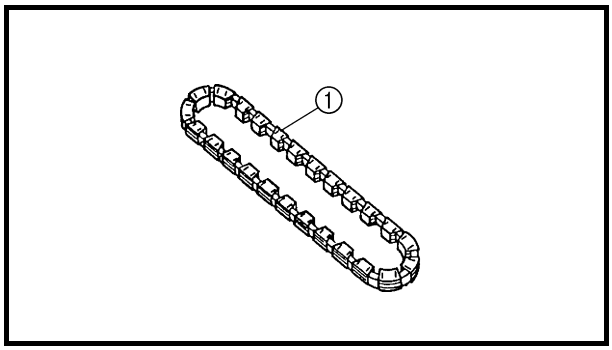
4. Remove:
   • Dowel pins

Crankcase inspection

1. Thoroughly wash the crankcase halves in a mild solvent.
2. Thoroughly clean all the gasket surfaces and crankcase mating surfaces.
3. Check:
   • Crankcase
   Cracks/damage → Replace.
   • Oil delivery passages
   Obstruction → Blow out with compressed air.



Timing chain inspection

1. Check:
   • Timing chain ①
   Damage/stiffness → Replace the timing chain and camshaft sprockets as a set.

Crankcase assembly

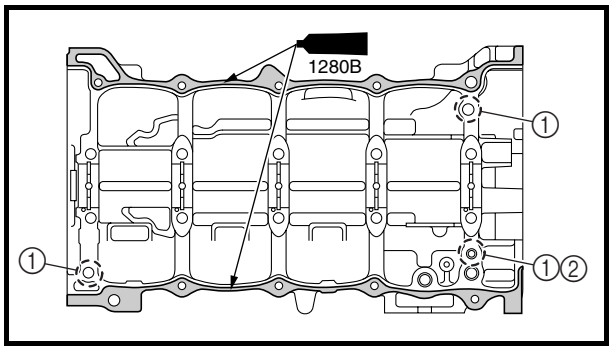
1. Lubricate:
   Crankshaft journal bearings
   (with the recommended lubricant)

	Recommended lubricant: Engine oil

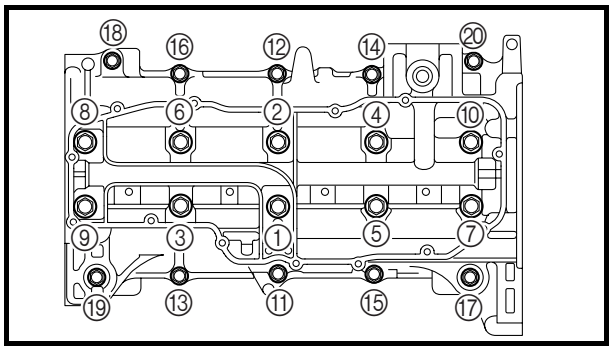
2. Apply:
   - ThreeBond 1280B
     (onto the crankcase mating surfaces)

NOTE:

Do not allow any sealant to come into contact with the oil gallery or crankshaft journal bearings.



3. Install:
   - Dowel pins ①
   - O-ring ②

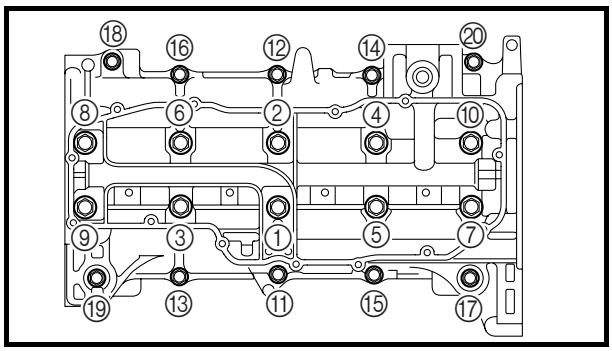


4. Install:
   - Crankcase bolts

NOTE:

- Lubricate the bolt ①–⑩ threads and washers with engine oil.
- Finger tighten the crankcase bolts.

M9 × 105 mm bolts: ①–⑩
M6 × 55 mm bolts: ⑪–⑱, ⑳
M6 × 70 mm bolts: ⑲



5. Tighten:
   - Crankcase bolts ①–⑩

NOTE:
- Do not reuse crankcase bolts ①–⑩.
- The tightening procedure of crankcase bolts ①–⑩ is angle controlled, therefore tighten the bolts using the following procedure.

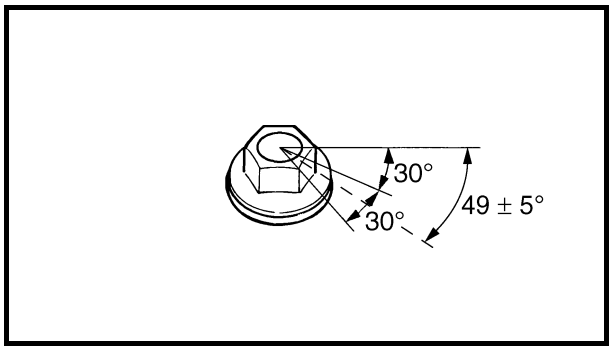
Tightening steps:
- Tighten the bolts in the order of the numbers on the crankcase.

