

# 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 x stroke	mm (in)		
	Displacement	cm <sup>3</sup> (cu in)		
	Compression ratio	10.7		
	Compression pressure (350 rpm and fully open throttle):	kPa (kgf/cm <sup>2</sup> , psi)		
	Number of piston rings	Pressure ring: 2, Oil ring: 1		
	Intake valve timing	Min. advance	Open	
			ABDC 23°	
		Max. retard	Open	
			ATDC 3°	
	Exhaust valve timing		Close	
			ABDC 73°	
	Valve clearance	mm (in)	Open	
			BBDC 60°	
			Close	
			ATDC 6°	
	Idle speed ["P" or "N" range]	rpm	Intake	
			0.20 <sup>+0.04</sup> <sub>-0.06</sub> (0.0079 <sup>+0.0016</sup> <sub>-0.0024</sub> )	
			Exhaust	
			0.35±0.05 (0.0138±0.020)	
	Ignition order		No load	
			650±50	
			A/C ON	
	Ignition timing		770±50	
	BTDC/rpm		1 → 6 → 3 → 2 → 5 → 4	
	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)	Stand- ard	A	89.205 — 89.215 (3.5120 — 3.5124)	
					B	89.195 — 89.205 (3.5116 — 3.5120)	
	Cylindricality			Standard		0.030 (0.0012)	
	Out-of-roundness			Standard		0.010 (0.0004)	
Piston clearance				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)	

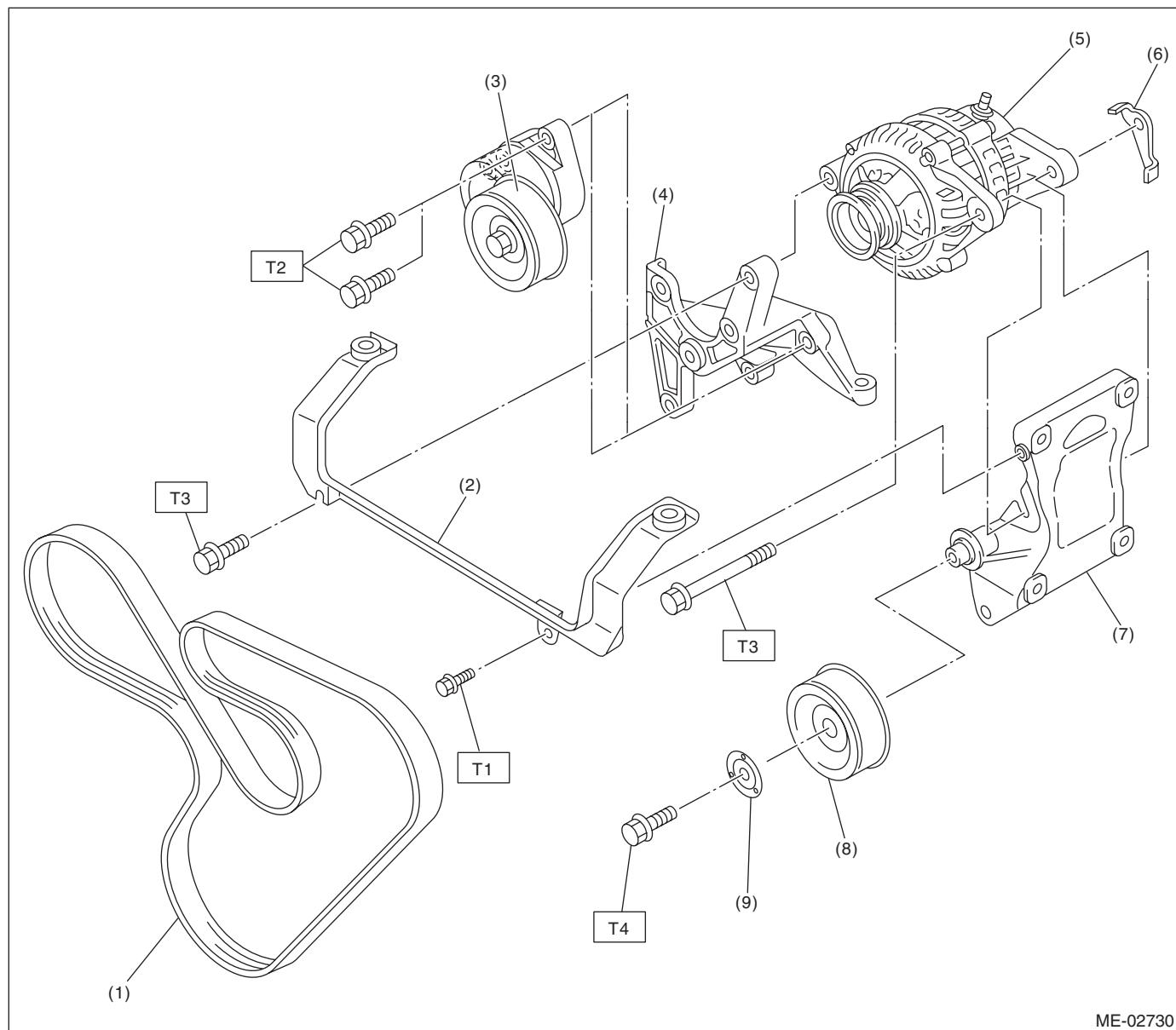
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Piston ring	Ring closed gap	mm (in)	Top ring	Standard	0.20 — 0.35 (0.0079 — 0.0138)
			Second ring	Standard	0.35 — 0.50 (0.0138 — 0.0197)
			Oil ring	Standard	0.20 — 0.60 (0.0079 — 0.0236)
	Ring groove gap	mm (in)	Top ring	Standard	0.040 — 0.080 (0.0016 — 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)
			Cylindricality	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	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)	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	

