MARINER OUTBOARDS

MERCURY OUTBOARDS

SERVICE MANUAL

MODELS
135 • 150 • 175 • 200 • 225

1992 and Newer 135 • 150 • 150 XR6 • 150 Magnum III • 150 EFI • 175 • 175 EFI • 200 • 200 EFI • 150/200/225 Pro Max • 150/200/225 Super Magnum

With Serial Numbers 0D082000 and Above

Printed in U.S.A.

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Notice

Throughout this publication, “Dangers”, “Warnings” and “Cautions” (accompanied by the International HAZARD Symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. **OBSERVE THEM CAREFULLY!**

These “Safety Alerts” alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus “Common Sense” operation, are major accident prevention measures.

⚠ DANGER

DANGER - Immediate hazards which WILL result in severe personal injury or death.

⚠ WARNING

WARNING - Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠ CAUTION

Hazards or unsafe practices which could result in minor personal injury or product or property damage.

Notice to Users of This Manual

This service manual has been written and published by the Service Department of Mercury Marine to aid our dealers’ mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures of these products, or like or similar products manufactured and marketed by Mercury Marine, that they have been trained in the recommended servicing procedures of these products which includes the use of mechanics’ common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the products safety will be endangered by the service procedure selected.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. As required, revisions to this manual will be sent to all dealers contracted by us to sell and/or service these products.

It should be kept in mind, while working on the product, that the electrical system and ignition system are capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.

It is important to note, during any maintenance procedure replacement fasteners must have the same measurements and strength as those removed. Numbers on the heads of the metric bolts and on the surfaces of metric nuts indicate their strength. American bolts use radial lines for this purpose, while most American nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for reuse in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

Cleanliness and Care of Outboard Motor

A marine power product is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten thousands of an inch./mm. When any product component is serviced, care and cleanliness are important. Throughout this manual, it should be understood that proper cleaning, and protection of machined surfaces and friction areas is a part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Before raising or removing and outboard engine from a boat, the following precautions should be adhered to:

1. Check that flywheel is secured to end of crankshaft with a locknut and lifting eye is threaded into flywheel a minimum of 5 turns.
2. Connect a hoist of suitable strength to the lifting eye.

In addition, personnel should not work on or under an outboard which is suspended. Outboards should be attached to work stands, or lowered to ground as soon as possible.

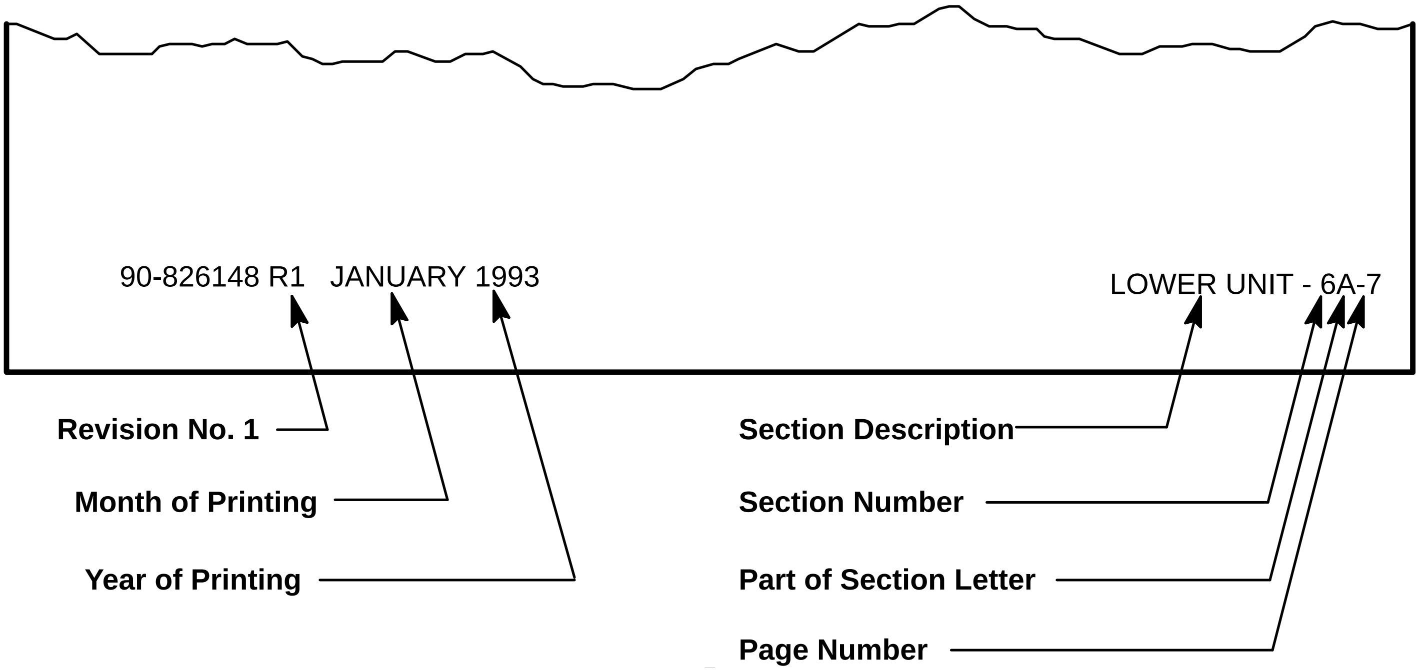
We reserve the right to make changes to this manual without prior notification.

Refer to dealer service bulletins for other pertinent information concerning the products described in this manual.

Page Numbering

Two number groups appear at the bottom of each page. The example below is self-explanatory.

EXAMPLE:



Service Manual Outline

IMPORTANT INFORMATION

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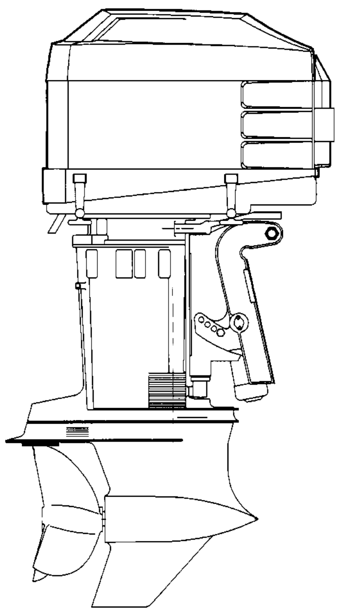

SPECIFICATIONS

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Master Specifications

Model 105/140Jet/135/150/XR6/MAGIII/175/200/150XRI/175XRI/200XRI PRO MAX/SUPER MAGNUM 150/200/225		
HORSEPOWER (KW)	**Model 135** **Model 105 Jet/150/150XRI** **Model XR6/MAGIII** **Model 175/175XRI** **Model 140 Jet/200/200XRI** **Model Pro Max/Super Magnum 150** **Model Pro Max/Super Magnum 200** **Model Pro Max/Super Magnum 225**	135 (100.6) 150 (111.8) 150 (111.8) 175(130.5) 200(149.1) 150 (111.8) 200(149.1) 225(167.9)
OUTBOARD WEIGHT	**Model 135/150** **Model Pro Max/Super Magnum 150/200/225** **Model XR6/MAGIII/175/200** **Model 150XRI/175XRI/200XRI** **Model 105 Jet** **Model 140 Jet**	404.0 lbs. (184.0kg) 350.0 lbs. (159.0kg) 395.0 lbs. (180.0kg) 410.0 lbs. (186.0kg) 428.0 lbs. (195.0kg) 408.0 lbs. (185.5kg)
CYLINDER BLOCK	**Model 105 Jet/135/150** **Type** **Displacement** **Model 140 Jet/XR6/MAGIII/I75/200 150XRI/175XRI/200XRI/Pro Max/ Super Magnum 150/200/225** **Type** **Displacement**	 V–6 Cylinder, Two Cycle, Loop Charged 121.9 cu. in. (1998cc) V–6 Cylinder, Two Cycle, Loop Charged 153.0 cu. in. (2507cc)
STROKE	**Length (All Models)**	2.650 in. (67.31mm)
CYLINDER BORE	**Diameter (Std)** **– Models 105 Jet/135/150** **– Models XR6/MAGIII/175/200 150XRI/175XRI/200XRI/140 Jet Pro Max/Super Magnum 150/200/225** **Taper/Out of Round/Maximum Wear** **Bore Type**	 3.125 in. (79.375mm) 3.501 in. (88.925mm) 0.003 in. (0.076mm) Cast Iron
PISTON	**Piston Type** **Models 105 Jet/135/150** **Standard** **0.015 in. (0.381mm) Oversize** **0.030 in. (0.762) Oversize** **Models XR6/MAGIII/175/200/140 Jet 150XRI/175XRI/200XRI/ProMax/ Super Magnum 150/200/225** **Standard** **0.015 in. (0.381mm) Oversize**	Aluminum 3.115 in. ± 0.002 in. (79.121mm ± 0.051mm) 3.130 in. ± 0.002 in. (79.502mm ± 0.051mm) 3.145 in. ± 0.002 in. (79.883mm ± 0.051mm) 3.494 in. ± 0.001 in. (88.748mm ± 0.025mm) 3.509 in. ± 0.001 in. (89.129mm ± 0.025mm)

Model 105/140Jet/135/150/XR6/MAGIII/175/200/150XRI/175XRI/200XRI PRO MAX/SUPER MAGNUM 150/200/225		
COMPRESSION	**All Models – Using a fully charged battery, throttle shutters wide open and cylinder block warm**	110 – 135 psi (753.3 – 924.5 kPa) Variance between cylinders should not exceed 15 psi (102.7 kPa)
REEDS	**Model 105 Jet/135/150** **Model XR6/MAGIII/175/200** **Model 150XRI/175XRI/200XRI** **Reed Type** **Reed Stand 0pen (Max.)** **Reed Stop (Max.)** **Model Pro Max/Super Magnum 150/200/225** **Reed Type** **Reed Stop (Max.)**	 Steel 0.020 in. (0.50mm) Not Adjustable 2 Stage Plastic No Stop
MID SECTION	**Transom Height - Short Shaft** **- Long Shaft** **Power Trim (Tilt Range)** **Steering Pivot Range** **Allowable Transom Thickness**	75° 20° 5 60° 2-3/8 in. (6.03cm) Maximum
GEAR HOUSING	**Gear Ratio** **– Models 135/150** **– Models XR6/MAGIII/150XRI** **– Models XR6/MAGIII (4-1/4″ dia.)** **– Models 175/200/175XRI/200XRI** **– Model Pro Max/Super Magnum 200/225** **Gear Ratio – High Altitude** **– Models 135/150** **– Models XR6/MAGIII/175/200 150XRI/175XRI/200XRI** **– Model Pro Max/Super Magnum 150** **Gearcase Capacity** **– 1.87:1/2.00:1/2.30:1** **– 1.78:1** **Pinion Height** **– All Models** **Forward Gear Backlash** **– 1.78:1 Ratio** **– 1.87:1 Ratio** **– 2.00:1 Ratio** **– 2.30:1 Ratio** **Water Pressure @ RPM**	 2.00:1 (14/28 teeth) 1.87:1 (15/28 teeth) 1.78:1 (14/25 teeth) 1.87:1 (15/28 teeth) 1.87:1 (15/28 teeth) 2.30:1 (13/30 teeth) 2.00:1 (14/28 teeth) 2.00:1 (14/28 teeth) 22.5 fl. oz. (665.4ml) 21.0 fl. oz. (621.0ml) 0.025 in. (0.64mm) 0.016 in – 0.019 in. (0.406mm – 0.482mm) 0.018 in. – 0.027 in. (0.460mm – 0.686mm) 0.015 in. – 0.022 in. (0.381mm – 0.558mm) 0.018 in. – 0.023 in. (0.460mm – 0.584mm) 12 PSI Minimum @ 5500 RPM

Model 105/140Jet/135/150/XR6/MAGIII/175/200/150XRI/175XRI/200XRI PRO MAX/SUPER MAGNUM 150/200/225		
FUEL SYSTEM	**Fuel**	Gasoline w/Oil Injection
	Recommended Gasoline	
	Model 105/140 Jet/135/150	
	Model XR6/MAGIII/175/200	
	Model 150XRI/175XRI/200XRI	Unleaded 87 Octane Minimum
	Model Pro Max/Super Magnum 150/200/225	Unleaded 89 Octane Minimum
	Recommended Oil	
	Model 105/140 Jet/135/150	
	Model XR6/MAGIII/175/200	
	Model 150XRI/175XRI/200XRI	
	Model Pro Max/Super Magnum 150/200/225	Quicksilver TC-W3 2 Cycle Outboard Oil Only
	Gasoline/Oil Ratio	50:1 (25:1 Break-In)
	Fuel Pressure – @ Idle	2 PSI
	– @ WOT	8 PSI
STARTING SYSTEM	**Manual Start – All Models**	Emergency Start Rope
	Electric Start – All Models	
	Starter Draw (Under Load)	175 Amperes
	Starter Load (No Load)	40 Amperes
	Battery Rating	Min. Reserve Cap. Rating of 100 Min. and CCA of 350 Amperes
IGNITION SYSTEM	**Type**	Capacitor Discharge
	Spark Plug Type	NGK BU8H
	Spark Plug Gap	Surface Gap
CHARGING SYSTEM	**Alternator Output (Regulated)**	40 Amperes @ 5000 RPM
FUEL INJECTION	**Idle RPM**	
	– All Models	650 ± 50
	Wide Open Throttle (WOT) RPM	
	– Model 150XRI/175XRI	5000 – 5600
	– Model 200XRI	5000 – 5800
	– Pro Max/Super Magnum	6200 – 6500
	Float Adjustment (Vapor Separator)	
	Float Level	Preset @ Factory
	Injectors	
	– All Models (Quantity)	6
	– Inner Switch Box Controls:	
	– #1 Primary Circuit	#3 and #4 Injectors
	– #3 Primary Circuit	#5 and #6 Injectors
	– #5 Primary Circuit	#1 and #2 Injectors
	Line Pressure @ Injectors	34 PSI – 36 PSI (234kPa – 248kPa)

Model 105/140Jet/135/150/XR6/MAGIII/175/200/150XRI/175XRI/200XRI PRO MAX/SUPER MAGNUM 150/200/225		
C A R B U R E T O R	**Idle RPM**	
	– Model 105/140 Jet	650 ± 50
	135/150/175/200	650 ± 50
	– Model Pro Max/Super Magnum 150/200/225	650 ± 50
	– Model XR6/MAGIII	675 ± 50
	Wide Open Throttle (WOT) RPM	
	– Model 105/140 Jet	5000 – 5600
	135/150/175/200	5000 – 5500
	– Model XR6/MAGIII	5000 – 5500
	– Model Pro Max/Super Magnum 150/200/225	6200 – 6500
	Idle Mixture Screw Adjustment (Preset - Turns Out)	
	– All Carburetor Models	1-1/2 ±1/8
	– All EFI Models	Not Adjustable
	Float Adjustment	
	Float Level	Float Even with Bowl Edge w/Bowl Inverted
	WMH Carburetor Jets	
	– Model 135 (WMH 30)	
	– Main Jet	.066
	– Off-Idle Jet	.050
	– Idle Air Jet	.054
	– Vent Jet	.084
	– Model 105 Jet/150 (WMH 31)	
	– Main Jet	.062
	– Off-Idle Jet	.050
	– Idle Air Jet	.052
	– Vent Jet	.086
	– Model XR6/MAGIII (WMH 32)	
	– Main Jet	.062
	– Off-Idle Jet	.040
	– Idle Air Jet	.058
	– Vent Jet	.090
	– Model 175 (WMH 33)	
	– Main Jet	.064
	– Off-Idle Jet	.050
	– Idle Air Jet	.048
	– Vent Jet	.084
	– Model 140 Jet/200 (WMH 34/39)	
	– Main Jet	Cyl. 1,2 – .066 Cyl. 3,4,5,6 – .064
	– Off-Idle Jet	.050
	– Idle Air Jet	.046
	– Vent Jet	.084

Model 105/140Jet/135/150/XR6/MAGIII/175/200/150XRI/175XRI/200XRI PRO MAX/SUPER MAGNUM 150/200/225		
C A R B U R E T O R	**WMV Carburetor Jets**	
	– Model 135 (WMV 1/1A)	
	– Main Jet	.072
	– Idle Air Jet	Cyl. 1,2,3,4,6 – .036; Cyl. 5 – .040
	– Vent Jet	.086
	– Model 105 Jet/150 (WMV 2/2A)	
	– Main Jet	.074
	– Idle Air Jet	Cyl. 1,2,3,4,6 – .034; Cyl.5 – .038
	– Vent Jet	.086
	– Model XR6/MAGIII (WMV 3/3A)	
	– Main Jet	.074
	– Idle Air Jet	Cyl. 1,2,3,4,6 – .044; Cyl.5 – .048
	– Vent Jet	.082
	– Model 175 (WMV 4/4A)	
	– Main Jet	.078
	– Idle Air Jet	Cyl. 1,2,3,4,6 – .030; Cyl.5 – .034
	– Vent Jet	.086
	– Model 140 Jet/200 (WMV 5/5A)	
	– Main Jet	Cyl 1,2 – .082 Cyl. 3,4,5,6 – .080
	– Idle Air Jet	Cyl 1,2 – .052 Cyl. 3,4,6 – .028 Cyl. 5 – .032
	– Vent Jet	.096

Model 105/140Jet/135/150/XR6/MAGIII/175/200/150XRI/175XRI/200XRI PRO MAX/SUPER MAGNUM 150/200/225		
TIMING	**Idle Speed/Pickup Timing**	
	– 105 JET/135/150 Carb Models	2° – 9° ATDC
	– XR6/MAG III/175 Carb **– 140 Jet/200 Carb** **– All Pro Max/Super Magnum** **– 150XRI/175 XRI Models** **– 200 XRI Model**	0° – 9° ATDC
	Maximum BTDC	
	– Model 105 Jet/135/150	
	@ Cranking Speed	21° BTDC
	@ WOT RPM	19° BTDC
	– XR6/MAG III/175 Carb **– 175 XRI** **– Pro Max/Super Magnum 150**	
	@ Cranking Speed	20° BTDC
	@ WOT RPM	19° BTDC
	– 150 XRI	
	@ Cranking Speed	15° BTDC
	@ WOT RPM	16° BTDC
	– 140 Jet/200 Carb **Models with Spark Advance Module**	
	@ Cranking Speed	21° BTDC
	@ WOT RPM	25° BTDC
	Models with Idle Stabilizer Module	
	@ Cranking Speed	22° BTDC
	@ WOT RPM	20° BTDC
	– Model 200XRI	
	@ Cranking Speed	16° BTDC
	@ 5800 RPM	22° BTDC
	– Pro Max/Super Magnum 200	
	@ Cranking Speed	With Spark Advance Box – 20° BTDC Without Spark Advance Box – 25° BTDC
	– Pro Max/Super Magnum 225	
	@ Cranking Speed	25° BTDC

NOTE: *Timing specifications listed are for 1998 model year engines. Refer to timing decal on engine for previous model year timing specifications.*

Model 105/140Jet/135/150/XR6/MAGIII/175/200/150XRI/175XRI/200XRI PRO MAX/SUPER MAGNUM 150/200/225		
OIL INJECTION	**Recommended Oil (All Models)** **Hi-Perf. Pro Max/Super Magnum**	Quicksilver TC-W3 Quicksilver TC-W3
	Oil Tank Capacity	3 gal. (11.4Liter)
	Approx. Time	
	– Model 105 Jet/135/150	8.7 hrs. Approx.
	– Model 140 Jet/XR6/MAGIII/175/200	6.6 hrs. Approx.
	– Model 150XRI/175XRI/200XRI/Pro Max/Super Magnum 150/200/225	6.6 hrs. Approx.
	Reserve Capacity/Approx. Time	.94 qt. (0.89Liter) 30 – 35 min.
	Output @ 1000 RPM for 3 Minutes with Pump @ Full Open	
	– Model 105 Jet/135/150	12cc @ 1000 RPM
	– Model 140 Jet/XR6/MAG III/175/200	15cc @ 1000 RPM
	– Model 150XRI/175XRI/200XRI/Pro Max/Super Magnum 150/200/225	15cc @ 1000 RPM

IMPORTANT INFORMATION

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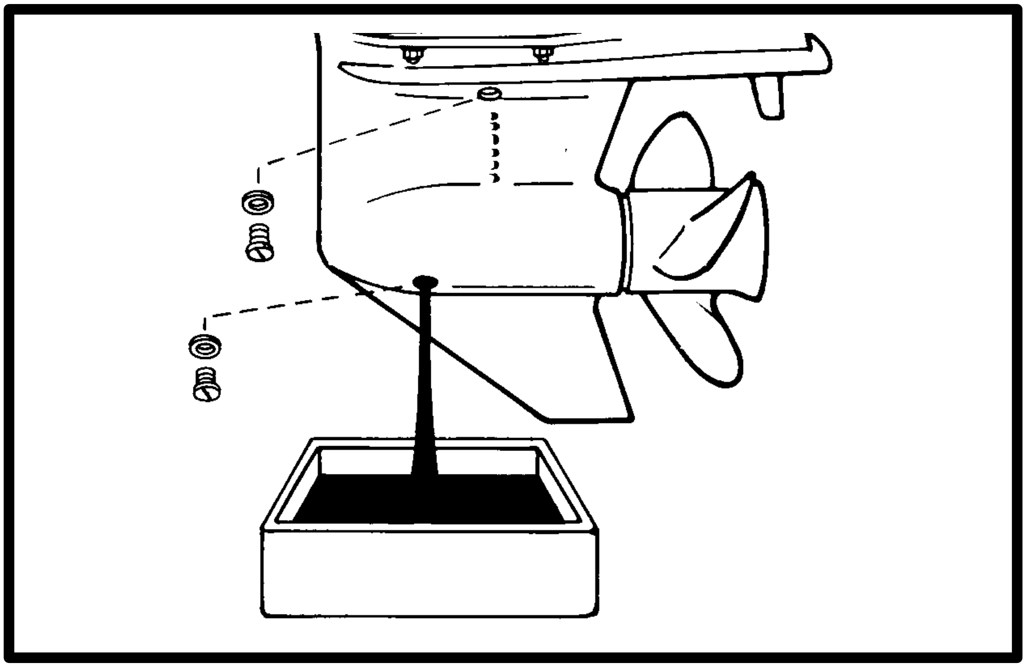

MAINTENANCE

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Specifications

Gear Case Lubricant Capacity

Gear Case Ratio	Capacity
1.78:1	21 fl. oz. (625ml)
1.87:1	24-1/4 fl oz. (717ml)
2.00:1	24-1/4 fl oz. (717ml)
2.30:1	24-1/4 fl oz. (717ml)

Special Tools

Description	Part No.
Flushing Attachment	44357A2
Grease Gun	91-37299A1

Quicksilver Lubricant/Sealant

Description	Part No.
Gear Lubricant - Premium Blend	92-19007A24
Anti-Corrosion Grease	92-78376A6
2-4-C Marine Lubricant with Teflon	92-825407A12
SAE 30W Motor Oil	Obtain Locally

Inspection and Maintenance Schedule

Before Each Use

1. Check that lanyard stop switch stops the engine.
2. Visually inspect the fuel system for deterioration or leaks.
3. Check outboard for tightness on transom.
4. Check steering system for binding or loose components.
5. Visually check steering link rod fasteners for proper tightness.
6. Check propeller blades for damage.

After Each Use

1. Flush out the outboard cooling system if operating in salt or polluted water.
2. Wash off all salt deposits and flush out the exhaust outlet of the propeller and gear case with fresh water if operating in salt water.

Every 100 Hours of Use or Once yearly, Whichever occurs first

1. Lubricate all lubrication points. Lubricate more frequently when used in salt water.
2. Inspect and clean spark plugs.
3. Check engine fuel filter for contaminants – Carburetor models.
4. Replace Water separating fuel filter – EFI models.
5. Check corrosion control anodes. Check more frequently when used in salt water.
6. Drain and replace gear case lubricant.
7. Lubricate splines on the drive shaft.*
8. Check power trim fluid.
9. Inspect battery.
10. Adjust carburetors (if required).*
11. Check engine timing setup.*
12. Check control cable adjustments.*
13. Remove engine deposits with Quicksilver Power Tune Engine Cleaner.

14. Check tightness of bolts, nuts, and other fasteners.

15. Replace water pump impeller (more often if overheating occurs or reduced water pressure is noted).∗

∗ *These items should be serviced by an authorized dealer.*

Before Periods of Storage

FUEL SYSTEM

IMPORTANT: Gasoline containing alcohol (ethanol or methanol) can cause a formation of acid during storage and can damage the fuel system. If the gasoline being used contains alcohol, it is advisable to drain as much of the remaining gasoline as possible from the fuel tank, remote fuel line and engine fuel system.

Fill the fuel system (tank, hoses, fuel pump, carburetors and fuel injection systems) with treated (stabilized) fuel to help prevent formation of varnish and gum. Proceed with following:

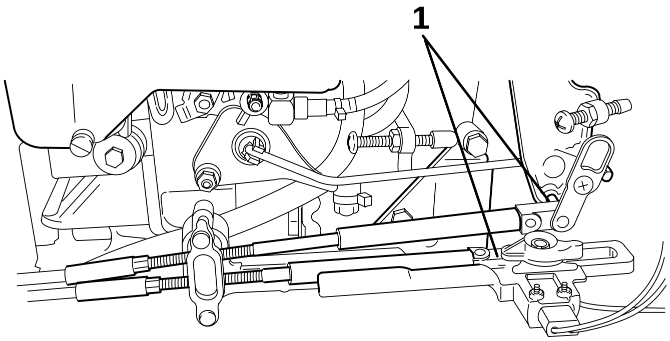
1. Portable Fuel Tank – Pour the required amount of Quicksilver Gasoline Stabilizer (follow instructions on container) into fuel tank. Tip fuel tank back and forth to mix stabilizer with the fuel.
2. Permanently Installed Fuel Tank – Pour the required amount of Quicksilver Gasoline Stabilizer (follow instructions on container) into a separate container and mix with approximately one quart (one liter) of gasoline. Pour this mixture into fuel tank.
3. Place the outboard in water or connect flushing attachment for circulating cooling water. Run the engine for ten minutes to allow treated fuel to fill the fuel system.

Lubrication Points

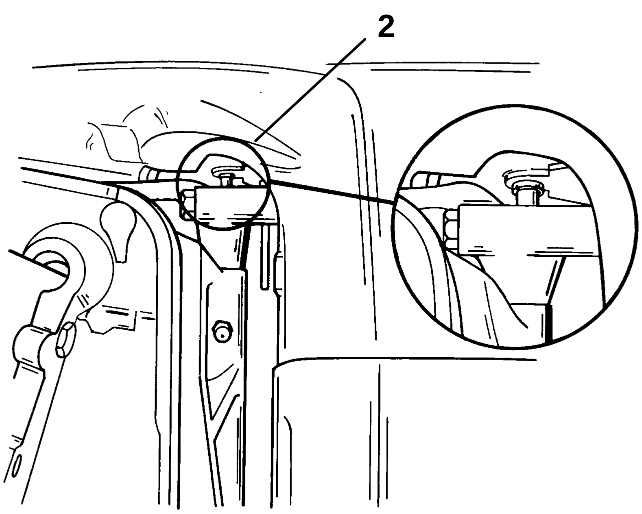
<table>
<tr><th>Item No.</th><th>Description</th><th>Type of Lubricant</th><th>Fresh Water Frequency</th><th>Salt Water Frequency</th></tr>
<tr><td>1</td><td>Throttle/ Shift Linkage Pivot Points</td><td rowspan="6">2-4-C w/Teflon</td><td rowspan="6" colspan="2">100 Hours of Use or Once in Season</td></tr>
<tr><td>2</td><td>Upper Shift Shaft</td></tr>
<tr><td>3</td><td>Tilt Lock Lever</td></tr>
<tr><td>4</td><td>Swivel Pin</td></tr>
<tr><td>5</td><td>Ride Guide Steering Cable</td></tr>
<tr><td>6</td><td>Tilt Tube</td></tr>
<tr><td>7</td><td>Steering Link Rod Pivot Points</td><td>SAE 30W Motor Oil</td><td colspan="2">100 Hours of Use or Once in Season</td></tr>
<tr><td>8</td><td>Trim Rod Ball Ends</td><td>2-4-C w/Teflon Anti-Corrosion Grease</td><td colspan="2">100 Hours of Use or Once in Season</td></tr>
<tr><td>9</td><td>Propeller Shaft</td><td>2-4-C w/Teflon</td><td colspan="2">100 Hours of Use or Once in Season</td></tr>
<tr><td>10</td><td>Gear Housing Bearing Carrier and Cover Nut</td><td>2-4-C w/Teflon</td><td colspan="2">100 Hours of Use or Once in Season</td></tr>
<tr><td>◊</td><td>Gear Housing</td><td>Quicksilver Premium Blend Gear Lube</td><td colspan="2">100 Hours of Use or Once in Season</td></tr>
<tr><td>°</td><td>Engine Driveshaft Splines</td><td>2-4-C w/Teflon</td><td>Once in Season</td><td>Once in Season</td></tr>
</table>

◊ Refer to “Gear Housing Lubrication”

° Refer to Gear Housing Removal and Installation” (Section 6)



1 - Throttle/Shift Linkage Pivot Point Lubrication



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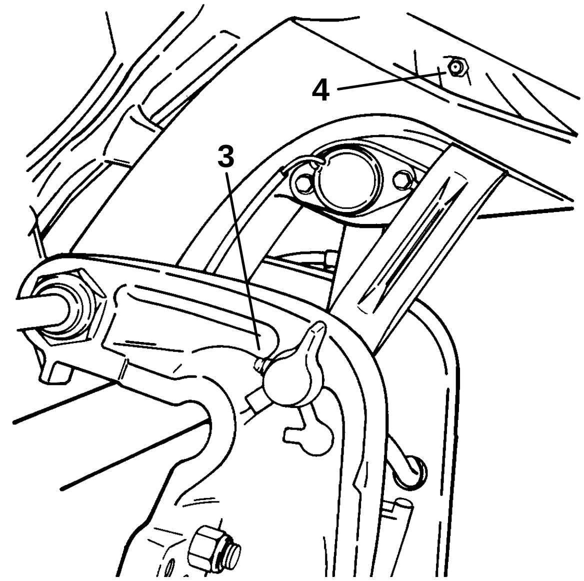
2 - Upper Shift Shaft Lubrication



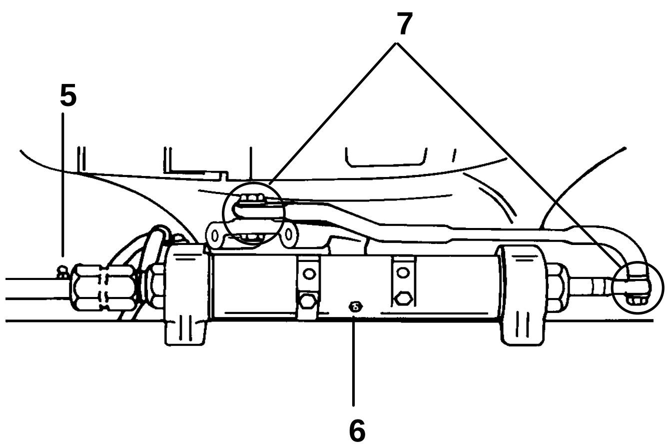
3 - Tilt Lock Lever Grease Fitting
4 - Swivel Pin Grease Fittings

RIDE-GUIDE STEERING CABLE AND PIVOT POINTS LUBRICATION

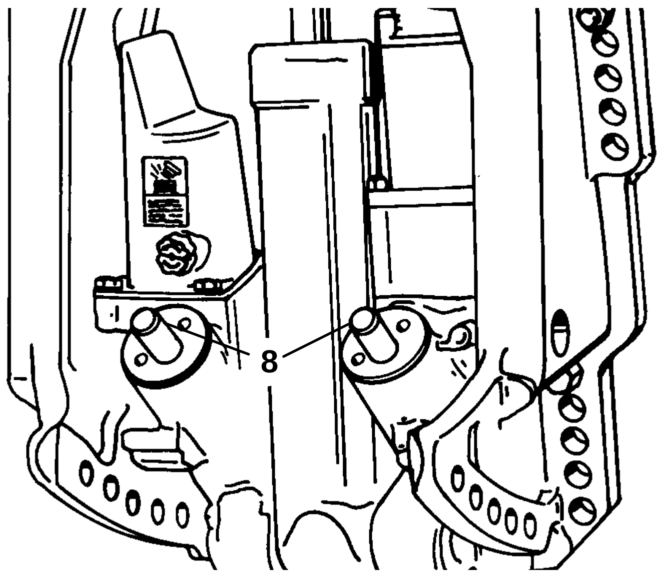
⚠ WARNING

Core of steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

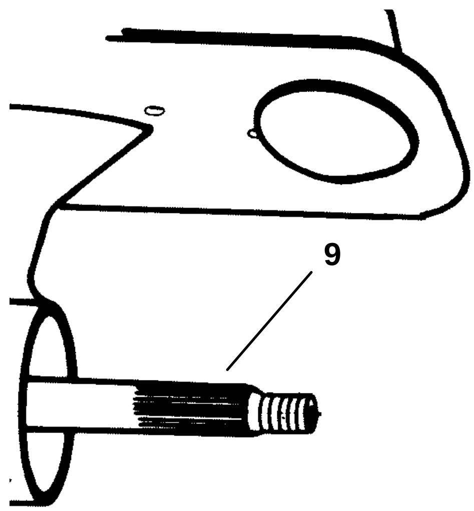
With core of Ride-Guide Steering cable (transom end) fully retracted, lubricate transom end of steering cable thru grease fitting and exposed portion of cable end with Quicksilver 2-4-C w/Teflon. Lubricate all pivot points with SAE 30W engine oil.



5 - Ride-Guide Steering Cable Grease Fitting
6 - Tilt Tube Grease Fitting
7 - Steering Link Rod Pivot Point Lubrication



8 - Trim Rod Ball Ends



9 - Propeller Shaft Lubrication

Checking Power Trim Fluid

The power trim system is filled at the manufacturer and is ready for use.

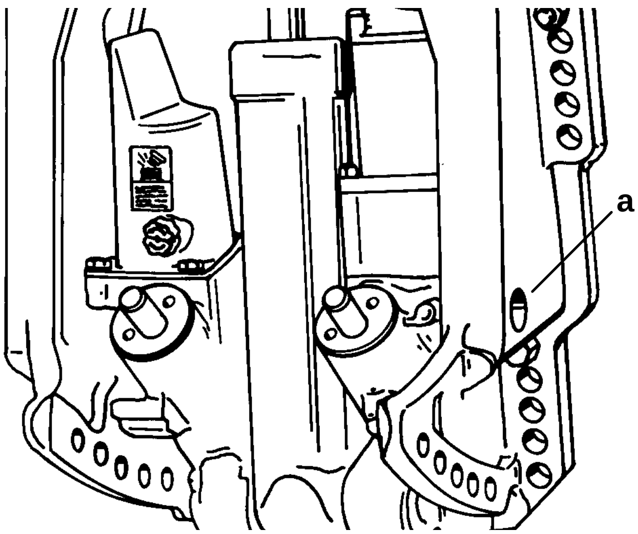
Trim outboard through entire trailing range several times to remove any air from the system.

The trim system is pressurized and is not externally vented.

The outboard can be raised or lowered manually by loosening the manual release valve 3 to 4 turns.

The trim “out” angle of this outboard is not adjustable. The trim system has an internal valve which will automatically stop the outward trim travel at 20° when engine RPM is approximately 2000 RPM or higher; outboard also has to be in water and in gear.

The outboard can be operated beyond the 20° trim limit for operating outboard in shallow water if engine RPM is kept below approximately 2000 RPM.



a - Manual Release Valve

Gear Case Lubrication

Gear Case Lubricant Capacity

Gear Case Ratio	Capacity
1.78:1	21 fl. oz. (621ml)
1.87:1	22.5 fl. oz. (665ml)
2.00:1	22.5 fl. oz. (665ml)
2.30:1	22.5 fl. oz. (665ml)

Draining Gear Case

⚠ WARNING

If gear housing is installed on outboard, to avoid accidental starting, disconnect (and isolate) spark plug leads from spark plugs before working near the propeller.

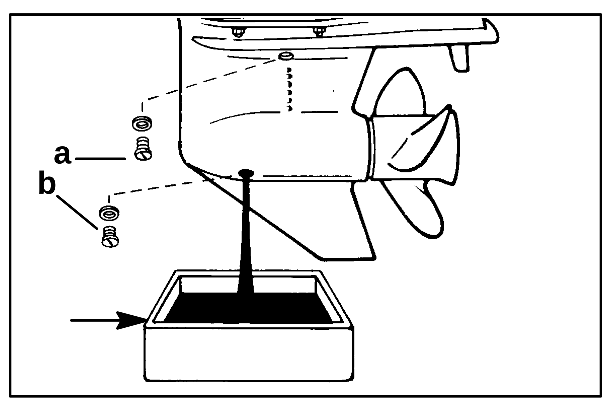
⚠ CAUTION

Do not use automotive grease in the gear housing. Use only Quicksilver Gear Lubricant.

1. Tilt outboard so that lubricant in gear housing will drain toward front of housing, out fill hole and into clean container.

IMPORTANT: Inspect FILL and VENT screw sealing washers for damage. Use new washers as needed.

2. Remove lubricant FILL screw and sealing washer. Note amount of metal particles on magnetic fill screw.
3. Remove VENT screw with sealing washer and allow sufficient time for all lubricant to drain.



a - Vent Screw w/Sealing Washer
b - Fill Screw w/Sealing Washer

4. Inspect gear lubricant for metal particles (lubricant will have a “metal flake” appearance). Presence of a small amount of fine metal particles (resembling powder) on the fill screw bar magnet indicates normal gear wear. An excessive amount of metal filings or larger particles (chips) may indicate abnormal wear and requires gear housing disassembly and component inspection.
5. Note color of gear lubricant. White or cream color indicates presence of water in lubricant. Gear lubricant which has been drained from a gear case recently in operation will have a yellowish color due to lubricant agitation/aeration. This is normal and should not be confused with the presence of water.
6. Presence of water in gear lubricant indicates the need for disassembly and inspection of oil seals, seal surfaces, o-rings, water pump gaskets as well as gear housing components for damage.

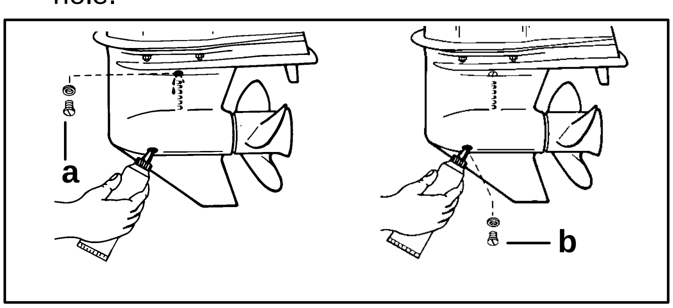
Checking Lubricant Level and Refilling Gear Case

IMPORTANT: Never add lubricant to gear housing without first removing VENT screw, as trapped air will prevent housing from being filled. Fill gear housing only when outboard is in operating position.

1. With outboard in vertical position, insert lubricant tube into fill hole.
2. Slowly fill housing thru “FILL” hole with Quicksilver Gear Lubricant until lubricant flows out of “VENT” hole and no air bubbles are visible.
3. Install “VENT” screw into “VENT” hole.

IMPORTANT: DO NOT lose more than one fluid ounce (30cc) of gear lubricant while reinstalling “FILL” screw.

4. Remove grease tube (or hose) from “FILL” hole and quickly install “FILL” screw into “FILL” hole.



a - Vent Screw
b - Fill Screw

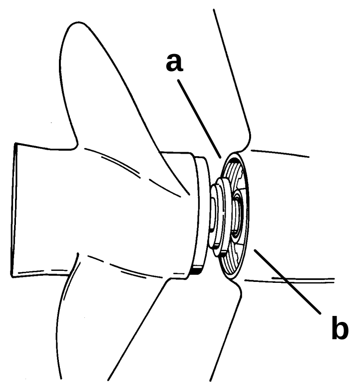
Propeller Replacement

Removal

⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing propeller from gear housing to prevent accidental starting of outboard.

1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.
2. Shift engine into neutral position.
3. Tilt engine to full up position and engage tilt lock lever.
4. Bend tabs of propeller tab washer away from thrust hub (rear), then remove propeller locknut, tab washer, thrust hub (rear), propeller and thrust hub (forward) from propeller shaft.



