

General Description

MECHANICAL

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 (3.917 × 3.110)
	Piston displacement cm ³ (cu in)			2,457 (150)
	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	BBDC 30°
			Close	ATDC 14°
	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 neutral position on MT, or “P” or “N” position on AT] rpm		MT	650±100 (No load) 850±100 (A/C ON)
			AT	700±100 (No load) 850±100 (A/C ON)
	Ignition order			1 → 3 → 2 → 4
	Ignition timing BTDC/rpm		MT	10°±8°/650
			AT	15°±10°/700

General Description

MECHANICAL

NOTE:

US: Undersize OS: Oversize

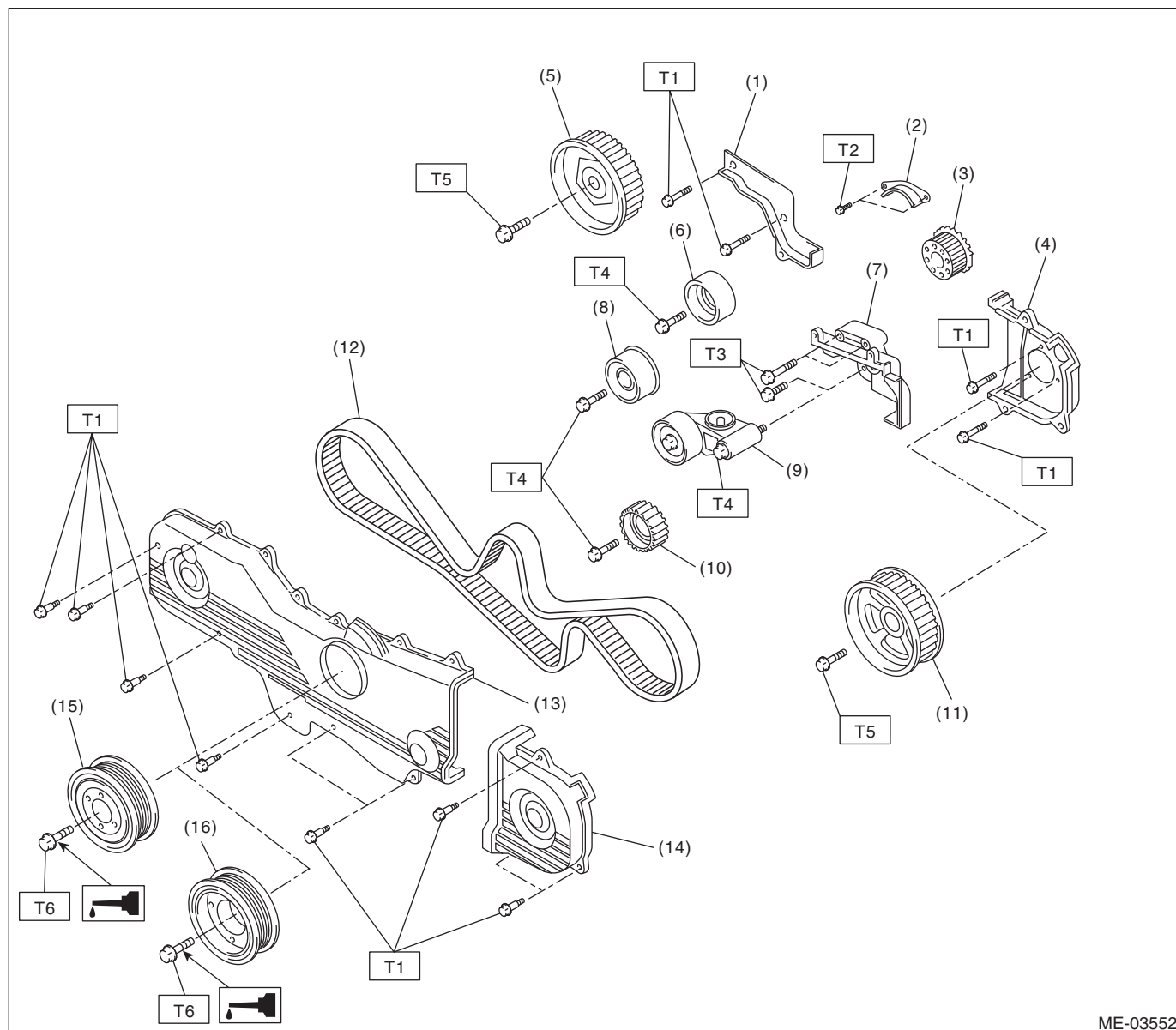
Belt tension adjuster	Protrusion of adjuster rod			mm (in)	5.2 — 6.2 (0.205 — 0.244)	
Valve rocker arm	Clearance between shaft and arm		mm (in)	Standard	0.020 — 0.054 (0.0008 — 0.0021)	
Camshaft	Bending limit			mm (in)	0.025 (0.00098)	
	Thrust clearance		mm (in)	Standard	0.030 — 0.090 (0.0012 — 0.0035)	
	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)	
	Camshaft journal O.D.			mm (in)	31.928 — 31.945 (1.2570 — 1.2577)	
	Camshaft journal hole I.D.			mm (in)	32.000 — 32.018 (1.2598 — 1.2605)	
Oil clearance		mm (in)	Standard	0.055 — 0.090 (0.0022 — 0.0035)		
Cylinder head	Surface warpage 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				90°	
	Contacting width	mm (in)	Intake	Standard	0.8 — 1.4 (0.03 — 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)	Intake	20.0 — 21.0 (0.787 — 0.827)	
				Exhaust	16.5 — 17.5 (0.650 — 0.689)	
Valve	Head edge thickness	mm (in)	Intake	Standard	0.8 — 1.2 (0.03 — 0.047)	
			Exhaust	Standard	1.0 — 1.4 (0.039 — 0.055)	
	Stem outer diameter		mm (in)	Intake	5.950 — 5.965 (0.2343 — 0.2348)	
				Exhaust	5.945 — 5.960 (0.2341 — 0.2346)	
	Valve stem gap	mm (in)	Standard	Intake	0.035 — 0.062 (0.0014 — 0.0024)	
				Exhaust	0.040 — 0.067 (0.0016 — 0.0026)	
	Overall length		mm (in)	Intake	120.6 (4.75)	
				Exhaust	121.7 (4.79)	
Valve spring	Free length			mm (in)	55.2 (2.173)	
	Squareness				2.5°, 2.4 (0.094) or less	
	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)	
Cylinder block	Surface warpage limit (mating 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)	
	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)	
	Cylinder inner diameter boring limit (diameter)			mm (in)	To 100.005 (3.9372)	
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)

