1. General Description

A: SPECIFICATION

Engine	Model			2.5 L
	Cylinder arrangement			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine
	Valve system mechanism			Belt driven, single overhead camshaft, 4 valve/cylinder
	Bore × Stroke mm (in)			99.5 × 79.0 (3.92 × 3.11)
	Displacement cm^3 (cu in)			2,457 (149.94)
	Compression ratio			10.0
	Compression pressure (at 200 — 300 rpm) kPa (kg/cm^2, psi)			1,020 — 1,275 (10.4 — 13.0, 148 — 185)
	Number of piston rings			Pressure ring: 2, Oil ring: 1
	Intake valve timing	Constant	Open	BTDC 0°
			Close	ABDC 58°
		Low speed	Open	BTDC 0°
			Close	ABDC –10°
		High speed	Open	BTDC 14°
			Close	ABDC 62°
	Exhaust valve timing		Open	BBDC30°
			Close	ATDC14°
	Valve clearance mm (in)		Intake	0.20±0.04 (0.0079±0.0016)
			Exhaust	0.25±0.04 (0.0098±0.0016)
	Idling speed (at “P” or “N” position on AT model, or neutral position on MT model) rpm		No load	AT model: 700±100
				MT model: 650±100
			A/C ON	850±100
	Ignition order			1 → 3 → 2 → 4
	Ignition timing BTDC/rpm			AT model: 15°±10°/700
				MT model: 10°±8°/650

