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, double 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				8.4
	Compression pressure (at 200 — 300 rpm)			kPa (kg/cm^2, psi) Standard	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 35°
			Close	Max. retard	ABDC 65°
				Min. advance	ABDC 25°
	Exhaust valve timing		Open		BBDC 55°
			Close		ATDC 5°
	Valve clearance mm (in)	Inspection value	Intake		$0.20^{+0.04}_{-0.06}$ ($0.0079^{+0.0016}_{-0.0024}$)
			Exhaust		0.35±0.05 (0.0138±0.0020)
		Adjustment value	Intake		$0.20^{+0.01}_{-0.03}$ ($0.0079^{+0.0004}_{-0.0012}$)
			Exhaust		0.35±0.02 (0.0138±0.0008)
	Idle speed (Gear shift lever is in neutral)		No load	Standard rpm	700±100
			A/C ON	Standard rpm	750±100
	Ignition order				1 → 3 → 2 → 4
	Ignition timing			Standard BTDC/rpm	12°±10°/700

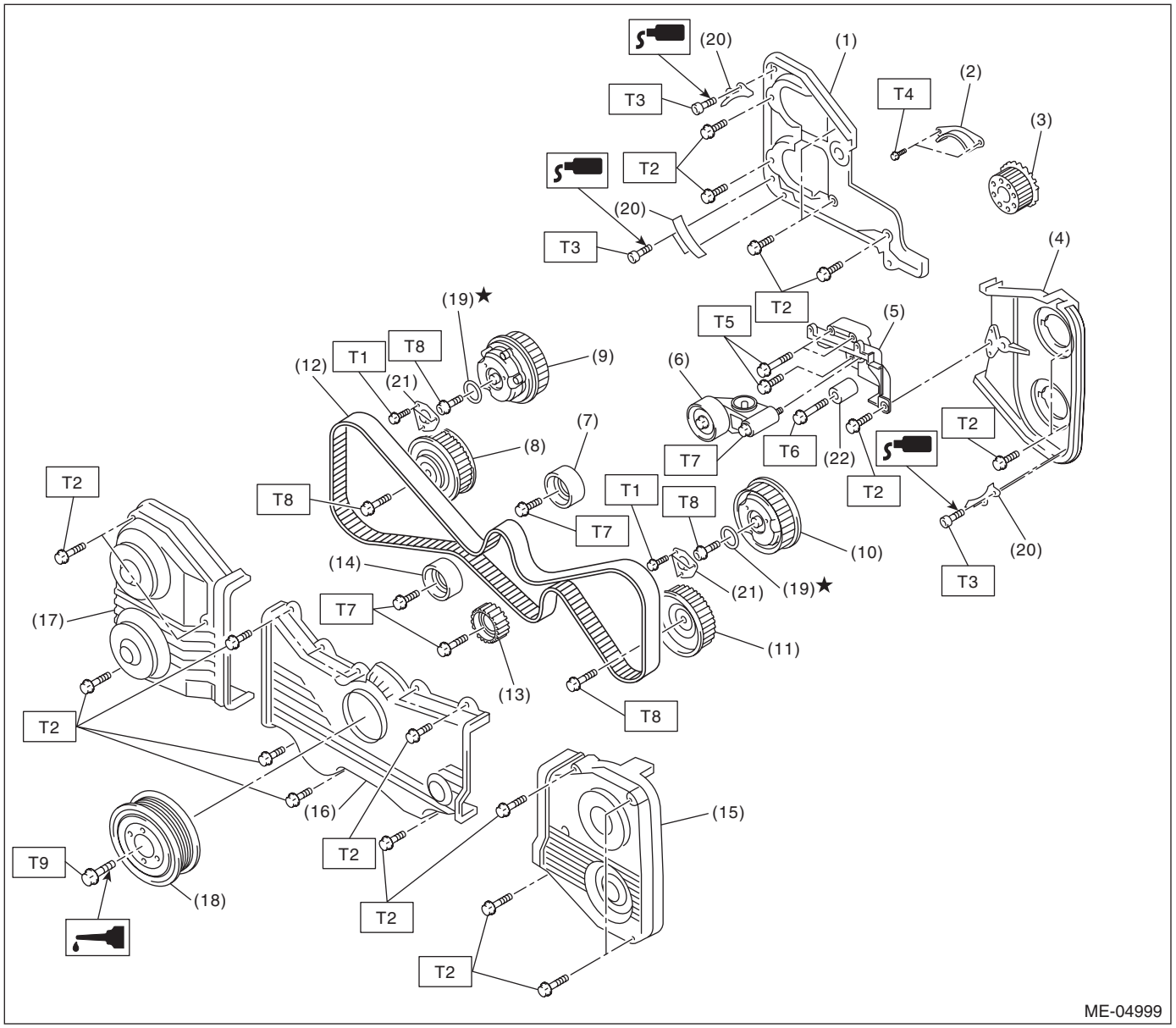
NOTE:
OS: Oversize US: Undersize

Belt tension adjuster	Adjuster rod protrusion amount		mm (in)	5.2 — 6.2 (0.205 — 0.244)
Camshaft	Bending limit		mm (in)	0.020 (0.00079)
	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)
	Cam base circle diameter mm (in)		Standard	37.0 (1.457)
	Journal O.D. mm (in)	Front	Standard	37.946 — 37.963 (1.4939 — 1.4946)
		Center, rear	Standard	29.946 — 29.963 (1.1790 — 1.1796)
	Oil clearance mm (in)		Standard	0.037 — 0.072 (0.0015 — 0.0028)
	Thrust clearance mm (in)		Standard	0.068 — 0.116 (0.0027 — 0.0047)
Cylinder head	Warping limit (mating surface with cylinder block)		mm (in)	0.035 (0.0014)
	Grinding limit		mm (in)	0.3 (0.012)
	Standard height		mm (in)	127.5 (5.02)
Valve seat	Seating angle between valve and valve seat			90°
	Contacting width between valve and valve seat mm (in)	Intake	Standard	0.6 — 1.4 (0.024 — 0.055)
		Exhaust	Standard	1.2 — 1.8 (0.047 — 0.071)
Valve guide	Clearance between the valve guide and valve stem mm (in)	Intake	Standard	0.030 — 0.057 (0.0012 — 0.0022)
		Exhaust	Standard	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		5.955 — 5.970 (0.2344 — 0.2350)
		Exhaust		5.945 — 5.960 (0.2341 — 0.2346)
	Valve guide protrusion amount		mm (in)	15.8 — 16.2 (0.622 — 0.638)
Valve	Head edge thickness mm (in)	Intake	Standard	1.0 — 1.4 (0.039 — 0.055)
		Exhaust	Standard	1.3 — 1.7 (0.051 — 0.067)
	Overall length mm (in)	Intake		104.4 (4.110)
		Exhaust		104.65 (4.1201)
Valve spring	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 (1.043)
	Squareness			2.5°, 2.1 mm (0.083 in) or less
Valve lifter	Outer diameter mm (in)		Standard	34.959 — 34.975 (1.3763 — 1.3770)
	Valve lifter mating surface inner diameter mm (in)		Standard	34.994 — 35.016 (1.3777 — 1.3786)
	Valve lifter and valve lifter mating surface clearance mm (in)		Standard	0.019 — 0.057 (0.0007 — 0.0022)
Cylinder block	Warping limit (mating surface 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)
	Cylindricality mm (in)		Limit	0.015 (0.0006)
	Out-of-roundness mm (in)		Limit	0.010 (0.0004)
	Clearance between cylinder and piston 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 (1.50)
	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	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).
	Clearance between piston pin 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 — 0.25 (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)
	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)	Limit	0.10 (0.0039)
	Thrust clearance		mm (in)	Standard	0.070 — 0.330 (0.0028 — 0.0130)
	Oil clearance		mm (in)	Standard	0.017 — 0.045 (0.0007 — 0.0018)
	Bearing size (Thickness at center) mm (in)			Standard	1.490 — 1.506 (0.0587 — 0.0593)
				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)
Crankshaft and crankshaft bearing	Bending limit				mm (in) 0.035 (0.0014)
	Crank pin	Cylindricality	mm (in)	Limit	0.006 (0.0002)
		Out-of-roundness	mm (in)	Limit	0.005 (0.0002)
		Grinding limit (dia.)			mm (in) To 51.750 (2.0374)
	Crank journal	Cylindricality	mm (in)	Limit	0.006 (0.0002)
		Out-of-roundness	mm (in)	Limit	0.005 (0.0002)
		Grinding limit (dia.)			mm (in) To 59.758 (2.3527)
	Crank pin outer diameter mm (in)			Standard	51.976 — 52.000 (2.0463 — 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	59.984 — 60.008 (2.3616 — 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 — 2.015 (0.0787 — 0.0793)
				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 — 2.017 (0.0787 — 0.0794)
				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

