

SECTION 5 - ENGINE MECHANICAL

MERCURY
SNOWMOBILES

PART I - 340 T/T and 440 T/T



A BRUNSWICK COMPANY

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340 T/T and 440 T/T

GENERAL

Engine "Disassembly" and "Reassembly" instructions are printed in a sequence that should be followed to assure best results when removing or replacing engine components. If complete disassembly is not necessary, start reassembly at point disassembly was stopped. (Refer to "Index", preceding.)

If major engine repairs are to be performed, remove engine from snowmobile. It is not necessary to remove engine for minor repairs on components, such as flywheel, stator, trigger, fan housing, secondary ignition coils and outer crankshaft oil seals.

An engine repair bracket can be fabricated from angle iron with holes and dimensions as shown in Figure 1. Install repair bracket to mounting plate holes of bottom crankcase half.

Clamp repair bracket and engine in a vise or other suitable holding fixture.

IMPORTANT: Refer to "Specifications" Section 8 for all torque values.

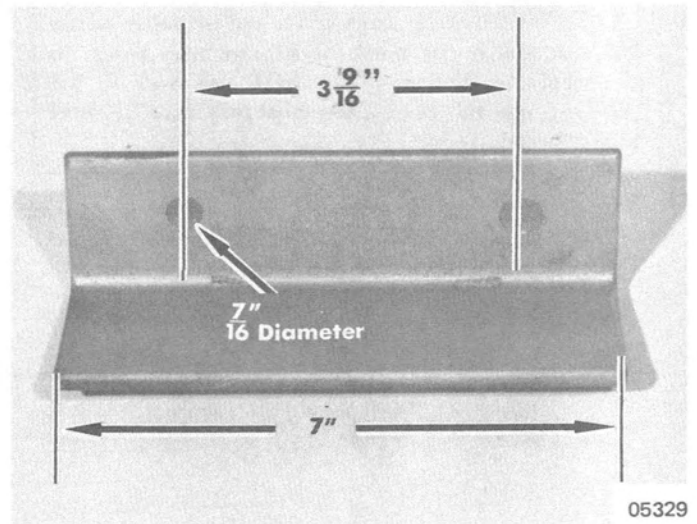


Figure 1. Engine Repair Bracket

ENGINE REMOVAL

1. Remove top cowl assembly from snowmobile.
2. Remove carburetor air intake from engine.
3. Disconnect spark plug high tension wires from spark plugs.
4. Close fuel shut-off valve at fuel tank. Remove carburetors and rubber mounting flanges from engine.

IMPORTANT: Carburetors **MUST BE** kept clean and protected.

5. Disconnect fuel pump pulse hose from crankcase fitting.
6. Disconnect engine harness from chassis harness by separating 3-wire connector. Remove 2 black ground wires from rewind attaching bolt.
7. Remove drive belt guard and drive belt.
8. Disconnect exhaust muffler from engine exhaust manifold by removing retaining springs and separating connection.
9. Remove rewind rope from rope guide that is attached to chaincase.

IMPORTANT: Flywheel should be removed at this time, if repairs being performed will require removal. If flywheel removal is not necessary, refer to "Step 11", following, and remove engine.

Flywheel Removal

10. If necessary, remove flywheel as follows:
 - a. Remove rewind starter assembly from fan housing.
 - b. Remove rewind starter cup, flywheel sheave plates and fan belt from flywheel.
 - c. Straighten tab on flywheel nut tab washer.

NOTE: For ease of removal, an air or electric impact wrench may be used to remove flywheel nut.

WARNING: If an impact wrench is used, **DO NOT** use belt wrench to keep crankshaft from turning. If necessary, hold drive sheave by hand.

- d. Prevent engine crankshaft from rotating by holding drive sheave with Belt Wrench (C-91-24937A1). Remove flywheel nut and tab washer.

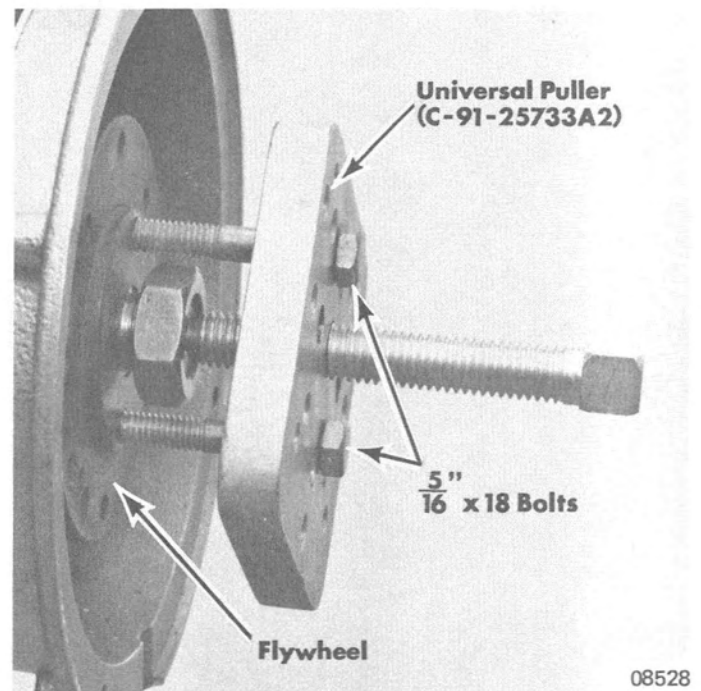


Figure 2. Flywheel Removal

- e. Install modified (refer to template, Section 9) Universal Puller (C-91-25733A2) on flywheel. (Figure 2) Use crankshaft protector or reinstall flywheel nut to protect crankshaft from damage.

CAUTION: Crankshaft damage may result if a protector cap is not used between crankshaft and puller.

- f. Keep engine crankshaft from rotating by holding drive sheave with belt wrench. Tighten center bolt of puller to 50 ft. lbs. (7mkg) maximum.
- g. Using a hammer and hardwood block, tap each side of

CAUTION: DO NOT hammer on end of puller center bolt to remove flywheel, or damage may result to crankshaft or bearings. DO NOT use heat to aid flywheel removal, as excessive heat may seize flywheel to crankshaft.

flywheel alternately (while maintaining torque on center bolt) until flywheel is free. Remove flywheel from crankshaft and puller from flywheel.

- 11. Refer to Section 2, Part C, and remove drive sheave from crankshaft taper.
- 12. Remove locknuts and washers which secure engine mounting plate to engine mounts.
- 13. Lift engine from snowmobile.
- 14. Remove engine mounting plate from crankcase and install engine in suitable holding fixture. Note position of spacers between mounting plate and crankcase.

ENGINE DISASSEMBLY

Fan Housing

REMOVAL

1. Disconnect stator and trigger wires from switch box.
2. If so equipped, disconnect black switch box wire from black engine harness wire by separating "bullet" connector.
3. Remove 4 bolts which secure stator to trigger.

NOTE: The secondary ignition coil housing is secured with 2 allen screws. Removal of top allen screw is not necessary for removal of fan housing.

4. Remove 4 allen screws which secure fan housing to air shroud.
5. Remove nuts and washers which secure fan housing to crankcase studs.
6. Remove fan housing assembly (with secondary ignition coils and switch box) from engine. Remove stator from housing by inserting edge of housing between 2 of the stator poles and pulling stator from housing.

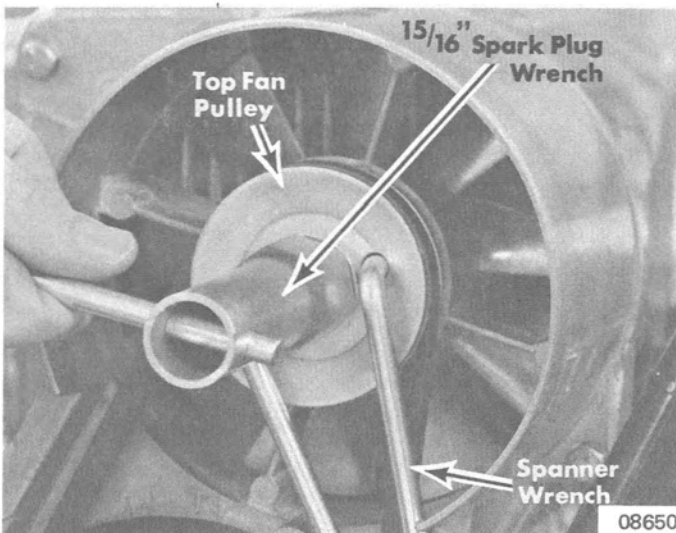


Figure 1. Fan Pulley Disassembly

DISASSEMBLY

1. Using spanner wrench (supplied with manufacturer's tool kit) and 15/16" wrench, remove top fan pulley retaining nut. (Figure 1)
2. Remove flat washer, outer fan pulley half, belt tension shims, inner fan pulley half and flat washer from fan shaft.
3. Remove key from fan shaft keyway.
4. Drive fan shaft from bearings with a leather mallet.
5. DO NOT remove fan bearings, unless bearing failure is evident. If replacement is necessary, press bearings from fan housing with suitable mandrels.