ME(H4SO)-3

General Description

MECHANICAL

Piston pin	Clearance between piston and piston pin: mm (in)		Standard	0.004 — 0.008 (0.0002 — 0.0003)
	Degree of fit			Piston pin can be fitted into position with thumb at 20°C (68°F).
Piston ring	Ring closed gap mm (in)	Top ring	Standard	0.20 — 0.35 (0.0079 — 0.0138)
		Second ring	Standard	0.37 — 0.52 (0.0144 — 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 — 0.0031)
		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)
	Thrust clearance mm (in)		Standard	0.070 — 0.330 (0.0028 — 0.0130)
Bearing of large end	Oil clearance mm (in)		Standard	0.016 — 0.044 (0.00063 — 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	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 59.758 (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)
	Thrust clearance mm (in)	Standard		0.030 — 0.115 (0.0012 — 0.0045)
	Oil clearance mm (in)	Standard		0.010 — 0.030 (0.0001 — 0.0012)
Main bearing	Main bearing 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-03552

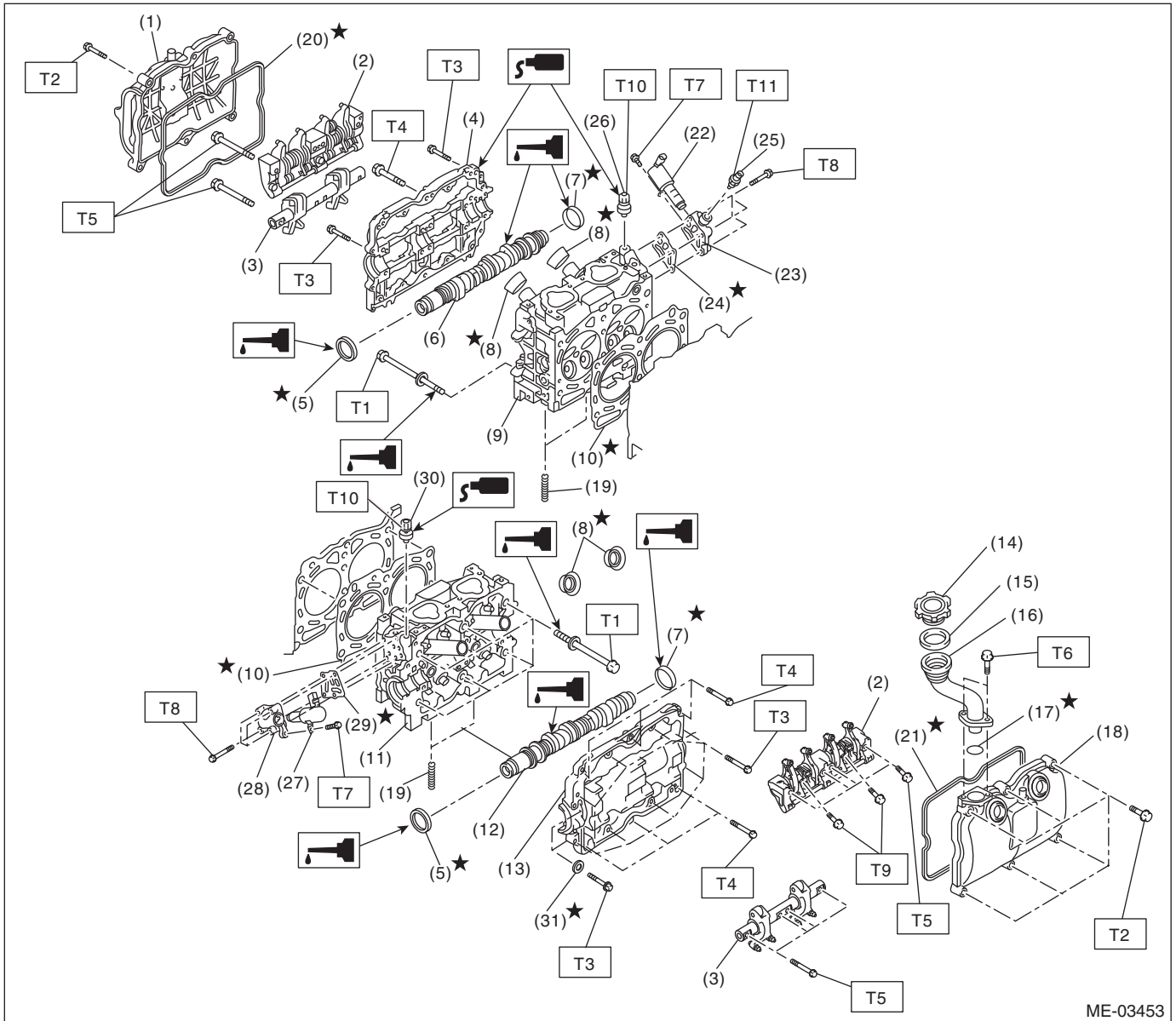
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| (1) Timing belt cover No. 2 RH | (10) Belt idler No. 2 |
| (2) Timing belt guide (MT model) | (11) Cam sprocket No. 2 |
| (3) Crank sprocket | (12) Timing belt |
| (4) Timing belt cover No. 2 LH | (13) Front timing belt cover |
| (5) Cam sprocket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

