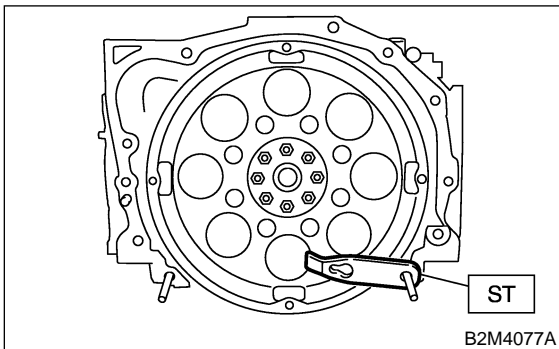


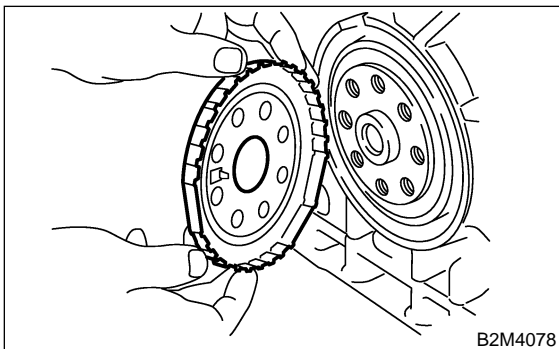
18. Cylinder Block S143090

A: REMOVAL S143090A18

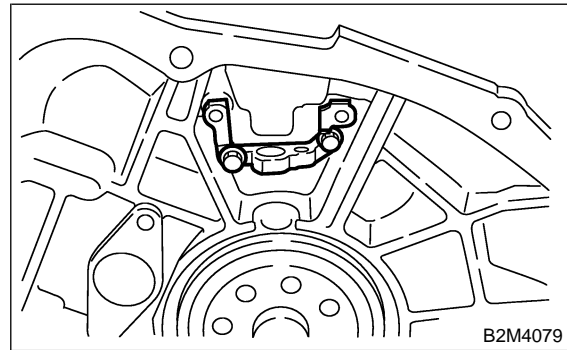
- 1) Remove crankshaft pulley. <Ref. to ME(H6)-42, REMOVAL, Crankshaft Pulley.>
 - 2) Remove front chain cover. <Ref. to ME(H6)-43, REMOVAL, Front Chain Cover.>
 - 3) Remove timing chain assembly. <Ref. to ME(H6)-45, REMOVAL, Timing Chain Assembly.>
 - 4) Remove camshaft sprockets. <Ref. to ME(H6)-50, REMOVAL, Camshaft Sprocket.>
 - 5) Remove crankshaft sprocket. <Ref. to ME(H6)-51, REMOVAL, Crankshaft Sprocket.>
 - 6) Remove rear chain cover. <Ref. to ME(H6)-52, REMOVAL, Rear Chain Cover.>
 - 7) Remove camshafts. <Ref. to ME(H6)-55, REMOVAL, Camshaft.>
 - 8) Remove cylinder head assembly. <Ref. to ME(H6)-59, REMOVAL, Cylinder Head Assembly.>
 - 9) Remove drive plate.
- Using ST, lock crankshaft.
ST 498497100 CRANKSHAFT STOPPER



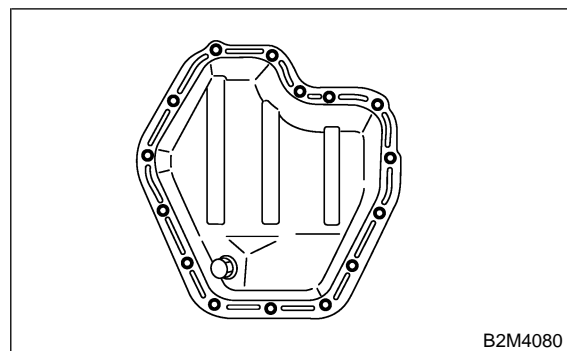
- 10) Remove crankshaft position sensor plate.



- 11) Remove crankshaft position sensor bracket.



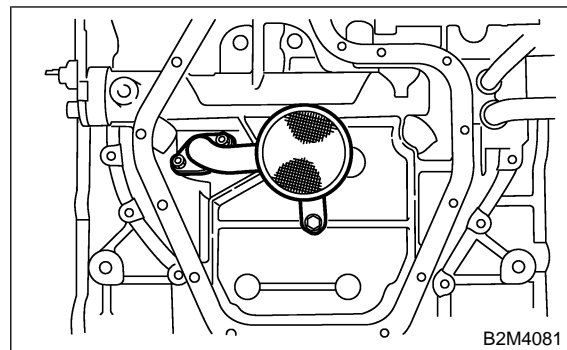
- 12) Rotate engine until oil pan comes to the top.
- 13) Remove bolts which secure lower oil pan to upper oil pan.



- 14) Insert an 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.

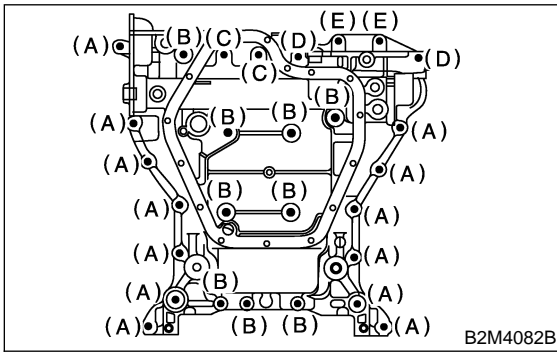
- 15) Remove oil strainer.



CYLINDER BLOCK

Mechanical

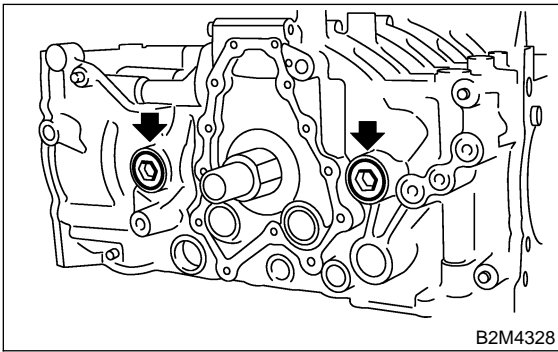
16) Remove bolts which secure upper oil pan to cylinder block.



Bolt dimension:

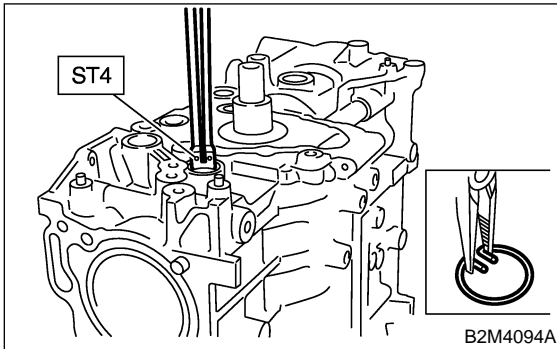
- (A) 8 × 40
- (B) 8 × 65
- (C) 8 × 85
- (D) 8 × 130
- (E) 8 × 24

17) Remove service hole cover and service hole plugs using hexagon wrench (14 mm).



18) 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 by using ST.

