

General Description

MECHANICAL

1. General Description

A: SPECIFICATION

Engine	Cylinder arrangement		Horizontally opposed, liquid cooled, 6-cylinder, 4-stroke gasoline engine		
	Valve system mechanism		Chain driven, double overhead camshaft, 4-valve/cylinder		
	Bore × Stroke		mm (in)	89.2 × 80 (3.512 × 3.150)	
	Displacement		cm ³ (cu in)	3,000 (183)	
	Compression ratio			10.7	
	Compression pressure (350 rpm and fully open throttle):		kPa (kgf/cm ² , psi)	1,275 — 1,471 (13.0 — 15.0, 185 — 213)	
	Number of piston rings			Pressure ring: 2, Oil ring: 1	
	Intake valve timing		Min. advance	Open	BTDC 47°
				Close	ABDC 23°
			Max. retard	Open	ATDC 3°
				Close	ABDC 73°
	Exhaust valve timing			Open	BBDC 60°
				Close	ATDC 6°
	Valve clearance		mm (in)	Intake	0.20 ^{+0.04} _{-0.06} (0.0079 ^{+0.0016} _{-0.0024})
				Exhaust	0.35±0.05 (0.0138±0.020)
	Idle rpm ["P" or "N" range]		rpm	No load	650±50
A/C ON				770±50	
Ignition order				1 → 6 → 3 → 2 → 5 → 4	
Ignition timing		BTDC/rpm		15°±8°/650	

NOTE:

OS: Oversize US: Undersize

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Camshaft	Side clearance	mm (in)	Intake		Standard	0.075 — 0.135 (0.0030 — 0.0053)
			Exhaust		Standard	0.030 — 0.090 (0.0012 — 0.0035)
	Cam lobe height	mm (in)	Intake	HIGH	Standard	42.09 — 42.19 (1.6571 — 1.6610)
				LOW1	Standard	38.14 — 38.24 (1.5016 — 1.5055)
				LOW2	Standard	34.94 — 35.04 (1.3756 — 1.3795)
			Exhaust		Standard	41.65 — 41.75 (1.6398 — 1.6437)
	Cam base circle diameter	mm (in)	Intake	HIGH	Standard	32.00 (1.2598)
				LOW1	Standard	31.84 (1.2535)
				LOW2	Standard	31.84 (1.2535)
			Exhaust		Standard	32.00 (1.2598)
Journal O.D.	mm (in)	Front		Standard	37.946 — 37.963 (1.4939 — 1.4946)	
		Except for front		Standard	25.946 — 25.963 (1.0215 — 1.0222)	
Oil clearance		mm (in)	Standard	0.037 — 0.072 (0.0015 — 0.0028)		
Cylinder head	Warping limit (Mating with cylinder block)		mm (in)	Standard	0.02 (0.0008)	
	Inner diameter of valve lifter hole		mm (in)		32.994 — 33.016 (1.2990 — 1.2998)	
	Standard height		mm (in)		124±0.05 (4.88±0.0020)	
Valve seat	Seating angle				90°	
	Contacting width	mm (in)	Intake	Standard	1.0 (0.039)	
Exhaust			Standard	1.5 (0.059)		
Valve guide	Inside diameter		mm (in)		5.500 — 5.512 (0.2165 — 0.2170)	
	Protrusion above head		mm (in)		11.4 — 11.8 (0.449 — 0.465)	
Valve	Head edge thickness	mm (in)	Intake		Standard	1.0 (0.039)
			Exhaust		Standard	1.2 (0.047)
	Stem outer diameter	mm (in)	Intake			5.455 — 5.470 (0.2148 — 0.2154)
			Exhaust			5.445 — 5.460 (0.2144 — 0.2150)
	Stem oil clearance		Intake		Standard	0.030 — 0.057 (0.0012 — 0.0022)
			Exhaust		Standard	0.040 — 0.067 (0.0016 — 0.0026)
Overall length	mm (in)	Intake			99.7 (3.925)	
		Exhaust			105.2 (4.142)	
Outer diameter of valve lifter		mm (in)		32.959 — 32.975 (1.2976 — 1.2982)		
Valve spring	Free length	mm (in)	Intake	Inner	39.55 (1.5571)	
				Outer	41.18 (1.6213)	
	Exhaust			46.32 (1.8236)		
	Squareness		Intake	Inner	2.5°, 1.7 mm (0.067 in)	
Outer				2.5°, 1.8 mm (0.071 in)		
Exhaust			2.5°, 2.0 mm (0.079 in)			
Cylinder block	Standard height		mm (in)		202 (7.95)	
	Warping limit (Mating with cylinder head)		mm (in)	Standard	0.02 (0.0008)	
	Cylinder inner diameter	mm (in)	Standard	A	89.205 — 89.215 (3.5120 — 3.5124)	
				B	89.195 — 89.205 (3.5116 — 3.5120)	
	Cylindricity		mm (in)	Standard	0.030 (0.0012)	
	Out-of-roundness		mm (in)	Standard	0.010 (0.0004)	
	Piston clearance		mm (in)	Standard	-0.010 — 0.010 (-0.0004 — 0.0004)	
Cylinder inner diameter boring limit (diameter)		mm (in)		To 89.715 (3.5321)		
Piston	Outer diameter	mm (in)	Standard	A	89.205 — 89.215 (3.5120 — 3.5124)	
				B	89.195 — 89.205 (3.5116 — 3.5120)	
			0.25 (0.0098) OS			89.445 — 89.465 (3.5215 — 3.5222)
			0.50 (0.0197) OS			89.695 — 89.715 (3.5313 — 3.5321)
Inner diameter of piston pin hole			Standard	22.000 — 22.006 (0.8661 — 0.8664)		