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)-50, INSTALLATION, Crank Pulley.>**

General Description

MECHANICAL

2. CYLINDER HEAD AND CAMSHAFT



General Description

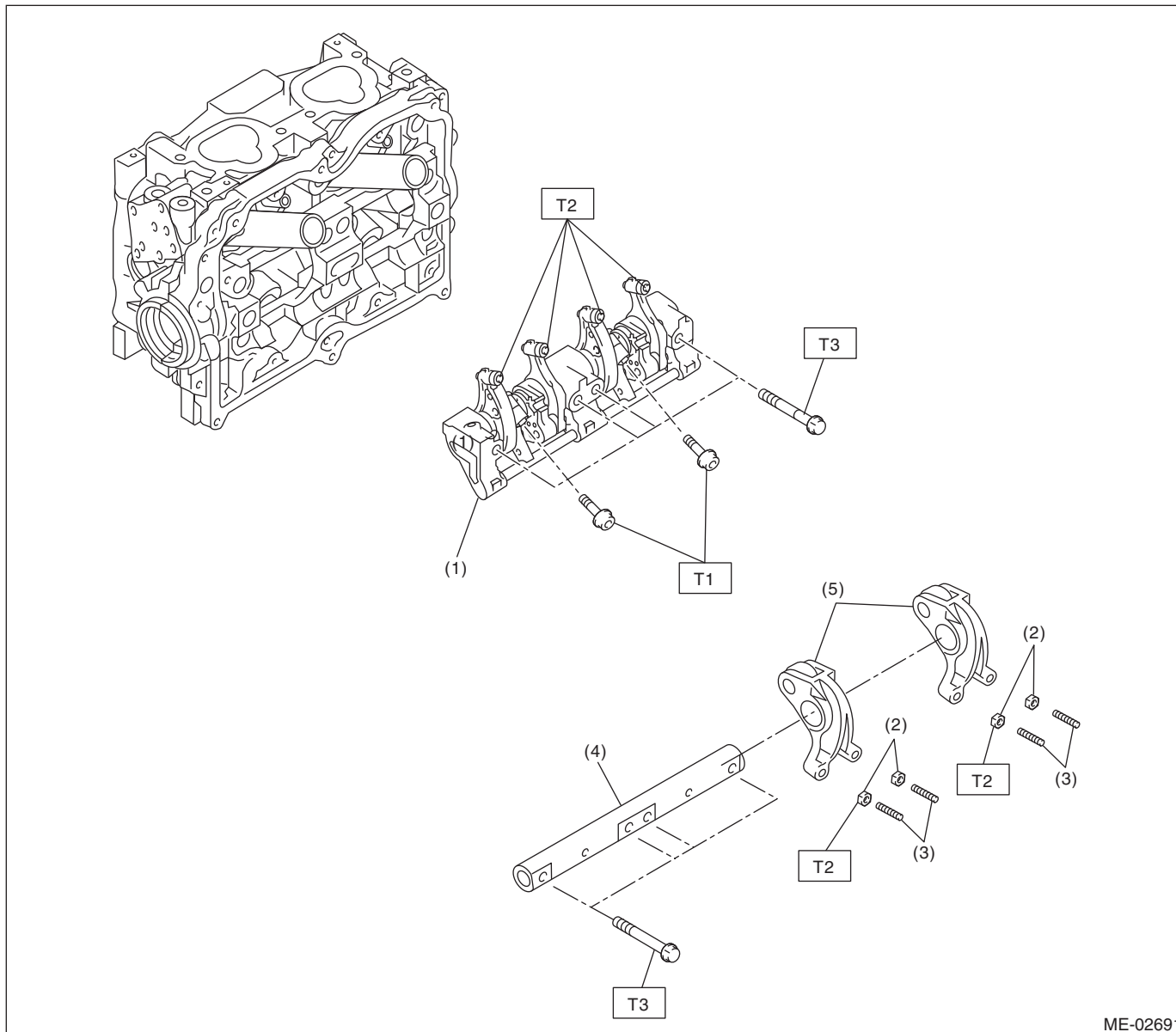
MECHANICAL

(1) Rocker cover RH	(18) Rocker cover LH	(31) Seal washer
(2) Intake valve rocker assembly	(19) Stud bolt	
(3) Exhaust valve rocker assembly	(20) Rocker cover gasket RH	<i>Tightening torque:N·m (kgf-m, ft-lb)</i>
(4) Camshaft cap RH	(21) Rocker cover gasket LH	<i>T1: <Ref. to ME(H4SO)-72, INSTALLATION, Cylinder Head.></i>
(5) Oil seal	(22) Oil switching solenoid valve RH	
(6) Camshaft RH	(23) Oil switching solenoid valve holder RH	<i>T2: <Ref. to ME(H4SO)-63, INSTALLATION, Valve Rocker Assembly.></i>
(7) Plug		
(8) Spark plug pipe gasket	(24) Gasket	<i>T3: 9.75 (1.0, 7.2)</i>
(9) Cylinder head RH	(25) Oil temperature sensor	<i>T4: 18 (1.8, 13.3)</i>
