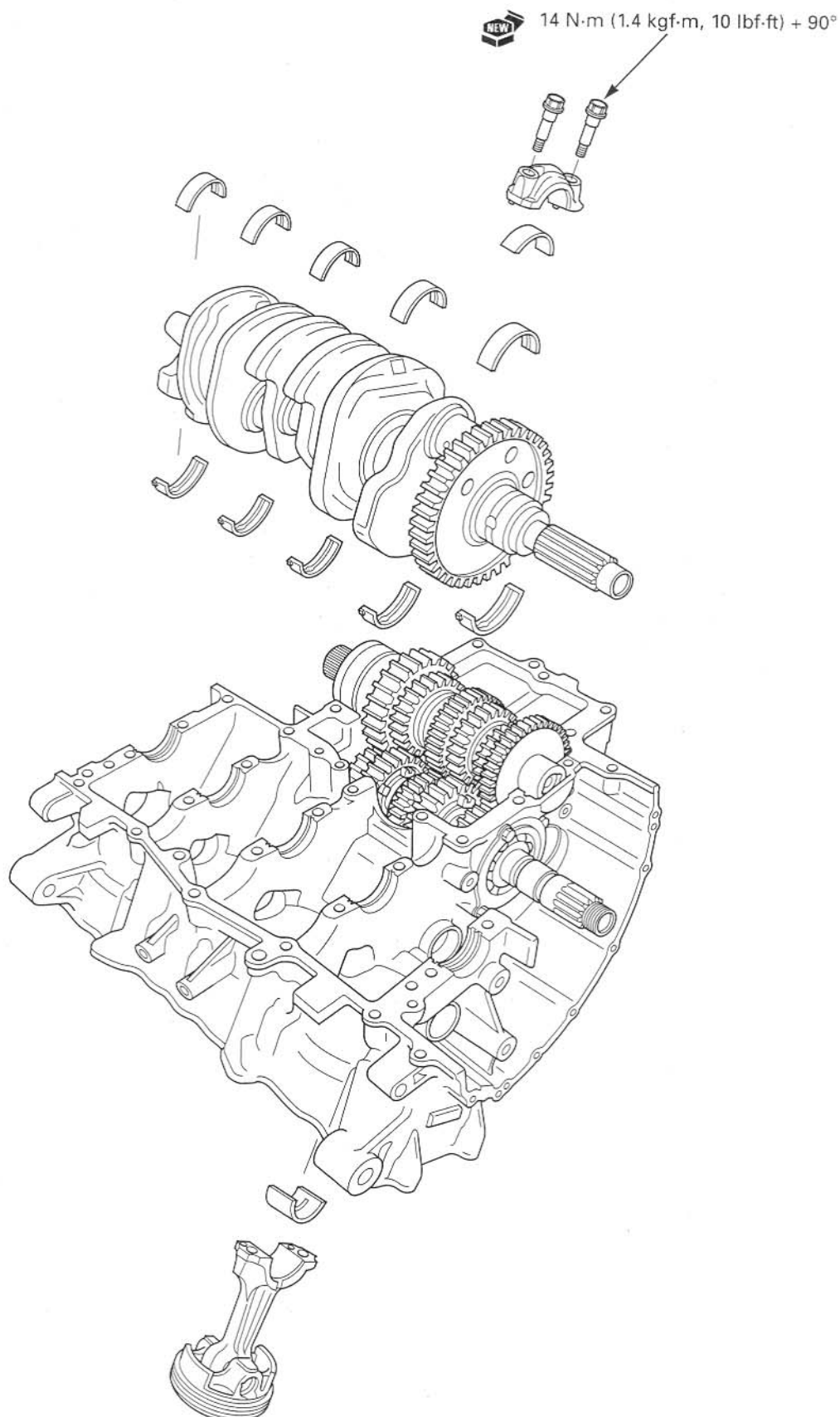


13. CRANKSHAFT/PISTON/CYLINDER

COMPONENT LOCATION	13-2	MAIN JOURNAL BEARING.....	13-8
SERVICE INFORMATION	13-3	CRANKPIN BEARING	13-11
TROUBLESHOOTING.....	13-4	PISTON/CYLINDER	13-13
CRANKSHAFT	13-5		

COMPONENT LOCATION



SERVICE INFORMATION

GENERAL

- The crankcase must be separated to service the crankshaft, cylinder and piston/connecting rod. Refer to procedures for crankcase separation (page 12-5) and assembly (page 12-16).
- Mark and store the connecting rods, bearing caps and bearing inserts to be sure of their correct locations for reassembly.
- The crankpin and main journal bearing inserts are select fit and are identified by color codes. Select replacement bearings from the code tables. After selecting new bearings, recheck the oil clearance with a plastigauge. Incorrect oil clearance can cause major engine damage.
- Clean the oil jets in the upper crankcase with compressed air before installing the pistons.

SPECIFICATIONS

Unit: mm (in)

ITEM		STANDARD	SERVICE LIMIT
Crankshaft	Connecting rod side clearance	0.15 – 0.30 (0.006 – 0.012)	0.35 (0.014)
	Crankpin bearing oil clearance	0.028 – 0.052 (0.0011 – 0.0020)	0.06 (0.002)
	Main journal bearing oil clearance	0.020 – 0.038 (0.0008 – 0.0015)	0.05 (0.002)
	Runout	–	0.05 (0.002)
Piston, piston rings	Piston O.D. at 10 (0.4) from bottom	66.965 – 66.985 (2.6364 – 2.6372)	66.90 (2.634)
	Piston pin bore I.D.	16.002 – 16.008 (0.6300 – 0.6302)	16.02 (0.631)
	Piston pin O.D.	15.994 – 16.000 (0.6297 – 0.6299)	15.98 (0.629)
	Piston-to-piston pin clearance	0.002 – 0.014 (0.0001 – 0.0006)	0.04 (0.002)
	Piston ring end gap	Top	0.10 – 0.20 (0.004 – 0.008)
		Second	0.21 – 0.31 (0.008 – 0.012)
		Oil (side rail)	0.2 – 0.7 (0.01 – 0.03)
	Piston ring-to-ring groove clearance	Top	0.030 – 0.060 (0.0012 – 0.0024)
		Second	0.015 – 0.050 (0.0006 – 0.0020)
Cylinder	I.D.	67.000 – 67.015 (2.6378 – 2.6384)	67.10 (2.642)
	Out of round	–	0.10 (0.004)
	Taper	–	0.10 (0.004)
	Warpage	–	0.10 (0.004)
Cylinder-to-piston clearance		0.015 – 0.050 (0.0006 – 0.0022)	0.10 (0.004)
Connecting rod small end I.D.		16.010 – 16.034 (0.6303 – 0.6313)	16.050 (0.6319)
Connecting rod-to-piston pin clearance		0.010 – 0.040 (0.0004 – 0.0016)	0.070 (0.0028)

TORQUE VALUES

Connecting rod bearing cap bolt 14 N·m (1.4 kgf·m, 10 lbf·ft) + 90° Apply oil to the threads and seating surface

CRANKSHAFT/PISTON/CYLINDER

TROUBLESHOOTING

Cylinder compression is too low, hard to starting or poor performance at low speed

- Leaking cylinder head gasket
- Worn, stuck or broken piston ring
- Worn or damaged cylinder and piston

Cylinder compression too high, overheating or knocking

- Excessive carbon built-up on piston head or combustion chamber

Excessive smoke

- Worn cylinder, piston or piston ring
- Improper installation of piston rings
- Scored or scratched piston or cylinder wall

Abnormal noise

- Worn piston pin or piston pin hole
- Worn connecting rod small end
- Worn cylinder, piston or piston rings
- Worn main journal bearings
- Worn crankpin bearings

Engine vibration

- Excessive crankshaft runout

CRANKSHAFT

Separate the crankcase halves (page 12-5).

