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			Chain driven, double overhead camshaft, 4-valve/cylinder
	Bore × Stroke mm (in)			94.0 × 90.0 (3.70 × 3.54)
	Displacement cm^3 (cu in)			2.498 (152.43)
	Compression ratio			10
	Compression pressure (at 200 — 300 rpm) kPa (kg/cm^2, psi)		Standard	1,050 — 1,400 (11 — 14, 152 — 203)
	Number of piston rings			Compression ring: 2 Oil ring: 1
	Intake valve timing	Open	Max. retard	ATDC 16°
			Min. advance	BTDC 39°
		Close	Max. retard	ABDC 80°
			Min. advance	ABDC 25°
	Exhaust valve timing		Open	BBDC 35°
			Open	ATDC 13°
	Cam clearance mm (in)	Intake	Standard	$0.13^{+0.02}_{-0.03}$ ($0.0051^{+0.0008}_{-0.0012}$)
		Exhaust	Standard	0.22±0.02 (0.0087±0.0008)
	Idle speed (For CVT model, select lever in “P” or “N” range. For MT model, gear shift lever in neutral position.) rpm	No load	Standard	CVT model: 675±100 MT model: 650±100
		A/C ON	Standard	850±100
	Ignition order			1 → 3 → 2 → 4
	Ignition timing BTDC/rpm		Standard	CVT model: 16°±10°/675 MT model: 16°±10°/650

NOTE:
OS: Oversize US: Undersize

Camshaft	Bending			mm (in)	Limit	0.020 (0.00079)
	Cam lobe height	mm (in)	Intake		Standard	40.34 — 40.44 (1.588 — 1.592)
			Exhaust		Standard	39.66 — 39.76 (1.561 — 1.565)
	Cam base circle diameter			mm (in)	Standard	34.0 (1.339)
	Journal outer diameter			mm (in)	Standard	25.946 — 25.963 (1.0215 — 1.0222)
	Thrust clearance			mm (in)	Standard	0.068 — 0.116 (0.0027 — 0.0047)
	Oil clearance			mm (in)	Standard	0.037 — 0.072 (0.0015 — 0.0028)
Cylinder head	Warpage (mating surface with cylinder block)			mm (in)	Limit	0.035 (0.0014)
	Grinding limit				mm (in)	To 98.4 (3.874)
	Height			mm (in)	Standard	98.5 (3.878)
Valve & valve guide	Valve overall length	mm (in)	Intake			104.95 (4.132)
			Exhaust			96.5 (3.799)
	Valve head edge thickness	mm (in)	Intake		Standard	0.8 — 1.2 (0.031 — 0.047)
			Exhaust		Standard	1.0 — 1.4 (0.039 — 0.055)
	Valve stem outer diameter	mm (in)	Intake		Standard	5.455 — 5.470 (0.2148 — 0.2154)
			Exhaust		Standard	5.445 — 5.460 (0.2144 — 0.2150)
	Valve guide inner diameter			mm (in)	Standard	5.500 — 5.512 (0.2165 — 0.2170)
	Clearance between valve and valve guide	mm (in)	Intake		Standard	0.030 — 0.057 (0.0012 — 0.0022)
			Exhaust		Standard	0.040 — 0.065 (0.0016 — 0.0026)
	Valve guide protrusion amount			mm (in)	Standard	11.4 — 11.8 (0.449 — 0.465)
Valve & valve shim	Valve stem end outer diameter	mm (in)	Intake		Standard	5.455 — 5.470 (0.2148 — 0.2154)
			Exhaust		Standard	5.445 — 5.460 (0.2148 — 0.2150)
	Valve shim inner diameter			mm (in)	Standard	5.500 — 5.560 (0.2165 — 0.2189)
	Clearance between valve and valve shim	mm (in)	Intake		Standard	0.030 — 0.105 (0.0012 — 0.0041)
			Exhaust		Standard	0.040 — 0.115 (0.0016 — 0.0045)
Valve seat	Seating width between valve and valve seat	mm (in)	Intake		Standard	0.8 — 1.6 (0.031 — 0.063)
			Exhaust		Standard	1.1 — 1.7 (0.043 — 0.067)
	Seating angle between valve and valve seat					45°
	Seating position between valve and valve seat					Valve face center

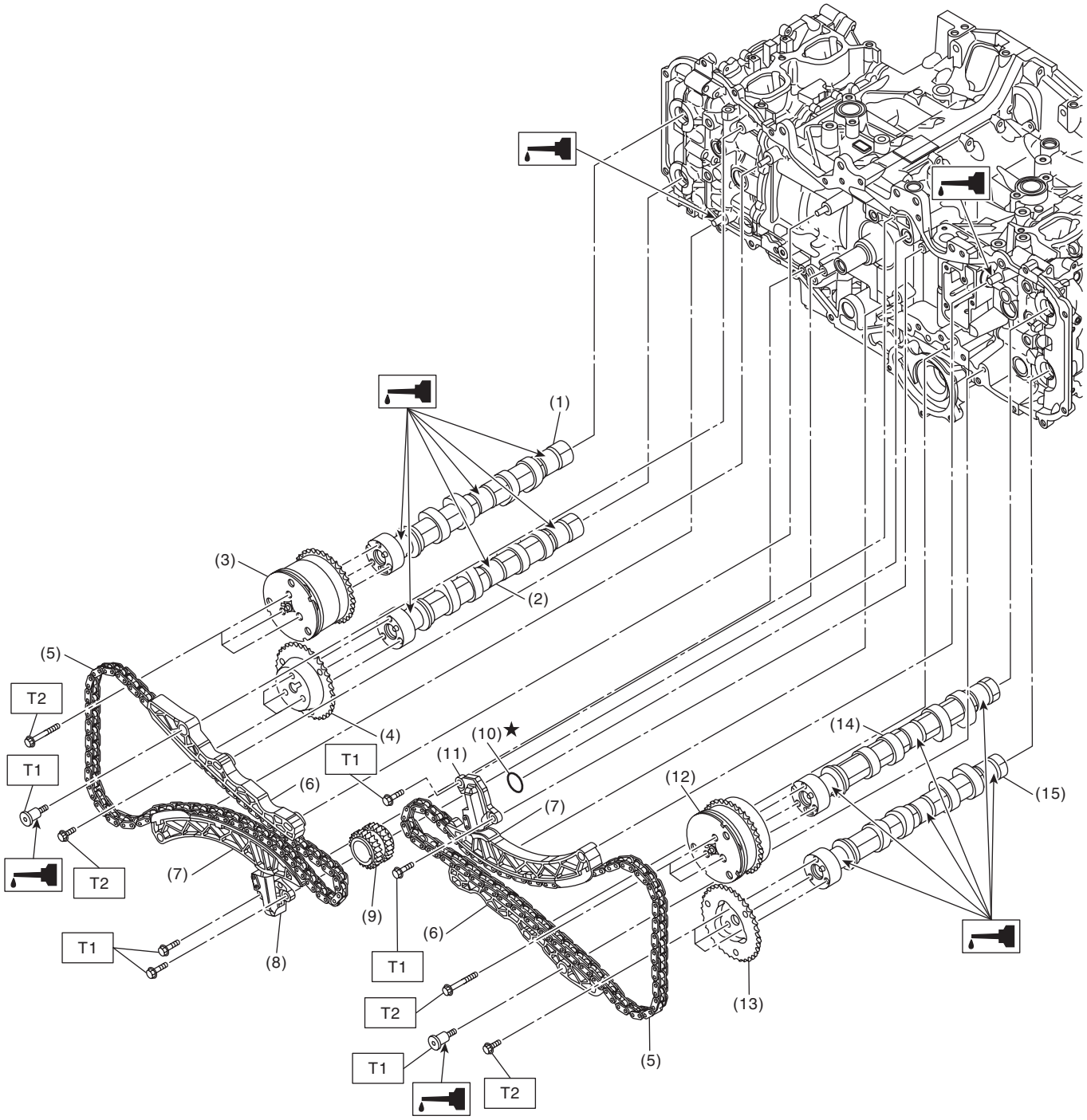
Valve spring	Free length	mm (in)		Standard	41.68 (1.641)
	Tension/spring height	N (kgf, lb)/mm (in)	Set	Standard	182 — 210 (18.56 — 21.41, 40.92 — 47.22)/ 33.0 (1.299)
			Lift	Standard	502 — 554 (51.18 — 56.49, 112.87 — 124.56)/ 22.0 (0.866)
	Squareness			Standard	2.5°, 1.8 mm (0.071 in) or less
Cylinder block & piston	Cylinder block warpage (Mating surface with cylinder head)	mm (in)		Limit	0.025 (0.00098)
	Grinding limit of cylinder block	mm (in)			To 204.9 (8.067)
	Height of cylinder block	mm (in)		Standard	205.0 (8.071)
	Inner diameter of cylinder liner	mm (in)	Cylinder bore size mark A	Standard	94.005 — 94.015 (3.7010 — 3.7014)
			Cylinder bore size mark B	Standard	93.995 — 94.005 (3.7006 — 3.7010)
	Cylindricality of cylinder liner	mm (in)		Limit	0.015 (0.0006)
	Out-of-roundness of cylinder liner	mm (in)		Limit	0.010 (0.0004)
	Piston grade point	mm (in)			13.3 (0.52)
	Piston outer diameter	mm (in)	Standard Size Grade A	Standard	93.980 — 93.990 (3.7000 — 3.7004)
			Standard Size Grade B	Standard	93.970 — 93.980 (3.6996 — 3.7000)
			0.25 (0.0098) OS	Standard	94.220 — 94.240 (3.7094 — 3.7102)
			0.50 (0.0197) OS	Standard	94.470 — 94.490 (3.7193 — 3.7201)
	Clearance between cylinder liner and piston	mm (in)		Standard	0.015 — 0.035 (0.00059 — 0.00138)
	Inner diameter of cylinder liner boring limit (diameter)	mm (in)			To 94.505 (3.7207)
Piston and piston pin	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).
	Clearance between piston and piston pin	mm (in)		Standard	0.004 — 0.008 (0.0002 — 0.0003)
Piston ring	Closed gap mm (in)	Compression ring	Top ring	Standard	0.20 — 0.30 (0.0079 — 0.0118)
			Second ring	Standard	0.30 — 0.45 (0.0118 — 0.0177)
		Oil ring (upper rail and lower rail)		Standard	0.20 — 0.50 (0.0079 — 0.0197)
	Clearance between compression ring and piston	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)
	Connecting rod bearing thickness (at center) mm (in)	Standard size	Standard	1.492 — 1.508 (0.0587 — 0.0594)
		0.03 (0.0012) US	Standard	1.511 — 1.515 (0.0595 — 0.0596)
		0.05 (0.0020) US	Standard	1.521 — 1.525 (0.0599 — 0.0600)
		0.25 (0.0098) US	Standard	1.621 — 1.625 (0.0638 — 0.0640)
	Oil clearance mm (in)		Standard	0.017 — 0.047 (0.0007 — 0.0019)
Piston pin & connecting rod bushing	Clearance between piston pin and connecting rod bushing mm (in)		Standard	0.004 — 0.026 (0.0002 — 0.0010)

