POWERHEAD

Section 4

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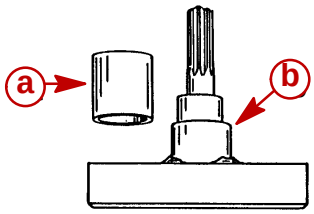
Specifications

Model 6/8/9.9/10/15		
KW (HP)	**Model 6** **Model 8** **Model 8 Sailmate** **Model 9.9** **Model 9.9 Sailpower** **XR/MAG/Viking10** **Model Sea Pro/Marathon 10** **Model 15** **Model Sea Pro/Marathon 15**	4.5 (6) 5.9 (8 5.9 (8) 7.4 (9.9) 7.4 (9.9) 7.5 (10.0) 7.5 (10.0) 11.2 (15) 11.2 (15)
STATIC THRUST	**Model 9.9 Sailpower**	W.O.T. in Forward – 920.7 N (207 Lbs.) W.O.T. in Reverse – 667.2 N (150 Lbs.)
OUTBOARD WEIGHT	**Manual Start** **6** **8** **8 Sailmate** **9.9** **9.9 Sailpower** **XR/MAG/Viking 10** **Sea Pro/Marathon 10** **15** **Sea Pro/Marathon 15** **Electric Start** **6** **8** **9.9** **9.9 Sailpower** **15**	 33.1 kg (73.0 lb) 33.1 kg (73.0 lb) 33.8 kg (74.5 lb) 33.8 kg (74.5 lb) 34.2 kg (76.5 lb) 33.8 kg (74.5 lb) 33.8 kg (74.5 lb) 34.0 kg (75.0 lb) 34.0 kg (75.0 lb) 36.1 kg (79.5 lb) 36.1 kg (79.5 lb) 36.7 kg (81.0 lb) 37.7 kg (83.0 lb) 37.0 kg (81.5 lb)

Model 6/8/9.9/10/15		
CYLINDER BLOCK	**Type**	Two-Stoke Cycle – Cross Flow
	Displacement (1994 Model)	
	6	209cc (12.8 cu. in.)
	8	209cc (12.8 cu. in.)
	9.9	209cc (12.8 cu. in.)
	9.9 Sailpower	209cc (12.8 cu. in.)
	10 Sea Pro/Marathon	262cc (16.0 cu. in.)
	XR/MAG10	262cc (16.0 cu. in.)
	15	262cc (16.0 cu. in.)
	Displacement (1995 and Newer)	
	9.9	262cc (16.0 cu. in.)
	9.9 Sailpower	262cc (16.0 cu. in.)
	10 Sea Pro/Marathon	262cc (16.0 cu. in.
	XR/MAG/Viking 10	262cc (16.0 cu. in.)
	15	262cc (16.0 cu. in.)
	15 Sea Pro/Marathon	262cc (16.0 cu. in.)
STROKE	**Length**	45.7mm (1.800 in.)
CYLINDER BORE	**Diameter (Standard)(1994 Model)**	
	6	53.975mm (2.125 in.)
	8	53.975mm (2.125 in.)
	8 Sailmate	53.975mm (2.125 in.)
	9.9	53.975mm (2.125 in.)
	9.9 Sailpower	53.975mm (2.125 in.)
	10 Sea Pro/Marathon	60.325mm (2.375 in.)
	XR/Mag 10	60.325mm (2.375 in.)
	15	60.325mm (2.375 in.)
	Diameter (Standard)(1995 Model)	
	9.9	60.325mm (2.375 in.)
	9.9 Sailpower	60.325mm (2.375 in.)
	10 Sea Pro/Marathon	60.325mm (2.375 in.)
	XR/Mag/Viking 10	60.325mm (2.375 in.)
	15	60.325mm (2.375 in.)
	15 Sea Pro/Marathon	60.325mm (2.375 in.)
	Taper/Out of Round Maximum	0.1016mm (0.004 in.)
	Bore Type	Cast Iron
CRANKSHAFT	**Top Main Bearing Journal**	19.1mm (0.7517 in.)
	Center Main Bearing Journal	20.6mm (0.8108 in.)
	Bottom Ball Bearing Journal	20.0mm (0.7880 in.)
	Connecting Rod Journal	20.6mm (0.8125 in.)
	Runout	0.076mm (0.003 in.)
CONNECTING ROD	**Piston Pin End (I.D.)**	20.8mm (0.8195 in.)
	Crankpin End (I.D.)	27.0mm (1.0635 in.)
PISTON	**Piston Type**	Aluminum
	Ring End Gap	0.25 mm - 0.46 mm (0.010 in. - 0.018 in.)
REEDS	**Reed Stand Open (Maximum)**	
	All Models	0.178mm (0.007 in.)
	Reed Stop Opening (Maximum)	
	All Models	7.54mm (0.296 in.)

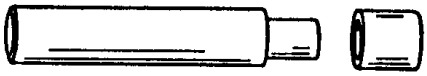
Special Tools

1. Powerhead Stand 91-13662T1

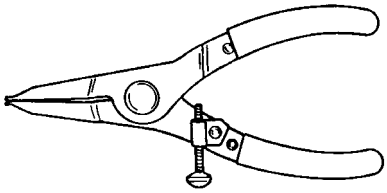


a - Bushing 23-13653
b - Stand 91-13662

2. Piston Pin Tool 91-13663T1

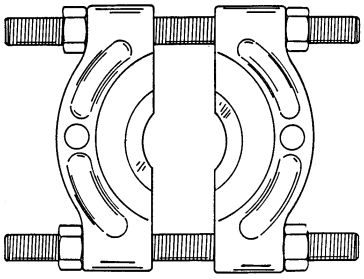


3. Snap Ring Pliers 91-24283 * **NLA**

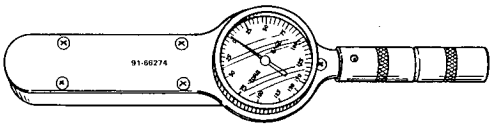


4. Torque Wrench (0-200 lb. ft.) 91-32610* **NLA**

5. Universal Puller Plate 91-37241

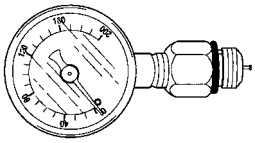


6. Torque Wrench (0-150 lb. in.) (91-66274)*

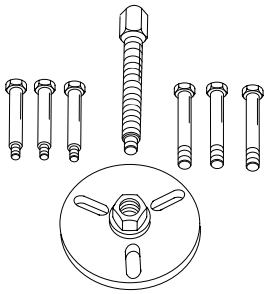


*May be obtained locally.

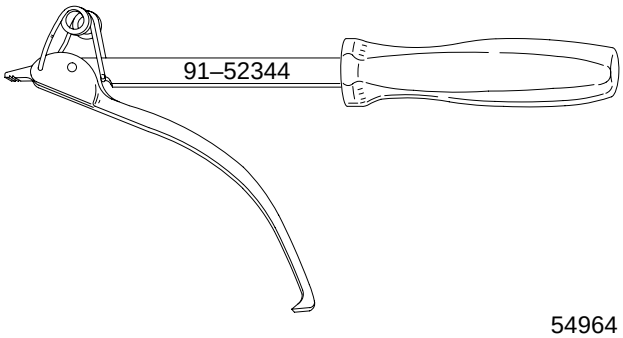
7. Compression Tester 91-29287



8. Flywheel Puller 91-83164M



9. Flywheel Holder 91-52344



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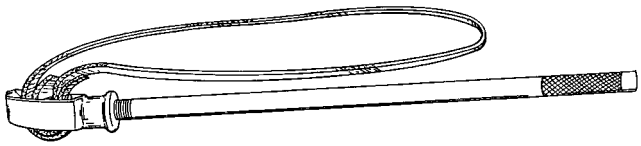
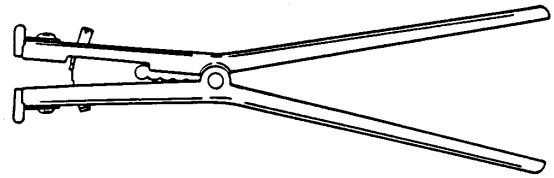
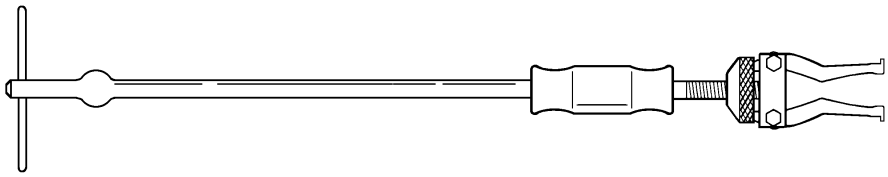
10. Strap Wrench 91-24937A1



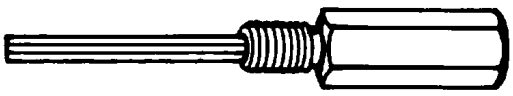
11. Ring Expander 91-24697



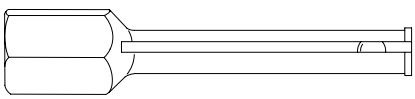
12. Slide Hammer 91-34569A1



13. Expanding Rod **CG40-4** (Snap-On)

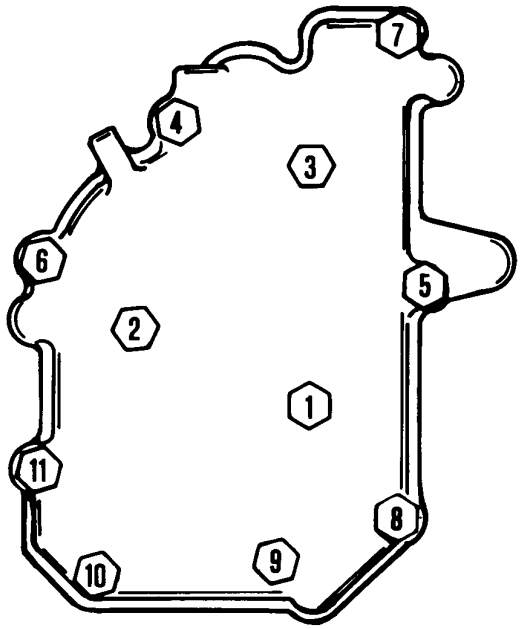


14. Collet **CG40-15** (Snap-On)



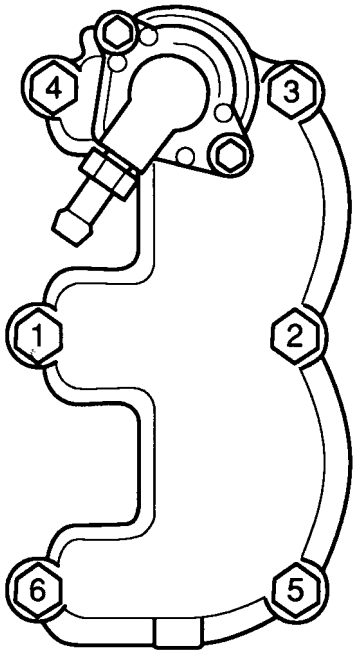
Powerhead Torque Sequence

EXHAUST COVER TORQUE SEQUENCE



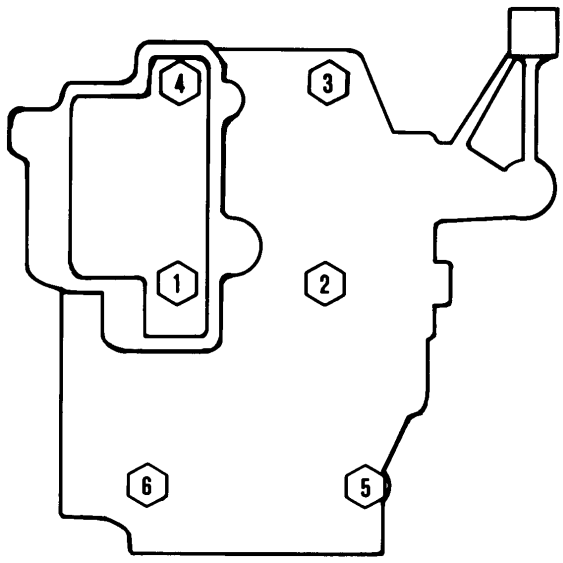
6.8 Nm (60 lb. in.)

CYLINDER BLOCK COVER TORQUE SEQUENCE

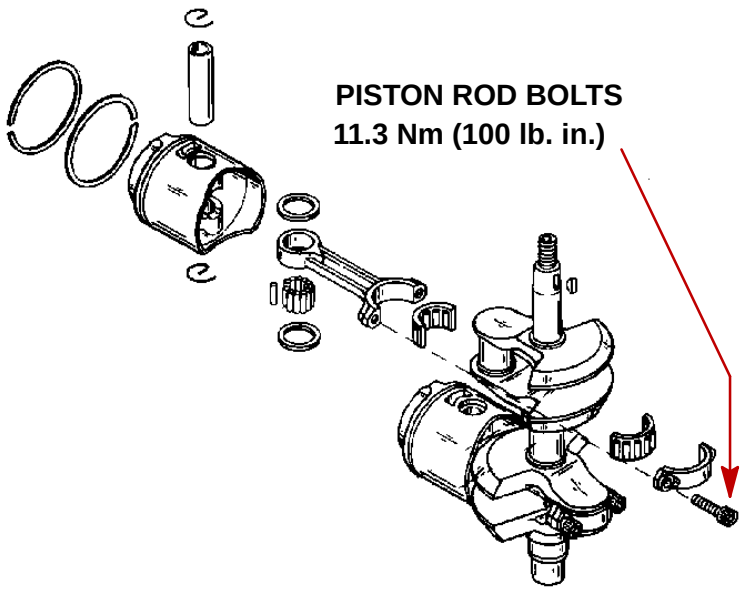


6.8 Nm (60 lb. in.)

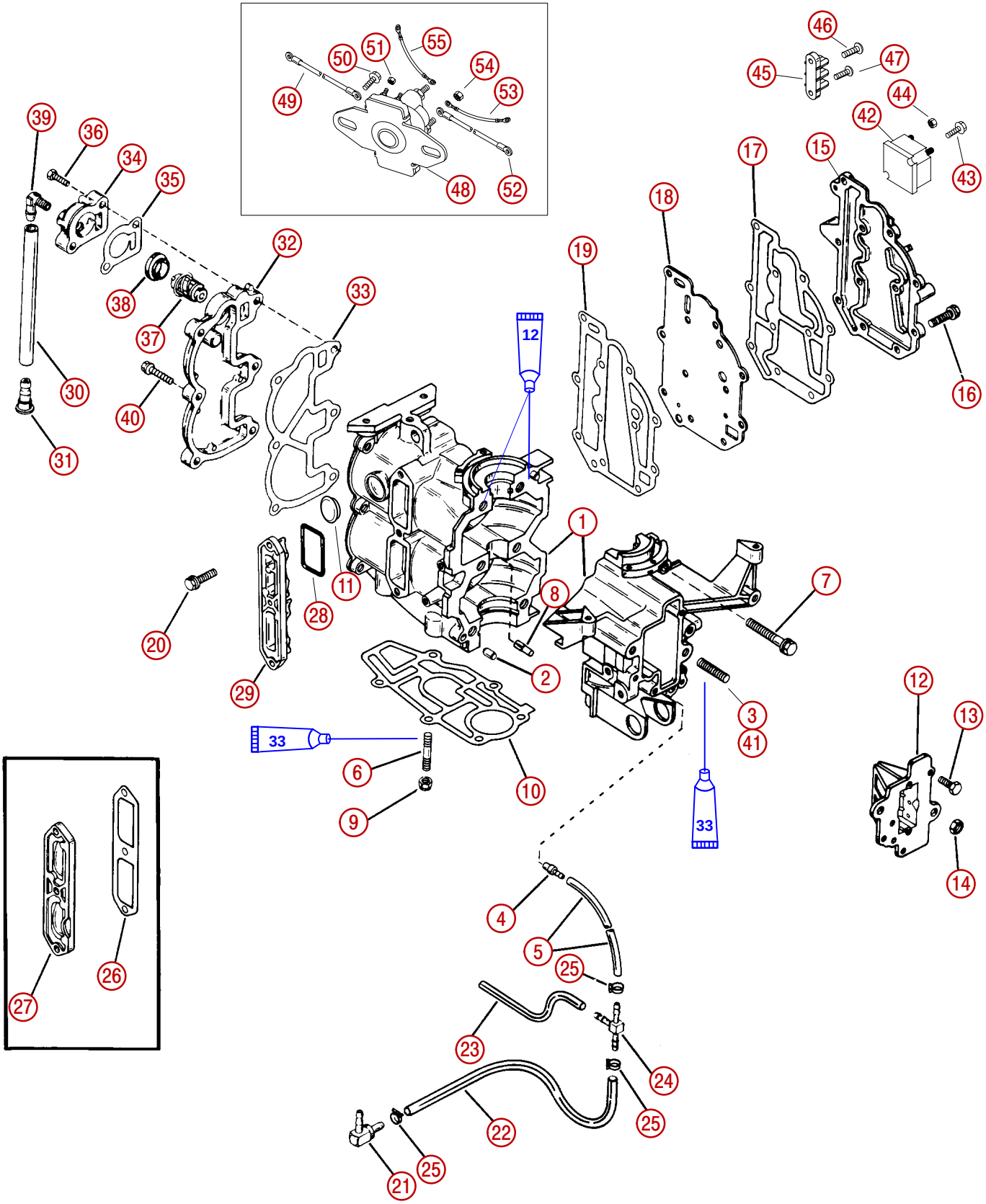
CRANKCASE COVER TORQUE SEQUENCE



22.6 Nm (16.7 lb. ft.)



Cylinder Block and Covers



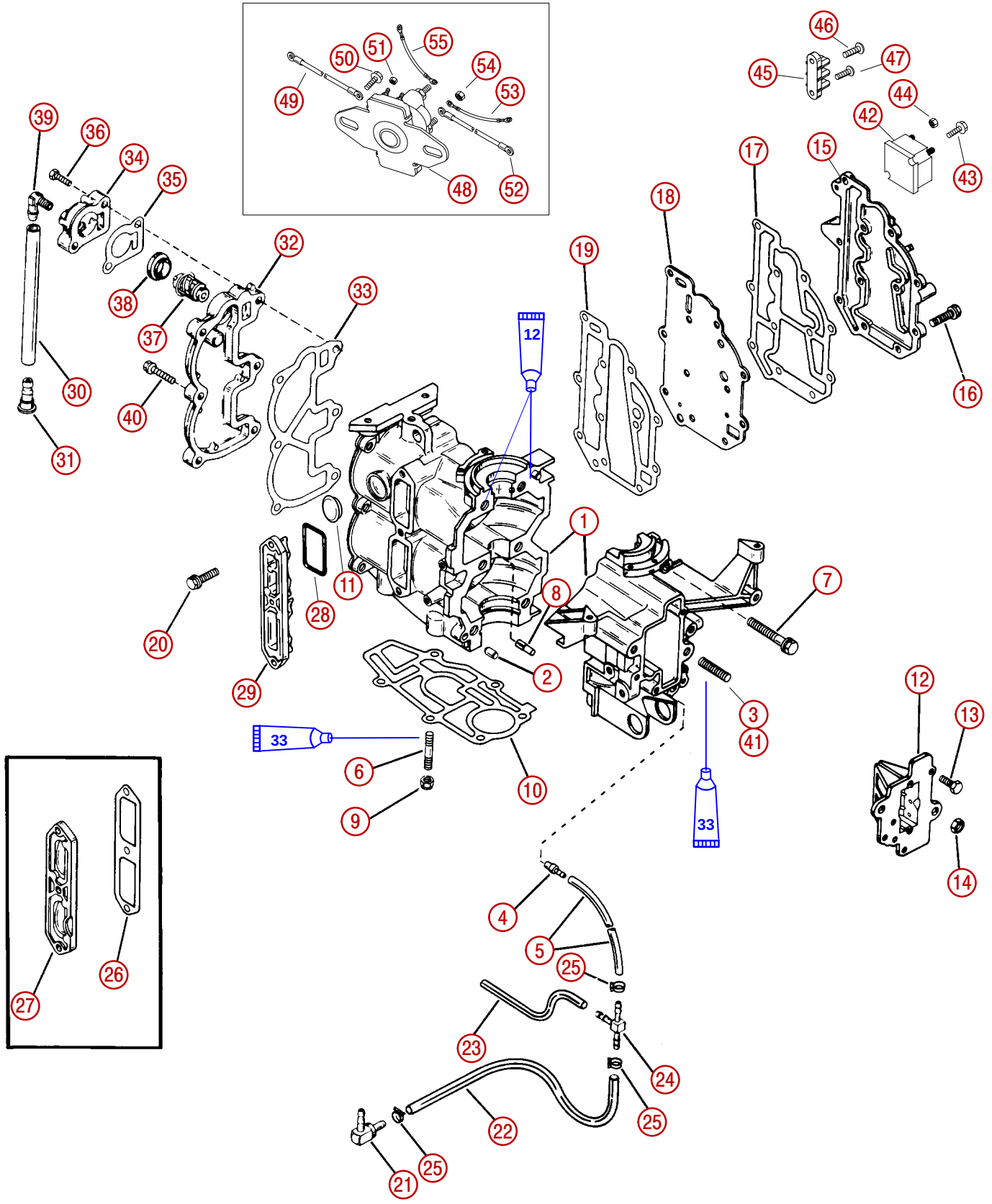
12 Loctite Master Gasket

33 Loctite 680 Retaining Compound

Cylinder Block and Covers (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CYLINDER BLOCK **(6)**			
	1	CYLINDER BLOCK **(8)**			
	1	CYLINDER BLOCK **(9.9/15)**			
2	2	DOWEL PIN–cylinder block			
3	2	STUD–carburetor			
4	1	CHECK VALVE–bleed hose			
5	1	HOSE–bleed (2-1/2 IN.)			
6	2	STUD–cylinder block			
7	6	SCREW–crankcase to cylinder block		16.5	22.6
8	1	GROOVE PIN **(9.9/15)**			
9	2	NUT–cylinder block stud	100		11.3
10	1	GASKET–powerhead			
11	1	PLUG-Serial Number			
12	1	REED BLOCK			
13	3	SCREW–reed block			
14	2	NUT–carburetor stud	125		14.1
15	1	COVER–exhaust			
16	11	SCREW–exhaust cover to cylinder block	60		6.8
17	1	GASKET–exhaust cover			
18	1	BAFFLE PLATE			
19	1	GASKET–baffle plate			
20	3	SCREW–cover to cylinder block	60		6.8
21	1	FITTING			
22	1	TUBING (7 IN.)			
23	1	TUBING (5-1/4 IN.)			
24	1	TEE			
25	AR	CABLE-TIE			

Cylinder Block and Covers (continued)



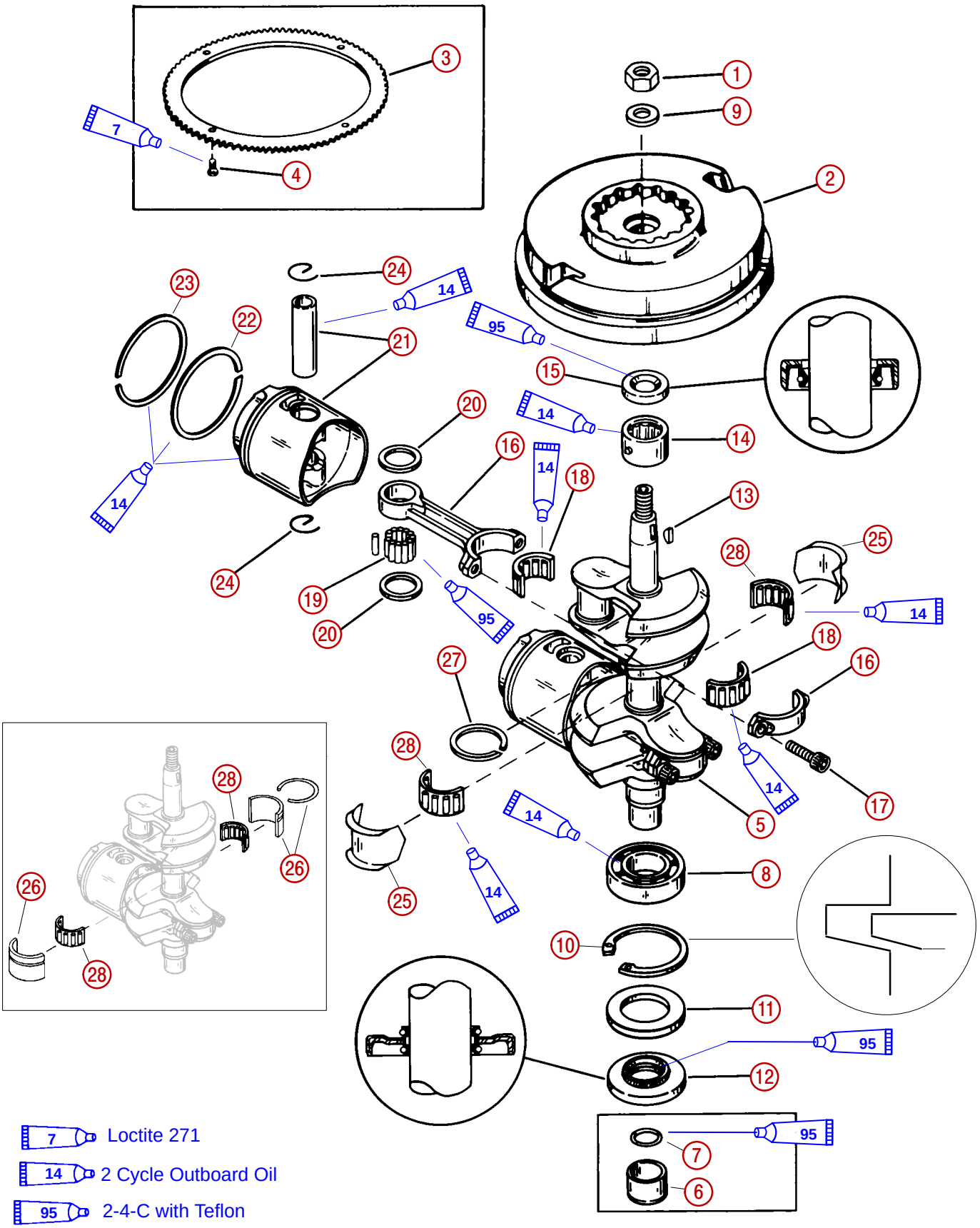
12 Loctite Master Gasket

33 Loctite 680 Retaing Compound

Cylinder Block and Covers (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
26	1	GASKET **6/8**			
27	1	INTAKE COVER			
28	2	O-RING **9.9/15**			
29	1	INTAKE COVER			
30	1	HOSE–tell tale (6 IN.)			
31	1	FITTING–tell tale hose - bottom cowl			
32	1	COVER ASSEMBLY			
33	1	GASKET			
34	1	COVER–thermostat			
35	1	GASKET			
36	2	SCREW	60		6.8
37	1	THERMOSTAT (120 degrees) **9.9/15**			
38	1	GASKET–thermostat			
39	1	FITTING			
40	6	SCREW–cover attaching	60		6.8
41	2	STUD-carb **(RESTRICTED/NORWAY MODELS)**			
42	1	RECTIFIER			
43	2	SCREW (5/8) **ELECTRIC**	Drive Tight		
44	3	NUT	25		2.8
45	1	TERMINAL BLOCK			
46	2	SCREW (5/8 IN.) **ALTERNATOR MODELS**	Drive Tight		
47	2	SCREW (3/8 IN.)	Drive Tight		
48	1	STARTER SOLENOID			
49	1	BATTERY CABLE **(NEGATIVE)**			
50	2	SCREW (M6 x 14) **ELECTRIC**	70		7.9
51	2	NUT (10-32)	15		1.7
52	1	BATTERY CABLE **(POSITIVE)**			
53	1	WIRE (YELLOW)			
54	2	NUT (1/4-20)	30		3.4
55	1	WIRE (RED)**(15 ELECTRIC HANDLE)**			

Crankshaft, Pistons and Flywheel



Crankshaft, Pistons and Flywheel (continued)

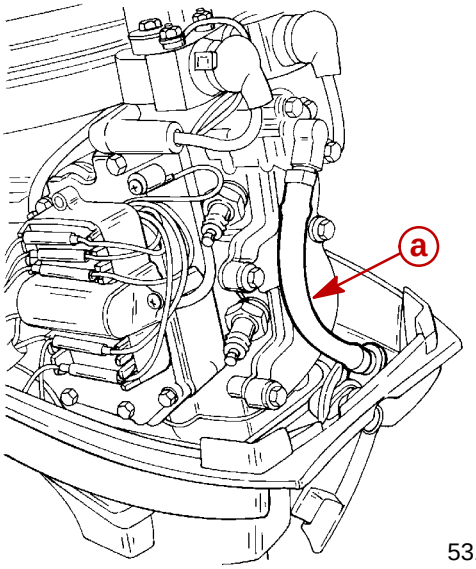
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	NUT		50	67.8
2	1	FLYWHEEL ASSEMBLY			
3	1	RING GEAR–flywheel **ELECTRIC**			
4	4	SCREW (M5 x 13)	65		7.3
5	1	CRANKSHAFT ASSEMBLY			
6	1	SLEEVE			
7	1	O-RING			
8	1	BALL BEARING - lower			
9	1	WASHER			
10	1	RETAINING RING			
11	1	WASHER - lower			
12	1	OIL SEAL - lower			
13	1	KEY			
14	1	ROLLER BEARING			
15	1	OIL SEAL - upper			
16	2	CONNECTING ROD ASSEMBLY			
17	4	SCREW	100		11.3
18	3	ROLLER BEARING			
19	48	NEEDLE BEARING - piston end			
20	4	THRUST BEARING			
21	2	PISTON AND PIN ASSEMBLY **(6/8)**			
	2	PISTON AND PIN ASSEMBLY **(9.9/15)**			
22	1	PISTON RING ASSEMBLY **(6/8)**			
	1	PISTON RING ASSEMBLY **(9.9/15)**			
23	2	PISTON RING - top **(6/8)**			
	2	PISTON RING - top **(9.9/15)**			
24	4	LOCK RING			
25	1	LINER – center main bearing **(6/8)**			
26	1	BEARING **(9.9/15)**			
27	1	SEAL – main bearing			
28	1	ROLLER BEARING**(9.9/15)**			

Powerhead Removal

1. Remove the following components/assemblies referring to the listed service manual sections:

Component/Assembly	Section
Rewind Starter	8
Flywheel and Ignition/Electrical Components	2A/B
Throttle/Shift Mechanism	7A/B/C
Carburetor	3

2. Disconnect tell-tale hose from bottom cowl.
3. Remove 4 bolts and 2 nuts.



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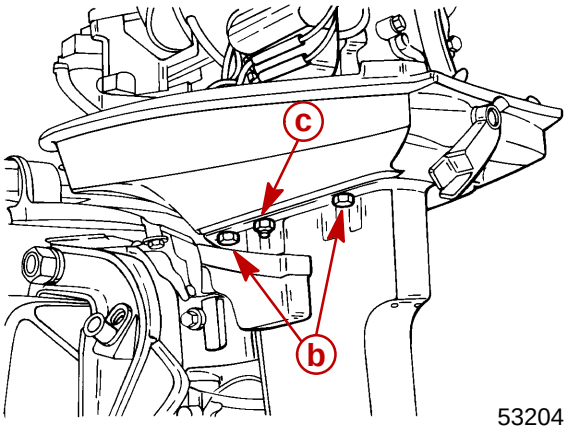
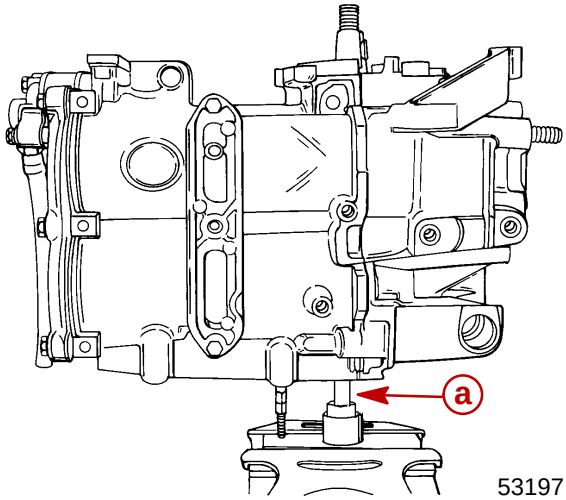


53204

a - Tell-tale hose
b - Bolts (2 each side)
c - Nut (1 each side)

4. Push powerhead sideways to break gasket and lift powerhead from drive shaft housing.
5. Place powerhead on bench or powerhead stand mounted in vise.



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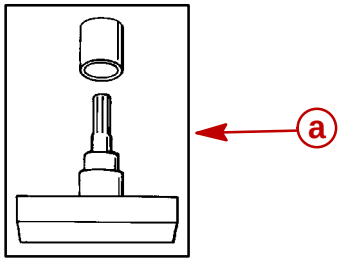


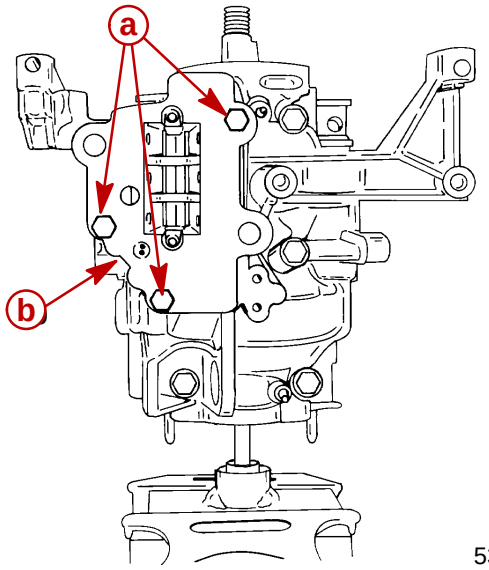
53203

a - Powerhead Stand (91-13662T1)

Powerhead Disassembly

Cylinder Block

1. Remove 3 bolts and remove intake manifold/reed block.



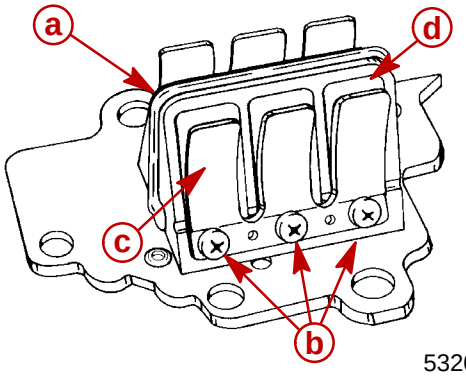
53191

a - Bolts
b - Intake manifold/reed block

IMPORTANT: Reed block can be inspected without disassembling. Refer to Cleaning and Inspection, following. If inspection of reed block indicates that replacement of a part is necessary, disassemble reed block as outlined.

2. If necessary, disassemble reed block as follows:
   a. Pull ends of rubber seal from holes in intake manifold/reed block.
   b. Remove 6 screws and separate reed stops and reeds.

1994 – 1996 Reed Blocks



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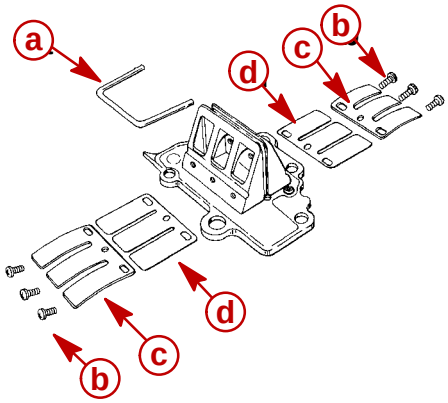
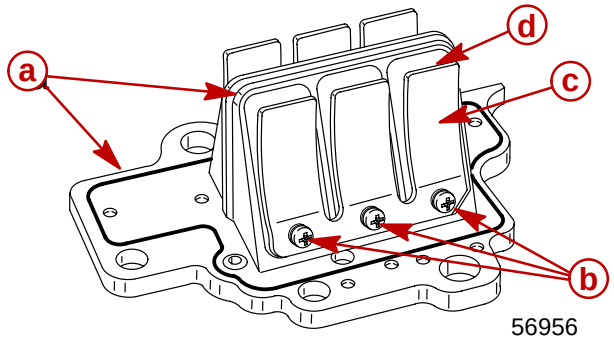


53196

a - Rubber seal
b - Screws
c - Reed stop
d - Reeds

1997 and Newer Reed Blocks (Rubber Coated)

NOTE: *Individual components of 1997 and newer reed block assemblies are not sold separately. If individual components are found to be not serviceable, entire reed block assembly must be replaced.*



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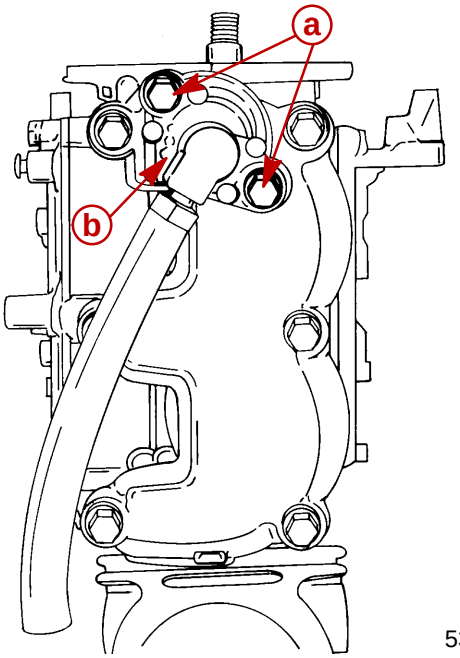
a - Rubber seal
b - Screws
c - Reed stop
d - Reeds

3. Remove 2 bolts and remove thermostat cover.
4. Remove thermostat (if equipped).
5. Remove 6 bolts and remove cylinder block cover.



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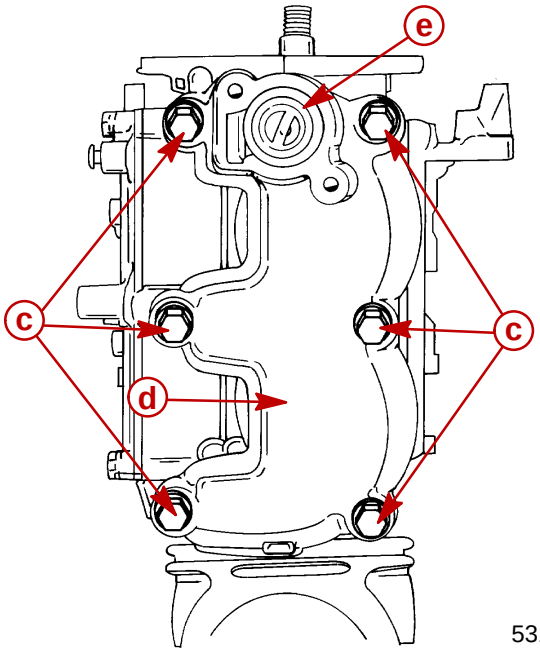


53193

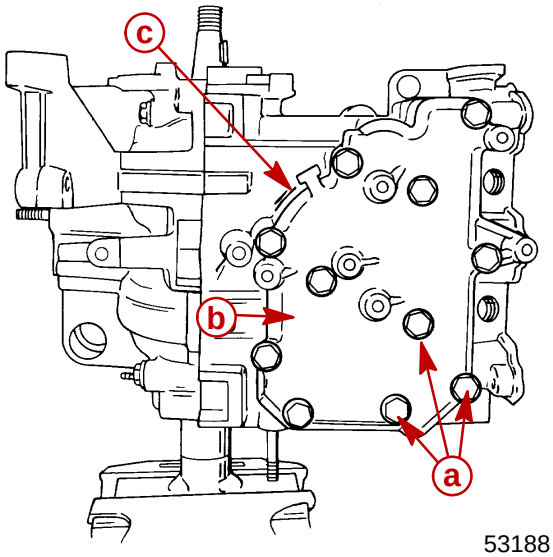
a - Bolts (2)
b - Cover
c - Bolts
d - Cover
e - Thermostat (if equipped)

6. Remove 10 bolts and separate exhaust cover and exhaust manifold from cylinder block.

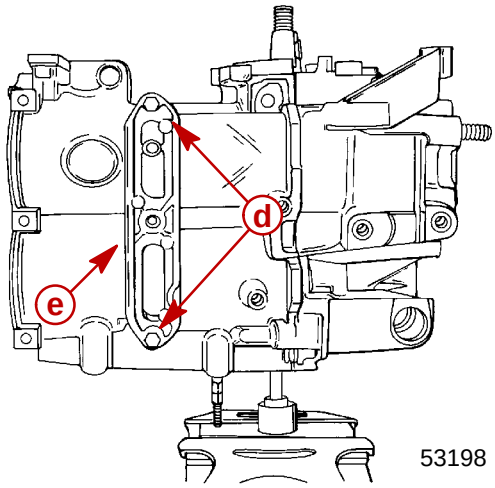
NOTE: *If engine is suspected of having been overheated or spark plugs are grayish colored (a sign of possible water intrusion), inspect exhaust manifold for warpage or for proper placement and integrity of gaskets which mayl allow water to enter cylinders through exhaust ports.*

7. Remove 2 bolts and intake cover.

NOTE: *1995-newer Model 9.9/15 powerheads have O-rings under intake cover instead of a gasket. This style intake cover with O-rings WILL NOT backfit prior models.*



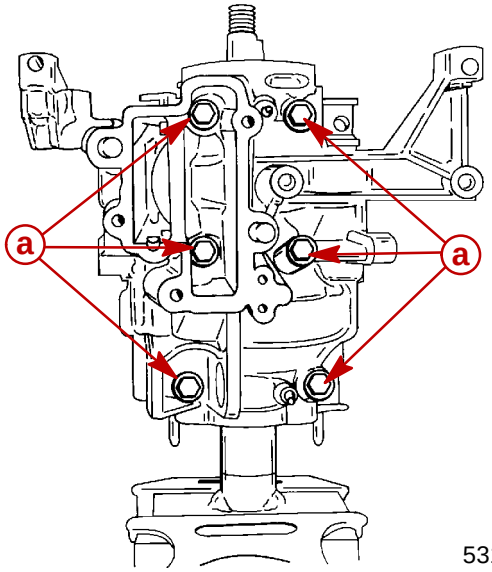
53188



53198

a - Bolts (10)
b - Exhaust cover
c - Exhaust manifold
d - Bolts (2)
e - Intake cover

8. Remove 6 bolts which secure crankcase cover to cylinder block.
9. Use soft mallet to break seal between crankcase cover and cylinder block.



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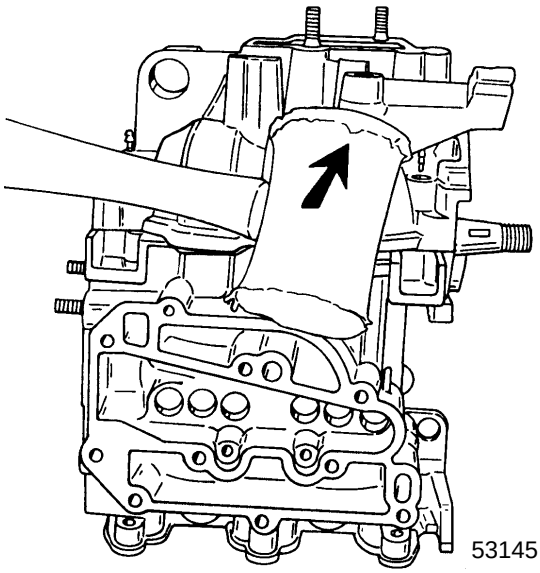
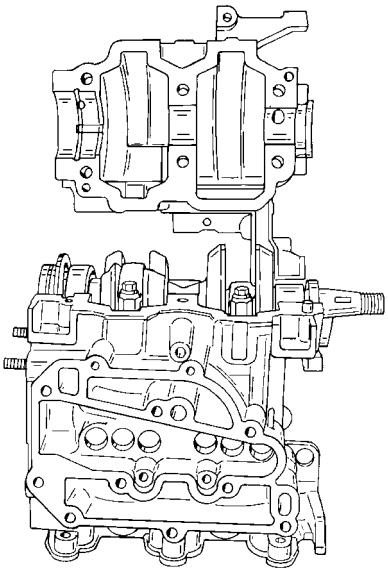


53145

a - Bolts (6)

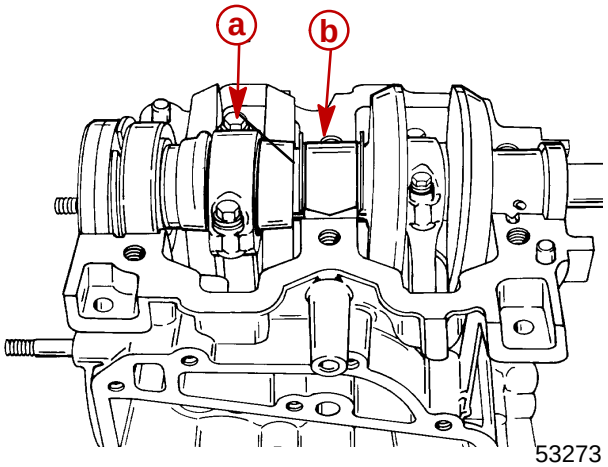
10. Lift crankcase cover from block.



53124

Crankshaft

1. Lift crankshaft assembly from cylinder block.
2. **All Models Except 15 and 1995 9.9/10:** Remove center main bearing halves and sleeve halves from crankshaft and/or cylinder block.
3. Remove upper crankshaft seal and bearing.
4. Remove lower crank shaft seal, stuffer washer and retaining ring.



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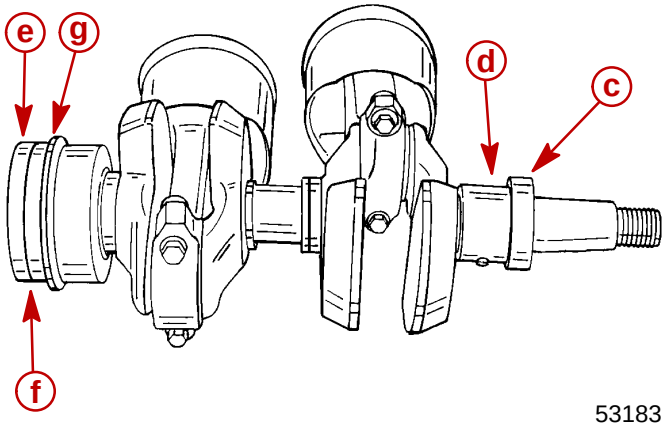
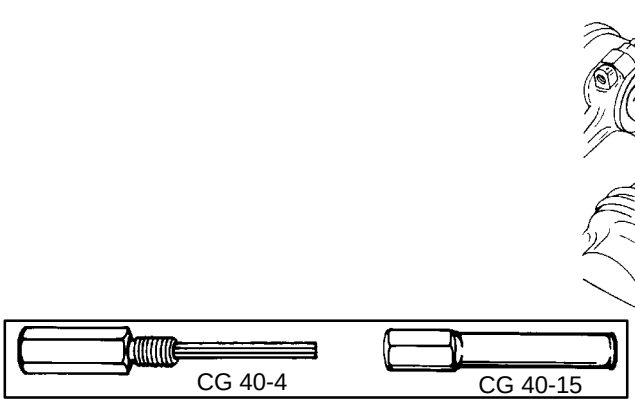


53183

a - Bearing halves (hidden)
b - Sleeve halves
c - Crankshaft seal (upper)
d - Bearing
e - Crankshaft seal (lower)
f - Stuffer washer
g - Retainer

5. Remove (and discard) coupling seal using:
   Snap On* Expanding Rod (CG 40-4)
   Snap On* Collet (CG 40-15)
   Slide Hammer (91-34569A1)
   *Purchase from: Snap On Tools Corporation
   2801 - 80th Street
   Kenosha, WI 53141-1410



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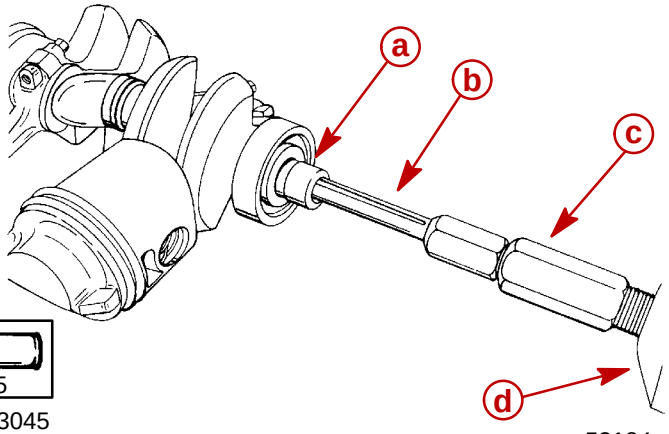
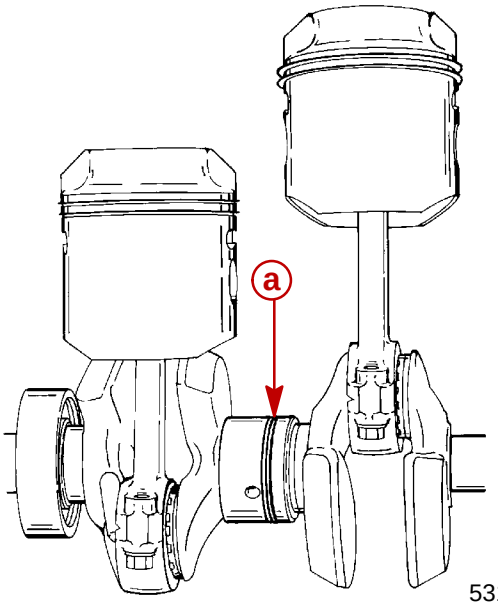


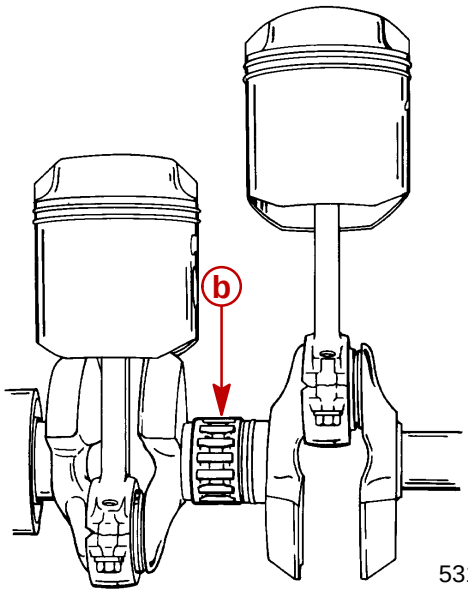
53184

a - Coupling seal
b - Collet (CG 40-15)
c - Expanding Rod (CG 40-4)
d - Slide Hammer (91-34569A1)

6. **Model 15 and 1995 9.9/10 Center Main Bearing Removal:**
   a. Remove retaining ring from groove of center main bearing race.
   b. Remove center main bearing races and center main bearing halves.



53128



53133

a - Retaining ring
b - Bearing halves

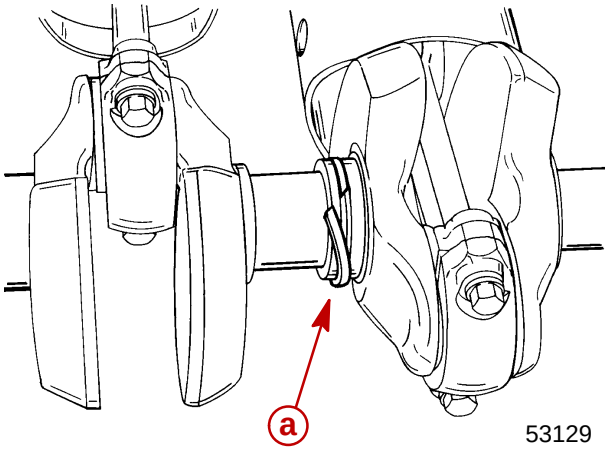
7. Remove sealing ring.

⚠ CAUTION

Eye protection MUST BE worn while removing piston pin lockrings.

IMPORTANT: Identify upper (#1) and lower (#2) pistons and connecting rods. Store piston pin, piston pin needle bearings, locating washers, connecting rod bearings, rod caps and bolts together with corresponding piston and connecting rod for reassembly.

