MECHANICAL

ME(TURBO)

1. General Description

A: SPECIFICATIONS

Engine	Type			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
	Valve arrangement			Belt driven, double overhead camshaft, 4-valve/cylinder	
	Bore x Stroke		mm (in)	92 x 75 (3.62 x 2.95)	
	Piston displacement		cm^3 (cu in)	1,994 (121.67)	
	Compression ratio			8.0	
	Compression pressure (at 200 — 300 rpm)		kPa (kgf/cm^2, psi)	981 — 1,177 (10 — 12, 142 — 171)	
	Number of piston rings			Pressure ring: 2, Oil ring: 1	
	Intake valve timing	Opening		3°BTDC	
		Closing		33°ABDC	
	Exhaust valve timing	Opening		33° BBDC	
		Closing		3° ATDC	
	Valve clearance	Intake	mm (in)	0.20±0.02 (0.0079±0.0008)	
		Exhaust	mm (in)	0.25±0.02 (0.0098±0.0008)	
	Idling speed [At neutral position]		rpm	MT	750±100 (No load) 800±150 (A/C switch ON)
				AT	750±100 (No load) 825±150 (A/C switch ON)
	Firing order			1 → 3 → 2 → 4	
	Ignition timing		BTDC/rpm	12°±3°/750 rpm	

NOTE:
STD: Standard I.D.: Inner Diameter O.D.: Outer Diameter OS: Oversize US: Undersize

Belt tension adjuster	Protrusion of adjuster rod			5.2 — 6.2 mm (0.205 — 0.244 in)
Belt tensioner	Spacer O.D.			17.955 — 17.975 mm (0.7069 — 0.7077 in)
	Tensioner bush I.D.			18.0 — 18.08 mm (0.7087 — 0.7118 in)
	Clearance between spacer and bush		STD	0.025 — 0.125 mm (0.0010 — 0.0049 in)
			Limit	0.175 mm (0.0069 in)
	Side clearance of spacer		STD	0.2 — 0.55 mm (0.0079 — 0.0217 in)
			Limit	0.81 mm (0.0319 in)
Camshaft	Bend limit			0.020 mm (0.0079 in)
	Thrust clearance		STD	0.015 — 0.070 mm (0.0006 — 0.0028 in)
			Limit	0.10 mm (0.0039 in)
	Cam lobe height	Intake	STD	44.75 — 44.85 mm (1.762 — 1.766 in)
			Limit	44.65 mm (1.758 in)
		Exhaust	STD	44.65 — 44.75 mm (1.758 — 1.762 in)
			Limit	44.55 mm (1.754 in)
	Jounal O.D.	STD	Front	37.946 — 37.963 mm (1.4939 — 1.4946 in)
			Center rear	29.946 — 29.963 mm (1.1790 — 1.1796 in)
	Oil clearance		STD	0.037 — 0.072 mm (0.0015 — 0.0028 in)
			Limit	0.10 mm (0.0039 in)
Cylinder head	Surface warpage limit			0.05 mm (0.0020 in)
	Surface grinding limit			0.3 mm (0.012 in)
	Standard height			127.5 mm (5.02 in)
Valve seat	Refacing angle			90°
	Contacting width	Intake	STD	1.0 mm (0.039 in)
			Limit	1.7 mm (0.067 in)
		Exhaust	STD	1.5 mm (0.059 in)
			Limit	2.2 mm (0.087 in)
Valve guide	Inner diameter			6.000 — 6.012 mm (0.2362 — 0.2367 in)
	Protrusion above head			15.8 — 16.2 mm (0.622 — 0.638 in)
Valve	Head edge thickness	Intake	STD	1.2 mm (0.047 in)
			Limit	0.8 mm (0.031 in)
		Exhaust	STD	1.5 mm (0.059 in)
			Limit	0.8 mm (0.031 in)
	Stem diameter		Intake	5.955 — 5.970 mm (0.2344 — 0.2350 in)
			Exhaust	5.945 — 5.960 mm(0.2341 — 0.2346 in)
	Stem oil clearance	STD	Intake	0.030 — 0.057 mm (0.0012 — 0.0022 in)
			Exhaust	0.040 — 0.067 mm (0.0016 — 0.0026 in)
		Limit	—	0.15 mm (0.0059 in)
	Overall length		Intake	104.4 mm (4.110 in)
			Exhaust	104.7 mm (4.122 in)
Valve spring	Free length			44.67 mm (1.7587 in)
	Squareness			2.5°, 2.0 mm (0.079 in)
	Tension/spring height			206 — 236 N (21.0 — 24.1 kgf, 46.2 — 53.0 lb)/ 36.0 mm (1.417 in) 485 — 537 N (49.5 — 54.8 kgf, 109.2 — 120.6 lb)/ 26.6 mm (1.047 in)

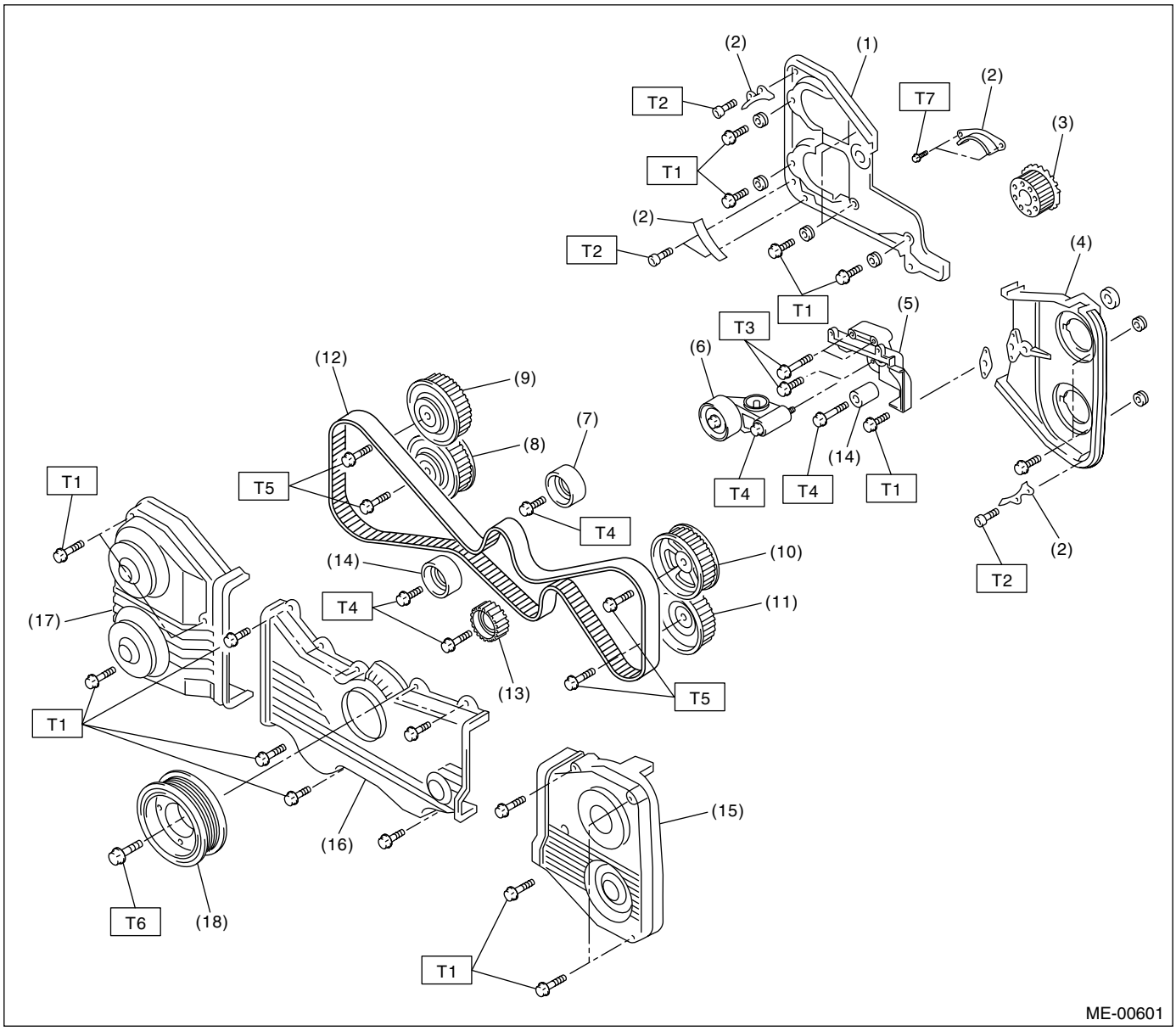
Cylinder block	Surface warpage limit (mating with cylinder head)			0.05 mm (0.0020 in)
	Surface grinding limit			0.1 mm (0.004 in)
	Cylinder bore	STD	A	92.005 — 92.015 mm (3.6222 — 3.6226 in)
			B	91.995 — 92.005 mm (3.6218 — 3.6222 in)
	Taper		STD	0.015 mm (0.0006 in)
			Limit	0.050 mm (0.0020 in)
	Out-of-roundness		STD	0.010 mm (0.0004 in)
			Limit	0.050 mm (0.0020 in)
	Piston clearance		STD	0.010 — 0.030 mm (0.0004 — 0.0012 in)
			Limit	0.050 mm (0.0020 in)
	Enlarging (boring) limit			0.5 mm (0.020 in)
Piston	Outer diameter	STD	A	91.985 — 91.995 mm (3.6214 — 3.6218 in)
			B	91.975 — 91.985 mm (3.6211 — 3.6214 in)
		0.25 mm (0.0098 in) OS		92.225 — 92.235 mm (3.6309 — 3.6313 in)
		0.50 mm (0.0197 in) OS		92.475 — 92.485 mm (3.6407 — 3.6411 in)
Piston pin	Standard clearance between piston pin and hole in piston		STD	0.004 — 0.008 mm (0.0002 — 0.0003 in)
			Limit	0.020 mm (0.0008 in)
	Degree of fit			Piston pin must be fitted into position with thumb at 20°C (68°F).
Piston ring	Piston ring gap	Top ring	STD	0.20 — 0.25 mm (0.0079 — 0.0098 in)
			Limit	1.0 mm (0.039 in)
		Second ring	STD	0.35 — 0.50 mm (0.0138 — 0.0197 in)
			Limit	1.0 mm (0.039 in)
		Oil ring	STD	0.20 — 0.50 mm (0.0079 — 0.0197 in)
			Limit	1.5 mm (0.059 in)
	Clearance between piston ring and piston ring groove	Top ring	STD	0.055 — 0.090 mm (0.0022 — 0.0035 in)
			Limit	0.15 mm (0.0059 in)
		Second ring	STD	0.030 — 0.070 mm (0.0012 — 0.0028 in)
			Limit	0.15 mm (0.0059 in)
Connecting rod	Bend twist per 100 mm (3.94 in) in length		Limit	0.10 mm (0.0039 in)
	Side clearance		STD	0.070 — 0.330 mm (0.0028 — 0.0130 in)
			Limit	0.4 mm (0.016 in)
Connecting rod bearing	Oil clearance		STD	0.020 — 0.046 mm (0.0008 — 0.0018 in)
			Limit	0.05 mm (0.0020 in)
	Thickness at center portion		STD	1.486 — 1.498 mm (0.0585 — 0.0590 in)
			0.03 mm (0.0012 in) US	1.504 — 1.512 mm (0.0592 — 0.0595 in)
			0.05 mm (0.0020 in) US	1.514 — 1.522 mm (0.0596 — 0.0599 in)
			0.25 mm (0.0098 in) US	1.614 — 1.622 mm (0.0635 — 0.0639 in)
Connecting rod bushing	Clearance between piston pin and bushing		STD	0 — 0.022 mm (0 — 0.0009 in)
			Limit	0.030 mm (0.0012 in)

Crankshaft	Bend limit			0.035 mm (0.0014 in)
	Crank pin and crank journal	Out-of-roundness		0.020 mm (0.0008 in) or less
		Grinding limit		0.25 mm (0.0098 in)
	Crank pin outer diameter		STD	51.984 — 52.000 mm (2.0466 — 2.0472)
			0.03 mm (0.0012 in) US	51.954 — 51.970 mm (2.0454 — 2.0461)
			0.05 mm (0.0020 in) US	51.934 — 51.950 mm (2.0447 — 2.0453)
			0.25 mm (0.0098 in) US	51.734 — 51.750 mm (2.0368 — 2.0374)
	Crank journal outer diameter	#1, #3, #5	STD	59.992 — 60.008 mm (2.3619 — 2.3625 in)
			0.03 mm (0.0012 in) US	59.962 — 59.978 mm (2.3607 — 2.3613 in)
			0.05 mm (0.0020 in) US	59.942 — 59.958 mm (2.3599 — 2.3605 in)
			0.25 mm (0.0098 in) US	59.742 — 59.758 mm (2.3520 — 2.3527 in)
		#2, #4	STD	59.992 — 60.008 mm (2.3619 — 2.3625 in)
			0.03 mm (0.0012 in) US	59.962 — 59.978 mm (2.3607 — 2.3613 in)
			0.05 mm (0.0020 in) US	59.942 — 59.958 mm (2.3599 — 2.3605 in)
			0.25 mm (0.0098 in) US	59.742 — 59.758 mm (2.3520 — 2.3527 in)
	Thrust clearance		STD	0.030 — 0.115 mm (0.0012 — 0.0045 in)
			Limit	0.25 mm (0.0098 in)
	Oil clearance	#1	STD	0.003 — 0.030 mm (0.0001 — 0.0012 in)
			Limit	0.040 mm (0.0016 in)
		#2	STD	0.012 — 0.033 mm (0.0005 — 0.0013 in)
			Limit	0.045 mm (0.0018 in)
		#3	STD	0.003 — 0.030 mm (0.0001 — 0.0012 in)
			Limit	0.040 mm (0.0016 in)
		#4	STD	0.012 — 0.033 mm (0.0005 — 0.0013 in)
			Limit	0.045 mm (0.0018 in)
		#5	STD	0.010 — 0.031 mm (0.0004 — 0.0012 in)
			Limit	0.040 mm (0.0016 in)

Crankshaft bearing	Crankshaft bearing thickness	#1, #3	STD	1.998 — 2.011 mm (0.0787 — 0.0792 in)
			0.03 mm (0.0012 in) US	2.017 — 2.020 mm (0.0794 — 0.0795 in)
			0.05 mm (0.0020 in) US	2.027 — 2.030 mm (0.0798 — 0.0799 in)
			0.25 mm (0.0098 in) US	2.127 — 2.130 mm (0.0837 — 0.0839 in)
		#2, #4, #5	STD	2.000 — 2.013 mm (0.0787 — 0.0793 in)
			0.03 mm (0.0012 in) US	2.019 — 2.022 mm (0.0795 — 0.0796 in)
			0.05 mm (0.0020 in) US	2.029 — 2.032 mm (0.0799 — 0.0800 in)
			0.25 mm (0.0098 in) US	2.129 — 2.132 mm (0.0838 — 0.0839 in)