Crankshaft and crankshaft bearing	Bending			Limit	0.035 (0.0014)
	Crankshaft 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 47.726 (1.8790)
	Crankshaft 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 67.735 (2.6667)
	Crankshaft pin outer diameter mm (in)		Standard size	Standard	47.976 — 48.000 (1.8888 — 1.8898)
			0.03 (0.0012) US	Standard	47.946 — 47.970 (1.8876 — 1.8886)
			0.05 (0.0020) US	Standard	47.926 — 47.950 (1.8868 — 1.8878)
			0.25 (0.0098) US	Standard	47.726 — 47.750 (1.8790 — 1.8799)
	Crankshaft journal outer diameter mm (in)		Standard size	Standard	67.985 — 68.009 (2.6766 — 2.6775)
			0.03 (0.0012) US	Standard	67.955 — 67.979 (2.6754 — 2.6763)
			0.05 (0.0020) US	Standard	67.935 — 67.959 (2.6746 — 2.6755)
			0.25 (0.0098) US	Standard	67.735 — 67.759 (2.6667 — 2.6677)
	Crankshaft bearing thickness (at center) mm (in)	#1, #2, #3, #4	Standard size	Standard	2.495 — 2.513 (0.0982 — 0.0989)
			0.03 (0.0012) US	Standard	2.519 — 2.522 (0.0992 — 0.0993)
			0.05 (0.0020) US	Standard	2.529 — 2.532 (0.0996 — 0.0997)
			0.25 (0.0098) US	Standard	2.629 — 2.632 (0.1035 — 0.1036)
		#5	Standard size	Standard	2.493 — 2.511 (0.0981 — 0.0989)
			0.03 (0.0012) US	Standard	2.517 — 2.520 (0.0991 — 0.0992)
			0.05 (0.0020) US	Standard	2.527 — 2.530 (0.0995 — 0.0996)
			0.25 (0.0098) US	Standard	2.627 — 2.630 (0.1034 — 0.1035)
	Thrust clearance			Standard	0.130 — 0.308 (0.00512 — 0.01213)
	Oil clearance			Standard	0.013 — 0.031 (0.00051 — 0.00122)

B: COMPONENT

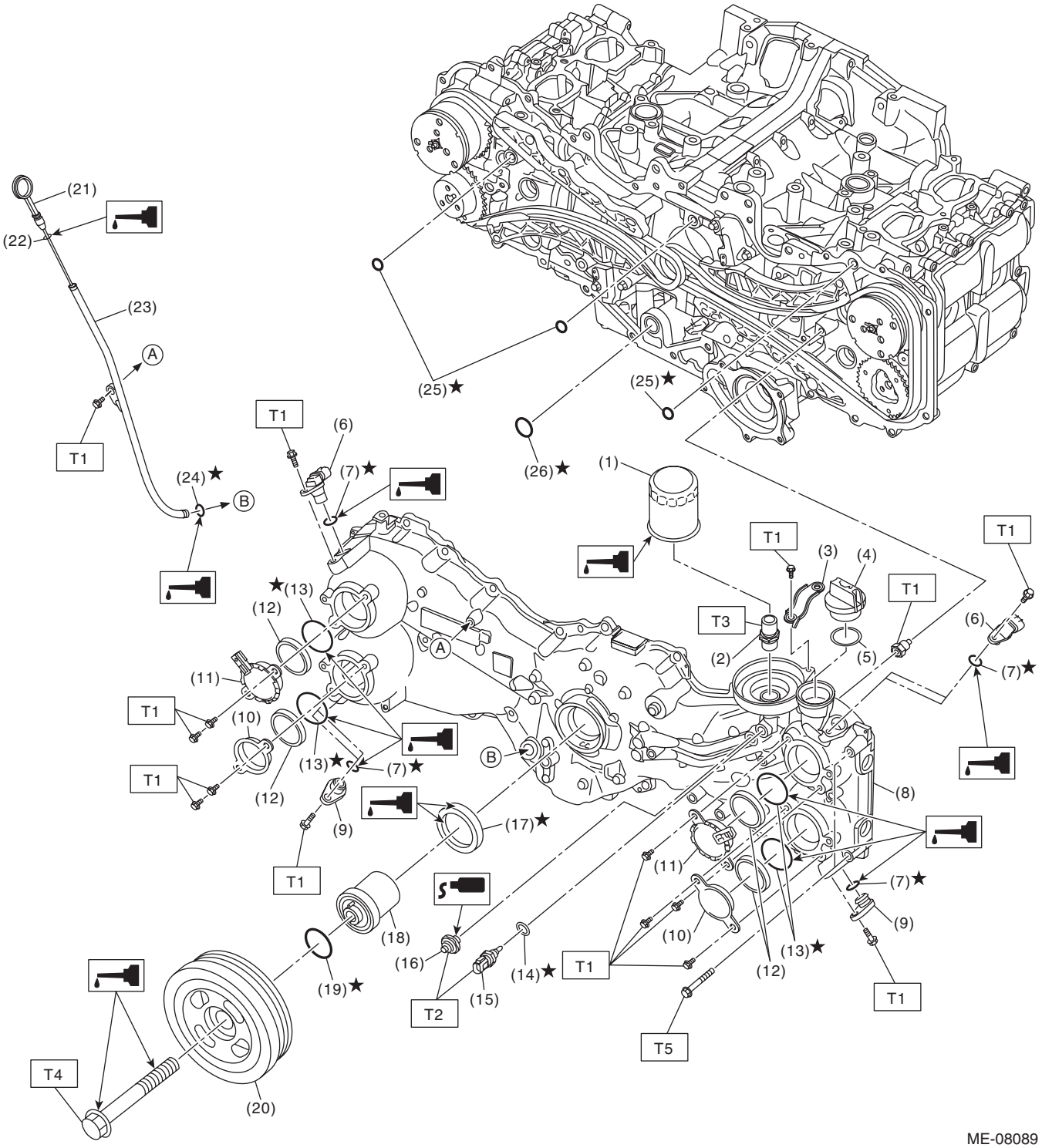
1. TIMING CHAIN



(1) Intake camshaft RH
(2) Exhaust camshaft RH
(3) Intake cam sprocket RH
(4) Exhaust cam sprocket RH
(5) Timing chain
(6) Chain guide
(7) Chain tension lever
(8) Chain tensioner RH
(9) Crank sprocket
(10) O-ring
(11) Chain tensioner LH
(12) Intake cam sprocket LH
(13) Exhaust cam sprocket LH
(14) Intake camshaft LH
(15) Exhaust camshaft LH

