

MECHANICAL

ME(H4DOTC)

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General Description

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1. General Description

A: SPECIFICATION

Engine	Cylinder arrangement			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine
	Valve system mechanism			Belt driven, double overhead camshaft, 4 valves/cylinder
	Bore × Stroke mm (in)			99.5 × 79.0 (3.92 × 3.11)
	Displacement cm ³ (cu in)			2,457 (149.94)
	Compression ratio			8.2
	Compression pressure (at 400 rpm) kPa (kg/cm ² , psi)			981 — 1,177 (10 — 12, 142 — 171)
	Number of piston rings			Pressure ring: 2, Oil ring: 1
	Intake valve timing	Open	Max.retard	ATDC 5°
			Min.advance	BTDC 15°
		Close	Max.retard	ABDC 65°
			Min.advance	ABDC 45°
	Exhaust valve timing	Open		BBDC 55°
		Close		BTDC 5°
	Valve clearance mm (in)	Intake		0.20 ^{+0.04} _{-0.06} (0.0079 ^{+0.0016} _{-0.0024})
		Exhaust		0.35±0.05 (0.0138±0.0020)
	Idle speed ["P"/"N" range] rpm	No-load		750±100
A/C ON		875±100		
Ignition order				1 → 3 → 2 → 4
Ignition timing BTDC/rpm	MT model		12°±10°/750	
	AT model		17°±10°/750	

NOTE:

OS: Oversize US: Undersize

Belt tension adjuster	Protrusion of adjuster rod			mm (in)	5.2 — 6.2 (0.205 — 0.244)
Belt tensioner	Spacer O.D.			mm (in)	17.955 — 17.975 (0.7069 — 0.7077)
	Tensioner bush I.D.			mm (in)	18.0 — 18.08 (0.7087 — 0.7118)
	Clearance between spacer and bush		mm (in)	Standard	0.025 — 0.125 (0.0010 — 0.0049)
	Side clearance of spacer		mm (in)	Standard	0.2 — 0.55 (0.0079 — 0.0217)
Camshaft	Bend limit			mm (in)	0.020 (0.00079)
	Side clearance		mm (in)	Standard	0.068 — 0.116 (0.0027 — 0.0047)
	Cam lobe height	mm (in)	Intake	Standard	46.55 — 46.65 (1.833 — 1.837)
			Exhaust	Standard	46.75 — 46.85 (1.841 — 1.844)
	Journal O.D.	mm (in)	Standard	Front	37.946 — 37.963 (1.4939 — 1.4946)
				Center rear	29.946 — 29.963 (1.1790 — 1.1796)
	Clearance at journal		mm (in)	Standard	0.037 — 0.072 (0.0015 — 0.0028)
Cylinder Head	Surface warpage limit			mm (in)	0.035 (0.0014)
	Grinding limit			mm (in)	0.3 (0.012)
	Standard height			mm (in)	127.5 (5.02)
Valve seat	Refacing angle				90°
	Contacting width	mm (in)	Intake	Standard	0.6 — 1.4 (0.024 — 0.055)
			Exhaust	Standard	1.2 — 1.8 (0.047 — 0.071)
Valve guide	Inside diameter			mm (in)	6.000 — 6.012 (0.2362 — 0.2367)
	Protrusion above head			mm (in)	15.8 — 16.2 (0.622 — 0.638)

General Description

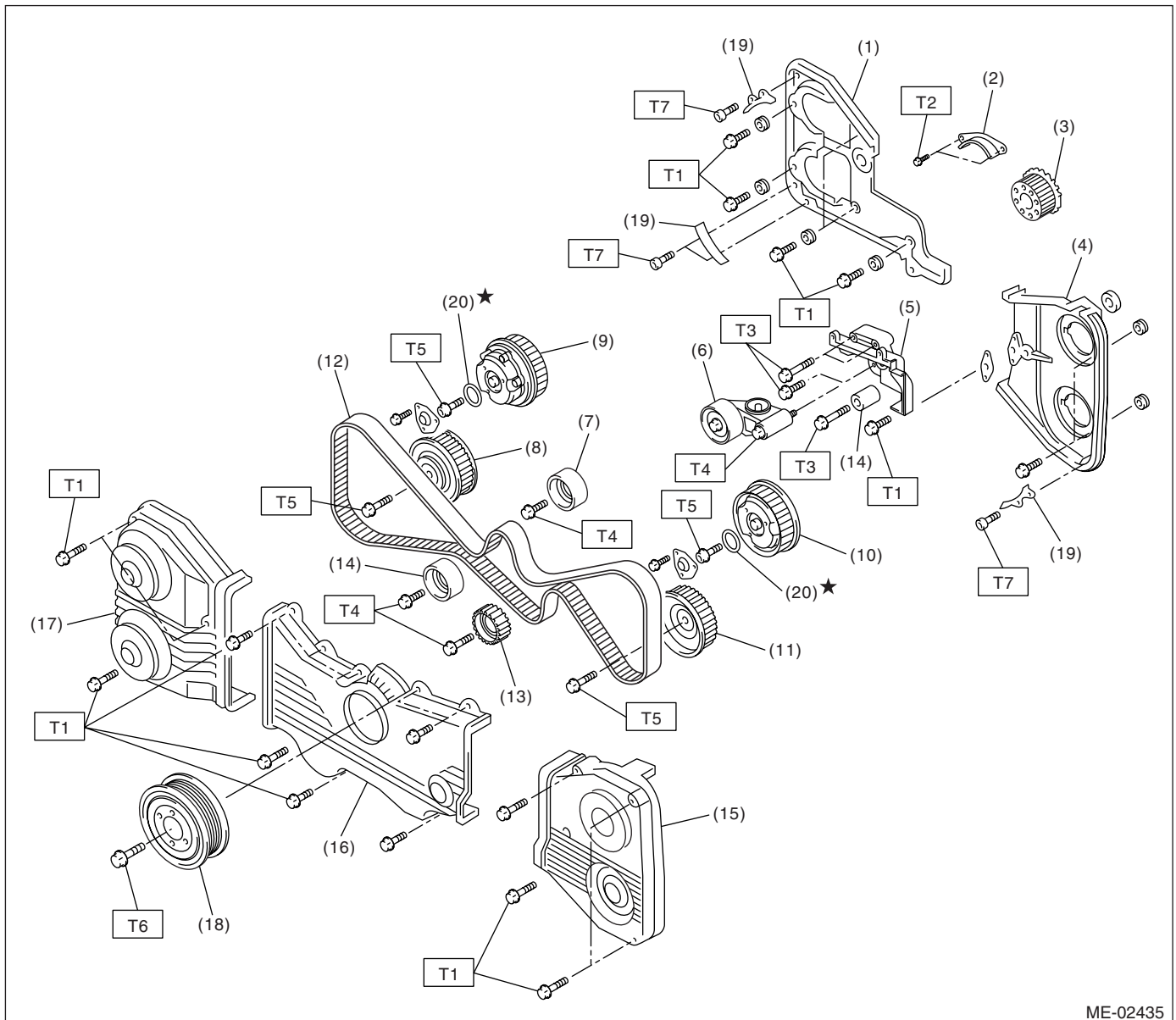
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Valve	Head edge thick- ness	mm (in)	Intake	Standard	1.0 — 1.4 (0.039 — 0.055)	
			Exhaust	Standard	1.3 — 1.7 (0.051 — 0.067)	
	Stem outer diam- eters	mm (in)	Intake		5.955 — 5.970 (0.2344 — 0.2350)	
			Exhaust		5.945 — 5.960 (0.2341 — 0.2346)	
	Valve stem gap	mm (in)	Standard	Intake	0.030 — 0.057 (0.0012 — 0.0022)	
				Exhaust	0.040 — 0.067 (0.0016 — 0.0026)	
Overall length	mm (in)	Intake		104.4 (4.110)		
		Exhaust		104.65 (4.1201)		
Valve springs	Free length				mm (in) 47.32 (1.863)	
	Squareness				2.5°, 2.1 mm (0.083 in)	
	Tension/spring height			N (kgf, lb) /mm (in)	Set	205 — 235 (20.9 — 24.0, 46.1 — 52.8)/36.0 (1.417)
					Lift	426 — 490 (43.4 — 50.0, 95.8 — 110)/26.50 (1.043)
Cylinder block	Surface warpage limit (mating with cylinder head)				mm (in) 0.025 (0.0098)	
	Grinding limit				mm (in) 0.1 (0.004)	
	Standard height				mm (in) 201.0 (7.91)	
	Cylinder inner diameter	mm (in)	Standard	A	99.505 — 99.515 (3.9175 — 3.9179)	
				B	99.495 — 99.505 (3.9171 — 3.9175)	
	Taper		mm (in)	Standard	0.015 (0.0006)	
	Out-of-roundness		mm (in)	Standard	0.010 (0.0004)	
Piston clearance		mm (in)	Standard	–0.010 — 0.010 (–0.00039 — 0.00039)		
Piston	Outer diameter	mm (in)	Standard	A	99.505 — 99.515 (3.9175 — 3.9179)	
				B	99.495 — 99.505 (3.9171 — 3.9175)	
			0.25 (0.0098) OS		99.745 — 99.765 (3.9270 — 3.9278)	
			0.50 (0.0197) OS		99.995 — 100.015 (3.9368 — 3.9376)	
Piston pin	Standard clearance between pis- ton and piston pin			mm (in)	Standard	0.004 — 0.008 (0.0002 — 0.0003)
	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).	
Piston ring	Ring closed gap	mm (in)	Top ring	Standard	0.20 — 0.25 (0.0079 — 0.0098)	
			Second ring	Standard	0.37 — 0.52 (0.015 — 0.0203)	
			Oil ring	Standard	0.20 — 0.50 (0.0079 — 0.0197)	
	Ring groove gap	mm (in)	Top ring	Standard	0.040 — 0.080 (0.0016 — 1.0031)	
			Second ring	Standard	0.030 — 0.070 (0.0012 — 0.0028)	
Connecting rod	Bend or twist per 100 mm (3.94 in) in length			mm (in)	Limit	0.10 (0.0039)
	Side clearance of large end			mm (in)	Standard	0.070 — 0.330 (0.0028 — 0.0130)
Bearing of large end	Oil clearance			mm (in)	Standard	0.017 — 0.045 (0.0007 — 0.0018)
	Bearing size (Thickness at center)	mm (in)	Standard		1.490 — 1.502 (0.0587 — 0.0591)	
			0.03 (0.0012) US		1.504 — 1.512 (0.0592 — 0.0595)	
			0.05 (0.0020) US		1.514 — 1.522 (0.0596 — 0.0599)	
			0.25 (0.0098) US		1.614 — 1.622 (0.0635 — 0.0639)	
Bushing of small end	Clearance between piston pin and bushing			mm (in)	Standard	0 — 0.022 (0 — 0.0009)

General Description

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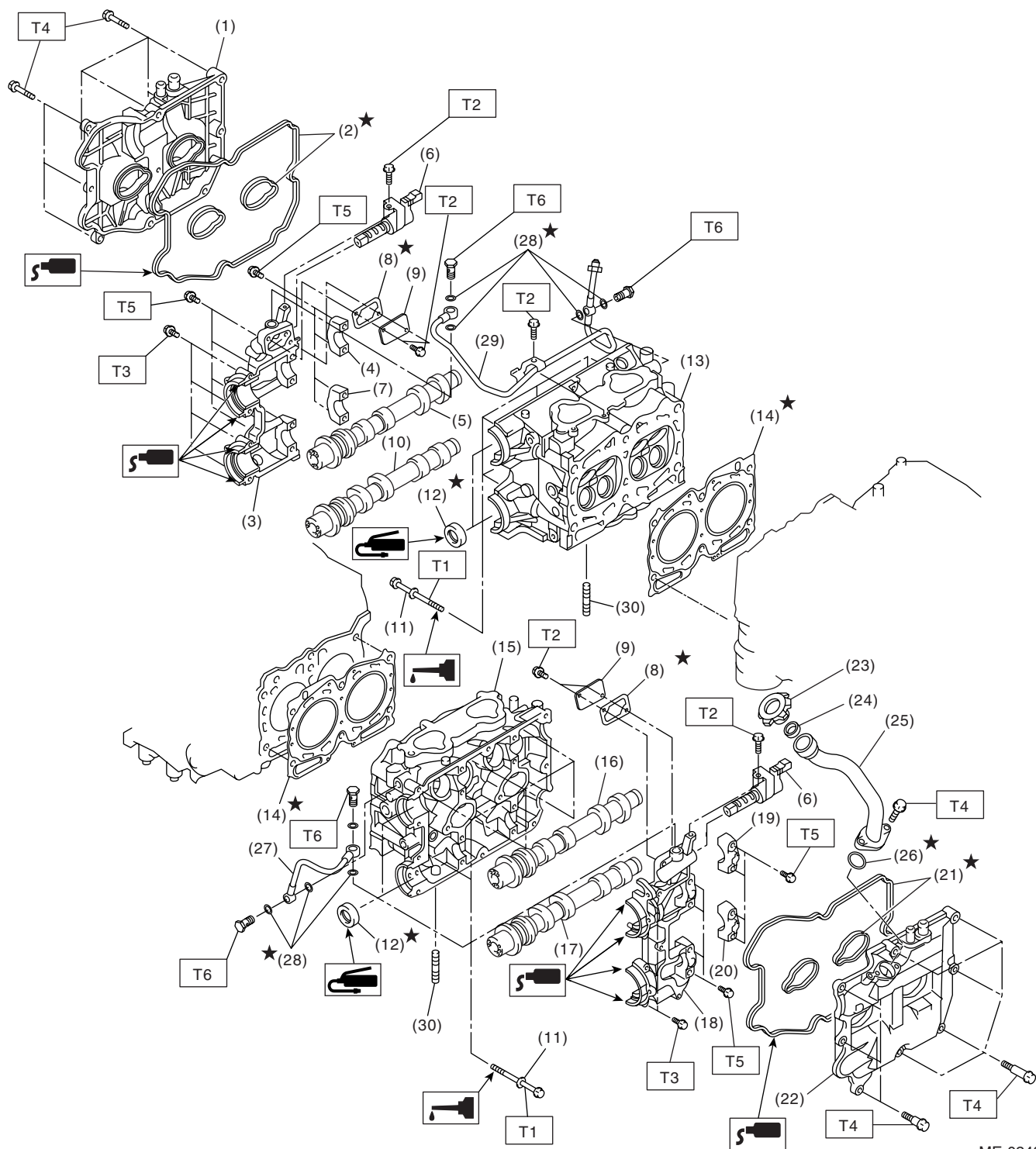
Crankshaft	Bend limit		mm (in)	0.035 (0.0014)	
	Crank pin	Out-of-roundness		mm (in)	0.003 (0.0001)
		Cylindricity		mm (in)	0.004 (0.0002)
		Grinding limit (dia.)		mm (in)	To 51.750 (2.0374)
	Crank journal	Out-of-roundness		mm (in)	0.005 (0.0002)
		Cylindricity		mm (in)	0.006 (0.0002)
		Grinding limit (dia.)		mm (in)	To 59.750 (2.3524)
	Crank pin outer diameter	mm (in)	Standard	51.984 — 52.000 (2.0466 — 2.0472)	
			0.03 (0.0012) US	51.954 — 51.970 (2.0454 — 2.0461)	
			0.05 (0.0020) US	51.934 — 51.950 (2.0447 — 2.0453)	
			0.25 (0.0098) US	51.734 — 51.750 (2.0368 — 2.0374)	
	Crank journal outer diameter	mm (in)	Standard	59.992 — 60.008 (2.3619 — 2.3625)	
			0.03 (0.0012) US	59.962 — 59.978 (2.3607 — 2.3613)	
			0.05 (0.0020) US	59.942 — 59.958 (2.3599 — 2.3605)	
			0.25 (0.0098) US	59.742 — 59.758 (2.3520 — 2.3527)	
Side clearance	mm (in)	Standard	0.030 — 0.115 (0.0012 — 0.0045)		
Oil clearance		mm (in)	0.010 — 0.030 (0.0004 — 0.0012)		
Main bearing	Bearing size (Thickness at center) mm (in)	#1, #3	Standard	1.998 — 2.011 (0.0787 — 0.0792)	
			0.03 (0.0012) US	2.017 — 2.020 (0.0794 — 0.0795)	
			0.05 (0.0020) US	2.027 — 2.030 (0.0798 — 0.0799)	
			0.25 (0.0098) US	2.127 — 2.130 (0.0837 — 0.0839)	
		#2, #4, #5	Standard	2.000 — 2.013 (0.0787 — 0.0793)	
			0.03 (0.0012) US	2.019 — 2.022 (0.0795 — 0.0796)	
			0.05 (0.0020) US	2.029 — 2.032 (0.0799 — 0.0800)	
			0.25 (0.0098) US	2.129 — 2.132 (0.0838 — 0.0839)	

B: COMPONENT**1. TIMING BELT**

ME-02435

- | | |
|--|-----------------------------------|
| (1) Timing belt cover No. 2 (RH) | (11) Exhaust cam sprocket (LH) |
| (2) Timing belt guide | (12) Timing Belt |
| (3) Crank sprocket | (13) Belt idler No. 2 |
| (4) Timing belt cover No. 2 (LH) | (14) Belt idler |
| (5) Tensioner bracket | (15) Timing belt cover (LH) |
| (6) Automatic belt tension adjuster ASSY | (16) Front belt cover |
| (7) Belt idler | (17) Timing belt cover (RH) |
| (8) Exhaust cam sprocket (RH) | (18) Crank pulley |
| (9) Intake cam sprocket (RH) | (19) Timing belt guide (MT model) |
| (10) Intake cam sprocket (LH) | (20) O-ring |

Tightening torque: N·m (kgf-m, ft-lb)**T1: 5 (0.5, 3.6)****T2: 10 (1.0, 7.2)****T3: 25 (2.5, 18.1)****T4: 39 (4.0, 28.9)****T5: <Ref. to ME(H4DOTC)-50, INSTALLATION, Cam Sprocket.>****T6: <Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>****T7: 6.4 (0.65, 4.7)**

2. CYLINDER HEAD AND CAMSHAFT

ME-02436

General Description

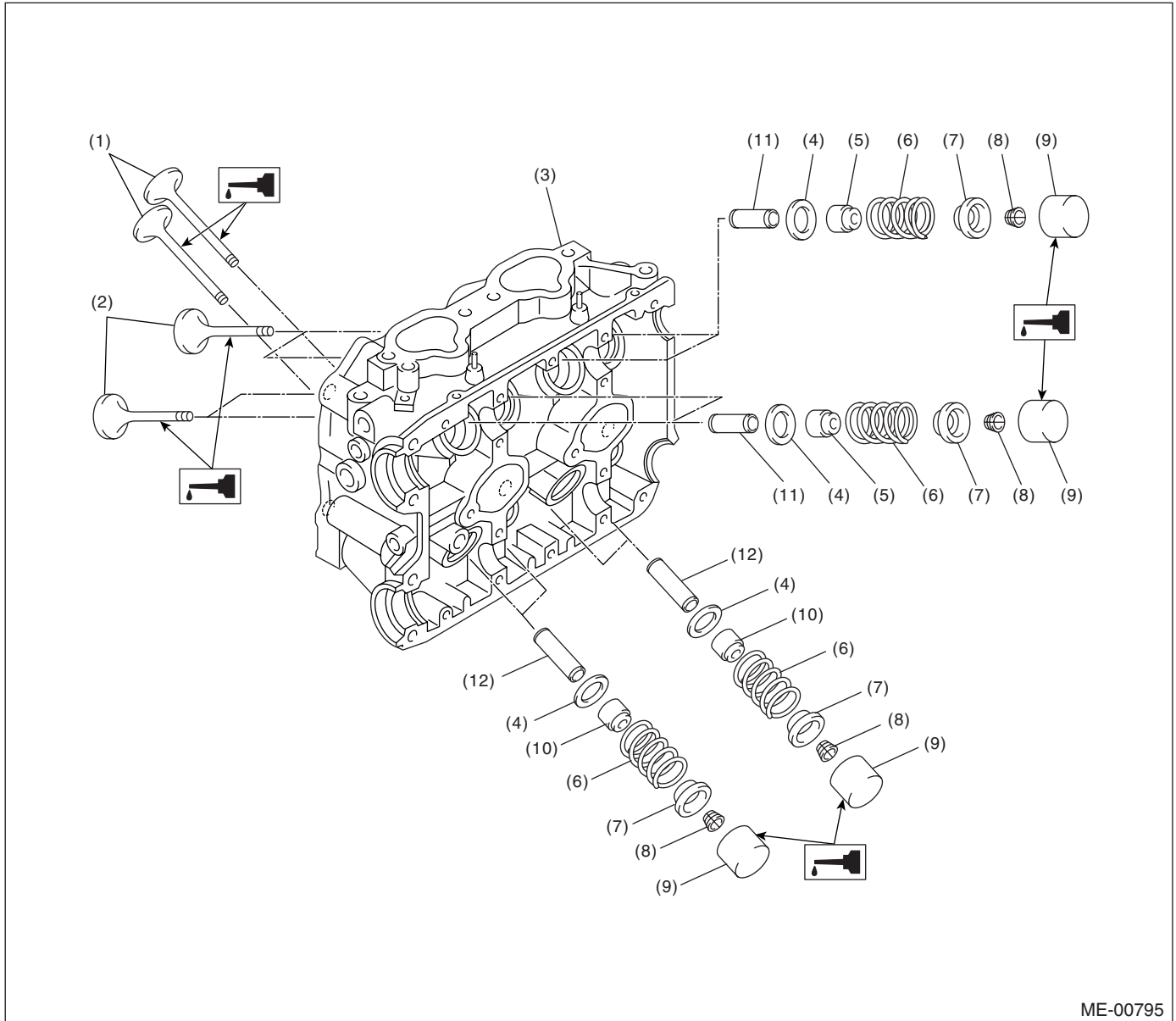
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(1) Rocker cover (RH)	(15) Cylinder head (LH)	(29) Oil pipe (RH)
(2) Rocker cover gasket (RH)	(16) Intake camshaft (LH)	(30) Stud bolt
(3) Camshaft cap (Front RH)	(17) Exhaust camshaft (LH)	
(4) Intake camshaft cap (Rear RH)	(18) Camshaft cap (Front LH)	Tightening torque: N·m (kgf-m, ft-lb)
(5) Intake camshaft (RH)	(19) Intake camshaft cap (Rear LH)	T1: <Ref. to ME(H4DOTC)-57, INSTALLATION, Cylinder Head.>
(6) Oil flow control solenoid valve	(20) Exhaust camshaft cap (Rear LH)	T2: 8 (0.8, 5.9)
(7) Exhaust camshaft cap (Rear RH)	(21) Rocker cover gasket (LH)	T3: <Ref. to ME(H4DOTC)-53, INSTALLATION, Camshaft.>
(8) Gasket	(22) Rocker cover (LH)	T4: 6.4 (0.65, 4.7)
(9) Oil return cover	(23) Oil filler cap	T5: <Ref. to ME(H4DOTC)-53, INSTALLATION, Camshaft.>
(10) Exhaust camshaft (RH)	(24) Gasket	T6: 29 (3.0, 21.4)
(11) Cylinder head bolt	(25) Oil filler duct	
(12) Oil seal	(26) O-ring	
(13) Cylinder head (RH)	(27) Oil pipe (LH)	
(14) Cylinder head gasket	(28) Gasket	

General Description

MECHANICAL

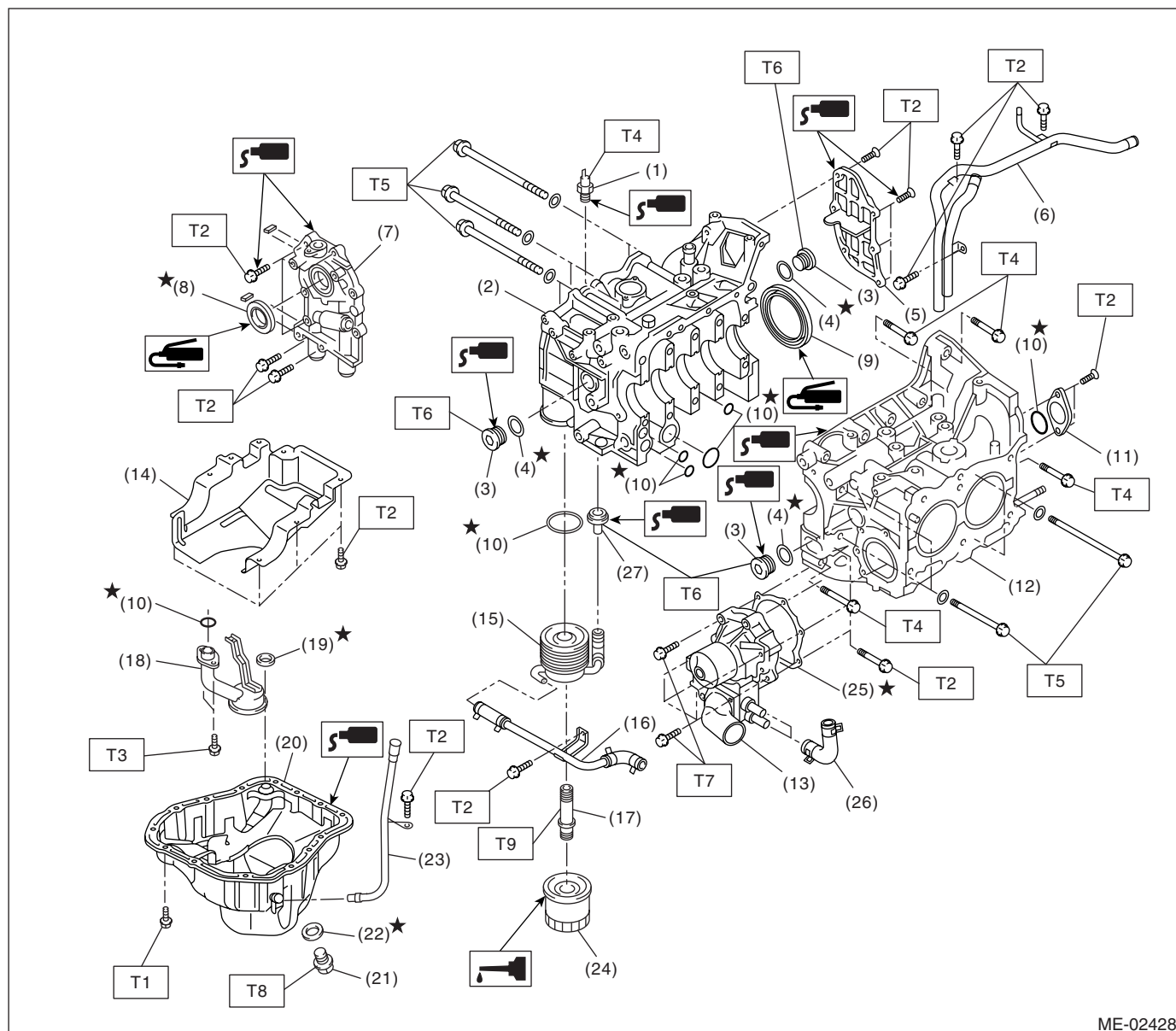
3. CYLINDER HEAD AND VALVE ASSEMBLY



ME-00795

- | | | |
|-----------------------|---------------------------|-----------------------------|
| (1) Exhaust valve | (5) Intake valve oil seal | (9) Valve lifter |
| (2) Intake valve | (6) Valve springs | (10) Exhaust valve oil seal |
| (3) Cylinder head | (7) Retainer | (11) Intake valve guide |
| (4) Valve spring seat | (8) Retainer key | (12) Exhaust valve guide |

4. CYLINDER BLOCK



ME-02428

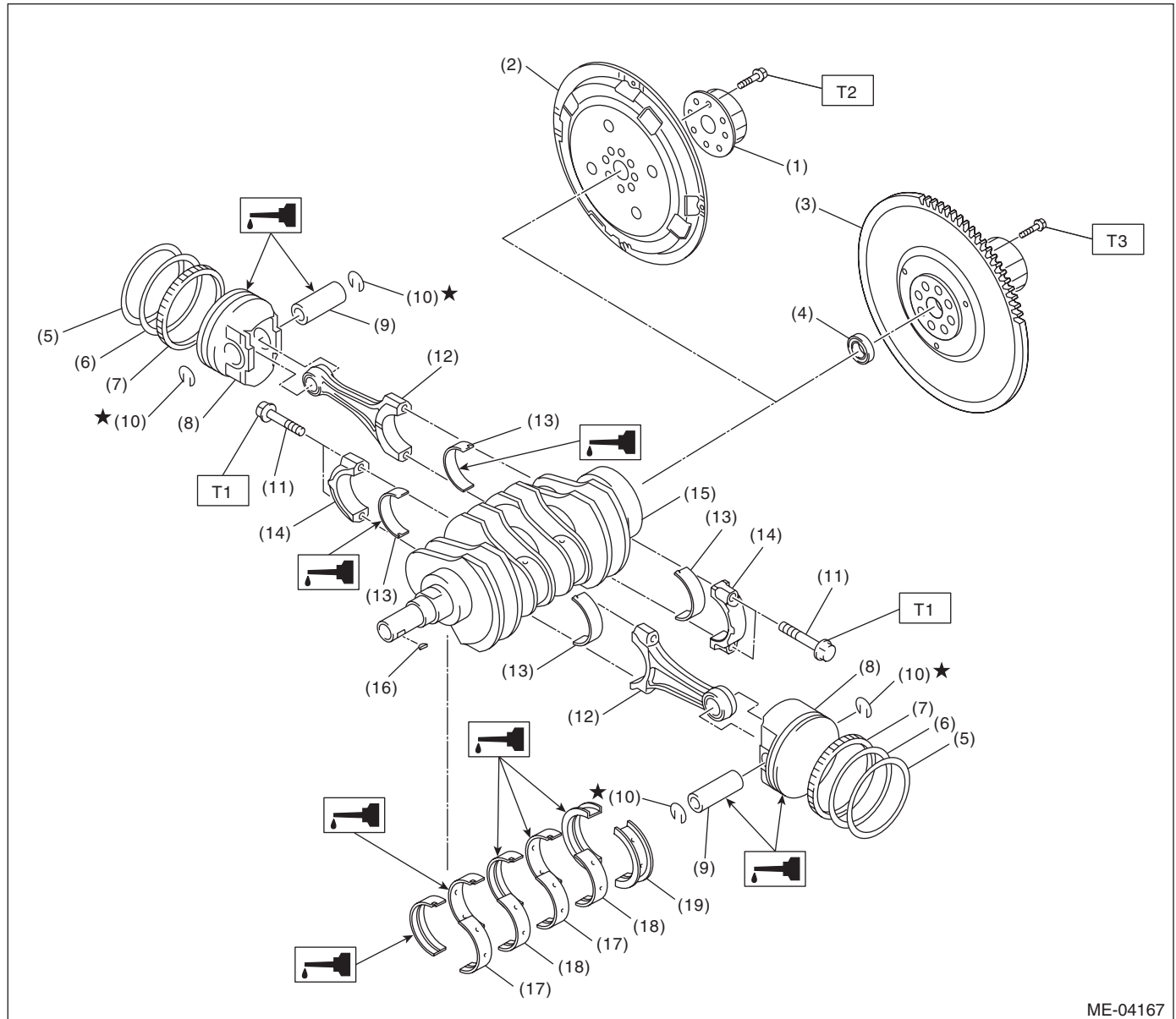
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|--------------------------|----------------------------|
| (1) Oil pressure switch | (15) Oil cooler |
| (2) Cylinder block (RH) | (16) Water by-pass pipe |
| (3) Service hole plug | (17) Connector |
| (4) Gasket | (18) Oil strainer |
| (5) Oil separator cover | (19) Gasket |
| (6) Water by-pass pipe | (20) Oil pan |
| (7) Oil pump | (21) Drain plug |
| (8) Front oil seal | (22) Metal gasket |
| (9) Rear oil seal | (23) Oil level gauge guide |
| (10) O-ring | (24) Oil filter |
| (11) Service hole cover | (25) Gasket |
| (12) Cylinder block (LH) | (26) Water pump hose |
| (13) Water pump | (27) Plug |
| (14) Baffle plate | |

Tightening torque: N·m (kgf-m, ft-lb)**T1: 5 (0.5, 3.6)****T2: 6.4 (0.65, 4.7)****T3: 10 (1.0, 7.2)****T4: 25 (2.5, 18.1)****T5: <Ref. to ME(H4DOTC)-67,
INSTALLATION, Cylinder
Block.>****T6: 70 (7.1, 50.6)****T7: First 12 (1.2, 8.9)
Second 12 (1.2, 8.9)****T8: 44 (4.5, 33)****T9: 54 (5.5, 40)**

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5. CRANKSHAFT AND PISTON



ME-04167

- | | |
|------------------------------|--------------------------------|
| (1) Reinforcement (AT model) | (10) Snap ring |
| (2) Drive plate (AT model) | (11) Connecting rod bolt |
| (3) Flywheel (MT model) | (12) Connecting rod |
| (4) Ball bearing (MT model) | (13) Connecting rod bearing |
| (5) Top ring | (14) Connecting rod cap |
| (6) Second ring | (15) Crankshaft |
| (7) Oil ring | (16) Woodruff key |
| (8) Piston | (17) Crankshaft bearing #1, #3 |
| (9) Piston pin | (18) Crankshaft bearing #2, #4 |

- (19) Crankshaft bearing #5

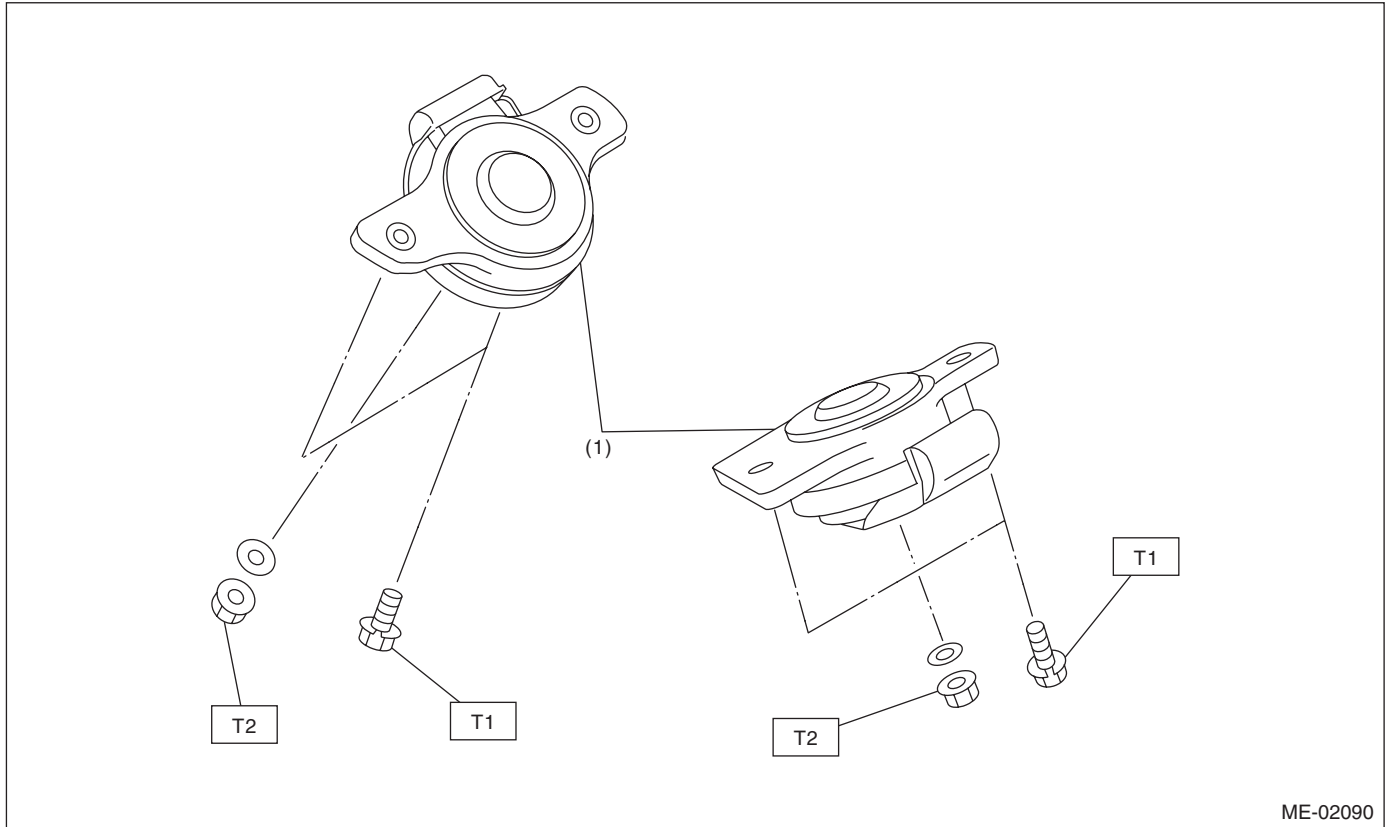
Tightening torque: N·m (kgf-m, ft-lb)

T1: 52 (5.3, 38.4)

T2: <Ref. to 5AT-68, INSTALLATION, Drive Plate.>

T3: <Ref. to CL-12, INSTALLATION, Flywheel.>

6. ENGINE MOUNTING



ME-02090

(1) Front cushion rubber

Tightening torque: N·m (kgf-m, ft-lb)

T1: 35 (3.6, 25.8)

T2: 75 (7.6, 55.3)

C: CAUTION

- Wear work clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust and dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly and replacement.
- Be careful not to burn yourself, because each part on the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or rigid racks at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the ground cable from battery.
- All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.