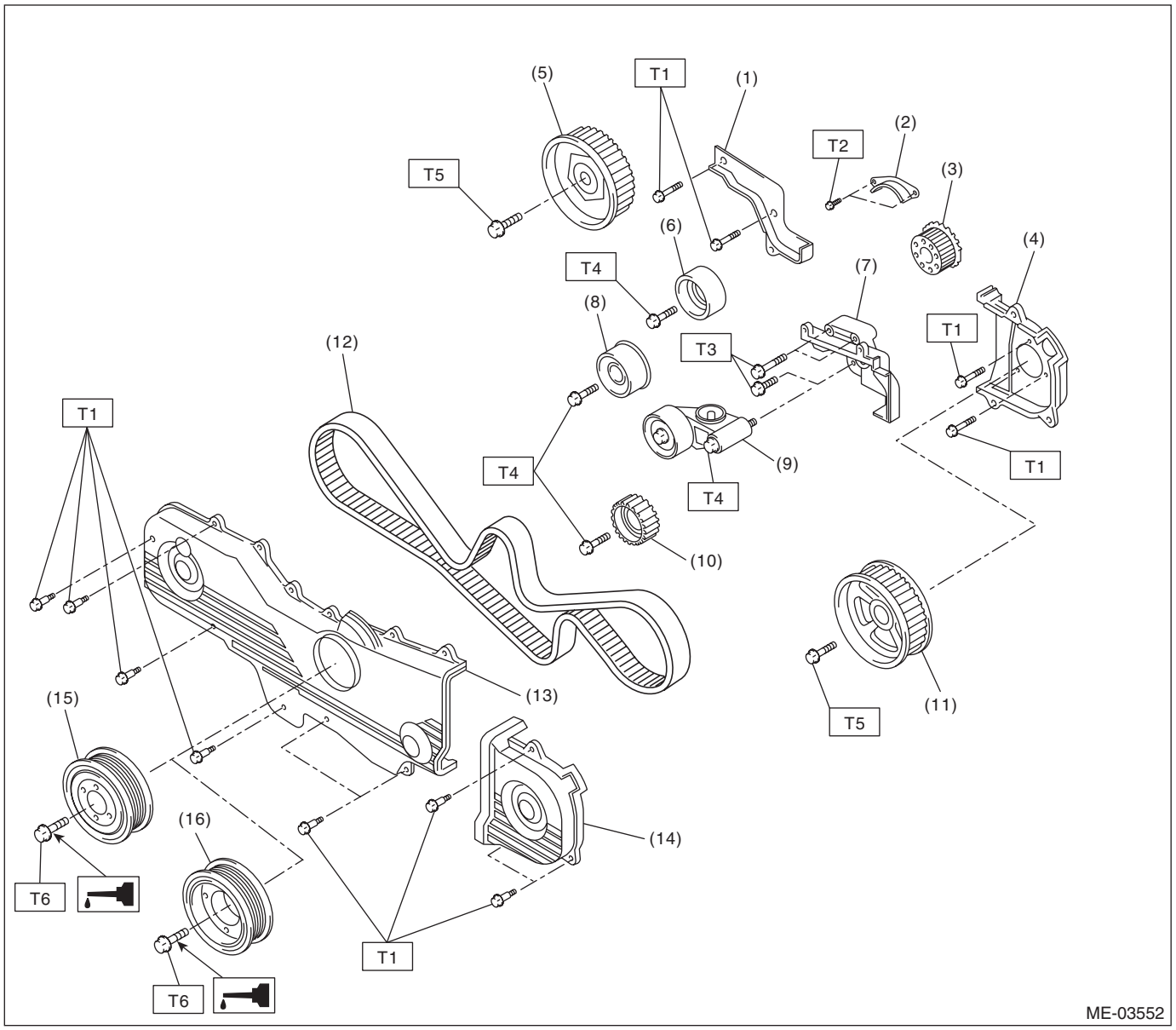
NOTE:
US: Undersize OS: Oversize

Belt tension adjuster	Protrusion of adjuster rod			mm (in)	5.2 — 6.2 (0.205 — 0.244)
Valve rocker arm	Clearance between shaft and arm			mm (in) Standard	0.020 — 0.054 (0.0008 — 0.0021)
Camshaft	Bending limit			mm (in)	0.025 (0.00098)
	Cam lobe height mm (in)	Intake	Constant	Standard	40.075 — 40.175 (1.5778 — 1.5817)
			Low speed	Standard	35.496 — 35.596 (1.3975 — 1.4014)
			High speed	Standard	40.315 — 40.415 (1.5872 — 1.5911)
		Exhaust		Standard	39.289 — 39.389 (1.5468 — 1.5507)
	Cam base circle diameter			mm (in) Standard	34.00 (1.3386)
	Base circle step of adjacent intake cams (low speed and high speed)			mm (in) Standard	0.03 (0.001)
	Journal O.D.			mm (in)	31.928 — 31.945 (1.2570 — 1.2577)
	Cylinder head journal I.D.			mm (in)	32.000 — 32.018 (1.2598 — 1.2605)
	Thrust clearance			mm (in) Standard	0.030 — 0.090 (0.0012 — 0.0035)
	Oil clearance			mm (in) Standard	0.055 — 0.090 (0.0022 — 0.0035)
Cylinder head	Warping limit (Mating surface with cylinder block)			mm (in)	0.035 (0.0014)
	Grinding limit			mm (in)	0.1 (0.004)
	Standard height			mm (in)	97.5 (3.84)
Valve seat	Seating angle between valve and valve seat				90°
	Contacting width between valve and valve seat mm (in)		Standard	Intake	0.8 — 1.4 (0.03 — 0.055)
				Exhaust	1.2 — 1.8 (0.047 — 0.071)
Valve guide	Clearance between the valve guide and valve stem mm (in)		Standard	Intake	0.035 — 0.062 (0.0014 — 0.0024)
				Exhaust	0.040 — 0.067 (0.0016 — 0.0026)
	Inside diameter			mm (in)	6.000 — 6.012 (0.2362 — 0.2367)
	Valve stem outer diameters			mm (in) Intake	5.950 — 5.965 (0.2343 — 0.2348)
				Exhaust	5.945 — 5.960 (0.2341 — 0.2346)
	Valve guide protrusion			mm (in) Intake	20.0 — 21.0 (0.787 — 0.827)
				Exhaust	16.5 — 17.5 (0.650 — 0.689)
Valve	Head edge thickness mm (in)		Standard	Intake	0.8 — 1.2 (0.03 — 0.047)
				Exhaust	1.0 — 1.4 (0.039 — 0.055)
	Overall length			mm (in) Intake	120.6 (4.75)
				Exhaust	121.7 (4.79)
Valve spring	Free length			mm (in)	55.2 (2.173)
	Tension/spring height N (kgf, lb)/mm (in)			Set	235.3 — 270.7 (24 — 27.6, 52.9 — 60.8)/45.0 (1.772)
				Lift	578.9 — 639.9 (59.1 — 65.3, 130.3 — 143.9)/ 34.7 (1.366)
	Squareness				2.5°, 2.4 mm (0.094 in) or less
Cylinder block	Warping limit (Mating surface with cylinder head)			mm (in)	0.025 (0.00098)
	Grinding limit			mm (in)	0.1 (0.004)
	Standard height			mm (in)	201.0 (7.91)
	Taper			mm (in) Standard	0.015 (0.0006)
	Out-of-roundness			mm (in) Standard	0.010 (0.0004)
	Cylinder to piston clearance at 20°C (68°F)			mm (in) Standard	–0.010 — 0.010 (–0.00039 — 0.00039)
	Cylinder inner diameter boring limit (diameter)			mm (in)	To 100.005 (3.9372)

Piston	Piston grade point mm (in)			38.2 (1.504)
	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 — 3.9277)
		0.50 (0.0197) OS		99.995 — 100.015 (3.9368 — 3.9376)
Piston pin	Degree of fit			Piston pin must be fitted into position with thumb at 20°C (68°F).
	Clearance between piston hole and piston pin mm (in)		Standard	0.004 — 0.008 (0.0002 — 0.0003)
Piston ring	Piston ring gap mm (in)	Top ring	Standard	0.20 — 0.35 (0.0079 — 0.0138)
		Second ring	Standard	0.37 — 0.52 (0.0146 — 0.0205)
		Oil ring	Standard	0.20 — 0.50 (0.0079 — 0.0197)
	Clearance between piston ring and piston ring groove mm (in)	Top ring	Standard	0.040 — 0.080 (0.0016 — 0.0031)
		Second ring	Standard	0.030 — 0.070 (0.0012 — 0.0028)
Connecting rod and connecting rod bearing	Bend or twist per 100 mm (3.94 in) in length mm (in)		Service limit	0.10 (0.0039)
	Thrust clearance mm (in)		Standard	0.070 — 0.330 (0.0028 — 0.0130)
	Oil clearance mm (in)	Standard		0.016 — 0.044 (0.0006 — 0.0017)
	Bearing size (Thickness at center) mm (in)	Standard		1.492 — 1.501 (0.0587 — 0.0591)
		0.03 (0.0012) US		1.510 — 1.513 (0.0594 — 0.0596)
		0.05 (0.0020) US		1.520 — 1.523 (0.0598 — 0.0600)
		0.25 (0.0098) US		1.620 — 1.623 (0.0638 — 0.0639)
Bushing of small end	Clearance between piston pin and bushing mm (in)		Standard	0 — 0.022 (0 — 0.0009)
Crankshaft and crankshaft bearing	Bending limit mm (in)			0.035 (0.0014)
	Crank pin	Out-of-roundness mm (in)		0.003 (0.0001)
		Cylindricality 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)
		Cylindricality mm (in)		0.006 (0.0002)
		Grinding limit (dia.) mm (in)		To 59.758 (2.3527)
	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 (2.0446 — 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)
	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)
	Thrust clearance mm (in)	Standard		0.030 — 0.115 (0.0012 — 0.0045)
	Oil clearance mm (in)	Standard		0.010 — 0.030 (0.0004 — 0.0012)

