ENGINE 2-3

1. Specifications

Engine	Model			2200 cc	2500 cc
	Type			Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
	Valve arrangement			Belt driven, single over-head camshaft, 4-valve/cylinder	
	Bore x Stroke		mm (in)	96.9 × 75.0 (3.815 × 2.953)	99.5 × 79.0 (3.917 × 3.110)
	Displacement		cm^3 (cu in)	2,212 (135)	2,457 (150)
	Compression ratio			9.7	
	Compression pressure (at 200 — 300 rpm)		kPa (kg/cm^2, psi)	1,079 — 1,275 (11.0 — 13.0, 156 — 185)	
	Number of piston rings			Pressure ring: 2, Oil ring: 1	
	Intake valve timing	Opening		2° BTDC	1° BTDC
		Closing		50° ABDC	51° ABDC
	Exhaust valve timing	Opening		46° BBDC	50° BBDC
		Closing		6° ATDC	6° 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 on MT, or “P” or “N” position on AT]		rpm	700±100 (No load) 850±50 (A/C switch ON)	
	Firing order			1 → 3 → 2 → 4	
	Ignition timing		BTDC/rpm	14°±8°/700 (MT), 20°±8°/700 (AT)	

2. Service Data

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

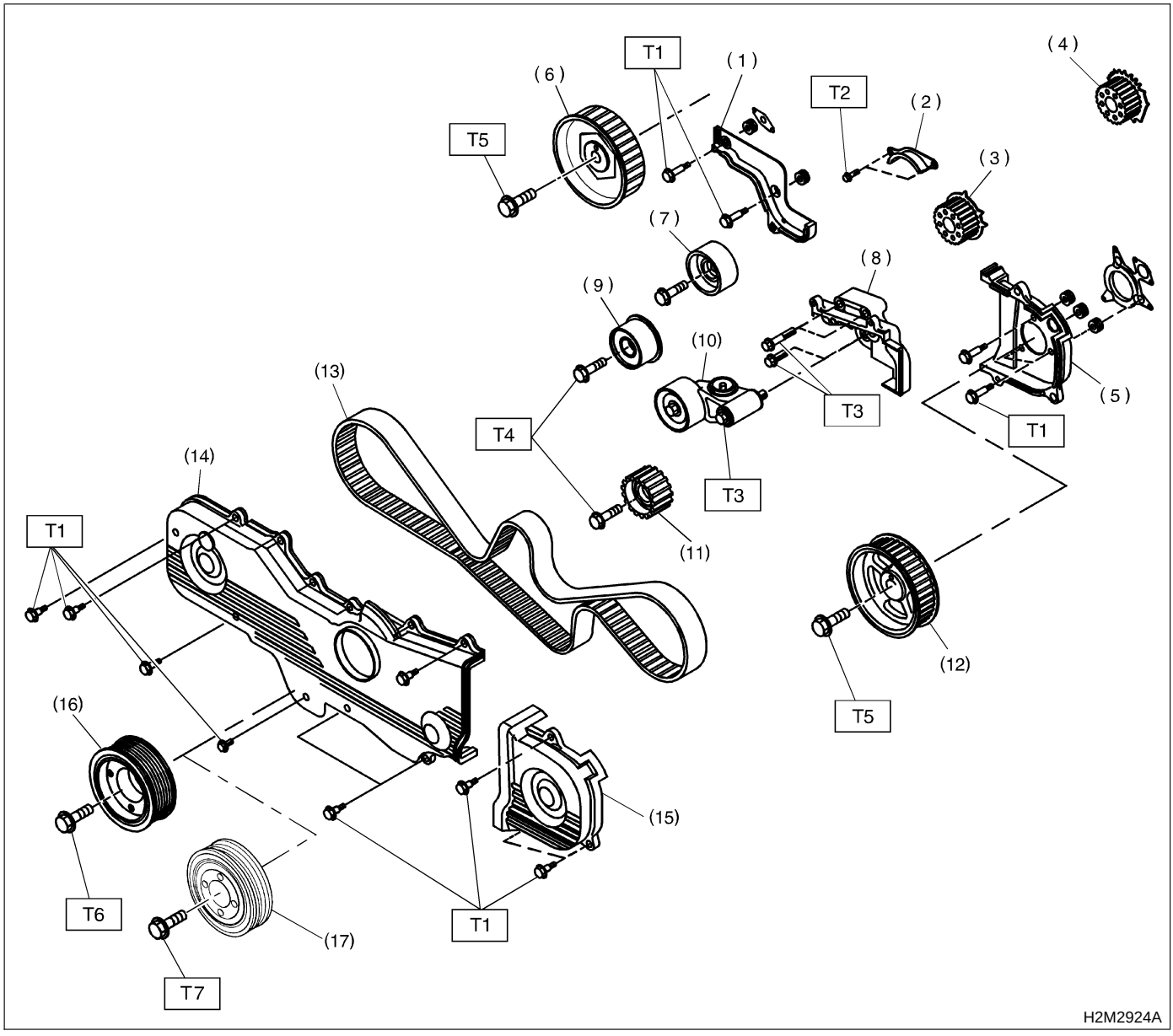
Belt tensioner adjuster	Protrusion of adjuster rod			5.2 — 6.2 mm	(0.205 — 0.244 in)
Belt tensioner	Spacer O.D.			17.955 — 17.975 mm	(0.7069 — 0.7077 in)
	Tensioner bush I.D			18.00 — 18.08 mm	(0.7087 — 0.7118 in)
	Clearance between spacer and bush		STD	0.025 — 0.125 mm	(0.0010 — 0.0049 in)
			Limit	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)
Valve rocker arm	Clearance between shaft and arm		STD	0.020 — 0.054 mm	(0.0008 — 0.0021 in)
			Limit	0.10 mm	(0.0039 in)
Camshaft	Bend limit			0.020 mm	(0.0008 in)
	Thrust clearance		STD	0.030 — 0.090 mm	(0.0012 — 0.0035 in)
			Limit	0.11 mm	(0.0043 in)
	Cam lobe height (2200 cc)	Intake	STD	38.732 — 38.832 mm	(1.5249 — 1.5288 in)
			Limit	38.632 mm	(1.5209 in)
		Exhaust	STD	39.257 — 39.357 mm	(1.5455 — 1.5495 in)
			Limit	39.157 mm	(1.5416 in)
	Cam lobe height (2500 cc)	Intake	STD	39.485 — 39.585 mm	(1.5545 — 1.5585 in)
			Limit	39.385 mm	(1.5506 in)
		Exhaust	STD	39.257 — 39.357 mm	(1.5455 — 1.5495 in)
			Limit	39.157 mm	(1.5416 in)
	Camshaft journal O.D.			31.928 — 31.945 mm	(1.2570 — 1.2577 in)
	Camshaft journal hole I.D.			32.000 — 32.018 mm	(1.2598— 1.2605 in)
	Oil clearance		STD	0.055 — 0.090 mm	(0.0022 — 0.0035 in)
			Limit	0.118 mm	(0.0046 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 set	Refacing angle			90°	
	Contacting width	Intake	STD	1.0 mm	(0.039 in)
			Limit	1.7 mm	(0.067 in)
		Exhaust	STD	1.4 mm	(0.055 in)
			Limit	2.1 mm	(0.083 in)
Valve guide	Inner diameter			6.000 — 6.012 mm	(0.2362 — 0.2367 in)
	Protrusion above head	Intake		20.0 — 20.5 mm	(0.787 — 0.807 in)
		Exhaust		16.5 — 17.0 mm	(0.650 — 0.669 in)

Valve	Head edge thickness	Intake	STD	1.0 mm	(0.039 in)
			Limit	0.6 mm	(0.024 in)
		Exhaust	STD	1.2 mm	(0.047 in)
			Limit	0.6 mm	(0.024 in)
	Stem diameter		Intake	5.950 — 5.965 mm	(0.2343 — 0.2348 in)
			Exhaust	5.945 — 5.960 mm	(0.2341 — 0.2346 in)
	Stem oil clearance	STD	Intake	0.035 — 0.062 mm	(0.0014 — 0.0024 in)
			Exhaust	0.040 — 0.067 mm	(0.0016 — 0.0026 in)
		Limit	—	0.15 mm	(0.0059 in)
	Overall length		Intake	120.6 mm	(4.75 in)
			Exhaust	121.7 mm	(4.79 in)
Valve spring	Free length			54.30 mm	(2.1378 in)
	Squareness			2.5°, 2.4 mm	(0.094 in)
	Tension/spring height			214.8 — 246.2 N (21.9 — 25.1 kg, 48.3 — 55.3 lb)/45.0 mm (1.772 in) 526.6 — 581.6 N (53.7 — 59.3 kg, 118.4 — 130.8 lb)/34.7 mm (1.366 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 (2200 cc)	STD	A	96.905 — 96.915 mm	(3.8151 — 3.8155 in)
			B	96.895 — 96.905 mm	(3.8148 — 3.8151 in)
	Cylinder bore (2500 cc)	STD	A	99.505 — 99.515 mm	(3.9175 — 3.9179 in)
			B	99.495 — 99.505 mm	(3.9171 — 3.9175 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 (2200 cc)	STD	A	96.885 — 96.895 mm	(3.8144 — 3.8148 in)
			B	96.875 — 96.885 mm	(3.8140 — 3.8144 in)
		0.25 mm (0.0098 in) OS		97.125 — 97.135 mm	(3.8238 — 3.8242 in)
		0.50 mm (0.0197 in) OS		97.375 — 97.385 mm	(3.8337 — 3.8340 in)
	Outer diameter (2500 cc)	STD	A	99.485 — 99.495 mm	(3.9167 — 3.9171 in)
			B	99.475 — 99.485 mm	(3.9163 — 3.9167 in)
		0.25 mm (0.0098 in) OS		99.725 — 99.735 mm	(3.9262 — 3.9266 in)
		0.50 mm (0.0197 in) OS		99.975 — 99.985 mm	(3.9360 — 3.9364 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 — 0.35 mm	(0.0079 — 0.0138 in)
			Limit	1.0 mm	(0.039 in)
		Second ring	STD	0.37 — 0.52 mm	(0.0146 — 0.0205 in)
			Limit	1.0 mm	(0.039 in)
		Oil ring	STD	0.20 — 0.50 mm	(0.0079 — 0.0197 in)
			Limit	1.0 mm	(0.039 in)
	Clearance between piston ring and piston ring groove	Top ring	STD	0.040 — 0.080 mm	(0.0016 — 0.0031 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 (2200 cc)		STD	0.010 — 0.038 mm	(0.0004 — 0.0015 in)
			Limit	0.05 mm	(0.0020 in)
	Oil clearance (2500 cc)		STD	0.020 — 0.046 mm	(0.0008 — 0.0018 in)
			Limit	0.050 mm	(0.0020 in)
	Thickness at center portion (2200 cc)		STD	1.492 — 1.501 mm	(0.0587 — 0.0591 in)
			0.03 mm (0.0012 in) US	1.510 — 1.513 mm	(0.0594 — 0.0596 in)
			0.05 mm (0.0020 in) US	1.520 — 1.523 mm	(0.0598 — 0.0600 in)
			0.25 mm (0.0098 in) US	1.620 — 1.623 mm	(0.0638 — 0.0639 in)
	Thickness at center portion (2500 cc)		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)

Crank-shaft	Bend limit			0.035 mm	(0.0014 in)
	Crankpin and crank journal		Out-of-roundness	0.030 mm (0.0012 in) or less	
			Grinding limit	0.250 mm	(0.0098 in)
	Crankpin outer diameter		STD	51.984 — 52.000 mm	(2.0466 — 2.0472 in)
			0.03 mm (0.0012 in) US	51.954 — 51.970 mm	(2.0454 — 2.0461 in)
			0.05 mm (0.0020 in) US	51.934 — 51.950 mm	(2.0446 — 2.0453 in)
			0.25 mm (0.0098 in) US	51.734 — 51.750 mm	(2.0368 — 2.0374 in)
	Crank journal outer diameter	#1, #5, #3	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		STD	0.010 — 0.030 mm	(0.0004 — 0.0012 in)
			Limit	0.040 mm	(0.0016 in)
Crank-shaft bearing	Crankshaft bearing thick-ness	#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)

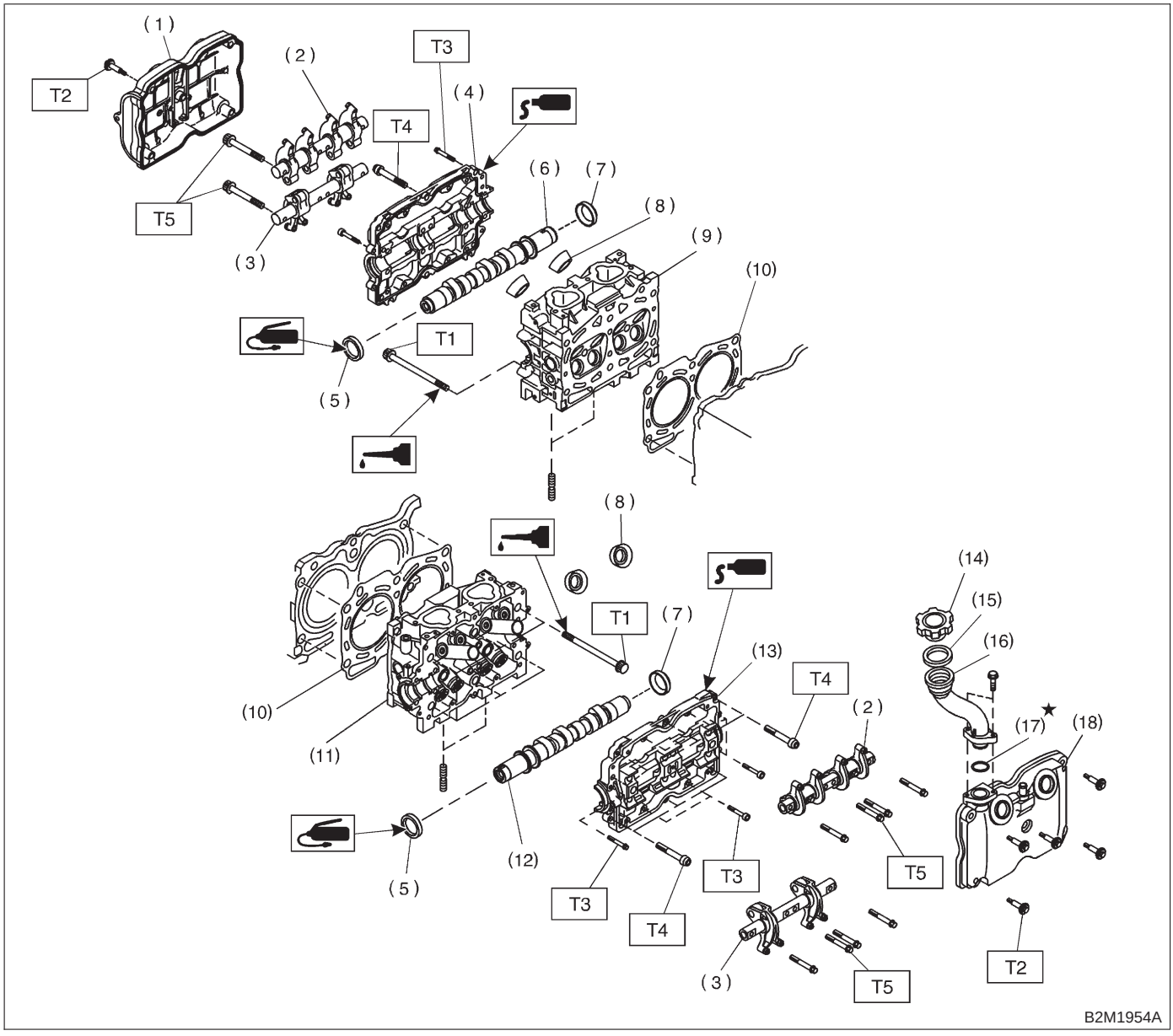
1. Timing Belt



(1) Belt cover No. 2 (RH)
(2) Timing belt guide (MT vehicles only)
(3) Crankshaft sprocket (Except 2200 cc California spec. vehicles)
(4) Crankshaft sprocket (2200 cc California spec. vehicles)
(5) Belt cover No. 2 (LH)
(6) Camshaft sprocket No. 1
(7) Belt idler (No. 1)
(8) Tensioner bracket
(9) Belt idler (No. 2)
(10) Automatic belt tension adjuster ASSY
(11) Belt idler No. 2
(12) Camshaft sprocket No. 2
(13) Timing belt
(14) Front belt cover
(15) Belt cover (LH)
(16) Crankshaft pulley (2200 cc model)
(17) Crankshaft pulley (2500 cc model)

Tightening torque: N·m (kg-m, ft-lb)
T1: 5±1 (0.5±0.1, 3.6±0.7)
T2: 9.8±1.0 (1.0±0.1, 7.2±0.7)
T3: 25±3 (2.5±0.3, 18.1±2.2)
T4: 39±4 (4.0±0.4, 28.9±2.9)
T5: 78±5 (8.0±0.5, 57.9±3.6)
T6: 127±5 (13.0±0.5, 94±3.6)
T7: 177±5 (18.0±0.5, 130.2±3.6)

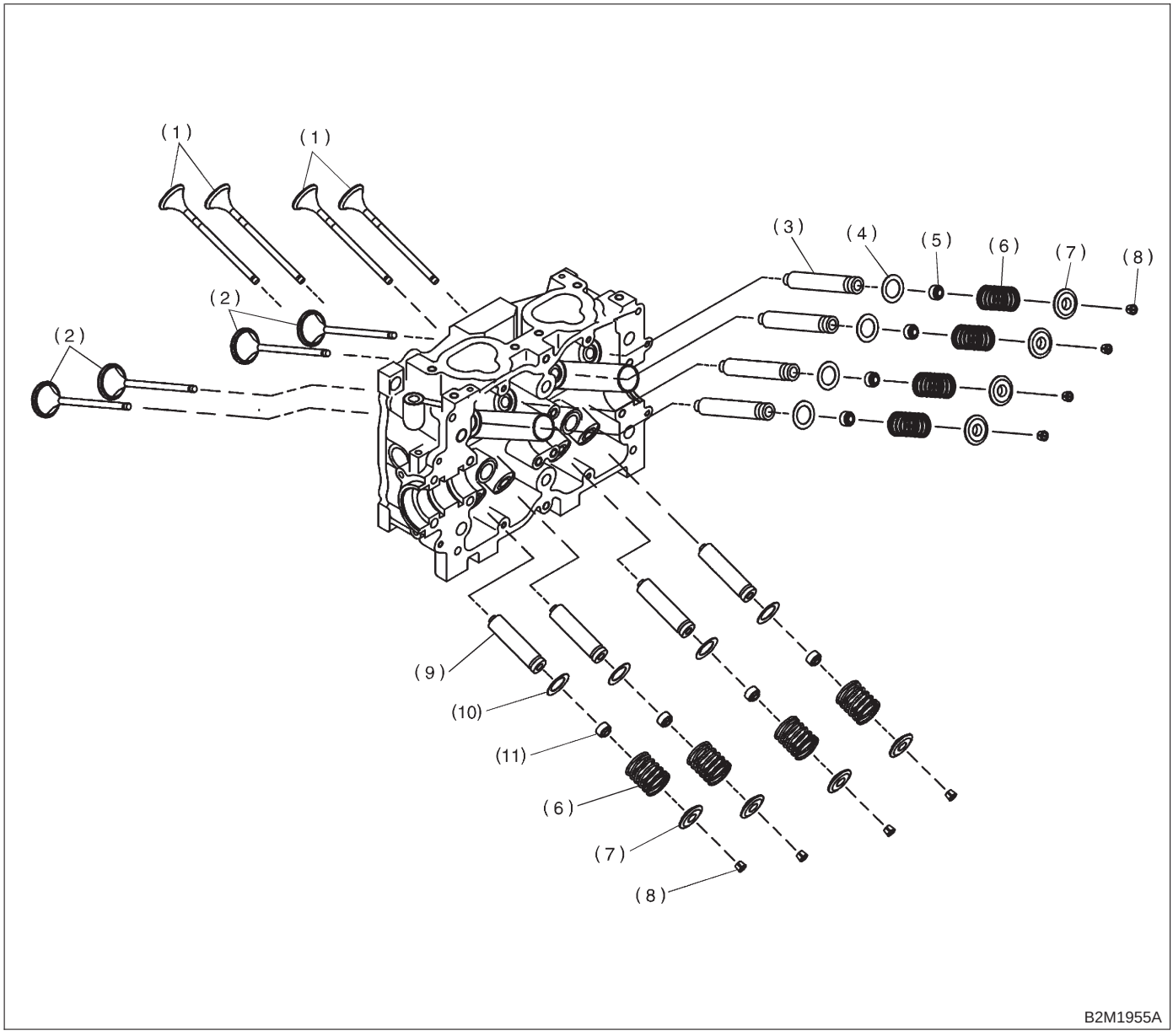
2. Cylinder Head and Camshaft



(1) Rocker cover (RH)
(2) Intake valve rocker ASSY
(3) Exhaust valve rocker ASSY
(4) Camshaft cap (RH)
(5) Oil seal
(6) Camshaft (RH)
(7) Plug
(8) Spark plug pipe gasket
(9) Cylinder head (RH)
(10) Cylinder head gasket
(11) Cylinder head (LH)
(12) Camshaft (LH)
(13) Camshaft cap (LH)
(14) Oil filler cap
(15) Gasket
(16) Oil filler pipe
(17) O-ring
(18) Rocker cover (LH)
(19) Stud bolt

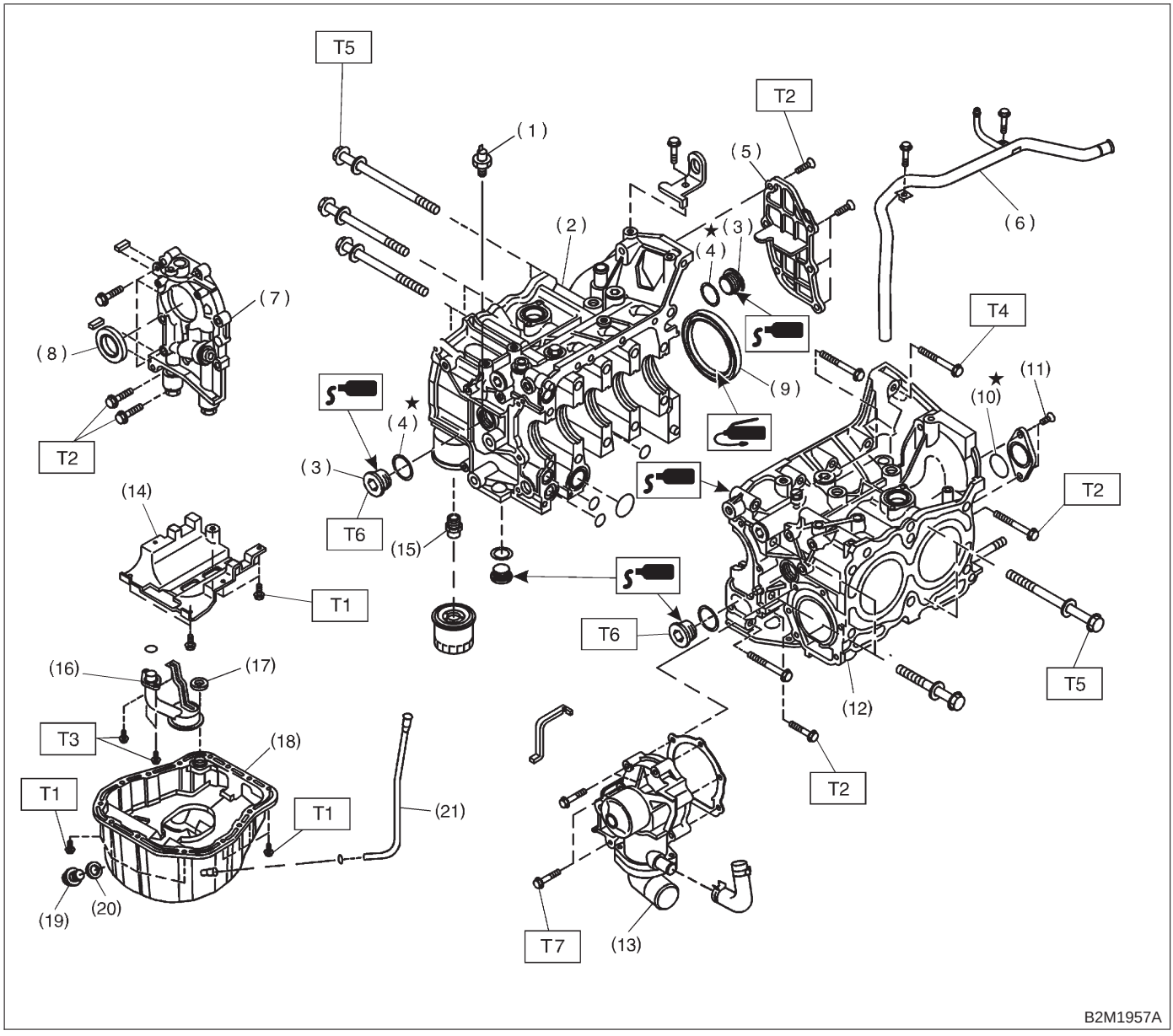
Tightening torque: N·m (kg-m, ft-lb)
T1: <Ref. to 2-3 [W5E1].>
T2: 5±1 (0.5±0.1, 3.6±0.7)
T3: 10±2 (1.0±0.2, 7.2±1.4)
T4: 18±2 (1.8±0.2, 13.0±1.4)
T5: 25±2 (2.5±0.2, 18.1±1.4)

3. Cylinder Head and Valve Assembly



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

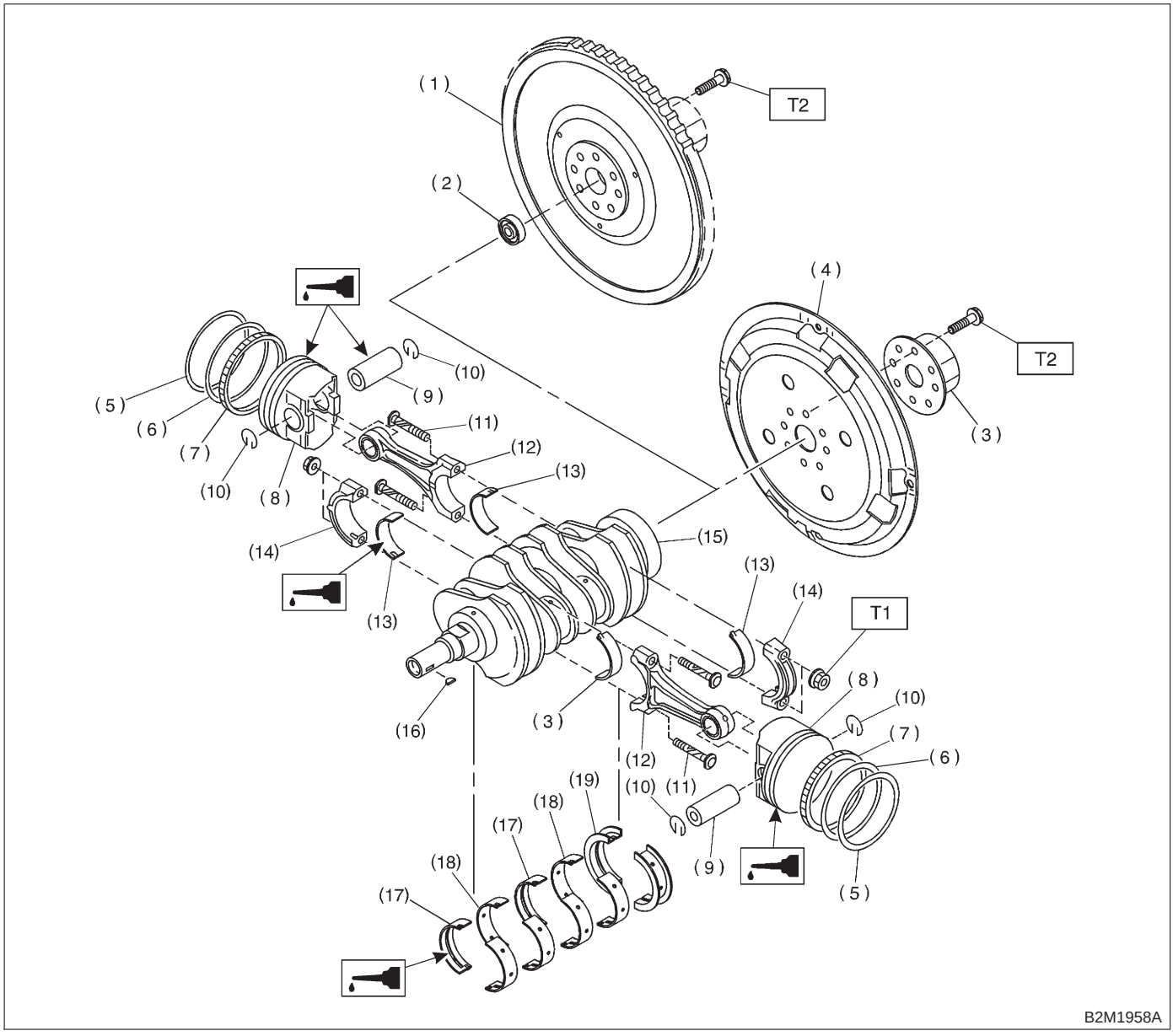
4. Cylinder Block



(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) Oil filter connector
(16) Oil strainer
(17) Gasket
(18) Oil pan
(19) Drain plug
(20) Metal gasket
(21) Oil level gauge guide

Tightening torque: N·m (kg-m, ft-lb)
T1: 5 (0.5, 3.6)
T2: 6.4 (0.65, 4.7)
T3: 10 (1.0, 7)
T4: 25±2 (2.5±0.2, 18.1±1.4)
T5: 47±3 (4.8±0.3, 34.7±2.2)
T6: 69±7 (7.0±0.7, 50.6±5.1)
T7: First 12±2 (1.2±0.2, 8.7±1.4)
Second 12±2 (1.2±0.2, 8.7±1.4)

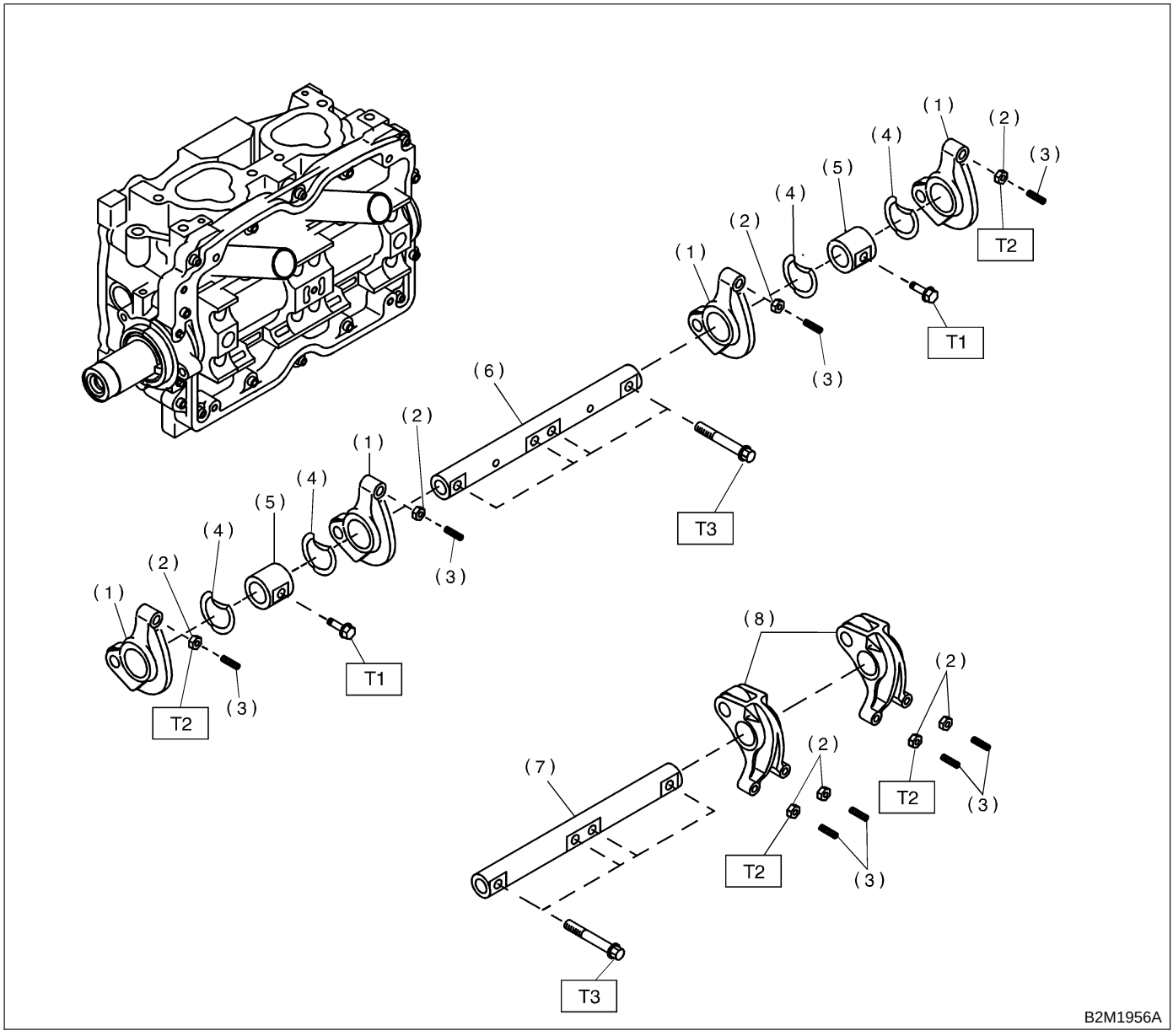
5. Crankshaft and Piston



(1) Flywheel (MT)
(2) Ball bearing (MT)
(3) Reinforcement (AT)
(4) Drive plate (AT)
(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 (kg-m, ft-lb)
T1: 44±2 (4.5±0.2, 32.5±1.4)
T2: 72±3 (7.3±0.3, 52.8±2.2)

6. Valve Rocker Assembly



(1) Intake valve rocker arm
(2) Valve rocker nut
(3) Valve rocker adjust screw
(4) Spring
(5) Rocker shaft support
(6) Intake rocker shaft
(7) Exhaust rocker shaft
(8) Exhaust valve rocker arm

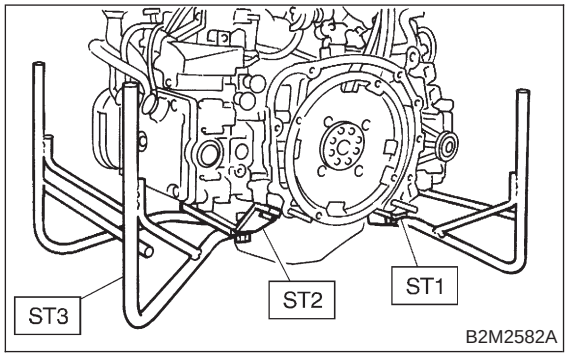
Tightening torque: N·m (kg-m, ft-lb)
T1: 5±1 (0.5±0.1, 3.6±0.7)
T2: 10±1 (1.0±0.1, 7.2±0.7)
T3: 25±2 (2.5±0.2, 18.1±1.4)

1. General Precautions

A: GENERAL PRECAUTIONS

1) Before disassembling engine, place it on ST3.

ST1	498457000	ENGINE STAND ADAPTER RH
ST2	498457100	ENGINE STAND ADAPTER LH
ST3	499817000	ENGINE STAND



2) All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.

3) Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.

4) Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.

5) All removed parts, if to be reused, should be reinstalled in the original positions and directions.

6) All removed parts, if to be reused, should be reinstalled in the original positions and directions.

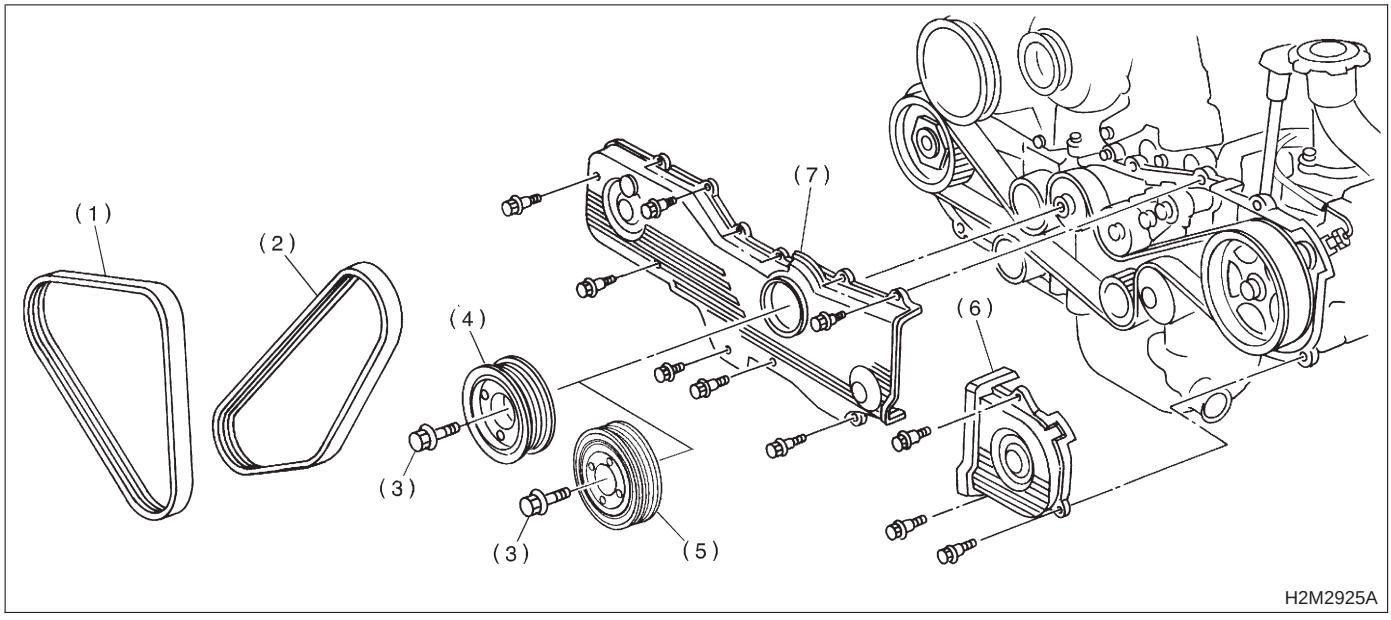
7) Bolts, nuts and washers should be replaced with new ones as required.