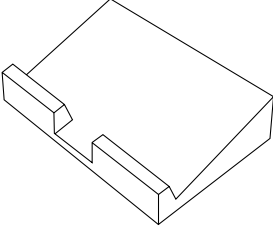
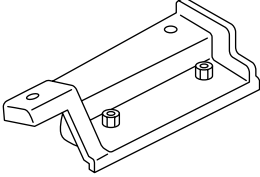
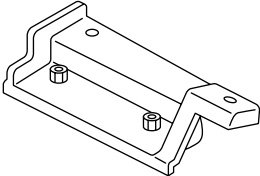
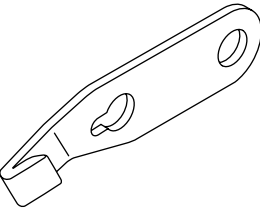
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.
- Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.
- All removed parts, if to be reused, should be re-installed in the original positions and directions.
- Bolts, nuts and washers should be replaced with new ones as required.
- Even if necessary inspections have been made in advance, proceed with assembly work while making rechecks.
- Remove or install the engine in an area where chain hoists, lifting devices, etc. are available for ready use.
- Be sure not to damage coated surfaces of body panels with tools, or not to stain seats and windows with coolant or oil. Place a cover over fender, as required, for protection.
- Prior to starting work, prepare the following:
Service tools, clean cloth, containers to catch coolant and oil, wire ropes, chain hoist, transmission jacks, etc.
- Lift-up or lower the vehicle when necessary. Make sure to support the correct positions.

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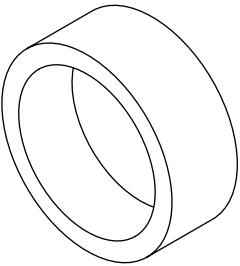
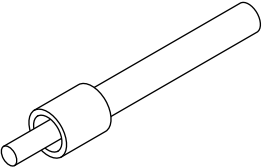
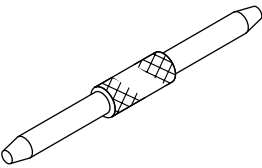
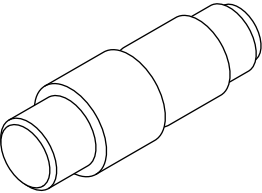
D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498267600	498267600	CYLINDER HEAD TABLE	- Used for replacing valve guides. - Used for removing and installing valve spring.
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	Used with ENGINE STAND (499817000).
 ST-498457100	498457100	ENGINE STAND ADAPTER LH	Used with ENGINE STAND (499817000).
 ST-498497100	498497100	CRANKSHAFT STOPPER	Used for stopping rotation of drive plate when loosening/tightening crank pulley bolt.

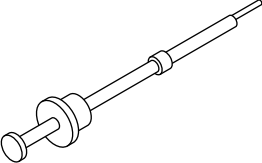
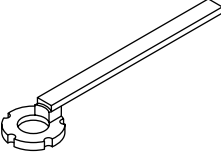
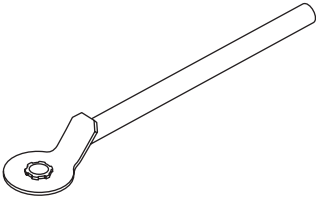
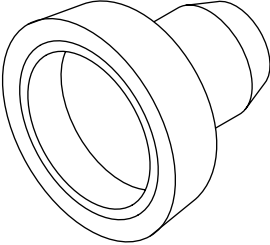
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ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498747300	498747300	PISTON GUIDE	Used for installing piston in cylinder. (2.5 L model)
 ST-498857100	498857100	VALVE OIL SEAL GUIDE	Used for press-fitting of intake and exhaust valve guide oil seals.
 ST-499017100	499017100	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 ST-499037100	499037100	CONNECTING ROD BUSHING REMOVER AND INSTALLER	Used for removing and installing connecting rod bushing.

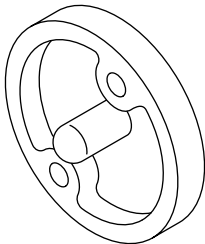
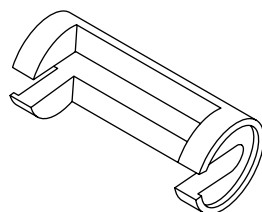
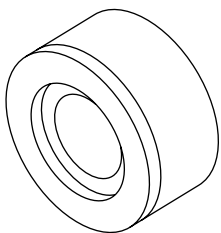
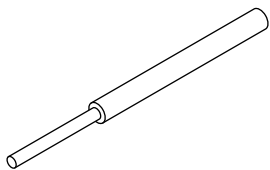
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ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499097700	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 ST-499207400	499207400	CAMSHAFT SPROCKET WRENCH	Used for removing and installing exhaust cam sprocket.
 ST-499977500	499977500	CAM SPROCKET WRENCH	Used for removing and installing the intake cam sprocket.
 ST-499587200	499587200	CRANKSHAFT OIL SEAL INSTALLER	• Used for installing crankshaft oil seal. • Used with CRANKSHAFT OIL SEAL GUIDE (499597100).

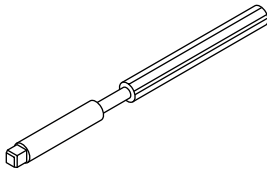
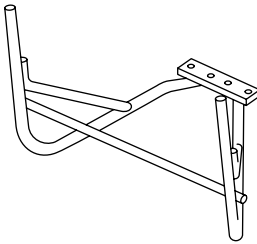
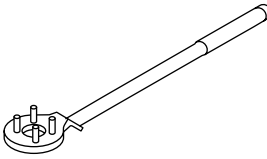
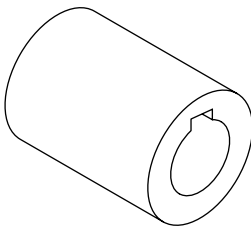
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499597100	499597100	CRANKSHAFT OIL SEAL GUIDE	- Used for installing crankshaft oil seal. - Used with CRANKSHAFT OIL SEAL INSTALLER (499587200).
 ST-499718000	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.
 ST18251AA020	18251AA020	VALVE GUIDE ADJUSTER	Used for installing intake and exhaust valve guides.
 ST-499767200	499767200	VALVE GUIDE REMOVER	Used for removing valve guides.

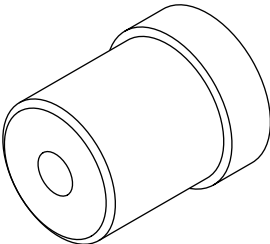
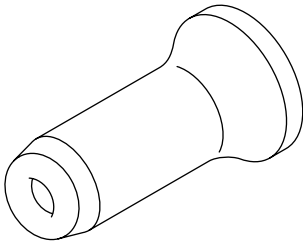
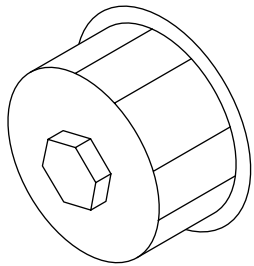
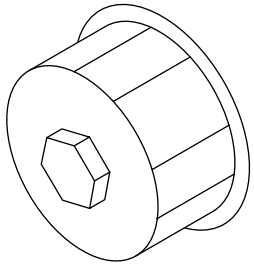
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499767400	499767400	VALVE GUIDE REAMER	Used for reaming valve guides.
 ST-499817000	499817000	ENGINE STAND	• Stand used for engine disassembly and assembly. • Used with ENGINE STAND ADAPTER RH (498457000) & LH (498457100).
 ST-499977100	499977100	CRANK PULLEY WRENCH	Used for stopping rotation of crank pulley when loosening/tightening crank pulley bolt.
 ST-499987500	499987500	CRANKSHAFT SOCKET	Used for rotating crankshaft.

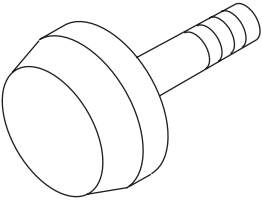
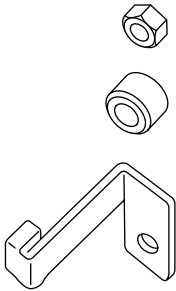
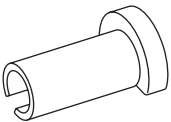
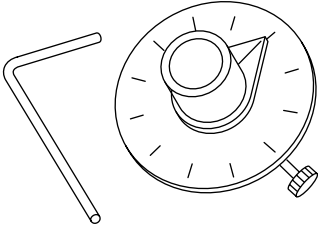
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499587100	499587100	OIL SEAL INSTALLER	Used for installing oil pump oil seal.
 ST-499587600	499587600	OIL SEAL INSTALLER	Used for installing camshaft oil seal for DOHC engine.
 ST18332AA000	18332AA000	OIL FILTER WRENCH	Used for removing and installing oil filter. (Outer diameter: 68 mm (2.68 in))
 ST18332AA010	18332AA010	OIL FILTER WRENCH	Used for removing and installing oil filter. (Outer diameter: 65 mm (2.56 in))

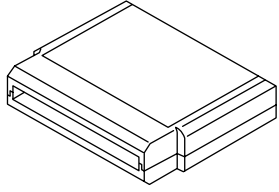
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499597200	499597200	OIL SEAL GUIDE	- Used for installing camshaft oil seal for DOHC engine. - Used with OIL SEAL INSTALLER (499587600)
 ST-498277200	498277200	STOPPER SET	Used for installing automatic transmission assembly to engine.
 ST42099AE000	42099AE000	CONNECTOR REMOVER	Used for removing quick connector in engine room.
 ST18854AA000	18854AA000	ANGLE GAUGE	Used for installing the crank pulley.

General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST24082AA260	24082AA260	CARTRIDGE	Troubleshooting for electrical system.
 ST22771AA030	22771AA030	SUBARU SELECT MONI- TOR KIT	Troubleshooting for electrical system.

2. GENERAL TOOL

TOOL NAME	REMARKS
Compression gauge	Used for measuring compression.

E: PROCEDURE

It is possible to conduct the following service procedures with engine on the vehicle, however, the procedures described in this section are based on the condition that the engine is removed from vehicle.

- V-belt
- Timing belt
- Camshaft
- Cylinder head

2. Compression

A: INSPECTION

CAUTION:

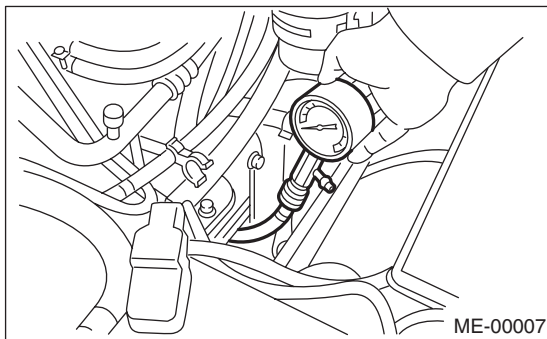
After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.

- 1) Remove the collector cover.
- 2) After warming-up the engine, turn the ignition switch to OFF.
- 3) Make sure that the battery is fully charged.
- 4) Release the fuel pressure. <Ref. to FU(H4DOTC)-44, RELEASING OF FUEL PRESSURE, PROCEDURE, Fuel.>
- 5) Remove all the spark plugs. <Ref. to IG(H4DOTC)-4, REMOVAL, Spark Plug.>
- 6) Fully open the throttle valve.
- 7) Check the starter motor for satisfactory performance and operation.
- 8) Hold the compression gauge tight against the spark plug hole.

NOTE:

When using a screw-in type compression gauge, the screw (put into cylinder head spark plug hole) should be less than 18 mm (0.71 in) long.

- 9) Crank the engine by means of the starter motor, and read the maximum value on the gauge when the pointer is steady.



- 10) Perform at least two measurements per cylinder, and make sure that the values are correct.

Compression pressure (350 rpm and Throttle fully open):

Standard:

981 — 1,177 kPa (10 — 12 kg/cm², 142 — 171 psi)

Difference between cylinders:

49 kPa (0.5 kgf/cm², 7 psi) or less

3. Idle Speed

A: INSPECTION

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

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

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

2) Idle the engine.

3) Stop the engine, and turn the ignition switch to OFF.

4) Insert the cartridge to Subaru Select Monitor.

5) Connect the Subaru Select Monitor to data link connector.

6) Turn the ignition switch to ON and Subaru Select Monitor switch to ON.

7) Select {Each System Check} in Main Menu.

8) Select {Engine} in Selection Menu.

9) Select {Current Data Display & Save} in Engine Control System Diagnosis.

10) Select {Data Display} in Data Display Menu.

11) Start the engine, and read the engine idle speed.

12) Check the idle speed when unloaded. (With headlights, heater fan, rear defroster, radiator fan, air conditioning, etc. OFF)

Idle speed [No load and gears in neutral]:

750±100 rpm

13) Check the idle speed when loaded. (Turn the air conditioning switch to “ON” and operate the compressor for at least one minute before measurement.)

Idle speed [A/C “ON”, and gears in neutral]:

875±100 rpm

NOTE:

Idle speed cannot be adjusted manually, because the idle speed is automatically adjusted. If the idle speed is out of specifications, refer to General Diagnosis Table under “Engine Control System”.
<Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>

4. Ignition Timing

A: INSPECTION

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

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

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

2) Idle the engine.

3) Stop the engine, and turn the ignition switch to OFF.

4) Insert the cartridge to Subaru Select Monitor.

5) Connect the Subaru Select Monitor to data link connector.

6) Turn the ignition switch to ON and Subaru Select Monitor switch to ON.

7) Select {Each System Check} in Main Menu.

8) Select {Engine} in Selection Menu.

9) Select {Current Data Display & Save} in Engine Control System Diagnosis.

10) Select {Data Display} in Data Display Menu.

11) Start the engine and check the ignition timing at idle speed.

Ignition timing [BTDC/rpm]:

MT model

12°±10°/750

AT model

17°±10°/750

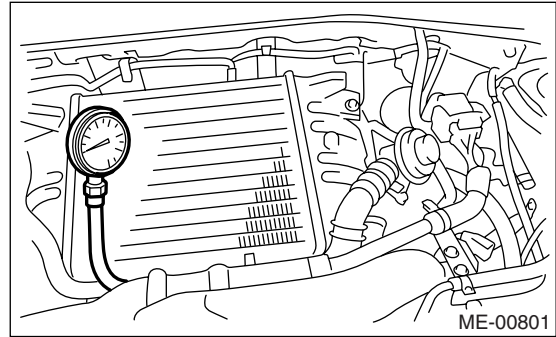
If the timing is not correct, check the ignition control system. Refer to "Engine Control System". <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>

5. Intake Manifold Vacuum

A: INSPECTION

- 1) Remove the collector cover.
- 2) Idle the engine.
- 3) Disconnect the brake vacuum hose from intake manifold, and then install the vacuum gauge.
- 4) Keep the engine at idle speed and read the vacuum gauge indication.

By observing the gauge needle movement, internal condition of the engine can be diagnosed as described below.



Vacuum pressure (at idling, A/C “OFF”):
–60.0 kPa (–450 mmHg, –17.72 inHg) or less

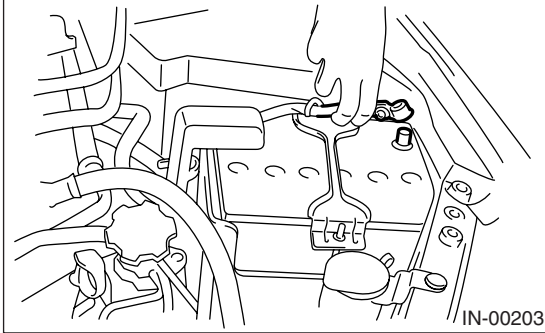
Diagnosis of engine condition by measurement of intake manifold vacuum	
Vacuum gauge indication	Possible engine condition
1. Needle motion is steady but lower than normal position. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket, or disconnected or damaged vacuum hose
2. Needle intermittently drops to the lower position than normal.	Leakage around cylinder
3. Needle drops suddenly and intermittently from normal position.	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 normal position in narrow range.	Defective ignition system or throttle chamber idle adjustment

6. Engine Oil Pressure

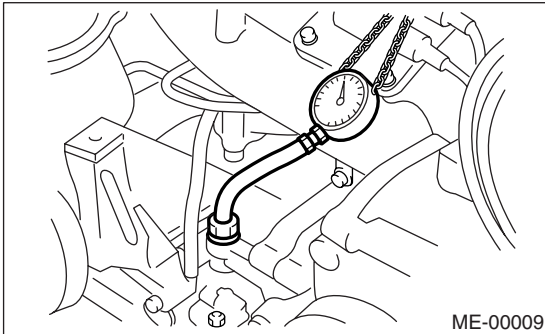
Tightening torque:
25 N·m (2.5 kgf-m, 18.1 ft-lb)

A: INSPECTION

- 1) Remove the collector cover.
- 2) Remove the oil pressure switch from engine cylinder block. <Ref. to LU(H4DOTC)-18, REMOVAL, Oil Pressure Switch.>
- 3) Connect the oil pressure gauge hose to cylinder block.
- 4) Connect the battery ground cable to battery.



- 5) Start the engine, and measure the oil pressure.



Oil pressure (Standard):

At 800 rpm

98 kPa (1.0 kgf/cm², 14 psi) or more

At 5,000 rpm

294 kPa (3.0 kgf/cm², 43 psi) or more

CAUTION:

- If the oil pressure is out of specification, check oil pump, oil filter and lubrication line. <Ref. to LU(H4DOTC)-25, INSPECTION, Engine Lubrication System Trouble in General.>
- If the oil pressure warning light is turned to ON and oil pressure is within specification, replace the oil pressure switch. <Ref. to LU(H4DOTC)-25, INSPECTION, Engine Lubrication System Trouble in General.>

NOTE:

The specified value is based on an engine oil temperature of 80°C (176°F).

- 6) After measuring the oil pressure, install the oil pressure switch. <Ref. to LU(H4DOTC)-18, INSTALLATION, Oil Pressure Switch.>

7. Fuel Pressure

A: INSPECTION

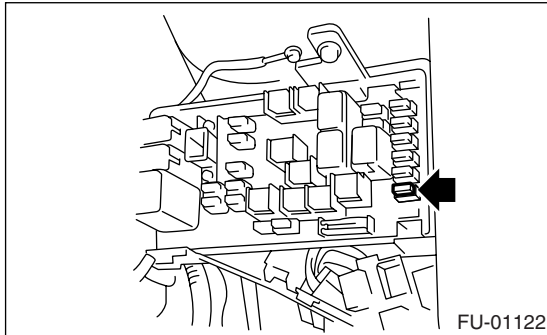
WARNING:

Before removing the fuel pressure gauge, release the fuel pressure.

NOTE:

When the fuel pressure is out of specification, check or replace the pressure regulator and pressure regulator vacuum hose.

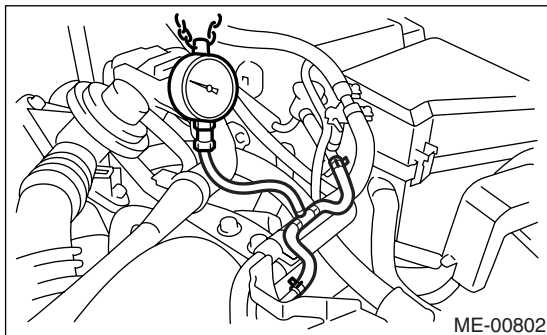
- 1) Remove the collector cover.
- 2) Release the fuel pressure. <Ref. to FU(H4DOTC)-44, RELEASING OF FUEL PRESSURE, PROCEDURE, Fuel.>
- 3) Open the fuel filler flap lid, and remove the fuel filler cap.
- 4) Disconnect the fuel delivery hose and connect fuel pressure gauge.
- 5) Install the fuse of fuel pump to main fuse box.



- 6) Start the engine.
- 7) Measure the fuel pressure while disconnecting pressure regulator vacuum hose from intake manifold.

Fuel pressure:

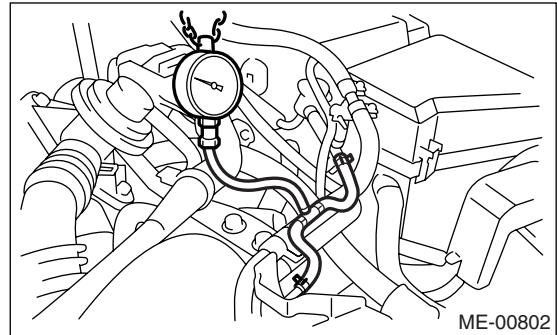
Standard: 284 — 314 kPa (2.9 — 3.2 kgf/cm², 41 — 46 psi)



- 8) After connecting the pressure regulator vacuum hose, measure the fuel pressure.

Fuel pressure:

Standard: 230 — 260 kPa (2.35 — 2.65 kgf/cm², 33 — 38 psi)



NOTE:

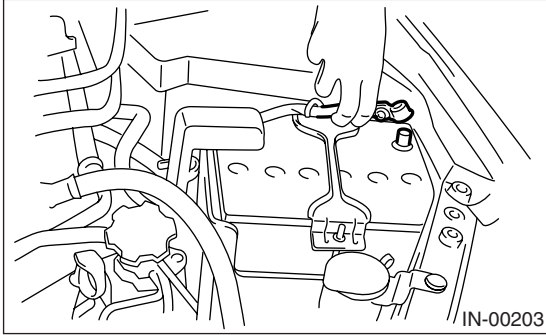
The fuel pressure gauge registers 10 to 20 kPa (0.1 to 0.2 kgf/cm², 1 to 3 psi) higher than standard values during high-altitude operations.

8. Valve Clearance

A: INSPECTION

Inspection and adjustment of valve clearance should be performed while engine is cold.

- 1) Lift-up the vehicle.
- 2) Remove the under cover.
- 3) Lower the vehicle.
- 4) Remove the collector cover.
- 5) Disconnect the ground cable from battery.



6) Remove the air intake duct. <Ref. to IN(H4DOTC)-9, REMOVAL, Air Intake Duct.>

7) Remove a bolt which secures timing belt cover (RH).

8) Loosen the remaining bolts which secure timing belt cover (RH), then remove the timing belt cover.

9) When inspecting #1 and #3 cylinders:

- (1) Remove the air cleaner case.<Ref. to IN(H4DOTC)-8, REMOVAL, Air Cleaner Case.>
- (2) Disconnect the connector from ignition coil.
- (3) Remove the ignition coil.
- (4) Place a suitable container under the vehicle.
- (5) Disconnect the PCV hose from rocker cover (RH).
- (6) Remove the bolts, then remove the rocker cover (RH).

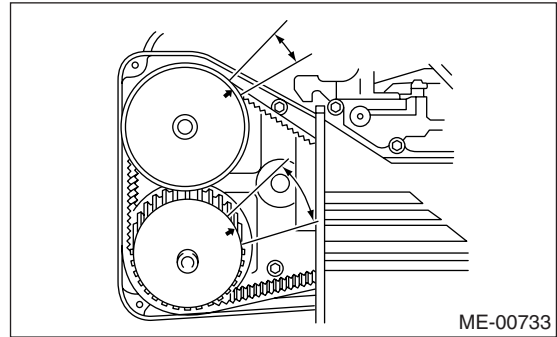
10) When inspecting #2 and #4 cylinders:

- (1) Disconnect the battery cable, and then remove the battery and battery carrier.
- (2) Disconnect the connector from ignition coil.
- (3) Remove the ignition coil.
- (4) Place a suitable container under the vehicle.
- (5) Disconnect the PCV hose from rocker cover (LH).
- (6) Remove the bolts, then remove the rocker cover (LH).

11) Turn the crank pulley clockwise until arrow mark on the cam sprocket is set to position shown in the figure.

NOTE:

Turn the crankshaft using a socket wrench.



12) Measure the #1 cylinder intake valve and #3 cylinder exhaust valve clearance by using thickness gauge (A).

NOTE:

- Insert the thickness gauge in as horizontal a direction as possible with respect to the valve lifter.
- Measure the exhaust valve clearances while lifting-up the vehicle.

Valve clearance

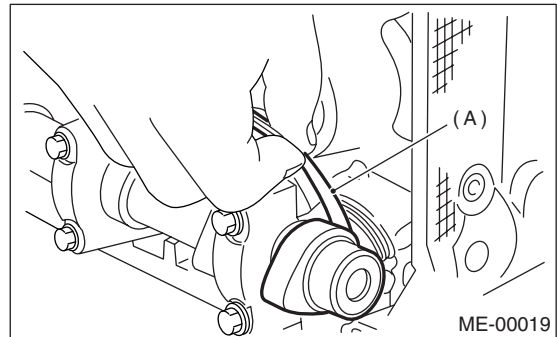
Intake:

$$0.20^{+0.04}_{-0.06} \text{ mm } (0.0079^{+0.0016}_{-0.0024} \text{ in})$$

Exhaust:

$$0.35 \pm 0.05 \text{ mm } (0.0138 \pm 0.0020 \text{ in})$$

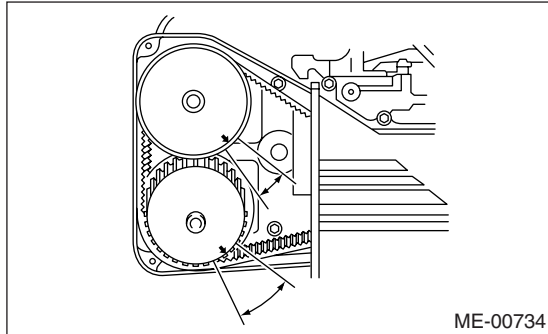
- If the measured value is not within specification, take notes of the value in order to adjust the valve clearance later on.



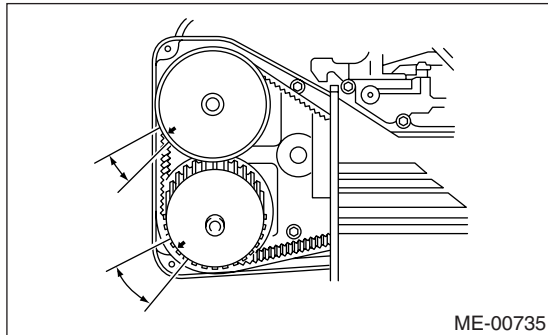
13) If necessary, adjust the valve clearance. <Ref. to ME(H4DOTC)-27, ADJUSTMENT, Valve Clearance.>

14) Further turn the crank pulley clockwise and then measure the valve clearances again.

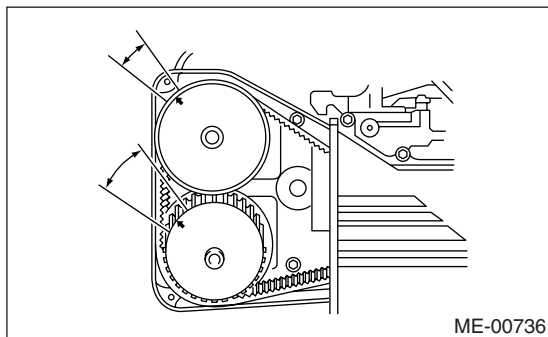
- (1) Set the arrow mark on cam sprocket to the position shown in the figure, and measure the #2 cylinder exhaust valve and #3 cylinder intake valve clearances.



- (2) Set the arrow mark on cam sprocket to the position shown in the figure, and measure the #2 cylinder intake valve and #4 cylinder exhaust valve clearances.

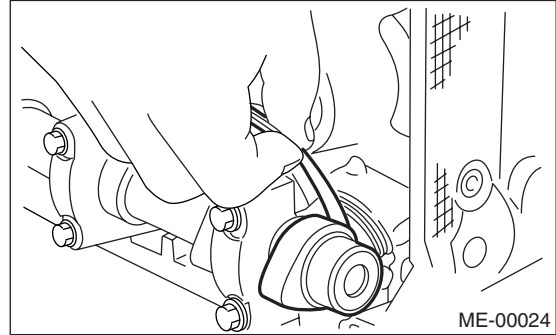


- (3) Set the arrow mark on cam sprocket to the position shown in the figure, and measure the #1 cylinder exhaust valve and #4 cylinder intake valve clearances.

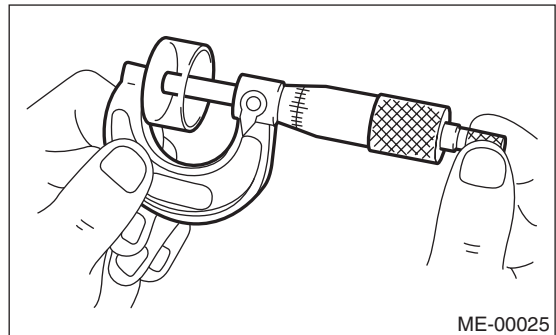


NOTE:

Record each valve clearance after it has been measured.



- 2) Remove the camshaft. <Ref. to ME(H4DOTC)-52, REMOVAL, Camshaft.>
3) Remove the valve lifter.
4) Measure the thickness of valve lifter with a micrometer.



- 5) Select a valve lifter of suitable thickness based on the measured valve clearance and valve lifter thickness, by referring to the following table.

Unit: (mm)	
Intake valve: $S = (V + T) - 0.20$	
Exhaust valve: $S = (V + T) - 0.35$	
S: Valve lifter thickness required	
V: Measured valve clearance	
T: Valve lifter thickness to be used	

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

B: ADJUSTMENT

CAUTION:

Adjustment of valve clearance should be performed while engine is cold.

- 1) Measure all valve clearances. <Ref. to ME(H4DOTC)-26, INSPECTION, Valve Clearance.>

Valve Clearance

MECHANICAL

Part number	Thickness mm (in)
13228 AB101	4.68 (0.1843)
13228 AB111	4.69 (0.1846)
13228 AB121	4.70 (0.1850)
13228 AB131	4.71 (0.1854)
13228 AB141	4.72 (0.1858)
13228 AB151	4.73 (0.1862)
13228 AB161	4.74 (0.1866)
13228 AB171	4.75 (0.1870)
13228 AB181	4.76 (0.1874)
13228 AB191	4.77 (0.1878)
13228 AB201	4.78 (0.1882)
13228 AB211	4.79 (0.1886)
13228 AB221	4.80 (0.1890)
13228 AB231	4.81 (0.1894)
13228 AB241	4.82 (0.1898)
13228 AB251	4.83 (0.1902)
13228 AB261	4.84 (0.1906)
13228 AB271	4.85 (0.1909)
13228 AB281	4.86 (0.1913)
13228 AB291	4.87 (0.1917)
13228 AB301	4.88 (0.1921)
13228 AB311	4.89 (0.1925)
13228 AB321	4.90 (0.1929)
13228 AB331	4.91 (0.1933)
13228 AB341	4.92 (0.1937)
13228 AB351	4.93 (0.1941)
13228 AB361	4.94 (0.1945)
13228 AB371	4.95 (0.1949)
13228 AB381	4.96 (0.1953)
13228 AB391	4.97 (0.1957)
13228 AB401	4.98 (0.1961)
13228 AB411	4.99 (0.1965)
13228 AB421	5.00 (0.1969)
13228 AB431	5.01 (0.1972)
13228 AB441	5.02 (0.1976)
13228 AB451	5.03 (0.1980)
13228 AB461	5.04 (0.1984)
13228 AB471	5.05 (0.1988)
13228 AB481	5.06 (0.1992)
13228 AB491	5.07 (0.1996)
13228 AB501	5.08 (0.2000)
13228 AB511	5.09 (0.2004)
13228 AB521	5.10 (0.2008)
13228 AB531	5.11 (0.2012)
13228 AB541	5.12 (0.2016)
13228 AB551	5.13 (0.2020)
13228 AB561	5.14 (0.2024)
13228 AB571	5.15 (0.2028)
13228 AB581	5.16 (0.2031)
13228 AB591	5.17 (0.2035)
13228 AB601	5.18 (0.2039)

Part number	Thickness mm (in)
13228 AB611	5.19 (0.2043)
13228 AB621	5.20 (0.2047)
13228 AB631	5.21 (0.2051)
13228 AB641	5.22 (0.2055)
13228 AB651	5.23 (0.2059)
13228 AB661	5.24 (0.2063)
13228 AB671	5.25 (0.2067)
13228 AB681	5.26 (0.2071)
13228 AB691	5.27 (0.2075)
13228 AB701	4.38 (0.1724)
13228 AB711	4.40 (0.1732)
13228 AB721	4.42 (0.1740)
13228 AB731	4.44 (0.1748)
13228 AB741	4.46 (0.1756)
13228 AB751	4.48 (0.1764)
13228 AB761	4.50 (0.1771)
13228 AB771	4.52 (0.1780)
13228 AB781	4.54 (0.1787)
13228 AB791	4.56 (0.1795)
13228 AB801	4.58 (0.1803)
13228 AB811	4.60 (0.1811)
13228 AB821	4.62 (0.1819)
13228 AB831	4.64 (0.1827)
13228 AB841	4.66 (0.1835)
13228 AB851	5.29 (0.2083)
13228 AB861	5.31 (0.2091)
13228 AB871	5.33 (0.2098)
13228 AB881	5.35 (0.2106)
13228 AB891	5.37 (0.2114)
13228 AB901	5.39 (0.2122)
13228 AB911	5.41 (0.2123)
13228 AB921	5.43 (0.2138)
13228 AB931	5.45 (0.2146)
13228 AB941	5.47 (0.2154)
13228 AB951	5.49 (0.2161)
13228 AB961	5.51 (0.2169)
13228 AB971	5.53 (0.2177)
13228 AB981	5.55 (0.2185)
13228 AB991	5.57 (0.2193)
13228 AC001	5.59 (0.2201)
13228 AC011	5.61 (0.2209)
13228 AC021	5.63 (0.2217)
13228 AC031	5.65 (0.2224)

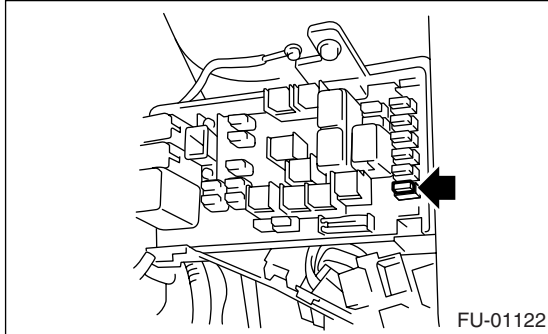
6) Inspect all valves for clearance again at this stage. If the valve clearance is not correct, repeat the procedure over again from the first step.

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

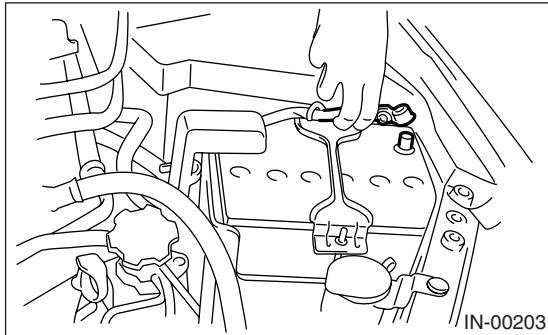
9. Engine Assembly

A: REMOVAL

- 1) Set the vehicle on a lift.
- 2) Open the front hood fully and support with a front food stay.
- 3) Collect the refrigerant from A/C system. <Ref. to AC-20, Refrigerant Recovery Procedure.>
- 4) Release the fuel pressure.
 - (1) Remove the fuse of fuel pump from main fuse box.

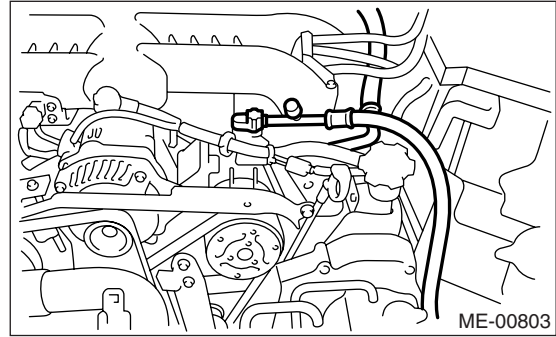


- (2) Start the engine, and run until stalls.
- (3) After the engine stalls, crank it for 5 seconds more.
- (4) Turn the ignition switch to OFF.
- 5) Remove the fuel filler cap.
- 6) Remove the collector cover.
- 7) Disconnect the ground cable from battery.