B: COMPONENT

1. TIMING BELT

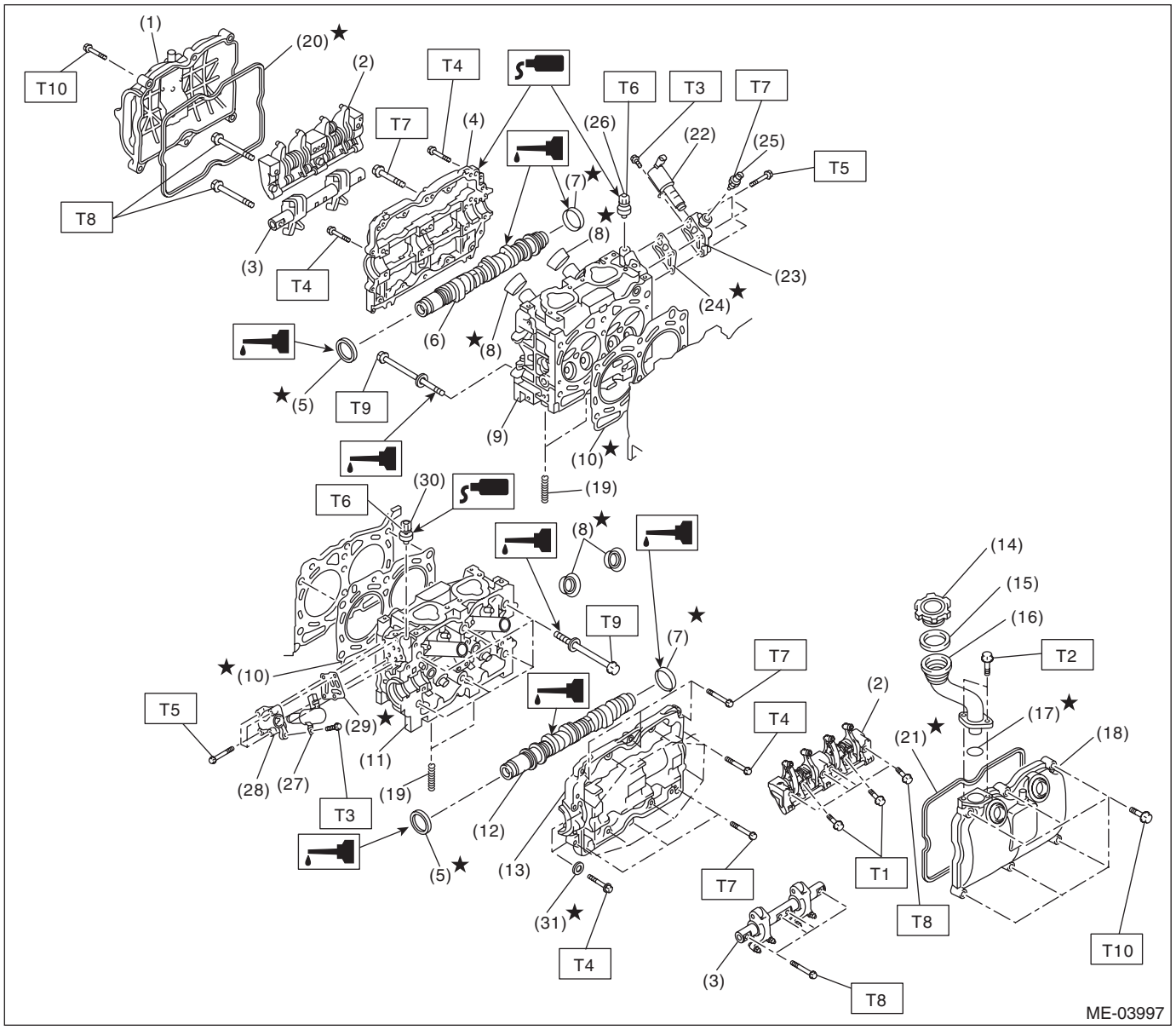


(1)	Timing belt cover No. 2 RH	(9)	Automatic belt tension adjuster ASSY
(2)	Timing belt guide (MT model)	(10)	Belt idler No. 2
(3)	Crank sprocket	(11)	Cam sprocket No. 2
(4)	Timing belt cover No. 2 LH	(12)	Timing belt
(5)	Cam sprocket No. 1	(13)	Front timing belt cover
(6)	Belt idler (A)	(14)	Timing belt cover LH
(7)	Tensioner bracket	(15)	Crank pulley (MT model)
(8)	Belt idler (B)	(16)	Crank pulley (AT model)

Tightening torque: N·m (kgf-m, ft-lb)

- ***T1: 5 (0.5, 3.7)***
- ***T2: 9.75 (1.0, 7.2)***
- ***T3: 24.5 (2.5, 18.1)***
- ***T4: 39 (4.0, 28.8)***
- ***T5: 78 (8.0, 57.5)***
- ***T6: <Ref. to ME(H4SO)-46, INSTALLATION, Crank Pulley.>***

