

General Description

MECHANICAL

1. General Description

A: SPECIFICATION

Engine	Cylinder arrangement		Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine		
	Valve system mechanism		Belt driven, double overhead camshaft, 4 valves/cylinder		
	Bore × Stroke		mm (in)		
	Displacement		cm ³ (cu in)		
	Compression ratio		8.2		
	Compression pressure (at 400 rpm)		kPa (kg/cm ² , psi)		
	Number of piston rings		Pressure ring: 2, Oil ring: 1		
	Intake valve timing		Open	Max.retard	ATDC 5°
				Min.advance	BTDC 15°
			Close	Max.retard	ABDC 65°
				Min.advance	ABDC 45°
	Exhaust valve timing		Open	BBDC 55°	
			Close	BTDC 5°	
	Valve clearance		mm (in)	Intake	0.20 ^{+0.04} _{-0.06} (0.0079 ^{+0.0016} _{-0.0024})
				Exhaust	0.35±0.05 (0.0138±0.0020)
Idle speed ["P"/"N" range]		rpm	No-load	750±100	
			A/C ON	875±100	
Ignition order		1 → 3 → 2 → 4			
Ignition timing		BTDC/rpm	MT model	12°±10°/750	
			AT model	17°±10°/750	

NOTE:

OS: Oversize US: Undersize

Belt tension adjuster	Protrusion of adjuster rod		mm (in)		5.2 — 6.2 (0.205 — 0.244)	
Belt tensioner	Spacer O.D.		mm (in)		17.955 — 17.975 (0.7069 — 0.7077)	
	Tensioner bush I.D.		mm (in)		18.0 — 18.08 (0.7087 — 0.7118)	
	Clearance between spacer and bush		mm (in)	Standard	0.025 — 0.125 (0.0010 — 0.0049)	
	Side clearance of spacer		mm (in)	Standard	0.2 — 0.55 (0.0079 — 0.0217)	
Camshaft	Bend limit		mm (in)		0.020 (0.0079) or less	
	Side clearance		mm (in)	Standard	0.068 — 0.116 (0.0027 — 0.0047)	
	Cam lobe height		mm (in)	Intake	Standard	46.55 — 46.65 (1.833 — 1.837)
				Exhaust	Standard	46.75 — 46.85 (1.841 — 1.844)
	Journal O.D.		mm (in)	Standard	Front	37.946 — 37.963 (1.4939 — 1.4946)
Center rear					29.946 — 29.963 (1.1790 — 1.1796)	
Clearance at journal		mm (in)		Standard	0.037 — 0.072 (0.0015 — 0.0028)	
Cylinder Head	Surface warpage limit		mm (in)		0.035 (0.0014)	
	Grinding limit		mm (in)		0.3 (0.012)	
	Standard height		mm (in)		127.5 (5.02)	
Valve seat	Refacing angle		90°			
	Contacting width		mm (in)	Intake	Standard	0.6 — 1.4 (0.024 — 0.055)
				Exhaust	Standard	1.2 — 1.8 (0.047 — 0.071)
Valve guide	Inside diameter		mm (in)		6.000 — 6.012 (0.2362 — 0.2367)	
	Protrusion above head		mm (in)		15.8 — 16.2 (0.622 — 0.638)	

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Valve	Head edge thickness	mm (in)	Intake	Standard	1.0 — 1.4 (0.039 — 0.055)
			Exhaust	Standard	1.3 — 1.7 (0.051 — 0.067)
	Stem outer diameters	mm (in)	Intake		5.955 — 5.970 (0.2344 — 0.2350)
			Exhaust		5.945 — 5.960 (0.2341 — 0.2346)
	Valve stem gap	mm (in)	Standard	Intake	0.030 — 0.057 (0.0012 — 0.0022)
				Exhaust	0.040 — 0.067 (0.0016 — 0.0026)
Overall length	mm (in)	Intake		104.4 (4.110)	
		Exhaust		104.65 (4.1201)	
Valve springs	Free length			mm (in)	47.32 (1.863)
	Squareness				2.5°, 2.1 mm (0.083 in)
	Tension/spring height	N (kgf, lb) /mm (in)	Set	205 — 235 (20.9 — 24.0, 46.1 — 52.8)/36.0 (1.417)	
			Lift	426 — 490 (43.4 — 50.0, 95.8 — 110)/26.50 (1.043)	
Cylinder block	Surface warpage limit (mating with cylinder head)			mm (in)	0.025 (0.0098)
	Grinding limit			mm (in)	0.1 (0.004)
	Standard height			mm (in)	201.0 (7.91)
	Cylinder inner diameter	mm (in)	Standard	A	99.505 — 99.515 (3.9175 — 3.9179)
				B	99.495 — 99.505 (3.9171 — 3.9175)
	Taper			mm (in)	Standard 0.015 (0.0006)
	Out-of-roundness			mm (in)	Standard 0.010 (0.0004)
Piston clearance			mm (in)	Standard -0.010 — 0.010 (-0.00039 — 0.00039)	
Piston	Outer diameter	mm (in)	Standard	A	99.505 — 99.515 (3.9175 — 3.9179)
				B	99.495 — 99.505 (3.9171 — 3.9175)
			0.25 (0.0098) OS		99.745 — 99.765 (3.9270 — 3.9278)
			0.50 (0.0197) OS		99.995 — 100.015 (3.9368 — 3.9376)
Piston pin	Standard clearance between piston and piston pin		mm (in)	Standard	0.004 — 0.008 (0.0002 — 0.0003)
	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).
Piston ring	Ring closed gap	mm (in)	Top ring	Standard	0.20 — 0.25 (0.0079 — 0.0098)
			Second ring	Standard	0.37 — 0.52 (0.015 — 0.0203)
			Oil ring	Standard	0.20 — 0.50 (0.0079 — 0.0197)
	Ring groove gap	mm (in)	Top ring	Standard	0.040 — 0.080 (0.0016 — 1.0031)
Second ring			Standard	0.030 — 0.070 (0.0012 — 0.0028)	
Connecting rod	Bend or twist per 100 mm (3.94 in) in length		mm (in)	Limit	0.10 (0.0039)
	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	0.017 — 0.045 (0.0007 — 0.0018)
	Bearing size (Thickness at center)	mm (in)	Standard		1.490 — 1.502 (0.0587 — 0.0591)
			0.03 (0.0012) US		1.504 — 1.512 (0.0592 — 0.0595)
			0.05 (0.0020) US		1.514 — 1.522 (0.0596 — 0.0599)
0.25 (0.0098) US			1.614 — 1.622 (0.0635 — 0.0639)		
Bushing of small end	Clearance between piston pin and bushing		mm (in)	Standard	0 — 0.022 (0 — 0.0009)

