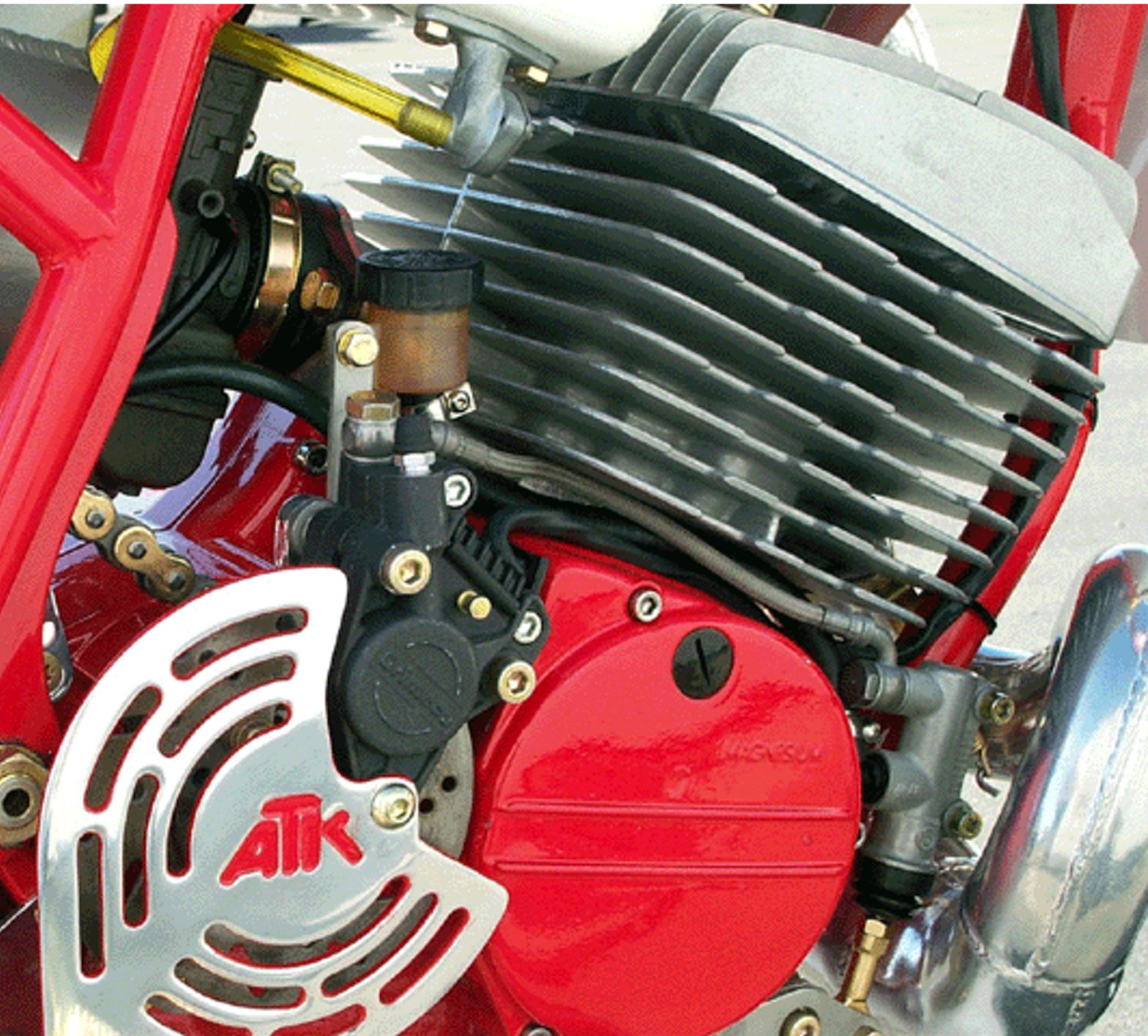


250/406 AIR COOLED



ENGINE REPAIR MANUAL

1988-1996
Updated 02/2015
ATK-2550






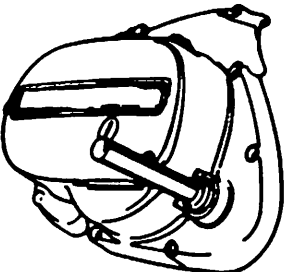
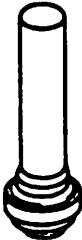
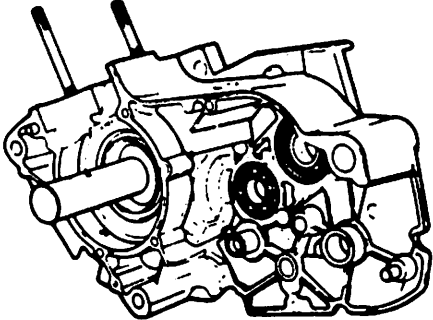
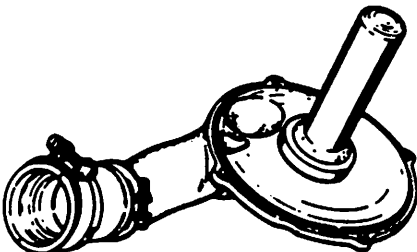
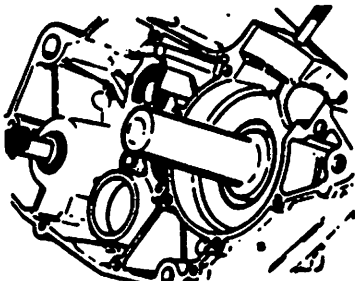
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ATK 250/406 Engine Service Manual.

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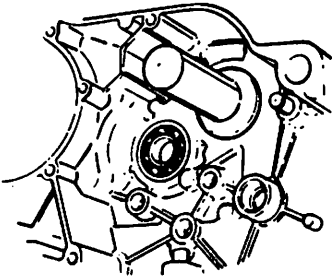
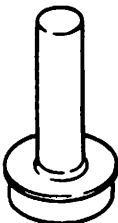
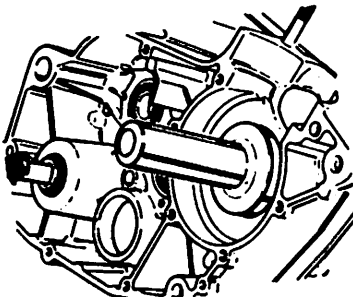

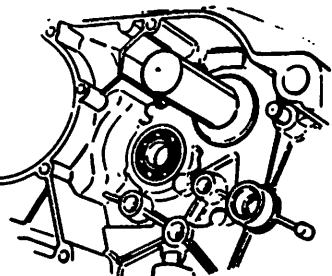
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SERVICE TOOLS

ITEM	USE	APPLICABLE TO
<p>Insertion pusher (420 277 850)</p> 	<p>To install kick starter seal.</p> 	<p>All engine types.</p>
<p>Insertion pusher (420 277 875)</p> 	<p>To install crankcase magneto side seal.</p> 	<p>244 engine types</p>
	<p>To install disc valve cover seal.</p> 	<p>244 engine types</p>
	<p>To install magneto side and clutch side crankcase seal.</p> 	<p>406 engine types</p>

SECTION 01 TOOLS

SUB-SECTION 01 (SERVICE TOOLS)

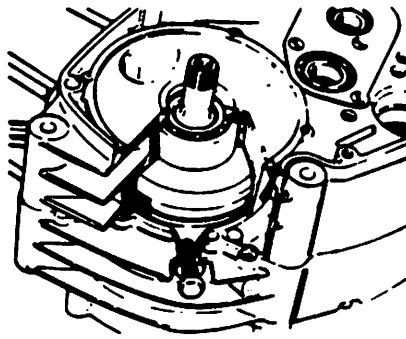
<p>Insertion pusher (420 277 861)</p> 	<p>To install transmission main shaft seal (sprocket side).</p> 	<p>406 engine type</p>
<p>Insertion pusher (420 276 190) (420 276 200) (420 276 930) (420 276 940)</p> 	<p>To install polyamid ring in crankcase.</p> 	<p>(420 276 190): clutch side 244- engine types</p> <p>(420 276 930): magneto side 244- engine types</p> <p>(420 276 940): magneto & clutch sides 406 engine types</p>
<p>Insertion pusher (420 277 870)</p> 	<p>To install transmission main shaft seal (sprocket side).</p> 	<p>244 engine types</p>

SECTION 01 TOOLS
SUB-SECTION 01 (SERVICE TOOLS)

**Crankshaft locking bolt
(420 241 965)**



**To lock crankshaft at top
dead center.**

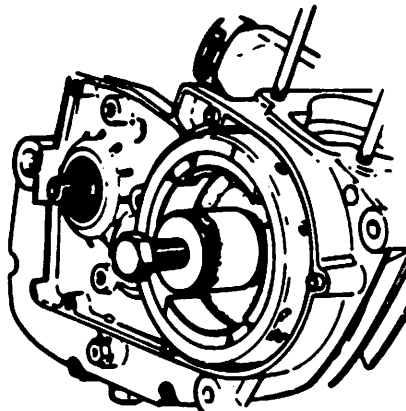


All engine types

**Flywheel puller
(420-276-705)**



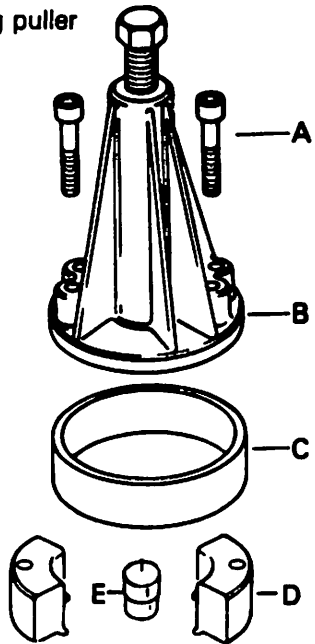
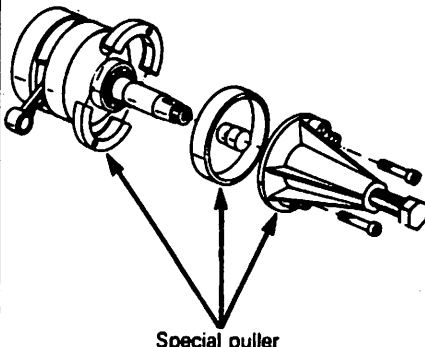
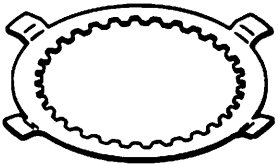
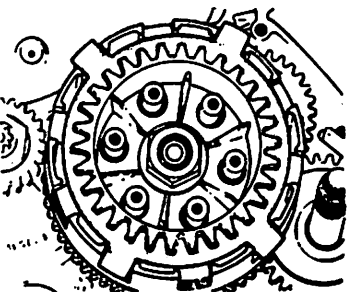
To remove the flywheel



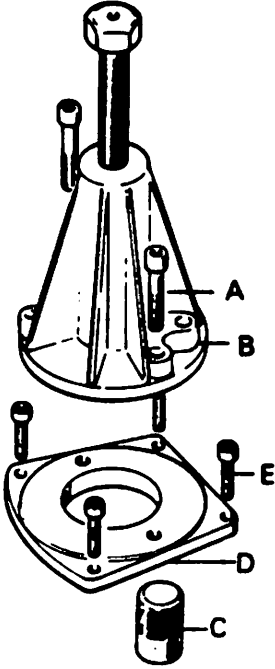
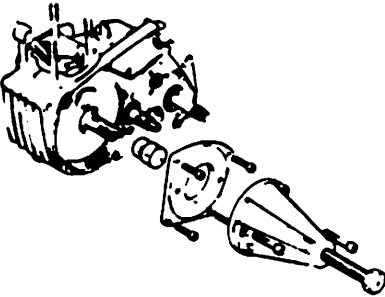

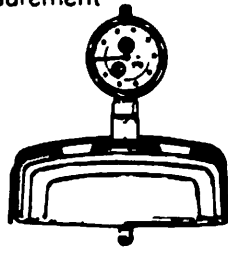
All engine types

SECTION 01 TOOLS

SUB-SECTION (SERVICE TOOLS)

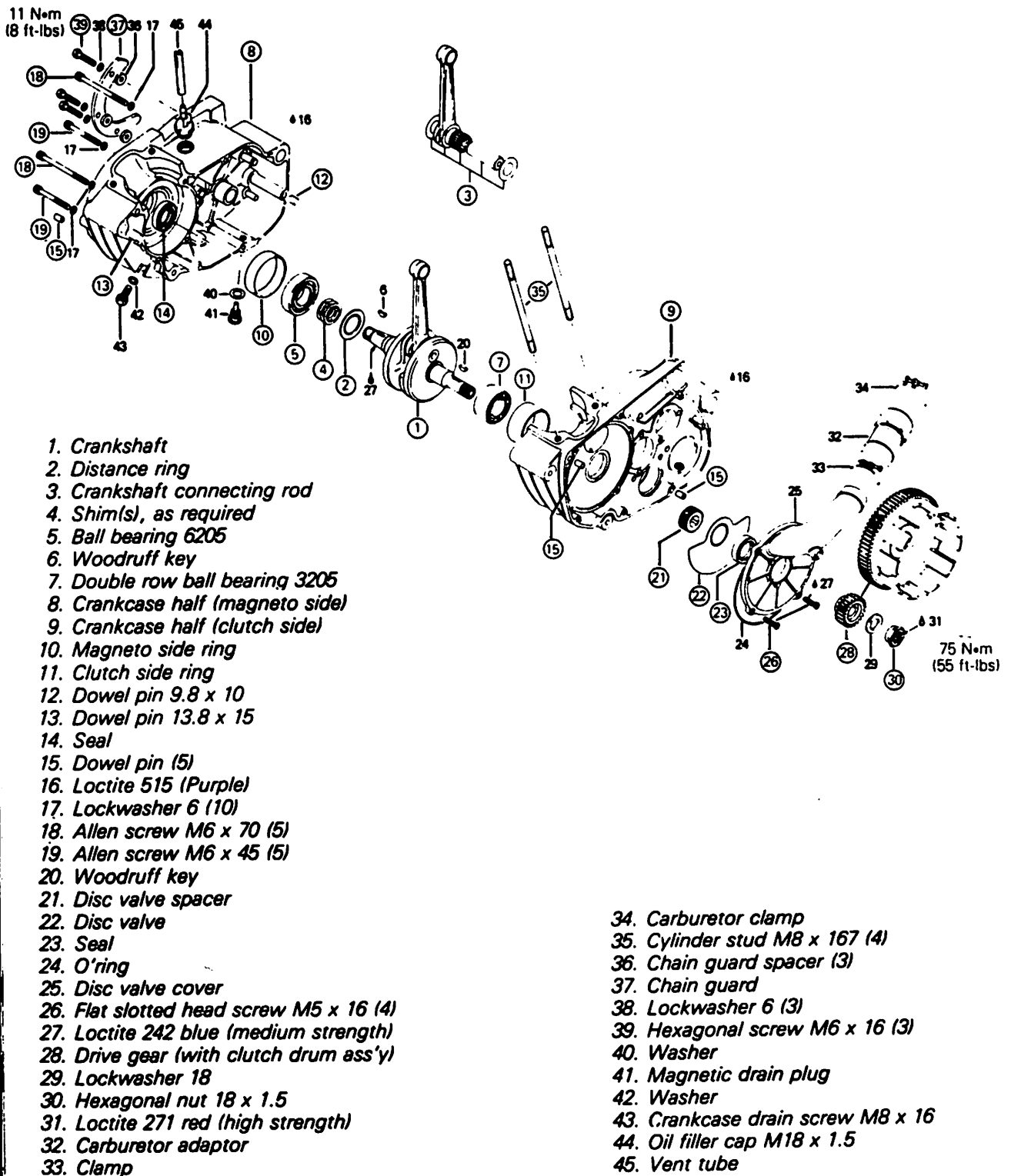
<p>Bearing puller</p>  <p>A) Allen screw M8 x 40 B) Puller C) Ring for puller D) Ring half for ball bearing E) Protection cap</p>	<p>To remove the crankshaft bearings</p>  <p>Special puller</p>	<p>A) (420 840 680): Screw M8 x 40 B) (420 876 296): C) (420 977 480): -244 engine types (420 977 490): 406 engine types D) 244 engine types, clutch side bearing. (420 276 020): 244- engine types, magneto side bearing. (420 977 470): - 406 engine types: magneto & clutch side bearing. E) 420 276 920</p>
<p>Clutch hub locking tool (420 277 885)</p> 	<p>To remove the clutch shaft nut</p> 	<p>All engine types.</p>

SECTION 01 TOOLS
SUB-SECTION SERVICE TOOLS)

<p>Crankcase separator</p>  <p>A) Allen screw B) Puller C) Protector cap D) Extractor plate E) Allen screw</p>	<p>To split engine crankcase</p> 	<p>A) (420 840 680): Allen screw M8 x 40</p> <p>B) (420 876 296):</p> <p>C) (420 276 920):</p> <p>D) (420 276 910): 244 engine types (420 276 915) 406 engine types</p> <p>E) (420 840 351): Cylinder screw M5 x 20 244 engine types (420 940 451): Cylinder screw M6 x 25 406 engine types</p>
<p>Dial indicator (T.D.C. gauge) (414 104 700)</p> 	<p>To perform B.T.D.C. measurement</p>  <p>(Basic timing)</p>	<p>All engine types.</p>

SECTION 02 ENGINE
SUB-SECTION 02 (ENGINE/TRANSMISSION)

BOTTOM END 250



SECTION 02 ENGINE

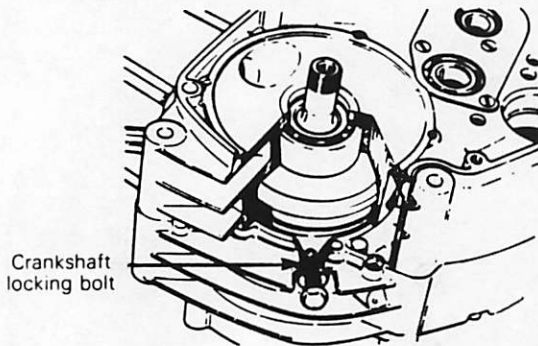
SUB-SECTION 02 (ENGINE/TRANSMISSION)

BOTTOM END

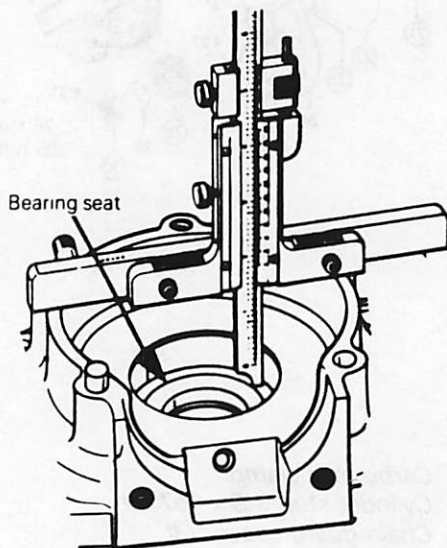
Disassembly & assembly

①③⑧⑨ At the replacement of the crankshaft, connecting rod and crankcase halves, the squish area should be measured (see engine tolerances measurements).

①⑧ To facilitate some procedures, the crankshaft can be locked at the top dead center position using a crankshaft locking bolt as illustrated.

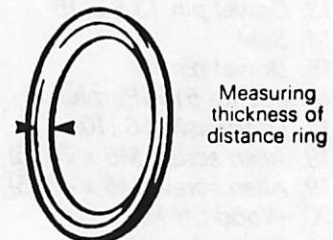
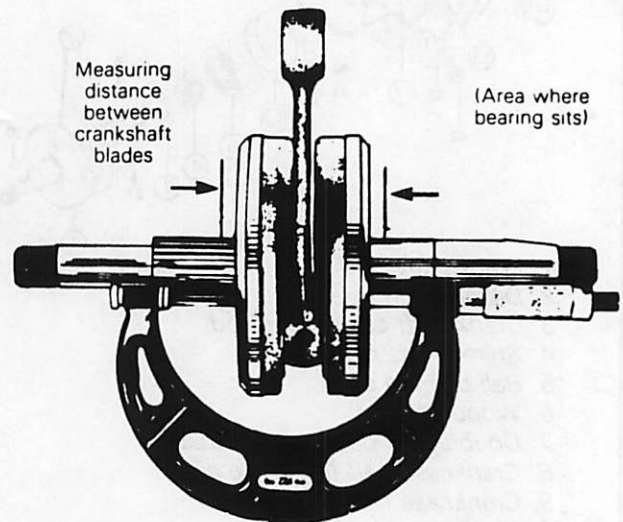
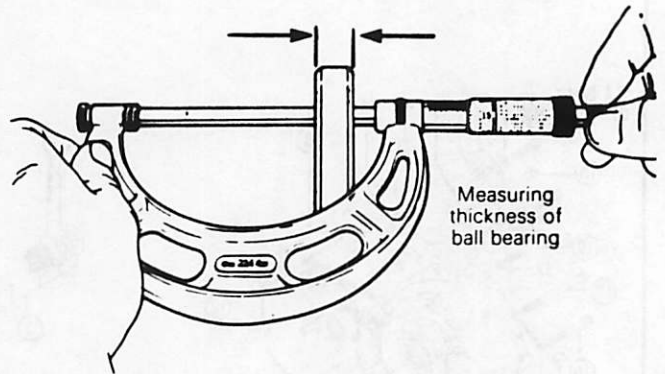


①④ The crankshaft end-play should be between 0.1 mm (0.004") to 0.3 mm (0.011"). To determine necessary shims: it is necessary to measure the crankcase. To do this first measure each half from mating surface to bottom of bearing seat. Add measurements of both halves, total equals A.



Measure the thickness of each ball bearing. Measure the distance between crankshaft blades, and measure the thickness of the distance ring.

Add the measurements, total equals B.



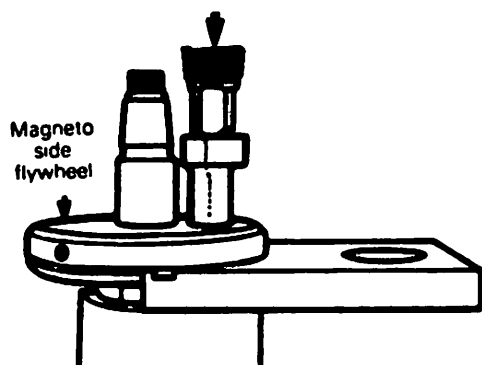
SECTION 02 ENGINE SUB-SECTION 02 (ENGINE/TRANSMISSION)

Subtract measurement B from measurement A, minus tolerance of 0.1 mm (0.004") to 0.3 mm (0.011"). Total balance is distance to be shimmed. Shim(s) must be located between distance ring and bearing.

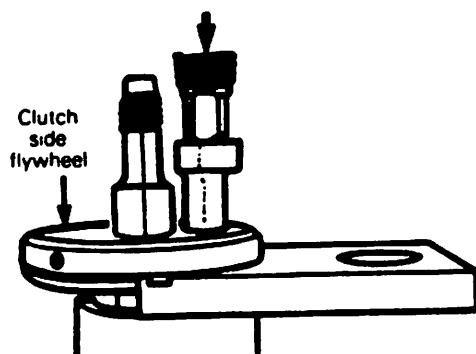
○ **NOTE:** Crankshaft end-play is adjusted only when crankshaft and/or crankcase is replaced.

② At assembly, position the distance ring with the chamfered side facing the crankshaft.

③ To replace the connecting rod proceed as follows:
Mount the crankshaft assembly in jig and press the crankpin out of the magneto side flywheel.

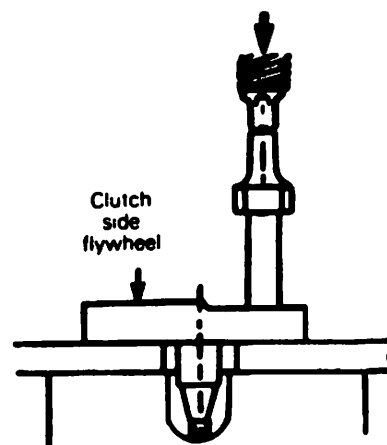


Remove the connecting rod and the bearing.
Press the crankpin out of the clutch side flywheel.



Press the new crankpin into the clutch side flywheel.

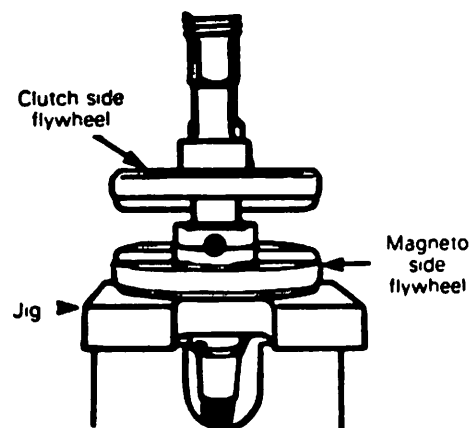
▼ **CAUTION:** The crankpin must enter the bore straight to prevent damage to the bore and/or the crankpin.



Fit the connecting rod and the bearing into place with light grease.

Place the magneto side flywheel on the jig. Align the clutch side flywheel with the magneto side flywheel and press the crankpin (with rod assembly) into magneto side flywheel.

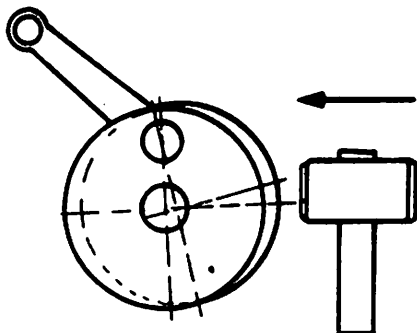
○ **NOTE:** The connecting rod side clearance must be 0.2 mm (.008") to 0.5 mm (.020").



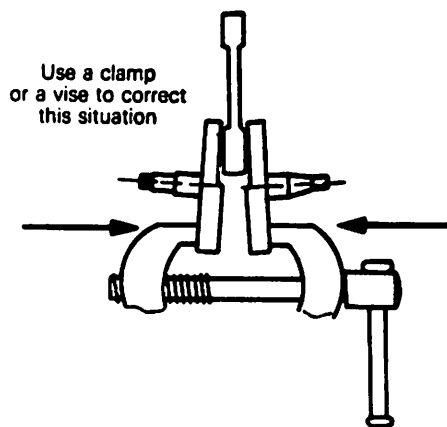
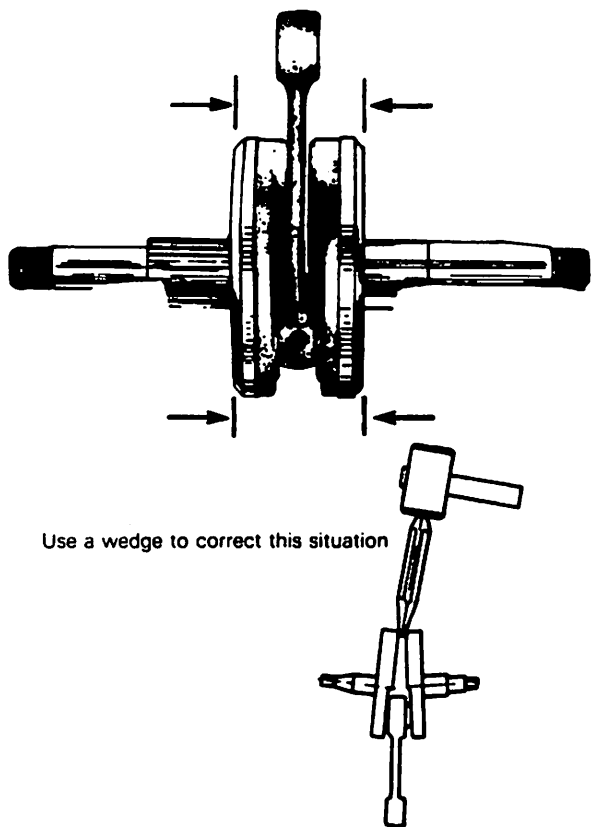
SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

Using a "straight edge", check for flywheel alignment
Drift with a heavy brass mallet to align if necessary.



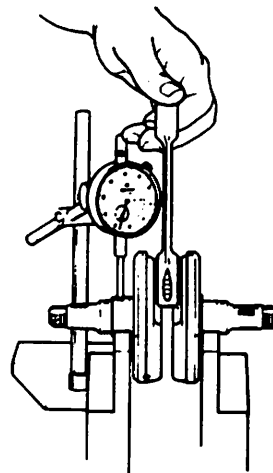
Using a micrometer or vernier caliper, check for flywheel alignment.



○ NOTE: For final alignment measures, see technical data.