8) Even if necessary inspections have been made in advance, proceed with assembly work while making rechecks.

2. Timing Belt

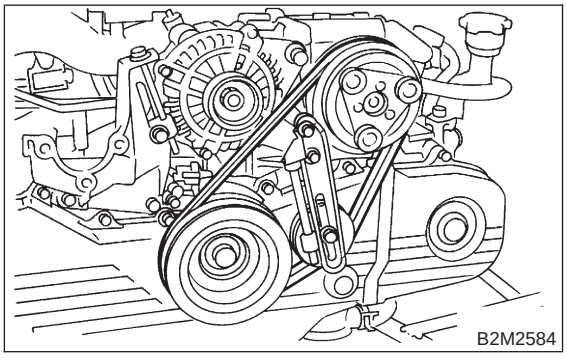
A: REMOVAL

1. CRANKSHAFT PULLEY AND BELT COVER

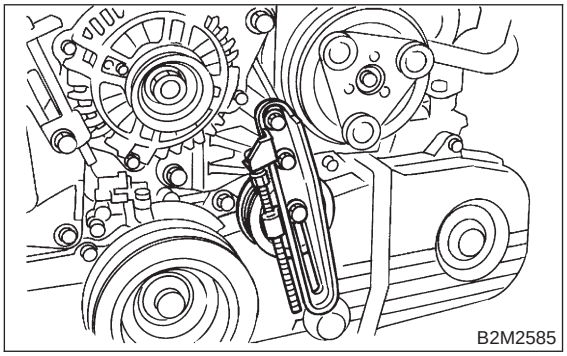


(1) Front side V-belt
(2) Rear side V-belt (With A/C model)
(3) Crankshaft pulley bolt
(4) Crankshaft Pulley (2200 cc model)
(5) Crankshaft pulley (2500 cc model)
(6) Belt cover (LH)
(7) Front belt cover (2500 cc model)

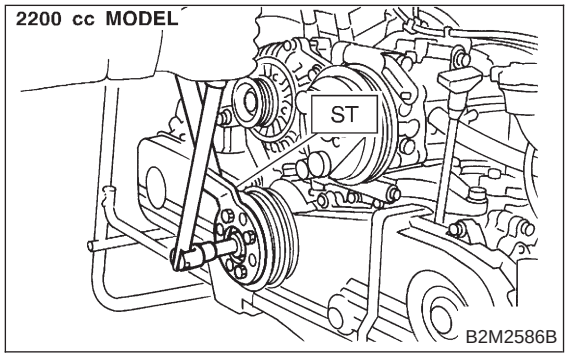
1) Remove A/C belt. (With A/C model)

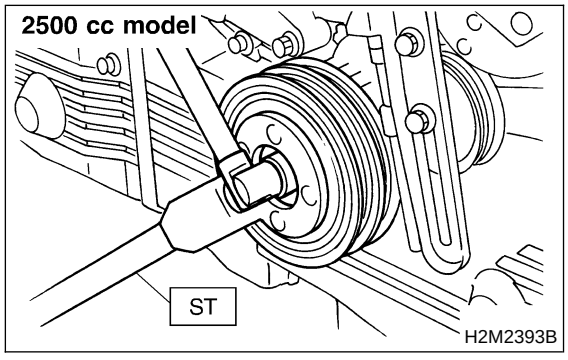


2) Remove A/C belt tensioner. (With A/C model)

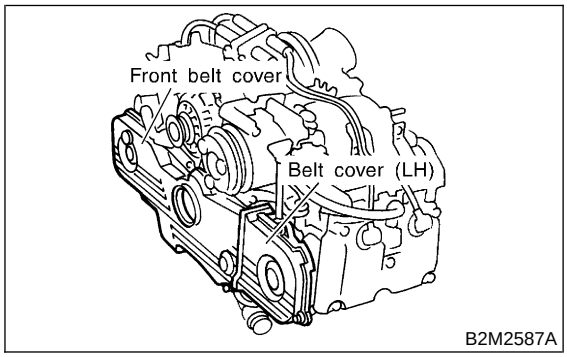


3) Remove crankshaft pulley bolt. To lock crankshaft, use ST.
ST 499977000 (2200 cc model)
ST 499977100 (2500 cc model)
CRANKSHAFT PULLEY WRENCH

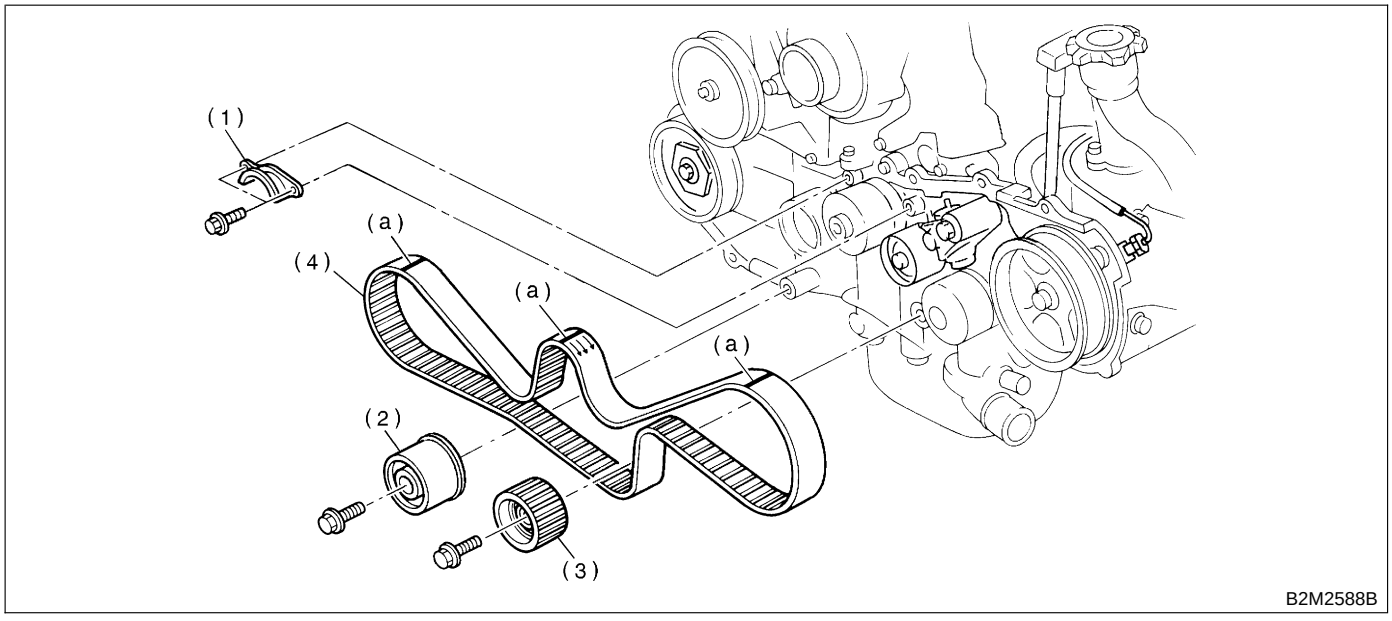




4) Remove crankshaft pulley.
5) Remove belt cover (LH).
6) Remove front belt cover.

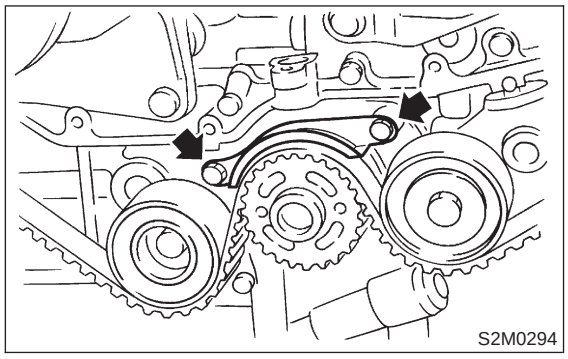


2. TIMING BELT

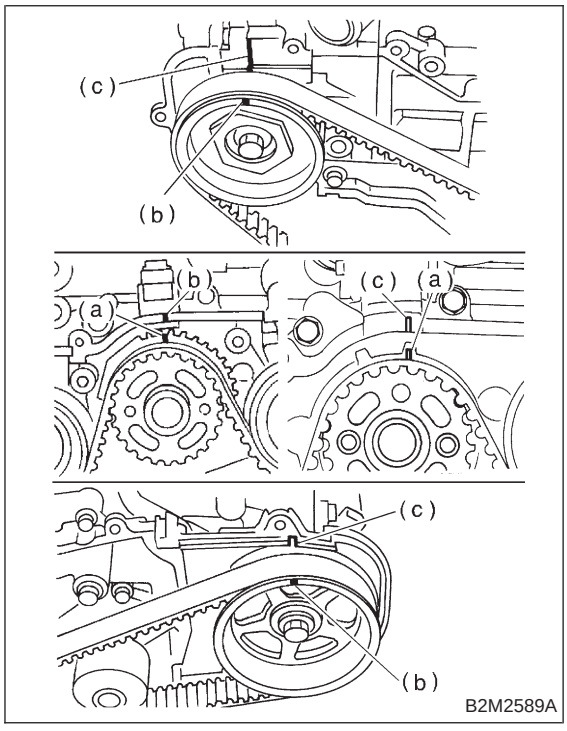


(a) Alignment mark
(1) Timing belt guide (MT vehicles only)
(2) Belt idler (No. 2)
(3) Belt idler No. 2
(4) Timing belt

1) Remove timing belt guide. (MT vehicles only)

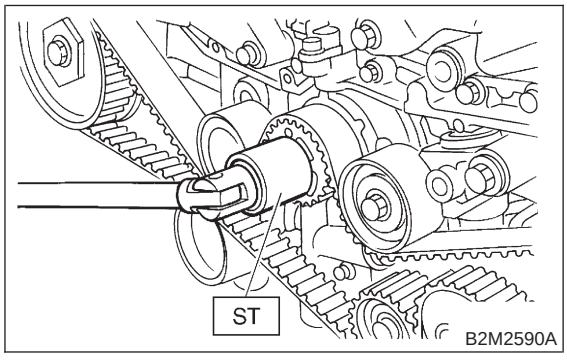


2) If alignment mark (a) and/or arrow mark (which indicates rotation direction) on timing belt fade away, put new marks before removing timing belt as shown in figure:

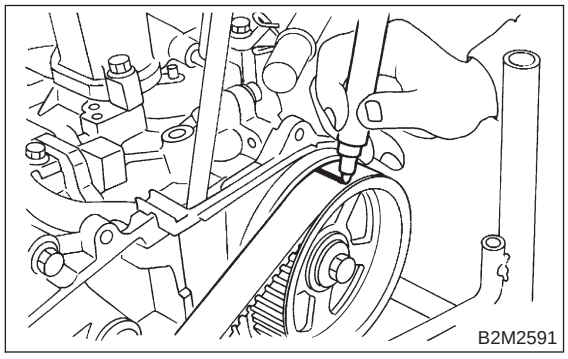


(1) Turn crankshaft using ST, and align alignment marks (c) on crankshaft sprocket, and left side camshaft sprocket with notch (c) of belt cover, and align the right side camshaft sprocket with notch (c) on the mating surface of camshaft cap and cylinder head.

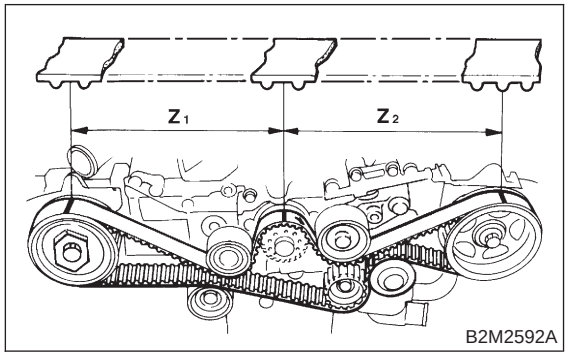
ST 499987500 CRANKSHAFT SOCKET



(2) Using white paint, put alignment and/or arrow marks on timing belts in relation to the sprockets.

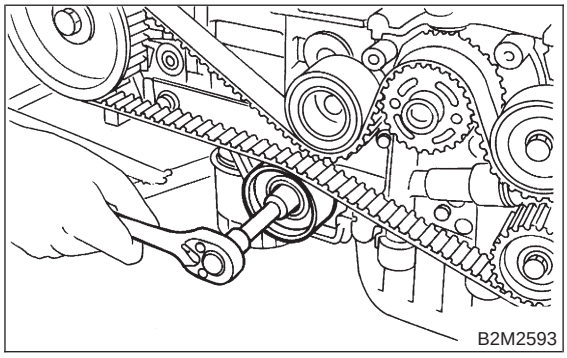

B2M2591

Specified data:
Z_1: 44 tooth length
Z_2: 40.5 tooth

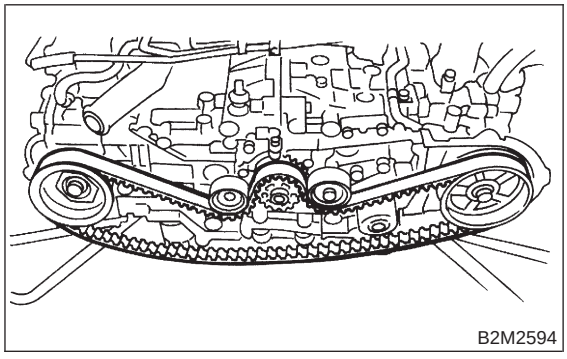


B2M2592A

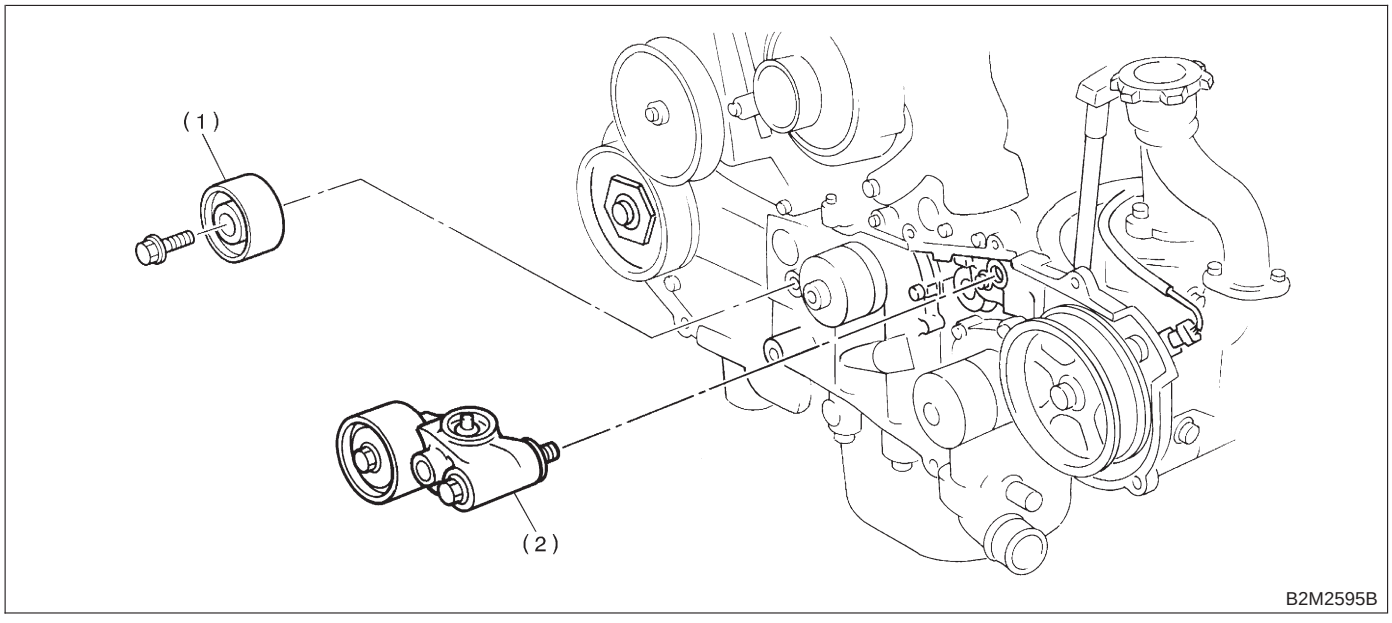
3) Remove belt idler (No. 2).
4) Remove belt idler No. 2.


B2M2593

5) Remove timing belt.


B2M2594

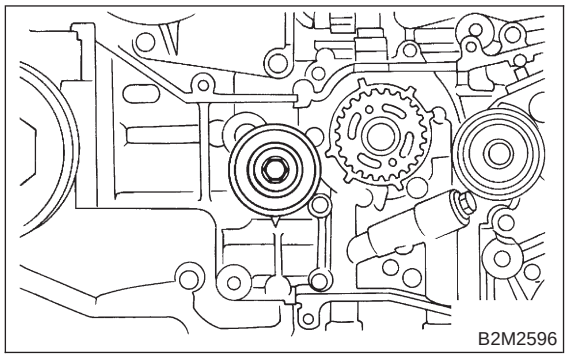
3. BELT IDLER AND AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY



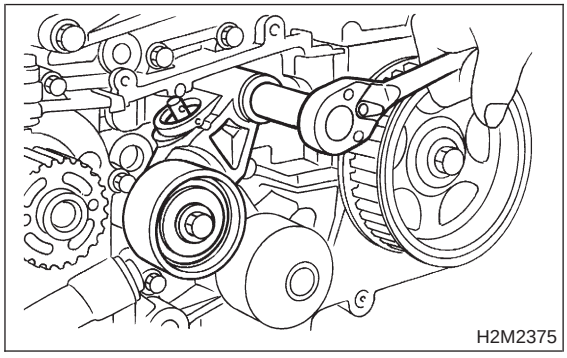
B2M2595B

(1) Belt idler (No. 1)
(2) Automatic belt tension adjuster ASSY

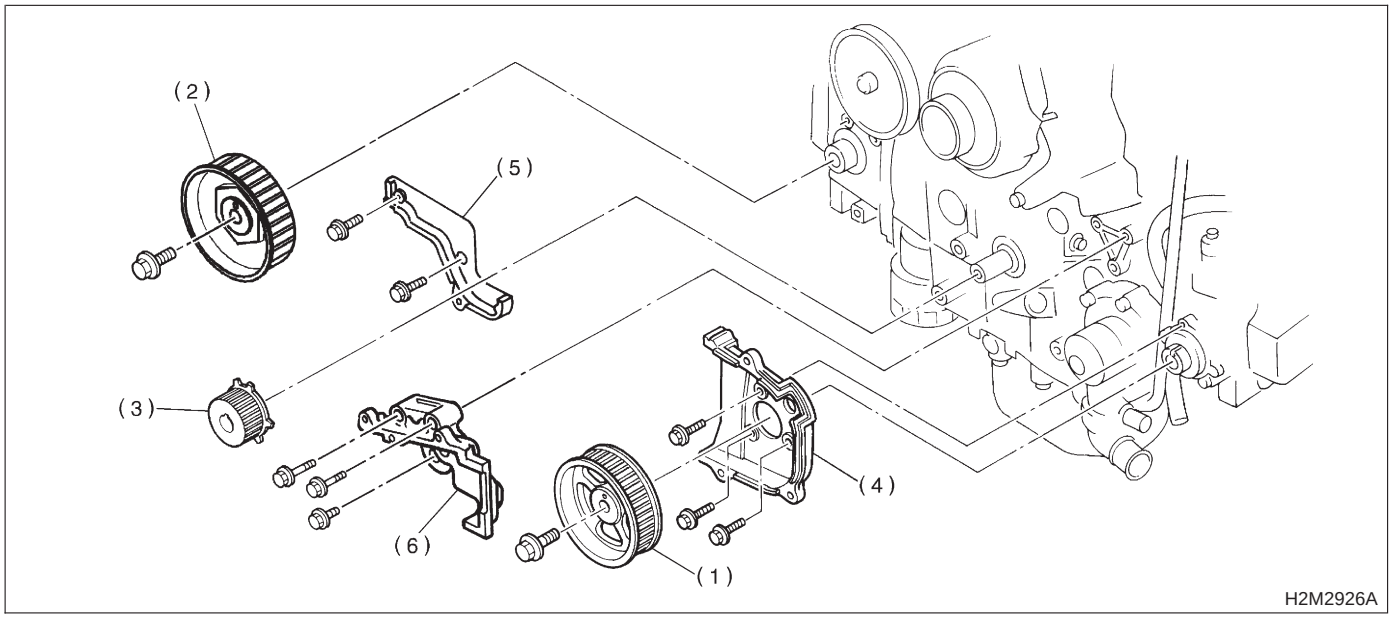
1) Remove belt idler (No. 1).



2) Remove automatic belt tension adjuster assembly.

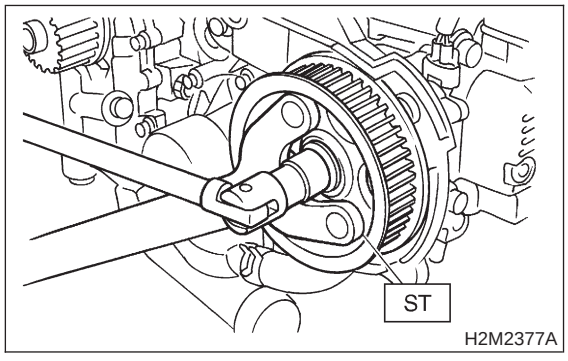


4. CAMSHAFT AND CRANKSHAFT SPROCKET

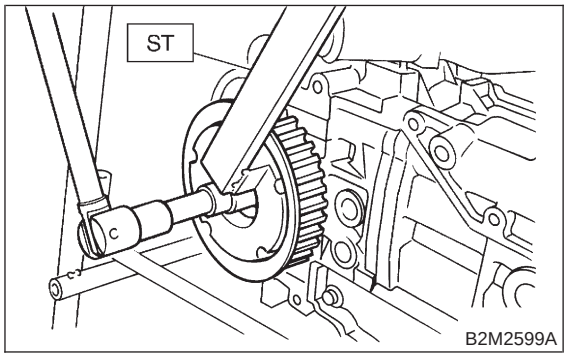


(1) Camshaft sprocket No. 2
(2) Camshaft sprocket No. 1
(3) Crankshaft sprocket (California spec. vehicles)
(4) Belt cover No. 2 (LH)
(5) Belt cover No. 2 (RH)
(6) Tensioner bracket

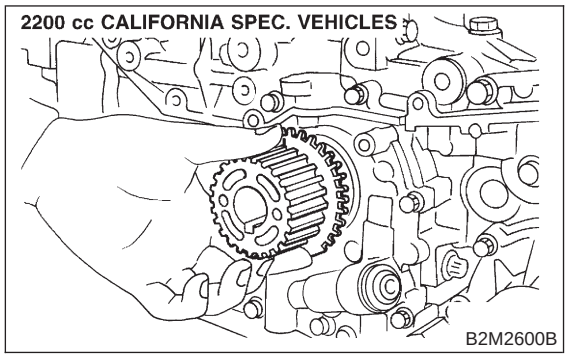
1) Remove camshaft sprocket No. 2. To lock camshaft, use ST.
ST 499207100 CAMSHAFT SPROCKET WRENCH

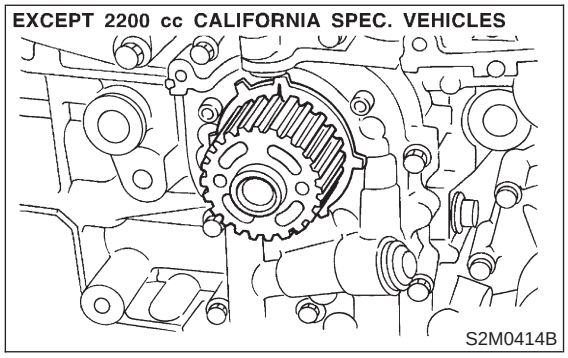


2) Remove camshaft sprocket No. 1. To lock camshaft, use ST.
ST 499207400 CAMSHAFT SPROCKET WRENCH



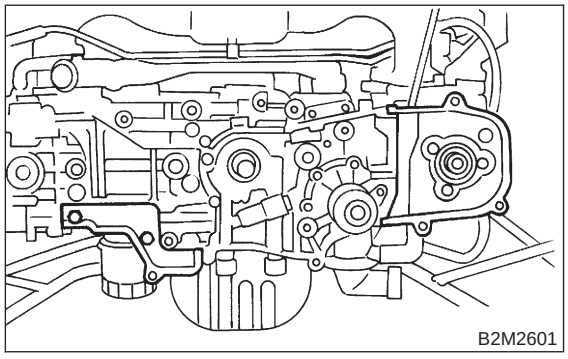
3) Remove crankshaft sprocket.



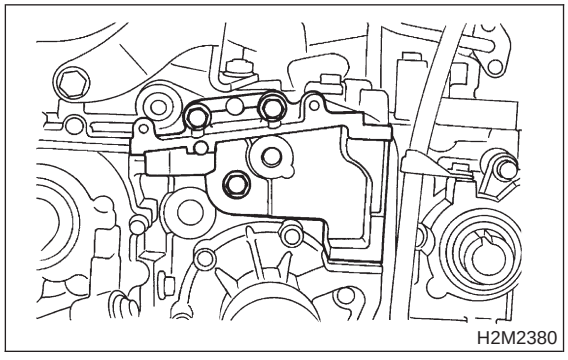


4) Remove belt cover No. 2 (LH).
5) Remove belt cover No. 2 (RH).

CAUTION:
Do not damage or lose the seal rubber when removing belt covers.



6) Remove tensioner bracket.



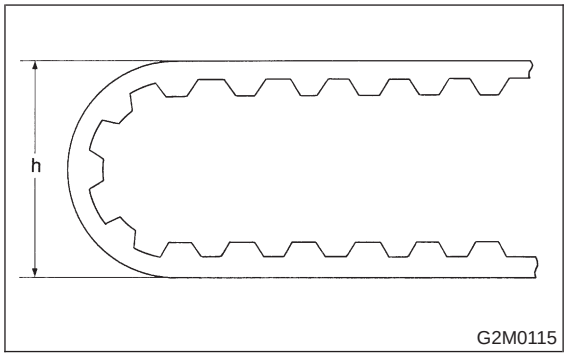
B: INSPECTION

1. TIMING BELT

1) Check timing belt teeth for breaks, cracks, and wear. If any fault is found, replace belt.
2) Check the condition of back side of belt; if any crack is found, replace belt.

CAUTION:
- **Be careful not to let oil, grease or coolant contact the belt. Remove quickly and thoroughly if this happens.**
- **Do not bend the belt sharply.**

Bending radius: h
60 mm (2.36 in) or more



2. AUTOMATIC BELT TENSION ADJUSTER

1) Visually check oil seals for leaks, and rod ends for abnormal wear or scratches. If necessary, replace faulty parts.

CAUTION:
Slight traces of oil at rod's oil seal does not indicate a problem.

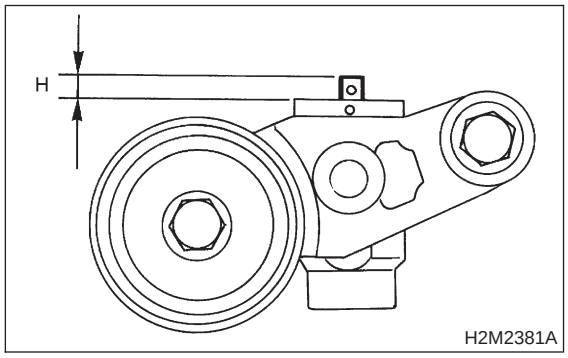
2) Check that the adjuster rod does not move when a pressure of 294 N (30 kg, 66 lb) is applied to it. This is to check adjuster rod stiffness.
3) If the adjuster rod is not stiff and moves freely when applying 294 N (30 kg, 66 lb), check it using the following procedures:
(1) Slowly press the adjuster rod down to the end surface of the cylinder. Repeat this motion 2 or 3 times.
(2) With the adjuster rod moved all the way up, apply a pressure of 294 N (30 kg, 66 lb) to it. Check adjuster rod stiffness.
(3) If the adjuster rod is not stiff and moves down, replace the automatic belt tension adjuster assembly with a new one.

CAUTION:
- **Always use a vertical type pressing tool to move the adjuster rod down.**
- **Do not use a lateral type vise.**
- **Push adjuster rod vertically.**

● Press-in the push adjuster rod gradually taking more than three minutes.
● Do not allow press pressure to exceed 9,807 N (1,000 kg, 2,205 lb).
● Press the adjuster rod as far as the end surface of the cylinder. Do not press the adjuster rod into the cylinder. Doing so may damage the cylinder.

4) Measure the extension of rod beyond the body. If it is not within specifications, replace with a new one.

Rod extension: H
5.7±0.5 mm (0.224±0.020 in)



3. BELT TENSION PULLEY

1) Check mating surfaces of timing belt and contact point of adjuster rod for abnormal wear or scratches. Replace automatic belt tension adjuster assembly if faulty.
2) Check tension pulley for smooth rotation. Replace if noise or excessive play is noted.
3) Check tension pulley for grease leakage.

4. BELT IDLER

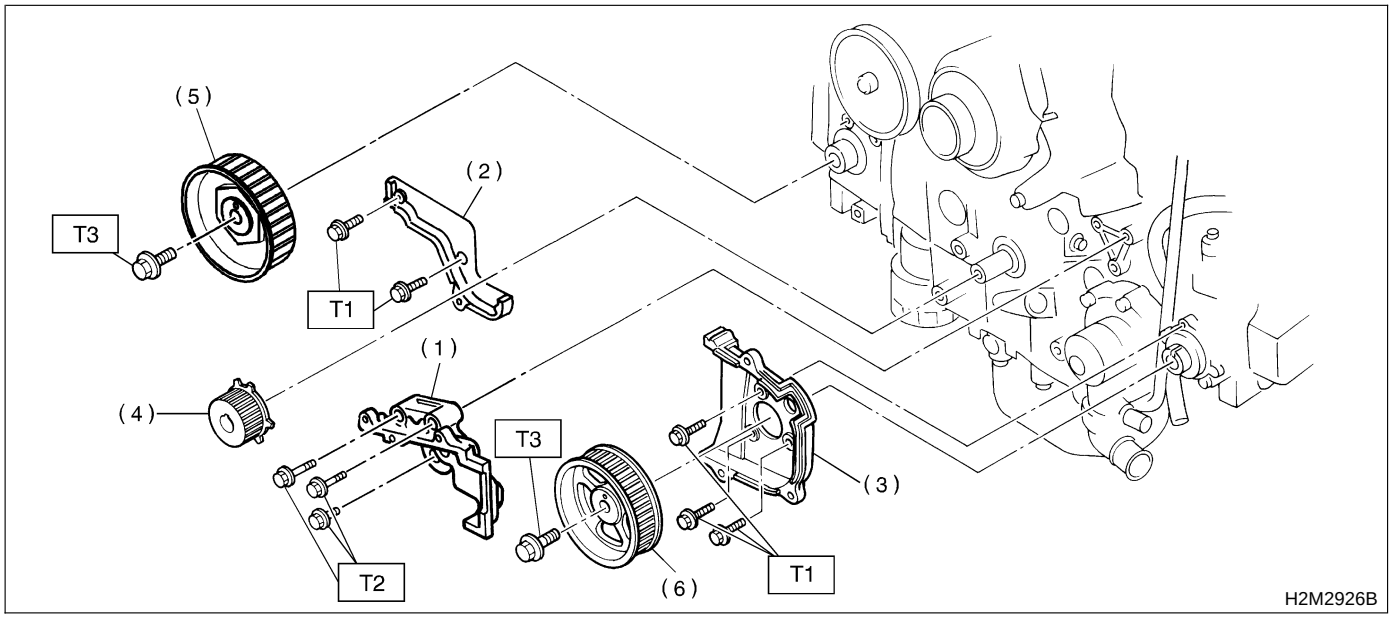
1) Check belt idler for smooth rotation. Replace if noise or excessive play is noted.
2) Check belt outer contacting surfaces of idler pulley for abnormal wear and scratches.
3) Check belt idler for grease leakage.

5. CAMSHAFT AND CRANKSHAFT SPROCKET

1) Check sprocket teeth for abnormal wear and scratches.
2) Make sure there is no free play between sprocket and key.
3) Check crankshaft sprocket notch for sensor for damage and contamination of foreign matter.

C: INSTALLATION

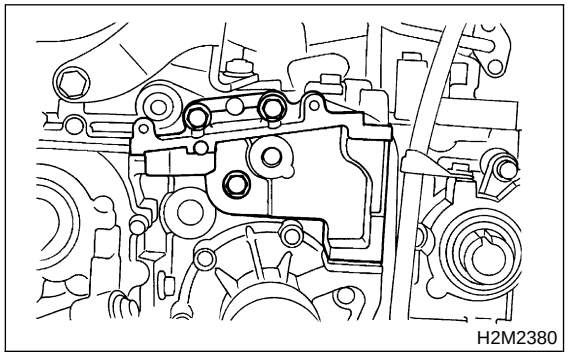
1. CAMSHAFT AND CRANKSHAFT SPROCKET



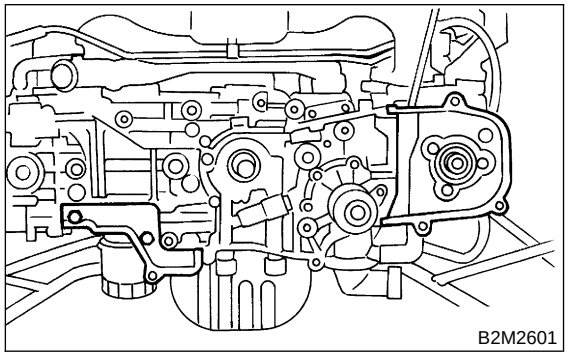
(1) Tensioner bracket
(2) Belt cover No. 2 (RH)
(3) Belt cover No. 2 (LH)
(4) Crankshaft sprocket
(5) Camshaft sprocket No. 1
(6) Camshaft sprocket No. 2

Tightening torque: N·m (kg-m, ft-lb)
T1: 5±1 (0.5±0.1, 3.6±0.7)
T2: 25±3 (2.5±0.3, 18.1±2.2)
T3: 78±5 (8.0±0.5, 57.9±3.6)

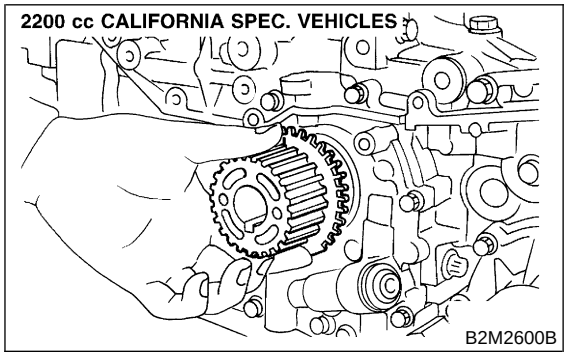
1) Install tensioner bracket.

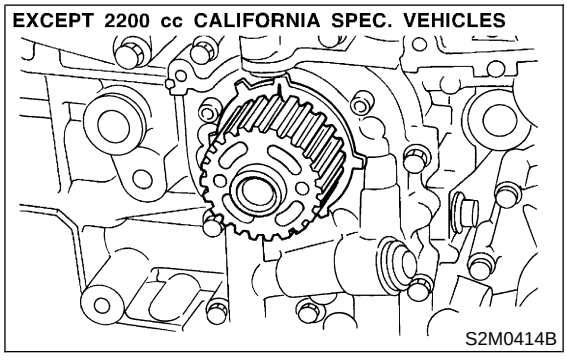


2) Install belt cover No. 2 (RH).
3) Install belt cover No. 2 (LH).

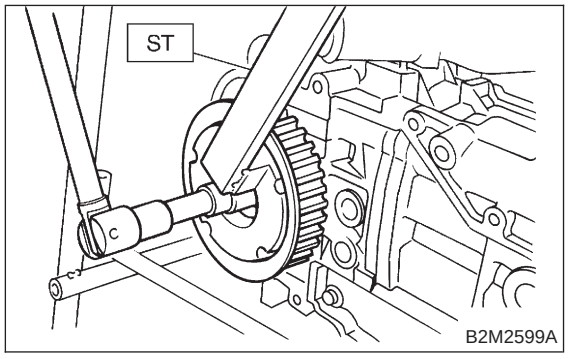


4) Install crankshaft sprocket.



