

CHAPTER 3

ENGINES

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ENGINES Torque Specifications

When tightening bolts, nuts, or screws, a torque pattern should be followed to ensure uniform equal tension is applied to all fasteners. Proper torque application prevents fasteners from loosening or breaking in critical service. It also minimizes wear and eliminates premature or needless repair costs. Following uniform torque application sequence patterns ensures optimum performance from precision machined, close tolerance assemblies.

The most common units of torque in the English system are ft. lb. and in. lb. In the Metric system, torque is commonly expressed in units of kg-m or Nm (Newton Meters). Multiply foot pounds by .1383 to obtain kg-m. Move decimal point one place to the right to obtain Nm from kg-m.

Engine	Cylinder Head*		Cylinder Base Nuts	Crankcase 8 mm	Crankcase 10 mm	Flywheel
Fan Cooled Twin Cylinder	18-19 ft. lbs. (2.5-2.65 kgm)		24-28 ft. lbs. (3.3-3.9 kgm)	17-18 ft. lbs. (2.2-2.3 kgm)	23-25 ft. lbs. (3.2-3.5 kgm)	60-65 ft. lbs. (8.3-9.0 kgm)
EC50PL EC58PL* EC70PL EC79PL	8 mm 17-20 ft. lbs. (2.4-2.8 kgm)	10 mm 24-26 ft. lbs. (3.3-3.6 kgm)	24-28 ft. lbs. (3.3-3.9 kgm)	17-18 ft. lbs. (2.2-2.3 kgm)	23-25 ft. lbs. (3.2-3.5 kgm)	60-65 ft. lbs. (8.3-9.0 kgm)
SN44** SN50**	20-24 ft.lbs. (2.9 - 3.3 kgm)		30-34 ft.lbs (4.1-4.7 kg-m)	20-24 ft.lbs. (2.8 - 3.3 kgm)		90 ft. lbs. (12.4 kgm)
SN60** SN70**	20-24 ft. lbs. (2.8 - 3.3 kgm)		30-34 ft.lbs (4.2-4.7 kg-m)	20-24 ft.lbs. (2.8 - 3.3 kgm)	26-30 Ft lbs (3.6-4.15 kgm)	55 ft. lbs. (7.4 kgm)

* Use high end of torque range on EC58PL

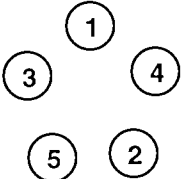
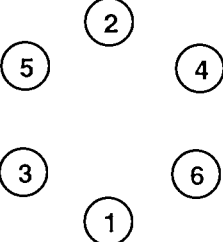
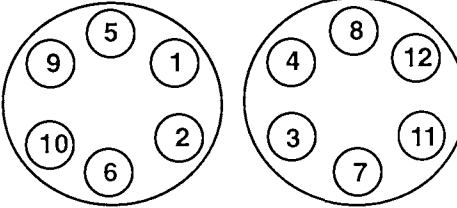
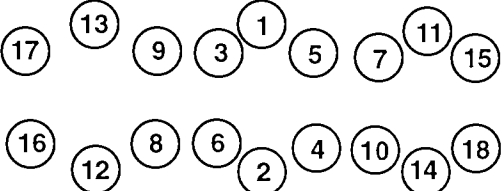
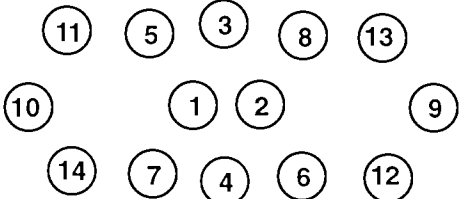
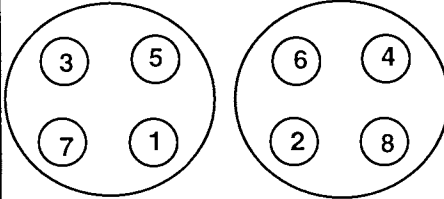
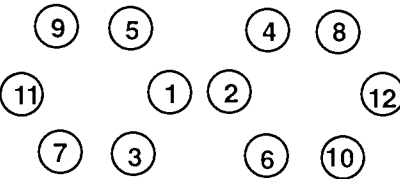
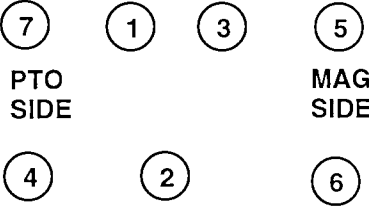
** Torque head bolts prior to torquing cylinder base nuts.. Apply loctite™ 242.

All 6mm Crankcase Bolts 108 in. lbs. (1.24 kg-m)

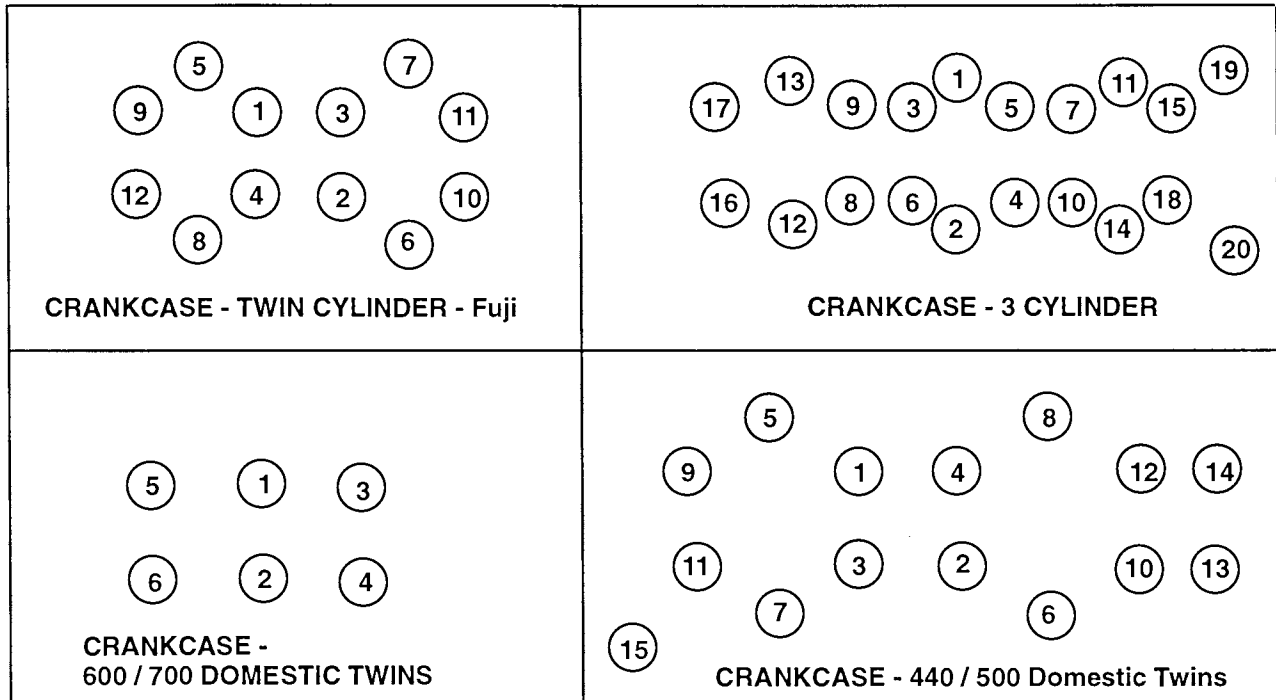
All 7/16-14 Engine Mount Strap Bolts 44-48 ft. lbs. (6.0-6.63 kg-m)

ENGINES

Torque Patterns - Cylinder Heads, Cylinder Base

 <p>CYLINDER HEAD - 5 STUD</p>	 <p>CYLINDER HEAD - 6 STUD</p>	 <p>CYLINDER HEAD Domestic Twins 500 / 600 / 700</p>
 <p>CYLINDER HEAD - EC58PL</p>		 <p>CYLINDER HEAD - EC45/50PL</p>
 <p>CYL. BASE - 500/600/700 Twins</p>	 <p>Cylinder Head - domestic 440</p>	 <p>PTO SIDE MAG SIDE</p> <p>Fuji Liquid Twins Cylinder Base</p>

ENGINES **Torque Patterns - Crankcase**



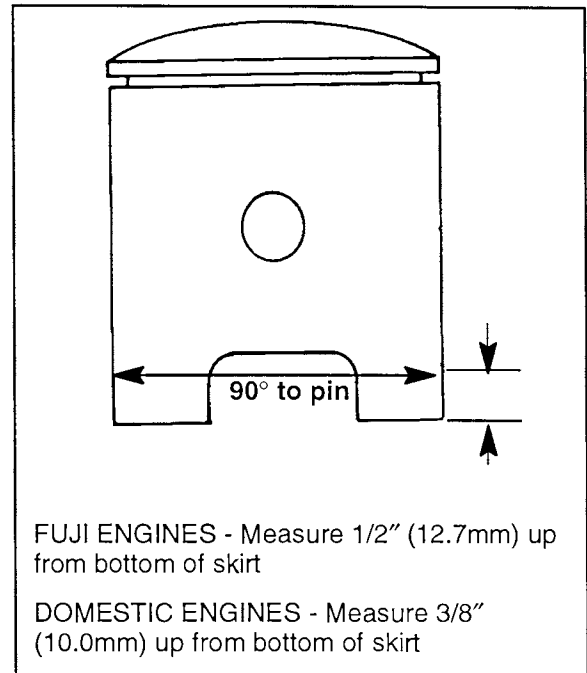
ENGINES

Piston/Cylinder Clearance Specifications

Piston Measurement

Whenever cylinders are honed or bore clearance is checked, it is important to measure piston diameter properly to arrive at its major dimension. Measurements should be taken with piston at room temperature, and **at right angles to the pin** as shown. Determine the largest diameter within this area and refer to the chart below for clearance specifications.

Cylinder bore must be straight and concentric. Refer to honing information outlined in this chapter for specific procedures. Refer to the specifications section in chapter 1 for *Target Clearance* when re-boring cylinder, or *Service Limit* specifications (to determine if piston requires replacement).



Piston to Cylinder Clearance

Refer to specifications in chapter 1 for specific models.

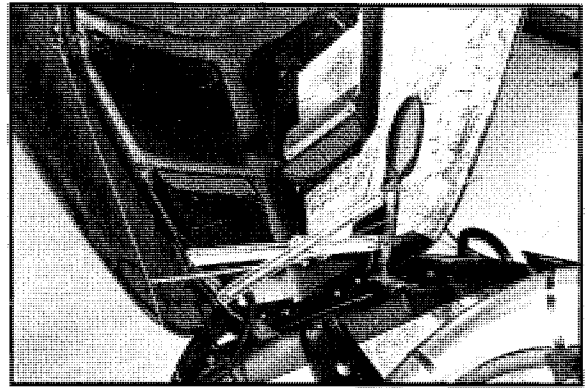
Piston Ring Installed Gap

Refer to specifications in chapter 1 for specific models.

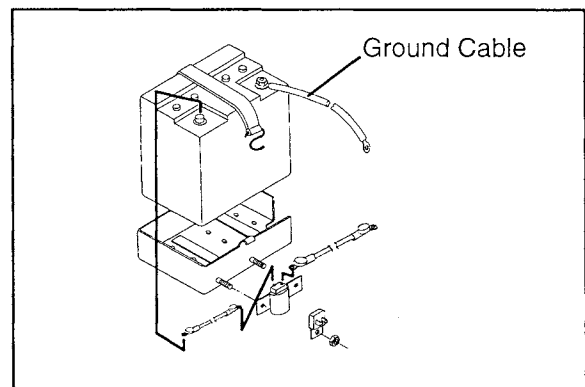
Important! Always verify piston to cylinder clearance and piston ring installed gap prior to assembling an engine.

Engine Removal, Typical

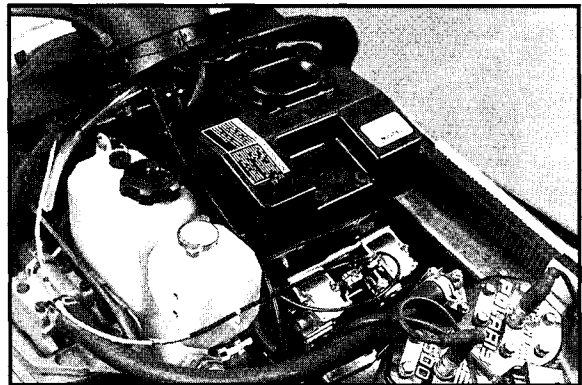
1. On some models, it may be necessary to remove the hood for earlier access to engine components or to prevent damage.



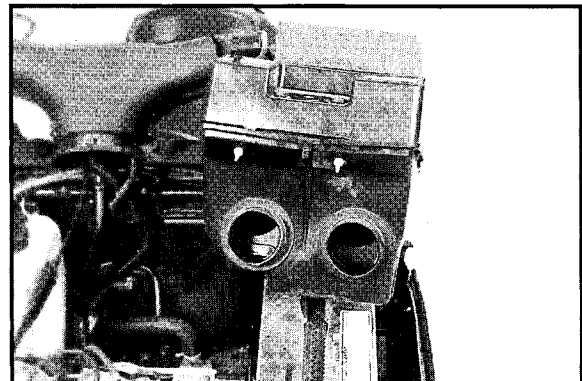
2. Disconnect battery ground (–) from battery (if applicable). Shut off fuel.



3. Remove fuel pump or CDI from airbox if applicable.



4. Remove airbox.



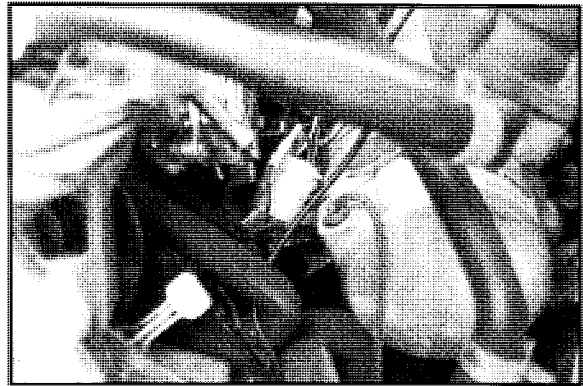
ENGINES

Engine Removal

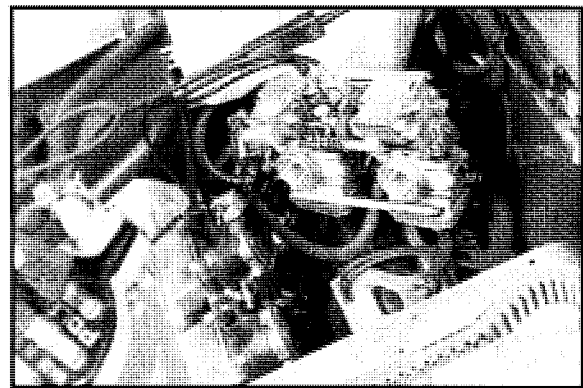
Engine Removal, Typical-Cont.

5. Free recoil rope from chassis.

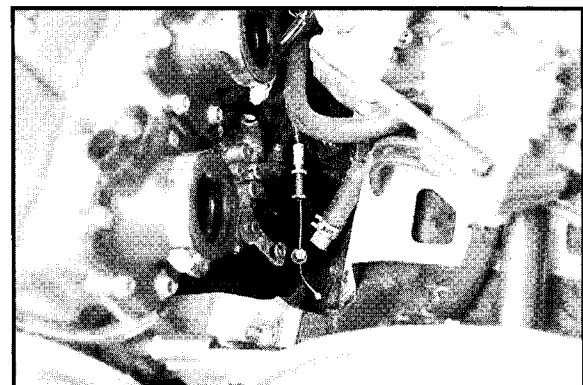
NOTE: Be sure to tie a knot in recoil rope upon removal so rope doesn't wind up into recoil housing.



6. Loosen clamps at carburetor mounting flange. Pull carbs from adaptors and secure out of the way. Note routing of all cables and hoses for reassembly.

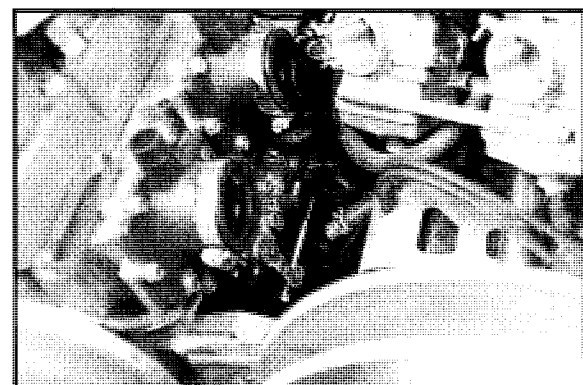


7. Disconnect oil pump control cable.



8. Disconnect and plug oil supply line.

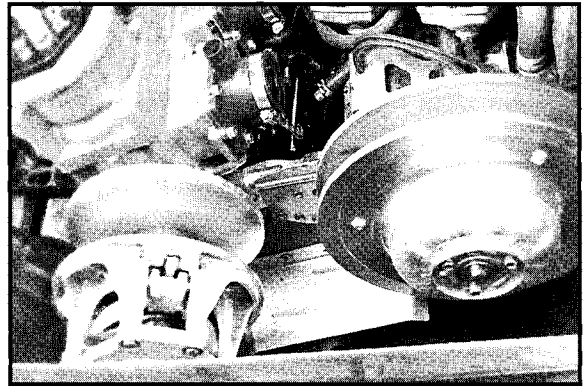
TIP: A bolt or spare water trap plug can be used to plug the oil line from the oil reservoir.



Engine Removal, Typical-Cont.

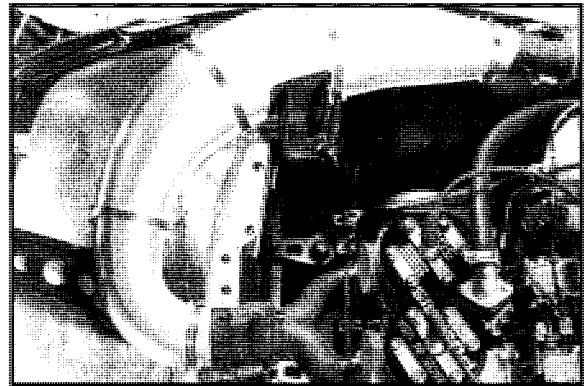
9. Remove drive belt.

NOTE: If drive clutch removal is necessary, it may be done at this time. Refer to Chapter 5, clutches.

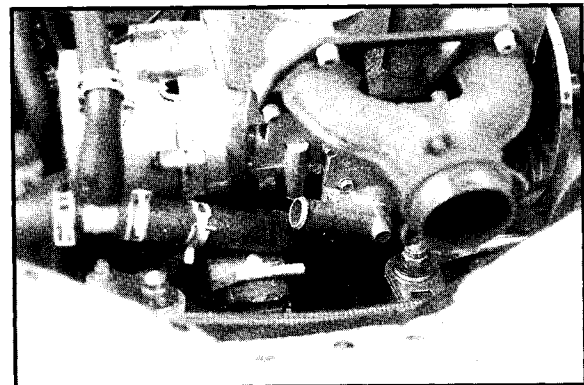


10. Remove exhaust system.

NOTE: On triple pipe models, mark pipe location to simplify reassembly.



11. Disconnect coolant supply hoses as necessary at the most convenient location on liquid cooled models. Drain coolant into suitable container.

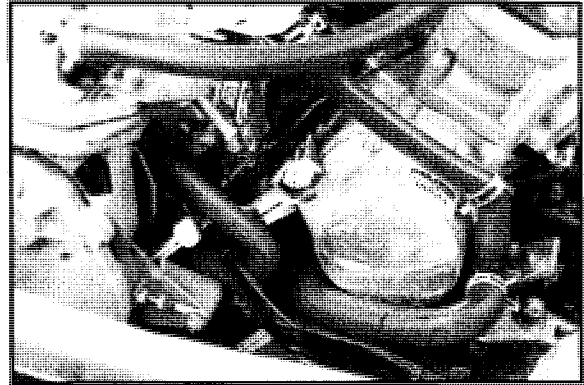


ENGINES

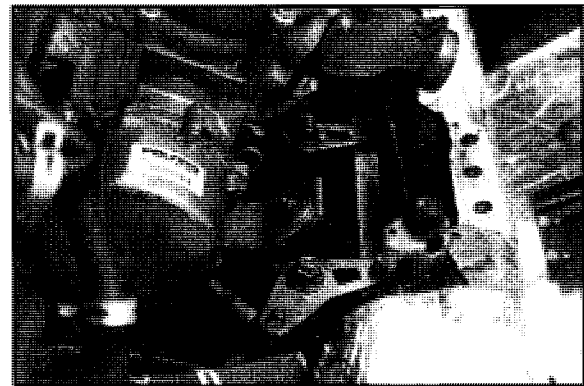
Engine Removal

Engine Removal, Typical-Cont.

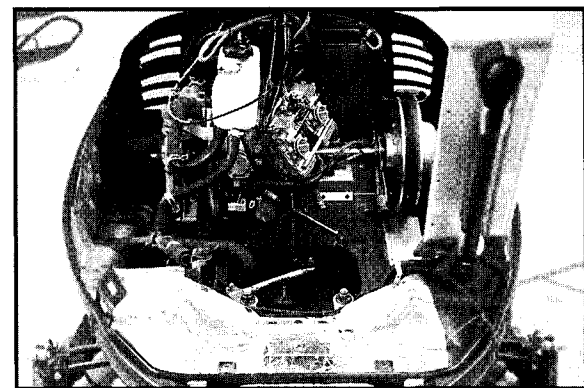
12. Disconnect electrical connections from stator and starter motor (where applicable).



13. Remove two front and two rear engine mount bolts (nuts) that secure engine mount plate (straps) to chassis.



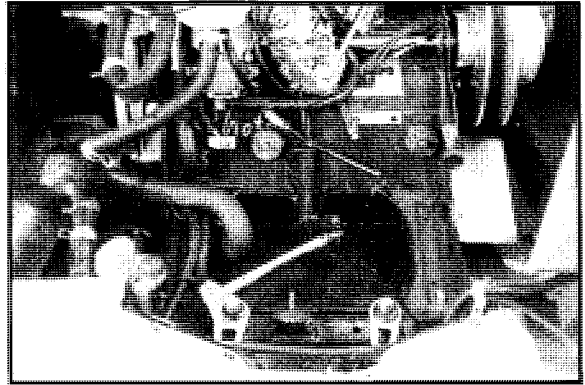
14. Remove engine from chassis.



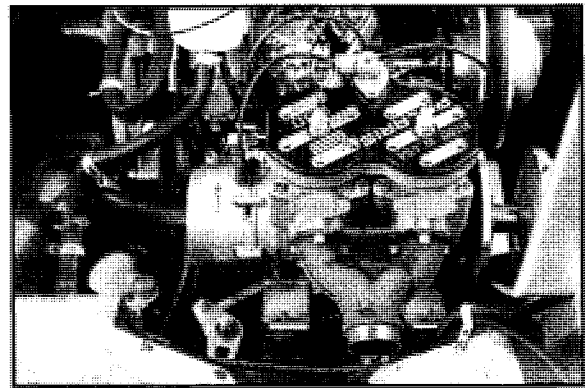
Engine Installation, Typical

1. Prepare chassis for engine installation by moving hoses and wiring out of the way.
2. If model is equipped with a torque stop, loosen locking screw and turn torque stop in to gain clearance when installing engine.

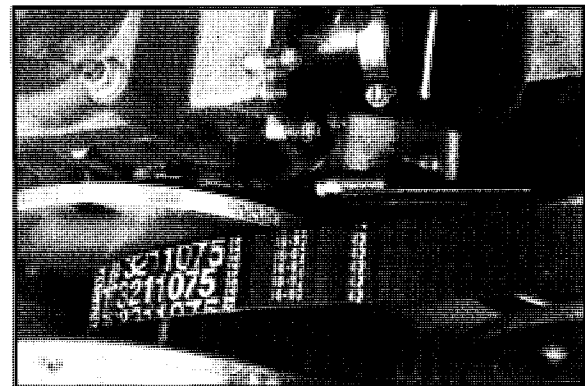
NOTE: Torque stop must be adjusted properly after clutch alignment (see chapter 5, clutches)



3. Check condition of bonded rubber engine mounts. Be sure mounts are tight before installing engine. With engine mounting plate or mount straps installed on engine, set engine on rubber mounts and loosely install mounting bolts and nuts.



4. Install drive belt (and clutch if removed) and check clutch offset/alignment. Adjust torque stop (where applicable). Refer to chapter 5, clutches, for torque stop adjustment procedure.



5. Tighten engine mounting bolts to specification.

Engine Mounting Bolt Torque-

Front - 28 Ft lbs (6.67 kgm)
Rear - 28 Ft lbs (6.67 kgm)



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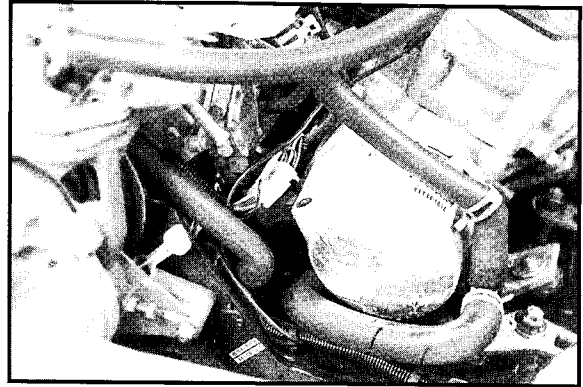
Engine Installation

Engine Installation, Typical-Cont.

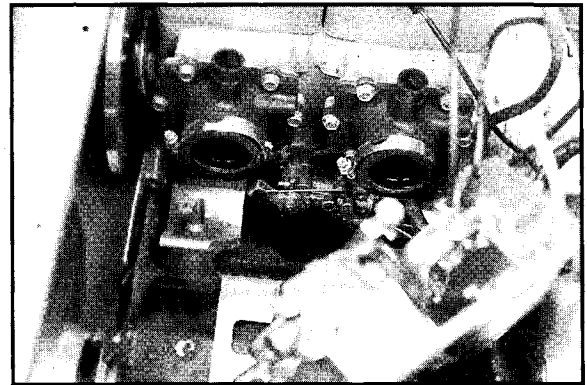
6. Apply a light film of Polaris dielectric grease to all connections. Connect all stator connections and temperature switch.

Dielectric grease-

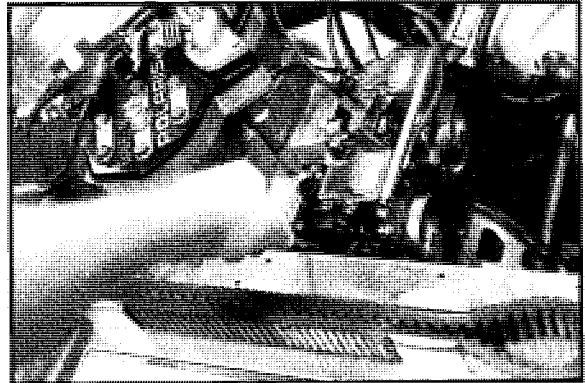
PN 2871329 - 1/4 oz.



7. Connect oil supply line to oil pump. Bleed oil pump by opening bleed screw until oil flows steadily. Tighten bleed screw securely. Install throttle cable to oil pump and check adjustment. Refer to General Inspection Procedures in this chapter for oil pump adjustment procedure.



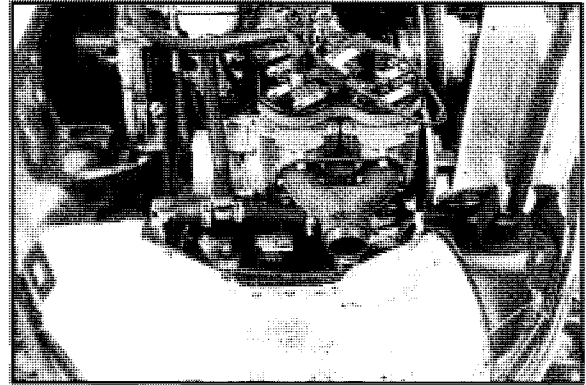
8. Install carburetors and tighten clamps. Make sure hoses and cables are routed correctly.



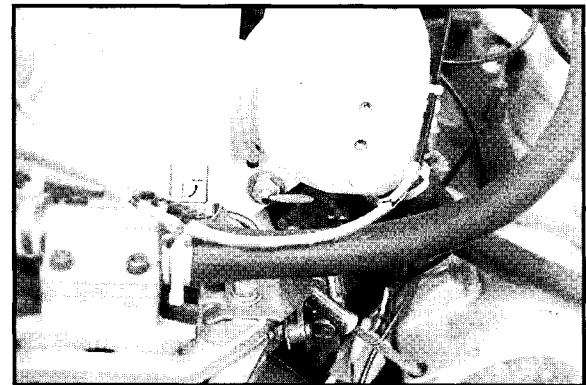
9. Connect oil lines to carburetors

Engine Installation, Typical-Cont.

10. Install coolant hoses where applicable. Make sure hoses are routed properly and hose clamps are positioned and tightened securely.

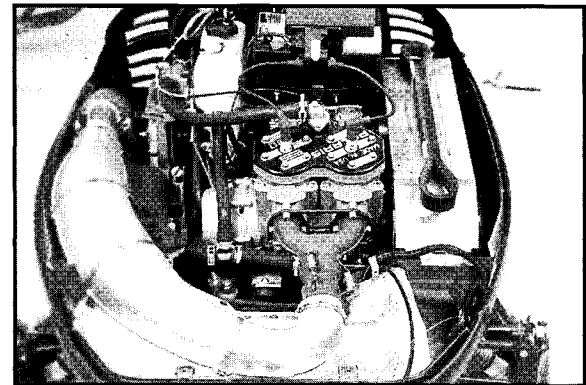


11. Route and install recoil rope to chassis.



12. Install starter and starter cables (electric star models).

13. Install exhaust system in reverse order of disassembly.

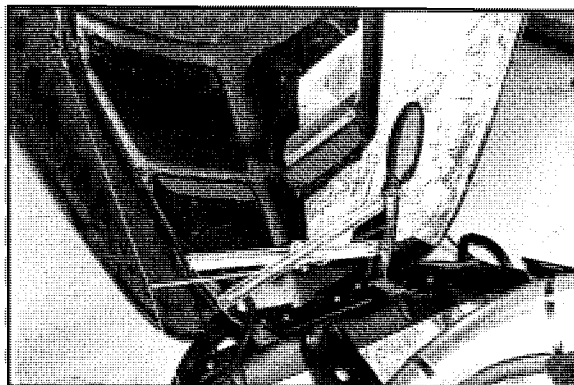


ENGINES

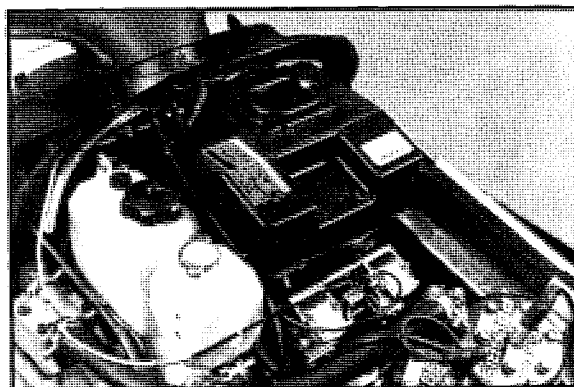
Engine Installation

Engine Installation, Typical-Cont.

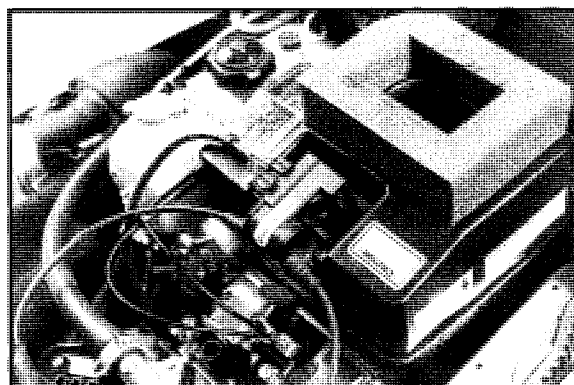
14. Install hood if previously removed.



15. Install airbox.

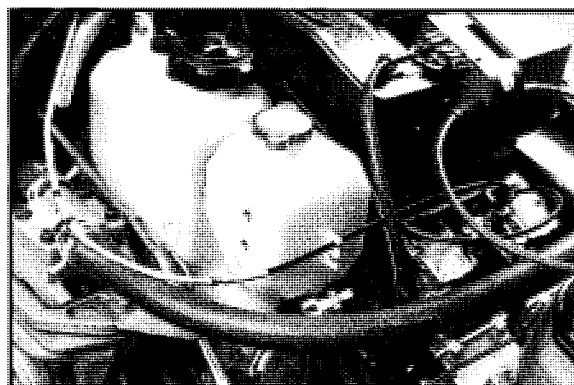


16. Secure fuel pump and CDI box.



17. Fill cooling system (liquid models) with Polaris Premium Antifreeze 60/40 premix.

**Polaris Premium Antifreeze
60/40 premix
Quart PN 2871534
Gallon PN 2871323**



18. Add a full tank of premix fuel (40:1) to fuel tank.

19. Start engine and check operation. Bleed cooling system on liquid models. See Cooling System Bleeding Procedures in this chapter.

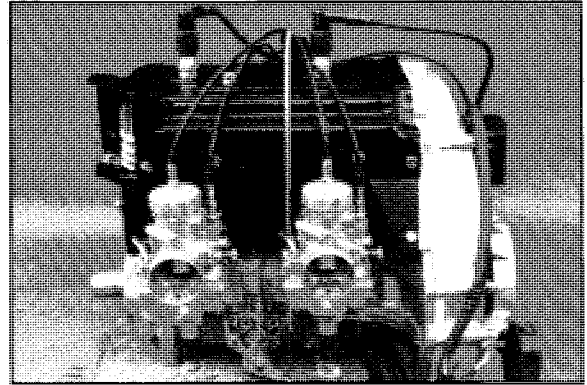
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Fan Cooled Twin Cylinder

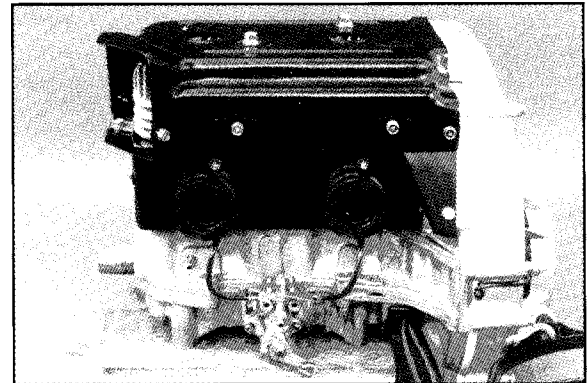
NOTE: Inspect all parts for wear or damage during disassembly. Replace all seals, O-rings, and gaskets during disassembly. Refer to pages 3.73-3.84 for general inspection procedures.

Engine Disassembly

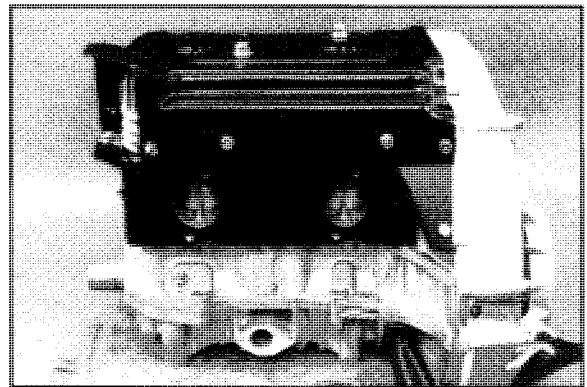
The photo at right shows a complete fan cooled twin cylinder engine.



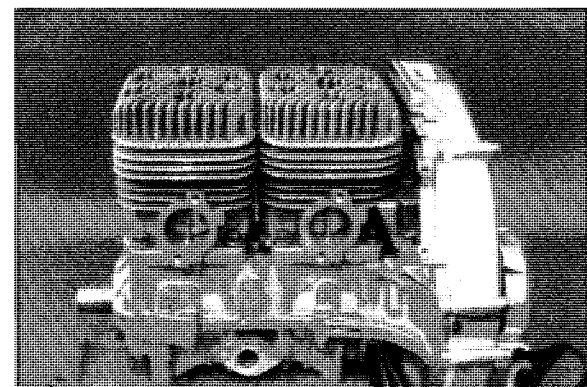
1. Remove carburetors.
2. Disconnect oil pump feed lines and remove oil pump.