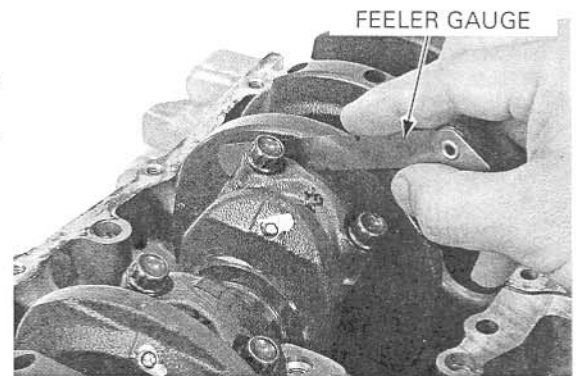
SIDE CLEARANCE INSPECTION

Measure the connecting rod side clearance.

SERVICE LIMIT: 0.35 mm (0.014 in)

If the clearance exceeds the service limit, replace the connecting rod.

Recheck and if still out of limit, replace the crankshaft.



REMOVAL

NOTICE

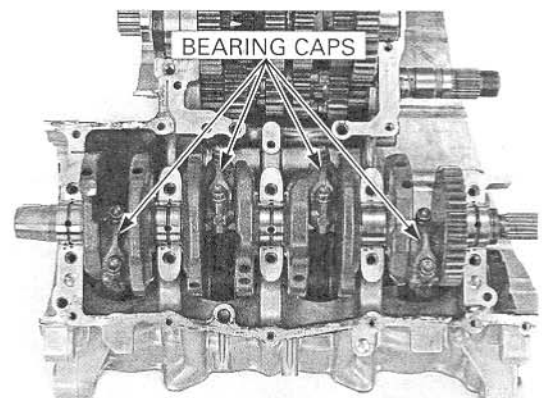
Before removal, position all the pistons at TDC (Top Dead Center) to prevent damaging the crankpin with the connecting rod.

Mark the bearing caps and bearings as you remove them to indicate the correct cylinder for reassembly.

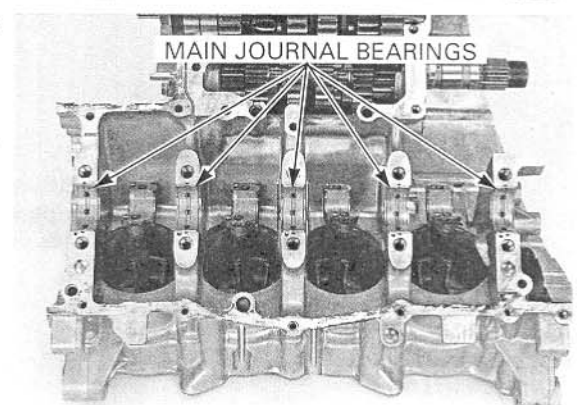
Remove the connecting rod bearing cap bolts and bearing caps.

Tap the side of the cap lightly if the bearing cap is hard to remove.

Remove the crankshaft.



Remove the main journal bearings from both the crankcase halves.

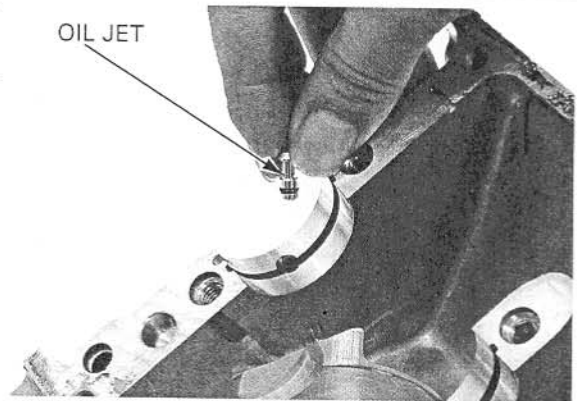


CRANKSHAFT/PISTON/CYLINDER

Remove the crankshaft oil jets from the upper crankcase.

Always replace the O-ring when the oil jets are removed.

Inspect the oil jets for clogs, and replace it if necessary.

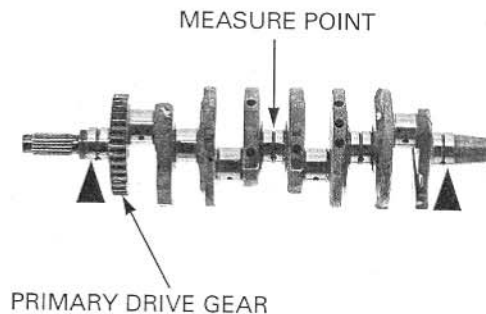


INSPECTION

Support the crankshaft on both end journals. Set a dial gauge on the center main journal of the crankshaft. Rotate the crankshaft two revolutions and read the runout.

SERVICE LIMIT: 0.05 mm (0.002 in)

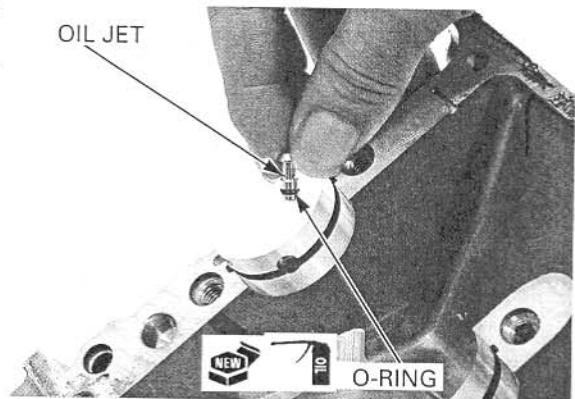
Check the primary drive gear teeth for abnormal wear or damage.



INSTALLATION

Apply engine oil to a new O-ring and install it to the oil jet.