Tightening torque: N·m (kgf-m, ft-lb)
T1: 6.4 (0.7, 4.7)
T2: 18 (1.8, 13.3)

2. CHAIN COVER

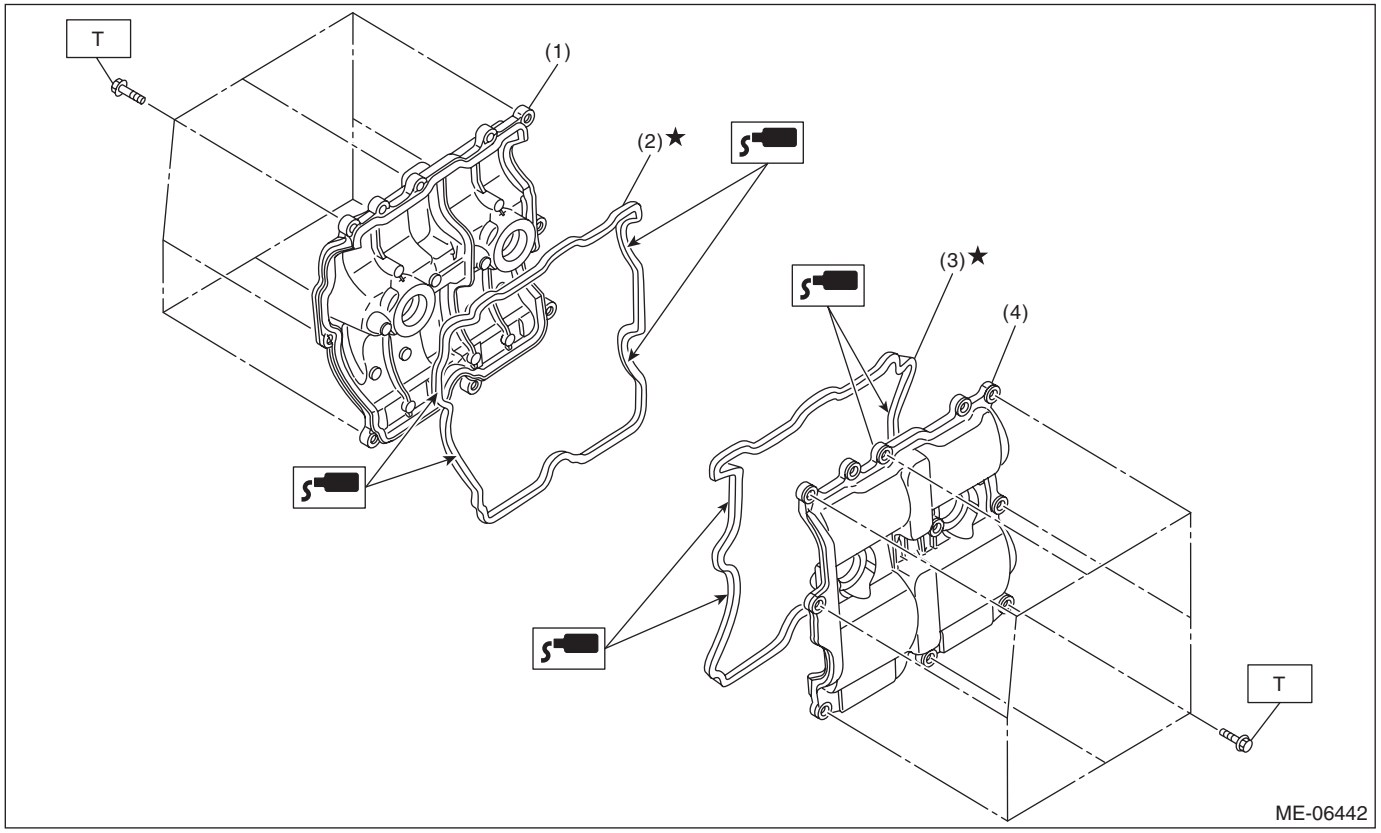


(1) Oil filter
(2) Oil pump union
(3) Generator cord stay
(4) Oil filler cap
(5) Gasket
(6) Camshaft position sensor
(7) O-ring
(8) Chain cover
(9) Sensor cover
(10) Actuator cover
(11) Oil control solenoid
(12) Back-up ring
(13) O-ring
(14) Gasket
(15) Engine oil temperature sensor
(16) Oil pressure switch
(17) Front oil seal
(18) Crank pulley boss
(19) O-ring
(20) Crank pulley
(21) Oil level gauge
(22) O-ring
(23) Oil level gauge guide
(24) O-ring
(25) O-ring
(26) O-ring

Tightening torque:N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)
T2: 18 (1.8, 13.3)
T3: 45 (4.6, 33.2)
T4: <Ref. to ME(H4DO)-99, INSTALLATION, Crank Pulley.>
T5: <Ref. to ME(H4DO)-111, INSTALLATION, Chain Cover.>