ST 18233AA000 PISTON PIN CIRCLIP PLIER

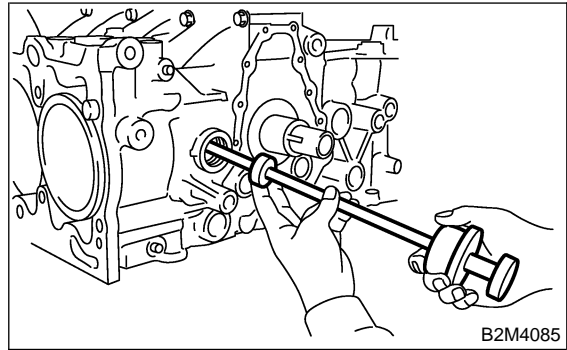


19) Draw out piston pin from #1 and #2 pistons by using ST.

ST 49997500 PISTON PIN REMOVER

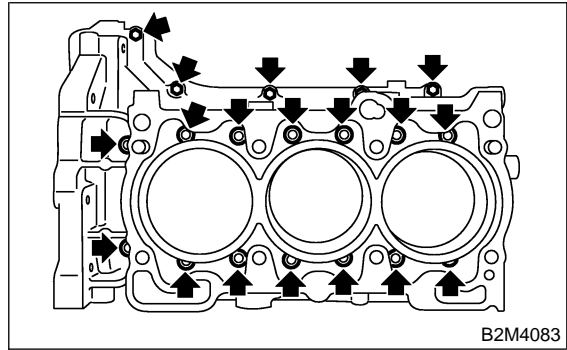
CAUTION:

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



20) Similarly remove piston pins from #3, #4, #5 and #6 pistons.

21) Remove bolts which connect cylinder block.



22) 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.

23) Remove rear oil seal.

24) Remove crankshaft together with connecting rod.

25) 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.

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

CAUTION:

Do not confuse combination of piston, piston pin and cylinder.

B: INSTALLATION S143090A11

1) Install ST to cylinder block, then install crankshaft bearing.

ST 18232AA000 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 and connecting rod on the #2, #4 and #6 cylinder.

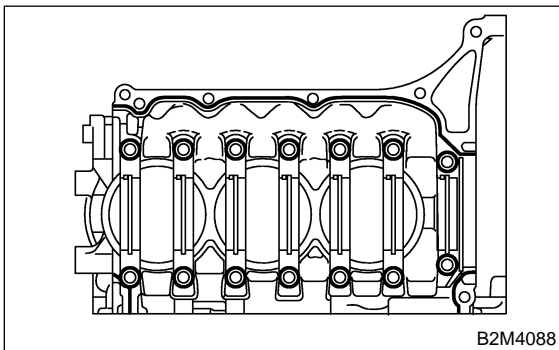
3) Apply fluid packing to the mating surface of #1, #3 and #5 cylinder block.

Fluid packing:

THREE BOND 1215B or equivalent

CAUTION:

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

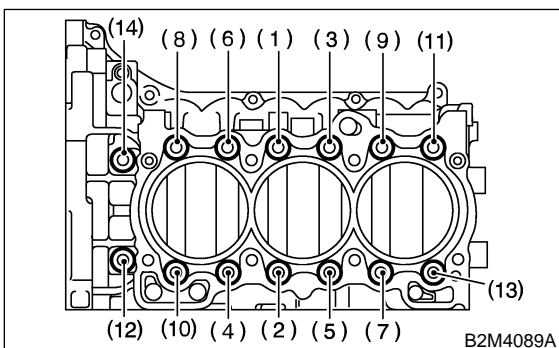


4) Apply engine oil to washers and threads of cylinder block connecting bolts. Tighten the bolts following the steps below.

(1) Tighten all the bolts in the numerical order shown in the figure.

Tightening torque:

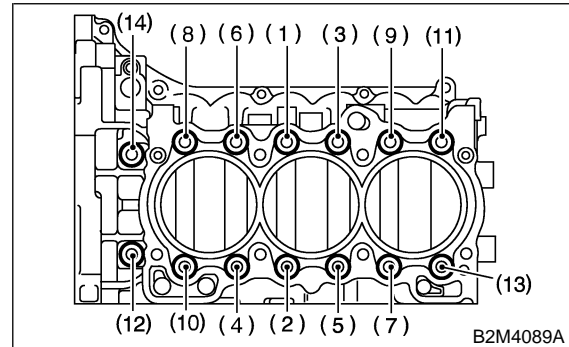
(1) to (11)	25 N·m (2.5 kgf-m, 18 ft-lb)
(12)	20 N·m (2.0 kgf-m, 14 ft-lb)
(13)	25 N·m (2.5 kgf-m, 18 ft-lb)
(14)	20 N·m (2.0 kgf-m, 14 ft-lb)



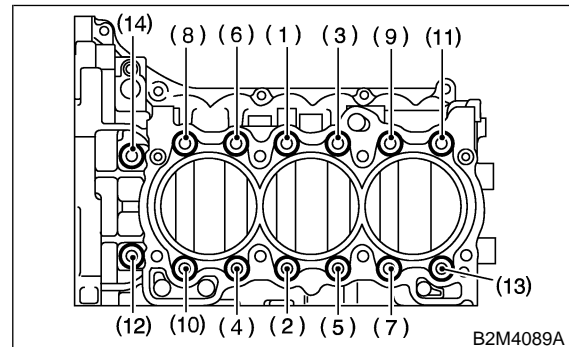
(2) Tighten all the bolts again in the order shown in the figure.

Tightening torque:

(1) to (11)	25 N·m (2.5 kgf-m, 18 ft-lb)
(12)	20 N·m (2.0 kgf-m, 14 ft-lb)
(13)	25 N·m (2.5 kgf-m, 18 ft-lb)
(14)	20 N·m (2.0 kgf-m, 14 ft-lb)



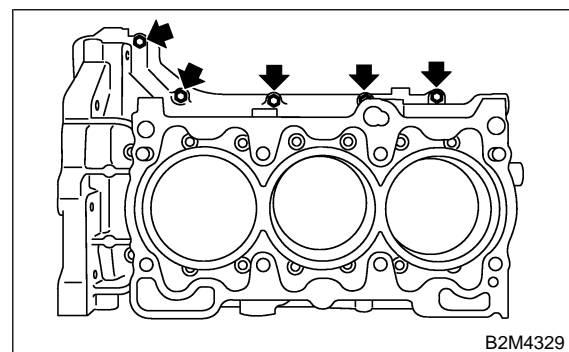
5) Tighten all the bolts by 90° in the order shown in the figure.



6) Install upper bolts on cylinder block.

Tightening torque:

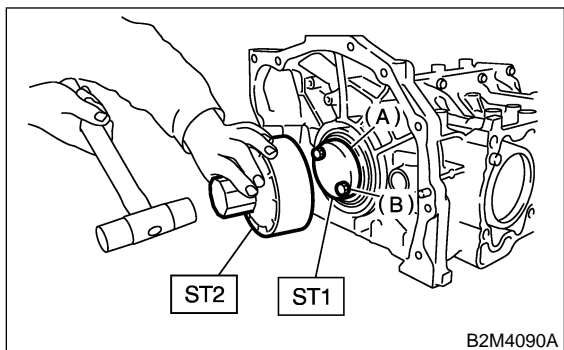
25 N·m (2.5 kgf-m, 18 ft-lb)



7) Install rear oil seal using ST1 and ST2.