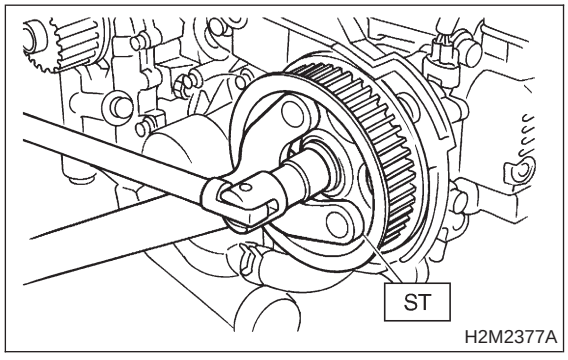


5) Install camshaft sprocket No. 1. To lock camshaft, use ST.
ST 499207400 CAMSHAFT SPROCKET WRENCH

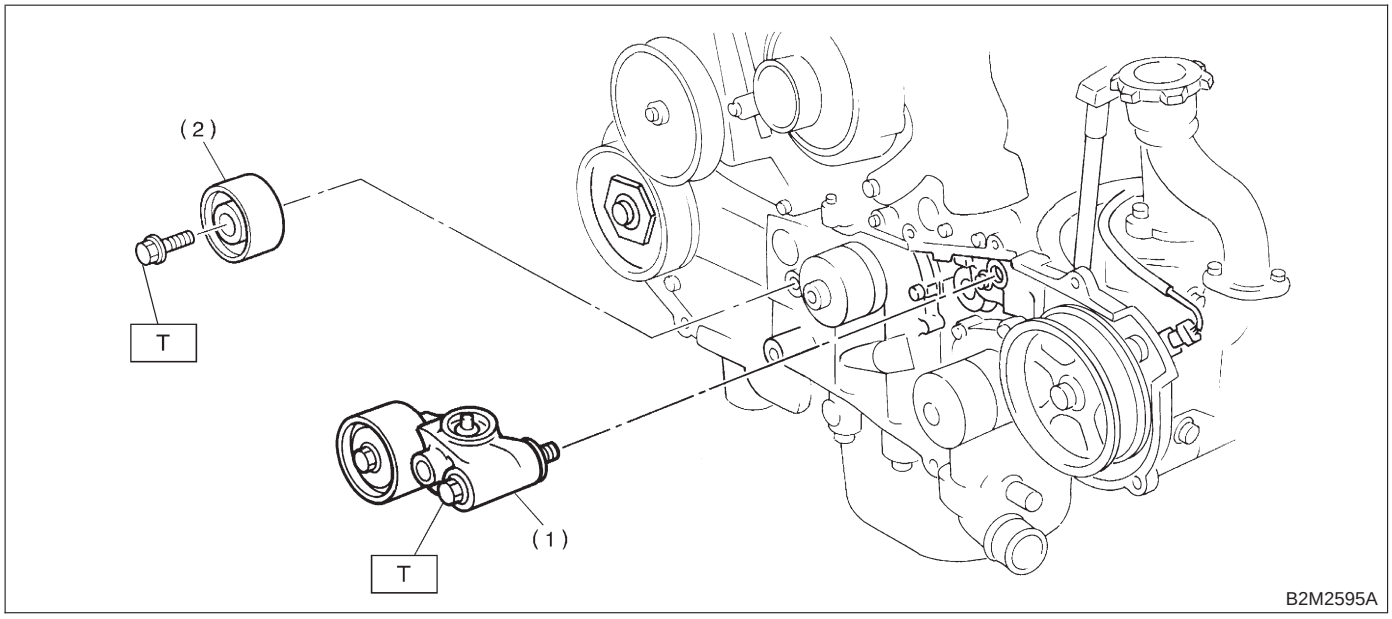


6) Install camshaft sprocket No. 2. To lock camshaft, use ST.
ST 499207100 CAMSHAFT SPROCKET WRENCH

CAUTION:
Do not confuse left and right side camshaft sprockets during installation. The camshaft sprocket No. 2 is identified by a projection used to monitor camshaft position sensor.



2. AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER



(1) Automatic belt tension adjuster ASSY
(2) Belt idler (No. 1)

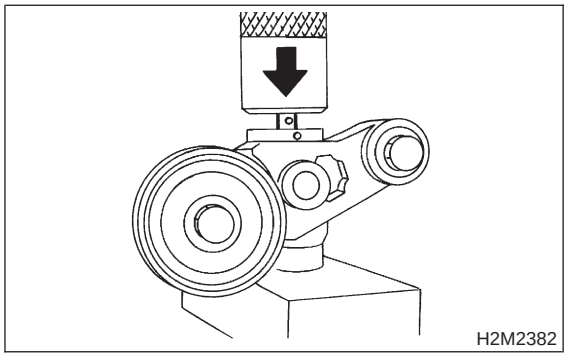
Tightening torque: N·m (kg-m, ft-lb)
T: 39±4 (4.0±0.4, 28.9±2.9)

1) Preparation for installation of automatic belt tension adjuster assembly;

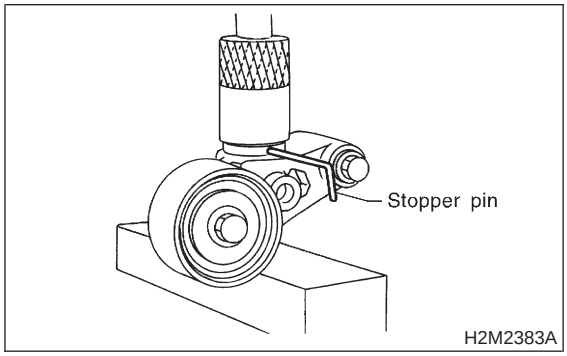
CAUTION:
- **Always use a vertical type pressing tool to move the adjuster rod down.**
- **Do not use a lateral type vise.**
- **Push adjuster rod vertically.**
- **Be sure to slowly move the adjuster rod down applying a pressure of 294 N (30 kg, 66 lb).**
- **Press-in the push adjuster rod gradually taking more than three minutes.**
- **Do not allow press pressure to exceed 9,807 N (1,000 kg, 2,205 lb).**
- **Press the adjuster rod as far as the end surface of the cylinder. Do not press the adjuster rod into the cylinder. Doing so may damage the cylinder.**
- **Do not release press pressure until stopper pin is completely inserted.**

(1) Attach the automatic belt tension adjuster assembly to the vertical pressing tool.

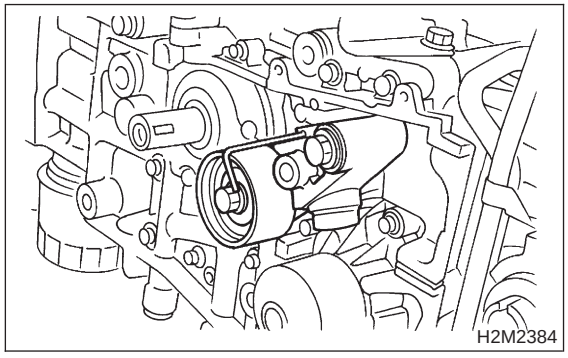
(2) Slowly move the adjuster rod down with a pressure of 294 N (30 kg, 66 lb) until the adjuster rod is aligned with the stopper pin hole in the cylinder.



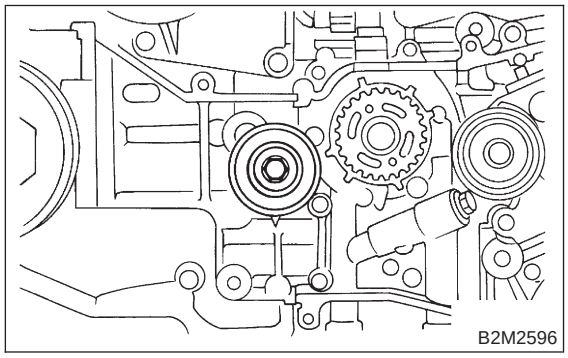
(3) With a 2 mm (0.08 in) dia. stopper pin or a 2 mm (0.08 in) (nominal) dia. hex bar wrench inserted into the stopper pin hole in the cylinder, secure the adjuster rod.



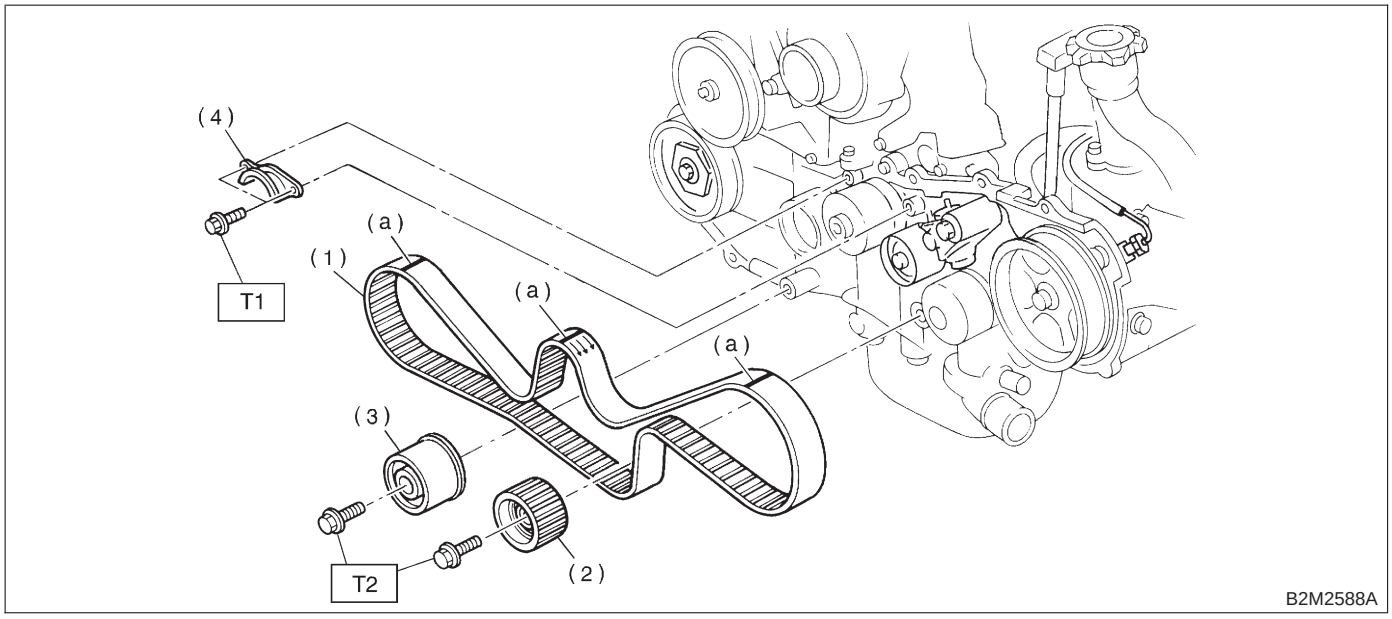
2) Install automatic belt tension adjuster assembly.



3) Install belt idler (No. 1).



3. TIMING BELT

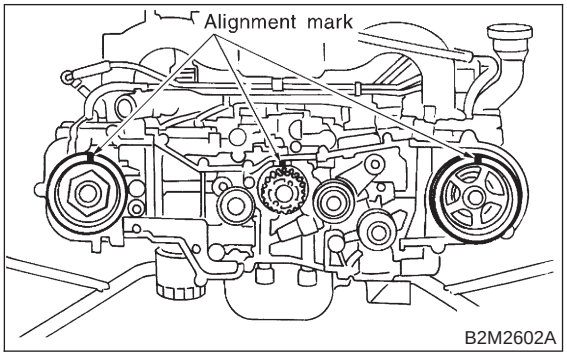


(a) Alignment mark
(1) Timing belt
(2) Belt idler No. 2
(3) Belt idler (No. 2)
(4) Timing belt guide (MT vehicles only)

Tightening torque: N·m (kg-m, ft-lb)
T1: 9.8±1.0 (1.0±0.1, 7.2±0.7)
T2: 39±4 (4.0±0.4, 28.9±2.9)

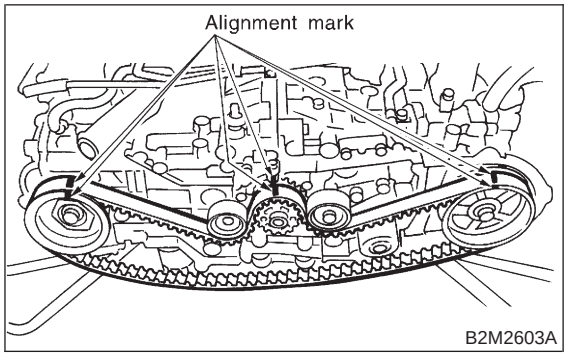
1) Installation of timing belt
(1) Turn camshaft sprocket No. 2 using ST1, and turn camshaft sprocket No. 1 using ST2 so that their alignment marks come to top positions.

ST1 499207100 CAMSHAFT SPROCKET WRENCH
ST2 499207400 CAMSHAFT SPROCKET WRENCH



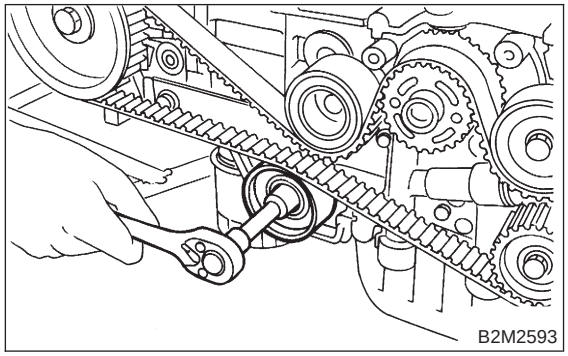
(2) While aligning alignment mark on timing belt with marks on sprockets, position timing belt properly.

CAUTION:
Ensure belt's rotating direction is correct.



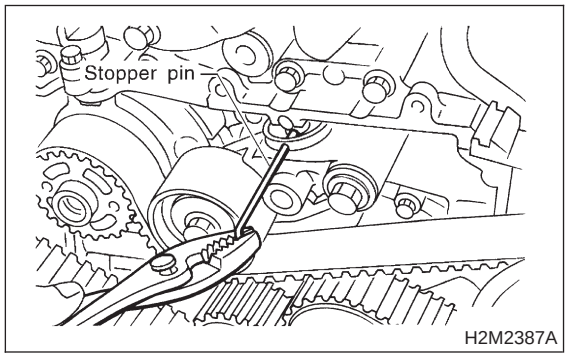
2) Install belt idler No. 2.

3) Install belt idler (No. 2).

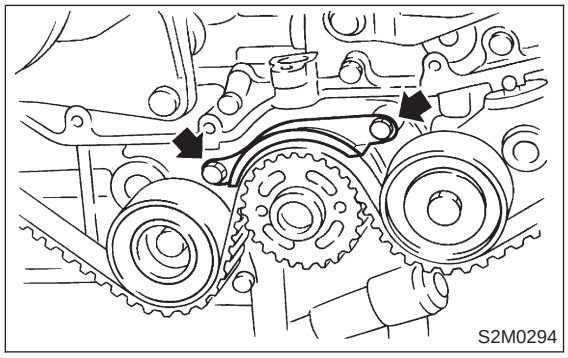


4) After ensuring that the marks on timing belt and camshaft sprockets are aligned, remove stopper pin from belt tensioner adjuster.

CAUTION:
After properly installing timing belt, remove rocker cover and ensure that the valve lash adjuster contains no air.

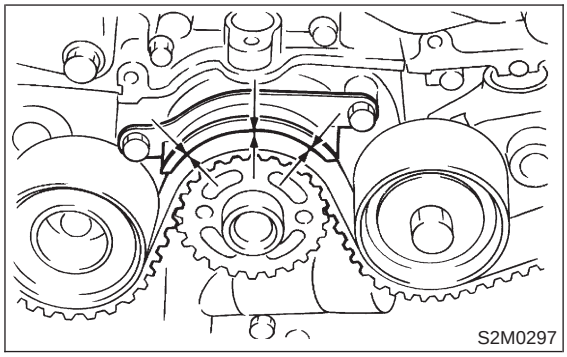


5) Install timing belt guide. (MT vehicles only)
(1) Temporarily tighten remaining bolts.

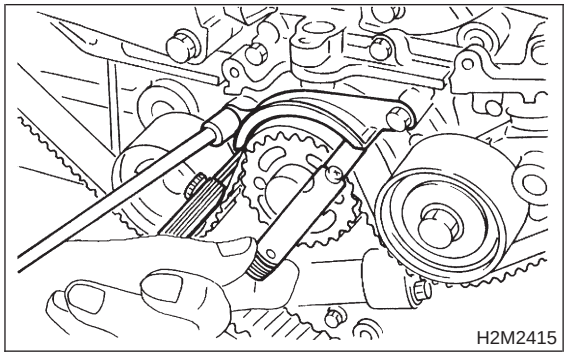


(2) Check and adjust clearance between timing belt and timing belt guide.

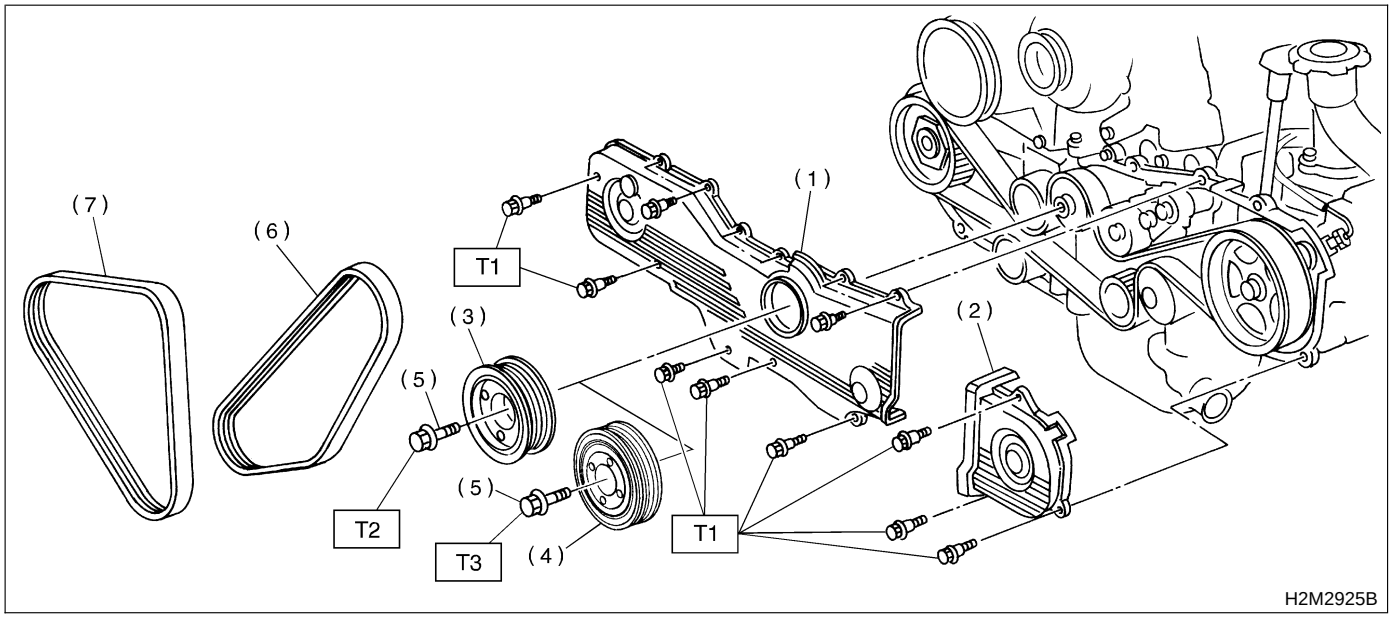
Clearance:
1.0±0.5 mm (0.039±0.020 in)



(3) Tighten remaining bolts.



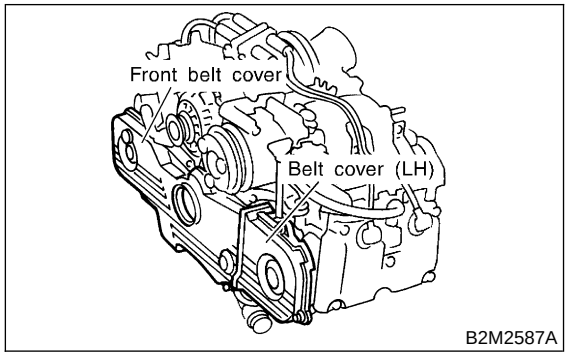
4. CRANKSHAFT PULLEY AND BELT COVER



(1) Front belt cover
(2) Belt cover (LH)
(3) Crankshaft pulley (2200 cc model)
(4) Crankshaft pulley (2500 cc model)
(5) Crankshaft pulley bolt
(6) Rear side V-belt (With A/C model)
(7) Front side V-belt

Tightening torque: N·m (kg-m, ft-lb)
T1: 5±1 (0.5±0.1, 3.6±0.7)
T2: 127±5 (13.0±0.5, 94±3.6)
T3: 177±5 (18.0±0.5, 130.2±3.6)

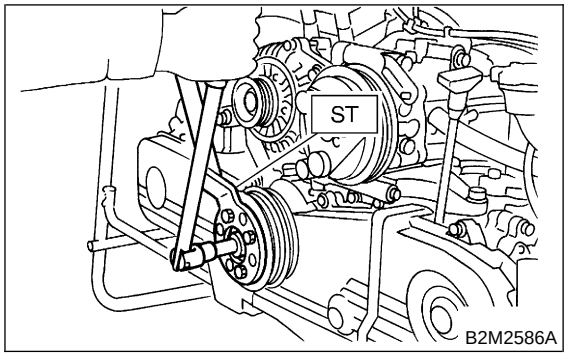
1) Install front belt cover.
2) Install belt cover (LH).



3) Install crankshaft pulley.

4) Install pulley bolt. (2200 cc model)
To lock crankshaft, use ST.
ST 499977000 CRANKSHAFT PULLEY WRENCH
(1) Clean the crankshaft pulley thread using an air gun.
(2) Apply engine oil to the crankshaft pulley bolt seat and thread.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kg-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts.

Tightening torque:
127±5 N·m (13.0±0.5 kg-m, 94.0±3.6 ft-lb)



5) Confirm that the tightening angle of the crankshaft pulley bolt is 45 degrees or more. If not, conduct the following procedures (1) through (4).

(1) Replace the crankshaft pulley bolts and clean them.

Crankshaft pulley bolt:
12369AA011

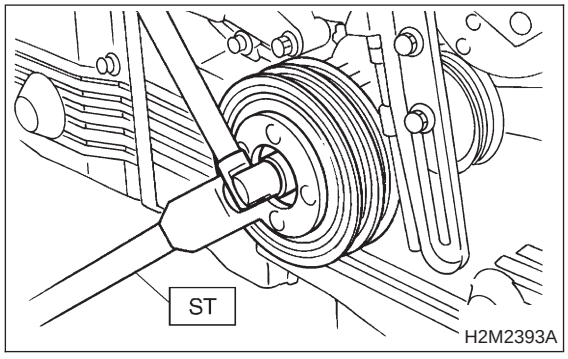
(2) Clean the crankshaft thread using an air gun.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kg-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts keeping them in an angle between 45 degrees and 60 degrees.

CAUTION:
Conduct the tightening procedures by confirming the turning angle of the crankshaft pulley bolt referring to the gauge indicated on the belt cover.

6) Install pulley bolt. (2500 cc model)
To lock crankshaft, use ST.
ST 499977100 CRANKSHAFT PULLEY WRENCH

(1) Clean the crankshaft pulley thread using an air gun.
(2) Apply engine oil to the crankshaft pulley bolt seat and thread.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kg-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts.

Tightening torque:
177±5 N·m (18.0±0.5 kg-m, 130.2±3.6 ft-lb)



7) Confirm that the tightening angle of the crankshaft pulley bolt is 65 degrees or more. If not, conduct the following procedures (1) through (4).

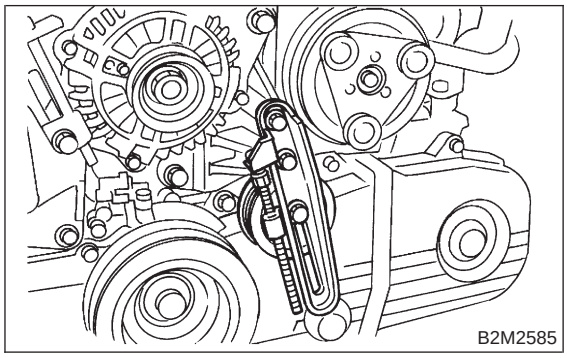
(1) Replace the crankshaft pulley bolts and clean them.

Crankshaft pulley bolt:
12369AA011

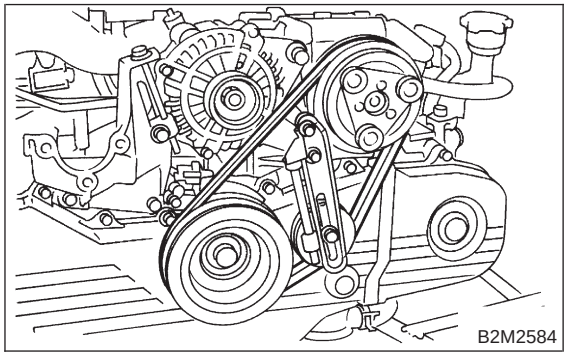
(2) Clean the crankshaft thread using an air gun.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kg-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts keeping them in an angle between 65 degrees and 75 degrees.

CAUTION:
Conduct the tightening procedures by confirming the turning angle of the crankshaft pulley bolt referring to the gauge indicated on the belt cover.

8) Install A/C belt tensioner. (With A/C model)

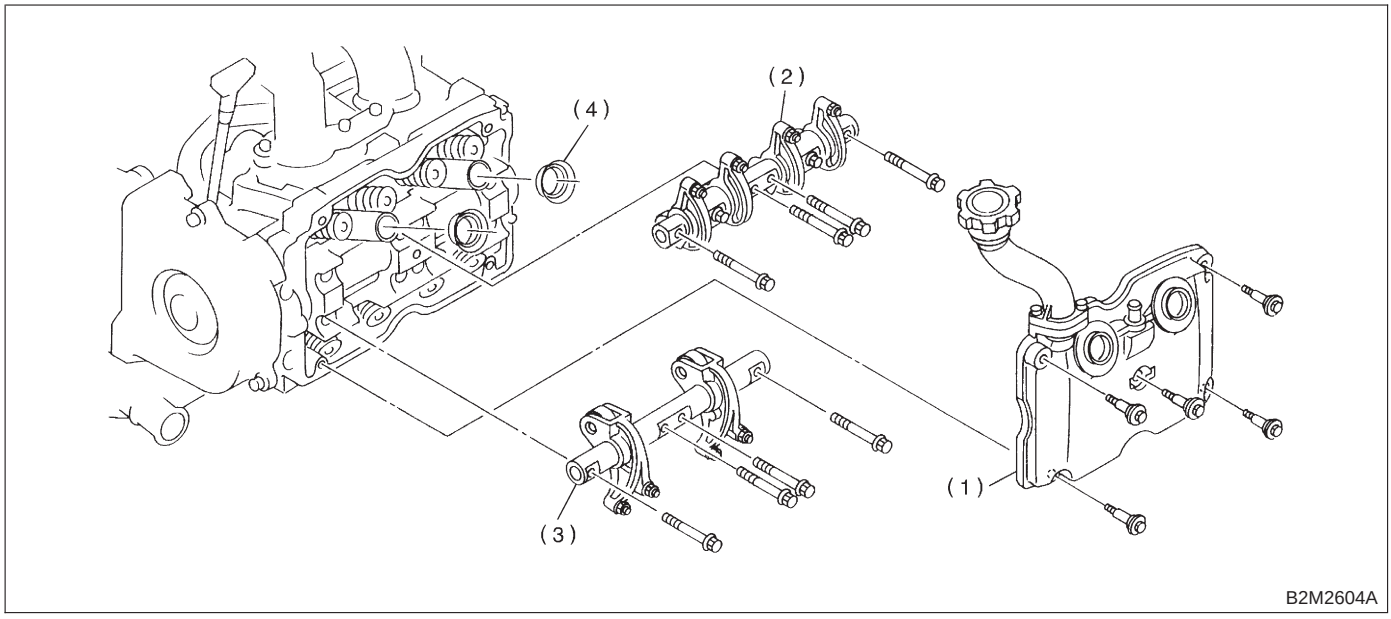


9) Install A/C belt. (With A/C model)



3. Valve Rocker Assembly

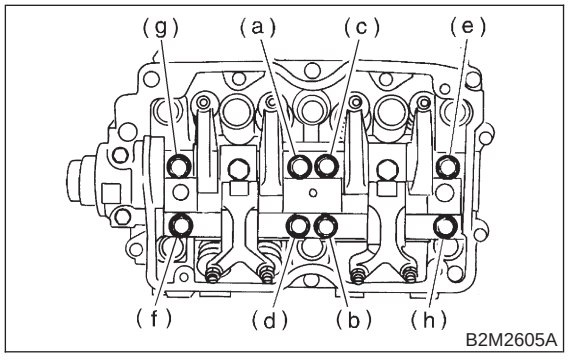
A: REMOVAL



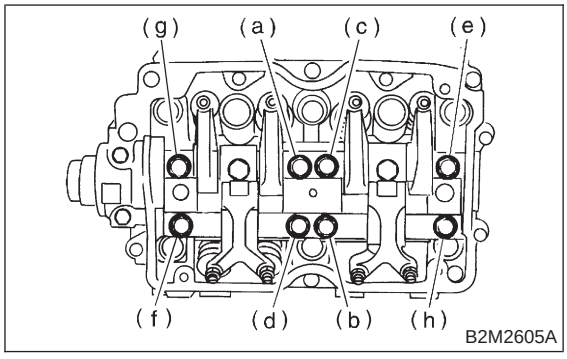
(1) Rocker cover
(2) Intake valve rocker ASSY
(3) Exhaust valve rocker ASSY
(4) Spark plug pipe gasket

1) Disconnect PCV hose and remove rocker cover.
2) Removal of valve rocker assembly
   (1) Remove bolts (a) through (b) in alphabetical sequence.

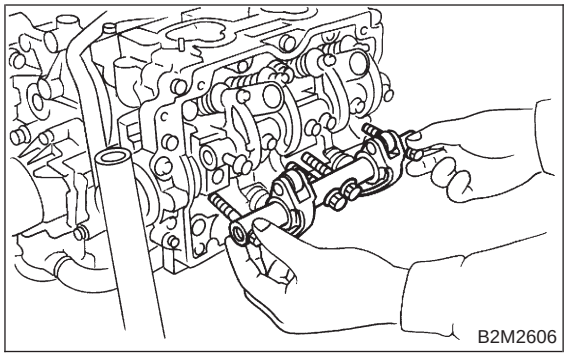
CAUTION:
Leave two or three threads of bolt (a) engaged to retain valve rocker assembly.



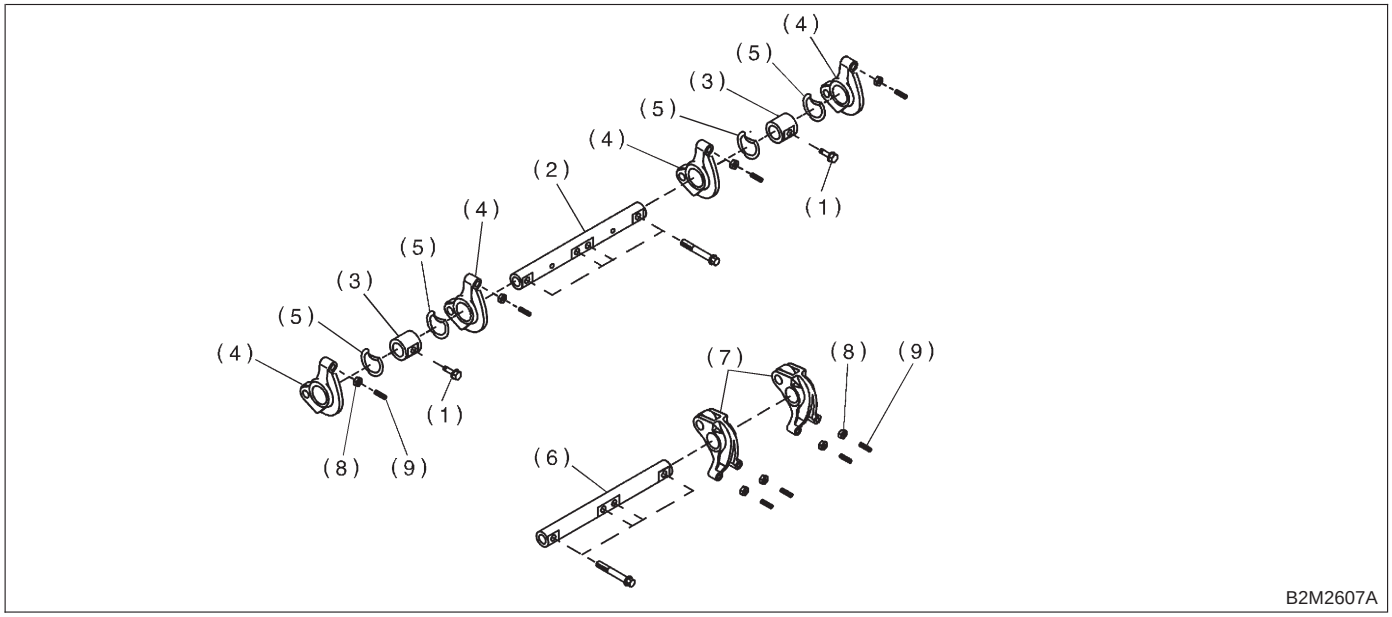
(2) Equally loosen bolts (e) through (h) all the way, being careful that knock pin is not gouged.



(3) Remove valve rocker assembly.



B: DISASSEMBLY



(1) Bolt
(2) Intake valve rocker shaft
(3) Rocker shaft support
(4) Intake valve rocker arm
(5) Spring
(6) Exhaust valve rocker shaft
(7) Exhaust valve rocker arm
(8) Valve rocker nut
(9) Valve rocker adjust screw

1) Remove bolts which secure rocker shaft.
2) Extract rocker shaft. Remove valve rocker arms, springs, plates and shaft supports from rocker shaft.

CAUTION:
Arrange all removed parts in order so that they can be installed in their original positions.

3) Remove nut and adjuster screw from valve rocker.

C: INSPECTION

1. VALVE ROCKER ARM

1) Measure inside diameter of valve rocker arm and outside diameter of valve rocker shaft, and determine the difference between the two (= oil clearance).

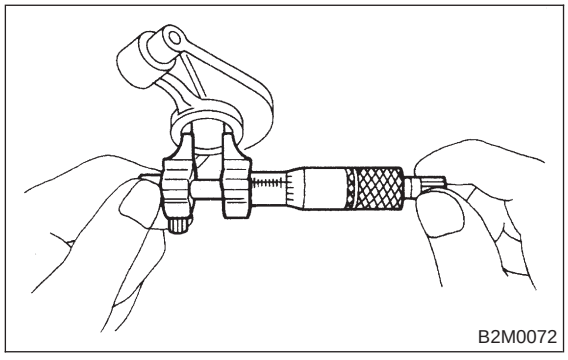
Clearance between arm and shaft:
Standard
0.020 — 0.054 mm (0.0008 — 0.0021 in)
Limit
0.10 mm (0.0039 in)

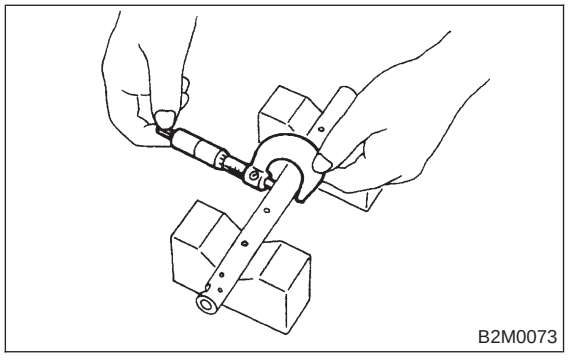
● If oil clearance exceeds specifications, replace valve rocker arm or shaft.

NOTE:
Replace valve rocker arm or shaft, whichever shows greater amount of wear.

Rocker arm inside diameter:
22.020 — 22.041 mm (0.8669 — 0.8678 in)

Rocker shaft diameter:
21.987 — 22.000 mm (0.8656 — 0.8661 in)


B2M0072


B2M0073

2) Measure inside diameter of rocker shaft support and outside diameter of valve rocker shaft, and determine the difference between the two (= oil clearance).

Clearance between support and shaft:
Standard
0.005 — 0.039 mm (0.0002 — 0.0015 in)
Limit
0.05 mm (0.0020 in)

● If oil clearance exceeds specifications, replace rocker shaft support or shaft.

NOTE:
Replace rocker shaft support or shaft, whichever shows greater amount of wear.

Rocker shaft support inside diameter:
22.005 — 22.026 mm (0.8663 — 0.8672 in)

Rocker shaft diameter:
21.987 — 22.000 mm (0.8656 — 0.8661 in)

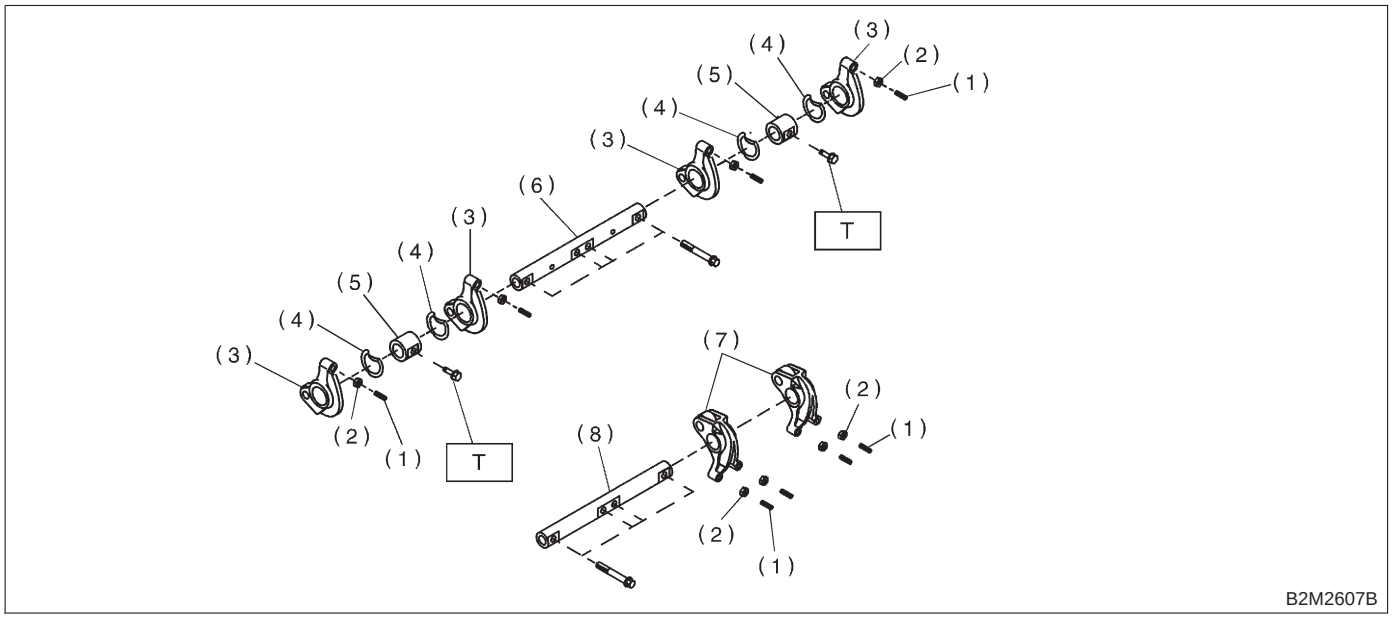
3) If cam or valve contact surface of valve rocker arm is worn or dented excessively, replace valve rocker arm.
4) Check that valve rocker arm roller rotates smoothly. If not, replace valve rocker arm.