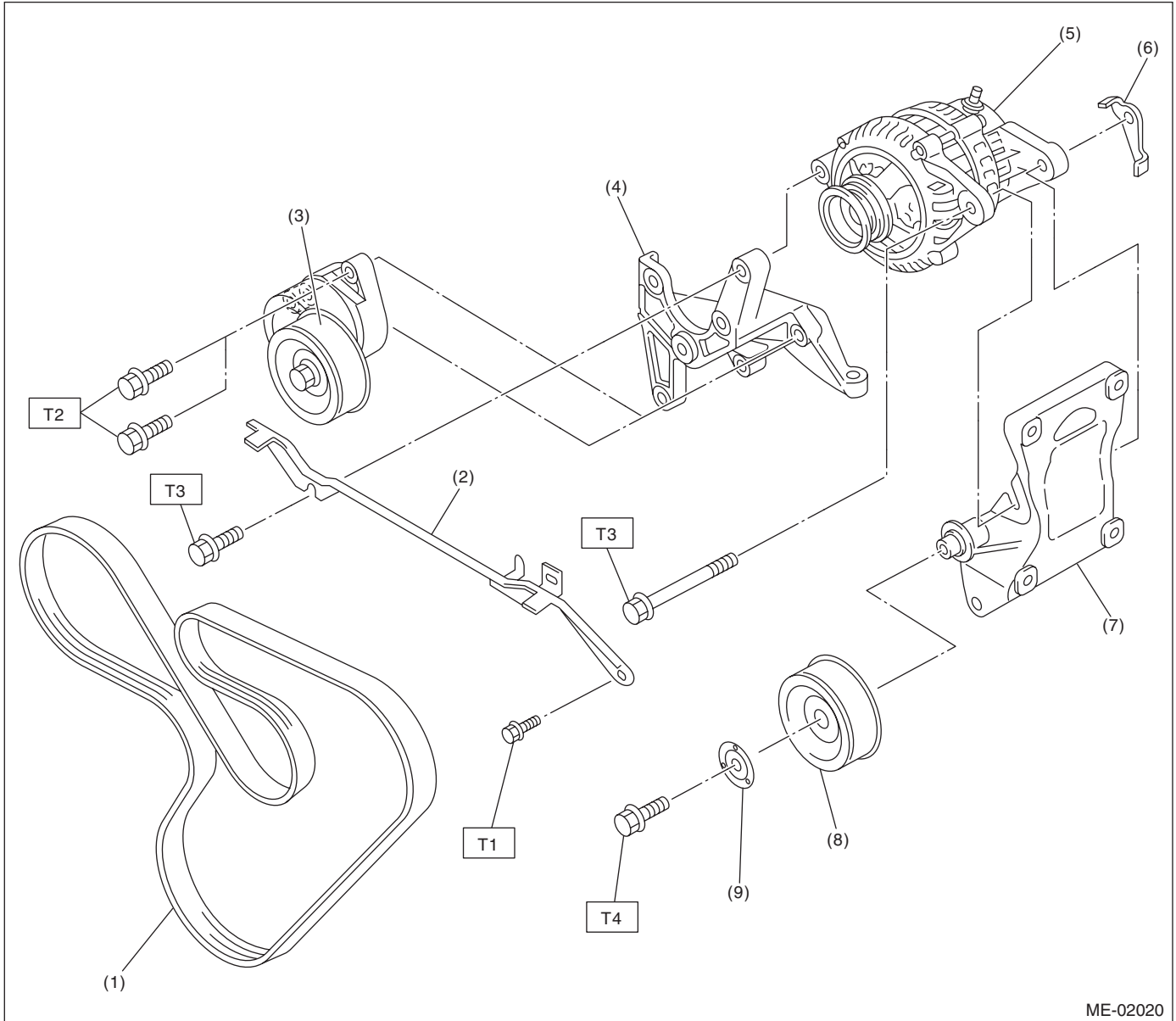
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Piston pin	Outer diameter		mm (in)	Standard	21.994 — 22.000 (0.8659 — 0.8661)	
	Standard clearance between piston and piston pin		mm (in)	Standard	0.004 — 0.008 (0.0002 — 0.0003)	
Piston ring	Ring closed gap	mm (in)	Top ring	Standard	0.20 — 0.35 (0.0079 — 0.0138)	
			Second ring	Standard	0.35 — 0.50 (0.0138 — 0.0197)	
			Oil ring	Standard	0.20 — 0.60 (0.0079 — 0.0236)	
	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)	
			Oil ring	Standard	0.045 — 0.125 (0.0018 — 0.0049)	
Connecting rod	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	0.016 — 0.043 (0.0006 — 0.0017)	
	Bearing size (Thickness at center)	mm (in)	Standard		1.490 — 1.506 (0.0587 — 0.0593)	
			0.03 (0.0012) US		1.509 — 1.513 (0.0594 — 0.0596)	
			0.05 (0.0020) US		1.519 — 1.523 (0.0598 — 0.0600)	
0.25 (0.0098) US			1.619 — 1.623 (0.0637 — 0.0639)			
Bushing of small end	Clearance between piston pin and bushing		mm (in)	Standard	0 — 0.022 (0 — 0.0009)	
Crankshaft	Crank pin and crank journal		Out-of-roundness	mm (in)	0.005 (0.0002)	
			Cylindricity	mm (in)	0.006 (0.0002)	
	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	#1, #3, #5, #7	mm (in)	Standard		63.992 — 64.008 (2.5194 — 2.5200)
				0.03 (0.0012) US		63.962 — 63.978 (2.5182 — 2.5188)
				0.05 (0.0020) US		63.942 — 63.958 (2.5174 — 2.5180)
				0.25 (0.0098) US		63.742 — 63.758 (2.5095 — 2.5102)
		#2, #4, #6	mm (in)	Standard		63.992 — 64.008 (2.5194 — 2.5200)
				0.03 (0.0012) US		63.962 — 63.978 (2.5182 — 2.5188)
				0.05 (0.0020) US		63.942 — 63.958 (2.5174 — 2.5180)
				0.25 (0.0098) US		63.742 — 63.758 (2.5095 — 2.5102)
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)		
Main bearing	Bearing size (Thickness at center)	mm (in)	#1, #3, #5, #7	Standard		1.992 — 2.005 (0.0784 — 0.0789)
				0.03 (0.0012) US		2.011 — 2.014 (0.0792 — 0.0793)
				0.05 (0.0020) US		2.021 — 2.024 (0.0796 — 0.0797)
				0.25 (0.0098) US		2.121 — 2.124 (0.0835 — 0.0836)
			#2, #4, #6	Standard		1.996 — 2.009 (0.0786 — 0.0791)
				0.03 (0.0012) US		2.015 — 2.018 (0.0793 — 0.0794)
				0.05 (0.0020) US		2.025 — 2.028 (0.0797 — 0.0798)
				0.25 (0.0098) US		2.125 — 2.128 (0.0837 — 0.0838)

B: COMPONENT

1. V-BELT



- | | |
|---------------------------------|-------------------------|
| (1) V-belt | (6) Generator plate |
| (2) Collector cover bracket | (7) A/C compressor stay |
| (3) Belt tension adjuster ASSY | (8) Idler pulley |
| (4) Power steering pump bracket | (9) Idler pulley cover |
| (5) Generator | |

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

T1: 6.4 (0.65, 4.7)

T2: 20 (2.0, 14)

