

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	
	Inside diameter × 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 speed [“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	Thrust 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	35.44 — 35.54 (1.3953 — 1.3992)	
			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	Flatness			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	mm (in)	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)
	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)	
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			mm (in)		Standard	22.000 — 22.006 (0.8661 — 0.8664)	
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)

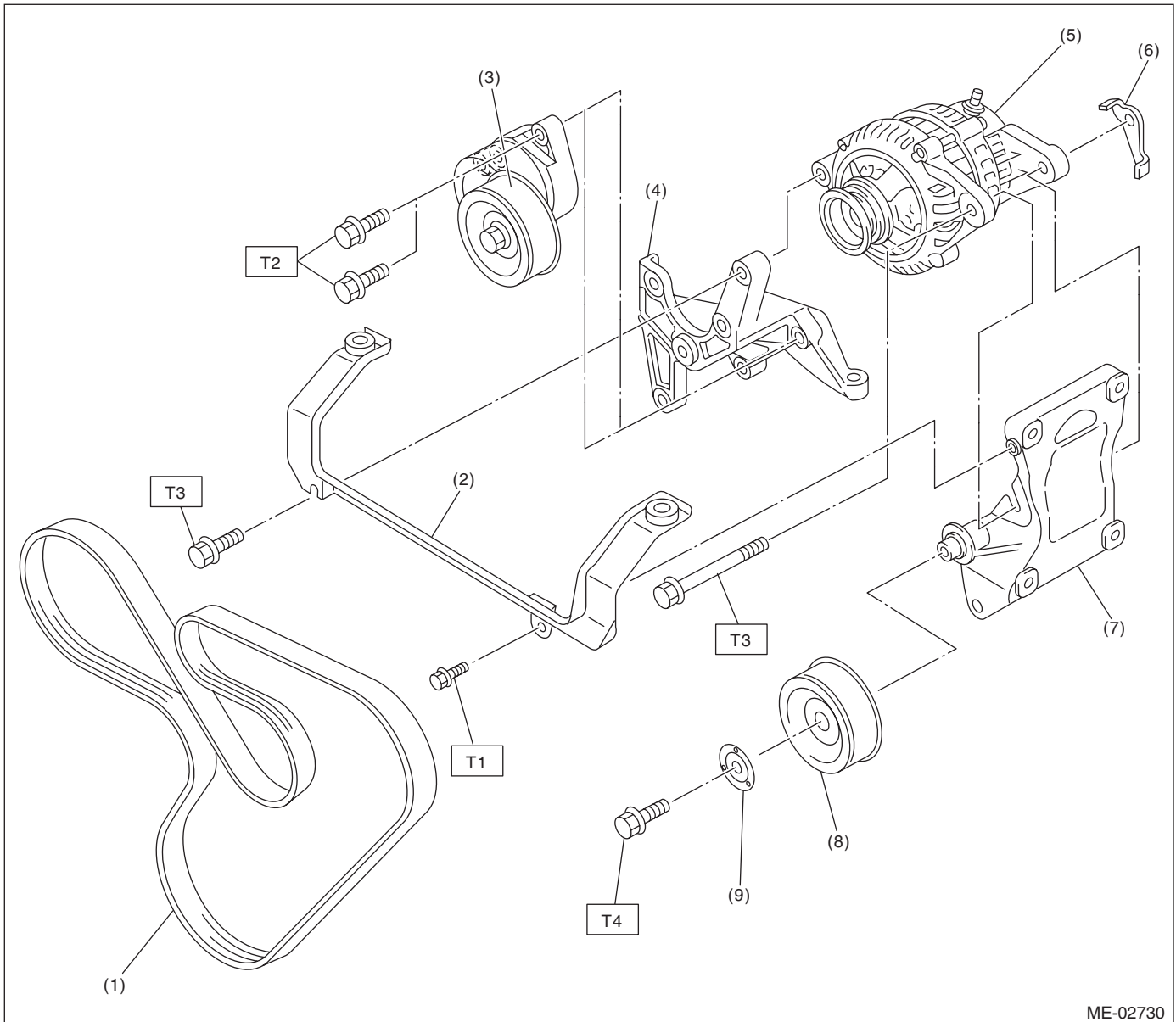
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Piston ring	Ring closed gap	mm (in)	Top ring	Standard	0.20 — 0.35 (0.0079 — 0.0138)	
			Second ring	Standard	0.35 — 0.50 (0.0138 — 0.0197)	
			Oil ring	Standard	0.20 — 0.60 (0.0079 — 0.0236)	
	Ring groove gap	mm (in)	Top ring	Standard	0.040 — 0.080 (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	Thrust clearance			mm (in)	Standard	0.070 — 0.330 (0.0028 — 0.0130)
Bearing of large end	Oil clearance			mm (in)	Standard	0.016 — 0.043 (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	mm (in)	#1, #3, #5, #7	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	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



ME-02730

- | | |
|---------------------------------|-------------------------|
| (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)