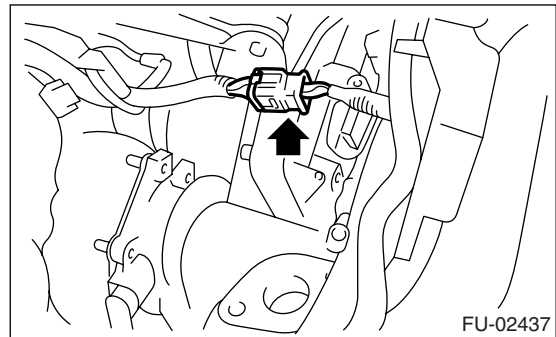
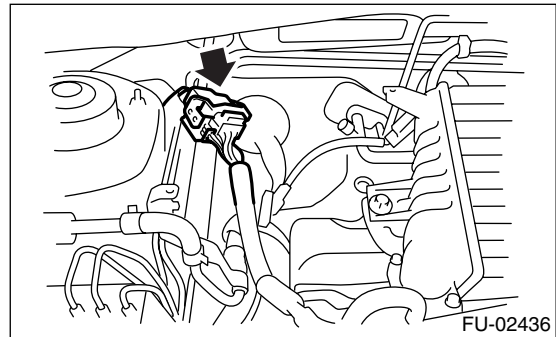
- 8) Remove the radiator from vehicle. <Ref. to CO(H4DOTC)-19, REMOVAL, Radiator.>
- 9) Remove the coolant filler tank. <Ref. to CO(H4DOTC)-31, REMOVAL, Coolant Filler Tank.>

- 10) Disconnect the A/C pressure hoses from A/C compressor.

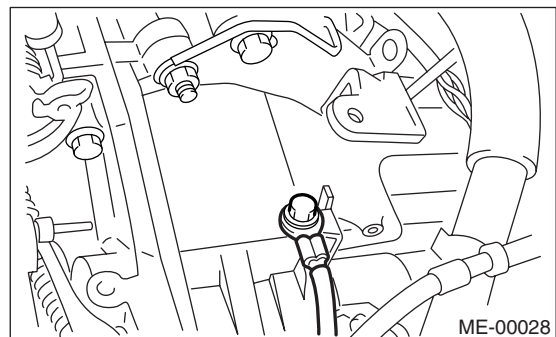


- 11) Repair the air intake system.
 - (1) Remove the intercooler. <Ref. to IN(H4DOTC)-12, REMOVAL, Intercooler.>
 - (2) Remove the air cleaner element and air cleaner case. <Ref. to IN(H4DOTC)-8, REMOVAL, Air Cleaner Case.>
- 12) Disconnect the following connectors and cables.

- (1) Engine harness connectors



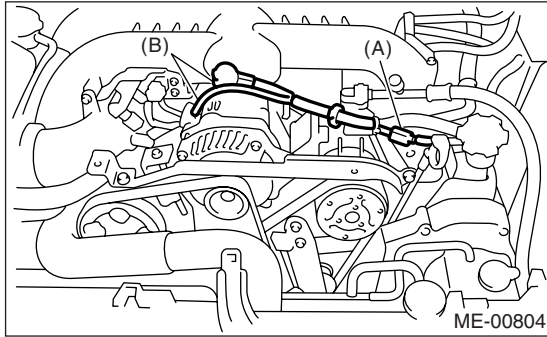
- (2) Engine ground terminals



Engine Assembly

MECHANICAL

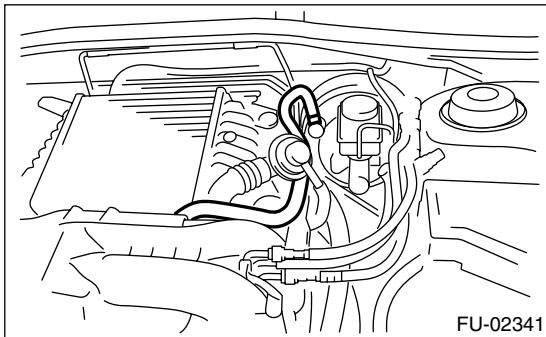
- (3) Generator connector, terminal and A/C compressor connector



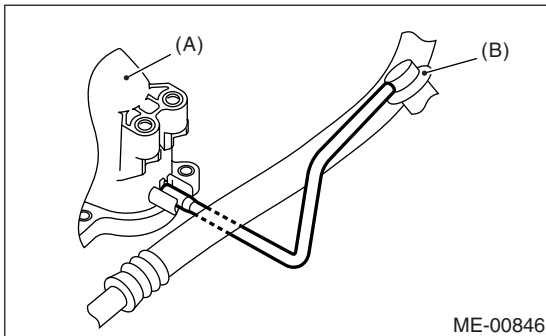
- (A) A/C compressor connector
(B) Generator connector and terminal

- 13) Disconnect the following hoses.

- (1) Brake booster vacuum hose



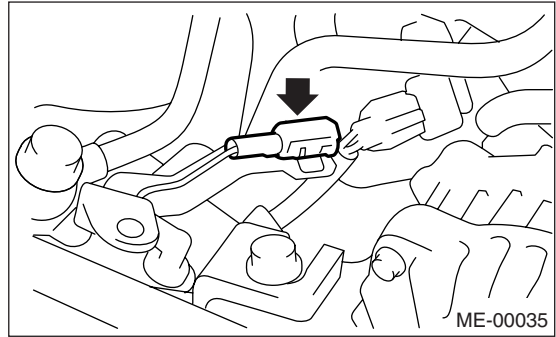
- (2) Heater inlet and outlet hoses
(3) Remove the hose between intake manifold (A) and pressure regulator (B).



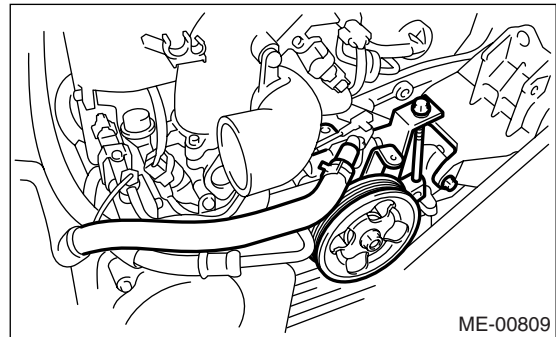
- 14) Remove the power steering pump from bracket.

- (1) Loosen the lock bolt and slider bolt, and remove the front side belt. <Ref. to ME(H4DOTC)-37, FRONT SIDE BELT, REMOVAL, V-belt.>

- (2) Disconnect the power steering switch connector.



- (3) Remove the power steering pump from engine.



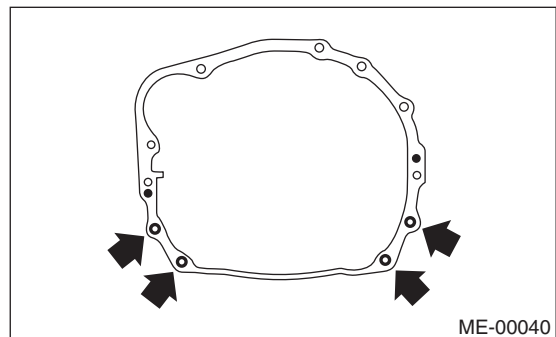
- (4) Place the power steering pump on the right side wheel apron.

- 15) Lift-up the vehicle.

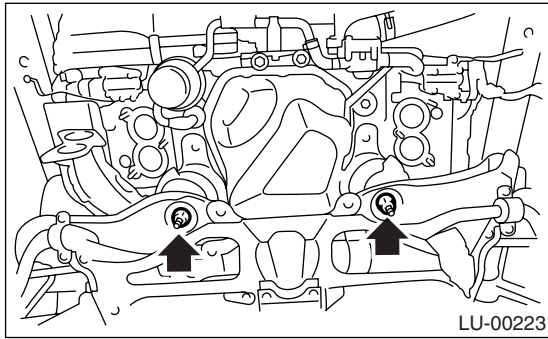
- 16) Remove the center exhaust pipe.

<Ref. to EX(H4DOTC)-8, REMOVAL, Center Exhaust Pipe.>

- 17) Remove the nuts which hold lower side of the transmission to engine.

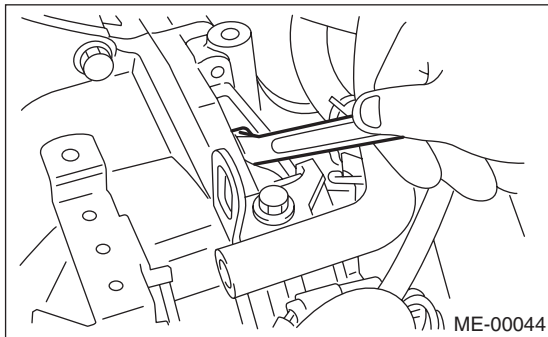


- 18) Remove the nuts which install front cushion rubber onto front crossmember.

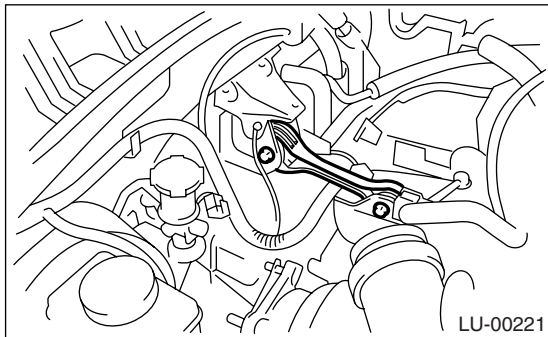


- 19) Separate the torque converter clutch from drive plate. (AT model)

- (1) Lower the vehicle.
- (2) Remove the service hole plug.
- (3) Remove the bolts which hold torque converter clutch to drive plate.
- (4) Remove other bolts while rotating the engine using a socket wrench.



- 20) Remove the pitching stopper.



- 21) Disconnect the fuel hose from fuel pipe.

- (1) Disconnect the connector of fuel pipe by pushing the ST in the direction of arrow.

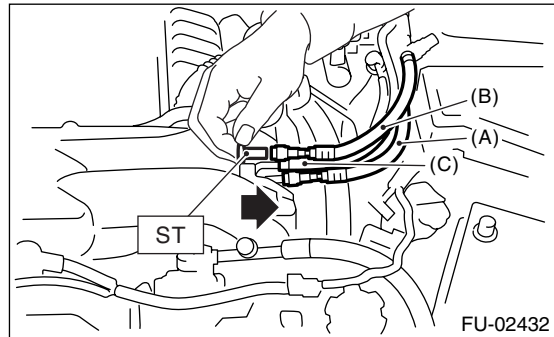
ST 42099AE000 CONNECTOR REMOVER

- (2) Remove the clip, and then disconnect the evaporation hose from pipe.

CAUTION:

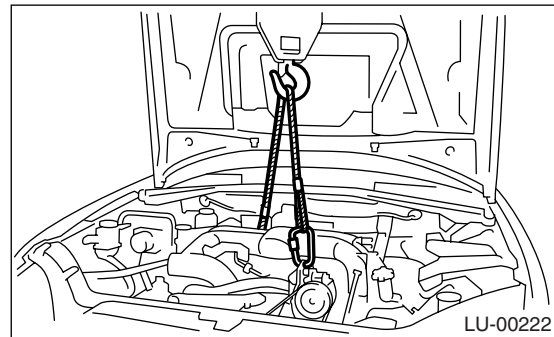
- Collect fuel from the hose into container.

- Disconnect the hose with its end wrapped with cloth to prevent fuel from splashing.



- (A) Fuel delivery hose
- (B) Fuel return hose
- (C) Evaporation hose

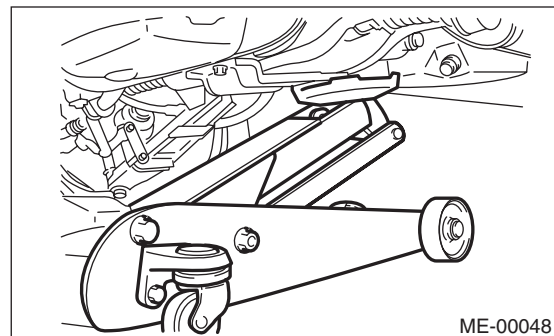
- 22) Support the engine with a lifting device and wire ropes.



- 23) Support the transmission with a garage jack.

CAUTION:

Doing this is very important because the transmission lowers for its own weight. This work is also of great importance for facilitating reinstallation.



CAUTION:

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

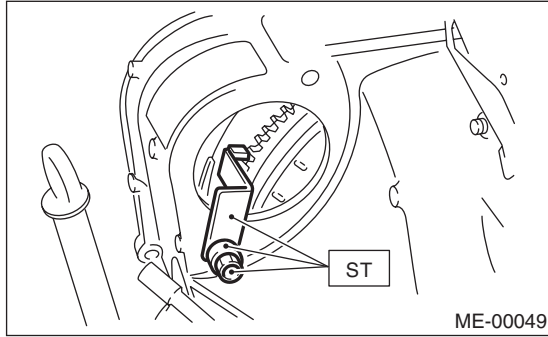
- 24) Separation of engine and transmission.

- (1) Remove the starter. <Ref. to SC(H4SO)-6, REMOVAL, Starter.>
- (2) Install the ST to converter case. (AT model)

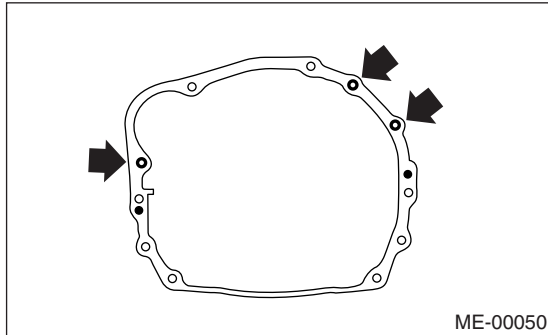
Engine Assembly

MECHANICAL

ST 498277200 STOPPER SET



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



- 25) Remove the engine from vehicle.
- (1) Slightly raise the engine.
 - (2) Raise the transmission with garage jack.
 - (3) Move the engine horizontally until main shaft is withdrawn from clutch cover.
 - (4) Slowly move the engine away from engine compartment.

NOTE:

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

26) Remove the front cushion rubbers.

B: INSTALLATION

1) Install the front cushion rubbers to engine.

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

- 2) Install the engine onto transmission.
- (1) Position the engine in engine compartment and align it with transmission.

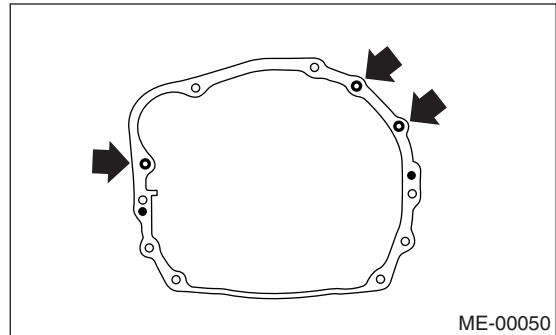
NOTE:

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

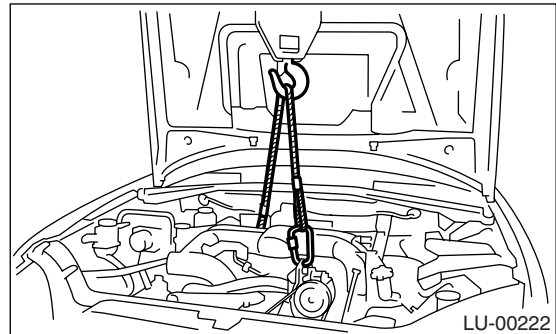
- (2) Apply a small amount of grease to the splines of mainshaft. (MT model)
- 3) Tighten the bolts which hold upper side of transmission to engine.

Tightening torque:

50 N·m (5.1 kgf-m, 36.9 ft-lb)



4) Remove the lifting device and wire ropes.

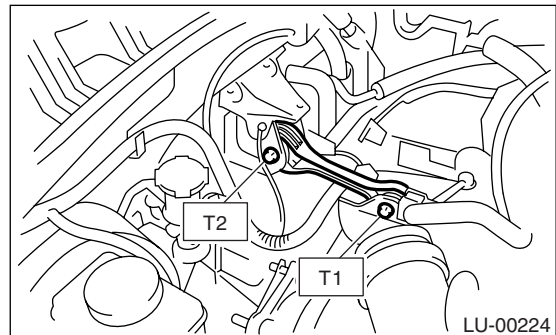


- 5) Remove the garage jack.
6) Install the pitching stopper.

Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

T2: 58 N·m (5.9 kgf-m, 43 ft-lb)



7) Remove the ST from converter case. (AT model)

NOTE:

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

ST 498277200 STOPPER SET

8) Install the starter. <Ref. to SC(H4SO)-6, INSTALLATION, Starter.>

9) Install the torque converter clutch to drive plate. (AT model)

- (1) Tighten the bolts which hold torque converter clutch to drive plate.
- (2) Tighten other bolts while rotating the engine by using ST.

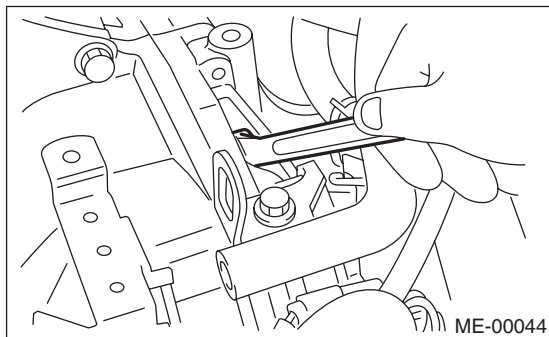
CAUTION:

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

ST 499977400 CRANK PULLEY WRENCH

Tightening torque:

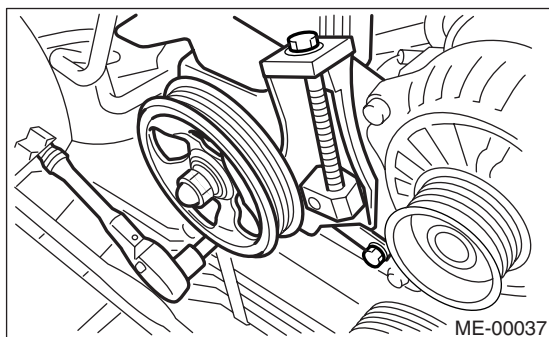
25 N·m (2.5 kgf-m, 18.1 ft-lb)



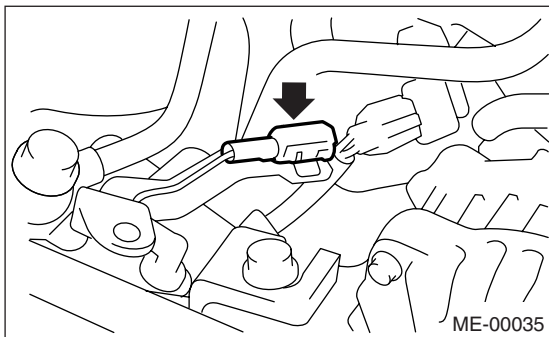
- 10) Install the power steering pump on bracket.
(1) Install the power steering pump.

Tightening torque:

20.1 N·m (2.05 kgf-m, 14.8 ft-lb)



- (2) Connect the power steering switch connector.



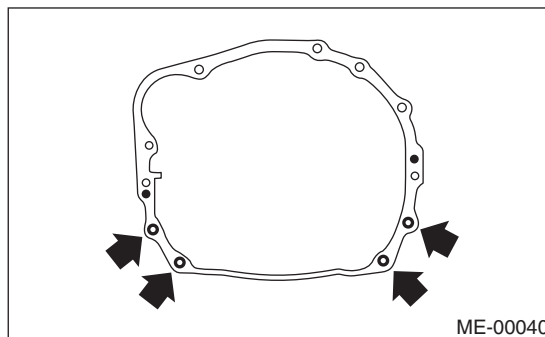
- (3) Install the front side belt and adjust it. <Ref. to ME(H4DOTC)-37, FRONT SIDE BELT, INSTALLATION, V-belt.>

- 11) Lift-up the vehicle.

- 12) Tighten the nuts which hold lower side of the transmission to engine.

Tightening torque:

50 N·m (5.1 kgf-m, 36.9 ft-lb)



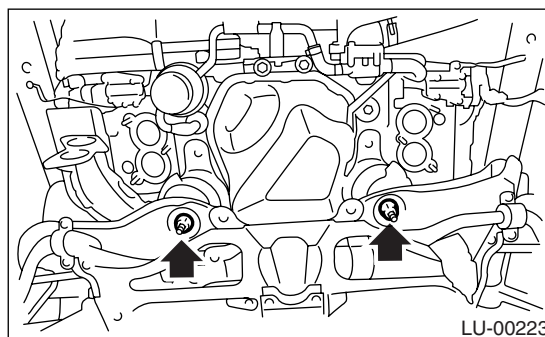
- 13) Tighten the nuts which install the front cushion rubber onto crossmember.

Tightening torque:

75 N·m (7.6 kgf-m, 55.3 ft-lb)

NOTE:

Make sure the front cushion rubber mounting bolts and locator are securely installed.



- 14) Install the center exhaust pipe.
<Ref. to EX(H4DOTC)-9, INSTALLATION, Center Exhaust Pipe.>

- 15) Lower the vehicle.

- 16) Connect the following hoses.

- (1) Fuel delivery hose, return hose and evaporation hose
- (2) Heater inlet and outlet hoses
- (3) Brake booster vacuum hose
- (4) Pressure regulator hose

- 17) Connect the following connectors and terminals.

- (1) Engine ground terminals
- (2) Engine harness connectors
- (3) Generator connector and terminal
- (4) A/C compressor connector

- 18) Install the air intake system.

- (1) Install the intercooler. <Ref. to IN(H4DOTC)-12, INSTALLATION, Intercooler.>
- (2) Install the air cleaner element and air cleaner case. <Ref. to IN(H4DOTC)-8, INSTALLATION, Air Cleaner Case.>

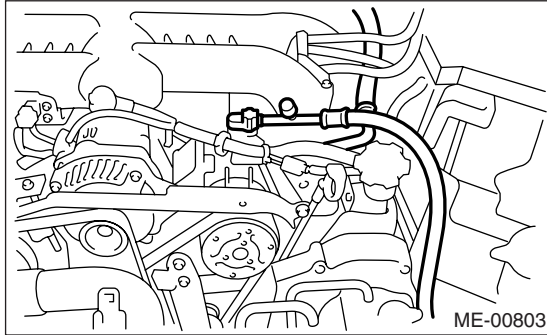
- 19) Install the A/C pressure hoses.

NOTE:

Use new O-rings.

Tightening torque:

25 N·m (2.5 kgf-m, 18.1 ft-lb)



20) Install the radiator. <Ref. to CO(H4DOTC)-20, INSTALLATION, Radiator.>

21) Install the coolant filler tank. <Ref. to CO(H4DOTC)-31, INSTALLATION, Coolant Filler Tank.>

22) Install the window washer tank.

23) Install the battery to vehicle, and connect the battery ground terminal.

24) Fill engine coolant.

<Ref. to CO(H4DOTC)-13, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

25) Charge the A/C system with refrigerant.

<Ref. to AC-21, PROCEDURE, Refrigerant Charging Procedure.>

26) Install the collector cover.

27) Remove the front hood stay, and close the front hood.

28) Take off the vehicle from a lift.

C: INSPECTION

1) Check pipes and hoses are connected firmly.

2) Check the engine coolant and ATF are at specified levels.

10.Engine Mounting

A: REMOVAL

- 1) Remove the engine assembly. <Ref. to ME(H4DOTC)-29, REMOVAL, Engine Assembly.>
- 2) Remove the engine mounting from engine assembly.

B: INSTALLATION

Install in the reverse order of removal.

NOTE:

Make sure the engine mounting cover of RH side is securely installed.

Tightening torque:

Engine mounting;

35 N·m (3.6 kgf-m, 25.8 ft-lb)

C: INSPECTION

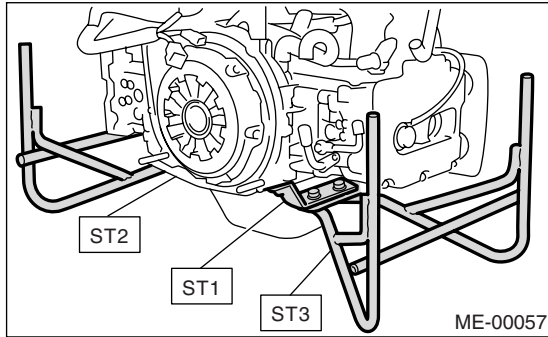
Make sure that cracks or other damages do not exist.

11. Preparation for Overhaul

A: PROCEDURE

1) After removing the engine from body, secure it in the STs shown below.

ST1	498457000	ENGINE STAND ADAPTER RH
ST2	498457100	ENGINE STAND ADAPTER LH
ST3	499817000	ENGINE STAND



2) In this section the procedures described under each index are all connected and stated in order. It will be the complete procedure for overhauling of the engine itself 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

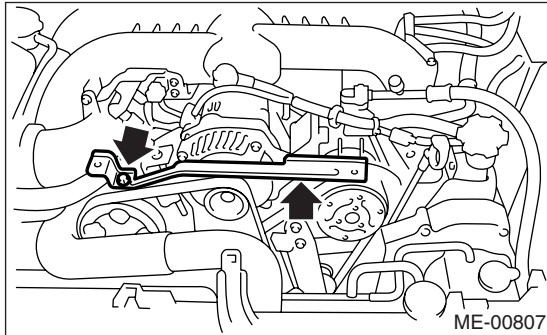
A: REMOVAL

NOTE:

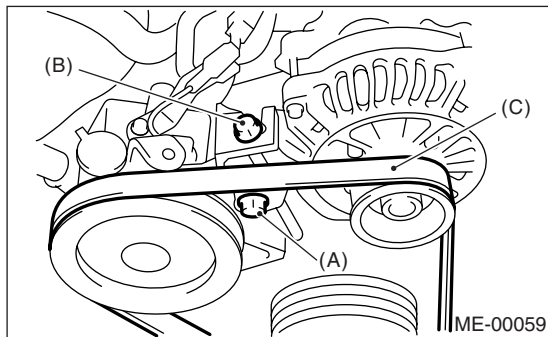
Perform the following procedures with the engine installed to the body.

1. FRONT SIDE BELT

- 1) Remove the collector cover.
- 2) Remove the V-belt covers.

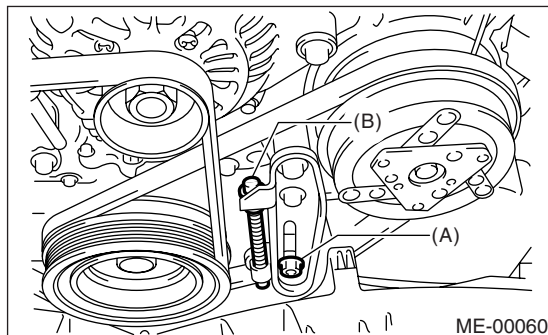


- 3) Loosen the lock bolt (A).
- 4) Loosen the slider bolt (B).
- 5) Remove the front side belt (C).



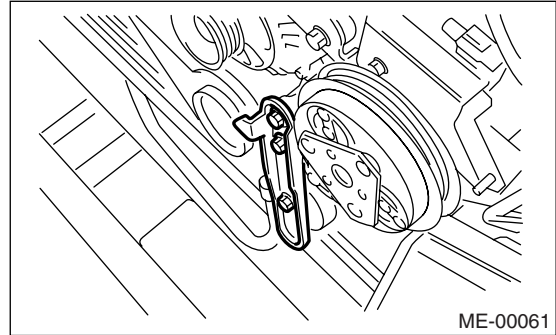
2. REAR SIDE BELT

- 1) Loosen the lock nut (A).
- 2) Loosen the slider bolt (B).



- 3) Remove the A/C belt.

- 4) Remove the A/C belt tensioner.



B: INSTALLATION

NOTE:

Wipe off any oil or water on the belt and pulley.

1. FRONT SIDE BELT

- 1) Install a V-belt (C), and tighten the slider bolt so as to obtain the specified belt tension. <Ref. to ME(H4DOTC)-38, INSPECTION, V-belt.>
- 2) Tighten the lock bolt (A).
- 3) Tighten the slider bolt (B).

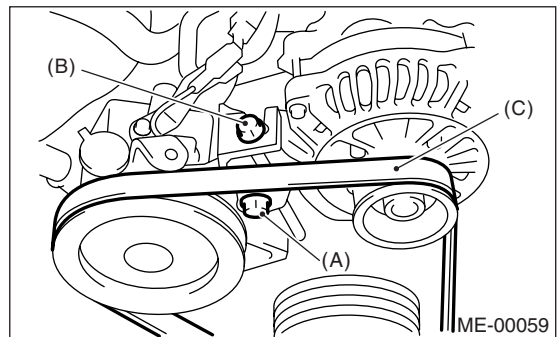
Tightening torque:

Lock bolt (A):

25 N·m (2.5 kgf-m, 18.1 ft-lb)

Slider bolt (B):

8 N·m (0.8 kgf-m, 5.9 ft-lb)



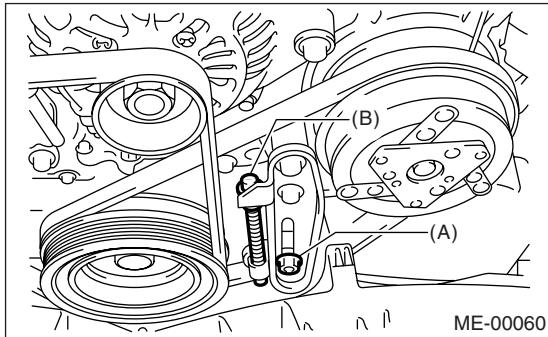
2. REAR SIDE BELT

- 1) Remove the A/C belt tensioner.
- 2) Install a V-belt, and tighten the slider bolt (B) so as to obtain the specified belt tension. <Ref. to ME(H4DOTC)-38, INSPECTION, V-belt.>
- 3) Tighten the lock nut (A).

Tightening torque:

Lock nut (A):

22.6 N·m (2.3 kgf·m, 16.6 ft-lb)



C: INSPECTION

- 1) Replace the belts, if crack, fraying or wear is found.
- 2) Check the V-belt tension and adjust it if necessary by changing the generator installing position and idler pulley installing position.

Belt tension (with belt tension gauge)

(A)

When installing new parts:

618 — 755 N (63 — 77 kgf, 139 — 170 lb)

At inspection:

490 — 640 N (50 — 65 kgf, 110 — 144 lb)

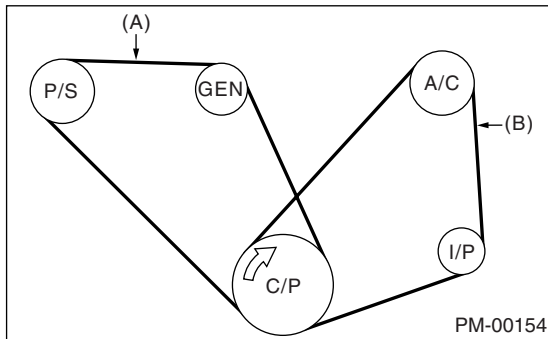
(B)

When installing new parts:

740 — 880 N (75 — 90 kgf, 166 — 198 lb)

At inspection:

350 — 450 N (36 — 46 kgf, 78 — 101 lb)



- (A) Front side belt
- (B) Rear side belt
- C/P Crank pulley
- GEN Generator
- P/S Power steering oil pump pulley
- A/C A/C compressor pulley
- I/P Idler pulley

Belt tension (without belt tension gauge)

(A)

When installing new parts:

7 — 9 mm (0.276 — 0.354 in)

At inspection:

9 — 11 mm (0.354 — 0.433 in)

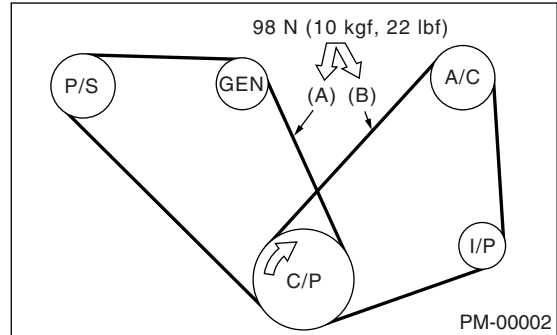
(B)

When installing new parts:

7.5 — 8.5 mm (0.295 — 0.335 in)

At inspection:

9.0 — 10.0 mm (0.354 — 0.394 in)



- (A) Front side belt
- (B) Rear side belt
- C/P Crank pulley
- GEN Generator
- P/S Power steering oil pump pulley
- A/C A/C compressor pulley
- I/P Idler pulley

13.Crank Pulley

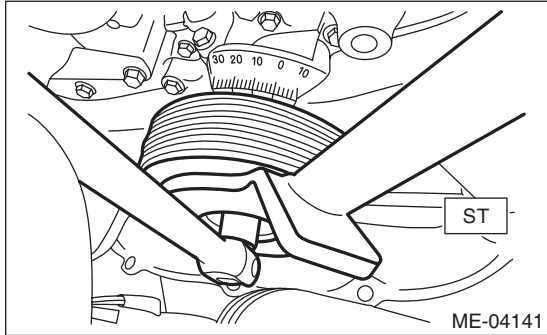
A: REMOVAL

NOTE:

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

- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 2) Use the ST to lock the crank pulley, and remove the crank pulley bolt.

ST 499977100 CRANK PULLEY WRENCH



- 3) Remove the crank pulley.

B: INSTALLATION

1. METHOD WITHOUT ANGLE GAUGE

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

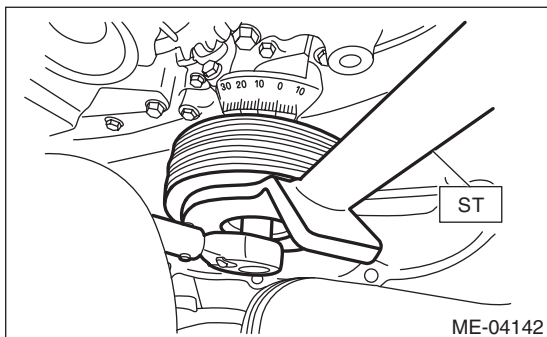
- 4) Tighten the crank pulley bolts.

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

ST 499977100 CRANK PULLEY WRENCH

Tightening torque:

47 N·m (4.8 kgf·m, 34.7 ft·lb)

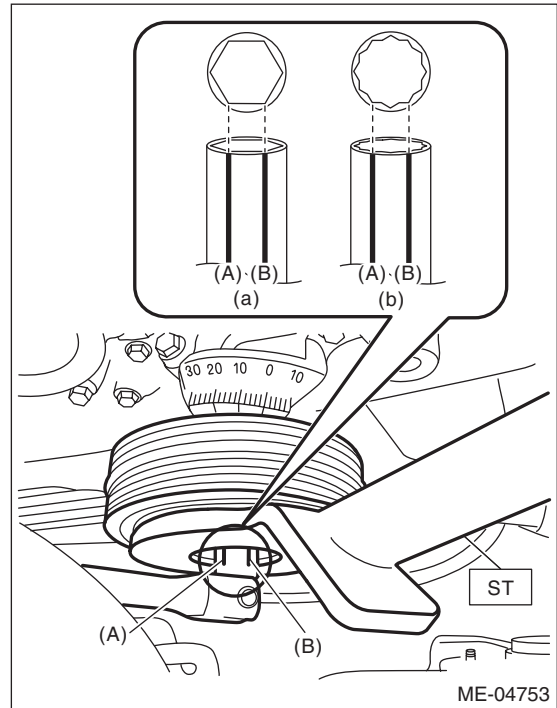


- (2) Draw reference lines (A) and (B) using a marker to set the socket to the crank pulley bolt as shown in the figure.

ST 499977100 CRANK PULLEY WRENCH

NOTE:

Set the socket onto the crank pulley bolt so that reference lines (A) and (B) is visible.

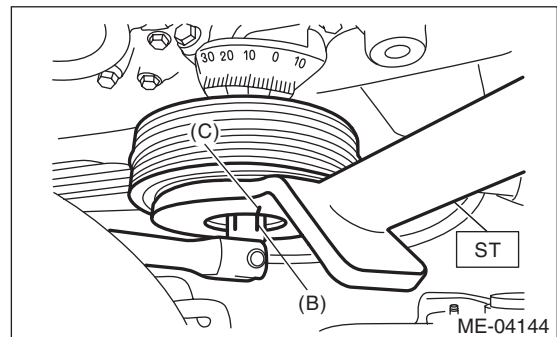


(a) When using 6-point socket

(b) When using 12-point socket

- (3) Draw end line (C) on ST using a marker at the same position as reference line (B) was drawn on the socket in step (2).