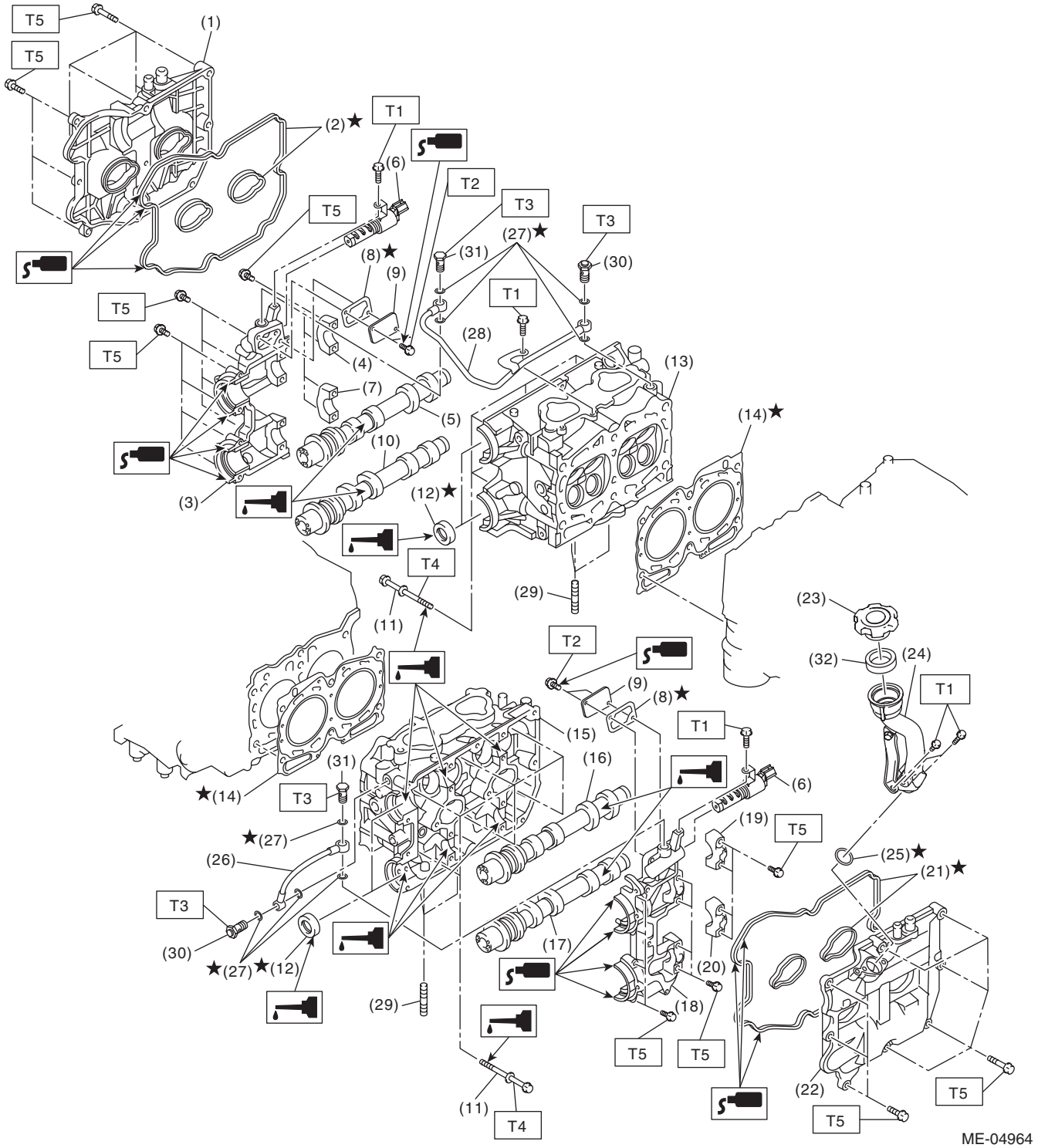
1. TIMING BELT



ME-04999

(1)	Timing belt cover No. 2 RH	(12)	Timing belt	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Timing belt guide	(13)	Belt idler No. 2	***T1: 3.4 (0.3, 2.5)***
(3)	Crank sprocket	(14)	Belt idler	***T2: 5 (0.5, 3.7)***
(4)	Timing belt cover No. 2 LH	(15)	Timing belt cover LH	***T3: 6.4 (0.7, 4.7)***
(5)	Tensioner bracket	(16)	Front belt cover	***T4: 9.75 (1.0, 7.2)***
(6)	Automatic belt tension adjuster ASSY	(17)	Timing belt cover RH	***T5: 24.5 (2.5, 18.1)***
(7)	Belt idler	(18)	Crank pulley	***T6: 25 (2.5, 18.4)***
(8)	Exhaust cam sprocket RH	(19)	O-ring	***T7: 39 (4.0, 28.8)***
(9)	Intake cam sprocket RH	(20)	Timing belt guide	***T8: <Ref. to ME(w/o STI)-57, INSTALLATION, Cam Sprocket.>***
(10)	Intake cam sprocket LH	(21)	Actuator cover	***T9: <Ref. to ME(w/o STI)-45, INSTALLATION, Crank Pulley.>***
(11)	Exhaust cam sprocket LH	(22)	Belt idler	

