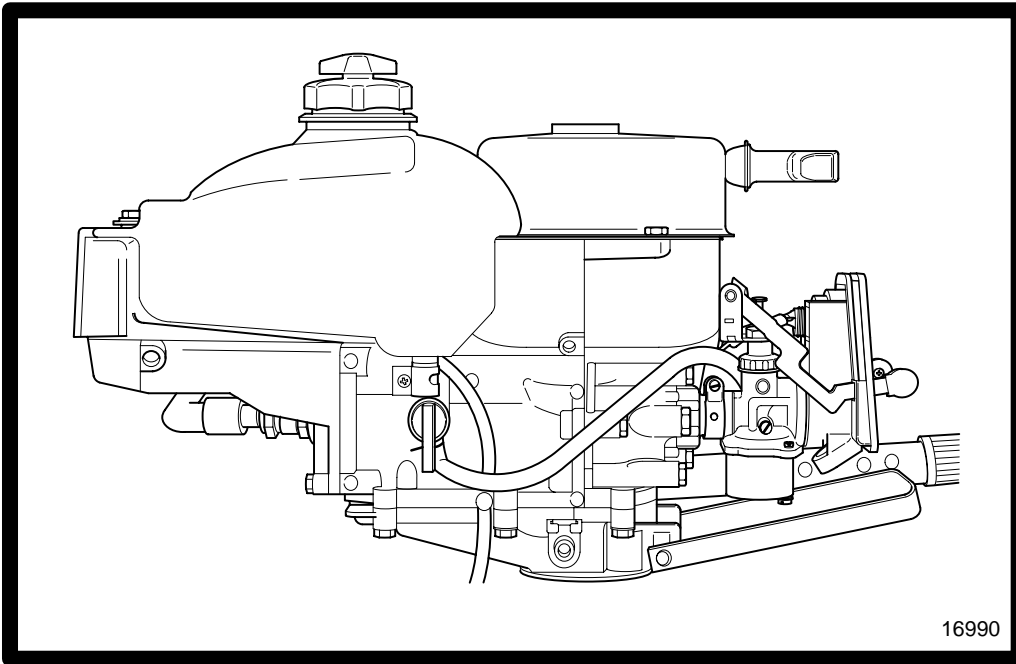




POWERHEAD



16990

4



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Powerhead

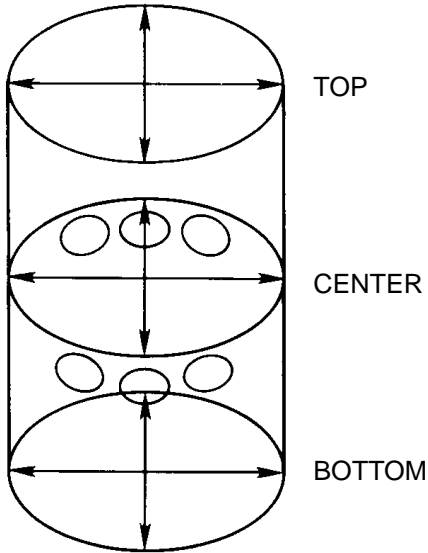
Specifications

Block

Type Two-Stroke Cycle
 Displacement 4.6 cu. in. (74.6cc)

Cylinder Bore

Dia. Standard 1.850 in. (47.05mm)
 Dia. 0.5mm Oversized 1.869 in. (47.55mm)
 Out of Round (Max.) 0.002 in. (0.05mm)
 Taper (Max.) 0.002 in. (0.05mm)



Piston

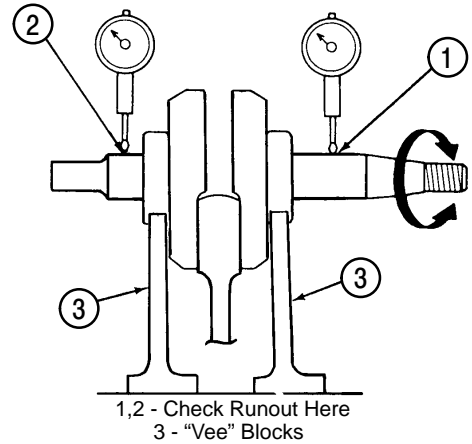
Clearance 0.002 in. to 0.005 in.
 (.06mm to .15mm)

Piston Ring

End Gap 0.006 in. to 0.012 in.
 (.18mm to .33mm)
 Side Clearance 0.003 in. to .0010 in.
 (.01mm to .05mm)

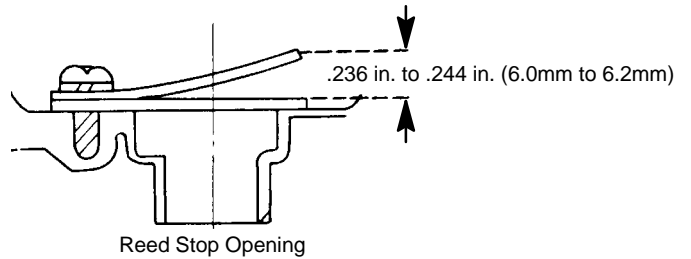
Crankshaft

Runout (Max.) 0.001 in. (0.05mm)
 Connecting Deflection 0.022 in. to 0.056 in.
 (0.6mm to 1.5mm)



Reed Block

Reed Stop Opening 0.236 in. to 0.244 in.
 (6mm to 6.2mm)