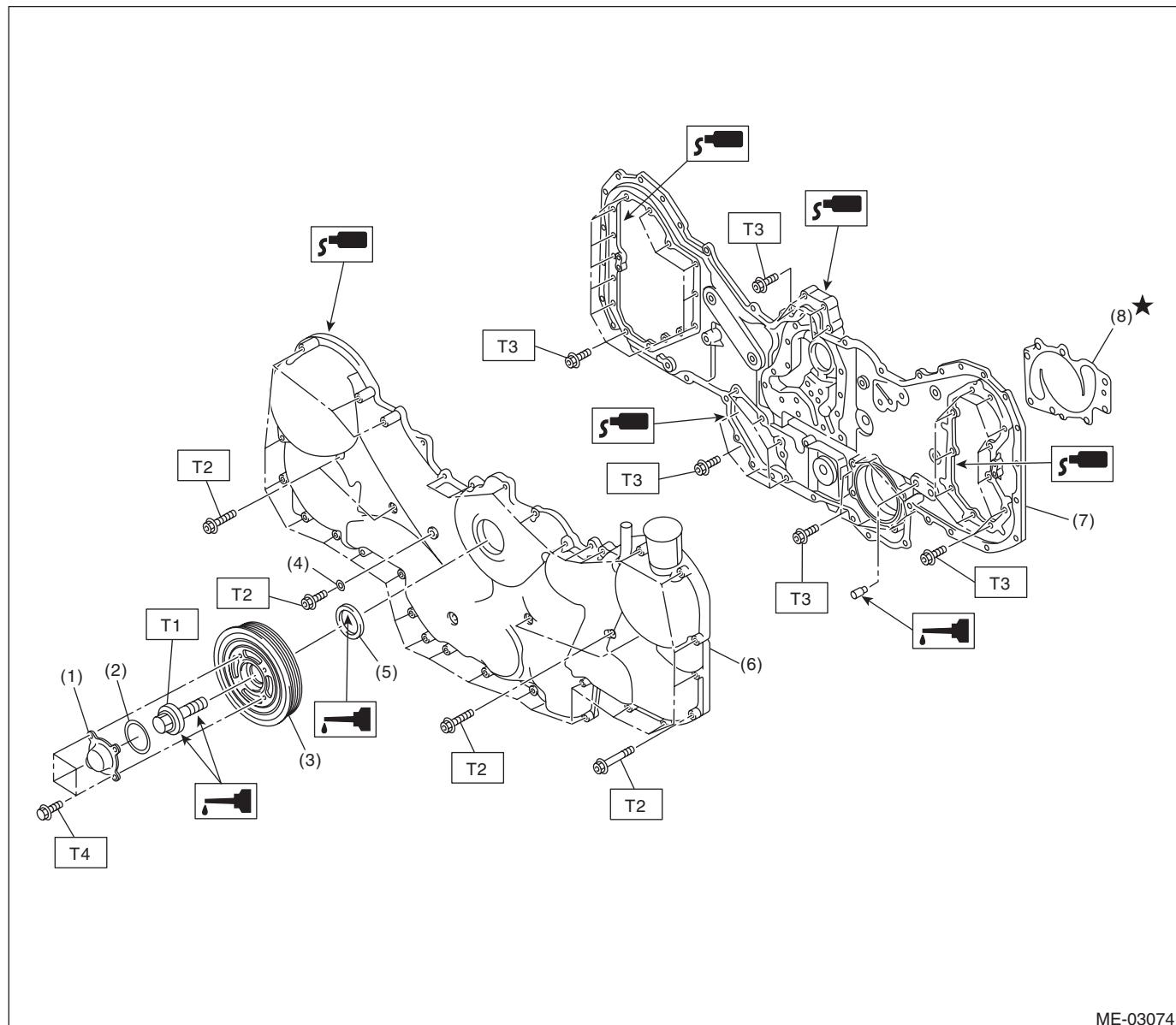
#### Tightening torque: N·m (kgf·m, ft·lb)

- T1: 6.4 (0.65, 4.7)
- T2: 20 (2.0, 14)
- T3: 25 (2.5, 18)
- T4: 33 (3.4, 24.3)