B: COMPONENT

1. TIMING BELT

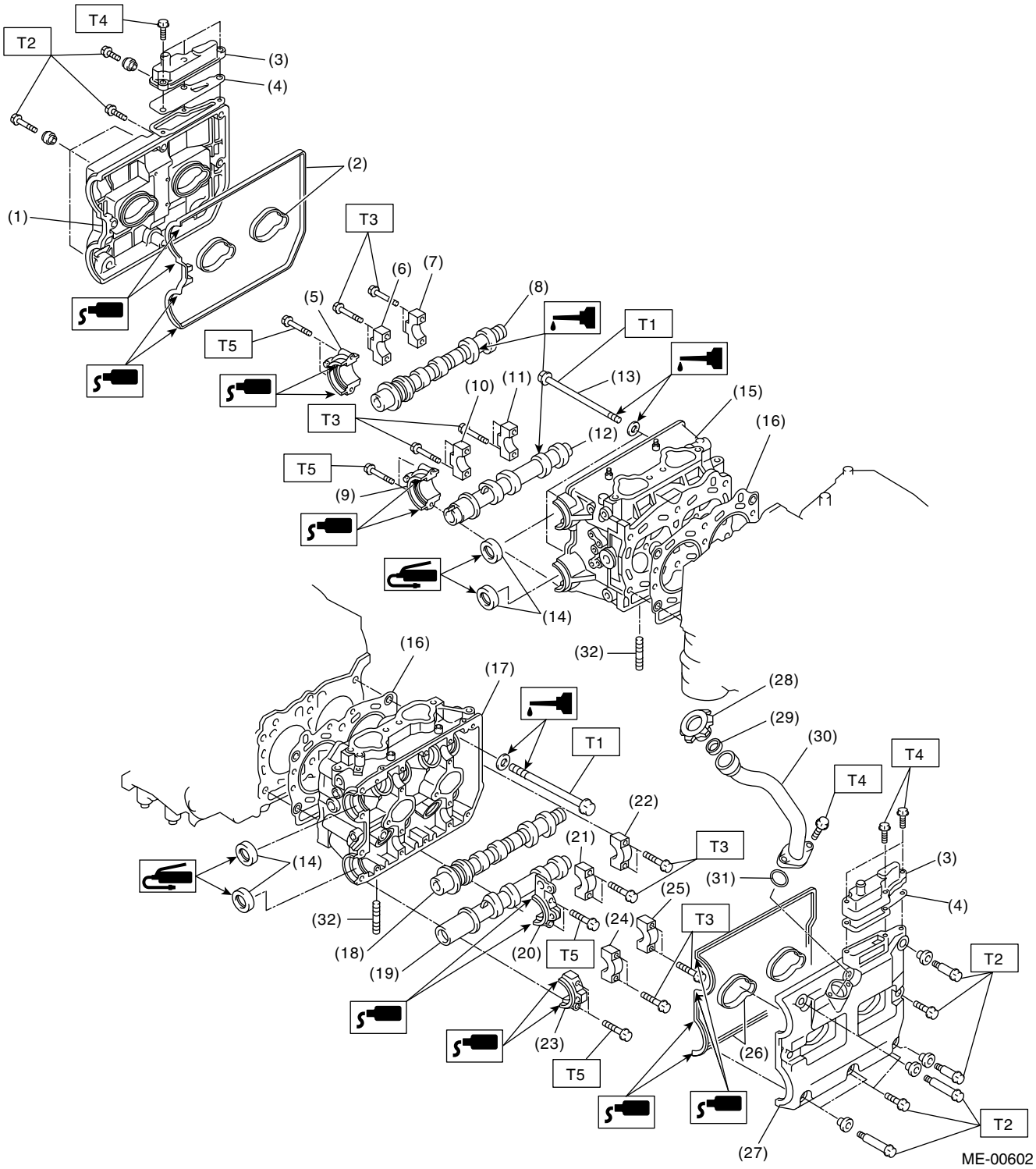


(1)	Belt cover No. 2 (RH)	(9)	Intake camshaft sprocket (RH)
(2)	Timing belt guide (MT vehicles only)	(10)	Intake camshaft sprocket (LH)
(3)	Crankshaft sprocket	(11)	Exhaust camshaft sprocket (LH)
(4)	Belt cover No. 2 (LH)	(12)	Timing belt
(5)	Tensioner bracket	(13)	Belt idler No. 2
(6)	Automatic belt tension adjuster ASSY	(14)	Belt idler
(7)	Belt idler	(15)	Belt cover (LH)
(8)	Exhaust camshaft sprocket (RH)	(16)	Front belt cover
		(17)	Belt cover (RH)
		(18)	Crankshaft pulley

Tightening torque: N·m (kgf-m, ft-lb)

- ***T1: 5 (0.5, 3.6)***
- ***T2: 6.4 (0.65, 4.7)***
- ***T3: 25 (2.5, 18.1)***
- ***T4: 39 (4.0, 28.9)***
- ***T5: 98 (10, 72.4)***
- ***T6: <Ref. to ME(TURBO)-46, INSTALLATION, Crankshaft Pulley.>***
- ***T7: 10 (1.0, 7.2)***

2. CYLINDER HEAD AND CAMSHAFT

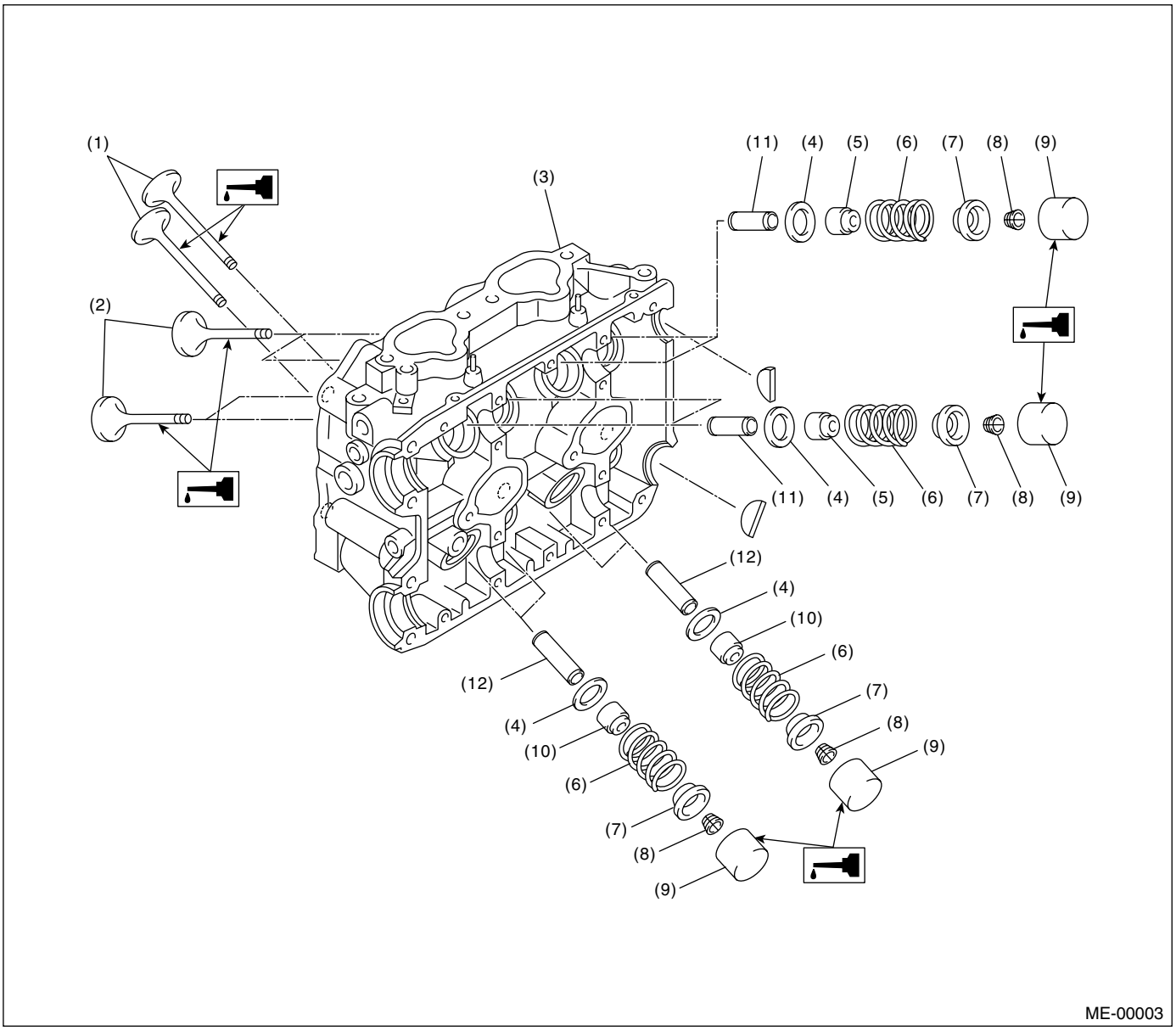


(1) Rocker cover (RH)
(2) Rocker cover gasket (RH)
(3) Oil separator cover
(4) Gasket
(5) Intake camshaft cap (Front RH)
(6) Intake camshaft cap (Center RH)
(7) Intake camshaft cap (Rear RH)
(8) Intake camshaft cap (RH)
(9) Exhaust camshaft cap (Front RH)
(10) Exhaust camshaft cap (Center RH)
(11) Exhaust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

Tightening torque: N·m (kgf-m, ft-lb)

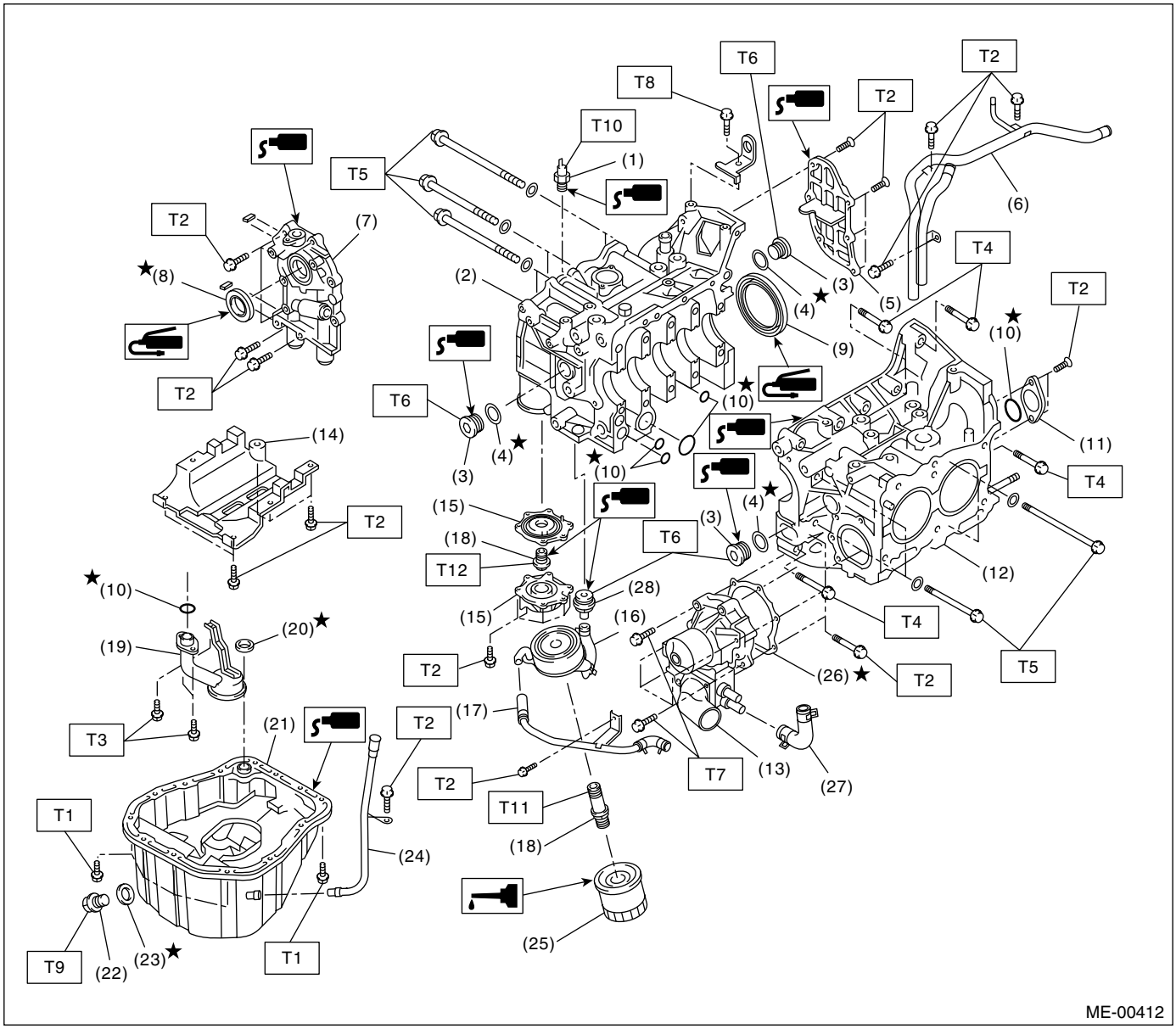
T1:	***<Ref. to ME(TURBO)-63, INSTALLATION, Cylinder Head Assembly.>***
T2:	***5 (0.5, 3.6)***
T3:	***20 (2.0, 14.5)***
T4:	***6.4 (0.65, 4.7)***
T5:	***10 (1.0, 7.2)***