8. Remove (and discard) piston pin lockrings.



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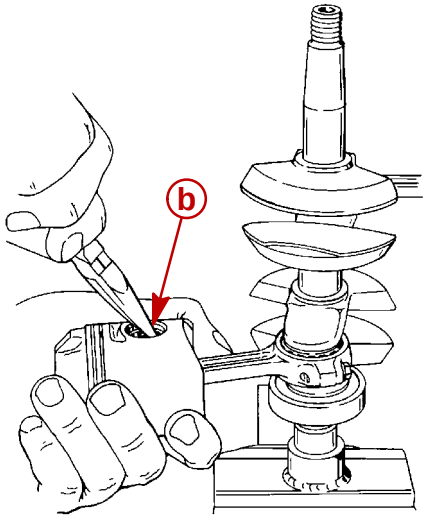
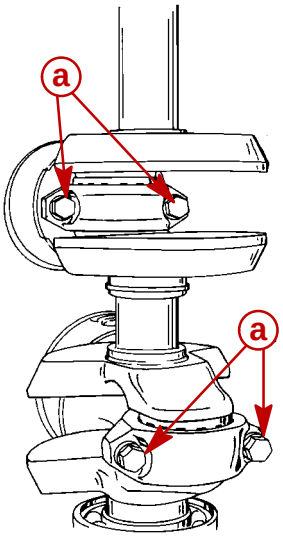


53139

a - Sealing ring
b - Lockrings

IMPORTANT: It is recommended that the piston and rod assembly be removed from the crankshaft before removing the piston pin to prevent possible bending of the connecting rod.

9. Remove rod bolts and remove piston and rod assembly from crankshaft.
10. While supporting piston, use Piston Pin Tool and soft faced mallet to drive piston pin from piston.



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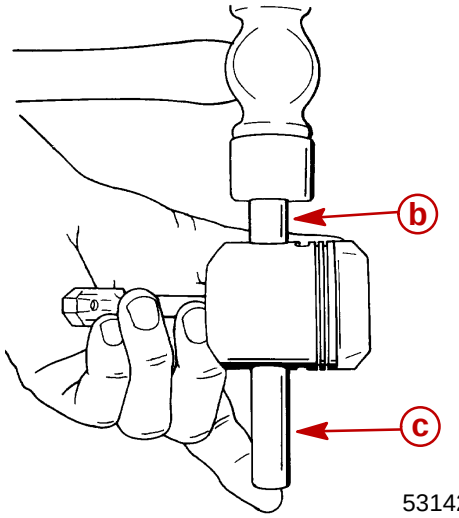
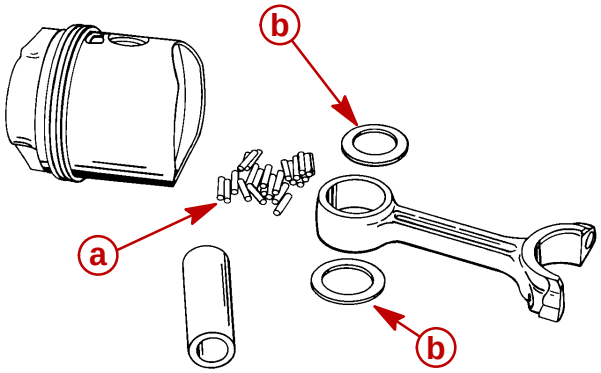


53142

a - Rod bolts
b - Piston Pin Tool (91-13663T 1)
c - Piston pin

IMPORTANT: Piston pin needle bearings and locating washers will fall out when piston is removed from connecting rod.

11. Slide piston pin tool from piston and remove piston, needle bearings and locating washers.
12. Using Piston Ring Expander, remove (and discard) piston rings.



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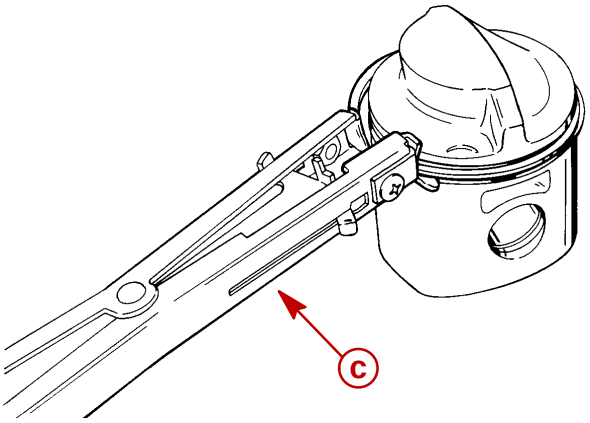
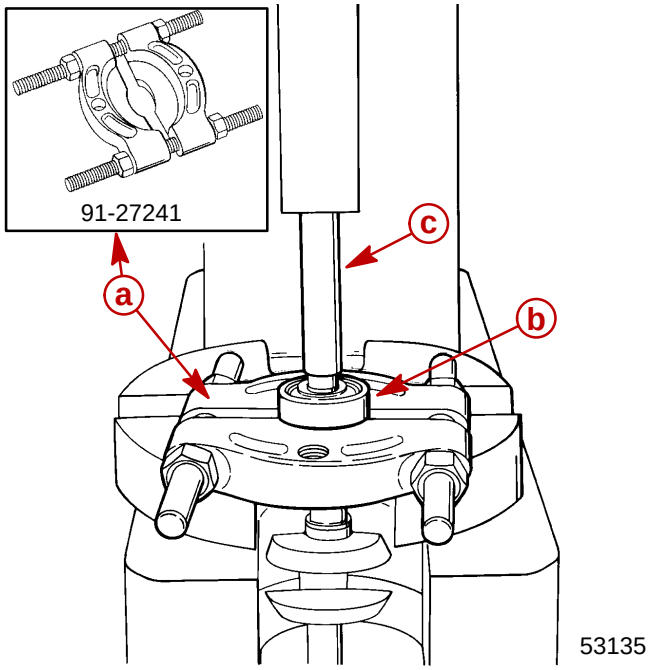


53271

a - Needle bearings
b - Locating washers
c - Ring Expander (91-24697)

IMPORTANT: DO NOT remove ball bearing from crank shaft unless replacement is necessary as removal process will damage bearing. Refer to Cleaning and Inspection following.

13. Remove lower crankshaft ball bearing using Universal Puller Plate, suitable mandrel (to protect crank shaft while pressing) and press.



53135

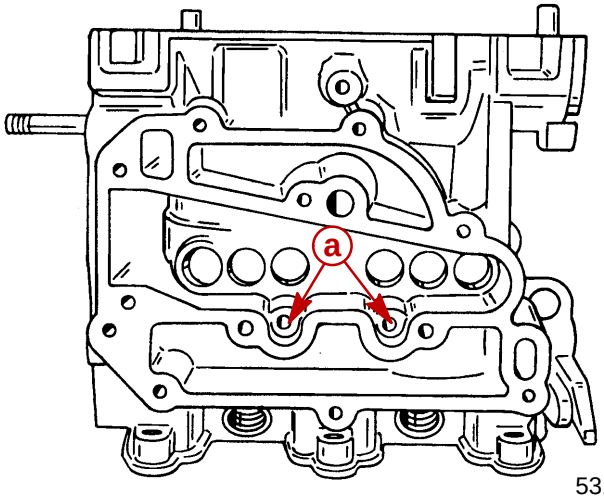
a - Universal Puller Plate (91-27241)
b - Ball bearing
c - Mandrel

Powerhead Cleaning and Inspection

Cylinder Block and Crankcase Cover

IMPORTANT: Crankcase cover and cylinder block are a matched, line-bored assembly and must be replaced as a set.

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



53148

a - Decompression ports

Exhaust Manifold and Exhaust Cover

1. Remove all carbon deposits and gasket material from exhaust manifold and cover.
2. Inspect for grooves, cracks or distortion that could cause leakage. Replace parts as required.

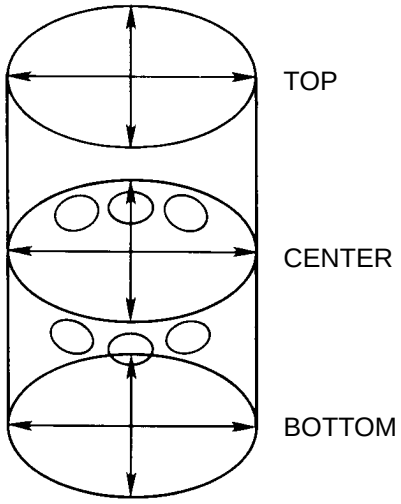
Cylinder Bore

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

MEASURING CYLINDER BORE

1. Inspect cylinder bores for scoring, scuffing or a transfer of aluminum from piston to cylinder wall. Scoring or scuffing, if NOT TOO SEVERE, can normally be removed by honing. If a transfer of aluminum has occurred, an acidic solution such as TIDY BOWL CLEANER should be applied to the areas of the cylinder bore where transfer of aluminum has occurred. After the acidic solution has removed the transferred aluminum, thoroughly flush the cylinder bores to remove any remaining acid. Cylinder walls may now be honed to remove any glaze and to aid in the seating of new piston rings.
2. Measure ring traveled area of cylinder bore at 3 depths, (6 places) by positioning measuring instrument in-line with and at right angle (90°) to piston pin centerline.

3. If cylinder bore is tapered, egg shaped or out-of-round by more than 0.1mm (0.004 in.), replace cylinder block.



STANDARD CYLINDER BORE DIAMETER

1994 MODEL	**6/8/9.9**	**53.98MM (2.125 IN.)**
	10/15	**60.3MM (2.375 IN.)**
1995 - NEWER MODEL	**6/8**	**53.98MM (2.125 IN.)**
	9.9/10/15	**60.3MM (2.375 IN.)**

HONING PROCEDURE

a. When cylinders are to be honed, follow 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 on both stones and work area.

⚠ CAUTION

When honing cylinder block, remove hone frequently and check condition of cylinder walls. 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 bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. A good cleaning is essential. 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, bores should be swabbed several times with engine oil and a clean cloth, then wiped with a clean, dry cloth. Cylinders **should not** be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

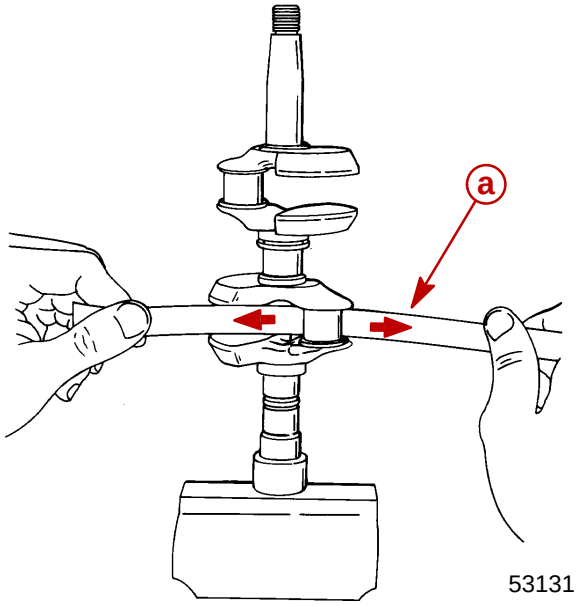
4. Hone all cylinder walls **just enough** to de-glaze walls.

5. Measure cylinder bore diameter (with a snap gauge micrometer) at top, middle and bottom of each cylinder. Check for tapered, out-of-round (egg-shaped) and oversize bore.

IMPORTANT: Ports must be deburred after honing.

Crankshaft

1. Inspect crankshaft to drive shaft splines for wear.
2. Check crankshaft for straightness [runout – 0.076mm (0.003 in.)].
3. Inspect crankshaft oil seal surfaces. Sealing surfaces must not be grooved, pitted or scratched. If top crankshaft sealing surface is severely worn, replace crankshaft. If bottom crankshaft sealing surface is worn, replace crankshaft coupling seal.
4. Check all crankshaft bearing surfaces for rust, water marks, chatter marks, uneven wear and/or overheating (blued).
5. If necessary, clean up crankshaft bearing surfaces with crocus cloth.

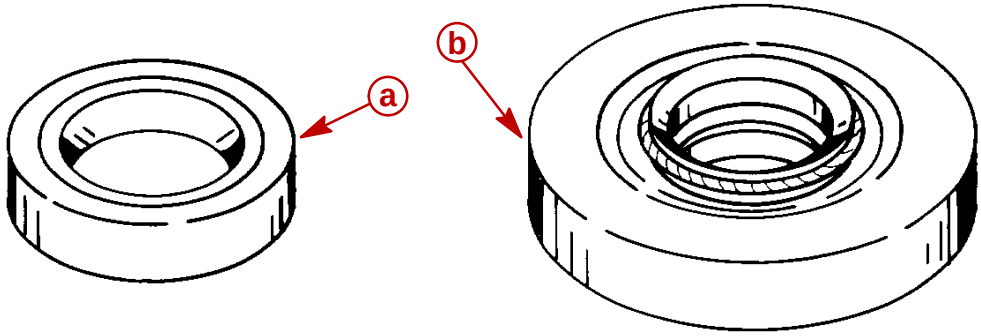


a - Crocus Cloth

6. Thoroughly clean crankshaft with solvent and dry with compressed air.
7. Recheck surfaces of crankshaft and replace crankshaft if surfaces can not be properly cleaned up.
8. If crankshaft will be reused, apply light oil to prevent rust.

Seals

It is recommended that all seals be replaced as a standard rebuilding procedure.



53200

a - Top crankshaft seal
b - Bottom crankshaft seal

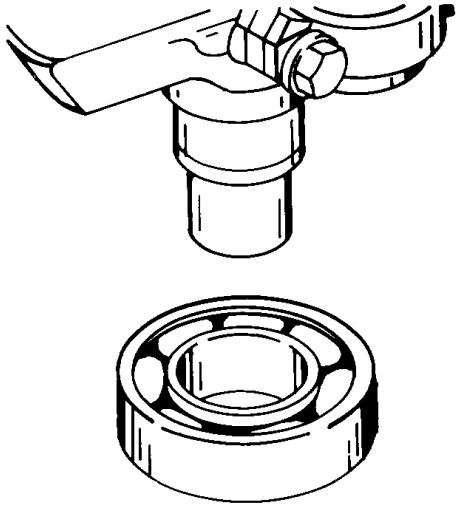
Bearings

BALL BEARINGS

⚠ WARNING

DO NOT spin-dry crankshaft ball bearings with compressed air.

1. Clean ball bearings with solvent and dry with compressed air.
2. Work inner bearing race in and out. There should not be excessive play.
3. Rotate bearing race. Bearing should have smooth action and no rust stains. If ball bearing sounds or feels rough or has catches, remove and discard bearing. Apply light oil to bearing after inspection to prevent rust.

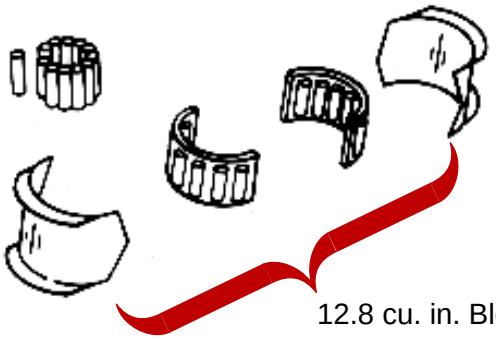


53200

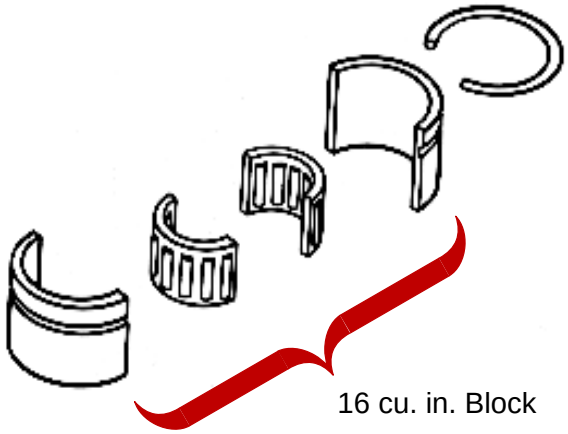
ROLLER BEARINGS

1. Clean roller bearing with solvent and dry with compressed air.
2. Inspect roller bearing for rust, fracturing, wear, galling or overheating (blued). Always replace bearings as a set if replacement is necessary.

3. Apply light oil to bearings after inspection to prevent rust.



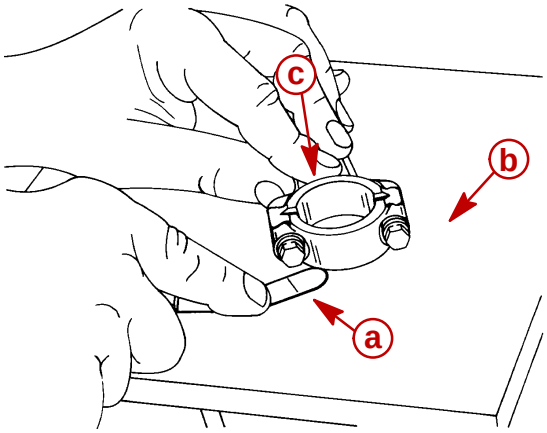
12.8 cu. in. Block



16 cu. in. Block

Connecting Rod

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 0.051mm (0.002 in.) feeler gauge can be inserted between any machined surface and surface plate, rod is bent and must be discarded.

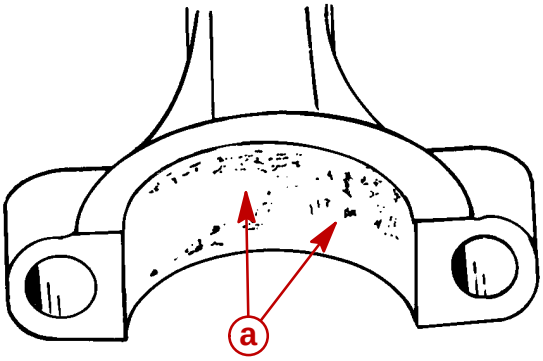


53205

a - Feeler gauge
b - Surface plate
c - Even downward pressure

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 pits to form on surfaces.

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



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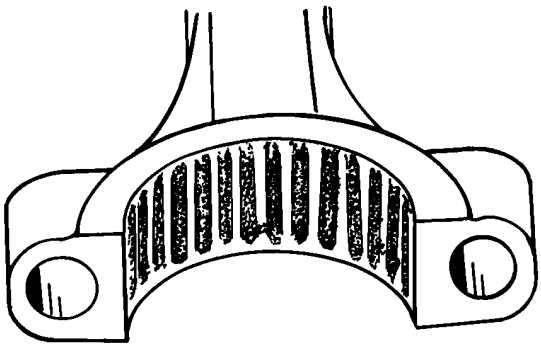
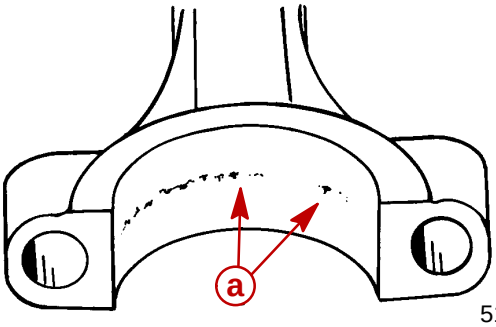


51853

a - Pitting

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.

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 surfaces 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 rods.



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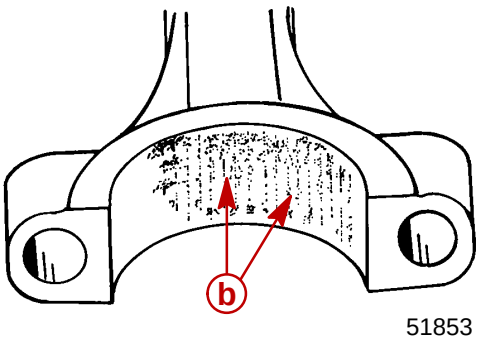

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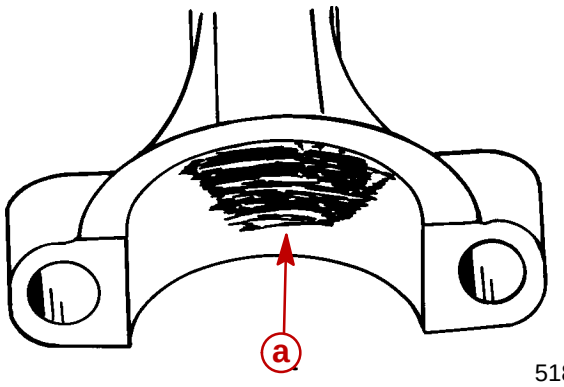
a - Spalling
b - Chatter marks between arrows

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



a - Uneven wear between arrows

8. If necessary, clean connecting rod bearing surfaces as follows

   a. Be sure that etched marks on connecting rod (crankshaft end) are perfectly aligned with etched marks on connecting rod cap. Tighten connecting rod cap attaching screws securely.

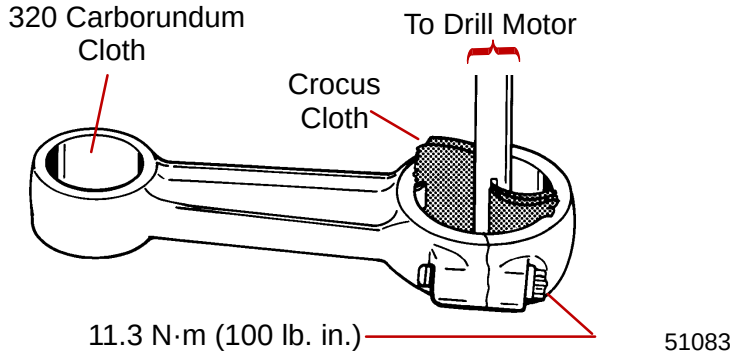
⚠ CAUTION

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.

   b. Clean crankshaft end of connecting rod by using CROCUS CLOTH placed in a slotted 9.5 mm (3/8 in.) diameter shaft as shown. Secure shaft in a drill press. Operate press at a high speed while keeping connecting rod at a 90° angle to slotted shaft.

IMPORTANT: Clean connecting rod just enough to clean up bearing surface. DO NOT continue to clean after marks are removed from bearing surface.



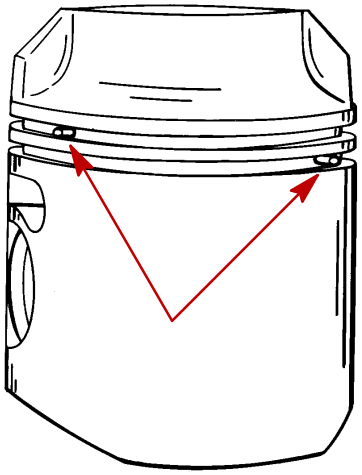
   c. Clean Piston pin end of connecting rod using the same method as in step “b” preceding, but using 320 carborundum cloth instead of crocus cloth.

   d. Thoroughly wash connecting rod to remove abrasive grit. Recheck bearing surface of connecting rod. Replace any connecting rod that cannot be properly cleaned up. Lubricate bearing surfaces of connecting rod with a light oil to prevent rust from forming.

Pistons

IMPORTANT: If engine was submerged while engine was running, piston and/or connecting rod may be bent. If piston pin is bent, piston must be replaced. If piston pin is bent, connecting rod must be checked for straightness.

1. Inspect pistons for scoring and excessive piston skirt wear.
2. Check tightness of piston ring locating pins. Locating pins must be tight.



3. Thoroughly clean pistons. Carefully remove carbon deposits from pistons, with a soft wire brush or carbon removal solution. Do not burr or round off machined edges of ring groves.

Inspect piston ring grooves for wear and carbon accumulation. If necessary, scrape carbon from piston ring grooves. Refer to procedure following for cleaning piston ring grooves.

CLEANING PISTON RING GROOVES

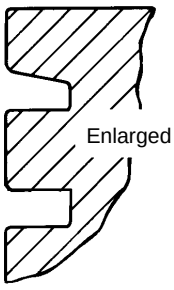
Keystone (tapered) ring grooves

⚠ CAUTION

Care must be taken not to scratch the side surfaces of the ring groove. Scratching the side surface of the ring groove will damage the ring groove.

1. Use a bristle brush and carbon removal solution to remove carbon from side surfaces.
2. A tool can be made for cleaning the inner diameter of the tapered ring grooves. For the top ring groove, break a tapered piston ring. This will enable the inside edge of the ring to reach the inner diameter of the groove. For the bottom ring groove, break a rectangular ring. Carefully scrape carbon from inner diameter of ring grooves. Care must be taken not to damage the grooves by scratching the side surfaces of the grooves.

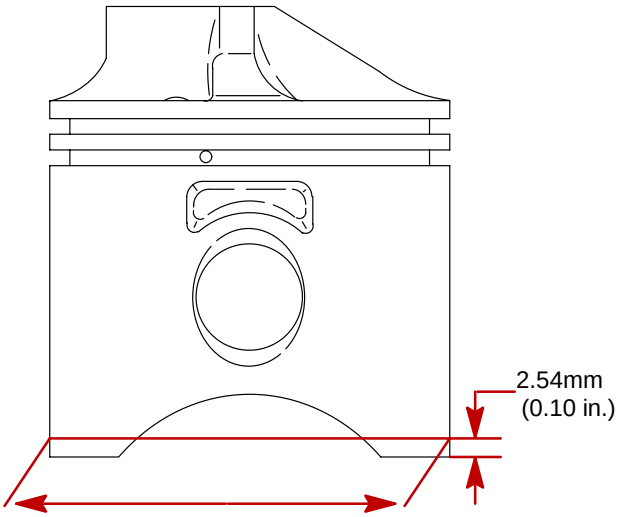
Piston with one (1) half keystone (half tapered) and one (1) rectangular ring.



Enlarged View of Piston Ring Grooves

MEASURING PISTON

1. Measure piston skirt at right angle (90°) to piston pin centerline.



56958

Standard Piston Diameter	
1994 – 6/8/9.9 **1994 – 10/15**	53.92mm (2.123 in.) 60.27mm (2.373 in.)
1995 and newer – 6/8 **9.9/10/15**	53.92mm (2.123 in,.) 60.27mm (2.373 in.)

PISTON CLEARANCE

MINIMUM BORE MEASUREMENT
– MAXIMUM PISTON MEASUREMENT
= PISTON CLEARANCE

PISTON CLEARANCE
0.05MM – 0.13MM (0.002 IN. – 0.005 IN.)

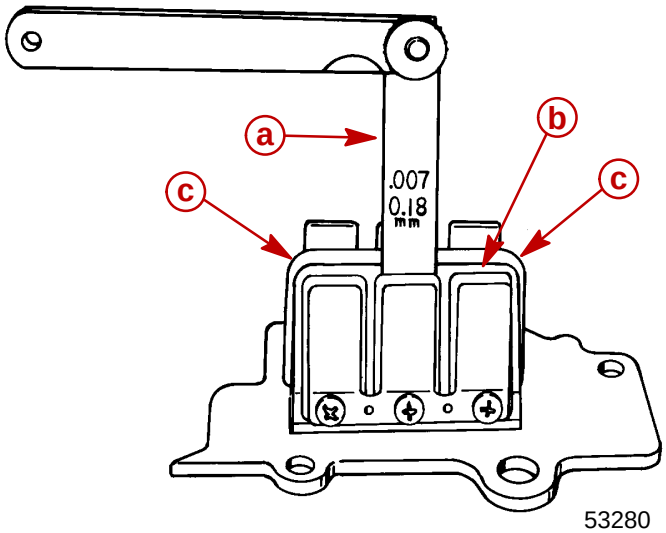
Reed Block

IMPORTANT: DO NOT remove reeds from reed block unless replacement is necessary. DO NOT turn used reeds over for reuse. Replace reeds in sets only.

1. Thoroughly clean reeds and reed block.
2. Check for wear (indentations), cracks or grooves on sealing surfaces of reed block that could cause leakage.
3. Check for chipped or broken reeds.
4. Inspect reed block seal for swelling or looseness. Replace seal if necessary.
5. Replace reeds as necessary.
6. After installing new reeds [having torqued screws to 2.3 Nm (20 lb. in.)], check new reeds as outlined in **Reed Opening** and **Reed Stop Opening** following.

REED OPENING

1. Check reeds for preload and stand open conditions. Stand open should not exceed 0.178mm (0.007 in.). Replace reeds if necessary.

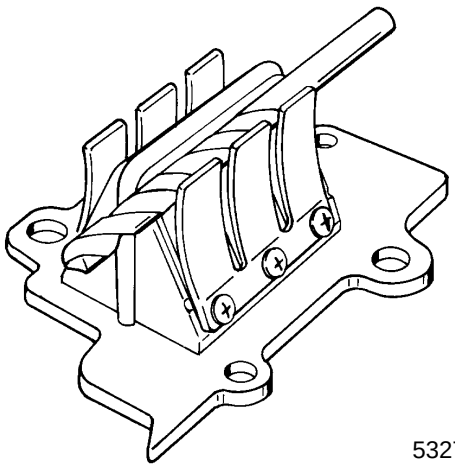


53280

a - Feeler gauge
b - Reed
c - Seal

REED STOP OPENING

Reed stop opening can be checked by placing the appropriate sized drill bit between reeds and reed stops. Carefully bend reed stops if adjustment is necessary.

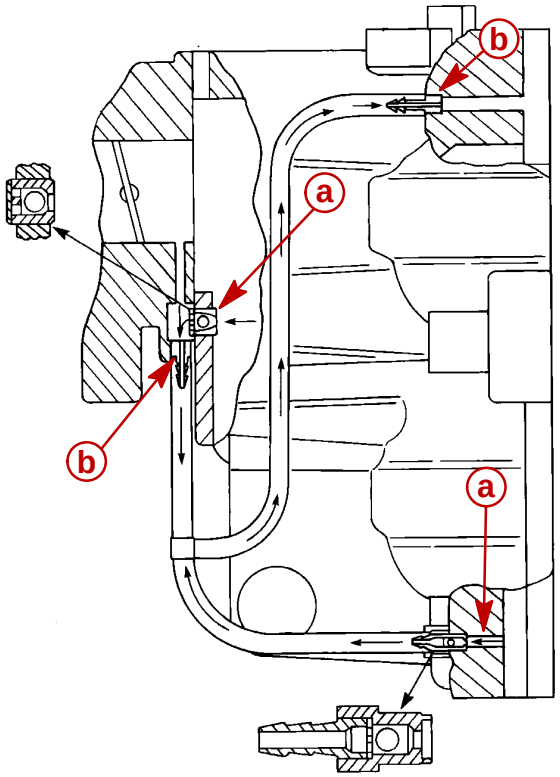


53278

ALL MODELS	7.6mm (19/64 in.)

Bleed System

1. Inspect bleed hoses for deterioration. Replace hoses as required.
2. Inspect bleed check valve in lower crankcase cover for proper function. Valve should flow fuel only one way – from bottom of crankcase cover to top crankshaft bearing via bleed fitting at top of crankcase cover. If check ball in valve is stuck open or closed, replace check valve. Bleed fitting at base of carburetor drains excess fuel which puddles at base of reed block.

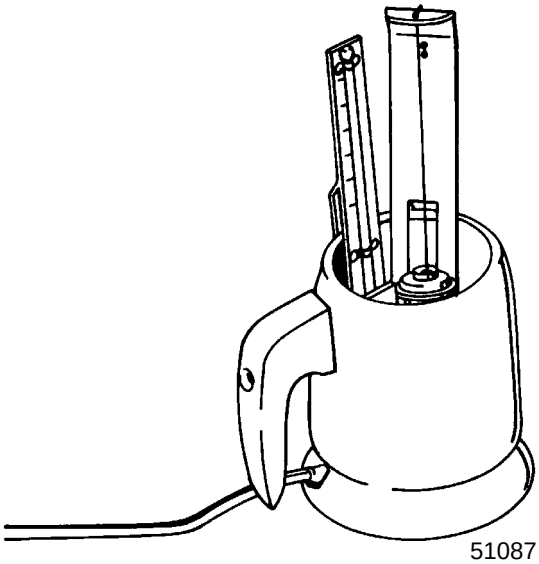


a - Check valve
b - Bleed fitting

Thermostat (If Equipped)

6/8/Work 10 (1999 And Prior)	No Thermostat
6/8/Work 10 (2000 And Newer)	120° Thermostat
9.9/10/15	120° Thermostat

1. Wash thermostat with clean water. Using a thermostat tester, similar to the one shown, test thermostat as follows:
2. Open thermostat valve, then insert a thread between valve and thermostat body. Allow valve to close against thread.
3. Suspend thermostat (from thread) and thermometer inside tester so that neither touches the container. Bottom of thermometer must be even with bottom of thermostat to obtain correct thermostat opening.
4. Fill thermostat tester with water to cover thermostat.
5. Plug tester into electrical outlet.
6. Observe temperature at which thermostat begins to open. Thermostat will drop off thread when it starts to open. Thermostat must begin to open when temperature reaches 3° C (5° F) above designated stamping on bottom of thermostat.
7. Continue to heat water until thermostat is completely open.
8. Unplug tester unit.
9. Replace thermostat, if it fails to open at the specified temperature, or if it does not fully open.



51087

Powerhead Reassembly

General Information

Before proceeding with powerhead reassembly, be sure that all parts to be reused have been carefully cleaned and thoroughly inspected, as outlined in **Cleaning and Inspection**. Parts, which have not been properly cleaned (or which are questionable), can severely damage an otherwise perfectly good powerhead within a few minutes of operation. All new powerhead gaskets must be installed during assembly.

During reassembly, lubricate parts with 2-Cycle Outboard Oil whenever 2-cycle oil is specified, and 2-4-C with Teflon whenever grease is specified.

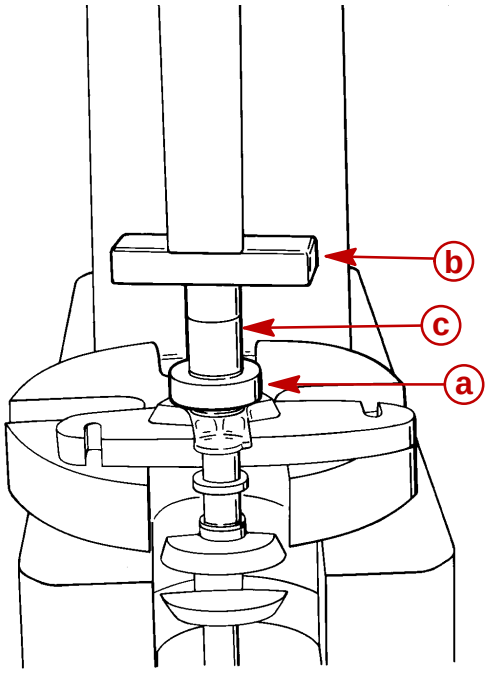
⚠ CAUTION

Any *GREASE* used for bearings *INSIDE* the powerhead MUST BE gasoline soluble. Use only Needle Bearing Assembly Lubricant or 2-4-C with Teflon.

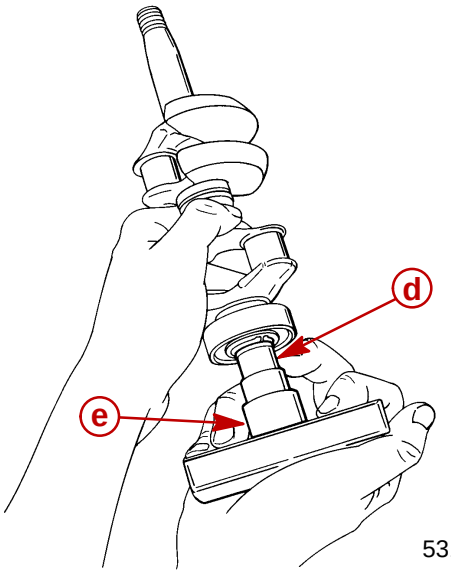
IMPORTANT: A torque wrench is essential for correct reassembly of powerhead. DO NOT attempt to reassemble powerhead without using a torque wrench.

Crankshaft

1. Support crankshaft in press and install lower crankshaft ball bearing (open side of ball retainer facing crank) using powerhead stand with bearing sleeve. Bearing inner race must be firmly seated against crank shoulder.
2. Lubricate O-ring of new coupling seal with 2-4-C with Teflon. Install seal using powerhead stand.



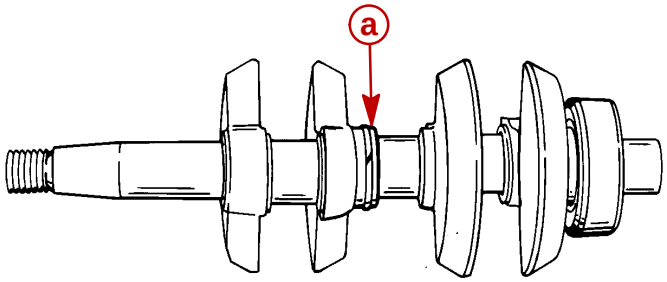
53134



53150

a - Bearing
b - Powerhead Stand (91-13662A1)
c - Sleeve
d - Seal
e - Powerhead Stand

3. Install a new sealing ring.



53130

a - Sealing Ring

NOTE: *It is recommended that the piston pin and piston be installed on the connecting rod prior to installing the connecting rod on the crankshaft to avoid possible bending of the rod during piston pin installation.*

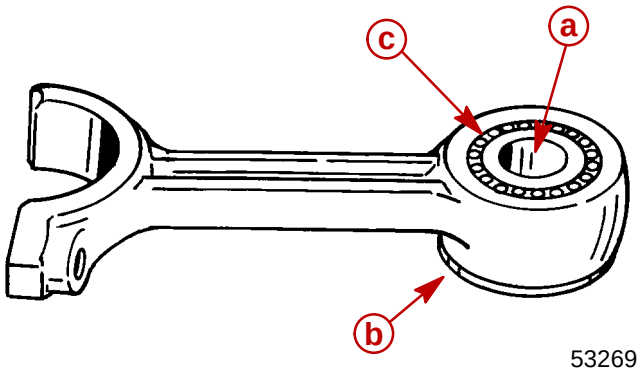
4. Install piston onto connecting rod as follows:

IMPORTANT: When replacing needle bearings, replace all needles as a set. DO NOT use old and new needles together.

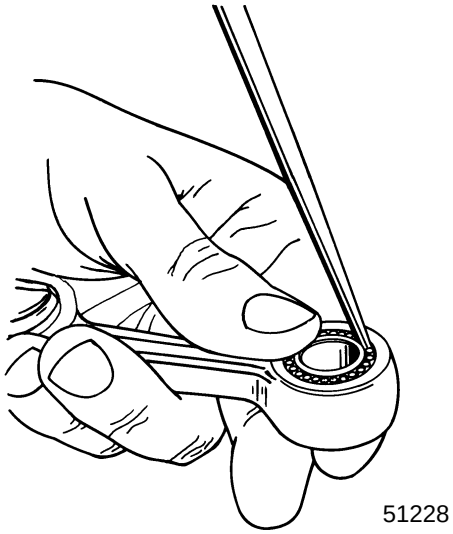
a. Lubricate sleeve of Piston Pin Tool with Needle Bearing Assembly Lubricant or 2-4-C with Teflon.

b. Hold lower locating washer and sleeve onto piston pin bore of connecting rod and install needle bearing set of 24.

NOTE: *If the tip of an awl can be inserted between the needle bearings, one or more needle is missing and must be replaced.*



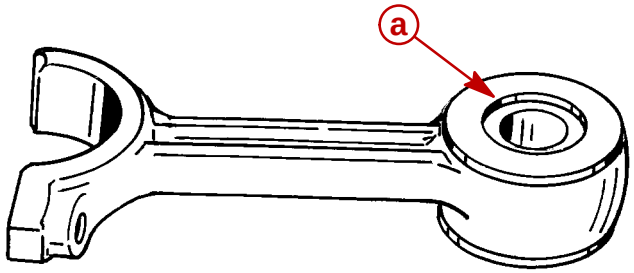
53269



51228

a - Sleeve
b - Locating washer
c - Needle bearings (24)

c. Install upper locating washer.



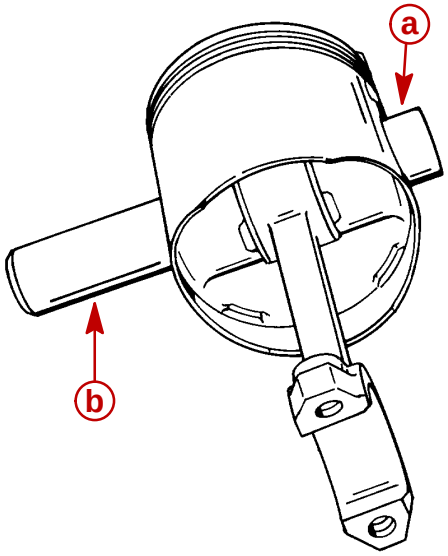
53267

a - Locating washer

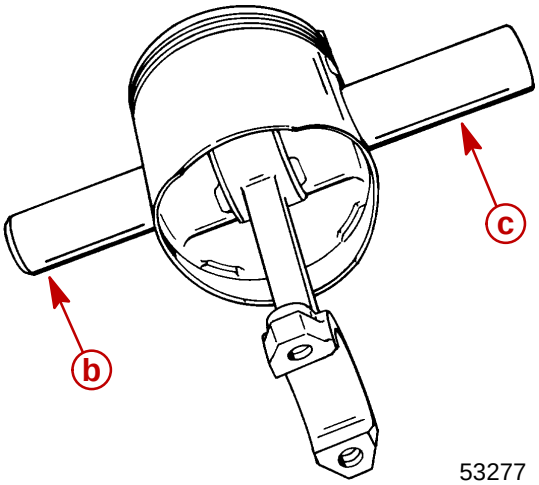
d. Slide piston onto connecting rod, centering piston pin bore over sleeve.

e. Slide piston tool up through piston pin bore and remove sleeve.

f. Apply light oil to piston pin and place piston pin onto tool.



53275



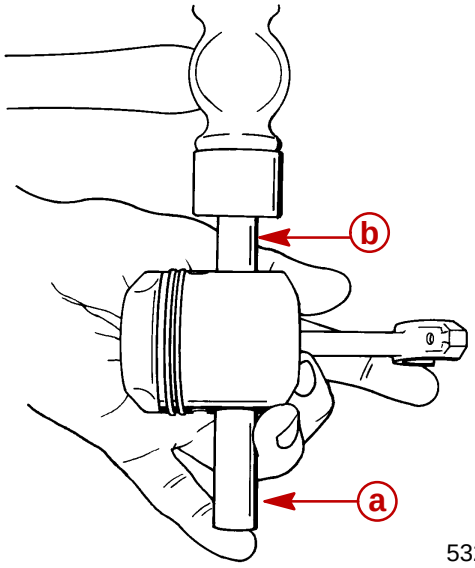
53277

a - Sleeve
b - Piston Pin Tool (91-13663A1)
c - Piston pin

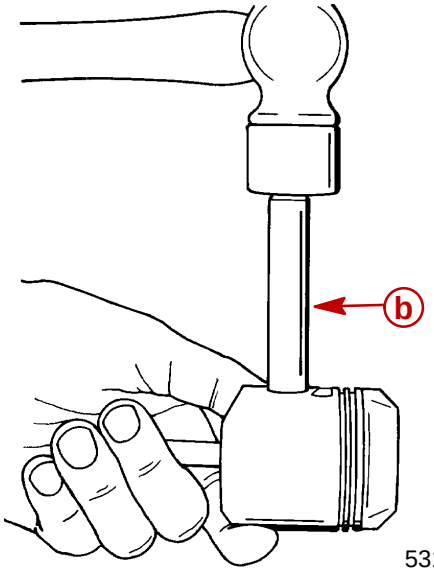
g. Support bottom of piston and hold piston pin tool up against piston pin.

h. Drive piston pin into piston pin bore (with a soft face mallet) until pin is flush with piston.

i. Move piston pin tool to top of piston pin bore and center piston pin in piston.



53276



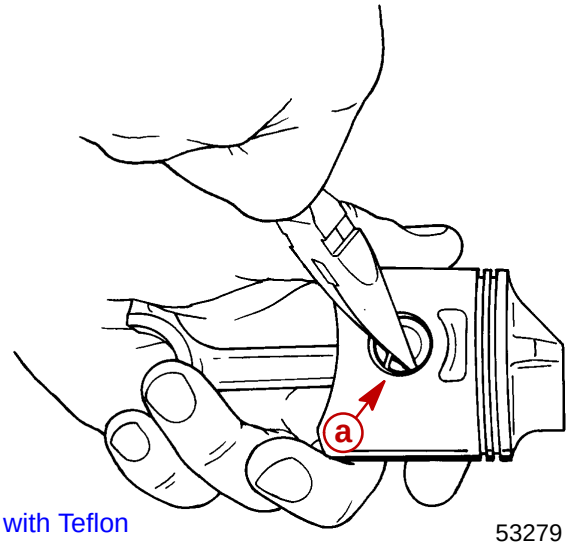
53143

a - Piston Pin Tool (91-13663A1)
b - Piston pin

5. Install new lockrings into grooves in both ends of piston pin bore.
6. Install connecting rods onto crankshaft as follows:
   a. Apply 2-4-C with Teflon to connecting rod big-end bearings.

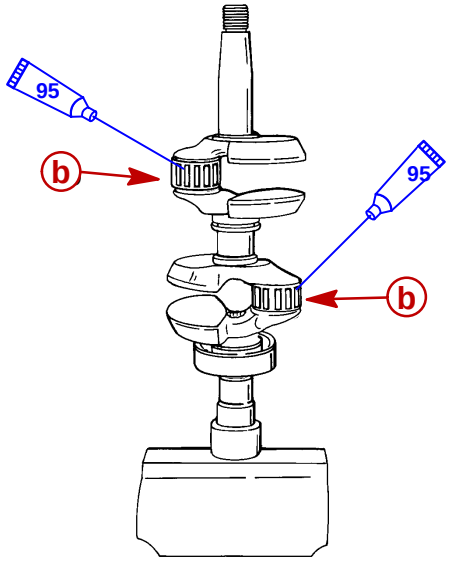
IMPORTANT: Replace roller bearing halves as a set. DO NOT use old and new halves together.

   b. Place both halves of connecting rod big-end roller bearing onto crank pin.



53279

95 2-4-C with Teflon

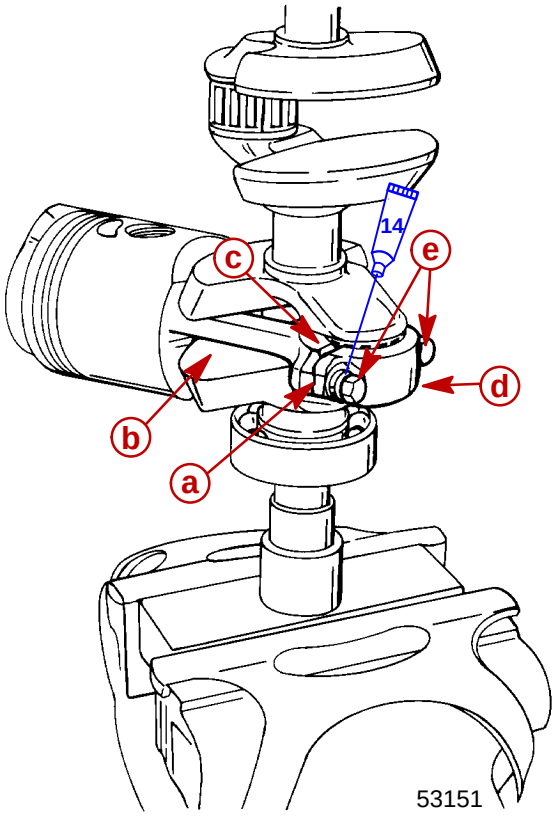


53132

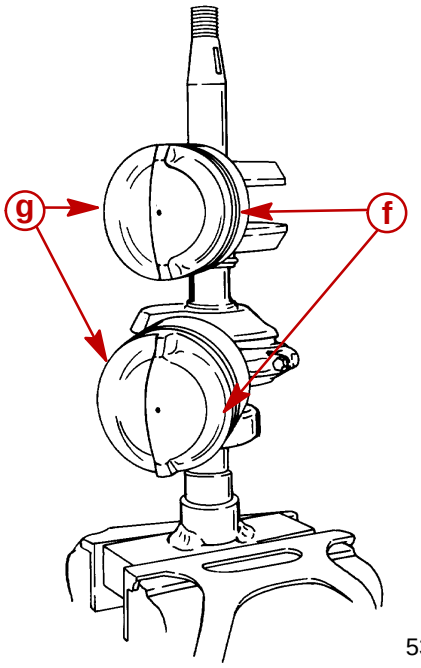
a - Lockring
b - Roller bearing

IMPORTANT: Clean connecting rod bolts with solvent and dry with compressed air. Inspect threads for damage. If threads are not damaged, bolts may be reused. Apply light oil to threads prior to installation.

c. Observe connecting rod/cap fracture line for correct alignment. Secure connecting rod (with v-notch of rod toward flywheel end of crankshaft) onto crankshaft with rod cap and bolts. Torque bolts to 11.3 Nm (100 lb. in.).



53151

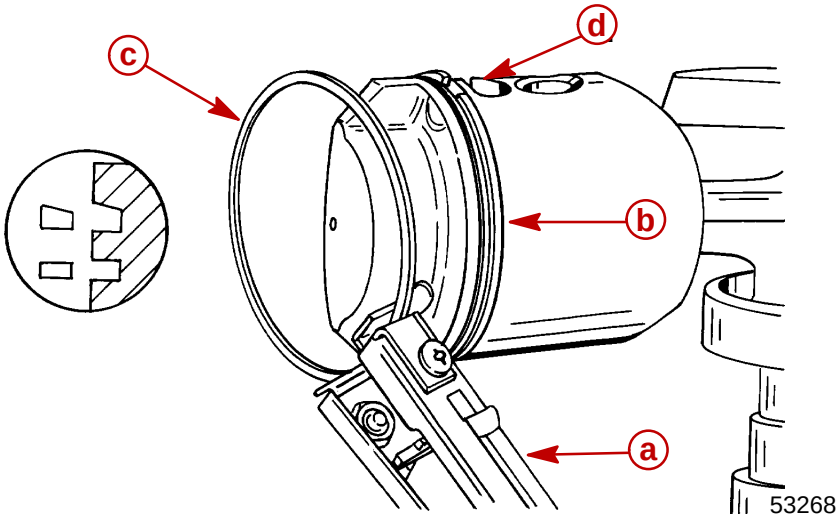


53138

14 2 Cycle Premium Outboard Oil

a - Fracture line
b - Connecting rod
c - V-notch (Ttoward flywheel)
d - Rod cap
e - Bolts [Torque to 11.3 Nm (100 lb. in.)]
f - Intake side
g - Exhaust side

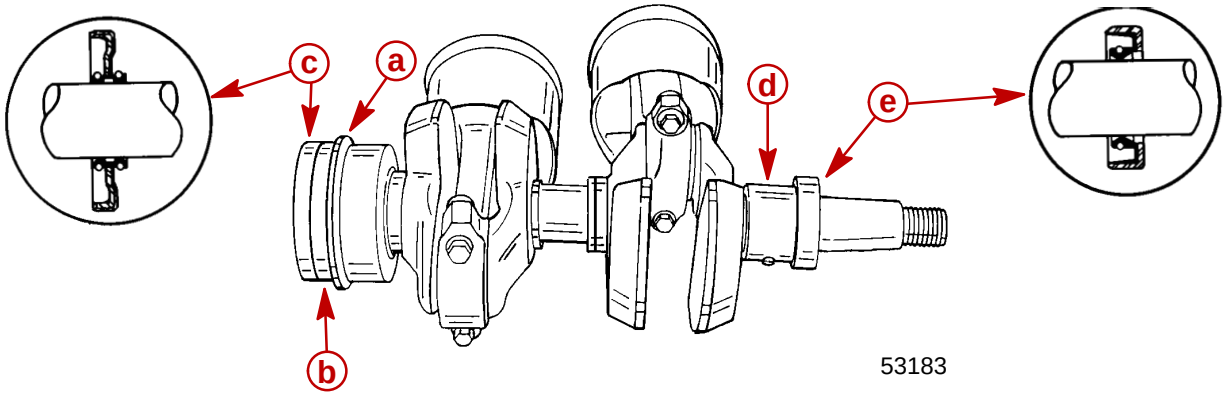
7. Install new piston rings using Piston Ring Expander. Install RECTANGULAR ring first in bottom ring groove. Install HALF-KEYSTONE ring in top ring groove. Align piston rings with ring locating pins.



a - Piston Ring Expander (91-24697)
b - Rectangular ring
c - Half-keystone ring
d - Locating pin

IMPORTANT: Chamfered side of retaining ring faces away from lower crankshaft ball bearing.