2. CYLINDER HEAD AND CAMSHAFT

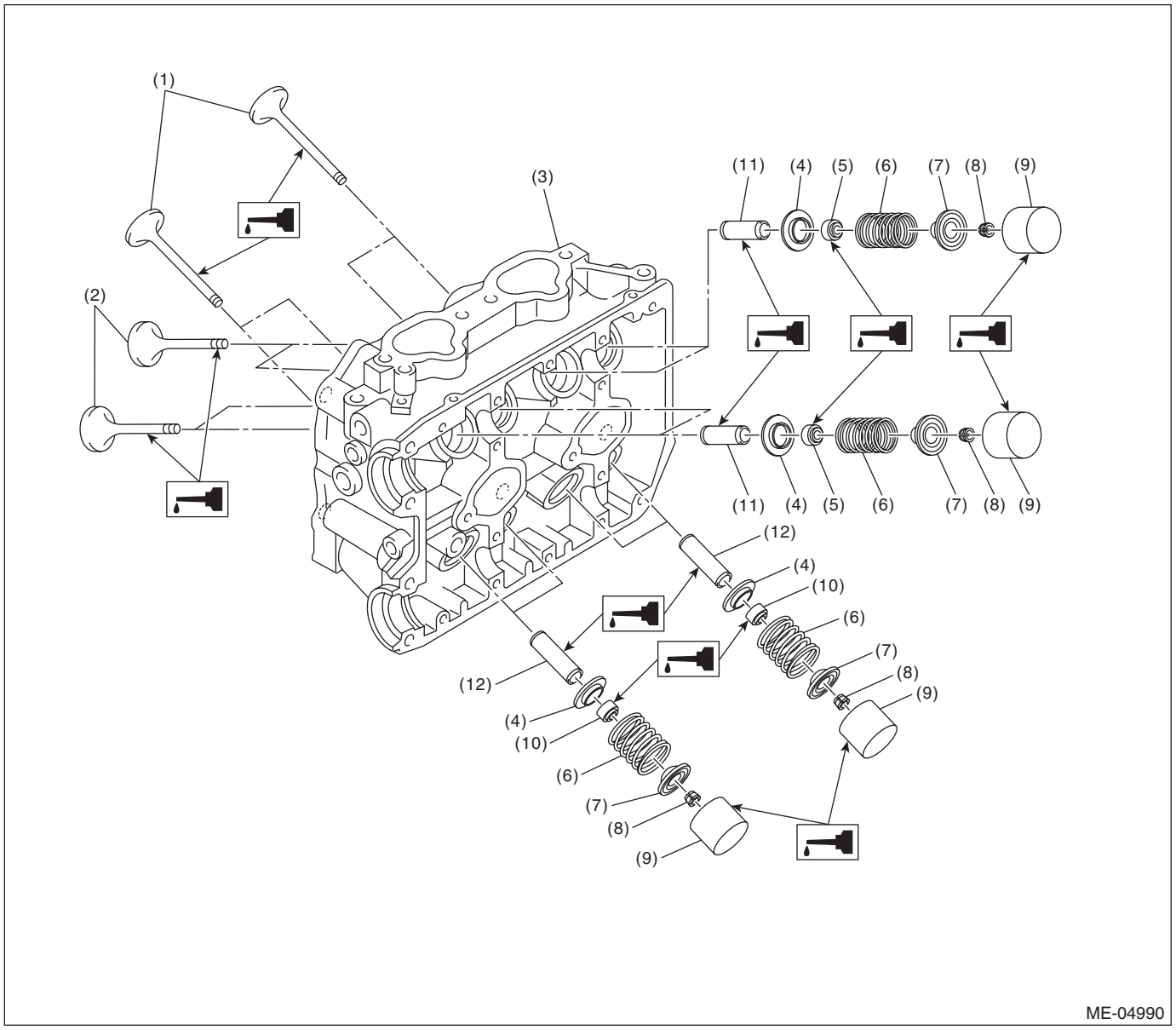


(1) Rocker cover RH
(2) Rocker cover gasket RH
(3) Front camshaft cap RH
(4) Intake camshaft cap RH
(5) Intake camshaft RH
(6) Oil flow control solenoid valve
(7) Exhaust camshaft cap RH
(8) Gasket
(9) Oil return cover
(10) Exhaust camshaft RH
(11) Cylinder head bolt
(12) Oil seal
(13) Cylinder head RH
(14) Cylinder head gasket
(15) Cylinder head LH
(16) Intake camshaft LH
(17) Exhaust camshaft LH
(18) Front camshaft cap LH
(19) Intake camshaft cap LH
(20) Exhaust camshaft cap LH
(21) Rocker cover gasket LH
(22) Rocker cover LH
(23) Oil filler cap
(24) Oil filler duct
(25) O-ring
(26) Oil pipe LH
(27) Gasket
(28) Oil pipe RH
(29) Stud bolt
(30) Union bolt with filter (with protrusion)
(31) Union bolt without filter (without protrusion)
(32) Gasket

Tightening torque: N·m (kgf-m, ft-lb)