CYLINDER BLOCK

Mechanical



- (A) Rear oil seal
- (B) Drive plate attaching bolt

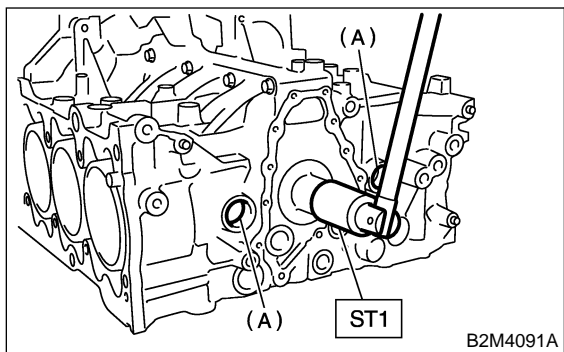
8) Installing piston.

CAUTION:

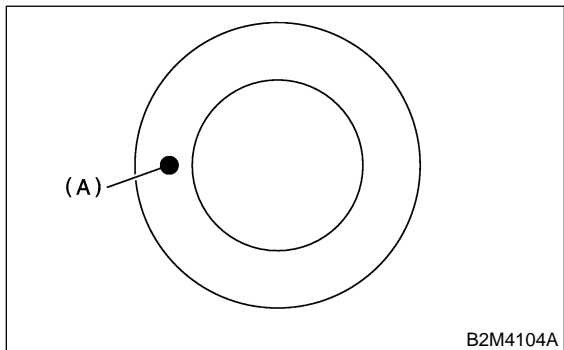
Install piston and piston pin to the same cylinder they were installed before overhaul.

- (1) Using ST1, rotate crankshaft until each small end of connecting rods #3 and #4 is aligned over service hole (A).

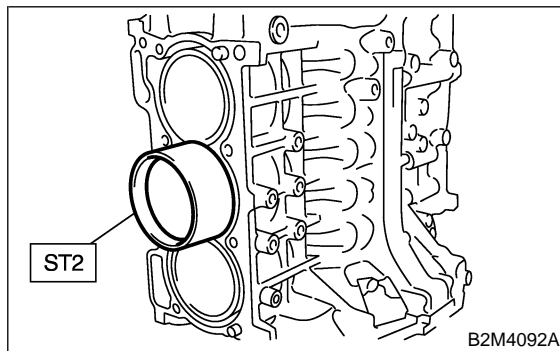
ST1 18252AA000 CRANKSHAFT SOCKET



- (2) Apply a coat of engine oil to piston and cylinders.
- (3) Install pistons with their front marks (A) facing the front of engine.

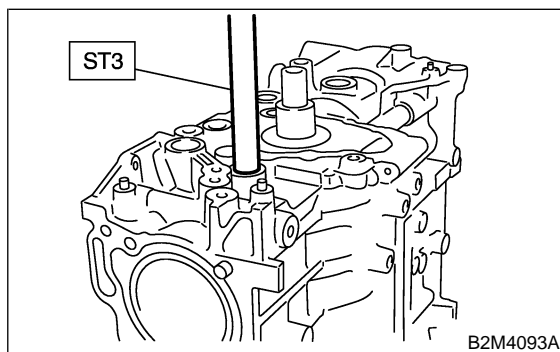


- (4) Insert pistons in their cylinders using ST2.
- ST2 18254AA000 PISTON GUIDE



9) Installing piston pin.

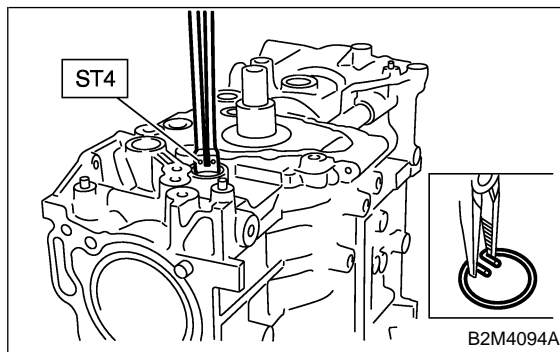
- (1) Apply a coat of engine oil to ST3.
- ST3 18253AA000 PISTON PIN GUIDE
- (2) Insert ST3 into service hole to align piston pin hole with connecting rod small end.



- (3) Apply a coat of engine oil to piston pin and insert piston pin into piston and connecting rod small end through service hole.
 - (4) Using ST4, install circlip.
- ST4 18233AA000 PISTON PIN CIRCLIP PLIER

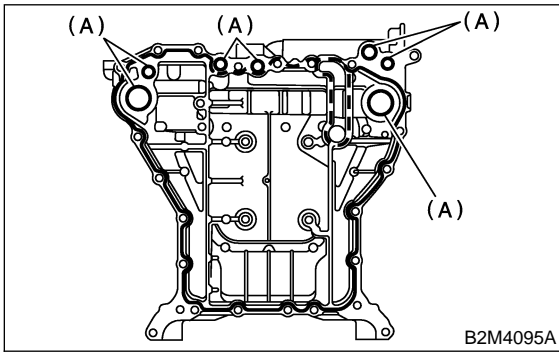
CAUTION:

Use a new circlip.



- 10) Repeat the same steps for pistons #1 and #2, #5 and #6.
- 11) Install service hole plug and cover.
- 12) Apply fluid packing to mating surface of upper oil pan.
- 13) Install O-ring.

**Fluid packing:
THREE BOND 1280B**

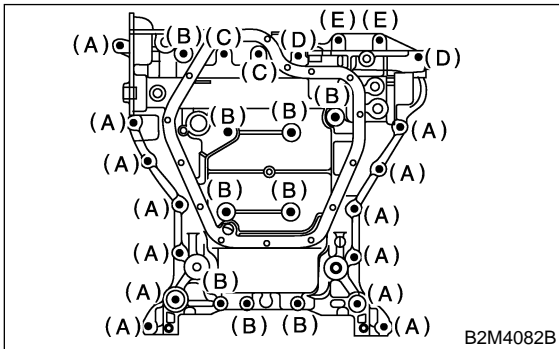


(A) O-ring

14) Temporarily tighten the upper oil pan.

CAUTION:

Do not confuse the mounting positions of the bolts.



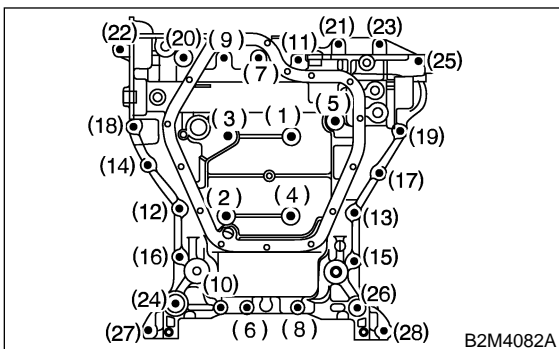
Bolt dimension:

- (A) 8 × 40
- (B) 8 × 65
- (C) 8 × 85
- (D) 8 × 130
- (E) 8 × 20

15) Tighten the upper oil pan mounting bolts in the numerical sequence shown in the figure.

