SECTION 4A – POWERHEAD

Table of Contents

4 A

Powerhead Specifications

Special Tools

Description	Part No.
12-point Socket	FT2953
Piston Tool	91-74607A3
Ring Remover/Installer	91-24697
Ring Compressor	FT2996
Lockring Removal Tool	91-52952A1
Lockring Installation Tool	91-77109A2
Flywheel Puller	91-73687A1
Powerhead Lifting Ring	91-90455

Specifications

Finished Hone Bore Size

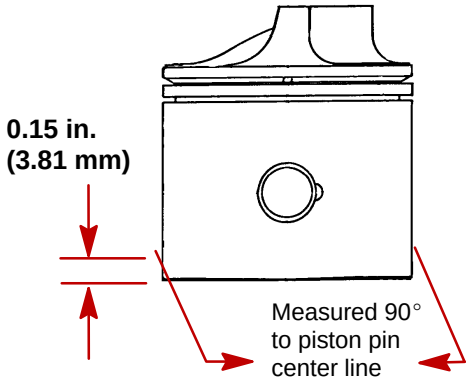
Standard Size		
Fraction	in.	(mm)
3-3/8	3.375	(85.725)

.015 Oversize	
in.	(mm)
3.390	(86.10)
.030 Oversize	
in.	(mm)
3.405	(86.487)

PISTON

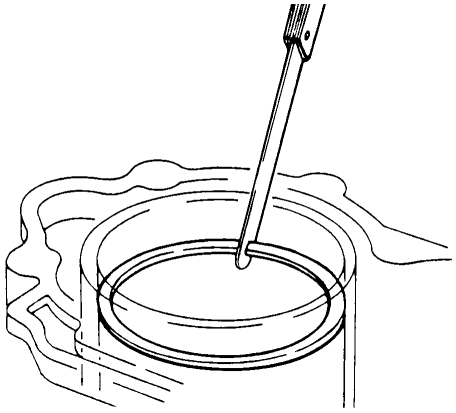
IMPORTANT: A zero minus tolerance and a plus .001 tolerance is acceptable.

IMPORTANT: Measure piston skirt at right angle (90°) to piston pin center-line, .15 in. (3.81 mm) up from bottom edge of skirt.



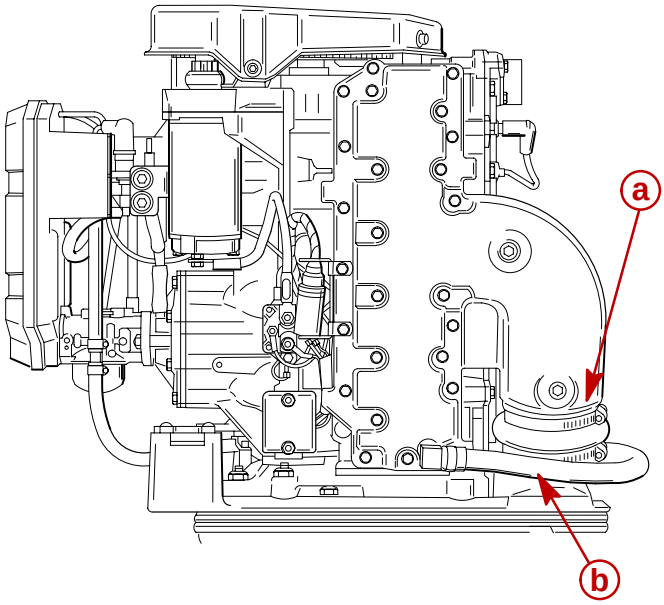
PISTON RING

	End Gap
Top Piston Ring	0.010 - 0.020 in. (0.254 - 0.508 mm)



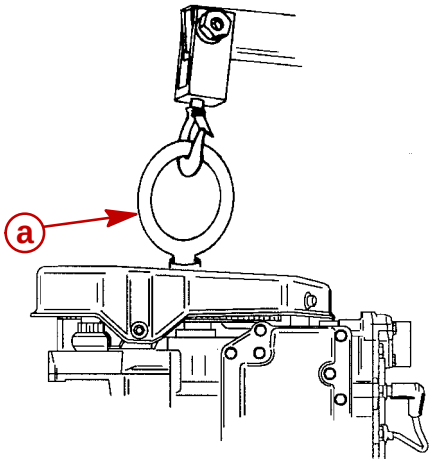
Powerhead Removal

1. Disconnect battery lead form battery.
2. Remove spark leads from spark plugs.
3. Disconnect remote control harness from engine.
4. Disconnect fuel line to fuel pump.
5. Remove throttle and shift cables.
6. Disconnect water inlet hose from pump cover.
7. Loosen top exhaust boot clamp.



a - Exhaust Boot Clamp
b - Water Inlet Hose

8. Remove four 13-mm nuts from studs that hold powerhead adapter plate to pump cover.
9. Remove four 15-mm nut from studs that hold adapter plate to pump cover.
10. Install lifting ring on end of crankshaft. If lifting hook has less than five turns of engagement remove flywheel nut.



a - Lifting Ring

11. Lift powerhead off pump cover.

⚠ WARNING

DO NOT leave powerhead suspended from hoist. Powerhead should be installed on a suitable stand or lowered to the floor upon removal from pump cover.

NOTE: *Refer to appropriate sections in service manual for removal of individual fuel and electrical subassemblies from powerhead.*

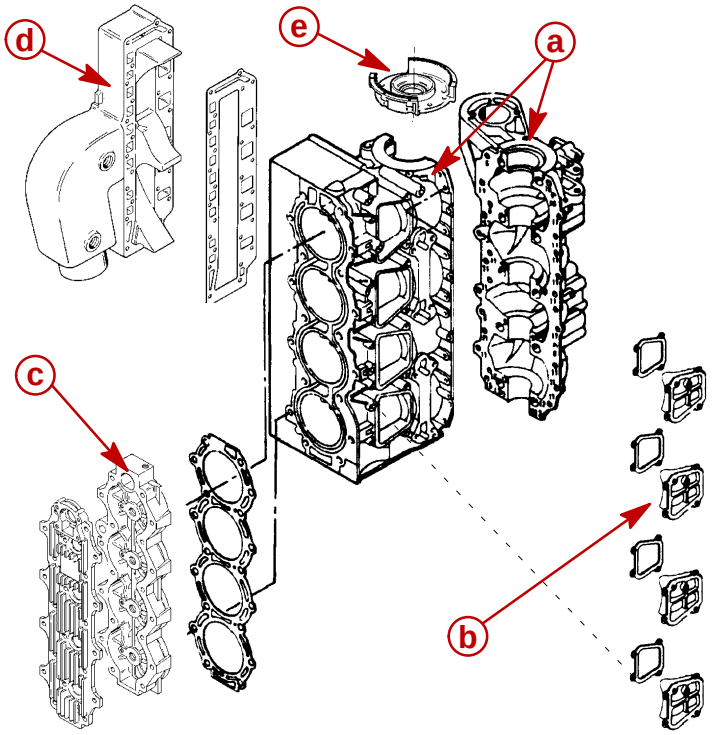
Component/Assembly	Section
Starter Motor	2C
Flywheel	2A*
Ignition Components (Switch Box, Stator, Trigger)	2A*
Carburetor and Linkage	3A
Fuel Pump	3B

*1996 Models, CDM Ignition

NOTE: *All ignition and electrical components can be removed and installed as an assembly.*

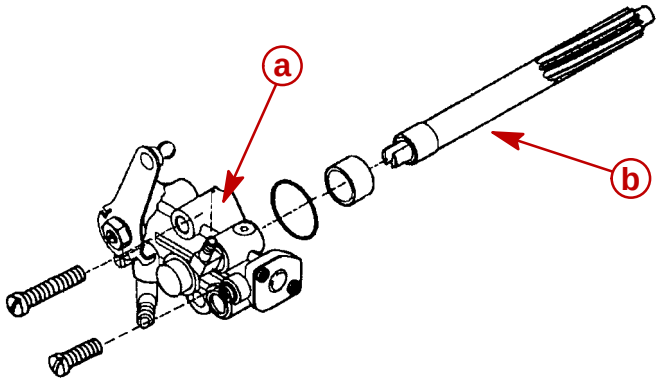
Powerhead Disassembly

1. Remove intake manifold and reed assemblies. See Section 3B.
2. Remove exhaust manifold. Discard gasket. Clean all gasket surfaces.
3. Remove cylinder head. Discard gasket. Clean all gasket surfaces.
4. Remove transfer port covers. Discard gasket. Clean all gasket surfaces.



