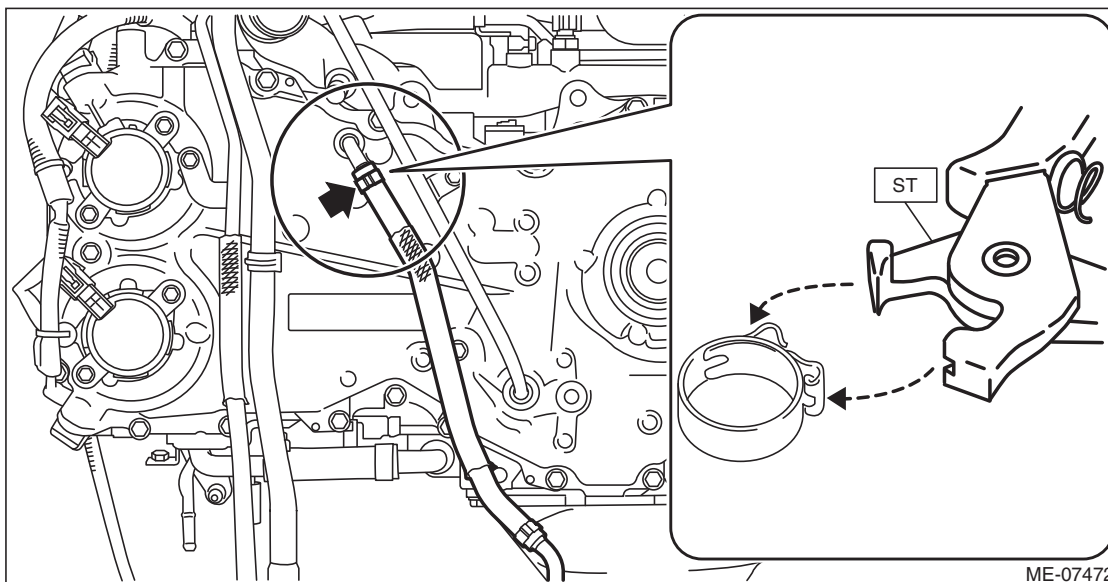
When working on the engine unit only, also perform the following steps.

- (1) Remove the PCV hose assembly together with the oil catch tank from the chain cover.

NOTE:

To disconnect the PCV hose assembly, fit the cut outs of the ST with the protrusions on the clamp as shown in the figure, squeeze the ST's handles together and unlock the clamp.

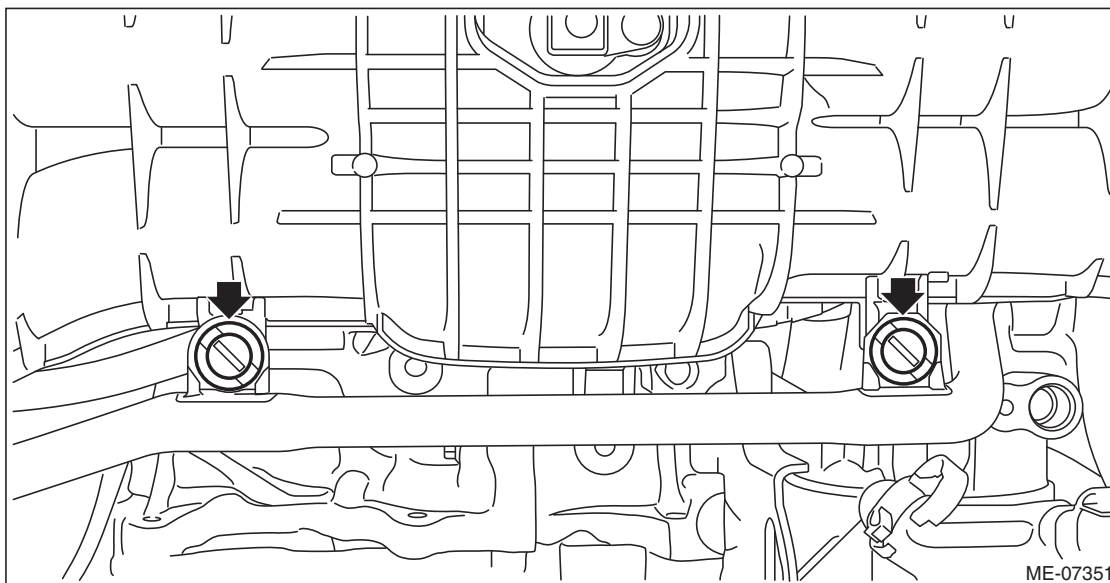
ST 18353AA000 CLAMP PLIERS



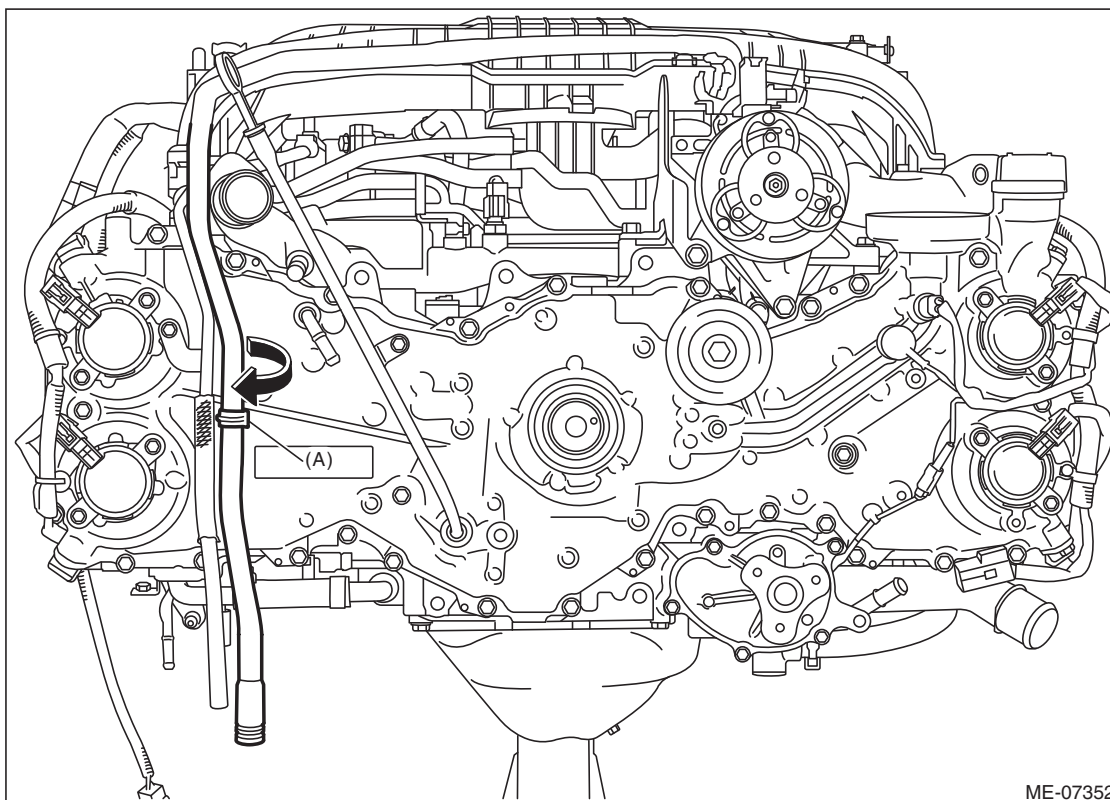
Chain Cover

MECHANICAL

- 10) Remove the clip securing the PCV pipe to the intake manifold.



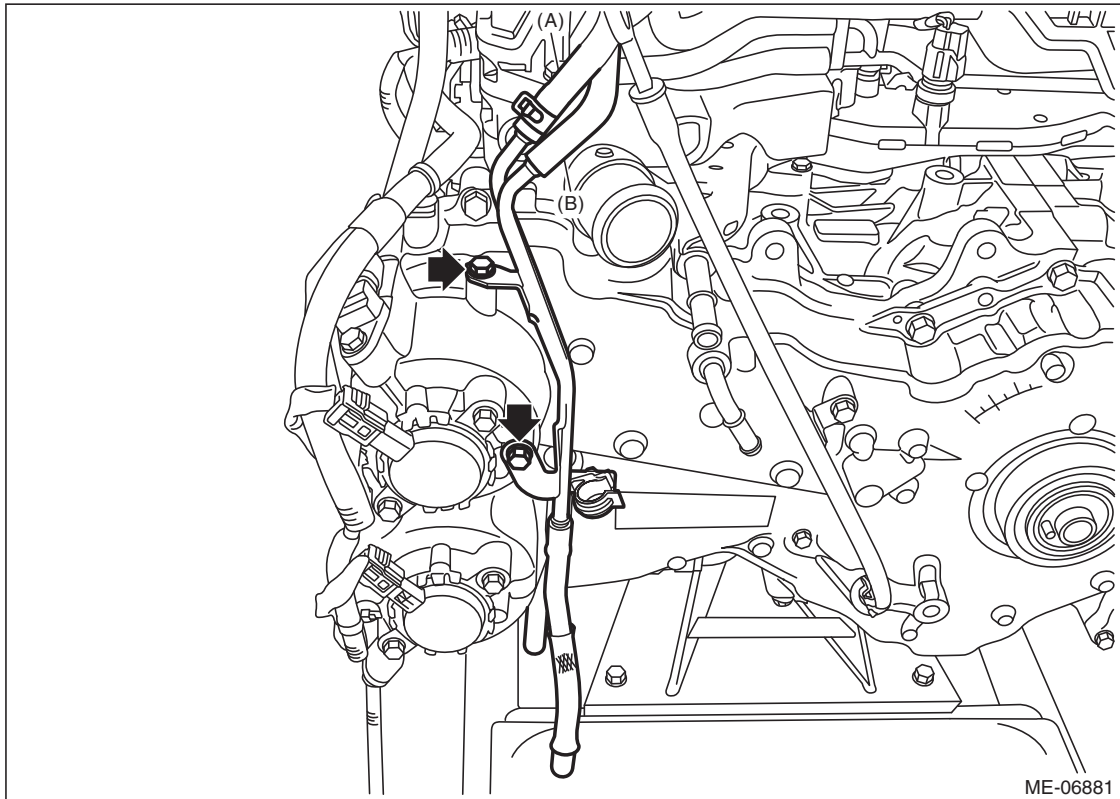
- 11) Remove the PCV pipe from the clip (A), and move the PCV pipe to the rocker cover RH side.



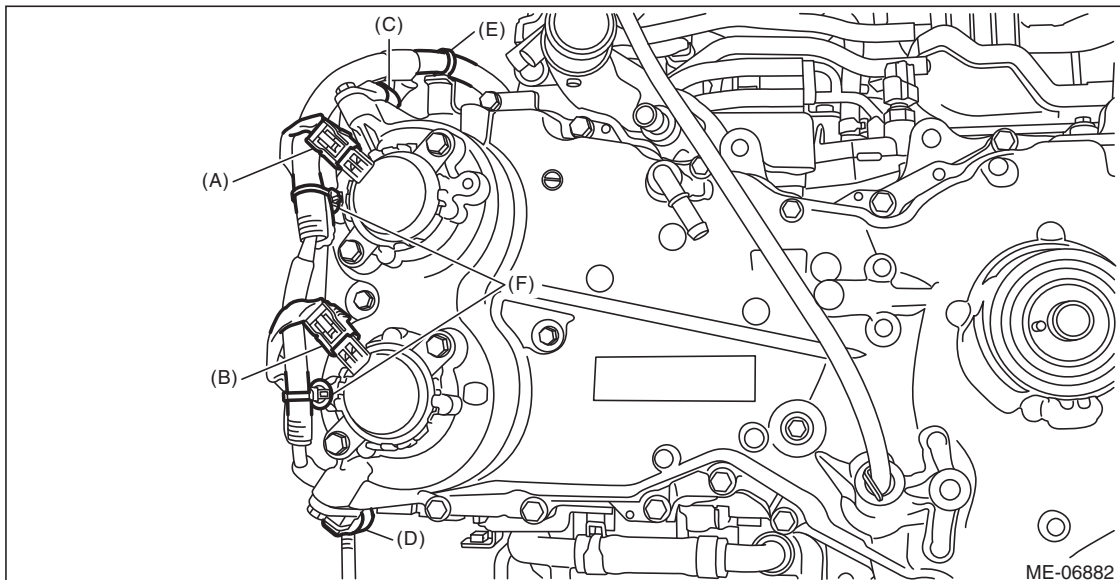
Chain Cover

MECHANICAL

12) Disconnect the vacuum control hose (A) and vacuum hose (B) from the vacuum pipe assembly, and remove the vacuum pipe assembly from the chain cover.



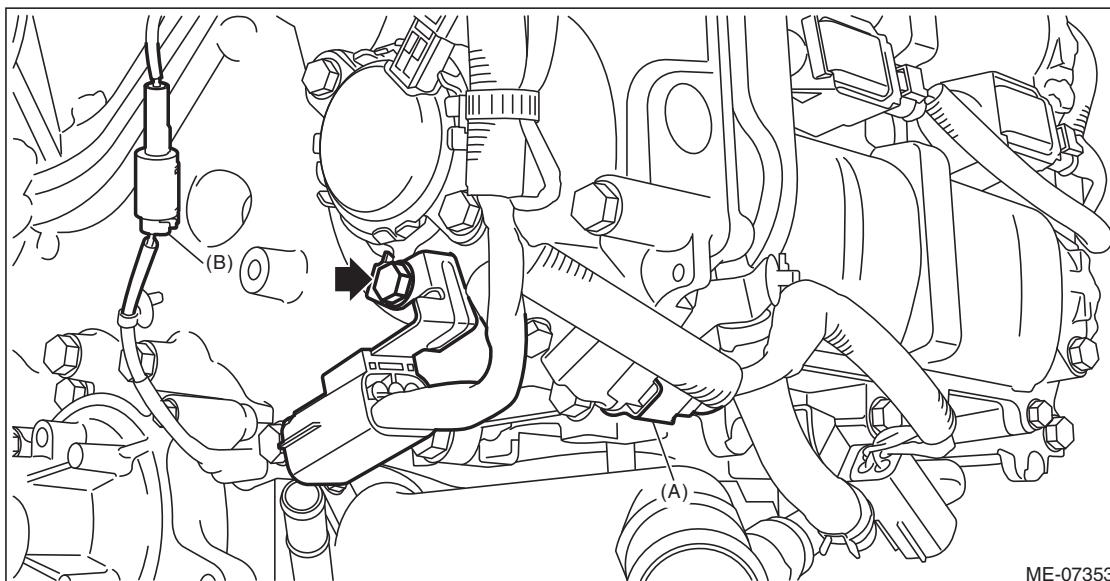
13) Disconnect the connector (A) from the intake oil control solenoid RH, connector (B) from the exhaust oil control solenoid RH, connector (C) from the intake camshaft position sensor RH, and the connector (D) from the exhaust camshaft position sensor RH, and then remove the clips (E) and (F) securing the engine harness.



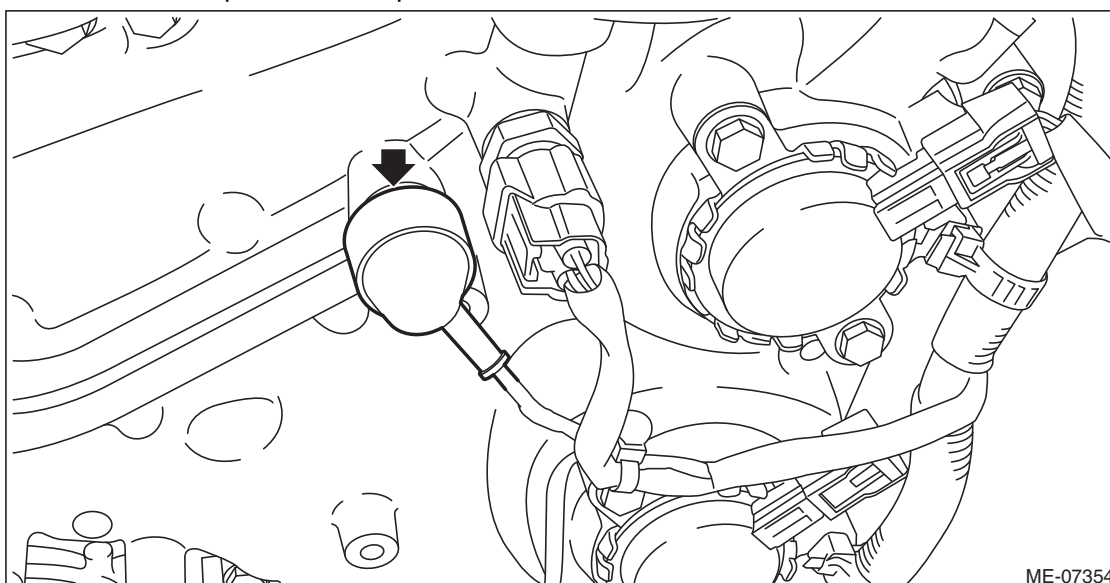
Chain Cover

MECHANICAL

- 14) Disconnect the connector (A) from the exhaust camshaft position sensor LH and the connector (B) from the oil level switch, and remove the engine harness stay from the chain cover.



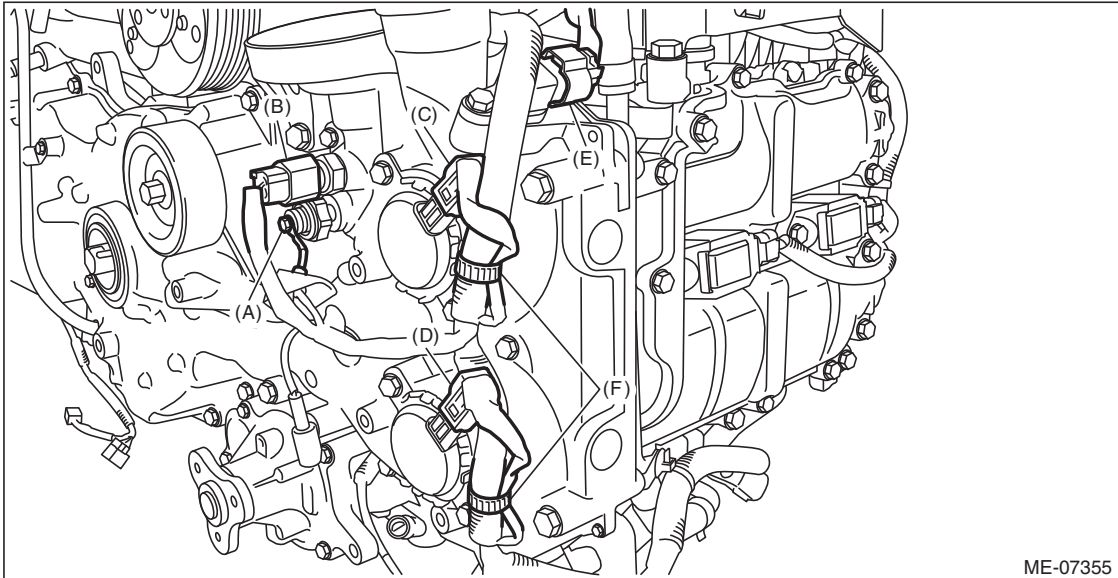
- 15) Remove the rubber cap from the oil pressure switch.



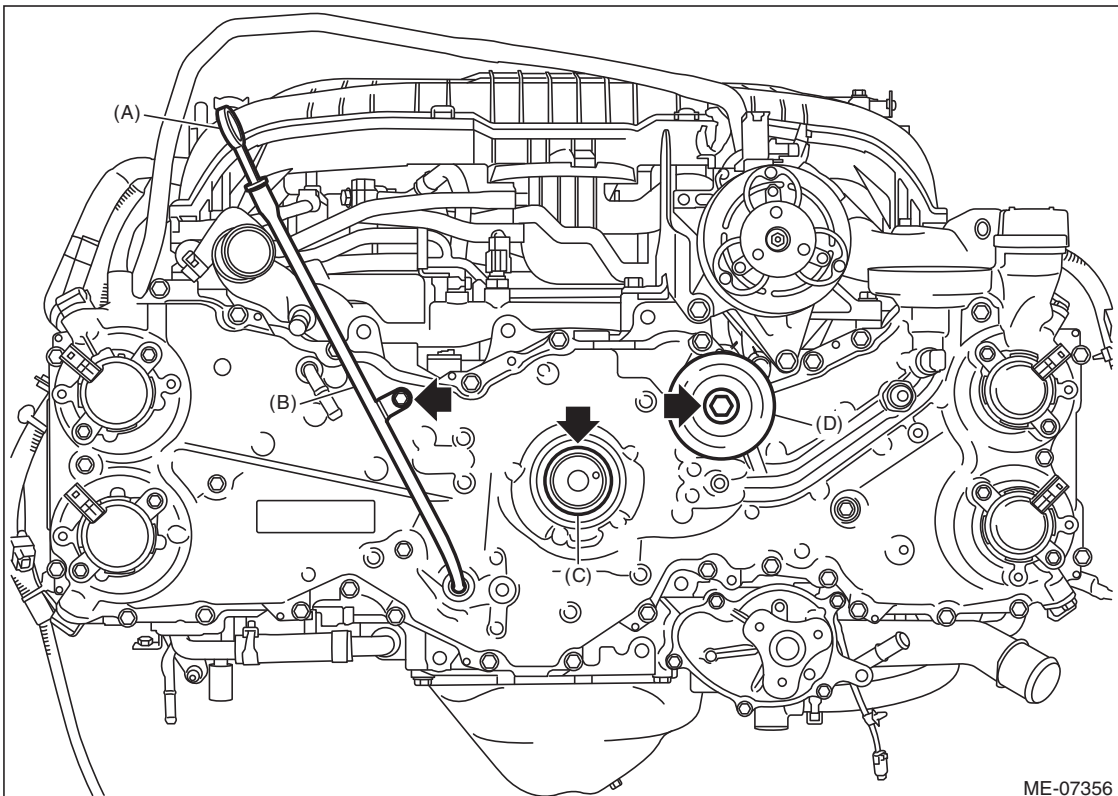
Chain Cover

MECHANICAL

16) Disconnect the terminal (A) from the oil pressure switch, connector (B) from the engine oil temperature sensor, connector (C) from the intake oil control solenoid LH, connector (D) from the exhaust oil control solenoid LH, and the connector (E) from the intake camshaft position sensor LH, and then remove the clip (F) securing the engine harness.



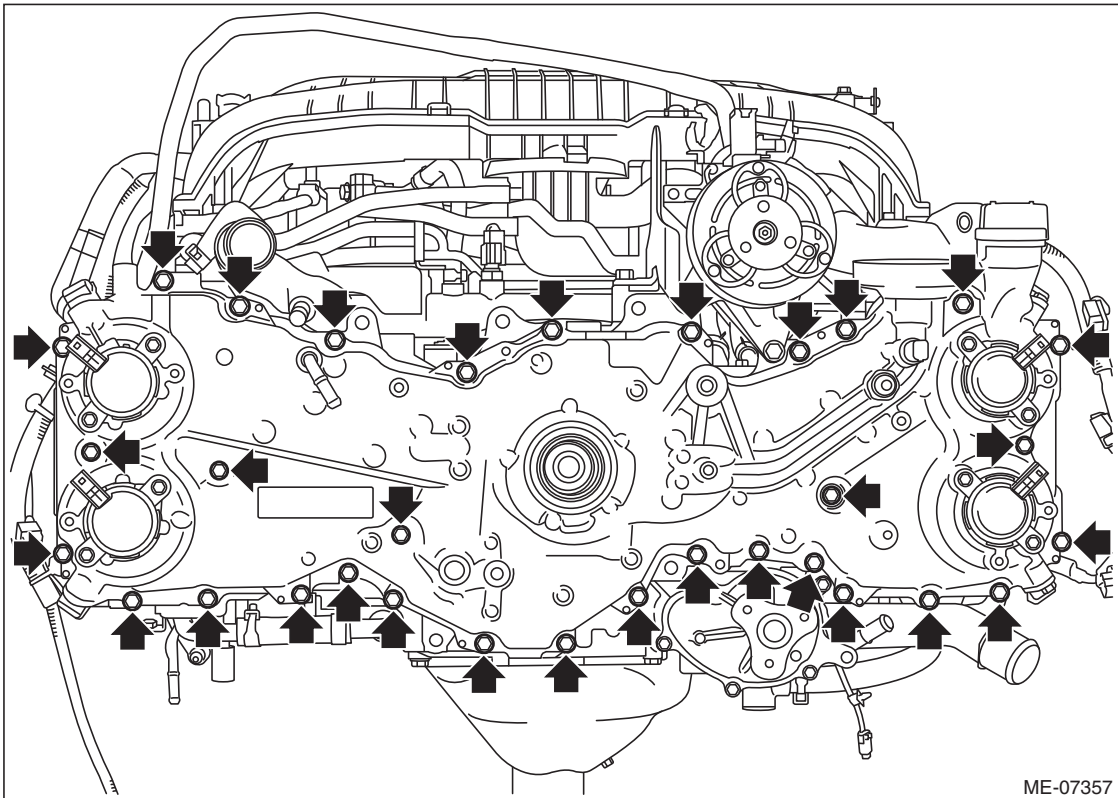
17) Pull out the oil level gauge (A), and remove the oil level gauge guide (B), crank pulley boss (C), and idler pulley (D).



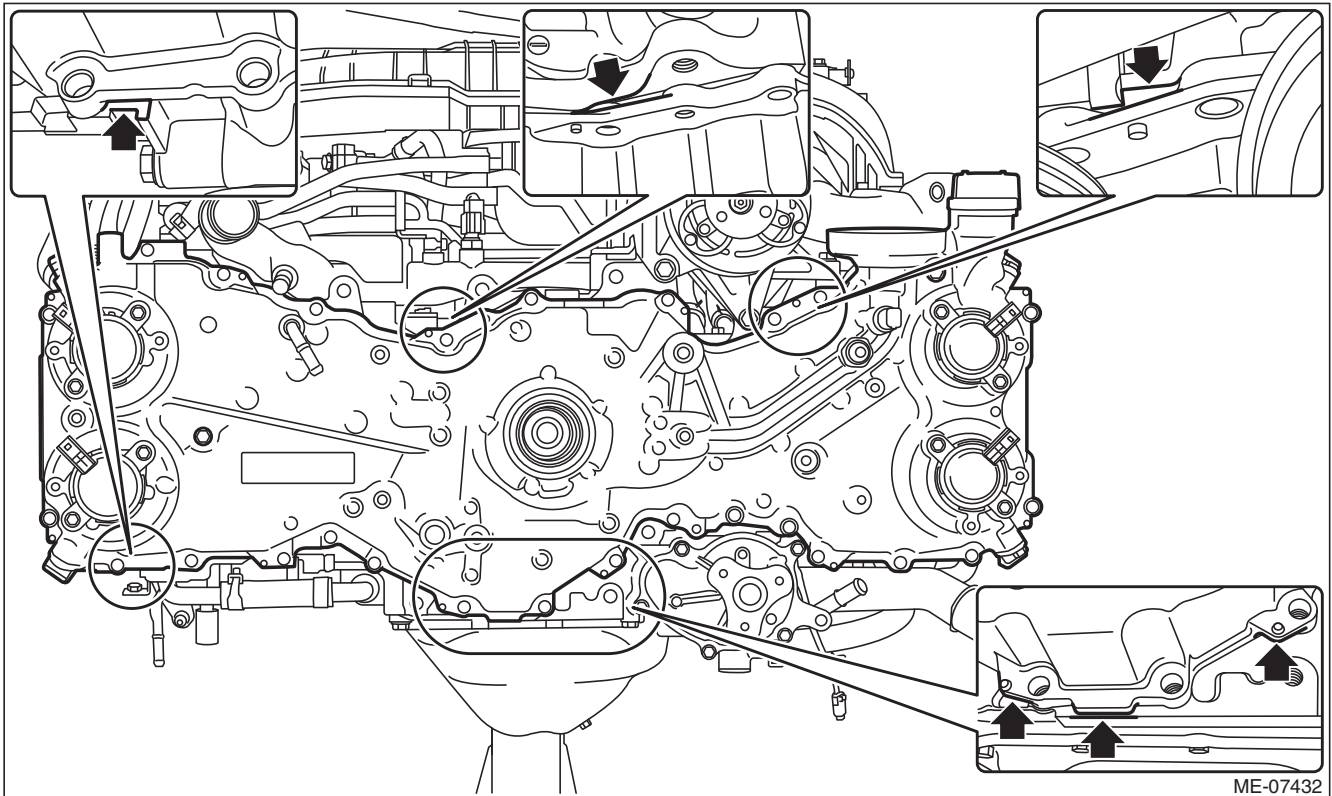
Chain Cover

MECHANICAL

18) Remove the bolts securing the chain cover to engine.



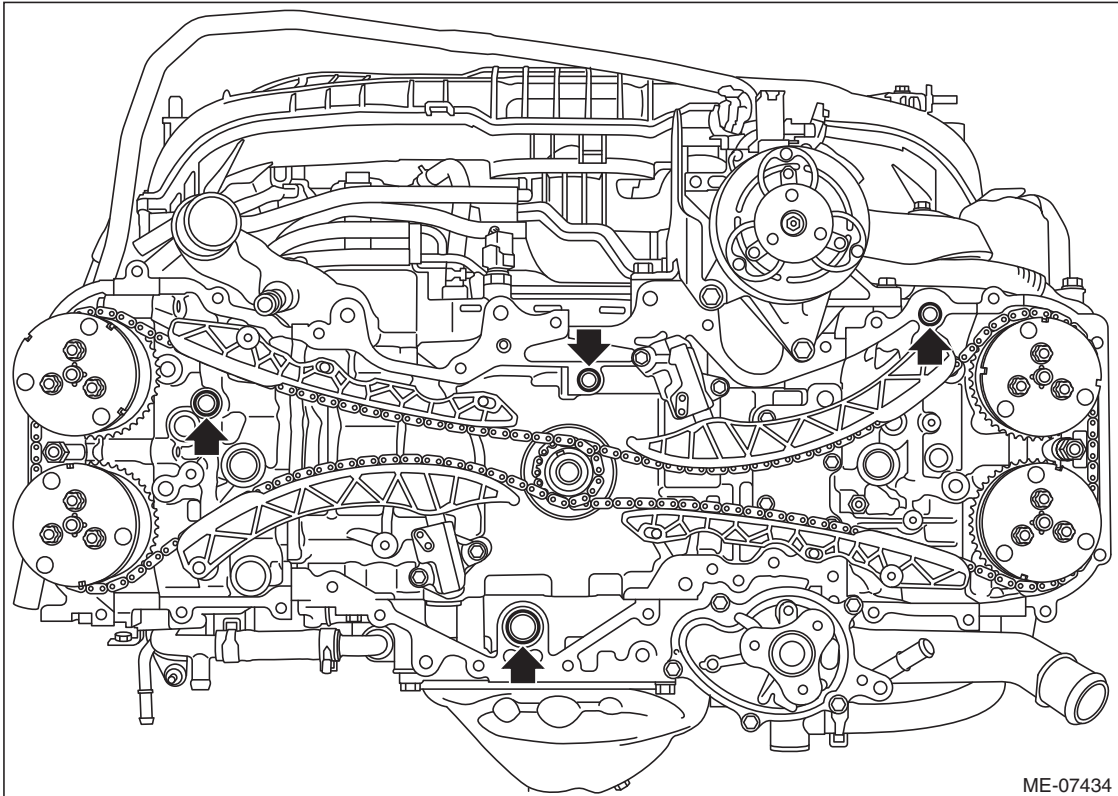
19) Pry the points shown in the figure with a crowbar wrapped by protective tape, and then remove the chain cover from the engine.



Chain Cover

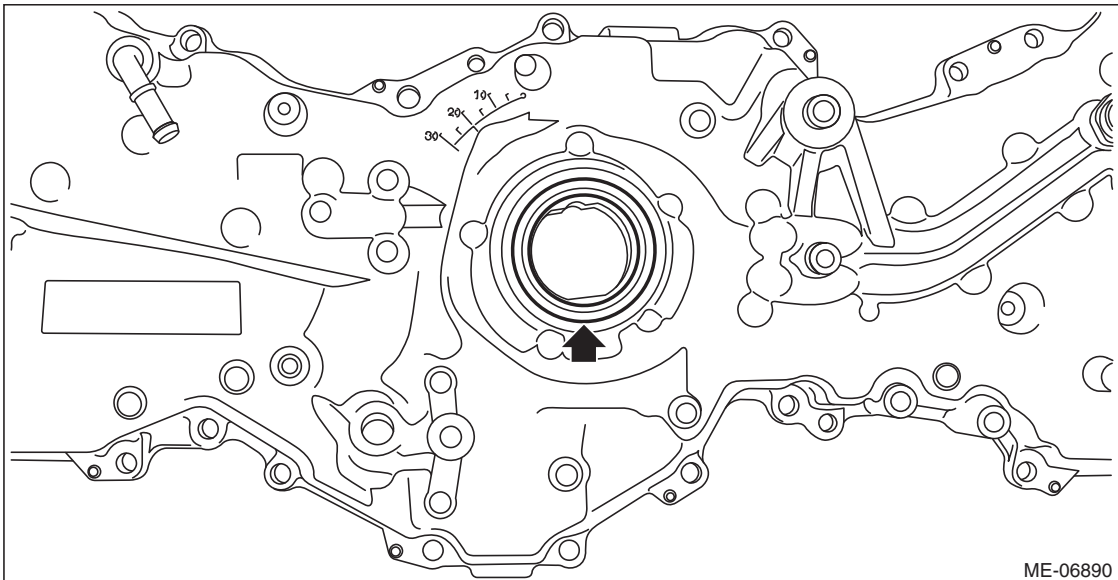
MECHANICAL

20) Remove the O-rings from cylinder head RH, cylinder head LH, cylinder block LH and oil pan upper.



21) Remove the liquid gasket from the chain cover and engine unit.

22) Remove the front oil seal from the chain cover.



Chain Cover

MECHANICAL

B: INSTALLATION

1) Apply a light coat of engine oil to the front oil seal inner periphery and outer periphery, and install the front oil seal to the chain cover using ST.

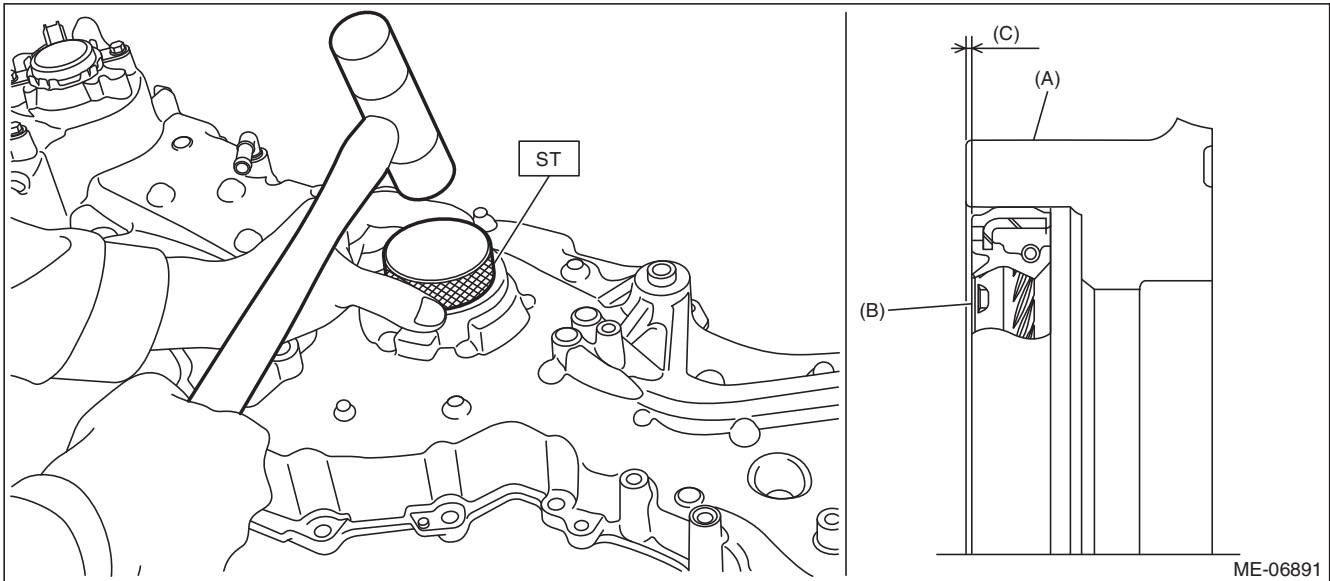
NOTE:

Use a new front oil seal.

ST 398437700 OIL SEAL INSTALLER

Front oil seal press-fit position:

1^{+0}_{-1} mm ($0.0039^{+0}_{-0.0039}$ in) position from chain cover end face



(A) Chain cover

(B) Oil seal

(C) Front oil seal press-fit position
(1^{+0}_{-1} mm ($0.0039^{+0}_{-0.0039}$ in)
position from chain cover end
face)

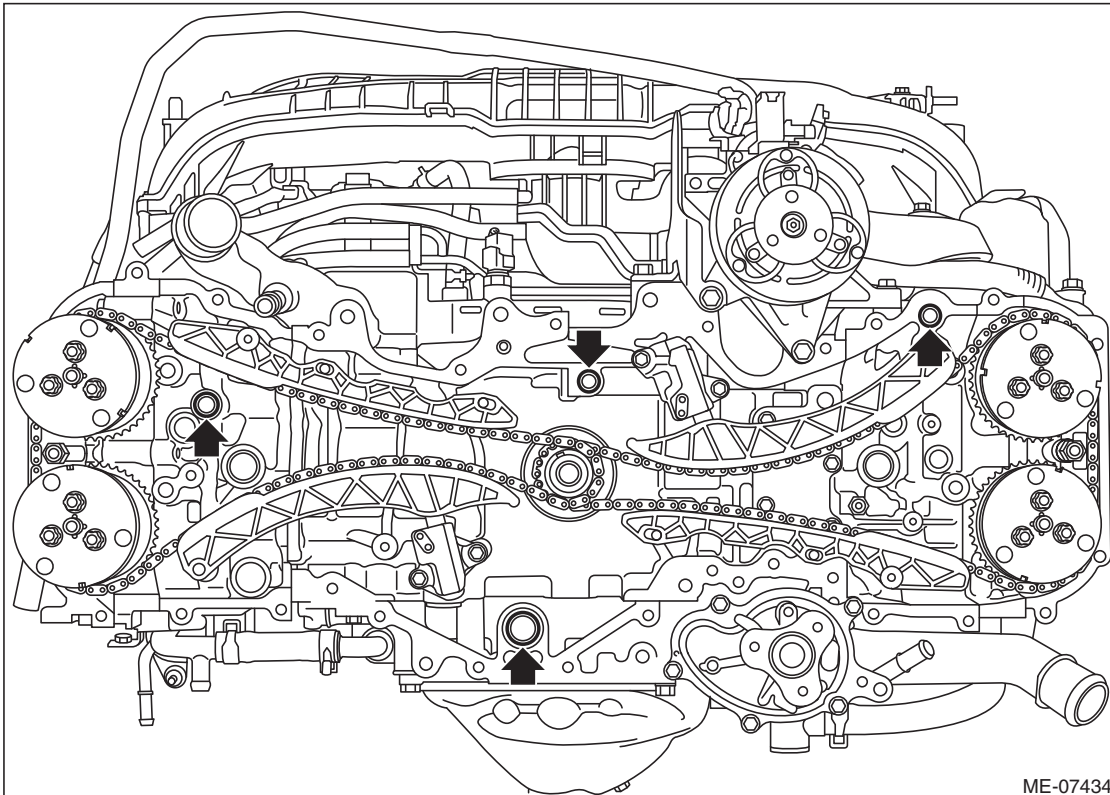
Chain Cover

MECHANICAL

2) Install the O-rings to cylinder head RH, cylinder head LH, cylinder block LH and oil pan upper.

NOTE:

- Use new O-rings.
- Apply a coat of engine oil to the O-rings.



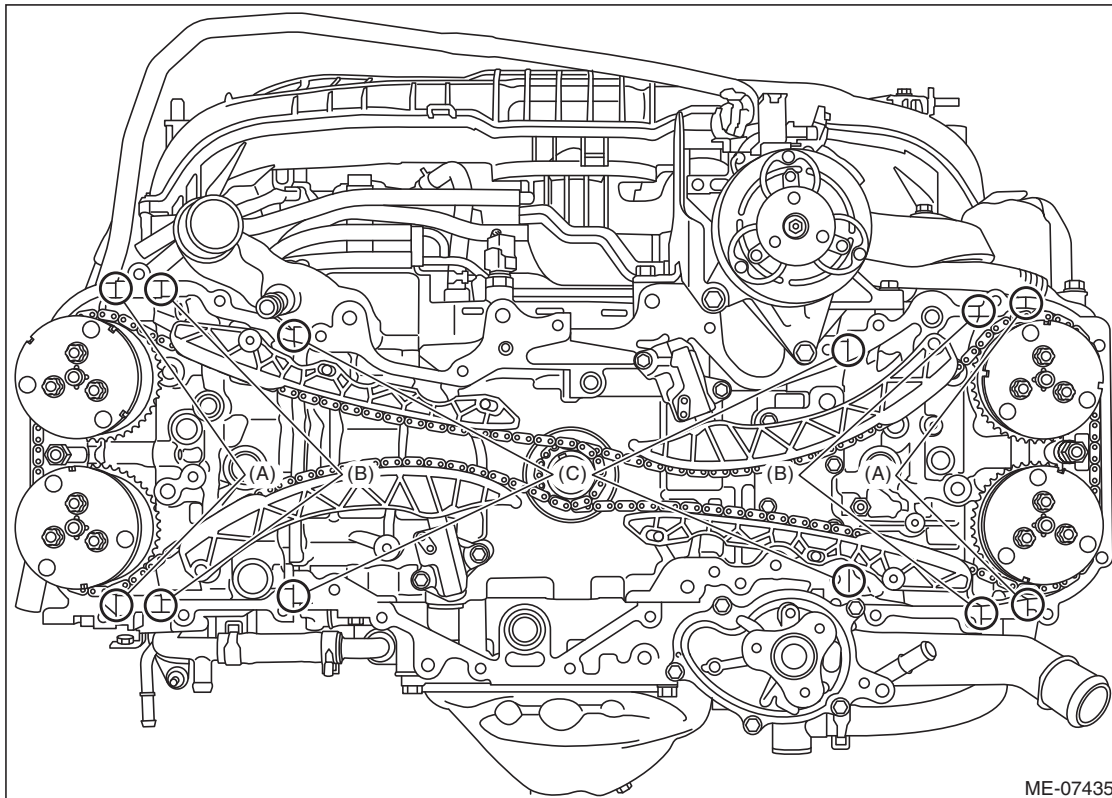
Chain Cover

MECHANICAL

3) Apply liquid gasket if there are gaps between front camshaft cap and cam carrier (A), cam carrier and cylinder head (B), and cylinder head and cylinder block (C) as shown in the figure.

Liquid gasket:

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



Chain Cover

MECHANICAL

4) Apply liquid gasket to the chain cover mating surface and center boss (5 places) as shown in the figure.

NOTE:

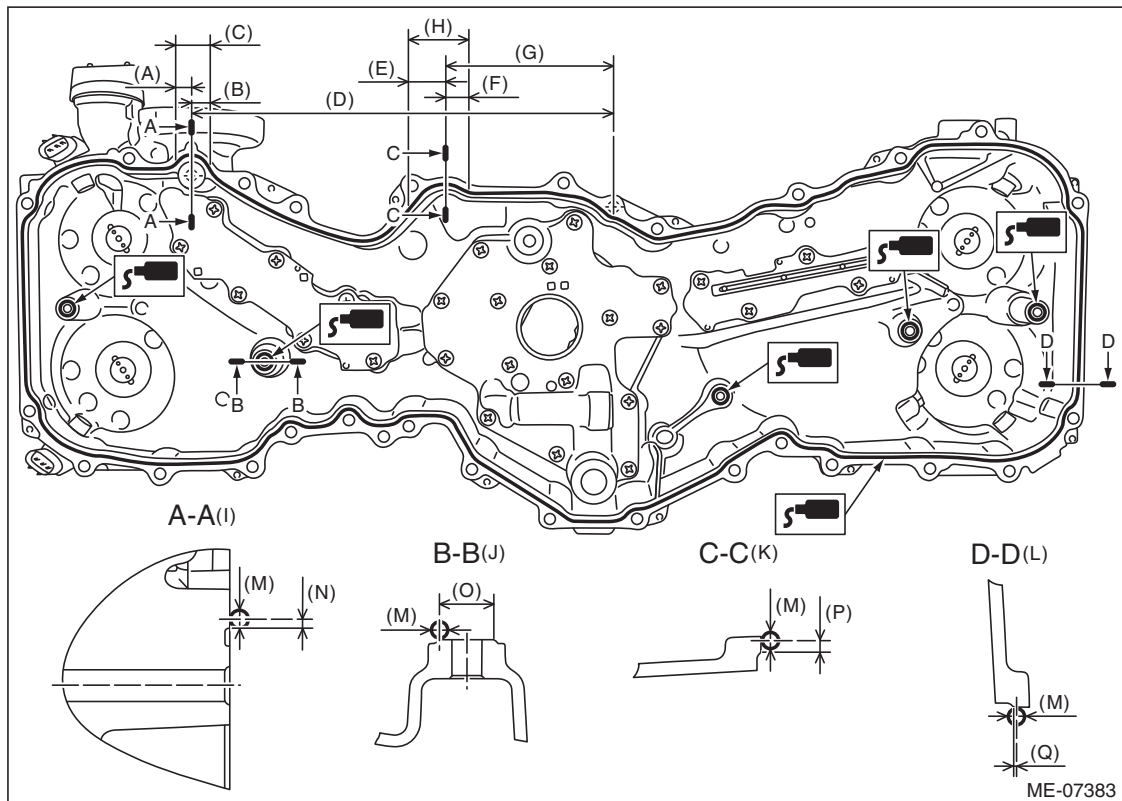
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine and chain cover.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

Liquid gasket applying diameter:

4 ± 0.5 mm (0.1575 ± 0.0197 in)



(A) 14.5 mm (0.5709 in)	(G) 127 mm (5.0000 in)	(M) $\phi 4 \pm 0.5$ mm (0.1575 ± 0.0197 in)
(B) 17.5 mm (0.6890 in)	(H) Range B	(N) 2 mm (0.0787 in)
(C) Range A	(I) Liquid gasket applying position of mating surfaces of range A	(O) $\phi 12$ mm (0.4724 in)
(D) 316.2 mm (12.4488 in)	(J) Liquid gasket applying position of center boss (5 places)	(P) 2.5 mm (0.0984 in)
(E) 24.5 mm (0.9646 in)	(K) Liquid gasket applying position of mating surfaces of range B	(Q) 0.5 mm (0.0197 in)
(F) 18.5 mm (0.7283 in)	(L) Liquid gasket applying position of mating surfaces other than range A and range B	

Chain Cover

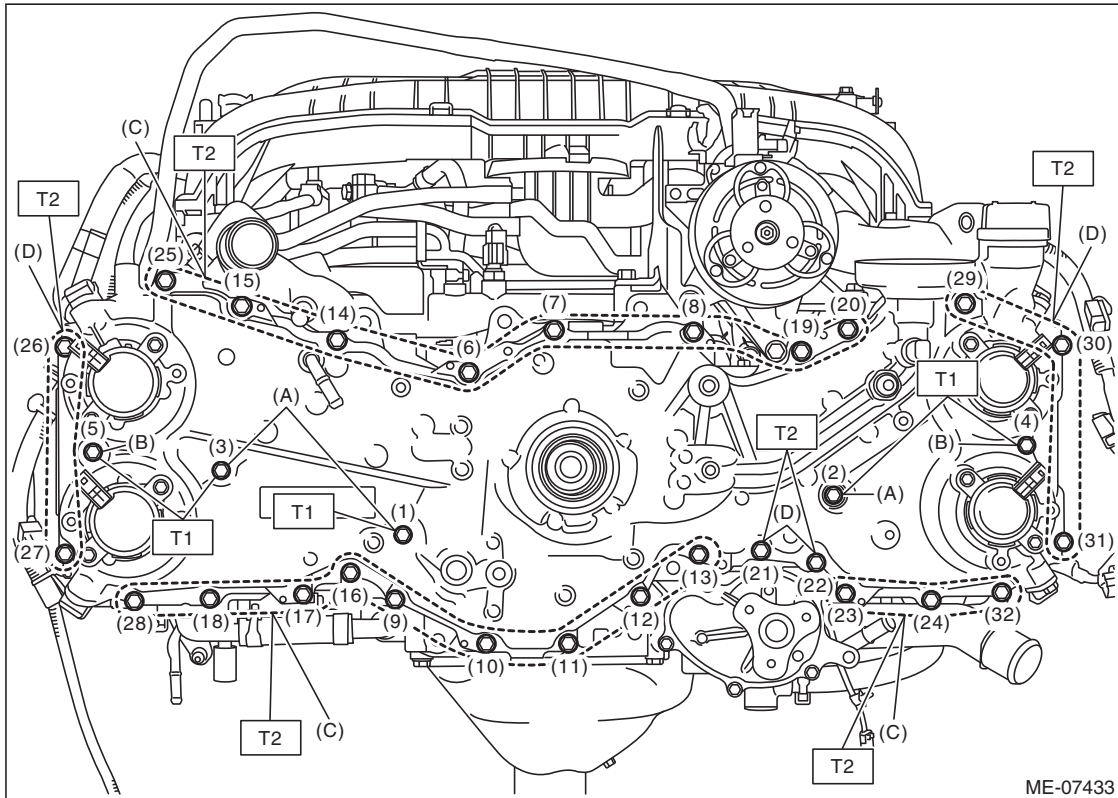
MECHANICAL

5) Set the chain cover, and tighten the bolts in numerical order as shown in the figure.

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.4 ft-lb)

T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)



- (A) M6 × 20
(B) M6 × 50

(C) M8 × 25

(D) M8 × 60

Chain Cover

MECHANICAL

6) Install the idler pulley (D), crank pulley boss (C) and oil level gauge guide (B), and insert the oil level gauge (A).

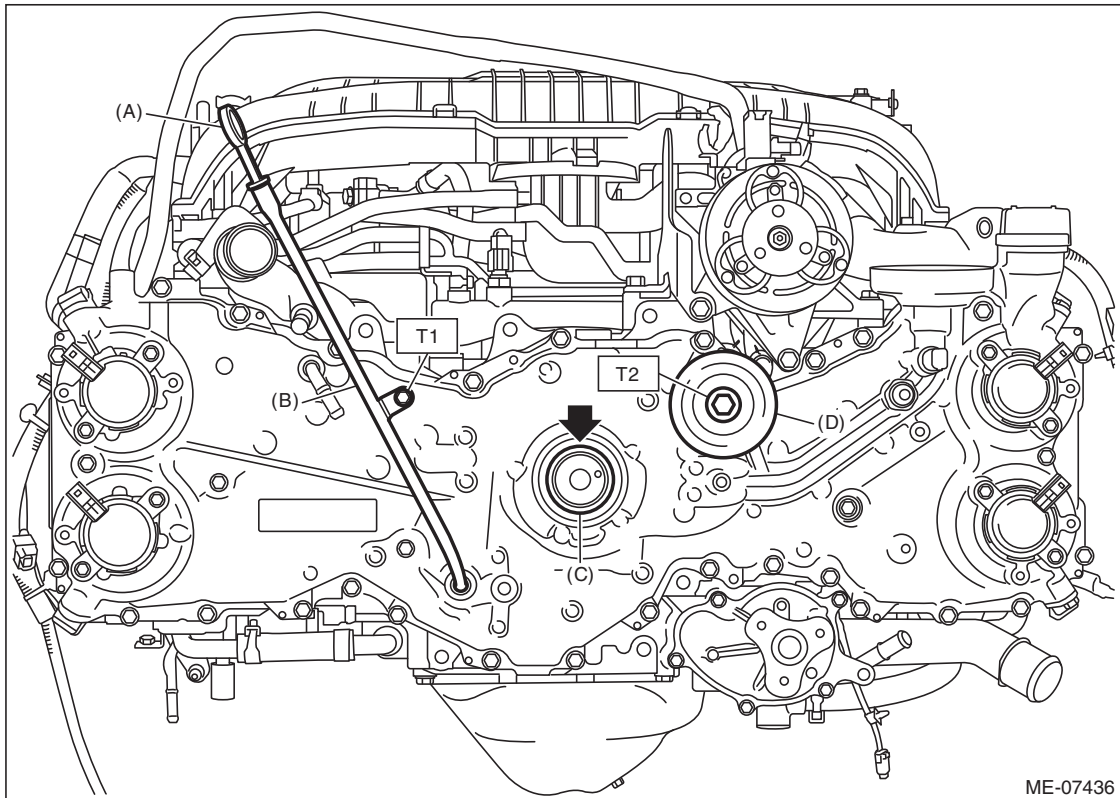
NOTE:

- Use a new O-ring to the oil level gauge guide.
- Apply a light coat of engine oil to the O-rings of the oil level gauge guide and the oil level gauge.

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 36 N·m (3.7 kgf-m, 26.6 ft-lb)



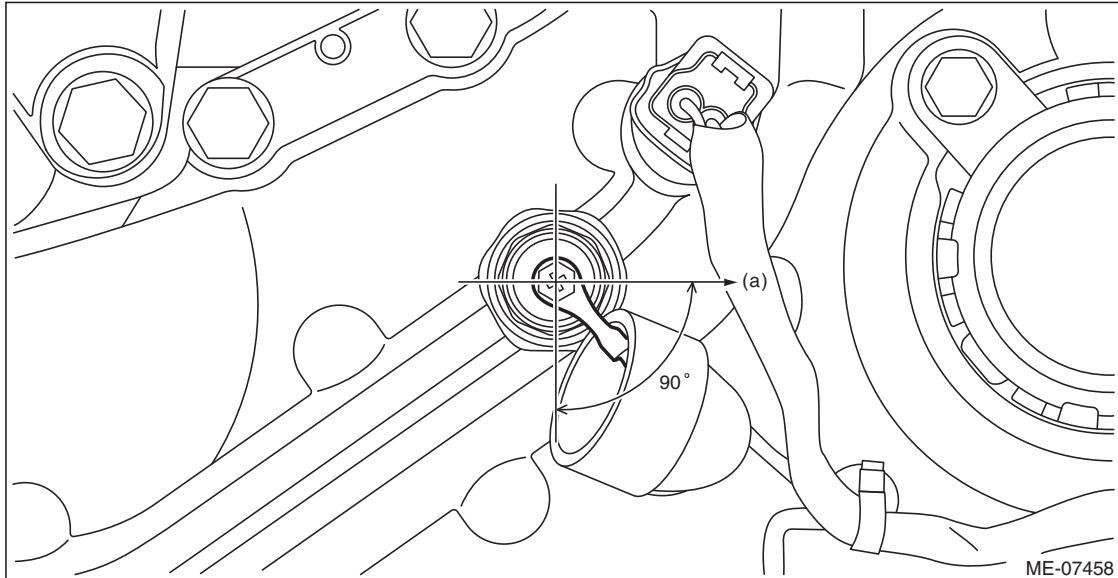
Chain Cover

MECHANICAL

7) Connect the terminal (A) to the oil pressure switch, connector (B) to the engine oil temperature sensor, connector (C) to the intake oil control solenoid LH, connector (D) to the exhaust oil control solenoid LH, and the connector (E) to the intake camshaft position sensor LH, and fix the engine harness using the clip (F).

NOTE:

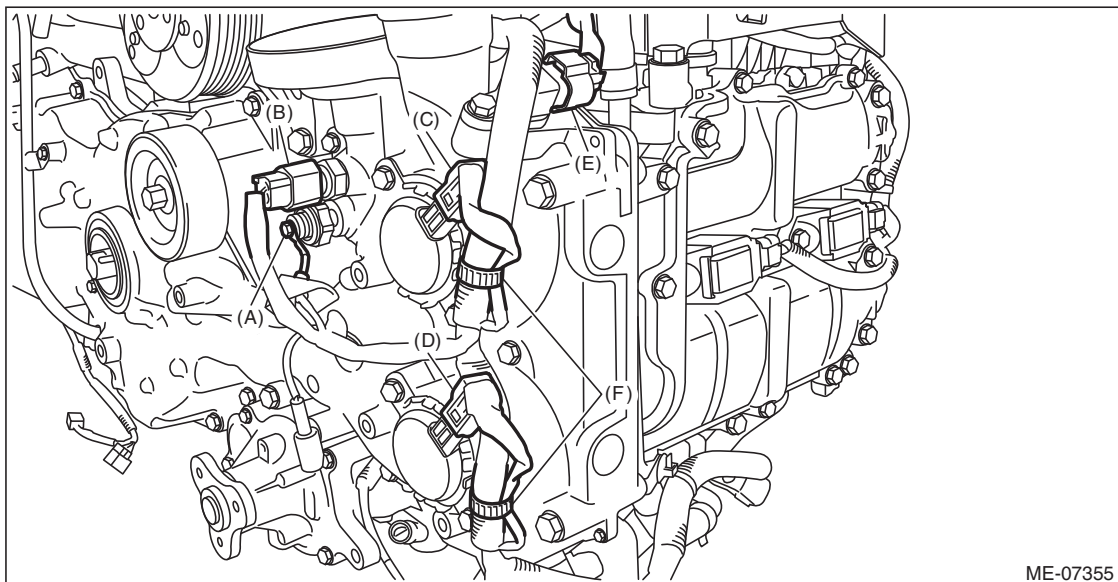
The oil pressure switch harness must be positioned toward the left lower side of the vehicle within the range of 90°.



(a) Left side of vehicle

Tightening torque:

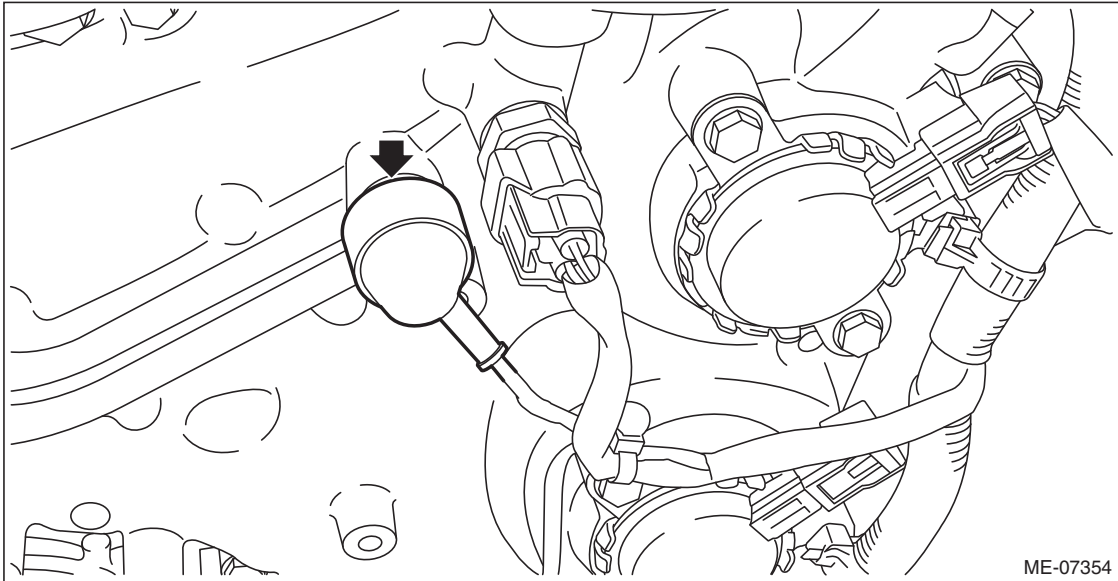
1.5 N·m (0.2 kgf-m, 1.1 ft-lb)



Chain Cover

MECHANICAL

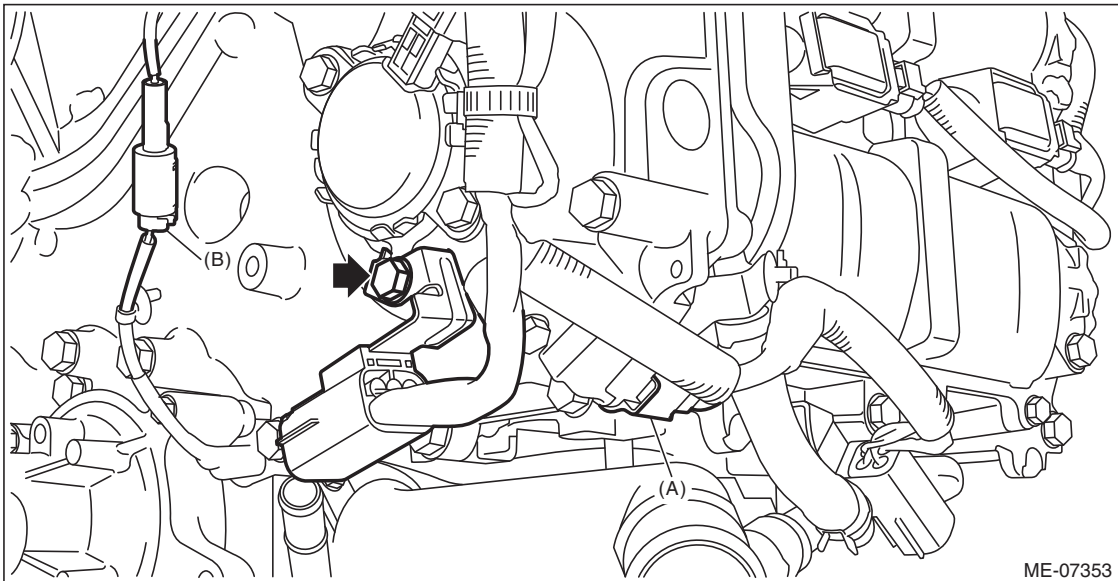
8) Attach the rubber cap to the oil pressure switch.



9) Connect the connector (A) to the exhaust camshaft position sensor LH and the connector (B) to the oil level switch, and install the engine harness stay to the chain cover.

Tightening torque:

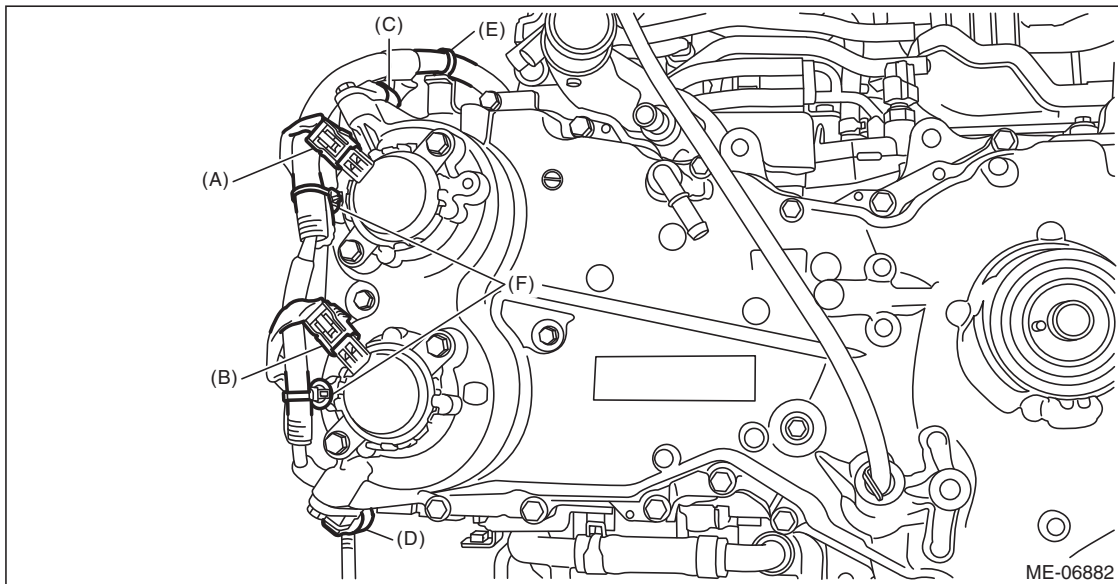
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Chain Cover

MECHANICAL

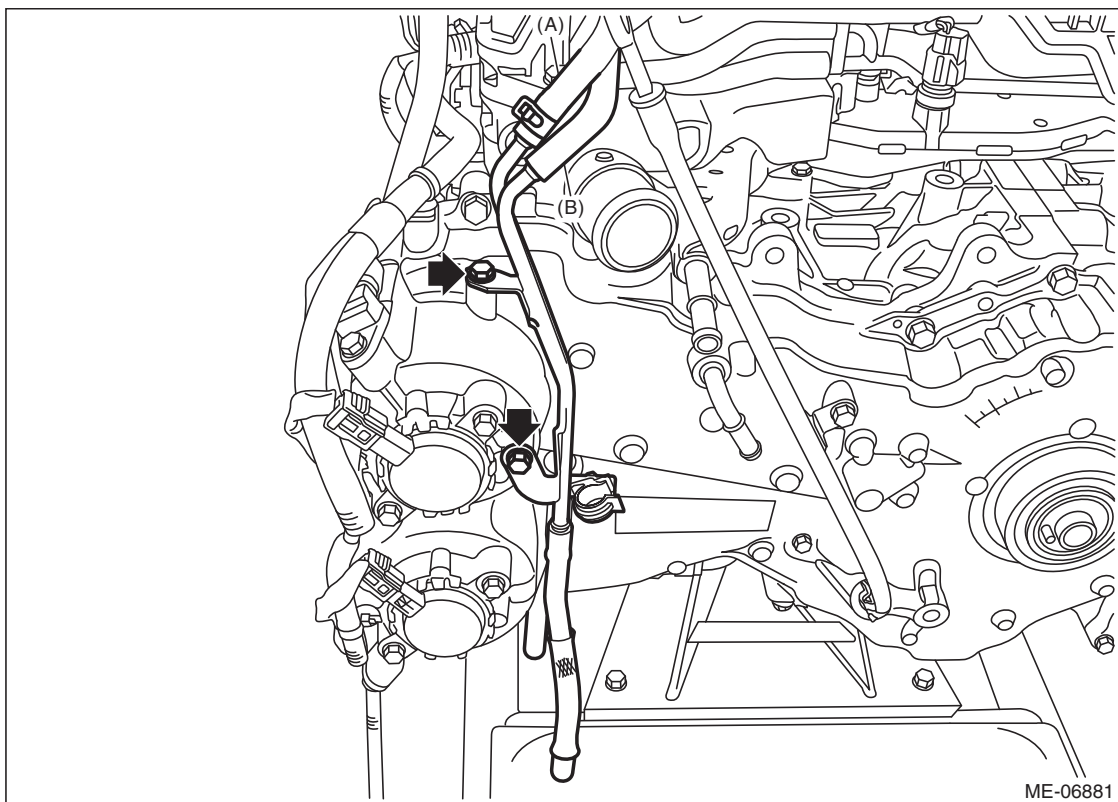
10) Connect the connector (A) to the intake oil control solenoid RH, connector (B) to the exhaust oil control solenoid RH, connector (C) to the intake camshaft position sensor RH, and the connector (D) to the exhaust camshaft position sensor RH, and then fix the engine harness using the clips (E) and (F).



11) Install the vacuum pipe assembly to the chain cover, and connect the vacuum control hose (A) and vacuum hose (B) to the vacuum pipe assembly.

Tightening torque:

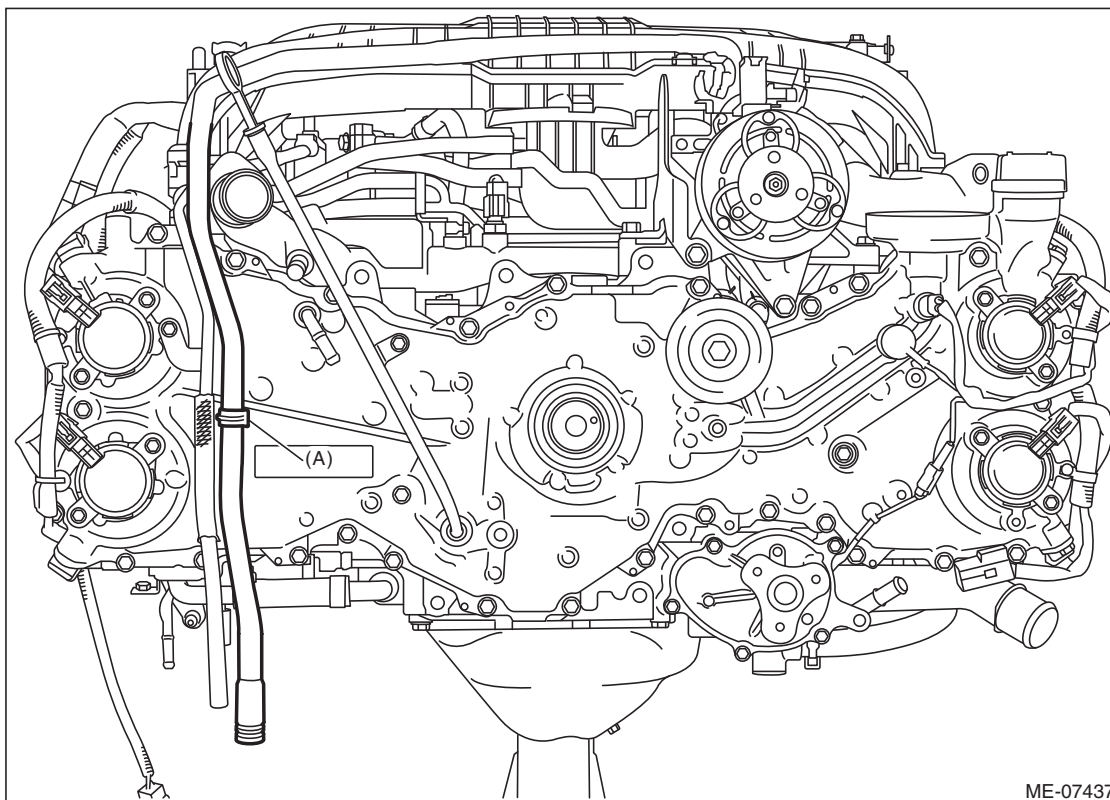
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



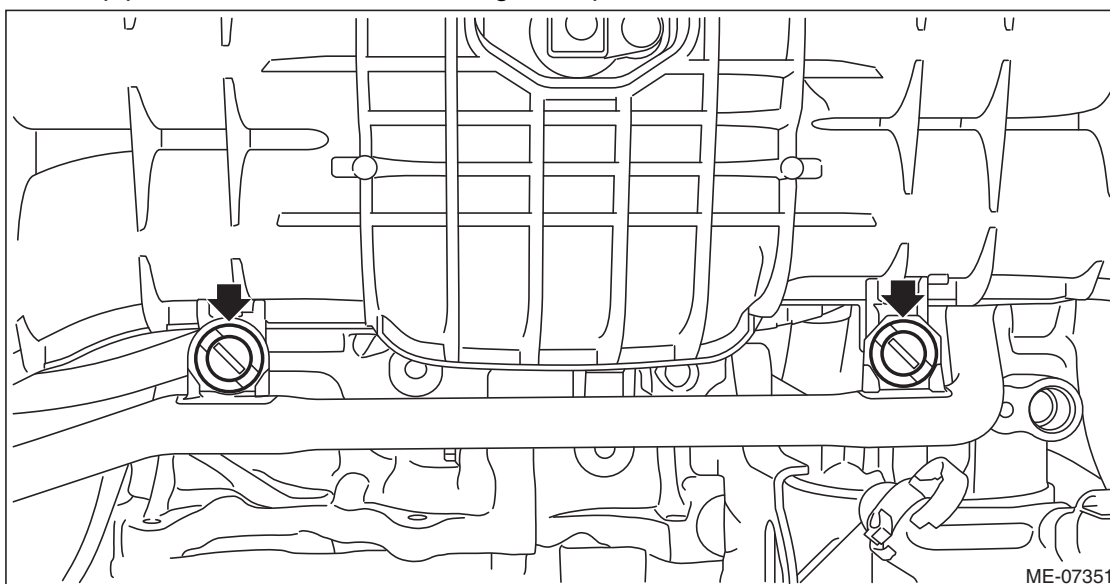
Chain Cover

MECHANICAL

- 12) Install the PCV pipe to the clip (A).



- 13) Fix the PCV pipe to the intake manifold using the clip.



Chain Cover

MECHANICAL

14) When worked on the engine unit only

NOTE:

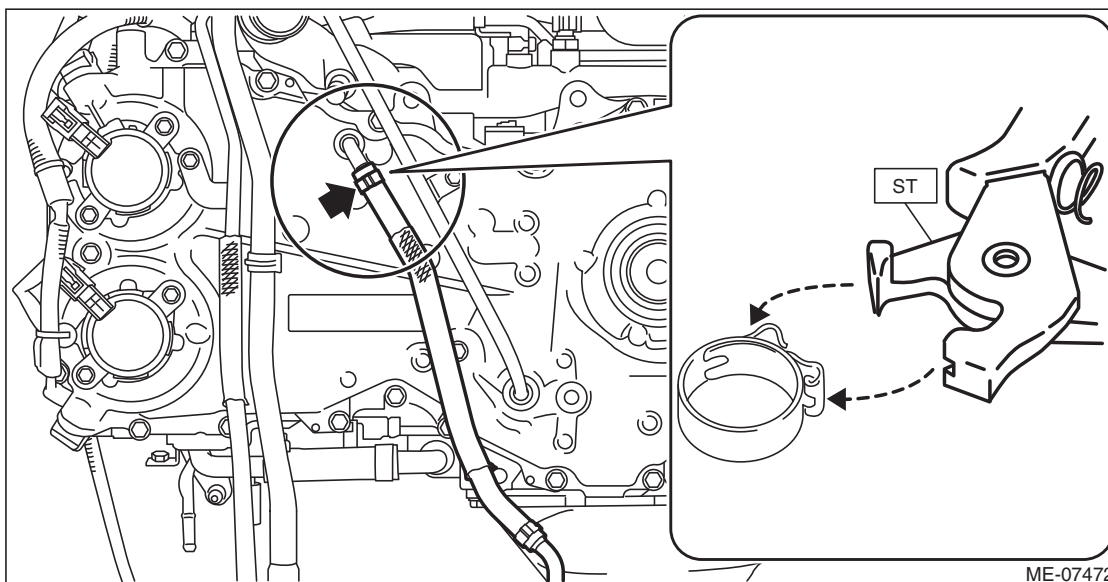
When work was done on the engine unit only, also perform the following steps.

(1) Install the PCV hose assembly together with the oil catch tank to the chain cover.

NOTE:

Use a new clamp. To connect the PCV hose assembly, fit the cut outs of the ST with the protrusions on the clamp as shown in the figure, squeeze the ST's handles together and lock the clamp.

ST 18353AA000 CLAMP PLIERS



15) Install the front engine oil cooler pipe assembly. <Ref. to LU(H4DO)-51, FRONT ENGINE OIL COOLER PIPE, INSTALLATION, Engine Oil Cooler Pipe.>

16) Attach the engine oil cooler. <Ref. to LU(H4DO)-47, INSTALLATION, Engine Oil Cooler.>

17) Install the crank pulley. <Ref. to ME(H4DOTC)-84, INSTALLATION, Crank Pulley.>

18) Install the water pump pulley. <Ref. to CO(H4DOTC)-17, WATER PUMP, INSTALLATION, Water Pump.>

19) Install the generator. <Ref. to SC(H4DO)-42, INSTALLATION, Generator.>

20) Install the V-belts. <Ref. to ME(H4DOTC)-78, V-BELT, INSTALLATION, V-belt.>

21) Fill engine oil. <Ref. to LU(H4DO)-14, REPLACEMENT, Engine Oil.>

22) When working on the vehicle

NOTE:

When working on the vehicle, perform the following steps also.

(1) Install the front exhaust pipe. <Ref. to EX(H4DOTC)-15, INSTALLATION, Front Exhaust Pipe.>

(2) Install the intake duct No. 1 and intake duct No. 2. <Ref. to IN(H4DOTC)-26, INTAKE DUCT NO. 1, INSTALLATION, Intake Duct.> <Ref. to IN(H4DOTC)-29, INTAKE DUCT NO. 2, INSTALLATION, Intake Duct.>

(3) Install the radiator. <Ref. to CO(H4DOTC)-44, INSTALLATION, Radiator.>

Chain Cover

MECHANICAL

C: DISASSEMBLY

1) When removal work was done on the vehicle

NOTE:

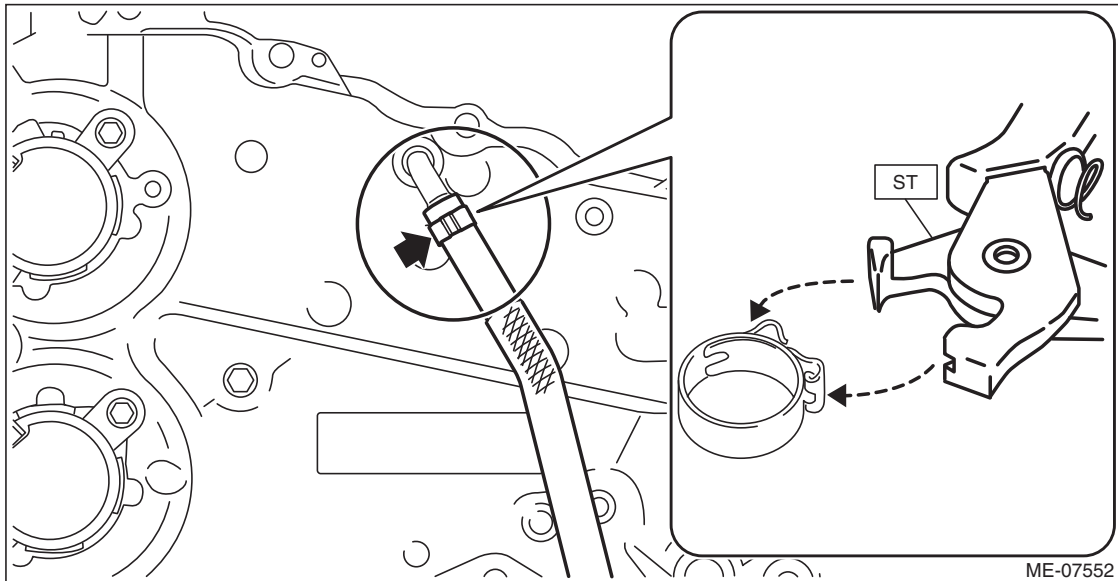
When removal work was done on the vehicle, also perform the following steps.

(1) Remove the PCV hose assembly together with the oil catch tank from the chain cover.

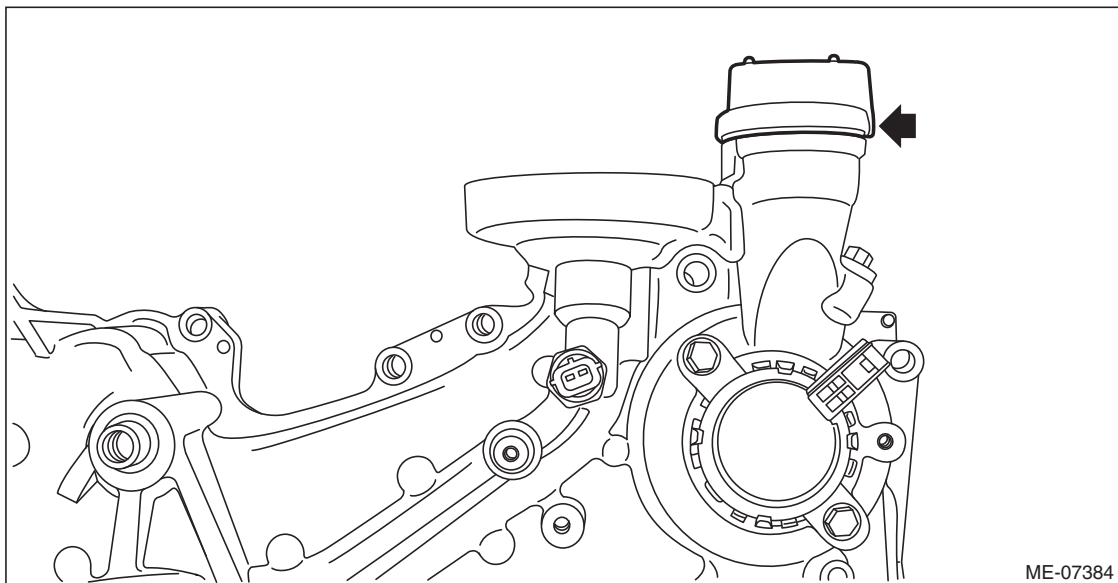
NOTE:

To disconnect the PCV hose assembly, fit the cut outs of the ST with the protrusions on the clamp as shown in the figure, squeeze the ST's handles together and unlock the clamp.

ST 18353AA000 CLAMP PLIERS



2) Remove the oil filler cap.



3) Remove the oil pressure switch. <Ref. to LU(H4DO)-42, REMOVAL, Oil Pressure Switch.>

4) Remove the engine oil temperature sensor. <Ref. to FU(H4DOTC)-96, REMOVAL, Engine Oil Temperature Sensor.>

5) Remove the oil control solenoid. <Ref. to FU(H4DOTC)-109, REMOVAL, Oil Control Solenoid.>

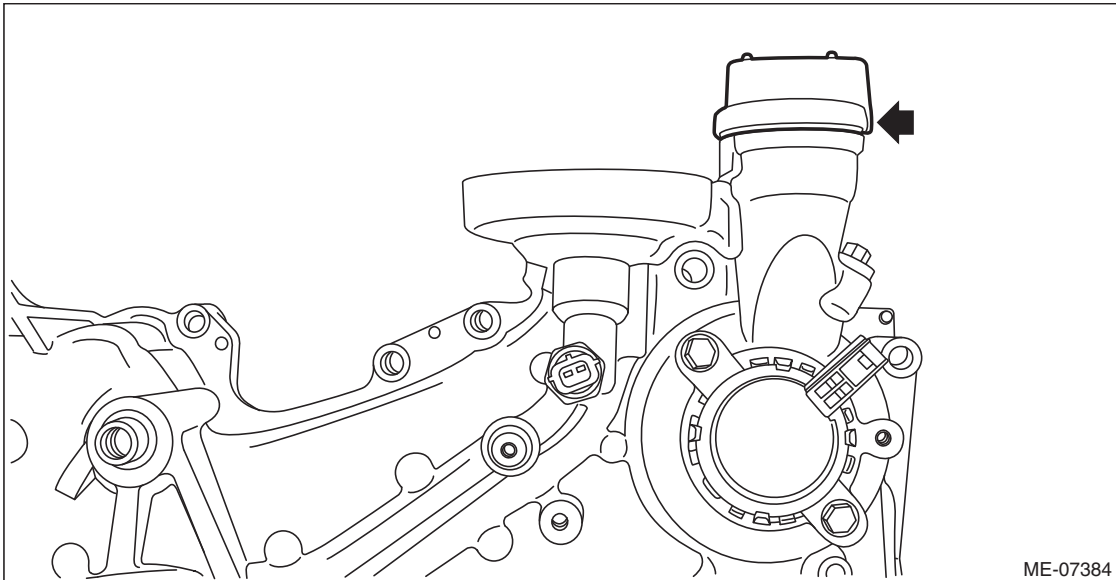
6) Remove the camshaft position sensor. <Ref. to FU(H4DOTC)-104, REMOVAL, Camshaft Position Sensor.>

Chain Cover

MECHANICAL

D: ASSEMBLY

- 1) Install the camshaft position sensor. <Ref. to FU(H4DOTC)-105, INSTALLATION, Camshaft Position Sensor.>
- 2) Install the oil control solenoid. <Ref. to FU(H4DOTC)-110, INSTALLATION, Oil Control Solenoid.>
- 3) Install the engine oil temperature sensor. <Ref. to FU(H4DOTC)-96, INSTALLATION, Engine Oil Temperature Sensor.>
- 4) Install the oil pressure switch. <Ref. to LU(H4DO)-43, INSTALLATION, Oil Pressure Switch.>
- 5) Install the oil filler cap.



- 6) When installation work is done on the vehicle

NOTE:

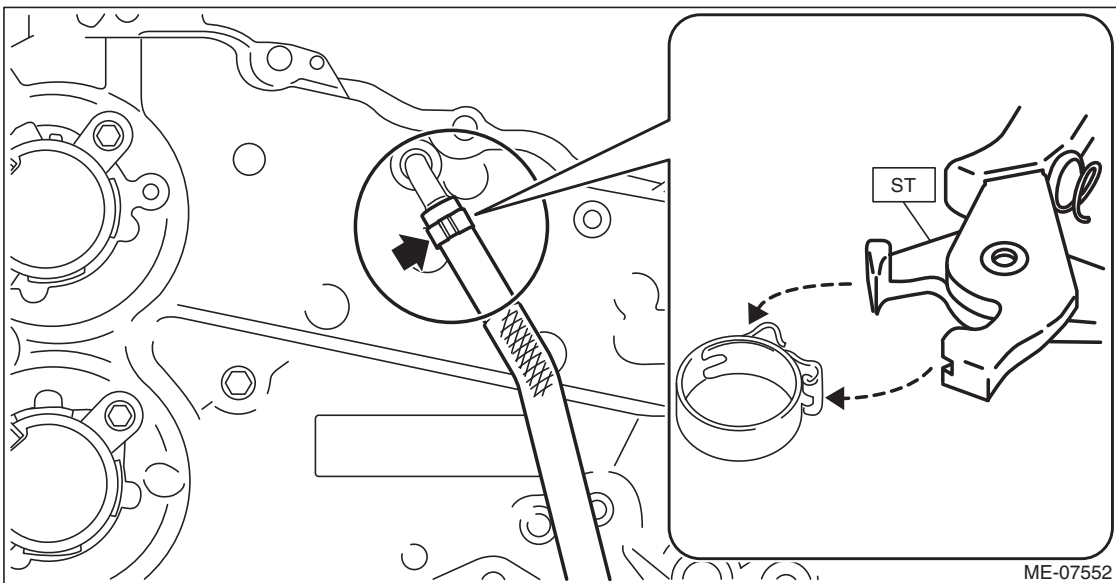
When installation work is done on the vehicle, also perform the following steps.

- (1) Install the PCV hose assembly together with the oil catch tank to the chain cover.

NOTE:

Use a new clamp. To connect the PCV hose assembly, fit the cut outs of the ST with the protrusions on the clamp as shown in the figure, squeeze the ST's handles together and lock the clamp.

ST 18353AA000 CLAMP PLIERS



Chain Cover

MECHANICAL

E: INSPECTION

Check that the chain cover does not have deformation, cracks and any other damage.

15. Timing Chain Assembly

A: REMOVAL

1. TIMING CHAIN RH

NOTE:

When replacing a single part, perform the work with the engine assembly installed to body.

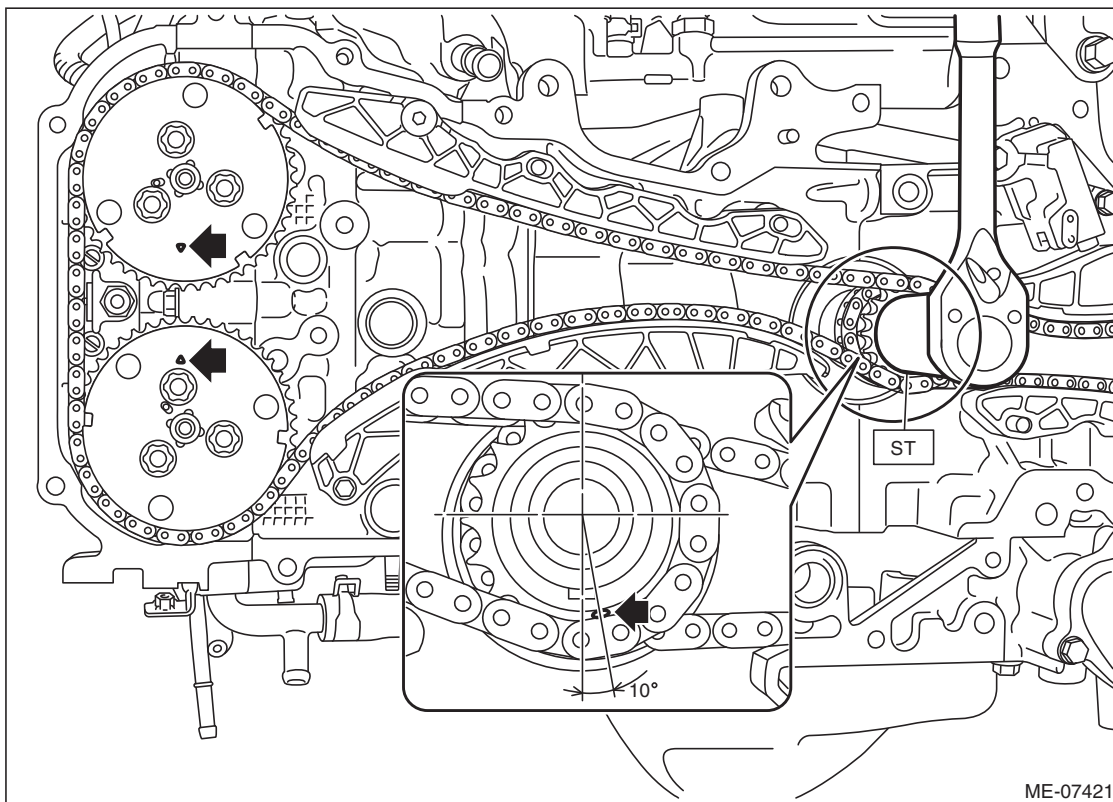
1) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>

2) Using ST and by turning the crankshaft, align the alignment marks of crank sprocket, intake cam sprocket RH and exhaust cam sprocket RH to the positions as shown in the figure.

NOTE:

If the alignment marks are aligned to the positions as shown in the figure, the crankshaft key is located at six o'clock position.

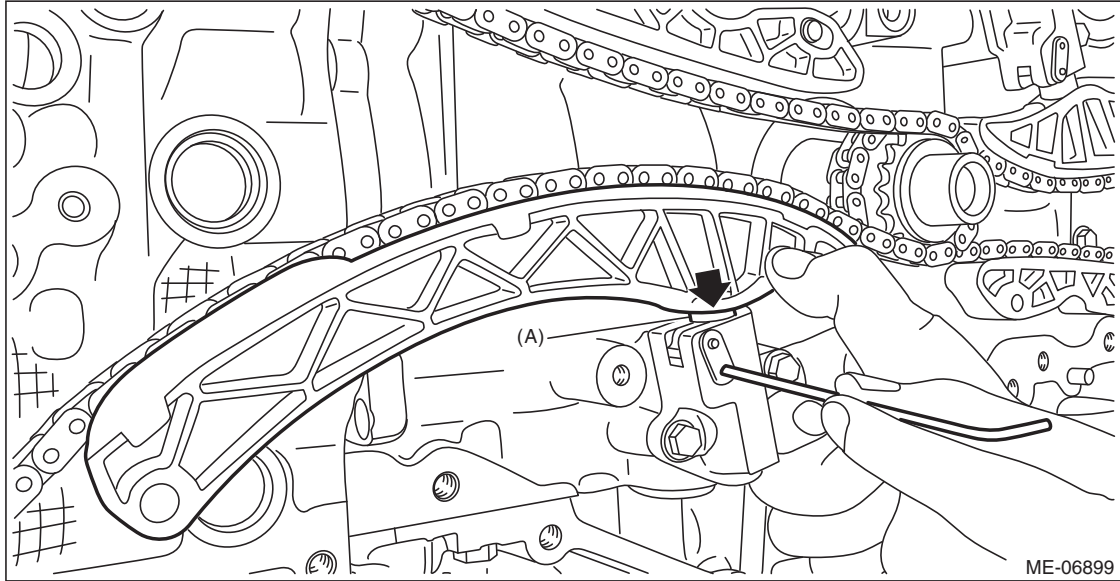
ST 18252AA000 CRANKSHAFT SOCKET



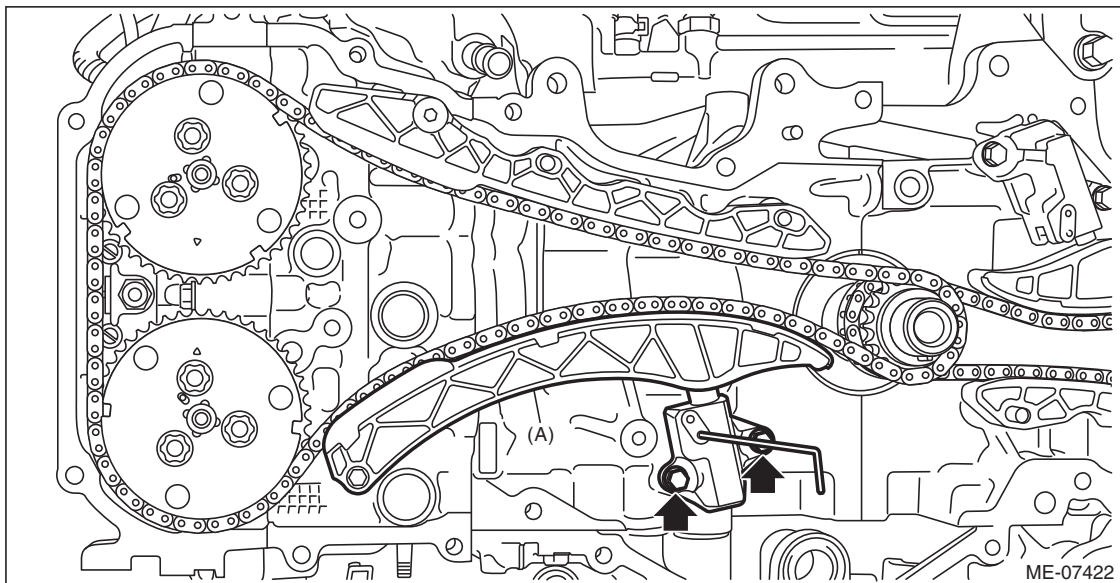
Timing Chain Assembly

MECHANICAL

3) Push down the chain lever tensioner RH, and with a 2.5 mm (0.98 in) dia. stopper pin or a 2.5 mm (0.98 in) dia. hex wrench inserted into the stopper pin hole in the chain tensioner RH, secure the plunger (A).



4) Remove the chain tensioner RH, and remove the chain tensioner lever RH (A).



Timing Chain Assembly

MECHANICAL

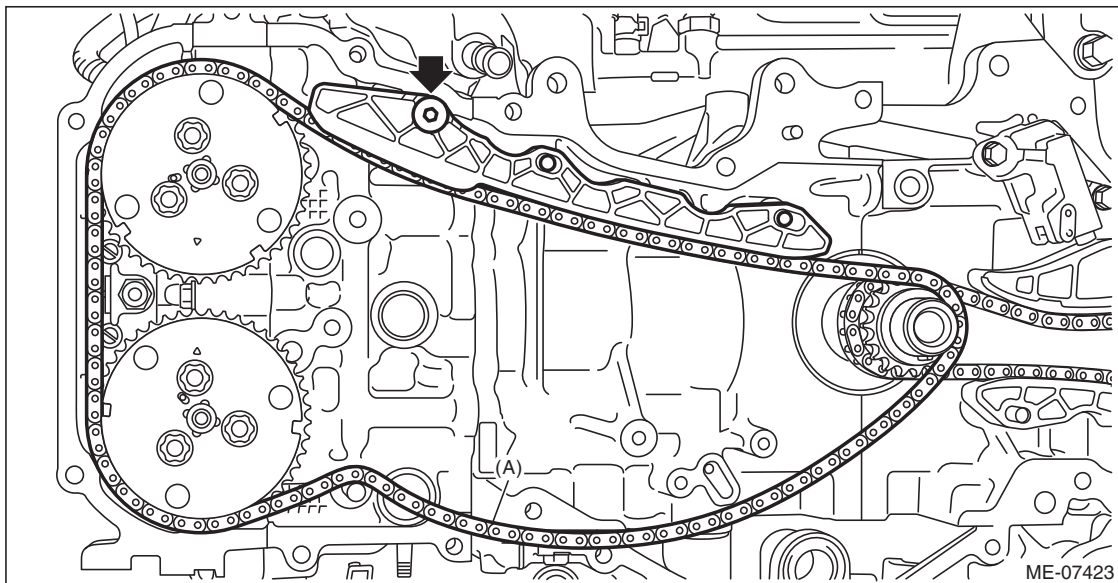
5) Remove the chain guide RH, and remove the timing chain RH (A).

CAUTION:

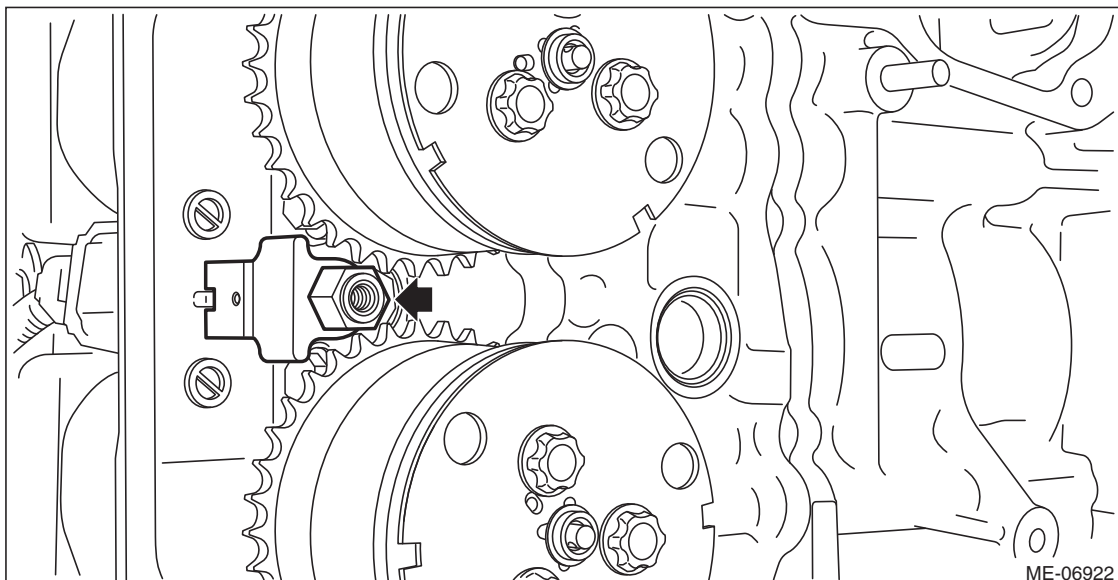
- If the timing chain RH is not installed, the intake camshaft RH and exhaust camshaft RH are kept at zero-lift position. All cams on the camshaft are not pressing down the roller rocker arm (intake valve and exhaust valve). (Under this condition, all valves remain unlifted.)
- Intake camshaft RH and exhaust camshaft RH can be independently rotated with the timing chain RH removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero-lift (in range where it can be turned lightly by hand).

NOTE:

To avoid mixing with LH side, keep the removed part in order.



6) Remove the chain guide RH from the front camshaft cap RH.



Timing Chain Assembly

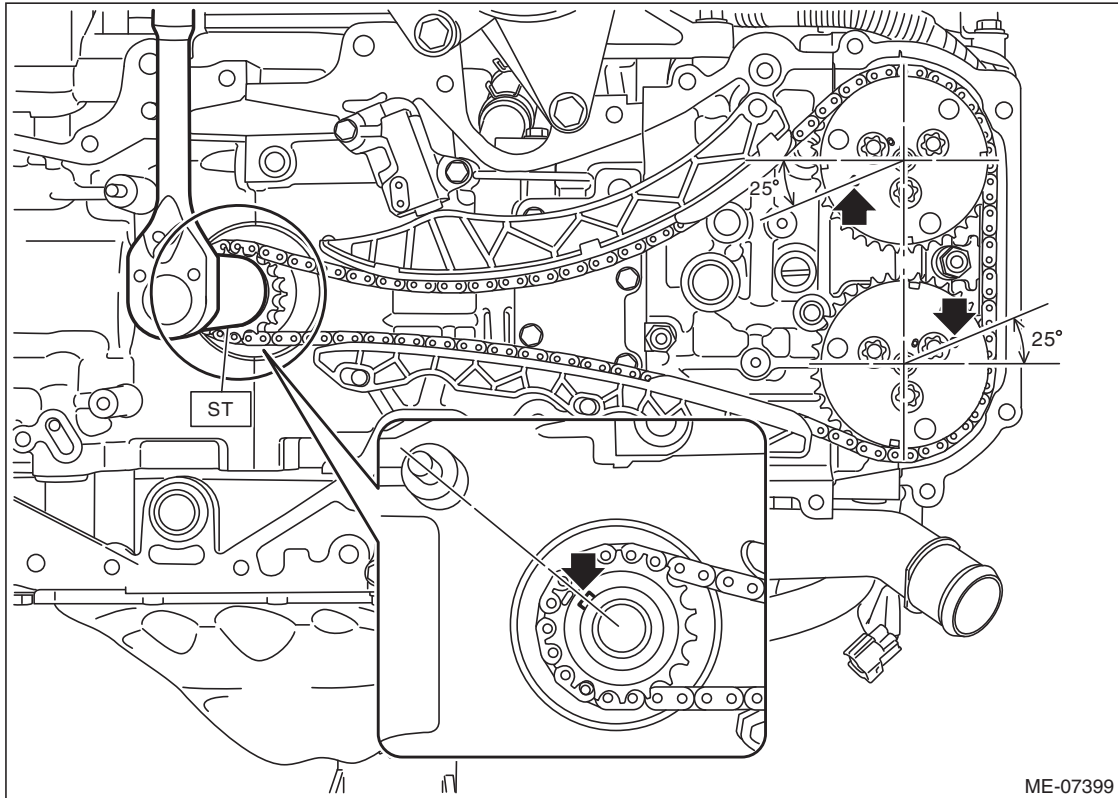
MECHANICAL

2. TIMING CHAIN LH

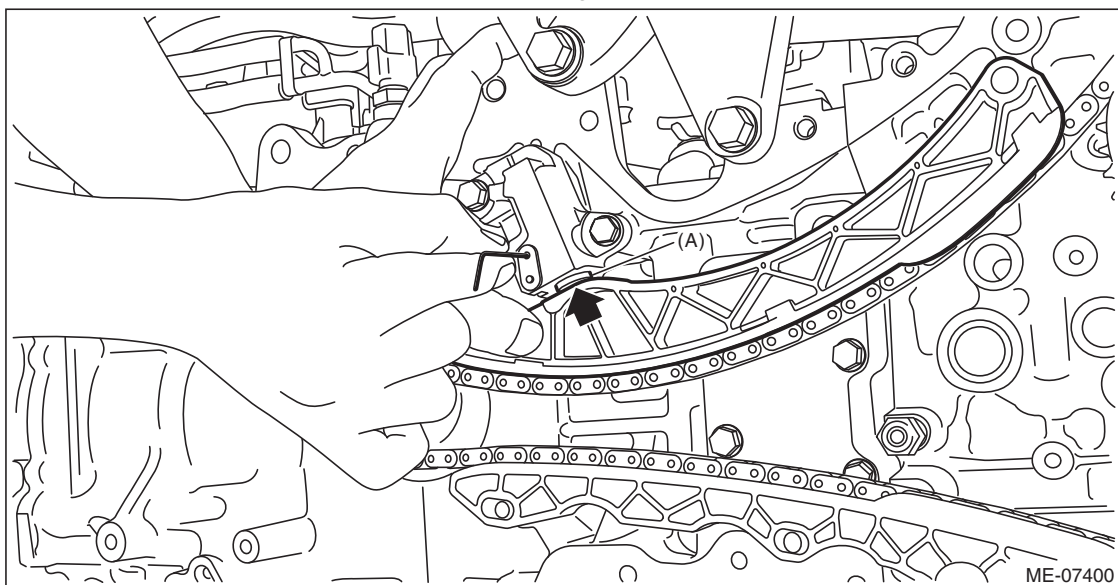
1) Remove the timing chain RH. <Ref. to ME(H4DOTC)-111, TIMING CHAIN RH, REMOVAL, Timing Chain Assembly.>

2) Using ST and by turning the crankshaft, align the alignment marks of crankshaft key, intake cam sprocket LH and exhaust cam sprocket LH to the positions as shown in the figure.

ST 18252AA000 CRANKSHAFT SOCKET



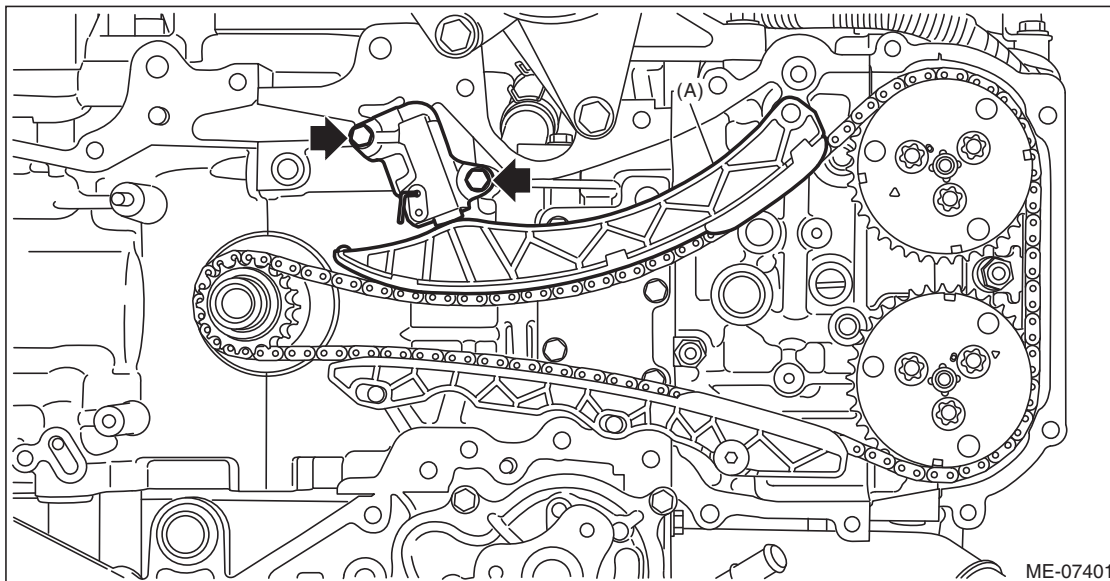
3) Push up the chain tensioner lever LH as shown in the figure, and with a stopper pin measuring 1.3 mm (0.05 in) dia. or less (clips, etc.), or with a hex wrench measuring 1.3 mm (0.05 in) dia. inserted into the stopper pin hole in the chain tensioner LH, secure the plunger (A).



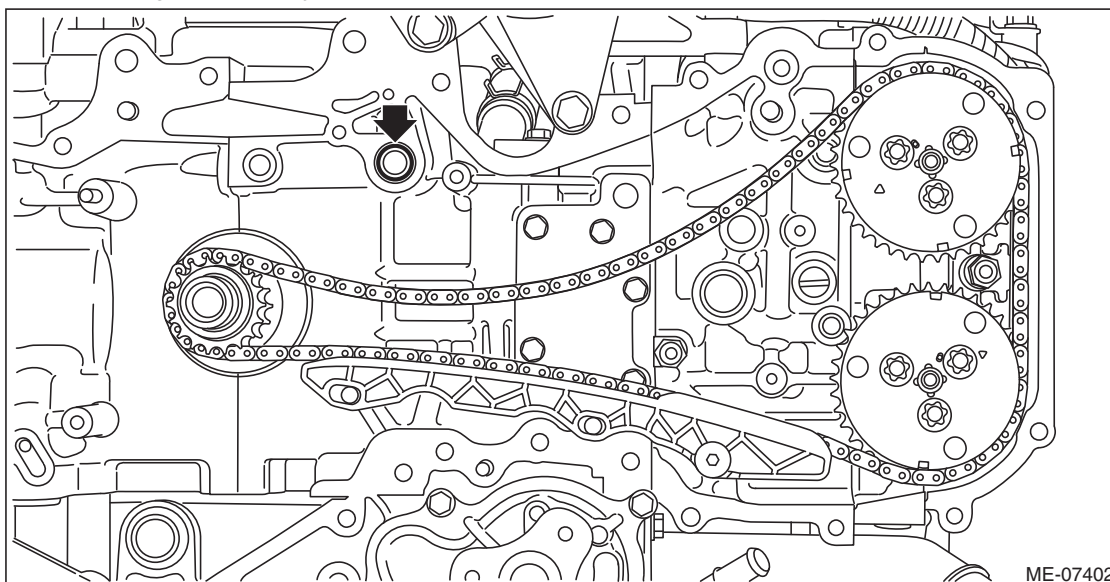
Timing Chain Assembly

MECHANICAL

- 4) Remove the chain tensioner LH, and remove the chain tensioner lever LH (A).



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



Timing Chain Assembly

MECHANICAL

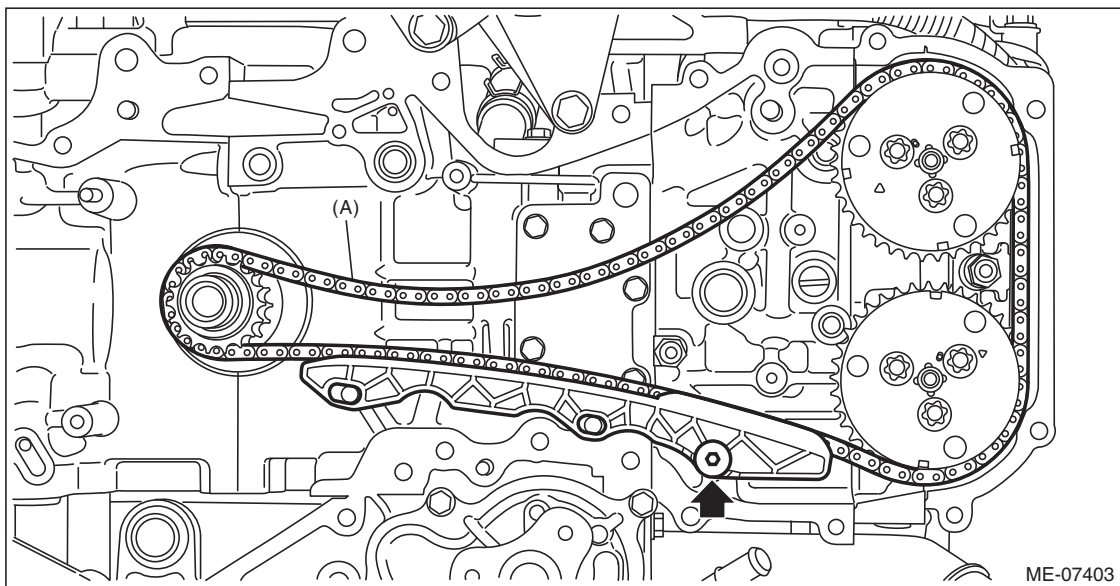
6) Remove the chain guide LH, and remove the timing chain LH (A).

CAUTION:

- If the timing chain LH is not installed, the exhaust camshaft LH is kept at zero-lift position. All cams on the exhaust camshaft LH are not pressing down the roller rocker arm (exhaust valve). (Under this condition, exhaust valves remain unlifted.)
- Intake camshaft LH is kept at lift position. All cams on the intake camshaft LH are pressing down the roller rocker arm (intake valve). (Under this condition, intake valves remain lifted.)
- Intake camshaft LH and exhaust camshaft RH can be independently rotated with the timing chain LH removed. When the exhaust camshaft LH is turned, the valve heads contact each other and valve stem may bend as described in above. Do not turn the exhaust camshaft LH to the outside of range of zero-lift (in range where it can be turned lightly by hand).
- #1 piston and #4 piston are located near TDC. If the intake camshaft LH is turned, the valve and the piston may contact and valve stem may bend. Do not turn the intake camshaft LH at this time.

NOTE:

To avoid mixing with RH side, keep the removed part in order.



Timing Chain Assembly

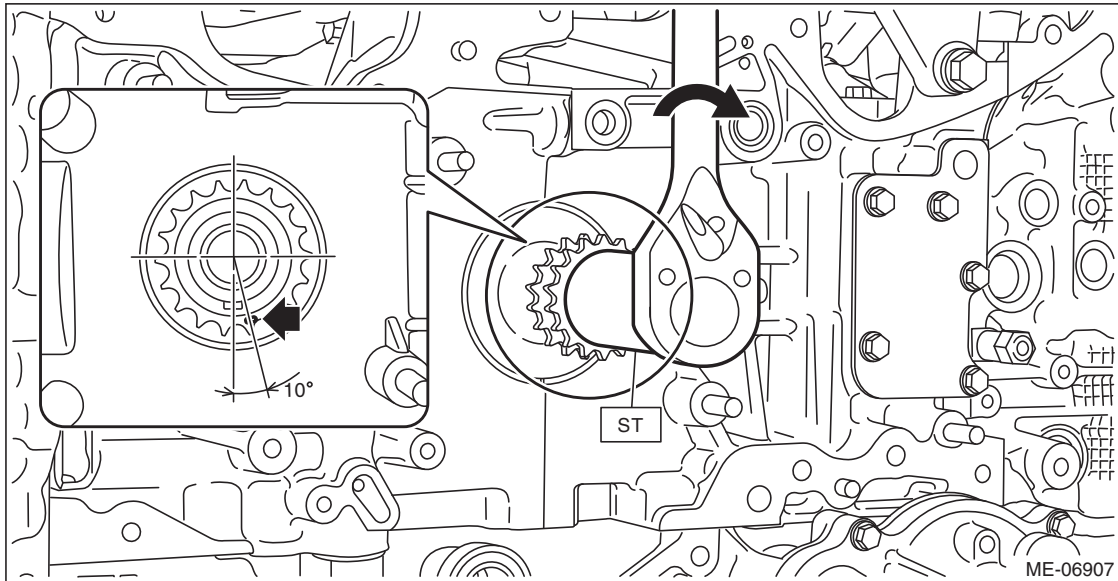
MECHANICAL

7) Using ST and by turning the crankshaft approximately 200° clockwise, align the alignment marks of crank sprocket to the positions as shown in the figure.

CAUTION:

- This procedure is required to prevent the valve and piston contacting with each other, by moving the all pistons to the middle of the cylinders.
- Never turn counterclockwise because the valve and piston may contact. Counterclockwise turn is allowed only when adjusting precisely the alignment marks, after turning the crank sprocket alignment mark clockwise near the position as shown in the figure.

ST 18252AA000 CRANKSHAFT SOCKET



Timing Chain Assembly

MECHANICAL

8) Using ST and by turning the intake cam sprocket LH approximately 130°, align the alignment marks of intake cam sprocket LH to the positions (zero-lift position) as shown in the figure.

CAUTION:

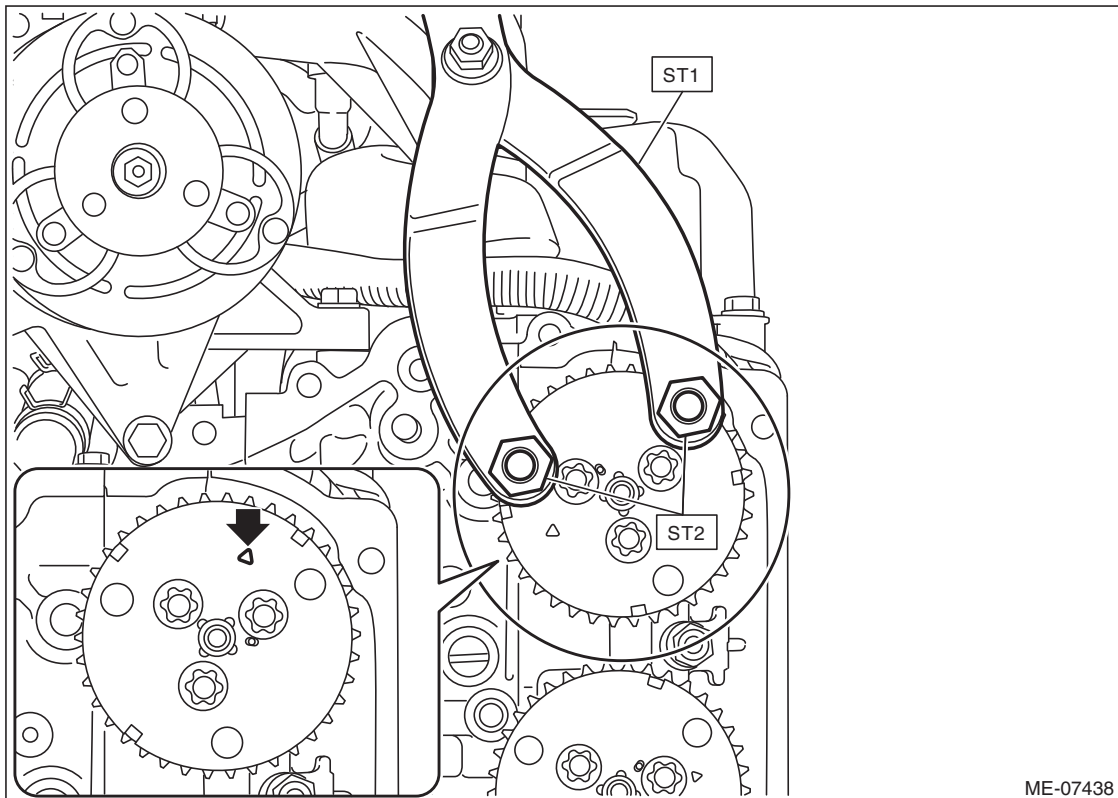
After this work, when the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn the intake camshaft LH and exhaust camshaft LH to the outside of range of zero-lift (in range where it can be turned lightly by hand).

NOTE:

Intake camshaft LH has three peaks of drive sections for the high-pressure fuel pump. Therefore, there is little range where it can be turned lightly by hand in zero-lift position.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

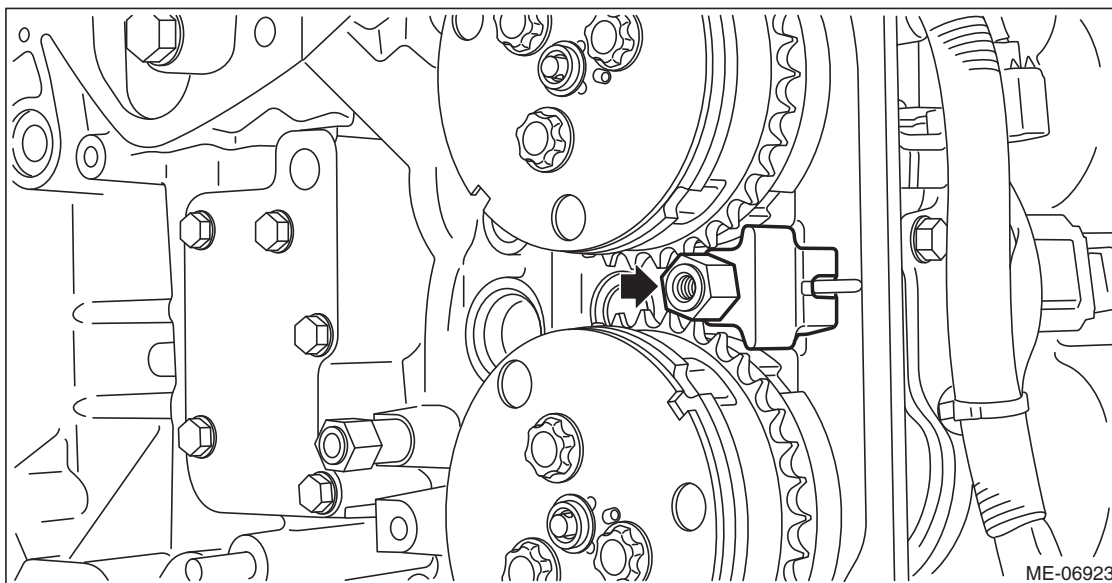


ME-07438

Timing Chain Assembly

MECHANICAL

- 9) Remove the chain guide LH from the front camshaft cap LH.



Timing Chain Assembly

MECHANICAL

B: INSTALLATION

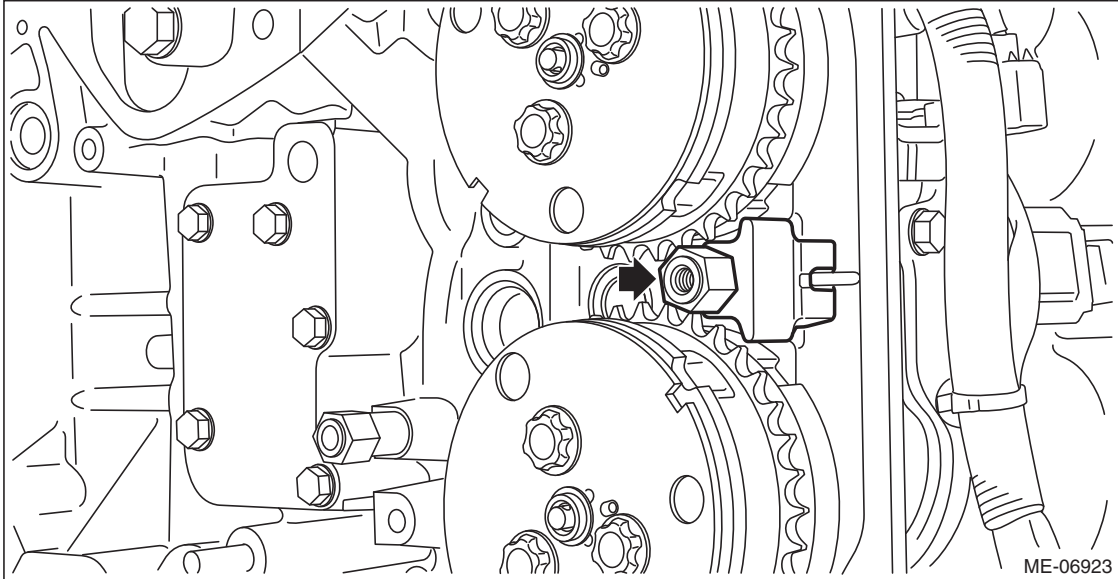
1. TIMING CHAIN LH

NOTE:

- Be careful that the foreign matter is not into or onto the assembled component during installation.
 - Apply engine oil to all component parts of the timing chain.
- 1) Install the chain guide LH to the front camshaft cap LH.