Tightening torque:

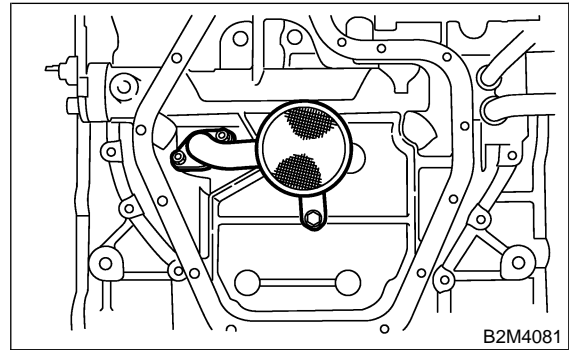
18 N-m (1.8 kgf-m, 13.0 ft-lb)



16) Install oil strainer.

CAUTION:

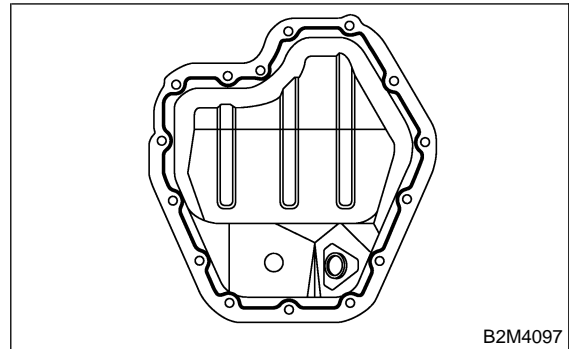
Use a new O-ring.



17) Apply fluid packing to mating surface of lower oil pan.

Fluid packing:

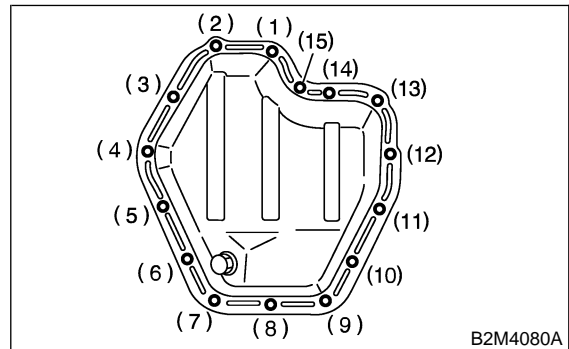
THREE BOND 1280B



18) Tighten the lower oil pan mounting bolts in the numerical sequence shown in the figure.

Tightening torque:

6.4 N-m (0.65 kgf-m, 4.7 ft-lb)



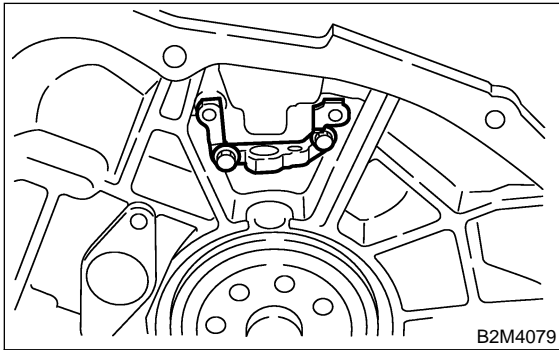
CYLINDER BLOCK

Mechanical

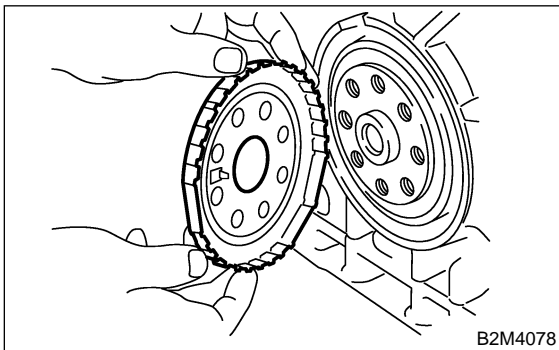
19) Install crankshaft position sensor bracket.

Tightening torque:

6.4 N·m (0.65 kgf-m, 4.7 ft-lb)



20) Install crankshaft position sensor plate.



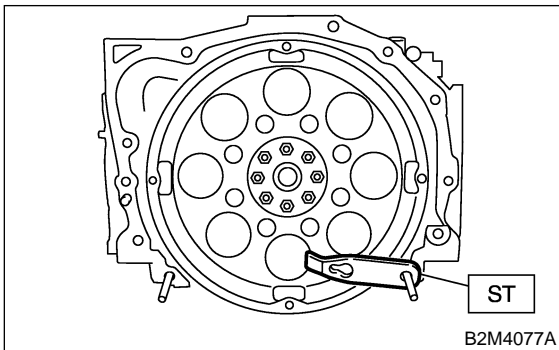
21) Install drive plate.

Using ST, lock crankshaft.

ST 498497100 CRANKSHAFT STOPPER

Tightening torque:

81 N·m (8.3 kgf-m, 60 ft-lb)



22) Install cylinder head assembly. <Ref. to ME(H6)-59, INSTALLATION, Cylinder Head Assembly.>

23) Install camshafts. <Ref. to ME(H6)-55, INSTALLATION, Camshaft.>

24) Install rear chain cover. <Ref. to ME(H6)-52, INSTALLATION, Rear Chain Cover.>