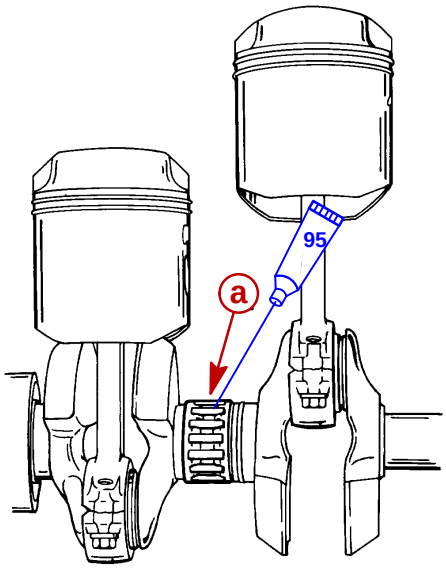
8. Install retaining ring, stuffer washer and lower crankshaft oil seal.
9. Install upper crankshaft roller bearing and oil seal.



a - Retaining ring
b - Stuffer washer
c - Lower oil seal
d - Roller bearing
e - Upper oil seal

IMPORTANT: When replacing roller bearing halves, replace both halves together.

10. Apply 2-4-C with Teflon to center main bearing surface of crankshaft and install center main roller bearing halves.



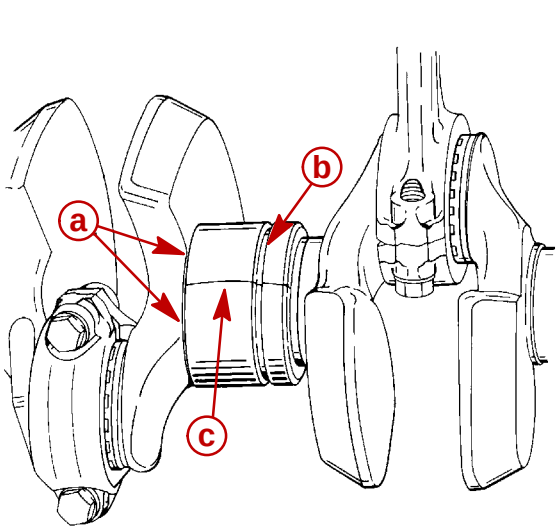
53133

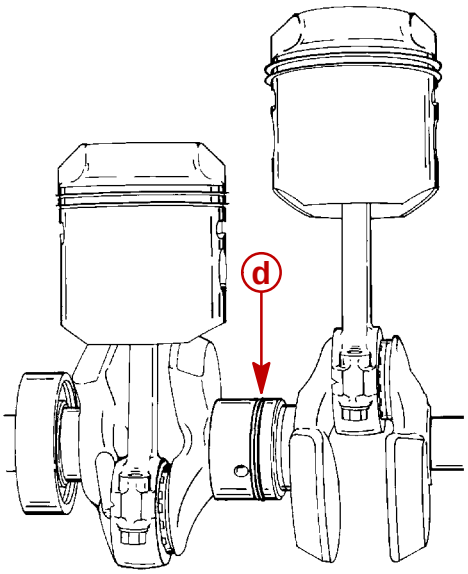
95 2-4-C with Teflon

a - Bearing halves

11. **Model 10 and 1995 and newer Model 9.9:** Position center main bearing race halves (retaining ring groove toward flywheel end of crankshaft) around center main roller bearing. Make sure fracture lines of race halves are correctly mated.

12. Secure center main bearing race halves together with retaining ring. Verify retaining ring bridges both fracture lines of bearing race.





53127

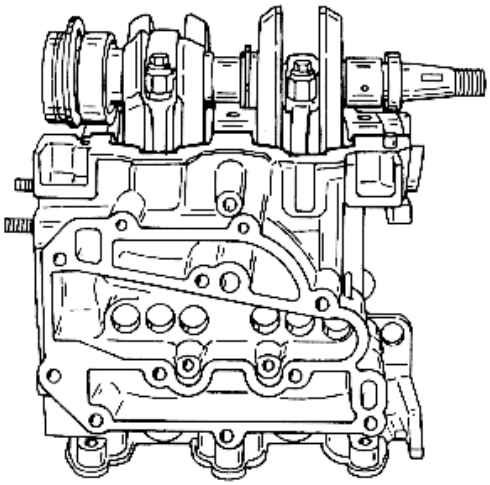
a - Bearing race halves
b - Retaining ring groove
c - Fracture lines
d - Retaining ring

Cylinder Block

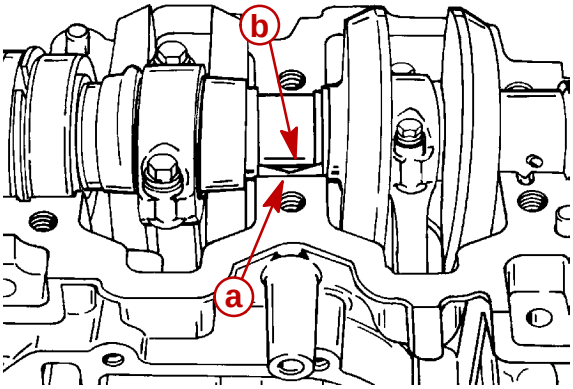
1. Lubricate piston rings, piston and cylinder wall with light oil.

IMPORTANT: DO NOT seat crankshaft fully into block until center main sleeve and bearing half are installed.

2. Keeping crankshaft horizontal, guide pistons into cylinder bores.



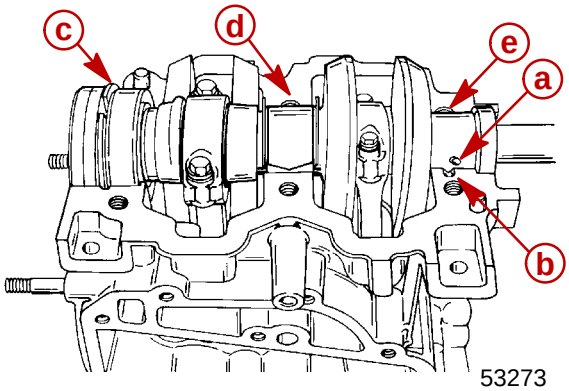
3. **1994 Model 9.9 and all Model 6/8:** Install 1/2 of center main bearing sleeve and bearing into cylinder block.



53272

a - Bearing sleeve
b - Bearing

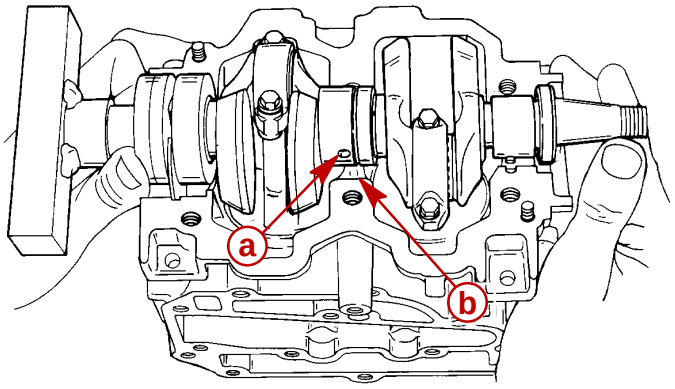
4. **1994 Model 6/8/9.9 and 1995 Model 6/8:** Install 2nd half of center main sleeve and bearing.



53273

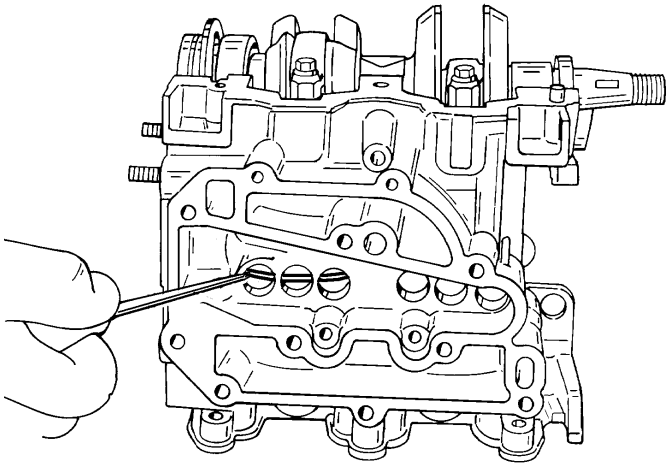
a - Alignment boss
b - Notch
c - Retaining ring
d - Sleeve
e - Bearing

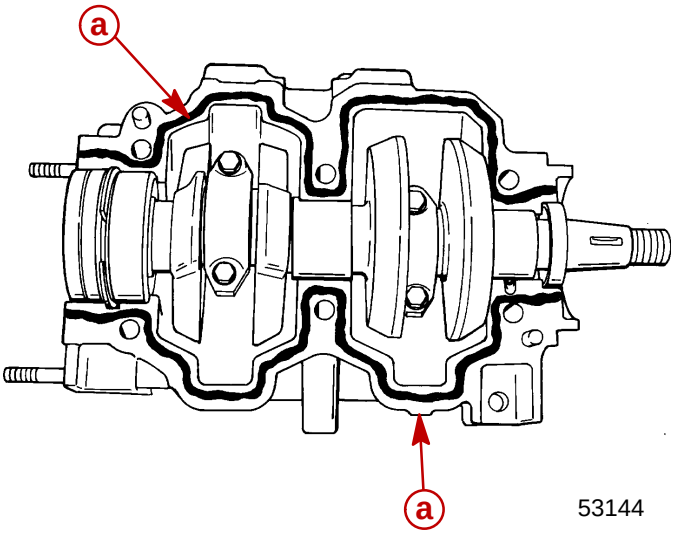
5. **Model 10/15 and 1995 and newer Model 9.9:** Align hole in center main bearing race with pin of cylinder block.



a - Hole
b - Pin (hidden)

6. Position alignment boss of upper crankshaft roller bearing into notch in cylinder block.
7. Firmly press retaining ring (bevel faces DOWN) into groove in cylinder block and gently seat crankshaft assembly into position.
8. Gently push seals inward to seat.
9. Check each piston ring for spring tension through transfer and exhaust ports by pressing with a screwdriver. If no spring tension exists (ring fails to return to position), it is likely that the piston ring was broken during assembly [replace broken piston rings]. Use caution not to burr piston rings while inspecting.
10. Clean crankcase sealing surfaces according to Loctite Master Gasket instructions. Apply a continuous bead of Loctite sealant along the inside of the mounting bolt holes of crankcase cover.


53124

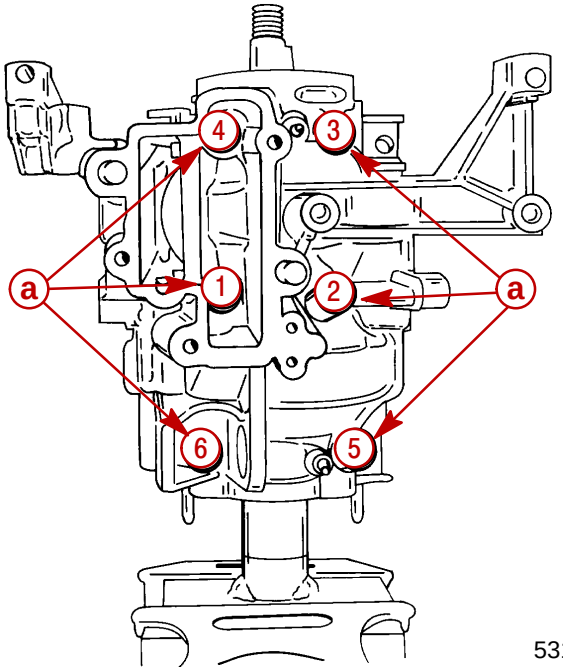


53144

a - Sealant

IMPORTANT: For 1994 Model 9.9 and all Models 6/8, split line of center main bearing sleeve halves MUST ALIGN when crankcase cover is installed onto cylinder block.

11. Place crankcase cover onto cylinder block and secure with 6 bolts. Torque bolts to 22.7 Nm (16.7 lb. ft.) in numbered torque sequence.



53192

a - Bolts [Torque to 22.7 Nm (16.7 lb. ft.)]

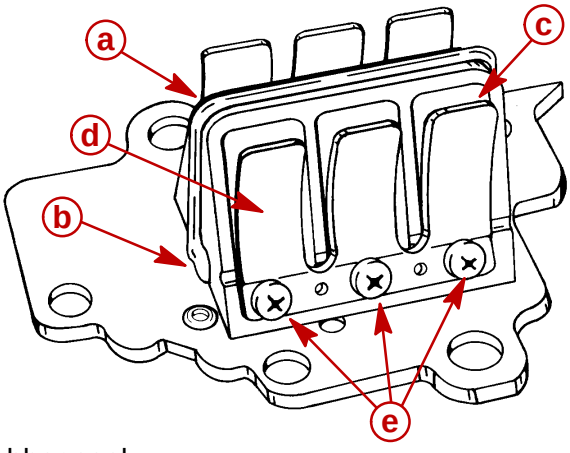
12. Rotate crankshaft several times to assure free operation.

13. If disassembled, assemble reed block as follows:

    a. Pull ends of rubber seal into holes in intake manifold/reed block. Trim off installation tabs from rubber seal and apply RTV Silicone Sealer at each location where seal passes through manifold.

NOTE: *1997 and newer reed blocks are rubber coated and do not require sealant.*

    b. Secure reeds and reed stops to intake manifold/reed block with 6 screws. Torque screws to 2.3 Nm (20 lb. in.).

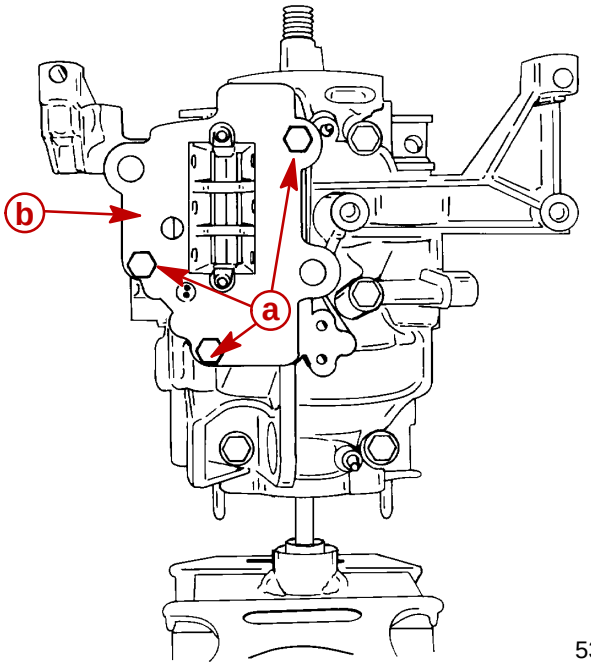


53202

a - Rubber seal
b - Apply sealant (each side)
c - Reeds
d - Reed stops
e - Screws [Torque to 2.3 Nm (20 lb. in.)]

14. **1996 Models and prior:** Apply 2-4-C with Teflon to rubber seal (to prevent seal from moving out of position) and secure intake manifold/reed block (with new gasket) using 3 bolts.

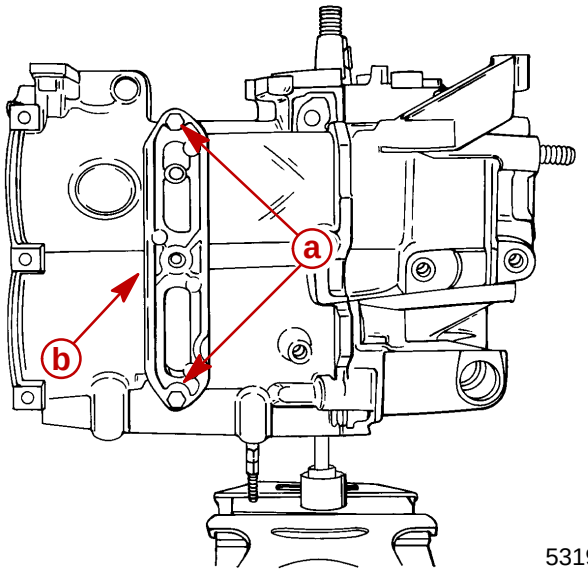
ALL Models: Torque bolts to 6.8 Nm (60 lb. in.).



53191

a - Bolts [Torque to 6.8 Nm (60 lb in.)]
b - Intake manifold/reed block

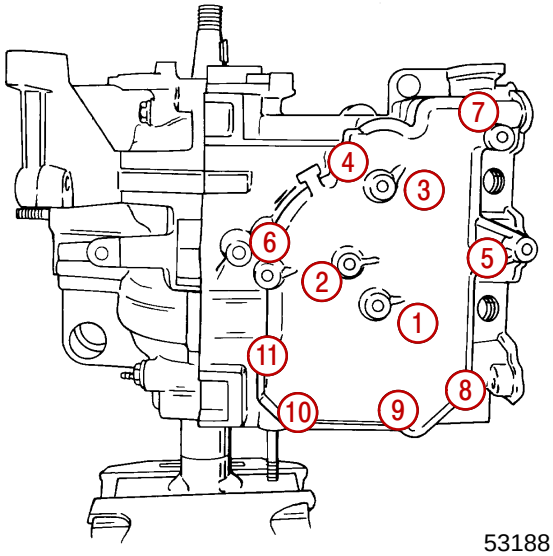
15. **1994 Models:** Secure intake cover (with new gasket) using 2 bolts.
1995 Models and newer: Inspect O-rings on intake cover for cuts or abrasions. Replace if necessary. Secure cover with 2 bolts. Torque bolts to 6.8 Nm (60 lb. in.).



53198

a - Bolts [Torque to 6.8 Nm (60 lb. in.)]
b - Intake cover

16. Secure exhaust manifold and cover (with new gaskets) using 11 bolts. Torque bolts to 6.8 Nm (60 lb. in.) in torque sequence listed.
17. Secure cylinder block cover to block with 6 bolts. Torque bolts to 6.8 Nm (60 lb. in.) in sequence shown. Install thermostat, if equipped.



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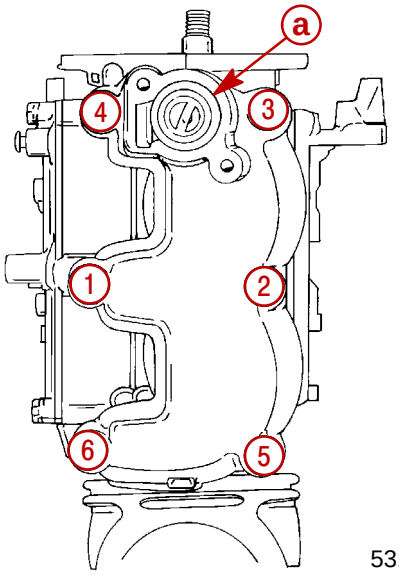
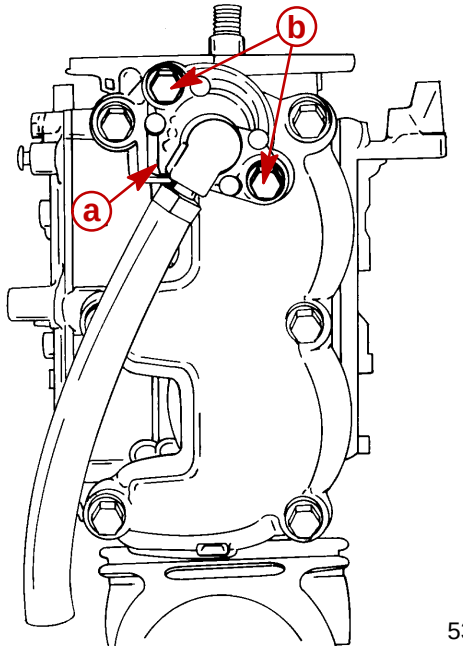


53193

a - Thermostat

18. Install thermostat cover. Torque bolts to 6.8 Nm (60 lb. in.).



53194

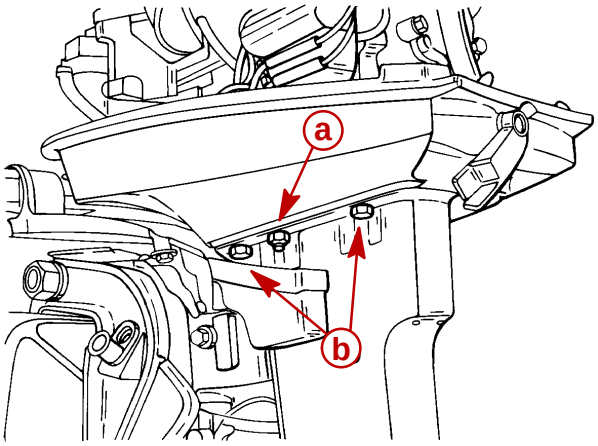
a - Cover
b - Bolts [Torque to 6.8 Nm (60 lb. in.)]

19. Install the following components/assemblies referring to the listed service manual sections.

Component/Assembly	Section
Carburetor	3
Throttle/Shift Mechanism	7A/B/C
Electrical/Ignition Components and Flywheel	2A/B
Rewind Starter	8

Powerhead Installation

1. Verify powerhead base surface and driveshaft housing mating surfaces are free of old gasket material.
2. Secure powerhead (with new gasket) onto driveshaft housing using 4 bolts and 2 nuts. Apply Loctite 680 Retaining Compound to threads of bolts. Torque bolts and nuts to 11.3 Nm (100 lb. in.).
3. Attach tell-tale hose to thermostat cover and fitting on bottom cowl.



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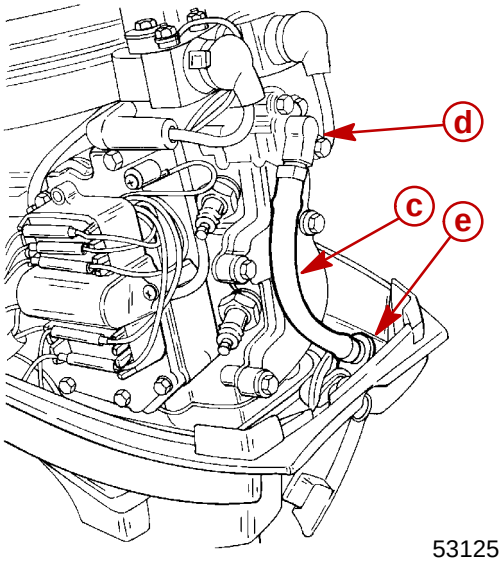
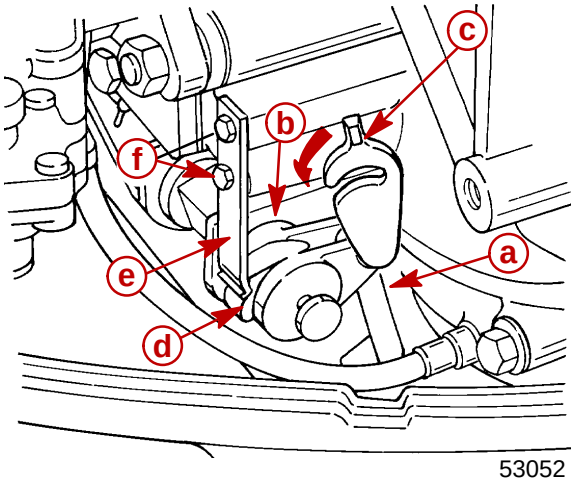


53125

a - Bolts (2 each side) [Torque to 11.3 Nm (100 lb. in.)]
b - Nuts (1 each side) [Torque to 11.3 Nm (100 lb. in.)]
c - Tell-tale hose
d - Thermostat cover
e - Cowl fitting

4. Secure end of shift shaft to yoke of horizontal shift shaft with lever.



53052

a - Shift shaft
b - Yoke
c - Lever
d - Apply 2-4-C with Teflon
e - Detent spring
f - Bolts [Torque to 2.8 Nm (25 lb. in.)]

Set-Up and Test-Run Procedures

⚠ CAUTION

When engine is started, IMMEDIATELY check for fuel leaks and water leaks. Check for water pump operation by water being discharged from tell-tale.

1. Following powerhead repairs, refer to Section 2C Timing/Synchronizing/Adjusting to perform set-up procedures.
2. While test running engine, check powerhead assembly for leaks and/or unusual noises. Make any repairs BEFORE returning engine to service.

Break-In Procedure

⚠ CAUTION

To avoid possible engine damage, break-in procedure MUST BE completed BEFORE operating engine continuously at full throttle. Failure to break-in engine in properly will result in engine failure or shortened powerhead life.

IMPORTANT: Advise the owner that the break-in procedure must be followed EXACTLY when returning an overhauled engine to service.

1. Mix gasoline and oil at the normal 50:1 ratio.
2. Operate engine 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 engine is ready for normal operation and may be run at any speed. DO NOT EXCEED the full throttle RPM range listed in **Specifications**, preceding.

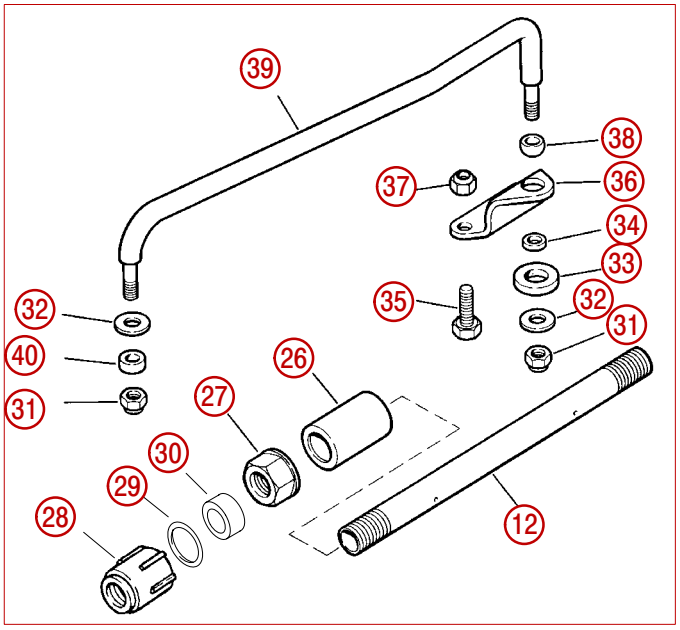
MID-SECTION

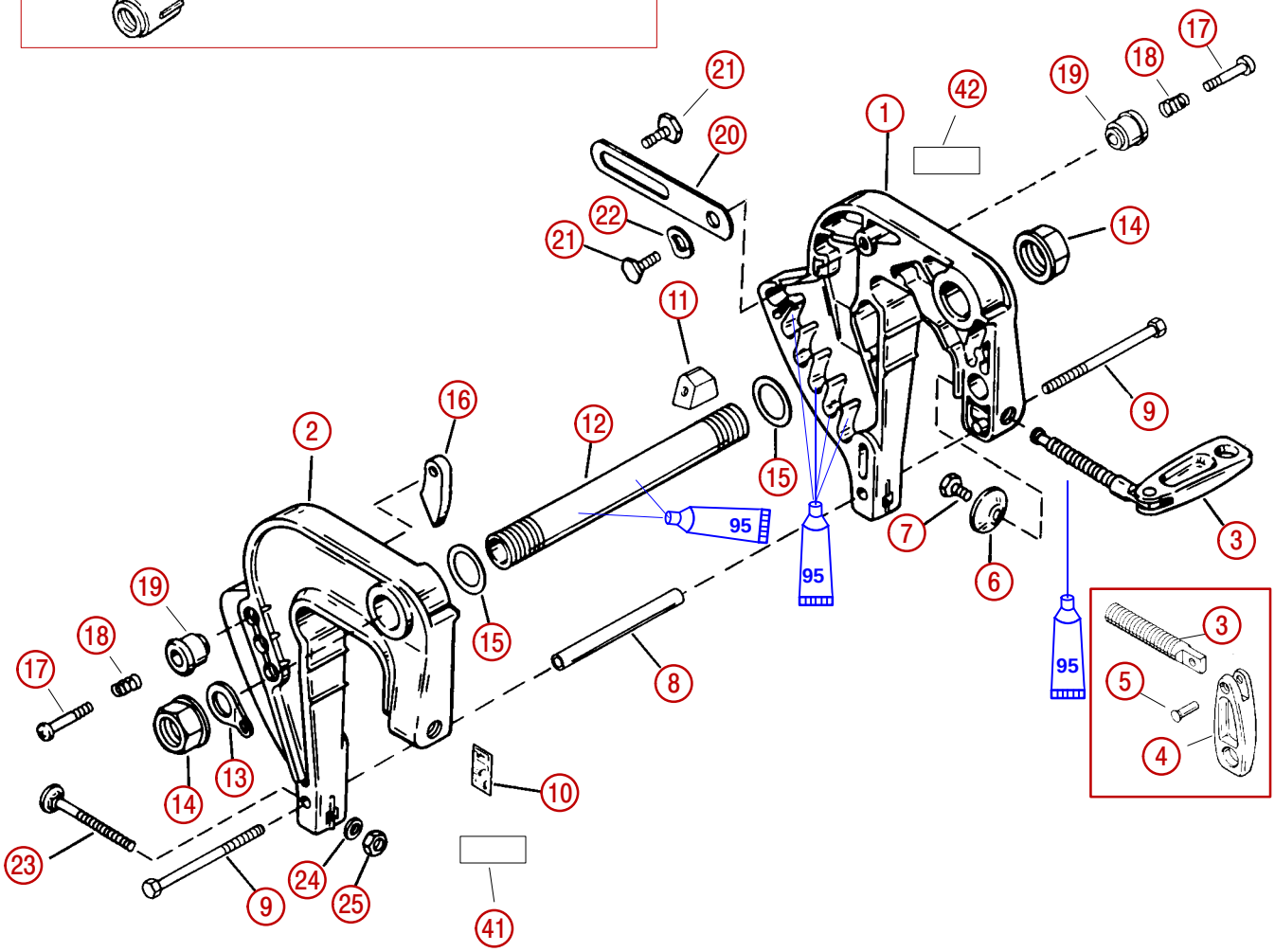
Section 5A – Clamp/Swivel Brackets and Drive Shaft Housing

Table of Contents

5 A

Clamp Bracket



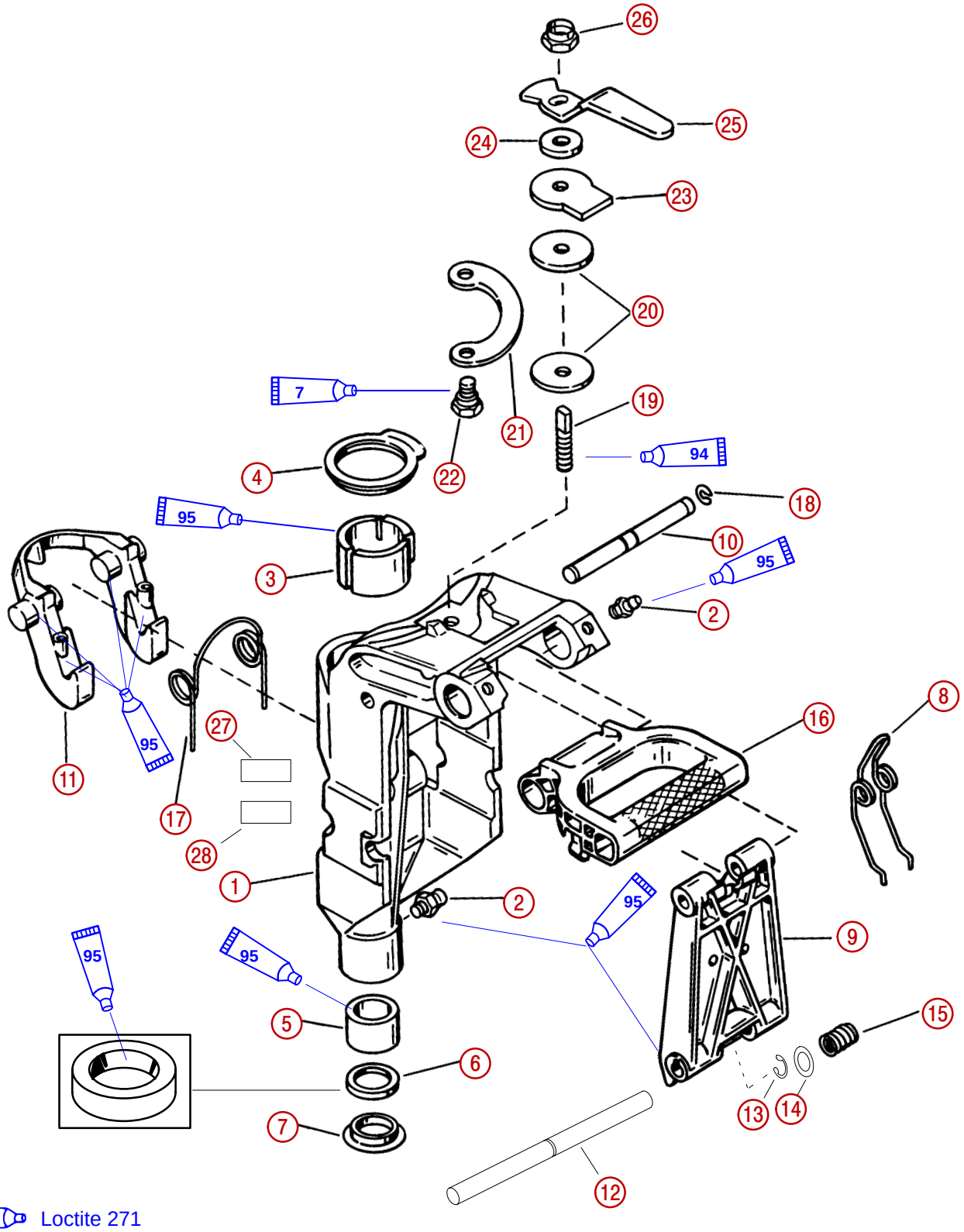


95 2-4-C with Teflon

Clamp Bracket (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CLAMP BRACKET **(BLACK-PORT)**			
2	1	CLAMP BRACKET **(BLACK-STARBOARD)**			
3	2	THUMB SCREW ASSEMBLY			
4	2	HANDLE			
5	2	RIVET			
6	2	WASHER–thumb screw			
7	2	SCREW–washer attaching	65		7.3
8	1	SPACER			
9	2	SCREW (M6 x 40)	60		6.8
10	1	DECAL (TILT)			
11	1	SHUTTLE–tilt lock			
12	1	TILT TUBE **(HANDLE MODELS)**			
	1	TILT TUBE **(RC MODELS)**			
13	1	CLIP–safety			
14	2	NUT–tilt tube	120		13.6
15	2	WASHER–tilt tube			
16	2	LEVER ASSEMBLY–tilt return			
17	2	SCREW (M5 x 35)			
18	2	SPRING			
19	2	KNOB			
20	1	STRAP–tilt stop - port side			
21	2	SCREW–strap to clamp bracket	60		6.8
22	1	WAVE WASHER–tilt stop strap screw			
23	2	BOLT–clamp bracket to transom (1/4-20 x 3-1/2)			
24	2	WASHER–clamp bracket bolt			
25	2	NUT–clamp bracket bolt			
26	1	SPACER			
27	2	NUT			
28	1	SEAL			
29	1	O RING			
30	1	SPACER **RC MODELS**			
31	2	NUT			
32	3	WASHER **(.625 O.D.)**			
33	1	WASHER			
34	1	WASHER			
35	2	SCREW (M8 x 30)			
36	1	BRACKET			
37	2	NUT			
38	1	BALL JOINT			
39	1	TIE ROD			
40	1	SPACER			
41	1	DECAL-Lower Tilt Limit			
42	1	DECAL-Tilt Lock			

Swivel Bracket



7 Loctite 271

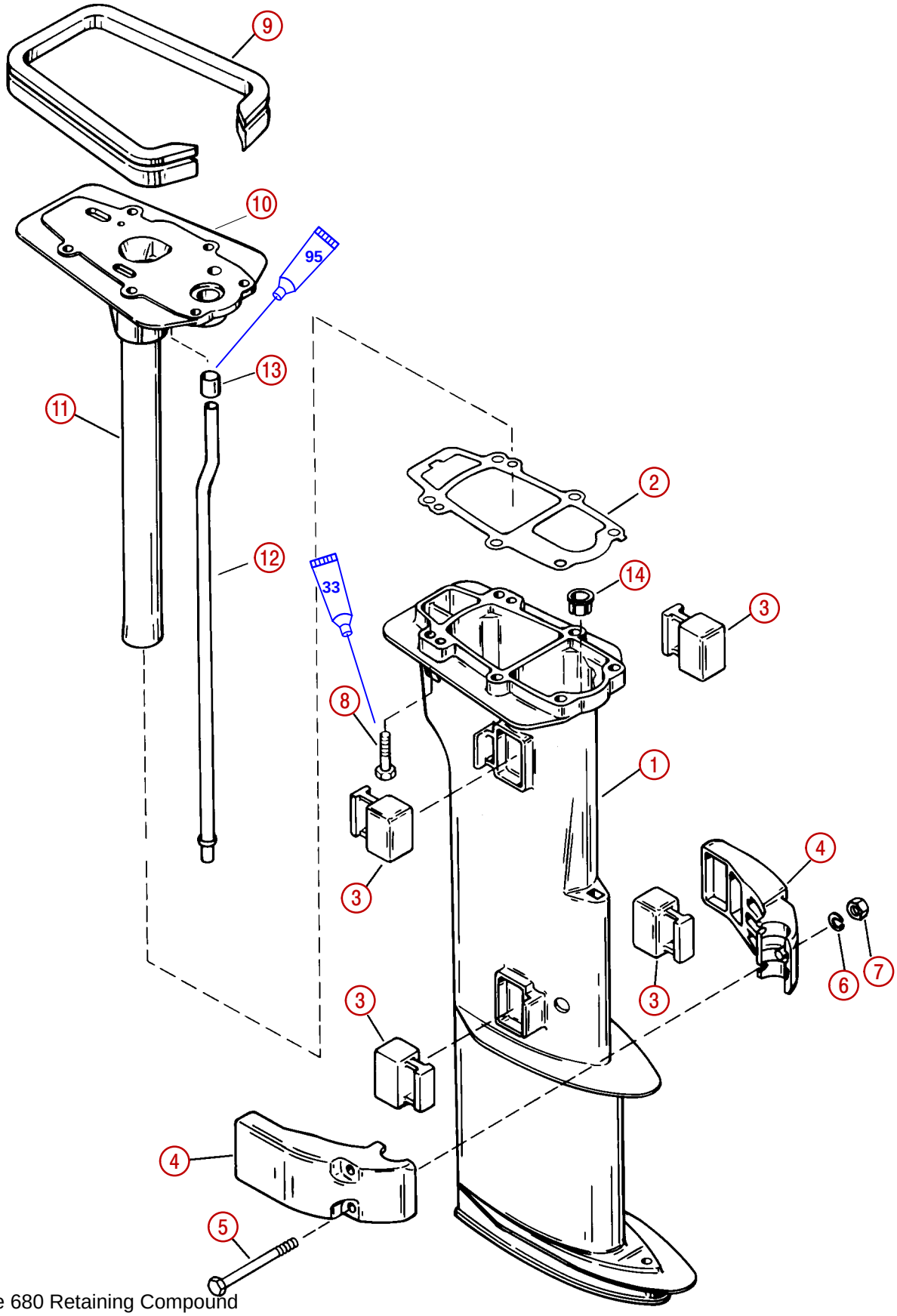
94 Anti-Corrosion Grease

95 2-4-C with Teflon

Swivel Bracket (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	SWIVEL BRACKET **(BLACK)**			
2	3	GREASE FITTING			
3	1	BEARING			
4	1	THRUST BEARING–upper			
5	1	BUSHING–lower			
6	1	SEAL			
7	1	THRUST WASHER–lower			
8	1	SPRING			
9	1	BRACKET			
10	1	PIN			
11	1	HOOK–reverse lock			
12	1	PIVOT PIN			
13	1	RETAINING RING			
14	1	WASHER			
15	1	SPRING			
16	1	CARRYING HANDLE **(BLACK)**			
17	1	SPRING–reverse hook			
18	2	E-RING			
19	1	ROD			
20	2	BRAKE DISC			
21	1	SWIVEL HEAD PLATE			
22	2	SCREW (M6 x 13)	70		7.9
23	1	BRAKE PLATE			
24	1	WASHER			
25	1	HANDLE			
26	1	NUT	125		14.1
27	1	DECAL–co-pilot			
28	1	DECAL-Serial Overlaminate			

Drive Shaft Housing



33 Loctite 680 Retaining Compound
95 2-4-C With Teflon

Drive Shaft Housing (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	HOUSING ASSEMBLY **(BLACK-SHORT)**			
	1	HOUSING ASSEMBLY **(BLACK-LONG)**			
2	1	GASKET–drive shaft housing			
3	4	MOUNT			
4	2	COVER–mount **(BLACK)**			
5	2	SCREW–mount cover (M6 x 80)			
6	2	WASHER			
7	2	NUT–cover screw	110		12.4
8	4	SCREW (M6 x 35)	100		11.3
9	1	SEAL–adaptor plate			
10	1	ADAPTOR PLATE **(NO EXHAUST TUBE)(6/8/9.9)**			
	1	ADAPTOR PLATE **(WITH EXHAUST TUBE) (15)**			
11	1	EXHAUST TUBE **(15)**			
12	1	WATER TUBE **(SHORT)**			
	1	WATER TUBE **(LONG)**			
13	1	SEAL–water tube			
14	1	BEARING BLOCK **(LONG)**			

Drive Shaft Housing Disassembly/Reassembly

Servicing components such as steering arm, drive shaft housing, exhaust assembly and swivel bracket will usually require powerhead and/or gear housing removal.

Refer to SECTION 4 for powerhead removal and SECTION 6 for gear housing removal.

NOTE: *With powerhead removed, always inspect and remove any carbon buildup in exhaust tube.*

The transom bracket, lower mount bracket, tilt tube and lower engine mounts can be serviced without powerhead/gear housing removal. However, OUTBOARD MUST BE SUPPORTED BEFORE SERVICING COMPONENTS.

IMPORTANT: All gaskets should be replaced when removing powerhead and/or disassembling drive shaft housing. Corresponding gasket mating surfaces should be cleaned of any gasket material before installing new gaskets.

MID-SECTION

Section 5B – Power Trim

Table of Contents

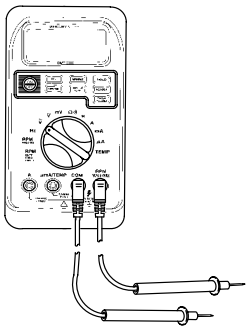
5 B

Specifications

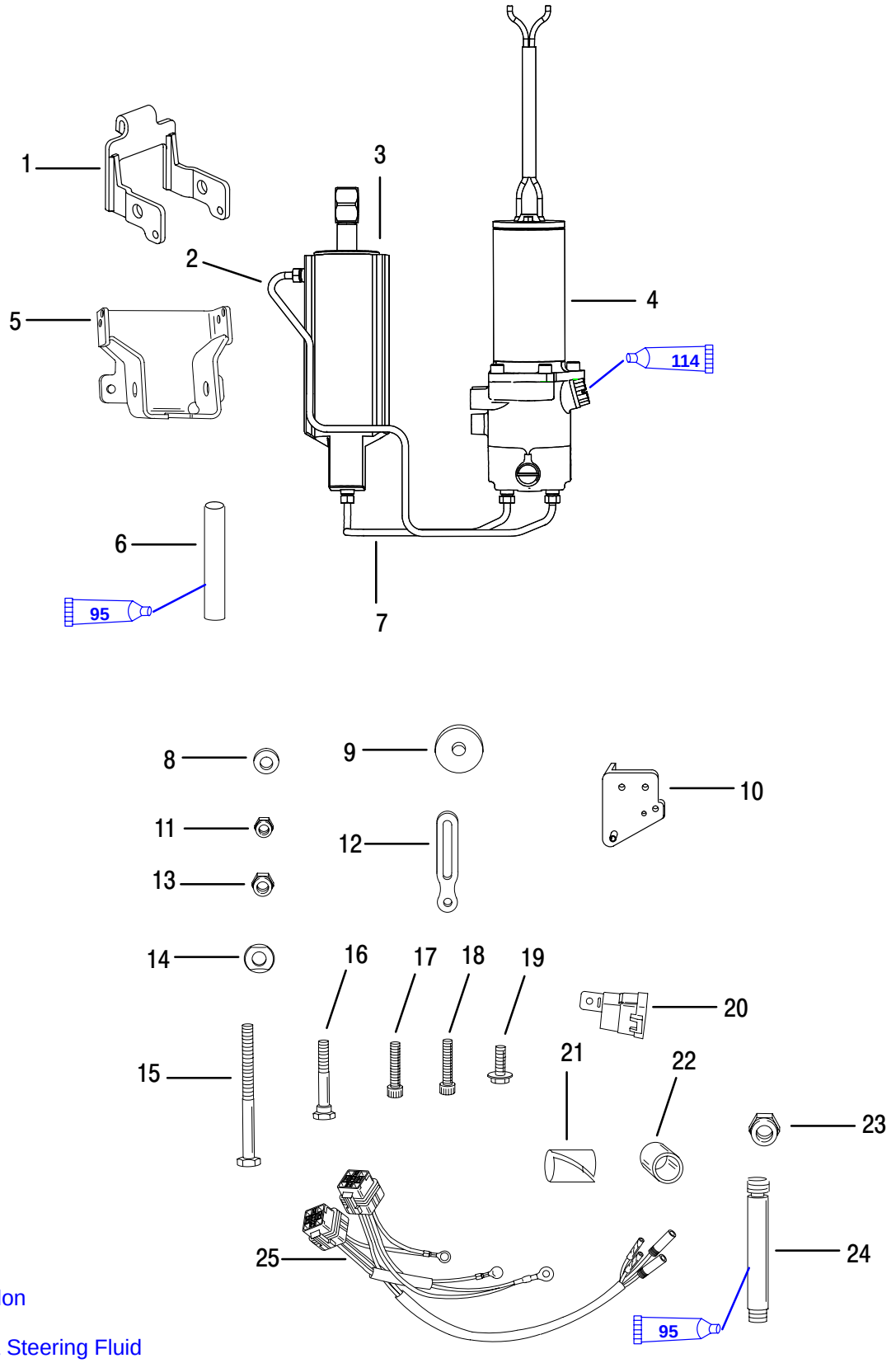
Total Trim Degrees	56°
Required Voltage	12V
Minimum Battery Size	335Marine Cranking Amperes (260 Cold Cranking Amperes)

Special Tools

1. DMT 2000 Digital Tachometer Multi-meter P/N 91-854009A1



Power Trim Components



95 2-4-C with Teflon

114 Power Trim & Steering Fluid

Power Trim Components (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in.	lb-ft	Nm
1	1	UPPER BRACKET			
2	1	LINE, HYDRAULIC			
3	1	CYLINDER			
4	1	HYDRAULIC PUMP			
5	1	LOWER BRACKET			
6	1	PIVOT PIN, UPPER			
7	1	LINE, HYDRAULIC			
8	2	WASHER .281 X .625			
9	2	WASHER .344			
10	1	MOUNTING PLATE			
11	6	NUT (.250-28)	144		16.3
12	1	TILT STOP STRAP			
13	2	NUT (.312-18)			
14	1	WAVE WASHER			
15	2	BOLT .(312-18 X 3.50)			
16	2	BOLT (.250-28 X 1.75)	144		16.3
17	2	BOLT (.250-28 X 1.25)	144		16.3
18	2	BOLT (.250-28 X 1.50)	144		16.3
19	3	BOLT (.250-20 X .625)	80		9
20	2	TRIM RELAY			
21	1	NYLON BUSHING, LOWER CYLINDER			
22	2	PIN SPACER, LOWER CYLINDER			
23	2	NUT LOCKING (.500 X 20)	120		13.6
24	1	PIVOT PIN , LOWER			
25	1	HARNESS			

Power Trim – General Information

DESCRIPTION

The Power Trim System consists of an electric motor, fluid reservoir, pump and a trim/tilt cylinder.

The remote control (or trim panel) has switches that trim the outboard UP or DOWN and tilt the engine for Trailering. The outboard can be trimmed and tilted while under power or when the outboard is not running.

TRIMMING CHARACTERISTICS

NOTE: *Because hull designs react differently in varying water conditions, Varying the trim position will often improve the ride and boat handling.*

TRIMMING UP (OUT)

⚠ WARNING

Excessive trim OUT may cause steering instability resulting in loss of operational control.

Trimming UP will lift the boat bow, increase the boat speed, may increase steering torque to the port, increases gearcase clearance over submerged objects, and/or can cause boat to porpoise and/or ventilation.

TRIMMING DOWN (IN)

⚠ WARNING

Excessive trim IN may cause undesirable and/or unsafe steering conditions.

Trimming DOWN aids in planing particularly with heavy loads, improves ride in choppy water, can cause bow steering (boat veers to left or right), and/or improves acceleration to planing speed.

Troubleshooting

IMPORTANT: Determine if Electrical or Hydraulic problem exist.

Hydraulic Troubleshooting

CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor runs; trim system does not move up or down.	1, 2, 5
B. Does not trim down.	1, 2,
C. Does not trim up.	1, 2
D. Partial or Jerky down/up.	1, 3
E. Thump noise when shifting.	2, 3
F. Does not trim under load.	1, 2,
G. Does not hold trim position under load.	2, 3
H. Trail out when backing off from high speed.	2
I. Leaks down and does not hold trim.	2, 3
J. Trim motor working hard and trims slow up and down.	1, 2, 4
K. Starts to trim up from full down position when IN trim button is depressed.	2
L. Trim position will not hold in reverse.	2, 3

PROBLEM

1. Low oil level.
2. Pump assembly faulty.
3. Tilt ram piston O-ring leaking or cut.
4. Check condition of battery.
5. Broken motor/pump drive shaft.

Electrical Troubleshooting

CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor does not run when trim button is depressed.	1, 2, 4, 5, 6, 7, 8
B. Trim system trims opposite of buttons.	3

PROBLEM

1. Battery low or discharged.
2. Open circuit in trim wiring.
3. Wiring reversed in remote control or in panel control.
4. Wire harness corroded through.
5. Internal motor problem (brushes, shorted armature).
6. Blown fuses.
7. Trim switch failure.
8. Verify relays are functioning correctly.

Power Trim Relay Test Procedure

The trim motor relay system used on permanent magnet trim systems, connects each of the two wires from the trim motor to either ground, or positive, in order to allow the motor to run in both directions.

If the motor will not run in the UP direction, it could be either the UP relay is not making contact to 12 volts **OR** the DOWN relay is not making contact to ground. The opposite is true if the system will not run DOWN. When the system is not energized, both relays should connect the heavy motor leads to ground.

To test which relay is faulty if the trim system does not operate in one direction:

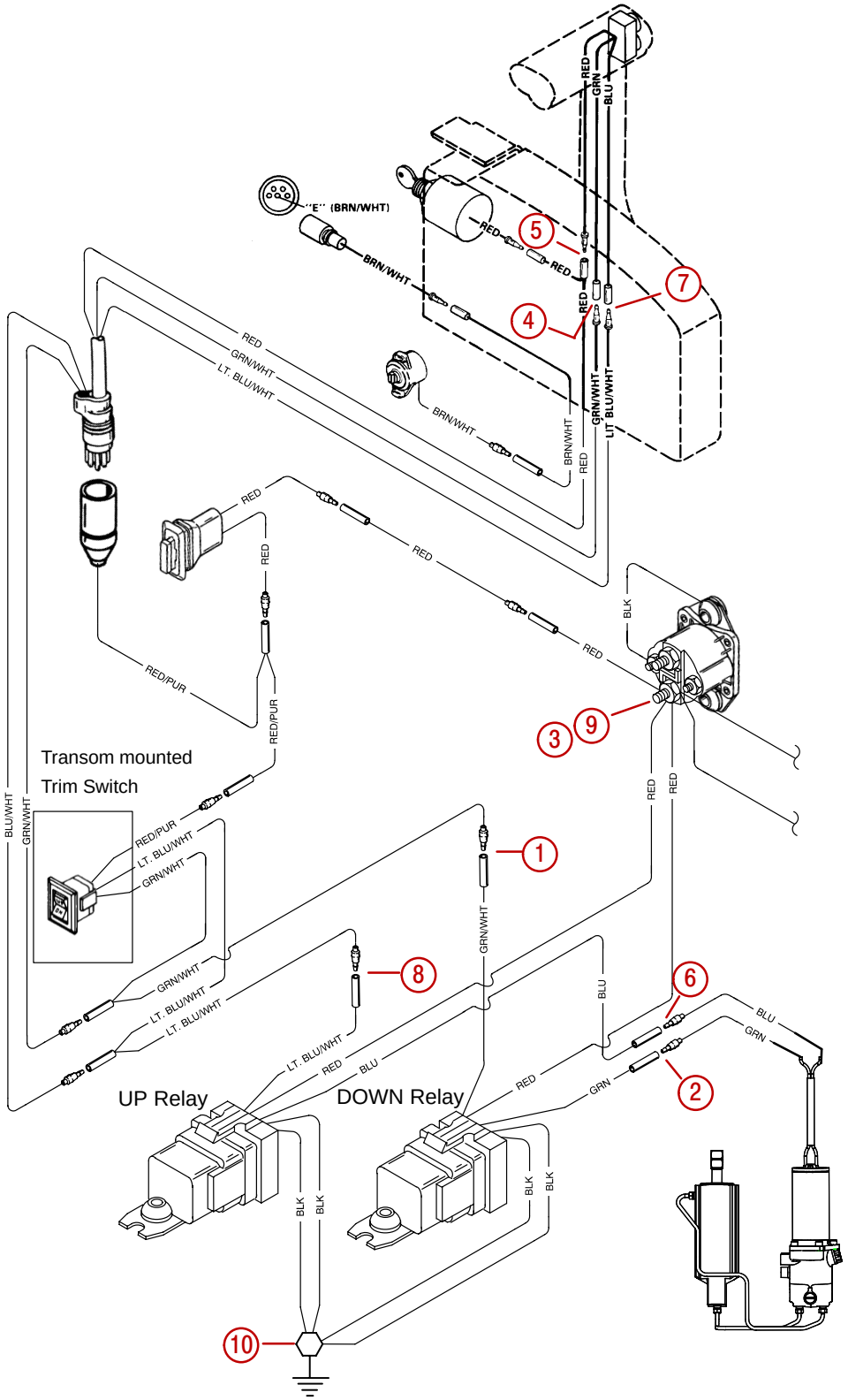
1. Disconnect the heavy gauge pump wires from the trim control relay.
2. Check for continuity between the heavy leads from the trim relays to ground.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading (R x 1)
Green and Ground	0	Full Continuity (Rx1)
Blue and Ground	0	Full Continuity (Rx1)

Replace the relay that does not have continuity.