3. Remove carburetor adaptors.



4. Remove air shrouds. **NOTE:** There may be gaskets between shroud and cylinder.

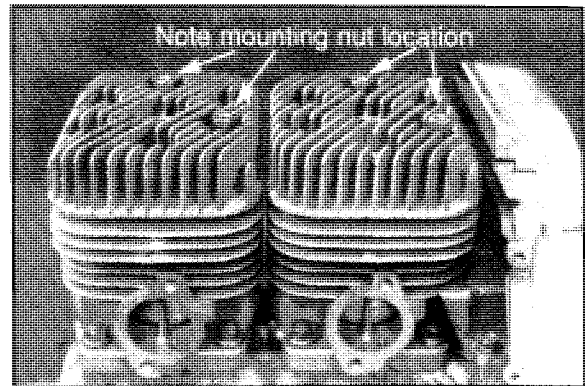


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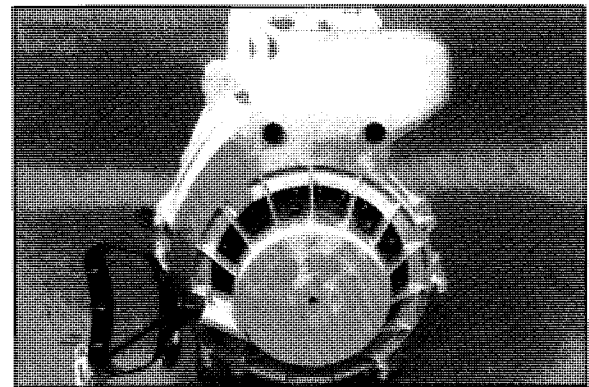
Fan Cooled Twin Cylinder

Engine Disassembly, Cont.

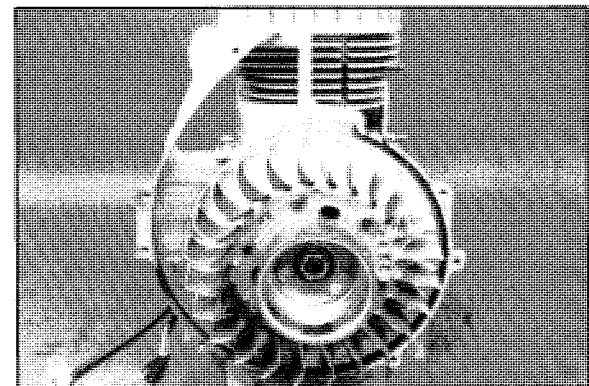
5. Note position of shroud retainer mounts on cylinder heads. These must be in the same position for reassembly.



6. Remove recoil fan housing.



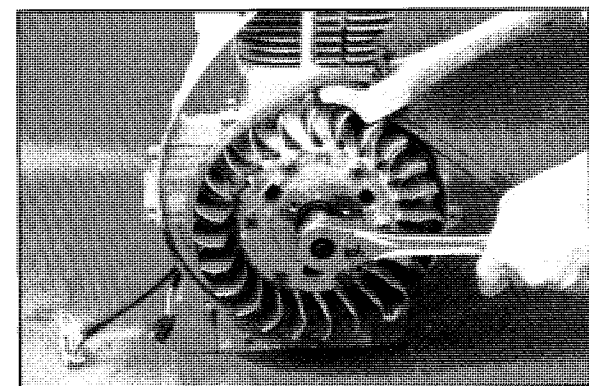
7. Remove recoil drive hub.



8. Hold flywheel with tool PN 8700229. Remove flywheel retaining nut.

Flywheel Holding Tool

PN 8700229



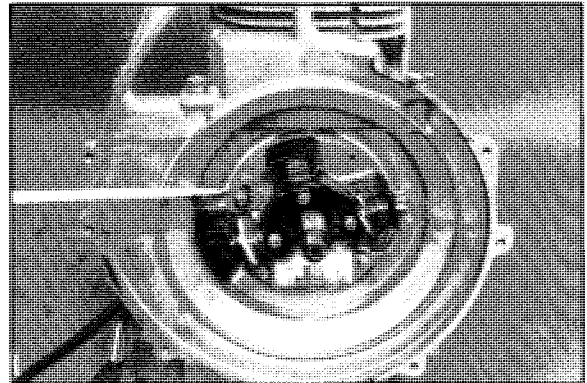
Engine Disassembly, Cont.

9. Using flywheel puller, remove flywheel. Use all available puller bolt holes on flywheel. Do not install puller bolts more than 5/16" (7mm) into flywheel threads or stator damage may result.

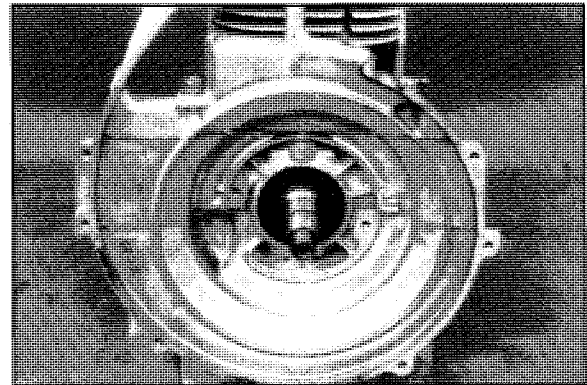
Flywheel Puller

PN 2871043

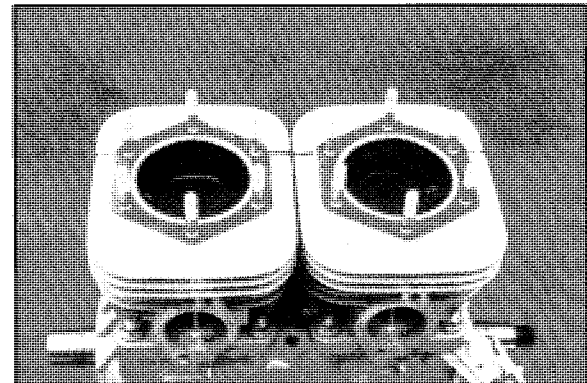
10. Mark stator plate and crankcase for reference upon reassembly. Remove stator plate.



11. Remove two bolts securing inner and upper shroud. Remove upper shroud.



12. Loosen and remove all bolts securing cylinder heads to cylinder. Remove heads.

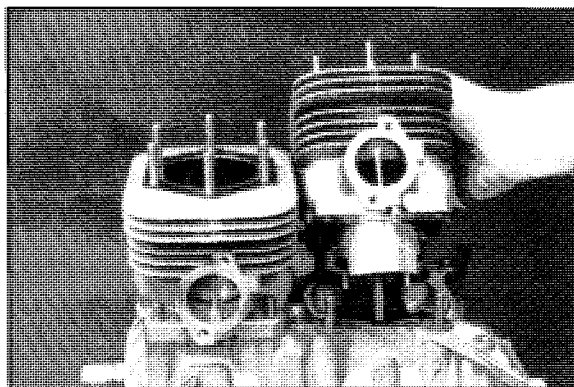


ENGINES

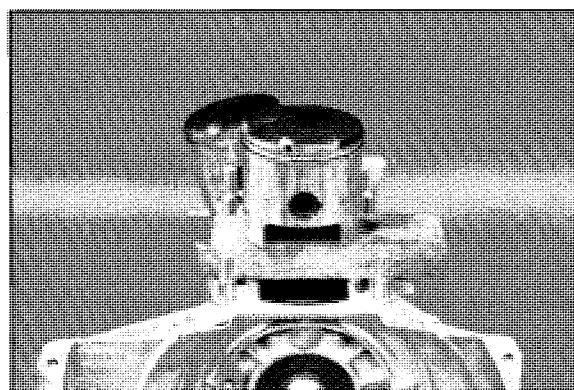
Fan Cooled Twin Cylinder

Engine Disassembly, Cont.

13. Remove cylinder base nuts and cylinders. **NOTE:** Refer to General Inspection Procedures for cylinder inspection.



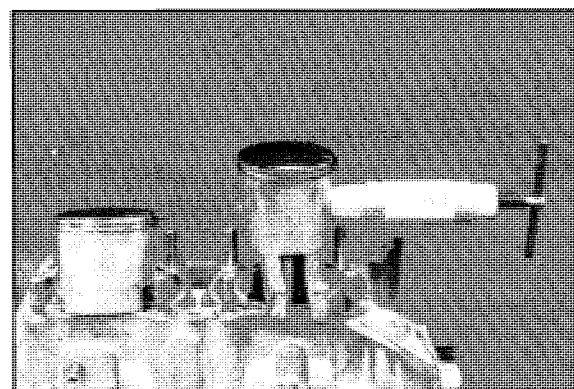
14. Support piston to prevent damage. Remove piston c-clip.



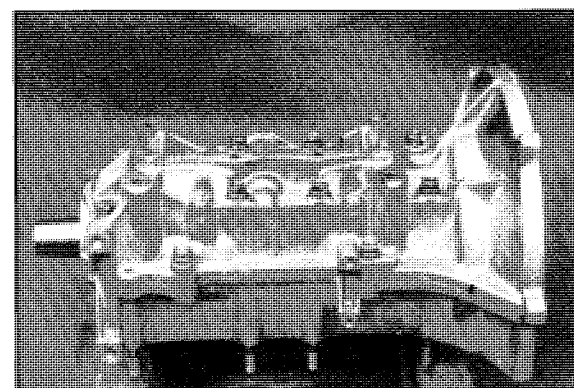
15. Remove piston pin and remove pistons. Refer to General Inspection Procedures in this chapter.

Piston Pin Puller

PN 2870386

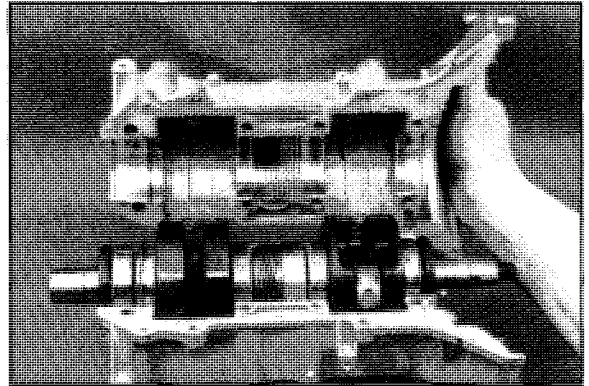


16. Remove engine mount plate or straps and remove all crankcase bolts.



Engine Disassembly, Cont.

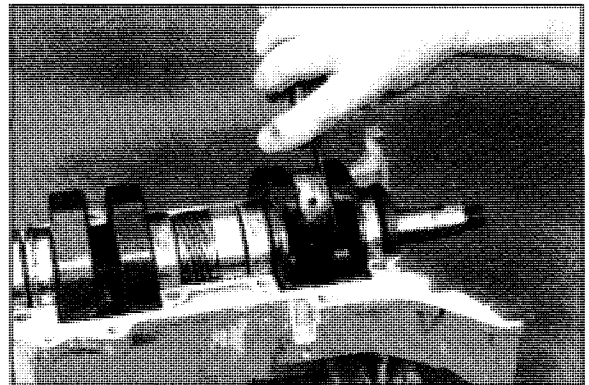
17. Separate crankcase halves.



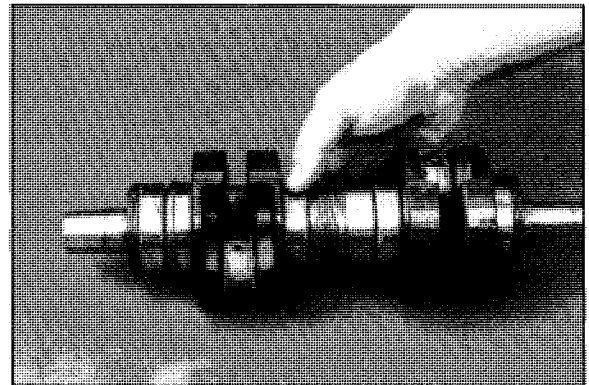
18. Measure connecting rod side clearance. Refer to General Inspection section for measurement procedure.

Connecting Rod Side Clearance

.012" - .016 (.30 - .40 mm)



19. Refer to General Inspection section for crankshaft inspection procedure.



ENGINES

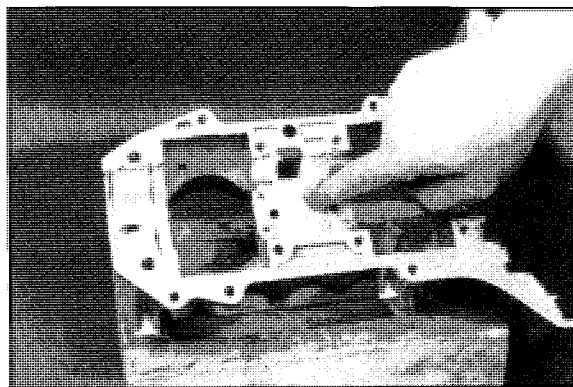
Fan Cooled Twin Cylinder

Engine Assembly

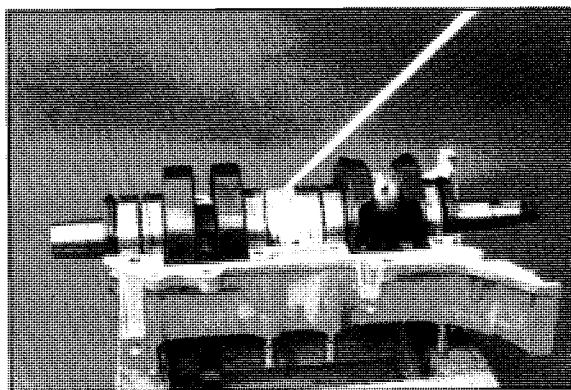
1. Clean all engine components thoroughly in a solvent tank. Blow dry with compressed air.
2. Apply 3-Bond™ sealer to top half of crankcase. Lubricate oil pump drive gear.

3-Bond™ 1215

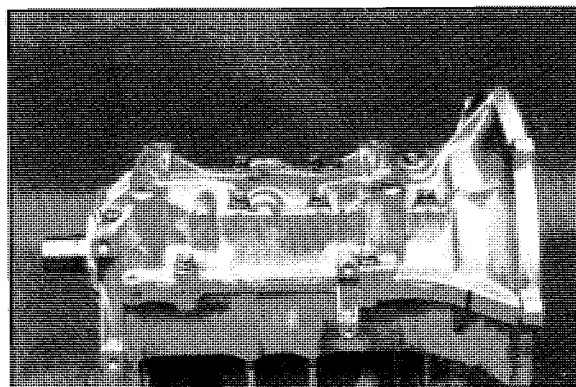
PN 2871557 120 Gram Tube



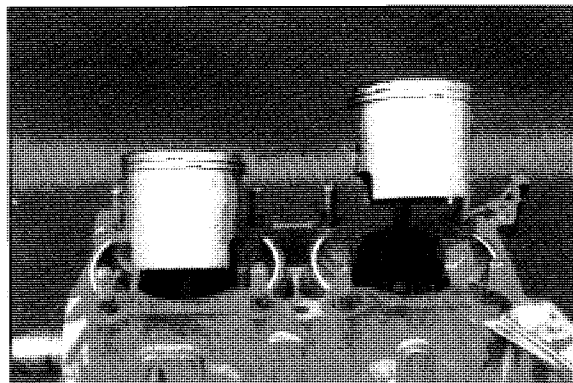
3. Lightly grease seals and install on crankshaft on crankshaft with lip (spring) facing inward toward crankshaft. Place crankshaft in upper crankcase half. Make sure seal and PTO bearing retainer fit properly into grooves.



4. Install bottom crankcase half and insert crankcase bolts. Torque to specification in proper sequence shown in beginning of this chapter. Lubricate crankshaft bearings through oil holes in upper crankcase.



5. Install pistons with arrow (▶) on piston facing flywheel. Install C-clips securely in piston groove.
6. Lubricate rings and pistons with two stroke oil. Install rings with letter, mark, or beveled side facing upward.
7. Install base gasket with adhesive sealant strip facing up (if applicable).

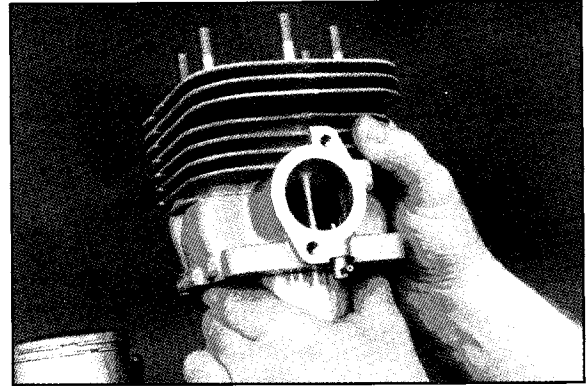


Engine Assembly, Cont.

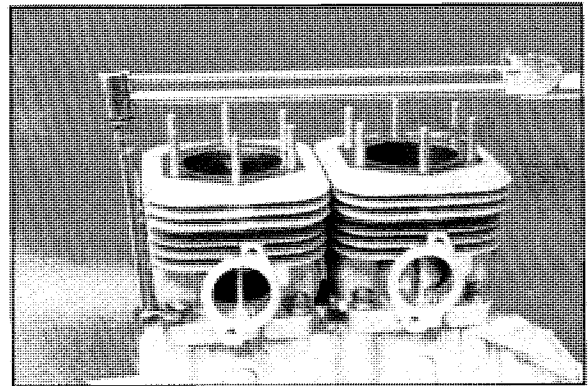
8. Lubricate cylinder with two stroke oil and install onto piston while compressing piston rings by hand. Be sure ring end gap is centered over locating pin or ring damage may occur. **NOTE:** Use a piston support block to help hold piston and prevent piston damage during assembly.

Piston Support Block

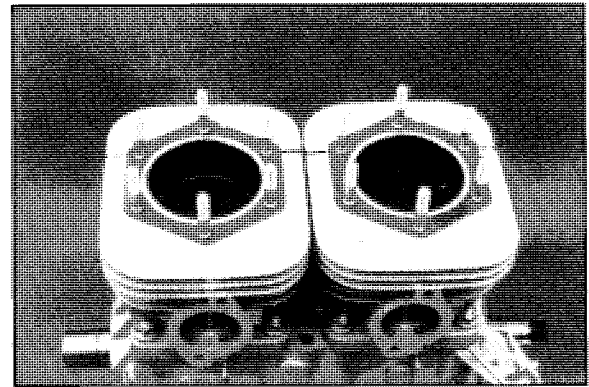
PN 2870390



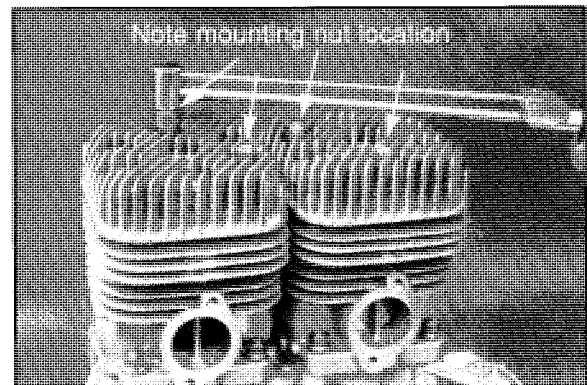
9. Torque cylinder base bolts to specification found in the beginning of this chapter.



10. Install head gasket with wide side of fire ring facing down (narrow side up).



11. Install cylinder heads and torque head bolts to specification found in the beginning of this chapter. **NOTE:** Make sure threaded head nuts are in the proper position for shroud mounting. See "x" in photo at right.



ENGINES

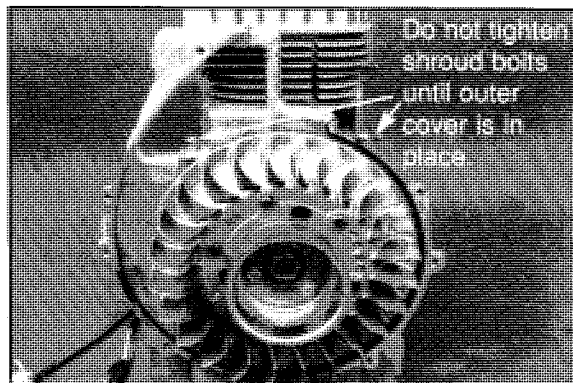
Fan Cooled Twin Cylinder

Engine Assembly, Cont.

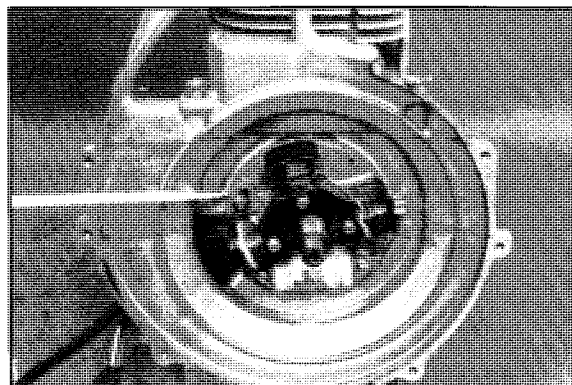
12. Install inner fan shroud.

CAUTION:

Do not tighten bolts until outer shroud is bolted in place. Outer shroud must determine placement of inner shroud, or damage may result.

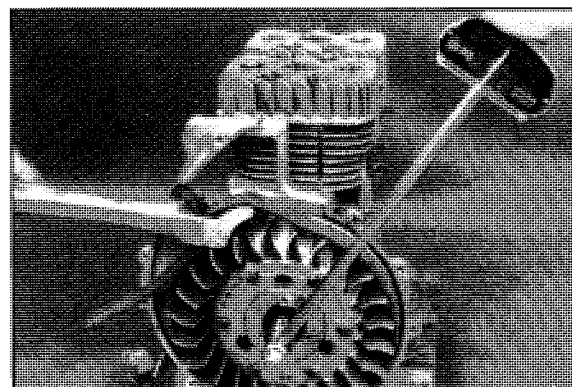


13. Install stator plate aligning ignition timing marks made during disassembly. Tighten stator mounting bolts securely.



14. Make sure key is on crankshaft and install flywheel aligning keyway.

15. Install flywheel nut and torque to specification found in the beginning of this chapter.



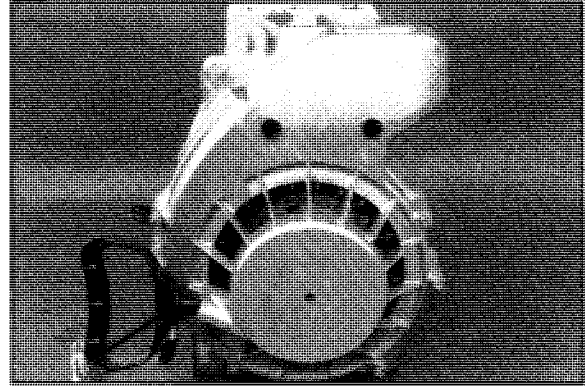
Flywheel Holding Wrench-

PN 8700229

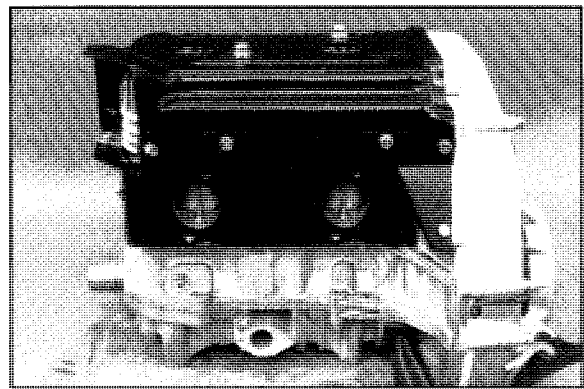
Engine Assembly, Cont.

16. Install recoil starter hub and recoil housing.

NOTE: Tighten two inner shroud bolts.



17. Reassemble cooling shroud.



18. Install oil pump. If crankcase, oil pump, or pump drive components were replaced, refer to General Inspection Procedures in this chapter to inspect drive gear end play.

Oil Pump Mounting Screw Torque:

48 - 72 in.lbs. (.55 - .83 kg-m)

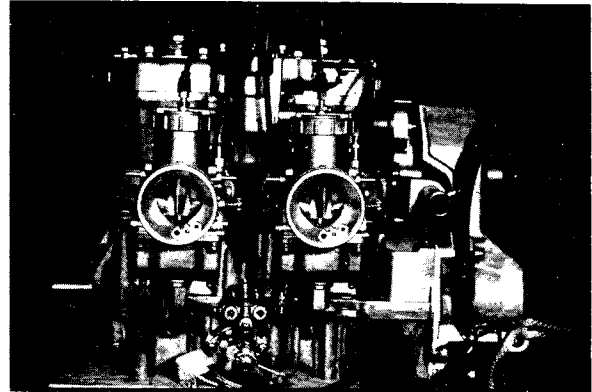
ENGINES

Liquid Twin Cylinder - Fuji

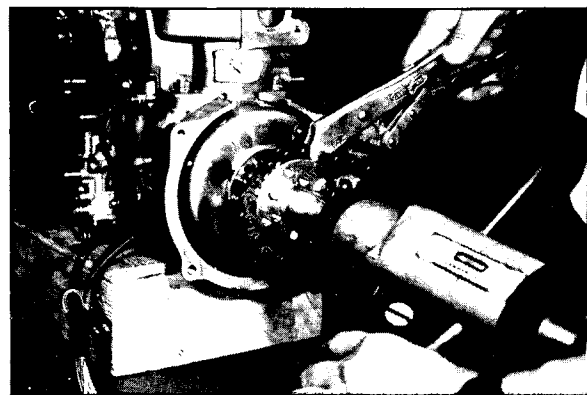
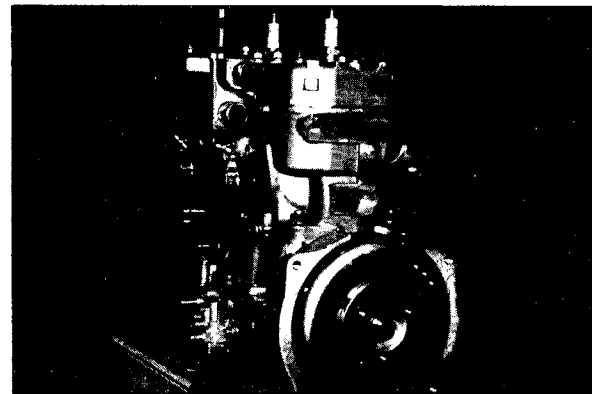
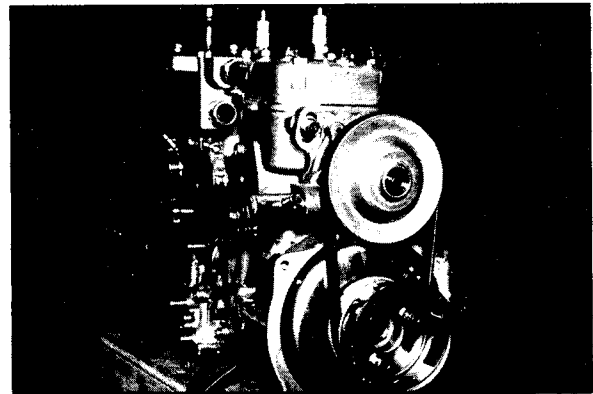
NOTE: Inspect all parts for wear or damage during disassembly. Replace all seals, O-rings, and gaskets during disassembly. Refer to pages 3.73-3.84 for general inspection procedures.

Disassembly

The photo at right shows a complete liquid cooled twin cylinder engine.



1. Remove carburetors.
2. Remove recoil housing and exhaust manifold.
3. Remove water pump, and starter recoil cup with water pump drive pulley and flywheel nut. Note position of shim washers for pulley alignment upon reassembly.
4. Install flywheel puller. Use all flywheel bolt holes. Do not install puller bolts more than 5/16" (7mm) into flywheel or stator damage may result.

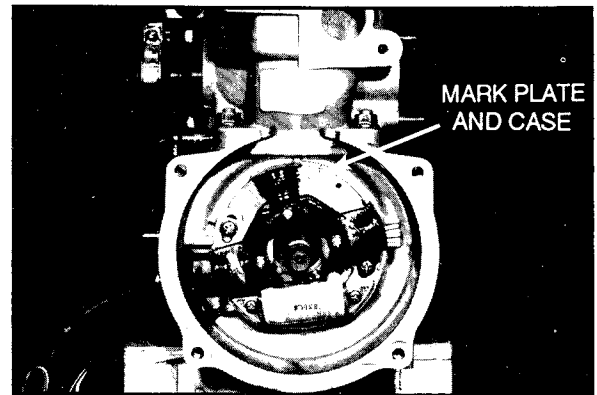


Flywheel Puller

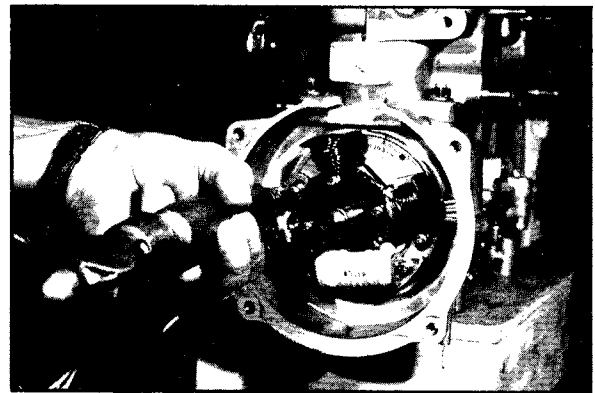
PN 2871043

Disassembly, Cont.

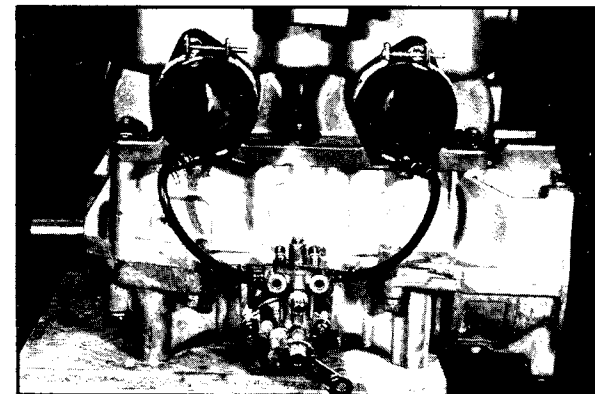
5. Mark stator plate and crankcase for reference when reassembling the engine.



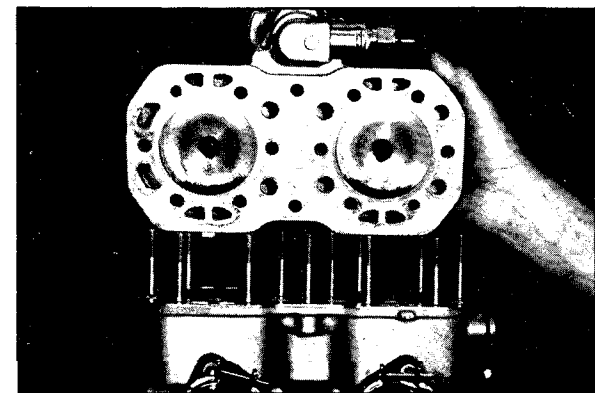
6. Using an impact screwdriver, remove stator screws.



7. Remove oil pump, oil pump feed lines, and banjo bolts from cylinder. Clean and inspect all components.



8. Remove cylinder head.

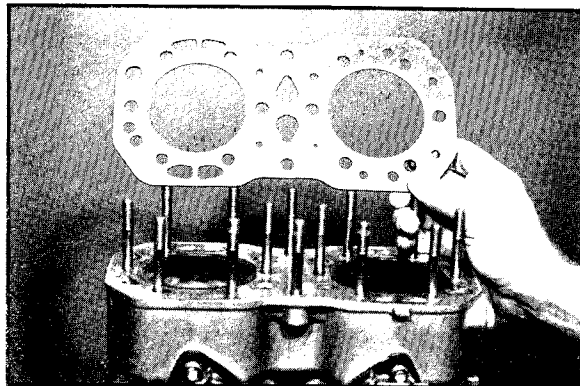


ENGINES

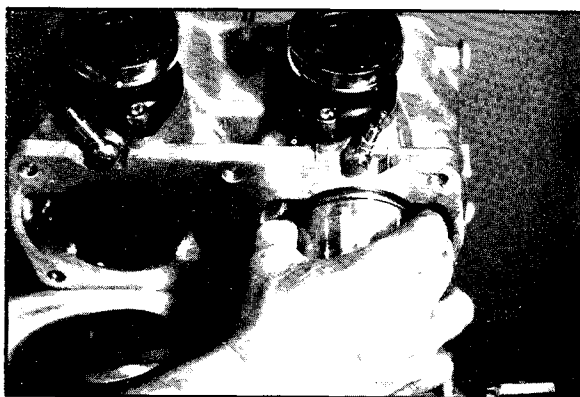
Liquid Twin Cylinder - Fuji

Disassembly, Cont.

9. Remove head gasket. Note position of head gasket inlet and outlet hole sizes for reference during reassembly.



10. Remove cylinder.



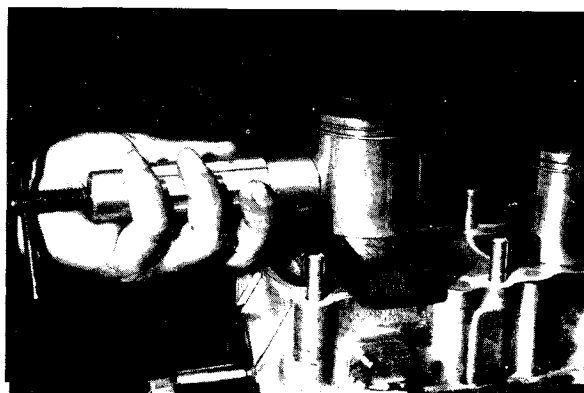
11. Remove C-clip retainers from piston as shown.



12. Using piston pin puller, remove piston pin from piston as shown.

Piston Pin Puller

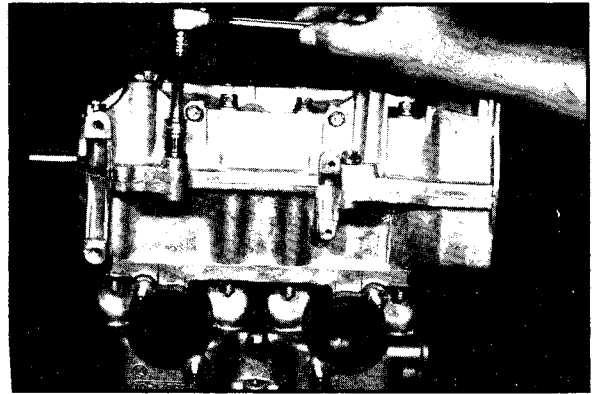
PN 2870386



Disassembly, Cont.

13. Remove crankcase bolts.

NOTE: Refer to General Inspection Procedures on pages 3.73-3.84 for engine component inspection (i.e. crankshaft and crankcase inspection, piston clearance, oil pump drive gear end play etc.).



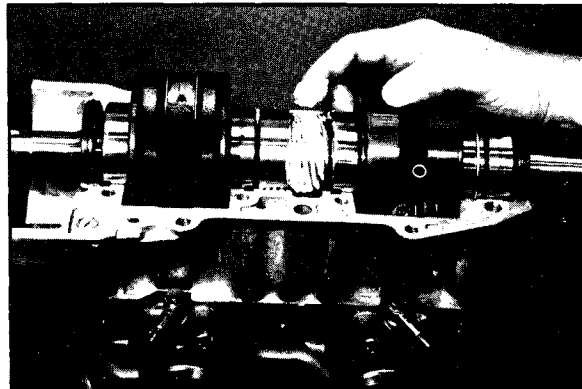
ENGINES

Liquid Twin Cylinder - Fuji

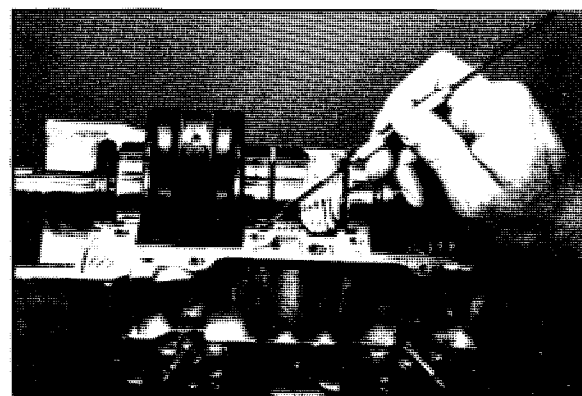
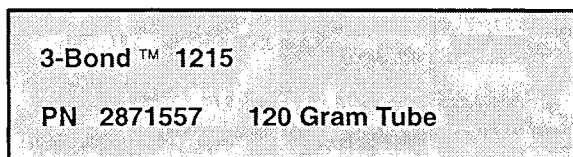
Assembly

Prior to assembly, refer to page 3.81 and check ring end gap and piston to cylinder clearance.