ST 499977100 CRANK PULLEY WRENCH



- (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 (C) are aligned.

ST 499977100 CRANK PULLEY WRENCH

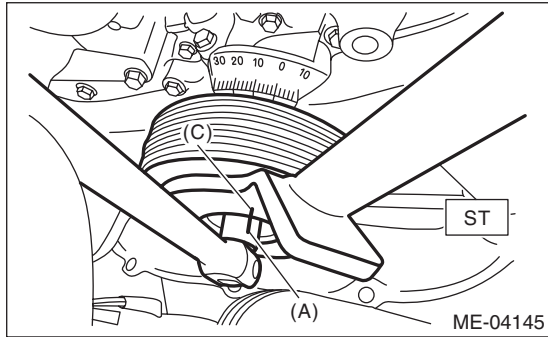
NOTE:

It should be approx. 60° when reference line (A) and end line (C) are aligned.

Crank Pulley

MECHANICAL

Tightening angle:
 $60^{\circ} \pm 5^{\circ}$



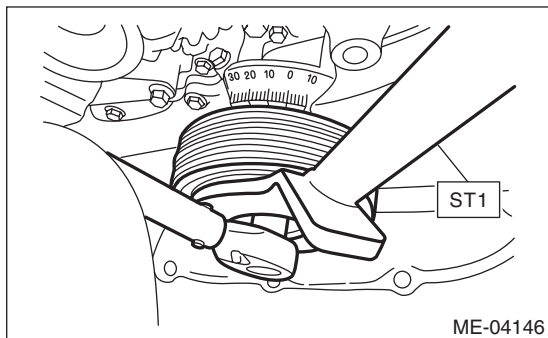
5) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

2. METHOD WITH ANGLE GAUGE

- 1) Clean the crankshaft thread using compressed air.
- 2) Install the crank pulley.
- 3) Apply engine oil to the crank pulley bolt seat and thread.
- 4) Tighten the crank pulley bolts.
 - (1) Remove the radiator main fan motor assembly and radiator sub motor assembly. <Ref. to CO(H4DOTC)-24, REMOVAL, Radiator Main Fan and Fan Motor.> <Ref. to CO(H4DOTC)-27, REMOVAL, Radiator Sub Fan and Fan Motor.>
 - (2) Use the ST1 to lock the crank pulley, and temporarily tighten the crank pulley bolt.

ST1 499977100 CRANK PULLEY WRENCH

Tightening torque:
47 N·m (4.8 kgf·m, 34.7 ft·lb)



- (3) Set the ST2, use the ST1 to lock the crank pulley, and tighten the crank pulley bolt to the specified angle.

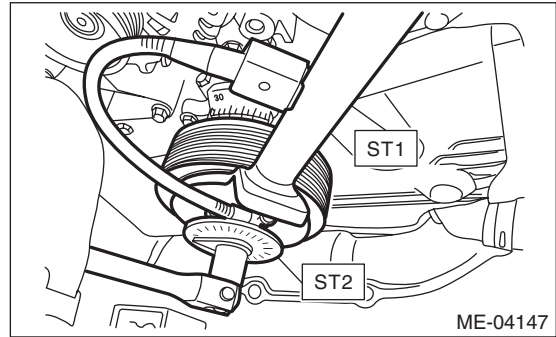
ST1 499977100 CRANK PULLEY WRENCH

ST2 18854AA000 ANGLE GAUGE

NOTE:

Attach the magnet used for securing the ST2 (ANGLE GAUGE) to ST1.

Tightening angle:
 $60^{\circ} \pm 5^{\circ}$



- (4) Install the radiator main fan motor assembly and radiator sub motor assembly. <Ref. to CO(H4DOTC)-24, INSTALLATION, Radiator Main Fan and Fan Motor.> <Ref. to CO(H4DOTC)-27, INSTALLATION, Radiator Sub Fan and Fan Motor.>

5) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

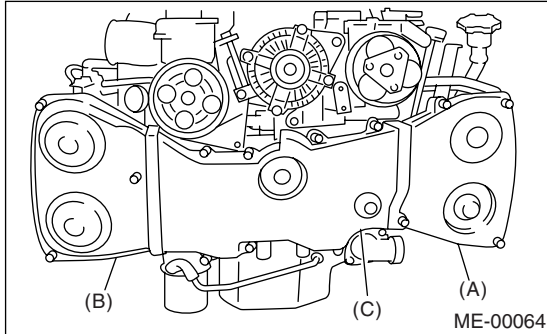
C: INSPECTION

- 1) Make sure the V-belt is not worn or damaged.
- 2) Check the tension of the front side belt. <Ref. to ME(H4DOTC)-38, INSPECTION, V-belt.>

14. Timing Belt Cover

A: REMOVAL

- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-39, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover (LH) (A).
- 4) Remove the timing belt cover (RH) (B).
- 5) Remove the front timing belt cover (C).



B: INSTALLATION

- 1) Install the front timing belt cover (C).

Tightening torque:

5 N·m (0.5 kgf-m, 3.6 ft-lb)

- 2) Install the timing belt cover (RH) (B).

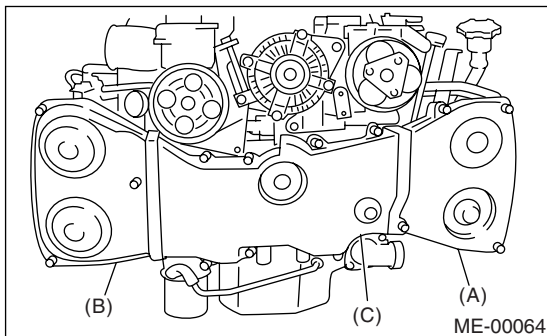
Tightening torque:

5 N·m (0.5 kgf-m, 3.6 ft-lb)

- 3) Install the timing belt cover (LH) (A).

Tightening torque:

5 N·m (0.5 kgf-m, 3.6 ft-lb)



- 4) Install the crank pulley. <Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>
- 5) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

C: INSPECTION

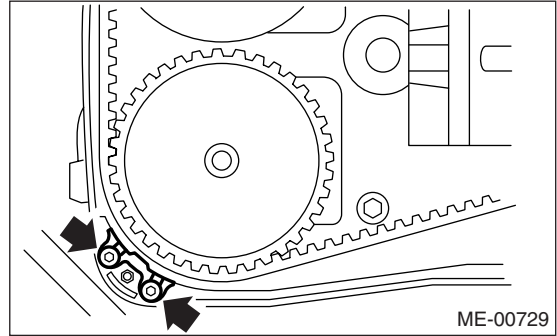
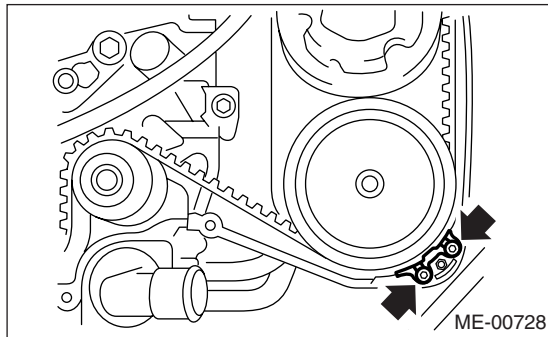
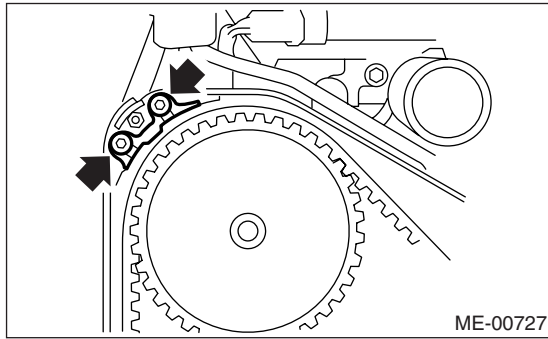
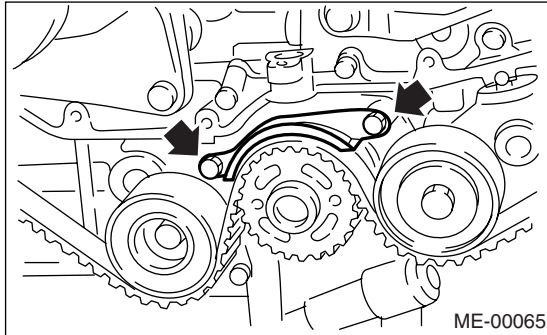
Check the cover for damage.

15. Timing Belt

A: REMOVAL

1. TIMING BELT

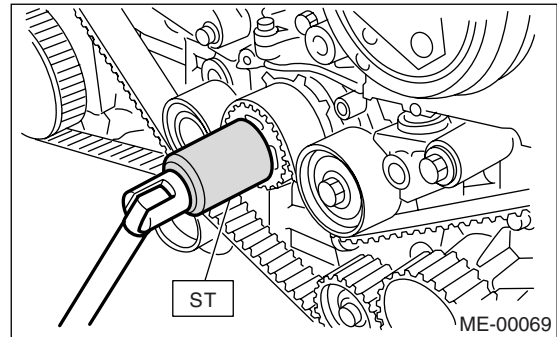
- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-39, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-41, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt guide. (With timing belt guide model)



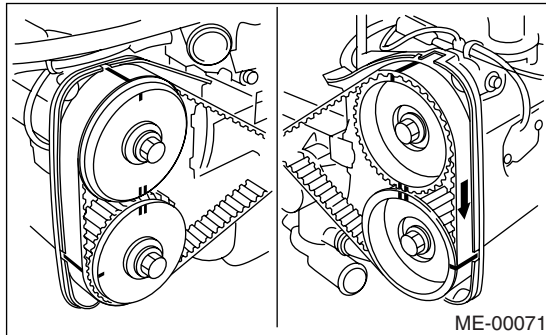
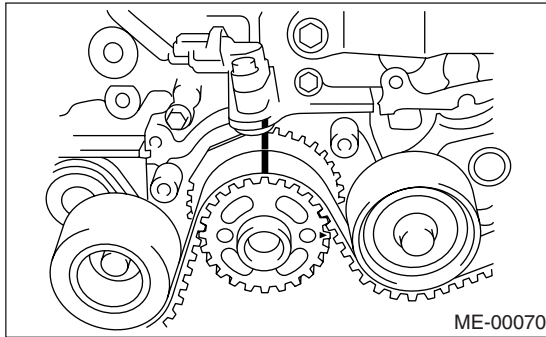
- 5) If the alignment mark or arrow mark (which indicates rotation direction) on timing belt fade away, put new marks before removing the timing belt as shown in procedures below.

- (1) Turn the crankshaft using ST, and align the alignment marks on crank sprocket, intake cam sprocket (LH), exhaust cam sprocket (LH), intake cam sprocket (RH) and exhaust cam sprocket (RH) with notches of timing belt cover and cylinder block.

ST 499987500 CRANKSHAFT SOCKET



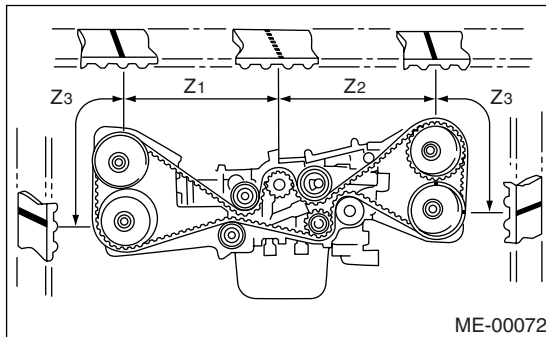
- (2) Using white paint, put alignment and/or arrow marks on the timing belts in relation to the cam sprockets.



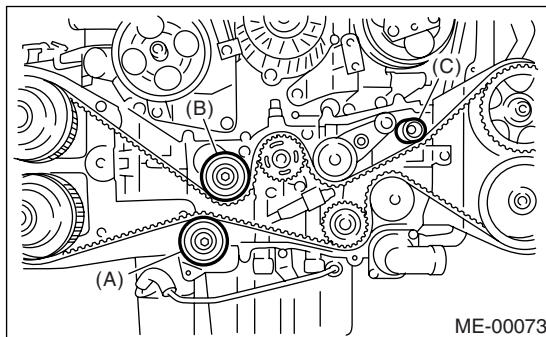
Z₁: 54.5 tooth length

Z₂: 51 tooth length

Z₃: 28 tooth length



- 6) Remove the belt idler (A).



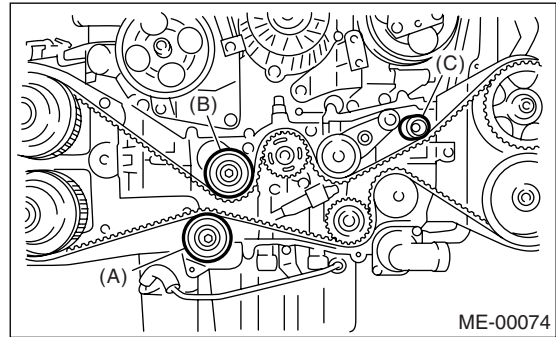
- 7) Remove the timing belt.

CAUTION:

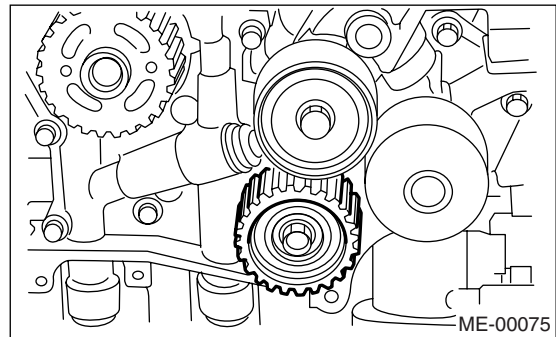
After the timing belt has been removed, never rotate the intake and exhaust cam sprocket. If the cam sprocket is rotated, the intake and exhaust valve heads strike together and valve stems are bent.

2. BELT IDLER AND AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY

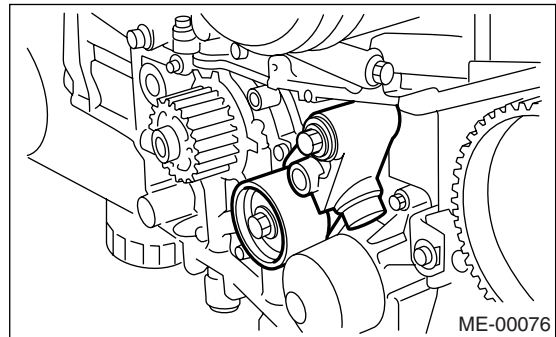
- 1) Remove the belt idler (B) and (C).



- 2) Remove the belt idler No. 2.



- 3) Remove the automatic belt tension adjuster assembly.



B: INSTALLATION

1. AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER

- 1) Preparation for installation of automatic belt tension adjuster assembly.

CAUTION:

- Always use a vertical type pressing tool to move the adjuster rod down.

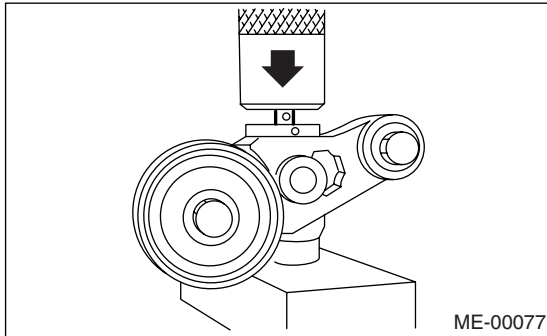
Timing Belt

MECHANICAL

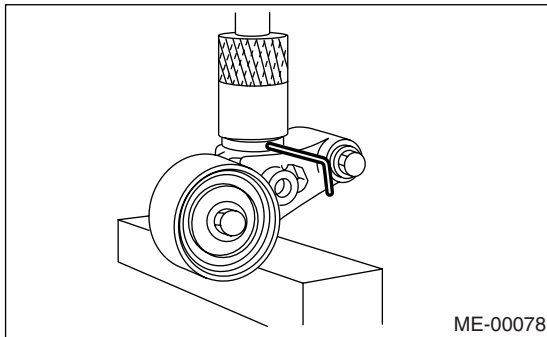
- Do not use a lateral type vise.
- Push the adjuster rod vertically.
- Press-in the push adjuster rod gradually taking more than three minutes.
- Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lb).
- Press the adjuster rod as far as the end surface of the cylinder. Do not press the adjuster rod into cylinder. Doing so may damage the cylinder.
- Do not release the press pressure until stopper pin is completely inserted.

(1) Attach the automatic belt tension adjuster assembly to the vertical pressing tool.

(2) Slowly move the adjuster rod down with a pressure of more than 165 N (16.8 kgf, 37.1 lb) until the adjuster rod is aligned with the stopper pin hole in the cylinder.

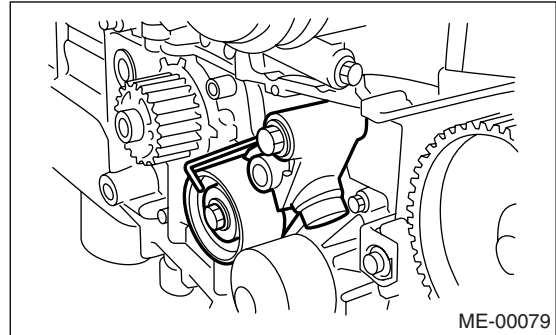


(3) With a 2 mm (0.08 in) dia. stopper pin or a 2 mm (0.08 in) (nominal) dia. hex wrench inserted into the stopper pin hole in cylinder, secure the adjuster rod.



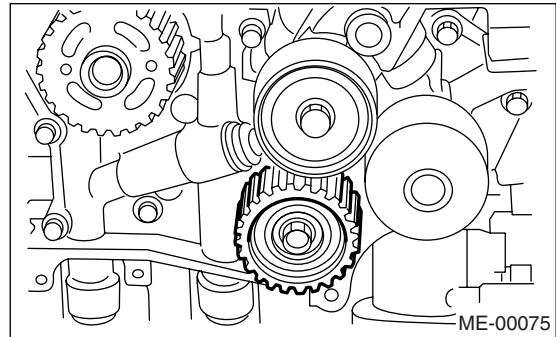
2) Install the automatic belt tension adjuster assembly.

Tightening torque:
39 N·m (4.0 kgf-m, 28.9 ft-lb)



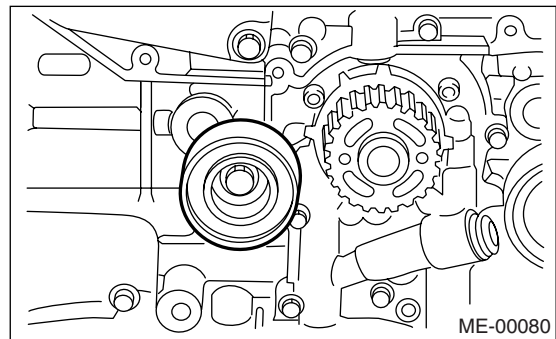
3) Install the belt idler No. 2.

Tightening torque:
39 N·m (4.0 kgf-m, 28.9 ft-lb)



4) Install the belt idlers.

Tightening torque:
39 N·m (4.0 kgf-m, 28.9 ft-lb)

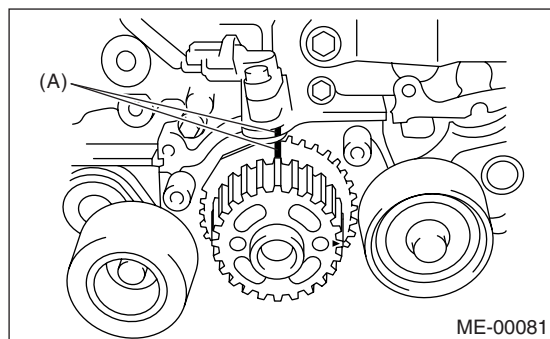


2. TIMING BELT

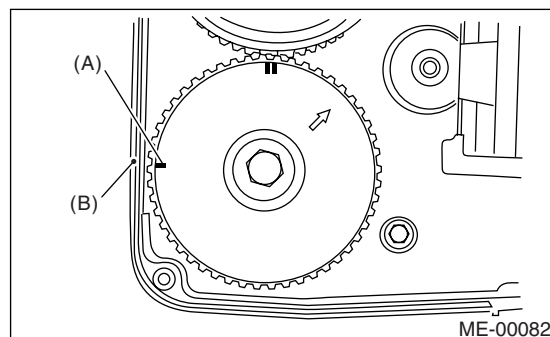
1) Preparation for installation of automatic belt tension adjuster assembly. <Ref. to ME(H4DOTC)-43, AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER, INSTALLATION, Timing Belt.>

2) Crankshaft and cam sprocket alignment

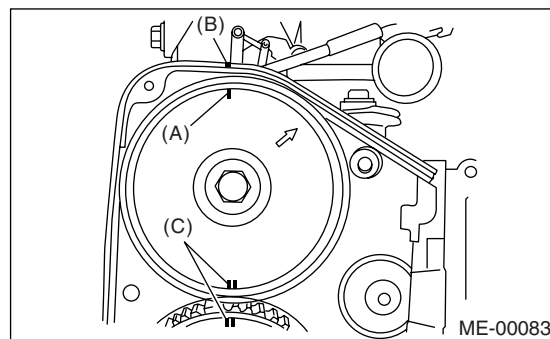
- (1) Align the mark (A) on crank sprocket with the mark on oil pump cover at cylinder block.



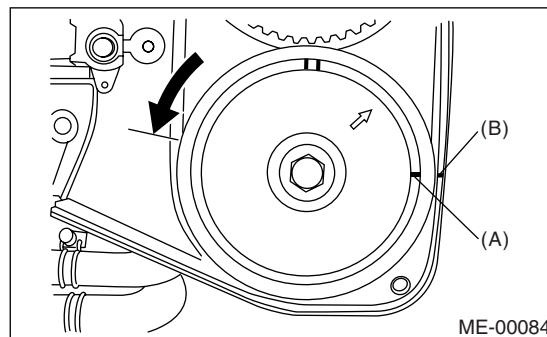
- (2) Align single line mark (A) on the exhaust cam sprocket (RH) with notch (B) on timing belt cover.



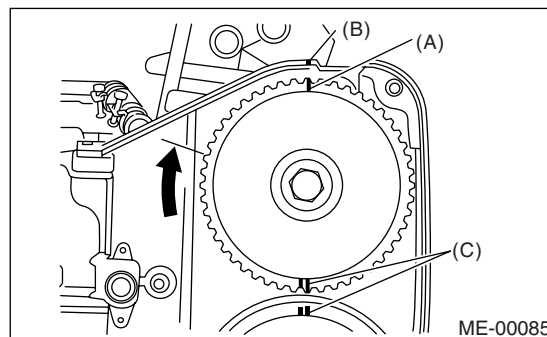
- (3) Align single line mark (A) on the intake cam sprocket (RH) with notch (B) on timing belt cover. (Ensure double lines (C) on intake and exhaust cam sprockets are aligned.)



- (4) Align single line mark (A) on exhaust cam sprocket (LH) with notch (B) on timing belt cover by turning the sprocket counterclockwise (as viewed from front of engine).



- (5) Align single line mark (A) on intake cam sprocket (LH) with notch (B) on timing belt cover by turning the sprocket clockwise (as viewed from front of engine). Ensure double lines (C) on intake and exhaust cam sprockets are aligned.



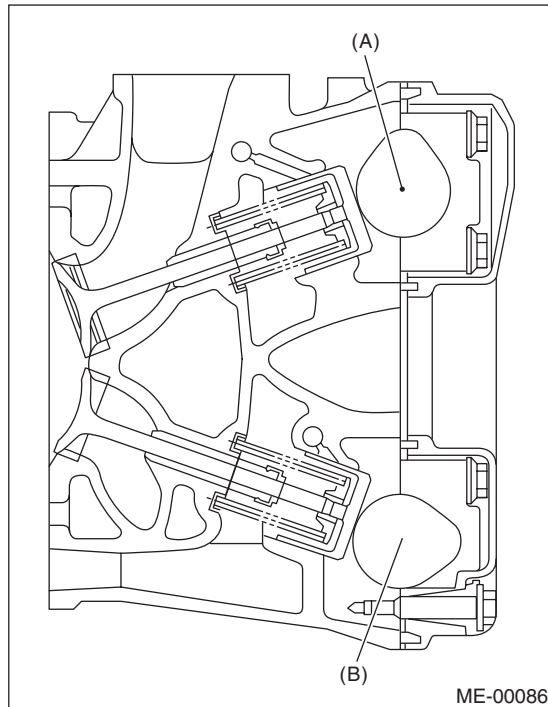
- (6) Ensure that the cam and crank sprockets are positioned properly.

Timing Belt

MECHANICAL

CAUTION:

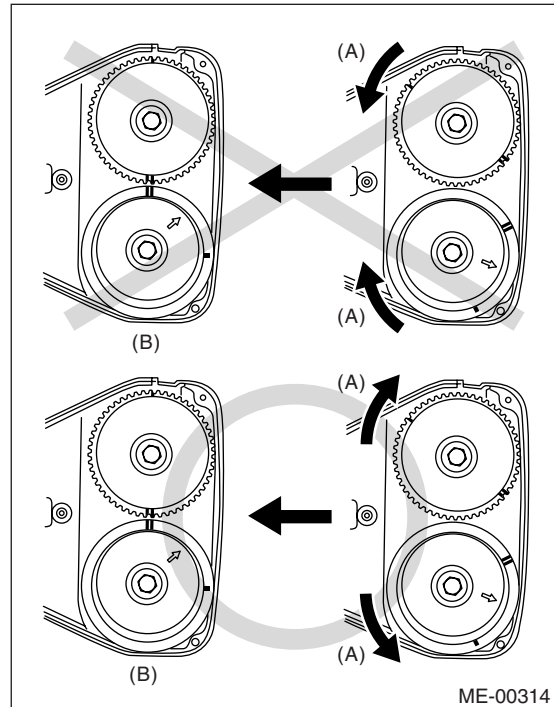
• Intake and exhaust camshafts for this DOHC engine can be independently rotated with the timing belts removed. As can be seen from the figure, if the intake and exhaust valves are lifted simultaneously, their heads will interfere with each other, resulting in bent valves.



(A) Intake camshaft
(B) Exhaust camshaft

- When the timing belts are not installed, four camshafts are held at the “zero-lift” position, where all cams on camshafts do not push the intake and exhaust valves down. (Under this condition, all valves remain unlifted.)
- When the camshafts are rotated to install the timing belts, #2 intake and #4 exhaust cam of camshafts (LH) are held to push their corresponding valves down. (Under this condition, these valves are held lifted.) Camshafts (RH) are held so that their cams do not push valves down.
- Camshafts (LH) must be rotated from the “zero-lift” position to the position where the timing belt is to be installed with the smallest possible angle, in order to prevent mutual interference of intake and exhaust valve heads.

- Do not allow the camshafts to rotate in the direction shown in the figure as this causes both intake and exhaust valves to lift simultaneously, resulting in interference with their heads.



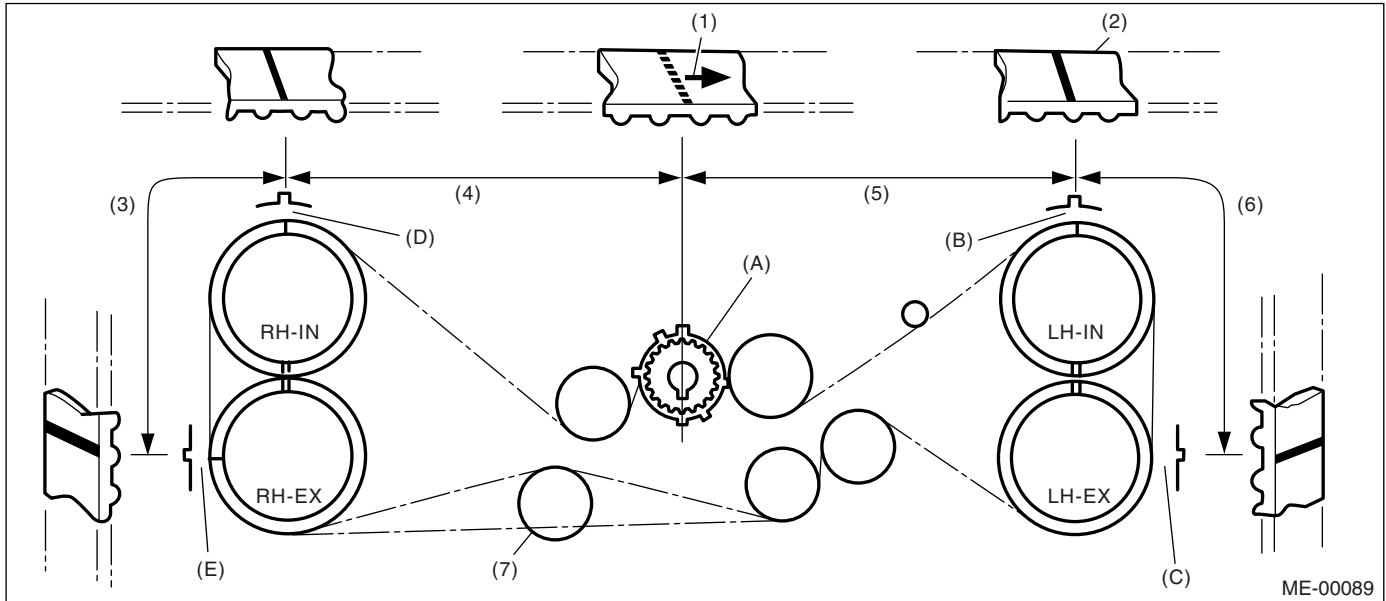
(A) Revolving direction
(B) Timing belt installation position

3) Installation of timing belt:

Align the alignment mark on the timing belt with marks on the sprockets in the alphabetical order shown in the figure. While aligning marks, position the timing belt properly.

CAUTION:

- Disengagement of more than three timing belt teeth may result in interference between valve and piston.
- Ensure the belt's rotating direction is correct.



ME-00089

- | | | |
|---------------------|-----------------------|---------------------------|
| (1) Arrow mark | (4) 54.5 tooth length | (7) Install it in the end |
| (2) Timing belt | (5) 51 tooth length | |
| (3) 28 tooth length | (6) 28 tooth length | |

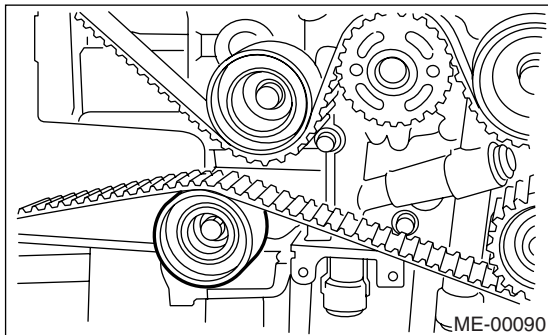
4) Install the belt idlers.

Tightening torque:

39 N·m (4.0 kgf-m, 28.9 ft-lb)

NOTE:

Make sure that the marks on the timing belt and sprockets are aligned.



ME-00090

5) After ensuring that the marks on the timing belt and sprockets are aligned, remove the stopper pin from tensioner adjuster.

6) Install the timing belt guide. (Model with timing belt guide)

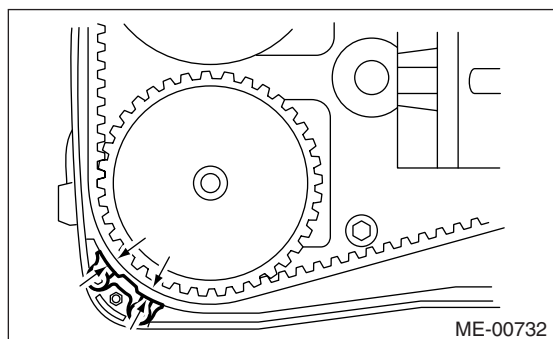
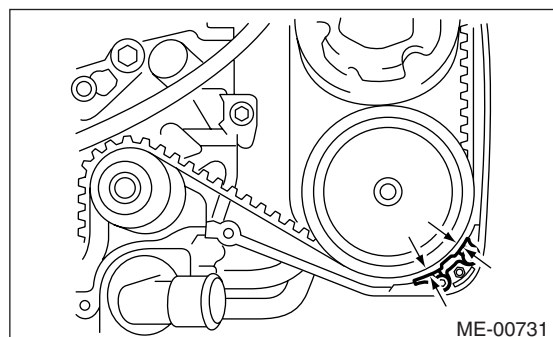
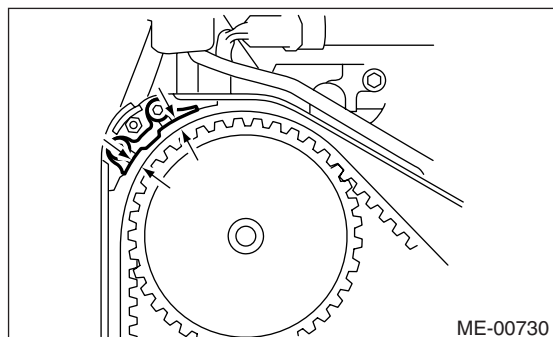
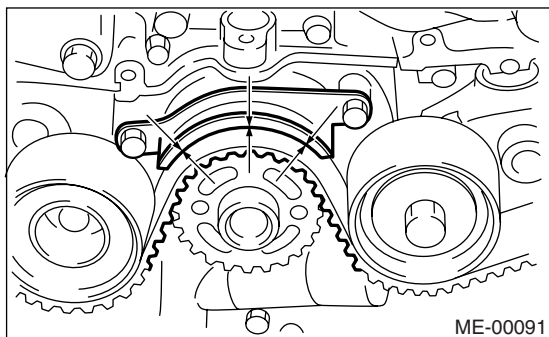
- (1) Temporarily tighten the bolts.
- (2) Check and adjust the clearance between timing belt and timing belt guide.

Timing Belt

MECHANICAL

Clearance:

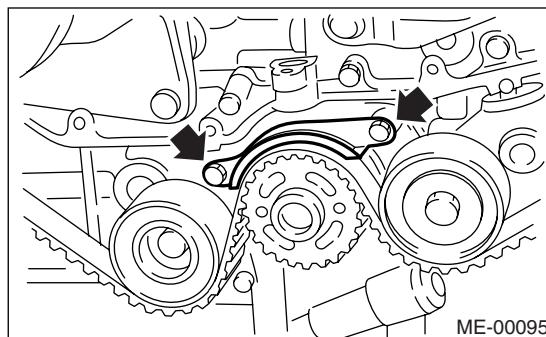
1.0 ± 0.5 mm (0.039 ± 0.020 in)



(3) Tighten the bolt.

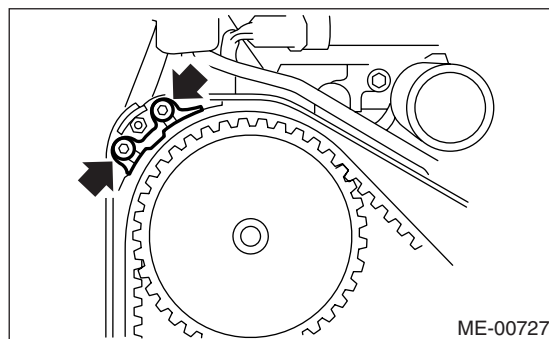
Tightening torque:

10 N·m (1.0 kgf·m, 7.2 ft·lb)



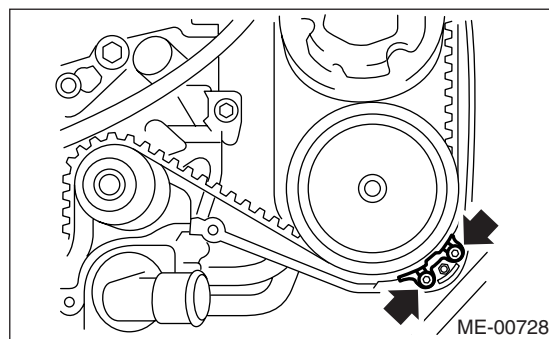
Tightening torque:

6.4 N·m (0.65 kgf·m, 4.7 ft·lb)



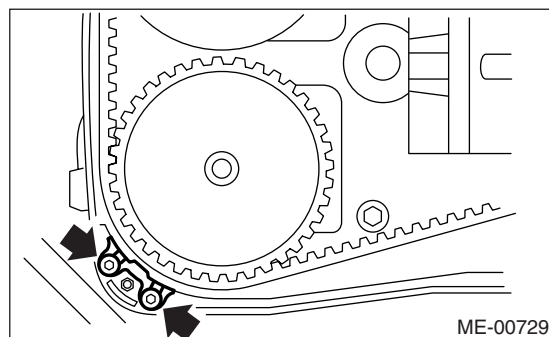
Tightening torque:

6.4 N·m (0.65 kgf·m, 4.7 ft·lb)



Tightening torque:

6.4 N·m (0.65 kgf·m, 4.7 ft·lb)



- 7) Install the timing belt cover.
<Ref. to ME(H4DOTC)-41, INSTALLATION, Timing Belt Cover.>
- 8) Install the crank pulley.
<Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>
- 9) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

C: INSPECTION

1. TIMING BELT

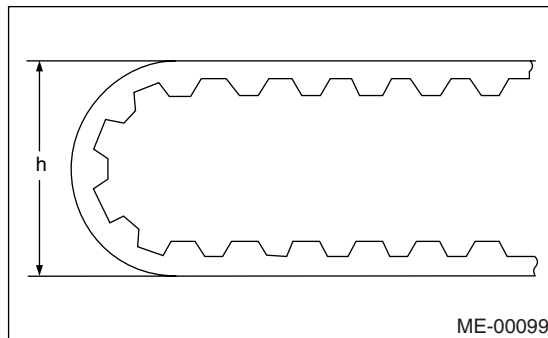
- 1) Check the timing belt teeth for breaks, cracks and wear. If any fault is found, replace the timing belt.
- 2) Check the condition of the backside of timing belt. If cracks are found, replace the timing belt.