(10) Cylinder head gasket	(26) Variable valve lift diagnosis oil pressure switch RH	<i>T5: 25 (2.5, 18.4)</i>
(11) Cylinder head LH		<i>T6: 6.4 (0.7, 4.7)</i>
(12) Camshaft LH	(27) Oil switching solenoid valve LH	<i>T7: 8 (0.8, 5.9)</i>
(13) Camshaft cap LH	(28) Oil switching solenoid valve holder LH	<i>T8: 10 (1.0, 7.4)</i>
(14) Oil filler cap		<i>T9: 6 (0.6, 4.4)</i>
(15) Gasket	(29) Gasket	<i>T10: 17 (1.7, 12.5)</i>
(16) Oil filler duct	(30) Variable valve lift diagnosis oil pressure switch LH	<i>T11: 18 (1.8, 13.3)</i>
(17) O-ring		

General Description

MECHANICAL

3. VALVE ROCKER ASSEMBLY



ME-02691

- (1) Intake valve rocker arm ASSY
- (2) Valve rocker nut
- (3) Valve rocker adjusting screw

- (4) Exhaust rocker shaft
- (5) Exhaust valve rocker arm

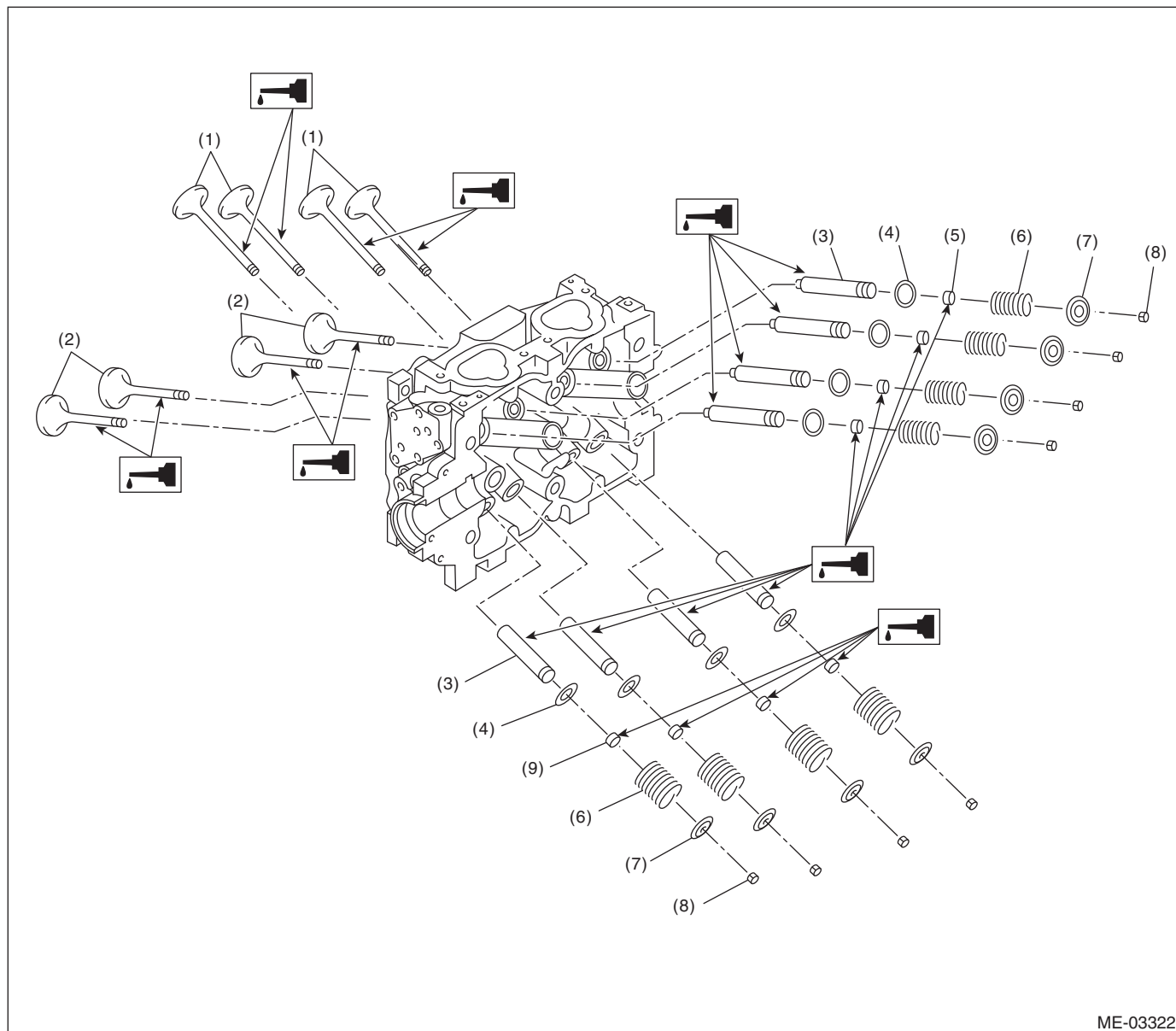
Tightening torque: N·m (kgf-m, ft-lb)