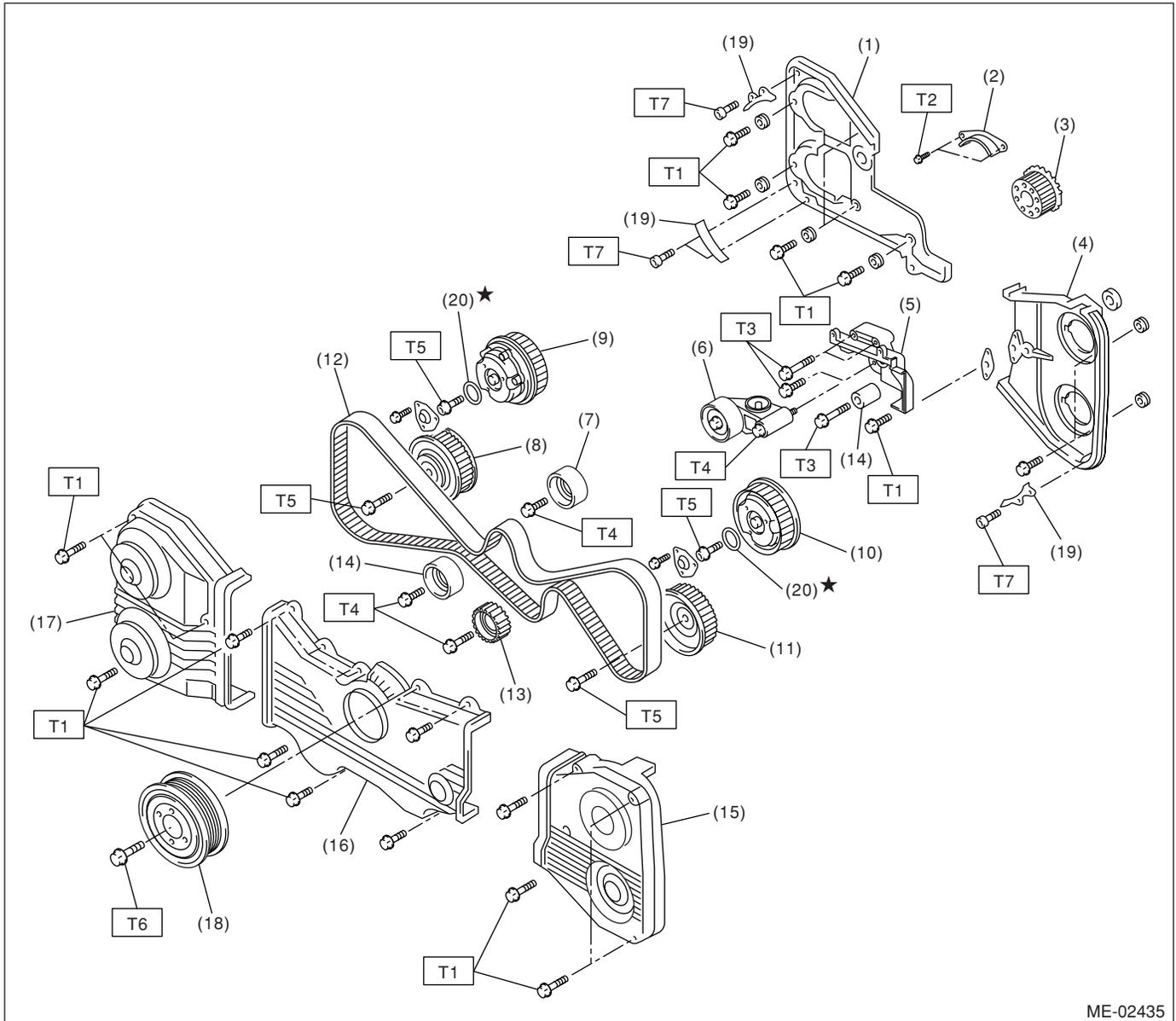
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Crankshaft	Bend limit		mm (in)	0.035 (0.0014)	
	Crank pin	Out-of-roundness		mm (in)	0.003 (0.0001)
		Cylindricality		mm (in)	0.004 (0.0002)
		Grinding limit (dia.)		mm (in)	To 51.750 (2.0374)
	Crank journal	Out-of-roundness		mm (in)	0.005 (0.0002)
		Cylindricality		mm (in)	0.006 (0.0002)
		Grinding limit (dia.)		mm (in)	To 59.750 (2.3524)
	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 (2.0447 — 2.0453)
			0.25 (0.0098) US		51.734 — 51.750 (2.0368 — 2.0374)
	Crank journal outer diameter	mm (in)	Standard		59.992 — 60.008 (2.3619 — 2.3625)
			0.03 (0.0012) US		59.962 — 59.978 (2.3607 — 2.3613)
			0.05 (0.0020) US		59.942 — 59.958 (2.3599 — 2.3605)
0.25 (0.0098) US			59.742 — 59.758 (2.3520 — 2.3527)		
Side clearance		mm (in)	Standard	0.030 — 0.115 (0.0012 — 0.0045)	
Oil clearance				mm (in)	0.010 — 0.030 (0.0004 — 0.0012)
Main bearing	Bearing size (Thickness at center) mm (in)	#1, #3	Standard		1.998 — 2.011 (0.0787 — 0.0792)
			0.03 (0.0012) US		2.017 — 2.020 (0.0794 — 0.0795)
			0.05 (0.0020) US		2.027 — 2.030 (0.0798 — 0.0799)
			0.25 (0.0098) US		2.127 — 2.130 (0.0837 — 0.0839)
		#2, #4, #5	Standard		2.000 — 2.013 (0.0787 — 0.0793)
			0.03 (0.0012) US		2.019 — 2.022 (0.0795 — 0.0796)
			0.05 (0.0020) US		2.029 — 2.032 (0.0799 — 0.0800)
			0.25 (0.0098) US		2.129 — 2.132 (0.0838 — 0.0839)