3. CYLINDER HEAD AND VALVE ASSEMBLY



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

4. CYLINDER BLOCK

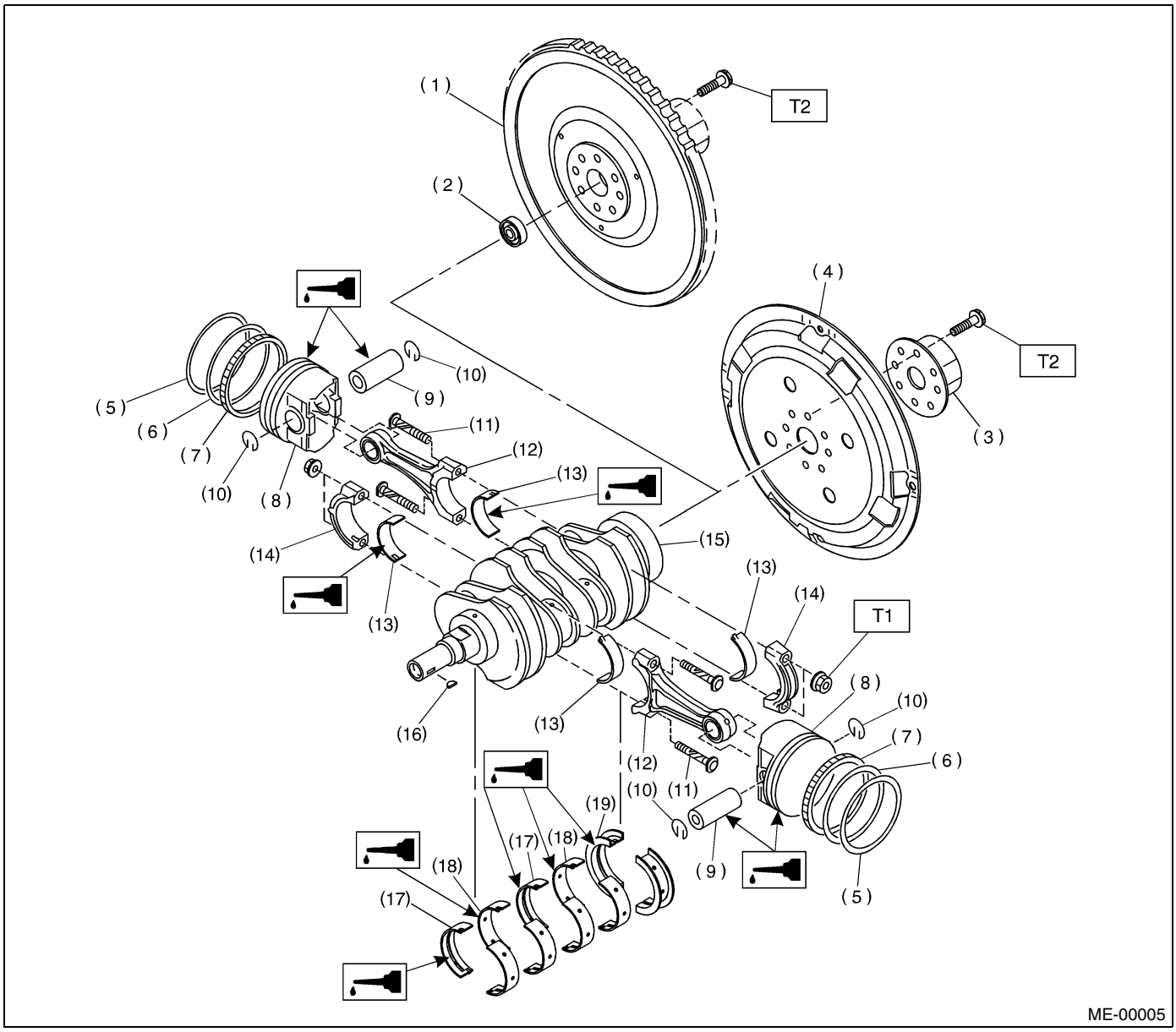


(1) Oil pressure switch
(2) Cylinder block (RH)
(3) Service hole plug
(4) Gasket
(5) Oil separator cover
(6) Water by-pass pipe
(7) Oil pump
(8) Front oil seal
(9) Rear oil seal
(10) O-ring
(11) Service hole cover
(12) Cylinder block (LH)
(13) Water pump
(14) Baffle plate
(15) Adapter
(16) Oil cooler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

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(TURBO)-74, INSTALLATION, Cylinder Block.>***
T6:	***70 (7.1, 50.6)***
T7:	***First 12 (1.2, 8.7) Second 12 (1.2, 8.7)***
T8:	***16 (1.6, 11.6)***
T9:	***44 (4.5, 33)***
T10:	***25 (2.5, 18.1)***
T11:	***54 (5.5, 40)***
T12:	***45 (4.6, 33)***

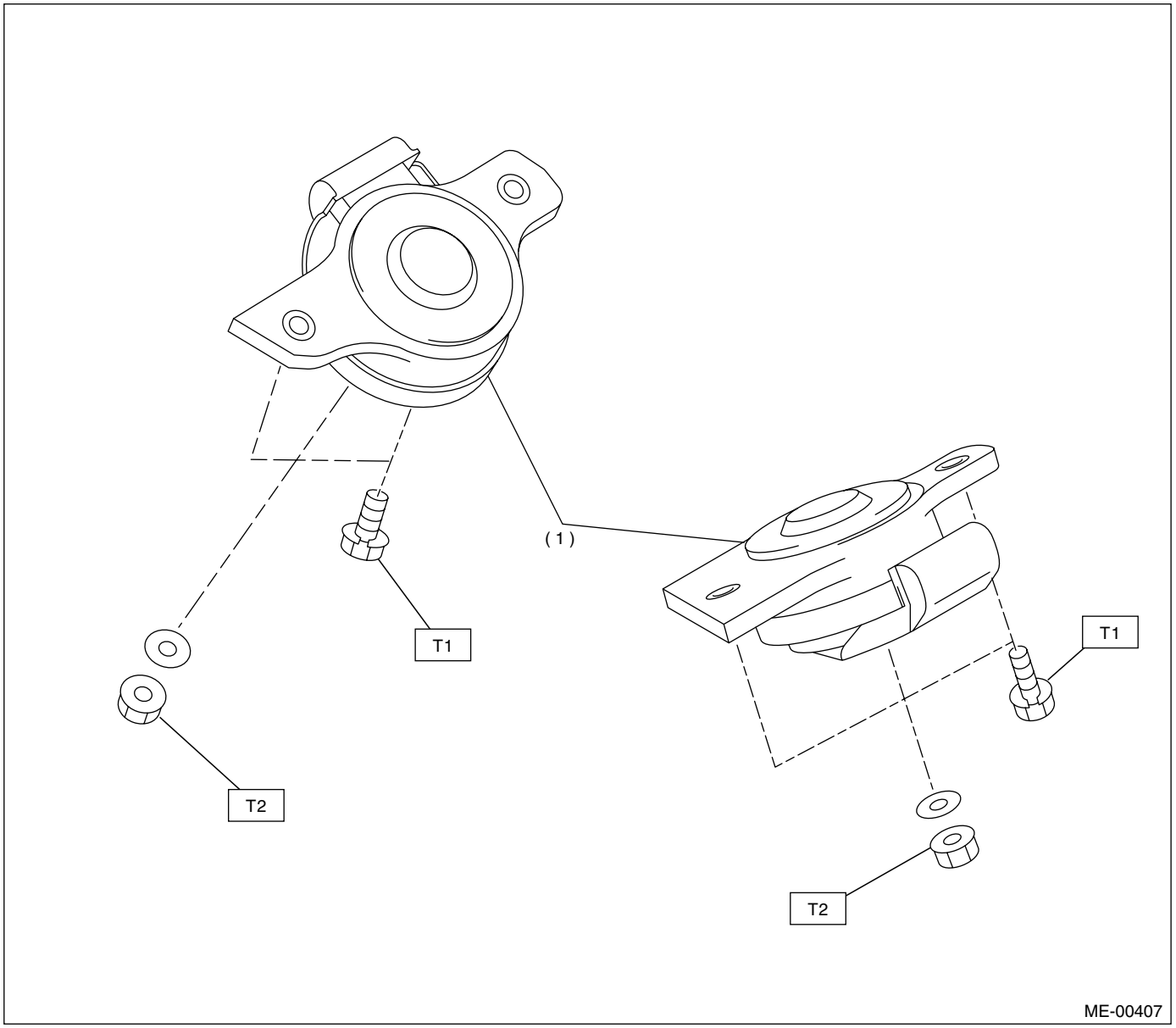
5. CRANKSHAFT AND PISTON



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

Tightening torque: N·m (kgf-m, ft-lb)
T1: 45 (4.6, 33.3)
T2: 72 (7.3, 52.8)

6. ENGINE MOUNTING



(1) Front cushion rubber

Tightening torque: N·m (kgf-m, ft-lb)
T1: 34 (3.5, 25.3)
T2: 85 (8.7, 62.7)

C: CAUTION

• Wear working 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 or dirt.
• Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
• Be careful not to burn your hands, because each part in the vehicle is hot after running.
• Be sure to tighten fasteners including bolts and nuts to the specified torque.
• Place shop jacks or safety stands 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 reinstalled 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 stain seats and windows with coolant or oil. Place a cover over fenders, 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 TOOLS

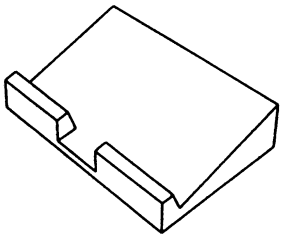
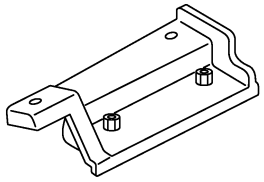
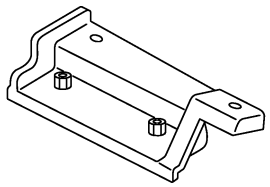
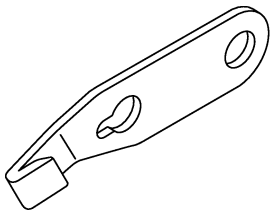
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498267600	498267600	CYLINDER HEAD TABLE	• Used for replacing valve guides. • Used for removing and installing valve springs.
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	Used with ENGINE STAND (499817000).
 ST-498457100	498457100	ENGINE STAND ADAPTER LH	Used with ENGINE STAND (499817000).
 ST-498497100	498497100	CRANKSHAFT STOPPER	Used for stopping rotation of flywheel when loosening and tightening crankshaft pulley bolt, etc.

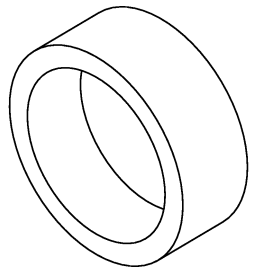
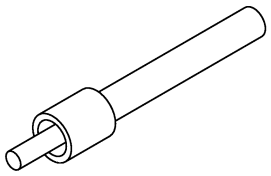
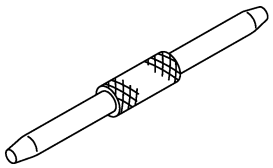
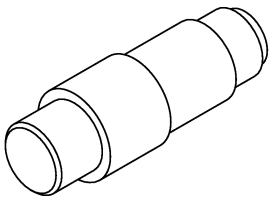
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-398744300	398744300	PISTON GUIDE	Used for installing piston in cylinder for 2000 cc engine.
 ST-498857100	498857100	VALVE OIL SEAL GUIDE	Used for press-fitting of intake and exhaust valve guide oil seals.
 ST-499017100	499017100	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.
 ST-499037100	499037100	CONNECTING ROD BUSHING REMOVER & INSTALLER	Used for removing and installing connecting rod bushing.

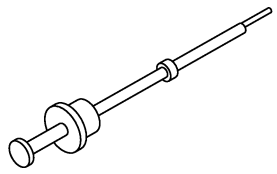
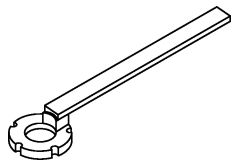
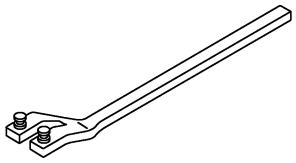
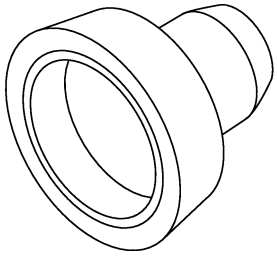
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499097700	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 ST-499207400	499207400	CAMSHAFT SPROCKET WRENCH	Used for removing and installing exhaust camshaft sprocket.
 ST18231AA010	18231AA010 (Newly adopted tool)	CAMSHAFT SPROCKET WRENCH	Used for removing and installing intake camshaft sprocket. (Intake camshaft sprocket LH)
 ST-499587200	499587200	CRANKSHAFT OIL SEAL INSTALLER	• Used for installing crankshaft oil seal. • Used with CRANKSHAFT OIL SEAL GUIDE (499597100).

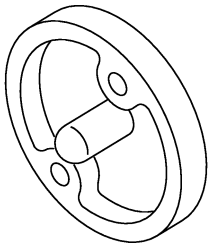
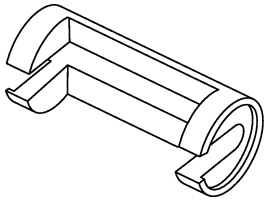
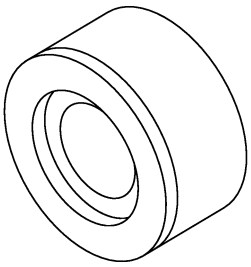
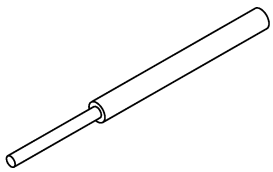
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499597100	499597100	CRANKSHAFT OIL SEAL GUIDE	• Used for installing crankshaft oil seal. • Used with CRANKSHAFT OIL SEAL INSTALLER (499587200).
 ST-499718000	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.
 ST18251AA020	18251AA020	VALVE GUIDE ADJUSTER	Used for installing intake and exhaust valve guides.
 ST-499767200	499767200	VALVE GUIDE REMOVER	Used for removing valve guides.

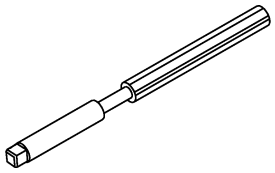
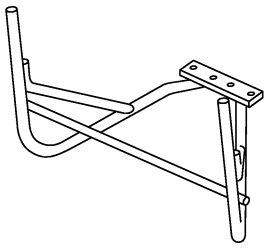
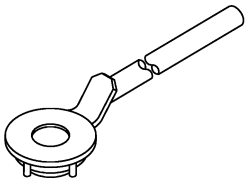
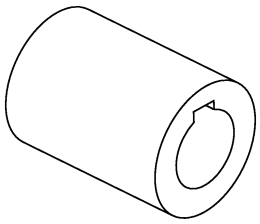
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499767400	499767400	VALVE GUIDE REAMER	Used for reaming valve guides.
 ST-499817000	499817000	ENGINE STAND	• Stand used for engine disassembly and assembly. • Used with ENGINE STAND ADAPTER RH (498457000) & LH (498457100).
 ST-499977400	499977400	CRANK PULLEY WRENCH	Used for stopping rotation of crankshaft pulley when loosening and tightening crankshaft pulley bolts.
 ST-499987500	499987500	CRANKSHAFT SOCKET	Used for rotating crankshaft.