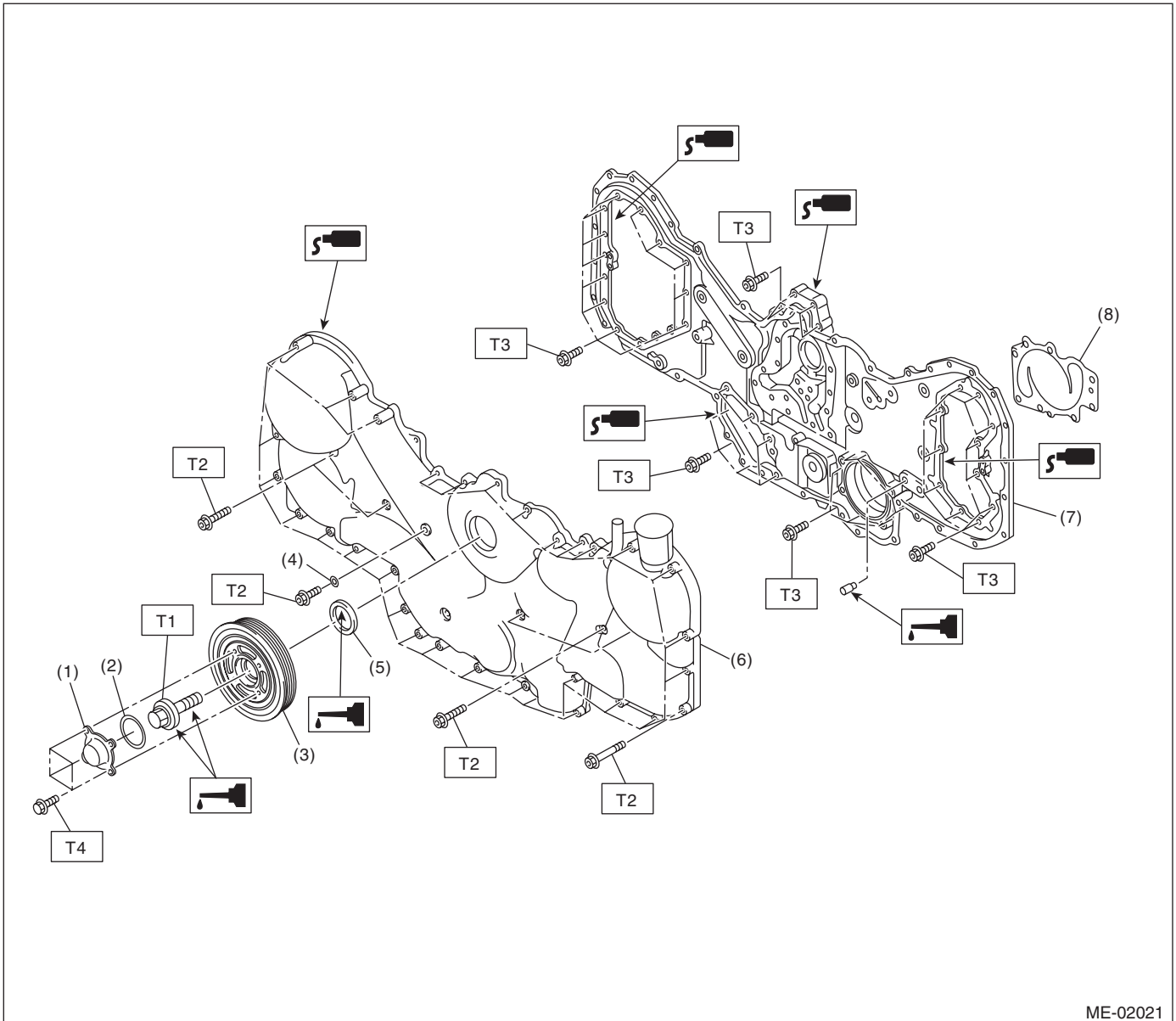
T3: 25 (2.5, 18)

T4: 33 (3.4, 25)

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2. TIMING CHAIN COVER



- | | |
|------------------------|-----------------------|
| (1) Crank pulley cover | (5) Oil seal |
| (2) O-ring | (6) Front chain cover |
| (3) Crank pulley | (7) Rear chain cover |
| (4) Sealing washer | (8) Water pump gasket |

Tightening torque: N·m (kgf·m, ft·lb)

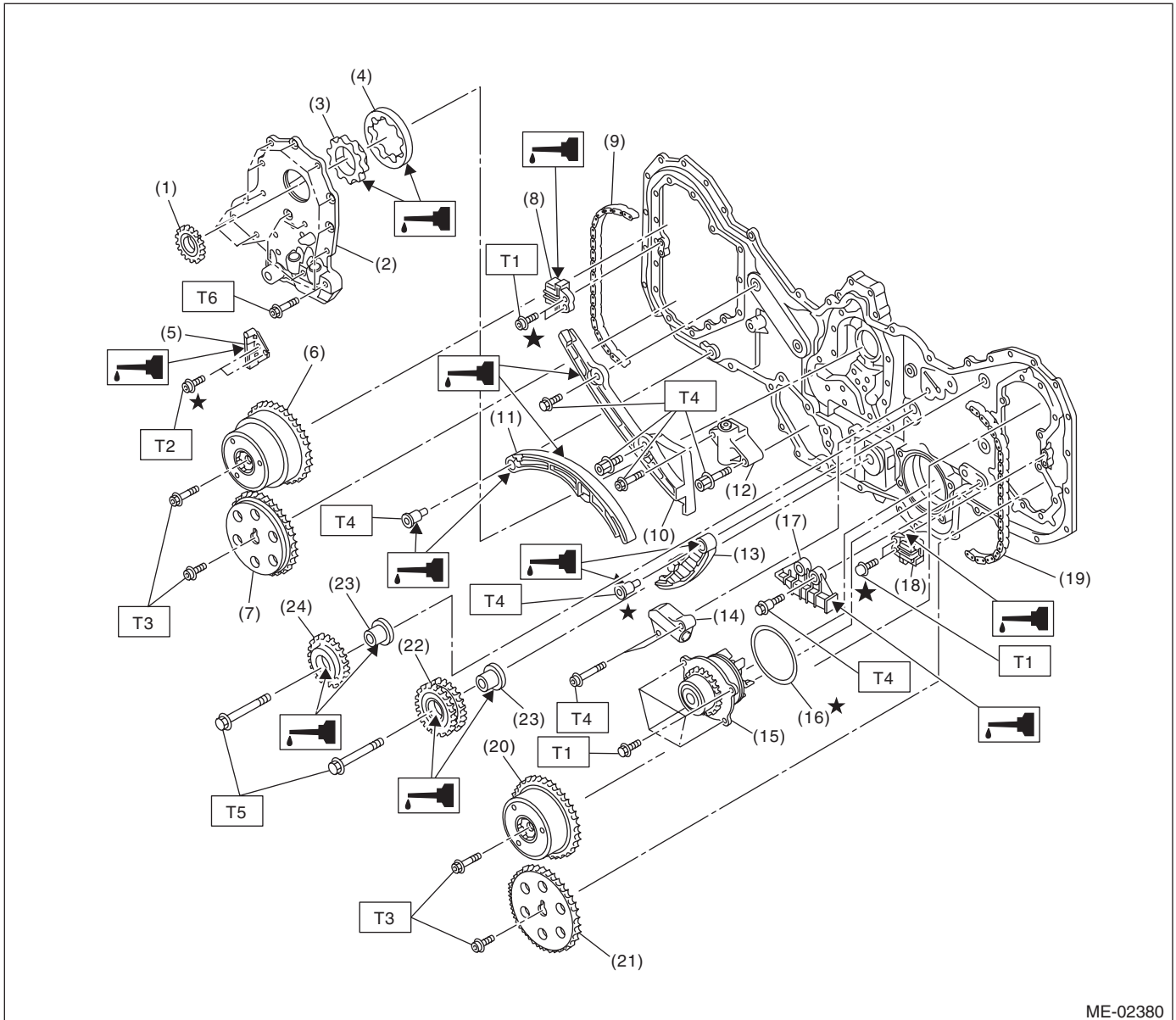
T1: <Ref. to ME(H6DO)-41, Crank Pulley.>