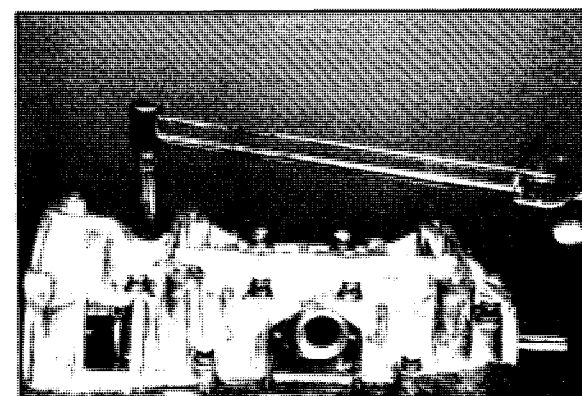
1. Grease crankshaft end seals and oil pump drive gear area as shown. Seals should be installed with spring and lip facing inward toward crankshaft.



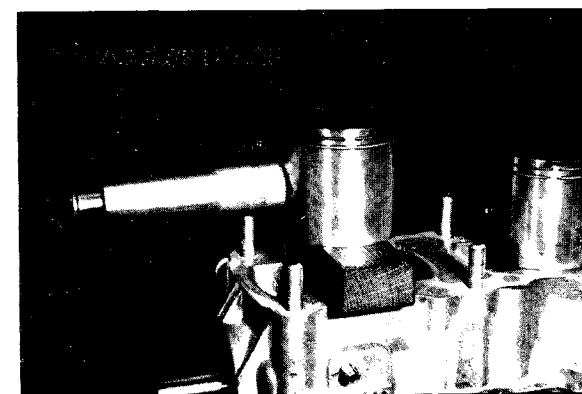
2. Turn bearing until anti-rotation pins are positioned in the proper location.
3. Apply 3-Bond™ sealant to crankcase halves.



4. Torque crankcase bolts following sequence outlined in beginning of this chapter. Lubricate crankshaft main bearings through access holes.

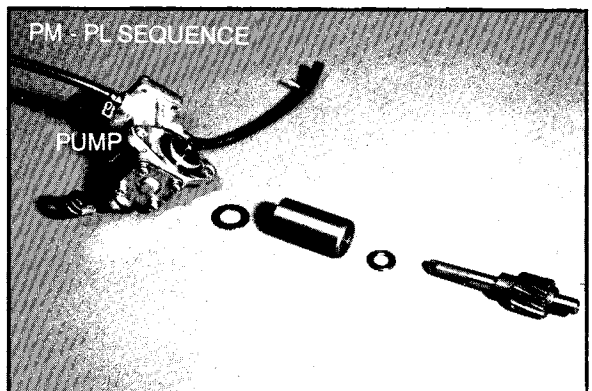
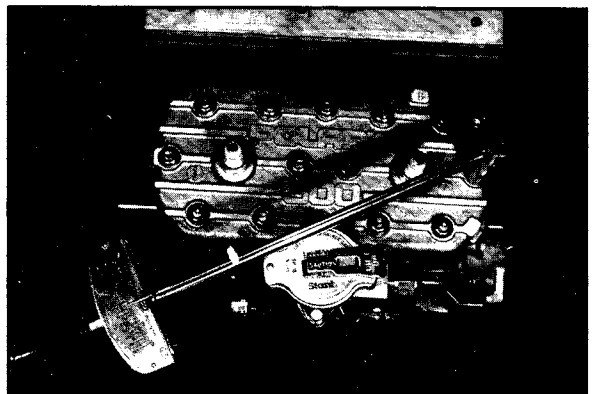
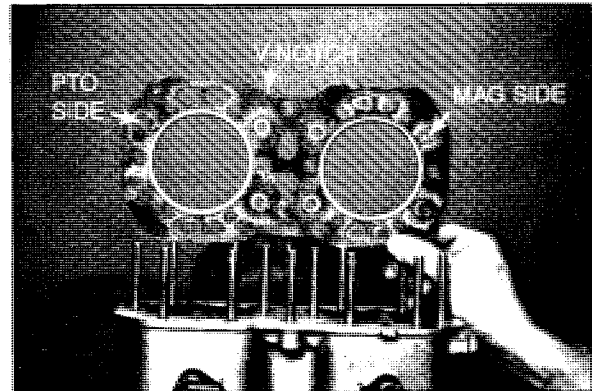
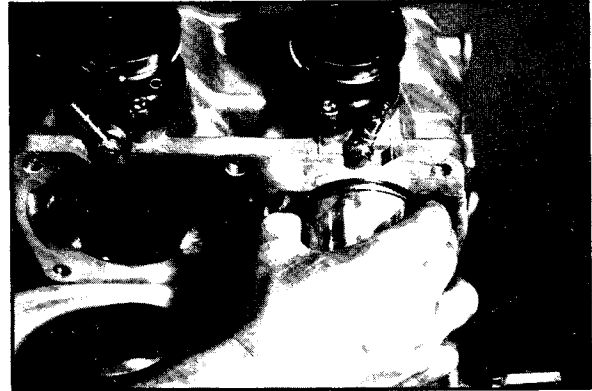


5. Install pistons with "F" mark or arrow (►) toward flywheel.
6. Install C-clip using installation tool PN 2870773.
7. Install new base gasket.
8. Lubricate rings and pistons with two stroke oil. Install rings with letter, mark, or beveled side facing upward.



Assembly, Cont.

9. Lubricate rings and cylinder with Premium 2 Cycle Lubricant and compress rings with fingers, aligning end gaps with locating pins. Install cylinder with a gentle front-to-back rocking motion, being careful not to damage rings. Install cylinder base nuts and tighten to correct specifications found in the beginning of this chapter
10. Install head gasket. Note proper position of gasket, "V" notch forward, small intake hole on right (mag) side, large hole on left (PTO) side.
11. Install cylinder head and torque cylinder head nuts following torque specs and pattern sequence in the beginning of this chapter.
12. Before installing oil pump drive gear, refer to end play adjustment in General Inspection Procedures.
13. Install oil pump in the sequence shown in photo at right.

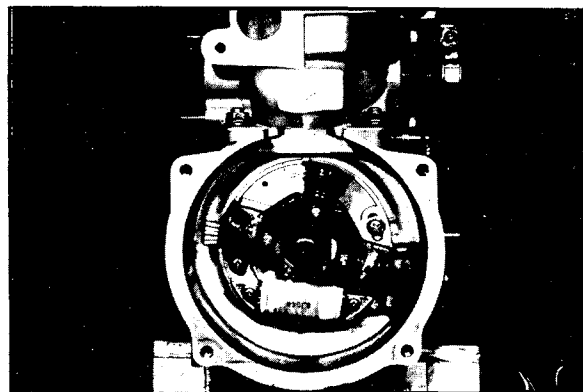


ENGINES

Liquid Twin Cylinder - Fuji

Assembly, Cont.

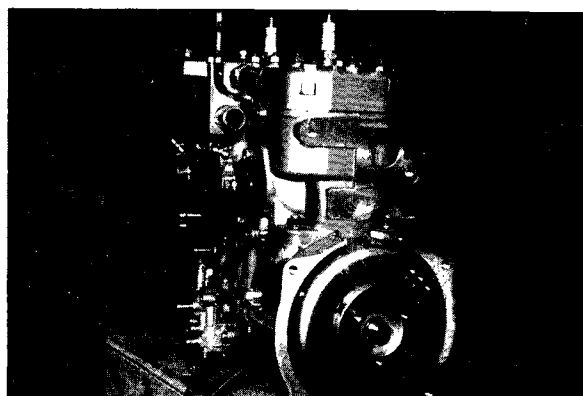
14. Connect oil feed lines to cylinder.
15. Align stator as previously marked on stator plate and secure with screws.



16. Install flywheel and torque flywheel nut to specification found in beginning of this chapter.

Flywheel Holding Tool -

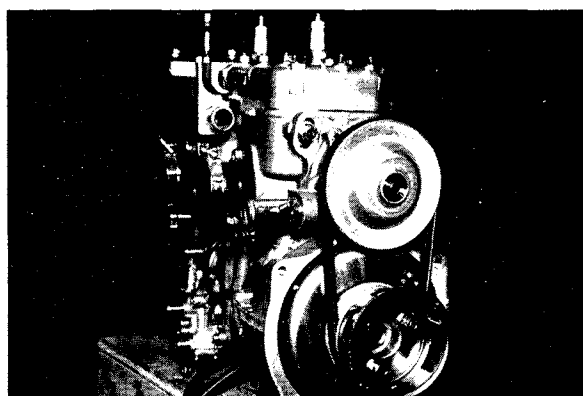
PN 8700229



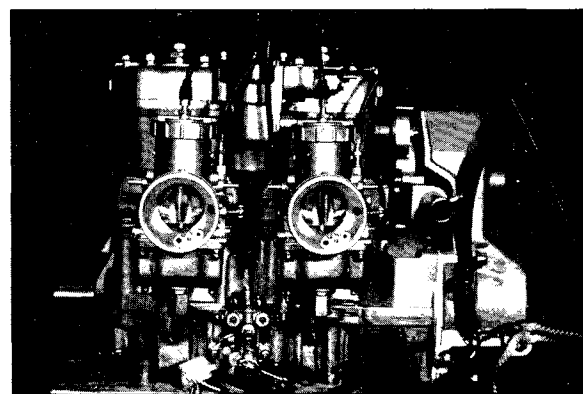
17. Install water pump and recoil starter cup.
18. Adjust tension on water pump belt by loosening mounting bolts, applying tension, and re-tightening bolts.

Water Pump Belt Deflection -

1/8 - 3/16" (.3 - .4 cm)



19. Install recoil housing, carburetors, and oil pump cable. Refer to oil pump bleeding in General Inspection Procedures.
20. Connect CDI to stator plug connector.



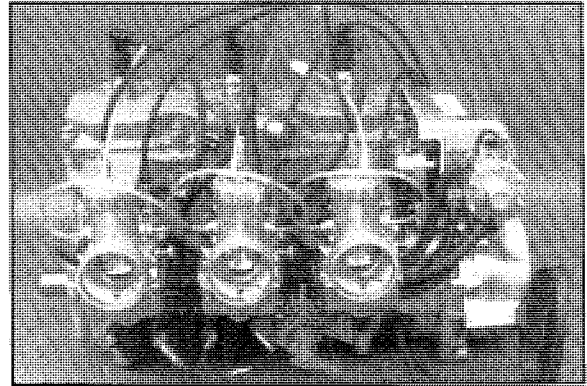
ENGINES

Three Cylinder Monoblock

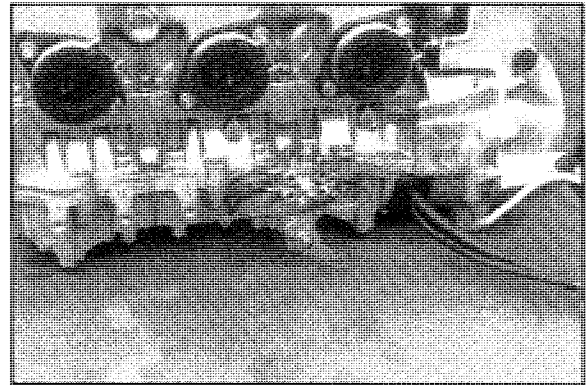
NOTE: Inspect all parts for wear or damage during disassembly. Replace all seals, O-rings, and gaskets during disassembly. Refer to pages 3.73-3.84 for general inspection procedures.

Disassembly

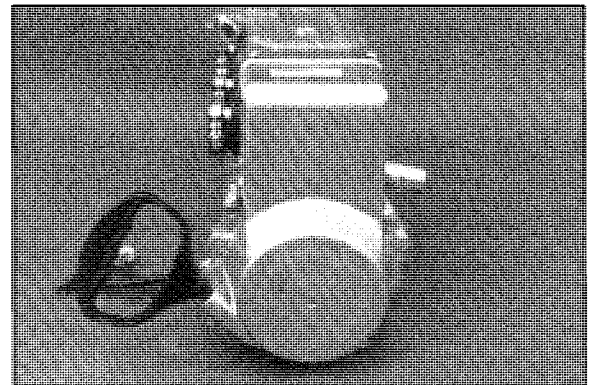
1. Remove carburetors and secondary coils.



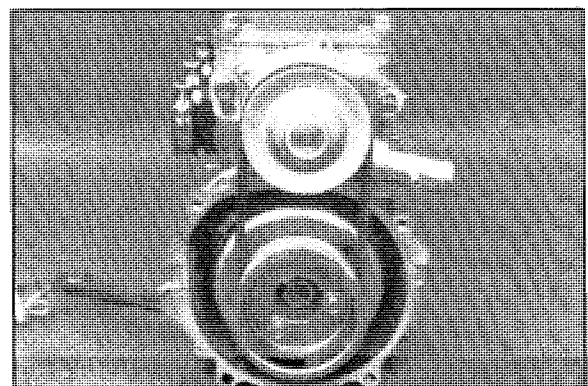
2. Remove oil pump.



3. Remove recoil housing.



4. Remove recoil hub.

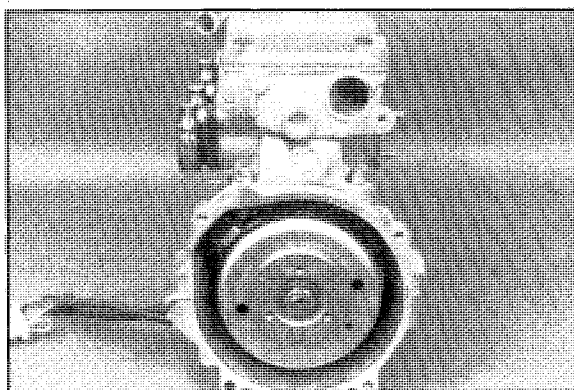


ENGINES

Three Cylinder Monoblock

Disassembly, Cont.

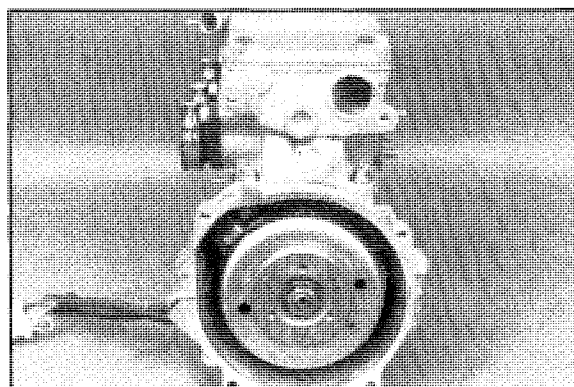
5. Remove water pump.



6. Remove flywheel retaining nut. Position flywheel holder as shown.

Flywheel Holder

PN 8700229



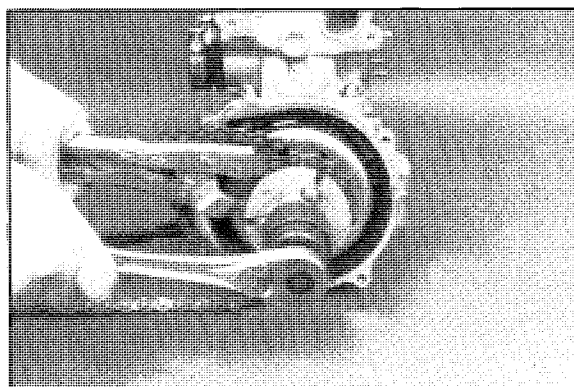
7. Install flywheel puller. Remove flywheel.

Flywheel Puller

PN 2871043

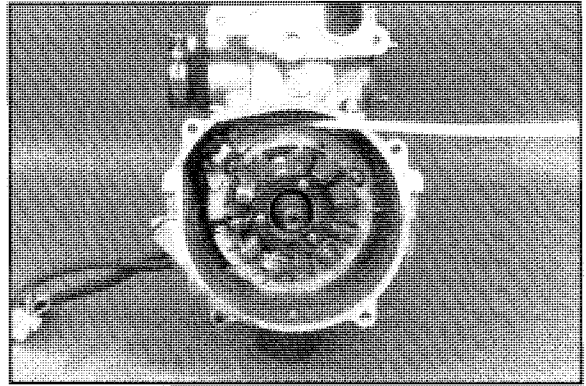
CAUTION:

Do not install puller bolts more than 5/16" (7.9 mm) or stator damage may result.

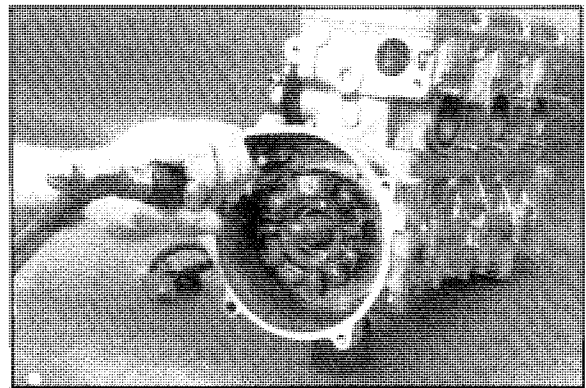


Disassembly, Cont.

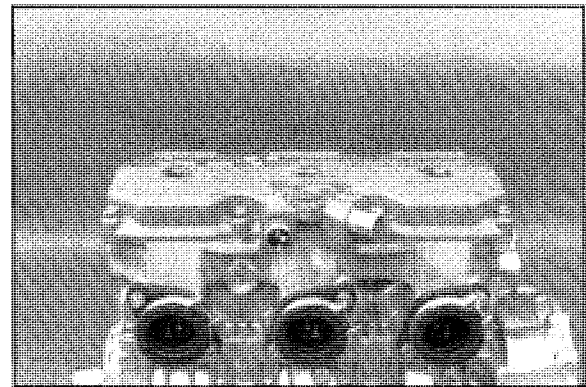
8. Mark or note location of stator plate on plate and crankcase.



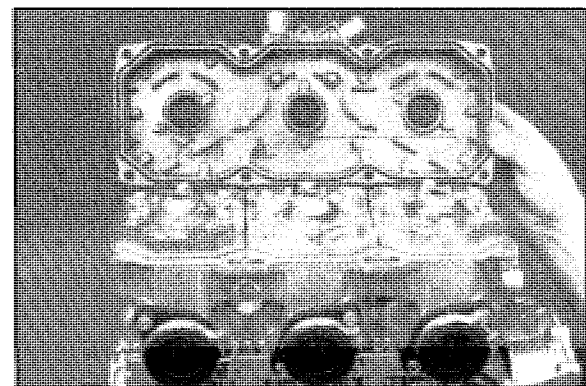
9. Remove stator. **NOTE:** Stator bolts may be loosened using an impact driver.



10. Remove cylinder head cover.



11. Note condition and location of spark plug seat O-rings in head cover. Also note the quantity and location of shim washers located beneath the O-rings.

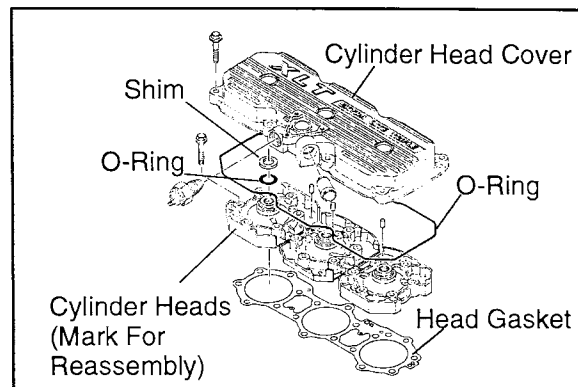


ENGINES

Three Cylinder Monoblock

Disassembly, Cont.

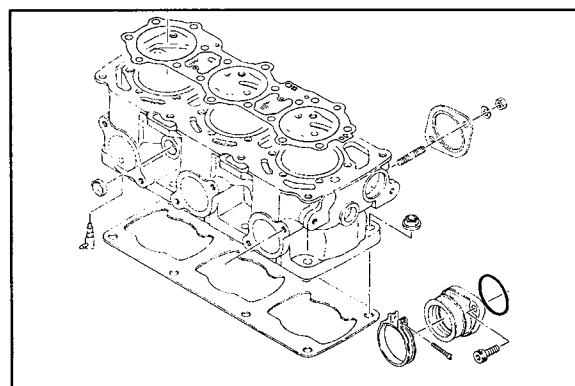
12. Remove cylinder heads. Mark PTO, Center, and Mag head to ensure correct reassembly.



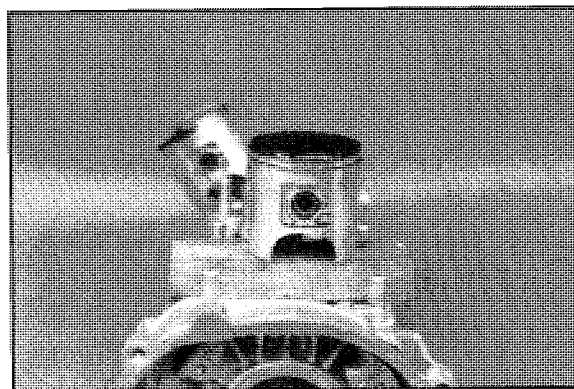
13. Remove cylinder and base gasket.
14. Refer to cylinder inspection procedure on page 3.86 to inspect cylinder.

CAUTION:

Use care to ensure pistons are not damaged as cylinder is removed.



15. Support pistons with piston support block and remove C-clips.

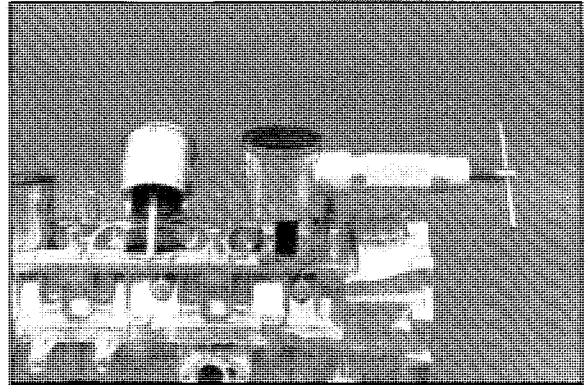


Disassembly, Cont.

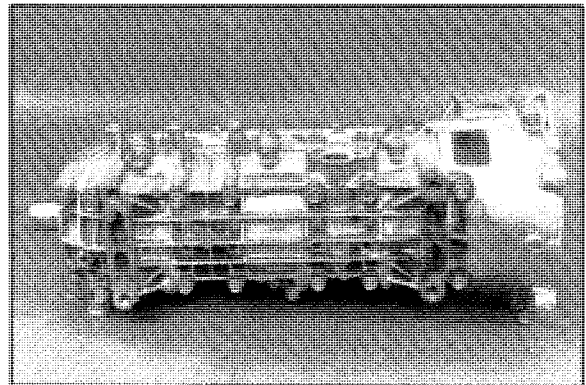
16. Remove piston pins using piston pin puller and adaptor as shown. Refer to General Inspection Procedures in this section.

Piston Pin Puller PN 2870386

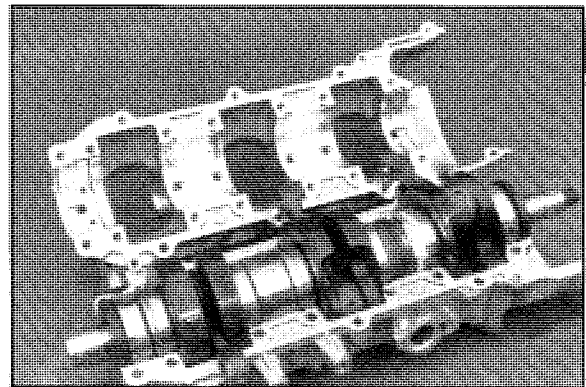
Adapter PN 5130971



17. Remove all crankcase bolts.



18. Separate crankcase halves and remove crankshaft.
19. Follow procedure in General Inspection Procedures for crankshaft inspection.
20. Clean all components in a solvent tank to remove any dust, dirt, debris, and excess sealant. Inspect mating surface of upper and lower crankcase for damage.



ENGINES

Three Cylinder Monoblock

Assembly

1. Apply 3-Bond™ to upper crankcase half. Lubricate oil pump drive gear. Lightly grease seals and install on crankshaft with seal lip (spring) facing inward.

3-Bond™ 1215

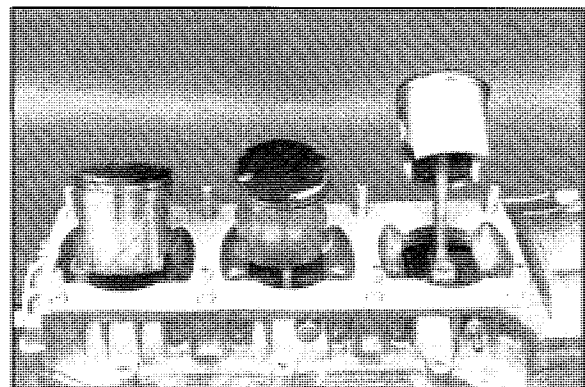
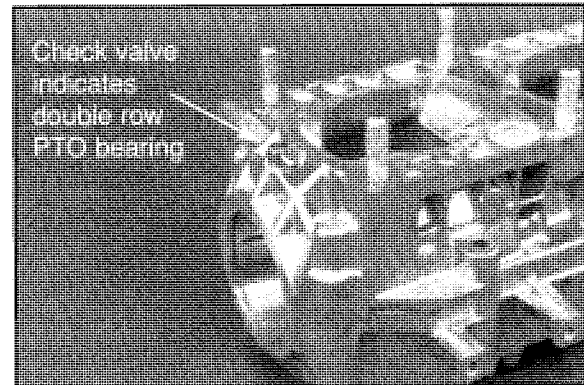
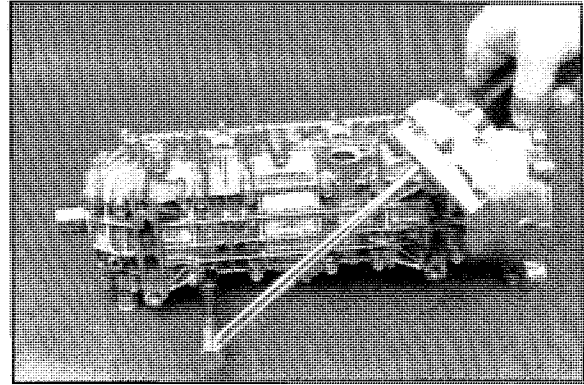
PN 2871557 120 Gram Tube

2. Install crankshaft in upper crankcase.

NOTE: Make sure seals and all locating (anti-rotation) pins fit correctly in grooves and detent notches.

3. Install bottom crankcase half. Make sure anti-rotation pins are aligned properly and torque bolts to specification found in beginning of this chapter.

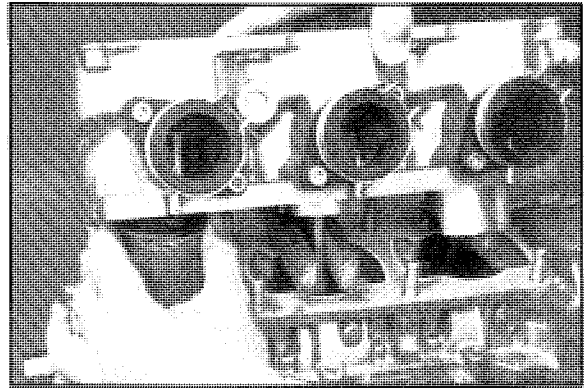
4. Lubricate crankshaft main bearings through oil holes in upper crankcase. Lubricate connecting rod big end bearing.
5. Lubricate pistons, rings, connecting rod small end bearing and cylinder before assembly. Install pistons, piston pins, and C-clips with end gap up or down. **NOTE:** Marking on piston faces flywheel. Be sure "C" clips are fully seated in groove.
6. Apply a small amount of Loctite 515 gasket eliminator to base gasket ends and install gasket noting location of transfer port reliefs. **NOTE:** The sealant on base gasket faces up.



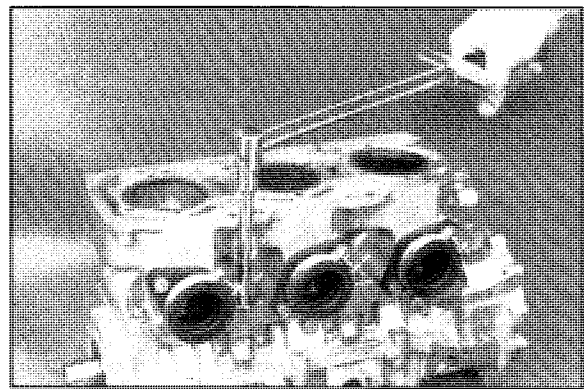
Assembly, Cont.

7. Before installing cylinder, refer to honing procedure on pages 3.73-3.74 of this section. Inspect piston to cylinder clearance and piston ring installed gap as shown on page 3.81. Install rings on pistons. Depress rings in alignment with locating pins on piston using either a ring compressor or your fingers. Carefully install the cylinder. Install pistons in the following order:

- Mag
- Center
- PTO

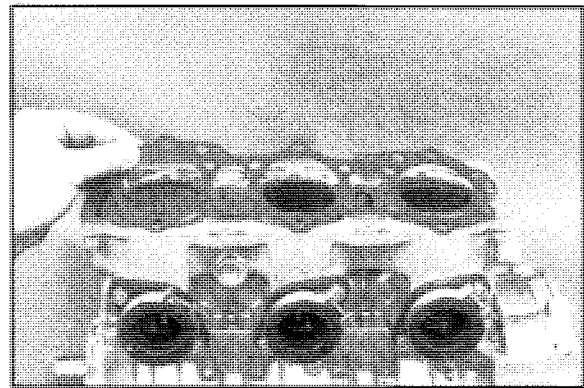


8. Torque base bolts, starting in the middle, alternate intake to exhaust side, moving toward PTO end and mag end. Refer to torque patterns in beginning of this chapter.

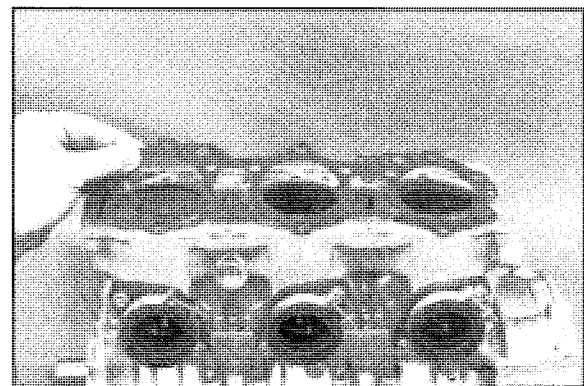


9. Install new head gasket. Be sure cylinder and cylinder head sealing surfaces are clean.

NOTE: EX stamping should be readable and facing exhaust side.



10. Install heads in the correct position and location as marked during disassembly. Torque head bolts to specification found in the beginning of this chapter.

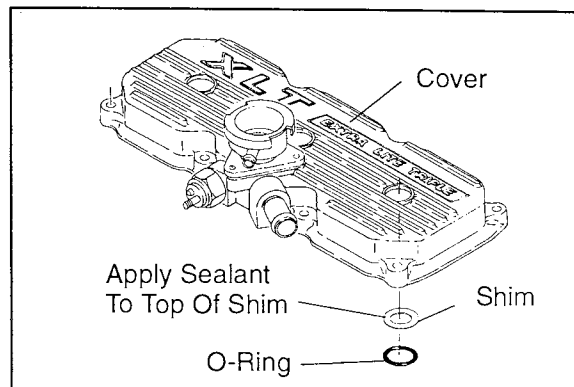


ENGINES

Three Cylinder Monoblock

Assembly, Cont.

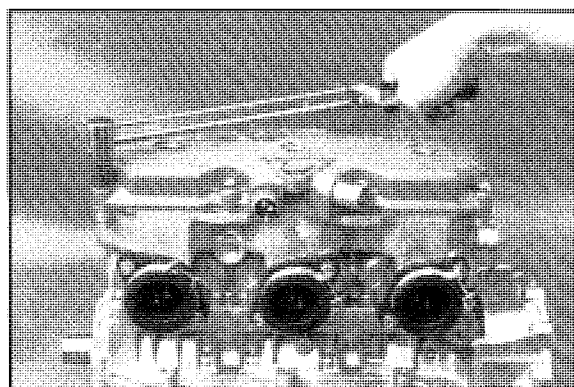
11. Replace outer O-ring on cover.
12. Apply Loctite 515 to cover as shown.
13. Position shim and O-Ring as shown.



14. Install head cover.
15. Install and torque head cover mounting bolts to specification.

Head Cover Mounting Bolt Torque

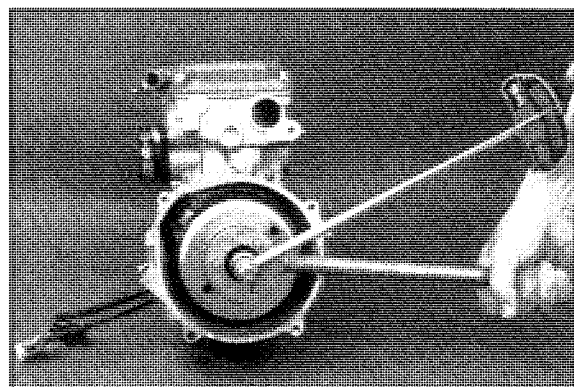
17-20 Ft lbs (2.4-2.8 kgm)



16. Install stator in the previously marked position and tighten screws securely.
17. Install and torque flywheel nut to specification found in beginning of this chapter.

Flywheel Holder Wrench:

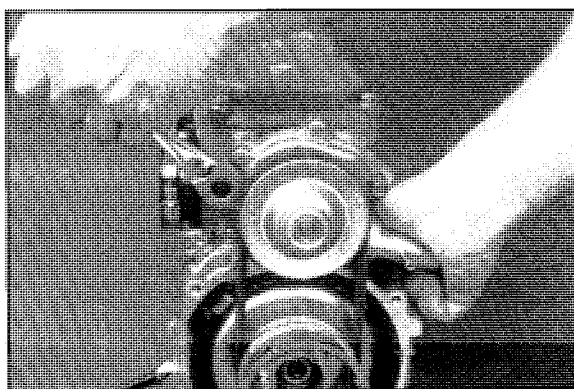
PN 8700229



18. Install water pump and belt. Apply proper tension to belt and tighten pump mounting bolts.

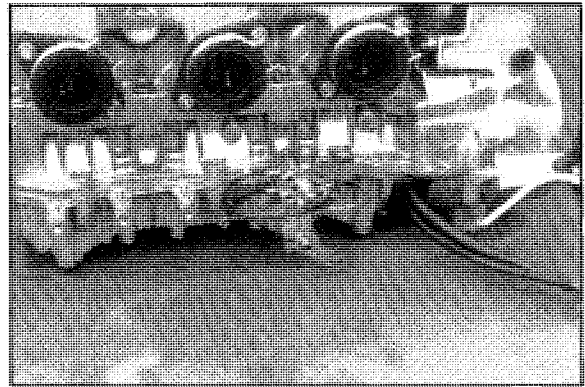
Water Pump Belt Tension

1/8" - 3/16" (3-4mm)

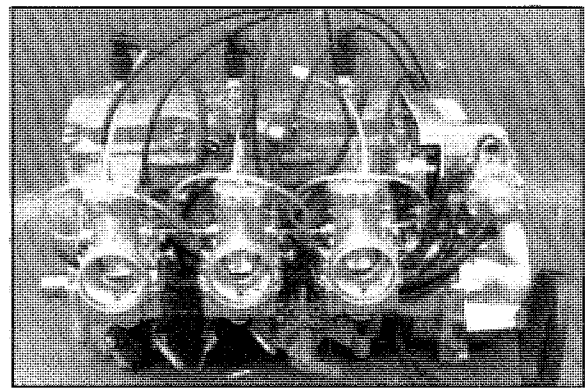


Assembly, Cont.