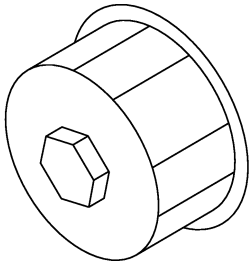
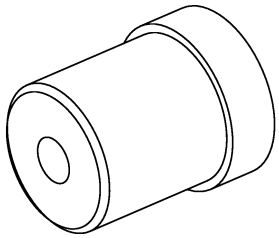
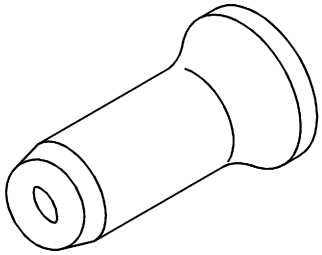
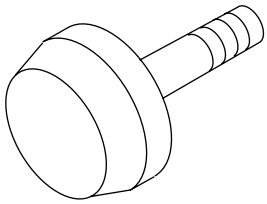
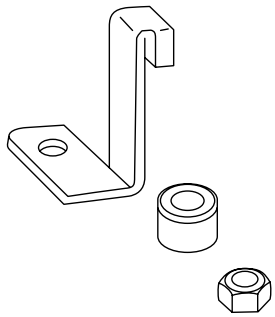
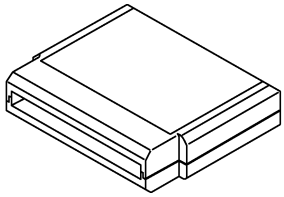
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18332AA000	18332AA000	OIL FILTER WRENCH	Used for removing and installing the oil filter.
 ST-499587100	499587100	OIL SEAL INSTALLER	Used for installing oil pump oil seal.
 ST-499587600	499587600	OIL SEAL INSTALLER	Used for installing camshaft oil seal for DOHC engine.
 ST-499597200	499597200	OIL SEAL GUIDE	• Used for installing camshaft oil seal for DOHC engine. • Used with OIL SEAL GUIDE (499587600).

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498277200	498277200	STOPPER SET	Used for installing automatic transmission assembly to engine.
 ST24082AA210	24082AA210 (Newly adopted tool)	CARTRIDGE	Troubleshooting for electrical systems.
 ST22771AA030	22771AA030	SELECT MONITOR KIT	Troubleshooting for electrical systems. • English: 22771AA030 (Without printer) • German: 22771AA070 (Without printer) • French: 22771AA080 (Without printer) • Spanish: 22771AA090 (Without printer)

2. GENERAL PURPOSE TOOLS

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 the vehicle.

- V-belt
- Timing Belt
- Camshaft
- Cylinder Head

2. Compression

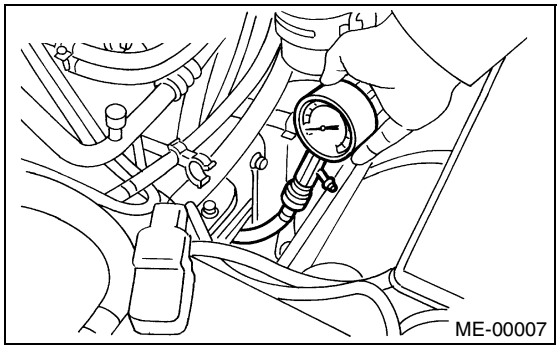
A: INSPECTION

CAUTION:
After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.

1) After warming-up the engine, turn the ignition switch to OFF.
2) Make sure that the battery is fully charged.
3) Release the fuel pressure. <Ref. to FU(TURBO)-52, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
4) Remove all the spark plugs. <Ref. to IG(TURBO)-5, REMOVAL, Spark Plug.>
5) Fully open the throttle valve.
6) Check the starter motor for satisfactory performance and operation.
7) Hold the compression gauge tight against spark plug hole.

NOTE:
When using a screw-in type compression gauge, the screw (put into cylinder head spark plug hole) should be less than 18 mm (0.71 in) long.

8) Crank the engine by means of starter motor, and then read the maximum value on the gauge when the pointer is steady.



9) Perform at least two measurements per cylinder, and make sure that the values are correct.

Compression (350 rpm and fully open throttle):
Standard;
951 — 1,147 kPa (9.7 — 11.7 kgf/cm^2, 138 — 166 psi)
Limit;
834 kPa (8.5 kgf/cm^2, 121 psi)
Difference between cylinders;
49 kPa (0.5 kgf/cm^2, 7 psi)

3. Idle Speed

A: INSPECTION

1. USING SUBARU SELECT MONITOR

1) Before checking the idle speed, check the following:
   (1) Ensure the air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and that the hoses are connected properly.
   (2) Ensure the malfunction indicator light (CHECK ENGINE light) does not illuminate.
2) Warm-up the engine.
3) Stop the engine, and then turn the ignition switch to OFF.
4) Insert the cartridge to SUBARU SELECT MONITOR.
5) Connect the SUBARU SELECT MONITOR to data link connector.
6) Turn the ignition switch to ON, and SUBARU SELECT MONITOR switch to ON.
7) Select the {2. Each System Check} in Main Menu.
8) Select the {Engine Control System} in Selection Menu.
9) Select the {1. Current Data Display & Save} in Engine Control System Diagnosis.
10) Select the {1.12 Data Display} in Data Display Menu.
11) Start the engine, and then read the engine idle speed.
12) Check the idle speed when unloaded. (With headlights, heater fan, rear defroster, radiator fan, air conditioning, etc. OFF)

Idle speed [No load and gears in neutral]:
750±100 rpm

13) Check the idle speed when loaded. (Turn the air conditioning switch to “ON” and operate the compressor for at least 1 minute before measurement.)

Idle speed [A/C “ON”, no load and gears in neutral]:
800±150 rpm (MT vehicles)
825±150 rpm (AT vehicles)

NOTE:
As idle speed is controlled by the automatic adjustment type, it can not be adjusted manually. If the idle speed is out of specifications, refer to General On-board Diagnosis Table under “Engine Control System”. <Ref. to EN(SOHC)-2, Basic Diagnostic Procedure.>

4. Ignition Timing

A: INSPECTION

1. USING SUBARU SELECT MONITOR

1) Before checking the ignition timing speed, check the following:
   (1) Ensure the air cleaner element is free from clogging, spark plugs are in good condition, and that hoses are connected properly.
   (2) Ensure the malfunction indicator light (CHECK ENGINE light) does not illuminate.
2) Warm-up the engine.
3) Stop the engine, and then turn the ignition switch to OFF.
4) Insert the cartridge to SUBARU SELECT MONITOR.
5) Connect the SUBARU SELECT MONITOR to data link connector.
6) Turn the ignition switch to ON, and SUBARU SELECT MONITOR switch to ON.
7) Select the {2. Each System Check} in Main Menu.
8) Select the {Engine Control System} in Selection Menu.
9) Select the {1. Current Data Display & Save} in Engine Control System Diagnosis.
10) Select the {1.12 Data Display} in Data Display Menu.
11) Start the engine, at idle speed and check the ignition timing.

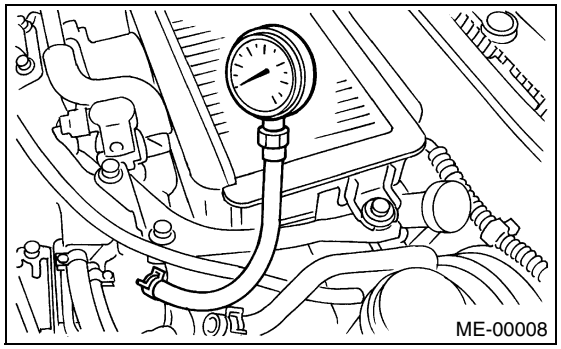
Ignition timing [BTDC/rpm]:
12°±3°/750

If the timing is not correct, check the ignition control system. Refer to Engine Control System. <Ref. to EN(TURBO)-2, Basic Diagnostic Procedure.>

5. Intake Manifold Vacuum

A: INSPECTION

1) Warm-up the engine.
2) Disconnect the brake vacuum hose, and then install the vacuum gauge to hose fitting on manifold.
3) Keep the engine at the idle speed, and then read the vacuum gauge indication.
By observing the gauge needle movement, the internal condition of engine can be diagnosed as described below.



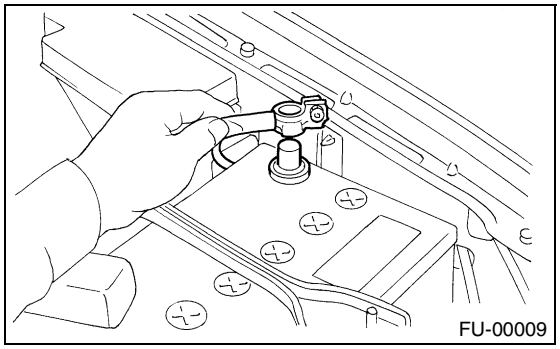
Vacuum pressure (at idling, A/C "OFF"): Less than –60.0 kPa (–450 mmHg, –17.72 inHg)

Diagnosis of engine condition by measurement of manifold vacuum	
Vacuum gauge indication	Possible engine condition
1. Needle is steady but lower than normal position. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket or disconnection or damaged vacuum hose
2. When engine speed is reduced slowly from higher speed, needle stops temporarily when it is lowering or becomes steady above normal position.	Back pressure too high, or exhaust system clogged
3. Needle intermittently drops to position lower than normal position.	Leakage around cylinder
4. Needle drops suddenly and intermittently from normal position.	Sticky valves
5. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs
6. Needle vibrates above and below normal position in narrow range.	Defective ignition system or throttle chamber idle adjustment

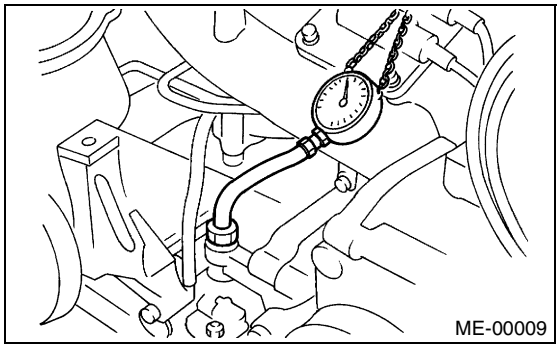
6. Engine Oil Pressure

A: INSPECTION

1) Remove the oil pressure switch from engine cylinder block. <Ref. to LU(SOHC)-21, REMOVAL, Oil Pressure Switch.>
2) Connect the oil pressure gauge hose to cylinder block.
3) Connect the battery ground cable to battery.



4) Start the engine, and then measure the oil pressure.



Oil pressure:
98 kPa (1.0 kg/cm^2, 14 psi) or more at 800 rpm
294 kPa (3.0 kg/cm^2, 43 psi) or more at 5,000 rpm

- If the oil pressure is out of specification, check oil pump, oil filter and lubrication line. <Ref. to LU(SOHC)-25, INSPECTION, Engine Lubrication System Trouble in General.>
- If the oil pressure warning light is turned ON and oil pressure is in specification, replace the oil pressure switch. <Ref. to LU(SOHC)-25, INSPECTION, Engine Lubrication System Trouble in General.>

NOTE:
The specified data is based on an engine oil temperature of 80°C (176°F).

5) After measuring the oil pressure, install the oil pressure switch. <Ref. to LU(SOHC)-21, INSTALLATION, Oil Pressure Switch.>

Tightening torque:
25 N·m (2.5 kgf-m, 18.1 ft-lb)

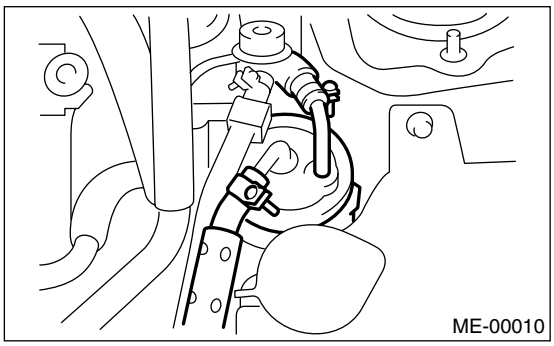
7. Fuel Pressure

A: INSPECTION

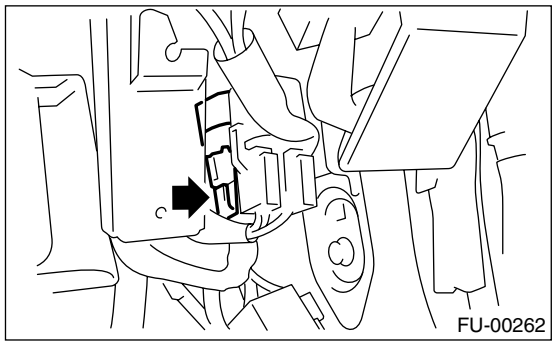
CAUTION:
Before removing the fuel pressure gauge, release the fuel pressure.

NOTE:
If out of specification, check or replace the pressure regulator and pressure regulator vacuum hose.

1) Release the fuel pressure. <Ref. to FU(TURBO)-52, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
2) Open the fuel flap lid, and then remove the fuel filler cap.
3) Disconnect the fuel delivery hoses from fuel filter, and then connect the fuel pressure gauge.

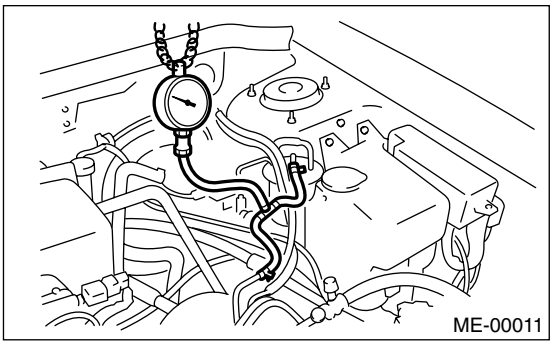


4) Connect the connector of fuel pump relay.



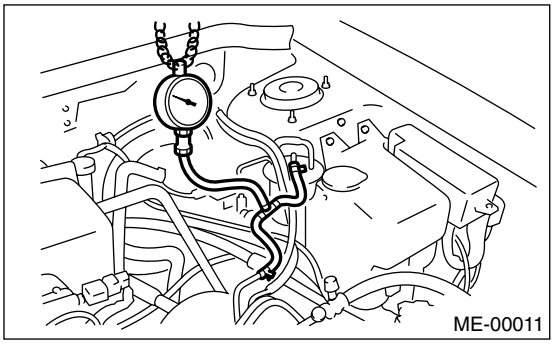
5) Start the engine.
6) Measure the fuel pressure while disconnecting the pressure regulator vacuum hose from intake manifold.

Fuel pressure:
Standard; 284 — 314 kPa (2.9 — 3.2 kgf/cm^2, 41 — 46 psi)



7) After connecting the pressure regulator vacuum hose, measure the fuel pressure.

Fuel pressure:
Standard; 230 — 260 kPa (2.35 — 2.65 kgf/cm^2, 33 — 38 psi)



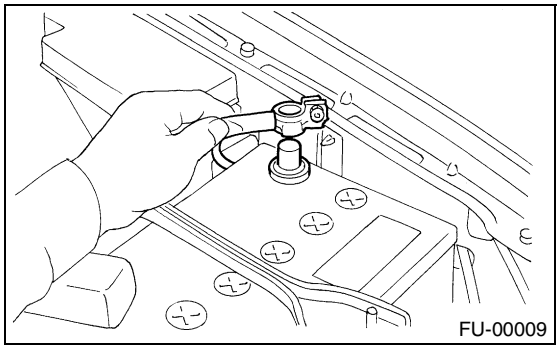
NOTE:
The fuel pressure gauge registers 10 to 20 kPa (0.1 to 0.2 kgf/cm^2, 1 to 3 psi) higher than standard values during high-altitude operations.