CAUTION:

- Be careful not to let oil, grease or engine coolant contact the belt. Remove quickly and thoroughly if this happens.
- Do not bend the timing belt sharply.

In radial diameter h:

60 mm (2.36 in) or more



2. AUTOMATIC BELT TENSION ADJUST-ER

- 1) Visually check the oil seals for leaks, and rod ends for abnormal wear and scratches. If necessary, replace the automatic belt tension adjuster assembly.

NOTE:

Slight trace of oil at rod's oil seal does not indicate a problem.

- 2) Check that the adjuster rod does not move when a pressure of 165 N (16.8 kgf, 37.1 lb) is applied to it. This is to check adjuster rod stiffness.
- 3) If the adjuster rod is not stiff and moves freely when applying 165 N (16.8 kgf, 37.1 lb), check it using the following procedures:

- (1) Slowly press the adjuster rod down to the end surface of the cylinder. Repeat this operation two to three times.

- (2) With the adjuster rod moved all the way up, apply a pressure of 165 N (16.8 kgf, 37.1 lb) to it. Check the adjuster rod stiffness.
- (3) If the adjuster rod is not stiff and moves down, replace the automatic belt tension adjuster assembly with a new one.

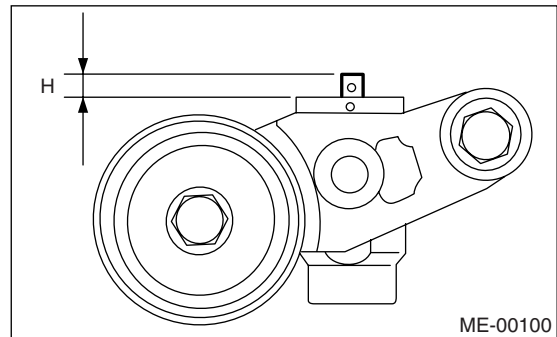
CAUTION:

- Always use a vertical type pressing tool to move the adjuster rod down.
- Do not use a lateral type vise.
- Push the adjuster rod vertically.
- Press-in the push adjuster rod gradually taking more than three minutes.
- Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lb).
- Press the adjuster rod as far as the end surface of the cylinder. Do not press the adjuster rod into cylinder. Doing so may damage the cylinder.

- 4) Measure the amount of rod protrusion beyond the body. If it is not within specifications, replace with a new one.

Amount of rod protrusion H:

5.7±0.5 mm (0.224±0.020 in)



3. BELT TENSION PULLEY

- 1) Check the mating surfaces of timing belt and contact point of adjuster rod for abnormal wear or scratches. Replace the belt tension pulley if faulty.
- 2) Check the belt tension pulley for smooth rotation. Replace if noise or excessive play occurs.
- 3) Check the belt tension pulley for grease leakage.

4. BELT IDLER

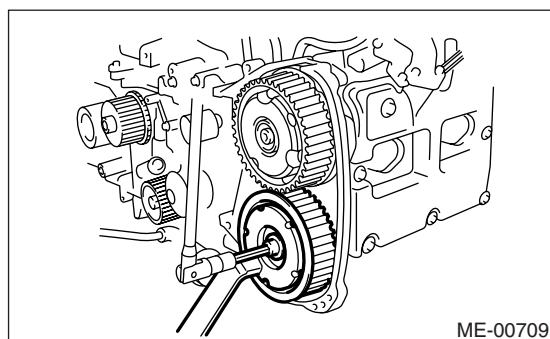
- 1) Check the belt idler for smooth rotation. Replace if noise or excessive play occurs.
- 2) Check the outer contacting surfaces of idler pulley for abnormal wear and scratches.
- 3) Check the belt idler for grease leakage.

16. Cam Sprocket

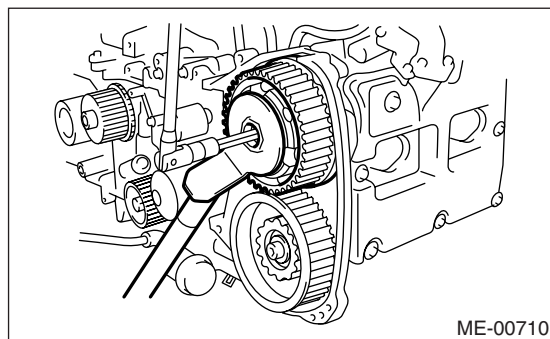
A: REMOVAL

- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-39, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-41, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt. <Ref. to ME(H4DOTC)-42, REMOVAL, Timing Belt.>
- 5) Remove the cam sprocket. To lock the camshaft, use ST.

ST 499207400 CAMSHAFT SPROCKET WRENCH



ST 499977500 CAMSHAFT SPROCKET WRENCH



B: INSTALLATION

- 1) Install the cam sprocket. To lock the camshaft, use ST.

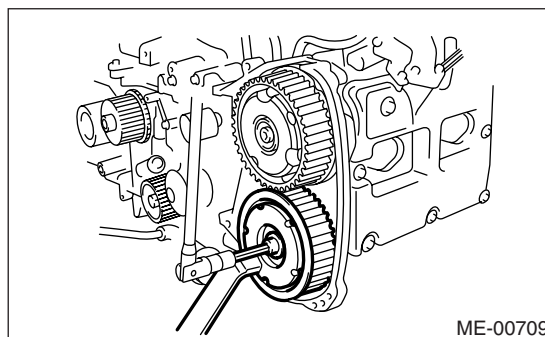
NOTE:

Do not confuse the cam sprockets (LH) and (RH) during installation.

ST 499207400 CAMSHAFT SPROCKET WRENCH

Tightening torque:

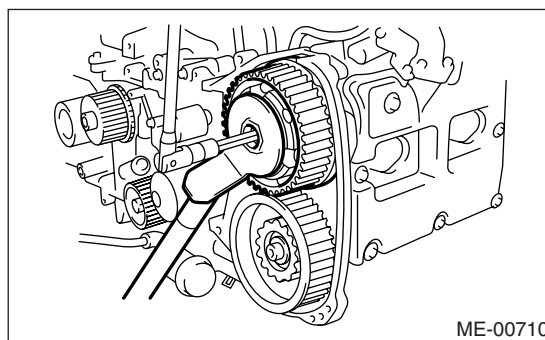
Tighten to 30 N·m (3.1 kgf-m, 22.1 ft-lb) of torque, and then tighten further by 45°



ST 499977500 CAMSHAFT SPROCKET WRENCH

Tightening torque:

Tighten to 30 N·m (3.1 kgf-m, 22.1 ft-lb) of torque, and then tighten further by 45°



- 2) Install the timing belt. <Ref. to ME(H4DOTC)-43, INSTALLATION, Timing Belt.>
- 3) Install the timing belt cover. <Ref. to ME(H4DOTC)-41, INSTALLATION, Timing Belt Cover.>
- 4) Install the crank pulley. <Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>
- 5) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

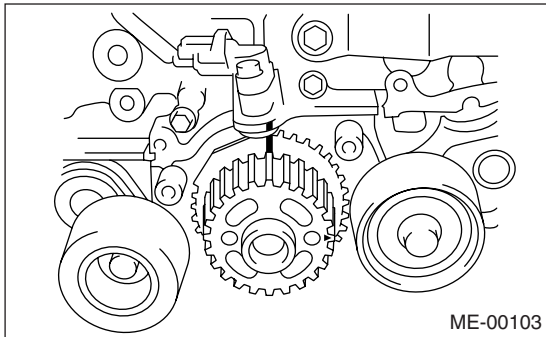
C: INSPECTION

- 1) Check the cam sprocket teeth for abnormal wear and scratches.
- 2) Make sure there is no free play between cam sprocket and key.
- 3) Check the cam sprocket protrusion used for sensor for damage and contamination of foreign matter.

17.Crank Sprocket

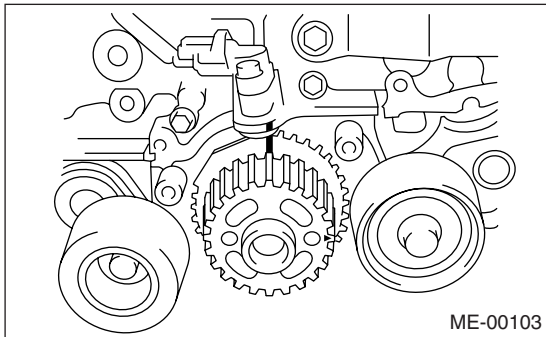
A: REMOVAL

- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 2) Remove the crank pulley.
<Ref. to ME(H4DOTC)-39, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover.
<Ref. to ME(H4DOTC)-41, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt.
<Ref. to ME(H4DOTC)-42, REMOVAL, Timing Belt.>
- 5) Remove the cam sprocket.
<Ref. to ME(H4DOTC)-50, REMOVAL, Cam Sprocket.>
- 6) Remove the crank sprocket.



B: INSTALLATION

- 1) Install the crank sprocket.



- 2) Install the cam sprocket.
<Ref. to ME(H4DOTC)-50, INSTALLATION, Cam Sprocket.>
- 3) Install the timing belt.
<Ref. to ME(H4DOTC)-43, INSTALLATION, Timing Belt.>
- 4) Install the timing belt cover.
<Ref. to ME(H4DOTC)-41, INSTALLATION, Timing Belt Cover.>
- 5) Install the crank pulley. <Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>
- 6) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

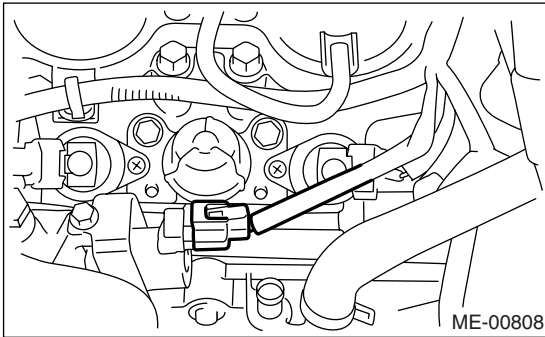
C: INSPECTION

- 1) Check the crank sprocket teeth for abnormal wear and scratches.
- 2) Make sure there is no free play between crank sprocket and key.
- 3) Check the crank sprocket protrusion used for sensor for damage and contamination of foreign matter.

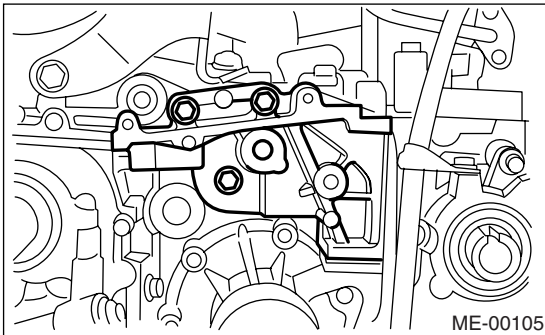
18. Camshaft

A: REMOVAL

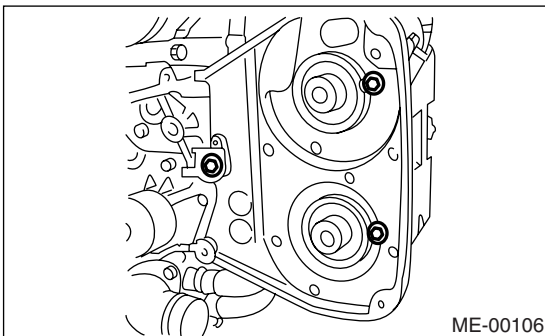
- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-39, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-41, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt. <Ref. to ME(H4DOTC)-42, REMOVAL, Timing Belt.>
- 5) Remove the cam sprocket. <Ref. to ME(H4DOTC)-50, REMOVAL, Cam Sprocket.>
- 6) Remove the crank sprocket. <Ref. to ME(H4DOTC)-51, REMOVAL, Crank Sprocket.>
- 7) Disconnect the oil flow control solenoid valve assembly connector.



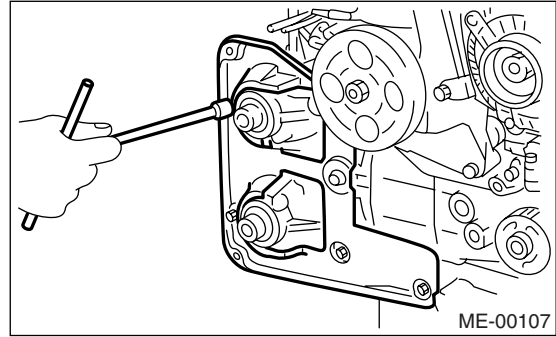
- 8) Remove the tensioner bracket.



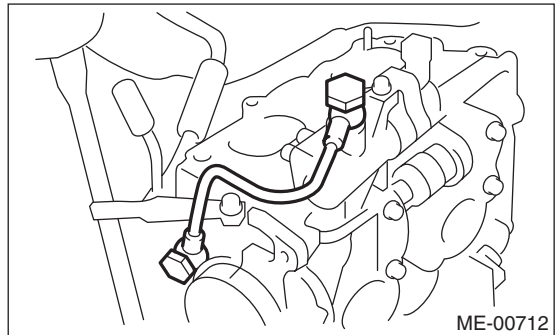
- 9) Remove the timing belt cover No. 2 (LH).



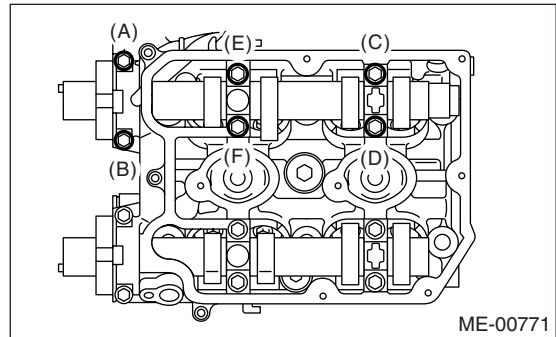
- 10) Remove the timing belt cover No. 2 (RH).



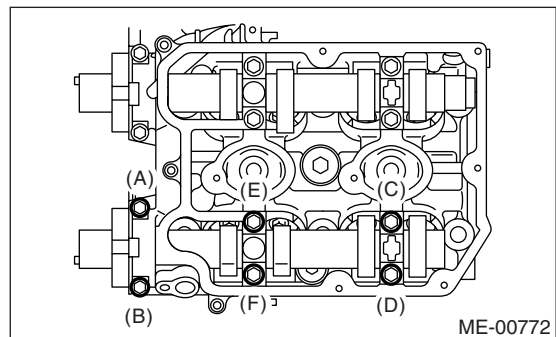
- 11) Remove the spark plug cords.
- 12) Remove the oil level gauge guide. (LH side)
- 13) Remove the rocker cover and gasket.
- 14) Remove the oil pipe.



- 15) Loosen the oil flow control solenoid valve assembly and intake camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.



- 16) Loosen the exhaust camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.



- 17) Remove the oil flow control solenoid valve assembly, intake camshaft cap and camshaft.
- 18) Remove the exhaust camshaft caps and camshaft.

NOTE:

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

- 19) Similarly, remove the camshafts (RH) and related parts.

B: INSTALLATION

1) Camshaft installation:

Apply engine oil to the cylinder head at camshaft bearing location before installing the camshaft. Install the camshaft so that each valve is close to or in contact with "base circle" of cam lobe.

NOTE:

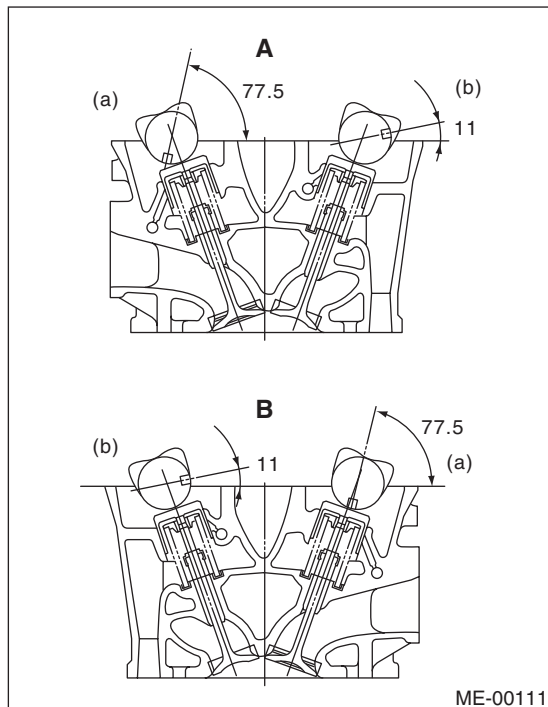
- Position the camshafts as shown in the figure. Camshaft (LH) need to be rotated at a minimum when installing the timing belt.
- Camshaft (RH) need not be rotated when set at the position shown in the figure.

Intake camshaft (LH):

Rotate 80° clockwise.

Exhaust camshaft (LH):

Rotate 45° counterclockwise.



A Cylinder head (LH)

B Cylinder head (RH)

(a) Intake camshaft

(b) Exhaust camshaft

2) Camshaft cap and oil flow control solenoid valve assembly installation:

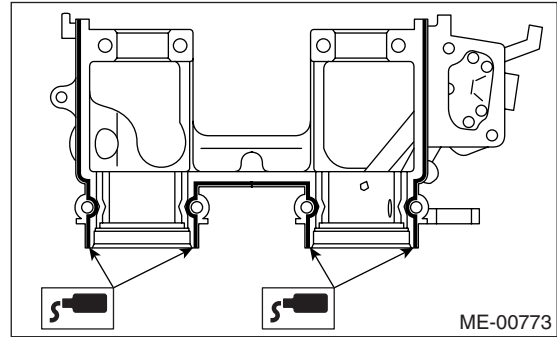
- (1) Apply small amount of liquid gasket to the cap mating surface.

NOTE:

Do not apply liquid gasket excessively. Otherwise, the excessive liquid gasket may come out and flow toward oil seal, resulting in oil leaks.

Liquid gasket:

THREE BOND 1215 (Part No. 004403007) or equivalent



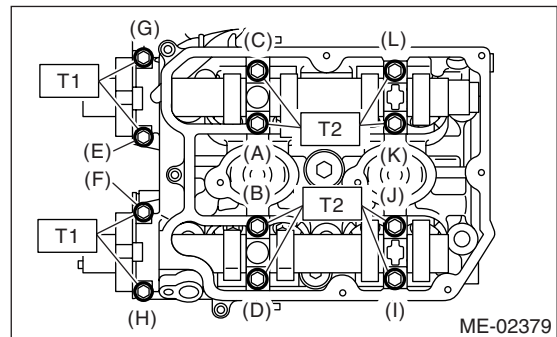
- (2) Apply engine oil to the cap bearing surface, and install the cap on camshaft as shown by identification mark.

- (3) Gradually tighten the camshaft cap and oil control valve assembly in at least two stages in alphabetical sequence shown in the figure, and then tighten to the specified torque.

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.2 ft-lb)

T2: 20 N·m (2.0 kgf-m, 14.5 ft-lb)



- (4) After tightening the camshaft cap, ensure the camshaft rotates only slightly while holding it at "base circle".

3) Camshaft oil seal installation:

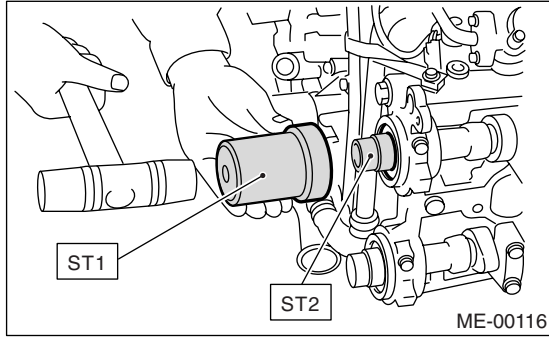
Apply grease to the new oil seal lips and press onto the front end of camshaft by using ST1 and ST2.

NOTE:

Use a new oil seal.

ST1 499587600 OIL SEAL INSTALLER

ST2 499597200 OIL SEAL GUIDE

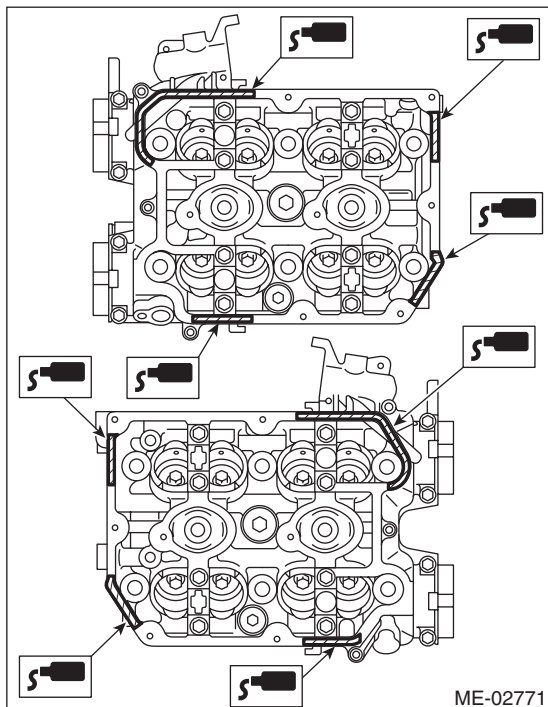


4) Rocker cover installation:

- (1) Install the gasket on rocker cover. Install the peripheral gasket and ignition coil gasket.
- (2) Apply liquid gasket to the designated point of cylinder head.

Liquid gasket:

THREE BOND 1215 (Part No. 004403007) or equivalent

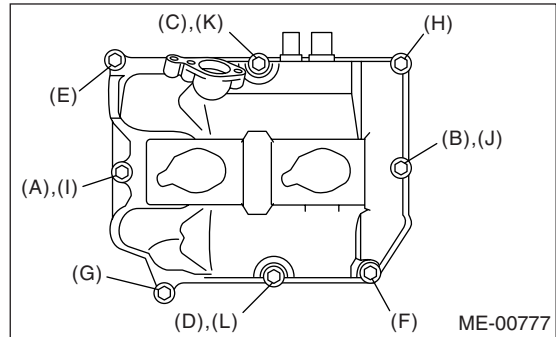


- (3) Install the rocker cover on cylinder head. Ensure the gasket is properly positioned during installation.

- (4) Tighten the rocker cover tightening bolt in alphabetical sequence shown in the figure, and then tighten to the specified torque.

Tightening torque:

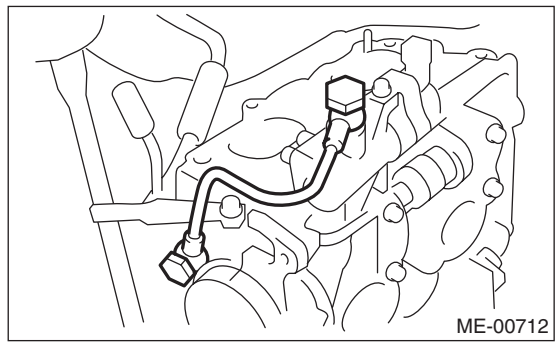
6.4 N·m (0.65 kgf-m, 4.7 ft-lb)



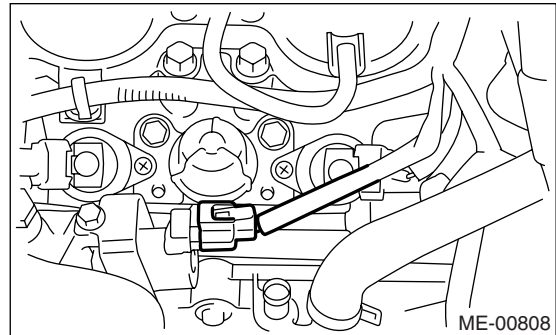
5) Install the oil pipe.

Tightening torque:

29 N·m (3.0 kgf-m, 21.4 ft-lb)



6) Connect the oil flow control solenoid valve connector.



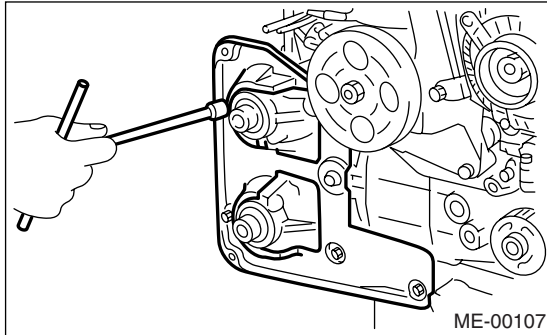
7) Install the spark plug cord.

8) Similarly, install the parts on right-hand side.

9) Install the timing belt cover No. 2 (RH).

Tightening torque:

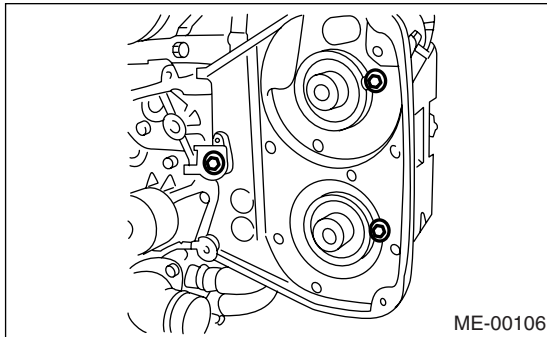
5 N·m (0.5 kgf-m, 3.6 ft-lb)



10) Install the timing belt cover No. 2 (LH).

Tightening torque:

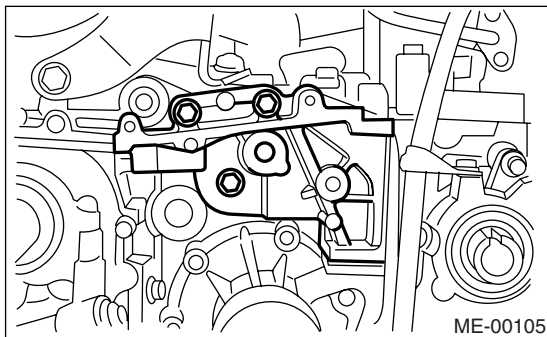
5 N·m (0.5 kgf-m, 3.6 ft-lb)



11) Install the tensioner bracket.

Tightening torque:

25 N·m (2.5 kgf-m, 18.1 ft-lb)



12) Install the crank sprocket.

<Ref. to ME(H4DOTC)-51, INSTALLATION, Crank Sprocket.>

13) Install the cam sprocket.

<Ref. to ME(H4DOTC)-50, INSTALLATION, Cam Sprocket.>

14) Install the timing belt. <Ref. to ME(H4DOTC)-43, INSTALLATION, Timing Belt.>

15) Install the timing belt cover.

<Ref. to ME(H4DOTC)-41, INSTALLATION, Timing Belt Cover.>

16) Install the crank pulley.

<Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>

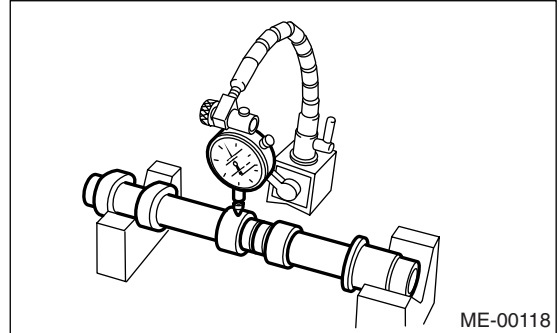
17) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

C: INSPECTION

1) Measure the bend, and repair or replace if necessary.

Service limit:

0.020 mm (0.00079 in)



2) Check the journal for damage and wear. Replace if faulty.

3) Measure the outside diameter of camshaft journal. If the journal diameter is not within specification, check the oil clearance.

	Camshaft journal	
	Front	Center, rear
Standard value	37.946 — 37.963	29.946 — 29.963
mm (in)	(1.4939 — 1.4946)	(1.1790 — 1.1796)

4) Measurement of the camshaft journal oil clearance:

(1) Clean the bearing caps and camshaft journals.

(2) Place the camshafts on cylinder head.

(3) Place a plastigauge across each of the camshaft journals.

(4) Gradually tighten the cap in at least two stages in alphabetical sequence shown in the figure, and then tighten to the specified torque. Do not turn the camshaft.

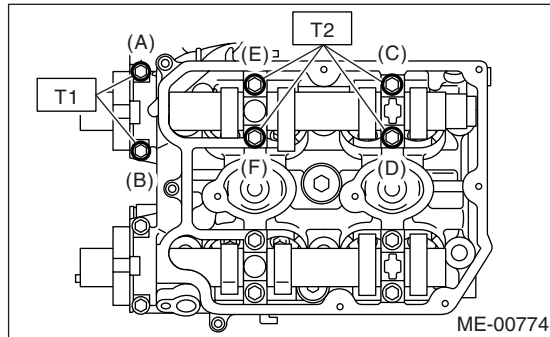
Camshaft

MECHANICAL

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.2 ft-lb)

T2: 20 N·m (2.0 kgf-m, 14.5 ft-lb)

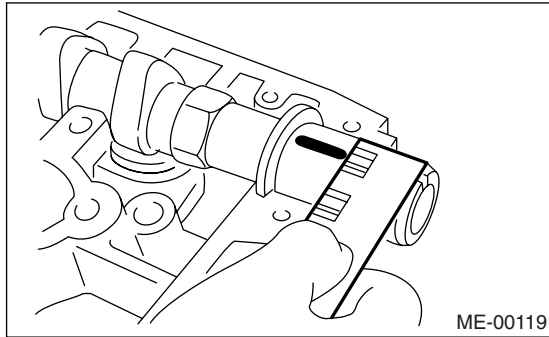


(5) Remove the bearing caps.

(6) Measure the widest point of the plastigauge on each journal. If oil clearance exceeds the limit, replace the camshaft. If necessary, replace the camshaft caps and cylinder head as a set.

Standard:

0.037 — 0.072 mm (0.0015 — 0.0028 in)



(7) Completely remove the plastigauge.

5) Check the cam face condition, and remove the minor faults by grinding with oil stone. Measure the cam height H. If it exceeds the limit or has partial wear, replace it.

Cam height H:

Standard

Intake

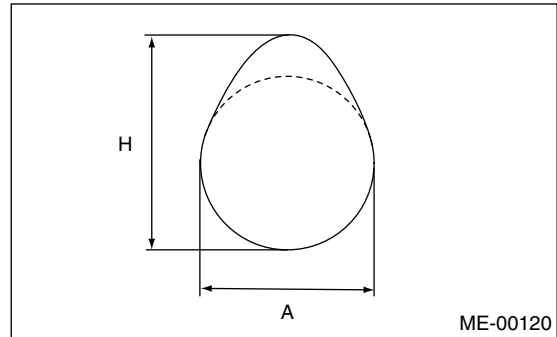
46.55 — 46.65 mm (1.833 — 1.837 in)

Exhaust

46.75 — 46.85 mm (1.841 — 1.844 in)

Cam base circle diameter A:

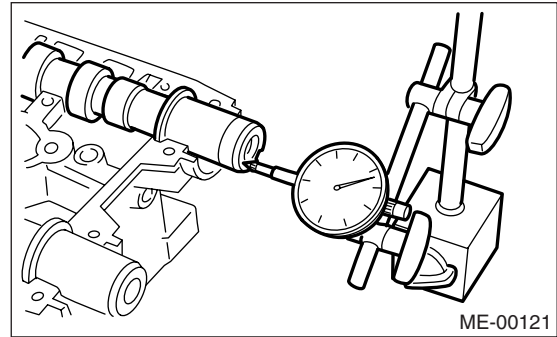
37.0 mm (1.457 in)



6) Measure the side clearance of camshaft with dial gauge. If the clearance exceeds the limit or has partial wear, replace the caps and cylinder head as a set. If necessary, replace the camshaft.

Standard:

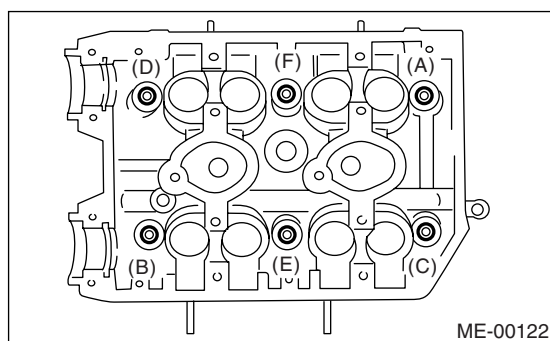
0.068 — 0.116 mm (0.0027 — 0.0047 in)



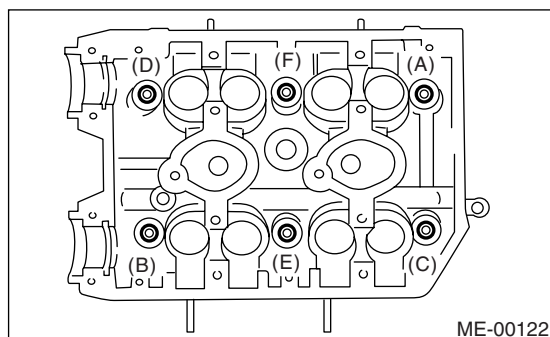
19. Cylinder Head

A: REMOVAL

- 1) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 2) Remove the crank pulley.
<Ref. to ME(H4DOTC)-39, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover.
<Ref. to ME(H4DOTC)-41, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt.
<Ref. to ME(H4DOTC)-42, REMOVAL, Timing Belt.>
- 5) Remove the cam sprocket.
<Ref. to ME(H4DOTC)-50, REMOVAL, Cam Sprocket.>
- 6) Remove the intake manifold.
<Ref. to FU(H4DOTC)-12, REMOVAL, Intake Manifold.>
- 7) Remove the bolt which installs the A/C compressor bracket on cylinder head.
- 8) Remove the camshaft. <Ref. to ME(H4DOTC)-52, REMOVAL, Camshaft.>
- 9) Remove the cylinder head bolts in alphabetical sequence shown in the figure.
Leave the bolts (A) and (D) engaged by three or four threads to prevent the cylinder head from falling.



- 10) While tapping the cylinder head with a plastic hammer, separate it from cylinder block.
Remove the bolts (A) and (D) to remove cylinder head.



- 11) Remove the cylinder head gasket.

CAUTION:

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

- 12) Similarly, remove the cylinder head (RH).

B: INSTALLATION

- 1) Install the cylinder head to the cylinder block.

CAUTION:

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

NOTE:

Use a new cylinder head gasket.

- (1) Clean the bolt threads and the bolt holes in the cylinder block.

CAUTION:

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

- (2) Apply a sufficient coat of engine oil to the washer and bolt thread.
- (3) Tighten all bolts to 40 N·m (4.1 kgf-m, 29.5 ft-lb) in alphabetical order.
- (4) Retighten all bolts to 95 N·m (9.7 kgf-m, 70.1 ft-lb) in alphabetical order.

CAUTION:

If the bolt makes stick-slip sound during tightening, repeat the procedure from step (1). In this case, the cylinder head gasket can be re-used.

- (5) Loosen all the bolts by 180° in the reverse order of installing, and loosen them further by 180°.
- (6) Tighten all bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in alphabetical order.
- (7) Retighten all bolts to 30 N·m (3.1 kgf-m, 22.1 ft-lb) in alphabetical order.
- (8) Retighten all bolts to 70 N·m (7.1 kgf-m, 51.6 ft-lb) in alphabetical order.
- (9) Retighten all bolts by 80 — 90° in alphabetical order.
- (10) Retighten all bolts by 40 — 45° in alphabetical order.

CAUTION:

The tightening angle of the bolt should not exceed 45°.