Crankcase bolt ①–⑩:
1st:
7.8 N • m
(0.78 kgf • m, 5.6 ft • lb)

- Loosen and retighten the crankcase bolts in the proper tightening sequence as shown.

Crankcase bolt ①–⑩:
2nd:
Loosen completely
3rd:
15 N • m (1.5 kgf • m, 11 ft • lb)

- Tighten the crankcase bolts further to reach the specified angle 49° in the proper tightening sequence as shown.



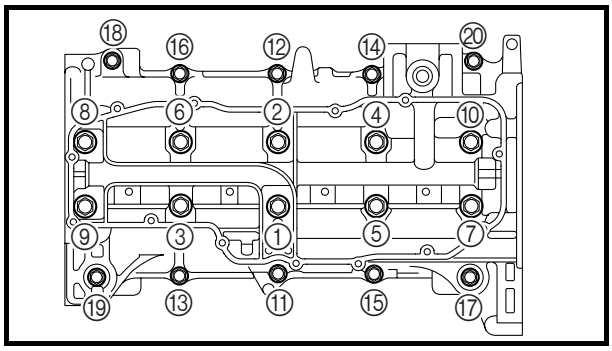
Crankcase bolt ①–⑩:
Final:
Specified angle 49 ± 5°

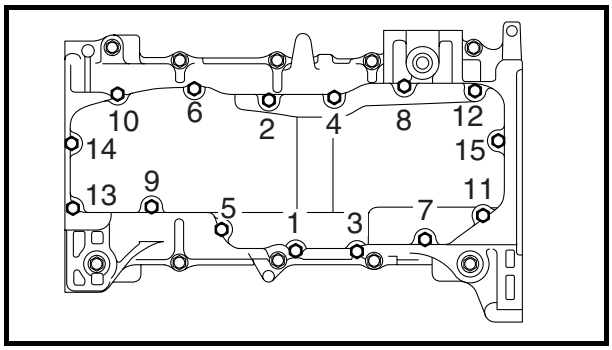
⚠ WARNING

When the bolts are tightened more than the specified angle, do not loosen the bolt and then retighten it.
Replace the bolt with a new one and perform the procedure again.

CAUTION:
- **Do not use a torque wrench to tighten the bolt to the specified angle.**
- **Tighten the bolt until it is at the specified angle.**

NOTE:
When using a hexagonal bolt, note that the angle from one corner to another is 60°.





6. Tighten:
- Crankcase bolts ⑪–⑳

NOTE:
Tighten the bolts in the order of the numbers on the crankcase.

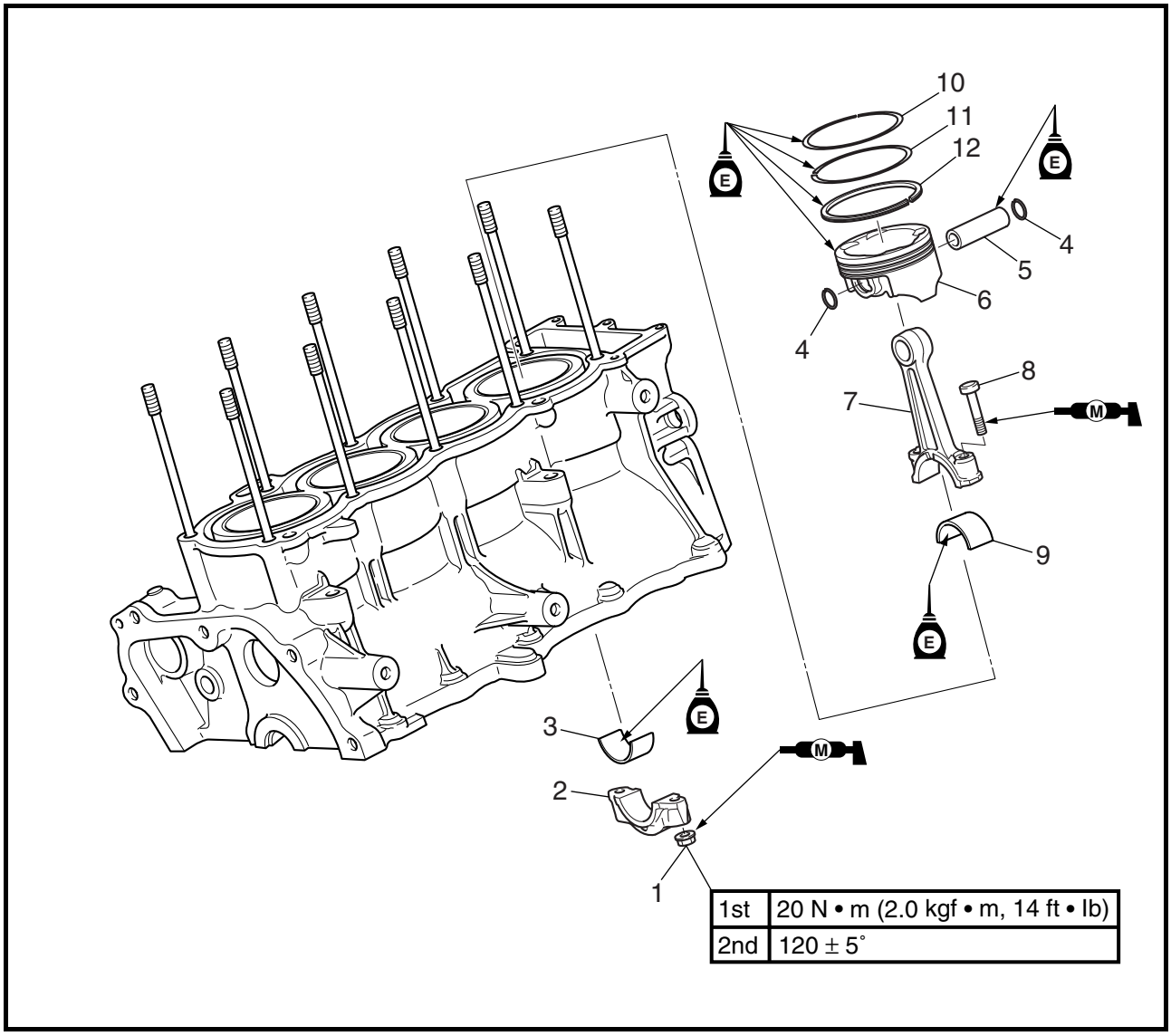
Crankcase bolt ⑪–⑳:
12 N • m (1.2 kgf • m, 8.7 ft • lb)
LOCTITE 572