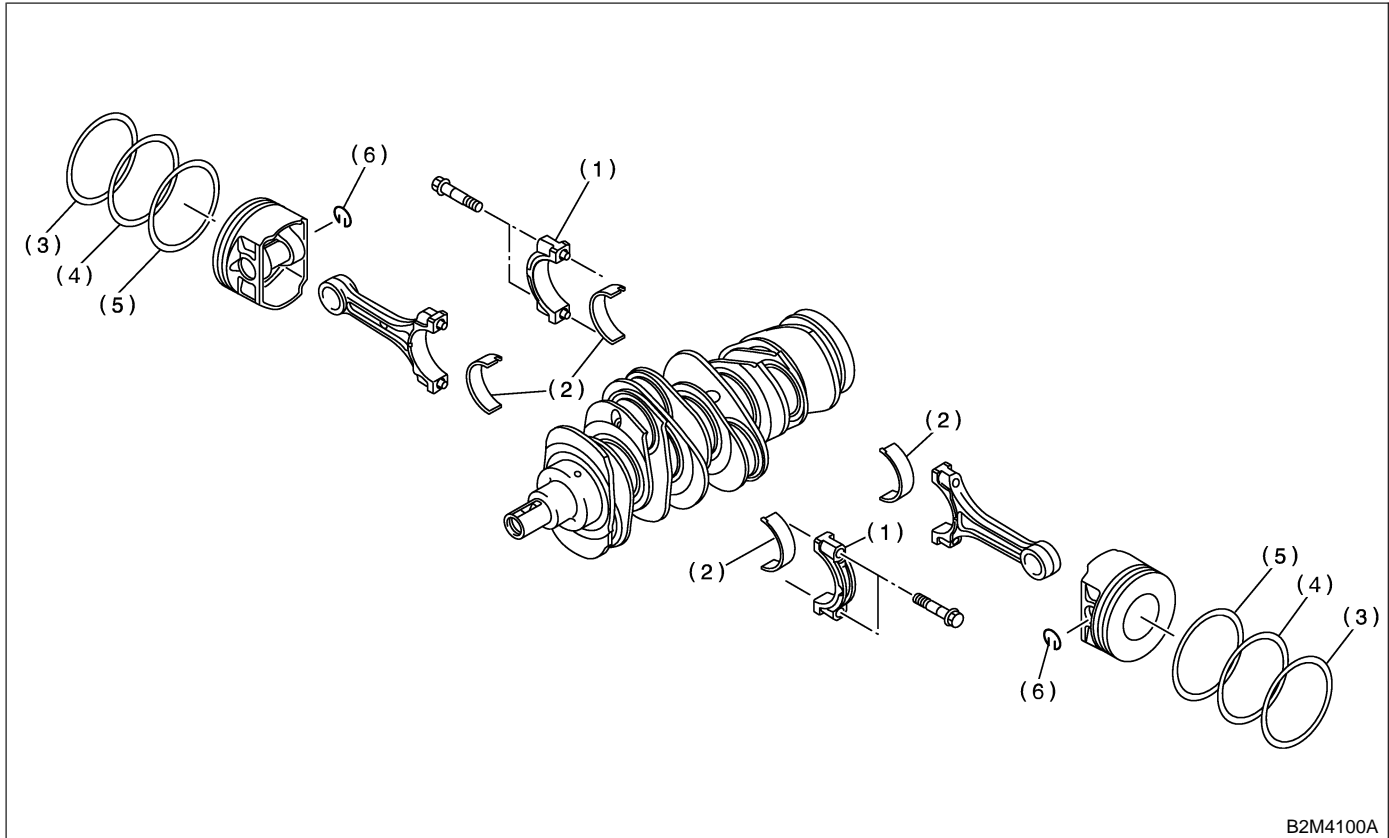
25) Install crankshaft sprocket. <Ref. to ME(H6)-51, INSTALLATION, Crankshaft Sprocket.>

26) Install camshaft sprockets. <Ref. to ME(H6)-50, INSTALLATION, Camshaft Sprocket.>

27) Install timing chain assembly. <Ref. to ME(H6)-46, INSTALLATION, Timing Chain Assembly.>

28) Install front chain cover. <Ref. to ME(H6)-43, INSTALLATION, Front Chain Cover.>

29) Install crankshaft pulley. <Ref. to ME(H6)-42, INSTALLATION, Crankshaft Pulley.>

C: DISASSEMBLY S143090A06

B2M4100A

- | | | |
|----------------------------|-----------------|--------------|
| (1) Connecting rod cap | (3) Top ring | (5) Oil ring |
| (2) Connecting rod bearing | (4) Second 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:

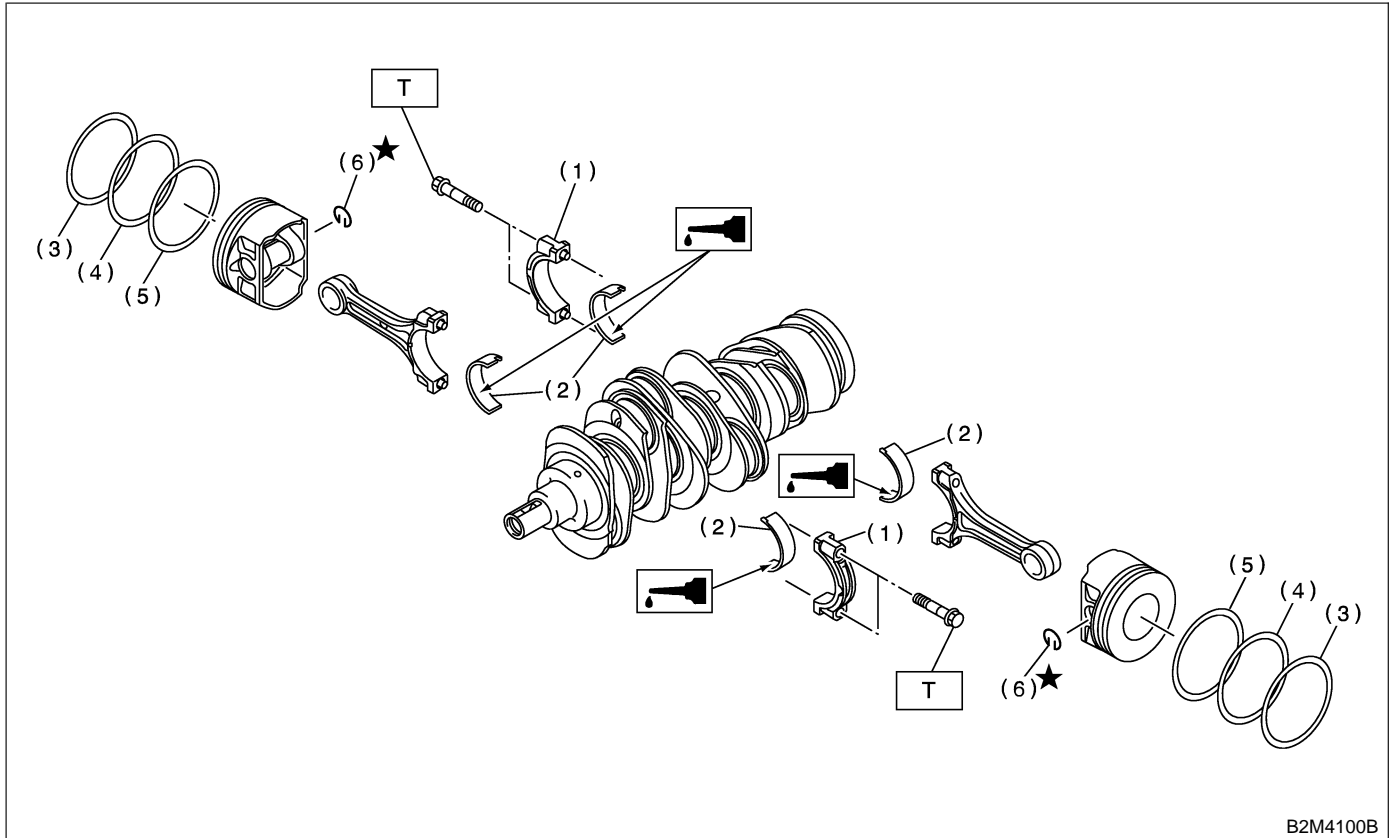
Arrange the removed piston rings in good order to prevent confusion.

- 5) Remove circlip.