Special Tools

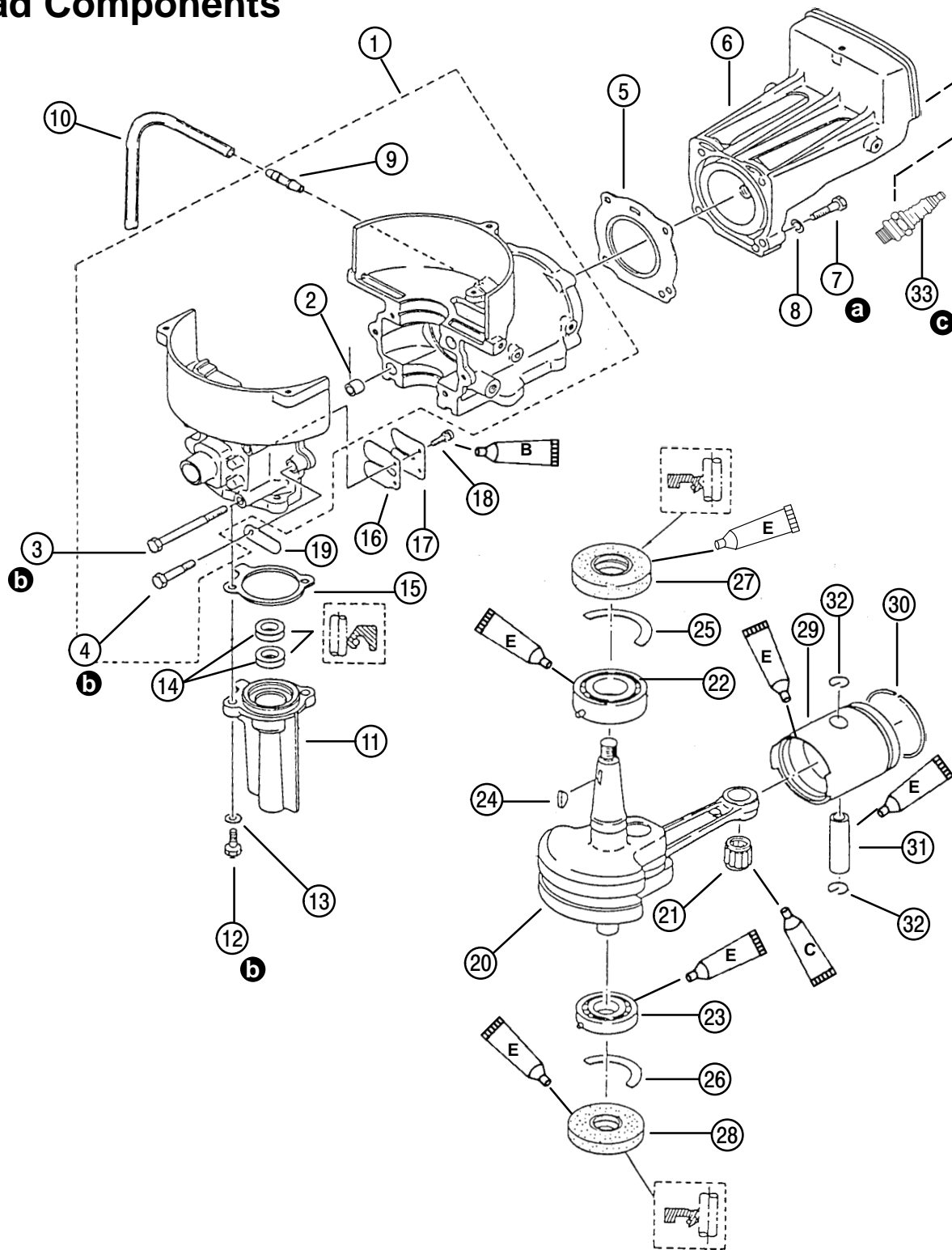
Description	Part No.
Piston Ring Expander	91-24697
Universal Puller Plate	91-37241
Flywheel Holder	91-83163M
Flywheel Puller	91-83164M

Torque Specifications

Flywheel Nut	30 lb. ft. (40.6 N·m)
Cylinder Head Bolts	85 lb. in. (9.6 N·m)
Crankcase Cover Bolts	50 lb. in. (5.6 N·m)
Lower End Cap Bolts	50 lb. in. (5.6 N·m)
Spark Plug	20 lb. ft. (27.1 N·m)

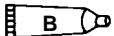
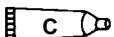
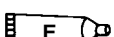


Powerhead Components



- 1 - Cylinder Block
- 2 - Alignment Pin (2)
- 3 - Bolt (4)
- 4 - Bolt (2)
- 5 - Gasket
- 6 - Cover
- 7 - Bolt (4)
- 8 - Wave Washer
- 9 - Fitting
- 10- Hose
- 11- End Cap
- 12- Bolt (2)
- 13- Washer (2)
- 14- Seal (2)
- 15- Gasket
- 16- Reed Valve
- 17- Reed Stop
- 18- Screw (2)
- 19- Clamp (Wires)
- 20- Crankshaft
- 21- Roller Bearing
- 22- Ball Bearing
- 23- Ball Bearing
- 24- Flywheel Key
- 25- Retainer
- 26- Retainer
- 27- Seal
- 28- Seal
- 29- Piston
- 30- Piston Ring
- 31- Piston Pin
- 32- Clip
- 33- Spark Plug

Quicksilver Lubrication/Sealant Application Points

-  Loctite "271" (92-32609-1)
-  Needle Bearing Assy. Lub. (92-42649A1)
-  2 Cycle Outboard Oil (92-13249A24)

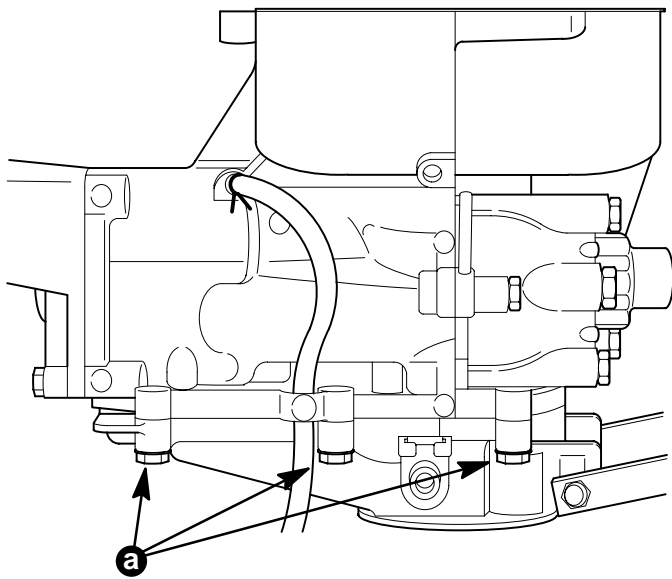
Torque Specifications

- a** 85 lb. in. (10 N-m)
- b** 50 lb. in. (6 N-m)
- c** 20 lb. ft. (27.1 N-m)



Engine Removal

1. Remove cowling from engine.
2. Remove spark plug lead from spark plug.
3. Remove rewind starter, flywheel, magneto base assembly and ignition coil as described on Section 2.
4. Drain fuel from engine mounted fuel tank.
5. Remove fuel tank, fuel shut-off valve and carburetor from engine as described in Section 3.
6. Remove 6 bolts securing powerhead to driveshaft housing.
7. Lift up on powerhead to break gasket between powerhead and driveshaft housing. Remove powerhead from driveshaft housing.

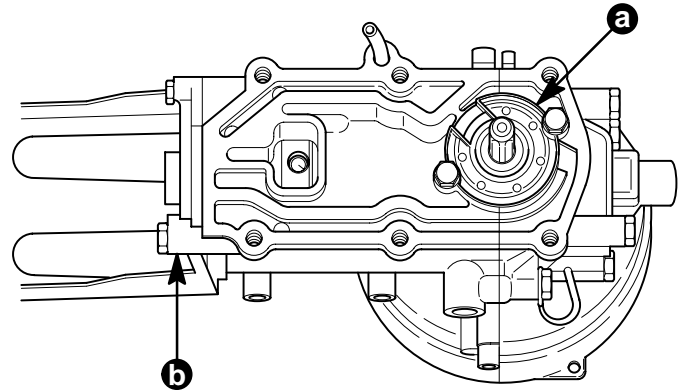


16995

a - Bolts (6)

Powerhead Disassembly

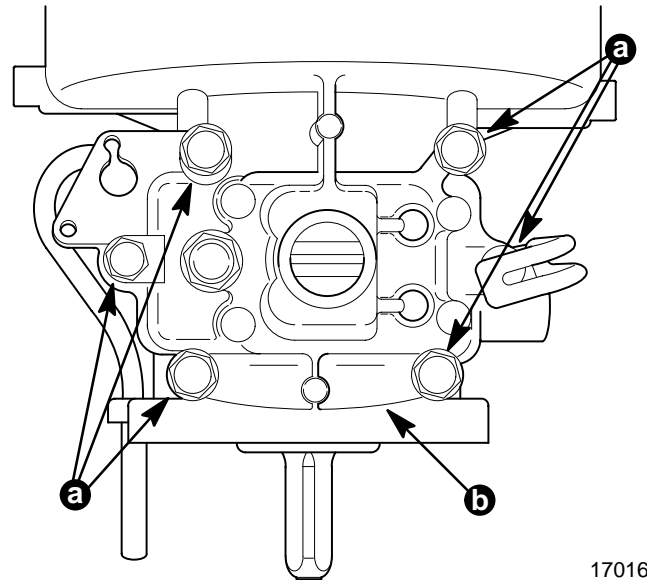
1. Remove lower end cap.
2. Remove cylinder head.