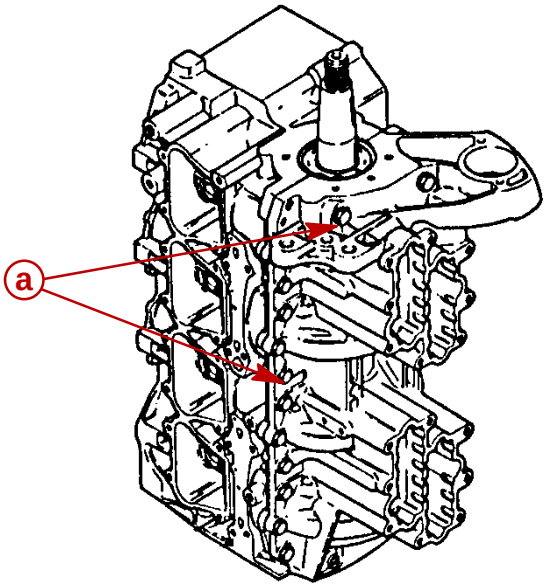
a - Cylinder Block (120 HP Shown)
b - Transfer Port Cover (4 on the 120 HP)
c - Cylinder Head
d - Exhaust Manifold
e - Bearing Cage

5. Remove bearing cage.
6. Remove oil injection pump and driven gear.



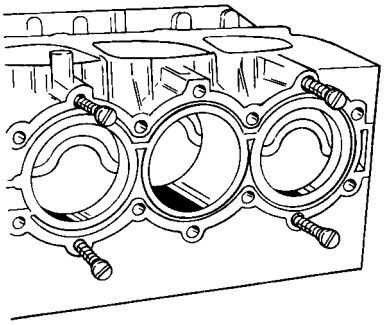
a - Oil Injection pump
b - Driven Gear

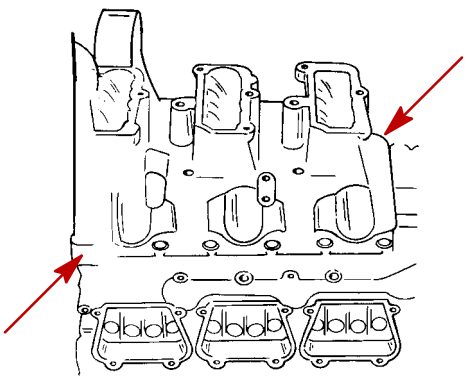
7. Remove crankcase cover screws.



a - Cover Screws (120 HP)

8. Install four bolts in cylinder block to protect gasket surface on cylinder block.
9. Remove bolts securing adapter plate to bottom of cylinder block. Remove adapter plate. Remove and discard gasket. Clean all gasket surfaces.
10. With all cover screws removed, pry crankcase apart starting at corner locations.

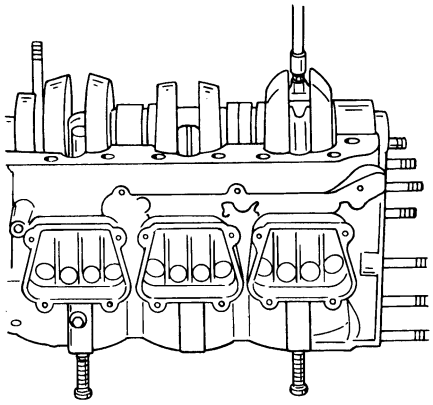




Removing Crankshaft

IMPORTANT: Mark rod caps and pistons as to the cylinder they are removed from.

1. Remove connecting rod screws with 12-point socket.



2. Remove bearing cage half. Rotate crankshaft and remove remaining bearing cage half.

IMPORTANT: DO NOT use a magnet to retrieve bearings.

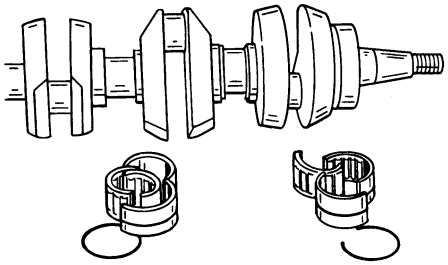
3. Push connecting rod down to clear crankshaft.
4. Repeat steps 1 through 3 for each cylinder.
5. Lift crankshaft out of cylinder block.

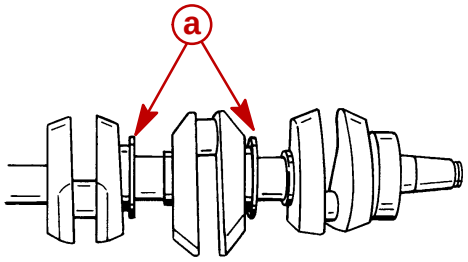
Disassembling Crankshaft

1. Remove snap rings from center main bearings. Remove bearing races and caged rollers.

IMPORTANT: Keep bearings separated, do not intermix components.

2. Remove and discard crankcase seals.

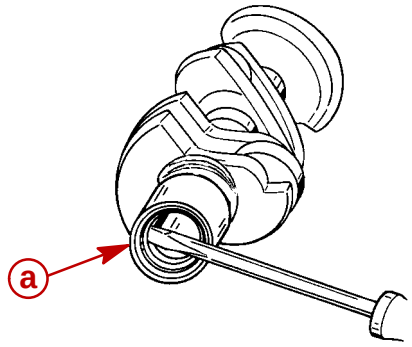




a - Crankshaft Seals

3. If replacement of the upper ball bearing is necessary, remove using universal bearing puller Special Tool 91-37241. Press new bearing onto crankshaft.

4. Remove lower crankcase seal.
   a. Slide lower main bearing to end of crankshaft.
   b. Pry seal out.

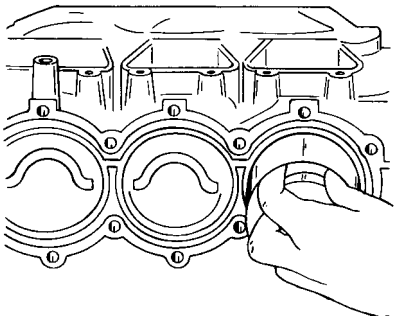


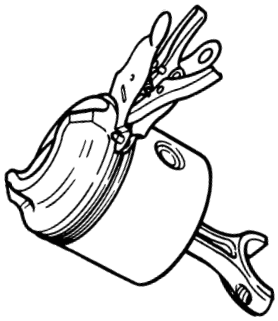
a - Seal

5. If replacement of the oil injection drive gear is necessary, the gear can be remove using universal bearing puller Special Tool 91-37241. The new gear must be pressed on the crankshaft.

Disassembling Piston

1. Hold connecting rod so that it does not scratch cylinder bore. Push piston out of cylinder block.
2. Remove piston ring using ring expander.



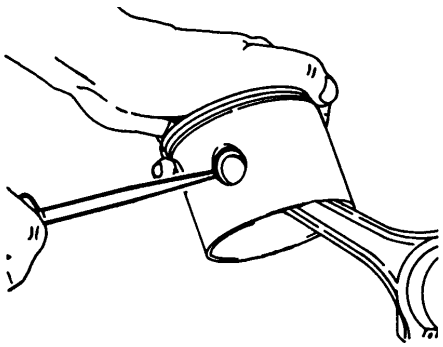


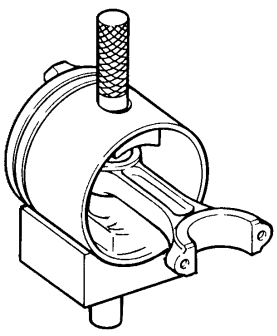
AS NEEDED

⚠ WARNING

Eye protection MUST be worn when removing piston pin lockrings.

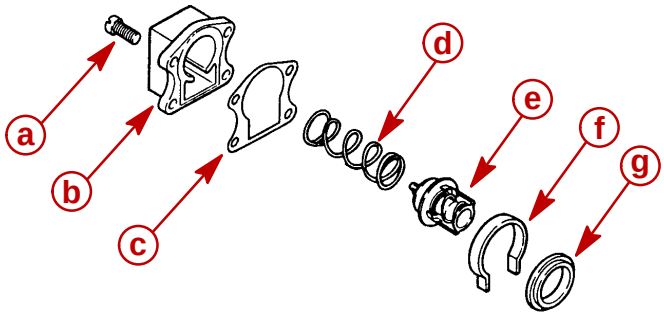
1. Snap out and discard piston lockring from both ends of piston pin.
2. Press piston pin out using Special Tool FT 2990-1 on Bottom Guided piston. Use Special Tool 91-74607A3 on Top Guided piston.