7. Tighten:
- Oil pan bolts

NOTE:
Tighten the bolts in the order of the numbers on the oil pan.

Oil pan bolt:
12 N • m (1.2 kgf • m, 8.7 ft • lb)
LOCTITE 572

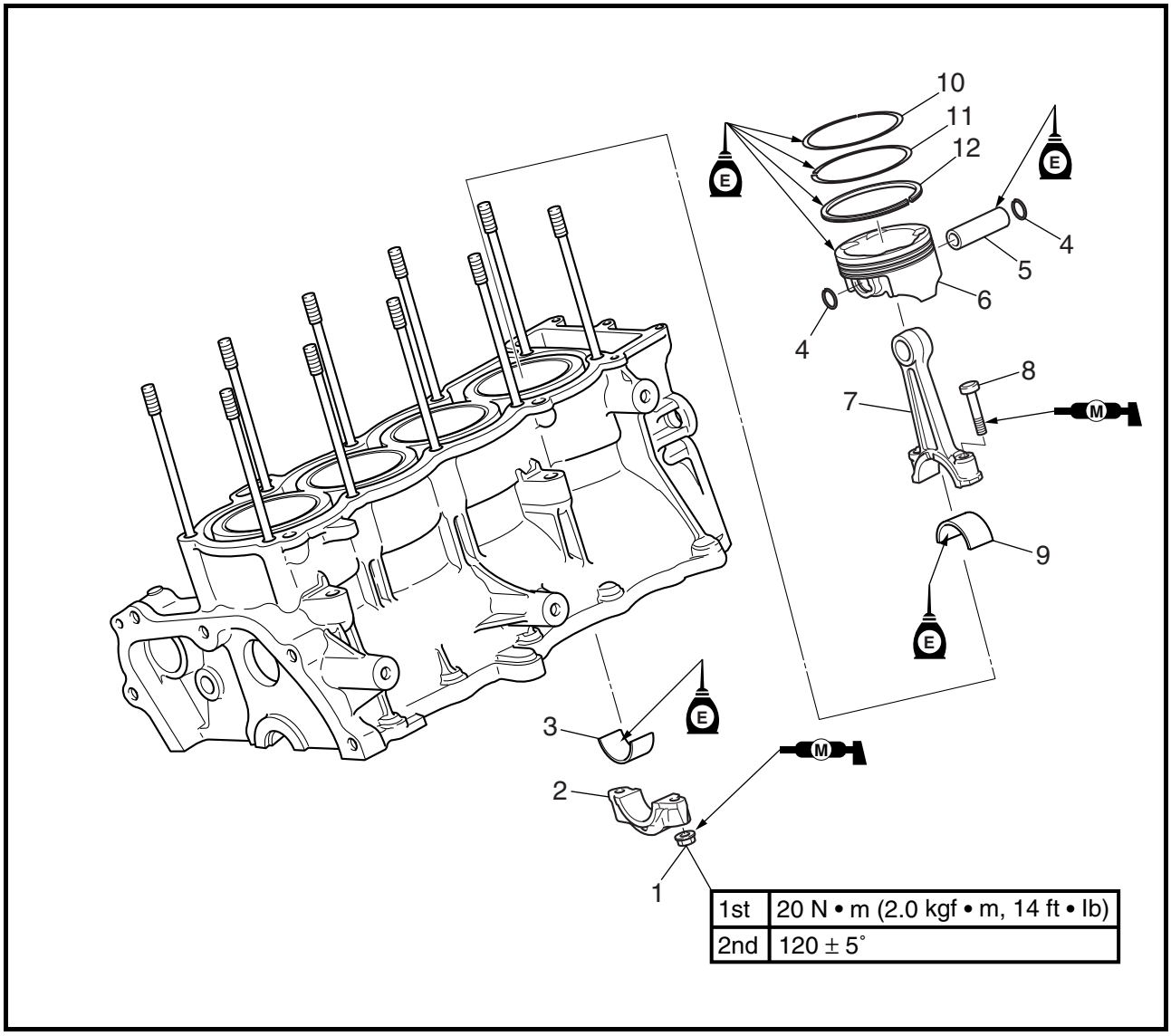
CONNECTING RODS AND PISTONS
EXPLODED DIAGRAM