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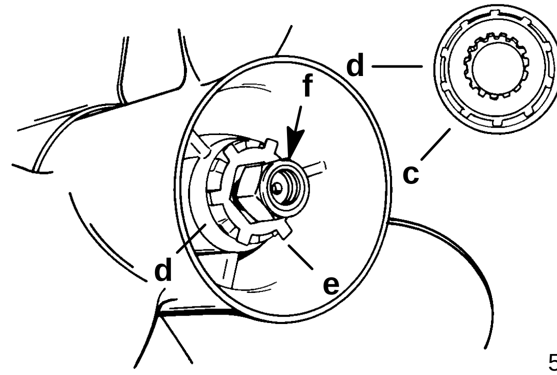

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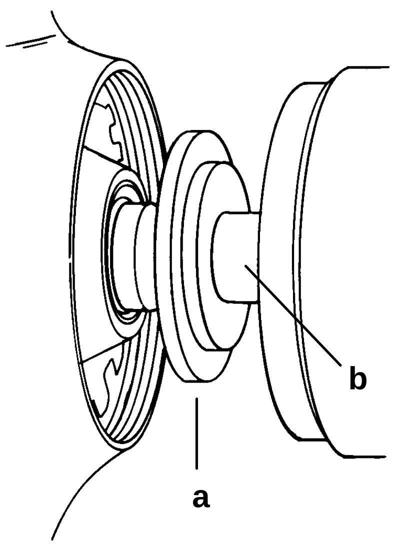
a - Thrust Hub (Forward)
b - Propeller Shaft
c - Continuity Washer (If Equipped)
d - Rear Thrust Hub
e - Tab Washer
f - Propeller Nut

Installation

⚠ WARNING

When installing or removing propeller, verify remote control is in NEUTRAL position and that key switch is "OFF." Place a block of wood between the anti-ventilation plate and propeller to prevent accidental engine starting and to protect hands from propeller blades while removing propeller nut.

1. To aid in future removal of the propeller, coat the propeller shaft splines with one of the following Quicksilver lubricants:
   - – Anti-Corrosion Grease
   - – 2-4-C w/Teflon
   - – Special Lubricant 101
2. Place forward thrust hub onto propeller shaft.
3. Align splines and slide propeller onto shaft.



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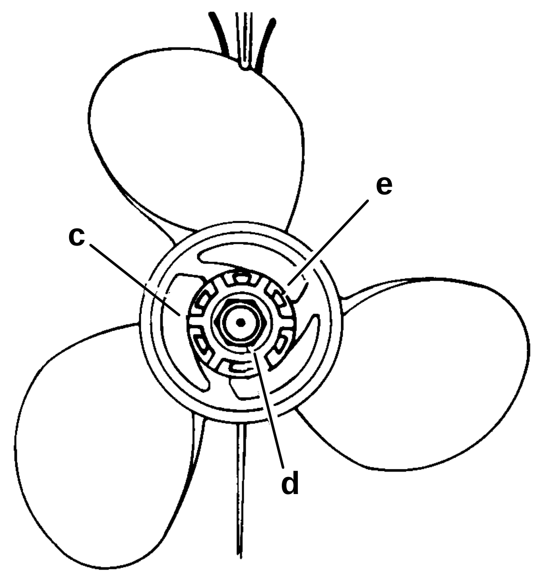
a - Forward Thrust Hub
b - Propeller Shaft

4. Place rear thrust hub on propeller shaft.
5. Place locking tab washer on propeller shaft, then thread propeller nut on shaft.
6. Place propeller nut into recess in locking tab washer and torque propeller nut to 55 lb. ft. (74.5 N·m). Verify nut is recessed into tab washer while applying torque.
7. Bend 3 tabs from locking tab washer down into grooves of propeller hub to secure propeller nut.
8. After first use, bend three tabs straight and retorque propeller nut [55 lb. ft. (74.5 N·m)]. Bend tabs down into propeller hub grooves (check periodically for tightness.)

⚠ CAUTION

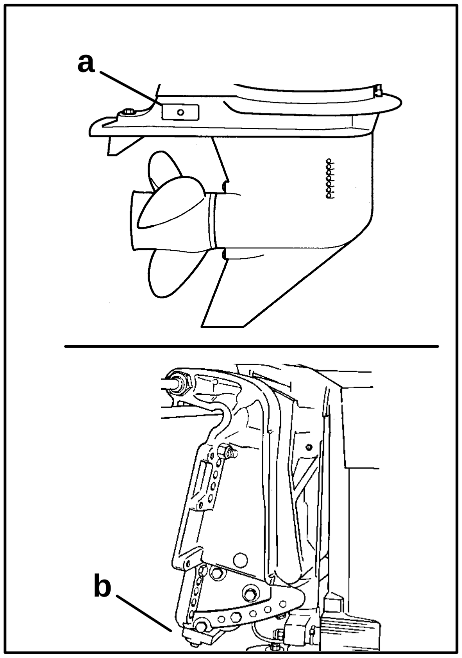
If propeller moves fore-and-aft on the propeller shaft, retighten the propeller nut. Operation with a loose propeller could cause damage to the thrust hub and gear housing during acceleration, deceleration or when shifting gears.



c - Locking Tab Washer (Bend Tabs into Thrust Hub Grooves)
d - Propeller Nut
e - Rear Thrust Hub

Corrosion Control Anode

The gear case has two corrosion control anodes. Another anode is installed on the bottom of the transom bracket assembly. An anode helps protect the outboard against galvanic corrosion by sacrificing its metal to be slowly eroded instead of the outboard metals.



a - Gear Case Anodes (2)
b - Transom Bracket Anode

Each anode requires periodic inspection especially in salt water which will accelerate the erosion. To maintain this corrosion protection, always replace the anode before it is completely eroded. Never paint or apply a protective coating on the anode as this will reduce effectiveness of the anode.

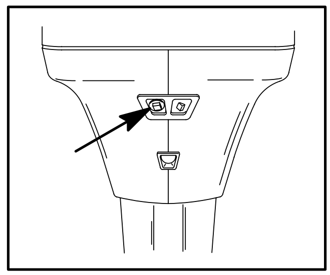
Flushing Engine

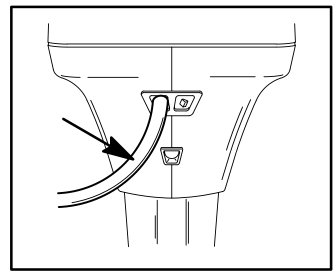
Flushing Cooling System with Engine NOT Running (Using Cowl Flush Plug)

Flush the internal water passages of the outboard with fresh water after each use in salt, polluted or muddy water. This will help prevent a buildup of deposits from clogging the internal water passages.

NOTE: *DO NOT have the engine running when flushing the cooling system using the cowl flush plug as the water pump impeller will not receive sufficient water to prevent being damaged.*

1. Remove the plug from fitting in the bottom cowl.





2. Attach a water hose to the fitting. Turn water on and flush for 3 to 5 minutes. DO NOT run the engine when flushing.

Flushing Cooling System with Engine Running (Using Flushing Attachment 44357A2)

⚠ WARNING

When flushing, verify that area in vicinity of propeller is clear and that no person is standing nearby – to avoid possible injury. It is recommended to remove propeller as a precautionary measure.

1. Install Quicksilver Flushing Attachment 44357A2 (or equivalent tool) on the gear housing from the FRONT side, positioning the rubber cups over the water intake openings.
2. Connect hose [1/2 in.(12.7mm) I.D. or larger] between flushing attachment and water tap.

IMPORTANT: To prevent water pump damage, do not start or run engine unless cooling water is flowing.

3. With the outboard in the normal operating position (vertical), partially open water tap (IT IS NOT NECESSARY to use full water pressure) and adjust water flow so that there is a significant water loss around the rubber cups.
4. Start engine and idle in NEUTRAL. Increase engine speed, not to exceed 2500 RPM.
5. Flush or service engine as required. Verify adequate cooling water is provided.
   a. Water must be discharged thru “tell tale.”

IMPORTANT: Prevent engine overheating. If water flow is insufficient, stop engine and determine cause before continuing.

   b. Flush until discharge water is clear. In saltwater areas, run outboard 3 to 5 minutes.
   c. Stop engine before turning off water.
6. Stop engine, turn water off and remove flushing attachment from gear housing.

IMPORTANT: While and after flushing, keep outboard in upright position until all water has drained from drive shaft housing to prevent water from entering the powerhead via drive shaft housing and exhaust ports.

Storage

PROTECTING EXTERNAL OUTBOARD COMPONENTS

1. Lubricate all outboard components listed in the Inspection and Maintenance Schedule.
2. Touch up any paint nicks.
3. Spray Quicksilver Corrosion Guard on engine exterior (except corrosion control anodes).

PROTECTING INTERNAL ENGINE COMPONENTS

Carburetor Models

1. Remove carburetor cover.

NOTE: *Before performing Steps 2 and 3, make sure the fuel system has been prepared for storage.*

2. Place the outboard in water or connect flushing attachment over the water intake for circulating cooling water. Start the engine and let it run in neutral to warm up.
3. With engine running at fast idle, stop the fuel flow by kinking the remote fuel line and run engine until it stops, draining the fuel system. When engine begins to stall, quickly spray Quicksilver Storage Seal into carburetors until engine stops from lack of fuel.
4. Remove spark plugs and inject a five second spray of Quicksilver Storage Seal around the inside of each cylinder.
5. Rotate the flywheel manually several times to distribute the storage seal in the cylinders. Reinstall spark plugs.

Electronic Fuel Injection (EFI) Models

NOTE: *Make sure the fuel system has been prepared for storage.*

1. Remove the spark plugs and inject a five second spray of Quicksilver Storage Seal around the inside of each cylinder.
2. Rotate the flywheel manually several times to distribute the storage seal in the cylinders. Reinstall spark plugs.
3. Remove the water separating fuel filter and empty contents in a suitable container. Replace fuel filter annually or every 100 hours of operation or if a large amount of fuel contamination is present.

GEAR CASE

Drain and refill the gear case lubricant.

POSITIONING OUTBOARD FOR STORAGE

Store outboard in an upright (vertical) position to allow water to drain out of outboard.

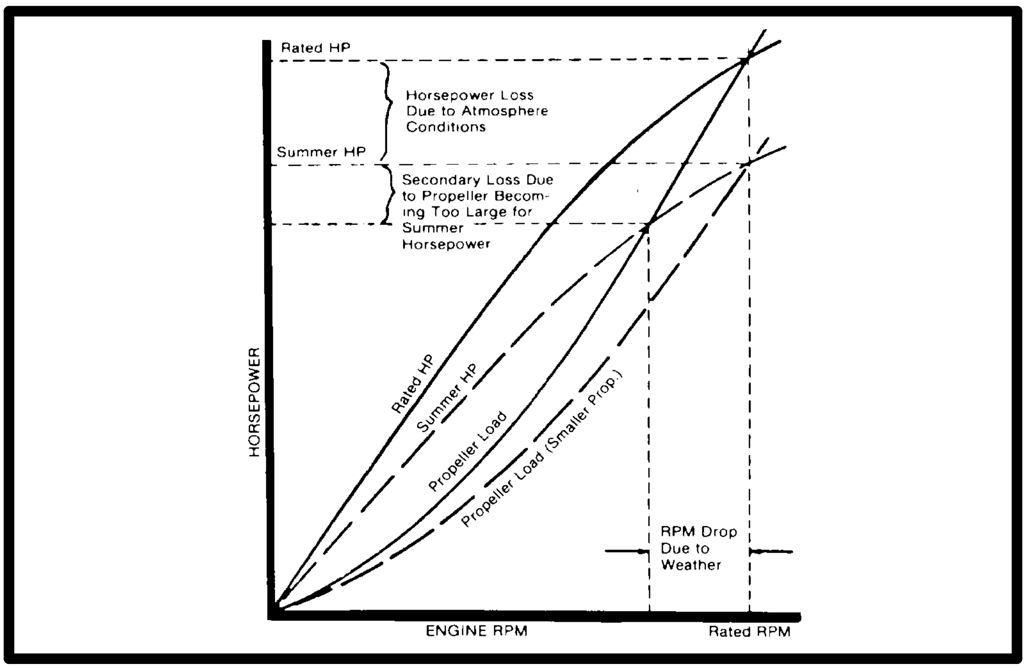
⚠ CAUTION

If outboard is stored tilted up in freezing temperature, trapped cooling water or rain water that may have entered the propeller exhaust outlet in the gear case could freeze and cause damage to the outboard.

BATTERY STORAGE

1. Follow the battery manufacturers instructions for storage and recharging
2. Remove the battery from the boat and check water level. Recharge if necessary.
3. Store the battery in a cool, dry place.
4. Periodically check the water level and recharge the battery during storage.

IMPORTANT INFORMATION



GENERAL INFORMATION

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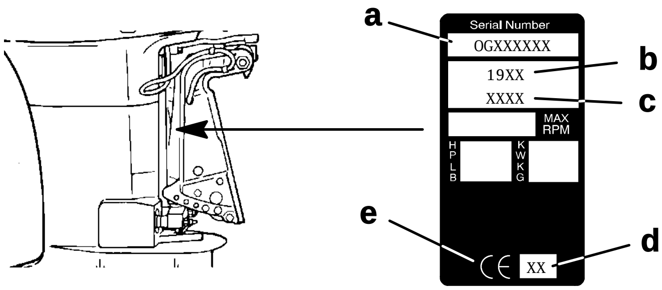
Serial Number Location

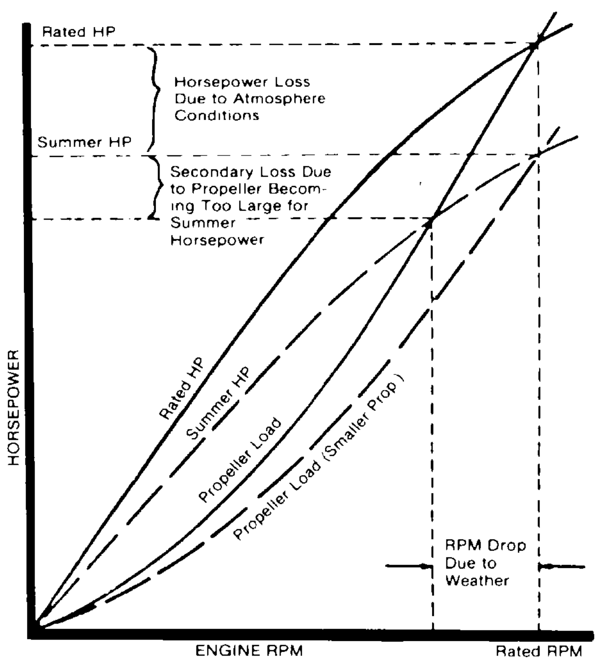
The engine serial number is located on the lower starboard side of the engine block. A serial number is also located on the starboard side of the swivel bracket.



a - Serial Number
b - Model Year
c - Model Designation
d - Year Manufactured
e - Certified Europe Insignia

Conditions Affecting Performance

Weather



Weather conditions exert a profound effect on power output of internal combustion engines. Established horsepower ratings refer to the power that the engine will produce at its rated RPM under a specific combination of weather conditions.

Corporations internationally have settled on adoption of I.S.O. (International Standards Organization) engine test standards, as set forth in I.S.O. 3046 standardizing the computation of horsepower from data obtained on the dynamometer, correcting all values to the power that the engine will produce at sea level, at 30% relative humidity at 77°F (25°C) temperature and a barometric pressure of 29.61 inches of mercury.

Summer conditions of high temperature, low barometric pressure and high humidity all combine to reduce engine power. This is reflected in decreased boat speeds – as much as 2 or 3 mph. Nothing will regain this speed for the boater but the coming of cool, dry weather.

In pointing out the consequences of weather effects, an engine – running on a hot, humid summer day – may loose as much as 14% of the horsepower it would produce on a dry, brisk spring or fall day. The horsepower that any internal combustion engine produces depends upon the density of the air that it consumes and this density is dependent upon the temperature of the air, its barometric pressure and water vapor (or humidity) content.

Accompanying this weather-inspired loss of power is a second but more subtle loss. At rigging time in early spring, the engine was equipped with a propeller that allowed the engine to run within its recommended RPM range at full throttle. With the coming of the summer weather and the consequent drop in available horsepower, this propeller will, in effect, become too large. Consequently, the engine operates at less than its recommended RPM.

Due to the horsepower/RPM characteristics of an engine, this will result in further loss of horsepower at the propeller with another decrease in boat speed. This secondary loss can be regained by switching to a smaller pitch propeller that allows the engine to run again at recommended RPM.

To obtain optimum engine performance under changing weather conditions, the engine MUST be propped to allow it to operate at or near the top end of the recommended maximum RPM range at wide-open-throttle with a normal boat load.

This will allow the engine to develop full power while operating in an RPM range that discourages damaging detonation.

Boat

WEIGHT DISTRIBUTION

1. Proper positioning of the weight inside the boat (persons and gear) has a significant effect on the boat's performance, for example:
   a. Shifting weight to the rear (stern)
      (1.) Generally increases top speed.
      (2.) If in excess, can cause the boat to porpoise.
      (3.) Can make the bow bounce excessively in choppy water.
      (4.) Will increase the danger of the following wave splashing into the boat when coming off plane.
   b. Shifting weight to the front (bow)
      (1.) Improves ease of planing off.
      (2.) Generally improves rough water ride.
      (3.) If excessive, can make the boat veer back-and-forth (bow steer).

BOTTOM

1. **Boat Bottom:** For maximum speed, a boat bottom should be nearly a flat plane where it contacts the water and particularly straight and smooth in fore-and-aft direction.
   a. **Hook:** Exists when bottom is concave in fore-and -aft direction when viewed from the side. When boat is planing, "hook" causes more lift on bottom near transom and allows bow to drop, thus greatly increasing wetted surface and reducing boat speed. "Hook" frequently is caused by supporting boat too far ahead of transom while hauling on a trailer or during storage.
   b. **Rocker:** The reverse of hook and much less common. "Rocker" exists if bottom is convex in fore-and-aft direction when viewed from the side, and boat has strong tendency to porpoise.
   c. **Surface Roughness:** Moss, barnacles, etc., on boat or corrosion of motor's gear housing increase skin friction and cause speed loss. Clean surfaces when necessary.
   d. **Gear Housing:** If unit is left in the water, marine vegetation may accumulate over a period of time. This growth MUST be removed from unit before operation, as it may clog the water inlet holes in the gear housing and cause the engine to overheat.

TRIM

TRIMMING OUTBOARD "OUT" ("UP")

⚠ WARNING

Excessive trim "out" also may reduce the stability of some high speed hulls. To correct instability at high speed, reduce the power GRADUALLY and trim the outboard "in" slightly before resuming high speed operation. (Rapid reduction in power will cause a sudden change of steering torque and may cause additional momentary boat instability.)

1. Will lift bow of boat, generally increasing top speed.
2. Transfers steering torque harder to left on single outboard installations below 23 in. (584mm) transom height.
3. Increases clearance over submerged objects.
4. In excess, can cause porpoising and/or ventilation.
5. If trimmed out beyond the water pickup, reduced water supply can cause overheating resulting in engine damage.

TRIMMING OUTBOARD "IN" ("DOWN") CHARACTERISTICS

⚠ WARNING

Excessive speed at minimum trim "in" may cause undesirable and/or unsafe steering conditions. Each boat should be tested for handling characteristics after any adjustment is made to the angle (trim adjustment bolt relocation.)

1. Will help planing off, particularly with a heavy load.
2. Usually improves ride in choppy water.
3. In excess, can cause boat to veer to the left or right (bow steer).
4. Transfers steering torque harder to right (or less to the left) on single outboard installations.
5. Improves planing speed acceleration (by moving trim adjustment bolt one hole closer to transom).

WATER ABSORPTION

It is imperative that all through hull fasteners be coated with a quality marine sealer at time of installation. Water intrusion into the transom core and/or inner hull will result in additional boat weight (reduced boat performance), hull decay and eventual structural failure.

CAVITATION

Cavitation is caused by water vapor bubbles forming either from a sharp edge or angle on the gear case or from an irregularity in the propeller blade itself. These vapor bubbles flow back and collapse when striking the surface of the propeller blade resulting in the erosion of the propeller blade surface. If allowed to continue, eventual blade failure (breakage) will occur.

VENTILATION

Ventilation occurs when air is drawn from the water's surface (excessive trim out angle) or from the engine exhaust flow (wrong propeller/propeller hardware installed or gear case labyrinth seal worn) into the propeller blades. These air bubbles strike the propeller blade surface and cause erosion of the blade surface. If allowed to continue, eventual blade failure (breakage) will occur.

Engine

DETONATION

Detonation in a 2-cycle engine resembles the "pinging" heard in an automobile engine. It can be otherwise described as a tin-like "rattling" or "plinking" sound.

Detonation is an explosion of an unburned portion of the fuel/air charge after the spark plug has fired. Detonation creates severe shock waves in the engine, and these shock waves often find or create a weakness: The dome of a piston, cylinder head/gasket, piston rings or piston ring lands, piston pin and roller bearings.

A few of the most common causes of detonation in a marine 2-cycle application are as follows:

a. Over-advanced ignition timing.

(1.) Use of low octane gasoline.

(2.) Propeller pitch too high (engine RPM below recommended maximum range).

(3.) Lean fuel mixture at or near wide-open-throttle.

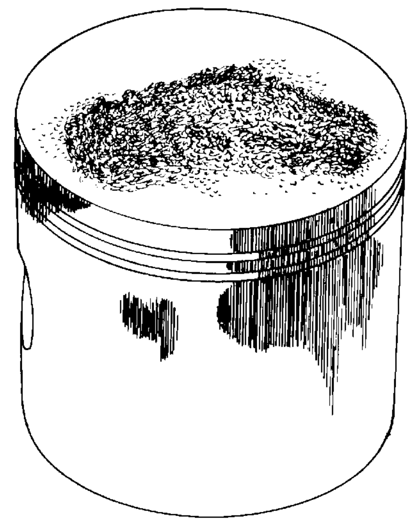
(4.) Spark plugs (heat range too hot – incorrect reach – cross-firing).

(5.) Inadequate engine cooling (deteriorated cooling system).

(6.) Combustion chamber/piston deposits (result in higher compression ratio).

Detonation usually can be prevented if:

1. The engine is correctly set up.
2. Diligent maintenance is applied to combat the detonation causes.



Damaged Piston Resulting from Detonation

Following Complete Submersion

Salt Water Submersion (Special Instructions)

Due to the corrosive effect of salt water on internal engine components, complete disassembly is necessary before any attempt is made to start the engine.

Submerged While Running (Special Instructions)

When an engine is submerged while running, the possibility of internal engine damage is greatly increased. If, after engine is recovered and with spark plugs removed, engine fails to turn over freely when turning flywheel, the possibility of internal damage (bent connecting rod and/or bent crankshaft) exists. If this is the case, the powerhead must be disassembled.

Submerged Engine (Fresh Water) (Plus Special Instructions)

1. Recover engine as quickly as possible.
2. Remove cowling.
3. Flush exterior of outboard with fresh water to remove mud, weeds, etc. DO NOT attempt to start engine if sand has entered powerhead, as powerhead will be severely damaged. Disassemble powerhead if necessary to clean components.
4. Remove spark plugs and get as much water as possible out of powerhead. Most water can be eliminated by placing engine in a horizontal position (with spark plug holes down) and rotating flywheel.
5. Pour alcohol into carburetor throats (alcohol will absorbed water). Again rotate flywheel.
6. Turn engine over and pour alcohol into spark plug openings and rotate flywheel.
7. Turn engine over (place spark plug openings down) and pour engine oil into throat of carburetors while rotating flywheel to distribute oil throughout crankcase.
8. Again turn engine over and pour approximately one teaspoon of engine oil into each spark plug opening. Again rotate flywheel to distribute oil in cylinders.
9. Remove and clean carburetors and fuel pump assembly.
10. Dry all wiring and electrical components using compressed air.
11. Disassemble the engine starter motor and dry the brush contacts, armature and other corrodible parts.
12. Reinstall spark plugs, carburetors and fuel pump.
13. Attempt to start engine, using a fresh fuel source. If engine starts, it should be run for at least one hour to eliminate any water in engine.
14. If engine fails to start, determine cause (fuel, electrical or mechanical). Engine should be run within 2 hours after recovery of outboard from water, or serious internal damage may occur. If unable to start engine in this period, disassemble engine and clean all parts. Apply oil as soon as possible.

Propeller Selection

For best all around performance from your outboard/boat combination, select a propeller that allows the engine to operate in the upper half of the recommended full throttle RPM range with the boat normally loaded (refer to Specifications). This RPM range allows for better acceleration while maintaining maximum boat speed.

If changing conditions cause the RPM to drop below the recommended range (such as warmer, more humid weather, operation at higher elevations, increased boat load or a dirty boat bottom/gear case) a propeller change or cleaning may be required to maintain performance and ensure the outboard's durability.

Check full-throttle RPM using an accurate tachometer with the engine trimmed out to a balanced-steering condition (steering effort equal in both directions) without causing the propeller to "break loose".

Painting Procedures

Cleaning & Painting Aluminum Propellers & Gear Housings

⚠ WARNING

Avoid serious injury from flying debris. Avoid serious injury from airborne particles. Use eye and breathing protection with proper ventilation.

PROPELLERS

1. Sand the entire area to be painted with 3M 120 Regalite Polycut or coarse Scotch-Brite, disc or belts.
2. Feather edges of all broken paint edges. Try not to sand through the primer.
3. Clean the surface to be painted using PPG Industries DX330 Wax and Grease Remover or equivalent (Xylene or M.E.K.).
4. If bare metal has been exposed, use Quicksilver's Light Gray Primer.
5. Allow a minimum of 1 hour dry time and no more than 1 week before applying the finish coat.
6. Apply the finish coat using Quicksilver's EDP Propeller Black.

GEAR HOUSINGS

The following procedures should be used in refinishing gear housings. This procedure will provide the most durable paint system available in the field. The materials recommended are of high quality and approximate marine requirements. The following procedure will provide a repaint job that compares with a properly applied factory paint finish. It is recommended that the listed materials be purchased from a local Ditzler Automotive Finish Supply Outlet. The minimum package quantity of each material shown following is sufficient to refinish several gear housings.

Procedure:

1. Wash gear housing with a muriatic acid base cleaner to remove any type of marine growth, and rinse with water, if necessary.
2. Wash gear housing with soap and water, then rinse.
3. Sand blistered area with 3M 180 grit sandpaper or P180 Gold Film Disc to remove paint blisters only. Feather edge all broken paint edges.
4. Clean gear housing thoroughly with (DX-330) wax and grease remover.
5. Spot repair surfaces where bare metal is exposed with (DX-503) alodine treatment.

IMPORTANT: Do not use any type of aerosol spray paints as the paint will not properly adhere to the surface nor will the coating be sufficiently thick to resist future paint blistering.

6. Mix epoxy chromate primer (DP-40) with equal part catalyst (DP-401) per manufacturers instructions, allowing proper induction period for permeation of the epoxy primer and catalyst.
7. Allow a minimum of one hour drying time and no more than one week before top coating assemblies.
8. Use Ditzler Urethane DU9000 for Mercury Black, DU34334 for Mariner Grey, and DU35466 for Force Charcoal, and DU33414M for Sea Ray White. Catalyze all three colors with Ditzler DU5 catalyst mixed 1:1 ratio. Reduce with solvents per Ditzler label.

⚠ CAUTION

Be sure to comply with instructions on the label for ventilation and respirators. Using a spray gun, apply one half to one mil even film thickness. Let dry, flash off for five minutes and apply another even coat of one half to one mil film thickness. This urethane paint will dry to the touch in a matter of hours, but will remain sensitive to scratches and abrasions for a few days.

9. The type of spray gun used will determine the proper reduction ratio of the paint.

IMPORTANT: Do not paint sacrificial zinc trim tab or zinc anode.

10. Cut out a cardboard "plug" for trim tab pocket to keep paint off of mating surface to maintain good continuity circuitry between trim tab and gear housing.

Decal Application

Decal Removal

1. Mark decal location before removal to assure proper alignment of new decal.
2. Carefully soften decal and decal adhesive with a heat gun or heat blower while removing old decal.
3. Clean decal contact area with a 1:1 mixture of isopropyl alcohol and water.
4. Thoroughly dry decal contact area and check for a completely cleaned surface.

Instructions for "Wet" Application

NOTE: *The following decal installation instructions are provided for a "Wet" installation.* ***All*** *decals should be applied wet.*

TOOLS REQUIRED

1. Plastic Squeegee*
2. Stick Pin
3. Dish Washing **Liquid/Detergent without ammonia**** "Joy" and "Drift" are known to be compatible for this process.

* Automotive Body Filler Squeegee

** Do not use a soap that contains petroleum based solvents.

SERVICE TIP: Placement of decals using the "Wet" application will allow time to position decal. Read entire installation instructions on this technique before proceeding.

TEMPERATURE

IMPORTANT: Installation of vinyl decals should not be attempted while in direct sunlight. Air and surface temperature should be between 60°F (15°C) and 100°F (38°C) for best application.

SURFACE PREPARATION

IMPORTANT: Do not use a soap or any petroleum based solvents to clean application surface.

Clean entire application surface with mild dish washing liquid and water. Rinse surface thoroughly with clean water.

DECAL APPLICATION

1. Mix $^1/_2$ ounce (16 ml) of dish washing liquid in one gallon (4 l) of cool water to use as wetting solution.

NOTE: *Leave protective masking, if present, on the face of decal until final steps of decal installation. This will ensure that the vinyl decal keeps it's shape during installation.*

2. Place the decal face down on a clean work surface and remove the paper backing from "adhesive side" of decal.
3. Using a spray bottle, flood the entire "adhesive side" of the decal with the pre-mixed wetting solution.
4. Flood area where the decal will be positioned with wetting solution.
5. Position pre-wetted decal on wetted surface and slide into position.
6. Starting at the center of the decal, "**lightly**" squeegee out the air bubbles and wetting solution with overlapping strokes to the outer edge of the decal. Continue going over the decal surface until all wrinkles are gone and adhesive bonds to the cowl surface.
7. Wipe decal surface with soft paper towel or cloth.
8. **Wait 10 - 15 minutes.**
9. Starting at one corner, "carefully and slowly" pull the masking off the decal surface at a 180° angle.

NOTE: *To remove any remaining bubbles, pierce the decal at one end of the bubble with stick pin and press out the entrapped air or wetting solution with your thumb (moving toward the puncture).*

IMPORTANT INFORMATION

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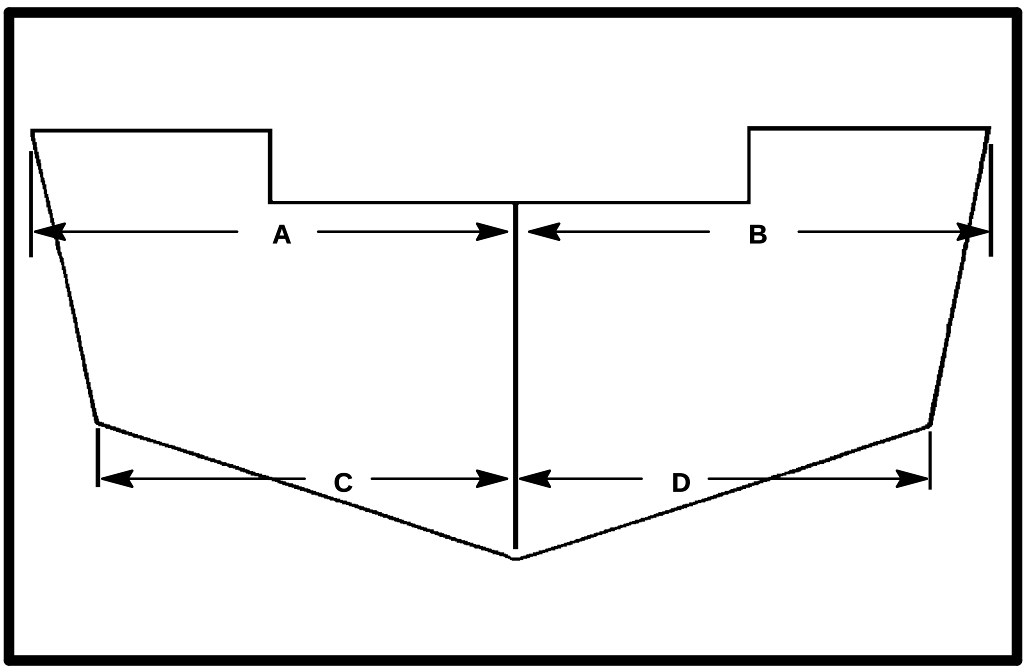


OUTBOARD MOTOR INSTALLATION

Table of Contents

Notice to Installer and Owner

This manual as well as safety labels posted on the outboard use the following safety alerts to draw your attention to special safety instructions that should be followed.

⚠ WARNING

WARNING - Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠ CAUTION

CAUTION - Hazards or unsafe practices which could result in minor injury or product or property damage.

Boat Horsepower Capacity

U.S. COAST GUARD CAPACITY	
MAXIMUM HORSEPOWER	XXX
MAXIMUM PERSON CAPACITY (POUNDS)	XXX
MAXIMUM WEIGHT CAPACITY	XXX

Do not overpower. Most boats will carry a required capacity plate indicating the maximum acceptable power and load as determined by the manufacturer following certain federal guidelines. If in doubt, contact the boat manufacturer.

⚠ WARNING

Using an outboard that exceeds the maximum horsepower limit of a boat can 1. cause loss of boat control 2. place too much weight at the transom altering the designed flotation characteristics of the boat or 3. cause the boat to break apart particularly around the transom area. Overpowering a boat can result in serious injury, death or boat damage.

Outboard Remote Control

The remote control connected to the outboard must be equipped with a start-in-gear protection device. This prevents the engine from starting when the outboard is in gear.

⚠ WARNING

Avoid serious injury or death from a sudden unexpected acceleration when starting the engine. The design of this outboard requires that the remote control used with it must have a built in start-in-gear protection device.

Selecting Accessories For The Outboard

Some accessories not manufactured or sold by Mercury Marine are not designed to be safely used with these outboards or outboard operating system. Acquire and read the installation, operation and maintenance manuals for all selected accessories.

⚠ WARNING

The misuse of acceptable accessories or the use of unacceptable accessories can result in serious injury, death or product failure.

Selecting Steering Cables and Remote Control Cables

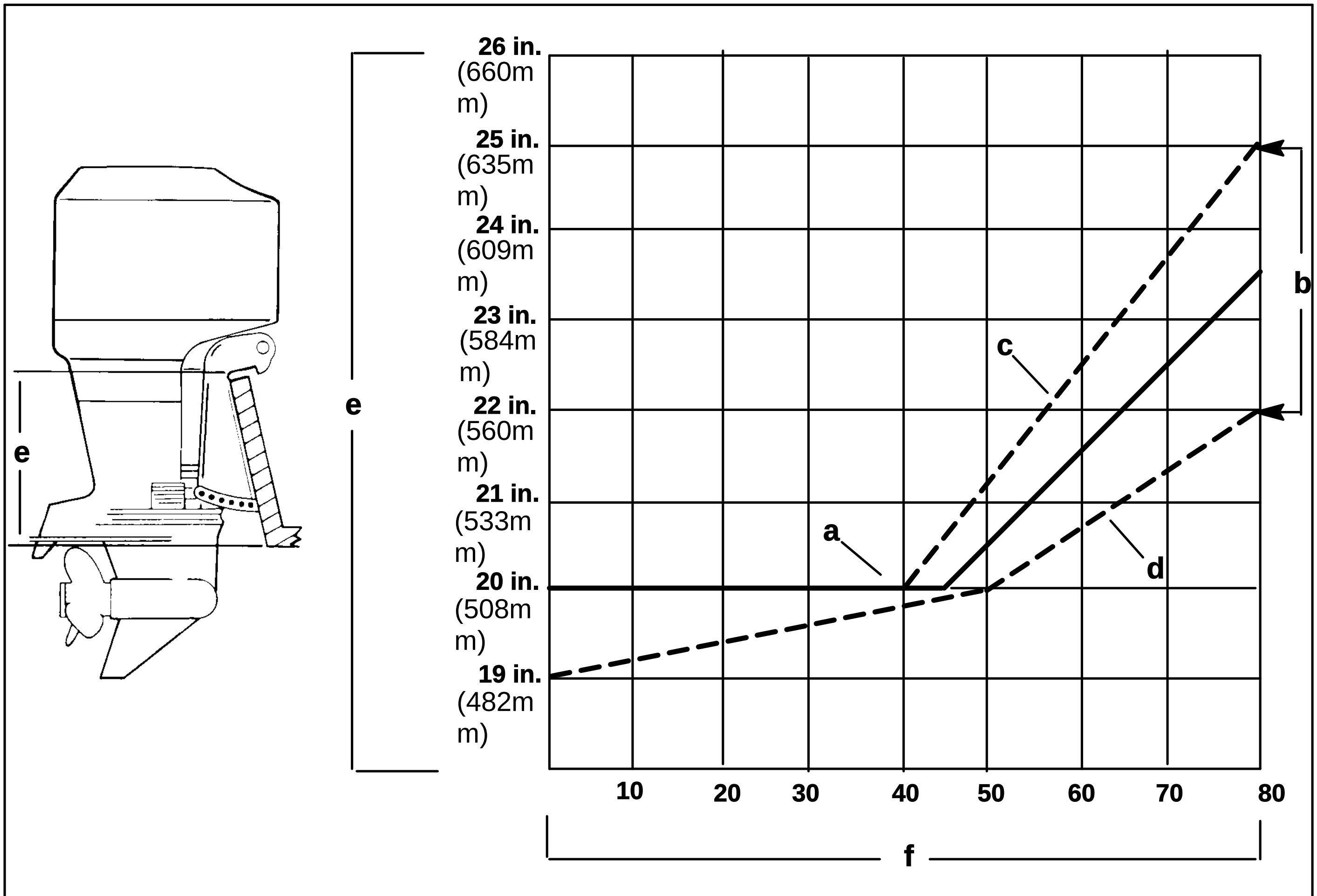
Refer to "Quicksilver Accessories Guide" to determine correct length of steering cables and remote control cables.

IMPORTANT: Steering cables and remote control cables must be the correct length. Sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables.

Determining Recommended Outboard Mounting Height

⚠ WARNING

Boat instability can occur at high speeds by installing engine at the wrong transom height. Contact the boat manufacturer for their recommendations for a specific engine installation.



NOTE: *Add 5 in. (127mm) for XL models and 10 in. (254mm) for XXL models to listed outboard mounting height.*

a. This solid line is recommended to determine the outboard mounting height.

IMPORTANT: Increasing the height of outboard generally will provide the following: 1) Less steering torque, 2) more top speed, 3) greater boat stability, but, 4) will cause more prop "break loose" which may be particularly noticeable when planing off or with heavy load.

b. These broken lines represent the extremes of known successful outboard mounting height dimensions.

c. This line may be preferred to determine outboard mounting height dimension, if maximum speed is the only objective.

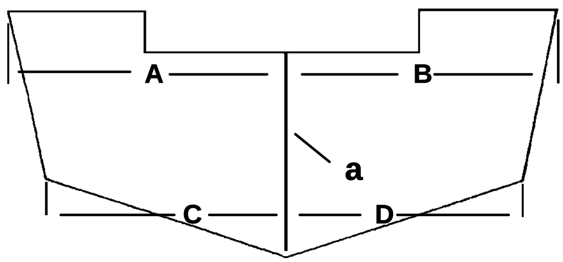
d. This line may be preferred to determine outboard mounting height dimension for dual outboard installation.

e. Outboard mounting height (height of outboard transom brackets from bottom of boat transom). For heights over 22 in. (560mm), a propeller, that is specifically designed for surfacing operation, such as the "Laser" and "Mirage" series, usually are preferred.

f. Maximum boat speed anticipated.

Locating Centerline of Boat Transom

Locate (and mark with pencil) vertical centerline (a) of boat transom.



a - Centerline of Transom

NOTE: *Dimensions "A" & "B" and "C" & "D" are equal length.*

Drilling Outboard Mounting Holes

IMPORTANT: Before drilling any mounting holes, carefully read "Determining Recommended Outboard Mounting Height," preceding. There is a 3/4 in. (19 mm) difference between outboard mounting holes in transom brackets.

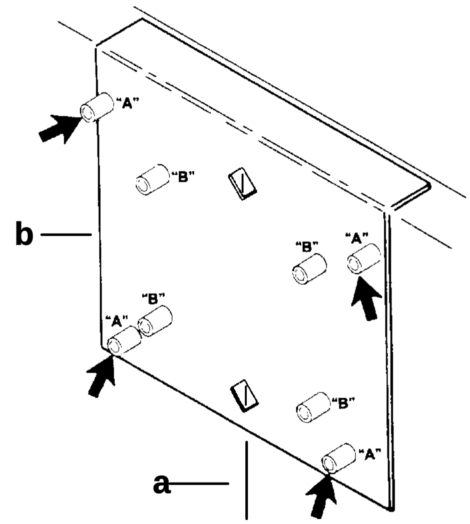
⚠ WARNING

DO NOT, under any circumstances, allow upper outboard mounting bolts to be closer than 1 in. (25.4 mm) from top of boat transom. Upper mounting bolts must never be installed thru shims.