CAUTION: When pressing bearings from fan housing, BE SURE fan housing is properly supported to prevent damaging housing.

CLEANING and INSPECTION

1. Clean and inspect fan blades and fan shaft. Replace fan if blades are cracked or chipped. Replace fan if fan shaft is bent or threads are damaged.

2. Clean and inspect fan housing. Replace housing if broken or cracked, particularly in the area of the fan supports. Check fan bearings for roughness. Replace bearings as necessary.

Cylinder Heads and Cylinders

REMOVAL

1. Remove exhaust manifold from cylinder exhaust pipes.
2. Remove rubber spark plug protectors and spark plugs.
3. Remove 3 allen screws, which secure air shroud, and lift 2 halves of air shroud from engine.
4. Remove cylinder head attaching nuts, lockwashers and flat washers. Lift cylinder heads off cylinder studs. Note positioning of 2 long spacer nuts to which air shroud is attached. Spacer nuts must be reinstalled in same locations during reassembly.
5. Remove and discard cylinder head gaskets.
6. Remove nuts and lockwashers which secure intake plate and intake manifolds to cylinders. Remove plate and manifolds from cylinders.
7. Scribe a mark on each cylinder to indicate which is No. 1 (PTO side) and which is No. 2 (rewind side).
8. Remove nuts, lockwashers and flat washers from thru bolts and studs which secure cylinders to crankcase.

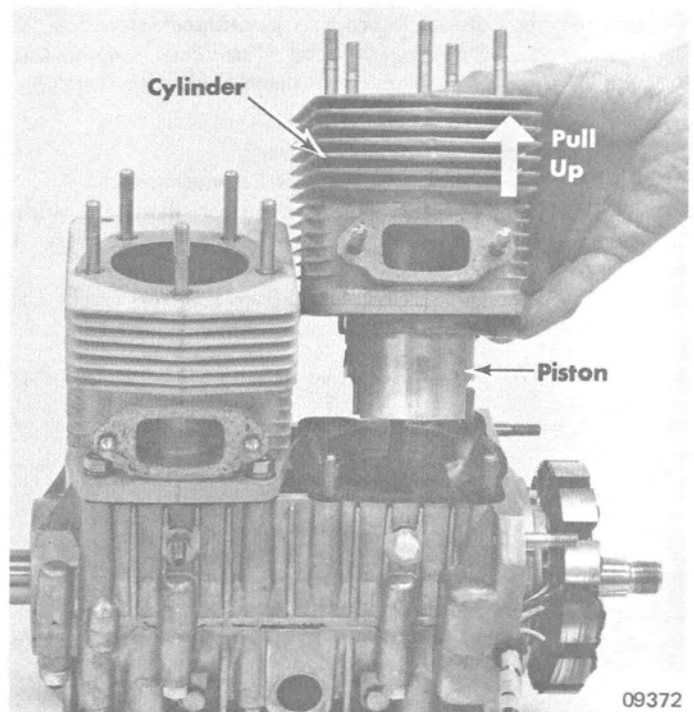


Figure 2. Removing Cylinders

9. Lift cylinders off crankcase and pistons. (Figure 2)
10. Remove and discard cylinder base gaskets.

CLEANING and INSPECTION

1. Thoroughly clean cylinder heads and gasket surfaces. Remove carbon deposits and "varnish" from cylinder heads.

NOTE: Cylinder head(s) should be replaced if badly damaged, or if carbon deposits cannot be removed.

2. Inspect cylinder heads. Check for deep grooves, cracks and distortion which could cause compression leakage.
3. Check spark plug holes for stripped or damaged threads.

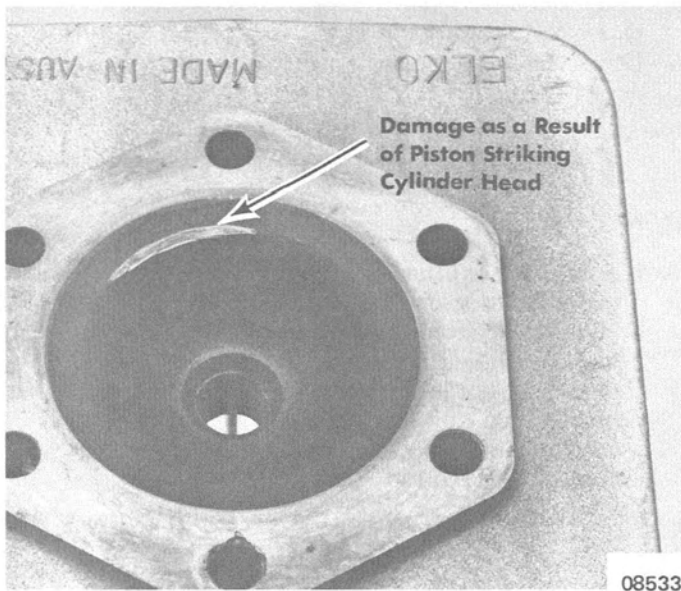


Figure 3. Damaged Cylinder Head

4. Inspect internal surface of cylinder heads for possible damage (as a result of pistons striking cylinder heads). (Figure 3)

NOTE: Piston striking cylinder head could be an indication of a defective or improperly positioned cylinder head, connecting rod bearing(s) failing, "stretched" connecting rod and/or that engine was assembled with improper cylinder gasket(s).

5. Replace cylinder head(s) as necessary.
6. Thoroughly clean cylinders and gasket mating surfaces.
7. Check cylinder studs for stripped or damaged studs. Replace damaged studs and secure with Loctite Type A (C-92-32609).
8. Check gasket surfaces for nicks, deep grooves, cracks and distortion which could cause compression leakage.

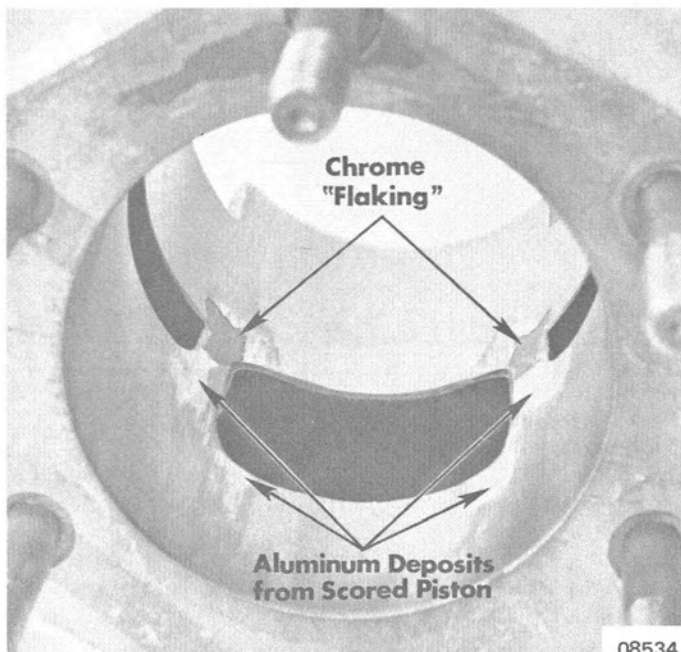


Figure 4. Chrome "Flaking"

9. Carefully inspect cylinder bores for signs of scoring, "flaking" (Figure 4) and grooves. If chrome surfacing is "flaking", grooved, scratched or worn thru, cylinder must be replaced.

IMPORTANT: Cylinder bores are surfaced with chrome. If chrome surfacing is "flaking" (Figure 4), grooved or damaged in any other manner, cylinder(s) must be replaced. If pistons have scored and transferred aluminum to cylinder bores, honing usually will "clean up" the cylinder bores.

10. Refer to "Cylinder Honing Procedure", following, and hone cylinder bores.
11. Carefully inspect cylinder bores for scratches, grooves or aluminum deposits which honing did not remove. Replace cylinder(s) as necessary.

Cylinder Honing Procedure

IMPORTANT: ALWAYS hone cylinder bores before installation. Honing of chrome cylinders is intended only as a method for removal of metal which has transferred from pistons and piston rings to cylinder bores.