8. Valve Clearance

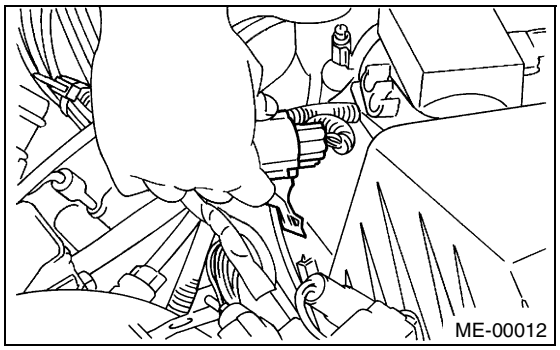
A: INSPECTION

Inspection and adjustment of the valve clearance should be performed while engine is cold.

1) Set the vehicle on a lift.
2) Disconnect the ground cable from battery.

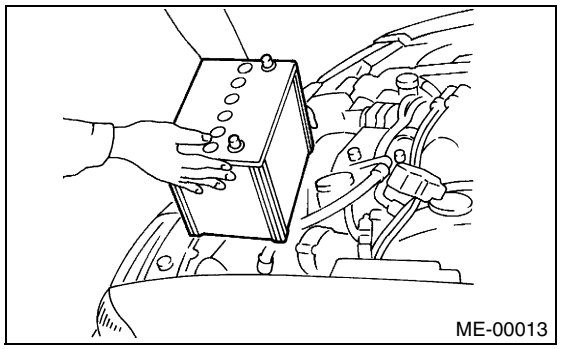


3) Remove the air intake duct. <Ref. to IN(TURBO)-8, REMOVAL, Air Intake Duct.>
4) Remove the bolt which secures belt cover (RH).
5) Lift-up the vehicle.
6) Remove the under cover.
7) Loosen the remaining bolts which secure belt cover (RH), and then remove the belt cover.
8) Lower the vehicle.
9) When inspecting the #1 and #3 cylinders:
   (1) Pull out the engine harness connector with bracket from air cleaner upper cover.

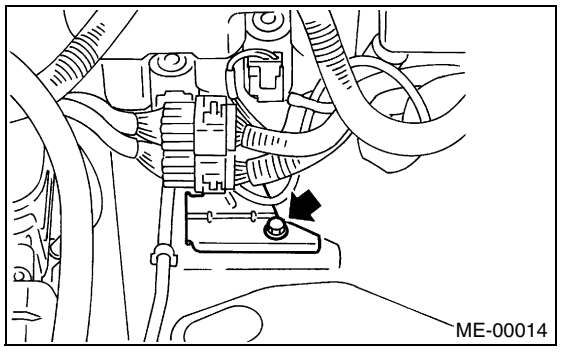


   (2) Remove the air cleaner case. <Ref. to IN(TURBO)-7, REMOVAL, Air Cleaner.>
   (3) Disconnect the ignition coil connector.
   (4) Remove the ignition coil.
   (5) Place a suitable container under the vehicle.
   (6) Disconnect the PCV hose from rocker cover (RH).
   (7) Remove the bolts, and then remove the rocker cover (RH).

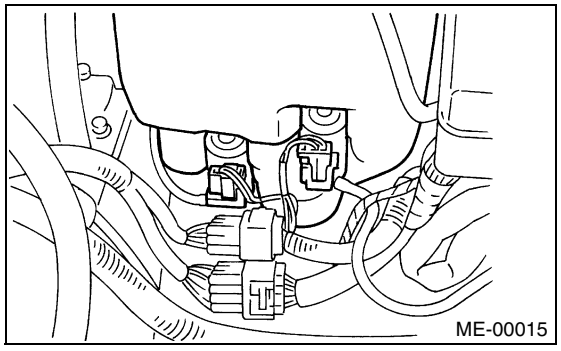
10) When inspecting the #2 and #4 cylinders:
   (1) Disconnect the battery cable, and then remove the battery and battery carrier.



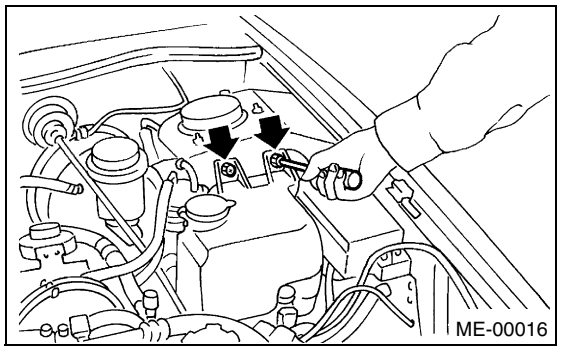
   (2) Remove the bolt which secures engine harness bracket onto body.



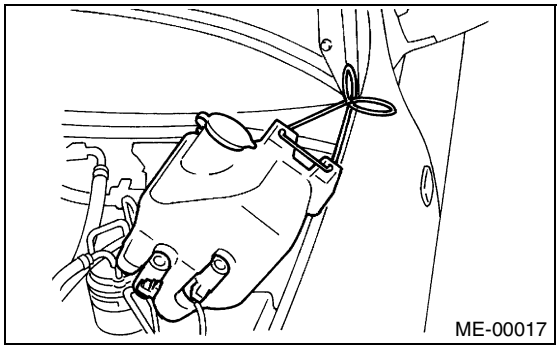
   (3) Disconnect the washer motor connectors.



   (4) Remove the washer tank mounting bolts.



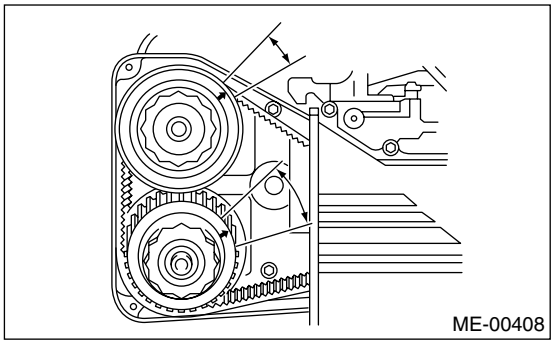
(5) Move the washer tank upward.



(6) Disconnect the ignition coil connector.
(7) Remove the ignition coil.
(8) Place a suitable container under the vehicle.
(9) Disconnect the PCV hose from rocker cover (LH).
(10) Remove the bolts, and then remove the rocker cover (LH).

11) Turn the crankshaft pulley clockwise until arrow mark on the camshaft sprocket is set to position shown in the figure.

NOTE:
Turn the crankshaft using socket wrench.

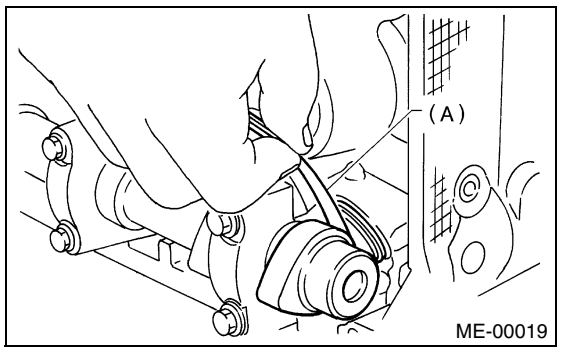


12) Measure the #1 cylinder intake valve and #3 cylinder exhaust valve clearance by using thickness gauge (A).

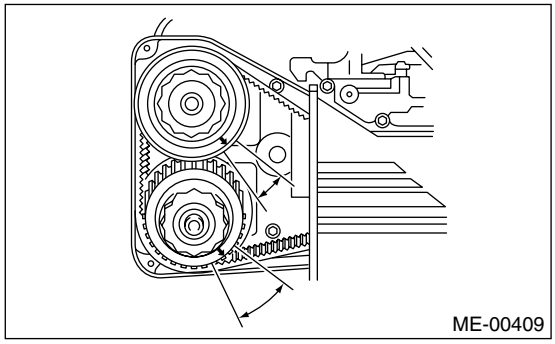
NOTE:
• Insert the thickness gauge in as horizontal a direction as possible with respect to the shim.
• Measure the exhaust valve clearances while lifting-up the vehicle.

Valve clearance:
Intake: 0.20±0.02 mm (0.0079±0.0008 in)
Exhaust: 0.25±0.02 mm (0.0098±0.0008 in)

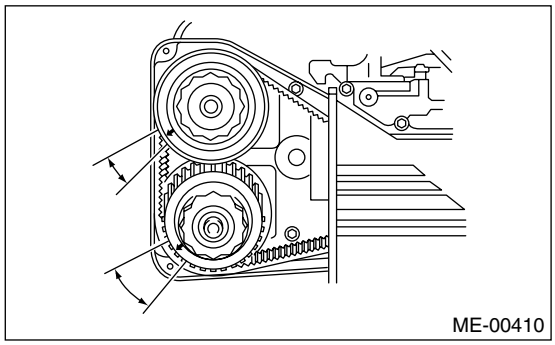
NOTE:
If the measured value is not within specification, take notes of the value in order to adjust the valve clearance later on.



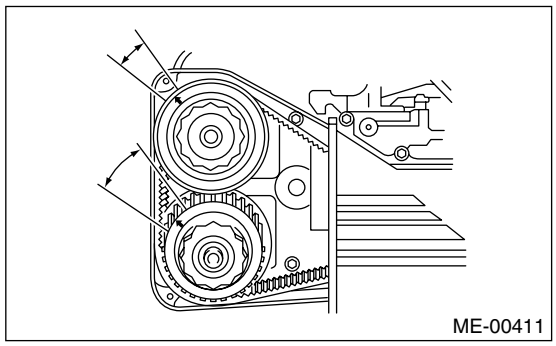
13) If necessary, adjust the valve clearance. <Ref. to ME(TURBO)-31, ADJUSTMENT, Valve Clearance.>
14) Further turn the crankshaft pulley clockwise.
Using the same procedures described previously, and then measure the valve clearances again.
(1) Set the arrow mark on camshaft sprocket to position shown in the figure, and then measure the #2 cylinder exhaust valve and #3 cylinder intake valve clearances.



(2) Set the arrow mark on camshaft sprocket to position shown in the figure, and then measure the #2 cylinder intake valve and #4 cylinder exhaust valve clearances.

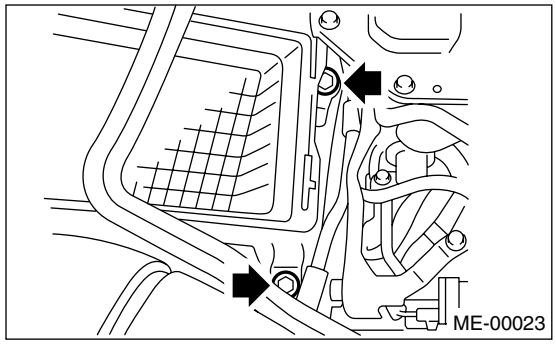


(3) Set the arrow mark on camshaft sprocket to position shown in the figure, and then measure the #1 cylinder exhaust valve and #4 cylinder intake valve clearances.


ME-00411

15) After inspection, install the related parts in the reverse order of removal.

Tightening torque:
32 N·m (3.3 kgf-m, 24 ft-lb)

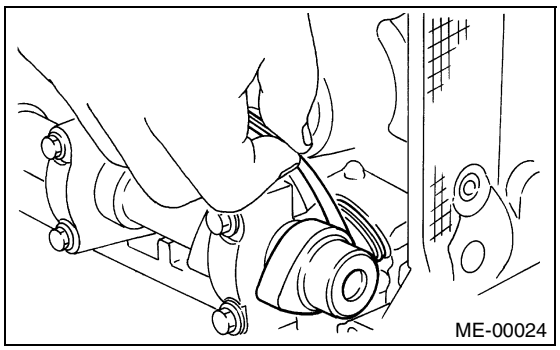

ME-00023

B: ADJUSTMENT

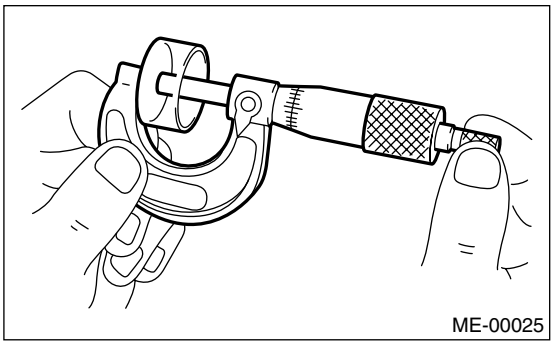
CAUTION:
Adjustment of the valve clearance should be performed while engine is cold.

1) Measure all valve clearances. <Ref. to ME(TURBO)-29, INSPECTION, Valve Clearance.>

NOTE:
Record each valve clearance after it has been measured.


ME-00024

2) Remove the camshaft. <Ref. to ME(TURBO)-58, REMOVAL, Camshaft.>
3) Remove the valve lifter.
4) Measure the thickness of valve lifter with a micrometer.


ME-00025

5) Select a shim of suitable thickness using measured valve clearance and valve lifter thickness, by referring to the following table.
6) Set the suitable shim selected in step 4) to valve lifter.