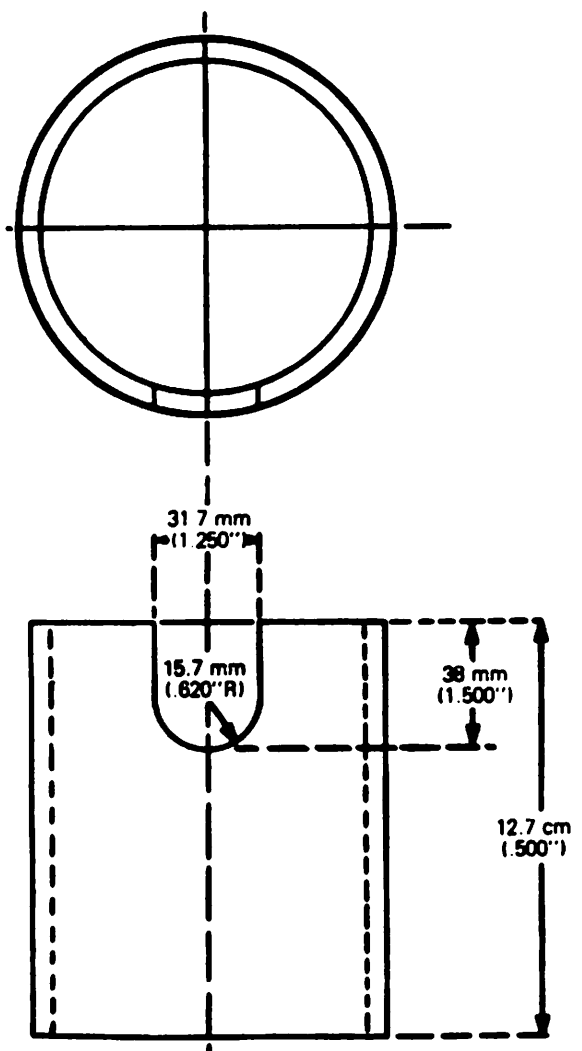
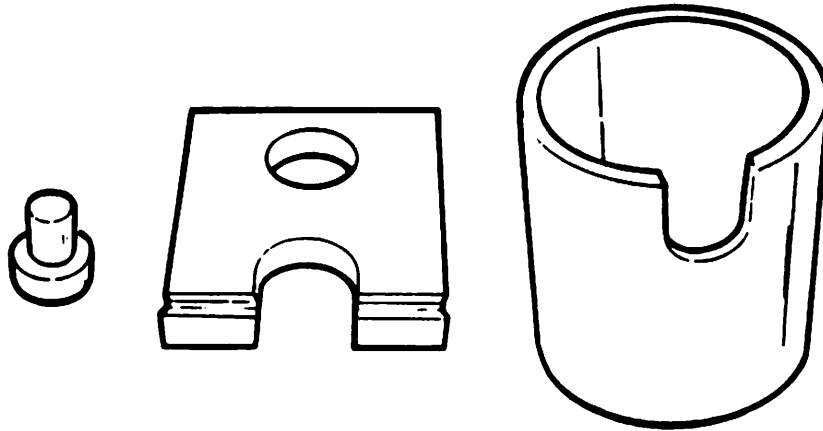
When overall alignment is completed, verify connecting rod side clearance.

○ NOTE: Make a final alignment check using a dial indicator.

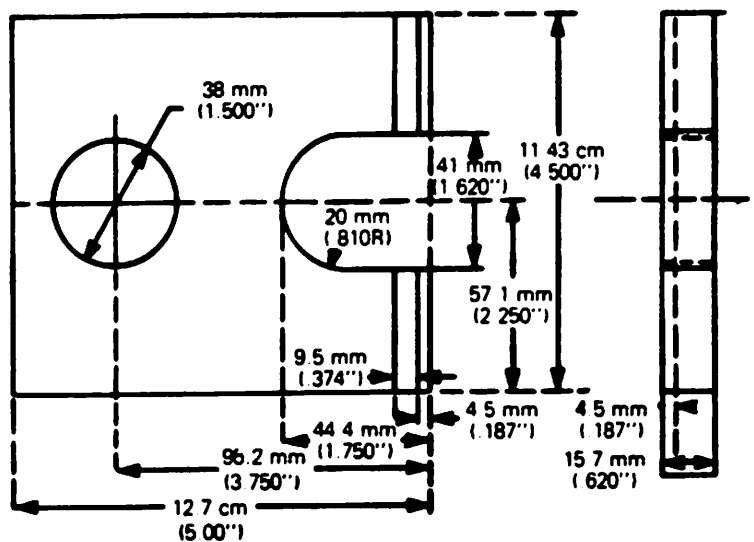


SECTION 02 ENGINE
SUB-SECTION 02 (ENGINE/TRANSMISSION)

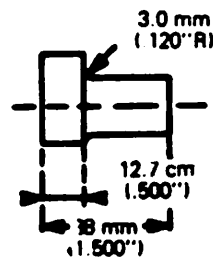
Suggested crankshaft repair tool



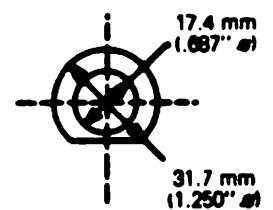
STEEL TUBE 11.43 cm (4.5'') O.D. x 63 mm (2.50'') WALL



H.R. ST'L PLATE 11.43 cm (4 1/2'') x 15.9 mm (.625'') THICK



H.R.C.O. ST'L 31.7 mm (1.250'') DIA



SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

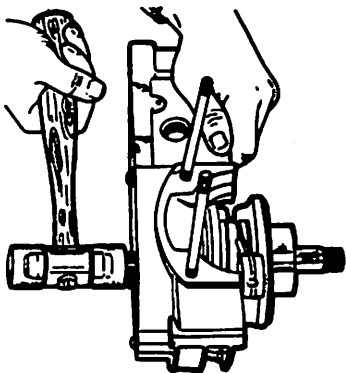
④ Shims are available in the following thickness:

0.1 mm (0.004")

0.2 mm (0.008")

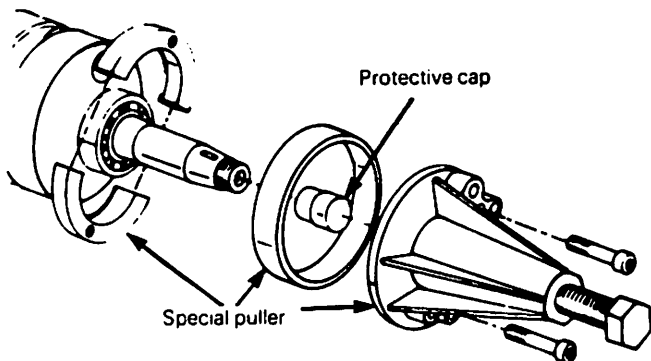
0.3 mm (0.012")

①⑤ Remove the crankshaft from the crankcase by tapping on the crankshaft end with a soft hammer.



▼ **CAUTION:** Prior to the crankshaft removal ensure that the crankshaft locking bolt is removed.

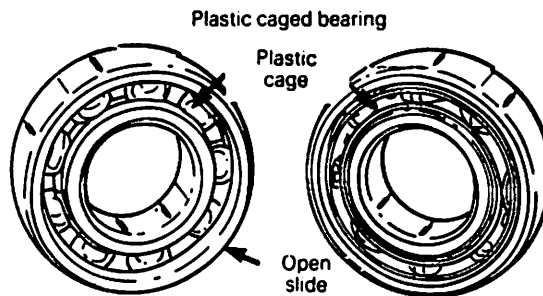
⑤⑦ To remove bearing from crankshaft use a bearing puller as illustrated. (See tool section).



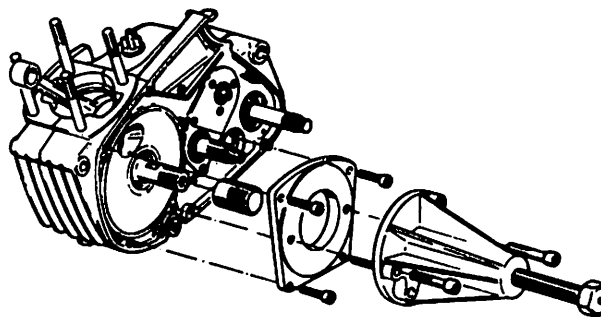
○ **NOTE:** Prior to magneto side bearing installation, install distance ring, required shim(s) and bearing on crankshaft.

At assembly, place bearings in an oil container and heat the oil to 93°C (200°F) for 5 to 10 min. This will expand the bearings and permit them to slide easily onto the shaft.

▼ **CAUTION:** If a plastic caged bearing is installed, always place the open face towards the **outside**.

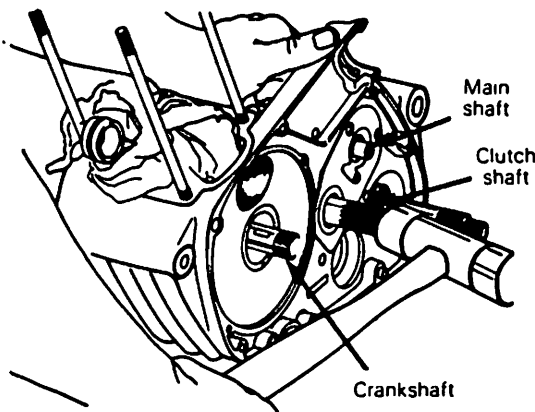


⑧⑨ To split the crankcase halves, use a protective cap and puller (See Tools section).



▼ **CAUTION:** Ensure that all the necessary screws have been removed prior to splitting the crankcase halves.

○ **NOTE:** The crankcase halves can also be splitted, by tapping equally on the main shaft, clutch shaft and crankshaft.



▼ **CAUTION:** Do not pry between crankcase halves, as score marks incurred are detrimental to crankcase sealing.

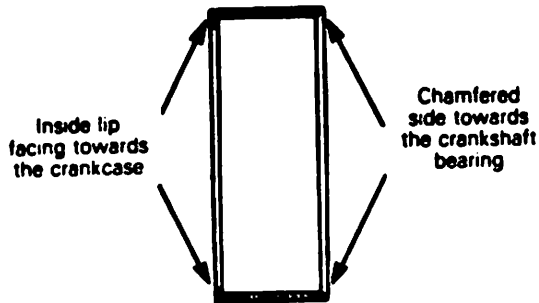
Prior to joining the crankcase halves carefully clean the mating surfaces with acetone, wood alcohol or equivalent.

Apply a light coat of Loctite 515 sealant.

SECTION 02 ENGINE SUB-SECTION 02 (ENGINE/TRANSMISSION)

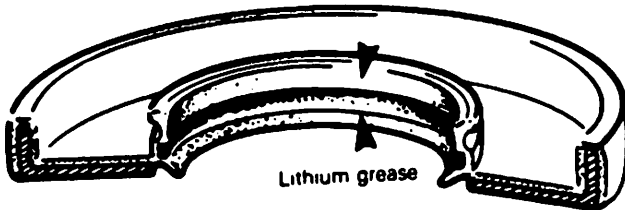
⑩ ⑪ To install a new polyamid ring use an appropriate insertion pusher (See Tool section).

▼ **CAUTION:** Make sure to position the polyamid ring with the inside lip portion facing towards the crankcase.



⑫ ⑬ ⑮ At assembly, ensure that the dowel pin sleeves are in place.

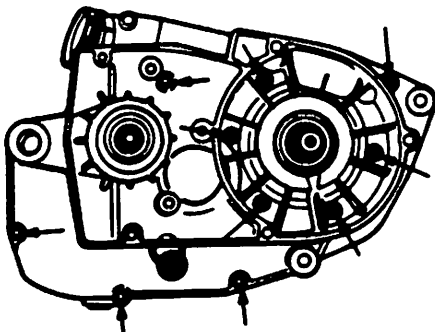
⑭ ⑲ To install new seals, use the appropriate seal insertion pusher. (See Tool section). At assembly, apply a light coat of lithium grease on the seal lips.



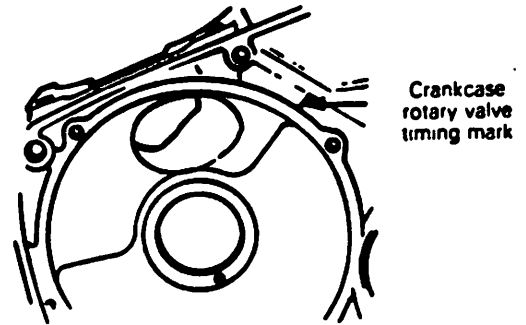
⑰ At assembly, the chamfered side of the disc valve spacer must face towards the crankshaft.

⑱ ⑲ At assembly, torque to 11 N•m (8 ft-lbs) following a criss-cross sequence.

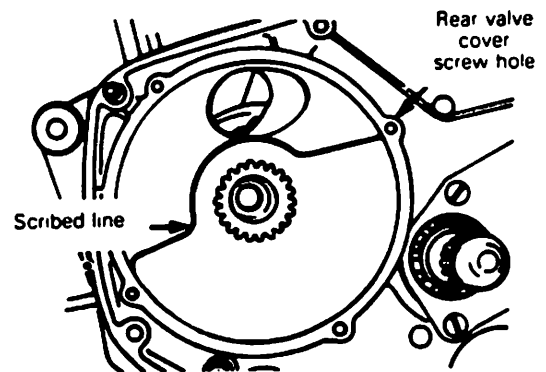
○ **NOTE:** It is recommended to apply a small drop of oil or a thin coat of grease on the threads.



⑳ On Enduro models the disc valve is symmetrical and can be installed either way but the leading edge must be aligned with the timing mark on the crankcase, with the crankshaft locked at top dead center (T.D.C.).



On ATK model the disc is asymmetrical and can only be installed one way. The valve cut-away must align with the line scribed on the crankcase disc valve surface with the crankshaft locked at top dead center (T.D.C.).

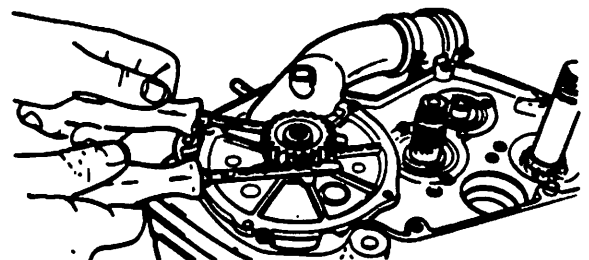


○ **NOTE:** If no line is scribed, refer to "Engine tolerances measurements" for positioning procedure.

㉔ At assembly, apply Loctite 242 blue (medium strength) on threads and torque to 5.5 N•m (4 ft-lbs).

㉕ Use 2 screwdrivers to remove the crankshaft drive gear.

▼ **CAUTION:** Excessive leverage may damage the rotary valve cover.



SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

Use a small finger puller if gear resists easy removal.

At assembly, install the crankshaft drive gear very carefully to avoid folding the seal lip over.

If replacement is needed; always replace both crankshaft drive gear and clutch drum.

③⑨ Prior to the installation of the crankshaft drive gear retaining nut, proceed as follows:

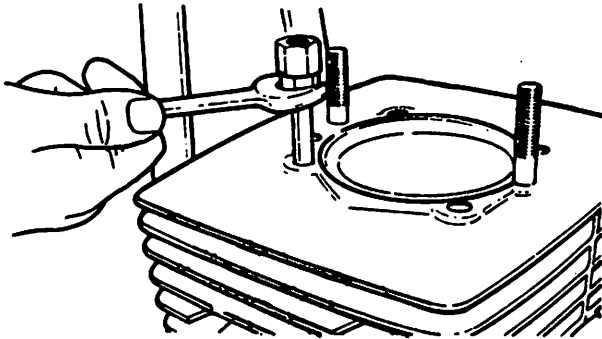
Clean the nut and crankshaft threads with Loctite "Kleen N'Prime" or equivalent. Apply Loctite 271 red (high strength) or equivalent on the inside threads of the drive gear retaining nut only.

▼ **CAUTION:** Do not apply Loctite on the threaded portion of the crankshaft as the drive gear could become glued to the crankshaft and damage to other engine parts could occur during the removal of the drive gear.

Torque the drive gear retaining nut to 75 N•m (55 ft-lbs).

○ **NOTE:** Allow at least one hour for the Loctite to set before starting the engine.

③⑨ To unscrew, use 2 cylinder base nuts blocked one against the other.



At assembly, position the long threaded portion of the stud into the crankcase.

Cleaning

Clean all the metal components in a metal cleaner.

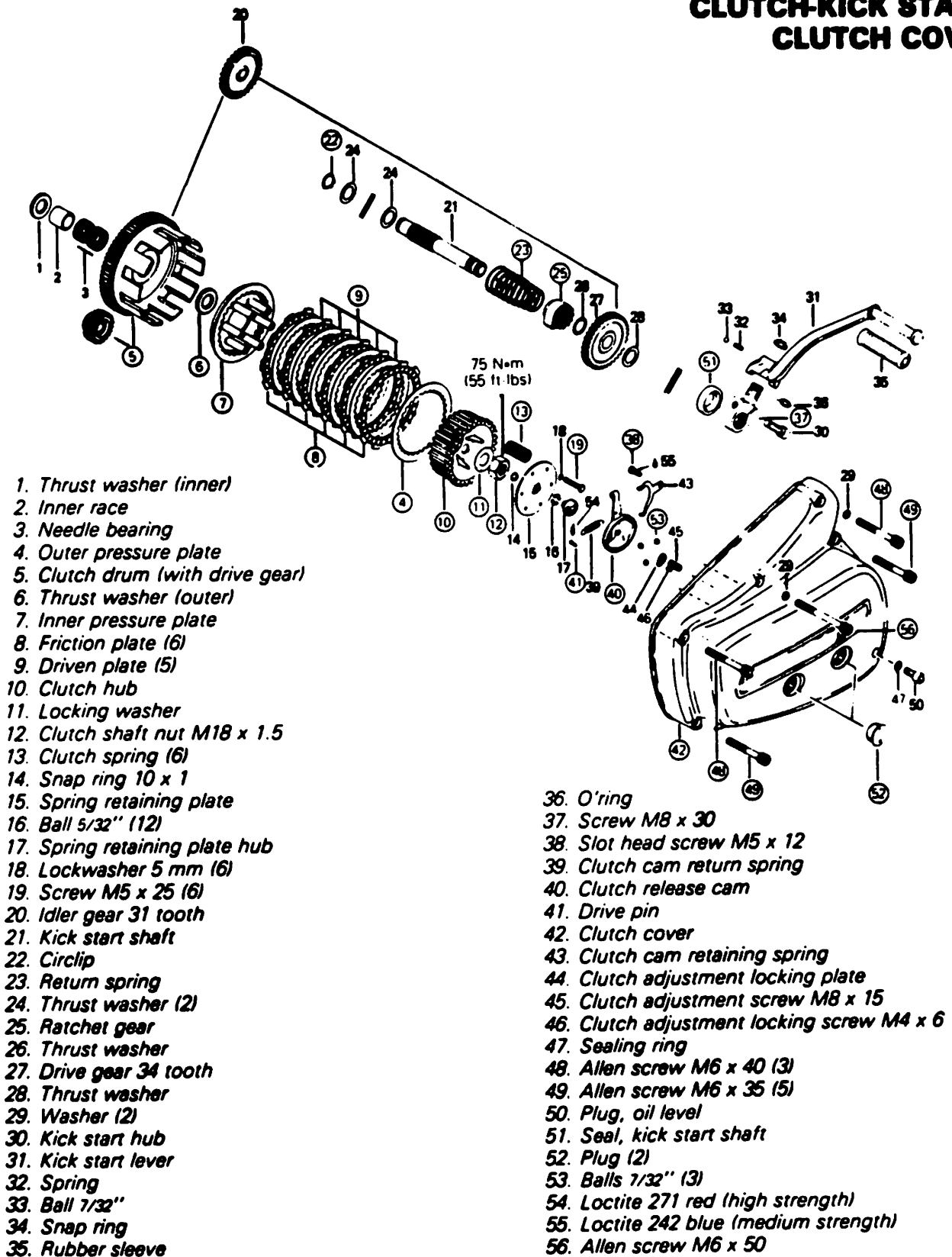
◆ **WARNING:** Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

Remove old sealant from mating surfaces of crankcase/clutch cover with acetone, wood alcohol or equivalent.

▼ **CAUTION:** Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase sealing.

SECTION 02 ENGINE
SUB-SECTION 02 (ENGINE/TRANSMISSION)

**CLUTCH-KICK START/
CLUTCH COVER**



SECTION 02 ENGINE

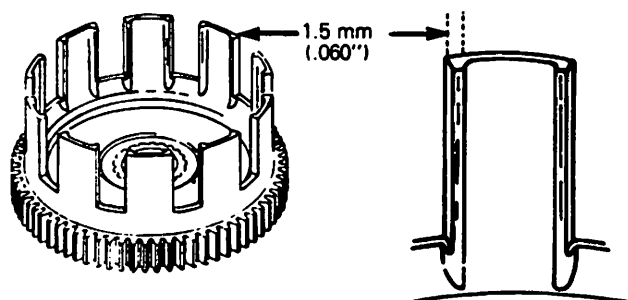
SUB-SECTION 02 (ENGINE/TRANSMISSION)

CLUTCH AND KICK START/ CLUTCH COVER

Disassembly & assembly

⑤ If the clutch drum splines are found to be severely worn. Replacement may not be necessary. File the damaged spline surfaces equally.

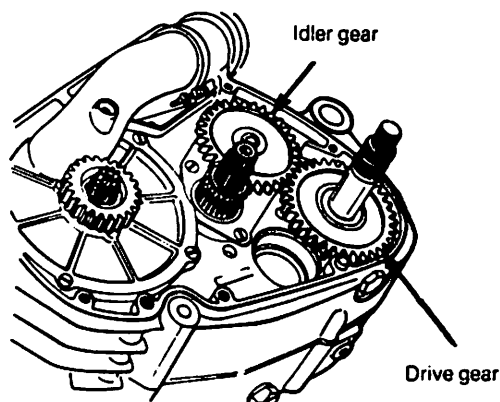
▼ **CAUTION:** The shouldered wall should not be filed thinner than 1.5 mm (.060").



If replacement is needed, always replace both crankshaft drive gear and clutch drum.

④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ Prior to assembling the clutch hub make sure to position the idler and drive gear as illustrated.

○ **NOTE:** The flanged side of the idler gear must face towards the crankcase.



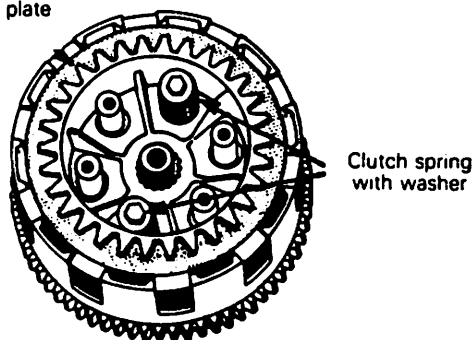
▼ **CAUTION:** Prior to the clutch hub installation, ensure to properly position the thrust washer ⑥.

With the clutch plates mounted on the clutch hub, fit the clutch inner pressure plate in alignment with hub splines. Carefully insert clutch hub/plate assembly into clutch drum and onto the clutch shaft.

Ensure to place the outer pressure plate ④ (thickest driven plate) on top.

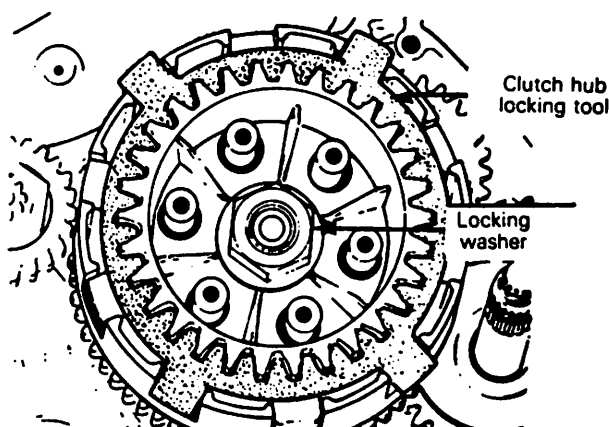
○ **NOTE:** To ease assembly, install two clutch springs with washers to hold the clutch together.

Outer pressure plate (thickest)



⑪ ▼ **CAUTION:** Locking washer should be replaced if bent more than twice. If in doubt, replace.

⑫ To remove clutch shaft nut, lock the crankshaft at top dead center, unbend the locking washer and lock the clutch using the clutch hub locking tool (see tool section).



At assembly, apply Loctite no. 271 red (high strength) on the threads of the clutch shaft nut and torque to 75 N•m (55 ft-lbs)

◆ **WARNING:** Make sure to bend the clutch shaft nut locking washer.

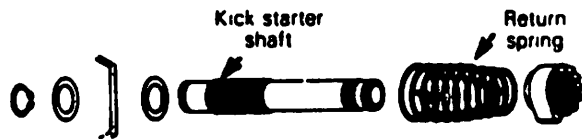
▼ **CAUTION:** Do not pry on the inner pressure plate spring post to bend the locking washer, use a pair of waterpump pliers.

SECTION 02 ENGINE SUB-SECTION 02 (ENGINE/TRANSMISSION)

⑬ If spring(s) replacement is needed, ensure to change the springs in sets only.

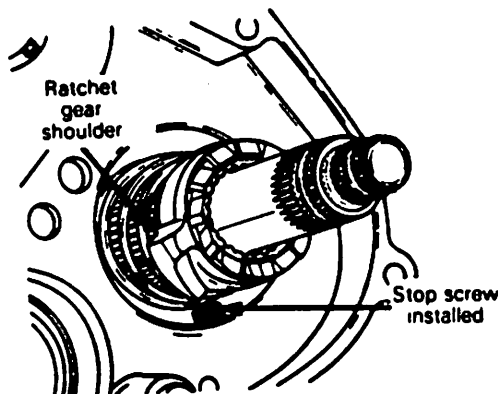
⑭ At assembly, tighten in a criss-cross sequence and torque to 5.5 N·m (4 ft-lbs).

⑮ To remove the kick start assembly from the crankcase remove the snap ring located in the inside portion of the crankcase and unscrew the kick starter stop screw under the left crankcase half.



⑯ It is possible to change the return spring without splitting the crankcase. At assembly, ensure that the spring ends are well positioned in the crankcase and ratchet gear holes.

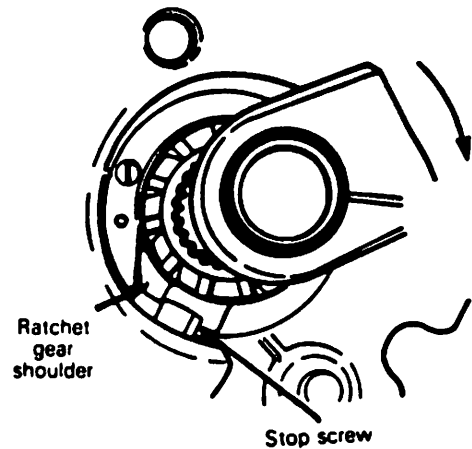
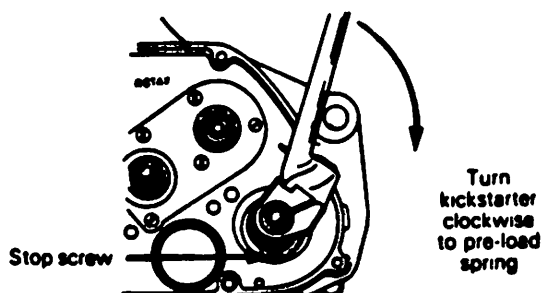
⑰ At assembly, position the spring end into the ratchet gear and partially engage the ratchet gear onto the shaft splines.



Install the kick starter lever and preload the return spring approximately 1 turn clockwise.

Completely slide the ratchet gear onto the splines while retaining the tension with the kick starter lever.

Slowly release the kick starter lever and the ratchet gear will lean against the stop screw.

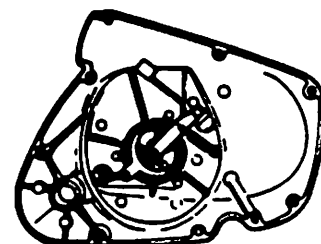
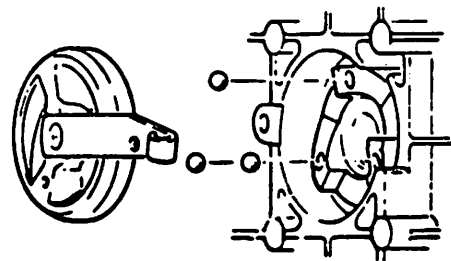
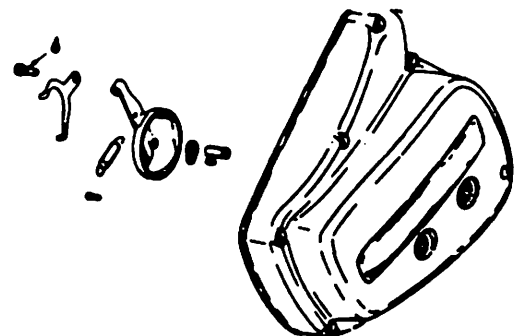


⚠ **WARNING:** Exercise care when removing or installing the ratchet gear.

○ **NOTE:** After assembly, do not remove the kick starter stop screw unless needed, otherwise the kick starter spring will loose its preload and the clutch cover will have to be removed to reposition.

⑱ At assembly, torque to 20 N·m (15 ft-lbs).

⑳ ④① At assembly, position as illustrated.



SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

Apply Loctite no. 242 blue (medium strength) on screw threads and torque to 5.5 N•m (4 ft-lbs).

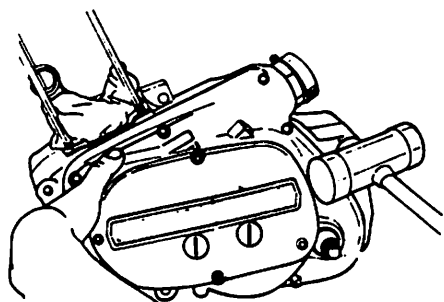
④① If replacement is needed, ensure to order the hardened type clutch release cam (P/N 420 259 790) which must be used with the clutch release mechanism with bearing balls.

▼ **CAUTION:** Ensure to install the proper clutch release cam otherwise damage will occur.

④① At assembly, apply Loctite no. 271 red (high strength) and force fit into place.

○ **NOTE:** Replace only if damaged or when replacing clutch cover.

④② To remove the clutch cover, tap lightly using a soft faced hammer to break the seal (as illustrated).



▼ **CAUTION:** Do not pry between sealing surfaces, as score marks incurred are detrimental to clutch cover sealing.

○ **NOTE:** The clutch cover can be removed with the engine in the frame, but it is necessary to remove the left foot peg.

Prior to removal, ensure to drain the engine oil.

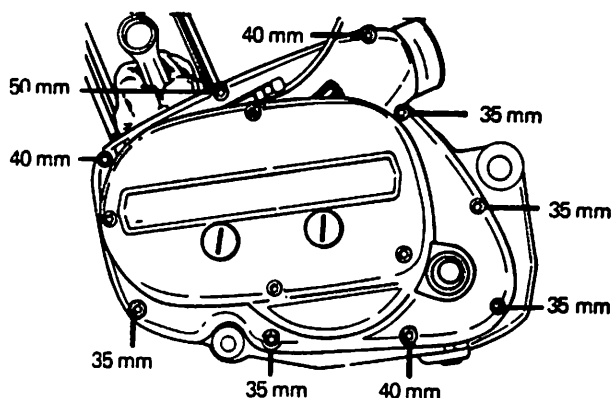
With clutch cable still connected, pull the clutch lever in. It will then preload against the cover to ease removal.