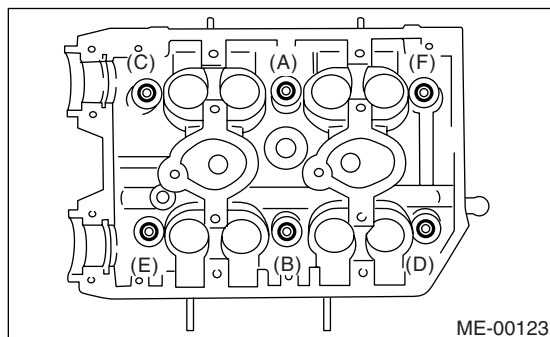
Cylinder Head

MECHANICAL

(11) Retighten bolts (A) and (B) by 40 — 45°.

CAUTION:

Make sure the total “tightening angle” of steps (10) and (11) does not exceed 90°.



2) Install the camshaft. <Ref. to ME(H4DOTC)-53, INSTALLATION, Camshaft.>

3) Install the A/C compressor bracket on cylinder head.

4) Install the intake manifold.

<Ref. to FU(H4DOTC)-14, INSTALLATION, Intake Manifold.>

5) Install the cam sprocket.

<Ref. to ME(H4DOTC)-50, INSTALLATION, Cam Sprocket.>

6) Install the timing belt.

<Ref. to ME(H4DOTC)-43, INSTALLATION, Timing Belt.>

7) Install the timing belt cover.

<Ref. to ME(H4DOTC)-41, INSTALLATION, Timing Belt Cover.>

8) Install the crank pulley.

<Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>

9) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

C: DISASSEMBLY

1) Remove the valve lifter.

2) Compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

ST1 498267600 CYLINDER HEAD TABLE

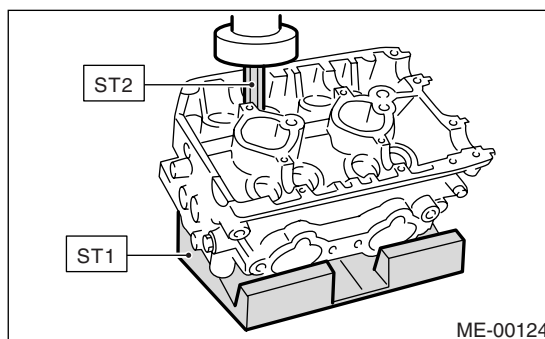
ST2 499718000 VALVE SPRING REMOVER

NOTE:

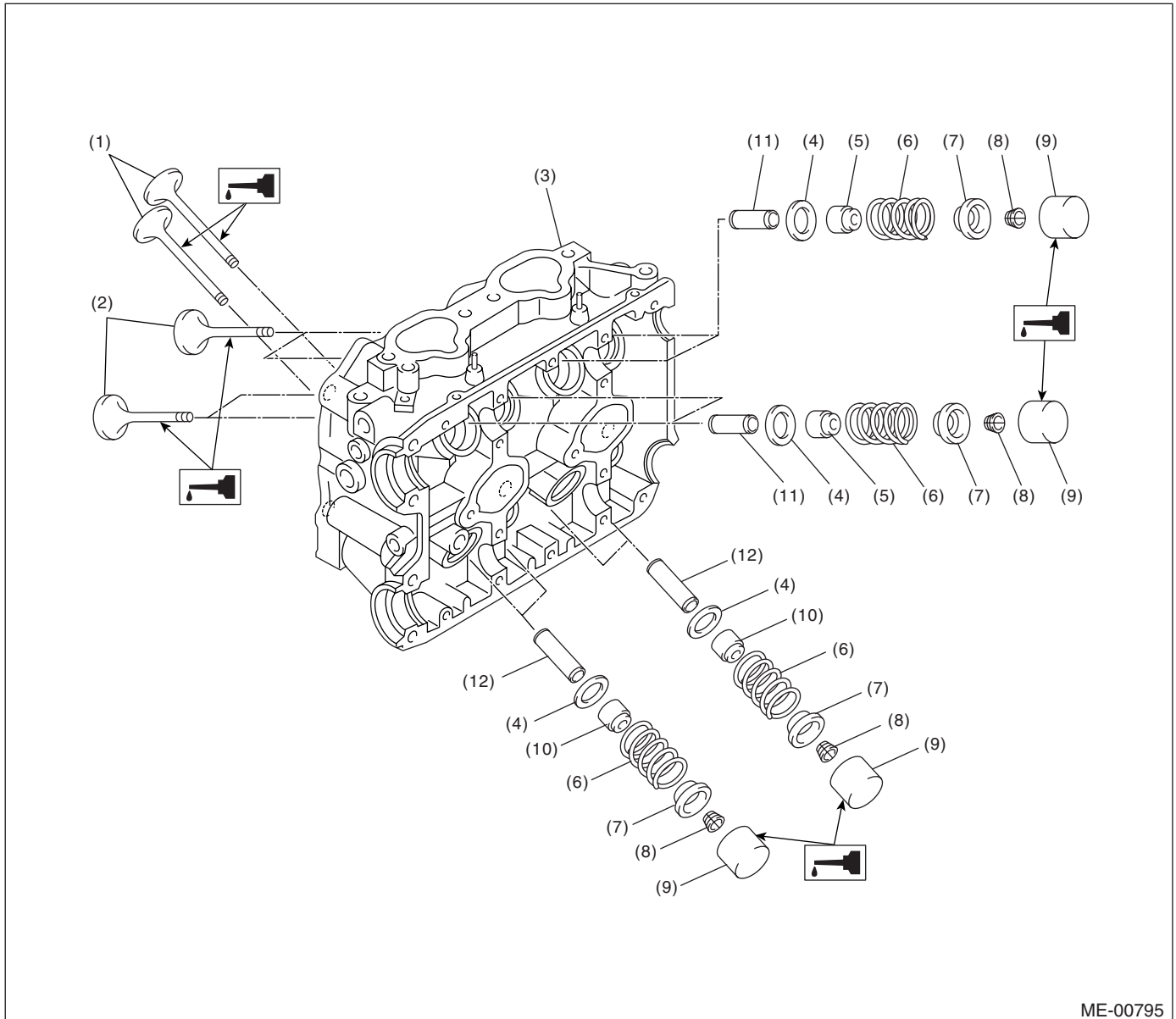
Keep all the removed parts in order for re-installing in their original positions.

CAUTION:

- Mark each valve to prevent confusion.
- Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.



D: ASSEMBLY



ME-00795

- | | | |
|-----------------------|---------------------------|-----------------------------|
| (1) Exhaust valve | (5) Intake valve oil seal | (9) Valve lifter |
| (2) Intake valve | (6) Valve spring | (10) Exhaust valve oil seal |
| (3) Cylinder head | (7) Retainer | (11) Intake valve guide |
| (4) Valve spring seat | (8) Retainer key | (12) Exhaust valve guide |

1) Installation of valve spring and valve:

- (1) Coat the 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.

- (2) Set the cylinder head on ST1.

- (3) Install the valve spring and retainer using ST2.

ST1 498267600 CYLINDER HEAD TABLE

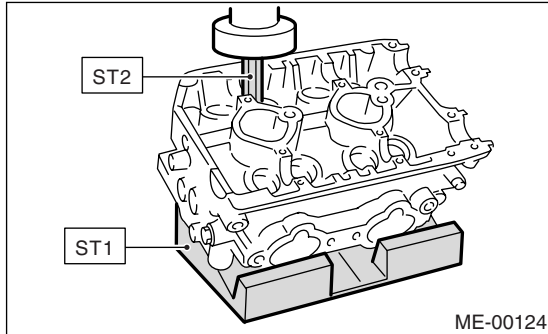
ST2 499718000 VALVE SPRING REMOVER

Cylinder Head

MECHANICAL

NOTE:

Be sure to install the valve spring with their close-coiled end facing the seat on the cylinder head.



(4) Compress the valve spring and fit the valve spring retainer key.

(5) After installing, tap the valve spring retainers lightly with a wooden hammer for better seating.

2) Apply oil to the surfaces of the valve lifter.

3) Install the valve lifter.

E: INSPECTION

1. CYLINDER HEAD

1) Make sure that cracks or other damages do not exist. In addition to visual inspection, inspect important areas using liquid penetrant tester.

2) Measure the warping of the cylinder head surface that mates with crankcase using a straight edge (A) and thickness gauge (B).

If the warping exceeds the limit, regrind the surface with a surface grinder.

Warping limit:

0.035 mm (0.0014 in)

Grinding limit:

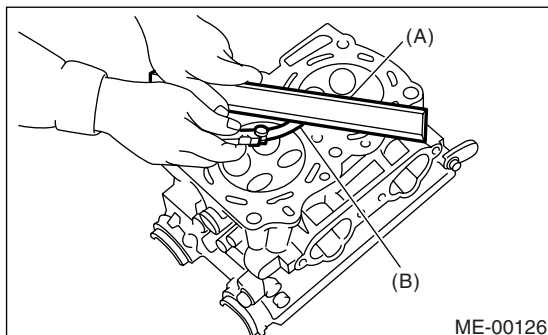
0.3 mm (0.012 in)

Standard height of cylinder head:

127.5 mm (5.02 in)

NOTE:

Uneven torque for the cylinder head nuts can cause warping. When reinstalling, pay special attention to the torque so as to tighten evenly.



2. VALVE SEAT

Inspect the intake and exhaust valve seats, and correct the contact surfaces with a valve seat cutter if they are defective or when valve guides are replaced.

Valve seat width W:

Intake

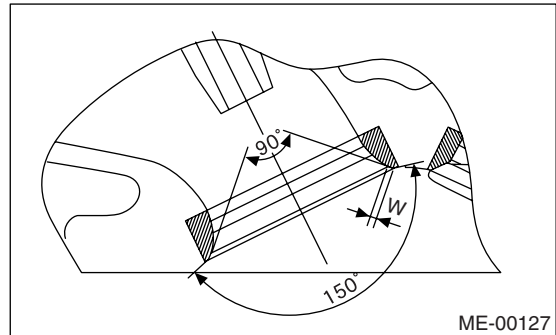
Standard

0.6 — 1.4 mm (0.024 — 0.055 in)

Exhaust

Standard

1.2 — 1.8 mm (0.047 — 0.071 in)



3. VALVE GUIDE

1) Check the clearance between valve guide and stem. The clearance can be checked by measuring the outer diameter of valve stem and inner diameter of valve guide respectively with a micrometer.

Clearance between the valve guide and valve stem:

Standard

Intake

0.030 — 0.057 mm (0.0012 — 0.0022 in)

Exhaust

0.040 — 0.067 mm (0.0016 — 0.0026 in)

2) If the clearance between valve guide and stem exceeds the standard value, replace the valve guide or valve itself whichever shows greater amount of wear or has abnormality such as scratch. See the following procedure for valve guide replacement.

Valve guide inner diameter:

6.000 — 6.012 mm (0.2362 — 0.2367 in)

Valve stem outer diameters:

Intake

5.955 — 5.970 mm (0.2344 — 0.2350 in)

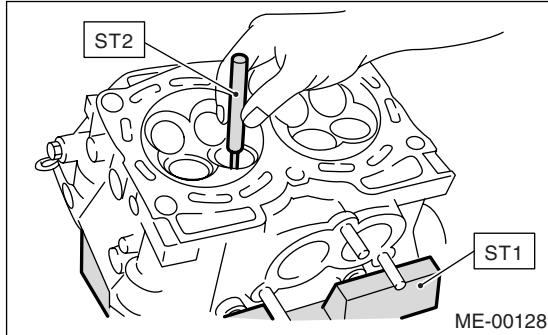
Exhaust

5.945 — 5.960 mm (0.2341 — 0.2346 in)

(1) Place the cylinder head on ST1 with the combustion chamber upward so that valve guides fit the holes in ST1.

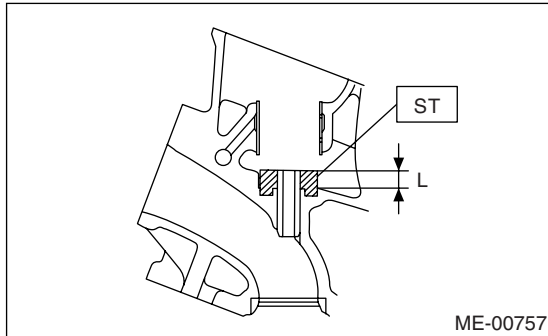
- (2) Insert the ST2 into valve guide and press it down to remove the valve guide.

ST1 498267600 CYLINDER HEAD TABLE
ST2 499767200 VALVE GUIDE REMOVER



- (3) Turn the cylinder head upside down and place the ST as shown in the figure.

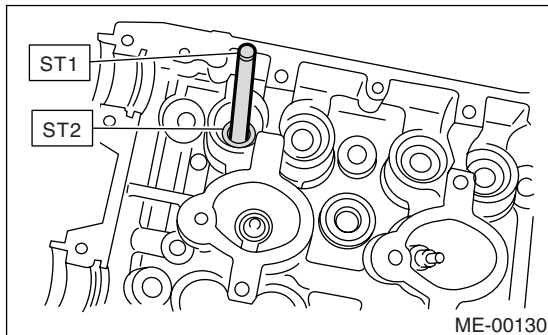
ST 18251AA020 VALVE GUIDE ADJUSTER



- (4) Before installing a new valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.

- (5) Put a new valve guide, coated with sufficient oil, in cylinder, and insert the ST1 into valve guide. Press-in until the valve guide upper end is flush with the upper surface of ST2.

ST1 499767200 VALVE GUIDE REMOVER
ST2 18251AA020 VALVE GUIDE ADJUSTER



- (6) Check the valve guide protrusion.

Valve guide protrusion L:
15.8 — 16.2 mm (0.622 — 0.638 in)

- (7) Ream the inside of valve guide using ST. Put the reamer in valve guide, and rotate the reamer slowly clockwise pushing it lightly. Bring the reamer back while rotating it clockwise. After reaming, clean the valve guide to remove chips.

ST 499767400 VALVE GUIDE REAMER

NOTE:

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

- (8) Recheck the contact condition between valve and valve seat after replacing the valve guide.

4. INTAKE AND EXHAUST VALVE

- 1) Inspect the flange and stem of valve, and replace them if damaged, worn, deformed or if "H" is exceed the standard value or if they have partial wear.

H:

Standard (Intake)

1.0 — 1.4 mm (0.039 — 0.055 in)

Standard (Exhaust)

1.3 — 1.7 mm (0.051 — 0.067 in)

Cylinder Head

MECHANICAL

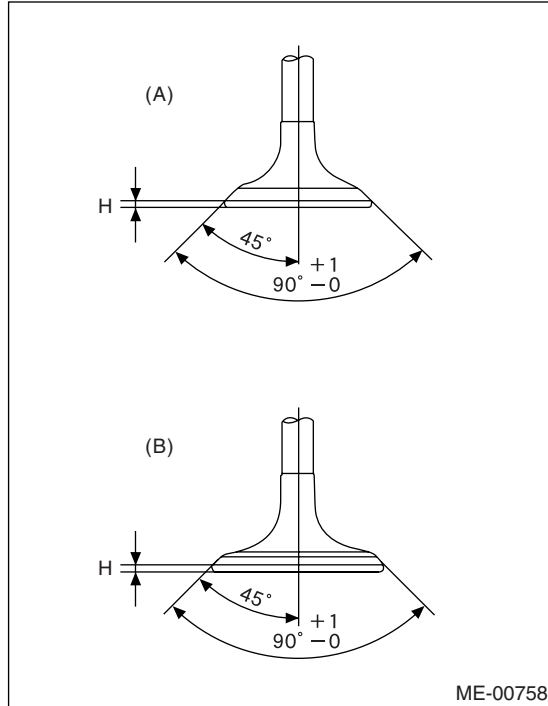
Valve overall length:

Intake

104.4 mm (4.110 in)

Exhaust

104.65 mm (4.1201 in)



(A) Intake

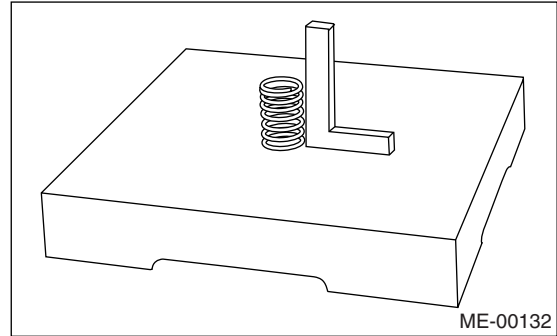
(B) Exhaust

2) Put a small amount of grinding compound on the seat surface, and lap the valve and seat surface. Install a new intake valve oil seal after lapping.

5. VALVE SPRINGS

- 1) Check the valve springs for damage, free length, and tension. Replace the valve spring if it is not within the standard value presented in the table.
- 2) To measure the squareness of the valve spring, stand the spring on a surface plate and measure its deflection at the top of spring using a try square.

Free length	mm (in)	47.32 (1.863)
Tension/spring height N (kgf, lb)/mm (in)	Set	205 — 235 (20.9 — 24.0, 46.1 — 52.8)/36.0 (1.417)
	Lift	426 — 490 (43.4 — 50.0, 95.8 — 110)/26.50 (1.041)
Squareness		2.5°, 2.1 mm (0.083 in)



6. INTAKE AND EXHAUST VALVE OIL SEAL

In the following case, pinch and remove the oil seal from valve using pliers, and then replace it with a new one.

- When the lip is damaged.
 - When the spring is out of the specified position.
 - When readjusting the surfaces of valve and valve sheet.
 - When replacing the valve guide.
- 1) Place the cylinder head on ST1.
 - 2) Using ST2, press-fit the oil seal.

NOTE:

- Apply engine oil to oil seal before press-fitting.
- When press-fitting the oil seal, do not use a hammer or strike in.

ST1 498267600 CYLINDER HEAD TABLE

ST2 498857100 VALVE OIL SEAL GUIDE

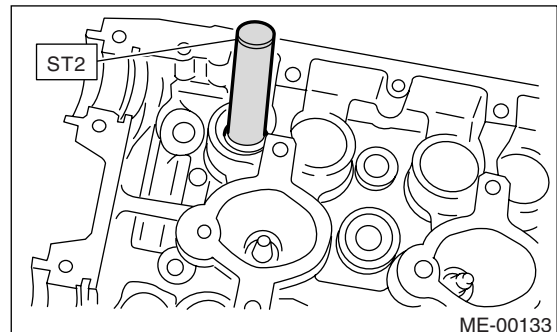
CAUTION:

Differentiate between the intake valve oil seal and exhaust valve oil seal by noting their difference in color.

Color of rubber part:

Intake [Gray]

Exhaust [Green]

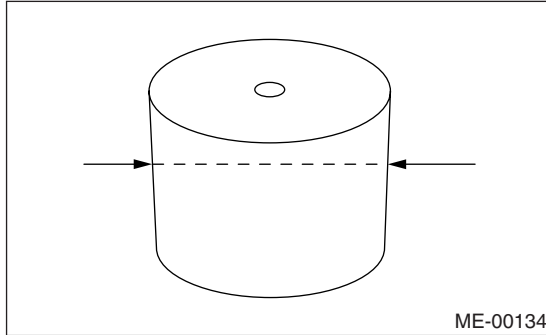


7. VALVE LIFTER

- 1) Check the valve lifter visually.
- 2) Measure the outer diameter of valve lifter.

Outer diameter:

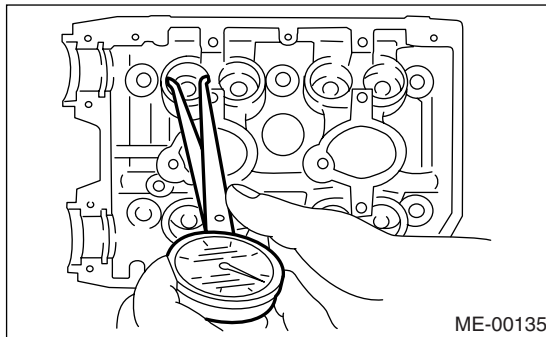
34.959 — 34.975 mm (1.3763 — 1.3770 in)



- 3) Measure the inner diameter of valve lifter mating part on cylinder head.

Inner diameter:

34.994 — 35.016 mm (1.3777 — 1.3786 in)



NOTE:

If difference between outer diameter of valve lifter and inner diameter of valve lifter mating part is over the standard or has partial wear in inner surface, replace the cylinder head.

Standard:

0.019 — 0.057 mm (0.0007 — 0.0022 in)

F: DISPOSAL

CAUTION:

- Metallic sodium is enclosed in the exhaust valve. Metallic sodium is extremely alkaline and may produce severe chemical reactions. Full consideration must therefore be given to the following points when handling or disposing of the valve.
- Since metallic sodium may cause blindness if contacted with the eyes, burns if contacted with the skin, and fire, do not deliberately take the valve apart.

- 1) If the valve is damaged, remove the valve and neutralize it by immersing it in water, and dispose of it in the same way that general steel materials are disposed of. The disposal method is described in the following.

- (1) Wearing rubber gloves, remove the damaged valve from the cylinder head.
- (2) Prepare a large receptacle (bucket or other container) in a well ventilated location, and fill the receptacle with water (at least 10 liters).
- (3) Immerse the damaged valve in the receptacle.

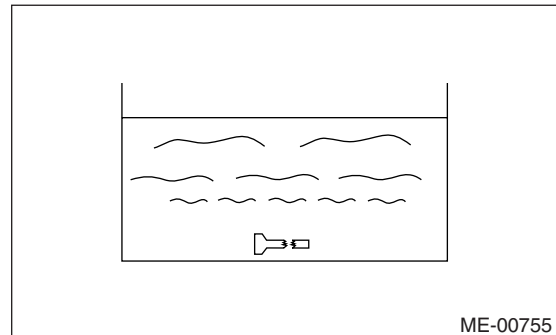
CAUTION:

A severe reaction may occur, so stand at least 2 — 3 m from the receptacle. Because the reaction will produce hydrogen gas, moreover, keep the receptacle away from sparks or flames.

- (4) Once the reaction is completed (about 4 — 5 hours have elapsed), carefully remove the valve using large pincers so that the reaction liquid does not contact your skin, and dispose of it with other parts that are being disposed of.
- (5) The reaction liquid is a strong alkaline solution, so it must be disposed of in accordance with local regulations.

CAUTION:

Make sure the reaction liquid does not contact your skin. If contact with skin occurs, immediately wash the affected area with large quantities of water.



20. Cylinder Block

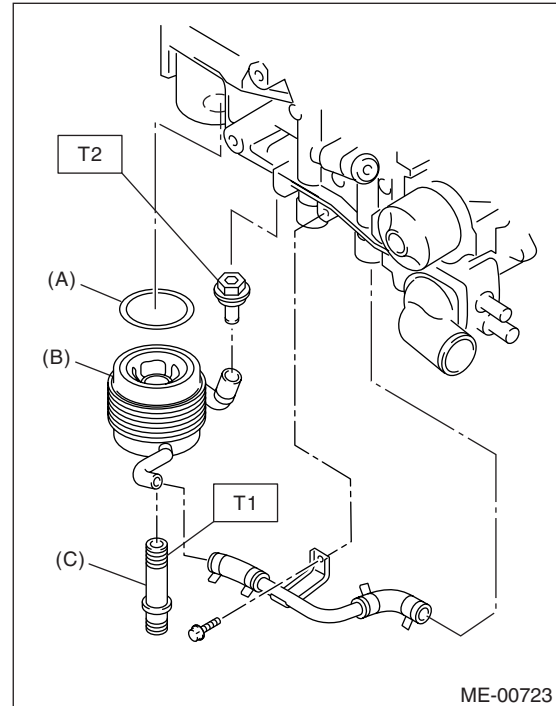
A: REMOVAL

NOTE:

Before conducting this procedure, drain engine oil completely.

- 1) Remove the intake manifold.
<Ref. to FU(H4DOTC)-12, REMOVAL, Intake Manifold.>
- 2) Remove the V-belts. <Ref. to ME(H4DOTC)-37, REMOVAL, V-belt.>
- 3) Remove the crank pulley.
<Ref. to ME(H4DOTC)-39, REMOVAL, Crank Pulley.>
- 4) Remove the timing belt cover.
<Ref. to ME(H4DOTC)-41, REMOVAL, Timing Belt Cover.>
- 5) Remove the timing belt.
<Ref. to ME(H4DOTC)-42, REMOVAL, Timing Belt.>
- 6) Remove the cam sprocket.
<Ref. to ME(H4DOTC)-50, REMOVAL, Cam Sprocket.>
- 7) Remove the crank sprocket.
<Ref. to ME(H4DOTC)-51, REMOVAL, Crank Sprocket.>
- 8) Remove the generator and A/C compressor with their brackets.
- 9) Remove the cylinder head.
<Ref. to ME(H4DOTC)-57, REMOVAL, Cylinder Head.>
- 10) Remove the clutch disc and cover. <Ref. to CL-9, REMOVAL, Clutch Disc and Cover.>
- 11) Remove the flywheel. (MT model) <Ref. to CL-12, REMOVAL, Flywheel.>
- 12) Remove the drive plate. (AT model) <Ref. to 5AT-68, REMOVAL, Drive Plate.>
- 13) Remove the oil separator cover.
- 14) Remove the water by-pass pipe for heater.
- 15) Remove the water pump.
- 16) Remove the oil filter. <Ref. to LU(H4DOTC)-24, REMOVAL, Engine Oil Filter.>

- 17) Remove the oil cooler.

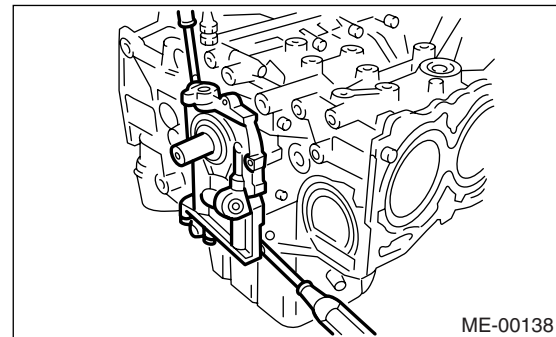


- (A) O-ring
- (B) Oil cooler
- (C) Oil cooler connector

- 18) Remove the bolts which secure oil pump to cylinder block.
- 19) Remove the oil pump by using flat tip screwdriver.

CAUTION:

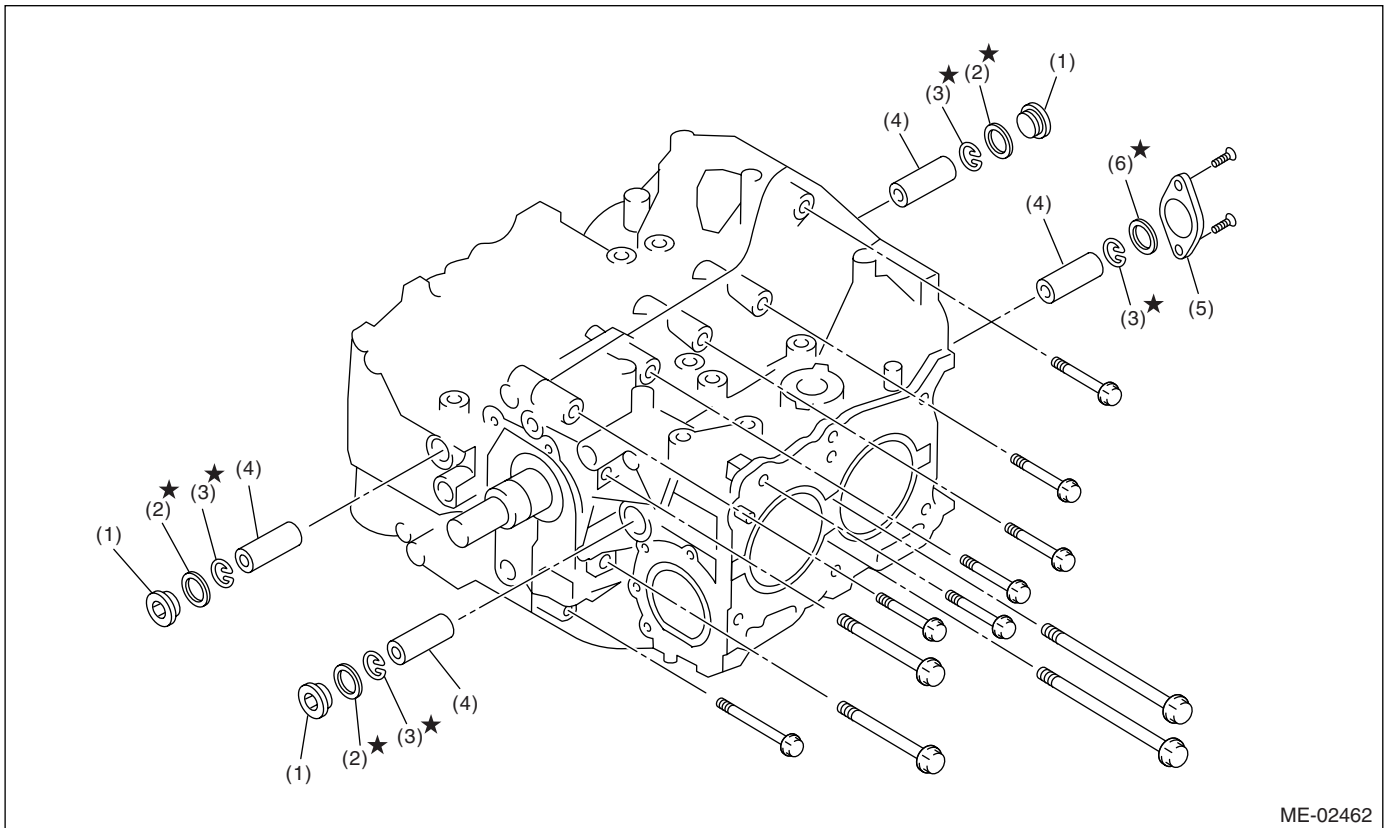
Be careful not to scratch the mating surface of cylinder block and oil pump.



- 20) Removal of oil pan:
 - (1) Place the cylinder block to face the #2 and #4 cylinder side upward.
 - (2) Remove the bolts which secure oil pan to cylinder block.
 - (3) Insert a oil pan cutter blade between cylinder block-to-oil pan clearance and remove the oil pan. Do not use a screwdriver or similar tools in place of oil pan cutter.
- 21) Remove the oil strainer stay.

- 22) Remove the oil strainer.
23) Remove the baffle plate.

- 24) Remove the water pipe.

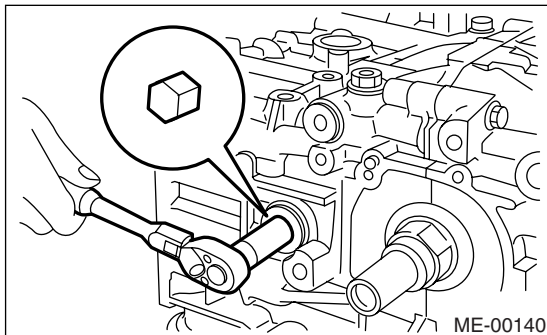


ME-02462

- (1) Service hole plug
(2) Gasket
(3) Snap ring
(4) Piston pin

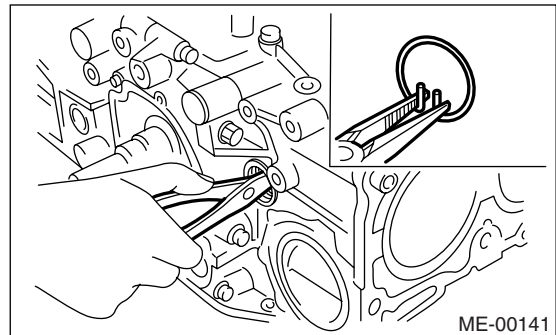
- (5) Service hole cover
(6) O-ring

- 25) Remove the service hole cover and service hole plugs using a hexagon wrench [14 mm].



ME-00140

- 26) Rotate the crankshaft to bring #1 and #2 pistons to bottom dead center position, then remove the piston snap ring through service hole of #1 and #2 cylinders.



ME-00141

- 27) Draw out the piston pins from #1 and #2 pistons using ST.

ST 499097700

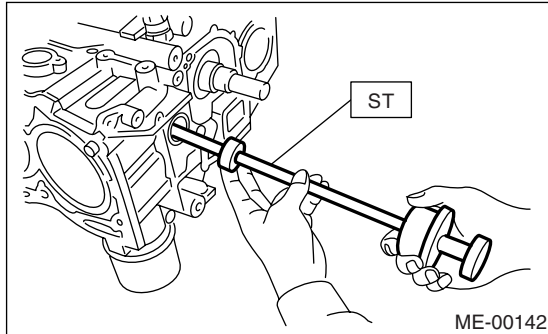
PISTON PIN REMOVER

Cylinder Block

MECHANICAL

NOTE:

Be careful not to confuse the original combination of piston, piston pin and cylinder.



28) Similarly remove the piston pins from #3 and #4 pistons.

29) Remove the bolts which connect cylinder block on the side of #2 and #4 cylinders.

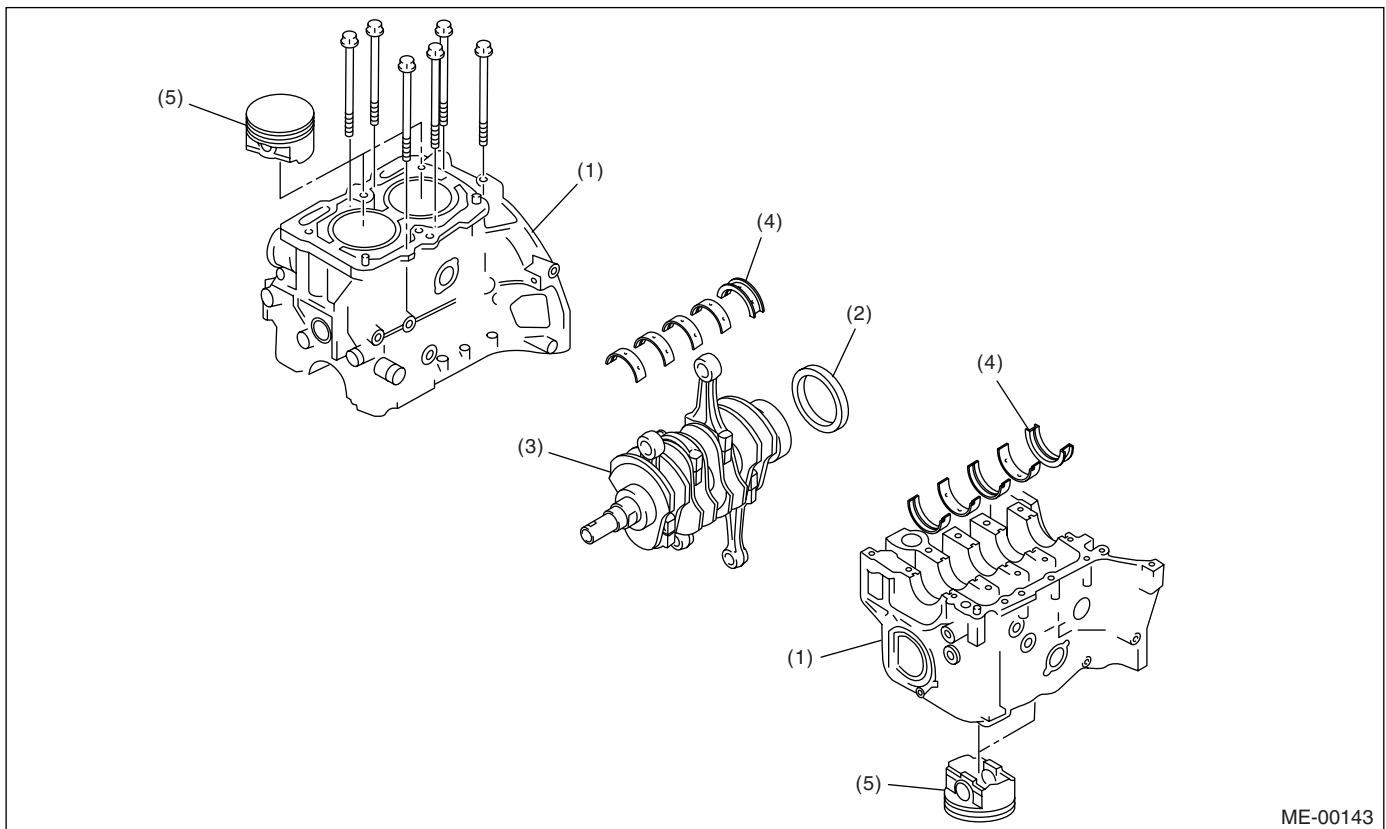
30) Back off the bolts which connect cylinder block on the side of #1 and #3 cylinders two or three turns.

31) Place the cylinder block to face the #1 and #3 cylinder side upward, and remove cylinder block connecting bolts.

32) Separate the cylinder block (LH) and (RH).

NOTE:

When separating the cylinder block, do not allow the connecting rod to fall and damage the cylinder block.