NOTE: *When drilling into a fiberglass boat, place masking tape directly onto boat where mounting holes will be drilled to help prevent fiberglass from chipping.*

Use a 17/32 inch (13.5mm) diameter drill bit and drill 4 mounting holes perpendicular to and thru the transom.

IMPORTANT: If using "Transom Drilling Fixture" (part number 91-98234A2), use drill guide holes marked "A" when drilling outboard mounting holes.



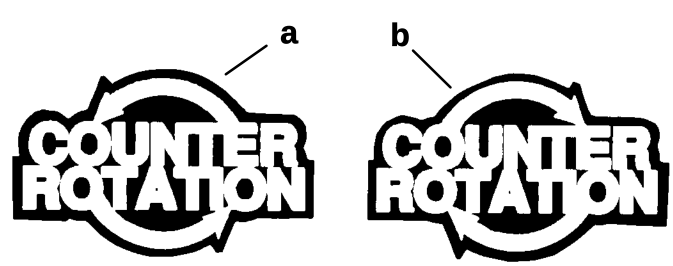
a - Centerline of Transom
b - Transom Drilling Fixture (91-98234A2)

IMPORTANT: During installation of dual or multiple V-6 product, the following is recommended. A minimum of 26 inches (660mm) centerline to centerline width is recommended. This is required to alleviate cowling interference during lock to lock turns if one outboard would be in the full tilt position, while the other outboard(s) are in the vertical running position.

Applying Counter Rotation Decals

IMPORTANT: For dual outboard counter rotation installations, the left-hand rotation outboard is generally placed on the port side of boat transom.

Apply "COUNTER ROTATION" decal (supplied with left-hand rotation outboard) onto bottom cowl (rear) of right-hand rotation outboard. Match decal placement with left-hand rotation outboard.



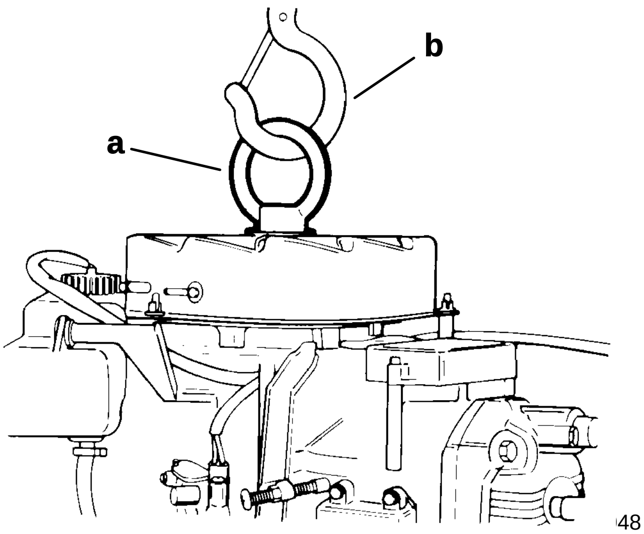
a - Counter Rotation Decal (Left-Hand Rotation Outboard)
b - Counter Rotation Decal (Right-Hand Rotation Outboard)

Lifting Outboard

⚠ WARNING

Verify lifting ring is threaded on crankshaft a minimum of 5 turns and that hoist has a maximum lift capacity over 500 lbs. (227 kg) BEFORE lifting outboard.

Remove cowling from outboard. Remove plastic cap from center of flywheel. Thread lifting eye (a) into flywheel hub a minimum of 5 turns. Replace plastic cap after installation. Connect hoist [minimum lift capacity of 500 lbs. (227 kg)] to lifting eye. Lift outboard and place on boat transom.



a - Lifting Eye (91-75132)
b - Hoist

Installing Outboard To Boat Transom

IMPORTANT: If boat is equipped with thru tilt tube steering, steering cable end must be installed into tilt tube of outboard (port outboard only for dual outboard installations) before securing outboard to transom. Refer to "Steering Cable and Steering Link Rod Installation" following.

Refer to "Determining Recommended Outboard Motor Mounting Height", preceding and position outboard on boat transom, to align mounting holes in transom bracket that will place the outboard nearest to the recommended mounting height.

⚠ CAUTION

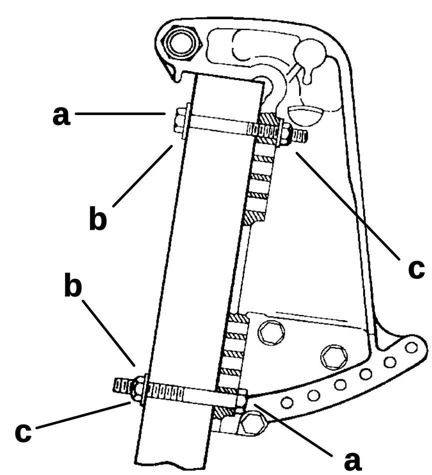
Marine sealer must be used on shanks bolts to make a water-tight installation.

IMPORTANT: DO NOT use an impact driver when tightening transom bolts.

Apply marine sealer to shanks of mounting bolts (not threads) and secure outboard to transom with 4 bolts, flat washers and locknuts, as shown. Be sure that installation is water-tight.

⚠ WARNING

Before operating, outboard(s) MUST BE SECURED to boat transom with four 1/2 in. diameter bolts and locknuts, as follows: 2 bolts must be installed thru upper mounting holes and 2 bolts thru lower mounting holes. Installation must be water-tight and outboard should be checked for tightness on the transom during operation. Failure to bolt outboard to transom (using 4 bolts and locknuts, as shown) may result in damage to boat and/or loss of outboard and possible injury to occupants of boat.



a - 1/2 in. Diameter Bolts
b - Flat Washers
c - Locknuts

Single Steering Cable and Steering link Rod Installation

NOTE: *These instructions are for single cable-single outboard installations. Instructions for mounting dual engines are included with the applicable dual engine attaching kit. Refer to "Quicksilver Accessories Guide" to determine correct kit.*

Refer to "Quicksilver Accessories Guide" to determine correct length of steering cable.

IMPORTANT: Steering cable must be correct length. Sharp bends on too-short of a cable result in "kinks;" too-long of a cable require unnecessary bends and/or loops. Both conditions place extra stress on the cable.

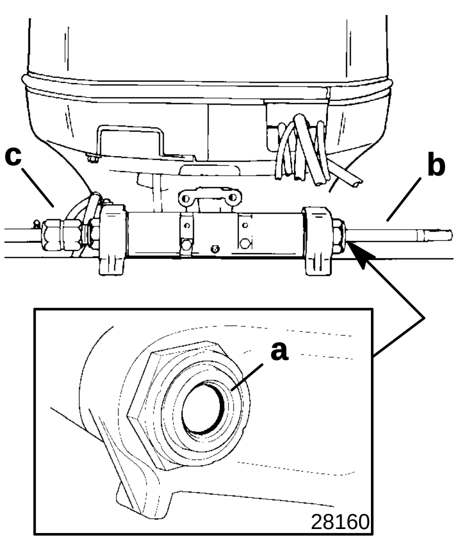
Install steering mount and steering wheel in accordance with installation instructions that accompany each.

Installing Ride Guide Cable to Outboard Tilt Tube

IMPORTANT: Before installing steering cable in tilt tube, lubricate entire cable end with Quicksilver 2-4-C w/Teflon Marine Lubricant.

NOTE: *Ride Guide steering cable is lubricated at the factory and requires no additional lubrication at initial installation.*

1. Lubricate seal (a) inside of outboard tilt tube and entire cable end (b) with Quicksilver 2-4-C w/Teflon Marine Lubricant.
2. Insert steering cable end thru outboard tilt tube and secure steering cable to tilt tube with steering cable attaching nut (c), as shown. Torque nut to 35 lb. ft. (41.0 N·m).



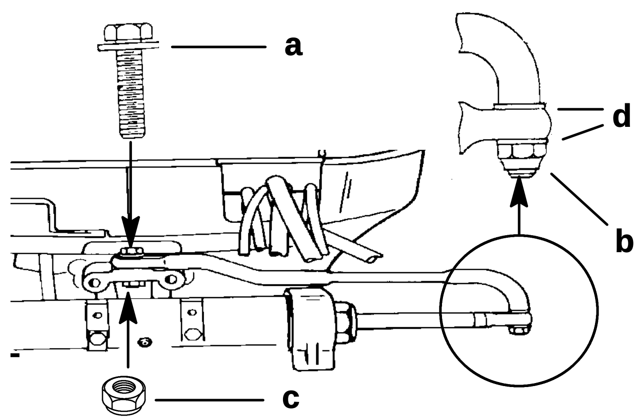
Steering Link Rod Installation

IMPORTANT: The steering link rod that connects the steering cable to the engine must be fastened using special washer head bolt ("a" - Part Number 10-14000) and self locking nuts ("b" & "c" - Part Number 11-34863). These locknuts must never be replaced with common nuts (non locking) as they will work loose and vibrate off freeing the link rod to disengage.

⚠ WARNING

Disengagement of a steering link rod can result in the boat taking a full, sudden, sharp turn. This potentially violent action can cause occupants to be thrown overboard exposing them to serious injury or death.

3. Assemble steering link rod to steering cable with two flat washers (d) and nylon insert locknut ("b" - Part Number 11-34863). Tighten locknut (b) until it seats, then back nut off 1/4 turn.
4. Assemble steering link rod to engine with special washer head bolt ("a" - Part Number 10-14000) and nylon insert locknut ("c" - Part Number 11-34863). First torque bolt (a) to 20 lb. ft. (27.0 N·m), then torque locknut (c) to 20 lb. ft. (27.0 N·m).



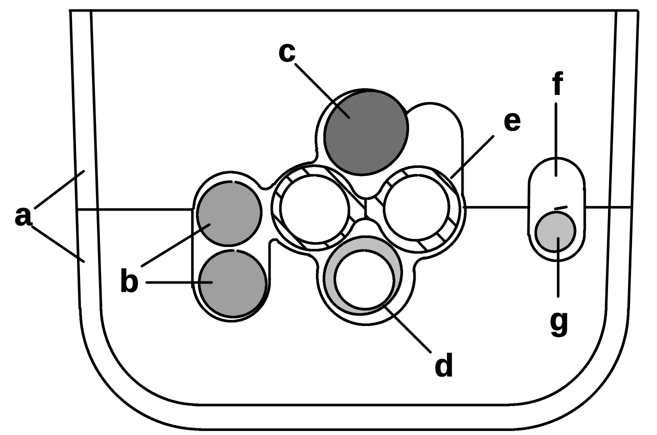
⚠ WARNING

After installation is complete (and before operating outboard), check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) and at all tilt angles to assure interference-free movement.

Routing location for Wiring and Hoses thru Clamp in Bottom Cowl

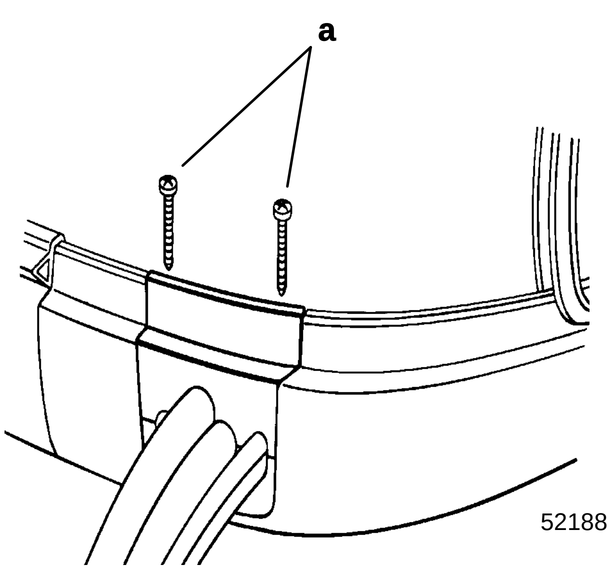
IMPORTANT: Sufficient slack must exist in engine wiring harness, battery cables, fuel hose, and oil hoses routed between clamp and engine attachment point, to relieve stress and prevent hoses from being kinked or pinched.

1. Route engine wiring harness, battery cables, fuel hose, oil hoses and control cables thru clamp in bottom cowl at locations shown.



a - Clamp (2 Halves)
b - Battery Cables
c - Engine Wiring Harness
d - Fuel Hose
e - Oil Hoses
f - Throttle Cable
g - Shift Cable

2. Secure clamp halves together with 2 screws.



a - Screws

Remote Control Installation

Refer to "Quicksilver Accessories Guide" to determine correct length of remote control cables.

IMPORTANT: Remote control cables must be correct length. Sharp bends on too-short cables result in "kinks;" too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables.

IMPORTANT: Install control cables to remote control and mount remote control BEFORE attaching control cables to engine. Refer to installation instructions included with remote control.

Counter (Left Hand) Rotation Outboards

IMPORTANT: Counter rotating (left hand) gear cases can be identified by a "L" stamped into the end of the propeller shaft.

On counter (left hand) rotation outboards, the shift guide block moves aft for FORWARD and towards the bow for REVERSE. This is opposite motion compared to a standard (right hand) rotation outboard.

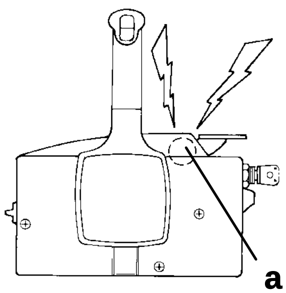
The Quicksilver Commander Series Dual Engine Console Mount Control, P/N 88688A22, is required to shift the counter rotation outboard. The installation instructions shipped with the control explain the procedure required to connect this control to a counter rotation outboard.

IMPORTANT: If the counter rotation outboard is rigged similar to a standard rotation outboard OR if a standard rotation outboard is rigged similar to a counter rotation outboard, the reverse gear and bearing in the gear case must function as forward gear. THE REVERSE GEAR/BEARING ARE NOT DESIGNED TO CARRY THE SUSTAINED LOADS THAT ARE GENERATED WHEN RUNNING UNDER CONSTANT HIGH RPM AND THRUST CONDITIONS.

Required Side Mount Remote Control or Ignition Key Switch Assembly

Boats Equipped with Side Mount Remote Control

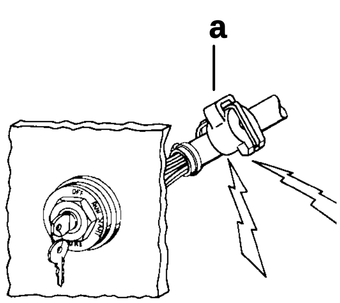
A Quicksilver Commander 2000 series Side Mount Remote Control equipped with a warning horn must be used with this outboard. This warning horn is necessary for the engine warning system.



a -Warning Horn

Boats Equipped with Panel or Console Mount Remote Control

A Quicksilver Ignition Key/Choke Assembly equipped with a warning horn must be used with this engine. This warning horn is necessary for the engine warning system.



a - Warning Horn

Shift and Throttle Cable Installation to the Outboard

Shift Cable Installation

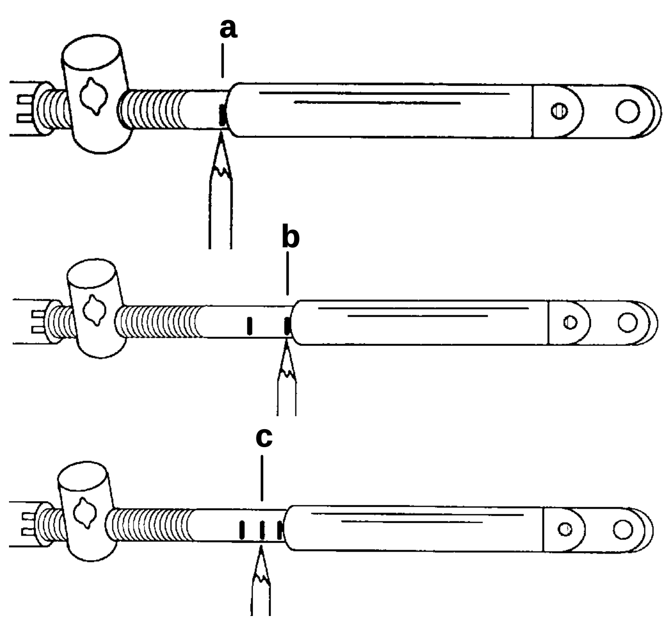
1. Install the shift cable to the remote control. Refer to installation instructions included with the remote control.
2. Before installing the shift cable to the engine, locate the center point of the slack or lost motion that exists in the remote control and shift cable as follows.

NOTE: *On counter rotation outboards, the location of marks "a" and "b" below on the shift cable will be reversed.*

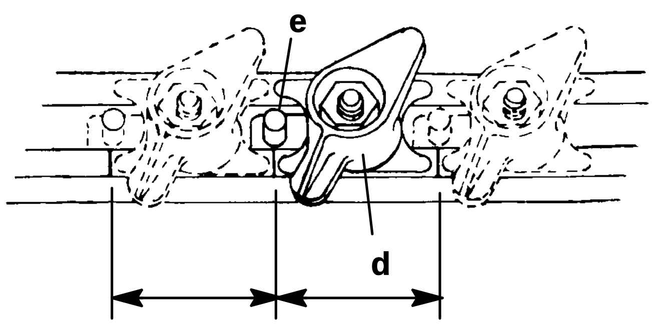
   a. Move the remote control handle into forward and advance the handle to the full speed position. Slowly return the handle back to the neutral detent position. Place a mark on the shift cable against the cable end guide at location (a).

   b. Move the remote control handle into reverse and advance the handle to the full speed position. Slowly return the handle back to the neutral detent position. Place a mark on the shift cable against the cable end guide at location (b).

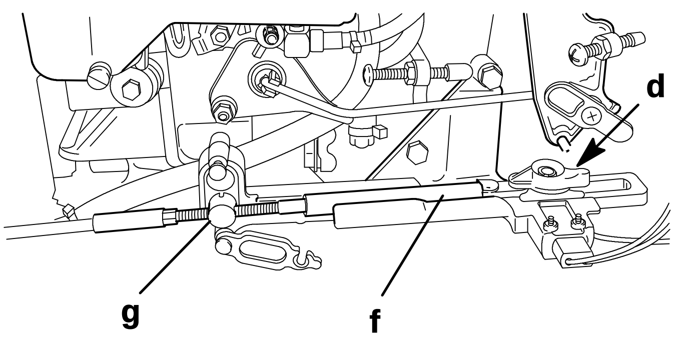
   c. Make a center mark (c) on the shift cable, midway between marks ("a" and "b"). Align the cable end guide against this center mark (c) when installing cable to the engine.



3. Position remote control into NEUTRAL detent.
4. Manually shift outboard into NEUTRAL position.
5. Slide the shift cable retainer (d) forward until resistance is felt, then slide cable anchor toward rear until resistance is felt. Center the anchor pin (e) between resistance points.



6. Align the shift cable end guide with the center mark as instructed in Step 2.
7. Place shift cable end guide (f) on anchor pin and adjust cable barrel (g) so that the barrel slips freely into the plastic barrel retainer.
8. Secure shift cable with shift cable retainer (d).



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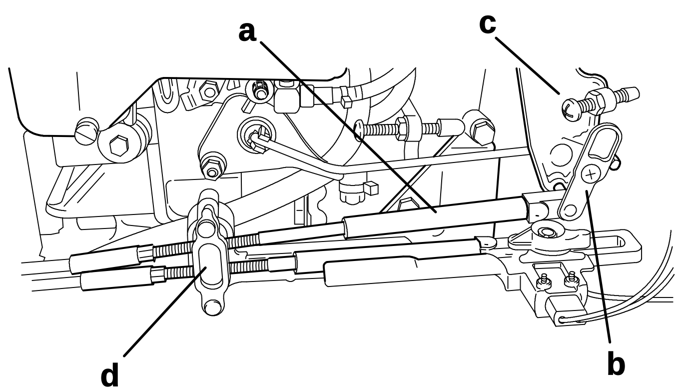
9. Check shift cable adjustments as follows:
   a. With remote control in forward, the propshaft should lock solidly in gear. If it does not, adjust cable barrel closer to cable end guide.
   b. Shift remote control into neutral. The propshaft should turn freely without drag. If not, adjust barrel away from cable end guide. Repeat steps a and b.
   c. Shift remote control into reverse while turning propeller. The propshaft should lock solidly in gear. If not, adjust barrel away from cable end guide. Repeat steps a thru c.
   d. Return remote control handle to neutral. The propeller should turn freely without drag. If not, adjust barrel closer to cable end guide. Repeat steps a thru d.

Throttle Cable Installation

NOTE: *Attach Shift cable to engine prior to attaching throttle cable.*

1. Start engine and adjust engine RPM to 600-700 RPM in forward gear. Stop the engine.
2. Shift remote control into NEUTRAL position.
3. Attach throttle cable end (a) to throttle lever anchor pin and secure with latch (b).
4. With end of throttle cable connected to throttle lever, hold idle screw (c) against the stop. Adjust throttle cable barrel to slip into barrel receptacle with a very light pre-load of the idle screw against the stop.
5. Lock barrels in place with cable retainer (d).
6. Check pre-load on throttle cable by placing a thin piece of paper between idle stop screw and the stop. Pre-load is correct when paper can be removed without tearing, but has some drag on it. Readjust cable barrel, if necessary.

IMPORTANT: Excessive pre-load on throttle cable will cause difficulty when shifting from FORWARD to NEUTRAL. (Readjust throttle cable barrel if necessary).



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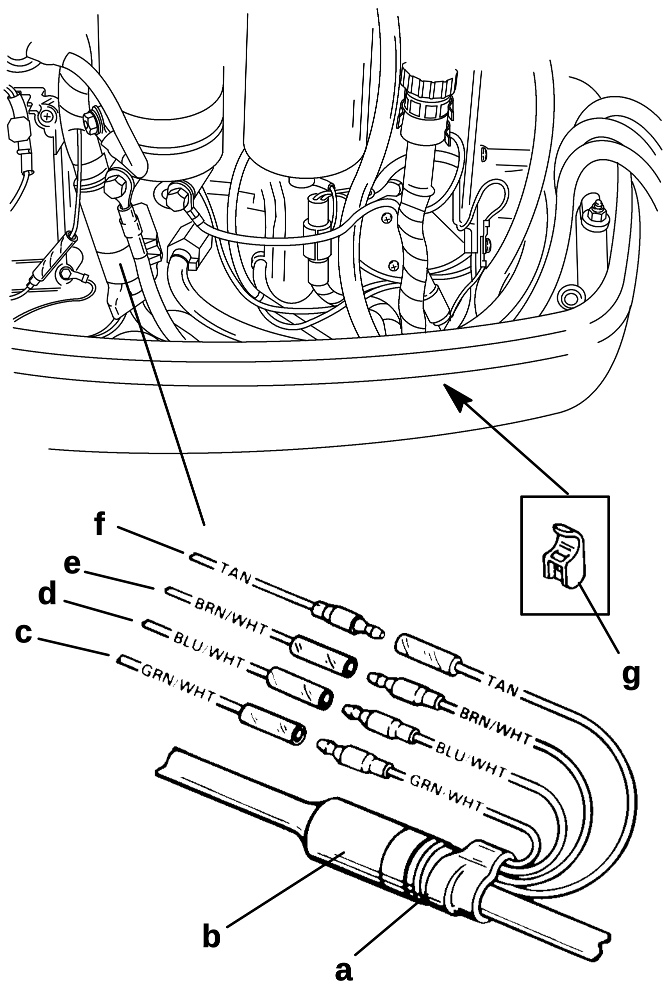
Remote Wiring Connections

1. Connect the remote wiring harness from the remote control or key switch assembly into the engine wiring harness connector.
2. Push the harness connection into the holder.
3. Place the remote wiring harness and battery cables into the harness holder.

Make wiring (bullet) connections between remote wiring harness and engine wiring.

IMPORTANT: Tape back and isolate any unused wiring harness leads.



a - Remote Wiring Harness
b - Engine Wiring Harness Connector
c - Lead From Trim Solenoid (Down Solenoid)
d - Lead From Trim Solenoid (Up Solenoid)
e - Lead From Trim Sender
f - Lead From Temperature Sender
g - Harness Holder (Located in Cowl) – Place Wiring Harness and Battery Cables into Holder

Battery Connections

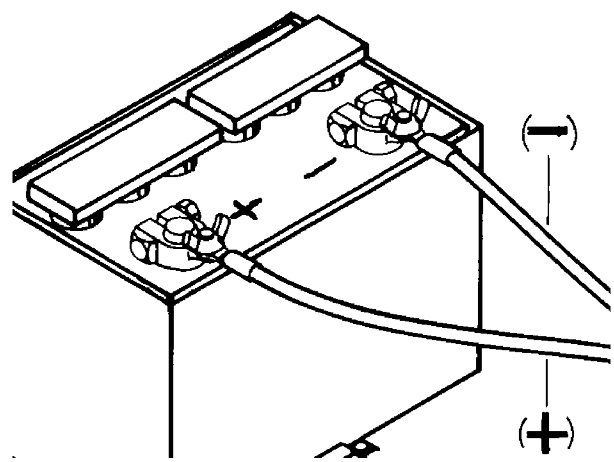
⚠ CAUTION

For dual outboard installations, the negative (-) battery cable of each engines starter motor ground circuit, MUST BE connected together by a common circuit (cable) capable of carrying the starting current of each engines' starter motor. [i.e. A locally obtained battery cable connected between the negative (-) terminal of each outboards cranking battery.]

⚠ CAUTION

Failure to observe correct polarity when connecting battery cables to battery will result in damage to the charging system.

Connect battery cables (from engine) to battery. Connect positive (+) battery cable to positive terminal and negative (–) battery cable to negative (–) battery terminal.

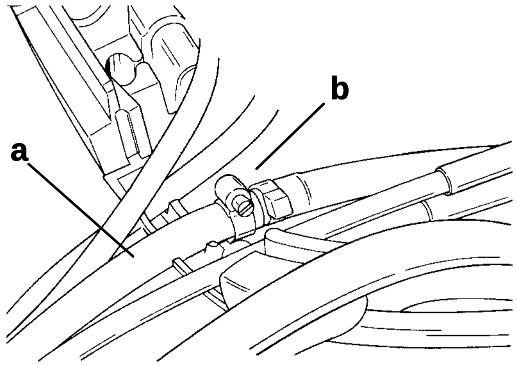


Fuel Connections

Connecting Fuel Hose to Engine

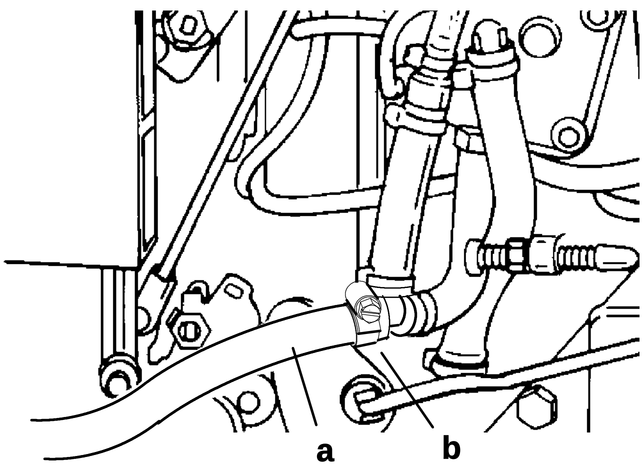
EFI MODELS

1. Connect fuel hose (a) to fitting inside of bottom cowl as shown. Secure with hose clamp (b).
2. Refer to page 6 for proper routing of fuel hose thru clamp in bottom cowl.



CARBURETOR MODELS

1. Connect fuel hose (a) to "T" fitting as shown. Secure with hose clamp (b).
2. Refer to page 7 for proper routing of fuel hose thru clamp in bottom cowl.



Portable Fuel Tank

Select a suitable location in boat within engine fuel line length limitations and secure tank in place.

Permanent Fuel Tank

These should be installed in accordance with industry and federal safety standards which include recommendations applicable to grounding, anti-siphon protection, ventilation, etc.

Fuel Line

Minimum fuel line inside diameter (I.D.) is 5/16 in. (8mm), with separate fuel line/fuel tank pickup for each engine.

Set Up Instructions for Oil Injection System

⚠ CAUTION

Be careful not to get dirt or other contamination in tanks, hoses or other components of the oil injection system during installation.

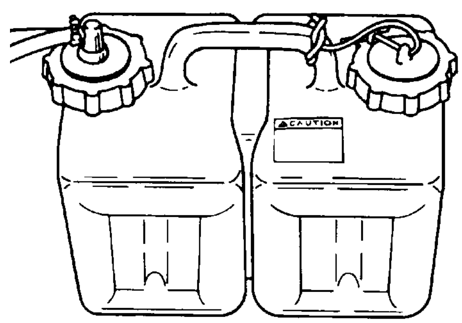
⚠ CAUTION

Oil injected engines additionally, must be run on a 50:1 gasoline/oil mixture during the engine break-in period. Refer to engine break-in procedure in the Operation & Maintenance Manual.

⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 6 psi. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 6 psi maximum.

Installing Remote Oil Tank



1. The remote oil tank should be installed in an area in the boat where there is access for refilling.
2. The tank should be restrained to keep it from moving around, causing possible damage. Use the oil tank hold down kit provided. Another acceptable means of restraining the tank would be the use of eye bolts and an elastic retaining strap about the midsection of the tank. Verify that any metal hooks do not puncture the tank.

NOTE: *Keep in mind, when installing in tight areas, that this tank will be under pressure when the engine is operating and will expand slightly.*

3. Oil hoses when routed thru engine well, must be able to extend to the hose fittings on engine.
4. Oil hoses must be arranged so they cannot become pinched, kinked, sharply bent or stretched during operation of the outboard.

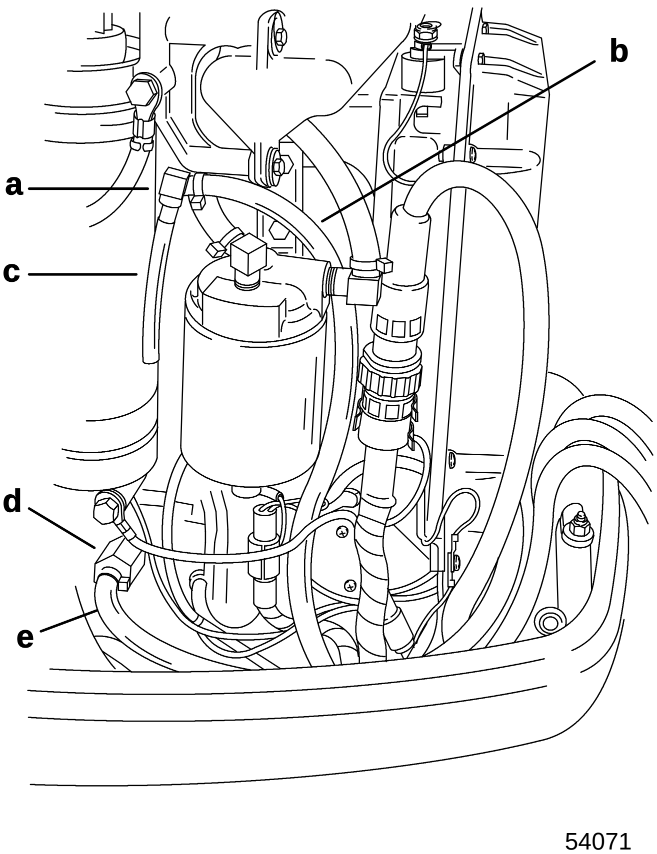
NOTE: *A Quicksilver Accessory oil hose extension kit (41729A3) is available for the remote oil tank.*

Installing Oil Hoses To Engine

1. Remove (and discard) the shipping cap from hose fitting (a).
2. Connect oil hose (“b” with blue stripe) to fitting as shown. Secure with sta-strap.

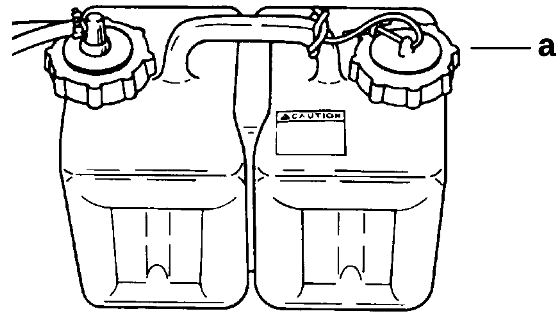
NOTE: *Hose (c) is a vent hose and does not get connected.*

3. Remove (and discard) shipping cap from pulse fitting (d).
4. Connect the second oil hose (e) to pulse fitting as shown. Secure with sta-strap.
5. Refer to page 6 for proper routing of oil hoses thru clamp in the bottom cowl.



Filling the Oil Injection System

1. Fill remote oil tank with the recommended oil listed in the Operation and Maintenance Manual. Tighten fill cap.

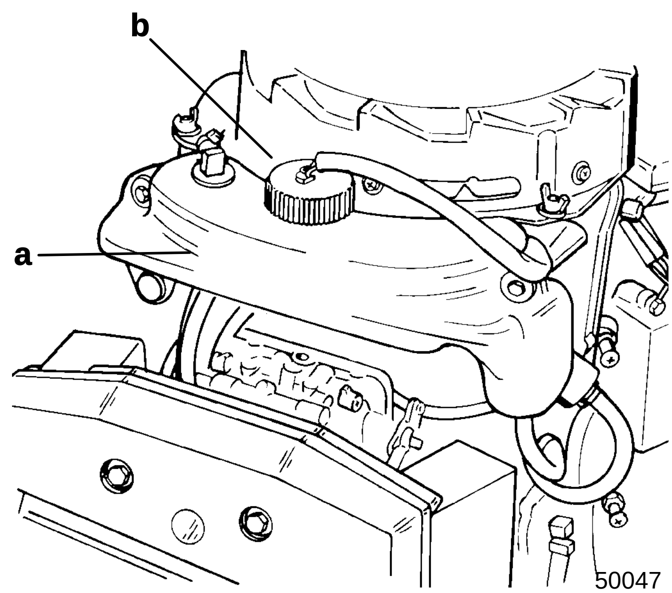


a - Fill Cap

2. Remove fill cap from the engine oil tank and fill the tank with oil. Reinstall the fill cap.
3. Loosen the fill cap on the engine oil tank. Run the engine until the all the air has been vented out of the tank and oil starts to flow out of the tank. Retighten fill cap.

⚠ CAUTION

Be certain that the fill caps on the engine oil tank and remote oil tank are installed tight. An air leak, at one of the caps on the remote oil tank, will prevent oil flow to the engine oil tank. A fill cap leak on the engine oil tank will cause oil leakage.



a - Engine Oil Tank
b - Fill Cap

Bleeding Air from Oil Injection Pump and Oil Injection Outlet Hose

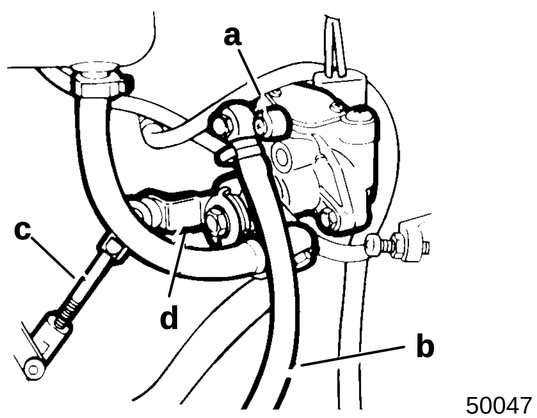
BLEEDING AIR FROM OIL INJECTION PUMP

With engine not running, place a shop towel below the oil injection pump. Loosen bleed screw three to four turns and allow oil to flow from bleed hole. Retighten bleed screw. This procedure allows the pump to fill with oil.

BLEEDING AIR FROM OIL INJECTION PUMP OUTLET HOSE

Any air bubbles in outlet hose in most cases will be purged out of the system during operation of the engine.

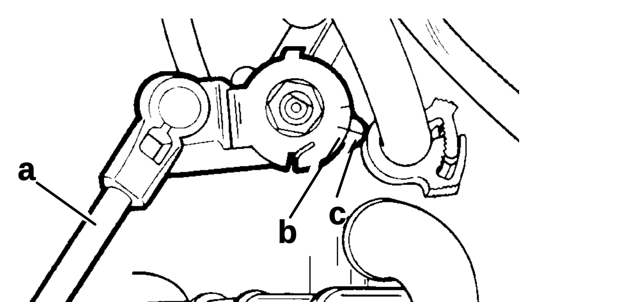
NOTE: *If air bubbles persist, they can be purged out of the hose by removing link rod and rotating the pump arm full clockwise while operating engine at 1000 to 1500 RPM: If necessary, gently pinch the fuel line between the remote fuel line connector and the oil injection pump "Tee" fitting. This will cause the fuel pump to provide a partial vacuum which will aid in removal of the air. Reinstall link rod.*



a - Bleed Screw
b - Outlet Hose
c - Link Rod
d - Pump Arm

Adjusting Oil Injection Pump

When throttle linkage is at idle position, alignment mark on oil injection arm should be in-line with mark on casting as shown. If necessary, adjust link rod.



a - Link Rod
b - Alignment Mark
c - Casting Mark

Propeller Selection

Refer to "Quicksilver Accessory Guide" for a complete list of available propellers.

For best all around performance from your outboard/boat combination, select a propeller that allows the engine to operate in the upper half of the recommended full throttle RPM range with the boat normally loaded (refer to Specifications in the Operators Manual). This RPM range allows for better acceleration while maintaining maximum boat speed.

Check full-throttle RPM using an accurate tachometer with the engine trimmed out to a balanced steering condition (steering effort equal in both directions) without causing the propeller to "break loose."

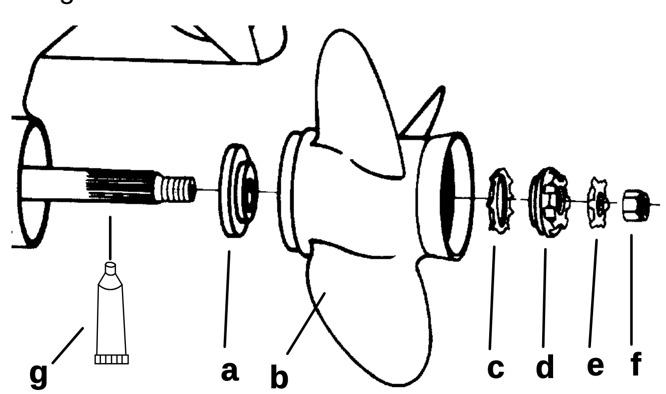
Propeller Installation

⚠ WARNING

When the propeller shaft is rotated and the engine is in gear, there is the possibility for the engine to crank over and start. To prevent this type of accidental engine starting and possible serious injury caused from being struck by a rotating propeller, always set the remote control into neutral and remove spark plug leads when you are servicing the propeller.

NOTE: *To prevent the propeller hub from corroding and seizing to the propeller shaft, especially in salt water, always apply a coat of Quicksilver Anti-Corrosion Grease to the entire shaft.*

1. Set the remote control into neutral position.
2. Remove leads from spark plugs to prevent engine from starting.
3. Coat the propeller shaft with Quicksilver Anti-Corrosion Grease (g).
4. Install thrust washer (a), propeller (b), continuity washer (c), thrust hub (d), tab washer (e), and self locking nut (f) onto the shaft.
5. Torque propeller nut to 55 lb. ft. (75 N·m).
6. Bend three of the tabs into the propeller hub grooves.



Power Trim System

General Information

The power trim system is filled at the manufacturer and is ready for use.

Trim outboard through entire trim and tilt range several times to remove any air from the system.

The trim system is pressurized and is not externally vented.

Power Trim Operation

With most boats, operating around the middle of the "trim" range will give satisfactory results. However, to take full advantage of the trimming capability, there may be times when you choose to trim your outboard all the way in or out. Along with an improvement in some performance aspects comes a greater responsibility for the operator, and this is being aware of some potential control hazards.The most significant of which is a pull or "torque" which can be felt on the steering wheel. This steering torque results from the outboard being trimmed so that the propeller shaft is not in a horizontal position.

⚠ WARNING

Avoid possible serious injury or death. When the outboard is trimmed in or out beyond a neutral steering condition, a pull on the steering wheel in either direction may result. Failure to keep a continuous firm grip on the steering wheel when this condition exists can result in loss of boat control as the steering wheel can spin freely. The boat can now "spin out" or go into a very tight maximum turn which, if unexpected, can result in occupants being thrown within the boat or out of the boat.

Consider the following lists carefully.