Unit: mm
Intake valve: S =(V + T) - 0.20 Exhaust valve: S =(V + T) - 0.25
S: Valve lifter thickness to be used V: Measured valve clearance T: Shim thickness required

VALVE CLEARANCE

Part No.	Thickness mm (in)
13228 AB101	4.68 (0.1843)
13228 AB111	4.69 (0.1846)
13228 AB121	4.70 (0.1850)
13228 AB131	4.71 (0.1854)
13228 AB141	4.72 (0.1858)
13228 AB151	4.73 (0.1862)
13228 AB161	4.74 (0.1866)
13228 AB171	4.75 (0.1870)
13228 AB181	4.76 (0.1874)
13228 AB191	4.77 (0.1878)
13228 AB201	4.78 (0.1882)
13228 AB211	4.79 (0.1886)
13228 AB221	4.80 (0.1890)
13228 AB231	4.81 (0.1894)
13228 AB241	4.82 (0.1898)
13228 AB251	4.83 (0.1902)
13228 AB261	4.84 (0.1906)
13228 AB271	4.85 (0.1909)
13228 AB281	4.86 (0.1913)
13228 AB291	4.87 (0.1917)
13228 AB301	4.88 (0.1921)
13228 AB311	4.89 (0.1925)
13228 AB321	4.90 (0.1929)
13228 AB331	4.91 (0.1933)
13228 AB341	4.92 (0.1937)
13228 AB351	4.93 (0.1941)
13228 AB361	4.94 (0.1945)
13228 AB371	4.95 (0.1949)
13228 AB381	4.96 (0.1953)
13228 AB391	4.97 (0.1957)
13228 AB401	4.98 (0.1961)
13228 AB411	4.99 (0.1965)
13228 AB421	5.00 (0.1969)
13228 AB431	5.01 (0.1972)
13228 AB441	5.02 (0.1976)
13228 AB451	5.03 (0.1980)
13228 AB461	5.04 (0.1984)
13228 AB471	5.05 (0.1988)
13228 AB481	5.06 (0.1992)
13228 AB491	5.07 (0.1996)
13228 AB501	5.08 (0.2000)
13228 AB511	5.09 (0.2004)
13228 AB521	5.10 (0.2008)
13228 AB531	5.11 (0.2012)
13228 AB541	5.12 (0.2016)
13228 AB551	5.13 (0.2020)
13228 AB561	5.14 (0.2024)
13228 AB571	5.15 (0.2028)
13228 AB581	5.16 (0.2031)
13228 AB591	5.17 (0.2035)
13228 AB601	5.18 (0.2039)

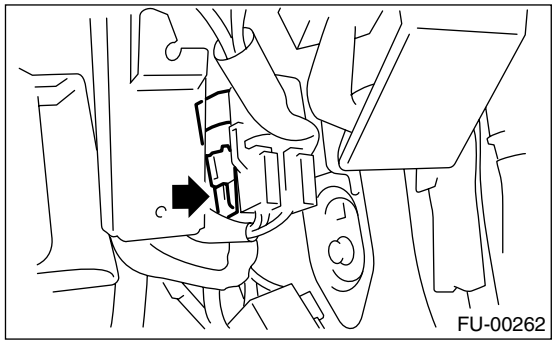
Part No.	Thickness mm (in)
13228 AB611	5.19 (0.2043)
13228 AB621	5.20 (0.2047)
13228 AB631	5.21 (0.2051)
13228 AB641	5.22 (0.2055)
13228 AB651	5.23 (0.2059)
13228 AB661	5.24 (0.2063)
13228 AB671	5.25 (0.2067)
13228 AB681	5.26 (0.2071)
13228 AB691	5.27 (0.2075)
13228 AB701	4.38 (0.1724)
13228 AB711	4.40 (0.1732)
13228 AB721	4.42 (0.1740)
13228 AB731	4.44 (0.1748)
13228 AB741	4.46 (0.1756)
13228 AB751	4.48 (0.1764)
13228 AB761	4.50 (0.1771)
13228 AB771	4.52 (0.1780)
13228 AB781	4.54 (0.1787)
13228 AB791	4.56 (0.1795)
13228 AB801	4.58 (0.1803)
13228 AB811	4.60 (0.1811)
13228 AB821	4.62 (0.1819)
13228 AB831	4.64 (0.1827)
13228 AB841	4.66 (0.1835)
13228 AB851	5.29 (0.2083)
13228 AB861	5.31 (0.2091)
13228 AB871	5.33 (0.2098)
13228 AB881	5.35 (0.2106)
13228 AB891	5.37 (0.2114)
13228 AB901	5.39 (0.2122)
13228 AB911	5.41 (0.2123)
13228 AB921	5.43 (0.2138)
13228 AB931	5.45 (0.2146)
13228 AB941	5.47 (0.2154)
13228 AB951	5.49 (0.2161)
13228 AB961	5.51 (0.2169)
13228 AB971	5.53 (0.2177)
13228 AB981	5.55 (0.2185)
13228 AB991	5.57 (0.2193)
13228 AC001	5.59 (0.2201)
13228 AC011	5.61 (0.2209)
13228 AC021	5.63 (0.2217)
13228 AC031	5.65 (0.2224)

7) Inspect all valves for clearance again at this stage. If the valve clearance is not correct, repeat the procedure over again from the first step.
8) After inspection, install the related parts in the reverse order of removal.

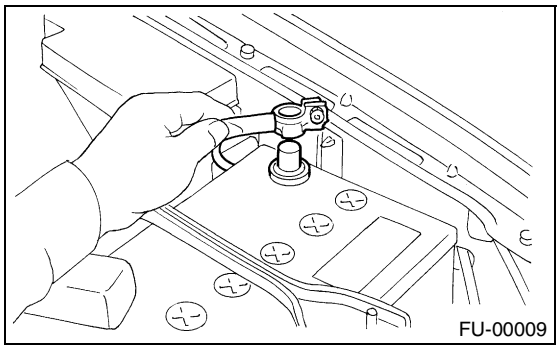
9. Engine Assembly

A: REMOVAL

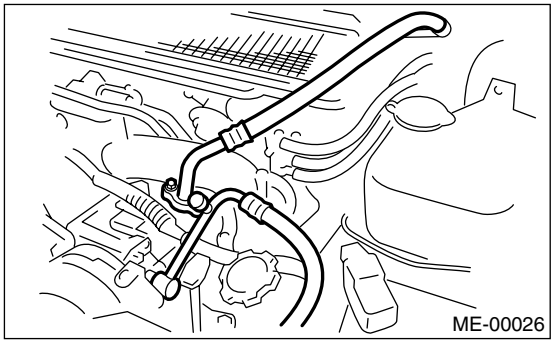
1) Set the vehicle on lift arms.
2) Open the front hood fully, and then support with the hood stay.
3) Collect the refrigerant from A/C system.
4) Release the fuel pressure.
   (1) Disconnect the fuel pump relay connector.



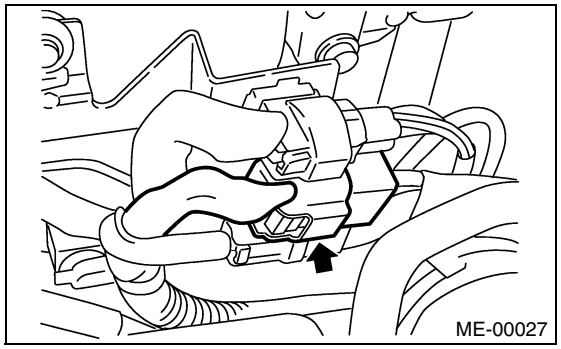
   (2) Start the engine, and run until stalls.
   (3) After the engine stalls, crank it for 5 seconds more.
   (4) Turn the ignition switch to OFF.
5) Remove the filler cap.
6) Disconnect the ground cable from battery.



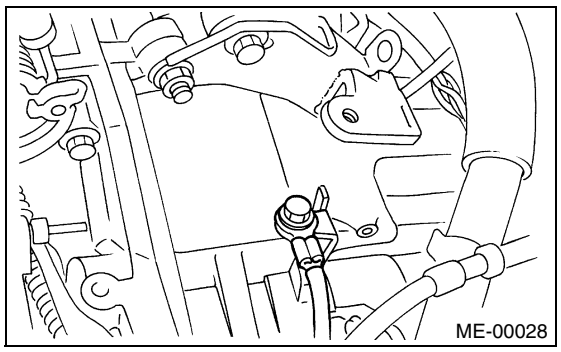
7) Remove the radiator from vehicle. <Ref. to CO(SOHC)-27, REMOVAL, Radiator.>
8) Remove the coolant filler tank. <Ref. to CO(SOHC)-42, REMOVAL, Coolant Filler Tank.>
9) Disconnect the A/C pressure hoses from A/C compressor.



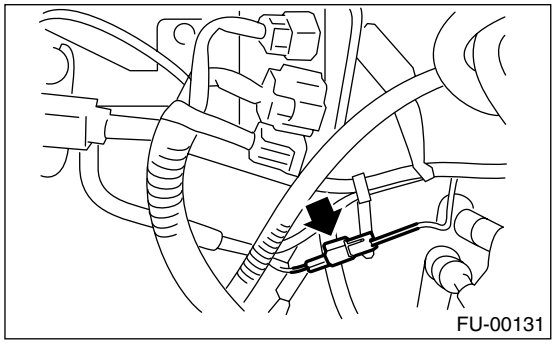
10) Remove the intercooler. <Ref. to IN(TURBO)-10, REMOVAL, Intercooler.>
11) Disconnect the following connectors and cable.
   (1) Engine harness connector

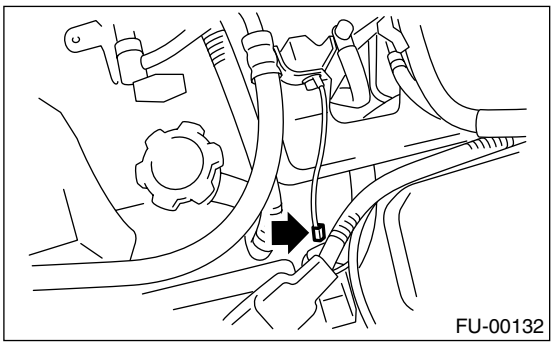


   (2) Engine ground terminal

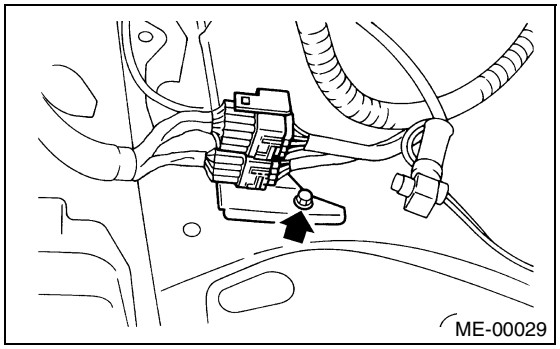


   (3) Disconnect the right and left side engine ground cables.

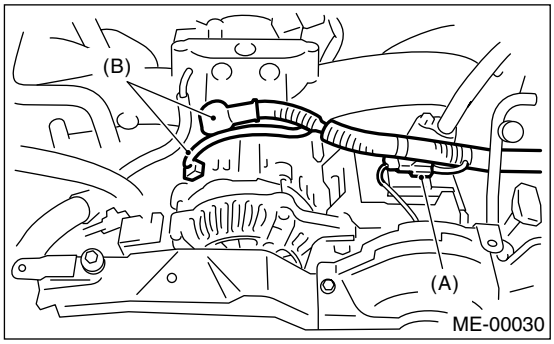




(4) Engine harness connector

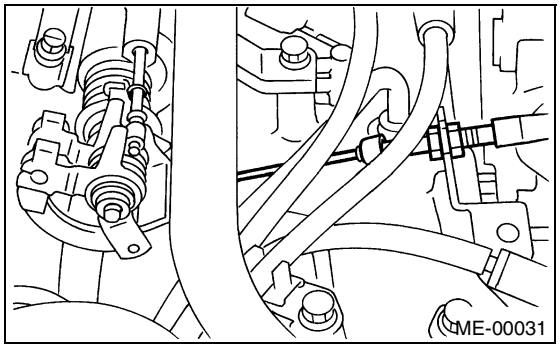


(5) Generator connector, terminal and A/C compressor connectors

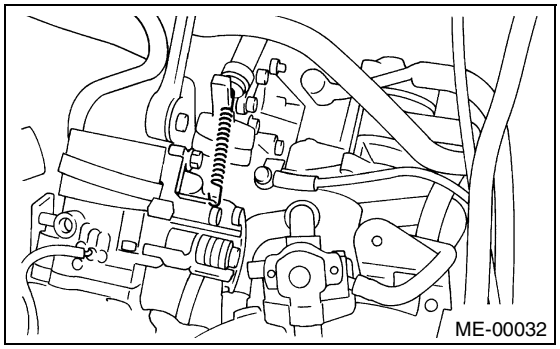


(A) A/C compressor connector
(B) Generator connector and terminal

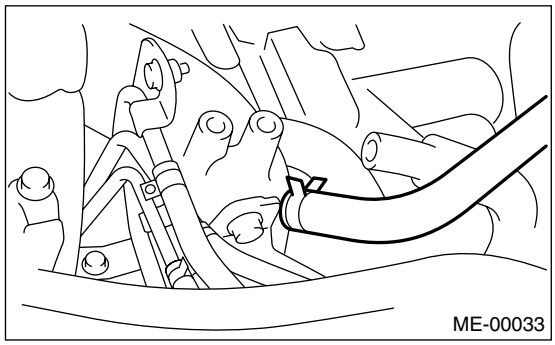
(6) Accelerator cable (MT vehicles)



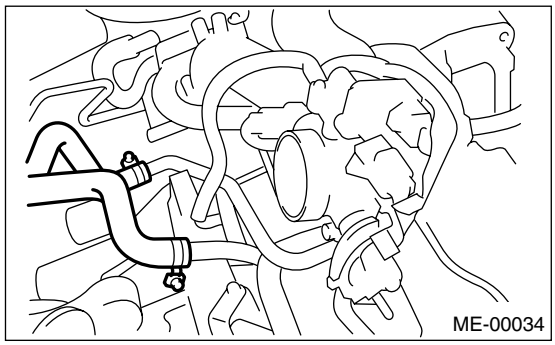
(7) Clutch release spring (MT vehicles)



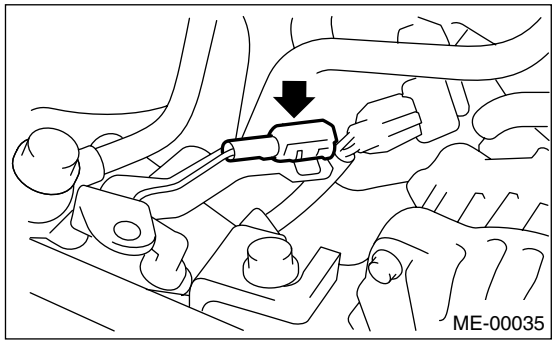
12) Disconnect the following hoses.
(1) Brake booster vacuum hose



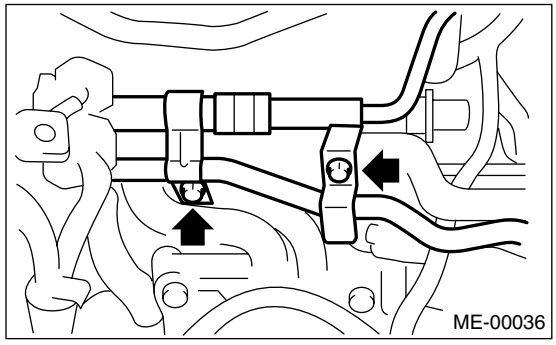
(2) Heater inlet outlet hose



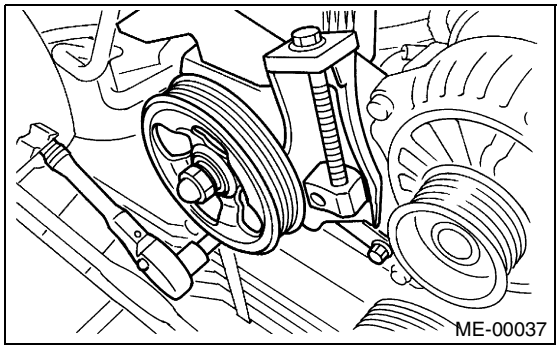
13) Remove the power steering pump from bracket.
(1) Loosen the lock bolt and slider bolt, and then remove the front side V-belt. <Ref. to ME(TURBO)-44, FRONT SIDE BELT, REMOVAL, V-belt.>
(2) Disconnect the power steering switch connector.