T1: 6 (0.6, 4.3)

T2: 9.75 (1.0, 7.2)

T3: 25 (2.5, 18.4)

4. CYLINDER HEAD AND VALVE ASSEMBLY



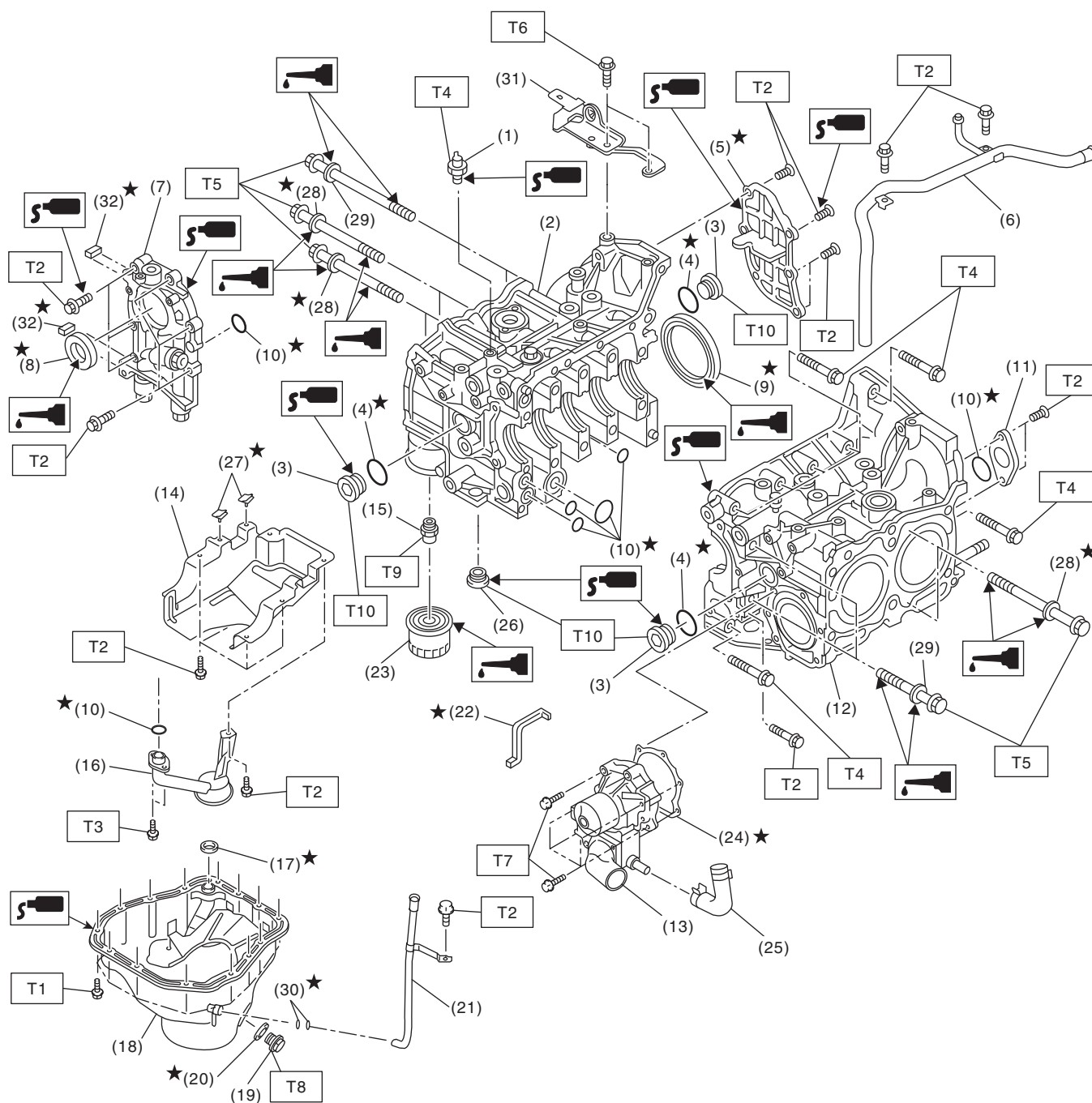
ME-03322

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

General Description

MECHANICAL

5. CYLINDER BLOCK



ME-03563

General Description

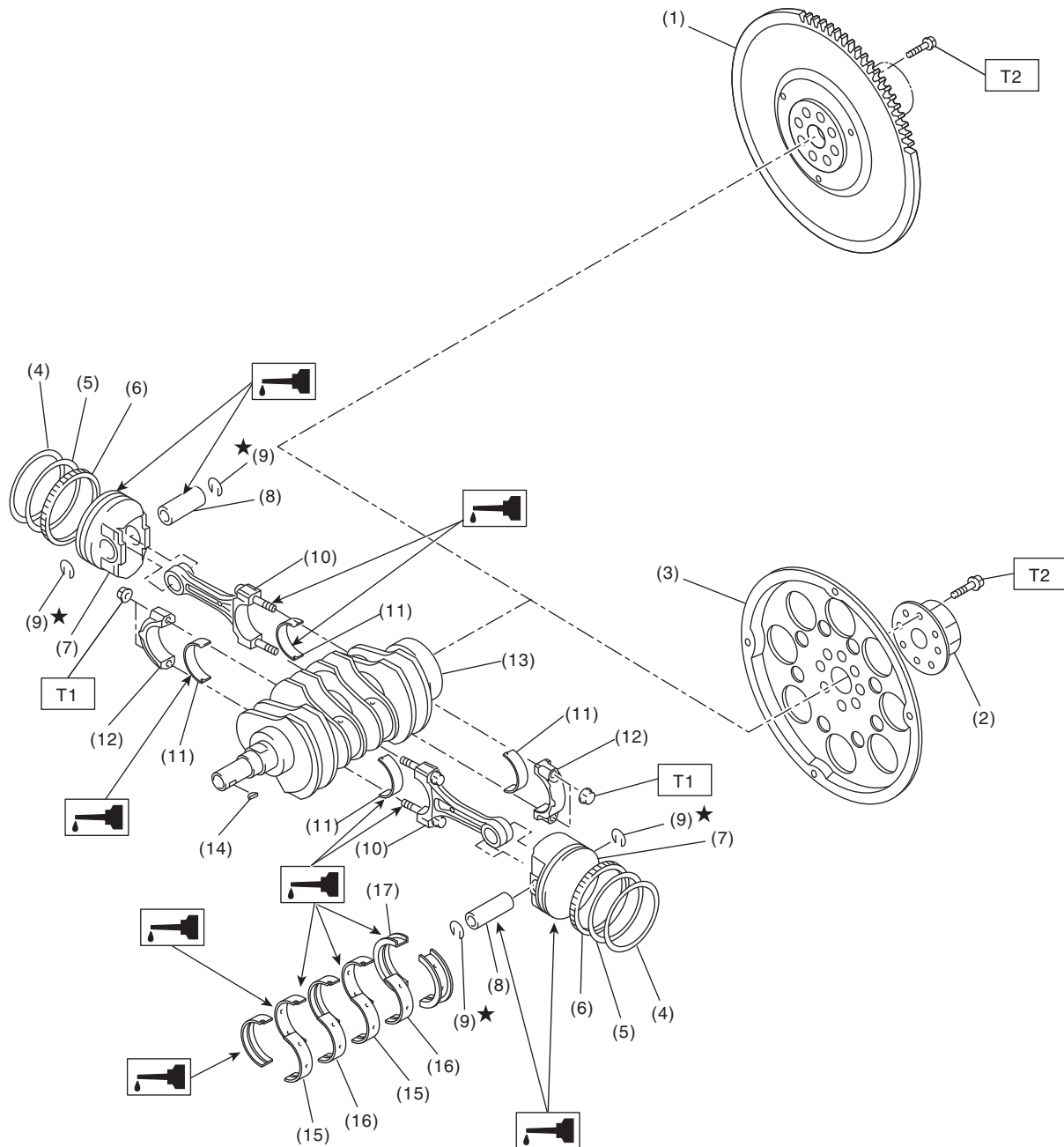
MECHANICAL

(1) Oil pressure switch	(17) Gasket	(32) Oil pump seal
(2) Cylinder block RH	(18) Oil pan	
(3) Service hole plug	(19) Drain plug	<i>Tightening torque:N·m (kgf-m, ft-lb)</i>
(4) Gasket	(20) Drain plug gasket	<i>T1: 5 (0.5, 3.7)</i>
(5) Oil separator cover	(21) Oil level gauge guide	<i>T2: 6.4 (0.7, 4.7)</i>
(6) Water by-pass pipe	(22) Water pump sealing	<i>T3: 10 (1.0, 7.4)</i>
(7) Oil pump	(23) Oil filter	<i>T4: 25 (2.5, 18.4)</i>
(8) Front oil seal	(24) Gasket	<i>T5: <Ref. to ME(H4SO)-85, INSTAL-</i>
(9) Rear oil seal	(25) Water pump hose	<i>LATION, Cylinder Block.></i>
(10) O-ring	(26) Plug	<i>T6: 16 (1.6, 11.8)</i>
(11) Service hole cover	(27) Seal	<i>T7: First 12 (1.2, 8.9)</i>
(12) Cylinder block LH	(28) Seal washer	<i>Second 12 (1.2, 8.9)</i>
(13) Water pump	(29) Washer	<i>T8: 44 (4.5, 32.5)</i>
(14) Baffle plate	(30) O-ring	<i>T9: 45 (4.6, 33.2)</i>
(15) Oil filter connector	(31) Engine rear hanger	<i>T10: 70 (7.1, 51.6)</i>
(16) Oil strainer		