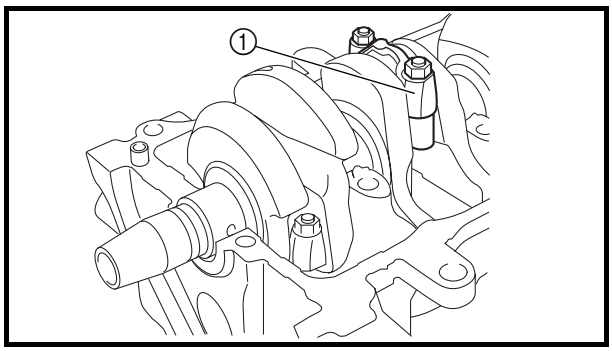
REMOVAL AND INSTALLATION CHART

Step	Procedure/Part name	Q'ty	Service points
	CONNECTING RODS AND PISTONS REMOVAL		Follow the left "Step" for removal.
	Crankcase		Separate Refer to "CRANKCASE".
1	Nut	8	**Not reusable**
2	Connecting rod cap	4	
3	Big end lower bearing	4	
4	Piston pin clip	8	**Not reusable**
5	Piston pin	4	
6	Piston	4	
7	Connecting rod	4	

EXPLODED DIAGRAM



Step	Procedure/Part name	Q'ty	Service points
8	Bolt	8	**Not reusable**
9	Big end upper bearing	4	
10	Top ring	4	
11	2nd ring	4	
12	Oil ring	4	
			Reverse the removal steps for installation.



SERVICE POINTS

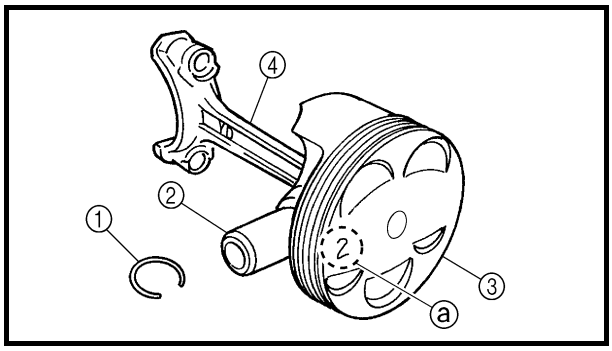
Connecting rod and piston removal

The following procedure applies to all of the connecting rods and pistons.

1. Remove:
   - Connecting rod cap ①
   - Big end bearings

NOTE:

Identify the position of each big end bearing so that it can be reinstalled in its original place.



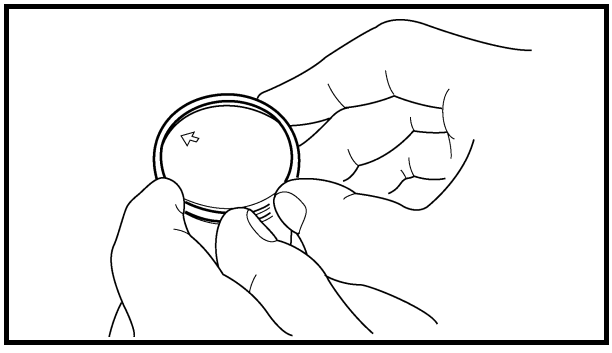
2. Remove:
   - Piston pin clips ①
   - Piston pin ②
   - Piston ③
   - Connecting rod ④

CAUTION:

Do not use a hammer to drive the piston pin out.

NOTE:

- For reference during installation, put an identification number ⓐ on the piston crown.
- Before removing the piston pin, deburr the piston pin clip's groove and the piston's pin bore area.



3. Remove:
   - Top ring
   - 2nd ring
   - Oil ring

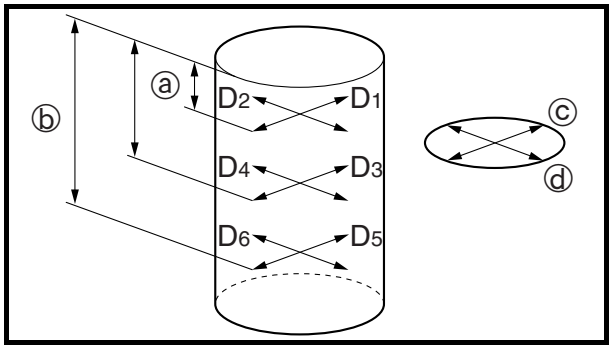
NOTE:

When removing a piston ring, open the end gap with your fingers and lift the other side of the ring over the piston crown.