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### 2. TIMING CHAIN COVER



ME-03074

(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)**

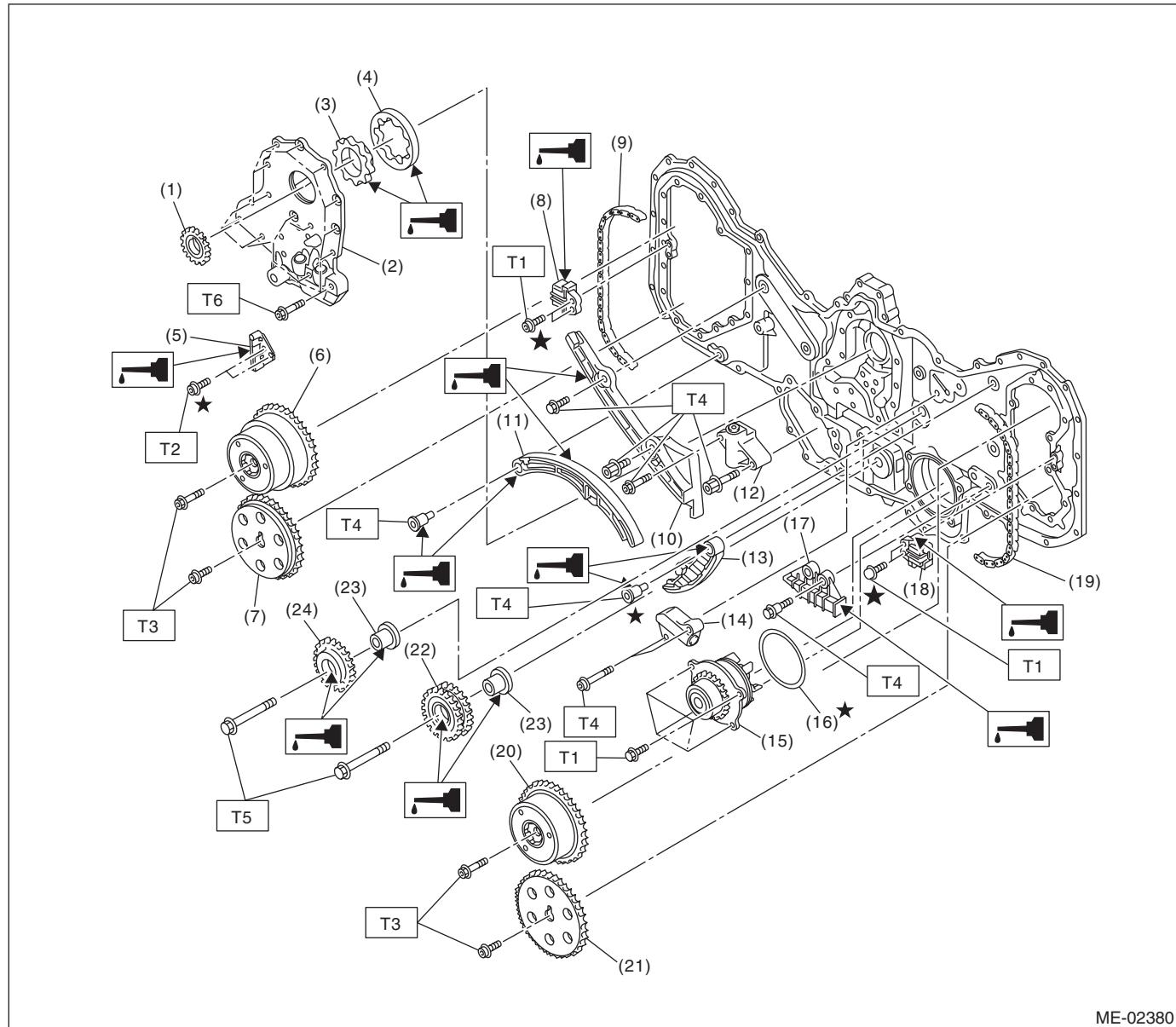
**T1:** <Ref. to ME(H6DO)-41, Crank Pulley.>