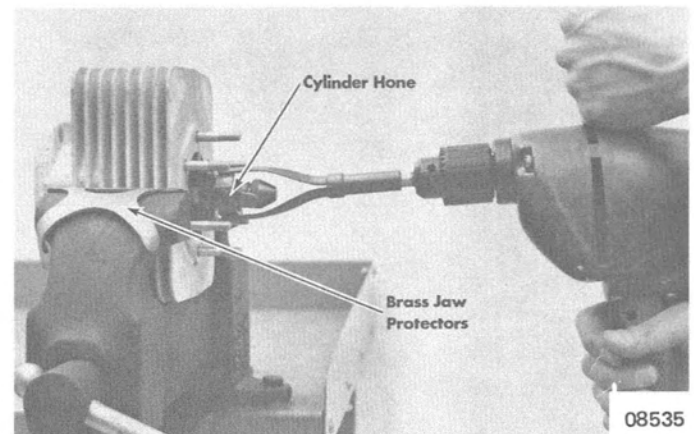


Figure 5. Honing Cylinder

1. Follow recommendations of the hone manufacturer for correct usage of hone and proper cleaning and lubrication during honing. (Figure 5)
2. Hone cylinder bore until aluminum deposits (a result of piston scoring) have been removed from cylinder wall.
3. When finish-honing a cylinder bore, hone should be moved up-and-down at a sufficient speed to obtain very fine uniform surface finish marks in a crosshatch pattern of approximately 45° to 65° included angle. Cylinder bore MUST BE free from embedded particles and torn or folded metal after honing.
4. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is absolutely essential that a good cleaning operation be performed. If any abrasive material is allowed to remain in cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to bearings which were lubricated by the contaminated oil. The bores should be swabbed several times with light engine oil and a clean cloth, then wiped with a clean, dry cloth.
5. Refer to "Fitting Cylinders to Pistons", following, and check clearance between respective pistons and cylinders.

Fitting Cylinders to Pistons

Production cylinders and pistons are a "select" fit (identified by a painted dot and a stamped letter or number). (Figures 6 and 7) Parts are identified by a "RED" (stamped "A" or "R" or "1"), "BLUE" (stamped "B" or "S" or "2") or "YELLOW" (stamped "C" or "T" or "3") painted dot. Color-coding and stamping on pistons and cylinders indicates its size. "RED" denotes small parts, "BLUE" indicates medium parts [approximately .0005" (.013mm) larger than "RED" parts] and "YELLOW" denotes large parts (approximately .0005" larger than "BLUE" parts). A red piston should be used in a red cylinder, blue with blue and yellow with yellow. If correct piston or cylinder is not available, parts may be substituted as outlined in "Cylinder and Piston Substitution Chart", following:

CYLINDER and PISTON SUBSTITUTION CHART *

Cylinder Code (See "IMPORTANT", Following)		Piston Code (See "IMPORTANT", Following)
"RED" (Stamped "A" or "R" or "1")	Use with	"RED" (Stamped "A" or "R" or "1")
"BLUE" (Stamped "B" or "S" or "2")	Use with	"RED" (Stamped "A" or "R" or "1") or "BLUE" (Stamped "B" or "S" or "2")
"YELLOW" (Stamped "C" or "T" or "3")	Use with	"RED" (Stamped "A" or "R" or "1") or "BLUE" (Stamped "B" or "S" or "2") or "YELLOW" (Stamped "C" or "T" or "3")

* Service replacement cylinders and pistons may NOT BE CODED. These parts are compatible with any coded (or uncoded) combination of parts.

IMPORTANT: Disregard any stamped letter that has been "X'd" out on cylinders or pistons.

1. Hone cylinder (as outlined, preceding) to clean up any score marks, scuffs or aluminum deposits in cylinder bore.
2. Measure cylinder bore diameter (with an inside micrometer) at top of cylinder bore, JUST ABOVE EXHAUST PORT. (Figure 8) Take measurements at right angles (90°) to each other and check for an out-of-round ("egg shaped") condition.
3. Measure piston at MIDDLE of piston skirt, just below piston pin, and at a right angle (90°) to piston pin. (Figure 9)

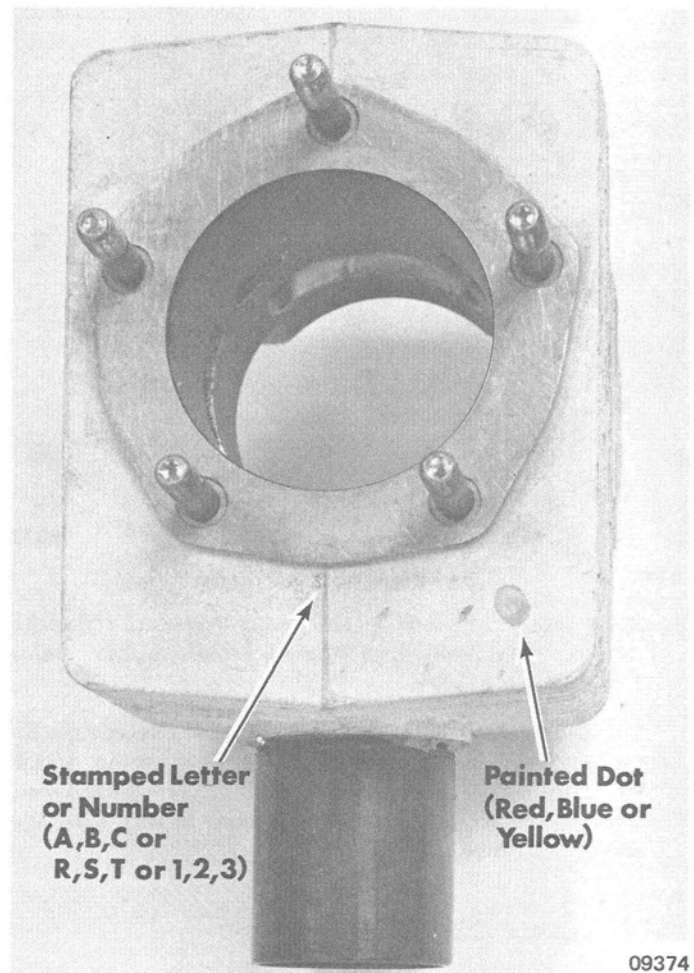


Figure 6. Cylinder Identification

IMPORTANT: When checking piston-to-cylinder clearance, be sure that No. 1 piston is mated with No. 1 cylinder and No. 2 piston with No. 2 cylinder.

4. Subtract piston skirt diameter from cylinder bore diameter to determine "Piston Skirt Clearance".

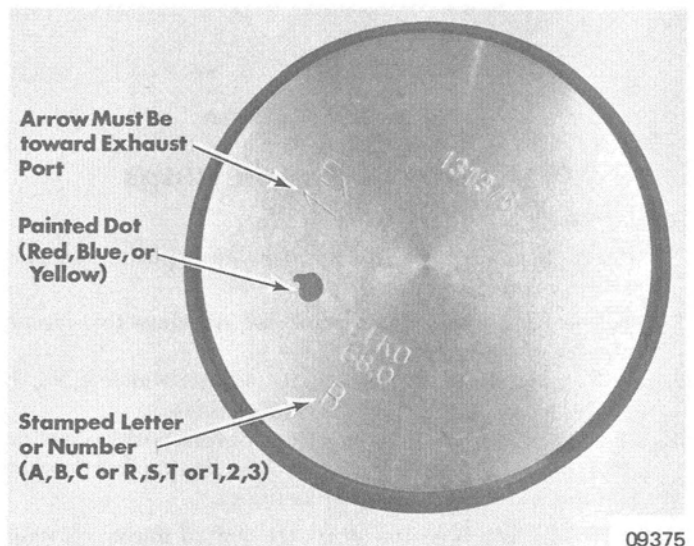


Figure 7. Piston Identification

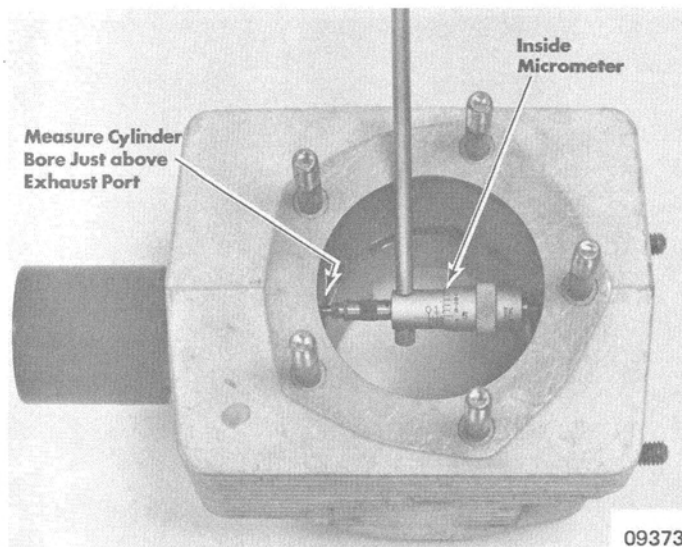


Figure 8. Measuring Cylinder

5. If clearance exceeds specifications (refer to "Specifications" Section 8) after honing, replace piston and/or cylinder, as necessary.

IMPORTANT: If "Piston Skirt Clearance" exceeds specifications, this usually will indicate a worn piston. Installation of a new piston should result in correct clearance. Chrome surfacing inside cylinder bore is very hard and usually will show little wear.