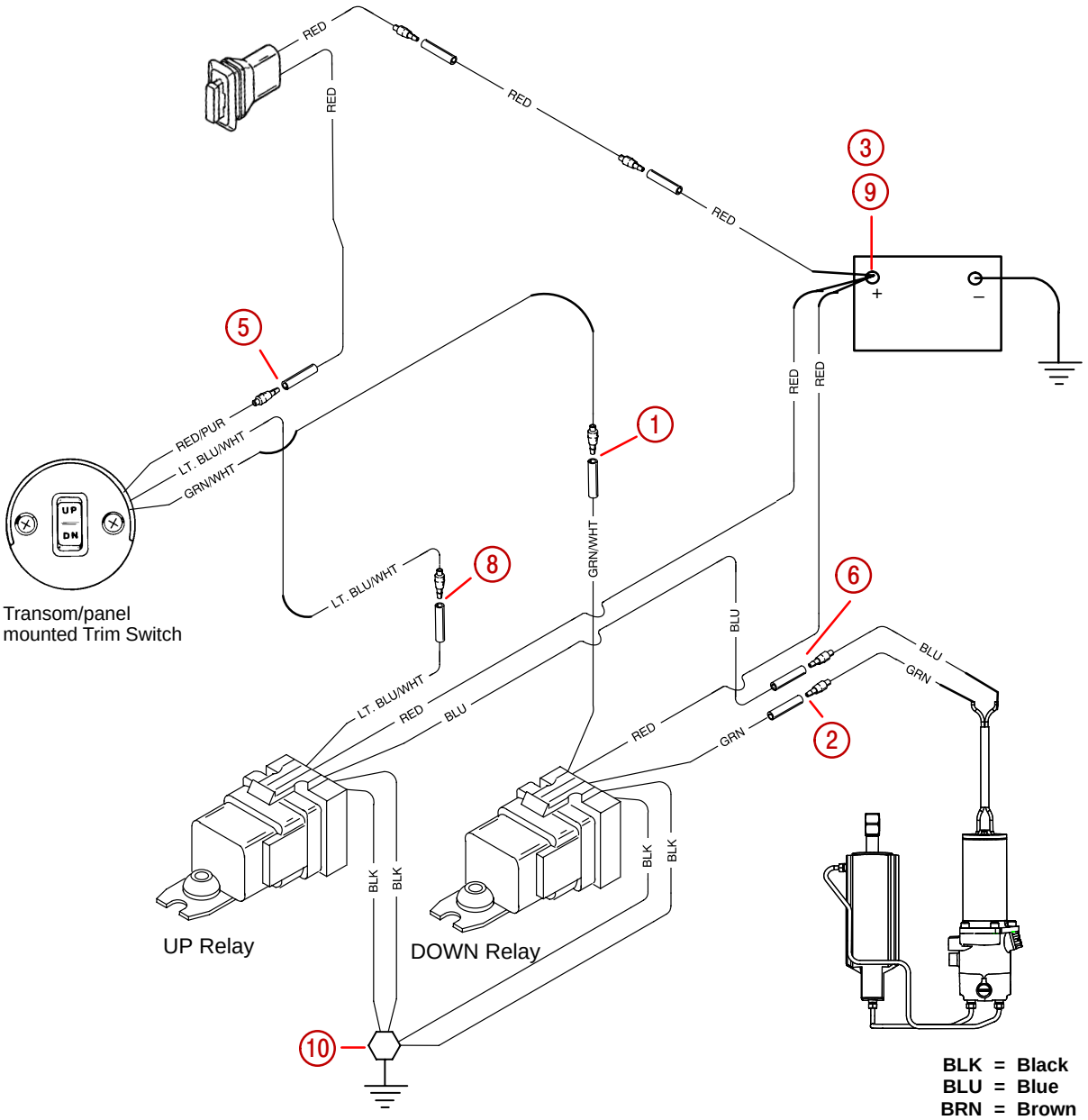
3. Connect a voltmeter to the heavy BLUE lead and to ground. You should have 12 volts on the BLUE lead when the UP switch is pushed. You should should also have 12 volts on the GREEN lead when the DOWN switch is pushed. Replace the relay that does not switch the lead to positive.

Remote Control



BLK	=	Black
BLU	=	Blue
BRN	=	Brown
GRY	=	Gray
GRN	=	Green
ORN	=	Orange
PNK	=	Pink
PUR	=	Purple
RED	=	Red
TAN	=	Tan
WHT	=	White
YEL	=	Yellow
LT	=	Light
DRK	=	Dark

Tiller Handle



BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LT = Light
DRK = Dark

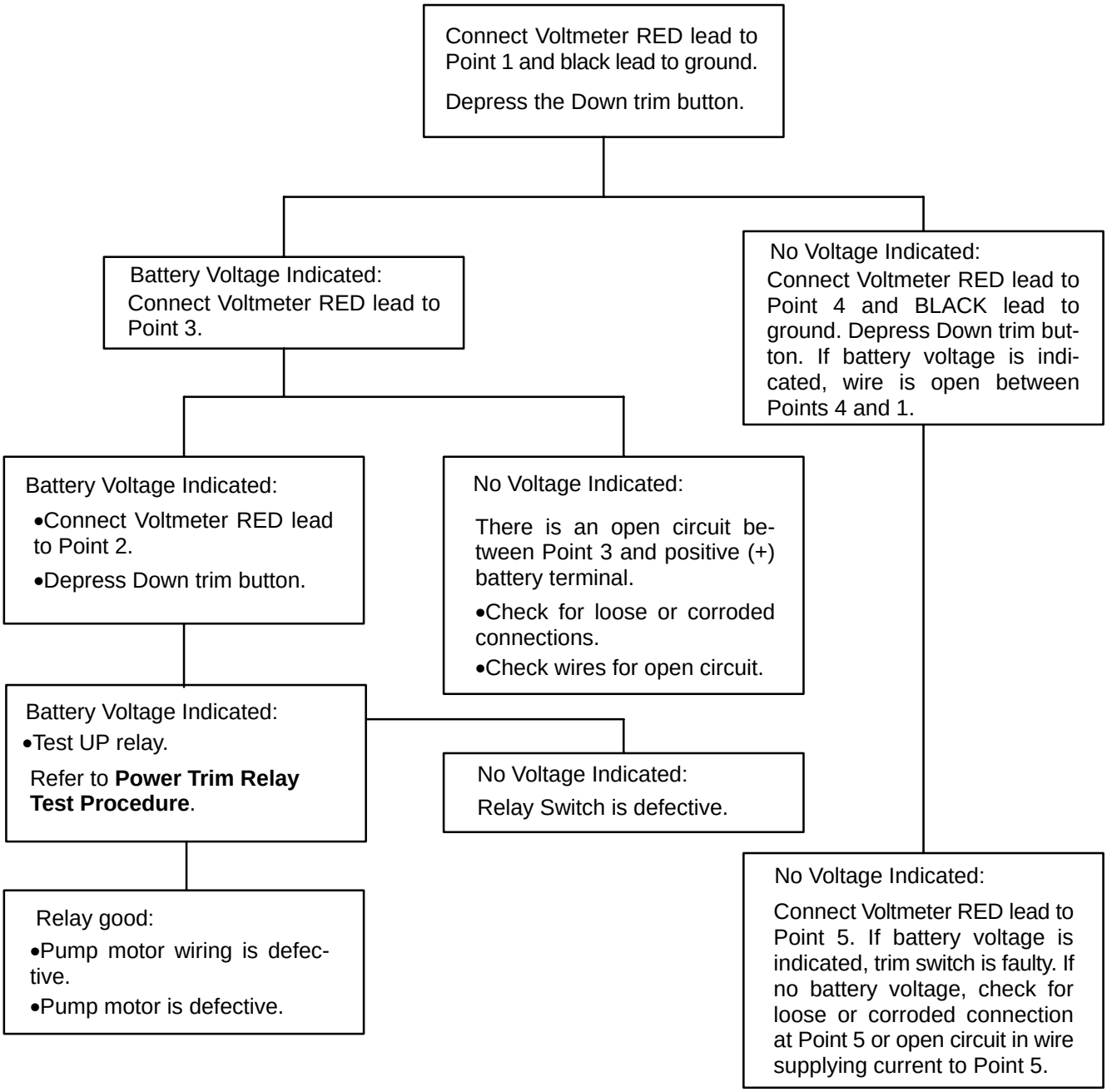
General Checks

Before troubleshooting the Power Trim electrical system, check the following:

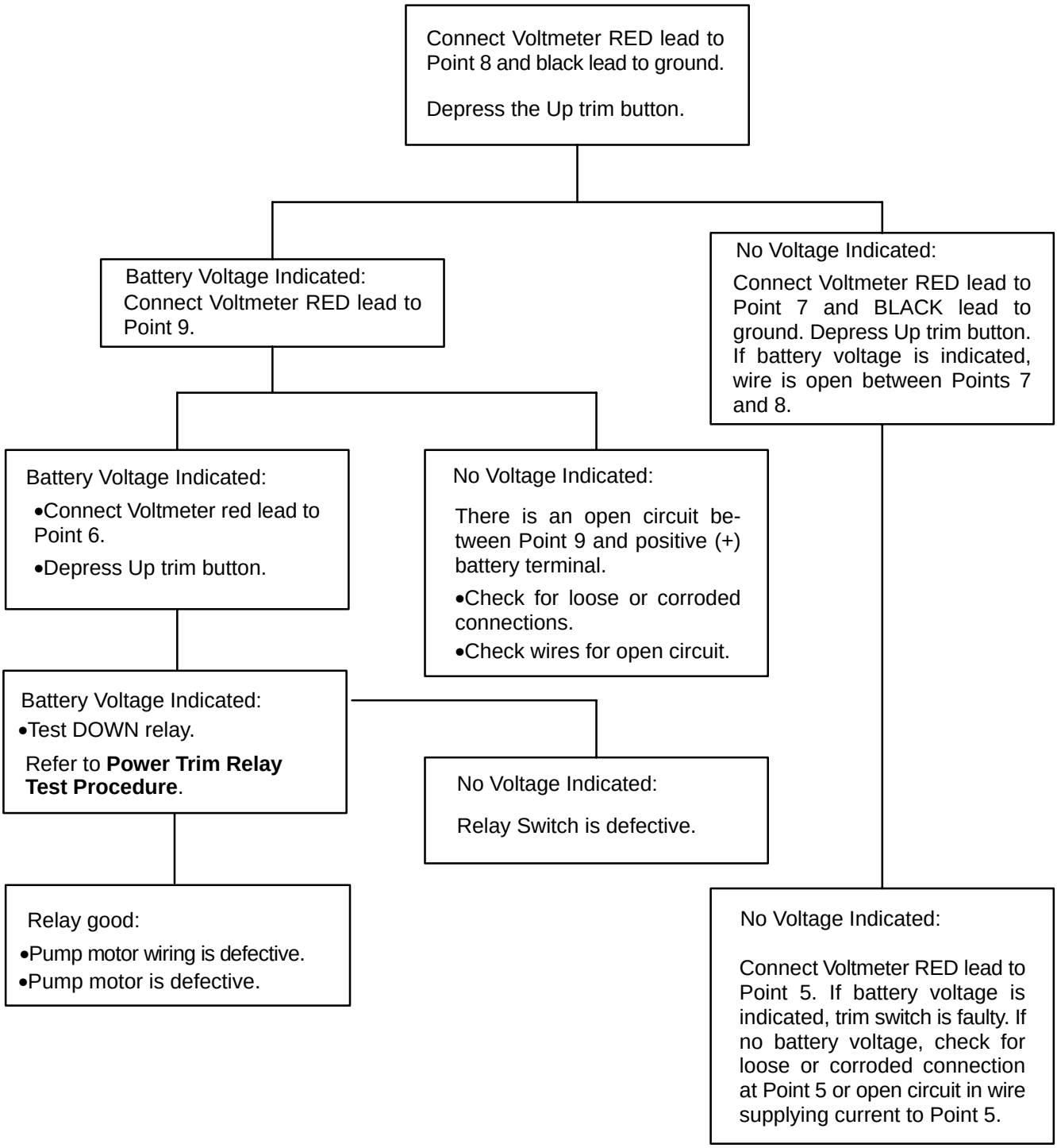
1. Check for disconnected wires.
2. Make certain all connections are tight and corrosion free.
3. Check that plug-in connectors are fully engaged.
4. Make certain battery is fully charged.

Refer to the preceding Remote Control or Tiller Handle wiring diagram for connection points when troubleshooting the electrical system. (Connection points are specified by number.)

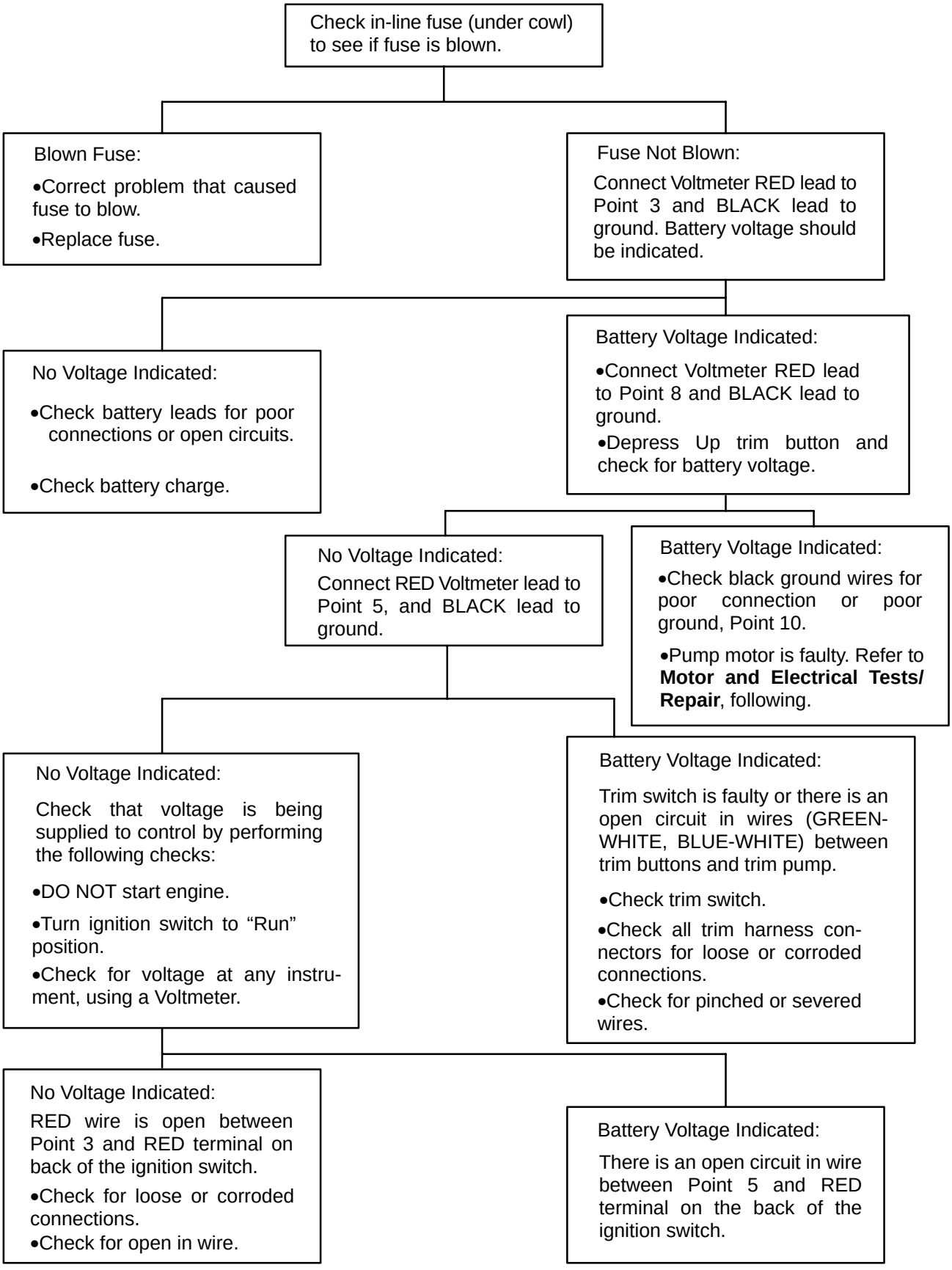
Troubleshooting the Down Circuit



Troubleshooting the Up Circuit



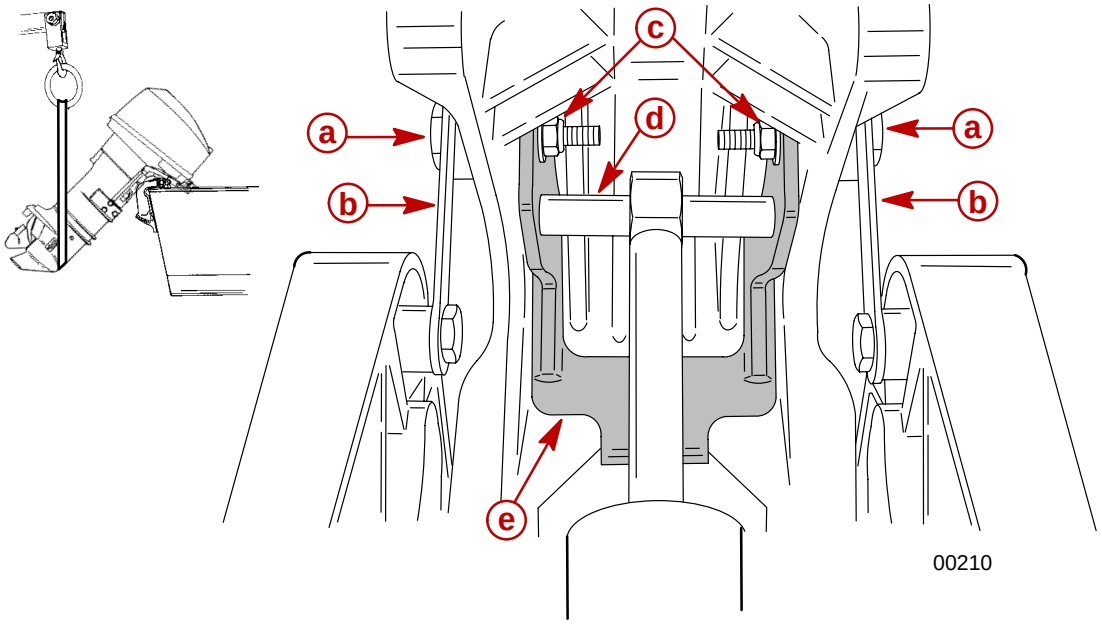
Troubleshooting the Down and Up Circuits (All Circuits Inoperative)



Power Trim

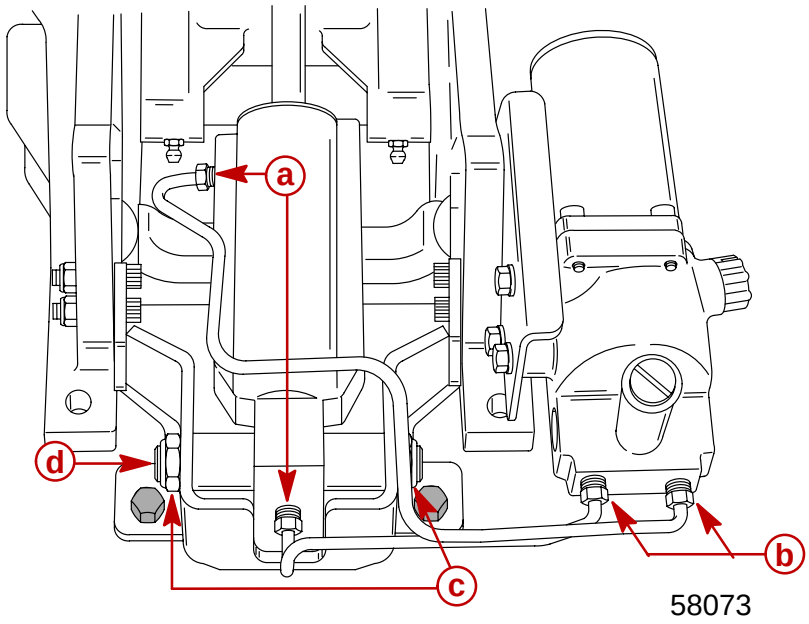
Cylinder Removal

1. Support outboard in a trimmed up position.
2. Remove the tilt stop strap retaining bolts/nuts.
3. Remove the upper bracket.
4. Remover the upper pivot pin from the bracket.



a - Tilt stop strap retaining bolt
b - Tilt stop strap
c - Upper bracket nut
d - Upper pivot pin
e - Upper bracket

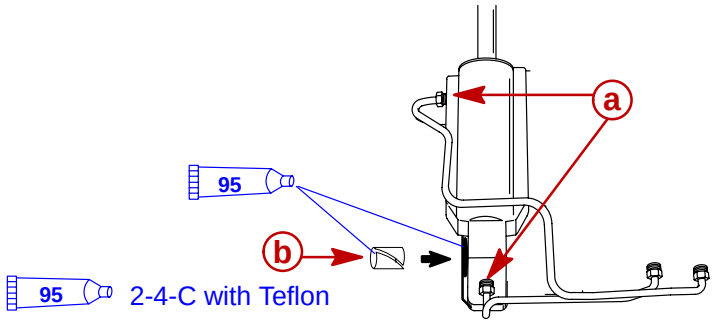
5. Loosen the cylinder hydraulic lines. Do not remove.
6. Remove the hydraulic lines from the pump assembly.
7. Remove the cylinder lower pivot pin nuts.
8. Remove the pivot pin.
9. Remove the hydraulic lines from the cylinder .



a - Cylinder hydraulic lines
b - Pump hydraulic lines
c - Lower pivot pin nut (2)
d - Lower pivot pin

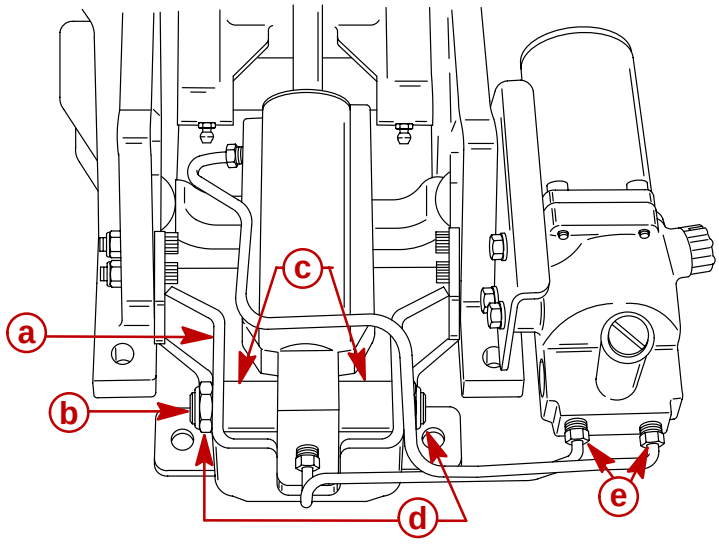
Cylinder Assembly/Installation

1. Install the hydraulic lines to cylinder. DO NOT TIGHTEN.
2. Insert the nylon bushing into the cylinder lower pivot bore.
3. Lubricate cylinder lower pivot bore with 2-4-C with Teflon.



a - Hydraulic line (2)
b - Nylon bushing

4. Insert the lower pivot pin into the support bracket.
5. Install the spacer.
6. Align the cylinder with the lower pivot pin. Push the pivot pin through the tilt cylinder so it is flush with cylinder.
7. Insert the remaining spacer and push pivot pin through.
8. Install pivot nuts. Tighten to the specified torque.
9. Install hydraulic lines to hydraulic pump finger tight. Be careful not to cross thread the hydraulic line flare nuts in the pump body.
10. Tighten all Hydraulic lines.



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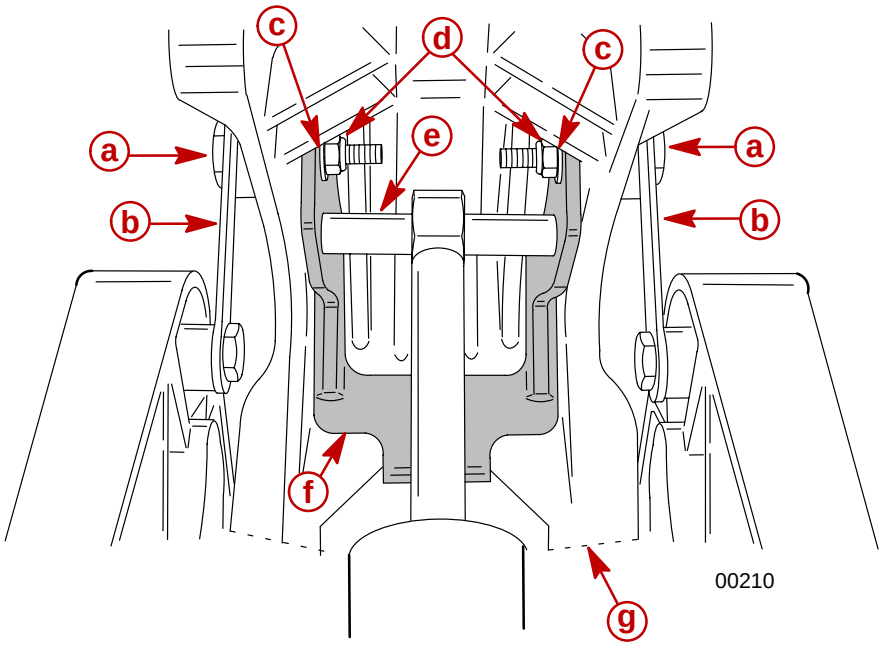
a - Support bracket
b - Pivot pin
c - Spacer (2)
d - Pivot nut (2)
e - Hydraulic line flare nut

Lower Pivot Pin Nut Torque
13.6 Nm (120 lb-in.)

11. Install the upper pivot pin into the upper bracket.
12. Guide the upper pivot through the trim cylinder rod eye and through the upper bracket.
13. Install the upper bracket to the swivel bracket.
14. Secure the bracket with 2 shoulder bolts inserted through the tilt stop brackets.
15. Install a washer and nylock nut on shoulder bolt. Tighten to specified torque.



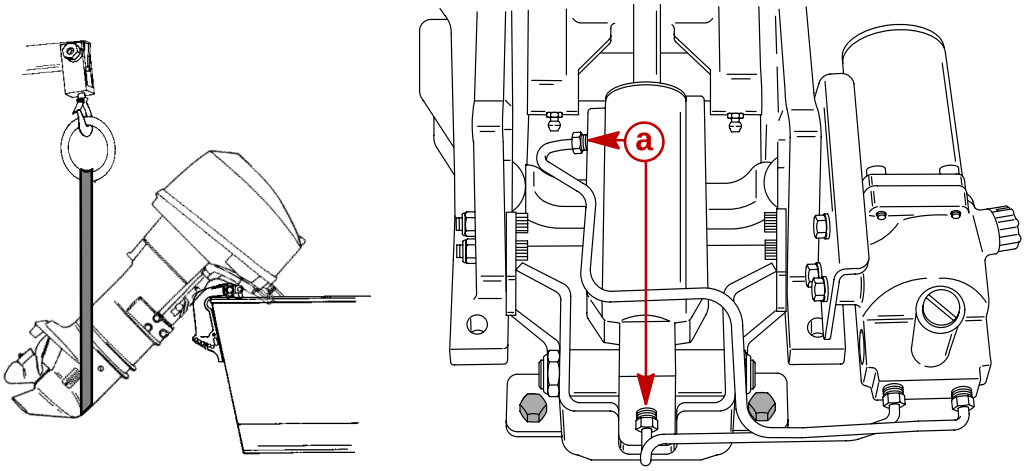
a - Tilt stop strap retaining bolt (2)
b - Tilt stop strap (2)
c - Washer (2)
d - Upper bracket nut (2)
e - Upper pivot pin
f - Upper bracket
g - Swivel bracket

Tilt Stop Strap Retaining Bolt Torque
16.3 Nm (144 lb-in.)

Hydraulic Pump

Removal

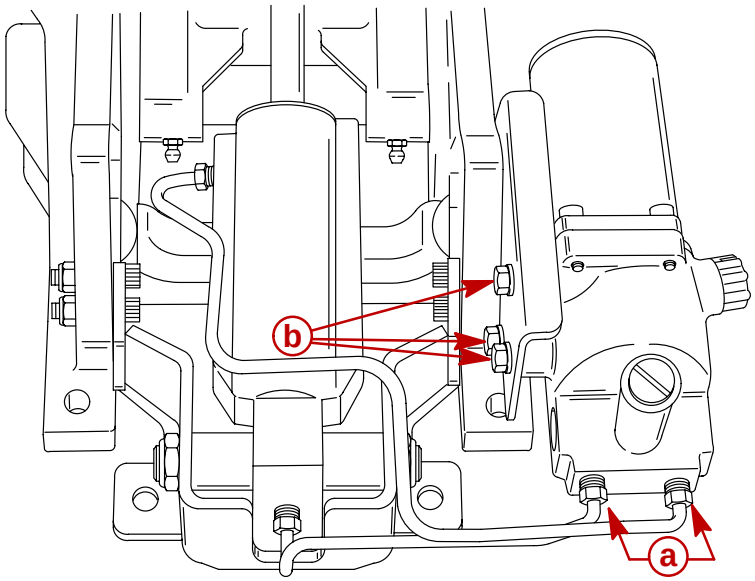
1. Support the outboard in a trimmed up position.
2. Loosen the hydraulic lines at the cylinder. (Do not remove hydraulic lines from cylinder).



58073

a - Cylinder hydraulic lines

3. Disconnect the trim motor wires from the solenoid harness. (Refer to the Remote Control and Tiller Handle Wiring Diagrams in this section.)
4. Remove the hydraulic lines from the hydraulic pump.
5. Remove the 3 screws holding the hydraulic pump to the support bracket.

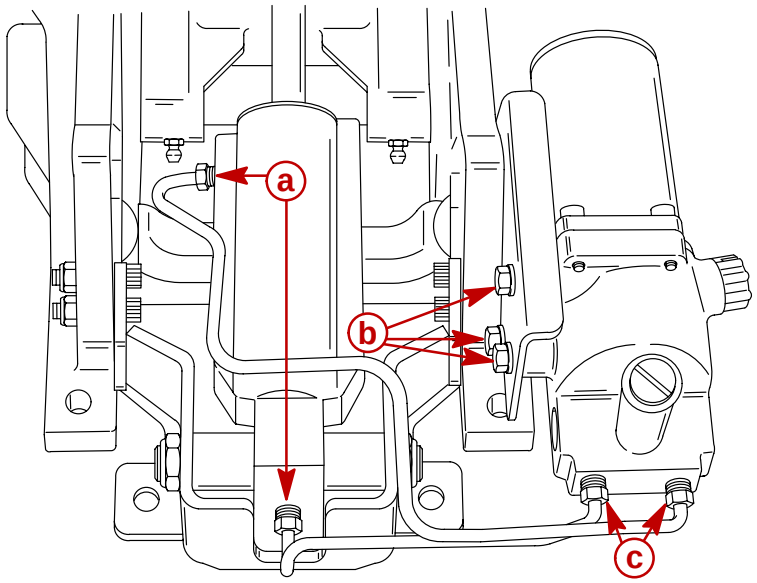


58073

a - Hydraulic lines
b - Hydraulic pump screws (3)

Installation

1. Install hydraulic pump to support bracket with 3 screws. Do not tighten.
2. Install hydraulic lines to hydraulic pump finger tight. Be careful not to cross thread the hydraulic line flare nut in the pump body.
3. Tighten the hydraulic pump mounting screws to the specified torque.
4. Tighten the hydraulic lines at the pump and cylinder.
5. Connect the motor wires to the solenoid harness.



58073

a - Cylinder hydraulic lines
b - Hydraulic pump mounting screw (3)
c - Hydraulic pump lines

Hydraulic Pump Mounting Screw Torque
9 Nm (80 lb-in.)

Filling Hydraulic Reservoir

1. Open the manual release valve 3 turns.
2. Fill the reservoir the with Power Trim and Steering Fluid. Install the fill cap.
3. Manually raise and lower the trim several times.
4. Check the level of the fluid in the reservoir. Fill as needed. Install the fill cap.
5. Manually raise and lower the trim several times as needed.
6. Tighten the manual release valve.
7. Cycle the trim 3 times electrically. Check for proper operation and fluid level in reservoir.

LOWER UNIT

Section 6 – Gear Housing

Table of Contents

6

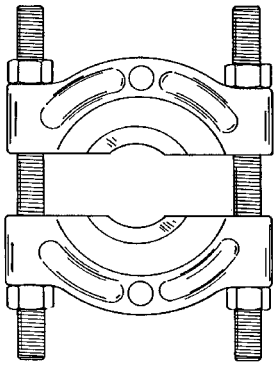
Specifications

GEAR HOUSING	**Gear Ratio**	2.0:1
	Gearcase Capacity	200 ml (6.8 fl. oz.)
	Lubricant Type	Premium Blend Gear Lubricant
	Forward Gear - No. of Teeth-Type	26 Spiral/Bevel
	Pinion Gear - No. of Teeth-Type	13 Spiral/Bevel
	Pinion Height	Floating
	Forward Gear Backlash	No Adjustment
	Reverse Gear Backlash	No Adjustment
	Water Pressure	
	With Thermostat	
	– @ W.O.T (5000 RPM)	(5 – 7 PSI)
	– @ Idle	3.4 - 10.3 kPa (.5 – 1.5 PSI)
	Without Thermostat	
	– @ W.O.T (5000 RPM	34.5 - 48.3 kPa (5 – 7 PSI)
	– @ Idle (750 RPM)	0 - 6.9 kPa (0 – 1 PSI)

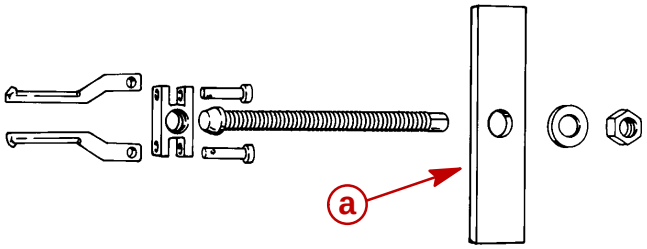
NOTE: *Tell-tale at IDLE may be intermittant on engines with thermostats installed.*

Special Tools

1. Universal Puller Plate 91-37241

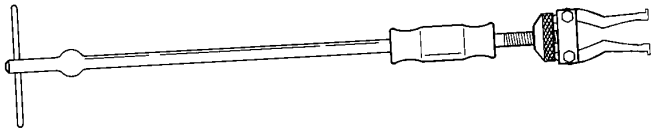


2. Puller Assembly 91-83165T and Puller Plate 91-29310

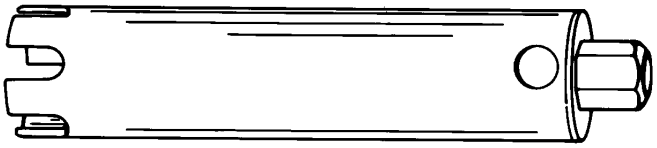


a - Puller Plate 91-29310

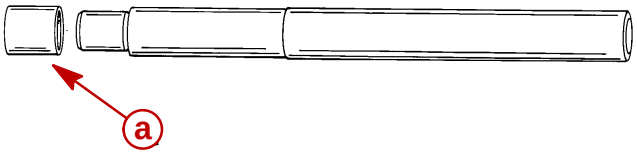
3. Slide Hammer 91-34569A1



4. Bearing Carrier Tool 91-13664

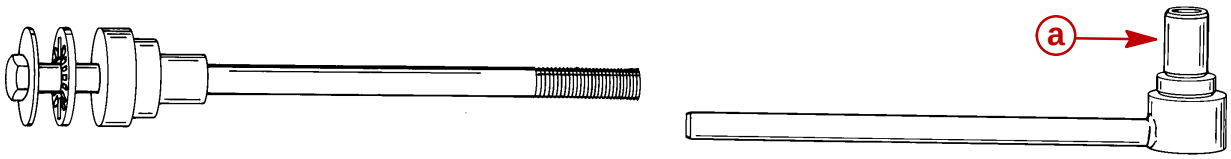


5. Drive Shaft Bearing Removal Tool 91-824788A1



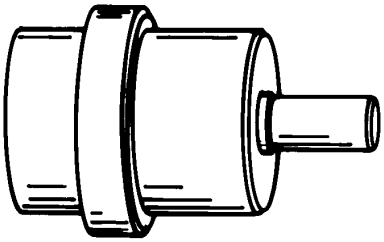
a - Drive Shaft Bushing Removal Tool 23-824789

6. Drive Shaft Bushing Installation Tool 91-824790A1

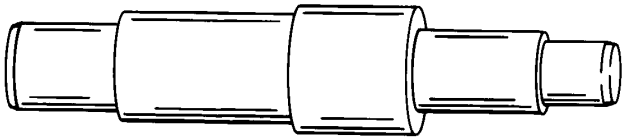


a - Drive Shaft Bearing Installation Tool 91-824791

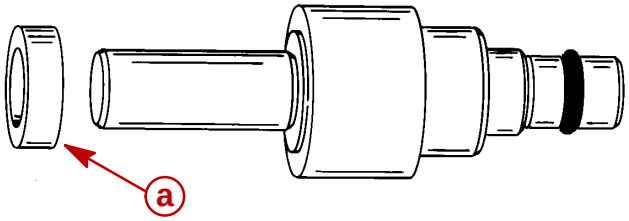
7. Mandrel 91-13658T



8. Bushing Removal Tool 91-824787

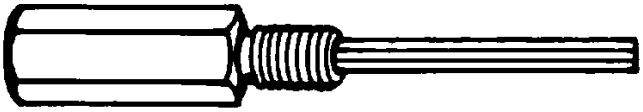


9. Seal Installation Tool 91-824785T1



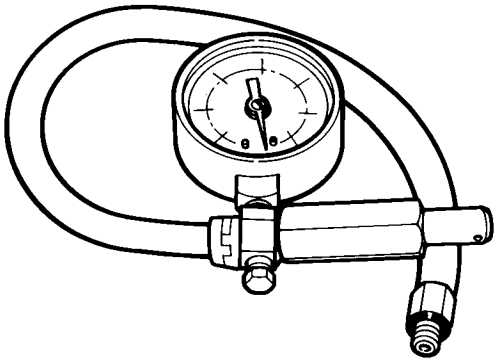
a - Seal/Bushing Installation Tool 23-824786

10. Expanding Rod (SNAP ON P/N CG40-4)*



11. Collet (Jaws) (SNAP ON P/N CG40-15)*

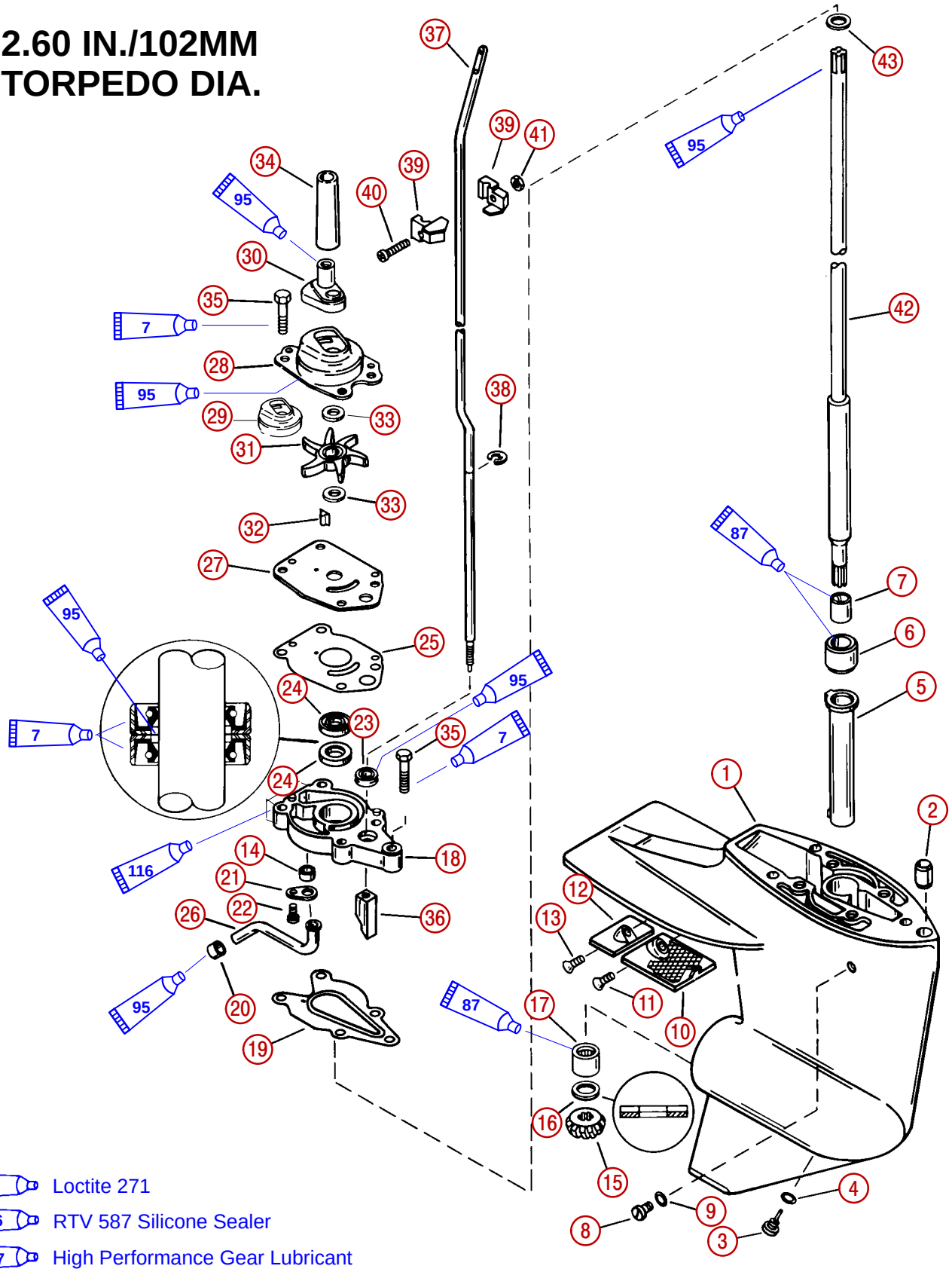
12. Leakage Tester FT8950



*Purchase From: SNAP ON TOOLS Corporation
2801 - 80th Street
Kenosha, Wi. 53141-1410

Gear Housing (Drive Shaft) (2.00:1 Gear Ratio)

2.60 IN./102MM TORPEDO DIA.



7 Loctite 271

116 RTV 587 Silicone Sealer

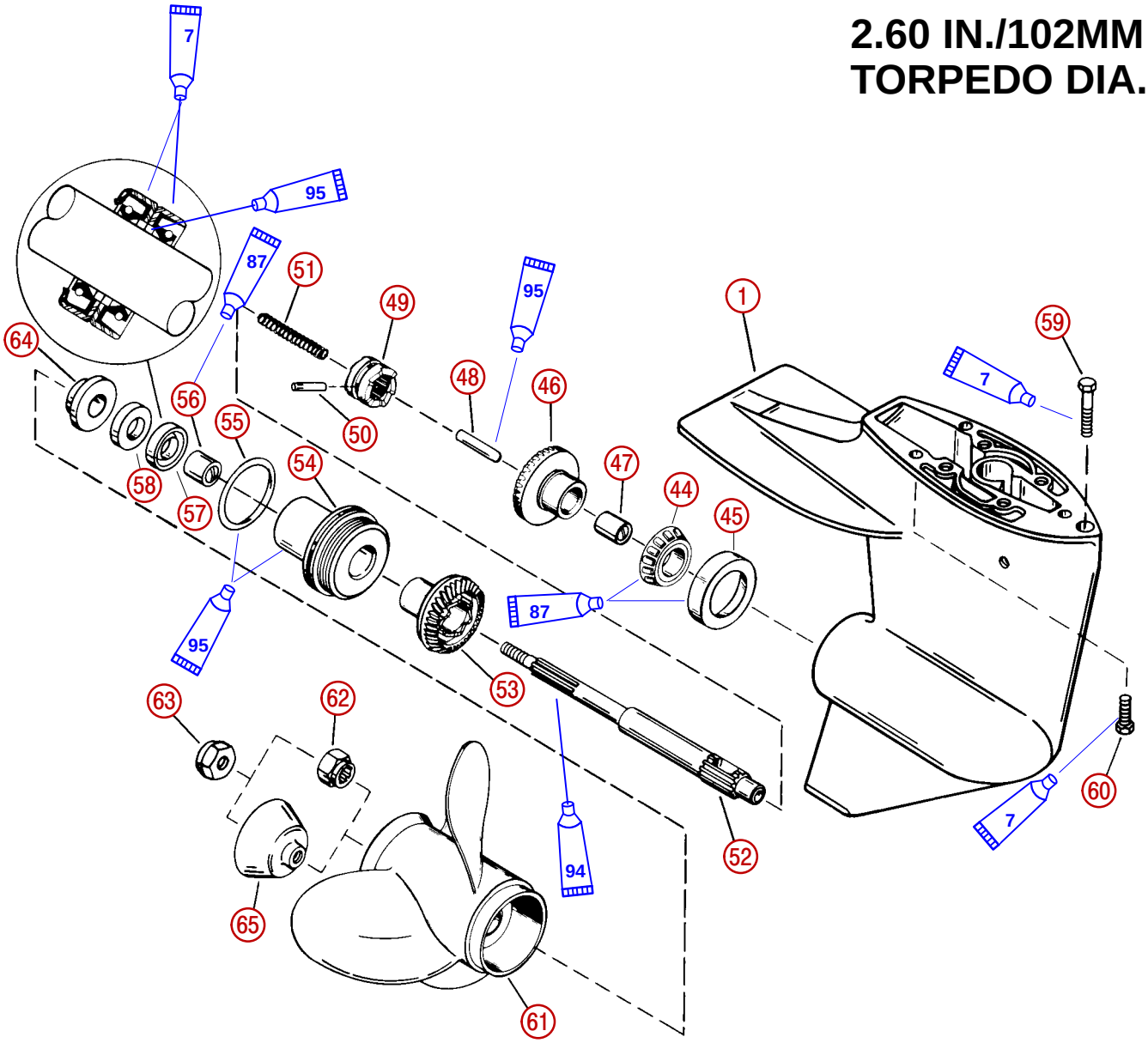
87 High Performance Gear Lubricant

95 2-4-C with Teflon

Gear Housing (Drive Shaft) (2.00:1 Gear Ratio) (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	GEAR HOUSING **(BLACK-SHORT)**			
–	1	GEAR HOUSING **(BLACK-LONG)**			
1	1	GEAR HOUSING **(BLACK-BASIC)**			
2	1	BUSHING–gear housing			
3	1	DRAIN SCREW			
4	1	SEALING WASHER			
5	1	SLEEVE ASSEMBLY			
6	1	SLEEVE			
7	1	BUSHING			
8	1	SCREW PLUG KIT			
9	1	SEALING WASHER			
10	1	SCREEN			
11	1	SCREW	30		3.4
12	1	ANODE ASSEMBLY			
13	1	SCREW	30		3.4
14	1	SEAL			
15	1	PINION GEAR (13 TEETH)			
16	1	WASHER–thrust			
17	1	BEARING			
18	1	WATER PUMP BASE			
19	1	GASKET			
20	1	SEAL			
21	1	RETAINER			
22	1	SCREW (10-16 x 1/2)	Drive Tight		
23	1	QUAD RING			
24	2	OIL SEAL			
25	1	GASKET			
26	1	WATER TUBE			
27	1	FACE PLATE			
28	1	COVER ASSEMBLY			
29	1	INSERT			
30	1	SEAL			
31	1	IMPELLER			
32	1	KEY ASSEMBLY			
33	2	WASHER			
34	1	GUIDE			
35	5	SCREW–water pump (M6 x 30)	50		5.6
36	1	CAM–shift			
37	1	SHIFT SHAFT **(SHORT)**			
	1	SHIFT SHAFT **(LONG)**			
38	1	E-RING			
39	2	GUIDE			
40	1	SCREW (M5 x 25)	45		5.1
41	1	NUT–guide screw	45		5.1
42	1	DRIVE SHAFT **(SHORT)**			
	1	DRIVE SHAFT **(LONG)**			
43	1	THRUST WASHER			

Gear Housing (Propeller Shaft) (2.00:1 Gear Ratio)



7 Loctite 271

87 High Performance Gear Lubricant

94 Anti-Corrosion Grease

95 2-4-C with Teflon

Gear Housing (Propeller Shaft) (2.00:1 Gear Ratio) (continued)

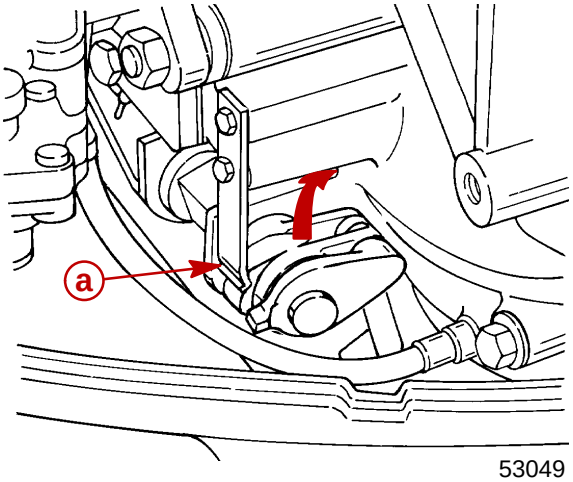
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	GEAR HOUSING **(BLACK-SHORT)**			
–	1	GEAR HOUSING **(BLACK-LONG)**			
1	1	GEAR HOUSING **(BLACK-BASIC)**			
44	1	ROLLER BEARING			
45	1	CUP			
46	1	FORWARD GEAR (26 TEETH)			
47	1	BUSHING			
48	1	CAM FOLLOWER			
49	1	CLUTCH ASSEMBLY			
50	1	CROSS PIN			
51	1	SPRING			
52	1	PROPELLER SHAFT			
53	1	REVERSE GEAR (26 TEETH)			
54	1	BEARING CARRIER		85	115.2
55	1	O-RING			
56	1	BUSHING			
57	1	OIL SEAL			
58	1	OIL SEAL			
59	1	SCREW (M8 x 50)	180		20.3
60	2	SCREW (M8 x 30)	180		20.3
61	1	PROPELLER **(9-1/4 IN. x 7 IN.)**			
	1	PROPELLER **(9 IN. x 9 IN.)**			
	1	PROPELLER **(9-3/4 IN. x 6-1/2 IN.)**			
62	1	SPACER			
63	1	PROPELLER NUT	100		11.3
64	1	THRUST HUB			
65	1	HI-REVERSE THRUST CUP			

Gearcase Removal

⚠ WARNING

To prevent accidental engine starting, remove (and isolate) spark plug leads from spark plugs BEFORE removing gear housing.