2. INTAKE AND EXHAUST VALVE ROCKER SHAFT

Visually check oil relief valve of shaft end for any of the following abnormalities.
● Breaks in check ball body
● Foreign particles caught in valve spring
● Oil leakage at check ball

CAUTION:
Repair or replace valve rocker shaft as necessary.

D: ASSEMBLY



(1) Valve rocker adjust screw
(2) Valve rocker nut
(3) Intake valve rocker arm
(4) Spring
(5) Rocker shaft support
(6) Intake valve rocker shaft
(7) Exhaust valve rocker arm
(8) Exhaust valve rocker shaft

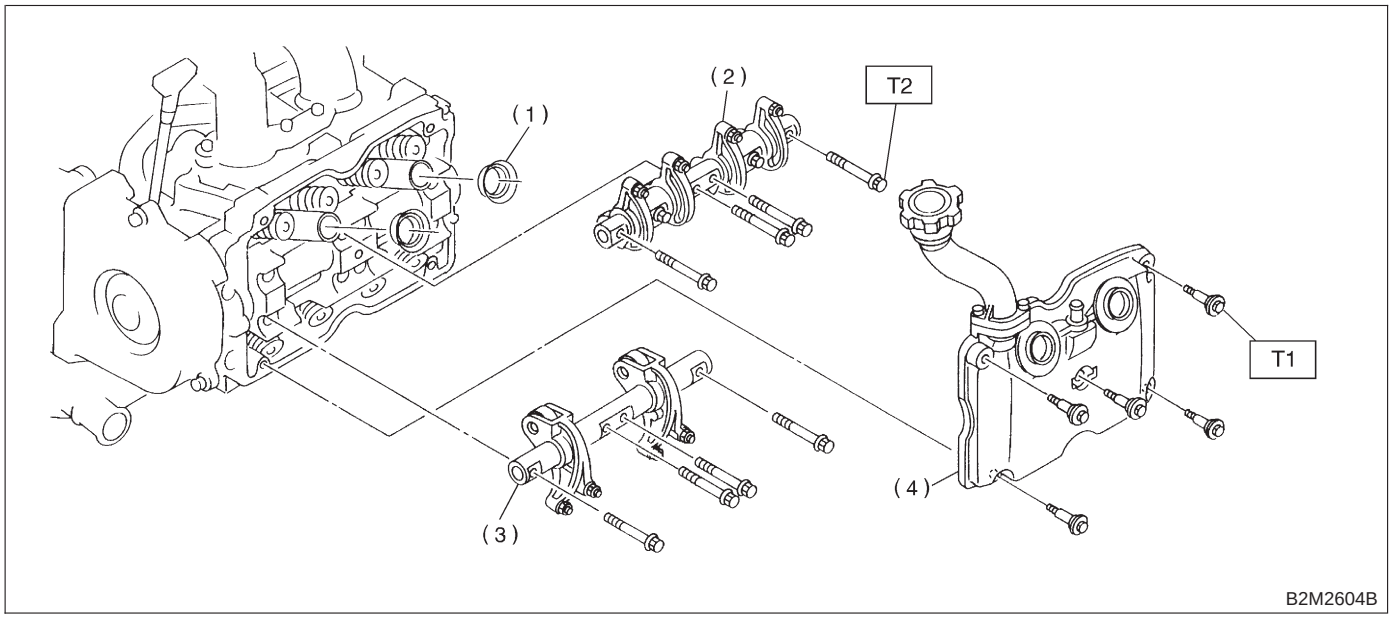
Tightening torque: N·m (kg-m, ft-lb)
T: 5±1 (0.5±0.1, 3.6±0.7)

1) Install adjuster screw and nut to valve rocker.
2) Arrange valve rocker arms, springs and shaft supports in assembly order and insert valve rocker shaft.

CAUTION:
Valve rocker arms, rocker shaft and shaft supports have identification marks. Ensure parts with same markings are properly assembled.

3) Install valve rocker shaft securing bolts.

E: INSTALLATION



(1) Spark plug pipe gasket
(2) Intake valve rocker ASSY
(3) Exhaust valve rocker ASSY
(4) Rocker cover

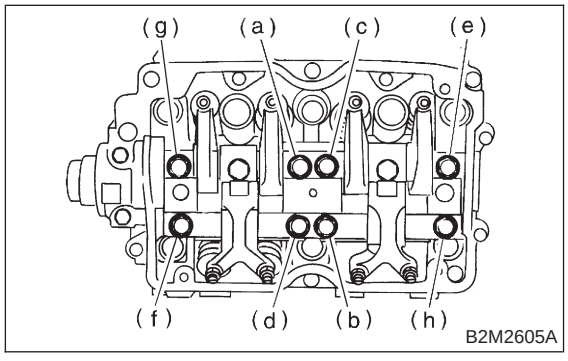
Tightening torque: N·m (kg-m, ft-lb)
T1: 5±1 (0.5±0.1, 3.6±0.7)
T2: 25±2 (2.5±0.2, 18.1±1.4)

1) Installation of valve rocker assembly
(1) Temporarily tighten bolts (a) through (d) equally as shown in figure.

CAUTION:
Do not allow valve rocker assembly to gouge knock pins.

(2) Tighten bolts (e) through (h) to specified torque.
(3) Tighten bolts (a) through (d) to specified torque.

Tightening torque:
25±2 N·m (2.5±0.2 kg-m, 18.1±1.4 ft-lb)



2) Adjust the valve clearances. <Ref. to 2-2 [W7B0].>
3) Install rocker cover and connect PCV hose.

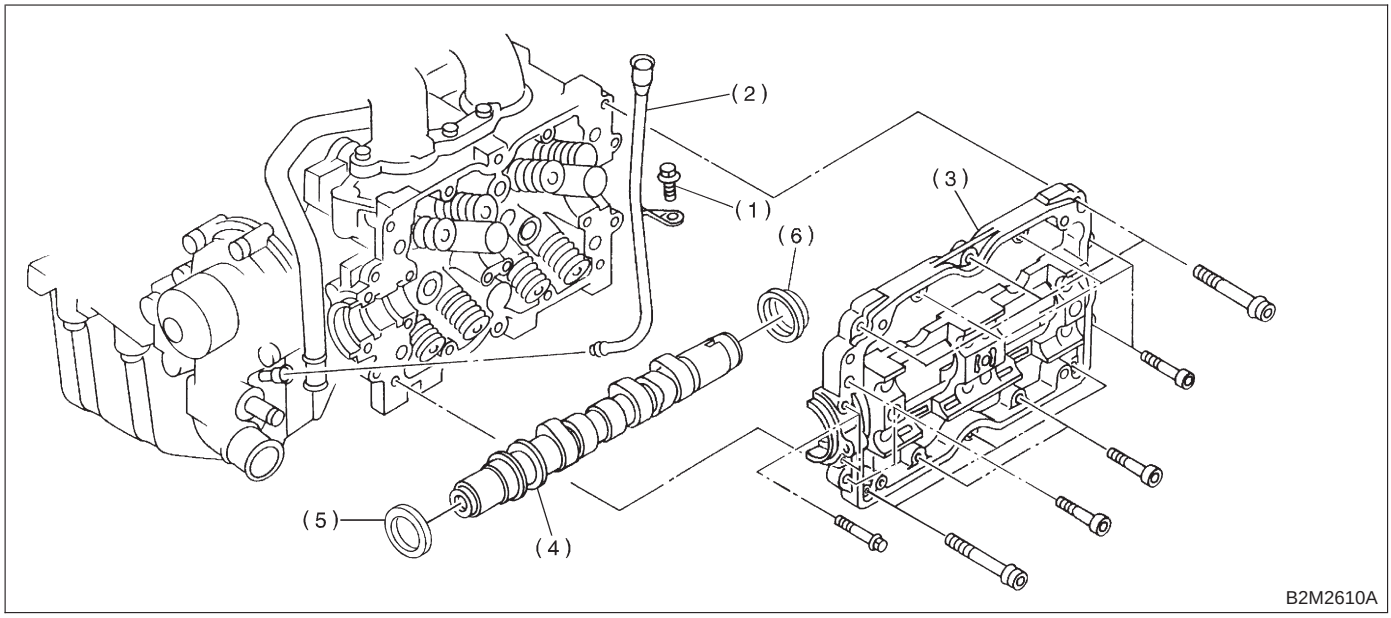
4. Camshaft

A: REMOVAL

1. RELATED PARTS

Remove timing belt, camshaft sprockets and related parts. <Ref. to 2-3 [W2A0].>

2. CAMSHAFT (LH)

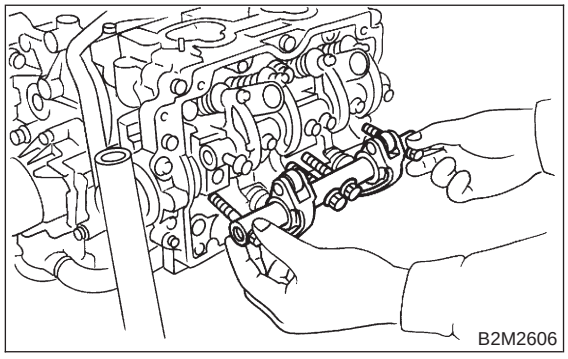


(1) Bolt
(2) Oil level gauge guide
(3) Camshaft cap
(4) Camshaft (LH)
(5) Oil seal
(6) Plug

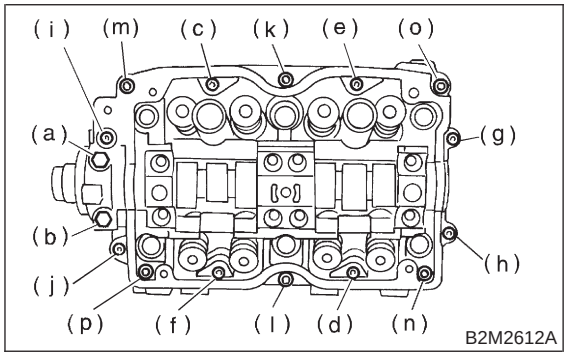
1) Remove camshaft position sensor.

CAUTION:
Do not damage the camshaft position sensor.

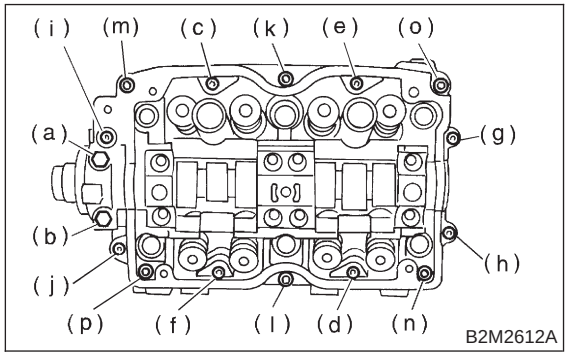
2) Remove oil level gauge guide attaching bolt.
3) Remove oil level gauge guide.
4) Remove camshaft position sensor support.
5) Remove camshaft cap.
   (1) Remove valve rocker assembly.
   <Ref. to 2-3 [W3A0].>



(2) Remove bolts (a) through (b) in alphabetical sequence.

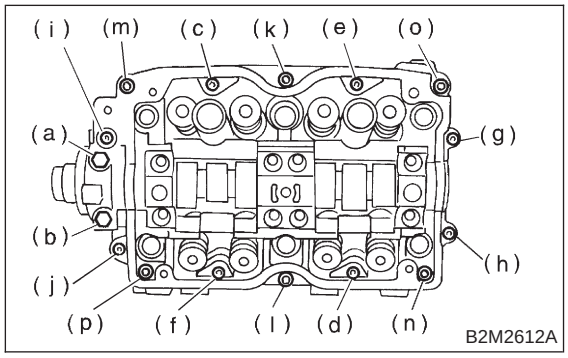


(3) Equally loosen bolts (c) through (j) all the way in alphabetical sequence.

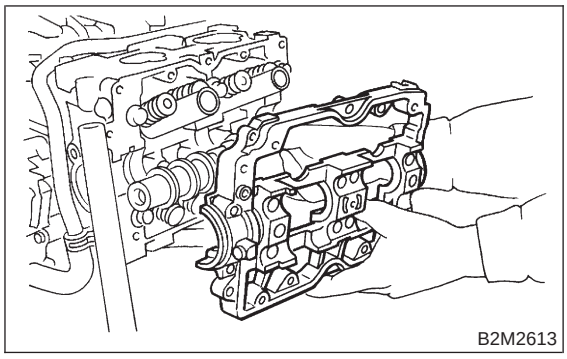


(4) Remove bolts (k) through (p) in alphabetical sequence using ST.

ST 499497000 TORX PLUS



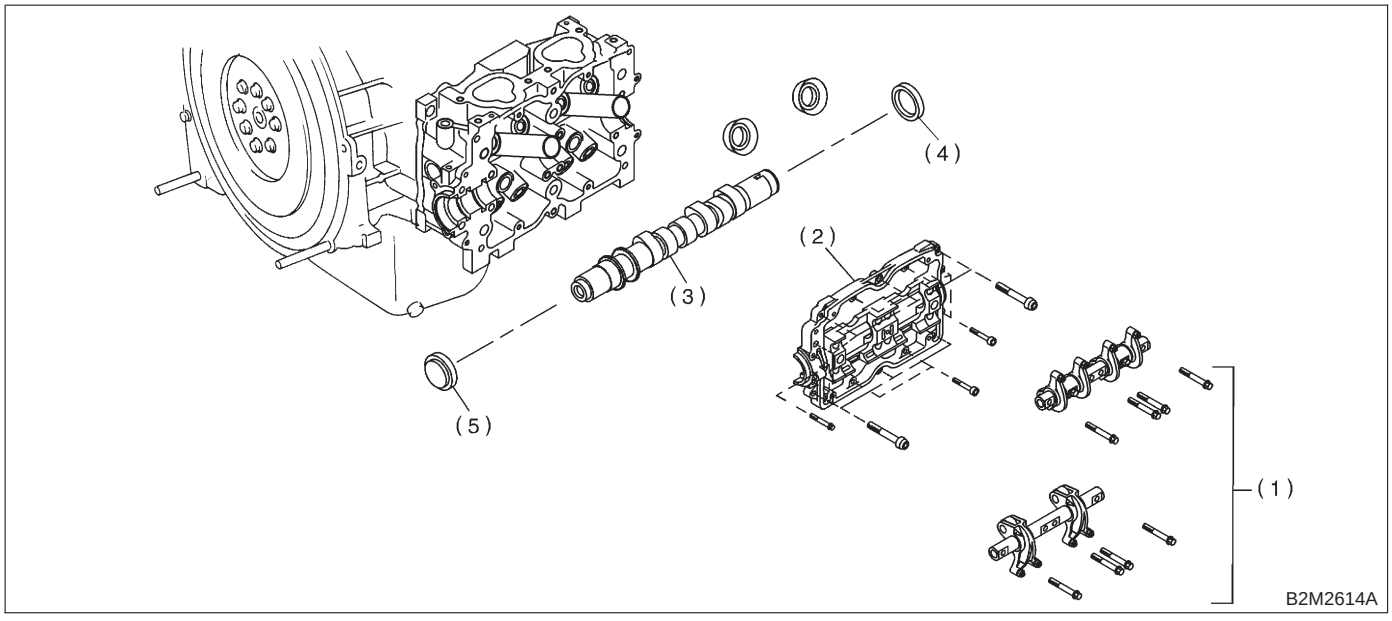
(5) Remove camshaft cap.



6) Remove camshaft (LH).
7) Remove oil seal.
8) Remove plug from rear side of camshaft (LH).

CAUTION:
- **Do not remove oil seal unless necessary.**
- **Do not scratch journal surface when removing oil seal.**

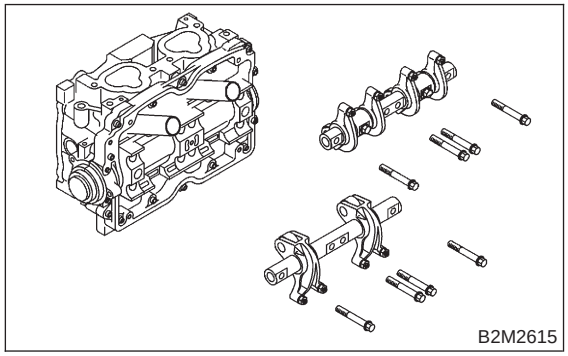
3. CAMSHAFT (RH)



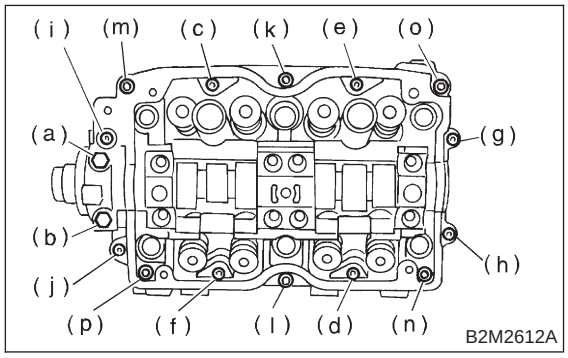
(1) Camshaft (RH)
(2) Camshaft cap
(3) Valve rocker ASSY
(4) Oil seal
(5) Plug

1) Remove camshaft cap.

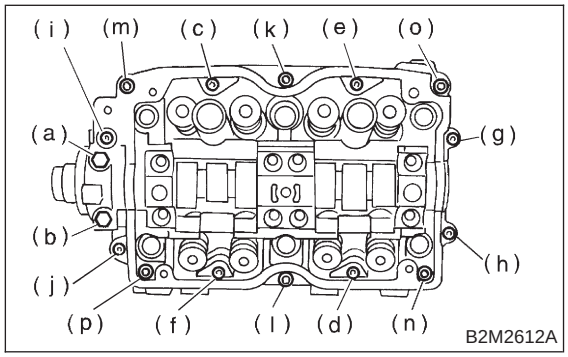
(1) Remove valve rocker assembly RH.
<Ref. to 2-3 [W3A0].>



(2) Remove bolts (a) through (b) in alphabetical sequence.

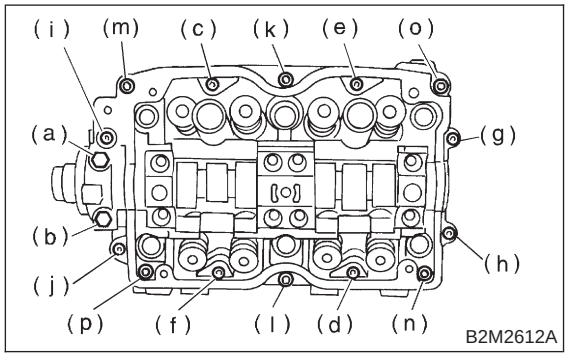


(3) Equally loosen bolts (c) through (j) all the way in alphabetical sequence.

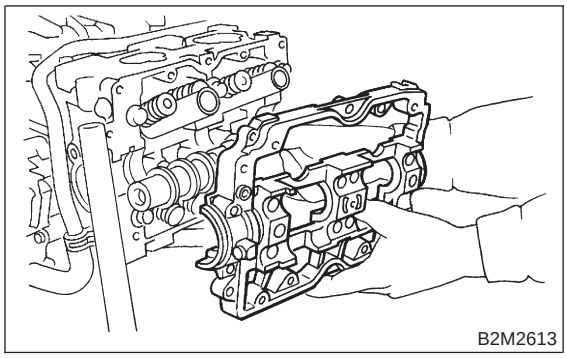


(4) Remove bolts (k) through (p) in alphabetical sequence using ST.

ST 499497000 TORX PLUS



(5) Remove camshaft cap.



2) Remove camshaft (RH).
3) Remove oil seal.
4) Remove plug from rear side of camshaft (RH).

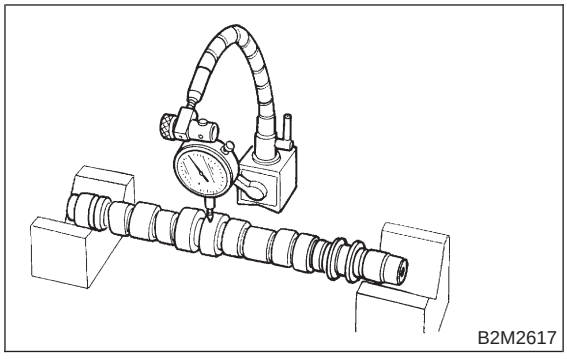
CAUTION:
- **Do not remove oil seal unless necessary.**
- **Do not scratch journal surface when removing oil seal.**

B: INSPECTION

1. CAMSHAFT

1) Measure the bend, and repair or replace if necessary.

Limit:
0.020 mm (0.0008 in)



2) Check journal for damage and wear. Replace if faulty.
3) Measure outside diameter of camshaft journal and inside diameter of cylinder head journal, and determine the difference between the two (= oil clearance). If oil clearance exceeds specifications, replace camshaft or cylinder head as necessary.

		Unit: mm (in)
Clearance at journal	Standard	0.055 — 0.090 (0.0022 — 0.0035)
	Limit	0.118 (0.0046)
Camshaft journal O.D.		31.928 — 31.945 (1.2570 — 1.2577)
Journal hole I.D.		32.000 — 32.018 (1.2598 — 1.2605)

4) Check cam face condition; remove minor faults by grinding with oil stone. Measure the cam height H; replace if the limit has been exceeded.

Cam height: H

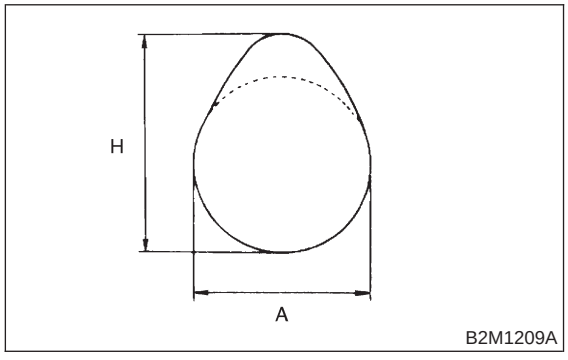
- **2200 cc**

Item	Standard	Limit (Unit: mm (in))
Intake	38.732 — 38.832 (1.5249 — 1.5288)	38.632 (1.5209)
Exhaust	39.257 — 39.357 (1.5455 — 1.5495)	39.157 (1.5416)

- **2500 cc**

Item	Standard	Limit (Unit: mm (in))
Intake	39.485 — 39.585 (1.5545 — 1.5585)	39.385 (1.5506)
Exhaust	39.257 — 39.357 (1.5455 — 1.5495)	39.157 (1.5416)

Cam base circle diameter A:
IN: 34.0 mm (1.339 in)
EX: 34.0 mm (1.339 in)

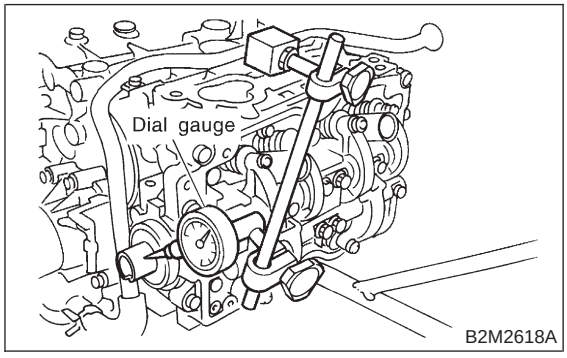


2. CAMSHAFT SUPPORT

Measure the thrust clearance of camshaft with dial gauge. If the clearance exceeds the limit, replace camshaft support.

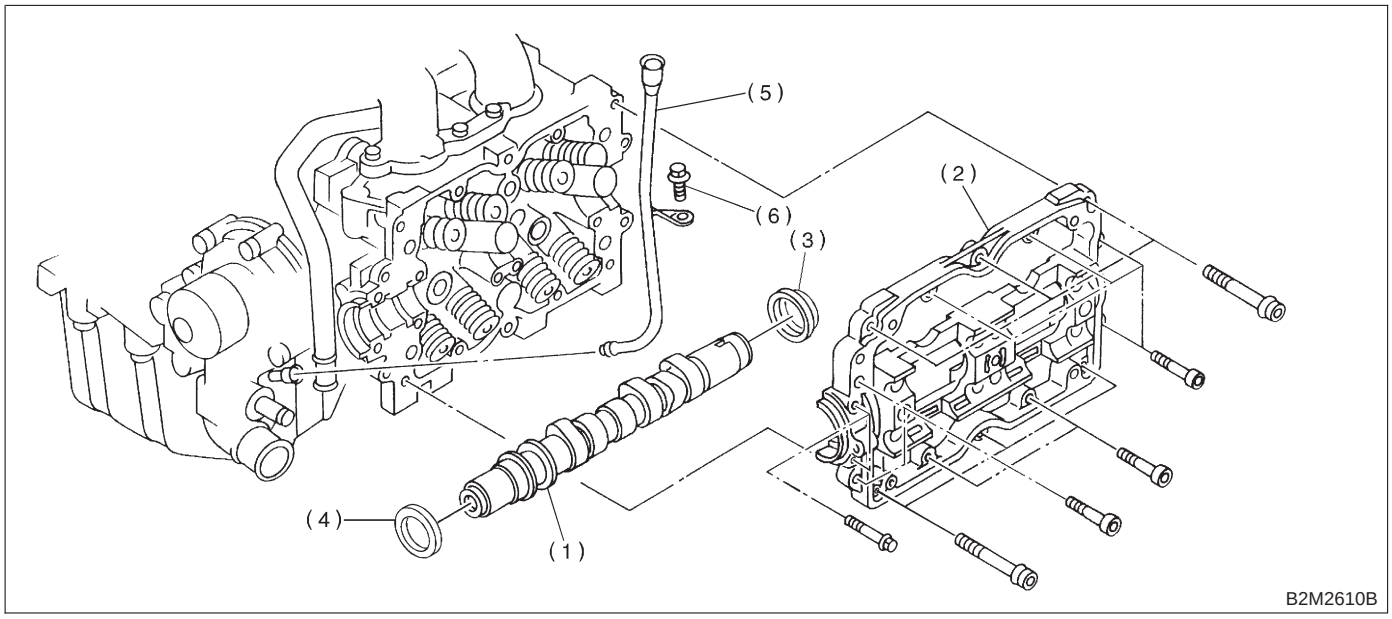
Standard:
0.030 — 0.090 mm (0.0012 — 0.0035 in)

Limit:
0.11 mm (0.0043 in)



C: INSTALLATION

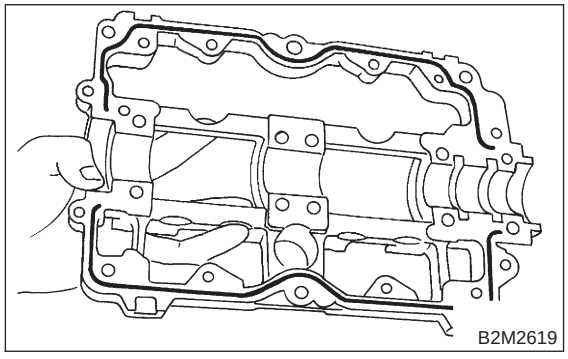
1. CAMSHAFT (LH)



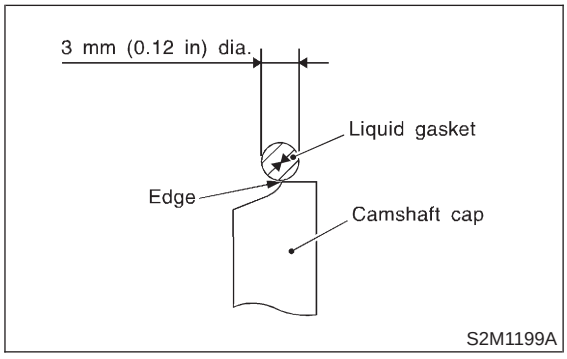
(1) Camshaft (LH)
(2) Camshaft cap
(3) Plug
(4) Oil seal
(5) Oil level gauge guide
(6) Bolt

1) Apply a coat of engine oil to camshaft journals and install camshaft (LH).
2) Install camshaft cap.
   (1) Apply liquid gasket on the around of camshaft cap.

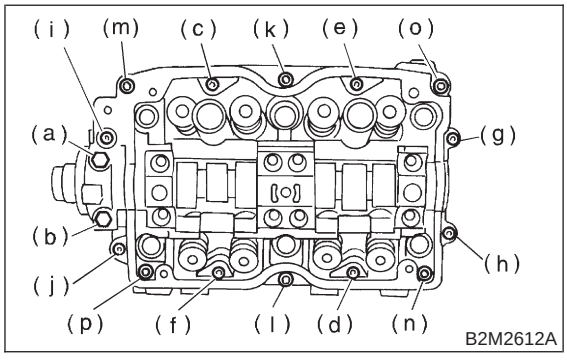
Liquid gasket:
THREE BOND 1280B



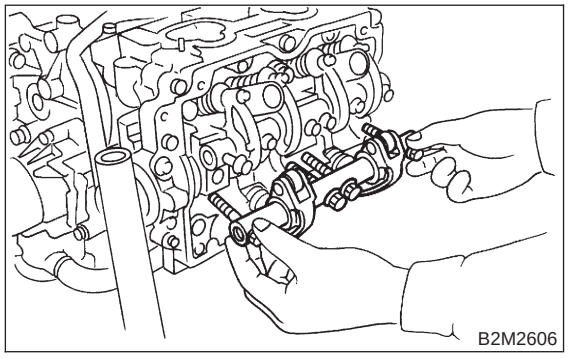
NOTE:
Apply a coat of 3 mm (0.12 in) dia. liquid gasket along edge of cam cap mating surface.



(2) Temporarily tighten bolts (g) through (j) in alphabetical sequence.

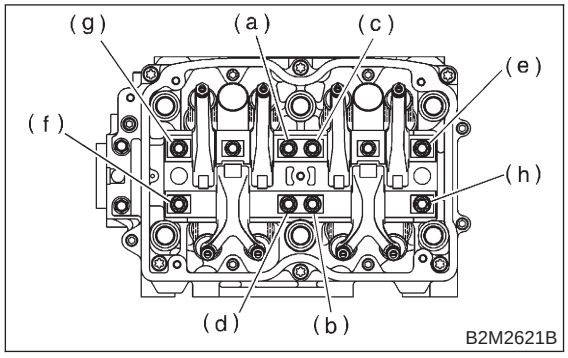


(3) Install valve rocker assembly.
<Ref. to 2-3 [W3E0].>



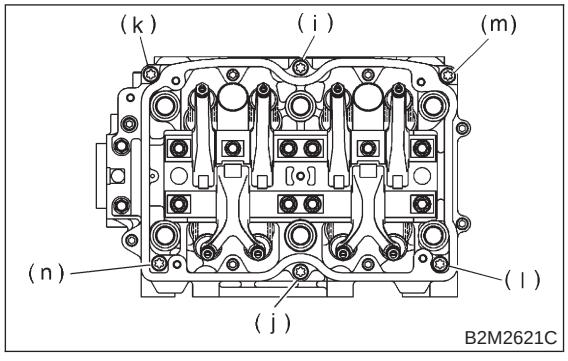
(4) Tighten bolts (a) through (h) in alphabetical sequence.

Tightening torque:
25±2 N·m (2.5±0.2 kg-m, 18.1±1.4 ft-lb)



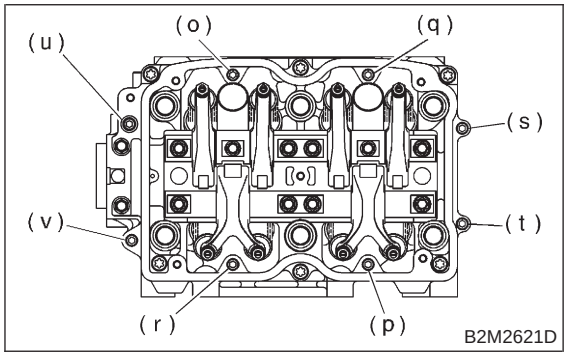
(5) Tighten TORX bolts (i) through (n) in alphabetical sequence using ST.
ST 499497000 TORX PLUS

Tightening torque:
18±2 N·m (1.8±0.2 kg-m, 13.0±1.4 ft-lb)



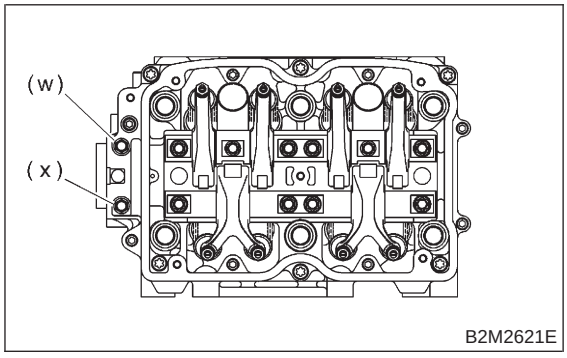
(6) Tighten bolts (o) through (v) in alphabetical sequence.

Tightening torque:
10±2 N·m (1.0±0.2 kg-m, 7.2±1.4 ft-lb)



(7) Tighten bolts (w) through (x) in alphabetical sequence.

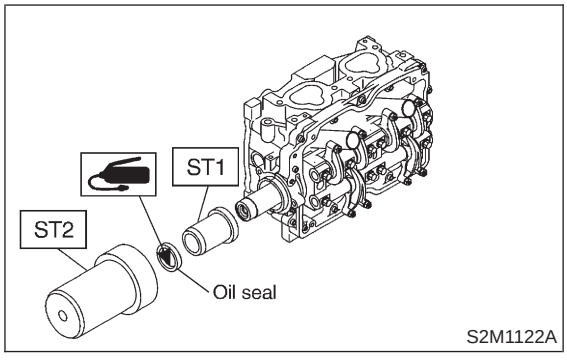
Tightening torque:
10±2 N·m (1.0±0.2 kg-m, 7.2±1.4 ft-lb)



3) Apply a coat of grease to oil seal lips and install oil seal (A) on camshaft using ST1 and ST2.

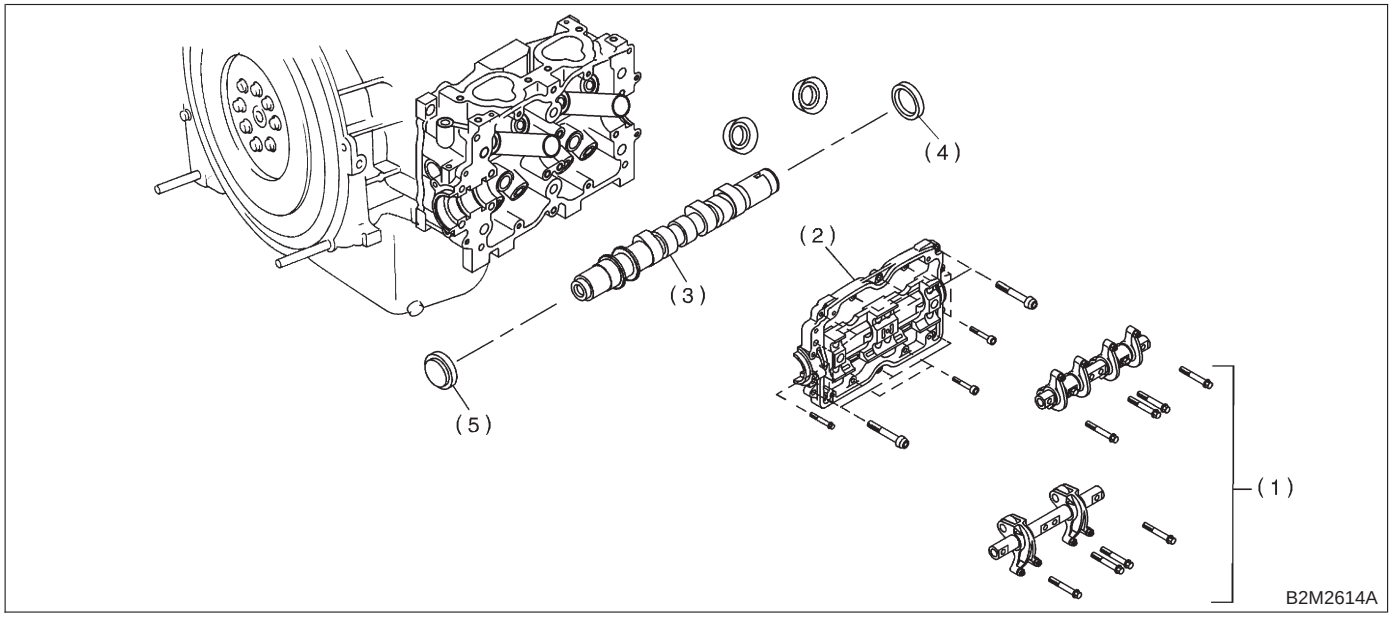
CAUTION:
Use a new oil seal.

ST1 499597000 OIL SEAL GUIDE
ST2 499587500 OIL SEAL INSTALLER



4) Install plug using ST.
ST 499587700 OIL SEAL INSTALLER
5) Install oil level gauge guide.
6) Install camshaft position sensor support.