19. Install oil pump and connect feed lines. If crankcase, oil pump, or drive components were replaced, refer to oil pump drive gear end play adjustment in General Inspection Procedures.
20. Install recoil housing.



21. Install secondary coils and secure carburetors to rubber mounts.



ENGINES

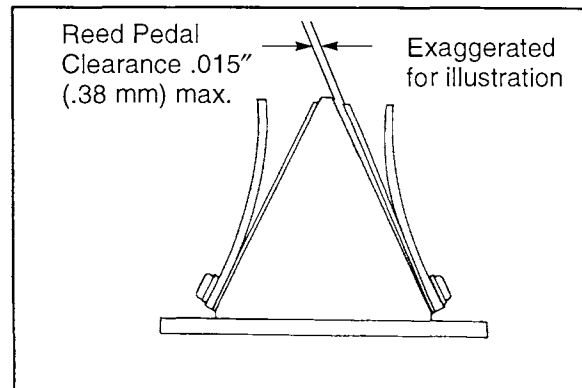
440/500 Domestic Case Reed Twin

NOTE: Inspect all parts for wear or damage during disassembly. Replace all seals, O-rings, and gaskets during disassembly. Refer to pages 3.73-3.84 for general inspection procedures.

Disassembly

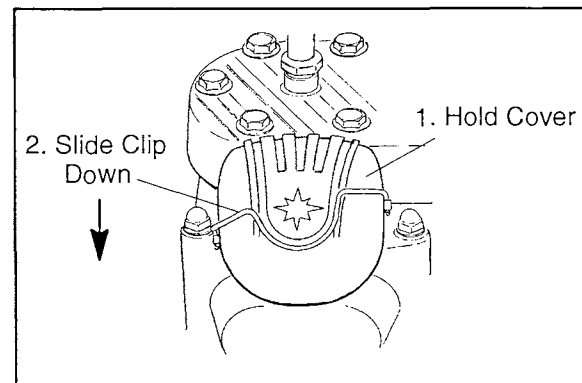
1. Remove carburetor mount adaptors, reed cages, stuffers, and oil pump. Note position of stator wire guide.

Measure air gap between fiber reed and reed block as shown. The air gap should not exceed .015" (.4 mm). If clearance is excessive DO NOT attempt to reverse the reeds to reduce the air gap. *Always replace them if damaged.* Check each fiber reed for white stress marks or missing material. Replace if necessary.



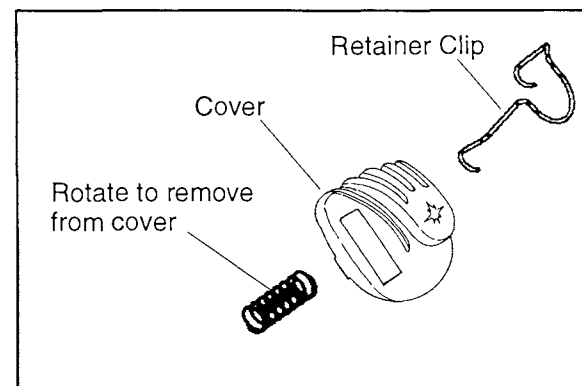
V.E.S. Removal - 440

2. Pull back cover retainer clip while holding the cover in place.
3. Remove cover and return spring.

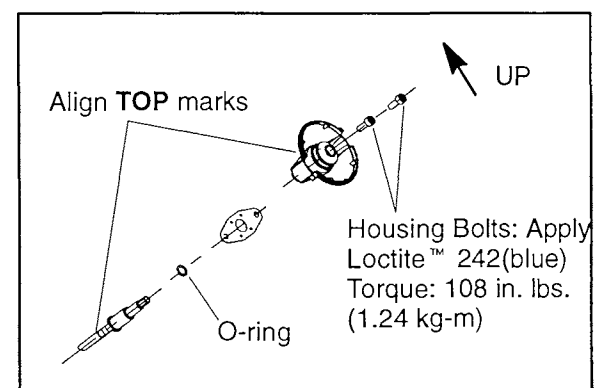


4. If the spring stays in the cover, hold the cover with spring facing toward you. Rotate spring in a counterclockwise direction while pulling outward on the spring. Do not distort the spring upon removal.

CAUTION: Do not attempt to remove the plastic valve piston at this time. The bellows must first be removed from the piston or damage may occur to the bellows or piston.

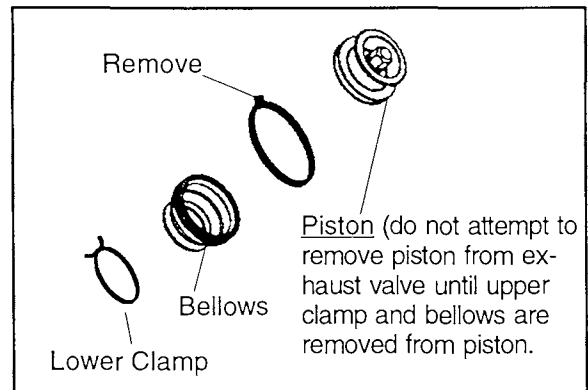


5. Remove two (5mm) hex screws from valve housing.
6. Note location of "TOP" marks on housing and exhaust valve. Lift entire valve assembly from cylinder along with gasket.

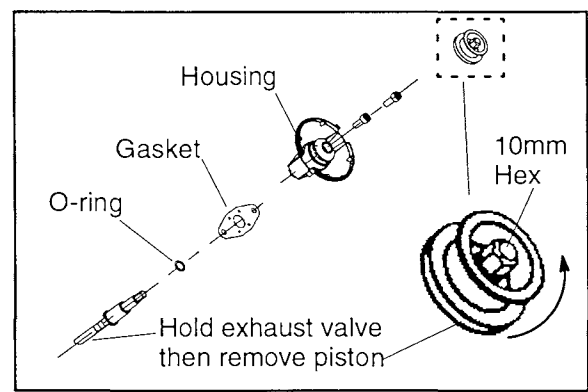


Disassembly, Cleaning, Inspection - VES - 440 XCR

1. Carefully remove the fastener strap in the area shown. Use care to avoid cutting the bellows.
2. Fold back upper edge of bellows to expose lower edge of piston.



3. Hold exhaust valve securely and remove piston by turning the 10mm hex counterclockwise.
4. Slide exhaust valve out of housing.
5. Remove O-ring from exhaust valve shaft.
6. Compress lower spring clamp and remove bellows and clamp.
7. Clean O-ring and bellows in warm water and mild detergent. Inspect bellows for holes, distortion or damage. Replace if necessary. Inspect O-ring for damage.
8. Clean all other parts with solvent. Be sure all parts are thoroughly clean.
9. Inspect the actuator port in cylinder and valve housing. Be sure it is clear and not obstructed by debris or carbon.
10. Carbon deposits can be removed from valve with a Scotch Brite™ pad or similar soft abrasive brush.
11. Lubricate exhaust valve with Polaris Premium Gold 2-cycle engine lubricant. Install valve in cylinder and move it through the entire travel range to check for free movement without binding. If the valve sticks anywhere in the travel range, check the valve and valve bore in the cylinder for carbon deposits and clean if necessary.

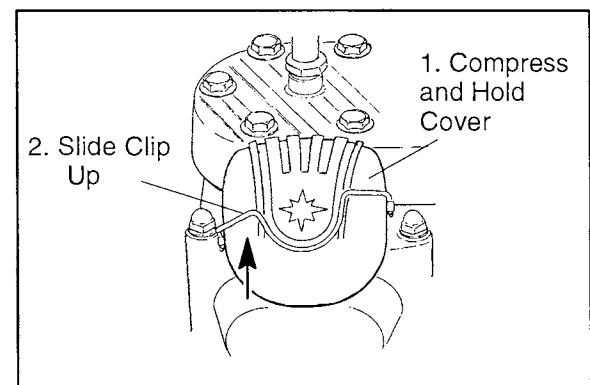
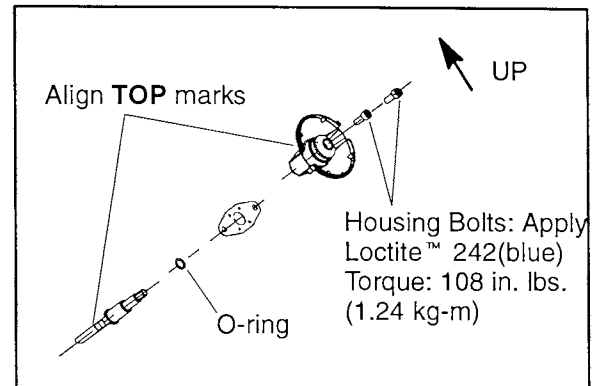


ENGINES

440/500 Domestic Case Reed Twin

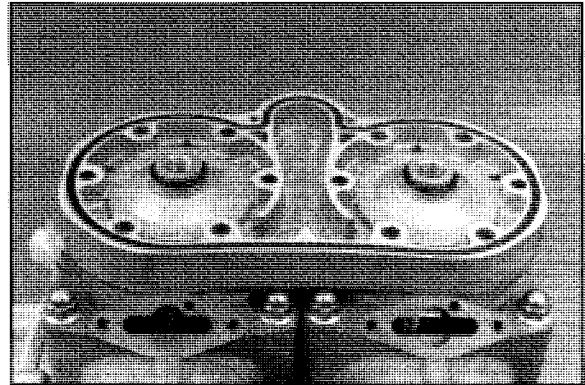
V.E.S. Assembly - 440 XCR

1. Install lower clamp over small end of bellows.
2. Assemble dry. Install bellows on housing. Be sure bellows is completely seated in groove, and install clamp.
3. Place a new o-ring and gasket on exhaust valve.
4. Insert exhaust valve in housing with TOP marks aligned. Both the valve housing and valve are marked with "TOP".
5. Apply Loctite™ 242 to threads of exhaust valve and install the piston. Hold exhaust valve and torque piston to 25 in. lbs. (.28 kg-m).
6. Install valve assembly in cylinder with TOP marks on valve and housing facing up. Apply Loctite 242 (blue) to housing bolt threads. Install and torque bolts to 108 in. lbs. (1.24 kg-m).
7. Fit upper sealing edge of bellows into groove on piston.
8. Secure the bellows by installing the fastener strap. **NOTE:** Move the valve up and down in the full travel range and check for smooth operation. If the valve binds in any spot, check the bellows to be sure it is not twisted on the piston.
9. Install spring and cover. Be sure spring is properly positioned on the piston and in the cover.

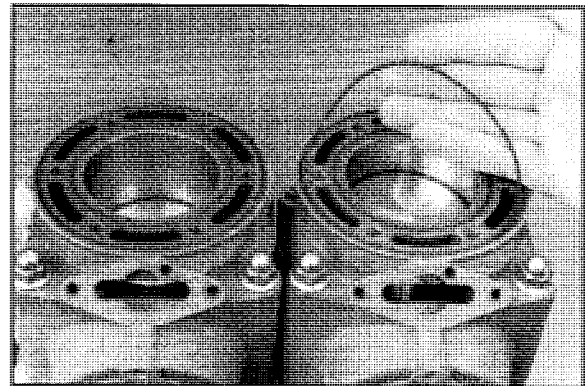


Disassembly, Cont.

7. Remove cylinder head cover and inspect O-rings and sealing surfaces for damage or debris. Use new O-rings upon assembly.

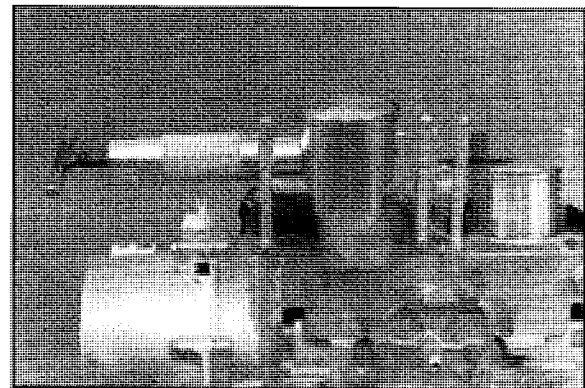


8. Remove cylinder base nuts. Note location of acorn nuts on exhaust side (where applicable).
9. Carefully remove cylinders while supporting pistons and connecting rods to prevent piston damage. Refer to General Inspection Procedures in this chapter.
10. Remove outer piston pin C-clips using a scribe through access slot in piston.

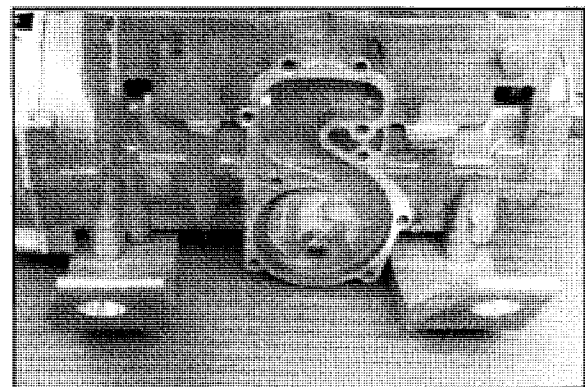


11. Place support block under piston and remove piston pins using pin puller.

Piston Pin Puller	PN 2870386
Support Block	PN 2870390



12. Remove water pump cover from front of engine.

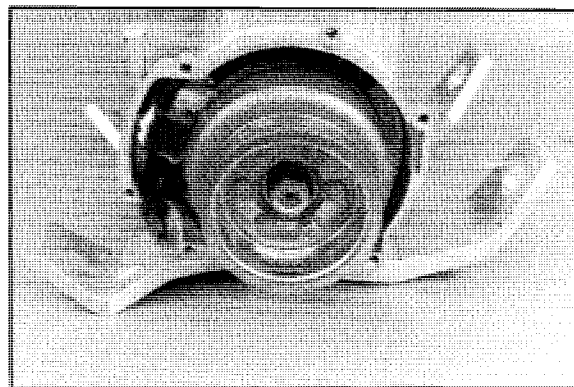


ENGINES

440/500 Domestic Case Reed Twin

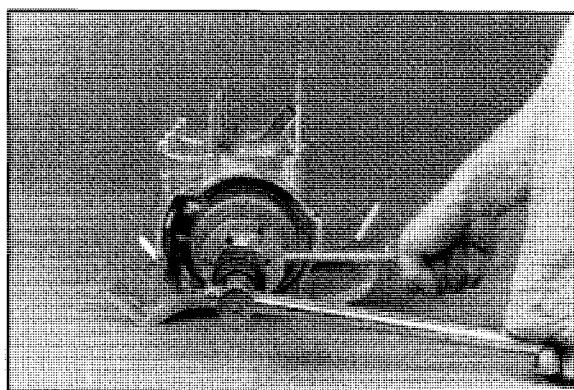
Disassembly, Cont.

13. Remove recoil housing and drive hub.

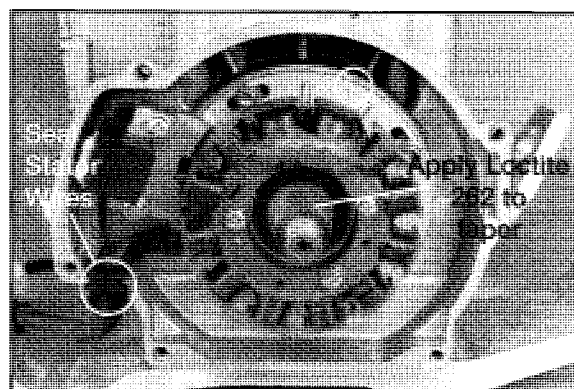


14. Remove flywheel using heavy-duty flywheel puller. Use drive clutch puller T-handle or a wrench to hold puller.

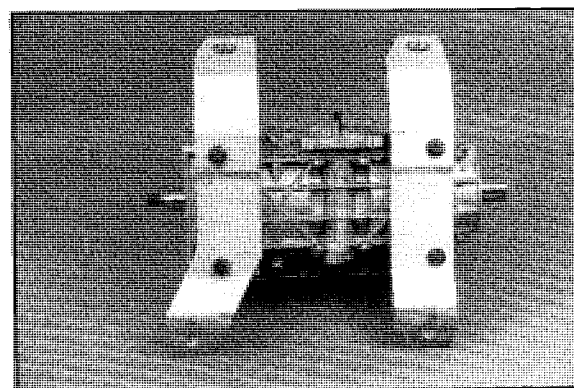
Flywheel Puller	PN 2871043
T-Handle	PN 5020326



15. Before removing stator plate, note where ignition timing marks are located, or scribe additional marks for reference upon reassembly.

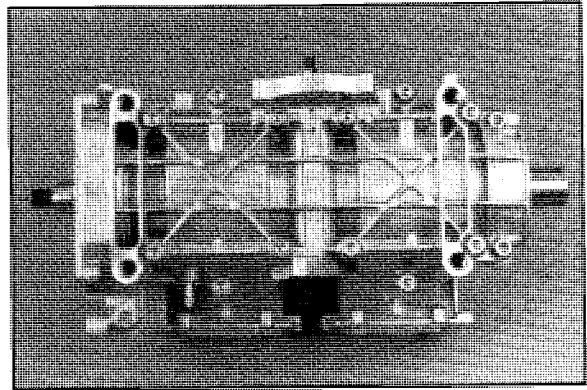


16. Mark or note location of engine mount straps and remove.

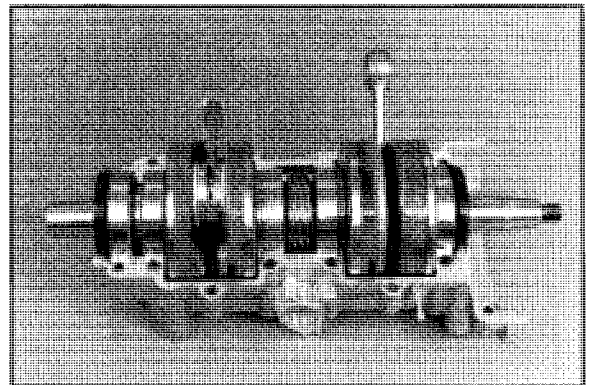


Disassembly, Cont.

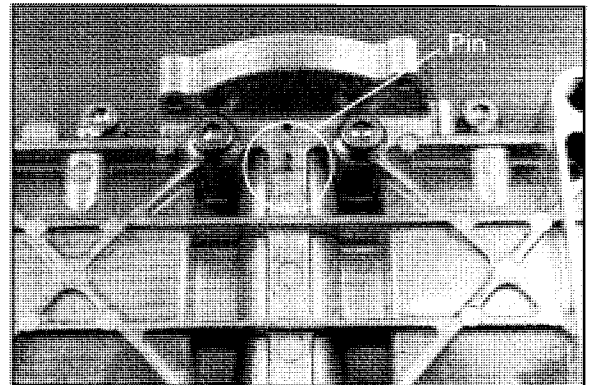
17. Remove bolts and separate case halves. Keep bolts in order for assembly.



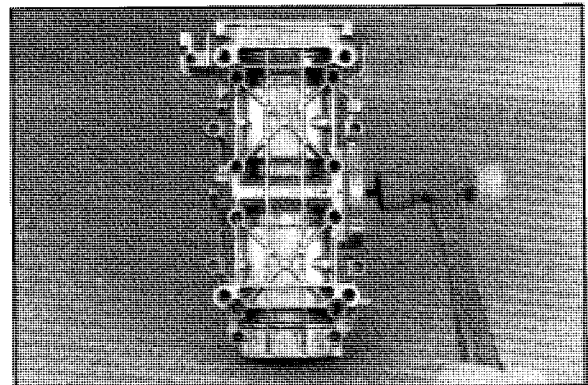
18. To prevent damage to snap-ring grooves, lift crankshaft straight upward and out of lower case.



19. If pump shaft removal is necessary, remove retaining pin from crankcase using a diagonal cutter or similar tool.



20. Using a soft faced hammer, tap pump shaft out of lower case half from front (water pump side) to rear (oil pump side). Note location washers on the shaft.

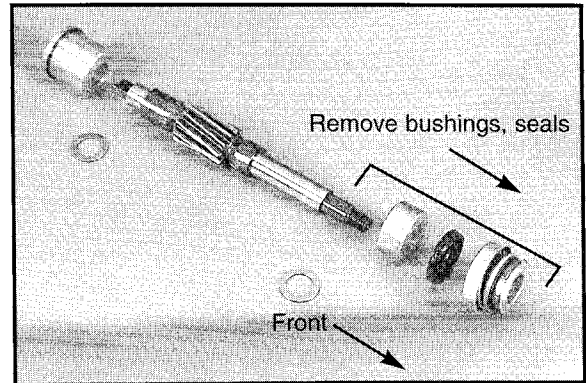


ENGINES

440/500 Domestic Case Reed Twin

Disassembly, Cont.

21. Press front bushing, oil seal and mechanical seal out of lower crankcase using a suitable (soft) drift from the oil pump (rear) side. Be careful not to damage bushing.

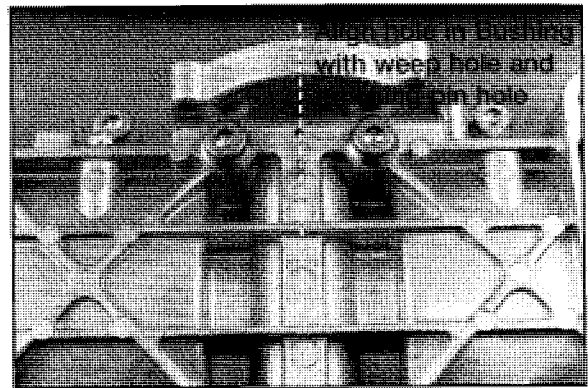


Assembly

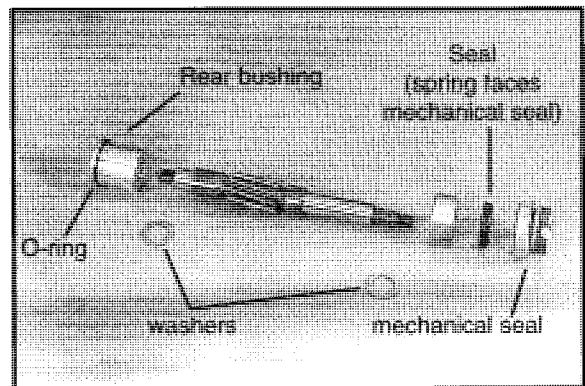
1. Insert bushing into case on water pump side using weep hole to align hole for retaining pin. Press in until firmly seated in case. Install retaining pin. Tap in until seated in bushing

NOTE: If front bushing is replaced it may be necessary to drill a retaining pin hole in the new bushing. If there is no hole in the bushing:

- Install bushing in crankcase as described above.
- Remove the retaining pin from lower crankcase.
- Using the retaining pin hole as a guide, carefully drill a hole in the new bushing to the same depth and diameter as the hole in the old bushing. Be careful not to enlarge the retaining pin hole.
- Install new retaining pin.



2. Install oil seal with spring facing outside of crankcase (toward you) until seated against bushing.
3. Lubricate and install washer on pump shaft (water pump end). Install shaft with washer through bushing and oil seal from the oil pump side of case. Be sure spring stays in position on seal lip.
4. Install remaining washer on shaft.
5. Lubricate and install rear bushing with new O-ring until seated against shaft.
6. Install oil pump, being careful to engage pump shaft in drive shaft.



Oil Pump Mounting Screw Torque:

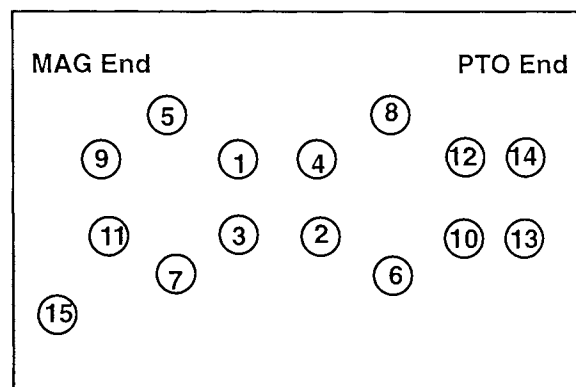
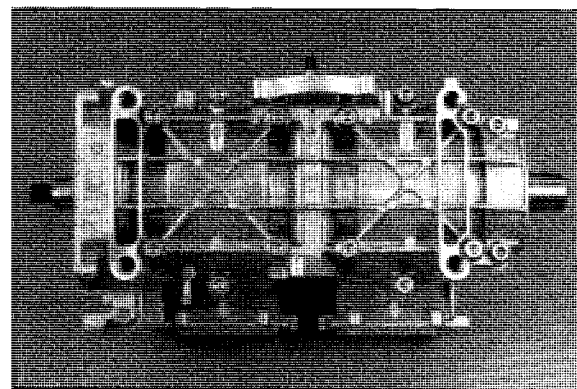
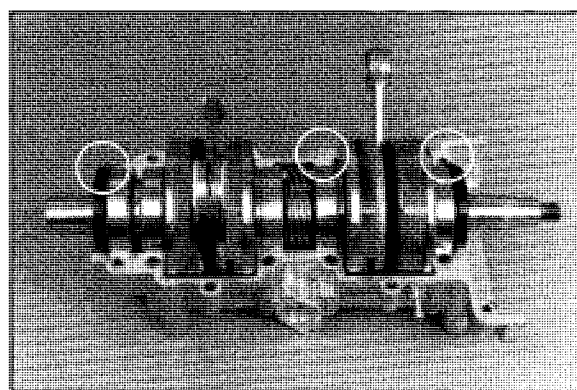
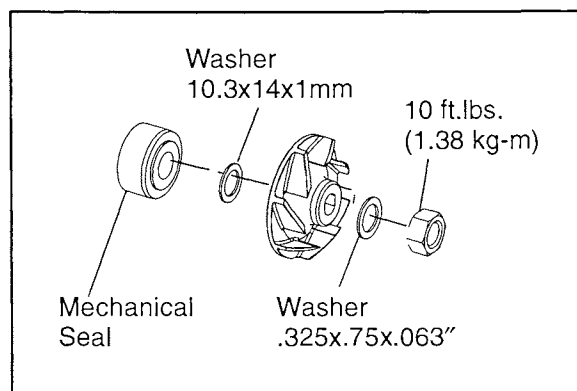
60 in. lbs. (.70 kg-m)

Assembly, Cont.

7. Install mechanical seal guide (special tool) on end of pump shaft.

Mechanical Seal Guide
Tool 1999 440/500
domestic engines
8.4mm: PN 2872010

8. Lubricate seal guide and drive or press a new mechanical seal into case until fully seated using the seal press tool.
9. Lubricate all crankshaft bearings with Premium 2-Cycle or Premium Gold Engine Lubricant.
10. Lightly grease pump shaft drive gear and sealing lip of crankshaft seals.
11. Install seals on crankshaft with spring facing inward (toward crankshaft).
12. Clean and de-grease lower crankcase and install crankshaft assembly, aligning seals and snap ring with grooves in case.
13. Apply a thin coating of 3-Bond 1215 sealant to lower crankcase mating surface.
14. Install upper crankcase on lower crankcase.
15. Apply Loctite 242 to threads of bolts and install. Torque bolts in three steps to specification outlined in beginning of this chapter following the sequence shown at right



ENGINES

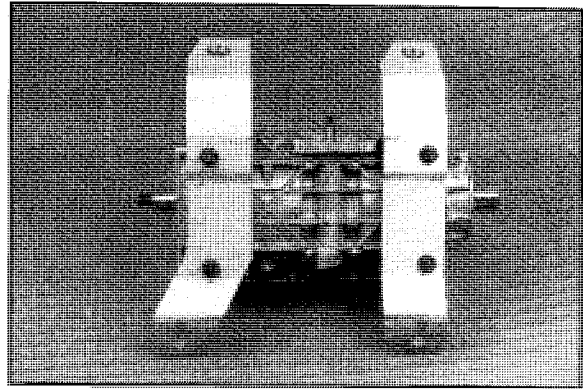
440/500 Domestic Case Reed Twin

Assembly, Cont.

16. Assemble engine mount straps to crankcase.

Engine Mount Strap Torque:

44-48 ft. lbs. (6.0-6.6 kg-m)

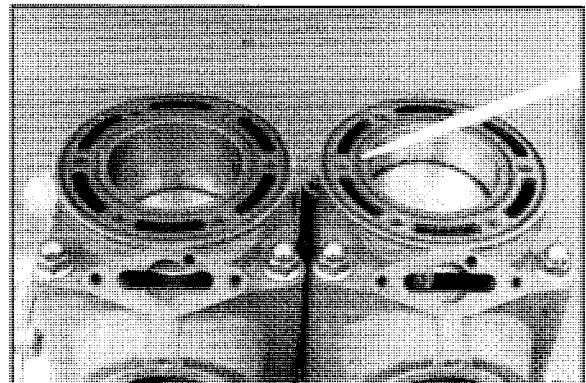
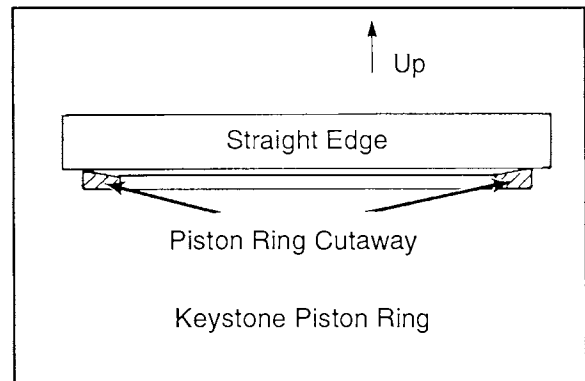


17. Lubricate main bearing oil holes with Polaris Premium 2 Cycle or Premium Gold engine oil and rotate crankshaft to distribute oil evenly.
18. Install a new C-clip in both pistons (inside) with gap facing down. Be sure clip is fully seated in groove.
19. Lubricate and install new connecting rod small end bearing in rod.
20. Install piston with arrow facing exhaust (ring locating pins should be facing intake). Warming the piston may help to ease installation of pin.
21. Install remaining C-clip with gap down. Be sure both clips are fully seated on the groove.
22. Install new base gasket. Be sure gasket surface is clean and free of nicks, burrs, or scratches.
23. Lubricate and install piston rings on piston with mark on end of ring facing upward.
24. Place piston support under skirt and lubricate pistons and cylinders thoroughly.
25. Align ring end gaps with locating pins and compress rings. Install cylinder carefully with a gentle front to rear rocking motion. Install cylinder base nuts loosely. Do not tighten them at this time. Repeat Steps 22-25 for other cylinder.

CAUTION:

Do not twist or force cylinder during installation.

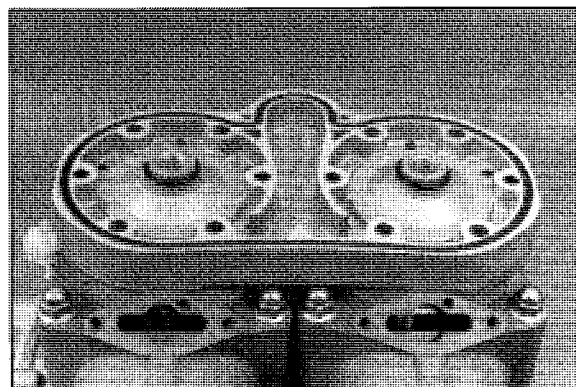
26. Install new cylinder head O-rings and install cylinder head. Make sure O-rings are properly seated in grooves. Apply a light film of grease to hold O-rings in place if necessary.



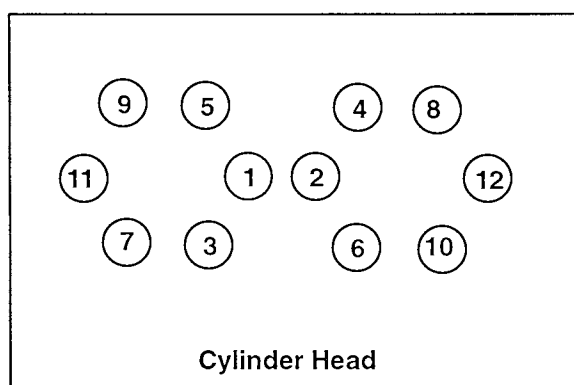
Assembly, Cont.

27. Install new cylinder head cover O-rings and install cylinder head cover. Make sure O-rings are properly seated in grooves. Apply a light film of grease to hold O-rings in place if necessary.

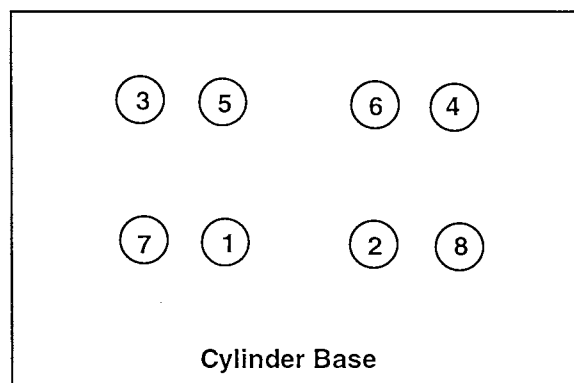
28. Loctite 242 to threads of head bolts and install.



29. Torque head bolts to specification outlined in beginning of this chapter in proper sequence.

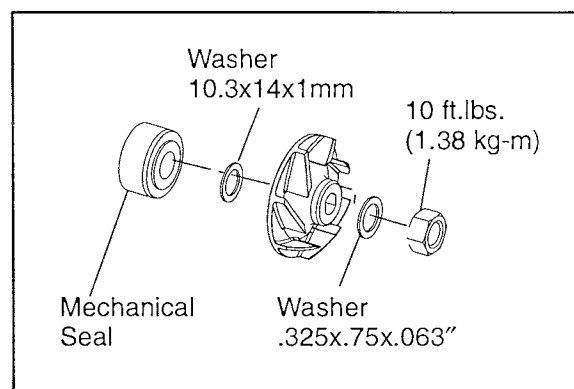


30. Torque cylinder base nuts outlined in beginning of this chapter in proper sequence.



31. Install washers and water pump impeller as shown and torque nut to 10 ft. lbs. (1.38 kg-m).

Impeller Nut Torque:
10 Ft lbs (1.38 kgm)



ENGINES

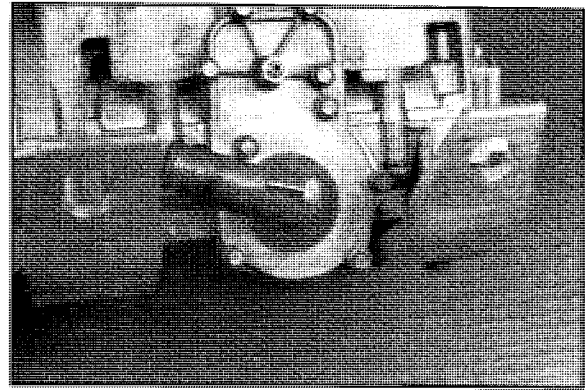
440/500 Domestic Case Reed Twin

Assembly, Cont.

32. Install water pump cover with new gasket.

Water Pump Cover Bolt Torque:

9 Ft lbs (1.25 kgm)



33. Install new exhaust manifold gaskets and manifold.

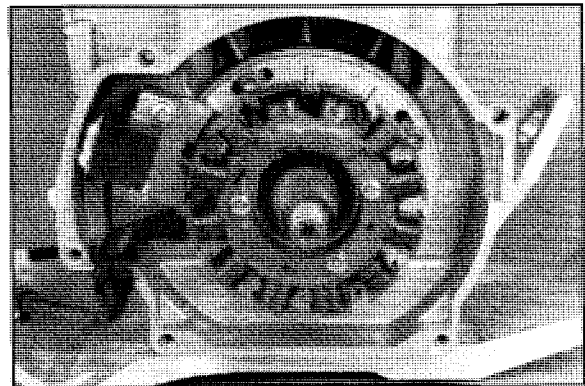
Exhaust Manifold Bolt Torque:

16 Ft lbs (2.21 kgm)

34. Assemble V.E.S. valve. Refer to V.E.S. procedures in beginning of this section.
35. Install reed valves, stuffers, and carburetor adaptors. Place stator wire guide on Mag side carburetor adaptor bolt.
36. Install stator assembly, aligning timing marks or marks made upon disassembly. Seal stator wires with high temperature silicone sealant. Install and tighten stator screws to specification.
37. Measure trigger (pulse) coil gap and compare to specification.