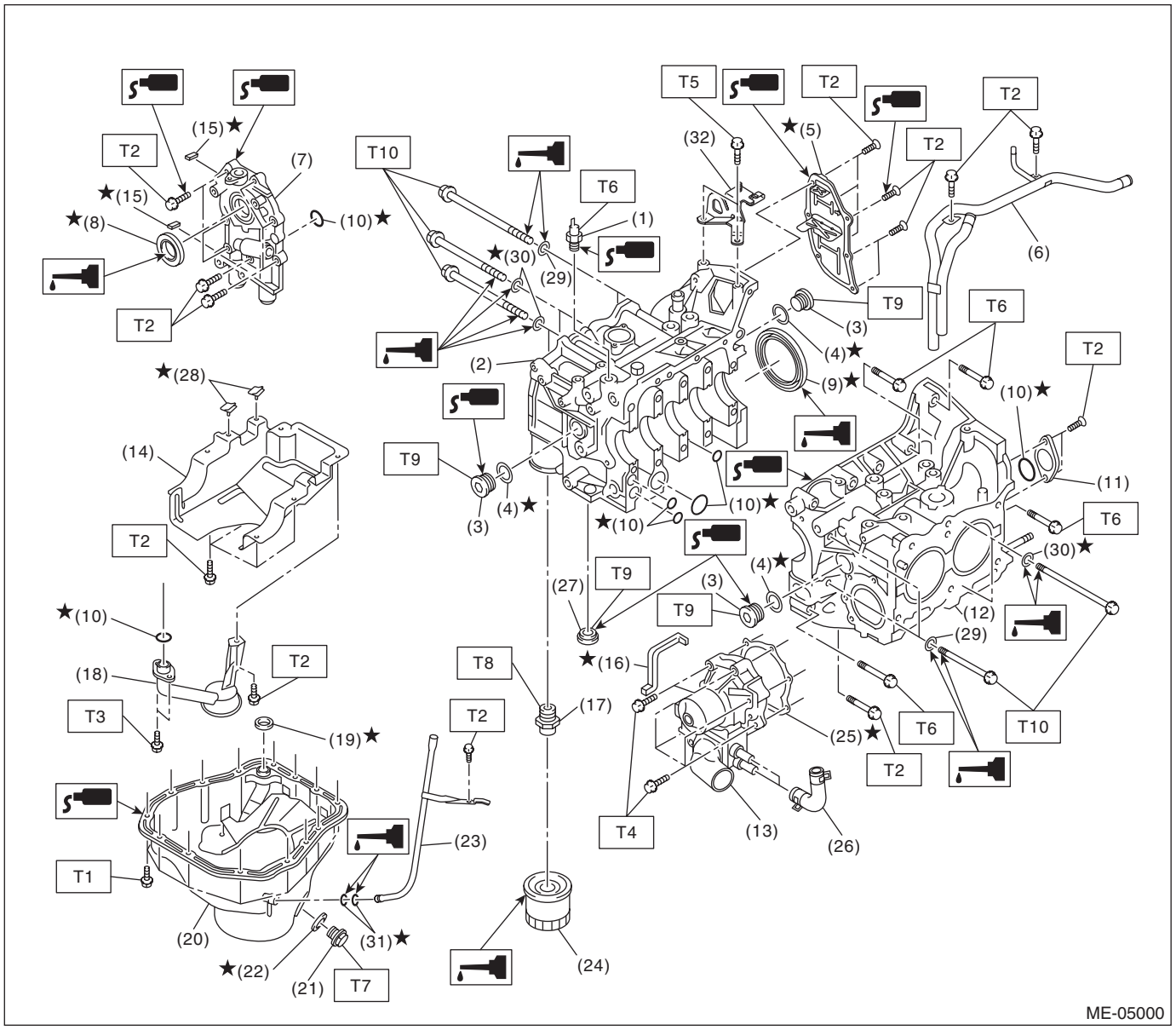
T1: 6.4 (0.7, 4.7)
T2: 9 (0.9, 6.6)
T3: 29 (3.0, 21.4)
T4: <Ref. to ME(w/o STI)-68, INSTALLATION, Cylinder Head.>
T5: <Ref. to ME(w/o STI)-61, INSTALLATION, Camshaft.>