Cylinder and piston inspection

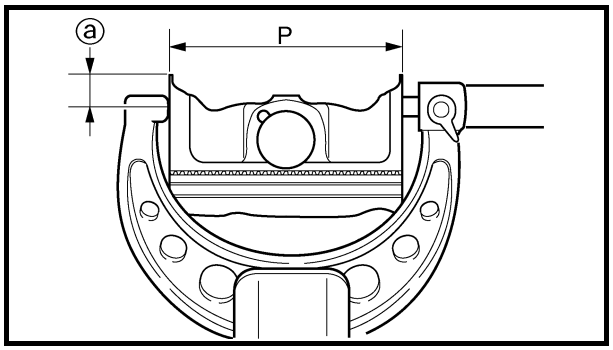
The following procedure applies to all of the cylinders and pistons.

1. Check:
   - Piston wall
   - Cylinder wall
     Vertical scratches → Replace the cylinder, and the piston and piston rings as a set.



2. Measure:
   - Piston-to-cylinder clearance

Measurement steps: • Measure cylinder bore “C” with the cylinder bore gauge.	
Cylinder bore “C”	**76.000–76.015 mm (2.9921–2.9927 in)**
Taper limit “T”	**0.08 mm (0.003 in)**
Out of round “R”	**0.05 mm (0.002 in)**
“C” = maximum of D_1–D_6	
“T” = maximum of D_1–D_5 (direction ⓒ) and D_2–D_6 (direction ⓓ)	
“R” = maximum of D_2–D_1 (measuring point ⓐ) and D_6–D_5 (measuring point ⓑ)	
• If out of specification, replace the cylinder, and the piston and piston rings as a set. • Measure piston skirt diameter “P” with the micrometer. ⓐ 5 mm (0.2 in) from the bottom edge of the piston	
	Piston size “P”
Standard	**75.895–75.910 mm (2.9880–2.9986 in)**

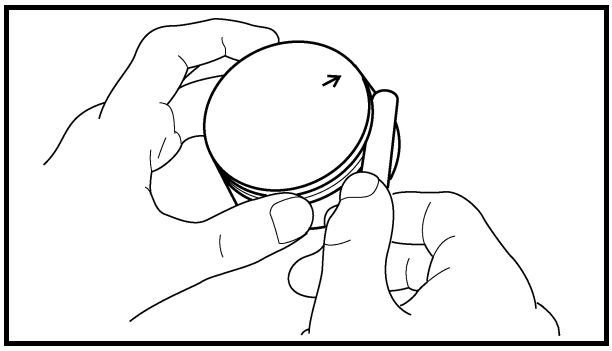


- If out of specification, replace the piston and piston rings as a set.
- Calculate the piston-to-cylinder clearance with the following formula.

Piston-to-cylinder clearance = Cylinder bore "C" – Piston skirt diameter "P"

Piston-to-cylinder clearance:
0.10–0.11 mm (0.0039–0.0043 in)
<Limit>: 0.17 mm (0.0067 in)

- If out of specification, replace the piston and piston rings as a set.

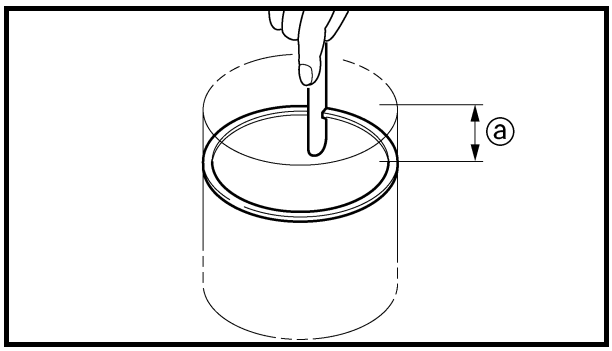


Piston ring inspection

1. Measure:
   - Piston ring side clearance
     Out of specification → Replace the piston and piston rings as a set.

NOTE:
Before measuring the piston ring side clearance, eliminate any carbon deposits from the piston ring grooves and piston rings.

Side clearance:
Top ring:
0.030–0.065 mm
(0.0012–0.0026 in)
2nd ring:
0.020–0.055 mm
(0.0008–0.0022 in)
Oil ring:
0.040–0.160 mm
(0.0016–0.0063 in)



2. Install:
   - Piston ring
     (into the cylinder)

NOTE:
Level the piston ring in the cylinder with the piston crown.

ⓐ 5 mm (0.2 in)

3. Measure:
   - Piston ring end gap
     Out of specification → Replace the piston ring.

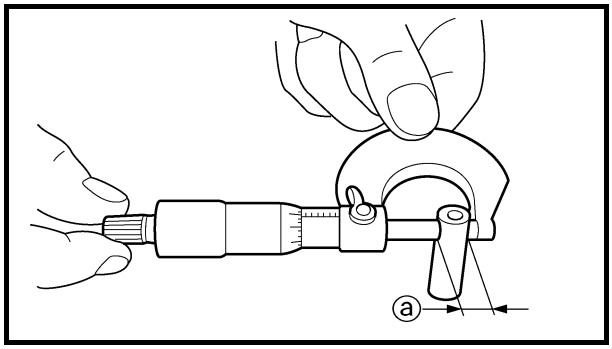
NOTE:
The oil ring expander spacer's end gap cannot be measured. If the oil ring rail's gap is excessive, replace all three piston rings.