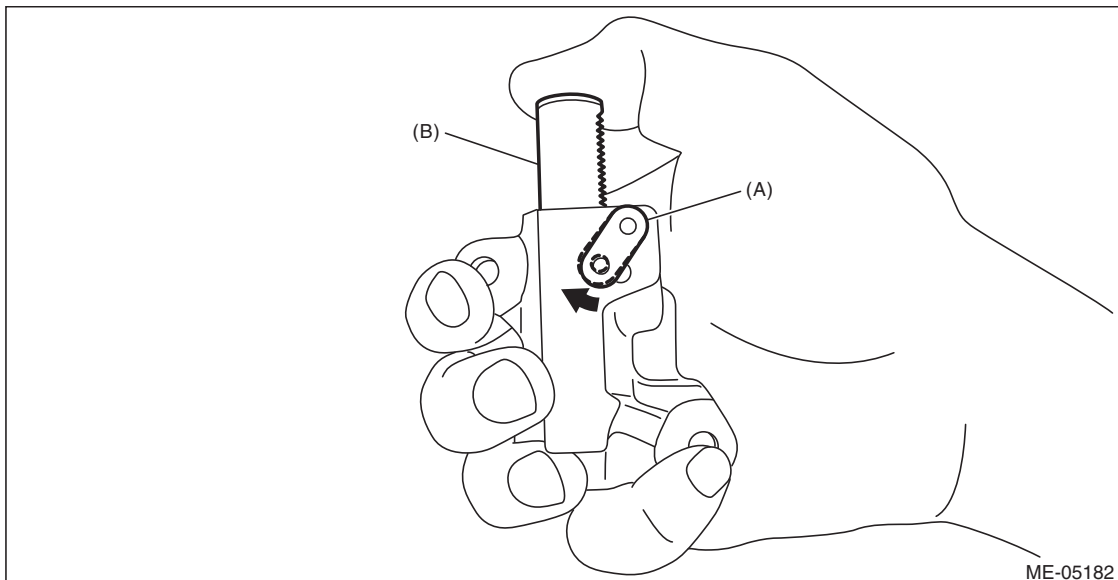
Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



2) Prepare to attach the chain tensioner LH.

- (1) Move the link plate (A) in the direction of arrow to press in the plunger (B).



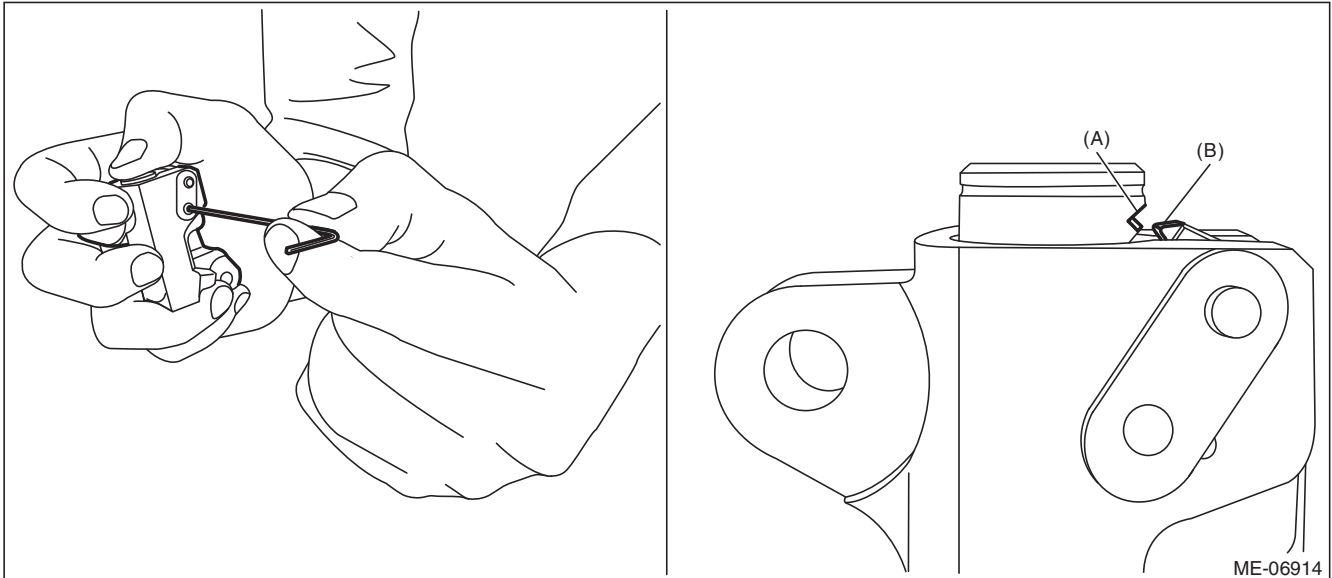
Timing Chain Assembly

MECHANICAL

- (2) With a stopper pin measuring 1.3 mm (0.05 in) dia. or less (clips, etc.) or a hex wrench measuring 1.3 mm (0.05 in) dia. inserted into the stopper pin hole, secure the plunger.

NOTE:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of plunger rack (A) is engaged with the stopper tooth (B). If not engaged, retract the plunger a little so that the first notch of plunger rack (A) is engaged with the stopper tooth (B).

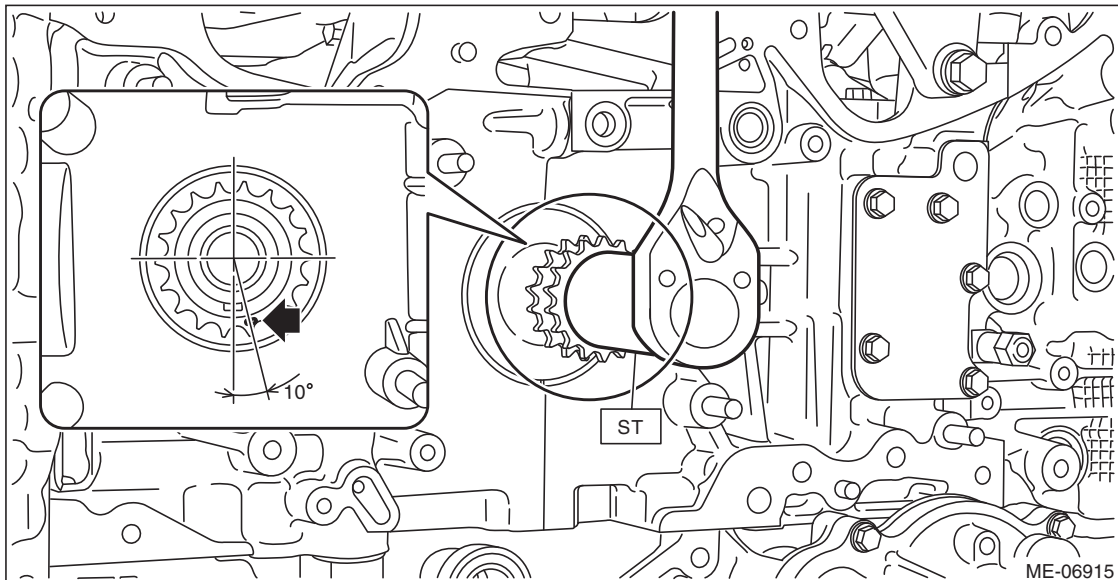


- 3) Check that the crank sprocket is located at the position shown in the figure. If not aligned, using ST turn the crankshaft to align the crank sprocket alignment mark to the position shown in the figure.

NOTE:

This procedure is required to prevent the valve and piston contacting with each other in the next step.

ST 18252AA000 CRANKSHAFT SOCKET



Timing Chain Assembly

MECHANICAL

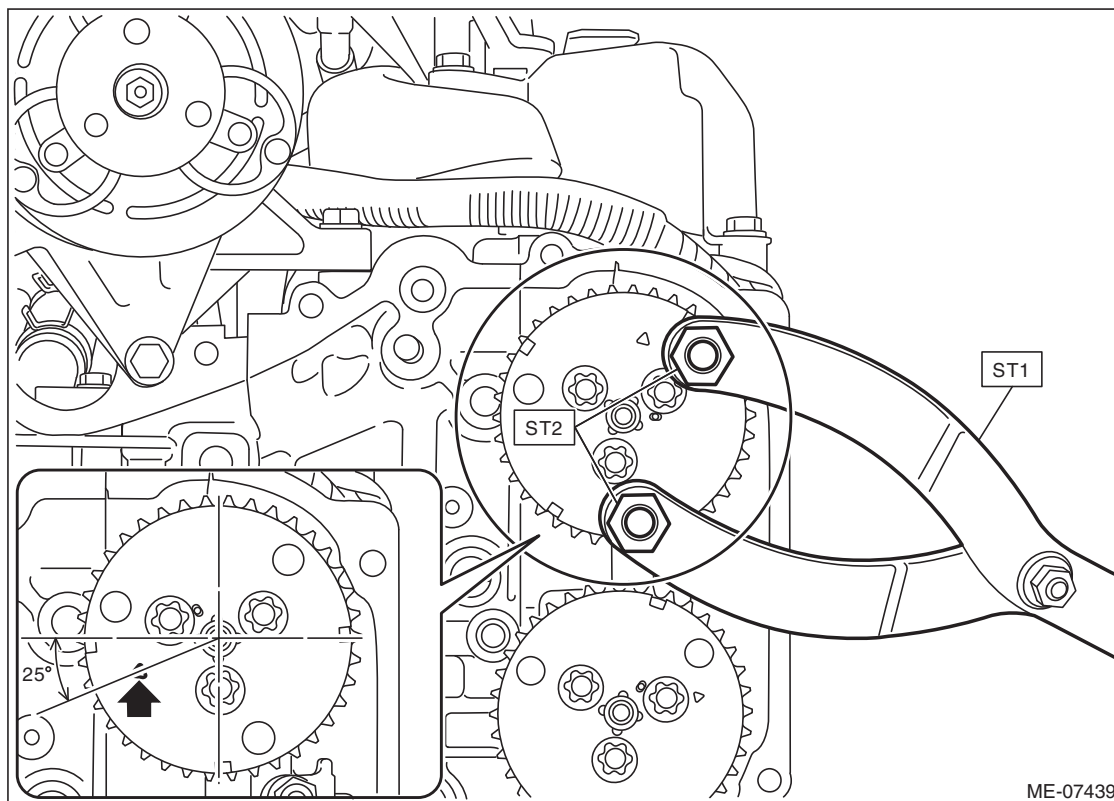
4) Using ST and by turning the intake cam sprocket LH, align the alignment marks to the positions as shown in the figure.

CAUTION:

When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn the exhaust camshaft LH.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET



Timing Chain Assembly

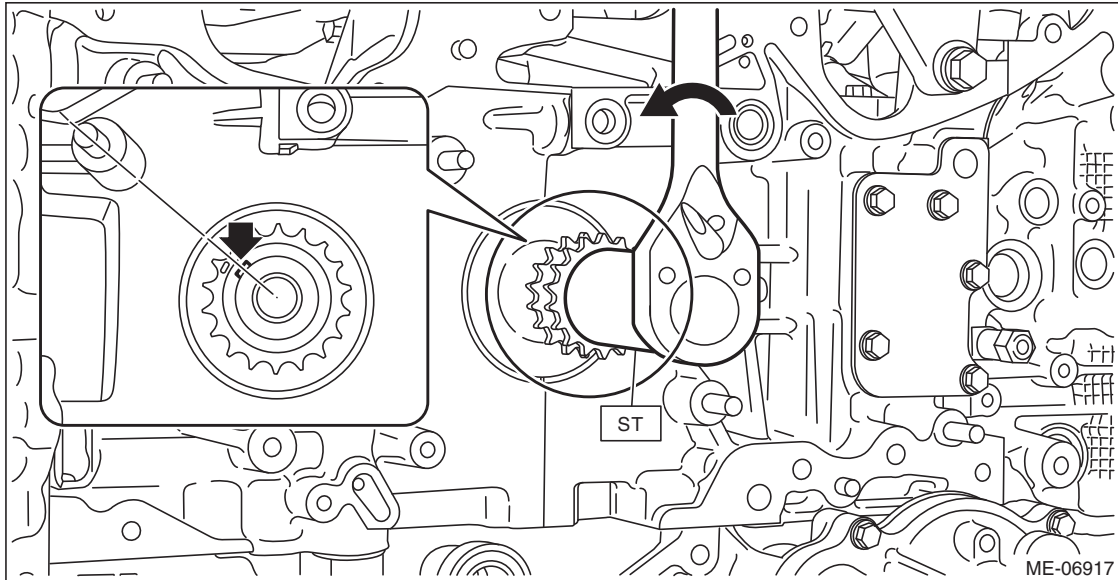
MECHANICAL

5) Using ST and by turning the crankshaft approximately 130° counterclockwise, align the alignment marks of crankshaft key to the positions as shown in the figure.

CAUTION:

Never turn clockwise because the valve and piston may contact. Clockwise turn is allowed only when adjusting the key position precisely, after turning the crankshaft counterclockwise to bring the key near the position as shown in the figure.

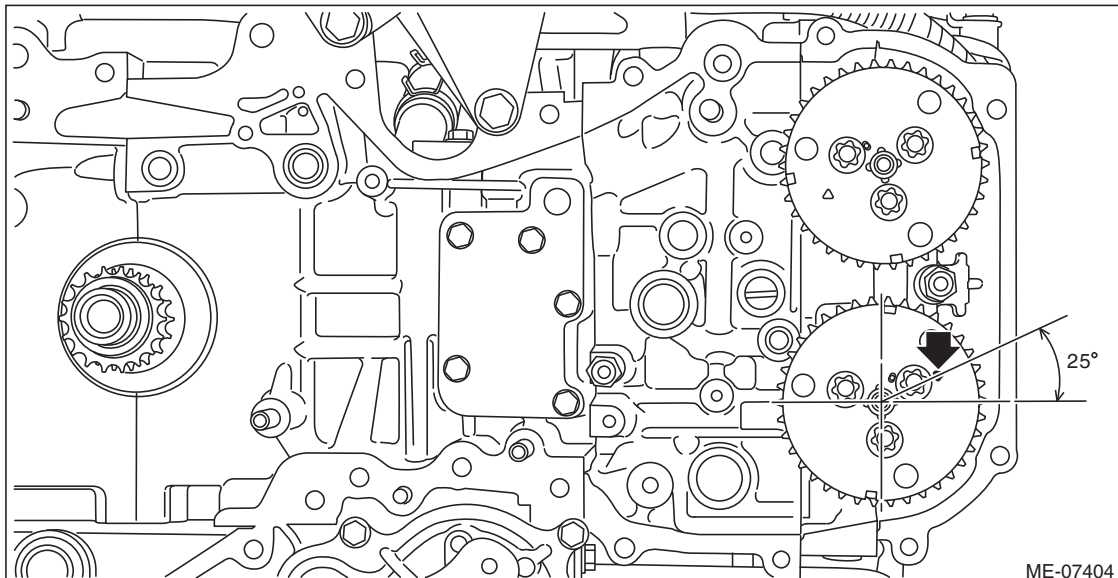
ST 18252AA000 CRANKSHAFT SOCKET



6) Align the alignment mark of exhaust cam sprocket LH to the position shown in the figure.

CAUTION:

To prevent valve damage, turn the exhaust cam sprocket LH only within the range of zero-lift (in range where it can be turned lightly by hand).



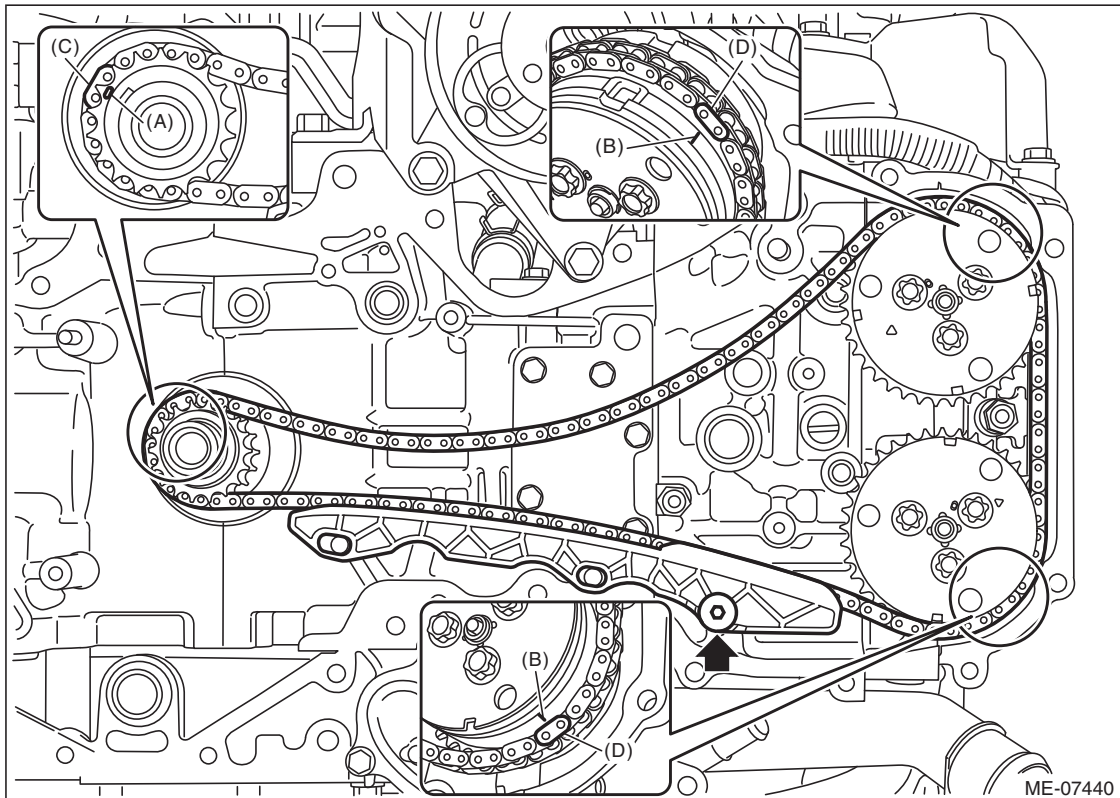
Timing Chain Assembly

MECHANICAL

- 7) Install the timing chain LH and the timing chain guide LH.
- (1) Match the timing chain mark (blue) to the alignment mark of the crank sprocket.
 - (2) Match the timing chain mark (pink) to the timing mark position of the intake cam sprocket LH.
 - (3) Match the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket LH.
 - (4) Install timing chain guide LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



- (A) Alignment mark
(B) Timing mark

(C) Blue

(D) Pink

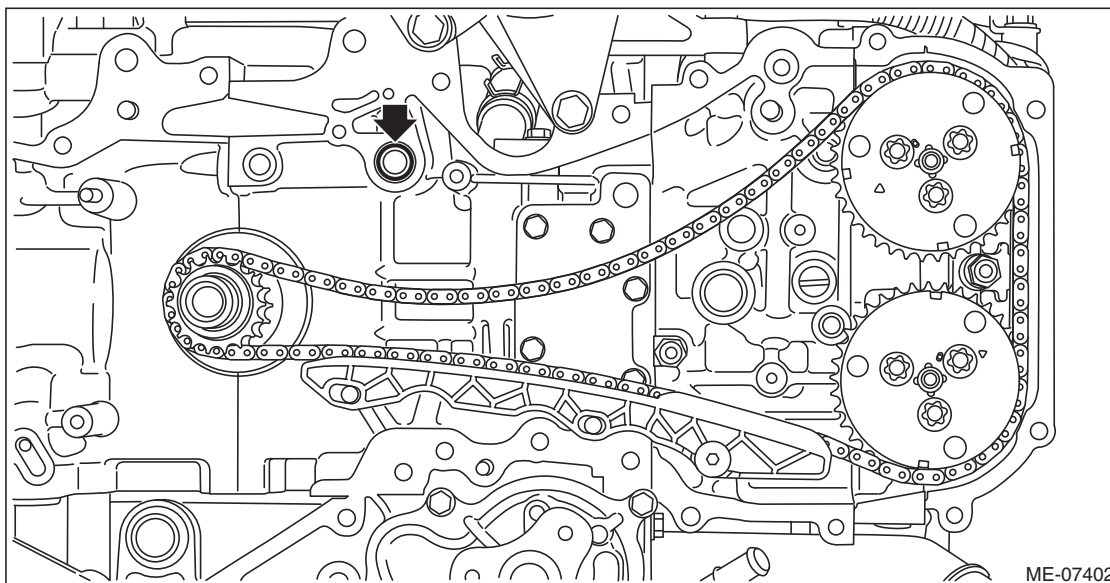
Timing Chain Assembly

MECHANICAL

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

NOTE:

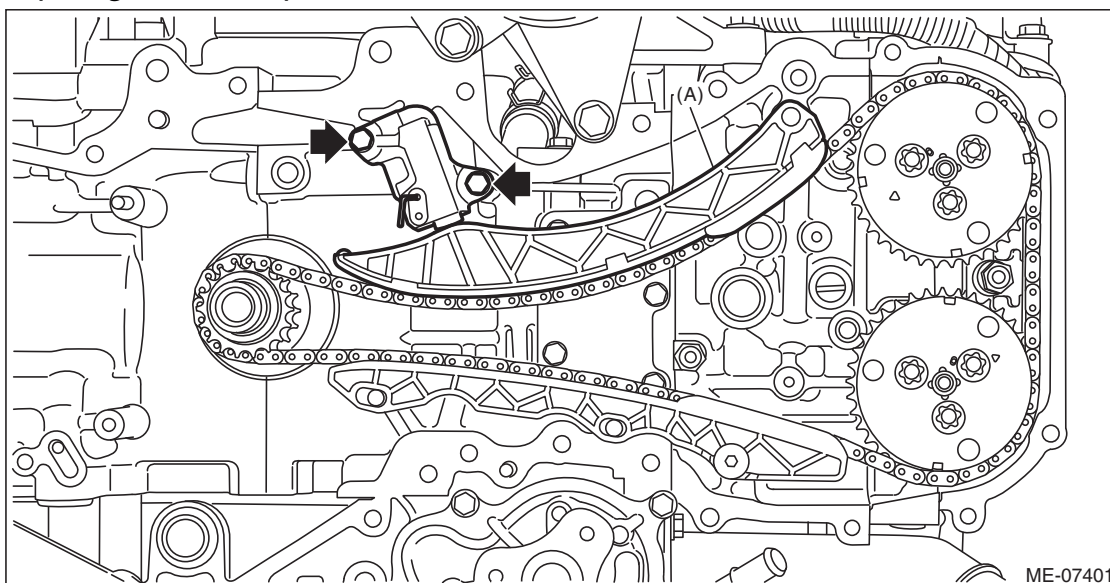
Use new O-rings.



9) Install the chain tensioner lever LH (A) and chain tensioner LH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Timing Chain Assembly

MECHANICAL

10) Pull out the stopper pin from the chain tensioner LH.

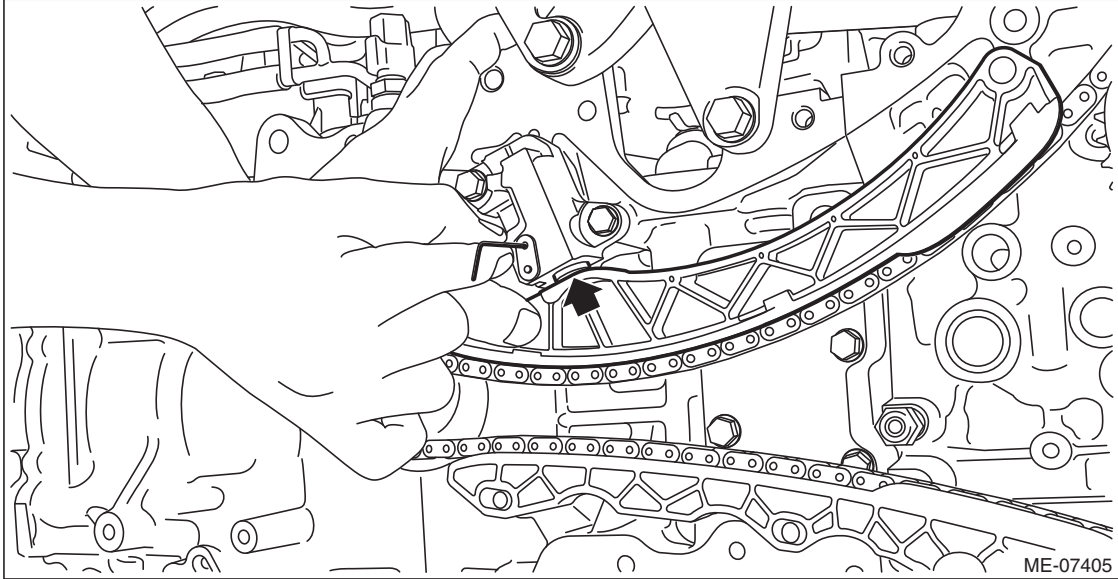
CAUTION:

Confirm the following before pulling out the stopper pin.

- Matching of the timing chain mark (blue) to the alignment mark of the crank sprocket.
- Matching of the timing chain mark (pink) to the timing mark position of the intake cam sprocket LH.
- Matching of the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket LH.

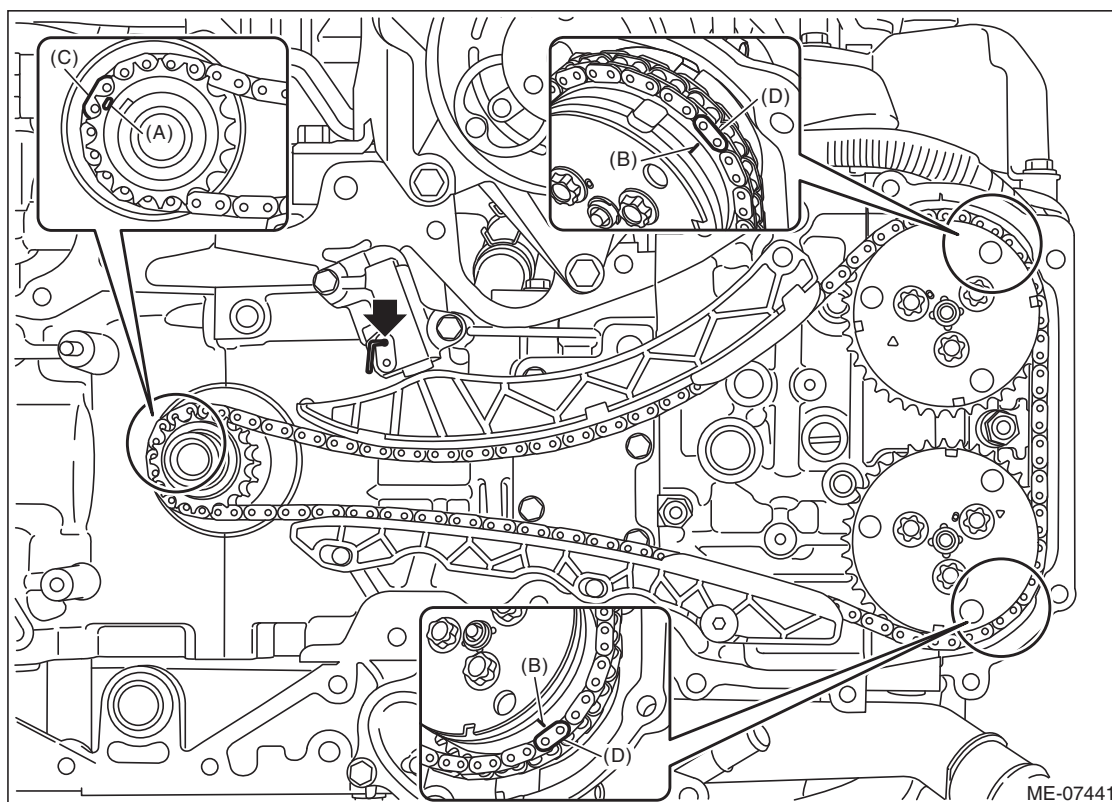
NOTE:

If the stopper pin cannot be removed, lift the chain tension lever LH to remove as shown in the figure.



Timing Chain Assembly

MECHANICAL



(A) Alignment mark

(C) Blue

(D) Pink

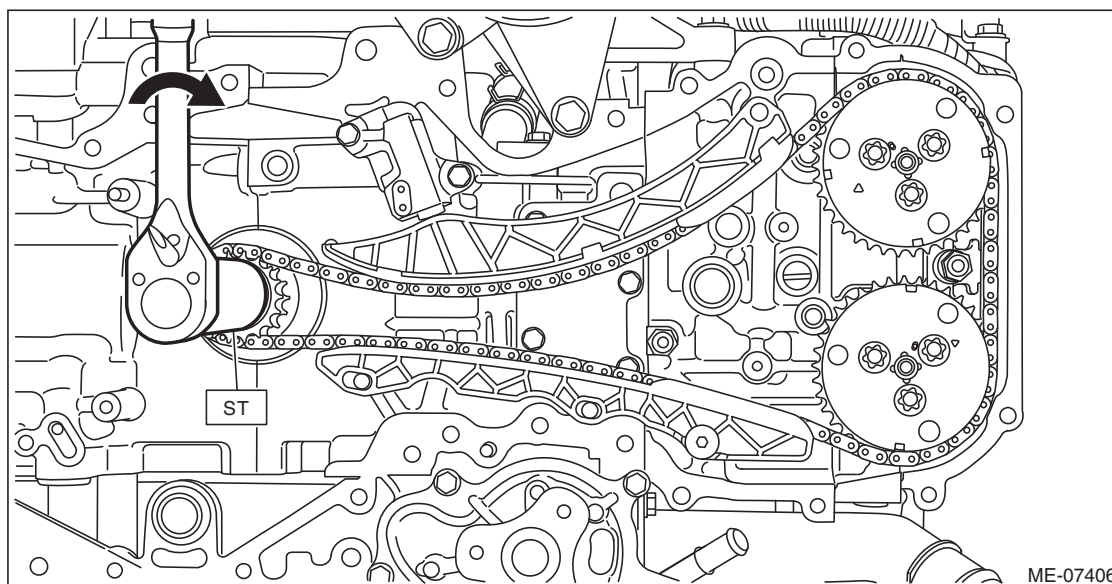
(B) Timing mark

11) Using the ST, turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

CAUTION:

Always make sure to perform this confirmation.

ST 18252AA000 CRANKSHAFT SOCKET



Timing Chain Assembly

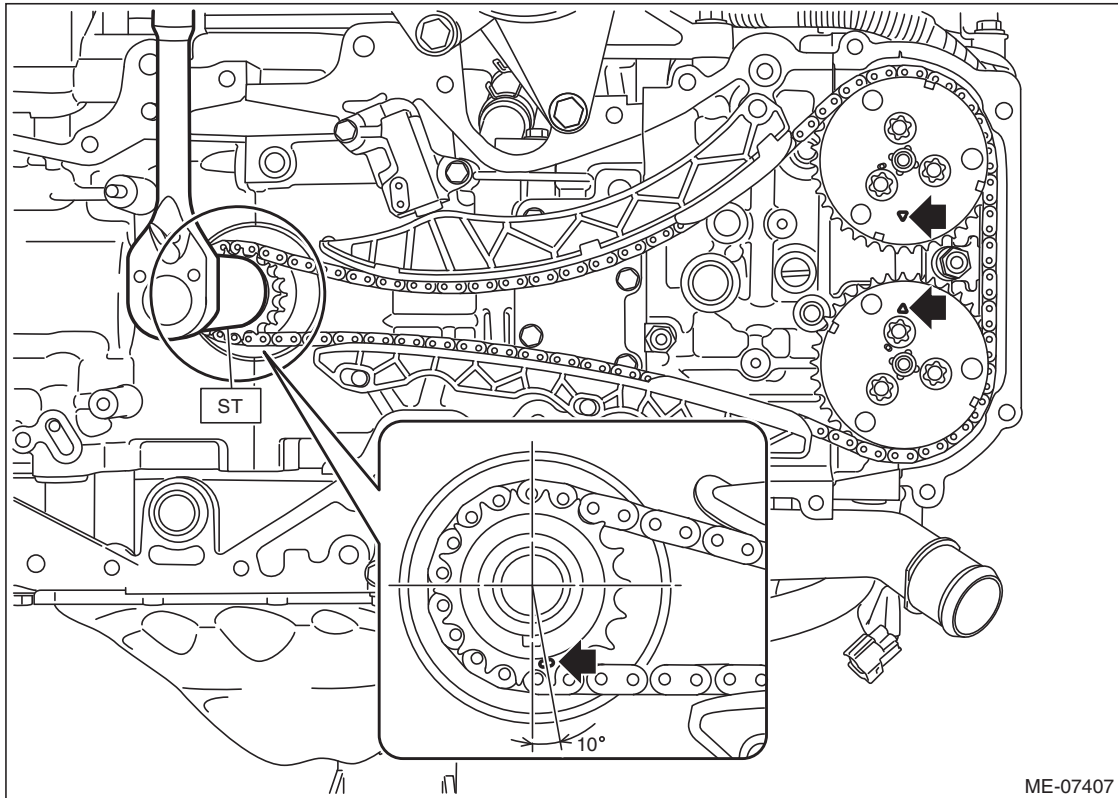
MECHANICAL

12) Using ST and by turning the crankshaft, align the alignment marks of crank sprocket, intake cam sprocket LH and exhaust cam sprocket LH to the positions as shown in the figure.

NOTE:

If the alignment marks are aligned to the positions as shown in the figure, the crankshaft key is located at six o'clock position.

ST 18252AA000 CRANKSHAFT SOCKET



13) Install the timing chain RH. <Ref. to ME(H4DOTC)-129, TIMING CHAIN RH, INSTALLATION, Timing Chain Assembly.>

Timing Chain Assembly

MECHANICAL

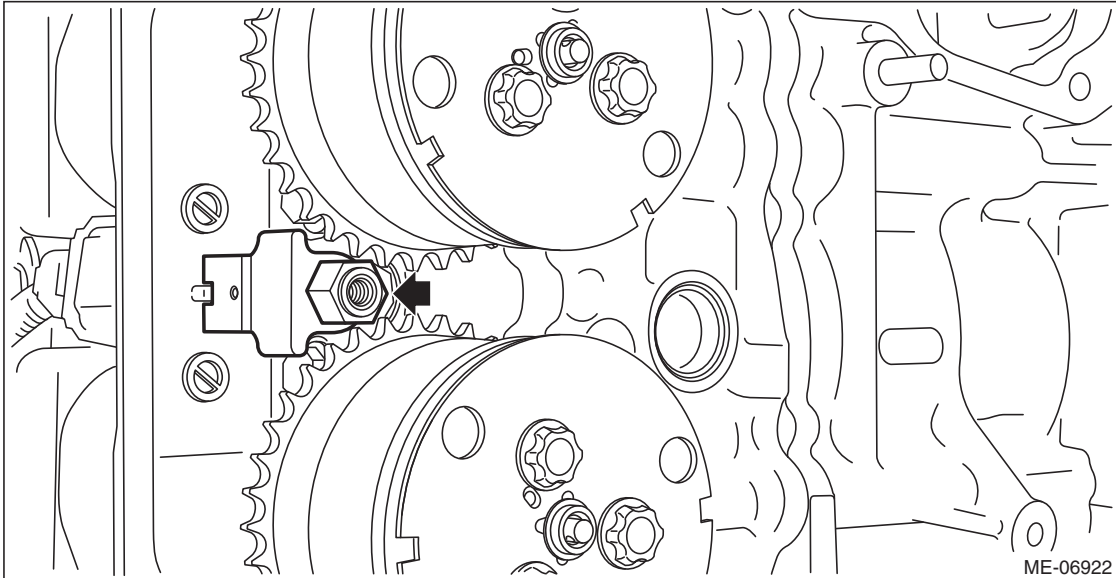
2. TIMING CHAIN RH

NOTE:

- Be careful that the foreign matter is not into or onto the assembled component during installation.
 - Apply engine oil to all component parts of the timing chain.
- 1) Install timing chain LH. <Ref. to ME(H4DOTC)-120, TIMING CHAIN LH, INSTALLATION, Timing Chain Assembly.>
 - 2) Install the chain guide RH to the front camshaft cap RH.

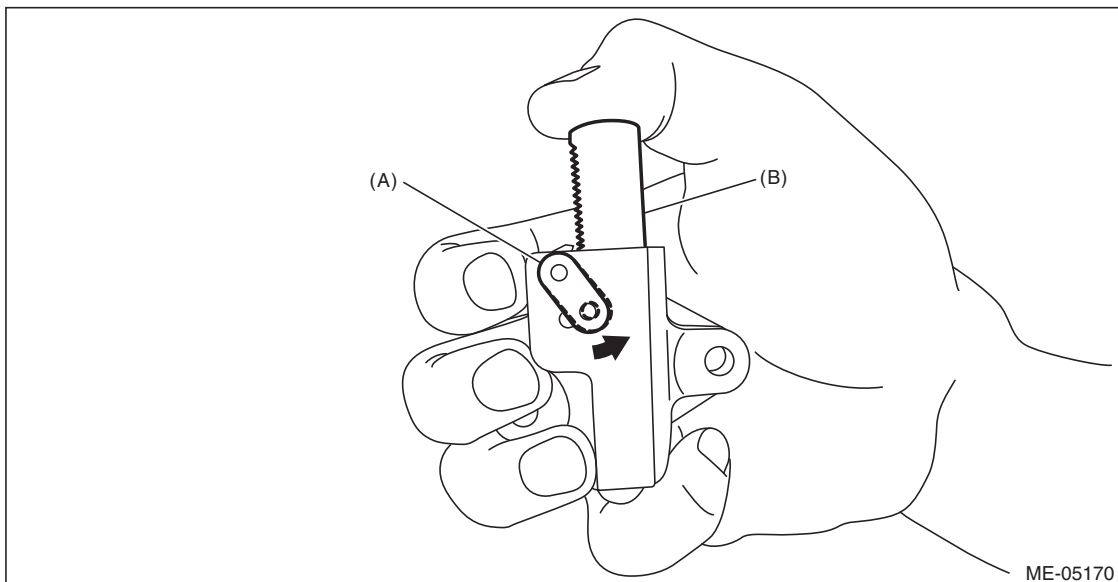
Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



3) Prepare to attach the chain tensioner RH.

- (1) Move the link plate (A) in the direction of arrow to press in the plunger (B).



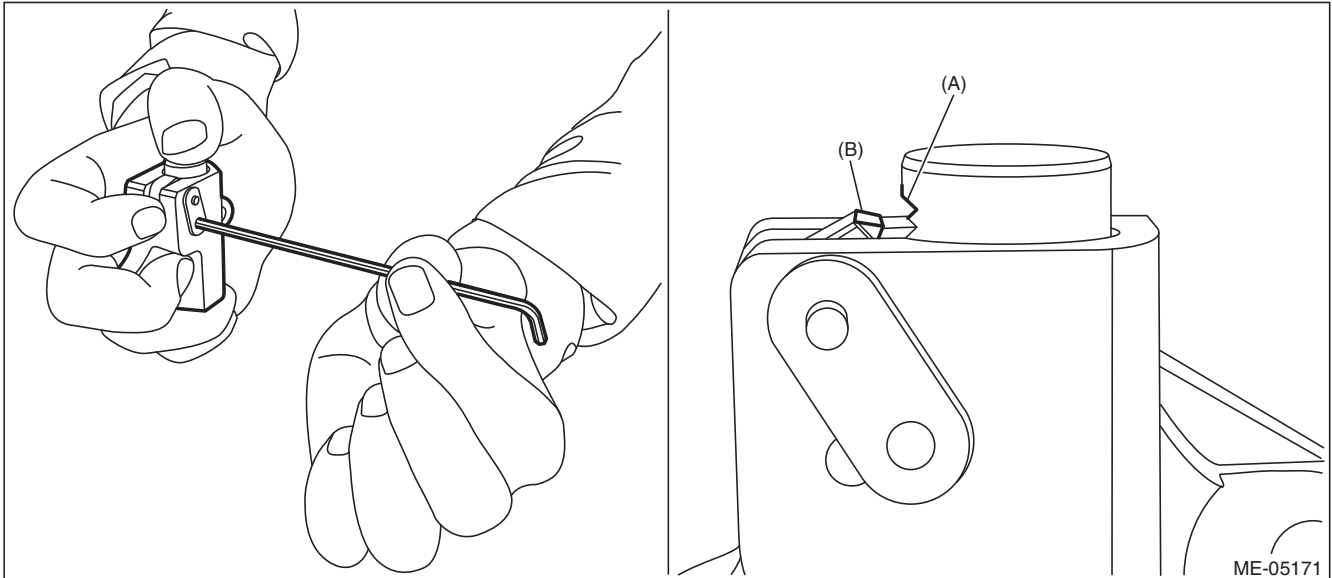
Timing Chain Assembly

MECHANICAL

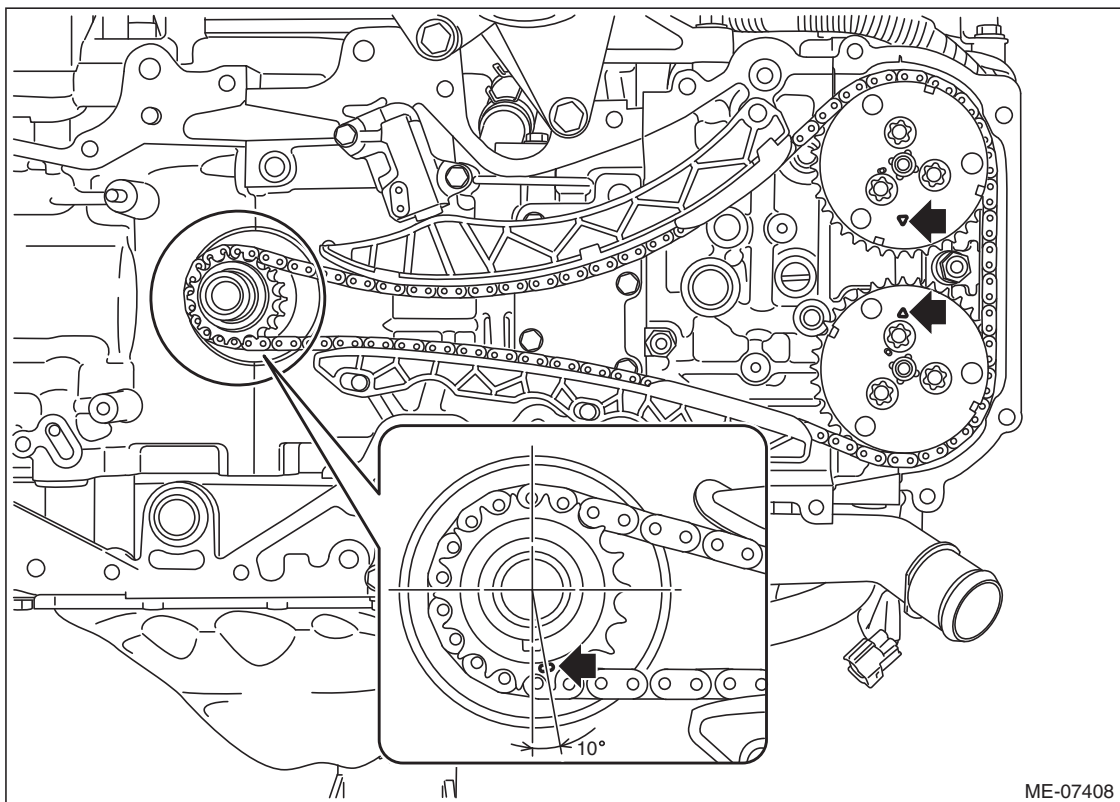
(2) With a 2.5 mm (0.98 in) dia. stopper pin or a 2.5 mm (0.98 in) (nominal) dia. hex wrench inserted into the stopper pin hole, secure the plunger.

NOTE:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of plunger rack (A) is engaged with the stopper tooth (B). If not engaged, retract the plunger a little so that the first notch of plunger rack (A) is engaged with the stopper tooth (B).



4) Make sure that the alignment marks of the crank sprocket, intake cam sprocket LH and exhaust cam sprocket LH are aligned to the positions as shown in the figure.



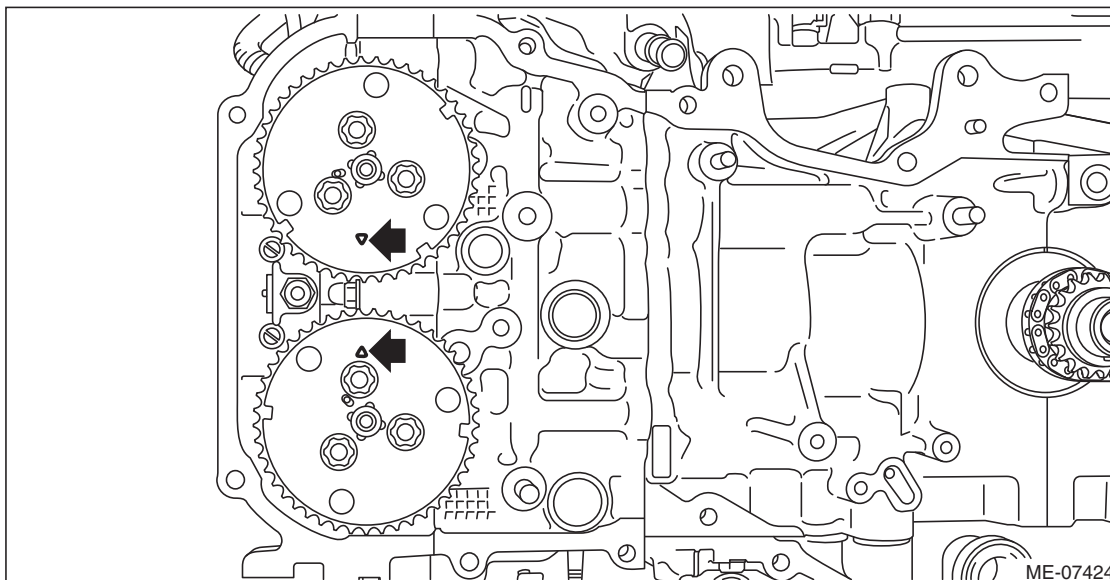
Timing Chain Assembly

MECHANICAL

5) Align the alignment marks of intake cam sprocket RH and exhaust cam sprocket RH to the positions as shown in the figure.

CAUTION:

To prevent valve damage, turn the intake cam sprocket RH and exhaust cam sprocket RH only within the range of zero-lift (in range where it can be turned lightly by hand).



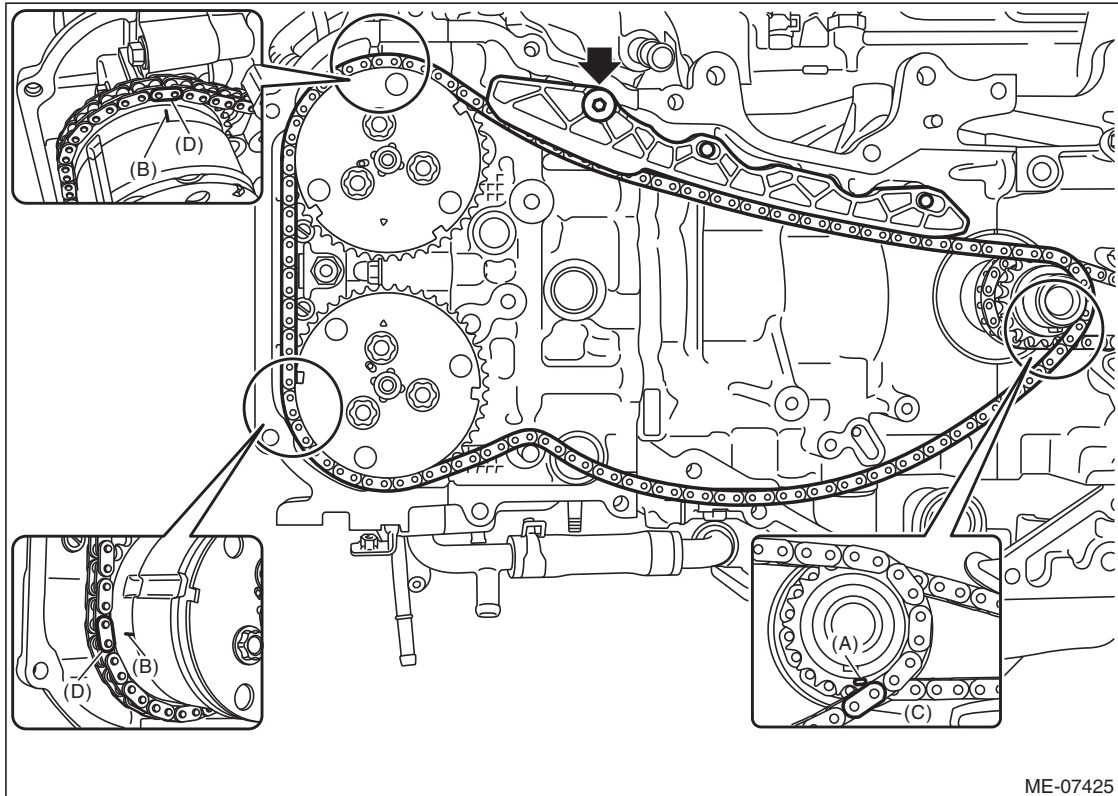
Timing Chain Assembly

MECHANICAL

- 6) Install the timing chain RH and the timing chain guide RH.
- (1) Match the timing chain mark (blue) to the alignment mark of the crank sprocket.
 - (2) Match the timing chain mark (pink) to the timing mark position of the intake cam sprocket RH.
 - (3) Match the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket RH.
 - (4) Install the timing chain guide RH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



(A) Alignment mark
(B) Timing mark

(C) Blue

(D) Pink

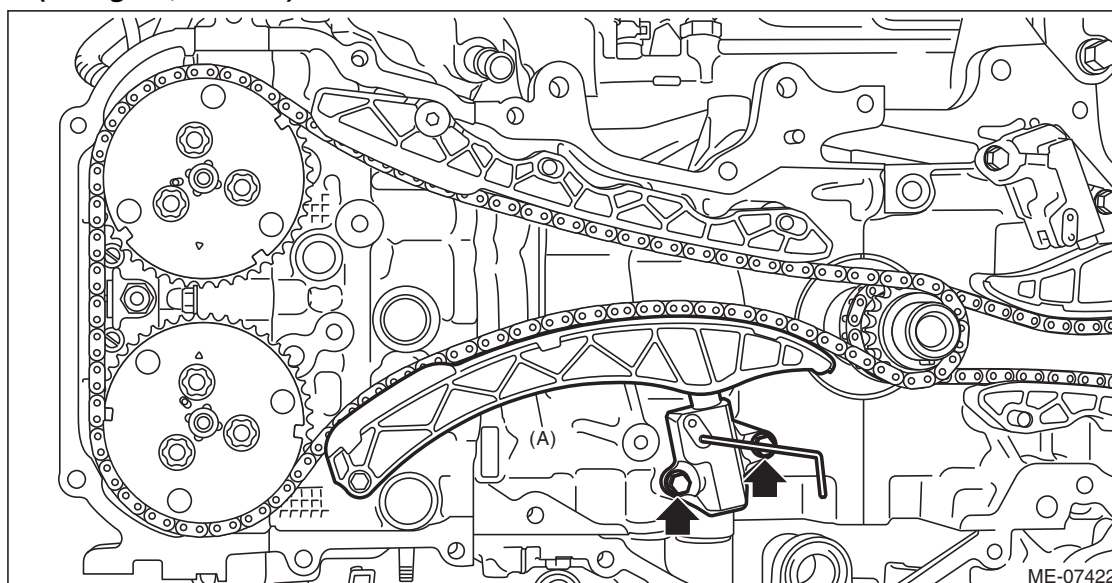
Timing Chain Assembly

MECHANICAL

7) Install the chain tensioner lever RH (A) and chain tensioner RH.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Timing Chain Assembly

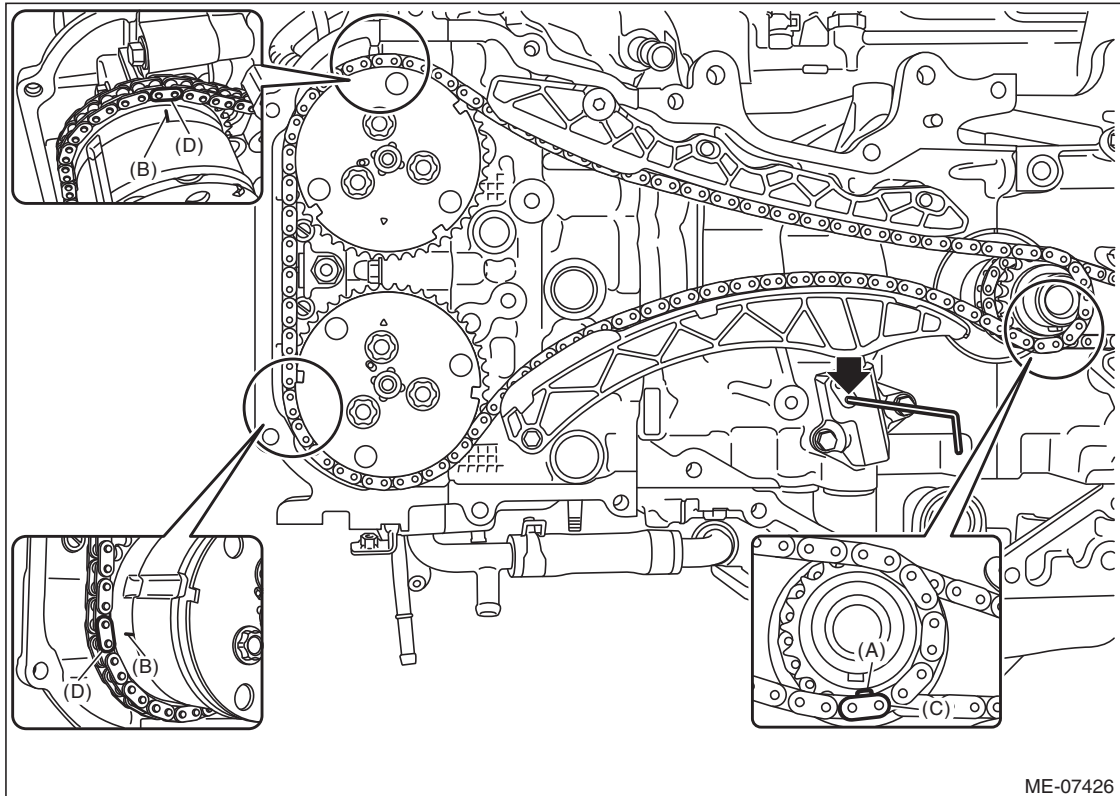
MECHANICAL

8) Pull out the stopper pin from the chain tensioner RH.

CAUTION:

Confirm the following before pulling out the stopper pin.

- Matching of the timing chain mark (blue) to the alignment mark of the crank sprocket.
- Matching of the timing chain mark (pink) to the timing mark position of the intake cam sprocket RH.
- Matching of the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket RH.



ME-07426

(A) Alignment mark
(B) Timing mark

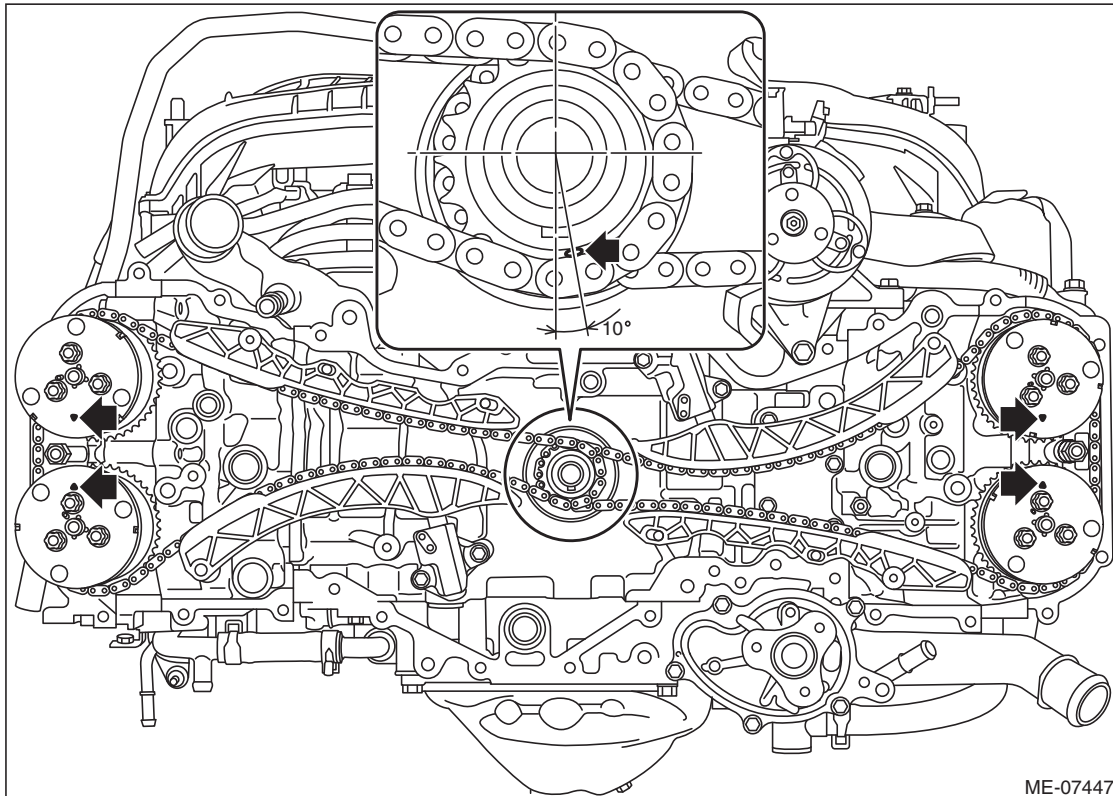
(C) Blue

(D) Pink

Timing Chain Assembly

MECHANICAL

9) Make sure that the alignment marks of the cam sprocket and crank sprocket are aligned to the positions as shown in the figure.

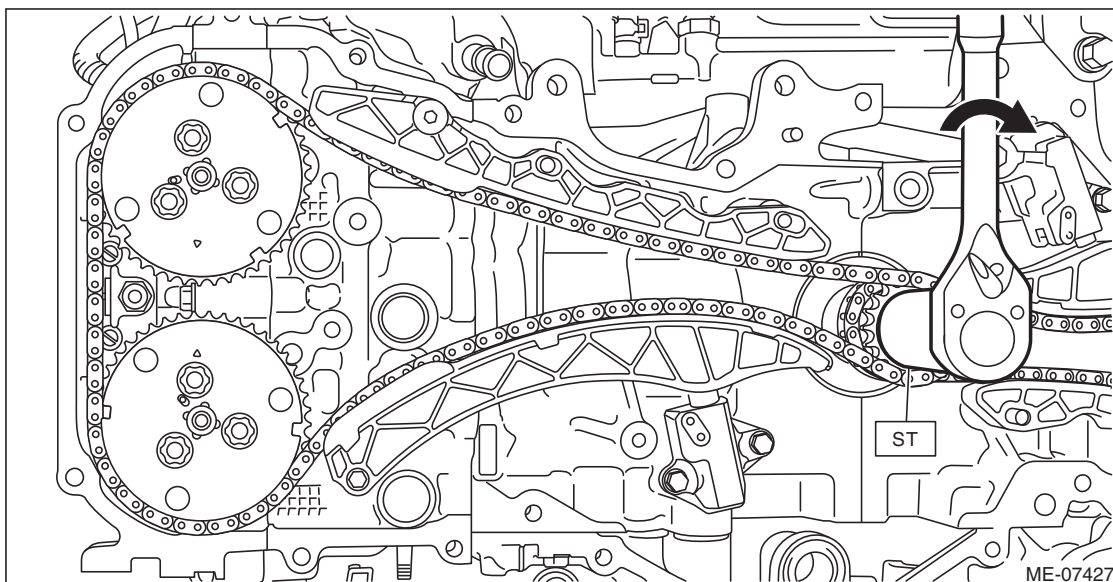


10) Using the ST, turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

CAUTION:

Always make sure to perform this confirmation.

ST 18252AA000 CRANKSHAFT SOCKET



11) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

Timing Chain Assembly

MECHANICAL

C: INSPECTION

- 1) Check the timing chain, chain guide, chain tensioner lever and chain tensioner for deformation, cracks or other damages.
- 2) Check the chain guide and chain tensioner lever for abnormal wear.

16. Cam Sprocket

A: REMOVAL

1. CAM SPROCKET RH

NOTE:

When replacing a single part, perform the work with the engine assembly installed to body.

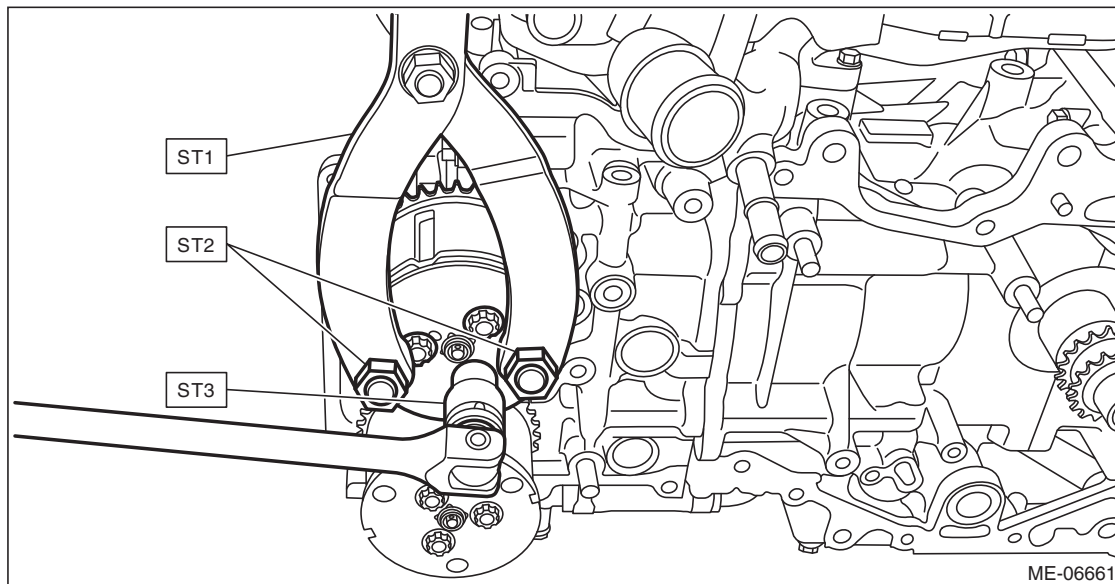
• Intake cam sprocket RH

- 1) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 2) Remove the timing chain RH. <Ref. to ME(H4DOTC)-111, TIMING CHAIN RH, REMOVAL, Timing Chain Assembly.>
- 3) Hold the intake cam sprocket RH using the ST1 and ST2, and remove the bolts using the ST3.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET



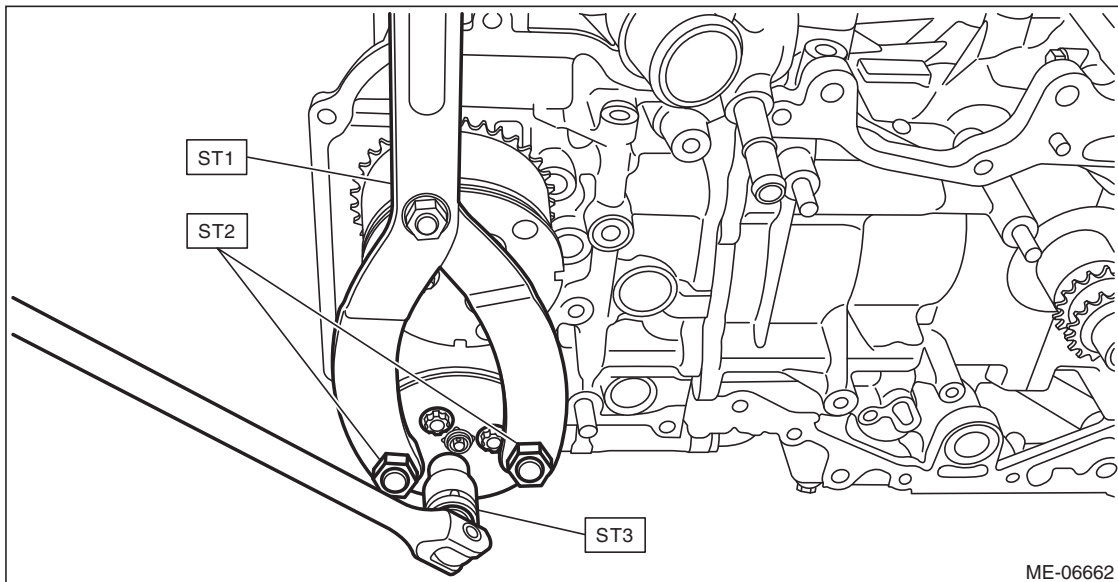
- 4) Remove the intake cam sprocket RH.

Cam Sprocket

MECHANICAL

• Exhaust cam sprocket RH

- 1) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
 - 2) Remove the timing chain RH. <Ref. to ME(H4DOTC)-111, TIMING CHAIN RH, REMOVAL, Timing Chain Assembly.>
 - 3) Hold the exhaust cam sprocket RH using the ST1 and ST2, and remove the bolts using the ST3.
- ST1 18355AA000 PULLEY WRENCH
ST2 18334AA030 PULLEY WRENCH PIN SET
ST3 18270KA010 SOCKET



- 4) Remove the exhaust cam sprocket RH.

2. CAM SPROCKET LH

NOTE:

When replacing a single part, perform the work with the engine assembly installed to body.

• Intake cam sprocket LH

- 1) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 2) Remove the timing chain LH. <Ref. to ME(H4DOTC)-114, TIMING CHAIN LH, REMOVAL, Timing Chain Assembly.>

Cam Sprocket

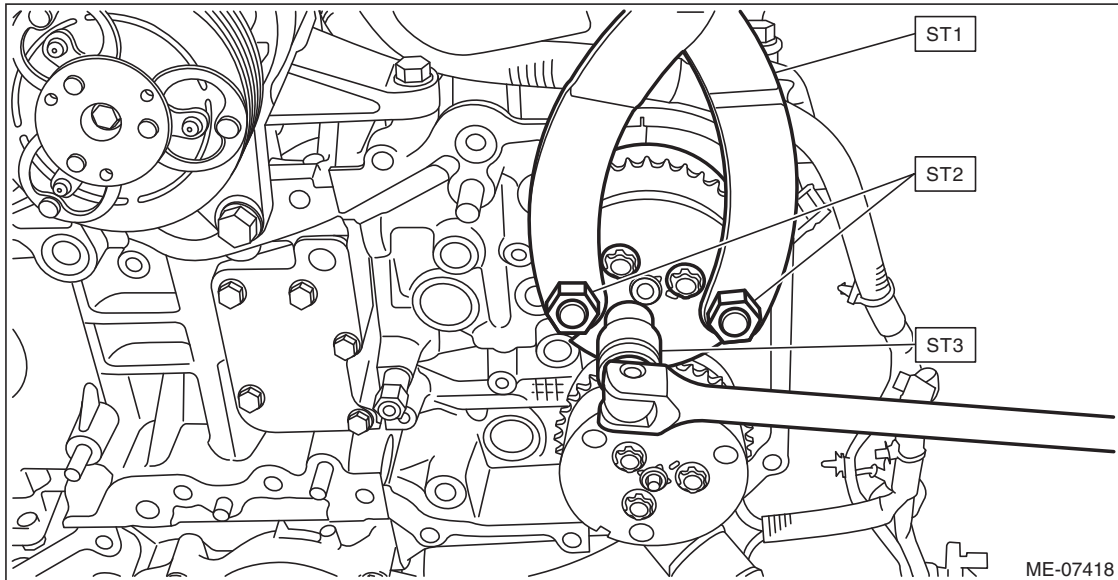
MECHANICAL

3) Hold the intake cam sprocket LH using the ST1 and ST2, and remove the bolts using the ST3.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET



4) Remove the intake cam sprocket LH.

• Exhaust cam sprocket LH

1) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>

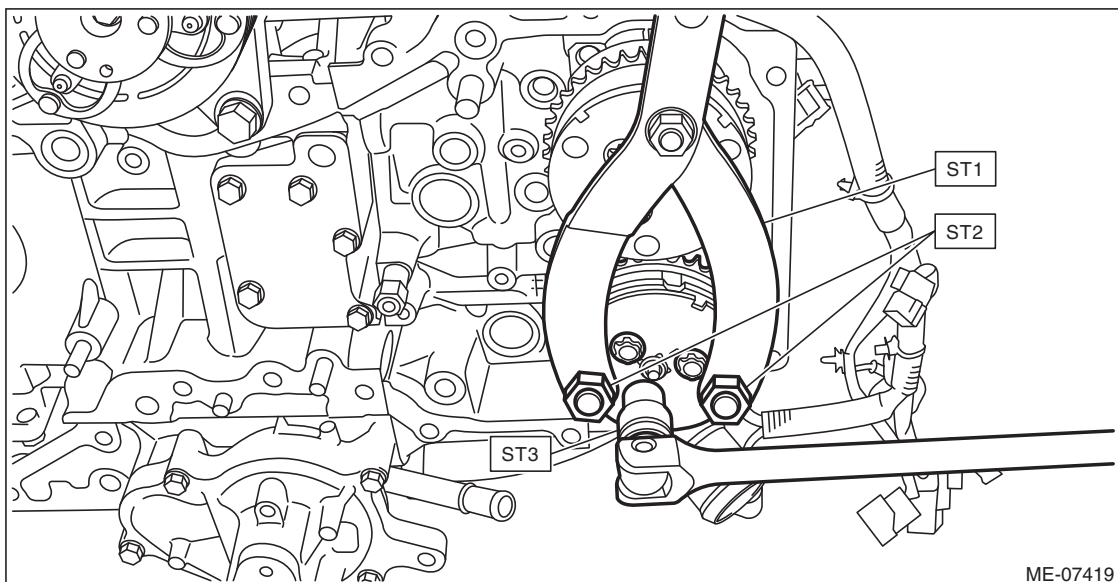
2) Remove the timing chain LH. <Ref. to ME(H4DOTC)-114, TIMING CHAIN LH, REMOVAL, Timing Chain Assembly.>

3) Hold the exhaust cam sprocket LH using the ST1 and ST2, and remove the bolts using the ST3.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET



4) Remove the exhaust cam sprocket LH.

Cam Sprocket

MECHANICAL

B: INSTALLATION

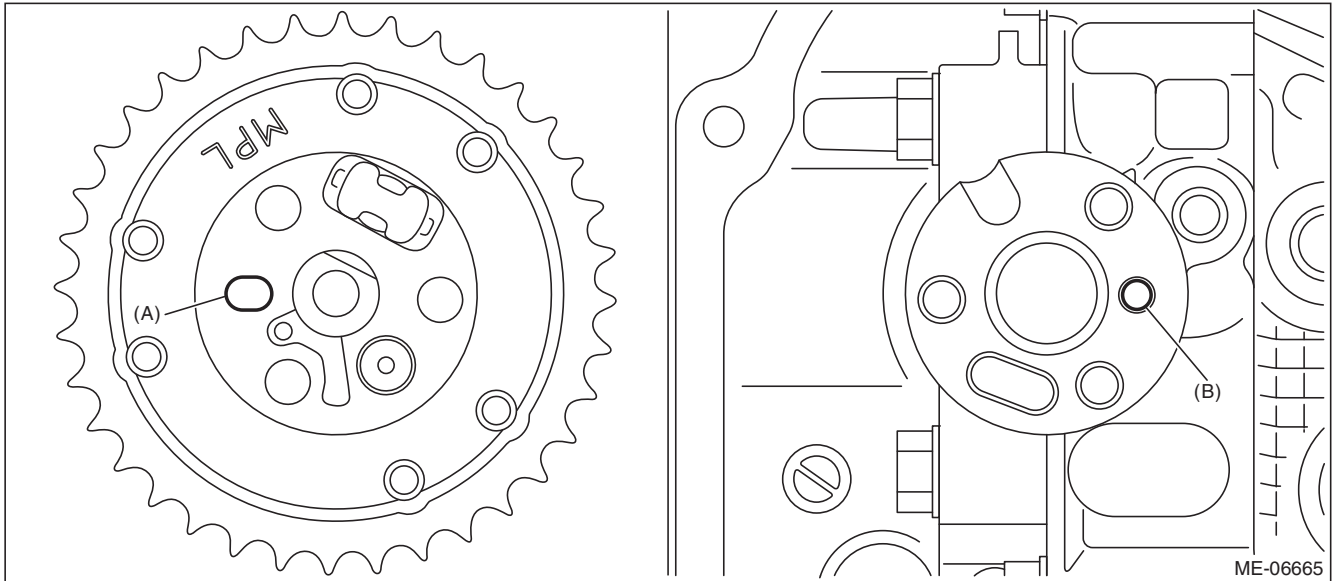
1. CAM SPROCKET RH

• Intake cam sprocket RH

1) Install the intake cam sprocket RH by aligning the knock hole (A) of intake cam sprocket RH and the knock pin (B) of intake camshaft RH.

NOTE:

Before installation, check that there is no foreign matter on the intake cam sprocket RH and intake camshaft RH.



2) Hold the intake cam sprocket RH using the ST1 and ST2, and install the bolts using the ST3.

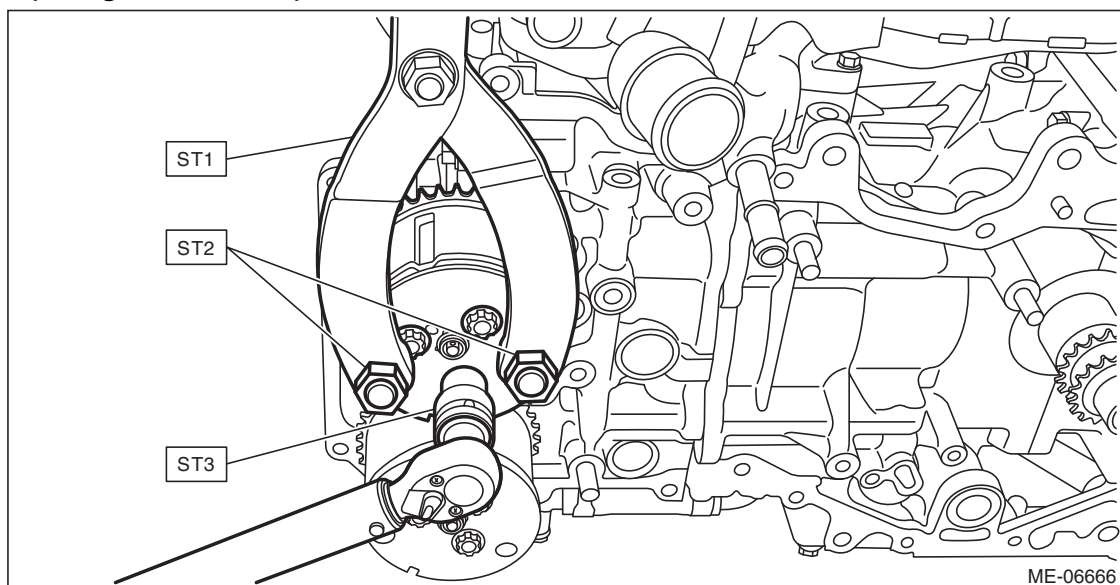
ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



3) Install the timing chain RH. <Ref. to ME(H4DOTC)-129, TIMING CHAIN RH, INSTALLATION, Timing Chain Assembly.>

Cam Sprocket

MECHANICAL

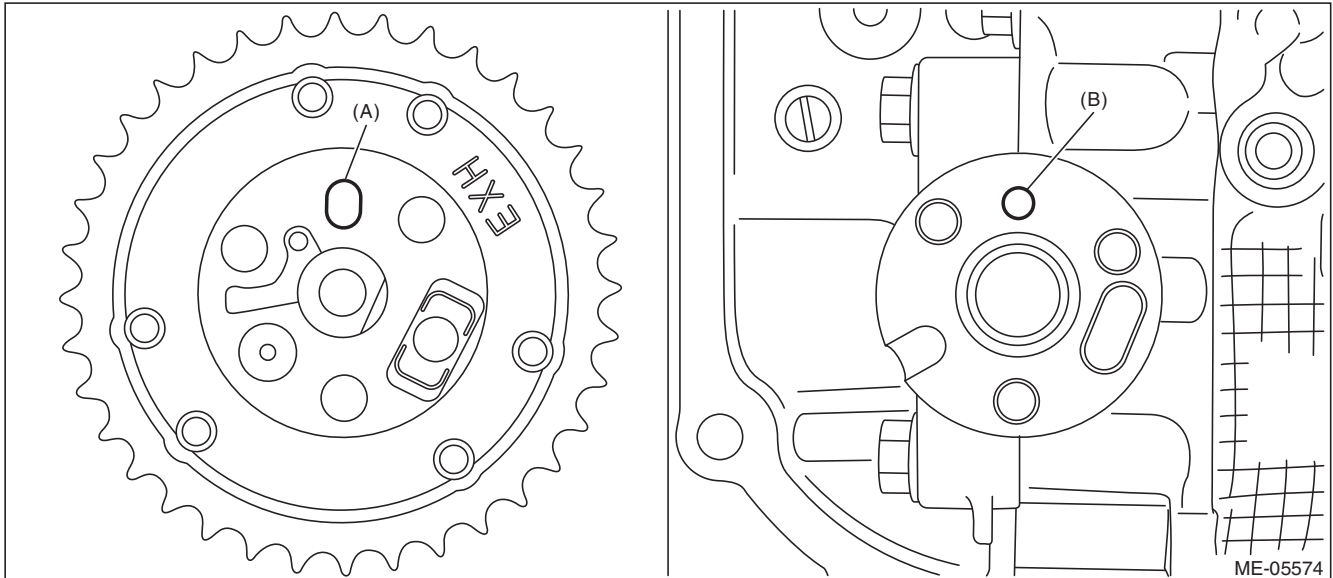
4) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

• Exhaust cam sprocket RH

1) Install the exhaust cam sprocket RH by aligning the knock hole (A) of exhaust cam sprocket RH and the knock pin (B) of exhaust camshaft RH.

NOTE:

Before installation, check that there is no foreign matter on the exhaust cam sprocket RH and exhaust camshaft RH.



2) Hold the exhaust cam sprocket RH using ST1 and ST2, and install the bolts using ST3.

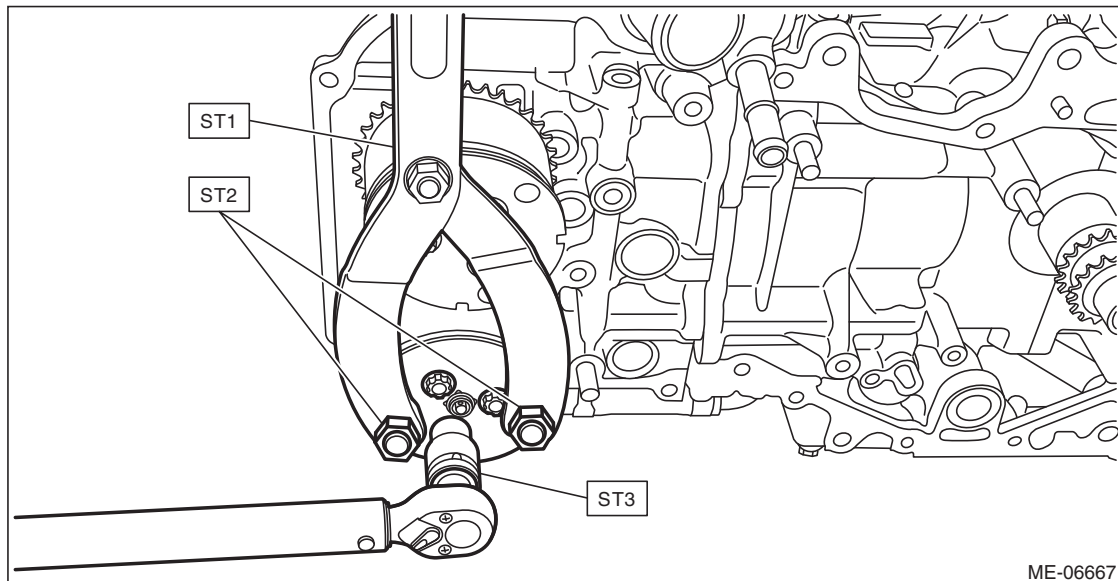
ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



3) Install the timing chain RH. <Ref. to ME(H4DOTC)-129, TIMING CHAIN RH, INSTALLATION, Timing Chain Assembly.>

4) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

Cam Sprocket

MECHANICAL

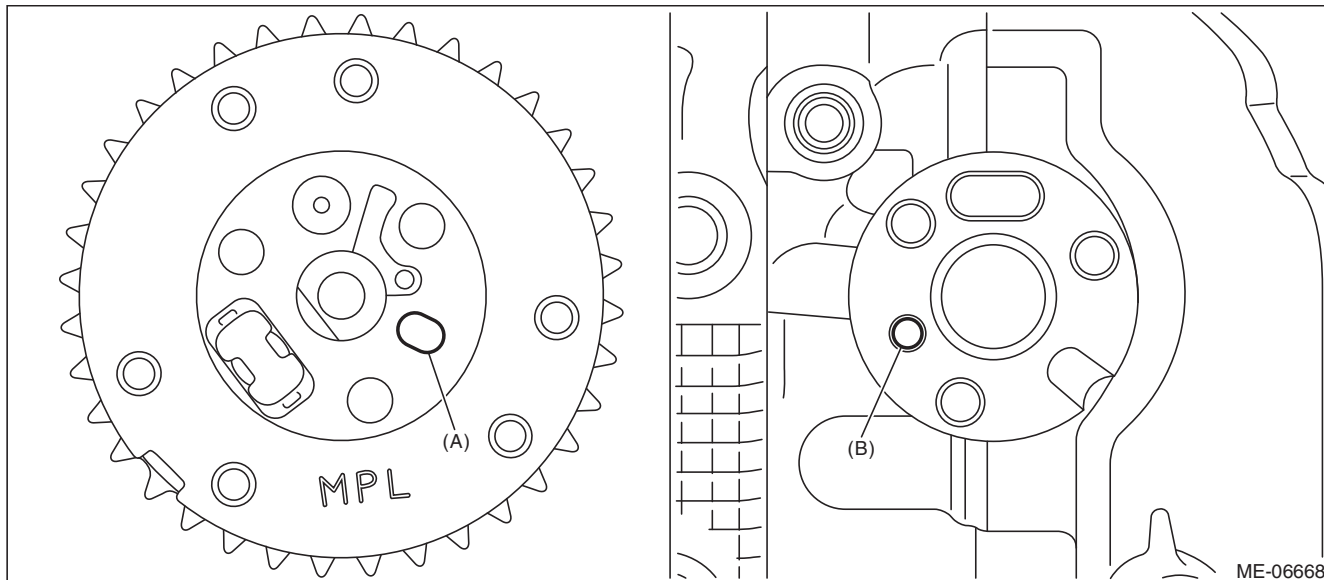
2. CAM SPROCKET LH

• Intake cam sprocket LH

1) Install the intake cam sprocket LH by aligning the knock hole (A) of intake cam sprocket LH and the knock pin (B) of intake camshaft LH.

NOTE:

Before installation, check that there is no foreign matter on the intake cam sprocket LH and intake camshaft LH.



2) Hold the intake cam sprocket LH using the ST1 and ST2, and install the bolts using the ST3.

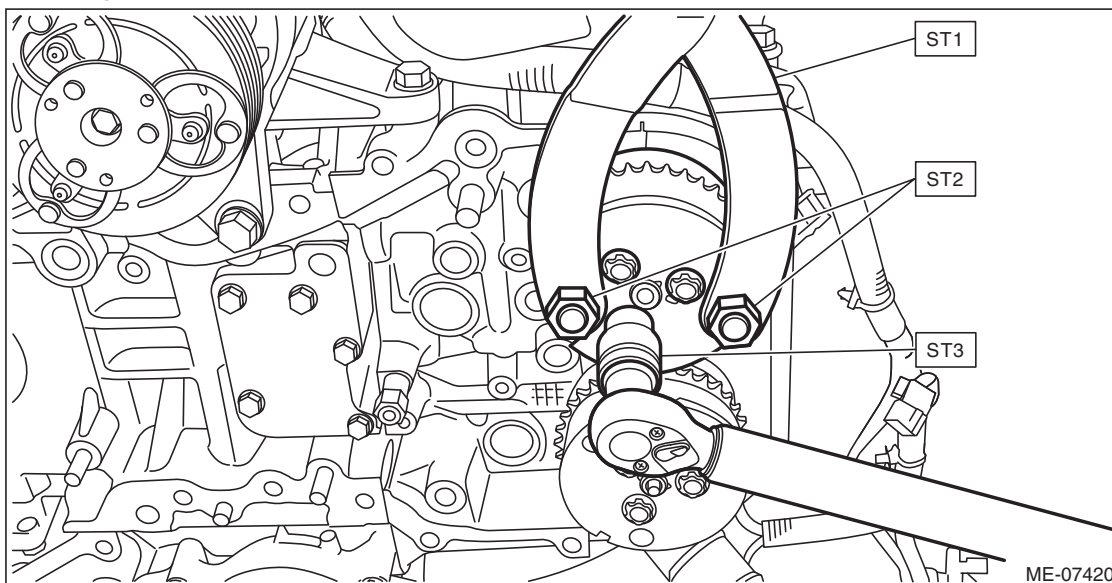
ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



3) Install timing chain LH. <Ref. to ME(H4DOTC)-120, TIMING CHAIN LH, INSTALLATION, Timing Chain Assembly.>

4) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

Cam Sprocket

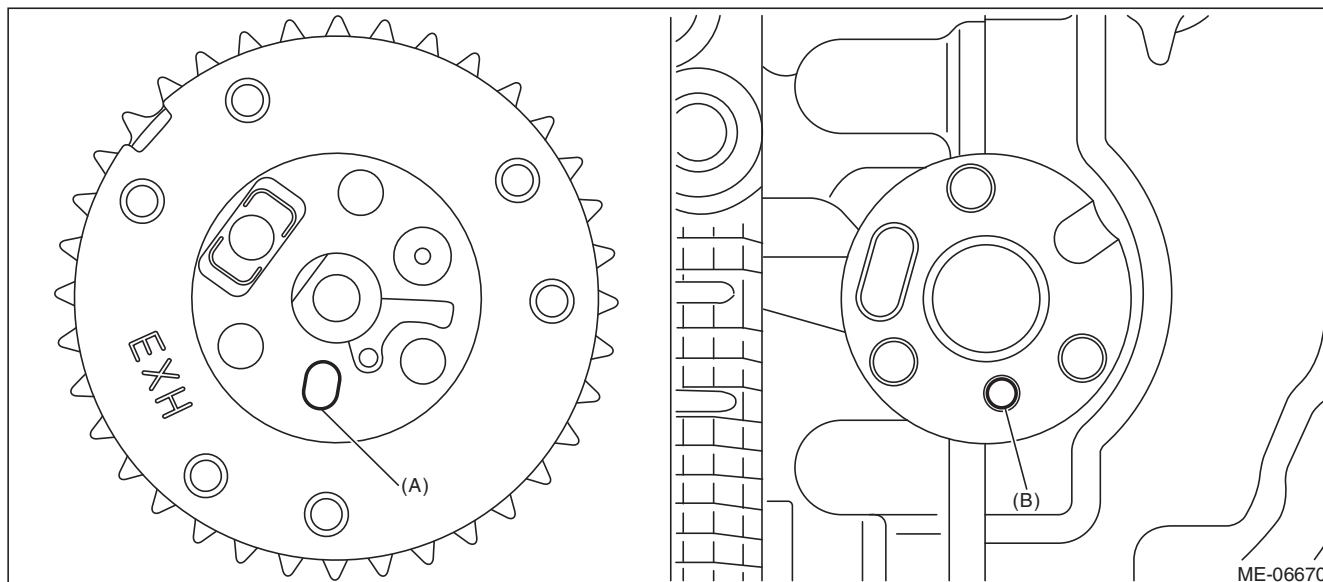
MECHANICAL

• Exhaust cam sprocket LH

1) Install the exhaust cam sprocket LH by aligning the knock hole (A) of exhaust cam sprocket LH and the knock pin (B) of exhaust camshaft LH.

NOTE:

Before installation, check that there is no foreign matter on the exhaust cam sprocket LH and exhaust camshaft LH.



2) Hold the exhaust cam sprocket LH using the ST1 and ST2, and install the bolts using the ST3.

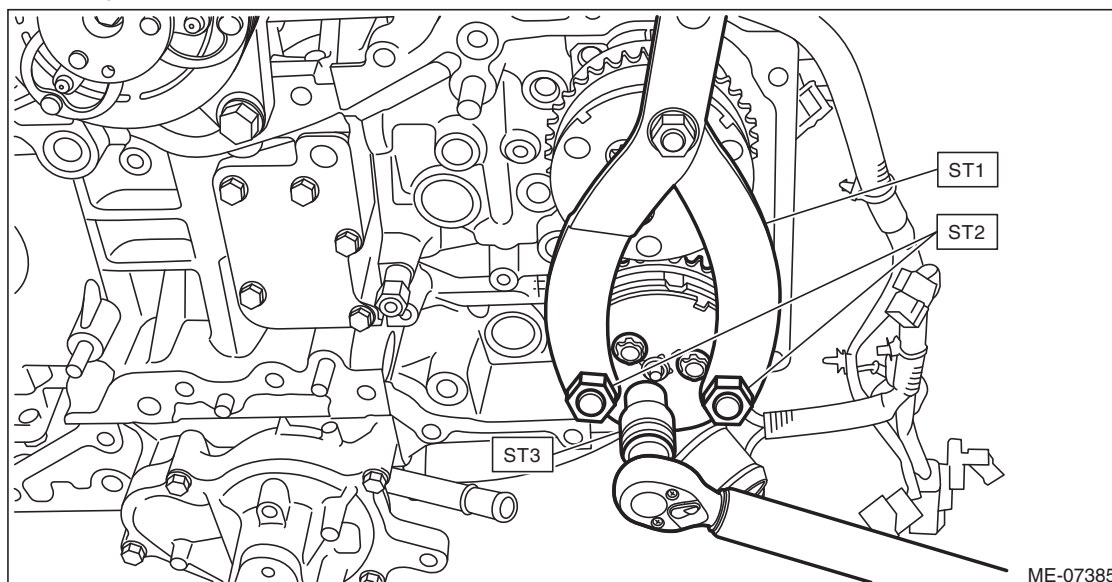
ST1 18355AA000 PULLEY WRENCH

ST2 18334AA030 PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



3) Install timing chain LH. <Ref. to ME(H4DOTC)-120, TIMING CHAIN LH, INSTALLATION, Timing Chain Assembly.>

4) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

Cam Sprocket

MECHANICAL

C: INSPECTION

Check the cam sprocket teeth for abnormal wear and scratches.

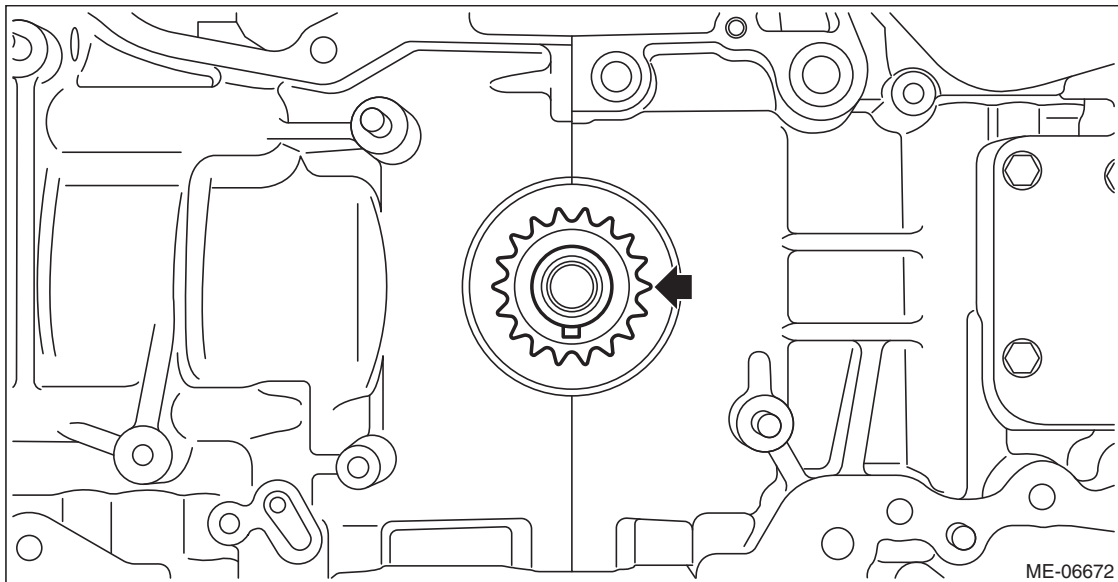
17.Crank Sprocket

A: REMOVAL

NOTE:

When replacing a single part, perform the work with the engine assembly installed to body.

- 1) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 2) Remove the timing chain. <Ref. to ME(H4DOTC)-111, REMOVAL, Timing Chain Assembly.>
- 3) Remove the crank sprocket.

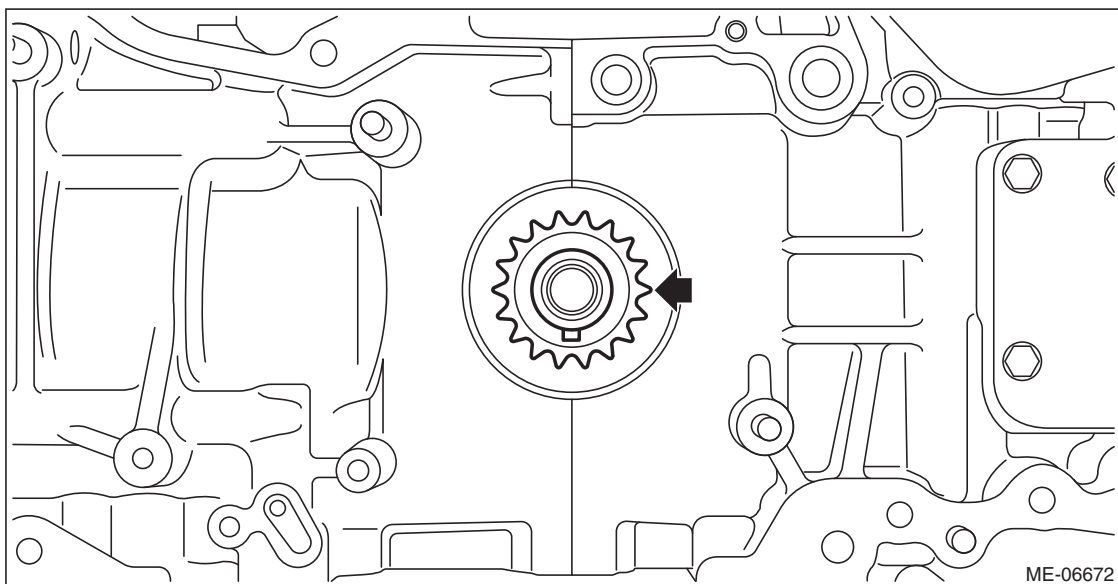


B: INSTALLATION

- 1) Install the crank sprocket.

NOTE:

The direction of installation is not specified for the crank sprocket.



- 2) Install the timing chain. <Ref. to ME(H4DOTC)-120, INSTALLATION, Timing Chain Assembly.>
- 3) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

Crank Sprocket

MECHANICAL

C: INSPECTION

- 1) Check the crank sprocket teeth for abnormal wear and scratches.
- 2) Make sure there is no free play between crank sprocket and key.

18.Rocker Cover

A: REMOVAL

1. ROCKER COVER RH

NOTE:

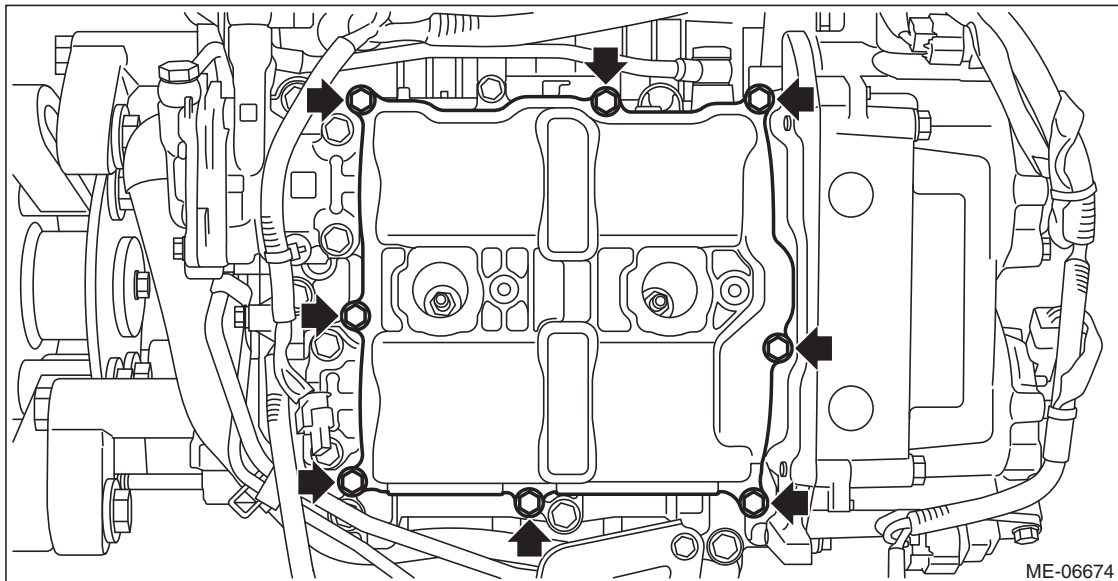
When replacing a single part, perform the work with the engine assembly installed to body.

1) When working on the vehicle

NOTE:

When working on the vehicle, perform the following steps also.

- (1) Remove the air cleaner case. <Ref. to IN(H4DOTC)-9, REMOVAL, Air Cleaner Case.>
- 2) Remove the #1 ignition coil and the #3 ignition coil. <Ref. to IG(H4DOTC)-9, REMOVAL, Ignition Coil.>
- 3) Remove the rocker cover RH.



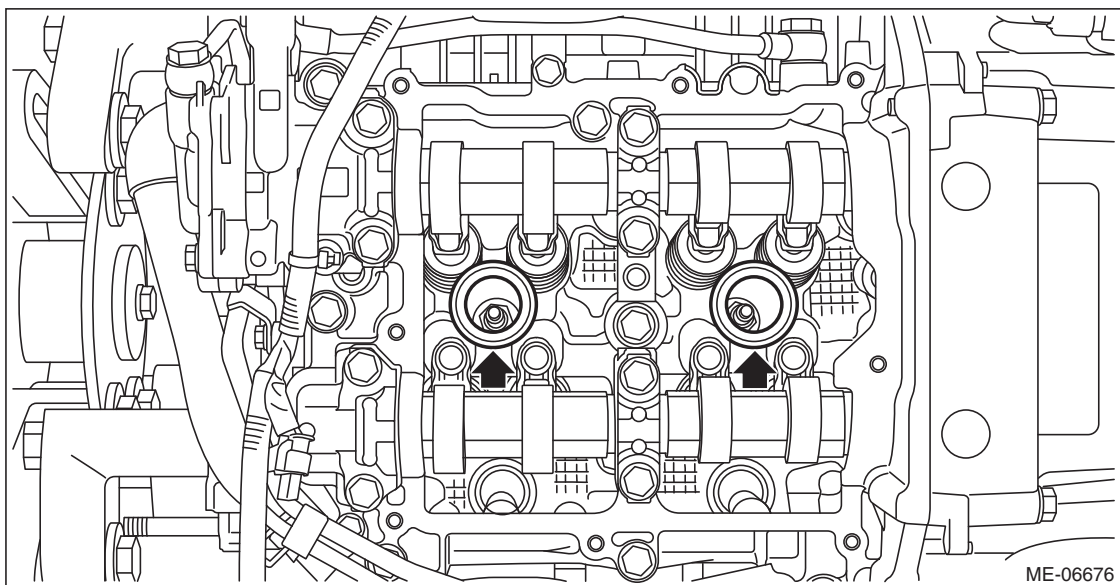
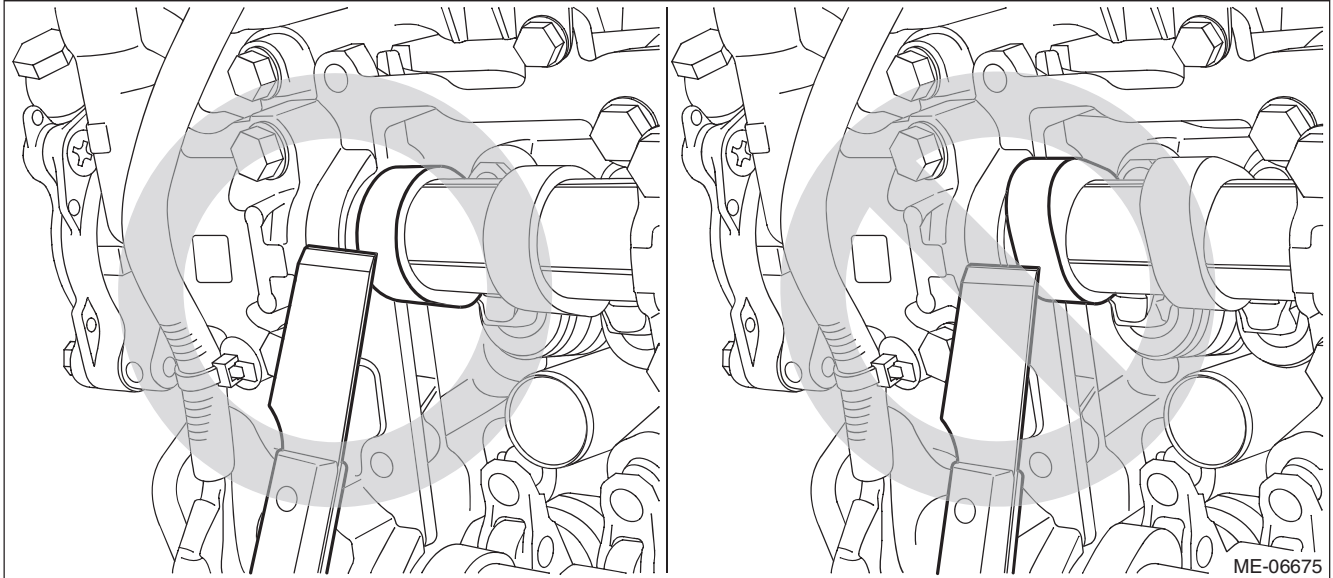
Rocker Cover

MECHANICAL

4) Remove the rocker cover gasket RH, #1 spark plug pipe gasket and #3 spark plug pipe gasket, and remove the liquid gasket.

CAUTION:

- When removing the liquid gasket from engine unit using scraper, use special care not to damage the cam lobe of camshaft RH.
- If the cam lobe of camshaft RH interferes, turn the crankshaft to the position where the scraper does not touch.



Rocker Cover

MECHANICAL

2. ROCKER COVER LH

NOTE:

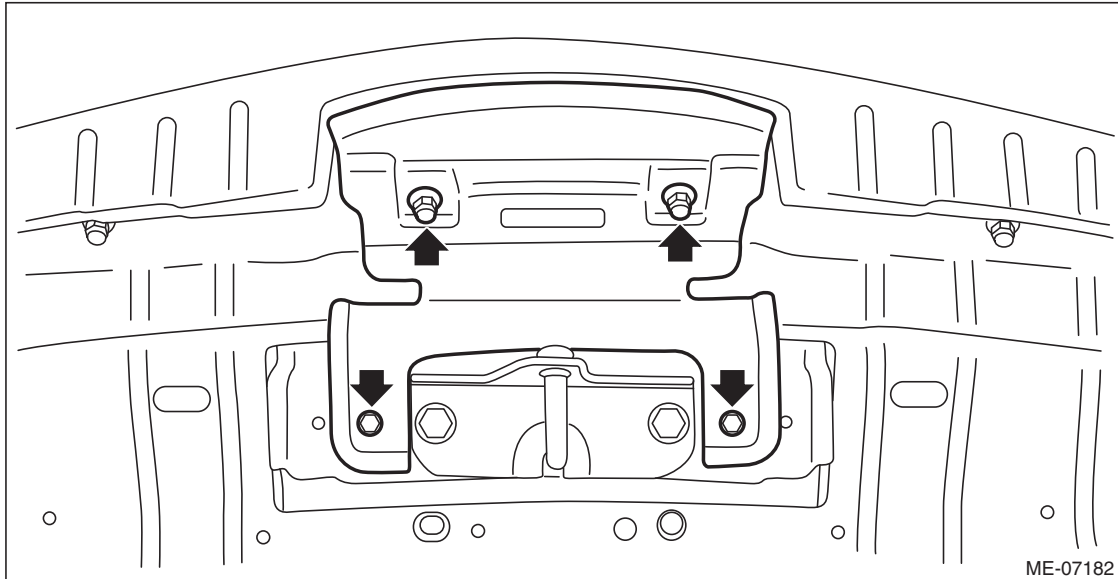
When replacing a single part, perform the work with the engine assembly installed to body.

1) When working on the vehicle

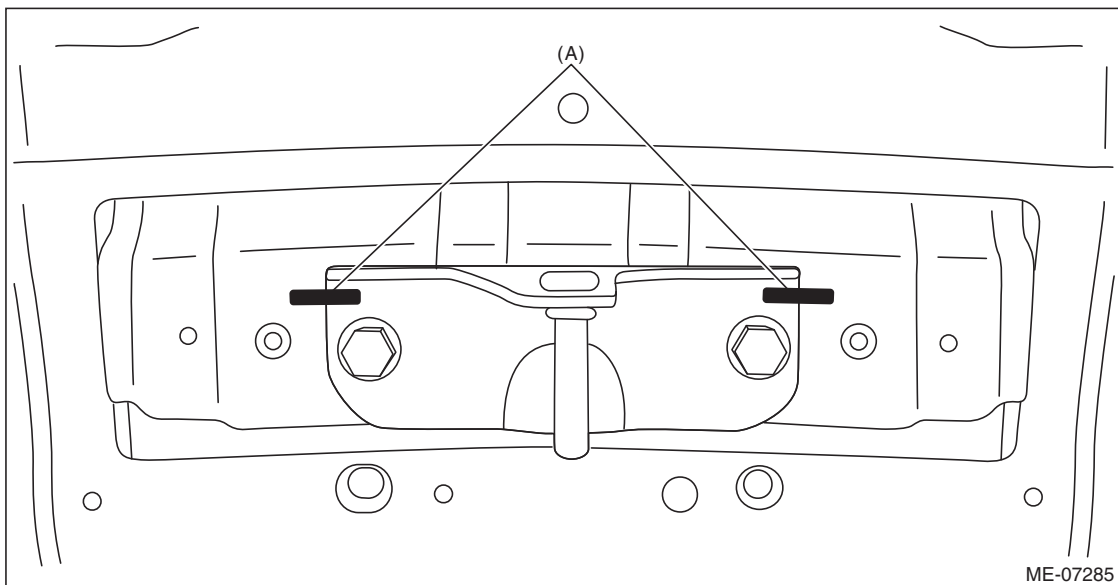
NOTE:

When working on the vehicle, perform the following steps also.

(1) Open the front hood, and remove the upper grille bracket from the front hood.



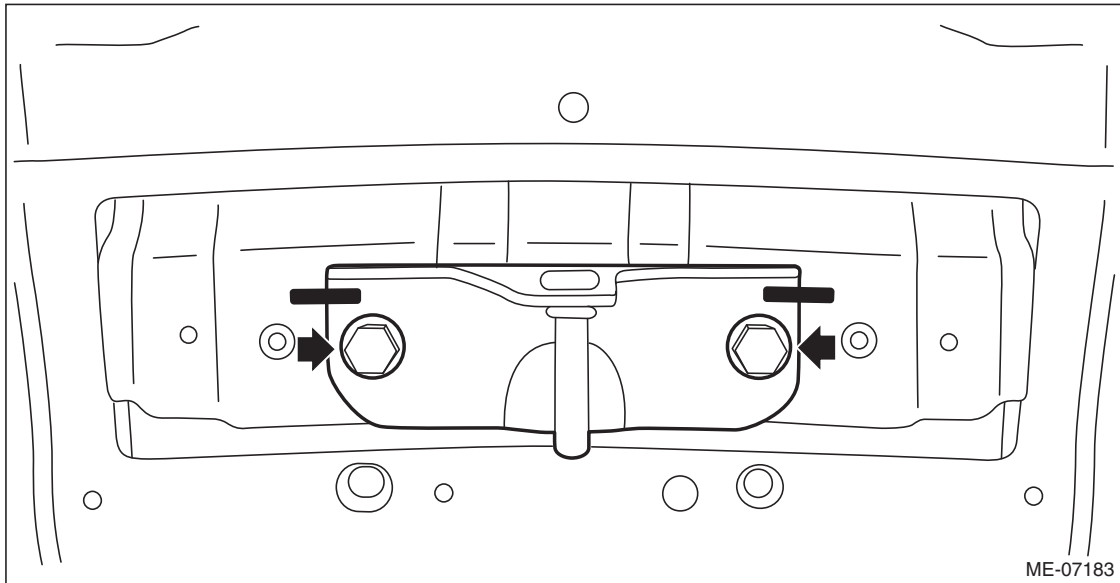
(2) Using a marker pen, make alignment marks (A) on both the front hood and the front hood striker.



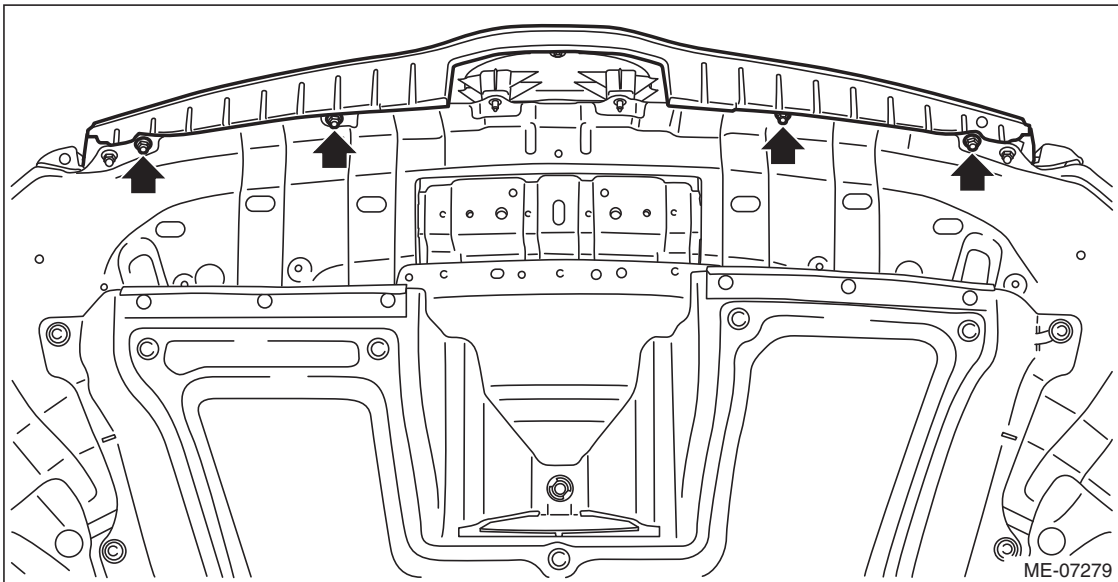
Rocker Cover

MECHANICAL

- (3) Remove the front hood striker from the front hood.



- (4) Remove the front center grille assembly from the front hood.



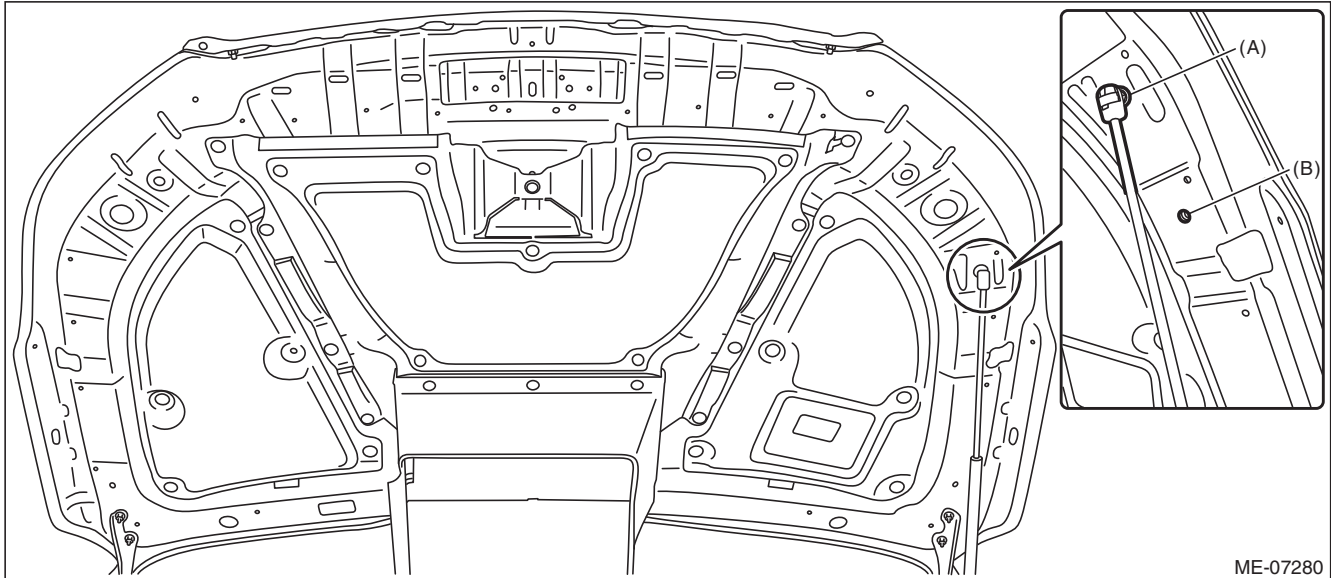
Rocker Cover

MECHANICAL

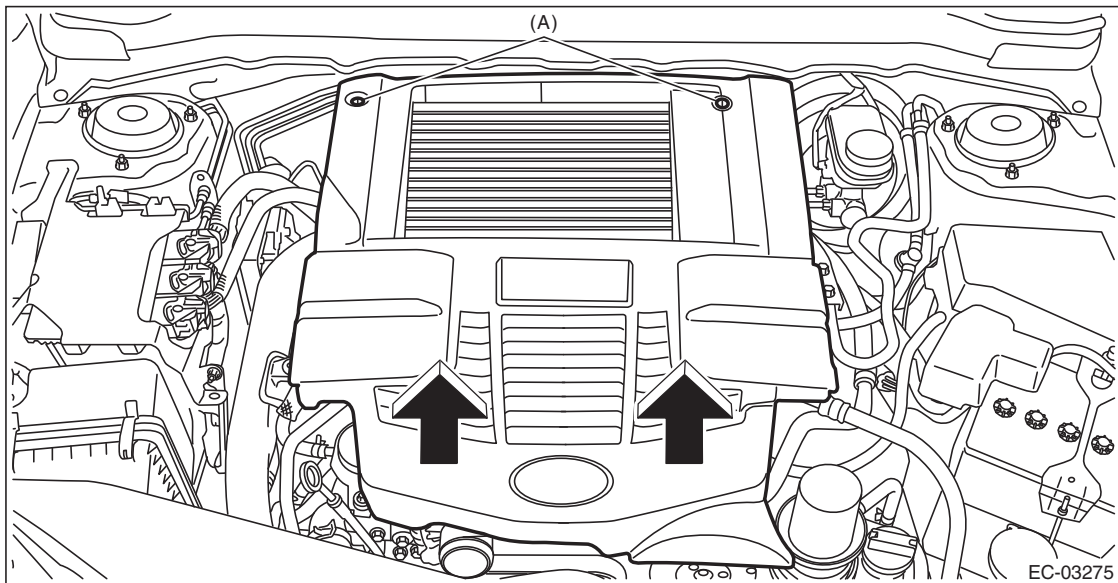
- (5) Change the front hood damper mounting position from (A) to (B), and completely open the front hood.

Tightening torque:

20 N·m (2.0 kgf-m, 14.8 ft-lb)



- (6) Remove the clip (A), lift the front of the collector cover in the direction of arrow, and then remove the collector cover.

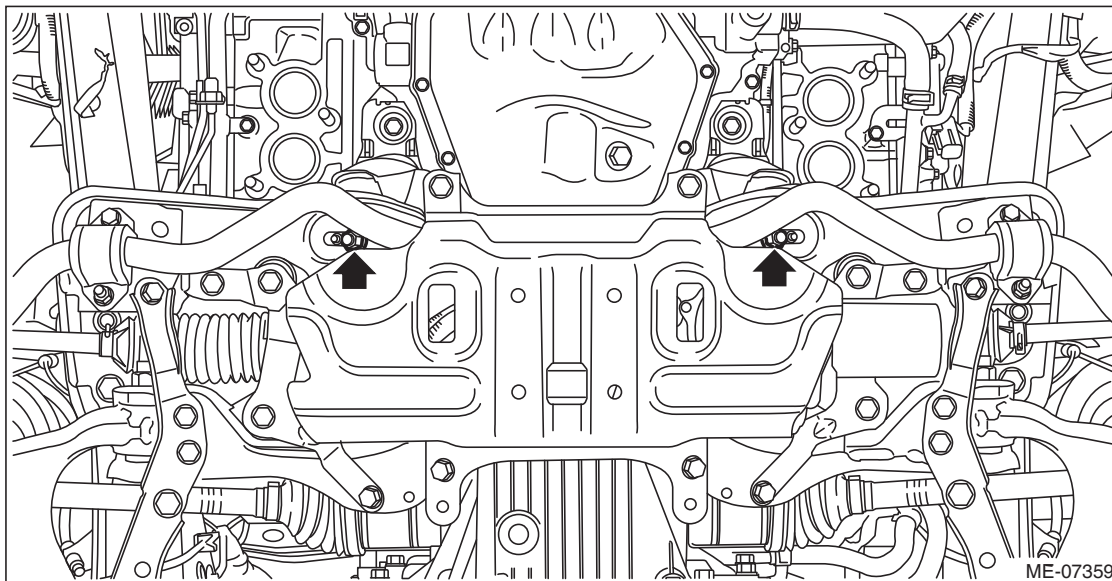


- (7) Remove the battery. <Ref. to SC(H4DO)-63, REMOVAL, Battery.>
(8) Remove the air intake duct (rear). <Ref. to IN(H4DOTC)-19, REMOVAL, Air Intake Duct.>
(9) Remove the front exhaust pipe. <Ref. to EX(H4DOTC)-7, REMOVAL, Front Exhaust Pipe.>

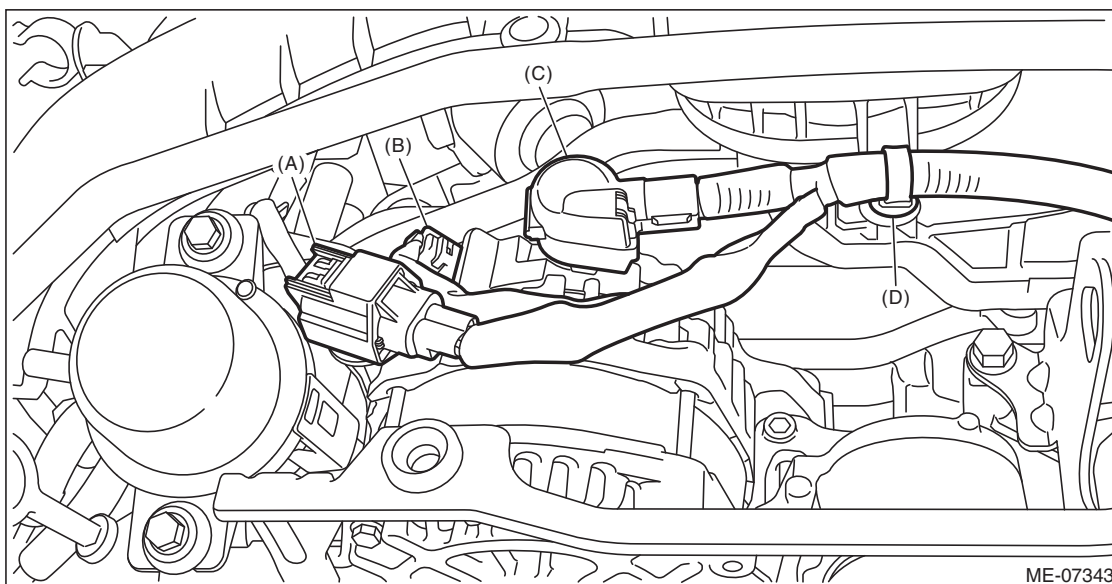
Rocker Cover

MECHANICAL

- (10) Remove the nuts which secure the engine mounting to the front crossmember.



- (11) Lower the vehicle.
(12) Remove the intercooler. <Ref. to IN(H4DOTC)-35, REMOVAL, Intercooler.>
(13) Disconnect the connector (A) from the brake vacuum pump.
(14) Disconnect connector (B) and terminal (C) from the generator, and remove the clip (D) securing the generator cord to the intake manifold.

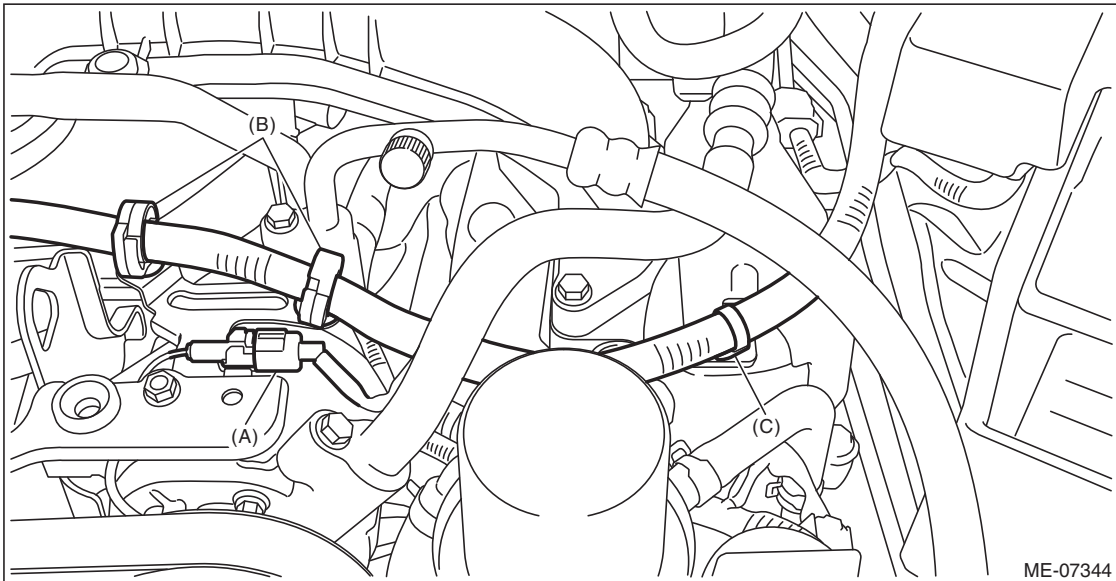


- (15) Disconnect connector (A) from A/C compressor, and remove the generator cord from clip (B).