At assembly, clean the mating surfaces of the crankcase and clutch cover with acetone, wood alcohol or equivalent. Apply a light coat of Loctite 515 sealant to the mating surfaces and lightly tap cover into place.

▼ **CAUTION:** At installation, ensure that the kick starter seal lip is not flipped over by the kick starter shaft splines when pushing the clutch cover into place.

④③ ④④ ⑤⑥ At assembly, torque the retaining screws to 8 N•m (6 ft-lbs) following a criss-cross sequence and apply a small drop of oil or a thin coat of grease on the threads.

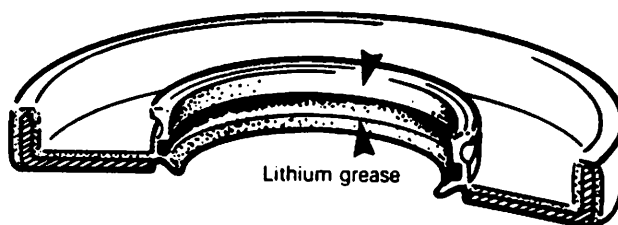
○ **NOTE:** For the proper location of the clutch cover retaining screws follow illustrated sequence.



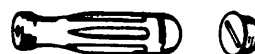
▼ **CAUTION:** Ensure to use the correct screw for its location otherwise damage to the crankcase will occur.

⑤① ▼ **CAUTION:** Make sure the kick starter seal is not flipped over by the kick starter shaft splines when pushing the clutch cover into place.

At assembly, apply lithium grease on the seal lips.



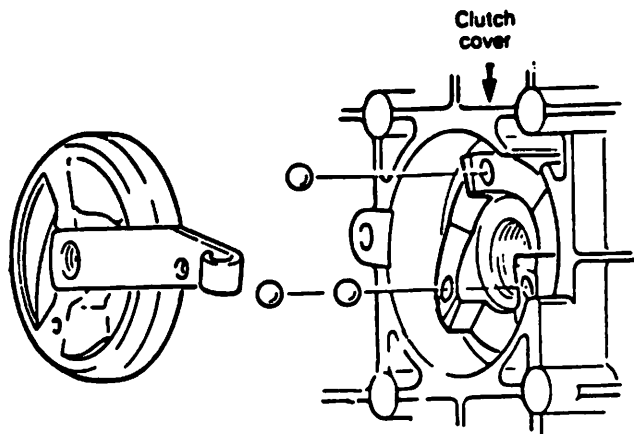
⑤② For removal or installation use the screwdriver grip end, provided with the motorcycle tool kit.



SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

③ At assembly, clean the three holes with compressed air. Drop a small amount of oil into the three holes and install the three 7/32" bearing balls.



Cleaning

Clean all the metal components in a metal cleaner.

◆ **WARNING:** Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

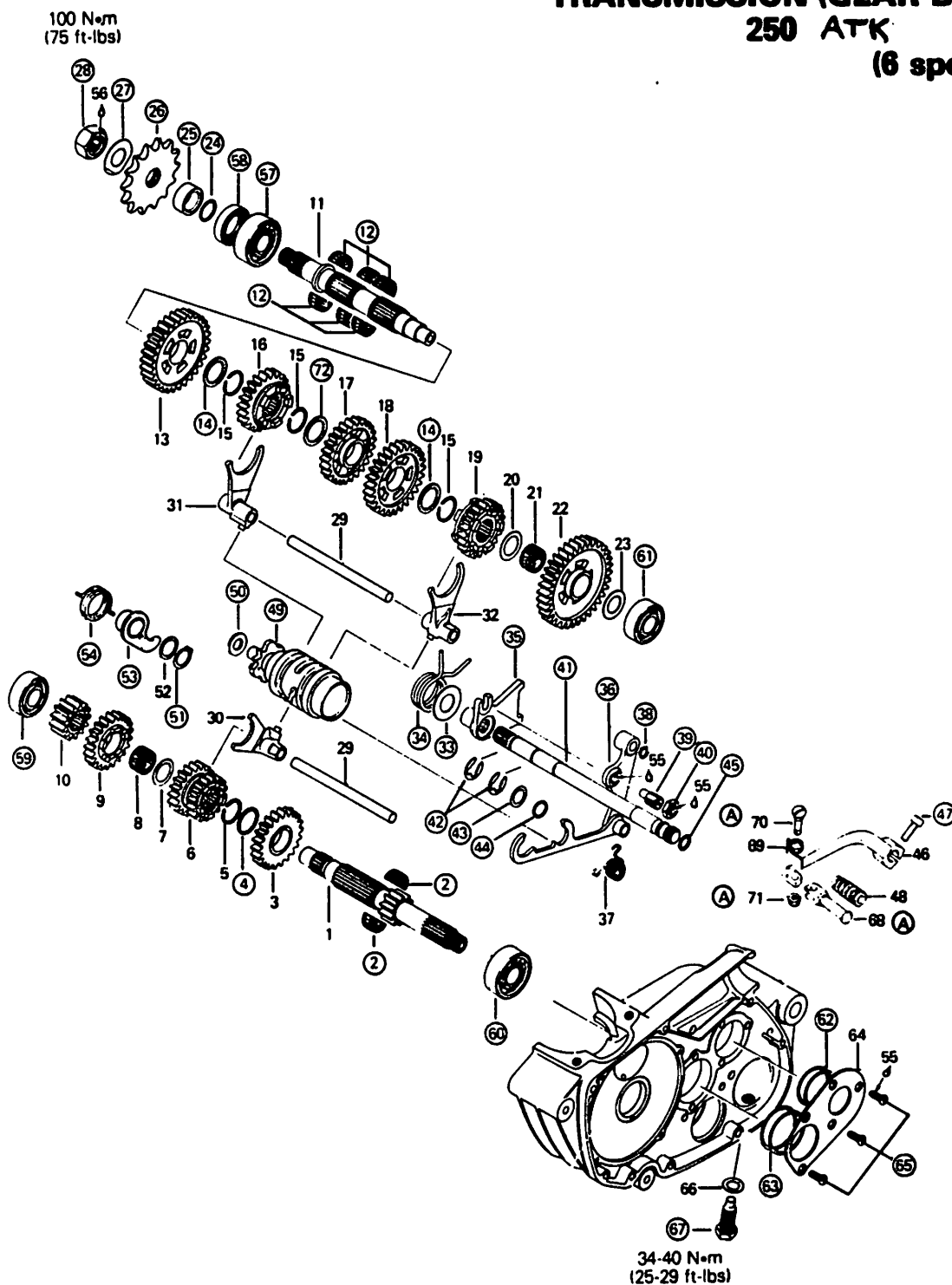
Remove old sealant from mating surfaces or crankcase/clutch cover with acetone, wood alcohol or equivalent.

▼ **CAUTION:** Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase/clutch cover sealing.

SECTION 02 ENGINE
SUB-SECTION 02 (ENGINE/TRANSMISSION)

TRANSMISSION (GEAR BOX)

TRANSMISSION (GEAR BOX)
250 ATK
(6 speed)



SECTION 02 ENGINE
SUB-SECTION 02 (ENGINE/TRANSMISSION)

ATK 250

(6 SPEED)

1. Clutch shaft 10T
2. Needle bearing ass'y, clutch shaft, width 9.73 mm (.383")
3. 6th gear, clutch shaft, 23T
4. Thrust washer, clutch shaft
5. Snap ring, clutch shaft
6. 3rd/4th gear, clutch shaft 16/19T
7. Thrust washer, clutch shaft
8. Needle bearing, clutch shaft
9. 5th gear, clutch shaft, 21T
10. 2nd gear, clutch shaft, 13T
11. Main shaft
12. Needle bearing ass'y main shaft, width 9.65 mm (.380") (3)
13. 2nd gear, main shaft, 30T
14. Thrust washer, main shaft (2)
15. Snap ring, main shaft (3)
16. 5th gear, main shaft, 23T
17. 4th gear, main shaft, 25T
18. 3rd gear, main shaft, 27T
19. 6th gear, main shaft, 21T
20. Thrust washer, main shaft
21. Needle bearing, main shaft
22. 1st gear, main shaft, 34T
23. Thrust washer, main shaft
24. "O" ring, main shaft
25. Sprocket spacer
26. Sprocket (15T)
27. Locking washer, main shaft
28. Main shaft nut M18 x 1.5
29. Guide pin, shift fork (2)
30. Shifting fork, 5-6th
31. Shifting fork, 2nd-4th
32. Shifting fork, 1st-3rd
33. Thrust washer, actuating lever
34. Spring, actuating lever
35. Actuating lever
36. Pawl ass'y
37. Pawl spring
38. Snap ring 10 x 1
39. Pawl positioning screw
40. Locking nut M12 x 1, pawl positioning screw
41. Shift shaft
42. Retaining ring (2)
43. Thrust washer, shift shaft
44. "O" ring, shift shaft
45. "O" ring, shift shaft
46. Shift lever (A)
47. Allen screw M6 x 20
48. Lever rubber
49. Shift drum ass'y
50. Washer shift drum
51. Snap ring
52. Washer
53. Index lever
54. Spring
55. Loctite 242 blue (medium strength)
56. Loctite 271 red (high strength)
57. Ball bearing 6204, main shaft, sprocket side
58. Seal main shaft
59. Ball bearing 6203, clutch shaft, sprocket side
60. Ball bearing 6204, clutch shaft, clutch side
61. Ball bearing 6203, main shaft, clutch side
62. Shim 0.5 mm (0.019"), 0.3 mm (0.011"), 0.1 mm (0.004"), main shaft bearing (A.R.)*
63. Shim 0.5 mm (0.019"), 0.3 mm (0.011"), 0.1 mm (0.004"), clutch shaft bearing (A.R.)*
64. Retaining plate (transmission bearings)
65. Countersunk screw M5 x 12 (5)
66. Gasket ring
67. Stop screw, kick starter
68. Folding lever (A)
69. Spring
70. Pivot screw M6 x 25 or M6 x 20 (A)
71. Hexagonal nut M6 (if applicable) (A)
72. Flanged thrust washer

*(A.R.): as required

(A) : Two types of shift lever can be used (long folding lever type and short folding lever type).
The long type uses a M6 x 25 pivot screw with an hexagonal nut M6.

SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

TRANSMISSION (GEAR BOX)

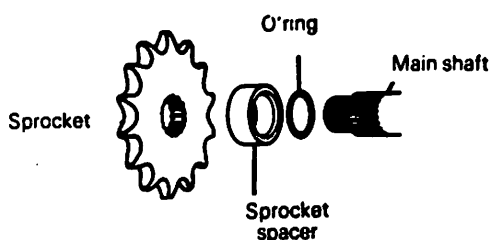
Disassembly & assembly

② ⑫ ⑬ The needle bearing halves must be replaced in pairs only.

▼ **CAUTION:** Make sure not to intermix the needle bearings halves, damage could occur. If bearing halves have been intermixed refer to the description to find the proper width of the bearing halves.

④ ⑭ The sharp edge of the splined thrust washer must face the retaining snap ring.

②④ ②⑤ ②⑥ At assembly, ensure that the chamfered portion of the sprocket spacer is installed towards the main shaft.



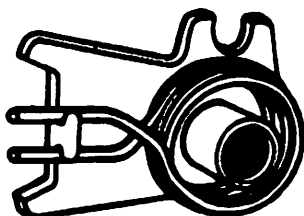
②⑦ ▼ **CAUTION:** Locking washer should be replaced if bent more than twice. If in doubt, replace.

②⑧ To remove the sprocket retaining nut, unbend locking washer. Lock crankshaft at the top dead center position and with the transmission in gear, unscrew the nut.

At assembly, follow the same procedure, apply Loctite no. 271 red (high strength) on the retaining nut threads and torque to: 100 N•m (75 ft-lbs)

○ **NOTE:** At assembly, position the sprocket retaining nut with the hollowed side facing the sprocket.

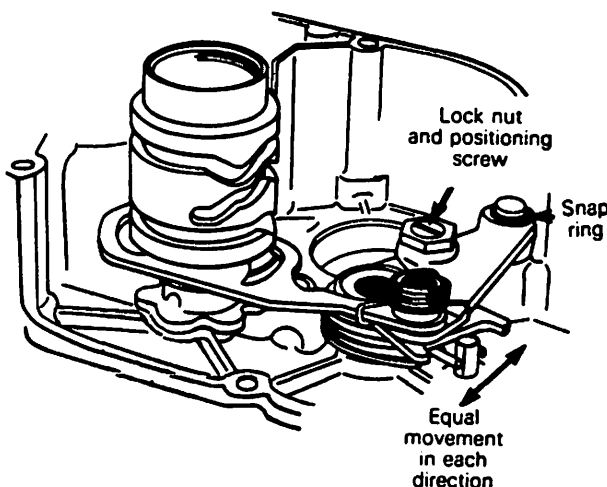
③③ ③④ ③⑤ Assemble the spring, thrust washer and actuating lever as illustrated.



◆ **WARNING:** Exercise care when removing or installing the actuating lever spring.

③⑥ ③⑦ ④① To adjust shifter drum pawl ass'y proceed as follows. Position shift drum ass'y in 2nd gear or above to obtain an even travel at the actuating lever.

Then with the shift shaft in position, gently move shift lever in each direction from the middle position until shifter pawl contacts the shifter drum pin and note the amount of movement in each direction at the actuating lever.

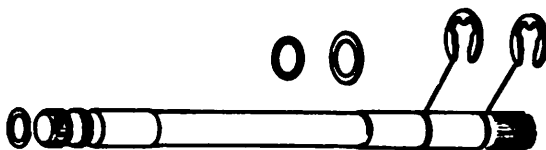


Movement in both direction must be equal. If not, the pawl ass'y can be repositioned by unlocking the lock nut and adjusting the pawl positioning screw. Lock the nut and verify. Repeat until the travel is equal on both sides.

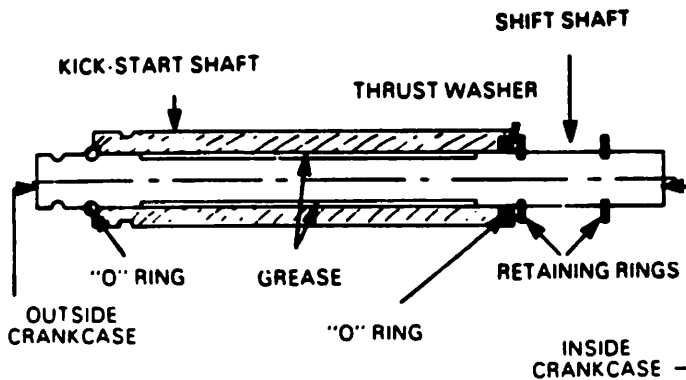
When final adjustment has been reached, apply Loctite no. 242 blue (medium strength) on the lock nut threads and torque to 27-29 N•m (20-22 ft-lbs).

③⑧ ▼ **CAUTION:** At the removal of the pawl ass'y take care not to overspread the snap ring. Prior to assembly, make sure to reclose snap ring gap.

④① ④② ④③ ④④ ④⑤ At assembly, position the retaining rings, thrust washers and "O" rings as illustrated.

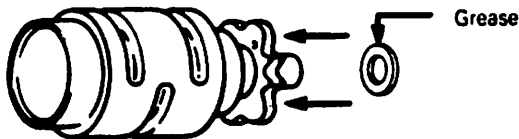


Coat the shift shaft with grease.



④7 At assembly, torque to 11 N•m (8 ft-lbs).

④9 ⑤0 At re-assembly it is recommended to coat the shift drum washer with grease, this will allow the washer to stick on the shift drum for ease of installation. (If applicable)



Hold the index lever (in crankcase) fully open while inserting the shift drum in place.

⑤1 ⑤3 ⑤4 At assembly, properly position the spring end into the index lever and crankcase hole.

▼ **CAUTION:** Ensure that the index snap ring is well seated in its groove.



⑤7 Heat is needed to remove or install the main shaft bearing into the sprocket side.

▼ **CAUTION:** Always apply heat to remove or install a bearing in the crankcase. Failure to apply heat may result in metal being drawn out of the bearing to crankcase contact surface, thus causing a loose fit within the crankcase.

Proceed as follows:

◆ **WARNING:** Engines have magnesium crankcase. Magnesium must be heated with great care.

Disassembly

Using a butane torch with a large soft flame, heat the outside crankcase bearing embossment with 4 to 5 rapid circular passes.

Drift the bearing out with an appropriate pusher and soft faced hammer.

Reassembly

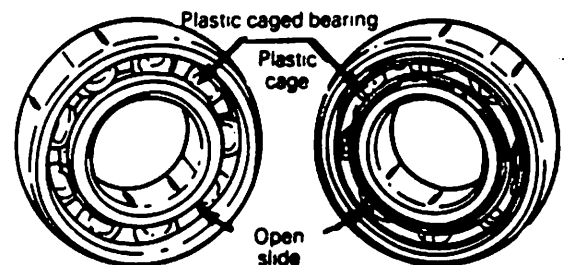
Grease the sprocket side main shaft seal with lithium grease.

Cut a 50 mm (2") diameter disc out of asbestos material. Place the disc over the seal to protect it from the flame.

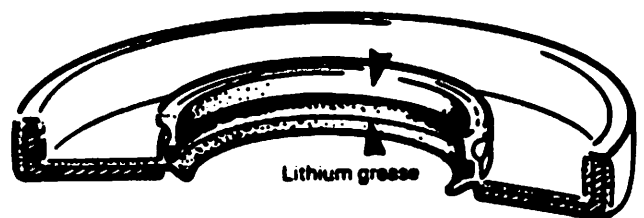
Heat the crankcase bearing embossment as described above.

Quickly turn the crankcase half over and drift the bearing into the crankcase using a soft hammer.

○ **NOTE:** If a plastic caged bearing is installed, always place the open side facing the inside of the crankcase.



⑤8 To install a new seal, use the appropriate oil seal insertion pusher. (See tool section). Apply a light coat of lithium grease on the seal lip.

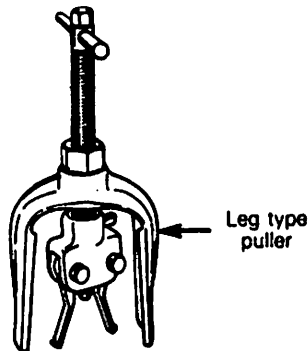


SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

○ **NOTE:** The seal can only be replaced with the main shaft bearing removed.

⑤⑨ Heat and a leg type puller is needed to remove the clutch shaft bearing from sprocket side crankcase.



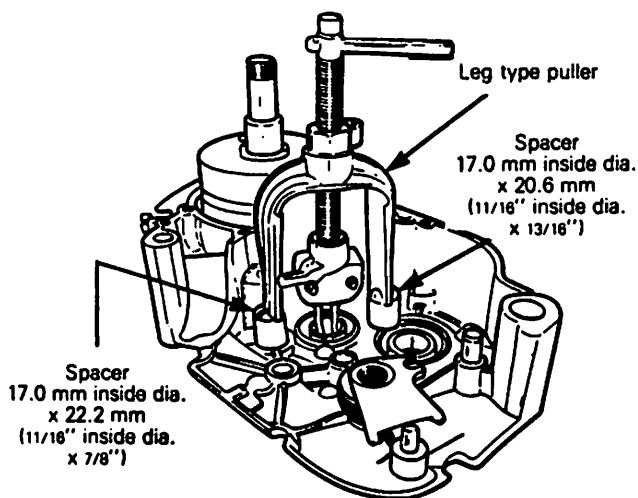
▼ **CAUTION:** Always apply heat to remove or install a bearing in the crankcase. Failure to apply heat may result in metal being drawn out of the bearing to crankcase contact surface, thus causing a loose fit in the crankcase.

Proceed as follows:

◆ **WARNING:** Engines have magnesium crankcase. Magnesium must be heated with great care.

Disassembly

Install the puller as illustrated.



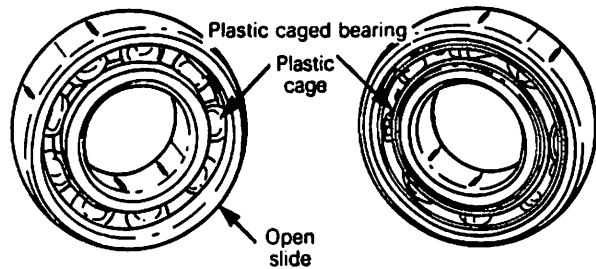
○ **NOTE:** Two cylindrical spacers are needed to properly position the puller in the crankcase.

Using a butane torch with a large **soft** flame, heat around the crankcase clutch shaft bearing area with 4 to 5 rapid circular passes, then extract the bearing.

Reassembly

Heat around the crankcase bearing area as described above and quickly drift the bearing into the crankcase using a **soft** hammer:

○ **NOTE:** If a plastic caged bearing is installed, always place the open side facing the inside of the crankcase.



⑥⑩ ⑥⑪ Heat is needed to remove or install the clutch and main shaft bearings in the clutch side crankcase.

▼ **CAUTION:** Always apply heat to remove or install a bearing in the crankcase. Failure to apply heat may result in metal being drawn out of the bearing to crankcase contact surface, thus causing a loose fit in the crankcase.

Proceed as follows:

◆ **WARNING:** Engines have magnesium crankcase. Magnesium must be heated with great care.

Disassembly

Remove the bearing retaining plate and shim(s).

Using a butane torch with a large **soft** flame, heat the crankcase (inside portion) around the bearing area with 4 to 5 rapid circular passes.

Drift the bearing(s) out with an appropriate pusher and a **soft** hammer.

Reassembly

Install the bearing retaining plate without shim(s).

Heat the crankcase (inside portion) as described above.

Quickly drift the bearing(s) into the crankcase using a **soft** hammer, until the bearing(s) seats against the bearing retaining plate.

SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

○ **NOTE:** If plastic caged bearings are installed, always place the open side facing the outside of the crankcase.

Remove the bearing retaining plate and verify the end play.

⑫ ⑬ The transmission shaft end-play must be 0.1 mm (.004") maximum.

Proceed as follows to verify the end-play.

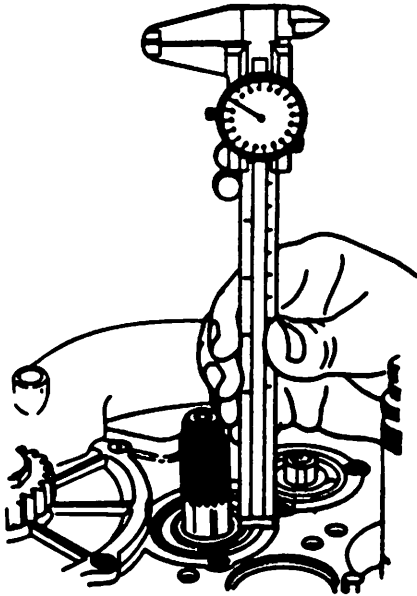
Remove the bearing(s) retaining plate and shims.

Tap both clutch and main shafts towards the sprocket side crankcase.

Tap both bearing inner races towards the sprocket side crankcase.

Measure the distance between the bearing outer race and the crankcase surface to determine the shims required between the bearing and the retaining plate.

The end-play must be 0.1 mm (.004") maximum.



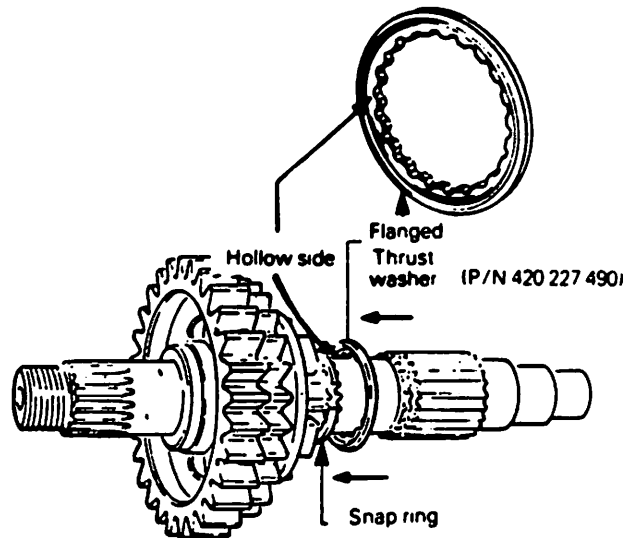
▼ **CAUTION:** If transmission shimming is too tight, transmission binding and excessive friction will occur.

⑭ At assembly, apply Loctite no. 242 blue (medium strength) on the retaining screw threads and torque to 4-5.5 N·m (3-4 ft-lbs).

⑮ At assembly, torque the kick starter stop screw to 34-40 N·m (25-29 ft-lbs).

○ **NOTE:** After assembly, do not remove the kick starter stop screw unless needed otherwise the kick starter spring will lose its preload and the removal of the clutch cover will be necessary to preload the spring.

⑯ At assembly, install the flanged thrust washer with the hollow side facing the snap ring (in order to partially cover the snap ring).



○ **NOTE:** Always install the snap ring so that the sharp edge points toward the sprocket. When installed, the snap ring should not be able to be turned by hand in the groove.

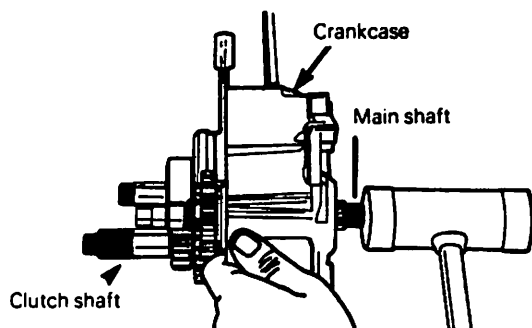
SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

TRANSMISSION GEAR CLUSTER 6 SPEED

Disassembly

To remove the clutch and main shaft gear cluster from the crankcase, tap on the sprocket side end of the main shaft. Use a soft hammer.

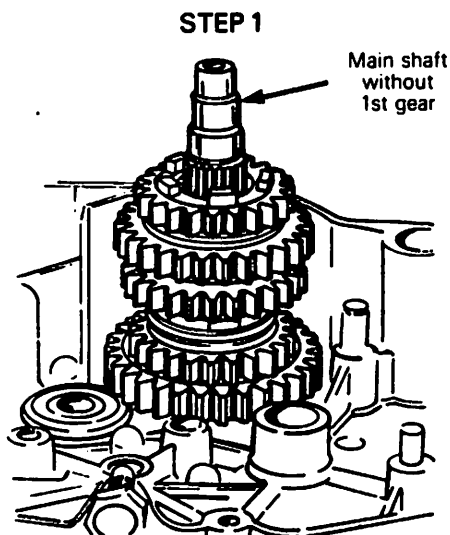


○ **NOTE:** To ease the clutch shaft removal, turn the clutch shaft manually while at the same time hitting the main shaft.

Reassembly

Proceed as follows:

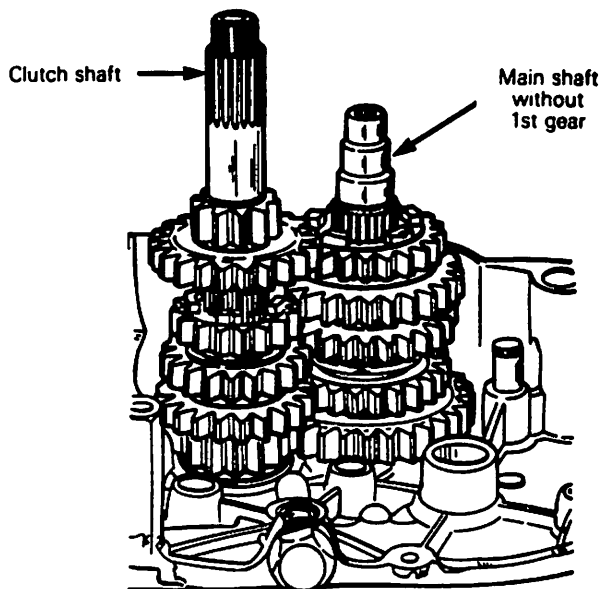
Position the main shaft as illustrated, tap gently without pushing completely the shaft into the bearing. (To ease the clutch shaft installation).



Position the clutch shaft as illustrated, tap gently to push the shaft into the bearing, while turning the main shaft manually; completely seat both shafts.

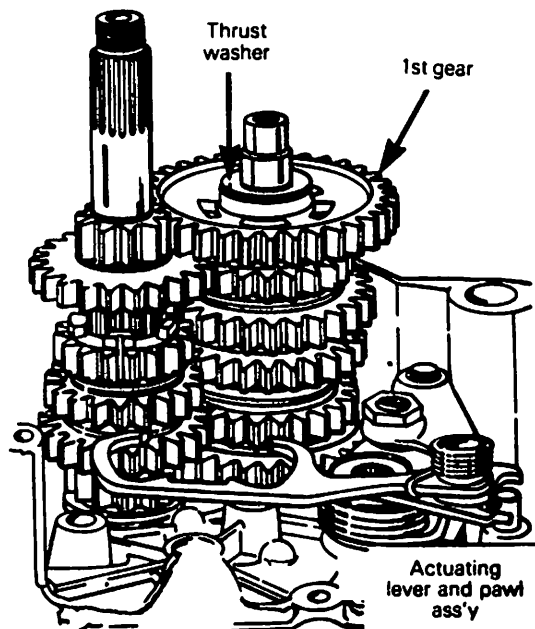
▼ **CAUTION:** Prior to pushing the clutch shaft into the bearing, make sure the gears match.