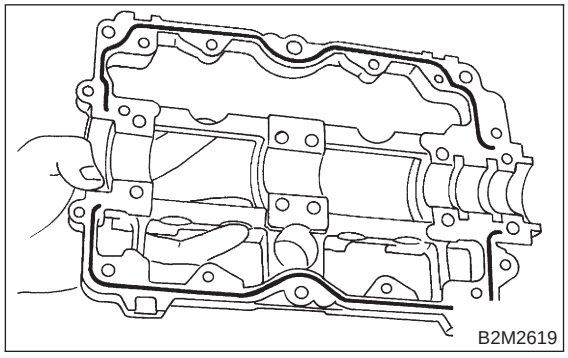
2. CAMSHAFT (RH)



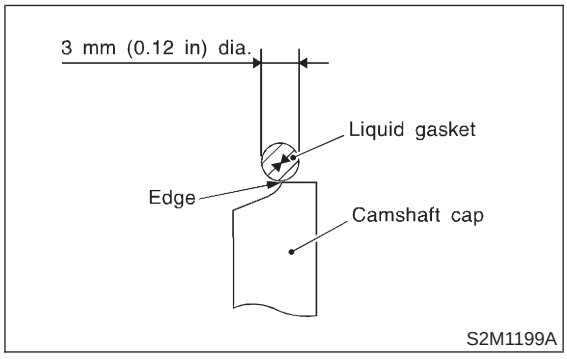
(1) Camshaft support (RH)
(2) O-ring
(3) Camshaft (RH)
(4) Oil seal
(5) Plug

1) Apply a coat of engine oil to camshaft journals and install camshaft (RH).
2) Install camshaft cap.
   (1) Apply liquid gasket on the around of camshaft cap.

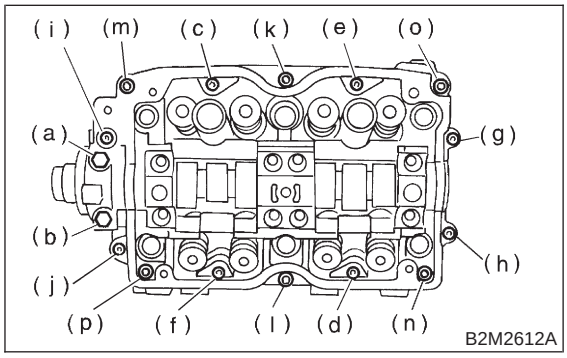
Liquid gasket:
THREE BOND 1280B



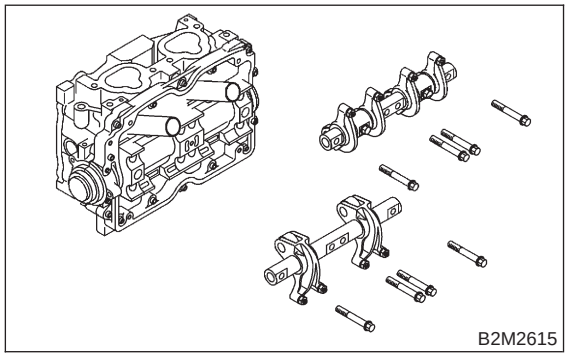
NOTE:
Apply a coat of 3 mm (0.12 in) dia. liquid gasket along edge of cam cap mating surface.



(2) Temporarily tighten bolts (g) through (j) in alphabetical sequence.

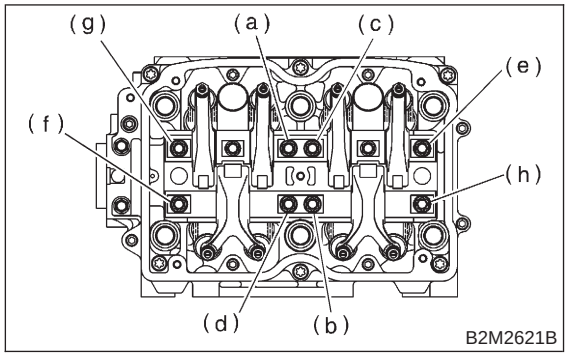


(3) Install valve rocker assembly.
<Ref. to 2-3 [W3E0].>



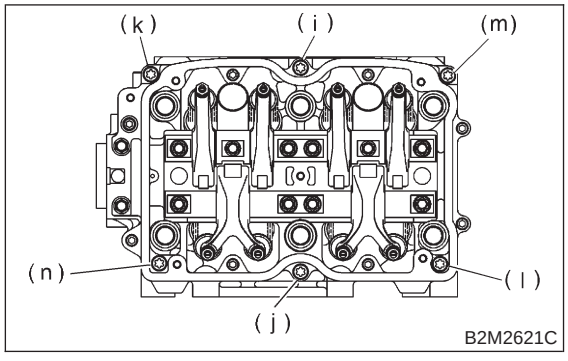
(4) Tighten bolts (a) through (h) in alphabetical sequence.

Tightening torque:
25±2 N·m (2.5±0.2 kg-m, 18.1±1.4 ft-lb)



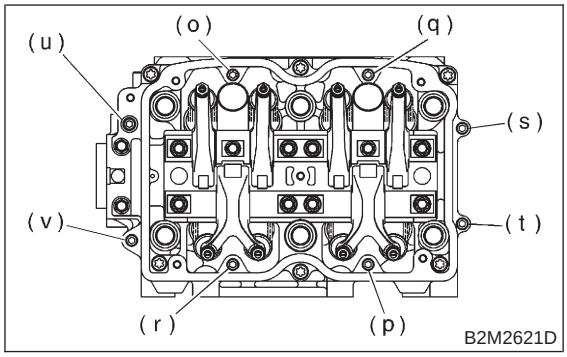
(5) Tighten TORX bolts (i) through (n) in alphabetical sequence using ST.
ST 499427000 TORX PLUS

Tightening torque:
18±2 N·m (1.8±0.2 kg-m, 13.0±1.4 ft-lb)



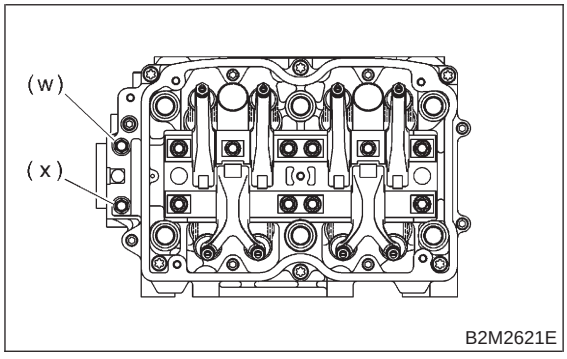
(6) Tighten bolts (o) through (v) in alphabetical sequence.

Tightening torque:
10±2 N·m (1.0±0.2 kg-m, 7.2±1.4 ft-lb)



(7) Tighten bolts (o) through (p) in alphabetical sequence.

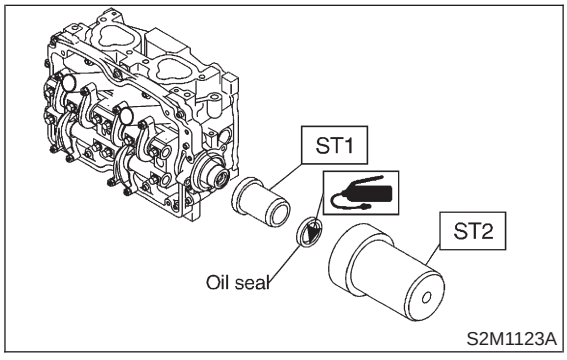
Tightening torque:
10±2 N·m (1.0±0.2 kg-m, 7.2±1.4 ft-lb)



3) Apply a coat of grease to oil seal lips and install oil seal (A) on camshaft using ST1 and ST2.

CAUTION:
Use a new oil seal.

ST1 499597000 OIL SEAL GUIDE
ST2 499587500 OIL SEAL INSTALLER



4) Install plug using ST.
ST 499587700 OIL SEAL INSTALLER

3. RELATED PARTS

Install timing belt, camshaft sprockets and related parts.
<Ref. to 2-3 [W2C0].>

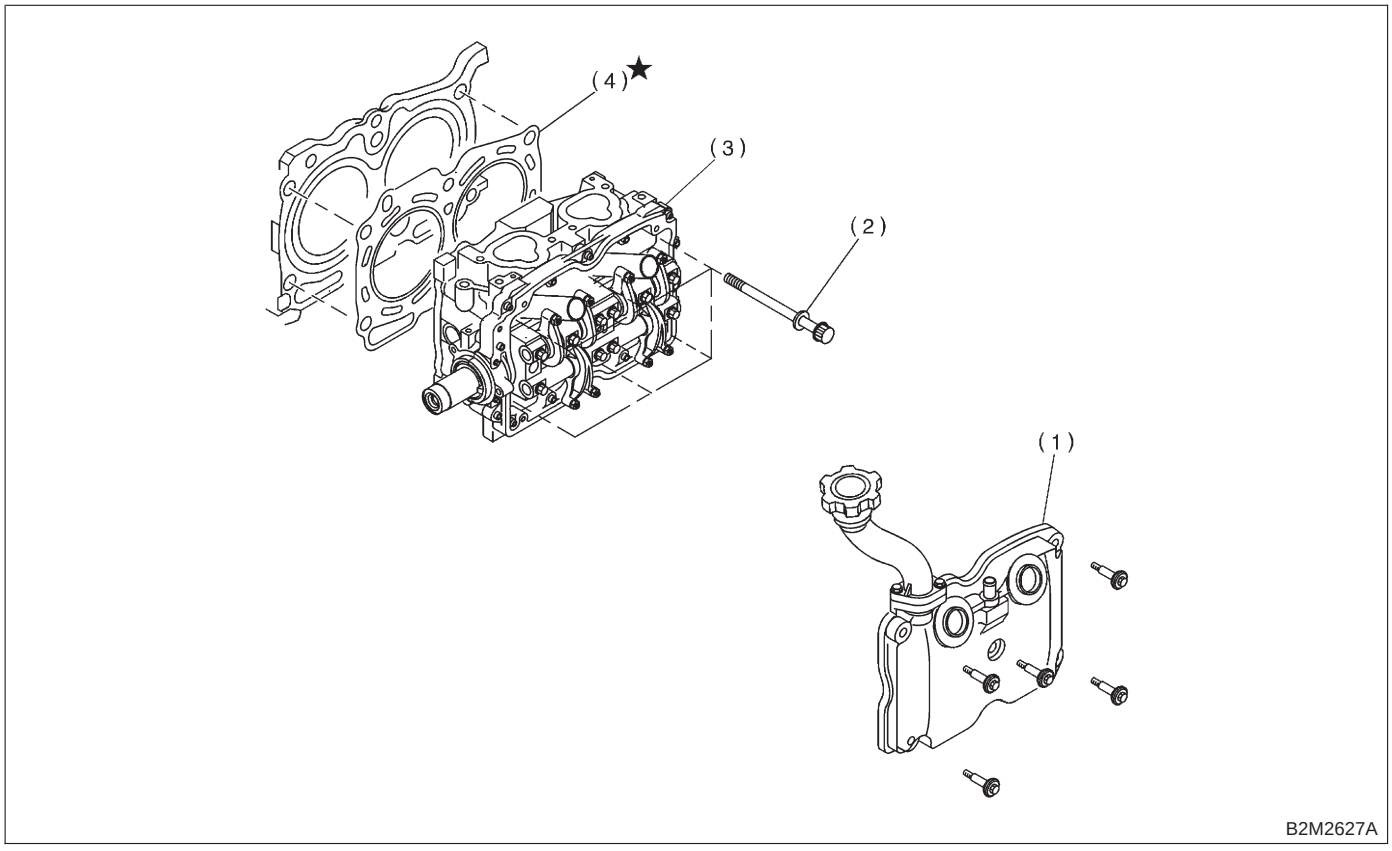
5. Cylinder Head

A: REMOVAL

1. RELATED PARTS

1) Release fuel pressure. <Ref. to 2-8 [W1B0].>
2) Drain engine coolant. <Ref. to 2-5 [W1A0].>
3) Remove V-belt(s).
4) Remove generator and bracket.
5) Remove A/C compressor and bracket. (With A/C model)
6) Disconnect spark plug cords.
7) Remove connector bracket attaching bolt.
8) Remove camshaft position sensor and camshaft position sensor support.
9) Disconnect oil pressure switch connector.
10) Disconnect blow-by hose.
11) Remove intake manifold. <Ref. to 2-7 [W4A0].>

2. CYLINDER HEAD

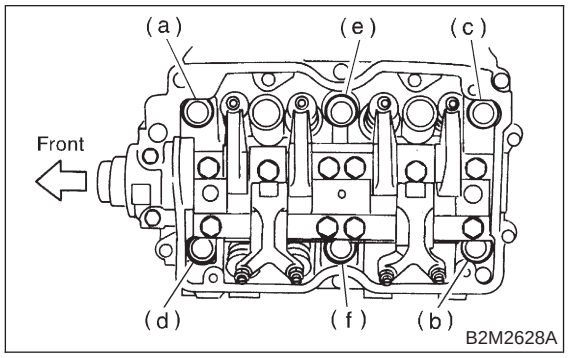


(1) Rocker cover
(2) Cylinder head bolt
(3) Cylinder head
(4) Cylinder head gasket

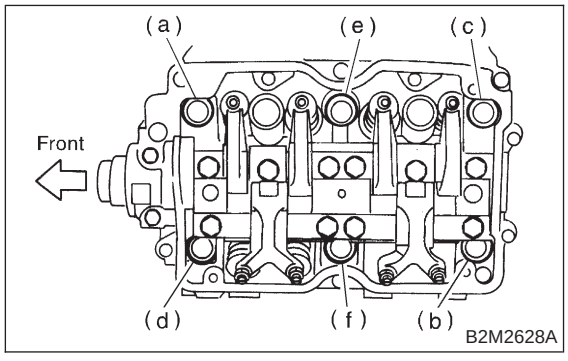
1) Remove timing belt, camshaft sprocket and related parts.
<Ref. to 2-3 [W2A0].>
2) Remove oil level gauge guide attaching bolt (left hand only) and oil level gauge guide.
3) Remove rocker cover.

4) Remove cylinder head bolts in alphabetical sequence shown in figure.

CAUTION:
Leave bolts (a) and (c) engaged by three or four threads to prevent cylinder head from falling.



5) While tapping cylinder head with a plastic hammer, separate it from cylinder block.
6) Remove bolts (a) and (b) to remove cylinder head.

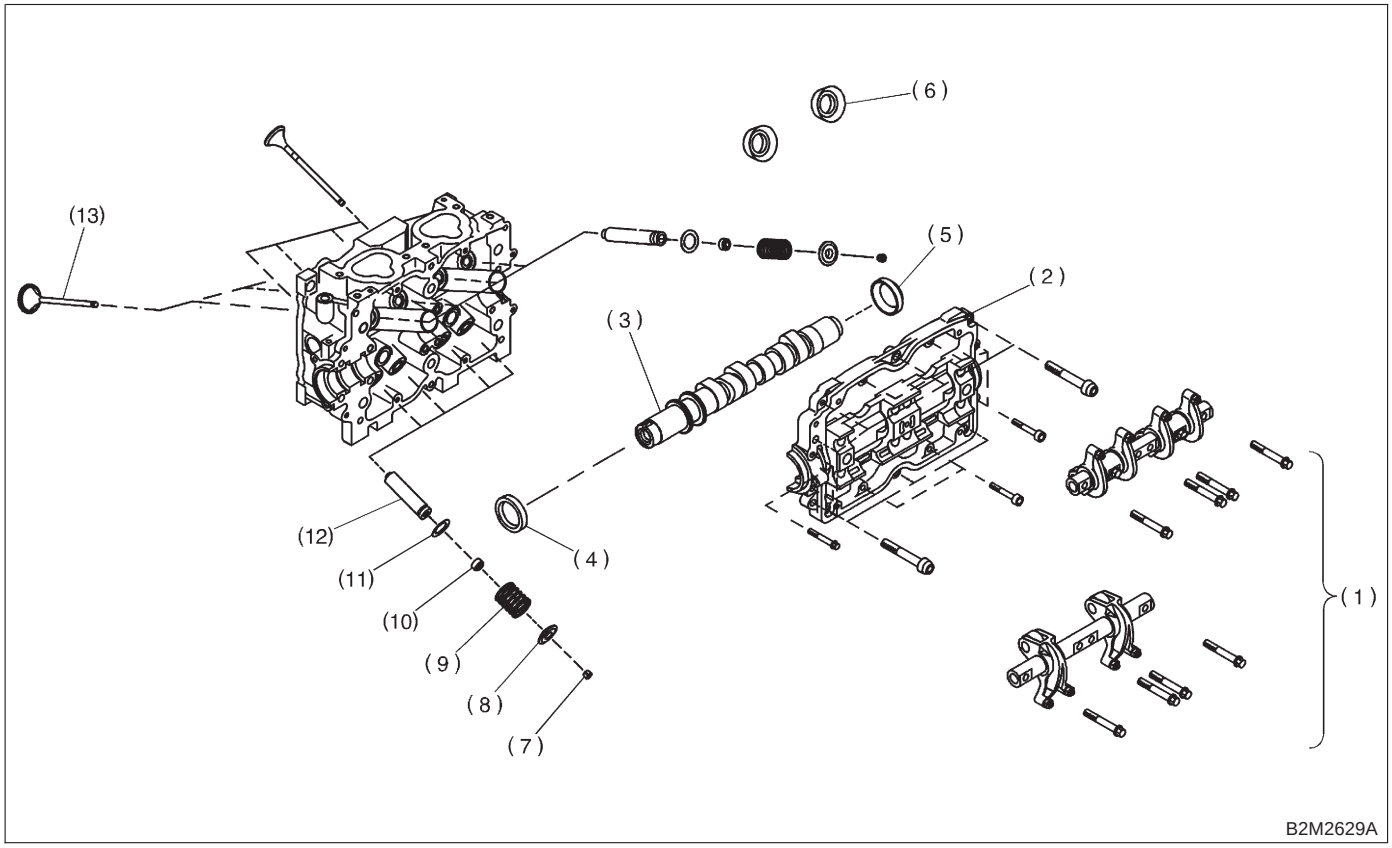


7) Remove cylinder head gasket.

CAUTION:
Do not scratch the mating surface of cylinder head and cylinder block.

8) Similarly, remove right side cylinder head.

B: DISASSEMBLY

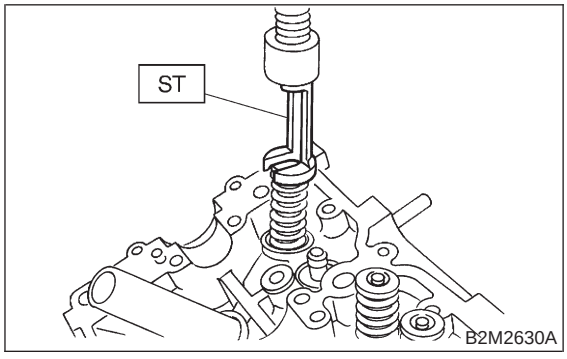


(1) Valve rocker ASSY
(2) Camshaft cap
(3) Camshaft
(4) Oil seal
(5) Plug
(6) Spark plug pipe gasket
(7) Retainer key
(8) Retainer
(9) Valve spring
(10) Oil seal
(11) Valve spring seat
(12) Valve guide
(13) Valve

1) Remove valve rocker assembly, camshaft cap and camshaft. <Ref. to 2-3 [W3A0].>
2) Remove oil seal.
3) Remove plug.
4) Place cylinder head on ST.
ST 498267800 CYLINDER HEAD TABLE

5) Set ST on valve spring. Compress valve spring and remove the valve spring retainer key. Remove each valve and valve spring.
ST 499718000 VALVE SPRING REMOVER

CAUTION:
- **Mark each valve to prevent confusion.**
- **Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.**



C: INSPECTION

1. CYLINDER HEAD

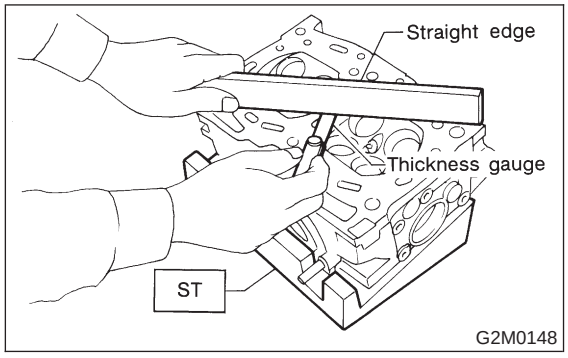
1) Make sure that no crack or other damage exists. In addition to visual inspection, inspect important areas by means of red lead check.
Also make sure that gasket installing surface shows no trace of gas and water leaks.
2) Place cylinder head on ST.
ST 498267800 CYLINDER HEAD TABLE
3) Measure the warping of the cylinder head surface that mates with crankcase using a straight edge and thickness gauge.
If the warping exceeds 0.05 mm (0.0020 in), regrind the surface with a surface grinder.

Warping limit:
0.05 mm (0.0020 in)

Grinding limit:
0.3 mm (0.012 in)

Standard height of cylinder head:
97.5 mm (3.839 in)

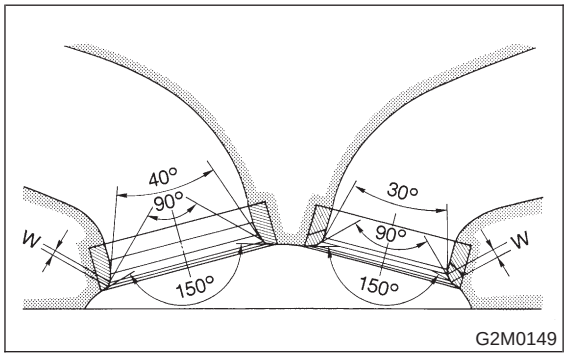
CAUTION:
Uneven torque for the cylinder head bolts can cause warping. When reassembling, pay special attention to the torque so as to tighten evenly.

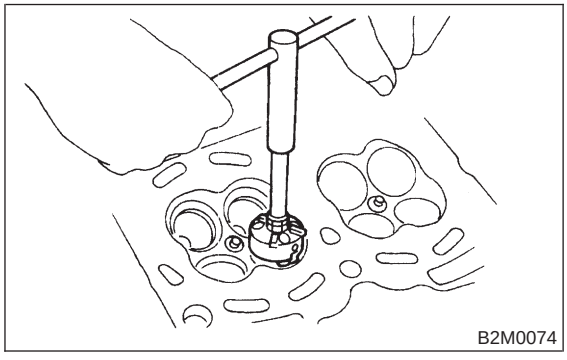


2. VALVE SEAT

Inspect intake and exhaust valve seats, and correct the contact surfaces with valve seat cutter if they are defective or when valve guides are replaced.

Valve seat width: W
Intake
Standard 1.0 mm (0.039 in)
Limit 1.7 mm (0.067 in)
Exhaust
Standard 1.4 mm (0.055 in)
Limit 2.1 mm (0.083 in)



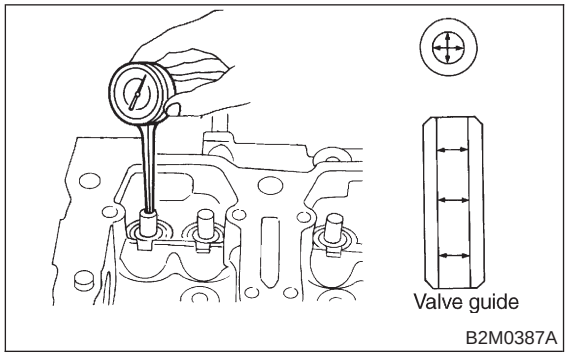


3. VALVE GUIDE

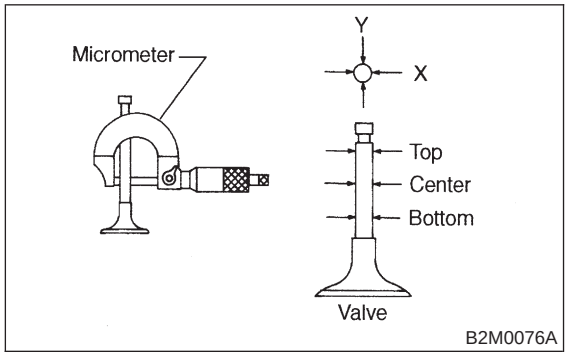
1) Check the clearance between valve guide and stem. The clearance can be checked by measuring the outside diameter of valve stem and the inside diameter of valve guide with outside and inside micrometers respectively.

Clearance between the valve guide and valve stem:
Standard
Intake 0.035 — 0.062 mm (0.0014 — 0.0024 in)
Exhaust 0.040 — 0.067 mm (0.0016 — 0.0026 in)
Limit
0.15 mm (0.0059 in)

Valve guide inner diameter:
6.000 — 6.012 mm (0.2362 — 0.2367 in)



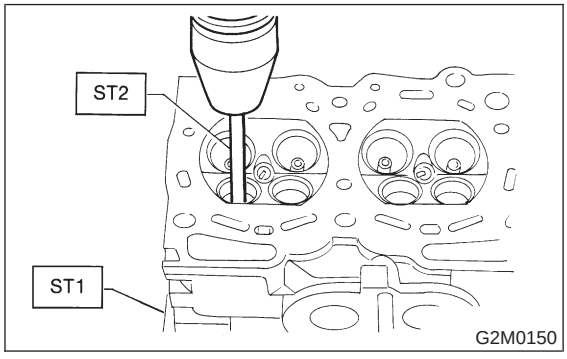
Valve stem outer diameters:
Intake
5.950 — 5.965 mm (0.2343 — 0.2348 in)
Exhaust
5.945 — 5.960 mm (0.2341 — 0.2346 in)



2) If the clearance between valve guide and stem exceeds the specification, replace guide as follows:

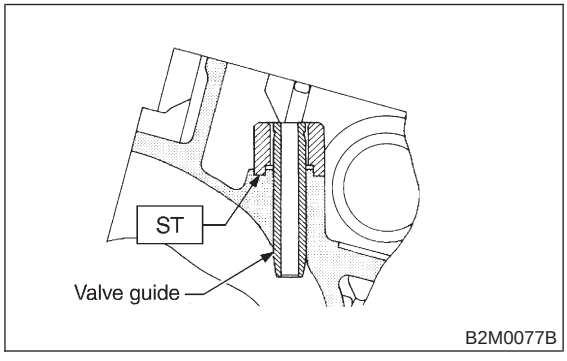
(1) Place cylinder head on ST1 with the combustion chamber upward so that valve guides enter the holes in ST1.
(2) Insert ST2 into valve guide and press it down to remove valve guide.

ST1 498267800 CYLINDER HEAD TABLE
ST2 499767400 VALVE GUIDE REMOVER



(3) Turn cylinder head upside down and place ST as shown in the figure.

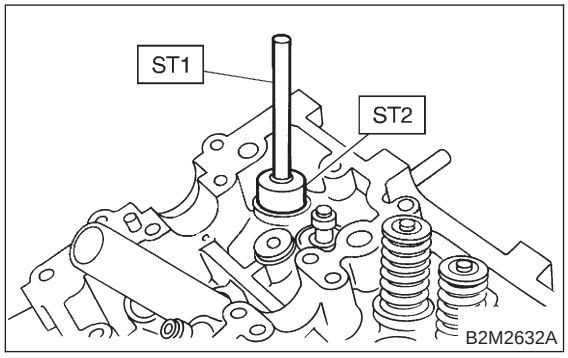
Intake side:
ST 499767700 VALVE GUIDE ADJUSTER
Exhaust side:
ST 499767800 VALVE GUIDE ADJUSTER



(4) Before installing new oversize valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.

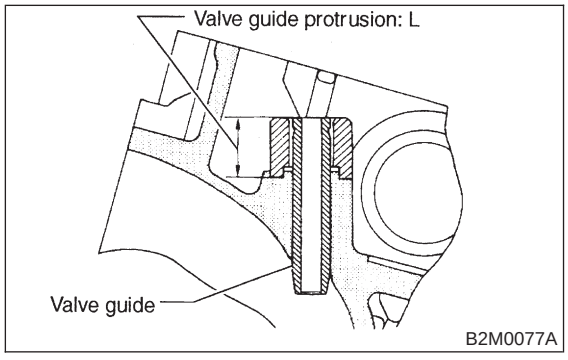
(5) Put new valve guide, coated with sufficient oil, in cylinder, and insert ST1 into valve guide. Press in until the valve guide upper end is flush with the upper surface of ST2.

ST1 499767400 VALVE GUIDE REMOVER
Intake side:
ST2 499767700 VALVE GUIDE ADJUSTER
Exhaust side:
ST2 499767800 VALVE GUIDE ADJUSTER



(6) Check the valve guide protrusion.

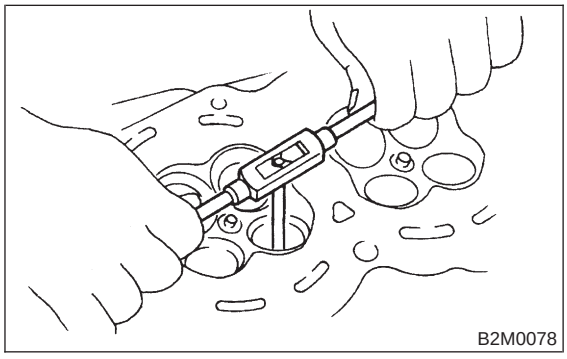
Valve guide protrusion: L
Intake
20.0 — 20.5 mm (0.787 — 0.807 in)
Exhaust
16.5 — 17.0 mm (0.650 — 0.669 in)



(7) Ream the inside of valve guide with ST. Gently rotate the reamer clockwise while pressing it lightly into valve guide, and return it also rotating clockwise. After reaming, clean valve guide to remove chips.

CAUTION:
● Apply engine oil to the reamer when reaming.
● If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.
● If the inner surface of the valve guide becomes lustrous and the reamer does not chips, use a new reamer or remedy the reamer.

ST 499767400 VALVE GUIDE REAMER



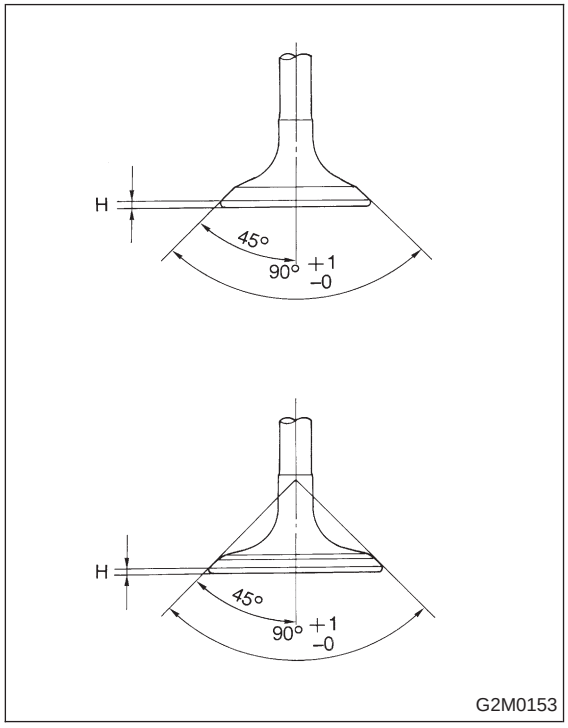
(8) Recheck the contact condition between valve and valve seat after replacing valve guide.

4. INTAKE AND EXHAUST VALVE

1) Inspect the flange and stem of valve, and replace if damaged, worn, or deformed, or if “H” is less than the specified limit.

H:
Intake
Standard 1.0 mm (0.039 in)
Limit 0.6 mm (0.024 in)
Exhaust
Standard 1.2 mm (0.047 in)
Limit 0.6 mm (0.024 in)

Valve overall length:
Intake
120.6 mm (4.75 in)
Exhaust
121.7 mm (4.79 in)

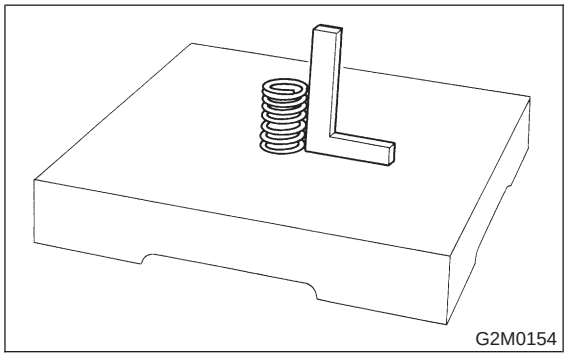


2) Put a small amount of grinding compound on the seat surface and lap the valve and seat surface. <Ref. to 2-3 [W6C2].> Install a new intake valve oil seal after lapping.

5. VALVE SPRING

1) Check valve springs for damage, free length, and tension. Replace valve spring if it is not to the specifications presented below.
2) To measure the squareness of the valve spring, stand the spring on a surface plate and measure its deflection at the top using a try square.

Free length	54.30 mm (2.1378 in)
Squareness	2.5°, 2.4 mm (0.094 in)
Tension/spring height	214.8 — 246.2 N (21.9 — 25.1 kg, 48.3 — 55.3 lb) / 45.0 mm (1.772 in)
	526.6 — 581.6 N (53.7 — 59.3 kg, 118.4 — 130.8 lb) / 34.7 mm (1.366 in)



6. INTAKE AND EXHAUST VALVE OIL SEAL

Replace oil seal with new one, if lip is damaged or spring out of place, or when the surfaces of intake valve and valve seat are reconditioned or intake valve guide is replaced.

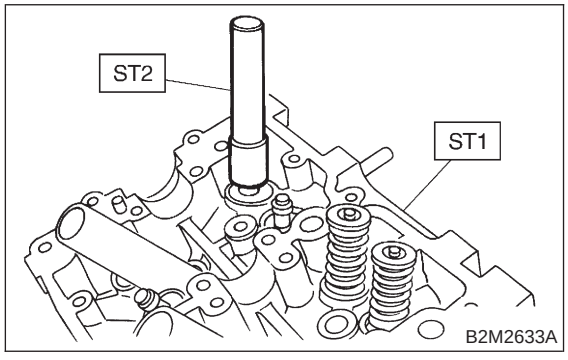
1) Place cylinder head on ST1.
2) Press-fit oil seal to the specified dimension indicated in the figure using ST2.

CAUTION:
● Apply engine oil to oil seal before press-fitting.
● When press-fitting oil seal, do not use hammer or strike in.
● Differentiate between intake valve oil seal and exhaust valve oil seal by noting their difference in color.

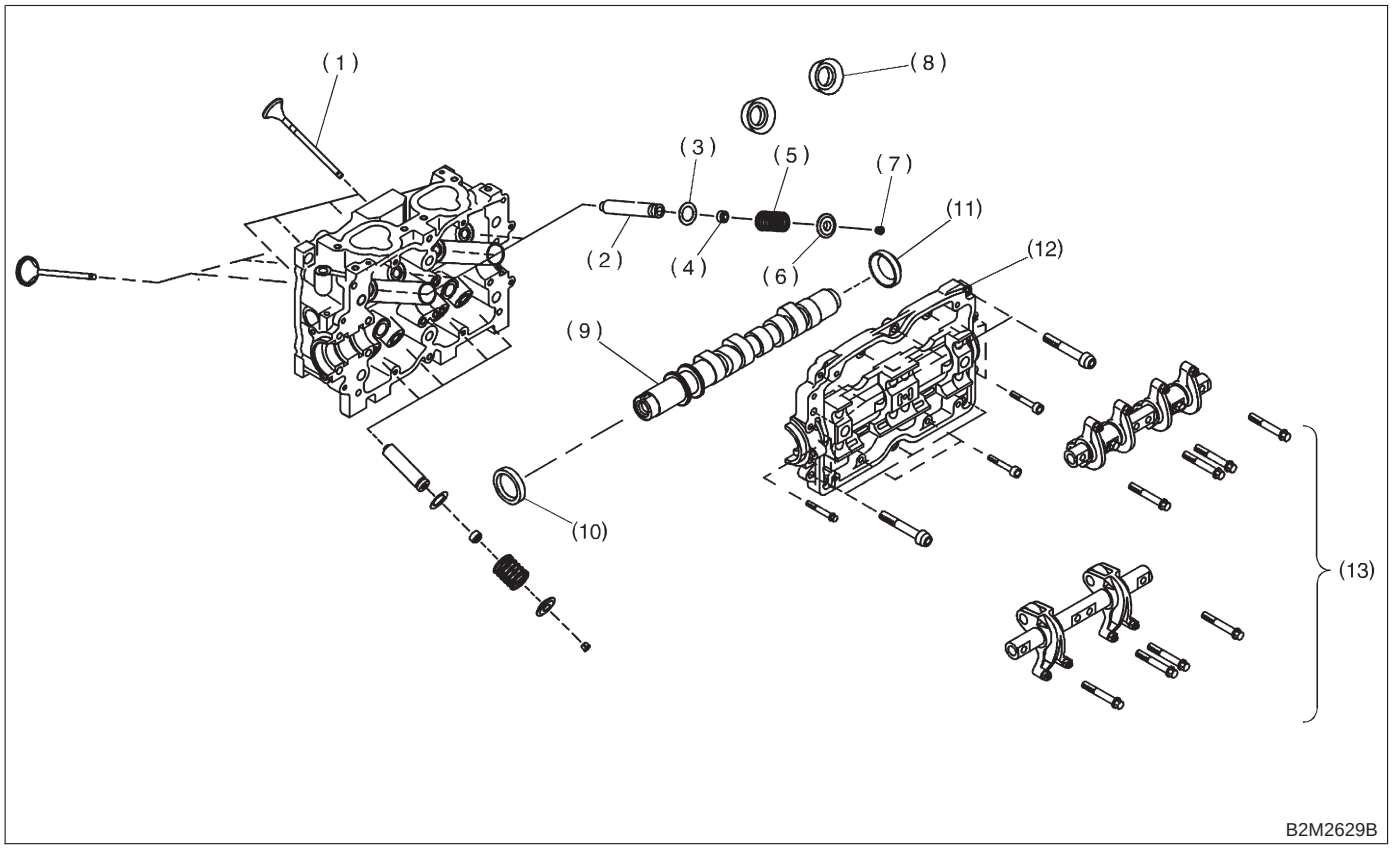
ST1 498267800 CYLINDER HEAD TABLE
ST2 498857100 VALVE OIL SEAL GUIDE

Color of rubber part:
Intake [Black]
Exhaust [Brown]

Color of spring part:
Intake [Silver]
Exhaust [Silver]



D: ASSEMBLY



(1) Valve
(2) Valve guide
(3) Valve spring seat
(4) Oil seal
(5) Valve spring
(6) Retainer
(7) Retainer key
(8) Spark plug gasket
(9) Camshaft
(10) Oil seal
(11) Plug
(12) Camshaft cap
(13) Valve rocker ASSY

1) Installation of valve spring and valve
(1) Place cylinder head on ST.