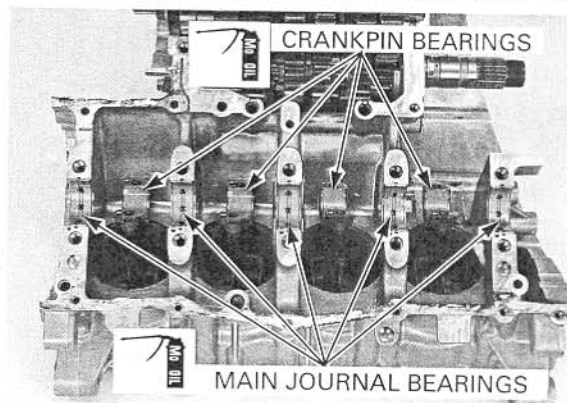
Install the crankcase oil jets into the upper crankcase main journal.



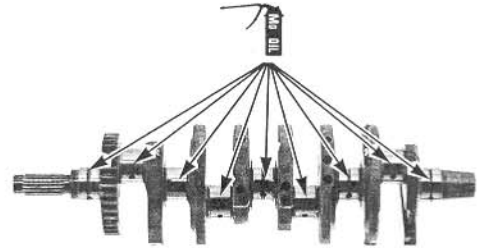
Apply molybdenum oil solution to the main journal bearing sliding surfaces on the upper crankcase and the crankpin bearing sliding surfaces on the connecting rods.

The bearing tabs should be aligned with the grooves in the crankcase.

Install the main journal bearings into the upper crankcase.



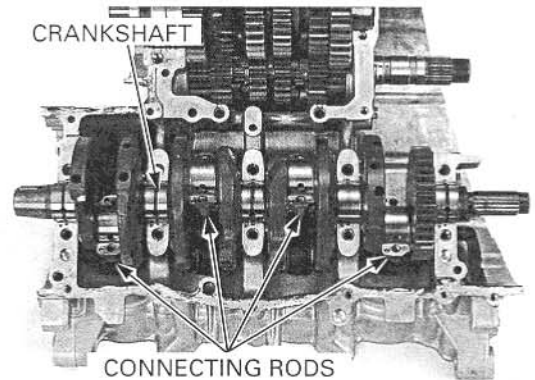
Apply molybdenum oil solution to the thrust surfaces of the crankshaft as shown.



NOTICE

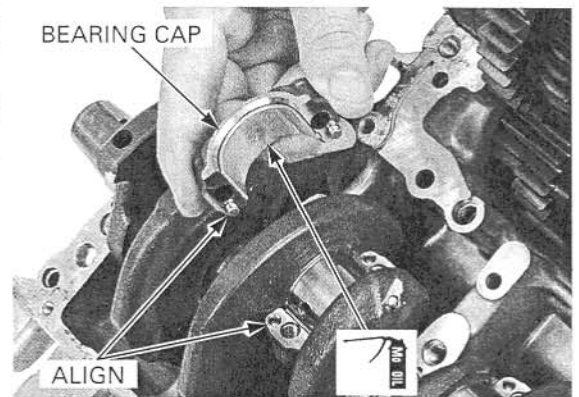
Position all the pistons at TDC (Top Dead Center) to prevent damaging the crankpin with the connecting rod.

Install the crankshaft onto the upper crankcase.
Set the connecting rods onto the crankpins.



Apply molybdenum oil solution to the crankpin bearing sliding surfaces on the connecting rod bearing caps.

Install the connecting rod bearing caps, aligning the dowel pins with the holes in the connecting rods. Be sure each part is installed in its original position, as noted during removal.



The connecting rod bolts cannot be reused. Once the connecting rod bolts have been loosened replace them with new ones.

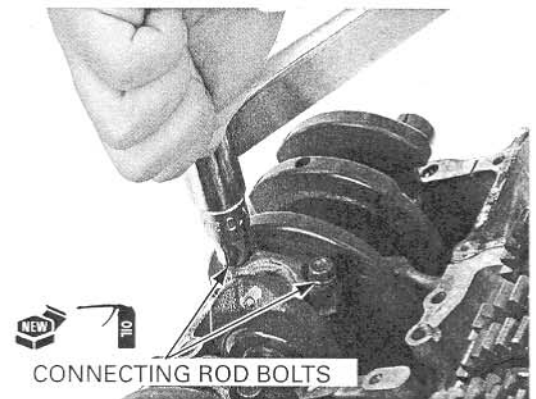
Apply oil to new connecting rod bearing cap bolt threads and seating surfaces, and install the bolts.

Tighten the bolts in two or three steps alternately.

Further tighten the bolts 90 degrees.

TORQUE: 14 N·m (1.4 kgf·m, 10 lbf·ft) + 90°

Assemble the upper and lower crankcase (page 12-16).



MAIN JOURNAL BEARING

NOTICE

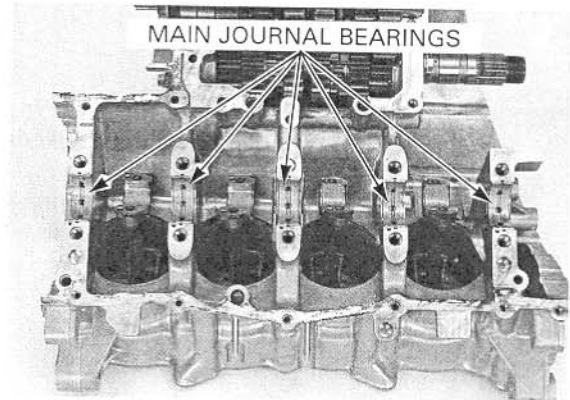
Do not interchange the bearing inserts. They must be installed in their original locations or the correct bearing oil clearance may not be obtained, resulting in engine damage.

Remove the crankshaft (page 13-5).

BEARING INSPECTION

Inspect the main journal bearing inserts on the upper and lower crankcase halves for unusual wear or peeling.

Check the bearing tabs for damage.



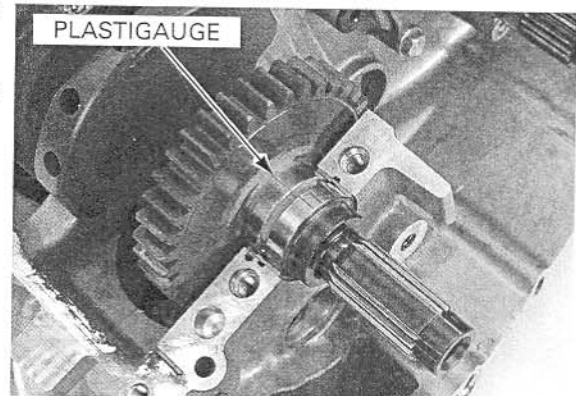
OIL CLEARANCE INSPECTION

Clean off any oil from the bearing inserts and main journals.

Install the crankshaft onto the upper crankcase.

Put a strip of plastigauge lengthwise on each main journal avoiding the oil hole.

- Do not rotate the crankshaft during inspection.



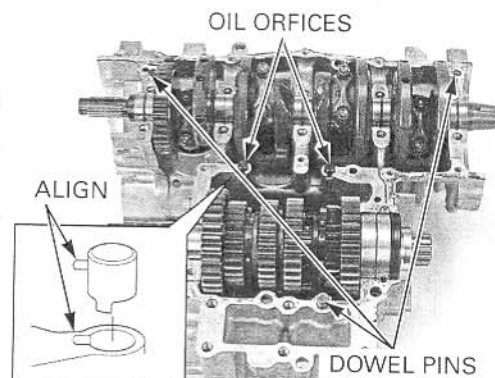
Install the three dowel pins.

Install the oil orifices in the upper crankcase.

NOTE:

- Right oil orifice: Align its pin with the crankcase groove as shown.
- Left oil orifice: Align its cut-out with the crankcase.

Install the lower crankcase onto the upper crankcase.



PLASTIC REGION TIGHTENING METHOD:

Install the crankcase 8 mm bolts (main journal 8 mm bolts).

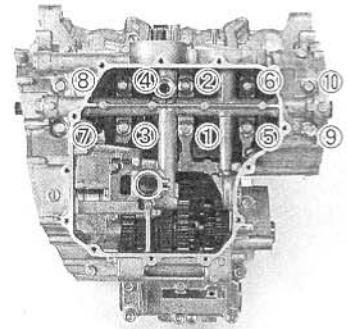
Loosely install all the crankcase bolts.

Make sure the upper and lower crankcase are seated securely.

Tighten the crankcase 8 mm bolts (main journal bolts) as follow:

Tighten the crankcase 8 mm bolts (main journal bolts) in numerical order in the illustration in two to three steps to the specified torque.

Further tighten the crankcase 8 mm bolts (main journal bolts) 120 degrees.

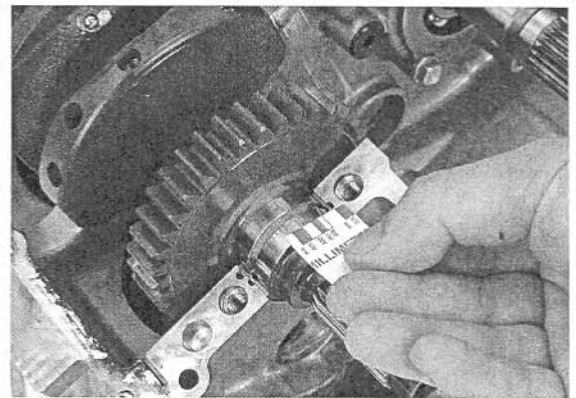


TORQUE: 15 N·m (1.5 kgf·m, 10 lbf·ft) +120°

Remove the crankcase 8 mm bolts (main journal bolts) and lower crankcase, measure the compressed plastigauge at its widest point on each main journal to determine the oil clearance.

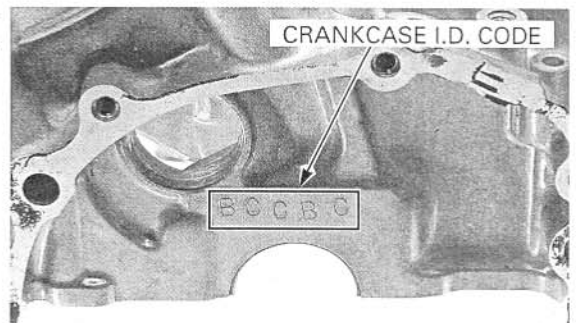
SERVICE LIMIT: 0.05 mm (0.002 in)

If the oil clearance exceeds the service limit, select a replacement bearing.



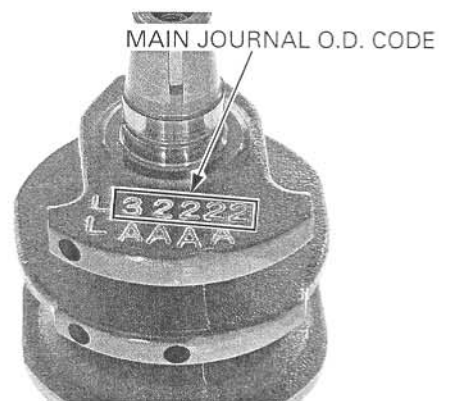
BEARING SELECTION

Record the crankcase bearing support I.D. code letters from the pad on the left side of the upper crankcase as shown.



Letters (A, B or C) on the left side of upper crankcase are the codes for the bearing support I.D.s from left to right.

Record the corresponding main journal O.D. code numbers from the crank weight.



Numbers (1, 2 or 3) on the crank weight are the codes for the main journal O.D.s from left to right.

CRANKSHAFT/PISTON/CYLINDER

Cross reference the main journal and bearing support codes to determine the replacement bearing color code.

MAIN JOURNAL BEARING SELECTION TABLE:

			BEARING SUPPORT I.D.CODE		
			A	B	C
			34.000 – 34.006 mm (1.3386 – 1.3388 in)	34.006 – 34.012 mm (1.3388 – 1.3391 in)	34.012 – 34.018 mm (1.3391 – 1.3393 in)
MAIN JOURNAL O.D. CODE	1	30.999 – 31.005 mm (1.2204 – 1.2207 in)	Pink	Yellow	Green
	2	30.993 – 30.999 mm (1.2202 – 1.2204 in)	Yellow	Green	Brown
	3	30.987 – 30.993 mm (1.2200 – 1.2202 in)	Green	Brown	Black

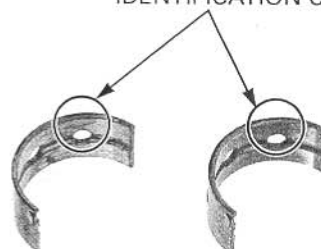
BEARING THICKNESS:

Black: Thickest
Brown:
Green: ↓
Yellow:
Pink: Thinnest

NOTICE

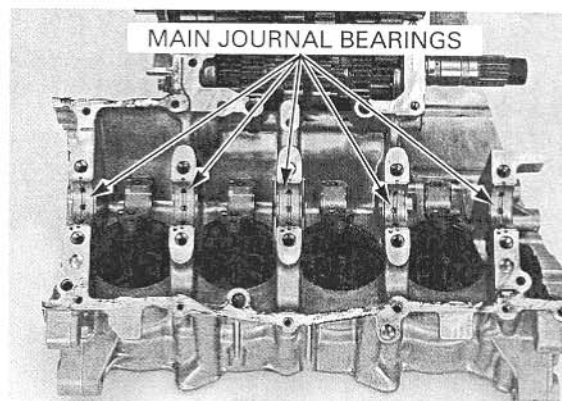
After selecting new bearings, recheck the clearance with a plastigauge. Incorrect clearance can cause severe engine damage.

IDENTIFICATION COLOR



BEARING INSTALLATION

Clean the bearing outer surfaces and crankcase bearing supports.
Install the main journal bearing inserts onto the crankcase bearing supports, aligning each tabs with each grooves.



CRANKPIN BEARING

NOTICE

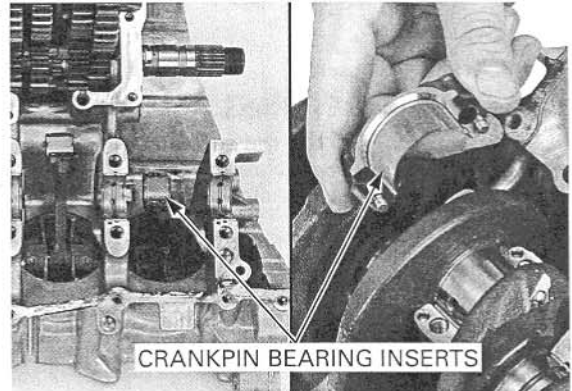
Do not interchange the bearing inserts. They must be installed in their original locations or the correct bearing oil clearance may not be obtained, resulting in engine damage.

Remove the crankshaft (page 13-5).

BEARING INSPECTION

Check the bearing inserts for unusual wear or peeling.

Check the bearing tabs for damage.



OIL CLEARANCE INSPECTION

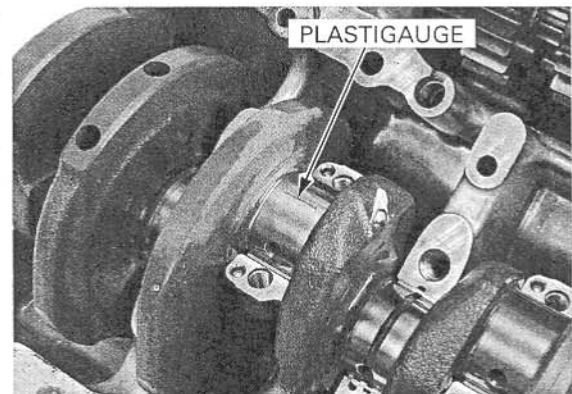
Clean off any oil from the bearing inserts and crankpins.

Carefully install the crankshaft onto the upper crankcase.

Set the connecting rods onto the crankpins.

Put a strip of plastigauge lengthwise on each crankpin avoiding the oil hole.

- Do not rotate the crankshaft during inspection.

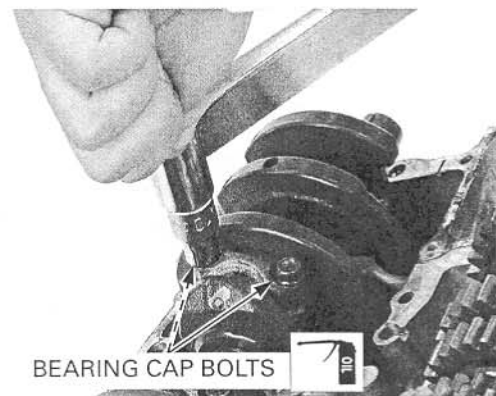


Carefully install the connecting rod bearing caps, aligning the dowel pins with the holes in the connecting rods.

Apply oil to the connecting rod bearing cap bolt threads and seating surfaces and install the bolts. Tighten the bolts in two or three steps alternately.

Further tighten the bolts 90 degrees.

TORQUE: 14 N·m (1.4 kgf·m, 10 lbf·ft) + 90°



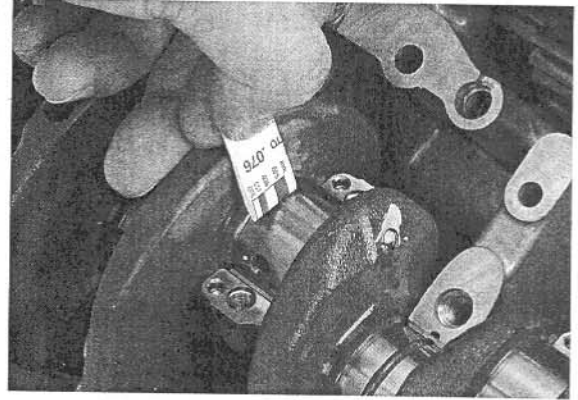
Use the removed connecting rod bolts when checking the oil clearance.

CRANKSHAFT/PISTON/CYLINDER

Remove the bearing caps and measure the compressed plastigauge at its widest point on the crankpin to determine the oil clearance.

SERVICE LIMIT: 0.06 mm (0.002 in)

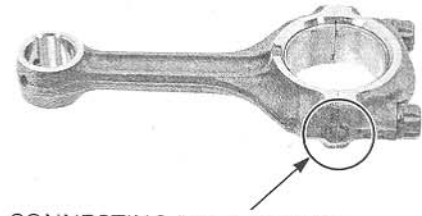
If the oil clearance exceeds the service limit, select the correct replacement bearings.



BEARING SELECTION

Numbers (1 or 2) on the connecting rods are the codes for the connecting rod I.D.

Record the connecting rod I.D. code number (1 or 2) or measure the I.D. with the connecting rod bearing cap installed without bearing inserts.

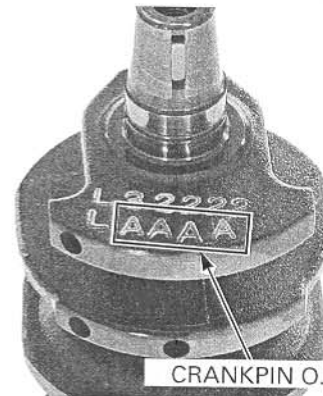


CONNECTING ROD I.D. CODE

Letters (A or B) on the crankweight are the codes for the crankpin O.D.s from left to right.

If you are replacing the crankshaft, record the corresponding crankpin O.D. code letter (A or B).

If you are reusing the crankshaft, measure the crankpin O.D. with the micrometer.



CRANKPIN O.D. CODE

Cross-reference the connecting rod and crankpin codes to determine the replacement bearing color.

CRANKPIN BEARING SELECTION TABLE:

			CONNECTING ROD I.D.CODE	
			1	2
CRANK PIN O.D.CODE	A	30.995 – 31.003 mm (1.2203 – 1.2206 in)	33.500 – 33.508 mm (1.3189 – 1.3192 in)	33.508 – 33.516 mm (1.3192 – 1.3195 in)
	B	30.984 – 30.995 mm (1.2198 – 1.2203 in)	Yellow	Green
			Green	Brown

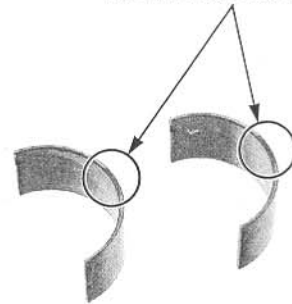
BEARING THICKNESS:

Brown:	Thickest
Green:	↓
Yellow:	Thinnest

NOTICE

After selecting new bearings, recheck the clearance with a plastigauge. Incorrect clearance can cause severe engine damage.

IDENTIFICATION COLOR

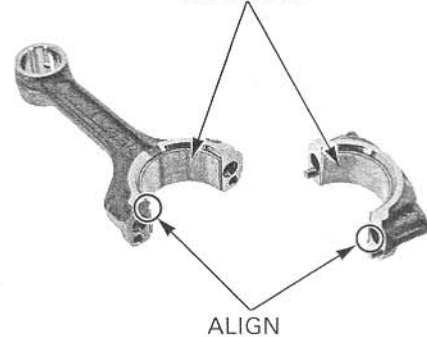


BEARING INSTALLATION

Clean the bearing outer surfaces, connecting rod bearing cap and connecting rod.

Install the crankpin bearing inserts onto the bearing cap and connecting rod, aligning each tab with each groove.

BEARINGS



PISTON/CYLINDER

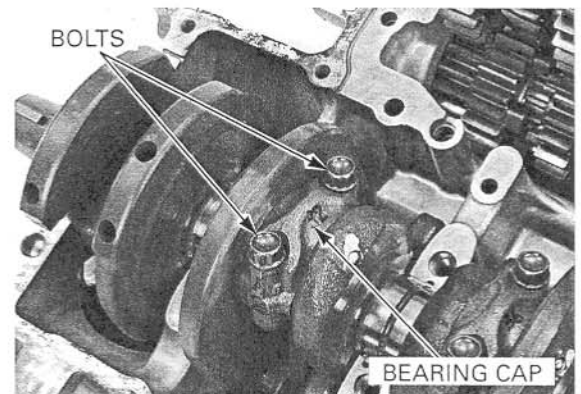
PISTON/CONNECTING ROD REMOVAL

NOTICE

- This motorcycle is equipped with aluminum cylinder sleeves. Before piston removal, place a clean shop towel around the connecting rod to prevent damaging the cylinder sleeve.
- Do not try to remove the piston/connecting rod assembly from bottom of the cylinder; the assembly will get stuck in the gap between the cylinder liner and the upper crankcase.
- Do not interchange the bearing inserts. They must be installed in their original locations or the correct bearing oil clearance may not be obtained, resulting in engine damage.

Mark all parts as you remove them to indicate the correct cylinder for reassembly.

Remove the bolts and connecting rod bearing caps.

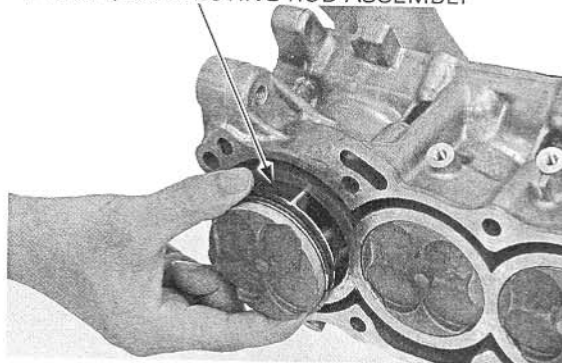


CRANKSHAFT/PISTON/CYLINDER

Do not try to remove the connecting rod/piston assembly from the bottom of the cylinder; the assembly will be locked so that the oil ring expands in the gap between the cylinder liner and the upper crankcase.

Remove the piston/connecting rod assembly from the top of the cylinder.

PISTON/CONNECTING ROD ASSEMBLY

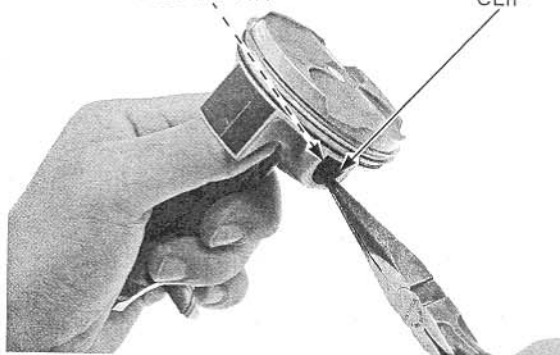


PISTON REMOVAL

Remove the piston pin clip with pliers. Push the piston pin out of the piston and connecting rod, and remove the piston.

PISTON PIN

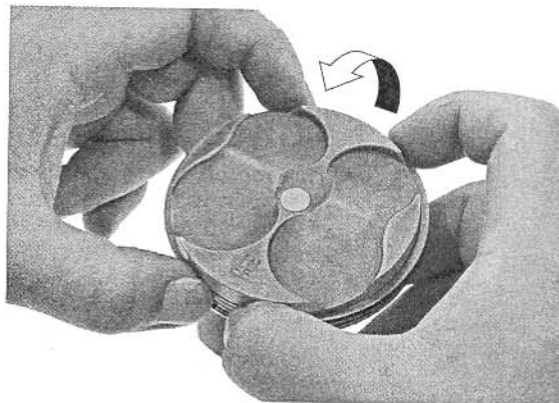
CLIP



PISTON DISASSEMBLY

Be careful not to damage the piston ring by spreading the ends too far.

Spread each piston ring ends and remove them by lifting up at a point opposite the gap.



Never use a wire brush; it will scratch the groove.

Clean carbon deposits from the piston ring grooves with a ring that will be discarded.



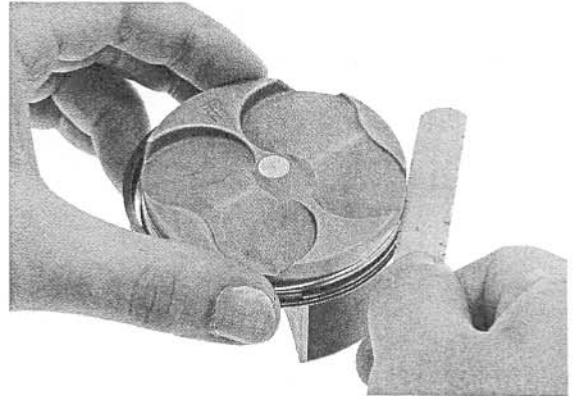
PISTON INSPECTION

Inspect the piston rings for movement by rotating the rings. The rings should be able to move in their grooves without catching.

Push the ring until the outer surface of the piston ring is nearly flush with the piston and measure the ring-to-ring groove clearance.

SERVICE LIMITS:

Top: 0.10 mm (0.004 in)
Second: 0.08 mm (0.003 in)

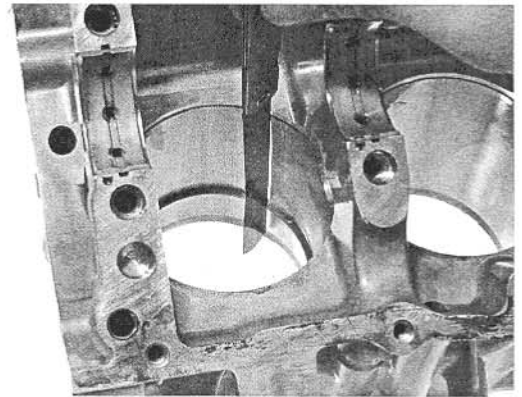


Push the rings into the cylinder with the top of the piston to be sure they are squarely in the cylinder.

Insert the piston ring squarely into the top of the cylinder and measure the ring end gap.

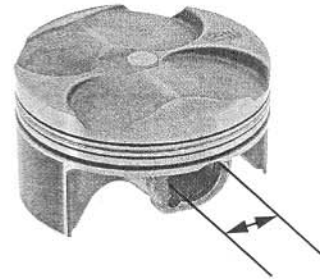
SERVICE LIMITS:

Top: 0.4 mm (0.02 in)
Second: 0.5 mm (0.02 in)
Oil (side rail): 1.0 mm (0.04 in)



Measure the piston pin bore.

SERVICE LIMIT: 16.02 mm (0.631 in)

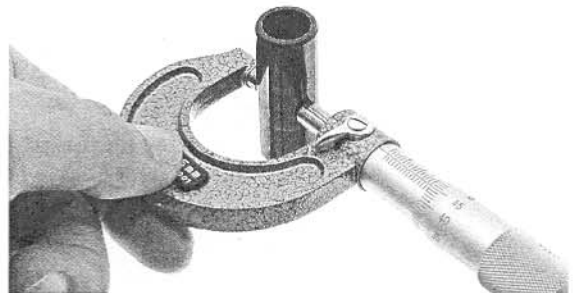


Measure the O.D. of the piston pin.

SERVICE LIMIT: 15.98 mm (0.629 in)

Calculate the piston-to-piston pin clearance.

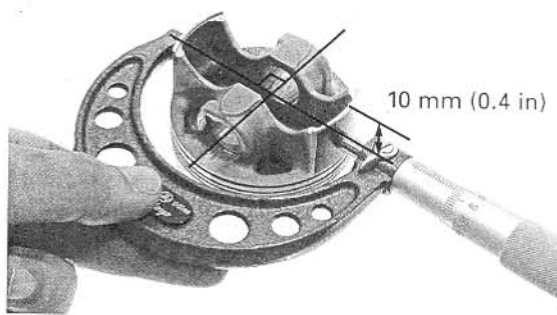
SERVICE LIMIT: 0.04 mm (0.002 in)



CRANKSHAFT/PISTON/CYLINDER

Measure the diameter of the piston at 10 mm (0.4 in) from the bottom and 90 degrees to the piston pin hole.

SERVICE LIMIT: 66.90 mm (2.634 in)



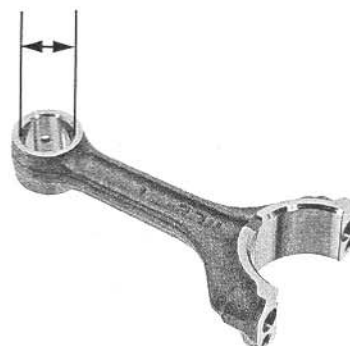
CONNECTING ROD INSPECTION

Measure the connecting rod small end I.D.

SERVICE LIMIT: 16.050 mm (0.6319 in)

Calculate the connecting rod-to-piston pin clearance.

SERVICE LIMIT: 0.070 mm (0.0028 in)



CYLINDER INSPECTION

Inspect the cylinder bore for wear or damage. Measure the cylinder I.D. in X and Y axis at three levels.

Take the maximum reading to determine the cylinder wear.

SERVICE LIMIT: 67.10 mm (2.642 in)

Calculate the piston-to-cylinder clearance. Take a maximum reading to determine the clearance.

Refer to the procedures for measurement of the piston O.D. (page 13-16).

SERVICE LIMIT: 0.10 mm (0.004 in)

Calculate the taper and out-of-round at three levels in X and Y axis. Take the maximum reading to determine them.

SERVICE LIMITS:

Taper: 0.10 mm (0.004 in)

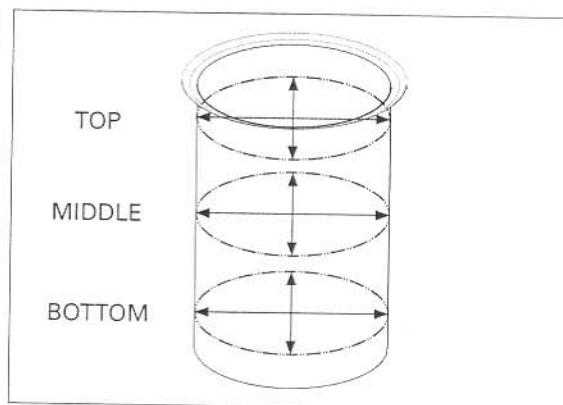
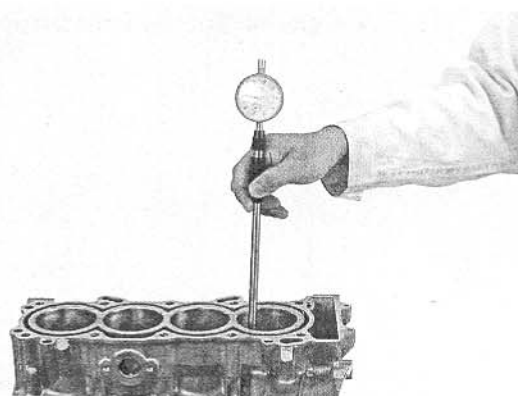
Out-of-round: 0.10 mm (0.004 in)

The cylinder must be rebored and an oversize piston fitted if the service limits are exceeded.

The following oversize piston is available:

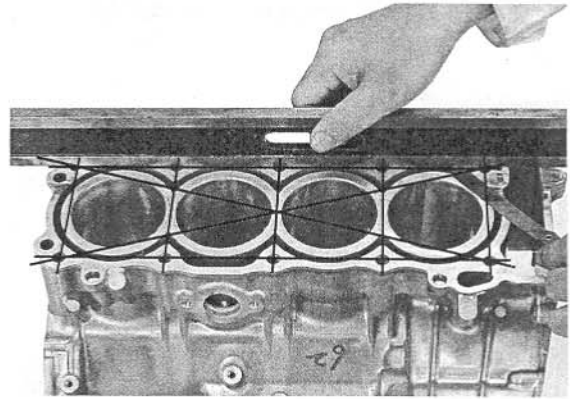
0.25 mm (0.010 in)

The piston to cylinder clearance for the oversize piston must be: 0.015 – 0.050 mm (0.0006 – 0.0020 in).



Inspect the top of the cylinder for warpage.

SERVICE LIMIT: 0.10 mm (0.004 in)



PISTON ASSEMBLY

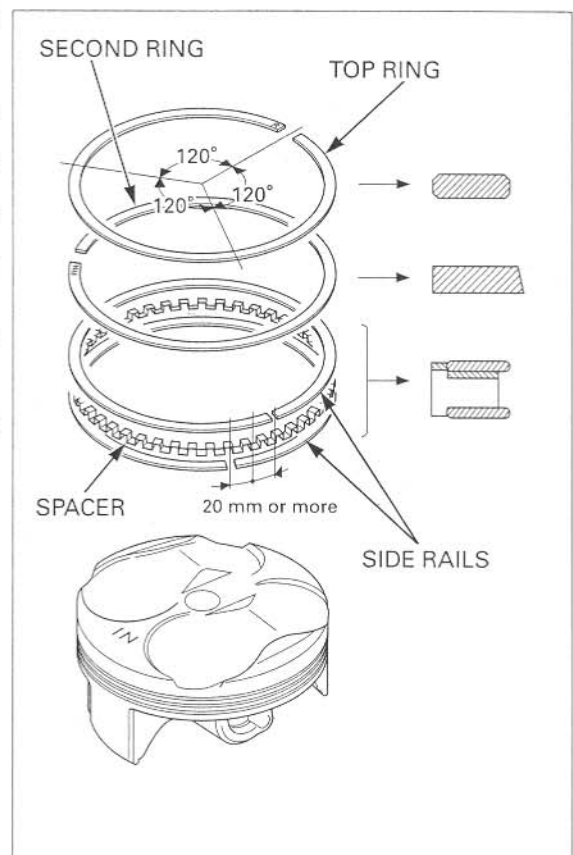
Clean the piston ring grooves thoroughly and install the piston rings.

- Apply oil to the piston rings.
- Avoid piston and piston ring damage during installation.
- Install the piston rings with the marking (R: top ring, RN: second ring) facing up.
- Do not mix the top and second rings; top ring is narrower than the second ring in width.
- To install the oil ring, install the spacer first, then install the side rails.

Stagger the piston ring end gaps 120° apart from each other.

Stagger the side rail end gaps as shown.

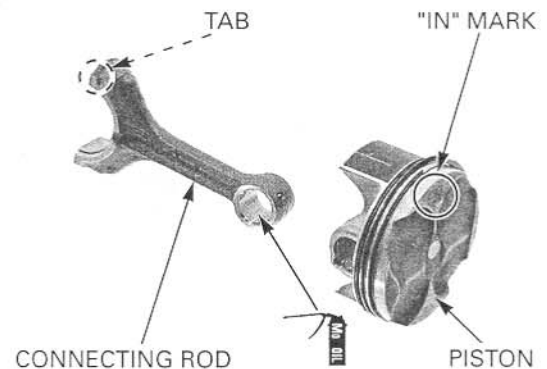
After installation, the rings should rotate freely in the ring groove.



PISTON INSTALLATION

Apply molybdenum oil solution to the connecting rod small end inner surfaces and piston pin outer surfaces.

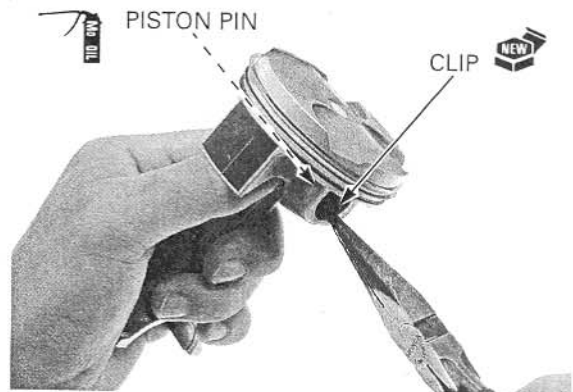
Assemble the piston and connecting rod with the journal bearing tab facing to the piston "IN" mark.



CRANKSHAFT/PISTON/CYLINDER

Install the piston pin and secure it using new piston pin clips.

- Make sure that the piston pin clips are seated securely.
- Do not align the piston pin clip end gap with the piston cut-out.



Coat the cylinder walls, pistons and piston rings with engine oil.

Install the piston/ connecting rod assembly with the piston "IN" mark facing the intake side.

Install the piston/connecting rod assemblies into the cylinders using a commercially available piston ring compressor tool.

When reusing the connecting rods, they must be installed in their original locations.

NOTICE

- While installing the piston, be careful not to damage the top surface of the cylinder, especially around the cylinder bore.
- Be careful not to damage the cylinder sleeve and crankpin with the connecting rod.

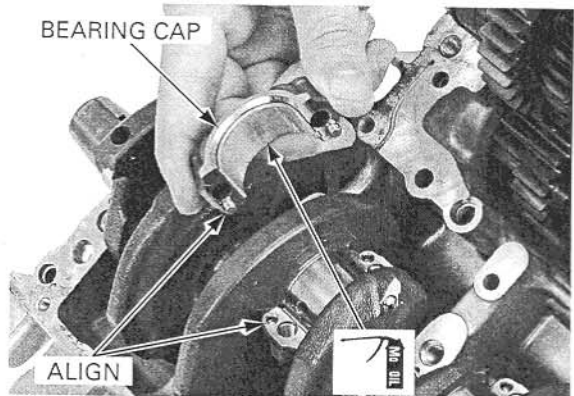
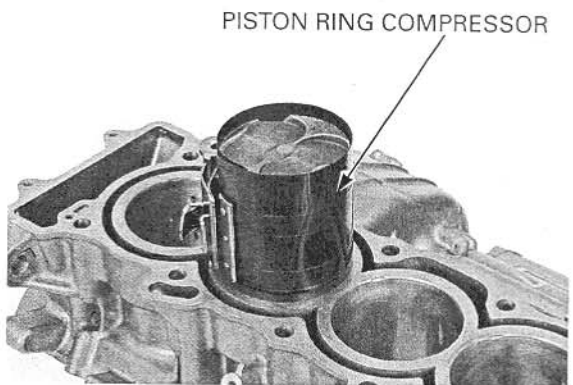
Make sure the piston ring compressor tool sits flush on the top surface of the cylinder.

Use the handle of a plastic hammer or equivalent tool to tap the piston into the cylinder.

Install the crankshaft (page 13-6).

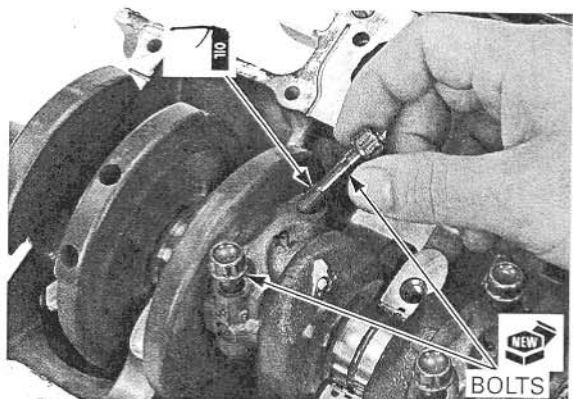
Apply molybdenum oil solution to the crankpin bearing sliding surface on the bearing caps.

Install the connecting rod bearing caps, aligning the dowel pins with the holes in the connecting rods.



The connecting rod bolts cannot be reused. Once the connecting rod bolts have been loosened replace them with new ones.

Apply oil to new connecting rod bearing cap bolt threads and seating surfaces, and install the bolts.



CRANKSHAFT/PISTON/CYLINDER

Tighten the bolts in two or three steps alternately.
Further tighten the bolts 90 degree.

TORQUE: 14 N·m (1.4 kgf·m, 10 lbf·ft) + 90°

Assemble the crankcase halves (page 12-16).