3. CYLINDER HEAD AND VALVE ASSEMBLY



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

4. CYLINDER BLOCK

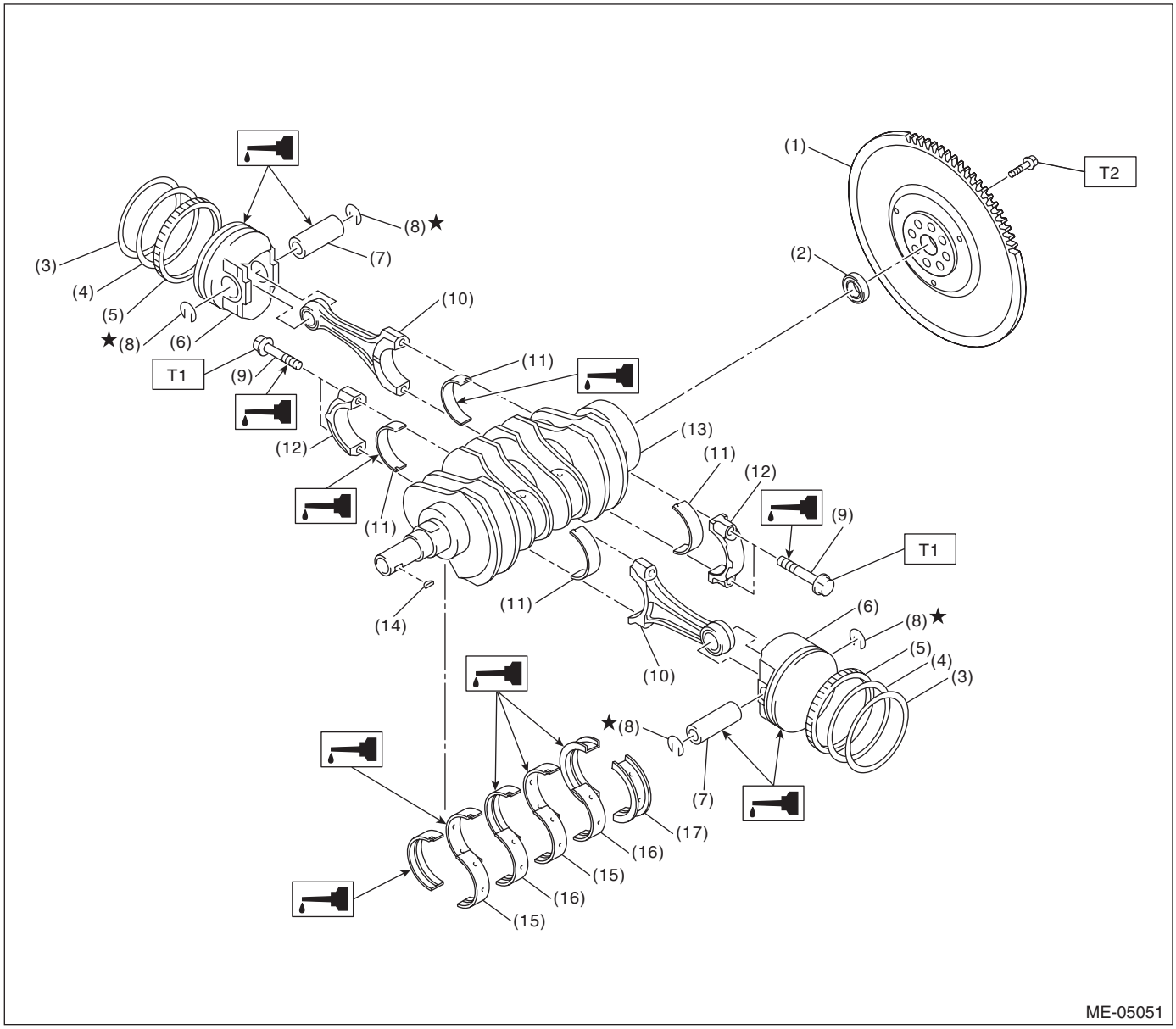


(1) Oil pressure switch
(2) Cylinder block RH
(3) Service hole plug
(4) Gasket
(5) Oil separator cover
(6) Water by-pass pipe
(7) Oil pump
(8) Front oil seal
(9) Rear oil seal
(10) O-ring
(11) Service hole cover
(12) Cylinder block LH
(13) Water pump
(14) Baffle plate
(15) Oil pump seal
(16) Water pump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

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, 7.2)***
T4:	***First 12 (1.2, 8.9) Second 12 (1.2, 8.9)***
T5:	***16 (1.6, 11.8)***
T6:	***25 (2.5, 18.4)***
T7:	***44 (4.5, 32.5)***
T8:	***45 (4.6, 33.2)***
T9:	***70 (7.1, 51.6)***
T10:	***<Ref. to ME(w/o STI)-81, INSTALLATION, Cylinder Block.>***