STEP 2



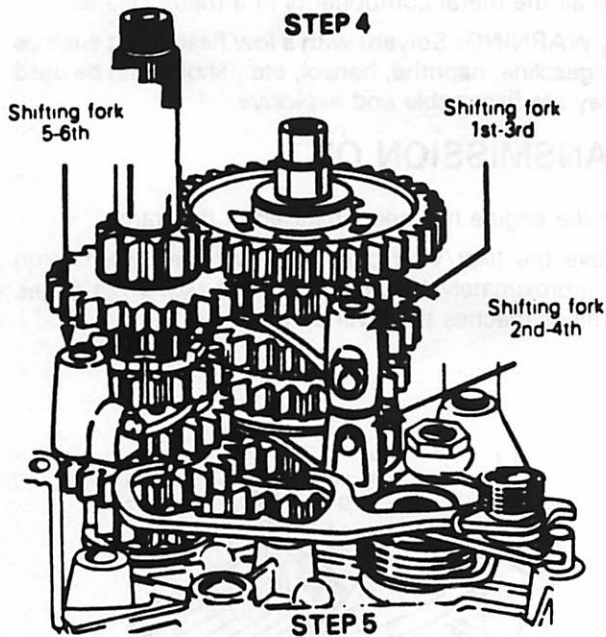
Position the thrust washer, needle bearing, first gear and thrust washer, and then the actuating lever and pawl ass'y as illustrated.

STEP 3



SECTION 02 ENGINE SUB-SECTION 02 (ENGINE/TRANSMISSION)

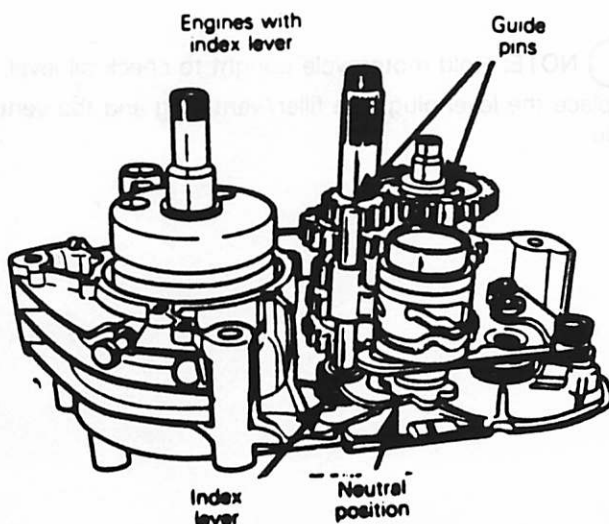
Position the shifting forks as illustrated.



Coat the shift drum washer with grease, this will allow the washer to stick on the shift drum for ease of installation. (If applicable).



Position the shift drum ass'y and match all the shifting forks with the drum slots then position the guide pins as illustrated.



Hold the index lever (in crankcase) fully open while inserting the shift drum in place.

○ **NOTE:** To facilitate the assembly of the shifting forks, position the shift drum assembly at the neutral position.



Prior to reassembly of the crankcase halves, adjust the shifting mechanism and ensure that the index lever is leaning against the neutral notch.

CLEANING

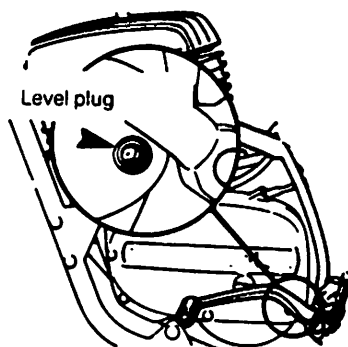
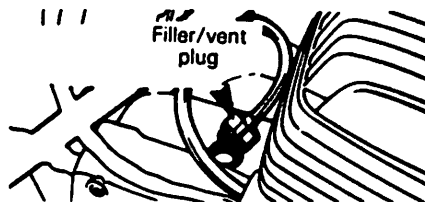
Clean all the metal components in a metal cleaner.

◆ **WARNING:** Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

TRANSMISSION OIL

After the engine has been installed in the frame.

Remove the filler/vent plug and refill the transmission with approximately 1200 ml (40 fl. oz.) **75W-90/80 Light viscosity** oil until oil reaches the level orifice.

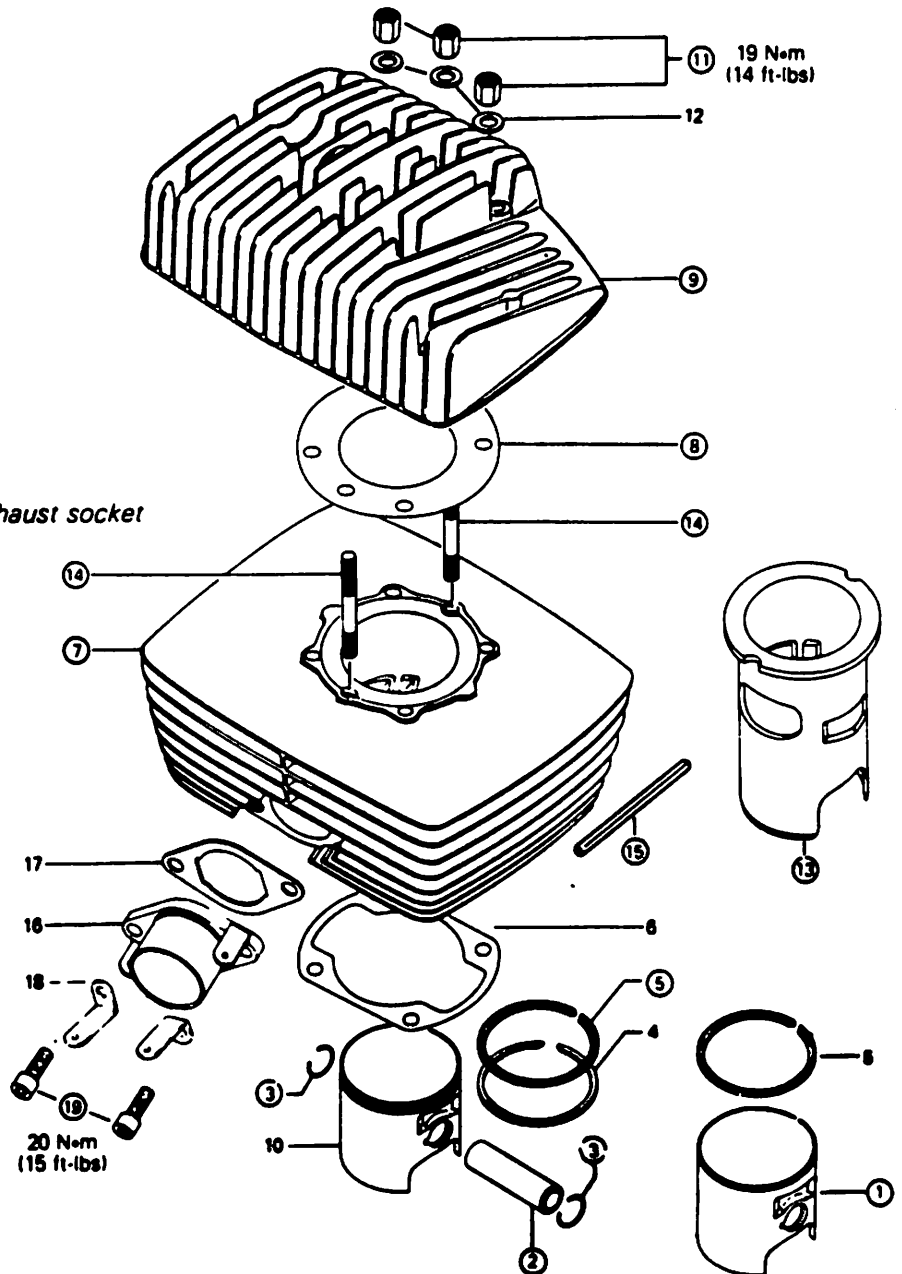


○ **NOTE:** Hold motorcycle upright to check oil level. Replace the level plug, the filler/vent plug and the vent tube.

244 ENGINE TYPES

TOP END

1. Piston (MX type)
2. Piston pin
3. Circlip
4. Rectangular ring (Qualifier)
5. L-semi-trapez ring
6. Cylinder base gasket
7. Cylinder
8. Cylinder head shim (as required)
9. Cylinder head
10. Piston (Qualifier Type)
11. Cylinder head nut M8 (6)
12. Flat washer 8.4 mm (6)
13. Cylinder sleeve
14. Cylinder head stud M8 x 49 (2)
15. Damper rubber
16. Exhaust socket
17. Exhaust gasket
18. Spring bracket
19. Allen screw M8 x 25 (2)



SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

TOP END

Disassembly & assembly

○ **NOTE:** Refer to Technical Data for component fitted tolerance wear limit.

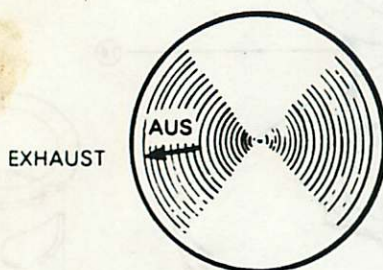
① ⑦ ⑨ ⑩ ⑬ At the replacement of the piston, cylinder, cylinder head and cylinder sleeve, the squish area should be remeasured (See "Engine tolerances measurements").

① ② ③ ⑩ Place a clean cloth over the crankcase to prevent circlips from falling into crankcase then use a pointed tool to remove circlips from piston.

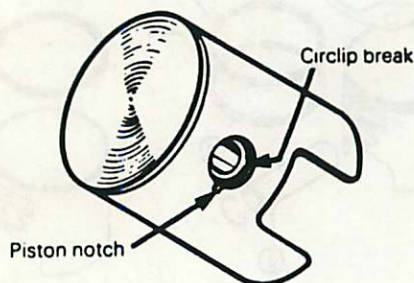
Drive the piston pin in or out using a suitable drive punch and hammer.

▼ **CAUTION:** When tapping piston pin in or out of piston, hold piston firmly in place to eliminate the possibilities of transmitting shock and pressure to the connecting rod.

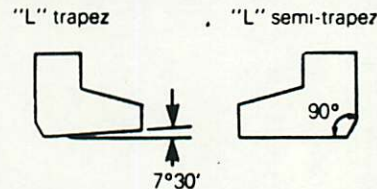
At assembly, place the piston over the connecting rod with the letters AUS, over an arrow on the piston dome, facing direction of the exhaust port.



Once the circlips are installed, turn each circlips so that the circlip break is not directly in line with piston notch. Using very fine emery cloth, remove any burrs on piston caused through circlip installation.



⑤ There are two different types of "L" ring.

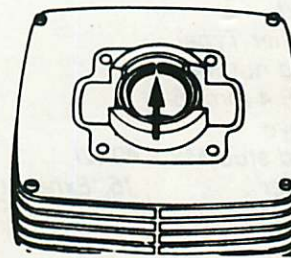


Qualifier uses 1 "L" semi-trapez ring, matched with one rectangular ring.

MX-6 uses 1 "L" semi-trapez ring only.

Ring end gap: 244 engines: 0.20-0.35 mm (.008"-0.014")

281 engines: 0.25-0.40 mm (0.010-0.016")

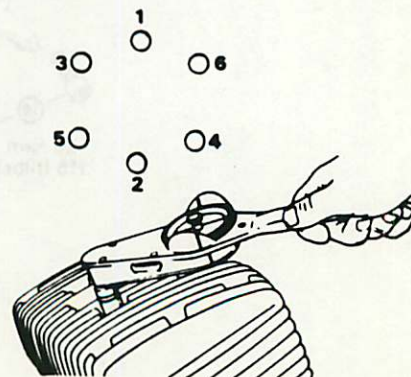


○ **NOTE:** 2nd oversize piston & rings are "L" trapez type.

▼ **CAUTION:** Prior to "L" ring replacement always ensure to visually identify the appropriate type needed. The two ring/piston types are not interchangeable. Damage may occur if interchanged.

⑥ At assembly, install a new lightly greased gasket.

⑨ ⑪ At assembly, torque to 19 N•m (14 ft-lbs) in a criss-cross sequence.



SECTION 02 ENGINE SUB-SECTION 02 (ENGINE/TRANSMISSION)

⑬ Cylinder sleeve should be replaced whenever its inside diameter becomes 0.14 mm (0.006") or more larger than a new 2nd oversize piston.

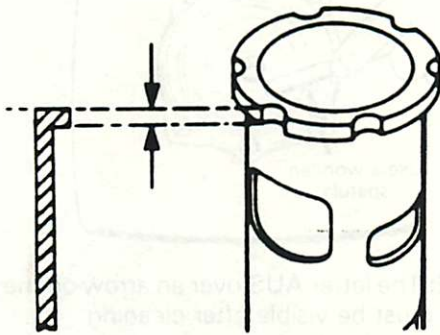
Proceed as follows:

Place the cylinder in a range oven for 30 minutes, at a temperature of 175°C (350°F) maximum.

Place the new cylinder sleeve in a freezer for one hour minimum.

Support cylinder barrel upside down and press out the cylinder sleeve using a suitable pusher.

Measure the thickness of the old liner top flange and if necessary, machine the new liner flange to the same measurement.



Inspect cylinder barrel, remove any grooves or scratches. Clean away any dirt or carbon.

Re-heat cylinder barrel in range oven for 30 minutes at a temperature of 175°C (350°F) maximum.

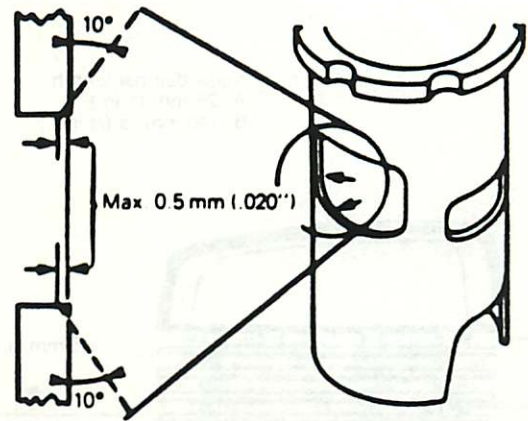
Immediately align chilled cylinder sleeve with hot cylinder, drop into place from top side making sure to align the exhaust port of the sleeve with the one of the cylinder barrel. To ease alignment, leave two cylinder studs in the cylinder.

○ NOTE: Only 3-4 seconds maximum are needed before cylinder cools sufficiently to grip onto sleeve.

Bore the new sleeve to provide piston clearance of:

	Minimum	Maximum
250 ATK	0.08 mm (0.002")	0.08 mm (0.003")

Using a rotary file or jeweler's hand file, chamfer the sharp edges of each port 10°, to width of 0.5 mm (.020").

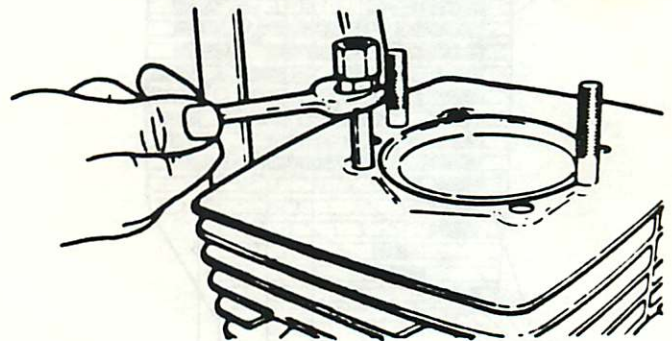


▼ CAUTION: Excessive chamfer will alter the port timing.

Check the ring end gap.

Make sure to check the squish area measurement during assembly. (See engine tolerances measurements).

⑭ To unscrew, use 2 cylinder head nuts blocked one against the other.



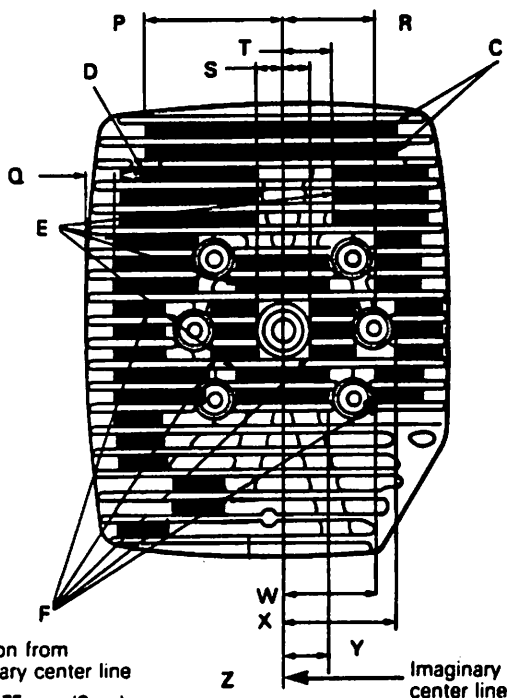
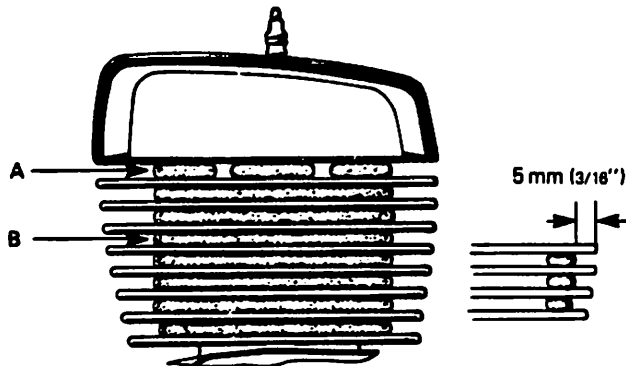
At assembly, screw the long threaded portion of the stud into the cylinder.

SECTION 02 ENGINE

SUB-SECTION 02 (ENGINE/TRANSMISSION)

⑮ If replaced, noise dampers should be installed as illustrated.

Noise damper length
A: 25 mm (1 in.)
B: 140 mm (5 1/2 in.)



Location from
imaginary center line

P - 75 mm (3 in.)
R - 50 mm (2 in.)
S - 15 mm (5/8 in.)
T - 25 mm (1 in.)
W - 50 mm (2 in.)
X - 63 mm (2 1/2 in.)
Y - 25 mm (1 in.)

Noise damper
length

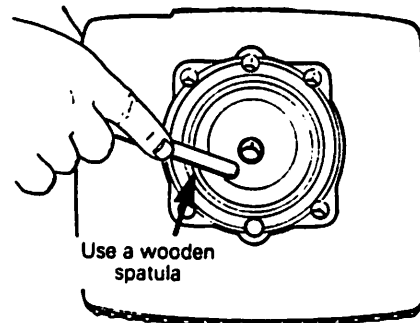
C - 140 mm (5 1/2 in.)
D - 70 mm (2 3/4 in.)
E - 50 mm (2 in.)
F - 25 mm (1 in.)

Cleaning

Clean all the metal components in a metal cleaner.

WARNING: Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

Scrape any carbon deposits from cylinder exhaust port, cylinder head and piston dome using a wooden spatula and repeat periodically.



○ NOTE: The letter AUS over an arrow on the piston dome must be visible after cleaning.

Clean the piston ring groove(s) with a groove cleaner tool, or using a piece of broken ring.

○ NOTE: It is suggested to periodically clean the cylinder head and piston of carbon build up.



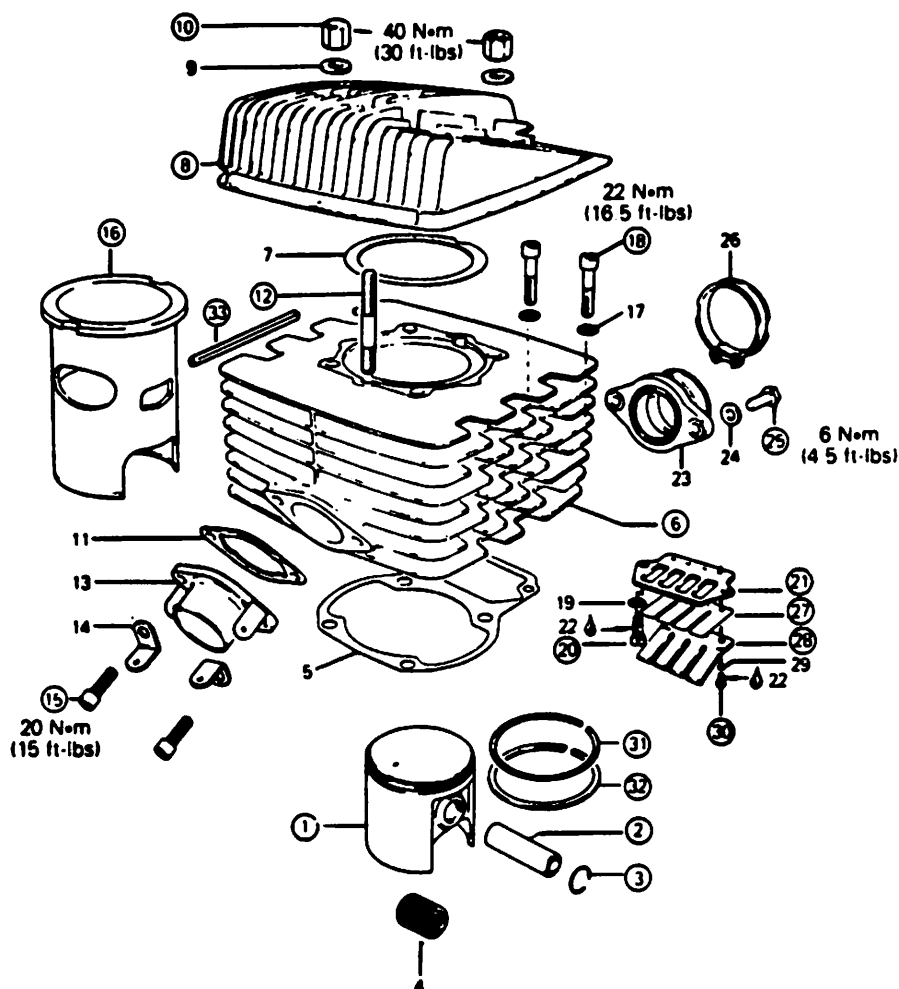
Scrape any deposit from the piston crown and inspect the piston for cracks or seizure marks.

Remove all traces of the cylinder base gasket and fit a new lightly greased gasket.

⑲ At assembly, torque to 20 N.m (15 ft-lbs).

406 ENGINE TYPE

TOP END



1. Piston
2. Piston pin
3. Circlip (2)
4. Needle bearing
5. Cylinder base gasket
6. Cylinder
7. Cylinder head shim A.R.*
8. Cylinder head
9. Washer 10.5 (6)
10. Cylinder head nut hexagonal M10 (6)
11. Gasket (exhaust)
12. Cylinder head stud M10 x 86 (2)
13. Exhaust socket
14. Spring bracket (2)
15. Allen screw M8 x 25 (2)
16. Cylinder sleeve
17. Lockwasher 8 (2)
18. Allen screw M8 x 40 (2)

19. Lockwasher 6 (2)
20. Pan head screw M6 x 16 (2)
21. Reed valve assembly
22. Loctite 242 blue (medium strength)
23. Rubber flange
24. Washer 8.4 (2)
25. Hexagonal screw M8 x 20 (2)
26. Clamp
27. Reed petal
28. Reed petal stop
29. Lockwasher 3 (4)
30. Screw M3 x 6 (4)
31. "L" Semi-trapez ring (1)
32. Rectangular ring (1)
33. Damper rubber (Qualifier)

*A.R.: As required

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

TOP END

Disassembly & Assembly

○ **NOTE:** Refer to Technical Data for component fitted tolerance and wear limit.

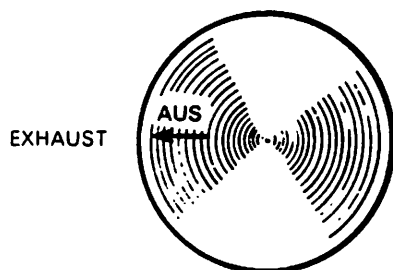
① ⑥ ⑧ ⑩ At the replacement of the piston, cylinder, cylinder head, cylinder sleeve, the compression ratio should be rechecked (See engine tolerance measurements).

① ② ③ Place a clean cloth over crankcase to prevent circlips from falling into crankcase then use a pointed tool to remove circlips from piston.

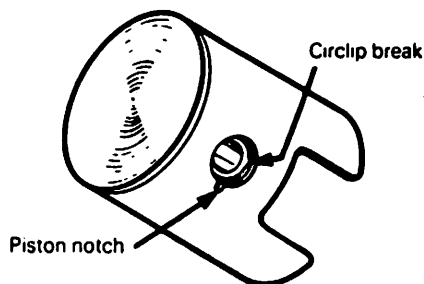
Drive the piston pin in or out using a suitable drive punch and hammer.

▼ **CAUTION:** When tapping piston pin in or out of piston, hold piston firmly in place to eliminate the possibilities of transmitting shock and pressure to the connecting rod.

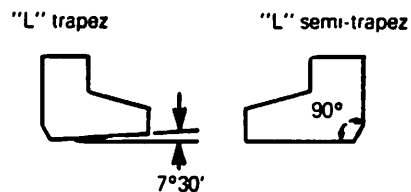
At assembly, place the piston over the connecting rod with the letters AUS (over an arrow on the piston dome) facing direction of the exhaust port.



Once the circlips are installed, turn each circlip so that the circlip break is not directly in line with piston notch. Using very fine every cloth, remove any burrs on piston caused through circlip installation.



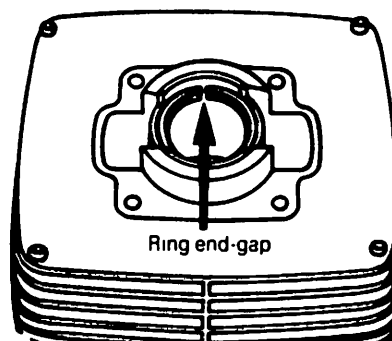
③ ⑫ There are two different types of "L" ring.



406 Engines use:

1 "L" semi-trapez ring with
1 rectangular ring

Ring end-gap: 0.25-0.40 mm (.010"-.016")



▼ **CAUTION:** Prior to "L" ring replacement always ensure to visually identify the appropriate type needed. The two ring types are not interchangeable. Damage may occur if interchanged.

⑤ At assembly, install a new slightly greased gasket.

⑥ It is possible to remove the cylinder from the engine with the engine in the frame.

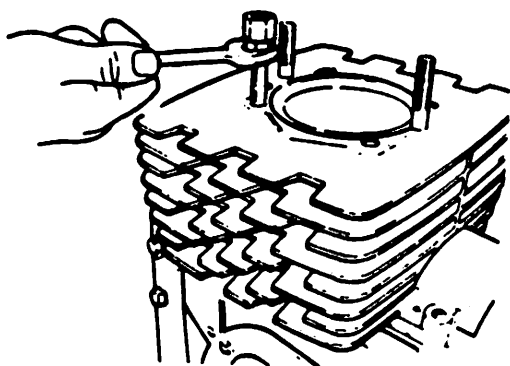
Proceed as follows:

- Remove the seat, the gas tank, the L.H. side panel and the complete exhaust pipe, including the engine exhaust socket.
- Disconnect the high tension wire and remove the carburetor and rubber flange.
- Remove the front and lower engine supports, including the R.H. and L.H. bushings under the engine.
- Remove the magneto cover.
- Remove the front bolt of the left foot peg.
- Slacken the swing arm bolt to ease the lowering of the engine.

SECTION 02 ENGINE

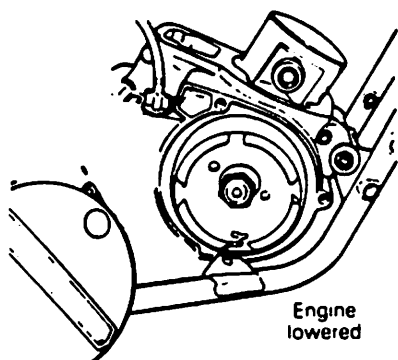
SUB-SECTION 03 (ENGINE/TRANSMISSION)

- Remove the cylinder head.
- Remove the four (4) cylinder studs.

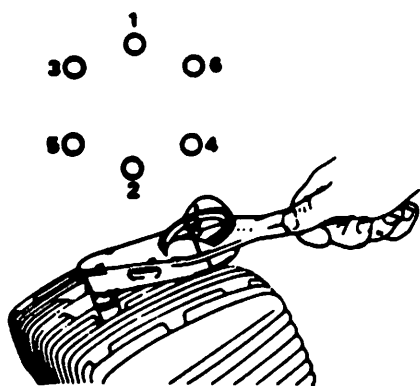


○ **NOTE:** It is not necessary to remove the front and rear middle studs which are screwed into the cylinder instead of the crankcase.

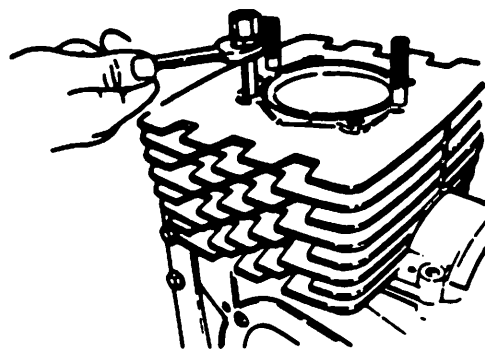
Lift and remove the cylinder.



⑧⑩ At assembly, torque to 40 N•m (30 ft-lbs) in a criss-cross sequence.



⑫ To unscrew, use 2 cylinder head nuts blocked one against the other.



At assembly, screw the short threaded portion of the stud into the cylinder.

⑮ At assembly, torque to 20 N•m (15 ft-lbs).

⑯ Cylinder sleeve should be replaced whenever its inside diameter becomes 0.18 mm (.007") or more larger than a new 2nd oversize piston.

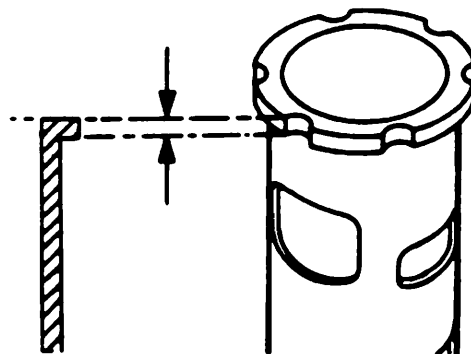
Proceed as follows:

Place the cylinder in a range oven for 30 minutes, at a temperature of 175°C (350°F) maximum.

Place the new cylinder sleeve in a freezer for one hour minimum.

Support cylinder barrel upside down and press out old cylinder sleeve using a suitable pusher.

Measure the thickness of the old liner top flange and if necessary, machine the new liner flange to the same measurement.