**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

(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)**

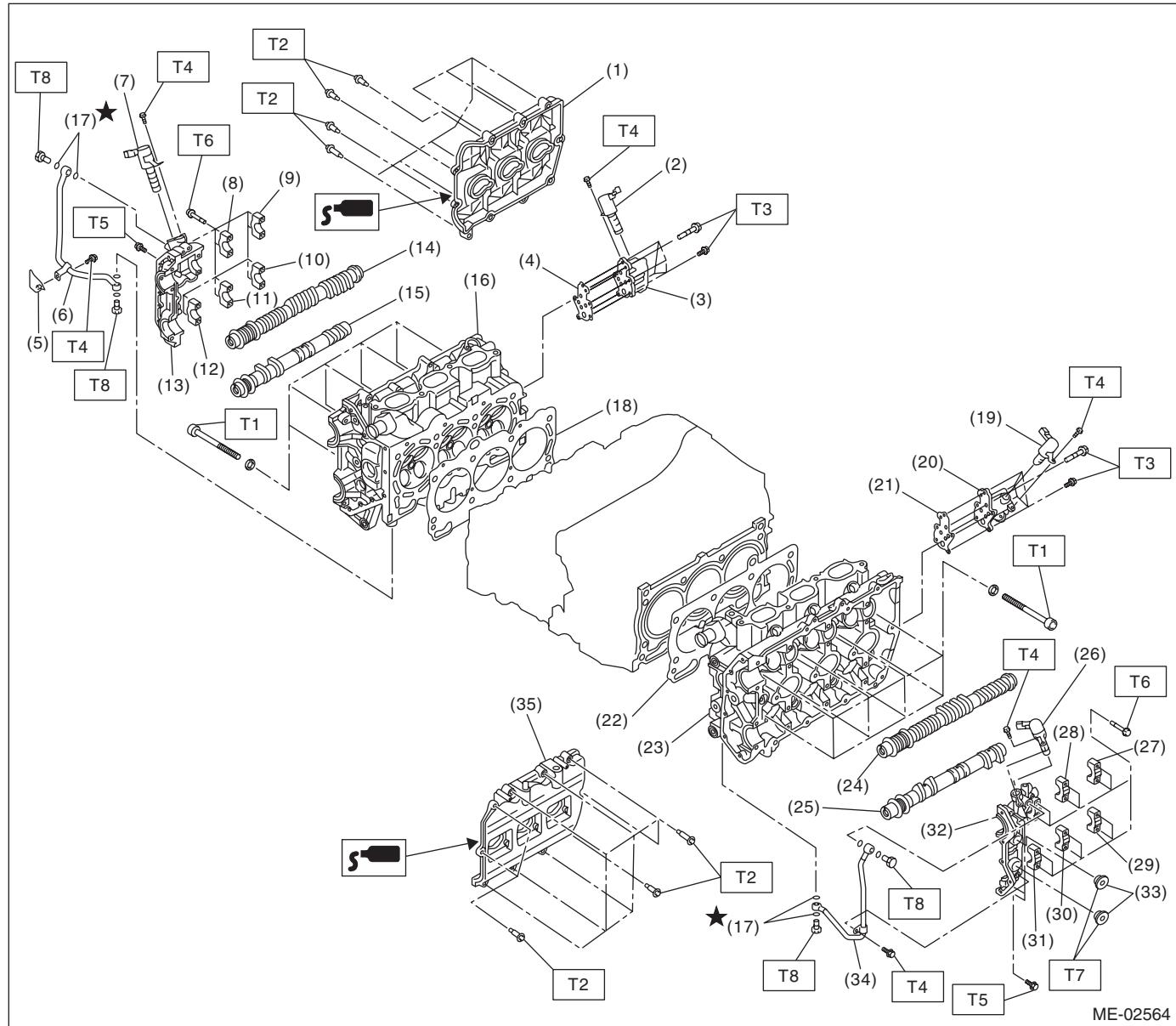
**T5: 69 (7.0, 50.6)**

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

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## MECHANICAL

### 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)	
(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)	

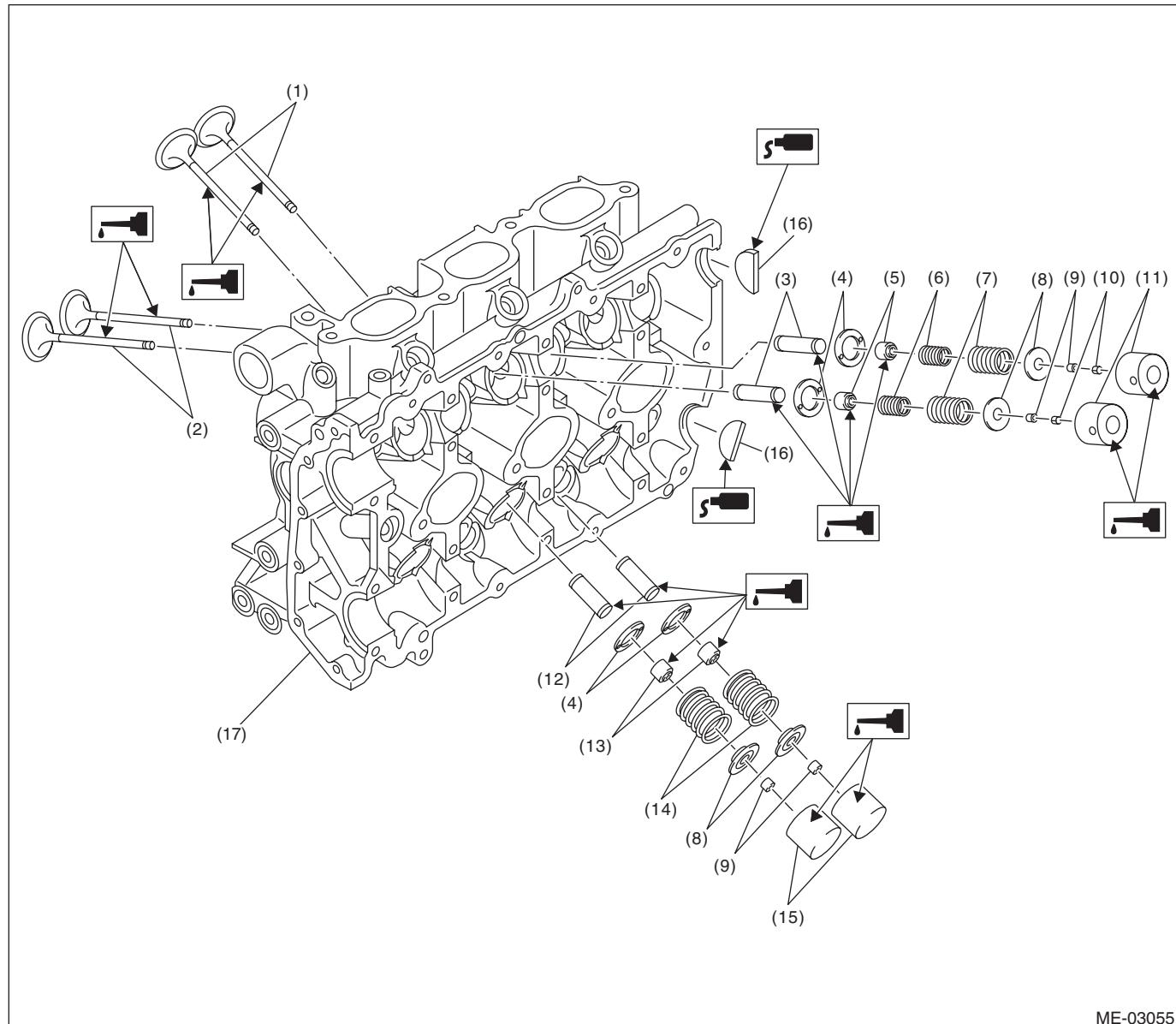
**Tightening torque:N·m (kgf·m, ft-lb)**