3. ROCKER COVER

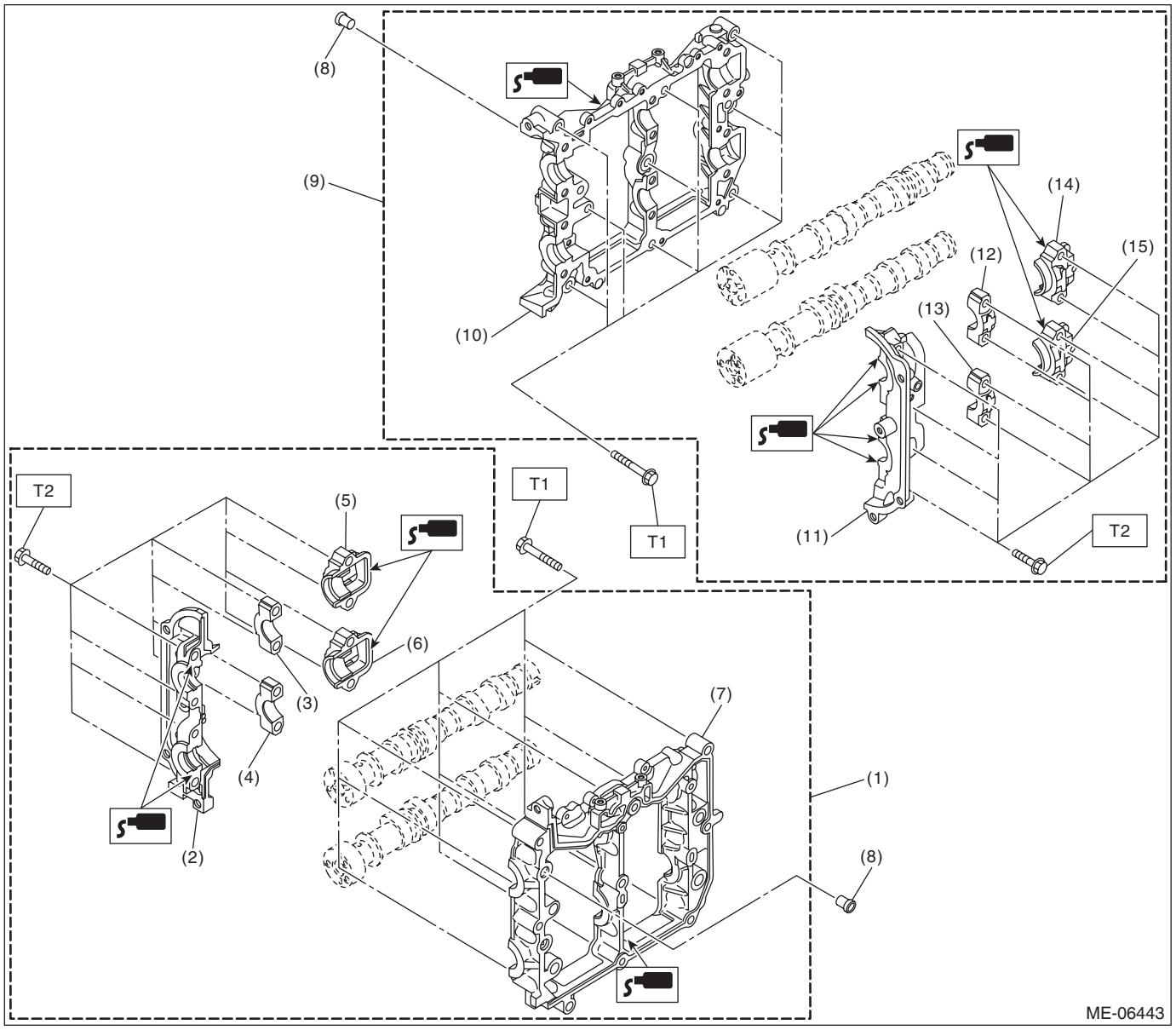


(1) Rocker cover RH
(2) Rocker cover gasket RH
(3) Rocker cover gasket LH
(4) Rocker cover LH

Tightening torque: N·m (kgf-m, ft-lb)

T: <Ref. to ME(H4DO)-162, INSTALLATION, Rocker Cover.>

4. CAM CARRIER



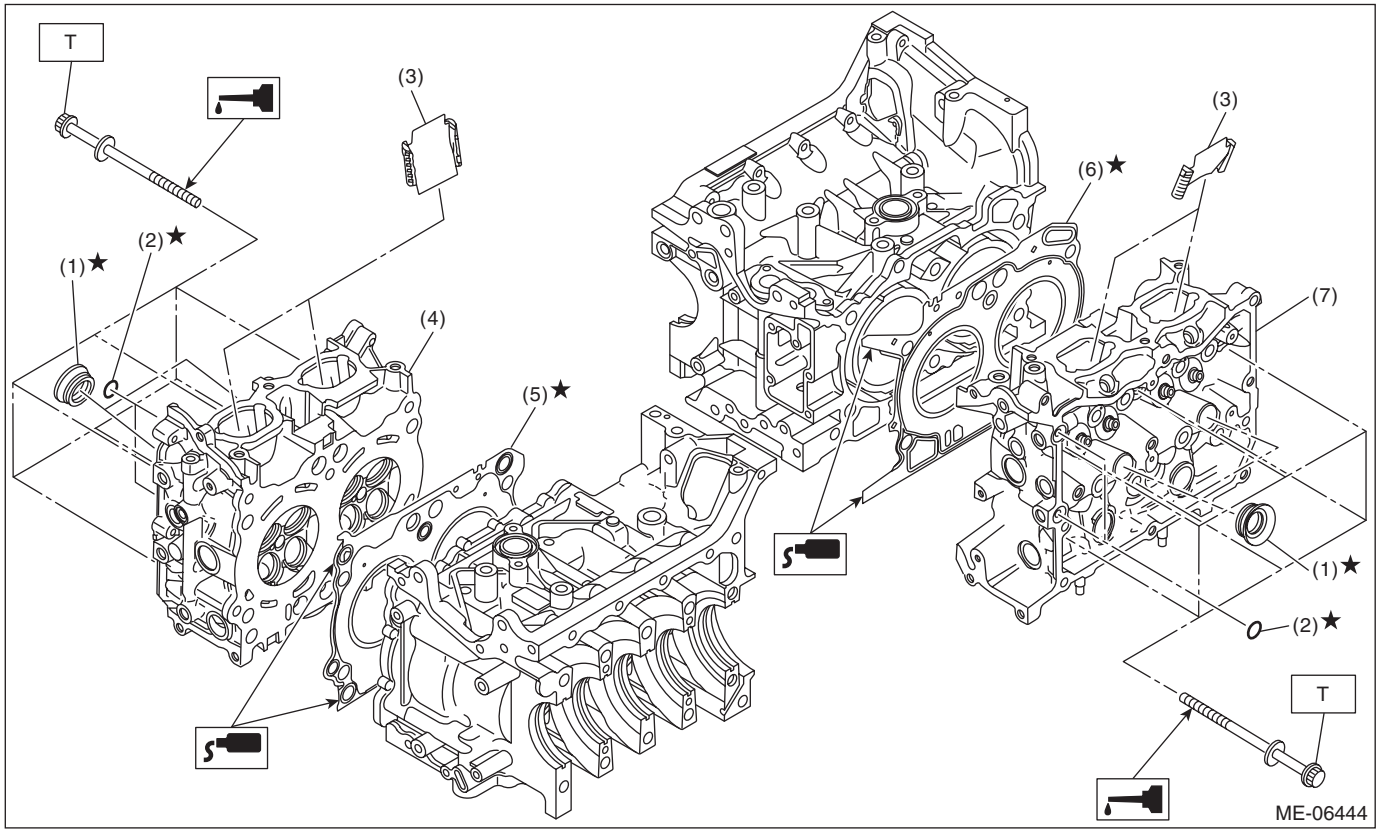
(1) Cam carrier ASSY
(2) Front camshaft cap RH
(3) Intake center camshaft cap RH
(4) Exhaust center camshaft cap RH
(5) Intake rear camshaft cap RH
(6) Exhaust rear camshaft cap RH
(7) Cam carrier RH
(8) Filter
(9) Cam carrier ASSY
(10) Cam carrier LH
(11) Front camshaft cap LH
(12) Intake center camshaft cap LH
(13) Exhaust center camshaft cap LH
(14) Intake rear camshaft cap LH
(15) Exhaust rear camshaft cap LH

Tightening torque: N·m (kgf-m, ft-lb)