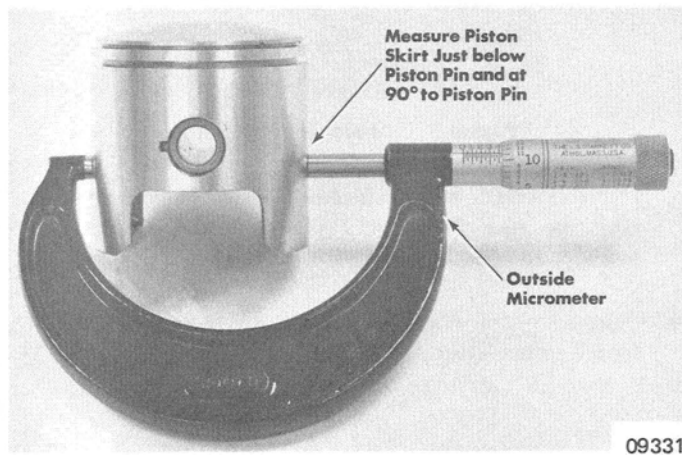


Figure 9. Measuring Piston

Pistons and Piston Rings

REMOVAL

NOTE: It is necessary to remove the opposite cylinder prior to removal of either piston.

1. Place a clean rag around crankcase openings to prevent entrance of foreign objects.
2. Scribe a mark on each piston to indicate which is No. 1 (PTO side) and which is No. 2 (rewind side).
3. Remove piston pin lockrings from pistons with an awl or other suitable tool. (Figure 10) Use caution not to mar piston skirt during removal of lockrings.

IMPORTANT: If piston skirts are marred during removal of lockrings, BE SURE that skirts are smoothed-off with 320 grit carborundum cloth before installation of pistons in cylinders.

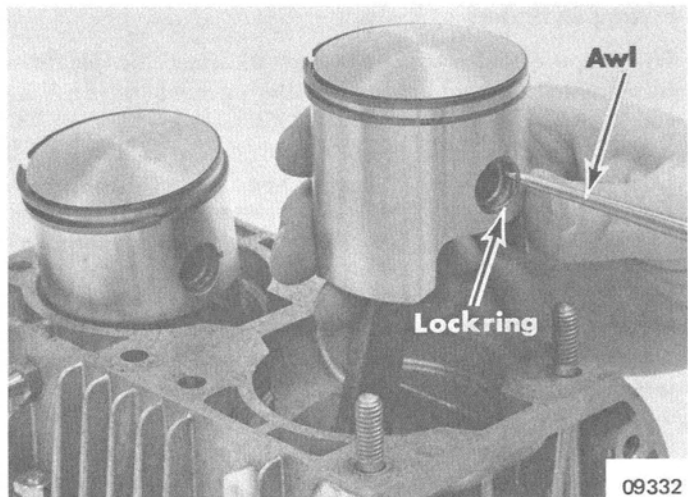


Figure 10. Removing Piston Pin Lockrings

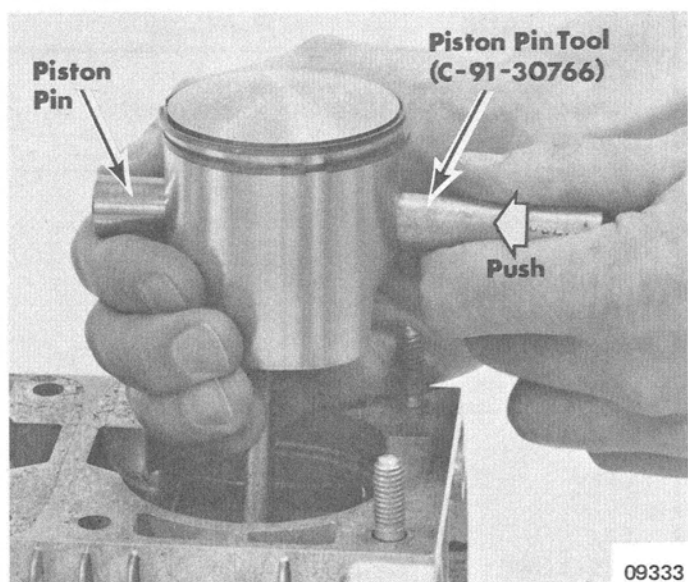


Figure 11. Piston Pin Removal

4. Remove piston pins with Piston Pin Tool (C-91-30766A1). (Figure 11) Remove pistons from connecting rods and reinsert piston pins into respective pistons.
5. Remove piston pin bearings from connecting rods.
6. Use Piston Ring Expander (C-91-24697) to remove piston rings from each piston. (Figure 12)

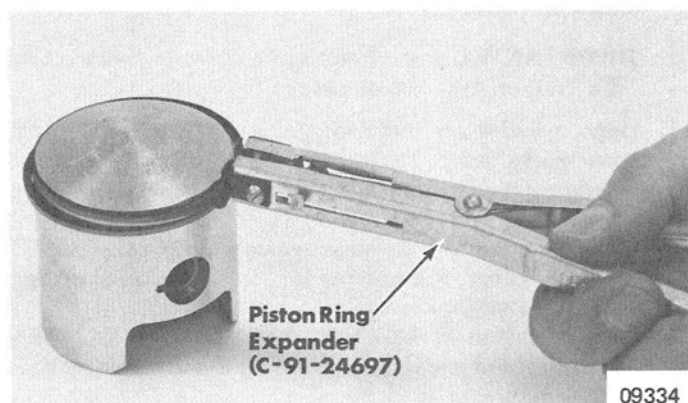


Figure 12. Piston Ring Replacement

CLEANING and INSPECTION

1. Replace piston(s), if scoring, pitting or metal damage is present.

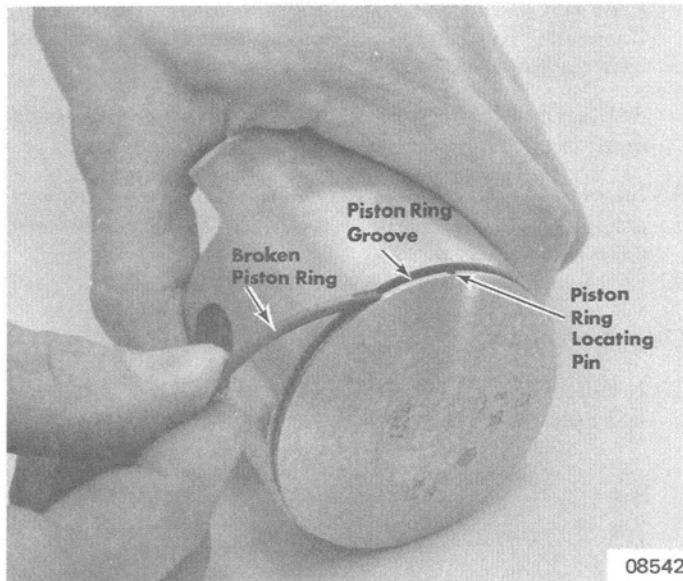


Figure 13. Cleaning Piston Ring Groove

2. Thoroughly clean pistons. Remove carbon deposits and "varnish" from pistons with a soft wire brush or carbon remover solution. Clean ring grooves with recessed end of a broken ring. (Figure 13) Do not burr or round machined edges.
3. Inspect piston domes for damage (as a result of pistons striking cylinder heads). (Figure 14)

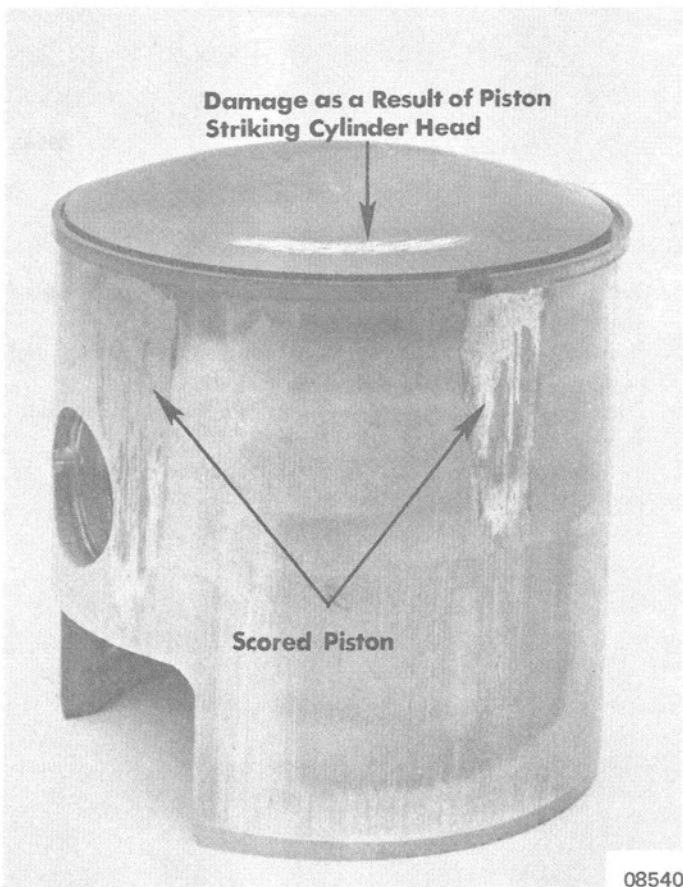


Figure 14. Damaged Piston

NOTE: Piston striking cylinder head could be an indication of a defective or improperly positioned cylinder head, connecting rod bearing(s) going "out" (insufficient lubrication), "stretched" connecting rod and/or that engine was assembled with improper cylinder gasket(s).