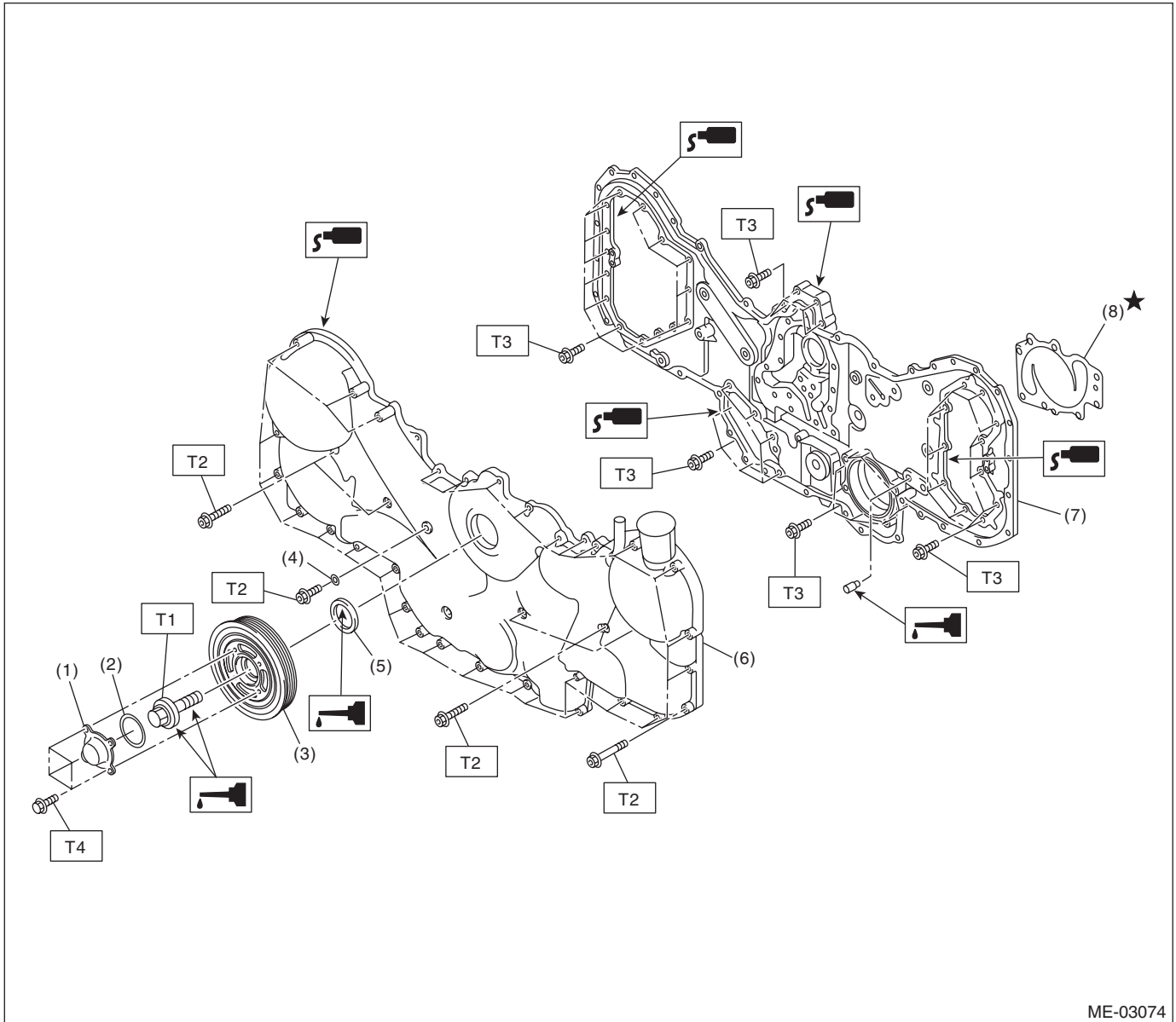
T3: 25 (2.5, 18)

T4: 33 (3.4, 24.3)

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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)

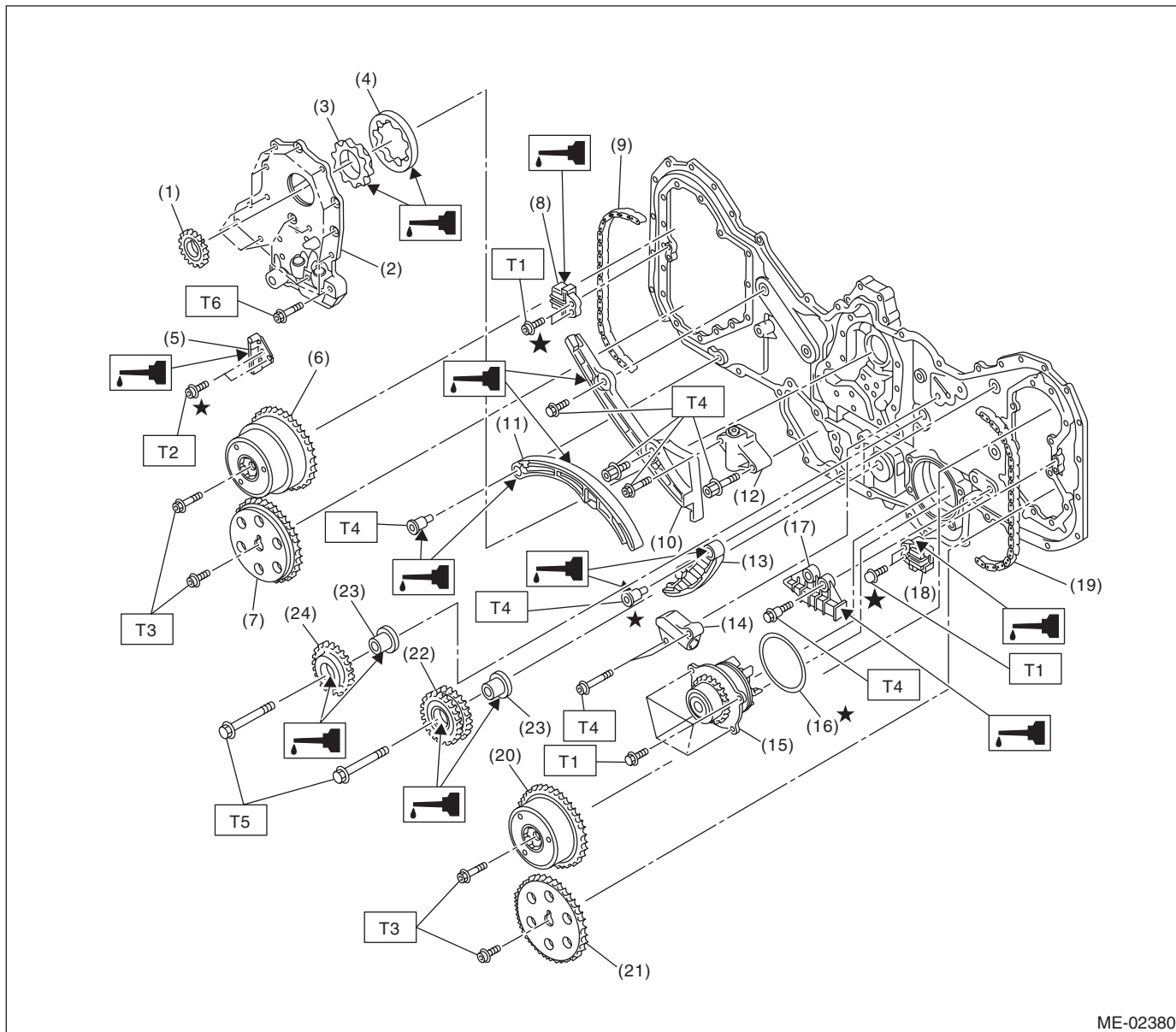
T1: <Ref. to ME(H6DO)-41, Crank Pulley.>