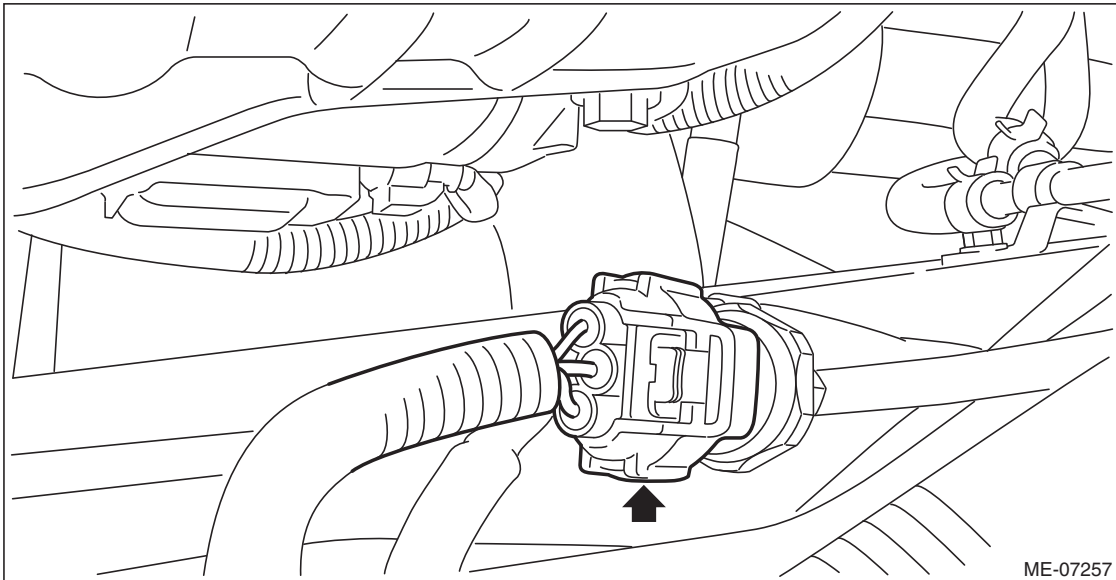
Rocker Cover

MECHANICAL

- (16) Remove the clip (C) securing the generator cord to the fuel pipe protector, and move the generator cord to the left side wheel apron.



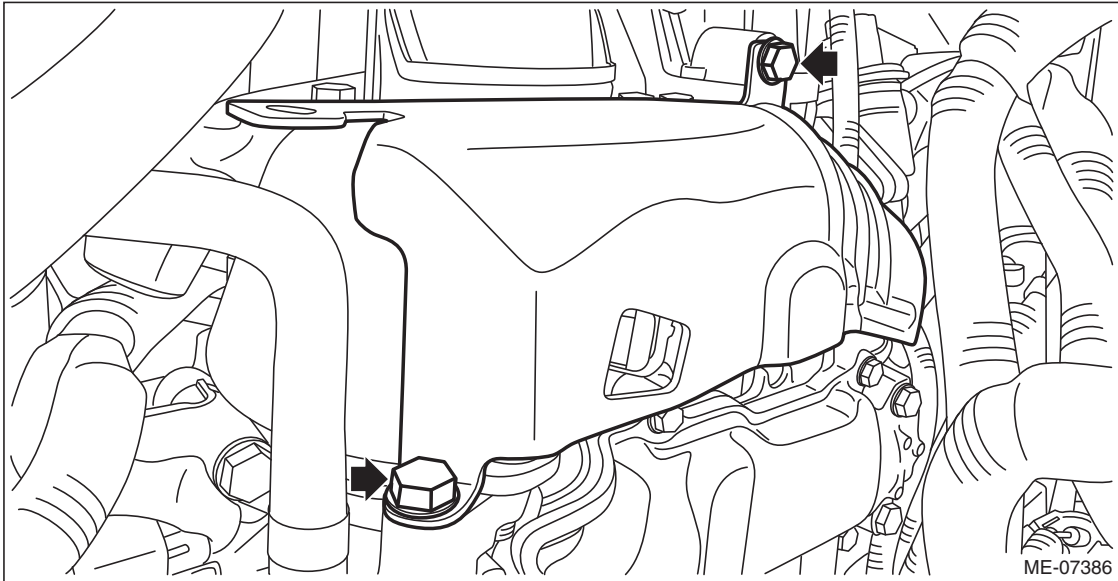
- (17) Disconnect the connector from pressure switch (triple pressure switch).



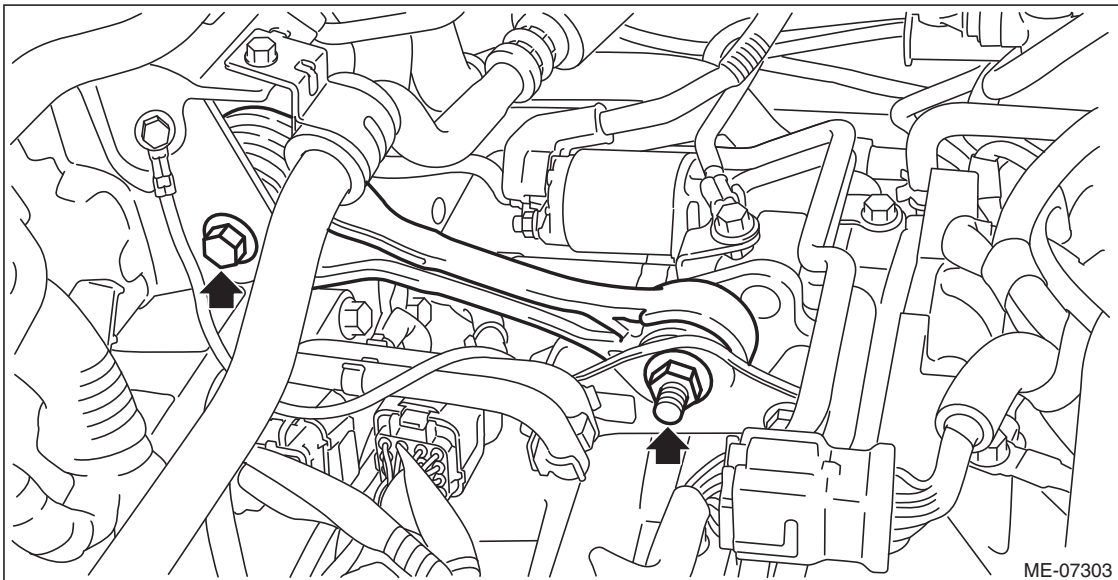
Rocker Cover

MECHANICAL

- (18) Remove the fuel pipe protector from the high-pressure fuel pump case and intake manifold.



- (19) Remove the pitching stopper.



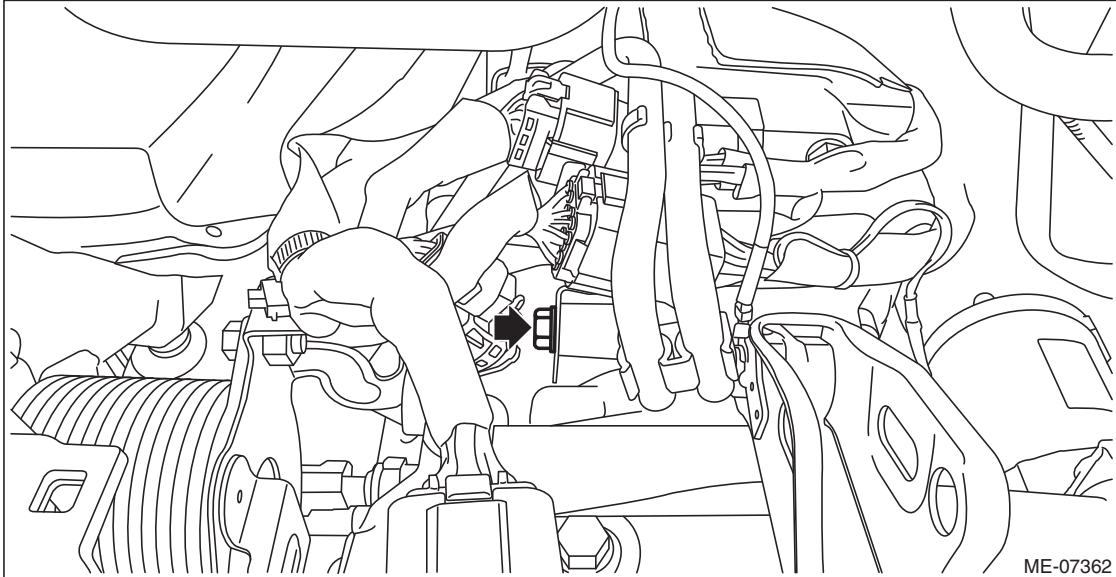
Rocker Cover

MECHANICAL

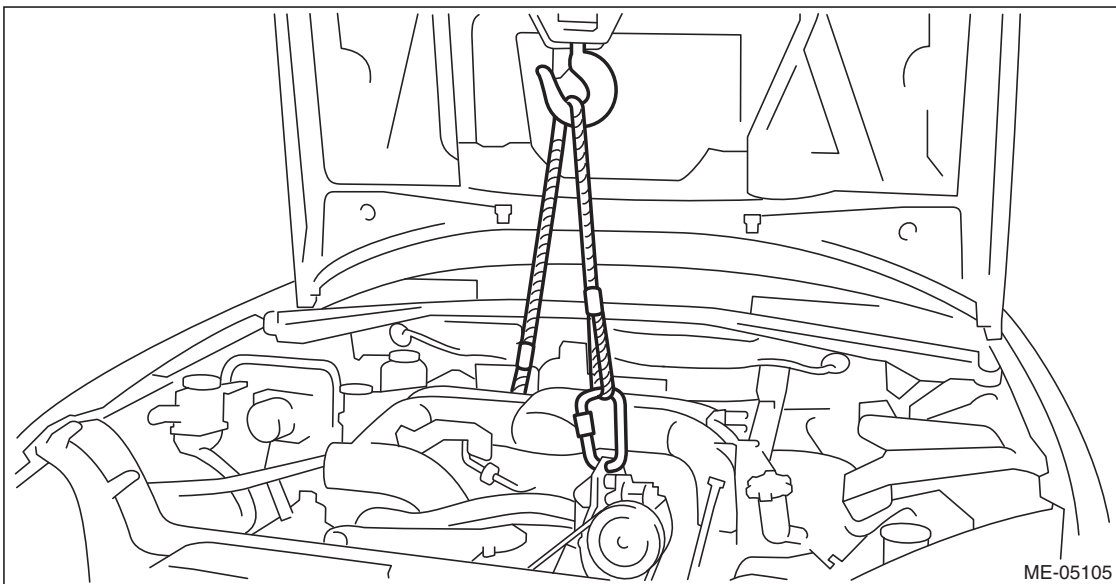
- (20) Remove the bolt securing the transmission harness stay to the CVT.

NOTE:

This procedure is required to prevent the transmission connector from touching the A/C pressure hose during engine removal/installation.



- (21) Support the engine with a lifting device and wire ropes.



Rocker Cover

MECHANICAL

(22) Lift the engine high enough until the stud bolt of the engine mount is drawn out of the crossmember.

CAUTION:

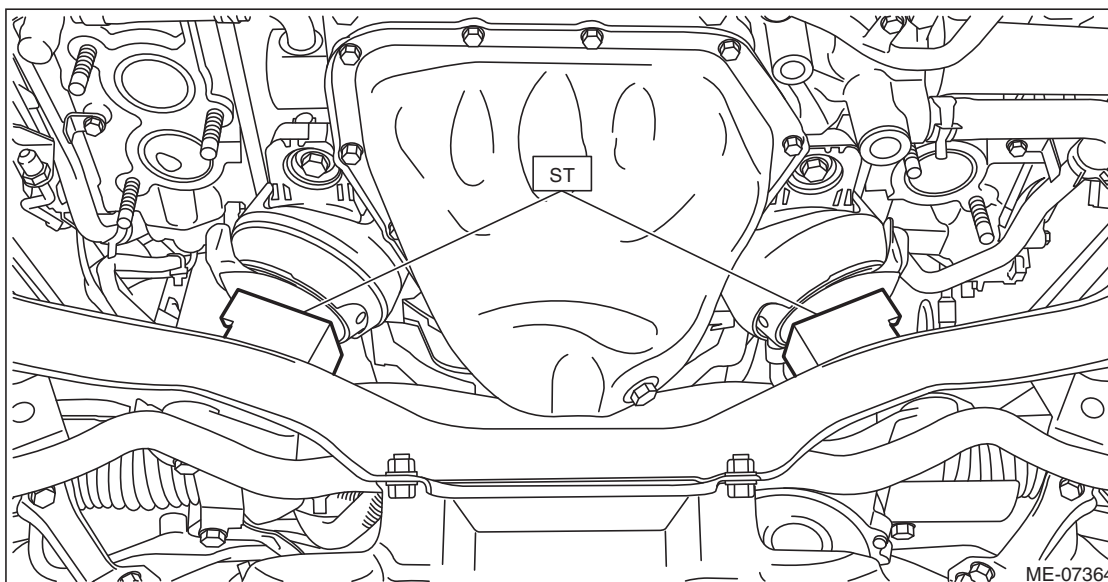
When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

(23) Set the ST between the engine mount and crossmember, and slowly lower the engine.

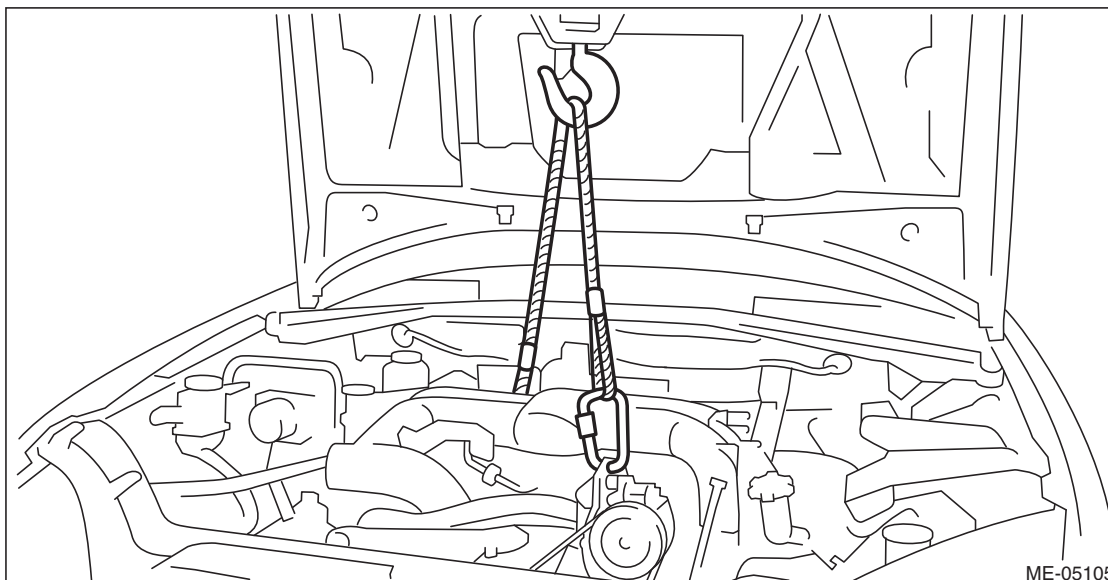
CAUTION:

After lowering the engine, check that the ST does not come off even if the engine is bounced.

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(24) Remove the lifting device and wire ropes.



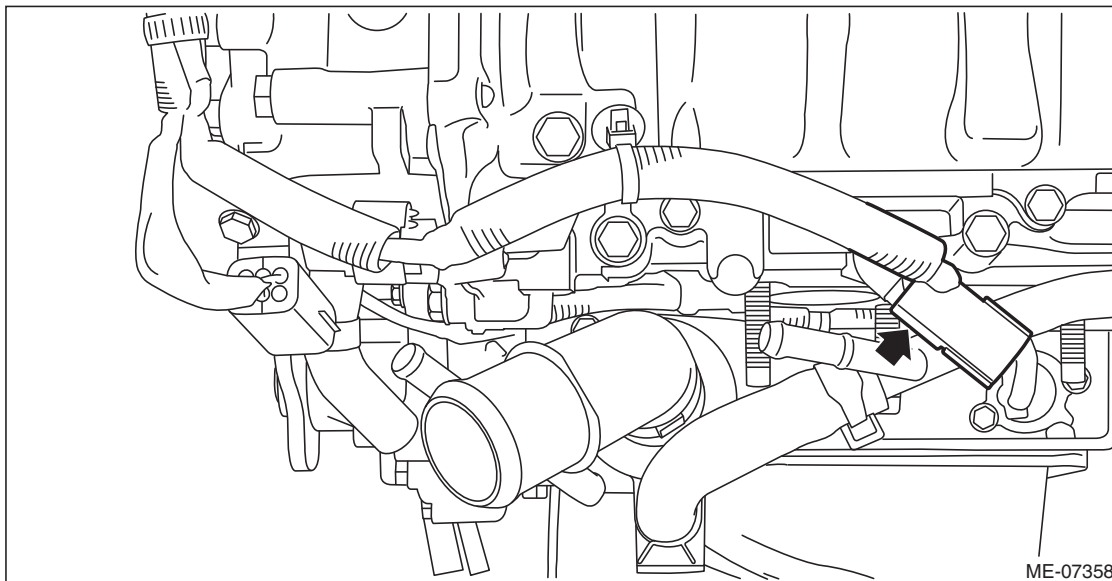
2) Remove the side engine oil cooler pipe assembly. <Ref. to LU(H4DO)-50, SIDE ENGINE OIL COOLER PIPE, REMOVAL, Engine Oil Cooler Pipe.>

3) Remove the #2 ignition coil and the #4 ignition coil. <Ref. to IG(H4DOTC)-9, REMOVAL, Ignition Coil.>

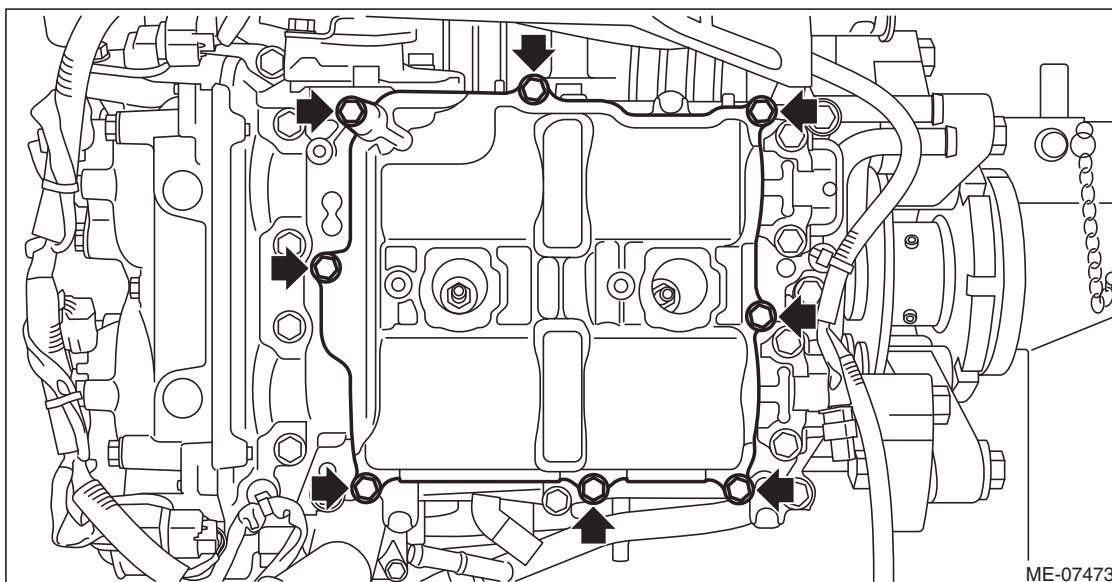
Rocker Cover

MECHANICAL

- 4) Remove the connector from the water pipe LH.



- 5) Remove the rocker cover LH.



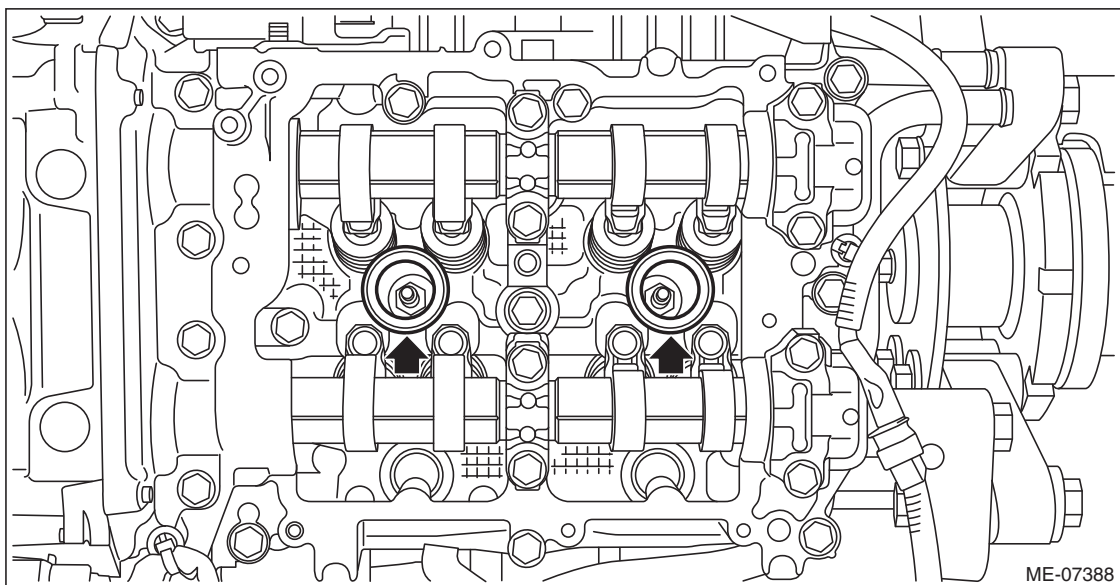
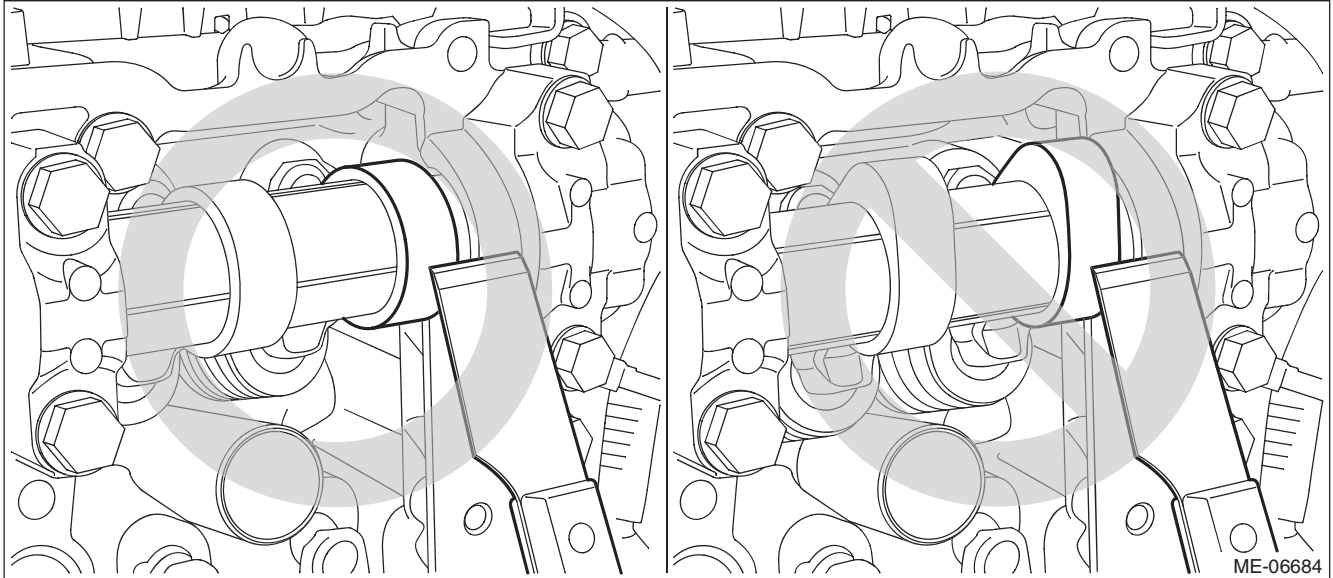
Rocker Cover

MECHANICAL

6) Remove the rocker cover gasket LH, #2 spark plug pipe gasket and #4 spark plug pipe gasket, and remove the liquid gasket.

CAUTION:

- When removing the liquid gasket from engine unit using scraper, use special care not to damage the cam lobe of camshaft LH.
- If the cam lobe of camshaft LH interferes, turn the crankshaft to the position where the scraper does not touch.



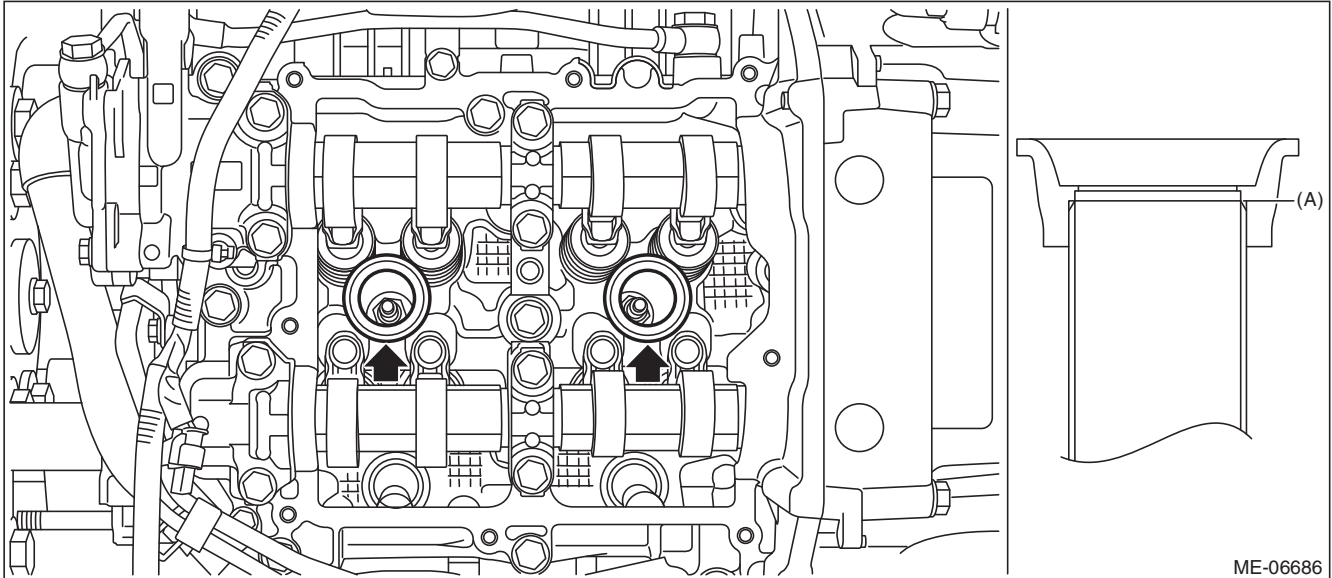
B: INSTALLATION

1. ROCKER COVER RH

1) Install the #1 spark plug pipe gasket and #3 spark plug pipe gasket to the #1 spark plug pipe and #3 spark plug pipe.

NOTE:

- Use a new #1 spark plug pipe gasket and #3 spark plug pipe gasket.
- Apply a light coat of engine oil to the #1 spark plug pipe gasket and #3 spark plug pipe gasket, and insert them onto the spark plug pipe edge (A).



2) Install the rocker cover gasket RH to the rocker cover RH.

NOTE:

Use a new rocker cover gasket RH.

Rocker Cover

MECHANICAL

3) Apply liquid gasket to the mating surface of rocker cover RH as shown in the figure.

NOTE:

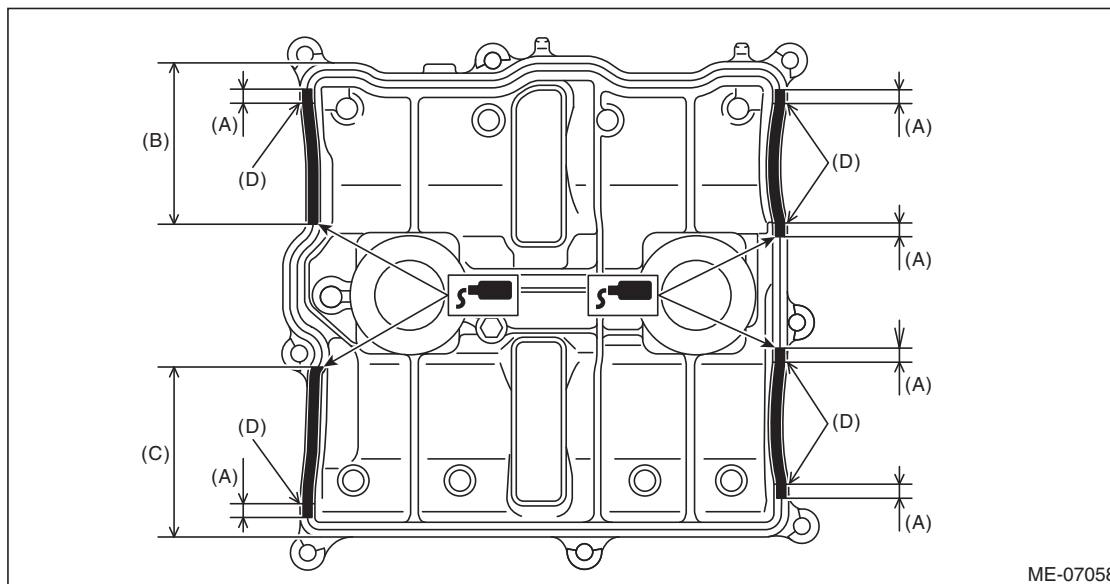
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine.
- Be careful not to allow liquid gasket to be squeezed out from rocker cover RH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

Liquid gasket applying diameter:

3 ± 1 mm (0.1181 ± 0.0394 in)



(A) 10 mm (0.394 in) or more

(C) 70.7 mm (2.783 in) or more

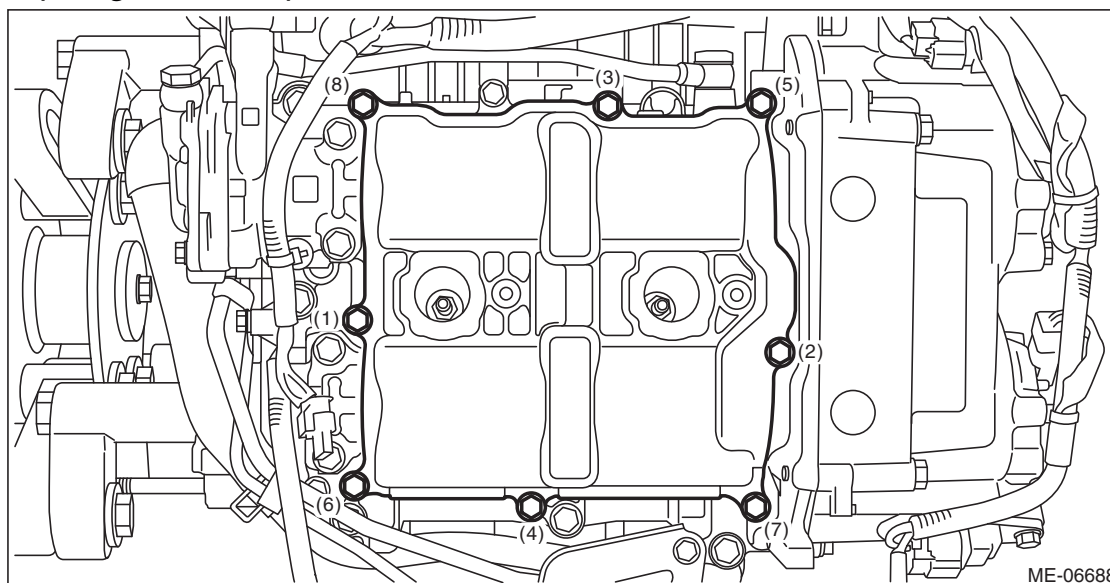
(D) Arch starting point

(B) 68 mm (2.677 in) or more

4) Set the rocker cover RH, and tighten the bolts in numerical order as shown in the figure.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



5) Install the #1 ignition coil and the #3 ignition coil. <Ref. to IG(H4DOTC)-9, INSTALLATION, Ignition Coil.>

Rocker Cover

MECHANICAL

6) When working on the vehicle

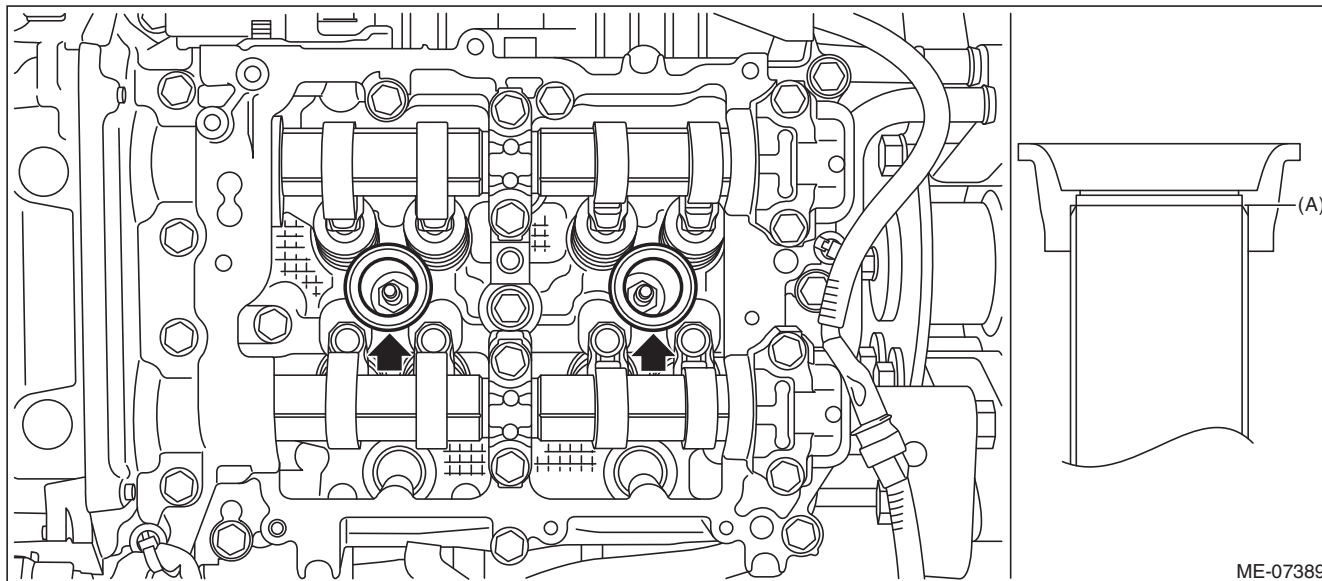
(1) Install the air cleaner case. <Ref. to IN(H4DOTC)-11, INSTALLATION, Air Cleaner Case.>

2. ROCKER COVER LH

1) Install the #2 spark plug pipe gasket and #4 spark plug pipe gasket to the #2 spark plug pipe and #4 spark plug pipe.

NOTE:

- Use a new #2 spark plug pipe gasket and #4 spark plug pipe gasket.
- Apply a light coat of engine oil to the #2 spark plug pipe gasket and #4 spark plug pipe gasket, and insert them onto the spark plug pipe edge (A).



2) Install the rocker cover gasket LH to the rocker cover LH.

NOTE:

Use a new rocker cover gasket LH.

Rocker Cover

MECHANICAL

3) Apply liquid gasket to the mating surface of rocker cover LH as shown in the figure.

NOTE:

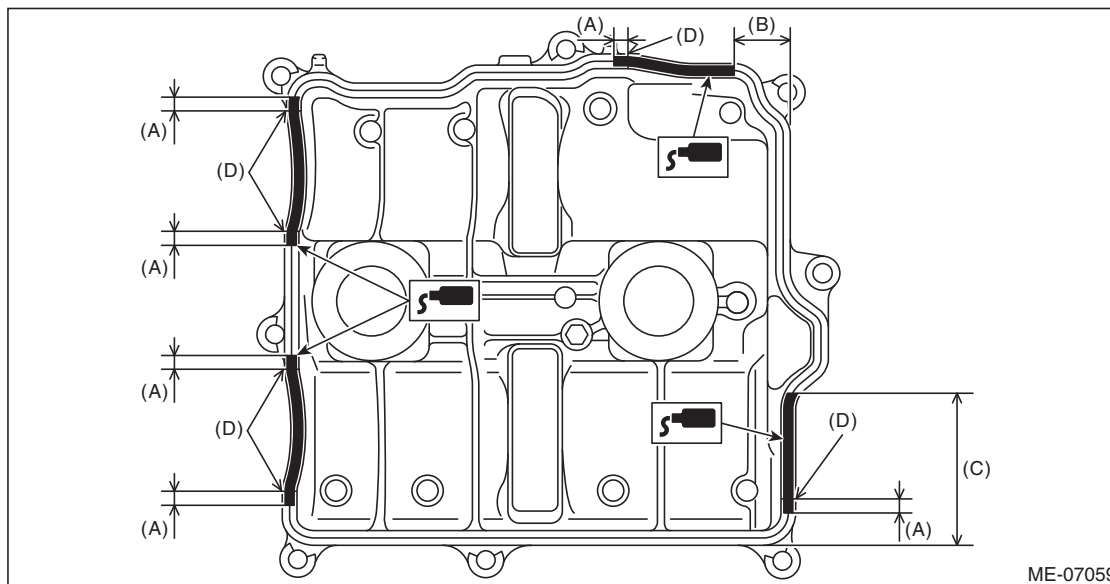
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine.
- Be careful not to allow liquid gasket to be squeezed out from rocker cover LH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

Liquid gasket applying diameter:

3 ± 1 mm (0.1181 ± 0.0394 in)



(A) 10 mm (0.394 in) or more

(C) 63 mm (2.480 in) or more

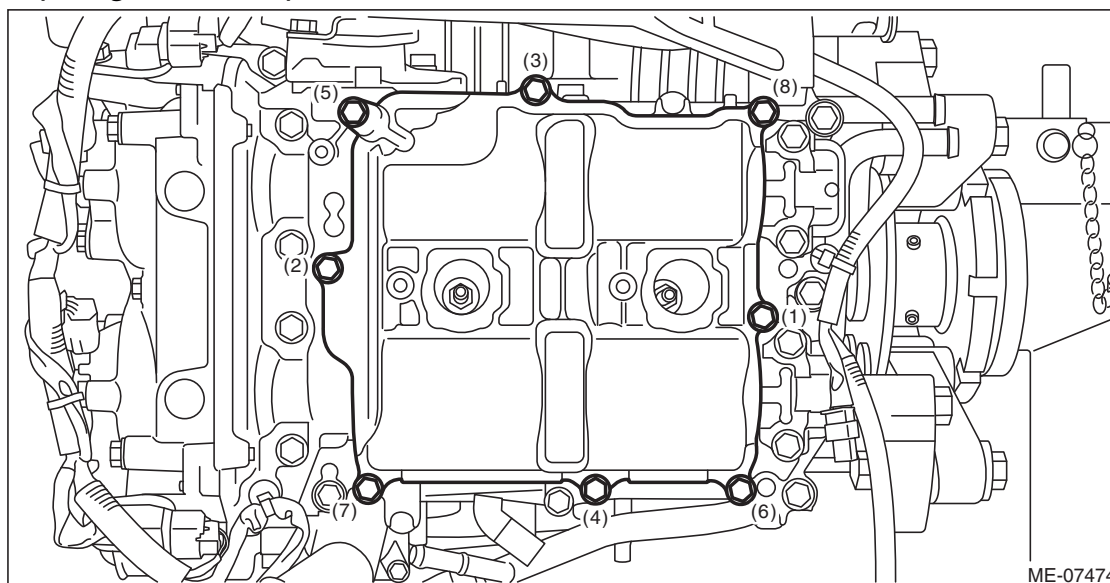
(D) Arch starting point

(B) 18.8 mm (0.7402 in) or more

4) Set the rocker cover LH, and tighten the bolts in numerical order as shown in the figure.

Tightening torque:

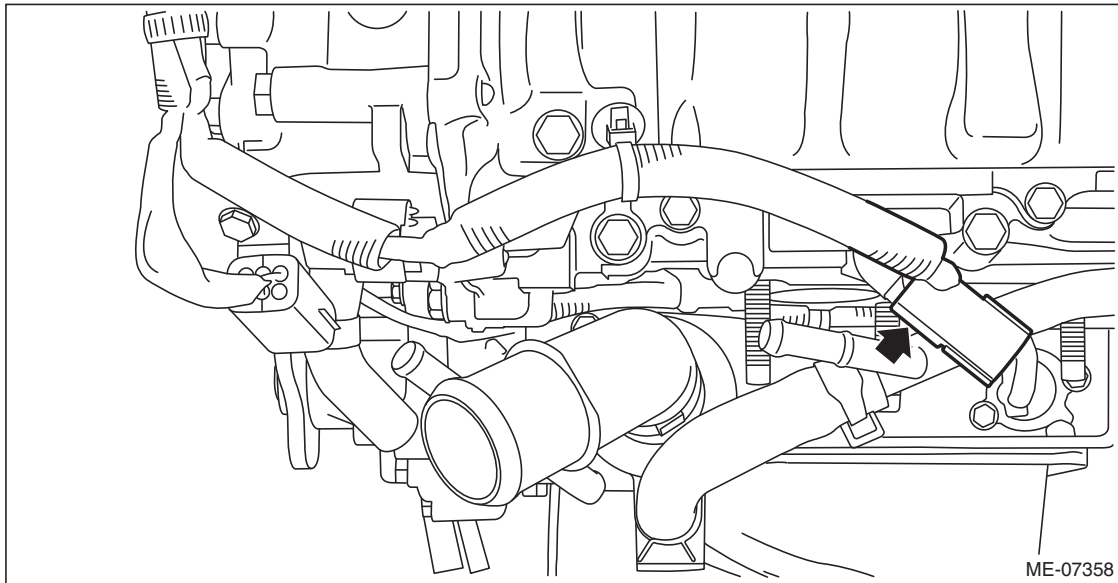
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Rocker Cover

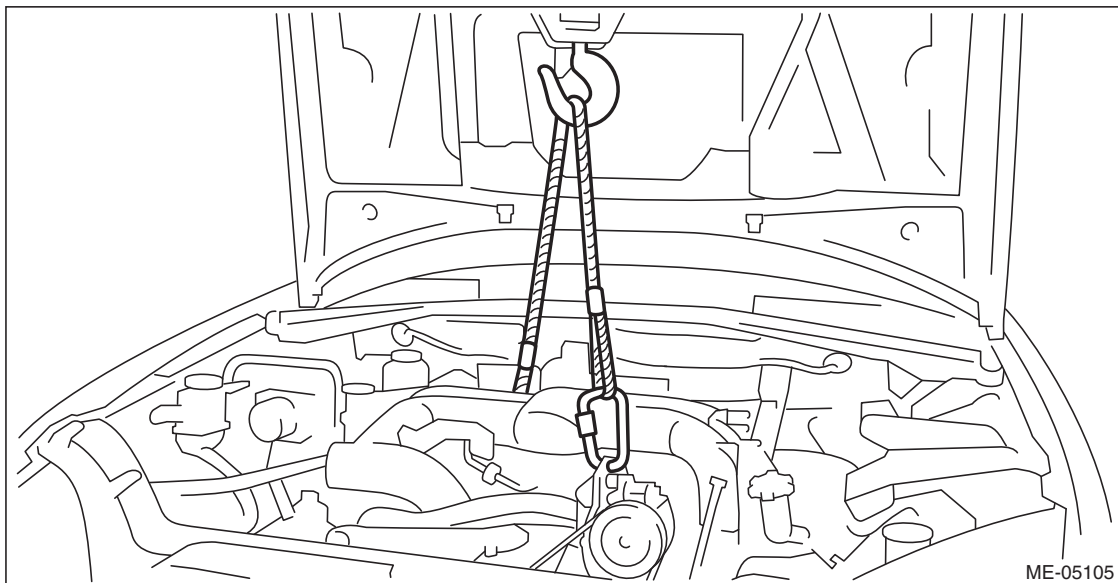
MECHANICAL

- 5) Connect the connector to the water pipe LH.



- 6) Install the #2 ignition coil and the #4 ignition coil. <Ref. to IG(H4DOTC)-9, INSTALLATION, Ignition Coil.>
7) Install the side engine oil cooler pipe assembly. <Ref. to LU(H4DO)-51, SIDE ENGINE OIL COOLER PIPE, INSTALLATION, Engine Oil Cooler Pipe.>
8) When working on the vehicle

- (1) Support the engine with a lifting device and wire ropes.



Rocker Cover

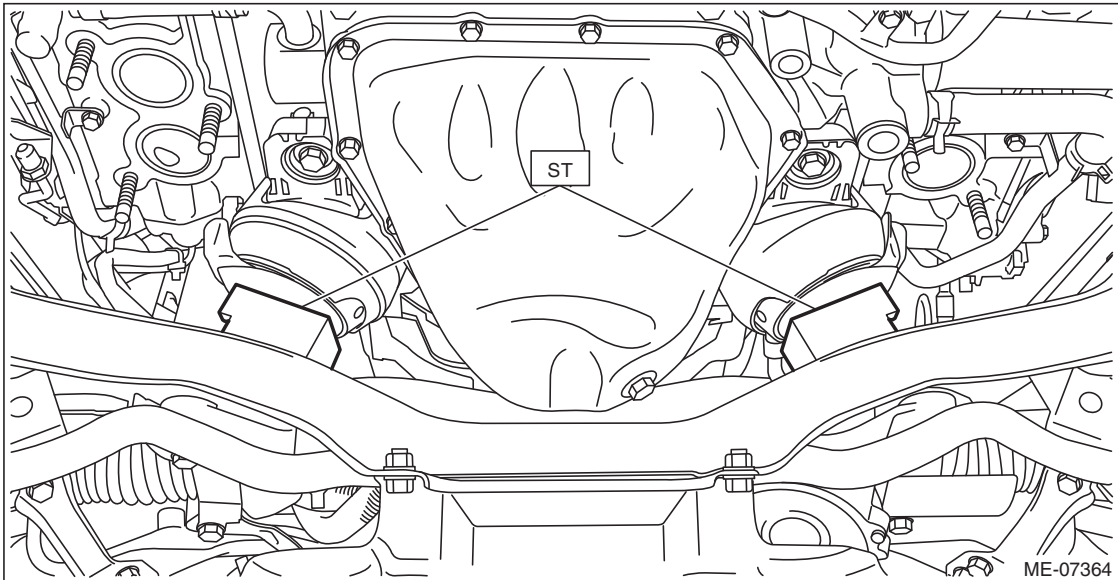
MECHANICAL

- (2) Lift the engine, and remove the ST.

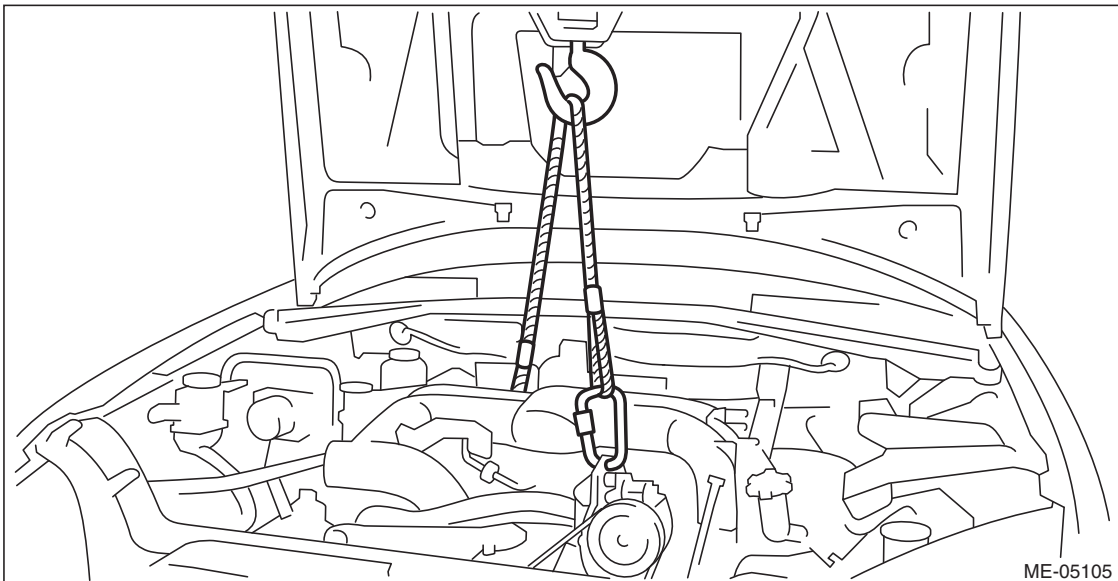
CAUTION:

When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

ST 18632AA020 STAND ASSY



- (3) Lower the engine and remove the lifting device and wire ropes.



Rocker Cover

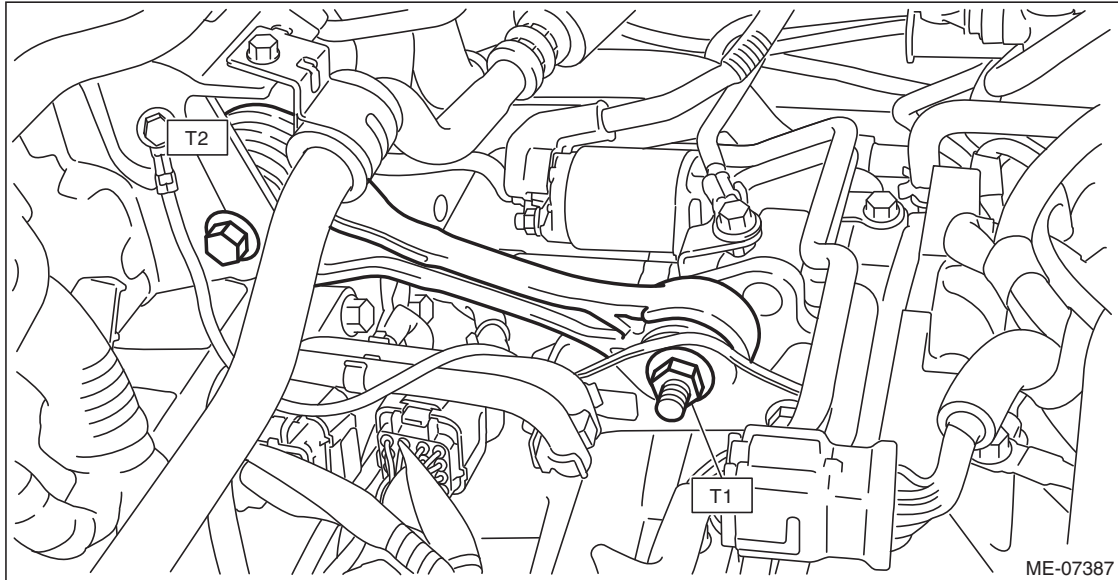
MECHANICAL

(4) Install the pitching stopper.

Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

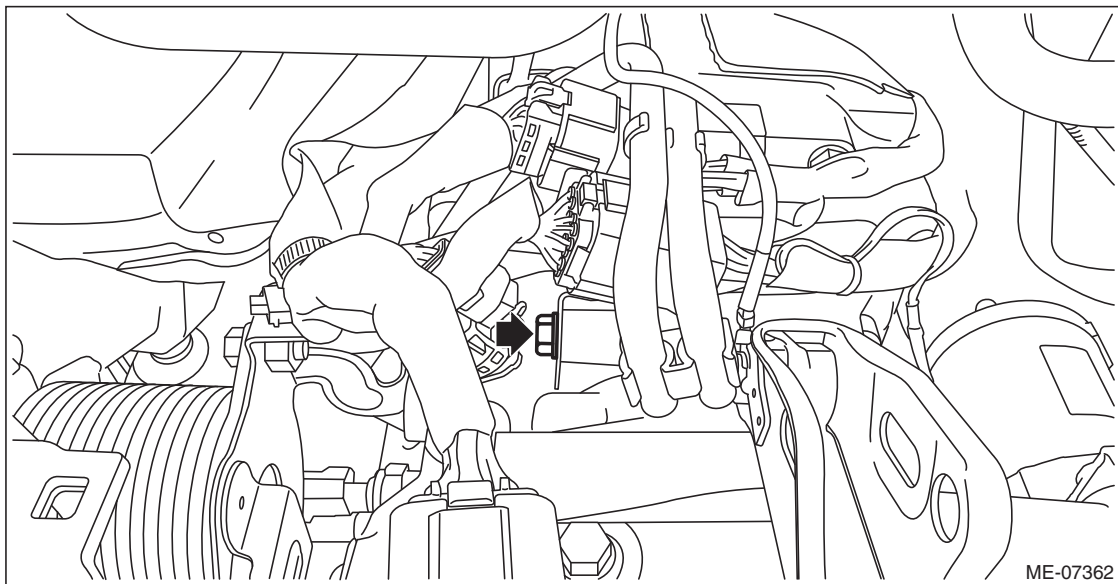
T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)



(5) Install the bolt which secures the transmission harness stay to the CVT.

Tightening torque:

15 N·m (1.6 kgf-m, 11.8 ft-lb)



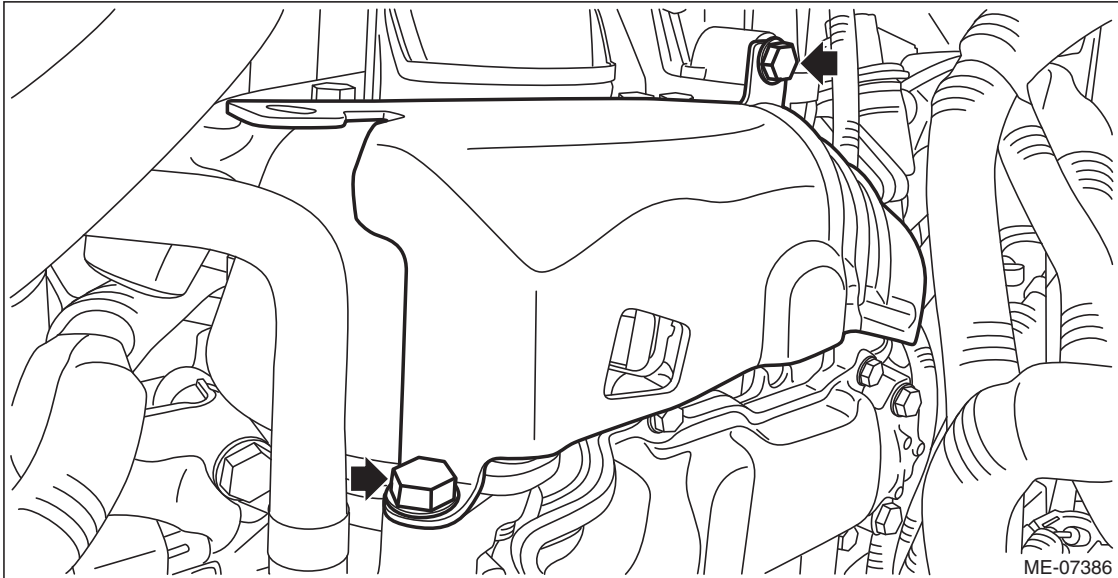
Rocker Cover

MECHANICAL

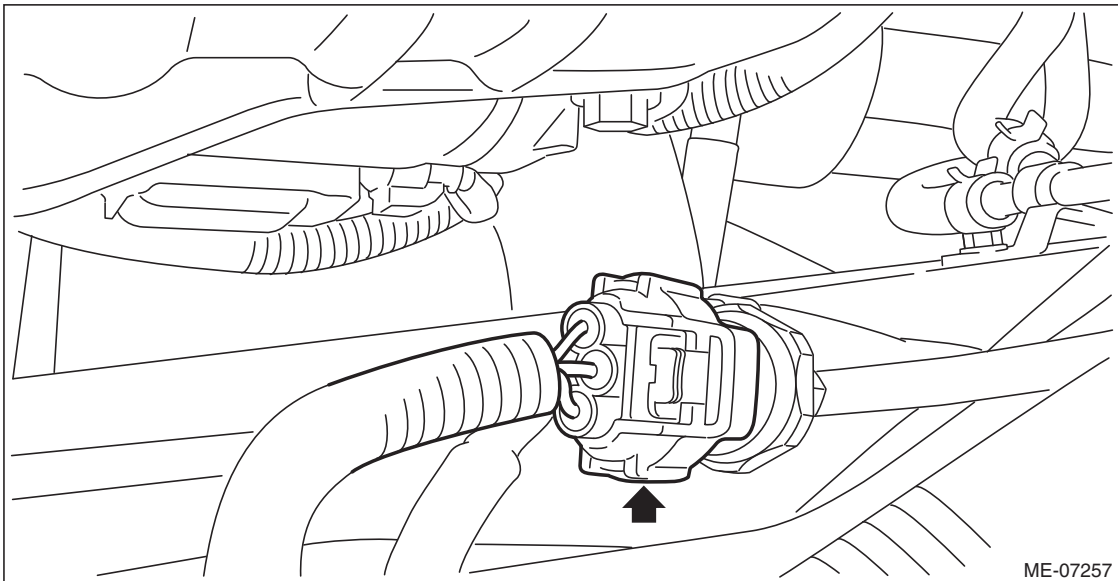
- (6) Install the fuel pipe protector to the high-pressure fuel pump case and intake manifold.

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)



- (7) Connect the connector to the pressure switch (triple pressure switch).

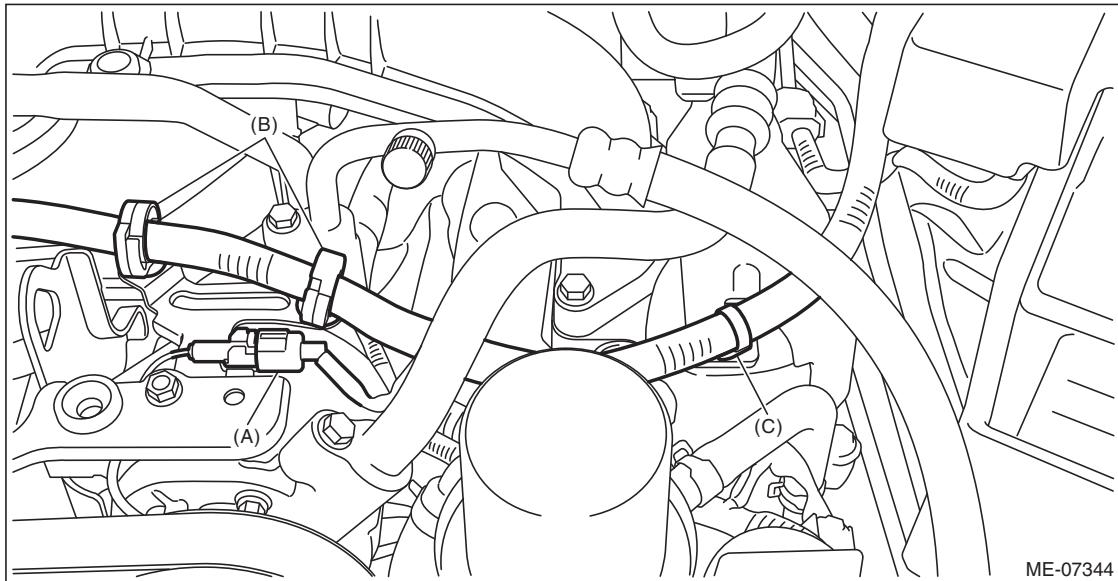


- (8) Set the generator cord, and fix the generator cord to the fuel pipe protector using clip (C).

Rocker Cover

MECHANICAL

- (9) Install the generator cord to clip (B), and connect the connector (A) to A/C compressor.

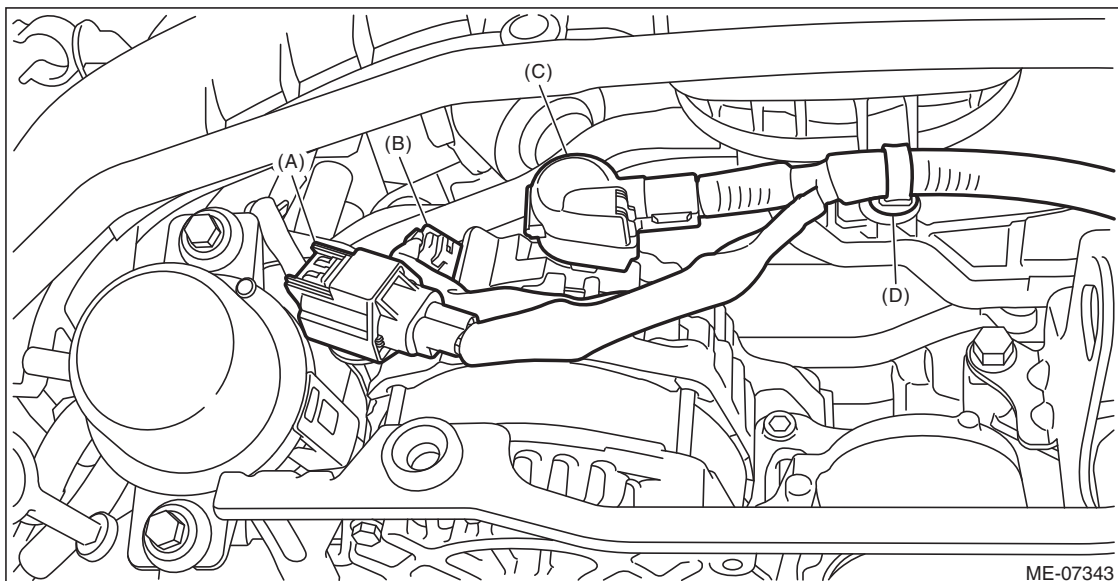


- (10) Using clip (D), fix the generator cord to the generator cord stay, and connect the connector (B) and the terminal (C) to the generator.

Tightening torque:

15 N·m (1.5 kgf-m, 11.1 ft-lb)

- (11) Connect the connector (A) to the brake vacuum pump.



- (12) Install the intercooler. <Ref. to IN(H4DOTC)-37, INSTALLATION, Intercooler.>
(13) Lift up the vehicle.

Rocker Cover

MECHANICAL

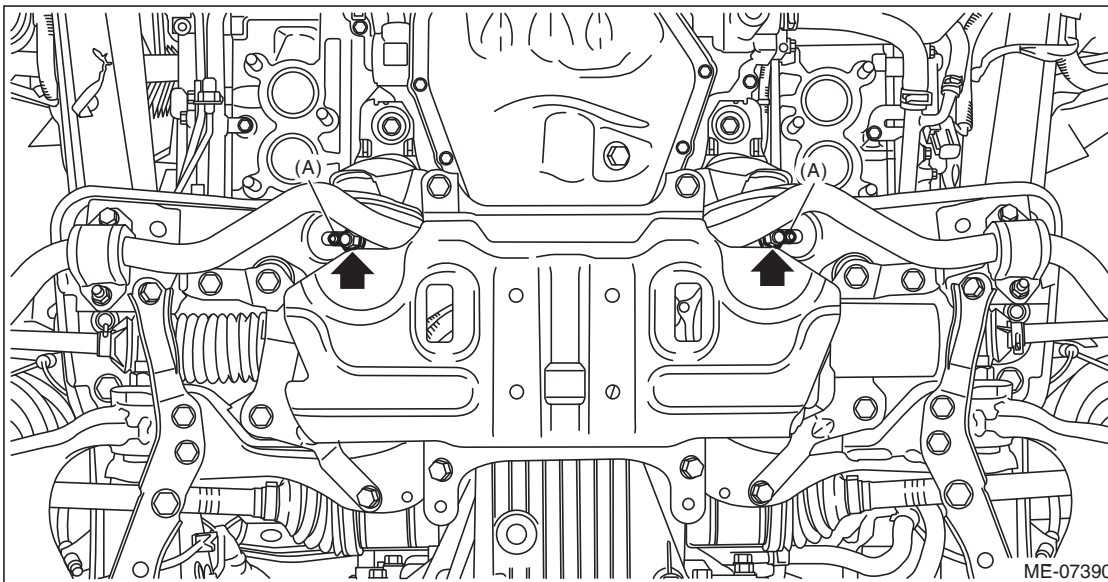
(14) Install the nuts which hold the engine mounting to the crossmember.

NOTE:

Make sure that locators (A) of the engine mounting are securely inserted.

Tightening torque:

45 N·m (4.6 kgf-m, 33.2 ft-lb)



(15) Install the front exhaust pipe. <Ref. to EX(H4DOTC)-15, INSTALLATION, Front Exhaust Pipe.>

(16) Install the air intake duct (rear). <Ref. to IN(H4DOTC)-19, INSTALLATION, Air Intake Duct.>

(17) Install the battery. <Ref. to SC(H4DO)-63, INSTALLATION, Battery.>

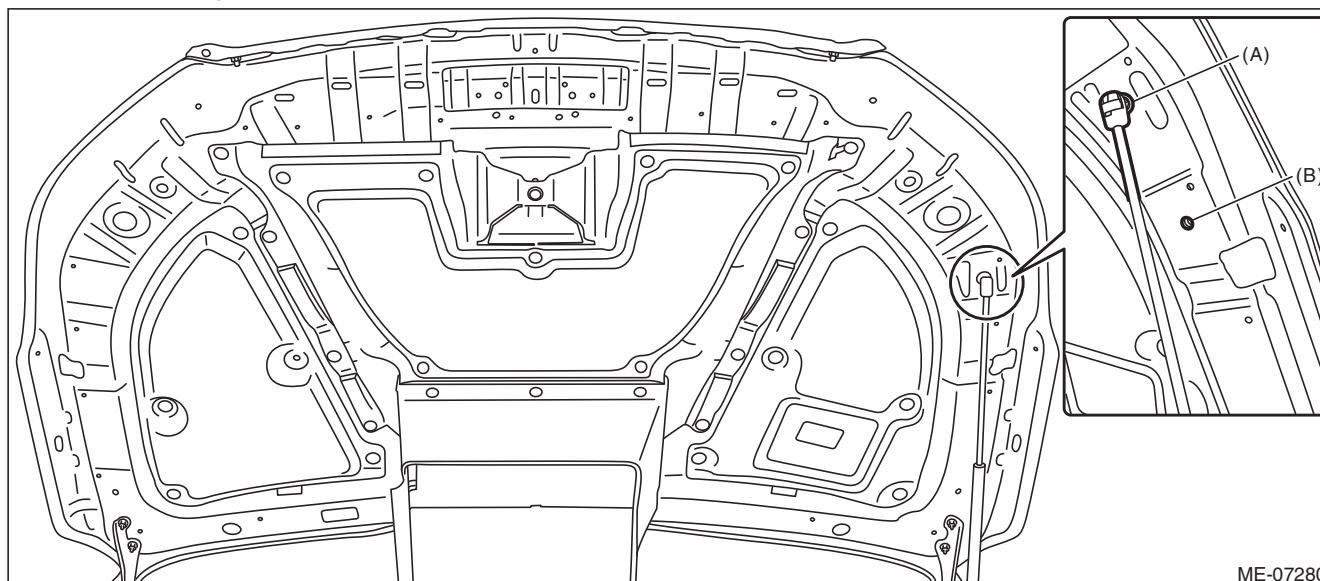
(18) Fill engine coolant. <Ref. to CO(H4DOTC)-14, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

(19) Install the collector cover.

(20) Change the installation position of the front hood damper from (B) to (A).

Tightening torque:

20 N·m (2.0 kgf-m, 14.8 ft-lb)



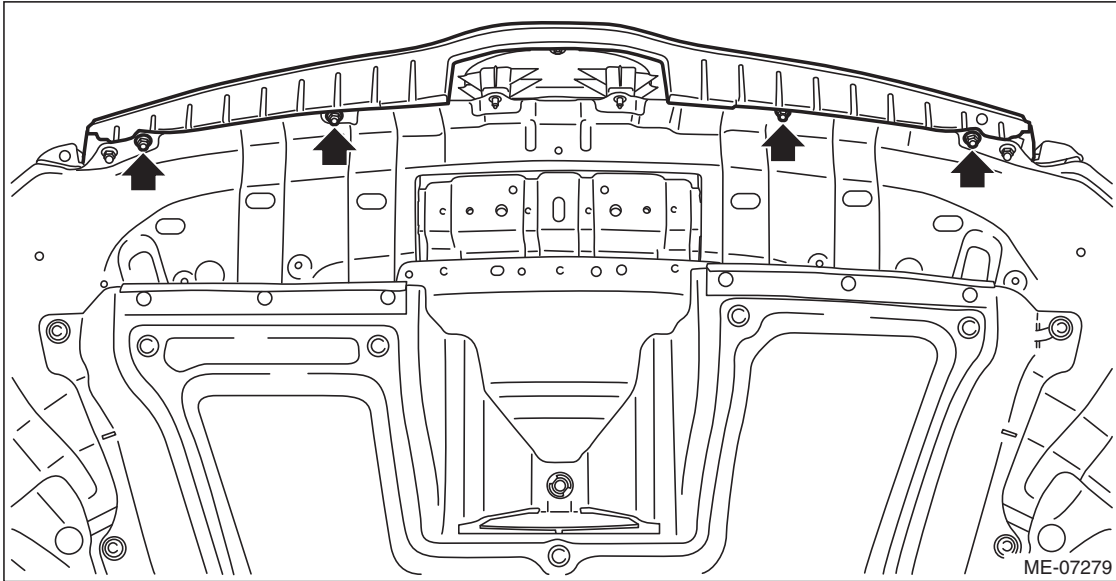
Rocker Cover

MECHANICAL

(21) Install the front center grille assembly to the front hood.

Tightening torque:

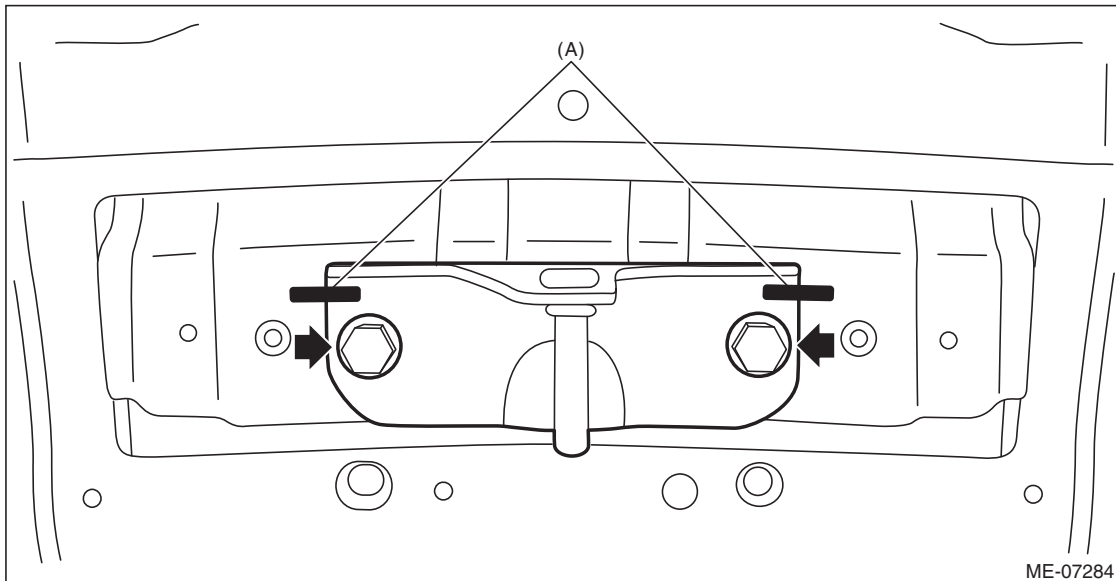
4.5 N·m (0.5 kgf-m, 3.3 ft-lb)



(22) Align the alignment marks (A), and install the front hood striker to the front hood.

Tightening torque:

33 N·m (3.4 kgf-m, 24.3 ft-lb)



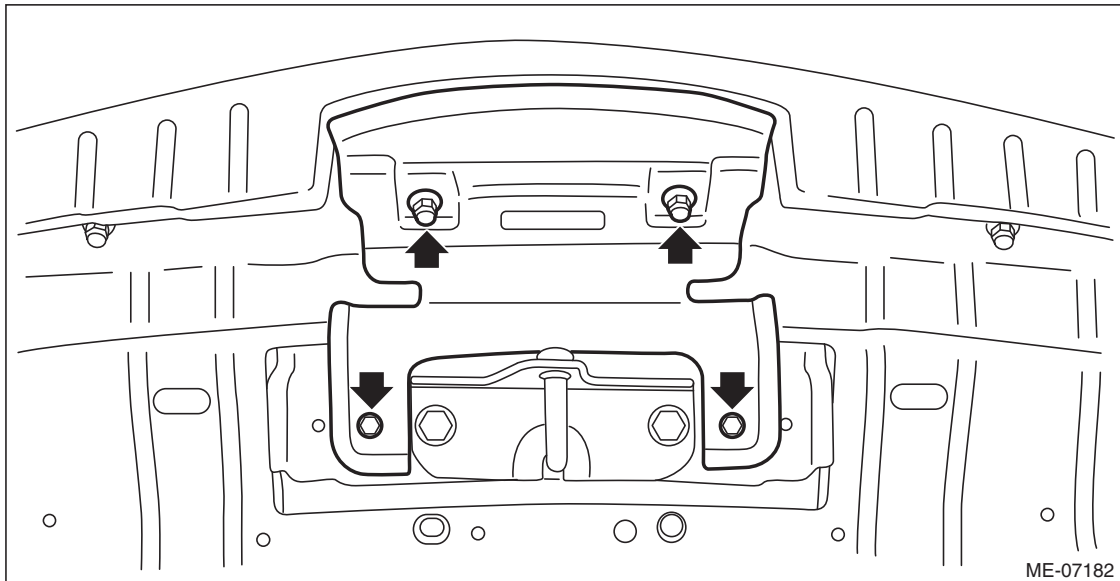
Rocker Cover

MECHANICAL

(23) Install the upper grille bracket to the front hood, and close the front hood.

Tightening torque:

4.5 N·m (0.5 kgf-m, 3.3 ft-lb)



C: INSPECTION

Check that the rocker cover does not have deformation, cracks and any other damage.



19. Camshaft

A: REMOVAL

1. CAMSHAFT RH

The camshaft RH and cam carrier are designed as removing as a unit. Refer to "Cam Carrier" for removal procedures of camshaft RH. <Ref. to ME(H4DOTC)-172, CAM CARRIER RH, REMOVAL, Cam Carrier.> <Ref. to ME(H4DOTC)-200, CAM CARRIER RH, DISASSEMBLY, Cam Carrier.>

2. CAMSHAFT LH

The camshaft LH and cam carrier are designed as removing as a unit. Refer to "Cam Carrier" for removal procedures of camshaft LH. <Ref. to ME(H4DOTC)-175, CAM CARRIER LH, REMOVAL, Cam Carrier.> <Ref. to ME(H4DOTC)-202, CAM CARRIER LH, DISASSEMBLY, Cam Carrier.>

B: INSTALLATION

1. CAMSHAFT RH

The camshaft RH and cam carrier are designed as installing as a unit. Refer to "Cam Carrier" for installation procedures of camshaft RH. <Ref. to ME(H4DOTC)-203, CAM CARRIER RH, ASSEMBLY, Cam Carrier.> <Ref. to ME(H4DOTC)-180, CAM CARRIER RH, INSTALLATION, Cam Carrier.>

2. CAMSHAFT LH

The camshaft LH and cam carrier are designed as installing as a unit. Refer to "Cam Carrier" for installation procedures of camshaft LH. <Ref. to ME(H4DOTC)-207, CAM CARRIER LH, ASSEMBLY, Cam Carrier.> <Ref. to ME(H4DOTC)-189, CAM CARRIER LH, INSTALLATION, Cam Carrier.>



Cam Carrier

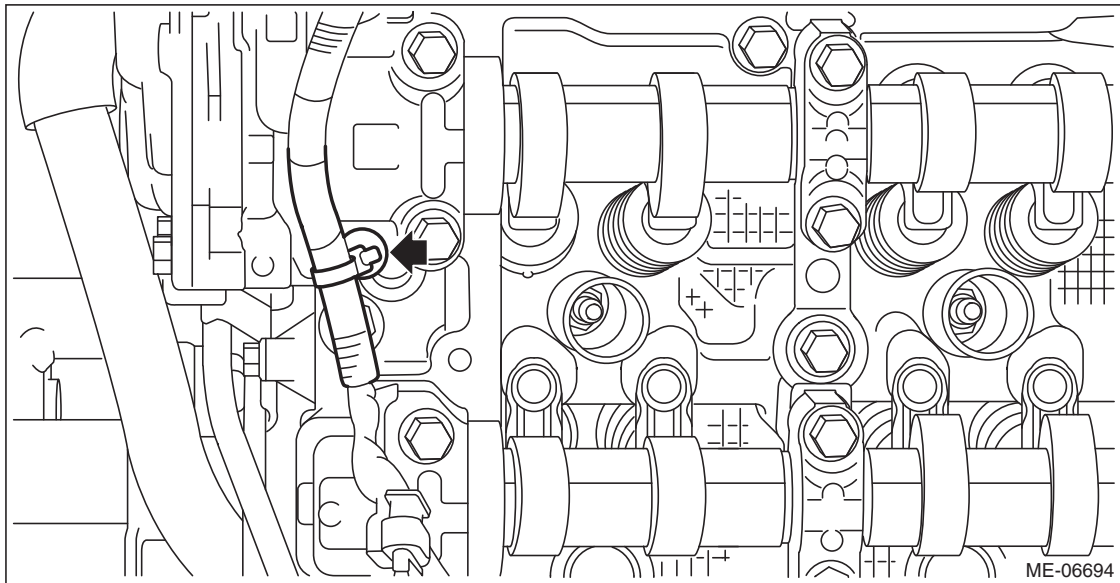
MECHANICAL

20. Cam Carrier

A: REMOVAL

1. CAM CARRIER RH

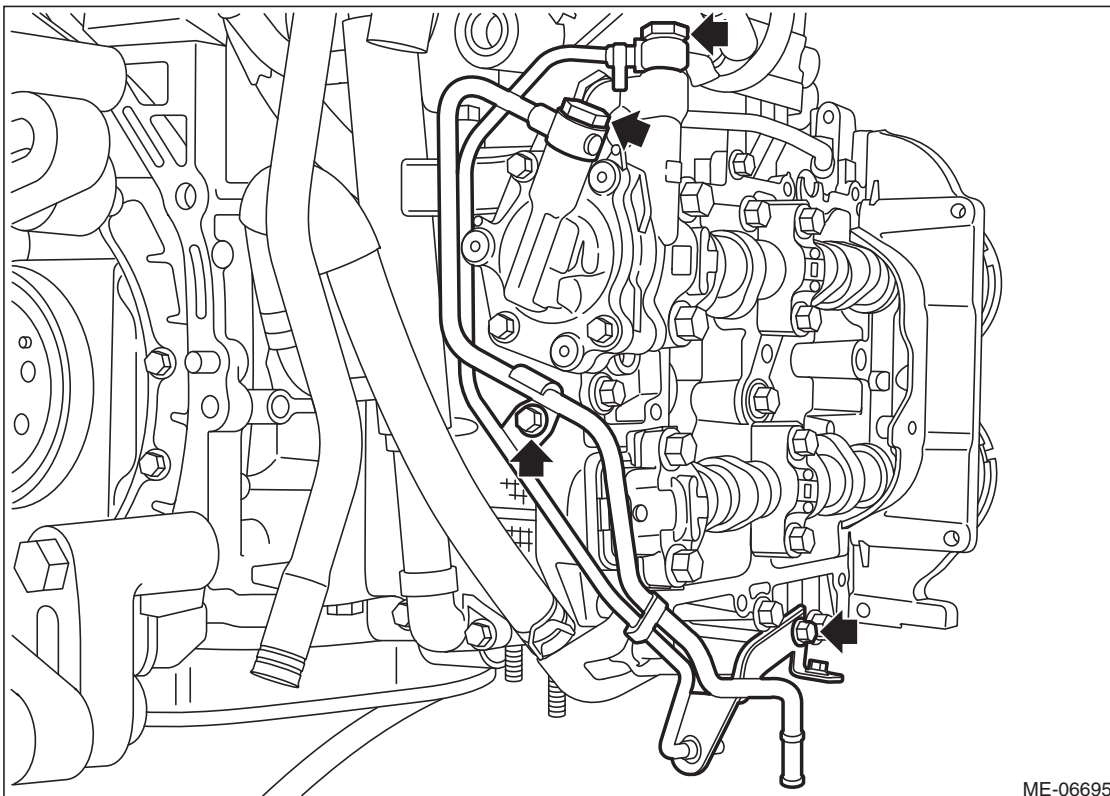
- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-44, REMOVAL, Engine Assembly.>
- 2) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 3) Remove the timing chain RH. <Ref. to ME(H4DOTC)-111, TIMING CHAIN RH, REMOVAL, Timing Chain Assembly.>
- 4) Remove the rocker cover RH. <Ref. to ME(H4DOTC)-147, ROCKER COVER RH, REMOVAL, Rocker Cover.>
- 5) Remove the clip holding the engine harness from cam carrier RH.



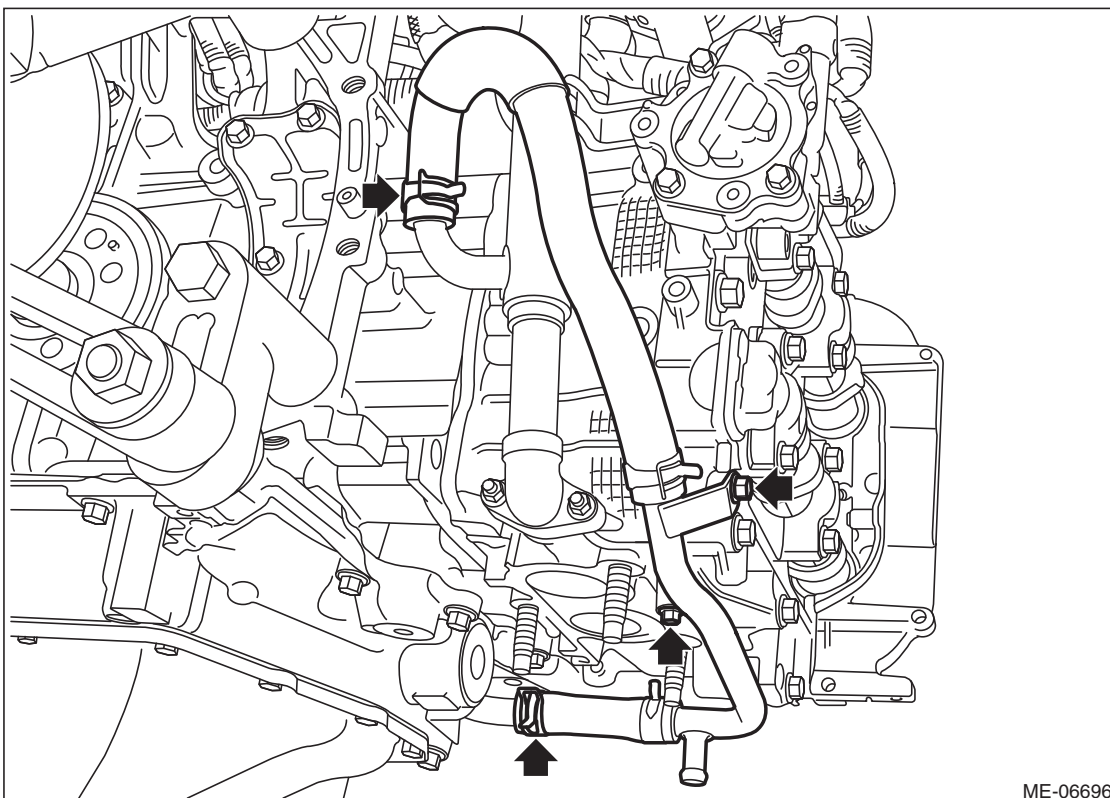
Cam Carrier

MECHANICAL

- 6) Remove the oil pipe assembly from the scavenge pump and cam carrier RH.



- 7) Disconnect the water pipe hose from oil pan upper and EGR cooler, and remove the water pipe assembly.



Cam Carrier

MECHANICAL

8) When disassembling the cam carrier RH

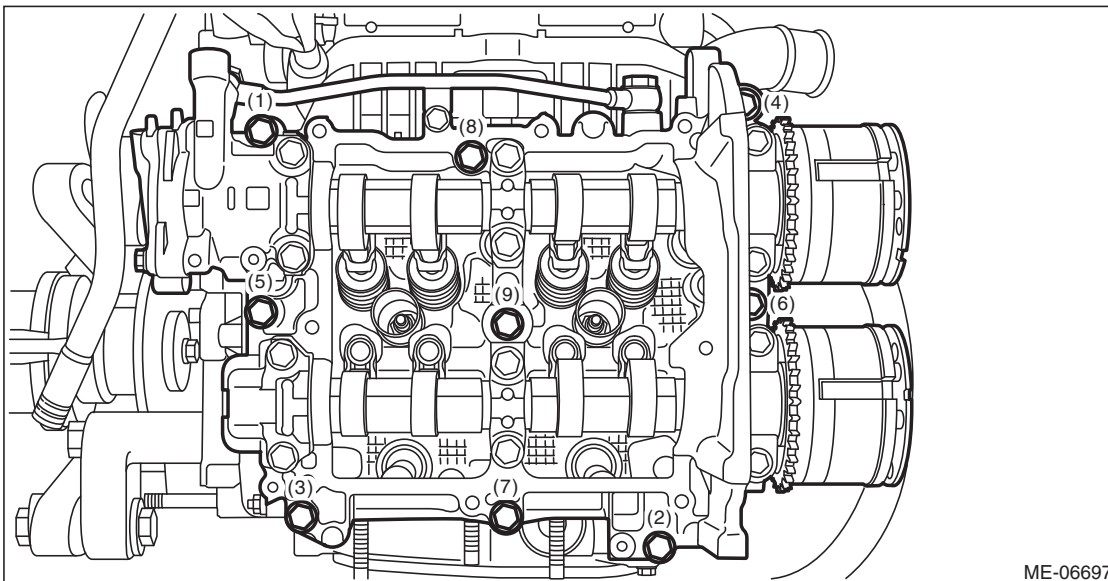
NOTE:

When disassembling the cam carrier RH, perform the following steps also.

- (1) Remove the scavenge pump. <Ref. to LU(H4DO)-54, REMOVAL, Scavenge Pump.>
- (2) Remove the cam sprocket RH. <Ref. to ME(H4DOTC)-137, CAM SPROCKET RH, REMOVAL, Cam Sprocket.>

9) Set the part so that the cam carrier RH is on the upper side.

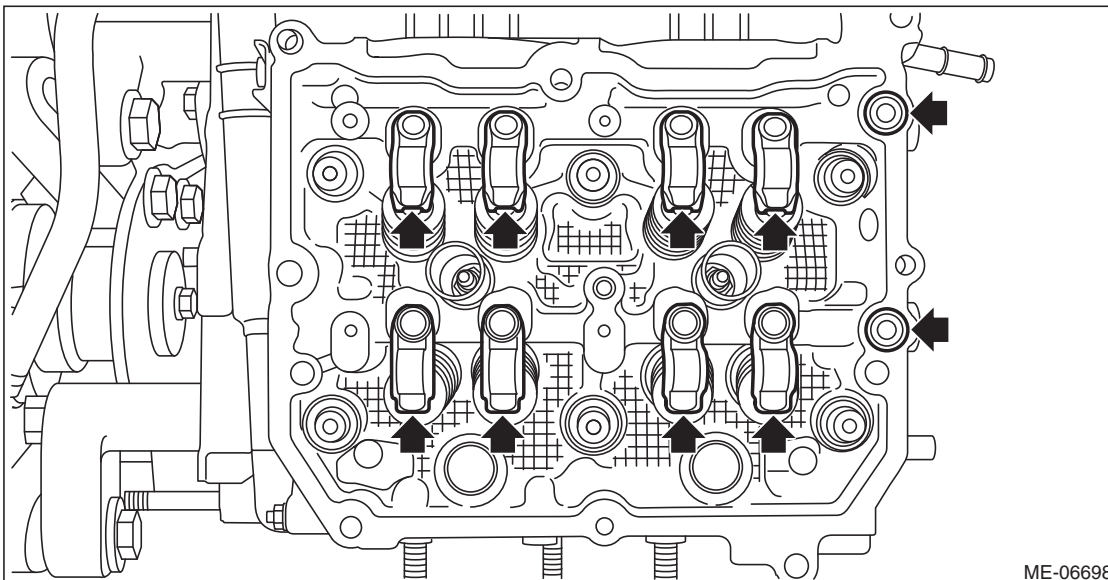
10) Loosen the bolts holding the cam carrier RH equally, a little at a time in numerical sequence as shown in the figure and remove the cam carrier RH.



11) Remove the O-ring and the roller rocker arm from cylinder head RH.

NOTE:

Be careful not to confuse the roller rocker arms.



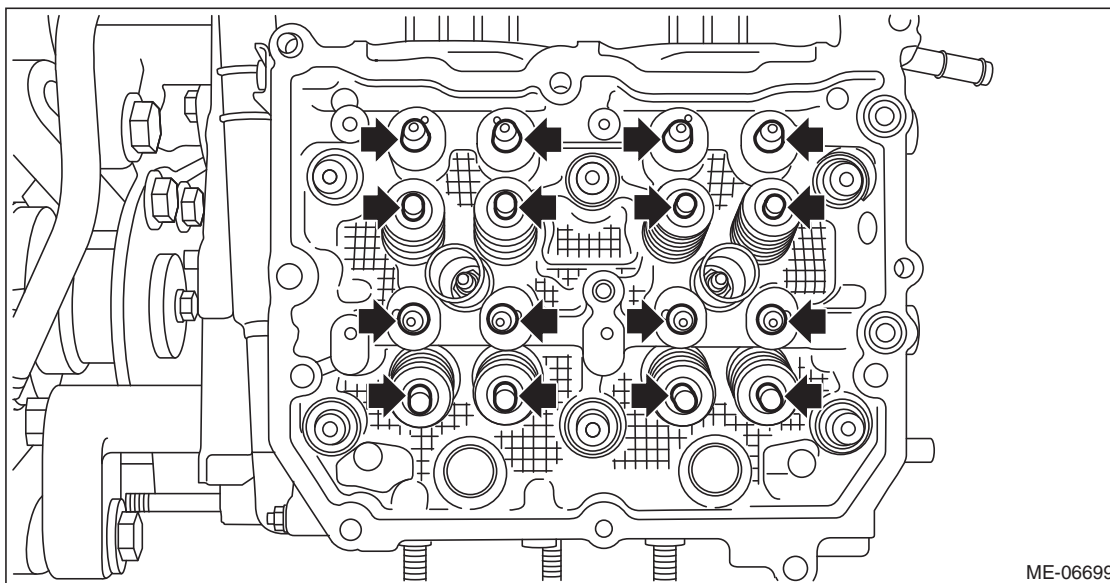
Cam Carrier

MECHANICAL

12) Remove the valve shim and the roller rocker arm pivot from cylinder head RH.

NOTE:

Be careful not to confuse the valve shim and the roller rocker arm pivot.



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

2. CAM CARRIER LH

1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-44, REMOVAL, Engine Assembly.>

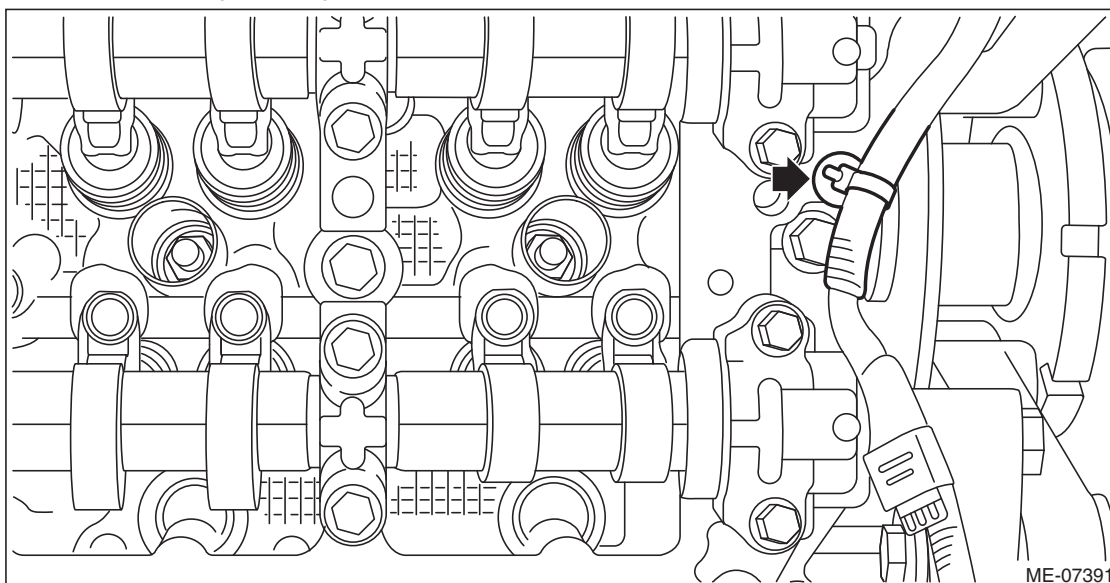
2) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>

3) Remove the timing chain LH. <Ref. to ME(H4DOTC)-114, TIMING CHAIN LH, REMOVAL, Timing Chain Assembly.>

4) Remove the intake manifold. <Ref. to FU(H4DOTC)-19, REMOVAL, Intake Manifold.>

5) Remove the rocker cover LH. <Ref. to ME(H4DOTC)-149, ROCKER COVER LH, REMOVAL, Rocker Cover.>

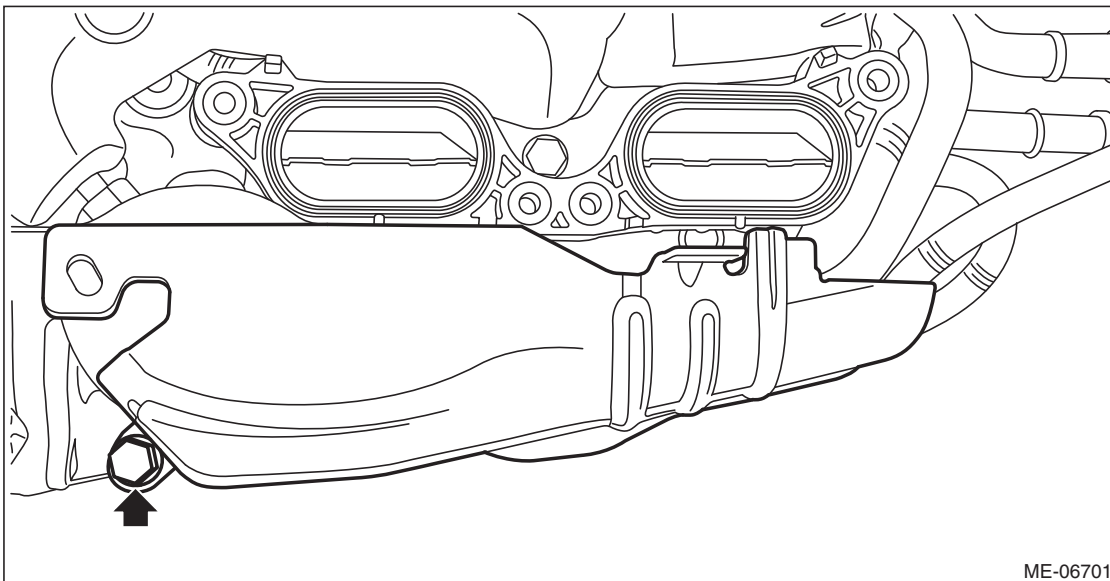
6) Remove the clip holding the engine harness from cam carrier LH.



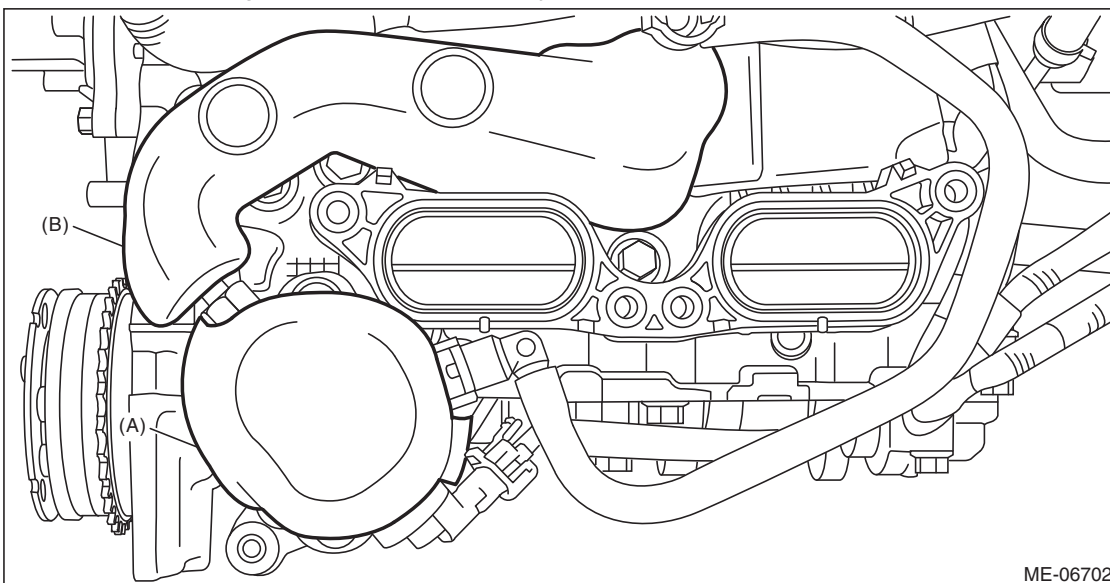
Cam Carrier

MECHANICAL

- 7) Remove the fuel pipe protector from the high-pressure fuel pump case.



- 8) Remove the fuel pump insulator (A) from the high-pressure fuel pump, and then remove the fuel pipe insulator No. 1 (B) from the high-pressure fuel delivery pipe.



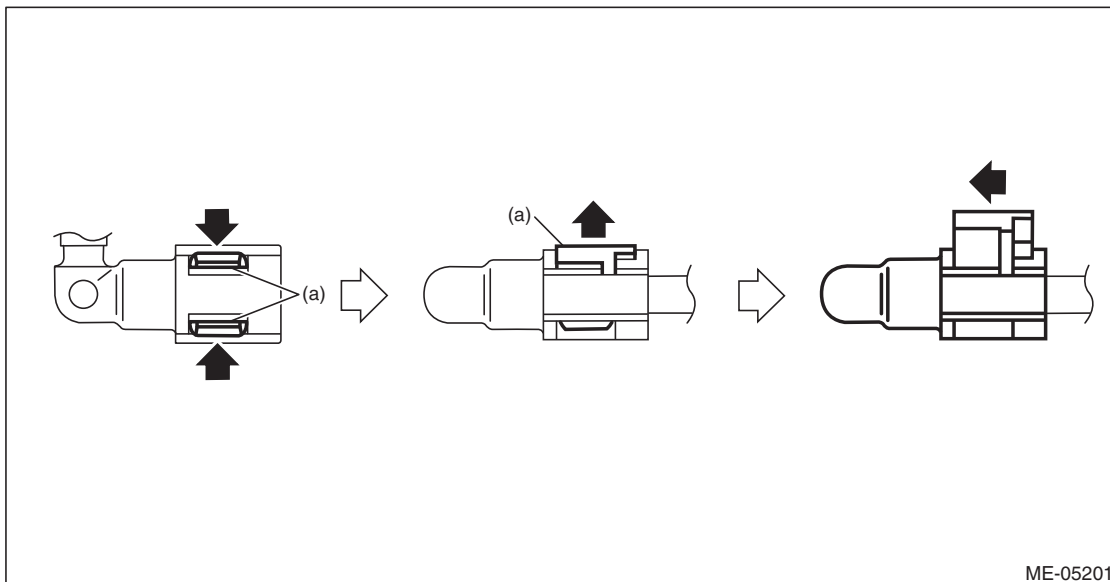
Cam Carrier

MECHANICAL

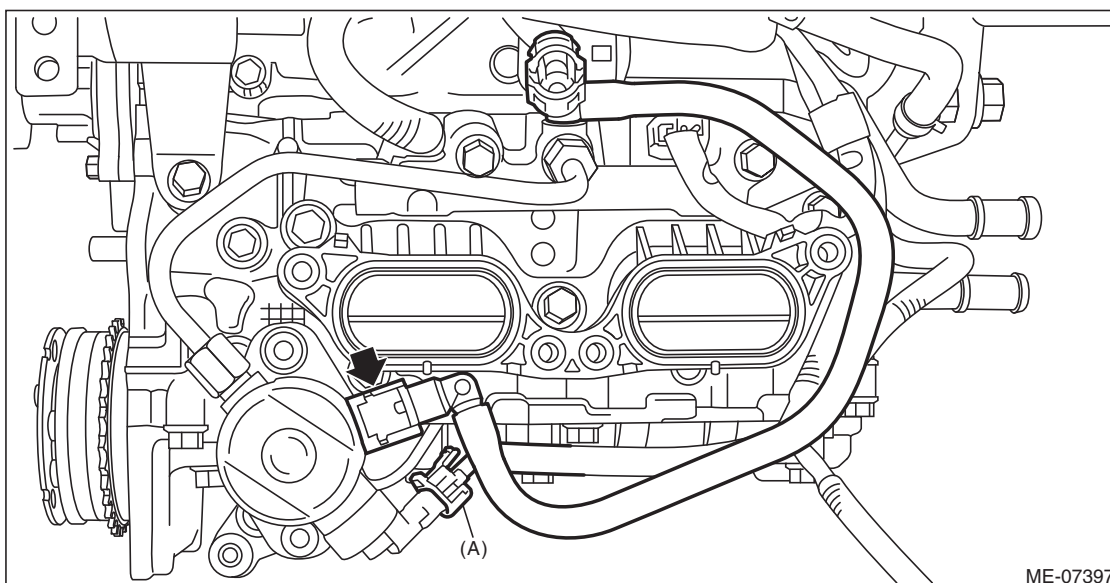
9) Disconnect the connector (A) from the high-pressure fuel pump, and remove the fuel delivery pipe from the high-pressure fuel pump.

NOTE:

Disconnect the quick connector as shown in the figure.



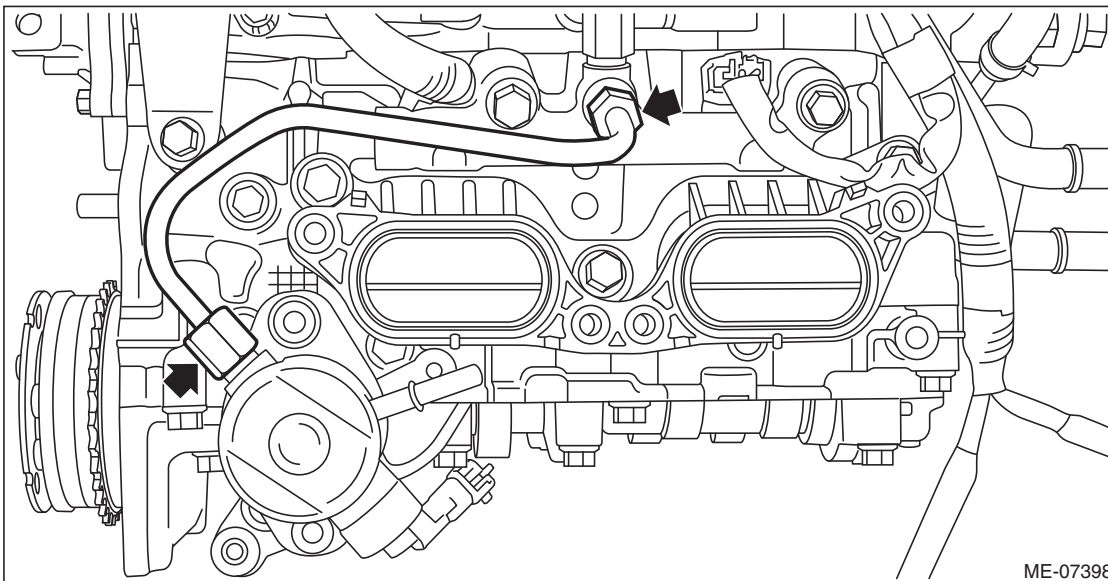
(a) Slider



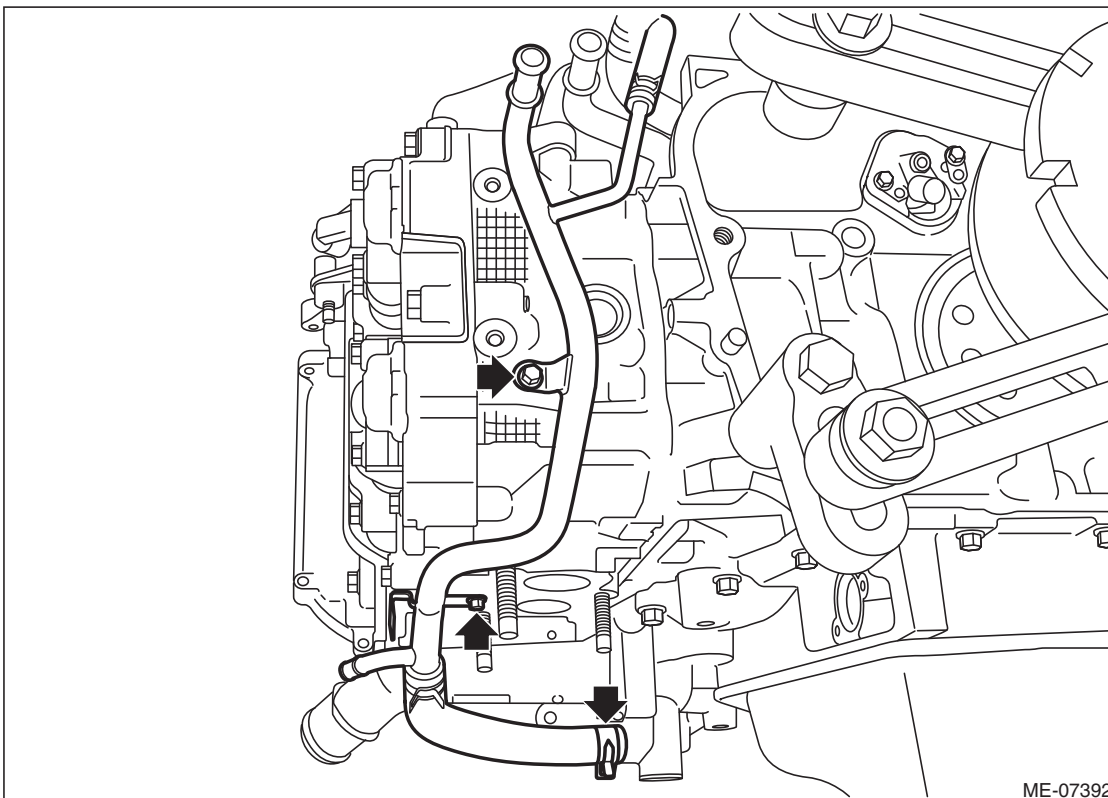
Cam Carrier

MECHANICAL

- 10) Remove the high-pressure fuel delivery pipe from the high-pressure fuel pump and fuel injector pipe.



- 11) Disconnect the water pipe hose from oil pan upper, and remove the water pipe assembly.



- 12) When disassembling the cam carrier LH

NOTE:

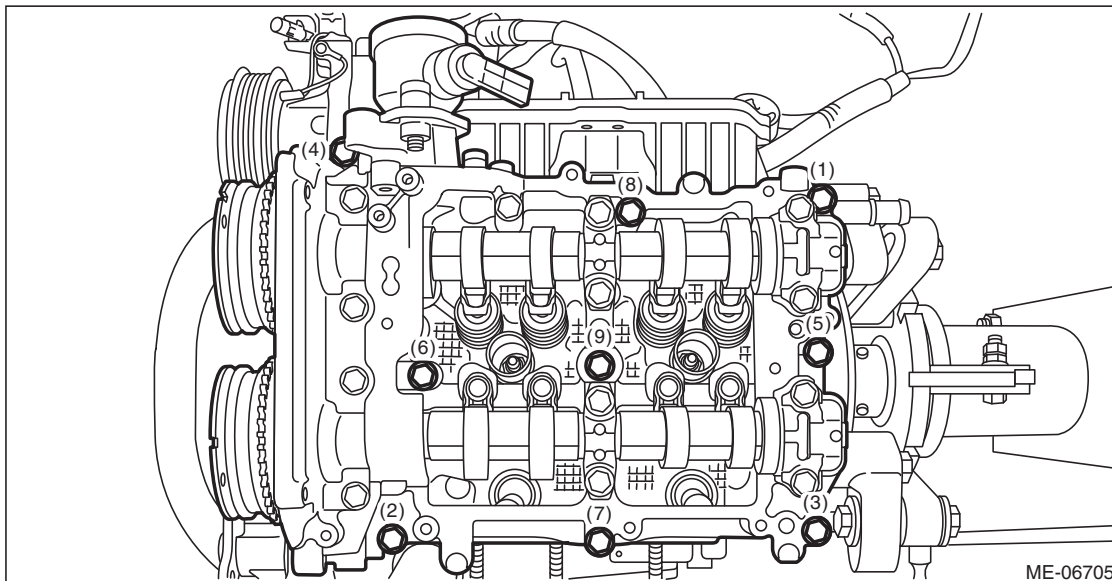
When disassembling the cam carrier LH, perform the following steps also.

- (1) Remove the high-pressure fuel pump. <Ref. to FU(H4DOTC)-75, REMOVAL, High Pressure Fuel Pump.>
 - (2) Remove the cam sprocket LH. <Ref. to ME(H4DOTC)-138, CAM SPROCKET LH, REMOVAL, Cam Sprocket.>
- 13) Set the part so that the cam carrier LH is on the upper side.

Cam Carrier

MECHANICAL

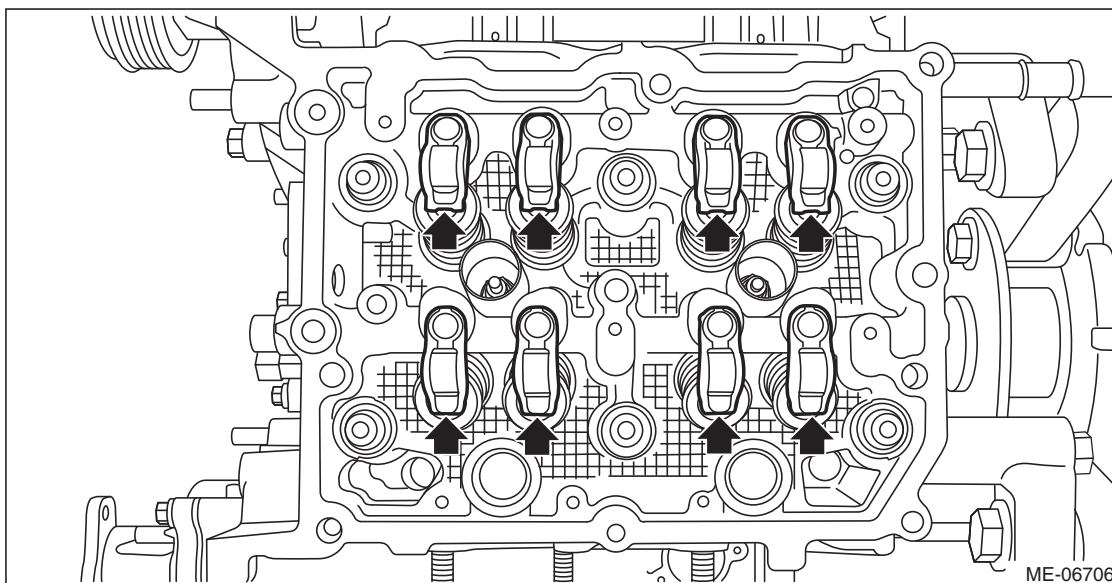
14) Loosen the bolts holding the cam carrier LH equally, a little at a time in numerical sequence as shown in the figure and remove the cam carrier LH.



15) Remove the O-ring and the roller rocker arm from cylinder head LH.

NOTE:

Be careful not to confuse the roller rocker arms.



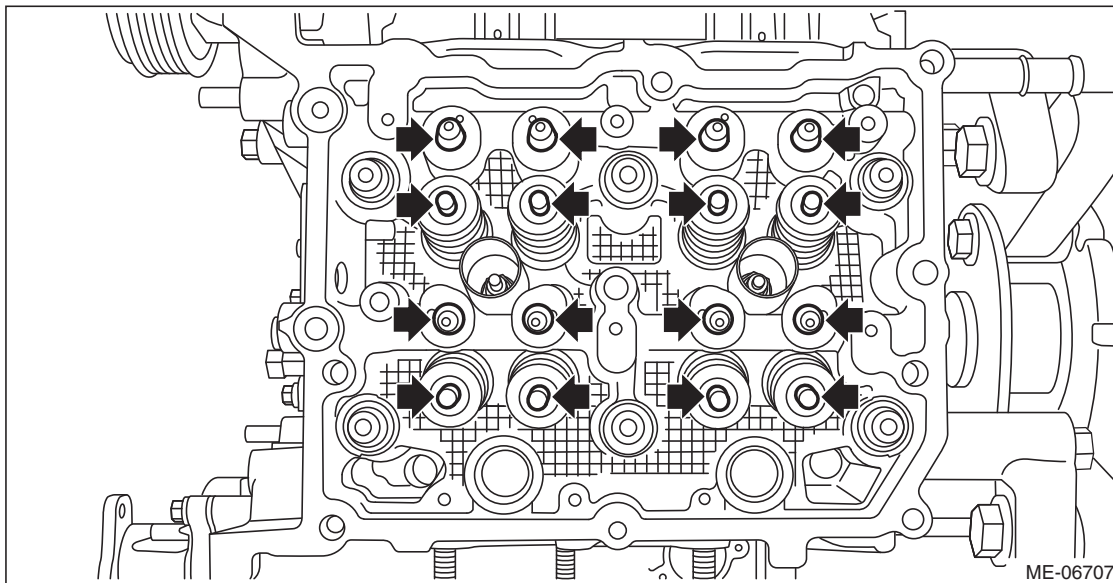
Cam Carrier

MECHANICAL

16) Remove the valve shim and the roller rocker arm pivot from cylinder head LH.

NOTE:

Be careful not to confuse the valve shim and the roller rocker arm pivot.



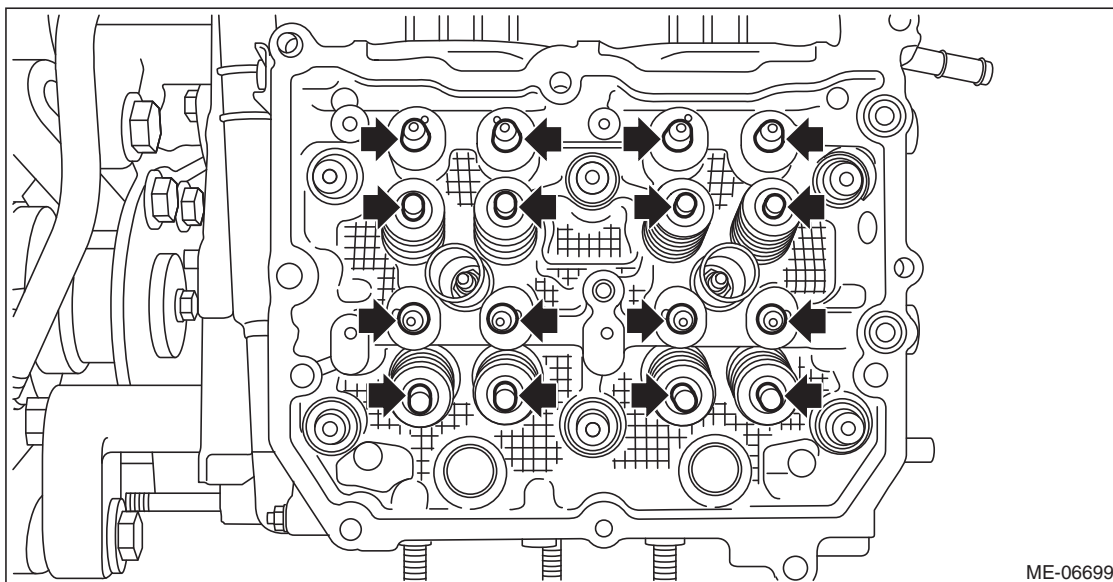
17) Remove the liquid gasket from cam carrier LH and cylinder head LH.

B: INSTALLATION

1. CAM CARRIER RH

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

2) Apply engine oil to the valve shim and the roller rocker arm pivot, and install the valve shim and the roller rocker arm pivot to the cylinder head RH.



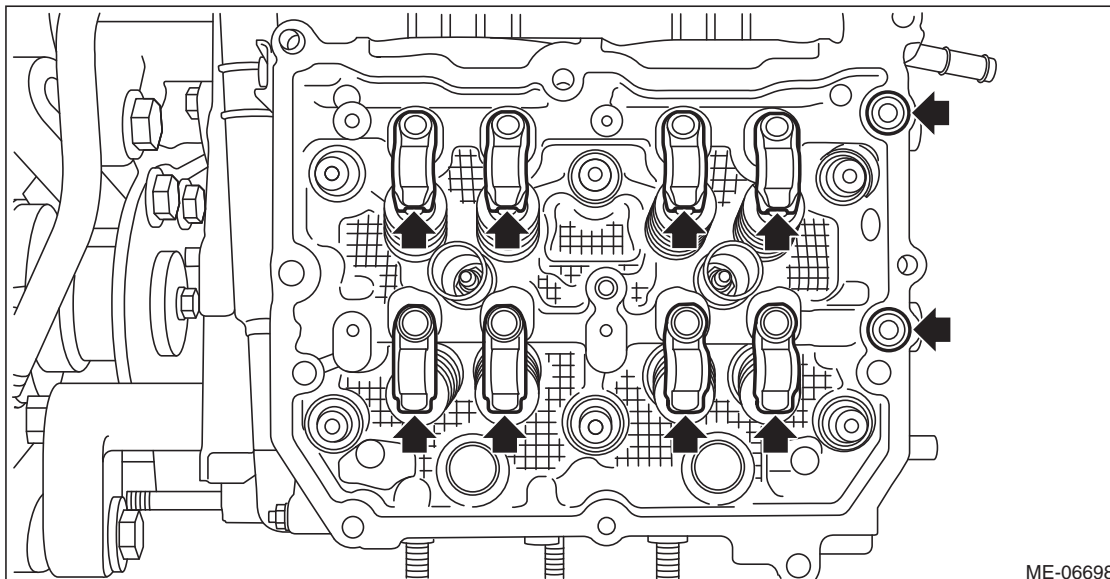
Cam Carrier

MECHANICAL

3) Apply engine oil to the O-ring and the roller rocker arm, and install the O-ring and the roller rocker arm to the cylinder head RH.

NOTE:

Use new O-rings.