Trimming In or Down Can:

1. Lower the bow.
2. Result in quicker planing off, especially with a heavy load or a stern heavy boat.
3. Generally improves the ride in choppy water.
4. Increase steering torque or pull to the right (with the normal right hand rotation propeller).
5. In excess, lowers the bow of some boats to a point where they begin to plow with their bow in the water while on plane. This can result in an unexpected turn in either direction called "bow steering" or "over steering" if any turn is attempted or if a significant wave is encountered.

⚠ WARNING

Avoid possible serious injury or death. Adjust outboard to an intermediate trim position as soon as boat is on plane to avoid possible ejection due to boat spin-out. Do not attempt to turn boat when on plane if outboard is trimmed extremely in or down and there is a pull on the steering wheel.

Trimming Out or Up Can:

1. Lift the bow out of the water.
2. Generally increase top speed.
3. Increase clearance over submerged objects or a shallow bottom.
4. Increase steering torque or pull to the left at a normal installation height (with the normal right hand rotation propeller).
5. In excess, cause boat "porpoising" (bouncing) or propeller ventilation.
6. Cause engine overheating if any water intake holes are above the water line.

Trim "In" Angle Adjustment

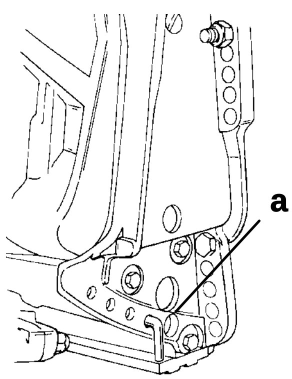
Some outboard boats, particularly some bass boats, are built with a greater than normal transom angle which will allow the outboard to be trimmed further "in" or "under". This greater trim "under" capability is desirable to improve acceleration, reduce the angle and time spend in a bow high boat attitude during planing off, and in some cases, may be necessary to plane off a boat with aft live wells, given the variety of available propellers and height range of engine installations.

However, once on plane, the engine should be trimmed to a more intermediate position to a avoid a bow-down planing condition called "plowing". Plowing can cause "bow steering" or "over steering" and inefficiently consumes horsepower. In this condition, if attempting a turn or encountering a diagonal, moderate wake, a more abrupt turn than intended may result.

In rare circumstances, the owner may decide to limit the trim under. This can be accomplished by purchasing a stainless steel tilt pin (P/N 17-49930A1) and inserting it through whatever pin hole is desired. The non-stainless steel shipping bolt should not be used in this application other than on a temporary basis.

⚠ WARNING

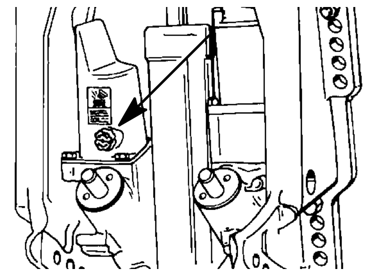
Avoid possible serious injury or death. Adjust outboard to an intermediate trim position as soon as boat is on plane to avoid possible ejection due to boat spin-out. Do not attempt to turn boat when engine is trimmed extremely under or in.



a - Tilt Pin

Checking Trim System Fluid Level

1. Tilt outboard to the full up position and engage the tilt support lever.
2. Remove fill cap and check fluid level. The fluid level should be even with the bottom of the fill hole. If necessary, add Quicksilver Power Trim & Steering Fluid or automotive transmission fluid (ATF) Type F, FA or Dexron II.



Trim Tab Adjustment

Propeller steering torque may cause your boat to pull in one direction. This steering torque results from your outboard not being trimmed so the propeller shaft is parallel to the water surface. The trim tab can help compensate for this steering torque and can be adjusted within limits to reduce any unequal steering effort.

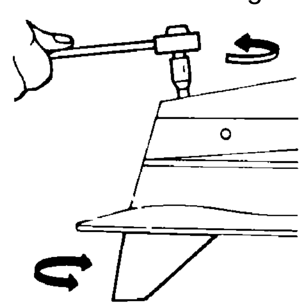
MODELS WITHOUT POWER STEERING

Operate your boat at normal cruising speed, trimmed to desired position. Turn your boat left and right and note the direction the boat turns more easily.

If adjustment is necessary, loosen trim tab bolt until trim tab moves freely (does not rub against locking ridges). DO NOT strike tab to make adjustments. Make small adjustments at a time. If the boat turns more easily to the left, move the trailing edge of trim tab to the left. If the boat turns more easily to the right move the trailing edge of trim tab to the right. Position trim tab in one of the locating grooves BEFORE tightening bolt to prevent damage to holding mechanism. Torque bolt to 40 lb. ft. (54.0 N·m) and retest.

MODELS WITH POWER STEERING

Trim tab adjustment is not required. The trailing edge of the trim tab should be set straight back.



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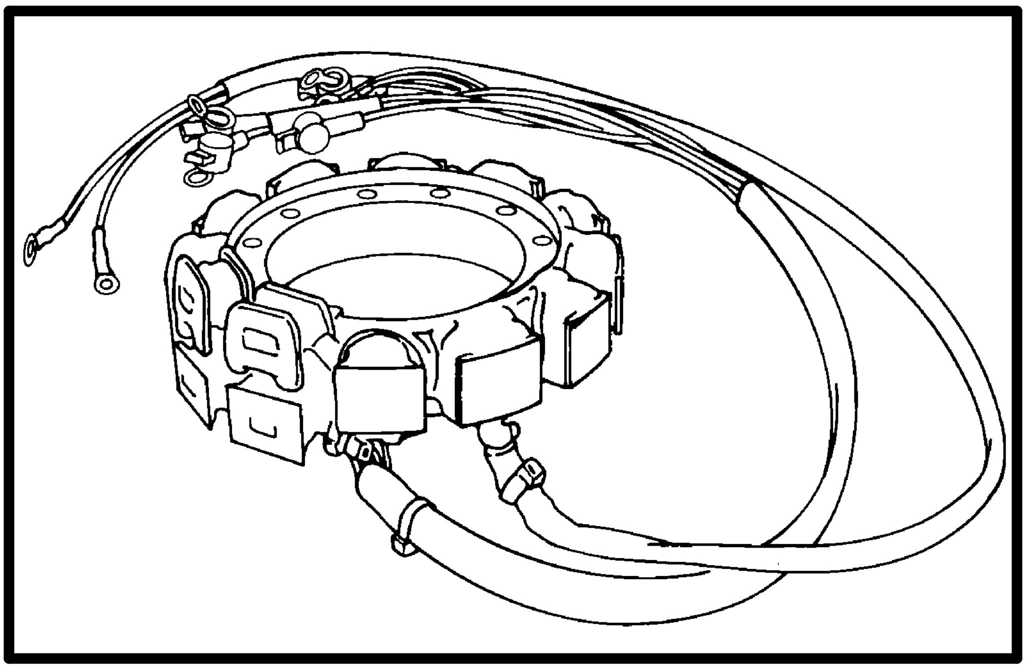


IGNITION SYSTEM

Table of Contents

Ignition Specifications

Ignition System	
Type	Capacitor Discharge
Spark Plug Type	NGK BU8H
Spark Plug Gap	Surface Gap
Voltage @ Spark Plugs	40000 Volts

40 Ampere Stator

Test Leads to	Resistance Ohms	Scale Reading
Between BLUE and RED Stator Leads	3500-4200	R x 1000
Between BLUE/ WHITE and RED/ WHITE Stator Leads	3500-4200	R x 1000
Between RED Stator Lead and BLACK Stator Lead	90-140	R x 1
Between RED/WHITE Stator Lead and BLACK Stator Lead	90-140	R x 1

Trigger

Test Leads to	Resistance Ohms	Scale Reading
Between BROWN Trigger Lead (without YELLOW Sleeve) and WHITE Trigger Lead (with YELLOW Sleeve)	1100-1400	R x 100
Between WHITE Trigger Lead (without YELLOW Sleeve) and VIOLET Trigger Lead (with YELLOW Sleeve)	1100-1400	R x 100
Between VIOLET Trigger Lead (without YELLOW Sleeve) and BROWN Trigger Lead (with YELLOW Sleeve)	1100-1400	R x 100

Ignition Coil

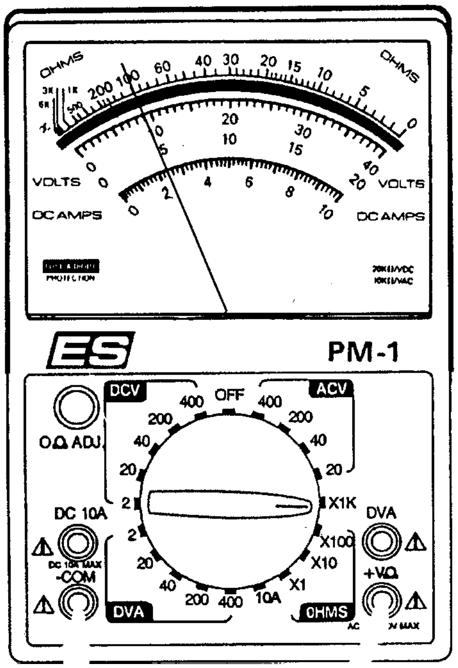
Test Leads to	Resistance Ohms	Scale Reading
Between (+) and (–) Coil Terminals	.02-.04	R x 1
On BLUE Color Coils Between Coil Tower and Either (+) or (–) Coil Terminal (Mounted or Removed)	800-1100	R x 100

DVA Specifications

Test	Selection Sw. Position	DVA Lead RED	DVA Lead BLACK	Scale Reading @ 400 RPM	Scale Reading @ 1000 RPM	Scale Reading @ 3000 RPM
Coil Primary	400 VDC*	Coil (+) Terminal	Coil (-) Terminal	90 - 145	125 - 175	175 - 240
Sw. Box - Stop Circuit	400 VDC*	Black/Yellow Sw. Box Terminal	Ground	200 - 300	225 - 400	225 - 400
Stator Low Speed	400 VDC*	Blue Sw. Box Terminal	Ground	100 - 265	195 - 265	255 - 345
Stator High Speed	400 VDC*	Red Sw. Box Terminal	Ground	25 - 50	120 - 160	230 - 320
Sw. Box - Bias	20VDC or 40VDC	[See Note 1] Ground	[See Note 1] White/Black Sw. Box Terminal	1 - 6	3 - 15	10 - 30

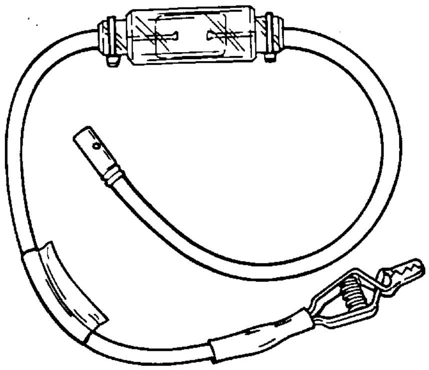
Special Tools

Multi-Meter DVA Tester 91-99750



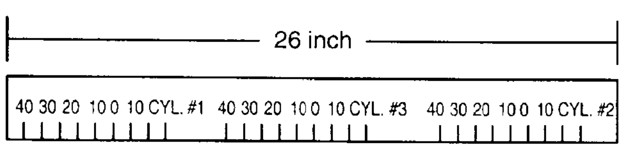
NOTE: *There are 3 different Multi-Meter DVA Testers using the part number 91-99750 or 91-99750A1 having a DVA built in. Any one of these testers will work with the 135-200 V-6 ignition system.*

Spark Gap Tester 91-63998A1

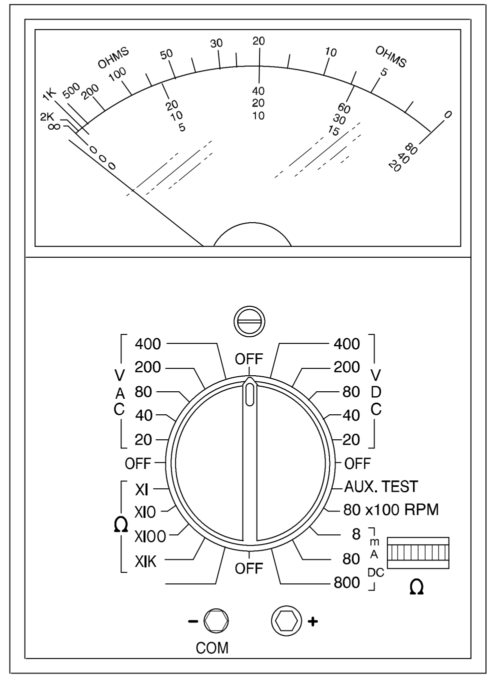


Cylinder Timing Decal 91-853883-1

Decal can be used to help troubleshoot ignition timing by determining the timing of individual cylinders.



Volt/Ohm Multi-Meter 91-62562



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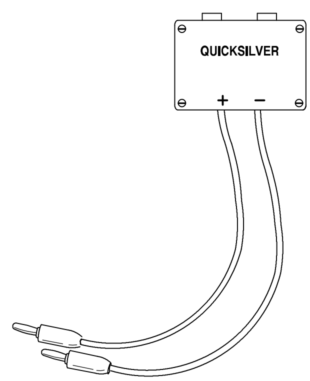
NOTE: *Volt/Ohm Multi-Meter 91-62562 can be used to test ignition system voltages if used in conjunction with DVA ADAPTOR 91-89045.*

DVA Adapter 91-89045



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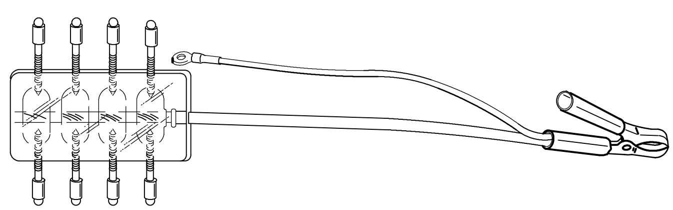
NOTE: *There are 2 versions of the DVA adapter – 1 with studs and 1 with leads. Both are designed to be used with Volt/Ohm Multi-Meter 91-62562 or any volt/ohm meter that has a 400 vdc or higher scale.*

Spark Gap Board 91-850439



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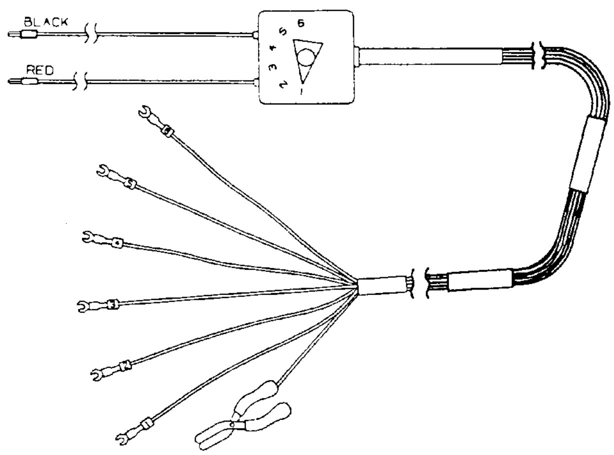
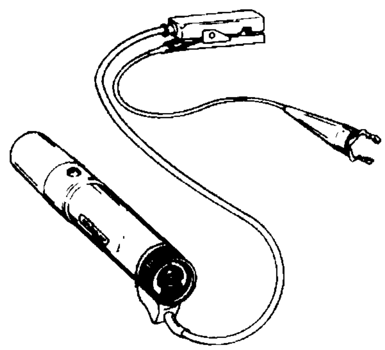
Test Harness 91-14443A1

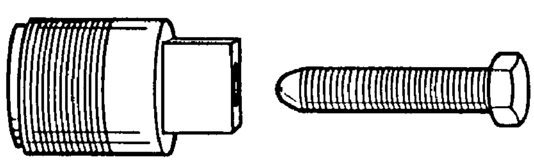


Timing Light 91-99379

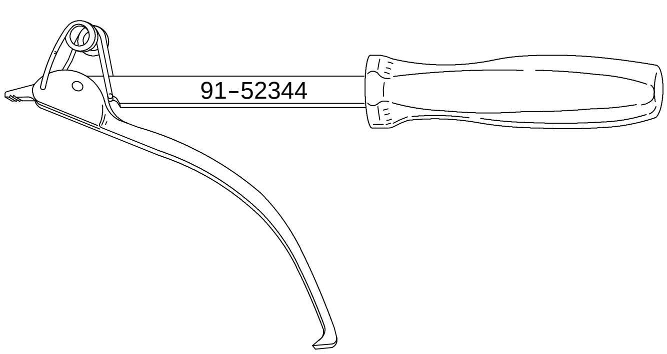


Crank Shaft Protector Cap 91-24161

Flywheel Puller 91-73687A2



Flywheel Holder 91-52344



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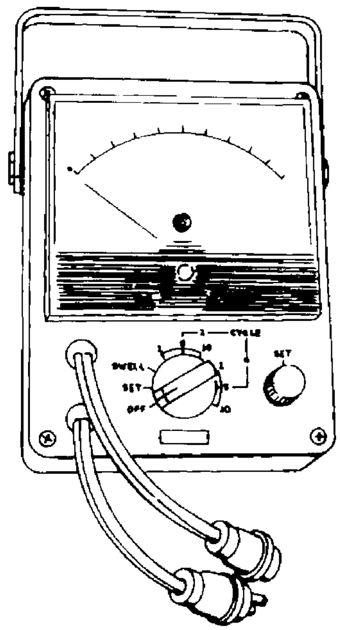
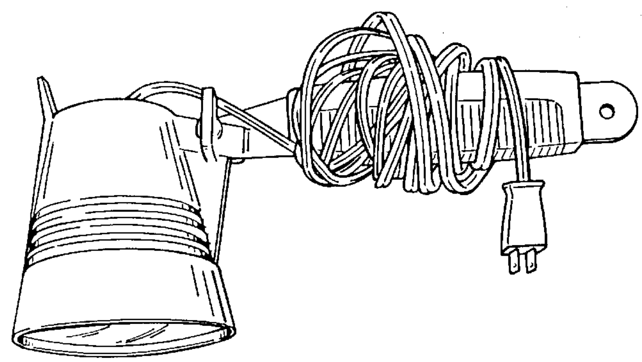
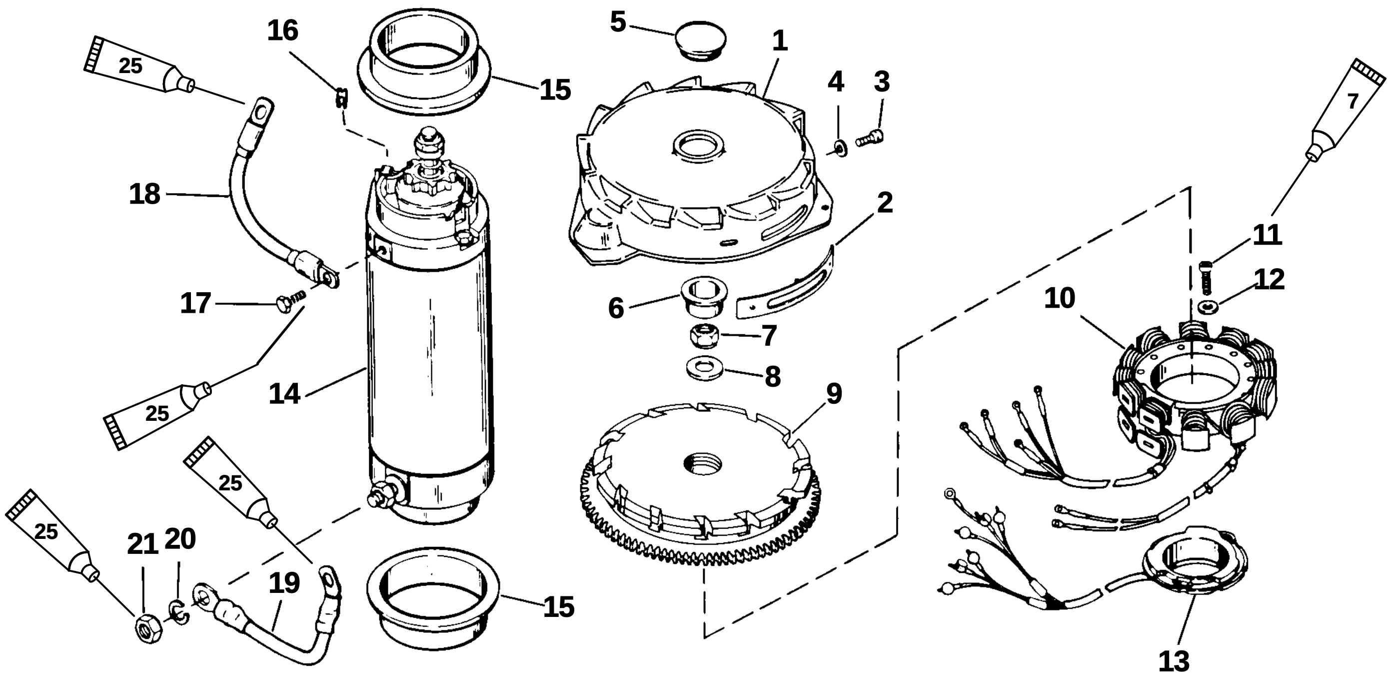
Service Tachometer 91-59339



Heat Lamp 91-63209



Flywheel/Starter Motor

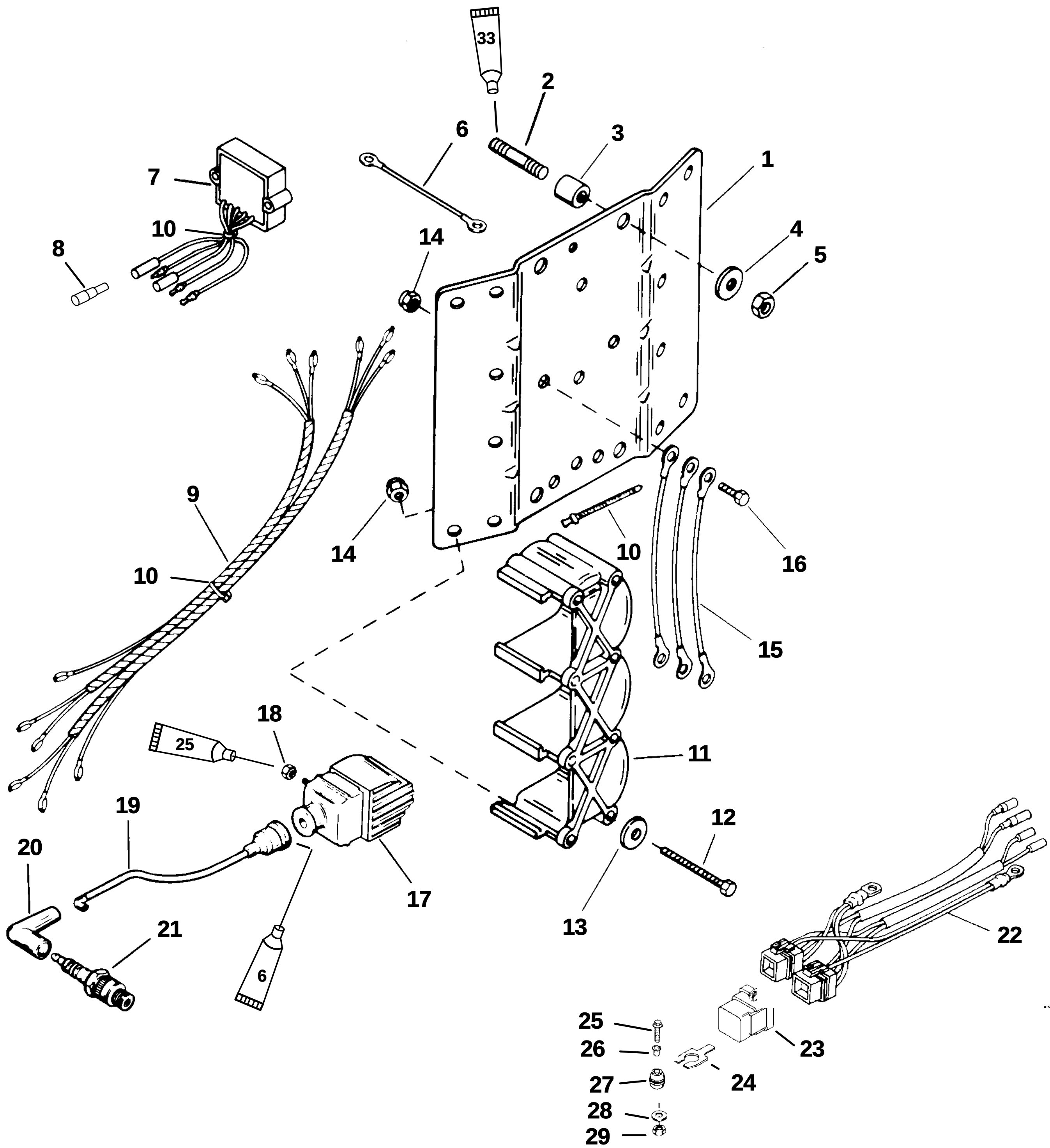


7 Loctite 271 (92-809820)

25 Liquid Neoprene (92-25711--2)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	FLYWHEEL COVER ASSEMBLY			
2	1	MARKER			
3	2	SCREW			
4	2	WASHER			
5	1	PLUG			
6	1	PLUG			
7	1	NUT		120	163
8	1	WASHER			
9	1	FLYWHEEL			
10	1	STATOR			
11	4	SCREW	50		5.5
12	4	WASHER			
13	1	TRIGGER PLATE ASSEMBLY			
14	1	STARTER MOTOR			
15	2	COLLAR			
16	2	RUBBER STOP			
17	1	SCREW	80		9.0
18	1	WIRE ASSEMBLY (BLACK)			
19	1	WIRE ASSEMBLY (BLACK)			
20	1	LOCKWASHER			
21	1	NUT	60		7.0

Ignition Coil/Voltage Regulator



6 Dielectric Grease (92-823506--1)

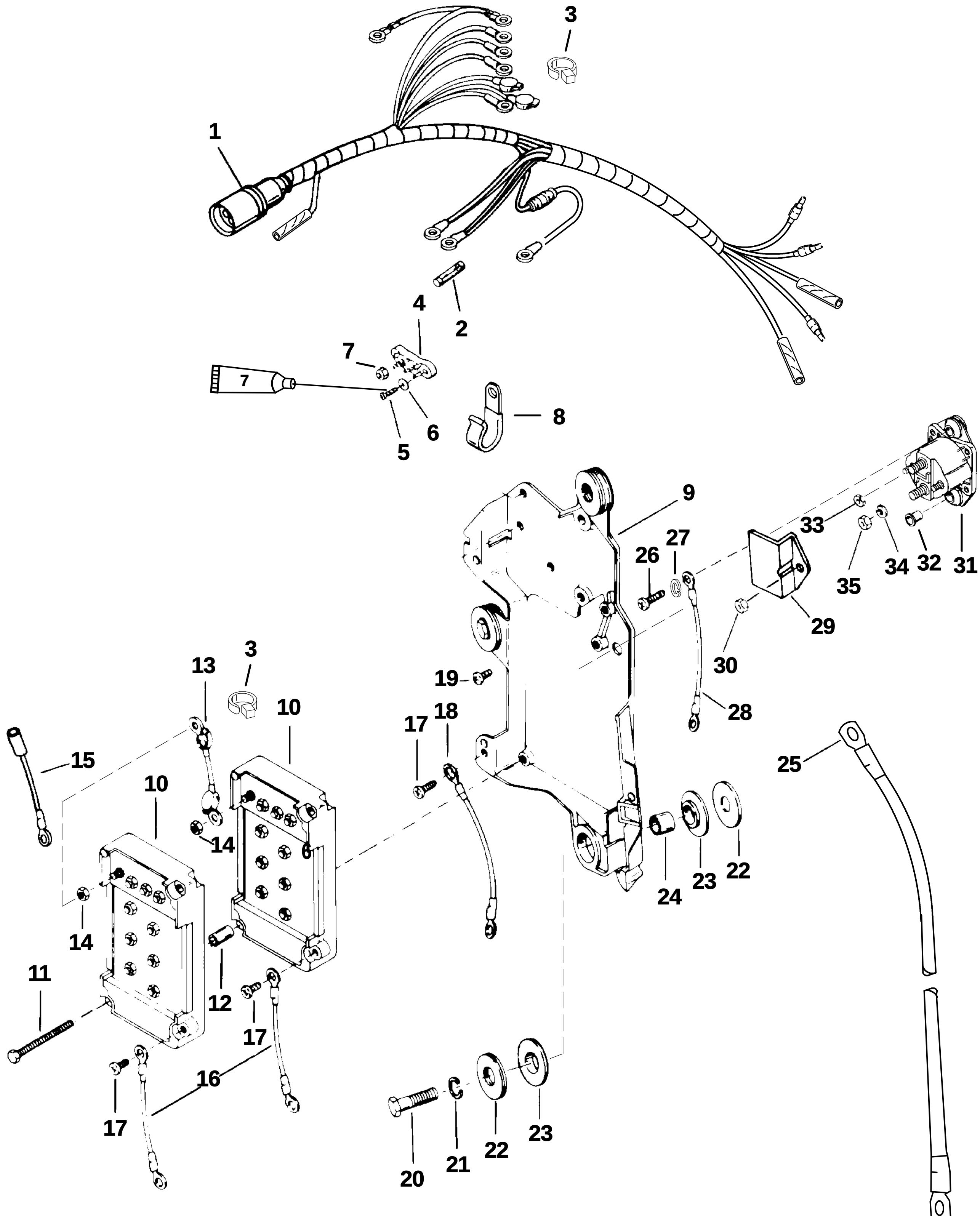
25 Liquid Neoprene (92-25711--2)

33 Loctite 680 (92-809833)

NOTE: *Apply Liquid Neoprene to all eyelet wiring terminal connections.*

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	MOUNTING PLATE			
2	4	STUD			
3	4	SPACER			
4	4	LOCKWASHER			
5	4	NUT	80		9.0
6	1	CABLE			
7	2	VOLTAGE REGULATOR			
8	1	PLUG			
9	1	HARNESS ASSEMBLY (#2,4 & 6)			
9	1	HARNESS ASSEMBLY (#1,3 & 5)			
10	4	STA-STRAP			
11	2	COVER–ignition coil			
12	12	SCREW–ignition coil cover	20		2.5
13	12	WASHER			
14	14	NUT–cover screw/ground wire	Drive Tight		
15	6	GROUND WIRE			
16	2	SCREW–grounding wire			
17	6	IGNITION COIL			
18	12	NUT–ignition coil terminal	30		3.5
19	1	CABLE–high tension			
20	6	PROTECTOR–high tension cable			
21	6	SPARK PLUG (NGK #BU8H)		20	27.0
21	6	SPARK PLUG (NGK #BUZ8H - Canada/Belgium)		20	27.0
22	1	HARNESS-Trim			
23	2	RELAY			
24	2	BRACKET			
25	2	SCREW			
26	2	BUSHING			
27	2	GROMMET			
28	2	WASHER			
29	2	NUT			

Wiring Harness/Starter Solenoid



7 Loctite 271 (92-809820)

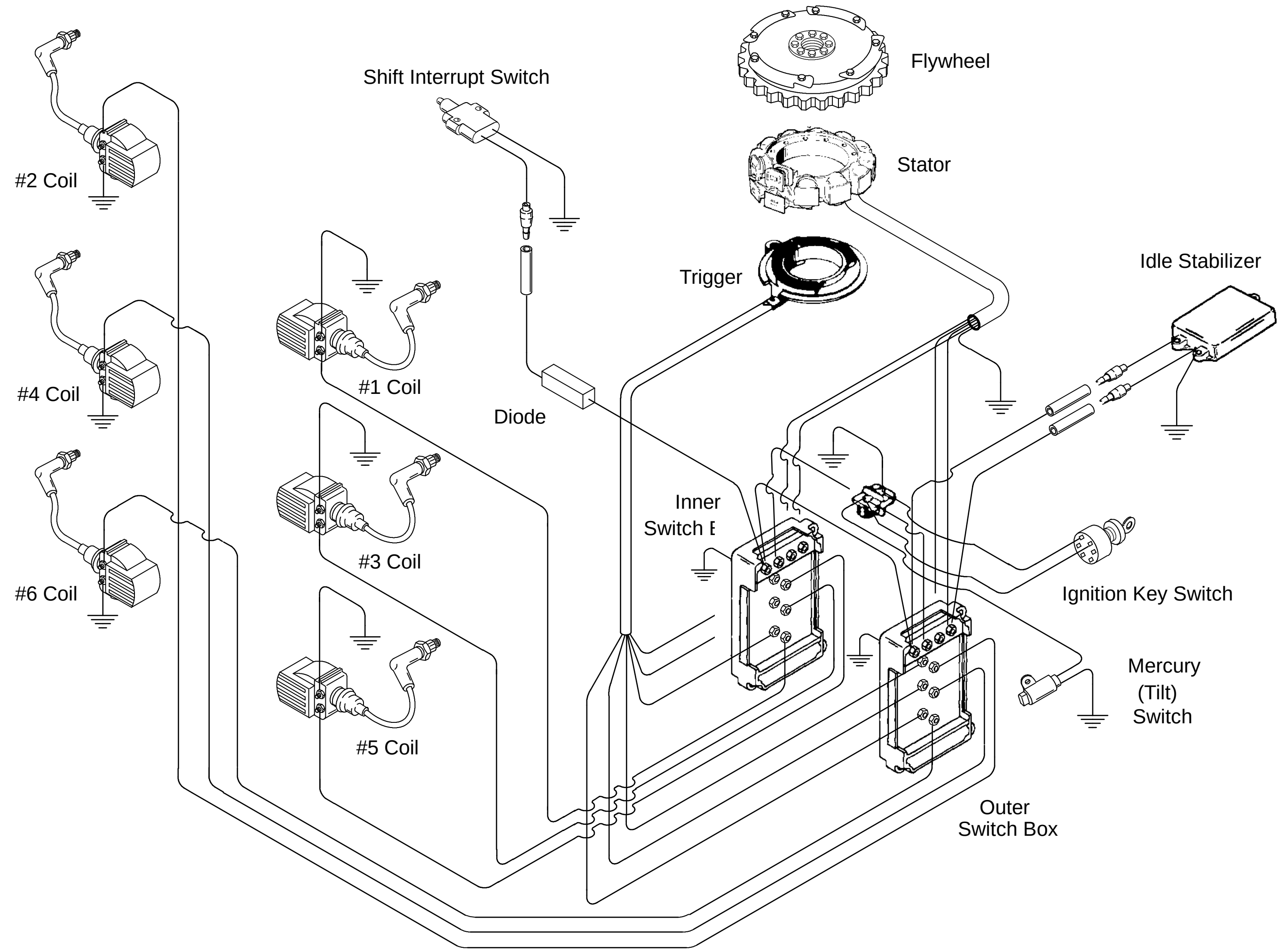
25 Liquid Neoprene (92-25711--2)

NOTE: *Apply Liquid Neoprene to all eyelet wiring terminal connections.*

Wiring Harness/Starter Solenoid

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	ENGINE HARNESS			
2	1	FUSE			
3	AR	STA-STRAP			
4	1	TERMINAL BLOCK			
5	2	SCREW			
6	2	WASHER			
7	2	NUT	30		3.5
8	1	J CLAMP			
9	1	IGNITION PLATE			
10	2	SWITCH BOX			
11	2	SCREW (2-1/2")	50		5.5
12	2	BUSHING			
13	1	CABLE ASSEMBLY **(150/175)**			
14	20	NUT	20		2.5
15	1	CABLE ASSEMBLY (3" - WHITE/BLACK)**(150/175)**			
15	1	CABLE ASSEMBLY (6" - RED/WHITE)			
16	2	WIRE			
17	2	SCREW	35		4.0
18	1	CABLE ASSEMBLY (BLACK)			
19	1	SCREW (1/2")	40		4.5
20	3	SCREW (1-1/4")	150	12.5	17.0
21	3	LOCKWASHER			
22	6	WASHER			
23	6	WASHER (RUBBER)			
24	3	BUSHING			
25	1	BATTERY CABLE **(POSITIVE)**			
25	1	BATTERY CABLE **(NEGATIVE)**			
26	2	SCREW (1-1/8")	40		4.5
27	2	LOCKWASHER			
28	1	CABLE ASSEMBLY (BLACK)			
29	1	INSULATOR			
30	4	NUT	15		1.5
31	1	STARTER SOLENOID			
32	2	BUSHING			
33	2	NUT (10-32)	15		1.5
34	2	LOCKWASHER (5/16")			
35	2	NUT (5/16-18)	50		5.5

Theory of Operation



Description

The V-6 outboard ignition system is alternator-driven with distributor-less capacitor discharge. Major components of the system are the flywheel, stator assembly, trigger assembly, 2 switch boxes, 6 ignition coils and 6 spark plugs.

The stator assembly is mounted below the flywheel and has 4 capacitor charging coils. The 4 capacitor charging coils are composed of 2 high speed and 2 low speed coils-1 high speed and1 low speed coil for each switch box. The low speed coils provide primary voltage for the switch boxes from idle to approximately 2500 RPM. The high speed coils provide primary voltage from 2000 RPM to the maximum RPM the outboard is capable of achieving.

The flywheel is fitted with permanent magnets inside the outer rim. As the flywheel rotates, the permanent magnets pass the capacitor charging coils producing AC voltage. The AC voltage is conducted to the switch boxes where it is rectified and stored in a capacitor.

The trigger assembly (also mounted under the flywheel) has 3 coils. Each coil controls the spark to 2 cylinders -1 cylinder each bank. The flywheel also has a second set of permanent magnets located around the center hub. As the flywheel rotates, the magnets pass the trigger coils producing AC voltage. The AC voltage is conducted to an electronic switch (SCR) in the switch box. The switch discharges the capacitor voltage into the ignition coil at the correct time and in firing order sequence.

Capacitor voltage is conducted to primary side of ignition coil. As this voltage goes to ground through the primary circuit of the coil, it induces a voltage rise in the secondary side of the ignition coil. This voltage can increase to approximately 40000 volts before bridging the spark plug gap and returning to ground.

The preceding sequence occurs once per engine revolution for each cylinder.

Spark timing is advanced or retarded by the movement of the trigger assembly attached to the throttle/ spark arm.

Ignition Test Procedures

⚠ WARNING

When testing or servicing the V-6 outboard ignition system, high voltage is present. Be extremely cautious. DO NOT TOUCH OR DISCONNECT any ignition parts while engine is running, while key switch is on or while battery cables are connected.

Failure to comply with the following items may result in damage to the ignition system.

1. DO NOT reverse battery cable connections. The battery negative cable is (-) ground.
2. DO NOT "spark" battery terminals with battery cable connections to check polarity.
3. DO NOT disconnect battery cables while engine is running.
4. DO NOT crank engine when switch boxes are not grounded to engine.

A process of elimination must be used when checking the ignition system without a voltmeter (capable of measuring 400 volts DC, or higher) and Direct Voltage Adaptor (91-89045), as the switch boxes and ignition coils cannot be thoroughly checked with conventional test equipment.

All other components can be tested with an ohmmeter. Before troubleshooting the ignition system, check the following:

1. Make sure that electrical harness, ignition switch, and mercury switch are not the source of the problem.
2. Check that plug-in connectors are fully engaged and terminals are free of corrosion.
3. Make sure that wire connections are tight and free of corrosion.
4. Check all electrical components, that are grounded directly to engine, and all ground wires to see that they are grounded to engine.
5. Check for disconnected wires and short and open circuits.

Checking for Loss of Spark

The use of an inductive timing light while cranking or running the engine will show whether there is spark present or not. The timing light will not show the strength of the spark.

The use of a spark gap or spark gap board will give a visual indication of the strength of the spark. Normal ignition spark is BLUE in color. A YELLOW or RED spark indicates a weak ignition.

Direct Voltage Adaptor (DVA)

The DVA can be used with Quicksilver VOA Meter 91-62562A1, Quicksilver Volt/Ohm meter 91-93572, Multi Meter/DVA Tester 91-99750 or an equivalent volt meter (capable of measuring 400 volts DC or higher) to check primary ignition voltage on Alternator Driven Ignition (ADI) systems. (Models are specified in Test Charts, following.)

⚠ CAUTION

To protect against meter and/or component damage, observe the following precautions:

-- MAKE CERTAIN that Positive (+) lead/terminal of DVA is connected to Positive (+) receptacle of meter.

-- 400 VDC test position (or higher) MUST BE used for all tests, except "switch box bias" test.

-- DO NOT CHANGE meter selector switch position while engine is running and/or "cranked."

-- Switch boxes MUST REMAIN GROUNDED (mounted) during tests. Running or cranking engine with switch boxes ungrounded may damage switch boxes. If removed for easier access, a separate ground MUST BE INSTALLED.