T1: ***<Ref. to ME(H4DO)-207, ASSEMBLY, Cam Carrier.>***

T2: ***<Ref. to ME(H4DO)-182, INSTALLATION, Cam Carrier.>***

5. CYLINDER HEAD

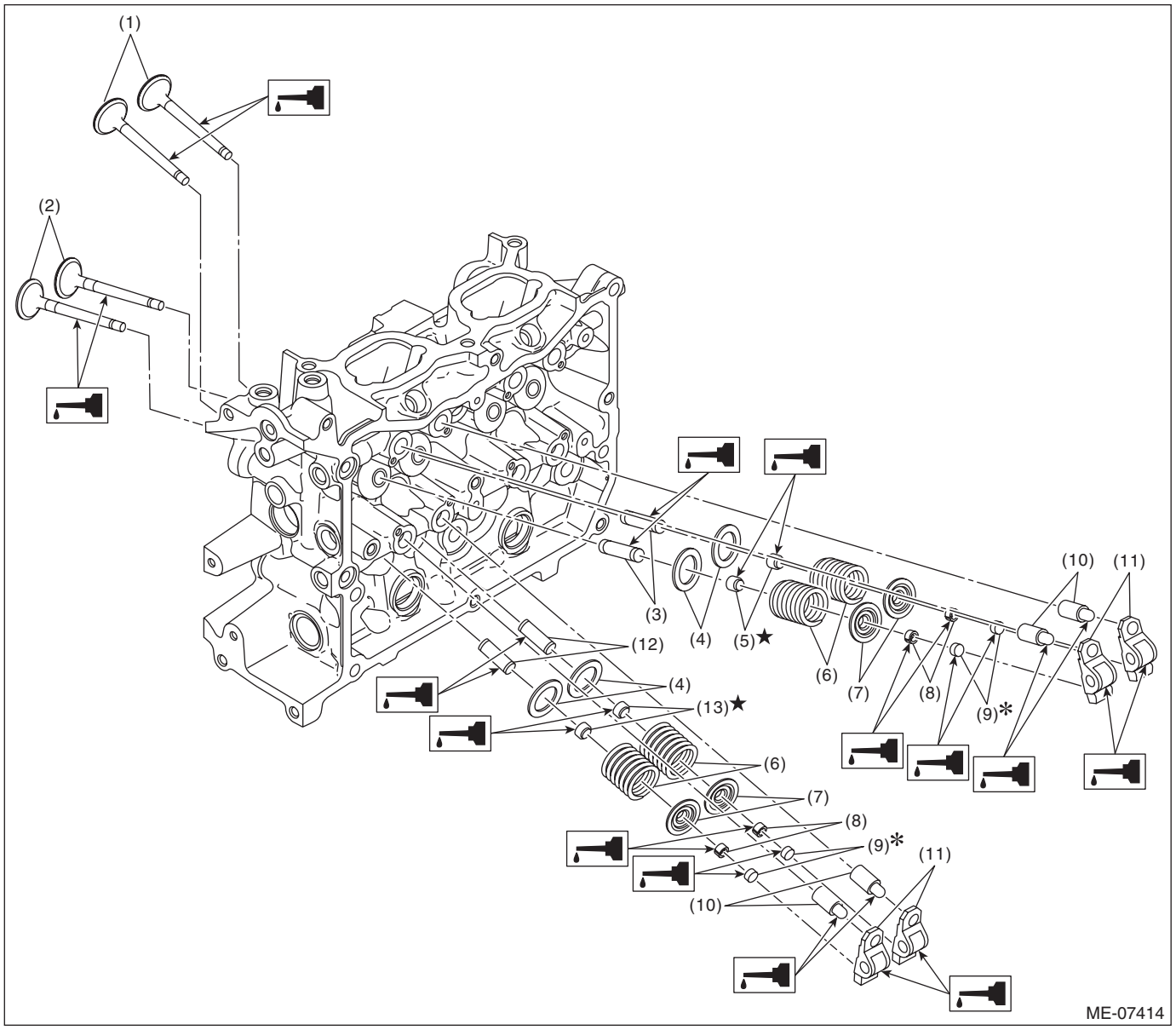


(1) Spark plug pipe gasket
(2) O-ring
(3) Cylinder head plate
(4) Cylinder head RH
(5) Cylinder head gasket RH
(6) Cylinder head gasket LH
(7) Cylinder head LH

Tightening torque: N·m (kgf-m, ft-lb)

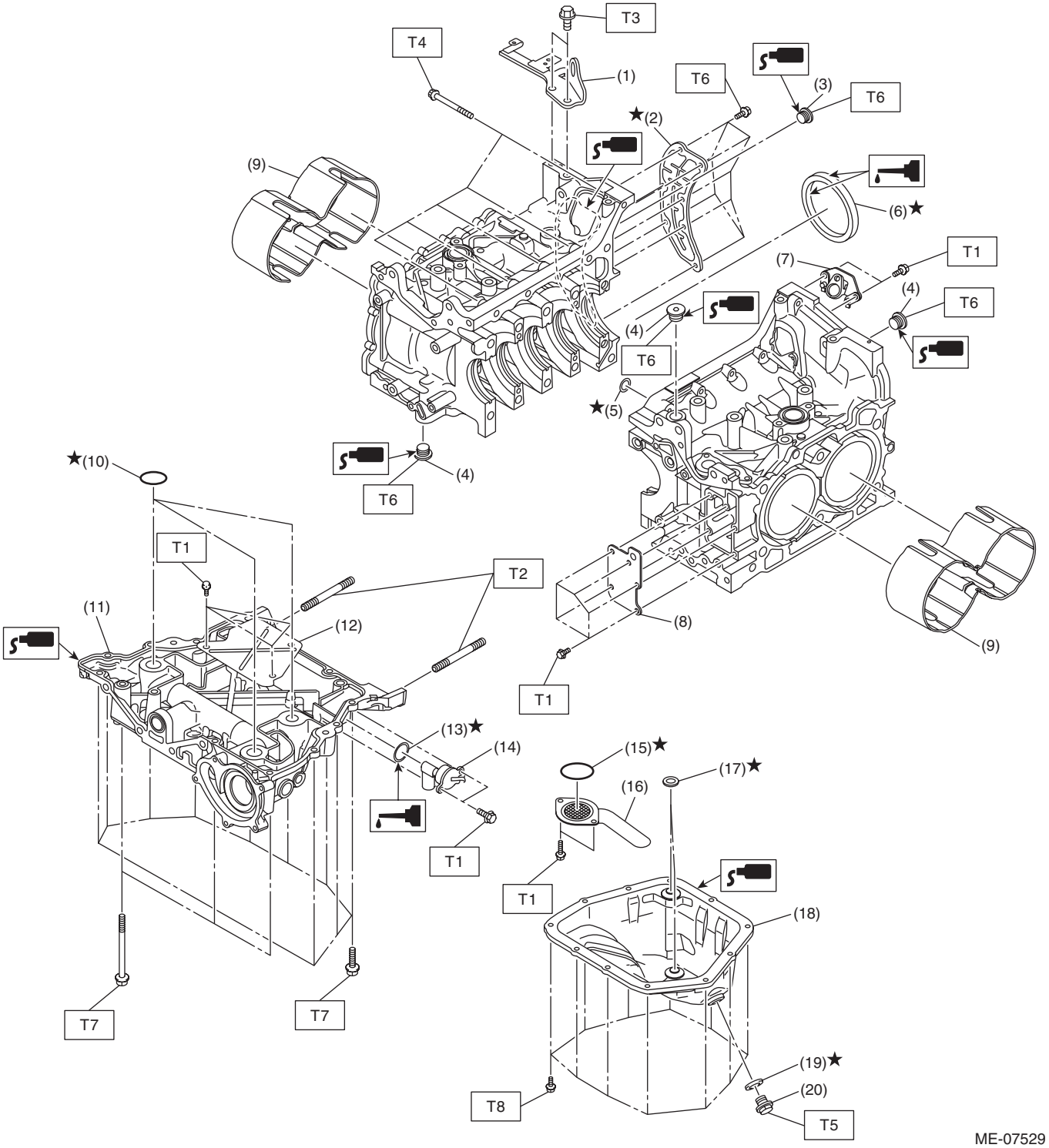
T: <Ref. to ME(H4DO)-221, INSTALLATION, Cylinder Head.>

6. VALVE ASSY



(1) Exhaust valve
(2) Intake valve
(3) Intake valve guide
(4) Valve spring seat
(5) Intake valve oil seal
(6) Valve spring
(7) Valve spring retainer
(8) Valve collet
(9) Valve shim
(10) Roller rocker arm pivot
(11) Roller rocker arm
(12) Exhaust valve guide
(13) Exhaust valve oil seal