2. CYLINDER HEAD AND CAMSHAFT

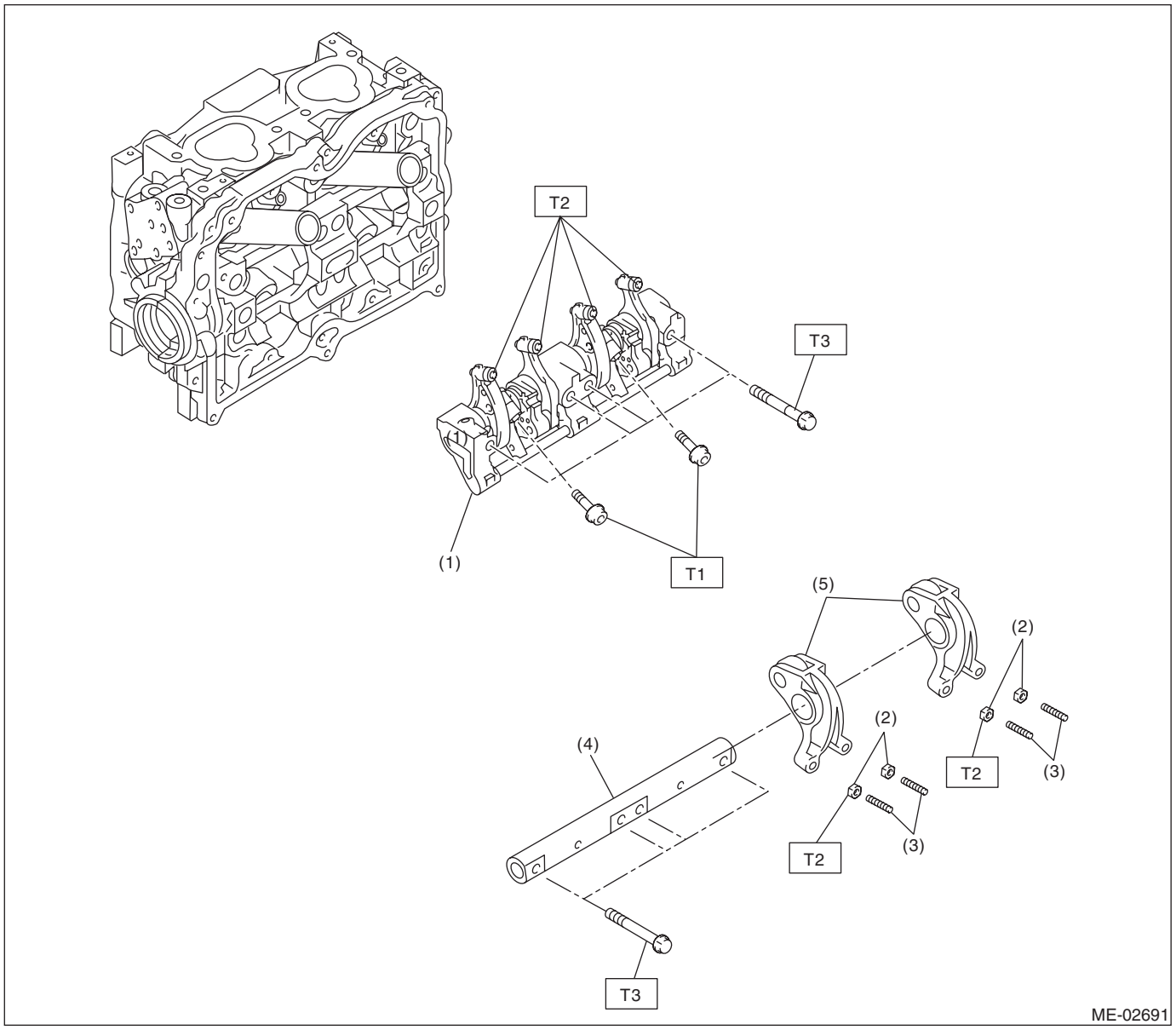


(1) Rocker cover RH
(2) Intake valve rocker ASSY
(3) Exhaust valve rocker ASSY
(4) Camshaft cap RH
(5) Oil seal
(6) Camshaft RH
(7) Plug
(8) Spark plug pipe gasket
(9) Cylinder head RH
(10) Cylinder head gasket
(11) Cylinder head LH
(12) Camshaft LH
(13) Camshaft cap LH
(14) Oil filler cap
(15) Gasket
(16) Oil filler duct
(17) O-ring
(18) Rocker cover LH
(19) Stud bolt
(20) Rocker cover gasket RH
(21) Rocker cover gasket LH
(22) Oil switching solenoid valve RH
(23) Oil switching solenoid valve holder RH
(24) Gasket
(25) Oil temperature sensor
(26) Variable valve lift diagnosis oil pressure switch RH
(27) Oil switching solenoid valve LH
(28) Oil switching solenoid valve holder LH
(29) Gasket
(30) Variable valve lift diagnosis oil pressure switch LH
(31) Seal washer

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6 (0.6, 4.4)
T2: 6.4 (0.7, 4.7)
T3: 8 (0.8, 5.9)
T4: 9.75 (1.0, 7.2)
T5: 10 (1.0, 7.4)
T6: 17 (1.7, 12.5)
T7: 18 (1.8, 13.3)
T8: 25 (2.5, 18.4)
T9: <Ref. to ME(H4SO)-64, INSTALLATION, Cylinder Head.>
T10: <Ref. to ME(H4SO)-56, INSTALLATION, Valve Rocker Assembly.>

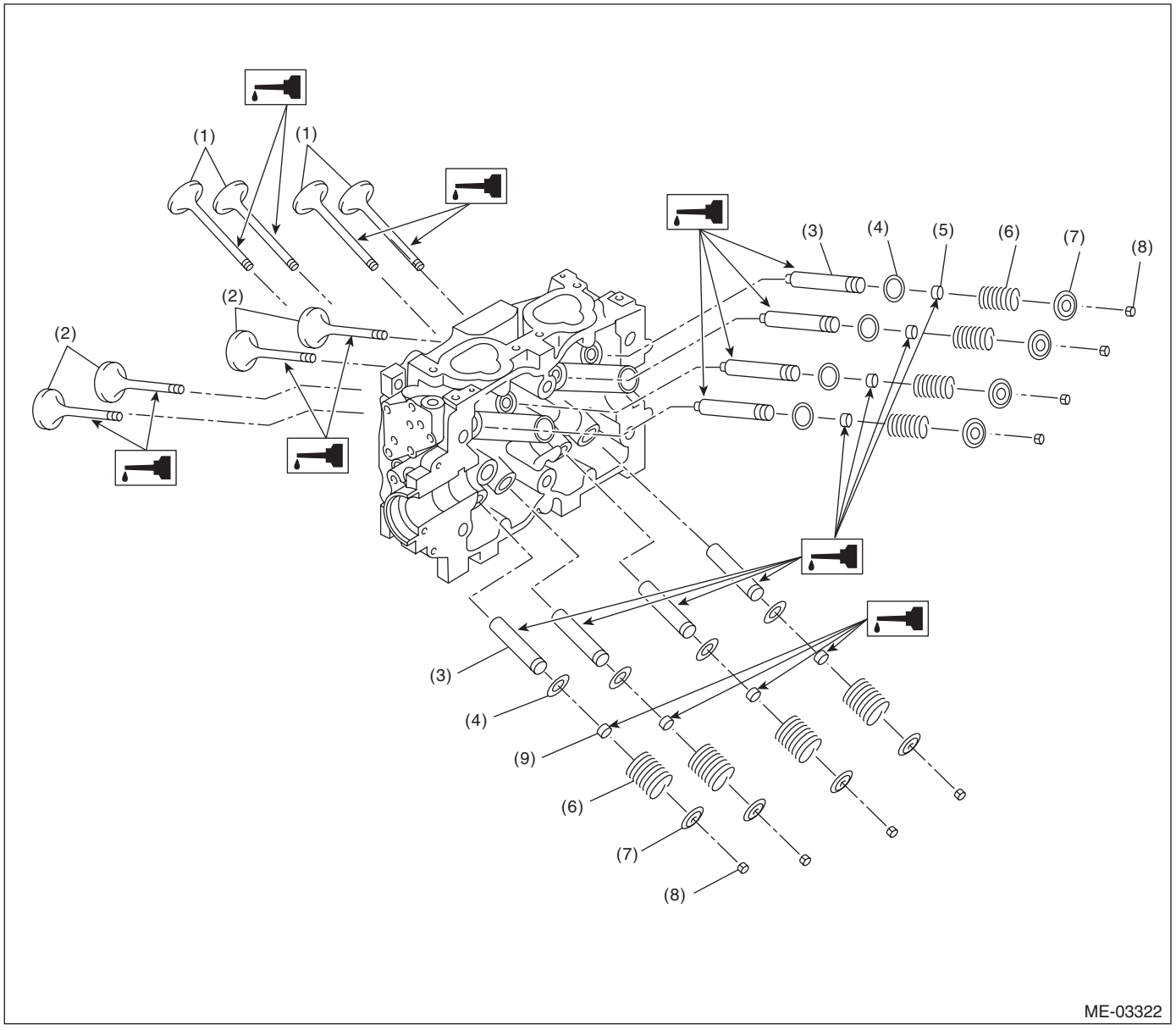
3. VALVE ROCKER ASSY



(1) Intake valve rocker ASSY
(2) Valve rocker nut
(3) Valve rocker adjusting screw
(4) Exhaust rocker shaft
(5) Exhaust valve rocker arm