Disassembling Cylinder Head

1. Remove thermostat housing and components.



a - Screw (4)
b - Housing
c - Gasket
d - Spring
e - Thermostat
f - Retainer
g - Seal

NOTE: *Test the thermostat by removing the rubber grommet and placing the thermostat in hot water. The thermostat should open at the temperature stamped on it.*

AS NEEDED

2. Remove thermoswitch by removing snap ring retainer and pry/pull thermoswitch from cavity.
3. Remove bolts from cylinder head cover. Remove cover. Discard gasket. Clean all gasket surfaces.

Inspecting and Repairing

Crankshaft

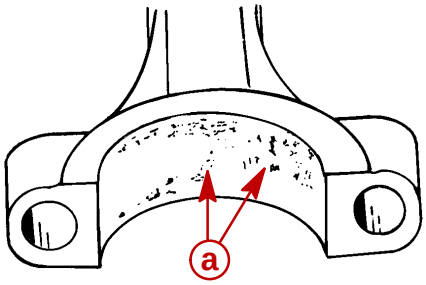
1. Inspect crankshaft to drive shaft splines for wear. Replace crankshaft if necessary.
2. Inspect upper and lower crankshaft bearings for roughness and excessive looseness. Replace as necessary.
3. Check all crankshaft bearing surfaces for rust, water marks, chatter marks, uneven wear and/or overheating.

- If necessary clean surfaces with crocus cloth as shown.

4. Thoroughly clean (with solvent) and dry crankshaft and crankshaft ball bearings. Re-check surfaces of crankshaft. Replace crankshaft if surfaces cannot be properly cleaned up. If crankshaft will be reused lubricate surfaces with 2 cycle oil to prevent rust.

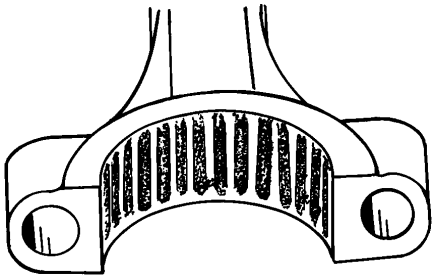
Connecting Rods

1. Check connecting rods for alignment by placing rods on a surface plate. If light can be seen under any portion of machined surfaces, if rod has a slight wobble on plate, or if a 0.002 in. (0.051mm) feeler gauge can be inserted between any machined surface and surface plate, rod is bent and must be discarded.
2. **Overheating:** Overheating is visible as a bluish bearing surface color that is caused by inadequate lubrication or excessive RPM.
3. **Rust:** Rust formation on bearing surfaces causes uneven pitting of surface(s).

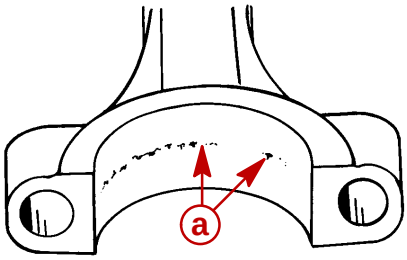


a - Pitting

4. **Water Marks:** When bearing surfaces are subjected to water contamination, a bearing surface “etching” occurs. This etching resembles the size of the bearing.

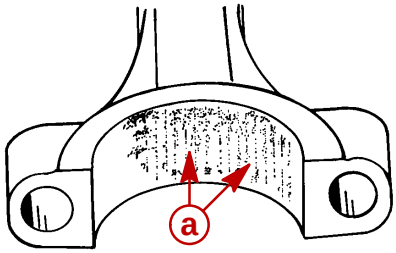


5. **Spalling:** Spalling is the loss of bearing surface, and it resembles flaking or chipping. Spalling will be most evident on the thrust portion of the connecting rod in line with the “I” beam. General bearing surface deterioration could be caused by or accelerated by improper lubrication.



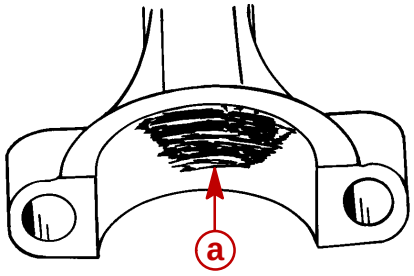
a - Spalling

6. **Chatter Marks:** Chatter marks are the result of a combination of low speed - low load - cold water temperature operation, aggravated by inadequate lubrication and/or improper fuel. Under these conditions, the crankshaft journal is hammered by the connecting rod. As ignition occurs in the cylinder, the piston pushes the connecting rod with tremendous force, and this force is transferred to the connecting rod journal. Since there is little or no load on the crankshaft, it bounces away from the connecting rod. The crankshaft then remains immobile for a split second until the piston travel causes the connecting rod to catch up to the waiting crankshaft journal, then hammers it. The repetition of this action causes a rough bearing surface(s) which resembles a tiny washboard. In some instances, the connecting rod crank pin bore becomes highly polished. During operation, the engine will emit a “whirr” and/or “chirp” sound when it is accelerated rapidly from idle speed to approximately 1500 RPM, then quickly returned to idle. If the preceding conditions are found, replace both the crankshaft and connecting rod(s).



a - Chatter Marks Between Arrows

7. **Uneven Wear:** Uneven wear could be caused by a bent connecting rod.



a - Uneven Wear

⚠ CAUTION

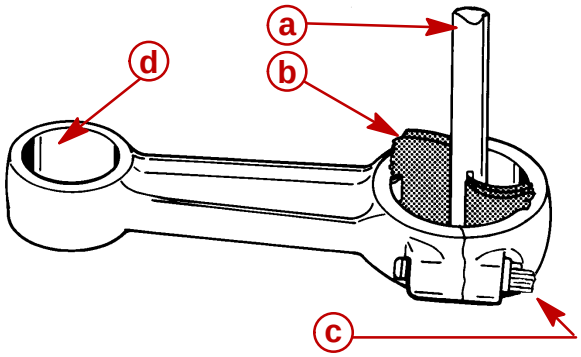
Crocus cloth MUST BE USED to clean bearing surface at CRANKSHAFT END OF CONNECTING ROD.

320 grit Carborundum cloth MUST BE USED to clean bearing surface at PISTON PIN END OF CONNECTING ROD.

VERIFY CAP TO ROD ALIGNMENT BEFORE TORQUING ROD BOLTS.

DO NOT continue to clean connecting rod bearing surfaces after marks have been removed.

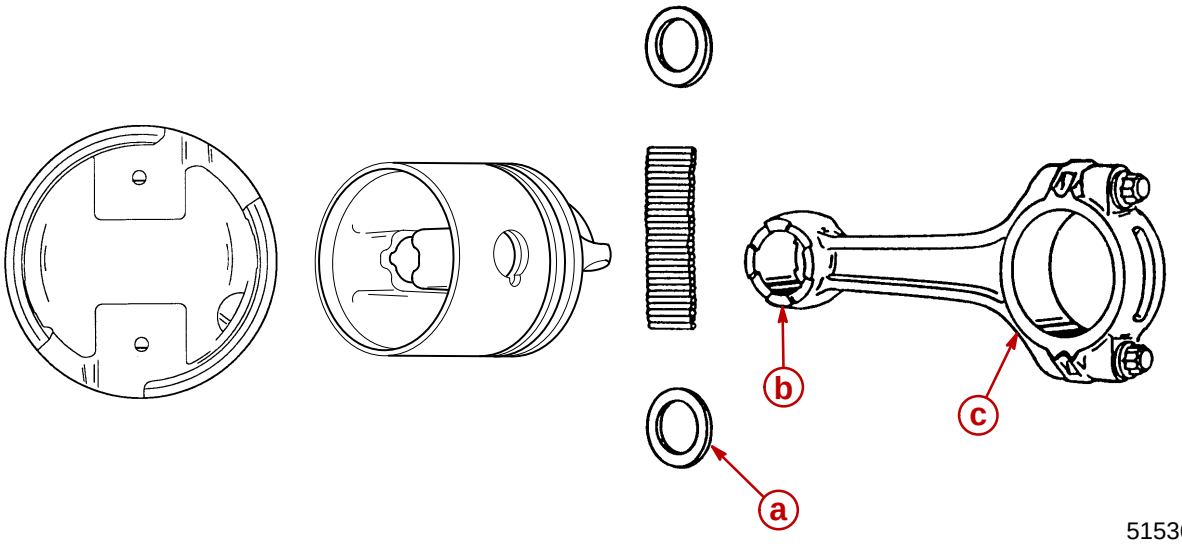
8. Clean connecting rods as necessary.