4. Inspect piston ring grooves for wear, burn and distortion. Piston ring locating pins (located in ring grooves - Figure 13) prevent rings from rotating. Locating pins must be tight in ring grooves. Replace piston(s) as necessary.

NOTE: Piston ring side clearances will exceed specifications if ring grooves are excessively worn. Ring side clearances should be checked during "Engine Reassembly", following.

5. Check piston pin "fit". Piston pins are not sold separately. Each piston pin is mated to only one piston. The piston and pin must be replaced as an assembly if pin is loose.
6. Refer to "Fitting Cylinders to Pistons", preceding (Figure 9), and check "fit" between piston and cylinders. If "Piston Skirt Clearance" exceeds specifications, piston may be worn and replacement will be necessary.

IMPORTANT: If piston replacement is necessary, **BE SURE** that replacement piston is compatible with its respective cylinder. (Refer to "Cylinder and Piston Substitution Chart", preceding.)

7. Check outer connecting rod bearings (piston pin end). Bearings must be smooth and should not bind. Replace bearings as necessary.
8. Inspect piston pin end of connecting rod for pitting or rust. Clean (if necessary), using 320 grit carborundum cloth.

Crankcase and Crankshaft Assembly GENERAL

NOTE: Crankshaft removal is not required when replacing crankshaft oil seals. Lubricate inner lips with Multipurpose Lubricant (C-92-63250-12) and place a **THIN** bead of Loctite Type "A" (C-92-32609-1) on outer edge (crankcase mating surface) of each oil seal. Install each oil seal (lip of seal inward) flush with crankcase.

Crankcase halves are a matched set and **MUST NOT** be interchanged.

Crankshaft is sold as a complete assembly with connecting rods, centermain bearings, centermain "O" rings and distance ring. Components, which are included in the crankshaft assembly (except "O" rings), cannot be purchased separately. If an internal crankshaft component fails, the entire crankshaft assembly must be replaced. Outer crankshaft ball bearings, "O" rings and oil seals can be replaced without replacing crankshaft assembly.

REMOVAL

1. Remove trigger attaching screws. Pull stator, trigger and wiring from crankcase.
2. Remove nuts and lockwashers from crankcase clamping studs.
3. Separate crankcase halves. Be careful not to damage crankcase sealing surfaces or crankshaft.

NOTE: A sealant is used between the crankcase halves. It may be necessary to **GENTLY TAP** on crankshaft with a soft lead hammer until crankcase halves separate.

4. Remove and discard oil seal from each end of crankshaft.
5. Remove crankshaft end bearing snap ring from each end of crankcase. (Figure 14)

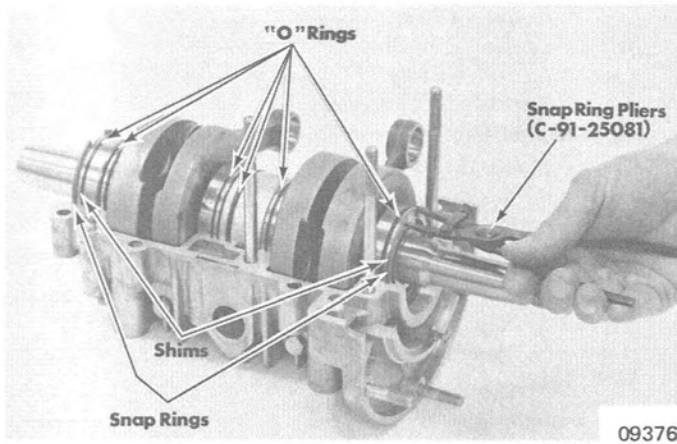


Figure 15. Removing Crankshaft

6. Remove shims from PTO side of crankshaft. (Figure 15) Note number and position of shims to aid in reassembly. Shims are used to adjust crankshaft end play.
7. Remove shims from rewind side of crankshaft. (Figure 15) Note number and position of shims (to aid in reassembly). Shims are used to adjust crankshaft end play.
8. Lift crankshaft assembly from crankcase half.
9. Remove and discard 3 crankshaft end bearing "O" rings (2 on PTO end, one on rewind end). (Figure 15)
10. Remove and discard 2 crankshaft centermain bearing "O" rings (one on each bearing) and "O" ring from distance ring. (Figure 15)

CLEANING and INSPECTION

1. Thoroughly clean all surfaces of crankcase halves. Be sure that crankcase sealer is removed from crankcase mating surfaces.
2. Inspect oil passage in PTO side of upper crankcase half. Oil passage allows fuel to lubricate PTO side outer crankshaft ball bearing. If this passage is plugged or restricted, bearing failure may result from lack of lubrication.
3. Inspect crankcase mating surfaces for cracks, scratches or grooves. Check crankcase halves for stripped threads and damaged studs. Replace parts as necessary.
4. Clean and dry crankshaft assembly.

WARNING: DO NOT spin-dry ball bearings with compressed air.

5. Grasp outer race of each ball bearing firmly and attempt to work race back-and-forth (should not be excessive play).
6. Lubricate each bearing with light oil. Rotate outer race of each ball bearing. Bearings should have smooth action and

no rust stains. If outside bearing(s) sound or feel "rough", replace bearing(s). If an inside bearing is "rough", replace crankshaft assembly.

7. Check connecting rod roller bearings (located on crankshaft end of rod). Lubricate roller bearings with light oil. Connecting rods should roll smoothly on bearings and not have excessive side play.

NOTE: A roller bearing, which is starting to fail, could result in piston hitting cylinder head.

8. Inspect oil seal surfaces of crankshaft. If sealing surfaces are grooved, pitted or scratched, replace crankshaft assembly.
9. Check crankshaft assembly for straightness.

DISASSEMBLY

1. Install Puller Plate (C-91-37241) between inner and outer end bearings on PTO side of crankshaft. (Figure 16)

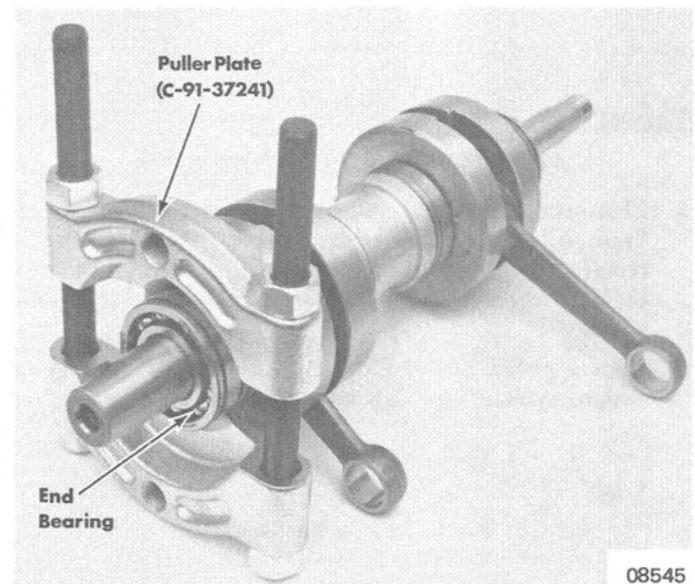


Figure 16. End Bearing Removal

2. Place crankshaft in press and support under Puller Plate.
3. Press crankshaft out of bearing.
4. Remove spacer from between bearings. Note position of spacer for reference during reassembly.
5. Reinstall Puller Plate between inner end bearing and counterweight on PTO side of crankshaft.
6. Place crankshaft in press and support under Puller Plate. Press crankshaft out of inner bearing.
7. If desired, remove end bearing from rewind side of crankshaft with Puller Plate and press.

ENGINE REASSEMBLY

IMPORTANT: Refer to "Specifications" Section 8 for All Torque Values.

Crankshaft Assembly and Crankcase

REASSEMBLY

1. Support crankshaft in press between counterweights and directly under crankshaft end (where end bearings are being installed).
2. On PTO side, install inner end bearing with "lettered side" up and "O" ring groove away from counterweight. Using tubing as a mandrel, press inner bearing on crankshaft. Press only on inner race of bearing. Be sure that bearing is seated firmly against counterweight.