General Description

MECHANICAL

6. CRANKSHAFT AND PISTON



ME-03292

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

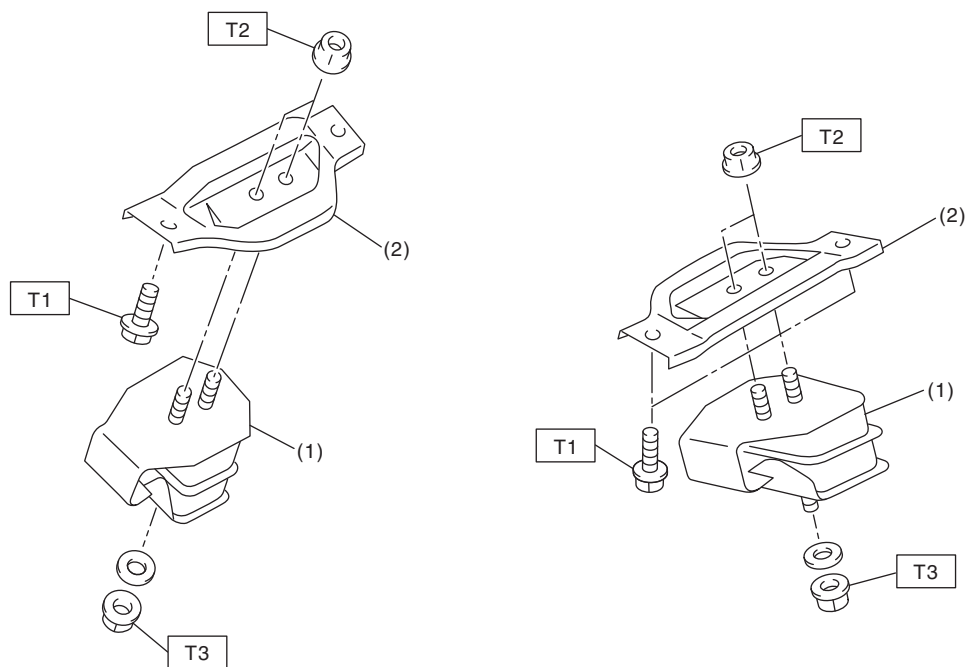
Tightening torque: N·m (kgf-m, ft-lb)

T1: 45 (4.6, 33.2)

T2: 72 (7.3, 53.1)

ME(H4SO)-12

7. ENGINE MOUNTING



ME-00413

(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)

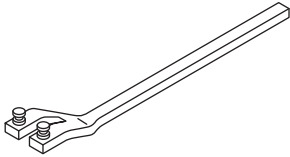
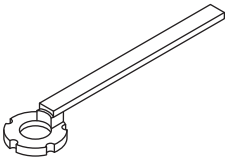
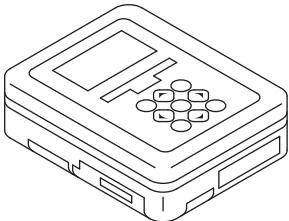
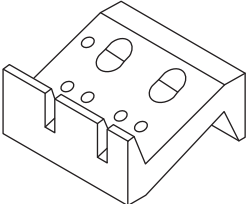
T3: 85 (8.7, 62.7)

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 the 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.

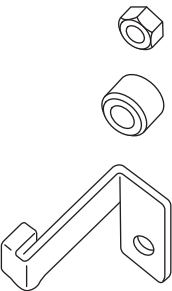
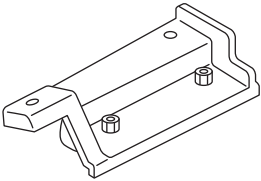
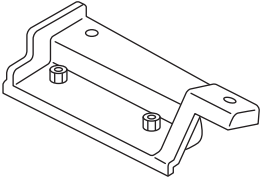
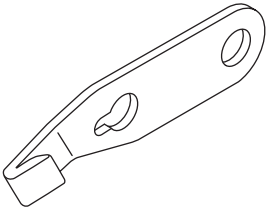
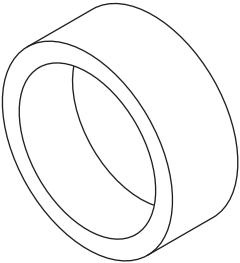
D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18231AA010	18231AA010	CAM SPROCKET WRENCH	- Used for removing and installing cam sprocket LH. - CAMSHAFT SPROCKET WRENCH (499207100) can also be used.
 ST-499207400	499207400	CAM SPROCKET WRENCH	Used for removing and installing cam sprocket RH.
 ST1B022XU0	1B022XU0 (Newly adopted tool)	SUBARU SELECT MONITOR III KIT	Used for troubleshooting for electrical system.
 ST-498267800	498267800	CYLINDER HEAD TABLE	- Used for replacing valve guides. - Used for removing and installing valve spring.

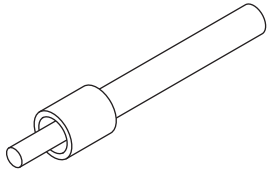
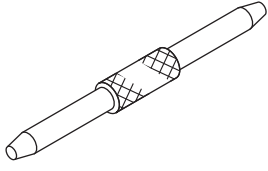
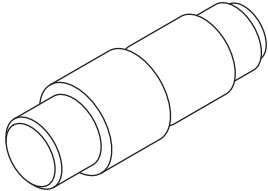
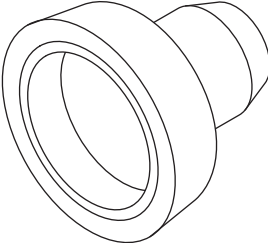
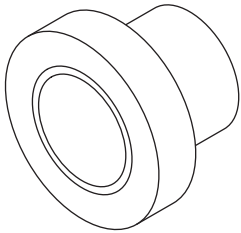
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498277200	498277200	STOPPER SET	Used for installing automatic transmission assembly to engine.
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	Used together with the ENGINE STAND (499817100).
 ST-498457100	498457100	ENGINE STAND ADAPTER LH	Used together with the ENGINE STAND (499817100).
 ST-498497100	498497100	CRANKSHAFT STOPPER	Used for removing and installing the flywheel and the drive plate.
 ST-498747300	498747300	PISTON GUIDE	Used for installing piston in cylinder.