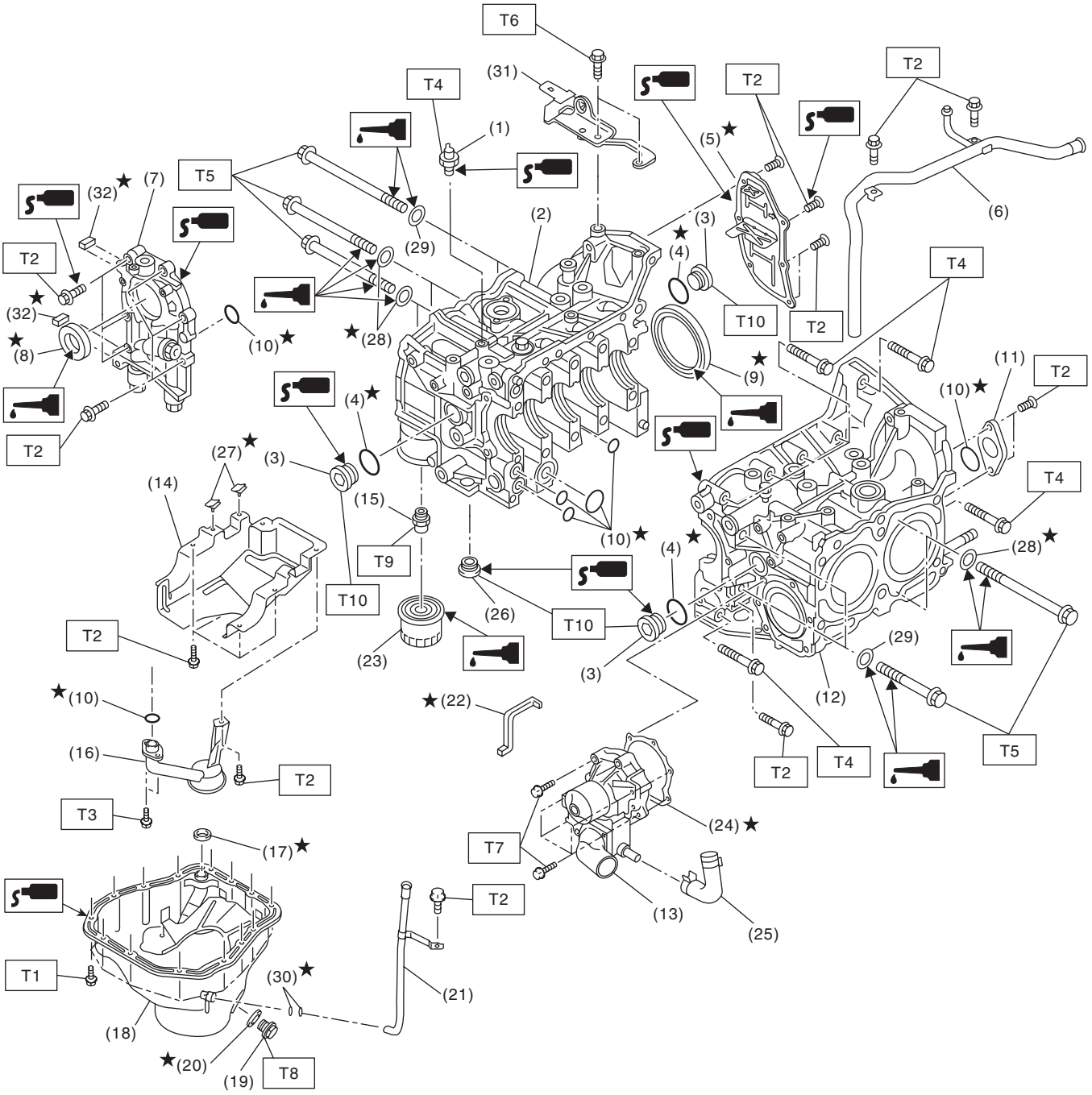
Tightening torque: N·m (kgf-m, ft-lb)
T1: 6 (0.6, 4.4)
T2: 9.75 (1.0, 7.2)
T3: 25 (2.5, 18.4)

4. CYLINDER HEAD AND VALVE ASSEMBLY



(1) Exhaust valve
(2) Intake valve
(3) Valve guide
(4) Valve spring seat
(5) Intake valve oil seal
(6) Valve spring
(7) Retainer
(8) Retainer key
(9) Exhaust valve oil seal