B: COMPONENT

1. TIMING BELT



ME-02435

- | | |
|--|-----------------------------------|
| (1) Timing belt cover No. 2 (RH) | (11) Exhaust cam sprocket (LH) |
| (2) Timing belt guide | (12) Timing Belt |
| (3) Crank sprocket | (13) Belt idler No. 2 |
| (4) Timing belt cover No. 2 (LH) | (14) Belt idler |
| (5) Tensioner bracket | (15) Timing belt cover (LH) |
| (6) Automatic belt tension adjuster ASSY | (16) Front belt cover |
| (7) Belt idler | (17) Timing belt cover (RH) |
| (8) Exhaust cam sprocket (RH) | (18) Crank pulley |
| (9) Intake cam sprocket (RH) | (19) Timing belt guide (MT model) |
| (10) Intake cam sprocket (LH) | (20) O-ring |

Tightening torque: N·m (kgf·m, ft·lb)

T1: 5 (0.5, 3.6)

T2: 10 (1.0, 7.2)

T3: 25 (2.5, 18.1)

T4: 39 (4.0, 28.9)

T5: <Ref. to ME(H4DOTC)-49, INSTALLATION, Cam Sprocket.>

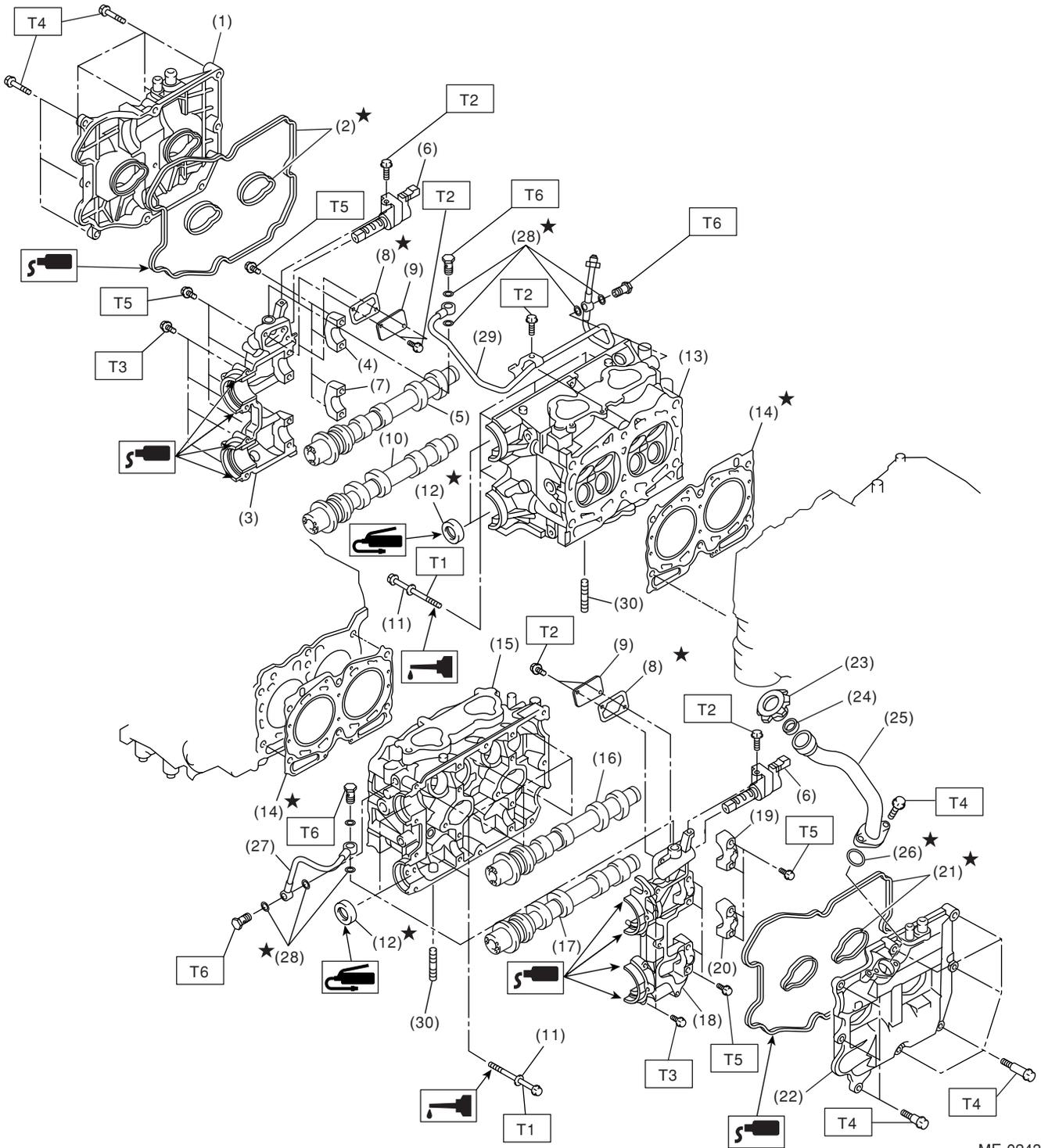
T6: <Ref. to ME(H4DOTC)-39, INSTALLATION, Crank Pulley.>