17019

a - End Cap
b - Cylinder Head

3. Remove 6 bolts and remove crankcase cover.

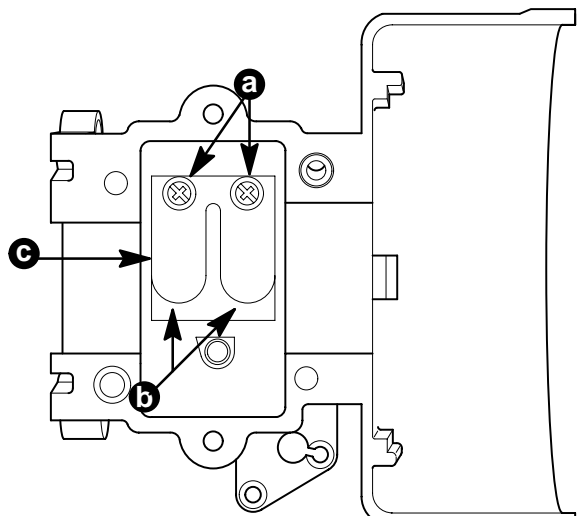


17016

a - Bolts (6)
b - Crankcase Cover



4. Remove 2 screws and remove reed stop and reed.



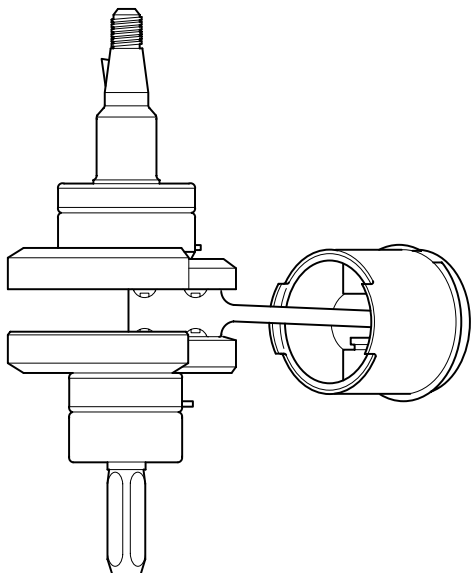
17015

- a - Screws (2)
- b - Reed
- c - Reed Stop

5. Remove crankshaft assembly from cylinder block.

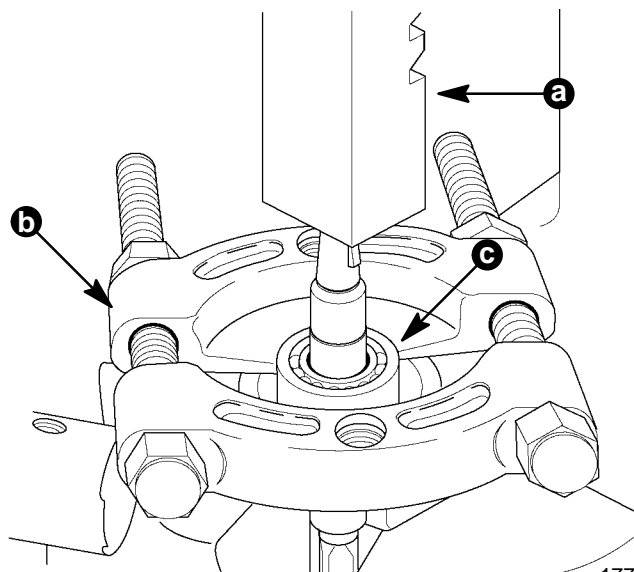
IMPORTANT: DO NOT remove ball bearings from crankshaft unless replacement is necessary.

6. Inspect crankshaft ball bearings as outlined in “Cleaning and Inspection,” following.



17422

7. If necessary, remove ball bearings from crankshaft as shown.



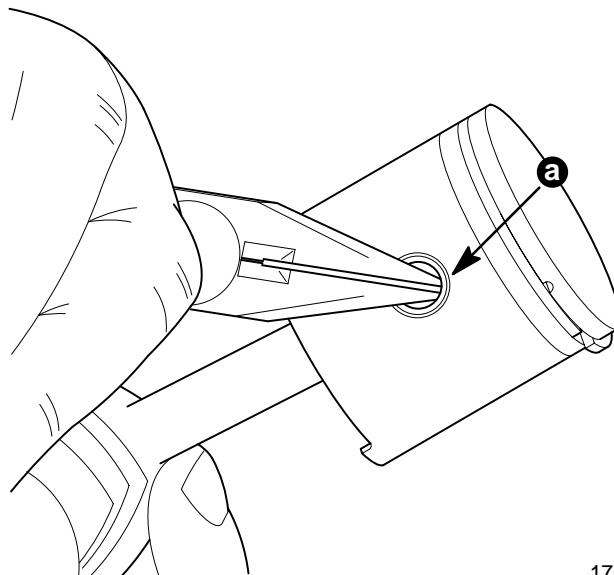
17766

- a - Press
- b - Universal Puller Plate (91-37241)
- c - Ball Bearing

⚠ WARNING

Eye protection must be worn when removing piston pin lockrings from piston.

8. Inspect piston as outlined in “Cleaning and Inspection,” following.
9. Remove piston ring from piston with Piston Ring Expander (91-24697).
10. Remove piston from connecting rod by removing piston pin “G” lockrings from both ends as shown and pushing pin out of piston.



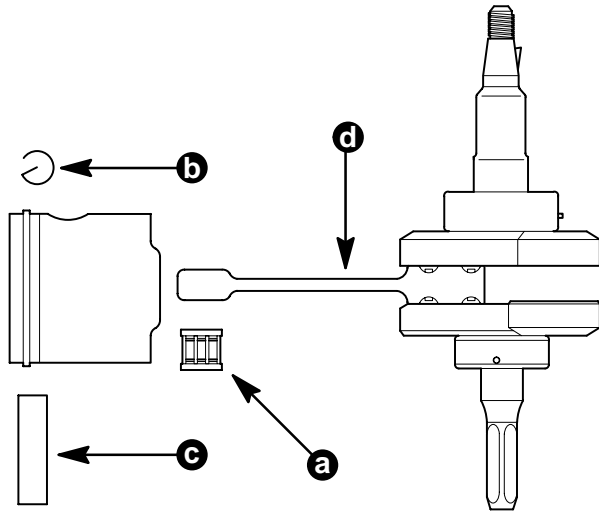
17004

- a - Lockring



11. Inspect connecting rod needle bearing as outlined in “**Cleaning and Inspecting**,” following.

NOTE: Connecting rod is not removable from crankshaft.