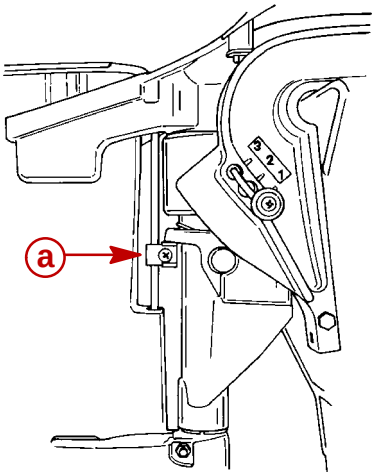
1. Remove and isolate spark plug leads from spark plugs.
2. Shift outboard into FORWARD gear.
3. Tilt outboard to full UP position.
4. Remove shift shaft retainer.



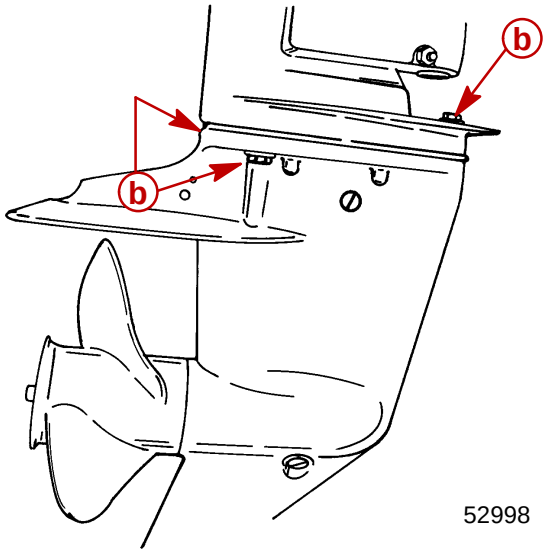
53049

a - Retainer

5. Remove reverse lock actuator.
6. Remove 3 bolts.



53004



52998

a - Actuator
b - Bolts (3)

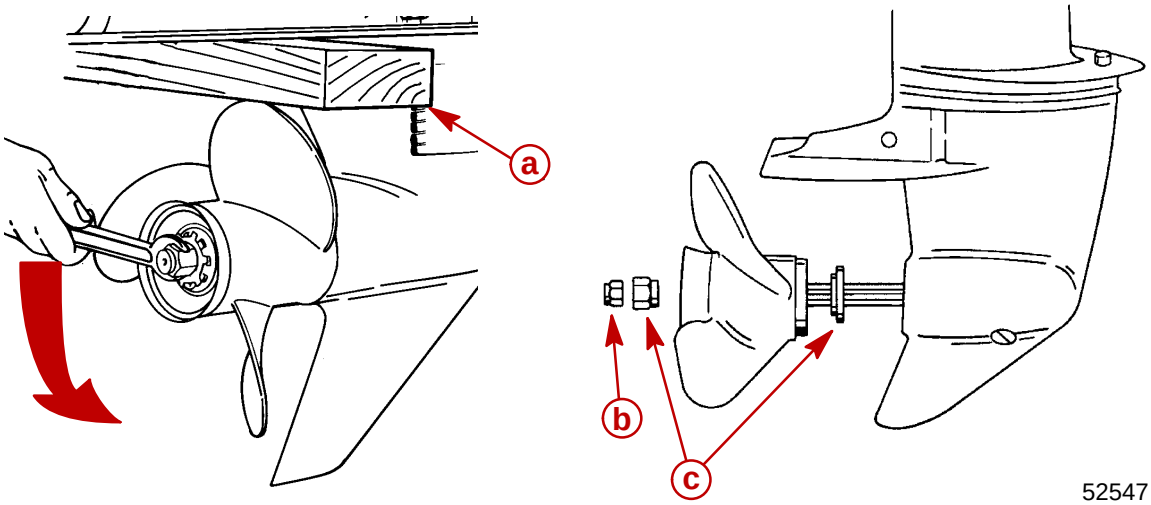
Gearcase Disassembly

Propeller Removal

⚠ WARNING

If gear housing is NOT removed from drive shaft housing, remove and isolate spark plug leads from spark plugs to prevent outboard from accidentally starting while removing and installing propeller.

1. Place a block of wood between anti-ventilation plate and propeller to prevent propeller from turning and to protect hands while removing prop.
2. Remove nut, thrust hubs and propeller.



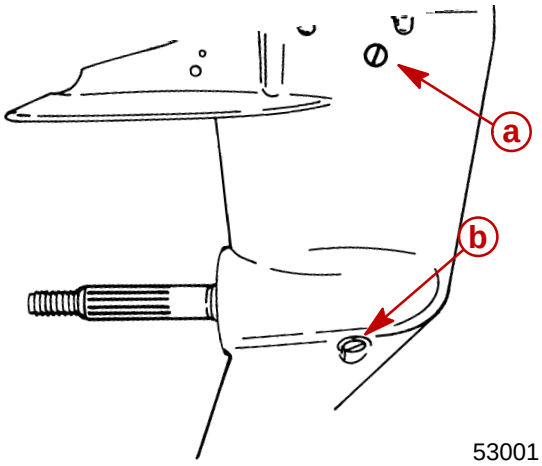
a - Wood
b - Nut
c - Thrust hub

Draining and Inspecting Gear Lubricant

1. Remove both VENT and FILL screws with gaskets.
2. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of large particles (chips) or a large quantity of fine particles indicates need for gear housing disassembly and component inspection.
3. Note color of gear lubricant. White or cream color indicates presence of water in lubricant.

NOTE: *When draining gearcase for the first time, lubricant may appear cream colored due to the mixing of assembly lubricant and gear lubricant. This is NOT an indication of water intrusion. If, during subsequent draining of gearcase, lubricant appears cream colored or milky, water may be present, gearcase should be disassembled and all gaskets, seals and O-rings replaced. Inspect all components for water damage.*

4. Check drain pan for water separation from lubricant. Presence of water in gear lubricant indicates the need for disassembly and inspection of oil seals, seal surfaces and gear housing components.

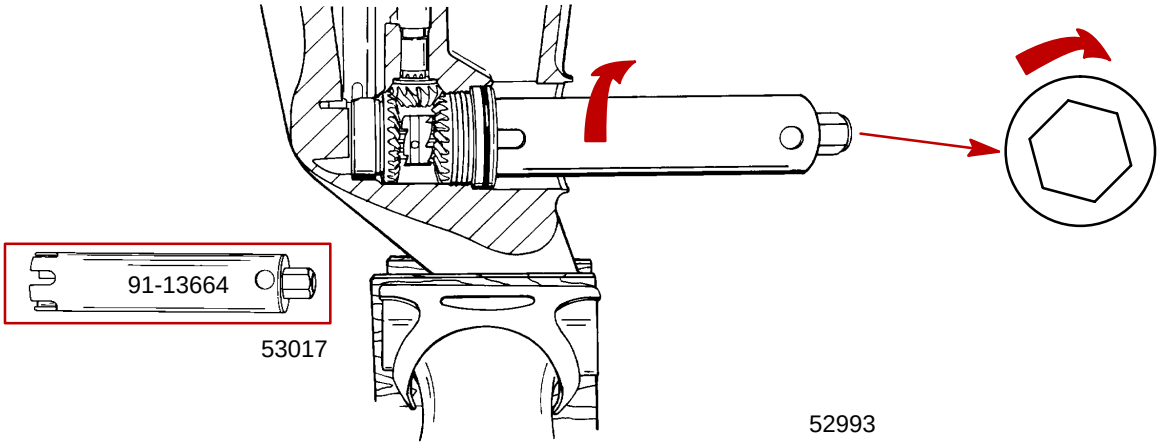


53001

a - Vent screw
b - Fill screw

Bearing Carrier

1. Remove bearing carrier (LEFT HAND thread) using Bearing Carrier Tool.

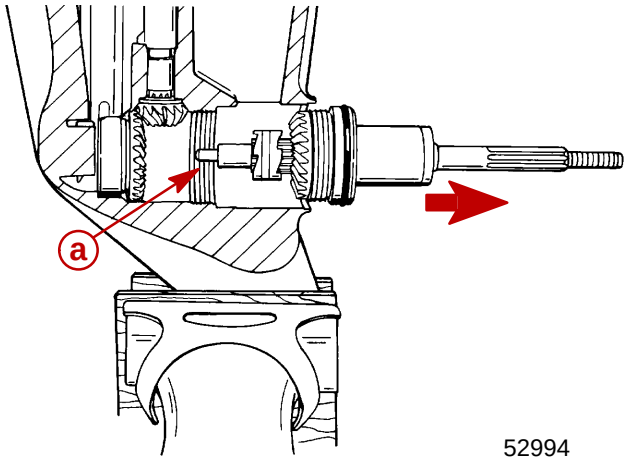


53017

52993

2. Remove carrier and propeller shaft assembly from housing.

NOTE: *Cam follower is free to slide out of propeller shaft.*



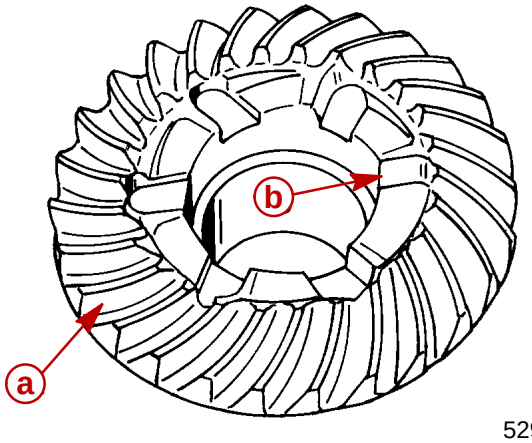
52994

a - Cam follower

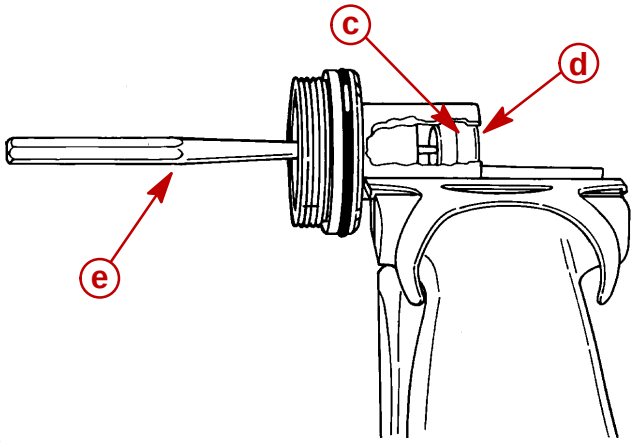
3. Remove propeller shaft and REVERSE gear from bearing carrier.
4. Replace REVERSE gear if gear teeth or clutch teeth are chipped or worn.

NOTE: *When using a punch to remove carrier seals, be careful to not to scar carrier seal surface with punch. If carrier seal surface is damaged, replace carrier.*

5. Using a suitable punch, remove both seals from bearing carrier.



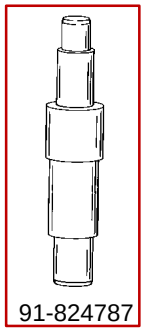
52988

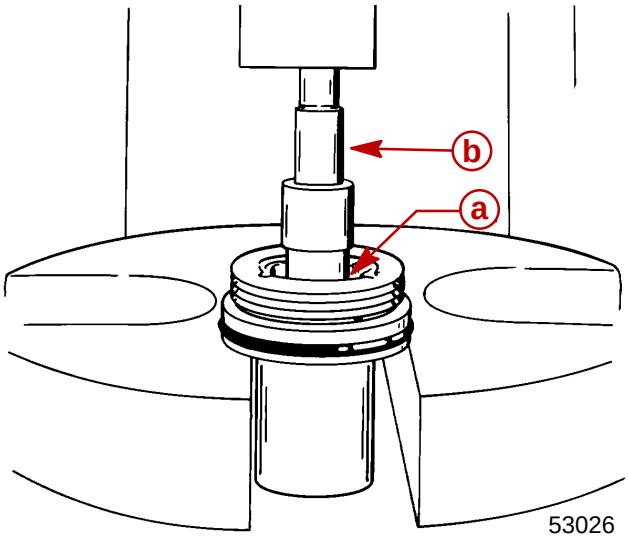


53002

a - Gear teeth
b - Clutch teeth
c - Oil seal
d - Fish line cutter seal
e - Punch

6. Replace bearing carrier bushing if bushing or area on propeller shaft that bushing contacts is pitted or worn. Press bushing from carrier using Bushing Removal Tool.


91-824787
53020

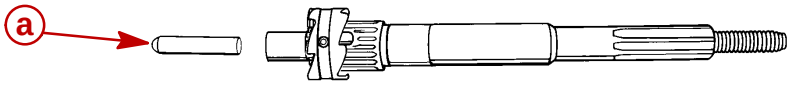


53026

a - Bushing
b - Bushing Removal Tool (91-824787)

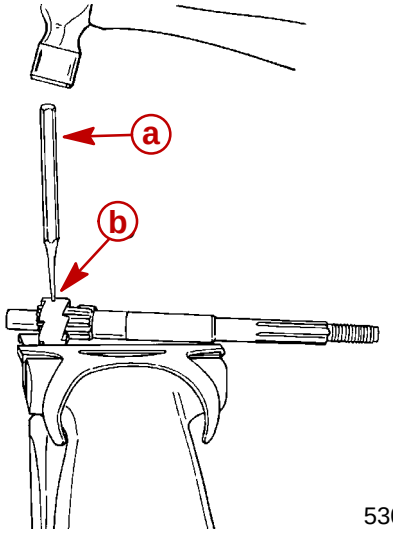
Propeller Shaft

1. Inspect cam follower for wear. If cam follower is worn, replace follower and inspect shift cam for serviceability. Replace cam if worn.



a - Cam follower

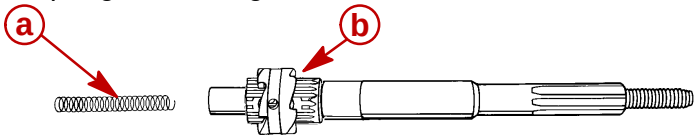
2. Remove groove pin from clutch/propeller shaft applying pressure to side of pin that is NOT grooved. Discard pin.



53013

a - Punch
b - Groove pin (discard)

3. Remove spring and sliding clutch.



53005

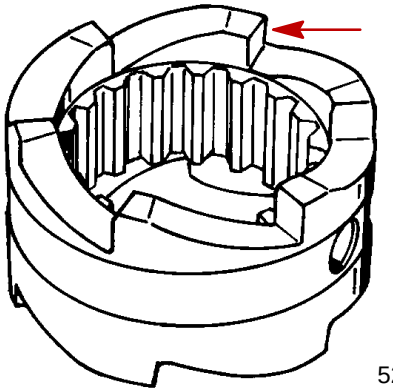
a - Spring
b - Clutch

4. Replace clutch if jaws are rounded or chipped. Rounded jaws may be caused by the following:

   a. Improper shift cable adjustment.

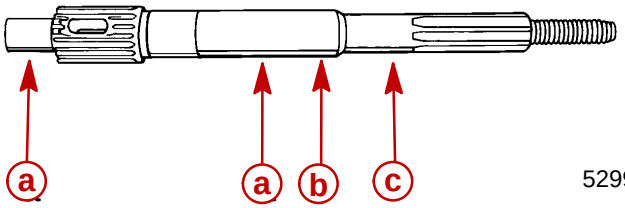
   b. Engine idle speed too high while shifting.

   c. Shifting too slowly from NEUTRAL into FORWARD or REVERSE.



52990

5. Inspect bushing surfaces of propeller shaft for pitting or wear. Replace shaft and corresponding bushing if wear or pitting is observed.
6. Replace shaft if any of the following exist:
   a. Splines are twisted or worn.
   b. Oil seal surface is grooved.
   c. Shaft has a noticeable wobble or is bent more than 0.15mm (.006 in.).



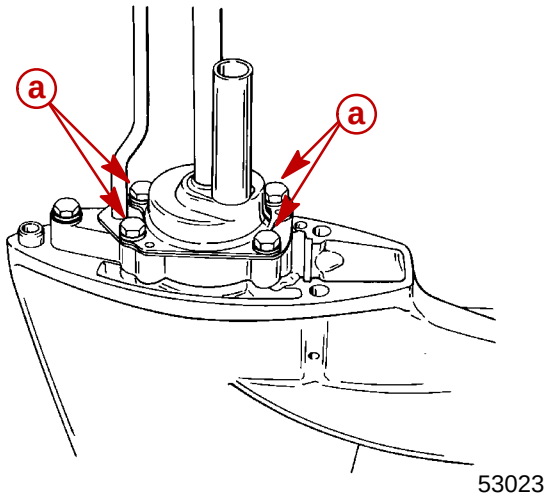
52997

a - Bushing surfaces
b - Oil seal surface
c - Measure here for wobble (When measuring shaft for wobble, use v-blocks and support at bushing surface)

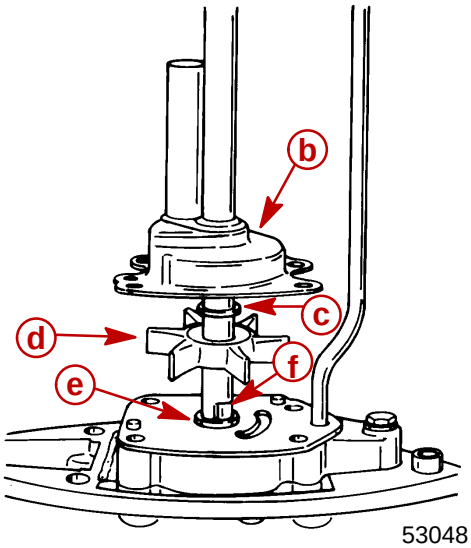
Water Pump, Drive Shaft and Shift Shaft

1. Remove 4 bolts from pump cover.
2. Remove cover, nylon washers above and below impeller, impeller and drive key from drive shaft.
3. It is recommended that impeller be replaced whenever gearcase is being serviced.

NOTE: *If impeller is not going to be replaced, DO NOT install impeller in reverse rotation to its original state as vanes have taken a set. Vanes will crack and break shortly after outboard is returned to service.*



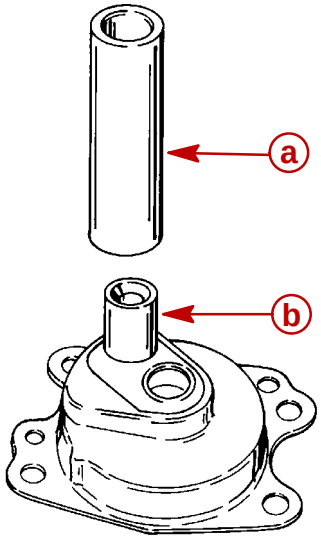
53023



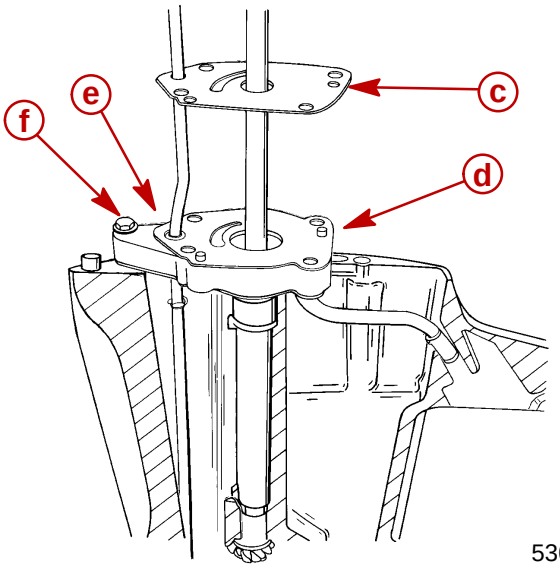
53048

a - Pump cover bolts (4)
b - Cover
c - Nylon washer
d - Impeller
e - Nylon washer
f - Key

4. Remove guide from cover.
5. Replace rubber seal if damaged.
6. Replace cover if inside is grooved.
7. Remove plate, gasket, quad-ring, bolt and washer.
8. Replace plate if grooved.



53032

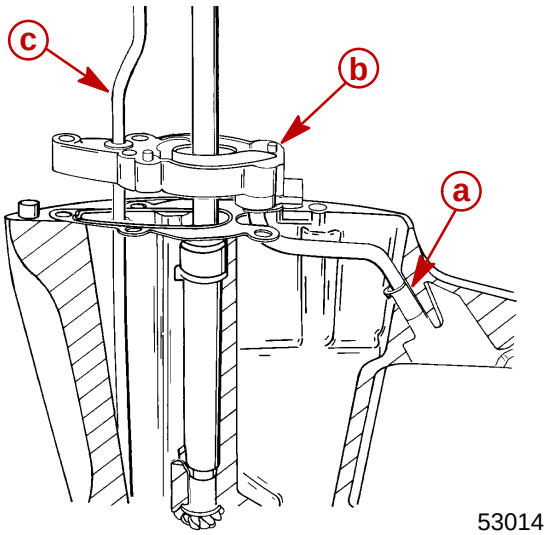


53012

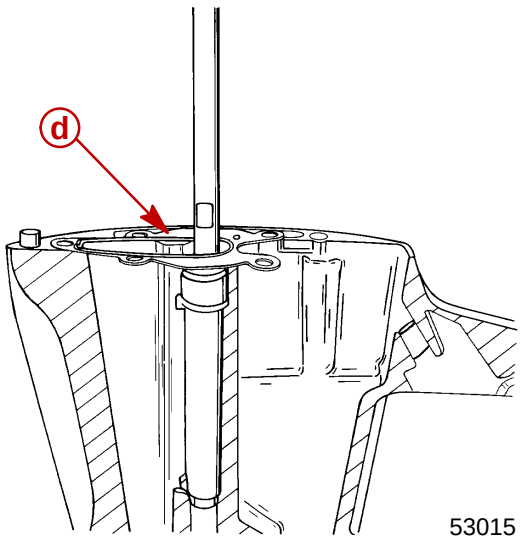
a - Guide
b - Seal
c - Plate
d - Gasket (discard)
e - Quad-ring
f - Bolt and washer

9. Replace seal if damaged.

10. Remove water pump base and shift shaft from housing.
11. Remove gasket.



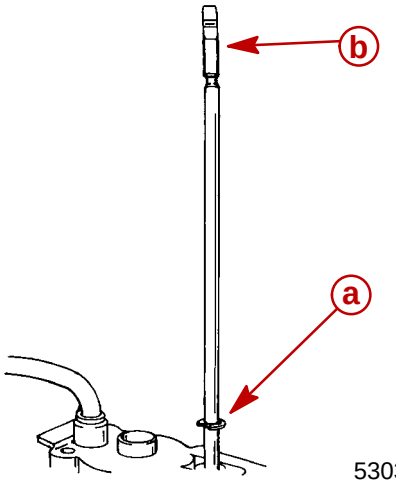
53014



53015

a - Seal
b - Pump base
c - Shift shaft
d - Gasket (discard)

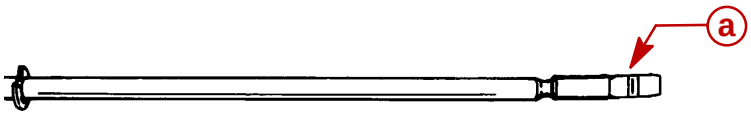
12. Remove clip from shift shaft. Unthread shift cam. Remove shaft from water pump base.



53034

a - Clip
b - Shift cam

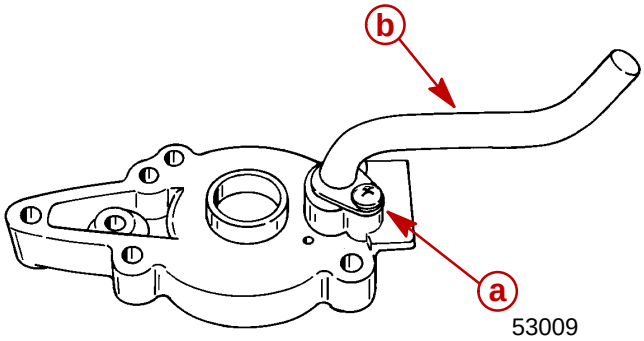
13. Inspect shift cam for wear. Replace if worn.



53034

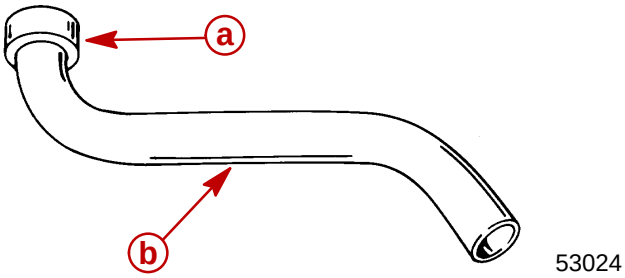
a - Shift cam

14. Remove screw and pull water tube from base.



a - Screw
b - Water tube

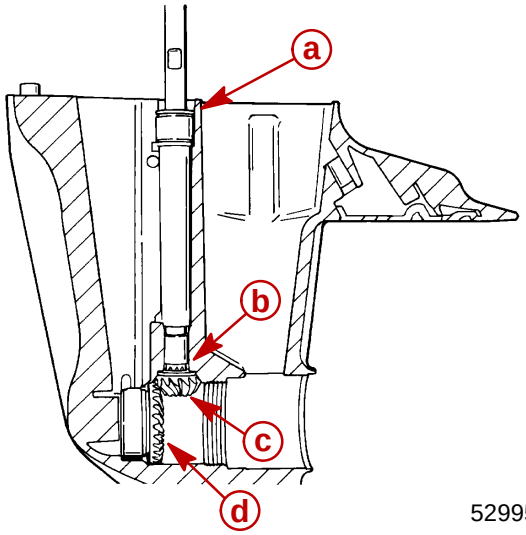
15. Replace seal if damaged. Replace water tube if corroded.



a - Seal
b - Water tube

16. Remove drive shaft from gear housing.

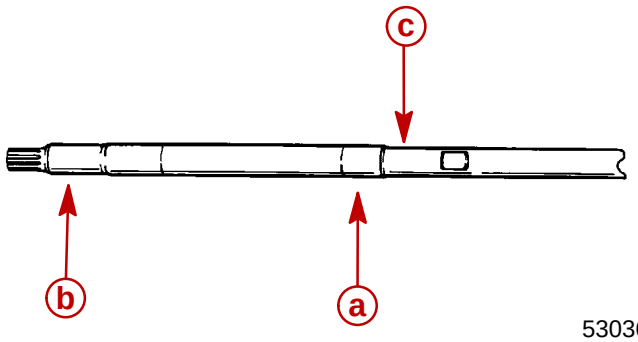
NOTE: *Thrust washers, pinion gear and forward gear assembly are free to fall from housing when drive shaft is removed.*



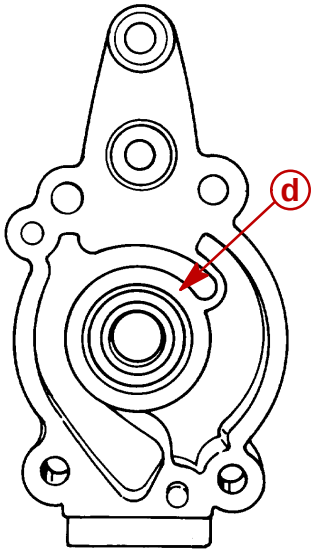
a - Thrust washer (without oil groove)
b - Thrust washer (with oil groove – groove faces down)
c - Pinion gear
d - Forward gear assembly

17. Inspect bearing/bushing surfaces of drive shaft for pitting or wear. If shaft is pitted or worn, replace shaft and corresponding bearing/bushing.

18. Replace drive shaft if the following exist:
    a. Splines are twisted or worn.
    b. Oil seal surface is grooved.
19. Using a screw driver or punch, carefully remove (and discard) seals from pump base.



53036



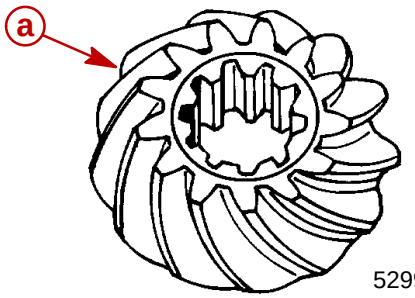
53010

a - Bushing surface
b - Bearing surface
c - Seal surface
d - Seals

Pinion Gear and Forward Gear

PINION GEAR

1. Inspect pinion gear teeth for breakage, rust, chipping or excessive wear.
2. If pinion gear teeth are damaged, inspect FORWARD and REVERSE gear for damage.
3. Replace gears as required.

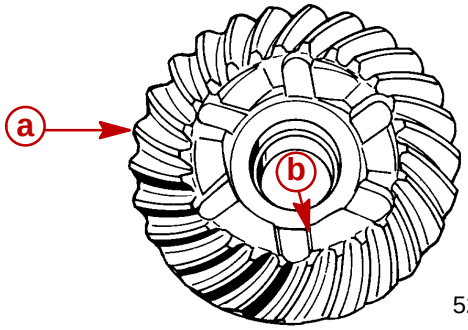


52991

a - Pinion gear

FORWARD GEAR

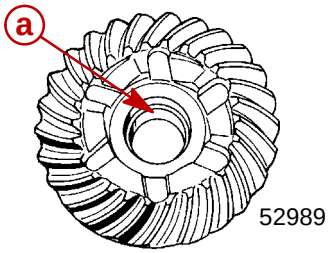
1. Inspect forward gear teeth for breakage, rust, chipping and excessive wear.
2. Inspect forward gear clutch jaws for wear. Rounded jaws indicate the following:
   a. Improper shift cable adjustment.
   b. Engine idle speed too high.
   c. Shifting too slowly.



52989

a - Gear teeth
b - Clutch teeth

3. Inspect propeller shaft FORWARD gear bushing surface to determine condition of bushing. If surface is discolored from lack of lubricant, pitted or worn, propeller shaft and bushing should be replaced.



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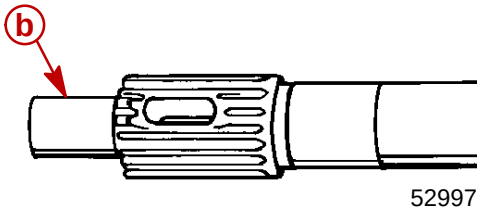
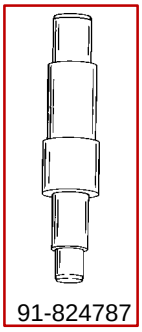
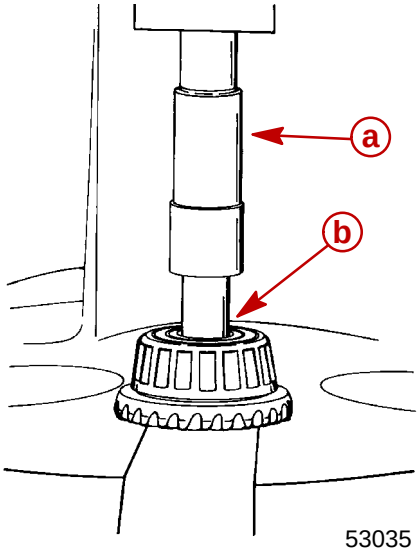


52997

a - Bushing
b - Bushing surface

4. If necessary, press bushing from gear using Bushing Removal Tool.



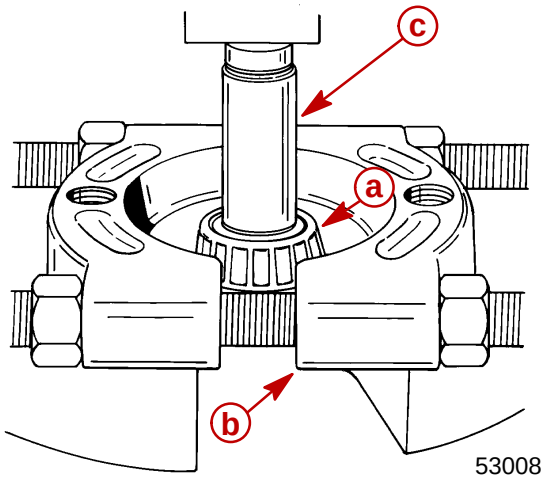


a - Bushing
b - Bushing Removal Tool (91-824787)

IMPORTANT: If FORWARD gear tapered bearing or race requires replacement, replace bearing and race as a set.

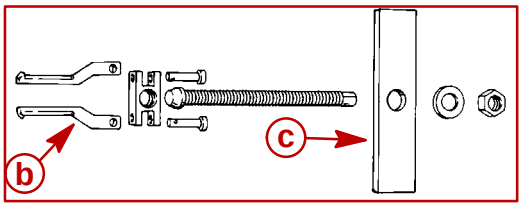
NOTE: *DO NOT remove tapered bearing from FORWARD gear unless replacement is necessary as removal process will damage bearing.*

5. Inspect FORWARD gear tapered bearing and race for rust, roughness or excessive wear.
6. If bearing is in serviceable condition, DO NOT remove bearing from gear as removal process will damage bearing.
7. If bearing must be replaced, remove bearing from gear using Universal Puller Plate and a suitable mandrel.

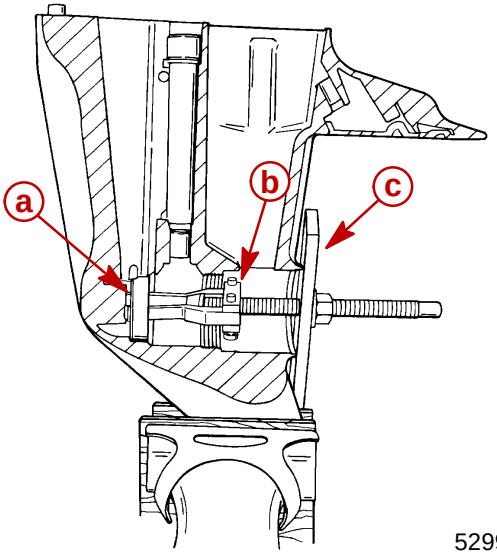


a - Bearing
b - Universal Puller Plate (91-37241)
c - Mandrel

8. Replace FORWARD gear race if it is rusted or damaged or if FORWARD gear tapered bearing must be replaced. Remove race from housing using Bearing Puller Assembly and Puller Plate.



53031

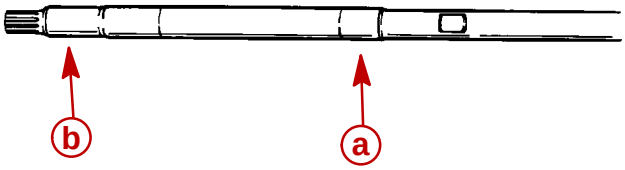


52996

a - Race
b - Bearing Puller Assembly (91-83165M)
c - Puller Plate (91-29310)

Drive Shaft Bushing, Bearing and Lubrication Sleeve

1. Inspect drive shaft bushing and bearing surface to determine condition of corresponding upper drive shaft bushing and lower drive shaft needle bearing. If drive shaft surface is rusted, pitted, discolored (blued – lack of lubrication) or worn; replace drive shaft and corresponding bushing/bearing. DO NOT remove bushing or bearing if replacement is not necessary.



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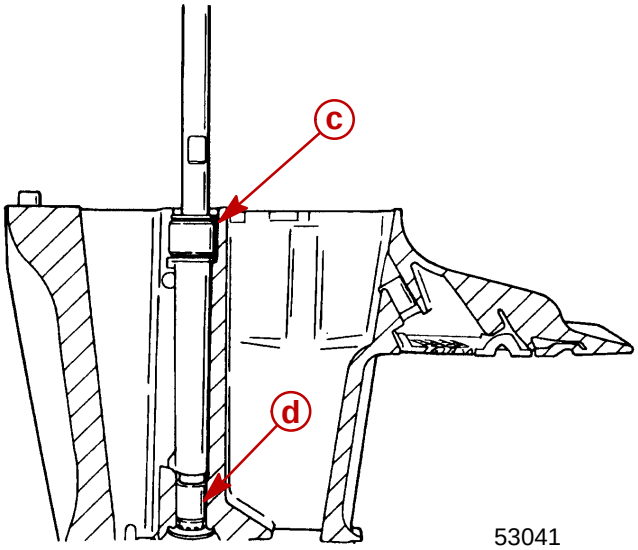
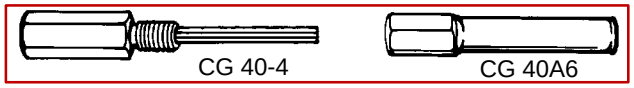


53041

a - Bushing surface
b - Bearing surface
c - Upper drive shaft bushing
d - Lower drive shaft needle bearing

IMPORTANT: If upper drive shaft bushing or lower drive shaft needle bearing appear to be spinning in their respective bores, the gear housing should be replaced.

2. To replace upper drive shaft bushing, use
   Snap On* Expanding Rod (CG 40-4)
   Snap On Collet (CG 40A6)
   Slide Hammer (91-34569A1)
   *Purchase from: Snap On Tools Corporation
   2801 - 80th Street
   Kenosha, WI 53141-1410



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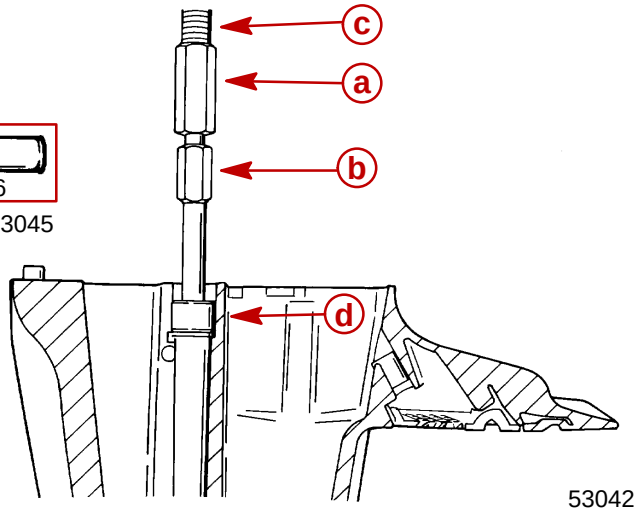


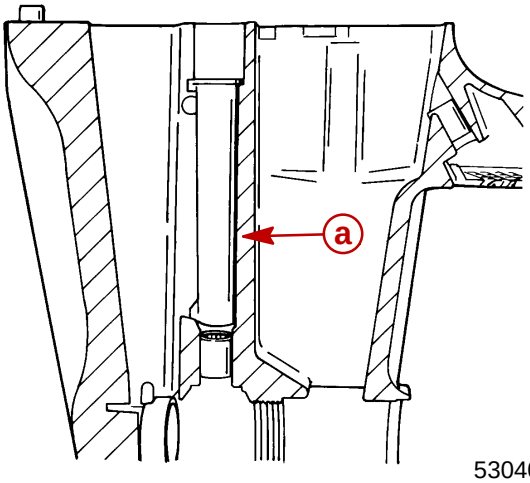
53042

a - Expanding Rod (CG 40-4)
b - Collet (CG 40A6)
c - Slide Hammer (91-34569A1)
d - Bushing

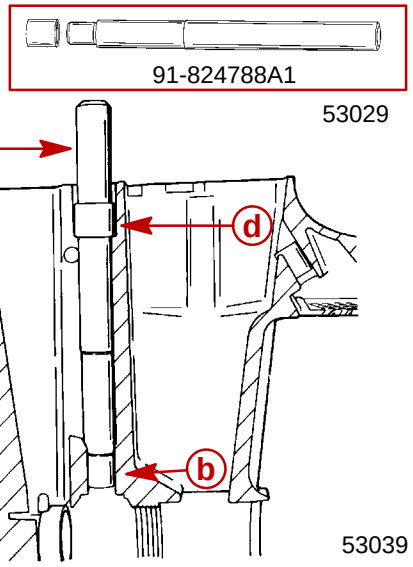
3. To gain access to lower drive shaft needle bearing, remove lubrication sleeve.

NOTE: *When upper drive shaft bushing is installed, a burr may be formed preventing the removal of the lubrication sleeve. Use a knife to remove burr.*

4. Remove needle bearing using Drive Shaft Bearing Removal Tool (91-824788A1).



53040



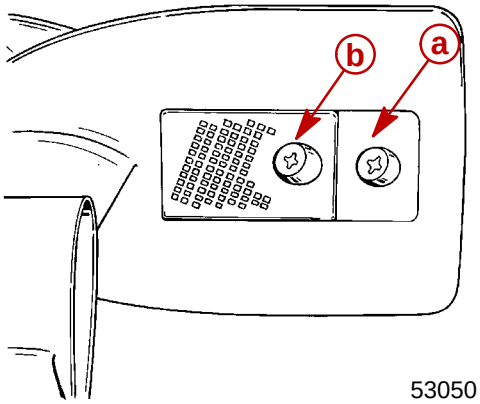
53029

53039

a - Lubrication Sleeve
b - Needle Bearing
c - Driver Shaft Bearing Removal Tool
d - Pilot

Aluminum Anode and Water Inlet

1. Replace aluminum anode if more than 50% consumed.
2. Remove water inlet and check that holes are not obstructed.

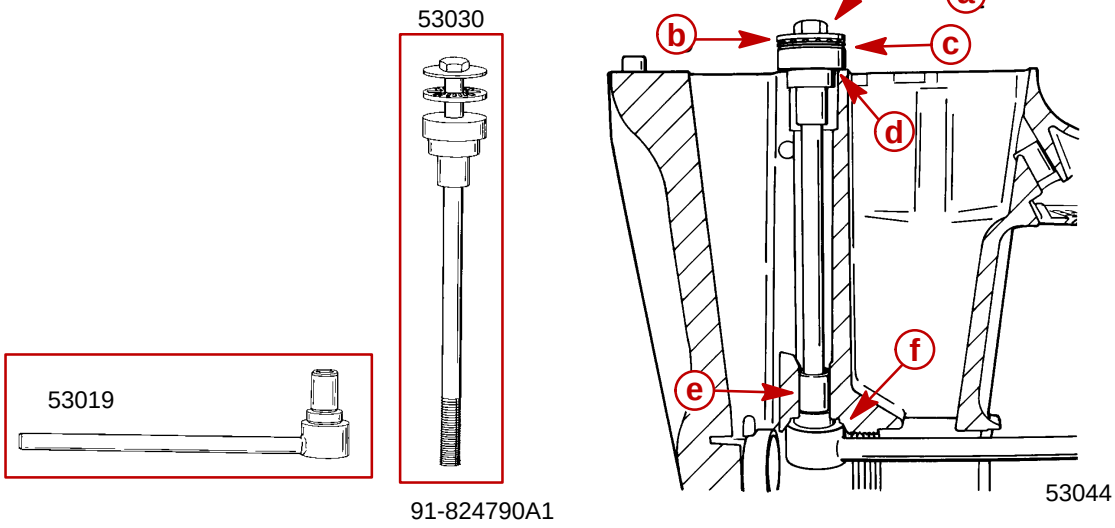


a - Aluminum anode
b - Water inlet

Reassembly

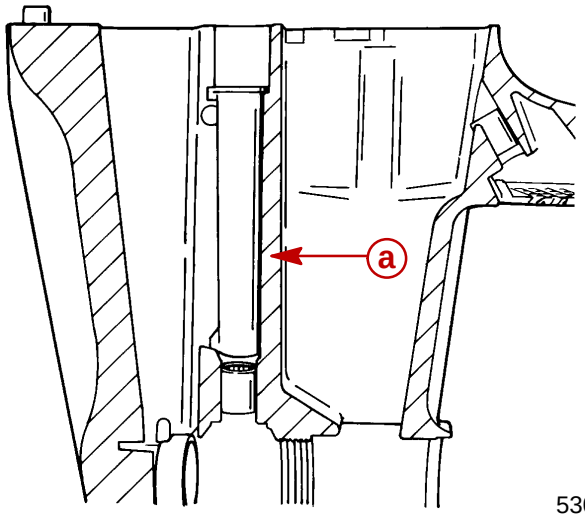
Drive Shaft Needle Bearing, Bushing and Lubrication Sleeve Installation

1. Install lower drive shaft needle bearing (numbers/letters face down) using Drive Shaft Bushing Tool.



a - Puller bolt
b - Flat washer
c - Wafer bearing
d - Pilot
e - Needle bearing
f - Mandrel

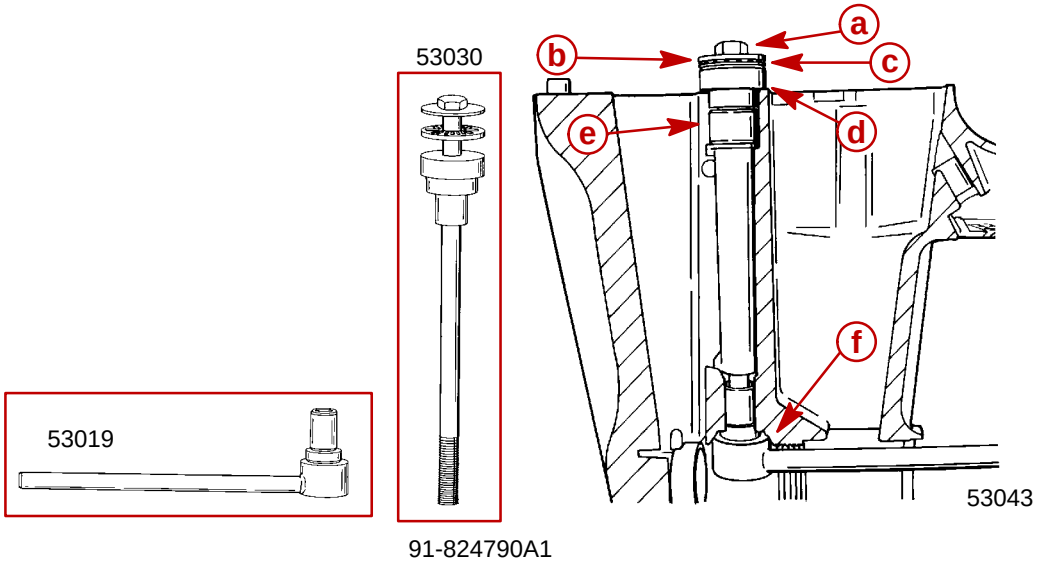
2. Install lubrication sleeve.



a - Sleeve

3. Install upper drive shaft bushing assembly using Drive Shaft Bushing Tool.

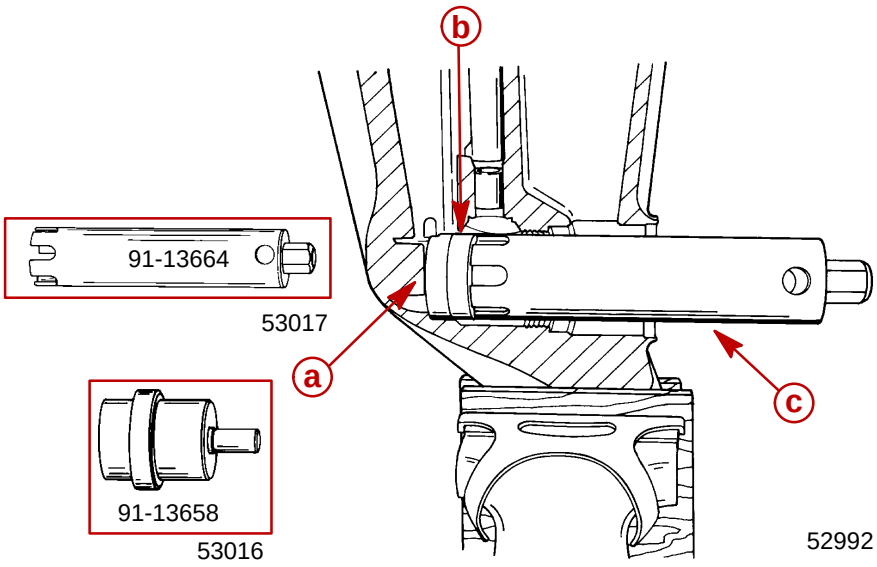
NOTE: *The upper drive shaft bushing is pressed into a sleeve. If the bushing is not worn into the sleeve or the bushing is not spinning within the sleeve, the bushing alone may be replaced. Press the new bushing into the sleeve using a suitable mandrel. If the sleeve is damaged, the bushing/sleeve assembly must be replaced.*



a - Puller bolt
b - Flat washer
c - Wafer bearing
d - Pilot
e - Bushing/Sleeve
f - Mandrel

Forward Gear Bearing Race Installation

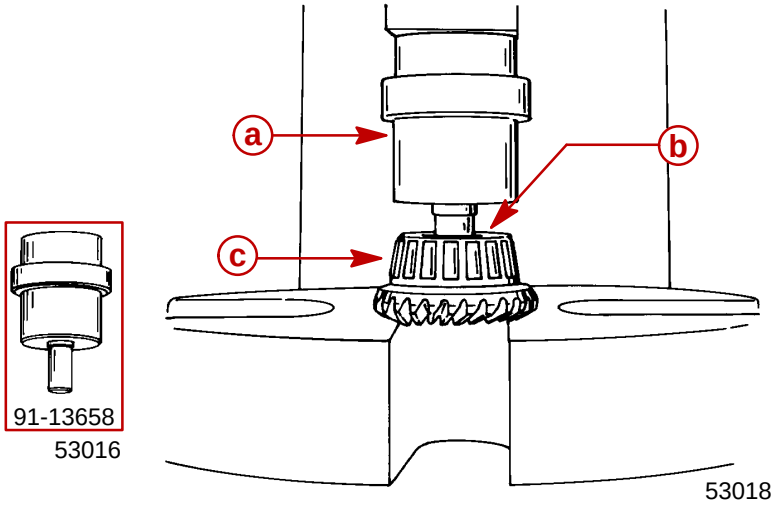
Install race into housing using Mandrel and Bearing Carrier Tool.



a - Race
b - Mandrel (91-13658)
c - Bearing Carrier Tool (91-13664)

Forward Gear Reassembly

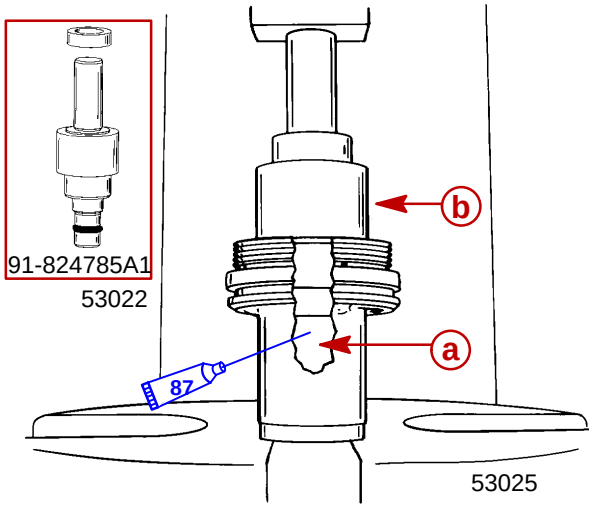
Install bushing and bearing using Mandrel and press.

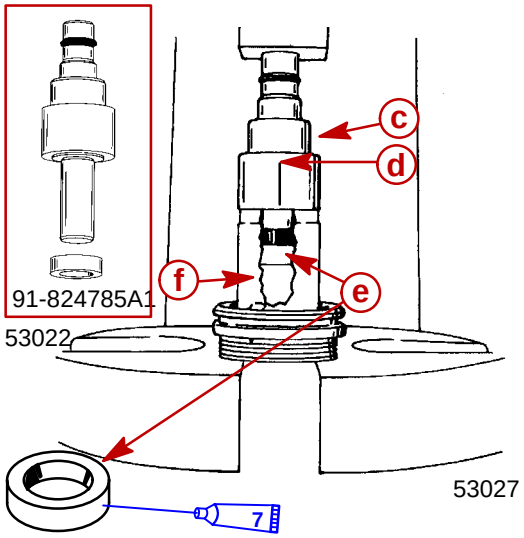


a - Mandrel (91-13658)
b - Bushing
c - Bearing

Bearing Carrier Reassembly

1. Apply High Performance Gear Lubricant to bushing and press bushing into carrier using Mandrel.
2. Apply Loctite 271 to O.D. of seal and with lip facing bushing, press seal into carrier using Mandrel.