T7: 6.4 (0.65, 4.7)

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2. CYLINDER HEAD AND CAMSHAFT



ME-02436

ME(H4DOTC)-6

General Description

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(1) Rocker cover (RH)	(15) Cylinder head (LH)	(29) Oil pipe (RH)
(2) Rocker cover gasket (RH)	(16) Intake camshaft (LH)	(30) Stud bolt
(3) Camshaft cap (Front RH)	(17) Exhaust camshaft (LH)	
(4) Intake camshaft cap (Rear RH)	(18) Camshaft cap (Front LH)	
(5) Intake camshaft (RH)	(19) Intake camshaft cap (Rear LH)	
(6) Oil flow control solenoid valve	(20) Exhaust camshaft cap (Rear LH)	
(7) Exhaust camshaft cap (Rear RH)	(21) Rocker cover gasket (LH)	
(8) Gasket	(22) Rocker cover (LH)	
(9) Oil return cover	(23) Oil filler cap	
(10) Exhaust camshaft (RH)	(24) Gasket	
(11) Cylinder head bolt	(25) Oil filler duct	
(12) Oil seal	(26) O-ring	
(13) Cylinder head (RH)	(27) Oil pipe (LH)	
(14) Cylinder head gasket	(28) Gasket	

Tightening torque: N·m (kgf·m, ft·lb)

T1: <Ref. to ME(H4DOTC)-56, INSTALLATION, Cylinder Head.>

T2: 8 (0.8, 5.9)

T3: <Ref. to ME(H4DOTC)-52, INSTALLATION, Camshaft.>

T4: 6.4 (0.65, 4.7)

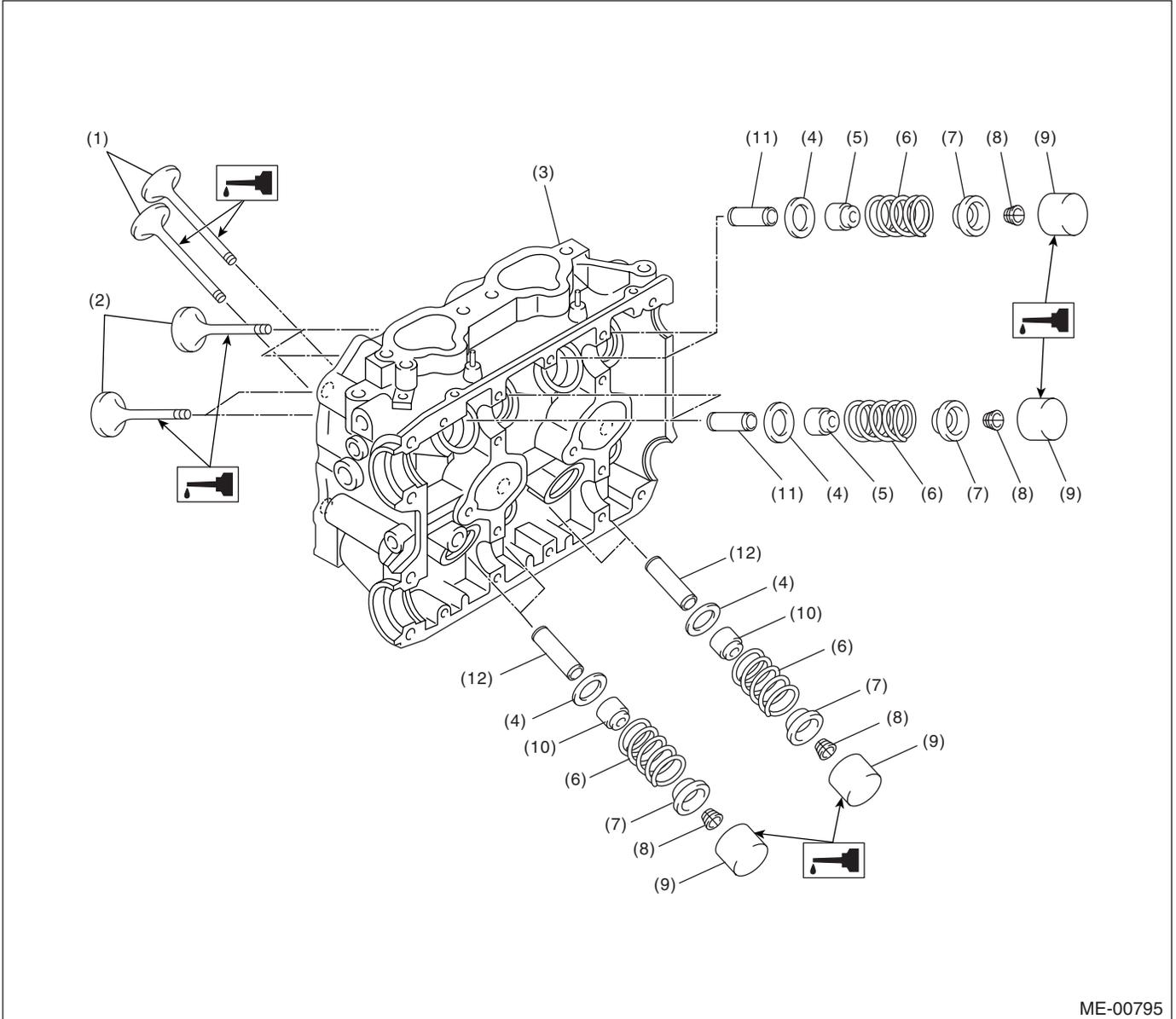
T5: <Ref. to ME(H4DOTC)-52, INSTALLATION, Camshaft.>