5. CYLINDER BLOCK

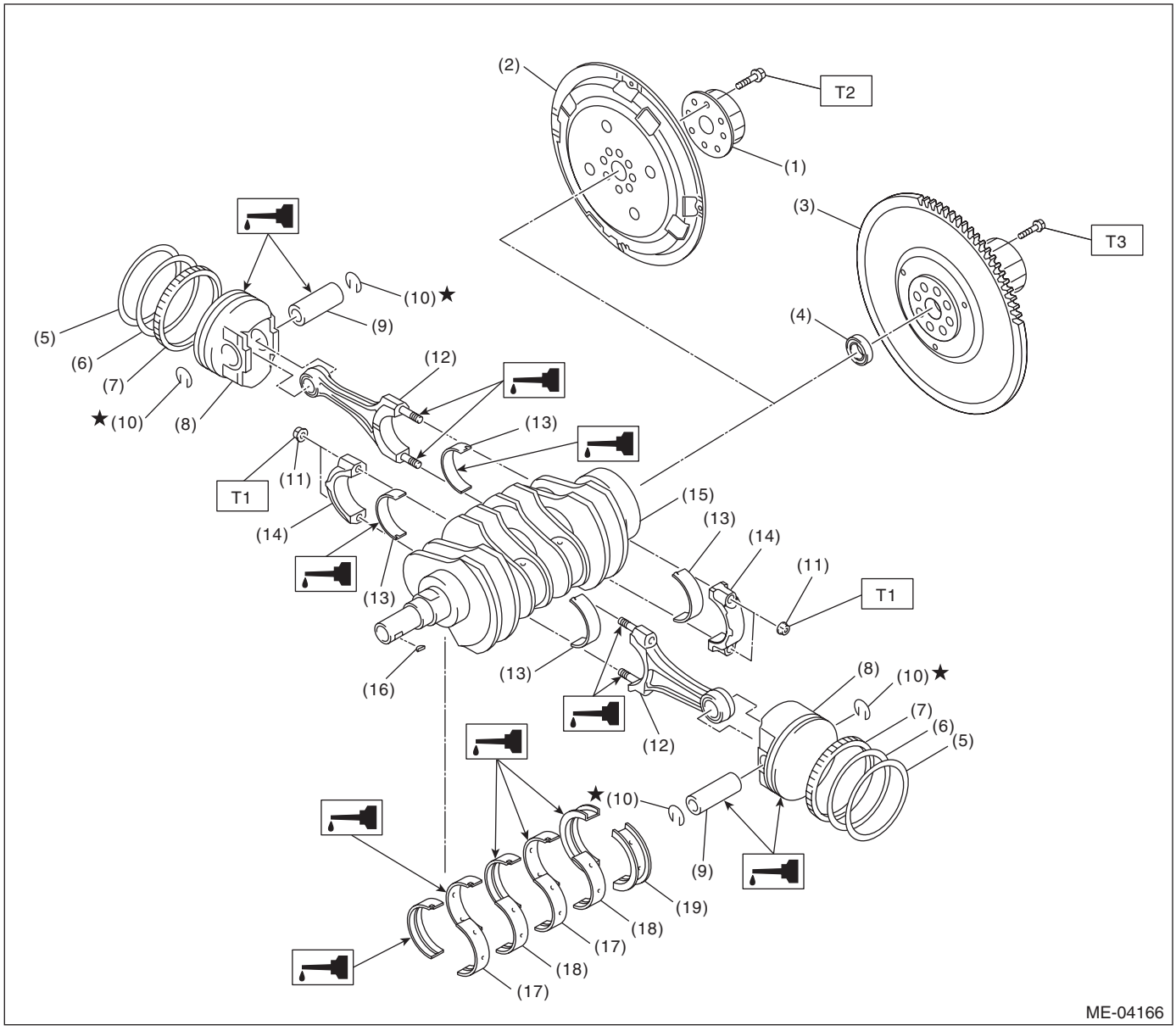


ME-03982

(1) Oil pressure switch
(2) Cylinder block RH
(3) Service hole plug
(4) Gasket
(5) Oil separator cover
(6) Water by-pass pipe
(7) Oil pump
(8) Front oil seal
(9) Rear oil seal
(10) O-ring
(11) Service hole cover
(12) Cylinder block LH
(13) Water pump
(14) Baffle plate
(15) Oil filter connector
(16) Oil strainer
(17) Gasket
(18) Oil pan
(19) Drain plug
(20) Drain plug gasket
(21) Oil level gauge guide
(22) Water pump sealing
(23) Oil filter
(24) Gasket
(25) Water pump hose
(26) Plug
(27) Seal
(28) Seal washer
(29) Washer
(30) O-ring
(31) Engine rear hanger
(32) Oil pump seal

Tightening torque: N·m (kgf-m, ft-lb)	
T1:	***5 (0.5, 3.7)***
T2:	***6.4 (0.7, 4.7)***
T3:	***10 (1.0, 7.4)***
T4:	***25 (2.5, 18.4)***
T5:	***<Ref. to ME(H4SO)-76, INSTALLATION, Cylinder Block.>***
T6:	***16 (1.6, 11.8)***
T7:	***First 12 (1.2, 8.7) Second 12 (1.2, 8.7)***
T8:	***44 (4.5, 32.5)***
T9:	***45 (4.6, 33.2)***
T10:	***70 (7.1, 51.6)***

6. CRANKSHAFT AND PISTON



(1)	Reinforcement (AT model)	(9)	Piston pin	(17)	Crankshaft bearing #1, #3
(2)	Drive plate (AT model)	(10)	Snap ring	(18)	Crankshaft bearing #2, #4
(3)	Flywheel (MT model)	(11)	Connecting rod nut	(19)	Crankshaft bearing #5
(4)	Ball bearing (MT model)	(12)	Connecting rod		
(5)	Top ring	(13)	Connecting rod bearing		
(6)	Second ring	(14)	Connecting rod cap		
(7)	Oil ring	(15)	Crankshaft		
(8)	Piston	(16)	Woodruff key		

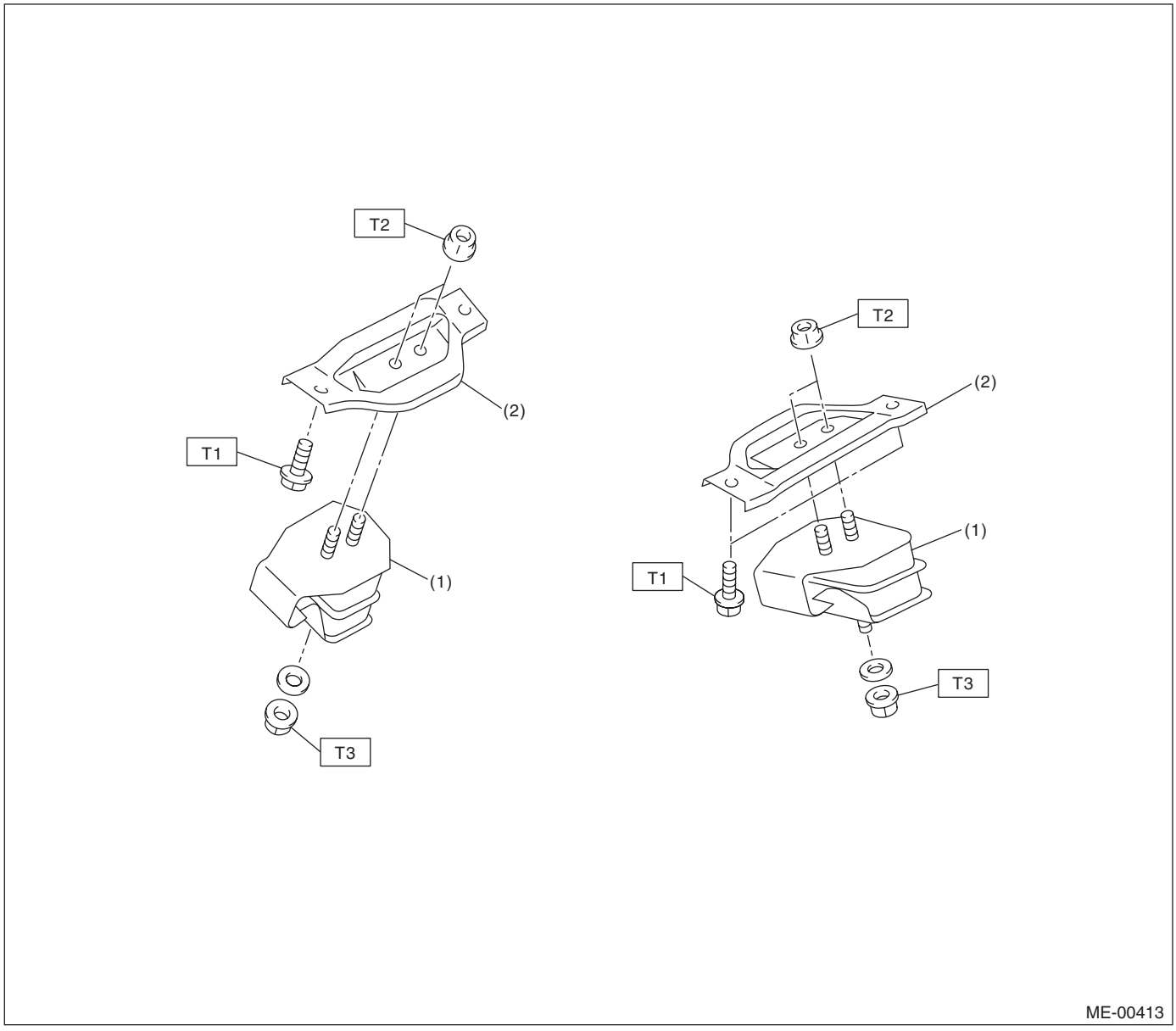
Tightening torque: N·m (kgf-m, ft-lb)