17021

- a - Needle Bearing
- b - Piston Pin Lockrings
- c - Piston Pin
- d - Connecting Rod

Cleaning and Inspection

Cylinder Block and Crankcase Cover

IMPORTANT: Crankcase cover and cylinder block are a matched, line-bored assembly and never should be mismatched by using a different crankcase cover or cylinder block.

CAUTION

If crankcase cover or cylinder block is to be submerged in a very strong solution, it will be necessary to remove the bleed system from the crankcase cover/cylinder block assembly to prevent damage to hose and check valve.

1. Thoroughly clean cylinder block and crankcase cover. Remove all sealant and old gasket material from mating surfaces. Remove all carbon deposits from exhaust ports and cylinder dome.
2. Inspect cylinder block and crankcase cover for cracks or fractures.
3. Inspect gasket surfaces for nicks, grooves, cracks and distortion that could cause compression leakages.
4. Inspect all water and fuel passages in cylinder block and crankcase cover for obstructions.
5. Verify all fittings and plugs are tight.

CYLINDER BORE (CLEANING AND INSPECTION)

NOTE: Cylinder sleeve is part of the cylinder block and cannot be replaced.

1.
 - a. If the piston is scored and has transferred aluminum to the cylinder wall, remove all loose aluminum deposits from cylinder wall with a stiff bristle brush.
 - b. If any aluminum deposits remain, apply a small amount of muriatic acid (or liquid toilet bowl cleaner) to deposits. Do not allow muriatic acid (or liquid toilet bowl cleaner) to contact aluminum portion of cylinder block.
 - c. Leave acid on aluminum deposit for 1 to 2 minutes and then wash cylinder thoroughly with hot water and detergent.
 - d. Steps “b” and “c” may require repeating several times before all the aluminum deposits are gone.
2. Inspect cylinder bore for scoring. Minor cylinder wall scoring usually can be “cleaned up” by honing. Refer to “**Honing Procedure**,” following.

HONING PROCEDURE

IMPORTANT: If cylinder wall is not scored, hone cylinder just enough to deglaze wall.

3.
 - a. Hone cylinder following the hone manufacturer’s recommendations for use of the hone and cleaning and lubrication during honing.
 - b. For best results, a continuous flow of honing oil should be pumped into the work area. If pumping oil is not practical, use an oil can. Apply oil generously and frequently to stones and cylinder wall.

CAUTION

When honing cylinder block, remove hone frequently and check condition of cylinder wall. DO NOT hone any more than absolutely necessary, as hone can remove cylinder wall material rapidly.

- c. Start stroking at smallest diameter. Maintain firm stone pressure against cylinder wall to assure fast stock removal and accurate results.
- d. Localize stroking in the smallest diameter until drill speed is constant throughout length of bore. Expand stones, as necessary, to compensate for stock removal and stone wear. Stroke at a rate of 30 complete cycles-per-minute to produce best cross-hatch pattern. Use honing oil generously.
- e. Thoroughly clean cylinder bore with hot water and detergent. Scrub well with stiff bristle brush and rinse thoroughly with hot water. It is essential that a good cleaning be performed. If any of the abrasive material is allowed to remain in the cylinder bore, it will cause rapid wear of new piston rings

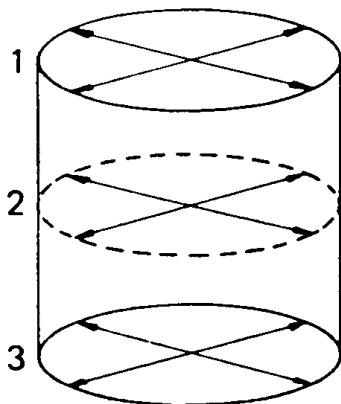


and cylinder bore, in addition to bearings. After cleaning, bore should be swabbed several times with engine oil and a clean cloth, then wiped with a clean, dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

4. Measuring Cylinder Bore

NOTE: A .020 in. (5mm) oversized piston is available to enable reboring of standard cylinder bore.

- a. Using an inside micrometer, take two measurements at top, center and bottom of cylinder as shown.



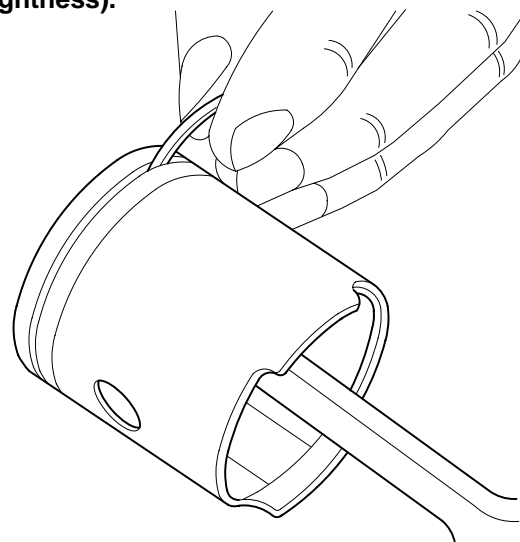
- b. If cylinder is tapered, out of round or worn more than .002 in. (.05mm) from standard cylinder bore, the cylinder can be rebored for oversized piston.

CYLINDER BORE	
Standard Bore	Wear Limit
1.850 in. (46.99mm)	1.852 in. (47.04mm) or greater
Oversize Bore	Wear Limit
1.869 in. (47.47mm)	1.871 in. (47.52mm) or greater

Piston

NOTE: To obtain maximum engine performance, it is recommended that piston rings be replaced during engine tear down.

IMPORTANT: If engine was submerged while engine was running, piston pin and/or connecting rod may be bent. If piston pin is bent, piston must be replaced. (Piston pins are not sold separately because of matched fit into piston.) If piston pin is bent, connecting rod must be checked for straightness (refer to "Connecting Rods," following, on how to check straightness).



Cleaning Piston Ring Groove

17764

1. Check piston for scoring, cracks, metal damage and cracked or worn piston bosses. If any of these conditions are found, replace piston.
2. Inspect piston ring groove for wear, burns, distortion or loose piston ring locating pins.
3. Clean piston dome, ring groove and piston skirt. Use the recessed end of a broken piston ring to clean carbon deposits from ring groove. DO NOT use an automotive type ring groove cleaner as this type tool could loosen piston ring locating pins.
4. Clean carbon deposits from top of piston with a soft wire brush, carbon removal solution or sand blasting. When wire brushing top of piston, DO NOT burr or round machined edges. Clean (polish) piston skirt with crocus cloth.