Piston ring end gap:
Top ring:
0.32–0.44 mm
(0.0126–0.0173 in)
2nd ring:
0.43–0.58 mm
(0.0169–0.0228 in)
Oil ring:
0.10–0.35 mm
(0.0039–0.0138 in)

Piston pin inspection

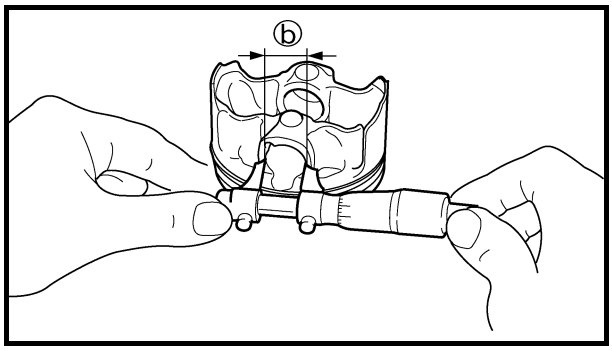
The following procedure applies to all of the piston pins.

1. Check:
   - Piston pin
     Bluediscoloration/grooves → Replace the piston pin and then check the lubrication system.



2. Measure:
   - Piston pin outside diameter ⓐ
     Out of specification → Replace the piston pin.

Piston pin outside diameter:
16.991–17.000 mm
(0.6689–0.6693 in)
<Limit>: 16.98 mm (0.67 in)



3. Measure:
   - Piston pin bore diameter (in the piston) ⓑ
     Out of specification → Replace the piston.

Piston pin bore diameter (in the piston):
17.002–17.013 mm
(0.6694–0.6698 in)

4. Calculate:
   - Piston-pin-to-piston clearance
     Out of specification → Replace the piston pin.

Piston-pin-to-piston clearance =
Piston pin bore diameter (in the piston) ⓑ – Piston pin outside diameter ⓐ

Piston-pin-to-piston clearance:
0.002–0.022 mm
(0.0001–0.0009 in)

Connecting rod inspection

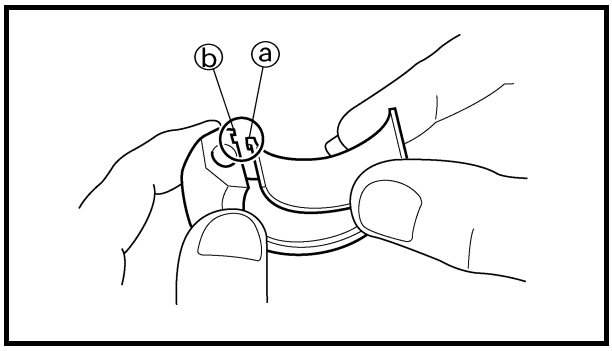
1. Measure:
   - Big end oil clearance
     Out of specification → Replace the big end bearings.

Big end oil clearance:
0.016–0.040 mm
(0.0006–0.0016 in)

Measurement steps:
The following procedure applies to all of the connecting rods.

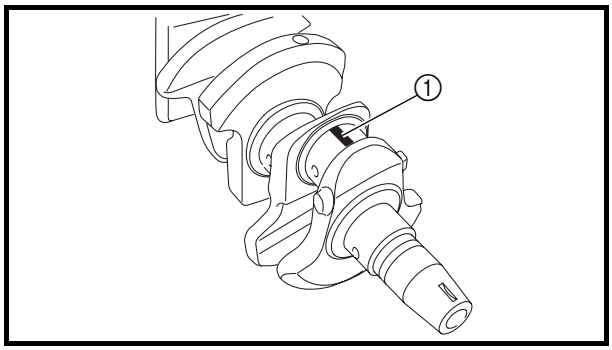
CAUTION:

Do not interchange the big end bearings and connecting rods. To obtain the correct big end oil clearance and prevent engine damage, the big end bearings must be installed in their original positions.