Stator Screw Torque

60 in. lbs. (.69 kg-m)



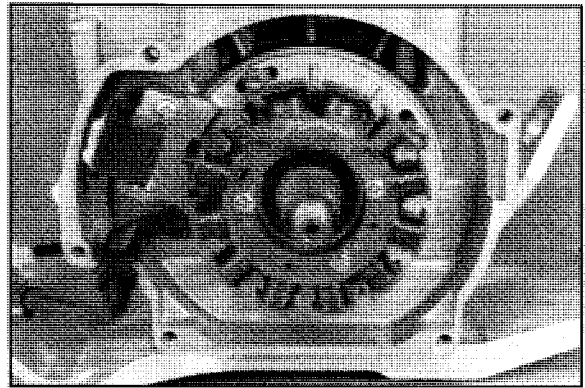
Trigger (Pulse) Coil Gap

Minimum: .020" (.5mm)

Maximum: .040" (1.0mm)

Assembly, Cont.

38. Apply Loctite™ 262 evenly to the flywheel mounting taper on crankshaft. Install woodruff key.
39. Install flywheel. Apply Loctite™ 242 to crankshaft threads. Install washer and nut.
40. Use flywheel holder to hold flywheel and torque nut to specification found in beginning of this chapter.



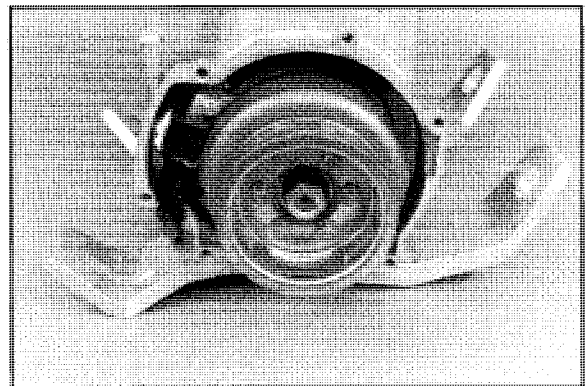
Flywheel Holder:

PN 8700229

41. Install recoil hub and recoil housing. Torque bolts to specification.

**Recoil Hub and Housing Bolt
Torque:**

108 in. lbs. (1.25 kg-m)



42. Install engine in chassis and align clutches.
43. Refer to General Inspection Procedures in this chapter to fill and bleed cooling system and oil pump.

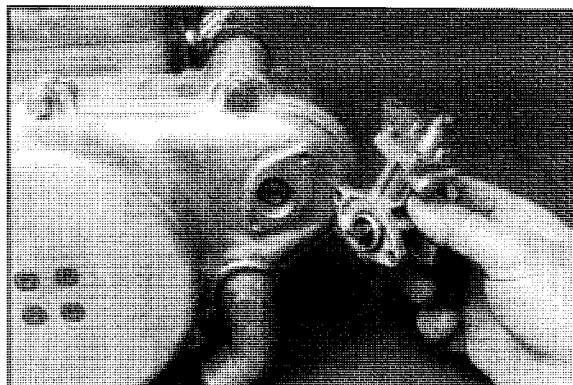
ENGINES

600/700 Domestic Case Reed Twin

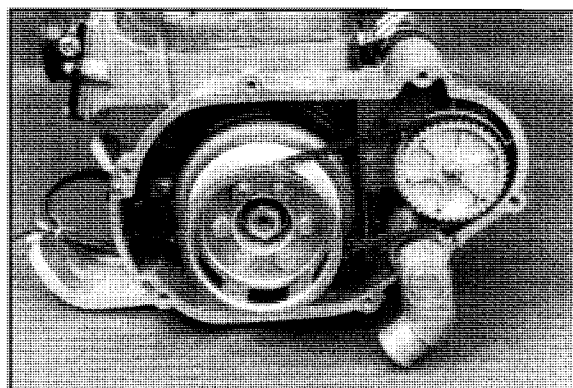
NOTE: Inspect all parts for wear or damage during disassembly. Replace all seals, O-rings, and gaskets during disassembly. Refer to pages 3.73-3.84 for general inspection procedures.

Disassembly

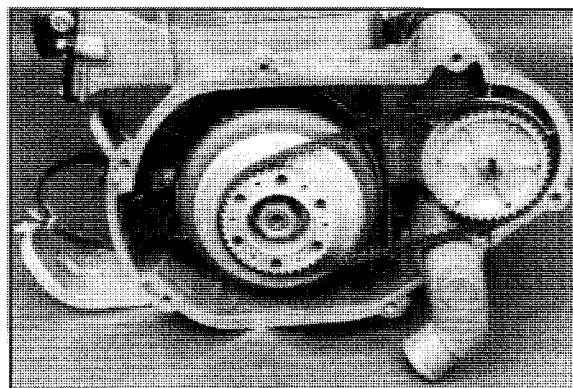
1. Remove oil pump.



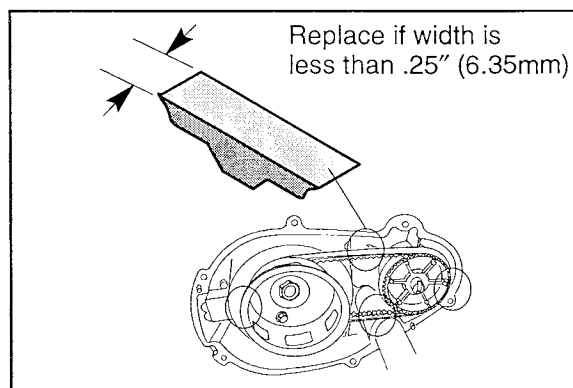
2. Remove recoil housing.



3. Remove recoil hub. Inspect waterpump drive belt for missing, cracked, or broken drive cogs. Replace if worn.



Measure the belt at 4 different points as shown. Replace if width is less than .25, (6.35mm). Nominal new width is .345, (8.75mm). Refer to Maintenance chapter for water pump belt installation.



Disassembly, Cont.

4. Remove drive gears and belt.
5. Remove flywheel nut using flywheel holder.

Flywheel Holder

PN 8700229

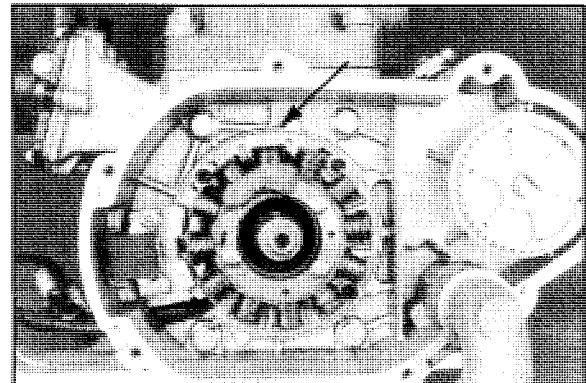
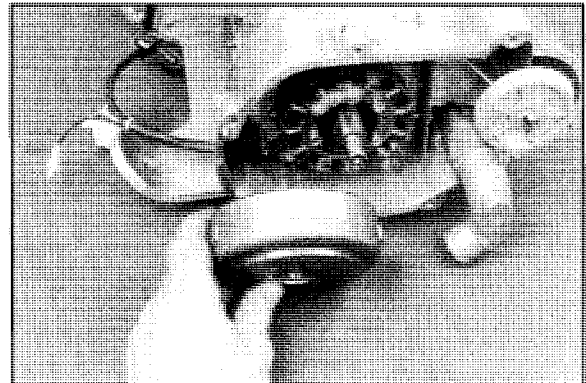
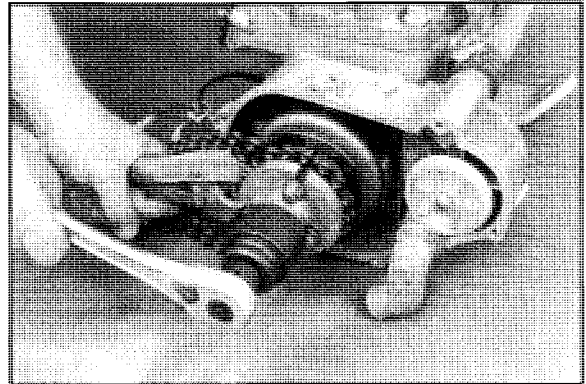
6. Remove flywheel using flywheel puller.

Flywheel Puller

PN 2871043

7. Note the ignition timing strip on the flywheel.

8. Before removing stator plate, mark the plate and crankcase for reference upon assembly.

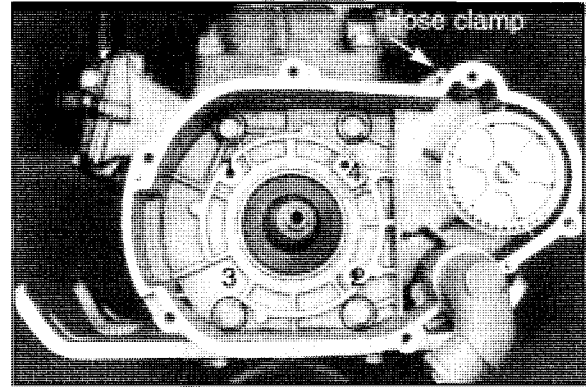


ENGINES

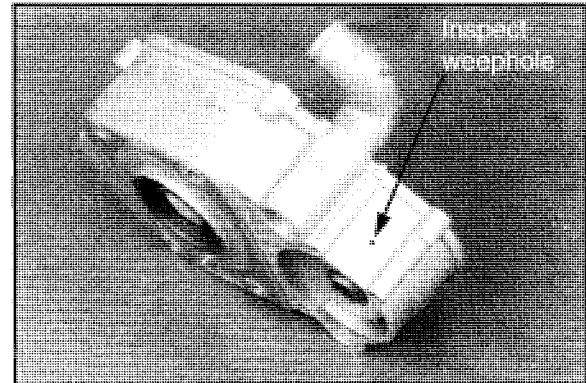
600/700 Domestic Case Reed Twin

Disassembly, Cont.

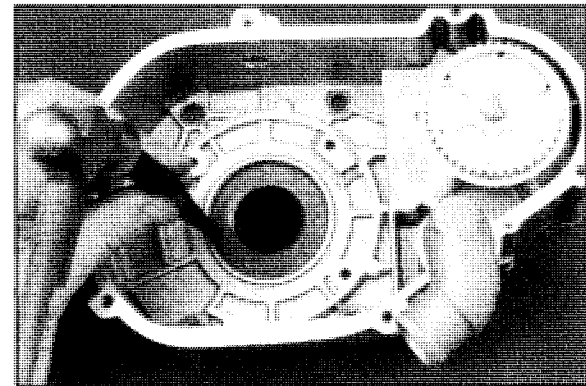
9. Remove bolts holding water pump housing to crankcase. Loosen hose clamp and remove housing.



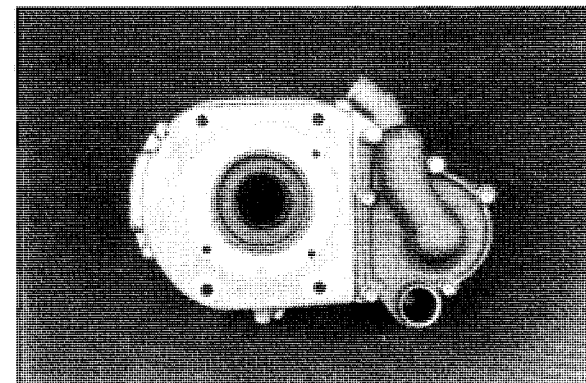
10. Inspect water pump weep hole for signs of leakage or blockage.



11. Remove crankshaft seal from housing by driving seal to inside of housing. Replace seal if removed.

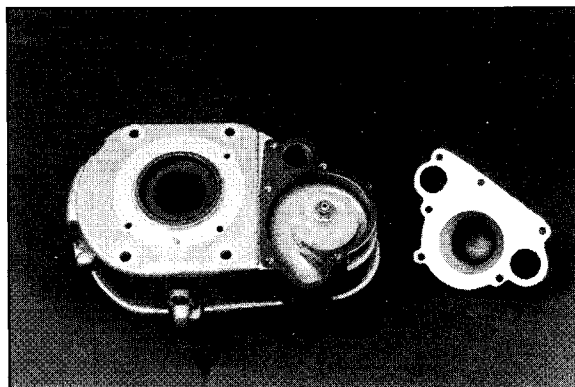


12. Remove water pump cover bolts.

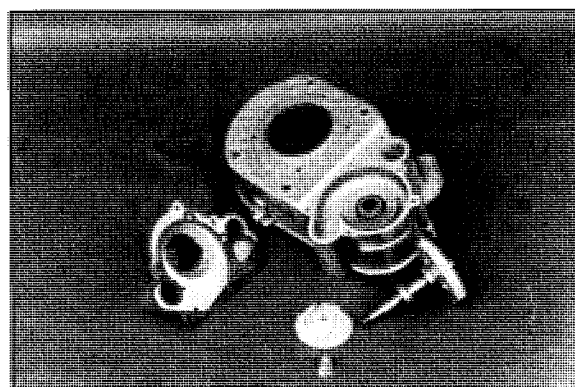


Disassembly, Cont.

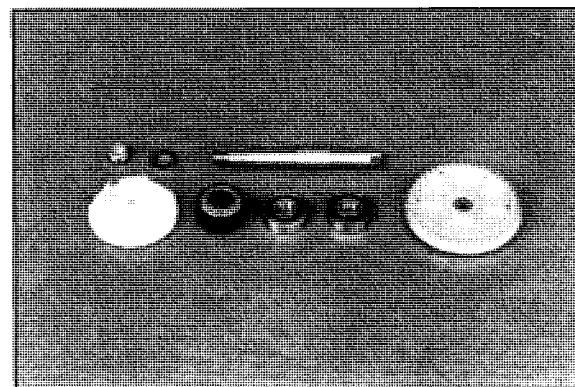
13. Remove impeller nut.



14. Slide shaft out back side.



15. Inspect bearings. Replace if necessary. Replace mechanical seal using the special tools listed below. Use the seal press to install a new mechanical seal in cover with spring sleeve toward impeller housing. Install seal guide over end of shaft and apply a light film of grease to seal guide. Carefully install shaft and bearings in cover. Assemble 10x14mm washer, impeller, washer, and nut. Torque impeller nut to specification.



**Water Pump Mechanical Seal
Installation Tool -
1999 600/700 domestic engines:
8.9mm. PN 2872389**

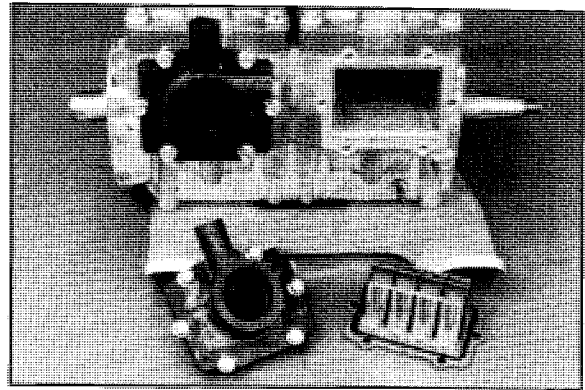
**Impeller Nut Torque
10 ft. lbs. (1.38 kg-m)**

ENGINES

600/700 Domestic Case Reed Twin

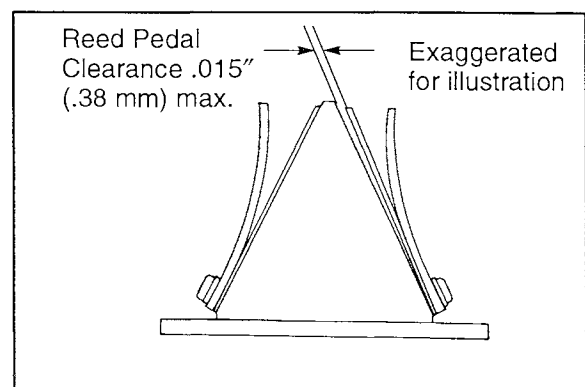
Disassembly, Cont.

16. Remove reed cover, reed stuffers, and reeds.

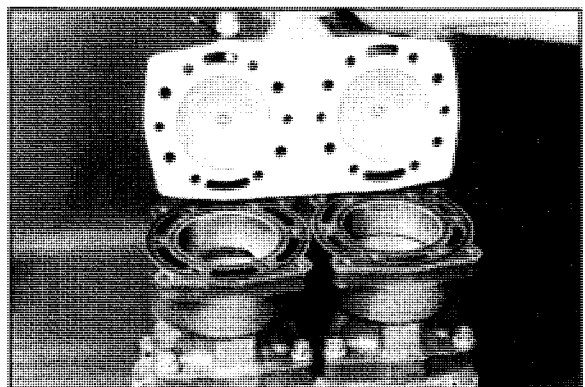


Reed Valve Inspection

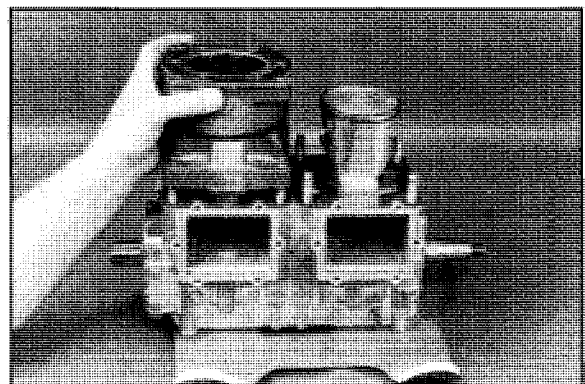
17. Measure air gap between fiber reed and reed block as shown. The air gap should not exceed .015" (.4 mm). If clearance is excessive DO NOT attempt to reverse the reeds to reduce the air gap. *Always replace them if damaged.* Check each fiber reed for white stress marks or missing material. Replace if necessary.



18. Remove cylinder head. Note condition and placement of both cylinder head O-rings.

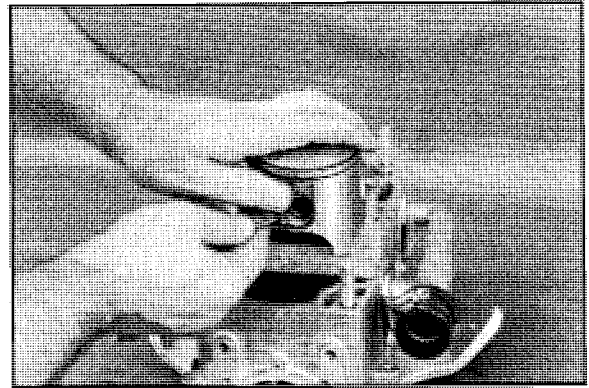


19. Loosen cylinder base nuts and remove cylinders.



Disassembly, Cont.

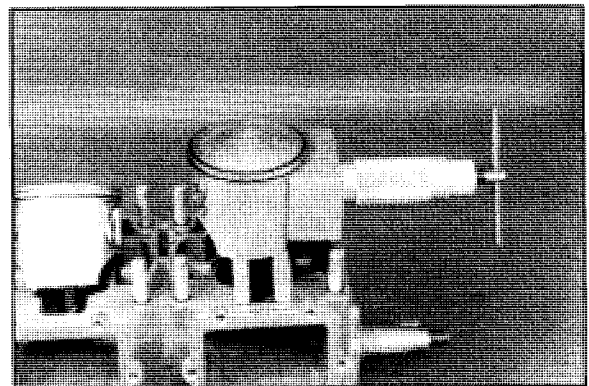
20. Carefully remove C-clip holding piston pin in place.



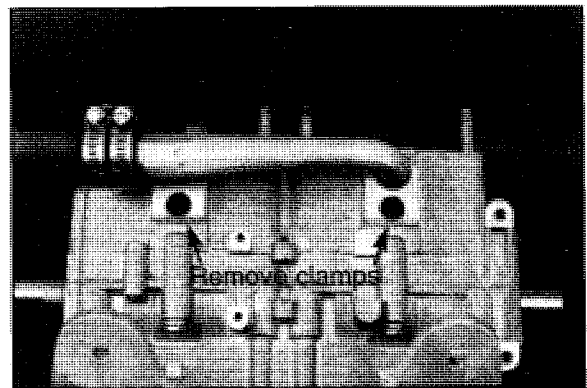
21. Remove piston pin using piston pin puller and adaptor.

Piston Pin Puller PN 2870386

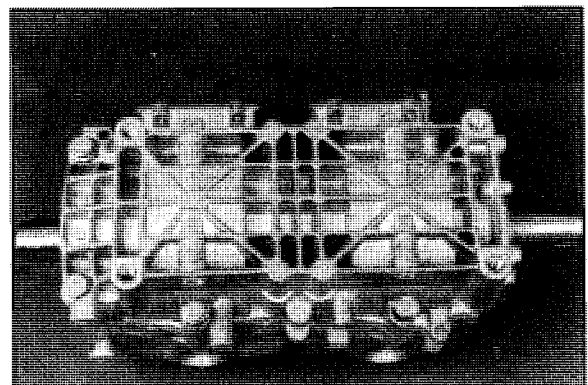
Adaptor PN 5130971



22. Remove water manifold by removing both retainer brackets.



23. Remove bottom crankcase bolts and separate crankcase halves.

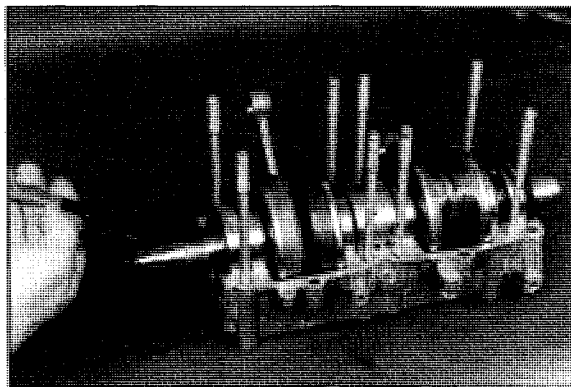


ENGINES

600/700 Domestic Case Reed Twin

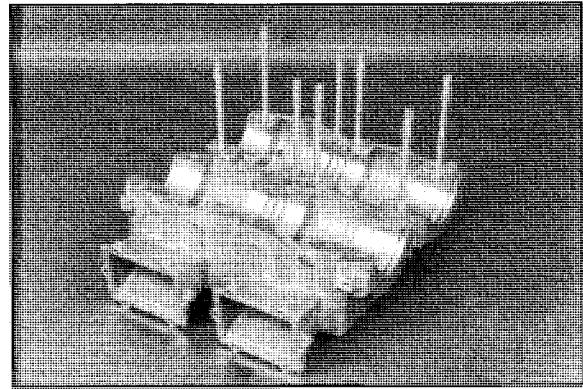
Disassembly, Cont.

24. Remove snap rings and crankshaft seals.
25. Clean thoroughly to remove all grease, oil, dirt, and old sealant.



Assembly

1. Clean all parts with solvent and dry with compressed air.

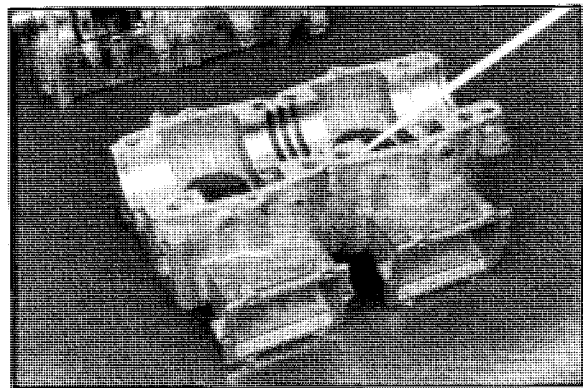


2. Apply 3-Bond™ 1215 sealant to upper crankcase half.

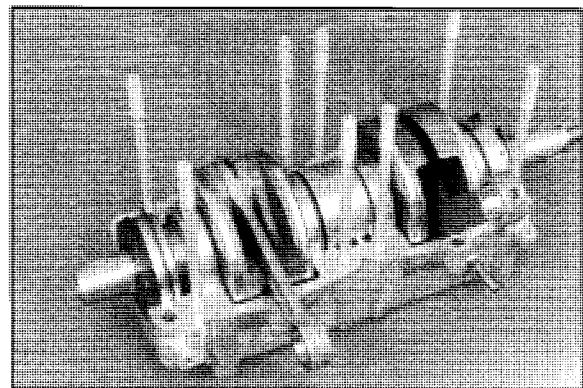
NOTE: Use only 3-Bond™ 1215 sealant. Curing time and film thickness are critical for proper bearing clearance.

3-Bond™ 1215

PN 2871557 120 Gram Tube



3. Set crankshaft in lower crankcase. Lubricate seal lips with Premium All Season Grease. Make sure seals are positioned properly with lip and spring facing inward toward crankshaft. Install snap rings with gap facing upward toward upper case half.



ENGINES

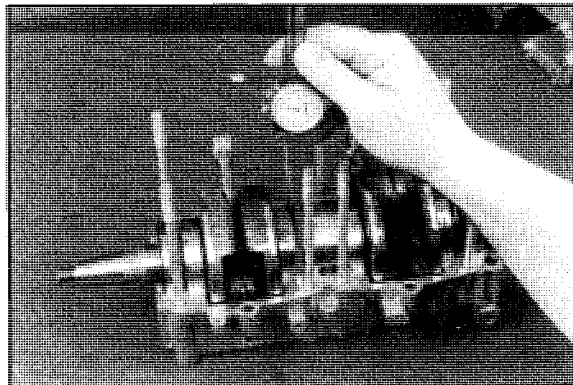
600/700 Domestic Case Reed Twin

Assembly, Cont.

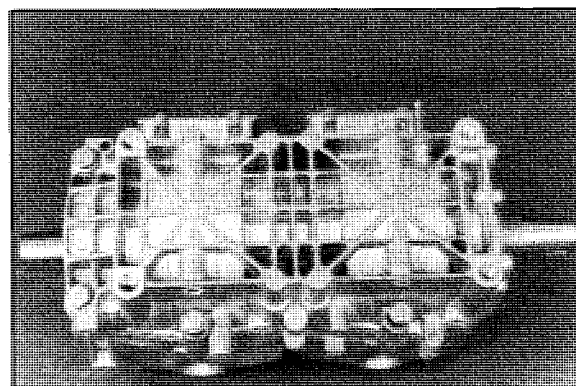
4. If studs were removed or new crankcase installed, apply Loctite™ 242 to threads of studs and screw in until bottomed. Tighten securely.
5. Measure installed length of stud bolt. This is the length necessary to allow cylinder installation.

Lower Crankcase Stud Height

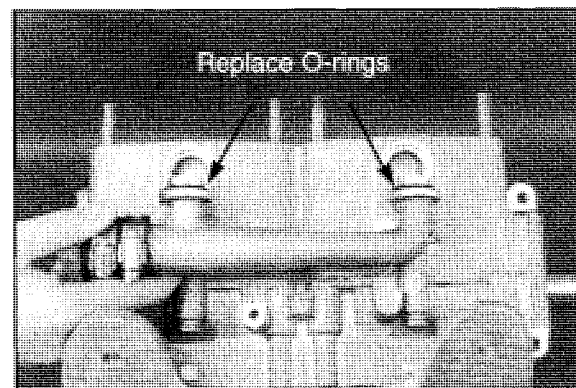
121-124 mm (4.76-4.88") from crankshaft parting line.



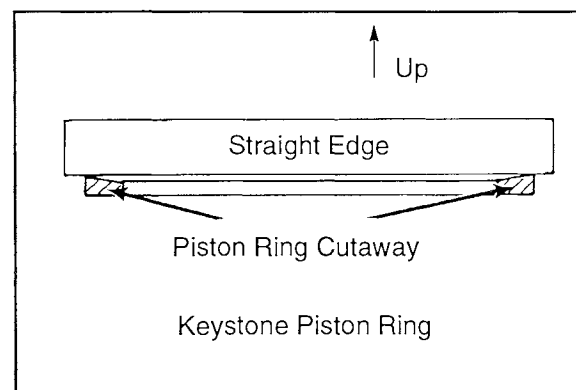
6. Install crankcase halves together. Torque bottom crankcase bolt to specification in the proper sequence found in the beginning of this chapter.



7. Install new O-rings on water manifold. Grease O-rings and install manifold.

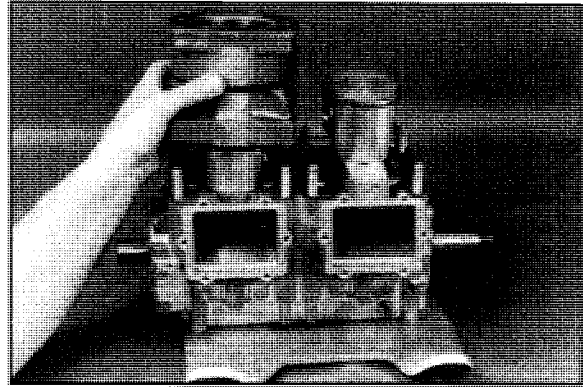


8. Install pistons and rings. Make sure C-clips are firmly seated in grooves. **NOTE:** Keystone ring bevel must be up. Marking near ring end gap faces upward.

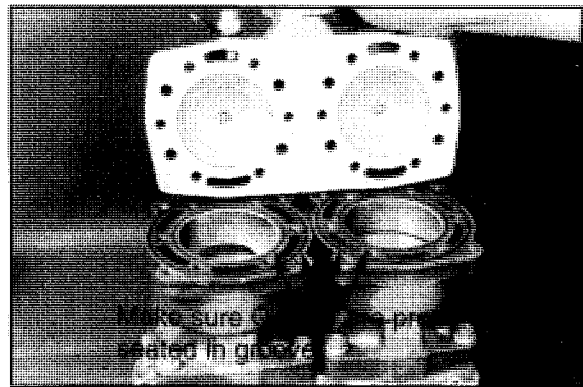


Assembly, Cont.

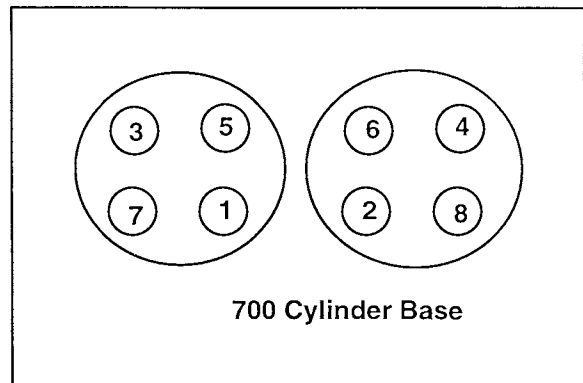
9. Lubricate pistons, rings, upper rod bearing, and cylinders with two stroke oil and install cylinders. Align ring end gaps with locating pins and compress rings. Install cylinder carefully with a gentle front to rear rocking motion. Loosely install cylinder nuts.



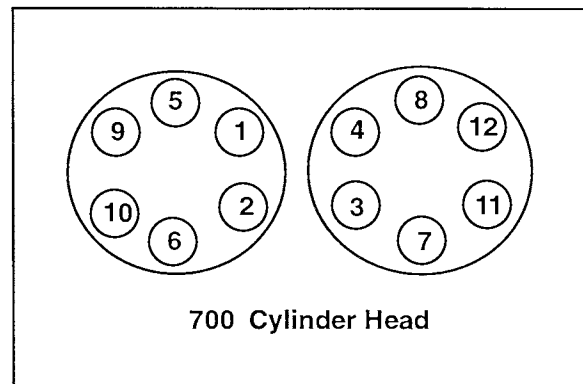
10. Install new cylinder head O-ring and install cylinder head. Make sure O-ring is properly seated in groove.



11. Torque cylinder base bolts in proper sequence. Refer to specifications in the beginning of this chapter.



12. Torque head bolts in proper sequence. Refer to specifications in the beginning of this chapter.

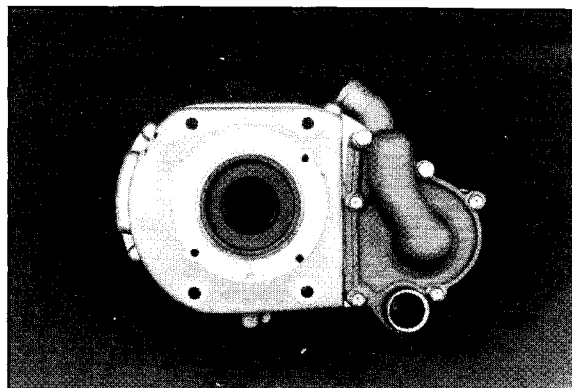


ENGINES

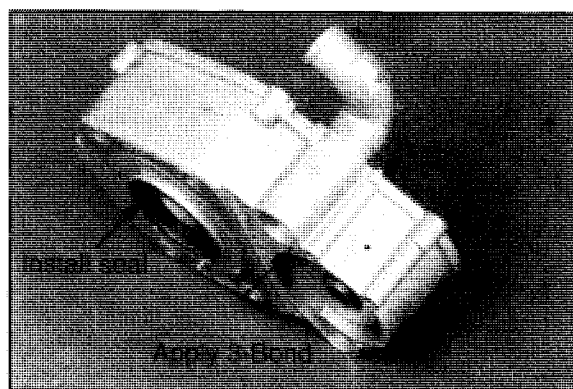
600/700 Domestic Case Reed Twin

Assembly, Cont.

13. Reassemble water pump carefully installing seal.

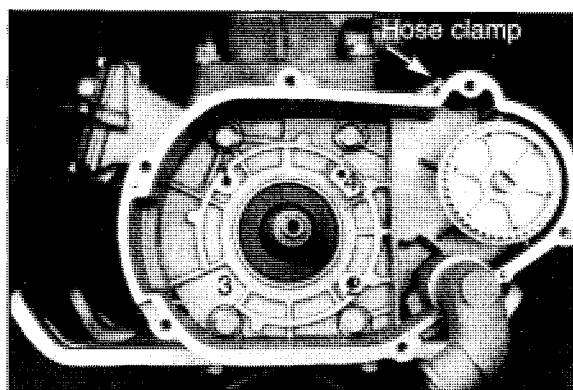


14. Install crankcase seal to ignition/water pump housing from inside toward outside until bottomed on housing. Spring and seal lip must face inward toward crankshaft.

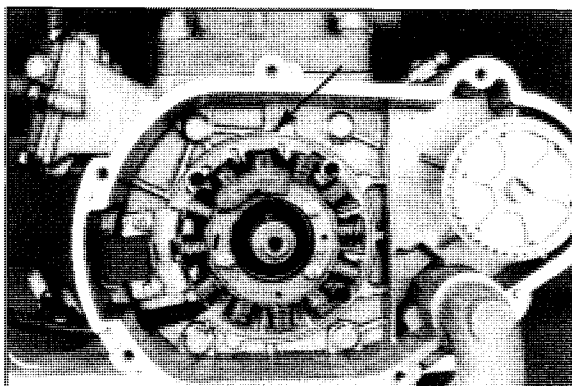


15. Apply 3 Bond™ sealant to pump housing crankcase mating surface and carefully install onto crankcase. Tighten water pump to engine hose clamp and torque bolts to specification.

Ignition/Water Pump Housing Torque
22 Ft. lbs (3.04kgm)



16. Align timing marks and install stator.

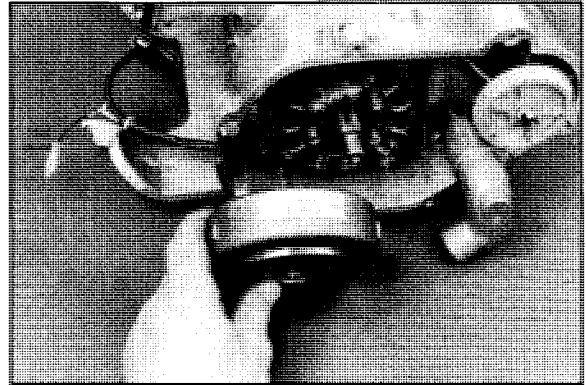


Assembly, Cont.