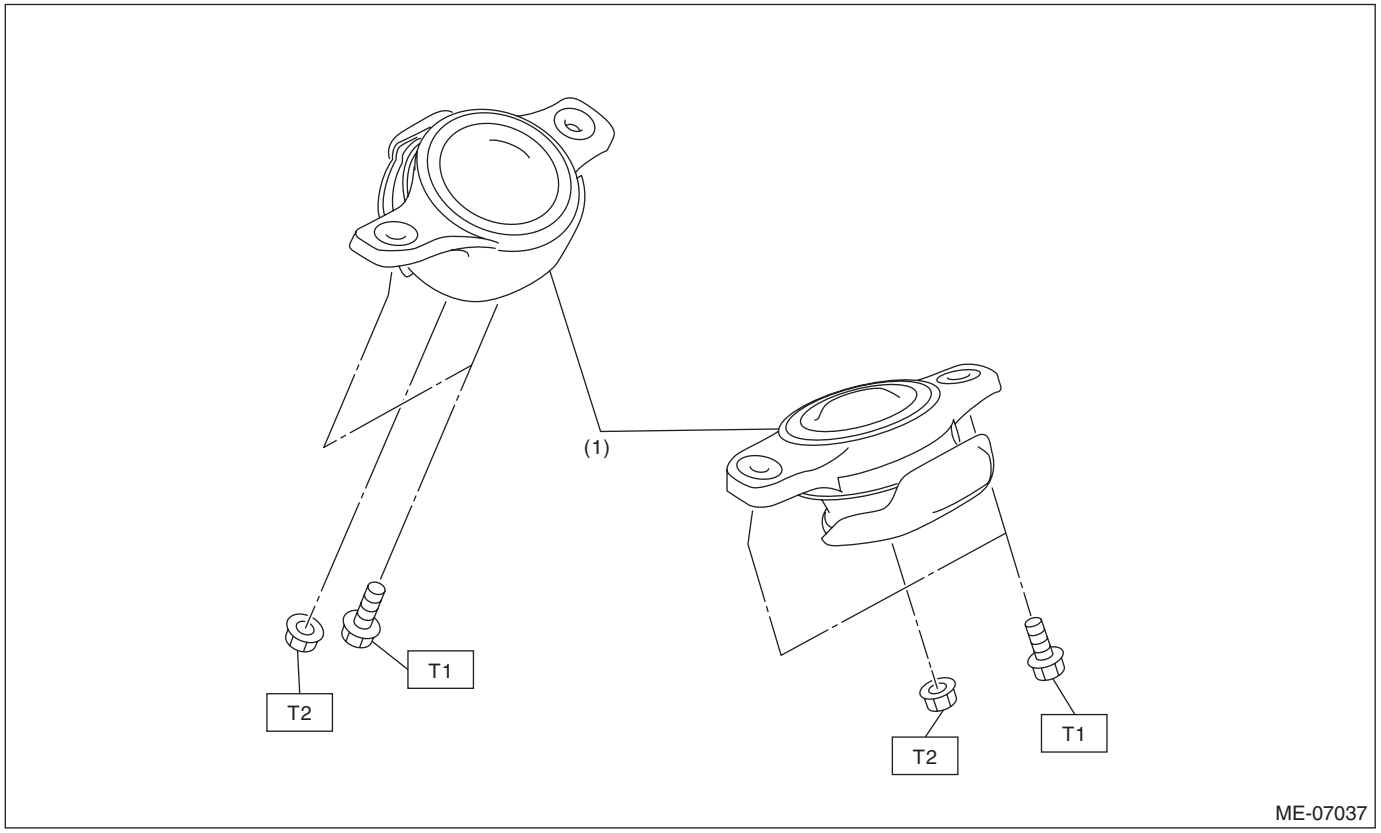
5. CRANKSHAFT AND PISTON



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

Tightening torque: N·m (kgf-m, ft-lb)
T1: 52 (5.3, 38.4)
T2: <Ref. to CL-14, INSTALLATION, Flywheel.>

6. ENGINE MOUNTING



(1) Front cushion rubber

Tightening torque: N·m (kgf-m, ft-lb)
T1: 35 (3.6, 25.8)
T2: 45 (4.6, 33.2)

C: CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove or install the engine in an area where chain hoists, lifting devices, etc. are available for ready use. When lifting up the vehicle, make sure to support the vehicle at the jack-up points.
- Be careful not to let any oil or grease contact the clutch disc, flywheel or timing belt.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil when being assembled.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

D: PREPARATION TOOL

1. SPECIAL TOOL

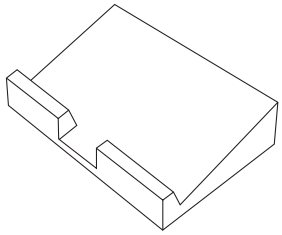
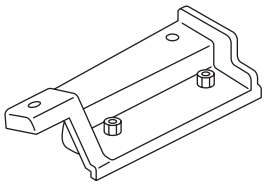
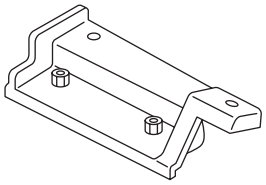
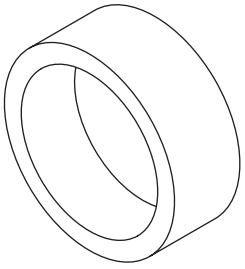
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498267600	498267600	CYLINDER HEAD TABLE	• Used for replacing valve guides. • Used for removing and installing valve spring.
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	Used together with ENGINE STAND (499817100).
 ST-498457100	498457100	ENGINE STAND ADAPTER LH	Used together with ENGINE STAND (499817100).
 ST-498747300	498747300	PISTON GUIDE	Used for installing the piston into the cylinder.

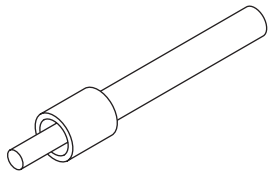