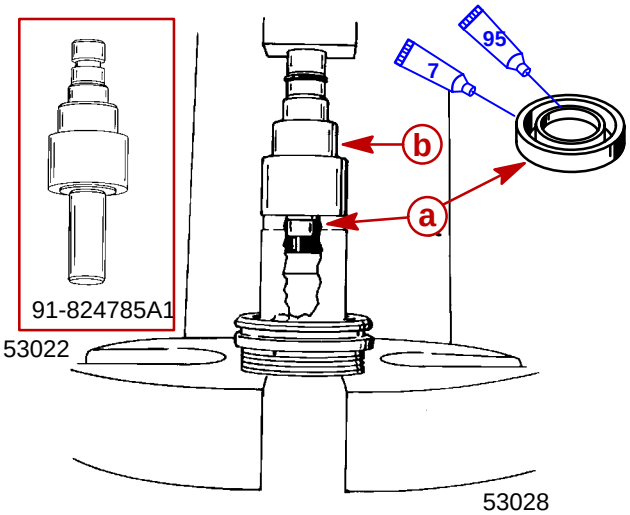


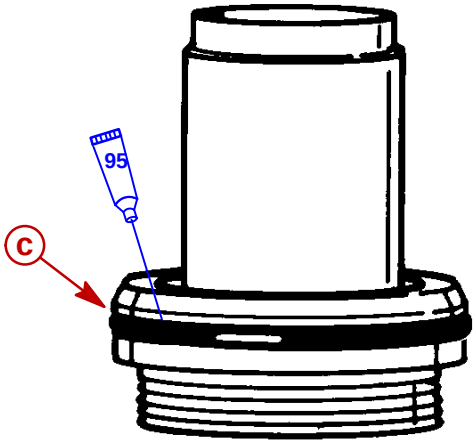
87 High Performance Gear Lubricant

7 Loctite 271

- **a** - Bushing
- **b** - Mandrel (91-824785A1)
- **c** - Mandrel (91-824785A1)
- **d** - Ring (used with mandrel)
- **e** - Seal (LIP FACES BUSHING)
- **f** - Bushing

3. Apply Loctite 271 to O.D. of fishline cutter seal. With ring removed from Mandrel, press seal, with LIP FACING Mandrel, into carrier. Apply 2-4-C with Teflon between lips of both seals.
4. Apply 2-4-C with Teflon to O-ring and install O-ring on carrier.





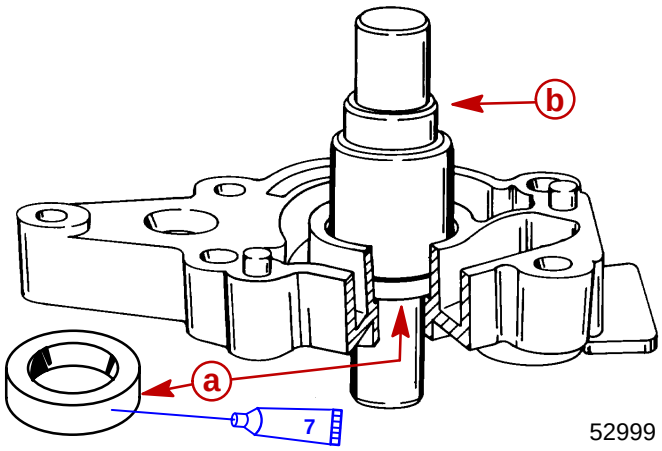
7 Loctite 271

95 2-4-C with Teflon

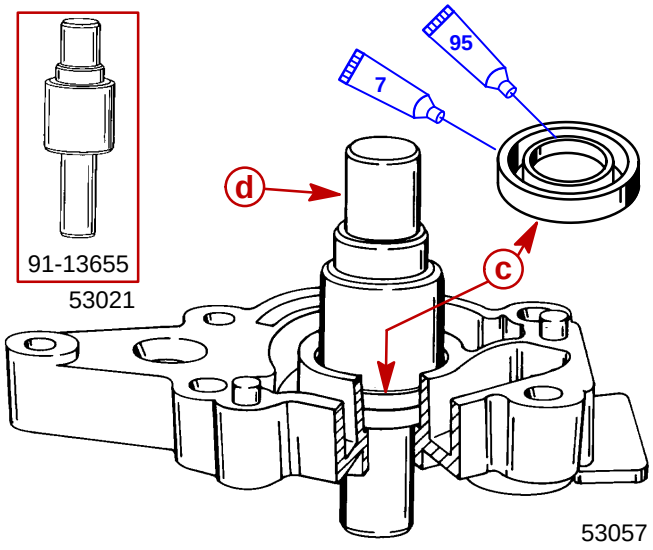
- **a** - Fishline cutter seal (LIP FACES MANDREL)
- **b** - Mandrel (without ring – 91-824785A1)
- **c** - O-ring

Water Pump Base and Shift Shaft Reassembly

1. Apply Loctite 271 to O.D. of seal. With lip of seal facing DOWN, push seal into base using Mandrel.
2. Apply Loctite 271 to O.D. of seal. With seal lip facing UP, push seal into base using Mandrel. Apply 2-4-C with Teflon between lips of both seals.



52999



53021

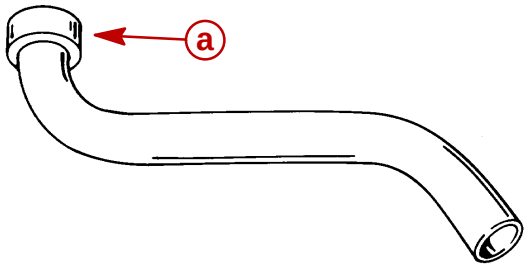
53057

7 Loctite 271

95 2-4-C with Teflon

- **a** - Seal (Lip FACES DOWN)
- **b** - Mandrel (91-13655)
- **c** - Seal (Lip FACES UP)
- **d** - Mandrel (91-13655)

3. Install seal onto water tube.
4. Secure water tube to pump base with retainer and screw.



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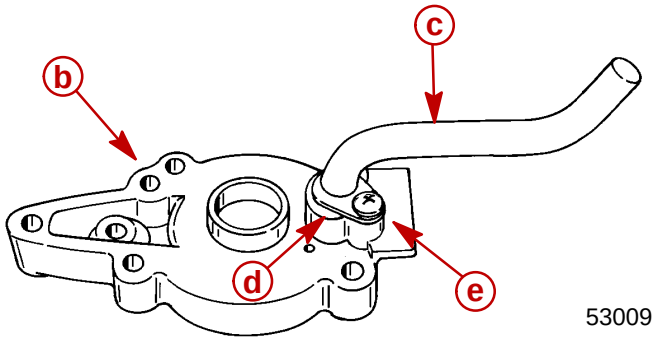
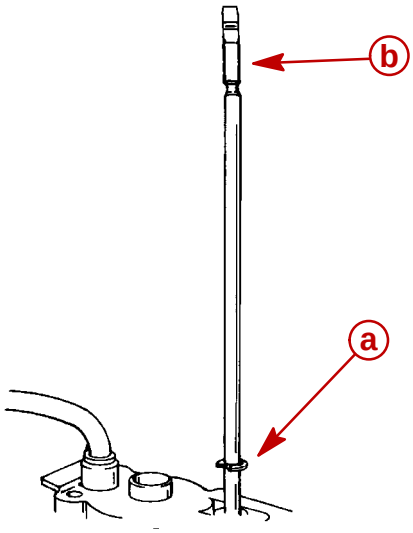


53009

- **a** - Seal
- **b** - Pump base
- **c** - Water tube
- **d** - Retainer
- **e** - Screw

5. Install shift shaft through pump base.
6. Install E-clip on shift shaft. Clip must be below pump base.
7. Thread shift cam onto shaft.

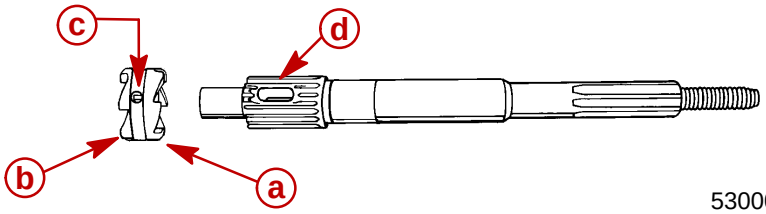


53034

a - E-clip
b - Shift cam

Propeller Shaft Reassembly

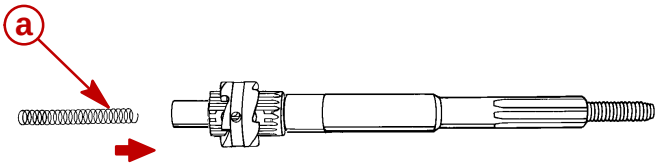
1. Slide clutch onto propeller shaft.



53000

a - Sliding clutch
b - Short end (FORWARD gear side)
c - Hole (must align with slot)
d - Slot

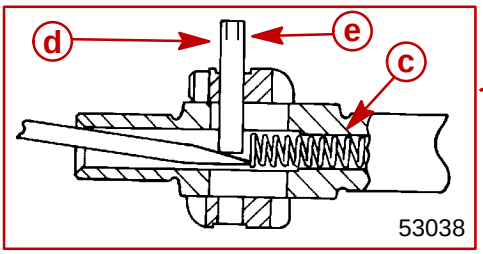
2. Insert cam follower spring into shaft.

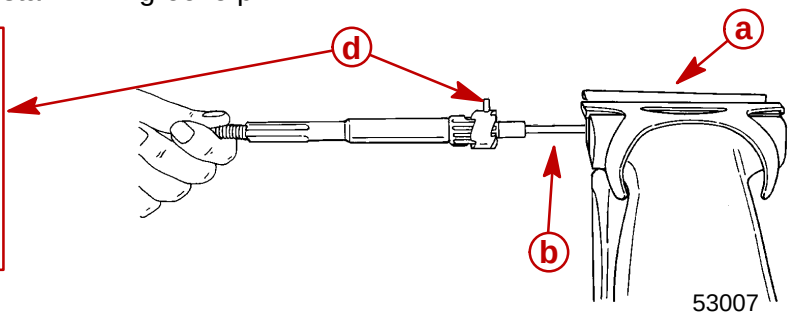


53005

a - Spring

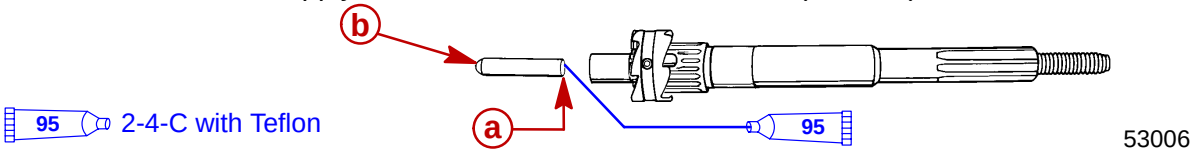
3. Compress spring and install NEW groove pin.





a - Vise
b - Screwdriver or small punch
c - Spring
d - Groove pin (press in until flush)
e - Serrations

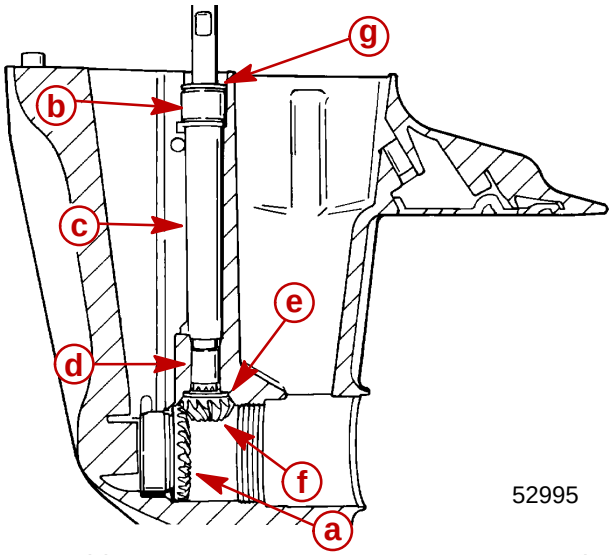
4. Apply 2-4-C with Teflon to cam follower (flat side) and install follower into shaft.



a - Cam Follower
b - Flat Side

Forward Gear, Pinion Gear and Drive Shaft Installation

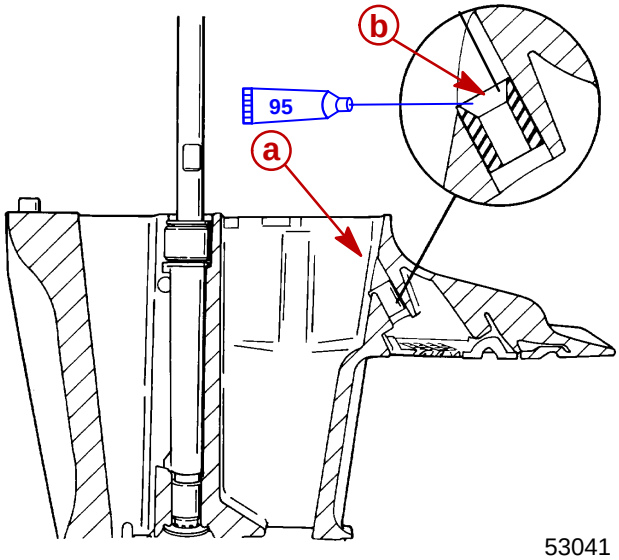
1. Install FORWARD gear assembly into forward gear race.
2. Install drive shaft through upper drive shaft bushing, oil sleeve and lower drive shaft needle bearing.
3. While lifting drive shaft slightly, install lower thrust washer (GROOVED SIDE FACES DOWN) and PINION gear. It may be necessary to rotate drive shaft slightly to engage pinion gear with splines of drive shaft and with forward gear teeth.
4. Install upper thrust washer above upper drive shaft bushing.



a - FORWARD gear assembly
b - Drive shaft bushing
c - Oil sleeve
d - Needle bearing
e - Lower thrust washer (GROOVED SIDE FACES DOWN)
f - Pinion gear
g - Upper thrust washer

Shift Shaft and Water Pump Base Installation

1. Apply 2-4-C with Teflon to I.D. of seal.
2. Install seal in housing with tapered end facing up.
3. Install base gasket with drain hole positioned as shown.



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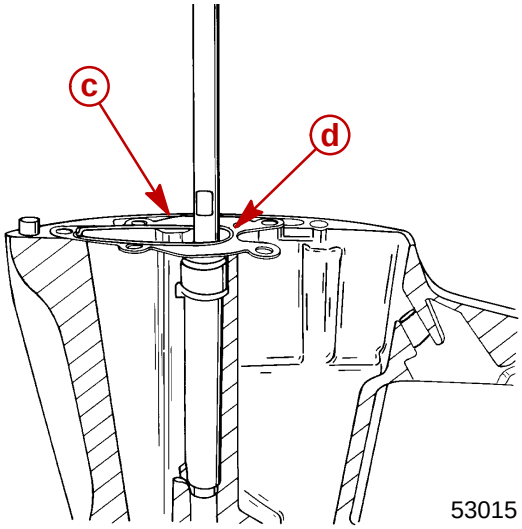


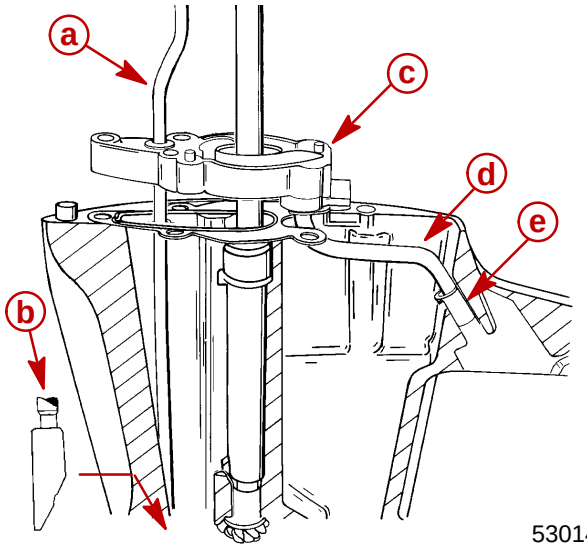
53015

95 2-4-C with Teflon

- **a** - Seal
- **b** - Tapered I.D.
- **c** - Base gasket
- **d** - Hole

IMPORTANT: Verify seal is not pushed out of position when water tube is installed.

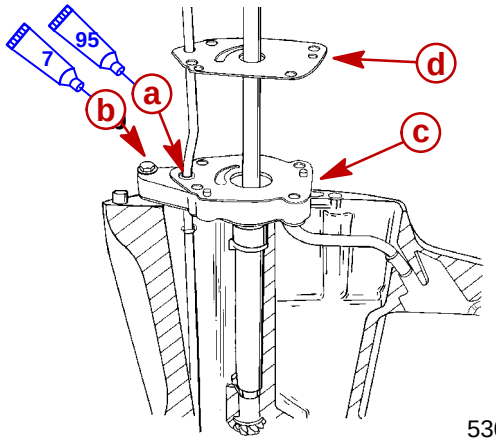
4. Slide water pump base with shift shaft down drive shaft. Align water tube with seal in housing while seating water pump base.



53014

- **a** - Shift shaft
- **b** - Shift cam (POSITION AS SHOWN)
- **c** - Pump base
- **d** - Water tube
- **e** - Seal

5. Apply 2-4-C with Teflon to I.D. and O.D. of shift shaft quad ring. Seat quad ring in pump base.
6. Apply Loctite 271 to bolt threads and secure pump base to housing with bolt and washer. Torque bolt to 5.6 Nm (50 lb in.).
7. Install gasket and face plate.



53012

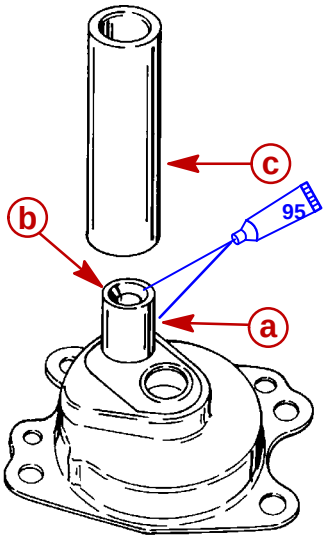
7 Loctite 271

95 2-4-C with Teflon

a - Quad ring
b - Bolt and washer [Torque to 5.6 Nm (50 lb. in.)]
c - Gasket
d - Face plate

Water Pump Cover Reassembly

1. Apply 2-4-C with Teflon to O.D. of seal and seal surface.
2. Install seal into cover.
3. Place water tube guide onto seal.



53032

95 2-4-C with Teflon

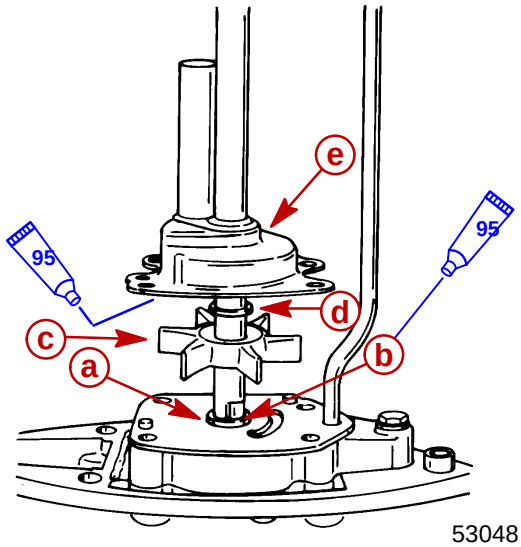
a - Seal
b - Seal surface
c - Guide

Impeller and Pump Cover Installation

1. Install neoprene washer.
2. Install drive key. Use 2-4-C with Teflon to hold key to drive shaft.

IMPORTANT: It is recommended that the impeller be replaced regardless of appearance. If impeller must be reused, it must be installed in the direction of original rotation. Installing impeller with vanes reversed from their previous set will result in vane breakage shortly after unit is returned to service.

3. Install new impeller and align with drive key.
4. Install neoprene washer.
5. Lubricate I.D. of water pump cover with 2-4-C with Teflon.
6. Install cover on drive shaft and while pushing down on cover, rotate drive shaft CLOCKWISE and install cover over impeller.
7. Apply Loctite 271 to threads of bolts. Secure cover with bolts and torque to 5.6 Nm (50 lb. in.) per following numbered torque sequence.



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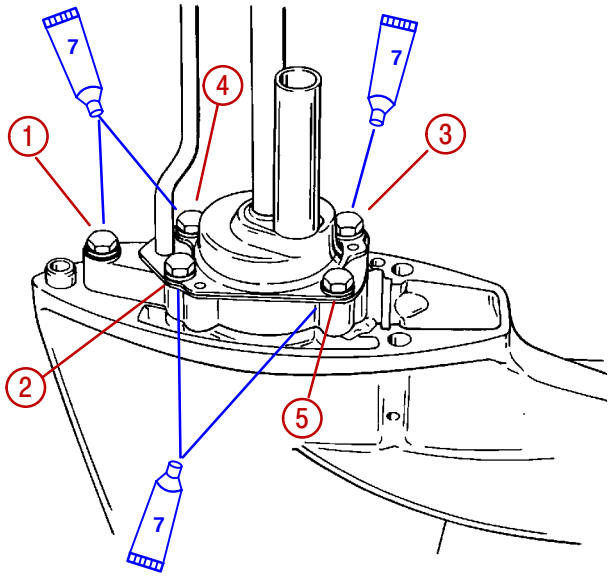


53023

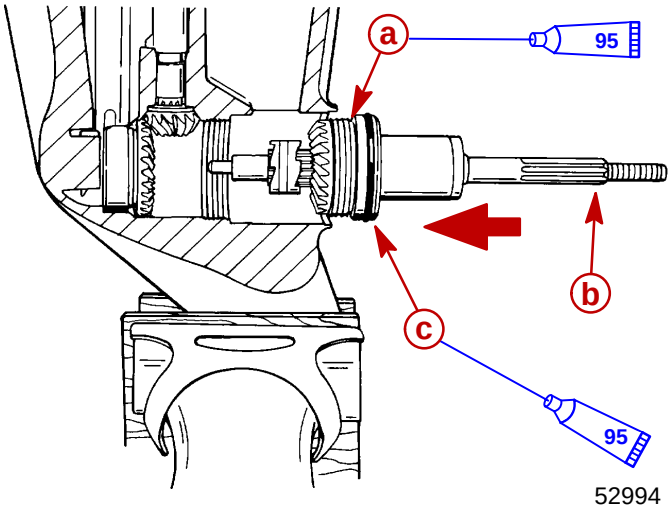
7 Loctite 271

95 2-4-C with Teflon

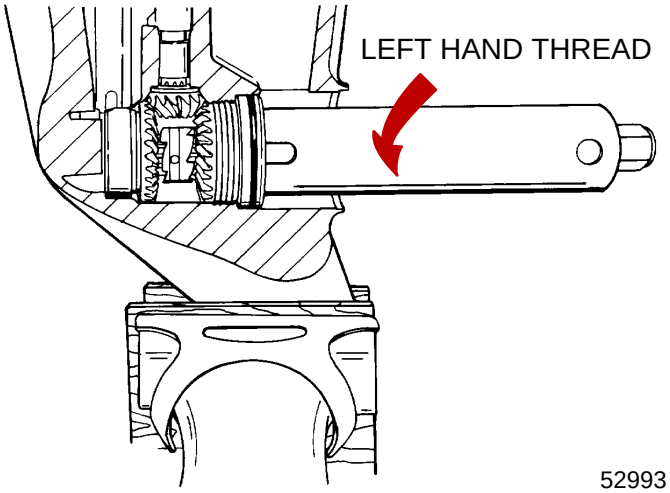
a - Neoprene washer
b - Drive key
c - Impeller
d - Neoprene washer
e - Cover

Propeller Shaft and Bearing Carrier Installation

1. Install REVERSE gear into bearing carrier.
2. If not previously lubricated, apply 2-4-C with Teflon to o-ring.
3. Apply 2-4-C with Teflon to bearing carrier threads and pilot diameter.
4. Slide bearing carrier onto propeller shaft and install entire assembly into gear housing.
5. Torque bearing carrier to 115.2 Nm (85 lb. ft.) using Bearing Carrier Tool (91-13664).



52994



52993

95 2-4-C with Teflon

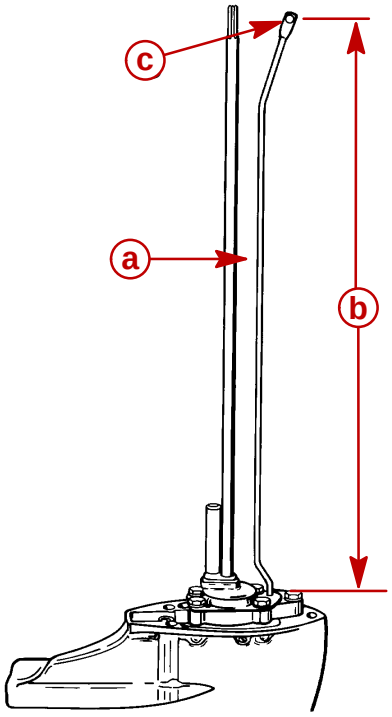
a - Bearing carrier threads
b - Propeller shaft
c - Pilot diameter

Installation

⚠ WARNING

To prevent accidental engine starting, remove and isolate spark plug leads from spark plugs. BEFORE installing gear housing.

1. Remove and isolate spark plugs leads from spark plugs.
2. Place shift linkage on engine in FORWARD gear position.
3. Tilt engine to full up position.
4. Place gear housing in NEUTRAL. Propeller will rotate freely in either direction when gear housing is in NEUTRAL.
5. Position shift shaft as shown when measuring distance in Step 6.
6. Distance between top of water pump base and center of hole, must be as specified below. Turn shift shaft clockwise to decrease distance or counter clockwise to increase distance.

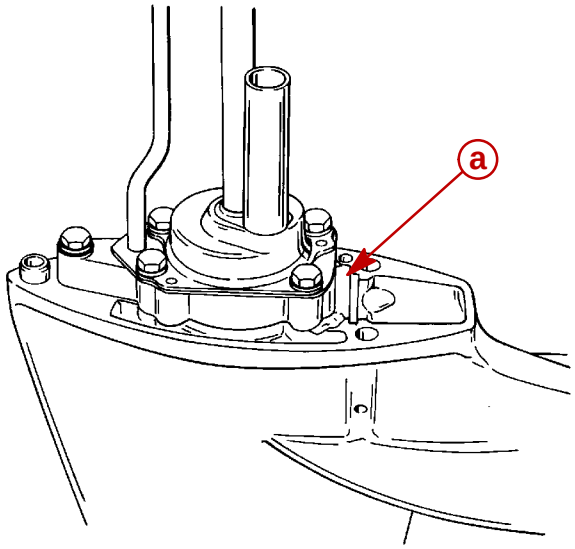


53051

a - Shift shaft
b - Shaft distance
c - Center of hole

Drive Shaft Length	Distance
Short	419mm (16-1/2 in.)
Long	559mm (22 in.)
Extra Long	698mm (27-1/2 in.)

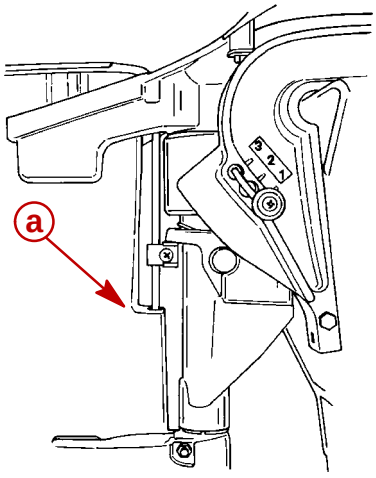
7. Place gear housing in FORWARD gear. Gear housing will ratchet when propeller shaft is turned clockwise.
8. Apply a 6.4mm (1/4 in.) diameter bead of RTV Sealer on water pump base.



53023

a - RTV Sealer

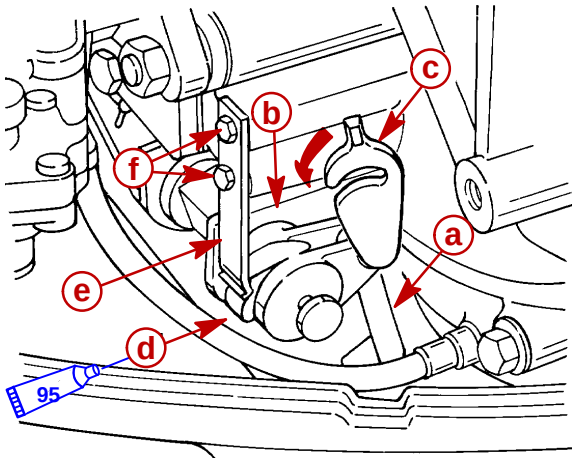
9. Install gear housing as follows:
   a. Position gear housing so that drive shaft and shift shaft extend into drive shaft housing.
   b. Move gear housing toward drive shaft housing while keeping mating surfaces parallel.
   c. Guide shift shaft through hole in mid-section.
   d. Guide water tube into water tube guide.
   e. Rotate propeller counterclockwise while pushing upward on gear housing to align drive shaft splines with crankshaft splines.
   f. Guide end of shift shaft into shift coupling yoke under cowl.



53004

a - Shift shaft hole

10. Secure detent spring to block with 2 bolts. Spring may have slotted holes. Install spring so that it is raised UP and at end of slot travel. Torque bolts to 2.8 Nm (25 lb. in.).
11. Secure end of shift shaft to yoke of horizontal shift shaft with coupler. Rotate coupler until it locks in place.

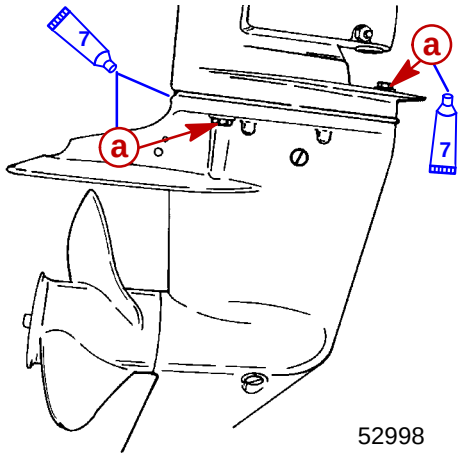


53052

95 2-4-C with Teflon

a - Shift shaft
b - Yoke
c - Coupler
d - Apply 2-4-C with Teflon
e - Detent spring
f - Bolts [Torque to 2.8 Nm (25 lb. in.)]

12. Apply Loctite 271 to 3 bolts and torque to 20.3 Nm (15.0 lb. ft.).



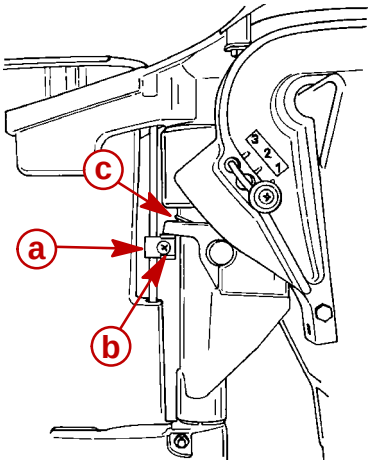
52998

7 Loctite 271

a - Bolts [Torque to 20.3 Nm (15.0 lb. ft.)]

13. Check shift operation as follows:
    a. Place shift lever in FORWARD. Gear housing should ratchet when propeller shaft is turned clockwise and resistance should be felt when propeller is turned counterclockwise.
    b. Place shift lever in NEUTRAL. Resistance should NOT be felt when propeller shaft is rotated in either direction.
    c. Place shift lever in REVERSE. Resistance should be felt when propeller shaft is rotated in either direction.
    d. If shift operation is not as described, remove gear housing and recheck distance measurement in Step 6.
14. Place shift lever in NEUTRAL.

15. Install reverse lock actuator loosely on shift shaft.
16. Position reverse lock actuator so that it just contacts reverse lock hook; secure in this position. Torque actuator screw to 5.1 Nm (45 lb. in.). The outboard will now ONLY TILT UP IN FORWARD GEAR. If the operator wishes the outboard to tilt up in FORWARD and NEUTRAL, place shift lever in REVERSE. Install reverse lock actuator loosely on shift shaft. Position actuator so that 6.4mm (0.25 in.) clearance exists between reverse lock hook and actuator. Secure actuator in this position. Torque actuator screw to 5.1 Nm (45 lb. in.).



53004

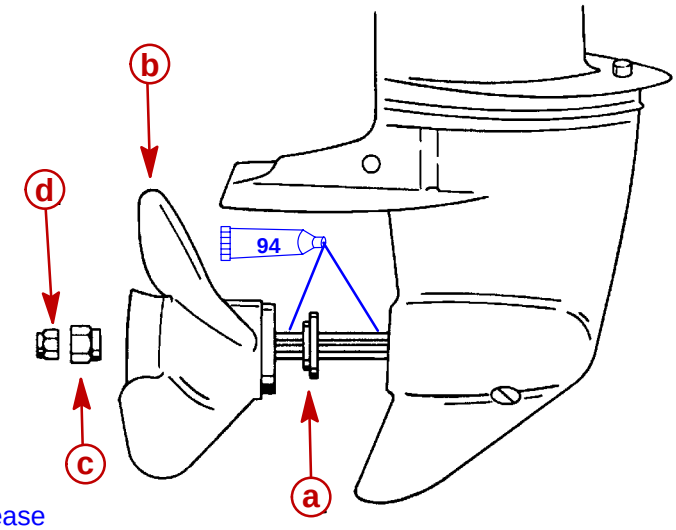
a - Reverse lock actuator
b - Screw and locknut [Torque to 5.1 Nm (45 lb. in.)]
c - Reverse lock hook

Propeller Installation

⚠ WARNING

If gear housing is NOT removed from drive shaft housing, BEFORE attempting to remove or install the propeller, remove (and isolate) spark plug leads from spark plugs to prevent engine from starting accidentally.

1. Apply Anti-Corrosion Grease to propeller shaft.
2. Install inner thrust hub.
3. Slide propeller onto shaft.
4. Install outer thrust hub.
5. Thread propeller nut onto shaft.

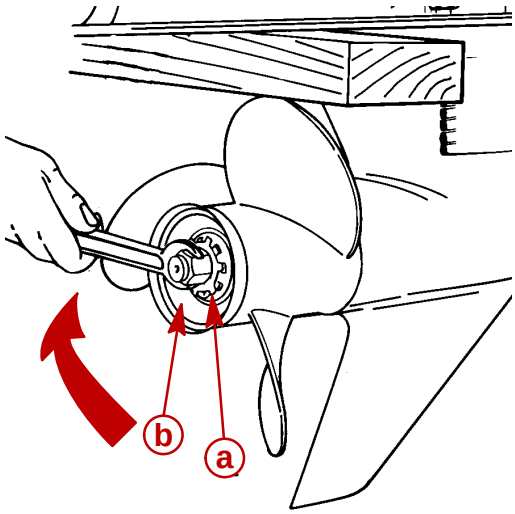


94 Anti-Corrosion Grease

52547

a - Inner thrust hub
b - Propeller
c - Outer thrust hub
d - Propeller nut

6. Place a block of wood between propeller and anti-ventilation plate to prevent propeller from turning and to protect hands. Torque nut to 7.9 Nm (70 lb. in.).



a - Outer thrust hub
b - Nut

Filling Gear Housing with Lubricant

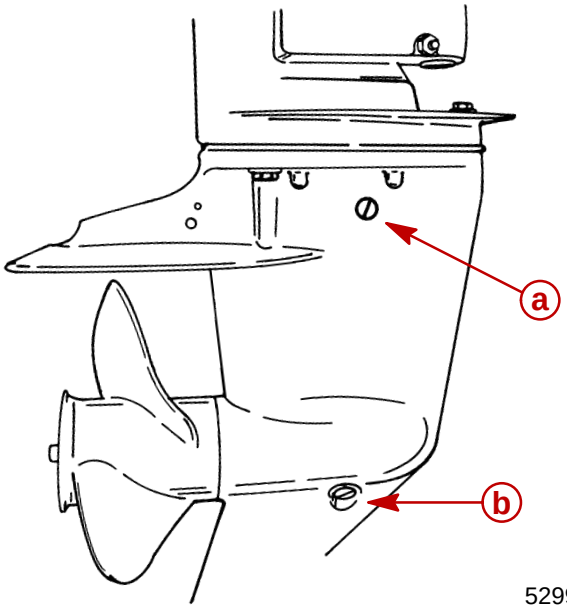
NOTE: *Gear housing lubricant capacity – 6.8 oz. (200 ml).*

IMPORTANT: DO NOT use automotive grease in the gear housing. Use Premium Gear Lubricant or High Performance Gear Lubricant

1. Remove any gasket material from “FILL” and “VENT” screws and housing.
2. Install new gaskets on “FILL” and “VENT” screws.

IMPORTANT: Never apply lubricant to gear housing without first removing “VENT” screw or gear housing cannot be filled because of trapped air. Fill gear housing ONLY when housing is in a vertical position.

3. Slowly fill housing through “FILL” hole until lubricant flows out of “VENT” hole and no air bubbles are present.
4. Reinstall “VENT” screw.
5. Remove grease tube from “FILL” hole and quickly install “FILL” screw.



52998

a - Vent screw
b - Fill screw

ATTACHMENTS/CONTROL LINKAGE

Section 7A – Throttle/Shift Linkage (Tiller Handle Shift Models)

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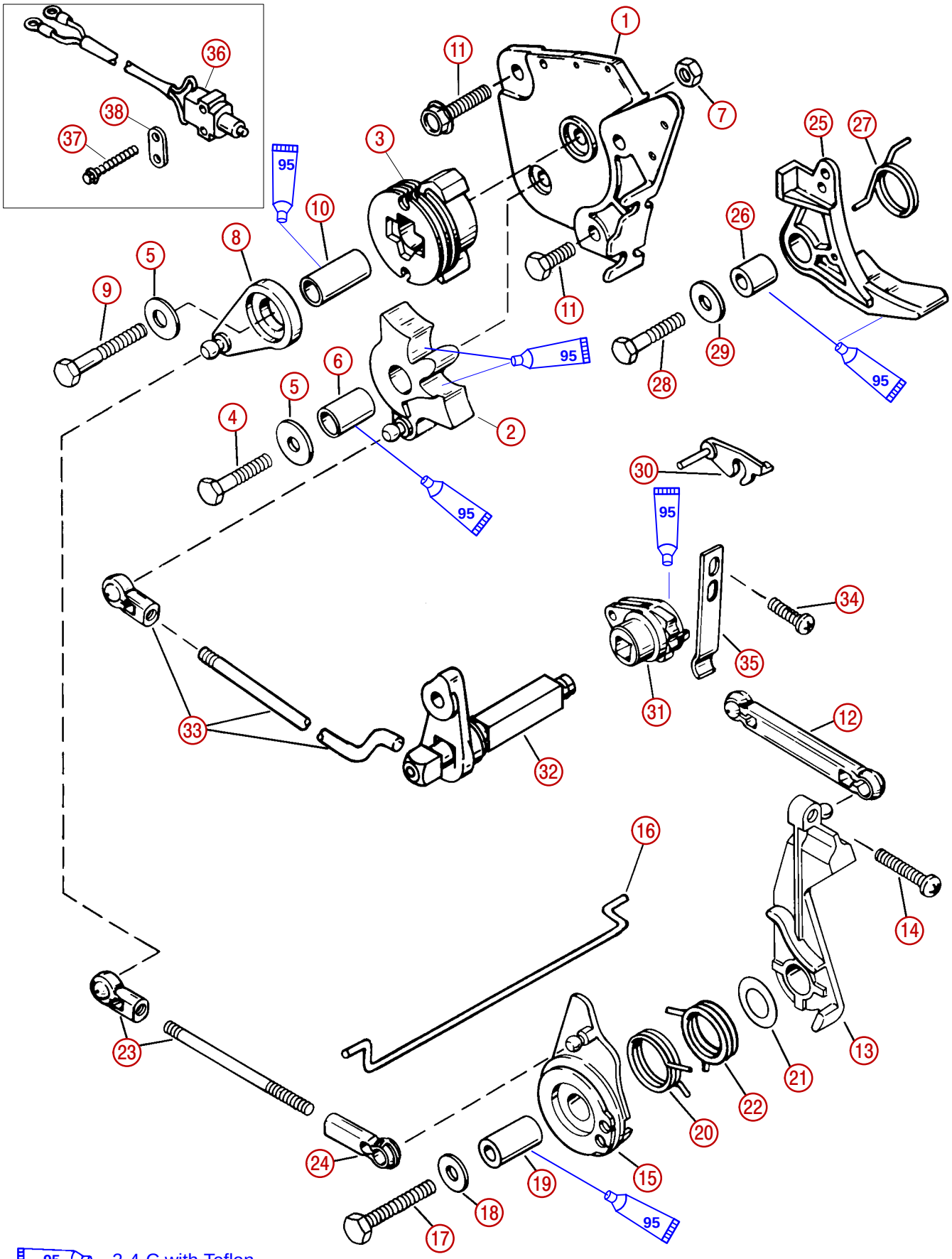
7 A

Throttle and Shift Linkage (Tiller Handle Shift)



Throttle and Shift Linkage (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CONTROL PLATFORM			
2	1	GEAR			
3	1	GEAR			
4	1	SCREW (M6 x 30)			
5	2	WASHER			
6	1	SPACER (SHORT)			
7	2	NUT	60		6.8
8	1	PRIMARY LEVER			
9	1	SCREW (M6 x 40)			
10	1	SPACER (LONG)			
11	2	SCREW (M6 x 16)	60		6.8
12	1	TIMING LINK			
13	1	CONTROL LEVER			
14	1	SCREW (M5 x 8 x 35)			
15	1	ACTUATOR			
16	1	LINK			
17	1	SCREW (M6 x 40)	70		7.9
18	1	WASHER			
19	1	BUSHING			
20	1	SPRING			
21	1	LOCKWASHER			
22	1	SPRING			
23	1	THROTTLE LINK			
24	1	SOCKET			
25	1	LEVER			
26	1	BUSHING			
27	1	SPRING			
28	1	SCREW (M6 x 30)	70		7.9
29	1	WASHER			
30	1	LEVER			
31	1	LEVER			
32	1	SHIFT SHAFT			
33	1	SHIFT LINK			
34	2	SCREW (M5 x 8 x 8)	25		2.8
35	1	SPRING			
36	1	SWITCH ASSEMBLY			
37	2	SCREW (20MM) **15 ELECTRIC HANDLE**			
38	1	PLATE			

Control Cables (Tiller Handle Shift)

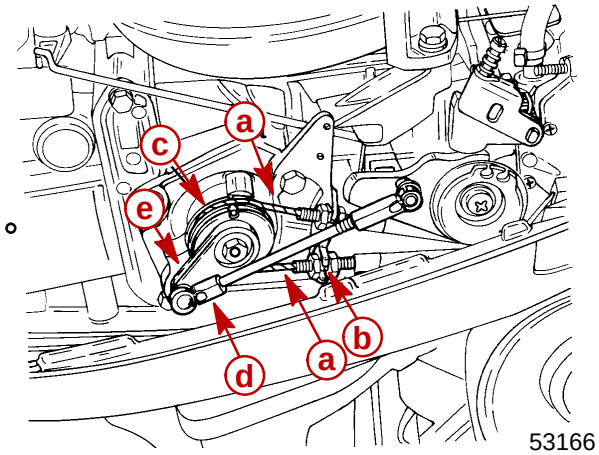
Removal/Installation

Refer to **Section 7C** for removal and installation instructions.

Control Platform

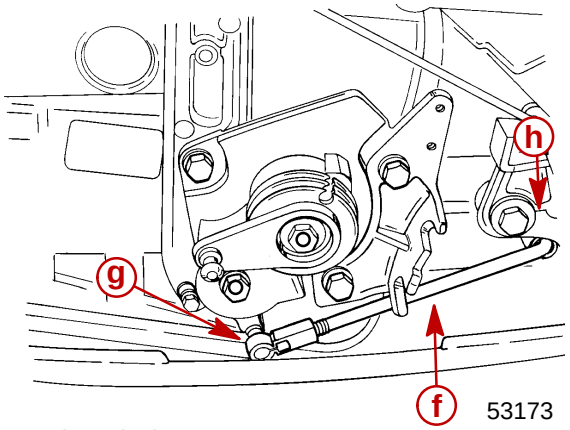
Removal/Disassembly

1. Disconnect control cables from anchor bracket and pulley as outlined in **Section 7C**.
2. Disconnect throttle link rod from ball joint of primary throttle lever.
3. Disconnect shift link rod from ball joint of gear shift lever.



53166

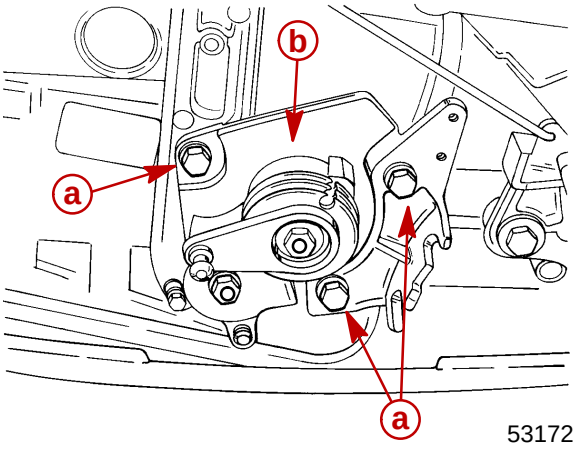
a - Cables
b - Bracket
c - Pulley
d - Link rod



53173

e - Throttle lever
f - Shift link rod
g - Gear shift lever
h - Shift lever

4. Remove 3 bolts and control platform.
5. Remove nuts and flat washers.



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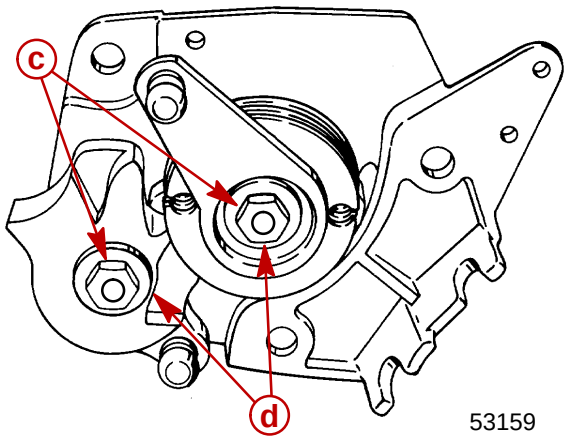
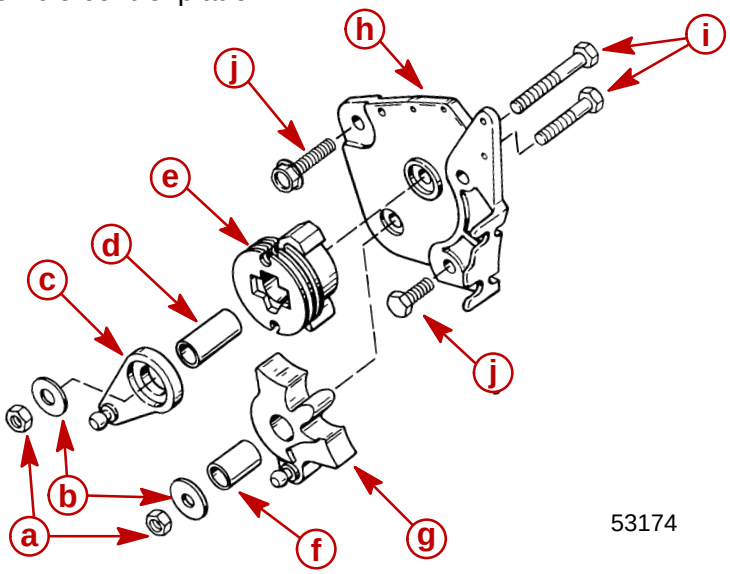


53159

a - Bolts
b - Control platform
c - Nuts
d - Flat washers

6. Disassemble control platform.

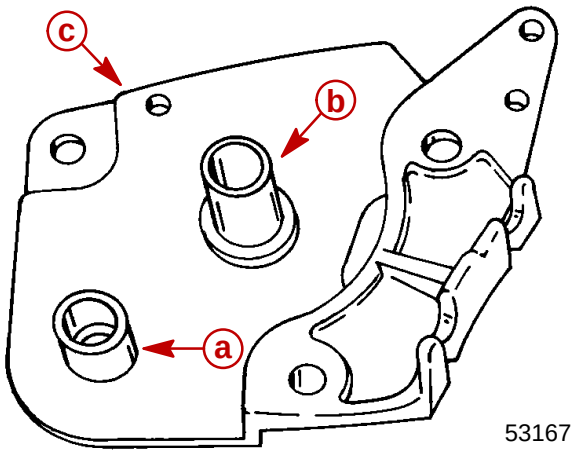


53174

a - Nuts (2) [Torque to 6.8 Nm (60 lb. in.)]
b - Flatwashers (2)
c - Primary throttle lever
d - Spacer (long)
e - Secondary gear
f - Spacer (short)
g - Gear shift lever
h - Control platform
i - Bolts (2)
j - Mount bolts [Torque to 6.8 Nm (60 lb. in.)]

Reassembly/Installation

1. Install short spacer and long spacer into recesses of control platform.
2. Lubricate spacers and area of platform traveled by gears with 2-4-C with Teflon.
3. Install gear shift lever and secondary gear over spacers and lubricate gear teeth with 2-4-C with Teflon.



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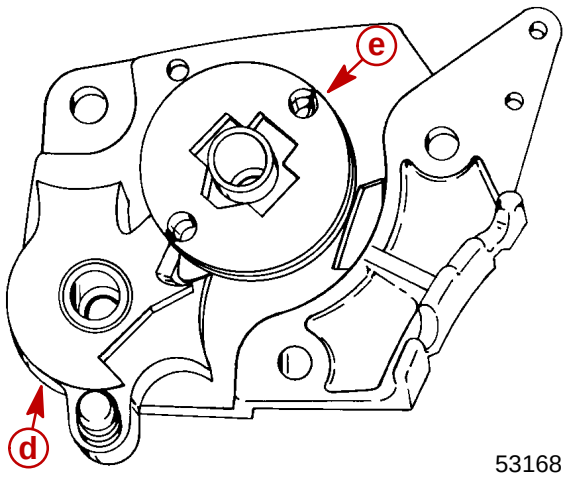
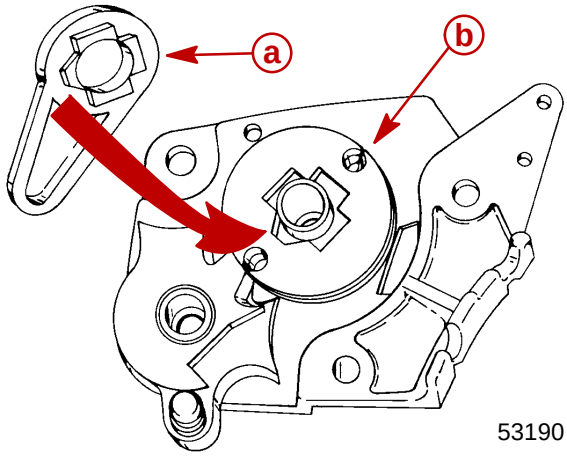


53168

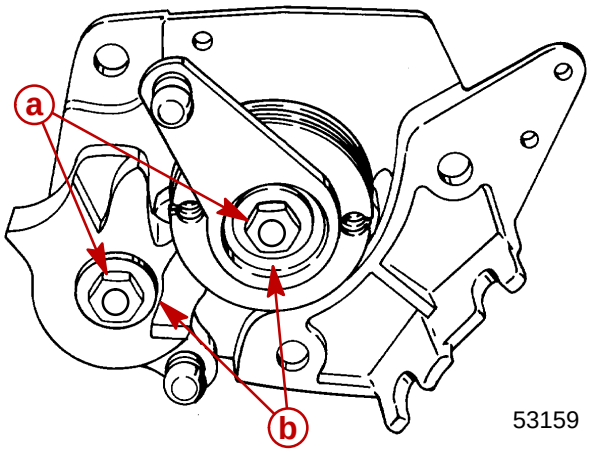
a - Short spacer
b - Long spacer
c - Platform
d - Gear shift lever
e - Secondary gear

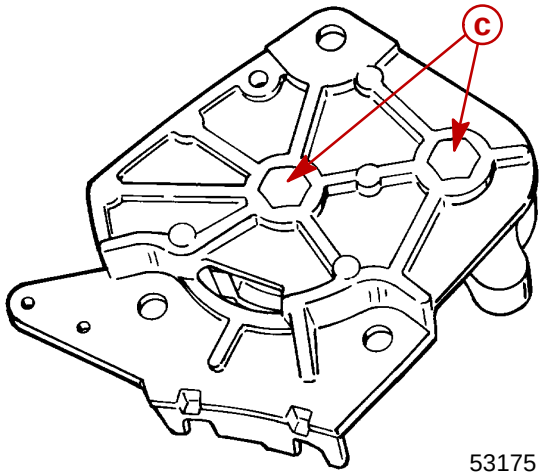
4. Index primary throttle lever into secondary gear.



a - Primary throttle lever
b - Secondary gear

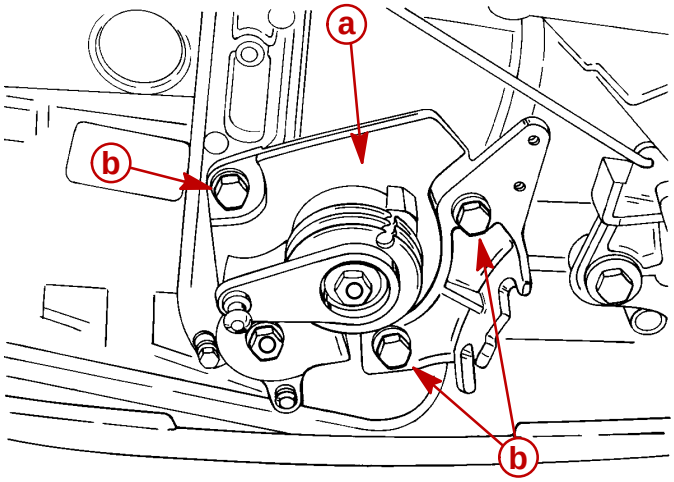
5. Install bolts, washers and nuts. Torque nuts to 6.8 Nm (60 lb. in.).