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

NOTE:

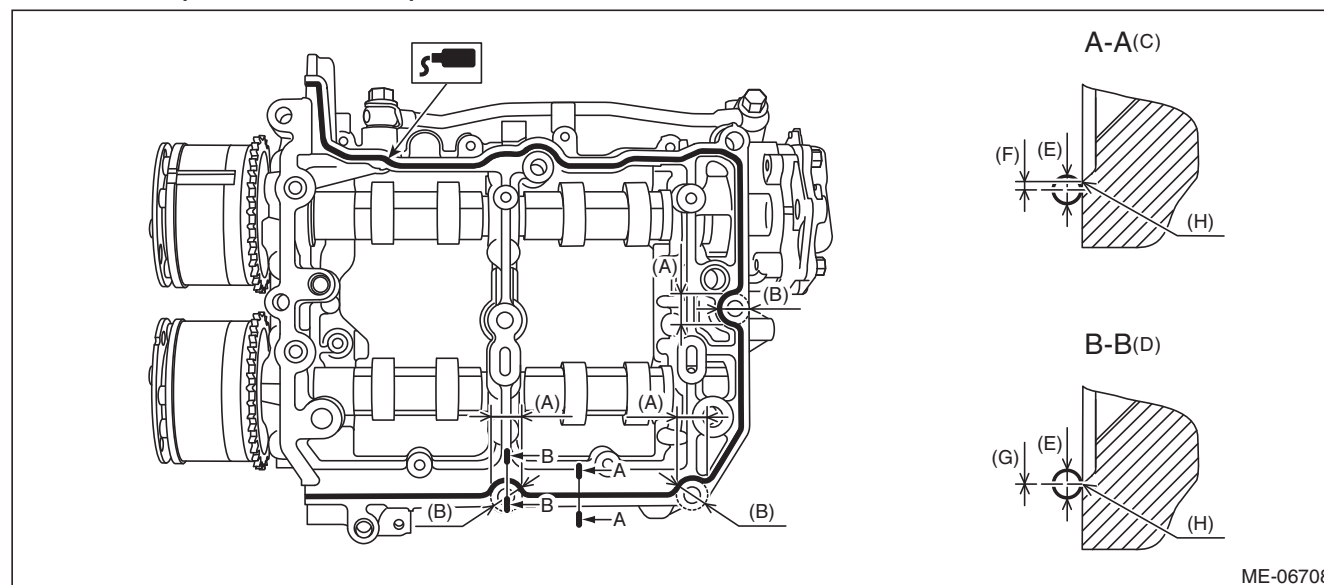
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder head RH and cam carrier RH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

Liquid gasket applying diameter:

3 ± 0.5 mm (0.1181 ± 0.0197 in)



- | | | |
|---|---|---|
| (A) Range A | (D) Liquid gasket applying position of mating surfaces other than range A | (F) 1 mm (0.0394 in) or less |
| (B) $\phi 18$ mm (0.7087 in) | (E) $\phi 3 \pm 0.5$ mm (0.1181 ± 0.0197 in) | (G) 0 ± 0.5 mm (0 ± 0.0197 in) |
| (C) Liquid gasket applying position of mating surfaces of range A | | (H) Chamfer edge |

ME(H4DOTC)-181

Cam Carrier

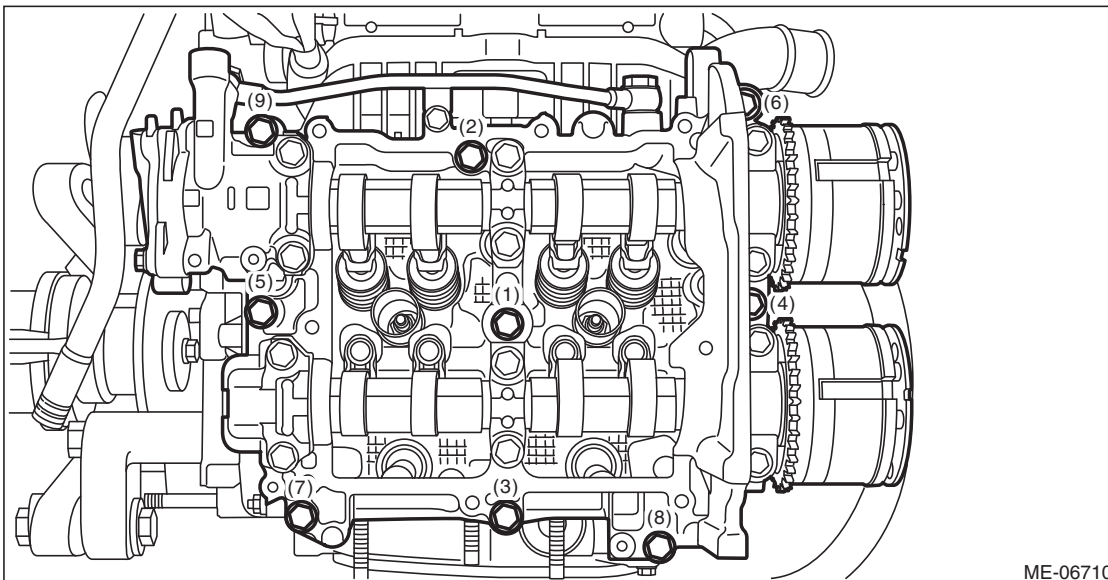
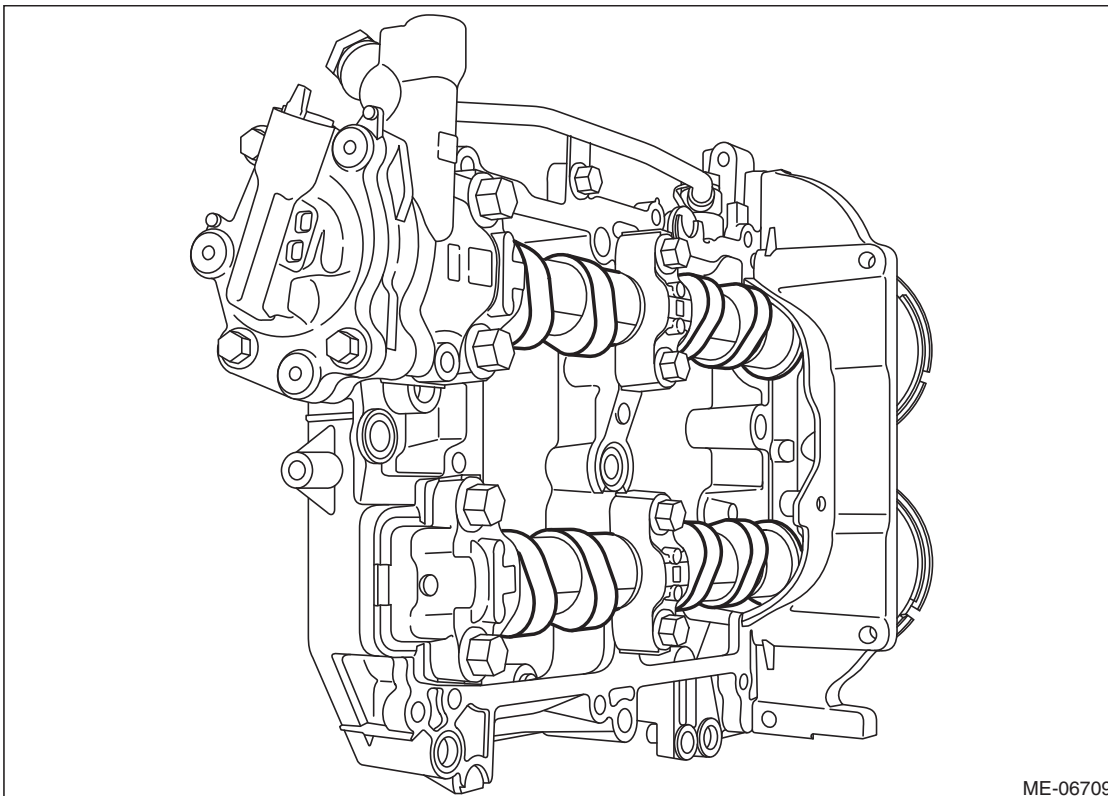
MECHANICAL

5) Install the cam carrier RH to the cylinder head RH.

(1) Mount the cam carrier RH, then tighten all bolts with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.

NOTE:

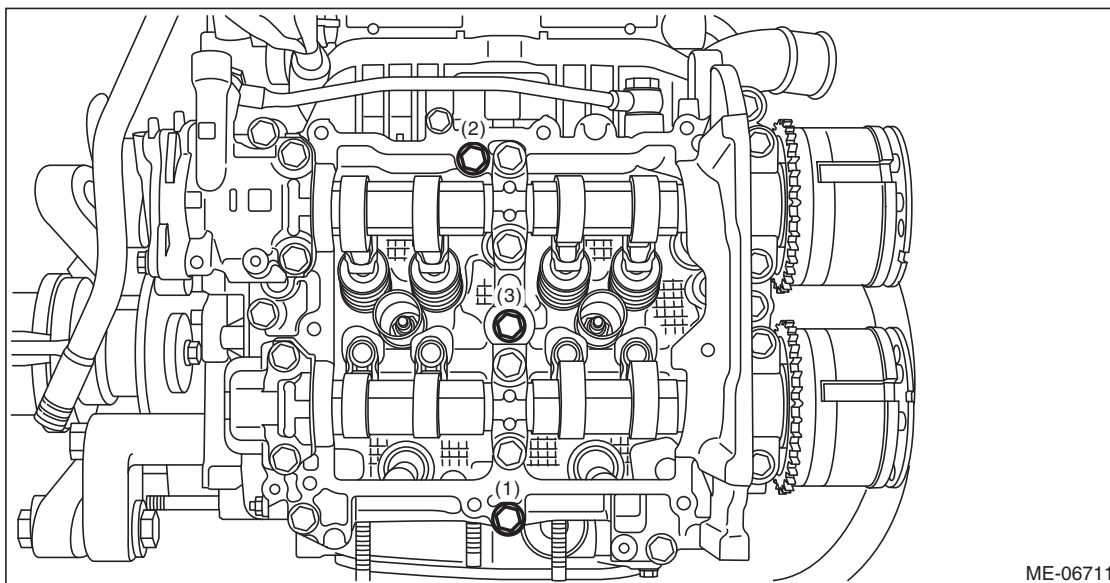
Set the intake camshaft RH and the exhaust camshaft RH to the zero-lift position as shown in the figure.



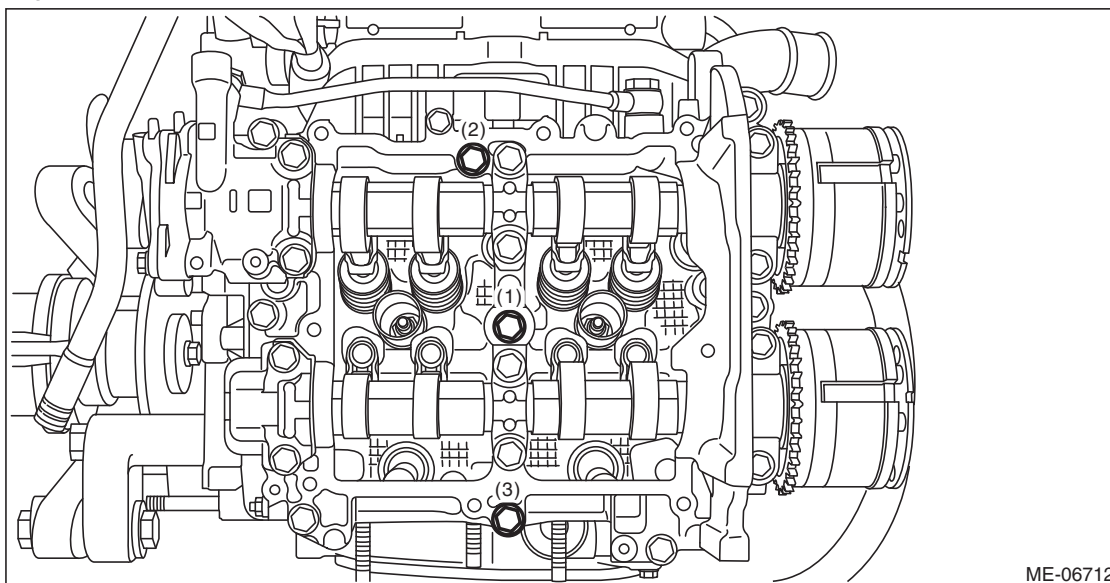
Cam Carrier

MECHANICAL

- (2) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.



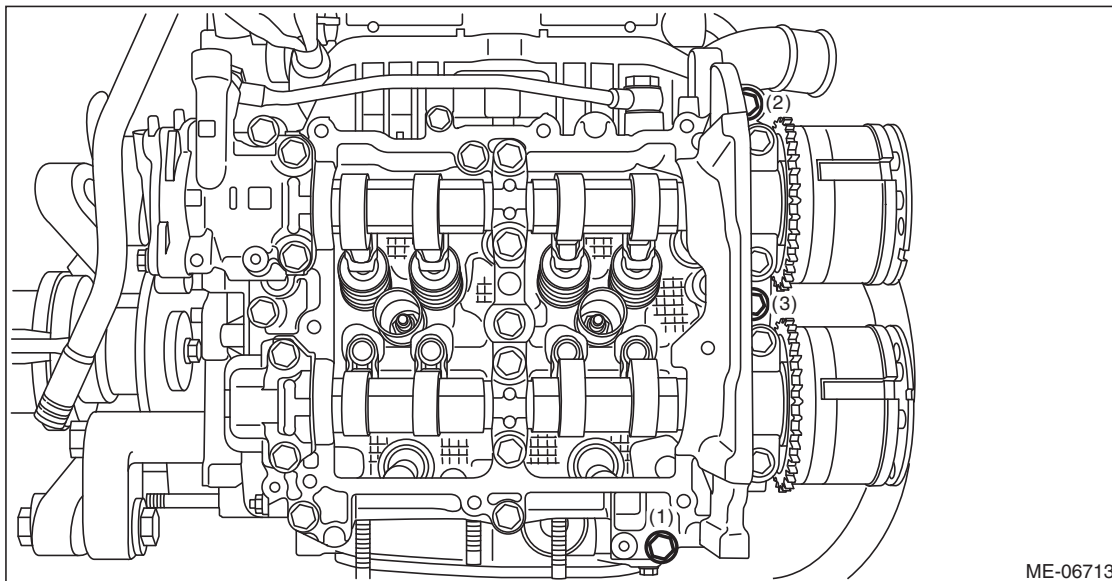
- (3) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.



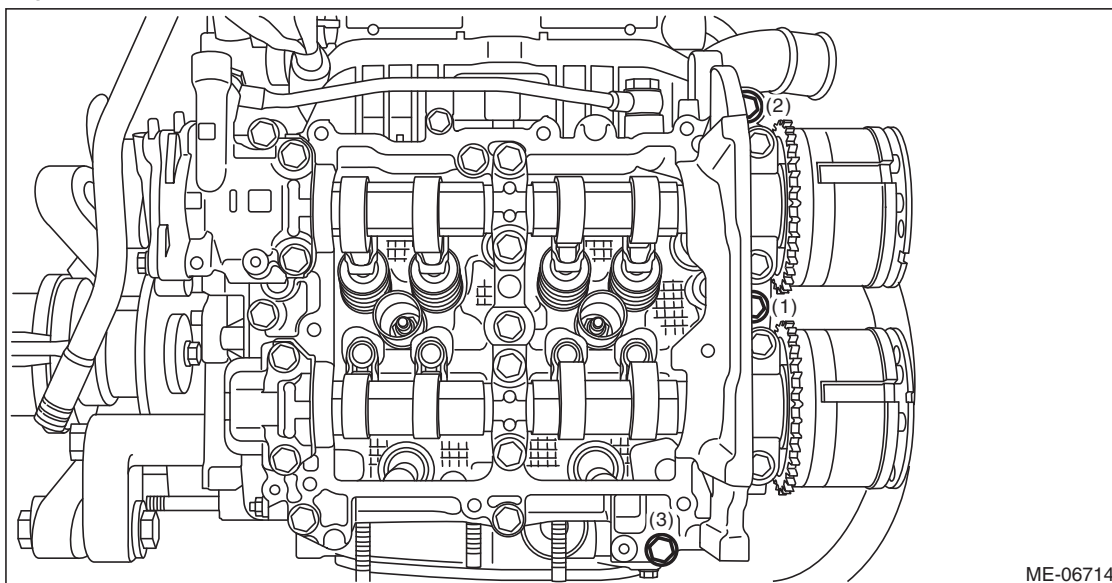
Cam Carrier

MECHANICAL

- (4) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.



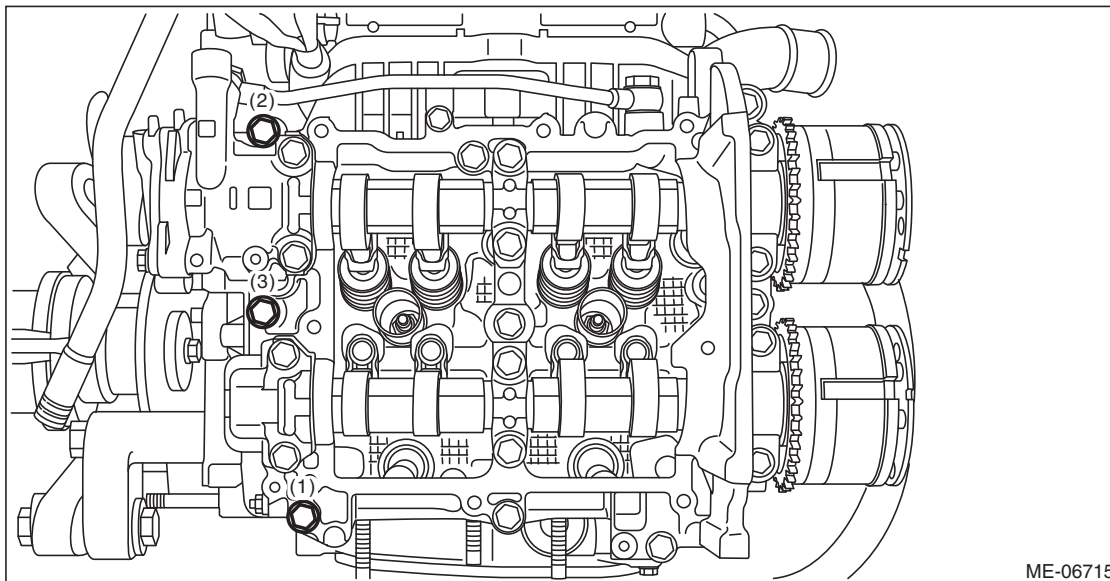
- (5) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.



Cam Carrier

MECHANICAL

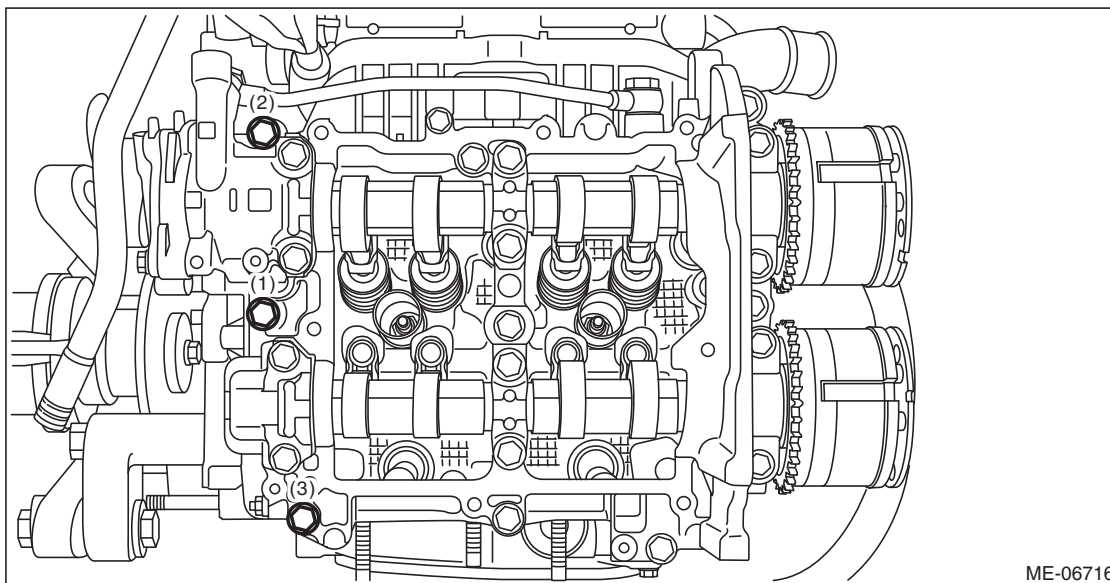
- (6) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.



- (7) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) 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.



- 6) Set the part so that the intake manifold is on the upper side.

- 7) When the cam carrier RH has been disassembled

NOTE:

When the cam carrier RH has been disassembled, perform the following steps also.

- (1) Install the cam sprocket RH. <Ref. to ME(H4DOTC)-140, CAM SPROCKET RH, INSTALLATION, Cam Sprocket.>
- (2) Install the scavenge pump. <Ref. to LU(H4DO)-55, INSTALLATION, Scavenge Pump.>

NOTE:

When installing the scavenge pump, do not turn the intake camshaft RH to the outside of range of zero-lift (in range where it can be turned lightly by hand).

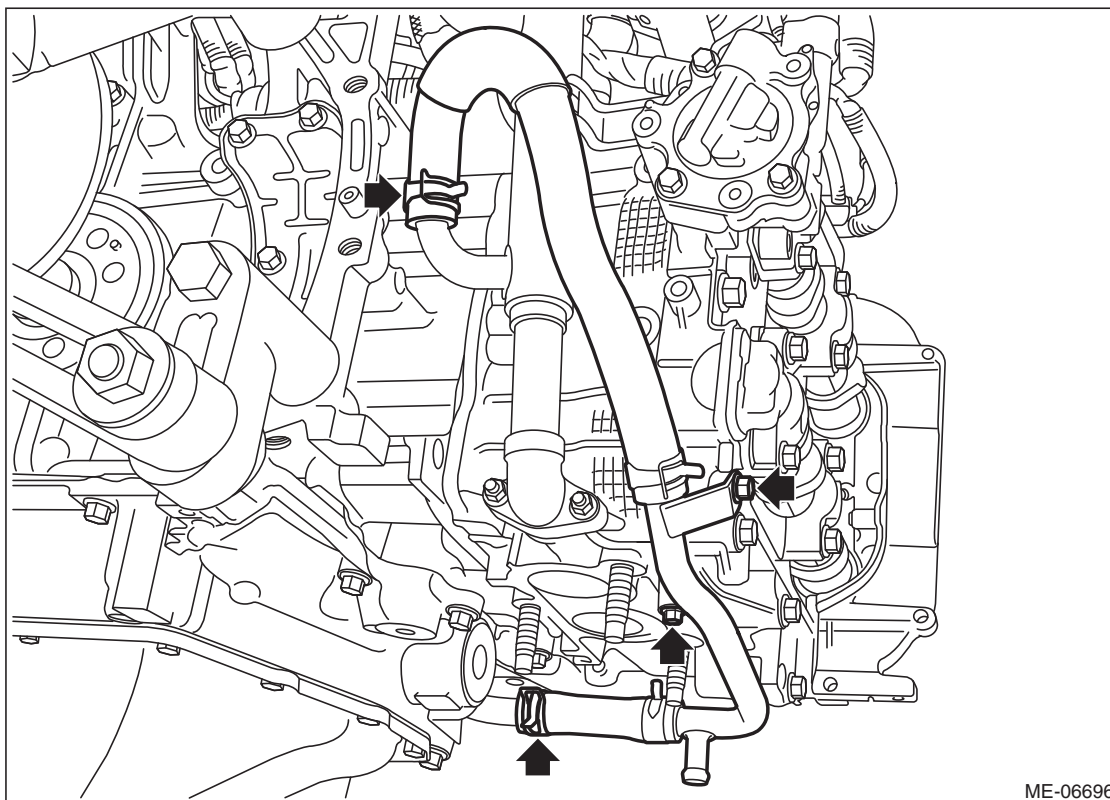
Cam Carrier

MECHANICAL

- 8) Check the cam clearance. <Ref. to ME(H4DOTC)-39, WHEN TIMING CHAIN ASSEMBLY IS REMOVED, INSPECTION, Cam Clearance.>
- 9) Connect the water pipe hose to oil pan upper and EGR cooler, and install the water pipe assembly.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



ME-06696

Cam Carrier

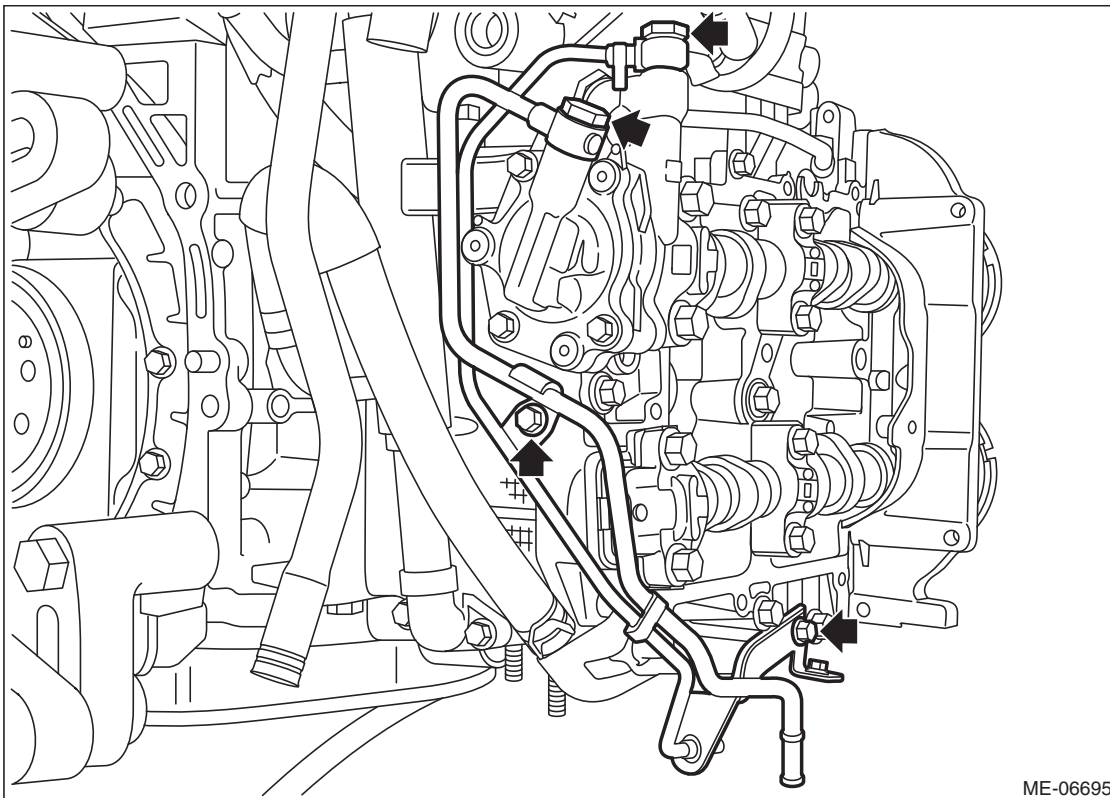
MECHANICAL

10) Install the oil pipe assembly to the scavenge pump and cam carrier RH.

(1) Set the oil pipe assembly to the scavenge pump and cam carrier RH, and temporarily tighten the bolts which secure the oil pipe assembly to the scavenge pump and cam carrier RH.

NOTE:

Use a new gasket.



ME-06695



Cam Carrier

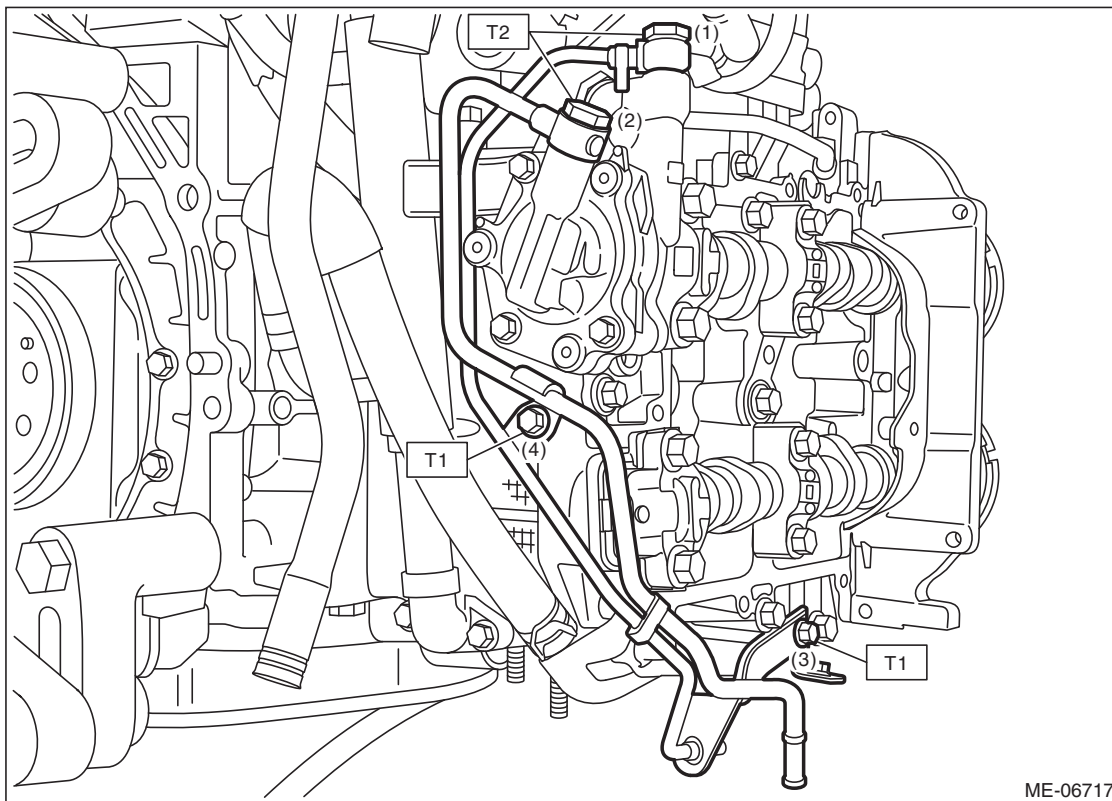
MECHANICAL

(2) Tighten the bolts which secure the oil pipe assembly to the scavenge pump and cam carrier RH in numerical order as shown in the figure.

Tightening torque:

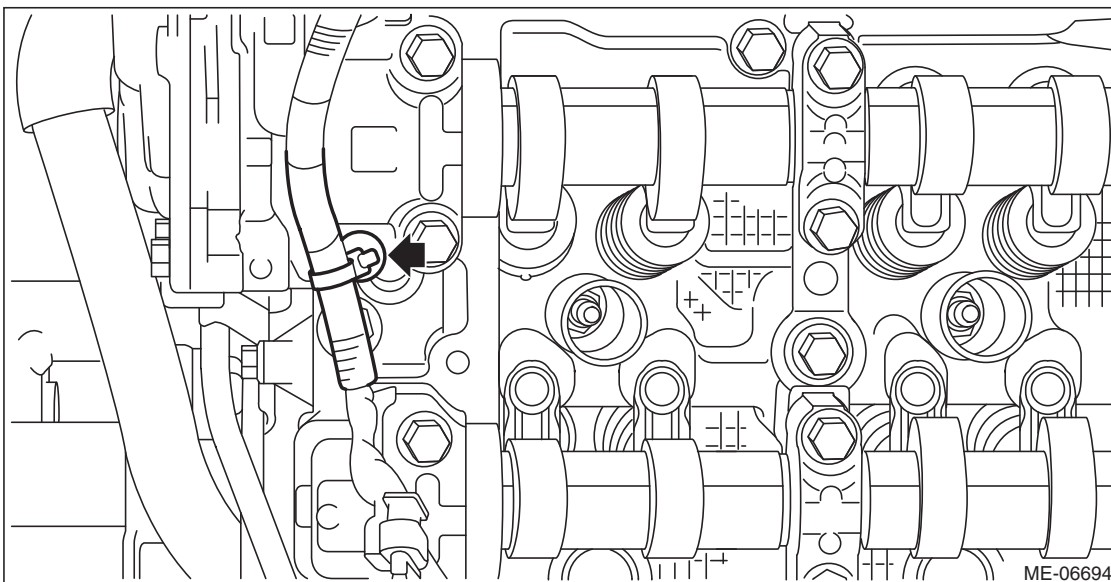
T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 29 N·m (3.0 kgf-m, 21.4 ft-lb)



ME-06717

11) Secure the engine harness to the cam carrier RH with a clip.



ME-06694

12) Install the rocker cover RH. <Ref. to ME(H4DOTC)-159, ROCKER COVER RH, INSTALLATION, Rocker Cover.>

13) Install the timing chain RH. <Ref. to ME(H4DOTC)-129, TIMING CHAIN RH, INSTALLATION, Timing Chain Assembly.>

14) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

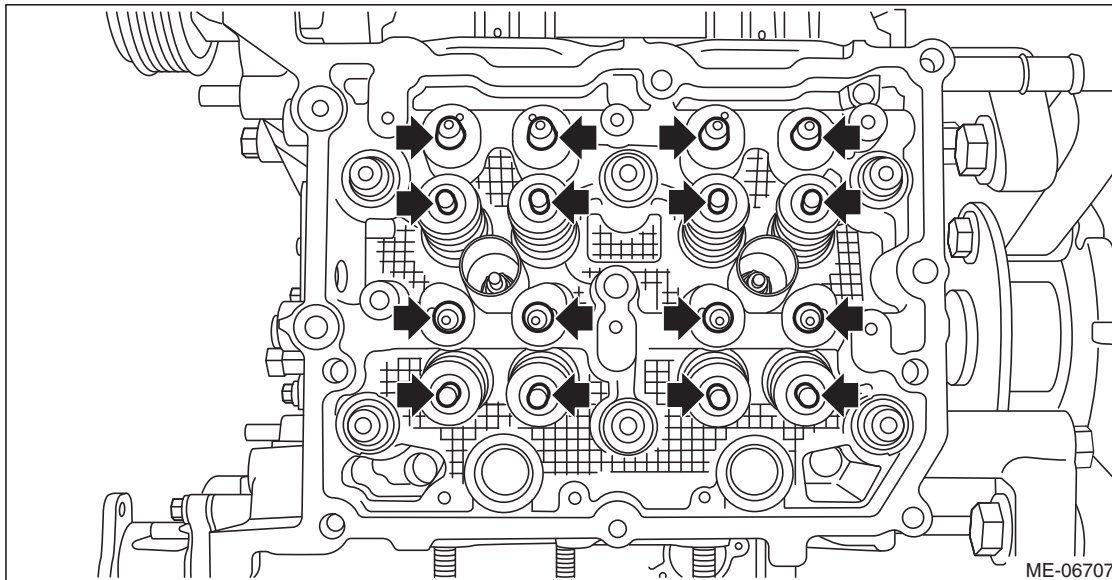
15) Install the engine to the vehicle. <Ref. to ME(H4DOTC)-59, INSTALLATION, Engine Assembly.>

Cam Carrier

MECHANICAL

2. CAM CARRIER LH

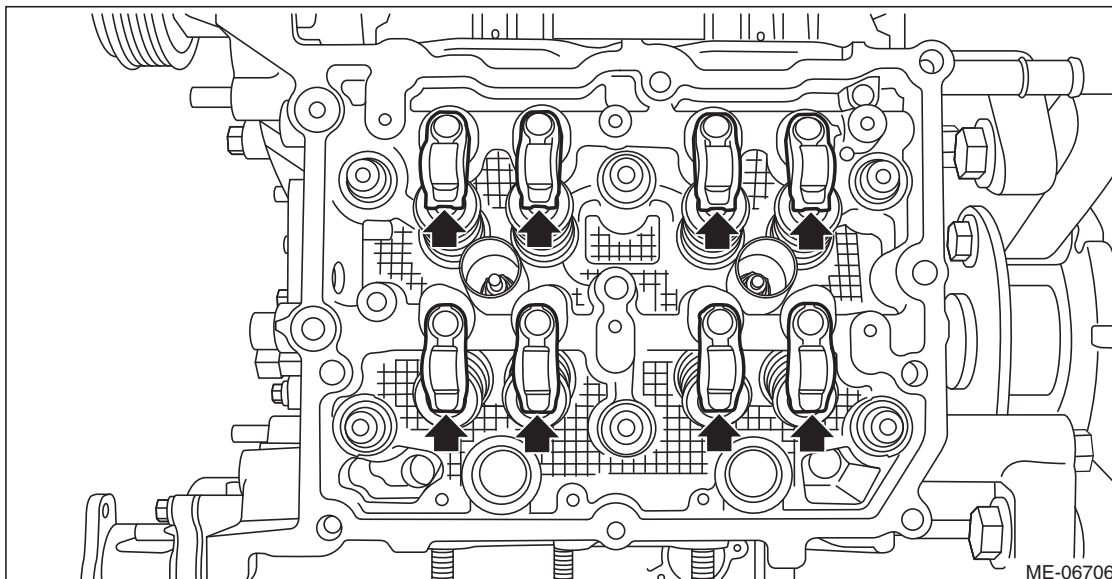
- 1) Set the part so that the cylinder head LH is on the upper side.
- 2) Apply engine oil to the valve shim and the roller rocker arm pivot, and install the valve shim and the roller rocker arm pivot to the cylinder head LH.



- 3) Apply engine oil to the O-ring and the roller rocker arm, and install the O-ring and the roller rocker arm to the cylinder head LH.

NOTE:

Use new O-rings.



Cam Carrier

MECHANICAL

4) Apply liquid gasket to the mating surface of cam carrier LH as shown in the figure.

NOTE:

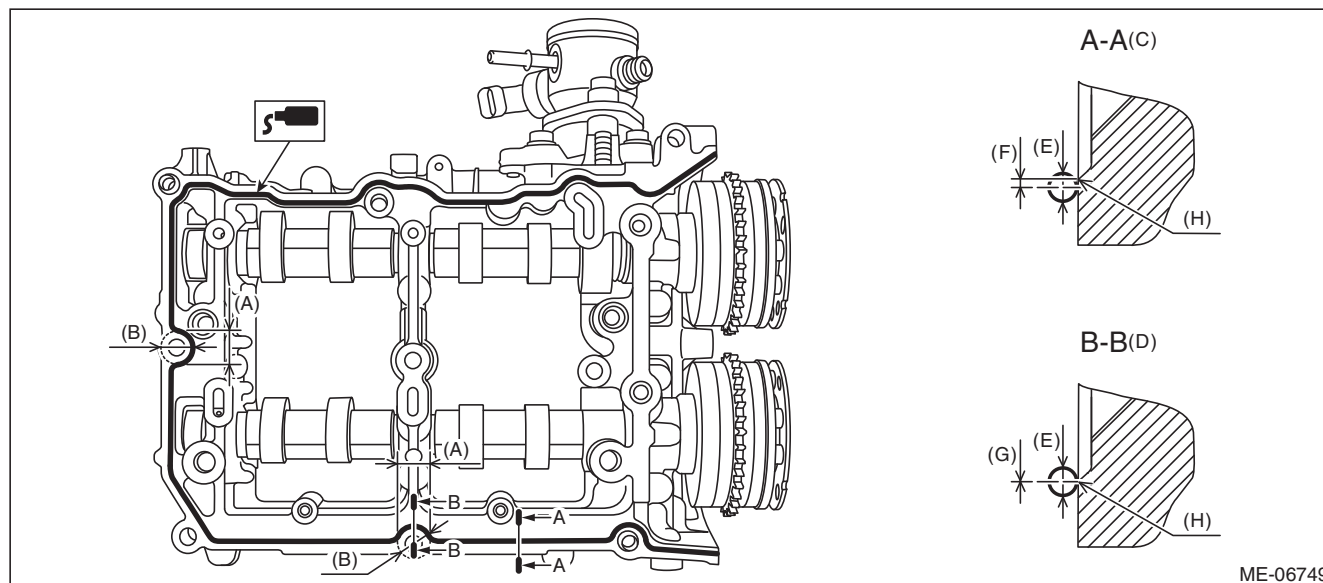
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder head LH and cam carrier LH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

Liquid gasket applying diameter:

3 ± 0.5 mm (0.1181 ± 0.0197 in)



- | | | |
|---|---|-------------------------------------|
| (A) Range A | (D) Liquid gasket applying position of mating surfaces other than range A | (G) 0 ± 0.5 mm (0 ± 0.0197 in) |
| (B) $\phi 18$ mm (0.7087 in) | (E) $\phi 3\pm0.5$ mm (0.1181 ± 0.0197 in) | (H) Chamfer edge |
| (C) Liquid gasket applying position of mating surfaces of range A | (F) 1 mm (0.0394 in) or less | |

Cam Carrier

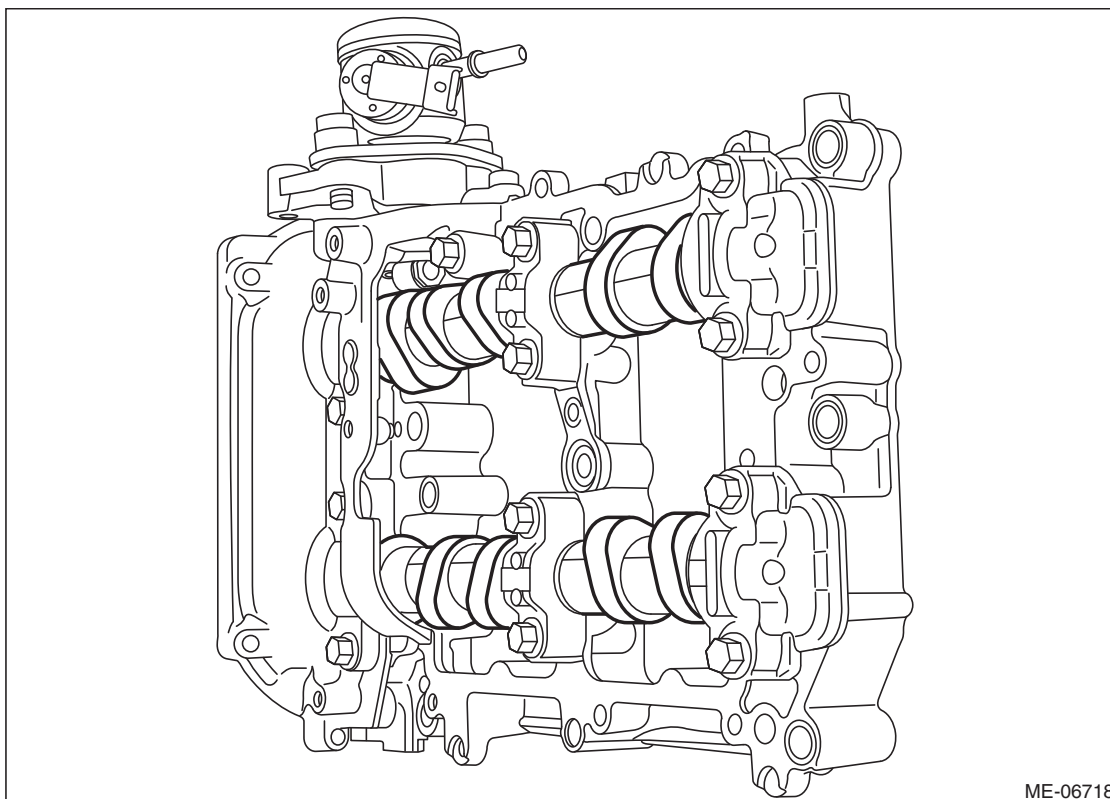
MECHANICAL

5) Install the cam carrier LH to the cylinder head LH.

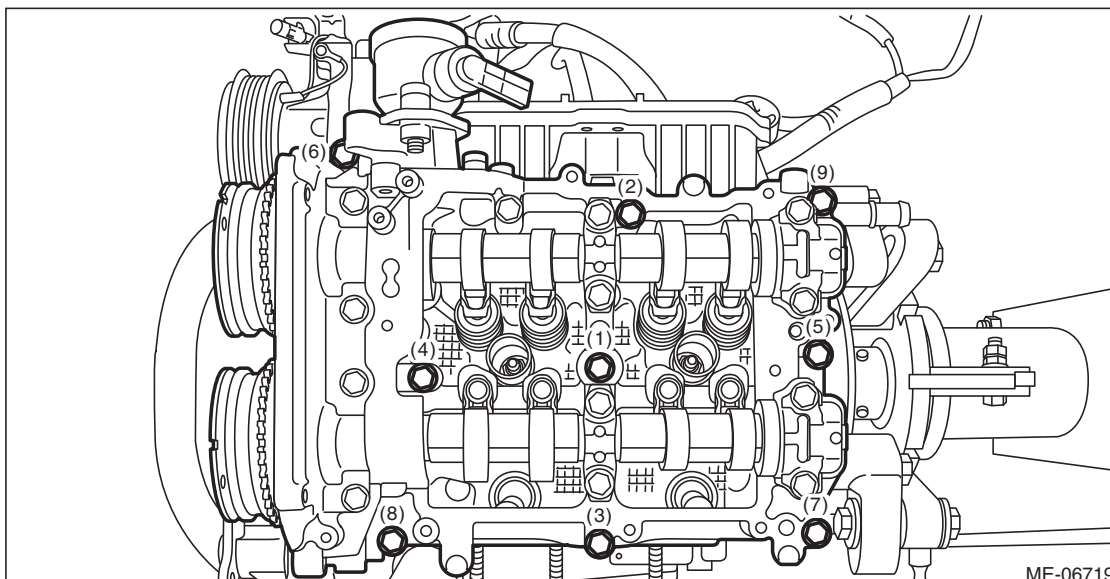
(1) Mount the cam carrier LH, then tighten all bolts with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.

NOTE:

Set the intake camshaft LH and the exhaust camshaft LH to the zero-lift position as shown in the figure.



ME-06718

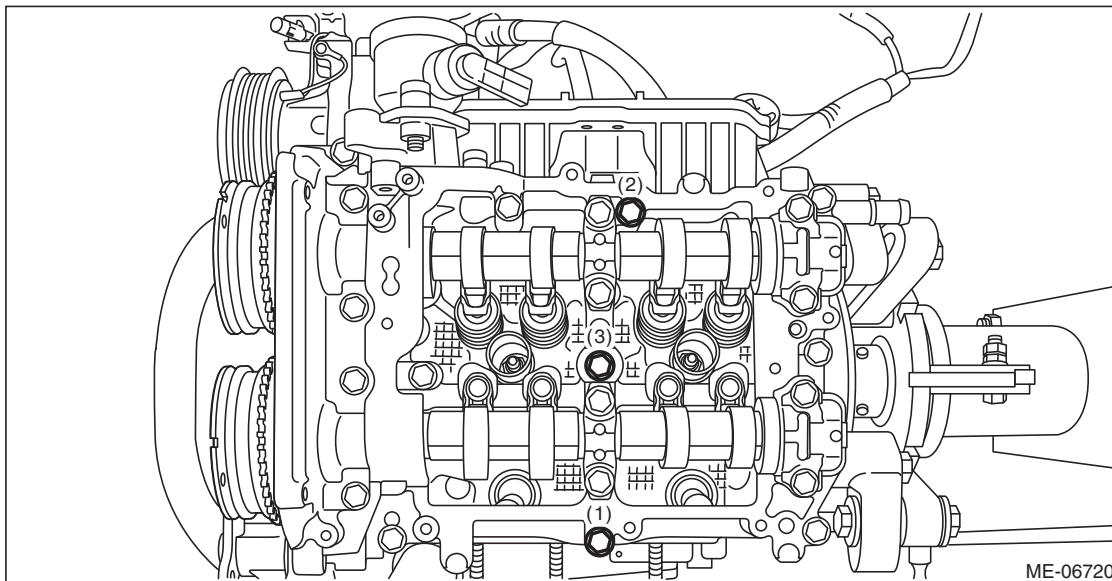


ME-06719

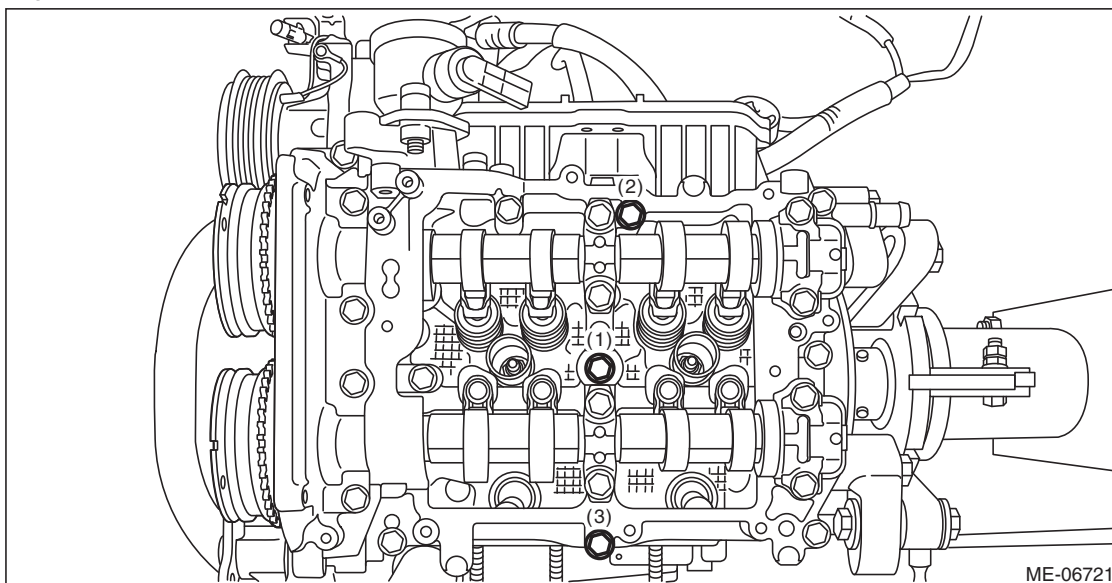
Cam Carrier

MECHANICAL

- (2) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.



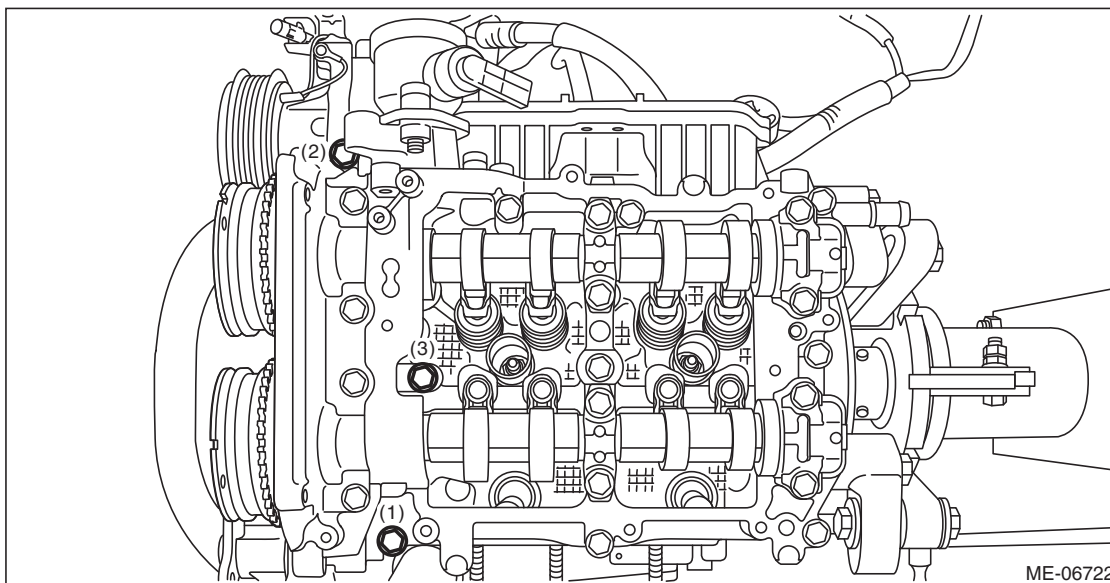
- (3) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.



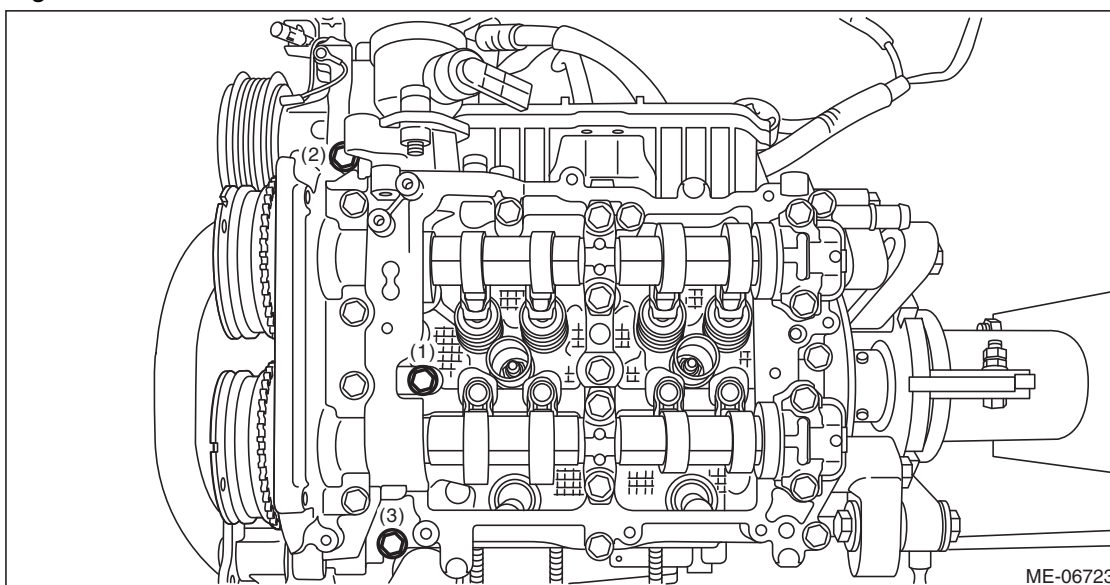
Cam Carrier

MECHANICAL

- (4) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.



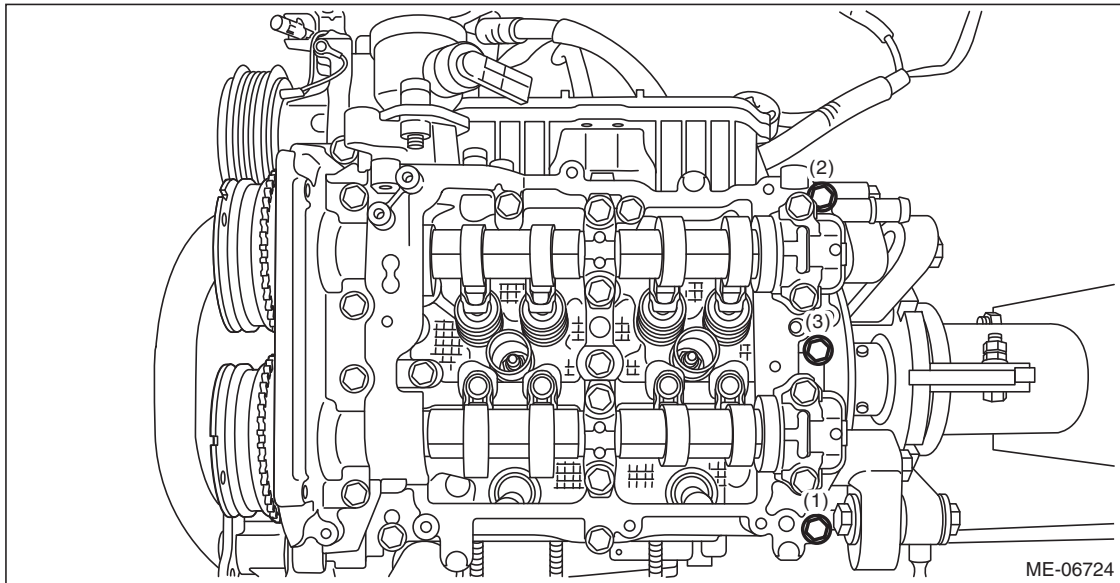
- (5) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.



Cam Carrier

MECHANICAL

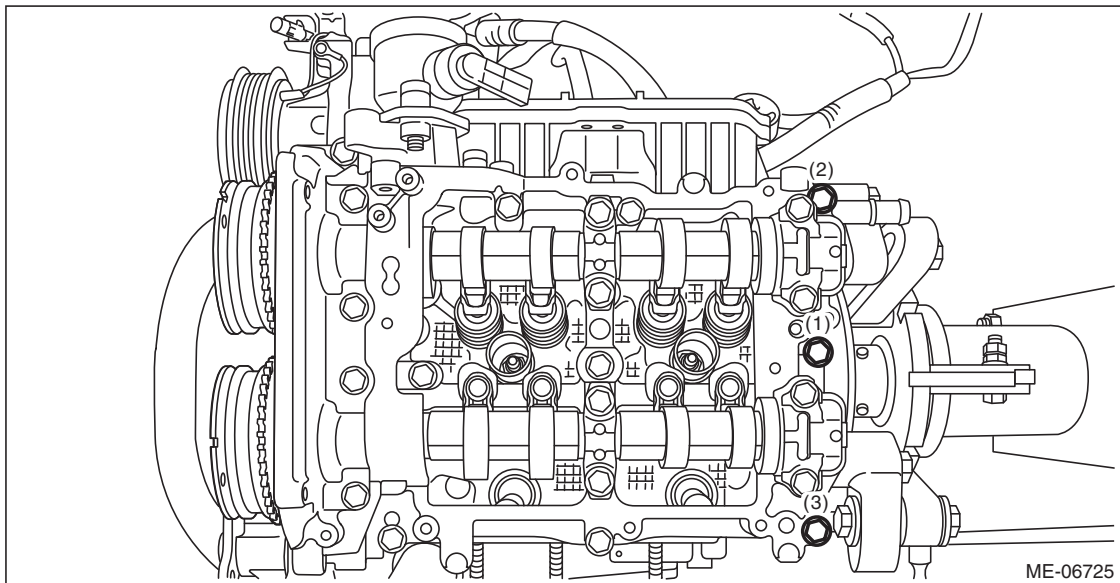
- (6) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.



- (7) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) 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.



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

Cam Carrier

MECHANICAL

7) When the cam carrier LH has been disassembled

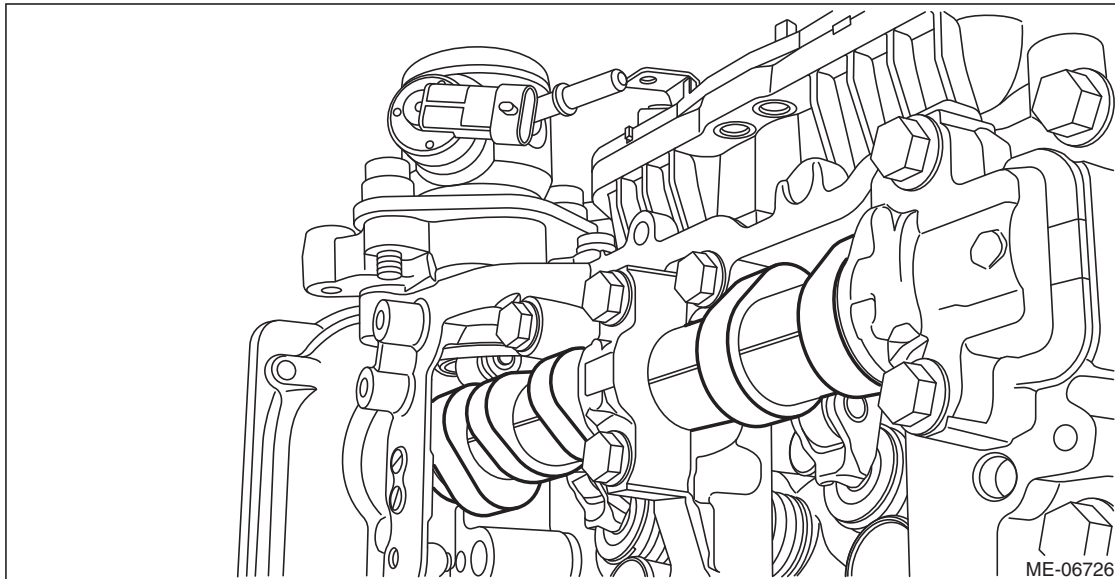
NOTE:

When the cam carrier LH has been disassembled, perform the following steps also.

- (1) Install the cam sprocket LH. <Ref. to ME(H4DOTC)-142, CAM SPROCKET LH, INSTALLATION, Cam Sprocket.>
- (2) Install the high-pressure fuel pump. <Ref. to FU(H4DOTC)-79, INSTALLATION, High Pressure Fuel Pump.>

NOTE:

Install the high-pressure fuel pump so that the cam lobes on the intake camshaft LH are positioned as shown in the figure. Perform adjustment within the range of zero-lift (in range where it can be turned lightly by hand).



8) Check the cam clearance. <Ref. to ME(H4DOTC)-39, WHEN TIMING CHAIN ASSEMBLY IS REMOVED, INSPECTION, Cam Clearance.>

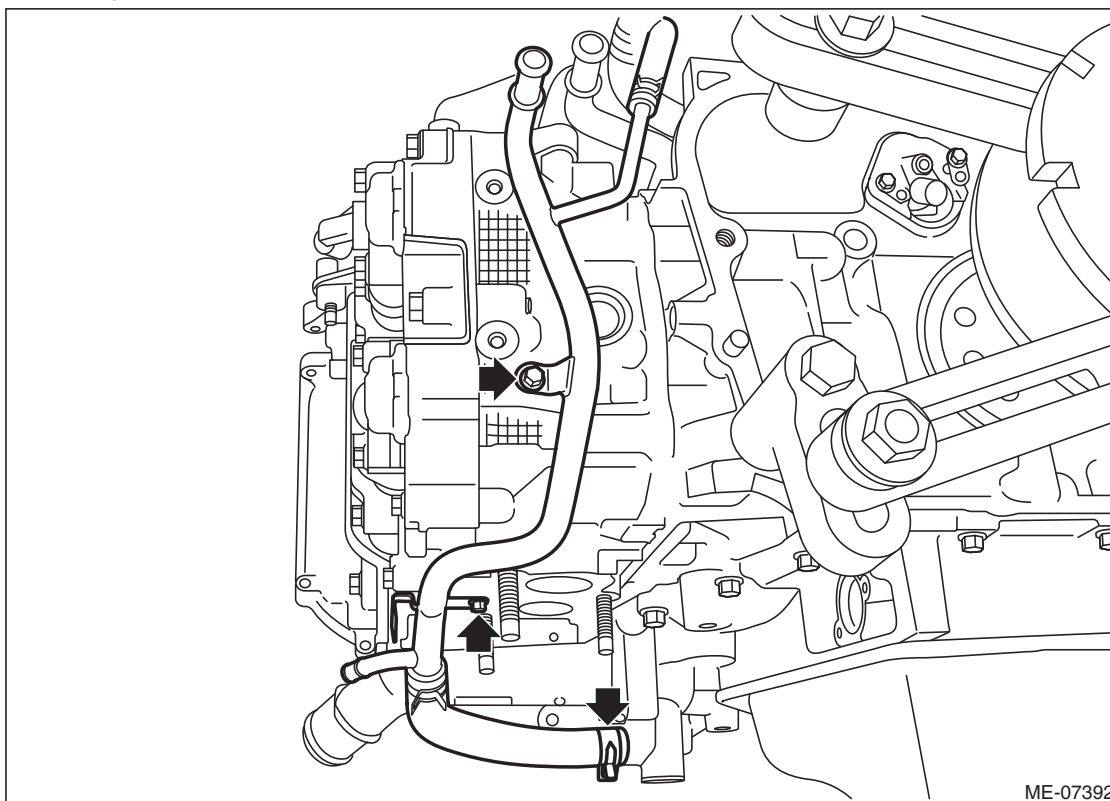
Cam Carrier

MECHANICAL

9) Connect the water pipe hose to oil pan upper, and install the water pipe assembly.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



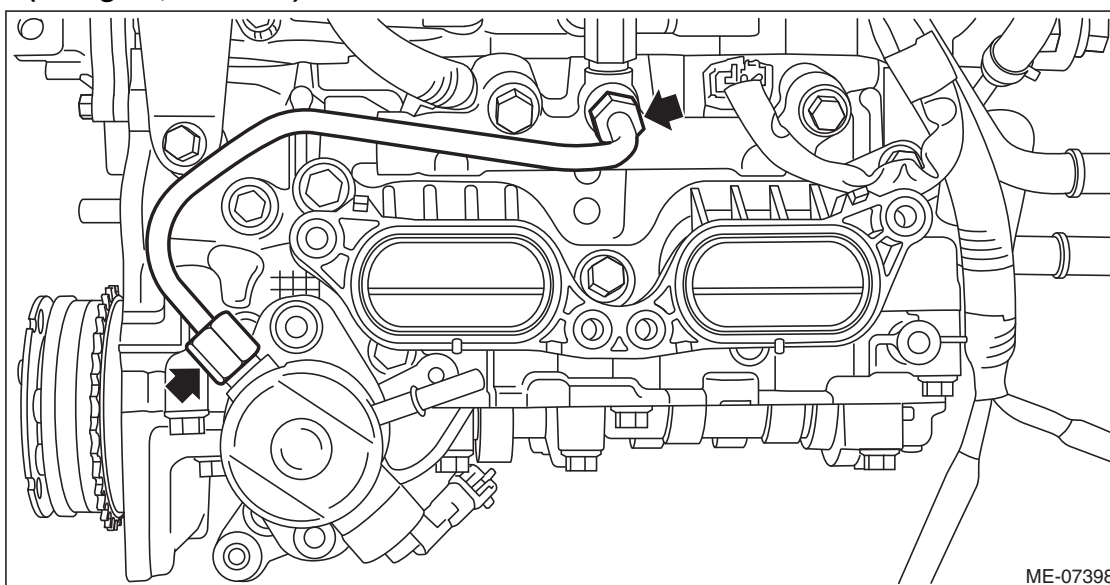
10) Install the high-pressure fuel delivery pipe to the high-pressure fuel pump and fuel injector pipe.

NOTE:

Use a new fuel delivery pipe.

Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)



Cam Carrier

MECHANICAL

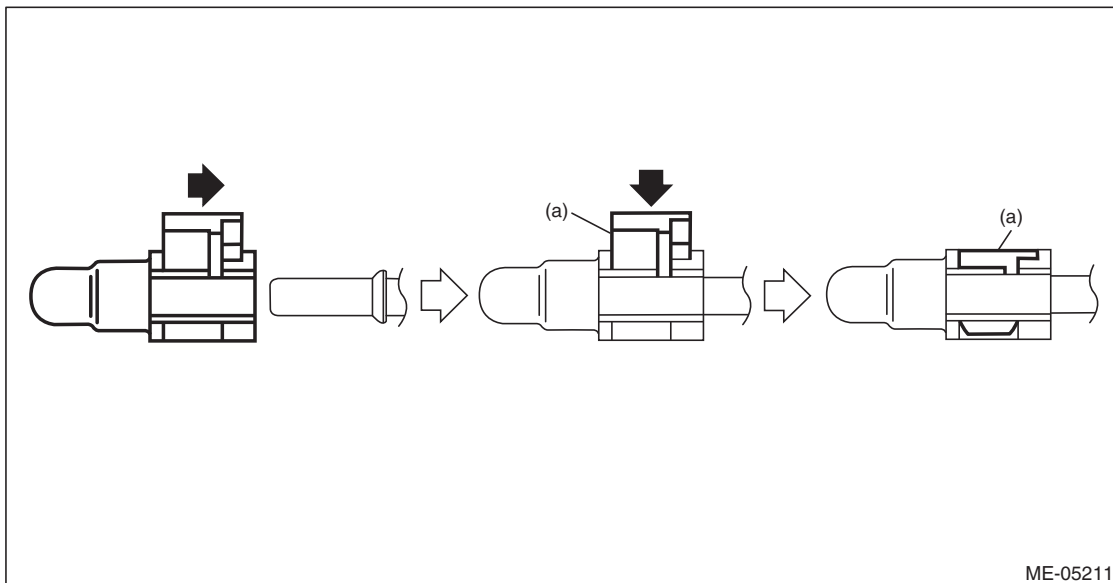
11) Install the fuel delivery pipe to the high-pressure fuel pump, and connect the connector (A) to the high-pressure fuel pump.

CAUTION:

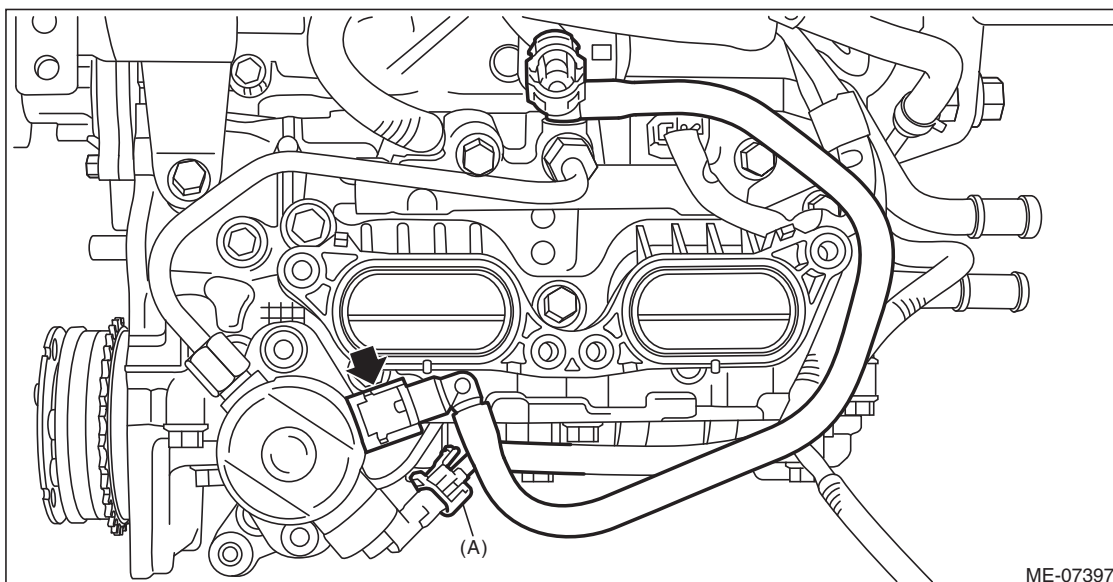
- Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.
- When connecting the quick connector, make sure to insert the pipe all the way in before locking the slider.
- When it is difficult to lock the slider, check that the pipe is fully inserted.
- Make sure that the quick connector is securely connected.

NOTE:

Connect the quick connector as shown in the figure.



(a) Slider



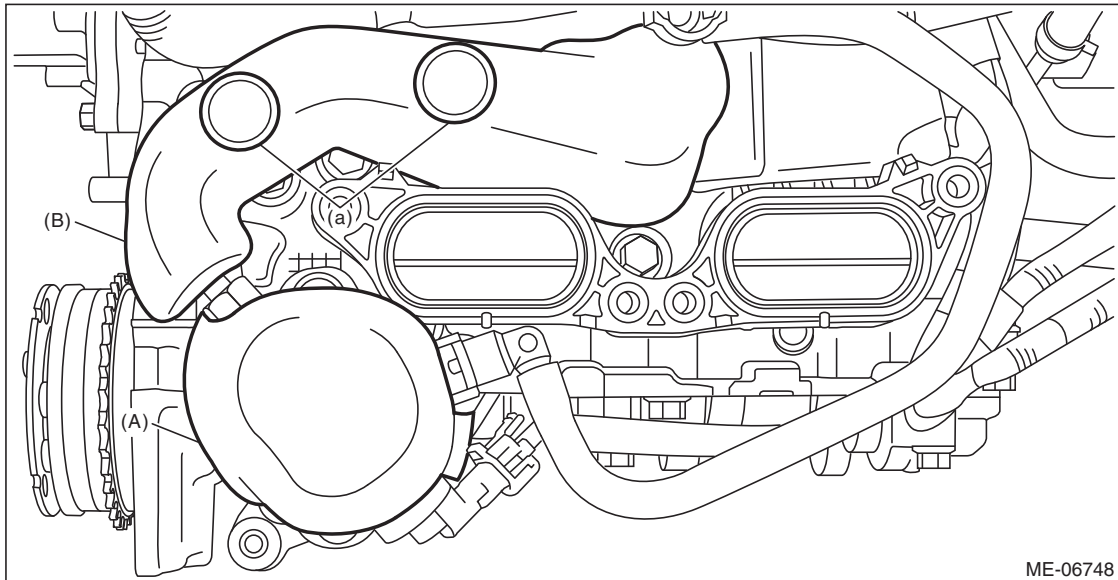
Cam Carrier

MECHANICAL

12) Install the fuel pump insulator (A) to the high-pressure fuel pump, and then install the fuel pipe insulator No. 1 (B) to the high-pressure fuel delivery pipe.

NOTE:

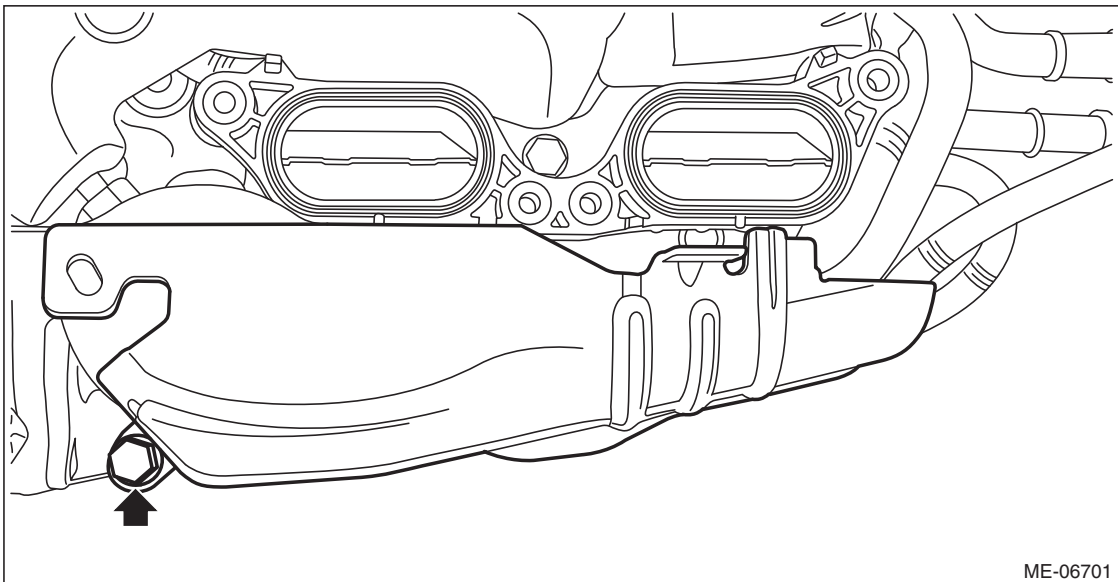
By pushing the sections (a) shown in the figure, fix the fuel pipe insulator No. 1 (B) to the high-pressure fuel delivery pipe.



13) Install the fuel pipe protector to the high-pressure fuel pump case.

Tightening torque:

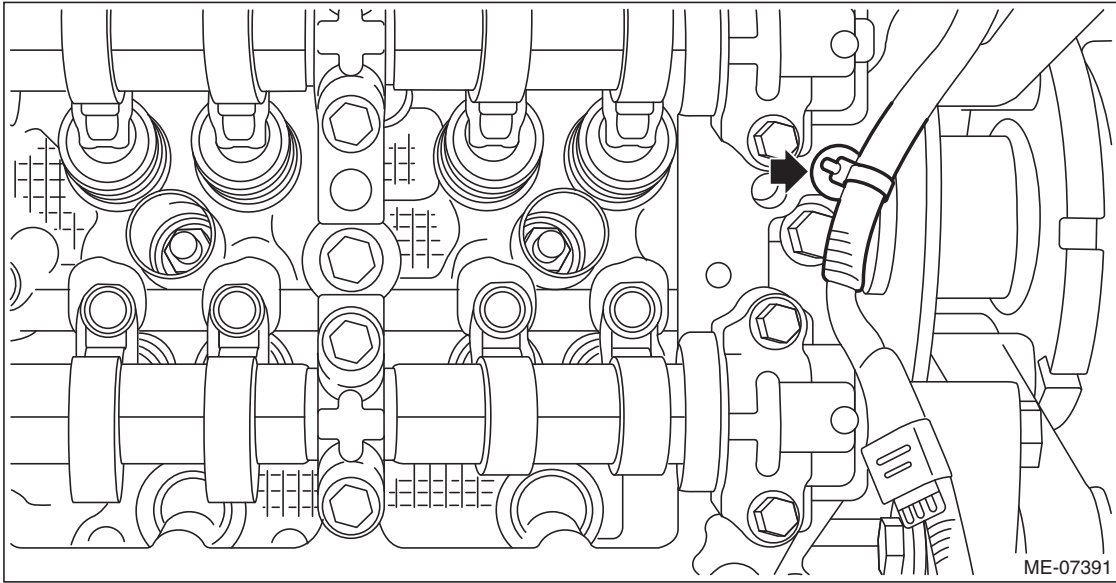
19 N·m (1.9 kgf-m, 14.0 ft-lb)



Cam Carrier

MECHANICAL

- 14) Secure the engine harness to the cam carrier LH with a clip.



- 15) Install the rocker cover LH. <Ref. to ME(H4DOTC)-161, ROCKER COVER LH, INSTALLATION, Rocker Cover.>
16) Install timing chain LH. <Ref. to ME(H4DOTC)-120, TIMING CHAIN LH, INSTALLATION, Timing Chain Assembly.>
17) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>
18) Install the engine to the vehicle. <Ref. to ME(H4DOTC)-59, INSTALLATION, Engine Assembly.>



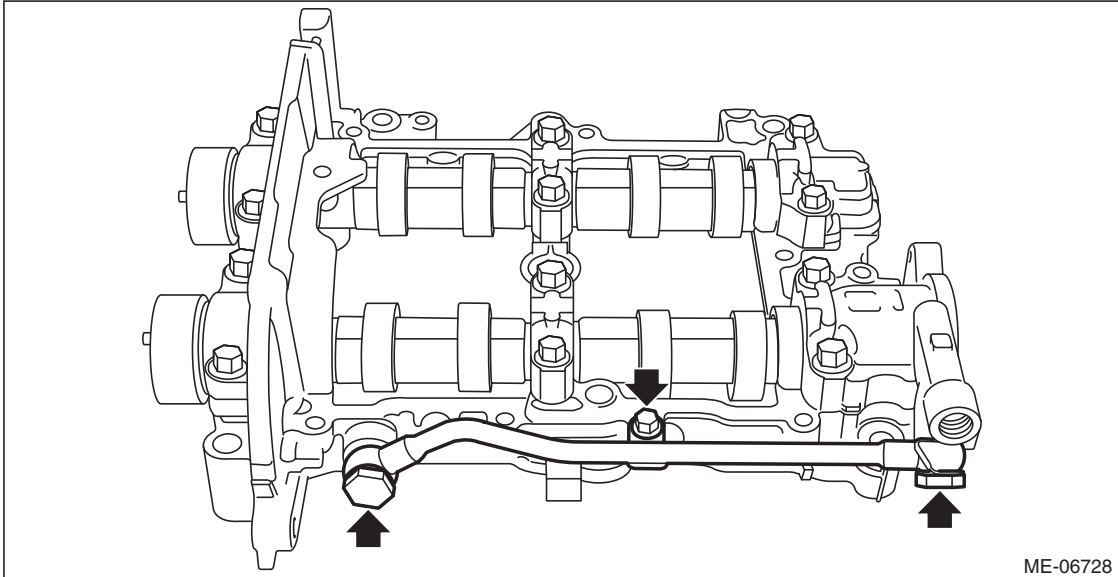
Cam Carrier

MECHANICAL

C: DISASSEMBLY

1. CAM CARRIER RH

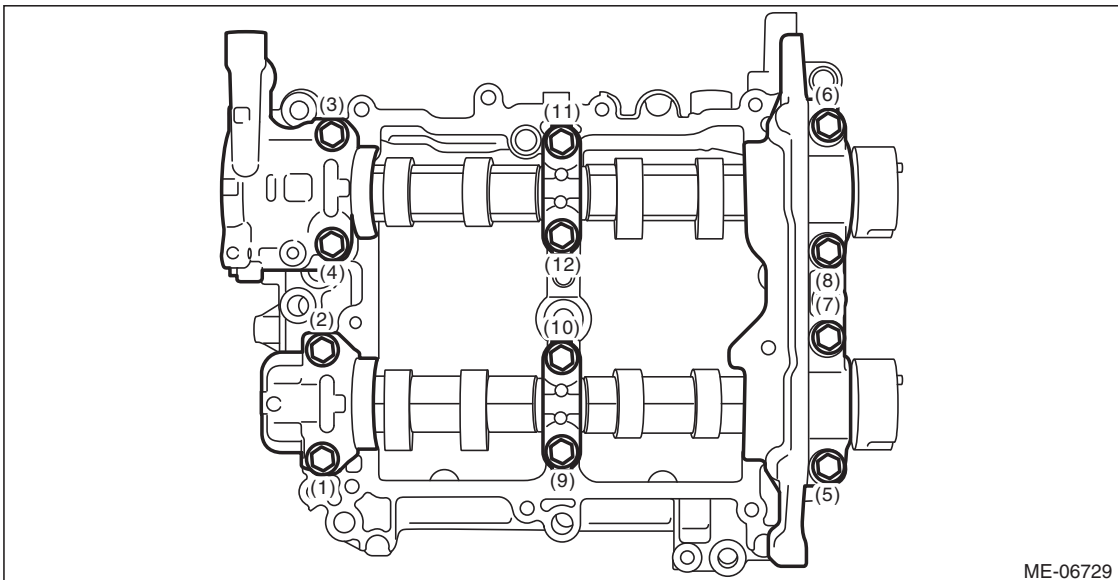
1) Remove the oil pipe from cam carrier RH.



2) Loosen the bolts (front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH, and exhaust rear camshaft cap RH) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.

NOTE:

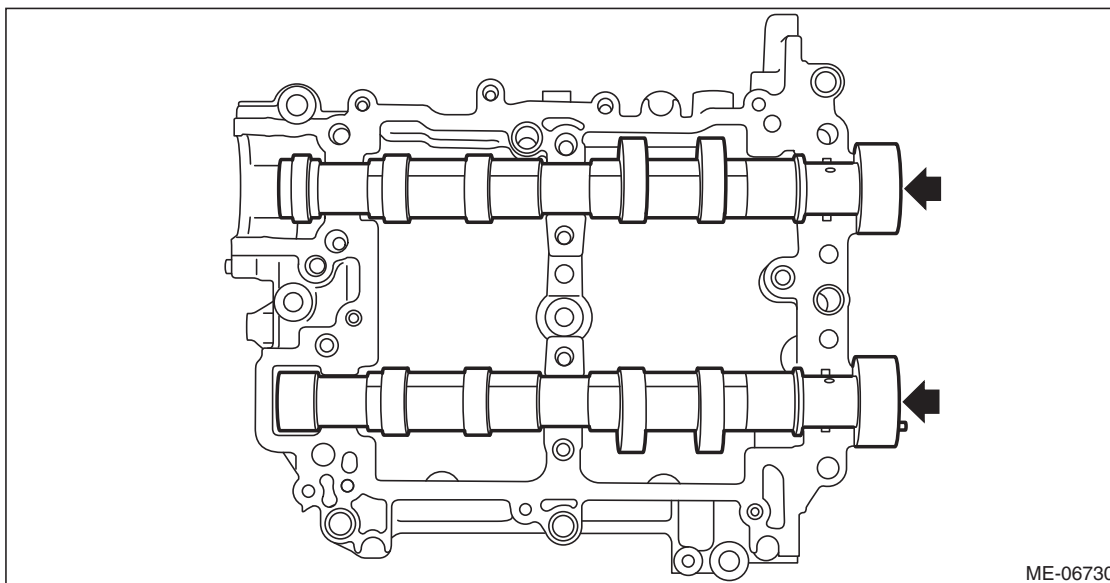
Arrange camshaft caps in order so that they can be installed in their original positions.



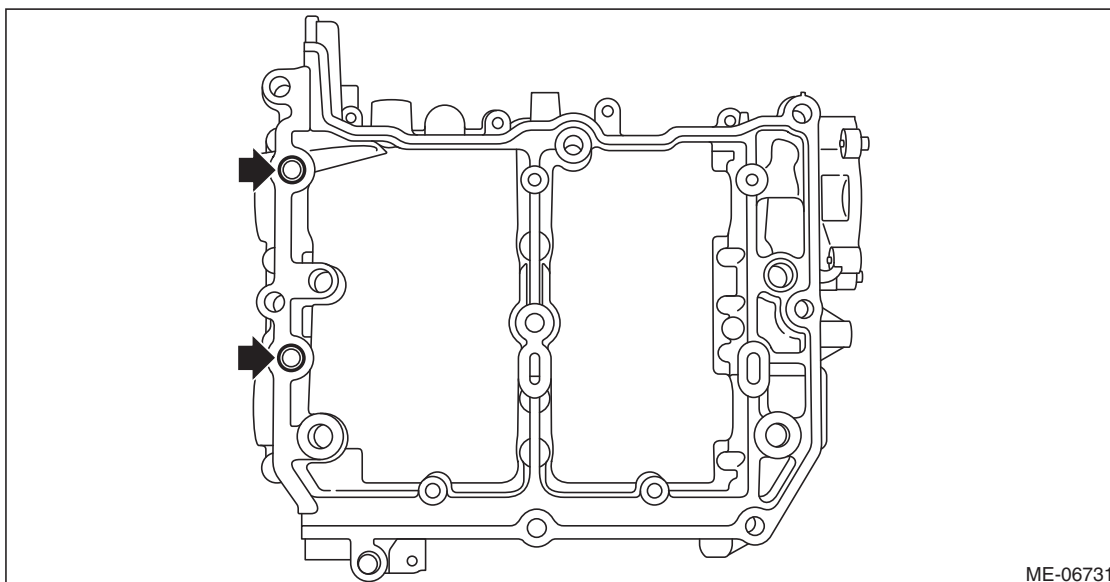
Cam Carrier

MECHANICAL

- 3) Remove the intake camshaft RH and the exhaust camshaft RH from cam carrier RH.



- 4) Remove the filter from cam carrier RH.



- 5) Remove the liquid gasket from cam carrier RH and front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH.

Cam Carrier

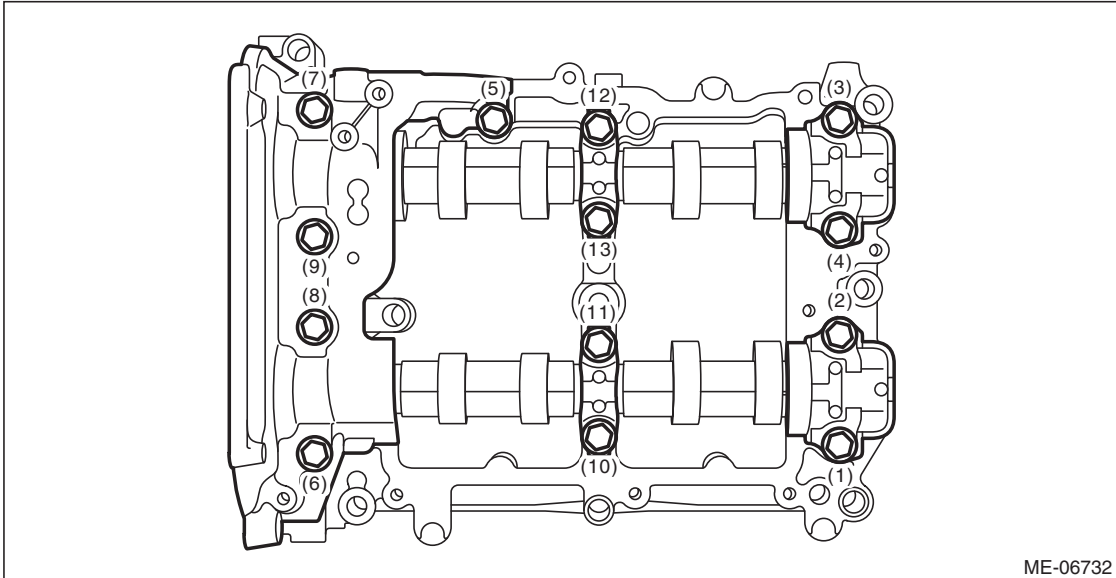
MECHANICAL

2. CAM CARRIER LH

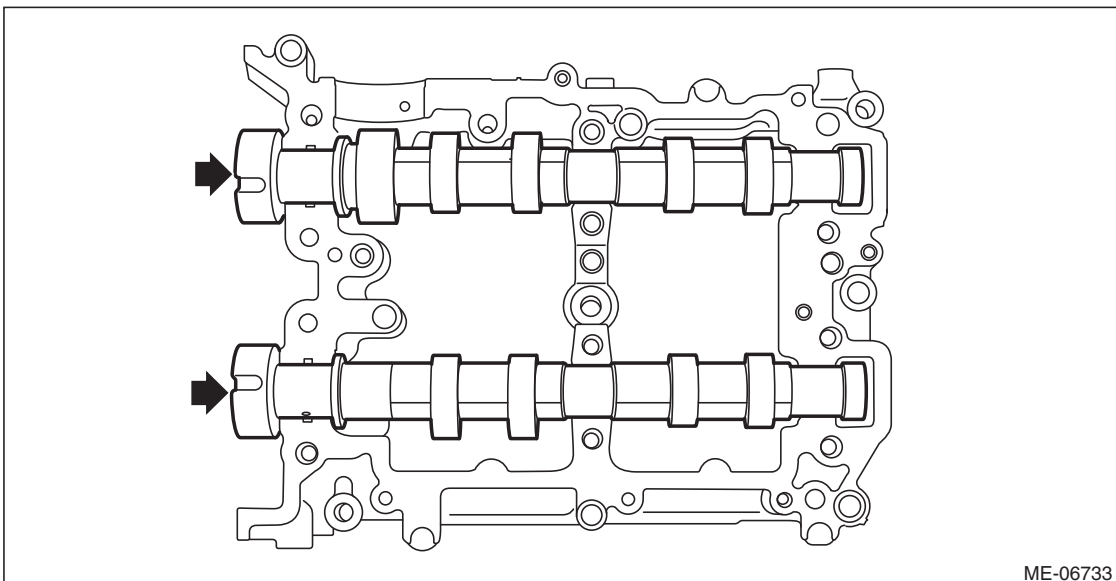
1) Loosen the bolts (front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.

NOTE:

Arrange camshaft caps in order so that they can be installed in their original positions.



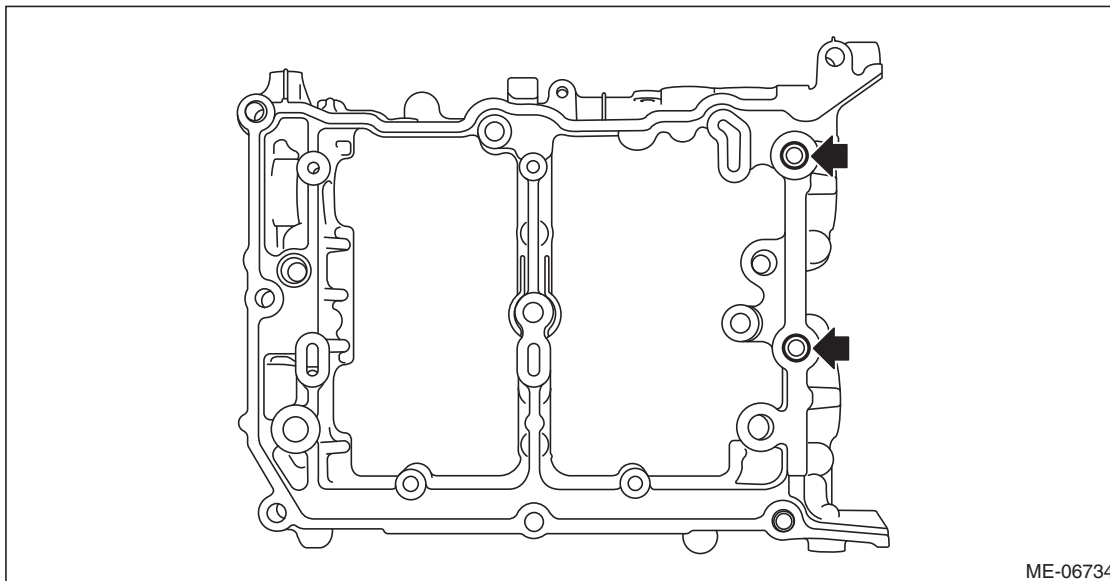
2) Remove the intake camshaft LH and the exhaust camshaft LH from cam carrier LH.



Cam Carrier

MECHANICAL

3) Remove the filter from cam carrier LH.



4) Remove the liquid gasket from cam carrier LH and front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH.

D: ASSEMBLY

1. CAM CARRIER RH

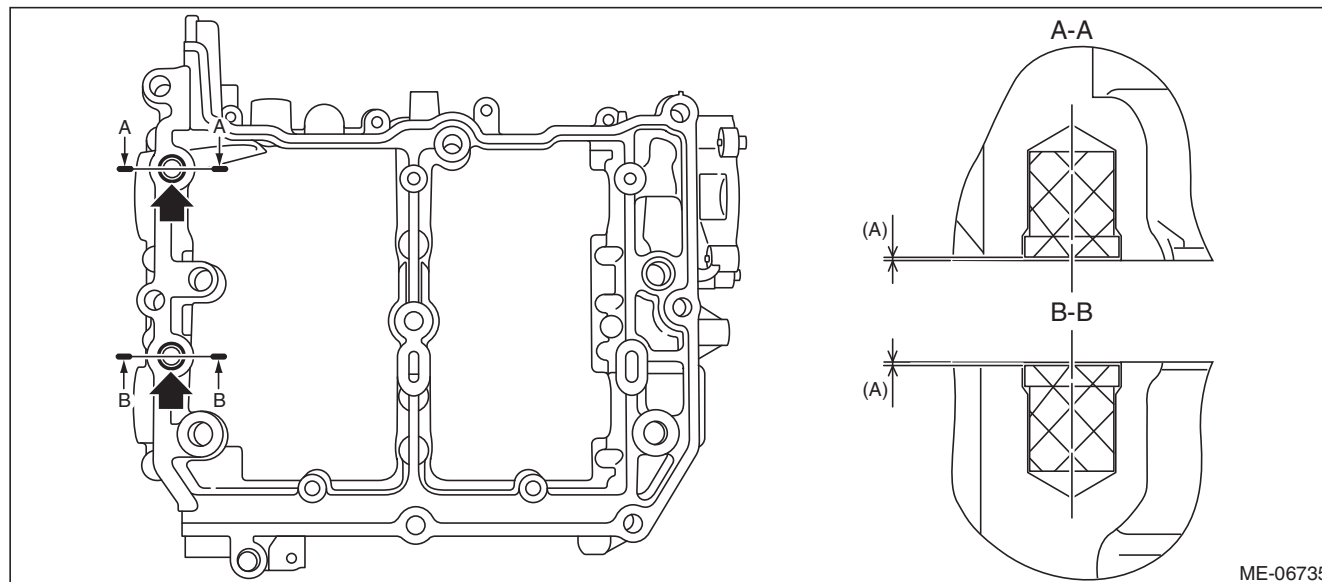
1) Install the filter to the cam carrier RH.

NOTE:

Use a new filter.

Filter insert position:

Cam carrier RH end face $0^{+0}_{-0.5}$ mm ($^{+0}_{-0.0197}$ in) position



(A) 0 — 0.5 mm (0 — 0.0197 in)

Cam Carrier

MECHANICAL

2) Set the intake camshaft RH and the exhaust camshaft RH to the cam carrier RH.

NOTE:

Apply engine oil to the journals of cam carrier RH before setting the intake camshaft RH and exhaust camshaft RH.

3) Install the front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH.

(1) Apply liquid gasket to the mating surface of front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH as shown in the figure.

CAUTION:

- Do not apply liquid gasket excessively. Applying excessively may cause excess gasket to flow toward camshaft journal, resulting in engine seizure.
- Do not apply liquid gasket excessively to the intake center camshaft cap RH and exhaust center camshaft cap RH.

NOTE:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the front camshaft cap RH, intake rear camshaft cap RH, exhaust rear camshaft cap RH, and cam carrier RH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

Liquid gasket applying diameter:

Mating surfaces other than ranges A and B

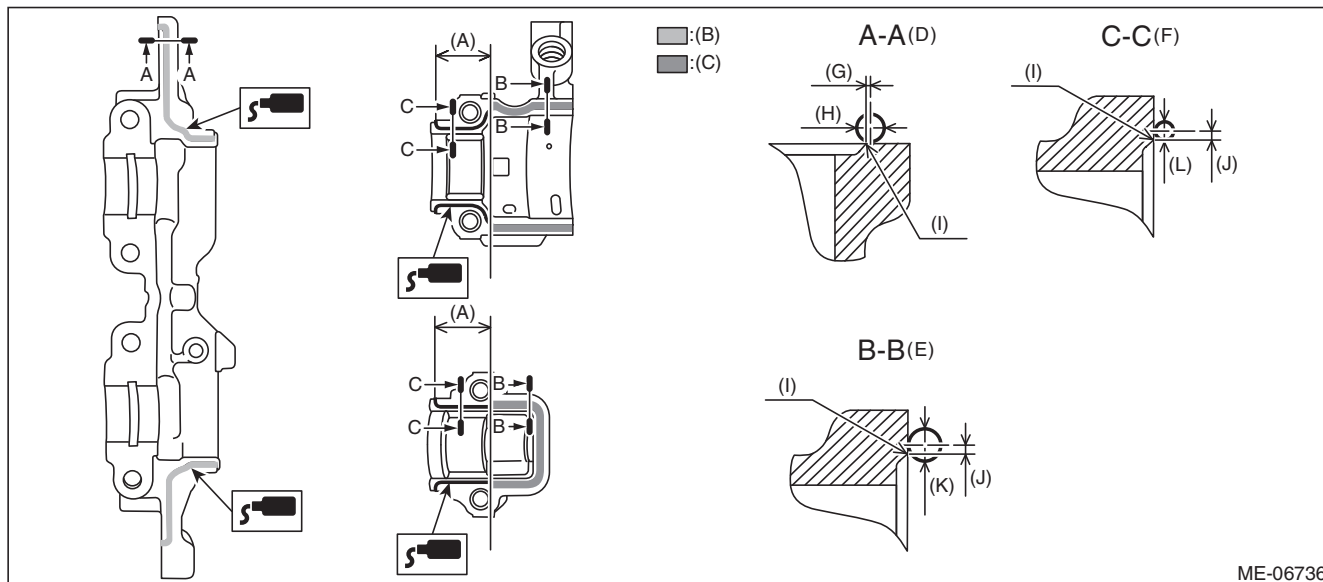
$2 \pm 0.5 \text{ mm } (0.0787 \pm 0.0197 \text{ in})$

Mating surfaces of range A

$3^{+1}_{-0.5} \text{ mm } (0.1181^{+0.0394}_{-0.0197} \text{ in})$

Mating surfaces of range B

$3.5 \pm 0.5 \text{ mm } (0.1378 \pm 0.0197 \text{ in})$



ME-06736

(A) 28.5 mm (1.122 in)

(B) Range A

(C) Range B

(D) Liquid gasket applying position of mating surfaces of range A

(E) Liquid gasket applying position of mating surfaces of range B

(F) Liquid gasket applying position of mating surfaces other than range A and range B

(G) 0.5 mm (0.0197 in)

(H) $\phi 3^{+1}_{-0.5} \text{ mm } (0.1181^{+0.0394}_{-0.0197} \text{ in})$

(I) Chamfer edge

(J) 1 mm (0.0394 in) or less

(K) $\phi 3.5 \pm 0.5 \text{ mm } (0.1378 \pm 0.0197 \text{ in})$

(L) $\phi 2 \pm 0.5 \text{ mm } (0.0787 \pm 0.0197 \text{ in})$

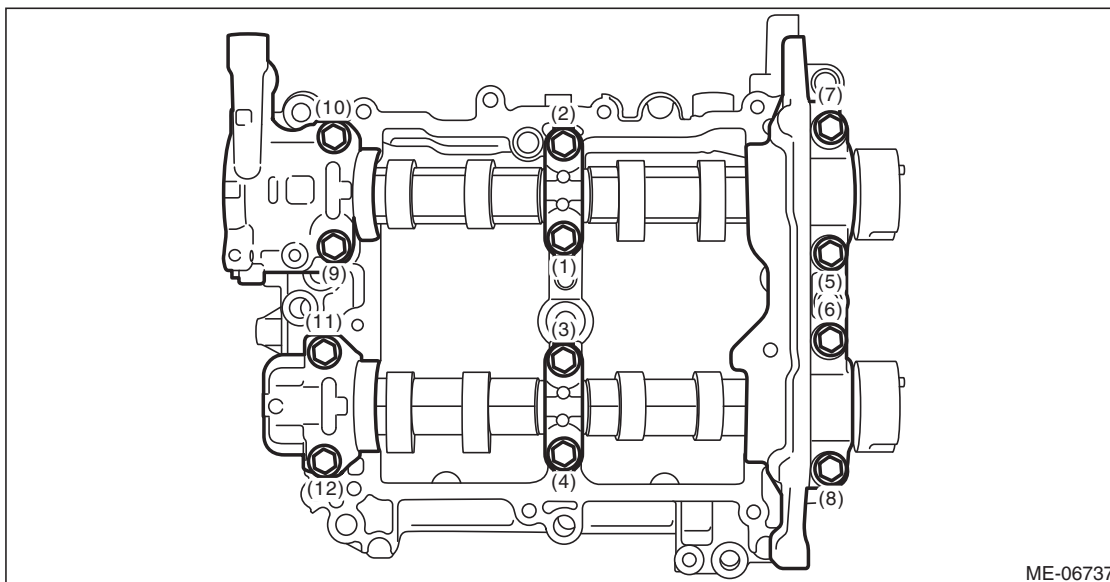
Cam Carrier

MECHANICAL

- (2) Apply engine oil to the journals of each camshaft cap before setting the camshaft cap.
- (3) Tighten the bolts which secure front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH in numerical order as shown in the figure.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

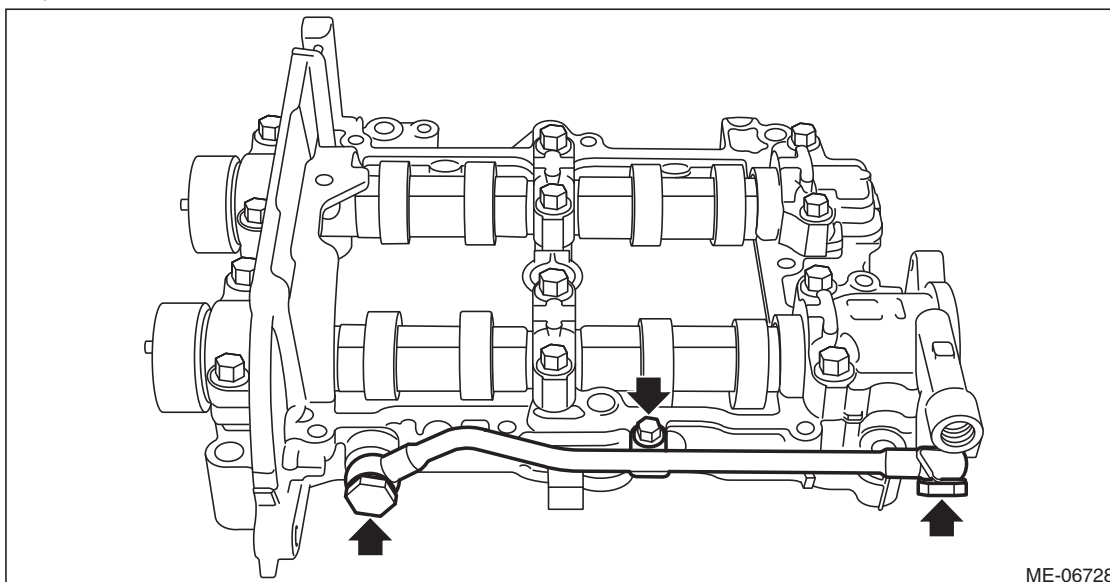


- 4) Install the oil pipe to the cam carrier RH.

- (1) Set the oil pipe to the cam carrier RH, and temporarily tighten the bolts which secure the oil pipe to the cam carrier RH.

NOTE:

Use a new gasket.



Cam Carrier

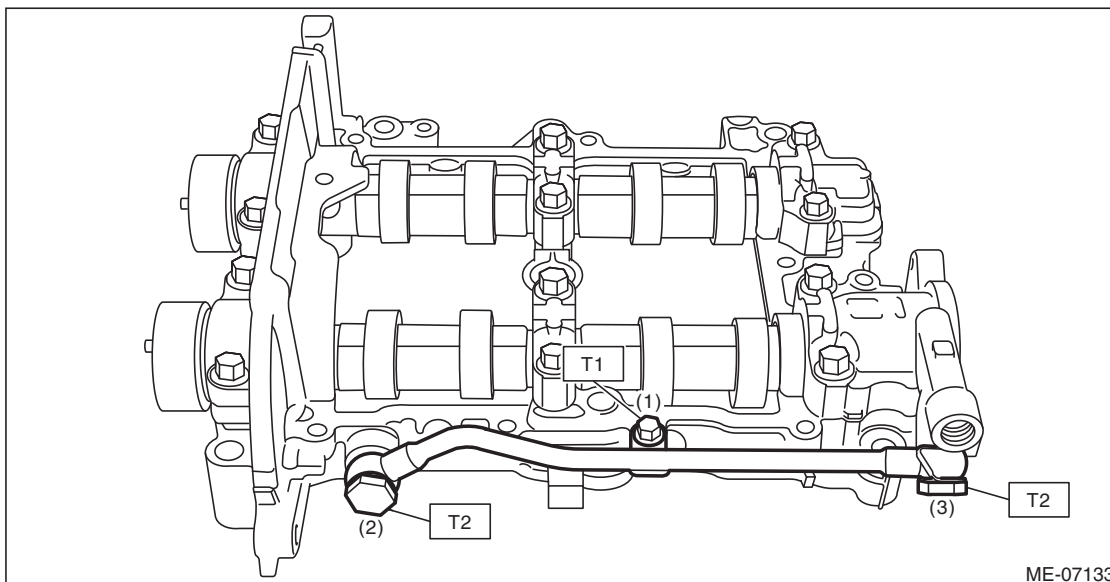
MECHANICAL

(2) Tighten the bolts which secures the oil pipe to the cam carrier 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: 31 N·m (3.2 kgf-m, 22.9 ft-lb)



Cam Carrier

MECHANICAL

2. CAM CARRIER LH

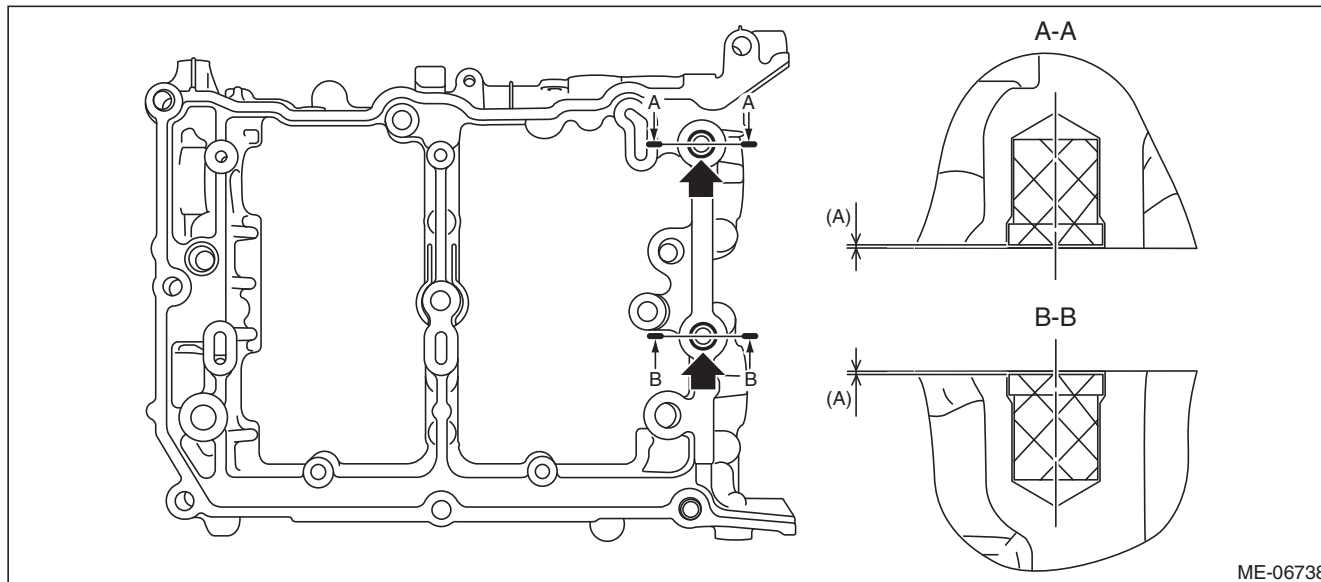
1) Install the filter to the cam carrier LH.

NOTE:

Use a new filter.

Filter insert position:

Cam carrier LH end face $0^{+0}_{-0.5}$ mm ($^{+0}_{-0.0197}$ in) position



(A) 0 — 0.5 mm (0 — 0.0197 in)

2) Set the intake camshaft LH and the exhaust camshaft LH to the cam carrier LH.

NOTE:

Apply engine oil to the journals of cam carrier LH before setting the intake camshaft LH and exhaust camshaft LH.

Cam Carrier

MECHANICAL

3) Install the front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH.

(1) Apply liquid gasket to the mating surface of front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH as shown in the figure.

CAUTION:

- Do not apply liquid gasket excessively. Applying excessively may cause excess gasket to flow toward camshaft journal, resulting in engine seizure.
- Do not apply liquid gasket excessively to the intake center camshaft cap LH and exhaust center camshaft cap LH.

NOTE:

- Before applying liquid gasket, degrease the old liquid gasket seal surface of the front camshaft cap LH, intake rear camshaft cap LH, exhaust rear camshaft cap LH, and cam carrier LH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

Liquid gasket applying diameter:

Mating surfaces other than ranges A, B and C

2 ± 0.5 mm (0.0787 $\pm$ 0.0197 in)

Mating surfaces of range A

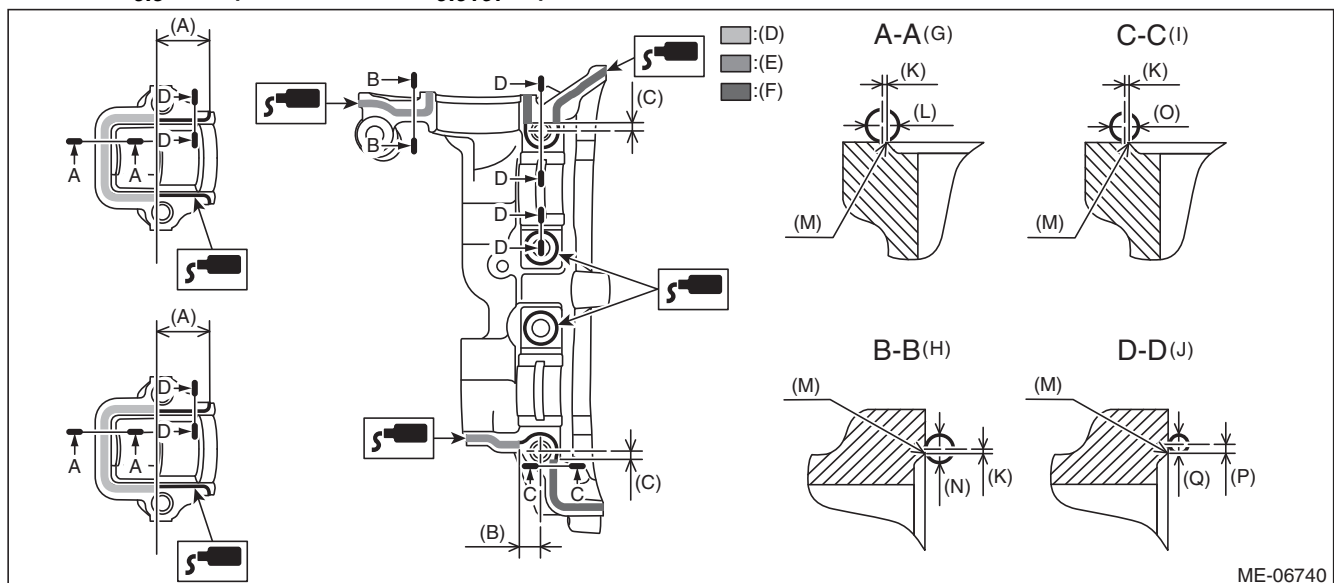
3.5 ± 0.5 mm (0.1378 $\pm$ 0.0197 in)

Mating surfaces of range B

3 ± 0.5 mm (0.1181 $\pm$ 0.0197 in)

Mating surfaces of range C

$3^{+1}_{-0.5}$ mm (0.1181 $^{+0.0394}_{-0.0197}$ in)



ME-06740

(A) 28.5 mm (1.122 in)

(B) 11.6 mm (0.4567 in)

(C) 5.1 mm (0.2008 in)

(D) Range A

(E) Range B

(F) Range C

(G) Liquid gasket applying position of mating surfaces of range A

(H) Liquid gasket applying position of mating surfaces of range B

(I) Liquid gasket applying position of mating surfaces of range C

(J) Liquid gasket applying position of mating surfaces other than range A, range B and range C

(K) 0.5 mm (0.0197 in)

(L) $\phi 3.5 \pm 0.5$ mm (0.1378 $\pm$ 0.0197 in)

(M) Chamfer edge

(N) $\phi 3 \pm 0.5$ mm (0.1181 $\pm$ 0.0197 in)

(O) $\phi 3^{+1}_{-0.5}$ mm (0.1181 $^{+0.0394}_{-0.0197}$ in)

(P) 1 mm (0.0394 in) or less

(Q) $\phi 2 \pm 0.5$ mm (0.0787 $\pm$ 0.0197 in)

ME(H4DOTC)-208

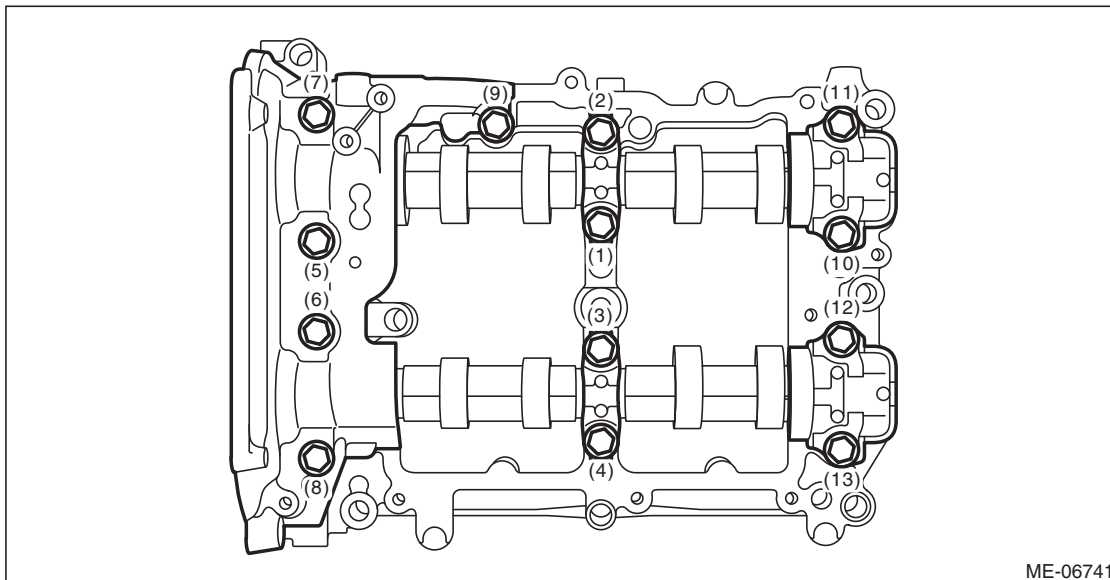
Cam Carrier

MECHANICAL

- (2) Apply engine oil to the journals of each camshaft cap before setting the camshaft cap.
- (3) Tighten the bolts which secure front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH in numerical order as shown in the figure.

Tightening torque:

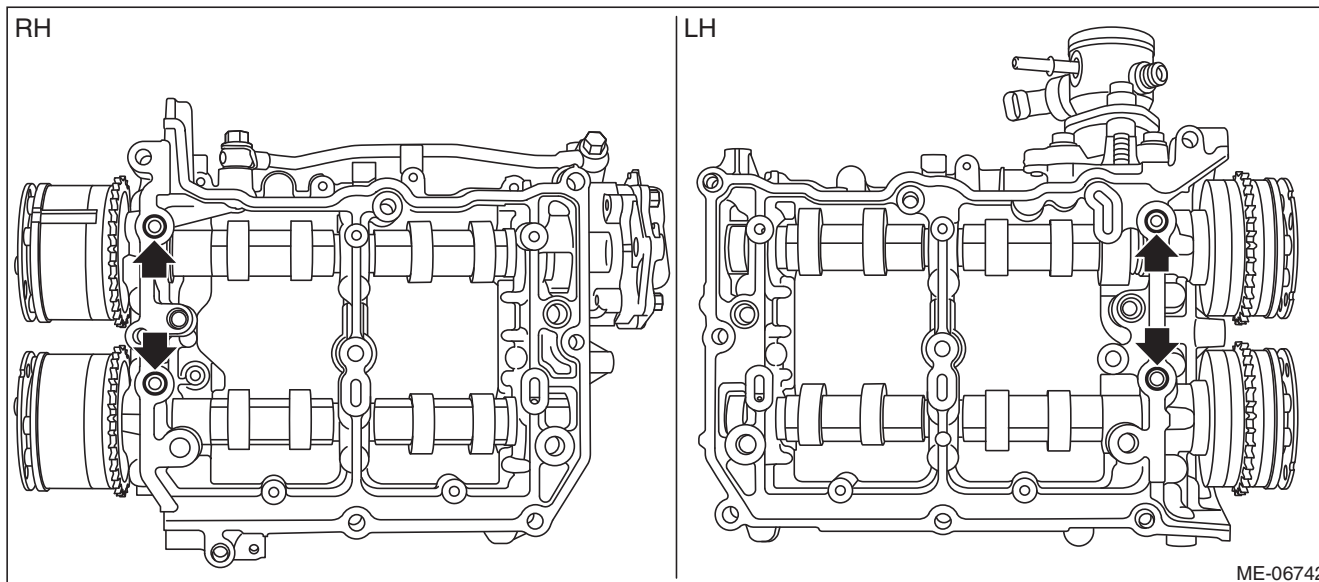
18 N·m (1.8 kgf-m, 13.3 ft-lb)



ME-06741

E: INSPECTION

- 1) Visually check the cam carrier filter, and if clogging is found, replace with a new part.



ME-06742

- 2) Check the camshaft journals for damage and wear. Replace the camshaft if faulty.
- 3) Check the cam face condition of camshaft, and remove the minor faults by grinding with oil stone. Replace the camshaft if uneven wear is found.

Cam Carrier

MECHANICAL

4) Using a dial gauge, check the camshaft bend. If it exceeds the limit, replace the camshaft.

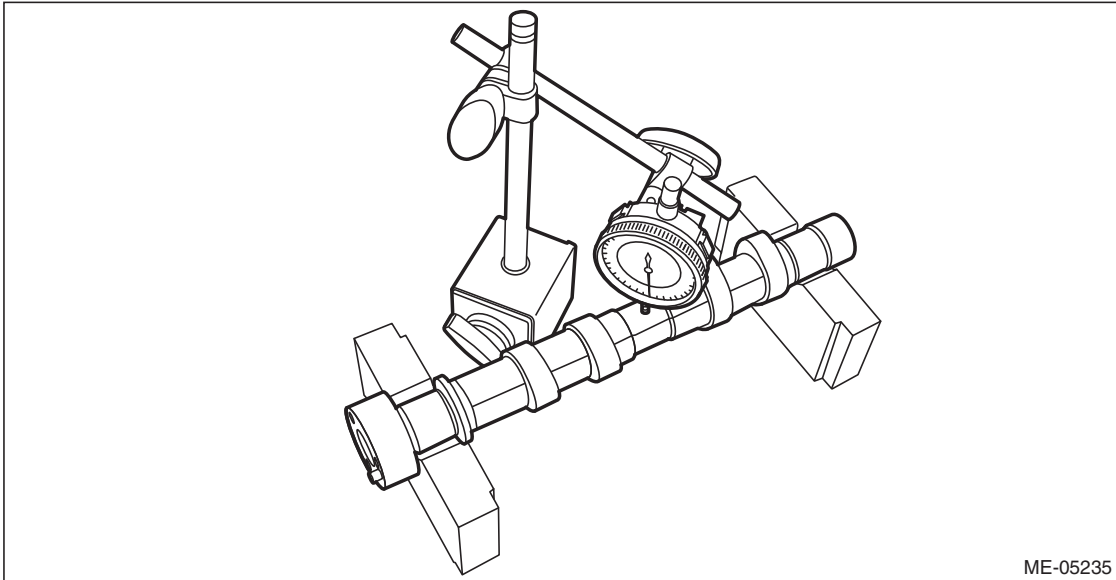
NOTE:

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

Camshaft bend:

Limit

0.020 mm (0.00079 in)



5) Check the cam lobe height “H” and cam base circle diameter “A” of camshaft as shown in the figure, using micrometer. If it is not within the standard, replace the camshaft.

NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Perform measurement of cam lobe height for fuel pump drive section at three points.

Camshaft cam lobe overall height H:

Intake

Valve drive section

Standard

40.77 — 40.87 mm (1.605 — 1.609 in)

Fuel pump drive section

Standard

41.97 — 42.03 mm (1.652 — 1.655 in)

Exhaust

Standard

40.72 — 40.82 mm (1.603 — 1.607 in)

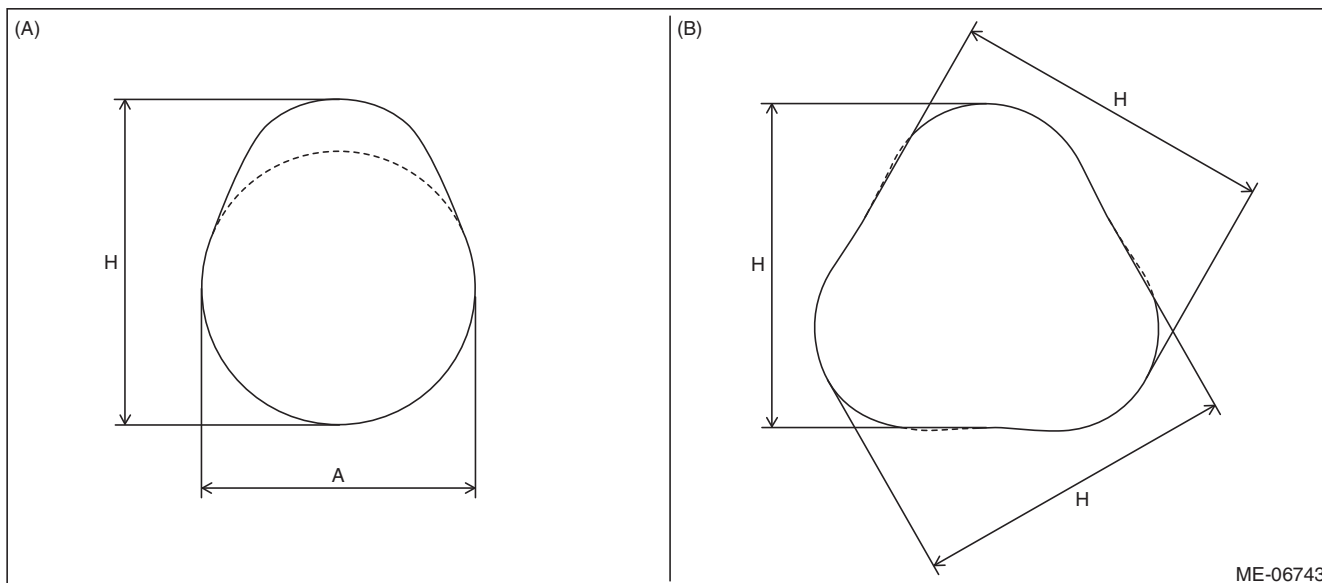
Camshaft cam base circle diameter A:

Standard

34.0 mm (1.339 in)

Cam Carrier

MECHANICAL



(A) Valve drive section

(B) Fuel pump drive section

6) Check the camshaft journal outer diameter using micrometer. If it is not within the standard, replace the camshaft.