T1: 45 (4.6, 33.2)

T2: <Ref. to 4AT-68, INSTALLATION, Drive Plate.>

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

7. ENGINE MOUNTING



(1) Front cushion rubber

(2) Front engine mounting bracket

Tightening torque: N·m (kgf-m, ft-lb)

T1: 35 (3.6, 25.8)

T2: 42 (4.3, 31.0)

T3: 85 (8.7, 62.7)

C: CAUTION

• Wear appropriate work clothing, including a cap, protective goggles and protective shoes when performing any work.
• 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.
• Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.
• 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 connectors of sensors or units, be sure to disconnect the ground cable from battery.
• All parts should be thoroughly cleaned, paying special attention to 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 reinstalled in the original positions and directions.
• Bolts, nuts and washers should be replaced with new parts 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.

D: PREPARATION TOOL

1. SPECIAL TOOL

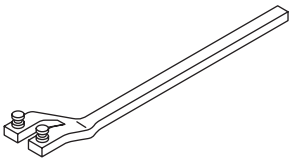
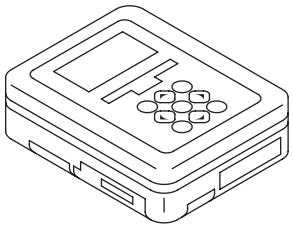
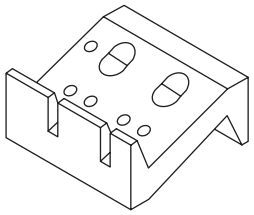
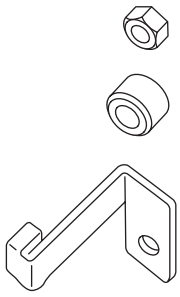
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18231AA010	18231AA010	CAM SPROCKET WRENCH	• Used for removing and installing cam sprocket. (LH side) • CAM SPROCKET WRENCH (499207100) can also be used.
 ST1B022XU0	1B022XU0	SUBARU SELECT MONITOR III KIT	Used for various inspections.
 ST-498267800	498267800	CYLINDER HEAD TABLE	• Used for replacing valve guides. • Used for removing and installing valve spring.
 ST-498277200	498277200	STOPPER SET	Used for installing automatic transmission assembly to engine.

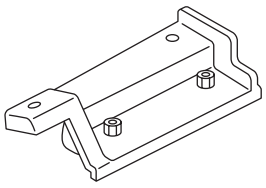
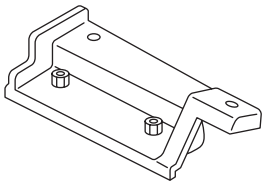
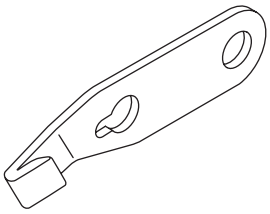
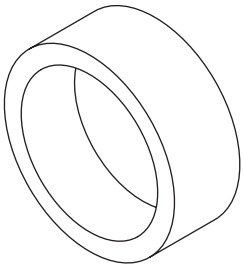
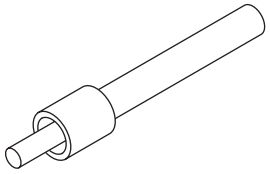
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	Used together with ENGINE STAND (499817100).
 ST-498457100	498457100	ENGINE STAND ADAPTER LH	Used together with ENGINE STAND (499817100).
 ST-498497100	498497100	CRANKSHAFT STOPPER	Used for removing and installing the flywheel and drive plate.
 ST-498747300	498747300	PISTON GUIDE	Used for installing piston in cylinder.
 ST-498857100	498857100	VALVE OIL SEAL GUIDE	Used for press-fitting of intake and exhaust valve guide oil seals.

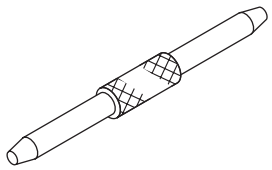
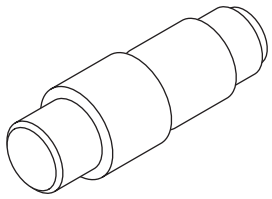
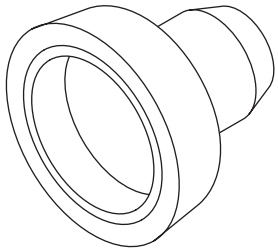
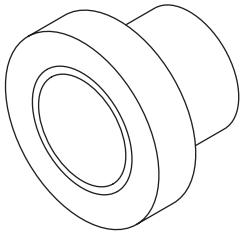
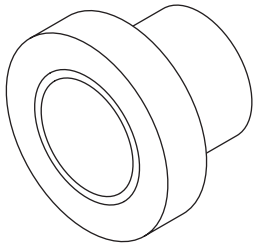
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499017100	499017100	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 ST-499037100	499037100	CONNECTING ROD BUSHING REMOVER AND INSTALLER	Used for removing and installing connecting rod bushing.
 ST-499587200	499587200	CRANKSHAFT OIL SEAL INSTALLER	• Used for installing crankshaft oil seal. • Used together with CRANKSHAFT OIL SEAL GUIDE (499597100).
 ST-499587500	499587500	OIL SEAL INSTALLER	• Used for installing the camshaft oil seal. • Used together with OIL SEAL GUIDE (499597000).
 ST-499587700	499587700	CAMSHAFT OIL SEAL INSTALLER	Used for installing cylinder head plug.