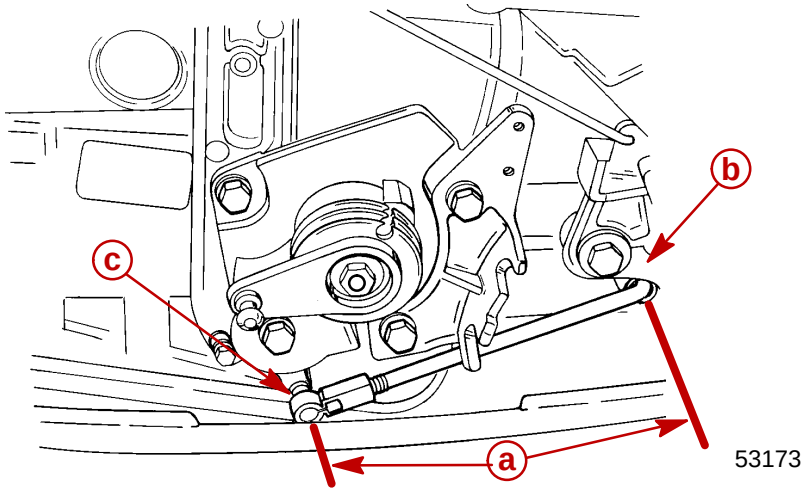
a - Nuts [Torque to 6.8 Nm (60 lb. in.)]
b - Washers
c - Bolts

6. Secure assembled control platform onto cylinder block using 3 bolts. Torque bolts to 6.8 Nm (60 lb. in.).



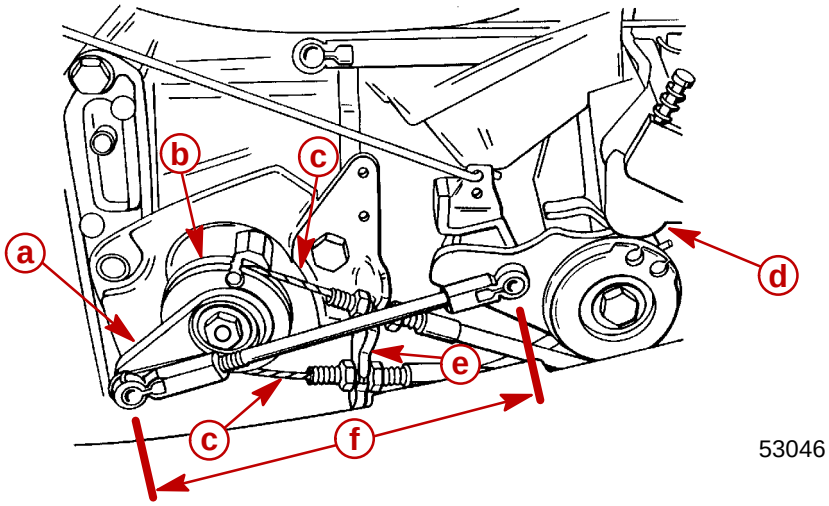
a - Platform
b - Bolts [Torque to 6.8 Nm (60 lb. in.)]

7. Adjust shift link rod to a length of 13.0 cm (5-1/8 in.) as measured between ball joint centerlines.
8. Connect shift link rod between joints of gear shift lever and shift shaft lever.



a - Shift link rod [Adjust to length of 13.0 cm (5-1/8 in.)]
b - Shift shaft lever
c - Gear shift lever

9. Adjust throttle link rod to a length of 12.4 cm (4-7/8 in.) as measured between ball joint centerlines.
10. Connect throttle link rod between ball joints of primary throttle lever and throttle cam.
11. Connect control cables to pulley of secondary gears and anchor bracket as outlined in **Section 7C**.

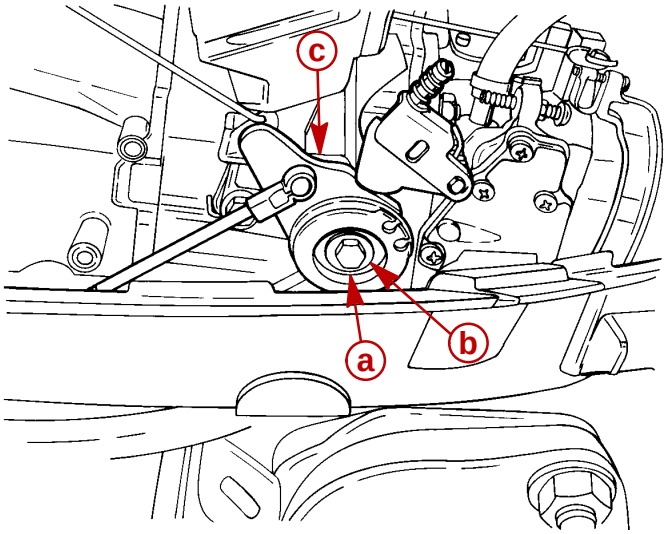


a - Primary throttle lever
b - Pulley
c - Control cables
d - Throttle cam
e - Anchor bracket
f - Throttle link rod [Adjust to length of 12.4cm (4-7/8 in.)]

Throttle Cam/Control Lever

Removal

1. Refer to **Section 7C** for removal of throttle cables.
2. Remove bolt and flat washer securing cam/lever to powerhead.

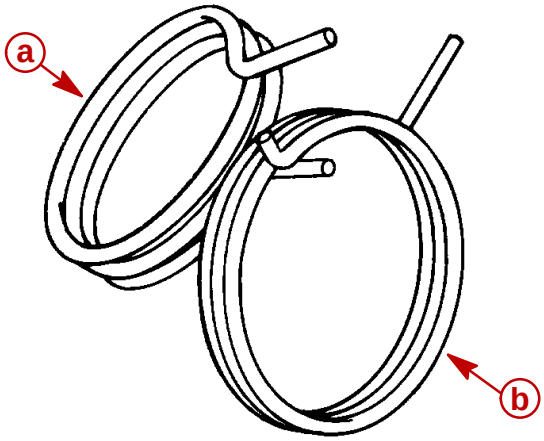


53162

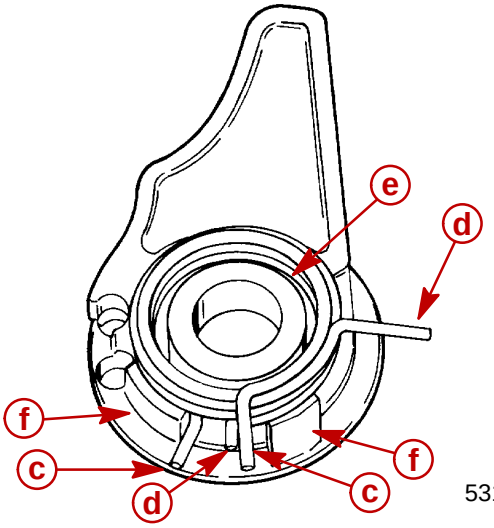
a - Bolt
b - Washer
c - Cam/lever

Reassembly

1. Assemble inner spring and outer spring together.
2. Position spring assembly over hub of throttle cam.



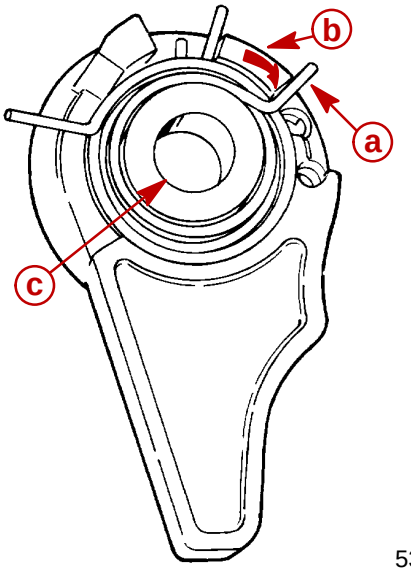
53182



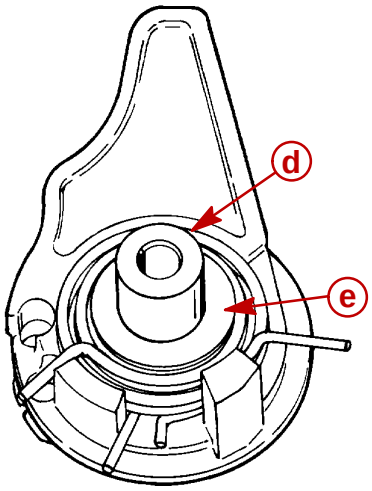
53177

a - Inner spring
b - Outer spring
c - Inner spring ends
d - Outer spring ends
e - Hub
f - Tabs

3. Wind end of inner spring to position tab of cam between inner spring ends. Verify spring windings are firmly held around diameter of cam hub and that no windings are positioned on top of hub.
4. Lubricate bushing with 2-4-C with Teflon and install bushing and wave washer.



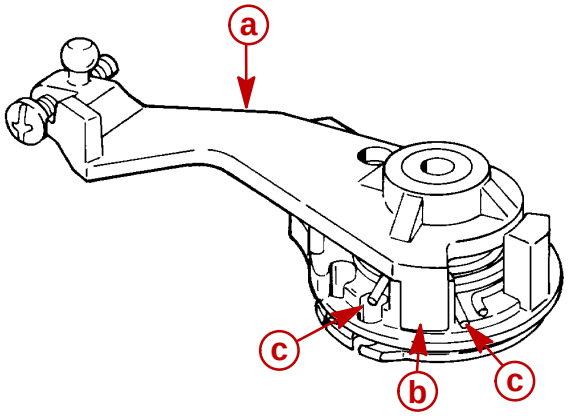
53178



53176

a - Inner spring end
b - Tab
c - Cam hub
d - Bushing
e - Wave washer

5. Install control lever onto throttle cam assembly so that tab of control lever is positioned between ends of inner spring.
6. Hook longer spring end of outer spring behind peg of control lever.



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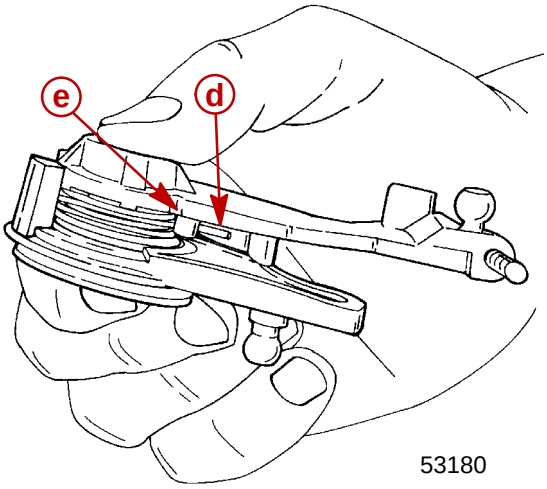
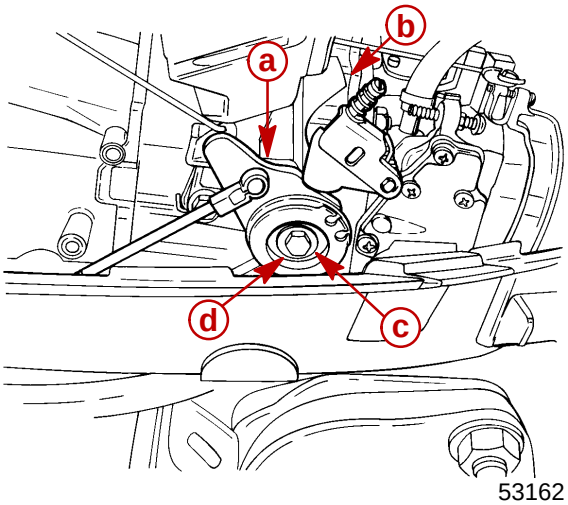


53180

a - Control lever
b - Tab
c - Ends of inner spring
d - Longer spring end
e - Peg

Installation

1. Secure throttle cam/control lever assembly onto mounting boss of crankcase cover with bolt. Torque bolt to 7.9 Nm (70 lb. in.).
2. Connect timing link between ball joints of control lever and trigger assembly.



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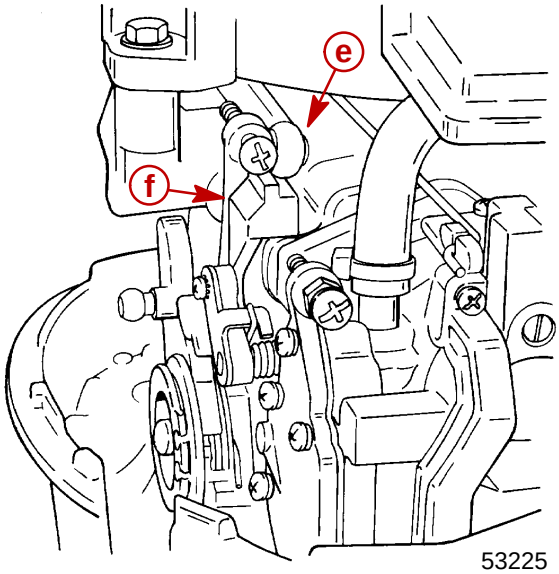
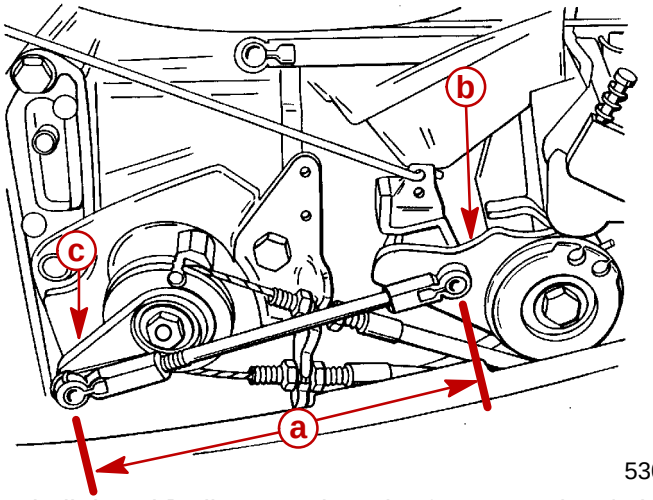


53225

a - Throttle cam
b - Control lever
c - Flat washer
d - Bolt [Torque bolt to 7.9 Nm (70 lb. in.)]
e - Timing link
f - Control lever

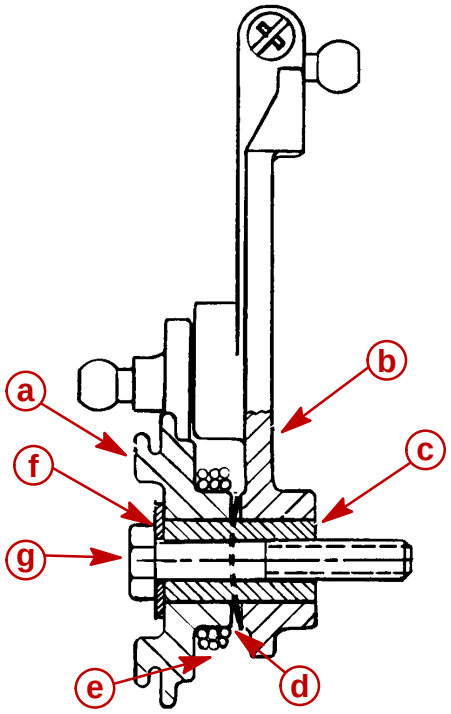
3. Adjust throttle link rod to a length of 12.4 cm (4-7/8 in.) as measured between ball joint center lines.
4. Connect throttle link rod between ball joints of throttle cam and primary throttle lever.



53046

a - Throttle link rod [Adjust to a length of 12.4 cm (4-7/8 in.)]
b - Throttle cam
c - Primary throttle lever

THROTTLE CAM/CONTROL LEVER CROSS SECTIONAL VIEW

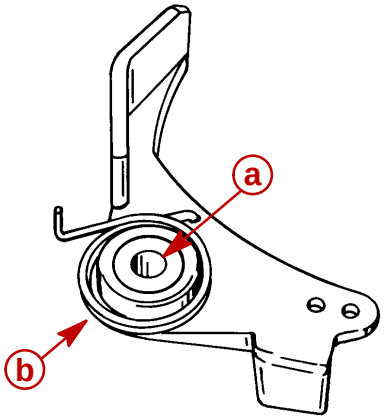


a - Throttle cam
b - Control lever
c - Bushing
d - Wave washer
e - Springs
f - Flat washer
g - Bolt [Torque to 7.9 Nm (70 lb. in.)]

Neutral Interlock Control Lever

Reassembly/Installation

1. Lubricate bushing with 2-4-C with Teflon and install bushing and spring.
2. Secure interlock lever components with bolt onto mounting boss of crankcase cover.



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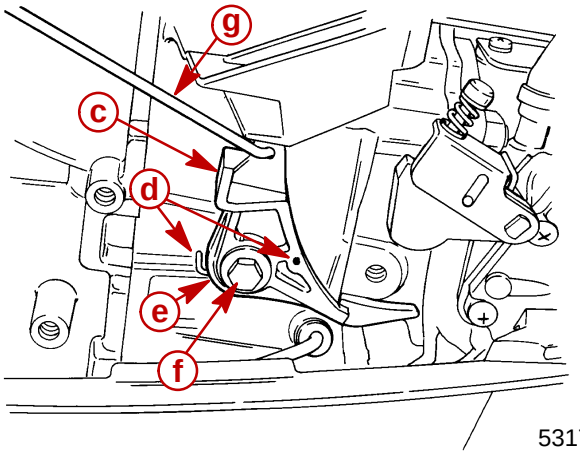


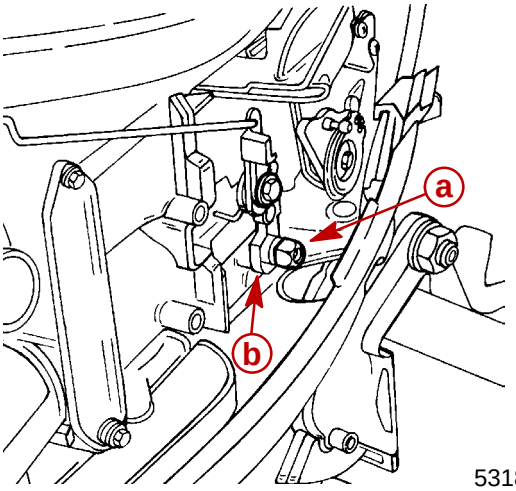
53171

a - Bushing
b - Spring
c - Interlock lever
d - Spring ends
e - Flat washer
f - Bolt [Torque to 7.9 Nm (70 lb. in.)]
g - Neutral interlock wire (install in top hole)

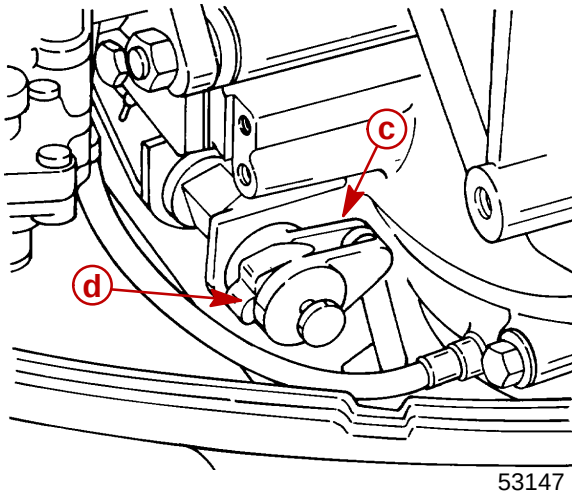
Horizontal Shift Shaft

Reassembly/Installation

1. Install horizontal shift shaft/shift lever assembly into opening in STARBOARD side of crankcase cover.
2. Apply 2-4-C with Teflon to detent of yoke and install yoke onto shift shaft.



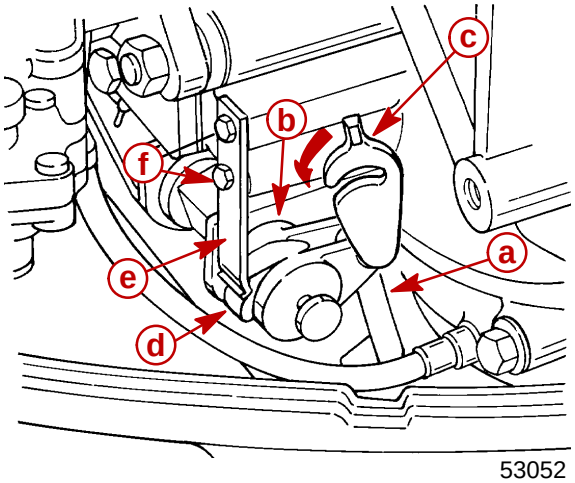
53187



53147

a - Horizontal shift shaft
b - Shift lever
c - Yoke
d - Detent

3. Secure detent spring to block with 2 bolts. Spring may have slotted holes. Install spring so that it is raised UP and at end of slot travel. Torque bolts to 2.8 Nm (25 lb. in.).
4. Secure end of shift shaft to yoke of horizontal shift shaft with lever.



53052

a - Shift shaft
b - Yoke
c - Lever
d - Apply 2-4-C with Teflon
e - Detent spring
f - Bolts [Torque to 2.8 Nm (25 lb. in)]

5. Refer to **Control Platform/Throttle Cam/Control Lever** previous and reinstall platform, shift link and throttle cam.

ATTACHMENTS/CONTROL LINKAGE

Section 7B – Throttle Shift Linkage (Side Shift Models)

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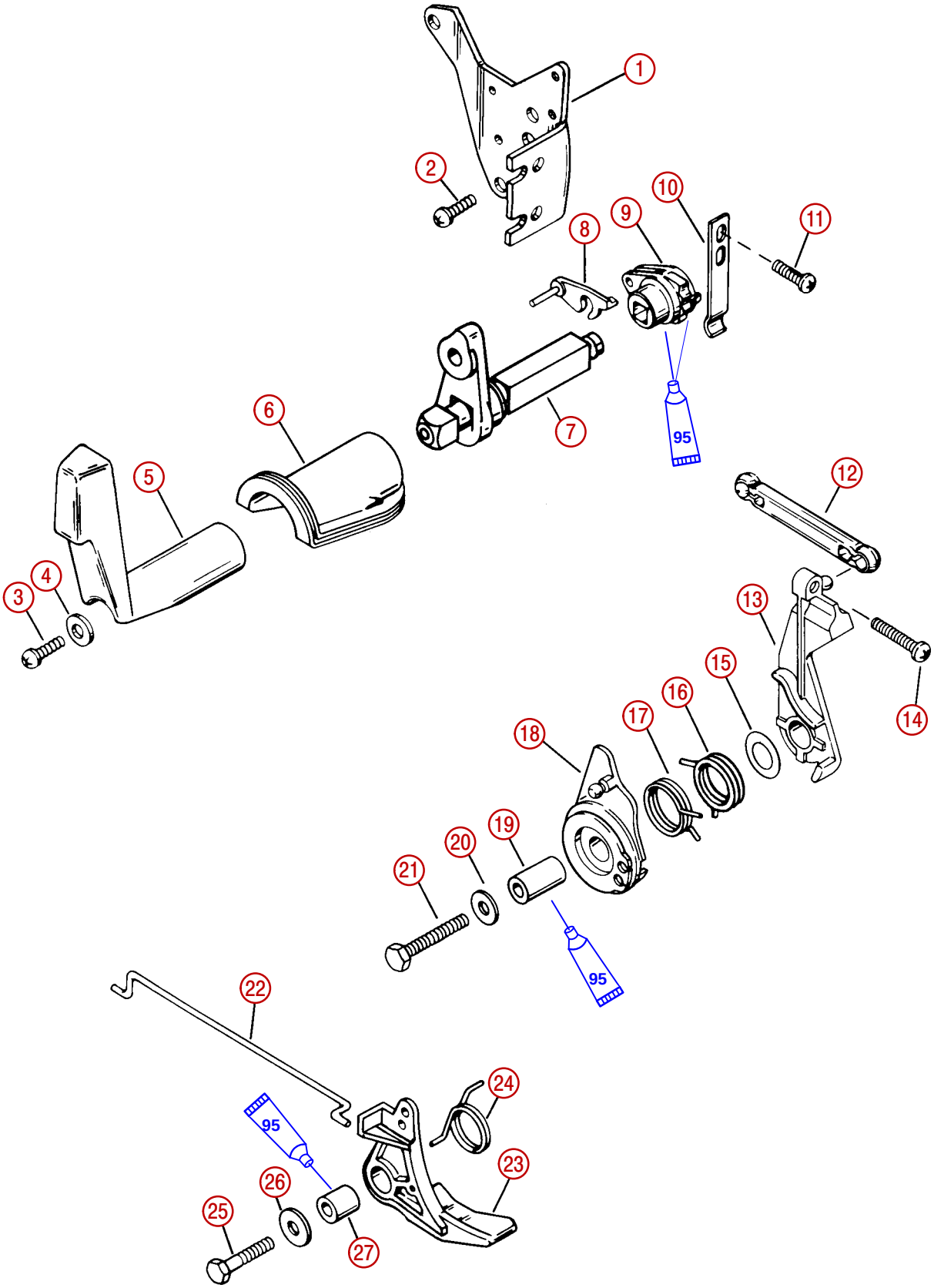
B

Throttle and Shift Linkage (Side Shift)



95 2-4-C with Teflon

Throttle and Shift Linkage (Side Shift) (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CABLE BRACKET			
2	2	SCREW	60		6.8
3	1	SCREW	35		4.0
4	1	WASHER			
5	1	SHIFT HANDLE			
6	1	GROMMET			
7	1	SHIFT SHAFT			
8	1	LEVER			
9	1	LEVER			
10	1	SPRING			
11	2	SCREW (M5 x 8 x 8)	25		2.8
12	1	TIMING LINK			
13	1	CONTROL LEVER			
14	1	SCREW (M5 x 8 x 35)			
15	1	LOCKWASHER			
16	1	SPRING			
17	1	SPRING			
18	1	ACTUATOR			
19	1	BUSHING			
20	1	WASHER			
21	1	SCREW	70		7.9
22	1	LINK			
23	1	LEVER			
24	1	SPRING			
25	1	SCREW	70		7.9
26	1	WASHER			
27	1	BUSHING			

Throttle Cables (Side Shift Models)

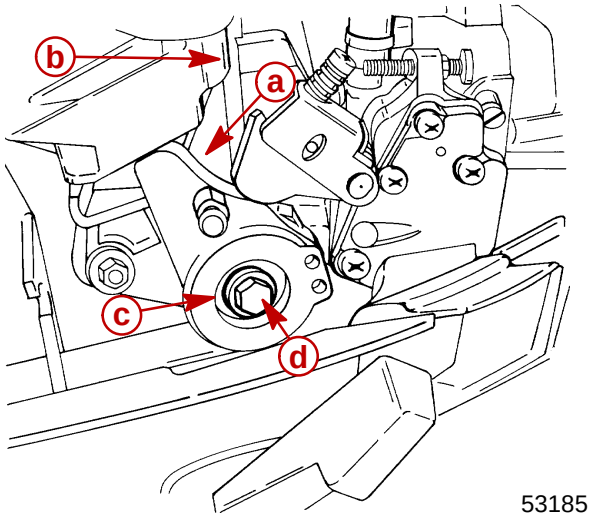
Removal/Installation

Refer to **Section 7C** for removal and installation instructions.

Throttle Cam/Control Lever

Removal

1. Refer to **Section 7C** for removal of throttle cables.
2. Remove bolt and flat washer securing cam/lever to powerhead.

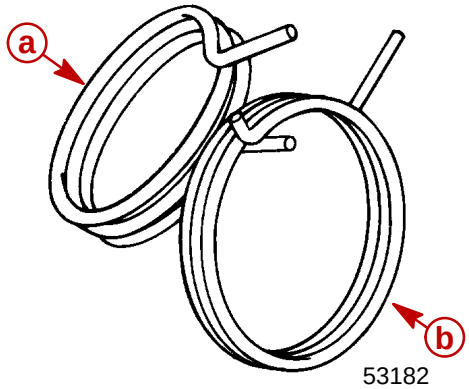


53185

a - Throttle Cam
b - Control Lever
c - Flat Washer
d - Bolt [Torque bolt to 7.9 Nm (70 lb. in.)]

Reassembly

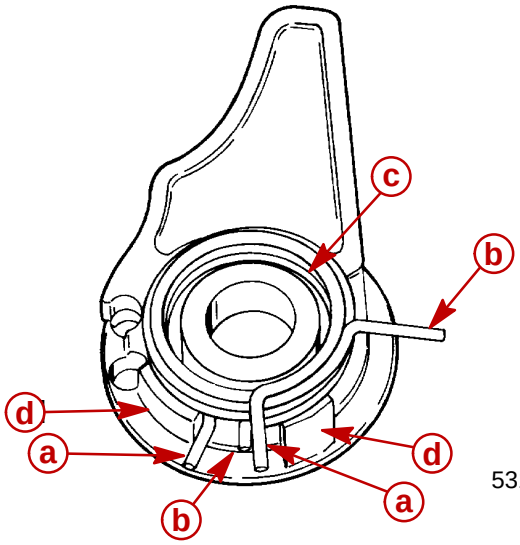
1. Assemble inner spring and outer spring together.



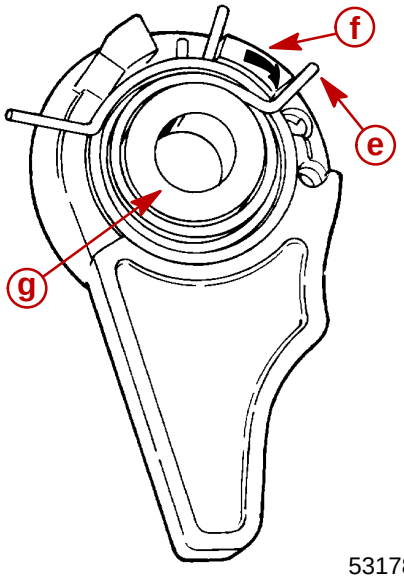
53182

a - Inner spring
b - Outer spring

2. Position spring assembly over hub of throttle cam.
3. Wind end of inner spring to position tab of cam between inner spring ends. Verify spring windings are firmly held around diameter of cam hub and that no windings are positioned on top of hub.



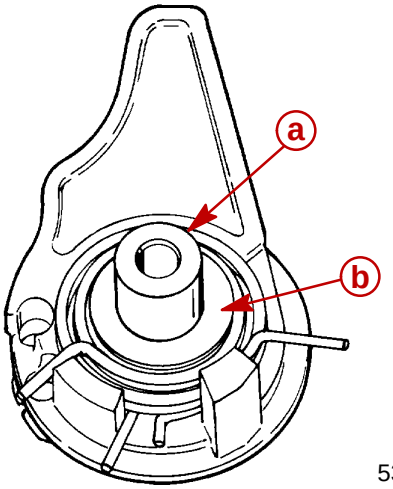
53177



53178

a - Inner spring ends
b - Outer spring ends
c - Hub
d - Tabs
e - Inner spring end
f - Tab
g - Cam hub

4. Lubricate bushing with 2-4-C with Teflon and install bushing and wave washer.
5. Install control lever onto throttle cam assembly so that tab of control lever is positioned between ends of inner spring.



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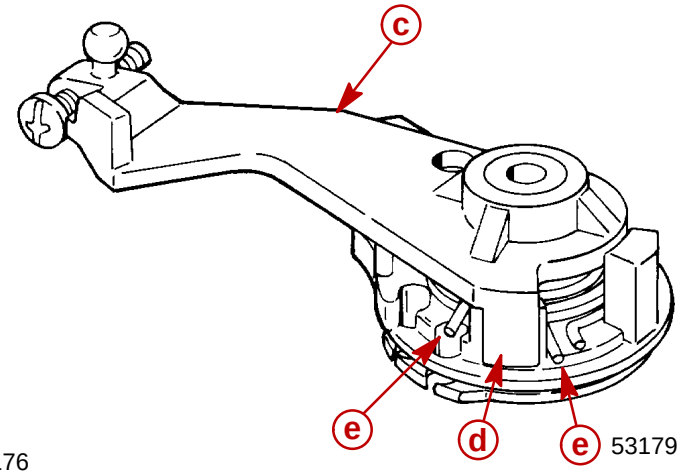
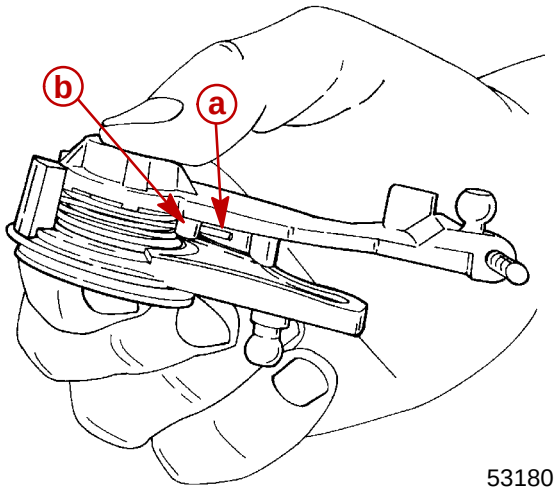


53179

a - Bushing
b - Wave washer
c - Control lever
d - Tab
e - Ends of inner spring

6. Hook longer spring end of outer spring behind peg of control lever.



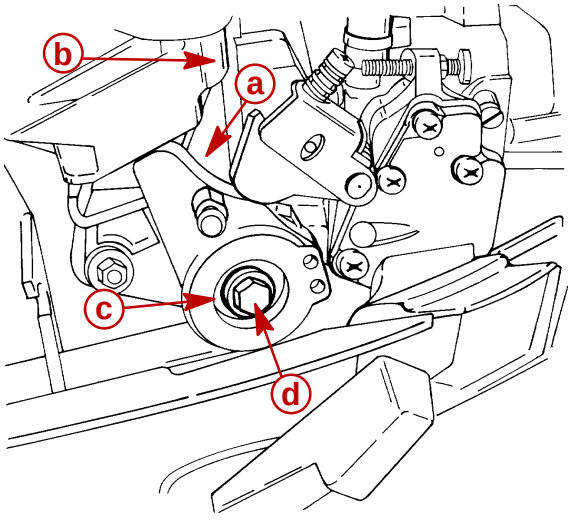
53180

a - Longer spring end
b - Peg

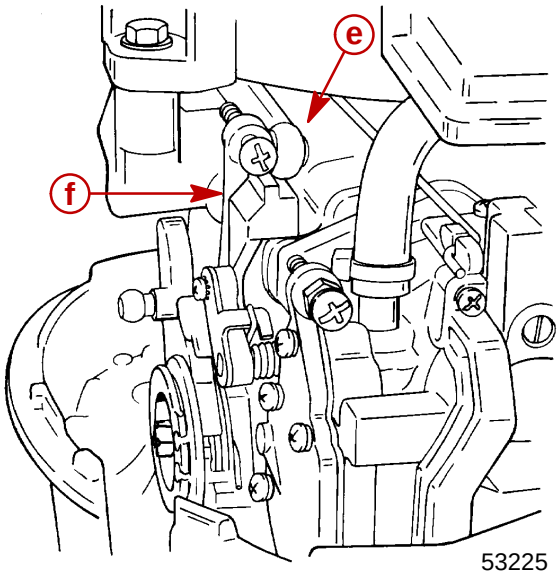
Installation

1. Secure throttle cam/control lever assembly onto mounting boss of crankcase cover with bolt. Torque bolt to 7.9 Nm (70 lb. in.).

2. Connect timing link between ball joints of control lever and trigger assembly.



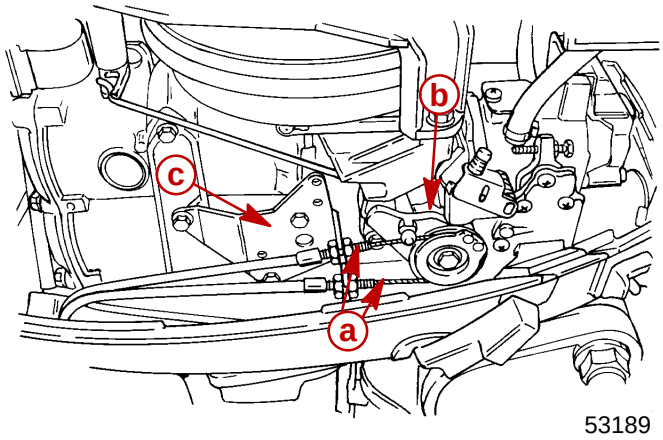
53185



53225

a - Throttle cam
b - Control lever
c - Flat washer
d - Bolt [Torque bolt to 7.9 Nm (70 lb. in.)]
e - Timing link
f - Control lever

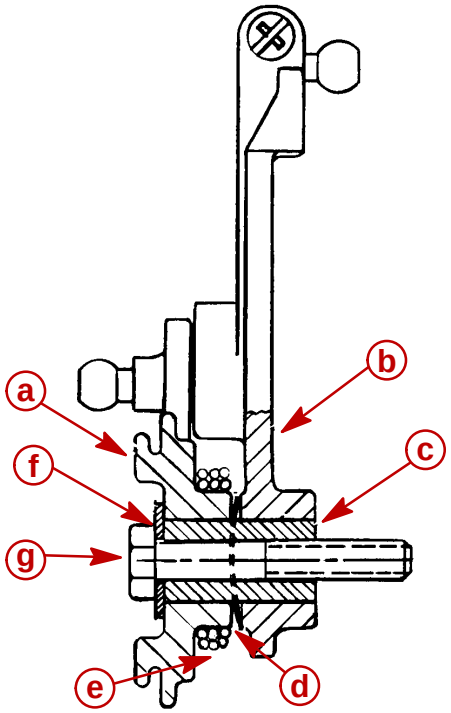
3. Connect throttle cables to throttle cam and throttle cable anchor bracket as outlined in Throttle Cable – Installation, preceding.



53189

a - Throttle cables
b - Throttle cam
c - Bracket

THROTTLE CAM/CONTROL LEVER CROSS SECTIONAL VIEW

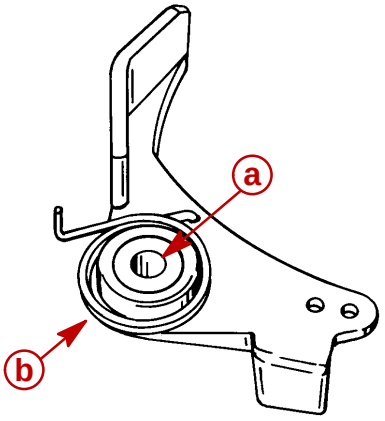


a - Throttle cam
b - Control lever
c - Bushing
d - Wave washer
e - Springs
f - Flat washer
g - Bolt [Torque to 7.9 Nm (70 lb. in.)]

Neutral Interlock Control Lever

Reassembly/Installation

1. Lubricate bushing with 2-4-C with Teflon and install bushing and spring.
2. Secure interlock lever components with bolt onto mounting boss of crankcase cover.



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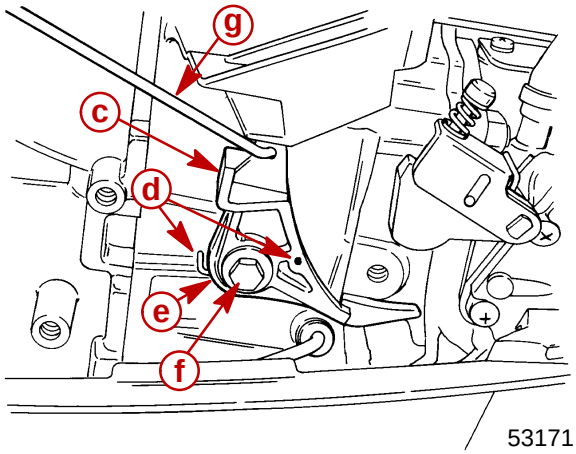


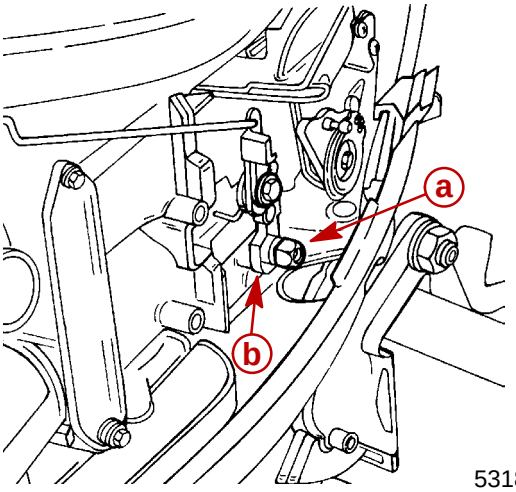
53171

a - Bushing
b - Spring
c - Interlock lever
d - Spring ends
e - Flat washer
f - Bolt [Torque to 7.9 Nm (70 lb. in.)]
g - Neutral interlock wire (install in top hole)

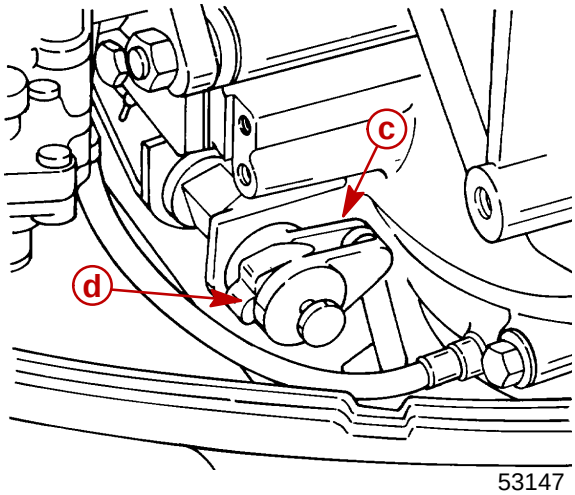
Horizontal Shift Shaft

Reassembly/Installation

1. Install horizontal shift shaft/shift lever assembly into opening in STARBOARD side of crankcase cover.
2. Apply 2-4-C with Teflon to detent of yoke and install yoke onto shift shaft.



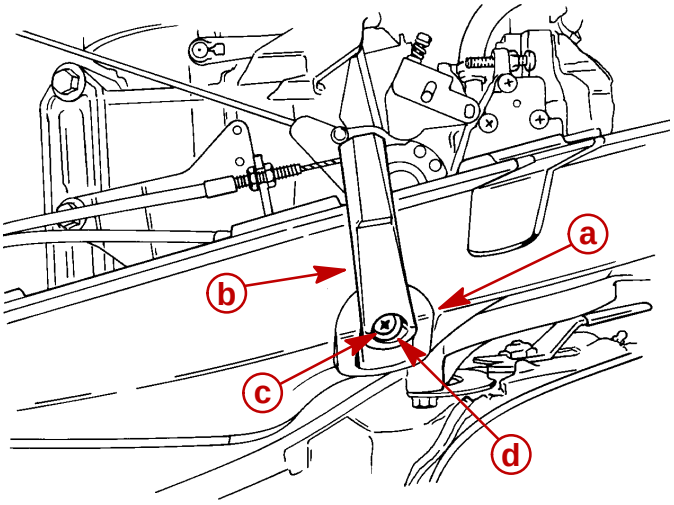
53187



53147

a - Horizontal shift shaft
b - Shift lever
c - Yoke
d - Detent

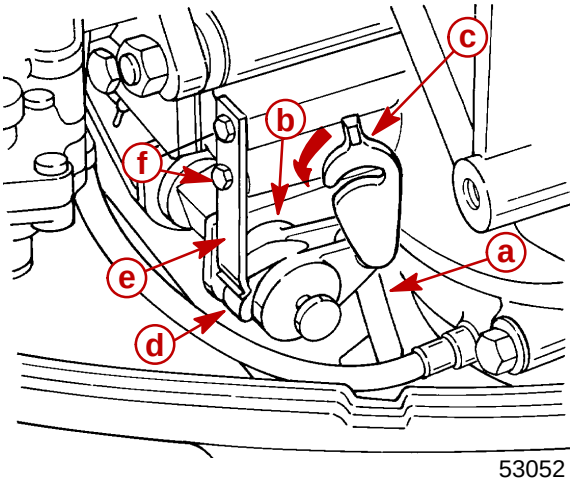
3. Install rubber grommet into opening in starboard side of bottom cowl.
4. Secure shift handle onto end of horizontal shift shaft with screw and flat washer. Torque screw to 4.0 Nm (35 lb. in.).



53181

a - Grommet
b - Shift handle
c - Screw
d - Washer

5. Secure detent spring to block with 2 bolts. Spring may have slotted holes. Install spring so that it is raised UP and at end of slot travel. Torque bolts to 2.8 Nm (25 lb. in.).
6. Secure end of shift shaft to yoke of horizontal shift shaft with coupler.



53052

a - Shift shaft
b - Yoke
c - Coupler
d - Apply 2-4-C with Teflon
e - Detent spring
f - Bolts [Torque to 2.8 Nm (25 lb. in.)]

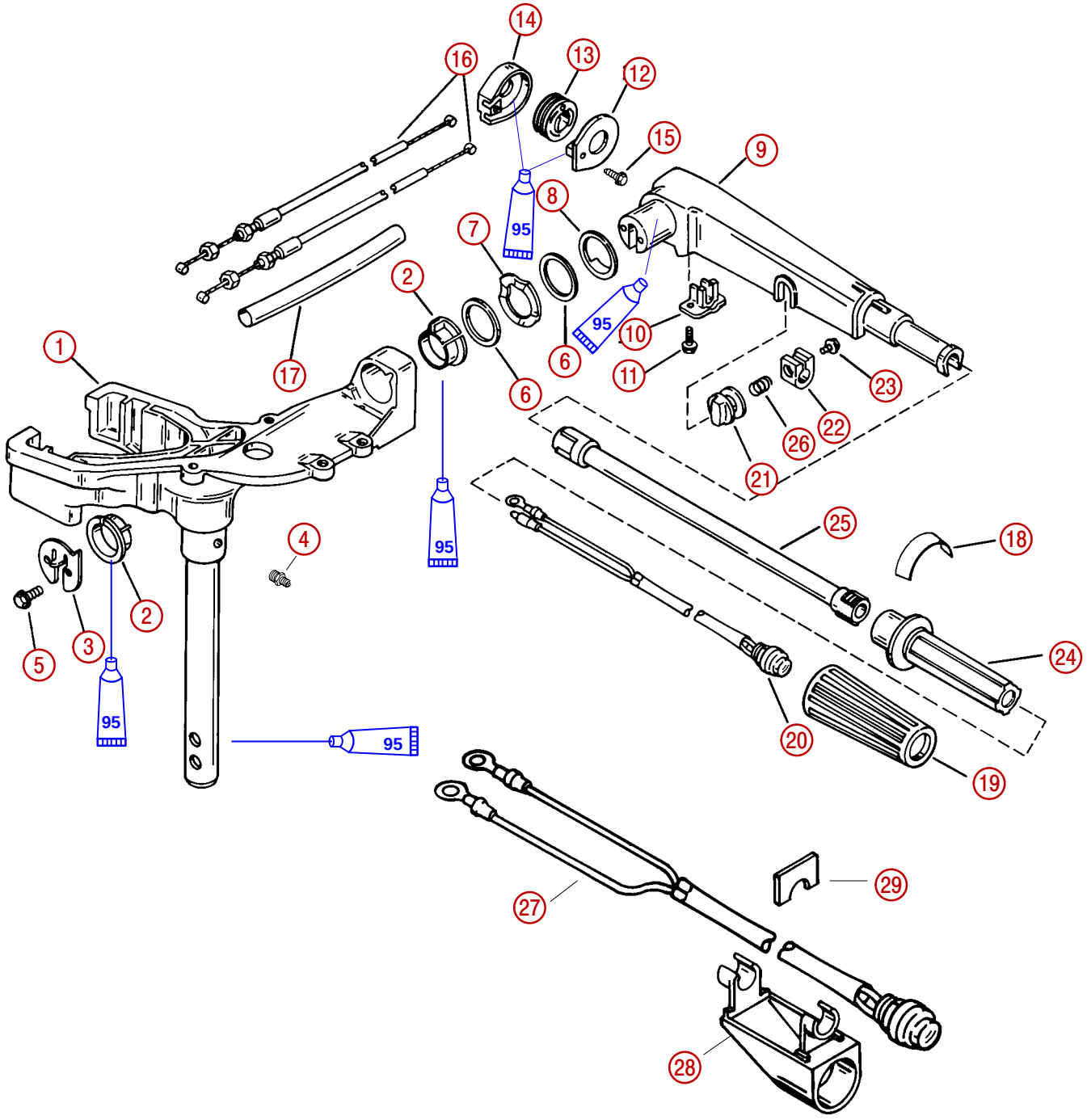
ATTACHMENTS/ CONTROL LINKAGE

Section 7C – Tiller Handle

Table of Contents

7
C

Swivel Head and Steering Handle



95 2-4-C with Teflon

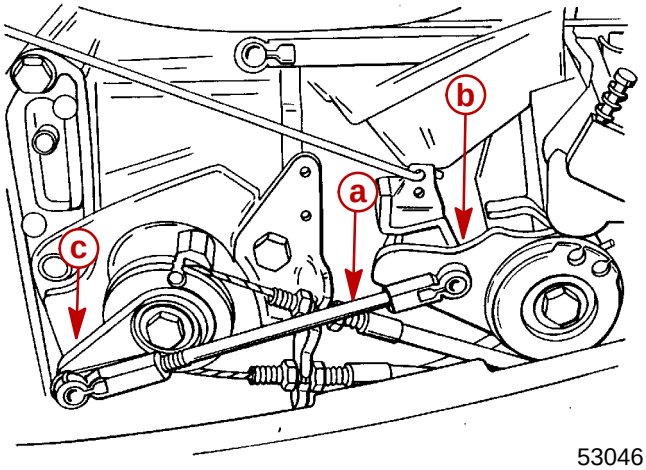
Swivel Head and Steering Handle (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	SWIVEL HEAD **(BLACK)**			
2	2	BUSHING			
3	1	PLATE			
4	1	GREASE FITTING			
5	2	SCREW (M5 x 1 x 16)	70		7.9
6	2	WASHER			
7	1	WAVE WASHER			
8	1	WASHER			
9	1	STEERING HANDLE ARM **(BLACK)**			
10	1	RETAINER			
11	1	SCREW (M5 x .8 x 16)	35		4.0
12	1	COVER KIT			
13	1	PULLEY			
14	1	PULLEY CASE			
15	1	SCREW (10-16 x 1/2)	20		2.3
16	2	THROTTLE CABLE			
17	1	SLEEVE			
18	1	DECAL			
19	1	GRIP			
20	1	STOP SWITCH			
21	1	THROTTLE FRICTION KNOB	Finger Tight		
22	1	THROTTLE FRICTION LOCK	As Required		
23	1	SCREW (M6 x 1 x 25)			
24	1	THROTTLE HANDLE			
25	1	TILLER TUBE			
26	1	SPRING			
27	1	START/STOP SWITCH			
28	1	HOUSING **ELECTRIC HANDLE**			
29	1	CLIP			

Control Cables (Tiller Handle Shift Models)

Removal

1. Place tiller handle twist grip in NEUTRAL position.
2. Remove throttle link rod from throttle cam and primary throttle lever.