ST 498267400 CYLINDER HEAD TABLE

(2) Coat stem of each valve with engine oil and insert valve into valve guide.

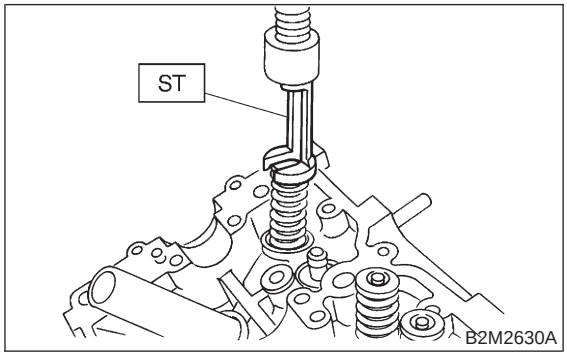
CAUTION:
When inserting valve into valve guide, use special care not to damage the oil seal lip.

(3) Install valve spring and retainer.

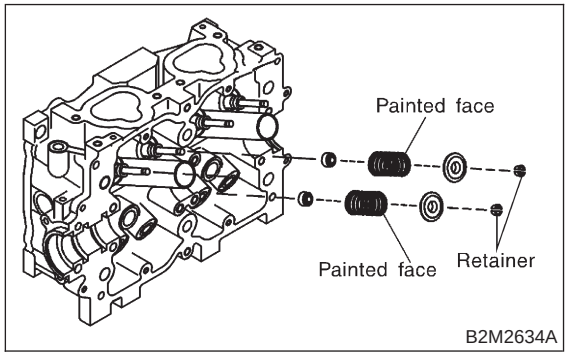
CAUTION:
Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

(4) Set ST on valve spring.

ST 499718000 VALVE SPRING REMOVER



(5) Compress valve spring and fit valve spring retainer key.



(6) After installing, tap valve spring retainers lightly with wooden hammer for better seating.

2) Install plug.

3) Install camshaft, camshaft cap and valve rocker assembly.

<Ref. to 2-3 [W3C0].>

4) Install plug using ST.

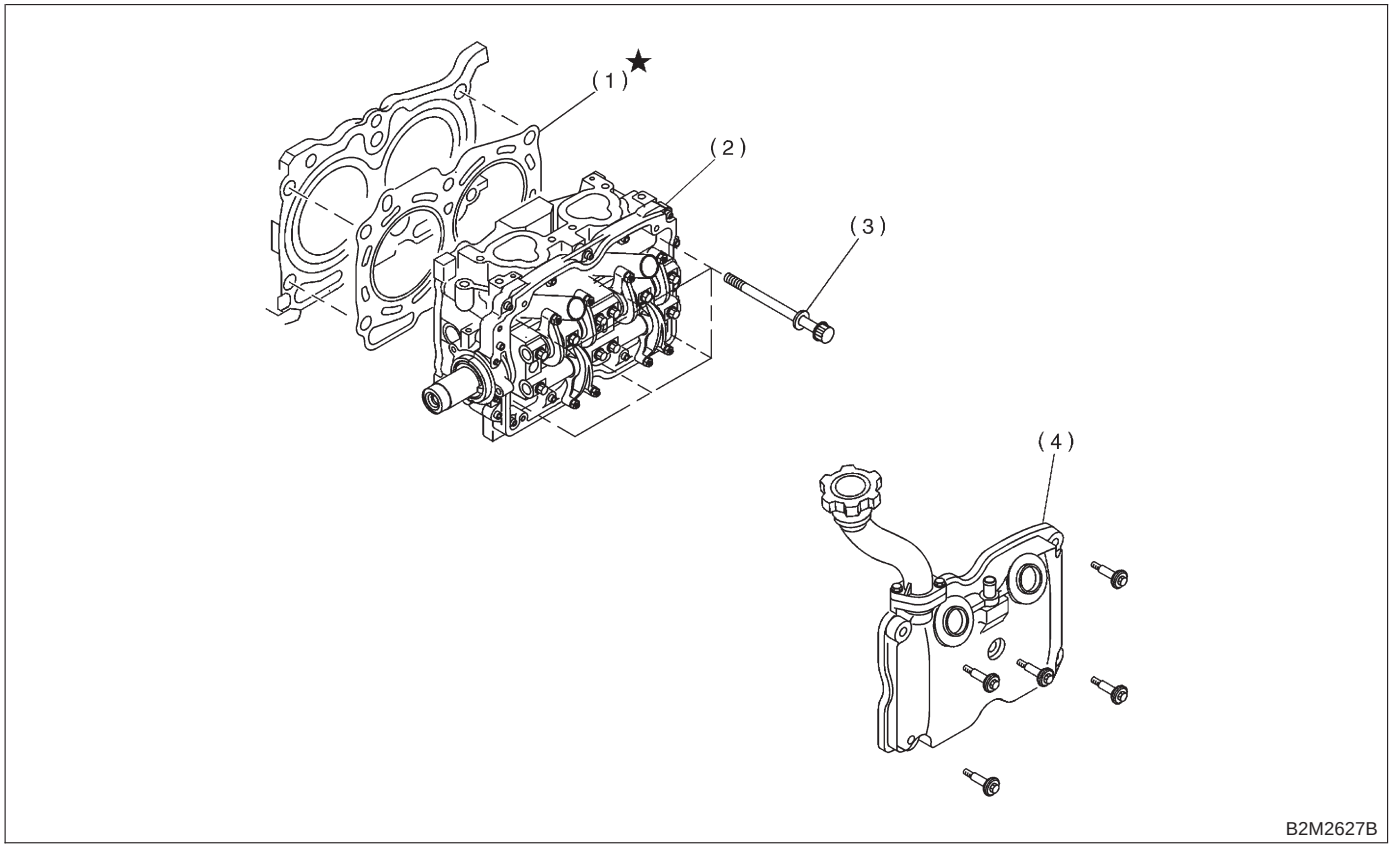
ST 499587100 OIL SEAL INSTALLER

5) Install oil seal using ST.

ST 499587500 OIL SEAL INSTALLER

E: INSTALLATION

1. CYLINDER HEAD



(1) Cylinder head gasket
(2) Cylinder head
(3) Cylinder head bolt
(4) Rocker cover

1) Install cylinder head and gaskets on cylinder block.

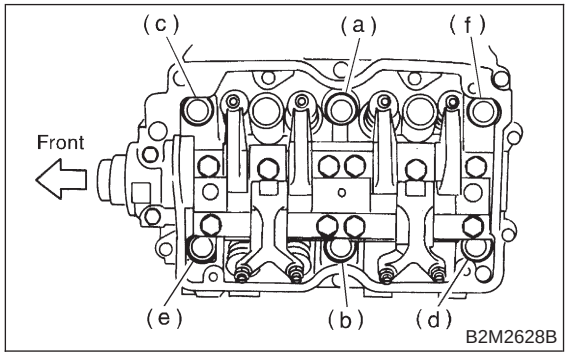
CAUTION:
Use new cylinder head gaskets.

2) Tighten cylinder head bolts.
(1) Apply a coat of engine oil to washers and bolt threads.
(2) Tighten all bolts to 29 N·m (3.0 kg-m, 22 ft-lb) in alphabetical sequence.
Then tighten all bolts to 69 N·m (7.0 kg-m, 51 ft-lb) in alphabetical sequence.
(3) Back off all bolts by 180° first; back them off by 180° again.
(4) Tighten bolts (a) and (b) to 34 N·m (3.5 kg-m, 25 ft-lb).
(5) Tighten bolts (c), (d), (e) and (f) to 15 N·m (1.5 kg-m, 11 ft-lb).
(6) Tighten all bolts by 80 to 90° in alphabetical sequence.

CAUTION:
Do not tighten bolts more than 90°.

(7) Further tighten all bolts by 80 to 90° in alphabetical sequence.

CAUTION:
Ensure that the total "re-tightening angle" [in the former two steps], do not exceed 180°.



3) Install oil level gauge guide and tighten attaching bolt (left side only).
4) Install timing belt, camshaft sprocket and related parts.
<Ref. to 2-3 [W2C0].>

2. RELATED PARTS

CAUTION:
Be careful not to scratch the mating surface of cylinder block and oil pump.

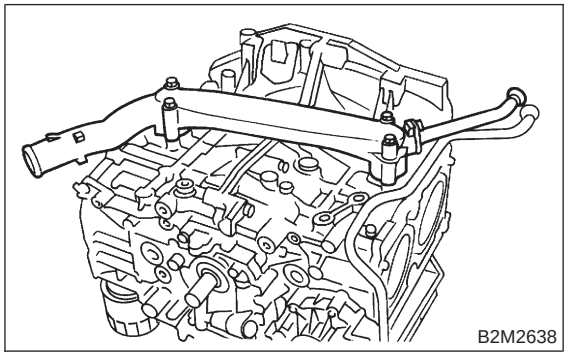
1) Install engine coolant pipe.
2) Install intake manifold. <Ref. to 2-7 [W4D0].>
3) Connect blow-by hose.
4) Connect oil pressure switch connector.
5) Install camshaft position sensor and camshaft position sensor support.
6) Install connector bracket attaching bolt.
7) Connect spark plug cords.
8) Install generator and bracket.
9) Install A/C compressor and bracket. (With A/C model)
10) Install V-belt(s).
11) Remove ENGINE STAND (ST).

6. Cylinder Block

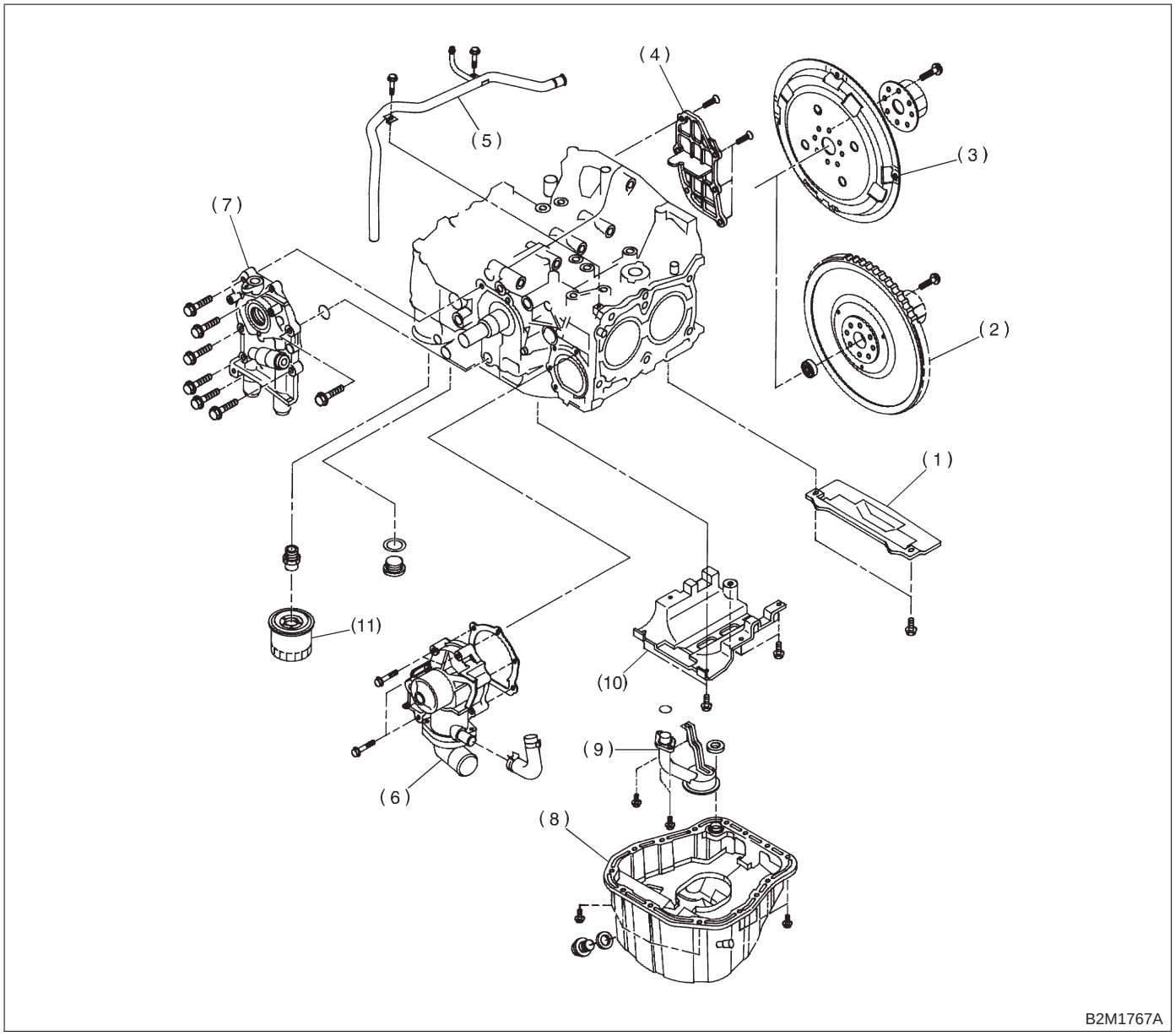
A: REMOVAL

1. RELATED PARTS

1) Remove timing belt, camshaft sprockets and related parts.
<Ref. to 2-3 [W2A0].>
2) Remove cylinder heads. <Ref. to 2-3 [W5A0].>
3) Remove water pipe. <Ref. to 2-5 [W8A0].>



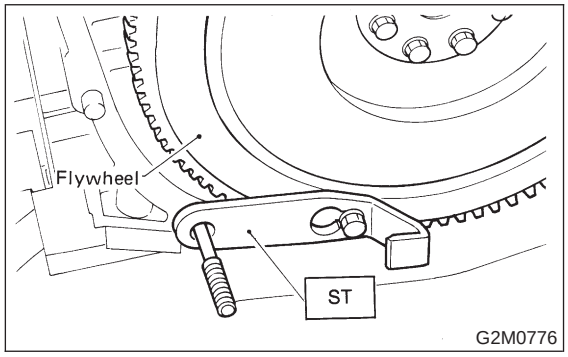
2. OIL PUMP AND WATER PUMP

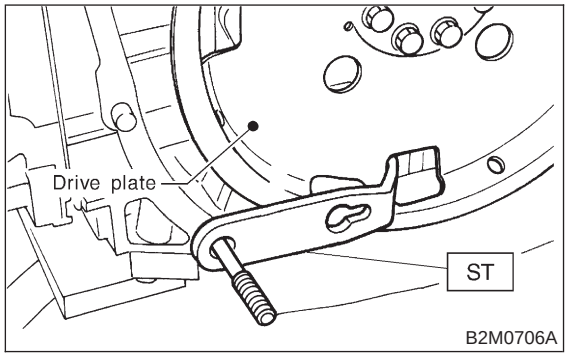


(1) Clutch housing cover (MT vehicles only)
(2) Flywheel (MT vehicles only)
(3) Drive plate (AT vehicles only)
(4) Oil separator cover
(5) Water by-pass pipe
(6) Water pump
(7) Oil pump
(8) Oil pan
(9) Oil strainer
(10) Baffle plate
(11) Oil filter

1) Remove clutch housing cover (MT vehicles only).

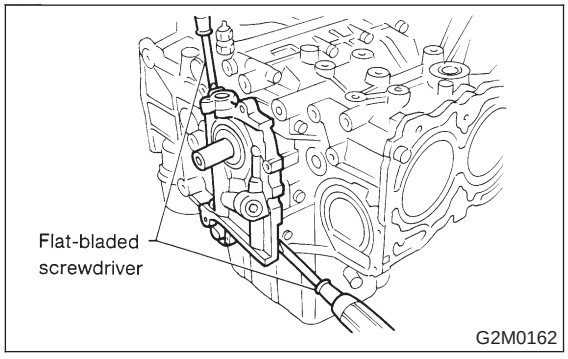
2) Remove flywheel (MT vehicles only) or drive plate (AT vehicles only).
Using ST, lock crankshaft.
ST 498497100 CRANKSHAFT STOPPER





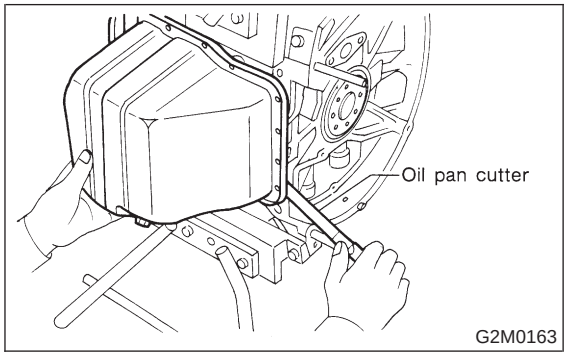
3) Remove oil separator cover.
4) Remove water by-pass pipe for heater.
5) Remove water pump.
6) Remove oil pump from cylinder block.
Use a flat-bladed screwdriver as shown in figure when removing oil pump.

CAUTION:
Be careful not to scratch the mating surface of cylinder block and oil pump.

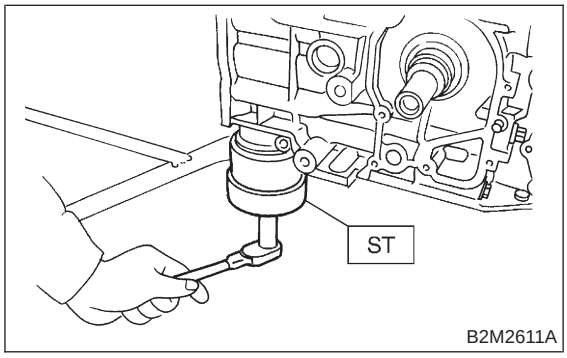


7) Removal of oil pan
(1) Turn cylinder block with #2 and #4 piston sides facing upward.
(2) Remove bolts which secure oil pan to cylinder block.
(3) Insert a oil pan cutter blade between cylinder block-to-oil pan clearance and remove oil pan.

CAUTION:
Do not use a screwdriver or similar tool in place of oil pan cutter.

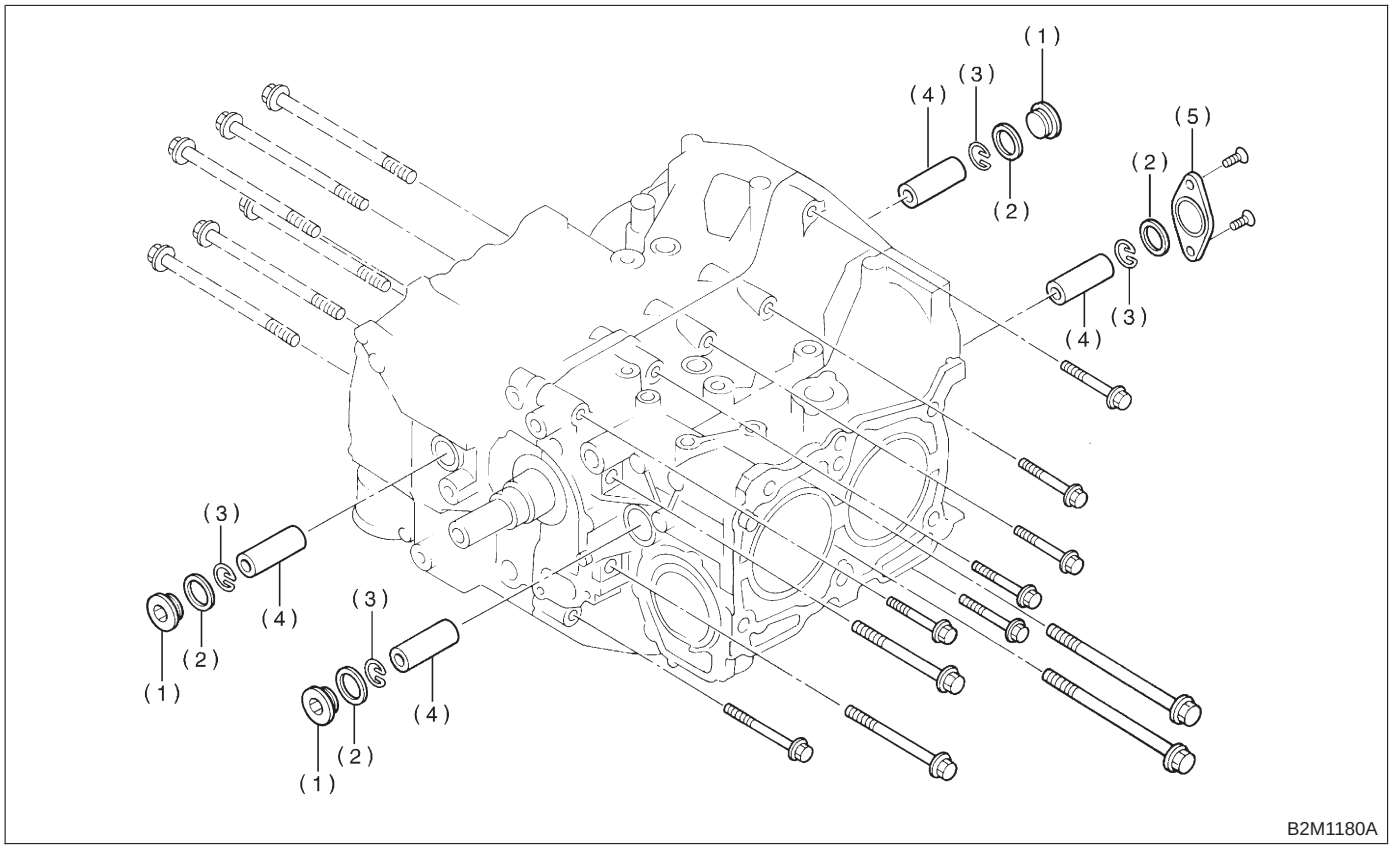


8) Remove oil strainer stay.
9) Remove oil strainer.
10) Remove baffle plate.
11) Remove oil filter using ST.
ST 498187300 OIL FILTER WRENCH



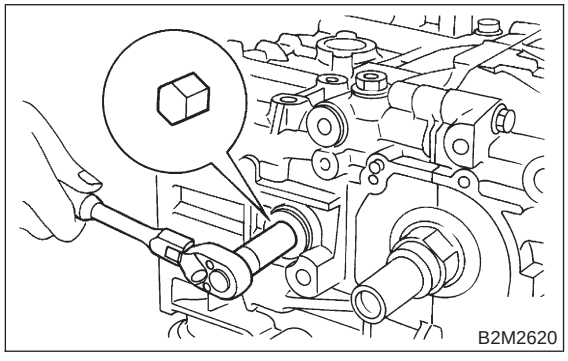
B: DISASSEMBLY

1. PISTON PIN AND CYLINDER BLOCK CONNECTING BOLT

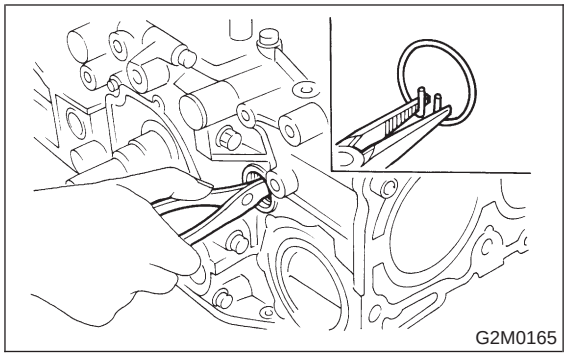


(1) Service hole plug
(2) Gasket
(3) Circlip
(4) Piston pin
(5) Service hole cover

1) Remove service hole cover and service hole plugs using hexagon wrench [14 mm (0.55 in)].

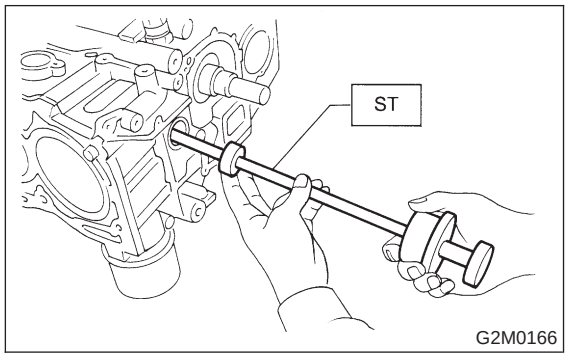


2) Rotate crankshaft to bring #1 and #2 pistons to bottom dead center position, then remove piston circlip through service hole of #1 and #2 cylinders.



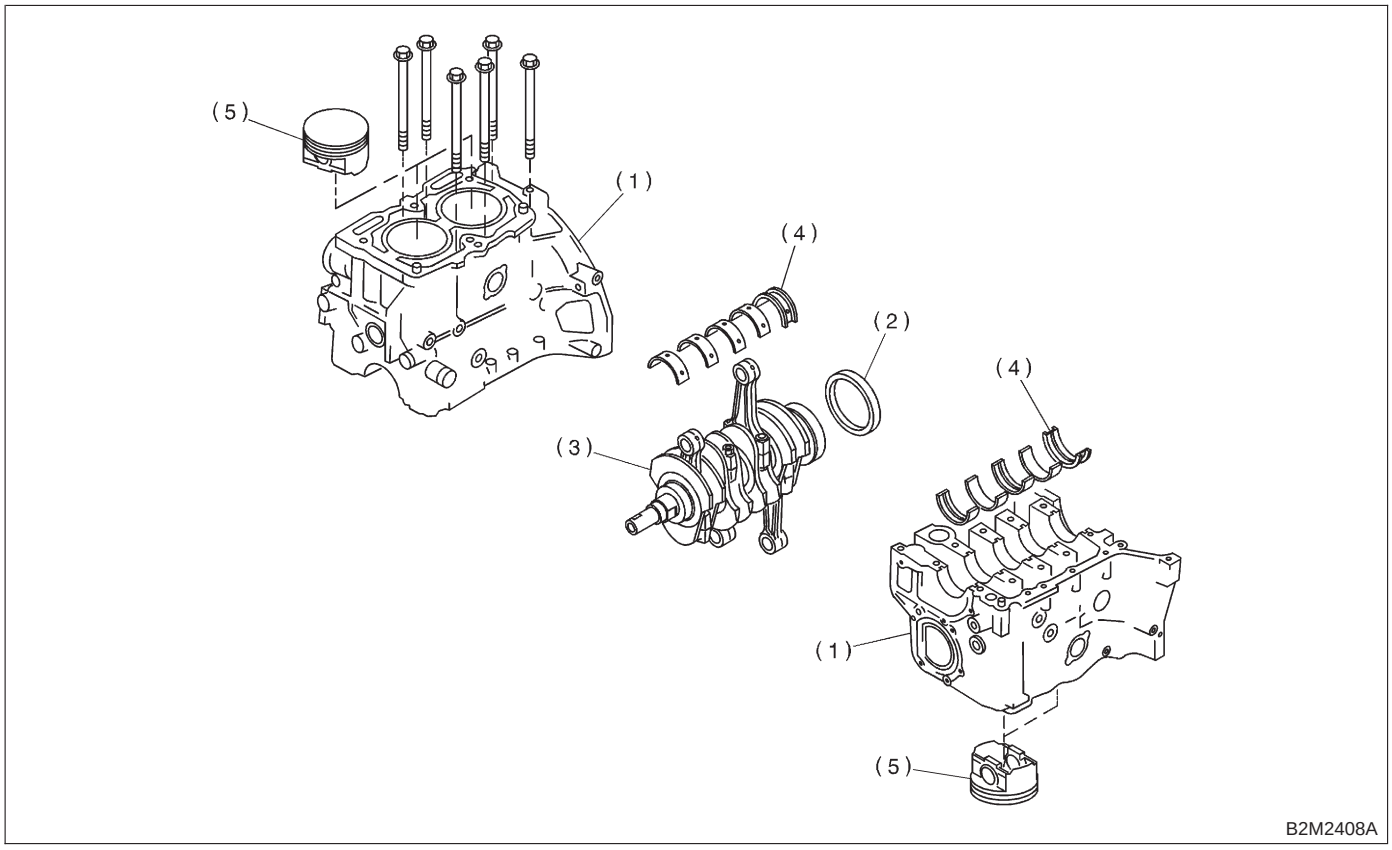
3) Draw out piston pin from #1 and #2 pistons using ST.
ST 499097700 PISTON PIN REMOVER

CAUTION:
Be careful not to confuse original combination of piston, piston pin and cylinder.



4) Similarly remove piston pins from #3 and #4 pistons.
5) Remove bolts which connect cylinder block on the side of #2 and #4 cylinders.
6) Back off bolts which connect cylinder block on the side of #1 and #3 cylinders two or three turns.

2. CYLINDER BLOCK



(1) Cylinder block
(2) Rear oil seal
(3) Crankshaft
(4) Crankshaft bearing
(5) Piston

1) Set up cylinder block so that #1 and #3 cylinders are on the upper side, then remove cylinder block connecting bolts.
2) Separate left-hand and right-hand cylinder blocks.

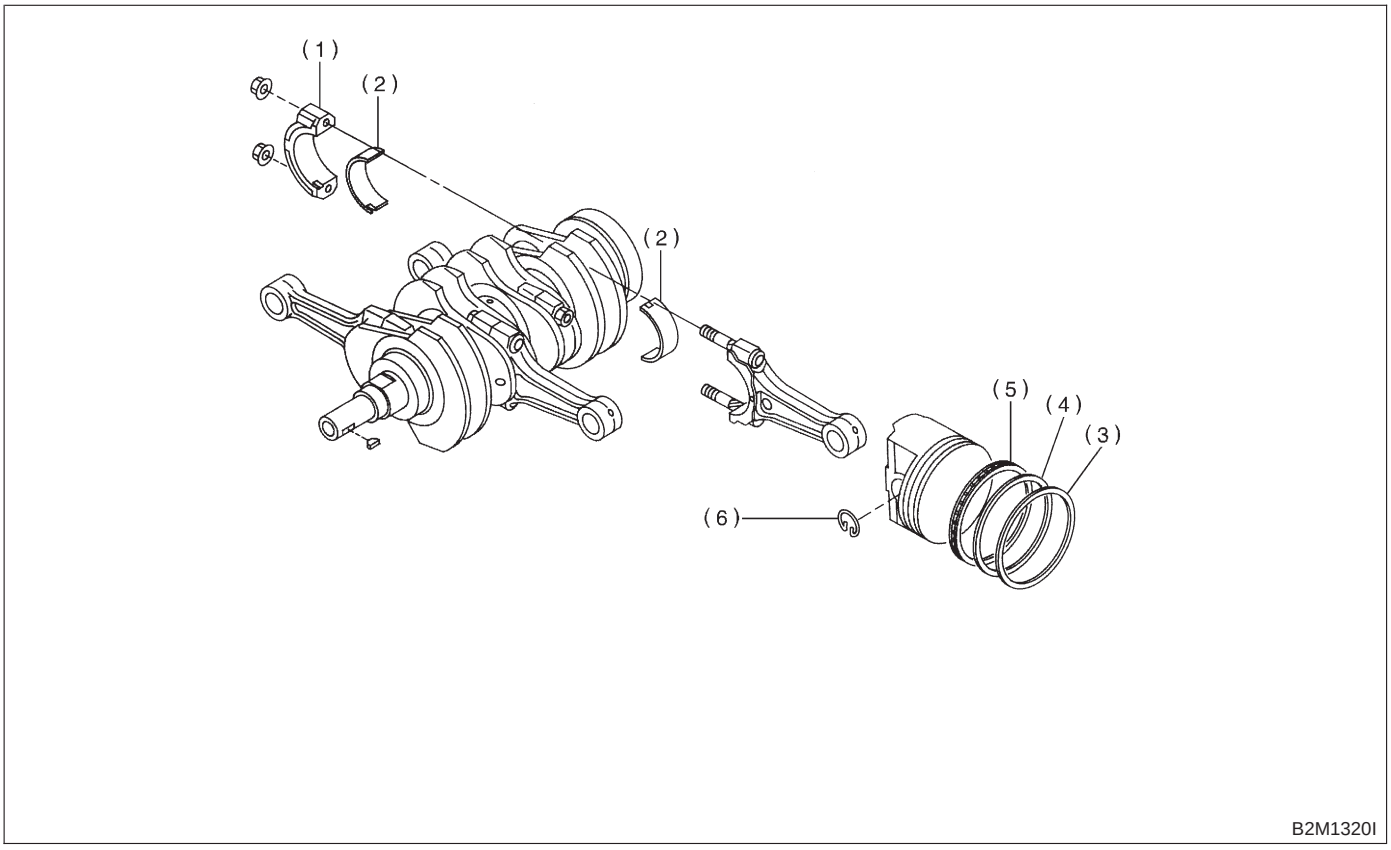
CAUTION:
When separating cylinder block, do not allow the connecting rod to fall and damage the cylinder block.

3) Remove rear oil seal.

4) Remove crankshaft together with connecting rod.
5) Remove crankshaft bearings from cylinder block using hammer handle.

CAUTION:
Do not confuse combination of crankshaft bearings. Press bearing at the end opposite to locking lip.

3. CRANKSHAFT AND PISTON



(1) Connecting rod cap
(2) Connecting rod bearing
(3) Top ring
(4) Second ring
(5) Oil ring
(6) Circlip

1) Remove connecting rod cap.
2) Remove connecting rod bearing.

CAUTION:
Arrange removed connecting rod, connecting rod cap and bearing in order to prevent confusion.

3) Remove piston rings using the piston ring expander.
4) Remove the oil ring by hand.

CAUTION:
Arrange the removed piston rings in good order to prevent confusion.

6) Draw out each piston from cylinder block using wooden bar or hammer handle.

CAUTION:
Do not confuse combination of piston and cylinder.

5) Remove circlip.

C: INSPECTION

1. CYLINDER BLOCK

1) Visually check for cracks and damage. Especially, inspect important parts by means of red lead check.
2) Check the oil passages for clogging.
3) Inspect crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

Warping limit:
0.05 mm (0.0020 in)

Grinding limit:
0.1 mm (0.004 in)

Standard height of cylinder block:
201.0 mm (7.91 in)

2. CYLINDER AND PISTON

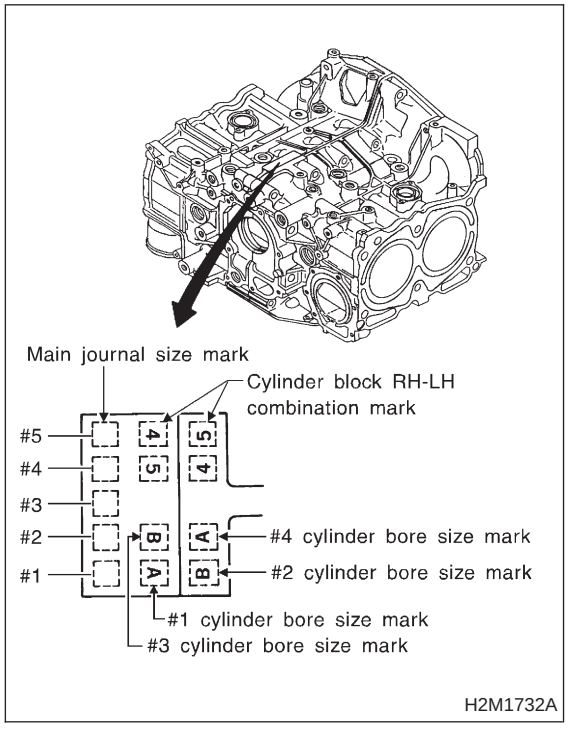
1) The cylinder bore size is stamped on the cylinder block's front upper surface.

CAUTION:
Measurement should be performed at a temperature 20°C (68°F).

NOTE:
Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as a guide line in selecting a standard piston.

Standard diameter (2200 cc)
A: 96.905 — 96.915 mm (3.8151 — 3.8155 in)
B: 96.895 — 96.905 mm (3.8148 — 3.8151 in)

Standard diameter (2500 cc)
A: 99.505 — 99.515 mm (3.9175 — 3.9179 in)
B: 99.495 — 99.505 mm (3.9171 — 3.9175 in)

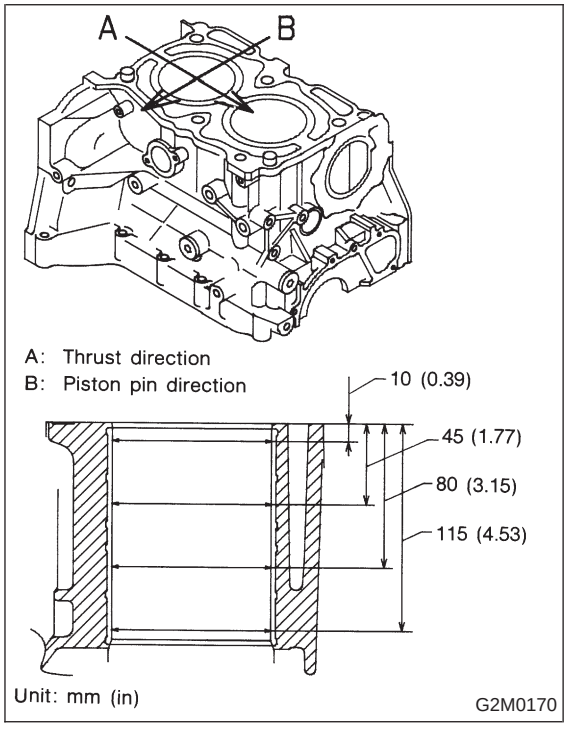


2) How to measure the inner diameter of each cylinder
Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights shown in the figure, using a cylinder bore gauge.

CAUTION:
Measurement should be performed at a temperature 20°C (68°F).