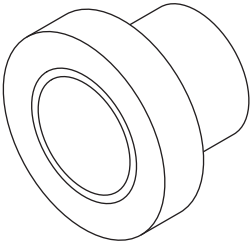
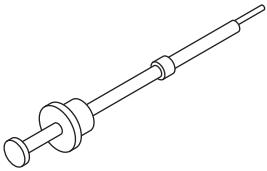
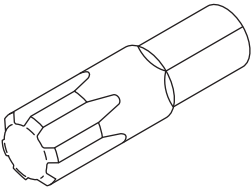
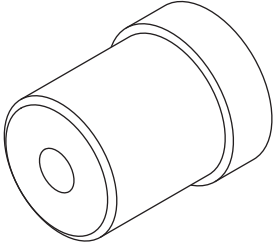
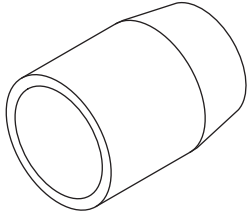
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 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 & 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 the CRANKSHAFT OIL SEAL GUIDE (499597100).
 ST-499587500	499587500	OIL SEAL INSTALLER	• Used for installing the camshaft oil seal. • Used together with the OIL SEAL GUIDE (499597000).

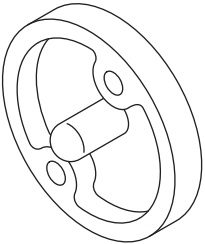
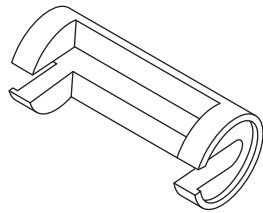
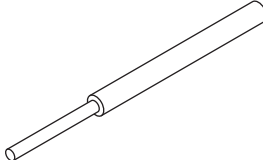
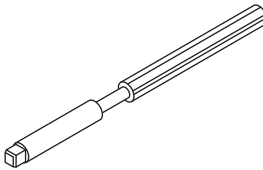
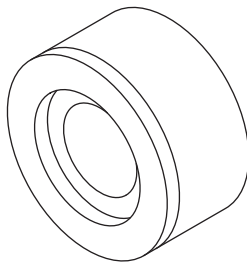
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499587700	499587700	CAMSHAFT OIL SEAL INSTALLER	Used for installing cylinder head plug.
 ST-499097700	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 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 the OIL SEAL INSTALLER (499587500).

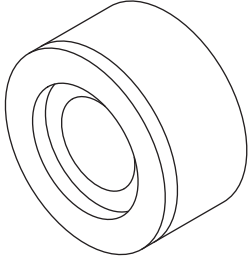
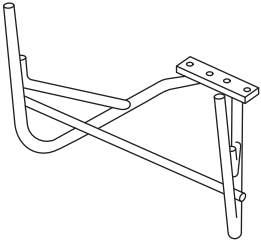
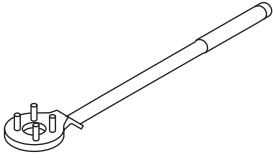
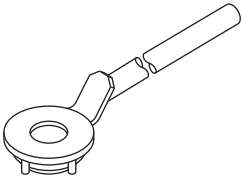
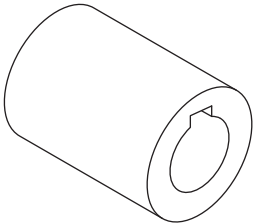
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499597100	499597100	CRANKSHAFT OIL SEAL GUIDE	- Used for installing crankshaft oil seal. - Used together with the 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)

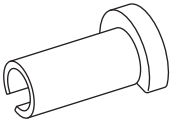
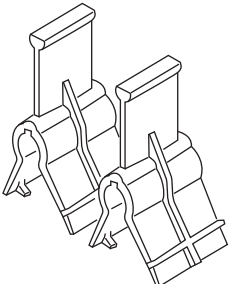
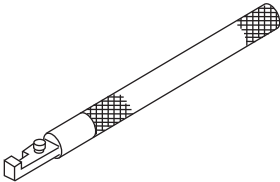
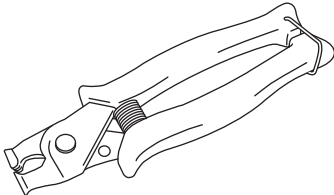
General Description

MECHANICAL

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 the ENGINE STAND ADAPTER RH (498457000) & LH (498457100).
 ST-499977100	499977100	CRANK PULLEY WRENCH	Used to stop rotation of the crank pulley when loosening or tightening crank pulley bolts. (MT model)
 ST-499977400	499977400	CRANK PULLEY WRENCH	Used to stop rotation of the crank pulley when loosening or tightening crank pulley bolts. (AT model)
 ST-499987500	499987500	CRANKSHAFT SOCKET	Used for rotating crankshaft.

General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST42099AE000	42099AE000	QUICK CONNEC-TOR 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).
 ST18353AA000	18353AA000	CLAMP PLIERS	- Used for removing and installing the PCV hose. - This is a general tool made by the French company CAILLAU. (code) 54.0.000.205 To make this easier to obtain in the same way as genuine Subaru parts, it has been provided with a tool number as an ST.

2. GENERAL TOOL

TOOL NAME	REMARKS
Compression gauge	Used for measuring compression.
Vacuum gauge	Used for measuring vacuum pressure.
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 assembly
- Camshaft
- Cylinder head