T2: <Ref. to ME(H6DO)-42, Front Chain Cover.>

T3: <Ref. to ME(H6DO)-51, Rear Chain Cover.>

T4: 6.4 (0.65, 4.7)

3. TIMING CHAIN



ME-02380

- | | | |
|------------------------------------|-------------------------------------|-----------------------------|
| (1) Crank sprocket | (13) Chain tensioner lever (LH) | (24) Idler sprocket (upper) |
| (2) Oil relief case | (14) Chain tensioner (LH) | |
| (3) Inner rotor | (15) Water pump | |
| (4) Outer rotor | (16) O-ring | |
| (5) Chain guide (center) | (17) Chain guide (LH) | |
| (6) Intake cam sprocket (RH) | (18) Chain guide (LH: between cams) | |
| (7) Exhaust cam sprocket (RH) | (19) Timing chain (LH) | |
| (8) Chain guide (RH: between cams) | (20) Intake cam sprocket (LH) | |
| (9) Timing chain (RH) | (21) Exhaust cam sprocket (LH) | |
| (10) Chain guide (RH) | (22) Idler sprocket (lower) | |
| (11) Chain tensioner lever (RH) | (23) Idler sprocket collar | |
| (12) Chain tensioner (RH) | | |

Tightening torque: N·m (kgf·m, ft·lb)

T1: 6.4 (0.65, 4.7)

T2: 7.8 (0.8, 5.8)

T3: <Ref. to ME(H6DO)-49, Cam Sprocket.>

T4: 16 (1.6, 12)

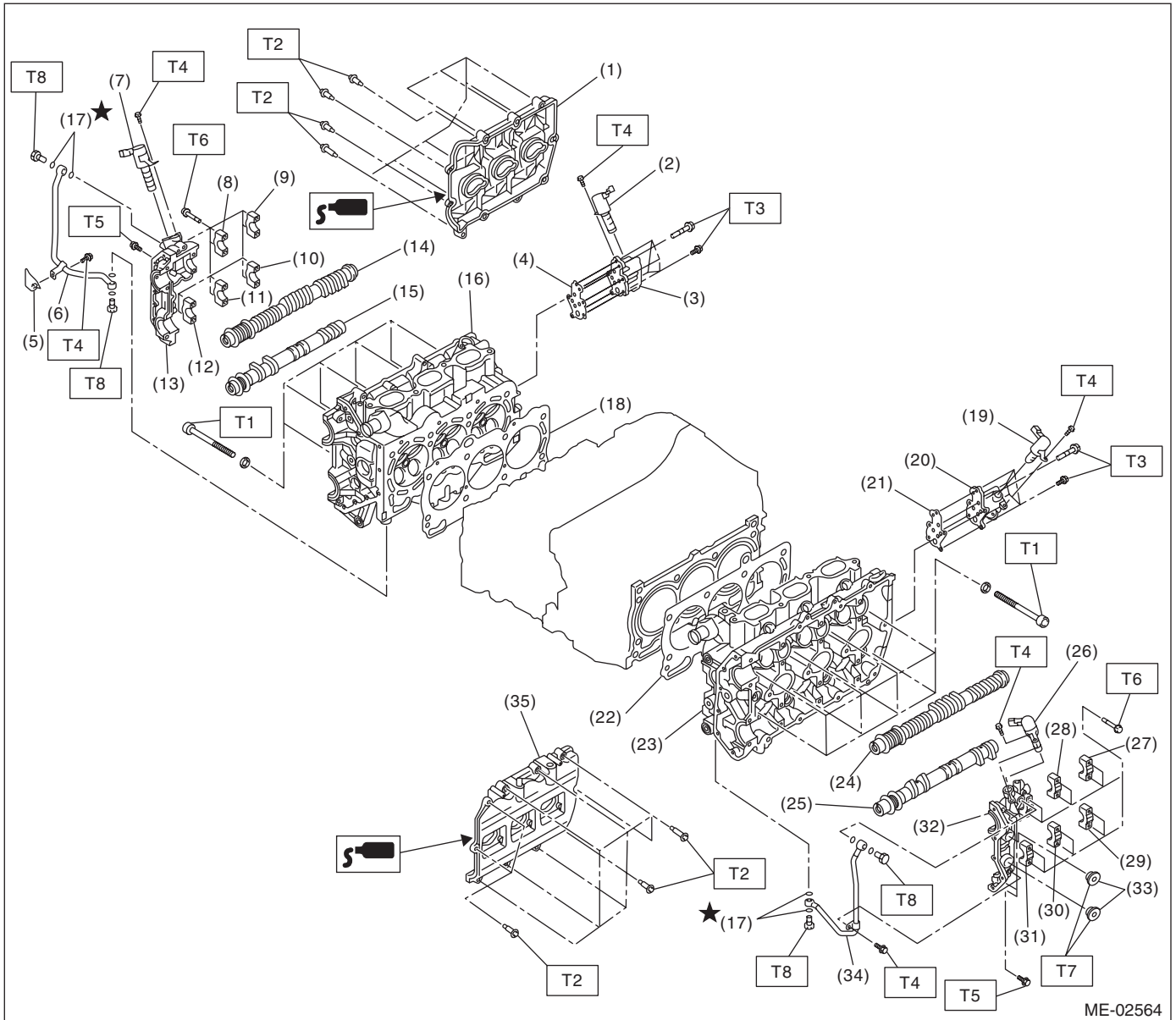
T5: 69 (7.0, 50.6)

T6: <Ref. to LU(H6DO)-8, Oil Pump.>

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4. CYLINDER HEAD AND CAMSHAFT