T6: 29 (3.0, 21.4)

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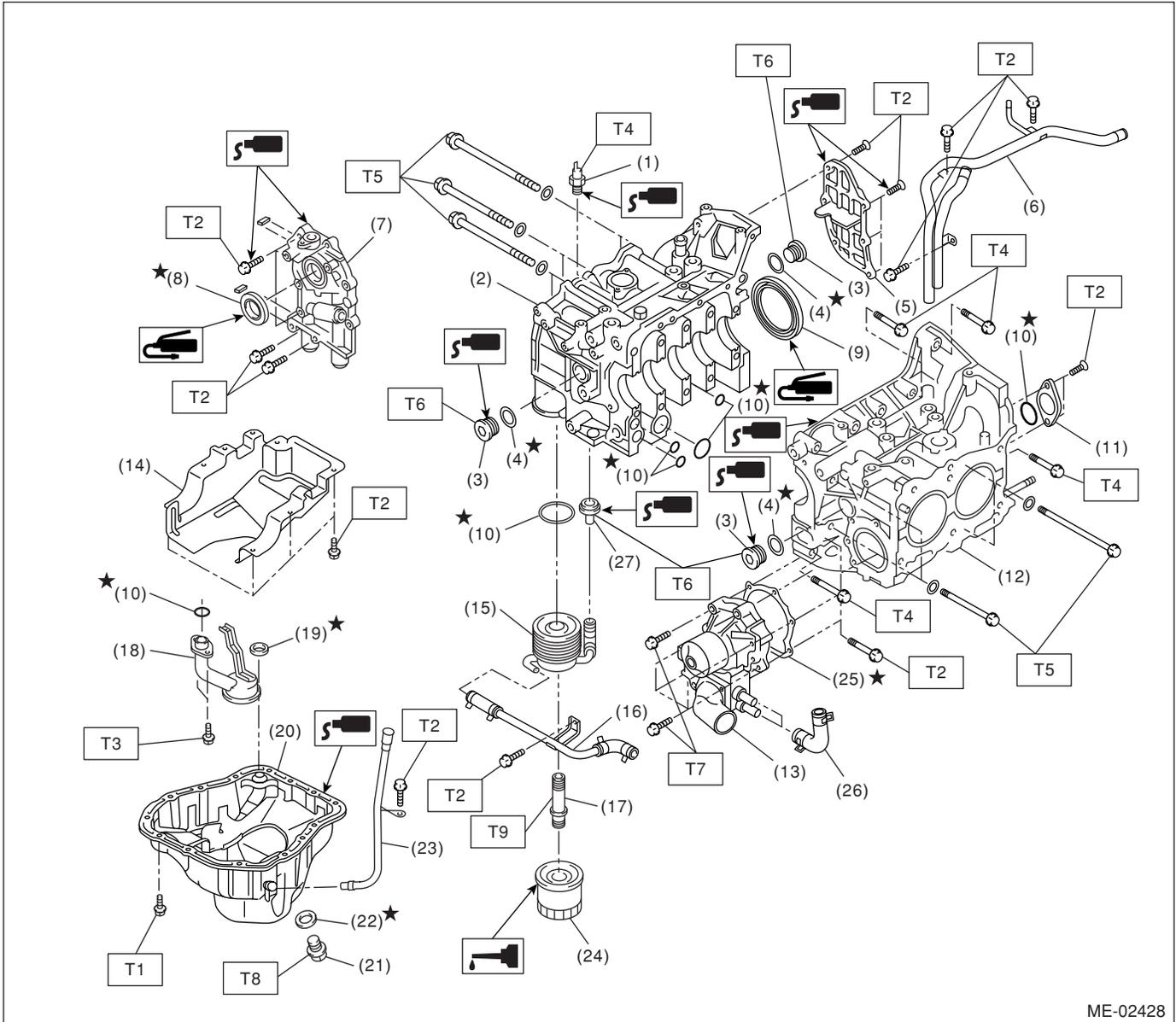
3. CYLINDER HEAD AND VALVE ASSEMBLY



ME-00795

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

4. CYLINDER BLOCK



ME-02428

- | | |
|--------------------------|----------------------------|
| (1) Oil pressure switch | (15) Oil cooler |
| (2) Cylinder block (RH) | (16) Water by-pass pipe |
| (3) Service hole plug | (17) Connector |
| (4) Gasket | (18) Oil strainer |
| (5) Oil separator cover | (19) Gasket |
| (6) Water by-pass pipe | (20) Oil pan |
| (7) Oil pump | (21) Drain plug |
| (8) Front oil seal | (22) Metal gasket |
| (9) Rear oil seal | (23) Oil level gauge guide |
| (10) O-ring | (24) Oil filter |
| (11) Service hole cover | (25) Gasket |
| (12) Cylinder block (LH) | (26) Water pump hose |
| (13) Water pump | (27) Plug |
| (14) Baffle plate | |