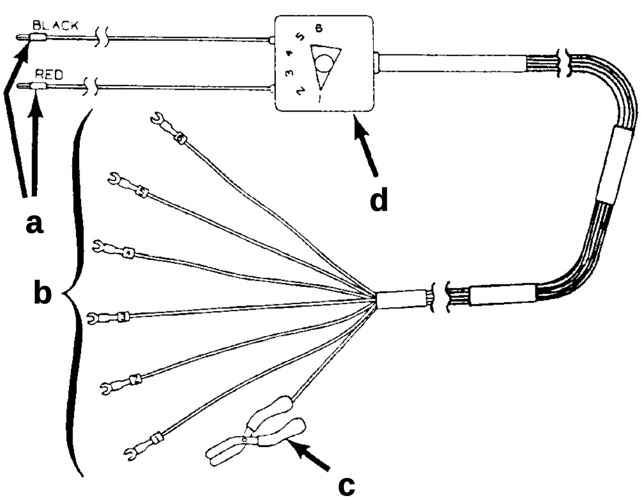
⚠ WARNING

DANGER - HIGH VOLTAGE/SHOCK HAZARD! Do Not touch ignition components and/or metal test probes while engine is running and/or "cranked."

Test procedures and specifications are provided for checking primary ignition voltage while the engine is running and/or being "cranked."

Troubleshooting Tips

1. Intermittent, weak or no spark output at 2 spark plugs (one plug from each bank of three cylinders) usually is caused by a bad TRIGGER.
2. A SWITCH BOX can also cause 2 cylinders (1 each bank) to lose spark.
3. Intermittant, weak or no spark output at 3 spark plugs (a complete bank of 3 cylinders) usually is caused by a bad STATOR or SWITCH BOX.
4. An IDLE STABILIZER/ADVANCE MODULE can also cause 3 cylinders on 1 bank to lose spark.
5. Intermittent, weak or no spark output at any one spark plug (single cylinder) usually is a bad COIL or SWITCH BOX.
6. Loss of spark to 1 cylinder could also be caused by a loose or broken PRIMARY LEAD between the switch box and ignition coil or a broken or loose GROUND lead between the ignition coil and engine ground.
7. To more easily troubleshoot high speed ignition problems, it is recommended that test harness 91-14443A1 be installed on outboard. This long harness allows the mechanic to remain at the driver's seat while checking primary voltage, stator voltage, trigger voltage and bias voltage.



a - Plug into Meter
b - Attach to Appropriate Terminals
c - Attach to Engine Ground
d - Selector Switch

8. A heat gun, hair dryer or heat lamp can be used to warm electrical components up (to find a short); or components can be place in a refrigerator to cool them down (to find an open).Resistance values will change as a component is heated or cooled. However, the resistance change should not be drastic as in a short or open unless the component is defective.

NOTE: *If using a heat device to warm electrical components, maximum temperature electrical components can be heated to without damage is 311 F° (155 C°).*

9. Repeat failures of the same electrical component could be caused by other electrical components.

   – If one circuit in a switch box keeps failing, it could be the result of high resistance in the primary of a coil, primary lead between the switch box and coil or high resistance on the coil primary ground wire.

   – If same switch box keeps failing, it could be because of a random open circuit in the trigger.

10. When testing DVA voltage at coil primary, the NEGATIVE test lead MUST be touching the NEGATIVE terminal of the ignition coil and NOT common ground.
11. Switch leads between components to isolate problem. Example:
    – If voltage is low to 1 switch box, move the RED and BLUE stator leads from 1 switch box to the other switch box. If voltage problem moves, STATOR is defective. If problem does not move, SWITCH BOX is defective.
    – No spark on 1 cylinder could be ignition coil or switch box. Moving the primary lead from 1 ignition coil to another should isolate the problem source. If the problem follows, the SWITCH BOX is defective. If the problem stays with the same cylinder, the IGNITION COIL is defective.
    – No spark to 2 cylinders could be a switch box or trigger. Move a pair of trigger leads from 1 switch box to another. If problem follows, TRIGGER is defective. If problem does not follow, SWITCH BOX is defective.
12. Trigger Voltage can be checked with a voltmeter set on the 20 VAC scale. Place 1 voltmeter lead on the switch box trigger terminal and the other voltmeter lead to engine ground. Voltage should be present; if not, reverse voltmeter leads. If voltage is still not present, trigger is defective.
13. Inspect spark plug high tension leads (especially spark plug boots) for cuts, nicks or abraisions which can allow voltage to leak to ground.

Ignition Troubleshooting

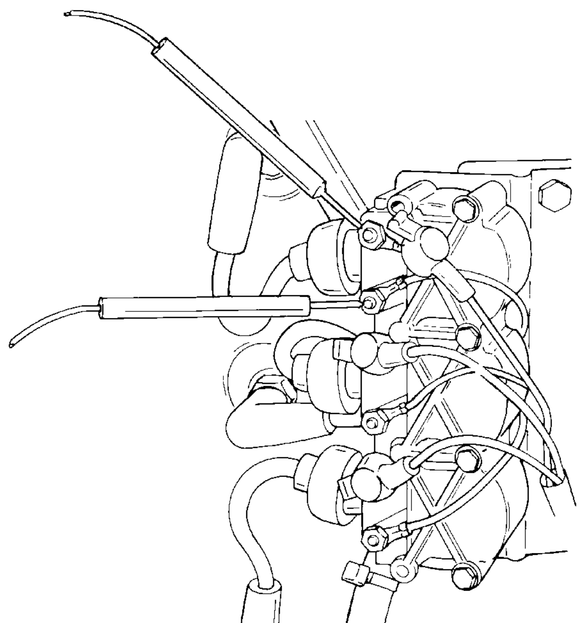
Multimeter/DVA Tester 91-99750A1

⚠ WARNING

DANGER - HIGH VOLTAGE/SHOCK HAZARD! Do Not touch ignition components and/or metal test probes while engine is running and/or "cranked."

Test Sequence

1-A. With DVA set @ 400VDC scale, check primary input voltage to coils. (See Test Chart, following.)



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DVA RED	DVA BLK	400 RPM	1000 RPM	3000 RPM
Coil (+)	Coil (–)	90 - 145	125 - 175	175 - 240

1. If voltage readings to coil(s) are BELOW specification, proceed with Step 2-A.
2. If voltage readings to coil(s) are WITHIN specification, proceed with Step 1-B.

1-B. Check coils for spark. [Connect Spark Gap Tester (91-63998A1) between coil high voltage tower and spark plug.]

1. If no spark or weak spark, COIL is bad.
2. If spark is OK, proceed with Step 1-C.

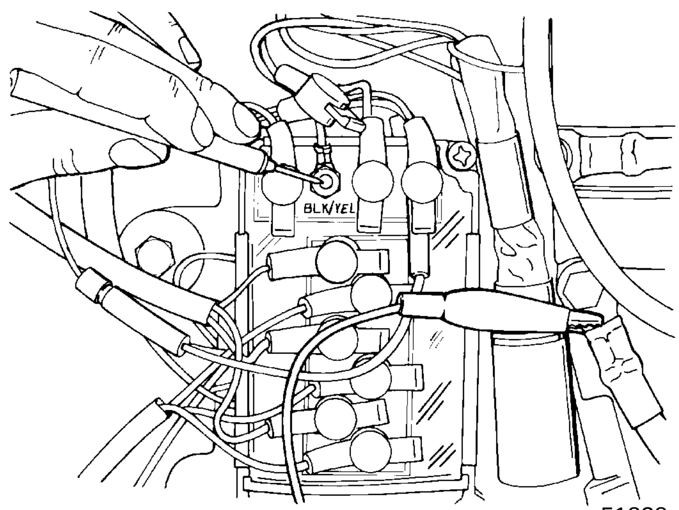
1-C. If Steps 1-A and 1-B check OK, replace spark plugs.

If problem still is evident after replacing spark plugs, proceed with Step 1-D.

1-D. If Steps 1-A, 1-B and 1-C check OK, check ignition timing.

1. If ignition timing DOES NOT check to specification (sudden and unexplained timing change), check trigger advance linkage for loose or broken parts and check trigger magnet ring in flywheel (affixed to flywheel hub) for tightness and/or shift in position.
2. If ignition timing is UNSTABLE (timing jumps around, at "cranking" speed and/or low RPM), proceed to Step 5-A.
3. If ignition timing checks to specification and engine still does not run or runs poorly, trouble exists with fuel system or engine mechanical.

2-A. With meter set @ 400DVA scale, check switch box "stop" circuit. (See Test Chart, following.)



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DVA RED	DVA BLK	400 RPM	1000 RPM	3000 RPM
BLK/YEL	GROUND	200 - 300	225 - 400	225 - 400

1. If reading is BELOW specification, proceed with Step 2-B.
2. If reading is ABOVE specification, either the trigger or switch box is bad (test trigger as out- lined in Outboard Service Manual; if trigger checks to specification replace switch box and repeat check).
3. If reading is WITHIN specification, proceed with Step 3-A.

2-B. Check ignition switch/wiring, as follows:

⚠ WARNING

DANGER--HIGH VOLTAGE SHOCK/FIRE HAZARD. STAY CLEAR OF SPARK PLUG LEADS. To assure personal safety, each individual spark plug lead should be grounded to the engine.

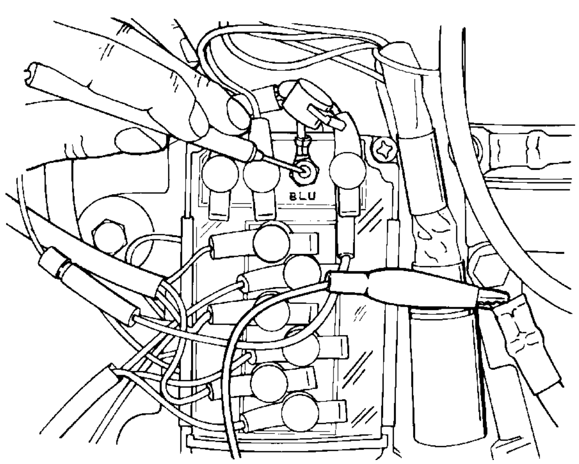
1. To prevent engine from starting, remove spark plug leads from ALL spark plugs, then ground ALL spark plug leads to the engine.
2. Remove ignition switch and mercury switch lead wire(s) from switch box(es) [lead wire(s) are connected to ORANGE switch box terminal(s) on EARLY model engines -- BLACK/YELLOW switch box terminal(s) on LATER model engines].

NOTE: *Be sure to disconnect ignition switch lead wire from both switch boxes.*

3. With ignition switch and mercury switch lead wire(s) ISOLATED (removed in preceding Step 2), repeat check in Step 2-A.
   a. If reading still is BELOW specification, proceed with Step 3-A.
   b. If reading now is WITHIN specification, either the ignition switch, mercury switch, lanyard stop switch or wiring is bad.

3-A. Check stator low speed and high speed input to switch box. (See Test Chart, following.)

NOTE: *This is INNER switch box.*



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STATOR LOW SPEED TEST

DVA RED	DVA BLK	400 RPM	1000 RPM	3000 RPM
BLUE	GROUND	100 - 265	195 - 265	255 - 345

STATOR HIGH SPEED TEST

DVA RED	DVA BLK	400 RPM	1000 RPM	3000 RPM
RED	GROUND	25 - 50	120 - 160	230 - 320

1. If either the low speed or high speed reading to switch box is BELOW specification, stator or switch box is bad (test stator as outlined in Outboard Service Manual; if stator checks to specification replace switch box and repeat check).

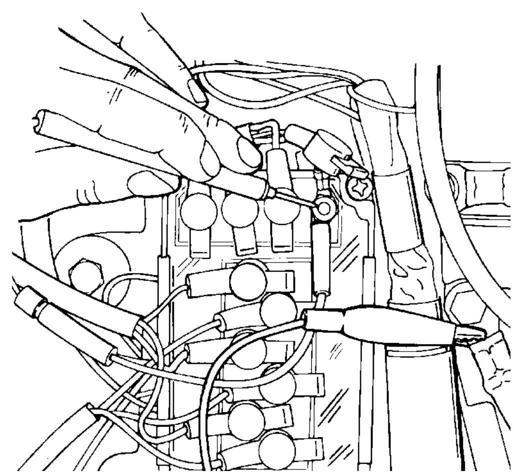
IMPORTANT: If engine is equipped with an Idle Speed Stabilizer and/or High Speed Spark Advance, disconnect and isolate both leads from switch box and repeat check to rule out possible stabilizer/spark advance malfunction.

2. If both the low speed and high speed readings are WITHIN specification, proceed with Step 4-A.

⚠ CAUTION

On V-6 models, OUTER switch box must be removed from engine (which also loosens INNER switch box) to gain access to INNER switch box. BEFORE checking stator input to INNER switch box, a GROUND LEAD MUST BE INSTALLED BETWEEN BOTH switch boxes (INNER and OUTER) and engine to prevent possible damage to ignition components and/or test equipment.

4-A. Check stator low speed and high speed input to OUTER switch box. (See Test Chart, following.)



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STATOR LOW SPEED TEST

DVA RED	DVA BLK	400 RPM	1000 RPM	3000 RPM
BLU/WHT	GROUND	100 - 265	195 - 265	255 - 345

STATOR HIGH SPEED TEST

DVA RED	DVA BLK	400 RPM	1000 RPM	3000 RPM
RED/WHT	GROUND	25 - 50	120 - 160	230 - 320

1. If either the low speed or high speed reading to switch box is BELOW specification, stator or switch box is bad (test stator as outlined in Outboard Service Manual; if stator checks to specification replace switch box and repeat check)

IMPORTANT: If engine is equipped with an Idle Speed Stabilizer and/or High Speed Spark Advance, disconnect and isolate both leads from switch box and repeat check to rule out possible stabilizer/spark advance malfunction.

2. If both the low speed and high speed readings are WITHIN specification, proceed with Step 5-A.

5-A. Check switch box bias. Bias circuit may checked using either a voltmeter or an ohmmeter. (To use a voltmeter, see Test Chart, following.) Use VOLTMETER only set on 20VDC or 40VDC scale; DVA not required.

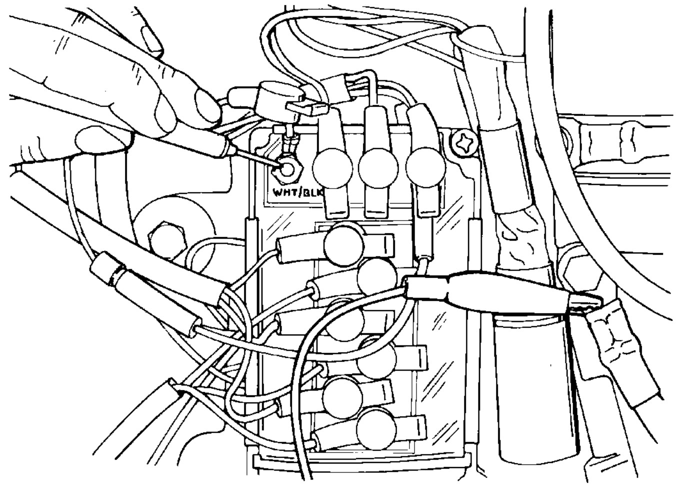
NOTE: *Using meter only, REVERSE LEAD POLARITY; connect leads as specified.*

BIAS CIRCUIT TEST

DVA RED	DVA BLK	400 RPM	1000 RPM	3000 RPM
GROUND	WHT/BLK	1 - 6	3 - 15	10 - 30

Ohm Test:

1. Disconnect WHITE/BLACK wire from switch box terminal.
2. With ohmmeter set to 1K scale, connect one ohm lead to WHT/BLK switch box terminal and one ohm lead to switch box case ground.



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3. Ohmmeter should indicate 1300 - 1500 ohms.

Voltage Test

NOTE: *Switch Box Bias Voltage is NEGATIVE (-) voltage applied to the ignition system to raise the trigger firing threshold as engine RPM is increased, thus stabilizing ignition timing and preventing random ignition firing.*

1. If bias reading is BELOW specification, one or both switch boxes are bad.

IMPORTANT: If engine is equipped with an Idle Speed Stabilizer and/or High Speed Spark Advance, disconnect and isolate both leads from switch box and repeat check to rule out possible stabilizer/spark advance malfunction.

Replace OUTER switch box and recheck bias; if necessary, replace INNER switch box and recheck bias.

2. If bias reading is WITHIN specification, and engine still does not run or runs poorly, one or both switch boxes or trigger is bad. [Test trigger as outlined in Outboard Service Manual; if trigger checks to specification replace switch box(es) and repeat check.]

Ignition System Test Chart

IMPORTANT: BEFORE attempting the ignition system checks, below, thoroughly read the preceding pages of these instructions to become familiar with the proper test sequence and procedures (particularly any "Warnings" and "Cautions"). ALL tests are performed with lead wires connected--terminals exposed. SWITCH BOXES MUST BE GROUNDED (CASE TO ENGINE BLOCK) FOR ALL TESTS--IF NOT, SWITCH BOXES MAY BE DAMAGED.

40 AMP CHARGING SYSTEM

Test	Selection Sw. Position	DVA Lead RED	DVA Lead BLACK	Scale Reading @ 400 RPM	Scale Reading @ 1000 RPM	Scale Reading @ 3000 RPM
Coil Primary	400 VDC*	Coil (+) Terminal	Coil (-) Terminal	90 - 145	125 - 175	175 - 240
Sw. Box - Stop Circuit	400 VDC*	Black/Yellow Sw. Box Terminal	Ground	200 - 300	225 - 400	225 - 400
Stator Low Speed	400 VDC*	Blue Sw. Box Terminal	Ground	100 - 265	195 - 265	255 - 345
Stator High Speed	400 VDC*	Red Sw. Box Terminal	Ground	25 - 50	120 - 160	230 - 320
Sw. Box - Bias	20VDC or 40VDC	[See Note 1] Ground	[See Note 1] White/Black Sw. Box Terminal	1 - 6	3 - 15	10 - 30

(1) Using meter only, REVERSE LEAD POLARITY; Connect leads as specified.

(*) If using a meter with a built-in DVA, place selector switch in the DVA/400 VDC position.

Ignition System

STATOR ASSEMBLY

The stator assembly has a BLACK ground wire which grounds the stator to the engine.

IMPORTANT: Stator must be grounded to engine.

STATOR TEST

1. Remove ignition plate cover.
2. Remove two screws and lift outer switch box from inner switch box. Refer to switch box removal and installation.
3. To test, disconnect BLUE/WHITE and RED/WHITE stator leads from outer switch box and BLUE and RED stator leads from inner switch box.
4. Use an ohmmeter and perform the following tests:

40 AMPERE STATOR

Test Leads to	Resistance Ohms	Scale Reading
Between BLUE and RED Stator Leads	3500-4200	R x 1000
Between BLUE/ WHITE and RED/ WHITE Stator Leads	3500-4200	R x 1000
Between RED Stator Lead and BLACK Stator Lead	90-140	R x 1
Between RED/ WHITE Stator Lead and BLACK Stator Lead	90-140	R x 1

5. If meter readings are other than specified, replace stator assembly. Refer to stator assembly removal and installation (see **"Table of Contents"**).

⚠ CAUTION

Switch boxes must be grounded to engine before cranking engine, or switch boxes will be damaged.

TRIGGER ASSEMBLY TEST

1. Remove 2 screws and lift outer switch box from inner switch box. Refer to switch box(es) removal and installation, following.
2. Disconnect all trigger leads from switch boxes.
3. Use an ohmmeter and perform the following checks:

Test Leads to	Resistance Ohms	Scale Reading
Between BROWN Trigger Lead (without YELLOW Sleeve) and WHITE Trigger Lead (with YELLOW Sleeve)	1100-1400	R x 100
Between WHITE Trigger Lead (without YELLOW Sleeve) and VIOLET Trigger Lead (with YELLOW Sleeve)	1100-1400	R x 100
Between VIOLET Trigger Lead (without YELLOW Sleeve) and BROWN Trigger Lead (with YELLOW Sleeve)	1100-1400	R x 100

4. If meter readings are not as specified, replace trigger assembly. Refer to **"Trigger Assembly Removal and Replacement,"** following.

⚠ CAUTION

Switch boxes must be grounded to engine before cranking engine, or switch boxes will be damaged.

IGNITION COIL TEST

IMPORTANT: Ohmmeter tests can only detect certain faults in the ignition coils. Replace ignition coil, if ohm- meter readings (listed in chart, following) are not as specified. If coil tests OK, and coil is still suspected of being faulty, use Multi-Meter/DVA Tester (91-99750) or a voltmeter and Direct Voltage Adaptor (91-89045) to thoroughly check coil.

1. Disconnect wires from the positive (+) and negative (-) coil terminals.
2. Remove the spark plug (hi-tension) lead from coil tower.
3. Use an ohmmeter and perform the following tests:

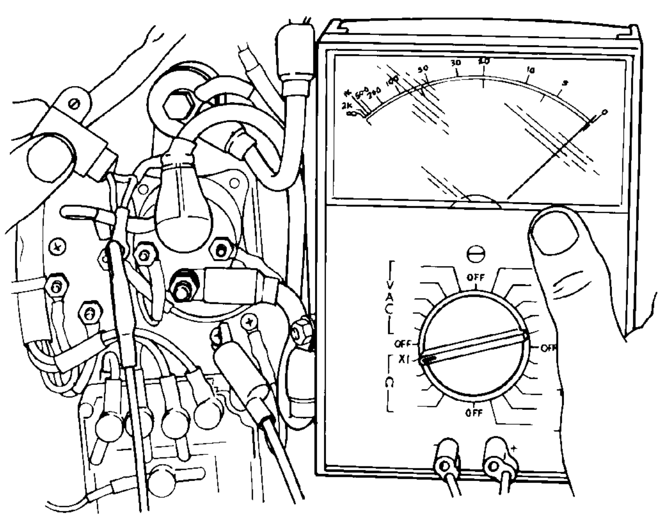
NOTE: *Copper wire is an excellent conductor, but it will have a noticeable difference in resistance from cold to hot temperatures. Reasonable variations from these specified readings are acceptable.*

Test Leads to	Resistance Ohms	Scale Reading
Between (+) and (–) Coil Terminals	.02-.04	R x 1
On BLUE Color Coils Between Coil Tower and Either (+) or (–) Coil Terminal (Mounted or Removed)	800-1100	R x 100

4. If meter readings are not as specified, replace ignition coil. Refer to **"Ignition Coil Removal and Installation,"** following.

MERCURY (TILT) STOP SWITCH TEST

1. Remove mounting screw that secures mercury switch and black ground wire to engine.
2. Connect an ohmmeter (R x 1 scale) between black lead and black/yellow lead or terminal stud on mercury switch.
3. Test mercury switch as follows:
   a. Position mercury switch as it would be installed when engine is in "down" position. The meter should indicate no continuity.
   b. Tilt mercury switch up and tap end of switch with finger. The meter should indicate continuity.
   c. If these readings are not obtained, replace mercury switch.



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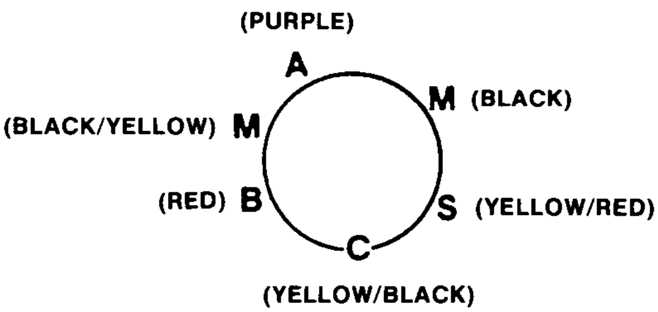
IGNITION (KEY) SWITCH TEST

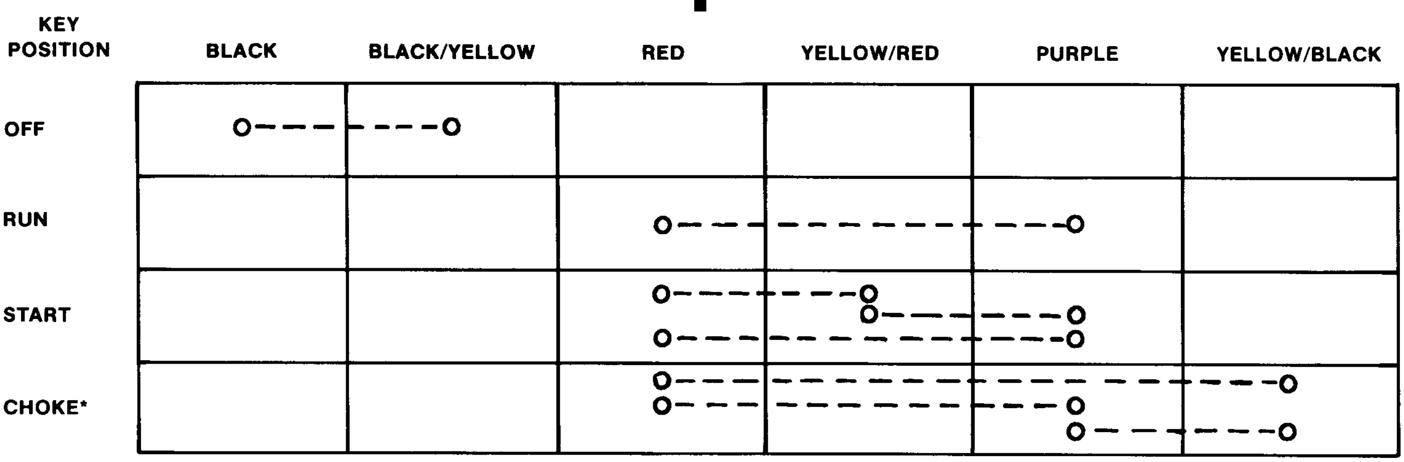
1. Disconnect remote control wiring harness and instrument panel connector.

NOTE: *Wiring diagram for control boxes is located in SECTION 2D.*

IGNITION SWITCH (SOLDERED CONNECTIONS)



2. Set ohmmeter on R x 1 scale for the following tests:

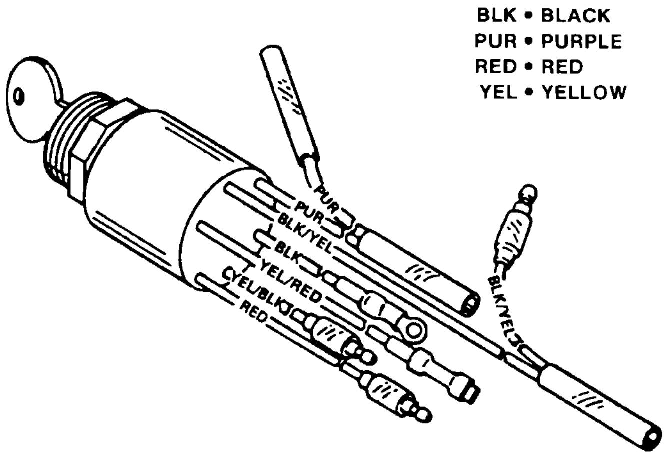


3. If meter readings are other than specified in the preceding tests, verify that switch and not wiring is faulty. If wiring checks OK, replace switch.

CONTINUITY SHOULD BE INDICATED AT THE FOLLOWING POINTS:

* Key switch must be positioned to "Run" or "Start" and key pushed in to actuate choke, for this continuity test.

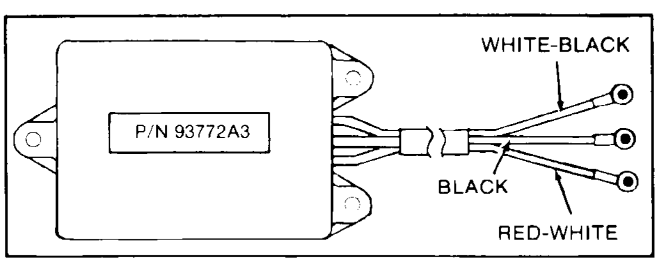
IGNITION SWITCH (BULLET CONNECTIONS)



LOW SPEED/HIGH SPEED SPARK ADVANCE MODULE DESCRIPTION:

MODEL	SERIAL NUMBER
200 (Carbureted)	0D077248 thru 0D122746

The low speed/high speed spark advance capabilities are combined in one module. If the engine idle speed falls below approximately 550 RPM, the module will electronically advance the timing by as much as 9°. This timing advance raises the idle RPM to an acceptable level (550 RPM). When the module senses the idle RPM is at the acceptable level, it returns the timing to the normal idle timing. The module also electronically advances the timing by 6° when the engine speed reaches 5000 RPM. The timing will remain advanced until the engine speed exceeds 5600 RPM. Above 5600 RPM the high speed advance module will retard the maximum timing by 4° to 6°. Timing will remain retarded until engine speed is reduced below 5600 RPM.



Low Speed/High Speed Spark Advance Module

TESTS FOR PROPER FUNCTION OF LOW SPEED/ HIGH SPEED SPARK ADVANCE MODULE

IMPORTANT: Due to the sensitivity characteristics of individual modules and tachometer variances, the engine RPM at which the module will advance/retard the ignition timing may vary slightly from specification.

LOW SPEED SPARK ADVANCE TEST

Connect a timing light to No. 1 spark plug lead (top, starboard bank). To test the low speed spark advance function, start the engine and allow it to idle above 600 RPM. Retard the ignition timing by slowly pulling forward on the spark advance lever. The system is functioning correctly if a rapid spark advance (as much as 9° from the idle setting) is observed as the engine speed slows down to below approximately 550 RPM.

HIGH SPEED SPARK ADVANCE TEST

NOTE: *If an engine dynamometer is available, the high speed spark advance function can be checked with a timing light while running the engine up to wide open throttle. If a dynamometer is not available and the boat/motor package will be lake tested, then it is recommended that a DC voltmeter and a tachometer be placed near one another inside the boat while the engine is being run up to wide open throttle. The DC voltmeter should be connected to read the NEGATIVE voltage on the WHITE/BLACK wire relative to engine ground. (The WHITE/BLACK wire connects the output of the spark advance module to the two switch boxes.) Normally, this voltage would be about -30 to -35 volts DC at 5000 RPM, and should drop to about half its previous value when the spark advance function is activated above 5000 RPM.*

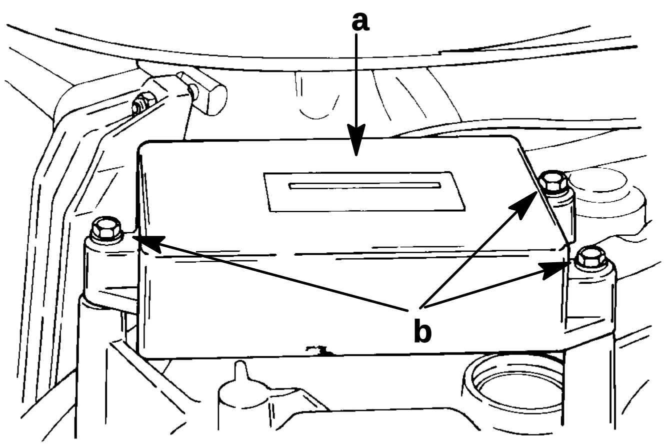
NOTE: *If engine speed exceeds 5600 RPM the NEGATIVE voltage observed will begin to increase as the maximum timing is retarded 4° to 6°.*

NOTE: *To read negative voltage, using some voltmeters, the red meter lead must be connected to engine ground and the black meter lead connected to the WHITE/BLACK wire.*

The low speed/high speed spark advance module is not repairable. Should the module fail to function as described, it will require replacement.

LOW SPEED/HIGH SPEED SPARK ADVANCE MODULE REMOVAL

1. Disconnect spark advance module harness leads from switch box.
2. Remove 3 bolts securing module to powerhead and remove module.



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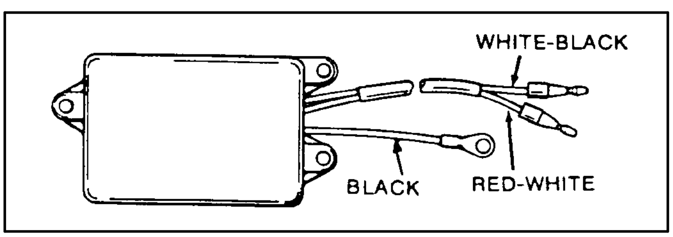
a - Low Speed/High Speed Advance Module
b - Bolts (3)

LOW SPEED/HIGH SPEED SPARK ADVANCE MODULE INSTALLATION

1. Connect module harness leads to switch box.
2. Apply Loctite 222 (FT2962-2) to threads of 3 module mounting bolts and secure module to powerhead.
3. Torque bolts to 30 Ib. in. (3.5 N·m).

Idle Stabilizer Modules



Idle Stabilizer

IDLE STABILIZER DESCRIPTION

The idle stabilizer will electronically advance the ignition timing by as much as 9° if the engine idle speed falls below approximately 550 RPM. This timing advance raises the idle RPM to an acceptable level (550 RPM). When the idle stabilizer senses the idle RPM has reached the acceptable level, it returns the timing to the normal idle timing.

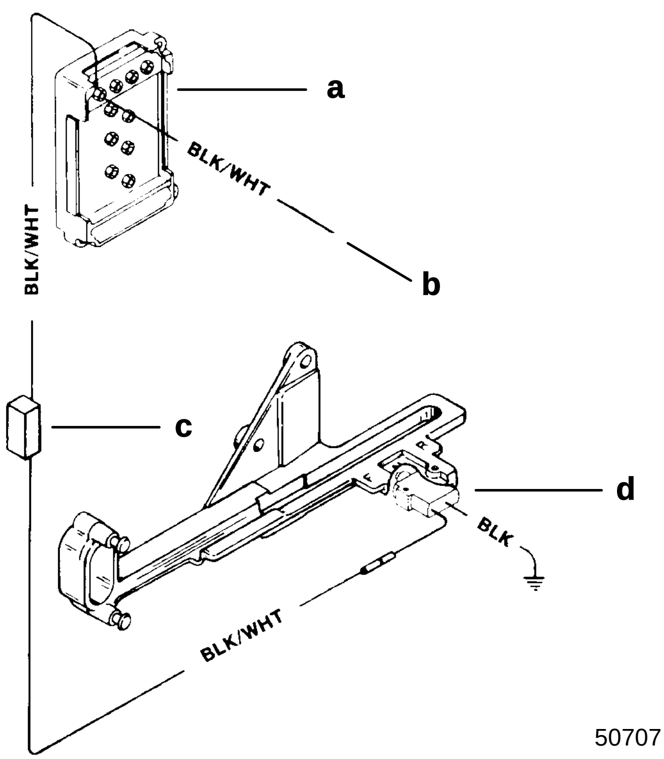
TEST FOR PROPER FUNCTION OF IDLE STABILIZER

IMPORTANT: Due to the sensitivity characteristics of individual modules and tachometer variances, the engine RPM at which the module will advance/retard the ignition timing may vary slightly from specification.

Connect a timing light to No. 1 spark plug lead (top, starboard bank). Start the engine, and allow it to idle above 600 RPM, then retard the ignition timing by slowly pulling forward on the spark advance lever. Observe that the system is functioning by noting a rapid spark advance (as much as 9° from the idle setting) as the engine slows down to below approximately 550 RPM.

The idle stabilizer is not repairable. Should the idle stabilizer fail to function as described, it will require replacement.

Idle Stabilizer Shift System (XR6 and Magnum III Models)



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a - Inner Switch Box
b - To Outer Switch Box
c - Resistor (6.8K)
d - Shift Switch

IDLE STABILIZER SHIFT SYSTEM DESCRIPTION

The idle stabilizer shift system advances ignition timing three degrees each time the outboard is shifted into gear.

The purpose of this system is to help prevent the outboard from stalling when shifting into gear while using a high pitch propeller.

IMPORTANT: On models OTHER THAN XR6 and Magnum III on which the IDLE STABILIZER SHIFT SYSTEM is installed as an ACCESSORY, the maximum timing MUST BE RETARDED three degrees. Refer to "TIMING, SYNCHRONIZING and ADJUSTING" SECTION 2C, for proper timing procedure.

TEST FOR PROPER FUNCTION OF IDLE STABILIZER SHIFT SYSTEM

Connect timing light to number one spark plug lead (top, starboard bank). Start the engine and allow it to idle at specified engine RPM. Place outboard in gear while monitoring ignition timing. Timing will advance three degrees if system is functioning correctly.

TROUBLESHOOTING IDLE STABILIZER SHIFT SYSTEM

When outboard is idling IN NEUTRAL, shift switch circuit is in the OPEN position and system is INACTIVE.

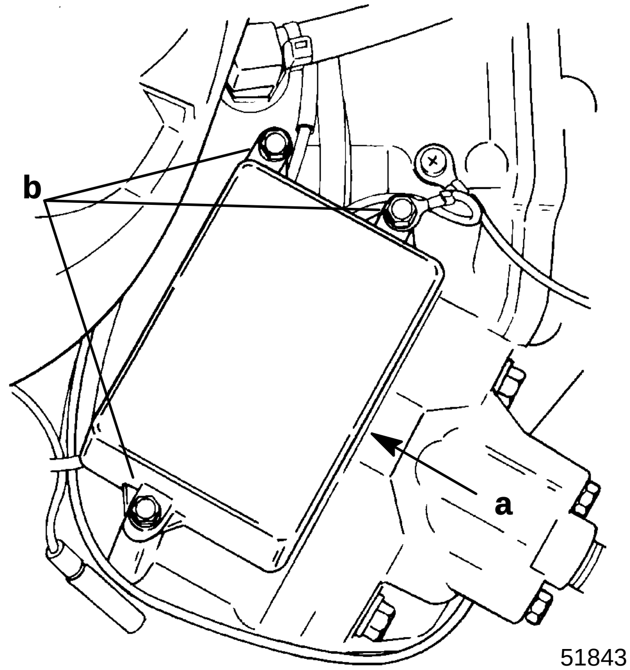
When outboard is shifted INTO GEAR, shift switch circuit CLOSES. BIAS VOLTAGE from each switch box is changed by a 6.8K (+.34K) resistor located in the WHITE/BLACK lead between the switch boxes and the shift switch. The shift switch is now CLOSED and completes the circuit to ground. THREE DEGREES of timing advance occurs when the shift system works properly.

If the resistor is OPEN or the shift switch circuit stays OPEN, the THREE DEGREES of advance will not occur when the outboard is shifted into gear AND maximum timing at W.O.T. will be RETARDED THREE DEGREES.

If the resistor should SHORT TO GROUND, engine timing will be overly advanced and damaging powerhead detonation will occur.

IDLE STABILIZER MODULE REMOVAL

1. Disconnect stabilizer module harness leads from switch box.
2. Remove bolts securing idle stabilizer to powerhead.



a - Idle Stabilizer
b - Bolts

IDLE STABILIZER MODULE INSTALLATION

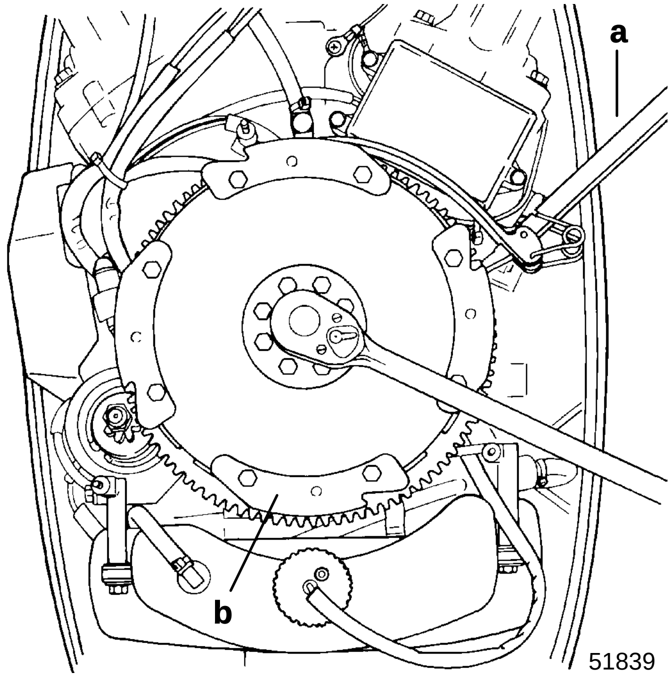
1. Connect module harness leads to switch box (Refer to wiring diagrams, section 2D).
2. Apply Loctite 222 (FT2962-2) to threads of module mounting bolts and secure module to powerhead.
3. Torque bolts to 30 Ib. in. (3.5 N m).