General Description

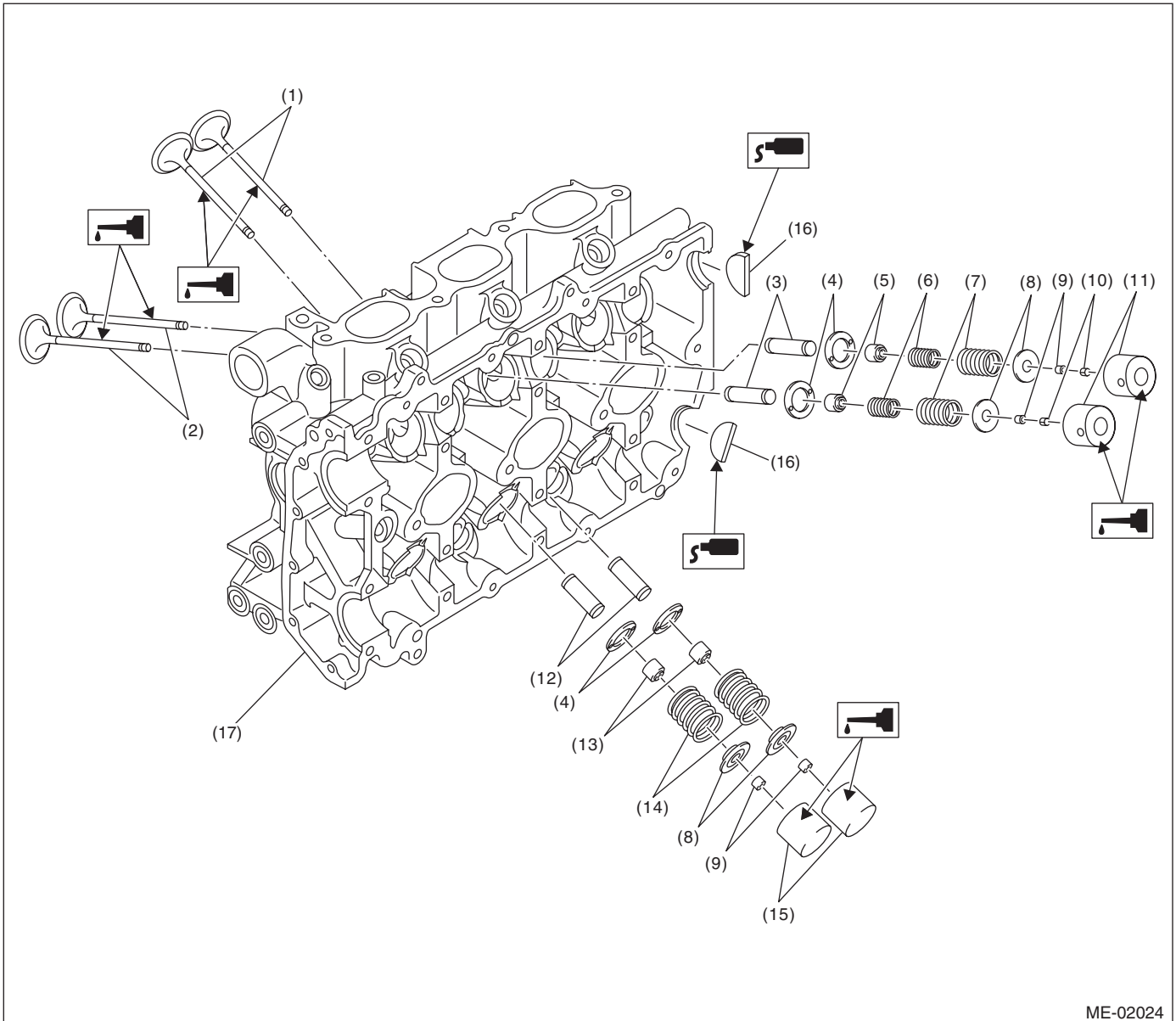
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(1) Rocker cover (RH)	(16) Cylinder head (RH)	(31) Exhaust camshaft cap (Front LH)
(2) Oil switching solenoid valve (RH)	(17) Gasket	(32) Front camshaft cap (LH)
(3) Oil switching solenoid valve holder (RH)	(18) Cylinder head gasket (RH)	(33) Plug
(4) Oil switching solenoid valve gasket (RH)	(19) Oil switching solenoid valve (LH)	(34) Oil pipe (LH)
(5) Rear chain cover	(20) Oil switching solenoid valve holder (LH)	(35) Rocker cover (LH)
(6) Oil pipe (RH)	(21) Oil switching solenoid valve gasket (LH)	
(7) Oil flow control solenoid valve (RH)	(22) Cylinder head gasket (LH)	<i>Tightening torque: N·m (kgf-m, ft-lb)</i>
(8) Intake camshaft cap (Center RH)	(23) Cylinder head (LH)	<i>T1: <Ref. to ME(H6DO)-57, Cylinder Head.></i>
(9) Intake camshaft cap (Rear RH)	(24) Intake camshaft (LH)	<i>T2: <Ref. to ME(H6DO)-53, Camshaft.></i>
(10) Exhaust camshaft cap (Rear RH)	(25) Exhaust camshaft (LH)	<i>T3: <Ref. to ME(H6DO)-78, Oil Switching Solenoid Valve.></i>
(11) Exhaust camshaft cap (Center RH)	(26) Oil flow control solenoid valve (LH)	<i>T4: 6.4 (0.65, 4.7)</i>
(12) Exhaust camshaft cap (Front RH)	(27) Intake camshaft cap (Rear LH)	<i>T5: 9.75 (1.0, 7.2)</i>
(13) Front camshaft cap (RH)	(28) Intake camshaft cap (Center LH)	<i>T6: 16 (1.6, 12)</i>
(14) Intake camshaft (RH)	(29) Exhaust camshaft cap (Rear LH)	<i>T7: 60 (6.1, 44)</i>
(15) Exhaust camshaft (RH)	(30) Exhaust camshaft cap (Center LH)	<i>T8: 29 (3.0, 21.4)</i>