IMPORTANT: BE SURE that same spacer, which was removed from between crankshaft end bearings (PTO side), is reinstalled between bearings.

3. Place spacer around PTO end of crankshaft and against inner end bearing.
4. Install outer end bearing (PTO side) with "lettered side" up and "O" ring groove away from counterweight. Using tubing as a mandrel, press on inner race of bearing until bearing is seated against spacer.
5. If removed, reinstall end bearing on rewind end of crankshaft with mandrel and press.
6. Remove crankshaft assembly from press.

CHECKING CRANKSHAFT END PLAY

1. Place crankshaft assembly (without "O" rings) in position on lower crankcase half.
2. Place shim(s) around PTO end of crankshaft and install end bearing snap ring outside of shims.
3. Position shim(s) around rewind end of crankshaft and install end bearing snap ring outside of shims.

NOTE: Shims should be reinstalled on crankshaft in same quantity and location as noted during disassembly.

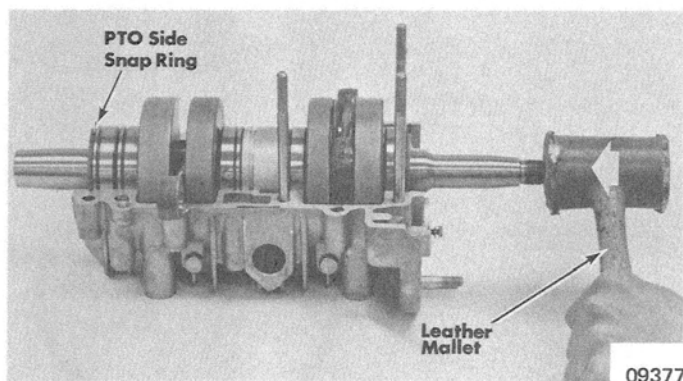


Figure 1. Seating Crankshaft

4. Tap on rewind end of crankshaft with a leather mallet until crankshaft is firmly seated against PTO side snap ring. (Figure 1)
5. Use feeler gauge to measure crankshaft end play between crankshaft end bearing and shims on rewind end. (Figure 2) Crankshaft end play of .006" to .012" (.15mm to .30mm) is permissible. Add shim(s) to decrease end play or remove shim(s) to increase end play.

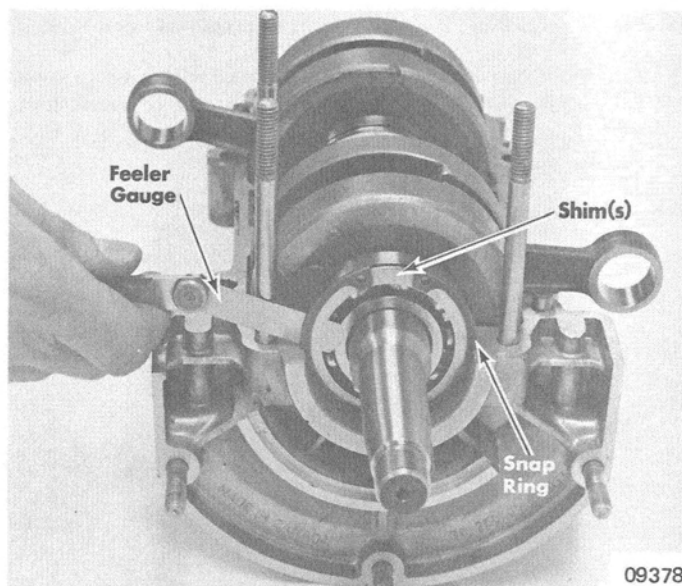


Figure 2. Checking Crankshaft End Play

IMPORTANT: Position an equal number of shims around each end of crankshaft so that counterweights are "centered" in lower crankcase openings.

6. Recheck crankshaft end play (as outlined, preceding), if shim(s) were added or removed from crankshaft.
7. Remove snap ring and shim(s) from rewind side of crankcase. (Figure 2)

IMPORTANT: Keep rewind side shims together to assure proper crankshaft end play during reassembly.

8. Remove snap ring and shim(s) from PTO side of crankcase.

IMPORTANT: Keep PTO side shims together to assure proper crankshaft end play during reassembly.

9. Lift crankshaft assembly from crankcase half.

INSTALLATION

1. Lubricate 5 new crankshaft bearing "O" rings and one new distance ring "O" ring with Multipurpose Lubricant (C-92-63250).
 2. Install large "O" ring around distance ring by stretching over counterweight and connecting rod.
 3. Install an "O" ring in groove of each centermain crankshaft bearing by stretching over counterweight and connecting rod.
 4. Install 3 remaining "O" rings in ring grooves of crankshaft end bearings (2 on PTO end, one on rewind end).
 5. Place crankshaft assembly in position on lower crankcase half.
 6. Place shim(s) around PTO end of crankshaft and install end bearing snap ring outside of shims.
- IMPORTANT:** Thickness and quantity of PTO end shims were determined in "Checking Crankshaft End Play", preceding. Reinstall shims as previously determined.
7. Tap on rewind end of crankshaft with a leather mallet until crankshaft is **LIGHTLY** seated against PTO side snap ring.

8. Place shim(s) around rewind end of crankshaft and install end bearing snap ring outside of shims.

IMPORTANT: Thickness and quantity of rewind end shims were determined in "Checking Crankshaft End Play", preceding. Reinstall shims as previously determined.

9. Lubricate lips of new crankcase oil seals with Multipurpose Lubricant. Install an oil seal on each end of crankshaft, with lips facing toward end bearings (inward) and flush against snap rings. (Figure 3)

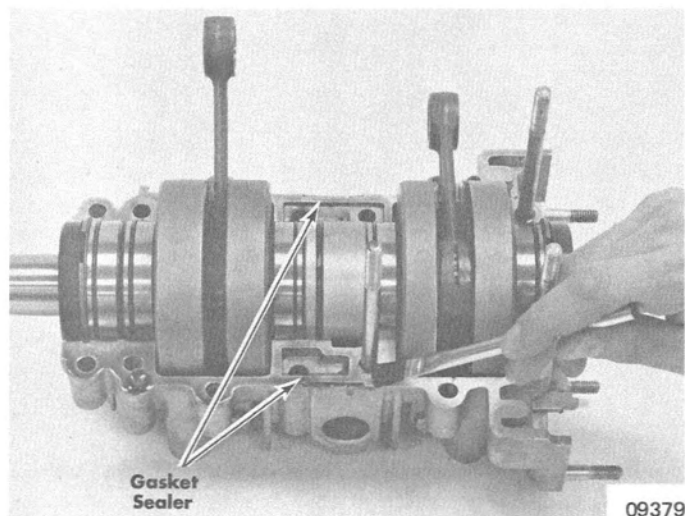


Figure 3. Applying Crankcase Sealer

10. Apply a THIN coat of Gasket Sealer (C-92-72592-1) to mating surfaces of crankcase halves. (Figure 3)
11. Place crankcase halves together and secure with lockwashers and nuts. Be sure that snap rings and oil seals are properly positioned between crankcase halves.
12. Tighten crankcase clamping nuts evenly until specified torque is reached.
13. Secure trigger to crankcase with attaching screws. Place stator in position but do not install attaching bolts at this time. Install grommet and wiring (trigger and stator) in position in crankcase notch.

NOTE: Ignition timing must be checked and readjusted, if necessary, during "Engine Installation", following.

Pistons and Piston Rings

CHECKING PISTON RING END GAP

1. Insert each new piston ring (one rectangular ring and one "L" ring in each cylinder) into the bore of its respective cylinder. Position each piston ring **JUST ABOVE EXHAUST PORT** and square with piston.

NOTE: If desired, piston may be used to push each piston ring into position, thus assuring proper positioning of ring.

2. Check end gap of each piston ring with a feeler gauge. (Figure 4) End gap must be within .008" to .016" (.20mm to .41mm). If end gap is in excess of these tolerances, check other new piston rings in cylinder bore until one, within tolerance, is found.
3. Remove piston rings from cylinder bores.

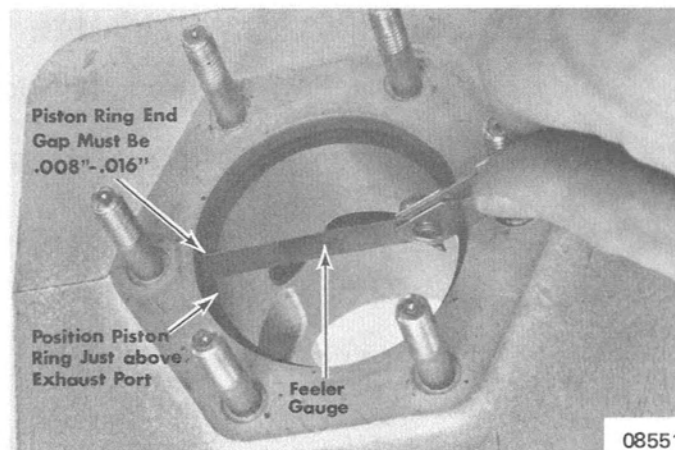


Figure 4. Checking Piston Ring End Gap

IMPORTANT: Piston rings, that are checked in No. 1 cylinder, **MUST BE** installed on No. 1 piston, and rings, that are checked in No. 2 cylinder, **MUST BE** installed on No. 2 piston.