CYLINDER BLOCK

Mechanical

D: ASSEMBLY S143090A02



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

Tightening torque: N·m (kgf·m, ft·lb)
T: 53 (5.4, 39)

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:

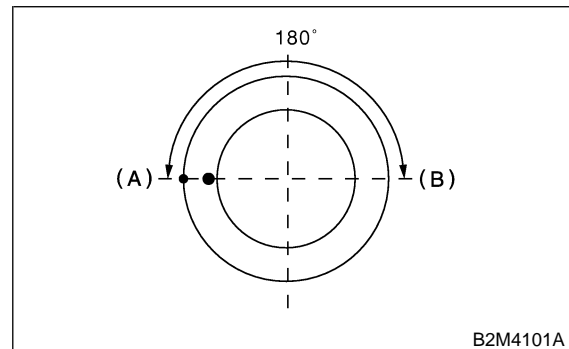
● **Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.**

● **When tightening the connecting rod nuts, apply oil on the threads.**

4) Installation of piston rings and oil ring

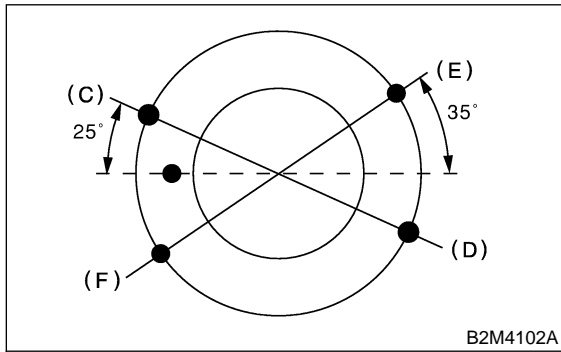
(1) Install oil ring spacer, upper rail and lower rail in this order by hand. Then install second ring and top ring with a piston ring expander.

(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.

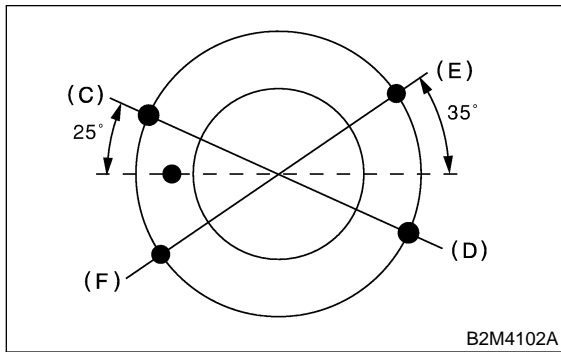


(5) Position the expander gap at 180° of the reverse side for the upper rail gap.

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

CAUTION:

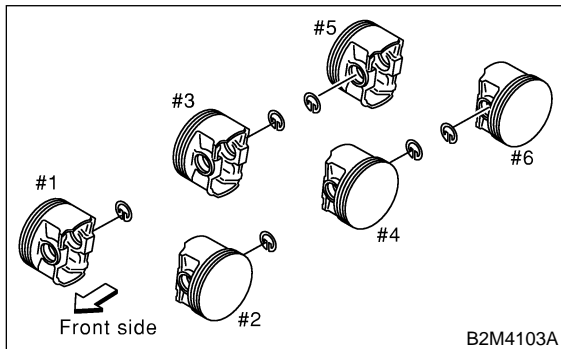
- Ensure ring gaps do not face the same direction.
- Ensure ring gaps are not within the piston skirt area.



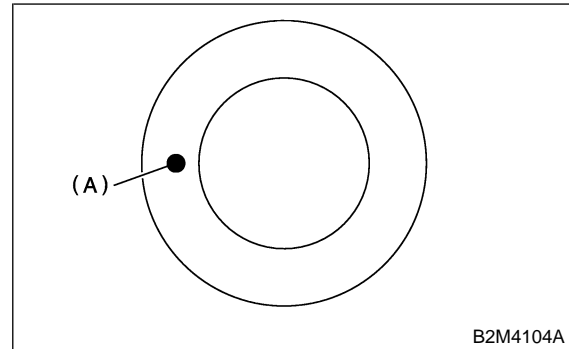
5) Install circlip.
Install circlips in piston holes located opposite service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

CAUTION:

Use new circlips.



CAUTION:
Piston front mark (A) faces towards the front of the engine.



E: INSPECTION S143090A10

1. CYLINDER BLOCK S143090A1002

- 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:
202 mm (7.95 in)

2. CYLINDER AND PISTON S143090A1003

- 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.

CYLINDER BLOCK

Mechanical

Standard diameter:

A: 89.205 — 89.215 mm (3.5120 — 3.5124 in)

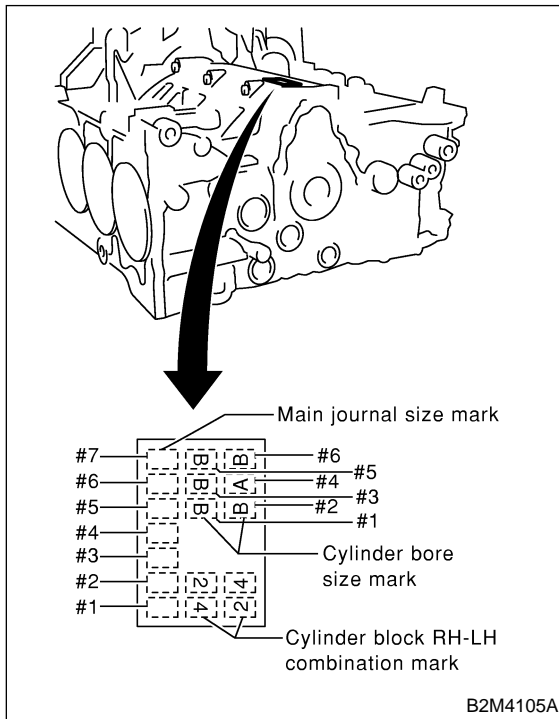
B: 89.195 — 89.205 mm (3.5116 — 3.5120 in)

Taper:

Limit
0.050 mm (0.0020 in)

Out-of-roundness:

Limit
0.050 mm (0.0020 in)

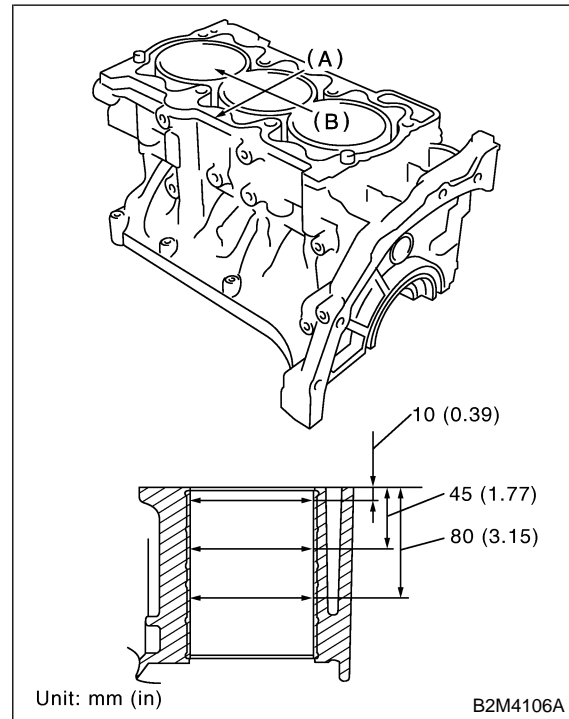


2) How to measure the inner diameter of each cylinder

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).