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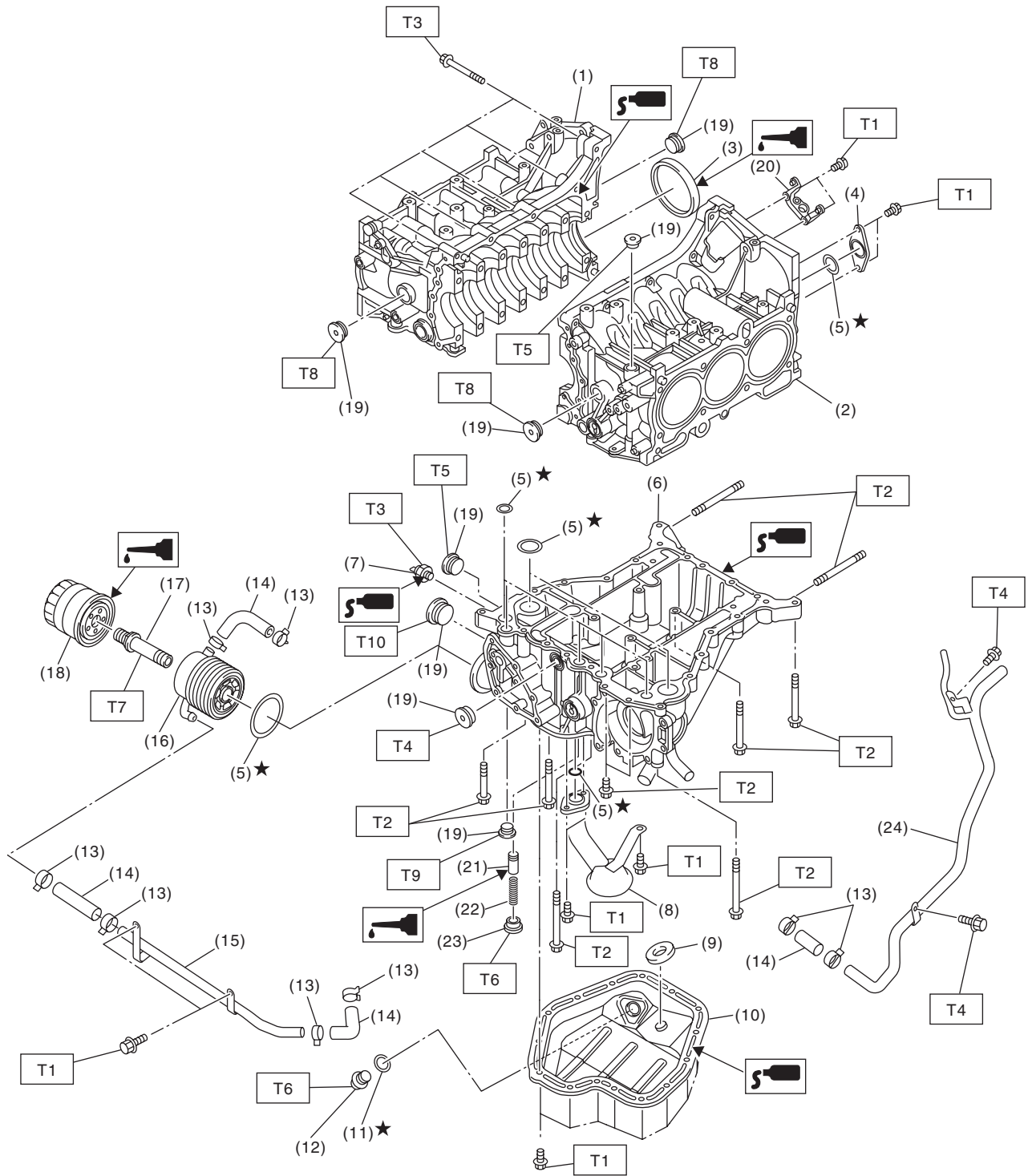
5. CYLINDER HEAD AND VALVE ASSEMBLY



ME-02024

- | | | |
|----------------------------|----------------------------|------------------------------|
| (1) Exhaust valve | (7) Valve spring (Outer) | (13) Exhaust valve stem seal |
| (2) Intake valve | (8) Retainer | (14) Valve spring |
| (3) Intake valve guide | (9) Retainer key | (15) Valve lifter (Exhaust) |
| (4) Valve spring seat | (10) Shim | (16) Cylinder head plug |
| (5) Intake valve stem seal | (11) Valve lifter (Intake) | (17) Cylinder head |
| (6) Valve spring (Inner) | (12) Exhaust valve guide | |