a - Attached to Drill Motor
b - Crocus Cloth
c - Torque to 16 lb. ft. (21.7 N·m)
d - Use 320 Carborundum Cloth

Top Guided

(centered in bore by piston)

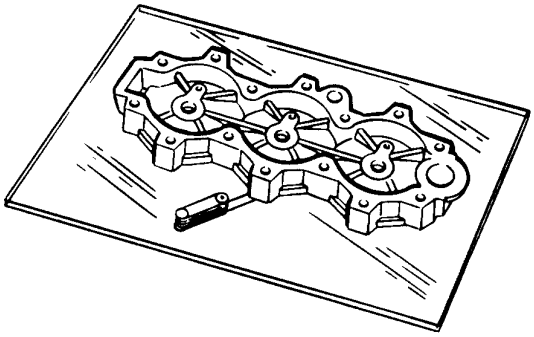


51536

a - Flat Washer
b - Scalloped
c - Smooth

Cylinder Block and Crankcase Cover

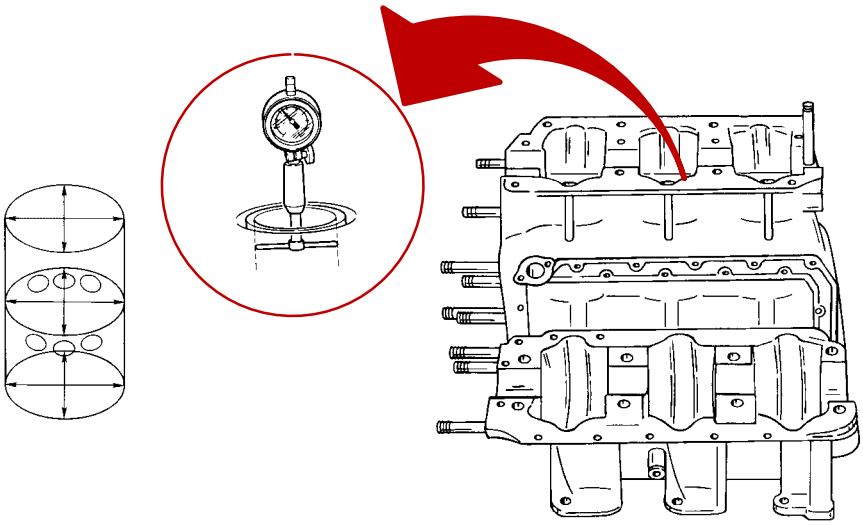
1. Inspect cylinder head gasket surface for erosion across gasket surface. Excessive erosion requires cylinder head replacement.
2. Inspect cylinder head for warpage.



(3 Cylinder Shown)

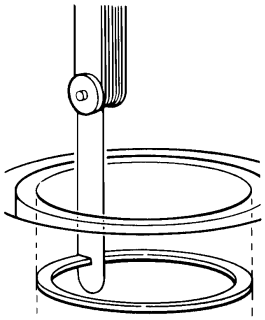
- A cylinder head with 0.012 in. (0.305 mm) or less can be resurfaced.
- If warped more than 0.012 in. (0.305 mm) replace cylinder head.

3. Measure cylinder bore diameter at top, middle and bottom of each cylinder as shown. Check for tapered, out-of-round and oversized bore.



- Refer to Specifications for Finished Hone Bore Size for Bottom Guided pistons and Top Guided pistons.

4. Measure piston ring end gap.



NOTE: *Refer to Specifications for dimensions. If gap is too small widened with a file. If gap is too wide recheck bore measurements.*

Powerhead Reassembly

Assembling Piston

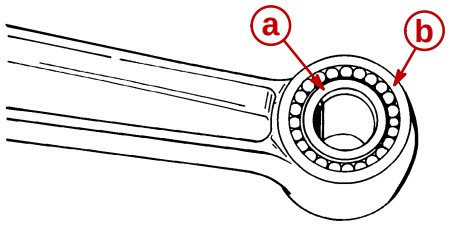
Place clean needle bearings on a clean sheet of paper and lubricate with Quicksilver Needle Bearing Lubricant (92-42649A1).

NOTE: *There are 29 needle bearings per piston.*

⚠ CAUTION

Never intermix new needle bearings with used needle bearings at the same connecting rod end. Never intermix needle bearings on one connecting rod with those of another connecting rod. Should one (or more) piston pin needle bearing of a connecting rod require replacement (or should one or more be lost), replace all of that connecting rod's piston pin needle bearings.

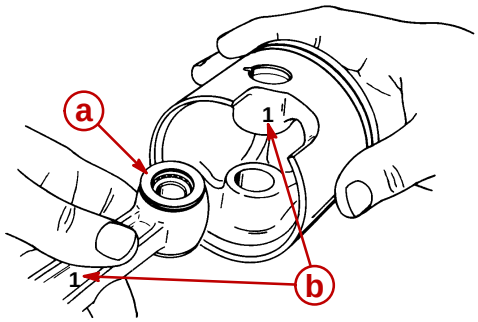
1. Place sleeve, which is part of Piston Pin Tool (91-74607A3), into connecting rod and install needle bearing around sleeve, as shown.



19537

a - Needle Bearings (29)
b - Sleeve [From Piston Pin Tool (91-74607A3)]

2. Place flat washers on connecting rod; keeping washers in place, carefully place piston over end of rod. Use disassembly marks for matching rod to piston and direction of insertion (which side of rod is "UP").



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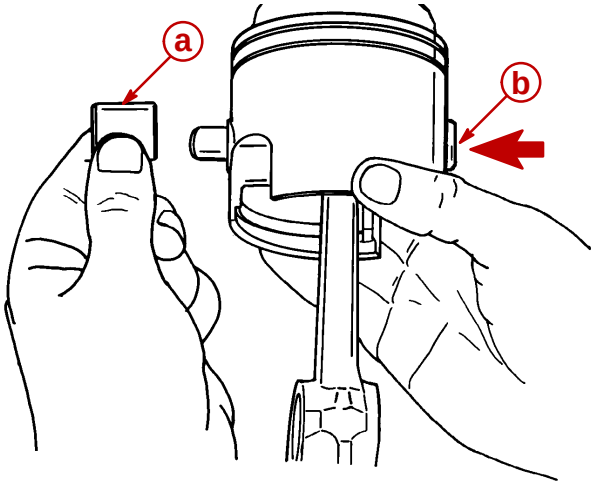
a - Scribed Identification Number
b - Locating Washer

3. Insert piston pin tool through piston in the direction shown, pushing out sleeve.
4. Place piston pin over end of tool, and tap into position (driving tool out other side).



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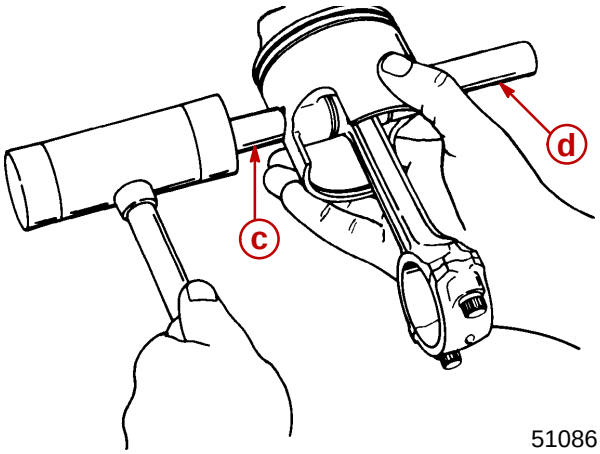


51086

a - Sleeve
b - Piston Pin Tool (91-74607A3)
c - Piston Pin
d - Piston Pin Tool

⚠ WARNING

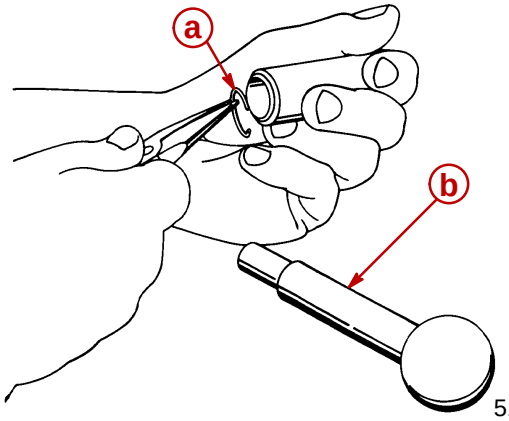
Eye protection must be worn while installing piston pin lockrings.