17. Install flywheel and torque flywheel nut to specification found in the beginning of this chapter.

Flywheel Holder

PN 8700229

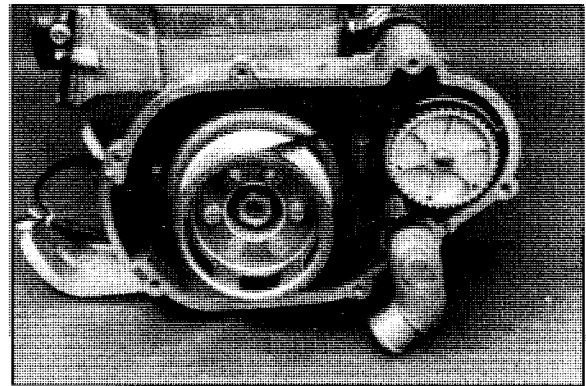


18. Install water pump belt and recoil hub.

NOTE: See 600/700 domestic twin water pump belt installation in chapter 2, Maintenance, for correct belt installation

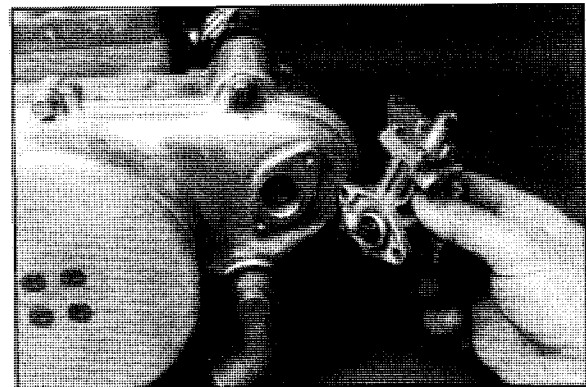
Recoil Hub Bolt Torque -

96-108 in. lbs. (1.11 - 1.25 kg-m)



19. Install recoil cover and oil pump. Make sure oil pump drive slot mates properly with water pump shaft.

20. Install reed valve, reed stuffer, and reed cover.



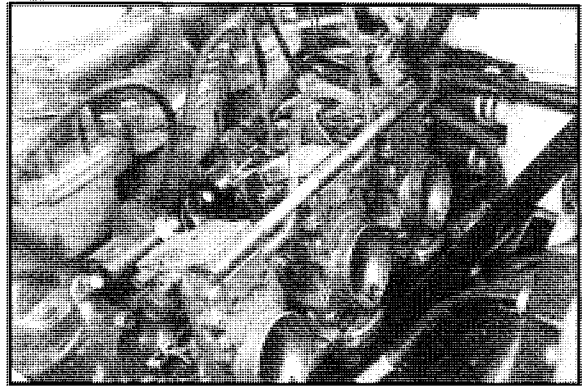
ENGINES

700/800 Case Reed - Fuji

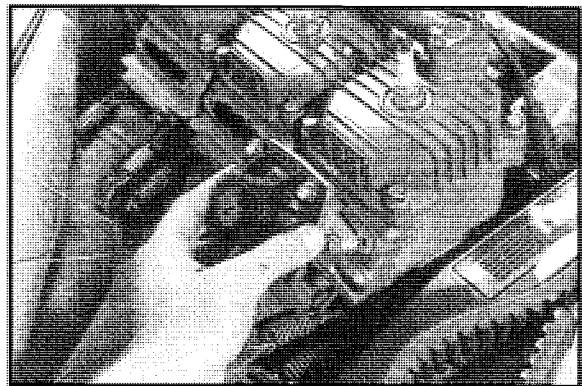
NOTE: Inspect all parts for wear or damage during disassembly. Replace all seals, O-rings, and gaskets during disassembly. Refer to pages 3.73-3.84 for general inspection procedures.

Disassembly

1. Remove carburetors, water outlet manifold, secondary coils, oil pump and reed valve cage assemblies. **NOTE:** Mark each components mag, center, and PTO so they will be in the correct location when reassembling.



2. Remove exhaust valve assembly from each cylinder.

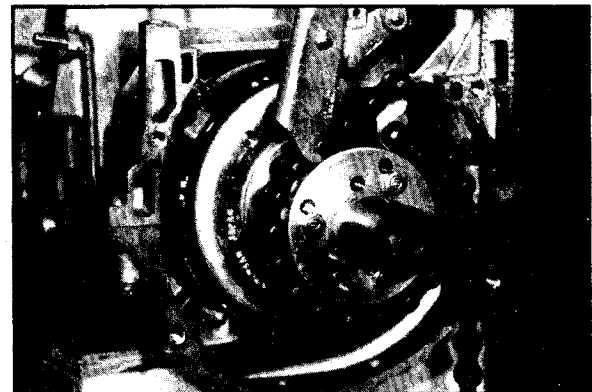


3. Remove recoil housing, water pump belt guard, water pump and flywheel nut.

Flywheel Holder PN 8700229

4. Install flywheel puller and remove flywheel.

**Flywheel Puller
PN 2871043**

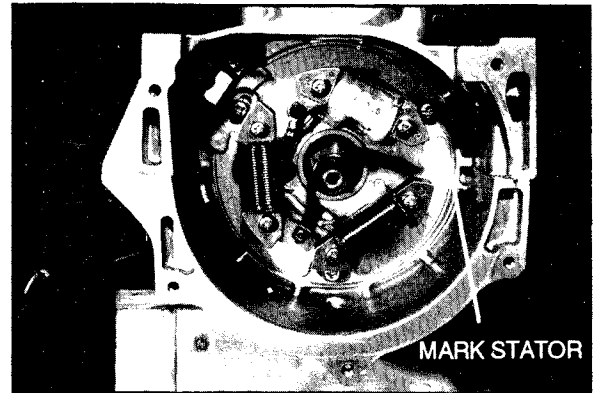


CAUTION:

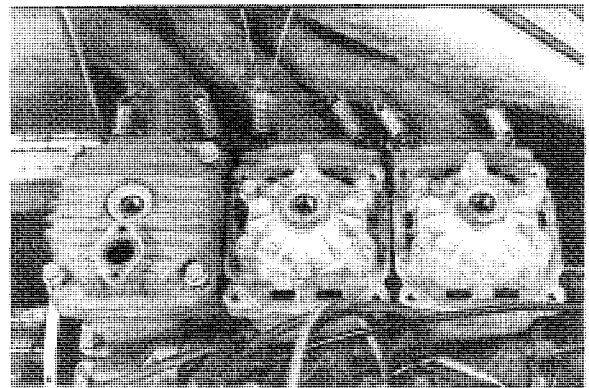
Do not thread puller bolts more than 3/8" (0.5 mm) into flywheel or stator coil damage may occur.

Disassembly, Cont.

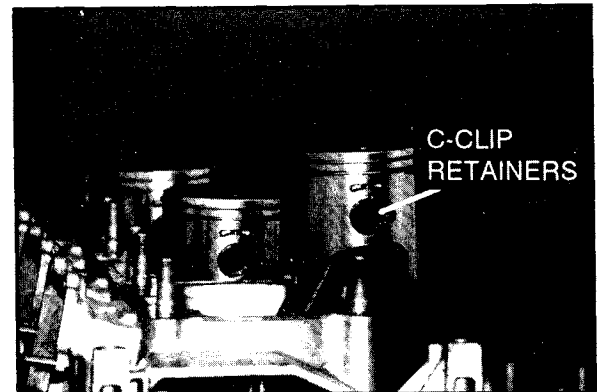
5. Mark stator plate at case parting line and remove plate.



6. Remove head covers, heads and cylinder base nuts.
7. Carefully remove cylinders.



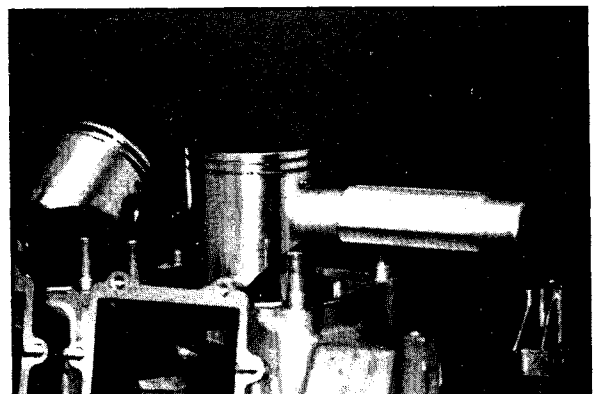
8. Remove C-clip retainers.



9. Use piston pin puller to remove piston pins.

Piston Pin Puller

PN 2870386

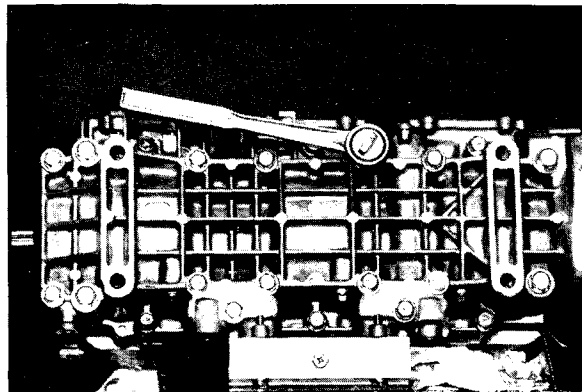


ENGINES

700/800 Case Reed - Fuji

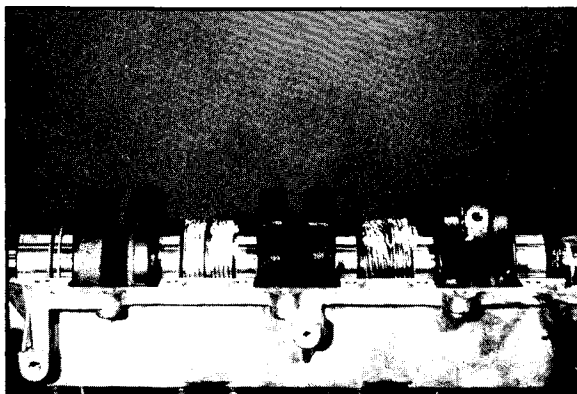
Disassembly, Cont.

10. Remove crankcase bolts and separate crankcase halves.
11. Inspect crankcase and crankshaft as outlined in general inspection procedures.
12. Clean crankcase thoroughly to remove all grease, oil, dirt, and old sealant.

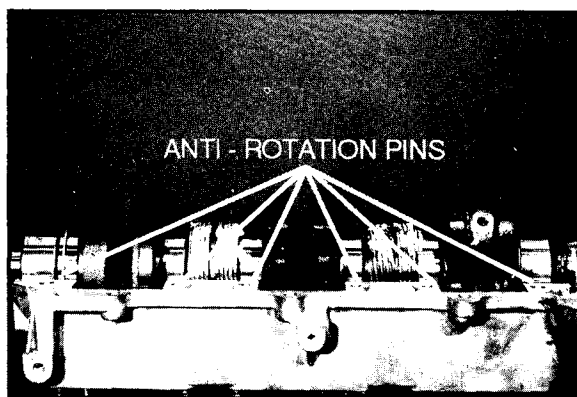


Assembly

1. Grease oil pump drive gear and end seals.

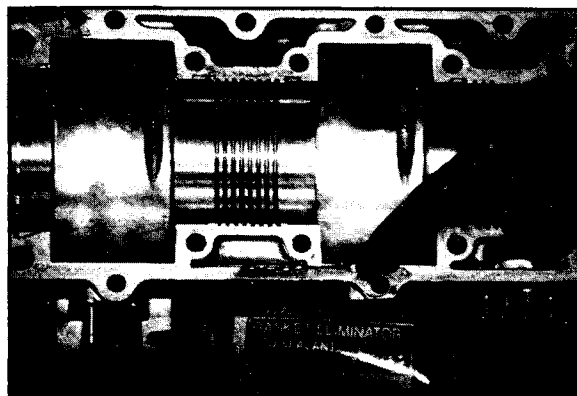


2. Position anti-rotation pins with relief in case.



3. Apply a light film of 3 Bond™ 1215 to crankcase and reassemble halves.

3-Bond™ 1215
PN 2871557 120 Gram Tube

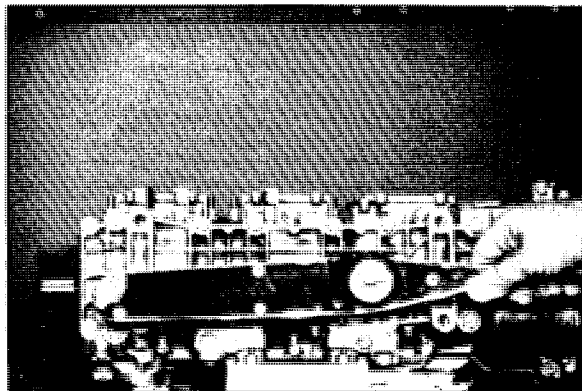


ENGINES

700/800 Case Reed - Fuji

Assembly, Cont.

4. Install bolts and torque to specifications and pattern found in beginning of this chapter.



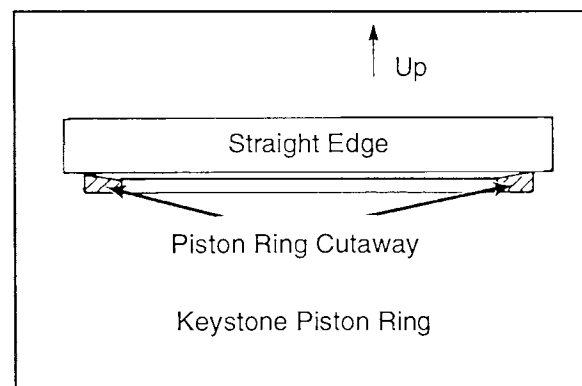
5. Install piston pin bearings.
6. Install piston with arrow (▶) toward flywheel.
7. Install C-clip retainers using tool. **NOTE:** The C-clip opening should be in the up or down position. Be sure C-clips are properly seated in groove.

C-Clip Retainer Installation Tool

PN 2870773

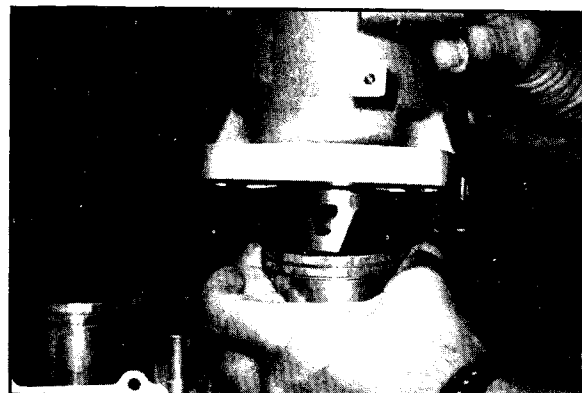


8. Lightly oil rings and cylinder. **NOTE:** Keystone ring bevel must be up. Marking near ring end gap faces upward.



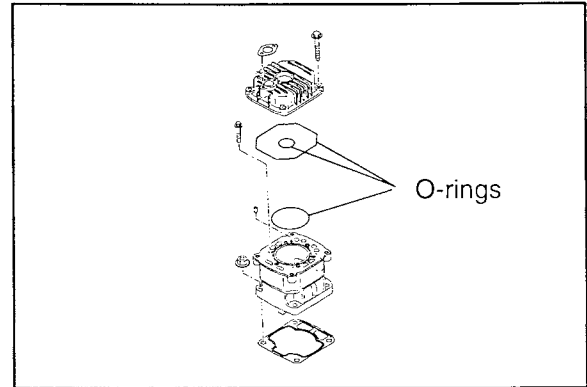
9. Install new base gaskets with sealant facing (where applicable).

10. Carefully compress rings and install cylinder over piston. Torque cylinder base nuts to specification found in the beginning of this chapter.

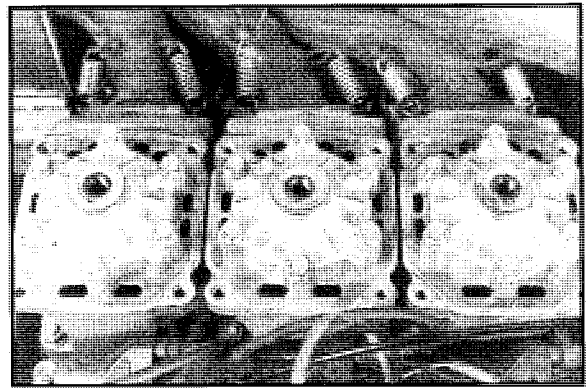


Assembly, Cont.

11. Install new head and head cover O-rings.

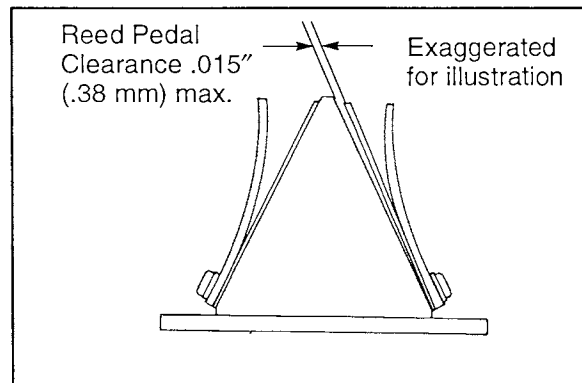


12. Install heads and torque to specification found in beginning of this chapter.



Reed Valve Inspection

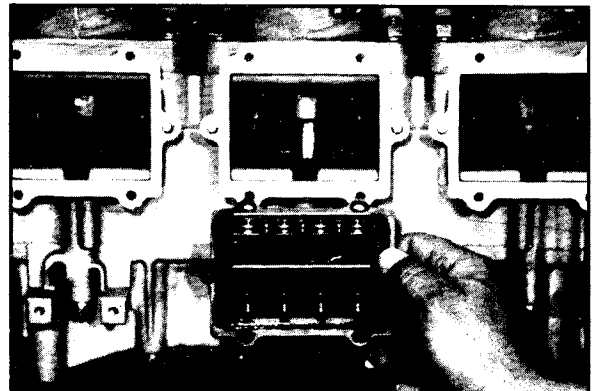
13. Measure air gap between fiber reed and reed block as shown. The air gap should not exceed .015" (.4 mm). If clearance is excessive DO NOT attempt to reverse the reeds to reduce the air gap. *Always replace them if damaged.* Check each fiber reed for white stress marks or missing material. Replace if necessary.



Reed Air Gap - Maximum

.015" (.4 mm)

14. Install reed cages and carburetor mounting flanges.

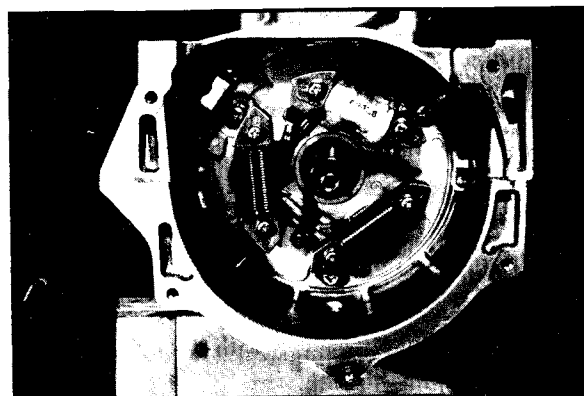


ENGINES

700/800 Case Reed - Fuji

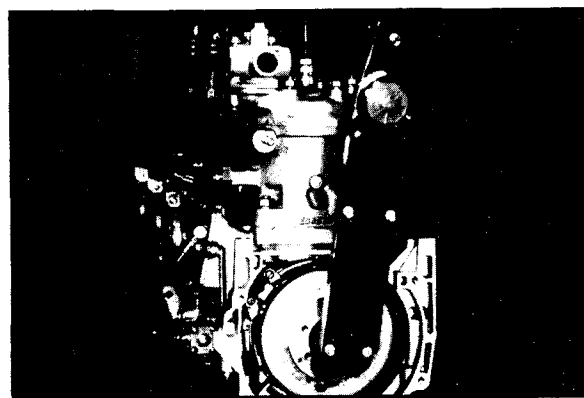
Assembly, Cont.

15. Install oil pump drive gear in correct sequence.
16. Check oil pump drive gear end play. See adjustment in General Inspection Procedures.
17. Install oil pump.
18. Position stator plate at previously marked position and secure in place.
19. Torque flywheel nut to specification found in beginning of this chapter. Install new O-ring on water pump and grease lightly. Install pump, recoil cup, and belt.



Flywheel Holder:

PN 8700229



20. Adjust tension on water pump belt by loosening mounting bolts, applying tension, and re-tightening bolts. Install recoil housing and belt guard.

Water Pump Belt Deflection -

1/8 - 3/16" (.3 - .4 cm)

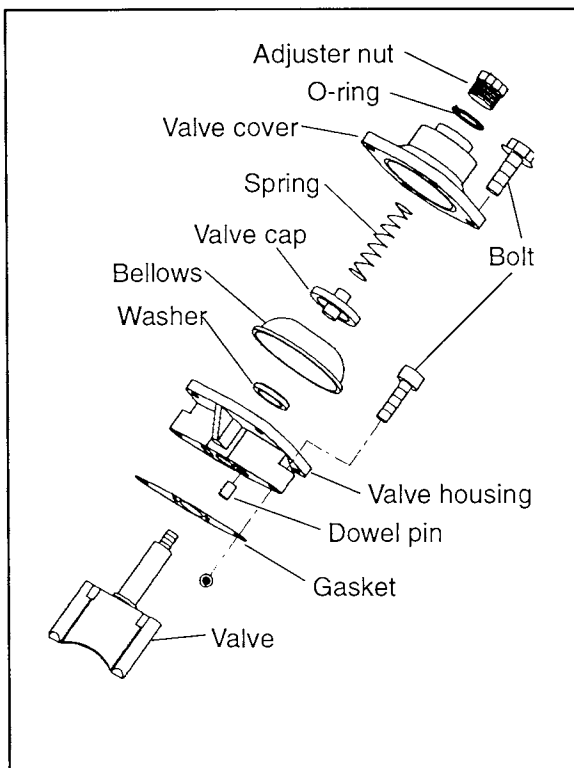
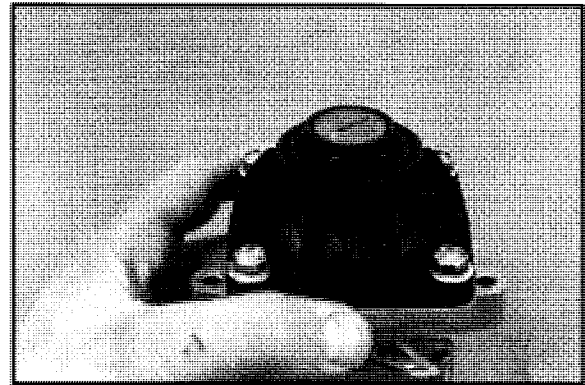
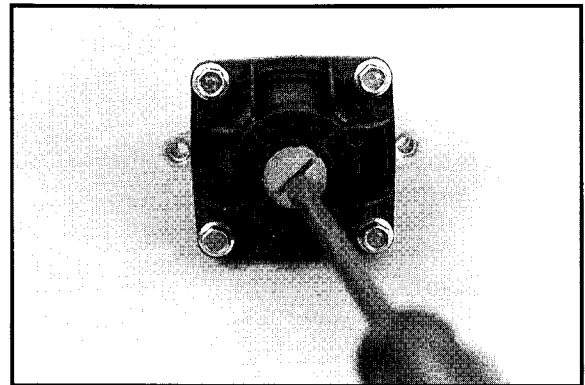
V.E.S. Adjustment - 700/800 XCR

The RPM at which the exhaust valves open and close can be tuned by turning the spring adjuster in or out for the desired valve characteristics.

1. Turning spring adjuster in:
 - Creates more spring pressure
 - Allows exhaust valve to open at slower rate
 - For applications such as drag racing
2. Turning spring adjuster out:
 - Creates less spring pressure
 - Allows exhaust valve to open at faster rate
 - For applications such as trail riding

Riders can fine tune the VES to suit their riding conditions and power delivery characteristics. Base setting is with adjuster screw flush with housing.

CAUTION: Do not turn spring adjuster too far. The spring adjuster is turned out to its maximum when the adjuster is flush with top of housing.



700/800 Case Reed - Fuji

V.E.S. Removal - 700/800 XCR

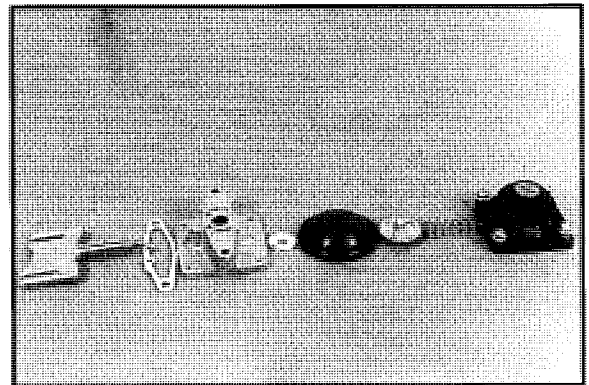
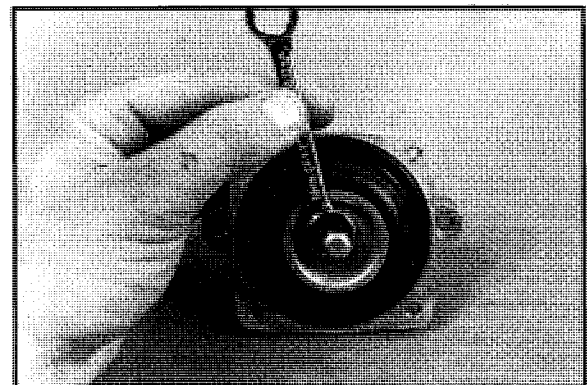
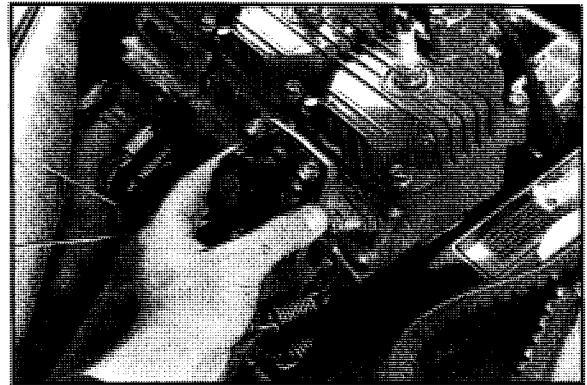
1. Remove two mounting bolts. Remove exhaust valve assembly from cylinder.
2. Remove four cover bolts, cover, and return spring.

CAUTION: Valve is spring loaded. Hold cover in position until all bolts are removed.

3. If the spring stays in the cover, hold the cover with spring facing toward you. Rotate spring in a counterclockwise direction while pulling outward on the spring. Do not distort the spring upon removal.
4. With a 10 mm wrench, loosen exhaust valve cap and remove.

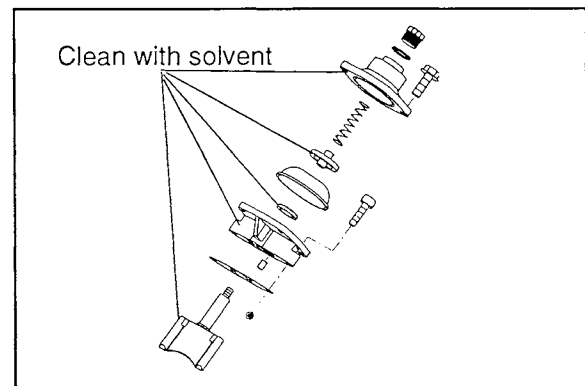
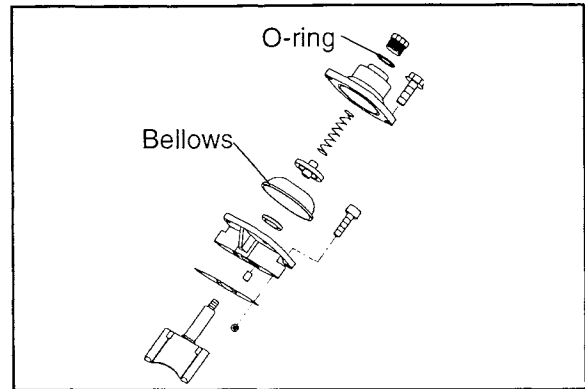
NOTE: Top nut is secured to valve with adhesive. Removing top nut may damage threads on valve.

5. Remove exhaust valve remaining components. NOTE: 700 XCR valves are marked "70 UP" and 800 XCR valves are marked "79 UP". Upon installation be sure this marking faces upward.



Disassembly, Cleaning, Inspection - VES - 700/800 XCR

1. Clean O-ring and bellows in warm water and mild detergent. Inspect bellows for holes, distortion or damage. Replace if necessary. Inspect O-ring for damage.
2. Clean all other parts with solvent. Be sure all parts are thoroughly clean.
3. Inspect the actuator port in cylinder and valve housing. Be sure it is clear and not obstructed by debris or carbon.
4. Carbon deposits can be removed from valve with a Scotch Brite™ pad or similar soft abrasive brush.
5. Lubricate exhaust valve with Polaris Premium Gold 2-cycle engine lubricant. Install valve in cylinder and move it through the entire travel range to check for free movement without binding. If the valve sticks anywhere in the travel range, check the valve and valve bore in the cylinder for carbon deposits and clean if necessary.

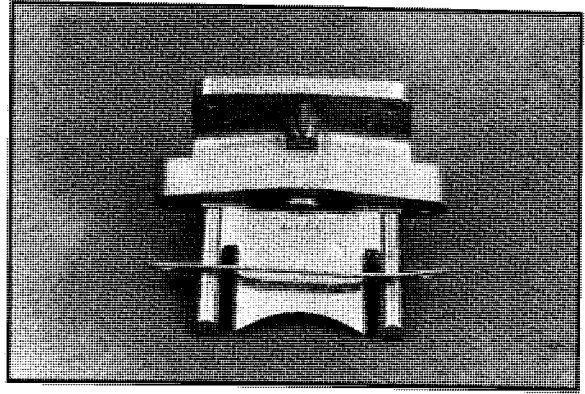


ENGINES

700/800 Case Reed - Fuji

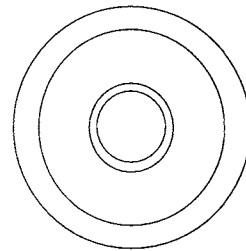
V.E.S. Assembly - 700/800 XCR

1. Replace gasket and insert exhaust valve into valve housing.

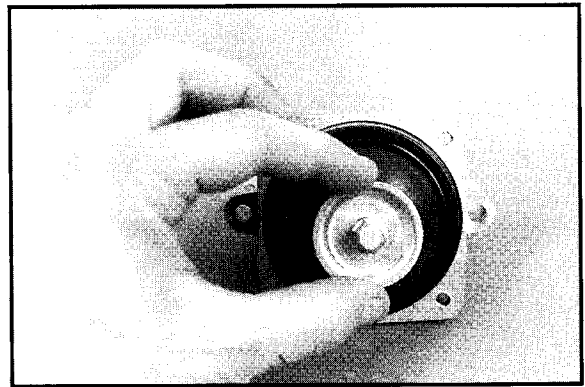


2. Install washer, beveled side out.

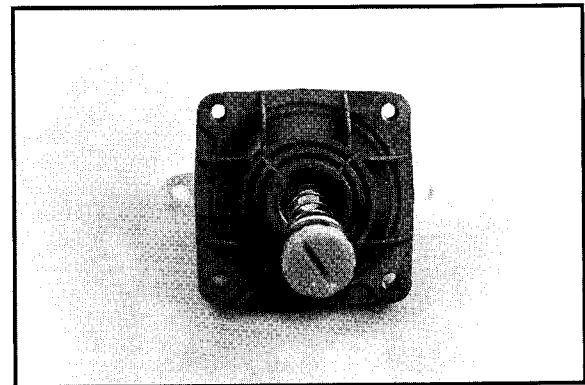
Bevel side out



3. Install bellows and valve cap.



4. Install spring, valve cover, and adjuster nut.
5. Set adjuster nut according to rider preference. Refer to page 3.69.



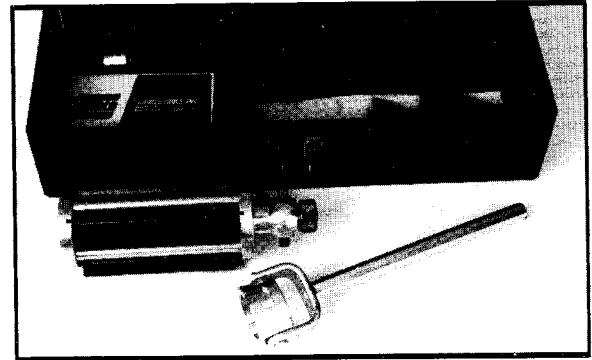
Cylinder Honing

The cylinder bore must be de-glazed whenever new piston rings are installed. A light honing with fine stones removes only a very small amount of material. A proper crosshatch pattern is important to provide a surface that will hold oil, and allow rings to seat properly. If the crosshatch is too steep, oil retention will be reduced. A cross-hatch angle which is too shallow will cause ring vibration, poor sealing, and overheating of the rings due to blow-by and reduced contact with the cylinder wall. Service life of the pistons and rings will be greatly reduced.

Cylinderhone Selection

Selecting a hone which will straighten as well as remove material from the cylinder is very important. Honing a cylinder with a spring loaded glaze breaker is never advised. Polaris recommends using a rigid type hone which also has the capability of oversizing. These hones are manufactured by such companies as Sunnen Products Company of St. Louis, Missouri; and Ammco Tools, Inc., of North Chicago, Illinois.

Shown at right is the Ammco No. 3950 hone. This hone has roughing and finishing stone sets available to service engines with cylinder bores up to 75mm in diameter.



De-glazing

If cylinder wear or damage is minimal, hone the cylinder lightly with finish stones following the procedure outlined on page 3.74

Honing To Oversize

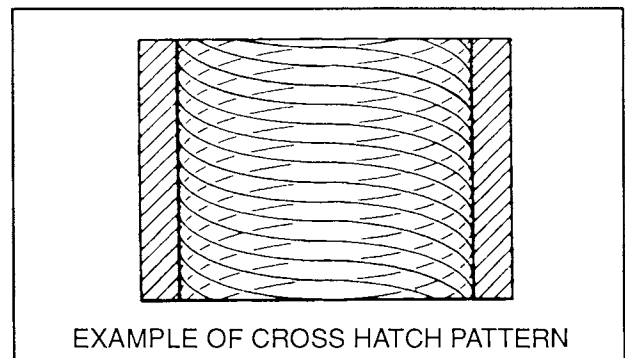
If cylinder wear or damage is excessive, it will be necessary to oversize the cylinder using a new oversize piston and rings. This may be accomplished by either boring the cylinder and then finish honing to the final bore size, or by rough honing followed by finish honing.

NOTE: Portable rigid hones are not recommended for oversizing cylinders, cylinder boring, and finish honing. The use of an arbor type honing machine is recommended.

For oversize honing always wet hone using honing oil and a coarse roughing stone. Measure the new piston at room temperature (see piston measurement) and rough hone to the size of the piston or slightly larger. Always leave .002 - .003" (.05 - .07 mm) for finish honing. Complete the sizing with fine grit stones to provide the proper cross-hatch finish and required piston clearance.

Inspect cylinder for taper and out-of-round. Taper or out-of-round on the finished bore should not exceed .0004" (.002mm).

NOTE: Always check piston to cylinder clearance and piston ring installed gap after boring/honing is complete!

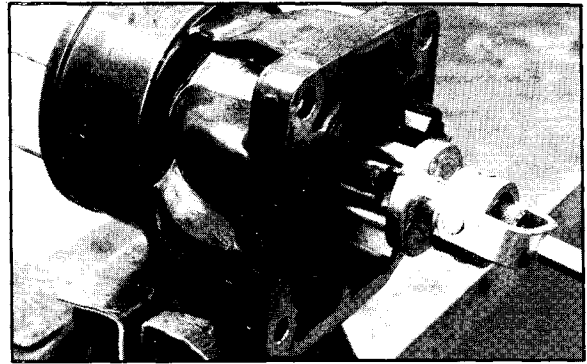


ENGINES

General Inspection Procedures

Honing Procedure

1. Wash cylinder with solvent. Clamp cylinder in a soft jawed vise by the exhaust port studs.
2. Place hone in cylinder and tighten stone adjusting knob until stone contacts the cylinder walls (DO NOT OVERTIGHTEN). Cylinders may be wet or dry honed depending on the hone manufacturer's recommendations. Wet honing removes more material faster and leaves a more distinct pattern in the bore. Using a 1/2" (13 mm) drill motor rotating at a speed of 300-500 RPM, run the hone in and out of the cylinder rapidly until cutting tension decreases. Remember to keep the hone drive shaft centered to prevent edge loading and always bring the stone approximately 1/2" (1.3 cm) beyond the bore at the end of each stroke. Release the hone at regular intervals to inspect bore size and finish.



Ni-Ca-Sil Honing

Ni-Ca-Sil cylinders can be lightly honed if the proper stone is used. Ammco #3955 honing stones (for use with the Ammco 3950 cylinder hone) are suitable and can be ordered through most automotive supply stores or VST. See General Information chapter for tool ordering information.