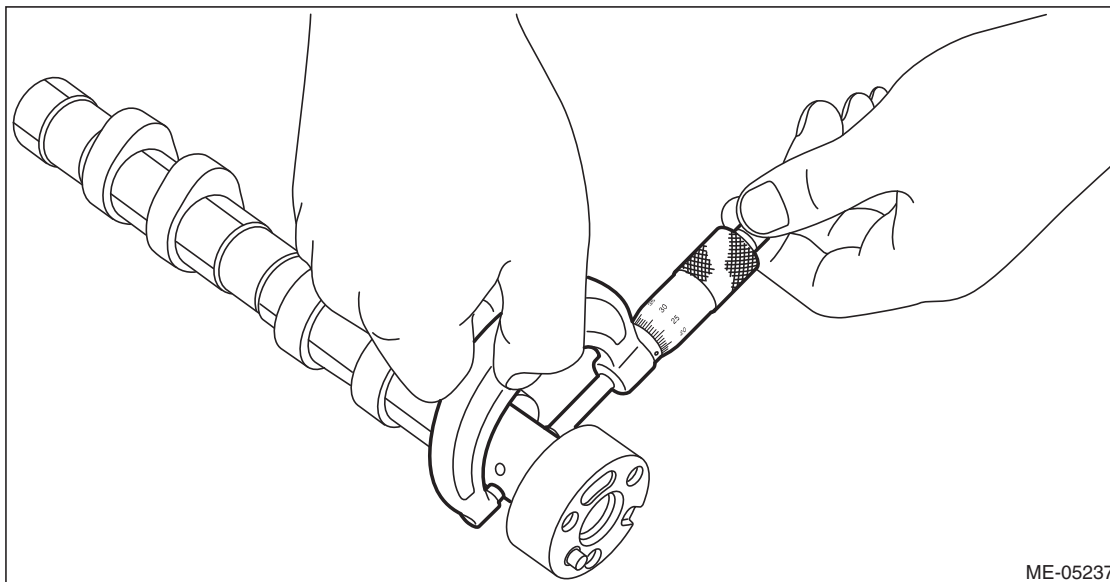
NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure outer diameter of each journal at several points, and read the value of most worn location.

Camshaft journal outer diameter:

Standard

25.946 — 25.963 mm (1.0215 — 1.0222 in)



Cam Carrier

MECHANICAL

7) Using a dial gauge, check the thrust clearance of the camshaft. If it is not within the standard or if uneven wear is found, replace each camshaft cap and cam carrier as a set. If necessary replace the camshaft.

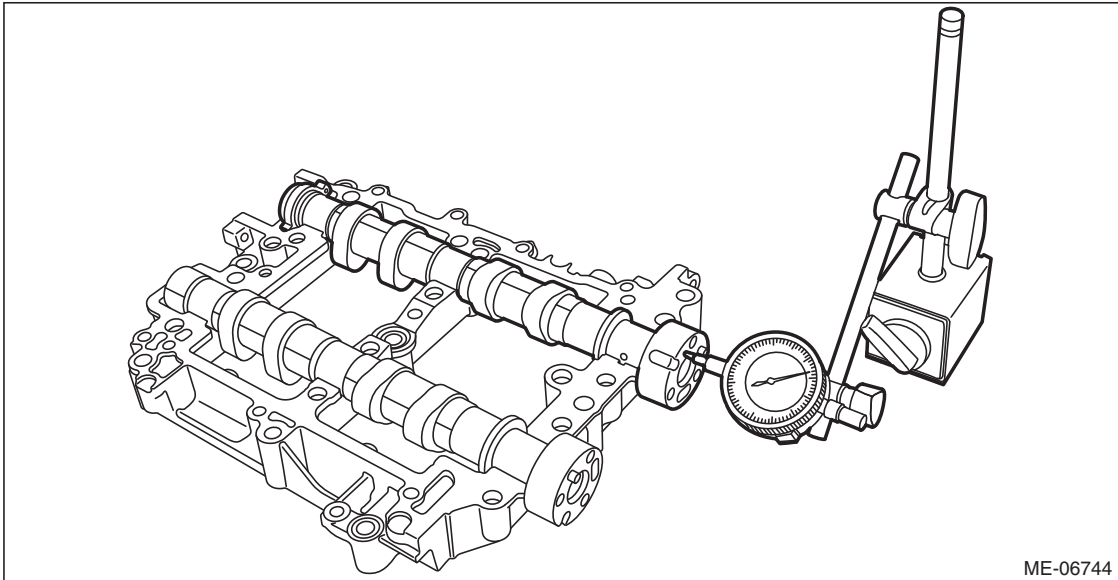
NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Set the dial gauge at end surface of camshaft.

Camshaft thrust clearance:

Standard

0.068 — 0.116 mm (0.0027 — 0.0047 in)



8) Check the oil clearance on the camshaft using a plastigauge.

NOTE:

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

- (1) Remove the liquid gasket from cam carrier and front camshaft cap, intake rear camshaft cap and exhaust rear camshaft cap.
- (2) Clean each camshaft cap and cam carrier journals.
- (3) Set the camshaft to the cam carrier.
- (4) Place a plastigauge across the camshaft journals of each camshaft and set the camshaft caps.



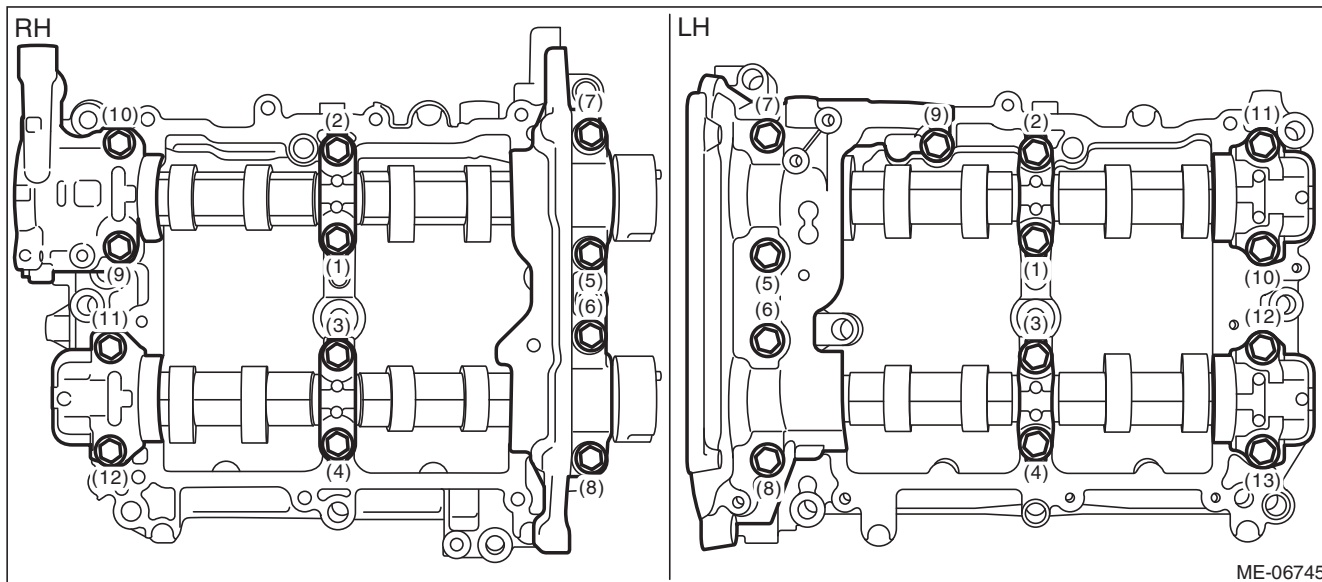
Cam Carrier

MECHANICAL

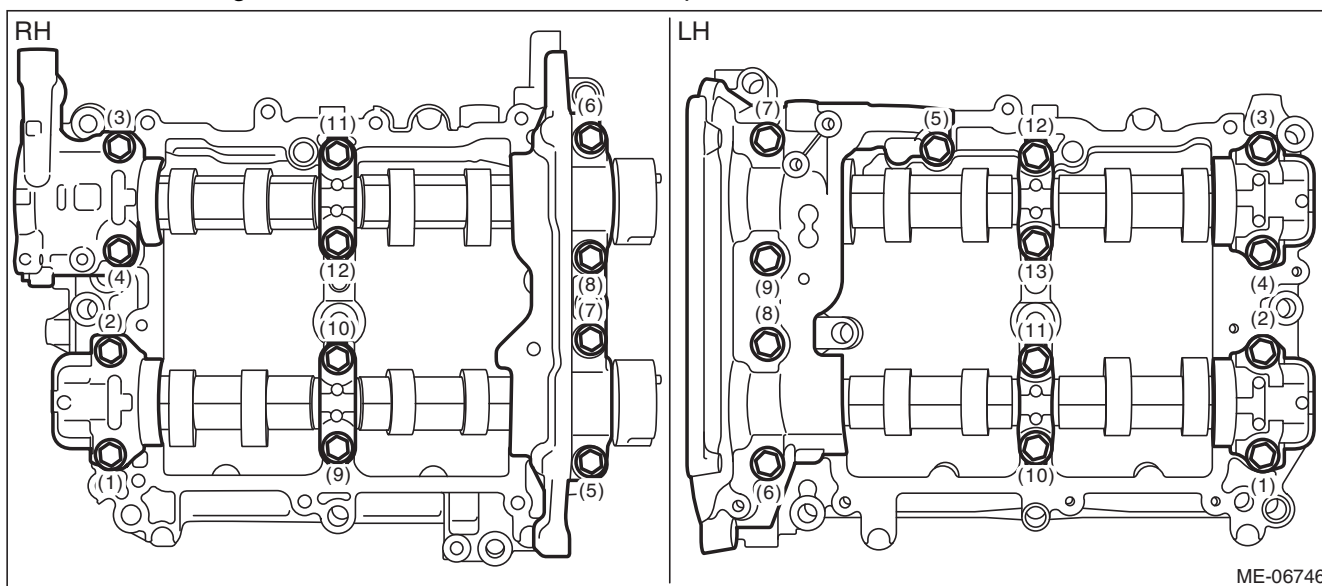
(5) Tighten the bolts which secure front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap in numerical order as shown in the figure.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



(6) Loosen the bolts (front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.



Cam Carrier

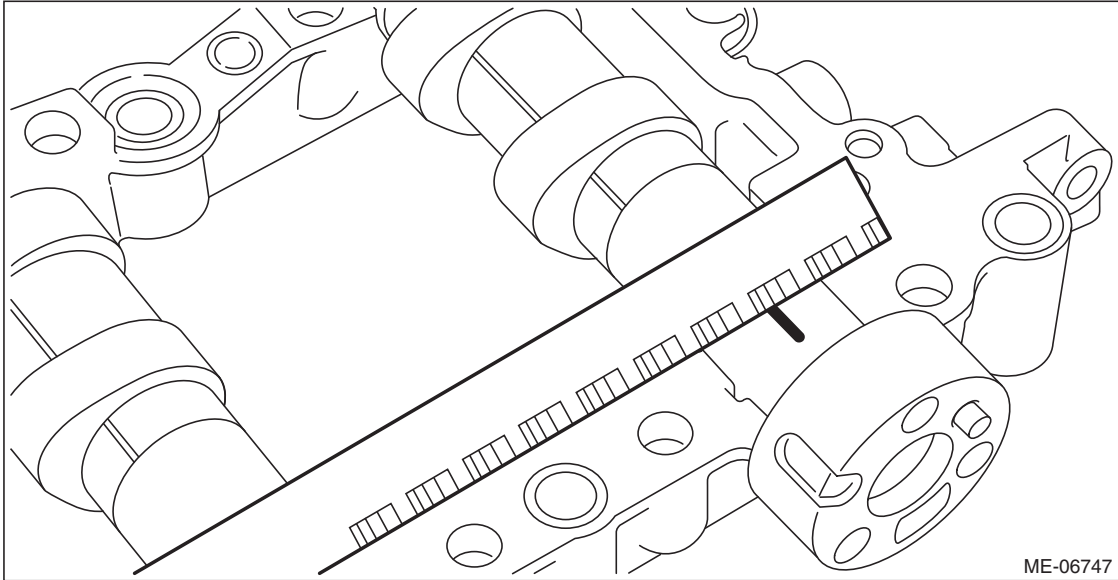
MECHANICAL

(7) Determine camshaft oil clearance by matching the widest point of plastigauge on each journal against scale printed on a package of plastigauge. If it is not within the standard, replace each camshaft cap and cam carrier as a set. If necessary replace the camshaft.

Camshaft oil clearance:

Standard

0.037 — 0.072 mm (0.0015 — 0.0028 in)



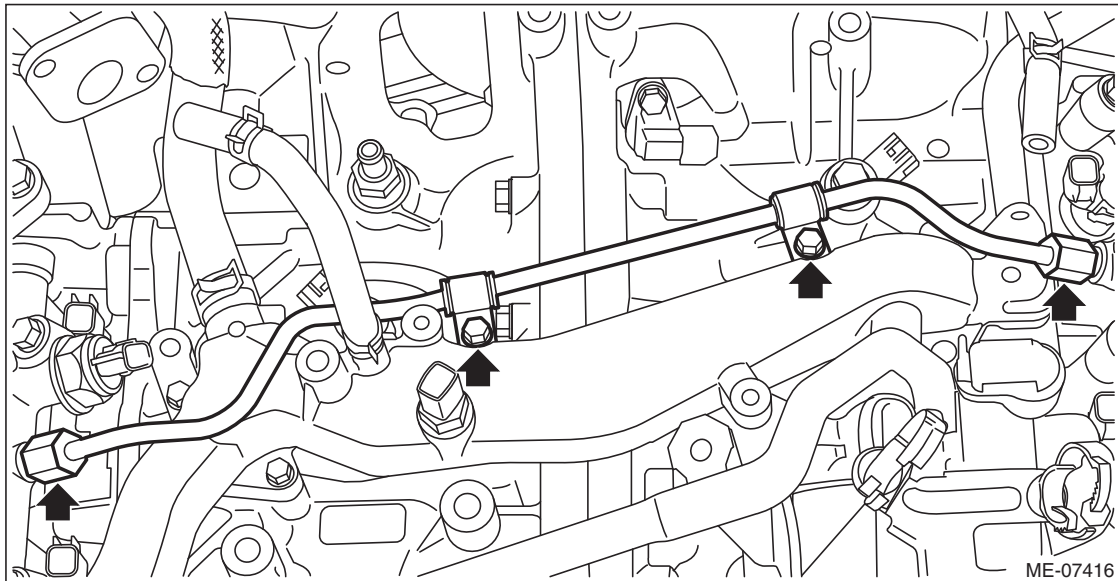
(8) Completely remove the plastigauge.

21. Cylinder Head

A: REMOVAL

1. CYLINDER HEAD RH

- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-44, 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)-86, REMOVAL, Engine Wiring Harness.>
- 4) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 5) Remove the rocker cover RH. <Ref. to ME(H4DOTC)-147, ROCKER COVER RH, REMOVAL, Rocker Cover.>
- 6) Remove the cam carrier RH. <Ref. to ME(H4DOTC)-172, 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

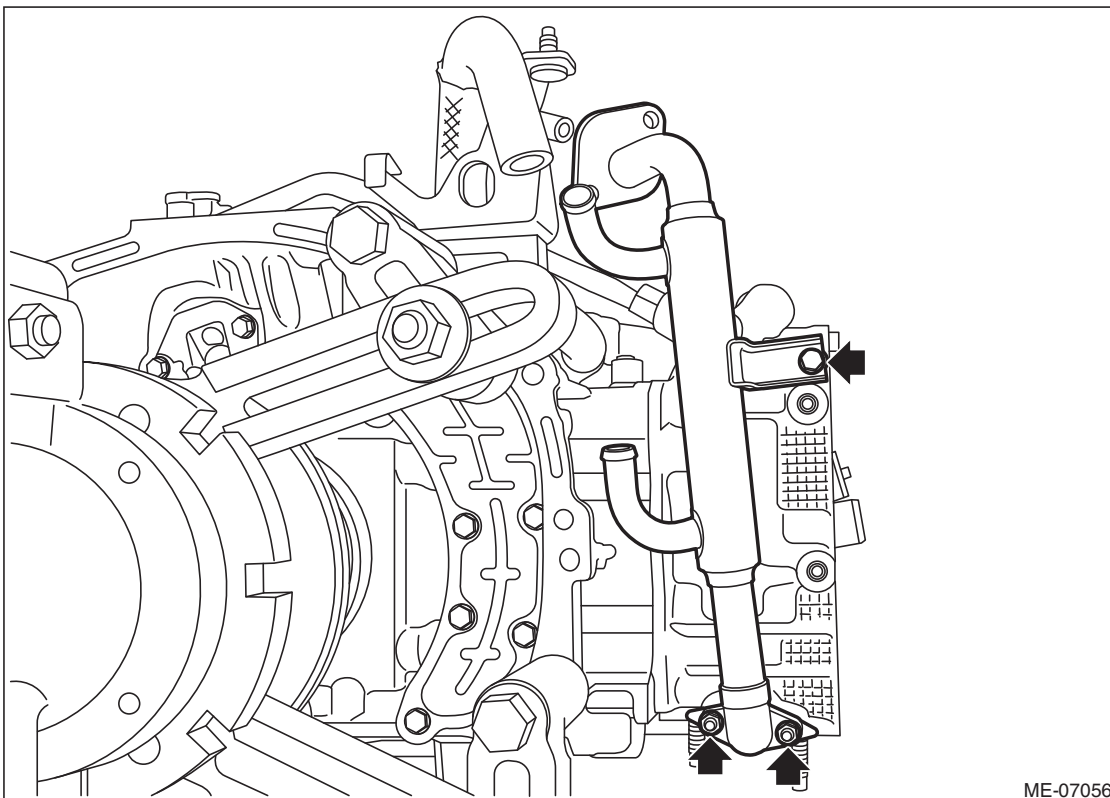
MECHANICAL

8) Disassemble the cylinder head RH.

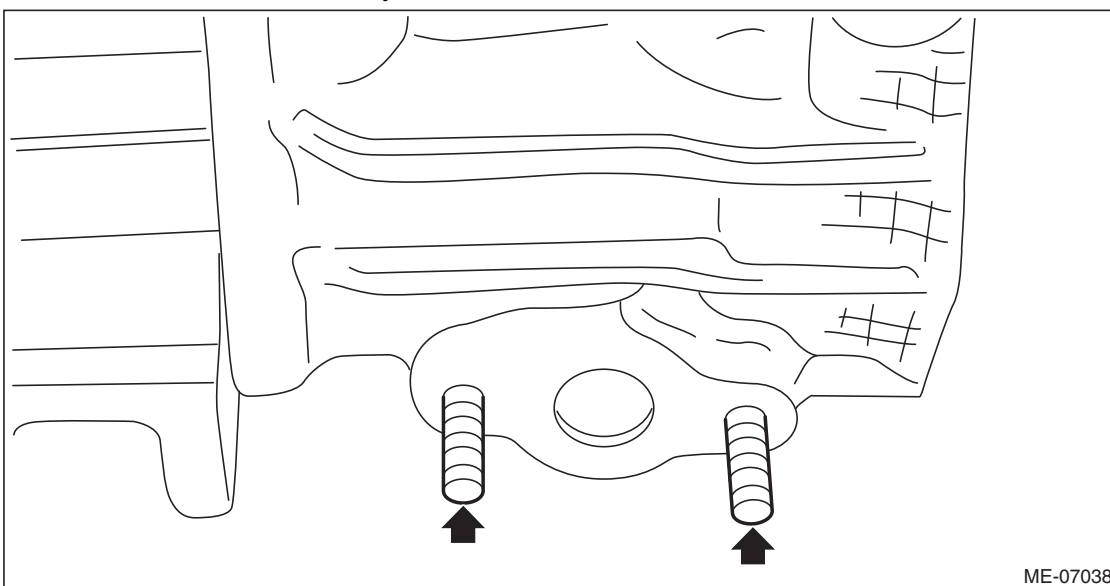
NOTE:

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

- (1) Remove the tumble generator valve assembly RH. <Ref. to FU(H4DOTC)-43, REMOVAL, Tumble Generator Valve Assembly.>
- (2) Remove the fuel injector RH. <Ref. to FU(H4DOTC)-51, 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.

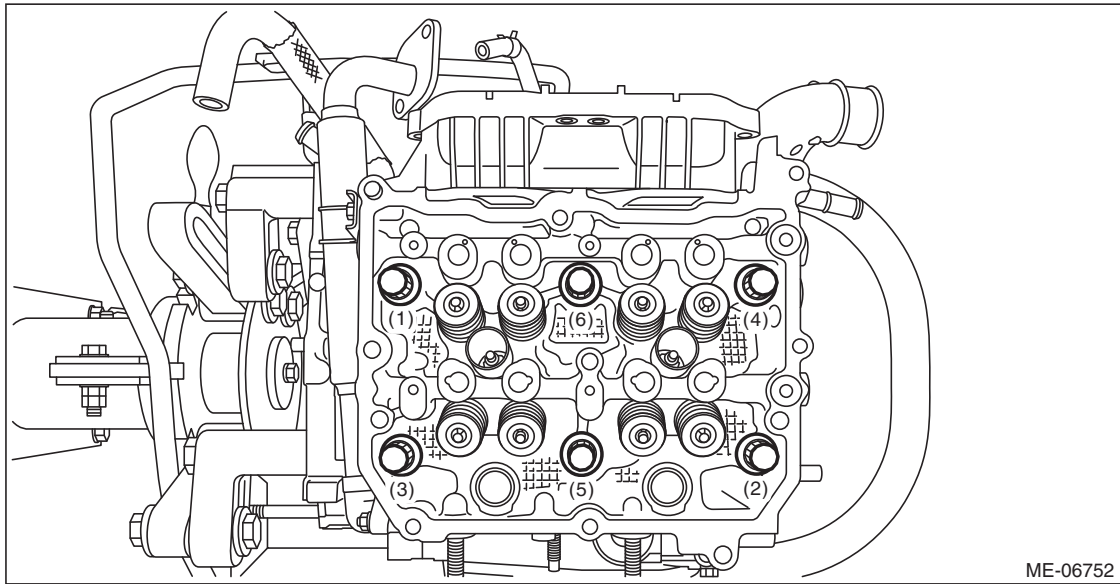


9) Set the part so that the cylinder head RH is on the upper side.

Cylinder Head

MECHANICAL

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.

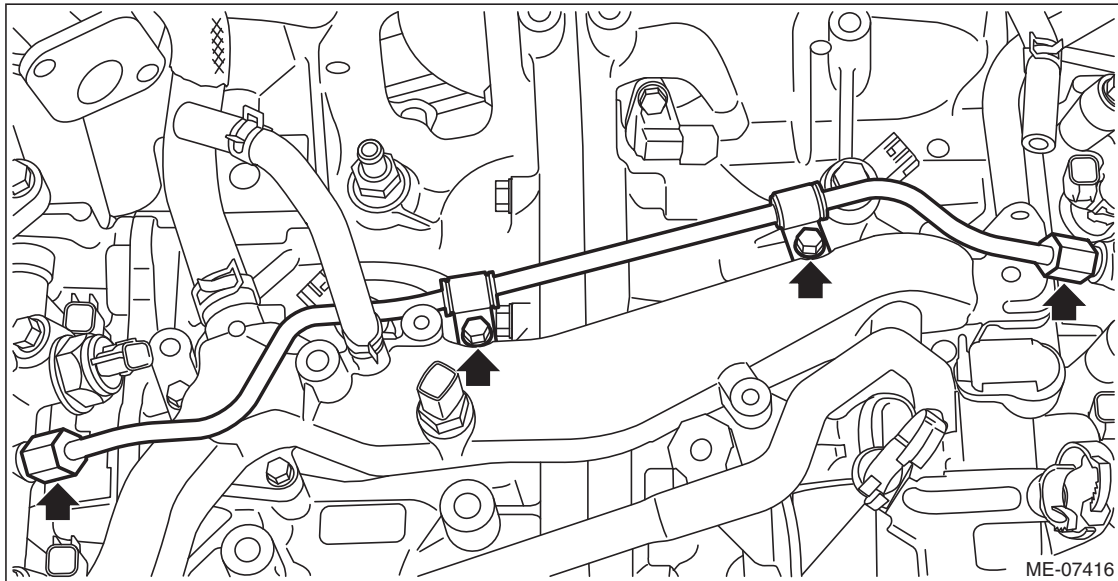


Cylinder Head

MECHANICAL

2. CYLINDER HEAD LH

- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-44, 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)-86, REMOVAL, Engine Wiring Harness.>
- 4) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 5) Remove the rocker cover LH. <Ref. to ME(H4DOTC)-149, ROCKER COVER LH, REMOVAL, Rocker Cover.>
- 6) Remove the cam carrier LH. <Ref. to ME(H4DOTC)-175, 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-52, REMOVAL, Compressor.>
- 9) When disassembling the cylinder head LH

NOTE:

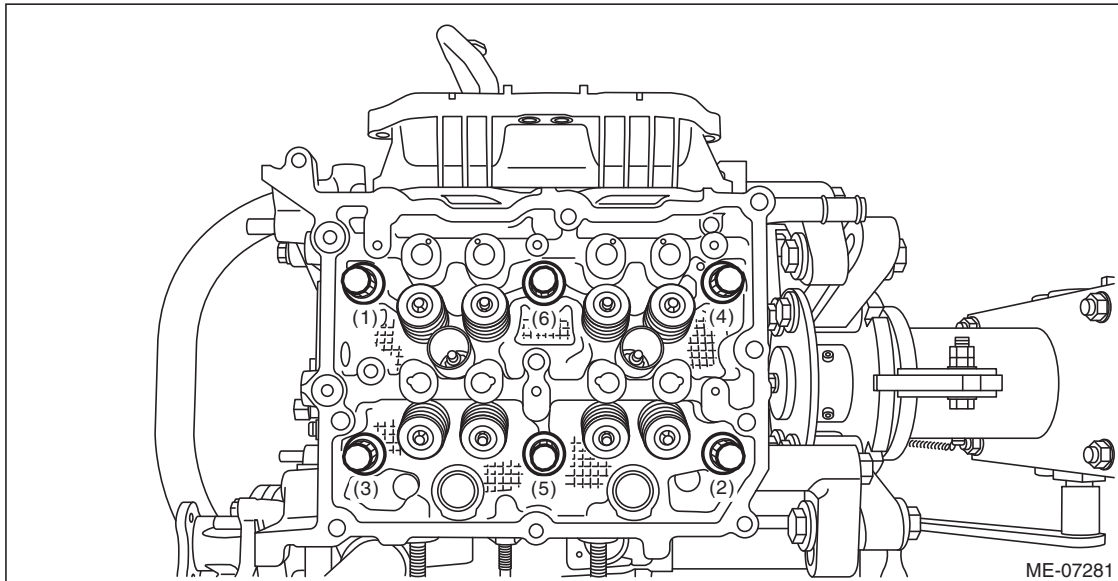
When disassembling the cylinder head LH, perform the following steps also.

- (1) Remove the tumble generator valve assembly LH. <Ref. to FU(H4DOTC)-43, REMOVAL, Tumble Generator Valve Assembly.>
 - (2) Remove the fuel injector LH. <Ref. to FU(H4DOTC)-55, FUEL INJECTOR LH, REMOVAL, Fuel Injector.>
- 10) Set the part so that the cylinder head LH is on the upper side.

Cylinder Head

MECHANICAL

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.

Cylinder Head

MECHANICAL

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:

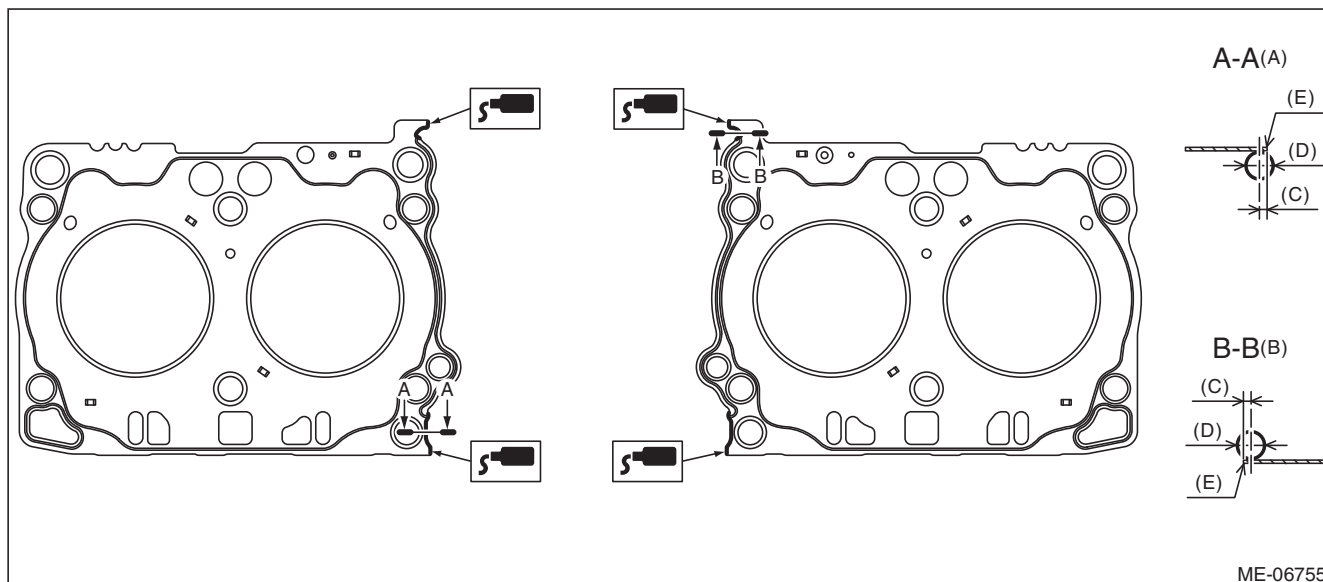
- Use a new cylinder head gasket RH.
- Before applying liquid gasket, degrease the mating surface of cylinder blocks RH and cylinder head RH.
- Install within 5 min. after applying liquid gasket.

Liquid gasket:

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

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) $\phi 3\pm1$ 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.

Cylinder Head

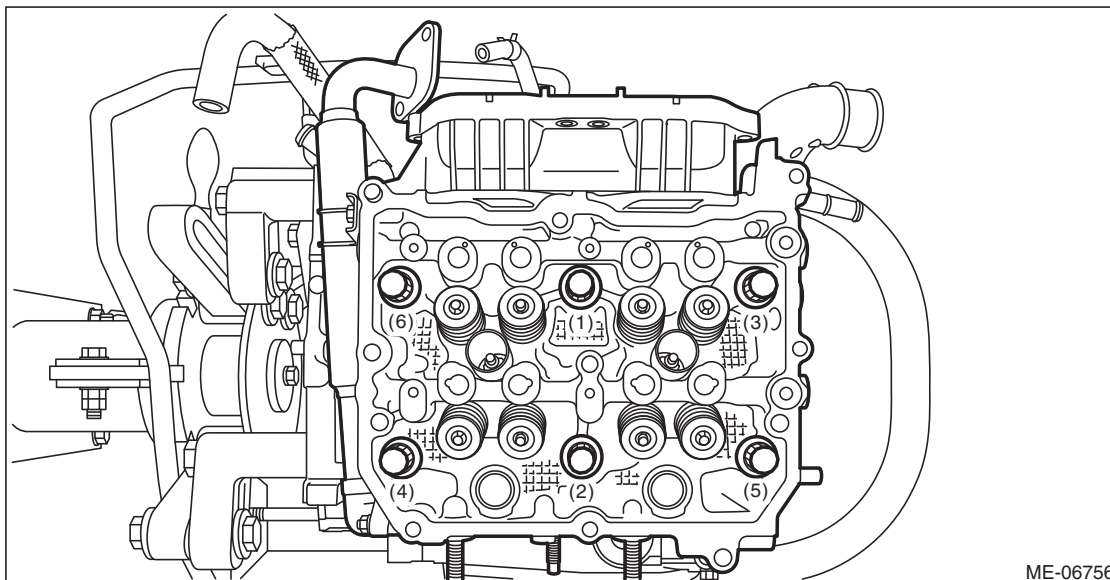
MECHANICAL

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.

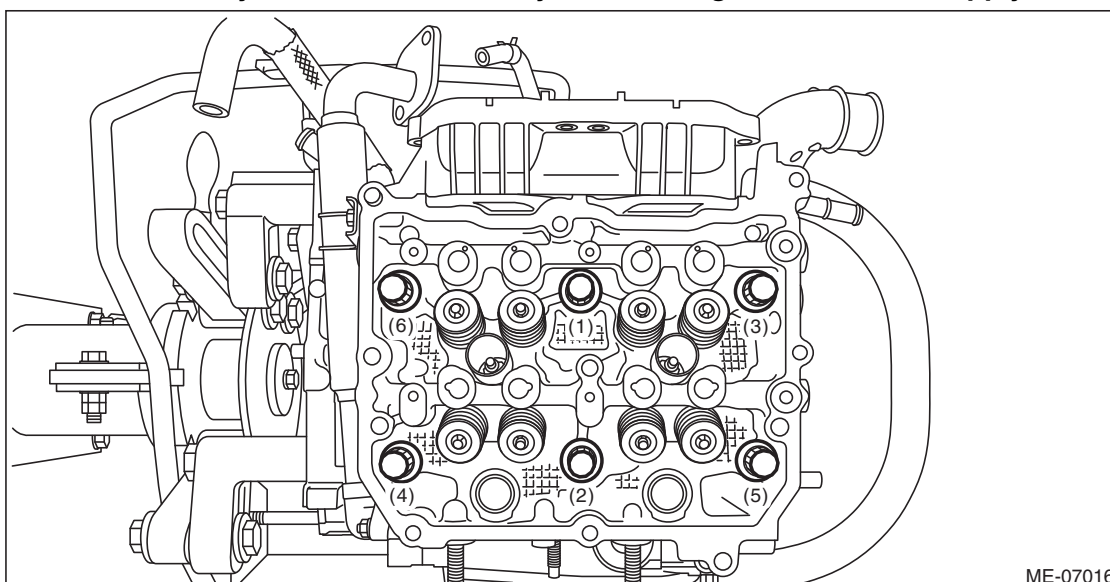
- (1) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolts threads.
- (2) Mount the cylinder head RH onto the cylinder block RH, and tighten all bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.



- (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:

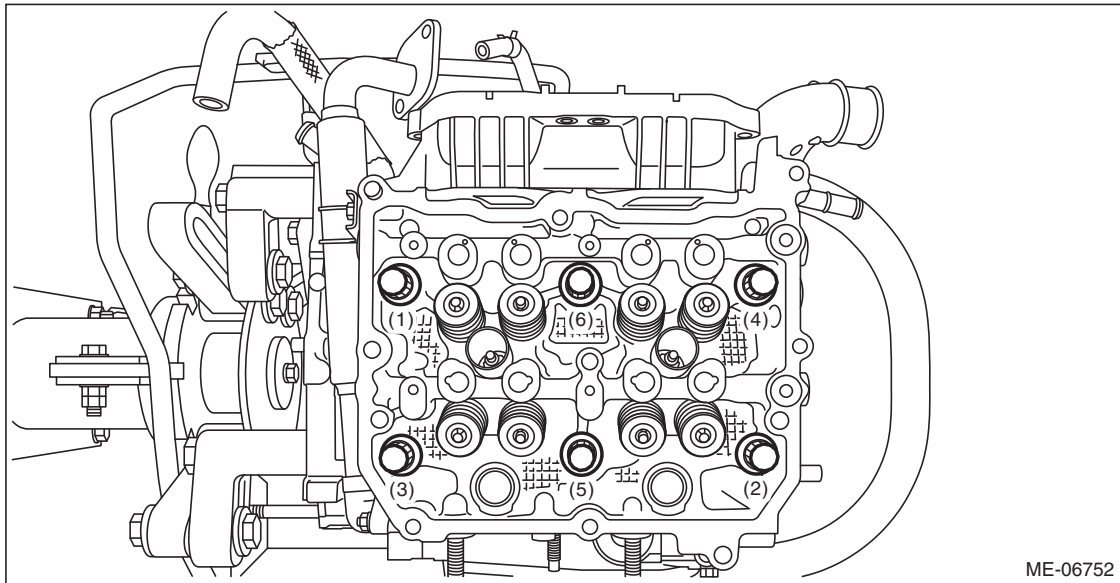
If the bolt makes stick-slip sound during tightening, repeat the procedure from step 1). In that case, the cylinder head gasket RH can be reused. But it is necessary to remove liquid gasket completely from cylinder block RH, cylinder head RH and cylinder head gasket RH and re-apply to them.



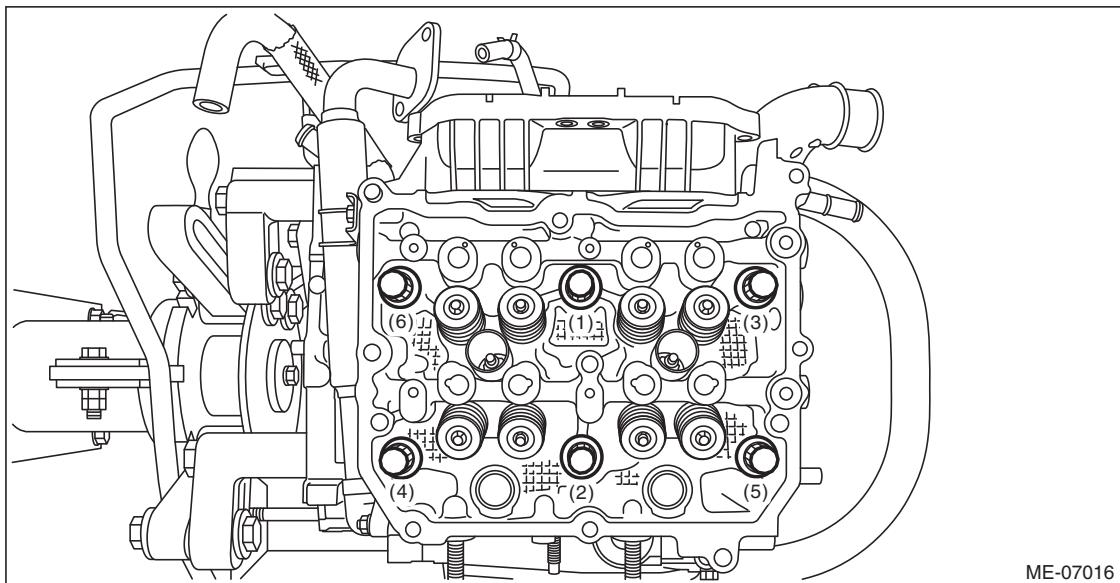
Cylinder Head

MECHANICAL

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



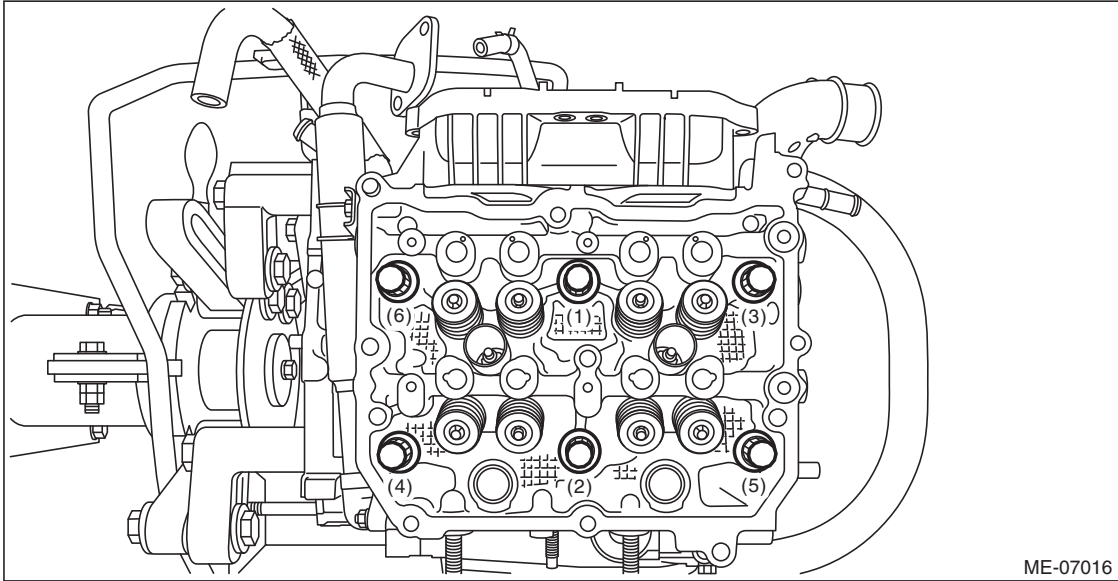
- (5) Tighten all bolts with torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical sequence as shown in the figure.



Cylinder Head

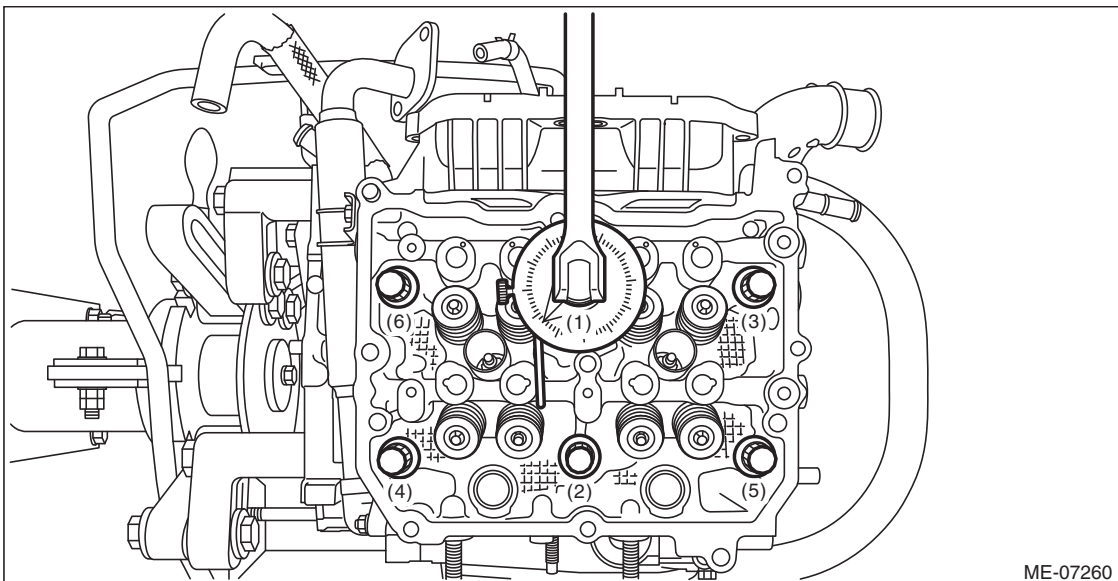
MECHANICAL

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



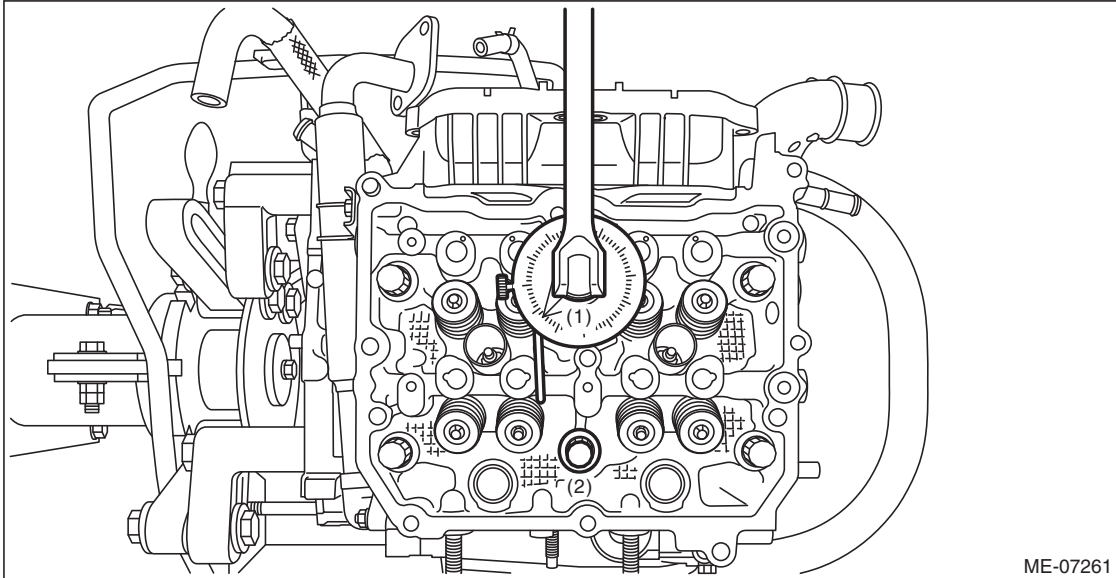
Cylinder Head

MECHANICAL

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

Tightening angle:

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



ME-07261

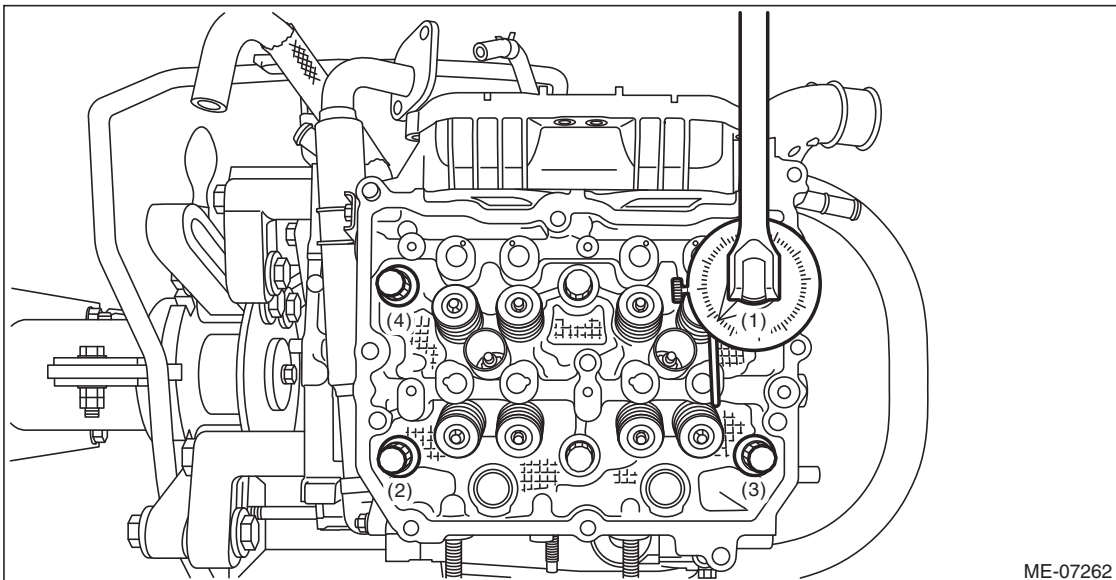
(9) Using angle gauge, tighten the cylinder head bolts (4 places) with specified angle in numerical order as shown in the figure.

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:

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



ME-07262

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.

Cylinder Head

MECHANICAL

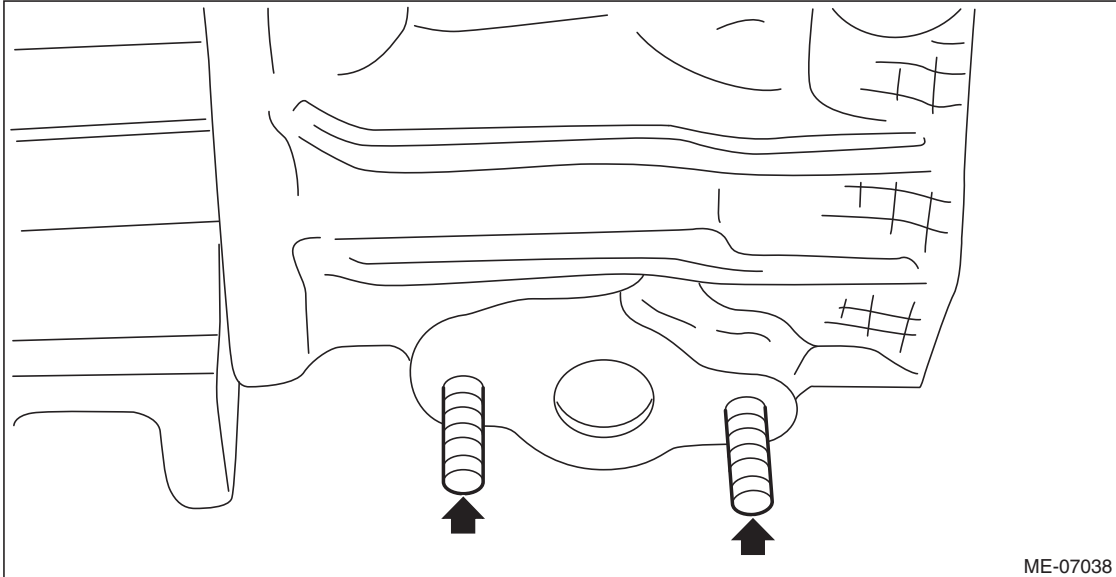
- (1) Install the stud bolts to the cylinder head RH.

NOTE:

Use a new stud bolt.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

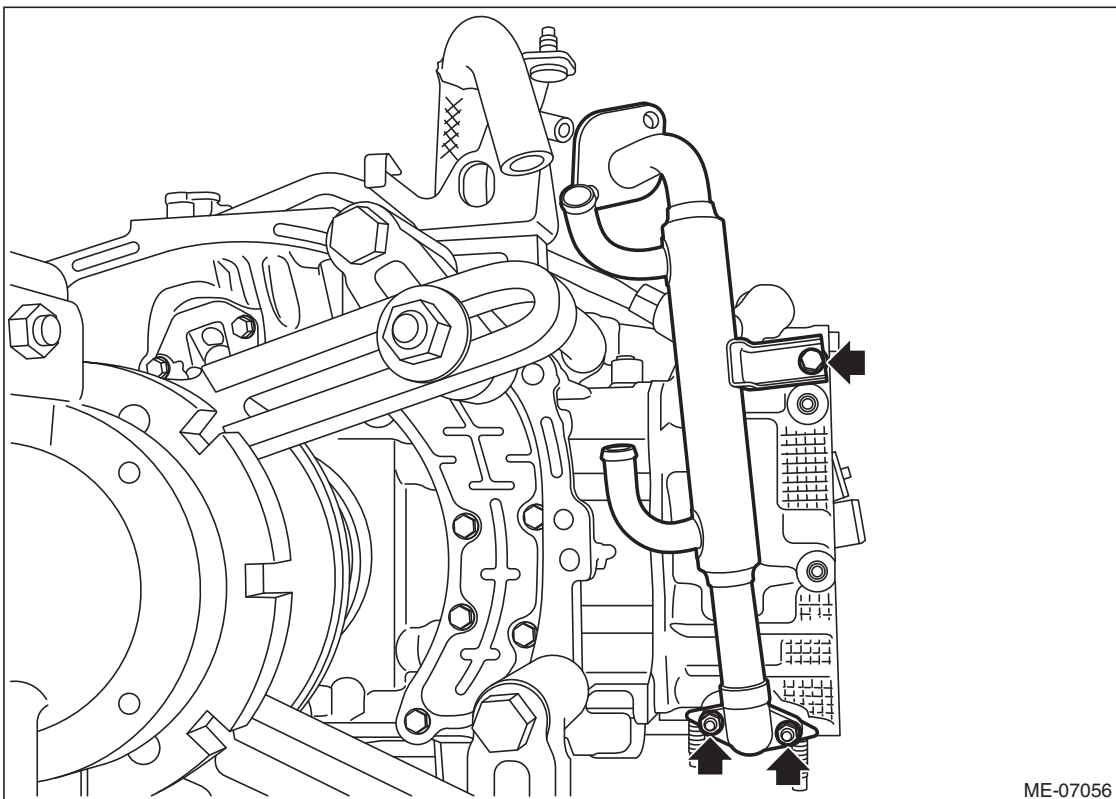


- (2) Install the EGR cooler to the cylinder head RH.

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(H4DOTC)-225

Cylinder Head

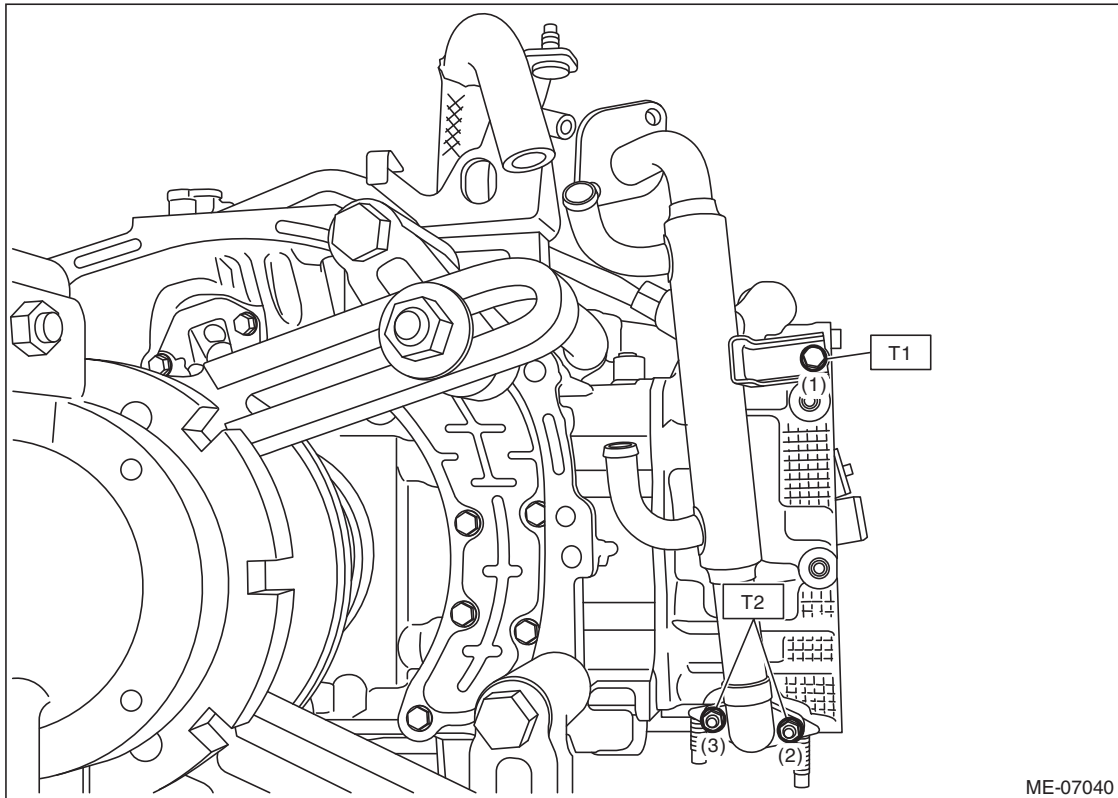
MECHANICAL

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)



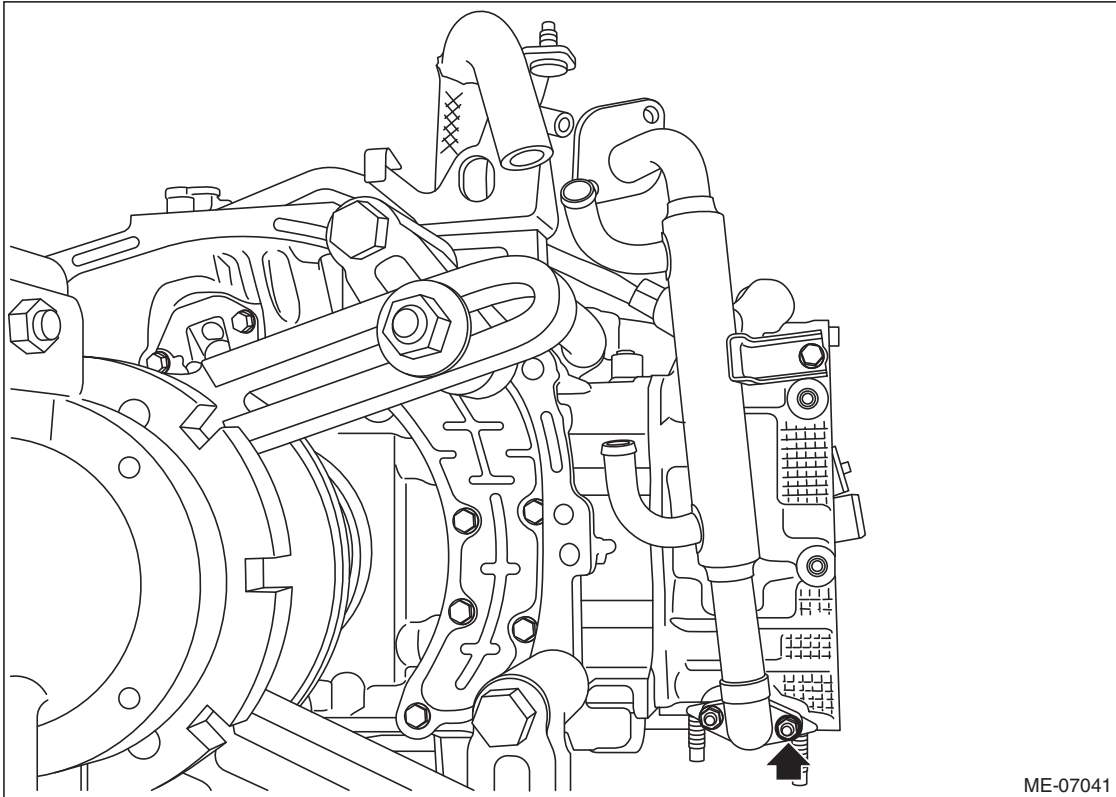
Cylinder Head

MECHANICAL

3. Retighten the nut shown in the figure.

Tightening torque:

9 N·m (0.9 kgf-m, 6.6 ft-lb)



ME-07041

(3) Install the fuel injector RH. <Ref. to FU(H4DOTC)-59, FUEL INJECTOR RH, INSTALLATION, Fuel Injector.>

(4) Install the tumble generator valve assembly RH. <Ref. to FU(H4DOTC)-44, INSTALLATION, Tumble Generator Valve Assembly.>

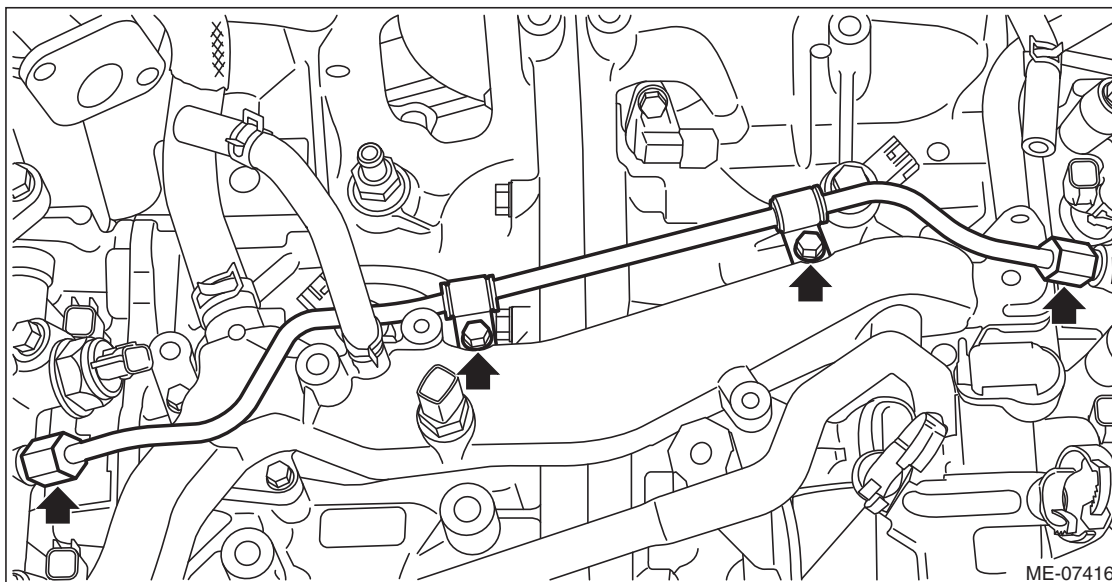
Cylinder Head

MECHANICAL

- 8) Install the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe.
(1) Set the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe, and temporarily tighten the bolt and flare nut which secure the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe.

NOTE:

Use a new high-pressure fuel delivery pipe assembly.

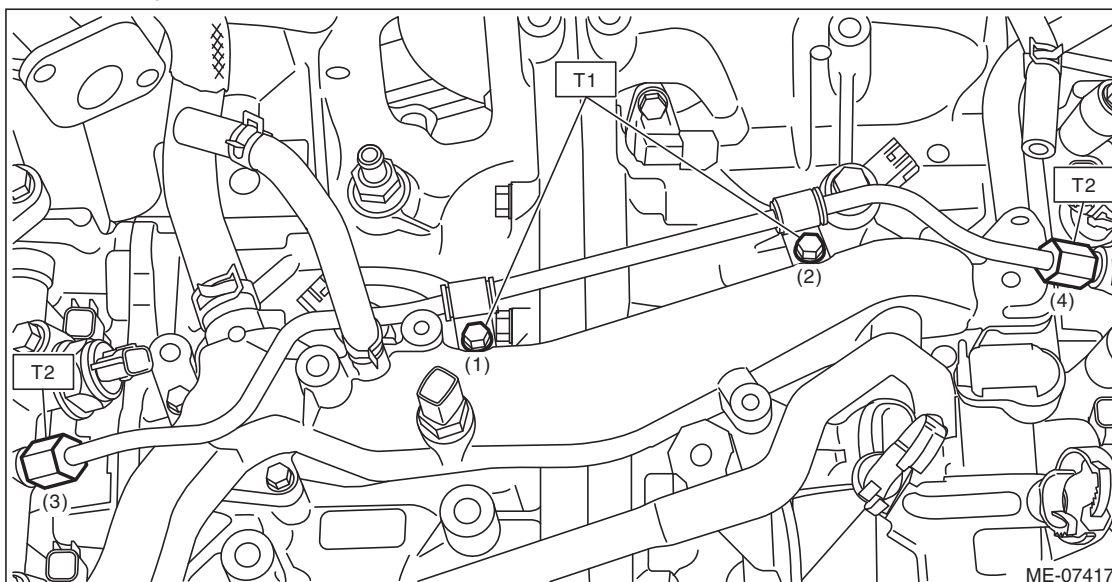


- (2) Tighten the bolts and flare nuts which secure the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe in numerical order as shown in the figure.

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)



- 9) Install the cam carrier RH. <Ref. to ME(H4DOTC)-180, CAM CARRIER RH, INSTALLATION, Cam Carrier.>
10) Install the rocker cover RH. <Ref. to ME(H4DOTC)-159, ROCKER COVER RH, INSTALLATION, Rocker Cover.>
11) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>
12) Install the engine wiring harness. <Ref. to FU(H4DOTC)-90, INSTALLATION, Engine Wiring Harness.>

Cylinder Head

MECHANICAL

- 13) Install the intake manifold. <Ref. to FU(H4DOTC)-29, INSTALLATION, Intake Manifold.>
14) Install the engine to the vehicle. <Ref. to ME(H4DOTC)-59, 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:

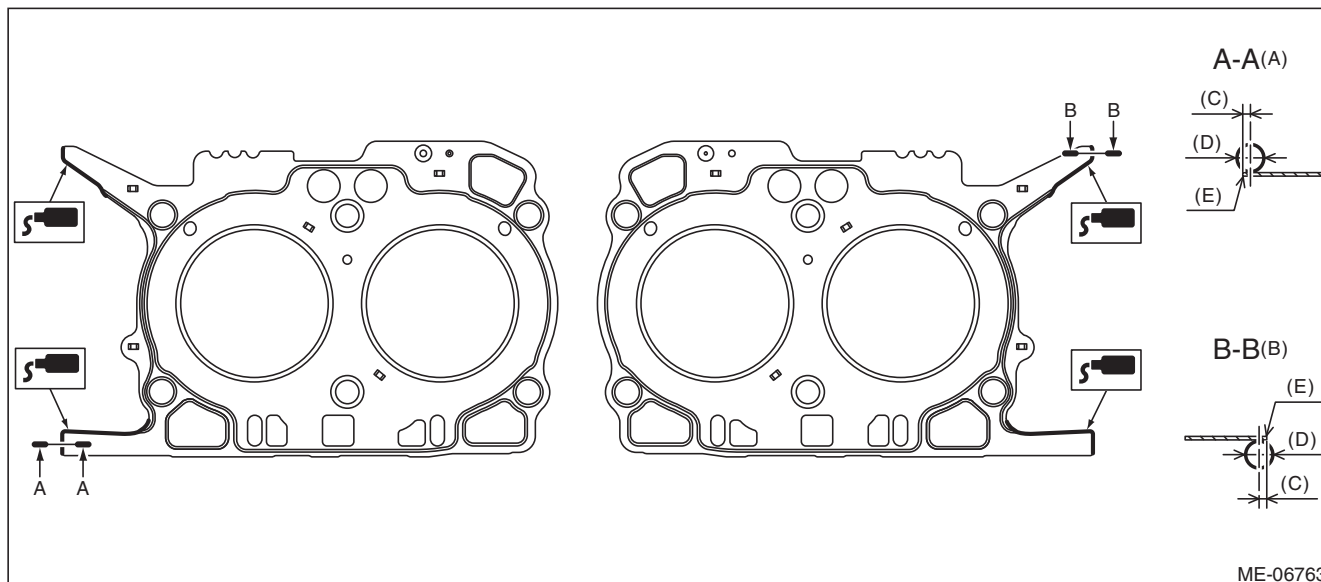
- Use a new cylinder head gasket LH.
- Before applying liquid gasket, degrease the mating surface of cylinder blocks LH and cylinder head LH.
- Install within 5 min. after applying liquid gasket.

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

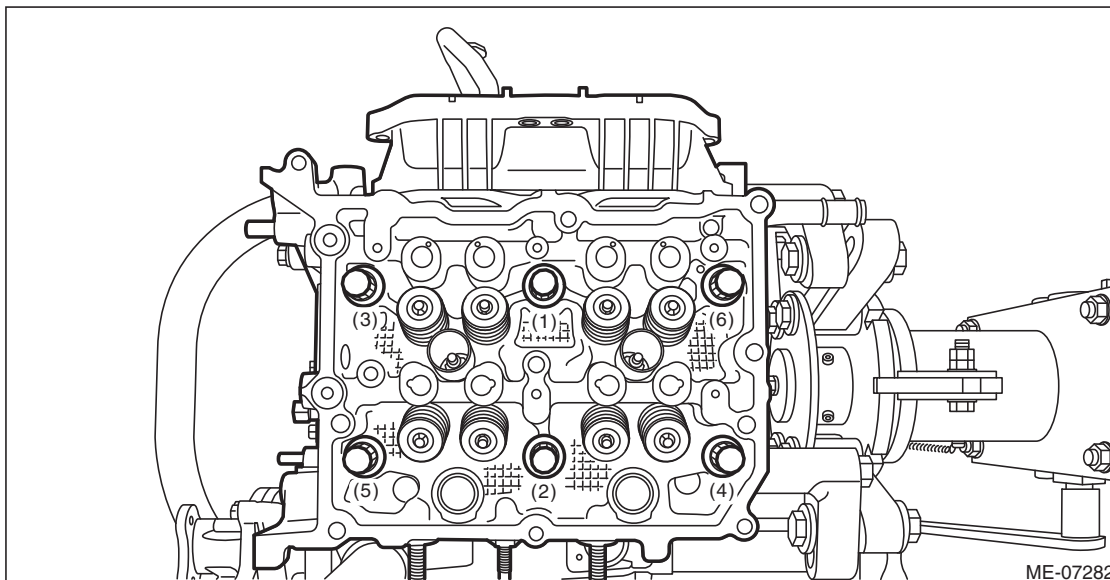
5) Install the cylinder head LH to the cylinder block LH.

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.

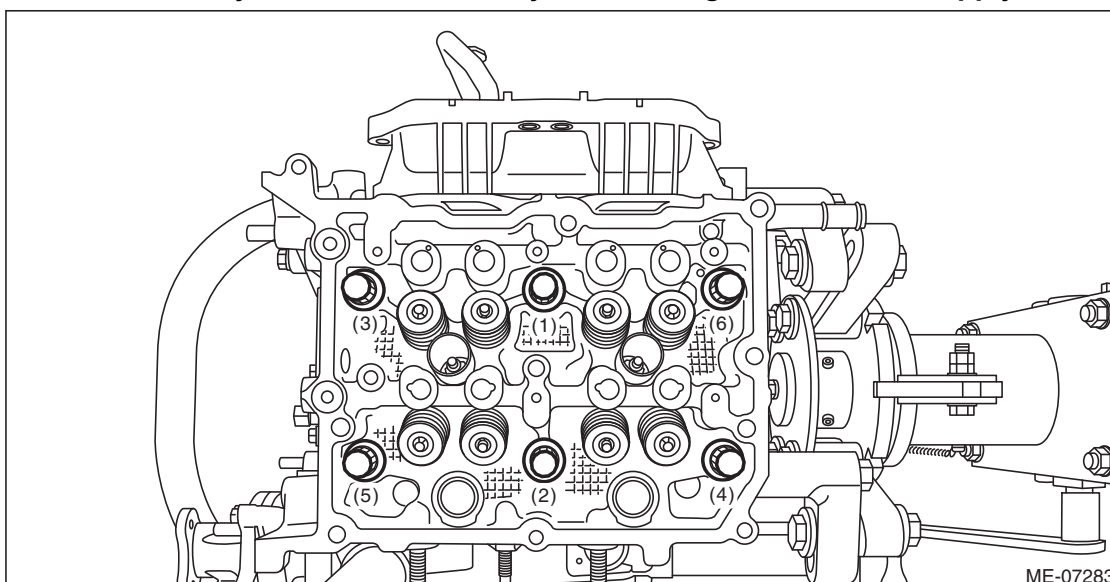
(2) Set the cylinder head LH to the cylinder block LH, then tighten all bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.



(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:

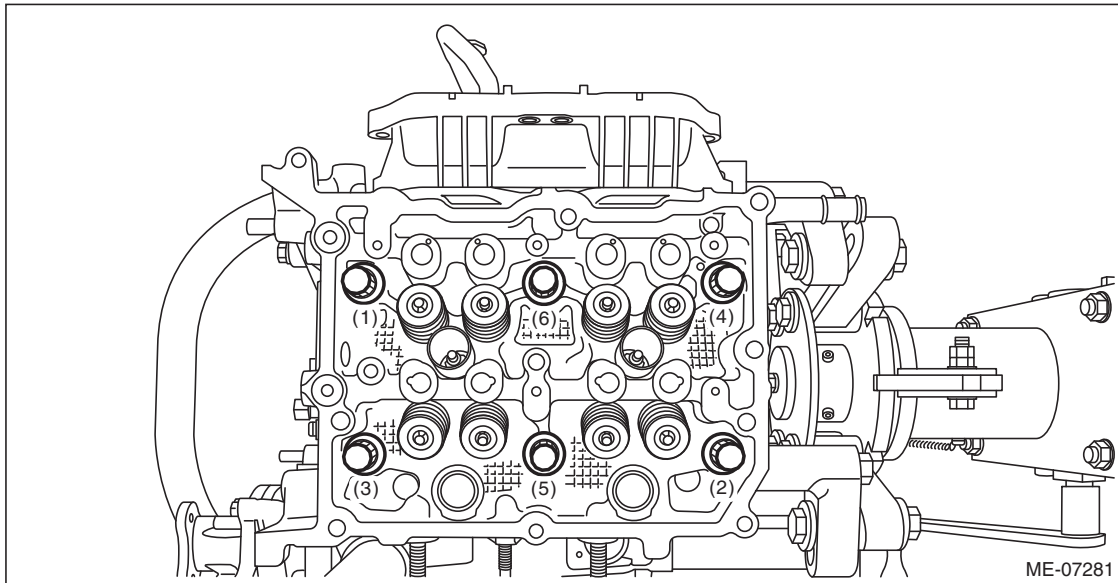
If the bolt makes stick-slip sound during tightening, repeat the procedure from step 1). In that case, the cylinder head gasket LH can be reused. But it is necessary to remove liquid gasket completely from cylinder block LH, cylinder head LH and cylinder head gasket LH and re-apply to them.



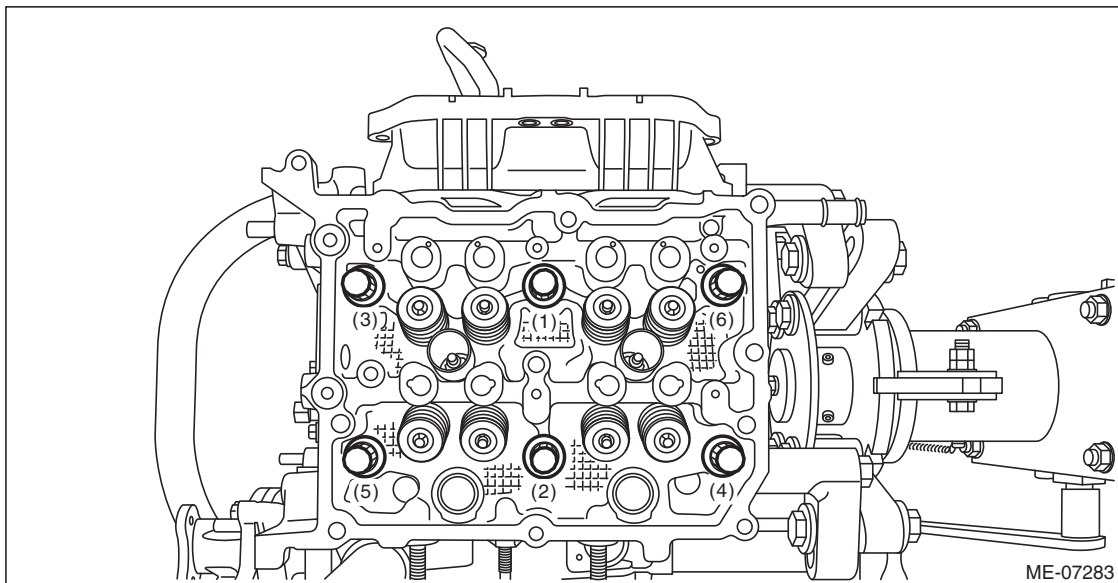
Cylinder Head

MECHANICAL

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



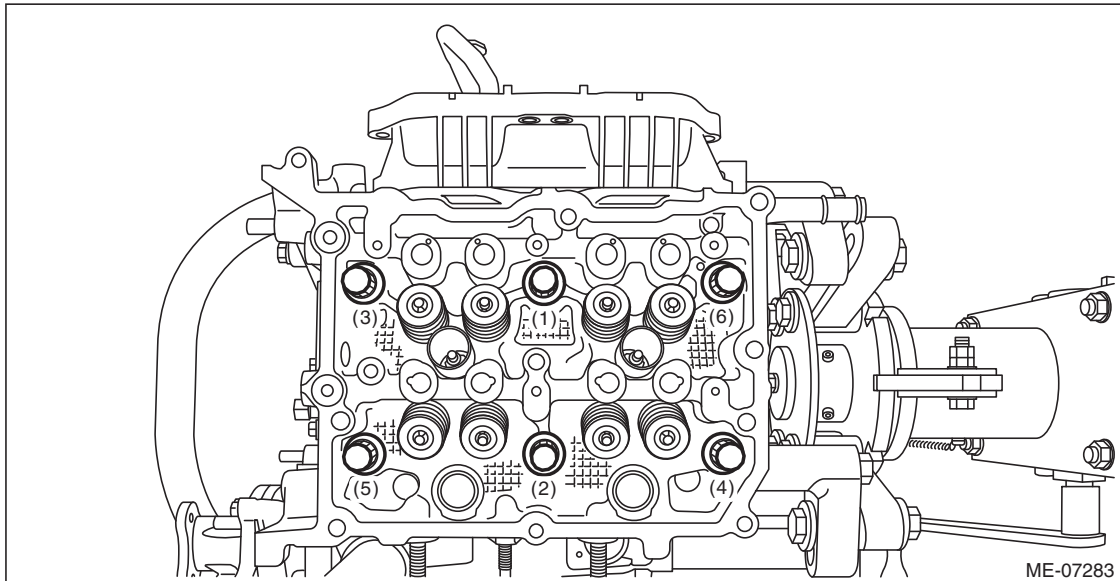
- (5) Tighten all bolts with torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical sequence as shown in the figure.



Cylinder Head

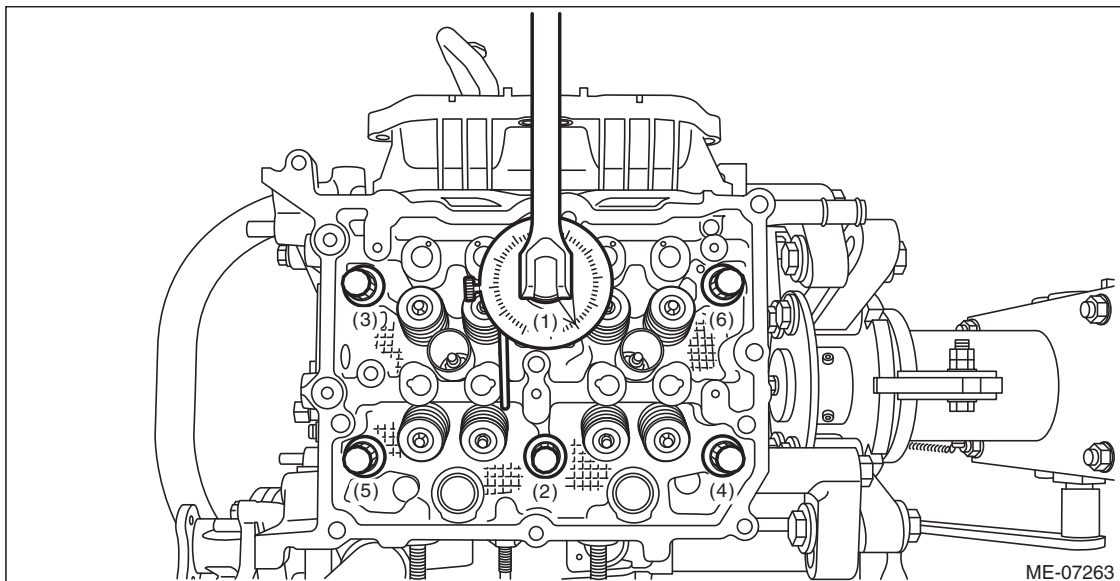
MECHANICAL

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



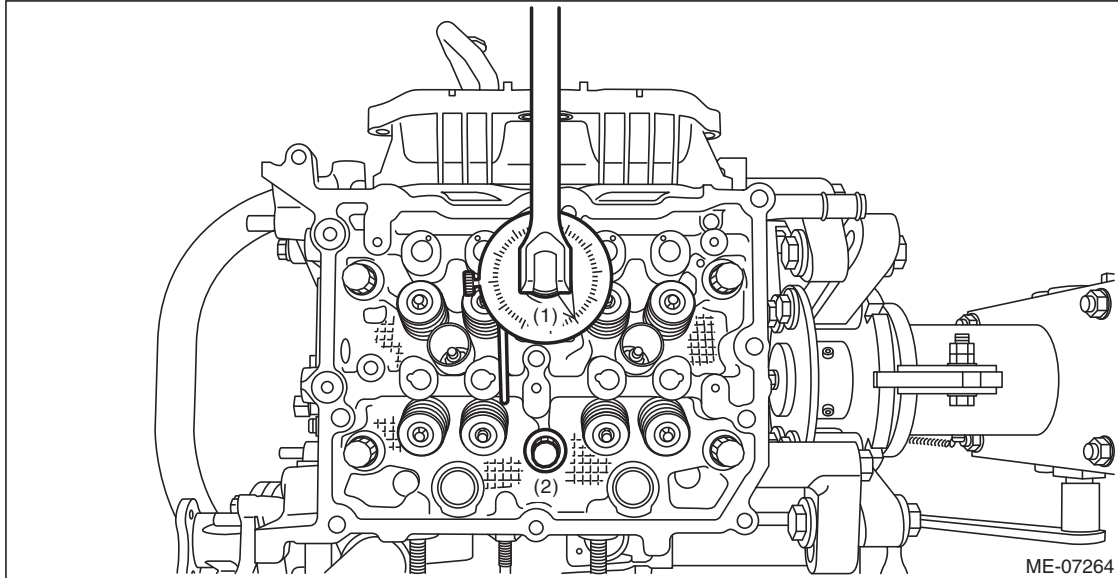
Cylinder Head

MECHANICAL

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

Tightening angle:

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



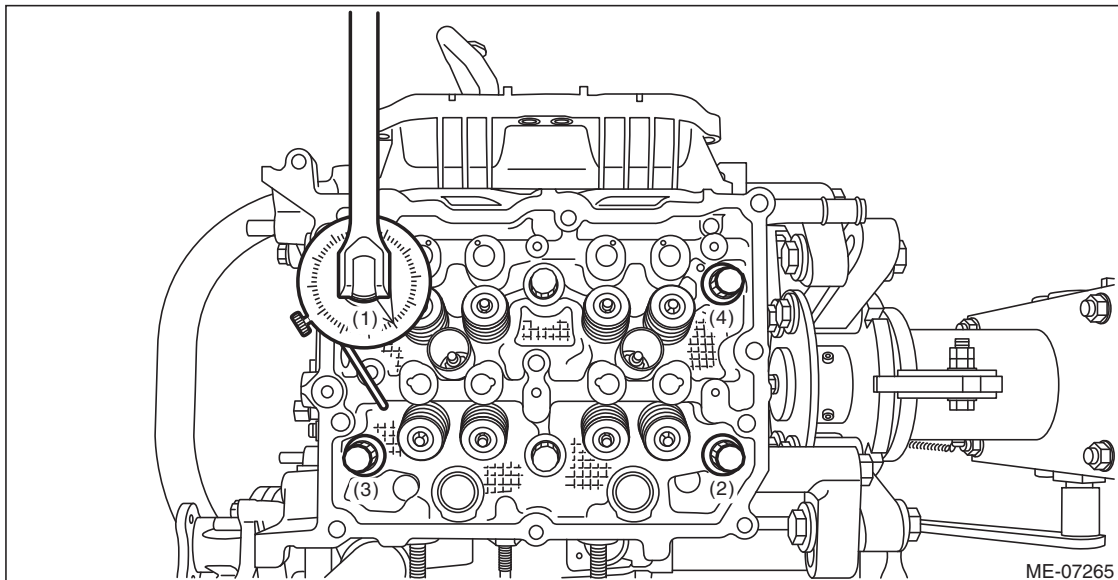
(9) Using angle gauge, tighten the cylinder head bolts (4 places) with specified angle in numerical order as shown in the figure.

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

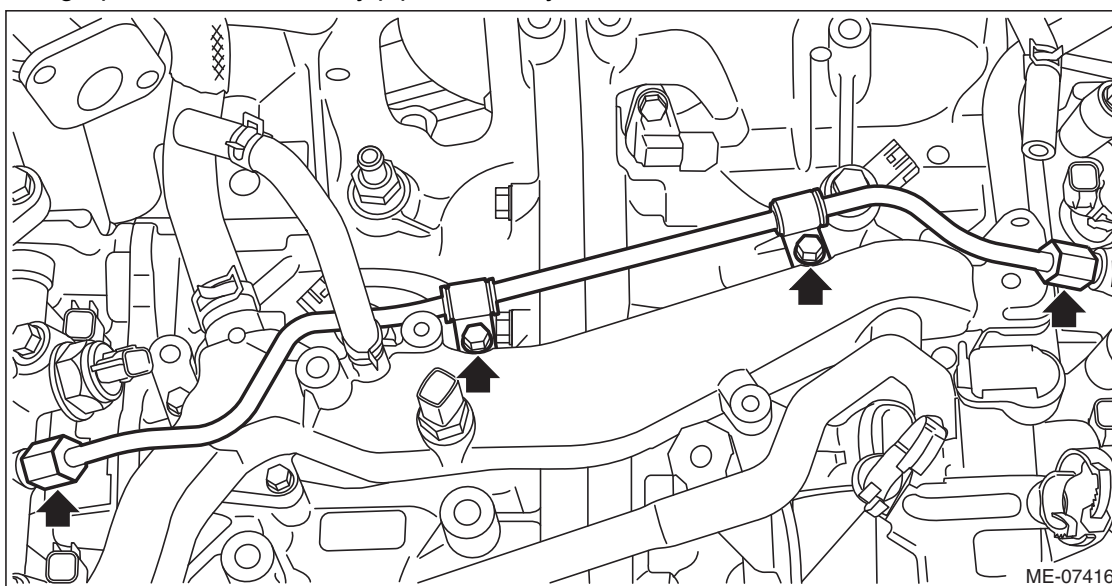
NOTE:

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

- (1) Install the fuel injector LH. <Ref. to FU(H4DOTC)-61, FUEL INJECTOR LH, INSTALLATION, Fuel Injector.>
- (2) Install the tumble generator valve assembly LH. <Ref. to FU(H4DOTC)-44, INSTALLATION, Tumble Generator Valve Assembly.>
- 8) Install the A/C compressor. <Ref. to ME(H4DOTC)-189, CAM CARRIER LH, INSTALLATION, Cam Carrier.>
- 9) Install the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe.
 - (1) Set the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe, and temporarily tighten the bolt and flare nut which secure the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe.

NOTE:

Use a new high-pressure fuel delivery pipe assembly.



Cylinder Head

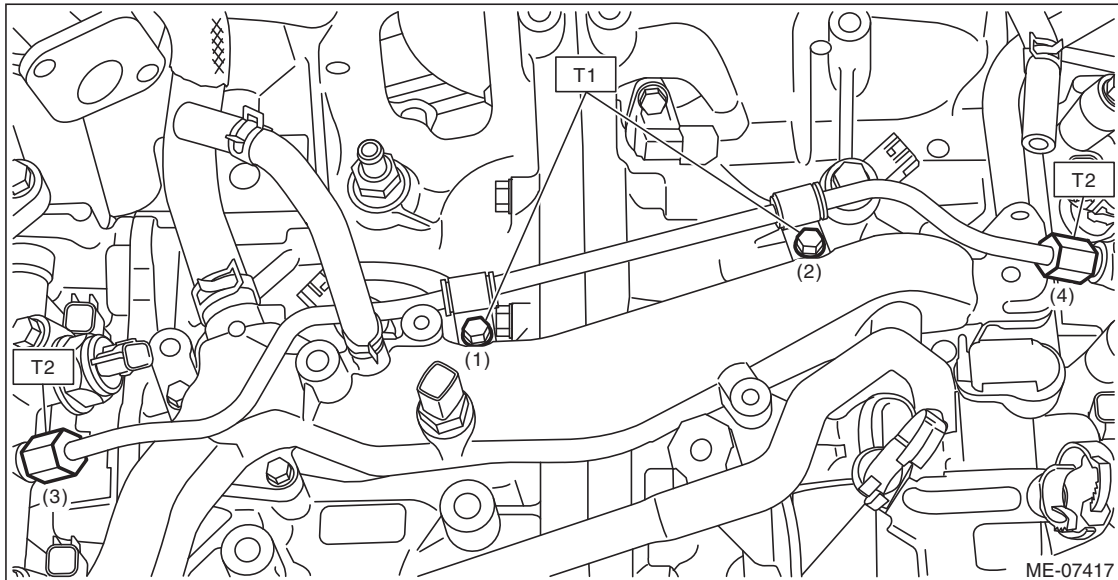
MECHANICAL

(2) Tighten the bolts and flare nuts which secure the high-pressure fuel delivery pipe assembly to the water pipe assembly and fuel injector pipe in numerical order as shown in the figure.

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)



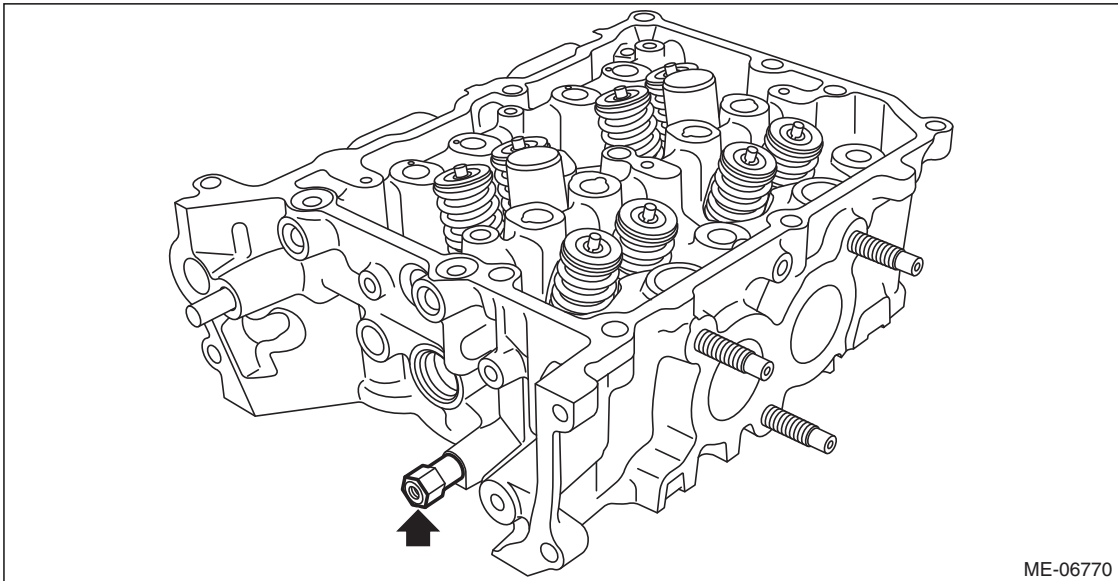
- 10) Install the cam carrier LH. <Ref. to ME(H4DOTC)-189, CAM CARRIER LH, INSTALLATION, Cam Carrier.>
- 11) Install the rocker cover LH. <Ref. to ME(H4DOTC)-161, ROCKER COVER LH, INSTALLATION, Rocker Cover.>
- 12) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>
- 13) Install the engine wiring harness. <Ref. to FU(H4DOTC)-90, INSTALLATION, Engine Wiring Harness.>
- 14) Install the intake manifold. <Ref. to FU(H4DOTC)-29, INSTALLATION, Intake Manifold.>
- 15) Install the engine to the vehicle. <Ref. to ME(H4DOTC)-59, INSTALLATION, Engine Assembly.>

Cylinder Head

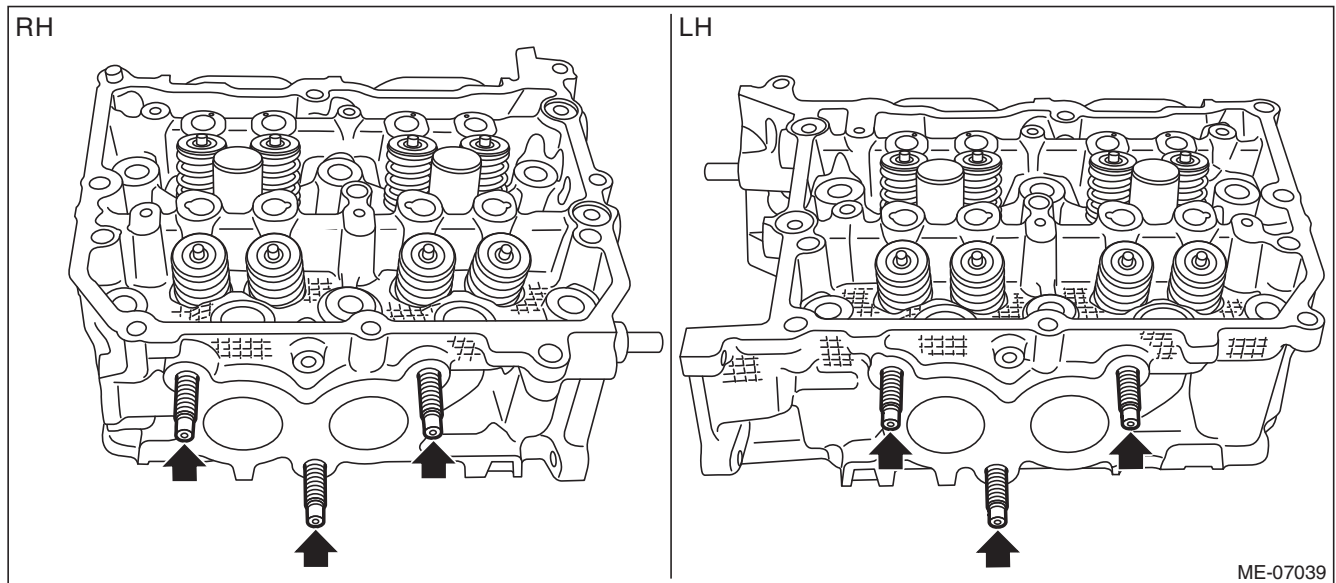
MECHANICAL

C: DISASSEMBLY

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



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



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:

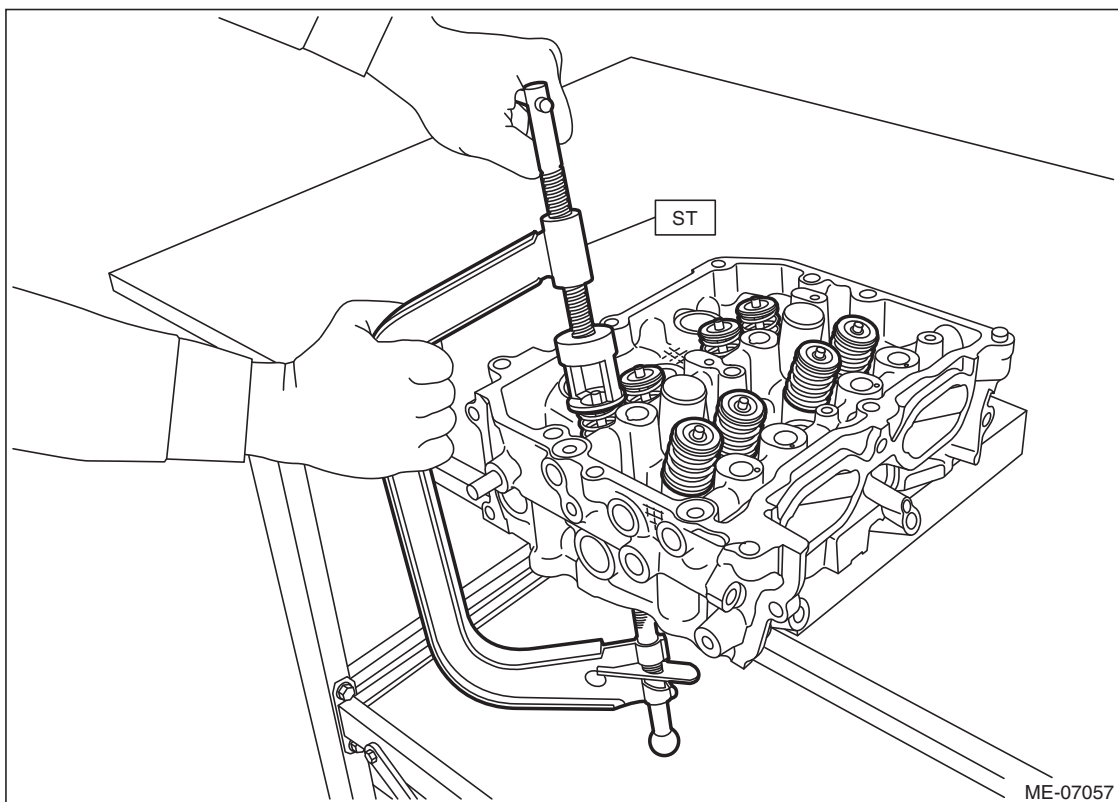
During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.

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



(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.

Cylinder Head

MECHANICAL

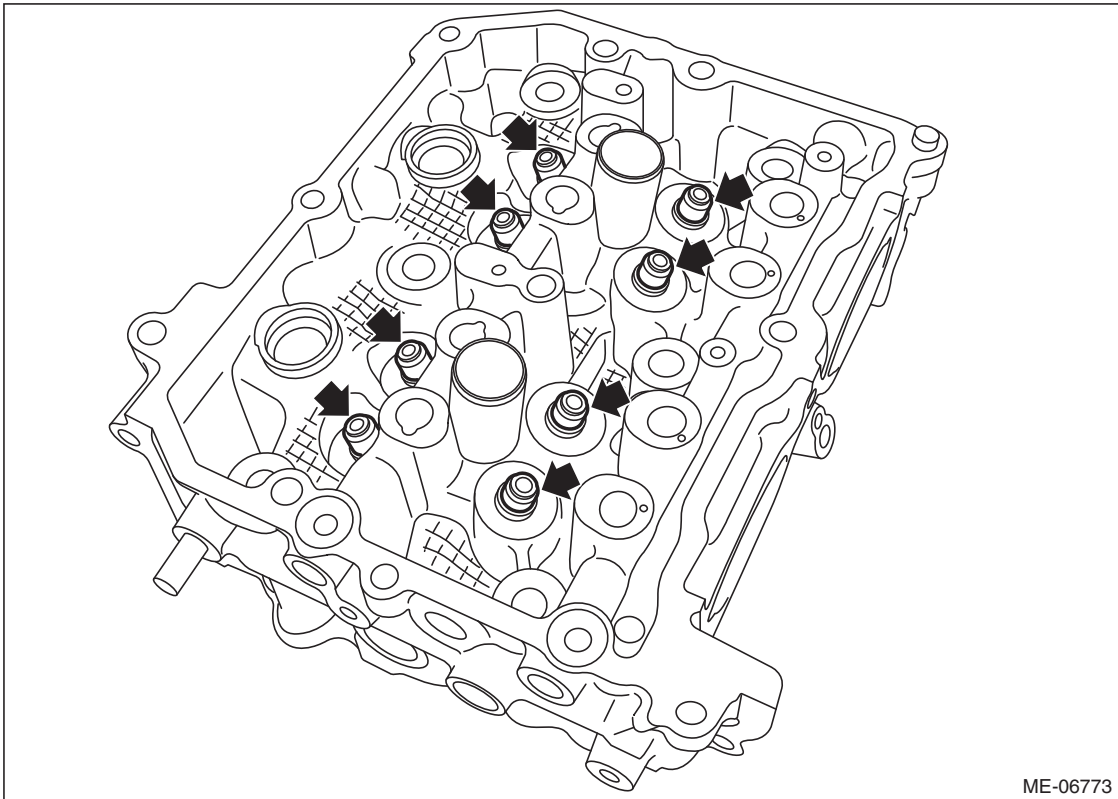
5) Remove the valve oil seals from valve guides of cylinder head RH.

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)-244, VALVE & VALVE GUIDE, INSPECTION, Cylinder Head.>

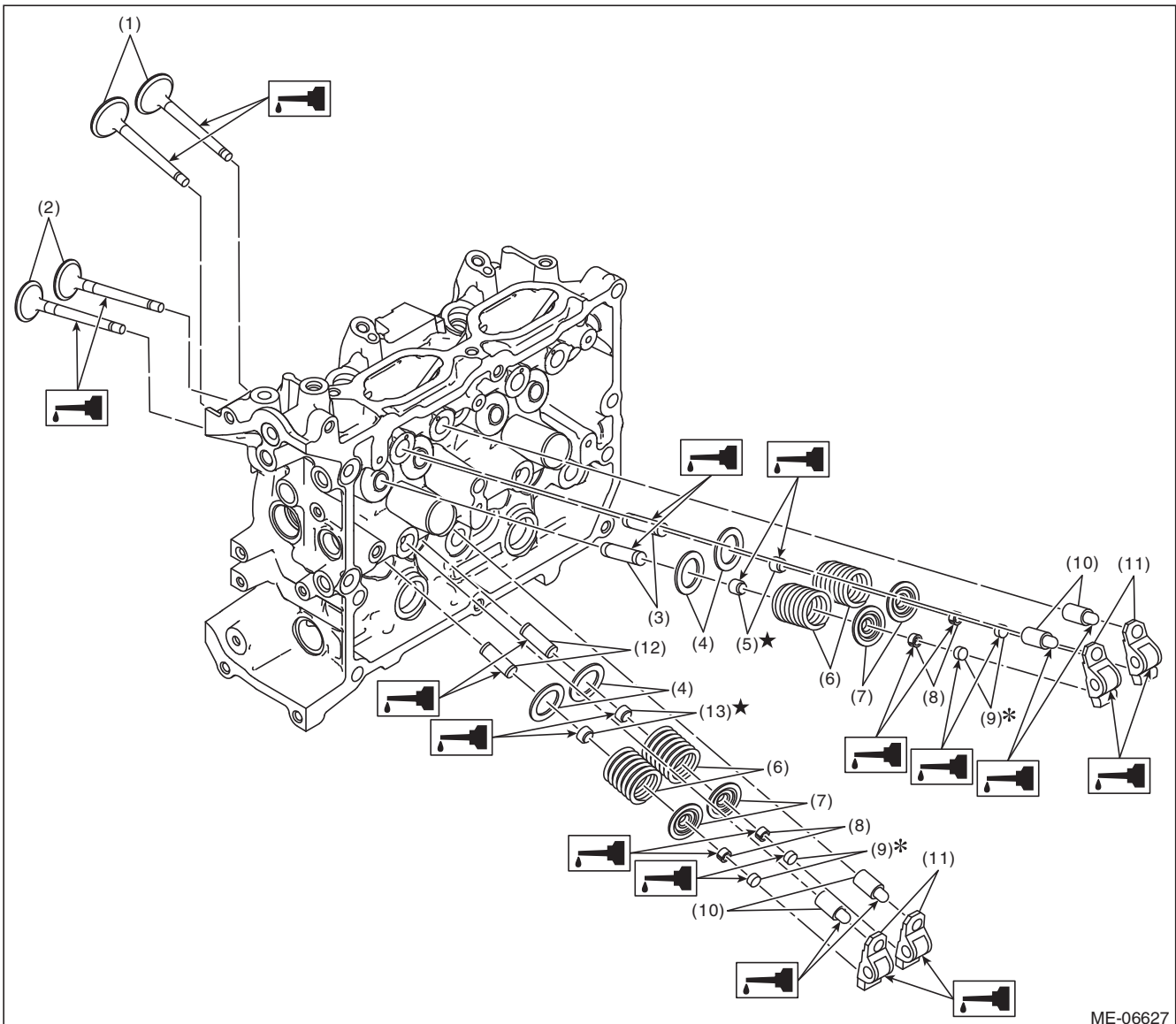


6) For cylinder head LH, remove the valve oil seal in the same manner.

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 | |

Cylinder Head

MECHANICAL

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.

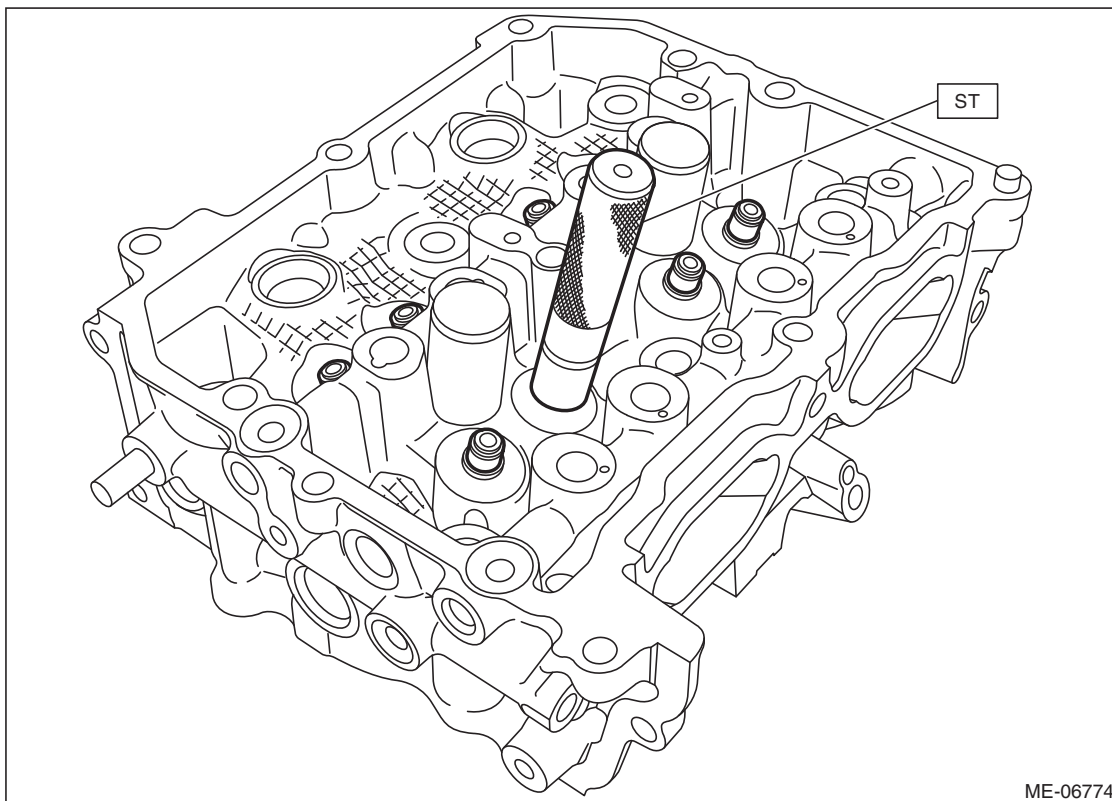
Identification colors:

Intake [Gray]

Exhaust [Green]

- For installation of valve guide, refer to INSPECTION. <Ref. to ME(H4DOTC)-244, VALVE & VALVE GUIDE, INSPECTION, Cylinder Head.>

ST 18261AA010 VALVE OIL SEAL GUIDE



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:

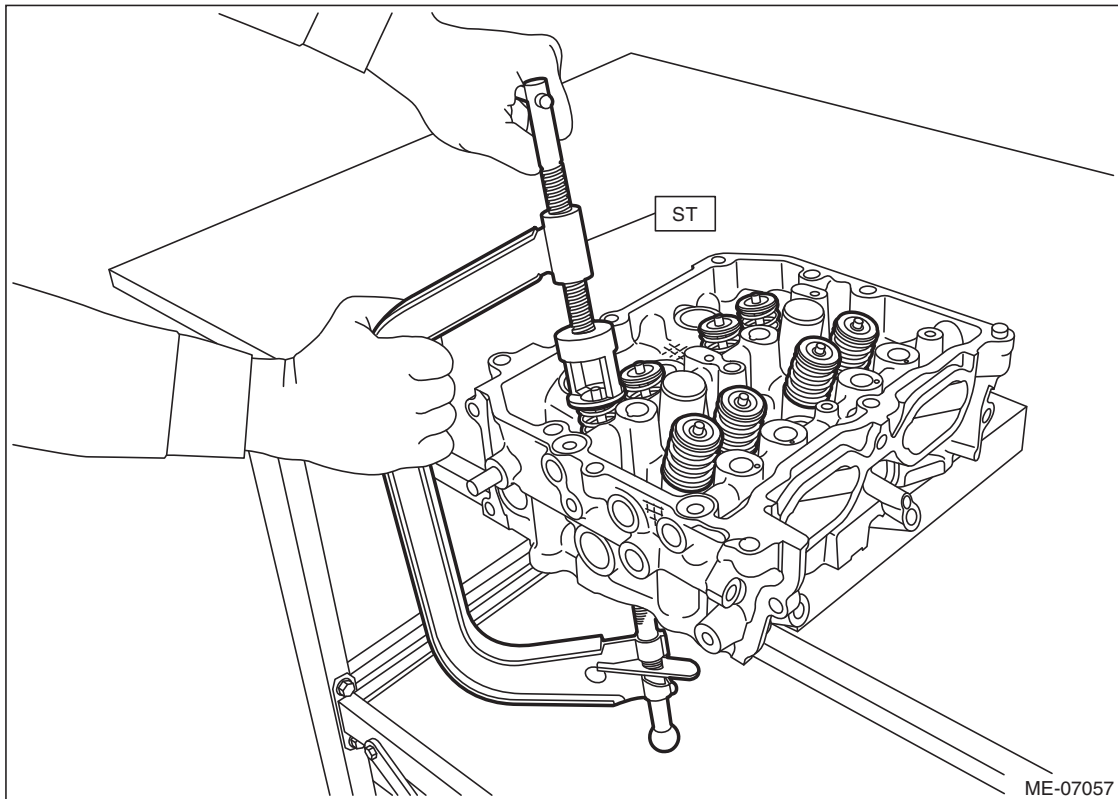
When inserting the valve into valve guide, use special care not to damage the oil seal lip.

ME(H4DOTC)-240

Cylinder Head

MECHANICAL

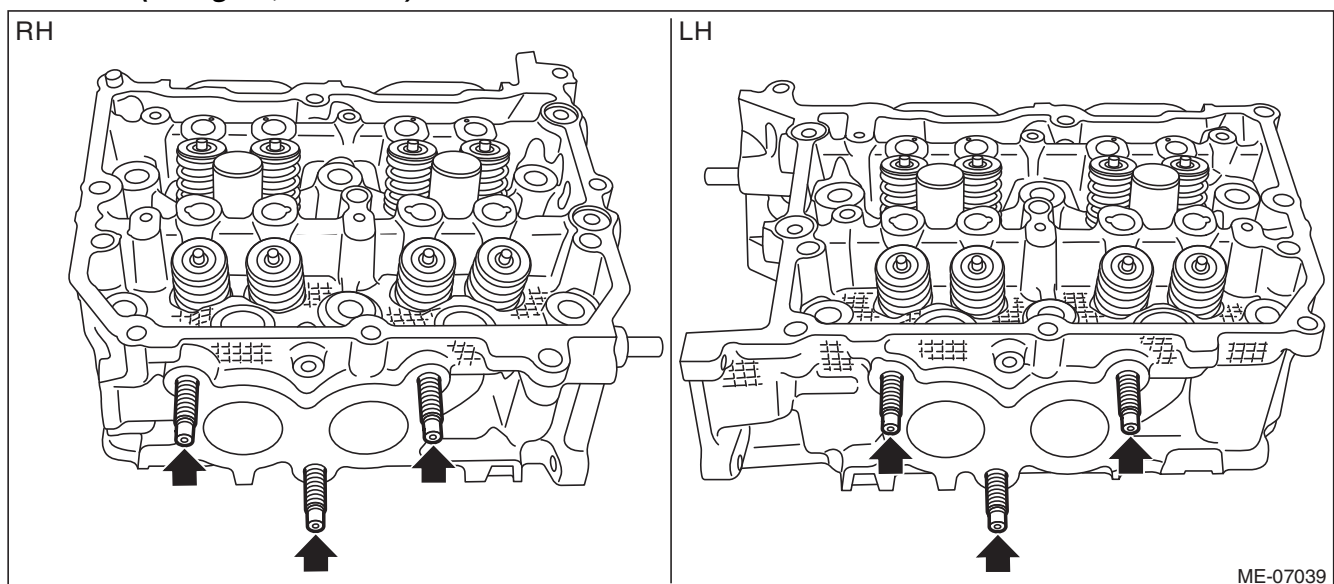
- (3) Compress the valve spring and install the valve collet using ST.
ST 0920287002000 REMOVER AND REPLACER



- 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)



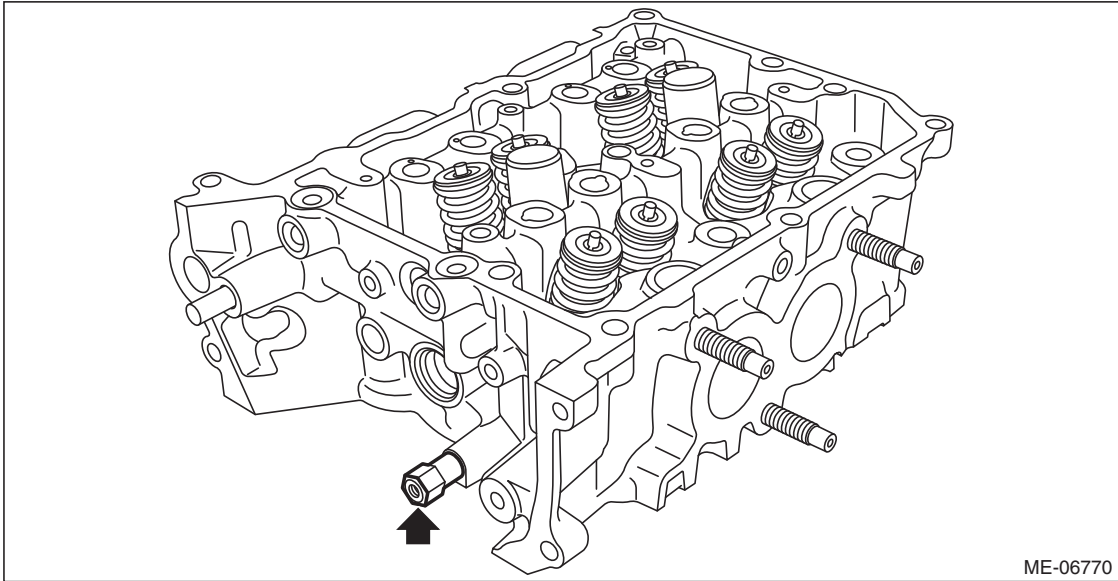
Cylinder Head

MECHANICAL

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 warping 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 height:

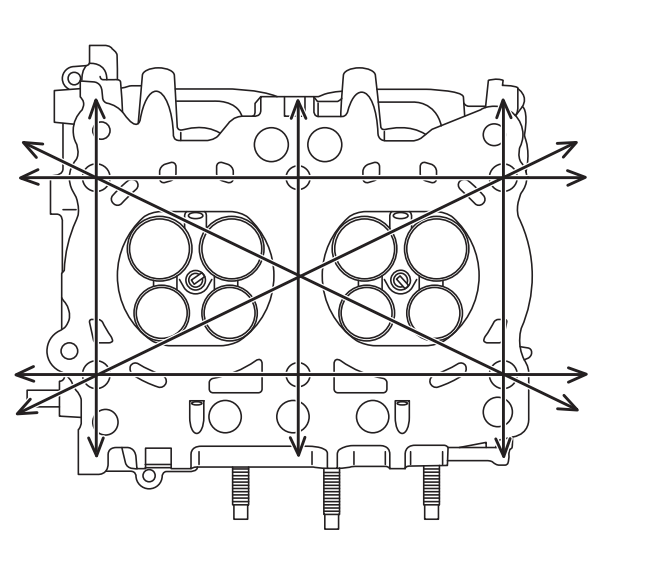
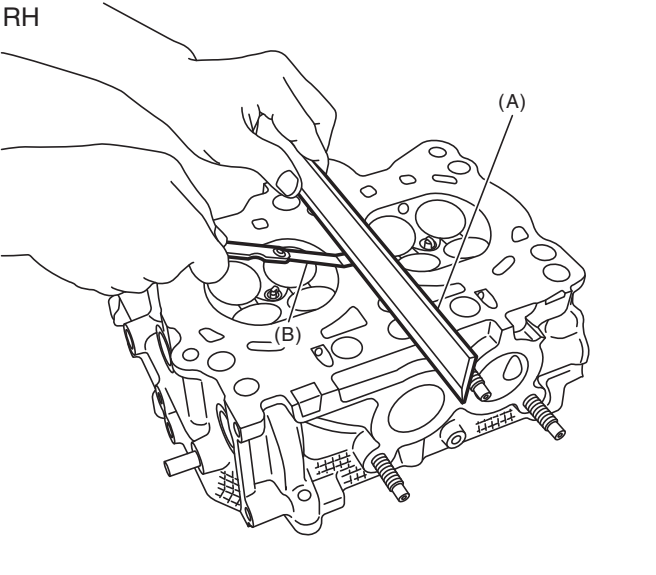
Standard

98.5 mm (3.878 in)

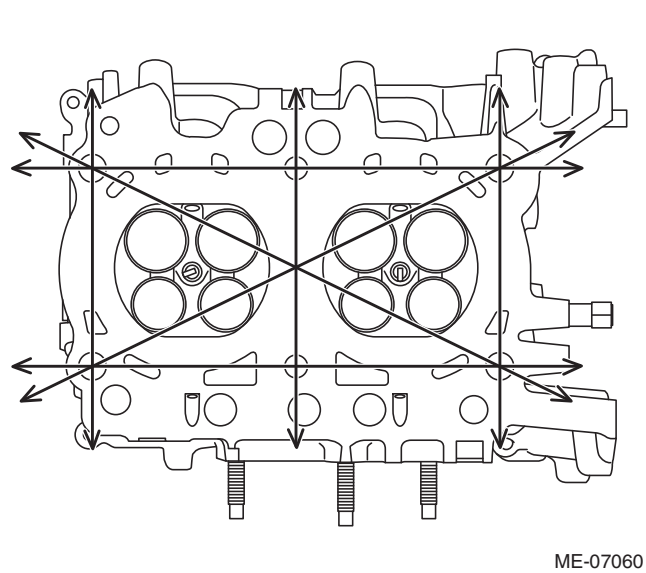
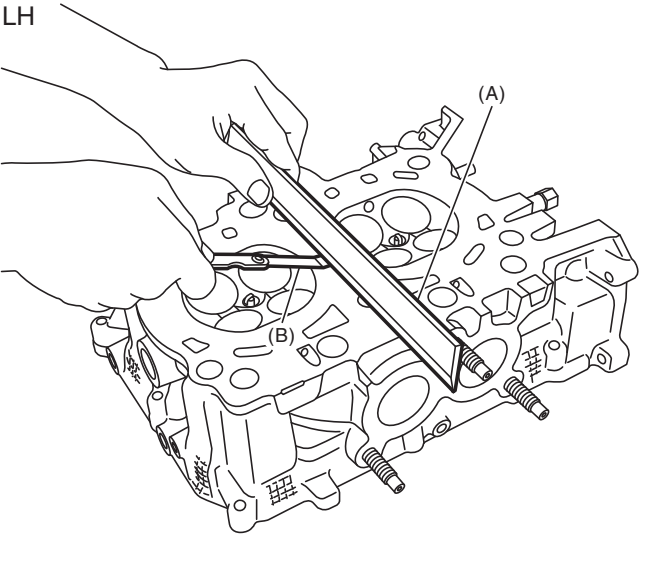
Cylinder Head

MECHANICAL

RH



LH



ME-07060

Cylinder Head

MECHANICAL

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

103.3 mm (4.067 in)

Exhaust

95.45 mm (3.758 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)

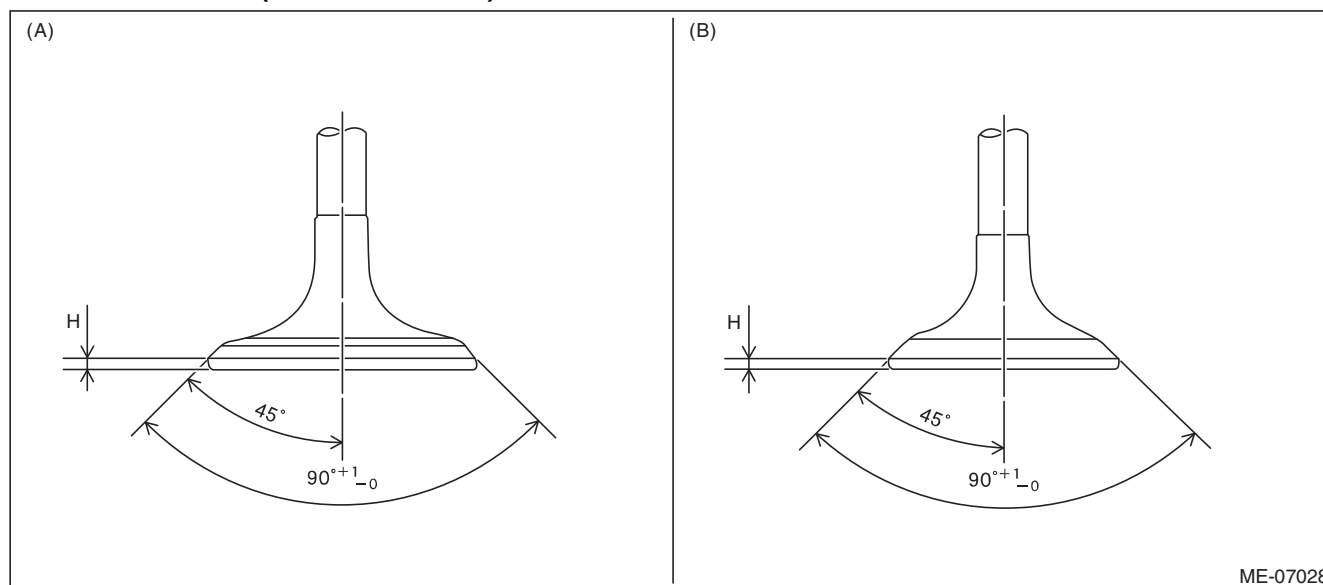
Standard

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

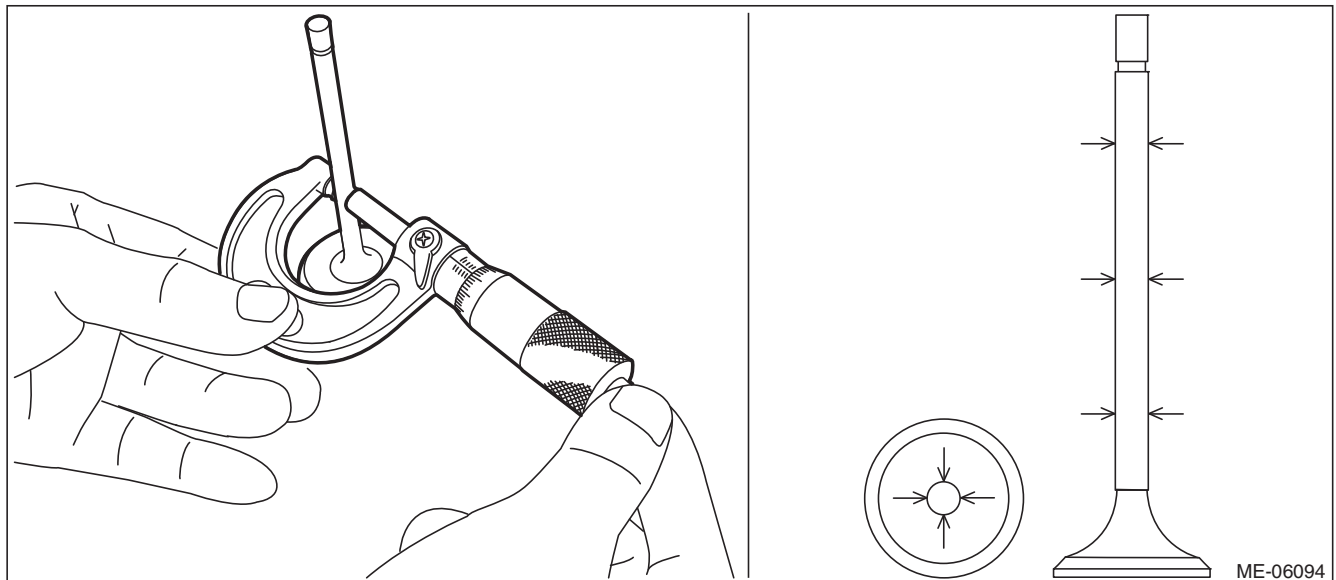
Standard

5.455 — 5.470 mm (0.2148 — 0.2154 in)

Exhaust

Standard

5.445 — 5.460 mm (0.2144 — 0.2150 in)



Cylinder Head

MECHANICAL

(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).