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

T3: <Ref. to ME(H6DO)-52, Rear Chain Cover.>

T4: 6.4 (0.65, 4.7)

3. TIMING CHAIN



ME-02380

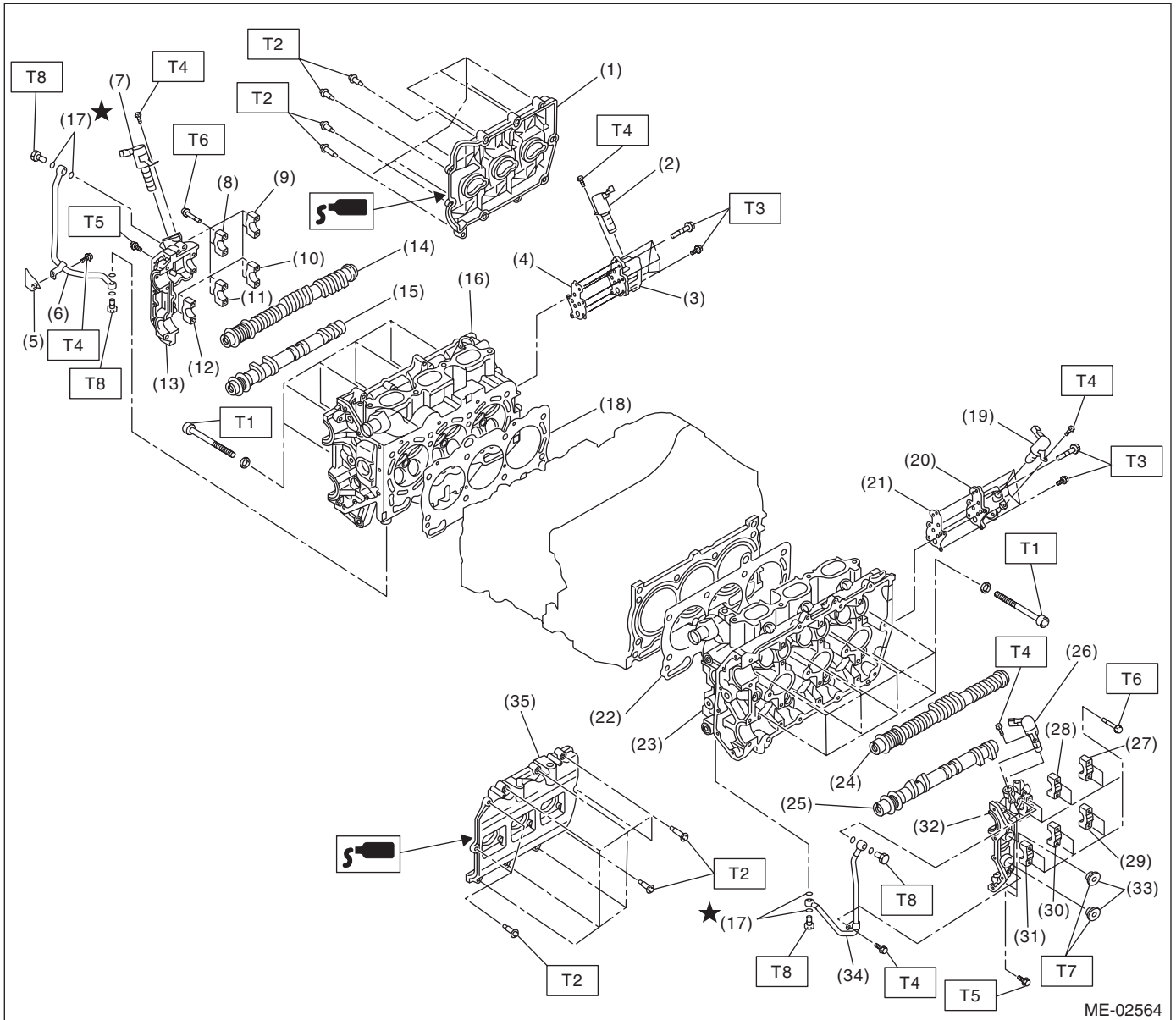
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|------------------------------------|-------------------------------------|-----------------------------|
| (1) Crank sprocket | (13) Chain tensioner lever (LH) | (24) Idler sprocket (upper) |
| (2) Oil relief case | (14) Chain tensioner (LH) | |
| (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)-50, 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