Ignition Components Removal and Installation

FLYWHEEL REMOVAL AND INSTALLATION

Flywheel Removal

1. Remove 3 wing nuts and lift flywheel cover off engine.
2. While holding flywheel with Flywheel Holder (91-52344), remove flywheel nut and washer.



a - Flywheel Holder (91-52344)
b - Flywheel

3. Install a crankshaft protector cap on end of crankshaft, then install Flywheel Puller (91-73687A1) into flywheel.

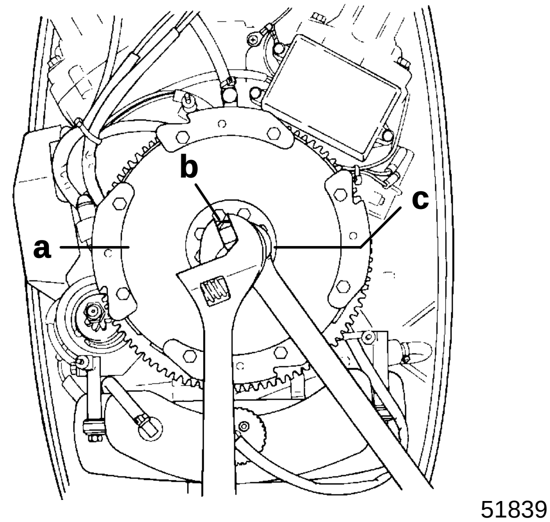
⚠ CAUTION

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

4. Remove flywheel by operating flywheel puller, as shown.

⚠ CAUTION

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

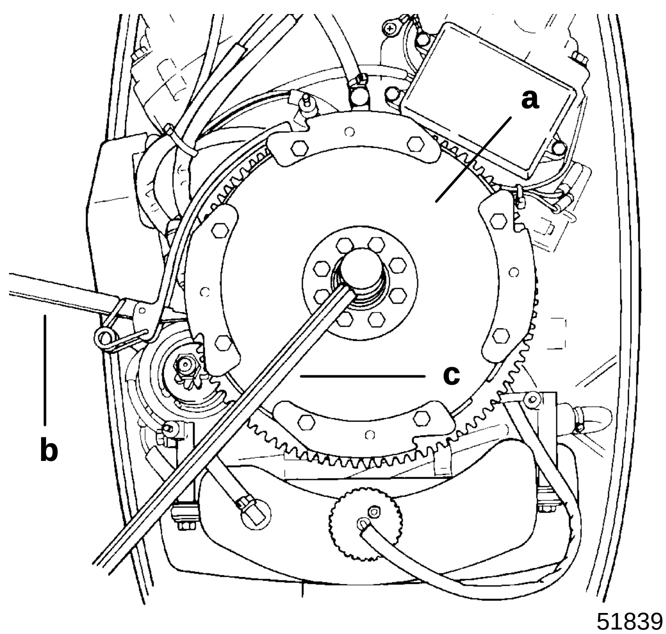


a - Flywheel
b - Flywheel Puller (91-73687A1)
c - Crankshaft Protector Cap (Hidden)

Flywheel Installation

IMPORTANT: Do not apply oil to crankshaft taper or flywheel taper as flywheel will not seat properly against crankshaft when torqued.

1. Reinstall flywheel on crankshaft. Secure flywheel with flat washer and locknut. While holding flywheel with Flywheel Holder (91-52344), torque flywheel nut to 120 lb. ft. (163.0 N m).



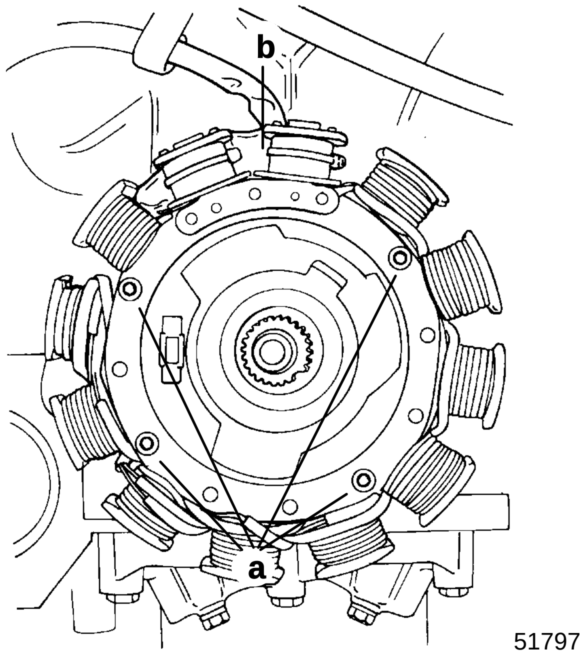
a - Flywheel
b - Flywheel Holder (91-52344)
c - Torque Wrench-Torque Nut to 120 lb. ft. (163.0 N·m)

2. Reinstall flywheel cover on engine.

STATOR ASSEMBLY REMOVAL AND INSTALLATION

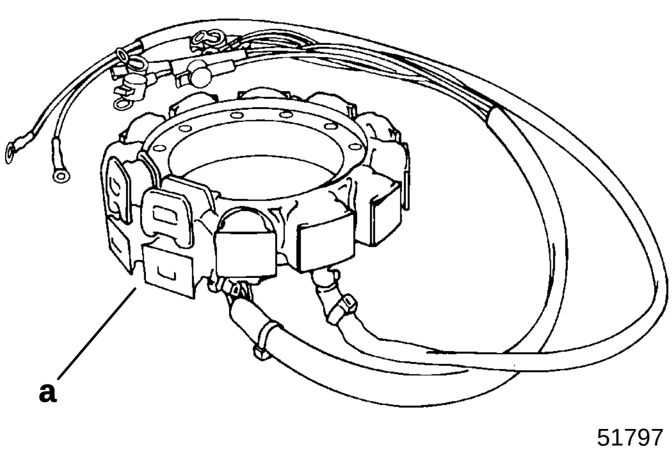
Stator Assembly Removal

1. Remove flywheel, as outlined in **"Flywheel Removal and Installation,"** preceding.
2. Remove 4 screws which secure stator to the upper end cap.



a - Stator Attaching Screws
b - Stator

3. Remove 2 screws and lift outer switch box from inner switch box. (Retain round metal spacers.)
4. Disconnect all stator leads from their respective terminals, cut sta-strap(s) and remove stator assembly from engine.



a - Stator Assembly

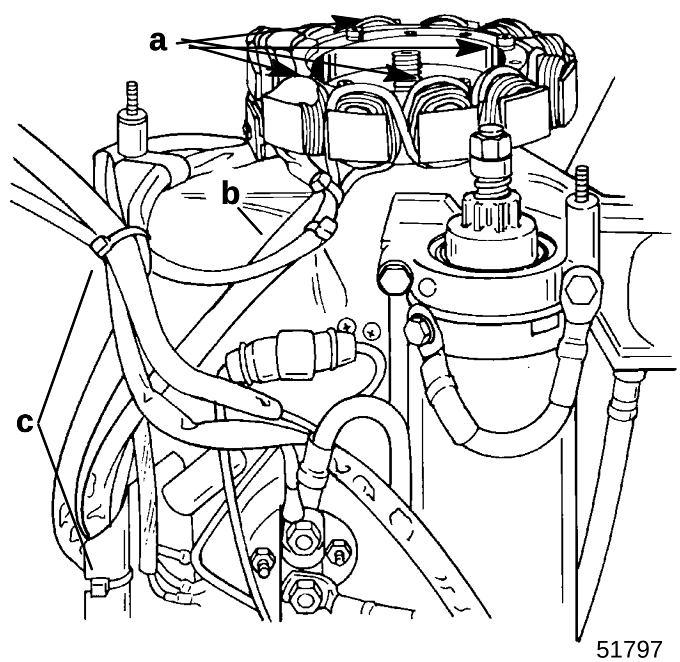
Stator Assembly Installation

1. Clean stator attaching screw threads with Loctite Primer T (92-59327--1) and apply Loctite 271 (obtain locally). Install stator assembly in position on upper end cap and secure with attaching screws. Torque screws to 50 lb. in. (5.5 N m).
2. Reconnect wires to proper terminals of voltage regulator/rectifier and switch boxes. Reconnect ground lead to ground. Refer to wiring diagram, following in this section. Wires with yellow identification sleeve must be connected to outer switch box.
3. Install switch boxes to engine with 2 screws and 2 round metal spacers. Refer to switch box(es) removal and installation (see **"Table of Contents"**). Make sure that both switch boxes are grounded to engine thru mounting screws and spacers.

⚠ CAUTION

Switch boxes must be grounded to engine before cranking engine, or switch boxes will be damaged.

4. Route stator wiring harness as shown. Secure with sta-strap and clamp.
5. Reinstall flywheel, as outlined in **"Flywheel Removal and Installation,"** preceding.

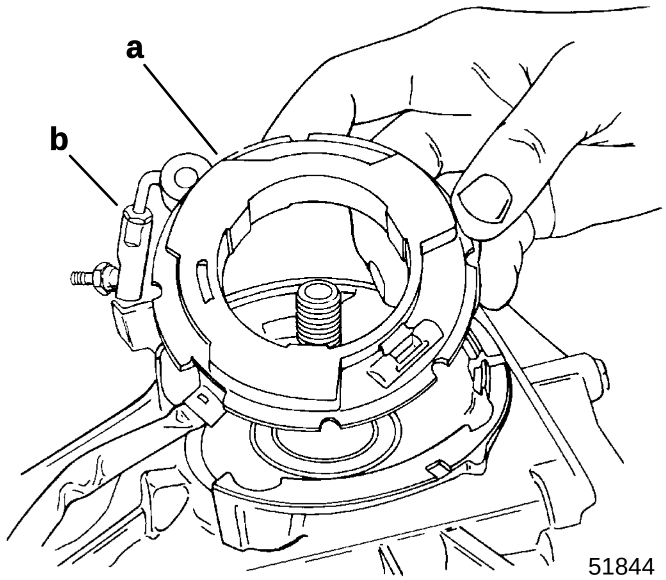


a - Stator Attaching Screws with Lock washers (4)
b - Stator Harness (Route as Shown; Wires with Yellow Sleeves Connected to Outer Switch Box)
c - Sta-Strap

TRIGGER PLATE ASSEMBLY REMOVAL AND INSTALLATION

Trigger Plate Assembly Removal

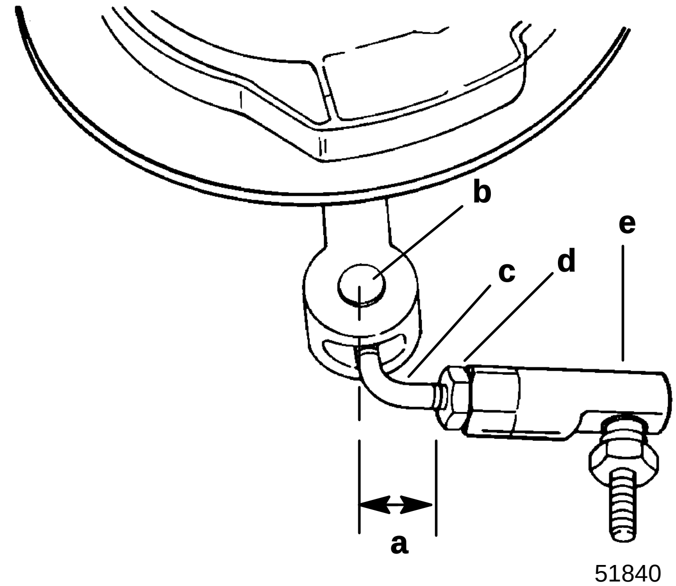
1. Remove flywheel, as outlined in **"Flywheel Removal and Installation,"** preceding.
2. Remove 4 screws which secure stator assembly to upper end cap. Lift stator off end cap and move to the side.
3. Remove locknut that secures link rod swivel into spark advance lever. Pull link rod out of lever.
4. Remove 2 screws and lift outer switch box from inner switch box. (Retain round metal spacers.)
5. Disconnect all trigger leads from their respective terminals. Cut sta-strap and remove trigger plate assembly from engine.
6. If trigger assembly is faulty, remove and retain link rod swivel from trigger.



a - Trigger
b - Link Rod Swivel

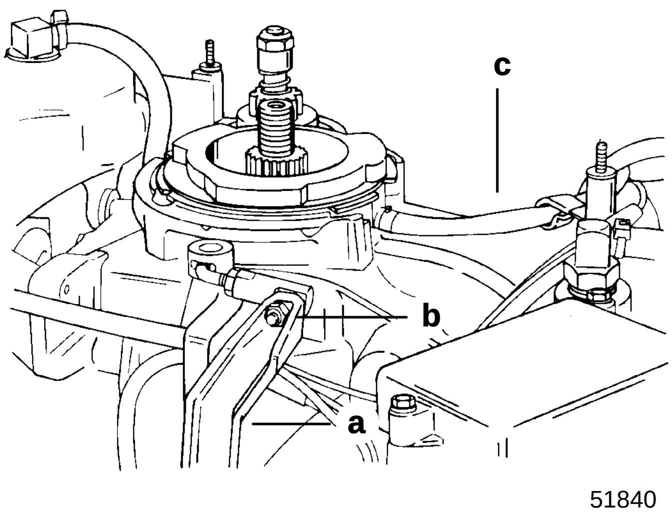
Trigger Plate Assembly Installation

1. If link rod swivel was disassembled or removed, reassemble to trigger as shown.



a - Retain This [11/16 in. (17.5 mm)] Dimension
b - Pivot
c - Link Rod
d - Hex Nut
e - Ball Joint

2. Place trigger plate assembly in upper end cap. Fasten link rod swivel to spark advance lever with locknut.



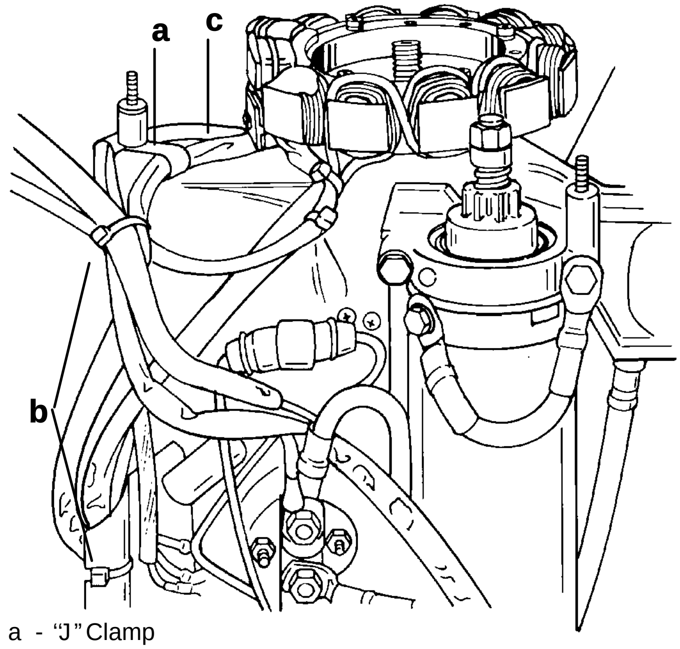
a - Spark Advance Lever
b - Locknut
c - Trigger Harness

3. Route trigger wiring harness as shown. Reconnect wires to proper terminals of switch boxes. Refer to wiring diagram, following in this section. Wires with yellow identification sleeve must be connected to outer switch box.
4. Install switch boxes to engine with 2 screws and 2 round metal spacers. Refer to switch box(es) removal and installation (see **"Table of Contents"**). Make sure that both switch boxes are grounded to engine thru mounting screws and spacers.

⚠ CAUTION

Switch boxes must be grounded to engine before cranking engine, or switch boxes will be damaged.

5. Clean stator attaching screw threads with Loctite Primer T (92-59327--1) and apply Loctite 222 (obtain locally). Install stator assembly in position on upper end cap and secure with attaching screws. Torque screws to 50 Ib. in. (5.5 N m).
6. Secure wires with sta-strap and "J" clamp.



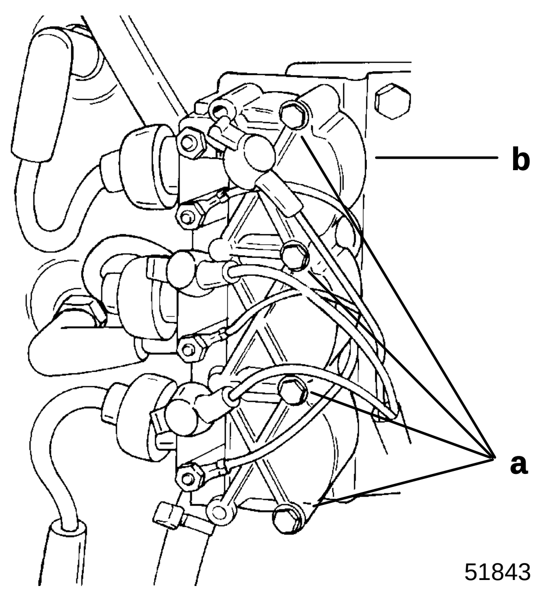
a - "J" Clamp
b - Sta-Strap
c - Trigger Wiring Harness (Routes as Shown-Wires with Yellow Sleeve Are Connected to Outer Switch Box

7. Reinstall flywheel as outlined in **"Flywheel Removal and Installation,"** preceding.

IGNITION COIL REMOVAL AND INSTALLATION

Ignition Coil Removal

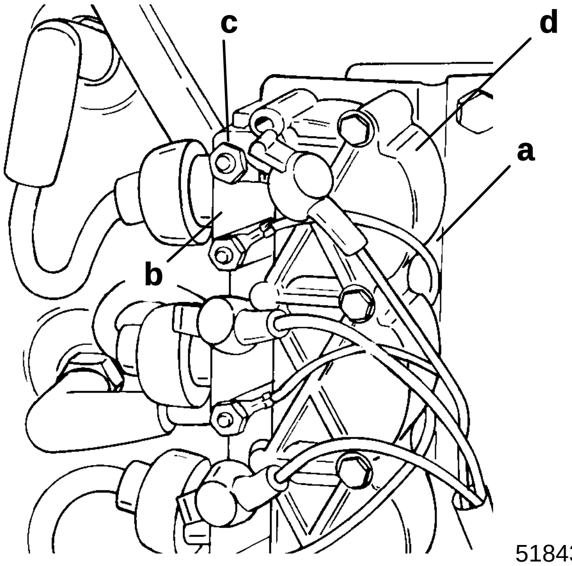
1. Remove the spark plug (high tension) lead from the defective coil.
2. Disconnect wires from (+) and (-) terminals on defective coil.
3. Remove 4 screws and nuts and lift coil cover along with coils from engine. Remove defective coil from cover.



a - Screws
b - Cover

Ignition Coil Installation

1. Place coil in coil cover and install to engine with 4 screws and nuts.



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a - Ground Wire [Between (-) Coil Terminal and Engine Ground]
b - Ignition Coil
c - (+) Coil Terminal
d - Coil Cover

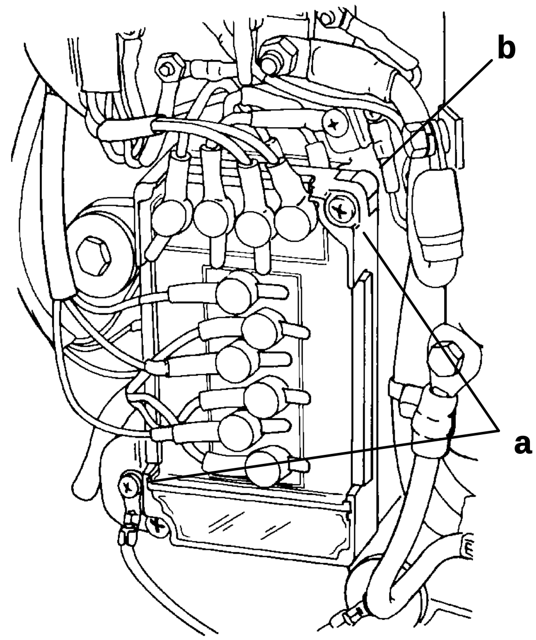
2. Reconnect switch box wire to (+) terminal of coil and black ground wire to (-) terminal.

3. Pull the boot back and insert spark plug lead into coil. Caution must be taken to ensure a complete connection of lead into coil. Form a water tight seal between coil tower and spark plug lead using Quicksilver Insulating Compound (92-41669). Assemble boot over coil terminal.

SWITCH BOX(ES) REMOVAL AND INSTALLATION

Switch Box(es) Removal

1. Remove 2 screws and lift switch boxes from engine. (Retain round metal spacers.)



51844

a - Screws
b - Spacers

2. Disconnect wires from switch boxes.

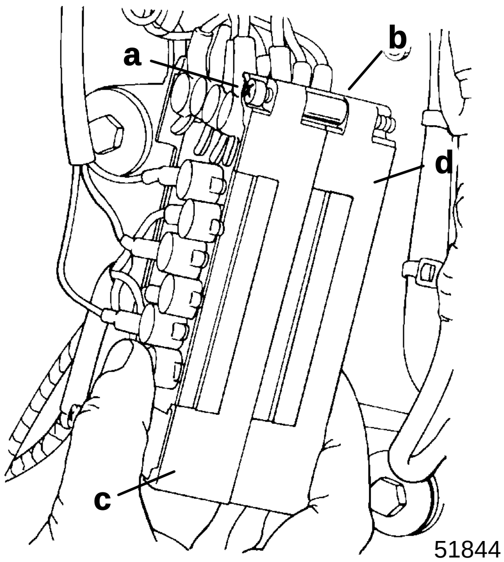
Switch Box(es) Installation

1. Reconnect wires to proper terminals of switch boxes. Secure a ground lead (if equipped) to each switch box using a screw. Refer to wiring diagram, following in this section. Wires with yellow identification sleeve must be connected to outer switch box. Outer switch box fires cylinders No. 2, 4 and 6.

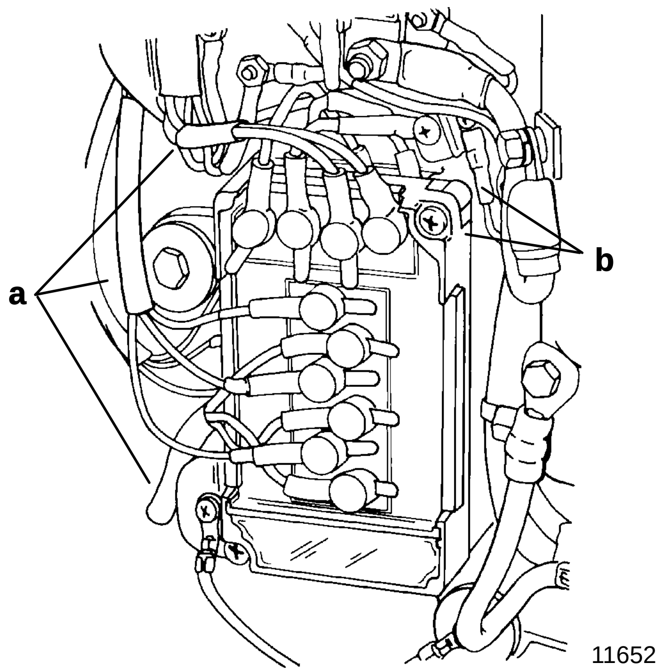
2. Install switch boxes to engine with 2 screws and 2 round metal spacers, as shown. Make sure that both switch boxes are grounded to engine thru mounting screws, spacers, and ground leads (if equipped).

⚠ CAUTION

Switch boxes must be grounded to engine before cranking engine, or switch boxes will be damaged.



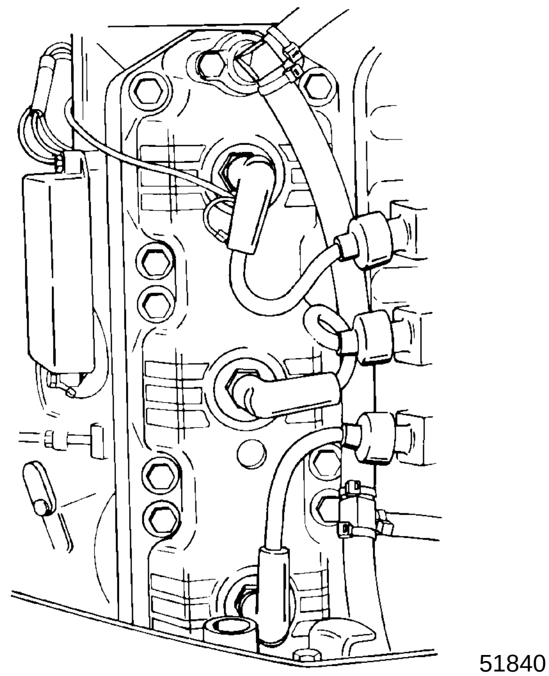
a - Switch Box Mounting Screws (2)
b - Round Metal Spacer (2)
c - Outer Switch Box
d - Inner Switch Box



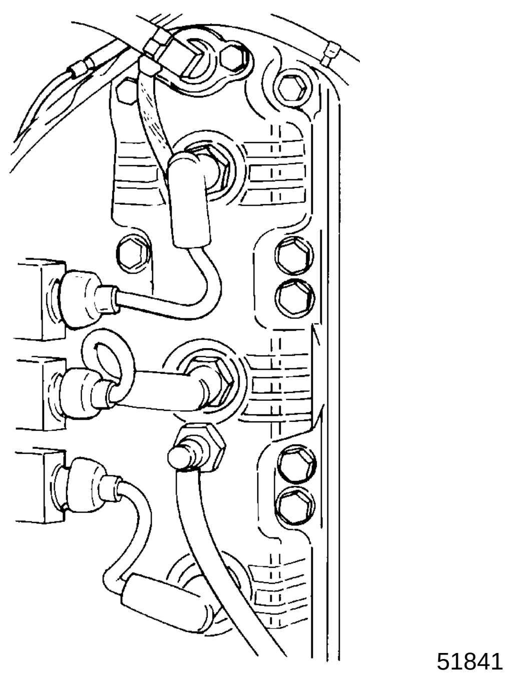
a - Wires with Yellow Sleeves Are Connected to Outer Switch Box
b - Switch Boxes MUST BE Grounded to Engine

SPARK PLUG WIRE ROUTING (PRODUCTION OUTBOARDS)

To avoid the possibility of cross-firing occurring between spark plug high tension leads, it is recommended that wiring be routed as shown:

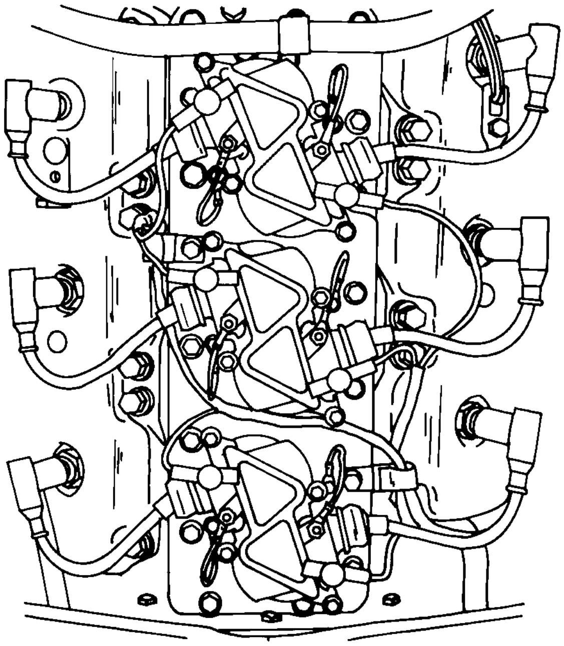


Plug Wire Routing - Port Side



Plug Wire Routing - Starboard Side

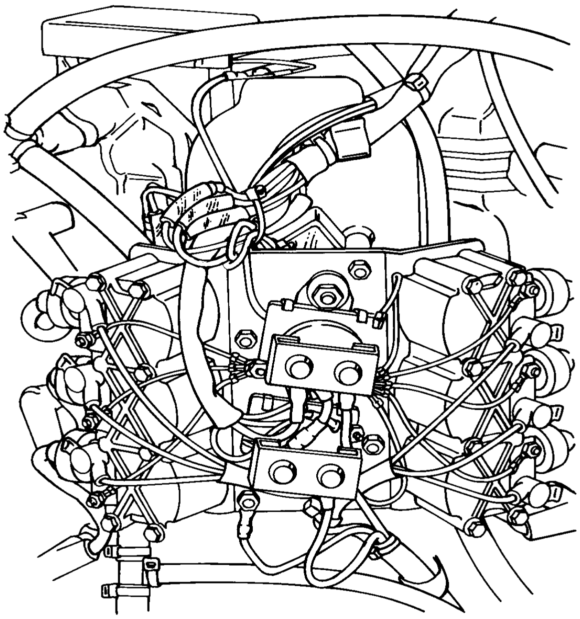
SPARK PLUG WIRE ROUTING (HIGH PERFORMANCE OUTBOARDS)



ELECTRICAL

2

B



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BATTERY CHARGING SYSTEM AND STARTING SYSTEM

Table of Contents

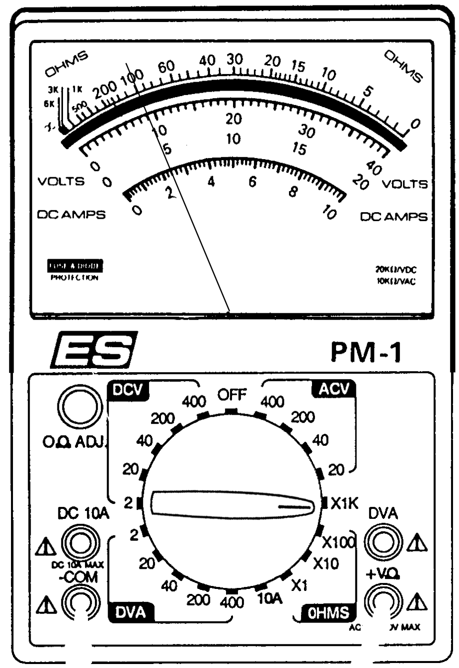
Specifications

Starter Draw (No Load)	40 Amperes
Starter Draw (Under Load)	175 Amperes
Battery Rating	630 Marine Cranking Amperes (MCA) 490 Cold Cranking Amperes (CCA)
Alternator Output (@ each regulator – 19-21 amperes)	38-42 Amperes Net @ 5000 RPM
Voltage Regulator Draw with Ignition Key in the OFF Position	2 – 10 Milliamperes EACH*. Total system draw: 4 – 20 Milliamperes.

NOTE: *Due to the fact that the voltage regulators draw voltage when the ignition key is in the OFF position, a noticable spark will occur when the battery cables are attached to the boat battery.*

Special Tools

Multi-Meter DVA Tester 91-99750



Hydrometer (obtain locally)

Ammeter (obtain locally)

Battery

Precautions

WARNING

If battery acid comes in contact with skin or eyes, wash skin immediately with a mild soap. Flush eyes with water immediately and see a doctor.

When charging batteries, an explosive gas mixture forms in each cell. Part of this gas escapes through holes in vent plugs and may form an explosive atmosphere around battery if ventilation is poor. This explosive gas may remain in or around battery for several hours after it has been charged. Sparks or flames can ignite this gas and cause an internal explosion which may shatter the battery.

The following precautions should be observed to prevent an explosion.

1. DO NOT smoke near batteries being charged or which have been charged very recently.
2. DO NOT break live circuits at terminals of batteries because a spark usually occurs at the point where a live circuit is broken. Always be careful when connecting or disconnecting cable clamps on chargers. Poor connections are a common cause of electrical arcs which cause explosions.
3. DO NOT reverse polarity of battery terminal to cable connections.

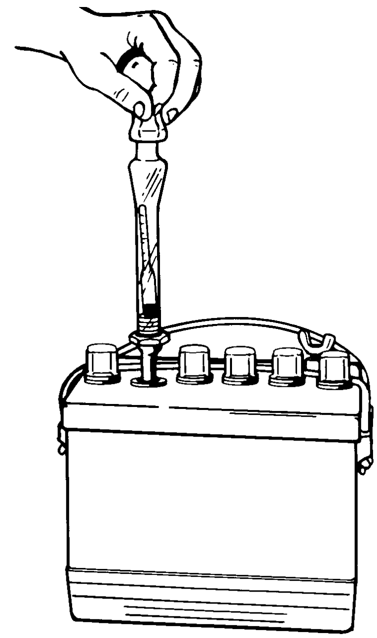
Specific Gravity Readings

Use a hydrometer to measure specific gravity of electrolyte in each cell.

Hydrometer measures percentage of sulfuric acid in battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. An indication of concentration of electrolyte is obtained with a hydrometer.

When using a hydrometer, observe the following points:

1. Hydrometer must be clean (inside and out) to insure an accurate reading.
2. Never take hydrometer readings immediately after water has been added. Water must be thoroughly mixed with electrolyte by charging for at least 15 minutes at a rate high enough to cause vigorous gassing.
3. If hydrometer has built-in thermometer, draw liquid in several times to ensure correct temperature before taking reading.
4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free-floating. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard curvature where liquid rises against float stem due to capillarity.



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5. Avoid dropping electrolyte on boat or clothing, as it is extremely corrosive. Wash off immediately with baking soda solution.

Specific gravity of electrolyte varies not only with percentage of acid in liquid but also with temperature. As temperature increases, electrolyte expands, so that specific gravity is reduced. As temperature drops, electrolyte contracts, so that specific gravity increases. Unless these variations in specific gravity are taken into account, specific gravity obtained by hydrometer may not give a true indication of acid in electrolyte.

A fully charged battery will have a specific gravity reading of approximately 1.270 at an electrolyte temperature of 80° F (27° C). If electrolyte temperature is above or below 80° F, additions or subtractions must be made in order to obtain a hydrometer reading corrected to 80° F standard. For every 10° F (3.3° C) above 80° F, add 4 specific gravity points (.004) to hydrometer reading. Example: A hydrometer reading of 1.260 at 110° F (43° C) would be 1.272 corrected to 80° F, indicating a fully charged battery.

For every 10° below 80° F, subtract 4 points (.004) from the reading. Example: A hydrometer reading of 1.272 at 0° F (-18° C) would be 1.240 corrected to 80° F, indicating a partially charged battery.

Specific Gravity Cell Comparison Test

This test may be used when an instrumental tester is not available. To perform this test, measure specific gravity of each cell, regardless of state of charge, and interpret results as follows: If specific gravity readings show a difference between highest and lowest cell of .050 (50 points) or more, battery is defective and should be replaced.

Electrolyte Level

Check electrolyte level in battery regularly. A battery in use in hot weather should be checked more frequently because of more rapid loss of water. If electrolyte level is found to be low, then distilled water should be added to each cell until liquid level rises approx. 3/16 in. (4.8mm) over plate. DO NOT OVERFILL, because this will cause loss of electrolyte and result in poor performance, short life and excessive corrosion.

⚠ CAUTION

During service, only distilled water should be added to the battery, not electrolyte.

Liquid level in cells should never be allowed to drop below top of plates, as portion of plates exposed to air may be permanently damaged with a resulting loss in performance.

Charging a Discharged Battery

The following basic rules apply to any battery charging situation:

1. Any battery may be charged at any rate (in amperes) or as long as spewing of electrolyte (from violent gassing) does not occur and for as long as electrolyte temperature does not exceed 125° F (52° C). If spewing of electrolyte occurs, or if electrolyte temperature exceeds 125° F, charging rate (in amperes) must be reduced or temporarily halted to avoid damage to the battery.
2. Battery is fully charged when, over a 2-hour period at a low charging rate (in amperes), all cells are gassing freely (not spewing liquid electrolyte), and no change in specific gravity occurs. Full charge specific gravity is 1.260-1.275, corrected for electrolyte temperature with electrolyte level at 3/16 in. (4.8mm) over plate, unless electrolyte loss has occurred (from age or over-filling) in which case specific gravity reading will be lower. For most satisfactory charging, lower charging rates in amperes are recommended.
3. If, after prolonged charging, specific gravity of at least 1.230 on all cells cannot be reached, battery is not in optimum condition and will not provide optimum performance; however, it may continue to provide additional service, if it has performed satisfactorily in the past.
4. To check battery voltage while cranking engine with electric starting motor, place RED (+) lead of tester on POSITIVE (+) battery terminal and BLACK (-) lead of tester on NEGATIVE (-) battery terminal. If the voltage drops below 9-1/2 volts while cranking, the battery is weak and should be recharged or replaced.

Winter Storage of Batteries

Battery companies are not responsible for battery damage either in winter storage or in dealer stock if the following instructions are not observed:

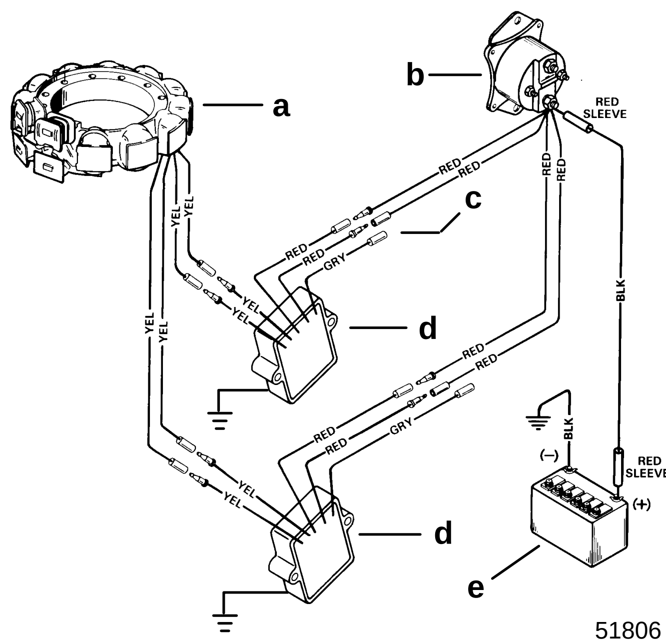
1. Remove battery from its installation as soon as possible and remove all grease, sulfate and dirt from top surface by running water over top of battery. Be sure, however, that vent caps are tight beforehand, and blow off all excess water thoroughly with compressed air. Check water level, making sure that plates are covered.
2. When adding distilled water to battery, be extremely careful not to fill more than 3/16 in. (4.8mm) above perforated baffles inside battery. Battery solution or electrolyte expands from heat caused by charging. Overfilling battery will cause electrolyte to overflow (if filled beyond 3/16 in. above baffles).
3. Grease terminal bolts well with 2-4-C Marine Lubricant and store battery in a COOL-DRY place. Remove battery from storage every 30-45 days, check water level and put on charge for 5 or 6 hours at 6 amperes. DO NOT FAST CHARGE.
4. If specific gravity drops below 1.240, check battery for reason and recharge. When gravity reaches 1.260, discontinue charging. To check specific gravity, use a hydrometer, which can be purchased locally.
5. Repeat preceding charging procedure every 30-45 days, as long as battery is in storage, for best possible maintenance during inactive periods to ensure a good serviceable battery in spring. When ready to place battery back in service, remove excess grease from terminals (a small amount is desirable on terminals at all times), recharge again as necessary and reinstall battery.

⚠ WARNING

Hydrogen and oxygen gases are produced during normal battery operation or charging. Sparks or flame can cause this mixture to ignite and explode, if they are brought near the vent openings. Sulfuric acid in battery can cause serious burns, if spilled on skin or in eyes. Flush or wash away immediately with clear water.

Battery Charging System Description

The battery charging system components are the flywheel permanent magnets, stator, voltage regulator/rectifier and battery. The rotating permanent magnets induce an alternating current (AC) in the stator coils. The AC current is rectified to direct current (DC) by the voltage regulator/rectifier. The DC output from the voltage regulator/rectifier is used to charge the battery. The voltage regulator/rectifier also senses the battery voltage as a measure of the battery's state of charge and thereby regulates the DC current flow to the battery. In this manner, the battery charge is maintained and the battery is protected from an overcharge condition.



a - 40 Ampere Stator
b - Starter Solenoid
c - To Tachometer
d - Voltage Regulator
e - 12 Volt Battery

Battery Charging System Troubleshooting

General Troubleshooting

A fault in the battery charging system will usually cause the battery to become UNDERCHARGED. A defective VOLTAGE REGULATOR may also allow the system to OVERCHARGE the battery.

If a problem exists in the charging system, visually check the following:

1. Check for correct battery polarity [RED cable to (+) POSITIVE battery terminal].

NOTE: *40 AMP CHARGING SYSTEM voltage regulator/rectifier is protected internally against incorrectly installed battery cables.*

2. Check for loose or corroded battery terminals.
3. Check condition of the battery.
4. Visually inspect all wiring between stator and battery for cuts, chafing and disconnected, loose or corroded connections.
5. Excessive electrical load (from too many accessories) will cause battery to run down, even if the system is operating correctly.

If the system is still OVERCHARGING the battery, the VOLTAGE REGULATOR is most likely defective and should be replaced.

If the battery is UNDERCHARGED, proceed with REGULATOR, STATOR, and RECTIFIER tests, following.