Inspect cylinder barrel, remove any grooves or scratches. Clean away any dirt or carbon.

Re-heat cylinder barrel in range oven for 30 minutes at a temperature of 175°C (350°F) maximum.

Immediately align chilled cylinder sleeve with hot cylinder, drop into place from top side making sure to align the exhaust port of the sleeve with the one of the cylinder barrel. To ease alignment, leave two cylinder studs in the cylinder.

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

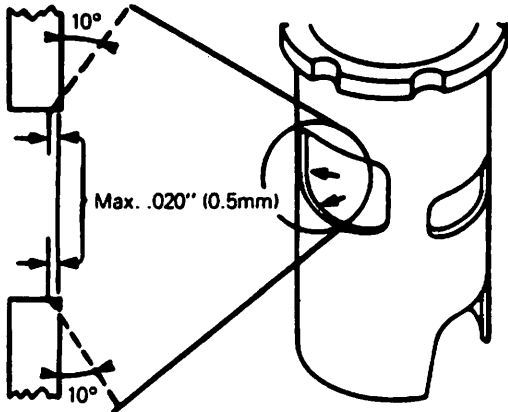
○ **NOTE:** Only 3-4 seconds maximum are needed before cylinder cools sufficiently to grip onto sleeve.

Bore the new sleeve to provide piston clearance of:

Minimum
0.07 mm (.003")

Maximum
0.09 mm (.0035")

Using a rotary file or jeweler's hand file, chamfer the sharp edges of each port 10°, to a width of 0.5 mm (.020").



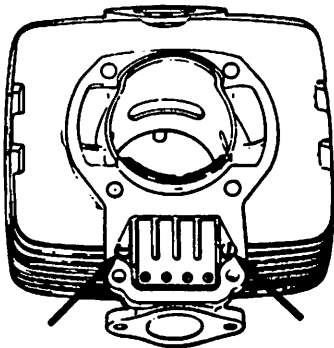
▼ **CAUTION:** Excessive chamfer will alter port timing.

Check the ring end gap.

Check the compression ratio during assembly (see engine tolerances measurements).

⑱ At assembly, torque to 22 N•m (16.5 ft-lbs).

⑳ ㉑ At assembly, apply Loctite 242 blue (medium strength) on threads and torque to 9 N•m (6.5 ft-lbs)

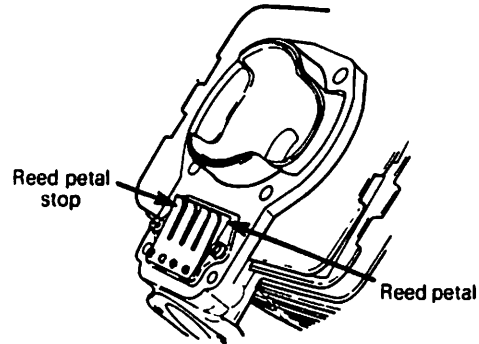


○ **NOTE:** It is necessary to use an impact screwdriver to remove the screws.

㉓ At assembly torque to 6 N•m (4.5 ft-lbs).

㉗ ㉘ ㉙ If the reed petal has to be removed proceed as follows:

Remove the four (4) screws retaining the reed petal stop.



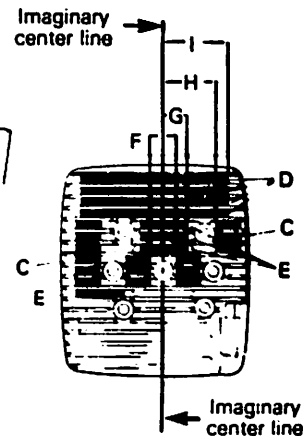
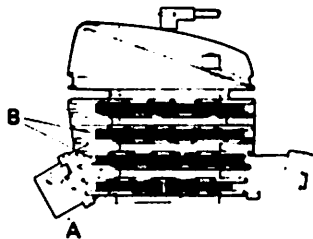
Remove the reed petal.

At reassembly install the reed petal stop and apply Loctite 242 blue (medium strength) on the retaining screws.



㉚ If replaced, noise dampers should be installed as illustrated.

Noise damper length
A: 70 mm (2 3/4)
B: 160 mm (6 1/4)



Location from imaginary center line
F - 16 mm (5/8")
G - 25 mm (1")
H - 60 mm (2 1/4")
I - 70 mm (2 3/4")

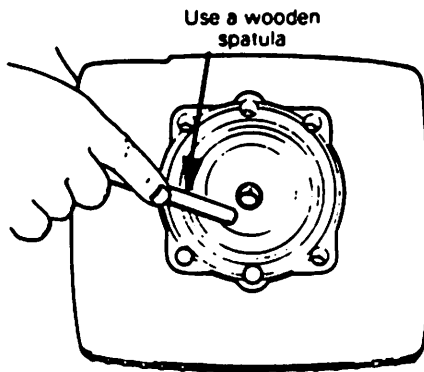
Noise damper length
C - 25 mm (1")
D - 160 mm (6 1/4")
E - 50 mm (2")

Cleaning

Clean all the metal components in a metal cleaner.

◆ **WARNING:** Solvent with a low flash point such as gasoline, maphtha, benzol, etc, should not be used as they are flammable and explosive.

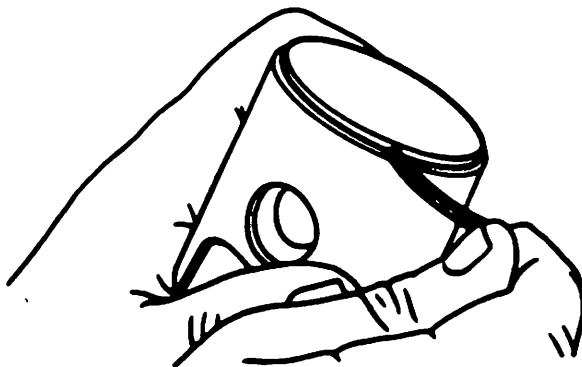
Scrape any carbon deposits from cylinder exhaust port, cylinder head and piston dome using a wooden spatula and repeat periodically.



○ **NOTE:** The letter AUS over an arrow on the piston dome must be visible after cleaning.

Clean the piston ring groove(s) with a groove cleaner tool, or using a piece of broken ring.

○ **NOTE:** It is suggested to periodically clean the cylinder head and piston of carbon build up.



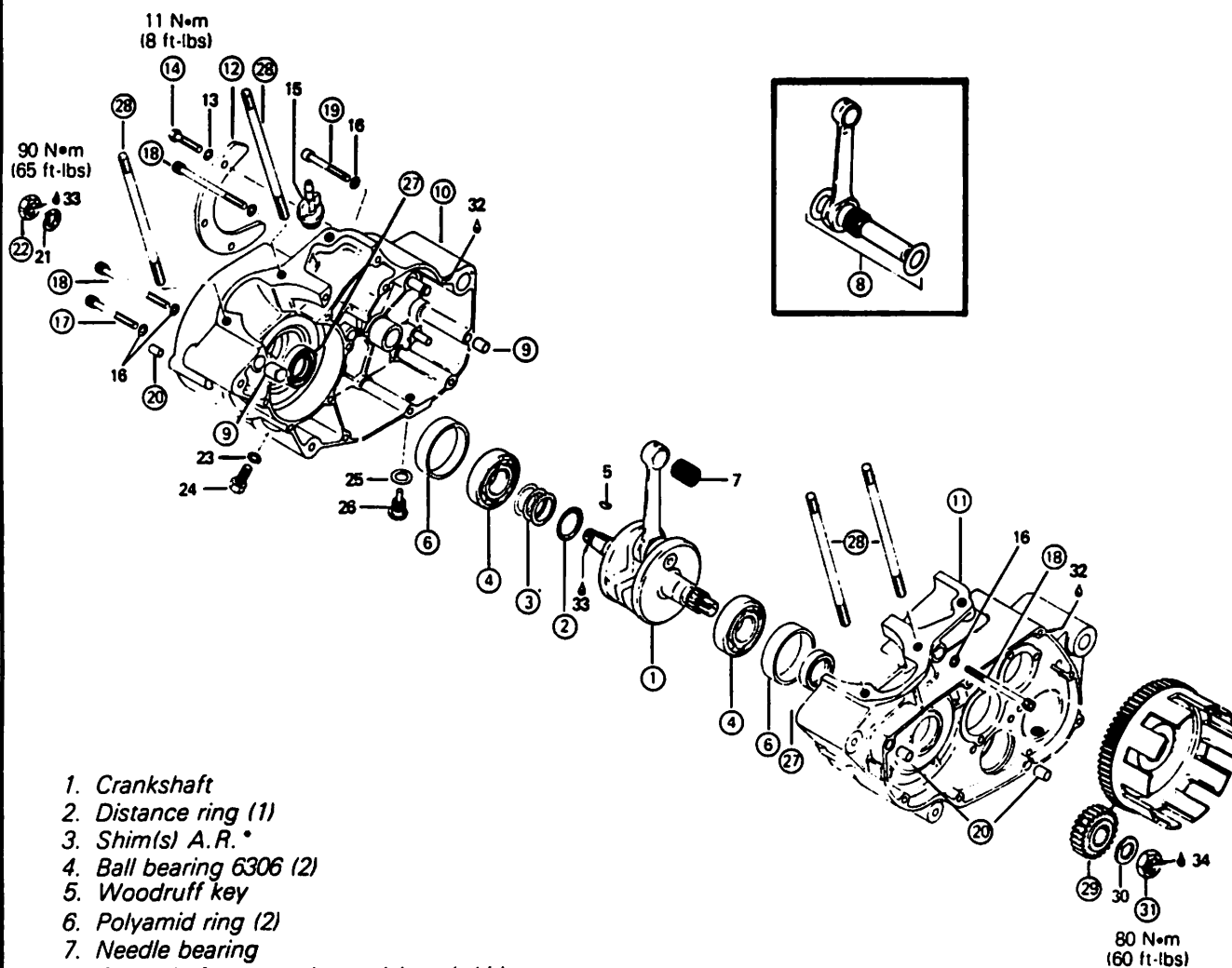
Scrape any deposit from the piston crown and inspect the piston for cracks or seizure marks.

Remove all traces of the cylinder base gasket and fit a new lightly greased gasket.

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

BOTTOM END



1. Crankshaft
2. Distance ring (1)
3. Shim(s) A.R.*
4. Ball bearing 6306 (2)
5. Woodruff key
6. Polyamid ring (2)
7. Needle bearing
8. Crankshaft connecting rod (repair kit)
9. Dowel pin (2)
10. Crankcase half (magneto side)
11. Crankcase half (clutch side)
12. Chain guard
13. Lockwasher 6 (3)
14. Hexagonal screw M6 x 16 (3)
15. Oil filler cap M18 x 1.5
16. Lockwasher 6 (13)
17. Allen screw M6 x 55 (4)
18. Allen screw M6 x 70 (8)
19. Allen screw M6 x 50 (1)
20. Dowel pin (5)
21. Lockwasher 18
22. Hexagonal nut M18 x 1.5 (magneto)
23. Gasket ring

24. Hexagonal screw M8 x 9 (crankcase drain)
25. Gasket ring
26. Magnetic drain plug
27. Seal magneto side and clutch side
28. Stud M10 x 191 (4)
29. Drive gear
30. Lockwasher 18
31. Nut M18 x 1.5
32. Loctite 515 sealant
33. Loctite 242 (blue) medium strength
34. Loctite 271 (red) high strength

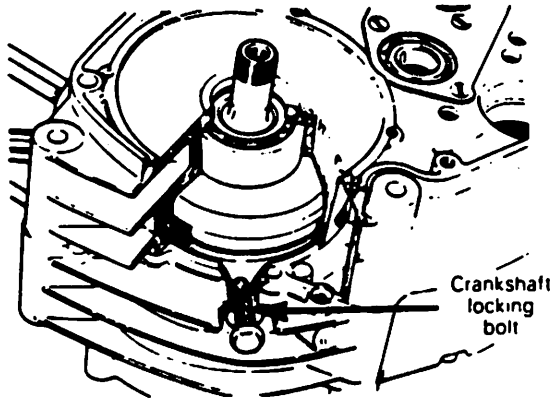
*A.R.: As required

BOTTOM END

Disassembly & Assembly

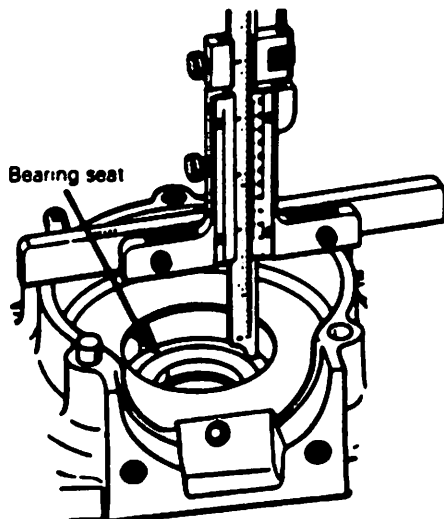
①⑧⑩⑪ At the replacement of the crankshaft, connecting rod and crankcase halves, the compression ratio should be checked (See engine tolerances measurements).

①⑩ To facilitate some procedures, the crankshaft can be locked at the top dead center position using a crankshaft locking bolt as illustrated.

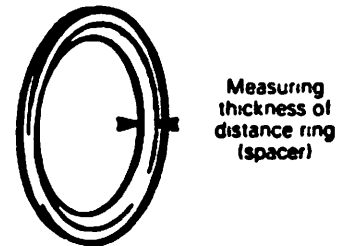
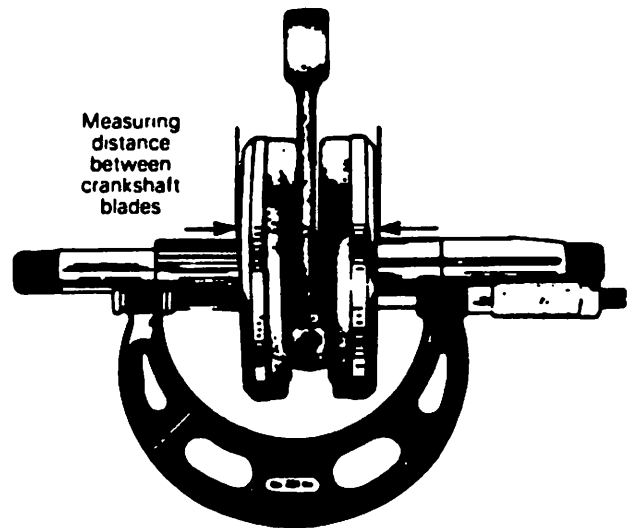
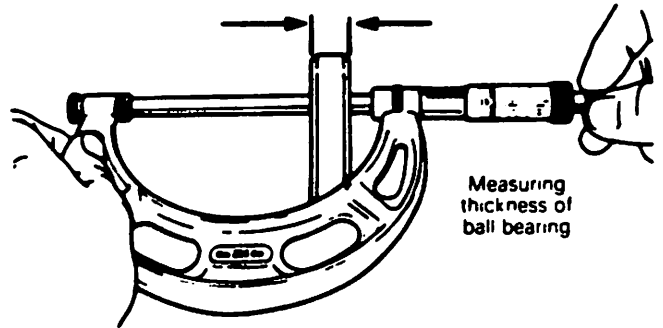


② At assembly, position the distance ring with the chamfered side facing the crankshaft.

①③ Crankshaft end-play should be between 0.1 mm (.004") to 0.3 mm (.011"). To determine the necessary shims: it is necessary to measure the crankcase. To do this, first measure each half from mating surface to bottom of bearing seat. Add measurements of both halves, total equals A.



Measure thickness of each ball bearing. Measure distance between crankshaft blades, and measure the thickness of the distance ring ②. Add measurements. Total equals B.



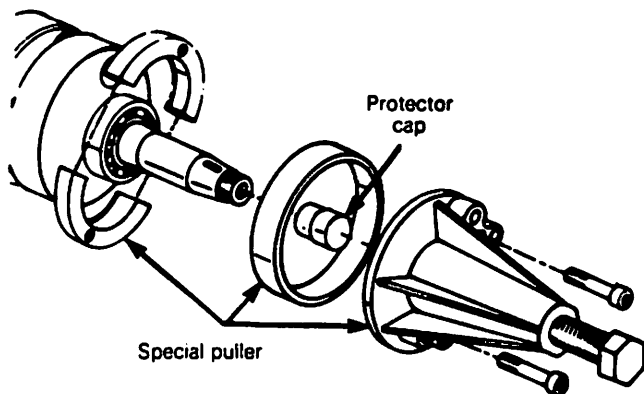
Subtract measurement B from measurement A, min. tolerance of 0.1 mm (.004") to 0.3 mm (.011"). Total balance is distance to be shimmed. Shim(s) must be located between distance ring and bearing.

○ NOTE: Crankshaft end-play is adjusted only when crankshaft and/or crankcase is replaced.

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

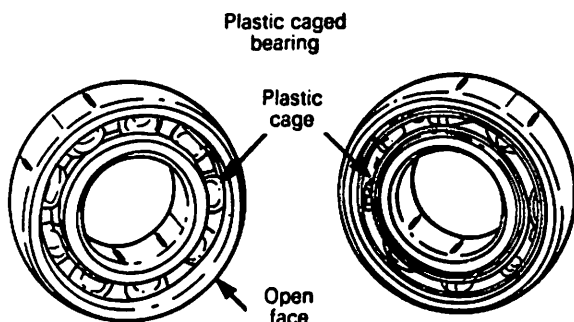
④ To remove bearing from crankshaft use a bearing puller as illustrated. (See tool section).



○ **NOTE:** Prior to magneto side bearing installation, install distance ring, required shim(s) and bearing on crankshaft.

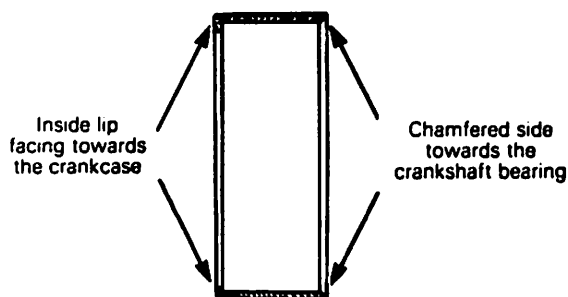
At assembly, place bearings in an oil container and heat the oil to 93°C (200°F) for 5 to 10 min. This will expand the bearings and permit them to slide easily onto the shaft.

▼ **CAUTION:** If a plastic caged bearing is installed, always place the open face towards the outside.



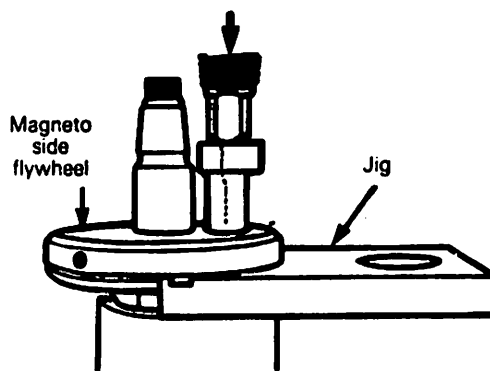
⑥ To install a new polyamid ring use an appropriate insertion pusher (See Tools section).

▼ **CAUTION:** Make sure to position the polyamid ring with the inside lip portion facing towards the crankcase.



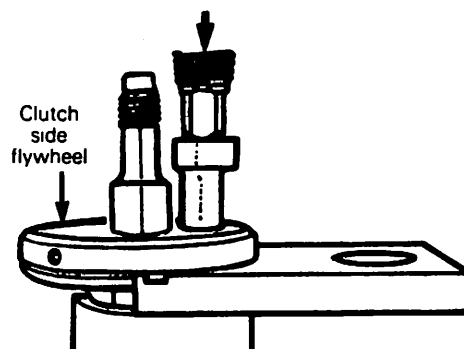
⑧ To replace the connecting rod proceed as follows:

Mount the crankshaft assembly in jig and press crankpin out of the magneto side flywheel.



Remove the connecting rod and the bearing.

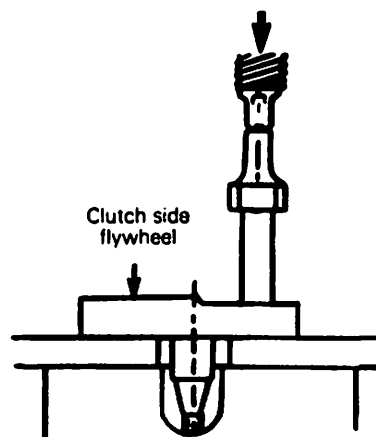
Press the crankpin out of the clutch side flywheel.



Press the new crankpin into the clutch side flywheel.

▼ **CAUTION:** The crankpin must enter the bore straight to prevent damage to the bore and/or the crankpin.

○ **NOTE:** The crankpin can be installed on both sides.

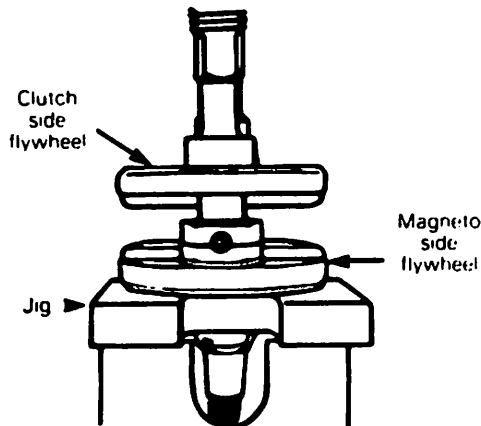


SECTION 02 ENGINE SUB-SECTION 03 (ENGINE/TRANSMISSION)

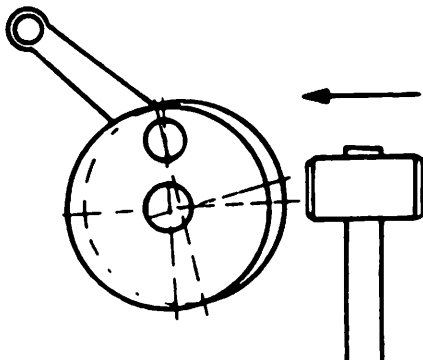
Fit the connecting rod and the bearing into place with light grease.

Place the magneto side flywheel on the jig. Align the clutch side flywheel with the magneto side flywheel and press the crankpin (with rod assembly) into magneto side flywheel.

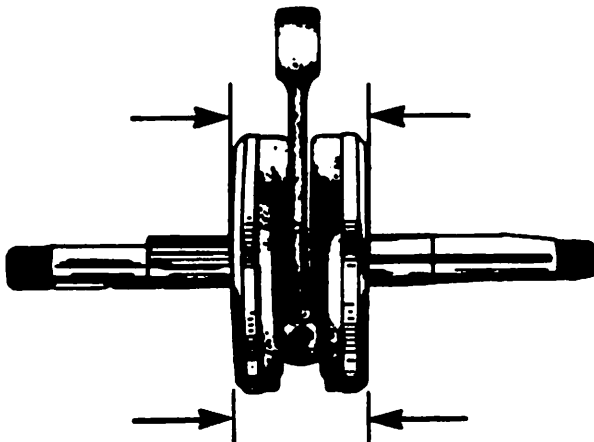
○ **NOTE:** The connecting rod side clearance must be 0.6 mm (.023") to 0.93 mm (.036").



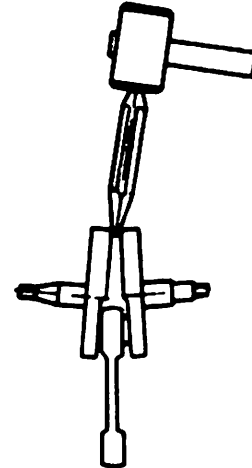
Using a "straight edge", check for flywheel alignment. Drift with a heavy brass mallet to align if necessary.



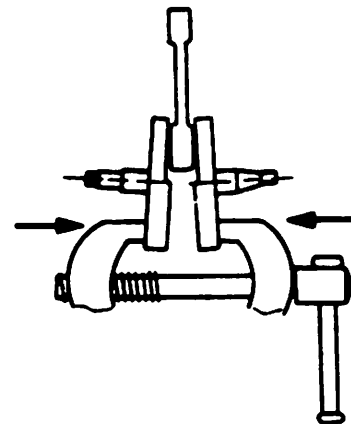
Using a micrometer or vernier caliper, check for counterweight alignment.



Use a wedge to correct this situation



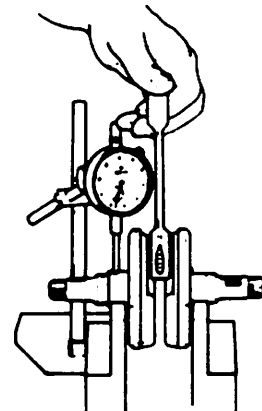
Use a clamp or vise to correct this situation



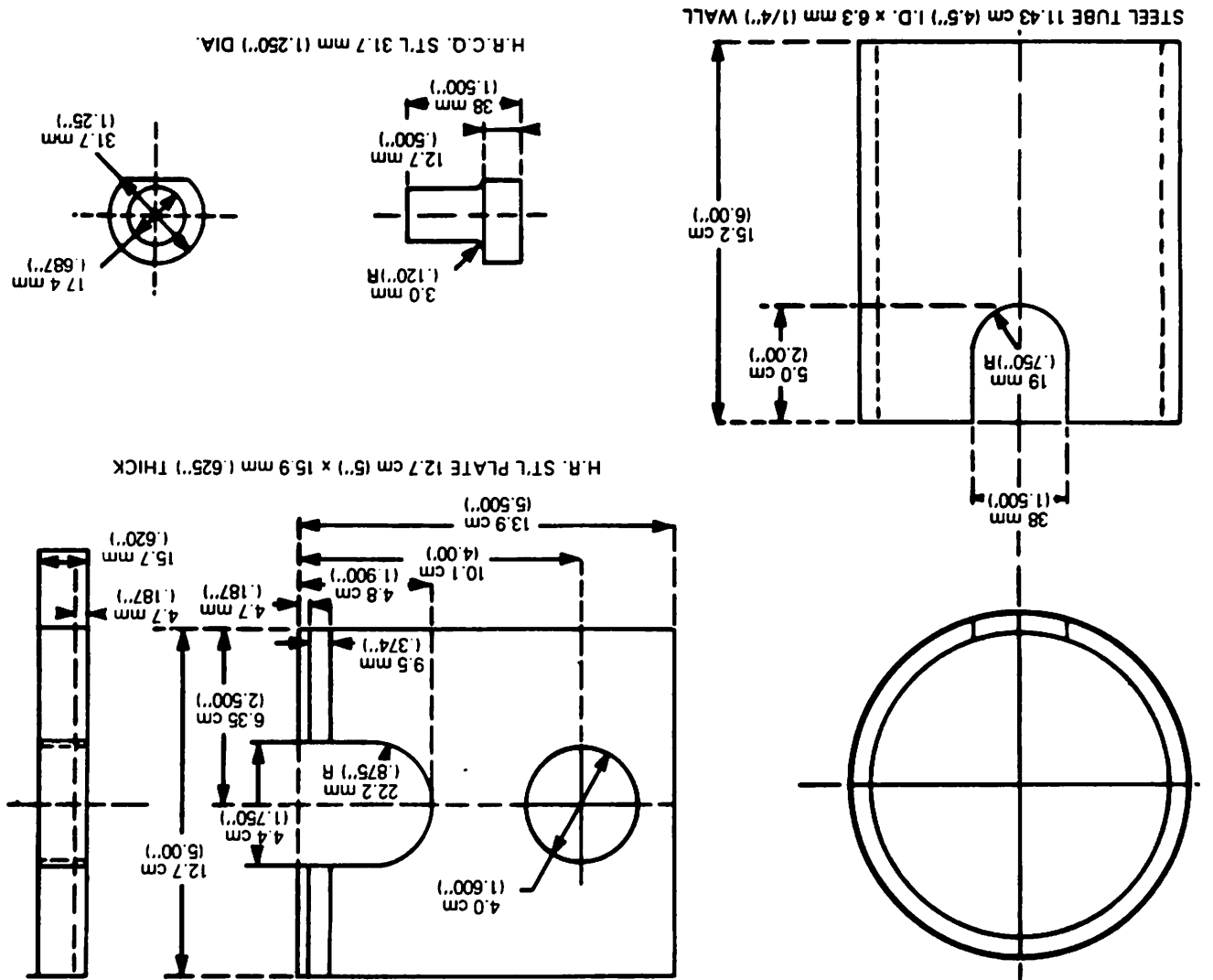
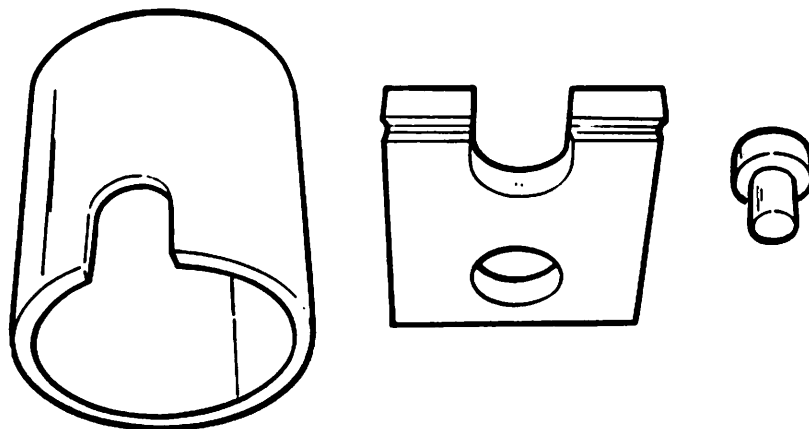
○ **NOTE:** For final alignment measures, see technical data.

When overall alignment is completed, verify connecting rod side clearance.

○ **NOTE:** Make a final alignment check using a dial indicator.