- (A) Thrust direction
- (B) Piston pin direction

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:
39.0 mm (1.535 in)

Piston outer diameter:
Standard

A: 89.185 — 89.195 mm
(3.5112 — 3.5116 in)

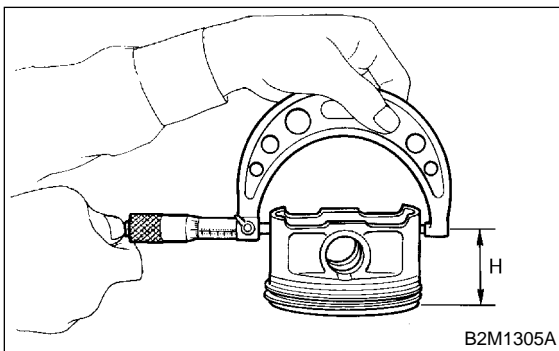
B: 89.175 — 89.185 mm
(3.5108 — 3.5112 in)

0.25 mm (0.0098 in) oversize

89.425 — 89.435 mm
(3.5207 — 3.5211 in)

0.50 mm (0.0197 in) oversize

89.675 — 89.685 mm
(3.5305 — 3.5309 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, rebores 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 S143090A1004

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 ME(H6)-73 CYLINDER AND PISTON, INSPECTION, Cylinder Block.> 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.

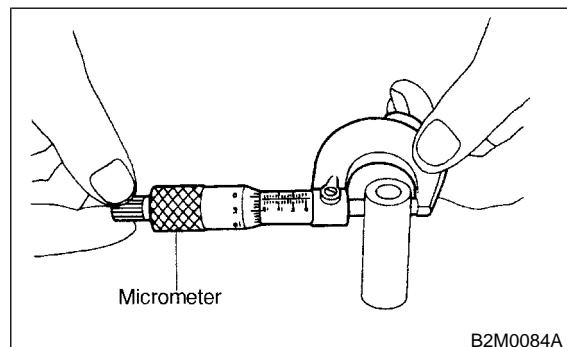
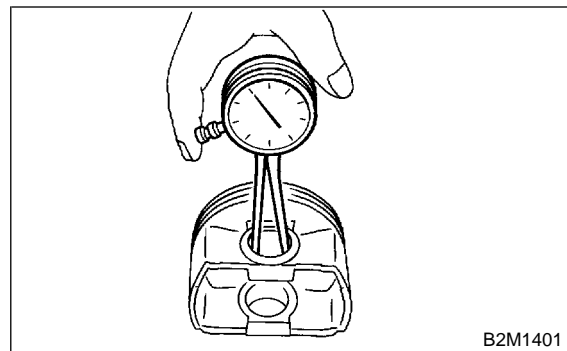
Standard clearance between piston pin and hole in piston:

Standard

0.004 — 0.008 mm (0.0002 — 0.0003 in)

Limit

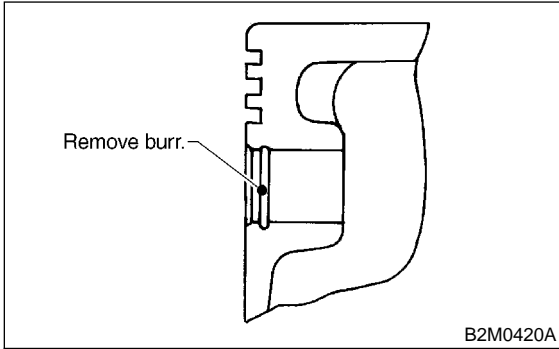
0.020 mm (0.0008 in)



CYLINDER BLOCK

Mechanical

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



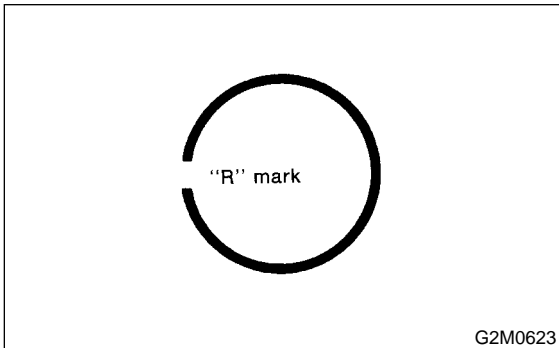
5) Check piston pin circlip for distortion, cracks and wear.

4. PISTON RING S143090A1005

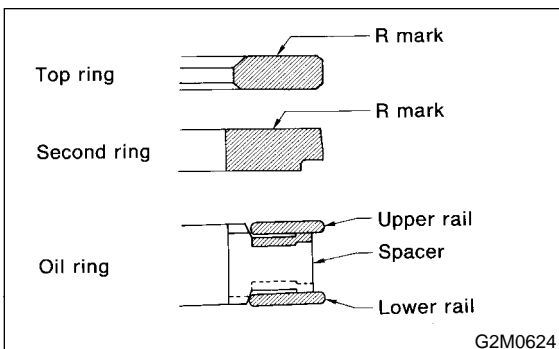
1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.

CAUTION:

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

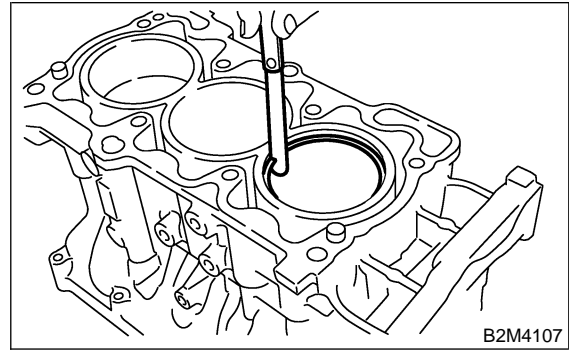


● The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful to assemble correctly.



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	0.35 — 0.50 (0.0138 — 0.0197)	1.0 (0.039)
	Oil ring rail	0.20 — 0.60 (0.0079 — 0.024)	1.5 (0.059)

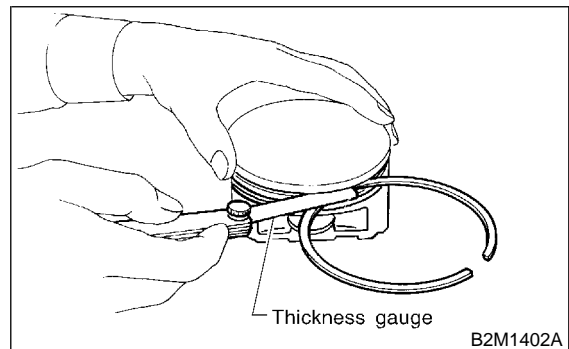


3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

CAUTION:

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

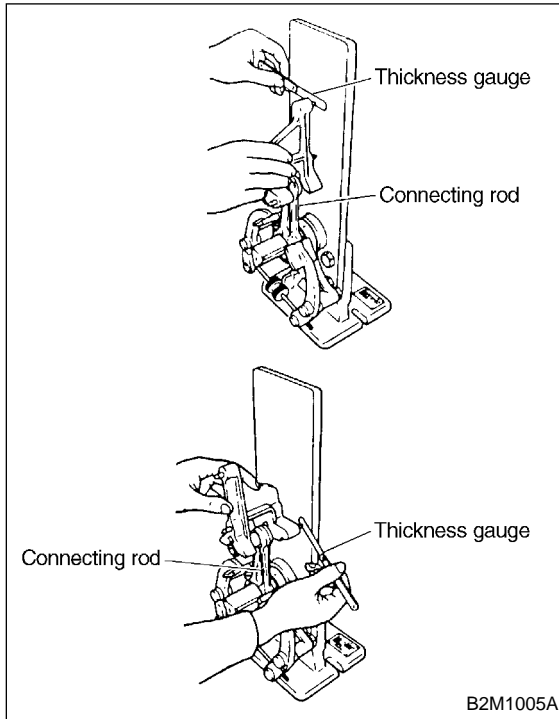
		Unit: mm (in)	
		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.040 — 0.080 (0.0016 — 0.0031)	0.15 (0.0059)
	Second ring	0.030 — 0.070 (0.0012 — 0.0028)	0.15 (0.0059)