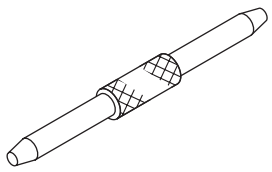
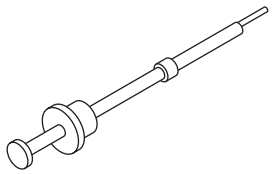
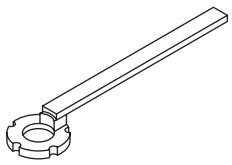
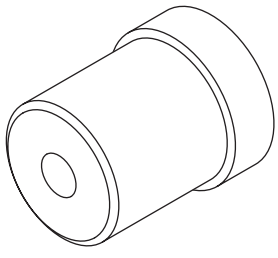
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498857100	498857100	VALVE OIL SEAL GUIDE	Used for press-fitting of intake valve guide oil seals and exhaust valve guide oil seals.
 ST-499017100	499017100	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 ST-499097700	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 ST-499207400	499207400	CAM SPROCKET WRENCH	Used for removing and installing exhaust cam sprocket.
 ST-499587100	499587100	OIL SEAL INSTALLER	Used for installing oil pump oil seal.

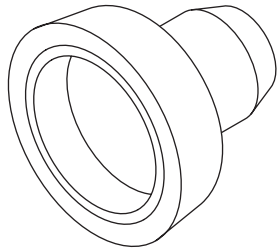
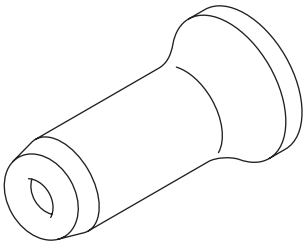
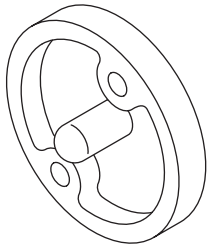
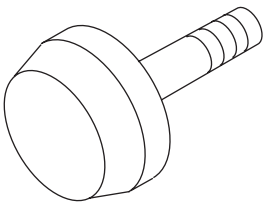
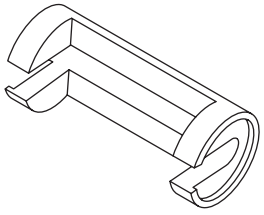
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499587200	499587200	CRANKSHAFT OIL SEAL INSTALLER	• Used for installing crankshaft oil seal. • Used together with CRANKSHAFT OIL SEAL GUIDE (499597100).
 ST-499587600	499587600	OIL SEAL INSTALLER	Used for installing the camshaft oil seal.
 ST-499597100	499597100	CRANKSHAFT OIL SEAL GUIDE	• Used for installing crankshaft oil seal. • Used together with CRANKSHAFT OIL SEAL INSTALLER (499587200).
 ST-499597200	499597200	OIL SEAL GUIDE	• Used for installing the camshaft oil seal. • Used together with OIL SEAL INSTALLER (499587600).
 ST-499718000	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.