6. CYLINDER BLOCK



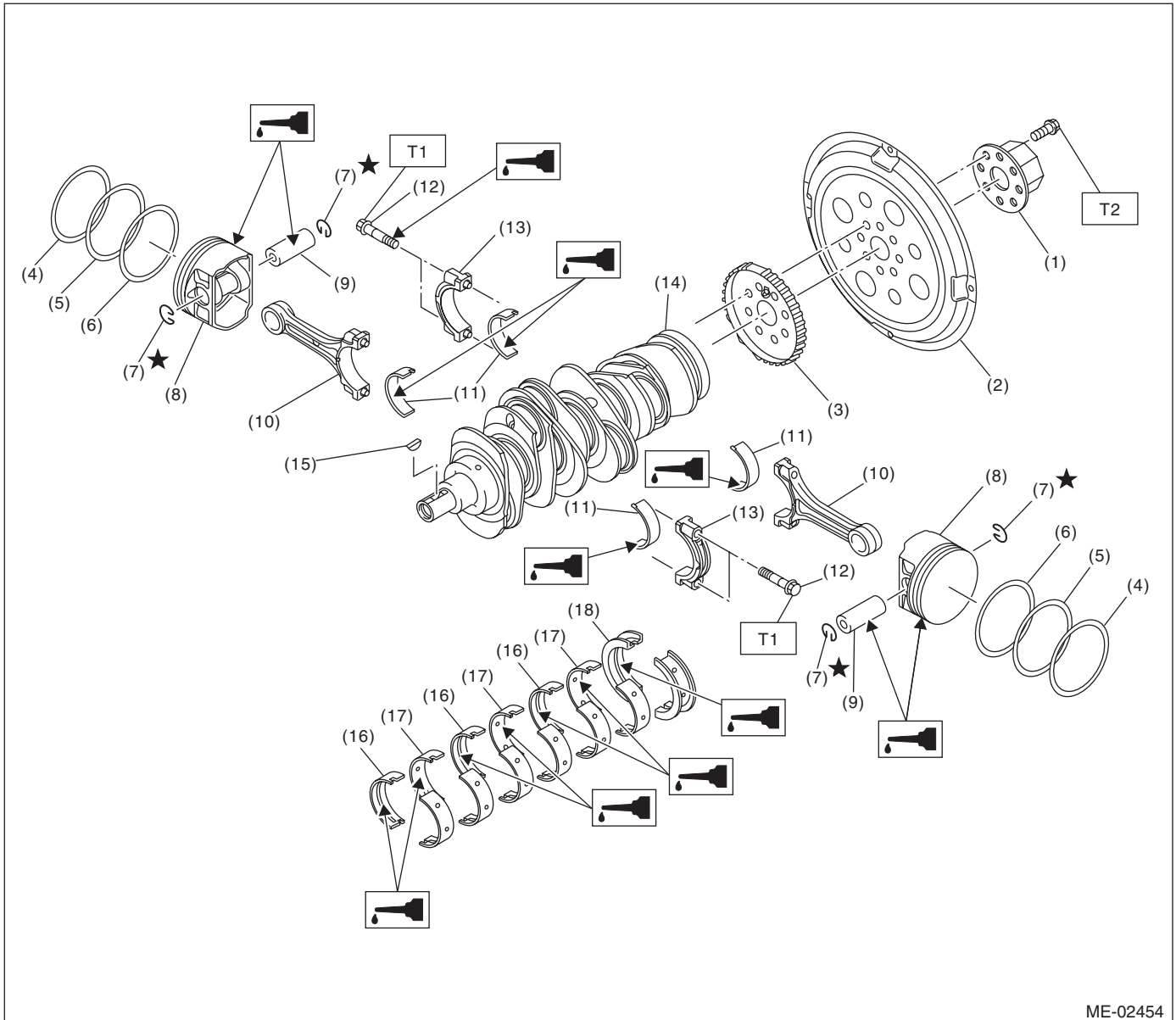
ME-02782

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(1) Cylinder block (RH)	(13) Clamp	<i>Tightening torque: N·m (kgf-m, ft-lb)</i>
(2) Cylinder block (LH)	(14) Hose	<i>T1: 6.4 (0.65, 4.7)</i>
(3) Rear oil seal	(15) Oil cooler pipe	<i>T2: 18 (1.8, 13.3)</i>
(4) Service hole cover	(16) Oil cooler	<i>T3: 25 (2.5, 18.4)</i>
(5) O-ring	(17) Connector	<i>T4: 16 (1.6, 12)</i>
(6) Oil pan upper	(18) Oil filter	<i>T5: 37 (3.8, 27)</i>
(7) Oil pressure switch	(19) Plug	<i>T6: 44 (4.5, 33)</i>
(8) Oil strainer	(20) Crankshaft position sensor holder	<i>T7: 54 (5.5, 40)</i>
(9) Magnet	(21) Relief valve	<i>T8: 70 (7.1, 52)</i>
(10) Oil pan lower	(22) Relief valve spring	<i>T9: 23 (2.3, 17)</i>
(11) Metal gasket	(23) Plug	<i>T10: 90 (9.2, 67)</i>
(12) Drain plug	(24) Water pipe	

7. CRANKSHAFT AND PISTON



ME-02454

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

Tightening torque: N·m (kgf·m, ft·lb)

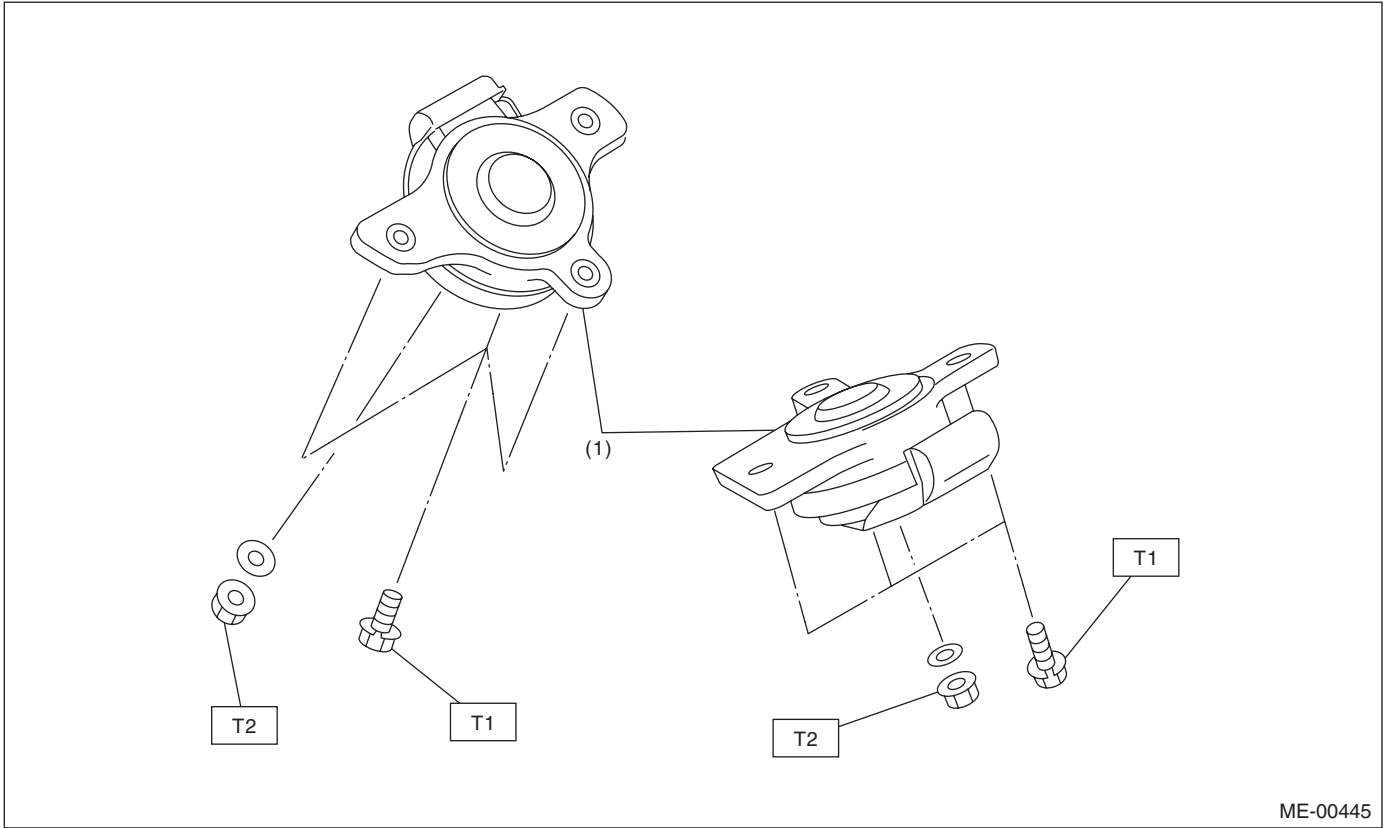
T1: 53 (5.4, 39)

T2: 81 (8.3, 60)

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8. ENGINE MOUNTING



(1) Front cushion rubber

Tightening torque: N·m (kgf-m, ft-lb)

T1: 35 (3.6, 25.8)

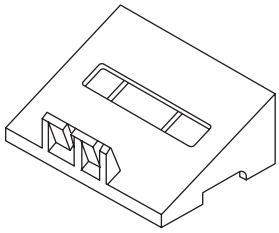
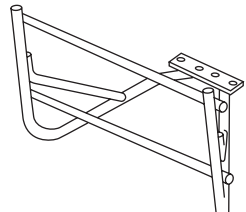
T2: 75 (7.6, 55.3)

C: CAUTION

- Wear 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 re-checks.
- 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.

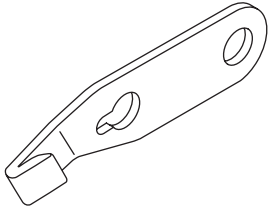
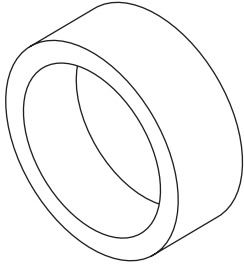
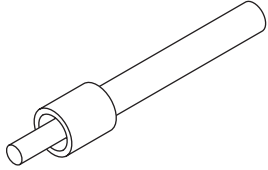
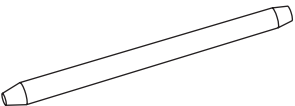
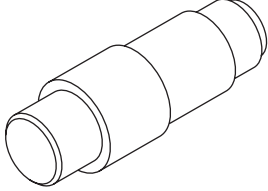
D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18250AA010	18250AA010	CYLINDER HEAD TABLE	<ul style="list-style-type: none"> • Used for replacing valve guides. • Used for removing and installing valve spring.
 ST18232AA000	18232AA000	ENGINE STAND	Used for disassembling and assembling engine.