40 Ampere Alternator System

40 AMP STATOR TEST (ALTERNATOR COILS ONLY)

NOTE: *Stator can be tested without removing from engine.*

1. Disconnect 2 short YELLOW and 2 long YELLOW stator leads from bullet connectors at rear of engine above ignition coil plate.
2. Use an ohmmeter and perform the following test:

Test Leads To-	Resistance (Ohms)	Scale Reading
Connect test leads between 2 short YELLOW and 2 long YELLOW stator leads	.25-.45*	R x 1
RED test lead to 1 short YELLOW (or long YELLOW) stator lead, and BLACK test lead to engine ground if stator is mounted or to steel frame of stator (if off engine)	No Continuity	R x 1000

***** Resistance of these windings generally is less than one ohm. A reading, that resembles a short, is acceptable. Copper wire is an excellent conductor but will have noticeable differences from cold to hot. Reasonable variation from specified reading is acceptable.

3. If meter readings are other than specified, replace stator assembly Refer to stator assembly replacement in Section 2A.

TROUBLESHOOTING 40 AMP ALTERNATOR SYSTEM

⚠ WARNING

Before connecting or disconnecting any electrical connection, battery cables MUST BE REMOVED from battery to prevent possible personal injury or damage to equipment.

IMPORTANT: The charging system may be connected to one or more batteries during these tests. However, these batteries MUST BE fully charged. These batteries MUST NOT BE connected to any other charging source.

IMPORTANT: Check that all connections are tight prior to starting tests. Ensure that the battery posts and terminals are clean and making good contact. Verify with test equipment that wiring harnesses are not at fault.

DETERMINING CAUSE OF PROBLEM

1. Connect outboard battery leads to battery(s) that are known to be in good condition and are fully charged.
2. Check voltage at battery(s) with an analog voltmeter. Digital voltmeters are not recommended as they may be inaccurate due to interference from outboard ignition system.
3. Start outboard and run at 1000 RPM. Voltage at battery should rise to and stabilize at approximately 14.5 volts if system is operating properly. If voltage does not increase from previously checked battery voltage values, refer to **"NO OUTPUT,"** following, for troubleshooting procedures. If voltage exceeds 16 volts and DOES NOT return down to and stabilize at 14.5 volts, refer to **"CONSTANT HIGH OUTPUT,"** following for troubleshooting procedures.

PROBLEM: CONSTANT HIGH OUTPUT

1. Remove flywheel and visually inspect stator. Discoloration of one or more poles, or burned windings will require replacement of stator.
2. If no visual defects of stator are found, reinstall fly- wheel. Temporarily install ammeter (of sufficient size to carry 50 amperes) in series with the RED output lead (MALE bullet lead) of the regulator and the starter solenoid.
3. Remove 1 short and 2 long YELLOW stator leads from their bullet connectors. Run engine at 1000-2000 RPM. If no output current is observed, disconnect 2 short YELLOW leads and 1 long YELLOW lead. Repeat the test with the second long YELLOW lead connected. Any output current indicates stator is shorted to ground. Replace stator.
4. If there is no output with either short or long YELLOW leads disconnected, the regulators are defective.

PROBLEM: NO OUTPUT

IMPORTANT: Regulators MUST have a good ground. Verify a clean contact surface exists between regulator case, powerhead and attaching hardware.

1. Check voltage on either RED wire to regulator(s) (bullet connectors). These leads must indicate battery voltage. If battery voltage is NOT present, wiring between the test point and battery terminals is defective. Refer to WIRING DIAGRAMS, SECTION 2D.
2. Connect an AC voltmeter to either the 2 short or 2 long YELLOW lead bullet connectors on the regulators. If the AC voltage at idle or above is greater than 16 VAC, the regulator is defective.

NOTE: *The tachometer signal is provided by either regulator. It is possible to still have an accurate tachometer signal with a defective regulator.*

REGULATION VOLTAGE CHECK

NOTE: *Battery must be fully charged before testing regulation voltage. A low battery will not allow an accurate reading of regulation voltage.*

1. Turn on all electrical accessories and crank engine for 20 seconds with the ignition lanyard switch turned off. This will discharge battery slightly.
2. Start engine and observe battery voltage. Voltage should slowly rise to approximately 14 to 15 volts. If voltage does not rise, repeat previous tests for stator and regulator.

NOTE: *If a digital voltmeter is used for this reading, measure voltage at the battery and keep meter as far away from engine as possible. This will reduce the possibility of erroneous readings from ignition noise.*

VOLTAGE REGULATOR TEST (USING OHM METER)

IMPORTANT: Make sure meter is "zeroed" by shorting meter leads together after changing selector knob to appropriate setting. The meter reading must read "0" Ohms.

IMPORTANT: The following regulator tests should be performed as soon as possible after suspected regulator failure. A "cold" regulator may test "GOOD" when in fact it is defective when "warm".

Disconnect all voltage regulator wires.

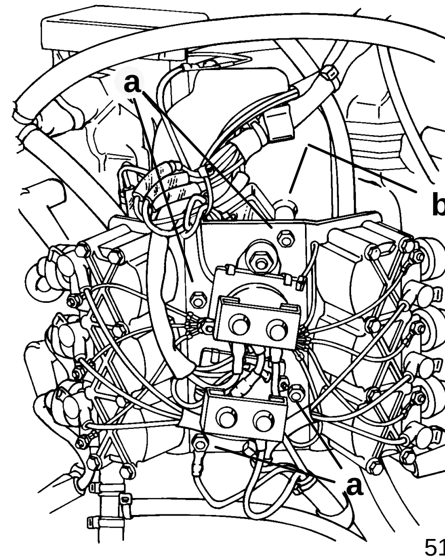
Using Ohm meter, perform each Ohms test listed below:

Test Leads To-	Resistance (Ohms)	Scale
Diode Check: Connect NEGATIVE (–) ohm lead to either YELLOW lead. Connect POSITIVE (+) test lead to thick RED lead.	100-400	R x 10
Diode Check: Connect NEGATIVE (–) ohm lead to thick RED lead. Connect POSITIVE (+) ohm lead to either YELLOW lead.	40K to ∞	R x 1K
SCR Checks: Connect NEGATIVE (–) ohm lead to either YELLOW lead. Connect POSITIVE (+) ohm lead to case ground.	10K to ∞	R x 1K
Tachometer Circuit Check: Connect NEGATIVE (–) ohm lead to case ground. Connect POSITIVE (+) ohm lead to GRAY lead.	10K to 30K	R x 1K

REMOVAL OF VOLTAGE REGULATORS

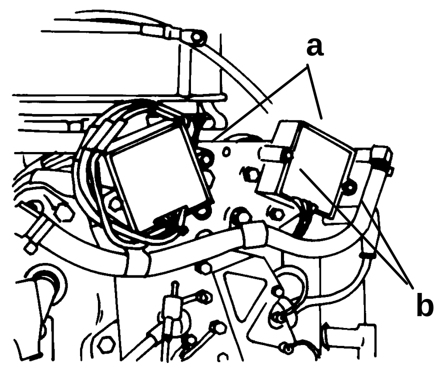
1. Remove 4 locknuts and spacers from coil mounting plate. Lay coil mounting plate off to one side.

Production Models –



a - 4 Locknuts
b - 4 Spacers (HIDDEN)

Pro Max/Super Magnum Models –



a - Regulators
b - Screws

2. Disconnect 2 YELLOW leads, 2 RED leads and GRAY tach lead (if connected) from respective bullet connectors.
3. Remove voltage regulator/rectifier from powerhead.

INSTALLATION OF VOLTAGE REGULATOR/RECTIFIER

1. Position regulators over attaching studs (production models).
2. Connect YELLOW, RED and GRAY (as required) leads to their respective bullet connectors.
3. Position spacers over attaching studs (production models).

__NOTE:__ Pro Max/Super Magnum regulators are secured to powerhead with bolts and lock nuts.

4. Position coil/solenoid plate over attaching studs. Place trim ground lead (BLACK) onto bottom stud.
5. Secure plate, regulators and trim ground lead to powerhead with locknuts. Torque nuts to 80 lb. in. (9.0 N·m).

INCORPORATING A BATTERY ISOLATOR WITH V-6 40 AMP CHARGING SYSTEM

A battery isolator will allow the charging system to charge both the starting battery and an auxiliary battery at the same time while preventing accessories, connected to the auxiliary battery, from drawing power from the cranking battery.

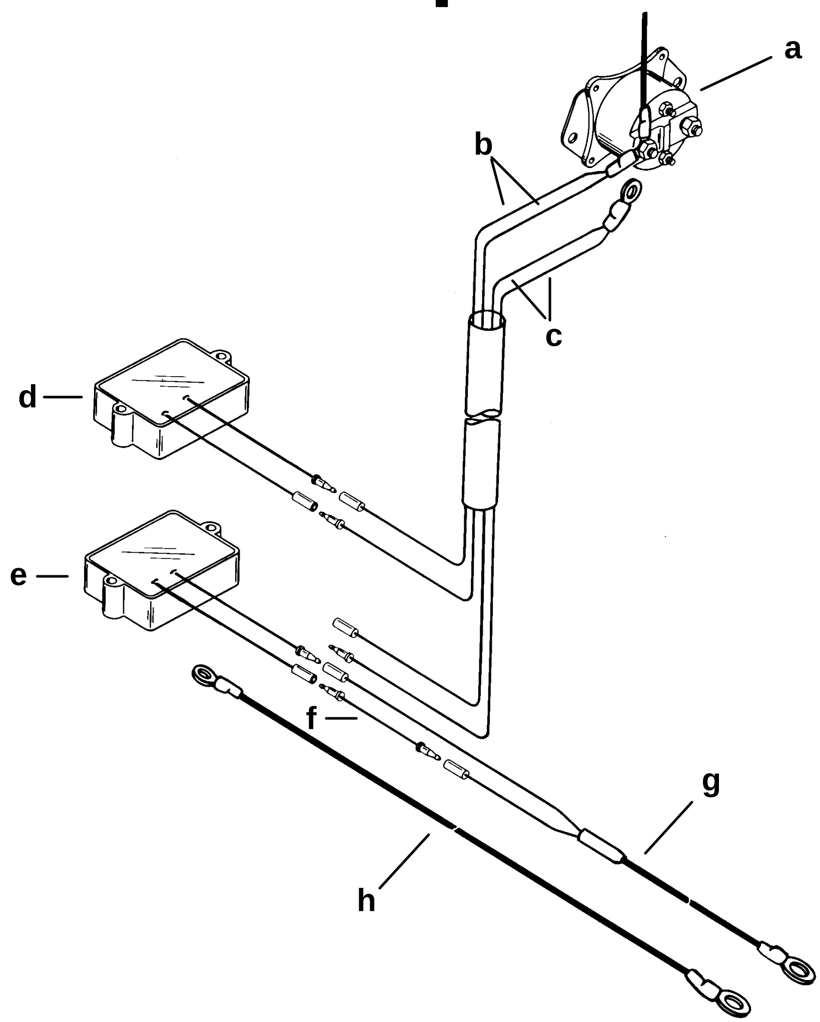
1. Install the isolator as prescribed by the manufacturer.

IMPORTANT: After electrical connections are made, coat all terminal connections using Quicksilver Liquid Neoprene (92-25711) to avoid corrosion.

2. Using **BATTERY ISOLATOR HARNESS KIT 84-815366A3**, charging system can be wired to provide either 20 amps to auxiliary battery and 20 amps to cranking battery or 40 amps to isolator.

System Wired for Split Output

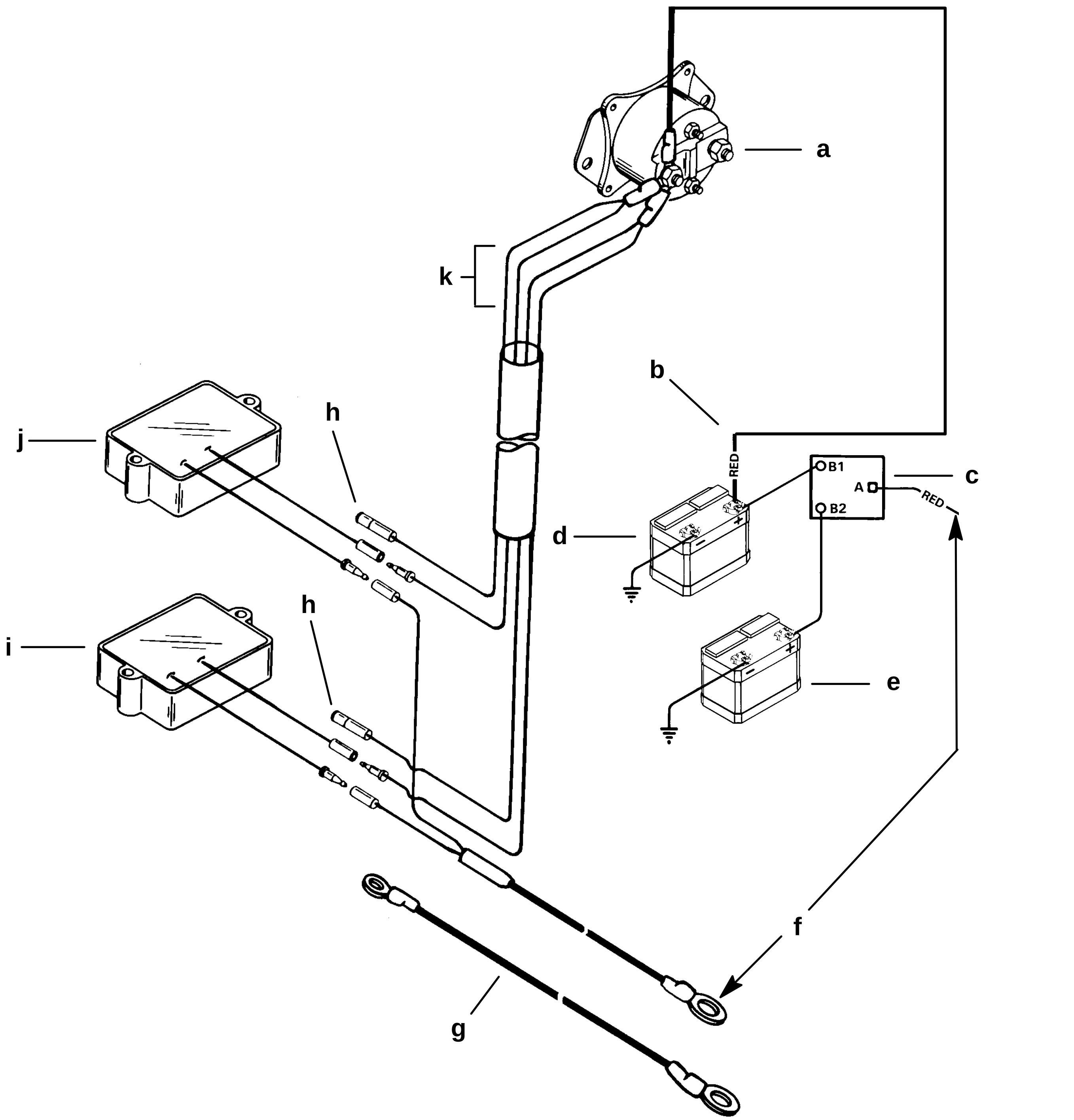
20 AMPERES TO AUXILIARY BATTERY; 20 AMPERES TO CRANKING BATTERY



a - Starter Solenoid
b - RED Leads – Engine Harness from Upper Regulator to Start Solenoid
c - Disconnect (and discard) Engine Harness RED Leads to Lower Regulator
d - Upper Regulator
e - Lower Regulator
f - Jumper Wire (from kit)
g - RED Pigtail Cable (from kit) to Auxiliary Battery "+" Terminal
h - BLACK Cable (from kit) Route from Auxiliary Battery "–" Terminal to suitable Engine Ground

System Wired for 40 Ampere Output to Isolator

IMPORTANT: After electrical connections are made, coat all terminal connections using Quicksilver Liquid Neoprene (92-25711) to avoid corrosion.



a - Starter Solenoid
b - RED Lead to Starter Solenoid
c - Battery Isolator
d - Start Battery
e - Auxiliary Battery
f - RED pigtail Cable (from kit) to Battery Isolator
g - BLACK Cable (from kit) route from Auxiliary Battery "–" Terminal to Engine Ground
h - Plug (from kit)
i - Lower Regulator
j - Upper Regulator
k - RED Leads – Engine Harness from Regulators to Starter Solenoid

Starter System

STARTER SYSTEM COMPONENTS

1. Battery
2. Starter Solenoid
3. Neutral Start Switch
4. Starter Motor
5. Ignition Switch

DESCRIPTION

The function of the starting system is to crank the engine. The battery supplies electricity to activate the starter motor. When the ignition switch is turned to the "START" position, the starter solenoid is energized and completes the starter circuit between the battery and starter.

The neutral start switch opens the starter circuit when the shift control lever is not in neutral thus preventing accidental starting when the engine is in gear.

⚠ CAUTION

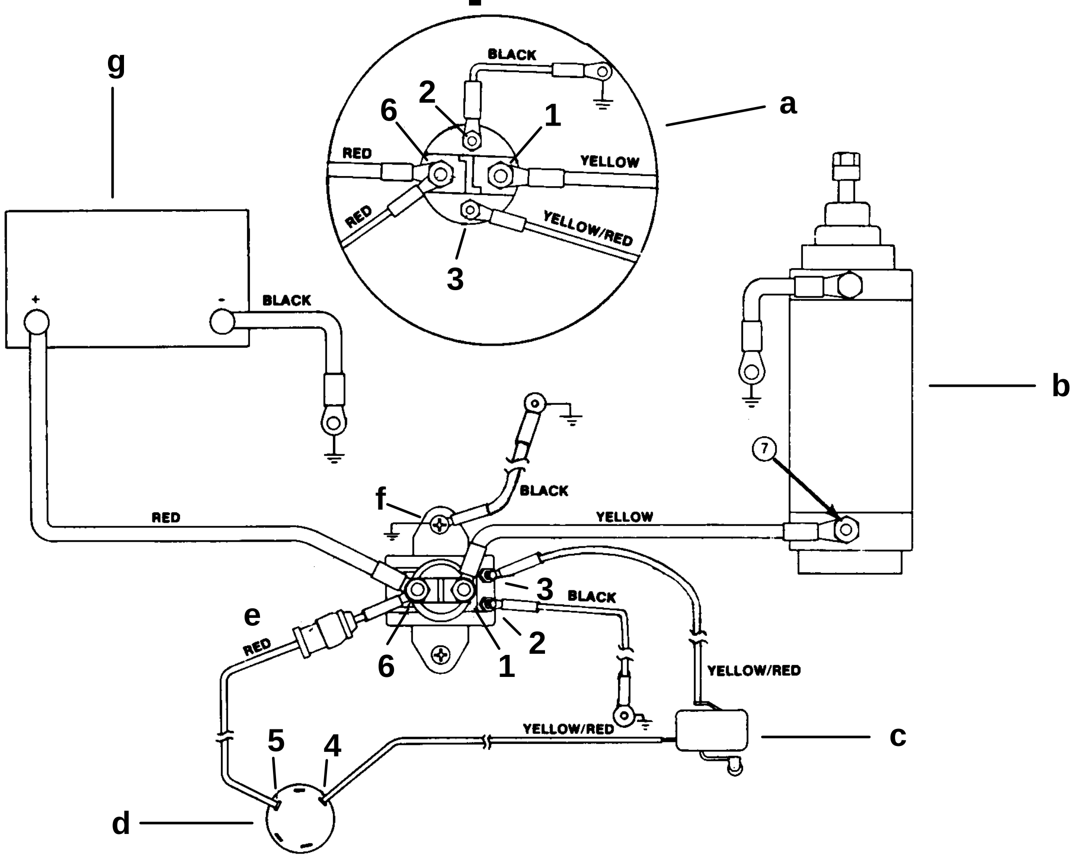
The starter motor may be damaged if operated continuously. DO NOT operate continuously for more than 30 seconds. Allow a 2 minute cooling period between starting attempts.

TROUBLESHOOTING THE STARTER CIRCUIT

Before beginning the troubleshooting flow chart, verify the following conditions:

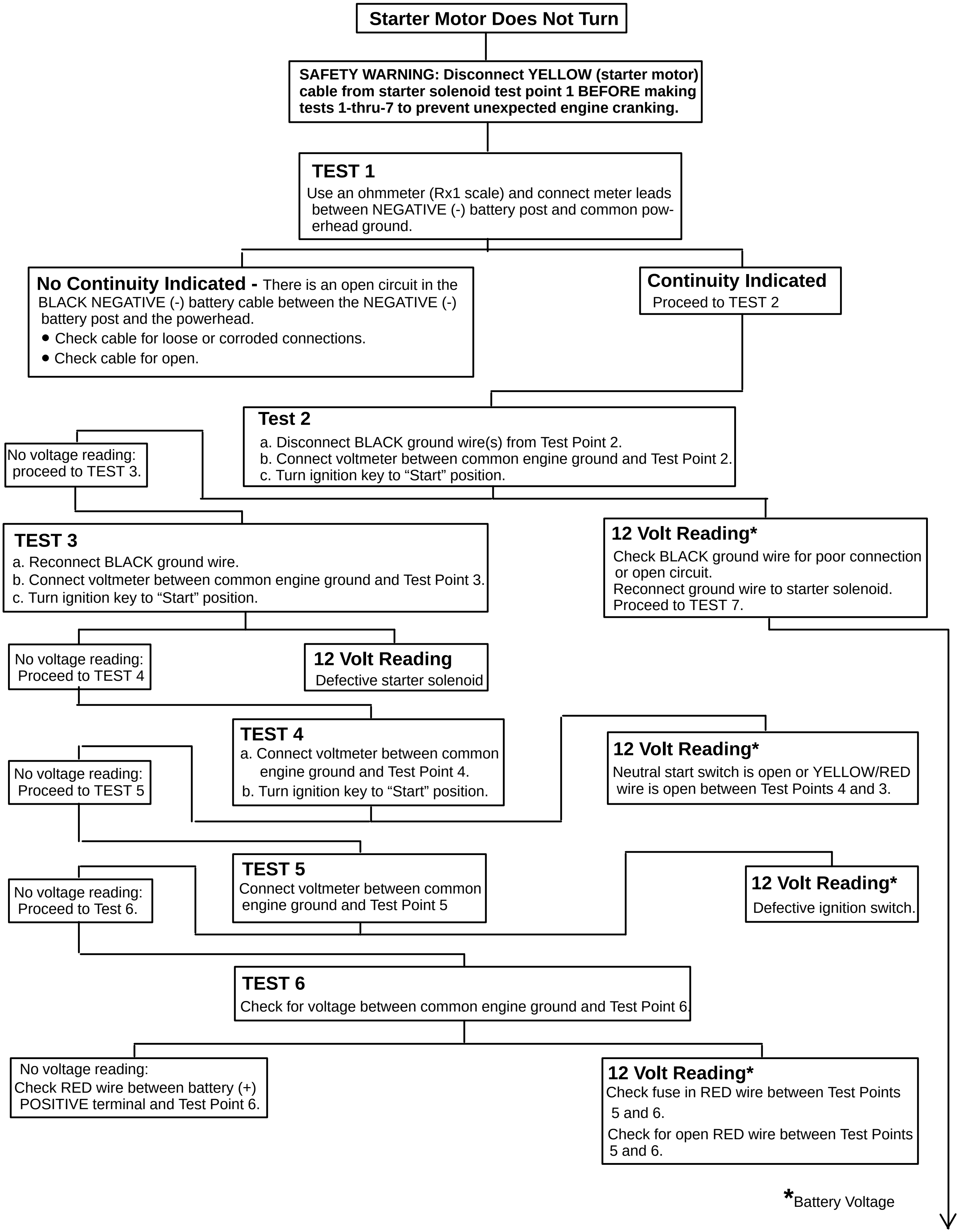
1. Confirm that battery is fully charged.
2. Check that control lever is in "NEUTRAL" position.
3. Check terminals for corrosion and loose connections.
4. Check cables and wiring for frayed and worn insulation.
5. Check 20 amp fuse.

Location of "Test Points" (called out in flow chart) are numbered below.



a - Starter Solenoid (89-68258)
b - Starter
c - Neutral Start Switch
d - Ignition Switch
e - 20 Ampere Fuse
f - Starter Solenoid (89-96054)
g - Battery

Starter Circuit Troubleshooting Flow Chart



TEST 7
a. Connect voltmeter between common engine and Test Point 1.
b. Turn ignition key to "Start" position.

No voltage reading:
Defective starter solenoid

12 Volt Reading*
Should hear solenoid click: proceed to TEST 8

TEST 8
a. Reconnect BLACK cable (with YELLOW sleeve) to starter solenoid Test Point 1.
b. Connect voltmeter between common engine ground and Test Point 7.
c. Turn ignition key to "Start" position.

No voltage reading:
Check BLACK cable (with YELLOW sleeve) for poor connection or open circuit.

12 Volt Reading*
If starter motor does not turn, check starter motor.

*Battery Voltage

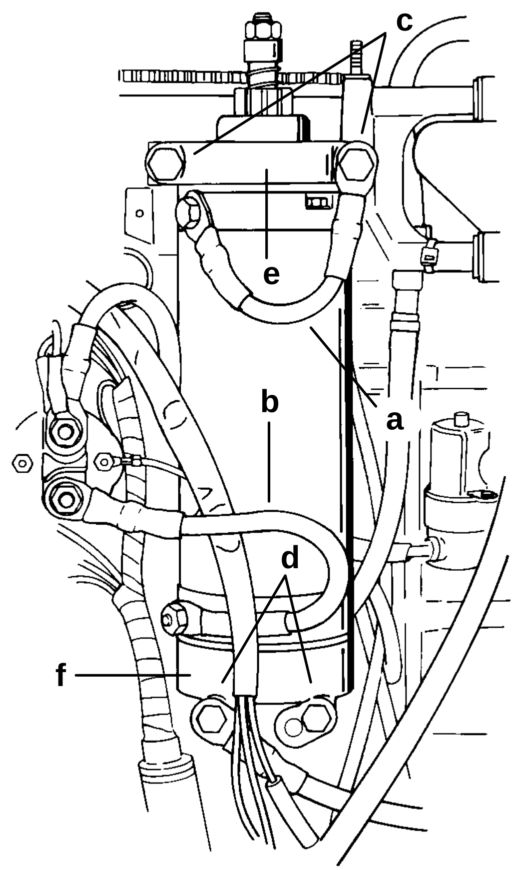
Starter Removal and Installation

REMOVAL

⚠ CAUTION

Disconnect battery leads from battery before removing starter.

1. Disconnect BLACK ground cable from starter.
2. Disconnect BLACK (with YELLOW sleeve) cable from starter.
3. Remove 4 bolts and upper and lower starter clamps. Lift starter from engine.

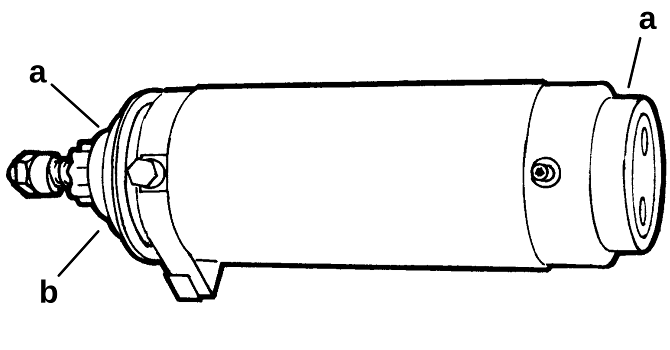


51840

a - BLACK Ground Cable
b - BLACK (with YELLOW sleeve) POSITIVE (+) 12-Volt Cable
c - Upper Mounting Bolts
d - Lower Mounting Bolt
e - Upper Clamp
f - Lower clamp

INSTALLATION

1. Slide rubber collars on starter.
2. If the removed starter was equipped with a spacer replace spacer on upper collar.

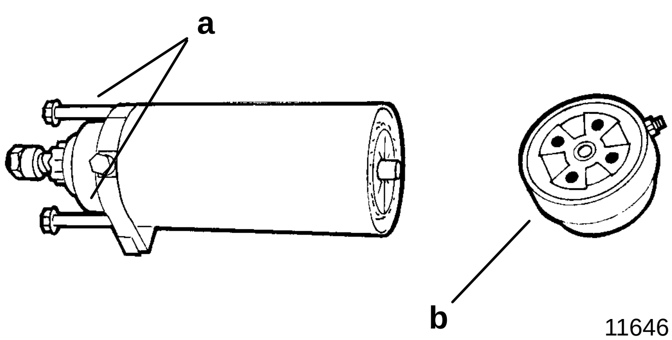


a - Rubber Collar
b - Spacer (If Equipped)

3. Install starter to engine with starter clamps. Make sure that black ground cable is fastened, along with lower mounting bolts. Torque bolts to 210 lb. in. (23.5 N·m).
4. Reconnect yellow cable to positive (+) terminal on starter.
5. Reconnect black ground cable to terminal on starter.

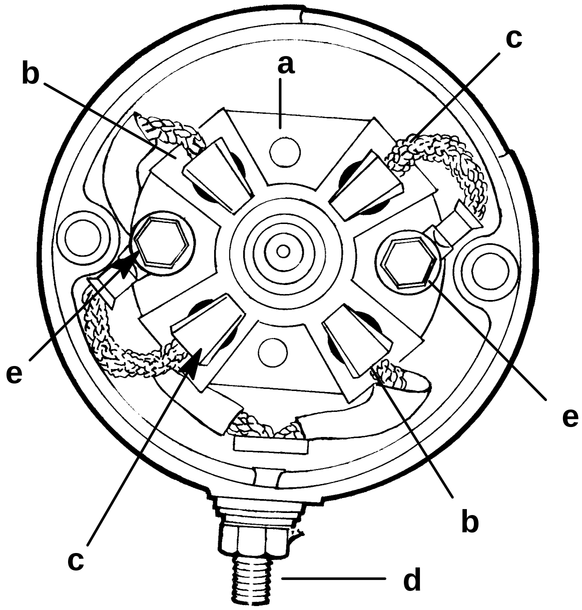
DISASSEMBLY

1. Remove starter as outlined in **"Starter Removal and Installation"**.
2. Remove 2 through bolts from starter.



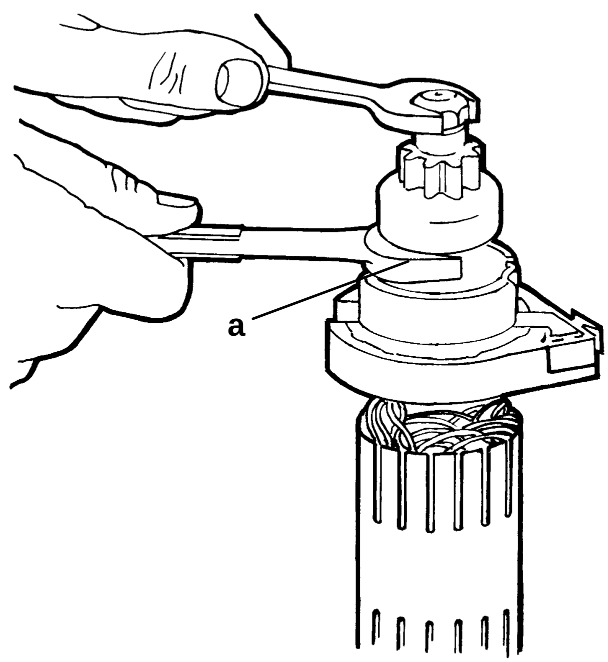
a - Through Bolts
b - Commutator End Cap

3. Tap commutator end cap to loosen and remove from frame. Do not lose brush springs.
4. Brush replacement is recommended if brushes are pitted, chipped or worn to less than 0.25 in. (6.4 mm). If necessary, remove brushes as follows:
   a. Remove hex nut and washers from POSITIVE (+) terminal and remove POSITIVE brushes and terminal as an assembly.
   b. Remove 2 bolts securing NEGATIVE (-) brushes and brush holder to end cap.



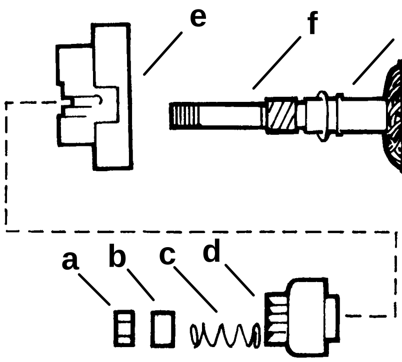
a - Brush Holder
b - POSITIVE Brushes
c - NEGATIVE Brushes
d - POSITIVE Terminal
e - Bolts (Fasten NEGATIVE Brushes and Holder)

5. Remove armature (with drive end cap) from starter frame.
6. Remove locknut and remove drive assembly from armature shaft.



a - Hold Armature Shaft with Wrench on Hex Portion of Drive Assembly

Then remove parts from shaft.



11658

a - Locknut
b - Spacer
c - Spring
d - Drive Assembly
e - Drive End Cap
f - Armature Shaft
g - Washer

Starter Cleaning, Inspection and Testing

CLEANING AND INSPECTION

1. Clean all starter motor parts.
2. Check pinion teeth for chips, cracks or excessive wear.
3. Replace the drive clutch spring and/or collar if tension is not adequate or if wear is excessive.
4. Inspect brush holder for damage or for failure to hold brushes against commutator.
5. Replace brushes that are pitted or worn to less than 1/4 in. (6.4mm) in length.
6. Inspect the armature conductor (commutator bar junction) for a tight connection. A loose connection (excessive heat from prolonged cranking melts solder joints) results in a burned commutator bar.
7. Resurface and undercut a rough commutator as follows:

⚠ CAUTION

Do not turn down the commutator excessively.

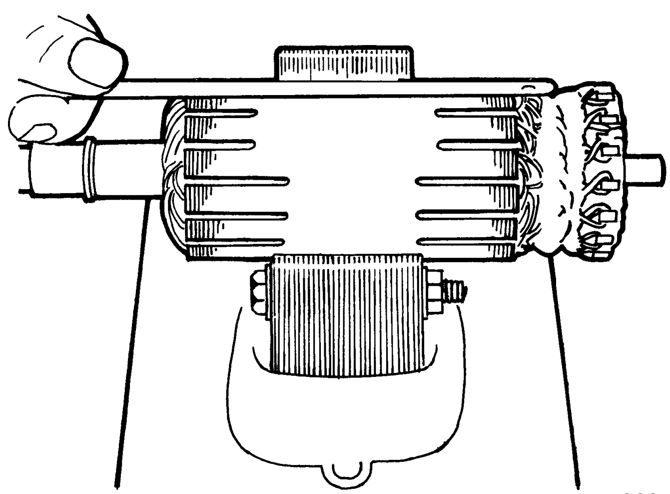
   a. Resurface the commutator and undercut the insulation between the commutator bars 1/32 in. (0.8mm) to the full width of the insulation and so that the undercut is flat.
   b. Clean the commutator slots after undercutting.
   c. Sand the commutator lightly with No. 00 sandpaper to remove burrs, then clean the commutator.
   d. Recheck the armature on a growler for shorts as specified in the following procedure (“Testing”).

8. Open-circuited armatures often can be repaired. The most likely place for an open circuit is at the commutator bars, as a result of long cranking periods. Long cranking periods overheat the starter motor so that solder in the connections melts and is thrown out. The resulting poor connections then cause arcing and burning of the commutator bars.
9. Repair bars, that are not excessively burned, by resoldering the leads in bars (using rosin flux solder) and turning down the commutator in a lathe to remove burned material, then undercut the mica.
10. Clean out the copper or brush dust from slots between the commutator bars.
11. Check the armature for ground. See the following procedure (“Testing”).

TESTING

Armature Test for Shorts

Check armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between commutator bars. If saw blade still vibrates, replace armature.



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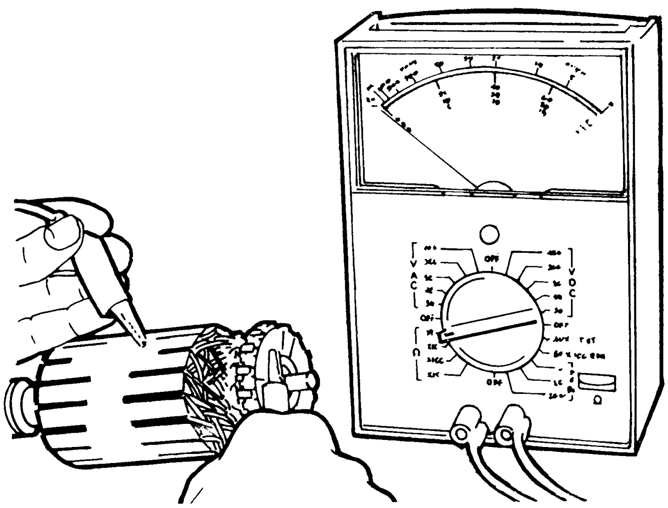
Armature Test for Ground

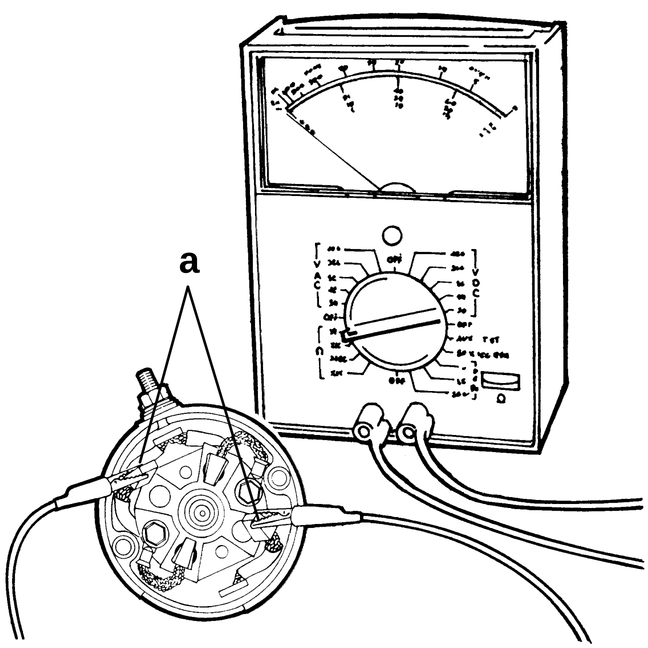
1. Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on armature core or shaft and other lead on commutator.
2. If meter indicates continuity, armature is grounded and must be replaced.



11675

Checking Positive Brushes and Terminal

Set ohmmeter to (R x 1 scale). Connect meter leads between POSITIVE brushes. Meter must indicate full continuity or zero resistance. If resistance is indicated, inspect lead to brush and lead to POSITIVE terminal solder connection. If connection cannot be repaired, brushes must be replaced.

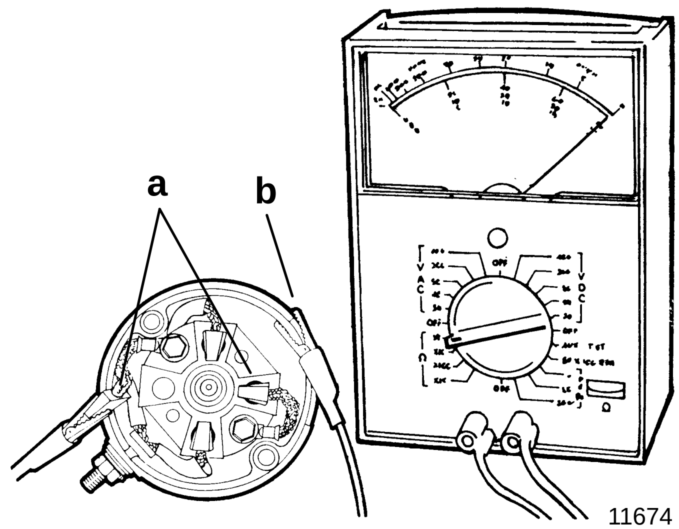


11673

a - POSITIVE (+) Brushes

Testing Negative Brushes for Ground

Set ohmmeter to (R x1 scale). Place one lead of the ohmmeter on the NEGATIVE brush and the other lead on the end cap (bare metal). If the meter indicates NO continuity, replace the NEGATIVE brush. Repeat this procedure on the other NEGATIVE brush.