5. CONNECTING ROD S143090A1006

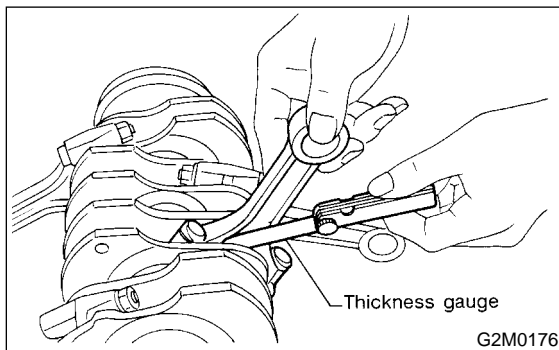
- 1) Replace connecting rod, if the large or small end thrust surface is damaged.
- 2) Check for bend or twist using a connecting rod aligner. Replace connecting rod if the bend or twist exceeds the limit.

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.

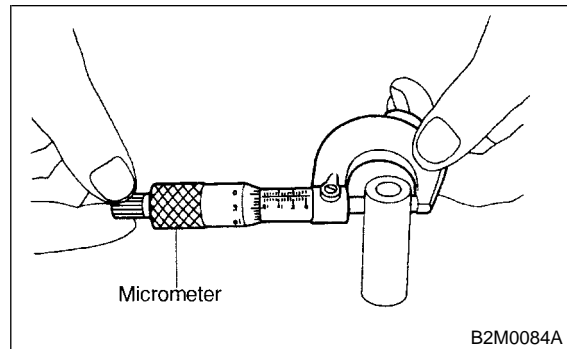
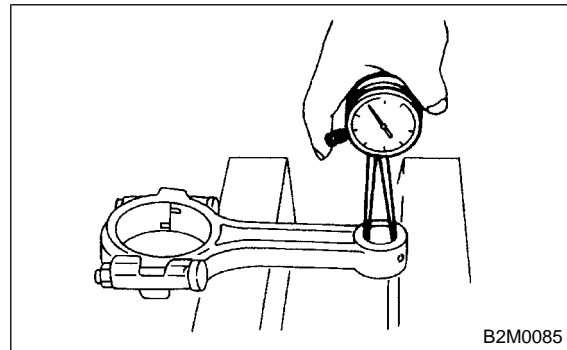
- 5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge. If any oil clearance is not within specification, replace the defective bearing with a new one of standard size or undersize as necessary. (See the table below.)

Connecting rod oil clearance:
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	1.490 — 1.502 (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)

- 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)



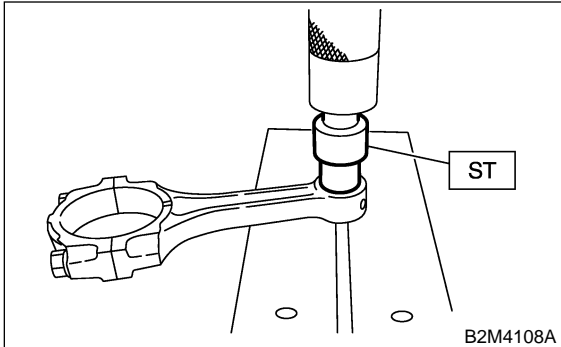
CYLINDER BLOCK

Mechanical

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 18350AA000 CONNECTING ROD BUSHING REMOVER AND INSTALLER



- (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 S143090A1007

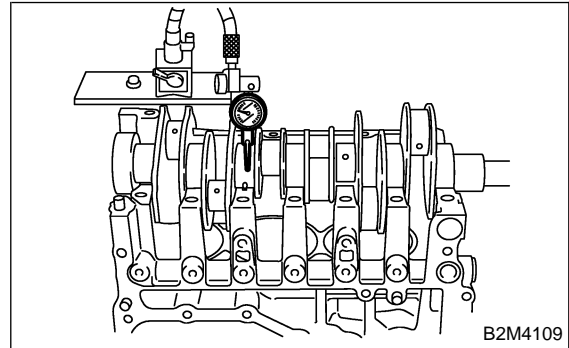
- 1) Clean crankshaft completely and check for cracks by means of red lead check etc., and replace if defective.
- 2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.

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 they are not within the specifications, replace bearing with a suitable (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

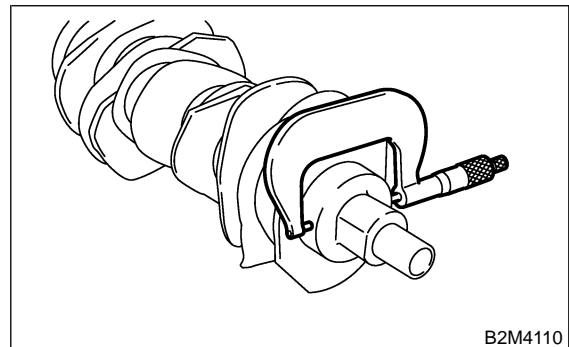
0.020 mm (0.0008 in) or less

Taper limit

0.07 mm (0.0028 in)

Grinding limit

0.250 mm (0.0098 in)



CYLINDER BLOCK

Mechanical

		Crank journal diameter		Unit: mm (in)
		#1, #3, #5, #7	#2, #4, #6	Crank pin diameter
Standard	Journal O.D.	63.992 — 64.008 (2.5194 — 2.5200)		51.984 — 52.000 (2.0466 — 2.0472)
	Bearing size (Thickness at center)	1.992 — 2.005 (0.0784 — 0.0789)	1.996 — 2.000 (0.0786 — 0.0787)	1.490 — 1.502 (0.0587 — 0.0591)
0.03 (0.0012) undersize	Journal O.D.	63.962 — 63.978 (2.5182 — 2.5188)		51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.020 (0.0795 — 0.0795)	1.510 — 1.513 (0.0594 — 0.0596)
0.05 (0.0020) undersize	Journal O.D.	63.942 — 63.958 (2.5174 — 2.5180)		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.	63.742 — 63.758 (2.5095 — 2.5102)		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.

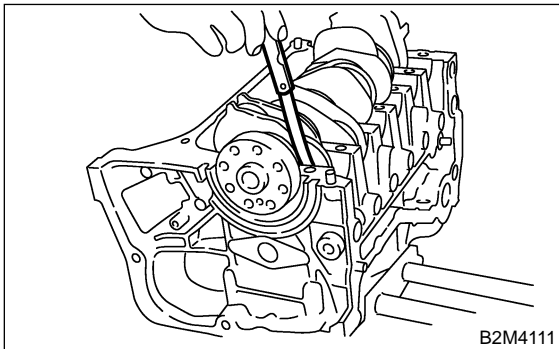
Crankshaft thrust clearance:

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)