**T1:** <Ref. to ME(H6DO)-58, Cylinder Head.>  
**T2:** <Ref. to ME(H6DO)-54, Cam-shaft.>  
**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)

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## MECHANICAL

### 5. CYLINDER HEAD AND VALVE ASSEMBLY



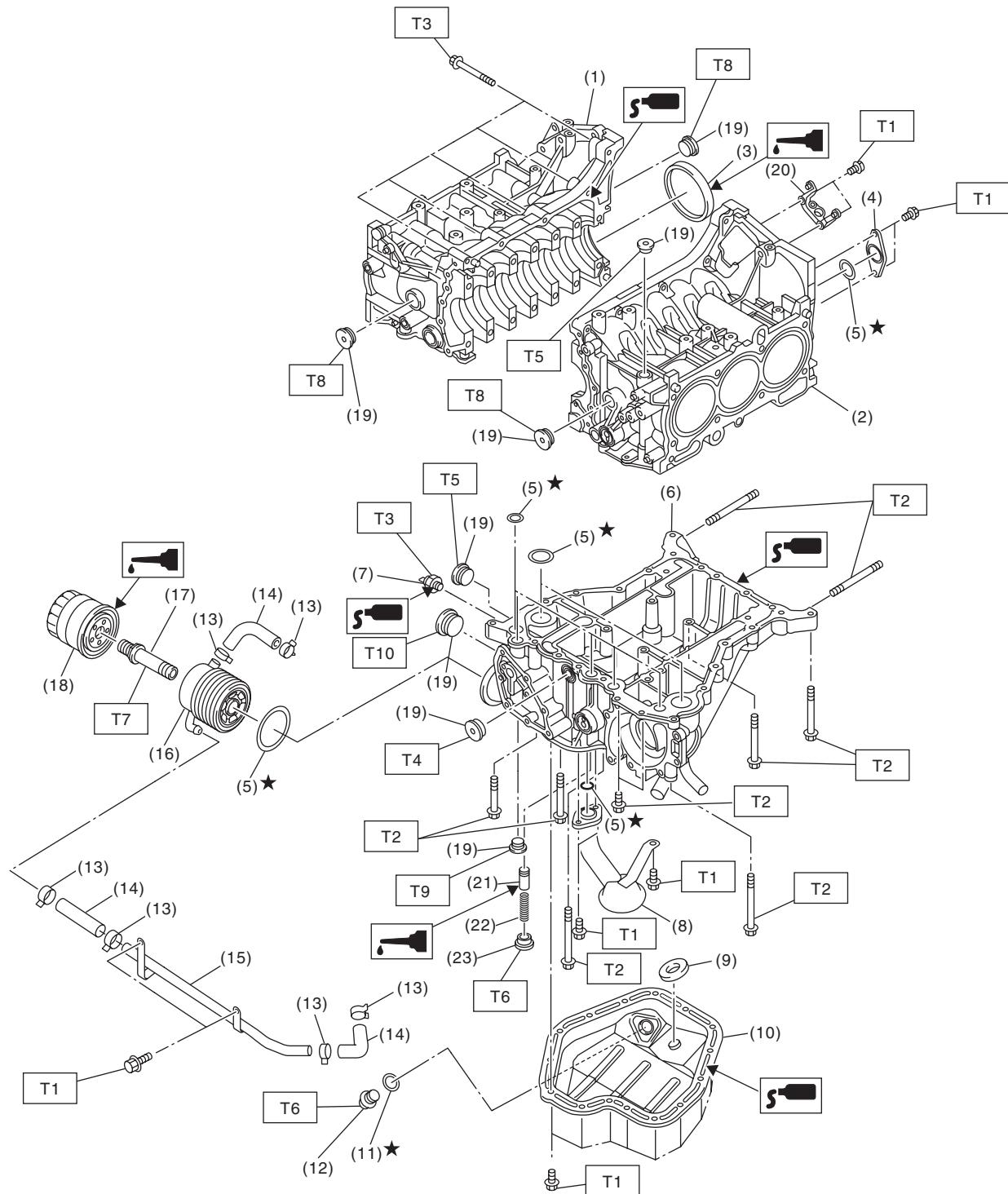
ME-03055

(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)	
(6) Valve spring (Inner)	(12) Exhaust valve guide	(17) Cylinder head

## General Description

## MECHANICAL

## 6. CYLINDER BLOCK



ME-02381

# General Description

## MECHANICAL

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(1) Cylinder block (RH)	(13) Clamp
(2) Cylinder block (LH)	(14) Hose
(3) Rear oil seal	(15) Oil cooler pipe
(4) Service hole cover	(16) Oil cooler
(5) O-ring	(17) Connector
(6) Oil pan upper	(18) Oil filter
(7) Oil pressure switch	(19) Plug
(8) Oil strainer	(20) Crankshaft position sensor holder
(9) Magnet	(21) Relief valve
(10) Oil pan lower	(22) Relief valve spring
(11) Metal gasket	(23) Plug
(12) Drain plug	

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

***T1: 6.4 (0.65, 4.7)***

***T2: 18 (1.8, 13.3)***

***T3: 25 (2.5, 18)***

***T4: 16 (1.6, 12)***

***T5: 37 (3.8, 27)***

***T6: 44 (4.5, 33)***

***T7: 54 (5.5, 40)***

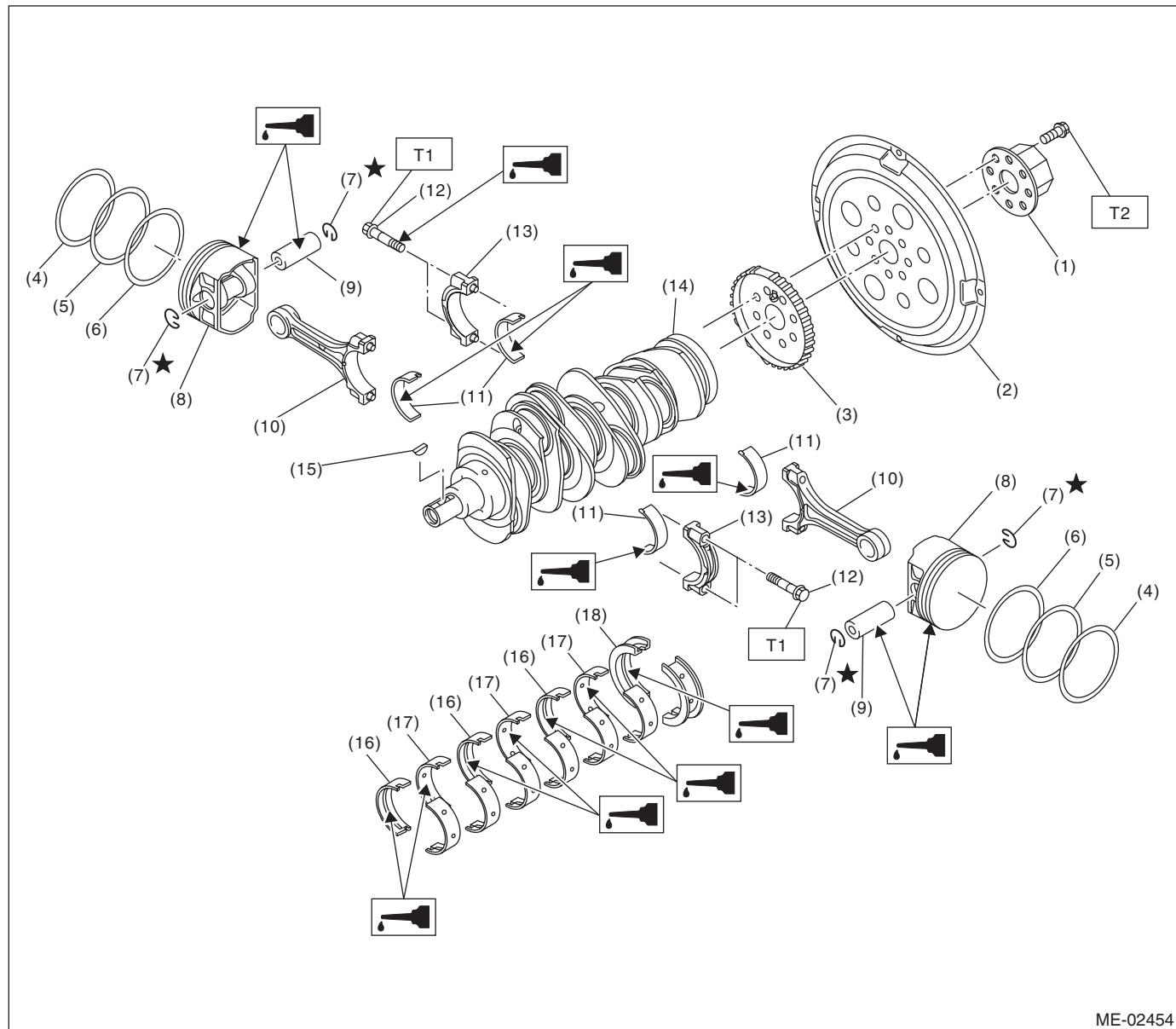
***T8: 70 (7.1, 52)***

***T9: 23 (2.3, 17)***

***T10: 90 (9.2, 67)***

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## 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)**

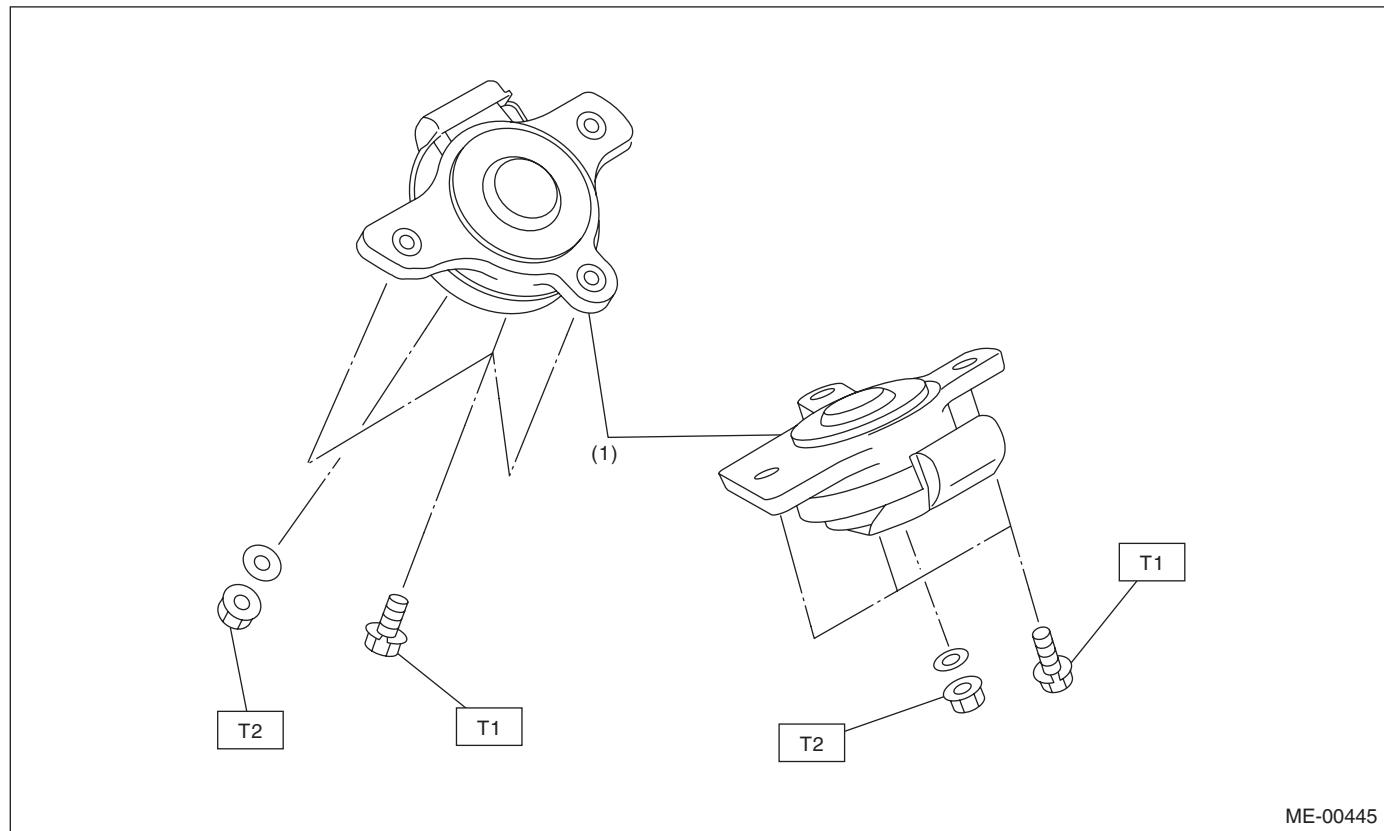
**T1: 53 (5.4, 39)**

**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)**

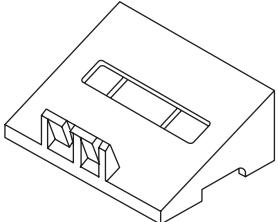
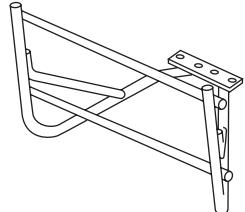
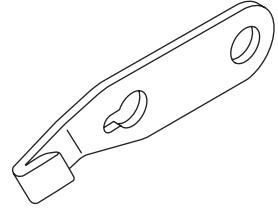
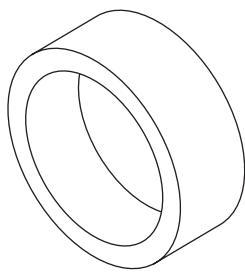
### C: CAUTION

- 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 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 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.