5. Install new piston pin lockrings (each side of piston) using Lockring Tool (91-77109A2).

Make sure lockrings are properly seated in piston grooves.

⚠ CAUTION

Do not reuse piston pin lockrings. Use only new lockrings and make sure they are properly seated in piston grooves.



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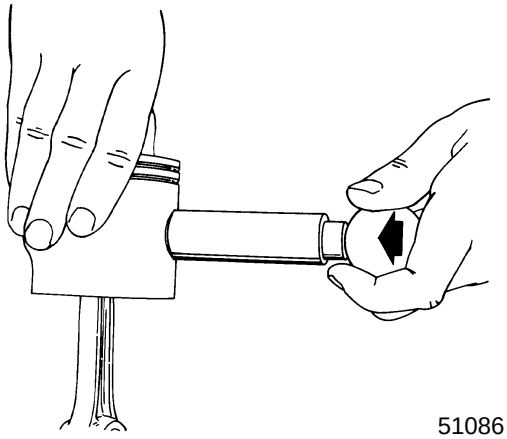
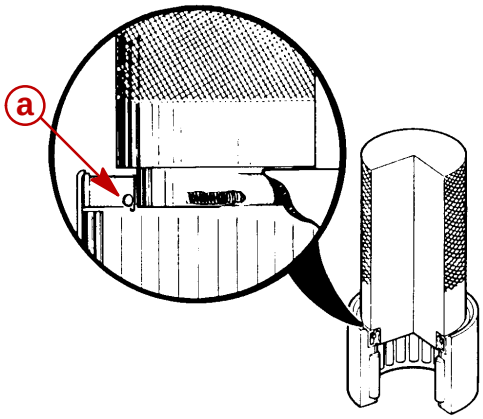

51086

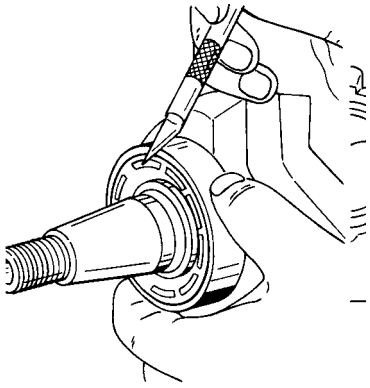
a - Lockring Installation Tool (91-77109A2)
b - Lockring (2)

6. Install piston rings. Top piston ring has one dot: install facing up. Bottom piston ring has two dots and a white stripe: install with dots facing up.

Assembling Crankshaft

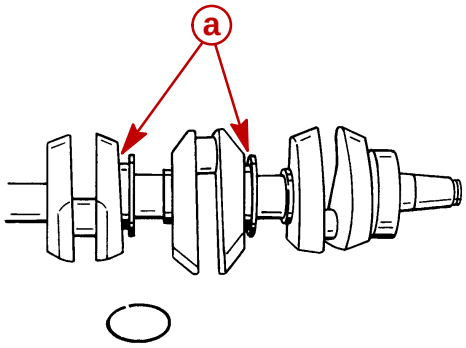
1. Install new seal into lower main bearing. Press seal into bearing with garter spring facing up. Use Special Tool FT 8925.
2. Apply Needle Bearing Lubricant 92-825265A1 between libs of seal and slide bearing on crankshaft.
3. Scrape old Loctite off upper bearing. Clean bearing surfaces with Locquic Primer 92-59327--1.

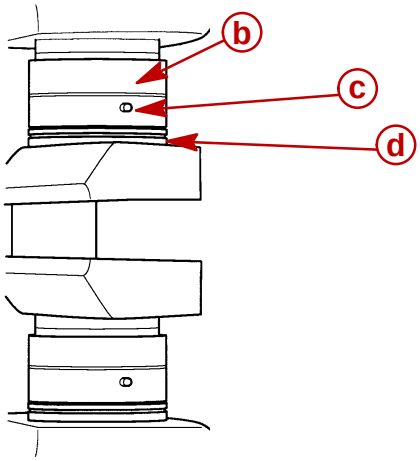




a - Garter Spring (Faces Up Toward Flywheel When Installed)

4. Install new crankshaft seals on crankshaft.
5. Install center main bearings on crankshaft with alignment holes of bearing race between snap ring groove and crankcase seal.

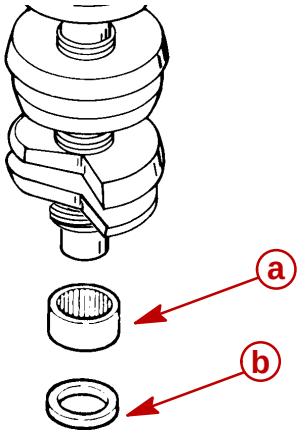




a - Crankcase Seals
b - Snap Ring Groove
c - Alignment Hole
d - Crankcase Seal

NOTE: *Position snap ring on center main bearings so that the gap is not over the fracture area of the bearings.*

6. Install lower bearing on crankshaft with seal.



a - Lower Bearing
b - Seal

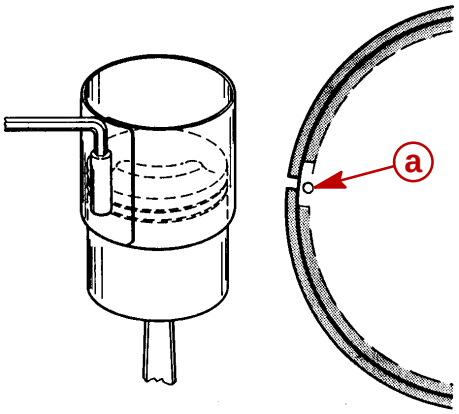
Installing Pistons Into Cylinder Block

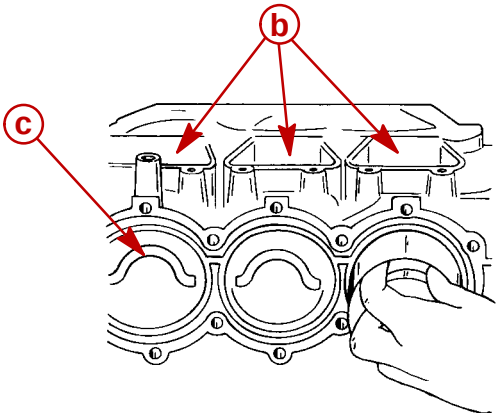
1. Coat pistons, rings, and cylinder bores with 2-cycle oil.
2. Install piston in ring compressor, Special Tool FT 2996.

IMPORTANT: Be sure to position end gap of rings at the ring alignment pin.

NOTE: *Pins are 180° apart on piston.*

3. Install piston in cylinder bore. Position piston so that piston dome faces intake port of cylinder block.





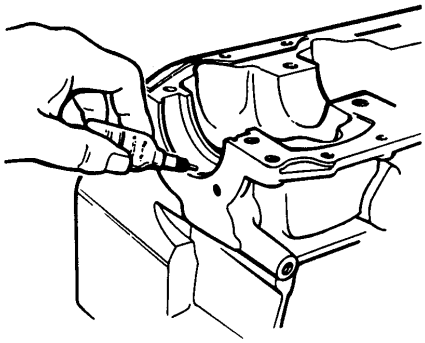
a - Alignment Pin
b - Intake Ports
c - Piston Dome

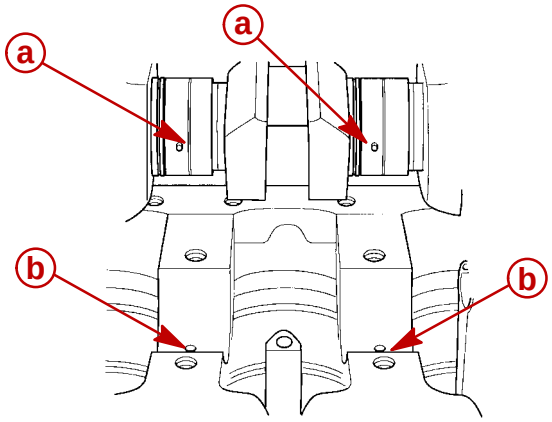
4. Push piston into cylinder bore.