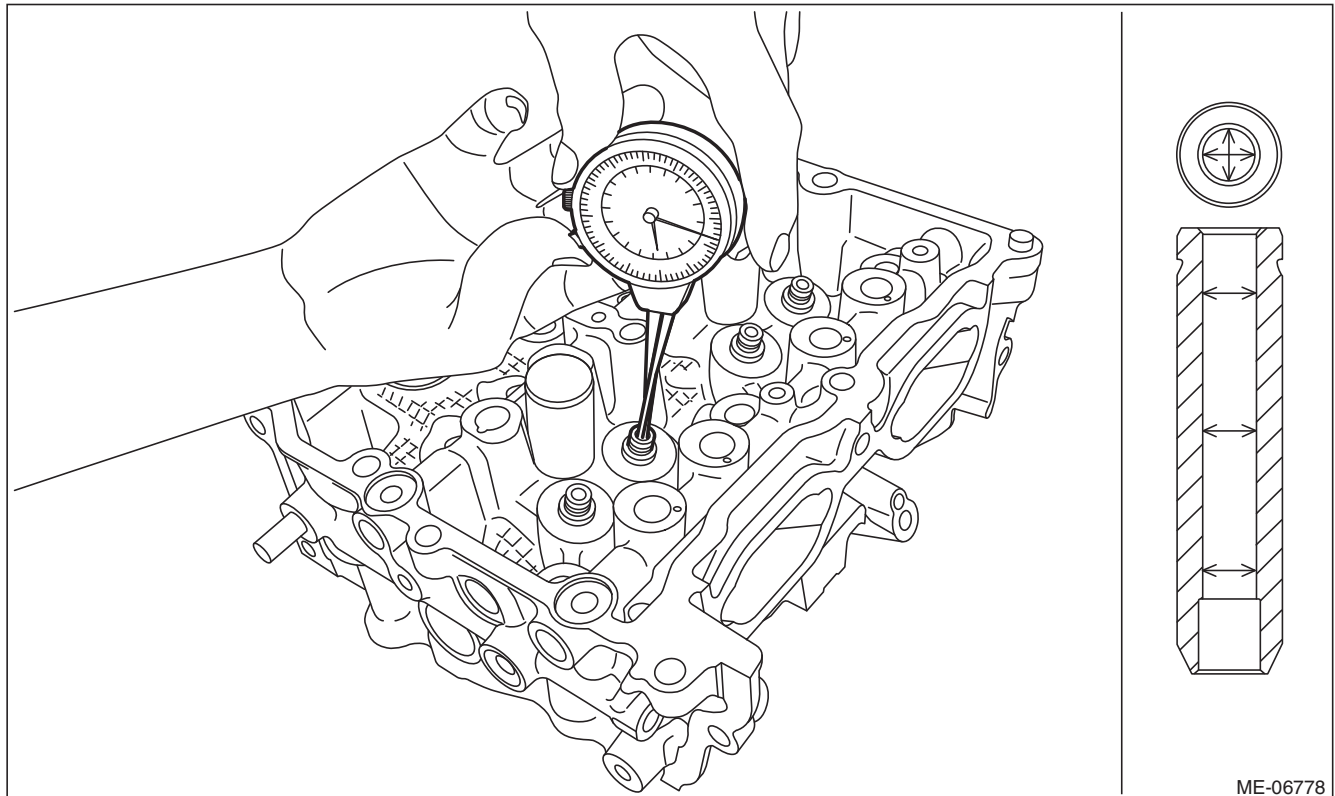
NOTE:

- 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)



(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:

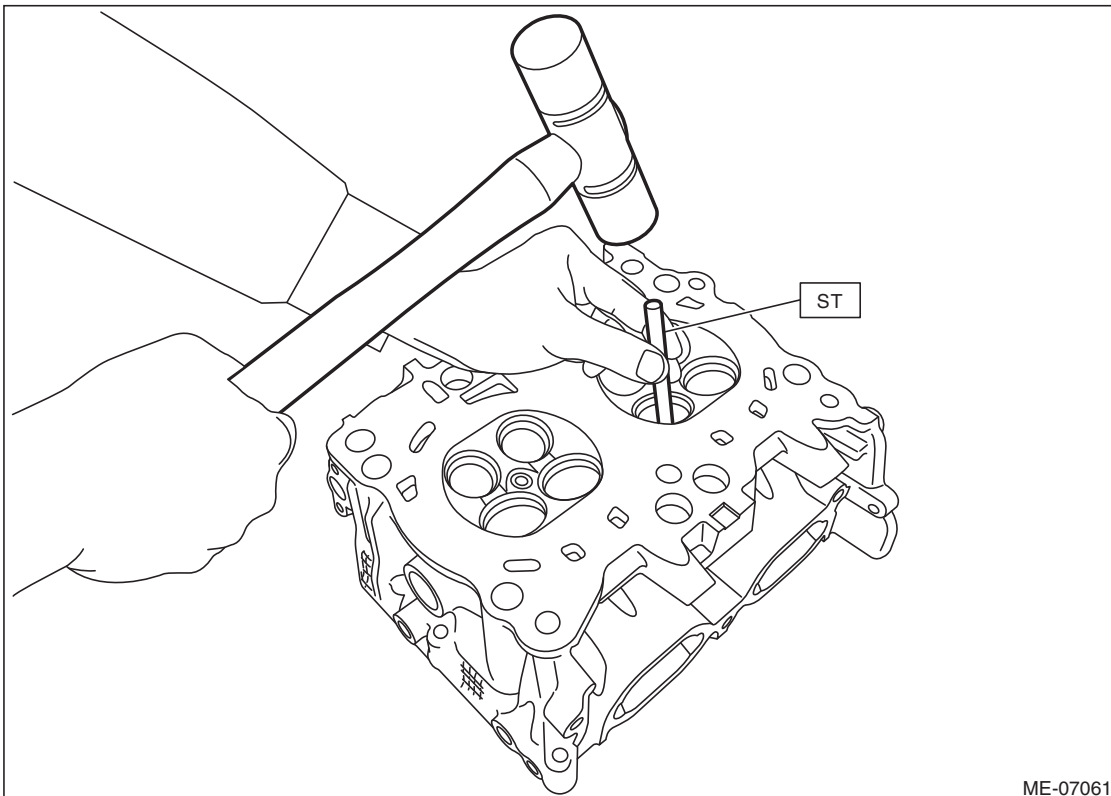
When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping. <Ref. to ME(H4DOTC)-255, VALVE SEAT, INSPECTION, Cylinder Head.>

(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



(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.

Cylinder Head

MECHANICAL

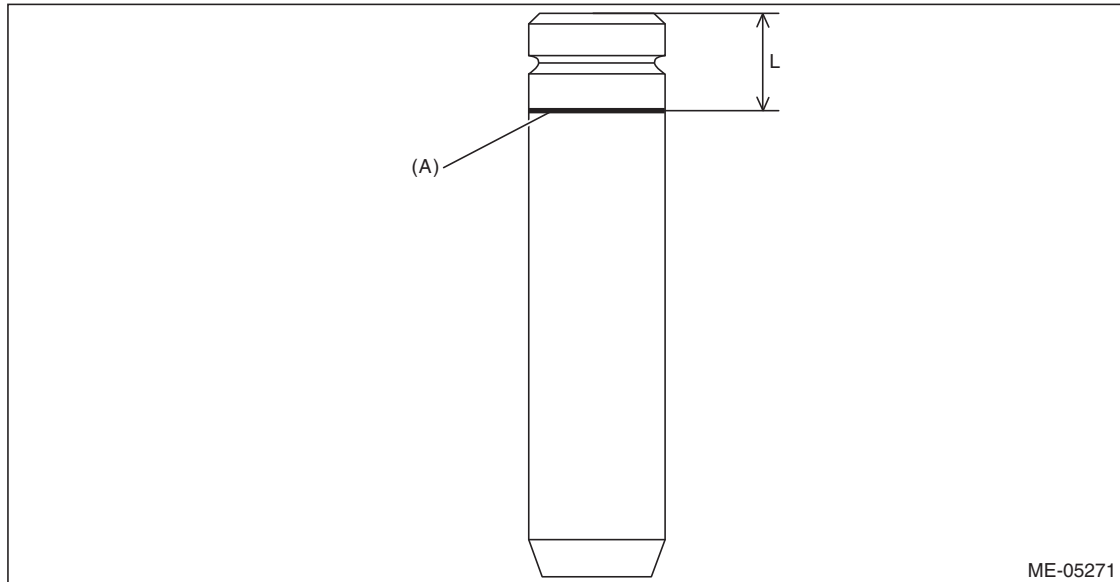
(3) Draw a reference line (A) for insert on the valve guide using a marker as shown in the figure.

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

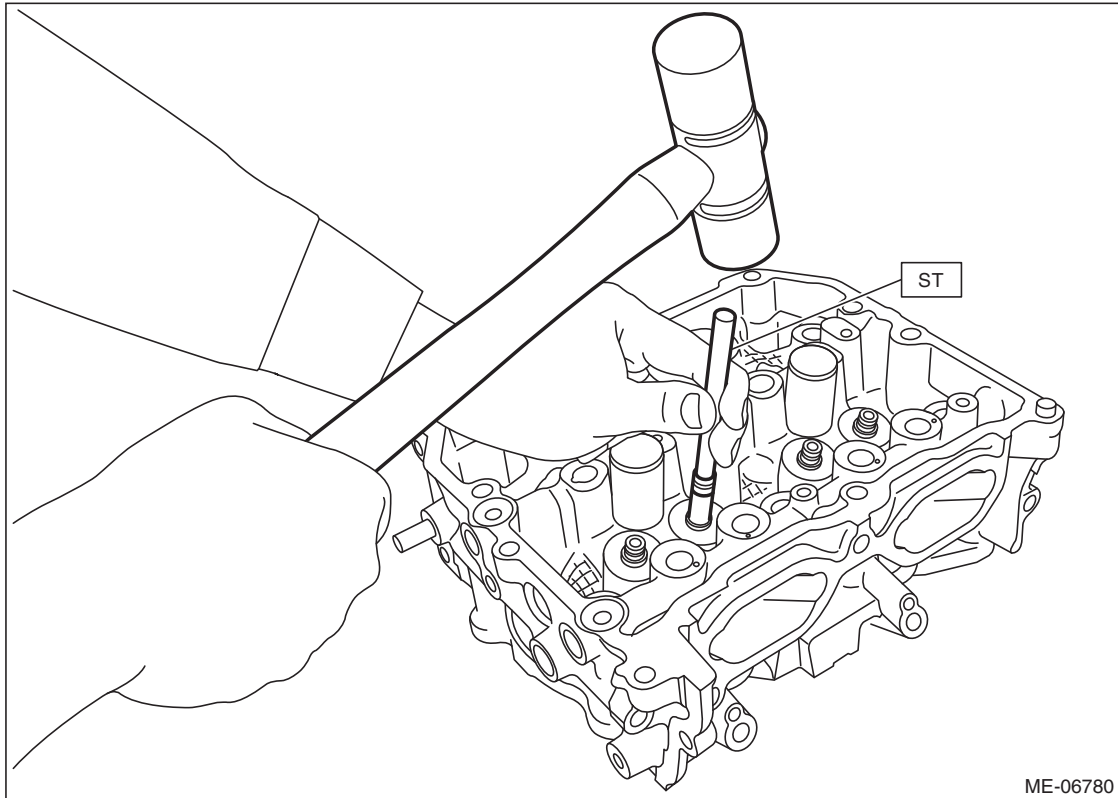
MECHANICAL

(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



Cylinder Head

MECHANICAL

(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:

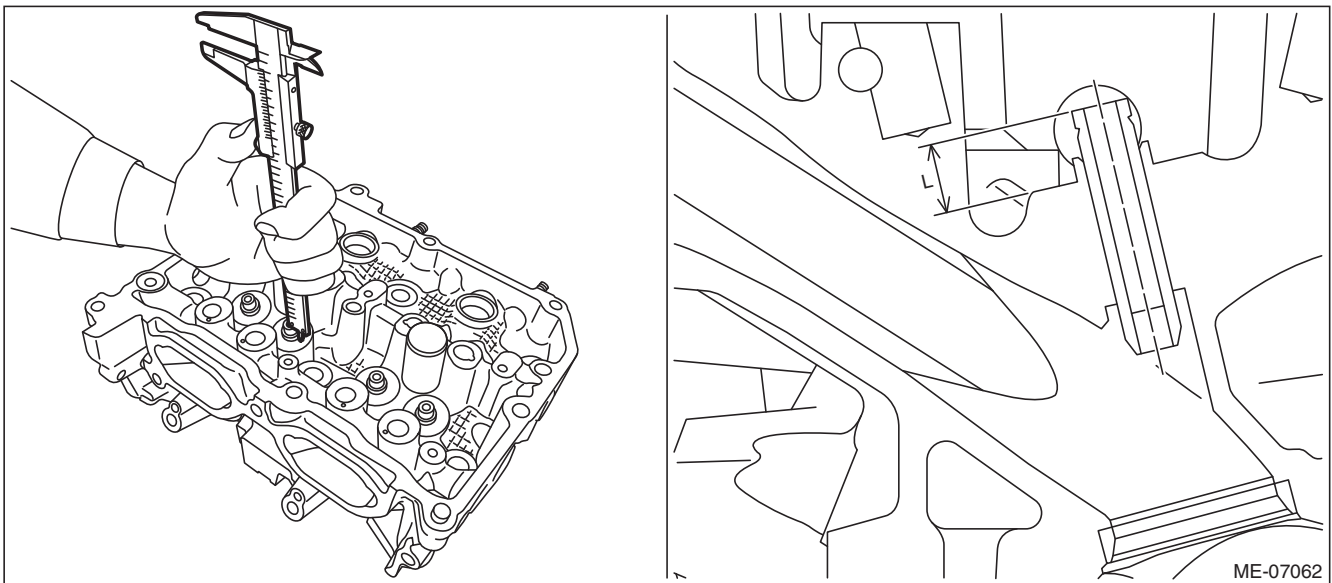
Be careful not to tap-in excessively by repeating the steps of Tapping-in → Measurement → Tapping-in → Measurement ... when installing the valve guide.

ST 499765700 VALVE GUIDE REMOVER AND INSTALLER

Valve guide protrusion amount L:

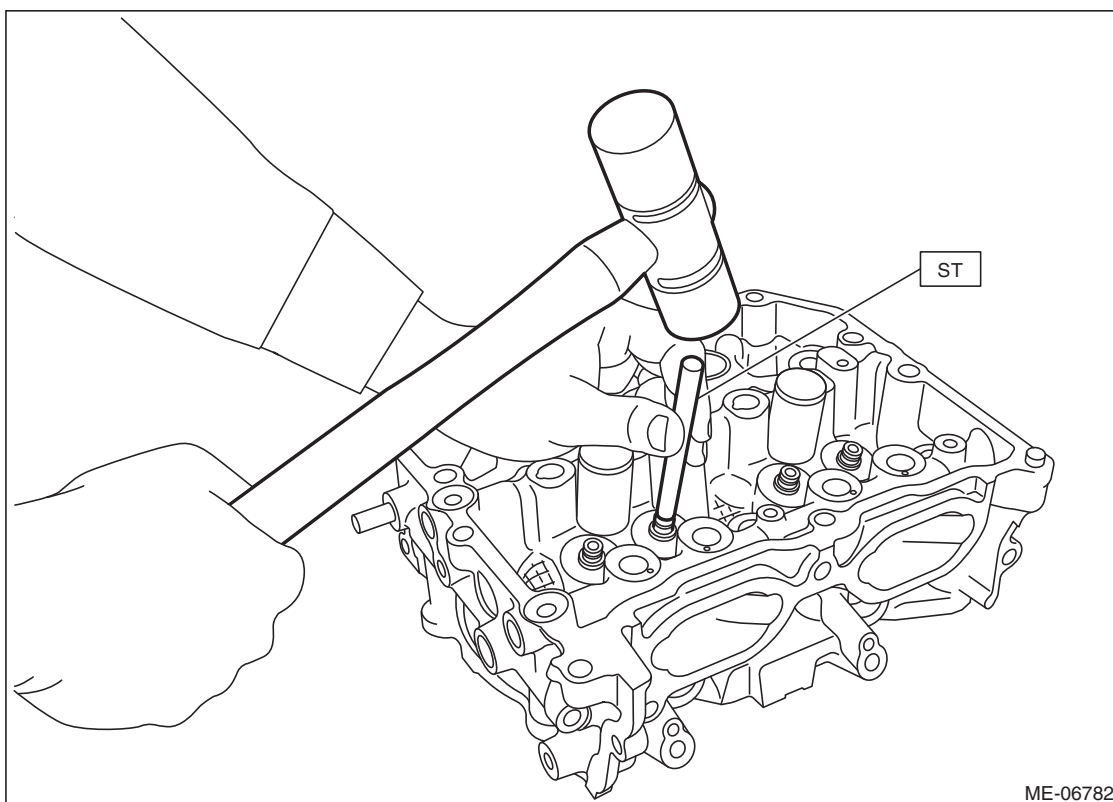
Standard

11.4 — 11.8 mm (0.449 — 0.465 in)



Cylinder Head

MECHANICAL



ME-06782

ME(H4DOTC)-251



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.

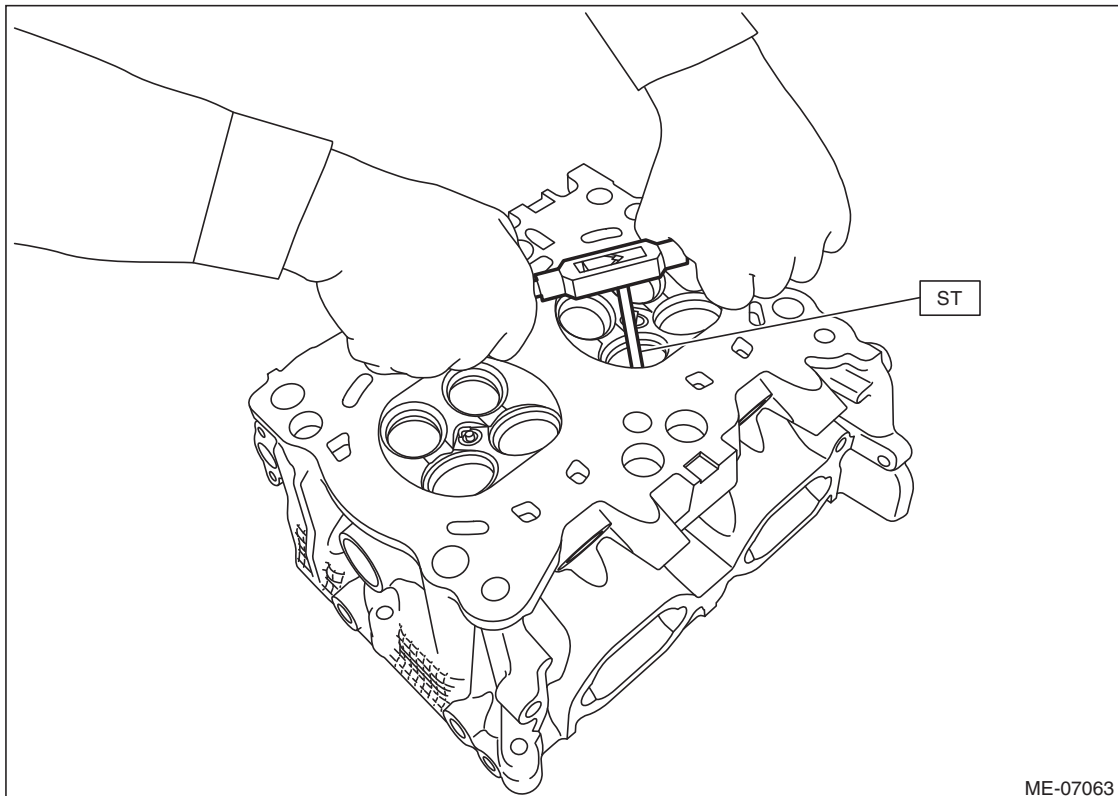
CAUTION:

- 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.>

Cylinder Head

MECHANICAL

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

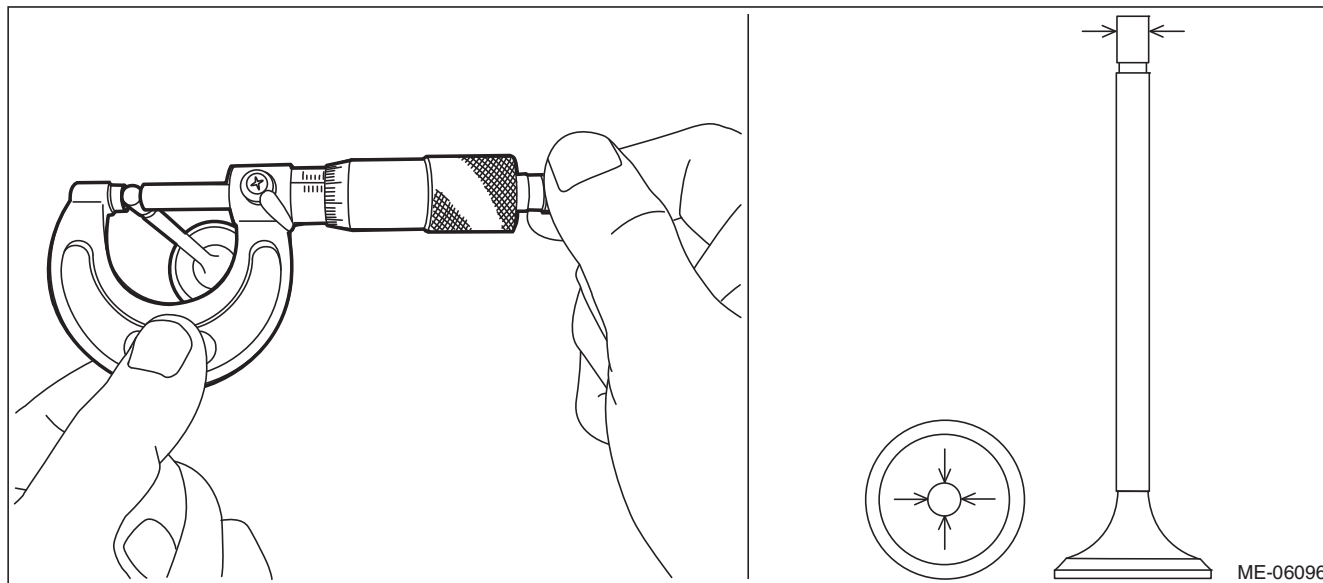
Standard

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.

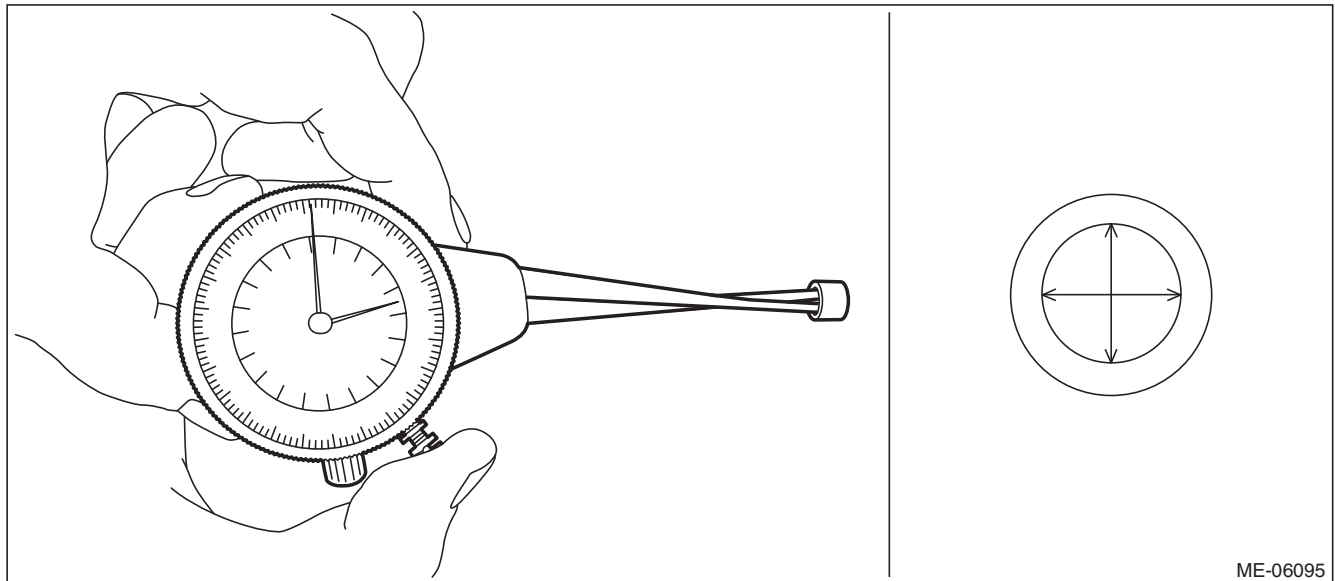
NOTE:

- 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)-39, WHEN TIMING CHAIN ASSEMBLY IS REMOVED, INSPECTION, Cam Clearance.>

Valve shim inner diameter:

Standard

5.500 — 5.560 mm (0.2165 — 0.2189 in)



(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)-39, 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)

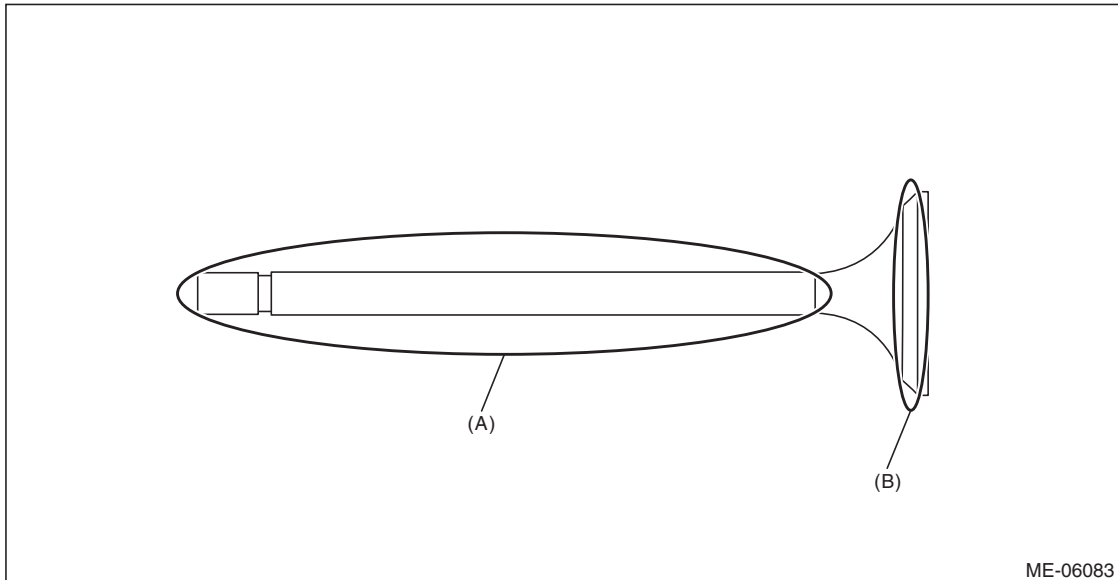
Exhaust

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).



ME-06083

- (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.



Cylinder Head

MECHANICAL

(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).

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

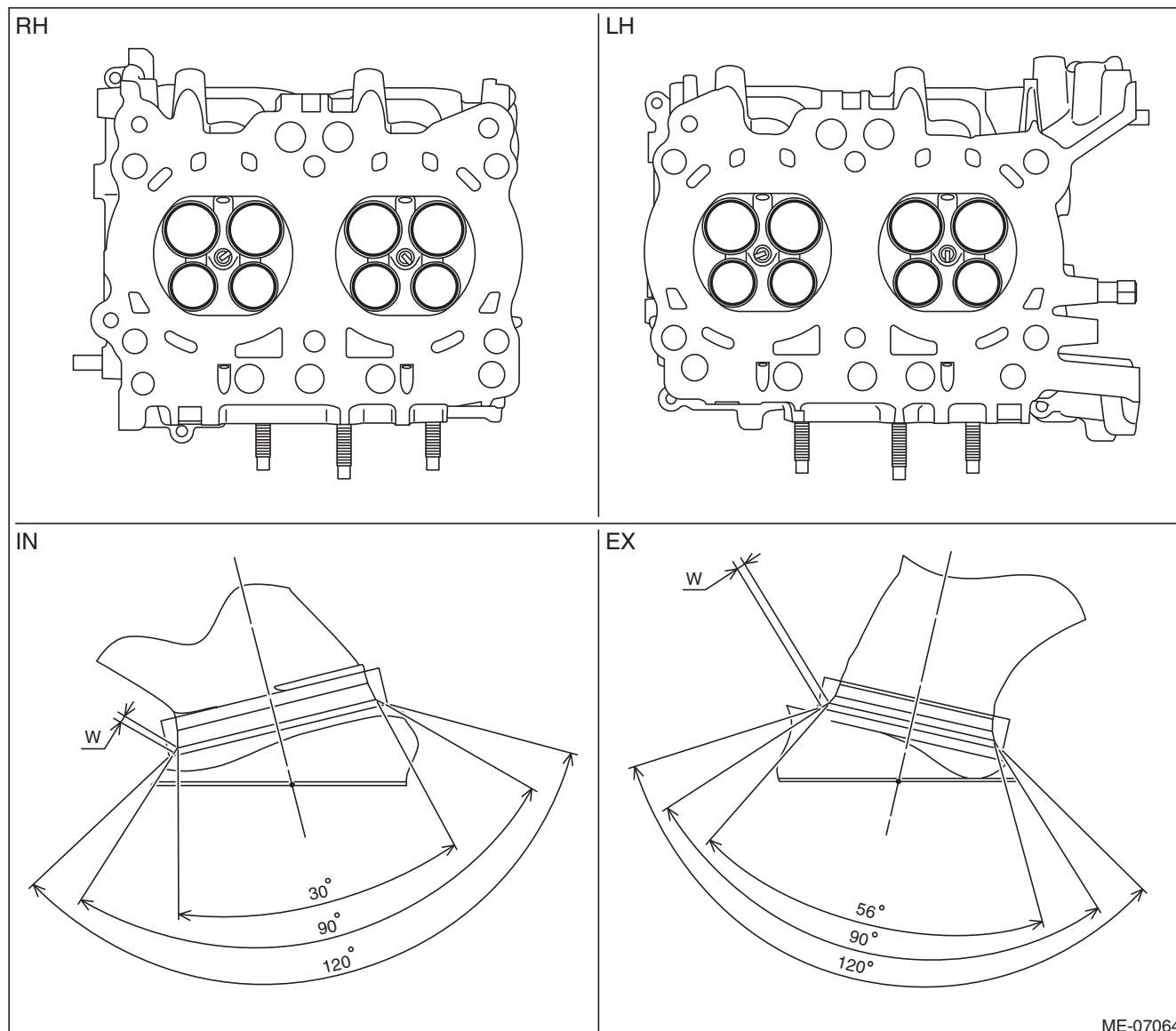
Standard

0.8 — 1.6 mm (0.031 — 0.063 in)

Exhaust

Standard

1.1 — 1.7 mm (0.043 — 0.067 in)

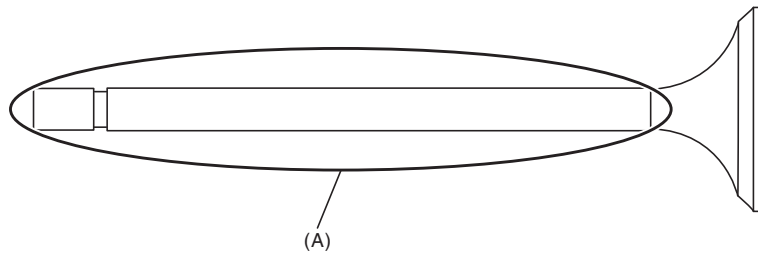


ME-07064

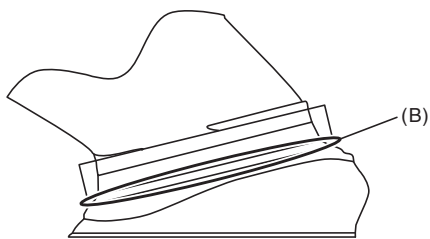
Cylinder Head

MECHANICAL

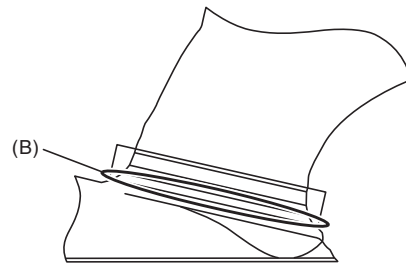
- (5) Wipe off the red dye on the valve and valve seat completely.
- (6) Coat the stem (A) of the valve lightly with engine oil and apply red dye evenly on the seating surface (B) between valve and valve seat.



IN



EX



ME-06785

- (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.

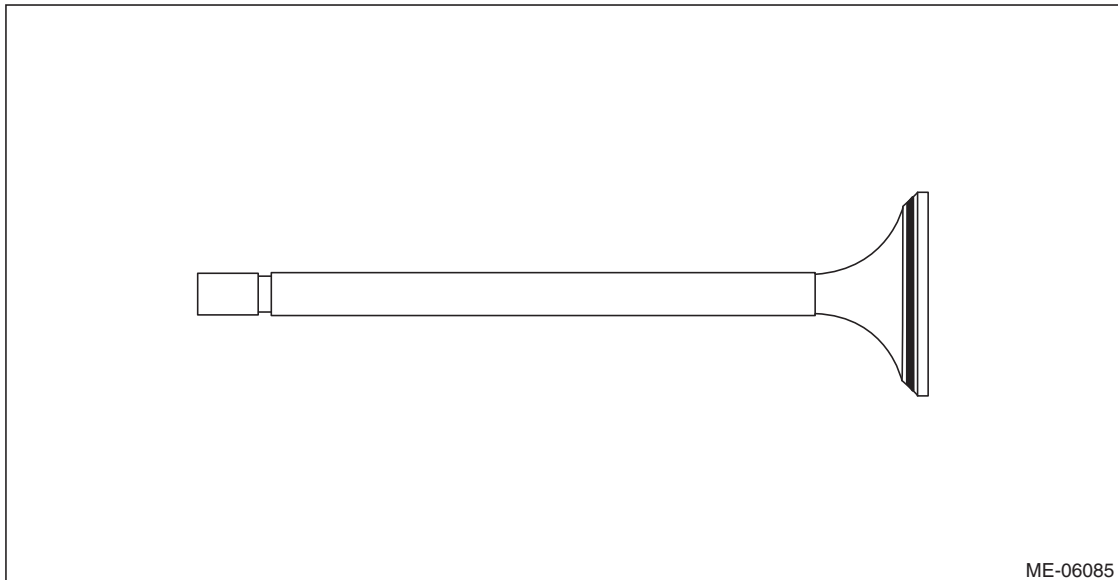
Cylinder Head

MECHANICAL

(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

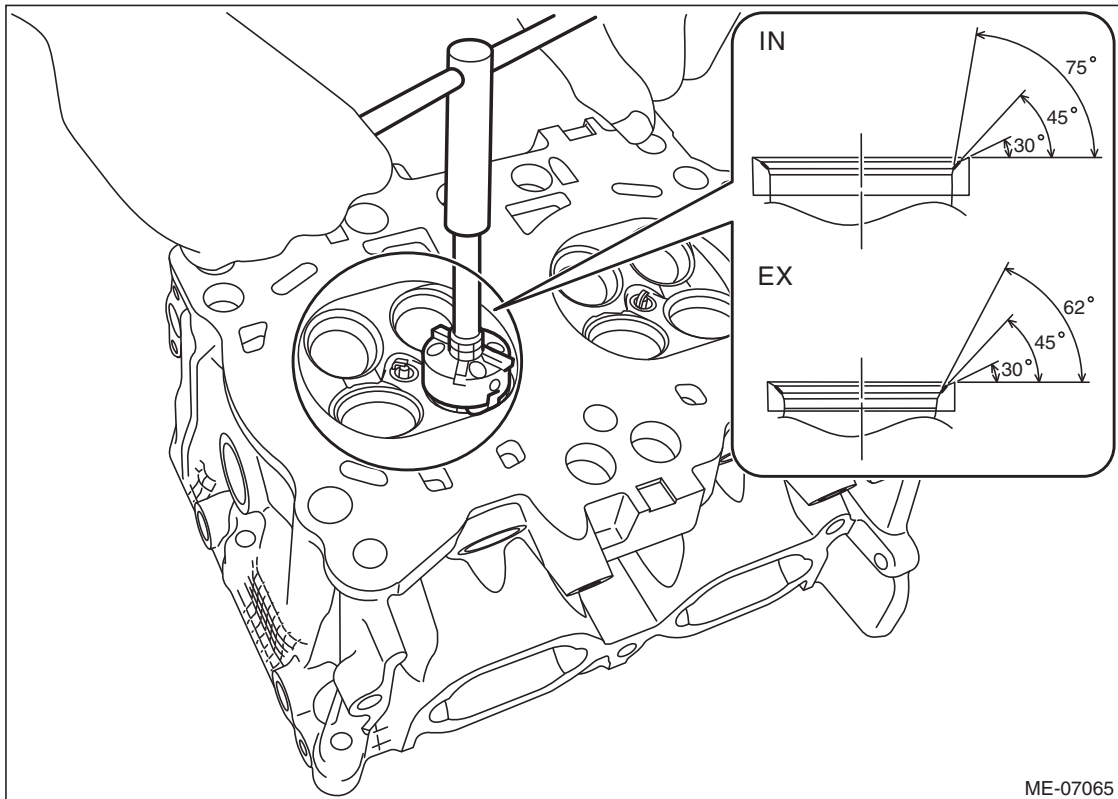
28.9 — 29.1 mm (1.138 — 1.146 in)

- 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.

Cylinder Head

MECHANICAL

Seating angle between valve and valve seat:
45°



(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).

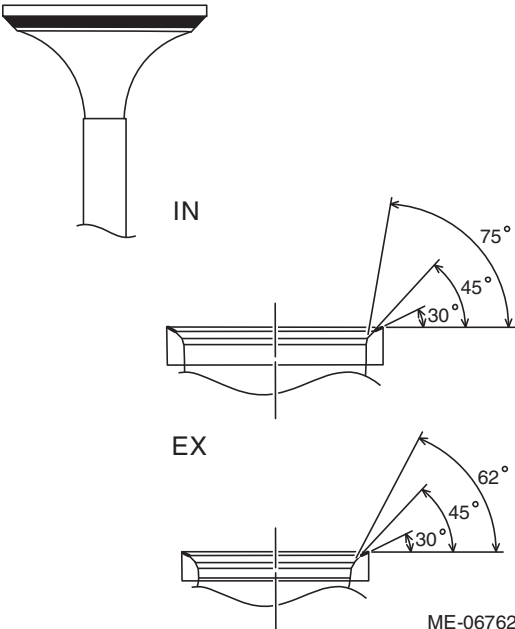
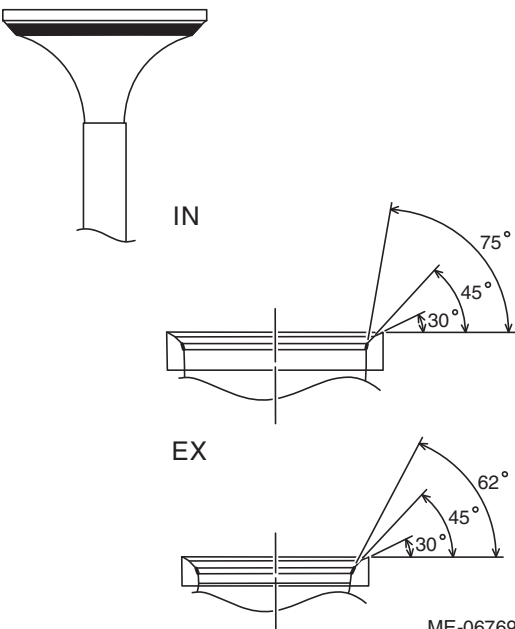
Cylinder Head

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.

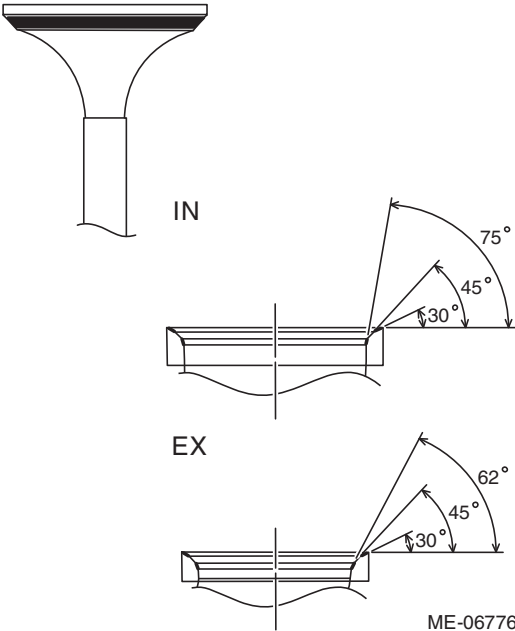
NOTE:

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

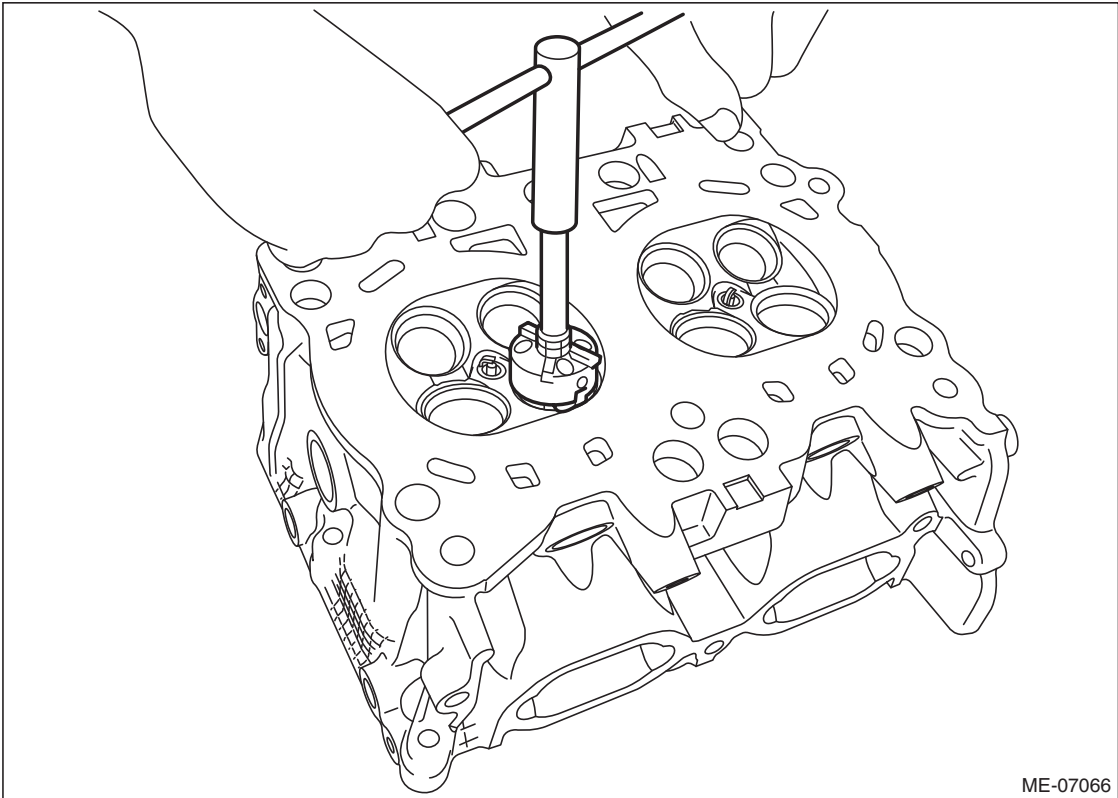
Seating position between valve and valve seat	Seat cutter selection
 IN EX ME-06762	When the seating position of valve face is high, grind the surface using the 30° seat cutter until seating width between valve and valve seat becomes the standard value.
 IN EX ME-06769	When the seating position of valve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

Cylinder Head

MECHANICAL

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.



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

Cylinder Head

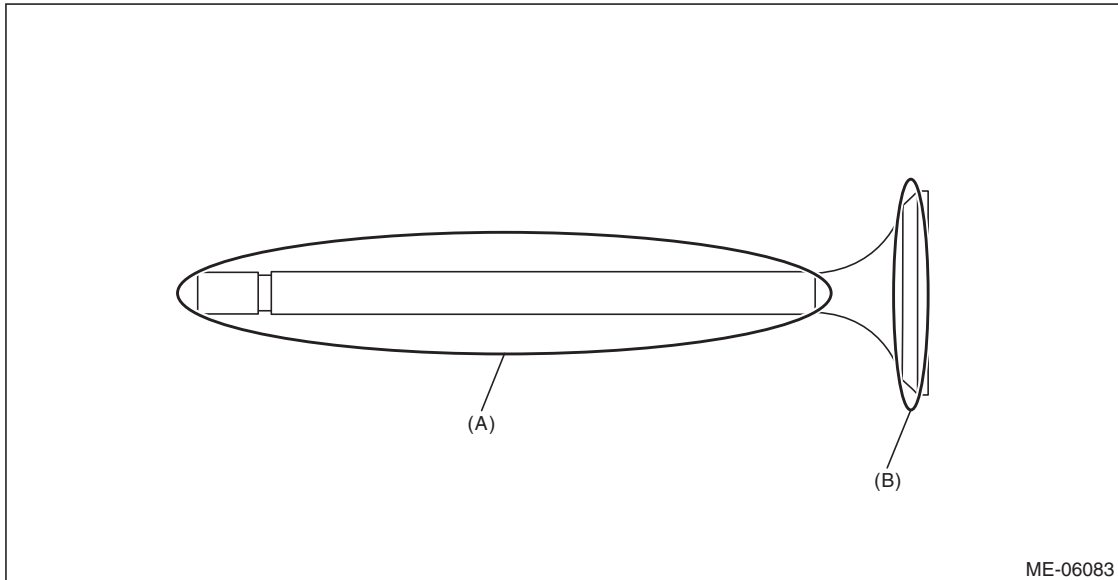
MECHANICAL

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.

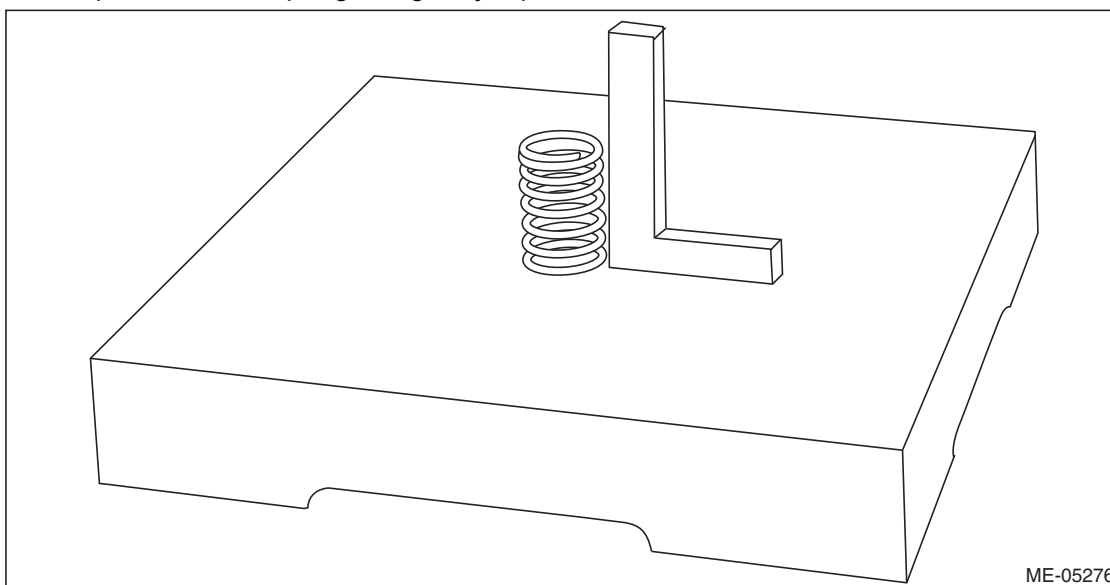
- (4) Check the seating width and seating position between valve and valve seat.

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

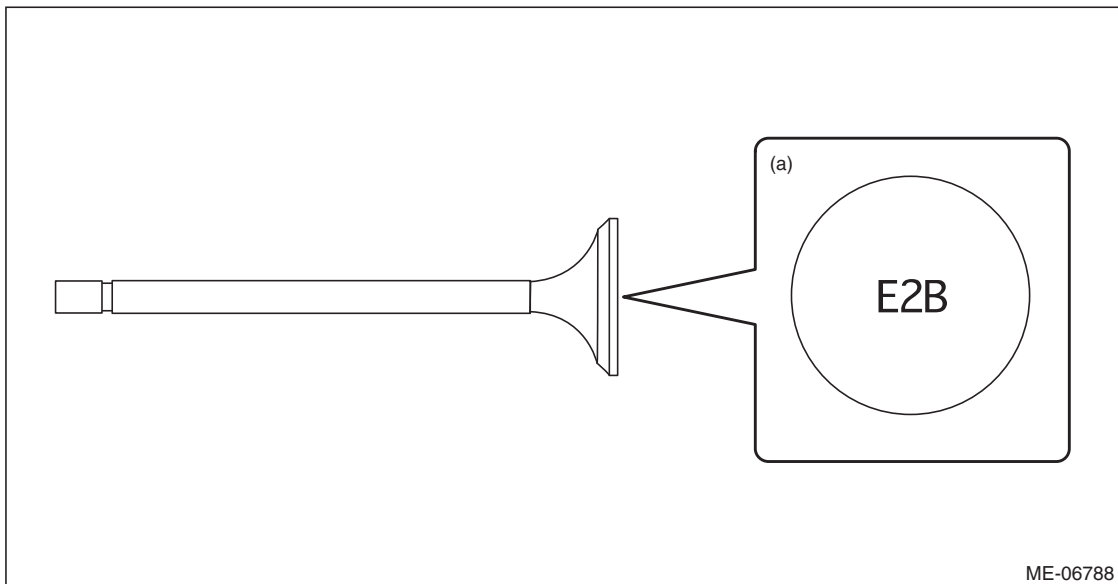
Cylinder Head

MECHANICAL

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: E2B)

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).

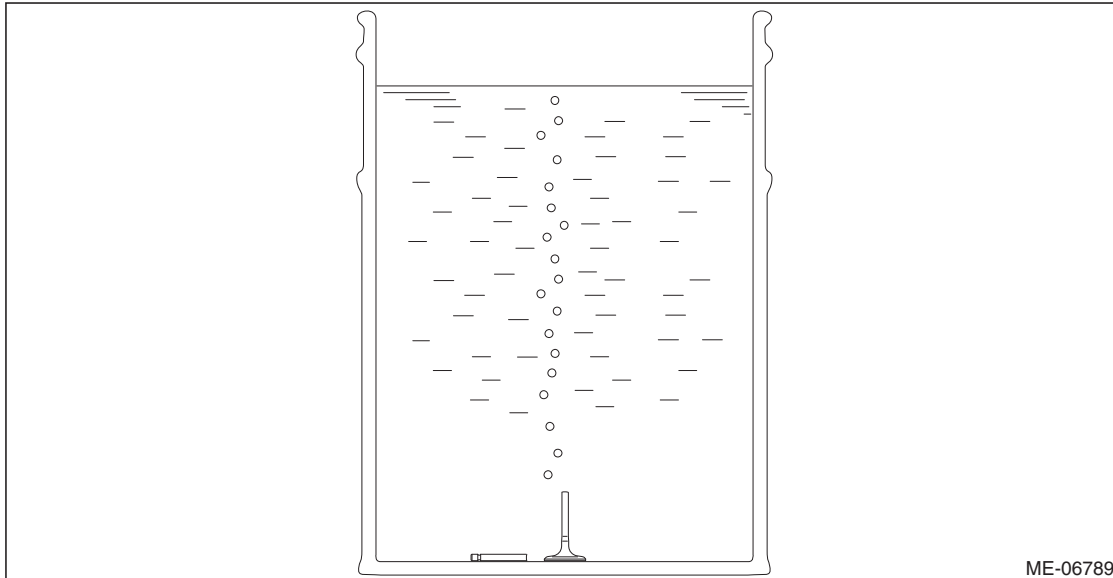
Cylinder Head

MECHANICAL

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.

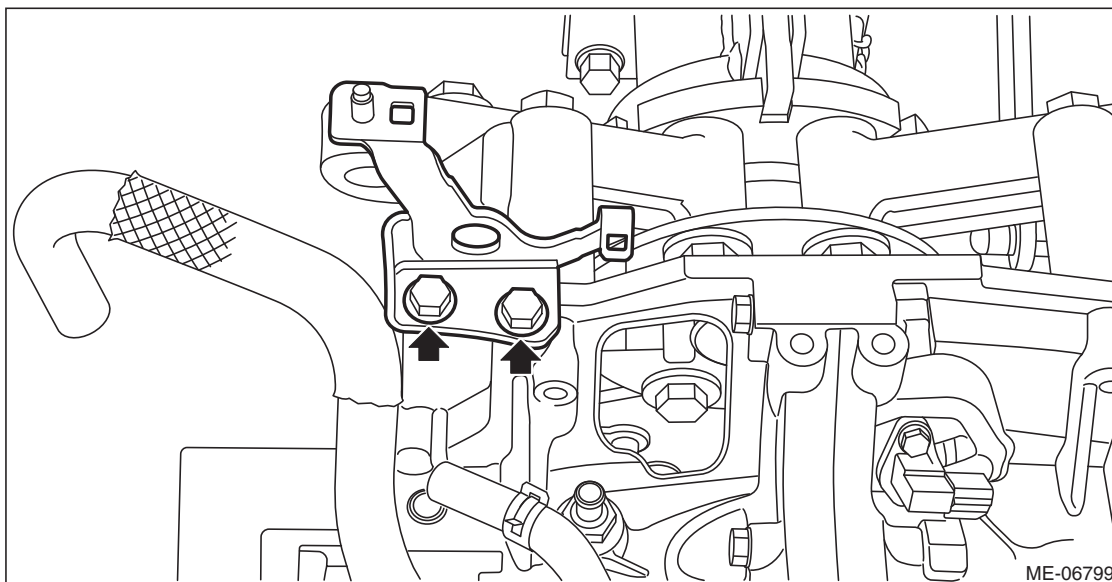
Cylinder Block

MECHANICAL

22. Cylinder Block

A: REMOVAL

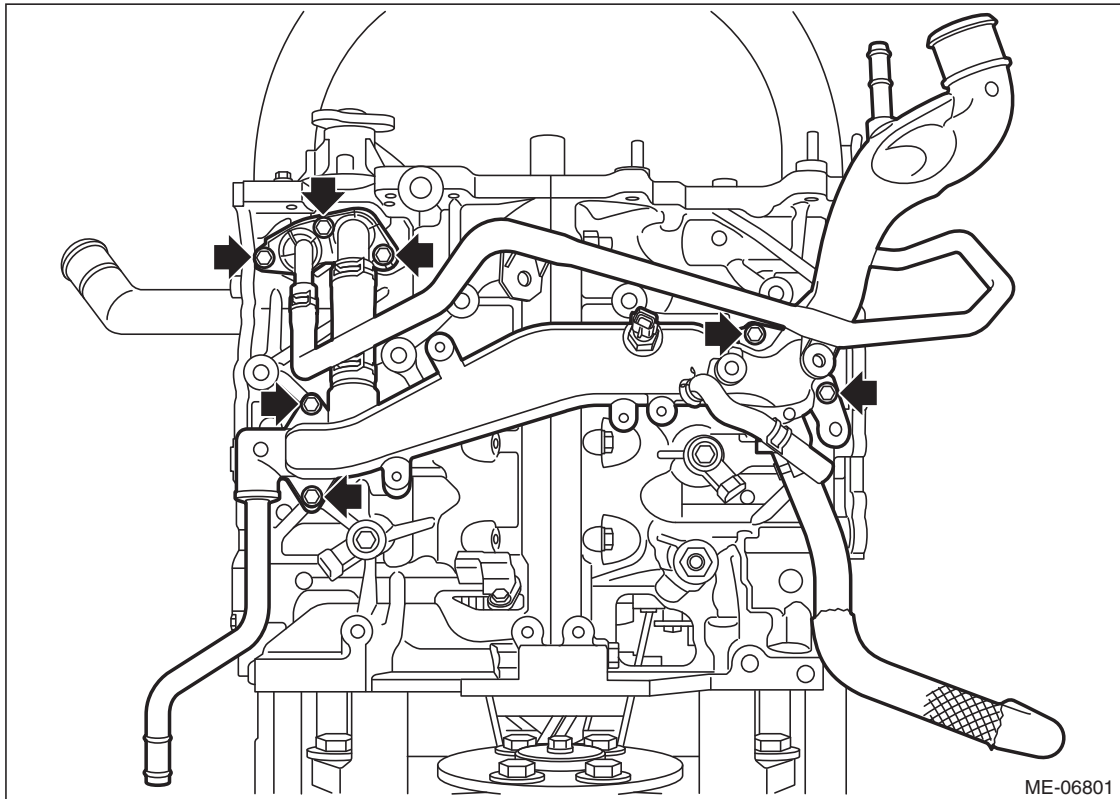
- 1) Remove the engine from the vehicle. <Ref. to ME(H4DOTC)-44, REMOVAL, Engine Assembly.>
- 2) Remove the crankshaft position sensor plate with drive plate. <Ref. to CVT(TR690)-133, REMOVAL, Drive Plate.>
- 3) Remove the intake manifold. <Ref. to FU(H4DOTC)-19, REMOVAL, Intake Manifold.>
- 4) Remove the tumble generator valve assembly. <Ref. to FU(H4DOTC)-43, REMOVAL, Tumble Generator Valve Assembly.>
- 5) Remove the engine wiring harness. <Ref. to FU(H4DOTC)-86, REMOVAL, Engine Wiring Harness.>
- 6) Remove the chain cover. <Ref. to ME(H4DOTC)-90, REMOVAL, Chain Cover.>
- 7) Remove the rocker cover. <Ref. to ME(H4DOTC)-147, REMOVAL, Rocker Cover.>
- 8) Remove the cam carrier. <Ref. to ME(H4DOTC)-172, REMOVAL, Cam Carrier.>
- 9) Remove the cylinder head. <Ref. to ME(H4DOTC)-215, REMOVAL, Cylinder Head.>
- 10) Remove the crank sprocket. <Ref. to ME(H4DOTC)-145, REMOVAL, Crank Sprocket.>
- 11) Remove the engine rear hanger from cylinder block RH.



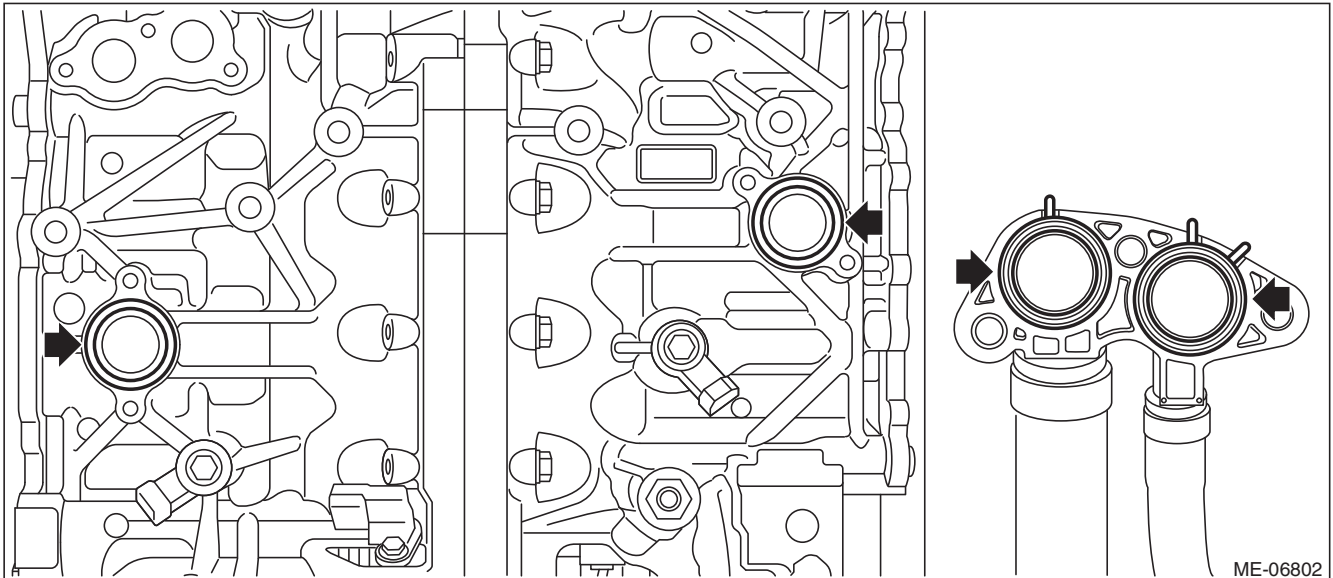
Cylinder Block

MECHANICAL

- 12) 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.



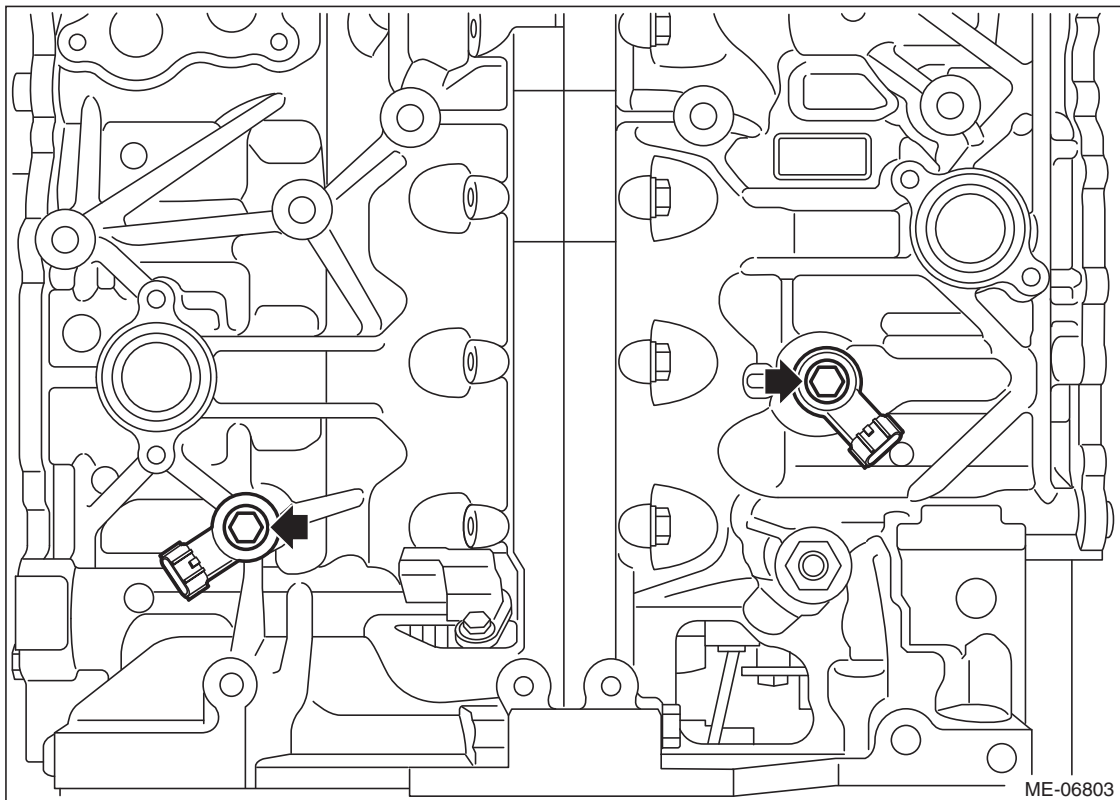
- 13) Remove the O-ring from the cylinder block and PCV connector.



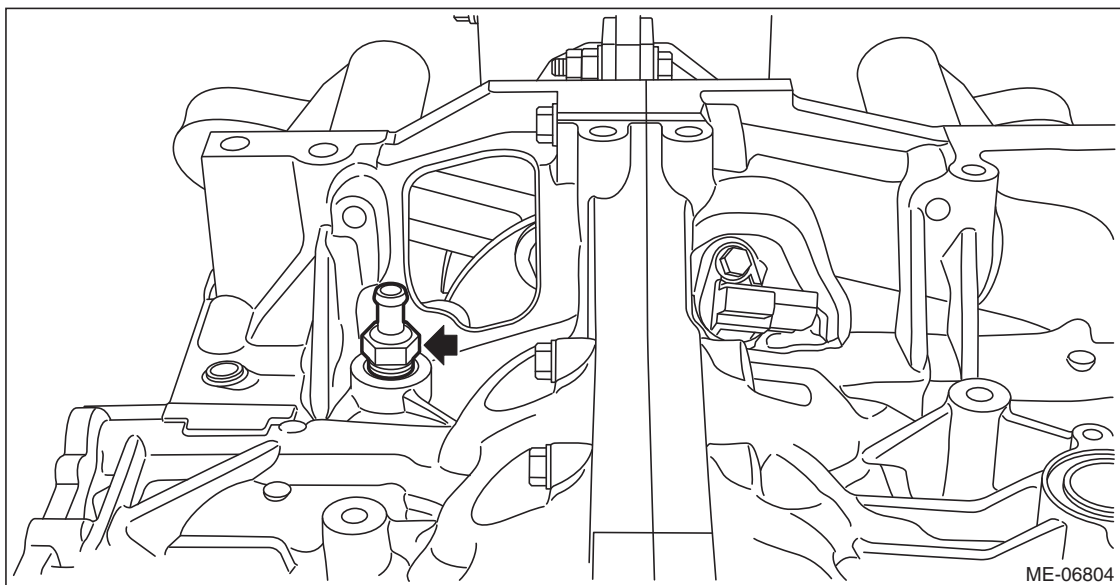
Cylinder Block

MECHANICAL

- 14) Remove the knock sensor from cylinder block LH.



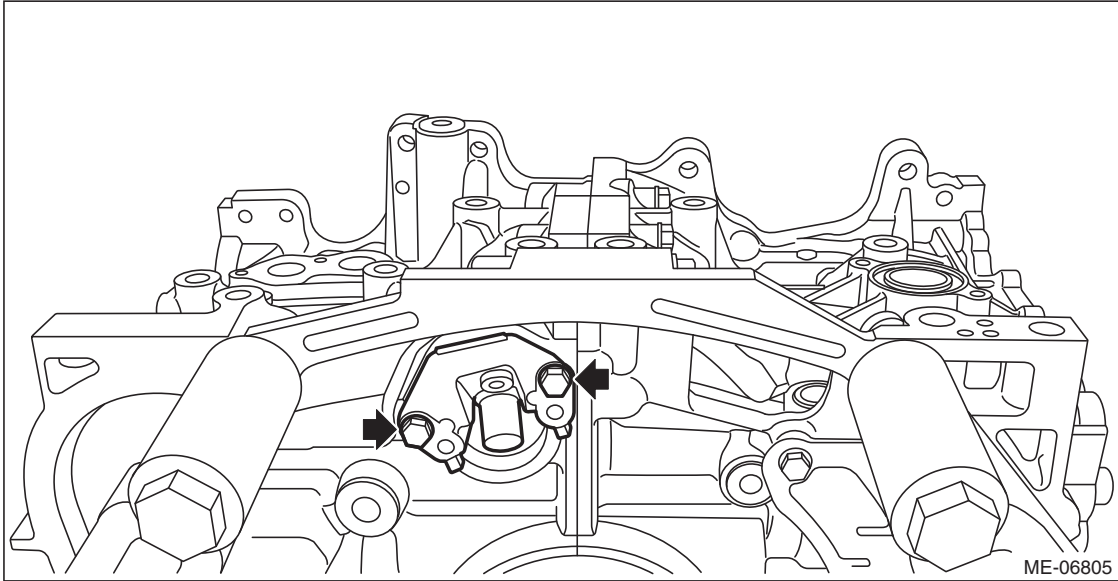
- 15) Remove the PCV valve from the cylinder block RH.



Cylinder Block

MECHANICAL

- 16) 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.



- 17) Set the part so that the oil pan is on the upper side.



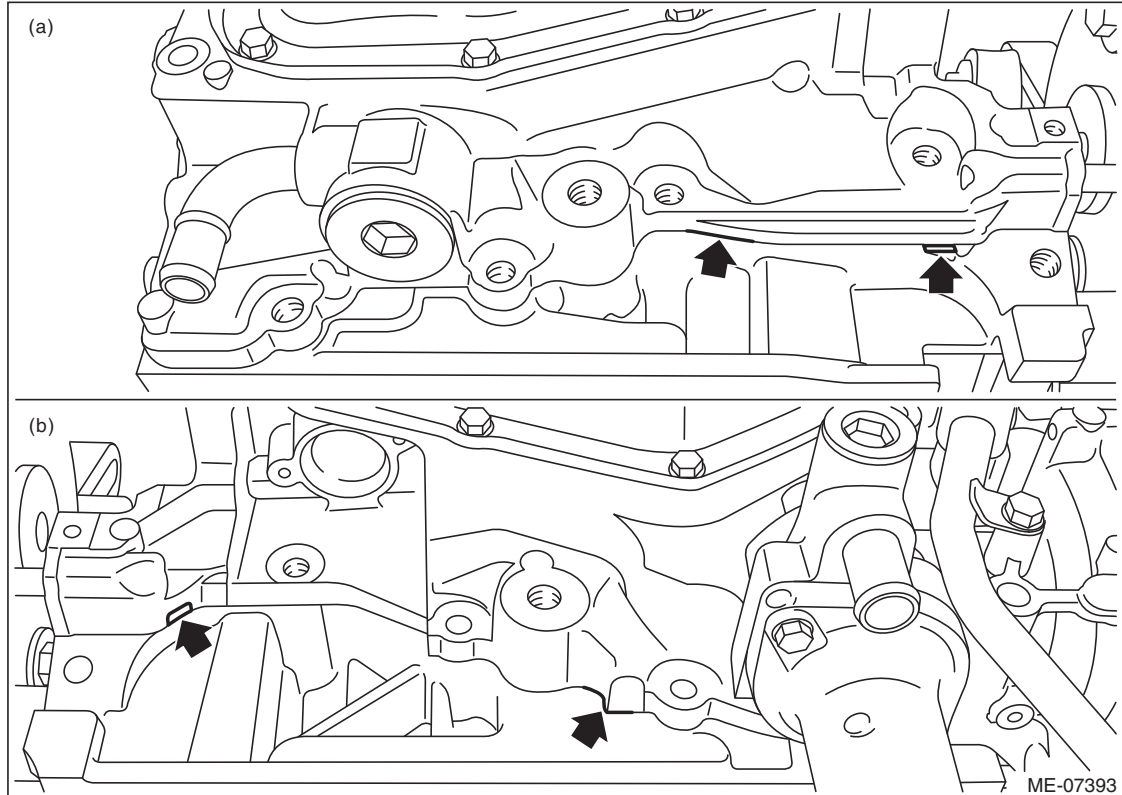
Cylinder Block

MECHANICAL

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

NOTE:

Pry the points shown in the figure with a crowbar wrapped by protective tape, and then remove the oil pan upper.

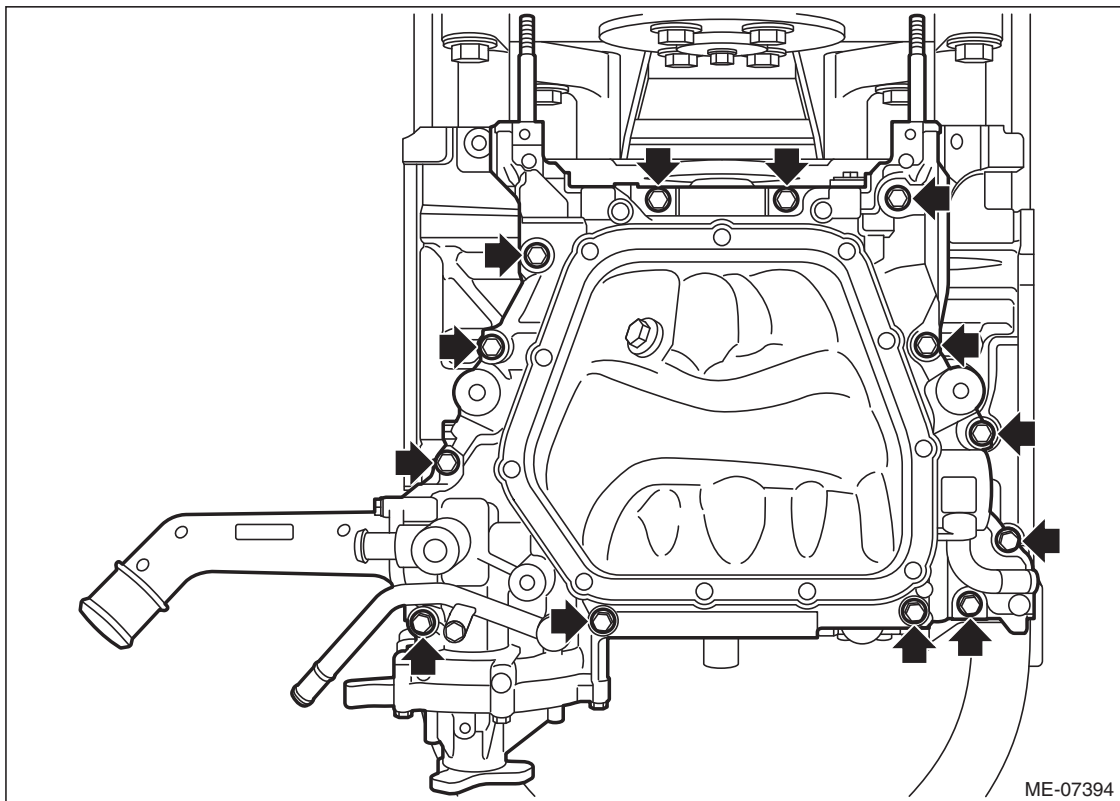


(a) RH side

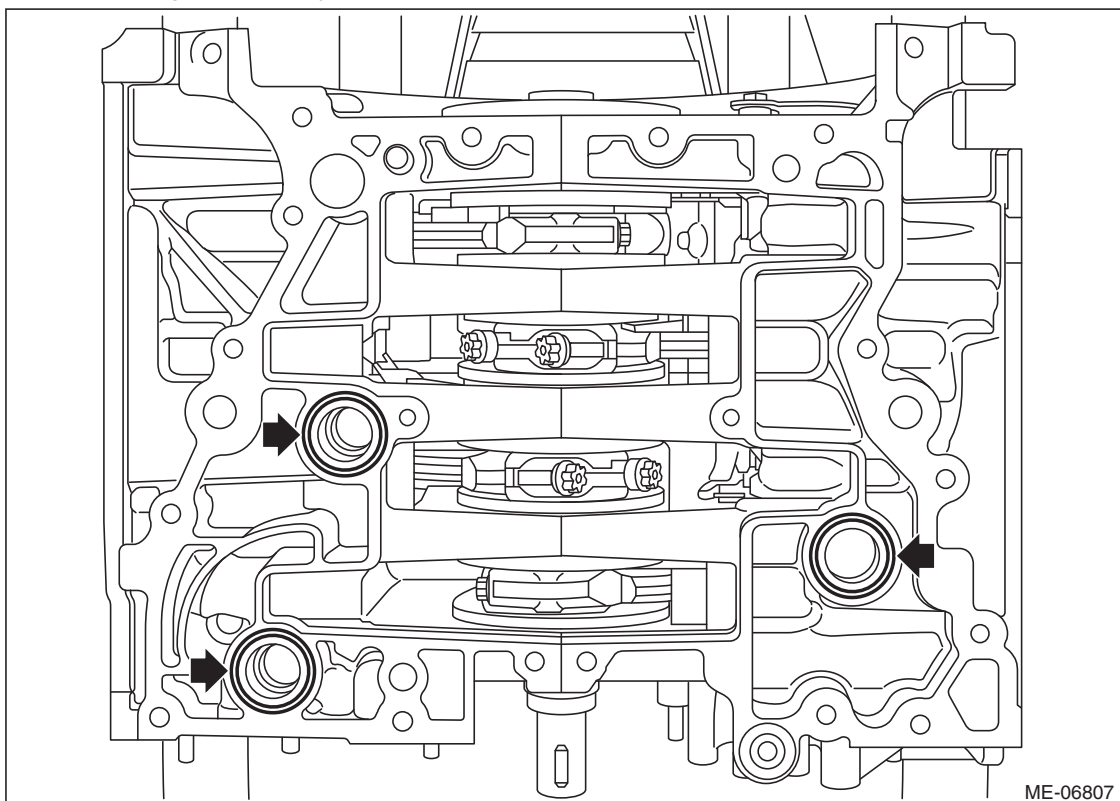
(b) LH side

Cylinder Block

MECHANICAL



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



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

Cylinder Block

MECHANICAL

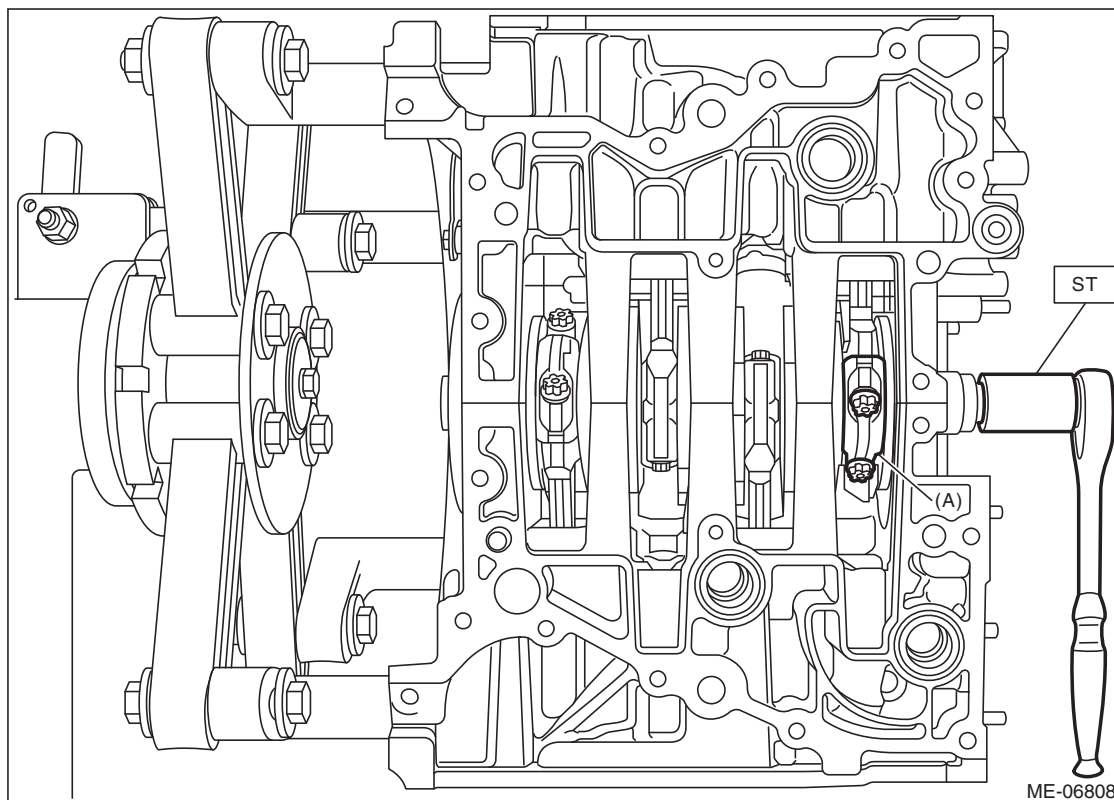
21) Remove the #1 and #3 connecting rod caps and pistons from the cylinder block.

NOTE:

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

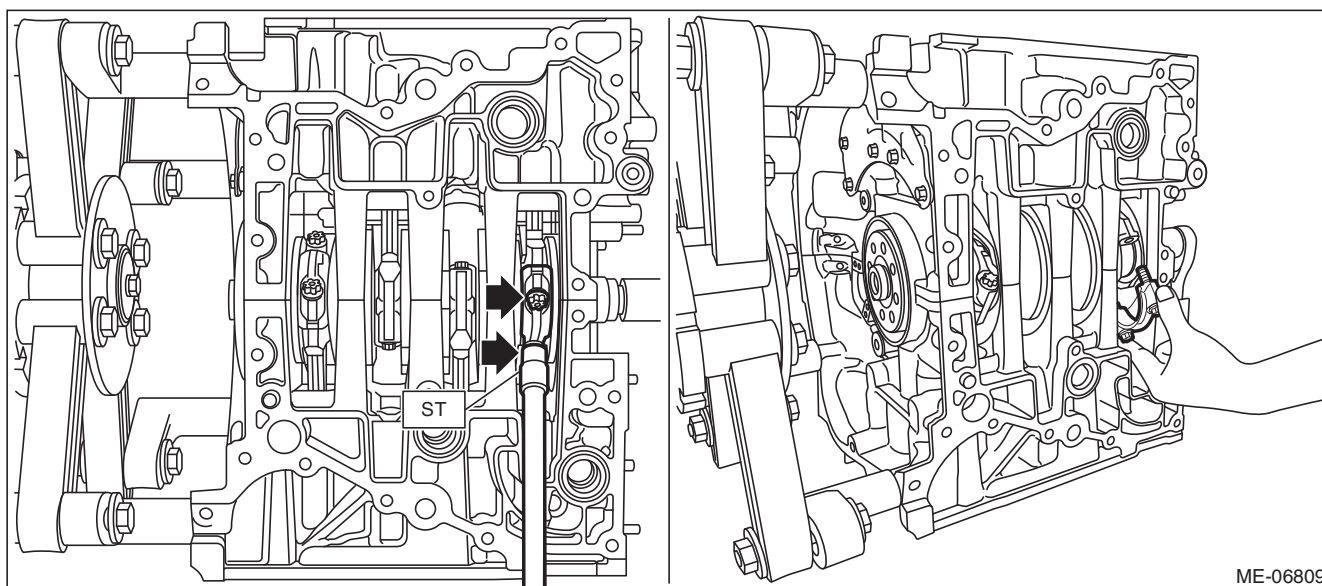
(1) Turn the crankshaft so that the #1 connecting rod cap (A) is located at the position shown in the figure using ST.

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 18270AA020 SOCKET

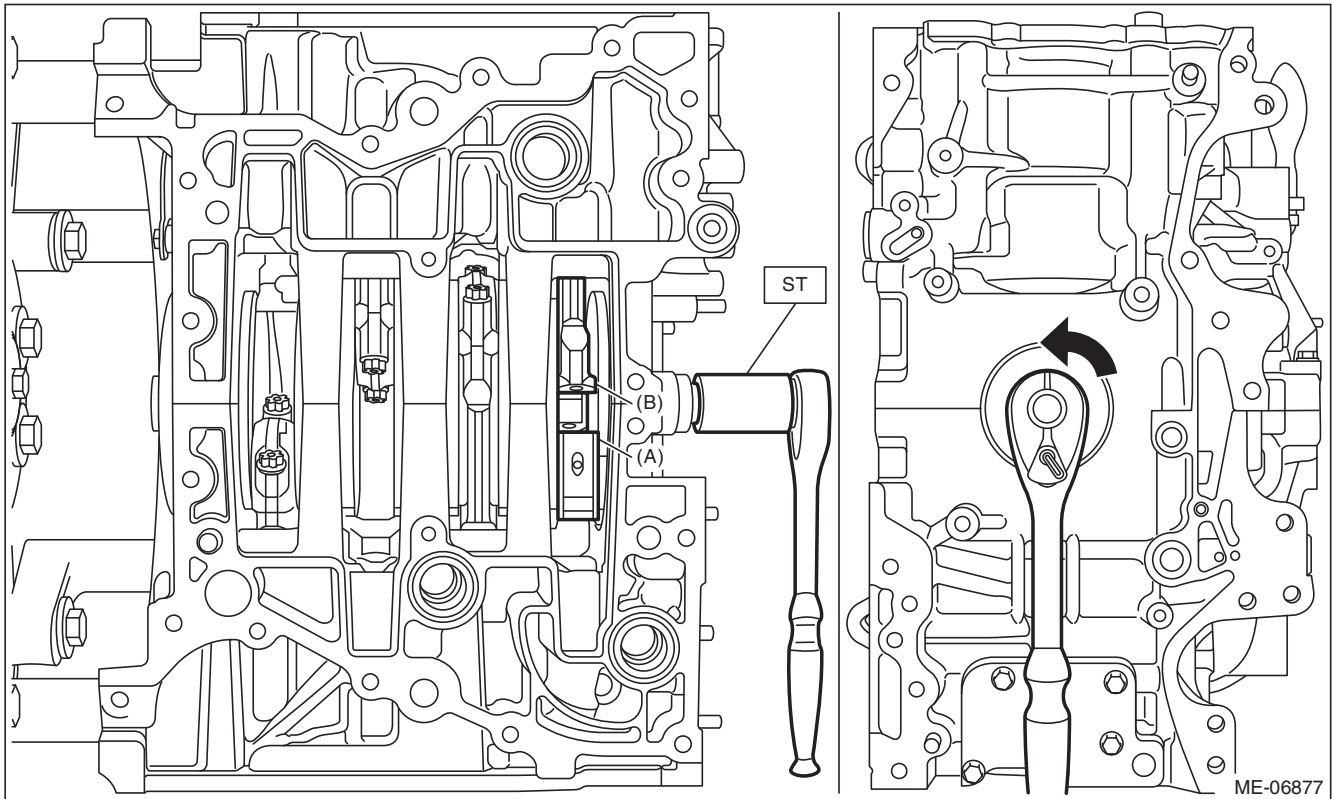


Cylinder Block

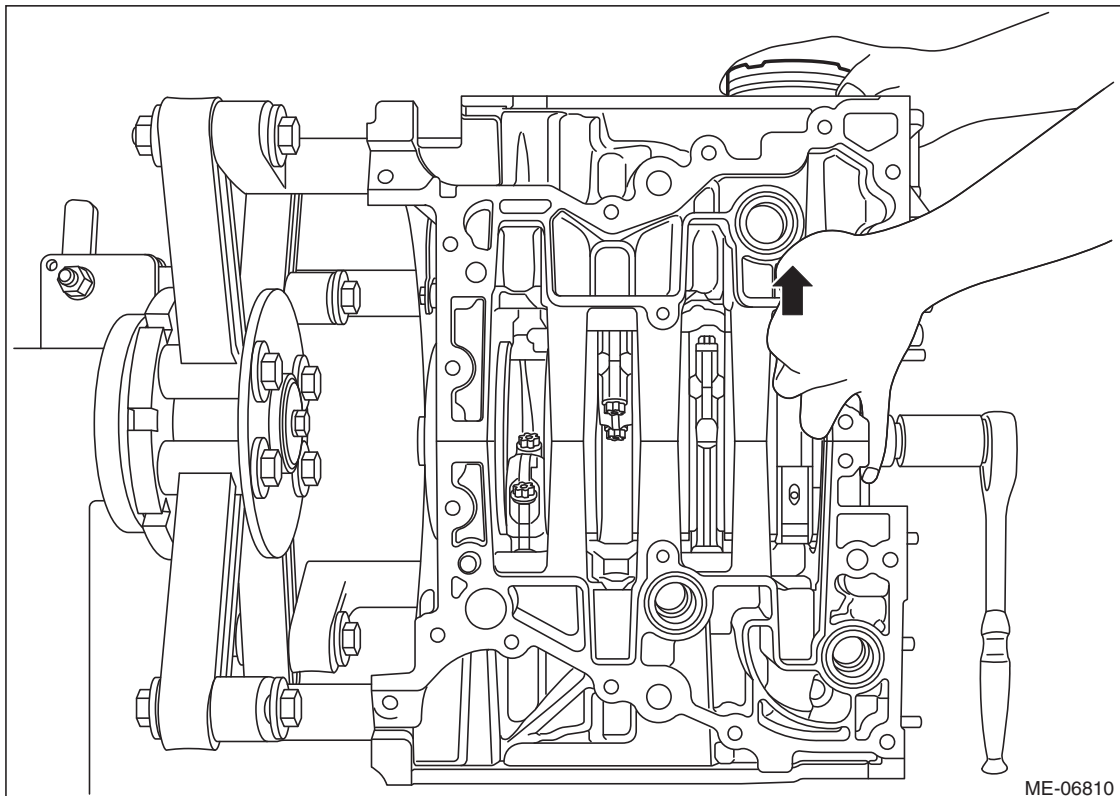
MECHANICAL

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

ST 18252AA000 CRANKSHAFT SOCKET



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



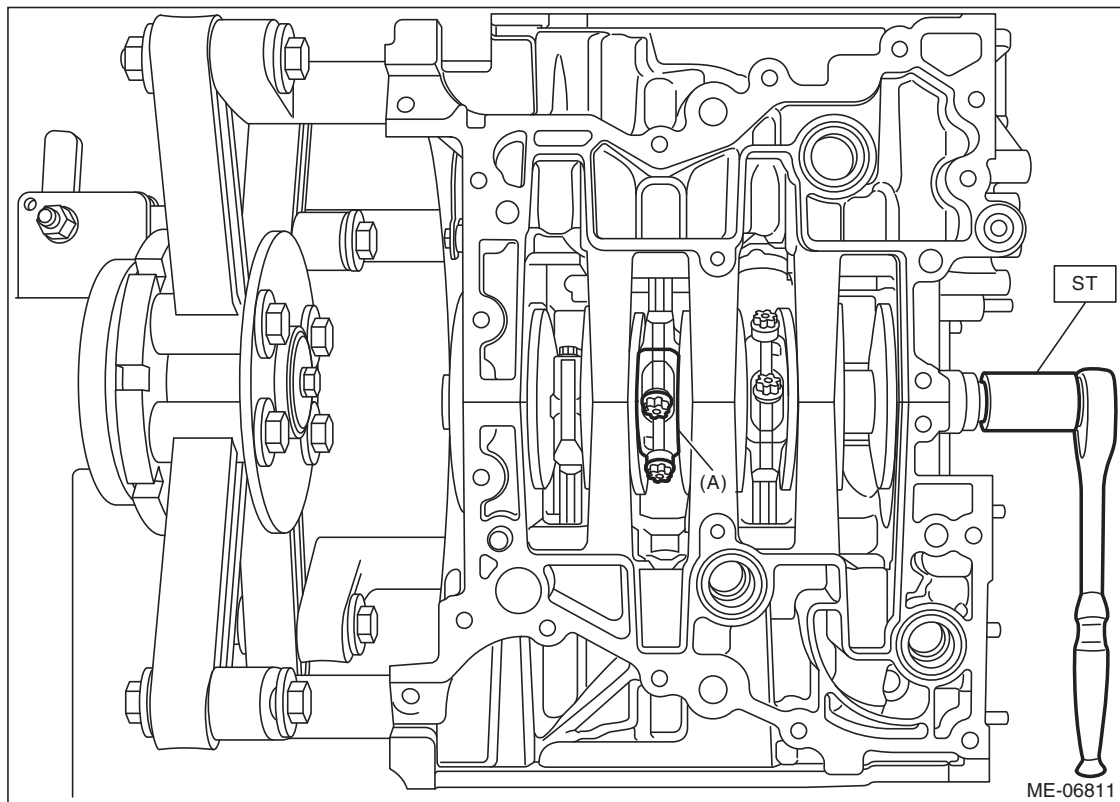
ME(H4DOTC)-273

Cylinder Block

MECHANICAL

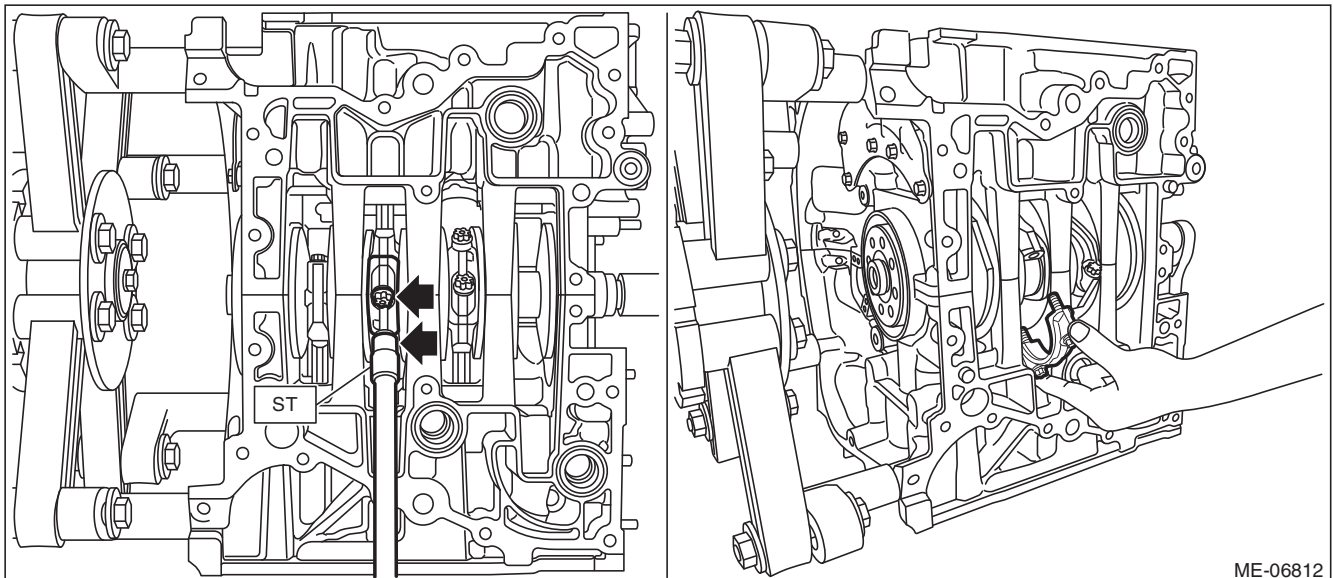
(5) Turn the crankshaft so that the #3 connecting rod cap (A) is located at the position shown in the figure using ST.

ST 18252AA000 CRANKSHAFT SOCKET



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

ST 18270AA020 SOCKET

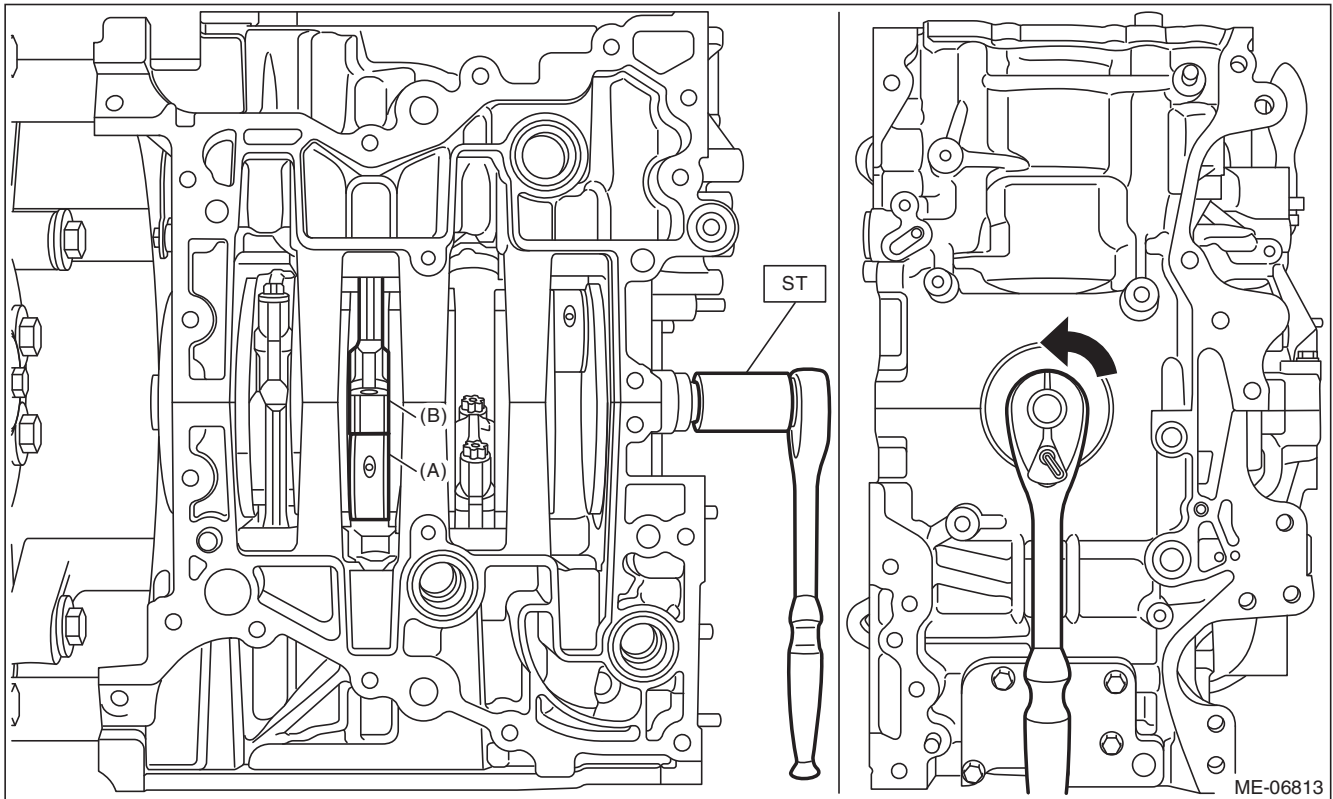


Cylinder Block

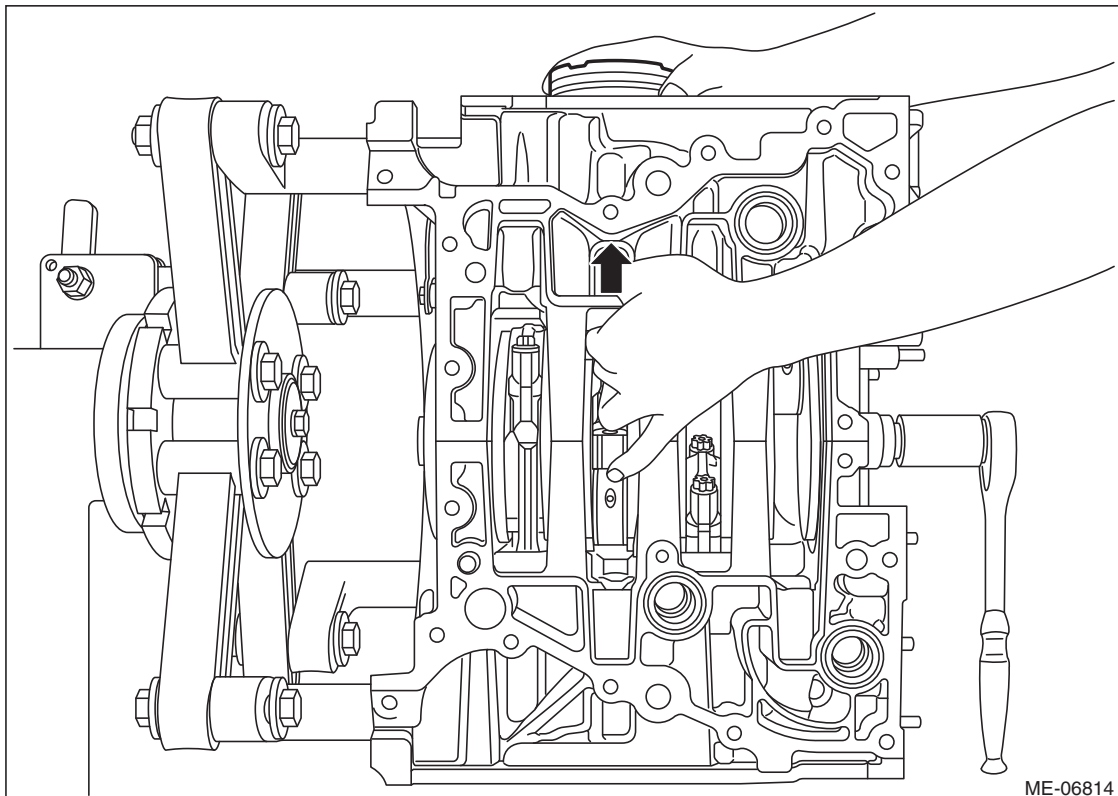
MECHANICAL

(7) Using the ST, turn the crankshaft counterclockwise and separate the positions of the #3 pin (A) of crankshaft and the large end (B) of #3 connecting rod.

ST 18252AA000 CRANKSHAFT SOCKET



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



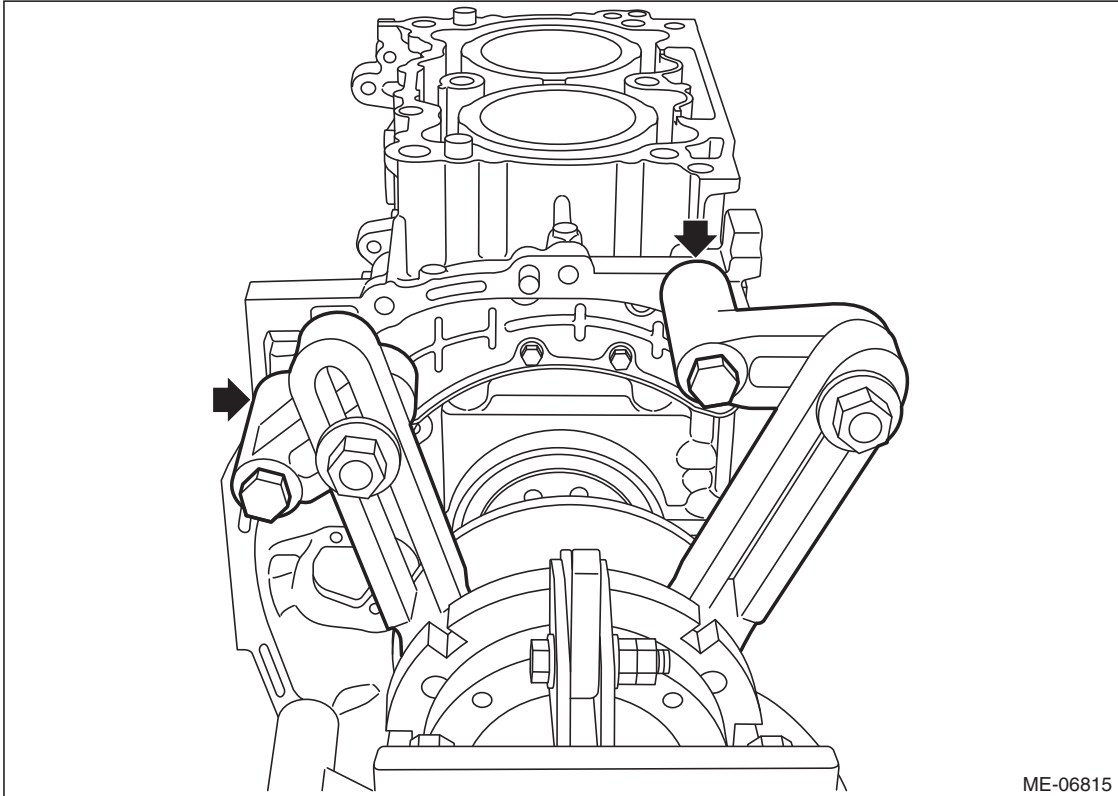
ME(H4DOTC)-275



Cylinder Block

MECHANICAL

- 22) Set the part so that the cylinder block LH is on the upper side.
- 23) Remove #2 and #4 connecting rod caps and pistons in the same removal procedure as #1 and 3# connecting rod caps and pistons.
- 24) Set the part so that the cylinder block RH is on the upper side, and separate the cylinder block.
 - (1) Remove the engine stand from the cylinder block RH.

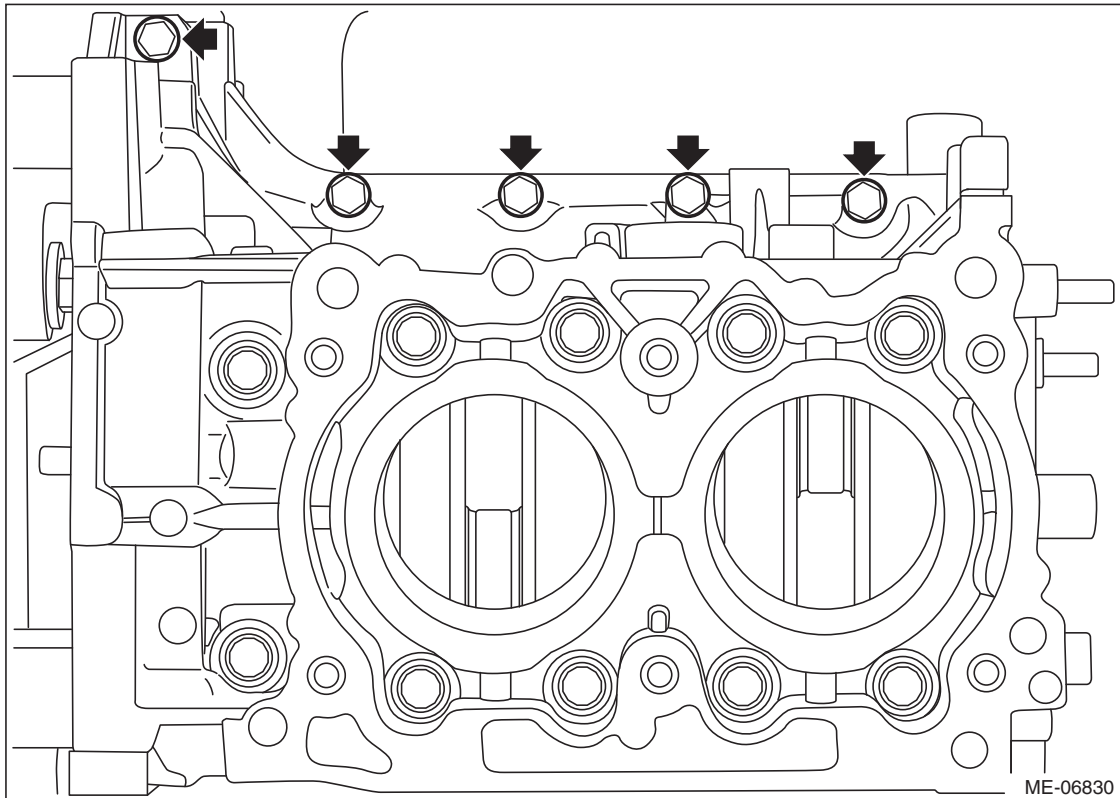


ME-06815

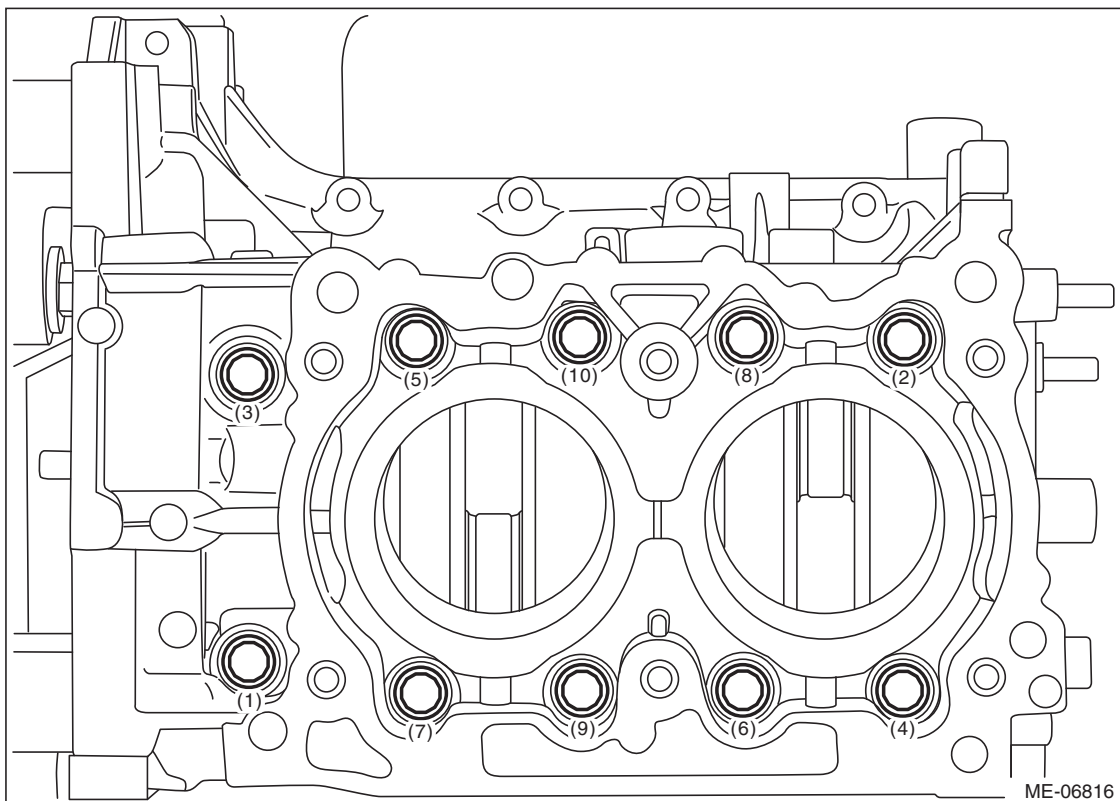
Cylinder Block

MECHANICAL

- (2) Remove the bolt shown in the figure.



- (3) Loosen the cylinder block mounting bolts in numerical order as shown in the figure.



Cylinder Block

MECHANICAL

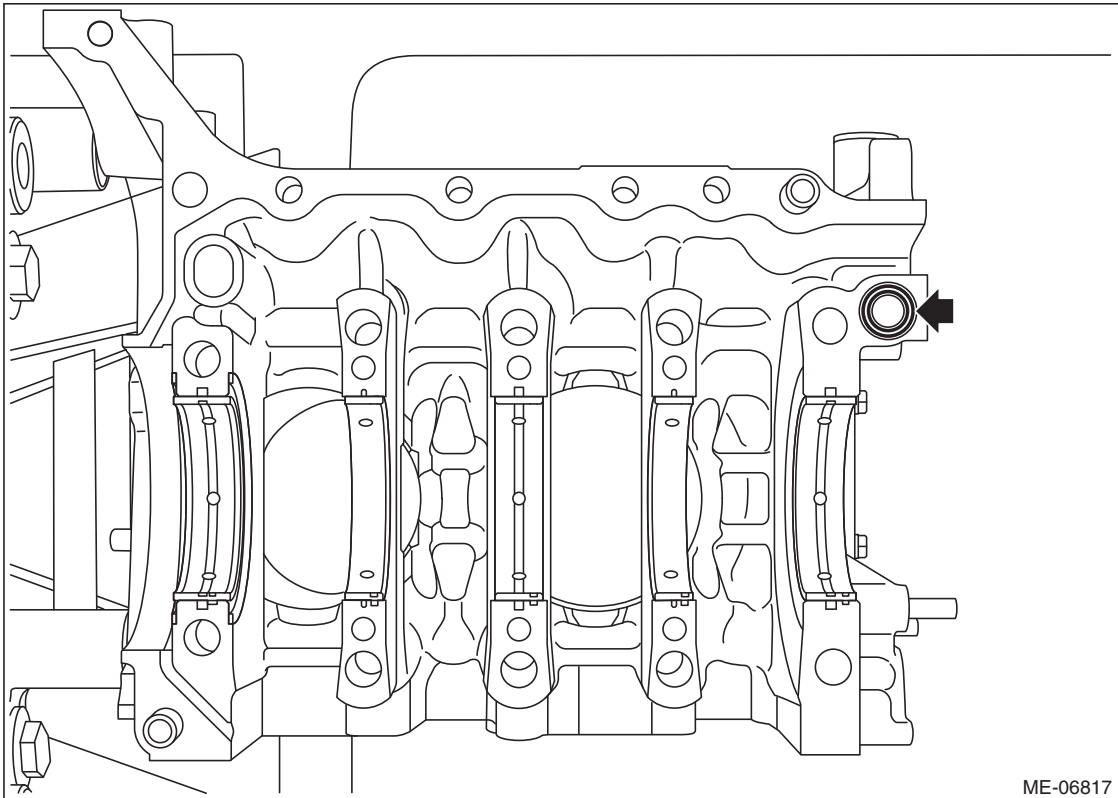
- (4) While tapping the cylinder block RH with a plastic hammer, separate the cylinder block RH from the cylinder block LH.

NOTE:

Lift the cylinder block RH gradually, 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.

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

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



ME-06817

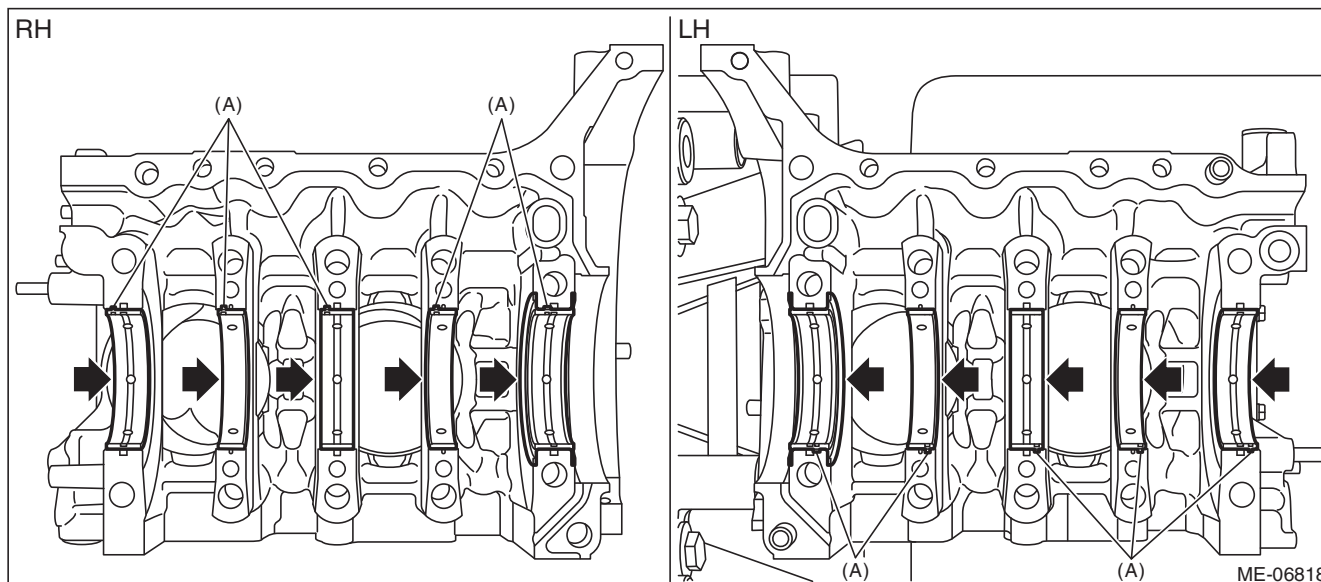
Cylinder Block

MECHANICAL

27) 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).



28) Remove the liquid gasket from cylinder block.

29) Remove the cylinder block LH from the engine stand.

B: INSTALLATION

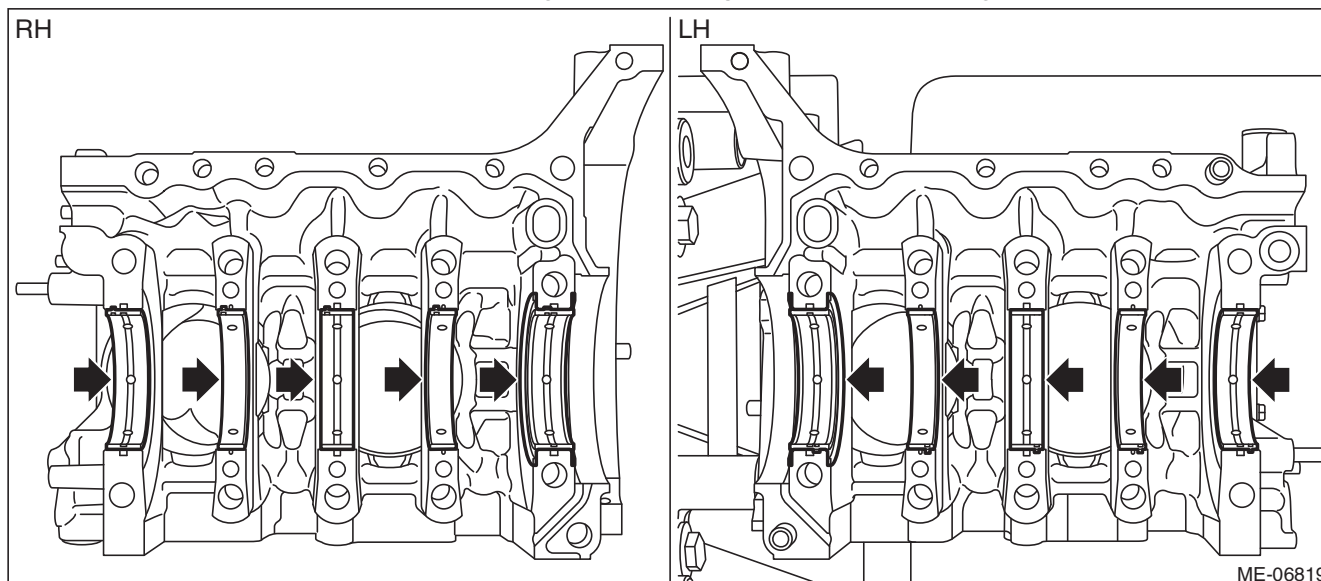
1) Install the cylinder block LH to the engine stand.

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

CAUTION:

When performing the operation of the cylinder block RH, be careful of the following.

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



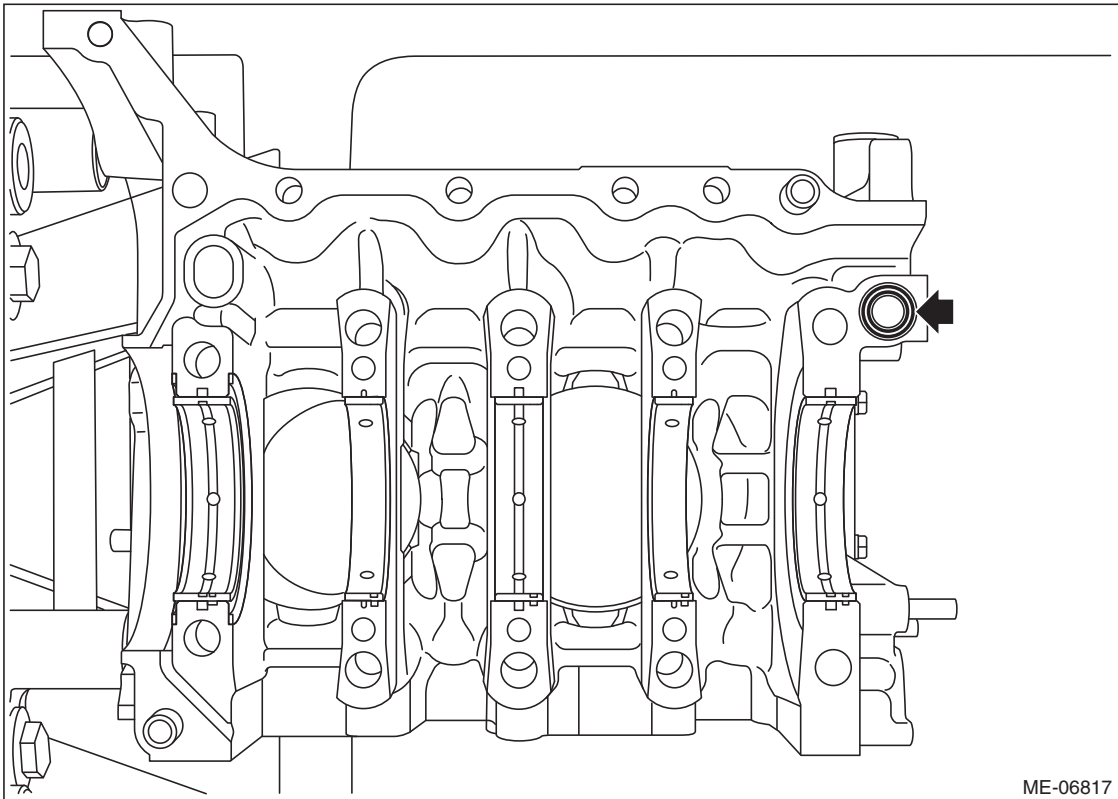
Cylinder Block

MECHANICAL

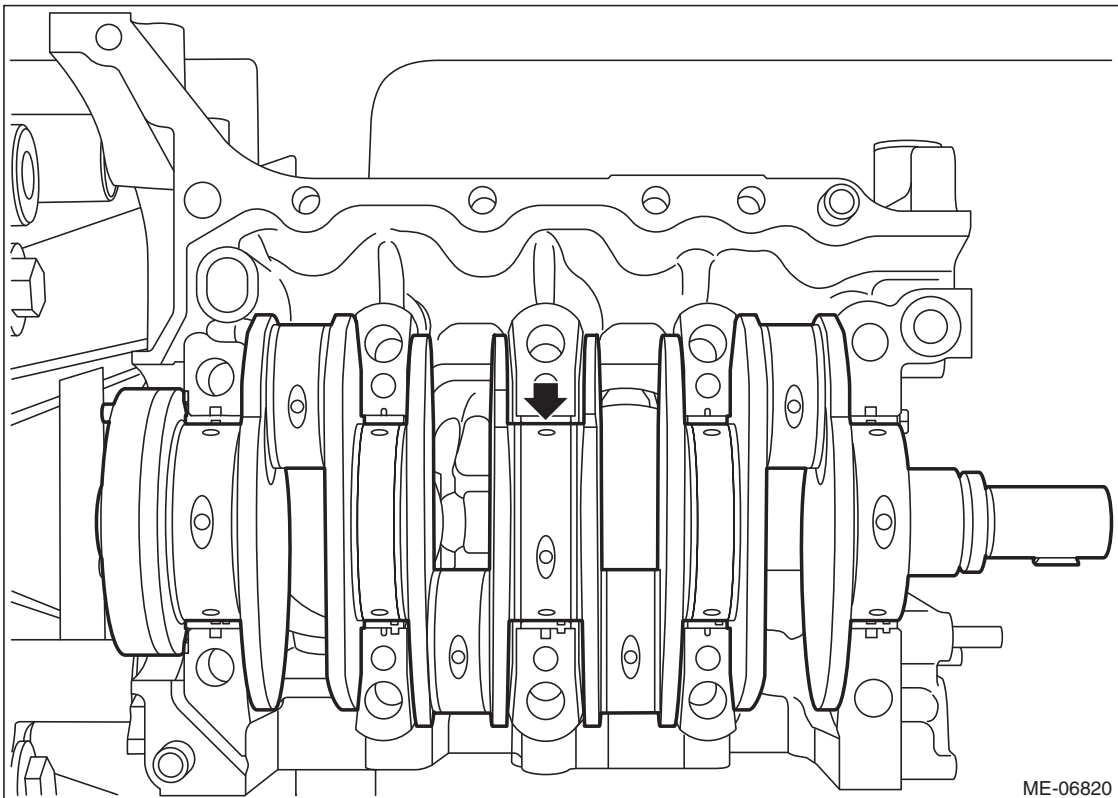
3) Install O-rings to the cylinder block LH.