DETERMINING PISTON CLEARANCE

1. Measure the outside diameter of the piston at the piston skirt and at right angle to the piston pin. Obtain maximum piston diameter.
2. Measure cylinder bore and obtain minimum bore diameter.
3. Subtract the maximum piston measurement from the minimum cylinder bore measurement. This equals your piston clearance.

$$\begin{array}{r} \text{Minimum Bore Measurement} \\ - \text{Maximum Piston Measurement} \\ \hline = \text{Piston Clearance} \end{array}$$

Piston Clearance

.002 in. to .005 in.
(.051mm to .127mm)

If piston clearance exceeds the specification, replace cylinder block or replace piston so that clearance is within the specification.

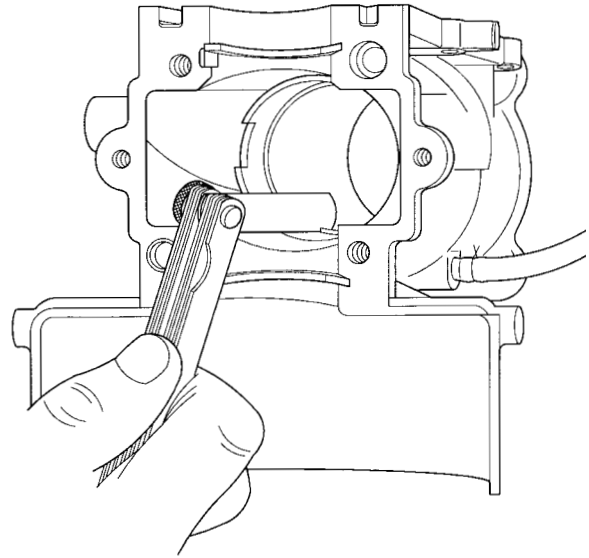
Piston Rings

Measure piston ring end gap as follows:

- a. Insert one ring into cylinder bore. Push ring approximately 1/2 in. (12.7mm) into cylinder using piston to position ring at right angle to the bore.
- b. Measure gap between piston ring ends using a feeler gauge.
- c. If end gap of ring exceeds specification, replace ring. If gap is less than specifications then you can file some material from piston ring ends.

Piston Ring End Gap

.006 in. to .012 in.
(0.152mm to 0.304mm)



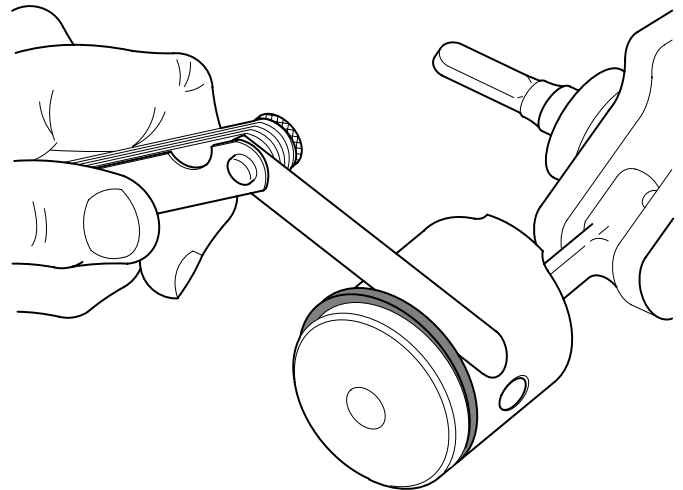
17765

Measure side clearance of piston ring grooves as follows:

Use a feeler gauge and check clearance between piston ring and groove as shown. Clearance should be within specification.

Clearance between Piston Ring and Ring Groove

.0003 in. to .0010 in.
(.0076mm to .0254mm)



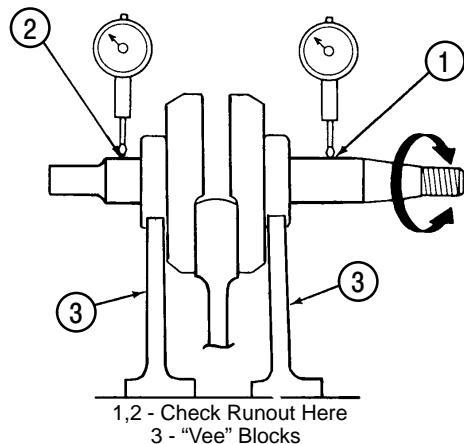
17762



Crankshaft

Check (off-centering) of crankshaft using “vee” blocks and a dial indicator as follows.

1. Position crankshaft in “vee” blocks as shown.
2. Rotate crankshaft. Movement of dial indicators must not exceed .001 in. (.025mm). If over .001 in. (.025mm), replace crankshaft assembly.

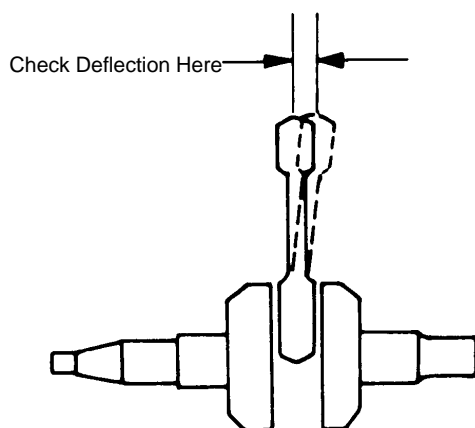


Check connecting rod deflection as follows:

1. Check the connecting rod deflection at the small end of the rod to determine the amount of wear of the crank pin and the bearing at the crank pin end.
2. If deflection of connecting rod exceeds tolerance, replace crankshaft assembly.

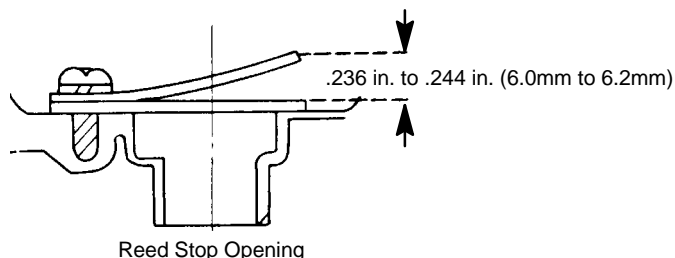
Connecting Rod Deflection

.022 in. to .056 in.
(.558mm to 1.422mm)



Reed Valve

1. Inspect reed petals for signs of fatigue, cracks or chips. The reed petals should fit flush or nearly flush against the seat.
2. Check for wear (indentation on face of seat). If reeds have made indentations in the seat, the crankcase cover/cylinder block will have to be replaced.
3. Check reed stop opening as shown. Replace reed stop if opening is not within specification.



Crankshaft Ball Bearings and Piston Needle Bearings

CRANKSHAFT BALL BEARINGS

Grasp outer race of crankshaft ball bearing and work race back-and-forth. There should not be excessive play.

Lubricate crankshaft ball bearings with light oil. Rotate outer bearing race. Bearing should have smooth action and no rust stains. If bearing sounds or feels “rough” or “catches,” replace bearing.

PISTON ROLLER BEARING

Thoroughly inspect piston roller bearing. If bearing is rusted, fractured, worn, galled or badly discolored, replace bearing.