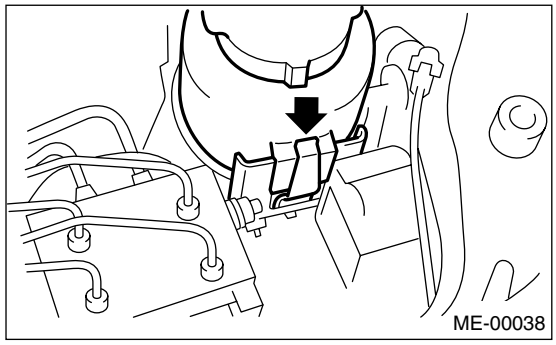
(3) Remove the pipe with bracket from intake manifold.



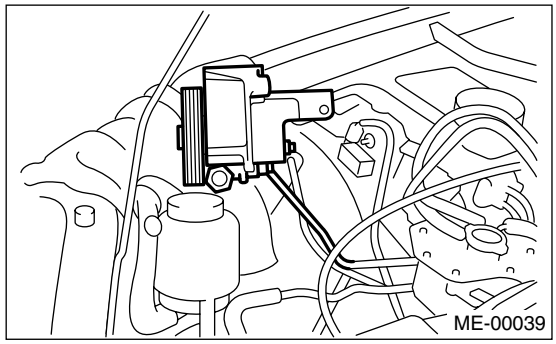
(4) Remove the power steering pump from engine.



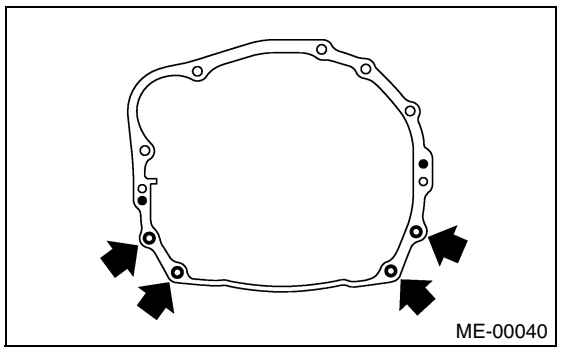
(5) Remove the power steering tank from bracket by pulling it upward.



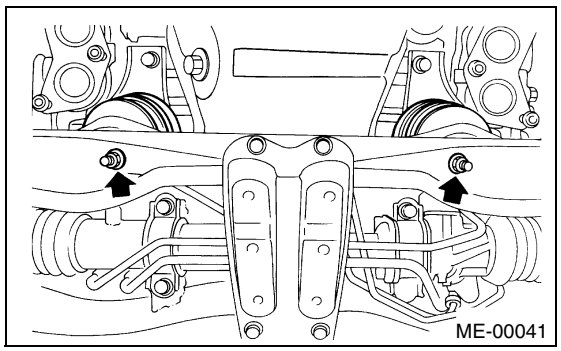
(6) Place the power steering pump on right side wheel apron.



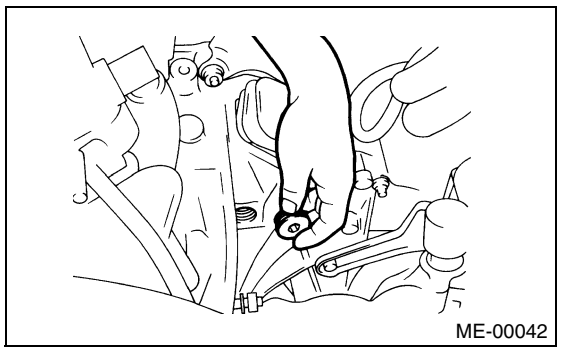
14) Lift-up the vehicle.
15) Remove the ATF cooler pipe from frame. (AT vehicles)
16) Remove the center exhaust pipe. <Ref. to EX(TURBO)-7, REMOVAL, Center Exhaust Pipe.>
17) Remove the nuts which hold lower side of transmission to engine.



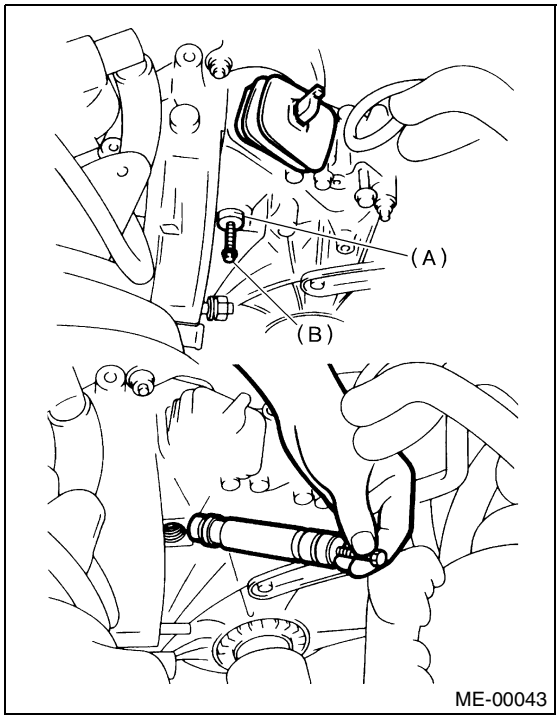
18) Remove the nuts which install front cushion rubber onto front crossmember.



19) Lower the vehicle.
20) Separate the clutch release fork from release bearing. (MT vehicles)
(1) Remove the clutch operating cylinder from transmission.
(2) Remove the plug using a 10 mm hexagon wrench.



(3) Screw the 6 mm dia. bolt into release fork shaft, and remove it.

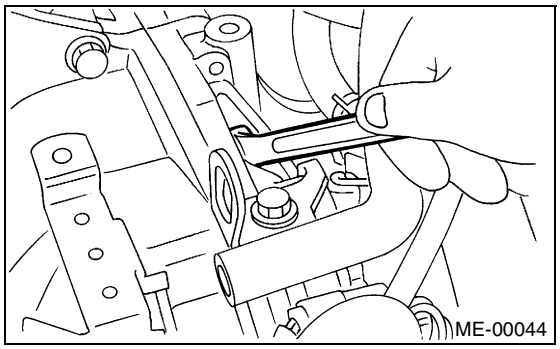


(A) Shaft
(B) Bolt

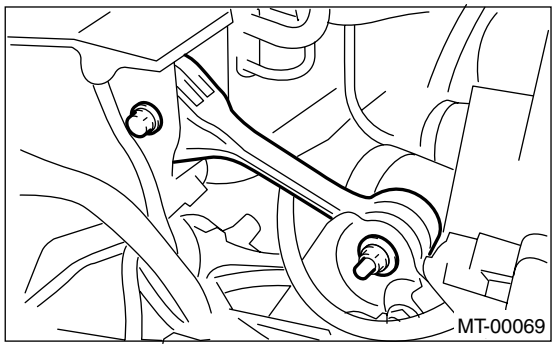
(4) Raise the release fork, and then unfasten the release bearing tabs to free release fork.

NOTE:
Step (4) is required to prevent interference with engine when removing the engine from transmission.

21) Separate the torque converter clutch from drive plate. (AT vehicles)
(1) Lower the vehicle.
(2) Remove the service hole plug.
(3) Remove the bolts which hold torque converter clutch to drive plate.
(4) Remove the other bolts while rotating the engine using socket wrench.

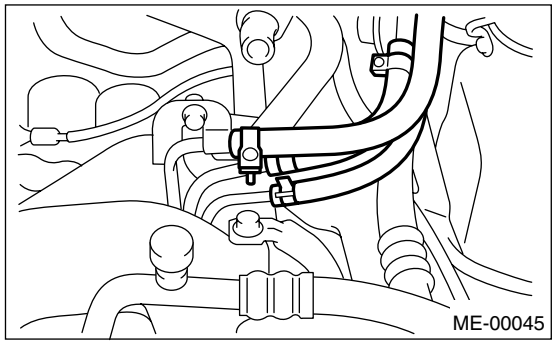


22) Remove the pitching stopper.

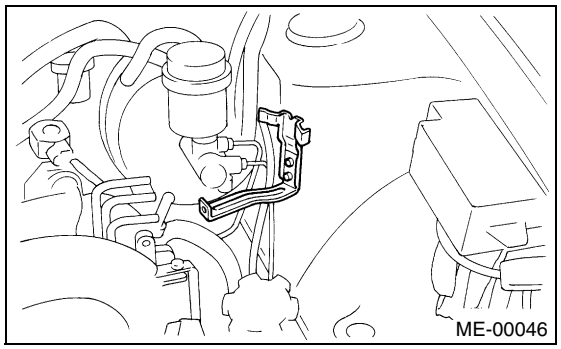


23) Disconnect the fuel delivery hose, return hose and evaporation hose.

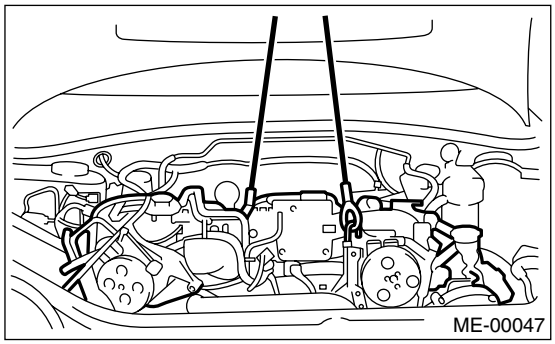
NOTE:
• Catch fuel from the hose into container.
• Disconnect the hose with its end wrapped with cloth to prevent fuel from splashing.



24) Remove the fuel filter and bracket.

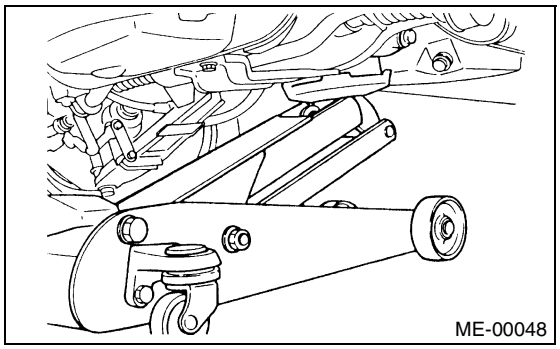


25) Support the engine with a lifting device and wire ropes.



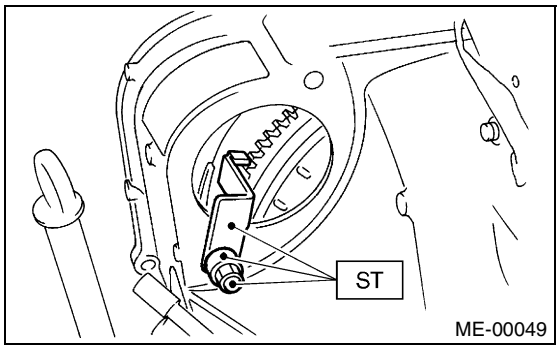
26) Support the transmission with a garage jack.

NOTE:
Before moving the engine away from transmission, check to be sure no work has been overlooked. Doing this is very important in order to facilitate re-installation and because transmission lowers under its own weight.


ME-00048

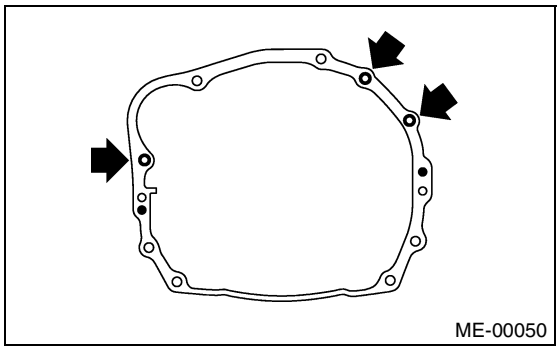
27) Separation of the engine and transmission.
(1) Remove the starter. <Ref. to SC(SOHC)-6, REMOVAL, Starter.>
(2) Install the ST to torque converter clutch case. (AT vehicles)

ST 498277200 STOPPER SET



ME-00049

(3) Remove the bolts which hold right upper side of transmission to engine.


ME-00050

28) Remove the engine from vehicle.
(1) Slightly raise the engine.
(2) Raise the transmission with garage jack.
(3) Move the engine horizontally until the mainshaft is withdrawn from clutch cover.
(4) Slowly move the engine away from engine compartment.

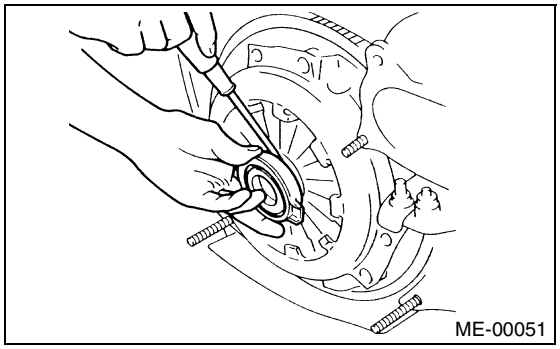
NOTE:
Be careful not to damage adjacent parts or body panels with crank pulley, oil pressure gauge, etc.

29) Remove the front cushion rubbers.

B: INSTALLATION

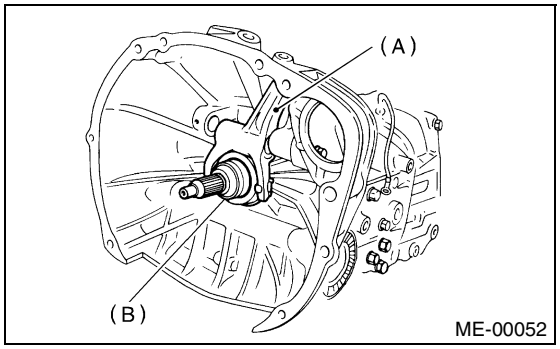
1) Install the clutch release fork and bearing onto transmission. (MT vehicles)

(1) Remove the release bearing from clutch cover with flat type screw driver.



(2) Install the release bearing on transmission.

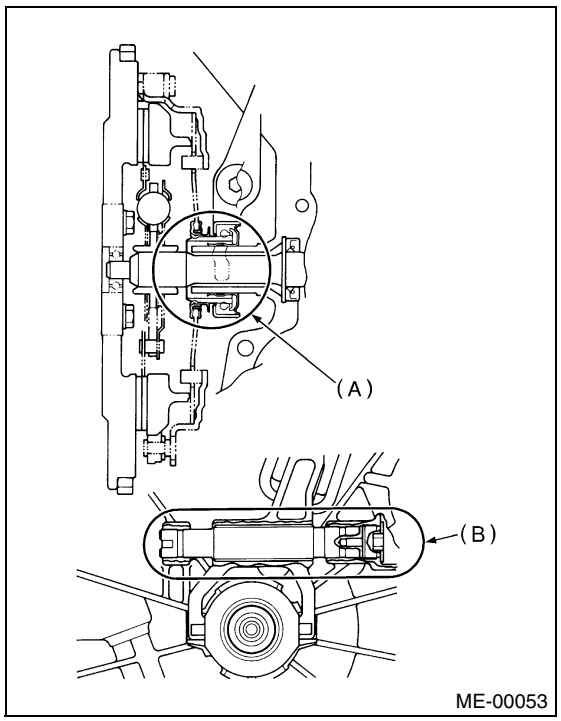
(3) Install the release fork into release bearing tab.