NOTE:

Use new O-rings.



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



ME(H4DOTC)-280

Cylinder Block

MECHANICAL

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

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.
- 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, B and C

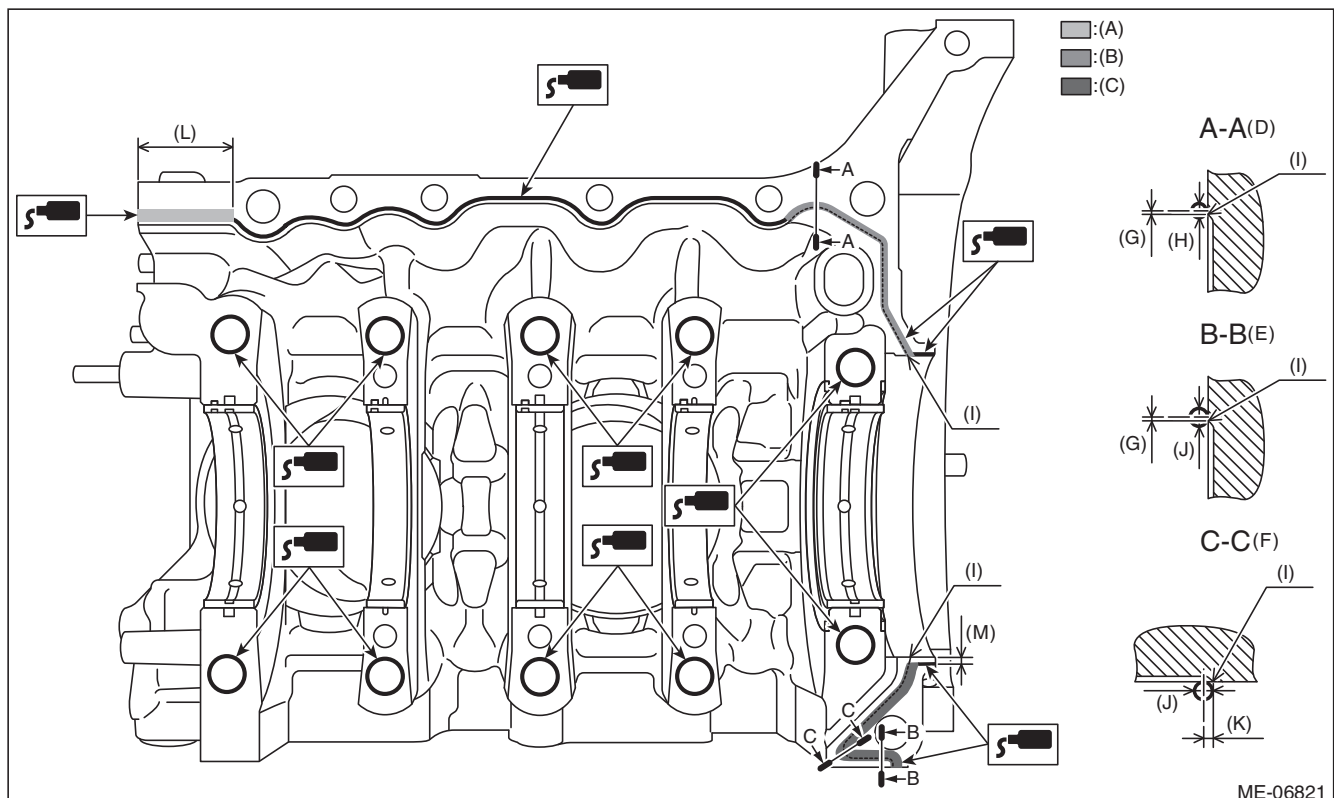
1±0.5 mm (0.0394±0.0197 in)

Mating surfaces of ranges A and C

4±0.5 mm (0.1575±0.0197 in)

Mating surfaces of range B

3.2±0.5 mm (0.1260±0.0197 in)



- | | | |
|---|--|--|
| (A) Range A | (F) Liquid gasket applying position of mating surfaces (the edge) of range C | (I) Chamfer edge |
| (B) Range B | (G) 1 mm (0.0394 in) or less | (J) $\phi 4 \pm 0.5$ mm (0.1575±0.0197 in) |
| (C) Range C | (H) $\phi 3.2 \pm 0.5$ mm (0.1260±0.0197 in) | (K) 2 mm (0.0787 in) |
| (D) Liquid gasket applying position of mating surfaces of range B | | (L) 36 mm (1.4173 in) |
| (E) Liquid gasket applying position of mating surfaces (other than the edge) of range C | | (M) 2.5 mm (0.0984 in) |

ME(H4DOTC)-281

Cylinder Block

MECHANICAL

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

7) Join the cylinder blocks.

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

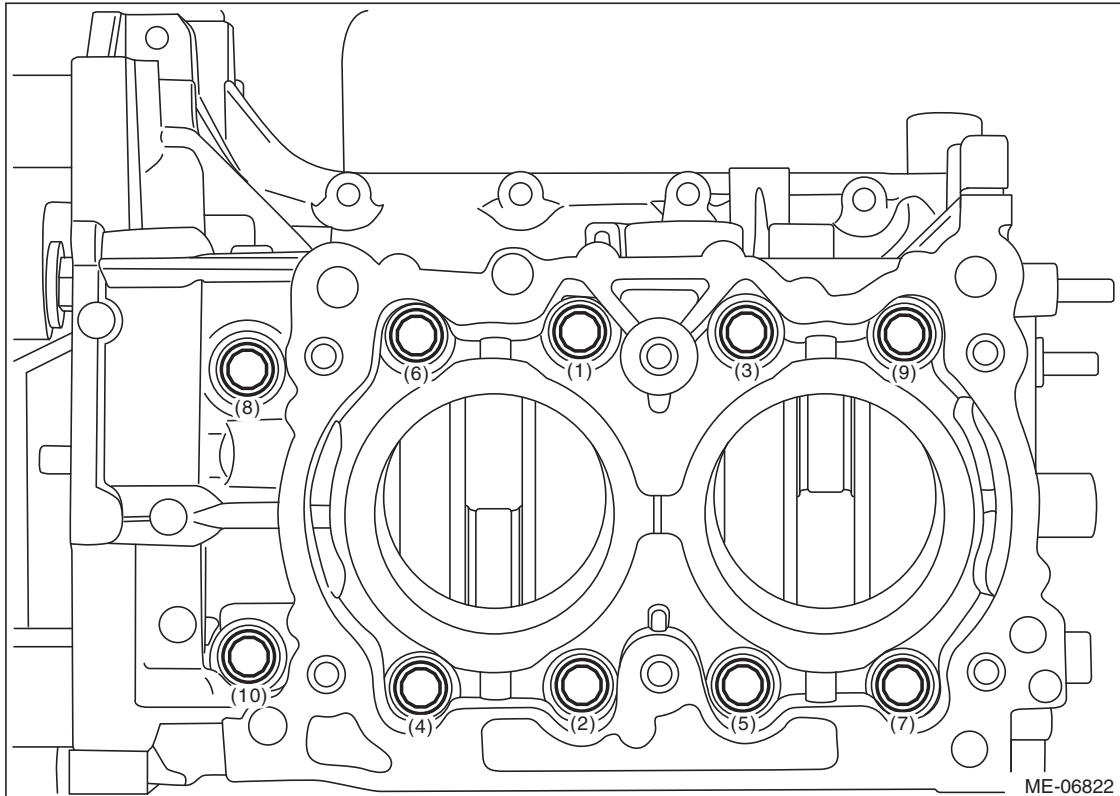
NOTE:

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

(2) 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.



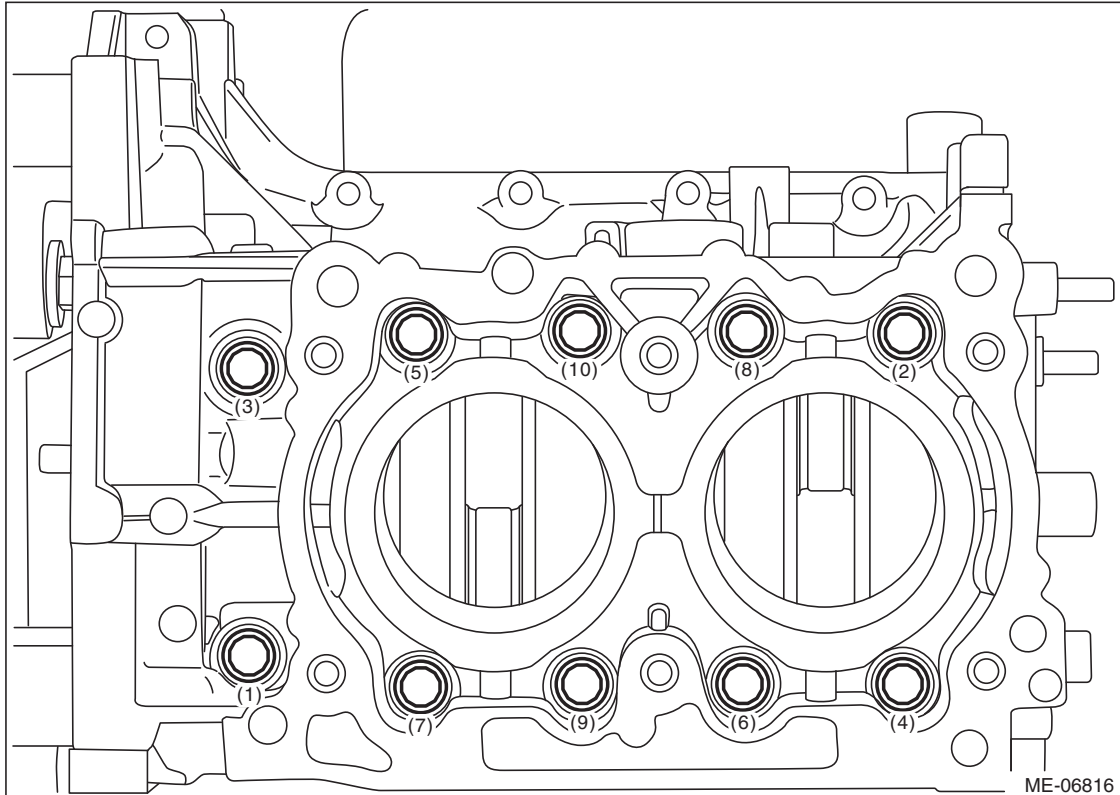
Cylinder Block

MECHANICAL

(3) 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.



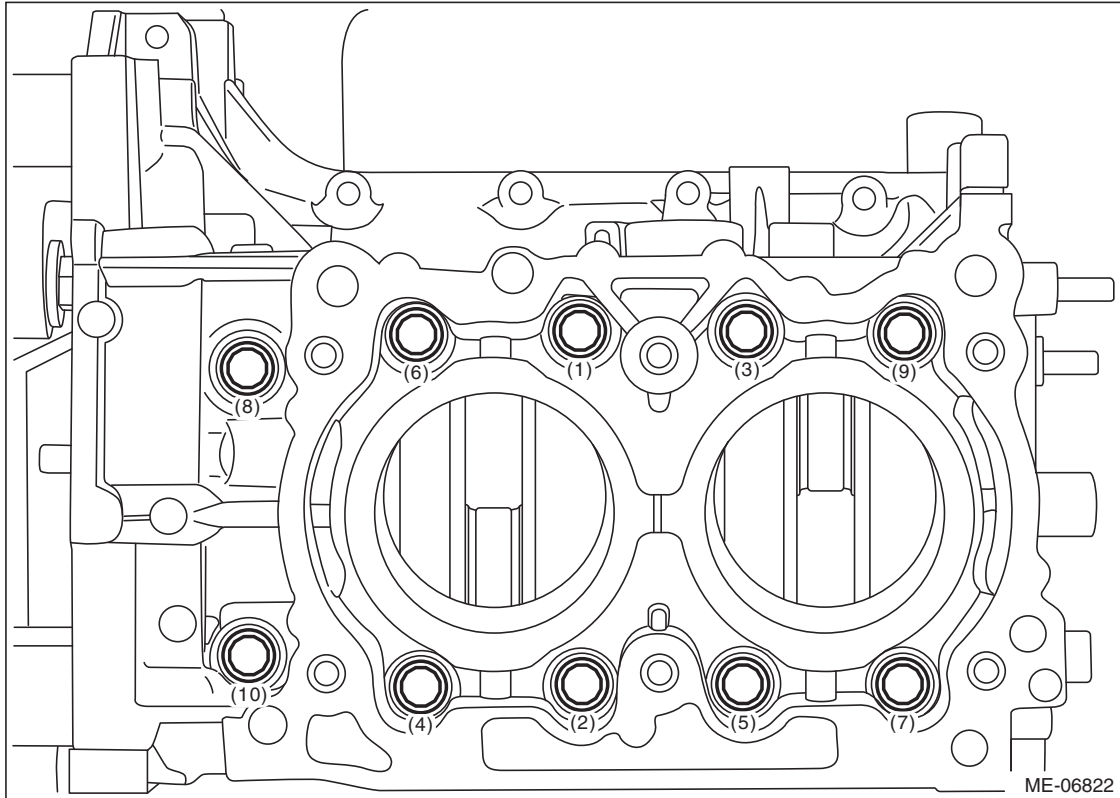
Cylinder Block

MECHANICAL

(4) 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.



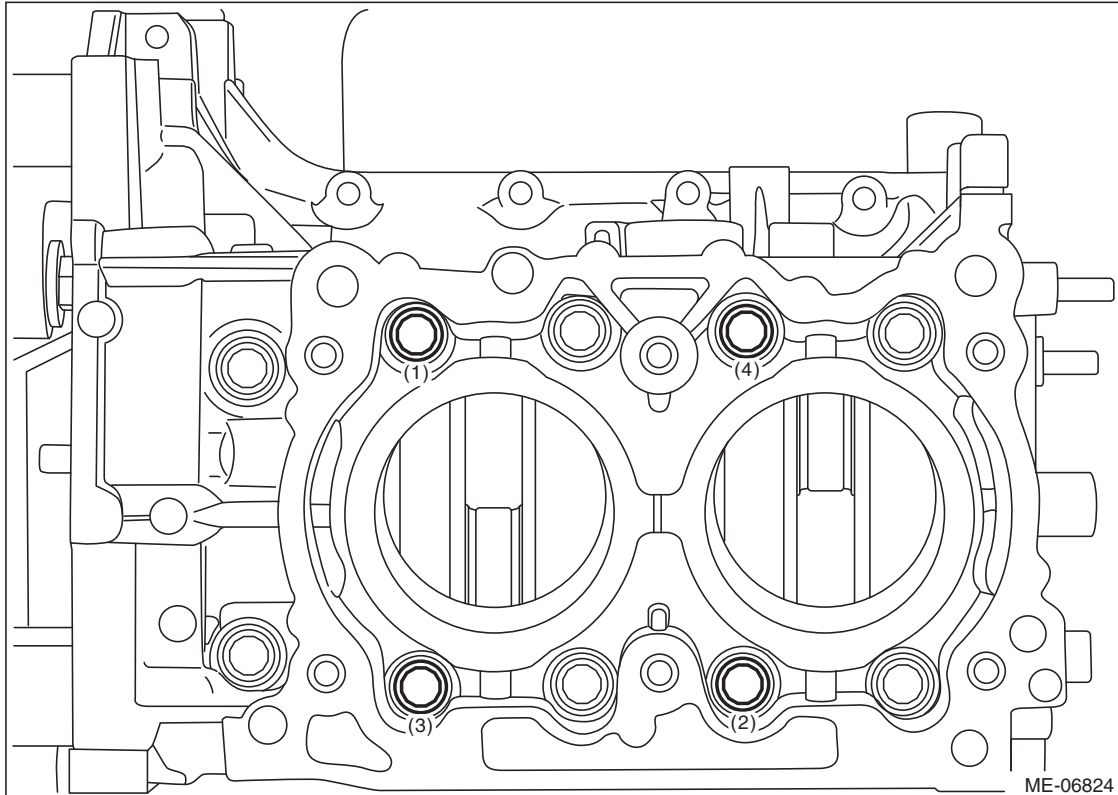
Cylinder Block

MECHANICAL

(5) 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.



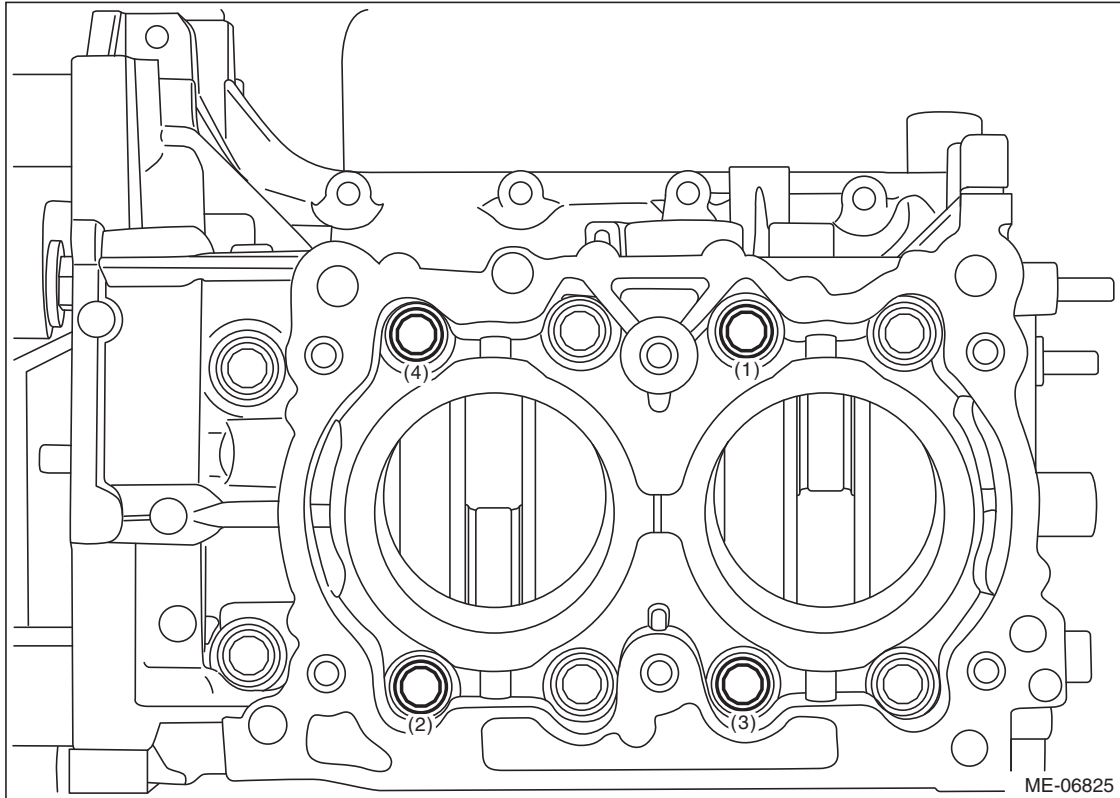
Cylinder Block

MECHANICAL

(6) 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

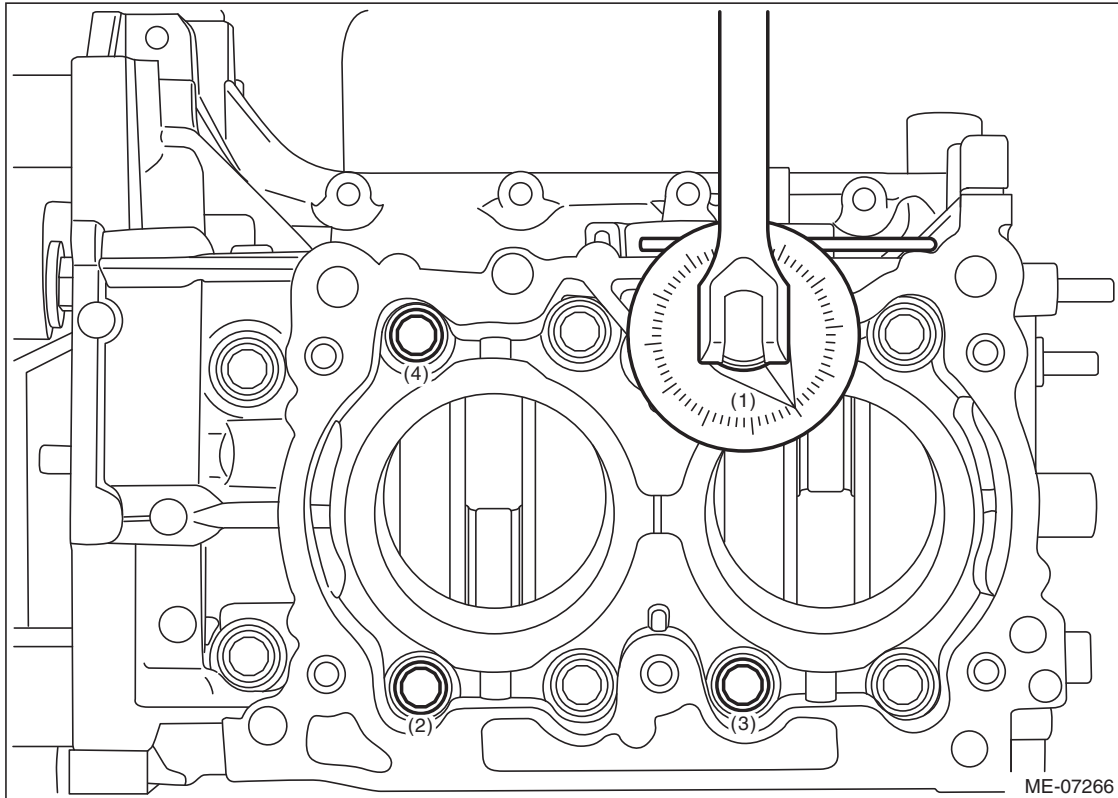
(7) Using angle gauge, tighten the mounting bolts (4 places) with specified angle in numerical order as shown in the figure.

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.

Tightening angle:

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



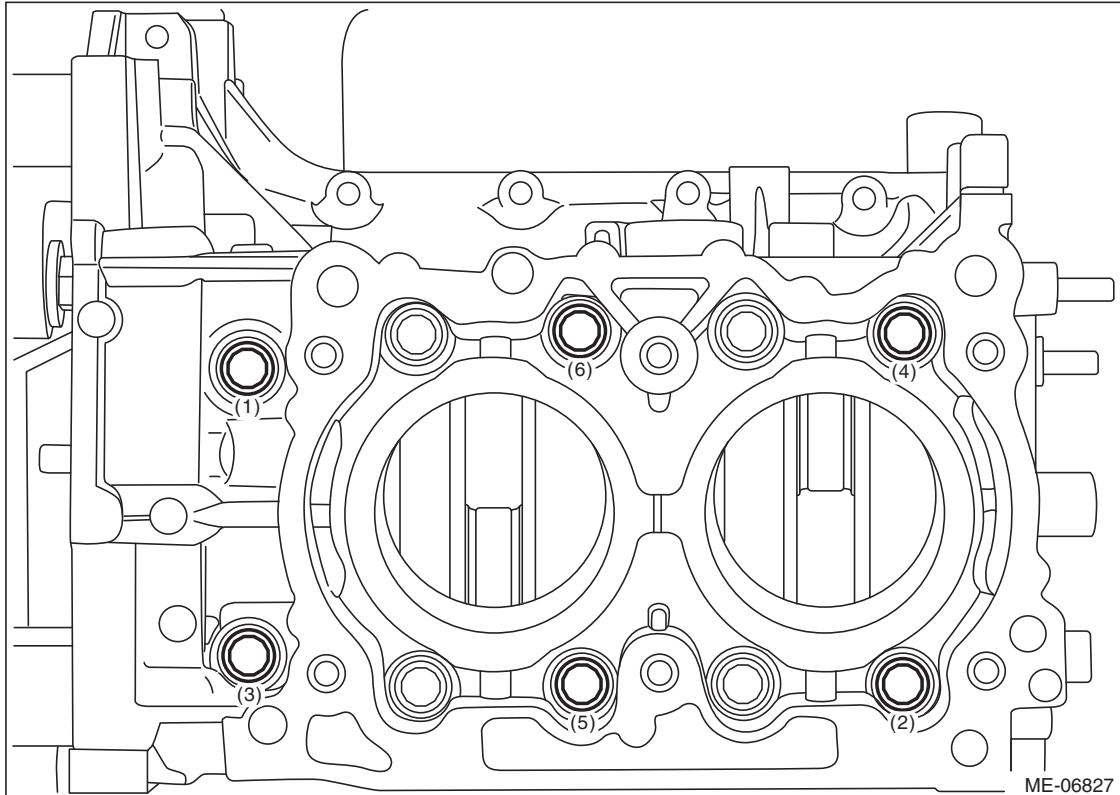
Cylinder Block

MECHANICAL

(8) 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.



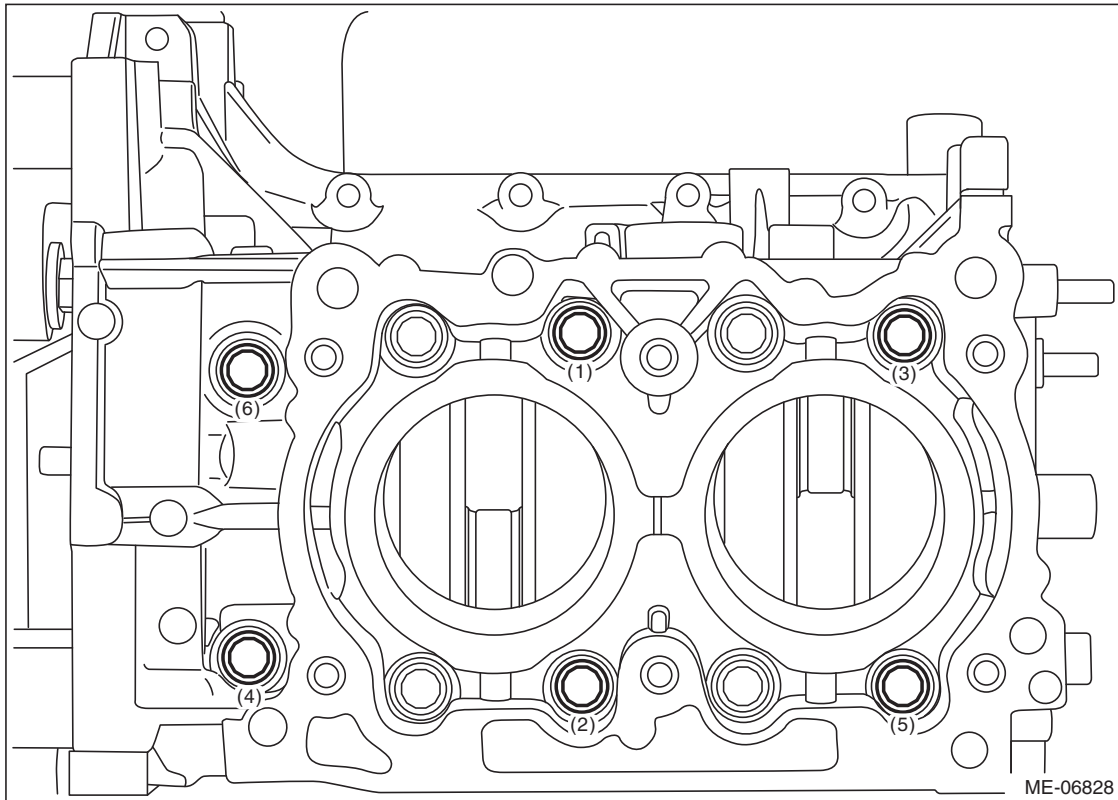
Cylinder Block

MECHANICAL

(9) 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.



Cylinder Block

MECHANICAL

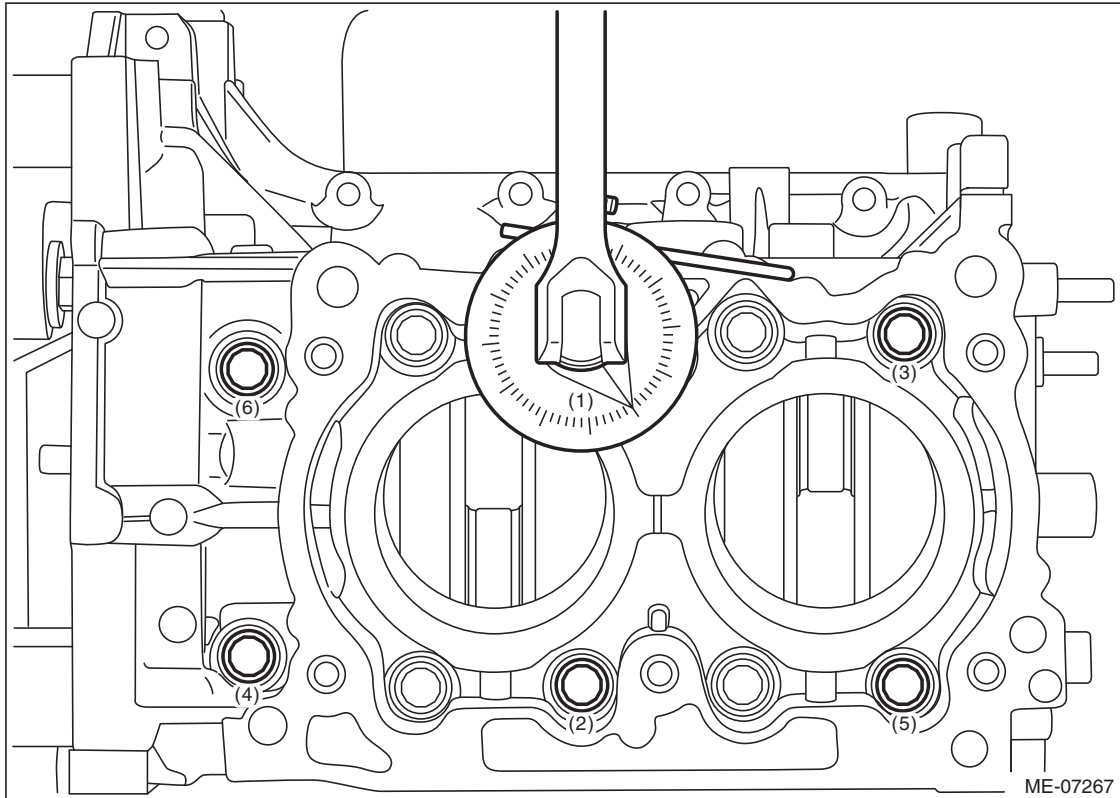
(10) Using angle gauge, tighten the mounting bolts (6 places) with specified angle in numerical order as shown in the figure.

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.

Tightening angle:

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



Cylinder Block

MECHANICAL

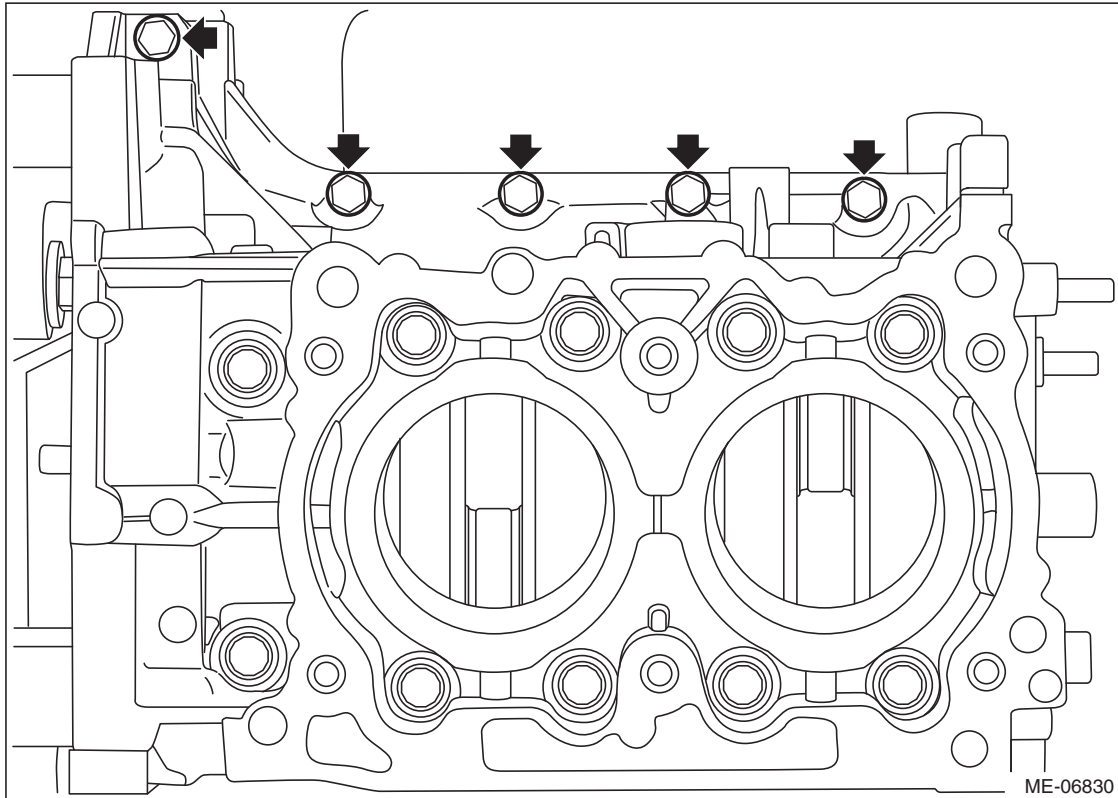
(11) Install the bolt shown in the figure.

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)



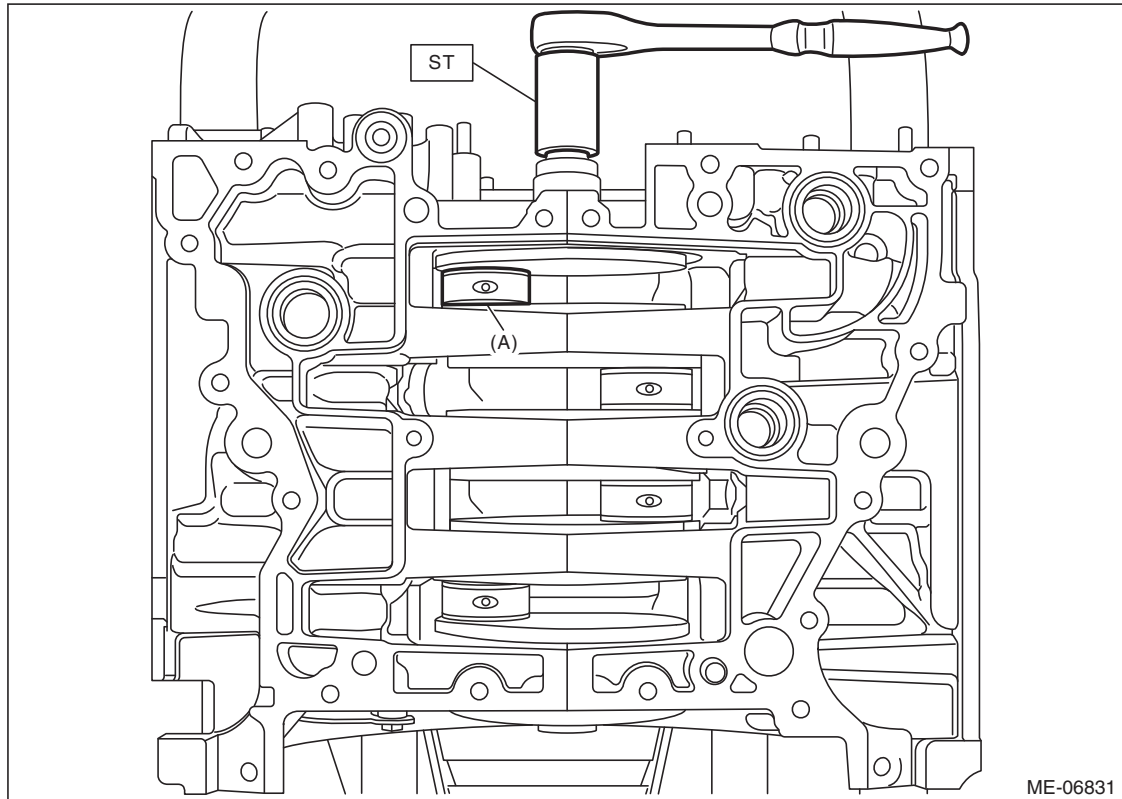
8) Set the part so that the installation surface of the oil pan upper is on the upper side.

9) Check that the piston ring gap for each piston is positioned correctly. <Ref. to ME(H4DOTC)-315, PISTON AND CONNECTING ROD, ASSEMBLY, Cylinder Block.>

Cylinder Block

MECHANICAL

- 10) 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



Cylinder Block

MECHANICAL

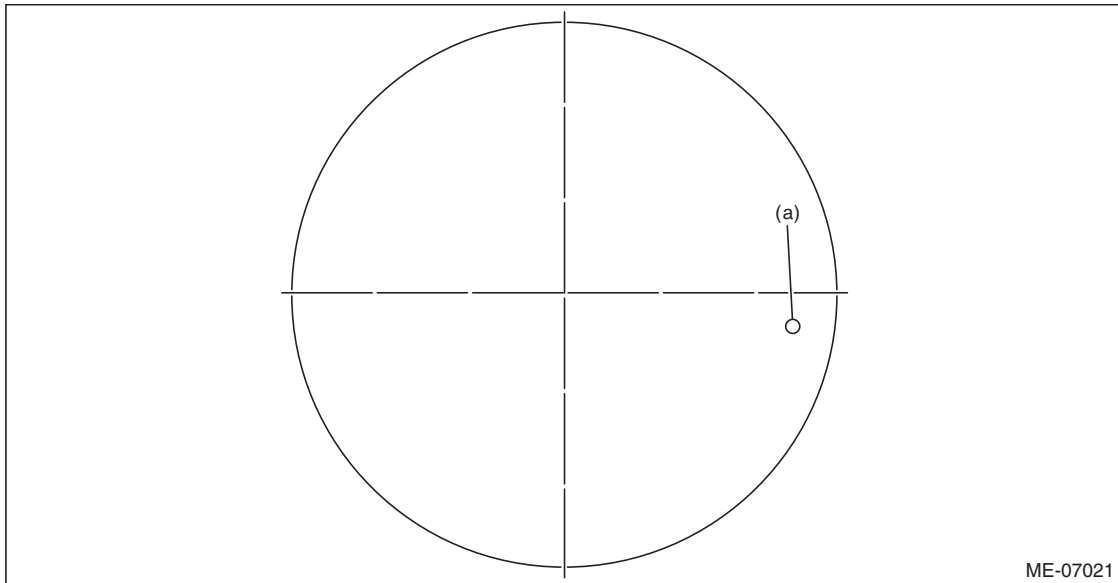
(3) Compress the piston ring using piston ring compressor, and insert the #1 connecting rod with #1 piston into cylinder block.

CAUTION:

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

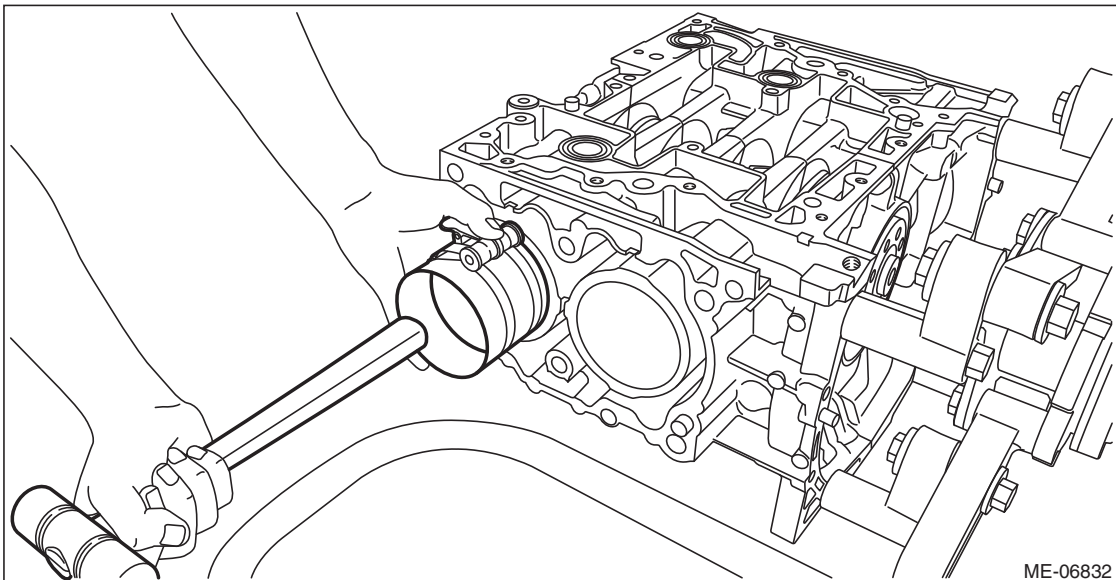
NOTE:

- 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

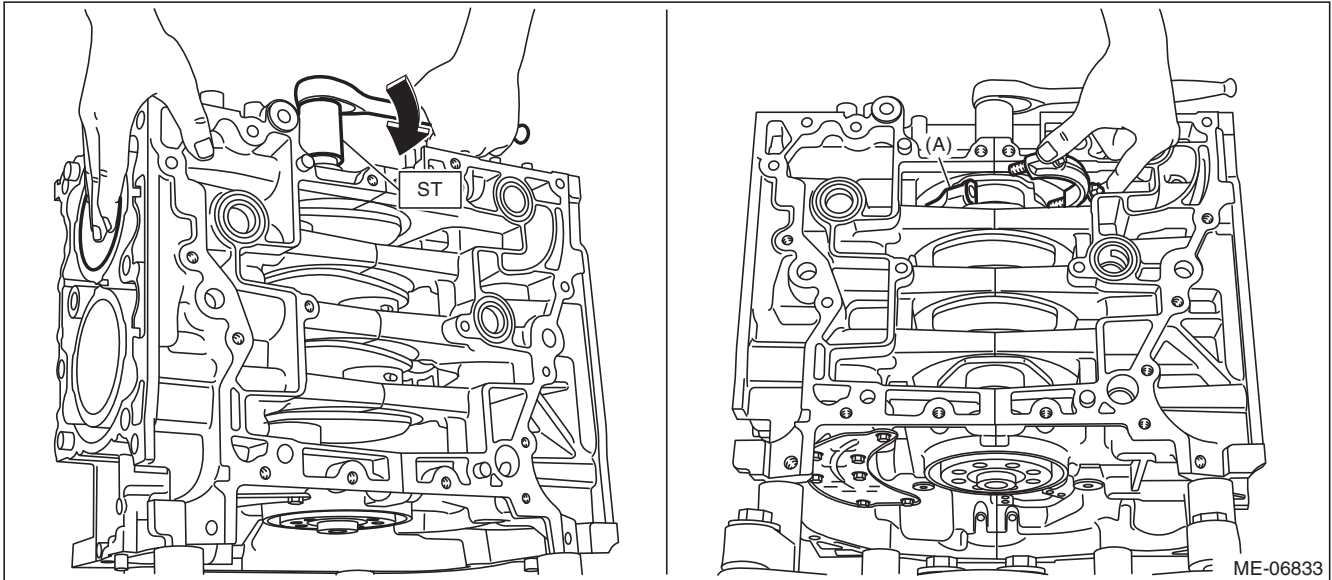
MECHANICAL

(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

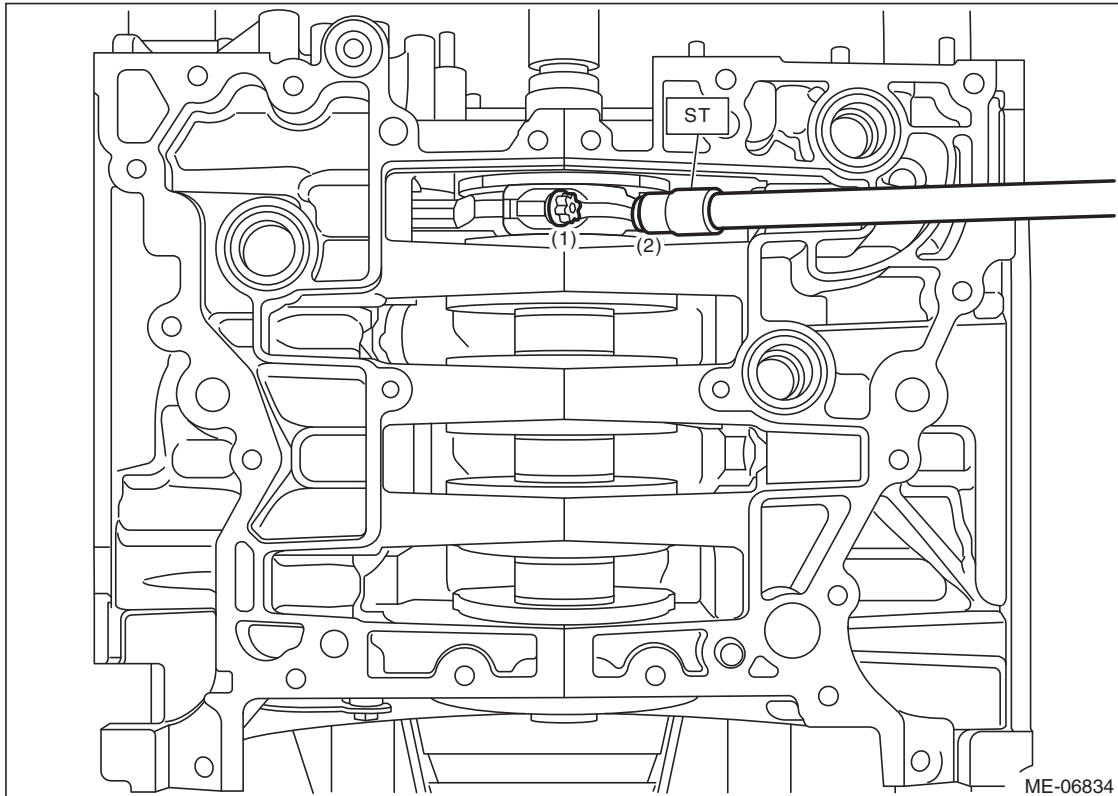


Cylinder Block

MECHANICAL

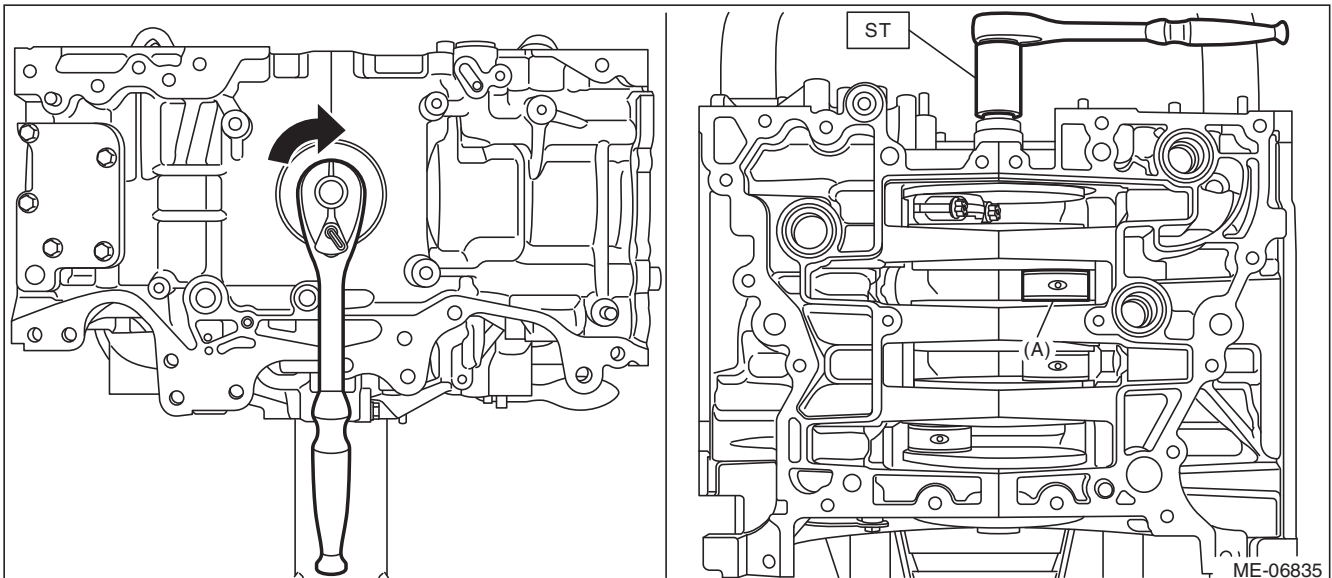
(5) Using ST, tighten the #1 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 25 N·m (2.5 kgf-m, 18.4 ft-lb) in numerical order as shown in the figure.

ST 18270AA020 SOCKET



(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

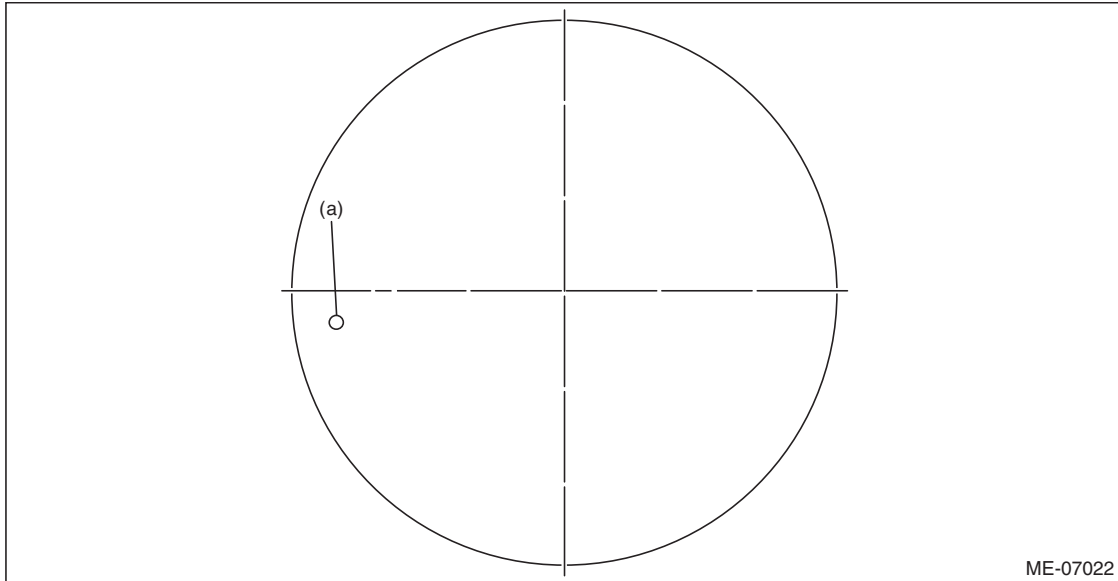
(7) Compress the piston ring using piston ring compressor, and insert the #2 connecting rod with #2 piston into cylinder block.

CAUTION:

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

NOTE:

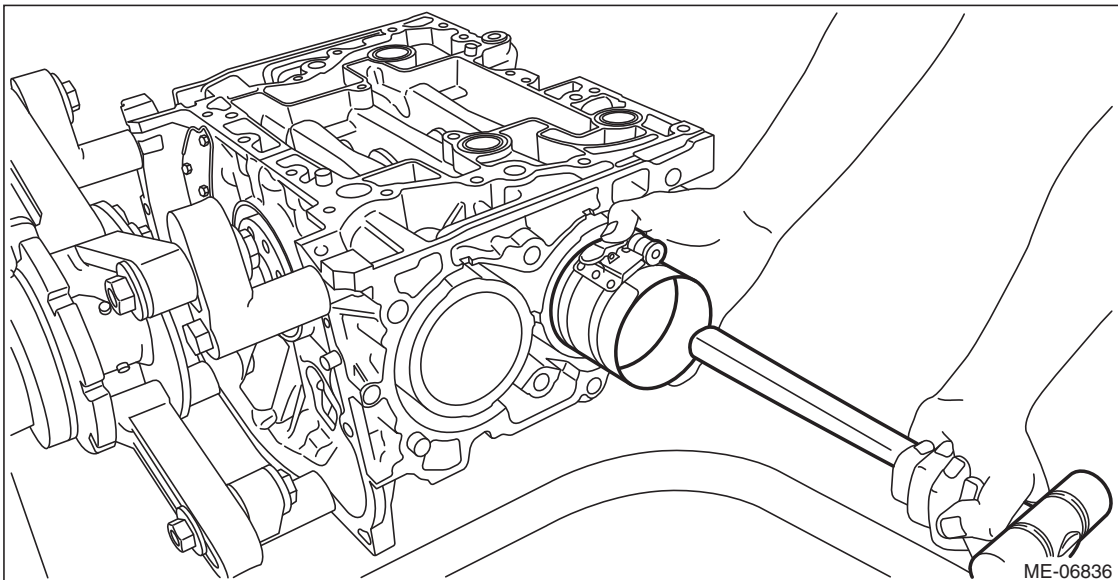
- Face the piston front mark (round mark) towards the front of the engine.



ME-07022

(a) Front mark

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



ME-06836



Cylinder Block

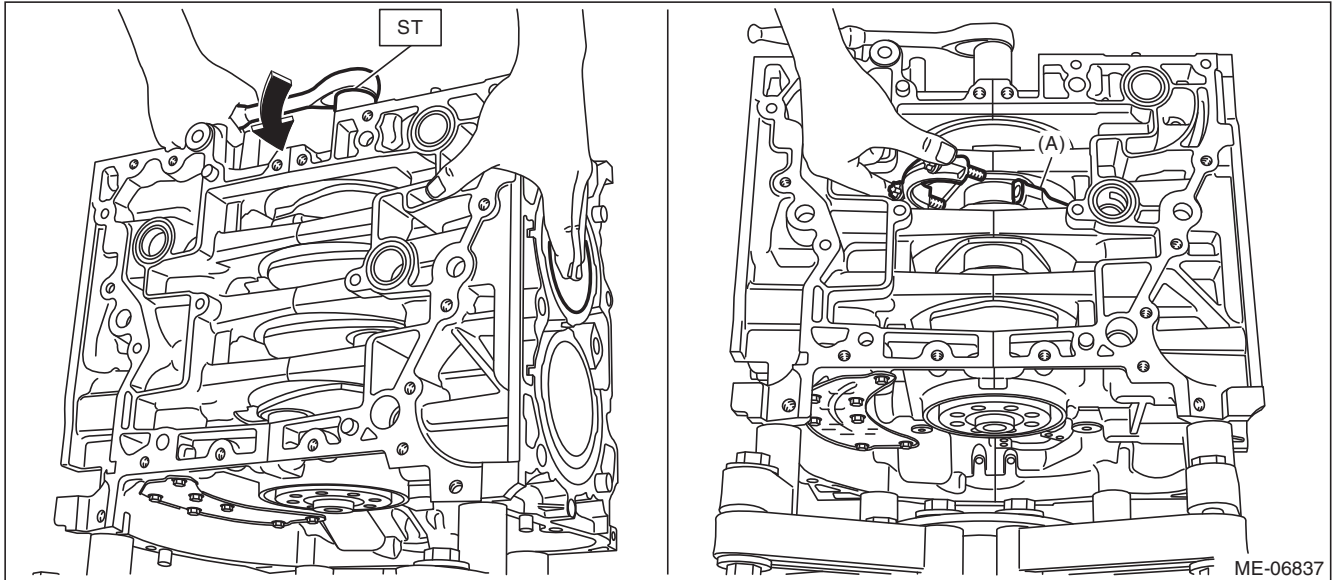
MECHANICAL

(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

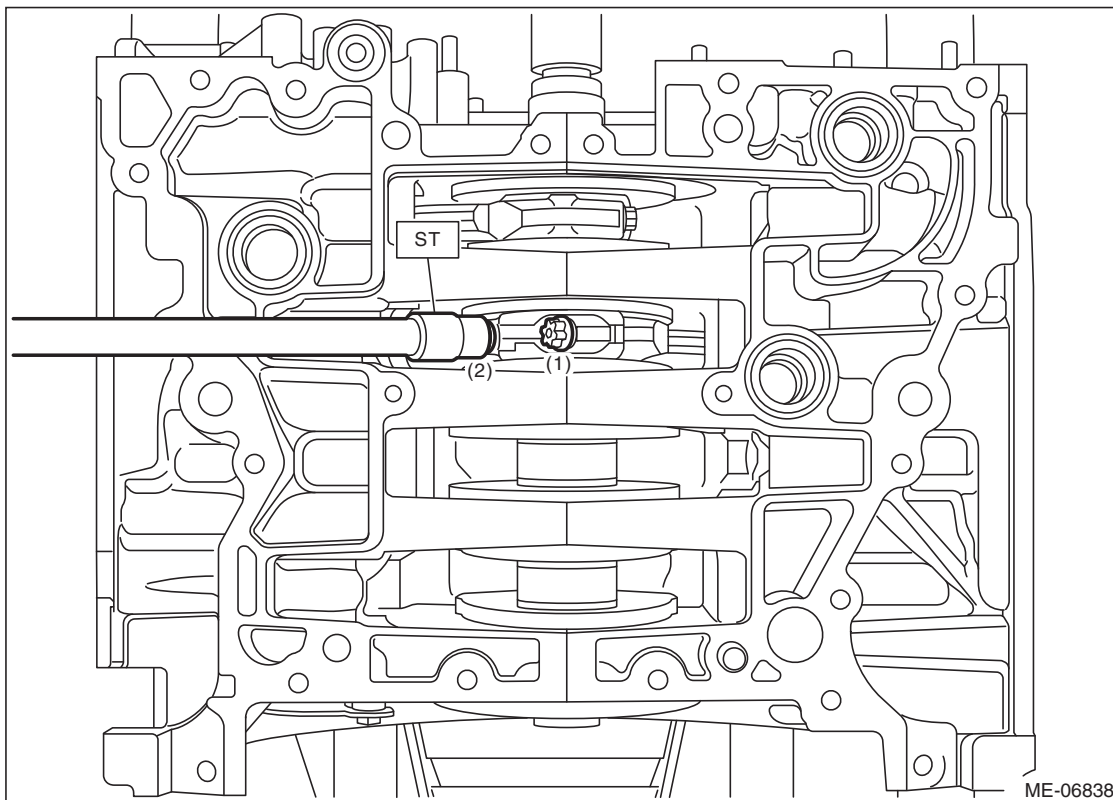


Cylinder Block

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 25 N·m (2.5 kgf-m, 18.4 ft-lb) in numerical order as shown in the figure.

ST 18270AA020 SOCKET



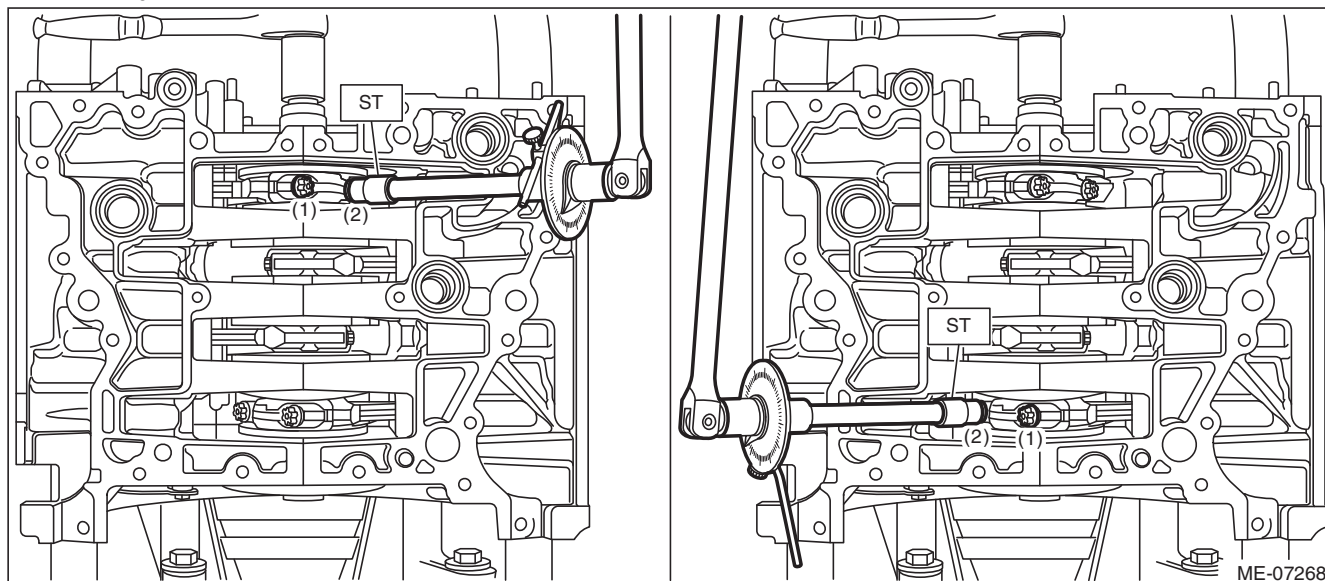
(10) Install #3 and #4 pistons and connecting rod caps in the same installation procedure as #1 and 2# pistons and connecting rod caps.

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

ST 18270AA020 SOCKET

Tightening angle:

$90^{+5}_{-0}^{\circ}$

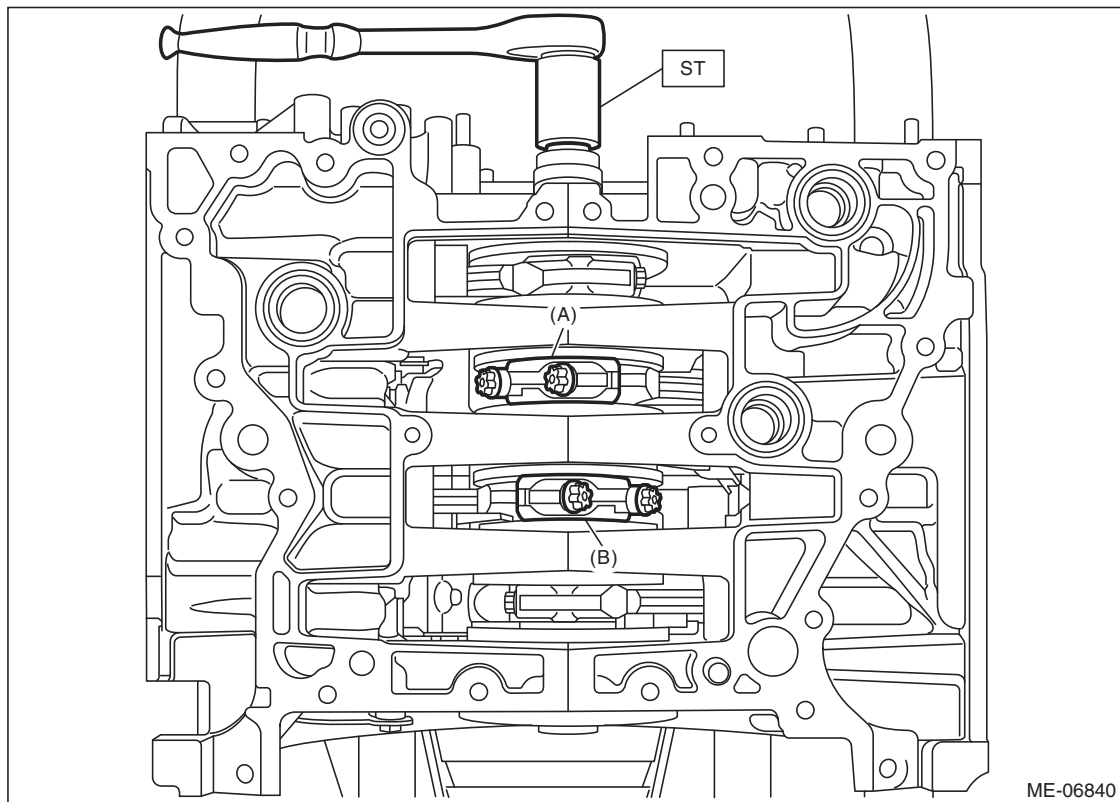


Cylinder Block

MECHANICAL

(12) 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

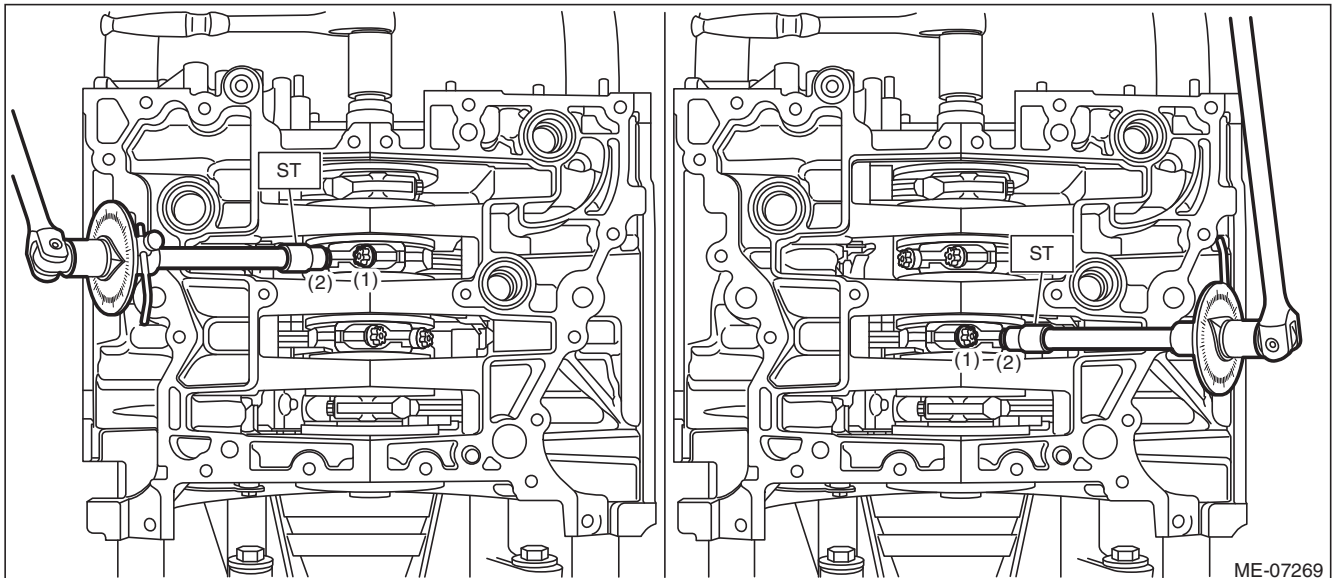


(13) Using ST and angle gauge, tighten the #2 connecting rod cap bolts and #3 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

ST 18270AA020 SOCKET

Tightening angle:

$90^{+5}_{-0}^{\circ}$



Cylinder Block

MECHANICAL

11) 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:

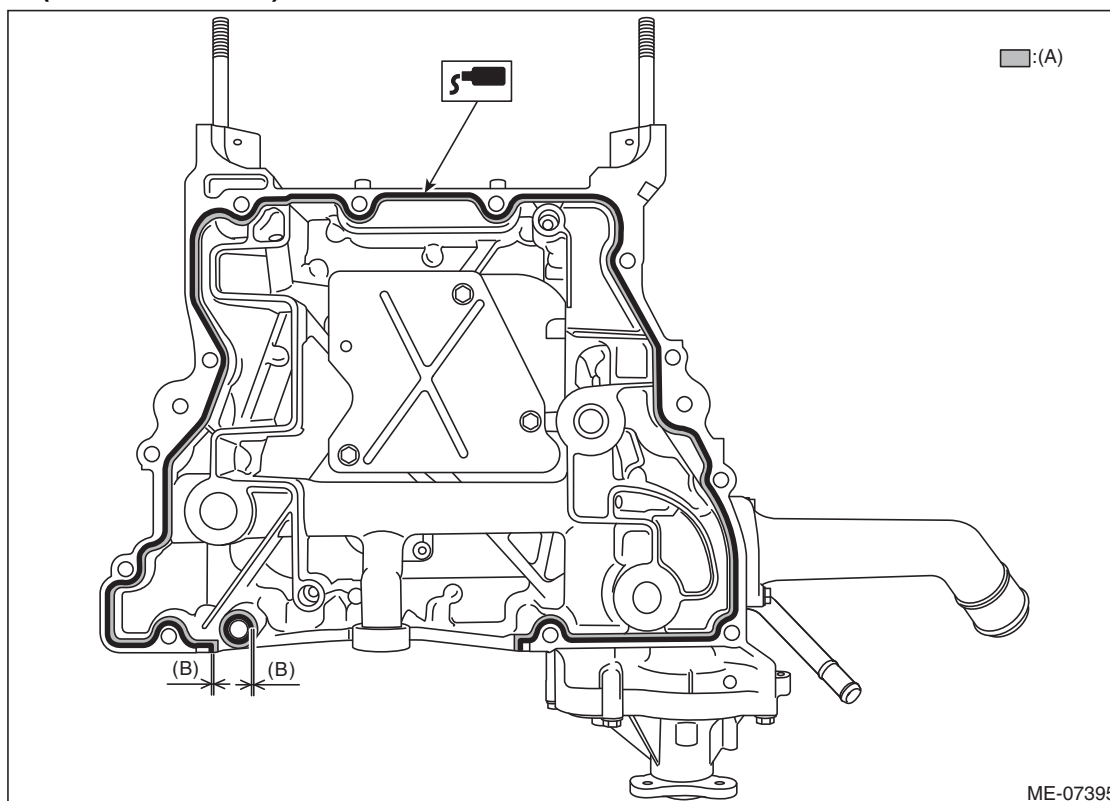
- Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder block and the oil pan upper.
- Install within 5 min. after applying liquid gasket.
- Apply liquid gasket 1.5 mm (0.0591 in) outside from the chamfer surface. However, application of liquid gasket on the chamfer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

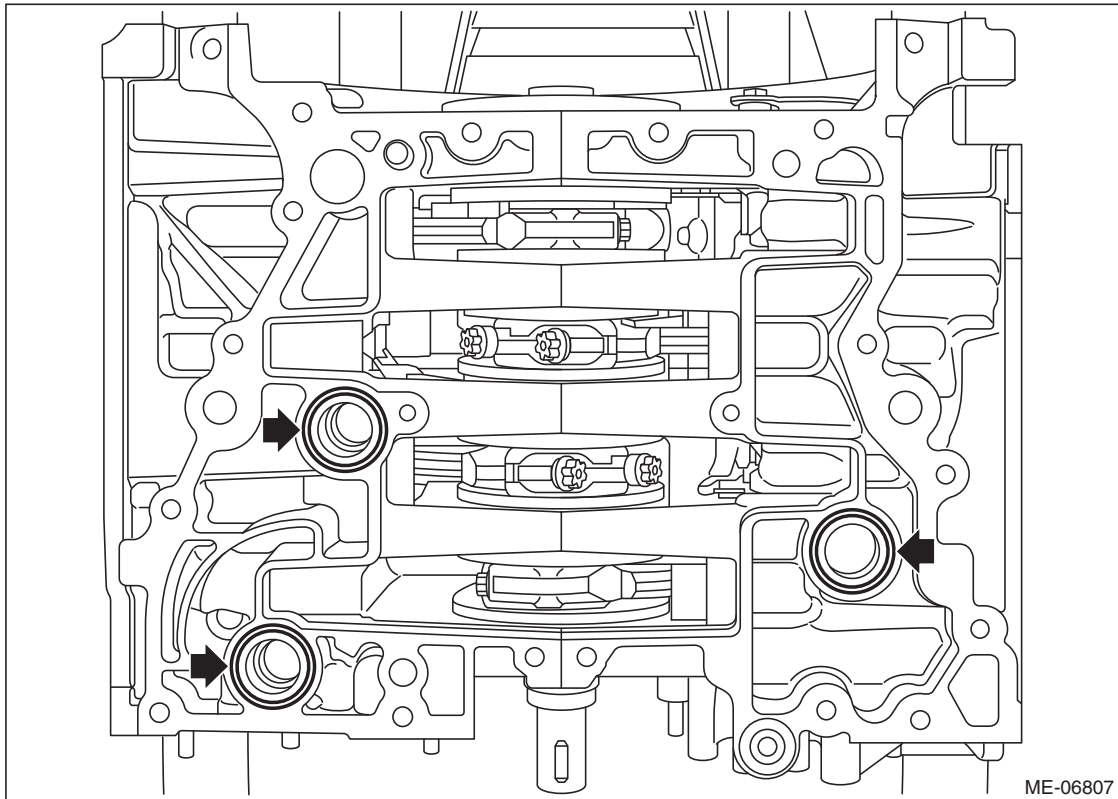
Cylinder Block

MECHANICAL

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

NOTE:

Use new O-rings.



Cylinder Block

MECHANICAL

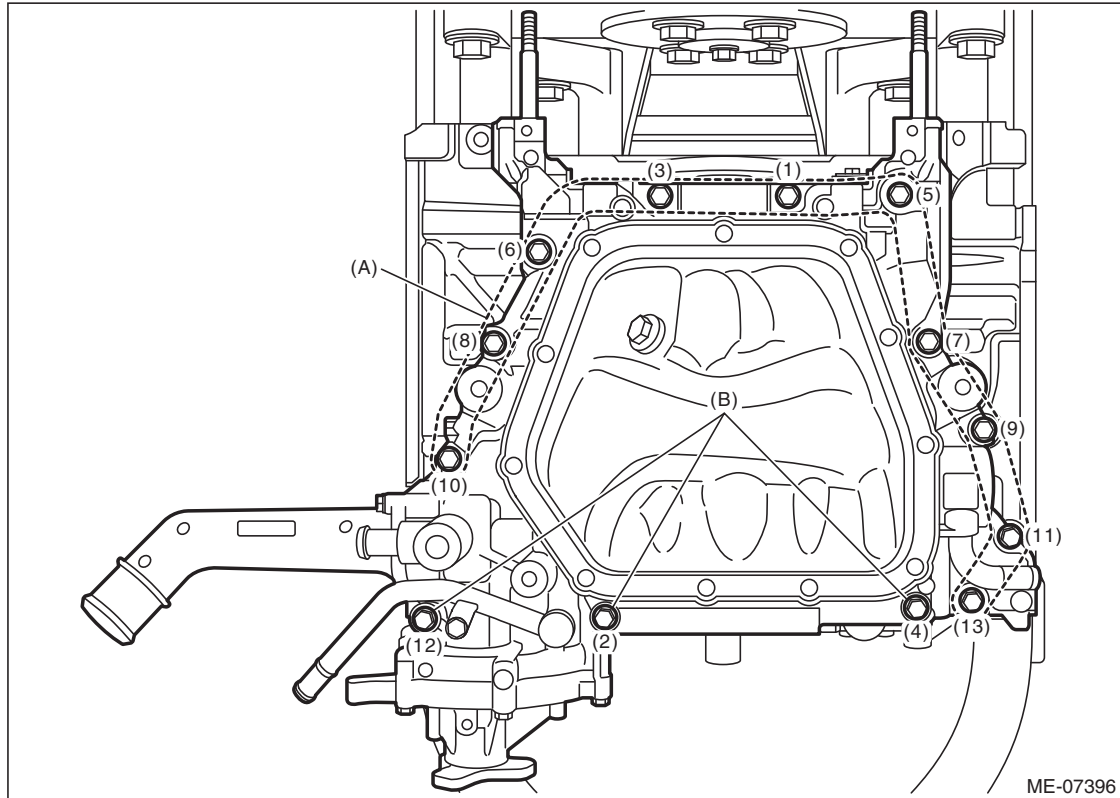
(3) Set the oil pan with oil pan upper to the cylinder block, and tighten the bolts in numerical order as shown in the figure.

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

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

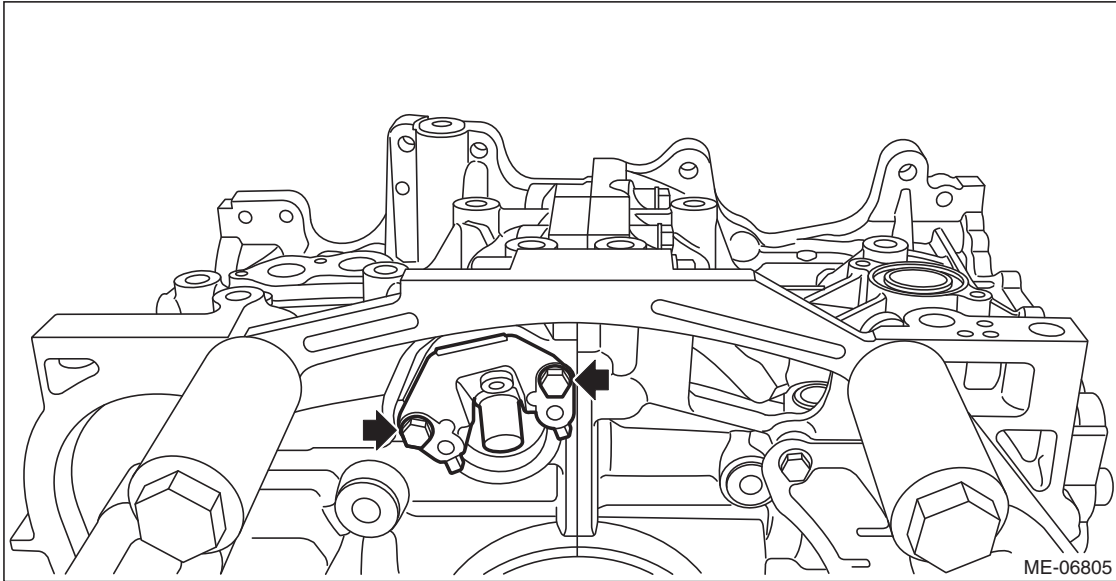
Cylinder Block

MECHANICAL

13) 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)



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

NOTE:

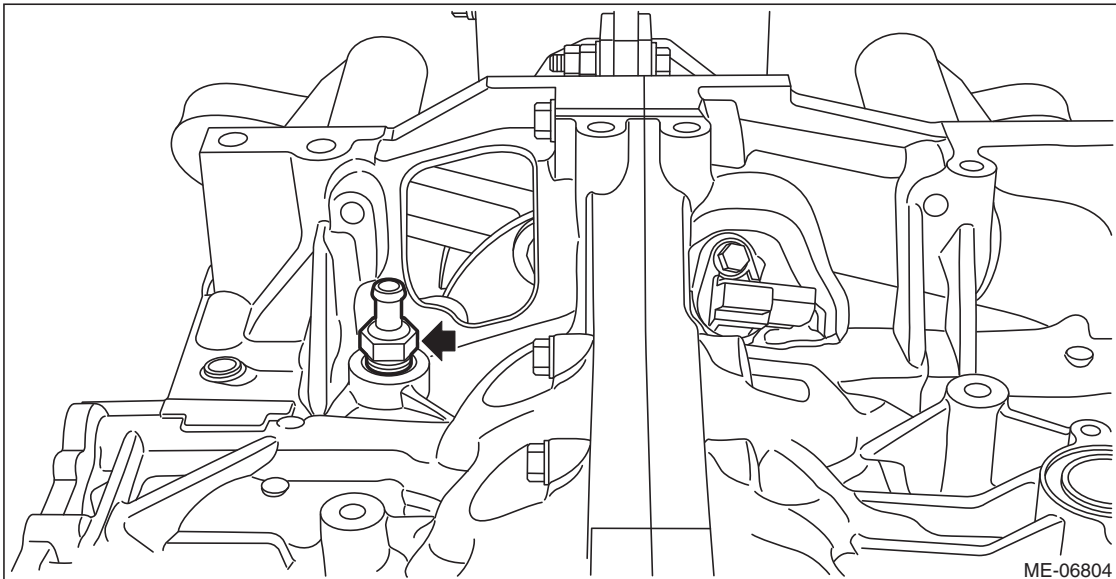
Apply liquid gasket to the bolt threads of PCV valve.

Liquid gasket:

THREE BOND 1141G or equivalent

Tightening torque:

23 N·m (2.3 kgf-m, 17.0 ft-lb)



Cylinder Block

MECHANICAL

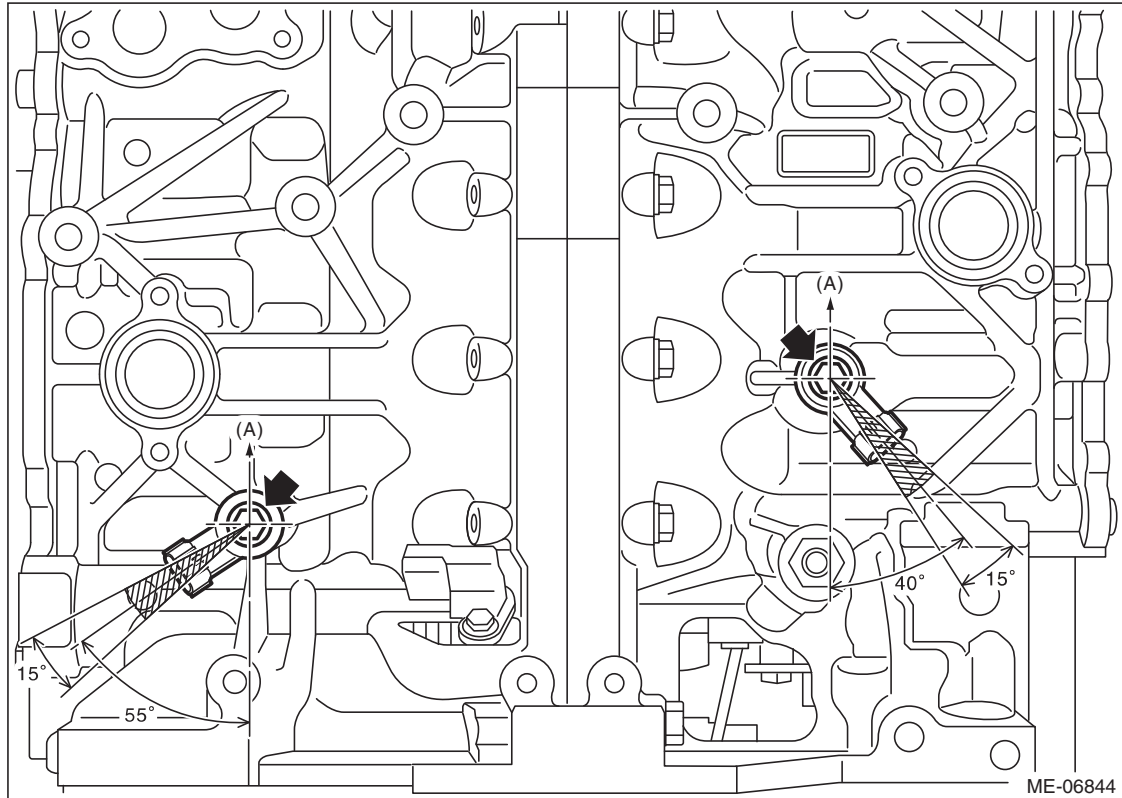
15) Install the knock sensor to the cylinder block LH.

NOTE:

Knock sensor must be positioned toward engine front so that the connector center position is within the range of shaded area shown in the figure.

Tightening torque:

24 N·m (2.4 kgf-m, 17.7 ft-lb)



(A) Front of engine

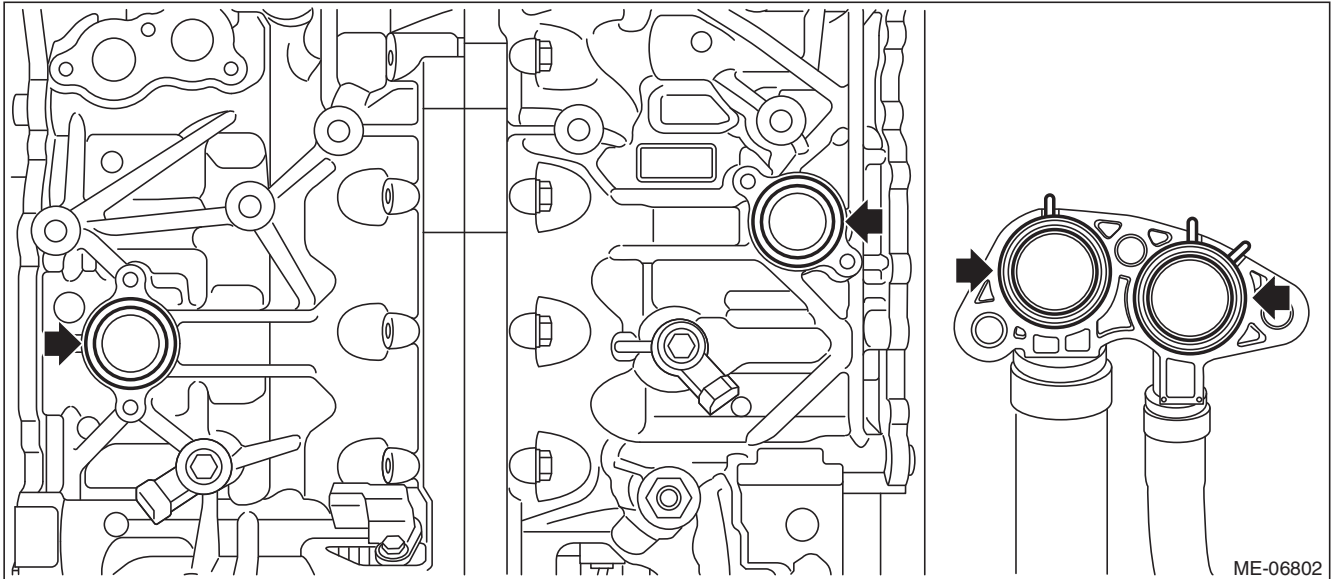
Cylinder Block

MECHANICAL

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

NOTE:

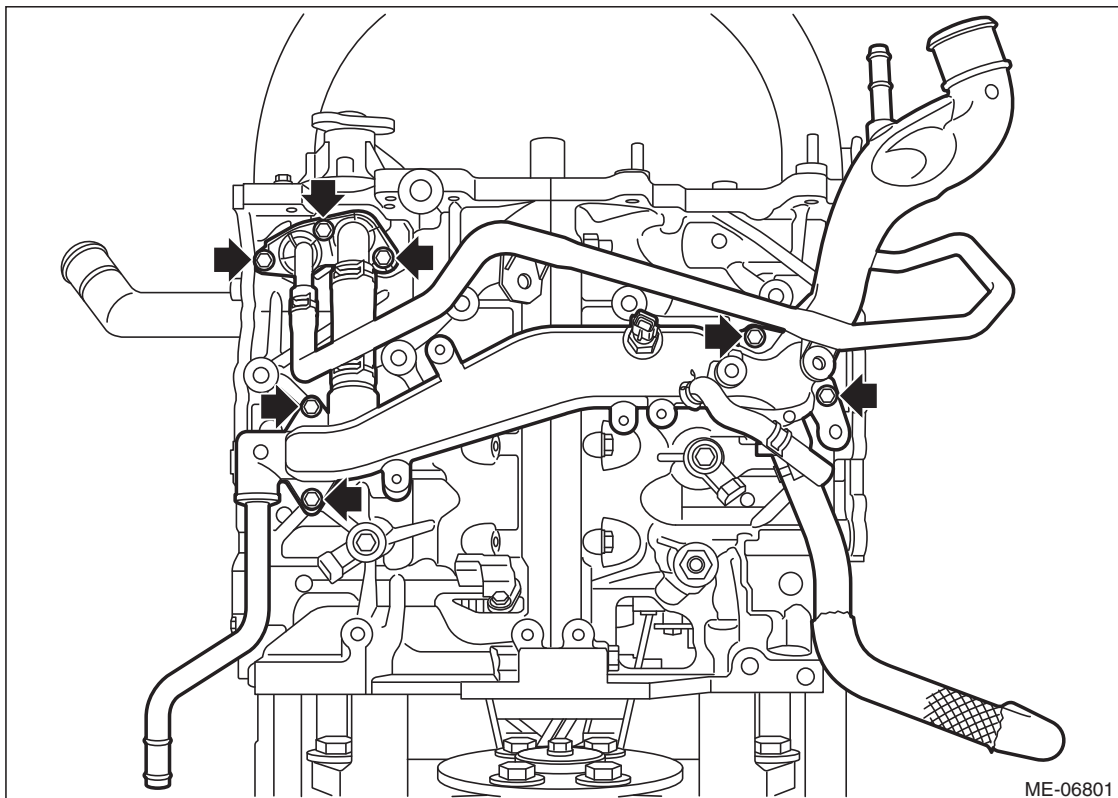
Use new O-rings.



17) 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)



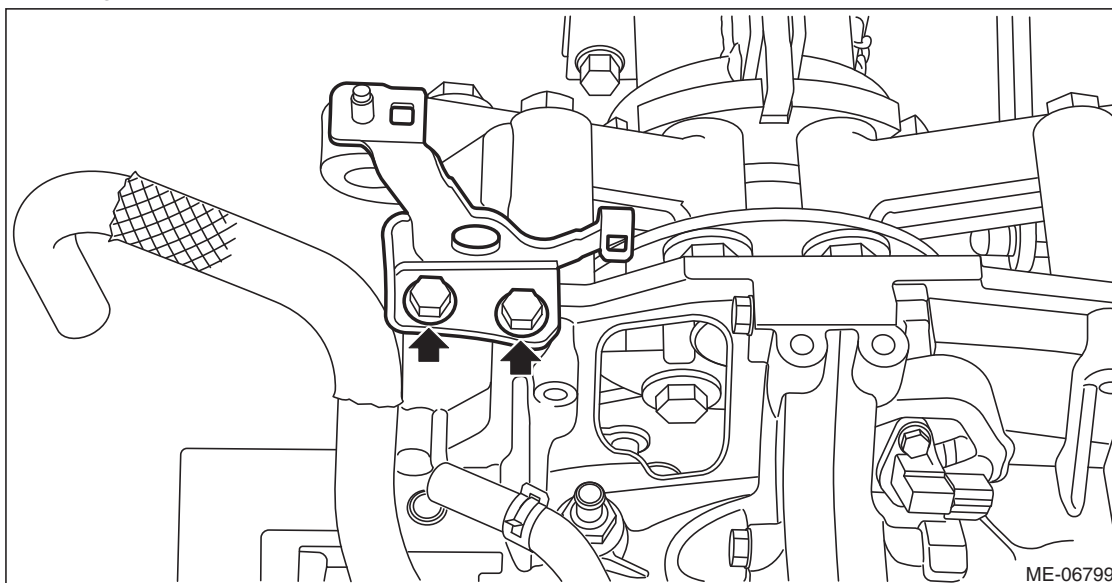
Cylinder Block

MECHANICAL

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

Tightening torque:

21 N·m (2.1 kgf-m, 15.5 ft-lb)



19) Install the crank sprocket. <Ref. to ME(H4DOTC)-145, INSTALLATION, Crank Sprocket.>

20) Install the cylinder head. <Ref. to ME(H4DOTC)-220, INSTALLATION, Cylinder Head.>

21) Install the cam carrier. <Ref. to ME(H4DOTC)-180, INSTALLATION, Cam Carrier.>

22) Install the rocker cover. <Ref. to ME(H4DOTC)-159, INSTALLATION, Rocker Cover.>

23) Install the chain cover. <Ref. to ME(H4DOTC)-97, INSTALLATION, Chain Cover.>

24) Install the engine wiring harness. <Ref. to FU(H4DOTC)-90, INSTALLATION, Engine Wiring Harness.>

25) Install the tumble generator valve assembly. <Ref. to FU(H4DO)-80, INSTALLATION, Tumble Generator Valve Assembly.>

26) Install the intake manifold. <Ref. to FU(H4DO)-29, INSTALLATION, Intake Manifold.>

Cylinder Block

MECHANICAL

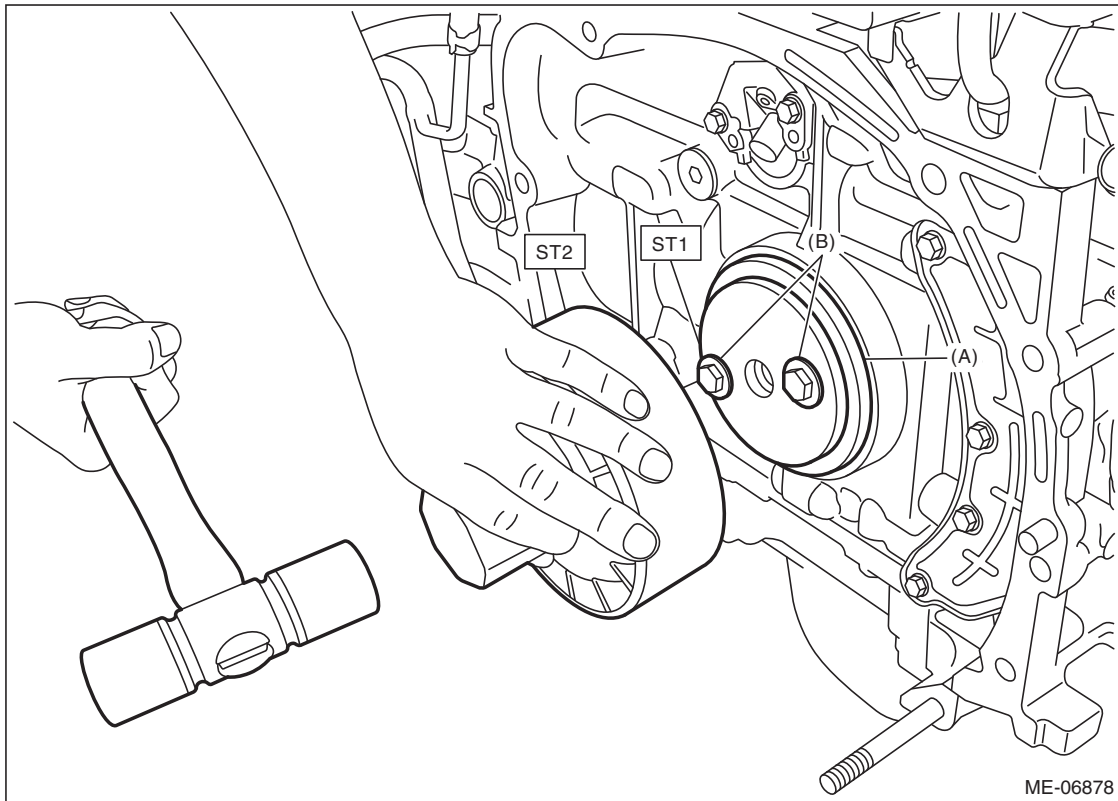
27) Apply a coat of engine oil to the oil seal inner periphery and outer periphery, and install the rear oil seal using ST1 and ST2.

NOTE:

Use a new rear oil seal.

ST1 18671AA020 OIL SEAL GUIDE

ST2 18657AA030 OIL SEAL INSTALLER



(A) Rear oil seal

(B) Drive plate mounting bolt

28) Install the crankshaft position sensor plate with drive plate. <Ref. to CVT(TR690)-134, INSTALLATION, Drive Plate.>

29) Install the engine to the vehicle. <Ref. to ME(H4DOTC)-59, INSTALLATION, Engine Assembly.>

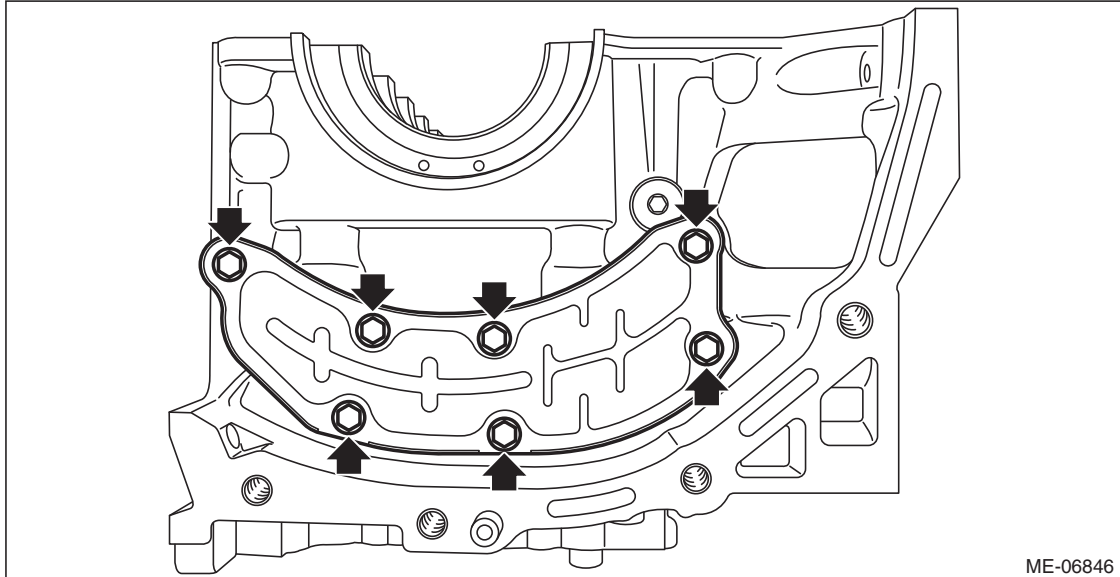
Cylinder Block

MECHANICAL

C: DISASSEMBLY

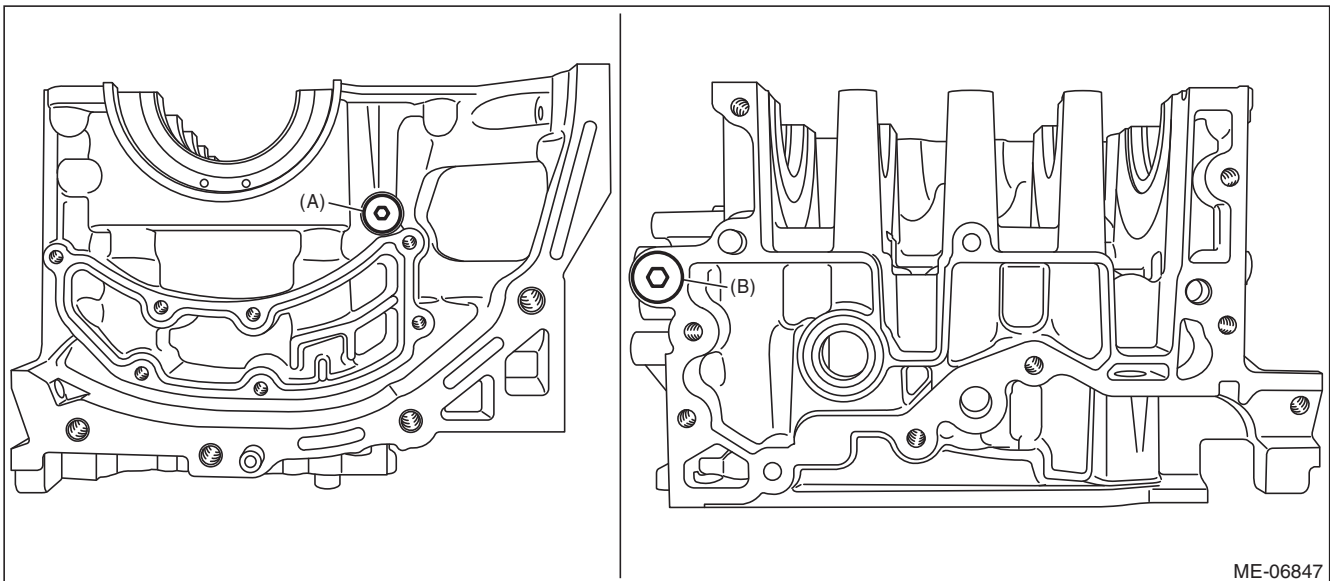
1. CYLINDER BLOCK

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



2) Remove the liquid gasket from cylinder block RH.

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

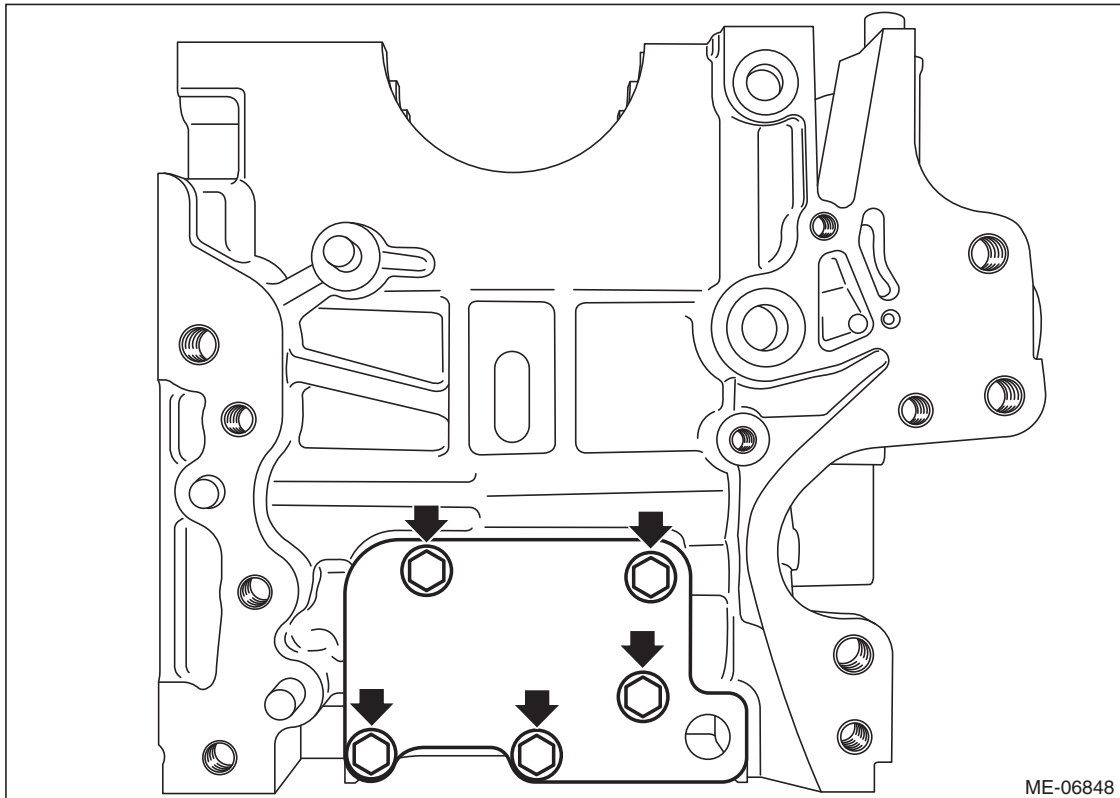


4) Remove the liquid gasket from the thread holes of the cylinder block RH, and from the threaded portions of cylinder block plug and main gallery plug.

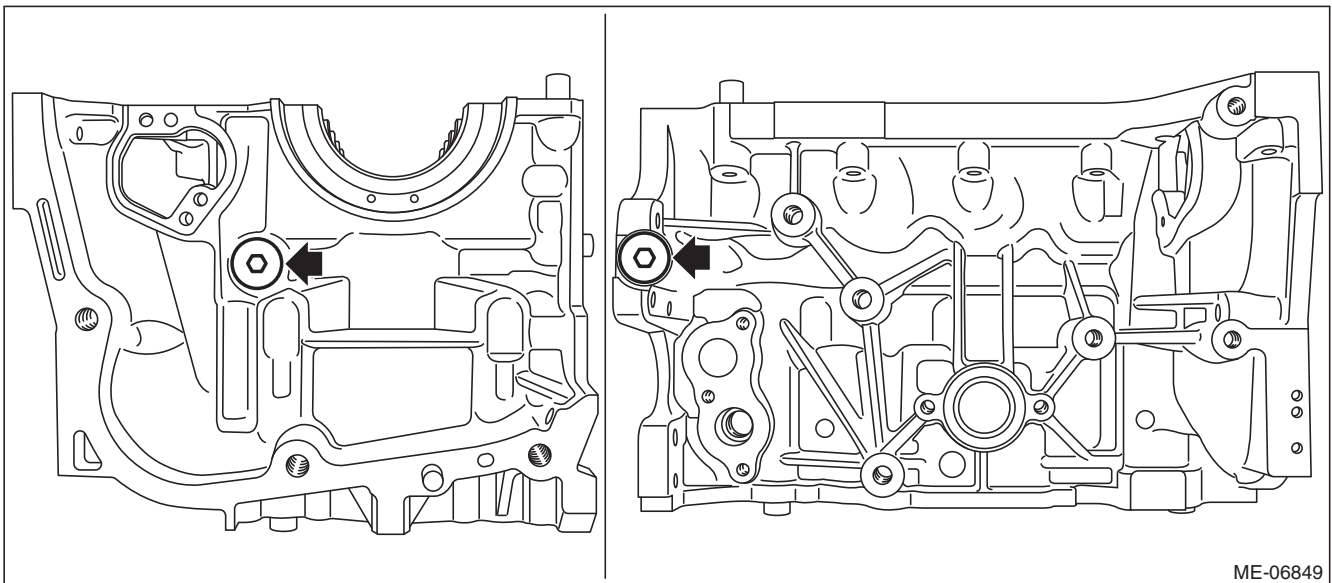
Cylinder Block

MECHANICAL

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



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

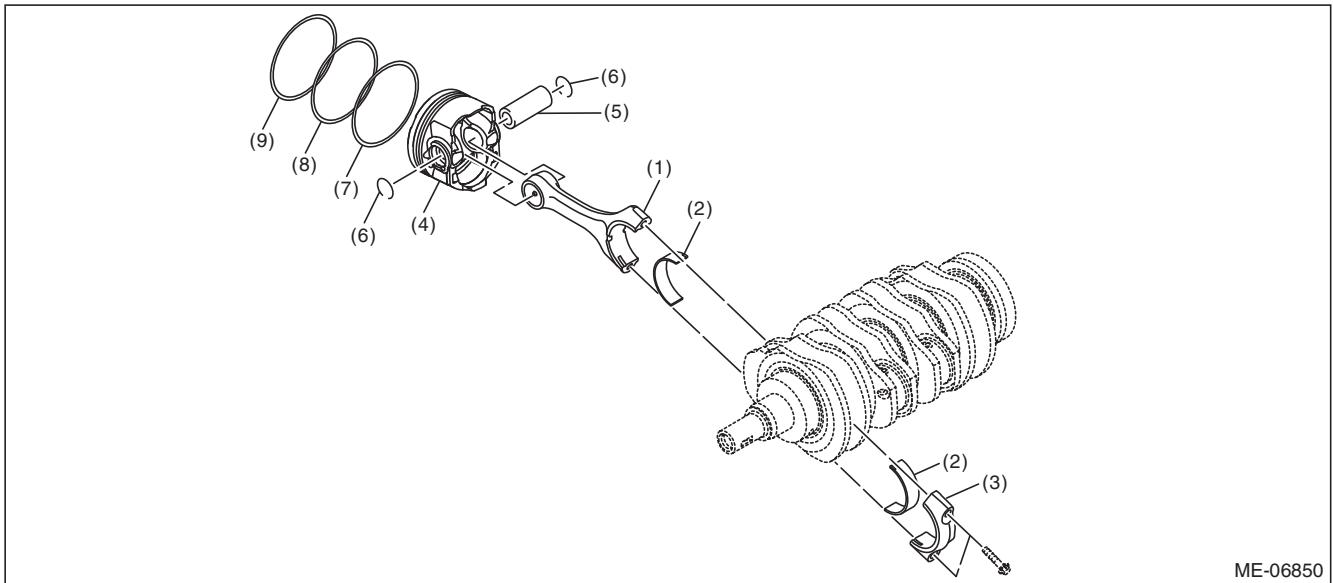


- 7) Remove the liquid gasket from the thread holes of the cylinder block LH and main gallery plug.

Cylinder Block

MECHANICAL

2. PISTON AND CONNECTING ROD



ME-06850

- | | | |
|----------------------------|----------------|-----------------|
| (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.
- 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.

Cylinder Block

MECHANICAL

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:

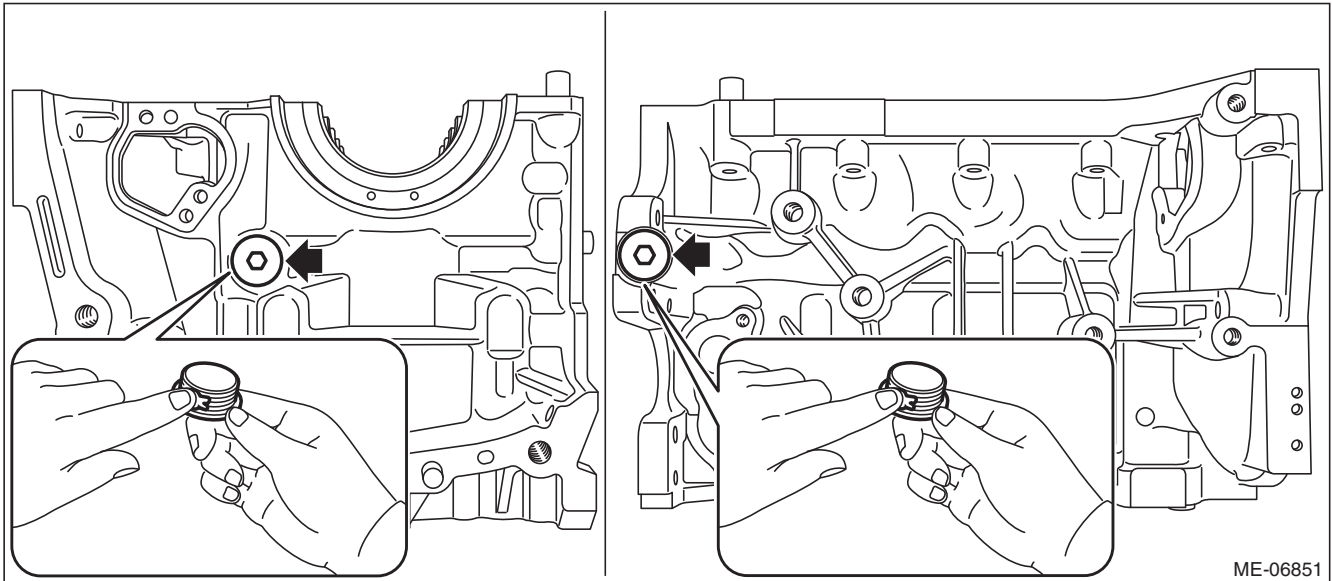
Before applying liquid gasket, degrease the thread holes of the cylinder block LH and main gallery plug.

Liquid gasket:

THREE BOND 1105 (Part No. 004403010) or equivalent

Tightening torque:

37 N·m (3.8 kgf-m, 27.3 ft-lb)



ME-06851

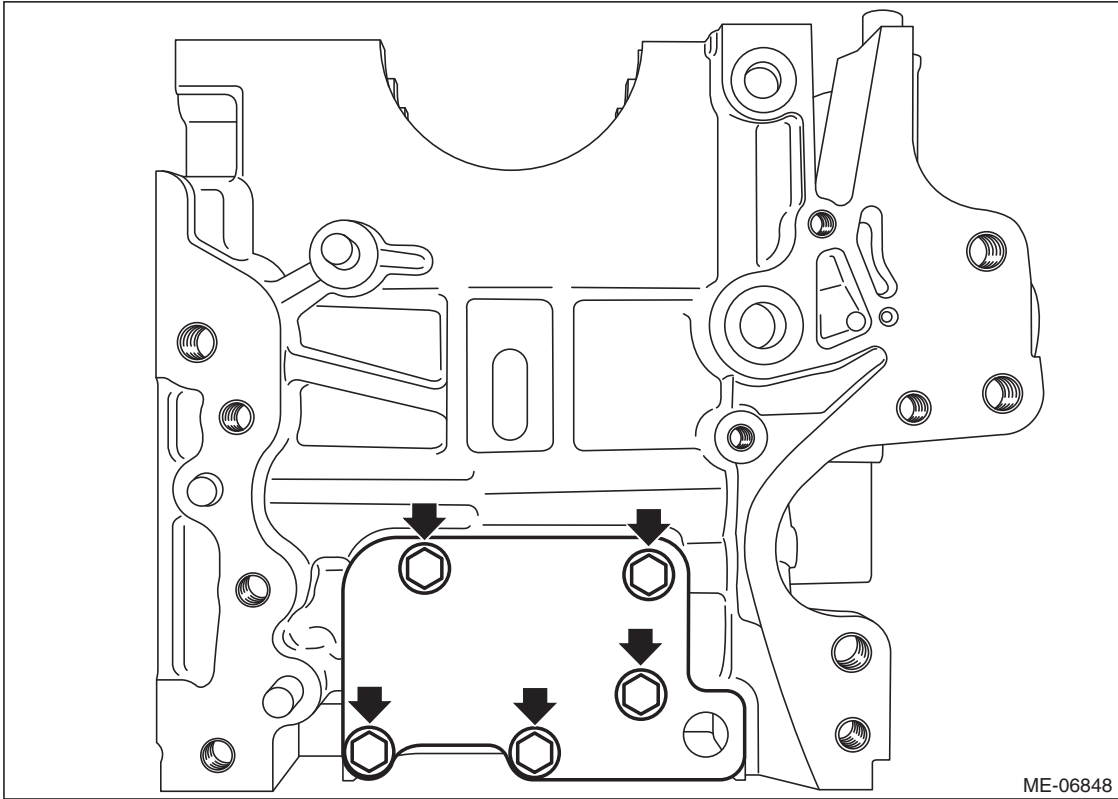
Cylinder Block

MECHANICAL

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.

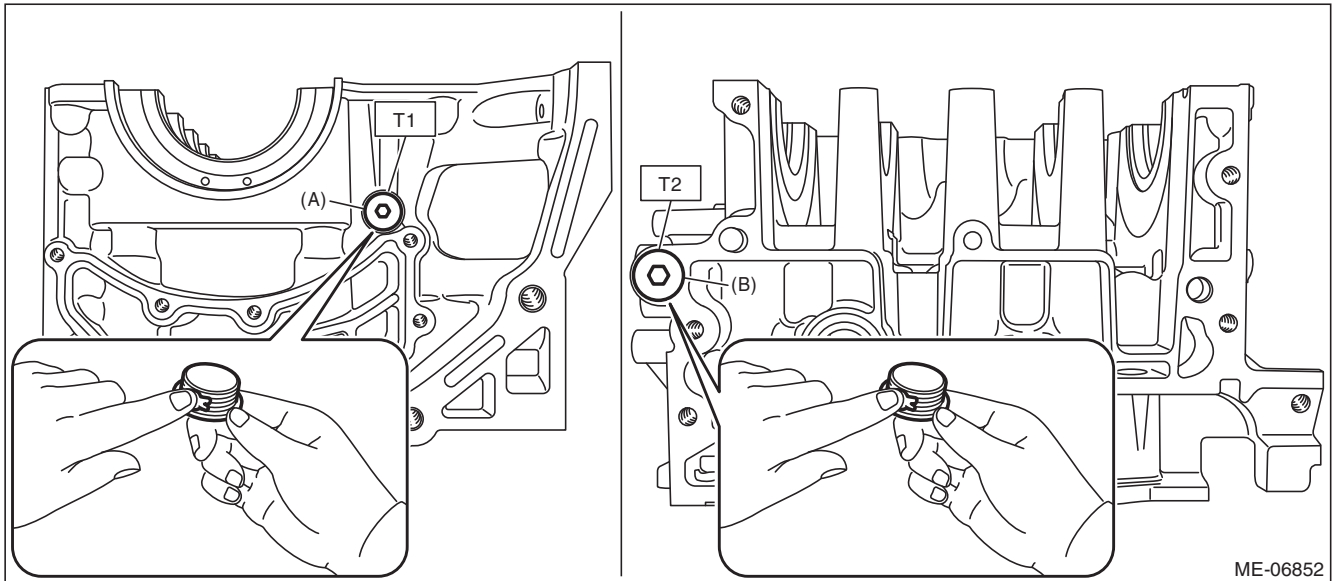
Liquid gasket:

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)



Cylinder Block

MECHANICAL

- 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.

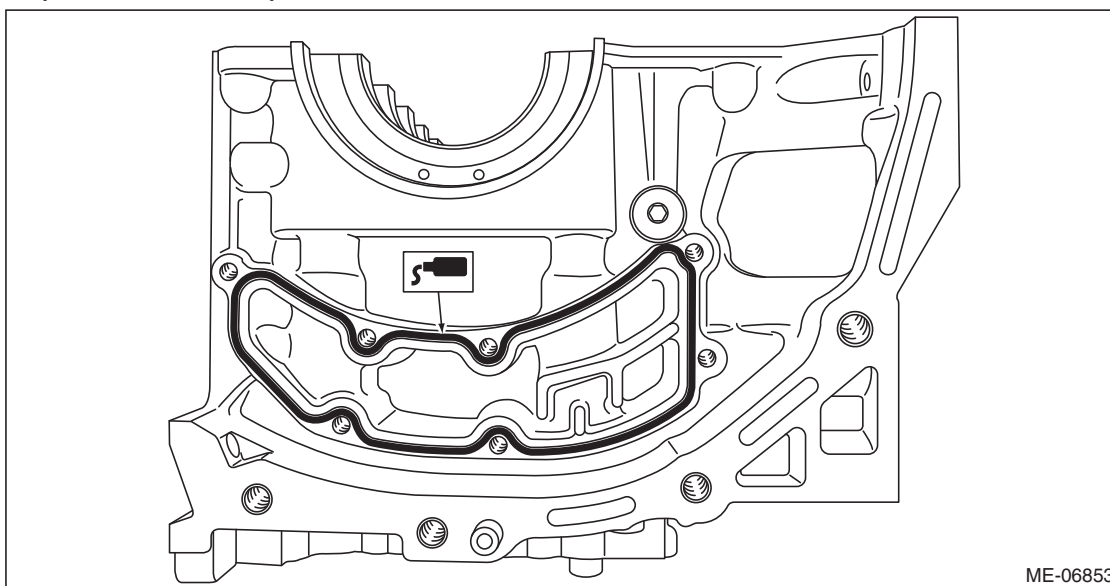
Liquid gasket:

Mating surface

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

Liquid gasket applying diameter:

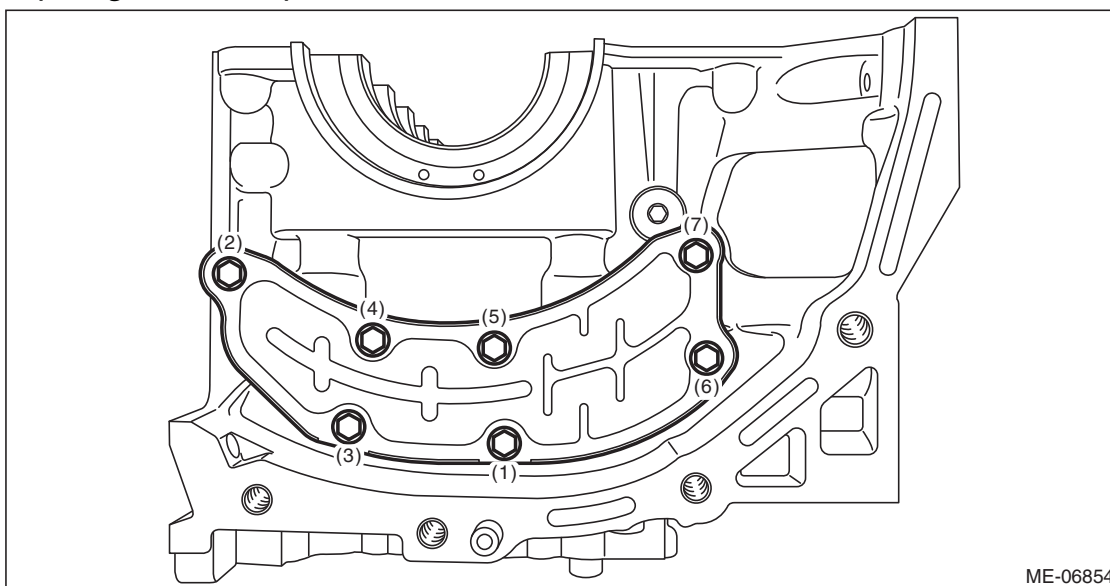
4±1 mm (0.1772±0.0394 in)



- (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:

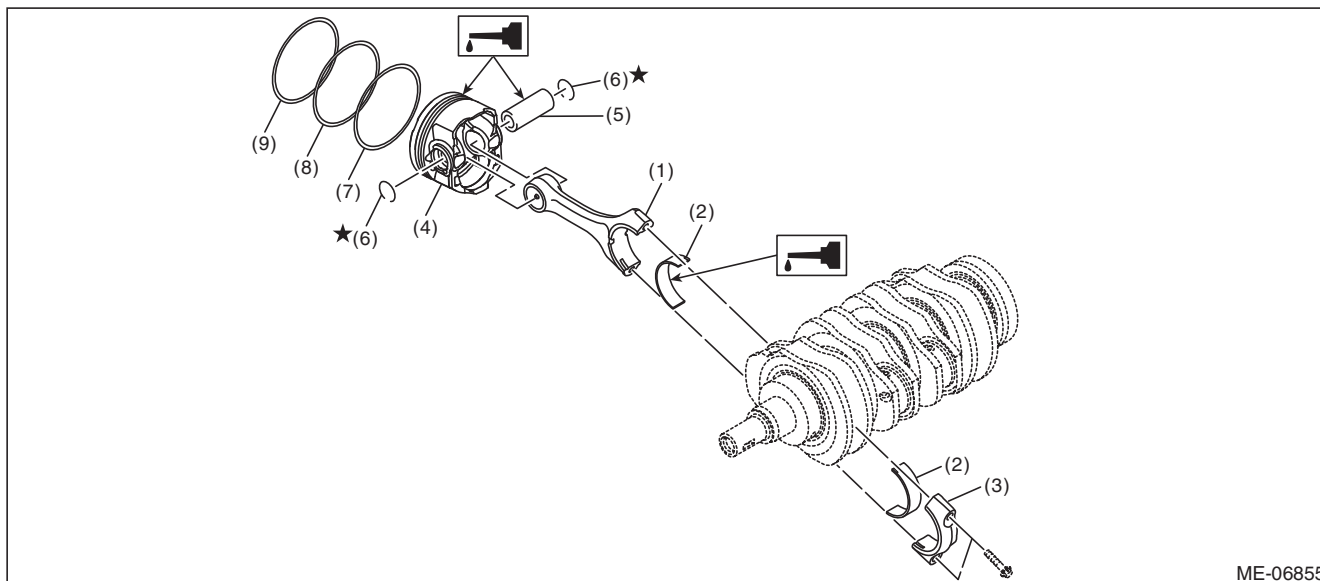
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Cylinder Block

MECHANICAL

2. PISTON AND CONNECTING ROD

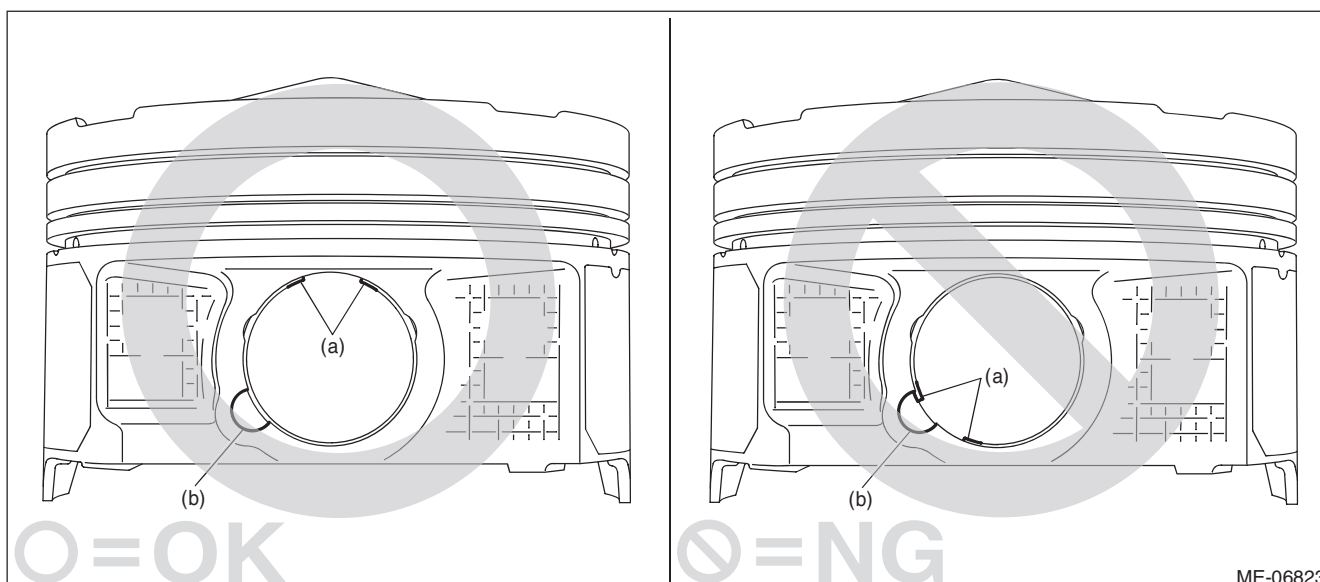


- | | | |
|----------------------------|----------------|-----------------|
| (1) Connecting rod | (4) Piston | (7) Oil ring |
| (2) Connecting rod bearing | (5) Piston pin | (8) Second ring |
| (3) Connecting rod cap | (6) Circlip | (9) Top ring |

- 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.