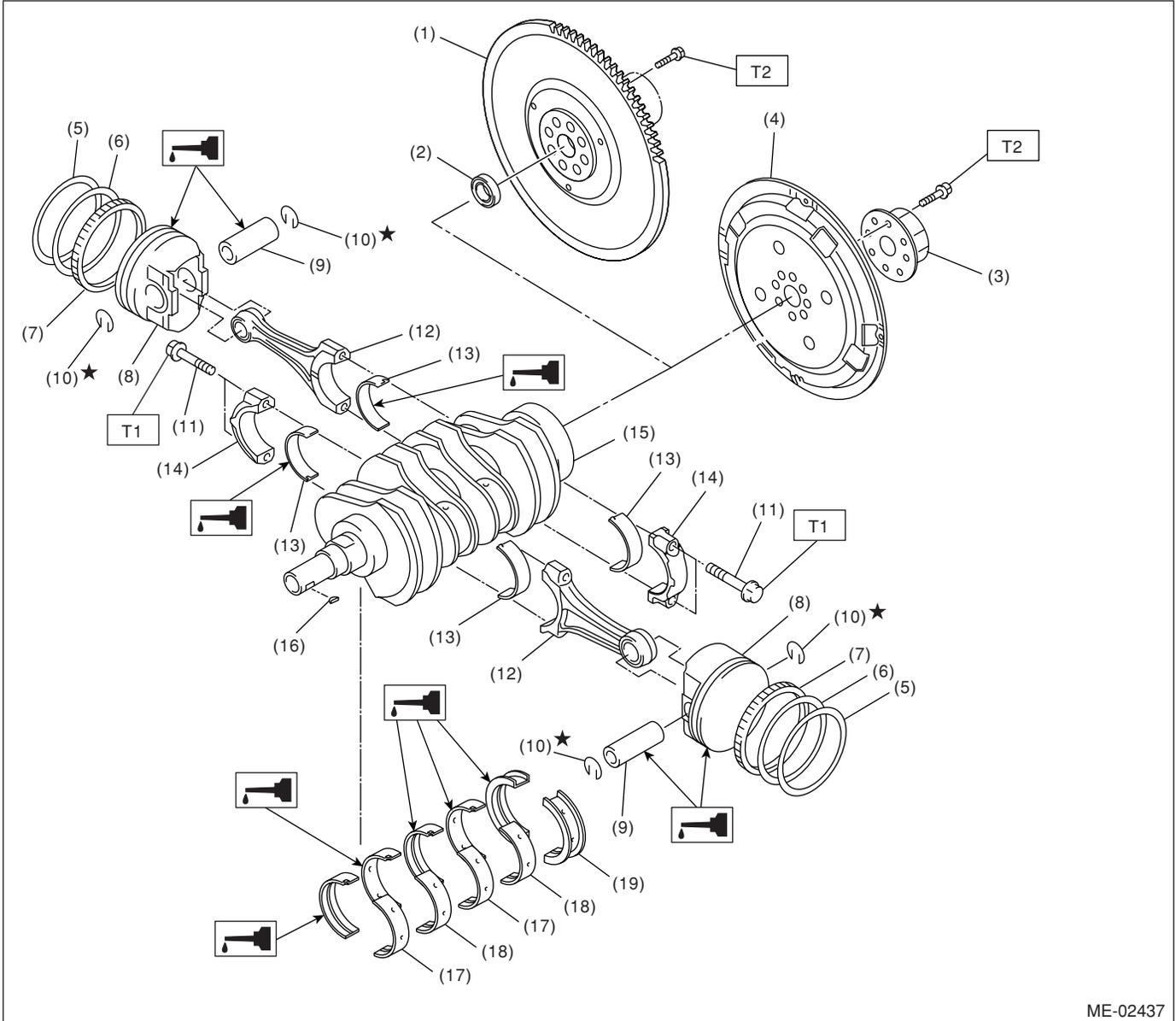
Tightening torque: N·m (kgf·m, ft·lb)

- T1: 5 (0.5, 3.6)**
T2: 6.4 (0.65, 4.7)
T3: 10 (1.0, 7.2)
T4: 25 (2.5, 18.1)
T5: <Ref. to ME(H4DOTC)-67, INSTALLATION, Cylinder Block.>
T6: 70 (7.1, 50.6)
T7: First 12 (1.2, 8.9)
Second 12 (1.2, 8.9)
T8: 44 (4.5, 33)
T9: 54 (5.5, 40)

General Description

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5. CRANKSHAFT AND PISTON



ME-02437

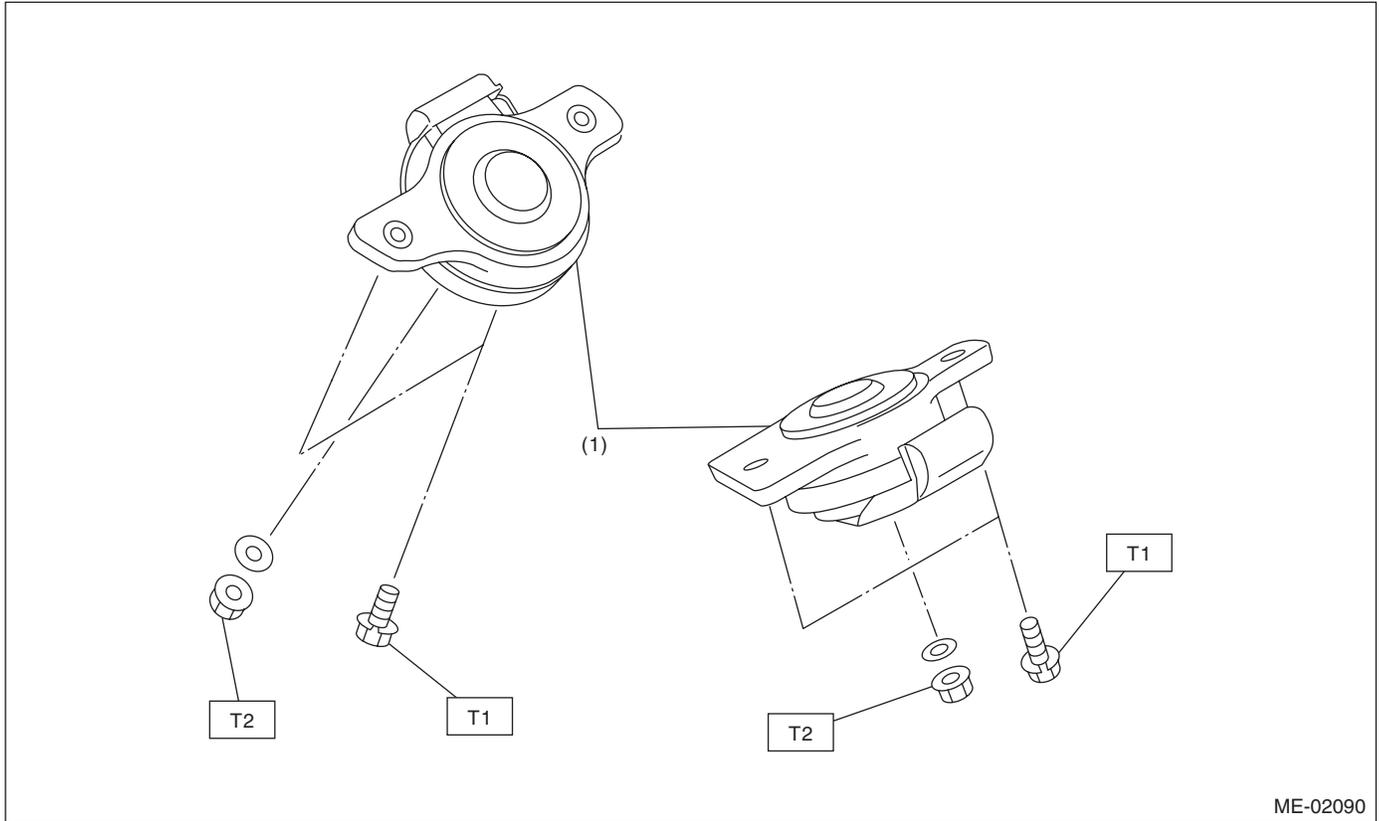
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|------------------------------|-----------------------------|--------------------------------|
| (1) Flywheel (MT model) | (9) Piston pin | (17) Crankshaft bearing #1, #3 |
| (2) Ball bearing (MT model) | (10) Snap ring | (18) Crankshaft bearing #2, #4 |
| (3) Reinforcement (AT model) | (11) Connecting rod bolt | (19) Crankshaft bearing #5 |
| (4) Drive plate (AT 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: 52 (5.3, 38.4)