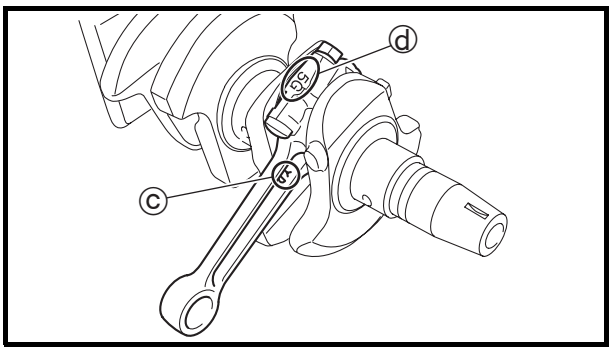


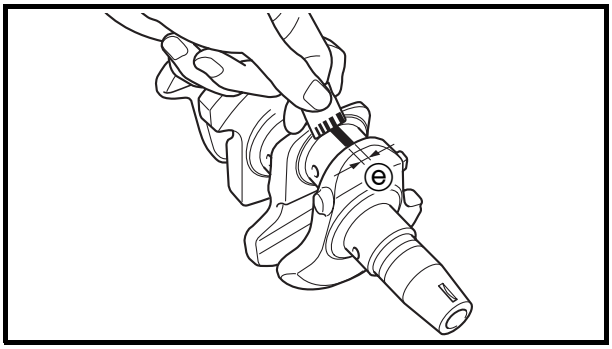
- Clean the big end bearings, crankshaft pins, and the inside of the connecting rod halves.
- Install the big end upper bearing into the connecting rod and the big end lower bearing into the connecting rod cap.

NOTE:
Align the projections ⓐ on the big end bearings with the notches ⓑ in the connecting rod and connecting rod cap.



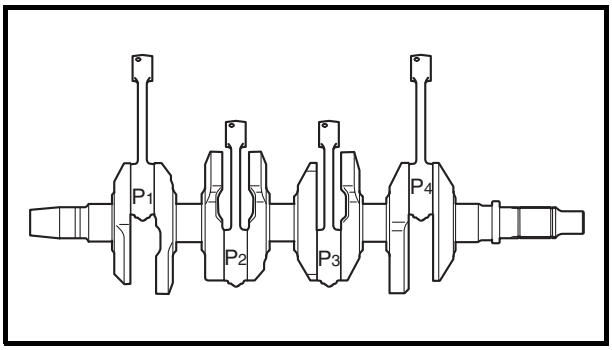
- Put a piece of Plastigauge ① on the crankshaft pin.
- Assemble the connecting rod halves.





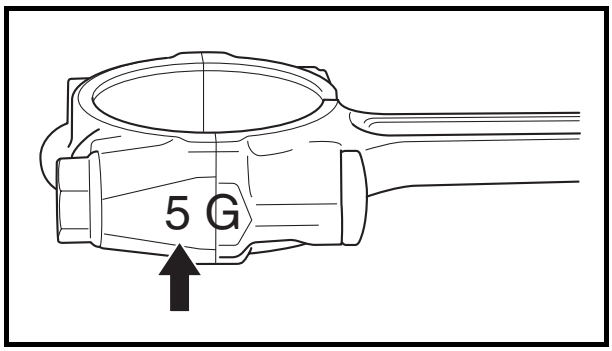
NOTE:
- Do not move the connecting rod or crankshaft until the clearance measurement has been completed.
- Lubricate the bolts threads and nut seats with molybdenum disulfide grease.
- Make sure the "Y" mark ⓒ on the connecting rod faces towards the front side of the crankshaft.
- Make sure the characters ⓓ on both the connecting rod and connecting rod cap are aligned.

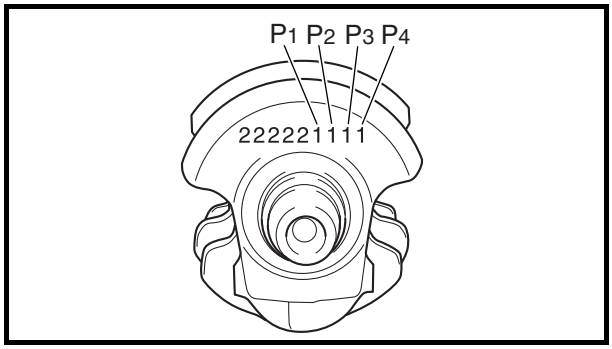
- Tighten the connecting rod nuts.
  Refer to "Connecting rod and piston installation".
- Remove the connecting rod and big end bearings.
  Refer to "Connecting rod and piston removal".
- Measure the compressed Plastigauge width ⓔ on the crankshaft pin.
  If the big end oil clearance is out of specification, select replacement big end bearings.

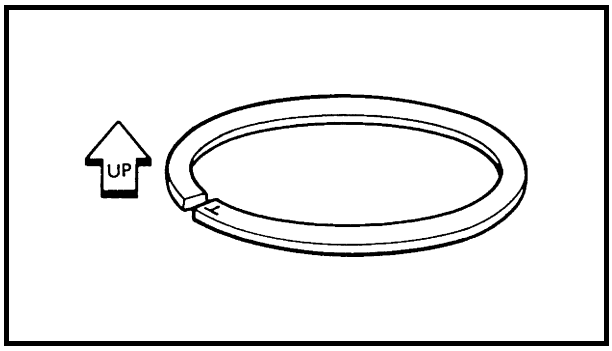


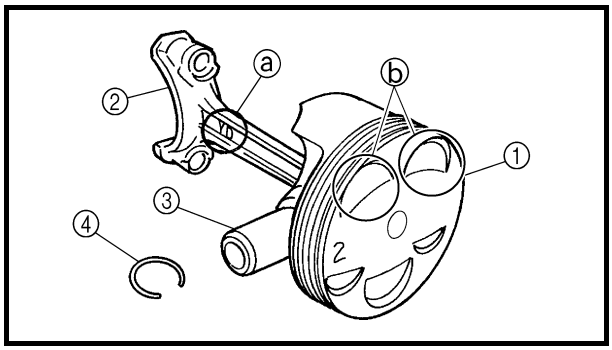
2. Select:
   - Big end bearings (P1–P4)

NOTE:
The numbers stamped into the crankshaft web and the numbers on the connecting rods are used to determine the replacement big end bearing sizes.