NOTE: *Be sure piston is installed in the same bore it was removed from.*

5. Install cylinder head to prevent pistons from falling out. Do Not torque the cylinder head bolts at this time.
6. Clean cylinder block upper bearing bore with Locquic Primer 92-59327--1.
7. Apply Loctite to upper main bearing bore.
8. Install crankshaft in cylinder block.

- Align holes in center main bearings with location pins in cylinder block.





a - Center Main Bearing Hole
b - Locating Pin

IMPORTANT: Install crankshaft with sealing ring gaps facing up. When the crankshaft is seated the ends of the sealing rings must be able to touch.

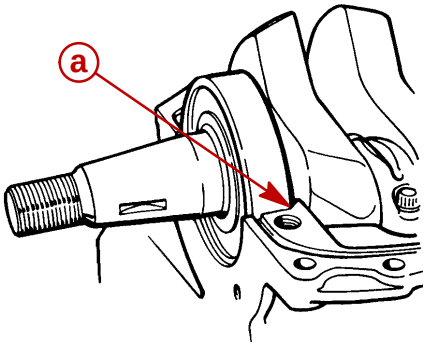
IMPORTANT: Make sure crankshaft is fully seated by pushing ends of crankshaft: there should be no rocking.

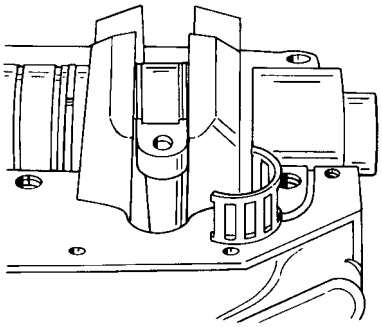
9. Spin crankshaft seals so that openings face down.

IMPORTANT: Seal rings break easily; handle carefully when turning.

IMPORTANT: Make sure upper crankshaft bearing is fully seated against the flange in the cylinder block. Tap on end of crankshaft to ensure seating.

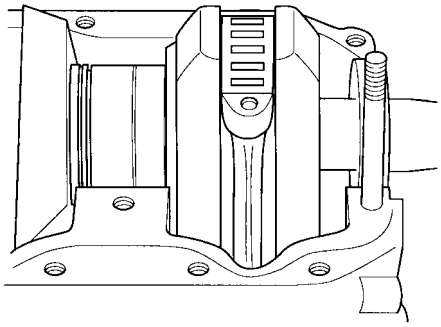
10. Install one half of bearing cage in connecting rod.
11. Carefully align connecting rod with crankshaft.





a - Bearing Seated Against Cylinder Block Flange

12. Install second half of bearing cage in connecting rod.

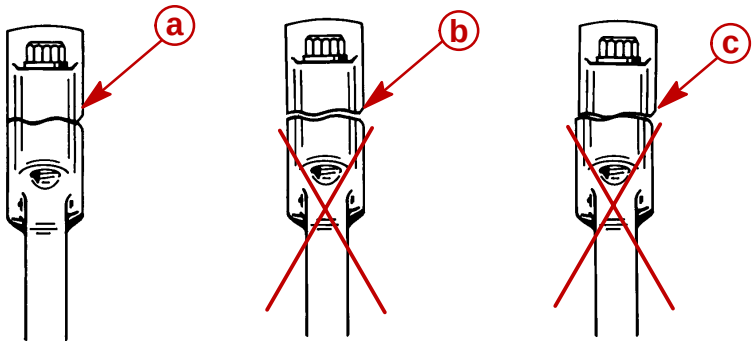


13. Install connecting rod cap.

IMPORTANT: Connecting rods and connecting rod caps are matched halves. Do not torque screws before checking alignment.

NOTE: *Do Not re-use old rod cap screws, always use new rod cap screws.*

- Install new rod cap screws and thread until cap and rod fit together. Inspect for alignment.



a - Correct Fit
b - Incorrect Fit - Gap Present
c - Incorrect Fit - Ridge Present

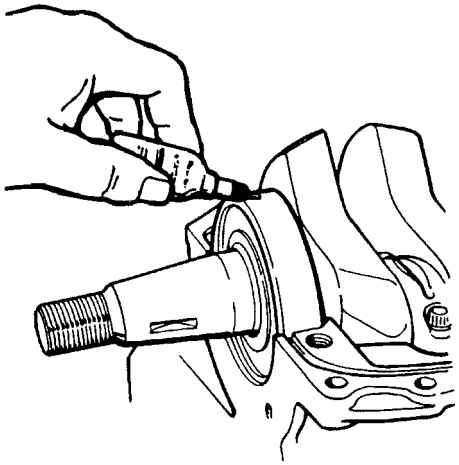
- Correct any misalignment.

14. Remove cap screws and apply Loctite FT 8936-1 to cap screw threads. Hand tight cap screws and check alignment. If alignment is good torque cap screws in increments of 50 lb. in. (5.65 N·m) until a torque of 120 lb. in. (13.55 N·m) is reached, then **turn an additional 90**°.

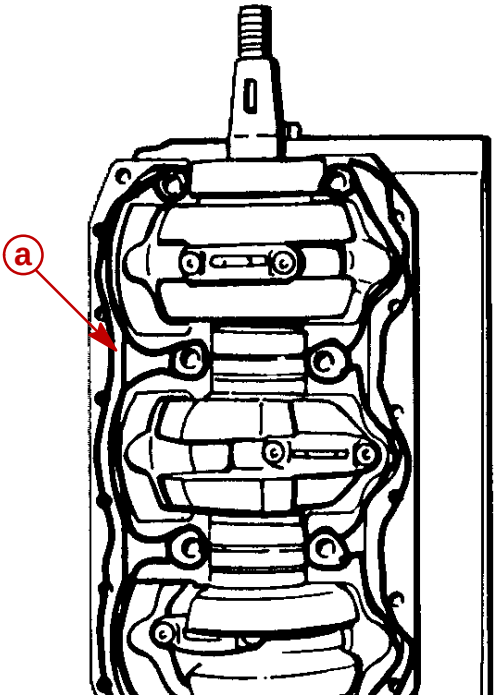
15. Repeat procedure for the remaining connecting rods.

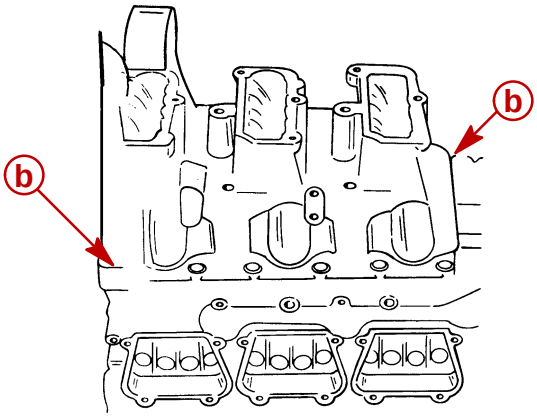
- Rotate the crankshaft after each rod is installed to check for binding. If any binding is present remove rod cap and check alignment.

16. Apply Loctite 92-823089--1 to the exposed portion of the upper bearing.



17. Apply Sealer 92-90113--2 on seal surface and around main bolt holes on block.
18. Install crankcase cover on cylinder block, aligning corner dowel pins.

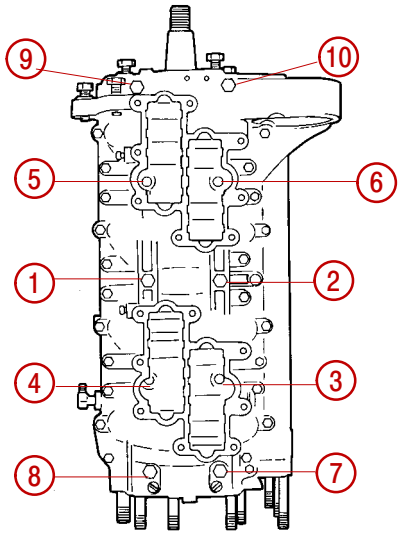




a - Sealer (92-90113--2)
b - Dowel Pins

19. Install crankcase bolts. Following torque pattern torque bolts to 270 lb. in. (30.5 N·m).

- Check crankshaft for free rotation.