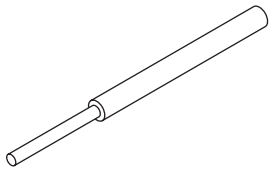
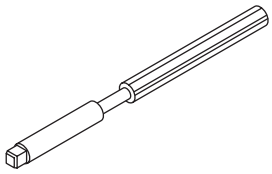
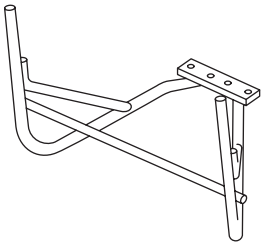
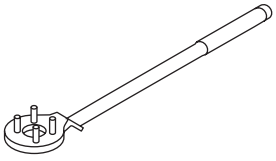
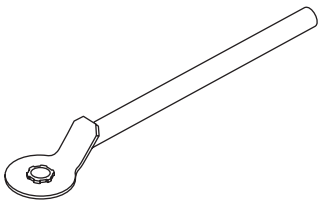
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499767200	499767200	VALVE GUIDE REMOVER	Used for removing valve guides.
 ST-499767400	499767400	VALVE GUIDE REAMER	Used for reaming valve guides.
 ST-499817100	499817100	ENGINE STAND	• Used for disassembling and assembling engine. • Used together with ENGINE STAND ADAPTER RH (498457000) & LH (498457100).
 ST-499977100	499977100	CRANK PULLEY WRENCH	Used for removing and installing the crank pulley.
 ST-499977500	499977500	CAM SPROCKET WRENCH	Used for removing and installing intake cam sprocket.

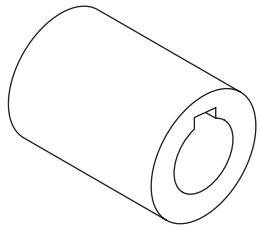
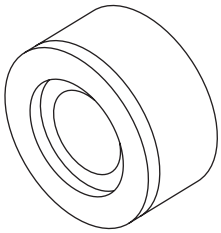
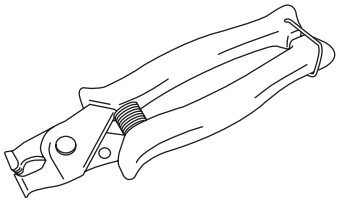
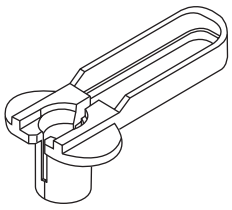
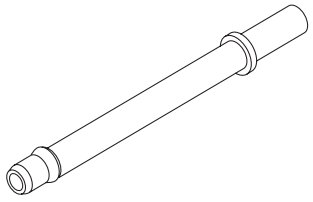
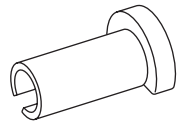
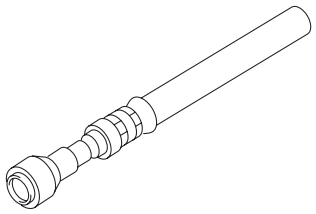
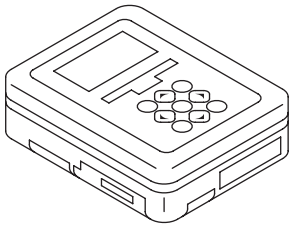
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499987500	499987500	CRANKSHAFT SOCKET	Used for rotating crankshaft.
 ST18251AA020	18251AA020	VALVE GUIDE ADJUSTER	Used for installing intake valve guides and exhaust valve guides.
 ST18353AA000	18353AA000	CLAMP PLIERS	• Used for removing and installing the PCV hose. • This tool is made by the French company CAILLAU. (code) 54.0.000.205 To make it easier to obtain, it has been provided with a tool number.
 ST18371AA000	18371AA000	CONNECTOR REMOVER	Used for disconnecting the quick connector on the fuel return hose side of the engine compartment (intake manifold).
 ST18471AA000	18471AA000	FUEL PIPE ADAPTER	Used for inspecting the fuel pressure.

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST42099AE000	42099AE000	QUICK CONNECTOR RELEASE	Used for removing the quick connector.
 ST42075AG690	42075AG690	FUEL HOSE	Used for inspecting the fuel pressure. NOTE: This is the SUBARU genuine part.
 ST1B022XU0	1B022XU0	SUBARU SELECT MONITOR III KIT	Used for various inspections.

2. GENERAL TOOL

TOOL NAME	REMARKS
Compression gauge	Used for measuring compression.
Timing light	Used for measuring ignition timing.
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.
Angle gauge	Used for installing the crank pulley.