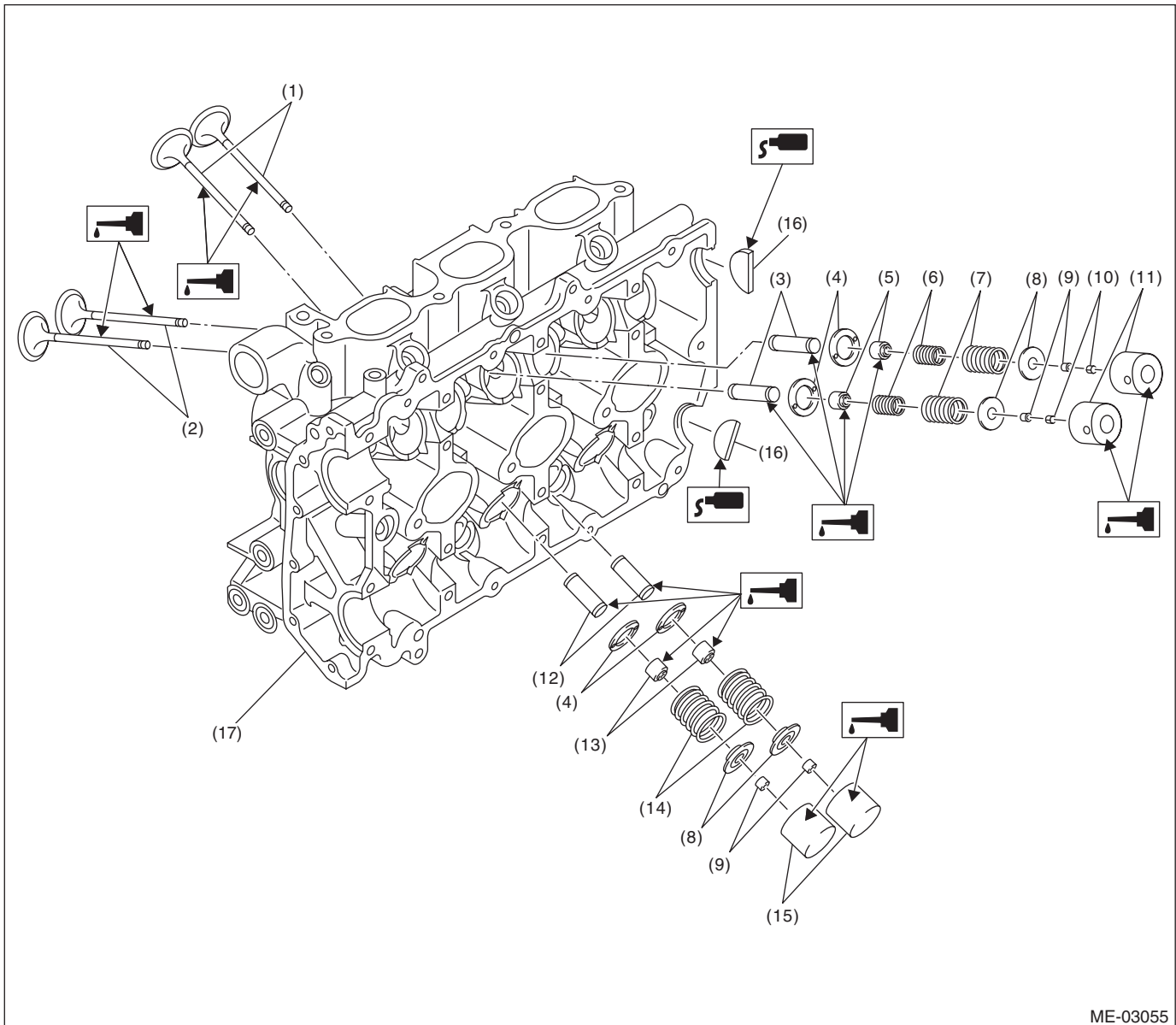
MECHANICAL

(1) Rocker cover (RH)	(17) Gasket	(33) Plug
(2) Oil switching solenoid valve (RH)	(18) Cylinder head gasket (RH)	(34) Oil pipe (LH)
(3) Oil switching solenoid valve holder (RH)	(19) Oil switching solenoid valve (LH)	(35) Rocker cover (LH)
(4) Oil switching solenoid valve gas- ket	(20) Oil switching solenoid valve holder (LH)	<hr/> Tightening torque:N·m (kgf-m, ft-lb) T1: <Ref. to ME(H6DO)-58, Cylinder Head.> T2: <Ref. to ME(H6DO)-54, Camshaft.> T3: <Ref. to ME(H6DO)-80, Oil Switching Solenoid Valve.> T4: 6.4 (0.65, 4.7) T5: 9.75 (1.0, 7.2) T6: 16 (1.6, 12) T7: 60 (6.1, 44) T8: 29 (3.0, 21.4) <hr/>
(5) Front chain cover	(21) Oil switching solenoid valve gas- ket	
(6) Oil pipe (RH)	(22) Cylinder head gasket (LH)	
(7) Oil flow control solenoid valve (RH)	(23) Cylinder head (LH)	
(8) Intake camshaft cap (Center RH)	(24) Intake camshaft (LH)	
(9) Intake camshaft cap (Rear RH)	(25) Exhaust camshaft (LH)	
(10) Exhaust camshaft cap (Rear RH)	(26) Oil flow control solenoid valve (LH)	
(11) Exhaust camshaft cap (Center RH)	(27) Intake camshaft cap (Rear LH)	
(12) Exhaust camshaft cap (Front RH)	(28) Intake camshaft cap (Center LH)	
(13) Front camshaft cap (RH)	(29) Exhaust camshaft cap (Rear LH)	
(14) Intake camshaft (RH)	(30) Exhaust camshaft cap (Center LH)	
(15) Exhaust camshaft (RH)	(31) Exhaust camshaft cap (Front LH)	
(16) Cylinder head (RH)	(32) Front camshaft cap (LH)	

General Description

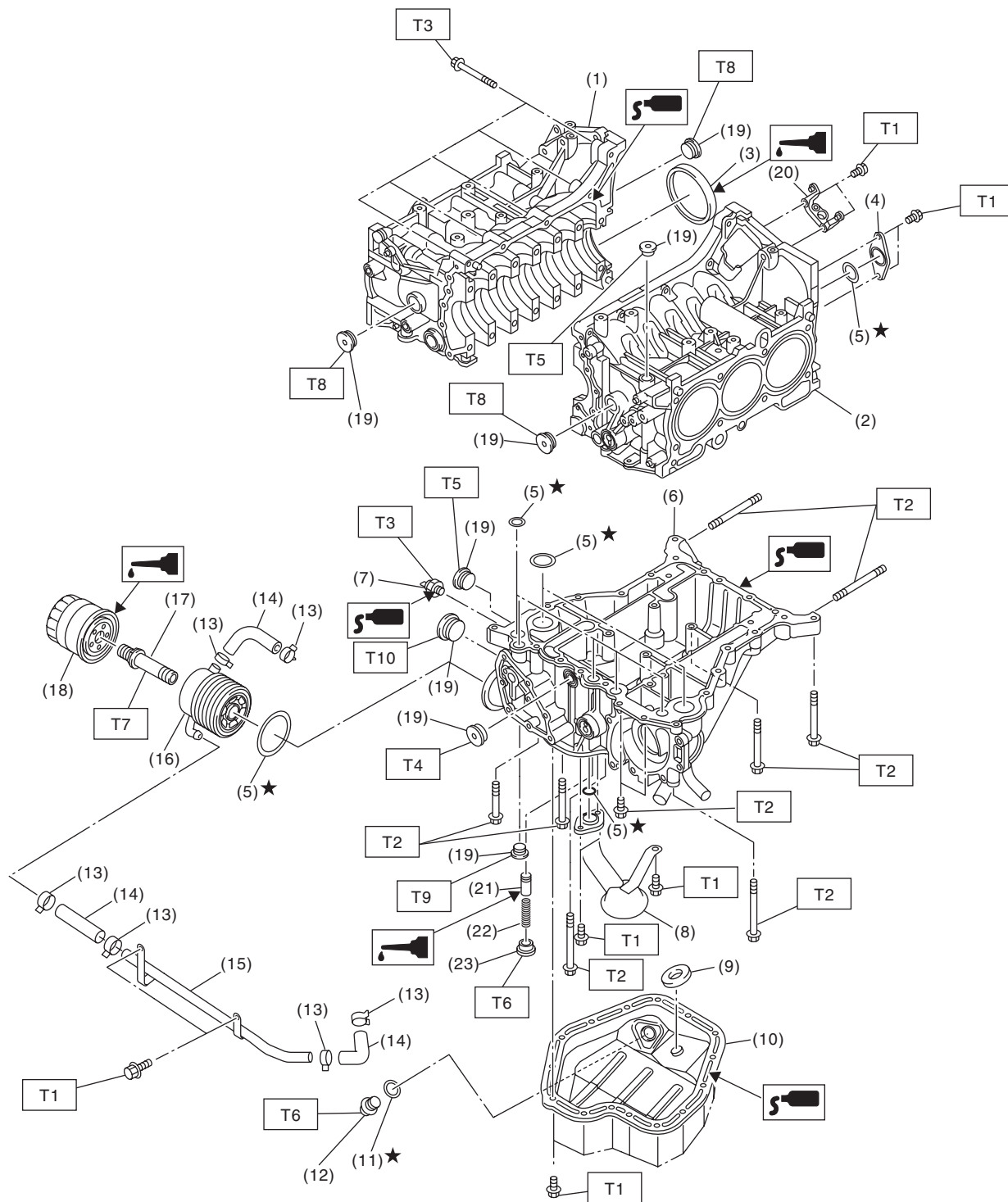
MECHANICAL

5. CYLINDER HEAD AND VALVE ASSEMBLY



- | | | |
|----------------------------|----------------------------|------------------------------|
| (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



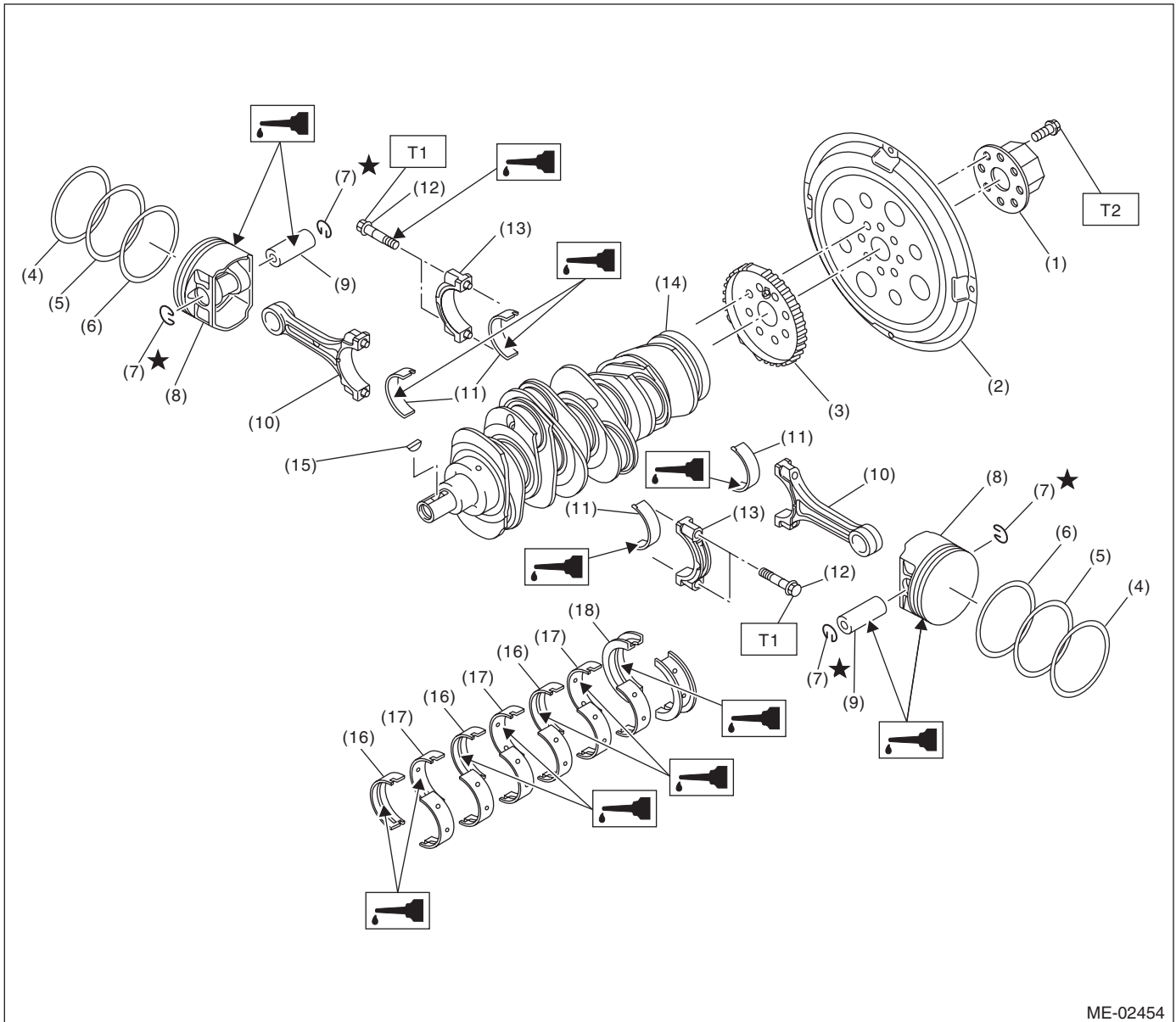
ME-02381

General Description

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

7. CRANKSHAFT AND PISTON



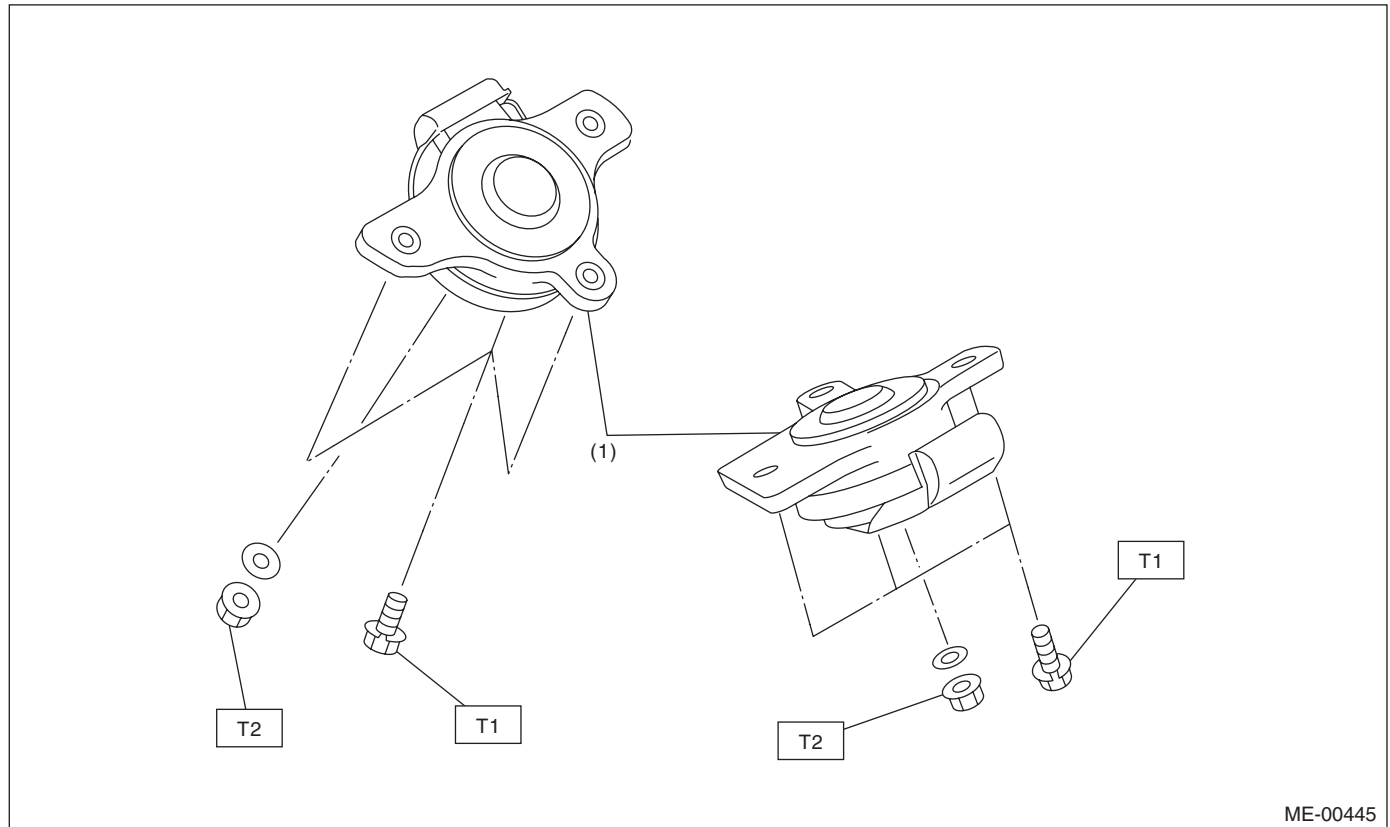
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|-----------------------------|-----------------------------|------------------------------------|
| (1) Reinforcement | (9) Piston pin | (16) Crankshaft bearing #1, #3, #5 |
| (2) Drive plate | (10) Connecting rod | (17) Crankshaft bearing #2, #4, #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)

8. ENGINE MOUNTING



ME-00445

(1) Front cushion rubber

Tightening torque: N·m (kgf-m, ft-lb)

T1: 35 (3.6, 25.8)

T2: 75 (7.6, 55.3)

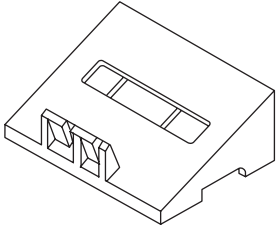
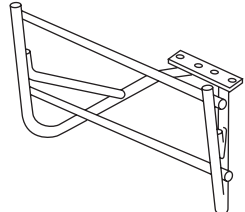
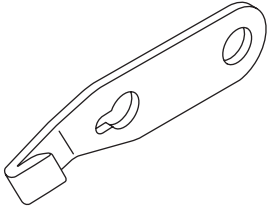
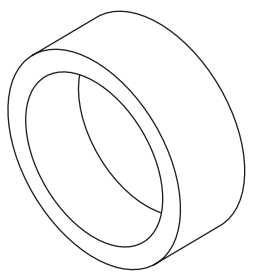
C: CAUTION

- 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 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.
- All removed parts, if to be reused, should be re-installed in the original positions and directions.
- Bolts, nuts and washers should be replaced with new 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.

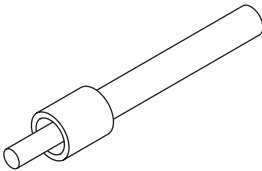
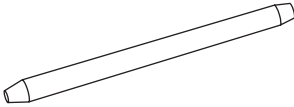
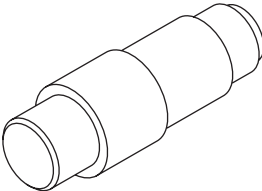
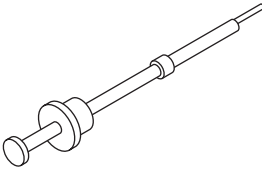
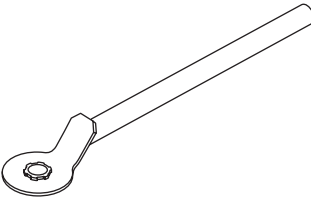
D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 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.
 ST-498497100	498497100	CRANKSHAFT STOPPER	Used for stopping rotation of flywheel or drive plate when loosening / tightening crank pulley bolt.
 ST18254AA000	18254AA000	PISTON GUIDE	Used for installing piston in cylinder.