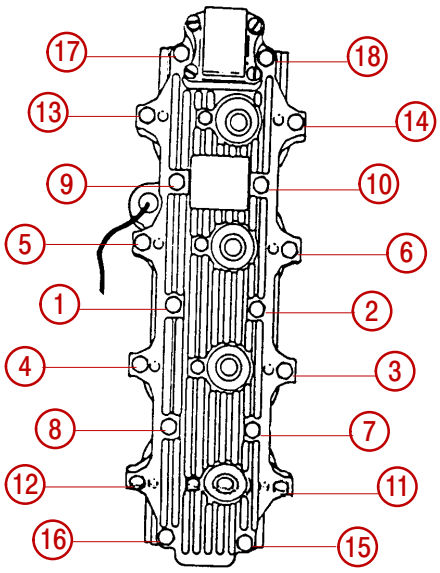


20. Using new gasket, install adapter plate on bottom of cylinder block. Torque bolts to 30 lb. ft. (40.7 N·m).

Assembling Cylinder Head

1. Install cylinder head cover on cylinder head. Torque center attaching screws to 70 lb. in. (7.91 N·m).
2. Apply sealant 92-90113--2 to cylinder head cover on cylinder block side of cover.
3. Using new gasket, install cylinder head.
4. Torque bolts as shown to 75 lb. in. (8.5 N·m), then torque 50 lb. in. (5.6 N·m) at a time until bolts are torqued to 225 lb. in. (29.14 N·m).

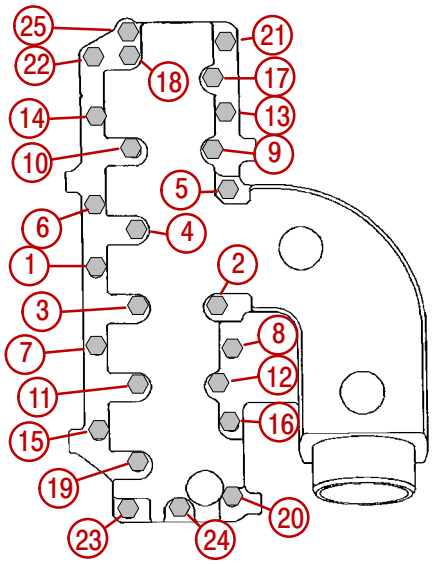
For S/N numbers 0E125509 and above apply light oil to threads and bolt head. Torque in sequence to 120 lb. in. (13.5 N·m). Then turn an additional 90°.



Completing Assembly

1. Install exhaust manifold using new gasket. Torque bolts in sequence from center out.

Apply light oil to threads and bolt head. Torque bolts in sequence to 115 lb. in. (13 N·m). Then **re-torque #'s 1 - 6**.



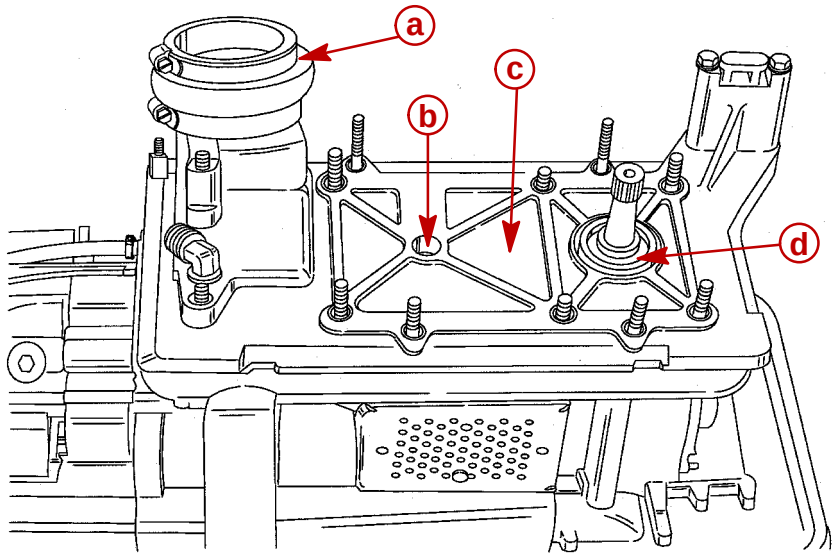
NOTE: *Refer to appropriate sections in service manual for installation of individual fuel and electrical subassemblies on powerhead.*

Component/Assembly	Section
Starter Motor	2C
Flywheel	2A
Ignition Components (Switch Box, Stator, Trigger)	2A
Carburetor and Linkage	3A
Fuel Pump, Reed Valves	3B

NOTE: *All ignition and electrical components can be removed and installed as an assembly.*

Installing Powerhead

1. Install top exhaust boot and clamp. Install O-ring in counterbore of drive housing cover.

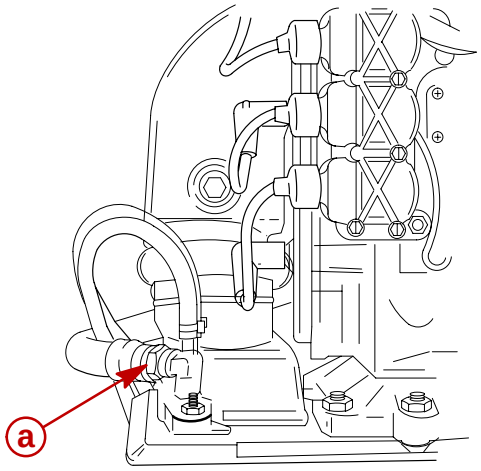


a - Exhaust Boot
b - O-Ring
c - Drive Housing Cover
d - Large O-Ring

2. Lubricant driveshaft splines with 2-4-C w/Teflon Lubricant 92-825407A12.

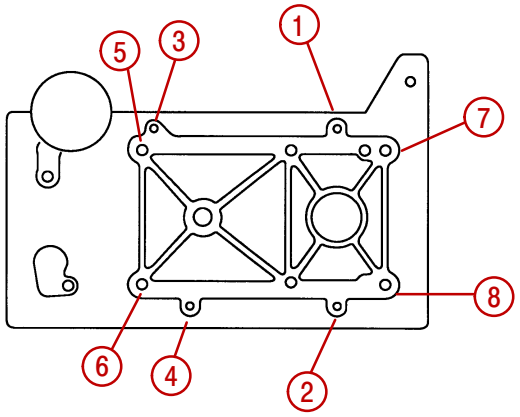
NOTE: *DO NOT apply lubricant to TOP of drive shaft as grease may pre-load drive shaft/ crankshaft resulting in damage to powerhead and/or pump housing.*

3. Lower powerhead on drive housing cover. Align exhaust boot with exhaust elbow, drive-shaft splines, and mounting studs.
4. Torque exhaust bellows clamp screws to 50 lb. in. (5.6 N·m).
5. Connect water inlet hose to fitting on drive housing cover. Snug nut with wrench, then tighten one additional flat (60 degrees).



a - Water Inlet Hose

6. Secure powerhead to drive housing cover with nuts.
7. Torque nuts in sequence shown below. The forward and aft nuts (7, 8 and 5, 6) are torqued to 35 lb. ft. (47.5 N·m). The left and right nuts (1, 2 and 3, 4) are torqued to 20 lb. ft. (27.1 N·m).