Powerhead Reassembly and Installation

General

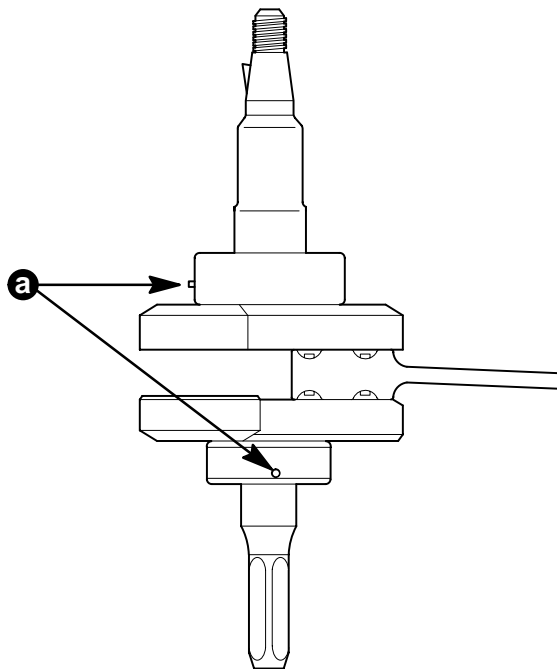
Before proceeding with powerhead reassembly, verify that all parts to be re-used have been carefully cleaned and thoroughly inspected, as outlined in “**Cleaning and Inspection,**” **preceding.** Parts, which have not been properly cleaned (or which are questionable), can severely damage an otherwise good powerhead within the first few minutes of operation.

All new powerhead gaskets **MUST BE** installed with Quicksilver Outboard Oil whenever “light oil” is specified or use Quicksilver Needle Bearing Assembly Lubricant where “grease” is specified. Mercury part numbers of lubricants, sealers and locking compound can be found on the exploded view of specific assemblies, if applicable.

A torque wrench is essential for correct reassembly of powerhead. **DO NOT** attempt to reassemble powerhead without using a torque wrench. Attaching bolts for covers **MUST** be torqued by tightening bolts in 3 progressive steps (following specified torque sequence) until correct torque is reached.

If removed, reinstall crankshaft ball bearings as follows:

IMPORTANT: Ball bearings must be installed so that alignment pins will be toward bottom of crankshaft as shown.



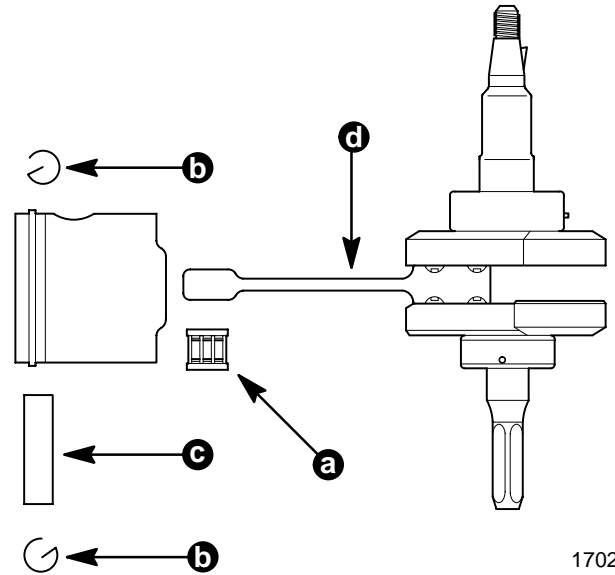
17003

a - Alignment Pins

Using a press and suitable side mandrel, press bearings onto crankshaft. Press only on inner race of bearing. Verify bearings are seated firmly against shoulder.

Powerhead Reassembly

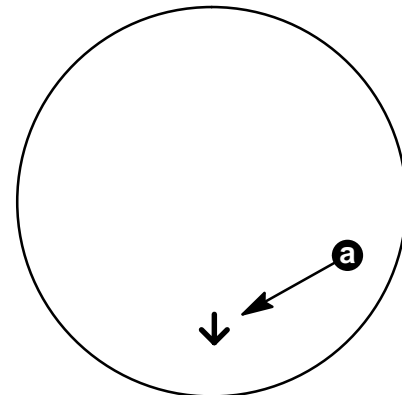
1. Place needle bearing into connecting rod.



17021

- a - Needle Bearing
- b - Piston Pin “G” Lockrings
- c - Piston Pin
- d - Connecting Rod

IMPORTANT: Install piston so arrow (on piston dome) is facing down toward exhaust port.

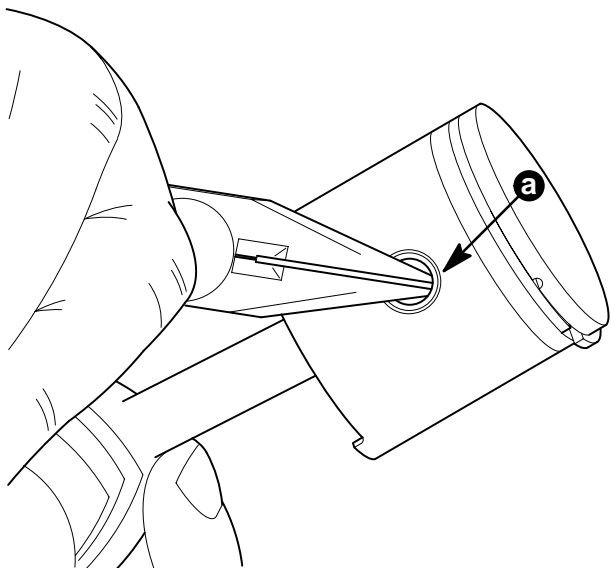


Piston

- a - Install Piston so Arrow is Facing Down Toward Exhaust Port



- Secure piston pin in piston with new "G" lockrings. Verify lockrings are seated in grooves.

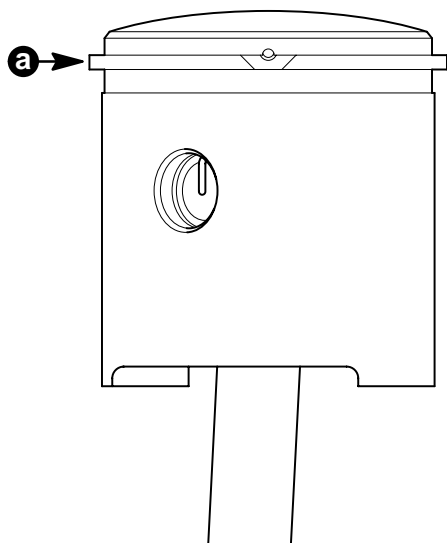


a - Lockrings

17004
17004

- Install piston using Piston Ring Expander Tool (91-24697) as shown.