(1) Cylinder block

(2) Rear oil seal

(3) Crankshaft

(4) Crankshaft bearing

(5) Piston

33) Remove the rear oil seal.

34) Remove the crankshaft together with connecting rod.

35) Remove the crankshaft bearings from cylinder block using a hammer handle.

NOTE:

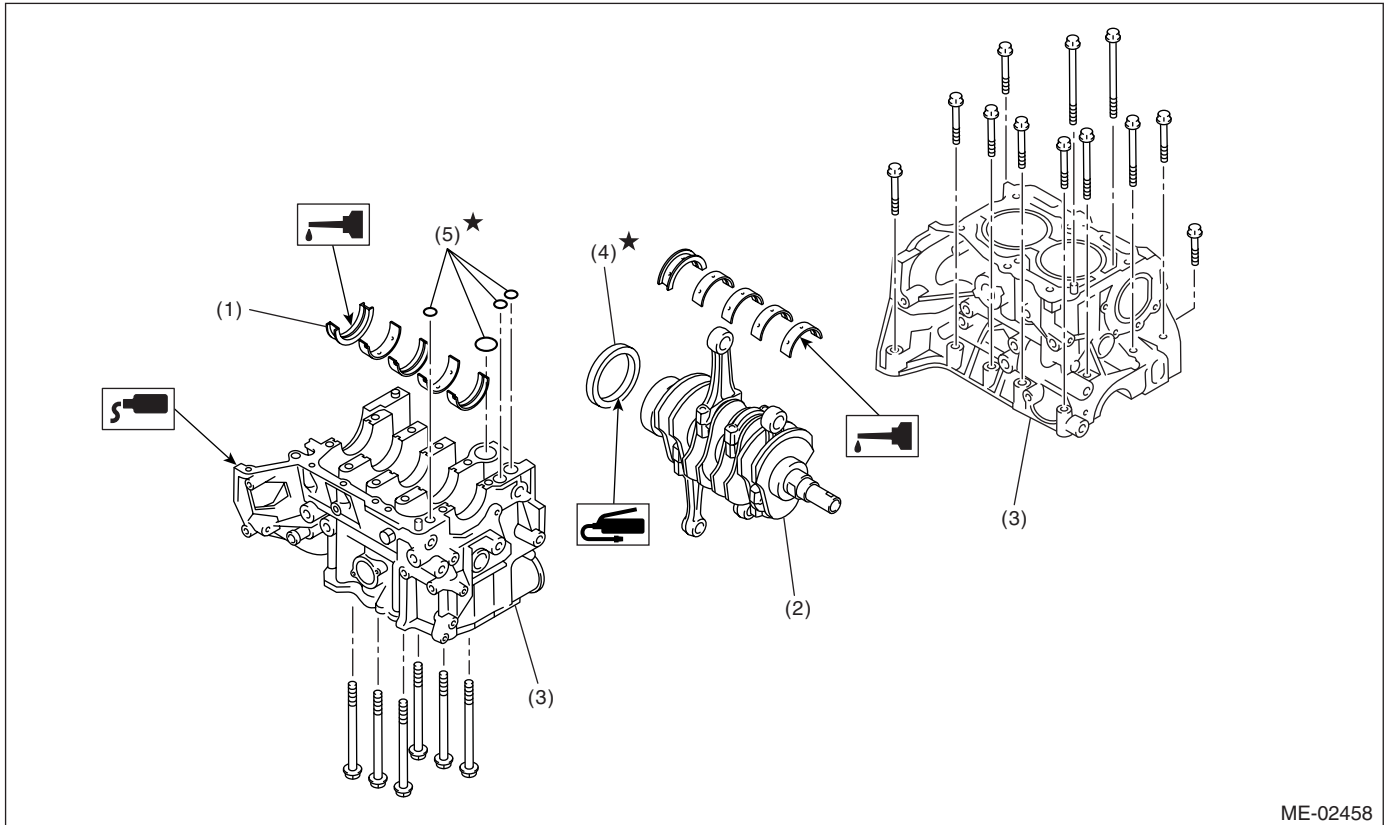
Do not confuse the combination of crankshaft bearings. Press the bearing at the end opposite to locking lip.

36) Draw out each piston from cylinder block using a wooden bar or hammer handle.

NOTE:

Be careful not to confuse the original combination of piston and cylinder.

B: INSTALLATION



ME-02458

- | | |
|------------------------|--------------------|
| (1) Crankshaft bearing | (3) Cylinder block |
| (2) Crankshaft | (4) Rear oil seal |

- (5) O-ring

1) Remove oil on the mating surface of bearing and cylinder block before installation. Apply a coat of engine oil to crankshaft pins.

2) Position the crankshaft on the #2 and #4 cylinder block.

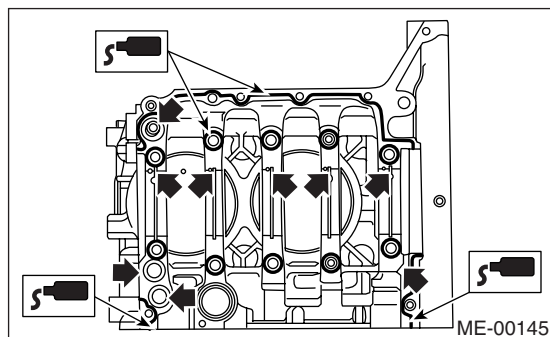
3) Apply liquid gasket to the mating surface of #1 and #3 cylinder block, and position it on #2 and #4 cylinder block.

Liquid gasket:

THREE BOND 1215 (Part No. 004403007) or equivalent

NOTE:

Do not allow liquid gasket to run over to O-ring grooves, oil passages, bearing grooves, etc.

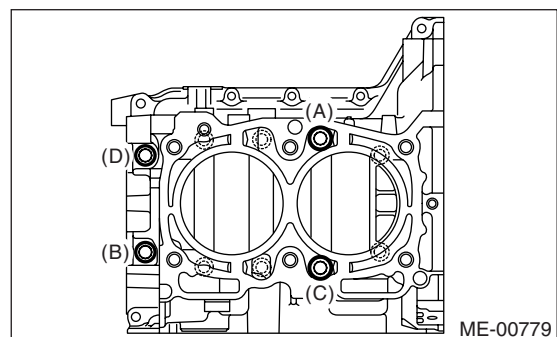


4) Apply a coat of engine oil to washers and bolt threads.

5) Tighten the 10 mm cylinder block connecting bolts on LH side (A — D) in alphabetical sequence.

Tightening torque:

10 N·m (1.0 kgf-m, 7.2 ft-lb)



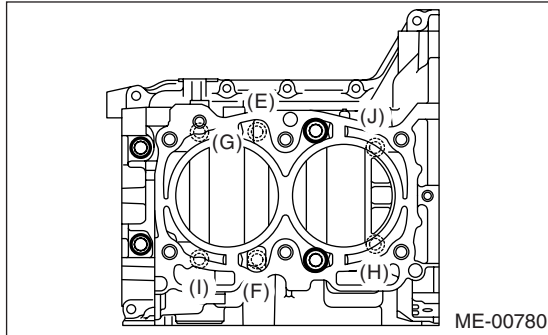
6) Tighten the 10 mm cylinder block connecting bolts on RH side (E — J) in alphabetical sequence.

Cylinder Block

MECHANICAL

Tightening torque:

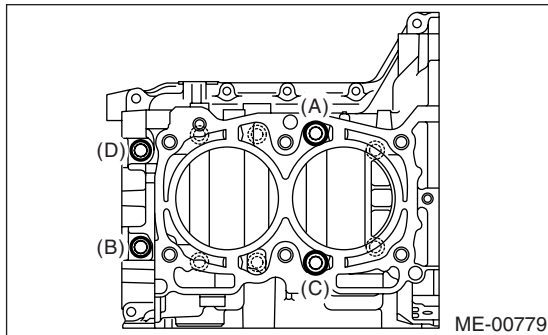
10 N·m (1.0 kgf-m, 7.2 ft-lb)



7) Further tighten the LH side bolts (A — D) in alphabetical sequence.

Tightening torque:

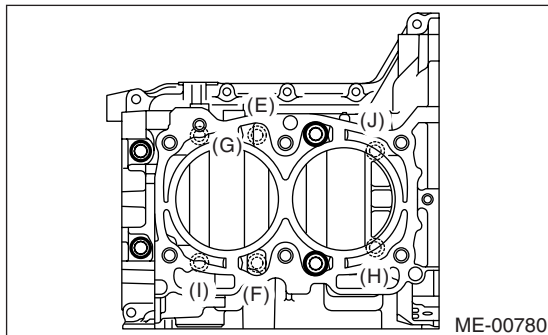
18 N·m (1.8 kgf-m, 13.0 ft-lb)



8) Further tighten the RH side bolts (E — J) in alphabetical sequence.

Tightening torque:

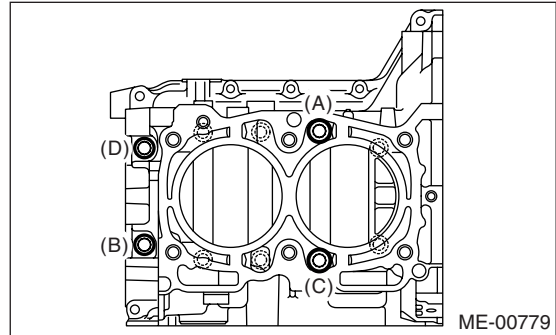
18 N·m (1.8 kgf-m, 13.0 ft-lb)



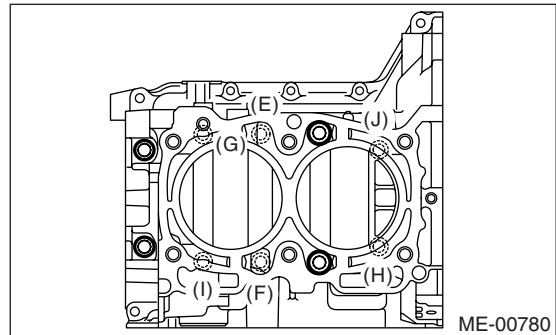
9) Further tighten the LH side bolts (A — D) in alphabetical sequence.

(A), (C): 90°

(B), (D): 40 N·m (4.1 kgf-m, 29.5 ft-lb)



10) Further tighten the RH side bolts (E — J) to 90° in alphabetical sequence.

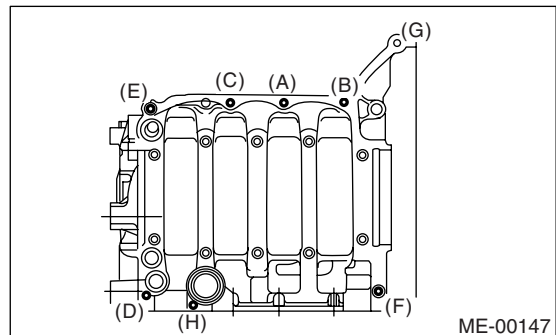


11) Tighten the 8 mm and 6 mm cylinder block connecting bolts on LH side (A — H) in alphabetical sequence.

Tightening torque:

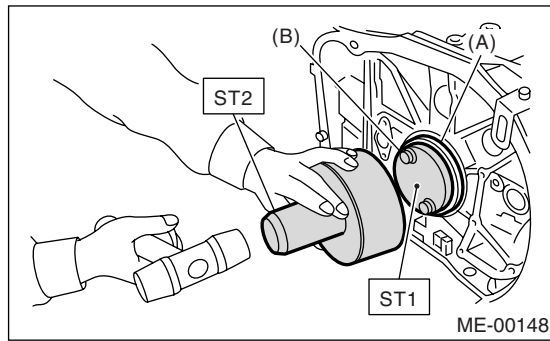
(A) — (G): 25 N·m (2.5 kgf-m, 18.1 ft-lb)

(H): 6.4 N·m (0.65 kgf-m, 4.7 ft-lb)



12) Install the rear oil seal using ST1 and ST2.
ST1 499597100 CRANKSHAFT OIL SEAL GUIDE

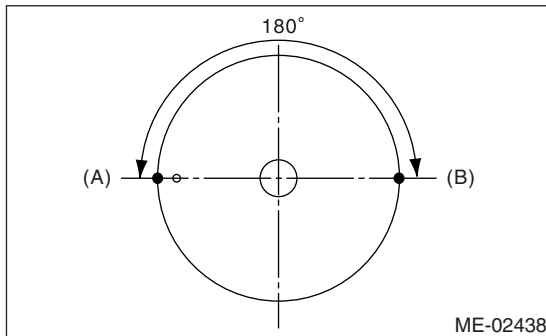
ST2 499587200 CRANKSHAFT OIL SEAL INSTALLER



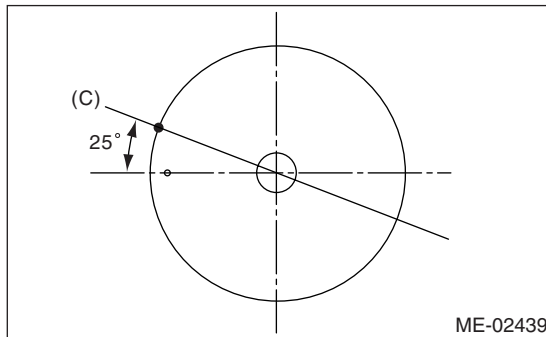
- (A) Rear oil seal
(B) Flywheel attaching bolt

13) Position the top ring gap at (A) or (B) in the figure.

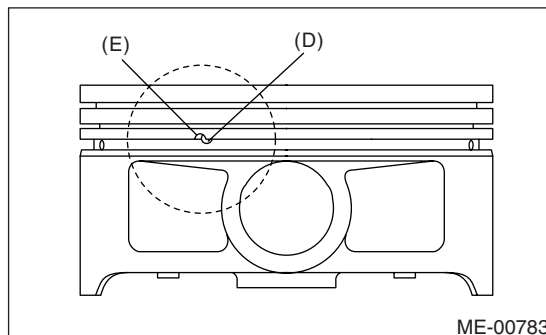
14) Position the second ring gap at 180° on the reverse side of the top ring gap.



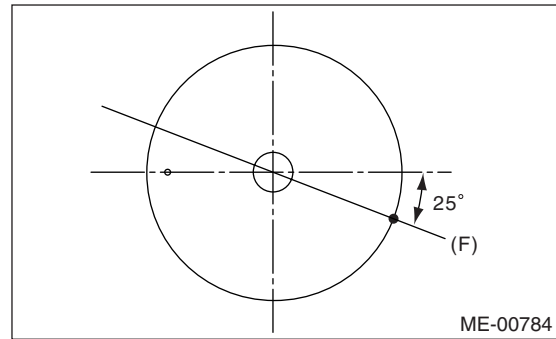
15) Position the upper rail gap at (C) in the figure.



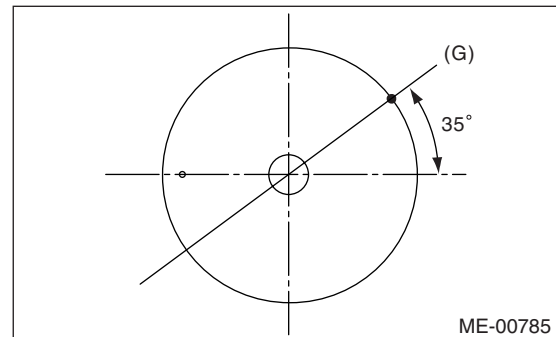
16) Align the upper rail spin stopper (D) to the side hole (E) on the piston.



17) Position the expander gap at 180° on the reverse side of (C) that shown (F) in the figure.



18) Position the lower rail gap at (G) in the figure.



CAUTION:

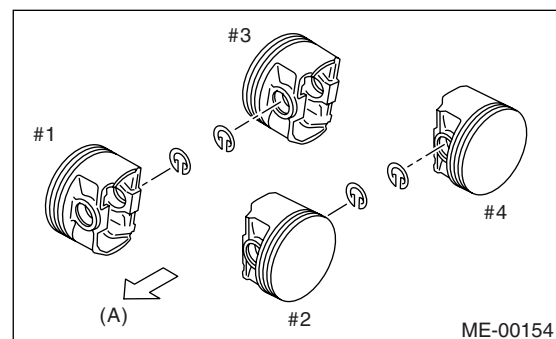
- Ensure ring gaps do not face the same direction.
- Ensure ring gaps are not within the piston skirt area.

19) Install the snap ring.

Install snap rings in the piston holes located opposite to the service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

NOTE:

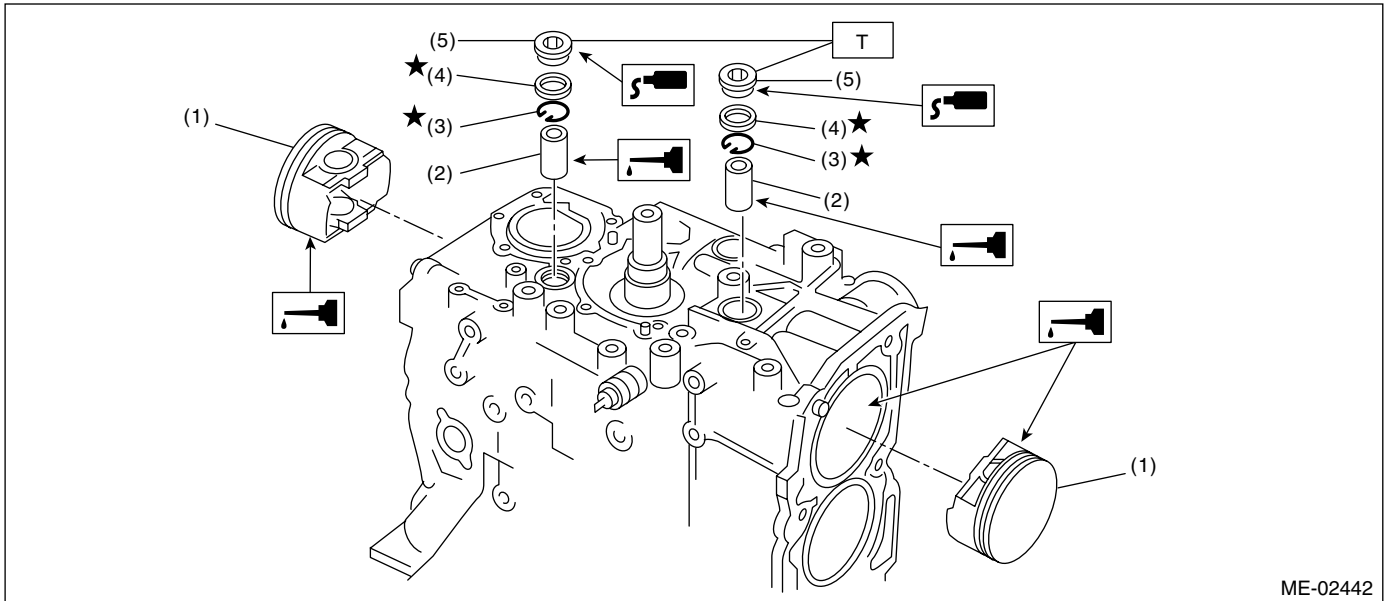
Use new snap rings.



(A) Front side

Cylinder Block

MECHANICAL



ME-02442

- | | |
|----------------|-----------------------|
| (1) Piston | (4) Gasket |
| (2) Piston pin | (5) Service hole plug |
| (3) Snap ring | |

Tightening torque: N·m (kgf-m, ft-lb)
T: 70 (7.1, 50.6)

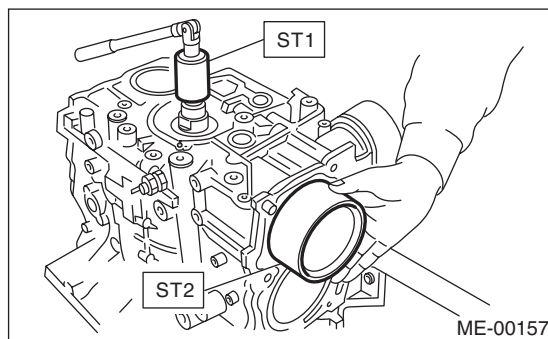
20) Installation of piston:

- (1) Place the cylinder block to face the #1 and #2 cylinder side upward.
- (2) Using the ST1, turn the crankshaft so that #1 and #2 connecting rods are set at bottom dead center.

ST1 499987500 CRANKSHAFT SOCKET

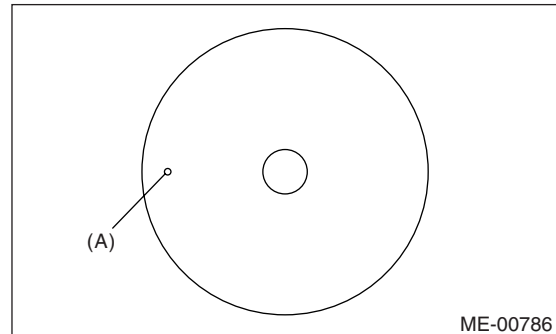
- (3) Apply a coat of engine oil to the pistons and cylinders and insert pistons in their cylinders using ST2.

ST2 498747300 PISTON GUIDE



NOTE:

Piston front mark faces towards the front of engine.

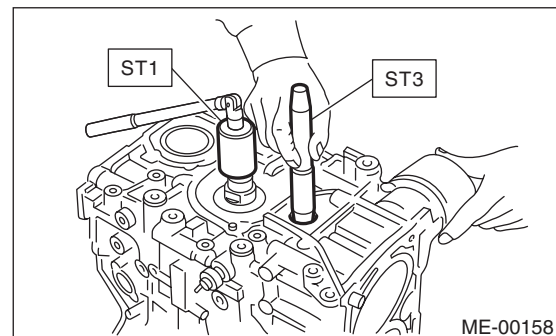


(A) Front mark

21) Installation of piston pin:

- (1) Apply a coat of engine oil to ST3 before insertion, and then insert it into the service hole to align piston pin hole with connecting rod small end.

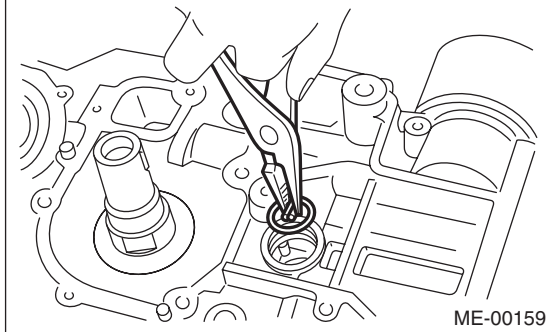
ST3 499017100 PISTON PIN GUIDE



- (2) Apply a coat of engine oil to piston pin, and insert the piston pin into piston and connecting rod through service hole.
- (3) Install the snap ring.

NOTE:

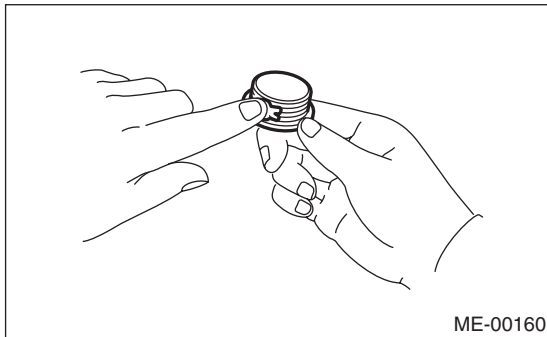
Use new snap rings.



- (4) Apply liquid gasket around the service hole plug.

Liquid gasket:

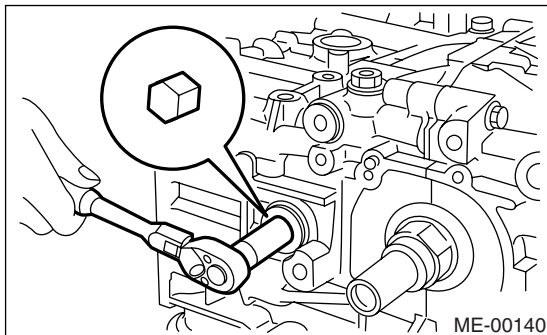
THREE BOND 1215 (Part No. 004403007) or equivalent



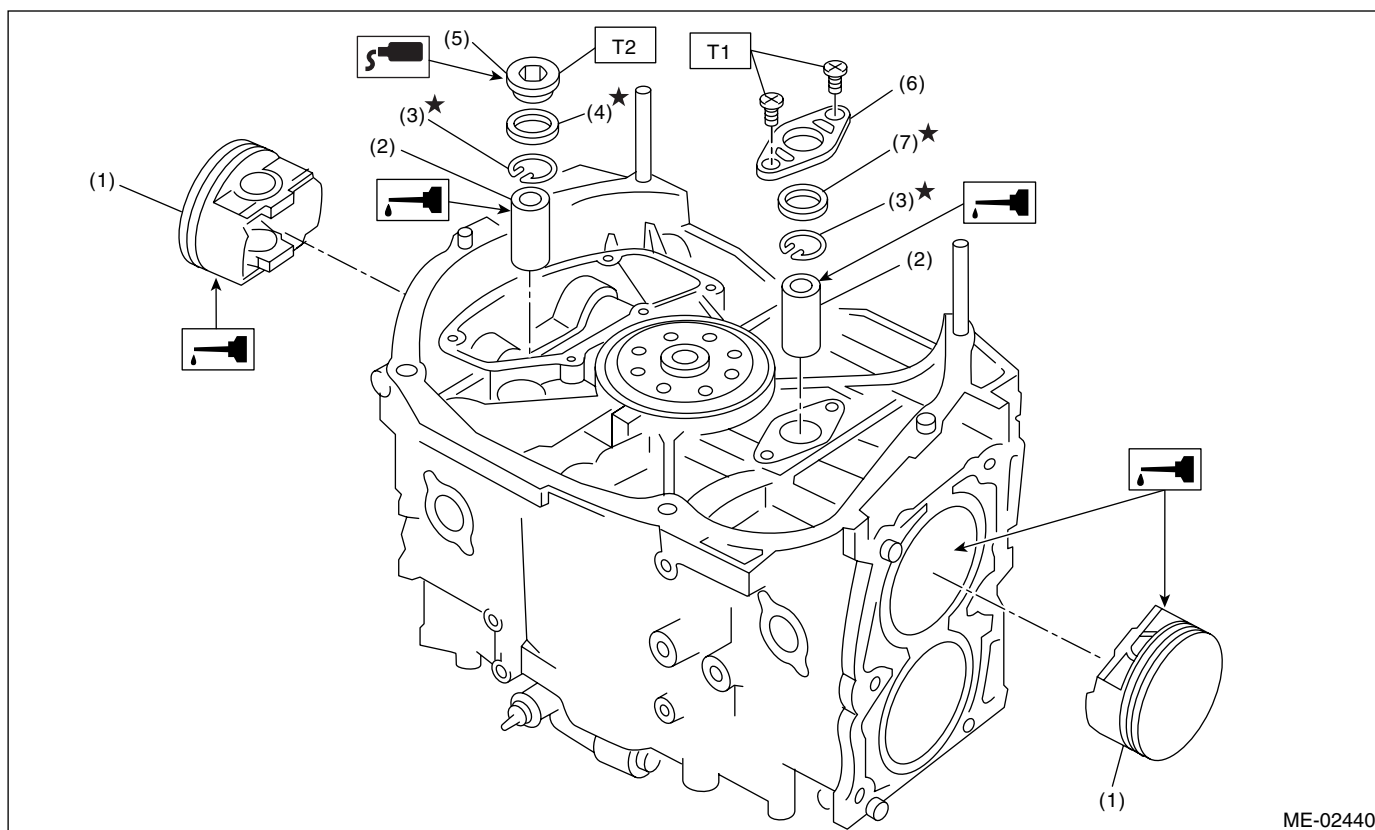
- (5) Install the service hole plug and gasket.

NOTE:

Use a new gasket.



Cylinder Block



ME-02440

- | | |
|----------------|------------------------|
| (1) Piston | (5) Service hole plug |
| (2) Piston pin | (6) Service hole cover |
| (3) Snap ring | (7) O-ring |
| (4) Gasket | |

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.65, 4.7)

T2: 70 (7.1, 50.6)

(6) Place the cylinder block to face the #3 and #4 cylinder side upward. Following the same procedures as used for #1 and #2 cylinders, install the pistons and piston pins.

- 22) Install the water pipe.
23) Install the baffle plate.

Tightening torque:

6.4 N·m (0.65 kgf-m, 4.7 ft-lb)

- 24) Install the oil strainer and O-ring.

Tightening torque:

10 N·m (1.0 kgf-m, 7.2 ft-lb)

- 25) Install the oil strainer stay.

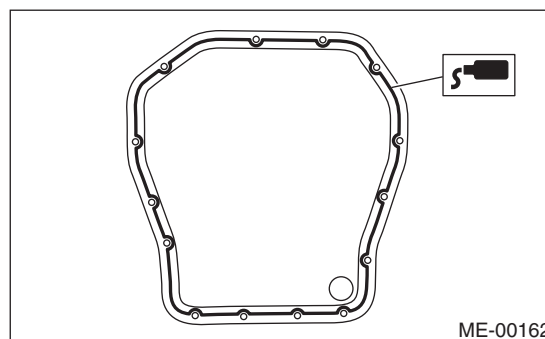
- 26) Apply liquid gasket to mating surfaces and install the oil pan.

Liquid gasket:

THREE BOND 1207C (Part No. 004403012) or equivalent

Tightening torque:

5 N·m (0.5 kgf-m, 3.6 ft-lb)



ME-00162

- 27) Apply liquid gasket to the mating surfaces and threaded portion of bolt (A) as shown in the figure, and install the oil separator cover.

NOTE:

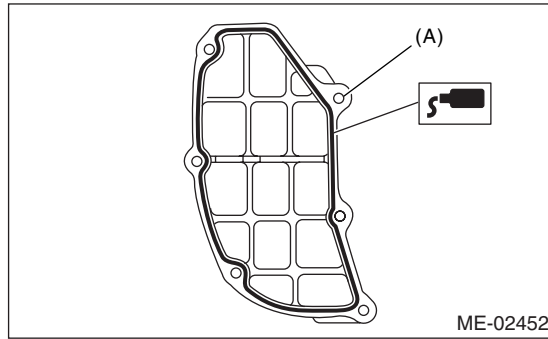
Install them within 20 min. from applying liquid gasket.

Liquid gasket:

THREE BOND 1207C (Part No. 004403012) or equivalent

Tightening torque:

6.4 N·m (0.65 kgf-m, 4.7 ft-lb)



28) Install the flywheel. (MT model) <Ref. to CL-12, INSTALLATION, Flywheel.>

29) Install the clutch disc and cover. (MT model) <Ref. to CL-9, INSTALLATION, Clutch Disc and Cover.>

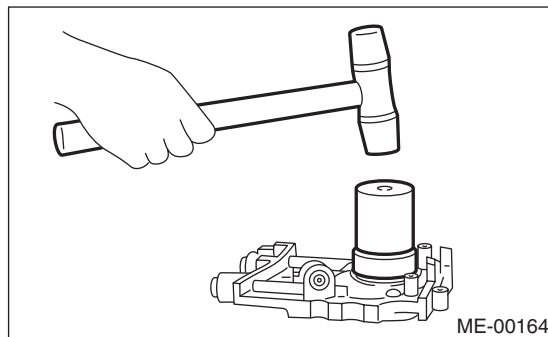
30) Install the drive plate. (AT model) <Ref. to 5AT-68, INSTALLATION, Drive Plate.>

31) Installation of oil pump:

(1) Install the front oil seal by using ST.
ST 499587100 OIL SEAL INSTALLER

NOTE:

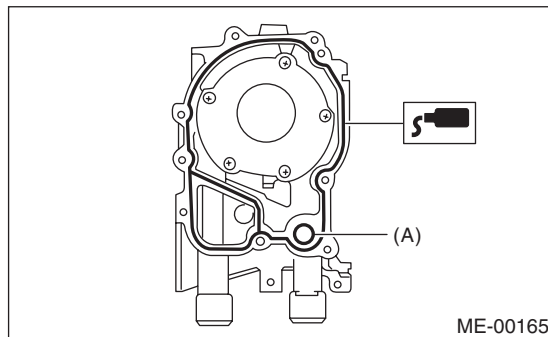
Use a new front oil seal.



(2) Apply liquid gasket to the matching surface of oil pump.

Liquid gasket:

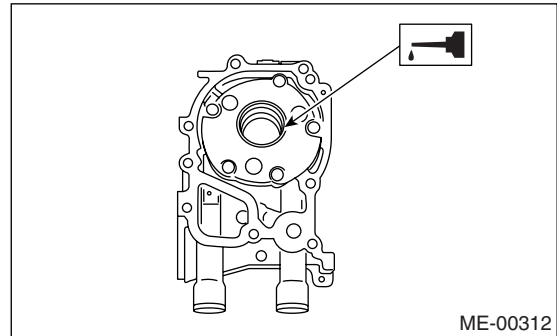
THREE BOND 1215 (Part No. 004403007) or equivalent



(A) O-ring

• When installing the water pump, tighten the bolts in two stages in alphabetical sequence as shown in the figure.

(3) Apply a coat of engine oil to the inside of oil seal.



(4) Install the oil pump on cylinder block. Be careful not to damage the oil seal during installation.

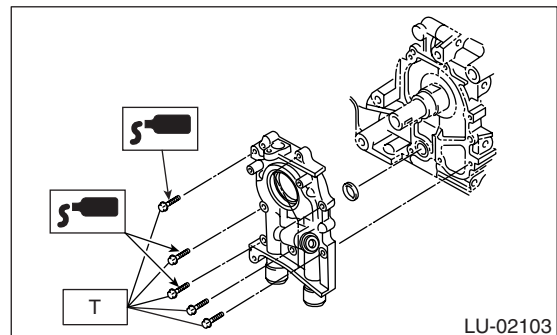
(5) Apply liquid gasket to the threaded portion of three bolts.

Fluid packing:

THREE BOND 1215 (Part No. 004403007) or equivalent

Tightening torque:

6.4 N·m (0.65 kgf-m, 4.7 ft-lb)



CAUTION:

- Do not forget to install the O-ring and seal when installing the oil pump.
- Align the flat surface of oil pump's inner rotor with crankshaft before installation.

32) Install the water pump and gasket.

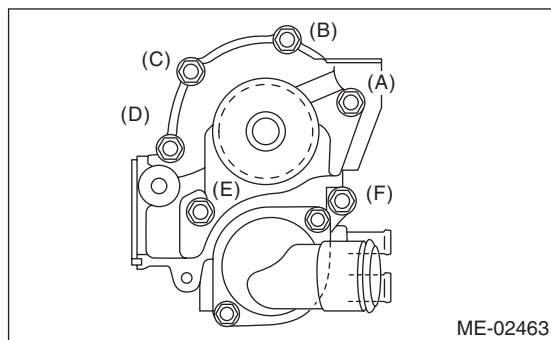
Tightening torque:

First: 12 N·m (1.2 kgf-m, 8.9 ft-lb)

Second: 12 N·m (1.2 kgf-m, 8.9 ft-lb))

CAUTION:

- Be sure to use a new gasket.



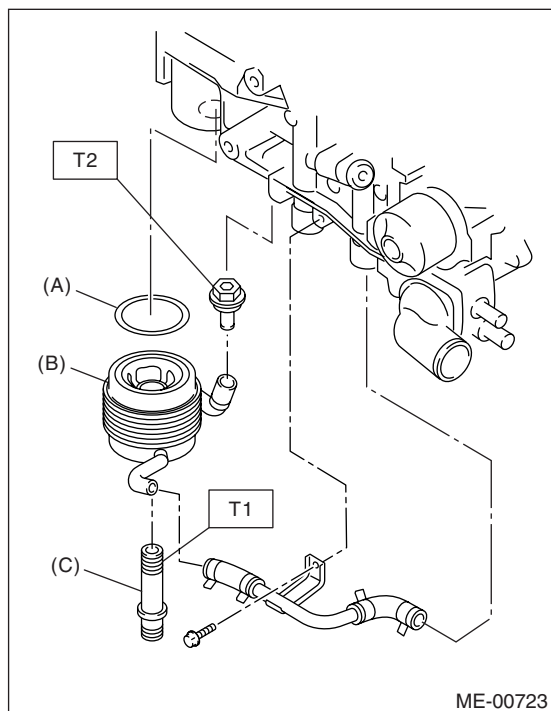
33) Install the water by-pass pipe for heater.

34) Install the oil cooler.

Tightening torque:

T1: 54 N·m (5.5 kgf-m, 40 ft-lb)

T2: 70 N·m (7.1 kgf-m, 50.6 ft-lb)



- (A) O-ring
- (B) Oil cooler
- (C) Oil cooler connector

35) Install the oil filter. <Ref. to LU(H4DOTC)-24, INSTALLATION, Engine Oil Filter.>

36) Install the water by-pass pipe between oil cooler and water pump.