SUGGESTED CRANKSHAFT REPAIR TOOL

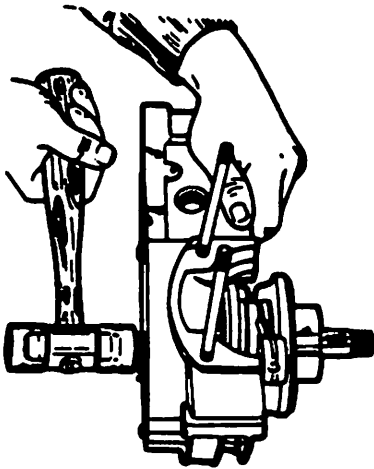


SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

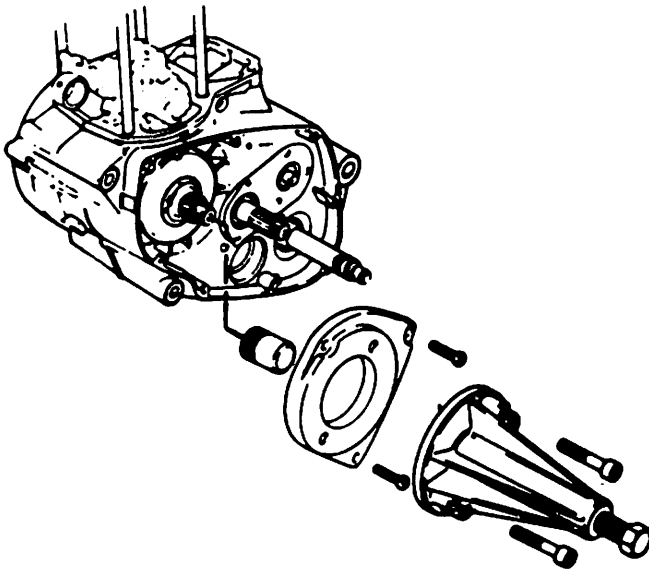
⑨ At the joining of the crankcase halves, make sure the dowel pin sleeves are in place.

⑩ Remove the crankshaft from the crankcase by tapping on the crankshaft end with a soft hammer.



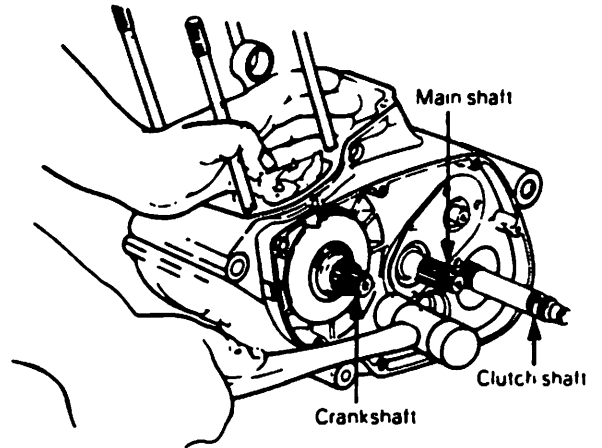
▼ CAUTION: Prior to the crankshaft removal ensure that the crankshaft locking bolt is removed.

⑩ ⑪ To split the crankcase halves, use a protective cap and puller (See Tools section).



○ NOTE: The crankcase halves can also be splitted, by tapping equally on the main shaft, clutch shaft and crankshaft with a soft faced hammer.

▼ CAUTION: Ensure that all the crankcase retaining screws have been removed (including the screw behind the chainguard).



▼ CAUTION: Do not pry between crankcase halves, as score marks incurred are detrimental to crankcase sealing.

Prior to joining the crankcase halves carefully clean the mating surfaces with acetone, wood alcohol or equivalent.

Apply a light coat of Loctite 515 sealant (purple).

⑫ At assembly, ensure to use the proper chain guard (14 teeth or 15 teeth engine sprocket).

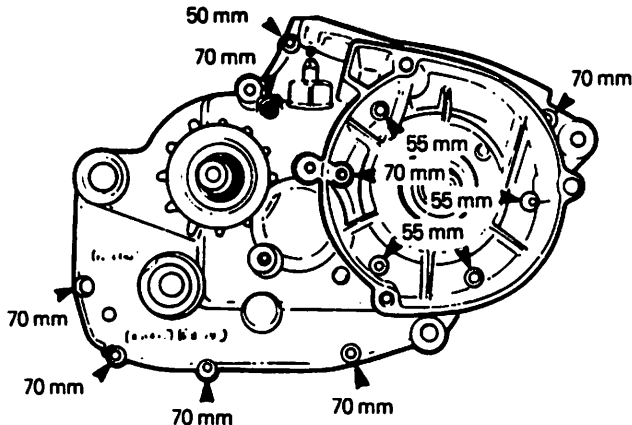
SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

⑭ At assembly, torque to 11 N•m (8 ft-lbs).

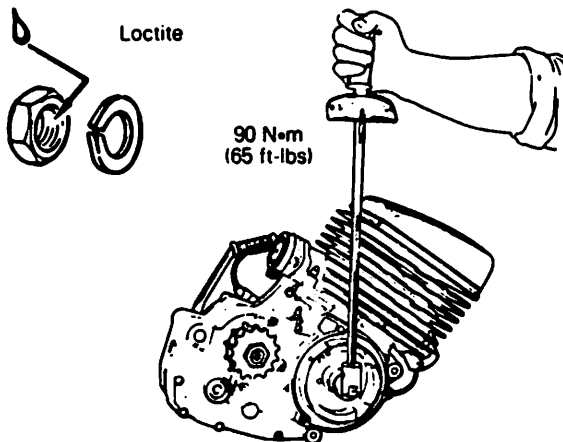
⑰ ⑱ At assembly, torque to 11 N•m (8 ft-lbs) following a criss-cross sequence.

○ **NOTE:** It is recommended to apply a small drop of oil or a thin coat of grease on the threads.

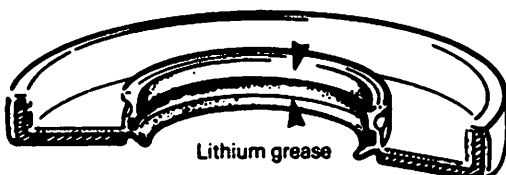


⑳ At assembly, ensure that the dowel pin sleeves are in place.

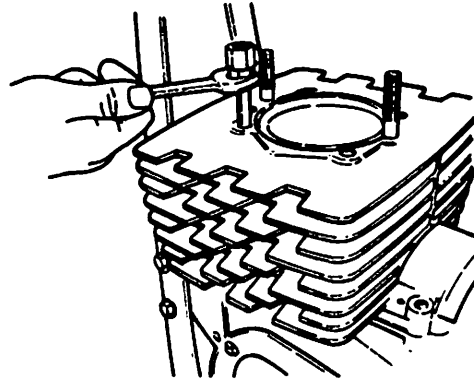
㉑ At assembly, apply Loctite 242 blue (medium strength) on the threads of the flywheel retaining nut and torque to 90 N•m (65 ft-lbs).



㉒ To install new seals, use the appropriate seal insertion pusher. (See Tool section). At assembly, apply a light coat of lithium grease on the seal lips.



㉓ To unscrew, use 2 cylinder head nuts blocked one against the other.



At assembly, position the long threaded portion of the stud into the crankcase.

㉔ If replacement is needed, always replace both crankshaft drive gear and clutch drum.

㉕ Prior to the installation of the crankshaft drive gear retaining nut, proceed as follows:

Clean the nut and crankshaft threads with Loctite "Kleen N' Prime" or equivalent, apply Loctite 271 red (high strength) on threads, install the locking washer, install the nut and torque to 80 N•m (60 ft-lbs).

○ **NOTE:** Allow at least one hour for the Loctite to set before starting the engine.

Cleaning

Clean all the metal components in a metal cleaner.

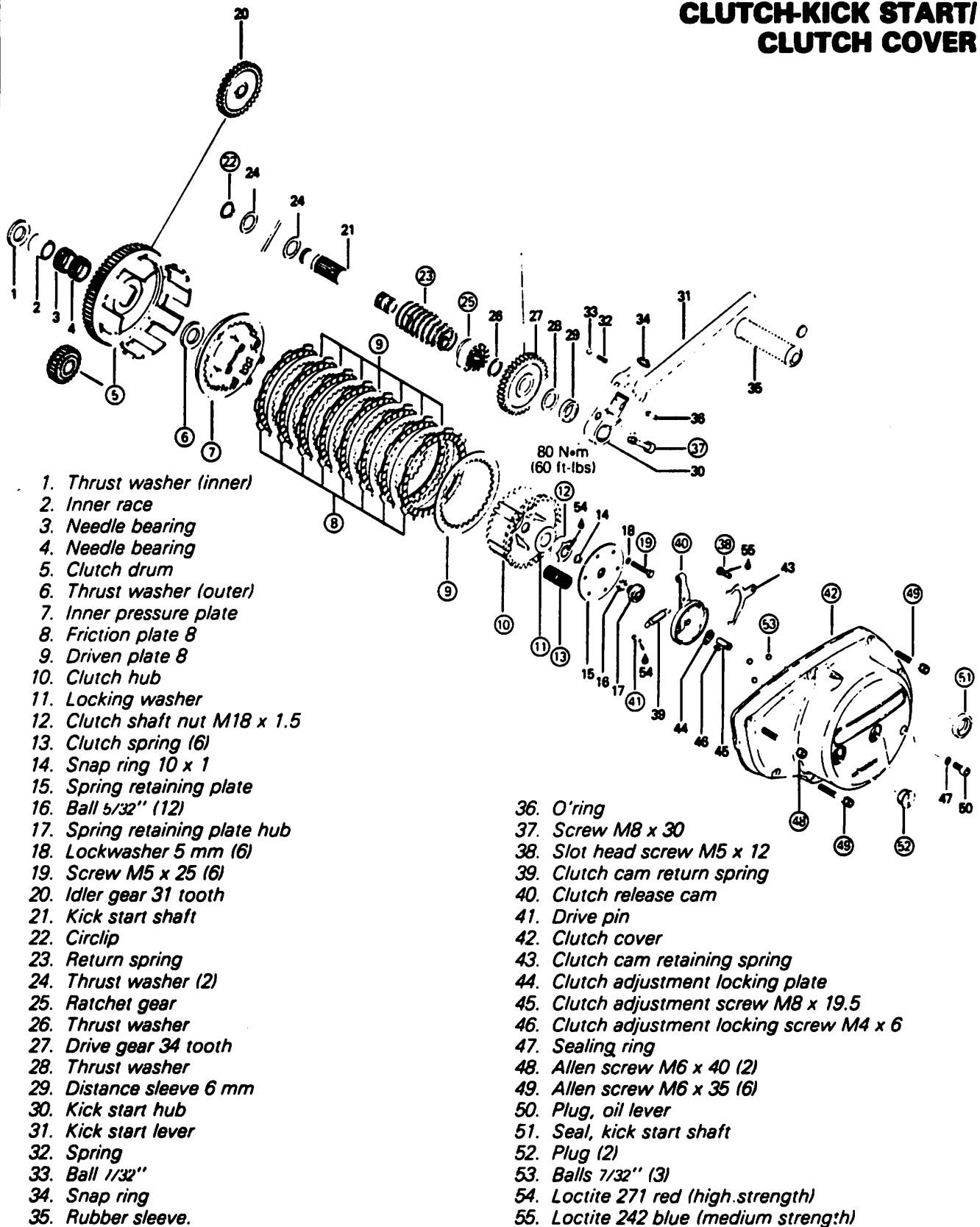
◆ **WARNING:** Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

Remove old sealant from mating surfaces of crankcase with acetone, wood alcohol or equivalent.

▼ **CAUTION:** Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase sealing.

SECTION 02 ENGINE
SUB-SECTION 03 (ENGINE/TRANSMISSION)

**CLUTCH-KICK START/
CLUTCH COVER**



SECTION 02 ENGINE

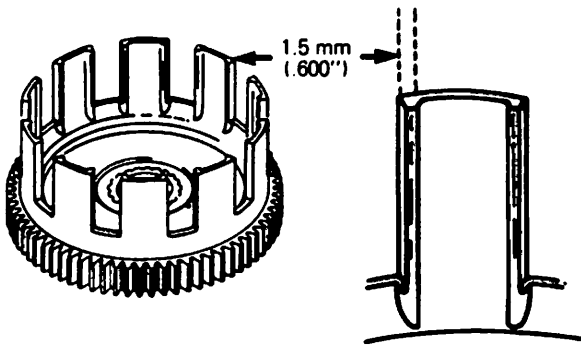
SUB-SECTION 03 (ENGINE/TRANSMISSION)

CLUTCH AND KICK START/ CLUTCH COVER

Disassembly & Assembly

⑤ If the clutch drum splines are found to be severely worn. Replacement may not be necessary. File the damaged spline surfaces equally.

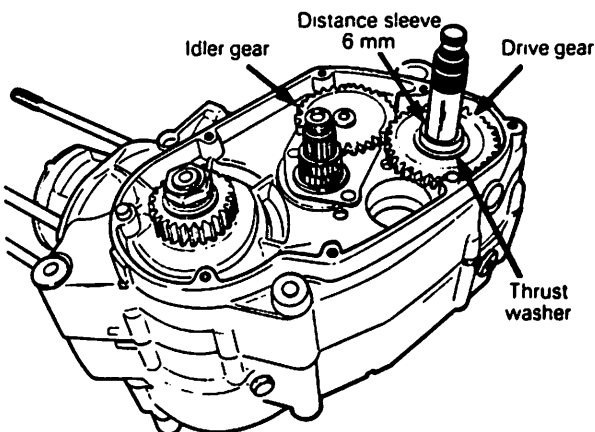
▼ **CAUTION:** The shouldered wall should not be filed thinner than 1.5 mm (.060").



If replacement is needed, always replace both crankshaft drive gear and clutch drum.

⑤⑥⑦⑧⑨⑩ Prior to assembling the clutch hub make sure to position the idler and drive gear as illustrated.

○ **NOTE:** The flanged side of the idler gear must face towards the crankcase.

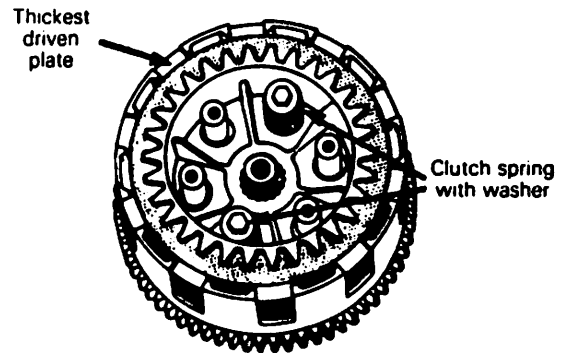


▼ **CAUTION:** Prior to the clutch hub installation, ensure to properly position the thrust washer ⑥.

With the clutch plates mounted on the clutch hub, fit clutch inner pressure plate in alignment with hub splines. Carefully insert clutch hub/plate assembly into clutch drum onto clutch shaft.

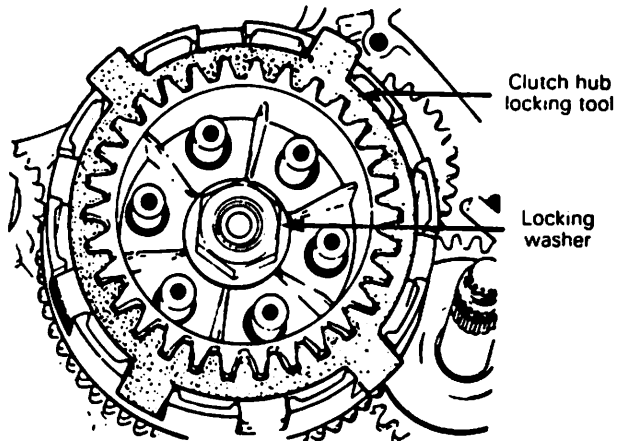
Ensure to place the thickest driven plate on the top.

○ **NOTE:** To ease assembly, install two clutch springs with washers to hold the clutch together.



▼ ⑪ **CAUTION:** Locking washer should be replaced if bent more than twice. If in doubt, replace.

⑫ To remove clutch shaft nut, lock the crankshaft at top dead center, unbend the locking washer and lock the clutch using the clutch hub locking tool (see tool section).



At assembly, apply Loctite no. 271 red (high strength) on the threads of the clutch shaft nut and torque to 80 N•m (60 ft-lbs).

◆ **WARNING:** Make sure to bend the clutch shaft nut locking washer.

▼ **CAUTION:** Do not pry on the inner pressure plate spring post to bend the locking washer, use a pair of waterpump pliers.

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

⑬ If spring(s) replacement is needed, ensure to change the springs in sets only.

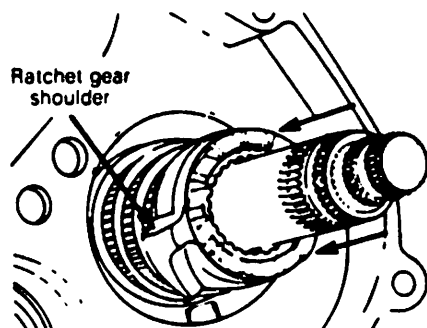
⑭ At assembly, tighten in a criss-cross sequence and torque to 5.5 N·m (4 ft-lbs).

⑮ To remove the kick start assembly from the crankcase remove the snap ring located in the inside portion of the crankcase and unscrew the kick starter stop screw under the left crankcase half.



⑯ It is possible to change the return spring without splitting the crankcase. At assembly, ensure that the spring ends are well positioned in the crankcase and ratchet gear holes.

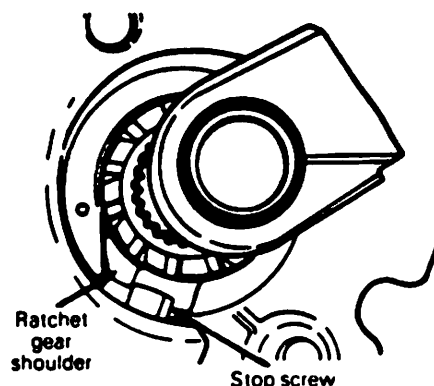
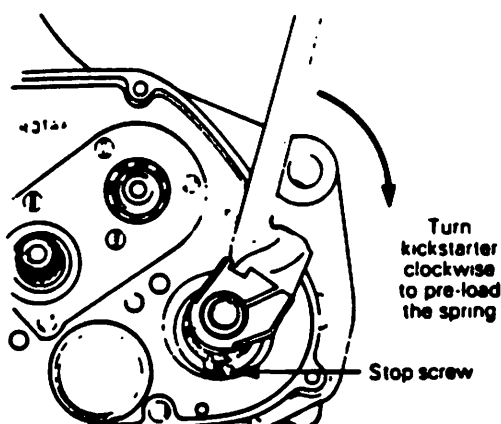
⑰ At assembly, position the spring end into the ratchet gear and partially engage the ratchet gear onto the shaft splines.



Install the kick starter lever and preload the return spring approximately 1 turn clockwise.

Completely slide the ratchet gear onto the splines while retaining the tension with the kick starter lever.

Release the kick starter lever and the ratchet gear will lean against the stop screw.

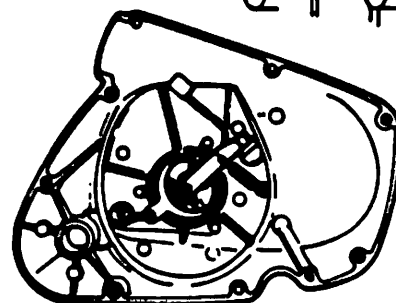
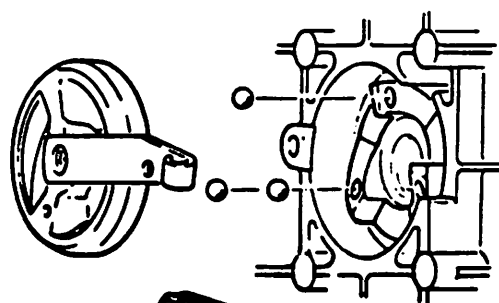
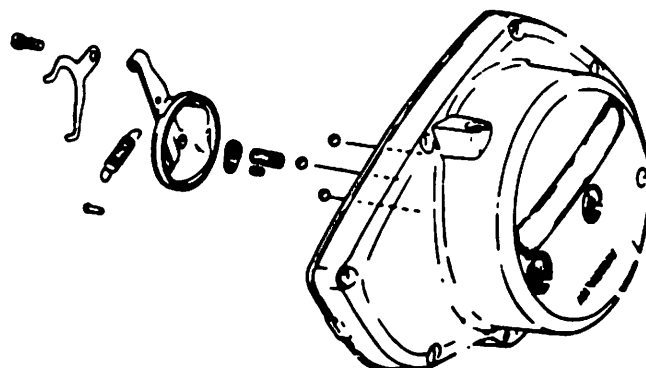


◆ **WARNING:** Exercise care when removing or installing the ratchet gear.

○ **NOTE:** After assembly, do not remove the kick starter stop screw unless needed, otherwise the kick starter spring will loose its preload and the clutch cover will have to be removed to reposition.

⑱ At assembly, torque to 20 N·m (15 ft-lbs).

⑲ ⑳ At assembly, position as illustrated.



SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

Apply Loctite no. 242 blue (medium strength) on screw threads and torque the screw to 5.5 N•m (4 ft-lbs).

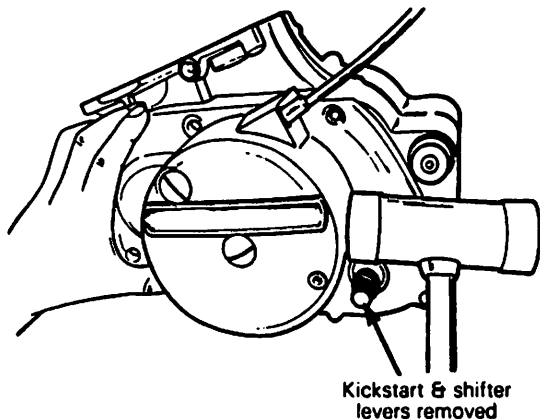
④⑩ If replacement is needed, ensure to order the hardened type clutch release cam (P/N 420 259 790) which must be used with the clutch release mechanism with bearing balls.

▼ **CAUTION:** Ensure to install the proper clutch release cam otherwise damage will occur.

④⑪ At assembly, apply Loctite no. 271 red (high strength) and force fit into place.

○ **NOTE:** Replace only if damaged or when replacing clutch cover.

④⑫ To remove the clutch cover, tap lightly using a soft faced hammer to break the seal (as illustrated).



▼ **CAUTION:** Do not pry between sealing surfaces, as score marks incurred are detrimental to clutch cover sealing.

○ **NOTE:** The clutch cover can be removed with the engine in the frame; but it is necessary to remove the left foot peg.

Prior to removal, ensure to drain the engine oil.

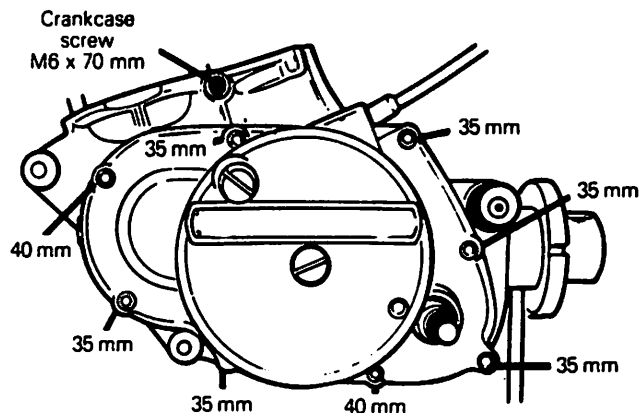
With clutch cable still connected, pull the clutch lever in. It will then preload against the cover to ease removal.

At assembly, clean the mating surfaces of the crankcase and clutch cover with acetone, wood alcohol or equivalent. Apply a light coat of Loctite 515 sealant and lightly tap cover into place.

▼ **CAUTION:** At installation, ensure that the kick starter seal lip is not flipped over by the kick starter shaft splines when pushing the clutch cover into place.

④⑬⑭ At assembly, torque the retaining screws to 8 N•m (6 ft-lbs) following a criss-cross sequence and apply a small drop of oil or a thin coat of grease on the threads.

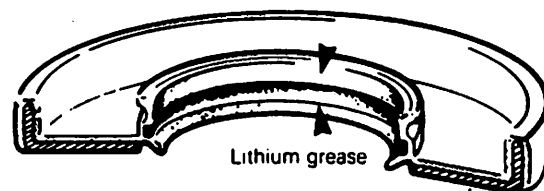
○ **NOTE:** For the proper location of the clutch cover retaining screws follow illustrated sequence.



▼ **CAUTION:** Ensure to use the correct screw for its location otherwise damage to the crankcase will occur.

▼ ⑤① **CAUTION:** Make sure the kick starter seal is not flipped over by the kick starter shaft splines when pushing the clutch cover into place.

At assembly, apply lithium grease on the seal lips.



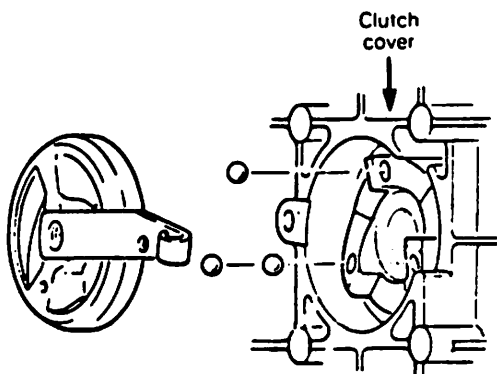
SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

⑤ For removal or installation use the screwdriver grip end, provided with the motorcycle tool kit.



⑥ At assembly, clean the three holes with compressed air. Drop a small amount of oil into the three holes and install the three bearing balls.



Cleaning

Clean all the metal components in a metal cleaner.

◆ **WARNING:** Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

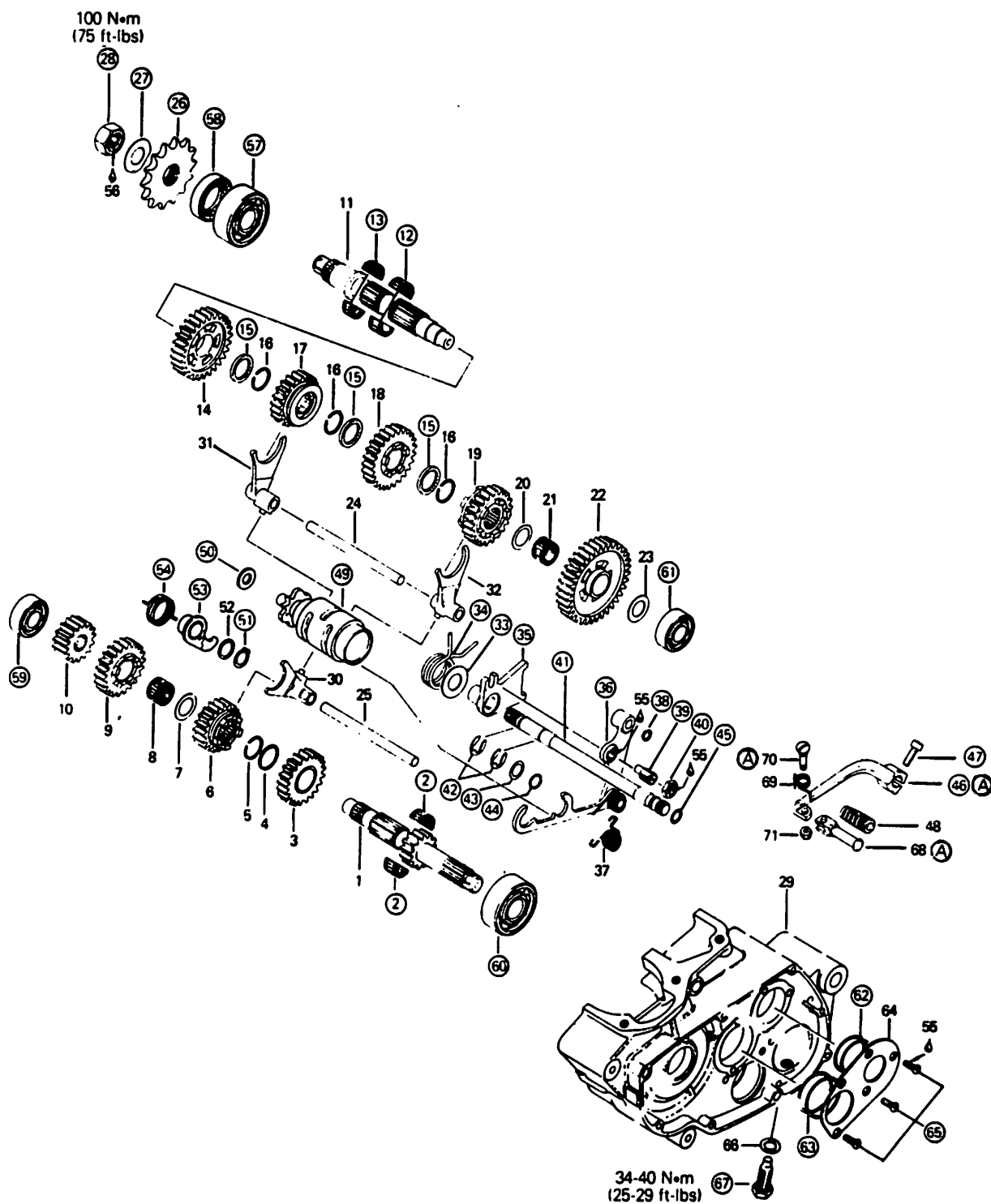
Remove old sealant from mating surfaces of crankcase/clutch cover with acetone, wood alcohol or equivalent.

▼ **CAUTION:** Never use a sharp object to scrape away old sealant as score marks incurred are detrimental to crankcase/clutch cover sealing.