7. CYLINDER BLOCK 1

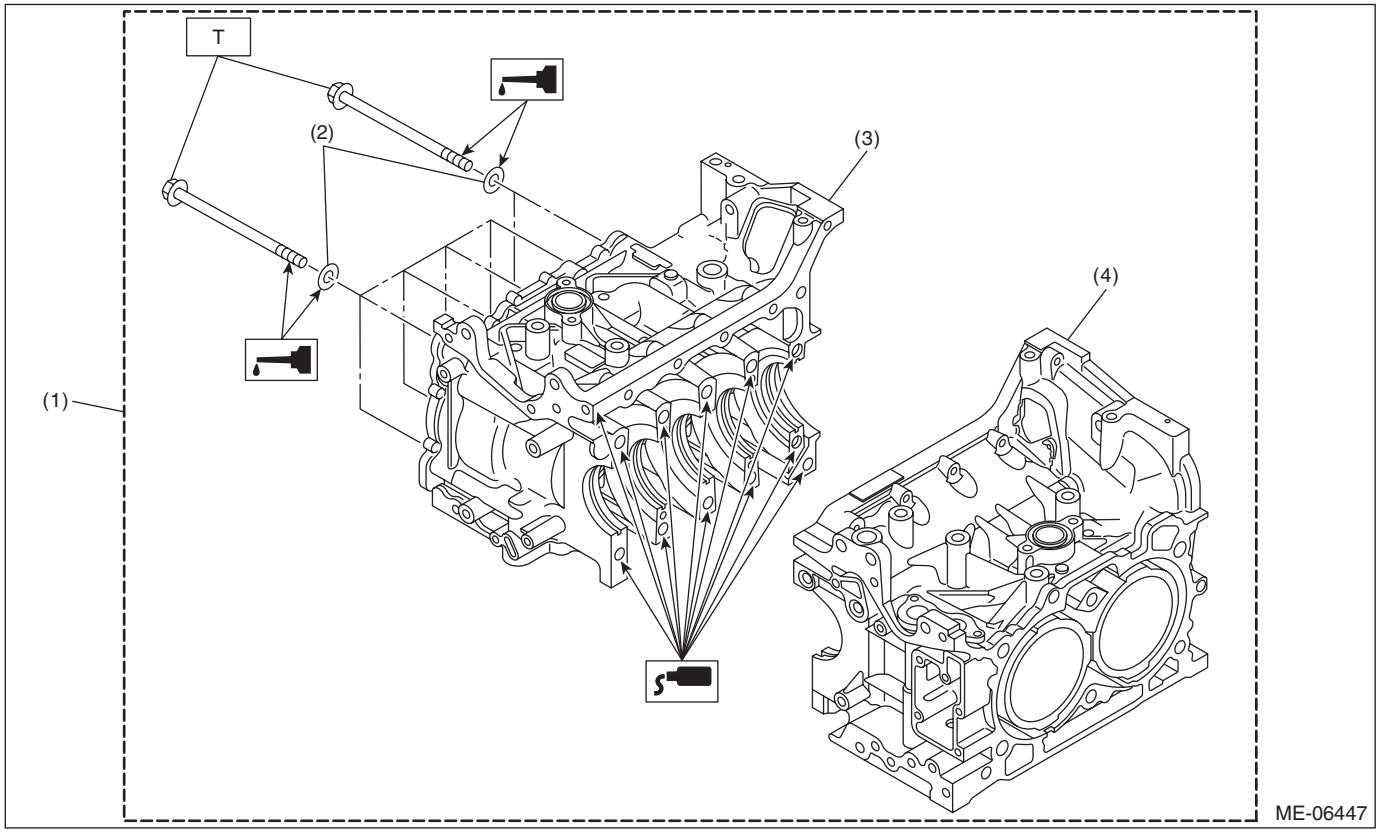


(1)	Engine rear hanger	(11)	Oil pan upper
(2)	Oil separator cover	(12)	Baffle plate
(3)	Cylinder block plug	(13)	O-ring
(4)	Main gallery plug	(14)	Oil level switch
(5)	O-ring	(15)	O-ring
(6)	Rear oil seal	(16)	Oil strainer
(7)	Crankshaft position sensor holder	(17)	Oil pan seal ring
(8)	Cylinder block plate	(18)	Oil pan
(9)	Water jacket spacer	(19)	Drain plug gasket
(10)	O-ring	(20)	Drain plug

Tightening torque: N·m (kgf-m, ft-lb)

- ***T1: 6.4 (0.7, 4.7)***
- ***T2: 10 (1.0, 7.4)***
- ***T3: 21 (2.1, 15.5)***
- ***T4: 25 (2.5, 18.4)***
- ***T5: 41.7 (4.3, 30.8)***
- ***T6: <Ref. to ME(H4DO)-326, CYLINDER BLOCK, ASSEMBLY, Cylinder Block.>***
- ***T7: <Ref. to ME(H4DO)-279, INSTALLATION, Cylinder Block.>***
- ***T8: <Ref. to LU(H4DO)-28, OIL PAN, INSTALLATION, Oil Pan and Strainer.>***

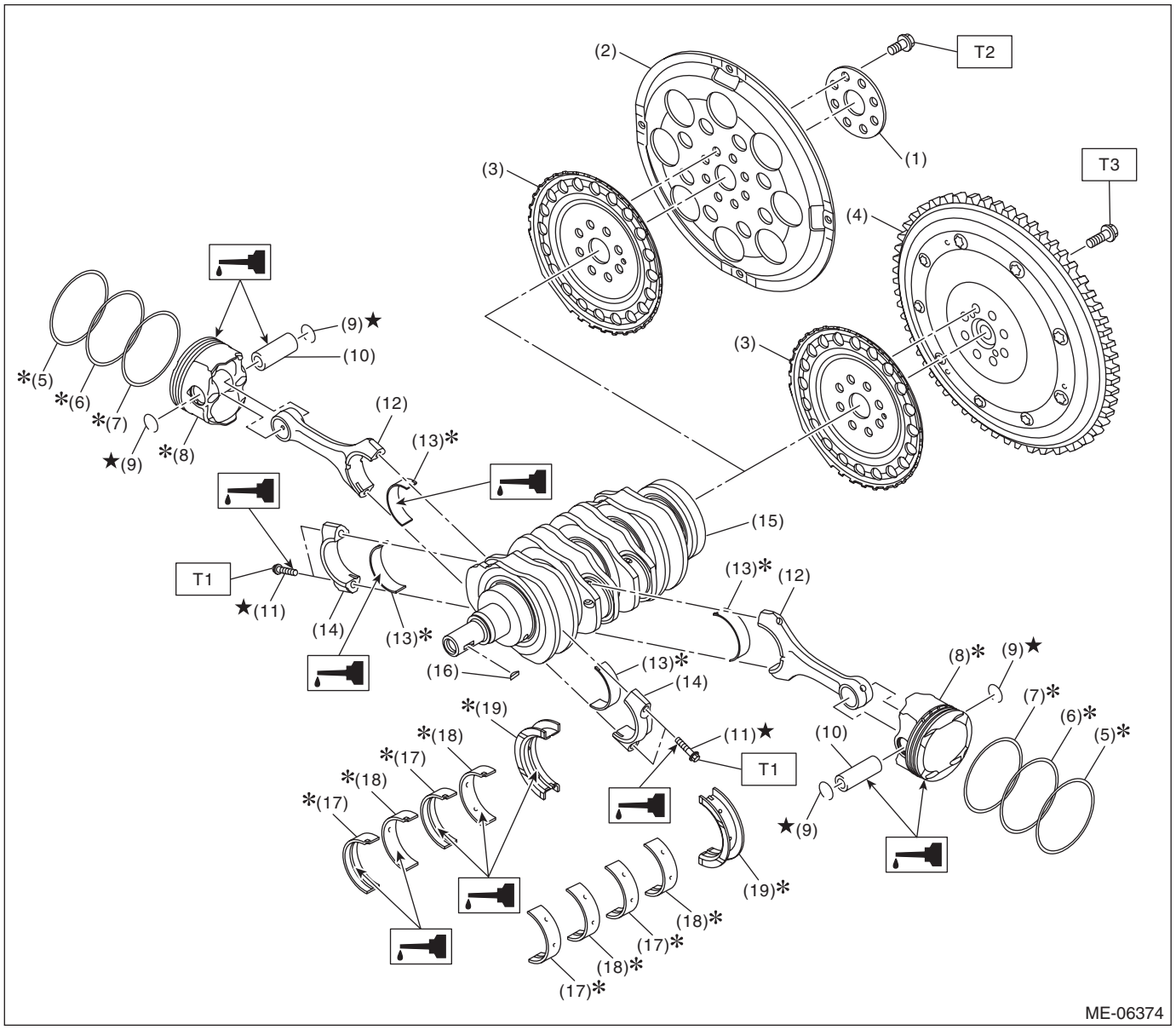
8. CYLINDER BLOCK 2



(1) Cylinder block ASSY
(2) Washer
(3) Cylinder block RH
(4) Cylinder block LH

Tightening torque: N·m (kgf-m, ft-lb)
T: <Ref. to ME(H4DO)-279, INSTALLATION, Cylinder Block.>

9. CRANKSHAFT AND PISTON



(1)	Reinforcement drive plate (CVT model)	(9)	Circlip	(17)	Crankshaft bearing #1, #3
(2)	Drive plate (CVT model)	(10)	Piston pin	(18)	Crankshaft bearing #2, #4
(3)	Crankshaft position sensor plate	(11)	Connecting rod cap bolt	(19)	Crankshaft bearing #5
(4)	Flywheel (MT model)	(12)	Connecting rod		
(5)	Top ring	(13)	Connecting rod bearing		
(6)	Second ring	(14)	Connecting rod cap		
(7)	Oil ring	(15)	Crankshaft		
(8)	Piston	(16)	Woodruff key		

Tightening torque:N·m (kgf-m, ft-lb)