Port Chamfering

Remove the sharp edges at the bottom and top of each port whenever boring or honing is performed. Make sure there are no sharp edges.

IMPORTANT:

Cleaning the Cylinder After Honing

It is very important that the cylinder be thoroughly cleaned after honing to remove all grit material. Wash the cylinder in a solvent, then in hot soapy water. Pay close attention to areas where the cylinder sleeve meets the aluminum casting (transfer port area). Use electrical contact cleaner if necessary to clean these areas. Rinse thoroughly, dry with compressed air, and oil the bore immediately with Polaris Premium 2 Cycle Lubricant.

NOTE: Always check piston to cylinder clearance and piston ring installed gap after boring/honing is complete!

Crankcase Inspection / Bearing Fit

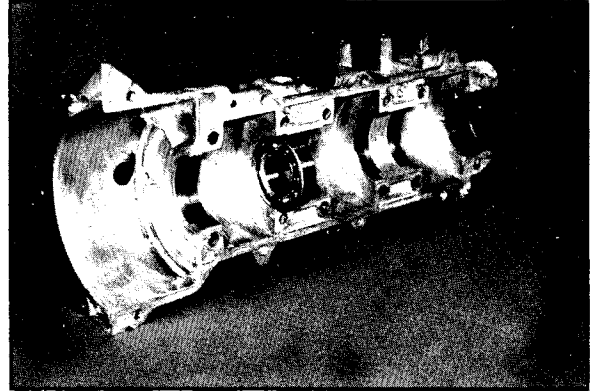
Any time crankshaft bearing failure occurs and the case is to be reused, Polaris recommends checking the bearing fit into the case halves using the following procedure.

1. With case halves cleaned, press a replacement bearing into each of the main bearing journals to determine a basic amount of press fit. **NOTE:** Do a comparison check of all journals by manually forcing the bearing into the bearing seats noting if any are noticeably loose or tight. Normal hand installation will be an indication of the recommended interference fit. If the bearing falls out of the case when the case is inverted, or if the crankcase bearing surface is severely galled or damaged, the case should be replaced.

Crankcase Bearing Interference Fit:

C-3 - .0006" (.015mm)

C-4 - .001" (.025mm)



Crankshaft Main Bearing Inspection

1. Clean crankshaft thoroughly and oil main and connecting rod bearings with Polaris Premium 2 engine oil. Carefully check each main bearing on the shaft.

NOTE: Due to extremely close tolerances, the bearings must be inspected visually, and by feel. Look for signs of discoloration, scoring or galling. Turn the outer race of each bearing. The bearings should turn smoothly and quietly. The inner race of each bearing should fit tightly on the crankshaft. The outer race should be firm with minimal side to side movement and no detectable up and down movement. Replace any loose or rough bearings.

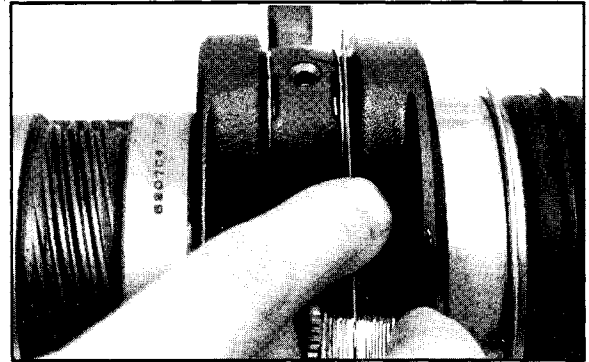
ENGINES

General Inspection Procedures

Connecting Rod (Big End) Bearing Inspection

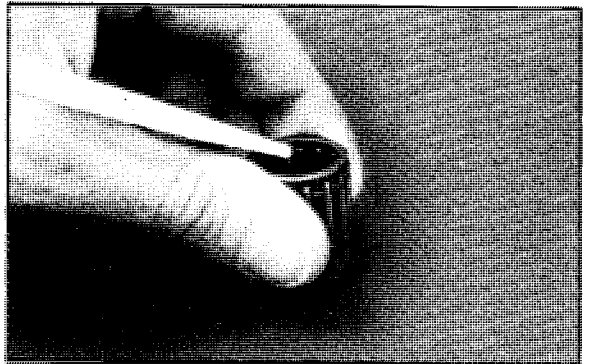
1. Measure connecting rod big end side clearance with a feeler gauge. Clearance should be equal on all rods (within .002"). Rotate rod on crankshaft and check for rough spots. Check radial end play in rod by supporting rod against one thrust washer and alternately applying up and down pressure. Replace bearing, pin, and thrust washers if side clearance is excessive or if there is any up and down movement detectable in the big end bearing.

NOTE: Specialized equipment and a sound knowledge of crankshaft repair and straightening is required to perform crankshaft work safely and correctly. Crankshaft repair should be performed by trained Polaris service technicians in a properly equipped shop.



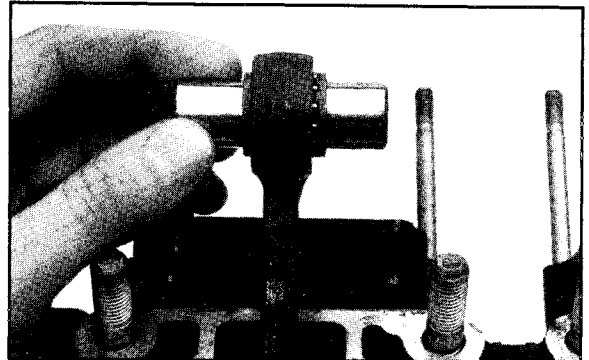
Piston Pin / Needle Bearing Inspection

1. Clean needle bearing in solvent and dry with compressed air.
2. Inspect needle cage carefully for cracks or shiny spots which indicate wear. Replace needle bearings if worn or cracked, and always replace them if piston damage has occurred.
3. Visually inspect piston pin for damage, discoloration, or wear. Run your fingernail along the length of the pin and replace it if any rough spots, galling or wear is detected.



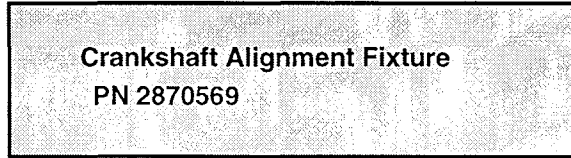
Connecting Rod Small End Inspection

1. Clean small end of connecting rod and inspect inner bore with a magnifying glass. Look for any surface irregularities including pitting, wear, or dents.
2. Run your fingernail around the inside of the rod and check for rough spots, galling, or wear.
3. Oil and install needle bearing and pin in connecting rod. Rotate pin slowly and check for rough spots or any resistance to movement. Slide pin back and forth through bearing while rotating and check for rough spots.
4. With pin and bearing centered in rod, twist ends back and forth in all directions to check for excessive axial play. Pull up and down evenly on both ends of pin to check for radial play. Replace pin and bearing if there is any resistance to rotation or excessive axial or radial movement. If play or roughness is evident with a new pin and bearing, replace the connecting rod.



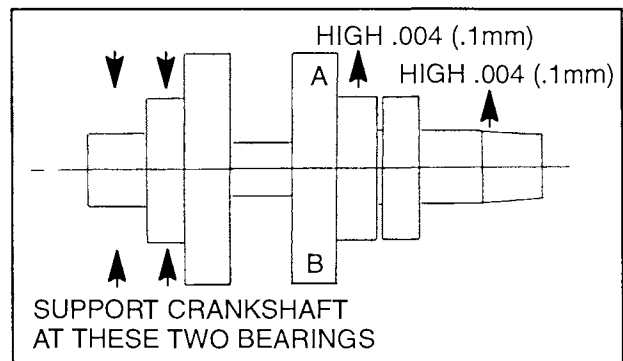
Crankshaft Truing

Lubricate the bearings and clamp the crankshaft securely in the holding fixture. On three cylinder crankshafts, straighten one of the ends (Magneto or PTO) and then straighten the center section. Place the center section in the holding fixture and then straighten the remaining end. If truing the crankshaft requires striking with a hammer, always be sure to re-check previously straightened areas to verify truing. Refer to the illustrations below.



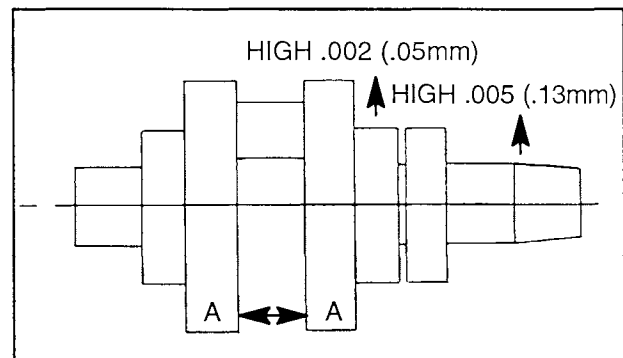
NOTE: The rod pin position in relation to the dial indicator position tells you what action is required to straighten the shaft.

5. To correct a situation like the one shown in the illustration at right, strike the shaft at point A with a brass hammer.



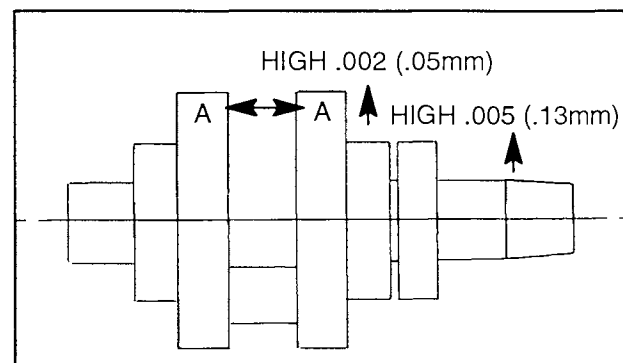
NOTE: The rod pin position in relation to the dial indicator position tells you what action is required to straighten the shaft.

6. To correct a situation like the one shown in the illustration at right, squeeze the crankshaft at point A. (Use tool from alignment kit).



7. If the crank rod pin location is 180° from the dial indicator (opposite that shown above), it will be necessary to spread the crankshaft at the A position as shown in the illustration at right. When rebuilding and straightening a crankshaft, straightness is of utmost importance. Runout must be as close to zero as possible.

NOTE: Maximum allowable runout is .004" (.1 mm).



ENGINES

General Inspection Procedures

Crankshaft Indexing

Polaris crankshafts are pressed together or “indexed” so the connecting rod journal center lines are 180° (twins) or 120° (triples) apart from each other.

It is sometimes necessary to check multi-cylinder crankshafts to verify that one cylinder has not been forced out of position relative to the other cylinder or cylinders. Causes for out-of-index crankshafts include but are not limited to:

- Hydrolock from water or fuel;
- Impact to drive clutch from foreign object or accident;
- Abrupt piston or other mechanical failure;
- Engine lock-up due to drive belt failure;

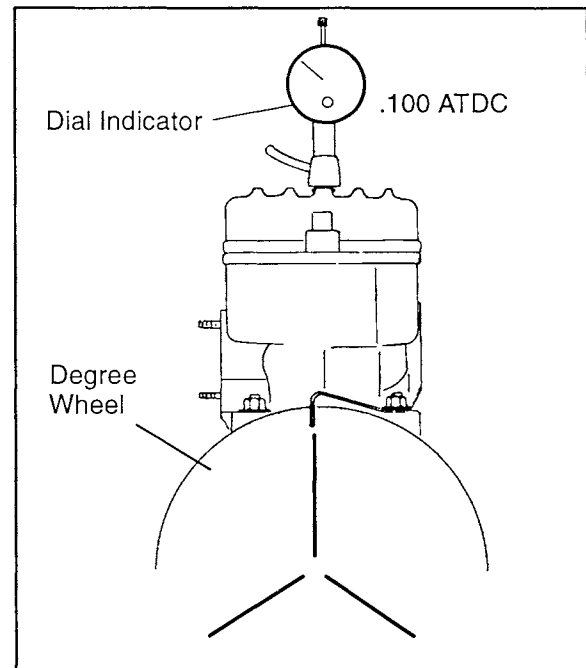
Following is a method of checking:

CAUTION:

Disconnect battery ground cable and **all** spark plug high tension leads; ground high tension leads to engine. Disconnect lanyard from engine stop switch before proceeding with the following steps.

1. Securely fasten a degree wheel on the flywheel or PTO end of crankshaft. Use a large degree wheel for more accuracy, and make sure it is mounted concentrically with the crankshaft center line.
2. Sharpen a coat hanger or section of welding rod and anchor it to a convenient spot. Point the sharpened end at the outer perimeter of the degree wheel.
3. Install a dial indicator into the magneto end cylinder spark plug hole (front) (#1). (The ignition timing is referenced by the magneto end.)
4. Rotate the engine to bring the piston to top dead center (TDC) on the cylinder with the indicator installed.
5. Locate TDC as accurately as possible by finding the center of the point where there is no piston movement. “Zero” the dial indicator at this point. Continue to rotate the crankshaft in the normal direction of rotation until the dial indicator reads .100” (2.54mm) after top dead center (ATDC).

IMPORTANT: Do not allow the crankshaft to move from this position.



Crankshaft Indexing (Continued)

6. Bend the pointer or move the degree wheel until the pointer aligns with the 180 or 120° mark on the degree wheel.
7. With the pointer aligned, make sure the degree wheel and pointer are secured and will not move out of position. Re-check accuracy of this location by repeating steps 4. and 5. . The pointer should align with the 180 or 120° mark when the dial indicator reads .100" (2.54mm) ATDC.

IMPORTANT: *Do not* move the degree wheel or pointer after the initial setting on the mag end cylinder - simply read the wheel and dial indicator.

8. Remove the dial indicator and install in cylinder #2 or center cylinder. Repeat steps 4. and 5. Note the degree wheel indication when the dial indicator reads .100" ATDC. It should be 180 or 120° ($\pm 2^\circ$) from cylinder #1. Repeat procedure on PTO cylinder (#3) where applicable. Cylinder #3 should also be 120° ($\pm 2^\circ$) from cylinder #1.

Symptoms of an out of index crankshaft can include:

- Difficulty calibrating carburetor (repetitive plug fouling on one cylinder with no other cause);
- Unexplained piston failure on one cylinder (i.e. severe detonation, broken ring lands, piston holding);
- Excessive vibration of engine, backfiring, etc.;
- Rough idle, poor top speed.

ENGINES

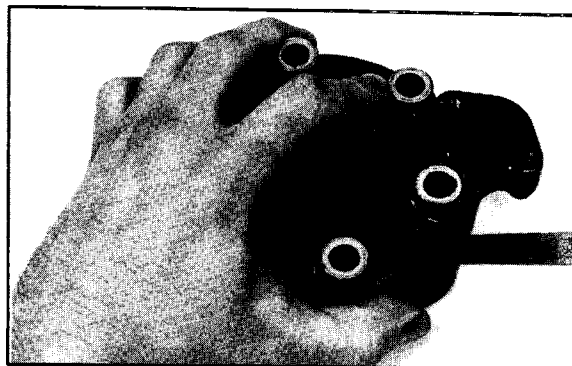
General Inspection Procedures

Cylinder Head Inspection

1. Inspect each cylinder head for warping. Replace cylinder head if warp exceeds service limit.

Cylinder Head Warp

Service Limit: .003" (.08mm)



Cylinder Measurement

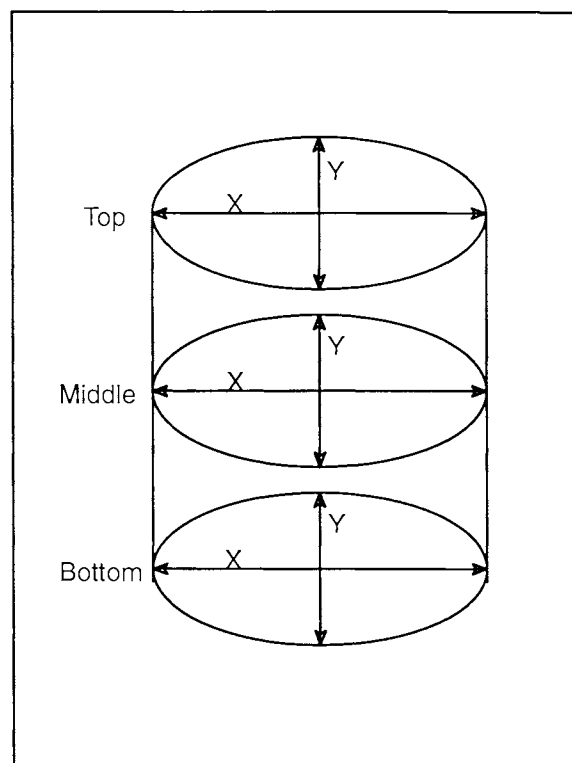
1. Inspect each cylinder for wear, scratches, or damage. If no damage is evident, measure the cylinder for taper and out of round with a telescoping gauge or a dial bore gauge. Measure the bore $1/2$ " from the top of the cylinder; in line with the piston pin and 90° to the pin to determine if the bore is out of round. Repeat the measurements at the middle of the cylinder and the bottom of the cylinder to determine taper or out of round at the bottom. Record all measurements.

Cylinder Taper

Limit: .002 Max.

Cylinder Out of Round

Limit: .002 Max.



Piston Inspection/Measurement

1. Check piston for scoring or cracks in piston crown or pin area. Excessive carbon buildup below the ring lands is an indication of piston, ring or cylinder wear.
2. Measure piston outside diameter at a point 10 mm (3/8") up from the bottom of the skirt at a 90° angle to the direction of the piston pin. Record the measurement for each piston.

NOTE: The piston must be measured at this point to provide accurate piston-to-cylinder clearance measurement.

3. Subtract this measurement from the minimum cylinder measurement recorded previously. If clearance exceeds the service limit, the cylinder should be re-bored and new pistons and rings installed.

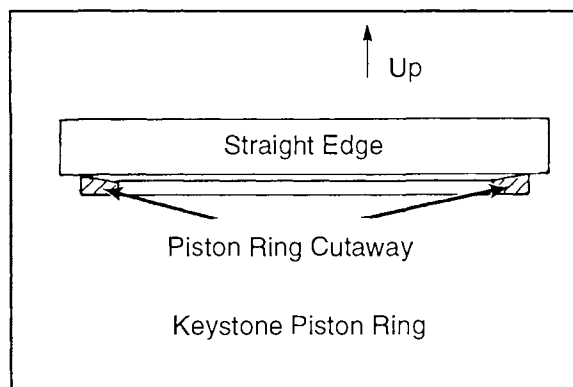
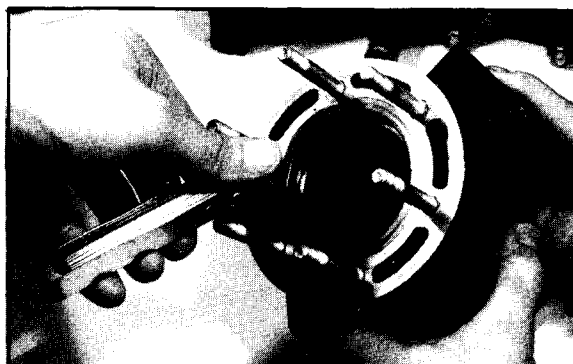
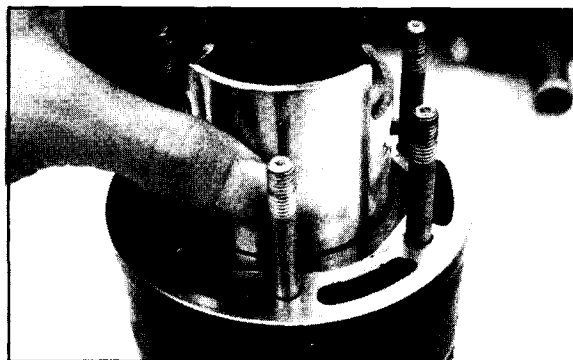


Piston Ring Installed Gap

1. Position ring 1/2" (1.3 cm) from the top of the cylinder using the piston to push it squarely into place. Measure installed gap with a feeler gauge at both the top and bottom of the cylinder.

NOTE: A difference in end gap indicates cylinder taper. The cylinder should be measured for excessive taper and out of round. Replace rings if the installed end gap exceeds the service limit.

NOTE: Always check piston ring installed gap after re-boring a cylinder or when installing new rings. Refer to specifications in chapter 1 for piston ring installed gap.



ENGINES

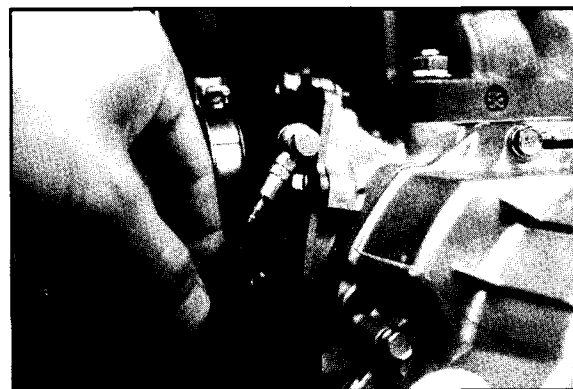
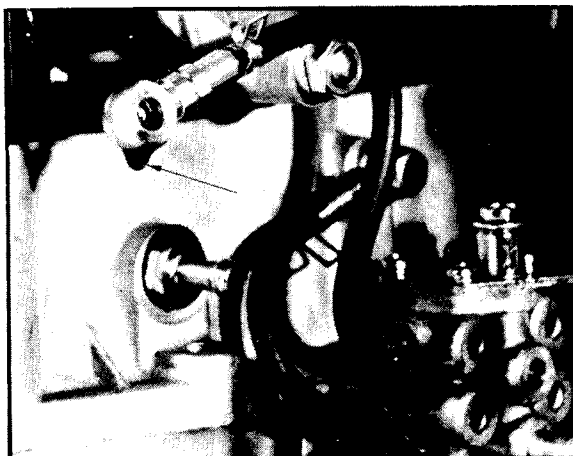
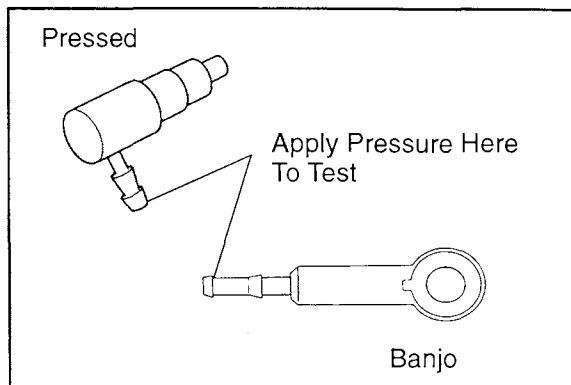
General Inspection Procedures

Oil Pump Operation and Troubleshooting

Any time the engine is disassembled or repaired, it is important that the oil supply from the pump to the engine be checked.

NOTE: Banjo type or pressed in valves should open with 2 to 7 lbs. of pressure. Perform this test with 40:1 premix in fuel tank.

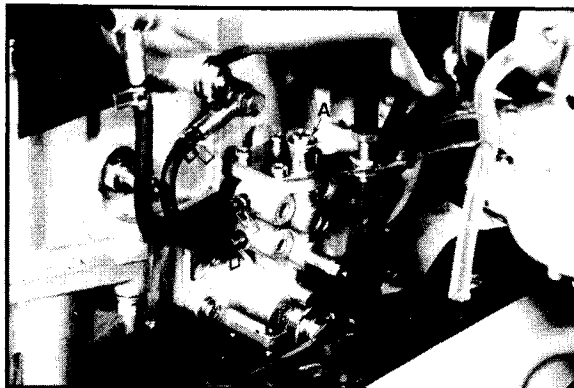
1. With engine in chassis, oil reservoir full, and pump bled, remove two oil feed line banjo bolts (A) from their location on the manifold or carburetors. **NOTE:** Install new sealing washers upon installation on either side of the banjo check valve.
2. Loosely thread only the banjo bolts back into the manifold or carburetors.
3. Place oil feed lines with their check valves away from the clutch area. Start the engine and let it idle at normal idle RPM.
4. Lift oil pump control lever up to its maximum flow position.
5. Drops of oil should be visible from the banjo check valves after the engine is idled one to two minutes, with a drop occurring approximately every few seconds.
6. If oil does not flow from one of the check valves, remove oil line from check valve and again idle engine. If oil then flows, the check valve is defective and must be replaced.
7. If oil does not flow with check valves removed from their feed lines, the malfunction is one of the following:
 - Inline filter blocked
 - Air not bled from oil pump
 - Feed lines leaking
 - Oil tank vent restricted or kinked
 - Defective pump.



Oil Pump Bleeding

The oil pump must always be bled following any service to the injector system or engine which allows the loss of oil and subsequent entrapped air during reassembly.

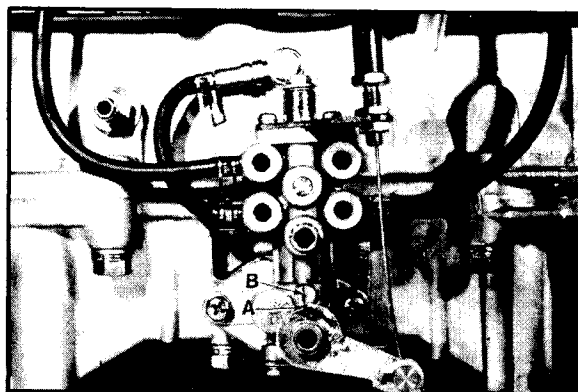
1. Fill oil reservoir with Polaris injector oil.
2. Loosen bleed screw (A). After a short time oil should flow from beneath the screw head to indicate the pump is free of air.
3. Tighten bleed screw securely.



Oil Pump Adjustment - All Models

NOTE: Adjust carburetor synchronization, idle speed, and throttle cable free play before adjusting oil pump.

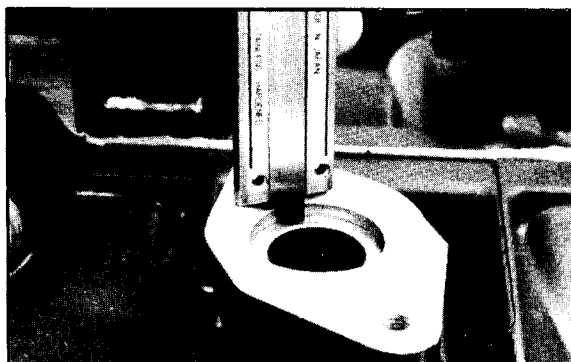
1. Stop engine.
2. With throttle in its idle position, the pump lever index mark (A) must align with the pump housing boss index mark (B). On domestic 500 cc engines, align the dot on the pump arm to the mark on pump.
3. Loosen lock nuts on cable housing sleeve and vary cable housing length as required until proper marks are aligned. **NOTE:** Verify pump lever moves upon initial throttle opening.



Oil Pump Bushing End Play Adjustment - Fuji

If the oil pump, crankcase, or any pump drive component is replaced, inspect the drive gear bushing end play using the following procedure:

1. Assemble oil pump drive gear assembly. Be sure the bushing is fully seated in the crankcase.
2. Measure distance from oil pump mounting surface to bushing. Call this measurement "A".

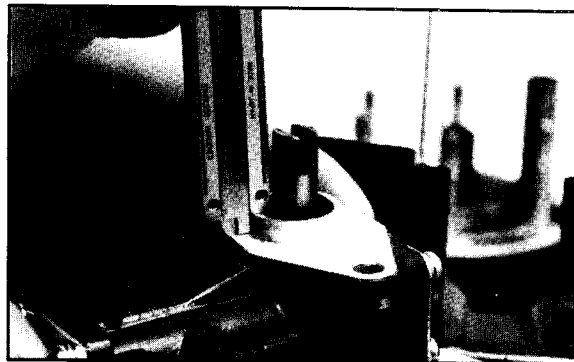


ENGINES

General Inspection Procedures

Oil Pump Bushing End Play Adjustment - Fuji, continued

3. Measure distance from oil pump mounting flange surface to end of seal flange as shown. Call this measurement "B".
4. Subtract measurement "B" from "A" to determine total bushing end play.



5. Measure thickness of existing shims and subtract from total bushing end play determined in step 3.
6. Add or subtract shims as required to provide specified end play.
7. Lightly grease a new O-ring and install it on the pump. Install pump, engaging slot in shaft with drive gear. Apply Loctite™ 242 to bolts and torque evenly to 78 in. lbs. (.9 kg-m).



End Play

.008 - .016" (.203 - .406 mm)

Optional Shims:

PN 3083671 = .006" (.15mm)

PN 3083672 = .012" (.3mm)

PN 3083673 = .024" (.6mm)

Oil Pump Mounting Bolt Torque (242 Blue)

78 in. lbs (.9 kg-m)

⚠ WARNING

Never remove the pressure cap when the engine is warm or hot. If the pressure cap is to be removed, the engine must be cool. Severe personal injury could result from steam or hot liquid. Use of a non-standard pressure cap will not allow the recovery system to function properly. If the cap should need replacement, install the correct Polaris cap with the same pressure rating. Refer to the appropriate parts manual.

NOTE: Always use Polaris premium antifreeze 60/40 premix. Bleed system at specified RPM or air will remain trapped in system, which may result in overheating.

Filling and Bleeding Procedure

If the cooling system should become low in the reservoir-tank and/or filler neck, the system should be bled of any trapped air using one of the following procedures, depending on model.

Fuji (except 700/800 XCR)

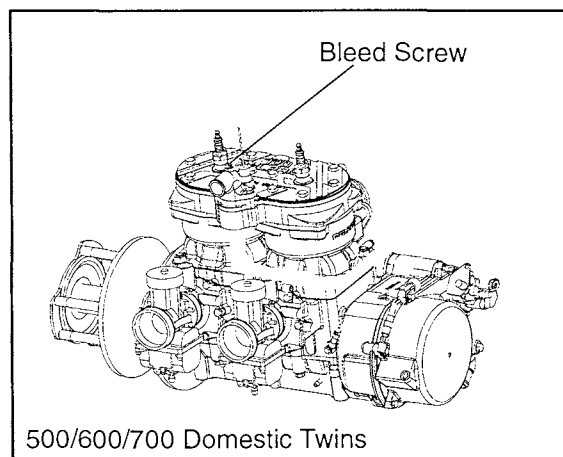
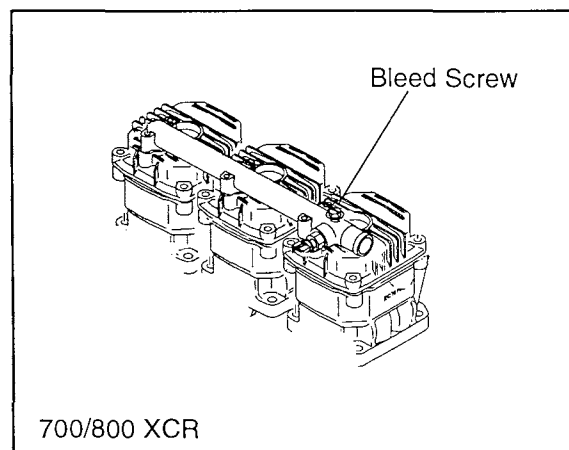
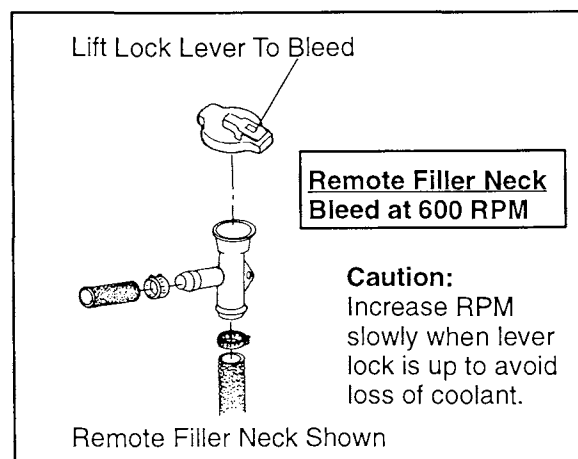
1. Elevate front end of machine approximately 10" (25 cm).
2. Fill coolant reservoir to indicated maximum level line.
3. Remove pressure cap and slowly add coolant until coolant level is even with top of filler neck. Install pressure cap and lift lever.
4. Install the pressure cap with the lever lock up in its release position and run the engine at low idle RPM (600 RPM \pm 100) to allow all air to purge and prevent trapped air which can lead to overheating and engine damage. Reset idle to specs after bleeding. System is properly bled when no air bubbles are visible in overflow line when RPM is increased slightly. Lock pressure cap and fill the coolant reservoir to proper level.

700 and 800 XCR Bleeding Procedure

1. Fill cooling system. Leave pressure cap off.
2. With engine running at specified idle speed, loosen bleed screw on water outlet manifold.
3. Continue adding antifreeze mixture to reservoir bottle until system is purged of air.
4. Close bleed screw and tighten securely.
5. Fill reservoir bottle until it is between the minimum and maximum fill marks.
6. Replace pressure cap.
7. Start engine and check for leaks.

500/600/700 Domestic Twins Bleeding Procedure

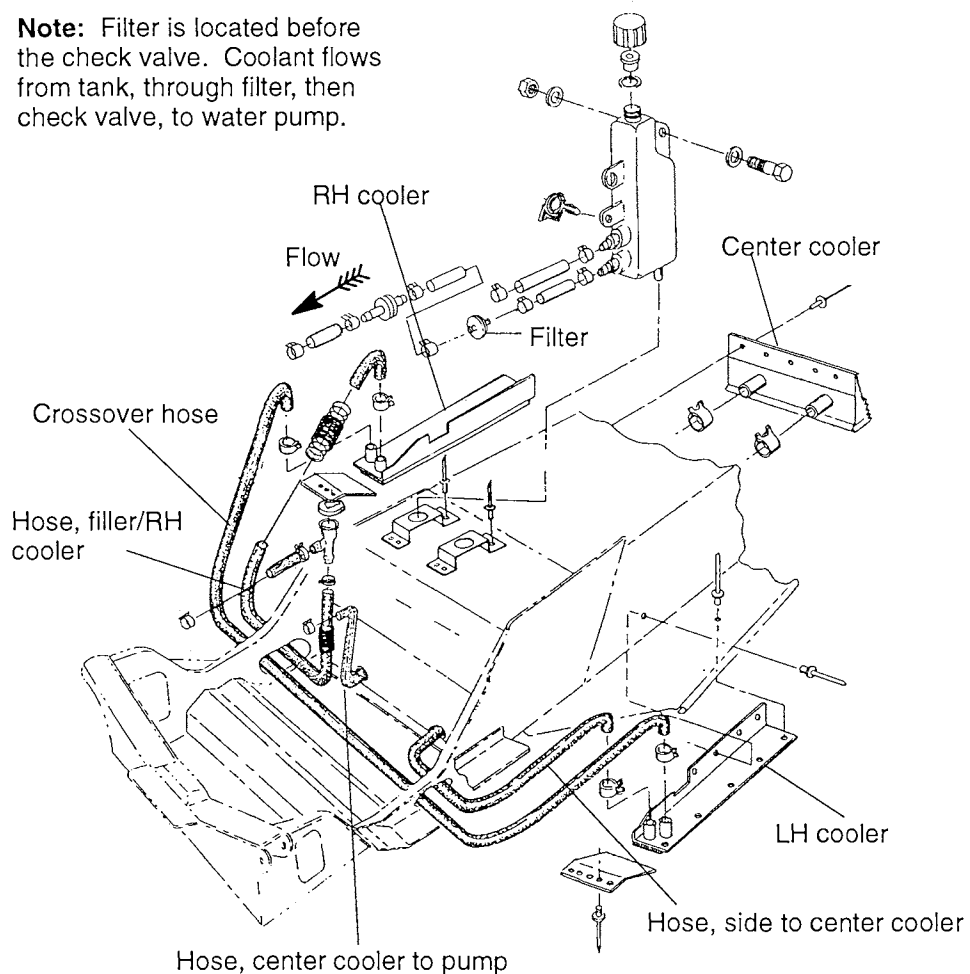
1. Fill cooling system. Leave pressure cap off.
2. With engine running at specified idle speed, loosen bleed screw on thermostat housing.
3. Continue adding antifreeze mixture to reservoir until system is purged of air.
4. Close bleed screw and tighten securely.
5. Fill reservoir bottle until coolant level is between the minimum and maximum fill marks.
6. Replace pressure cap.
7. Start engine and test for leaks.