(A) Release fork
(B) Release bearing

(4) Apply grease to the specified points.

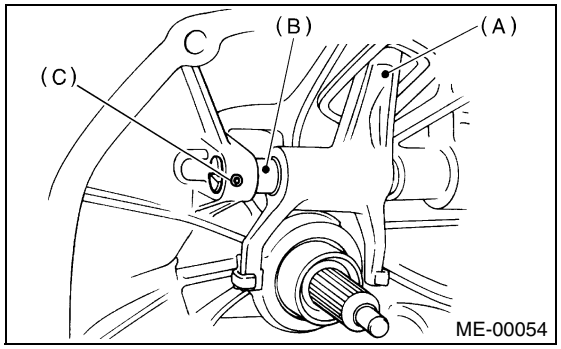
- Spline FX2200
- Shaft SUNLIGHT 2



(A) Spline (FX2200)
(B) Shaft (SUNLIGHT 2)

(5) Insert the release fork shaft into release fork.

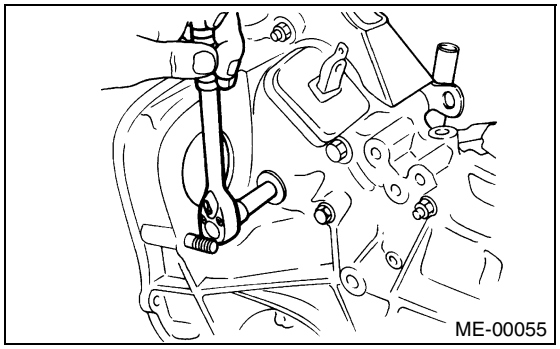
CAUTION:
Make sure the cutout portion of release fork shaft contacts spring pin.



(A) Release fork
(B) Release shaft
(C) Spring pin

(6) Tighten the plug.

Tightening torque:
44 N·m (4.5 kgf-m, 32.5 ft-lb)



2) Install the front cushion rubbers to engine.

Tightening torque:
34 N·m (3.5 kgf-m, 25.3 ft-lb)

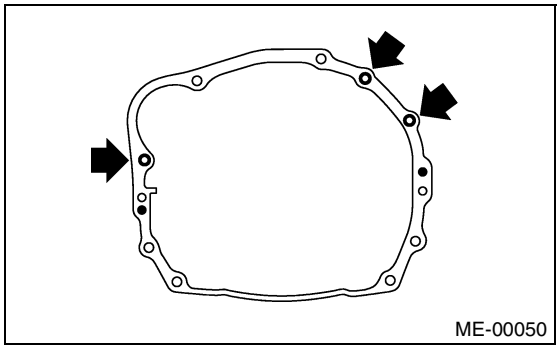
3) Install the engine onto transmission.
(1) Position the engine in engine compartment, and then align it with the transmission.

NOTE:
Be careful not to damage the adjacent parts or body panels with crank pulley, oil pressure gauge, etc.

(2) Apply a small amount of grease to the splines of mainshaft. (MT vehicles)

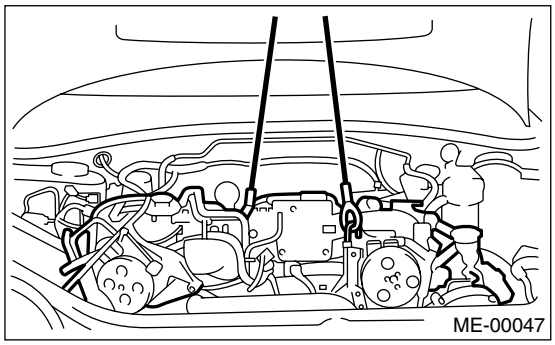
4) Tighten the bolts which hold right upper side of transmission to engine.

Tightening torque:
50 N·m (5.1 kgf-m, 36.9 ft-lb)



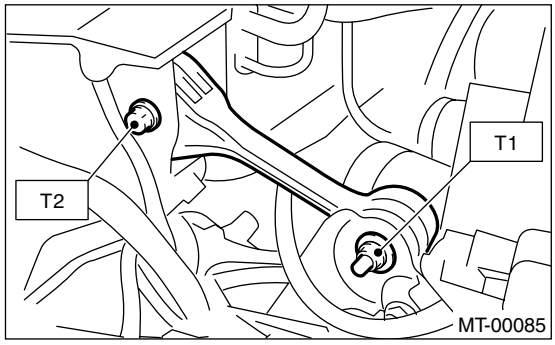
5) Remove the lifting device and wire ropes.

6) Remove the garage jack.



7) Install the pitching stopper.

Tightening torque:
T1: 50 N·m (5.1 kgf-m, 37 ft-lb)
T2: 58 N·m (5.9 kgf-m, 43 ft-lb)



8) Remove the ST from torque converter clutch case. (AT vehicles)

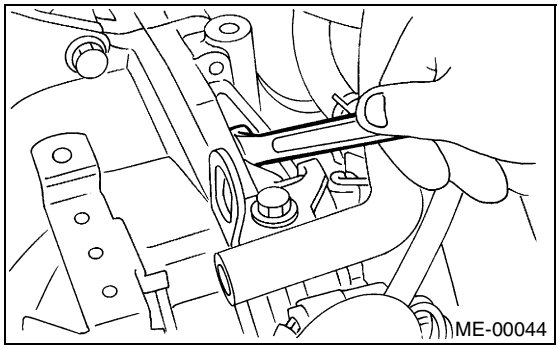
NOTE:
Be careful not to drop the ST into torque converter clutch case when removing ST.
ST 498277200 STOPPER SET

9) Install the starter. <Ref. to SC(SOHC)-6, INSTALLATION, Starter.>

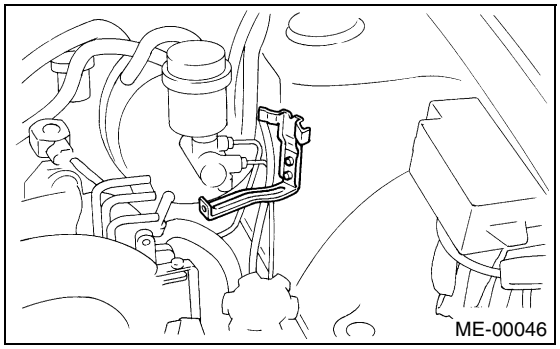
10) Install the torque converter clutch onto drive plate. (AT vehicles)
(1) Tighten the bolts which hold torque converter clutch to drive plate.
(2) Tighten other bolts while rotating the engine by using ST.

CAUTION:
Be careful not to drop bolts into the torque converter clutch housing.
ST 499977300 CRANK PULLEY WRENCH

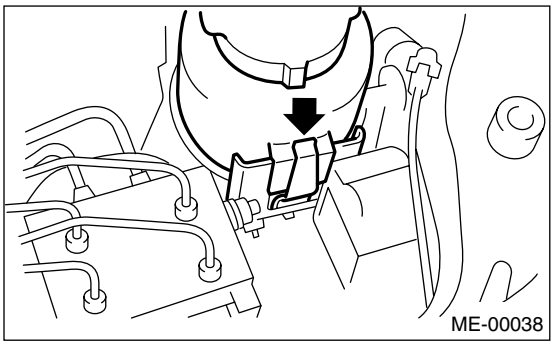
Tightening torque:
25 N·m (2.5 kgf-m, 18.1 ft-lb)



(3) Clog the service hole with plug.
11) Install the fuel filter and bracket.

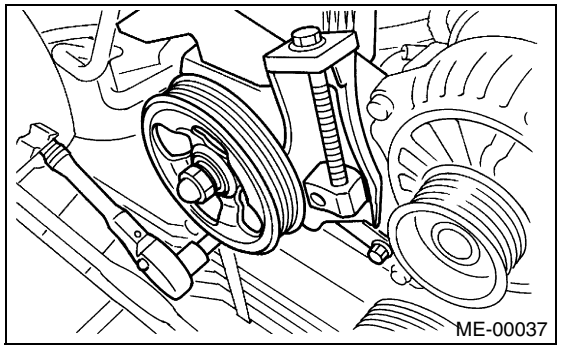


12) Install the power steering pump on bracket.
(1) Install the power steering tank on bracket.

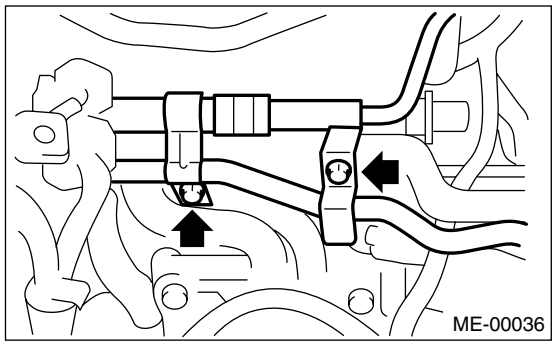


(2) Install the power steering pump.

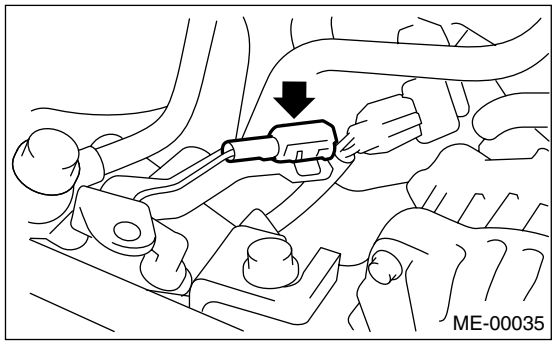
Tightening torque:
20.1 N·m (2.05 kgf-m, 14.8 ft-lb)



(3) Install the power steering pipe bracket on right side intake manifold.



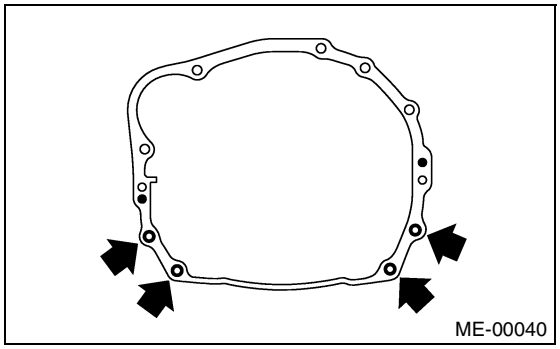
(4) Connect the power steering switch connector.



(5) Install the front side V-belt, and adjust it. <Ref. to ME(TURBO)-44, FRONT SIDE BELT, INSTALLATION, V-belt.>
13) Lift-up the vehicle.

14) Tighten the nuts which hold lower side of transmission to engine.

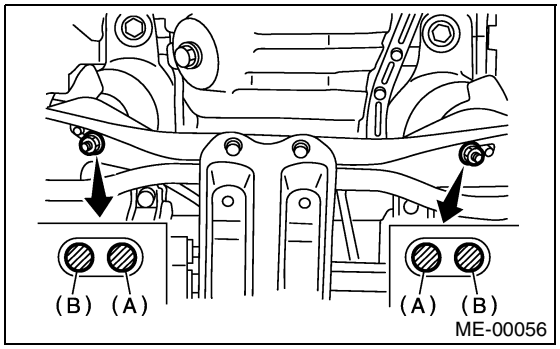
Tightening torque:
50 N·m (5.1 kgf-m, 36.9 ft-lb)



15) Tighten the nuts which install front cushion rubber onto crossmember.

Tightening torque:
83 N·m (8.5 kgf-m, 61 ft-lb)

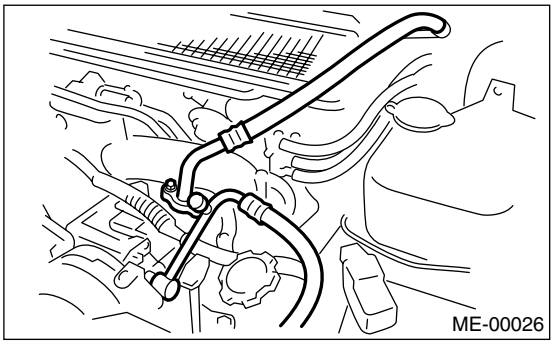
NOTE:
Make sure the front cushion rubber mounting bolts (A) and locator (B) are securely installed.



16) Install the ATF cooler pipe to frame. (AT vehicles)
17) Install the center exhaust pipe.
<Ref. to EX(TURBO)-8, INSTALLATION, Center Exhaust Pipe.>
18) Lower the vehicle.
19) Connect the following hoses:
(1) Fuel delivery hose, return hose and evaporation hose
(2) Heater inlet and outlet hoses
(3) Brake booster vacuum hose
20) Connect the following connectors and terminals:
(1) Engine ground terminal
(2) Engine harness connectors
(3) Generator connector and terminal
(4) A/C compressor connectors
21) Connect the following cables:
(1) Accelerator cable
(2) Clutch release spring
22) After connecting each cable, adjust them.
23) Install the air intake system.
(1) Install the intercooler. <Ref. to IN(TURBO)-11, INSTALLATION, Intercooler.>
(2) Install the air cleaner element and air cleaner upper cover.
(3) Install the engine harness connector bracket.
(4) Install the filler hose to air cleaner case.
24) Install the A/C pressure hoses.

NOTE:
Use new O-rings.

Tightening torque:
25 N·m (2.5 kgf-m, 18.1 ft-lb)



25) Install the radiator. <Ref. to CO(SOHC)-29, INSTALLATION, Radiator.>
26) Install the coolant filler tank. <Ref. to CO(SOHC)-42, INSTALLATION, Coolant Filler Tank.>
27) Install the window washer tank.
28) Install the battery in the vehicle, and connect cables.
29) Fill coolant.
<Ref. to CO(SOHC)-18, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>
30) Charge the A/C system with refrigerant.
<Ref. to AC-27, OPERATION, Refrigerant Charging Procedure.>
31) Remove the front hood stay, and close the front hood.
32) Take off the vehicle from lift arms.

10.Engine Mounting

A: REMOVAL

1) Remove the engine assembly. <Ref. to ME(TURBO)-33, REMOVAL, Engine Assembly.>
2) Remove the engine mounting from engine assembly.

B: INSTALLATION

Install in the reverse order of removal.

Tightening torque:
Engine mounting;
34 N·m (3.5 kgf-m, 25.3 ft-lb)

C: INSPECTION

Make sure there are no cracks or other damage.