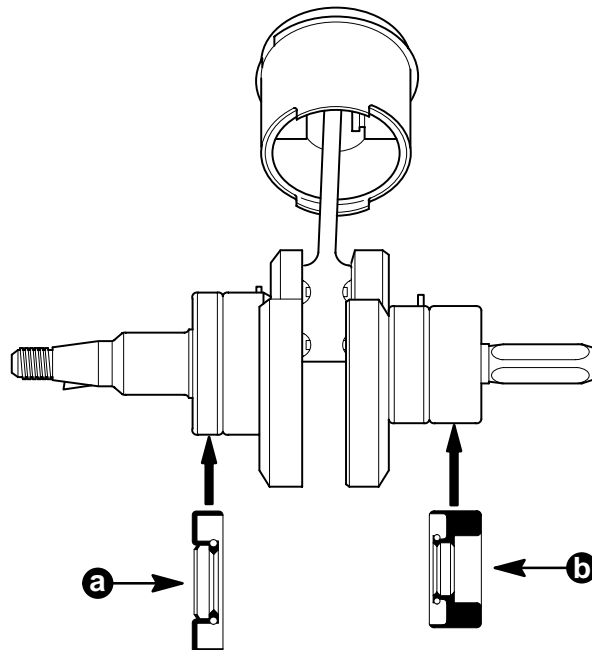
IMPORTANT: Piston ring must be installed so that the grooved end of the piston ring is toward top side of piston as shown.



a - Piston Ring

17009

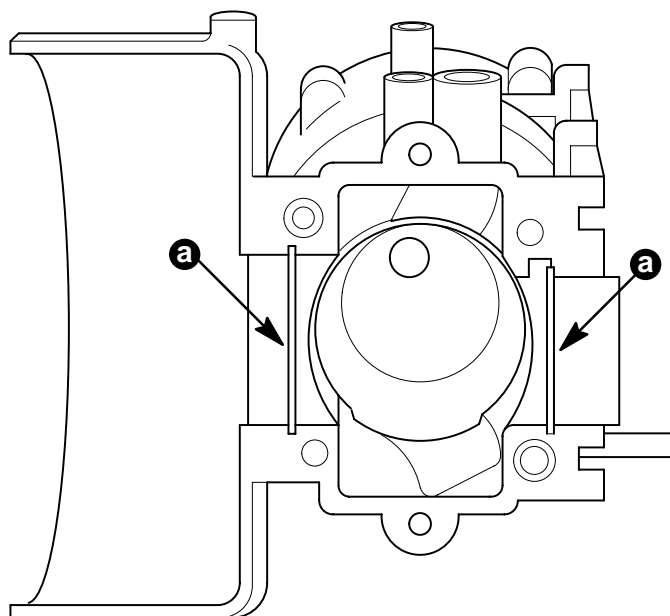
- Lubricate lips on oil seals with 2-4-C Marine Lubricant.
- Install oil seals on crankshaft so that lips are positioned as shown.



a - Position of Top Seal
b - Position of Bottom Seal

17422

- Install bearing retainers into cylinder block



a - Bearing Retainers

17027

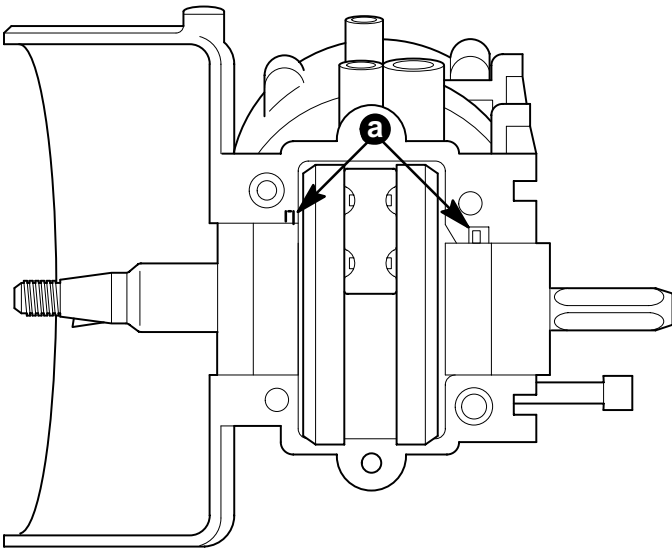


7. Install crankshaft assembly into cylinder block as follows:

- a. Lubricate piston ring, piston and cylinder wall with light oil.
- b. Align ends of piston ring with locating pin as shown.

NOTE: Ring Compressor is not used to install piston into cylinder.

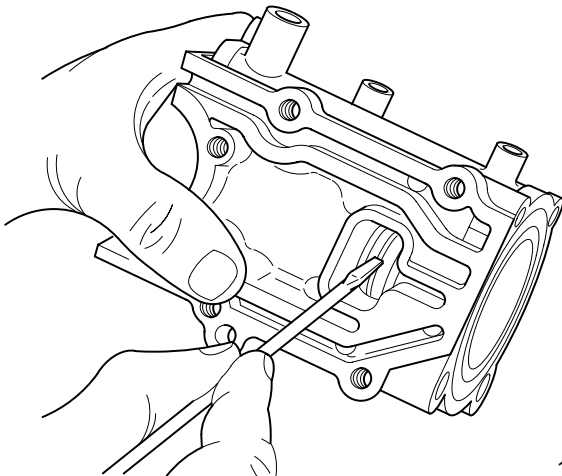
- c. Keeping crankshaft horizontal, push piston into cylinder.
8. Gently push crankshaft down into position. Rotate bearings so that alignment pins are positioned into notches.
9. Position oil seals against retainers.



17028

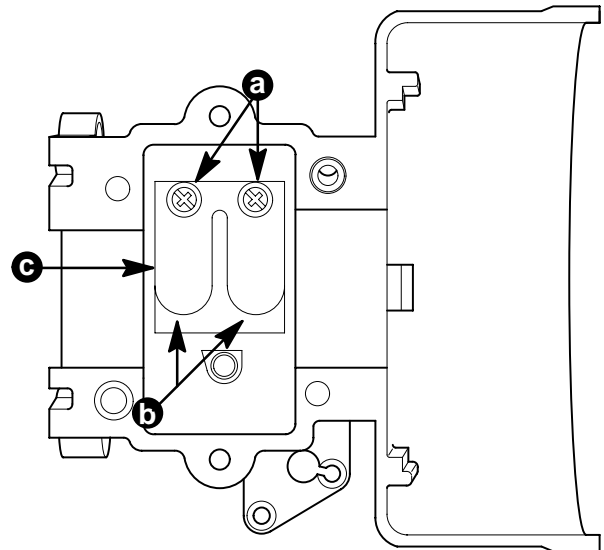
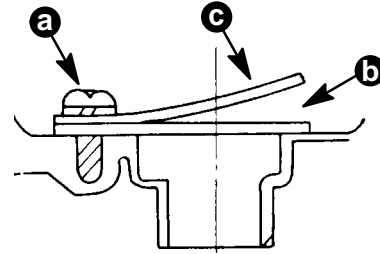
a - Alignment Pins

10. Check piston ring for spring tension thru exhaust port by pressing with a screwdriver as shown. If no tension exists (ring fails to return to position) it is likely that the ring was broken during installation and must be replaced.