SECTION 02 ENGINE
SUB-SECTION 03 (ENGINE/TRANSMISSION)

TRANSMISSION (GEAR BOX)

(5 speed)



SECTION 02 ENGINE
SUB-SECTION 03 (ENGINE/TRANSMISSION)

1. Clutch shaft 11 T
 2. Needle bearing ass'y, clutch shaft
width 11.68 mm (.460")
 3. 4th gear, clutch shaft, 17 T
 4. Thrust washer, clutch shaft
 5. Snap ring, clutch shaft
 6. 3rd gear, clutch shaft, 15 T
 7. Thrust washer, clutch shaft
 8. Needle bearing, clutch shaft
 9. 5th gear, clutch shaft, 23 T
 10. 2nd gear, clutch shaft 12 T
 11. Main shaft
 12. Needle bearing ass'y main shaft
width 12.55 mm (.494")
 13. Needle bearing ass'y main shaft
width 9.65 mm (.380")
 14. 2nd gear, main shaft, 24 T
 15. Thrust washer, main shaft (3)
 16. Snap ring, main shaft (3)
 17. 5th gear, main shaft, 21 T
 18. 3rd gear, main shaft, 21 T
 19. 4th gear, main shaft, 19 T
 20. Thrust washer, main shaft
 21. Needle bearing, main shaft
 22. 1st gear, main shaft 32 T
 23. Thrust washer, main shaft
 24. Shift fork guide pin
 25. Shift fork guide pin
 26. Sprocket, 15 T (Qualifier 3)
14 T (MX-6)
 27. Locking washer, main shaft
 28. Main shaft nut M20 x 1.5
 29. Magneto side crankcase half
 30. Shifting fork, 4-5th
 31. Shifting fork, 2nd
 32. Shifting fork, 1st-3rd
 33. Thrust washer, actuating lever
 34. Spring, actuating lever
 35. Actuating lever
 36. Pawl ass'y
 37. Pawl spring
 38. Snap ring 10 x 1
 39. Pawl positioning screw
 40. Locking nut M12 x 1, pawl positioning screw
 41. Shift shaft
 42. Retaining ring (2)
 43. Thrust washer, shift shaft
 44. "O" ring, shift shaft
 45. "O" ring, shift shaft
 46. Shift lever (A)
 47. Allen screw M6 x 20
 48. Shift lever rubber
 49. Shift drum ass'y
 50. Washer, shift drum
 51. Index snap ring
 52. Index washer
 53. Index lever
 54. Index spring
 55. Loctite 242 blue (medium strength)
 56. Loctite 271 red (high strength)
 57. Ball bearing 6205, main shaft, sprocket side
 58. Seal main shaft
 59. Ball bearing 6203, clutch shaft, sprocket side
 60. Ball bearing 6204, clutch shaft, clutch side
 61. Ball bearing 6203, main shaft, clutch side
 62. Shim 0.5 mm (0.019"), 0.3 mm (0.011"), 0.1 mm (0.004"), main shaft bearing *A.R.
 63. Shim 0.5 mm (0.019"), 0.3 mm (0.011"), 0.1 mm (0.004") clutch shaft bearing *A.R.
 64. Retaining plate (transmission bearings)
 65. Countersunk screw M5 x 12 (5)
 66. Gasket ring
 67. Stop screw, kick starter
 68. Folding lever (A)
 69. Spring
 70. Pivot screw M6 x 25 or M6 x 20 (A)
 71. Hexagonal nut M6 (if applicable)
- *A.R.: As required
- (A) : Two types of shift levers can be used (long folding lever type and short folding lever type) the long type uses a M6 x 25 pivot screw with an hexagonal nut M6.

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

TRANSMISSION (GEAR BOX)

Disassembly & Assembly

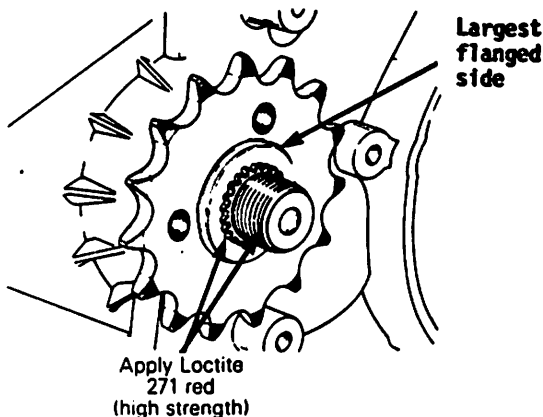
⑫⑬ The needle bearing halves must be replaced in pairs only.

▼ **CAUTION:** Make sure not to intermix the needle bearings halves, damage could occur. If bearing halves have been intermixed refer to the description to find the proper width of the bearing halves.

⑮ The sharp edge of the splined thrust washer must face retaining snap ring.

⑲ At assembly, apply Loctite 271 red (high strength) on the splines.

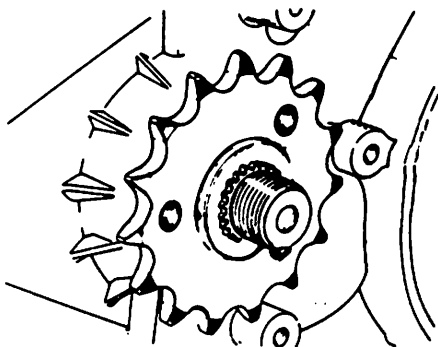
▼ **CAUTION:** Ensure to position the sprocket with the largest side facing outward.



○ **NOTE:** Three more optional sprockets are now available:

- 14 teeth P/N 420 236 040
- 15 teeth P/N 420 236 041
- 16 teeth P/N 420 236 042

However, to correctly install these sprockets, it will be necessary to remove the chain guard and to cut off the fixation embossments using a metal saw.



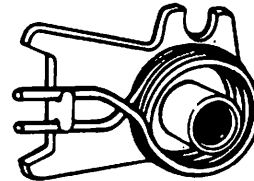
▼ **CAUTION:** Locking washer should be replaced if bent more than twice. If in doubt, replace.

⑳ To remove the sprocket retaining nut, unbend locking washer. Lock crankshaft at the top dead center position and with the transmission in gear, unscrew the nut.

At assembly, follow the same procedure, apply Loctite no. 271 red (high strength) on the retaining nut threads and torque to 100 N·m (75 ft-lbs).

○ **NOTE:** At assembly, position the sprocket retaining nut with the hollowed side facing the sprocket.

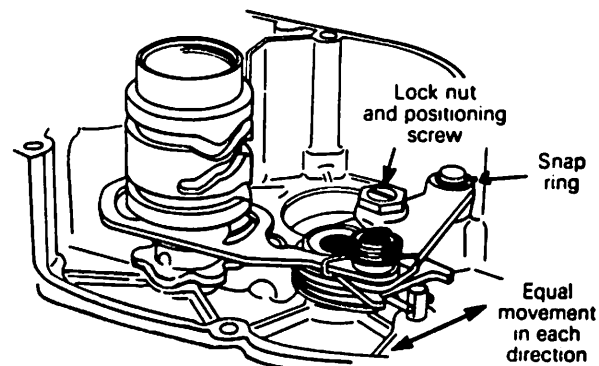
㉓㉔㉕ Assemble the spring, thrust washer and actuating lever as illustrated.



◆ **WARNING:** Exercise care when removing or installing the actuating lever spring.

㉖㉗㉘ To adjust shifter drum pawl assembly proceed as follows. Position shift drum ass'y in 2nd gear or above to obtain an even travel at the actuating lever.

Then with the shift shaft in position, gently move shift lever in each direction from the middle position until shifter pawl contacts the shifter drum pin and note the amount of movement in each direction at the actuating lever.



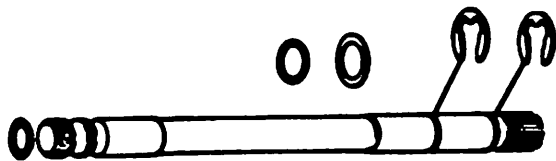
Movement in both direction must be equal. If not, the pawl ass'y can be repositioned by unlocking the lock nut and adjusting the pawl positioning screw. Lock the nut and verify. Repeat until the travel is equal on both sides.

SECTION 02 ENGINE SUB-SECTION 03 (ENGINE/TRANSMISSION)

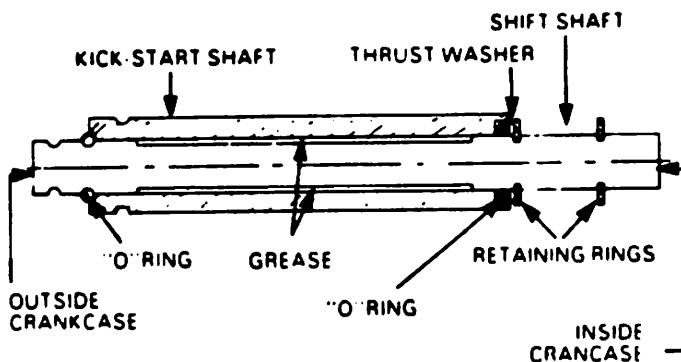
When final adjustment has been reached, apply Loctite no. 242 blue (medium strength) on the lock nut threads and torque to 27-29 N•m (20-22 ft-lbs).

▼ **CAUTION:** At the removal of the pawl ass'y take care not to overspread the snap ring. Prior to assembly, make sure to reclose snap ring gap.

①②③④⑤ At assembly, position the retaining rings, thrust washers and "O" rings as illustrated

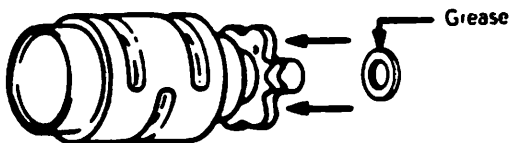


Coat the shift shaft with grease



⑦ At assembly, torque to 11 N•m (8 ft-lbs).

⑨⑩ At re-assembly it is recommended to coat the shift drum washer with grease, this will allow the washer to stick on the shift drum for ease of installation. (If applicable)



Hold the index lever (in crankcase) fully open while inserting the shift drum in place

⑪⑫⑬ At assembly, properly position the spring end into the index lever and crankcase hole.

▼ **CAUTION:** Ensure that the index snap ring is well seated in its groove.



⑮ Heat is needed to remove or install the main shaft bearing into the sprocket side.

▼ **CAUTION:** Always apply heat to remove or install a bearing in the crankcase. Failure to apply heat may result in metal being drawn out of the bearing to crankcase contact surface, thus causing a loose fit within the crankcase.

Proceed as follows

◆ **WARNING:** Engines have magnesium crankcase. Magnesium must be heated with great care.

Disassembly

Using a butane torch with a large soft flame, heat the outside crankcase bearing embossment with 4 to 5 rapid circular passes

Drift the bearing out with an appropriate pusher and soft faced hammer.

Reassembly

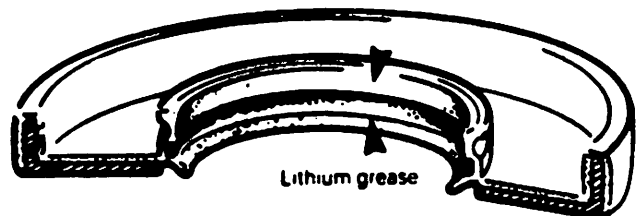
Grease the sprocket side main shaft seal with lithium grease

Cut a 50 mm (2") diameter disc out of asbestos material. Place the disc over the seal to protect it from the flame

Heat the crankcase bearing embossment as described above

Quickly turn the crankcase half over and drift the bearing into the crankcase using a soft hammer and an appropriate pusher.

⑭ To install a new seal, use the appropriate seal insertion pusher. (See tool section). Apply a light coat of lithium grease on the seal lip

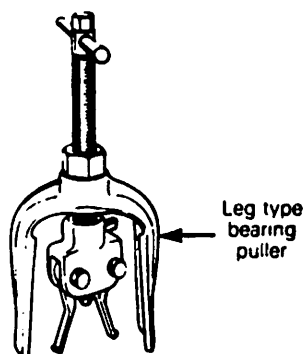


○ **NOTE:** The seal can only be replaced with the main shaft bearing removed.

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

59 Heat and a leg type puller is needed to remove the clutch shaft bearing from sprocket side crankcase.



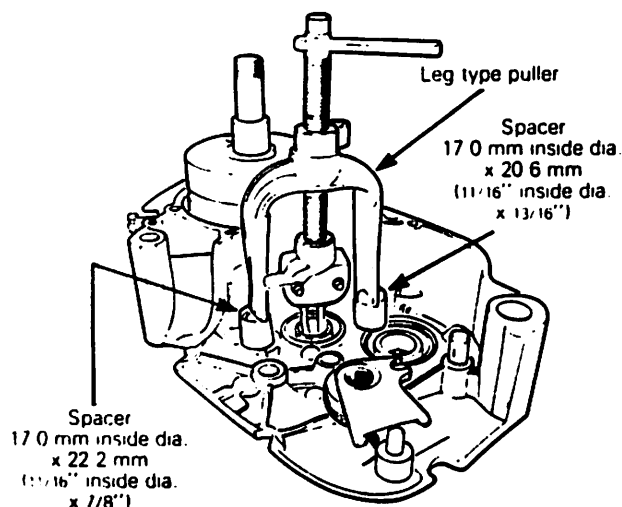
CAUTION: Always apply heat to remove or install a bearing in the crankcase. Failure to apply heat may result in metal being drawn out of the bearing to crankcase contact surface, thus causing a loose fit in the crankcase.

Proceed as follows:

WARNING: Engines have magnesium crankcase. Magnesium must be heated with great care.

Disassembly

Install the puller as illustrated.



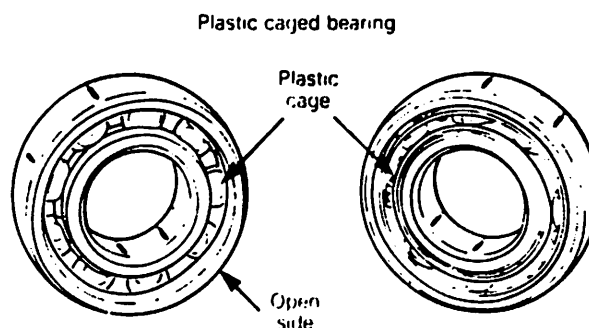
NOTE: Two cylindrical spacers are needed to properly position the puller in the crankcase.

Using a butane torch with a large **soft** flame, heat around the crankcase clutch shaft bearing area with 4 to 5 rapid circular passes, then extract the bearing.

Reassembly

Heat around the crankcase bearing area as described above and quickly drift the bearing into the crankcase using a **soft** hammer:

NOTE: If a plastic caged bearing is installed, always place the open side facing the inside of the crankcase.



60 61 Heat is needed to remove or install the clutch and main shaft bearings in the clutch side crankcase.

CAUTION: Always apply heat to remove or install a bearing in the crankcase. Failure to apply heat may result in metal being drawn out of the bearing to crankcase contact surface, thus causing a loose fit in the crankcase.

Proceed as follows:

WARNING: Engines have magnesium crankcase. Magnesium must be heated with great care.

Disassembly

Remove the bearing retaining plate and shim(s).

Using a butane torch with a large **soft** flame, heat the crankcase (inside portion) around the bearing area with 4 to 5 rapid circular passes.

Drift the bearing(s) out with an appropriate pusher and soft hammer.

Reassembly

Install the bearings retaining plate without shim(s).

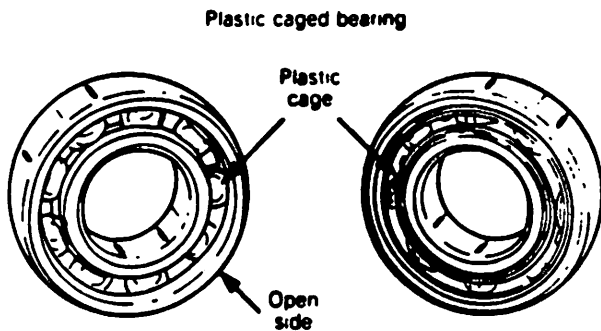
Heat the crankcase (inside portion) as described above.

Quickly drift the bearing(s) into the crankcase using a soft hammer, until the bearing(s) seats against the bearing retaining plate.

SECTION 02 ENGINE

SUB-SECTION 03 (ENGINE/TRANSMISSION)

○ **NOTE:** If plastic caged bearings are installed, always place the clutch shaft bearing with the open side facing the inside of the crankcase and the main shaft bearing with the open side facing the outside of the crankcase.



Remove the bearing retaining plate and verify the end play

⑤⑤ The transmission shaft end-play must be 0.1 mm (.004") maximum

Proceed as follows to verify the end-play

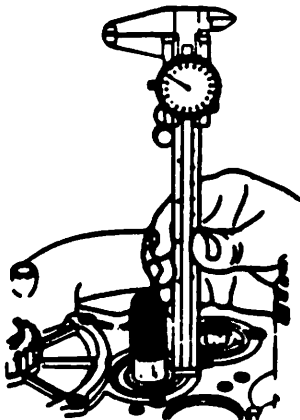
Remove the bearing(s) retaining plate and shims

Tap both clutch and main shafts towards the sprocket side crankcase

Tap both bearing inner races towards the sprocket side crankcase

Measure the distance between the bearing outer race and the crankcase surface to determine the shims required between the bearing and the retaining plate

The end-play must be 0.1 mm (.004") maximum.



▼ **CAUTION:** If transmission shimming is too tight, transmission binding and excessive friction will occur.

⑤ At assembly, apply Loctite no. 242 blue (medium strength) on the retaining screw threads and torque to 4-5.5 N·m (3-4 ft-lbs)

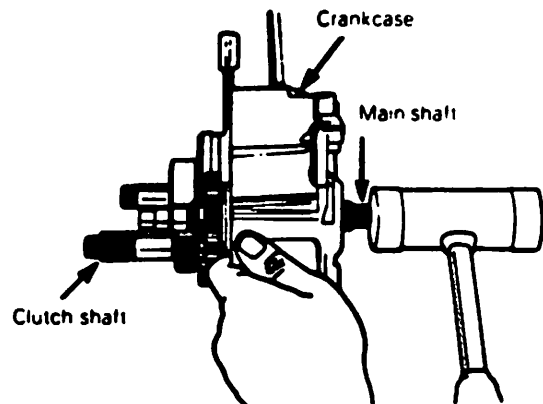
⑦ At assembly, torque the kick starter stop screw to 34-40 N·m (25-29 ft-lbs).

○ **NOTE:** After assembly, do not remove the kick starter stop screw unless needed otherwise the kick starter spring will lose its preload and the removal of the clutch cover will be necessary to repreload the spring

TRANSMISSION GEAR CLUSTER

Disassembly

To remove the clutch and main shaft gear cluster from the crankcase, tap on the sprocket side end of the main shaft



○ **NOTE:** To ease the clutch shaft removal, turn the clutch shaft manually while at the same time hitting the main shaft.

SECTION 02 ENGINE

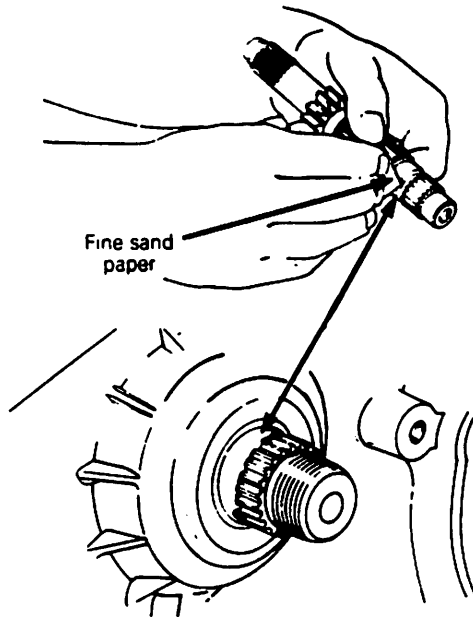
SUB-SECTION 03 (ENGINE/TRANSMISSION)

Reassembly

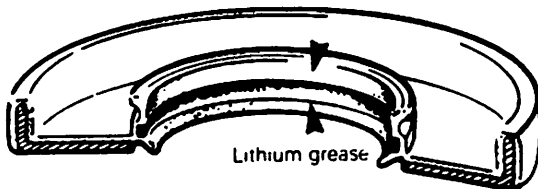
Proceed as follows:

○ **NOTE:** To prevent the seal lip from flipping over while inserting the main shaft:

- Remove the mainshaft sharp edge.

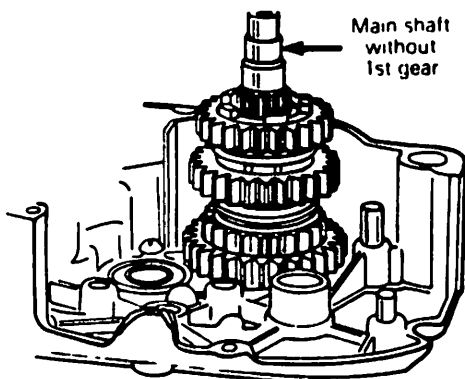


- Apply a liberal amount of grease on the seal lip.



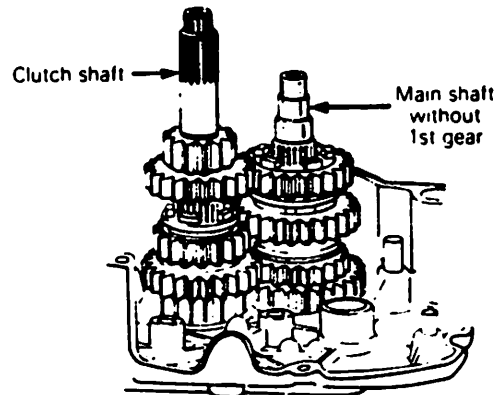
- Ensure to rotate the main shaft at installation.

Step 1 position the main shaft as illustrated tap gently without pushing completely the shaft into the bearing (to ease the clutch shaft installation).

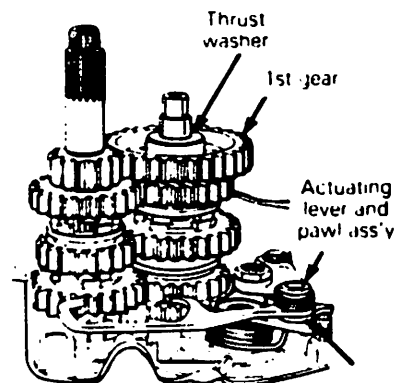


Step 2 position the clutch shaft as illustrated, tap gently to push the shaft into the bearing, while turning the main shaft manually, completely seat both shafts.

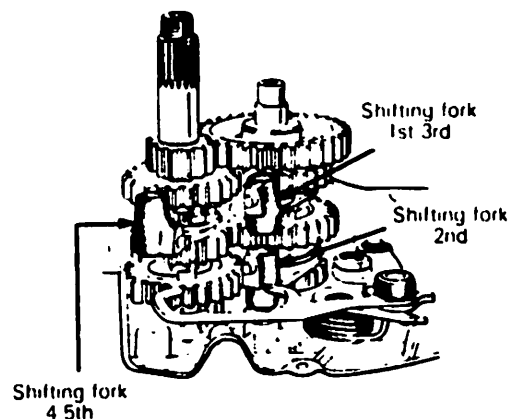
▼ **CAUTION:** Prior to pushing the clutch shaft into the bearing, make sure the gears match one another.



Step 3 position the thrust washer, needle bearing, first gear and thrust washer, and then the actuating lever and pawl ass'y as illustrated.



Step 4 position the shifting forks as illustrated.



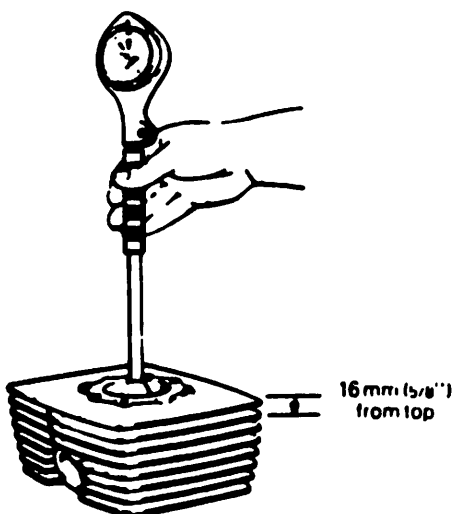
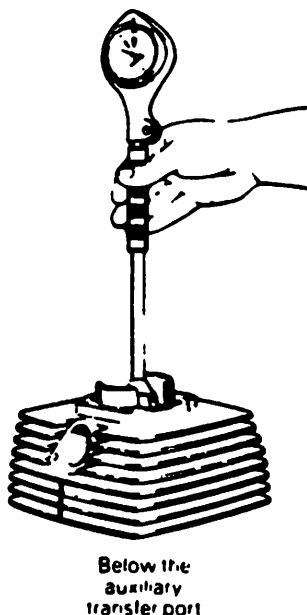
ENGINE TOLERANCES MEASUREMENTS

CYLINDER TAPER

Maximum: 0.08 mm (.003")

Compare cylinder diameter 16 mm (5/8") from top of cylinder with down to just below auxiliary transfer port, facing exhaust port

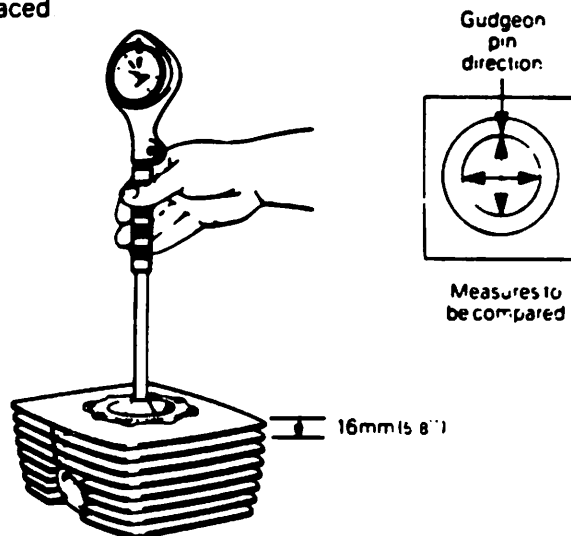
If the difference exceeds 0.08 mm (.003") the cylinder should be rebores and honed or the cylinder sleeve should be replaced



CYLINDER OUT OF ROUND

Maximum: 0.05 mm (.002")

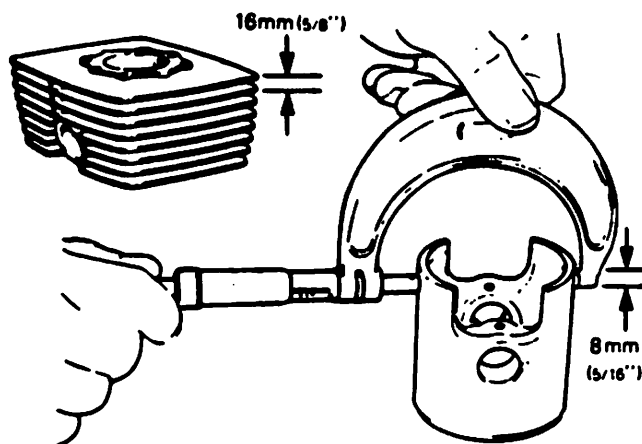
Measuring 16 mm (5/8") from top of cylinder with a cylinder gauge, check if the cylinder out of round is more than 0.05 mm (.002"). If larger, cylinder should be rebores and honed or the cylinder sleeve should be replaced



PISTON TO CYLINDER WALL CLEARANCE

Accurate measurement

To determine piston to wall clearance, the piston should be measured 8 mm (5/16") above its bottom edge and the cylinder should be measured 16 mm (5/8") below its top edge.



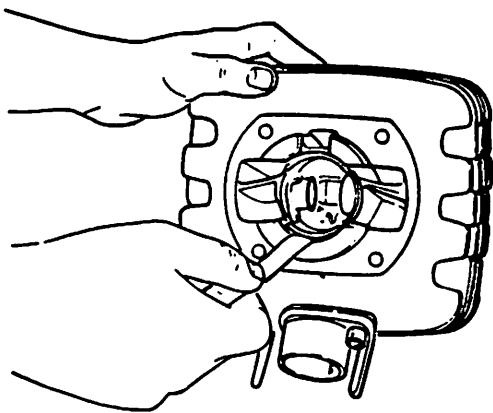
The difference between these two measurements should be within specified tolerance.

SECTION 02 ENGINE

SUB-SECTION 04 (ENGINE TOLERANCES MEASUREMENTS)

Quick measurement

Place cylinder upside down on a work-bench and press a feeler gauge against the cylinder wall (intake side) while trying to insert the piston without any ring in its usual position.

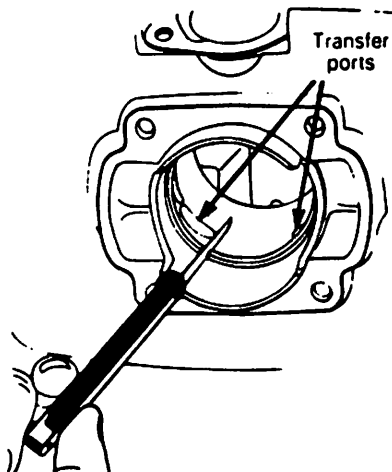


The thickest possible to use feeler gauge will determine the piston to wall clearance.

RING END GAP

Position ring under the transfer ports. Using a feeler gauge, check ring end gap. If gap exceeds specified tolerance the ring should be replaced.

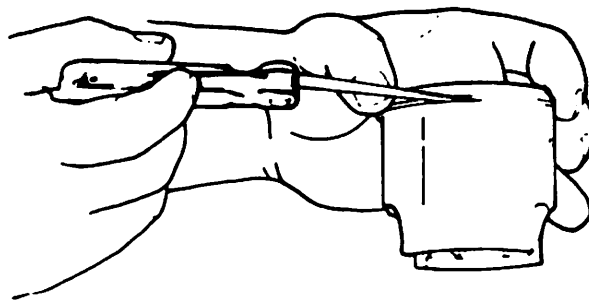
NOTE: In order to correctly position the ring in the cylinder, use the piston as a pusher.



PISTON "R" RING/GROOVE CLEARANCE (QUALIFIER MODELS)

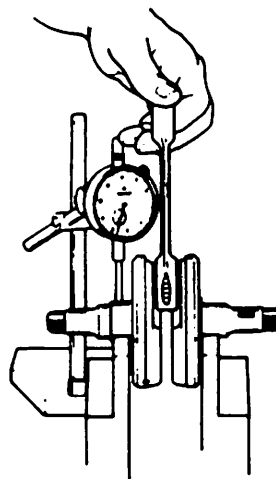
Maximum: 0.20 mm (.008")

Using a feeler gauge check clearance between rectangular ring and groove. If clearance exceeds 0.20 mm (.008"), replace piston.