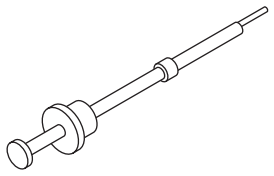
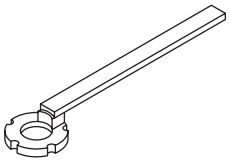
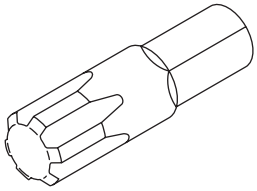
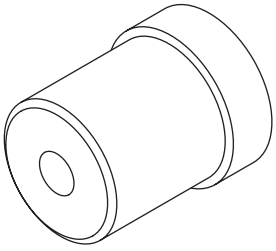
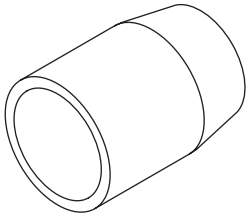
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499097700	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 ST-499207400	499207400	CAM SPROCKET WRENCH	Used for removing and installing cam sprocket. (RH side)
 ST-499497000	499497000	TORX® PLUS	Used for removing and installing camshaft cap.
 ST-499587100	499587100	OIL SEAL INSTALLER	Used for installing oil pump oil seal.
 ST-499597000	499597000	OIL SEAL GUIDE	• Used for installing the camshaft oil seal. • Used together with CAMSHAFT OIL SEAL INSTALLER (499587500).

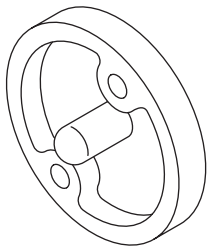
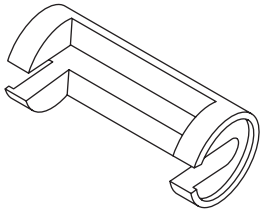
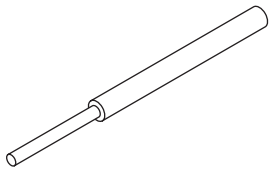
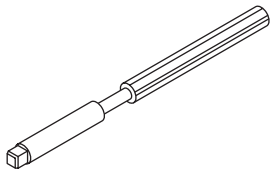
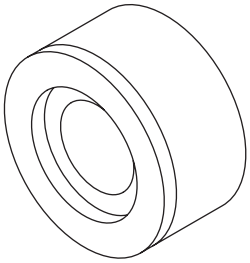
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499597100	499597100	CRANKSHAFT OIL SEAL GUIDE	• Used for installing crankshaft oil seal. • Used together with CRANKSHAFT OIL SEAL INSTALLER (499587200).
 ST-499718000	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.
 ST-499767200	499767200	VALVE GUIDE REMOVER	Used for removing valve guides.
 ST-499767400	499767400	VALVE GUIDE REAMER	Used for reaming valve guides.
 ST-499767700	499767700	VALVE GUIDE ADJUSTER	Used for installing valve guides. (Intake side)

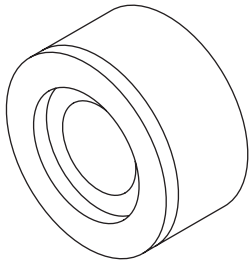
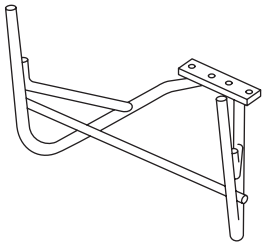
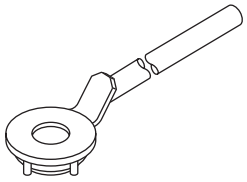
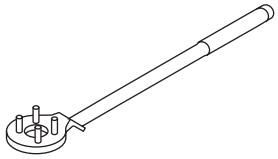
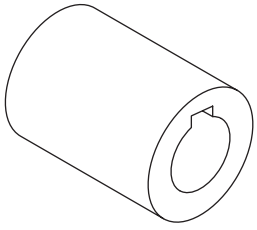
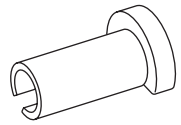
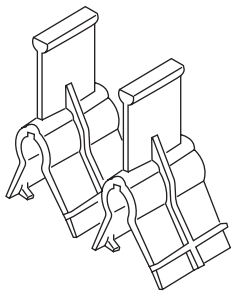
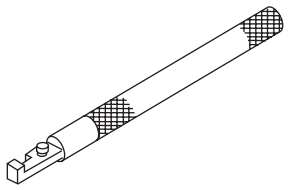
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499767800	499767800	VALVE GUIDE ADJUSTER	Used for installing valve guides. (Exhaust side)
 ST-499817100	499817100	ENGINE STAND	• Stand used for engine disassembly and assembly. • Used together with ENGINE STAND ADAPTER RH (498457000) & LH (498457100).
 ST-499977400	499977400	CRANK PULLEY WRENCH	Used to stop rotation of the crank pulley when loosening or tightening crank pulley bolts. (AT model)
 ST-499977100	499977100	CRANK PULLEY WRENCH	Used to stop rotation of the crank pulley when loosening or tightening crank pulley bolts. (MT model)
 ST-499987500	499987500	CRANKSHAFT SOCKET	Used for rotating crankshaft.

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST42099AE000	42099AE000	QUICK CONNECTOR RELEASE	Used for removing the quick connector.
 ST18354AA000	18354AA000	VALVE ROCKER HOLDER	Used for installing the valve rocker assembly (intake). (2-piece set)
 ST18258AA000	18258AA000	SPRING INSTALLER	Used for installing the valve rocker assembly (intake).

2. GENERAL TOOL

TOOL NAME	REMARKS
Compression gauge	Used for measuring compression.
Vacuum gauge	Used for measuring intake manifold vacuum.
Oil pressure gauge	Used for measuring engine oil pressure.
Fuel pressure gauge	Used for measuring fuel pressure.
Timing light	Used for measuring ignition timing.

E: PROCEDURE

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

- V-belt
- Timing belt
- Valve rocker ASSY
- Camshaft
- Cylinder head