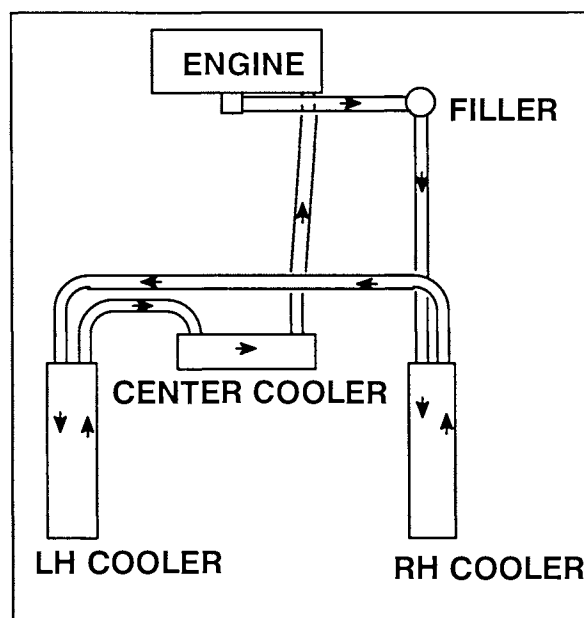
ENGINES

Cooling System - Indy 500/500 RMK, Classic, Classic Touring Widetrak LX, XLT Classic, XLT Touring

Note: Filter is located before the check valve. Coolant flows from tank, through filter, then check valve, to water pump.

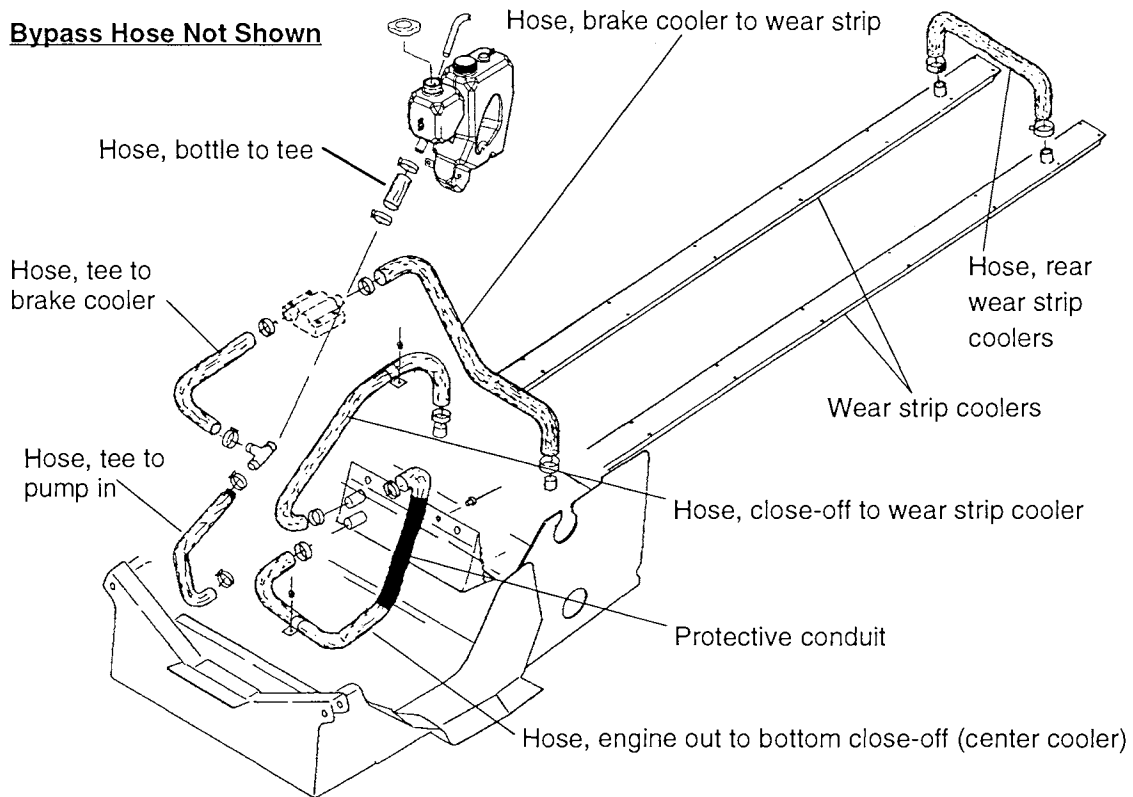


NOTE: When leak testing cooling system, system pressure should not exceed 2 lbs. less than cap pressure. Refer to filling and bleeding procedure on page 3.85.

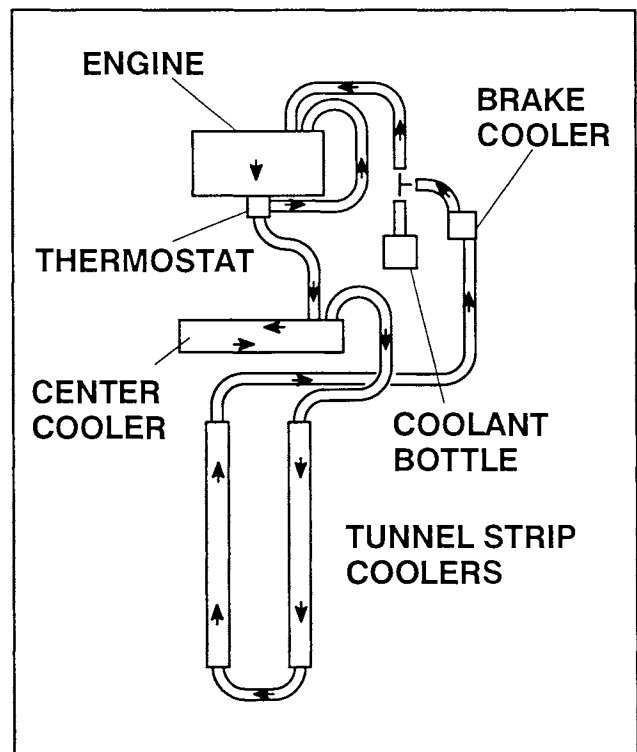


ENGINES **Cooling System - 600 XC/SP, 700 XC/SP**

Bypass Hose Not Shown



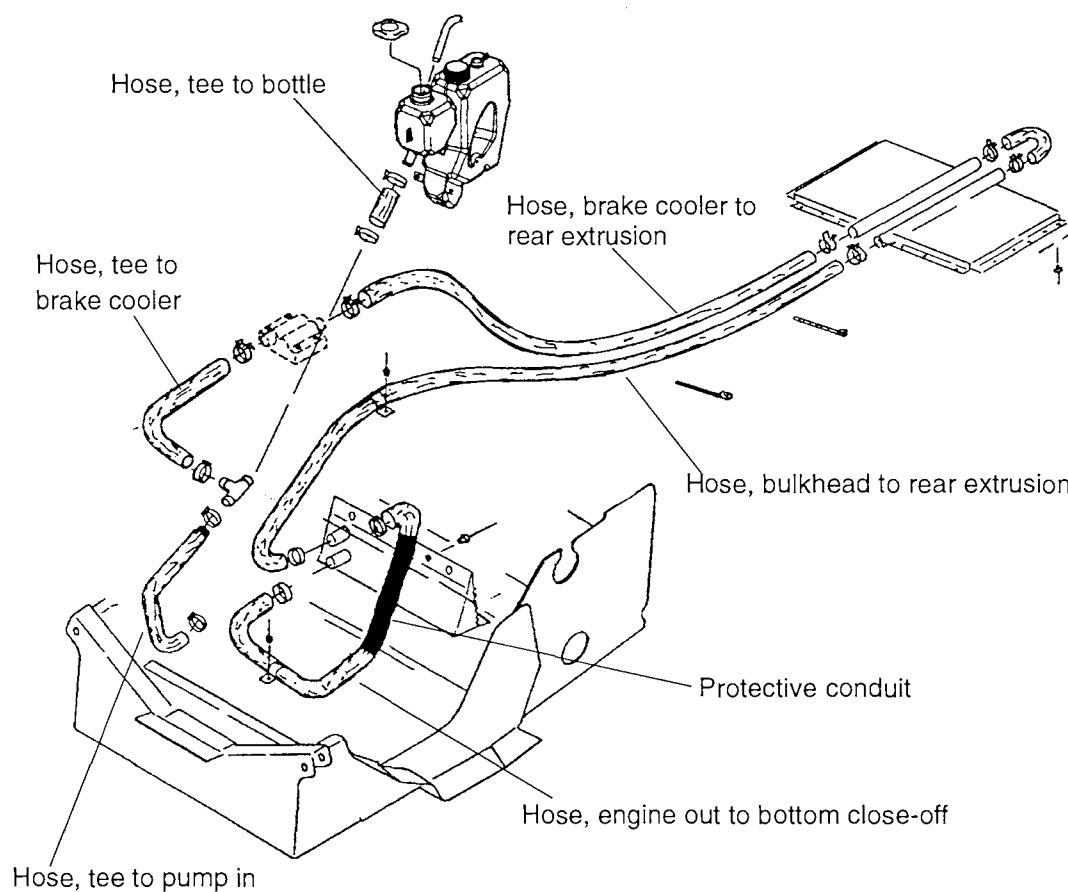
NOTE: When leak testing cooling system, system pressure should not exceed 2 lbs. less than cap pressure. Refer to filling and bleeding procedure on page 3.85.



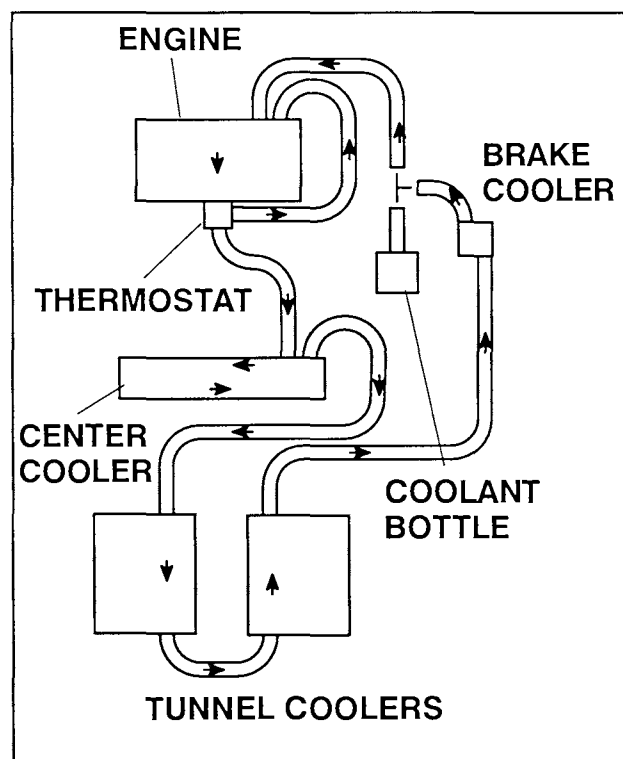
ENGINES

Cooling System - 600 RMK, 700 RMK, 700 SKS

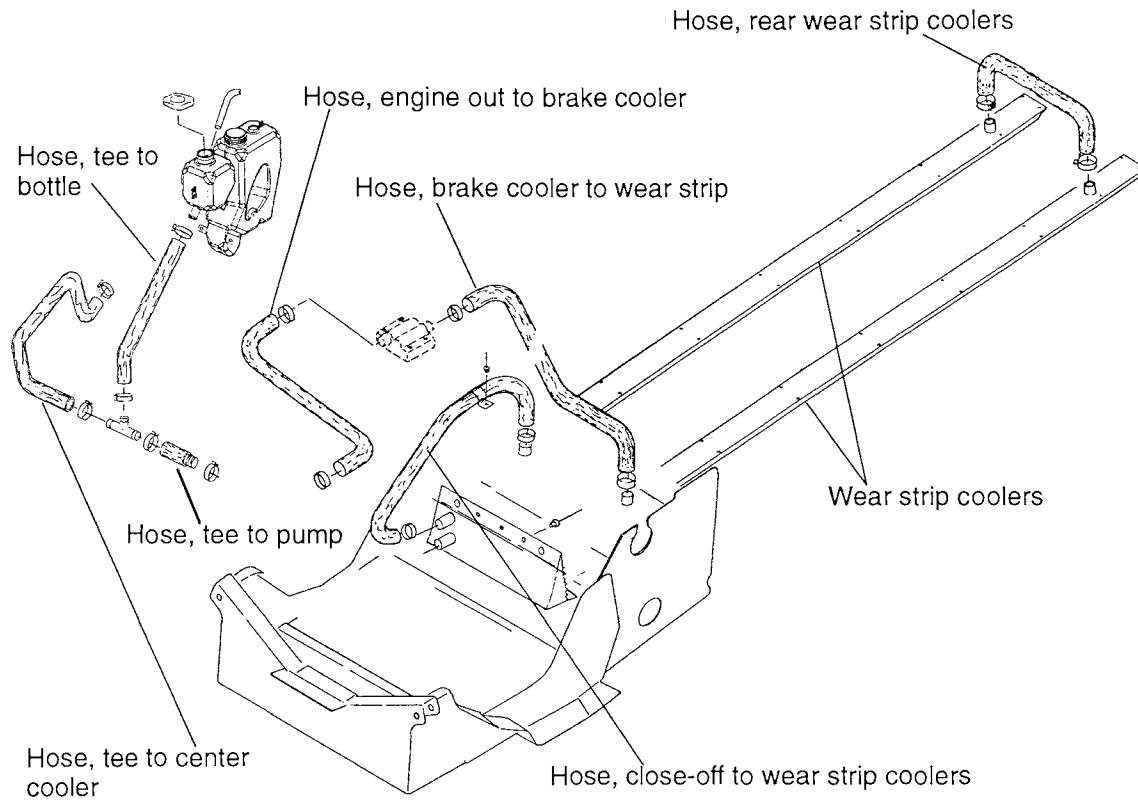
Bypass Hose Not Shown



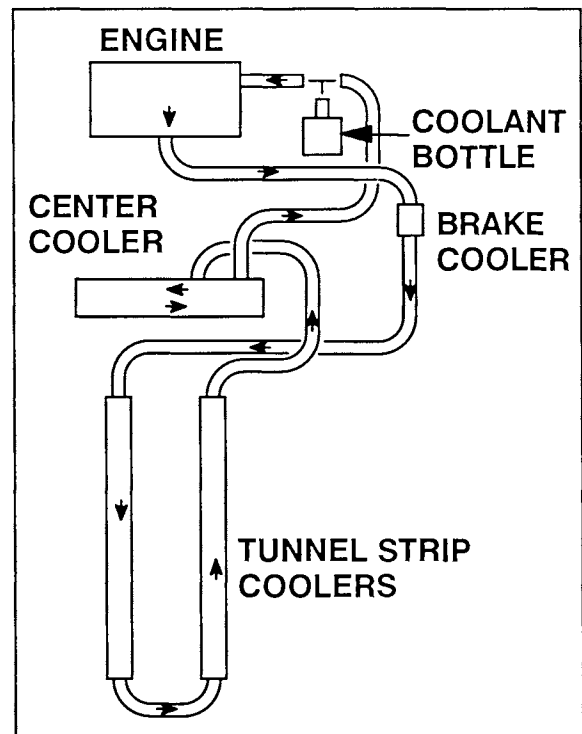
NOTE: When leak testing cooling system, system pressure should not exceed 2 lbs. less than cap pressure. Refer to filling and bleeding procedure on page 3.85.



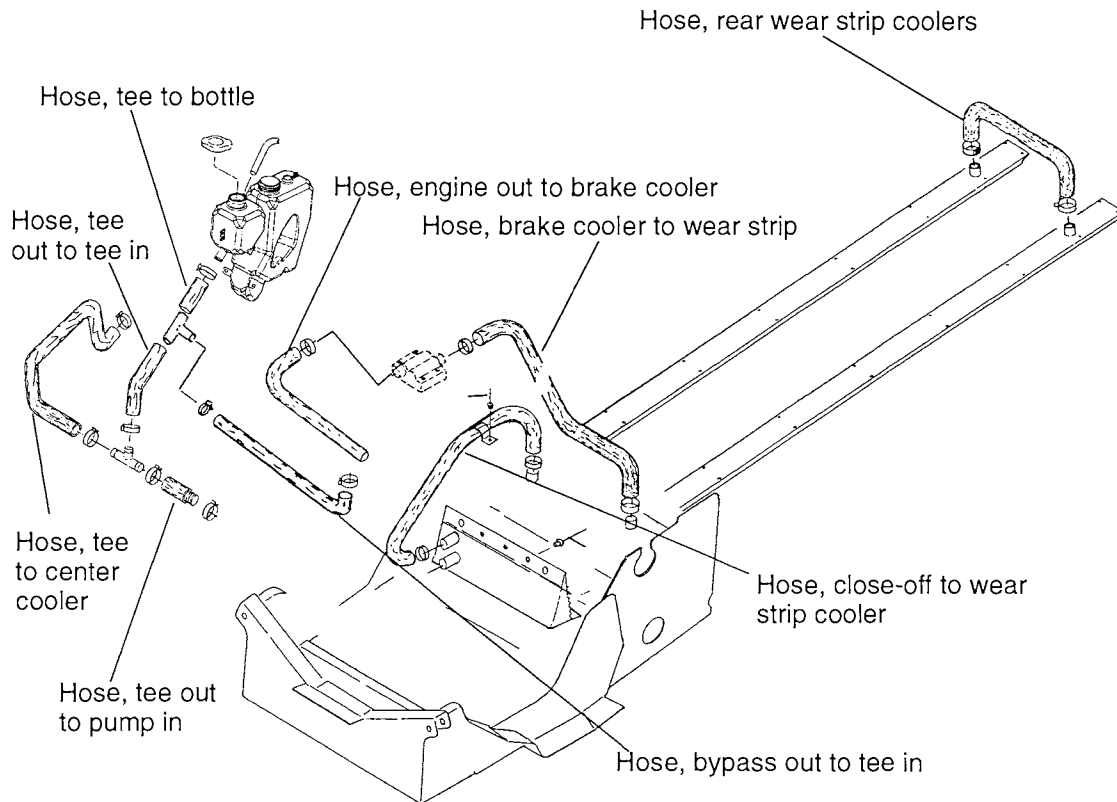
ENGINES **Cooling System - 440 XCR**



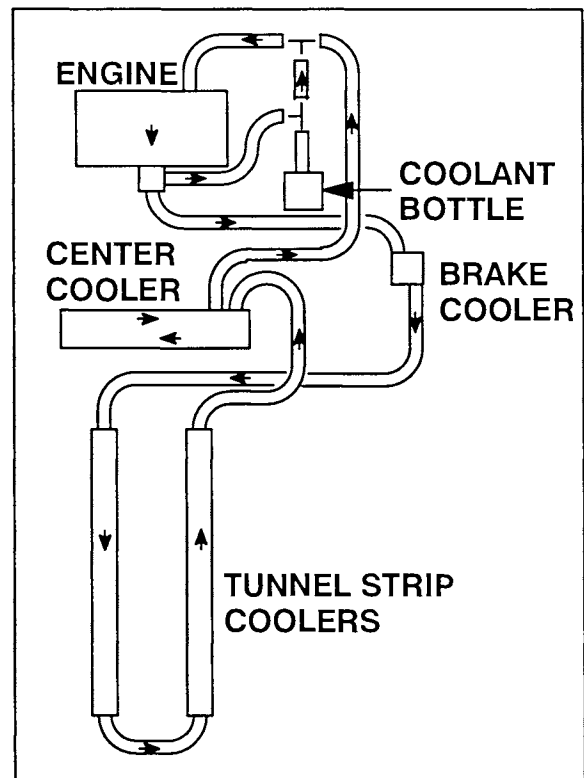
NOTE: When leak testing cooling system, system pressure should not exceed 2 lbs. less than cap pressure. Refer to filling and bleeding procedure on page 3.85.



ENGINES **Cooling System - 500 XC/SP**

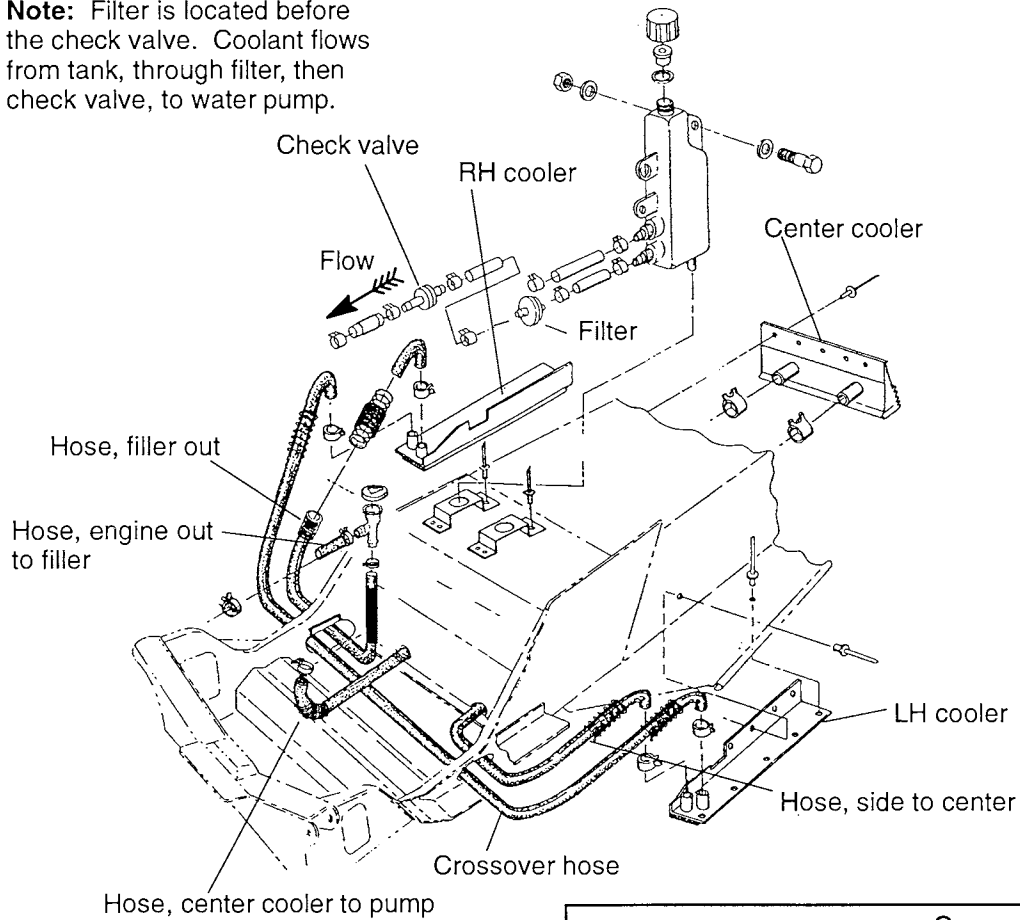


NOTE: When leak testing cooling system, system pressure should not exceed 2 lbs. less than cap pressure. Refer to filling and bleeding procedure on page 3.85.

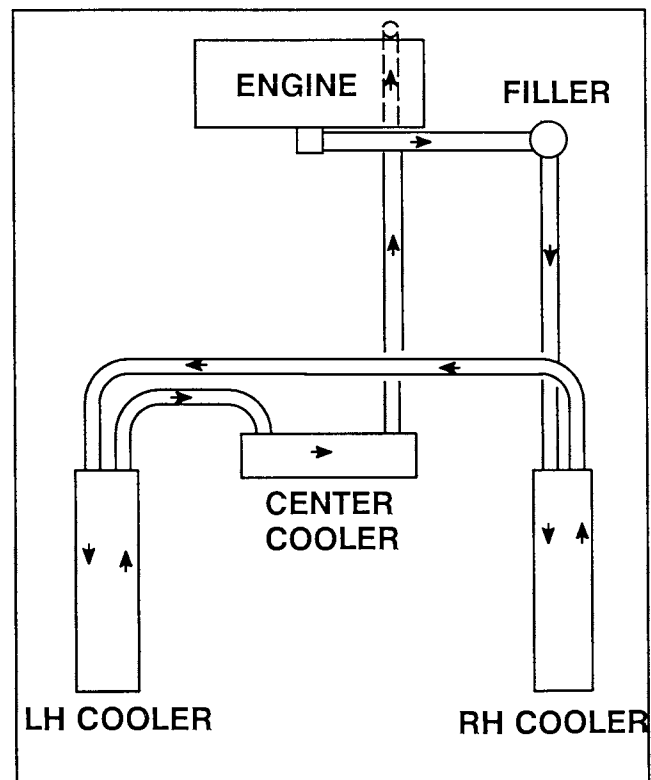


ENGINES Cooling System - XLT Special

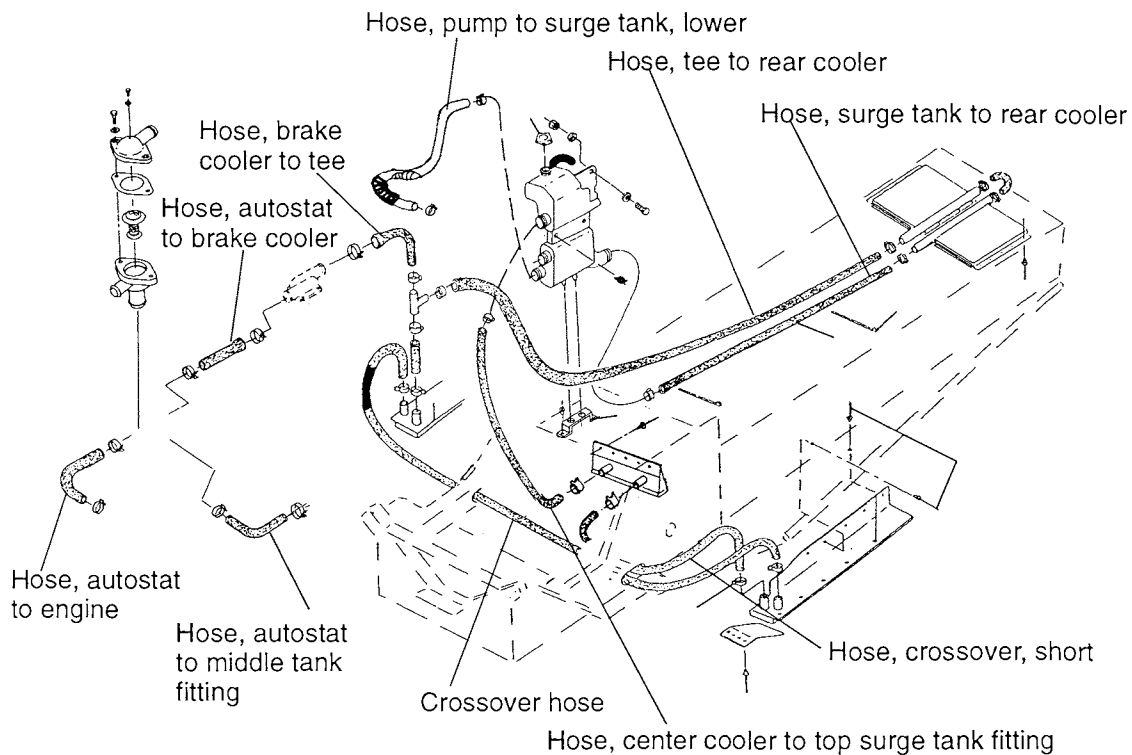
Note: Filter is located before the check valve. Coolant flows from tank, through filter, then check valve, to water pump.



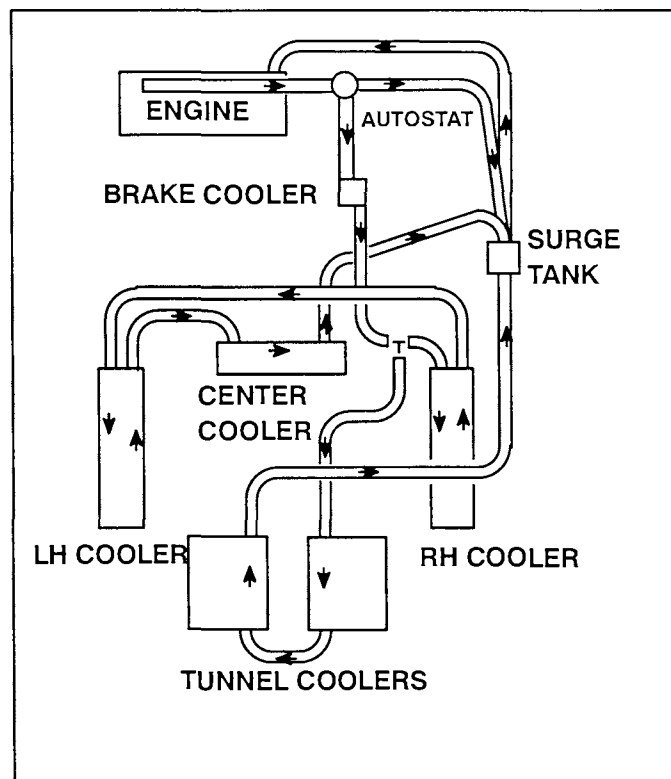
NOTE: When leak testing cooling system, system pressure should not exceed 2 lbs. less than cap pressure. Refer to filling and bleeding procedure on page 3.85.



ENGINES **Cooling System - 700/800 XCR**



NOTE: When leak testing cooling system, system pressure should not exceed 2 lbs. less than cap pressure. Refer to filling and bleeding procedure on page 3.85.



Disassembly

CAUTION:

Wear eye protection when servicing recoil. Spring can unwind suddenly and unexpectedly if dislodged.

1. Remove recoil handle and allow rope to retract and spring to unwind completely.
2. Remove retaining nut, friction plate, and ratchet pawl from reel face.
3. Lift reel assembly straight up, out of housing. **NOTE:** If spring tension is relieved and the reel is lifted straight out, the spring will most likely remain in the housing; however-be sure to heed caution above.

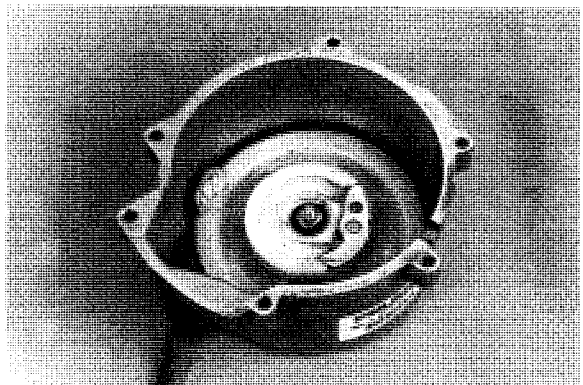
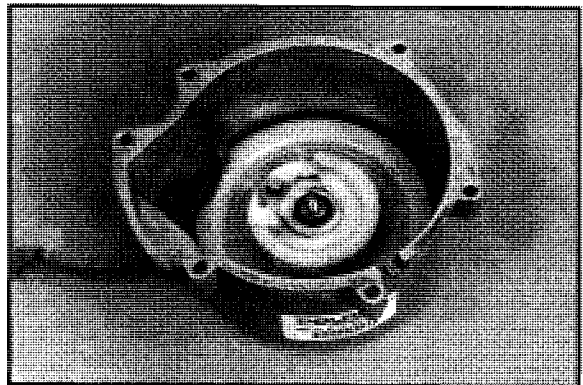
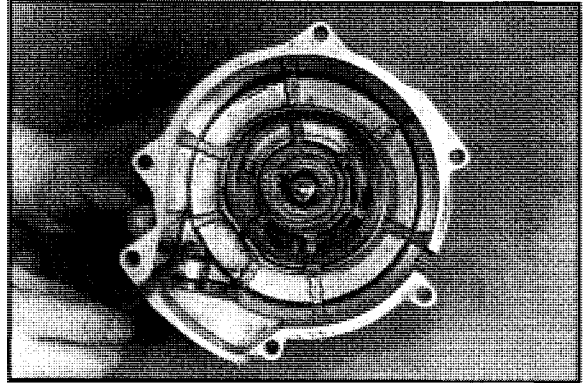
Assembly

1. If the spring was removed, reinstall it by spiraling counterclockwise toward the center.
2. Lubricate center shaft and spring with grease.

Premium All Season Grease

PN 2871423 (14 oz.)

3. Wind rope in a counterclockwise direction around outside of reel, as viewed from ratchet side of reel.
4. Pass end of rope through rope guide and slide reel down onto shaft and spring. **NOTE:** Make sure reel tab engages hook on end of spring.
5. Reinstall ratchet pawl onto reel face. **NOTE:** Ratchet spring must hold ratchet in retracted position.
6. Reinstall friction plate with one end of friction spring in hole on end of ratchet pawl.
7. Reinstall flange nut and torque to 5 ft. lbs. (.69 kg/m).
8. Pull recoil rope to full extension and align notch on outside edge of reel with housing rope guide hole.
9. Using a needle nose pliers or hooked wire, pull a loop of rope through the notch into center of housing.
10. Holding side of rope loop attached to reel, wind reel counterclockwise until coil bind is felt. Then unwind reel between one and two turns.
11. Pull loop to outside of housing by pulling on rope handle.
12. Allow rope to fully retract and check for normal recoil and ratchet operation.



ENGINES

Troubleshooting

PROBLEM	PROBABLE CAUSE
Will not start/ hard starting	<ul style="list-style-type: none"> -Check ignition switch for run position, moisture contamination -Check auxiliary shut-off switch operation -Check fuel supply -Check wiring from engine to coil(s) or spark plug(s) -Check spark plug(s) -Disconnect engine connector to eliminate any shorts that might be in the system -If starter won't work (electric models), check wires from starter solenoid and battery or check battery and battery cables -Open or broken reed valves
Low compression	<ul style="list-style-type: none"> -Crankcase plug is out -Head gasket faulty -Poor ring sealing, piston damage
No spark	<ul style="list-style-type: none"> -Spark plug fouled -Secondary coil faulty or wires disconnected; poor ground on secondary coil mount -Primary coil shorted or open -Ignition switch shorted, contaminated with moisture -Auxiliary switch shorted or contaminated with moisture
Engine idles but no acceleration	<ul style="list-style-type: none"> -Restricted fuel flow/air flow -Clogged main jet -Timing -Clutching -Engine not running on all cylinders
Engine runs but fails to reach maximum RPM	<ul style="list-style-type: none"> -Clogged fuel filter -Incorrect track tension -Incorrect main jet -Throttle slides not fully open -Chain too tight -Clutching -Excessive driveline friction (HiFax overheating) -Engine not running on all cylinders
Engine runs but fails to idle	<ul style="list-style-type: none"> -Incorrect air mixture setting -Throttle stop screw incorrectly adjusted -Restricted pilot jet -Low compression -Tight belt -Piston damage -Enricher plunger not seating properly
Engine runs, but overloads with fuel	<ul style="list-style-type: none"> -Enricher plunger are not seating properly -Fuel pump diaphragm is ruptured (caused by engine backfiring) -Carburetor slides are not synchronized -Main jet too large -Needle and seat not seating properly -Incorrect float level -Check reed valve condition
Carburetion and plug fouling	-Verify <i>all</i> tune up adjustments: carb sync, oil pump adjustment, pilot screw setting, spark plug type and gap, venting for carbs, proper jetting for altitude and temperature, belt tension, clutch operation. If tune up items are correct, check: float level, jet needle position, jet needle wear, inlet needle and seat wear, spark quality, etc.
Engine runs but overheats	<ul style="list-style-type: none"> -Coolant level low or air in cooling system -Incorrect main jet -Incorrect timing -Incorrect spark plug -Water pump belt loose or broken -Cooling restriction -Inadequate snow for cooling (ice and/or marginal conditions)
Battery will not charge (battery equipped mod- els only)	<ul style="list-style-type: none"> -Check for faulty connections -Check alternator output -Check diodes (rectifier) -Sulphated battery -Battery electrolyte overfilled or low -Refer to alternator testing in chapter 9, electrical

ENGINES Troubleshooting

PROBLEM	PROBABLE CAUSE
Lights don't work	<ul style="list-style-type: none"> -Engine must be running -Check wiring harness connector -Check for burned out bulbs -Check wiring for shorts or loose connections -Disconnect taillight if headlight works, short is in taillight wiring or taillight
Unit fails to propel itself	<ul style="list-style-type: none"> -Check belt (center distance) -Check clutch -Check chain -Check drive sprocket assembly -Track frozen or stuck
Track wears unevenly	<ul style="list-style-type: none"> -Check tension -Check for proper alignment -Check for loose, bent, or broken suspension parts
Chaincase overheating	<ul style="list-style-type: none"> -Check oil level -Check chain tension -Check track assembly