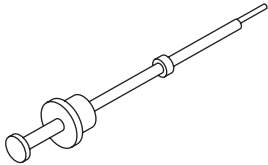
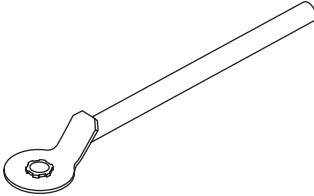
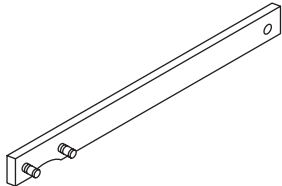
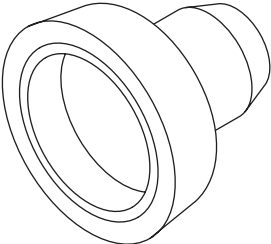
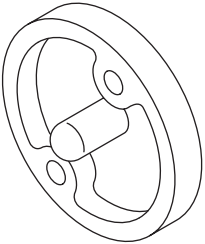
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ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-498497100</p>	498497100	CRANKSHAFT STOPPER	Used for stopping rotation of flywheel or drive plate when loosening / tightening crank pulley bolt.
 <p style="text-align: center;">ST18254AA000</p>	18254AA000	PISTON GUIDE	Used for installing piston in cylinder.
 <p style="text-align: center;">ST-499585500</p>	499585500	VALVE OIL SEAL GUIDE	Used for press-fitting of intake and exhaust valve guide oil seals.
 <p style="text-align: center;">ST18253AA000</p>	18253AA000	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 <p style="text-align: center;">ST18350AA000</p>	18350AA000	CONNECTING ROD BUSHING REMOVER AND INSTALLER	Used for removing and installing connecting rod bushing.

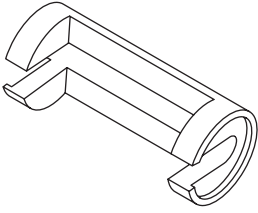
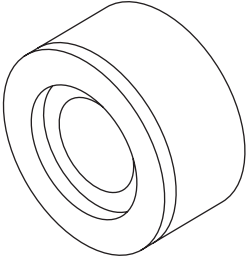
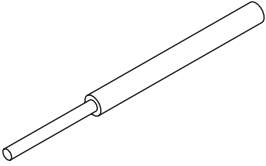
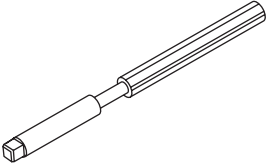
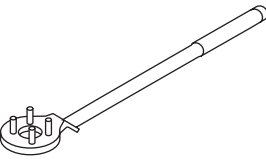
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-499097500</p>	499097500	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 <p style="text-align: center;">ST-499977500</p>	499977500	CAM SPROCKET WRENCH	Used for removing and installing intake cam sprocket.
 <p style="text-align: center;">ST18231AA020</p>	18231AA020	CAM SPROCKET WRENCH	Used for removing and installing exhaust cam sprocket.
 <p style="text-align: center;">ST-499587200</p>	499587200	CRANKSHAFT OIL SEAL INSTALLER	<ul style="list-style-type: none"> • Used for installing crankshaft oil seal. • Used with CRANKSHAFT OIL SEAL GUIDE (499597100).
 <p style="text-align: center;">ST-499597100</p>	499597100	CRANKSHAFT OIL SEAL GUIDE	<ul style="list-style-type: none"> • Used for installing crankshaft oil seal. • Used with CRANKSHAFT OIL SEAL INSTALLER (499587200).

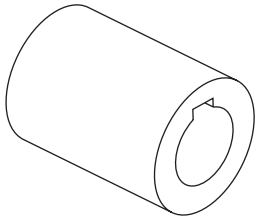
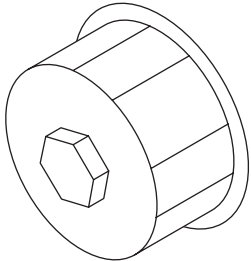
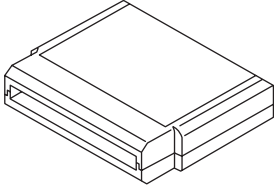

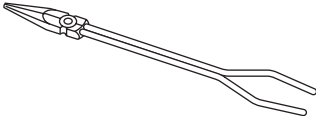
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-499718000</p>	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.
 <p style="text-align: center;">ST18251AA040</p>	18251AA040	VALVE GUIDE ADJUSTER	Used for installing valve guides.
 <p style="text-align: center;">ST-499765700</p>	499765700	VALVE GUIDE REMOVER	Used for removing valve guides.
 <p style="text-align: center;">ST-499765900</p>	499765900	VALVE GUIDE REAMER	Used for reaming valve guides.
 <p style="text-align: center;">ST-499977100</p>	499977100	CRANK PULLEY WRENCH	Used for stopping rotation of crank pulley when loosening/tightening crank pulley bolt.

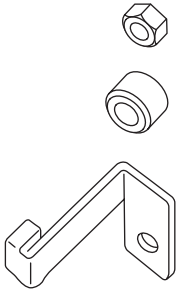
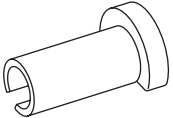
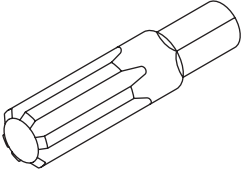
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST18252AA000</p>	18252AA000	CRANKSHAFT SOCKET	Used for rotating crankshaft.
 <p style="text-align: center;">ST-498547000</p>	498547000	OIL FILTER WRENCH	Used for removing and installing oil filter.
 <p style="text-align: center;">ST18482AA010</p>	18482AA010	CARTRIDGE	Troubleshooting for electrical system.
 <p style="text-align: center;">ST22771AA030</p>	22771AA030	SUBARU SELECT MONITOR KIT	Troubleshooting for electrical system.
 <p style="text-align: center;">ST18233AA000</p>	18233AA000	PISTON PIN SNAP RING PLIERS	Used for removing and installing snap ring of piston pin.

General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-498277200</p>	498277200	STOPPER SET	Used for installing automatic transmission assembly to engine.
 <p style="text-align: center;">ST42099AE000</p>	42099AE000	CONNECTOR REMOVER	Used for disconnecting quick connector of the engine compartment.
 <p style="text-align: center;">ST-499057000</p>	499057000	TORX PLUS®	Used for removal and installation of the flywheel (dual mass flywheel type) and the drive plate.

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 vehicle, however, the procedures described in this section are based on the condition that the engine is removed from vehicle.

- Camshaft
- Cylinder head