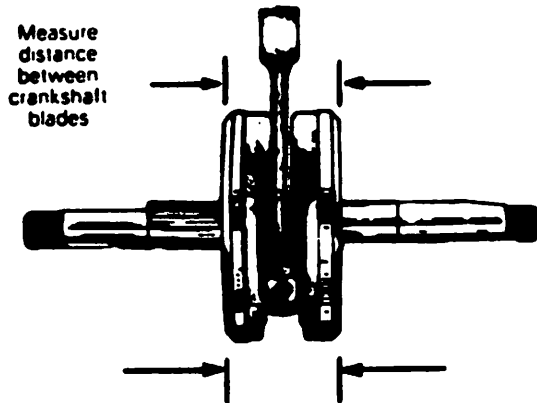


CRANKSHAFT EXCENTRICITY

If possible, mount the bearings on the crankshaft and install it on two crankshaft supporting blocks, install a dial indicator as close as possible to crankshaft blade (or bearing) then rotate the crankshaft and measure the deflection on each side. If deflection exceed 0.05 mm (.002") the crankshaft should be repaired by a specialized shop or it should be replaced.



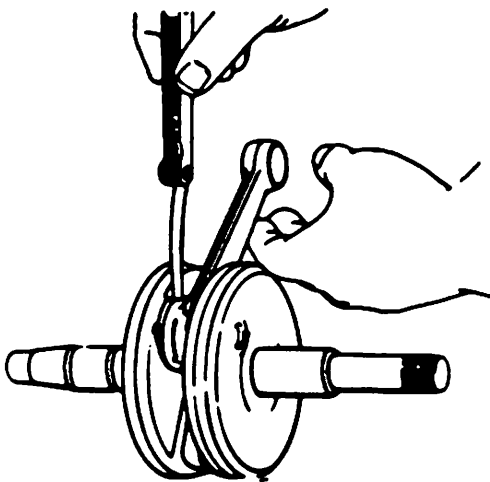
CRANKSHAFT BLADE WIDTH



The distance between the two points must be equal.

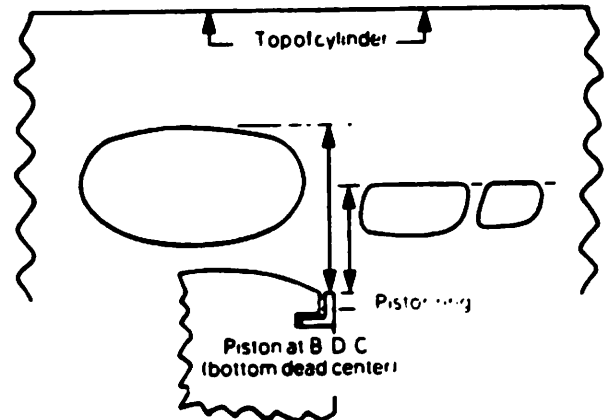
CONNECTING ROD BIG END AXIAL PLAY

Using a feeler gauge measure distance between connecting rod and thrust washer. If axial play exceeds wear limit the crankshaft should be rebuilt or replaced.

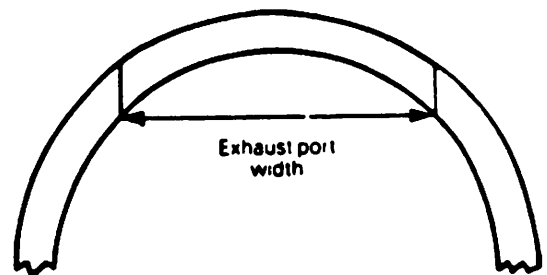


PORT HEIGHT MEASUREMENT

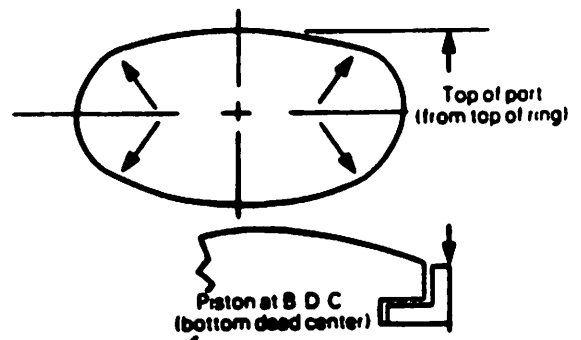
Port heights are measured on the inside diameter of the cylinder and are taken from the top of the piston ring with the piston at bottom dead center (BDC).



The exhaust port width is measured in a straight line from edge to edge (Not around the cylinder wall)



The height and width specifications do not include port radius or edge chamfer.



The port shape must be approximately as shown to prevent piston ring breakage. The radius in each "Corner" guides the piston ring back into place as the piston travels past the port.

SECTION 02 ENGINE

SUB-SECTION 04 (ENGINE TOLERANCES MEASUREMENTS)

ROTARY VALVE TIMING

The rotary valve controls the opening and closing of the intake port, therefore, its installation position is critical toward efficient operation.

For example, an engine with the following specifications:

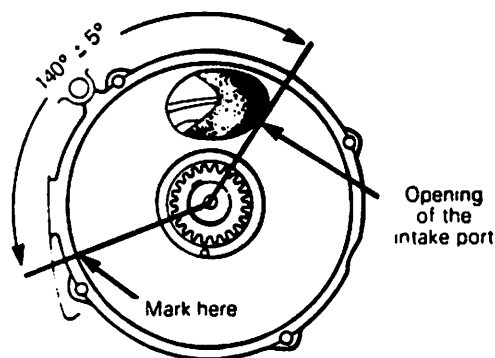
Disc opening at 140° B.T.D.C.

Disc closing at 85° A.T.D.C.

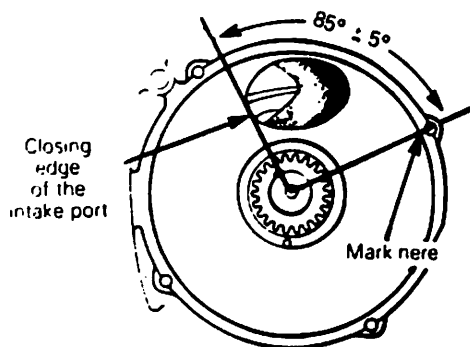
Disc is asymmetrical.

Proceed as follows:

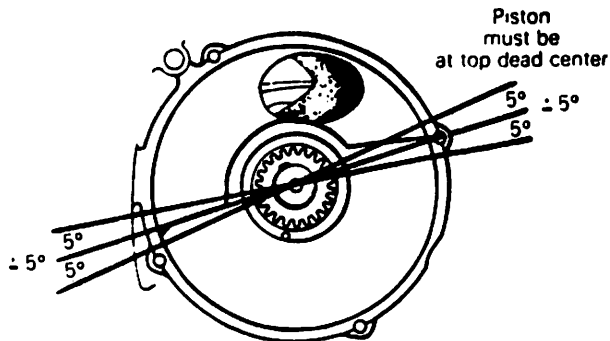
Using a degree wheel, mark 140° after the opening of the intake port. (Degrees follow a counter-clockwise direction).



From the closing edge of the intake port, mark 85° (degrees follow a clockwise direction).



Using a dial indicator, place the piston at top dead center to have the edges of the disc as close as possible to the marks. If the edges do not align exactly, make sure the error is subdivided equally on either side of the marks. The maximum tolerance is 5° on either side of the marks.



SQUISH AREA MEASUREMENT/COMPRESSION RATIO

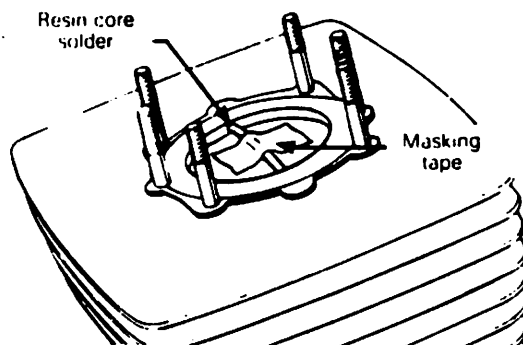
Squish area

In a criss-cross sequence, gradually remove the cylinder head nuts, then remove the head. Note the head shim/s used, (if any).

Bring the piston to $1/4''$ B.T.D.C. and place a length of soft resin core solder (maximum of $1/8''$ diameter) across the piston, making sure it is positioned parallel to the wrist pin to obtain an equal reading on each side of the cylinder.

CAUTION: Do not use acid core solder, the acid can damage the piston and cylinder wall.

NOTE: To hold the resin core solder in place, clean the piston surface and use masking tape.

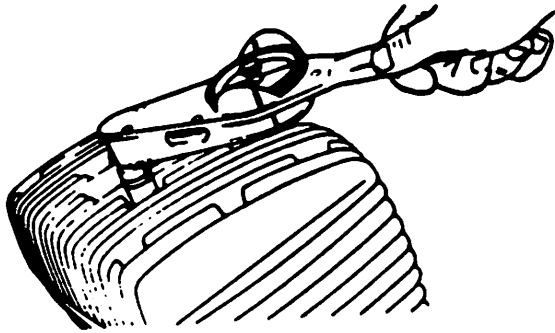


SECTION 02 ENGINE

SUB-SECTION 04 (ENGINE TOLERANCES MEASUREMENTS)

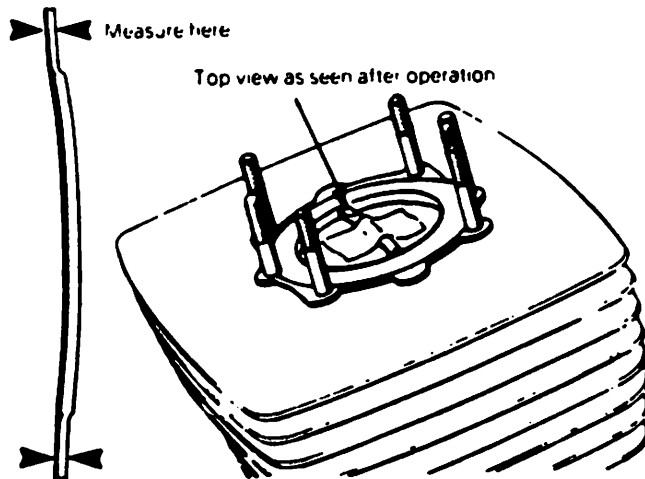
Install the cylinder head and using a criss-cross sequence, gradually torque the cylinder head nuts to the correct specifications:

244- 19 N•m (14 ft-lbs)
406 40 N•m (30 ft-lbs)



Using the magneto side crankshaft nut, rotate the crankshaft in order for the piston to pass the T D C. point

Remove the head, remove the resin core solder and measure both ends



Using this measurement, calculate the required head shim(s) needed to provide the specified squish area.

○ **NOTE:** The head shim is not a head gasket and does not need replacement unless damaged.

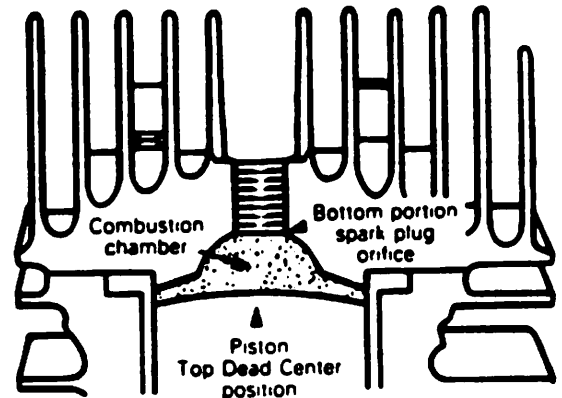
Fit the necessary shim/s (if required) and, using a criss-cross sequence, gradually torque the head nuts to the correct torque.

▼ **CAUTION:** It is imperative to check the compression ratio after the squish has been corrected.

COMPRESSION RATIO

To check the compression ratio, bring the piston to the top dead center position and pour a given amount (see chart) of oil (30 grade) into the combustion chamber through the spark plug orifice.


The compression ratio will be correct, when the specific given amount of oil fills the combustion chamber up to the bottom portion of the spark plug orifice



MODEL	REQUIRED VOLUME OF OIL (mL) (30 grade)	NOMINAL COMPRESSION RATIO
250 ATK	21.6 ± 1.0	12-13 to 1
400 ATK	40.7 ± 2.0	10.3-11.3 to 1
125	8.5 ± 0.3	15-16 to 1
250	20.0 ± 0.8	13-14 to 1
400	36.3 ± 1.7	11.5-12.5 to 1

SECTION 02 ENGINE

SUB-SECTION 04 (ENGINE TOLERANCES MEASUREMENTS)

 **CAUTION:** To carry out some of the following procedures, it is necessary that special equipment be available. If you do not possess such equipment, have the cylinder head modified in a work-shop equipped with a proper tooling.

POSSIBILITY CHART

SQUISH TOO SMALL

Compression ratio OK	Machine the squish angle to correct squish, then machine the flat surface of the cylinder head to correct the compression and re-verify the squish.
Compression ratio too high	Add shim/s.

SQUISH TOO LARGE

Compression ratio OK	Machine flat surface of cylinder head to correct the squish and then machine the radius of the combustion chamber to correct the compression ratio.
Compression ratio too low	Remove the shim/s (if any) or machine flat surface of cylinder head to correct squish and verify compression ratio.
Compression ratio too high	Remove the shim/s (if any) to correct squish or machine flat surface of the cylinder head to correct squish and then machine the radius of the combustion chamber to correct the compression ratio.

SQUISH OK

Compression ratio too low	Remove the shim/s (if any) to correct the compression or machine the flat surface of the cylinder head to correct the compression and then machine the squish angle to re-correct the squish and re-verify the compression ratio.
Compression ratio too high	Machine the radius of the combustion chamber to correct the compression ratio.

COMPRESSION RATIO OK

Squish too small	Machine the squish angle to correct squish then machine the flat surface of the cylinder head to correct the compression and re-verify the squish.
Squish too large	Remove the shim/s (if any) or machine the flat surface of cylinder head to correct the squish then machine the radius of the combustion chamber to correct the compression ratio.

SECTION 02 ENGINE

SUB-SECTION 04 (ENGINE TOLERANCES MEASUREMENTS)

COMPRESSION RATIO TOO HIGH

Squish too small	Add shim/s and verify the compression ratio.
Squish OK	Machine the radius of the combustion chamber to correct the compression.
Squish too large	Remove shim/s (if any) or machine the flat surface of the cylinder head to correct squish area then machine the radius of the combustion chamber to correct the compression.

COMPRESSION RATIO TOO LOW

Squish too small	Remove the shim/s (if any) to correct the compression or machine the flat surface of the cylinder head to correct the compression ratio and then machine the squish angle to correct the squish, re-verify the compression ratio.
Squish too large	Remove the shim/s (if any) or machine the flat surface of the cylinder head to correct the squish and verify compression ratio
Squish OK	Machine the flat surface of the cylinder head to correct the compression and then machine the squish angle to re-correct the squish

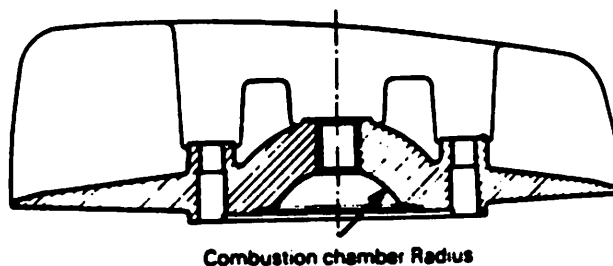
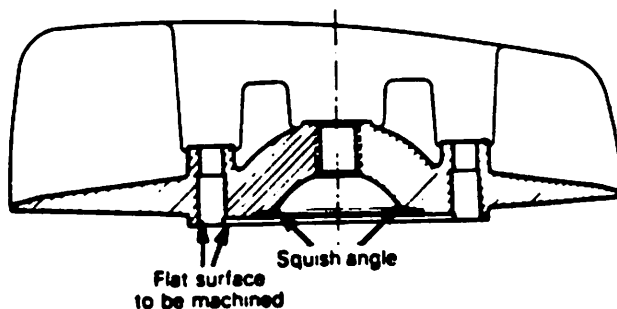
CAUTION: It is very difficult to pre-determine the amount of material to remove from the cylinder head anytime the squish and/or compression ratio needs to be modified, so, when machining is required, we recommend very light cuts and verify the results between each cut.

SQUISH ANGLE	
250	12°
400	N.A.

N.A.: Not applicable

COMBUSTION CHAMBER RADIUS	
250 ATK	27 mm
400 ATK	63.2 mm
125 MX	44 mm
250 MX	31.5 mm
400 MX	63.2 mm

CAUTION: Squish area and compression ratio are interrelated, do not modify one without checking the other.



SECTION 02 ENGINE
SUB-SECTION 06 (TECHNICAL DATA)

POWER HEAD				
	STANDARD	FIRST OVERSIZED	SECOND OVERSIZED	THIRD OVERSIZED
Cylinder bore (nominal dimension)				
124	54 mm (2.125")	54.25 mm (2.135")	54.50 mm (2.145")	54.75 mm (2.155")
174	62 mm (2.440")	62.25 mm (2.450")	62.50 mm (2.460")	62.75 mm (2.470")
244	72 mm (2.834")	72.25 mm (2.844")	72.50 mm (2.854")	not available
281	76 mm (2.992")	76.25 mm (3.002")	76.50 mm (3.012")	not available
406	84 mm (3.307")	84.25 mm (3.317")	84.50 mm (3.327")	not available
		WHEN FITTING NEW PARTS		
		MINIMUM	MAXIMUM	WEAR LIMIT
Piston to cylinder wall clearance				
124-174		0.060 mm (.002")	0.085 mm (.003")	0.14 mm (.006")
244-281-406		0.070 mm (.003")	0.090 mm (.0035")	0.18 mm (.007")
Piston ring end gap				
124		0.15 mm (.006")	0.30 mm (.011")	0.8 mm (.031")
174-244		0.20 mm (.008")	0.35 mm (.014")	1.0 mm (.039")
281-406		0.25 mm (.010")	0.40 mm (.016")	1.2 mm (.047")
Squish area measurement				
124		not applicable		
174		1.2 mm (.047")	1.6 mm (.062")	
244 (MX)		1.4 mm (.055")	1.8 mm (.070")	
244		1.8 mm (.070")	2.2 mm (.086")	
281		1.7 mm (.066")	2.1 mm (.082")	
406		not applicable		
Compression ratio (uncorrected)				
124		15 to 1	16 to 1	
174		13.2 to 1	14.2 to 1	
244 (MX)		13 to 1	14 to 1	
244 ATK		12 to 1	13 to 1	
281		12 to 1	13 to 1	
406 (MX)		11.4 to 1	12.4 to 1	
406 ATK		10.3 to 1	11.3 to 1	

SECTION 02 ENGINE
SUB-SECTION 05 (TECHNICAL DATA)

	WHEN FITTING NEW PARTS		WEAR LIMIT
	MINIMUM	MAXIMUM	
Exhaust port height 124 174 244 281 406 (MX) 406 ATK	13 mm (.530") 27 mm (1.063") 30 mm (1.181") 30 mm (1.181") 34 mm (1.338") 34 mm (1.338")		
Exhaust port width 124-174 244-281 406	40 mm (1.575") 52 mm (2.047") 55 mm (2.165")		
Transfer port height 124 174 244-281 406	13 mm (.511") 12.8 mm (.504") 15 mm (.590") 17.5 mm (.688")		
Rotary valve disc opens BTDC 244 (ATK) 88 174-244-281 406	140° 137° not applicable		
Rotary valve disc closes ATDC 244 (ATK) 88 174-244-281 406	85° 75° not applicable		
Cylinder sleeve outside diameter 124 174 244 281 406	59.124 mm (2.327") 68.1 mm (2.681") 79.12 mm (3.115") 82.124 mm (3.233") 90.126 mm (3.548")	68.121 mm (2.682") 79.14 mm (3.116") 90.146 mm (3.549")	

WHEN FITTING NEW PARTS		
WEAR LIMIT	MINIMUM	MAXIMUM
Cylinder inside dia. (without sleeve)	124 174 244 281 406 59 mm (2.32") 68 mm (2.67") 79 mm (3.11") 82 mm (3.22") 90 mm (3.54")	124 174 244 281 406 68.03 mm (2.678") 79.035 mm (3.111") 90.035 mm (3.544")
Cylinder/sleeve interference fit	124 174 244 281 406 0.124 mm (.0048") 0.072 mm (.003") 0.101 mm (.004") 0.124 mm (.0048") 0.09 mm (.0035")	124 174 244 281 406 0.121 mm (.005") 0.152 mm (.006") 0.146 mm (.0057")

CRANKSHAFT/CRANKCASE			
Crankshaft end play	0.1 mm (.004")	0.3 mm (.012")	
Crankshaft eccentricity		0.05 mm (.002")	0.1 mm (.004")
Crankshaft blade width (nominal)	124 174 244-281 406		
Connecting rod side play in crankshaft	406 124-174-244-281		
Crankpin interference fit	124-174-244-281-406		
Connecting rod to crankpin clearance	406 124-174-244-281		

SECTION 02 ENGINE

SUB-SECTION 05 (TECHNICAL DATA)

	WHEN FITTING NEW PARTS		WEAR LIMIT
	MINIMUM	MAXIMUM	
Connecting rod to piston pin radial clearance 124-174-244-281-406		0.01 mm (.0004")	0.03 mm (.001")
Piston pin outside diameter	18 mm (.7086")		17.98 mm (.7078")
Depth of groove caused by crankshaft seals			0.1 mm (.004")
Ball bearings clearances (all axial)			0.1 mm (.004")
Ball bearings clearances (all radial)			0.05 mm (.002")
Crankshaft balance factor 124-174 244-281 406	50% 50% 50%		
Clearance between bearing and polyamid ring			0.02 mm (.001")
Disc valve rotational play 124-174-244-281 406			1.0 mm (.039") not applicable

CLUTCH			
Radial clearance of clutch drum needle bearing			0.05 mm (.002")
Rotational play between slots of clutch drum and friction plate area			2.0 mm (.078")
Rotational play between the splines of clutch hub and the teeth of driven plate			1.0 mm (.039")
Thickness of friction plate 124-174-244-281 406	3.4 mm (.133") 2.9 mm (.114")	3.6 mm (.141") 3.1 mm (.122")	3.2 mm (.125") 2.7 mm (.106")

TRANSMISSION			
Needle bearing radial play			0.08 mm (.003")
Axial clearance between shift fork and groove in gear			0.07 mm (.003")

SECTION 02 ENGINE
SUB-SECTION 05 (TECHNICAL DATA)

	WHEN FITTING NEW PARTS		LIMITE
	MINIMUM	MAXIMUM	
Axial clearance between pin of shift forks and groove in shift drum (Measured with shifter drum indexed in each gear except neutral)			0.3 mm (.011")
Main shaft end play		0.1 mm (.004")	
Clutch shaft end play		0.1 mm (.004")	
Shifter shaft end play	0.03 mm (.001")	1.18 mm (.046")	
Shifter drum end play		0.47 mm (.018")	
Kick starter shaft end play	0.02 mm (.0007")	0.74 mm (.029")	
Shifter shaft radial clearance	0.127 mm (.005")	0.152 mm (.006")	

SECTION 03 ELECTRICAL

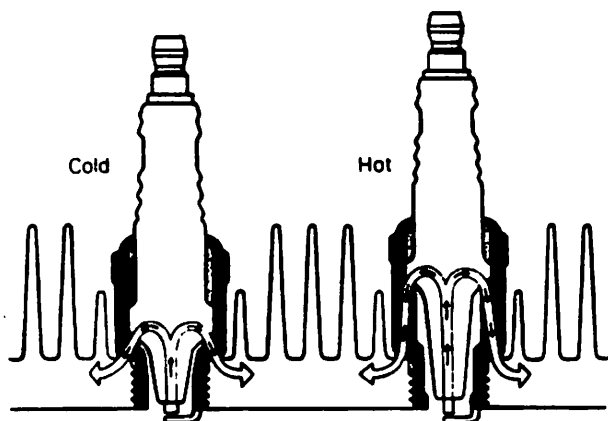
SUB-SECTION 05 (SPARK PLUG)

Difference between a "cold" and a "hot" spark plug:

A "cold" type plug has a relatively short insulator nose and transfers heat very rapidly into the cylinder head.

Such a plug is used in heavy duty or continuous high speed operation to avoid overheating.

The "hot" type plug has a longer insulator nose and transfers heat more slowly away from its firing end. It runs hotter and burns off combustion deposits which might tend to foul the plug during prolonged idle or low speed operation.



CAUTION: Severe engine damage can occur if a wrong heat range plug is used:

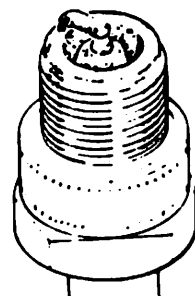
A too "hot" plug will result in overheating and re-hot points pre-ignition, etc.

A too "cold" plug will result in fouling (shorting the spark) or may create carbon build up which can heat up red-hot and cause pre-ignition or detonation.

SPARK PLUG ANALYSIS

The plug face reveals the condition of the engine, operating condition, method of driving, and fuel mixture. For this reason it is advisable to inspect the spark plug at regular intervals, examining in particular the plug face (i.e. the part of the plug projecting into the combustion chamber). The plug face generally reveals any trouble symptoms.

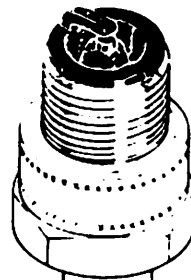
A brownish tip reflects ideal conditions.



Normal
(brownish)

A black insulator tip indicates fouling caused by:

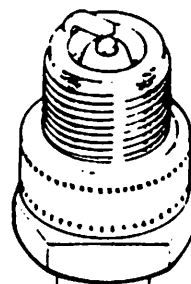
- fuel/oil mixture too rich
- dirty air cleaner element
- wrong spark plug heat range (too cold)
- fuel/air mixture too rich, wrong jetting
- weak or faulty ignition system.



Fouled
(black)

A light gray, ash white insulator tip indicates a lean mixture caused by:

- advanced ignition timing
- insufficient lubrication
- clogged carburetor jets or lean jetting
- wrong spark plug heat range
- spark plug loose in head or no gasket fitted
- leaking seal or gasket.



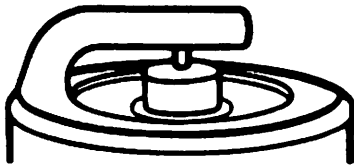
Overheated
(light grey)

SECTION 03 ELECTRICAL

SUB-SECTION 05 (SPARK PLUG)

Lead or carbon particles wedged or fused between the electrodes are caused by:

- excessive carbon in cylinder
- brand of fuel or oil
- dirt particles entering through the carburetor with the air flow
- improper ratio of fuel/oil mixture.



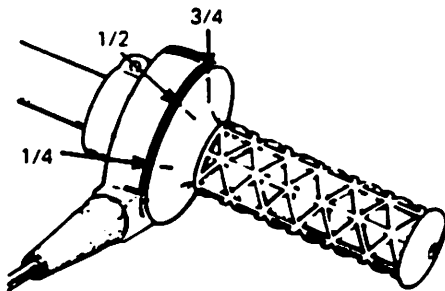
Gap binding

Spark plug check procedure

The reading of the spark plug face is the best method to find the good spark plug heat range or to achieve correct carburetor jetting.

Proceed as follows to check the carburetor jetting.

Mark the throttle twist grip and the twist grip body to indicate 1/4, 1/2, 3/4 throttle opening:



CAUTION: It is best to start test with standard jetting or slightly richer to ensure engine protection.

Install a brand new spark plug and run the motorcycle along a level 1 mile open road, at a steady 1/4 throttle opening. At the end of the 1 mile pull the clutch lever in while readily stopping the engine using the kill switch.

Remove the spark plug and perform a plug reading.

If the plug reads lean, fit a larger idle jet; if the plug reads rich, fit a smaller idle jet.

NOTE: It is important to readily stop the engine at the end of a steady throttle opening test to have an accurate plug reading.

Variable throttle opening and prolonged idle period alter the readings.

NOTE: To obtain a very accurate reading, a brand new spark plug should be installed before each run. The air filter should always be clean and the engine in perfect condition.

Proceed to the 1/2 throttle opening and adjust as necessary.

If the plug reads lean, position the needle clip in a lower groove or install a larger needle jet.

If the plug reads rich, position the needle clip in a higher groove or install a smaller needle jet.

Proceed to the 3/4 full throttle opening and adjust as necessary. If the plug reads rich, fit a smaller main jet.

If the plug reads lean, fit a larger main jet.

CAUTION: Always verify each jetting change by repeating the test before proceeding to the next step.

This chart indicates the range of throttle openings through which each adjustment is effective.	
4	3/4 - Full Opening Main jet size
3	1/4 - 3/4 Opening Needle jet size and needle clip position. Throttle slide cut-away
2	1/8 - 1/4 Opening Idle jet size and air screw adjustment.
1	0 - 1/8 Opening

NOTE: Unless effected by climatic conditions, altitude or special engine modifications, carburation should be left at standard settings.

SPARK PLUG MAINTENANCE/INSTALLATION

Clean the electrodes and the ceramic insulator and wash the plug in gasoline.

WARNING: Gasoline is flammable and explosive under certain conditions. Always use caution and work in a well ventilated area.

Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, set electrode gap to 0.5 mm (.020").
2. Apply a light coat of graphite grease over the spark plug threads to prevent possible seizure.
3. Hand screw spark plug into cylinder head and tighten with a torque wrench.

SECTION 03 . ELECTRICAL

SUB-SECTION 05 (SPARK PLUG)

Torque to: 27 N•m (20 ft-lbs)

○ **NOTE:** A used spark plug needs a lot more voltage to spark than a new one, but when cleaned and re-gapped the voltage needed drops near the specification and the service life of the plug is extended.

OPTIONAL SPARK PLUGS

250 400 models: **Bosch W3CC, Autolite 4053**

▼ **CAUTION:** Use as a guideline only, check spark plug heat range. Due to the different design, material etc., heat ranges vary from one plug manufacturer to another.