Taper:
Standard
0.015 mm (0.0006 in)
Limit
0.050 mm (0.0020 in)

Out-of-roundness:
Standard
0.010 mm (0.0004 in)
Limit
0.050 mm (0.0020 in)



3) When piston is to be replaced due to general or cylinder wear, determine a suitable sized piston by measuring the piston clearance.

4) How to measure the outer diameter of each piston
Measure the outer diameter of each piston at the height shown in the figure. (Thrust direction)

CAUTION:
Measurement should be performed at a temperature of 20°C (68°F).

Piston grade point H:
2200 cc: 40.0 mm (1.575 in)
2500 cc: 37.0 mm (1.457 in)

Piston outer diameter:

2200 cc:

Standard
A: 96.885 — 96.895 mm (3.8144 — 3.8148 in)

B: 96.875 — 96.885 mm (3.8140 — 3.8144 in)

0.25 mm (0.0098 in) oversize
97.125 — 97.135 mm (3.8238 — 3.8242 in)

0.50 mm (0.0197 in) oversize
97.375 — 97.385 mm (3.8337 — 3.8340 in)

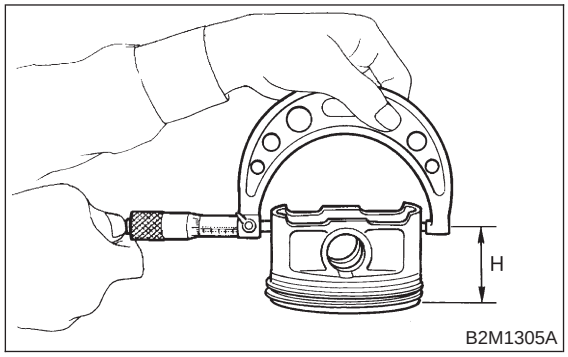
2500 cc:

Standard
A: 99.485 — 99.495 mm (3.9167 — 3.9171 in)

B: 99.475 — 99.485 mm (3.9163 — 3.9167 in)

0.25 mm (0.0098 in) oversize
99.725 — 99.735 mm (3.9262 — 3.9266 in)

0.50 mm (0.0197 in) oversize
99.975 — 99.985 mm (3.9360 — 3.9364 in)



5) Calculate the clearance between cylinder and piston.

CAUTION:
Measurement should be performed at a temperature of 20°C (68°F).

Cylinder to piston clearance at 20°C (68°F):
Standard
0.010 — 0.030 mm (0.0004 — 0.0012 in)
Limit
0.050 mm (0.0020 in)

6) Boring and honing

(1) If the value of taper, out-of-roundness, or cylinder- to-piston clearance measured exceeds the specified limit or if there is any damage on the cylinder wall, rebore it to use an oversize piston.

CAUTION:
When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only, nor use an oversize piston for one cylinder only.

(2) If the cylinder inner diameter exceeds the limit after boring and honing, replace the crankcase.

CAUTION:
Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

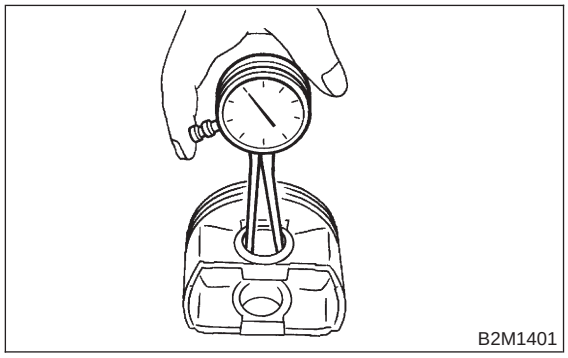
Limit of cylinder enlarging (boring):
0.5 mm (0.020 in)

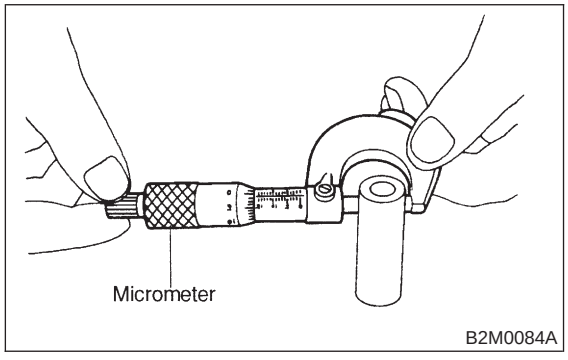
3. PISTON AND PISTON PIN

1) Check pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
2) Measure the piston-to-cylinder clearance at each cylinder. <Ref. to 2-3 [W6C2].> If any of the clearances is not to specification, replace the piston or bore the cylinder to use an oversize piston.

3) Make sure that piston pin can be inserted into the piston pin hole with a thumb at 20°C (68°F). Replace if defective.

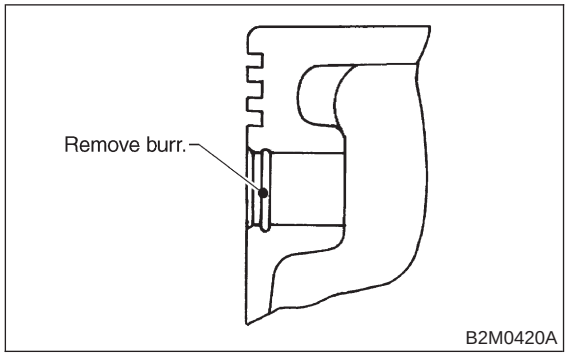
Standard clearance between piston pin and hole in piston:
Standard
0.004 — 0.008 mm (0.0002 — 0.0003 in)
Limit
0.020 mm (0.0008 in)


B2M1401



B2M0084A

4) Check circlip installation groove on the piston for burr. If necessary, remove burr from the groove so that piston pin can lightly move.



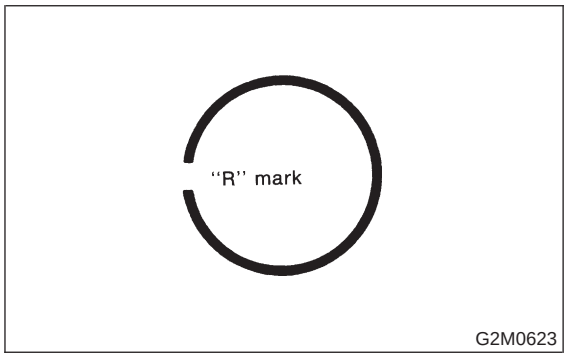
B2M0420A

5) Check piston pin circlip for distortion, cracks and wear.

4. PISTON RING

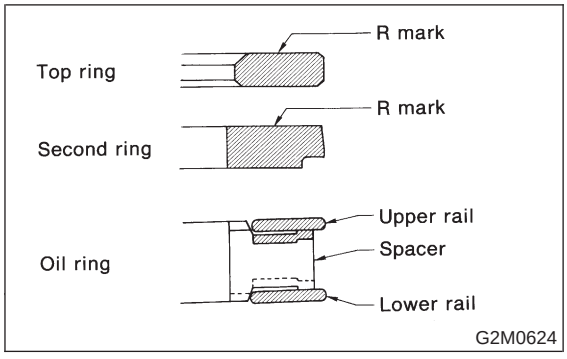
1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.

CAUTION:
● "R" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.



G2M0623

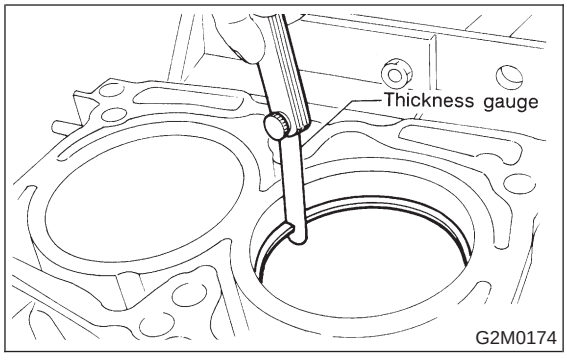
● The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful to assemble correctly.



G2M0624

2) Squarely place piston ring and oil ring in cylinder, and measure the piston ring gap with a thickness gauge.

		Unit: mm (in)	
		Standard	Limit
Piston ring gap	Top ring	0.20 — 0.35 (0.0079 — 0.0138)	1.0 (0.039)
	Second ring	0.37 — 0.52 (0.0146 — 0.0205)	1.0 (0.039)
	Oil ring rail	0.20 — 0.50 (0.0079 — 0.0197)	1.0 (0.039)

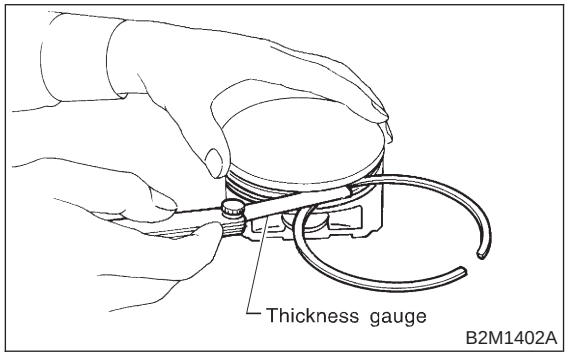


G2M0174

3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

CAUTION:
Before measuring the clearance, clean the piston ring groove and piston ring.

		Unit: mm (in)	
		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.040 — 0.080 (0.0016 — 0.0031)	0.15 (0.0059)
	Second ring	0.030 — 0.070 (0.0012 — 0.0028)	0.15 (0.0059)

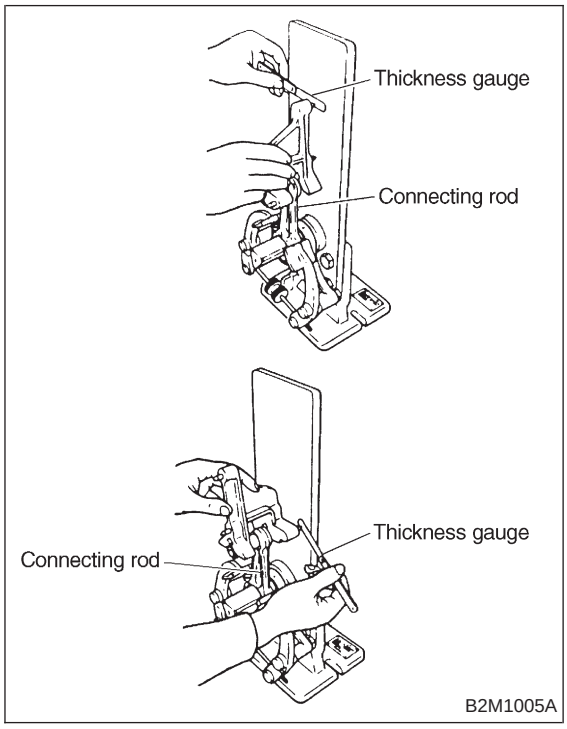


5. CONNECTING ROD

1) Replace connecting rod, if the large or small end thrust surface is damaged.

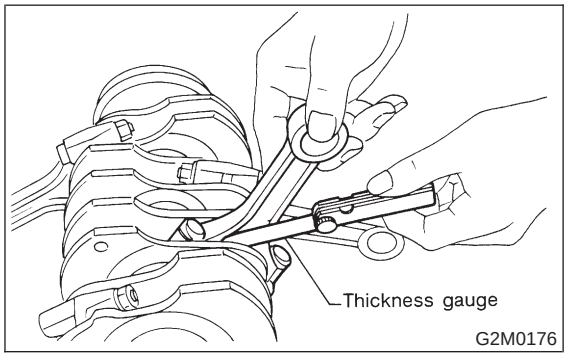
2) Check for bend or twist using a connecting rod aligner. Replace connecting rod if the bend or twist exceeds the limit.

Limit of bend or twist per 100 mm (3.94 in) in length:
0.10 mm (0.0039 in)



3) Install connecting rod fitted with bearing to crankshaft and measure the side clearance (thrust clearance). Replace connecting rod if the side clearance exceeds the specified limit.

Connecting rod side clearance:
Standard
0.070 — 0.330 mm (0.0028 — 0.0130 in)
Limit
0.4 mm (0.016 in)



4) Inspect connecting rod bearing for scar, peeling, seizure, melting, wear, etc.

5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge. If any oil clearance is not within specification, replace the defective bearing with a new one of standard size or undersize as necessary. (See the table below.)

Connecting rod oil clearance:

- ***2200 cc***
  Standard
  0.010 — 0.038 mm (0.0004 — 0.0015 in)
  Limit
  0.05 mm (0.0020 in)

Unit: mm (in)

Bearing	Bearing size (Thickness at center)	Outer diameter of crank pin
Standard	1.492 — 1.501 (0.0587 — 0.0591)	51.984 — 52.000 (2.0466 — 2.0472)
0.03 (0.0012) undersize	1.510 — 1.513 (0.0594 — 0.0596)	51.954 — 51.970 (2.0454 — 2.0461)
0.05 (0.0020) undersize	1.520 — 1.523 (0.0598 — 0.0600)	51.934 — 51.950 (2.0446 — 2.0453)
0.25 (0.0098) undersize	1.620 — 1.623 (0.0638 — 0.0639)	51.734 — 51.750 (2.0368 — 2.0374)

Connecting rod oil clearance:

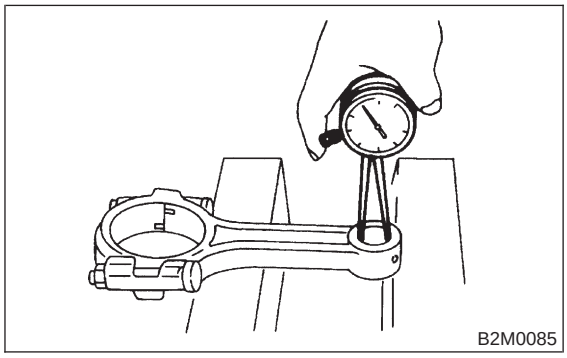
- ***2500 cc***
  Standard
  0.020 — 0.046 mm (0.0008 — 0.0018 in)
  Limit
  0.050 mm (0.0020 in)

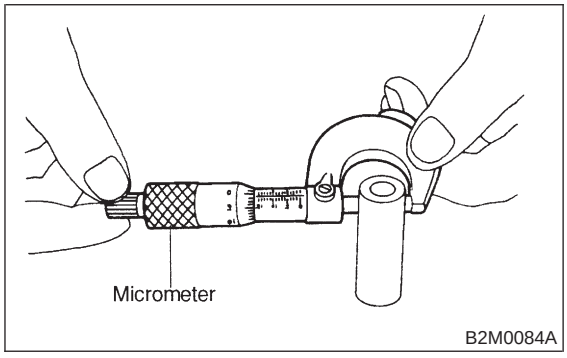
Unit: mm (in)

Bearing	Bearing size (Thickness at center)	Outer diameter of crank pin
Standard	1.486 — 1.498 (0.0585 — 0.0590)	51.984 — 52.000 (2.0466 — 2.0472)
0.03 (0.0012) undersize	1.504 — 1.512 (0.0592 — 0.0595)	51.954 — 51.970 (2.0454 — 2.0461)
0.05 (0.0020) undersize	1.514 — 1.522 (0.0596 — 0.0599)	51.934 — 51.950 (2.0446 — 2.0453)
0.25 (0.0098) undersize	1.614 — 1.622 (0.0635 — 0.0639)	51.734 — 51.750 (2.0368 — 2.0374)

6) Inspect bushing at connecting rod small end, and replace if worn or damaged. Also measure the piston pin clearance at the connecting rod small end.

Clearance between piston pin and bushing:
Standard
0 — 0.022 mm (0 — 0.0009 in)
Limit
0.030 mm (0.0012 in)

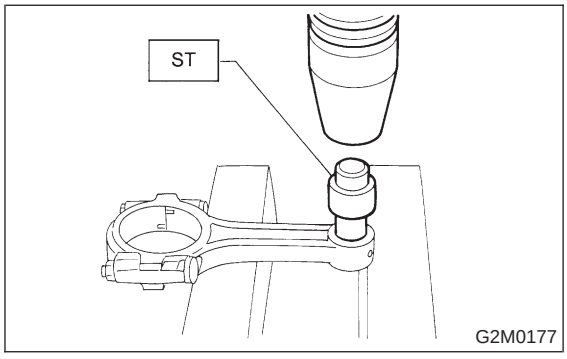

B2M0085



B2M0084A

7) Replacement procedure is as follows.
(1) Remove bushing from connecting rod with ST and press.
(2) Press bushing with ST after applying oil on the periphery of bushing.

ST 499037100 CONNECTING ROD BUSHING REMOVER AND INSTALLER



G2M0177

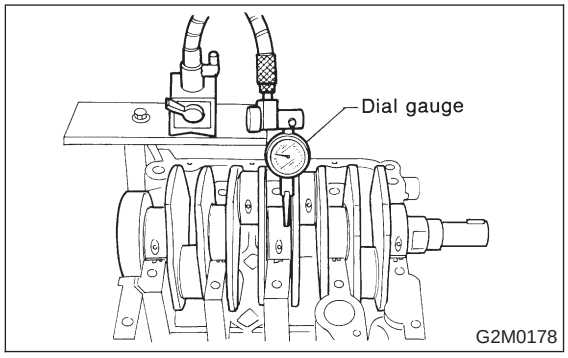
(3) Make two 3 mm (0.12 in) holes in bushing. Ream the inside of bushing.
(4) After completion of reaming, clean bushing to remove chips.

6. CRANKSHAFT AND CRANKSHAFT BEARING

1) Clean crankshaft completely and check for cracks by means of red lead check etc., and replace if defective.
2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.

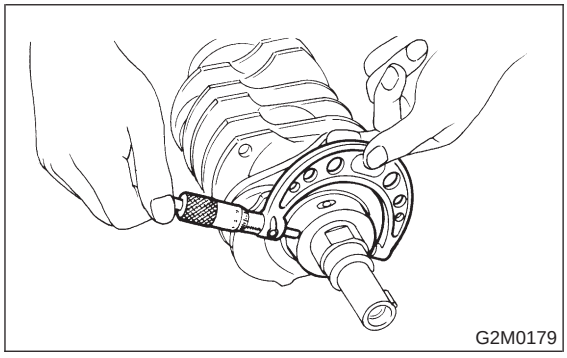
CAUTION:
If a suitable V-block is not available, install #1 and #5 crankshaft bearing on cylinder block, position crankshaft on these bearings and measure crankshaft bend using a dial gauge.

Crankshaft bend limit:
0.035 mm (0.0014 in)



3) Inspect the crank journal and crank pin for wear. If not to specifications, replace bearing with an undersize one, and replace or recondition crankshaft as necessary. When grinding crank journal or crank pin, finish them to the specified dimensions according to the undersize bearing to be used.

Crank pin and crank journal:
Out-of-roundness
0.030 mm (0.0012 in) or less
Taper limit
0.07 mm (0.0028 in)
Grinding limit
0.250 mm (0.0098 in)



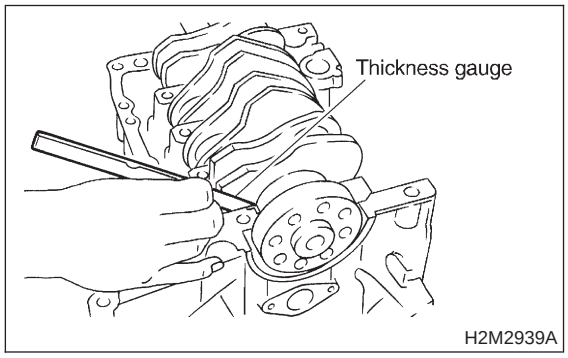
Unit: mm (in)

		Crank journal diameter		Crank pin diameter
		#1, #3	#2, #4, #5	
Standard	Journal O.D.	59.992 — 60.008 (2.3619 — 2.3625)	59.992 — 60.008 (2.3619 — 2.3625)	51.984 — 52.000 (2.0466 — 2.0472)
	Bearing size (Thickness at center)	1.998 — 2.011 (0.0787 — 0.0792)	2.000 — 2.013 (0.0787 — 0.0793)	1.492 — 1.501 (0.0587 — 0.0591)
0.03 (0.0012) undersize	Journal O.D.	59.962 — 59.978 (2.3607 — 2.3613)	59.962 — 59.978 (2.3607 — 2.3613)	51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.022 (0.0795 — 0.0796)	1.510 — 1.513 (0.0594 — 0.0596)
0.05 (0.0020) undersize	Journal O.D.	59.942 — 59.958 (2.3599 — 2.3605)	59.942 — 59.958 (2.3599 — 2.3605)	51.934 — 51.950 (2.0446 — 2.0453)
	Bearing size (Thickness at center)	2.027 — 2.030 (0.0798 — 0.0799)	2.029 — 2.032 (0.0799 — 0.0800)	1.520 — 1.523 (0.0598 — 0.0600)
0.25 (0.0098) undersize	Journal O.D.	59.742 — 59.758 (2.3520 — 2.3527)	59.742 — 59.758 (2.3520 — 2.3527)	51.734 — 51.750 (2.0368 — 2.0374)
	Bearing size (Thickness at center)	2.127 — 2.130 (0.0837 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	1.620 — 1.623 (0.0638 — 0.0639)

O.D. ... Outer Diameter

4) Measure the thrust clearance of crankshaft at center bearing. If the clearance exceeds the limit, replace bearing.

Crankshaft thrust clearance:
Standard
0.030 — 0.115 mm (0.0012 — 0.0045 in)
Limit
0.25 mm (0.0098 in)

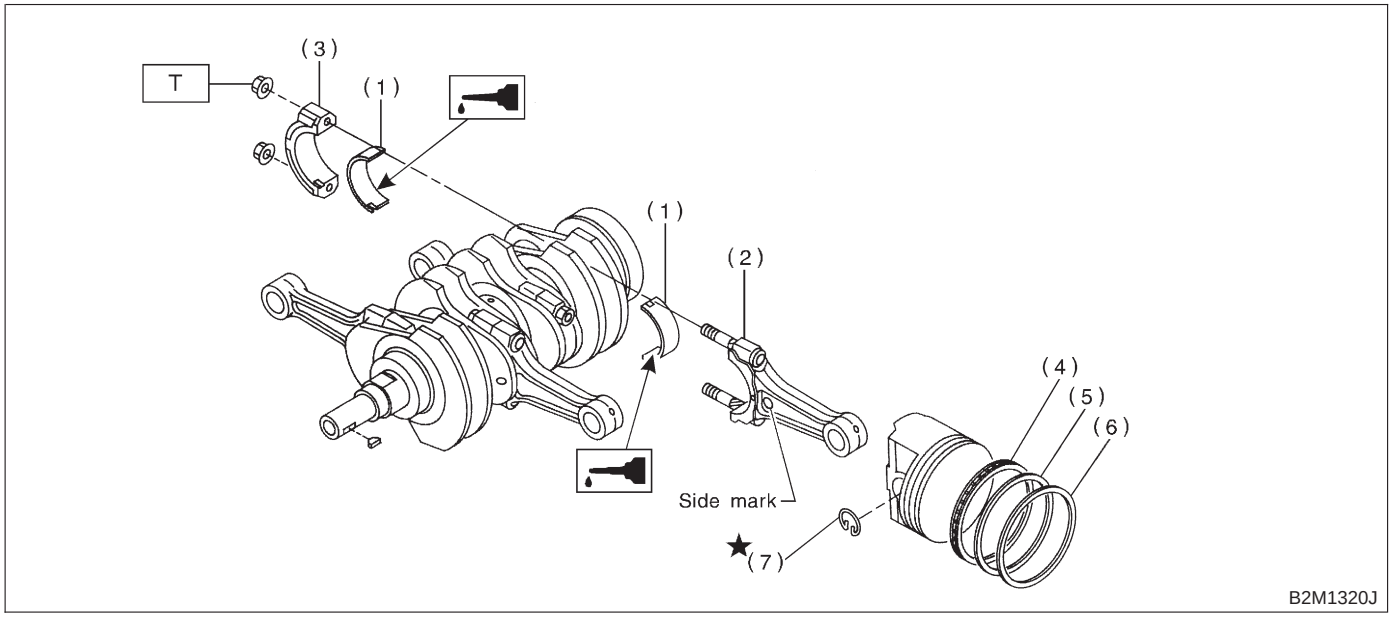


5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.
6) Measure the oil clearance on each crankshaft bearing by means of plastigauge. If the measurement is not within the specification, replace defective bearing with an undersize one, and replace or recondition crankshaft as necessary.

Unit: mm (in)	
Crankshaft oil clearance	
Standard	0.010 — 0.030 (0.0004 — 0.0012)
Limit	0.040 (0.0016)

D: ASSEMBLY

1. CRANKSHAFT AND PISTON



(1) Connecting rod bearing
(2) Connecting rod
(3) Connecting rod cap
(4) Oil ring
(5) Second ring
(6) Top ring
(7) Circlip

Tightening torque: N·m (kg-m, ft-lb)
T: 44±2 (4.5±0.2, 32.5±1.4)

1) Install connecting rod bearings on connecting rods and connecting rod caps.

CAUTION:
Apply oil to the surfaces of the connecting rod bearings.

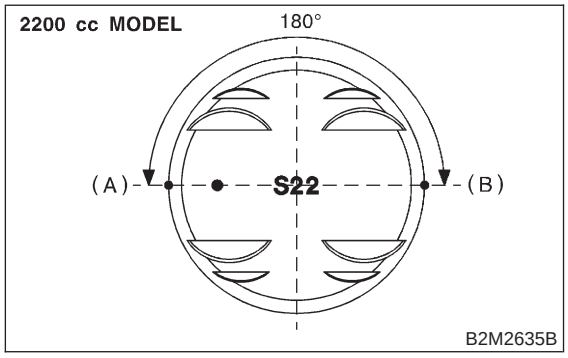
2) Install connecting rod on crankshaft.

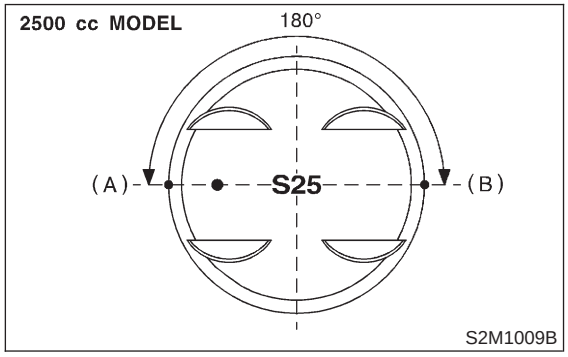
CAUTION:
Position each connecting rod with the side marked facing forward.

3) Install connecting rod cap with connecting rod nut.
Ensure the arrow on connecting rod cap faces the front during installation.

CAUTION:
● Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.
● When tightening the connecting rod nuts, apply oil on the threads.

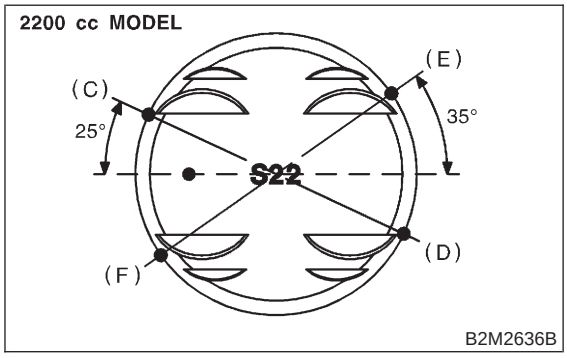
4) Installation of piston rings and oil ring
(1) Install oil ring spacer, upper rail and lower rail in this order by hand. Then install second ring and top ring with a piston ring expander.
(2) Position the top ring gap at (A) or (B) in the figure.

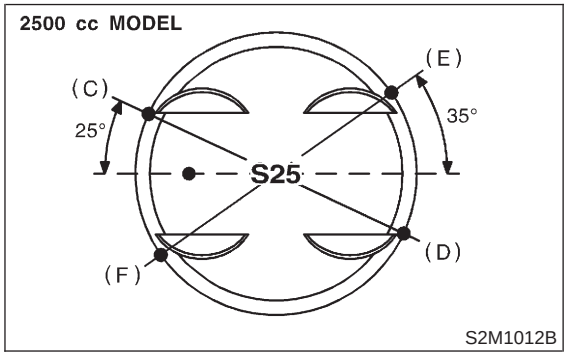




(3) Position the second ring gap at 180° on the reverse side for the top ring gap.

(4) Position the upper rail gap at (C) or (D) in the figure.

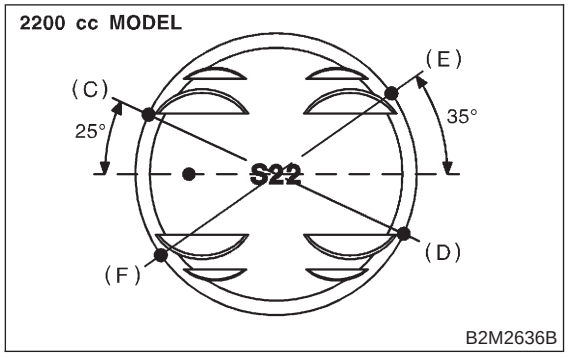


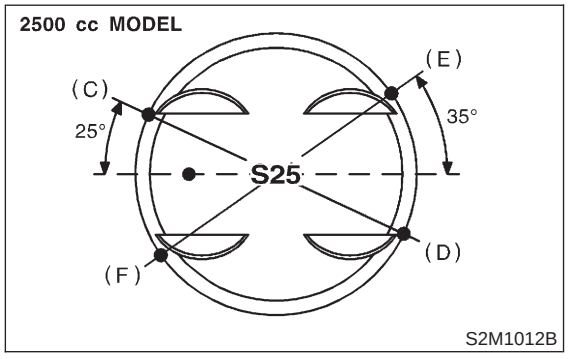


(5) Position the expander gap at 180° of the reverse side for the upper rail gap.

(6) Position the lower rail gap at (E) or (F) in the figure.

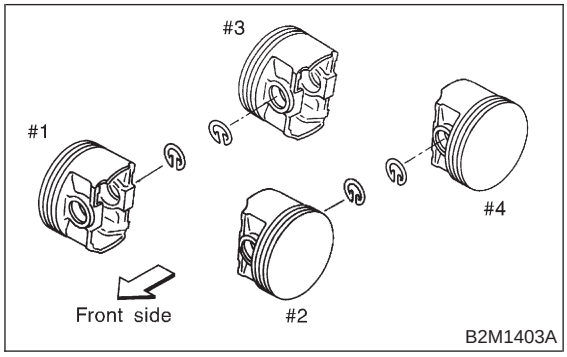
CAUTION:
● Ensure ring gaps do not face the same direction.
● Ensure ring gaps are not within the piston skirt area.



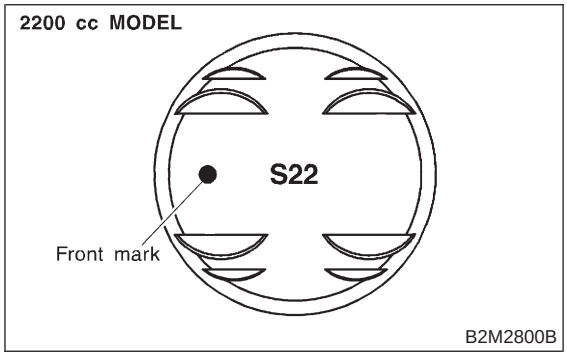


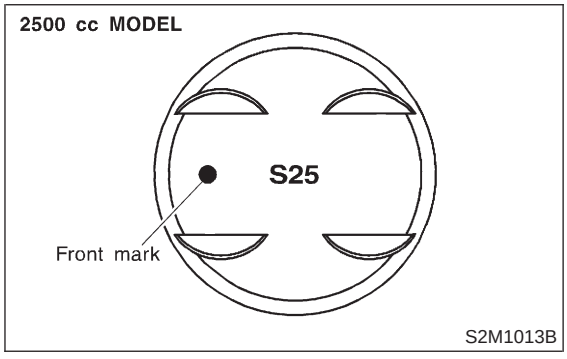
5) Install circlip.
Install circlips in piston holes located opposite service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

CAUTION:
Use new circlips.

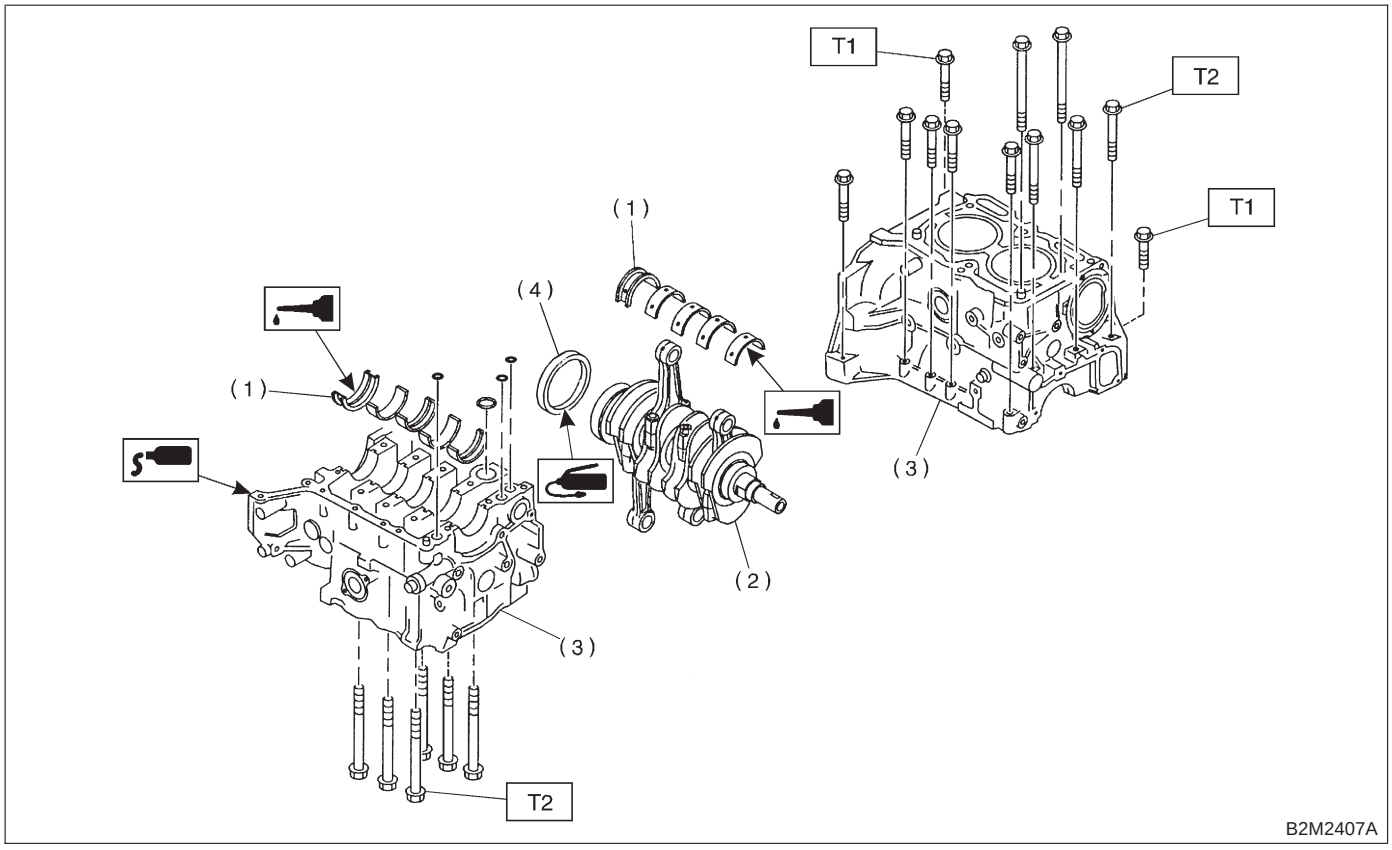


CAUTION:
Piston front mark faces towards the front of the engine.





2. CYLINDER BLOCK



(1) Crankshaft bearing
(2) Crankshaft
(3) Cylinder block
(4) Rear oil seal

Tightening torque: N·m (kg-m, ft-lb)
T1: 25±2 (2.5±0.2, 18.1±1.4)
T2: 47±3 (4.8±0.3, 34.7±2.2)

1) Install ST to cylinder block, then install crankshaft bearings.
ST 499817000 ENGINE STAND

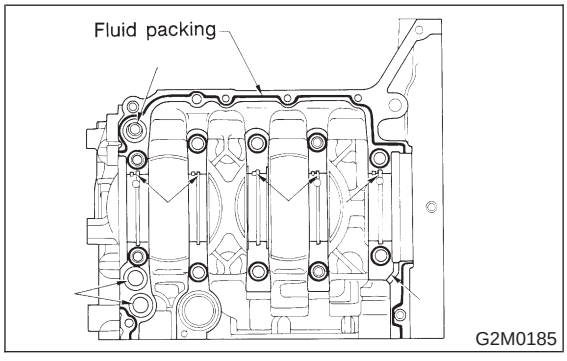
CAUTION:
Remove oil in the mating surface of bearing and cylinder block before installation. Also apply a coat of engine oil to crankshaft pins.

2) Position crankshaft on the #2 and #4 cylinder block.

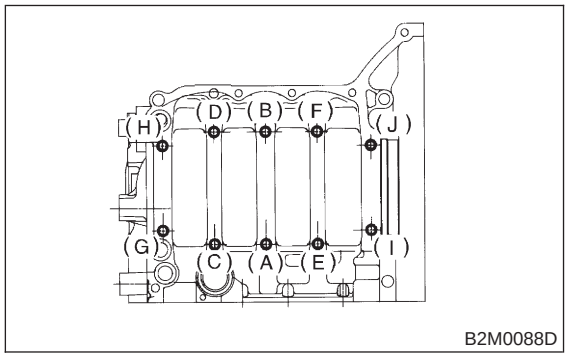
3) Apply fluid packing to the mating surface of #1 and #3 cylinder block, and position it on #2 and #4 cylinder block.

Fluid packing:
THREE BOND 1215 or equivalent

CAUTION:
Do not allow fluid packing to jut into O-ring grooves, oil passages, bearing grooves, etc.