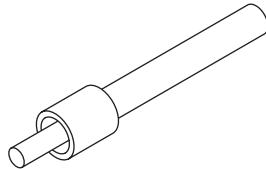
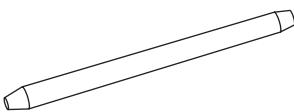
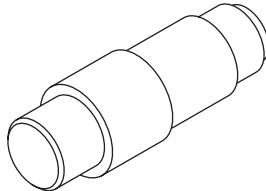
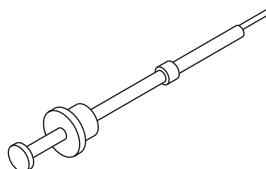
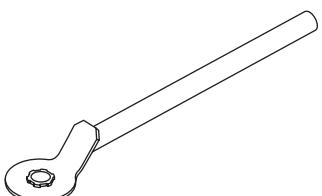
## D: PREPARATION TOOL

### 1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18250AA010	18250AA010	CYLINDER HEAD TABLE	<ul style="list-style-type: none"><li>Used for replacing valve guides.</li><li>Used for removing and installing valve spring.</li></ul>
 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.

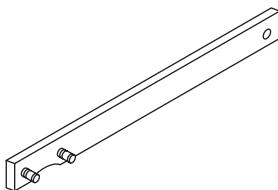
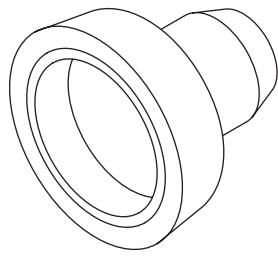
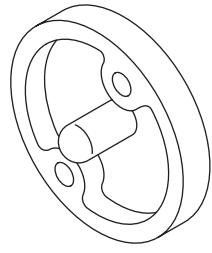
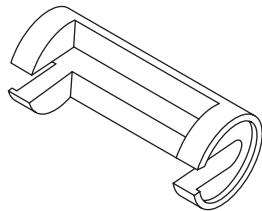
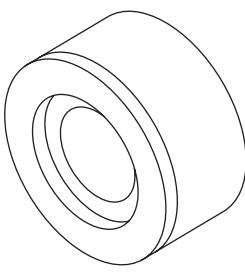
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 ST-499585500	499585500	VALVE OIL SEAL GUIDE	Used for press-fitting of intake and exhaust valve guide oil seals.
 ST18253AA000	18253AA000	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 ST18350AA000	18350AA000	CONNECTING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

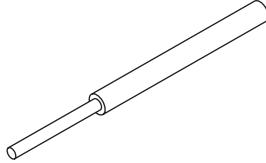
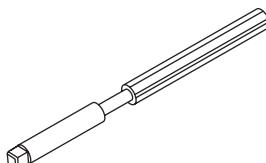
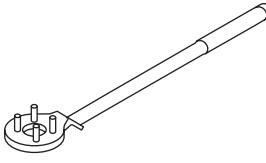
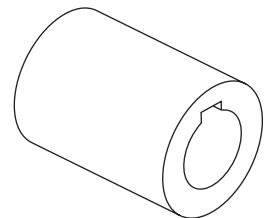
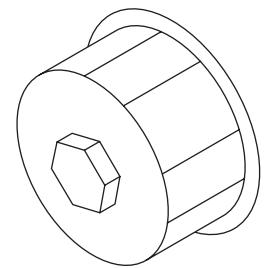
# General Description

MECHANICAL

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

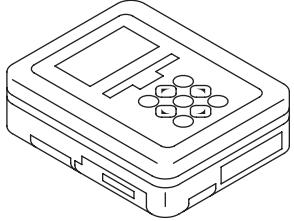
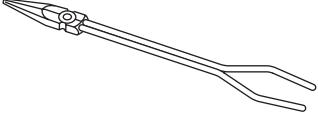
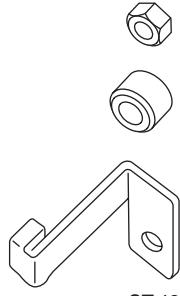
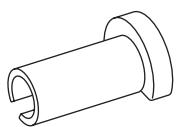
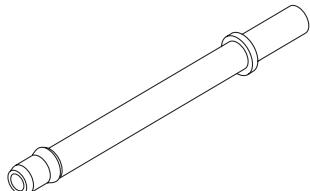
# General Description

## MECHANICAL

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

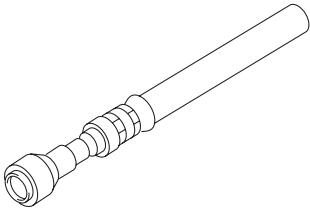
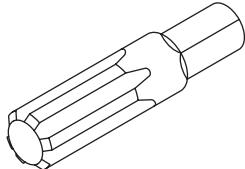
# General Description

MECHANICAL

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

# General Description

## MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	42075AG690	FUEL HOSE	<ul style="list-style-type: none"> <li>Used for measuring fuel pressure.</li> <li>This is a genuine Subaru part.</li> </ul>
	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