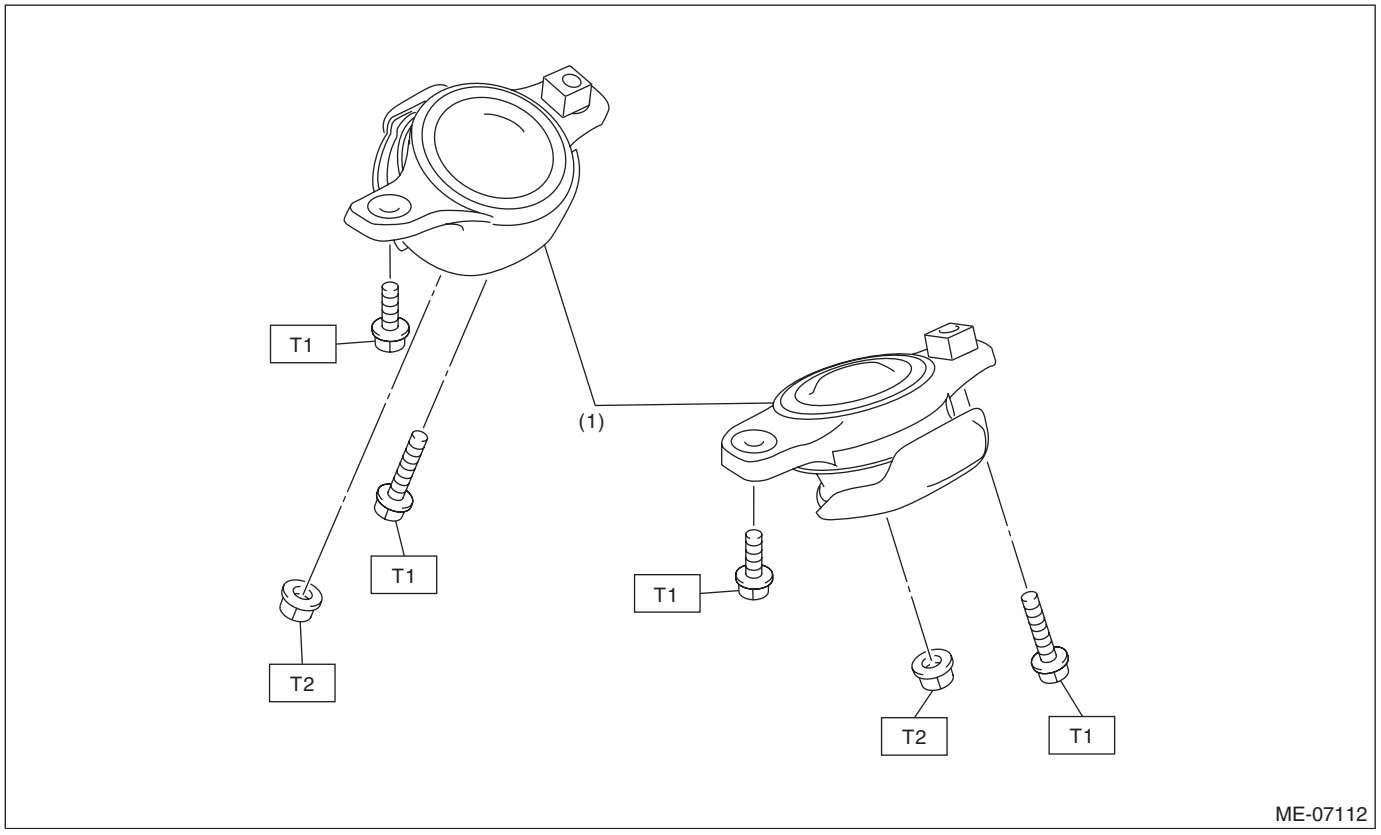
T1: ***<Ref. to ME(H4DO)-279, INSTALLATION, Cylinder Block.>***

T2: ***<Ref. to CVT(TR580)-159, INSTALLATION, Drive Plate.>***

T3: ***<Ref. to CL-13, INSTALLATION, Flywheel.>***

10.ENGINE MOUNTING

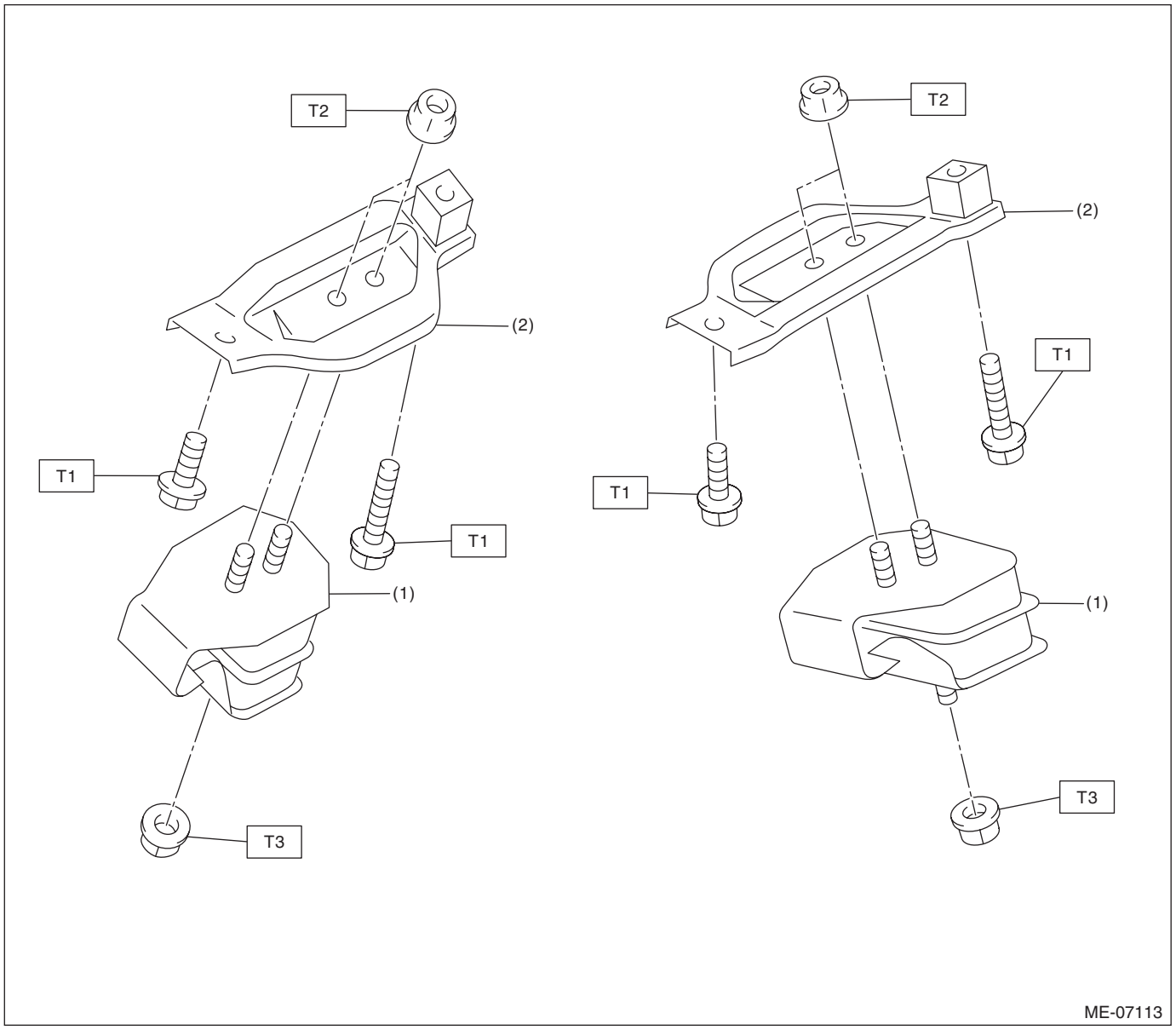
- Hydraulic engine mounting model



(1) Front cushion rubber

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

- Solid engine mounting model



(1) Front cushion rubber

(2) Front engine mounting bracket

Tightening torque: N·m (kgf-m, ft-lb)
T1: 35 (3.6, 25.8)
T2: 42 (4.3, 31.0)
T3: 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 or flywheel.
- 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

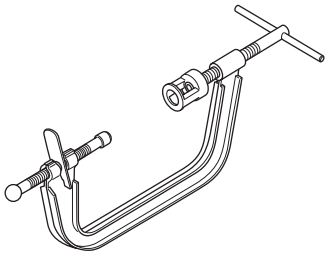
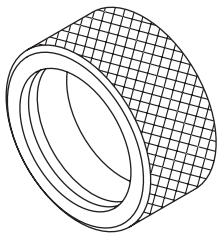
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST0920287002000	0920287002000	REMOVER AND REPLACER	Used for removing and installing valve spring.
 ST-398437700	398437700	OIL SEAL INSTALLER	Used for installing the front oil seal of engine.