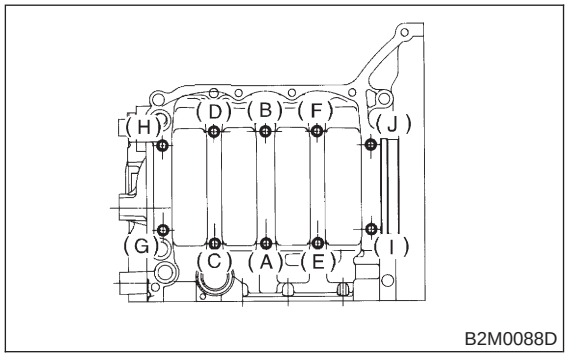


4) Temporarily tighten 10 mm cylinder block connecting bolts in alphabetical sequence shown in figure.



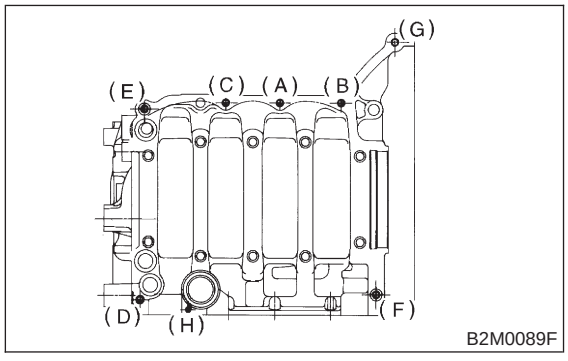
5) Tighten 10 mm cylinder block connecting bolts in alphabetical sequence.

Tightening torque:
47±3 N·m (4.8±0.3 kg-m, 34.7±2.2 ft-lb)

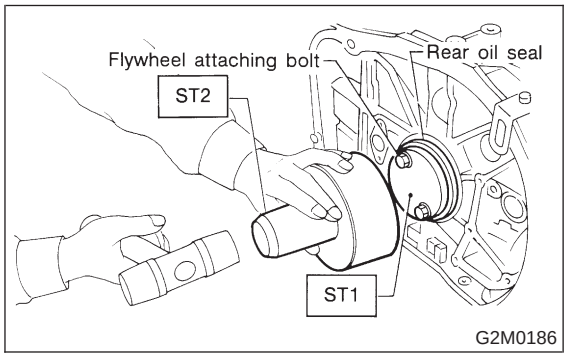


6) Tighten 8 mm and 6 mm cylinder block connecting bolts in alphabetical sequence shown in figure.

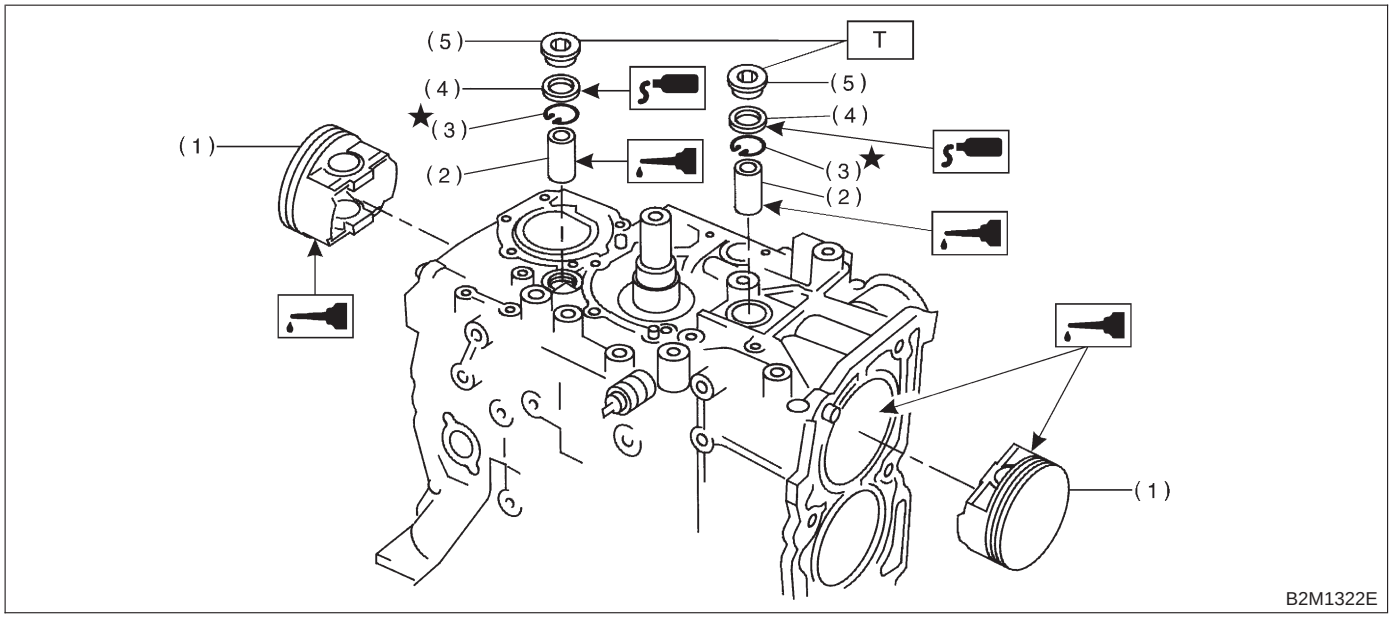
Tightening torque:
(A) — (G): 25±2 N·m (2.5±0.2 kg-m, 18.1±1.4 ft-lb)
(H): 6.4 N·m (0.65 kg-m, 4.7 ft-lb)



7) Install rear oil seal using ST1 and ST2.
ST1 499597100 OIL SEAL GUIDE
ST2 499587200 OIL SEAL INSTALLER



3. PISTON AND PISTON PIN (#1 AND #2)



(1) Piston
(2) Piston pin
(3) Circlip
(4) Gasket
(5) Service hole plug

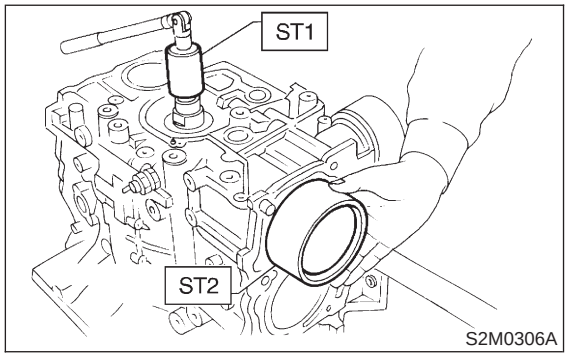
Tightening torque: N·m (kg-m, ft-lb)
T: 69±7 (7.0±0.7, 50.6±5.1)

1) Installing piston
(1) Turn cylinder block so that #1 and #2 cylinders face upward.
(2) Using ST1, turn crankshaft so that #1 and #2 connecting rods are set at bottom dead center.

ST1 499987500 CRANKSHAFT SOCKET

(3) Apply a coat of engine oil to pistons and cylinders and insert pistons in their cylinders using ST2.

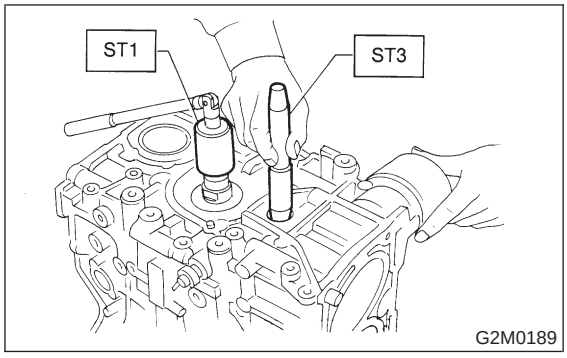
ST2 498747100 PISTON GUIDE



2) Installing piston pin
(1) Insert ST3 into service hole to align piston pin hole with connecting rod small end.

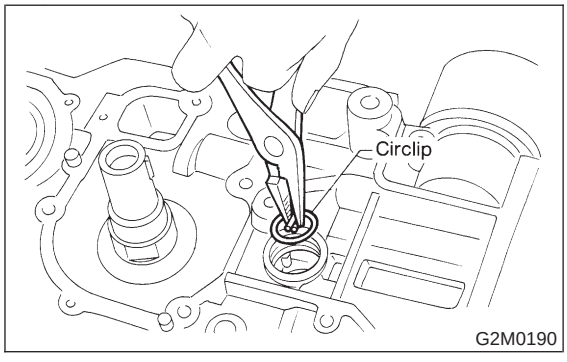
CAUTION:
Apply a coat of engine oil to ST3 before insertion.

ST3 499017100 PISTON PIN GUIDE



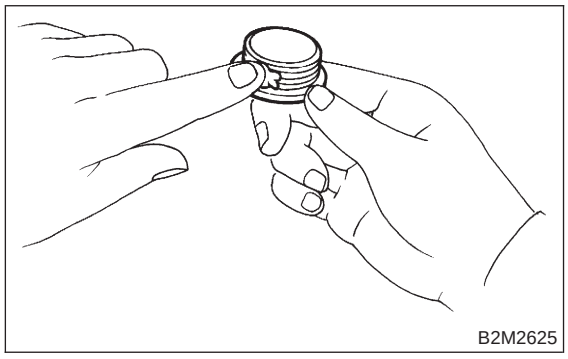
(2) Apply a coat of engine oil to piston pin and insert piston pin into piston and connecting rod through service hole.
(3) Install circlip.

CAUTION:
Use new circlips.



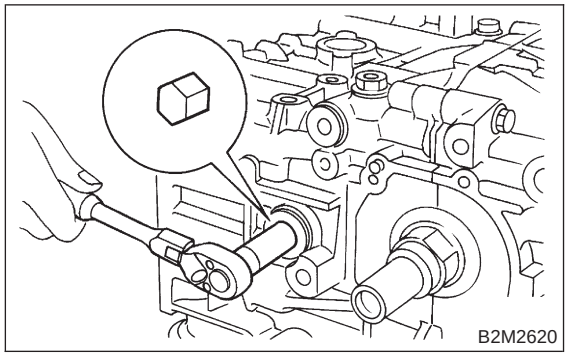
(4) Apply fluid packing around the service hole plug.

Fluid packing:
THREE BOND 1215 or equivalent

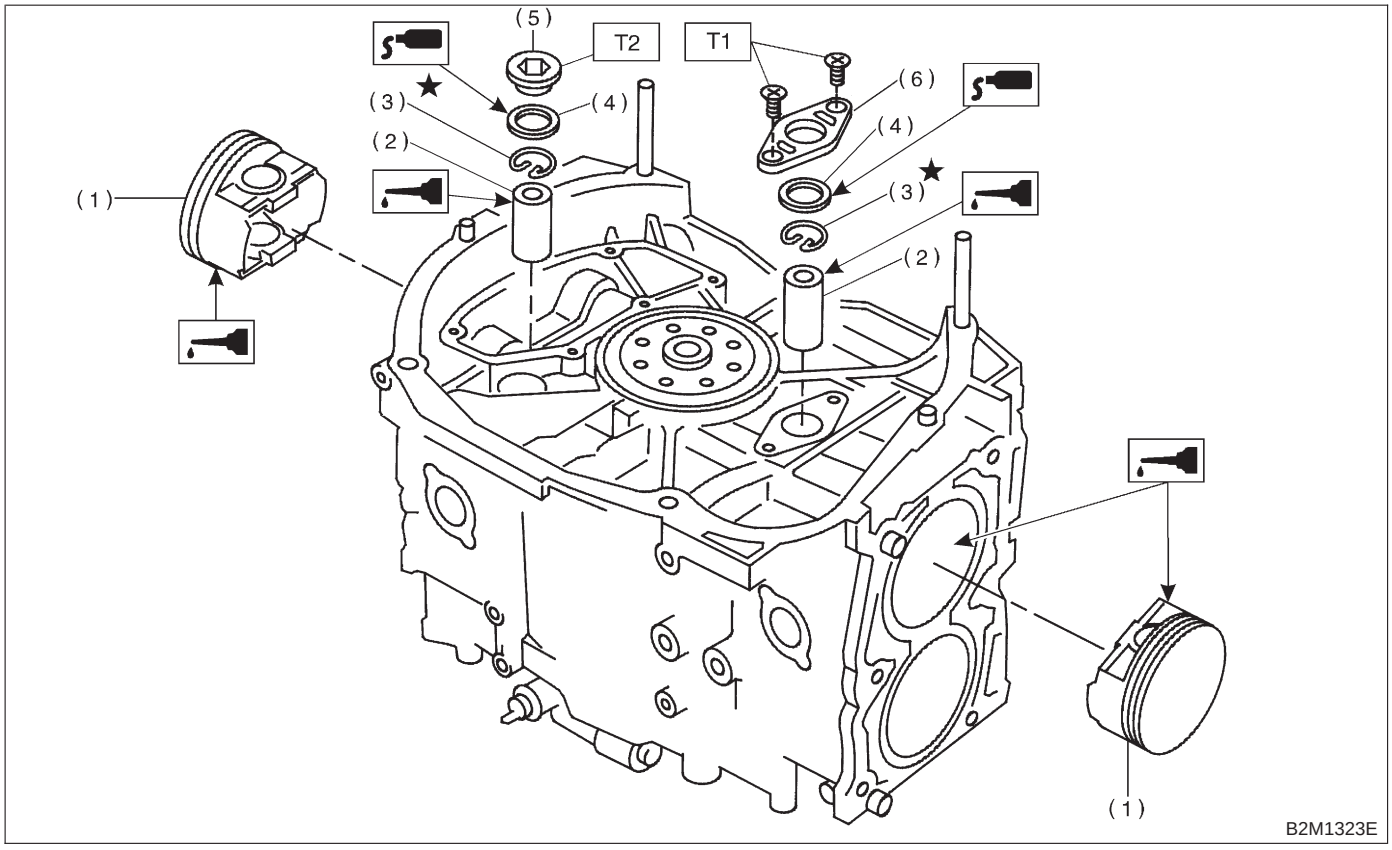


(5) Install service hole plug and gasket.

CAUTION:
Use a new gasket.



4. PISTON AND PISTON PIN (#3 AND #4)



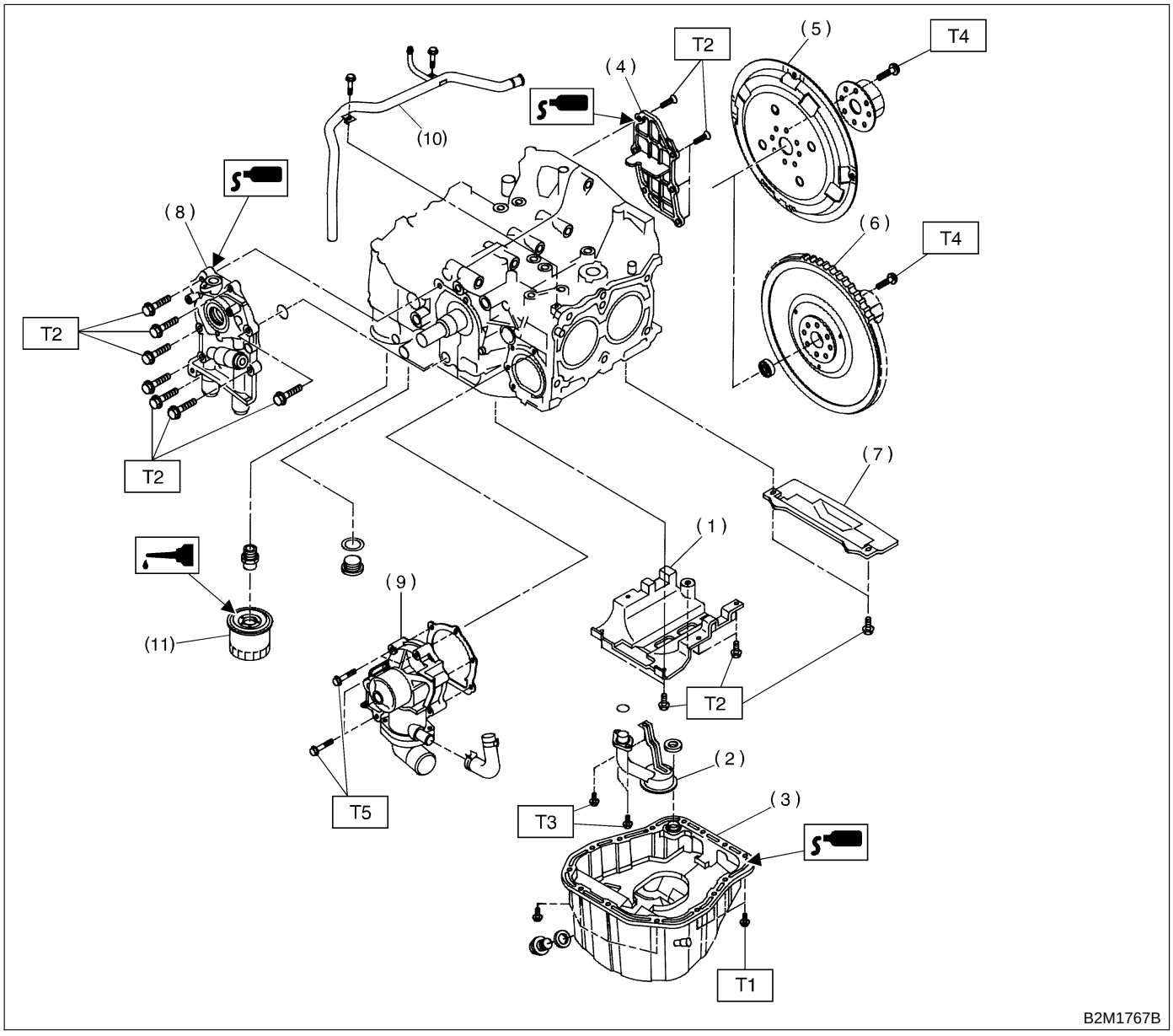
(1) Piston
(2) Piston pin
(3) Circlip
(4) Gasket
(5) Service hole plug
(6) Service hole cover

Tightening torque: N·m (kg-m, ft-lb)
T1: 6.4 (0.65, 4.7)
T2: 69±7 (7.0±0.7, 50.6±5.1)

Turn cylinder block so that #3 and #4 cylinders face upward. Using the same procedures as used for #1 and #2 cylinders, install pistons and piston pins.

E: INSTALLATION

1. OIL PUMP AND WATER PUMP



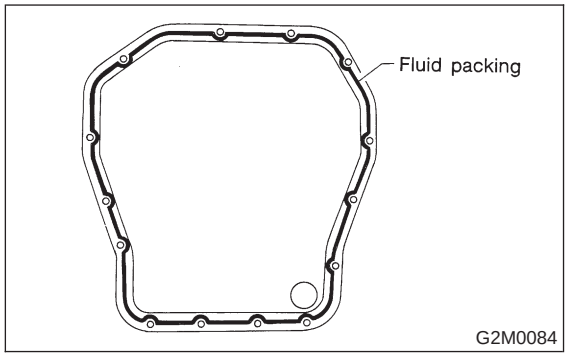
(1) Baffle plate
(2) Oil strainer
(3) Oil pan
(4) Oil separater cover
(5) Drive plate (AT vehicles only)
(6) Flywheel (MT vehicles only)
(7) Clutch housing cover (MT vehicles only)
(8) Oil pump
(9) Water pump
(10) Water by-pass pipe
(11) Oil filter

Tightening torque: N·m (kg-m, ft-lb)
T1: 5 (0.5, 3.6)
T2: 6.4 (0.65, 4.7)
T3: 10 (1.0, 7)
T4: 72±3 (7.3±0.3, 52.8±2.2)
T5: First 12±2 (1.2±0.2, 8.7±1.4)
Second 12±2 (1.2±0.2, 8.7±1.4)

1) Install baffle plate.
2) Install oil strainer and O-ring
3) Install oil strainer stay.

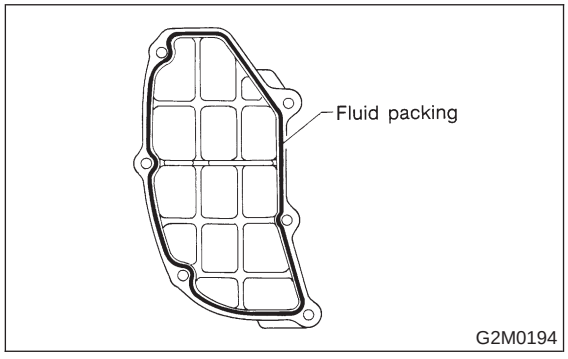
4) Apply fluid packing to matching surfaces and install oil pan.

Fluid packing:
THREE BOND 1215 or equivalent

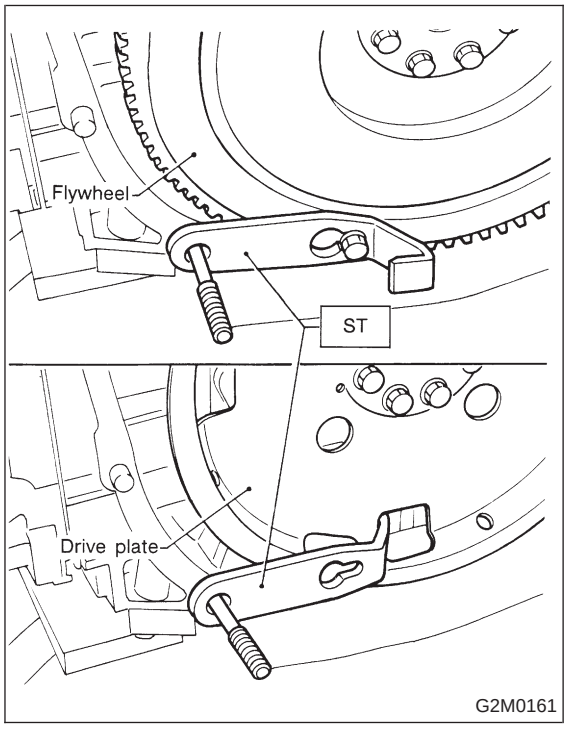


5) Apply fluid packing to matching surfaces and install oil separator cover.

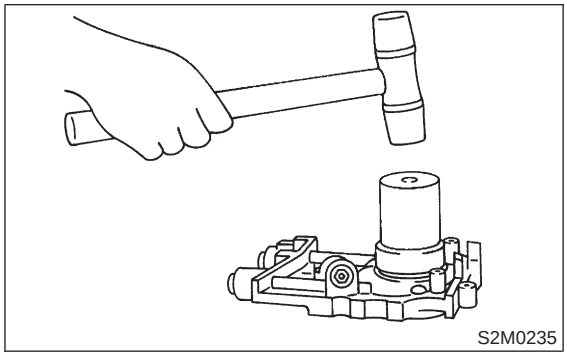
Fluid packing:
THREE BOND 1215 or equivalent



6) Install flywheel or drive plate.
To lock crankshaft, use ST.
ST 498497100 CRANKSHAFT STOPPER

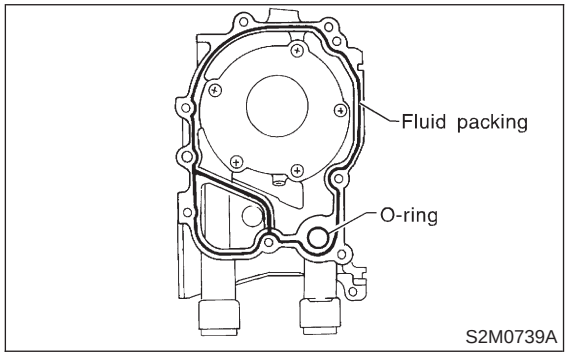


7) Install housing cover.
8) Installation of oil pump
(1) Discard front oil seal after removal. Replace with a new one using ST.
ST 499587100 OIL SEAL INSTALLER

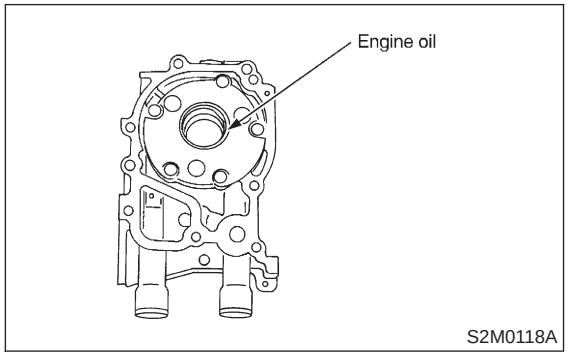


(2) Apply fluid packing to matching surface of oil pump.

Fluid packing:
THREE BOND 1215 or equivalent



(3) Apply a coat of engine oil to the inside of the oil seal.

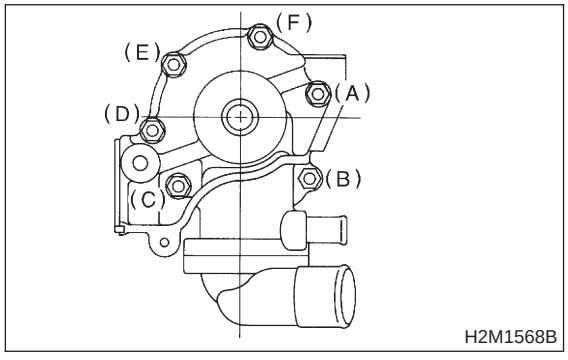


(4) Install oil pump on cylinder block. Be careful not to damage oil seal during installation.

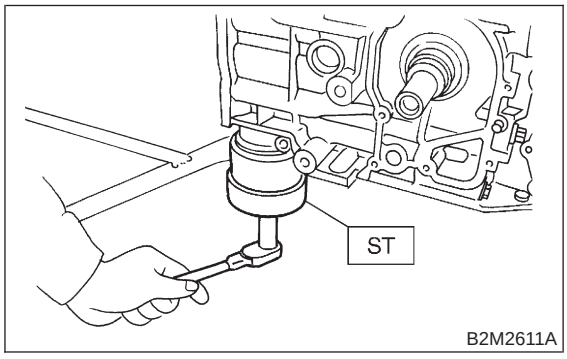
CAUTION:
● Do not forget to install O-ring and seal when installing oil pump.
● Align flat surface of oil pump's inner rotor with crankshaft before installation.

9) Install water pump and gasket.

CAUTION:
● Be sure to use a new gasket.
● When installing water pump, tighten bolts in two stages in alphabetical sequence as shown in figure.



10) Install water by-pass pipe for heater.
11) Install oil filter using ST.
ST 498187300 OIL FILTER WRENCH



2. RELATED PARTS

1) Install cylinder head, valve rocker assembly and rocker cover.
<Ref. to 2-3 [W5E0].>
2) Install timing belt and camshaft sprocket.
<Ref. to 2-3 [W2C0].>
3) Install water pipe. <Ref. to 2-5 [W8B0].>
4) Install intake manifold. <Ref. to 2-7 [W4D0].>

1. Engine Trouble in General

NOTE:
"RANK" shown in the chart refer to the possibility of reason for the trouble in order ("Very often" to "Rarely")
A — Very often
B — Sometimes
C — Rarely

TROUBLE	PROBLEM PARTS, ETC.	POSSIBLE CAUSE	RANK
1. Engine will not start.			
1) Starter does not turn.	● Starter	● Defective battery-to-starter harness	B
		● Defective starter switch	C
		● Defective inhibitor switch or neutral switch	C
		● Defective starter	B
	● Battery	● Poor terminal connection	A
		● Run-down battery	A
		● Defective charging system	B
	● Friction	● Seizure of crankshaft and connecting rod bearing	C
		● Seized camshaft	C
		● Seized or stuck piston and cylinder	C
2) Initial combustion does not occur.	● Starter	● Defective starter	C
	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Fuel line	● Defective fuel pump and relay	A
		● Lack of or insufficient fuel	B
	● Belt	● Defective	B
		● Defective timing	B
	● Compression	● Incorrect valve clearance	C
		● Loosened spark plugs or defective gasket	C
		● Loosened cylinder head bolts or defective gasket	C
		● Improper valve seating	C
		● Defective valve stem	C
		● Worn or broken valve spring	B
		● Worn or stuck piston rings, cylinder and piston	C
		● Incorrect valve timing	B
		● Improper engine oil (low viscosity)	B

TROUBLE	PROBLEM PARTS, ETC.	POSSIBLE CAUSE	RANK
3) Initial combustion occur.	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Defective intake manifold gasket	B
		● Defective throttle body gasket	B
	● Fuel line	● Defective fuel pump and relay	C
		● Clogged fuel line	C
		● Lack of or insufficient fuel	B
	● Belt	● Defective	B
		● Defective timing	B
	● Compression	● Incorrect valve clearance	C
		● Loosened spark plugs or defective gasket	C
		● Loosened cylinder head bolts or defective gasket	C
		● Improper valve seating	C
		● Defective valve stem	C
		● Worn or broken valve spring	B
		● Worn or stuck piston rings, cylinder and piston	C
		● Incorrect valve timing	B
		● Improper engine oil (low viscosity)	B
4) Engine stalls after initial combustion.	Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Loosened or cracked intake duct	B
		● Loosened or cracked PCV hose	C
		● Loosened or cracked vacuum hose	C
		● Defective intake manifold gasket	B
		● Defective throttle body gasket	B
		● Dirty air cleaner element	C
	● Fuel line	● Clogged fuel line	C
		● Lack of or insufficient fuel	B
	● Belt	● Defective	B
		● Defective timing	B
	● Compression	● Incorrect valve clearance	C
		● Loosened spark plugs or defective gasket	C
		● Loosened cylinder head bolts or defective gasket	C
		● Improper valve seating	C
		● Defective valve stem	C
		● Worn or broken valve spring	B
		● Worn or stuck piston rings, cylinder and piston	C
		● Incorrect valve timing	B
		● Improper engine oil (low viscosity)	B

TROUBLE	PROBLEM PARTS, ETC.	POSSIBLE CAUSE	RANK
2. Rough idle and engine stall	Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Loosened or cracked intake duct	A
		● Loosened or cracked PCV hose	A
		● Loosened or cracked vacuum hose	A
		● Defective intake manifold gasket	B
		● Defective throttle body gasket	B
		● Defective PCV valve	C
		● Loosened oil filter cap	B
		● Dirty air cleaner element	C
	● Fuel line	● Defective fuel pump and relay	C
		● Clogged fuel line	C
		● Lack of or insufficient fuel	B
	● Belt	● Defective timing	C
	● Compression	● Incorrect valve clearance	B
		● Loosened spark plugs or defective gasket	B
		● Loosened cylinder head bolts or defective gasket	B
		● Improper valve seating	B
		● Defective valve stem	C
		● Worn or broken valve spring	B
		● Worn or stuck piston rings, cylinder and piston	B
		● Incorrect valve timing	A
		● Improper engine oil (low viscosity)	B
	● Lubrication system	● Incorrect oil pressure	B
		● Defective rocker cover gasket	C
	● Cooling system	● Overheating	C
	● Others	● Malfunction of evaporative emission control system	A
		● Stuck or damaged throttle valve	B
		● Accelerator cable out of adjustment	C

TROUBLE	PROBLEM PARTS, ETC.	POSSIBLE CAUSE	RANK
3. Low output, hesitation and poor acceleration	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Loosened or cracked intake duct	A
		● Loosened or cracked PCV hose	A
		● Loosened or cracked vacuum hose	B
		● Defective intake manifold gasket	B
		● Defective throttle body gasket	B
		● Defective PCV valve	B
		● Loosened oil filter cap	B
		● Dirty air cleaner element	A
	● Fuel line	● Defective fuel pump and relay	B
		● Clogged fuel line	B
		● Lack of or insufficient fuel	C
	● Belt	● Defective timing	B
	● Compression	● Incorrect valve clearance	B
		● Loosened spark plugs or defective gasket	B
		● Loosened cylinder head bolts or defective gasket	B
		● Improper valve seating	B
		● Defective valve stem	C
		● Worn or broken valve spring	B
		● Worn or stuck piston rings, cylinder and piston	C
		● Incorrect valve timing	A
		● Improper engine oil (low viscosity)	B
	● Lubrication system	● Incorrect oil pressure	B
	● Cooling system	● Overheating	C
		● Over cooling	C
	● Others	● Malfunction of evaporative emission control system	A

TROUBLE	PROBLEM PARTS, ETC.	POSSIBLE CAUSE	RANK
4. Surging	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Loosened or cracked intake duct	A
		● Loosened or cracked PCV hose	A
		● Loosened or cracked vacuum hose	A
		● Defective intake manifold gasket	B
		● Defective throttle body gasket	B
		● Defective PCV valve	B
		● Loosened oil filter cap	B
		● Dirty air cleaner element	B
	● Fuel line	● Defective fuel pump and relay	B
		● Clogged fuel line	B
		● Lack of or insufficient fuel	C
	● Belt	● Defective timing	B
	● Compression	● Incorrect valve clearance	B
		● Loosened spark plugs or defective gasket	C
		● Loosened cylinder head bolts or defective gasket	C
		● Improper valve seating	C
		● Defective valve stem	C
		● Worn or broken valve spring	C
		● Worn or stuck piston rings, cylinder and piston	C
		● Incorrect valve timing	A
		● Improper engine oil (low viscosity)	B
	● Cooling system	● Overheating	B
	● Others	● Malfunction of evaporative emission control system	C
5. Engine does not return to idle.	Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Loosened or cracked vacuum hose	A
	● Others	● Stuck or damaged throttle valve	A
		● Accelerator cable out of adjustment	B
6. Dieseling (Run-on)	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Cooling system	● Overheating	B
	● Others	● Malfunction of evaporative emission control system	B

TROUBLE	PROBLEM PARTS, ETC.	POSSIBLE CAUSE	RANK
7. After burning in exhaust system	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Loosened or cracked intake duct	C
		● Loosened or cracked PCV hose	C
		● Loosened or cracked vacuum hose	B
		● Defective PCV valve	B
		● Loosened oil filter cap	C
	● Belt	● Defective timing	B
	● Compression	● Incorrect valve clearance	B
		● Loosened spark plugs or defective gasket	C
		● Loosened cylinder head bolts or defective gasket	C
		● Improper valve seating	B
		● Defective valve stem	C
		● Worn or broken valve spring	C
		● Worn or stuck piston rings, cylinder and piston	C
		● Incorrect valve timing	A
	● Lubrication system	● Incorrect oil pressure	C
	● Cooling system	● Over cooling	C
	● Others	● Malfunction of evaporative emission control system	C
8. Knocking	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Loosened oil filter cap	B
	● Belt	● Defective timing	B
	● Compression	● Incorrect valve clearance	C
		● Incorrect valve timing	B
	● Cooling system	● Overheating	A
9. Excessive engine oil consumption	● Intake system	● Loosened or cracked PCV hose	A
		● Defective PCV valve	B
		● Loosened oil filter cap	C
	● Compression	● Defective valve stem	A
		● Worn or stuck piston rings, cylinder and piston	A
	● Lubrication system	● Loosened oil pump attaching bolts and defective gasket	B
		● Defective oil filter seal	B
		● Defective crankshaft oil seal	B
		● Defective rocker cover gasket	B
		● Loosened oil drain plug or defective gasket	B
		● Loosened oil pan fitting bolts or defective oil pan	B

TROUBLE	PROBLEM PARTS, ETC.	POSSIBLE CAUSE	RANK
10. Excessive fuel consumption	● Fuel injection system <Ref. to 2-7 [T6A0].>		A
	● Intake system	● Dirty air cleaner element	A
	● Belt	● Defective timing	B
	● Compression	● Incorrect valve clearance	B
		● Loosened spark plugs or defective gasket	C
		● Loosened cylinder head bolts or defective gasket	C
		● Improper valve seating	B
		● Defective valve stem	C
		● Worn or broken valve spring	C
		● Worn or stuck piston rings, cylinder and piston	B
		● Incorrect valve timing	B
	● Lubrication system	● Incorrect oil pressure	C
	● Cooling system	● Over cooling	C
	● Others	● Accelerator cable out of adjustment	B

2. Engine Noise

Type of sound	Condition	Possible cause
Regular clicking sound	Sound increases as engine speed increases.	● Valve mechanism is defective. ● Incorrect valve clearance ● Worn valve rocker ● Worn camshaft ● Broken valve spring
Heavy and dull clank	Oil pressure is low.	● Worn crankshaft main bearing ● Worn connecting rod bearing (big end)
	Oil pressure is normal.	● Loose flywheel mounting bolts ● Damaged engine mounting
High-pitched clank (Spark knock)	Sound is noticeable when accelerating with an overload.	● Ignition timing advanced ● Accumulation of carbon inside combustion chamber ● Wrong spark plug ● Improper gasoline
Clank when engine speed is medium (1,000 to 2,000 rpm).	Sound is reduced when fuel injector connector of noisy cylinder is disconnected. (NOTE*)	● Worn crankshaft main bearing ● Worn bearing at crankshaft end of connecting rod
Knocking sound when engine is operating under idling speed and engine is warm	Sound is reduced when fuel injector connector of noisy cylinder is disconnected. (NOTE*)	● Worn cylinder liner and piston ring ● Broken or stuck piston ring ● Worn piston pin and hole at piston end of connecting rod
	Sound is not reduced if each fuel injector connector is disconnected in turn. (NOTE*)	● Unusually worn valve lifter ● Worn cam gear ● Worn camshaft journal bore in crankcase
Squeaky sound	—	● Insufficient generator lubrication
Rubbing sound	—	● Defective generator brush and rotor contact
Gear scream when starting engine	—	● Defective ignition starter switch ● Worn gear and starter pinion
Sound like polishing glass with a dry cloth	—	● Loose drive belt ● Defective engine coolant pump shaft
Hissing sound	—	● Loss of compression ● Air leakage in air intake system, hoses, connections or manifolds
Timing belt noise	—	● Loose timing belt ● Belt contacting case/adjacent part
Valve tappet noise	—	● Incorrect valve clearance

NOTE*:
When disconnecting fuel injector connector, Malfunction Indicator Light (CHECK ENGINE light) illuminates and trouble code is stored in ECM memory.
Therefore, carry out the CLEAR MEMORY MODE <Ref. to 2-7 [T3D0].> and INSPECTION MODE <Ref. to 2-7 [T3E0].> after connecting fuel injector connector.

MEMO: