

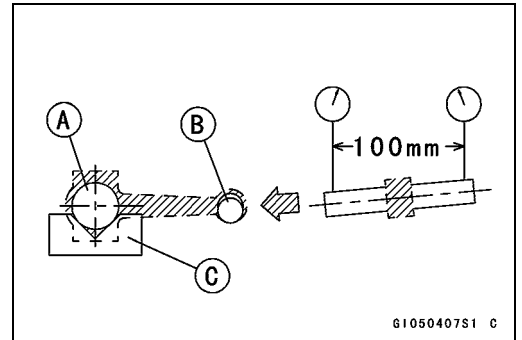
Crankshaft and Connecting Rods

Connecting Rod Twist Inspection

- With the big-end arbor [A] still on V block [C], hold the connecting rod horizontally and measure the amount that the arbor [B] varies from being paralleled with the surface plate over a 100 mm (3.94 in.) length of the arbor to determine the amount of connecting rod twist.
- ★ If the connecting rod twist exceeds the service limit, the connecting rod must be replaced.

Connecting Rod Twist

Service Limit: TIR 0.2/100 mm (0.008/3.94 in.)



Connecting Rod Big End Side Clearance Inspection

- Measure connecting rod big end side clearance.
- Insert a thickness gauge [A] between the big end and either crank web to determine clearance.

Connecting Rod Big End Side Clearance

Standard: 0.13 ~ 0.38 mm (0.0051 ~ 0.0150 in.)

Service Limit: 0.58 mm (0.023 in.)

- ★ If the clearance exceeds the service limit, replace the connecting rod with new one and then check clearance again. If the clearance is too large after connecting rod replacement, the crankshaft also must be replaced.



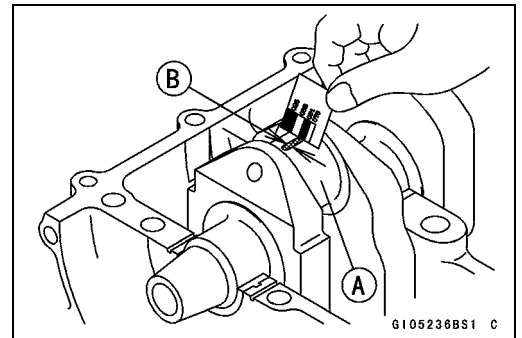
Connecting Rod Big End Bearing Insert/Crankpin Wear Inspection

- Remove the connecting rod big end (see Connecting Rod Removal).
- Cut strips of plastigage to crankpin width. Place a strip on the crankpin parallel to the crankshaft installed in the correct position.
- Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).

NOTE

○ Do not move the connecting rod and crankshaft during clearance measurement.

- Remove the connecting rod big end again, measure each clearance between the bearing insert and crankpin [A] using plastigage (press gauge) [B].



CAUTION

After measurement, replace the connecting rod bolts and nuts.

Connecting Rod Big End Bearing Insert/Crankpin Clearance

Standard: 0.044 ~ 0.081 mm (0.0017 ~ 0.0032 in.)

Service Limit: 0.11 mm (0.0043 in.)

9-24 CRANKSHAFT/TRANSMISSION

Crankshaft and Connecting Rods

- ★ If the clearance is within the standard, no bearing replacement is required.
- ★ If the clearance is between 0.082 mm (0.0032 in.) and the service limit (0.11 mm, 0.0043 in.), replace the bearing inserts [A] with inserts painted blue [B]. Check insert/crankpin clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.
- ★ If the clearance exceeds the service limit, measure the diameter of the crankpins.

Crankpin Diameter

Standard: 29.987 ~ 30.000 mm (1.1806 ~ 1.1811 in.)

Service Limit: 29.98 mm (1.1803 in.)

- ★ If any crankpin has worn past the service limit, replace the crankshaft with a new one.
- ★ If the measured crankpin diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.

Crankpin Diameter Marks

None 29.984 ~ 29.992 mm (1.1805 ~ 1.1808 in.)

○ 29.993 ~ 30.000 mm (1.1808 ~ 1.1811 in.)

△: Crankpin Diameter Marks, "○" or no mark.

- Measure the connecting rod big end inside diameter, and mark each connecting rod big end in accordance with the inside diameter.
- Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).

NOTE

○ The mark already on the big end should almost coincide with the measurement.

Connecting Rod Big End Inside Diameter Marks

None 33.000 ~ 33.008 mm (1.2992 ~ 1.2995 in.)

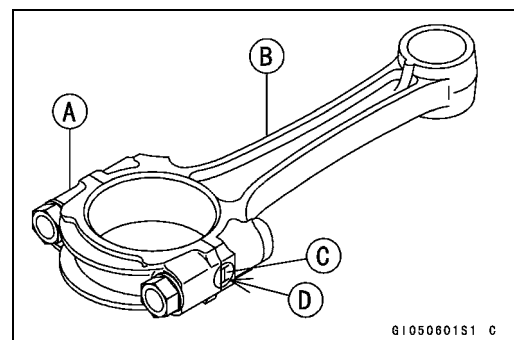
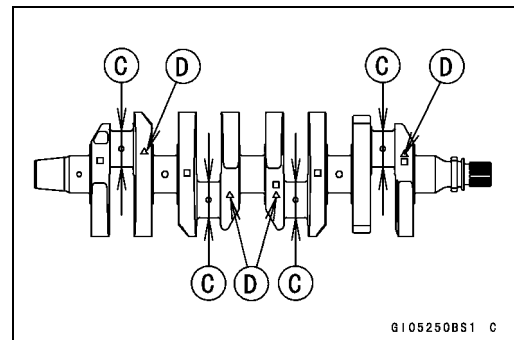
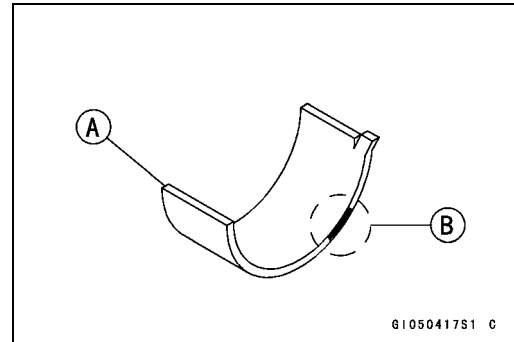
○ 33.009 ~ 33.016 mm (1.2996 ~ 1.2998 in.)

Big End Cap [A]

Connecting Rod [B]

Weight Mark, Alphabet [C]

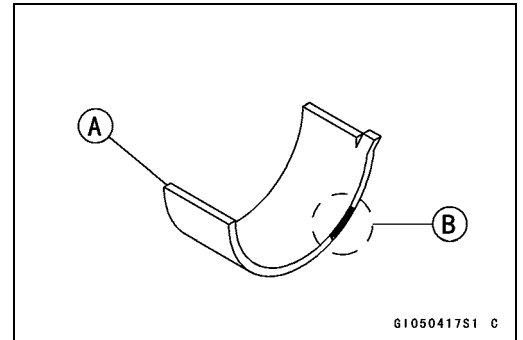
Diameter Mark (Around Weight Mark) [D]: "○" or no mark



Crankshaft and Connecting Rods

- Select the proper bearing insert [A] in accordance with the combination of the connecting rod and crankshaft coding. Size Color [B]

Con-rod Big End Inside Diameter Marking	Crankpin Diameter Marking	Bearing Insert	
		Size Color	Part Number
None	○	Brown	92139-0167
None	None	Black	92139-0166
○	○		
○	None	Blue	92139-0165



- Install the new inserts in the connecting rod and check insert/crankpin clearance with the plastigage.

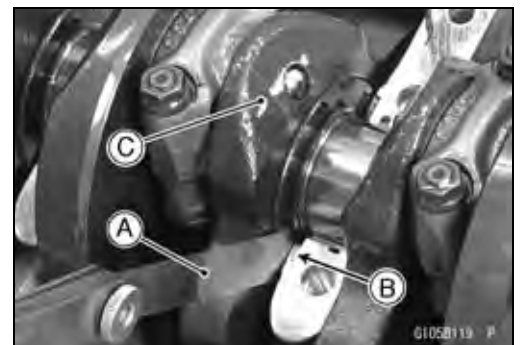
Crankshaft Side Clearance Inspection

- Insert a thickness gauge [A] between the thrust washer [B] on the crankcase and the crank web [C] at the #3 main journal to determine clearance.
- ★ If the clearance exceeds the service limit, replace the thrust washers as a set and check the width of the crankshaft #3 main journal.

Crankshaft Side Clearance

Standard: 0.05 ~ 0.25 mm (0.0020 ~ 0.0098 in.)

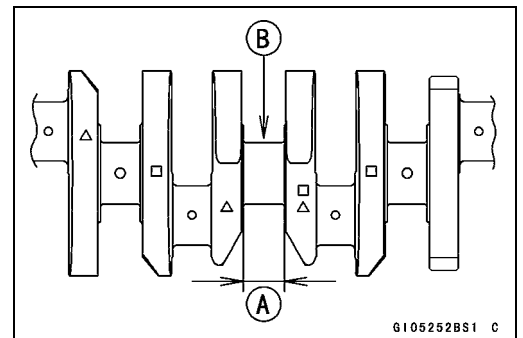
Service Limit: 0.45 mm (0.0177 in.)



- Measure the width [A] of the crankshaft #3 main journal [B].
- ★ If the measurement exceeds the standard, replace the crankshaft.

Crankshaft #3 Main Journal Width

Standard: 21.09 ~ 21.14 mm (0.8303 ~ 0.8323 in.)



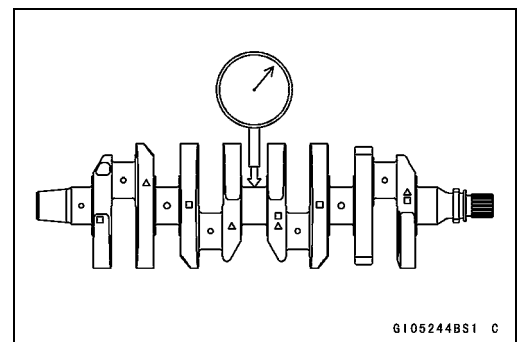
Crankshaft Runout Inspection

- Measure the crankshaft runout.
- ★ If the measurement exceeds the service limit, replace the crankshaft.

Crankshaft Runout

Standard: TIR 0.02 mm (0.0008 in.) or less

Service Limit: TIR 0.05 mm (0.0020 in.)



9-26 CRANKSHAFT/TRANSMISSION

Crankshaft and Connecting Rods

Crankshaft Main Bearing Insert/Journal Wear Inspection

- Split the crankcase (see Crankcase Splitting).
- Cut strips of plastigage to journal width. Place a strip on each journal parallel to the crankshaft installed in the correct position.
- Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).

NOTE

- Do not turn the crankshaft during clearance measurement.
- Journal clearance less than 0.025 mm (0.00098 in.) can not be measured by plastigage [A], however, using genuine parts maintains the minimum standard clearance.
- Split the crankcase again, measure each clearance between the bearing insert and journal [B] using plastigage (press gauge).

Crankshaft Main Bearing Insert/Journal Clearance

Standard: 0.028 ~ 0.060 mm (0.0011 ~ 0.0024 in.)

Service Limit: 0.09 mm (0.0035 in.)

- ★ If the clearance is within the standard, no bearing replacement is required.
- ★ If the clearance is between 0.061 mm (0.0024 in.) and the service limit (0.09 mm, 0.0035 in.), replace the bearing inserts [A] with inserts painted blue and purple [B]. Check insert/journal clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.
- ★ If the clearance exceeds the service limit, measure the diameter of the crankshaft main journal.

Crankshaft Main Journal Diameter

Standard: 30.984 ~ 31.000 mm (1.2198 ~ 1.2205 in.)

Service Limit: 30.96 mm (1.2189 in.)

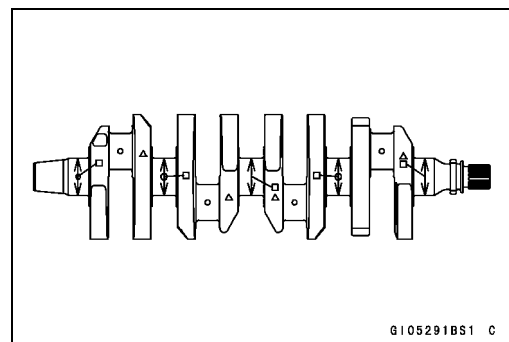
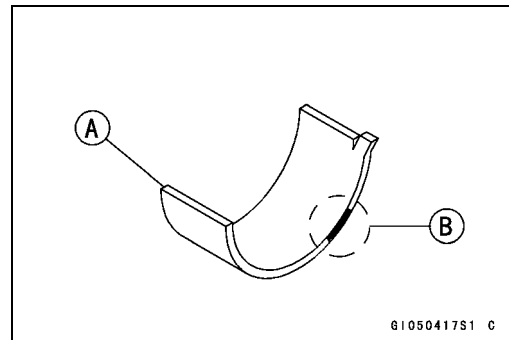
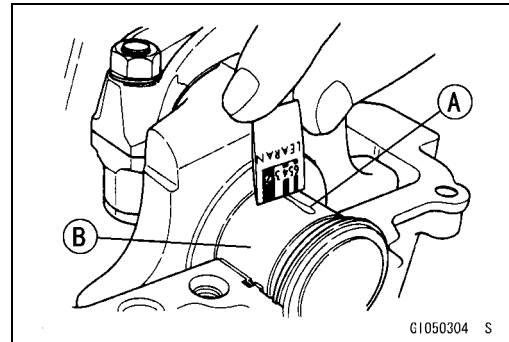
- ★ If any journal has worn past the service limit, replace the crankshaft with a new one.
- ★ If the measured journal diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.

Crankshaft Main Journal Diameter Marks

None 30.984 ~ 30.992 mm (1.2198 ~ 1.2202 in.)

1 30.993 ~ 31.000 mm (1.2202 ~ 1.2205 in.)

- : Crankshaft Main Journal Diameter Marks, "1" or no mark.



Crankshaft and Connecting Rods

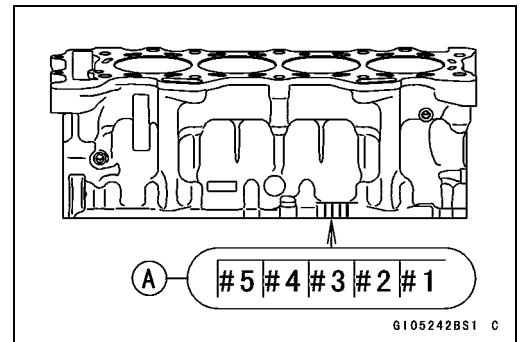
- Measure the main bearing inside diameter, and mark the upper crankcase half in accordance with the inside diameter.

[A]: Crankcase Main Bearing Inside Diameter Marks, “○” or no mark.

- Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).

NOTE

○ The mark already on the upper crankcase half should almost coincide with the measurement.

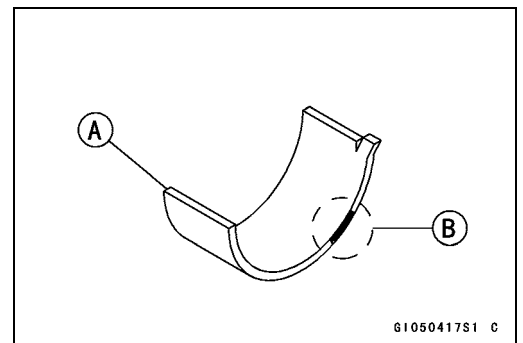


Crankcase Main Bearing Inside Diameter Marks

○ 34.000 ~ 34.008 mm (1.3386 ~ 1.3389 in.)

None 34.009 ~ 34.016 mm (1.3389 ~ 1.3392 in.)

- Select the proper bearing insert [A] in accordance with the combination of the crankcase and crankshaft coding. Size Color [B]



Crankcase Main Bearing Inside Diameter Marking	Crankshaft Main Journal Diameter Marking	Bearing Insert*		
		Size Color	Part Number	Journal Nos.
○	1	Brown	92139-0247	1, 5
			92139-0250	2, 4
		Yellow	92139-0253	3
None	1	Black	92139-0246	1, 5
			92139-0249	2, 4
		Green	92139-0252	3
○	None	Black	92139-0246	1, 5
			92139-0249	2, 4
		Green	92139-0252	3
None	None	Blue	92139-0245	1, 5
			92139-0248	2, 4
		Purple	92139-0251	3

*: The bearing inserts for Nos. 2 and 4 journals have an oil groove, respectively.

- Install the new inserts in the crankcase halves and check insert/journal clearance with the plastigage.

9-28 CRANKSHAFT/TRANSMISSION

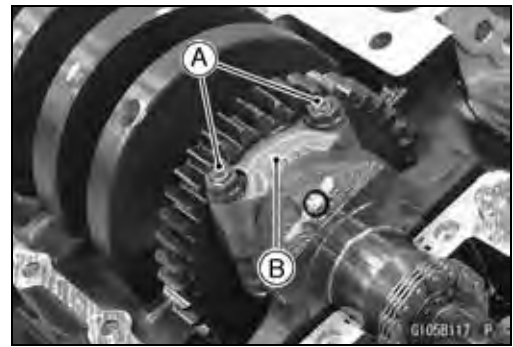
Pistons

Piston Removal

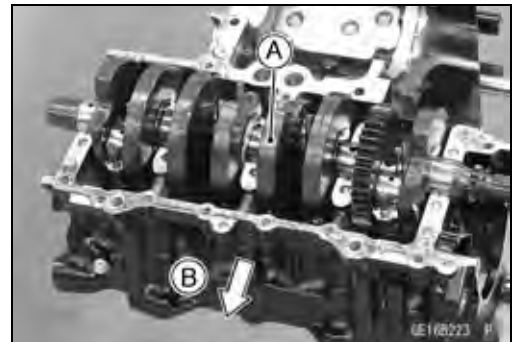
- Split the crankcase (see Crankcase Splitting).
- Remove the connecting rod big end nuts [A] and caps [B].

NOTE

○ Mark and record the locations of the connecting rods and their big end caps so that they can be reassembled in their original positions.



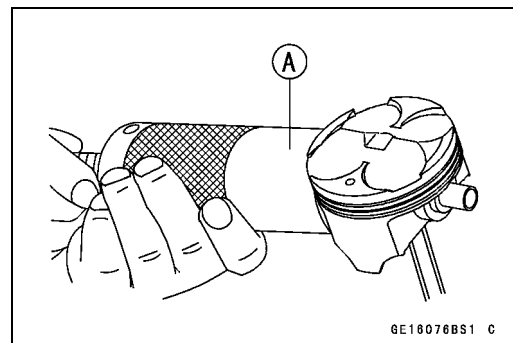
- Remove:
 - Camshaft Chain (see Camshaft Chain Removal in the Engine Top End chapter)
 - Crankshaft [A]
- Remove the connecting rods with pistons to the cylinder head side [B].



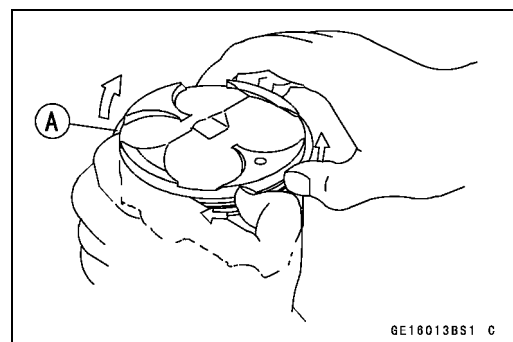
- Remove the piston pin snap rings [A].



- Using the piston pin puller assembly [A], remove the piston pins.
Special Tool - Piston Pin Puller Assembly: 57001-910
- Remove the pistons from the connecting rods.



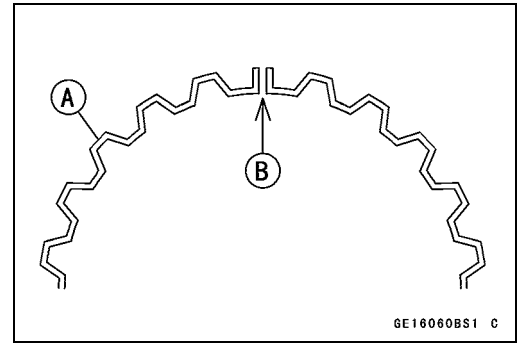
- Carefully spread the ring opening with your thumbs and then push up on the opposite side of the ring [A] to remove it.
- Remove the 3-piece oil ring with your thumbs in the same manner.



Pistons

Piston Installation

- Apply molybdenum disulfide oil solution to the oil ring expander, and install the oil ring expander [A] in the bottom piston ring groove so the ends [B] not butt together.
- Apply molybdenum disulfide oil solution to the oil ring steel rails, and install the oil ring steel rails, one above the expander and one below it.
- Spread the rail with your thumbs, but only enough to fit the rail over the piston.
- Release the rail into the bottom piston ring groove.



NOTE

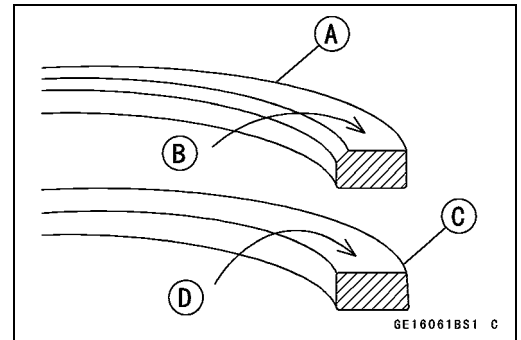
- The oil ring rails have no “top” or “bottom”.

- Apply molybdenum disulfide oil solution to the piston rings.

NOTE

- Do not mix up the top and second ring.

- Install the top ring [A] so that the “R” mark [B] faces up.
- Install the second ring [C] so that the “RN” mark [D] faces up.

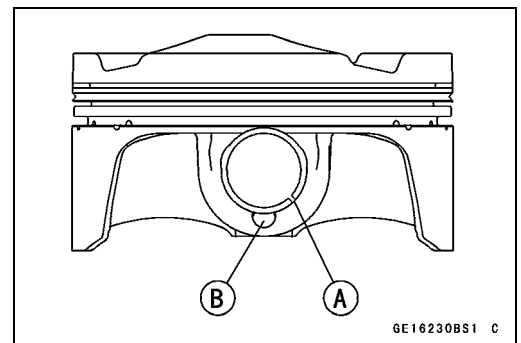


- Apply molybdenum disulfide oil solution to the piston pins and piston journals.

NOTE

- If a new piston is used, use new piston ring.

- Fit a new piston pin snap ring into the side of the piston so that the ring opening [A] does not coincide with the slit [B] of the piston pin hole.
- When installing the piston pin snap ring, compress it only enough to install it and no more.

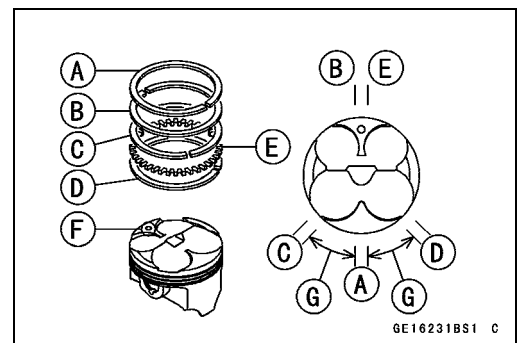


CAUTION

Do not reuse snap rings, as removal weakens and deforms them. They could fall out and score the cylinder wall.

- The piston ring openings must be positioned as shown in the figure. The openings of the oil ring steel rails must be about 30 ~ 40° of angle from the opening of the top ring.

- Top Ring [A]
- Second Ring [B]
- Upper Oil Ring Steel Rail [C]
- Lower Oil Ring Steel Rail [D]
- Oil Ring Expander [E]
- Hollow [F]
- 30 ~ 40° [G]



9-30 CRANKSHAFT/TRANSMISSION

Pistons

- Apply molybdenum disulfide oil solution to the cylinder bore and piston skirt.
- Install the piston with its marking hollow [A] facing exhaust side.
- Using the piston ring compressor assembly [B] to install the piston from the cylinder head side.

Special Tools - Piston Ring Compressor Grip: 57001-1095
Piston Ring Compressor Belt, $\phi 67 \sim \phi 79$: 57001-1097

- Install:
 - Crankshaft (see Crankshaft Installation)
 - Connecting Rod Big End Caps (see Connecting Rod Installation)

Cylinder (Upper Crankcase) Wear Inspection

- Since there is a difference in cylinder wear (upper crankcase) in different directions, take a side-to-side and a front-to-back measurement at each of the two locations (total of four measurements) as shown in the figure.
- ★ If any of the cylinder inside diameter measurements exceeds the service limit, replace the crankcase.
 - 10 mm (0.39 in.) [A]
 - 60 mm (2.36 in.) [B]

Cylinder (Upper Crankcase) Inside Diameter

Standard: 67.000 ~ 67.012 mm (2.6378 ~ 2.6383 in.)
Service Limit: 67.09 mm (2.6413 in.)

Piston Wear Inspection

- Measure the outside diameter [A] of each piston 5 mm (0.20 in.) [B] up from the bottom of the piston at a right angle to the direction of the piston pin.
- ★ If the measurement is under service limit, replace the piston.

Piston Diameter

Standard: 66.960 ~ 66.975 mm (2.6362 ~ 2.6368 in.)
Service Limit: 66.81 mm (2.6303 in.)

Piston Ring, Piston Ring Groove Wear Inspection

- Check for uneven groove wear by inspecting the ring seating.
- ★ The rings should fit perfectly parallel to groove surfaces. If not, replace the piston and all the piston rings.
- With the piston rings in their grooves, make several measurements with a thickness gauge [A] to determine piston ring/groove clearance.

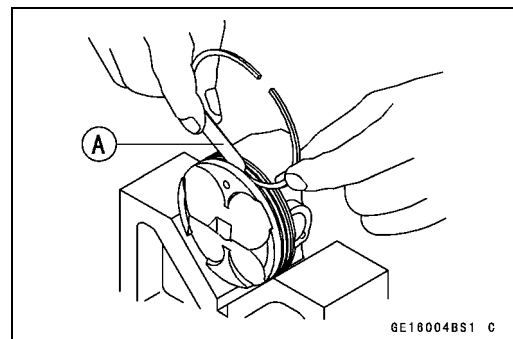
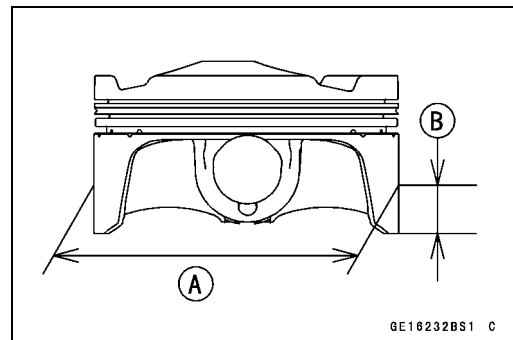
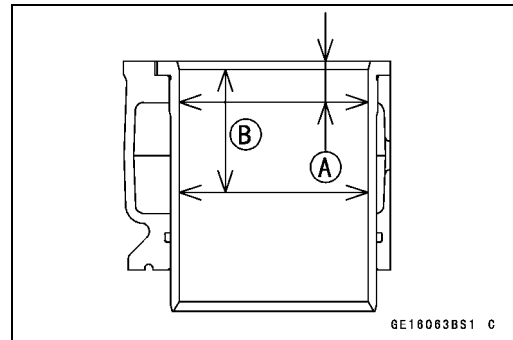
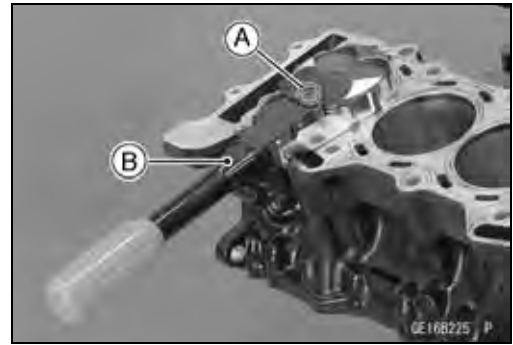
Piston Ring/Groove Clearance

Standard:

Top 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)
Second 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in.)

Service Limit:

Top 0.17 mm (0.0067 in.)
Second 0.17 mm (0.0067 in.)



Pistons

Piston Ring Groove Width Inspection

- Measure the piston ring groove width.
- Use a vernier caliper at several points around the piston.

Piston Ring Groove Width

Standard:

Top [A] 0.82 ~ 0.84 mm (0.0323 ~ 0.0331 in.)

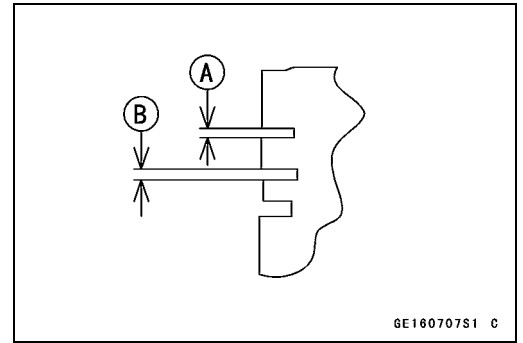
Second [B] 0.82 ~ 0.84 mm (0.0323 ~ 0.0331 in.)

Service Limit:

Top 0.92 mm (0.036 in.)

Second 0.92 mm (0.036 in.)

- ★ If the width of any of the two grooves is wider than the service limit at any point, replace the piston.



Piston Ring Thickness Inspection

- Measure the piston ring thickness.
- Use the micrometer to measure at several points around the ring.

Piston Ring Thickness

Standard:

Top [A] 0.77 ~ 0.79 mm (0.0303 ~ 0.0311 in.)

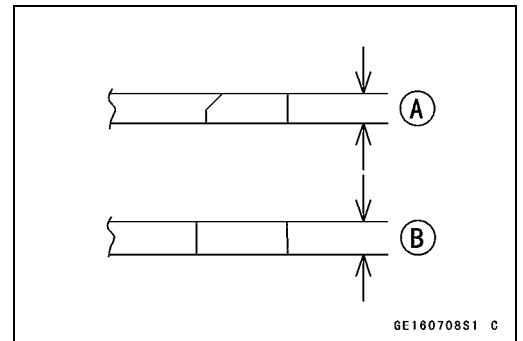
Second [B] 0.77 ~ 0.79 mm (0.0303 ~ 0.0311 in.)

Service Limit:

Top 0.70 mm (0.028 in.)

Second 0.70 mm (0.028 in.)

- ★ If any of the measurements is less than the service limit on either of the rings, replace all the rings.



NOTE

- When using new rings in a used piston, check for uneven groove wear. The rings should fit perfectly parallel to the groove sides. If not, replace the piston.

Piston Ring End Gap Inspection

- Place the piston ring [A] inside the cylinder (upper crankcase), using the piston to locate the ring squarely in place. Set it close to the bottom of the cylinder, where cylinder wear is low.
- Measure the gap [B] between the ends of the ring with a thickness gauge.

Piston Ring End Gap

Standard:

Top 0.12 ~ 0.22 mm (0.0047 ~ 0.0087 in.)

Second 0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in.)

Oil 0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in.)

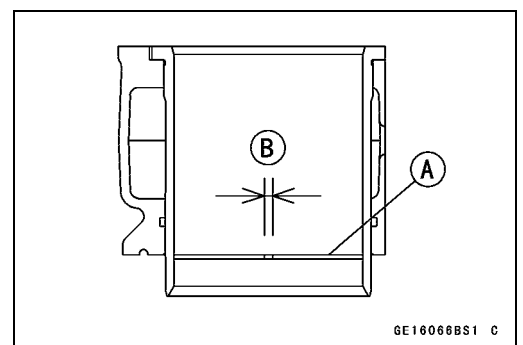
Service Limit:

Top 0.5 mm (0.020 in.)

Second 0.8 mm (0.031 in.)

Oil 1.0 mm (0.039 in.)

- ★ If the end gap of either ring is greater than the service limit, replace all the rings.

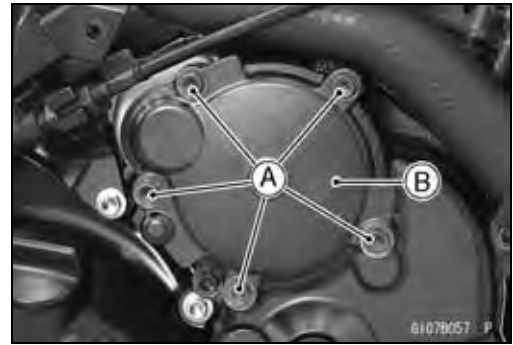


9-32 CRANKSHAFT/TRANSMISSION

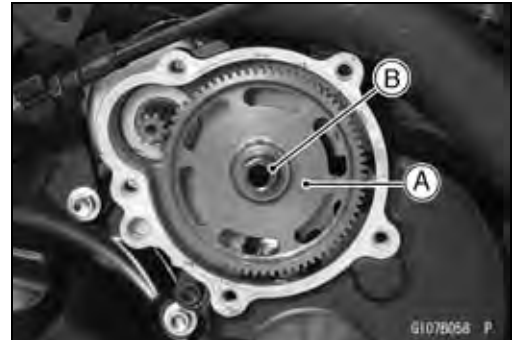
Starter Idle Gear and Starter Clutch

Starter Idle Gear Removal

- Remove:
 - Right Fairing Cover (see Fairing Cover Removal in the Frame chapter)
 - Bolts [A]
 - Idle Gear Cover [B]



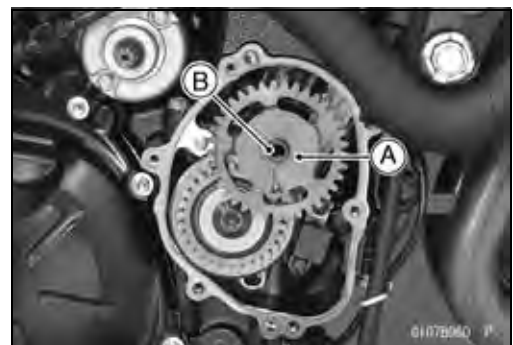
- Pull out the idle gear (starter motor side) [A] with the shaft [B].



- Remove:
 - Bolts [A]
 - Starter Clutch Cover [B]



- Pull out the idle gear (starter clutch side) [A] with the shaft [B].



Starter Idle Gear Installation

- Apply molybdenum disulfide grease [A] to the idle gear shaft (starter clutch side) [B].
- Fit the pin [C] into the groove [D] of the crankcase.

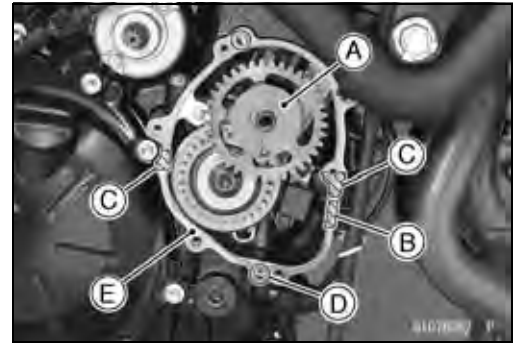


Starter Idle Gear and Starter Clutch

- Install the idle gear (starter clutch side) [A] on the shaft.
- Engage the idle gear with the starter clutch gear.
- Apply silicone sealant to the following portion.
 - Crankshaft Sensor Lead Grommet [B]
 - Crankcase Halves Mating Surfaces [C]

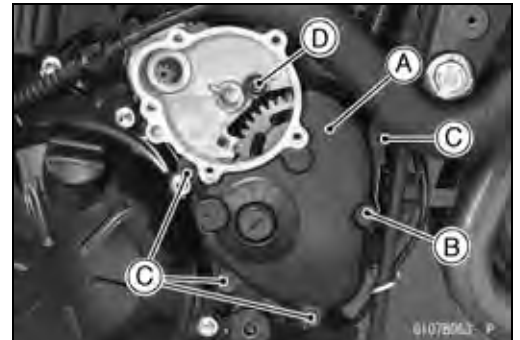
Sealant - Kawasaki Bond (Silicone Sealant): 92104-0004

- Install the dowel pins [D] and new gasket [E].