T2: 72 (7.3, 53.1)

6. ENGINE MOUNTING



ME-02090

(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 work clothing, including a cap, protective goggles, and protective shoes during operation.
- 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.
- Be careful not to burn yourself, because each part on the vehicle is hot after running.
- 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 electrical connectors of sensors or units, be sure to disconnect the ground cable from battery.
- All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.

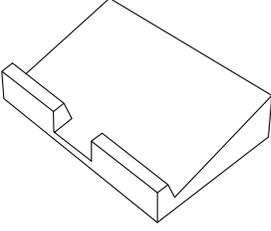
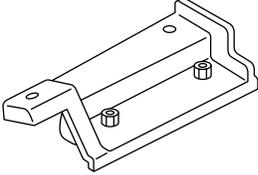
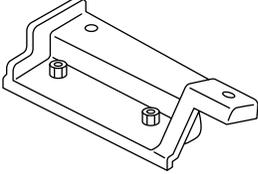
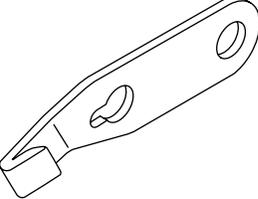
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.
- Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.
- All removed parts, if to be reused, should be re-installed in the original positions and directions.
- Bolts, nuts and washers should be replaced with new ones 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.

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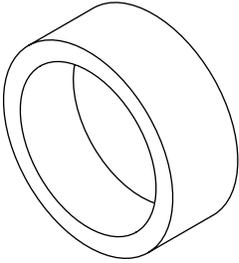
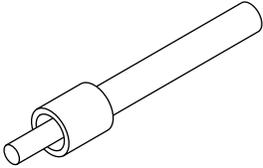
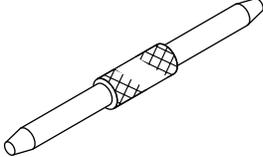
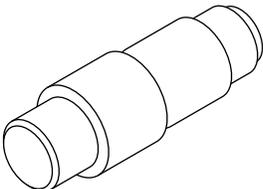
D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p>ST-498267600</p>	498267600	CYLINDER HEAD TABLE	<ul style="list-style-type: none"> • Used for replacing valve guides. • Used for removing and installing valve spring.
 <p>ST-498457000</p>	498457000	ENGINE STAND ADAPTER RH	Used with ENGINE STAND (499817000).
 <p>ST-498457100</p>	498457100	ENGINE STAND ADAPTER LH	Used with ENGINE STAND (499817000).
 <p>ST-498497100</p>	498497100	CRANKSHAFT STOPPER	Used for stopping rotation of drive plate when loosening/tightening crank pulley bolt.

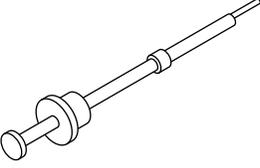
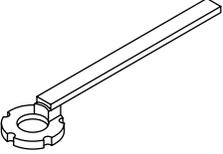
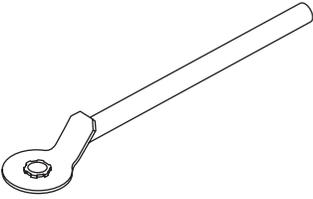
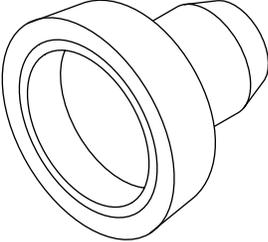
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 <p style="text-align: center;">ST-498747300</p>	498747300	PISTON GUIDE	Used for installing piston in cylinder. (2.5 L model)
 <p style="text-align: center;">ST-498857100</p>	498857100	VALVE OIL SEAL GUIDE	Used for press-fitting of intake and exhaust valve guide oil seals.
 <p style="text-align: center;">ST-499017100</p>	499017100	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 <p style="text-align: center;">ST-499037100</p>	499037100	CONNECTING ROD BUSHING REMOVER AND INSTALLER	Used for removing and installing connecting rod bushing.