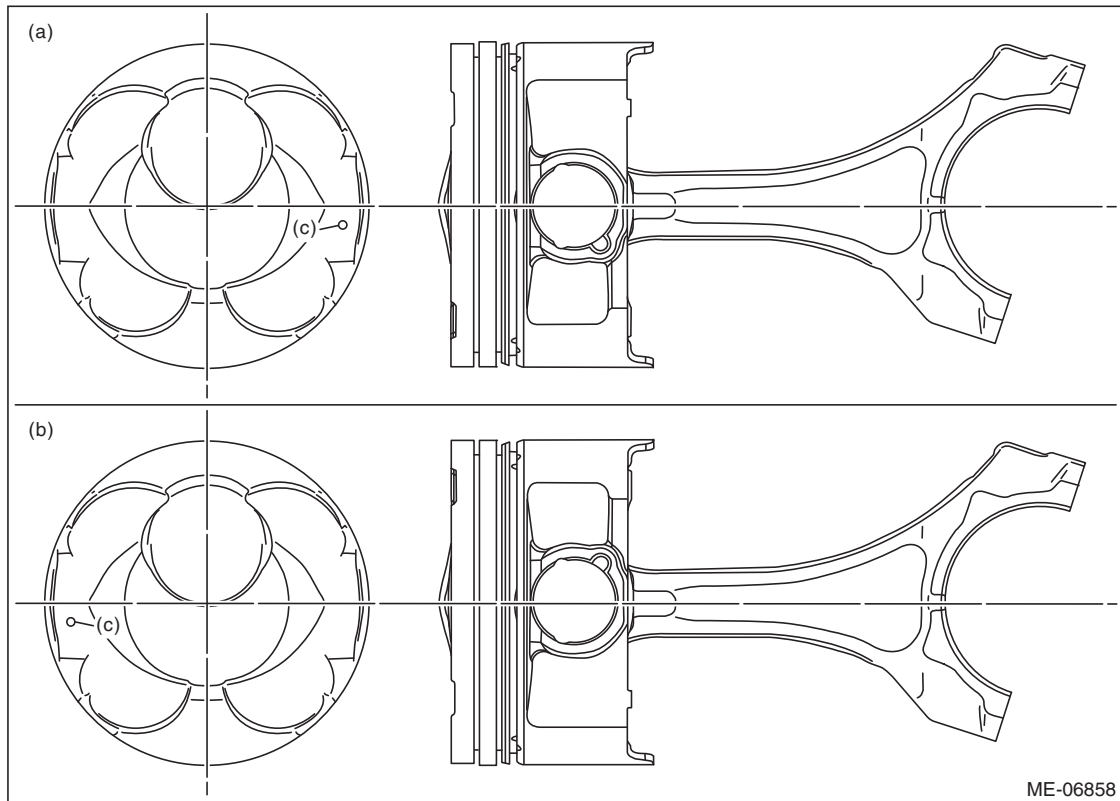
Cylinder Block

MECHANICAL

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.



ME-06858

(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.

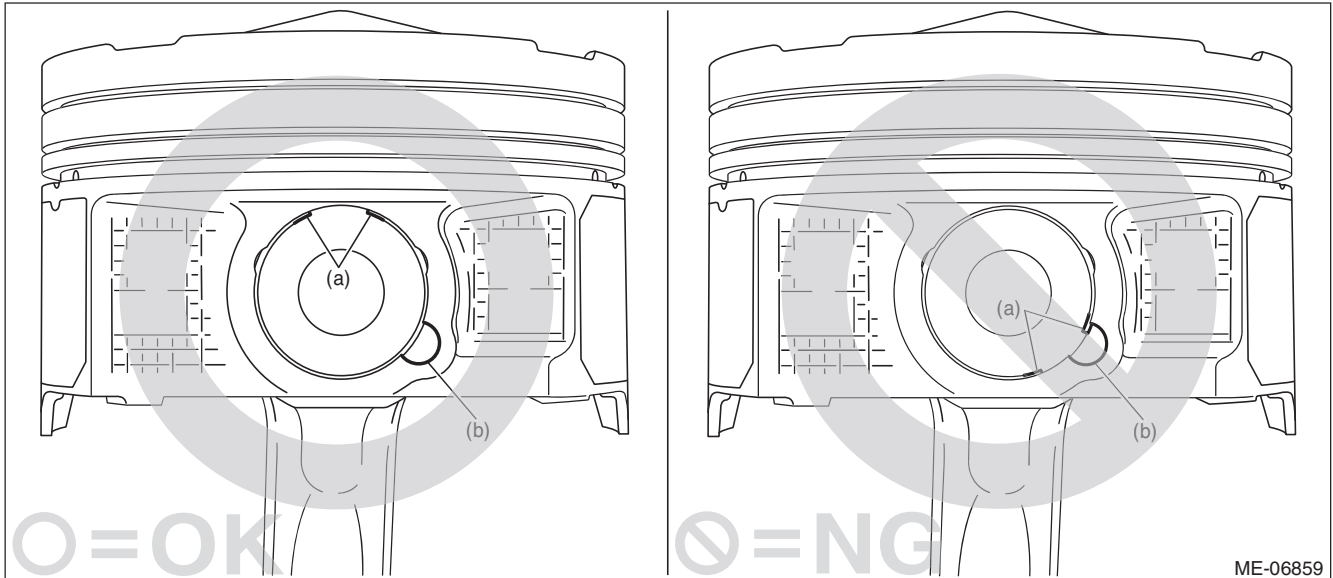
Cylinder Block

MECHANICAL

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

NOTE:

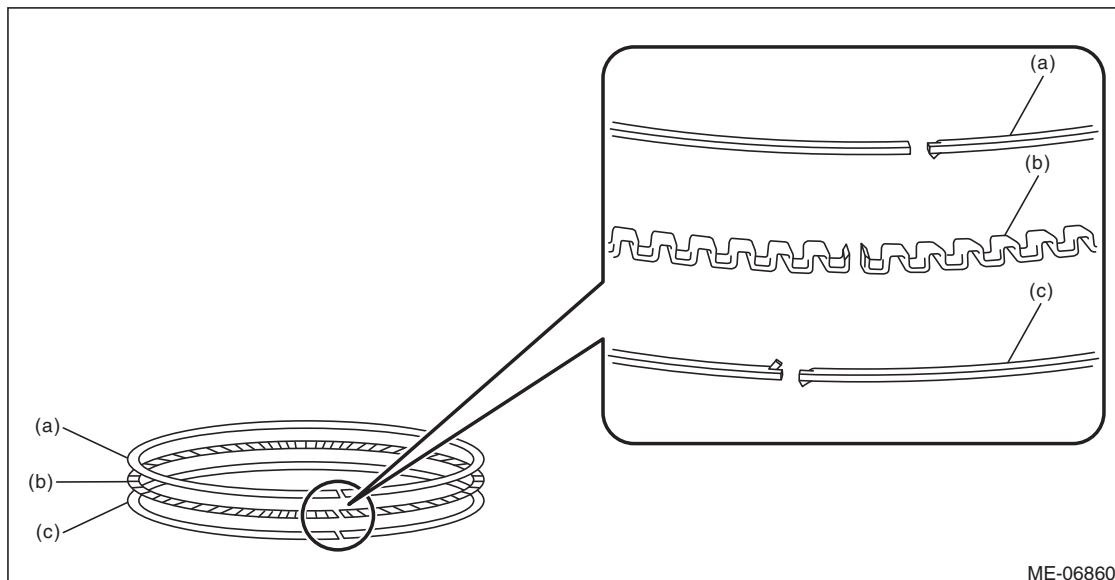
- Be careful not damage the piston and piston pin, by wrapping the tip of flat tip screwdriver with tape.
- Make sure the circlip is firmly inserted into the circlip groove.
- After installing the circlip, rotate the circlip so that its end part (a) and the cutout portion of circlip groove (b) do not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



6) Install the oil rings to the piston 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

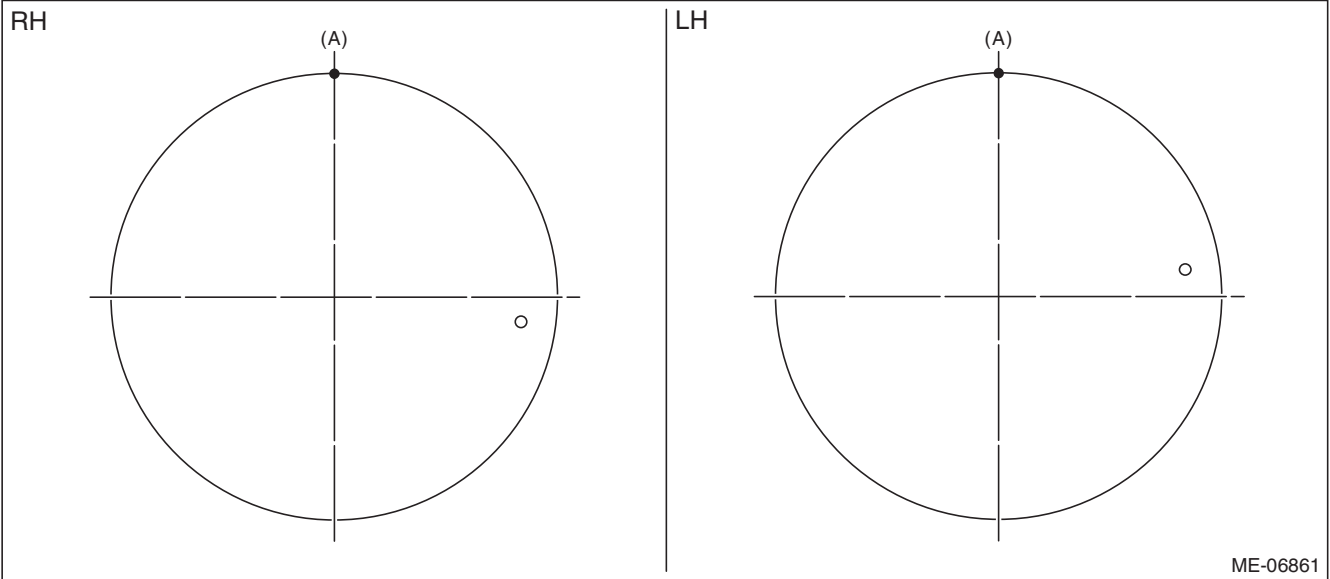
(b) Expander

(c) Lower rail

Cylinder Block

MECHANICAL

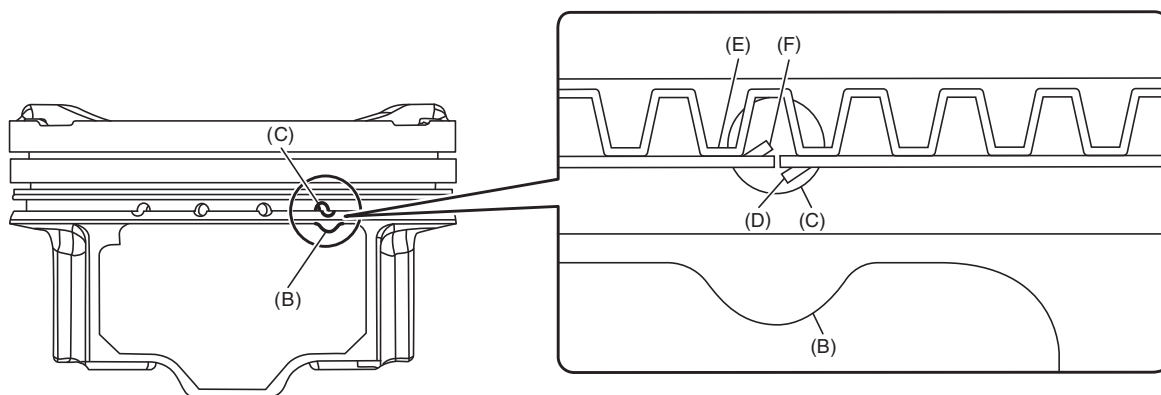
(1) Set the ring gap of the expander to the position (A).



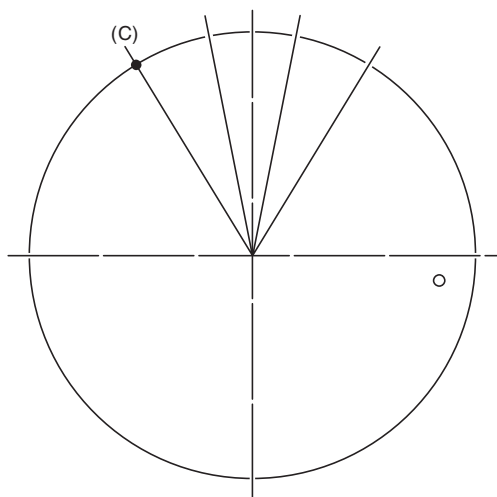
Cylinder Block

MECHANICAL

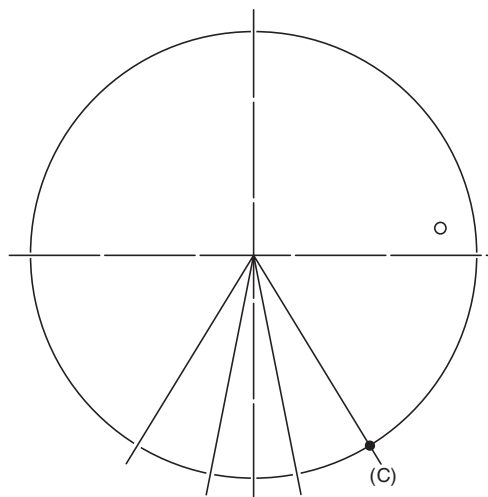
(2) Set the lower rail spin stopper (D) to the oil groove (C) located above the cutout portion (B) of the piston skirt coating, and hook the lower rail spin stopper (F) to the expander (E).



RH



LH

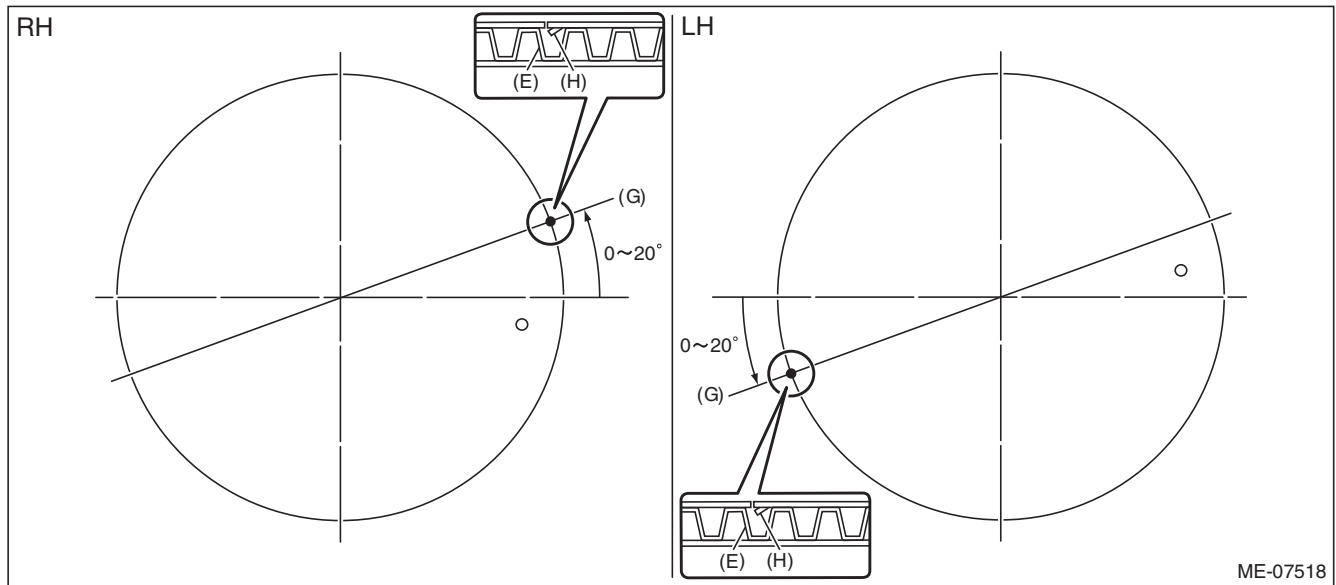


ME-07477

Cylinder Block

MECHANICAL

(3) Set the upper rail gap to the position (G), and hook the upper rail spin stopper (H) to the expander (E).

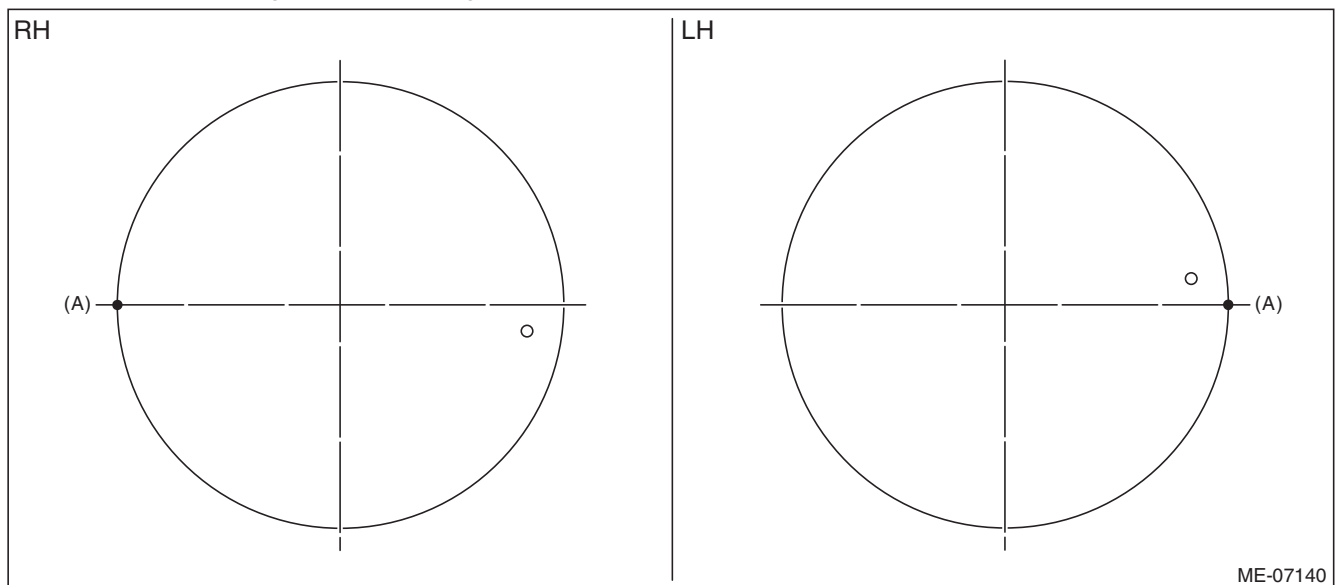


7) Install the compression rings to the piston in the order of second ring and top ring, using piston ring expander.

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

NOTE:

Install the second ring so that the ring mark (2N) faces the piston crown.



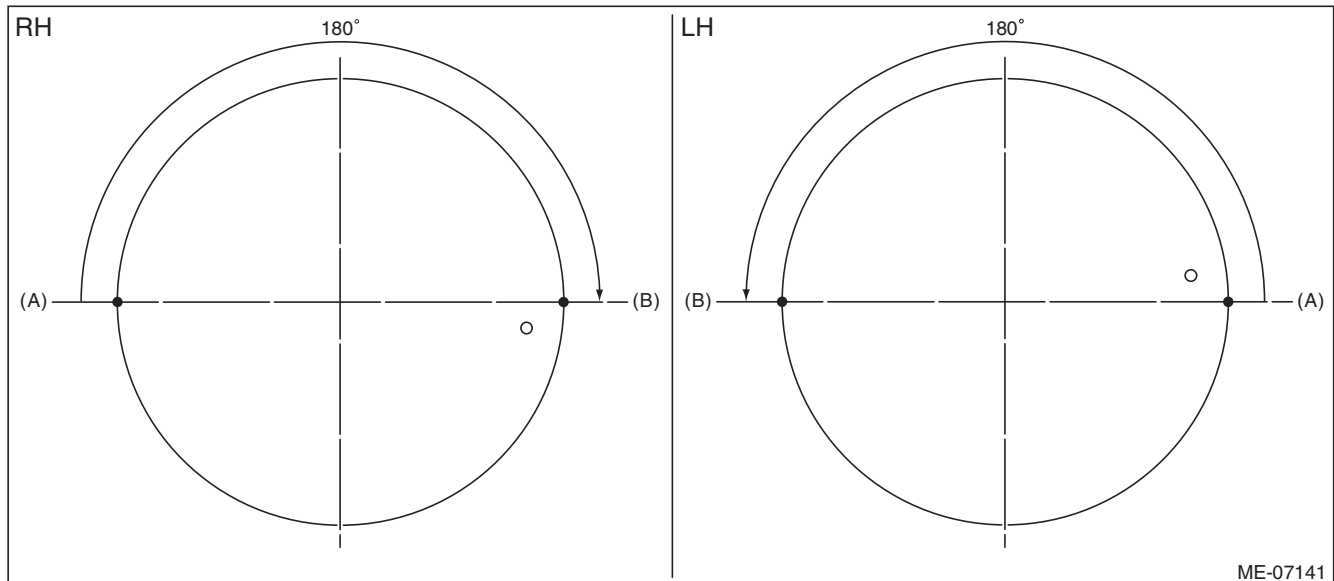
Cylinder Block

MECHANICAL

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

NOTE:

Install the top ring so that the ring mark (TN) faces the piston crown.



8) Check that the piston ring is installed correctly.

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)

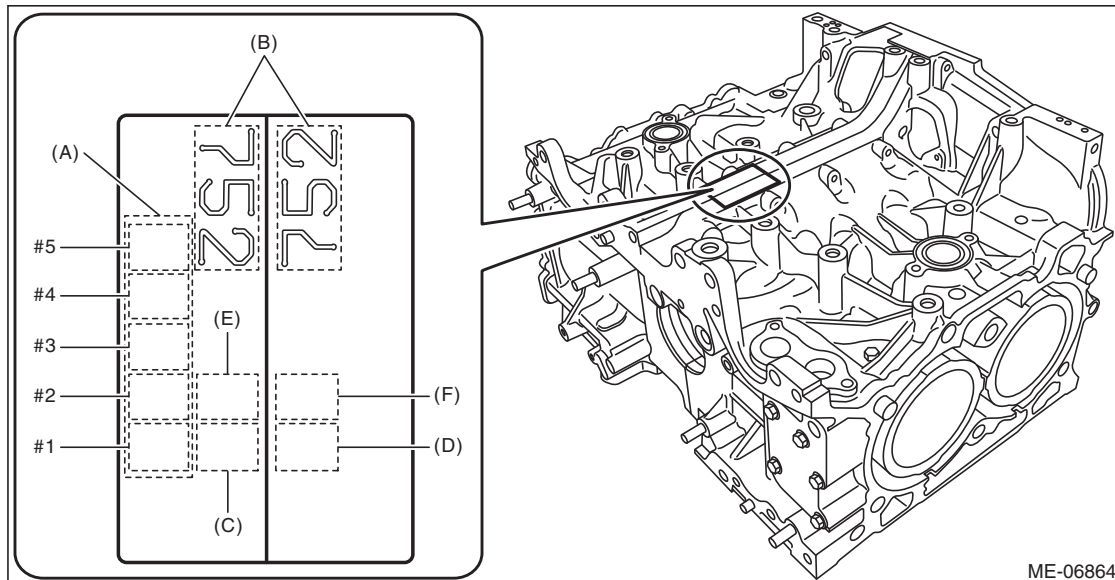
Cylinder Block

MECHANICAL

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

86.005 — 86.015 mm (3.3860 — 3.3864 in)

Cylinder bore size mark B

Standard

85.995 — 86.005 mm (3.3856 — 3.3860 in)

Cylindricity of cylinder liner:

Limit

0.03 mm (0.0012 in)

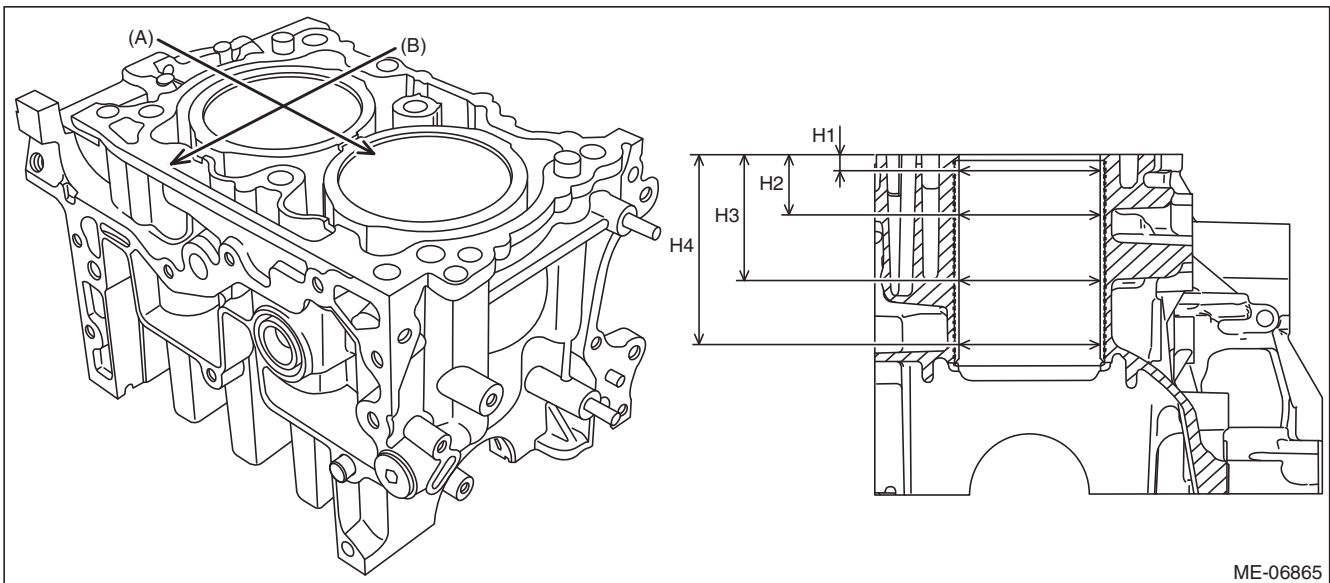
Out-of-roundness of cylinder liner:

Limit

0.010 mm (0.0004 in)

Cylinder Block

MECHANICAL



(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)

ME(H4DOTC)-323



Cylinder Block

MECHANICAL

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:

40.0 mm (1.57 in)

Piston outer diameter:

Standard size (grade A)

Standard

85.985 — 85.995 mm (3.3852 — 3.3856 in)

Standard size (grade B)

Standard

85.975 — 85.985 mm (3.3848 — 3.3852 in)

0.25 mm (0.0098 in) oversize

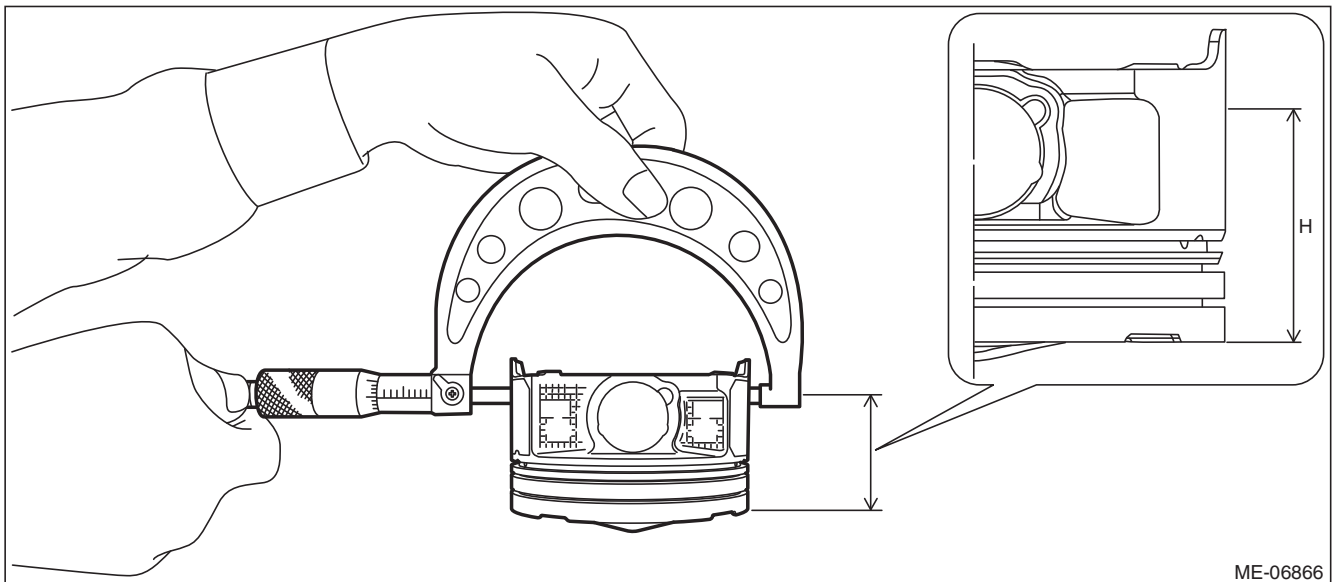
Standard

86.225 — 86.245 mm (3.3947 — 3.3955 in)

0.50 mm (0.0197 in) oversize

Standard

86.475 — 86.495 mm (3.4045 — 3.4053 in)



ME-06866

(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

0.010 — 0.030 mm (0.00039 — 0.00118 in)

Cylinder Block

MECHANICAL

8) Boring and honing

- (1) If any of the inner diameter, cylindricality, out-of-roundness or clearance between cylinder liner and piston is out of standard or if there is any damage on the cylinder liner, rebore it to replace with an over-size 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):

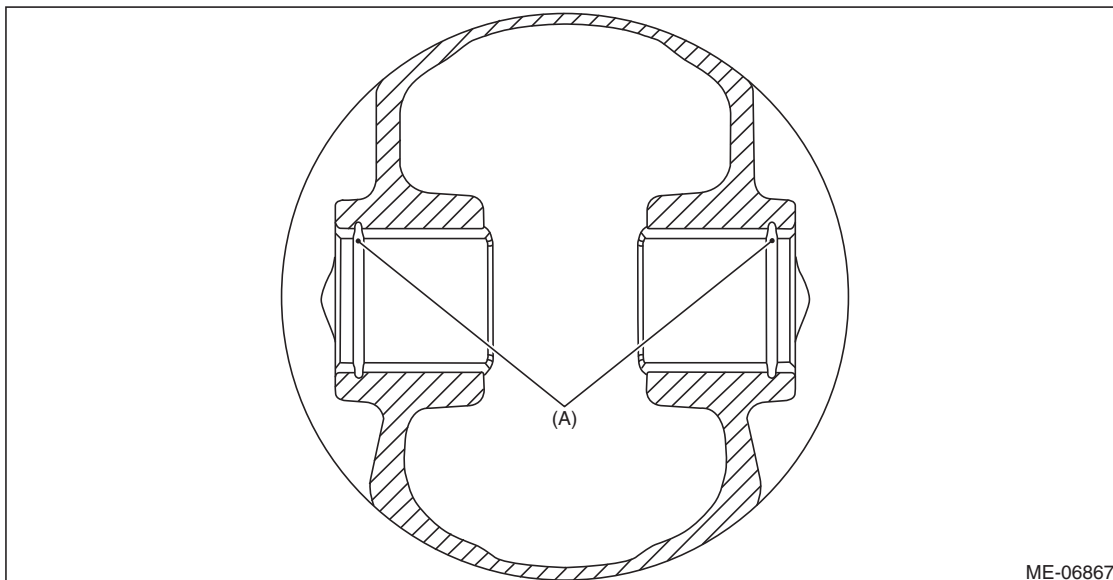
To 86.505 mm (3.4057 in)

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).

Cylinder Block

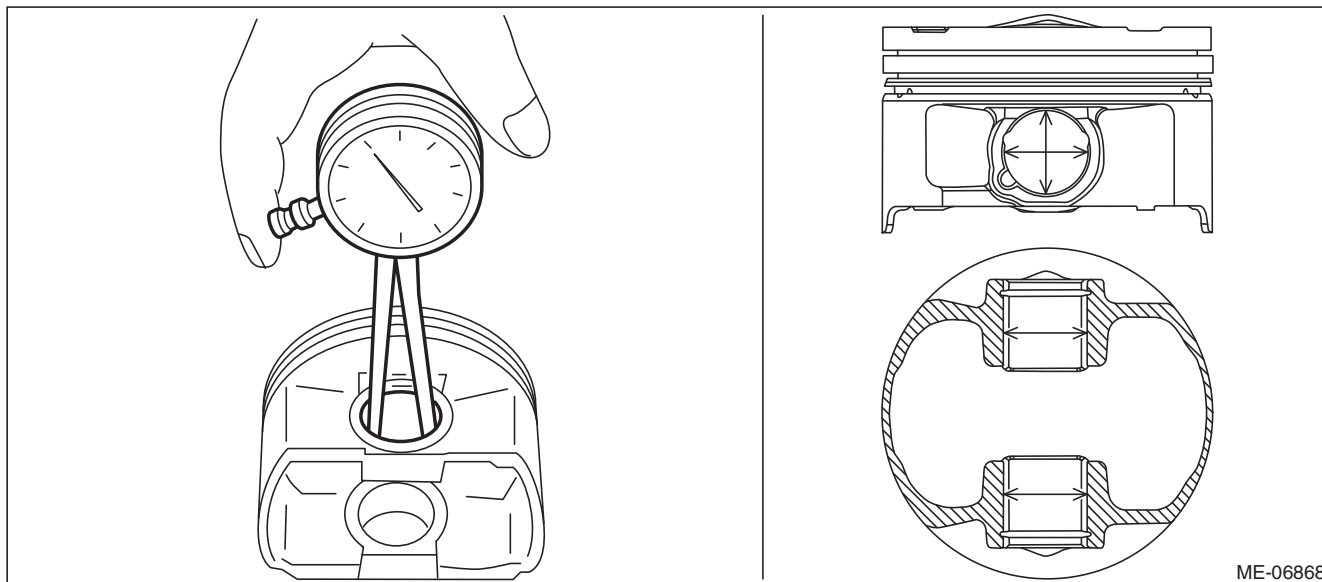
MECHANICAL

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:

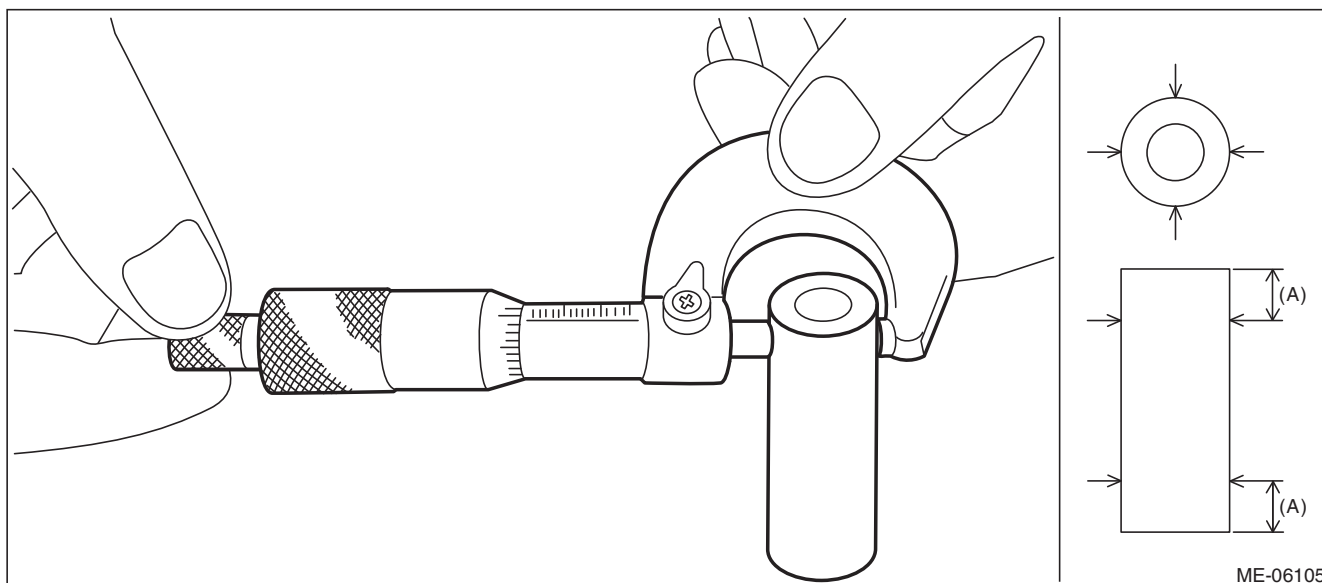
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inner diameter of the piston pin hole at the four locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



(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.



(A) 10 mm (0.394 in)

Cylinder Block

MECHANICAL

(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)

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 — 0.25 mm (0.0079 — 0.0098 in)

Compression ring (second ring)

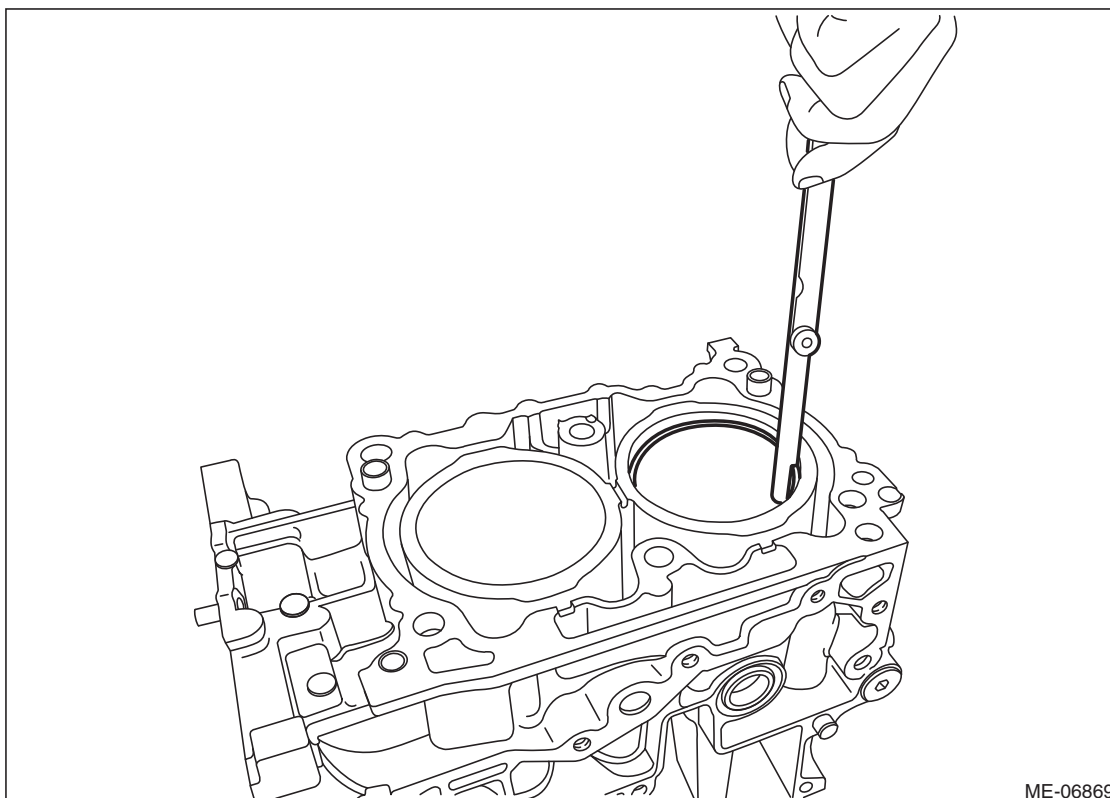
Standard

0.40 — 0.50 mm (0.0157 — 0.0197 in)

Oil ring (upper rail and lower rail)

Standard

0.10 — 0.35 mm (0.0039 — 0.0138 in)



ME-06869

Cylinder Block

MECHANICAL

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

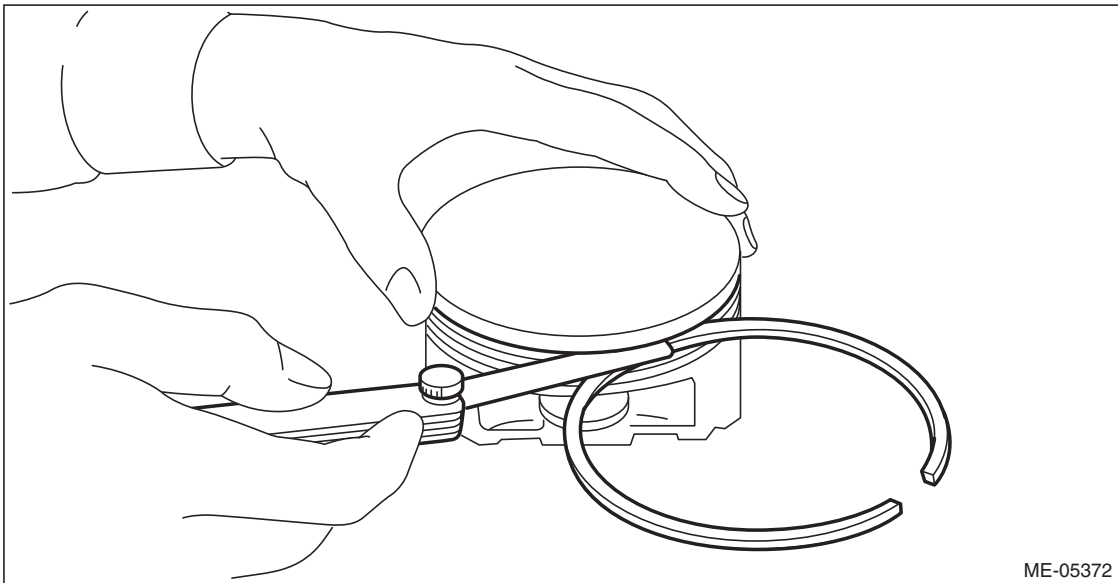
Standard

0.040 — 0.080 mm (0.0016 — 0.0031 in)

Second ring

Standard

0.045 — 0.085 mm (0.0018 — 0.0033 in)



ME-05372

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.

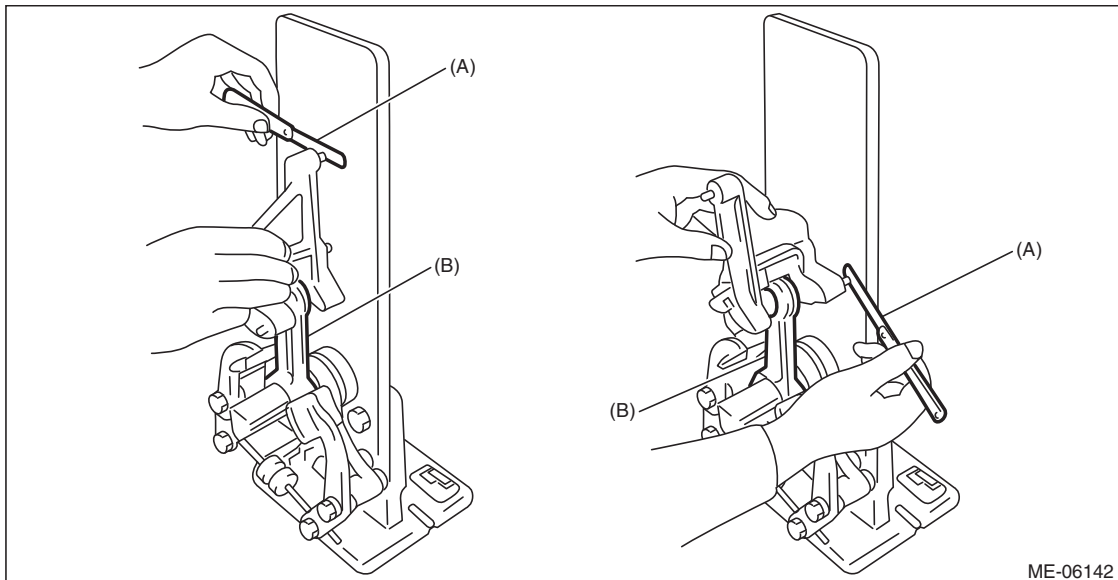
NOTE:

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

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.

Cylinder Block

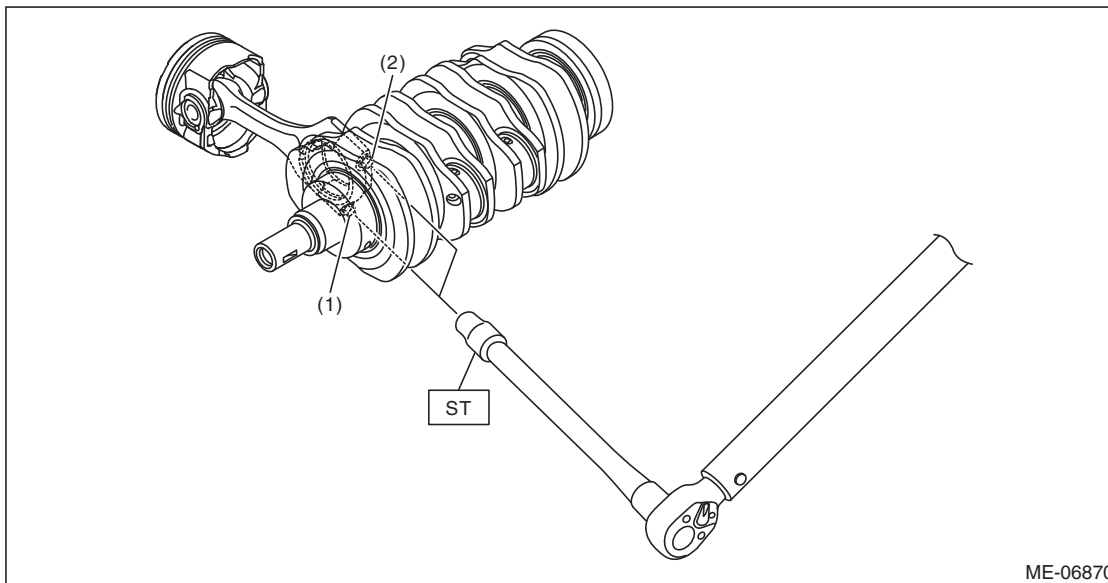
MECHANICAL

(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 25 N·m (2.5 kgf-m, 18.4 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 18270AA020 SOCKET



(5) Using ST and angle gauge, 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.

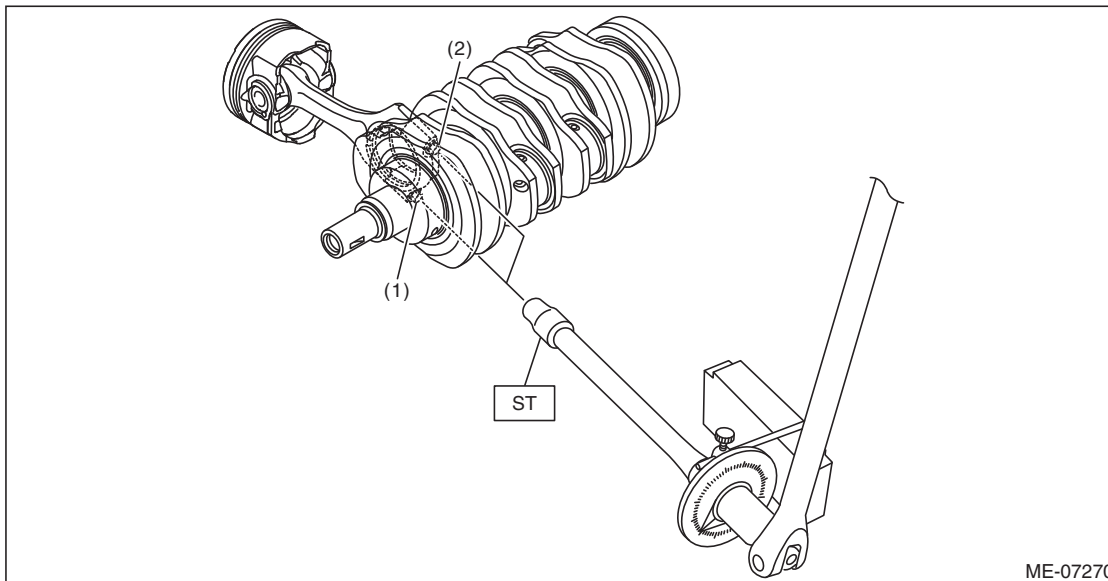
NOTE:

Prevent angle gauge from rotating using a V-block, etc.

ST 18270AA020 SOCKET

Tightening angle:

90^{+5}_{-0} °



Cylinder Block

MECHANICAL

- (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.

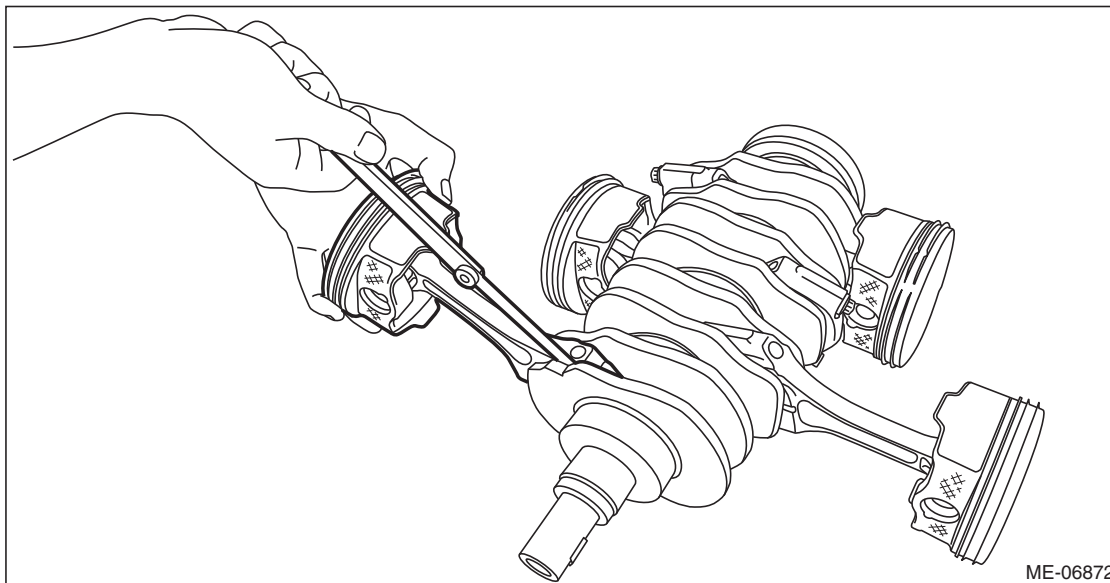
NOTE:

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)



- 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.

Cylinder Block

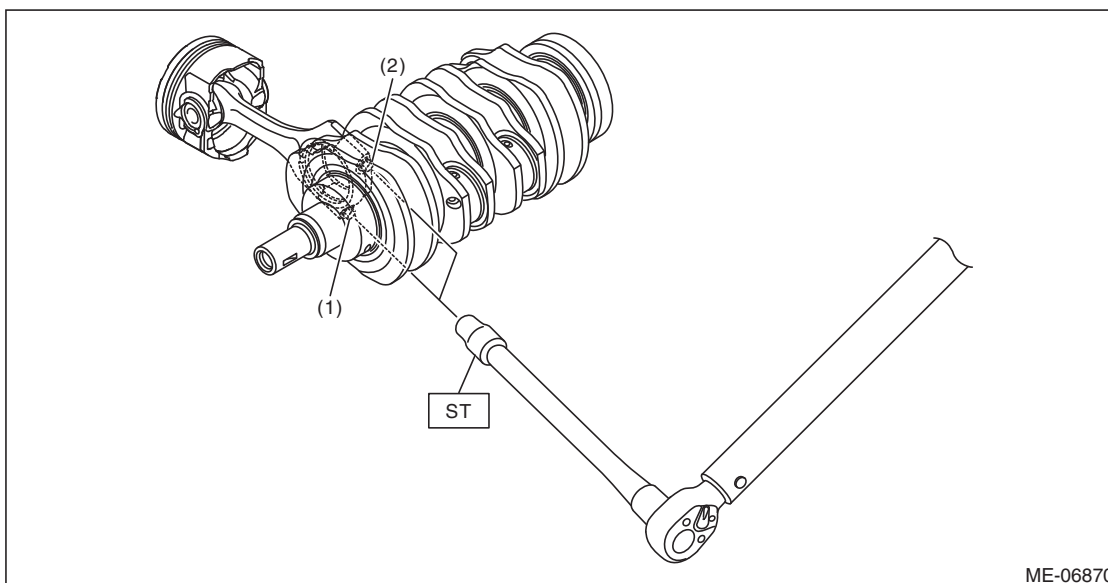
MECHANICAL

(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 25 N·m (2.5 kgf-m, 18.4 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 18270AA020 SOCKET



(5) Using ST and angle gauge, 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.

Cylinder Block

MECHANICAL

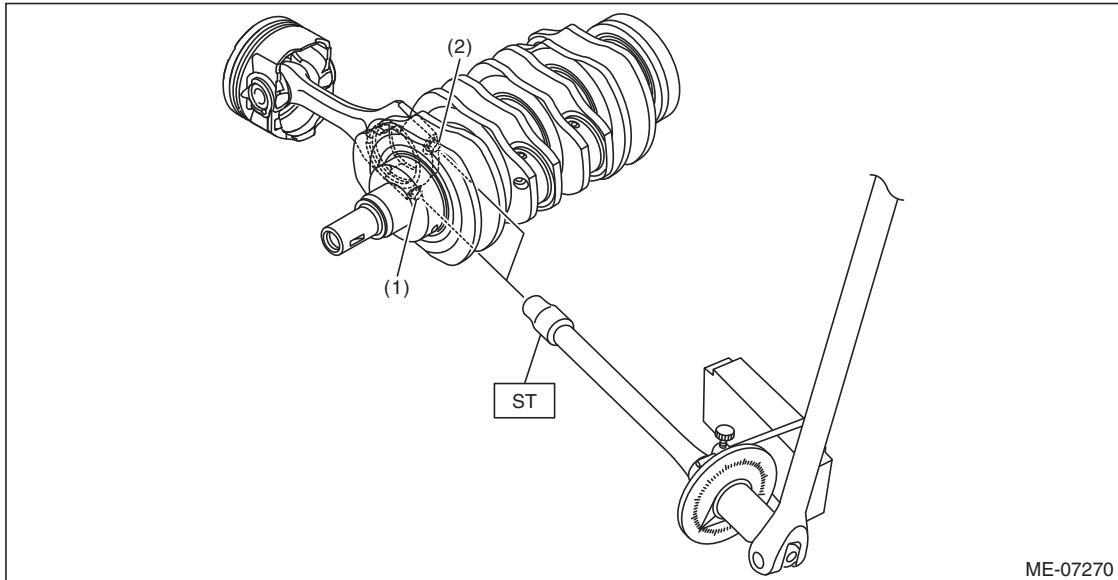
NOTE:

Prevent angle gauge from rotating using a V-block, etc.

ST 18270AA020 SOCKET

Tightening angle:

$90^{+5^{\circ}}_{-0^{\circ}}$

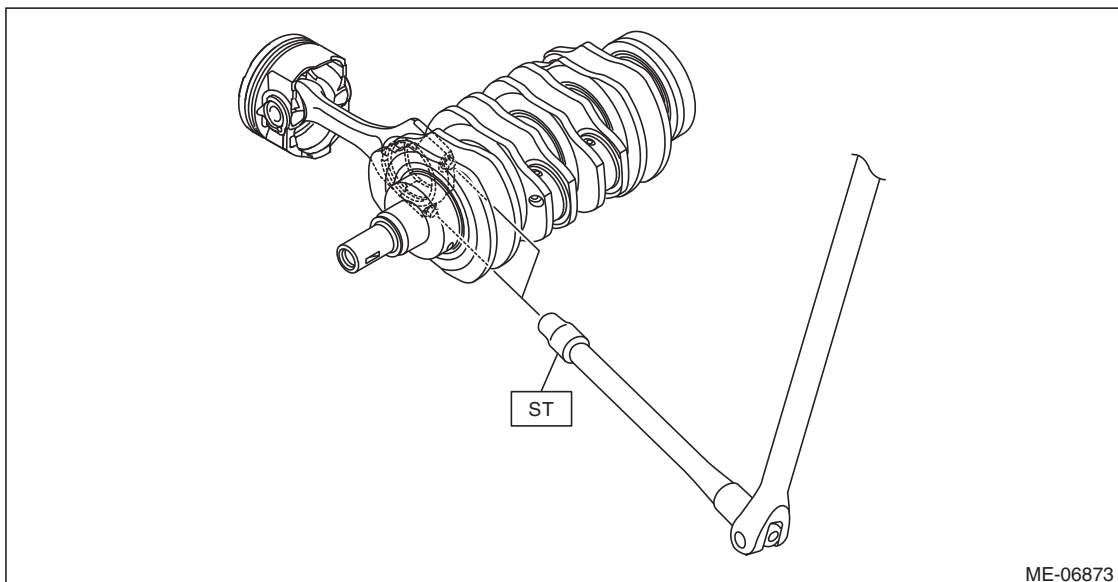


(6) Using ST, loosen the #1 connecting rod cap bolt, and remove the #1 connecting rod cap bolt and #1 connecting rod cap.

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 18270AA020 SOCKET



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:

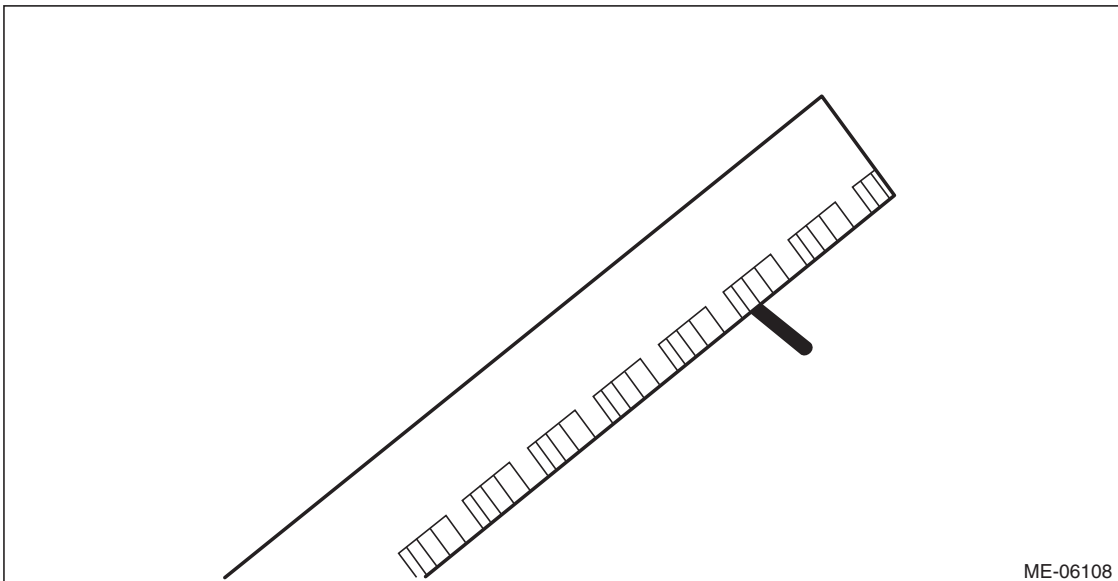
Measure the outer diameter of crankshaft pin using micrometer, and select the suitable size connecting rod bearing when replacing the connecting rod bearing.

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)	49.976 — 50.000 (1.9676 — 1.9685)
0.03 (0.0012) Undersize	1.511 — 1.515 (0.0595 — 0.0596)	49.946 — 49.970 (1.9664 — 1.9673)
0.05 (0.0020) Undersize	1.521 — 1.525 (0.0599 — 0.0600)	49.926 — 49.950 (1.9656 — 1.9665)
0.25 (0.0098) Undersize	1.621 — 1.625 (0.0638 — 0.0640)	49.726 — 49.750 (1.9577 — 1.9587)

Connecting rod bearing oil clearance:

Standard

0.025 — 0.055 mm (0.0010 — 0.0022 in)



(8) Completely remove the plastigauge.

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

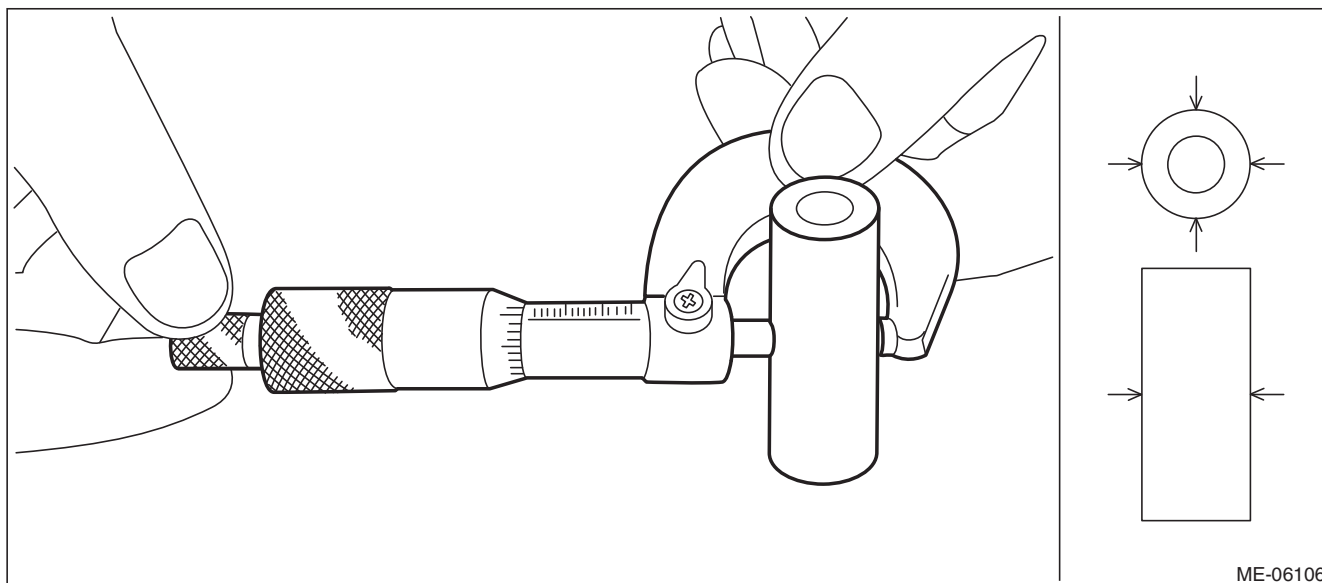
5. PISTON PIN & CONNECTING ROD BUSHING

- 1) Check that the connecting rod bushing is not damaged.
- 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:

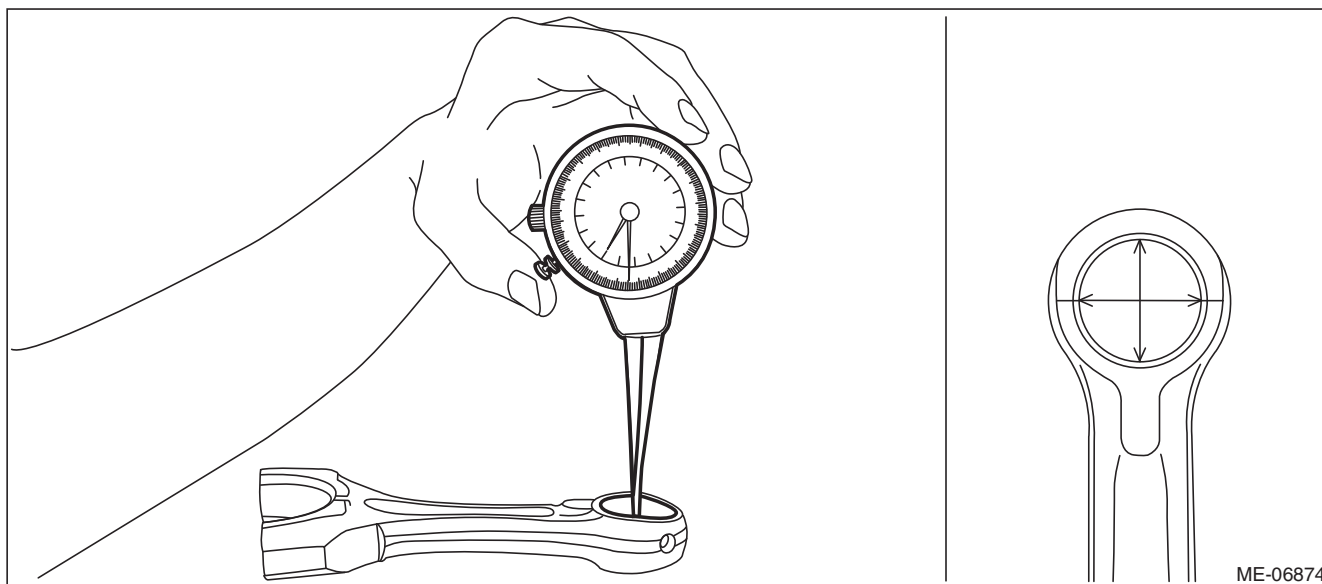
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the piston pin at the two locations as shown in the figure, and read the value of most worn location.
- Record the measured value.



(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 and piston pin as a set.

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.

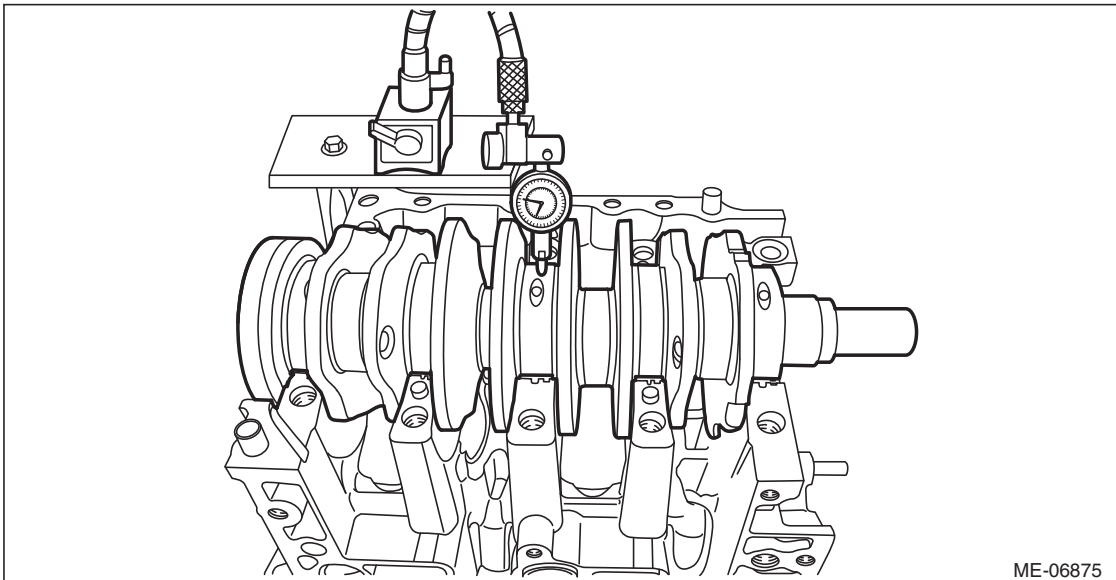
NOTE:

- 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-06875

- 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.

Cylinder Block

MECHANICAL

Unit: mm (in)					
Bearing	Connecting rod bearing thickness (at center)	Crankshaft pin outer diameter	Crankshaft bearing thickness (at center)		Crankshaft journal outer diameter
	Standard		#1, #2, #3, #4	#5	
Standard size	1.492 — 1.508 (0.0587 — 0.0594)	49.976 — 50.000 (1.9676 — 1.9685)	2.495 — 2.513 (0.0982 — 0.0989)	2.493 — 2.511 (0.0981 — 0.0989)	67.985 — 68.009 (2.6766 — 2.6775)
0.03 (0.0012) Undersize	1.511 — 1.515 (0.0595 — 0.0596)	49.946 — 49.970 (1.9664 — 1.9673)	2.519 — 2.522 (0.0992 — 0.0993)	2.517 — 2.520 (0.0991 — 0.0992)	67.955 — 67.979 (2.6754 — 2.6763)
0.05 (0.0020) Undersize	1.521 — 1.525 (0.0599 — 0.0600)	49.926 — 49.950 (1.9656 — 1.9665)	2.529 — 2.532 (0.0996 — 0.0997)	2.527 — 2.530 (0.0995 — 0.0996)	67.935 — 67.959 (2.6746 — 2.6755)
0.25 (0.0098) Undersize	1.621 — 1.625 (0.0638 — 0.0640)	49.726 — 49.750 (1.9577 — 1.9587)	2.629 — 2.632 (0.1035 — 0.1036)	2.627 — 2.630 (0.1034 — 0.1035)	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 49.726 mm (1.9577 in)

Crankshaft journal:

Cylindricity

Limit

0.006 mm (0.0002 in)

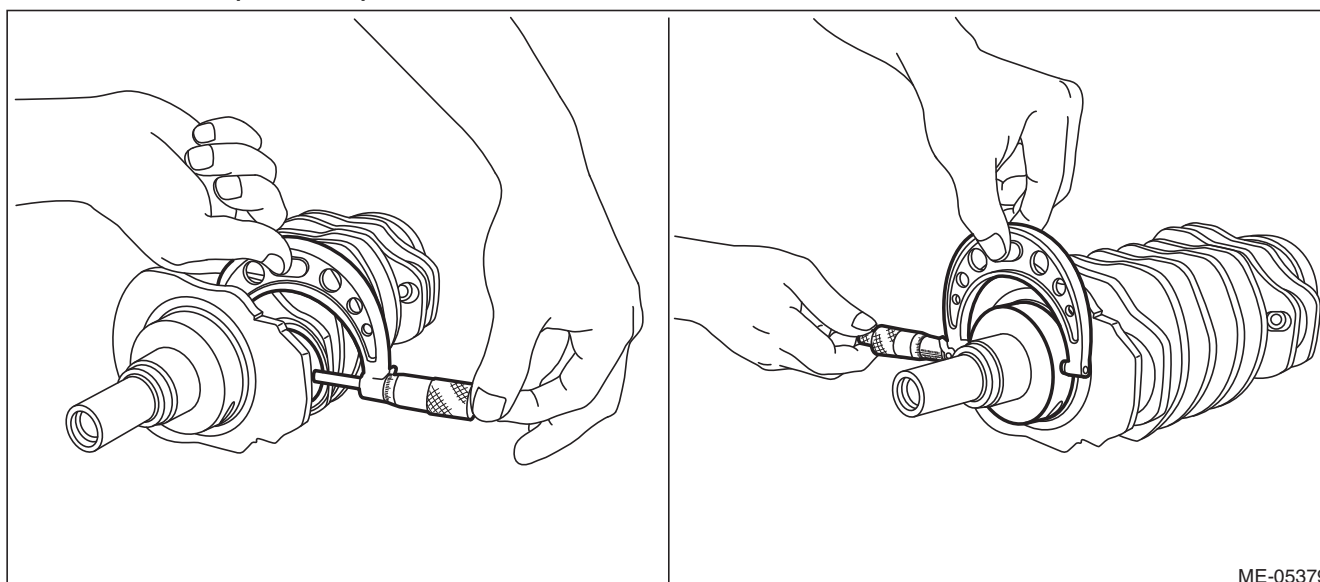
Out-of-roundness

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.

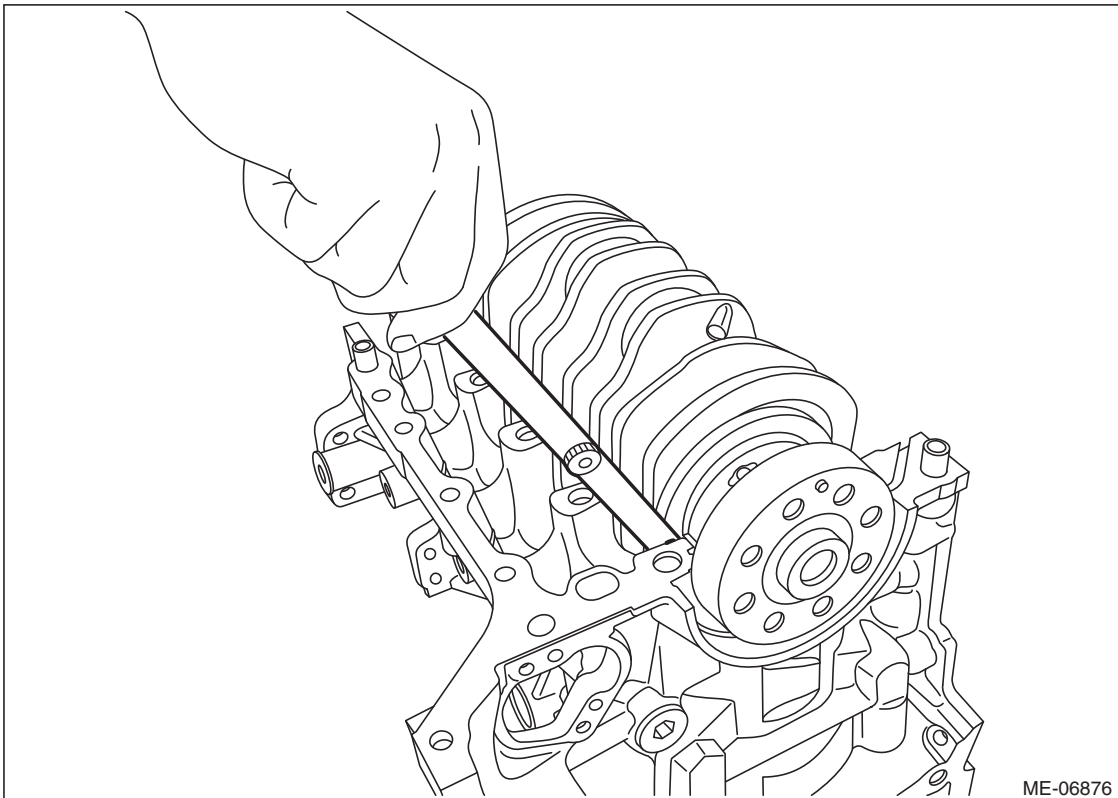
NOTE:

- 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) Install the cylinder block LH to the engine stand.

CAUTION:

- **When the engine stand is not used, 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) Remove the liquid gasket from cylinder block.
- (3) Clean each crankshaft bearing and crankshaft journal.

Cylinder Block

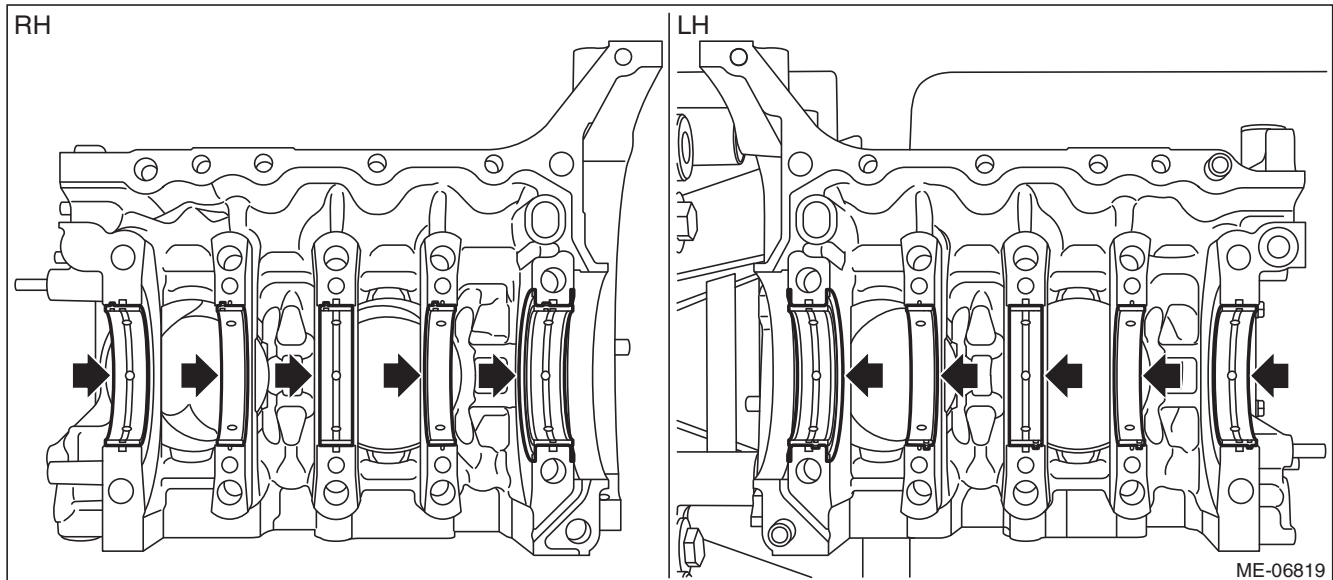
MECHANICAL

(4) Set each crankshaft bearing to the cylinder block.

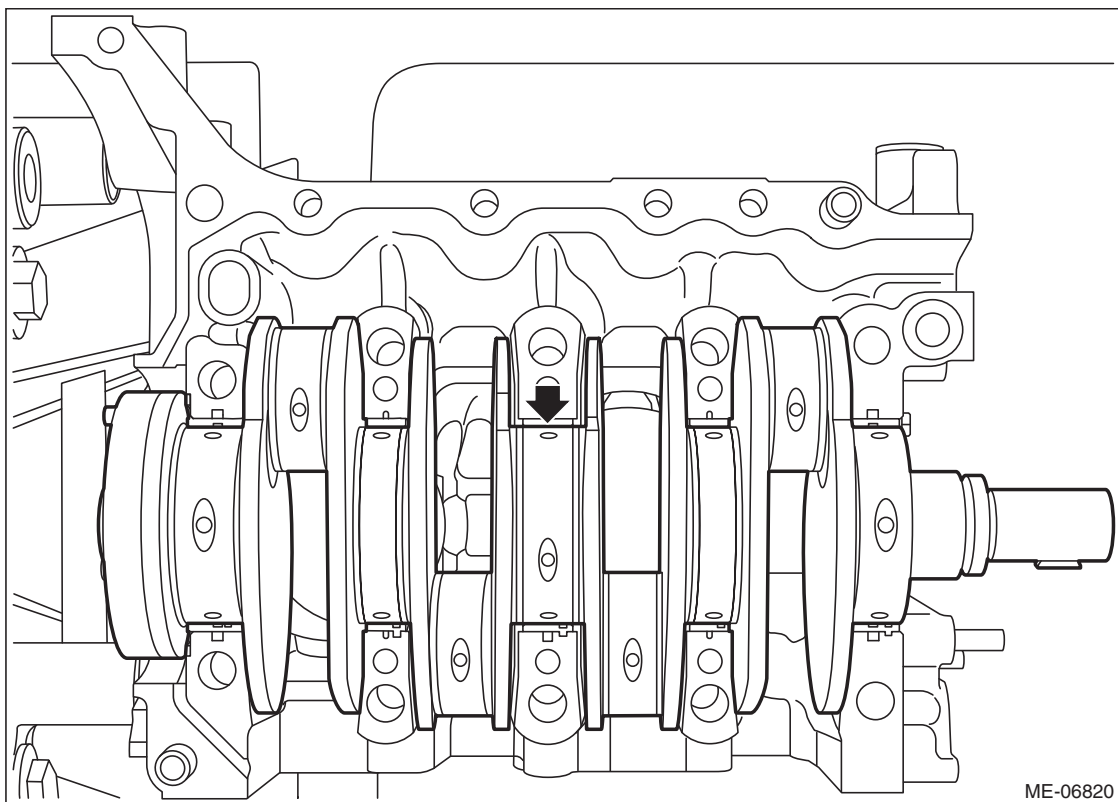
CAUTION:

When performing the operation of the cylinder block RH, be careful of the following.

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



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



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

Cylinder Block

MECHANICAL

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

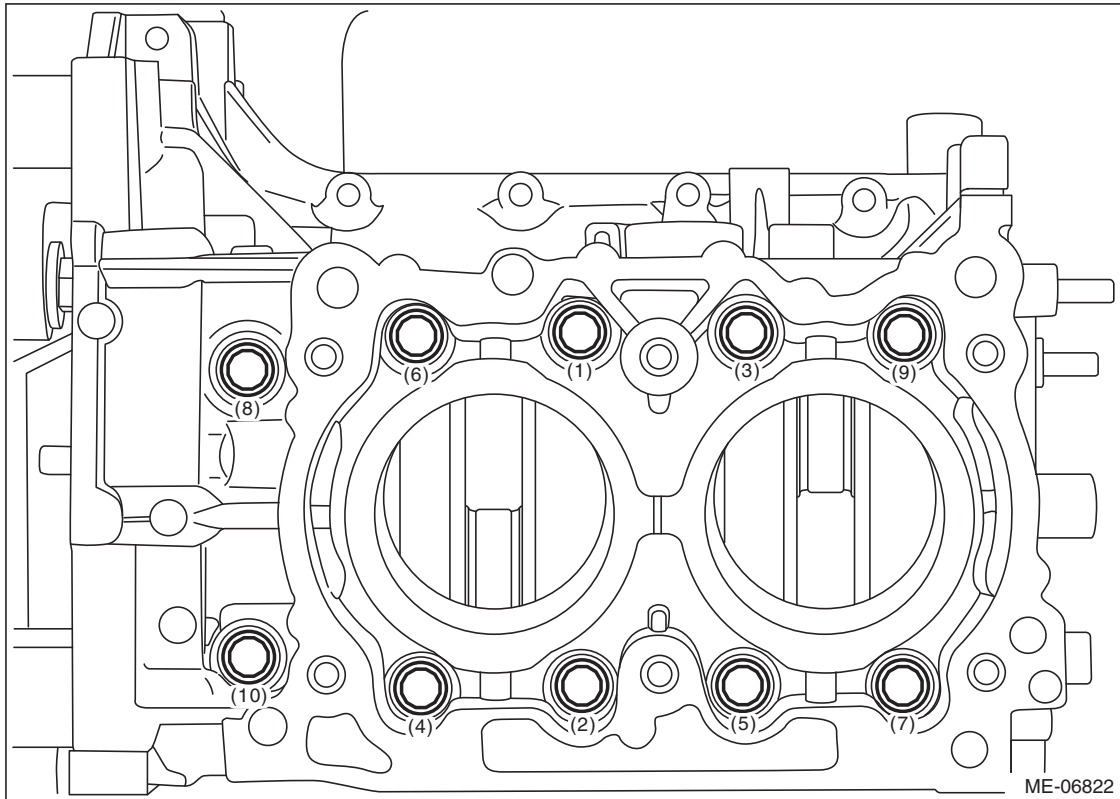
NOTE:

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

(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.



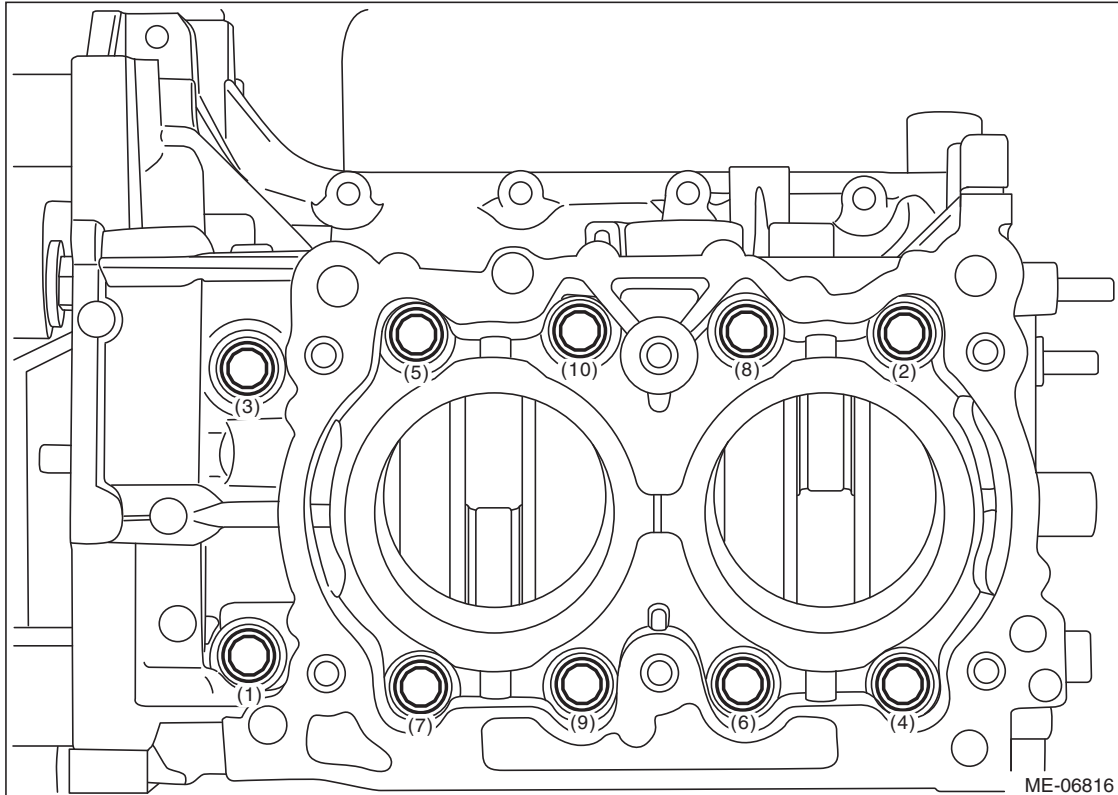
Cylinder Block

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.



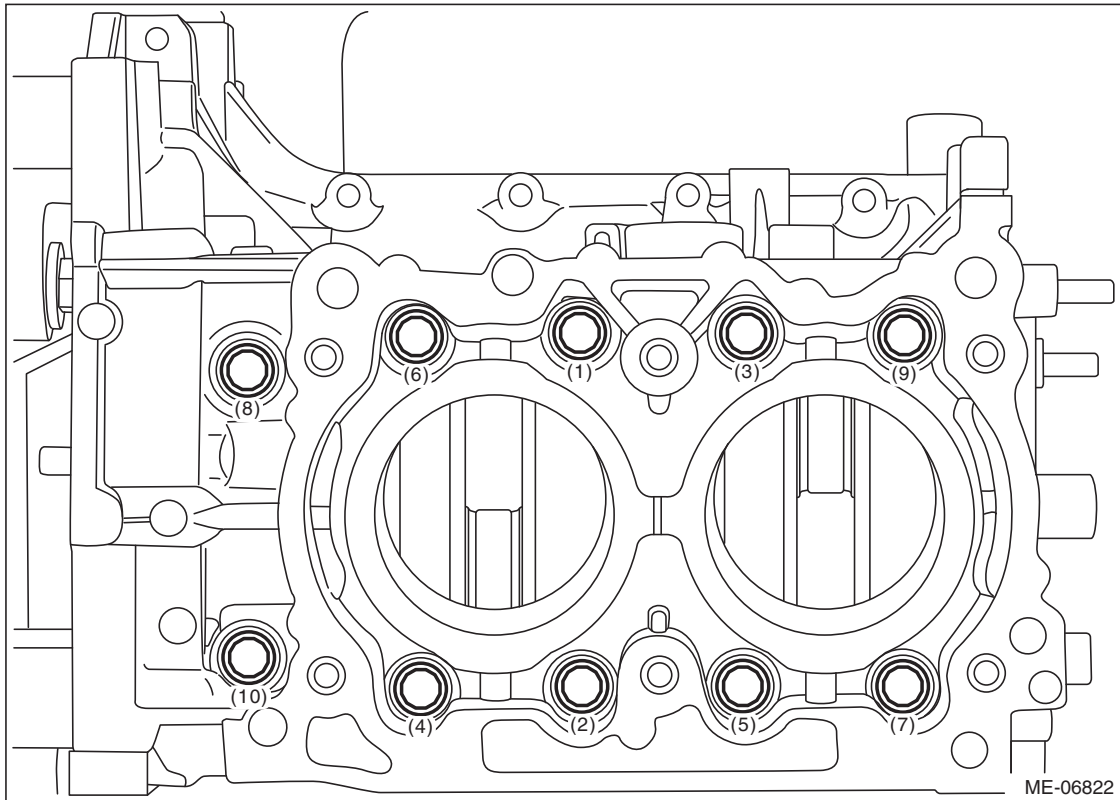
Cylinder Block

MECHANICAL

(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.



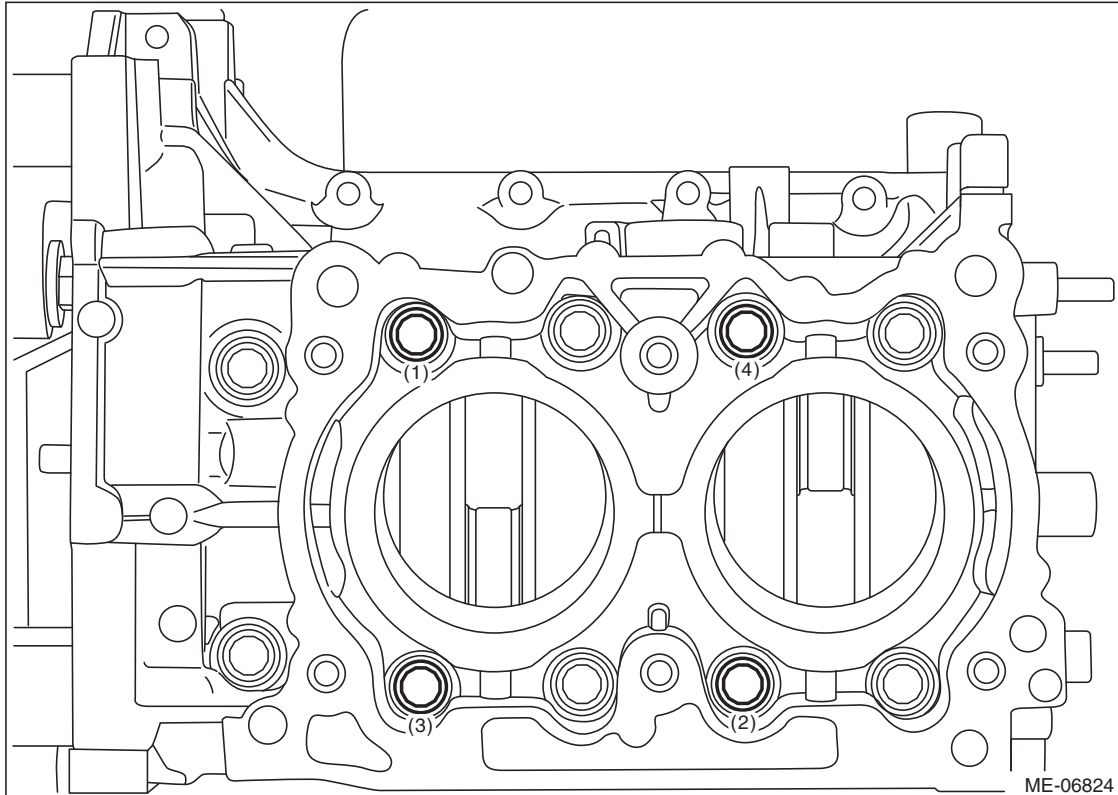
Cylinder Block

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.



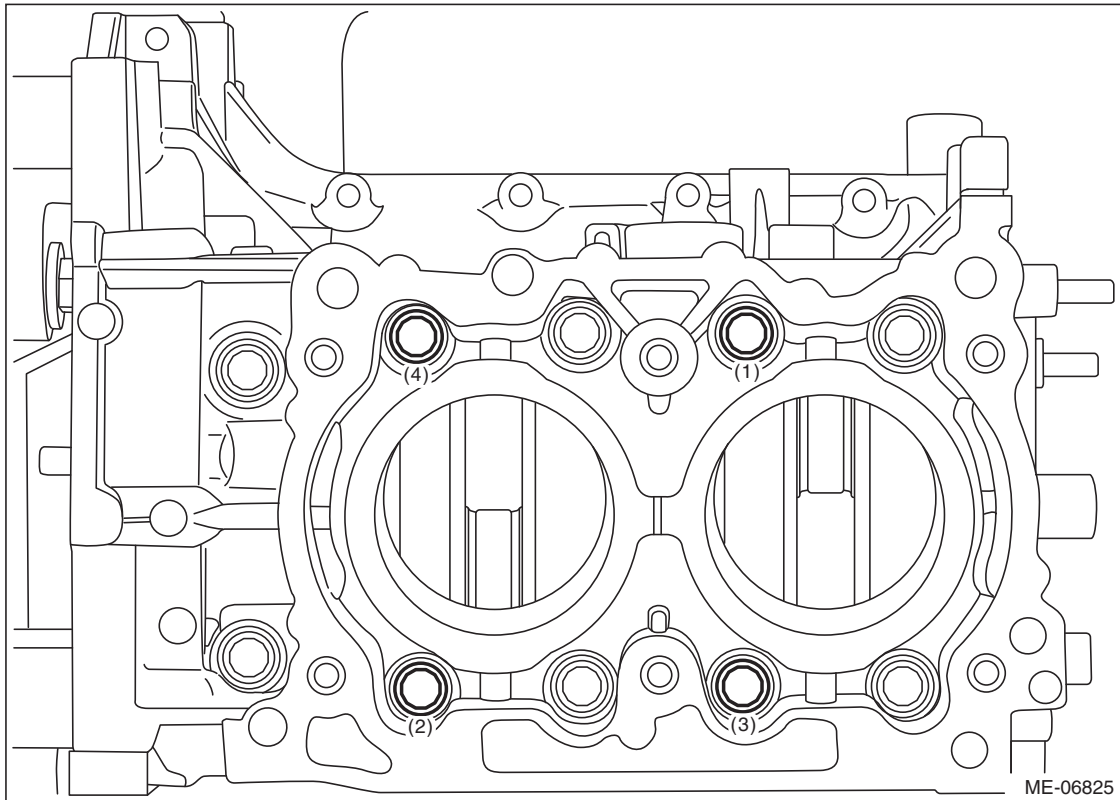
Cylinder Block

MECHANICAL

(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

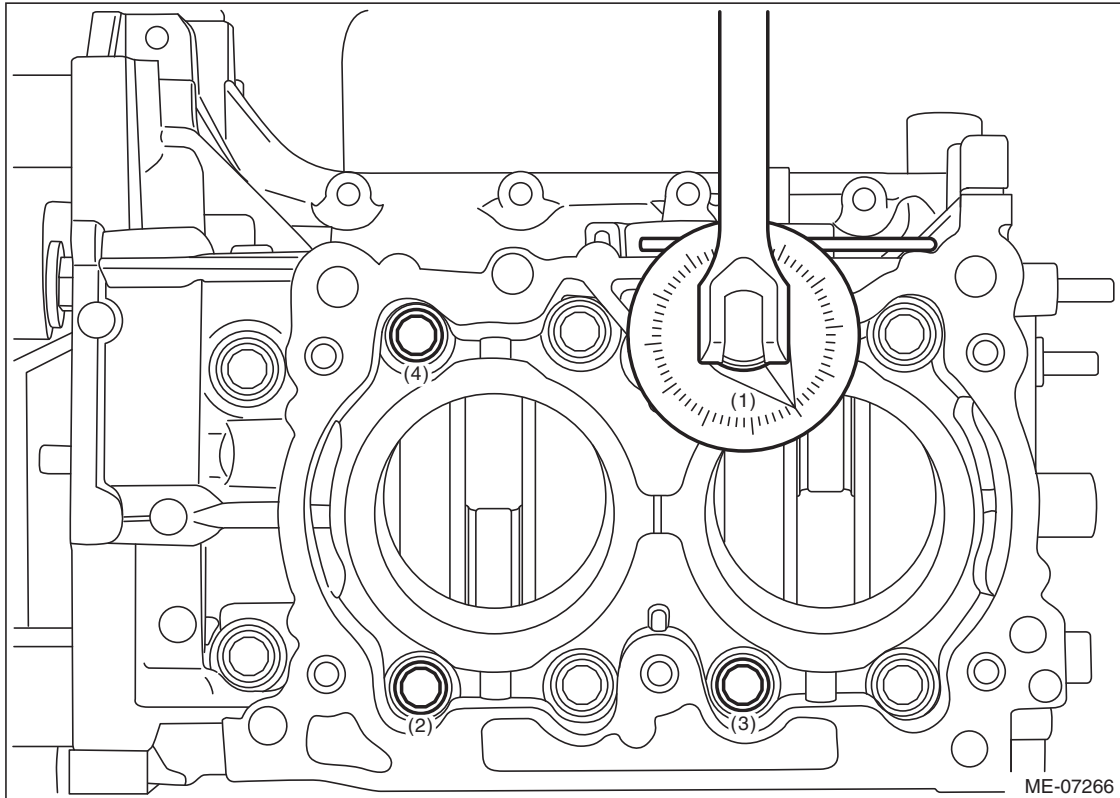
(13) Using angle gauge, tighten the mounting bolts (4 places) with specified angle in numerical order as shown in the figure.

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.

Tightening angle:

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



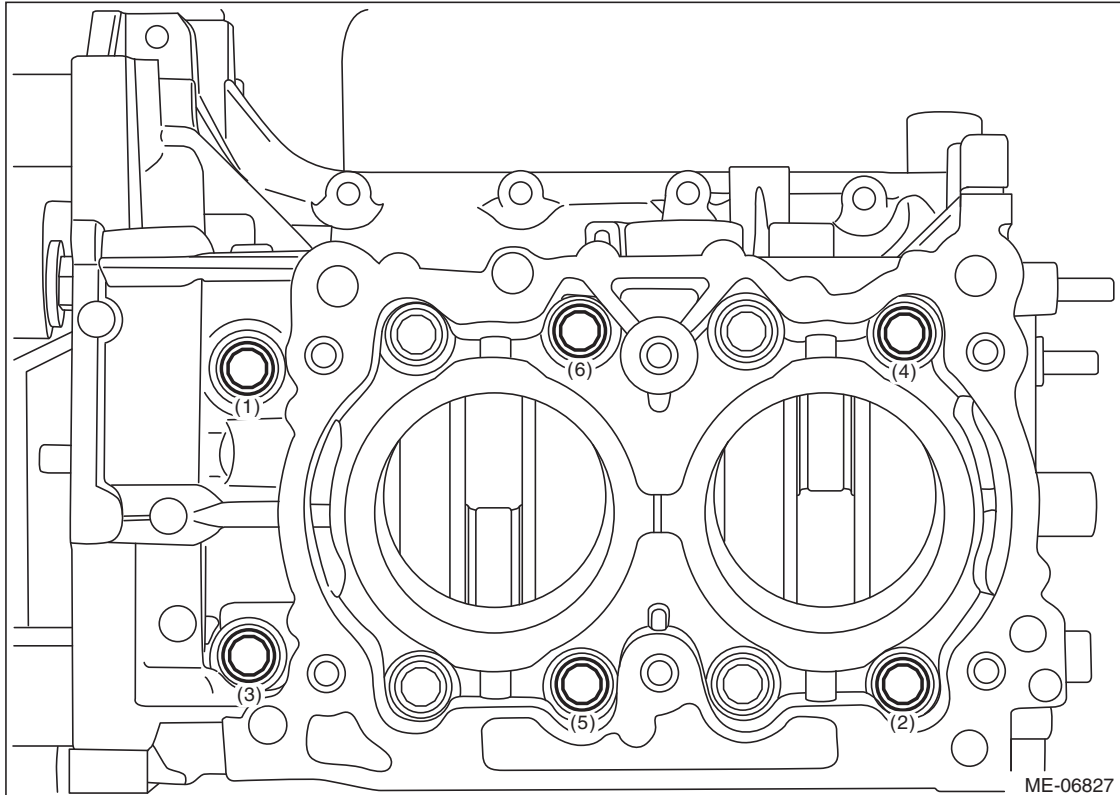
Cylinder Block

MECHANICAL

(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.



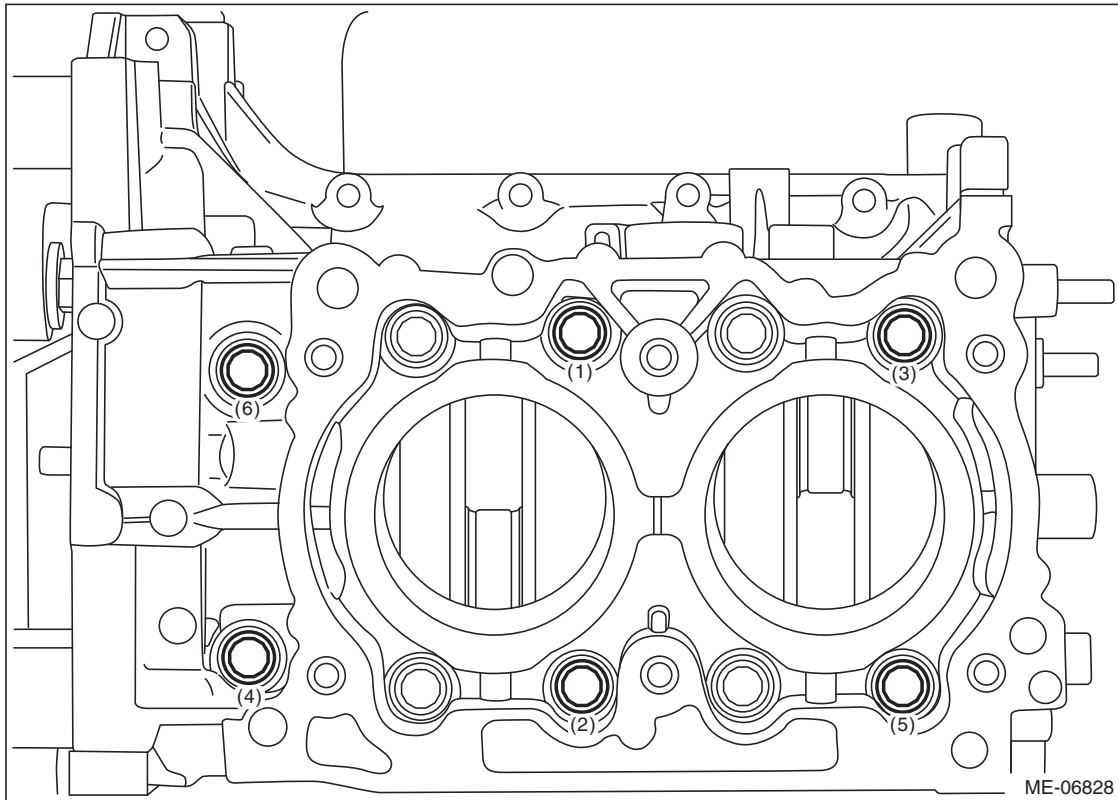
Cylinder Block

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.



Cylinder Block

MECHANICAL

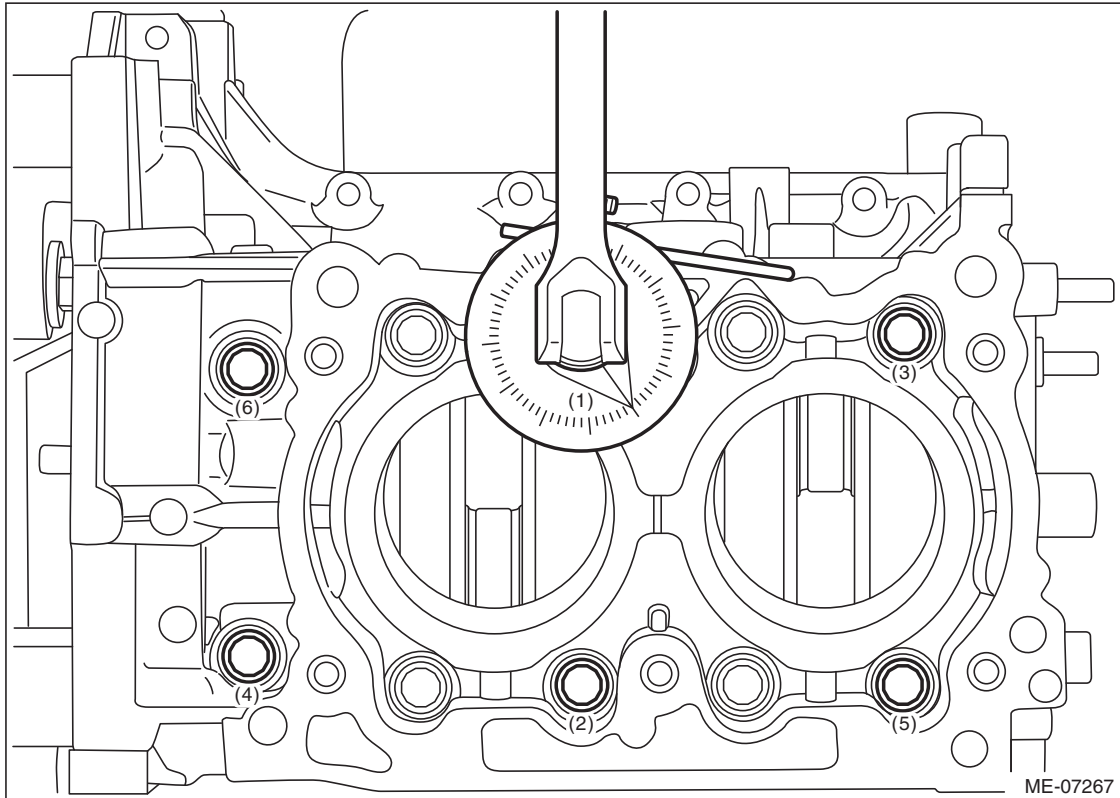
(16) Using angle gauge, tighten the mounting bolts (6 places) with specified angle in numerical order as shown in the figure.

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.

Tightening angle:

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



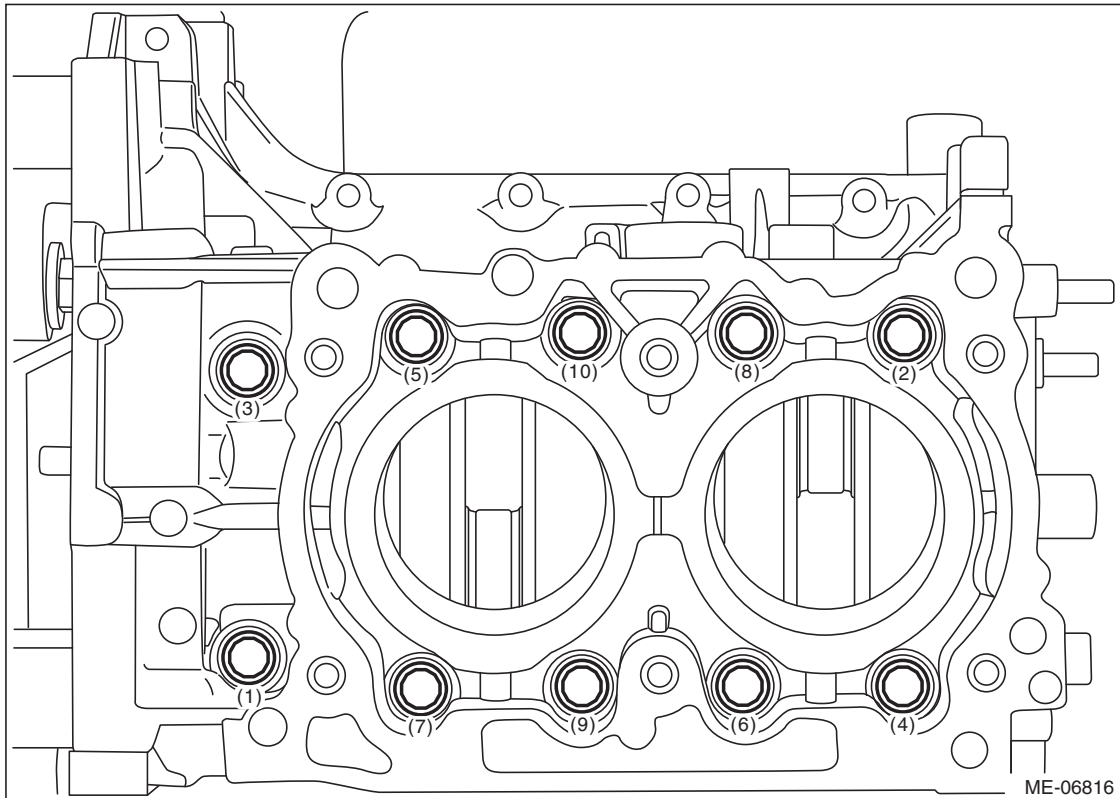
Cylinder Block

MECHANICAL

(17) 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.



Cylinder Block

MECHANICAL

(18) 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.

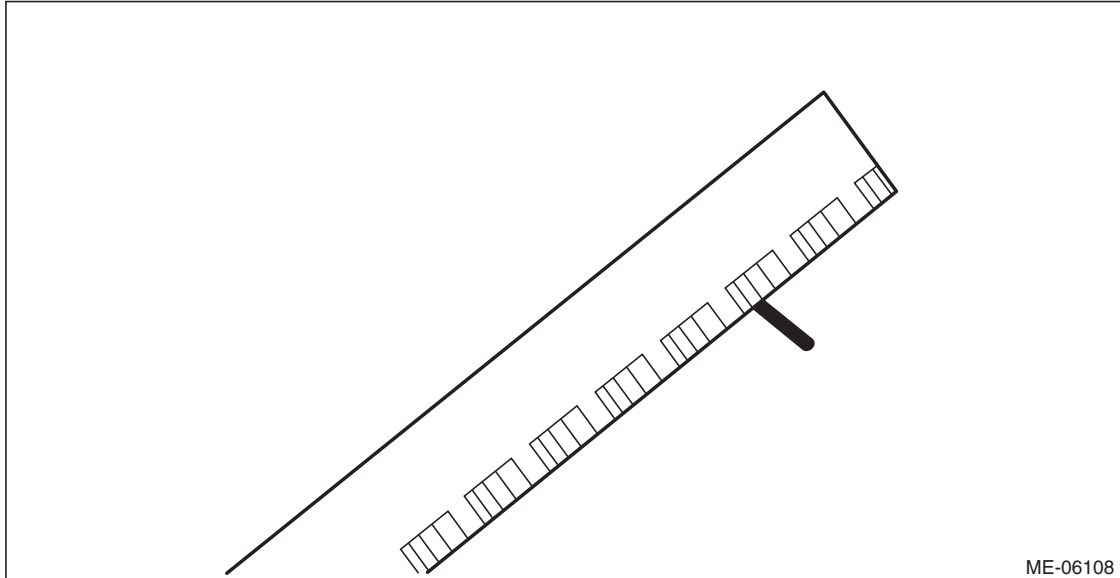
NOTE:

- 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)



(19) Completely remove the plastigauge.

23.Intake and Exhaust Valve

A: SPECIFICATION

Refer to "Cylinder Head" for removal and installation procedures of the intake and exhaust valves. <Ref. to ME(H4DOTC)-215, REMOVAL, Cylinder Head.> <Ref. to ME(H4DOTC)-220, INSTALLATION, Cylinder Head.>

Piston

MECHANICAL

24. Piston

A: SPECIFICATION

Refer to "Cylinder Block" for removal and installation procedures of pistons. <Ref. to ME(H4DOTC)-266, REMOVAL, Cylinder Block.> <Ref. to ME(H4DOTC)-279, INSTALLATION, Cylinder Block.>

25.Connecting Rod

A: SPECIFICATION

Refer to "Cylinder Block" for removal and installation procedures of connecting rod.

<Ref. to ME(H4DOTC)-266, REMOVAL, Cylinder Block.> <Ref. to ME(H4DOTC)-279, INSTALLATION, Cylinder Block.>

Crankshaft

MECHANICAL

26.Crankshaft

A: SPECIFICATION

Refer to "Cylinder Block" for removal and installation procedures of the crankshaft. <Ref. to ME(H4DOTC)-266, REMOVAL, Cylinder Block.> <Ref. to ME(H4DOTC)-279, INSTALLATION, Cylinder Block.>

27.Engine Trouble in General

A: INSPECTION

NOTE:

The "RANK" shown in the chart shows the possibilities of the cause of trouble in order from "Very often" to "Rarely".

A — Very often

B — Sometimes

C — Rarely

Symptoms	Problem parts etc.	Possible cause	RANK
1. Engine does not start.			
1) Starter does not turn.	Starter	Defective battery-to-starter harness	B
		Defective starter switch	C
		Defective inhibitor switch	C
		Defective starter	B
	Battery	Improper connection of terminal	A
		Run-down battery	A
		Defective charging system	B
	Friction	Seizure of crankshaft and connecting rod bearing	C
		Seized camshaft	C
		Seized or stuck piston and cylinder	C
	Immobilizer system <Ref. to IM(diag)-2, Basic Diagnostic Procedure.>		A
2) Initial combustion does not occur.	Starter	Defective starter	C
	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Fuel line	Defective fuel pump and relay	A
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Trouble	B
		Defective timing	B
	Compression	Incorrect cam clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder liner and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B

Engine Trouble in General

MECHANICAL

Symptoms	Problem parts etc.	Possible cause	RANK
3) Initial combustion occurs.	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Defective intake manifold gasket	B
		Defective throttle body gasket	B
	Fuel line	Defective fuel pump and relay	C
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Trouble	B
		Defective timing	B
	Compression	Incorrect cam clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder liner and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B
4) Engine stalls after initial combustion.	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened or cracked intake duct	B
		Loosened or cracked PCV hose	C
		Loosened or cracked vacuum hose	C
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Dirty air cleaner element	C
	Fuel line	Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Trouble	B
		Defective timing	B
	Compression	Incorrect cam clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B



Engine Trouble in General

MECHANICAL

Symptoms	Problem parts etc.	Possible cause	RANK
2. Rough idle and engine stall	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	A
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	C
		Loosened oil filler cap	B
		Dirty air cleaner element	C
	Fuel line	Defective fuel pump and relay	C
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Defective timing	C
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective cylinder head gasket	B
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	B
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Lubrication system	Incorrect oil pressure	B
		Defective rocker cover gasket	C
	Cooling system	Over-heating	C
	Other	Evaporative emission control system malfunction	A
		Stuck or damaged throttle valve	B

Engine Trouble in General

MECHANICAL

Symptoms	Problem parts etc.	Possible cause	RANK
3. Low output, hesitation and poor acceleration	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	B
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	B
		Loosened oil filler cap	B
		Dirty air cleaner element	A
	Fuel line	Defective fuel pump and relay	B
		Clogged fuel line	B
		Lack of fuel or insufficient fuel	C
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective cylinder head gasket	B
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Lubrication system	Incorrect oil pressure	B
	Cooling system	Over-heating	C
		Over-cooling	C
	Other	Evaporative emission control system malfunction	A

Engine Trouble in General

MECHANICAL

Symptoms	Problem parts etc.	Possible cause	RANK
4. Surging	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	A
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	B
		Loosened oil filler cap	B
		Dirty air cleaner element	B
	Fuel line	Defective fuel pump and relay	B
		Clogged fuel line	B
		Lack of fuel or insufficient fuel	C
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Cooling system	Over-heating	B
	Other	Evaporative emission control system malfunction	C
5. Engine does not return to idle	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened or cracked vacuum hose	A
	Other	Stuck or damaged throttle valve	A
6. Dieseling (run-on)	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Cooling system	Over-heating	B
	Other	Evaporative emission control system malfunction	B
7. After burning in exhaust system	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened or cracked intake duct	C
		Loosened or cracked PCV hose	C
		Loosened or cracked vacuum hose	B
		Defective PCV valve	B
		Loosened oil filler cap	C
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C
	Other	Evaporative emission control system malfunction	C

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Engine Trouble in General

MECHANICAL

Symptoms	Problem parts etc.	Possible cause	RANK
8. Knocking	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened oil filler cap	B
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	C
		Incorrect valve timing	B
	Cooling system	Over-heating	A
9. Excessive engine oil consumption	Intake system	Loosened or cracked PCV hose	A
		Defective PCV valve	B
		Loosened oil filler cap	C
	Compression	Defective valve stem	A
		Worn or stuck piston rings, cylinder and piston	A
	Lubrication system	Loosened chain cover attaching bolts and defective gasket	B
		Defective oil filter gasket	B
		Defective crankshaft oil seal	B
		Defective rocker cover gasket	B
		Loosened oil drain plug or defective gasket	B
		Loosened oil pan mounting bolt or defective oil pan	B
10. Excessive fuel consumption	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Dirty air cleaner element	A
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder gasket	C
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	B
		Incorrect valve timing	B
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C



Engine Noise

MECHANICAL

28.Engine Noise

A: INSPECTION

Type of sound	Condition	Possible cause
Regular clicking sound	Sound increases as engine speed increases.	- Valve mechanism is defective - Incorrect cam clearance - Worn camshaft - Broken valve spring - Defective valve shim
Heavy and dull clank	Oil pressure is low.	- Worn crankshaft bearing - Worn connecting rod bearing
	Oil pressure is normal.	Damaged engine mounting
High-pitched clank	Sound is noticeable when accelerating with an overload condition.	- Ignition timing advanced - Accumulation of carbon inside combustion chamber - Wrong heat range of spark plug - Improper octane value gasoline
Clank when engine speed is between 1,000 and 2,000 rpm.	Sound is reduced when the fuel injector of the noisy cylinder is stopped.*	- Worn crankshaft bearing - Worn connecting rod bearing
Knocking sound when engine is operating under idling speed and engine is warm	Sound is reduced when the fuel injector of the noisy cylinder is stopped.*	- Worn cylinder liner and piston ring - Broken or stuck piston ring - Worn piston pin and piston pin hole of piston
	Sound is not reduced if each fuel injector is stopped in turn.*	- Unusually worn valve rocker - Unusually worn valve shim - Worn cam sprocket - Worn journal of cam carrier and camshaft cap
Squeaky sound	—	Insufficient generator lubrication
Rubbing sound	—	Poor contact of generator brush and rotor
Gear scream when starting engine	—	- Defective ignition starter switch - Worn gear and starter pinion
Sound like polishing glass with a dry cloth	—	- Defective V-belt tensioner assembly (loose V-belt) - Defective water pump shaft
Hissing sound	—	- Insufficient compression - Air leakage in air intake system, hose, connection or manifold
Timing chain noise	—	- Loose timing chain - Timing chain contacting with adjacent part
Valve noise	—	Incorrect cam clearance

*Fuel injector can be stopped using the Subaru Select Monitor. <Ref. to EN(H4DOTC)(diag)-61, OPERATION, System Operation Check Mode.>

Engine Noise

MECHANICAL