- Apply grease to the O-ring of the starter motor.
- Install the starter clutch cover [A].
- Tighten:
 - Torque - Starter Clutch Cover Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**

- L = 40 mm (1.57 in.) [B]
- L = 30 mm (1.18 in.) [C]
- L = 20 mm (0.79 in.) [D]



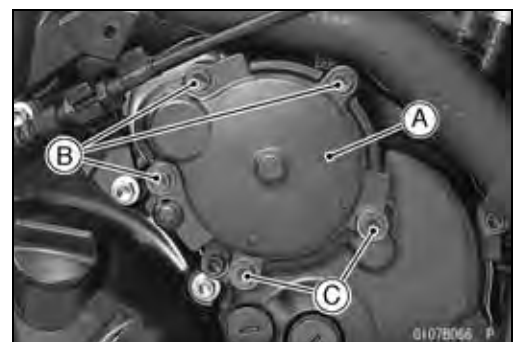
- Apply molybdenum disulfide grease to the idle gear shaft (starter motor side) [A].
- Install the idle gear (starter motor side) [B] on the shaft.
- Engage the idle gear with the starter motor gear and idle gear (starter clutch side).
- Fit the pin [C] into the groove [D] of the starter clutch cover.
- Install the dowel pin [E] and new gasket.



- Position the idle gear [A] to inside of the mating surface [B] of the cover.



- Install:
 - Idle Gear Cover [A]
 - Idle Gear Cover Bolts [B]
 - Idle Gear Cover Bolts [C] with New Gaskets
- Tighten:
 - Torque - Idle Gear Cover Bolts: 9.8 N·m (1.0 kgf·m, 87 in·lb)**
- Install the removed parts (see appropriate chapters).



9-34 CRANKSHAFT/TRANSMISSION

Starter Idle Gear and Starter Clutch

Starter Clutch Removal

- Remove:
 - Alternator Cover (see Alternator Cover Removal in the Electrical System chapter)
 - Starter Clutch Cover (see Starter Idle Gear Removal)
 - Idle Gear (Starter Clutch Side) (see Starter Idle Gear Removal)
- Unscrew the starter clutch bolt [A], while holding the alternator rotor steady with the rotor holder (see Alternator Rotor Removal in the Electrical System chapter).

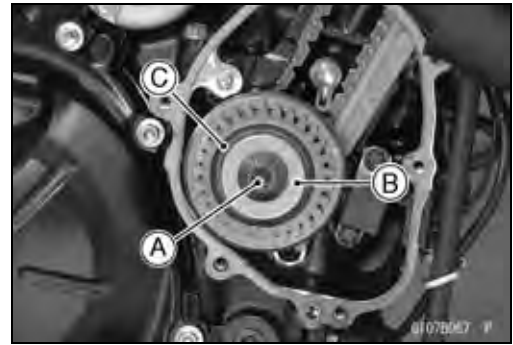
Special Tools - Grip: 57001-1591

Rotor Holder: 57001-1666

Stopper: 57001-1679

Rotor Holder Attachment: 57001-1689

- Remove:
 - Washer [B]
 - Starter Clutch [C]



Starter Clutch Installation

- Install the starter clutch [A] while fitting the alignment notch [B] of the splines onto the alignment tooth [C].
- Install the washer.
- Tighten the starter clutch bolt, while holding the alternator rotor steady with the rotor holder (see Alternator Rotor Installation in the Electrical System chapter).

Special Tools - Grip: 57001-1591

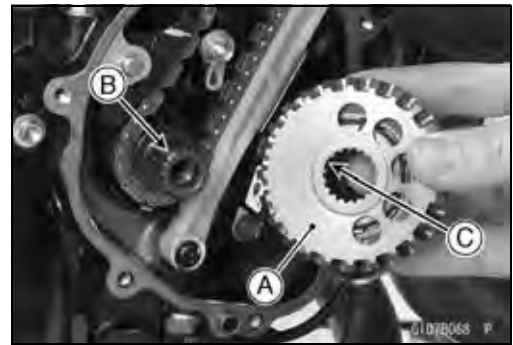
Rotor Holder: 57001-1666

Stopper: 57001-1679

Rotor Holder Attachment: 57001-1689

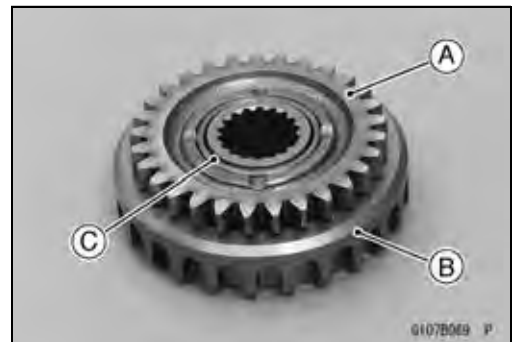
Torque - Starter Clutch Bolt: 49 N·m (5.0 kgf·m, 36 ft·lb)

- Install the removed parts (see appropriate chapters).



Starter Clutch Disassembly

- Remove the starter clutch (see Starter Clutch Removal).
- Pull the starter clutch gear [A] out of the starter clutch [B].
- Remove the needle bearing [C].



- Remove the snap ring [A].
- Pull the one-way clutch [B] out of the starter clutch case [C].