17763

11. Apply Loctite 271 to threads on screws and install reed valve and reed stop as shown.

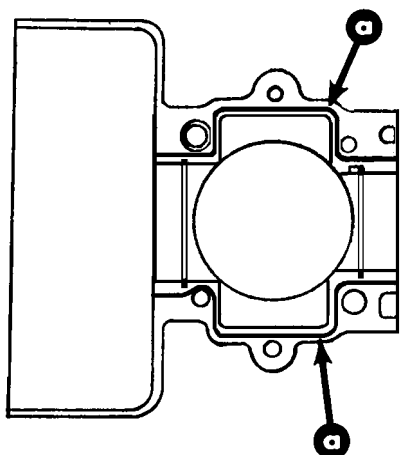


17015

a - Screws
b - Reed Valve
c - Reed Stop



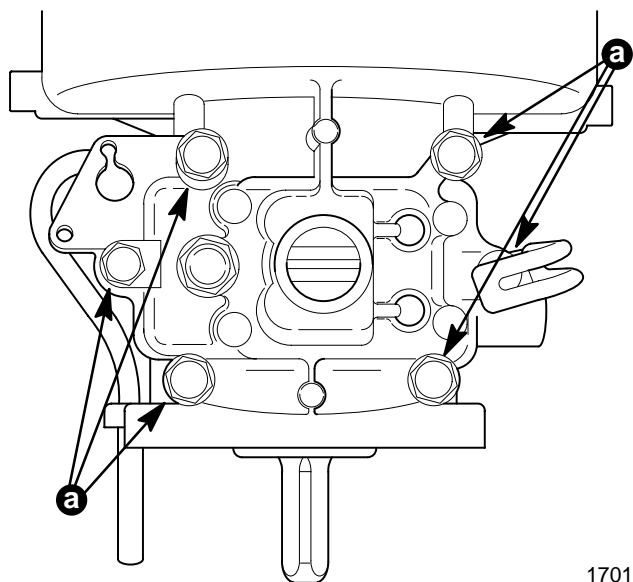
12. Thoroughly clean mating surface of crankcase cover and cylinder block with solvent to remove oil.
13. Apply a continuous bead of Loctite Master Gasket on cylinder block, as shown.



CAUTION

Before applying Loctite Master Gasket to cylinder block, verify that mating surface of crankcase cover and cylinder block are clean and free of oil. Loctite must be applied in a continuous bead along the inside of mounting bolt holes. If a void should occur when applying a bead of Loctite, either remove the entire bead with a rag or apply an additional bead parallel to the void and overlapping the previously applied bead. Assemble crankcase cover to cylinder block without lateral movement.

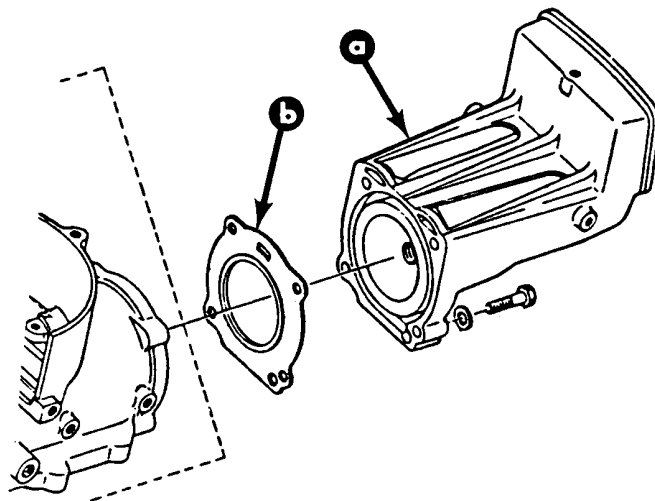
14. Place crankcase cover in position on cylinder block and fasten with 6 bolts. Tighten bolts evenly and torque to 50 lb. in. (5.6 N-m).



a - Bolt (6) [Torque to 50 lb. in. (5.6 N-m)]

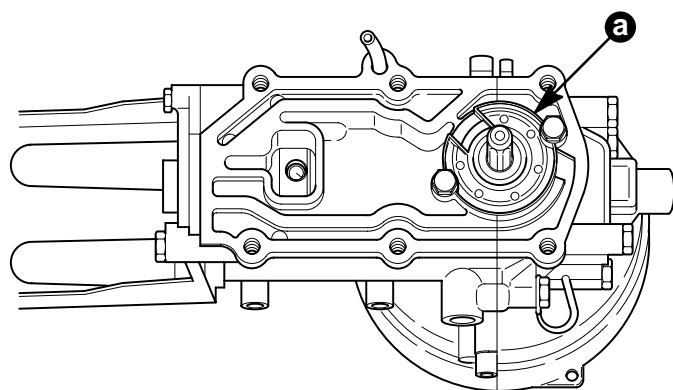
17016

15. Install cylinder head with gasket. Torque bolts to 85 lb. in. (9.6 N-m).



a - Cylinder Head [Torque to 85 lb. in. (9.6 N-m)]
b - Gasket

16. Install lower end cap with 2 bolts. Torque bolts to 50 lb. in. (5.6 N-m).



a - End Cap

17. Rotate crankshaft several times to assure free operation (no binds and/or catches).

17019



Powerhead Installation

1. Reinstall powerhead and new gasket to driveshaft.
2. Apply Perfect Seal to threads of powerhead mounting bolts and secure powerhead to driveshaft housing. Torque bolts to 50 lb. in. (5.6 N·m).
3. Install electrical components, flywheel and rewind starter to engine as described in **Section 2**.
4. Install carburetor, fuel shut-off valve and fuel tank as described in **Section 3**.

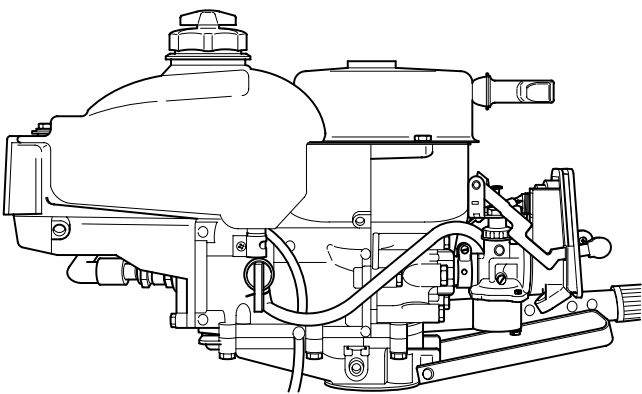
⚠ CAUTION

When engine is started, check that water pump is operating. Operation of water pump is indicated by water discharging from “tell-tale.”

5. While test running engine, check powerhead cylinder block, cylinder block cover and exhaust cover for water leaks. Inspect fuel system for any fuel leaks. If leaks are detected, correct problem before returning outboard to service.

⚠ CAUTION

To avoid possible engine damage, “Break-in Procedure,” following, MUST BE completed BEFORE operating engine at full throttle continuously.



16990

Break-in Procedure

1. Mix gasoline and oil at the normal 50:1 ratio.
2. Operate motor at varied throttle settings for the first hour (1 hour). AVOID both wide-open-throttle operation and prolonged idle in cold water areas during this period.
3. After the first hour of operation, the motor is ready for normal operation and may be run at any speed. DO NOT EXCEED the full throttle RPM range.