CHECKING PISTON RING SIDE CLEARANCES

IMPORTANT: Before checking piston ring side clearances, piston ring end gap must be checked as outlined, preceding. **BE SURE** to install piston rings on their respective piston; i.e., install rings, which were checked in No. 1 cylinder, on No. 1 piston, etc.

1. Using Piston Ring Expander (C-91-24697), install No. 1 piston rings on No. 1 piston and No. 2 piston rings on No. 2 piston. (Figure 12 in "Engine Disassembly", preceding) Install "rectangular" piston ring in lower ring groove and "L" ring in upper ring groove of each piston.

CAUTION: Piston rings must be properly installed with piston locating pins between ring gaps. Top piston rings must be installed with edge of "L" ring "up".

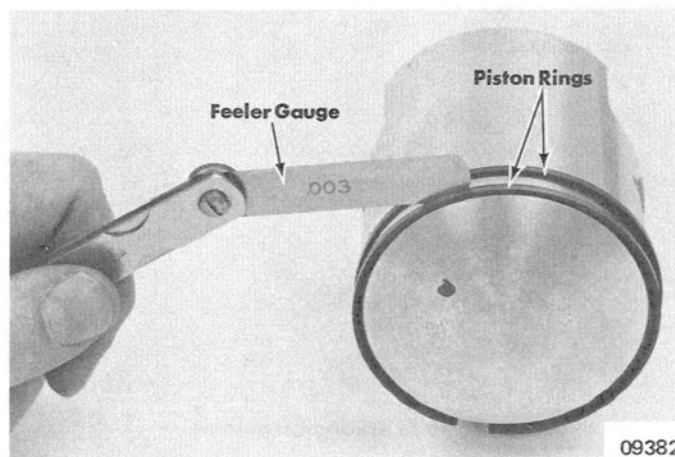


Figure 5. Checking Piston Ring Side Clearances

2. With each piston ring seated in its ring groove, check piston ring side clearances with a feeler gauge. Insert feeler gauge between lower edge of each piston ring and its ring groove. (Figure 5) Side clearances must be within toler-

ances. (Refer to "Piston Ring Side Clearance Chart", following.) If side clearances are in excess of tolerances, ring grooves are worn beyond limits and piston(s) must be replaced.

CAUTION: If piston replacement is necessary, BE SURE that replacement piston is compatible with its respective cylinder. (Refer to "Cylinder and Piston Substitution Chart", preceding.) Reinstall new piston rings, which were checked in that cylinder bore, on replacement piston.

PISTON RING SIDE CLEARANCE CHART

Piston Ring	Side Clearance
Top "L" Ring	.0022" - .0037" (.056mm-.094mm)
Bottom "Rectangular" Ring	.0012" - .0024" (.030mm-.061mm)

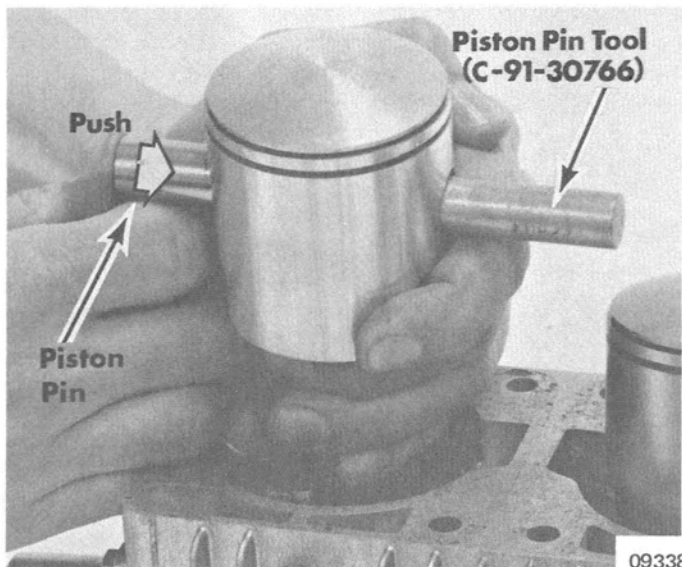


Figure 6. Installing Pistons

INSTALLATION

1. Insert piston pin bearings in connecting rods.

IMPORTANT: Pistons and cylinders were marked (during removal) to designate which parts are used together. Install No. 1 piston and cylinder on PTO side and No. 2 piston and cylinder on rewind side.

2. Position each piston on its connecting rod with arrow on dome of piston (Figure 7 in "Engine Disassembly", preceding) toward exhaust port side of engine.
3. Install each piston pin, using Piston Pin Tool (C-91-30766A1) as a guide. (Figure 6)
4. Install new piston pin lockrings (2 on each piston). (Figure 7)

CAUTION: DO NOT re-use lockrings. Use only new lockrings and make sure that they are properly seated in grooves. Do not "mar" piston skirts.

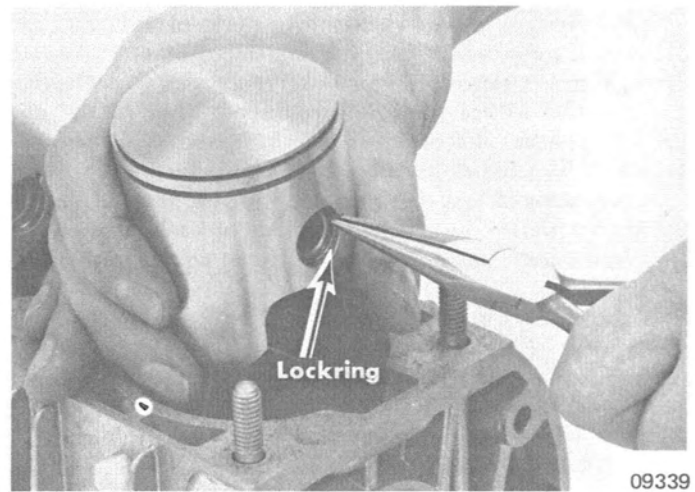


Figure 7. Installing Lockrings

Cylinders and Cylinder Heads

IMPORTANT: If piston has been striking cylinder head, it may be helpful to install cylinder head gasket and cylinder head on cylinder BEFORE installing cylinder over piston. Place new cylinder head gasket and cylinder head on cylinder and, making sure that combustion chamber of cylinder head is centered in cylinder bore, secure cylinder head with flat washers, lockwashers and nuts. Install cylinder assembly as outlined, following.

1. Lubricate cylinder bores, piston skirts and piston rings with CLEAN Quicksilver Formula 50-D Oil (C-92-65193).
2. Place new cylinder base gaskets on crankcase.

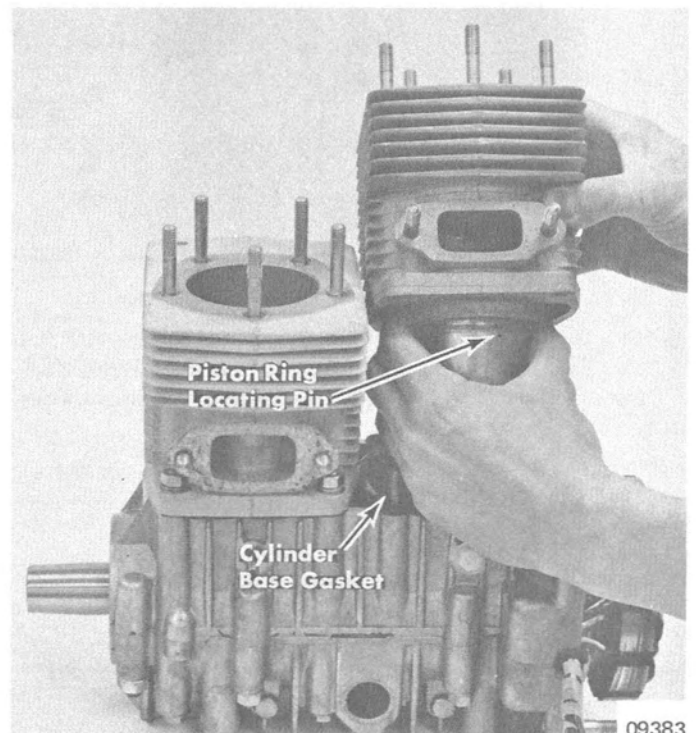


Figure 8. Installing Cylinder

3. Install No. 1 cylinder over No. 1 piston and No. 2 cylinder over No. 2 piston. Compress piston rings with fingers while installing each cylinder over its respective piston. (Figure 8) Piston rings must be properly positioned with piston ring locating pins at piston ring gaps. Cylinders are

properly positioned when intake ports of cylinders are toward pulse hose fitting in crankcase. Rotate crankshaft until piston rings can be viewed thru exhaust port. Depress each ring with a small punch or screwdriver (it will not "spring back" if broken). Replace broken ring(s), if any.