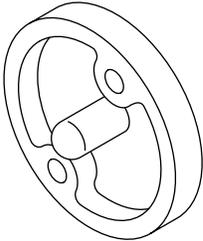
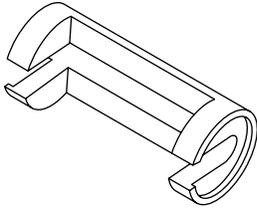
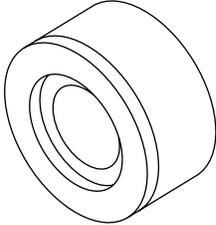
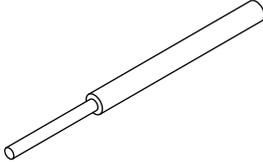
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 <p style="text-align: center;">ST-499097700</p>	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 <p style="text-align: center;">ST-499207400</p>	499207400	CAMSHAFT SPROCKET WRENCH	Used for removing and installing exhaust cam sprocket.
 <p style="text-align: center;">ST-499977500</p>	499977500	CAM SPROCKET WRENCH	Used for removing and installing the intake 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).

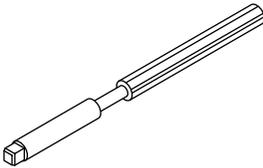
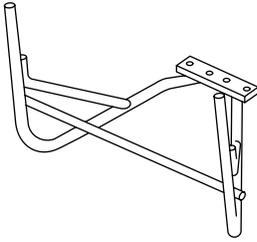
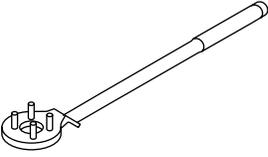
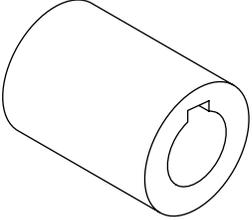
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <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).
 <p style="text-align: center;">ST-499718000</p>	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.
 <p style="text-align: center;">ST18251AA020</p>	18251AA020	VALVE GUIDE ADJUSTER	Used for installing intake and exhaust valve guides.
 <p style="text-align: center;">ST-499767200</p>	499767200	VALVE GUIDE REMOVER	Used for removing valve guides.

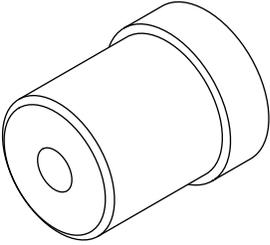
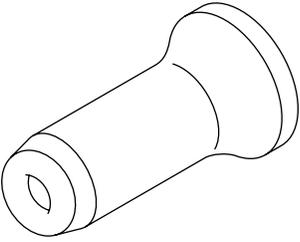
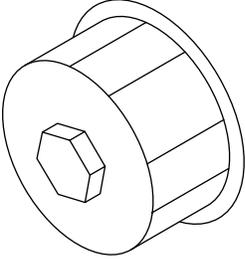
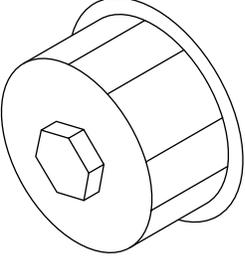
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-499767400</p>	499767400	VALVE GUIDE REAMER	Used for reaming valve guides.
 <p style="text-align: center;">ST-499817000</p>	499817000	ENGINE STAND	<ul style="list-style-type: none"> • Stand used for engine disassembly and assembly. • Used with ENGINE STAND ADAPTER RH (498457000) & LH (498457100).
 <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.
 <p style="text-align: center;">ST-499987500</p>	499987500	CRANKSHAFT SOCKET	Used for rotating crankshaft.

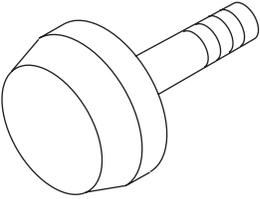
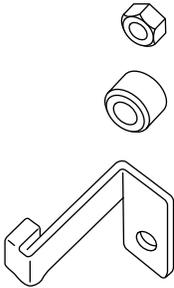
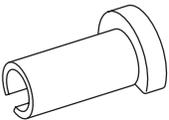
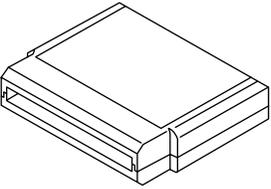
General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-499587100</p>	499587100	OIL SEAL INSTALLER	Used for installing oil pump oil seal.
 <p style="text-align: center;">ST-499587600</p>	499587600	OIL SEAL INSTALLER	Used for installing camshaft oil seal for DOHC engine.
 <p style="text-align: center;">ST18332AA000</p>	18332AA000	OIL FILTER WRENCH	Used for removing and installing oil filter. (Outer diameter: 68 mm (2.68 in))
 <p style="text-align: center;">ST18332AA010</p>	18332AA010	OIL FILTER WRENCH	Used for removing and installing oil filter. (Outer diameter: 65 mm (2.56 in))

General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 <p style="text-align: center;">ST-499597200</p>	499597200	OIL SEAL GUIDE	<ul style="list-style-type: none"> • Used for installing camshaft oil seal for DOHC engine. • Used with OIL SEAL INSTALLER (499587600)
 <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 removing quick connector in engine room.
 <p style="text-align: center;">ST24082AA260</p>	24082AA260	CARTRIDGE	Troubleshooting for electrical system.

General Description

MECHANICAL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST22771AA030	22771AA030	SUBARU SELECT MONI- TOR KIT	Troubleshooting for electrical system.

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

- V-belt
- Timing belt
- Camshaft
- Cylinder head