37) Install the water pipe.

NOTE:

Always use new O-rings.

38) Install the cylinder head.

<Ref. to ME(H4DOTC)-57, INSTALLATION, Cylinder Head.>

39) Install the oil level gauge guide. (LH side)

40) Install the rocker cover and rocker cover gasket.

NOTE:

Use a new rocker cover gasket.

41) Install the crank sprocket.

<Ref. to ME(H4DOTC)-51, INSTALLATION, Crank Sprocket.>

42) Install the cam sprocket.

<Ref. to ME(H4DOTC)-50, INSTALLATION, Cam Sprocket.>

43) Install the timing belt.

<Ref. to ME(H4DOTC)-43, INSTALLATION, Timing Belt.>

44) Install the timing belt cover.

<Ref. to ME(H4DOTC)-41, INSTALLATION, Timing Belt Cover.>

45) Install the crank pulley.

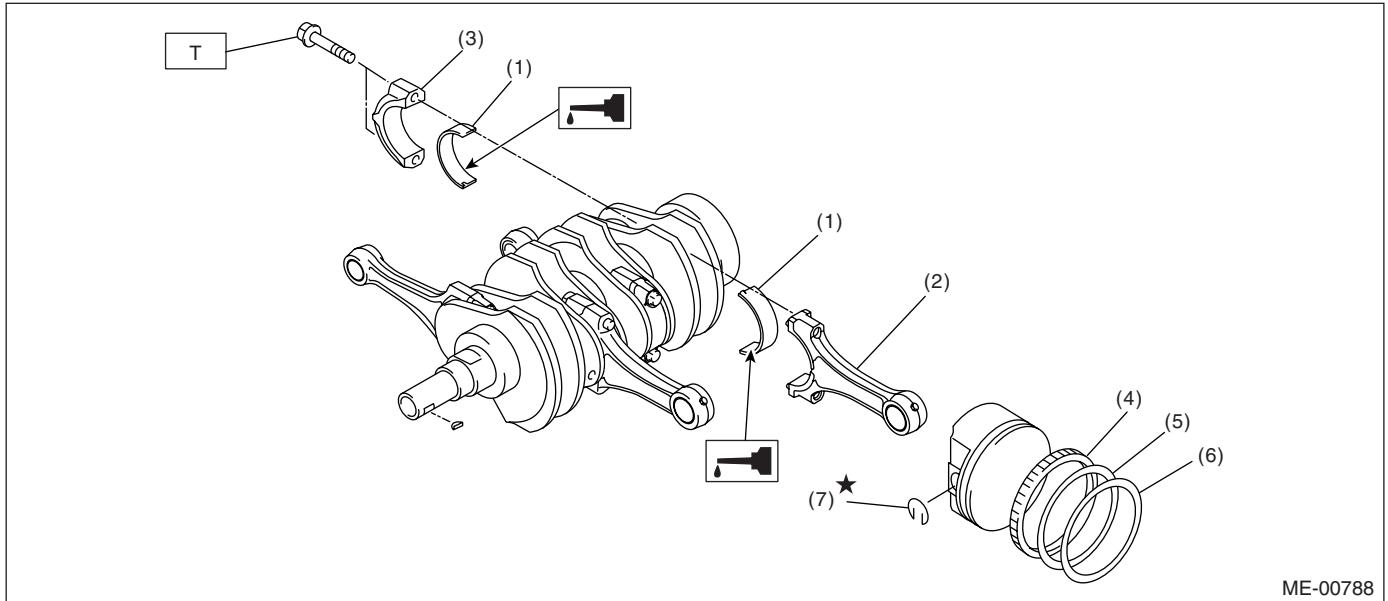
<Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>

46) Install the generator and A/C compressor brackets on cylinder head.

47) Install the V-belts. <Ref. to ME(H4DOTC)-37, INSTALLATION, V-belt.>

48) Install the intake manifold.

<Ref. to FU(H4DOTC)-14, INSTALLATION, Intake Manifold.>

C: DISASSEMBLY

- | | |
|----------------------------|-----------------|
| (1) Connecting rod bearing | (5) Second ring |
| (2) Connecting rod | (6) Top ring |
| (3) Connecting rod cap | (7) Snap ring |
| (4) Oil ring | |

Tightening torque: N·m (kgf-m, ft-lb)

T: 52 (5.3, 38.4)

- 1) Remove the connecting rod cap.
- 2) Remove the connecting rod bearing.

NOTE:

Arrange the removed connecting rod, connecting rod cap and bearing in order to prevent confusion.

3) Remove the piston rings using a piston ring expander.

4) Remove the oil ring by hand.

NOTE:

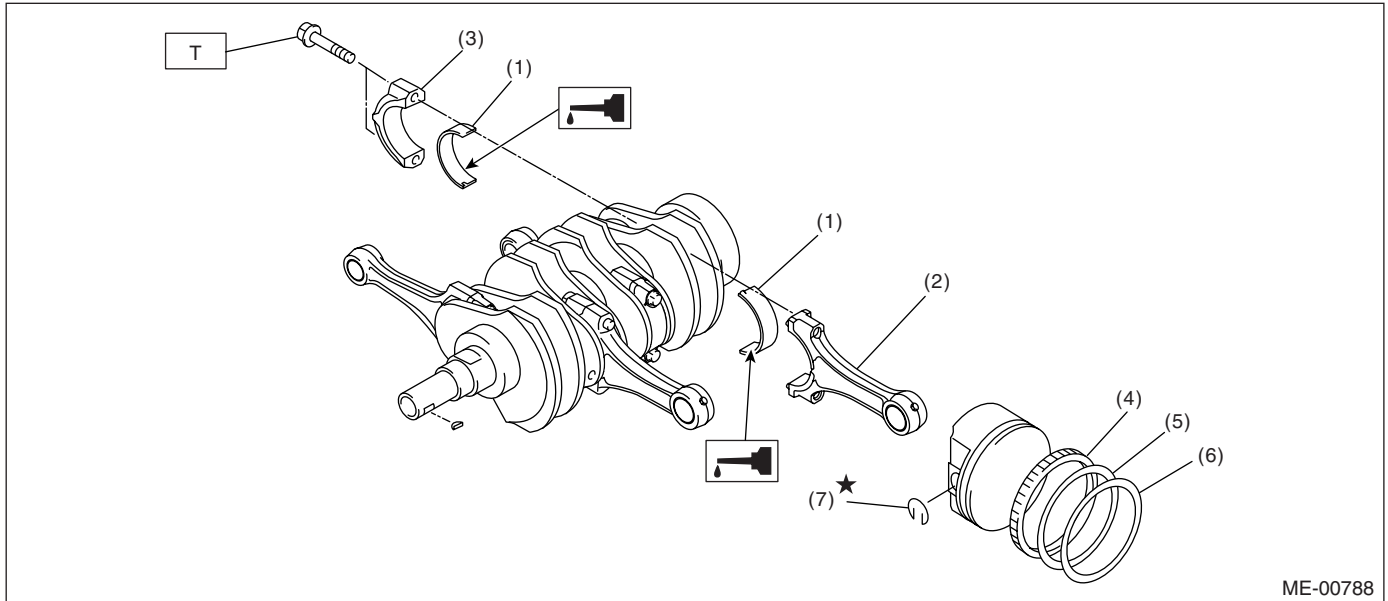
Arrange the removed piston rings in proper order to prevent confusion.

5) Remove the snap ring.

Cylinder Block

MECHANICAL

D: ASSEMBLY



- | | |
|----------------------------|-----------------|
| (1) Connecting rod bearing | (5) Second ring |
| (2) Connecting rod | (6) Top ring |
| (3) Connecting rod cap | (7) Snap ring |
| (4) Oil ring | |

Tightening torque: N·m (kgf-m, ft-lb)
T: 52 (5.3, 38.4)

- 1) Apply oil to the surfaces of the connecting rod bearings. Install the connecting rod bearings on connecting rods and connecting rod caps.
- 2) Install the connecting rod on crankshaft.

NOTE:

Position each connecting rod with the side marked facing forward.

- 3) Install the connecting rod cap.

Ensure the arrow mark on connecting rod cap facing front during installation.

CAUTION:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.
- When tightening the connecting rod nuts, apply oil on the threads.

- 4) Install the oil ring spacer, upper rail and lower rail in this order by hand. Then install the second ring and top ring using a piston ring expander.

E: INSPECTION

1. CYLINDER BLOCK

- 1) Visually check for cracks and damage. Especially, inspect the important parts using liquid penetrant tester.
- 2) Check the oil passages for clogging.
- 3) Inspect the crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

Warping limit:

0.025 mm (0.00098 in)

Grinding limit:

0.1 mm (0.004 in)

Standard height of cylinder block:

201.0 mm (7.91 in)

2. CYLINDER AND PISTON

- 1) The cylinder bore size is stamped on the cylinder block's front upper surface.

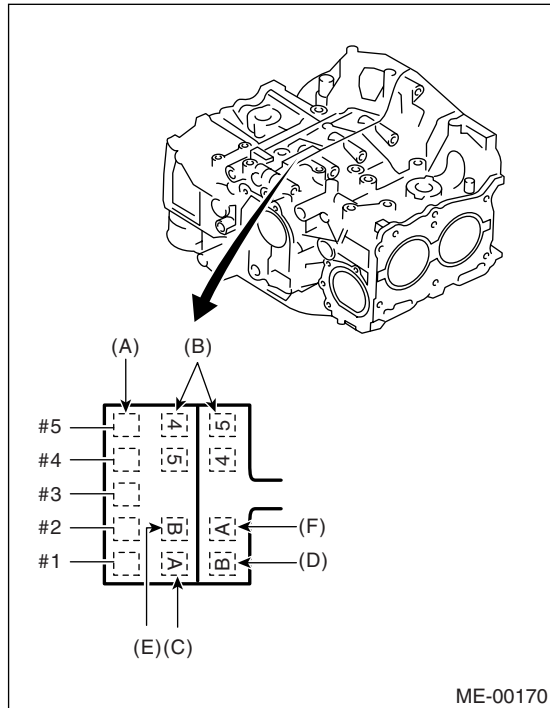
NOTE:

- Measurement should be performed at a temperature of 20°C (68°F).
- Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as guide lines in selecting a standard piston.

Standard diameter:

A: 99.505 — 99.515 mm (3.9175 — 3.9179 in)

B: 99.495 — 99.505 mm (3.9171 — 3.9175 in)



ME-00170

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

2) How to measure the inner diameter of each cylinder:

Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights as shown in the figure, using a cylinder bore gauge.

NOTE:

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

Taper:

Standard

0.015 mm (0.0006 in)

Piston outer diameter:

Standard

A: 99.505 — 99.515 mm (3.9175 — 3.9179 in)

B: 99.495 — 99.505 mm (3.9171 — 3.9175 in)

0.25 mm (0.0098 in) oversize

99.745 — 99.765 mm (3.9270 — 3.9278 in)

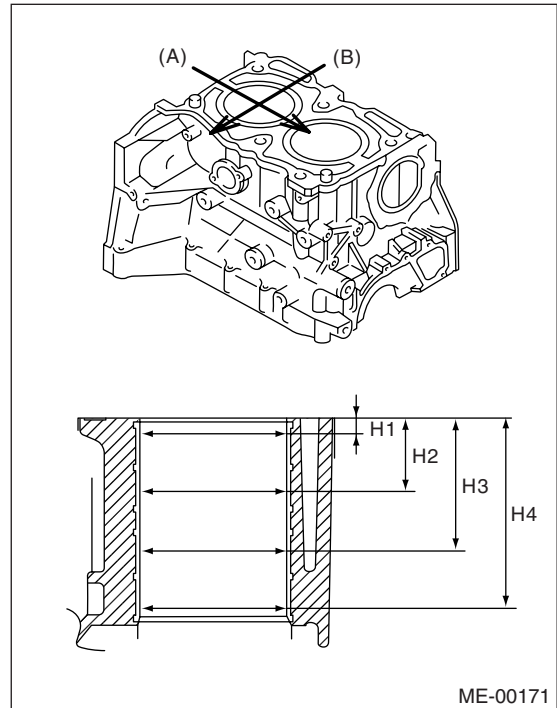
0.50 mm (0.0197 in) oversize

99.995 — 100.015 mm (3.9368 — 3.9376 in)

Out-of-roundness:

Standard

0.010 mm (0.0004 in)



ME-00171

- (A) Piston pin direction
- (B) Thrust direction
- H1: 10 mm (0.39 in)
- H2: 45 mm (1.77 in)
- H3: 80 mm (3.15 in)
- H4: 115 mm (4.53 in)

3) When the piston is to be replaced due to general or cylinder wear, determine a suitable sized piston by measuring the piston clearance.

4) How to measure the outer diameter of each piston:

Measure the outer diameter of each piston at the height as shown in the figure. (Thrust direction)

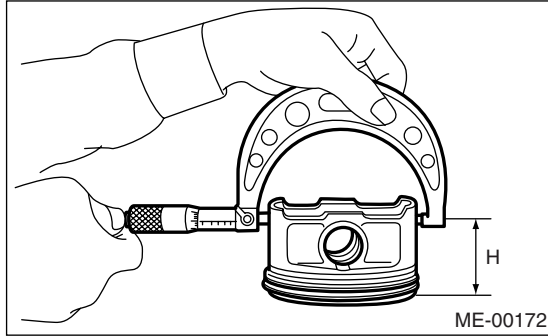
NOTE:

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

Piston grade point H:

38.2 mm (1.50 in)

Cylinder Block



5) Calculate the clearance between cylinder and piston.

NOTE:

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

Cylinder to piston clearance at 20°C (68°F):

Standard

-0.010 — 0.010 mm (-0.00039 — 0.00039 in)

6) Boring and honing:

- (1) If one of the values of taper, out-of-roundness, or cylinder-to-piston clearance exceeds the specified limit or is out of standard, or if there is any damage on the cylinder wall, rebore it to use an oversize piston.

CAUTION:

When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only. Nor use an oversize piston for one cylinder only.

- (2) If the cylinder inner diameter exceeds 100.015 mm (3.9376 in) after boring and honing, replace the crankcase.

NOTE:

Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

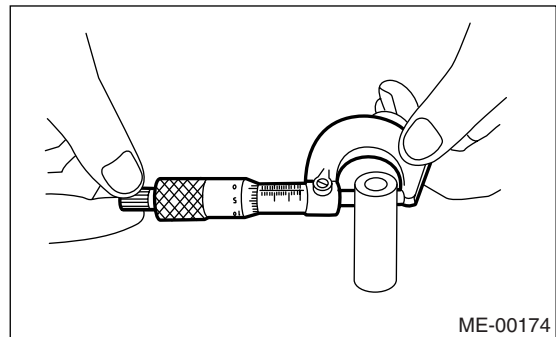
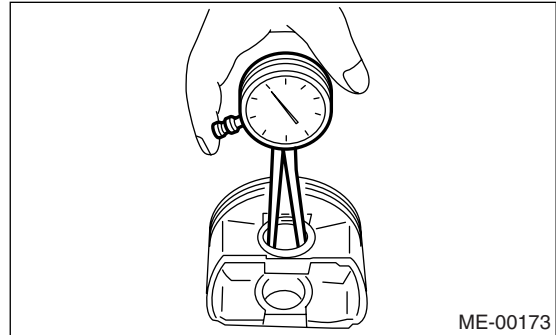
3. PISTON AND PISTON PIN

- 1) Check the pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
- 2) Measure the piston-to-cylinder clearance at each cylinder. <Ref. to ME(H4DOTC)-76, CYLINDER AND PISTON, INSPECTION, Cylinder Block.> If any of the clearances is out of specification, replace the piston or bore the cylinder to use an oversize piston.
- 3) Make sure that the piston pin can be inserted into the piston pin hole with your thumb at 20°C (68°F). Replace if defective.

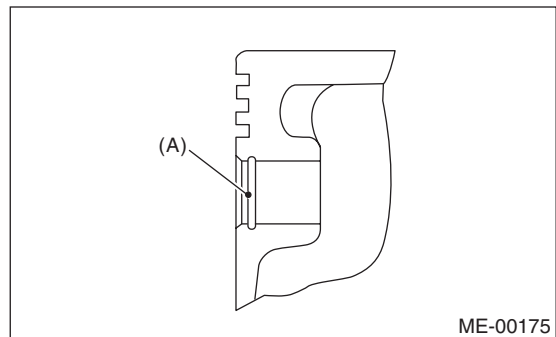
Standard clearance between piston pin and hole in piston:

Standard

0.004 — 0.008 mm (0.0002 — 0.0003 in)



4) Check the snap ring installation groove on the piston for burr (A). If necessary, remove burr from the groove so that the piston pin can lightly move.



5) Check the piston pin snap ring for distortion, cracks and wear.

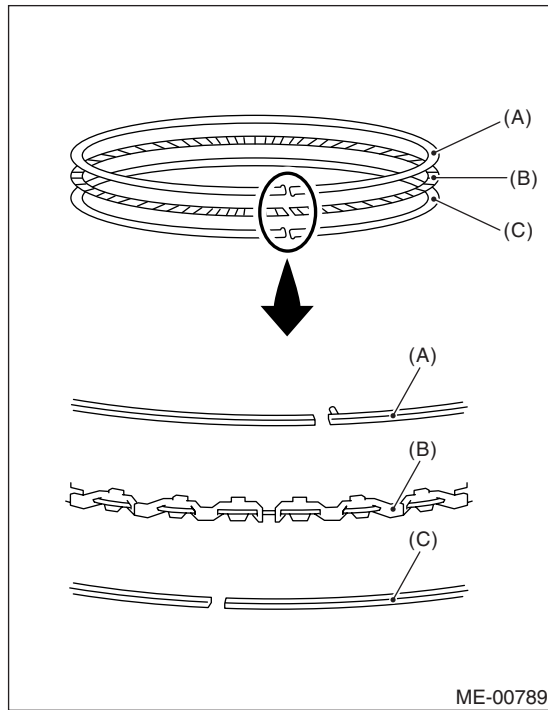
4. PISTON RING

- 1) If the piston ring is broken, damaged or worn, or if its tension is insufficient, or when the piston is replaced, replace the piston ring with a new one of the same size as the piston.

CAUTION:

• Marks are displayed on the end of top and second rings. When installing the rings to the piston, face those marks upward.

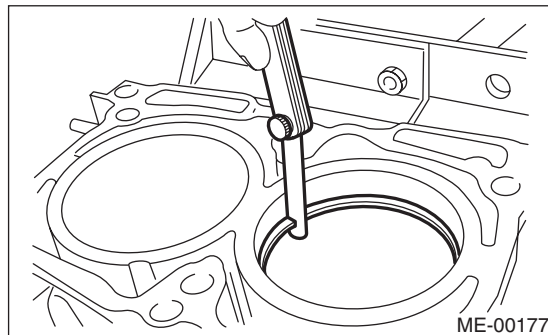
- Oil ring consists of the upper rail, expander and lower rail. When installing on piston, be careful of each rail's direction.



- (A) Upper rail
(B) Expander
(C) Lower rail

2) Squarely place the piston ring and oil ring in cylinder, and measure the piston ring gap with a thickness gauge.

Standard mm (in)		
Piston ring gap	Top ring	0.20 — 0.25 (0.0079 — 0.0098)
	Second ring	0.37 — 0.52 (0.015 — 0.020)
	Oil ring rail	0.20 — 0.50 (0.0079 — 0.0197)

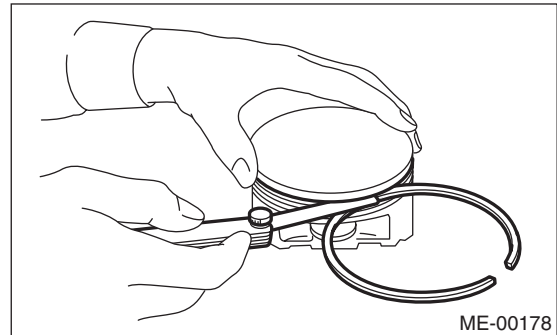


3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

NOTE:

Before measuring the clearance, clean the piston ring groove and piston ring.

Standard mm (in)		
Clearance between piston ring and pis- ton ring groove	Top ring	0.040 — 0.080 (0.0016 — 0.0031)
	Second ring	0.030 — 0.070 (0.0012 — 0.0028)

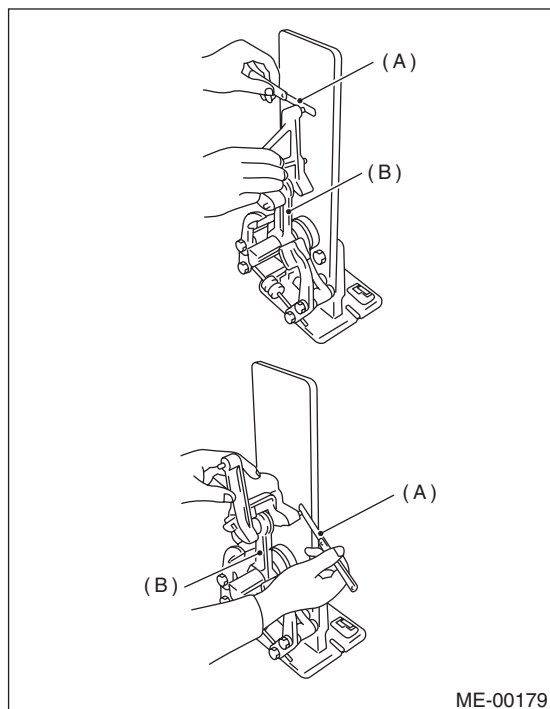


5. CONNECTING ROD

- 1) Replace the connecting rod, if the large or small end thrust surface is damaged.
- 2) Check for bend or twist using a connecting rod aligner. Replace the connecting rod if the bend or twist exceeds the limit.

Cylinder Block

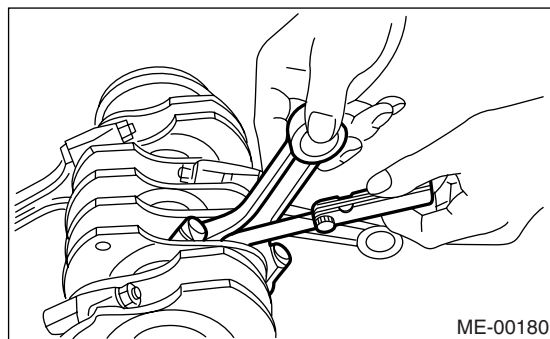
Limit of bend or twist per 100 mm (3.94 in) in length:
0.10 mm (0.0039 in)



(A) Thickness gauge
 (B) Connecting rod

3) Install the connecting rod fitted with bearing to crankshaft and measure the side clearance (thrust clearance). If side clearance exceeds the limit or has partial wear, replace the connecting rod.

Connecting rod side clearance:
Standard
0.070 — 0.330 mm (0.0028 — 0.0130 in)



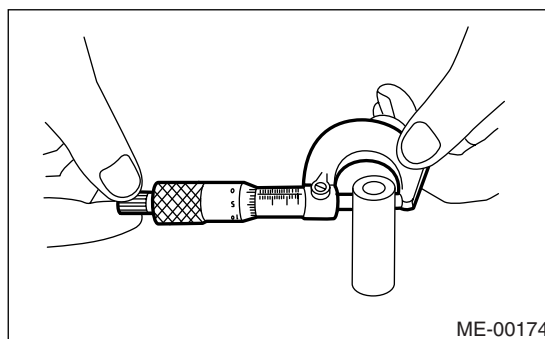
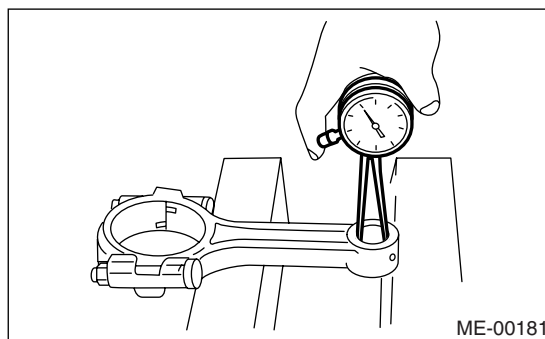
4) Inspect the connecting rod bearing for scar, peeling, seizure, melting, wear, etc.
 5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge. If any oil clearance is not within the specification, replace the defective bearing with a new one of standard size or undersize as necessary. (See the table below.)

Connecting rod oil clearance:
Standard
0.017 — 0.045 mm (0.0007 — 0.0018 in)

Unit: mm (in)		
Bearings	Bearing size (Thickness at center)	Outer diameter of crank pin
Standard	1.490 — 1.502 (0.0587 — 0.0591)	51.984 — 52.000 (2.0466 — 2.0472)
0.03 (0.0012) undersize	1.504 — 1.512 (0.0592 — 0.0595)	51.954 — 51.970 (2.0454 — 2.0461)
0.05 (0.0020) undersize	1.514 — 1.522 (0.0596 — 0.0599)	51.934 — 51.950 (2.0447 — 2.0453)
0.25 (0.0098) undersize	1.614 — 1.622 (0.0635 — 0.0639)	51.734 — 51.750 (2.0368 — 2.0374)

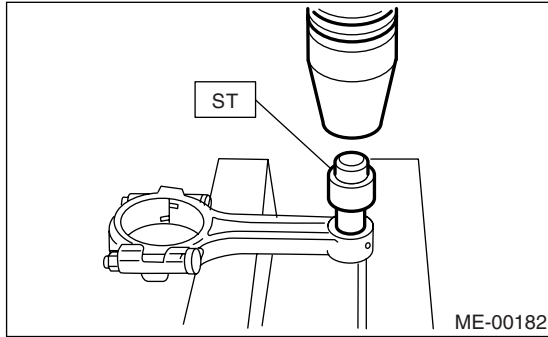
6) Inspect the bushing at connecting rod small end, and replace if worn or damaged. Also measure the piston pin clearance at the connecting rod small end.

Clearance between piston pin and bushing:
Standard
0 — 0.022 mm (0 — 0.0009 in)



7) Replacement procedure is as follows.
 (1) Remove the bushing from connecting rod with ST and press.
 (2) Press the bushing with ST after applying oil on the periphery of bushing.

ST 499037100 CONNECTING ROD BUSH-
ING REMOVER AND IN-
STALLER



- (3) Make two 3 mm (0.12 in) holes in bushing. Ream the inside of bushing.
- (4) After completion of reaming, clean the bushing to remove chips.

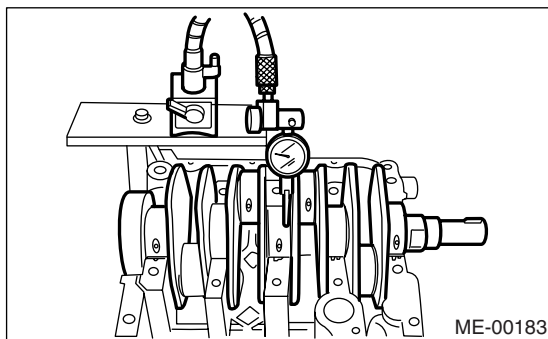
6. CRANKSHAFT AND CRANKSHAFT BEARING

- 1) Clean the crankshaft completely, and check it for cracks using liquid penetrant tester. Replace if defective.
- 2) Measure the bend of crankshaft. If it exceeds the limit, repair or replace it.

NOTE:

If a suitable V-block is not available, install #1 and #5 crankshaft bearing on cylinder block, position the crankshaft on these bearings, and then measure the crankshaft bend using a dial gauge.

Crankshaft bend limit:
0.035 mm (0.0014 in)



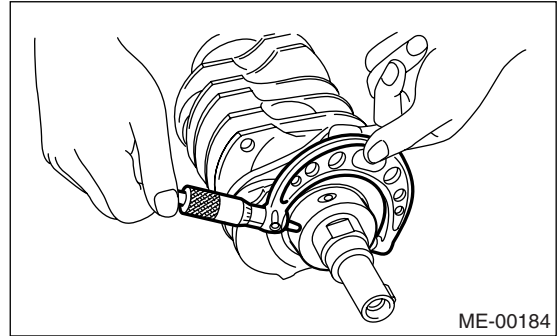
- 3) Inspect the crank journal and crank pin for wear. If they are not within the specifications, replace the bearing with a suitable (undersize) one, and replace or recondition crankshaft as necessary. When grinding the crank journal or crank pin, finish them to the specified dimensions according to the undersize bearing to be used.

Crank pin:

Out-of-roundness
0.003 mm (0.0001 in)
Cylindricity
0.004 mm (0.0002 in)
Grinding limit (dia)
To 51.750 mm (2.0374 in)

Crank journal:

Out-of-roundness
0.005 mm (0.0002 in)
Cylindricity
0.006 mm (0.0002 in)
Grinding limit (dia)
To 59.750 mm (2.3524 in)



Cylinder Block

MECHANICAL

Unit: mm (in)				
		Crank journal diameter		Crank pin diameter
		#1, #3	#2, #4, #5	
Standard	Journal O.D.	59.992 — 60.008 (2.3619 — 2.3625)	59.992 — 60.008 (2.3619 — 2.3625)	51.984 — 52.000 (2.0466 — 2.0472)
	Bearing size (Thickness at center)	1.998 — 2.011 (0.0787 — 0.0792)	2.000 — 2.013 (0.0787 — 0.0793)	1.486 — 1.498 (0.0585 — 0.0590)
0.03 (0.0012) undersize	Journal O.D.	59.962 — 59.978 (2.3607 — 2.3613)	59.962 — 59.978 (2.3607 — 2.3613)	51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.022 (0.0795 — 0.0796)	1.504 — 1.512 (0.0592 — 0.0595)
0.05 (0.0020) undersize	Journal O.D.	59.942 — 59.958 (2.3599 — 2.3605)	59.942 — 59.958 (2.3599 — 2.3605)	51.934 — 51.950 (2.0447 — 2.0453)
	Bearing size (Thickness at center)	2.027 — 2.030 (0.0798 — 0.0799)	2.029 — 2.032 (0.0799 — 0.0800)	1.514 — 1.522 (0.0596 — 0.0599)
0.25 (0.0098) undersize	Journal O.D.	59.742 — 59.758 (2.3520 — 2.3527)	59.742 — 59.758 (2.3520 — 2.3527)	51.734 — 51.750 (2.0368 — 2.0374)
	Bearing size (Thickness at center)	2.127 — 2.130 (0.0837 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	1.614 — 1.622 (0.0635 — 0.0639)

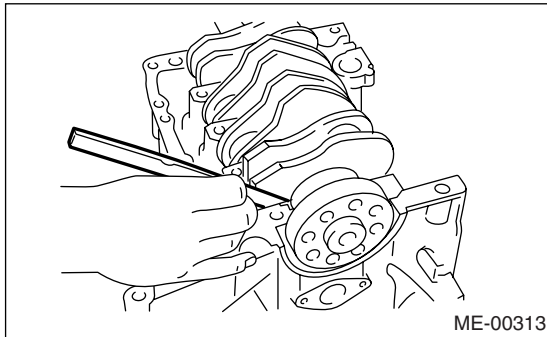
O.D. : Outer Diameter

4) Measure the thrust clearance of crankshaft at center bearing. If clearance exceeds the limit, replace the bearing.

Crankshaft side clearance:

Standard

0.030 — 0.115 mm (0.0012 — 0.0045 in)



5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.

6) Measure the oil clearance on each crankshaft bearing by means of plastigauge. If the measurement is not within the specification, replace the defective bearing with an undersize one, and replace or recondition the crankshaft as necessary.

Crankshaft oil clearance:

Standard

0.010 — 0.030 mm (0.0004 — 0.0012 in)

21.Intake and Exhaust Valve

A: SPECIFICATION

Refer to “Cylinder Head” for removal and installation procedures of intake and exhaust valves. <Ref. to ME(H4DOTC)-57, REMOVAL, Cylinder Head.>
<Ref. to ME(H4DOTC)-57, INSTALLATION, Cylinder Head.>

22.Piston

A: SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of pistons. <Ref. to ME(H4DOTC)-64, REMOVAL, Cylinder Block.> <Ref. to ME(H4DOTC)-67, INSTALLATION, Cylinder Block.>

23.Connecting Rod

A: SPECIFICATION

Refer to "Cylinder Block" for removal and installation procedures of connecting rod. <Ref. to ME(H4DOTC)-64, REMOVAL, Cylinder Block.>
<Ref. to ME(H4DOTC)-67, INSTALLATION, Cylinder Block.>

24.Crankshaft

A: SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of crankshaft. <Ref. to ME(H4DOTC)-64, REMOVAL, Cylinder Block.>
<Ref. to ME(H4DOTC)-67, INSTALLATION, Cylinder Block.>

25.Engine Trouble in General

A: INSPECTION

NOTE:

“RANK” shown in the chart refers to the possibility of the cause of trouble in order (“Very often” to “Rarely”)

A — Very often

B — Sometimes

C — Rarely

Symptom	Problem parts, etc.	Possible cause	RANK
1. Engine does not start.			
1) Starter does not turn.	Starter	Defective battery-to-starter harness	B
		Defective ignition starter switch	C
		Defective inhibitor switch or neutral switch	C
		Defective starter	B
	Battery	Poor terminal connection	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
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
		Lack of or insufficient fuel	B
	Belt	Trouble	B
		Defective timing	B
	Compression	Incorrect valve clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective 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
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 or insufficient fuel	B
	Belt	Trouble	B
		Defective timing	B
	Compression	Incorrect valve clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective 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

Symptom	Problem parts, etc.	Possible cause	RANK
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 or insufficient fuel	B
	Belt	Trouble	B
		Defective timing	B
	Compression	Incorrect valve clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective 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
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 or insufficient fuel	B
	Belt	Defective timing	C
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective 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

Symptom	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 or insufficient fuel	C
	Belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective 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
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 or insufficient fuel	C
	Belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective 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

Engine Trouble in General

MECHANICAL

Symptom	Problem parts, etc.	Possible cause	RANK
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
	Belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective 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
8. Knocking	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Loosened oil filler cap	B
	Belt	Defective timing	B
	Compression	Incorrect valve 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 oil pump attaching bolts and defective gasket	B
		Defective oil filter O-ring	B
		Defective crankshaft oil seal	B
		Defective rocker cover gasket	B
		Loosened oil drain plug or defective gasket	B
		Loosened oil pan fitting bolts or defective oil pan	B

Engine Trouble in General

MECHANICAL

Symptom	Problem parts, etc.	Possible cause	RANK
10. Excessive fuel consumption	Engine control system <Ref. to EN(H4DOTC)(diag)-2, Basic Diagnostic Procedure.>		A
	Intake system	Dirty air cleaner element	A
	Belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective 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

26.Engine Noise

A: INSPECTION

Type of sound	Condition	Possible cause
Regular clicking sound	Sound increases as engine speed increases.	- Valve mechanism is defective. - Incorrect valve clearance - Worn camshaft - Broken valve spring
Heavy and dull clank	Oil pressure is low.	- Worn crankshaft main bearing - Worn connecting rod bearing (large end)
	Oil pressure is normal.	- Loose flywheel mounting bolts - Damaged engine mounting
High-pitched clank	Sound is noticeable when accelerating with an overload.	- Ignition timing advanced - Accumulation of carbon inside combustion chamber - Wrong spark plug - Improper gasoline
Clank when engine speed is 1,000 to 2,000 rpm	Sound is reduced when fuel injector connector of noisy cylinder is disconnected. (NOTE*)	- Worn crankshaft main bearing - Worn bearing at crankshaft end of connecting rod
Knocking sound when engine is operating under idling speed and engine is warm	Sound is reduced when fuel injector connector of noisy cylinder is disconnected. (NOTE*)	- Worn cylinder liner and piston ring - Broken or stuck piston ring - Worn piston pin and hole at piston end of connecting rod
	Sound is not reduced if each fuel injector connector is disconnected in turn. (NOTE*)	- Unusually worn valve lifter - Worn cam sprocket - Worn camshaft journal bore in crankcase
Squeaky sound	—	Insufficient generator lubrication
Rubbing sound	—	Defective generator brush and rotor contact
Gear scream when starting engine	—	- Defective ignition starter switch - Worn gear and starter pinion
Sound like polishing glass with a dry cloth	—	- Loose drive belt - Defective water pump shaft
Hissing sound	—	- Loss of compression - Air leakage in air intake system, hoses, connections or manifolds
Timing belt noise	—	- Loose timing belt - Belt contacting case/adjacent part
Valve tappet noise	—	Incorrect valve clearance

NOTE*:

When disconnecting the fuel injector connector, the malfunction indicator light illuminates and DTC is stored in ECM memory. Therefore, carry out the clear memory mode <Ref. to EN(H4DOTC)(diag)-45, OPERATION, Clear Memory Mode.> and inspection mode <Ref. to EN(H4DOTC)(diag)-36, PROCEDURE, Inspection Mode.> after connecting the fuel injector connector.