4. Insert 5 cylinder-attaching thru bolts (with washers) thru crankcase and cylinder flanges. Secure cylinders by installing flat washer, lockwasher and a nut on each thru bolt (5) and on each crankcase stud (3). Do not tighten nuts at this time.
5. Temporarily install exhaust manifold in position on cylinder exhaust pipes.
6. Tighten cylinder attaching nuts evenly until specified torque is reached.
7. Remove exhaust manifold from cylinder exhaust pipes.
8. Install new intake manifold gaskets, intake manifolds and intake plate on cylinder studs. Secure with lockwashers and nuts. Tighten nuts evenly until specified torque is reached.

NOTE: Intake manifolds are properly installed when carburetor mounting studs point straight back.

9. Place new cylinder head gaskets on cylinders.

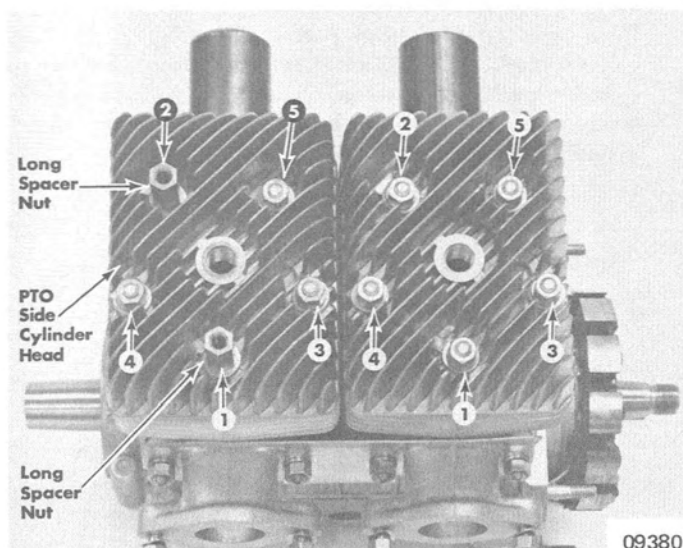


Figure 9. Cylinder Head Torquing Sequence

10. Set cylinder heads on cylinder studs and secure with flat washers, lockwashers and nuts. Tighten nuts evenly (following sequence shown in Figure 9) until specified torque is reached.

NOTE: Be sure that 2 long spacer nuts are installed on correct studs of PTO side cylinder. (Figure 9) Spacer nuts are used to secure air shroud to engine.

11. Install 2 halves of engine air shroud and secure with 3 allen screws.
12. Install spark plugs and rubber spark plug protectors.
13. Reinstall exhaust manifold on cylinder exhaust pipes. Tighten clamping bolts securely.

Fan Assembly

REASSEMBLY

1. If removed, reinstall fan shaft bearings and spacer into fan housing. Press bearings into housing until they are flush with housing. Be sure that spacer is installed between bearings.

CAUTION: When pressing bearings into fan housing, **BE SURE** that housing is properly supported to prevent damaging housing.

2. Install fan shaft (with a leather mallet) in position.
3. Reinstall key in fan shaft keyway.
4. Install flat washer, inner fan pulley half, belt tension shims, outer fan pulley half, flat washer and nut in position on fan shaft.
5. Hold fan pulley with spanner wrench (supplied with manufacturer's tool kit) and torque nut to specification. (Figure 1 in "Engine Disassembly", preceding.)

INSTALLATION

1. Place fan housing assembly (with secondary ignition coils and switchbox) in position around crankshaft.

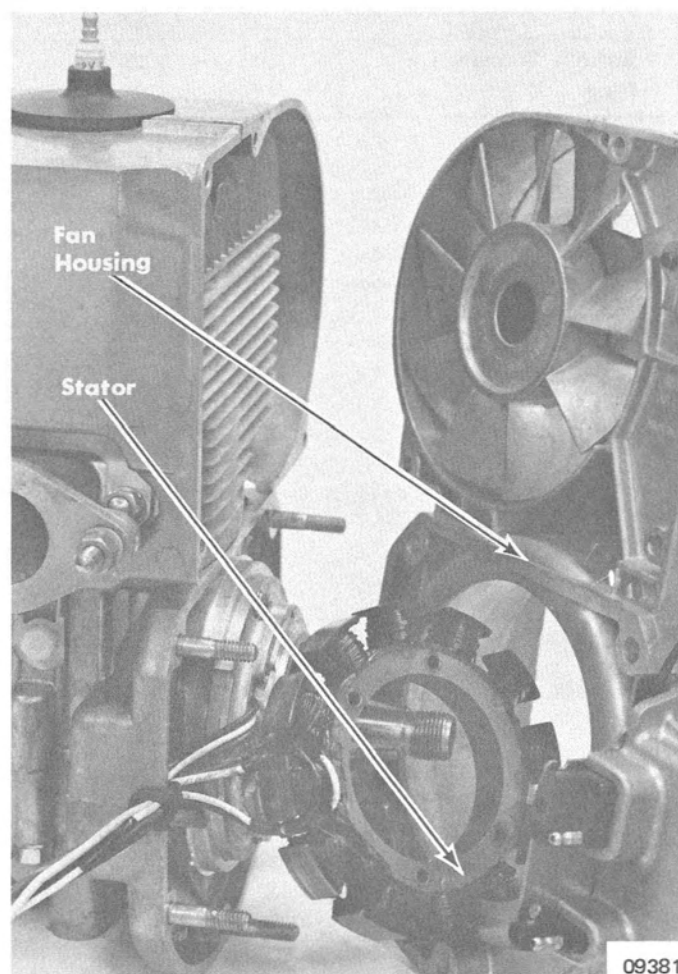


Figure 10. Installing Fan Housing

2. Install stator thru fan housing opening by inserting edge of housing between 2 of the stator poles and pulling stator thru housing. (Figure 10)
3. Push fan housing into position on crankcase studs. Secure housing to crankcase studs with washers and nuts. Tighten nuts evenly until specified torque is reached.
4. Secure stator to trigger with 4 attaching bolts. Do not tighten bolts at this time. Engine timing must be adjusted during "Engine Installation", following.
5. Secure fan housing to air shroud with allen screws.
6. If so equipped, connect black switch box wire to black engine harness wire at "bullet" connector.
7. Connect stator and trigger wires to switch box.

ENGINE INSTALLATION

1. Remove engine holding fixture (if used) from crankcase.
2. Position spacers between engine mounting plate and crankcase. Secure mounting plate to engine with washers and bolts. Torque bolts to specification shown in Section 8.
3. Set engine assembly (into chassis) on engine mounts.
4. Refer to Section 2, Part C, and install drive sheave on crankshaft.
5. Install variable speed drive belt.
6. Secure engine mounting plate to engine mounts with washers and locknuts. Torque locknuts to specification.
7. Check drive belt tension as outlined in Section 2, Part B. Readjust tension as required.
8. Install drive belt guard.
9. Secure exhaust muffler to engine exhaust manifold with retaining springs.
10. Connect engine harness to chassis harness by connecting 3-wire connector (located by right rear engine mount).
11. Connect fuel pump pulse hose to crankcase fitting. Clamp hose securely.
12. Install rubber mounting flanges and carburetors on intake manifolds. Open fuel shut-off valve at fuel tank.

Flywheel Installation

13. Install flywheel as outlined following:
 - a. If trigger was loosened or removed from engine, refer to Section 3, Part C, and adjust ignition timing. Reinstall stator and tighten attaching bolts securely.
 - b. Place flywheel key (if removed) in crankshaft keyway.
 - c. Align flywheel keyway with crankshaft key and install flywheel. Secure with tab washer and attaching nut.
 - d. Prevent engine crankshaft from rotating by holding drive sheave with Belt Wrench (C-91-24937A1).
 - e. Torque flywheel nut to specification shown in Section 8.
 - f. Bend tab on tab washer to secure flywheel nut.
 - g. Install fan belt, flywheel sheave plates and rewind starter cup.
 - h. Install rewind starter assembly on fan housing. Be sure that 2 black ground wires are attached to one of the rewind starter attaching bolts.
14. Pull rewind rope from starter assembly and install in rope guide attached to chaincase.
15. Connect spark plug high tension wires to respective spark plugs.
16. Refer to Section 4, Part A, and check carburetor adjustments.
17. Install carburetor air intake on engine.
18. Install top cowl assembly.