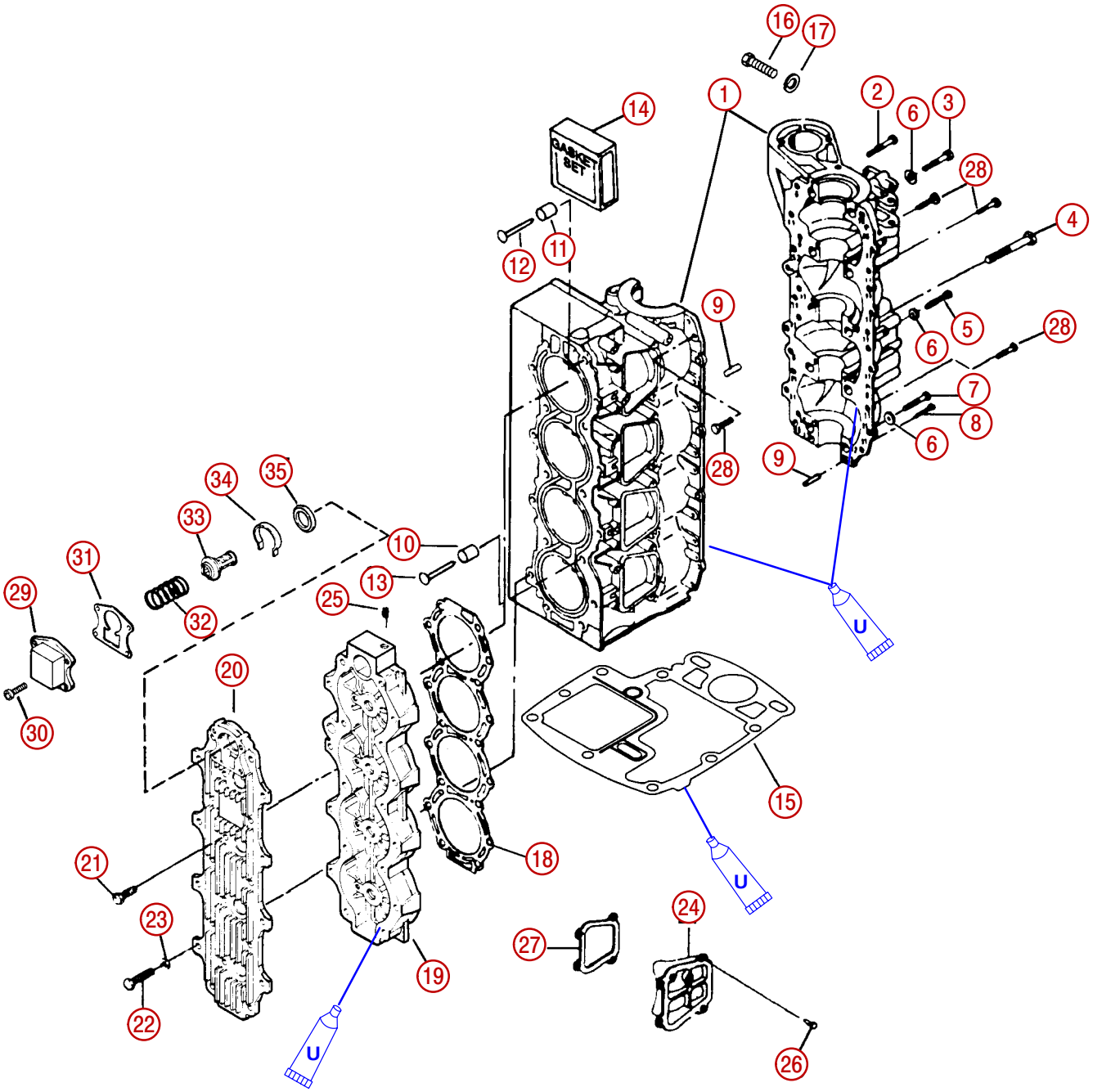
REFER TO SECTION 6 “ENGINE INSTALLATION” TO COMPLETE INSTALLATION OF WIRE HARNESS, CONTROL CABLES, SET-UP AND TIMING.

IMPORTANT: Follow Break-In procedure as out lined in Section 6: Engine Installation.

⚠ CAUTION

SEVERE DAMAGE to your engine can result by not complying with the proper break-in procedure.

Powerhead Components 120 HP

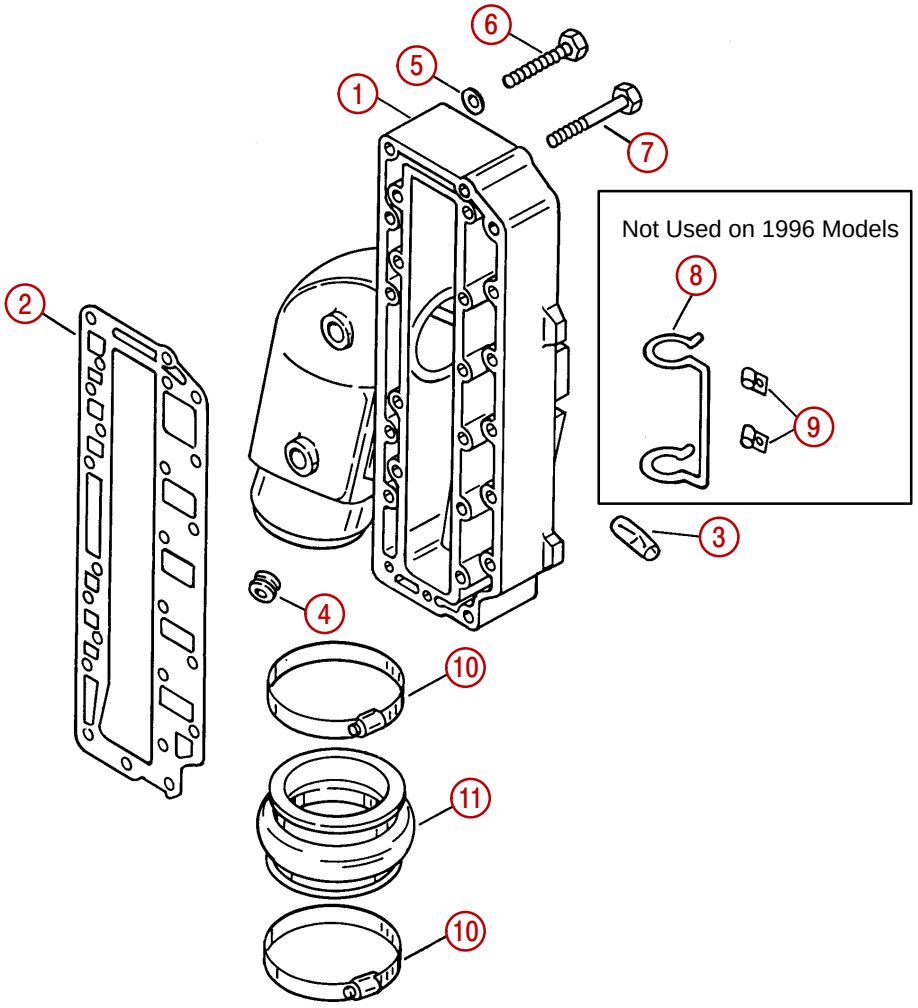


Quicksilver Lubrication/Sealant Application Points

U RTV Sealant 92-90113--2

Item	Qty.	Description	Torque		
			Lb. In.	Lb. Ft.	N·m
1	1	Cylinder Block			
2	1	Bolt (3/8-16x3-1/8)	270	22.5	30.5
3	1	Bolt (3/8-16x2-3/4)	270	22.5	30.5
4	2	Bolt (3/8-16x3)	270	22.5	30.5
5	4	Bolt (3/8-16x2)	270	22.5	30.5
6	10	Washer			
7	2	Bolt (3/8-16x1-3/4)		22.5	30.5
8	2	Bolt (1/4-20x1-1/4)	70		7.9
9	2	Dowel Pin (3/8x5/8)			
10	3	Tube			
11	1	Tube			
12	1	Pin			
13	3	Pin			
14	1	Gasket Set			
15	1	Gasket			
16	1	Bolt (5/16-18x3/4)		13	17.6
17	1	Lock Washer (5/16)			
18	1	Gasket			
19	1	Cylinder Head			
20	1	Cover			
21	4	Bolt (1/4-20x5/8)	70		7.9
22	18	Bolt (5/16-18x2-3/8) S/N 0E125509 and Above - Apply Light Oil to Bolt Head & Threads	120 lb. in. (13.5 N·m) Then Turn An Additional 90°		
23	18	Washer - Only Used On 1995-1/2 S/N 0E125508 and Below			
24	3	Cover Kit			
25	1	Plug			
26	12	Bolt (1/4-20x5/8)	70		7.9
27	3	Gasket			
28	24	Bolt (1/4-20x7/8)	70		7.9
29	1	Cover			
30	4	Bolt (1/4-20x3/4)	70		7.9
31	1	Gasket			
32	1	Spring (RED)			
33	1	Thermostat (130°)			
34	1	Spacer			
35	1	Seal			

Powerhead Components (Continued)
Exhaust Manifold 120 HP



Item	Qty	Description	Torque		
			Lb. In.	Lb. Ft.	N·m
1	1	Manifold			
2	1	Gasket			
3	1	Strainer Tube			
4	4	Plug (3/4-14)			
5	25	Washer Only Used On 1995-1/2 S/N 0E125508 and Below			
6*	21	Bolt (1/4-20x3) Apply Light Oil to Bolt Head & Threads	115		13
7	4	Bolt (1/4-20x4)	115		13
8	1	Retainer			
9	2	Clip			
10	2	Clamp			
11	1	Bellows			

* Refer to torque sequence listed on page 4A-21.