For example, if the connecting rod "P1" and the crankshaft web "P1" numbers are "5" and "1" respectively, then the bearing size for "P1" is:

Bearing size of P1:
"P1" (connecting rod) –
"P1" (crankshaft web)
5 – 1 = 4 (green)

BEARING COLOR CODE	
1	brown
2	black
3	blue
4	green

Connecting rod and piston installation

The following procedure applies to all of the pistons and connecting rods.

1. Install:
   - Oil ring
   - 2nd ring
   - Top ring

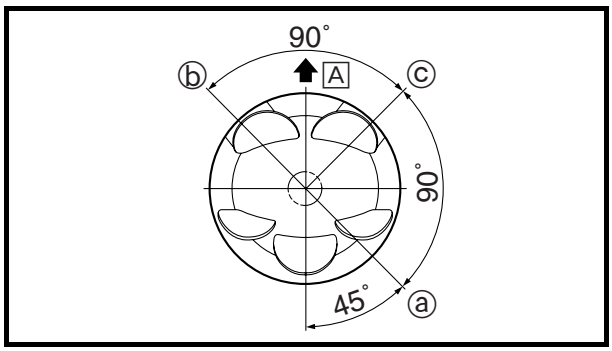
NOTE:

Be sure to install the piston rings so that the manufacturer's marks or numbers face up.

2. Install:
   - Piston ①
   - Connecting rod ②
   - Piston pin ③
   - Piston pin clips ④

NOTE:

- Apply engine oil onto the piston pin.
- When installing the connecting rod to the piston, make sure that the "Y" mark ⓐ on the connecting rod faces towards the left when the exhaust valve recesses ⓑ on the piston face upward. Refer to the illustration.
- Reinstall each piston into its original cylinder (numbering order starting from the front: #1 to #4).



3. Offset:
   - Piston ring end gaps

ⓐ Top ring, oil ring expander spacer
ⓑ 2nd ring, lower oil ring rail
ⓒ Upper oil ring rail
A Exhaust side

4. Lubricate:
   - Piston
   - Piston rings
   - Cylinder

   (with the recommended lubricant)

	Recommended lubricant: Engine oil

5. Lubricate:
   - Bolt threads
   - Nut seats

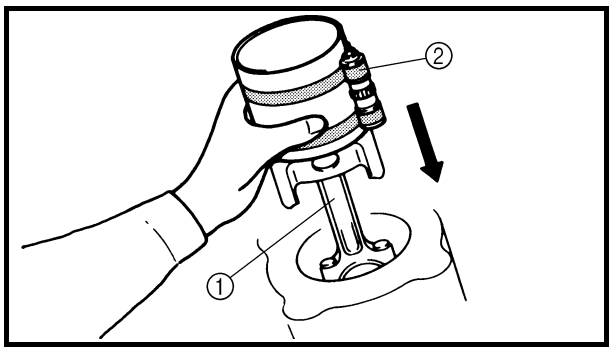
   (with the recommended lubricant)

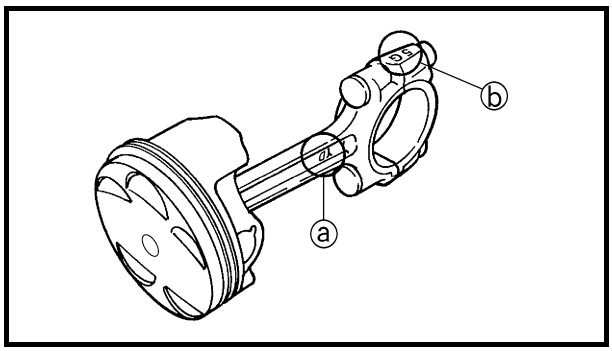
	Recommended lubricant: Molybdenum disulfide grease

6. Lubricate:
   - Crankshaft pins
   - Big end bearings

   (with the recommended lubricant)

	Recommended lubricant: Engine oil





7. Install:
   - Big end bearings
   - Connecting rod assembly ①
     (into the cylinder and onto the crankshaft pin)
   - Connecting rod cap
     (onto the crankshaft pin)

NOTE:
- Align the projections on the big end bearings with the notches in the connecting rods and connecting rod caps.
- Be sure to reinstall each big end bearing in its original place.
- While compressing the piston rings with piston ring compressor ②, install the connecting rod assembly into the cylinder with the other hand.
- Make sure the "Y" marks ⓐ on the connecting rods face towards the front side of the crankshaft.
- Make sure the characters ⓑ on both the connecting rod and connecting rod cap are aligned.

Piston ring compressor:
YM-08037/90890-05158

8. Align:
   - Bolt heads
     (with the connecting rod)