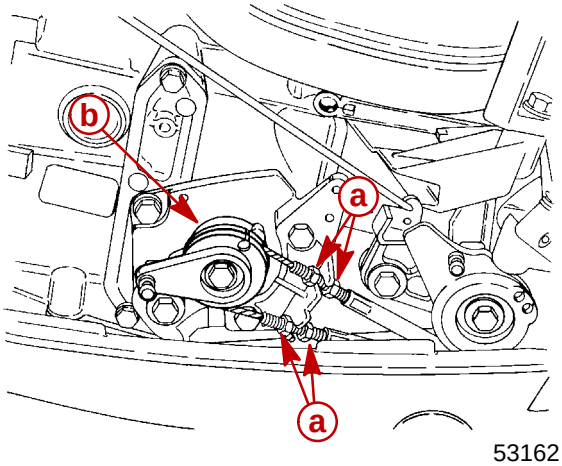
53046

a - Link rod
b - Throttle cam
c - Primary throttle lever

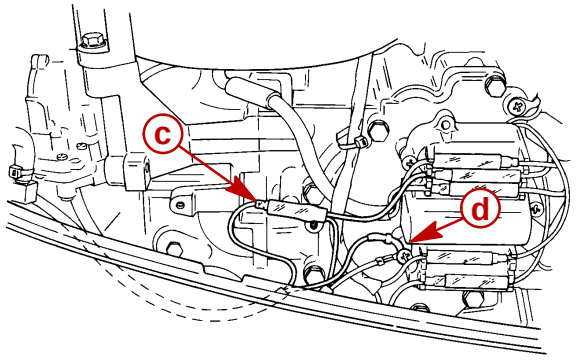
3. Loosen jam nuts which secure control cables to anchor bracket.
4. Unwrap and remove control cables from pulley of secondary gear.

NOTE: *If not replacing control cables, mark top cable with a piece of tape to aid in reassembly.*

5. Disconnect stop button wires – BLACK/YELLOW and BLACK.



53162



53157

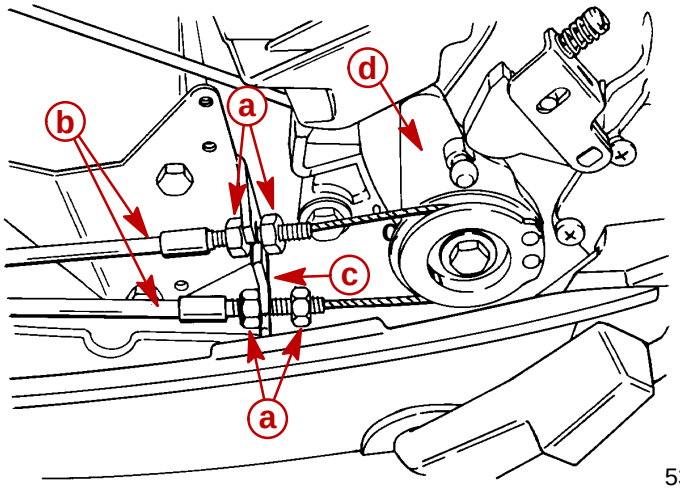
a - Jam nuts
b - Secondary gear
c - BLACK/YELLOW
d - BLACK

Throttle Cables (Side Shift Models)

Removal

1. Loosen jam nuts which secure throttle cables to anchor bracket and remove cables from pulley of throttle cam.

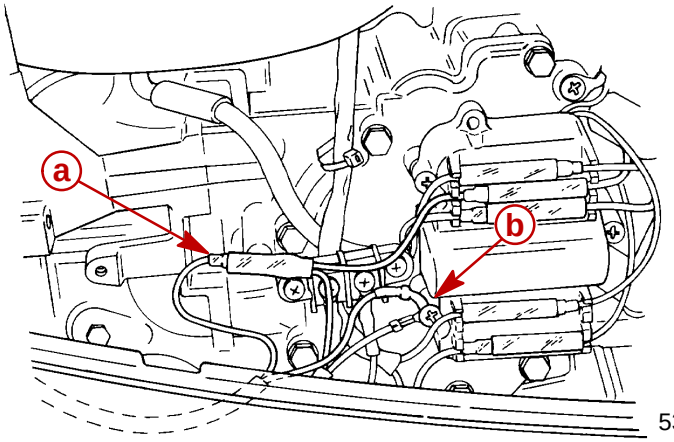
NOTE: *If not replacing throttle cables, mark top cable with a piece of tape to aid in reassembly.*



53186

a - Jam nuts
b - Throttle cables
c - Anchor bracket
d - Throttle cam

2. Disconnect stop button wires – BLACK/YELLOW and BLACK.



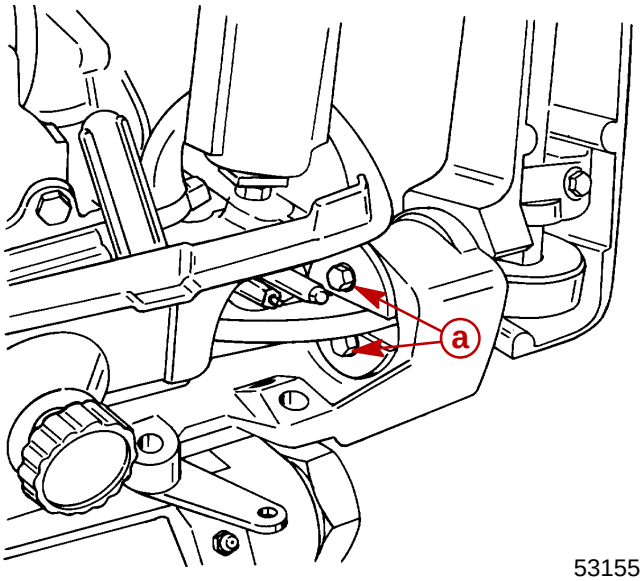
53156

a - BLACK/YELLOW
b - BLACK

Tiller Handle Removal/Disassembly

Removal

1. Remove 2 bolts securing tiller handle to anchor bracket and remove tiller handle assembly.

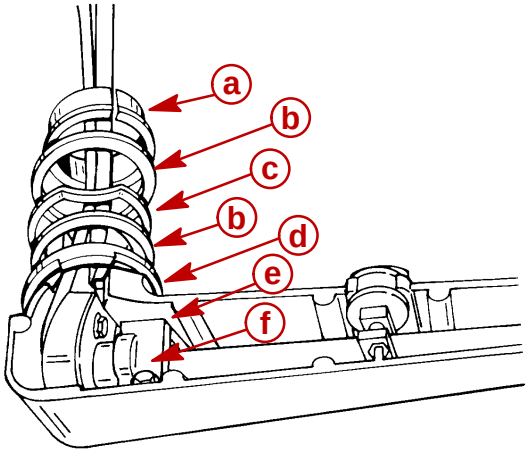


53155

a - Bolts

2. Remove bushing, flatwashers (2), wave washer and tiller handle washer. Remove retainer and bolt.

3. Slide tiller tube out of pulley case.



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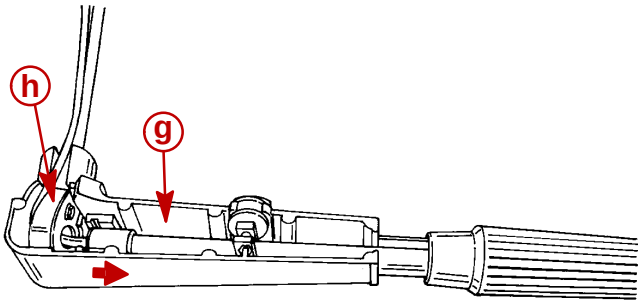
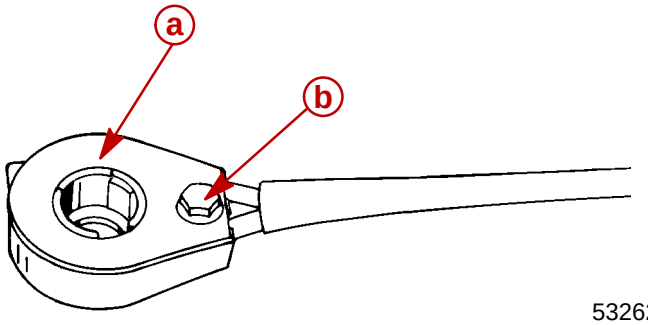


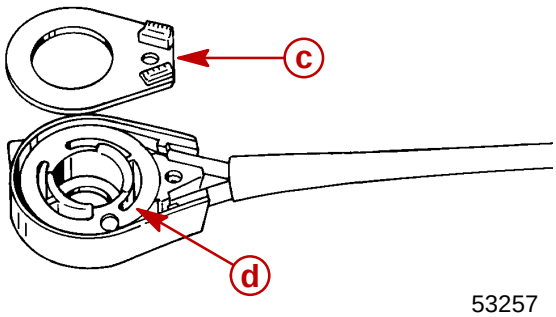
53256

a - Bushing
b - Flat washer (2)
c - Wave washer
d - Tiller handle washer
e - Retainer
f - Bolt
g - Tiller tube
h - Pulley case

4. Remove pulley case assembly from tiller handle and remove cover bolt.
5. Remove cover and lift pulley assembly from case. Replace cables as required.



53262

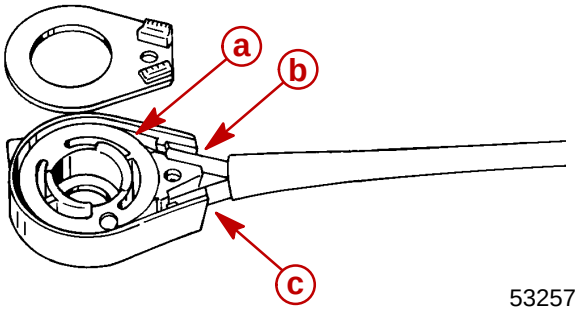


53257

a - Pulley case assembly
b - Cover bolt
c - Cover
d - Pulley assembly

Installation

1. Wrap cables around pulley. Top cable wraps and locks in top groove. Bottom cable wraps and locks in bottom groove.
2. Place pulley and cable assembly into pulley case.
3. Install pulley cover and secure cover with bolt. Torque bolt to 2.3 Nm (20 lb. in.).



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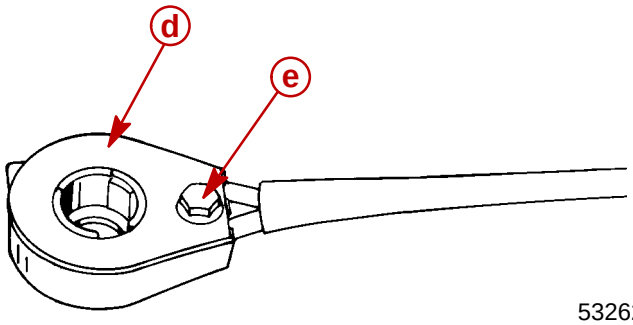
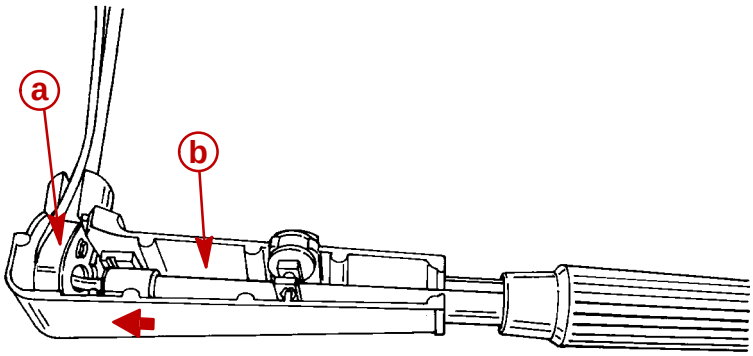


53262

a - Pulley
b - Top cable
c - Bottom cable
d - Cover
e - Bolt [Torque to 2.3 Nm (20 lb. in.)]

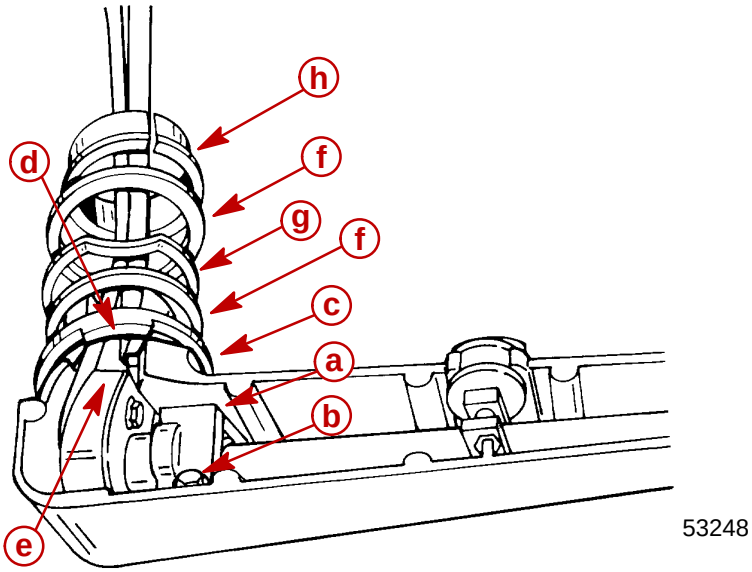
4. Install pulley assembly into tiller handle and slide tiller tube into pulley.



53256

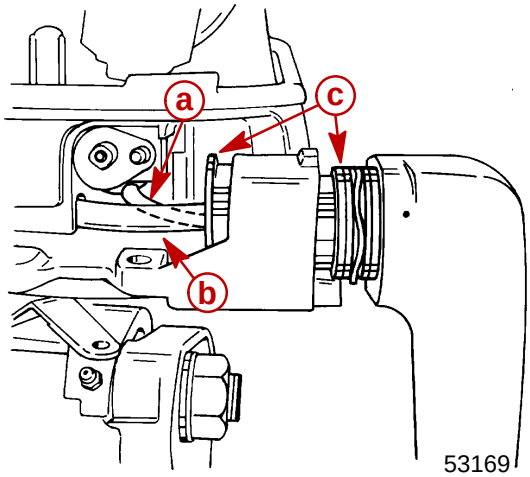
a - Pulley assembly
b - Tiller tube

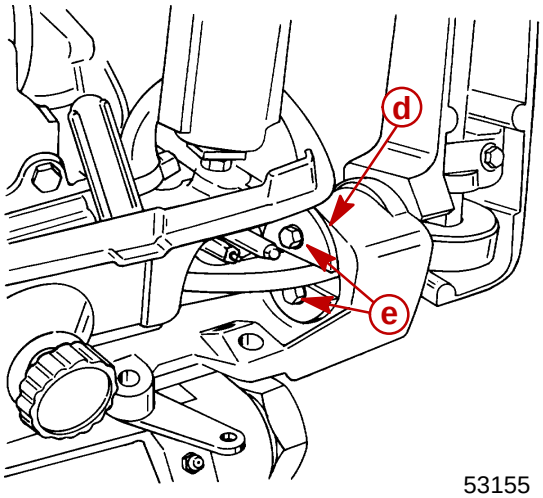
5. Secure tiller tube in handle with retainer and bolt. Torque bolt to 4.0 Nm (35 lb. in.).
6. Install tiller washer (tab aligns with slot in handle), plain washer, wave washer, plain washer and flanged bushing over cable/harness assembly.



a - Retainer
b - Bolt [Torque to 4.0 Nm (35 lb. in.)]
c - Tiller washer
d - Tab
e - Slot
f - Plain washer
g - Wave washer
h - Flanged bushing

7. Slide tiller handle assembly into anchor bracket.
8. Route stop button harness through fuel connector opening in bottom cowl.
9. Route control cables through opening in bottom cowl.
10. Align tabs of inner and outer flanged bushings with slots in anchor bracket.
11. Pull on cable ends to remove slack and secure tiller handle to anchor bracket with plate and 2 bolts. Torque bolts to 7.9 Nm (70 lb. in.).



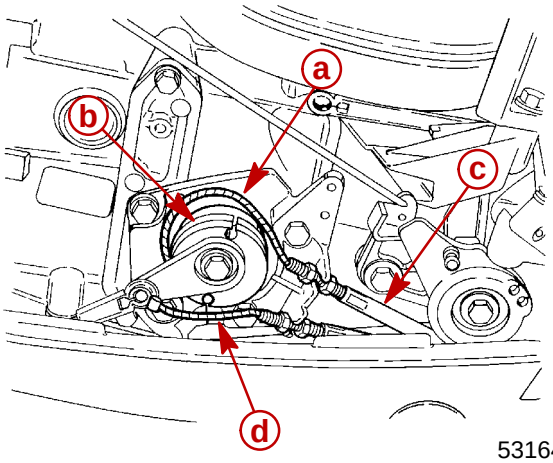


a - Stop button harness
b - Control cables
c - Tabs
d - Plate
e - Bolts [Torque to 7.9 Nm (70 lb. in.)]

Control Cables (Tiller Handle Shift Models)

Installation

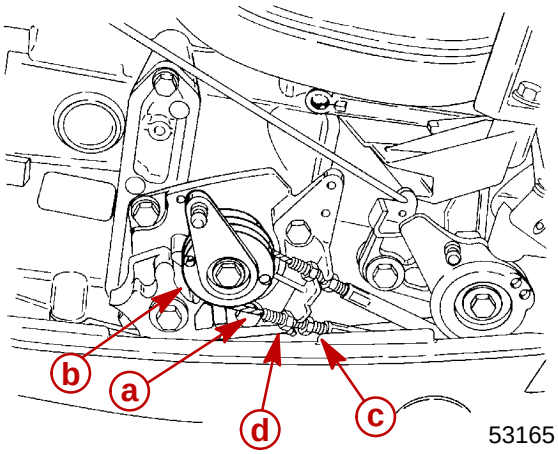
1. Rotate tiller handle twist grip to REVERSE gear position.
2. Route extended cable over top of secondary gear pulley and secure cable into inner groove of pulley. Place cable jacket into inner notch of cable anchor bracket.



53164

a - Extended cable
b - Inner groove
c - Cable jacket
d - Inner notch

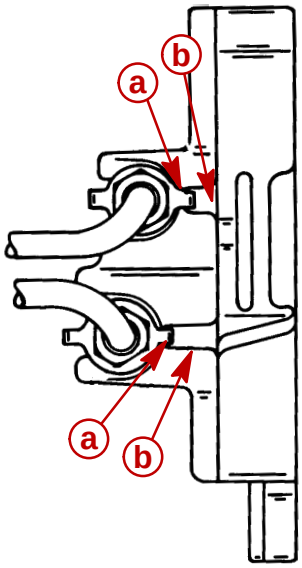
3. Rotate tiller handle to FORWARD gear position.
4. Route remaining cable below secondary gear pulley and secure cable into outer groove of pulley. Place cable jacket into lower notch of cable anchor bracket.



53165

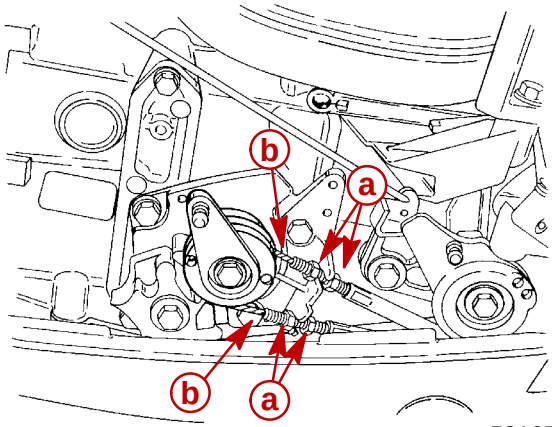
a - Cable
b - Outer groove
c - Cable jacket
d - Lower notch

5. Position tab washers to lock control cables to holes of cable anchor bracket.



a - Tab washers
b - Hole

6. Rotate tiller handle twist grip to NEUTRAL.
7. Adjust jam nuts to remove slack from control cables while allowing full travel of throttle/shift linkage.



53165

a - Jam nuts
b - Cables

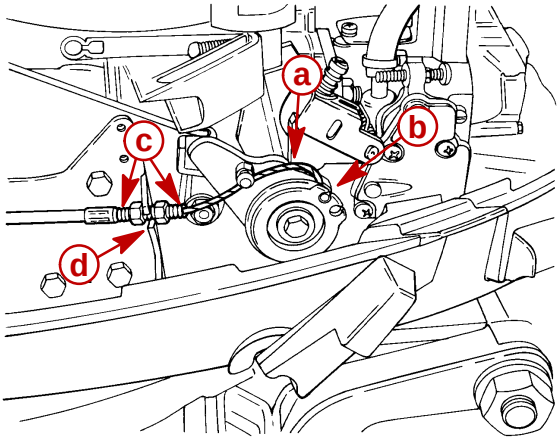
8. After cables are adjusted, verify FORWARD, NEUTRAL and REVERSE gears can be selected while smoothly advancing and retarding throttle. If throttle/shift operation is not correct, inspect for pinched or kinked cables, misaligned linkage or loose attaching bolts.

NOTE: *It may be necessary to rotate propeller shaft in order to select REVERSE gear.*

Throttle Cable (Side Shift Models)

Installation

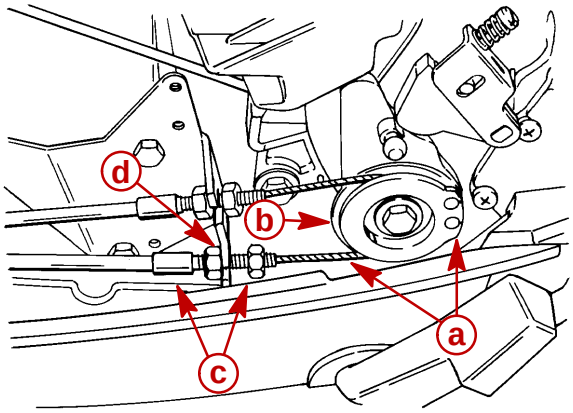
1. Rotate tiller handle twist grip to FAST position.
2. Place gear shift lever into FORWARD gear.
3. Secure extended cable into groove in top side of throttle cam pulley. Place cable jacket into upper notch of cable anchor bracket.



53190

a - Extended cable
b - Pulley
c - Cable jacket
d - Notch

4. Rotate tiller handle twist grip to SLOW position.
5. Secure remaining cable into groove in bottom side of pulley. Place cable jacket into lower notch of anchor bracket.
6. Secure throttle cables into notches of cable anchor bracket.
7. Rotate tiller handle twist grip to SLOW position.
8. Adjust jam nuts to remove slack from throttle cables while allowing full travel of throttle linkage/carburetor throttle shutter.



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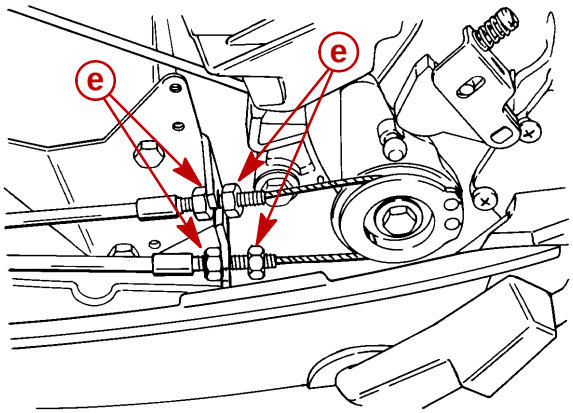

53186

a - Cable
b - Pulley
c - Cable jacket
d - Notch
e - Jam nuts

MANUAL STARTER

Section 8

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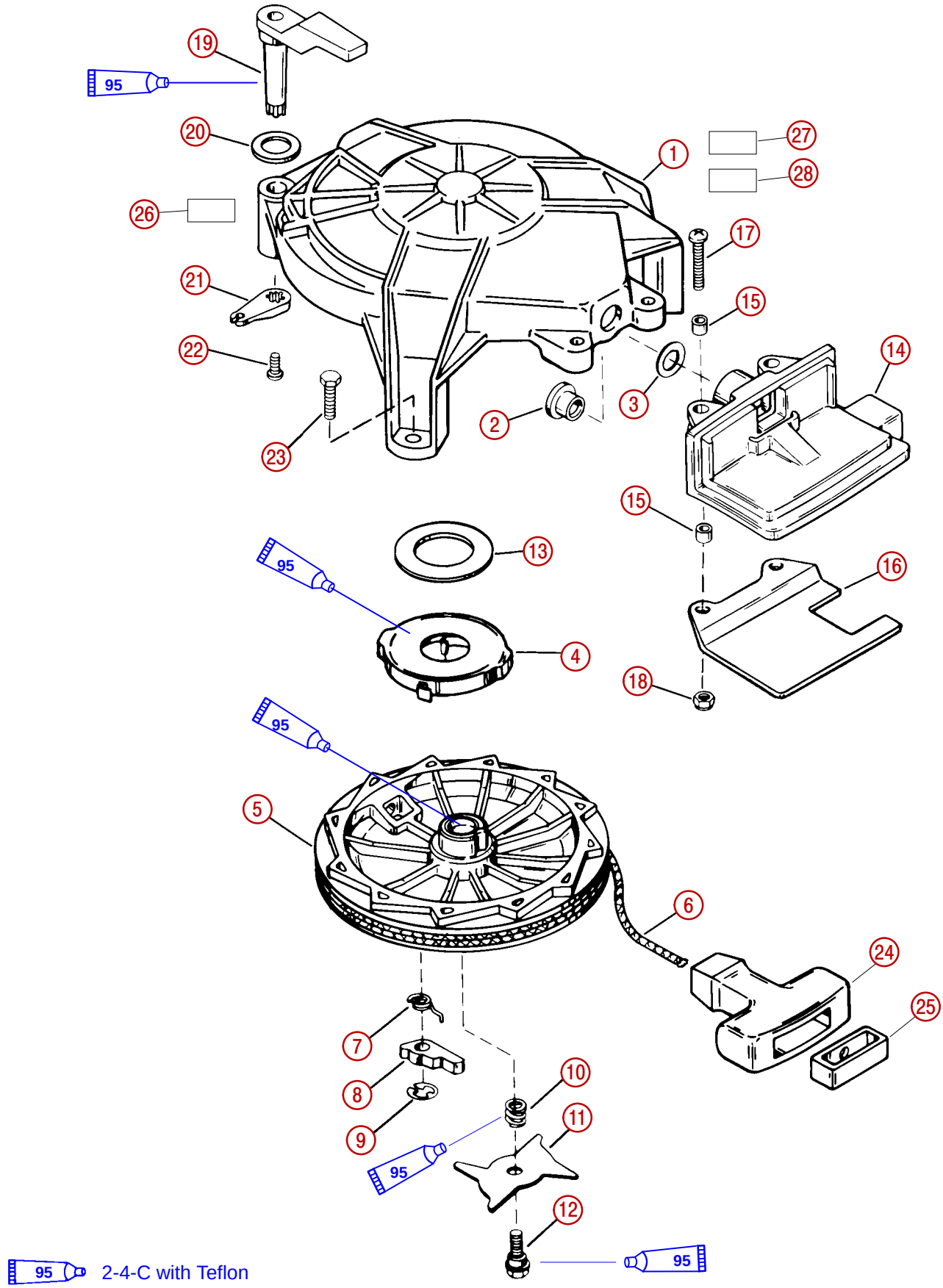
Manual Starter



Manual Starter (continued)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	RECOIL STARTER ASSEMBLY			
1	1	STARTER HOUSING			
2	1	BUSHING			
3	1	RETAINING RING			
4	1	SPRING			
5	1	STARTER PULLEY			
6	1	ROPE–starter			
7	2	SPRING			
8	2	CAM			
9	2	RETAINING RING			
10	1	SPRING			
11	1	CAM			
12	1	SCREW	135		15.3
13	1	FELT PAD			
14	1	REST			
15	4	SPACER–rest screw			
16	1	SUPPORT			
17	2	SCREW–rest to starter housing (M5 x 35)			
18	2	NUT–rest screw	30		3.4
19	1	LEVER–lock **(UPPER)**			
20	1	WASHER–upper lock lever			
21	1	LEVER–lock **(LOWER)**			
22	1	SCREW–lower lock lever (10-16 x 1/2)	30		3.4
23	3	SCREW–starter housing attaching (M6 x 20)	70		7.9
24	1	HANDLE ASSEMBLY			
25	1	RETAINER			
26	1	DECAL-Servicing Referral			
27	1	DECAL-Warning-High Voltage			
28	1	DECAL-Emergency Starting Procedure			

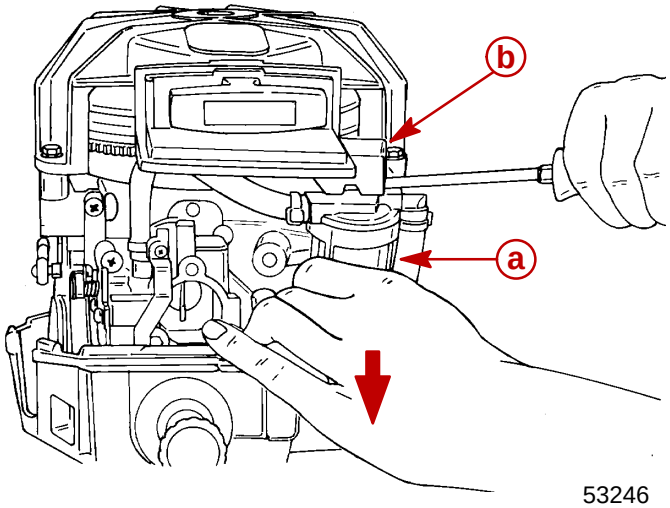
Rewind Starter Assembly

Removal

⚠ CAUTION

DO NOT turn fuel filter assembly when removing. Remove fuel filter by pulling straight down. Turning fuel filter may break fuel line connection on filter.

1. Pry fuel filter from starter rope guide. DO NOT turn filter; pull straight down.
2. Unsnap interlock link rod from lower lock lever.



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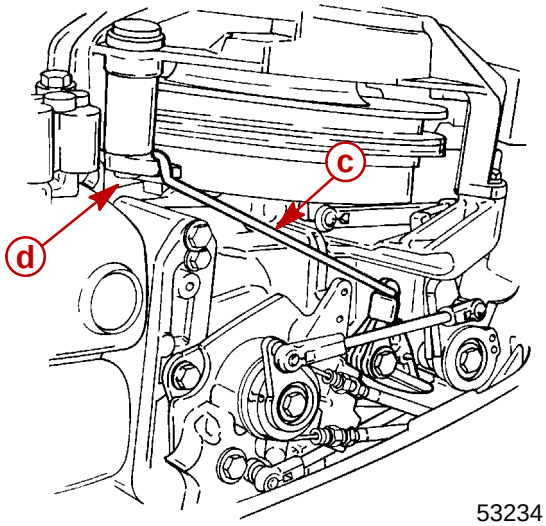
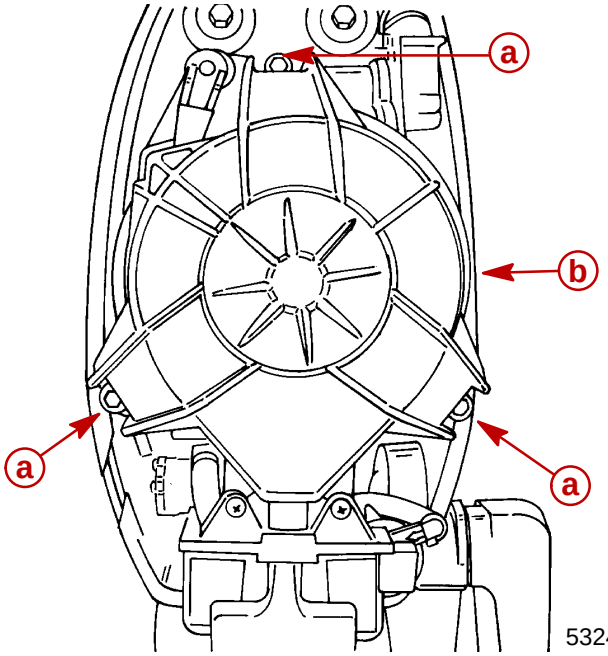


53234

a - Filter
b - Guide
c - Link rod
d - Lock lever

3. Remove 3 bolts and lift rewind starter from engine.

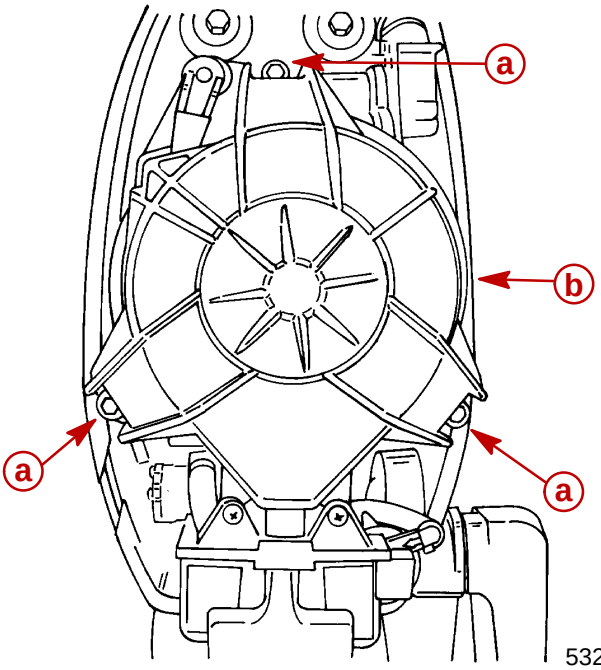


53242

a - Bolts
b - Rewind starter

Installation

1. Secure rewind starter to engine with 3 bolts. Torque bolts to 7.9 Nm (70 lb. in.).
2. Snap interlock link rod into lower lock lever.



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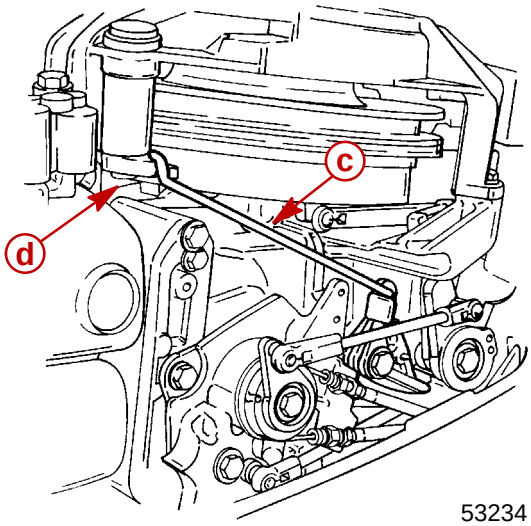


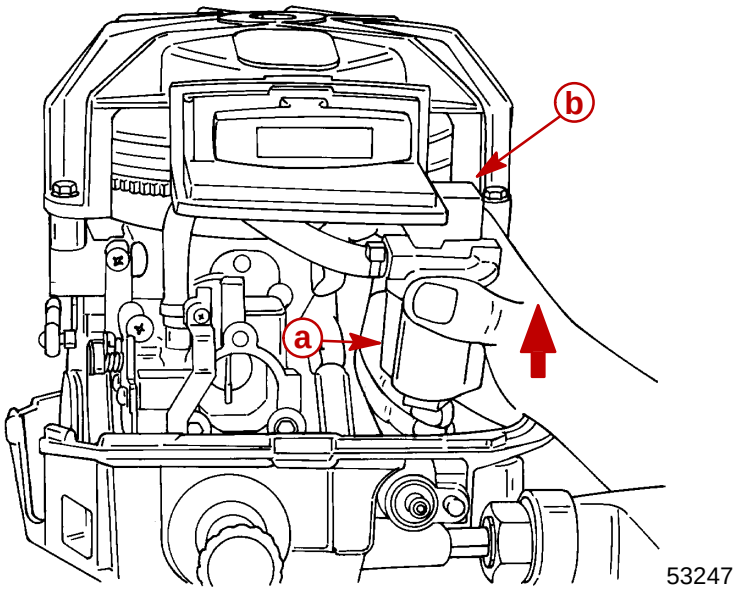
53234

a - Bolts [Torque to 7.9 Nm (70 lb. in.)]
b - Rewind starter
c - Link rod
d - Lock lever

⚠ CAUTION

Push filter straight up when installing. Turning filter may break fuel line connection on filter.

3. Push ball of fuel filter into socket of rope guide. DO NOT turn fuel filter.



53247

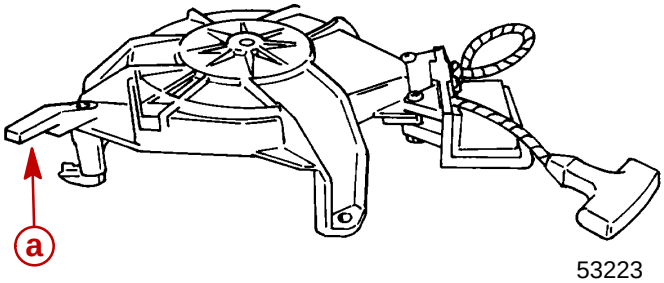
a - Filter
b - Guide

Starter Rope Replacement

1. Remove rewind starter from engine, as outlined previously.

NOTE: *If starter is broken, remove all remaining rope from sheave.*

2. Disengage starter interlock from starter sheave.
3. Pull starter rope handle out from rewind starter about 30.5 cm (1 ft.) and tie a knot at this point to prevent rope from being pulled back into rewind starter.
4. Remove rope retainer from starter handle and rope.



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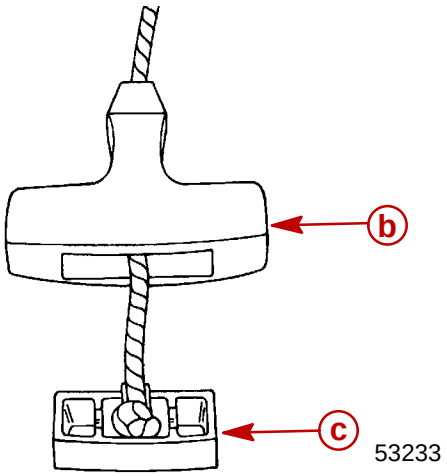


53233

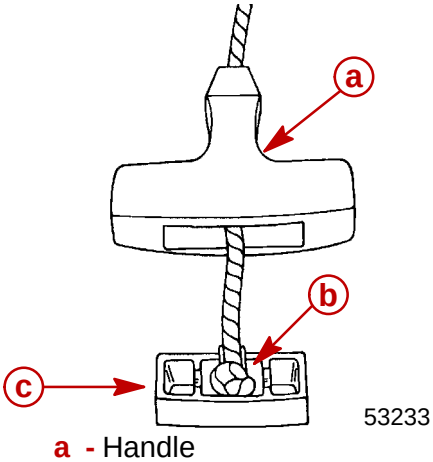
a - Interlock
b - Starter handle
c - Retainer

5. Install starter handle on new rope [cut to a length of 157.5 cm (62 in.)]. Tie a knot into end of rope. Place knot into recess of rope retainer. Install rope retainer into starter handle.

⚠ CAUTION

Starter sheave must be firmly held against spring tension to prevent spring from unwinding.

6. Pull starter rope from rewind starter until rope is fully unwound from starter sheave.



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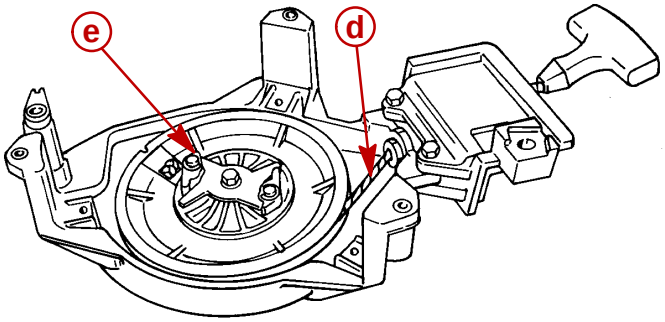
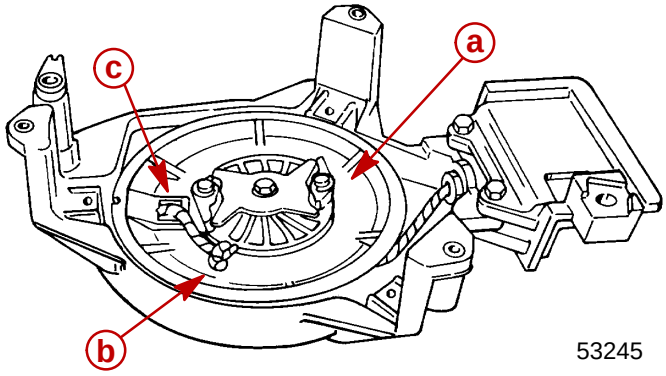


53221

a - Handle
b - Knot
c - Retainer
d - Rope
e - Sheave

7. While holding sheave in this position, lift knot from recess and pull all remaining rope from sheave.
8. Turn sheave COUNTERCLOCKWISE until stop, indicating spring is wound tight.
9. Slowly turn sheave CLOCKWISE (with spring tension) until knot recess is aligned with rope hole in starter housing.



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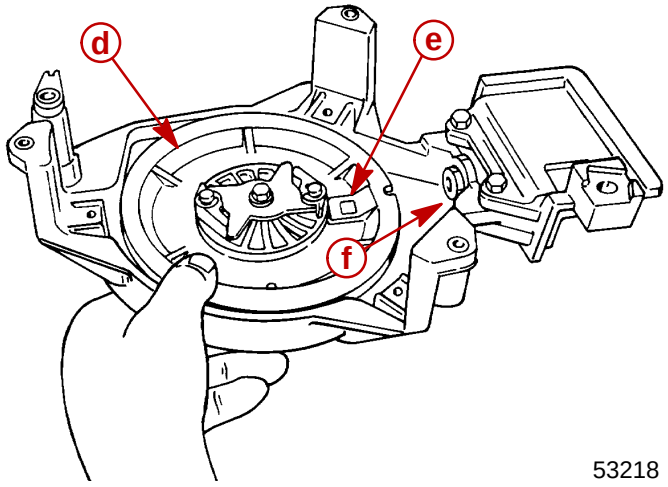
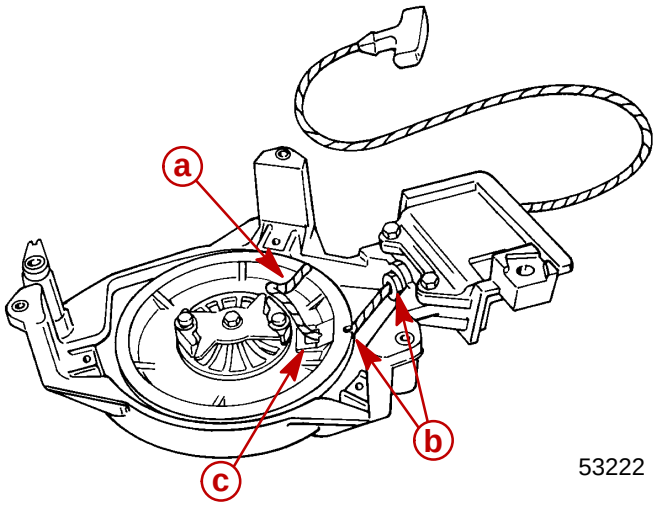


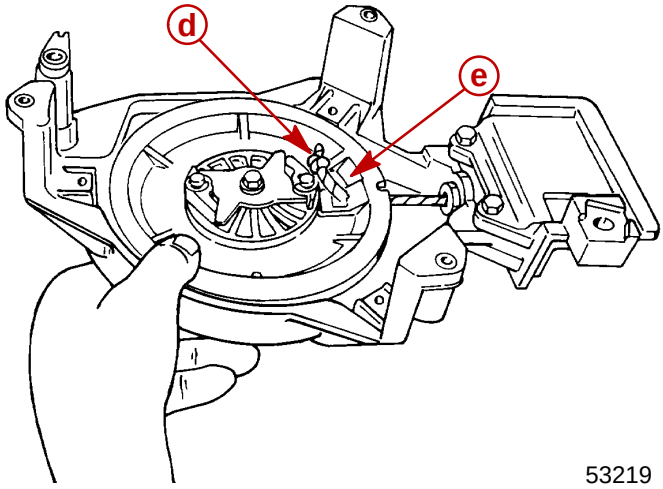
53218

a - Sheave
b - Knot
c - Recess
d - Sheave
e - Knot recess
f - Rope hole

10. Push end of new rope through rope holes in starter housing and starter sheave. Pull end of rope out of knot recess.
11. Tie a knot into end of rope and pull knot back into knot recess.



53222



53219

a - Rope
b - Holes
c - Knot recess
d - Knot
e - Knot recess

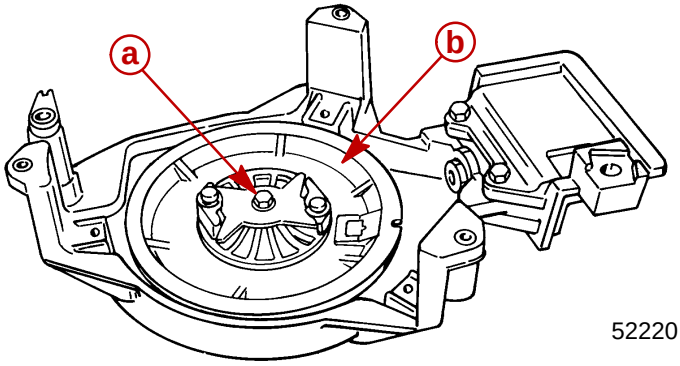
12. Allow starter rope to be slowly rewound onto starter sheave.

Disassembly

⚠ WARNING

When disassembling rewind starter, SAFETY GLASSES MUST BE WORN in case spring should uncoil out of housing.

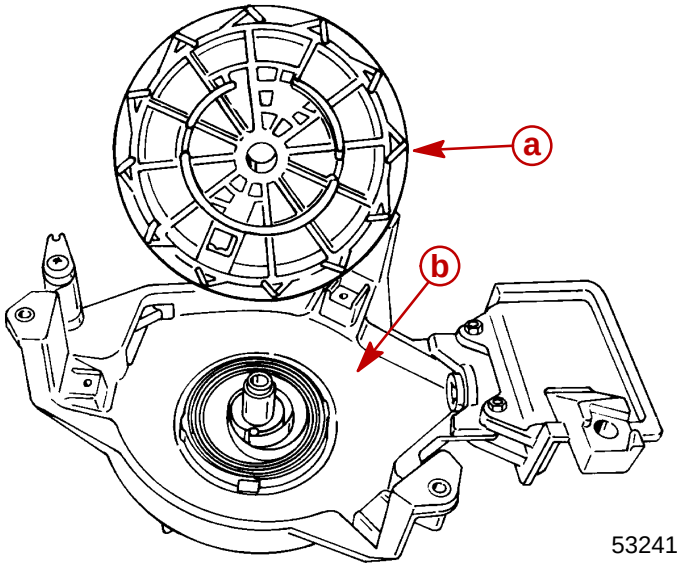
1. Remove starter rope as outlined previously.
2. With rope removed, allow sheave to slowly unwind to release spring tension.
3. Remove bolt securing cam and sheave to housing.



52220

a - Bolt
b - Sheave

4. Gently lift starter sheave from housing.
5. Rewind spring assembly may be replaced as required. DO NOT remove spring from retainer. Spring and retainer are replaced as an assembly.



53241

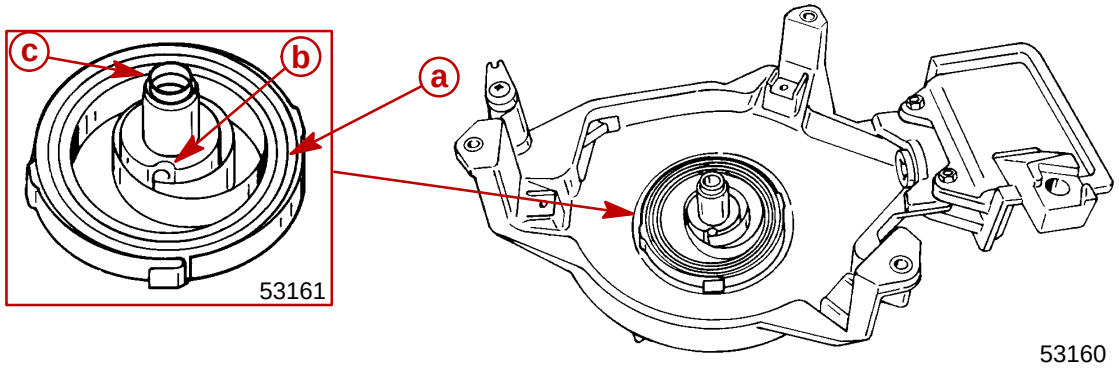
a - Sheave
b - Rewind spring

Cleaning and Inspection

1. Clean rewind spring assembly with solvent and dry with compressed air.
2. Inspect rewind spring (without removing spring from retainer) for kinks, burrs or breakage. Replace assembly if necessary.
3. Inspect cam tension spring for damage. Replace as necessary.
4. Inspect starter sheave and housing for nicks, grooves, cracks and distortion especially in area of rope travel. Replace assembly if necessary.
5. Inspect starter rope for wear and replace if necessary.

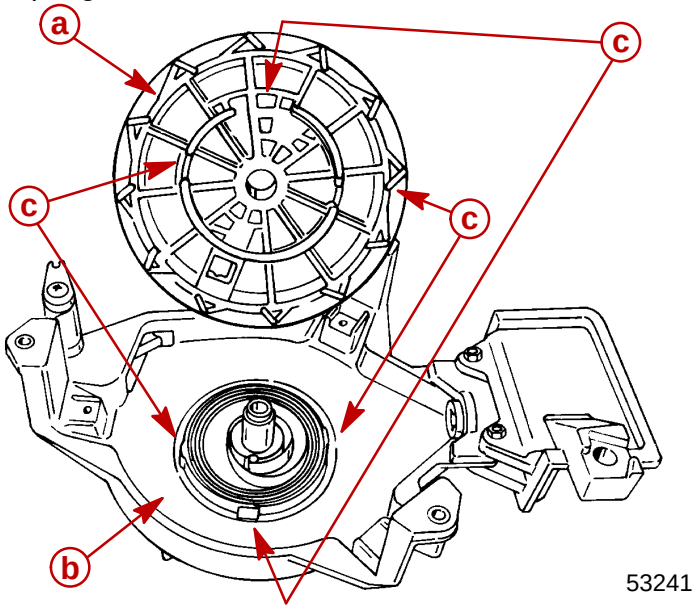
Reassembly

1. Apply 2-4-C with Teflon to rewind spring and cam tension spring.
2. Install rewind spring assembly into recoil housing positioning end of spring in notch.



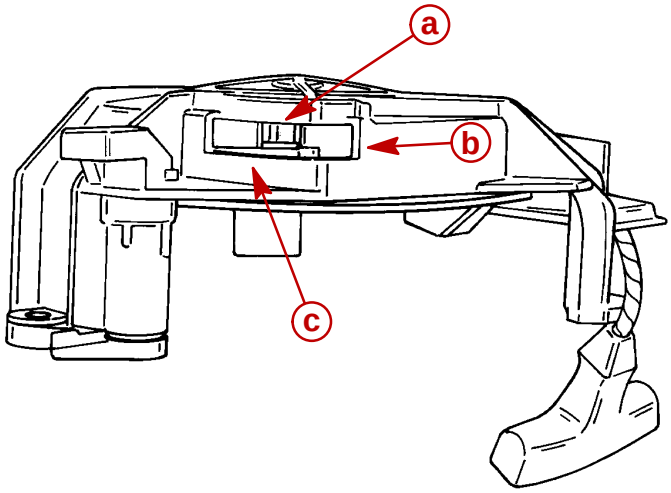
a - Rewind spring
b - Notch
c - Cam tension spring

3. Install starter sheave into housing aligning notches in sheave with appropriate locations on recoil spring retainer.



a - Sheave
b - Retainer
c - Alignment notches

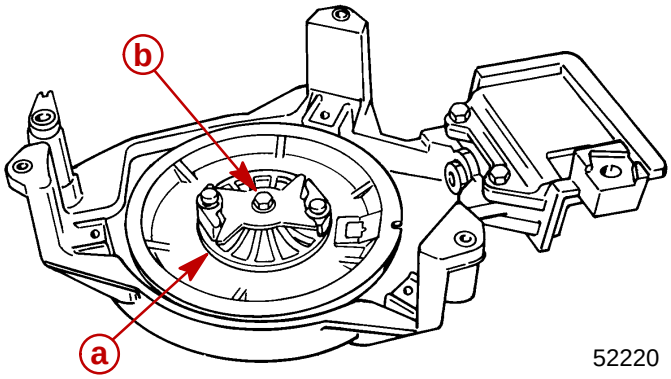
NOTE: *If sheave will not seat fully over recoil spring assembly, inspect spring retainer, through lock lever access hole in housing, for proper alignment with sheave.*



53217

a - Spring retainer
b - Lock lever access hole
c - Sheave

4. Secure cam to housing with bolt. Torque bolt to 7.9 Nm (70 lb. in.).



52220

a - Cam
b - Bolt

NOTE: *If, after tightening cam retaining bolt, sheave does not move freely, sheave is not aligned properly with recoil spring retainer. Remove cam retainer bolt and check alignment of sheave with spring retainer.*

5. Install starter rope as outlined previously.
6. Install rewind starter as outlined previously.