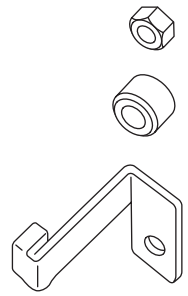
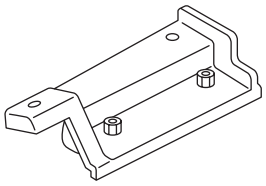
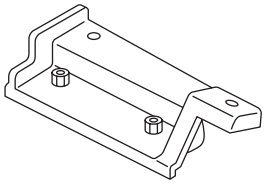
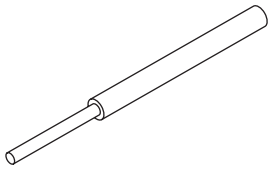
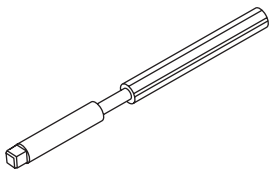
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498277200	498277200	STOPPER SET	Used for preventing the torque converter from falling when removing and installing the engine.
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	• Used for disassembling and assembling engine. • Used together with ENGINE STAND (499817100) and ADAPTER (18362AA020).
 ST-498457100	498457100	ENGINE STAND ADAPTER LH	• Used for disassembling and assembling engine. • Used together with ENGINE STAND (499817100) and ADAPTER (18362AA020).
 ST-499765700	499765700	VALVE GUIDE REMOVER AND INSTALLER	Used for removing and installing valve guide.
 ST-499765900	499765900	VALVE GUIDE REAMER	Used for reaming valve guides.

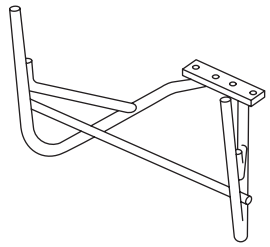
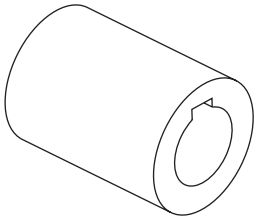
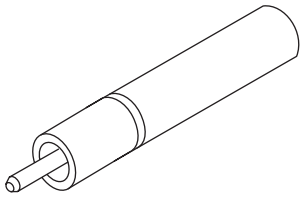
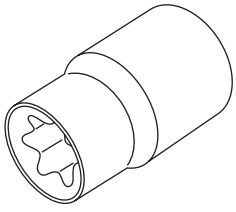
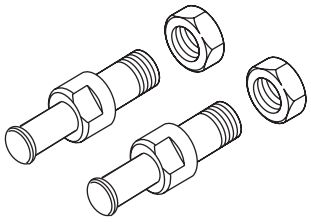
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499817100	499817100	ENGINE STAND	• Used for disassembling and assembling engine. • Used together with ADAPTER (18362AA020), ENGINE STAND ADAPTER RH (498457000) and LH (498457100).
 ST18252AA000	18252AA000	CRANKSHAFT SOCKET	Used for rotating crankshaft.
 ST18261AA010	18261AA010	VALVE OIL SEAL GUIDE	Used for press-fitting of intake valve guide stem seals and exhaust valve guide stem seals.
 ST18270AA020	18270AA020	SOCKET	Used for removing and installing connecting rod.
 ST18334AA000	18334AA000	PULLEY WRENCH PIN SET	• Used for removing and installing the crank pulley. • Used together with PULLEY WRENCH (18355AA000).

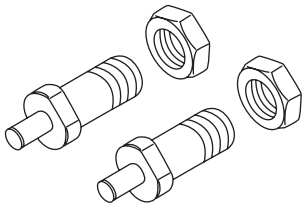
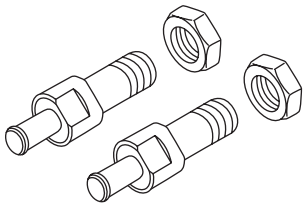
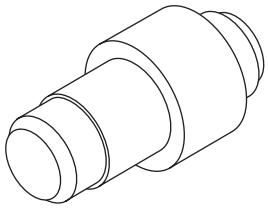
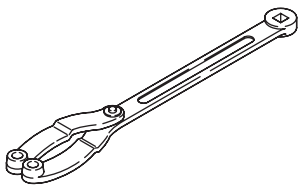
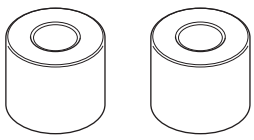
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18334AA020	18334AA020	PULLEY WRENCH PIN SET	• Used for removing and installing exhaust cam sprocket LH. • Used together with PULLEY WRENCH (18355AA000).
 ST18334AA030	18334AA030	PULLEY WRENCH PIN SET	• Used for removing and installing water pump pulley and intake cam sprocket. • Used together with PULLEY WRENCH (18355AA000).
 ST18350AA000	18350AA000	CONNECTING ROD BUSHING REMOVER AND INSTALLER	Used for removing and installing the connecting rod bushing at connecting rod small end.
 ST18355AA000	18355AA000	PULLEY WRENCH	• Used for removing and installing the crank pulley. • Used for installing and removing the water pump pulley. • Used for removing and installing intake cam sprocket and exhaust cam sprocket. • Used together with PULLEY WRENCH PIN SET (18334AA000), PULLEY WRENCH PIN SET (18334AA020) or PULLEY WRENCH PIN SET (18334AA030).
 ST18362AA020	18362AA020	ADAPTER	• Used for disassembling and assembling engine. • Used together with STAND (499817100), ENGINE STAND ADAPTER RH (498457000) and LH (498457100). • Bolt used: M10 × 50 (SUBARU genuine Part No.: 010410500)

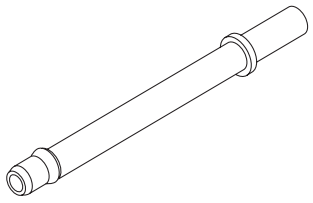
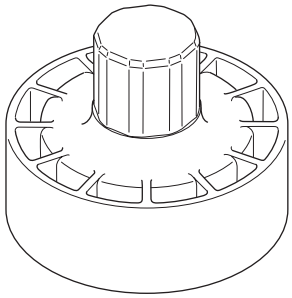
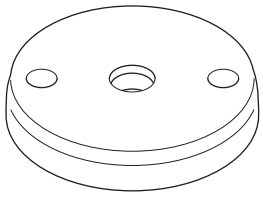
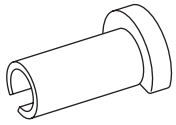
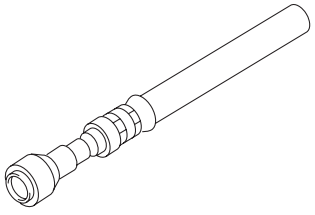
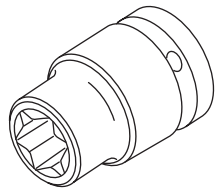
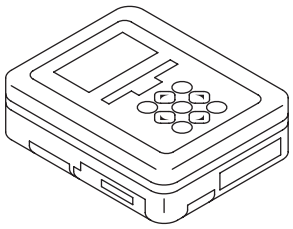
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18471AA000	18471AA000	FUEL PIPE ADAPTER	Used for inspecting the fuel pressure.
 ST18657AA030	18657AA030	OIL SEAL INSTALLER	• Used for installing the rear oil seal of engine. • Used together with OIL SEAL GUIDE (18671AA020).
 ST18671AA020	18671AA020	OIL SEAL GUIDE	• Used for installing the rear oil seal of engine. • Used together with OIL SEAL INSTALLER (18657AA030).
 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.

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18270KA010	18270KA010	SOCKET	Used for installing and removing intake cam sprocket and exhaust cam sprocket.
 ST1B022XU0	1B022XU0	SUBARU SELECT MONITOR III KIT	Used for various inspections.

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.
Piston ring compressor	Used for installing the piston into the cylinder block.
Thickness gauge	Used for various inspections.
Angle gauge	Used for angle tightening.