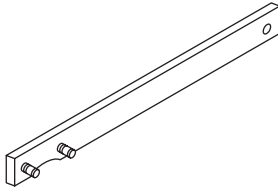
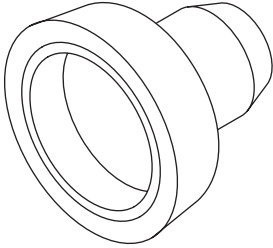
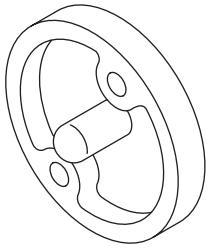
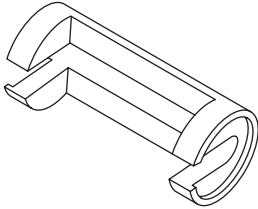
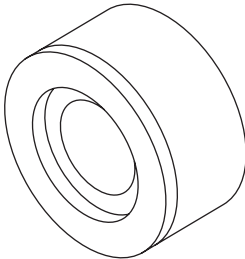
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ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p>ST-499585500</p>	499585500	VALVE OIL SEAL GUIDE	Used for press-fitting of intake and exhaust valve guide oil seals.
 <p>ST18253AA000</p>	18253AA000	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 <p>ST18350AA000</p>	18350AA000	CONNECTING ROD BUSHING REMOVER AND INSTALLER	Used for removing and installing connecting rod bushing.
 <p>ST-499097700</p>	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 <p>ST-499977500</p>	499977500	CAM SPROCKET WRENCH	Used for removing and installing intake cam sprocket.

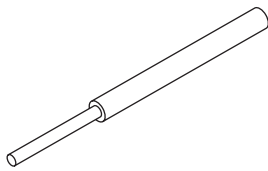
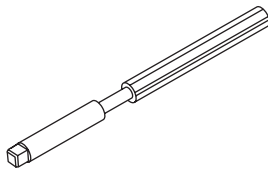
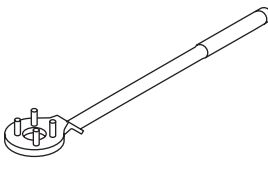
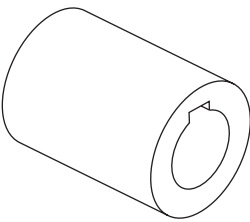
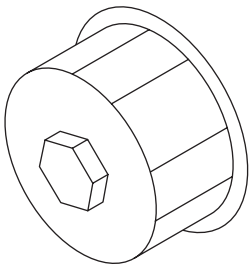
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p>ST18231AA020</p>	18231AA020	CAM SPROCKET WRENCH	Used for removing and installing exhaust cam sprocket.
 <p>ST-499587200</p>	499587200	CRANKSHAFT OIL SEAL INSTALLER	<ul style="list-style-type: none"> Used for installing crankshaft oil seal. used together with CRANKSHAFT OIL SEAL GUIDE (499597100).
 <p>ST-499597100</p>	499597100	CRANKSHAFT OIL SEAL GUIDE	<ul style="list-style-type: none"> Used for installing crankshaft oil seal. used together with CRANKSHAFT OIL SEAL INSTALLER (499587200).
 <p>ST-499718000</p>	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.
 <p>ST18251AA040</p>	18251AA040	VALVE GUIDE ADJUSTER	Used for installing valve guides.

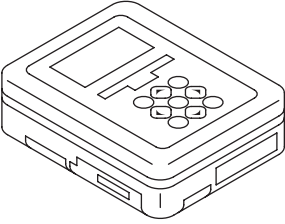
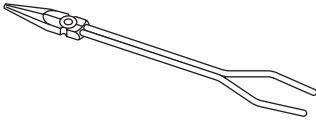
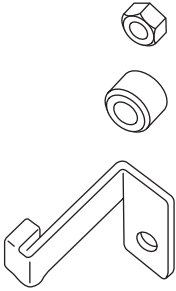
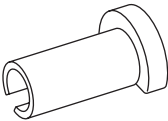
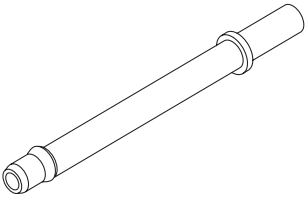
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p>ST-499765700</p>	499765700	VALVE GUIDE REMOVER	Used for removing valve guides.
 <p>ST-499765900</p>	499765900	VALVE GUIDE REAMER	Used for reaming valve guides.
 <p>ST-499977100</p>	499977100	CRANK PULLEY WRENCH	Used for stopping rotation of crank pulley when loosening/tightening crank pulley bolt.
 <p>ST18252AA000</p>	18252AA000	CRANKSHAFT SOCKET	Used for rotating crankshaft.
 <p>ST-498547000</p>	498547000	OIL FILTER WRENCH	Used for removing and installing oil filter.

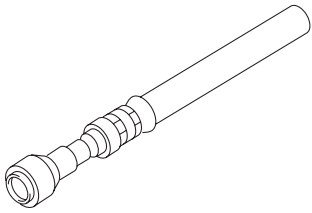
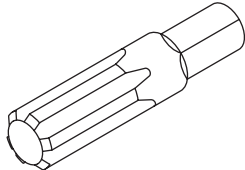
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p>ST1B020XU0</p>	1B020XU0	SUBARU SELECT MONITOR KIT	Used for troubleshooting the electrical system.
 <p>ST18233AA000</p>	18233AA000	PISTON PIN SNAP RING PLIERS	Used for removing and installing snap ring of piston pin.
 <p>ST-498277200</p>	498277200	STOPPER SET	Used for installing automatic transmission assembly to engine.
 <p>ST42099AE000</p>	42099AE000	CONNECTOR REMOVER	Used for disconnecting quick connector of the engine compartment.
 <p>ST18471AA000</p>	18471AA000	FUEL PIPE ADAPTER	Used for measuring fuel pressure.

General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST42075AG690	42075AG690	FUEL HOSE	<ul style="list-style-type: none"> Used for measuring fuel pressure. This is a genuine Subaru part.
 ST-499057000	499057000	TORX PLUS®	Used for removing and installing the flywheel (dual mass flywheel type) and the drive plate.

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.

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 chain
- Camshaft
- Cylinder head