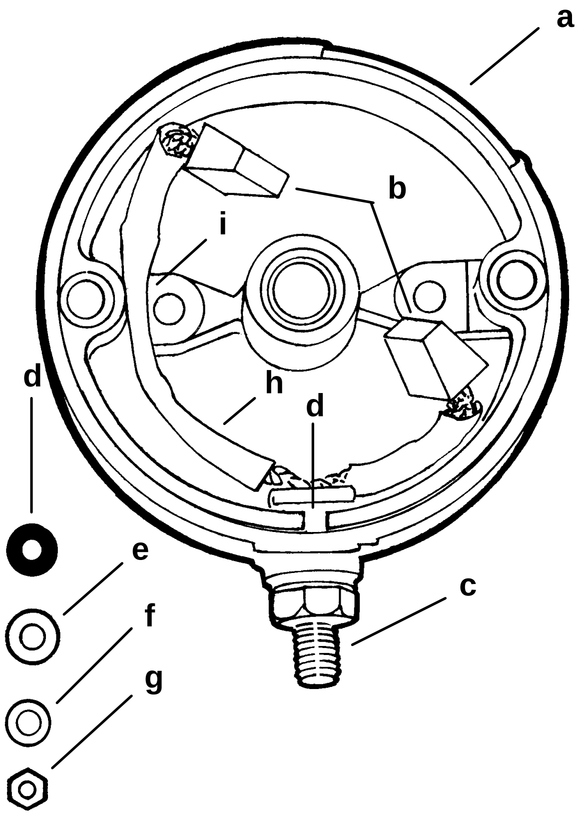


11674

a - NEGATIVE (-) Brushes
b - End Cap

STARTER REASSEMBLY

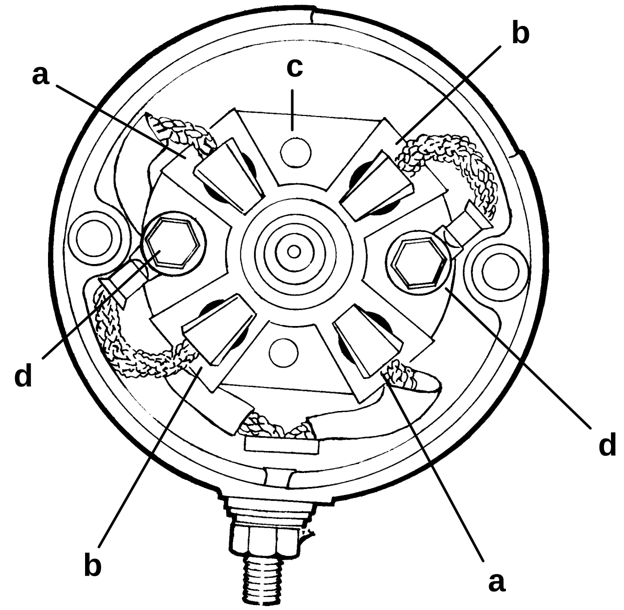
1. If brushes were removed, replace as follows:
   a. Install POSITIVE brushes (along with POSITIVE terminal) into commutator end cap.



11660

a - End Cap
b - POSITIVE Brushes
c - POSITIVE Terminal
d - Insulating Bushing
e - Washer
f - Split Washer
g - Hex Nut
h - Long Brush Lead
i - Push Lead into Slot

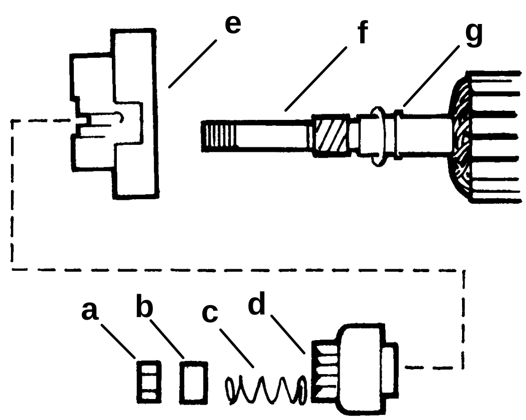
   b. Install NEGATIVE brushes (along with brush holder).



11656

a - POSITIVE (+)Brushes
b - NEGATIVE (-) Brushes
c - Brush Holder
d - Bolts (Fasten NEGATIVE Brushes and Holder)

2. If removed, reinstall parts on armature shaft. Use a new locknut and tighten securely on end of shaft.

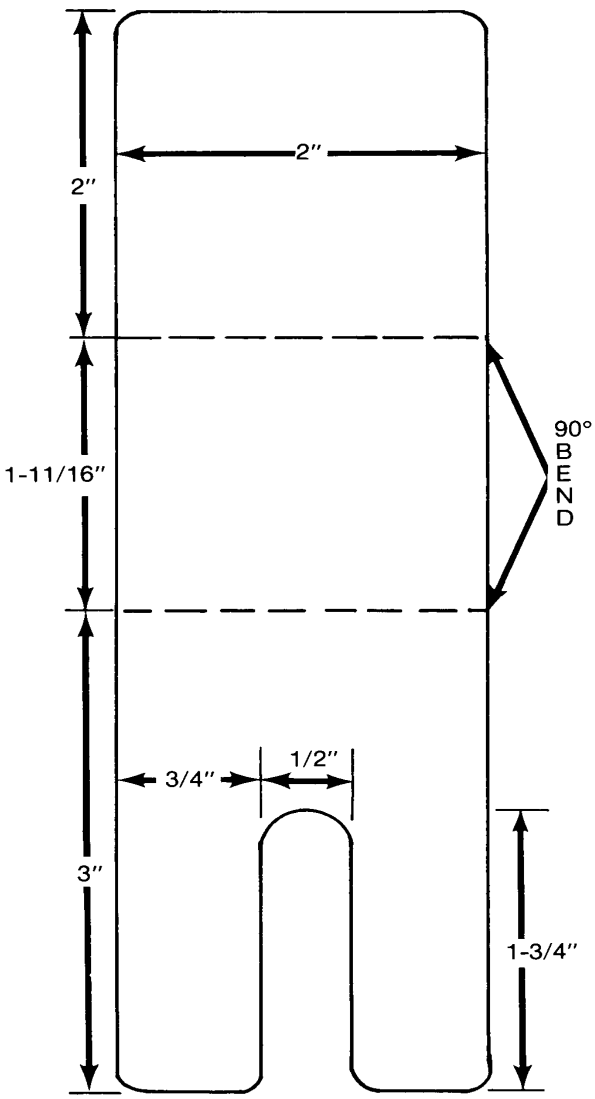


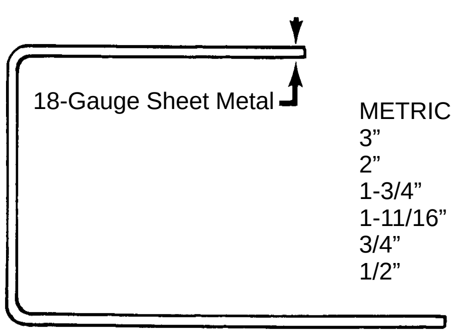
11658

a - Locknut
b - Spacer
c - Spring
d - Drive Assembly
e - Drive End Cap
f - Armature Shaft
g - Washer

3. Lubricate helix threads on armature shaft with a drop of SAE 10W oil.
4. Lubricate bushing in drive end plate with a drop of SAE 10W oil.

5. Position armature into starter frame.
6. To prevent damage to brushes and springs when installing commutator end cap, it is recommended that a brush retaining tool be made as shown:



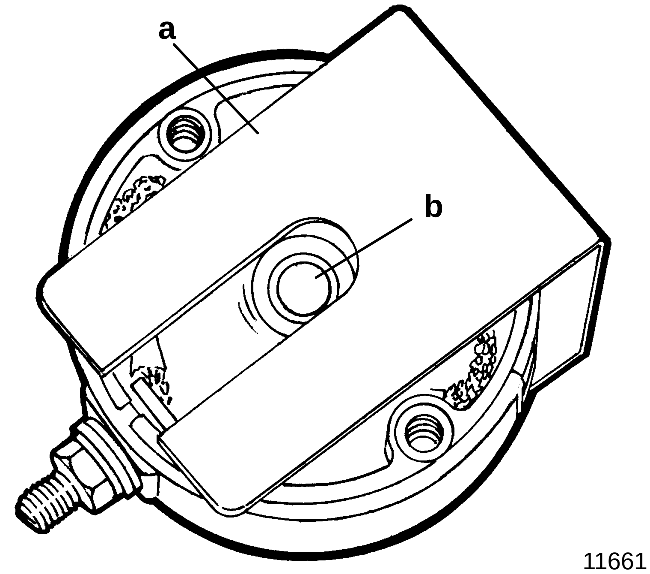


METRIC SCALE

3”	= 76.2mm
2”	= 50.8mm
1-3/4”	= 44.5mm
1-11/16”	= 42.9mm
3/4”	= 19.1mm
1/2”	= 12.7mm

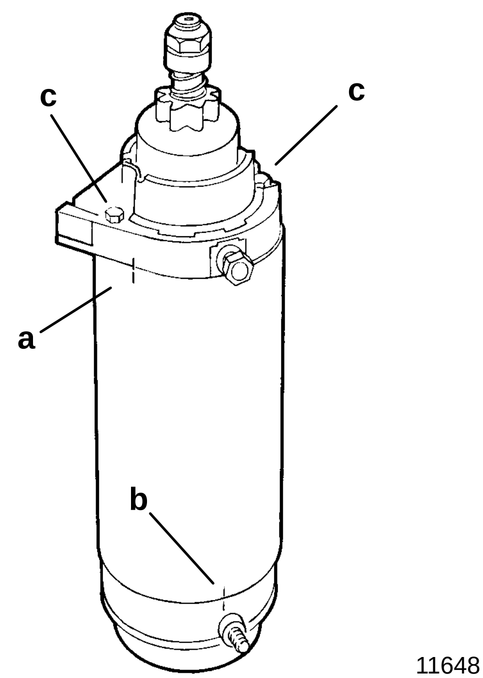
7. Lubricate bushing (located in commutator end cap) with one drop of SAE 10W oil. DO NOT over lubricate.

8. Place springs and brushes into brush holder and hold in place with brush retainer tool.



a - Brush Retainer Tool
b - Bushing (DO NOT over lubricate)

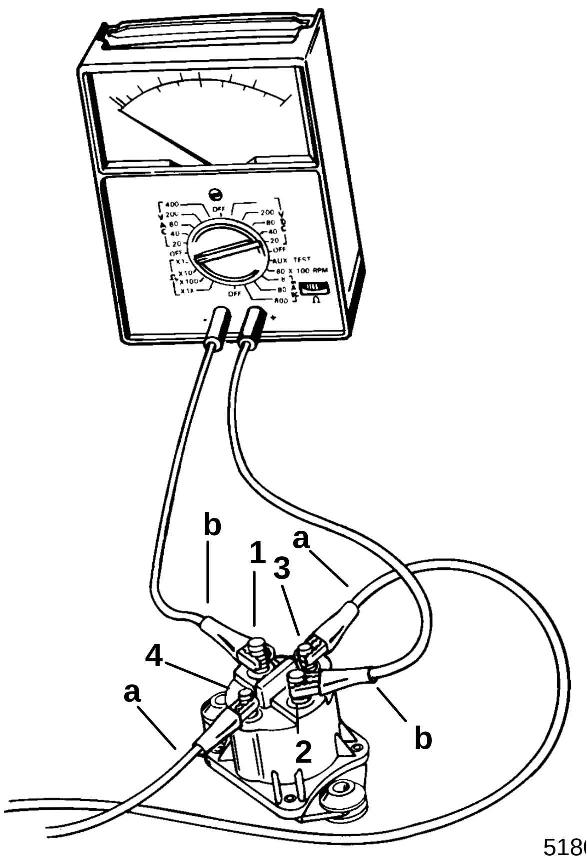
9. Install armature into starter frame and align match marks (a). Install commutator end cap onto starter frame and align match marks (b). Remove brush retainer tool. Install through bolts (c) and torque to 70 lb. in. (8.0 N·m).



a - Alignment Marks
b - Alignment Marks
c - Bolts [Torque to 70 lb. in. (8.0 N·m)]

STARTER SOLENOID TEST

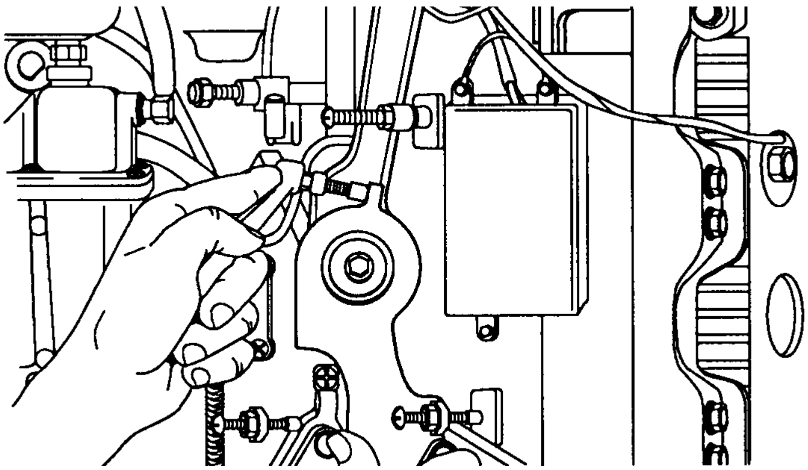
1. Disconnect all wires from solenoid.
2. Use an ohmmeter (R x1 scale) and connect meter leads between solenoid terminals 1 and 2.
3. Connect a 12-volt power supply between solenoid terminals 3 and 4. Solenoid should click and meter should read 0 ohms (full continuity).
4. If meter does not read 0 ohms (full continuity), replace solenoid.



a - 12-VOLT Supply
b - VOA Leads

ELECTRICAL

2
C



TIMING, SYNCHRONIZING & ADJUSTING

Table of Contents

Timing/Synchronizing/ Adjusting

Specifications

CARBURETED MODELS

Models 105 JET/135/150	
Full Throttle RPM Range	5000-5600
Idle RPM (in Forward Gear)	625-725
Maximum Timing: @ Cranking Speed @ Wide Open Throttle	 21° BTDC 19° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

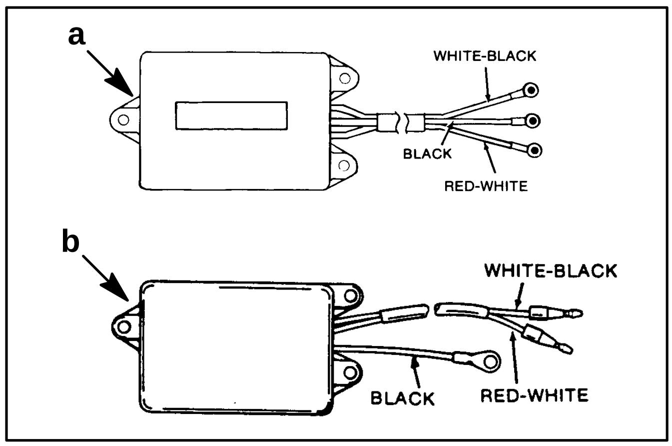
Model XR6/Magnum III	
Full Throttle RPM Range	5000-5600
Idle RPM (in Forward Gear)	625-725
Maximum Timing: @ Cranking Speed @ Wide Open Throttle	 20° BTDC 19° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

Model 175 Carb	
Full Throttle RPM Range	5000-5600
Idle RPM (in Forward Gear)	600-700
Maximum Timing: @ Cranking Speed @ 5000 RPM	 20° BTDC 19° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

Model 140 JET/200	
Full Throttle RPM Range	5000-5600
Idle RPM (in Forward Gear)	625-725
Maximum Timing: ***(Models with Spark Advance Module)** @ Cranking Speed @ Wide Open Throttle	 21° BTDC 25° BTDC
Maximum Timing: ***(Models with Idle Stabilizer Module)** @ Cranking Speed @ Wide Open Throttle	 22° BTDC 20° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

Carburetor Models

***IMPORTANT: Remove idle stabilizer/advance module, install idle stabilizer and reset timing. Refer to Service Bulletin 91-35.**



a - Spark Advance Module
b - Idle Stabilizer Module

ELECTRONIC FUEL INJECTION MODELS

Models 150 XRI	
Full Throttle RPM Range	5000-5600
Idle RPM (in Forward Gear)	625-725
1992 – 1997 Model Maximum Timing: @ Cranking Speed @ 5000 RPM 1998 Model Maximum Timing: @ Cranking Speed @ 5000 RPM	 20° BTDC 19° BTDC 15° BTDC 16° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

Model 175 XRI	
Full Throttle RPM Range	5000-5600
Idle RPM (in Forward Gear)	625-725
Maximum Timing: @ Cranking Speed @ 5000 RPM	 20° BTDC 19° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

Model 200 XRI	
Full Throttle RPM Range	5000-5800
Idle RPM (in Forward Gear)	625-725
Maximum Timing: @ Cranking Speed @ 5800 RPM	 16° BTDC 22° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

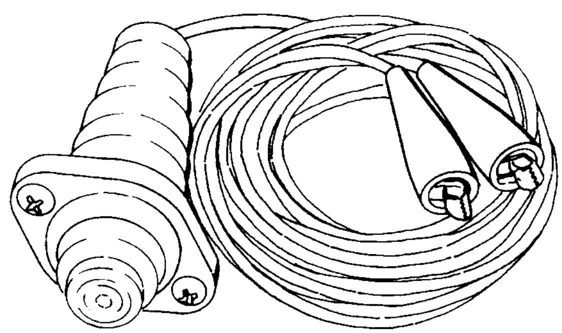
Model 150 PRO MAX/SUPER MAGNUM	
Full Throttle RPM Range	6200-6500
Idle RPM (in Forward Gear)	600-700
Maximum Timing: @ Cranking Speed	 20° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

Model 200/225 PRO MAX/SUPER MAGNUM	
Full Throttle RPM Range	6200-6500
Idle RPM (in Forward Gear)	600-700
Maximum Timing: @ Cranking Speed ***(Note)***	 25° BTDC
Idle Speed/Pickup Timing	0°-9° ATDC
Spark Plug	NGK-BU8H
Firing Order	1-2-3-4-5-6

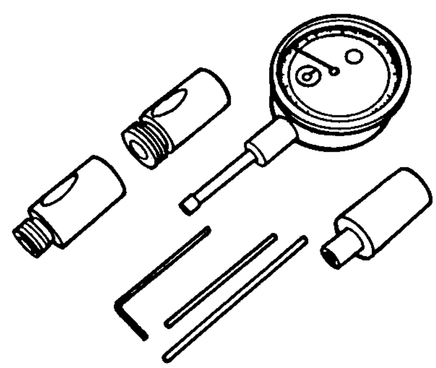
NOTE: *Early model 200 engines equipped with the detonation module should set the timing at 20° BTDC.*

Special Tools

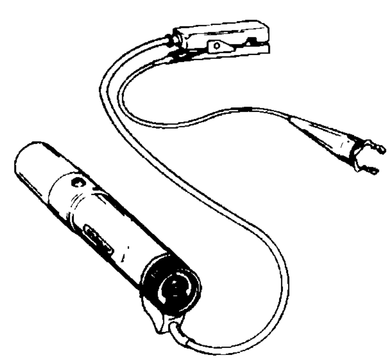
Remote Starter Switch 91-52024A1



Dial Indicator 91-58222A1



Timing Light 91-99379



Adjustments

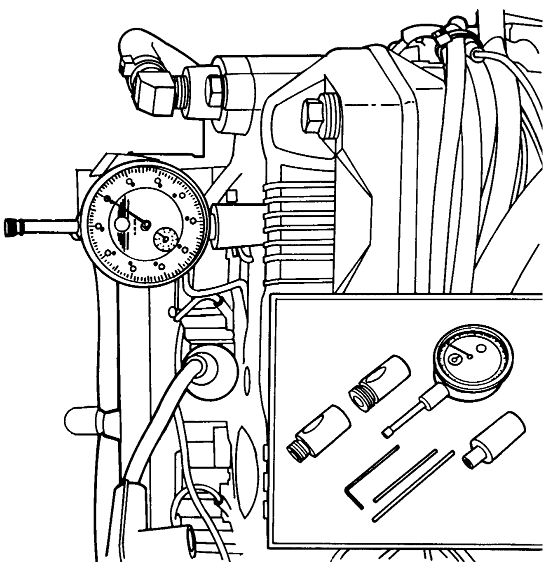
Carburetor Models

TIMING POINTER ADJUSTMENT

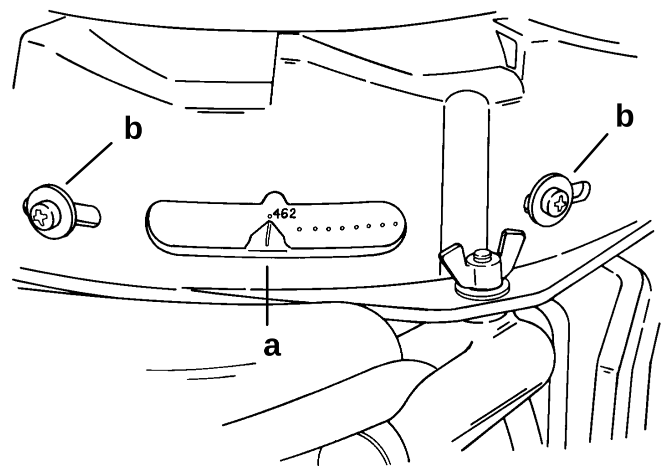
⚠ WARNING

Engine could start when turning flywheel to check timing pointer adjustment. Remove all spark plugs from engine to prevent engine from starting.

1. Remove all spark plugs and install Dial Indicator (91-58222A1) into No. 1 cylinder (top cylinder, starboard bank).

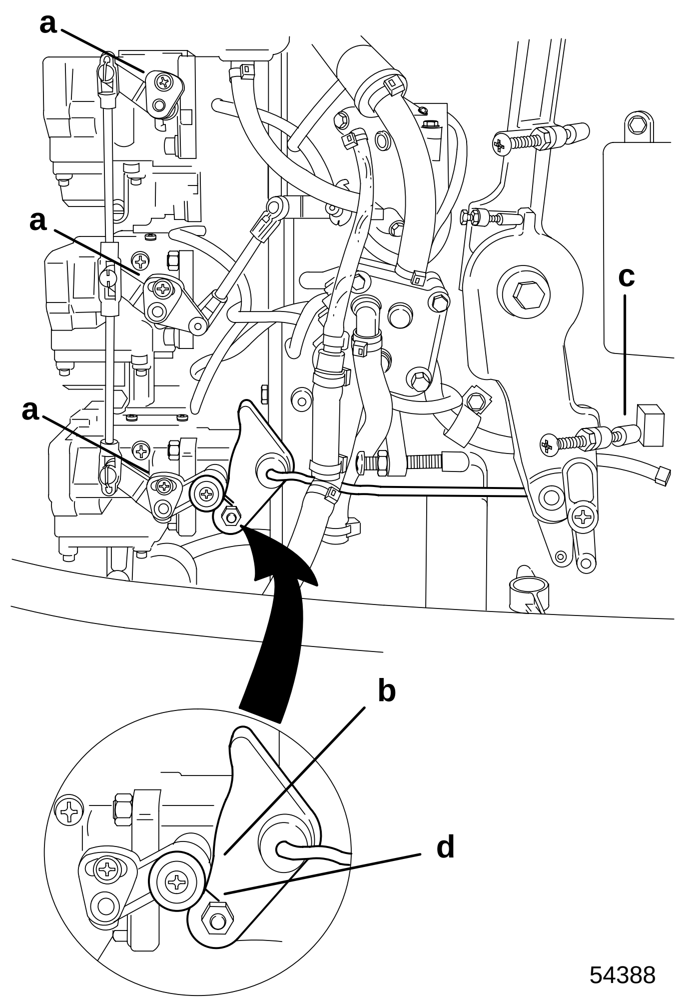


2. Turn flywheel in a clockwise direction until No. 1 piston is at top dead center (TDC). Set dial indicator at “O” (zero) and tighten indicator set screw.
3. Turn flywheel counterclockwise until dial indicator needle is approximately 1/4-turn beyond .462 in., then turn flywheel clockwise so that dial indicator reads .462 in. (11.7mm) exactly.
4. Reposition timing pointer (a) so that timing pointer is aligned with .462 in. mark on timing decal. Retighten pointer attaching screws (b).
5. Remove dial indicator from cylinder.



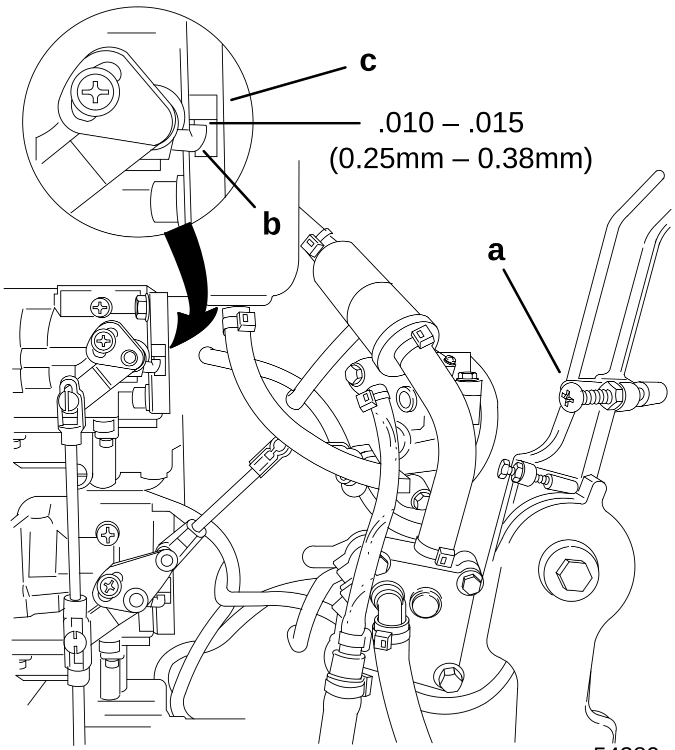
CARBURETOR SYNCHRONIZATION

1. Loosen 3 carburetor synchronization screws (a) to allow shutter plates to close completely.
2. Position throttle lever so that idle stop screw is against idle stop and move roller arm until roller lightly touches throttle cam (b). Adjust idle stop screw (c) on throttle arm to align mark (d) on throttle cam with center of roller. Without moving roller from this position, retighten carburetor synchronization screws.



3. Verify throttle shutter plates open and close simultaneously during throttle lever operation. Readjust if necessary.

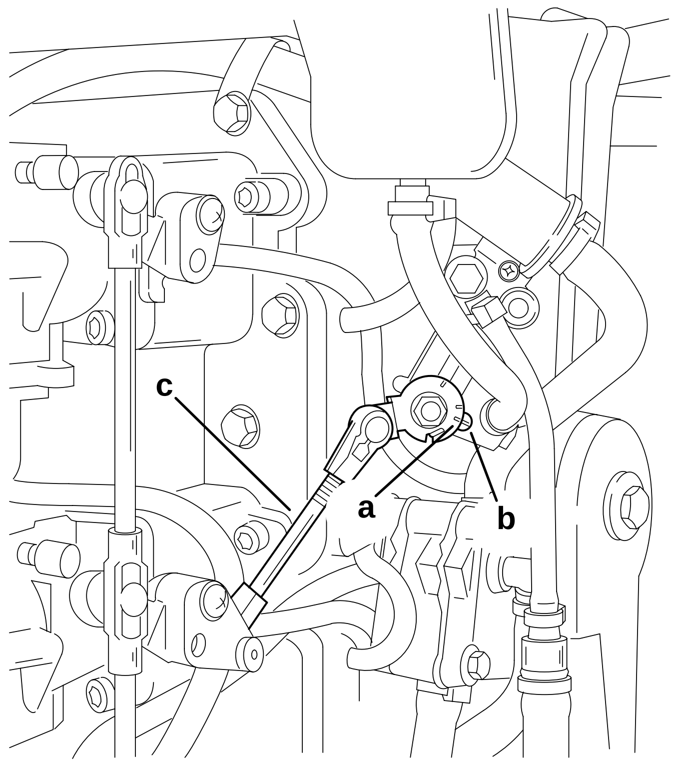
4. Move throttle lever to wide-open-throttle (W.O.T.) position and adjust full throttle stop screw (a) to allow full throttle shutter opening at W.O.T. Verify that throttle shutters do not act as a throttle stop. Allow .010 in. - .015 in. (.25mm - .38mm) clearance between throttle shaft arm(b) and stop (c) at W.O.T. Retighten jam nut on adjustment screw.



54389

CARBURETOR/OIL PUMP SYNCHRONIZATION

1. When carburetor linkage is at idle position, alignment mark (a) on oil injection arm should be in-line with mark on casting (b) as shown. If necessary, adjust link rod (c).



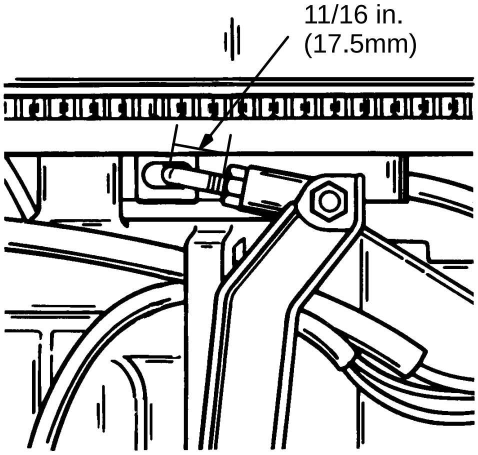
TIMING ADJUSTMENTS

⚠ CAUTION

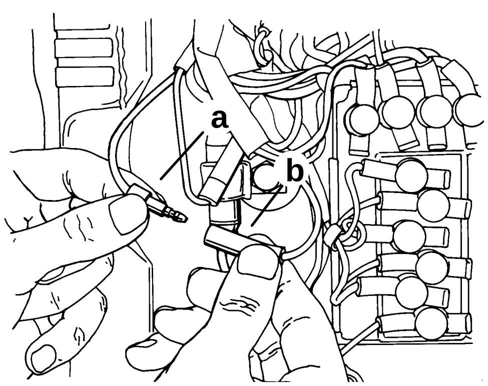
Engine may be timed while cranking engine with starter motor. To prevent engine from starting when being cranked, all spark plugs must be removed.

1. Insert Spark Gap Tool (91-63998A1) into each spark plug boot and attach alligator clips to good engine ground
2. Disconnect remote fuel line from engine.
3. Connect remote control electrical harness to engine wiring harness.
4. Remove throttle cable barrel from barrel retainer.

IMPORTANT: If trigger link rod was disassembled verify that 11/16 in. (17.5mm) length is retained.



5. Disconnect and isolate white/black lead (a) (starboard side of engine) from 3 wire stabilizer box at bullet connector (b).



⚠ WARNING

While cranking outboard, keep clear of propeller as it may rotate.

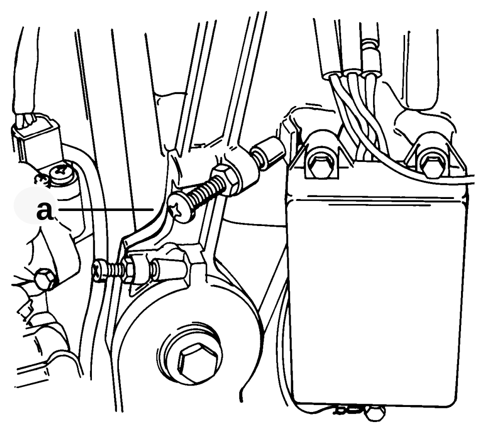
IMPORTANT: To time outboard at cranking speed, a fully charged battery must be used.

MAXIMUM TIMING ADJUSTMENT

⚠ CAUTION

Models equipped with Idle Stabilizer Shift Kit Accessory (P/N 87-814281A1), <u>excluding</u> Mercury XR6, Mariner Magnum III and 175 require maximum timing at cranking speed in neutral to be retarded 3° from specifications listed on page 2C-1. Note, Stabilizer Shift Kit is standard on XR6, Magnum III and 175 models and already has retarded timing degrees calibrated into specifications listed on page 2C-1.

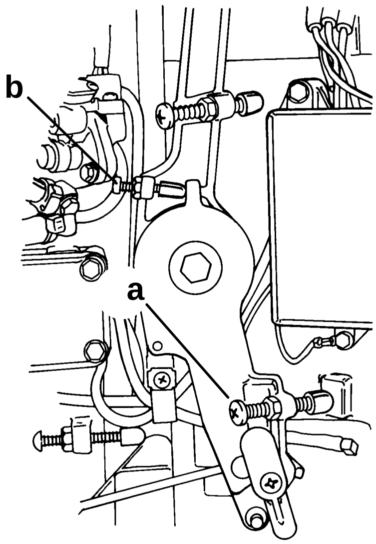
1. Connect timing light to No 1 spark plug lead (TOP STARBOARD BANK).
2. With engine in neutral, move throttle lever to place maximum spark advance screw (a) against stop. Crank engine with starter motor and adjust maximum spark advance timing mark (see specifications on page 2C-1) with timing pointer. Due to the spark advance/retardation characteristics of this ignition system, this cranking speed adjustment will increase (XR6, Magnum III and 175) or decrease (135,150 and 200) timing at 5000 RPM and above. Retighten jam nut on adjustment screw.



PRIMARY PICKUP TIMING ADJUSTMENT

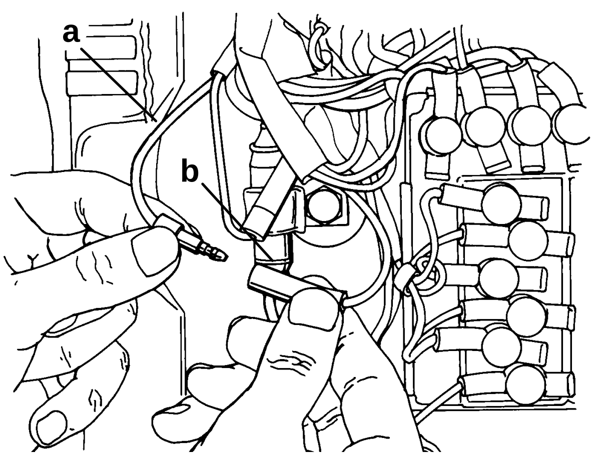
1. With engine in neutral, hold throttle arm so that idle stop screw (a) is against idle stop. Crank engine with starter motor and adjust throttle primary pickup screw (b) to align specified throttle primary pickup mark on timing decal with timing pointer. Retighten jam nut on adjustment screw.

NOTE: *Primary pickup timing also determines engine RPM, refer to “Idle Speed Adjustment” following.*



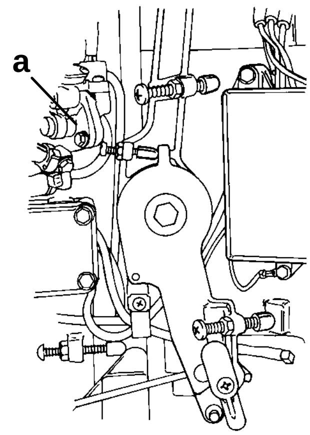
NOTE: *All timing adjustments made to outboard under cranking speed conditions should be verified with outboard running and adjustments made if necessary. This is due to advance characteristics of individual ignition systems.*

2. Remove timing light from No. 1 spark plug lead.
3. Remove spark gap tools (91-63998A1) from each spark plug boot.
4. Install all spark plugs into cylinder heads. Torque spark plugs to 20 lb. ft. (27.0 N·m) and attach spark plug leads to spark plugs.
5. Reconnect WHITE/BLACK lead (a) (starboard side of engine) from idle stabilizer at bullet connector (b).



IDLE SPEED ADJUSTMENT

1. With engine in water, connect fuel line to engine. Start engine and allow to warm up.
2. Place outboard in gear and monitor engine RPM. If RPM is above or below recommended RPM (see specifications), readjust primary pickup (a) screw to attain recommended engine speed. Retighten jam nut.



⚠ CAUTION

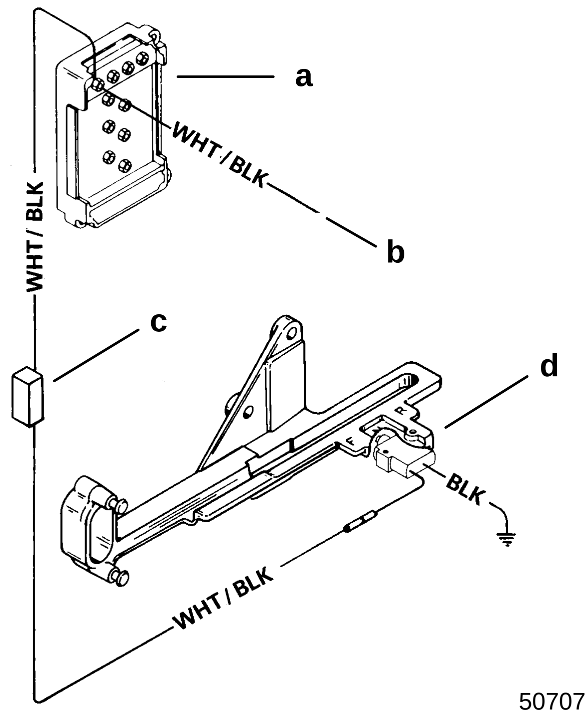
Engine idle RPM must NEVER EXCEED 750 RPM in gear.

3. With end of throttle cable connected to throttle lever, hold throttle lever against idle stop. Adjust throttle cable barrel to slip into barrel retainer on cable anchor bracket with a very light preload of throttle lever against idle stop. Lock barrel in place.
4. Check preload on throttle cable by placing a thin piece of paper between idle stop screw and idle stop. Preload is correct when paper can be removed without tearing but has some drag on it. Readjust cable barrel, if necessary.

IMPORTANT: **Excessive preload on throttle cable will cause difficulty when shifting from forward to neutral. (Readjust throttle cable barrel, if necessary.)**

NOTE: *Carburetors are equipped with idle mixture adjustment screws. See carburetor specifications for mixture screw adjustment.*

NOTE: *If sufficient throttle cable barrel adjustment is not available, check for correct installation of link rod between the throttle lever and throttle cam. Each end of this link rod must be threaded into its plastic barrel until it bottoms against the throttle lever or throttle cam casting, then turned out only far enough to obtain correct orientation of link rod (less than one turn). All timing adjustments must be reset after this procedure.*



a - Inner Switch Box
b - To Outer Switch Box
c - Diode
d - Shift Interrupt Switch

Adjustments

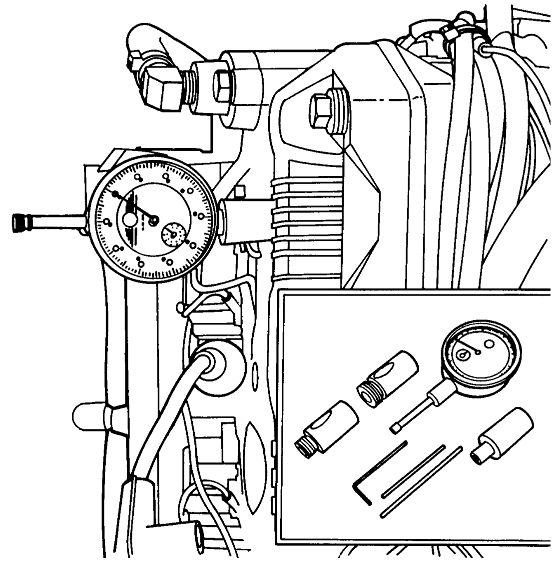
Electronic Fuel Injection Models

TIMING POINTER ADJUSTMENT

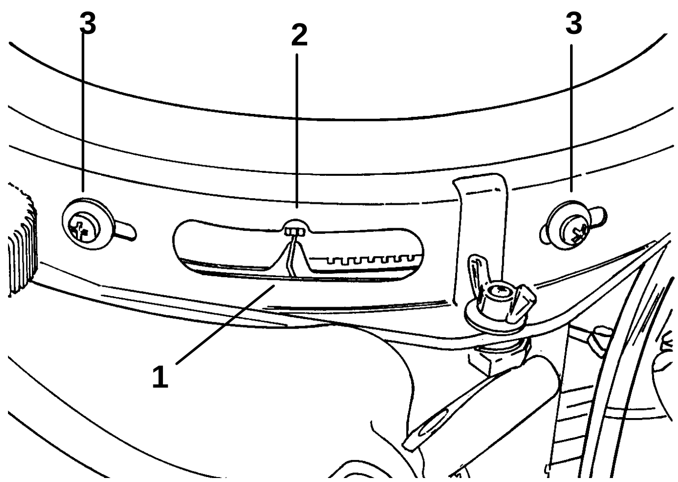
⚠ WARNING

Engine could start when turning flywheel to check timing pointer adjustment. Remove all spark plugs from engine to prevent engine from starting.

1. Remove all spark plugs and install Dial Indicator (91-58222A1) into No. 1 cylinder (top cylinder, starboard bank).
2. Turn flywheel in a clockwise direction until No. 1 piston is at top dead center (TDC). Set dial indicator at “O” (zero) and tighten indicator set screw.
3. Turn flywheel counterclockwise until dial indicator needle is approximately 1/4 turn beyond .462 in., then turn flywheel clockwise so that dial indicator reads .462 in. (11.7mm) exactly.



4. Reposition timing pointer (1) (if necessary) so that timing pointer is aligned with .462 in. mark (2) on timing decal. Retighten pointer attaching screws (3).



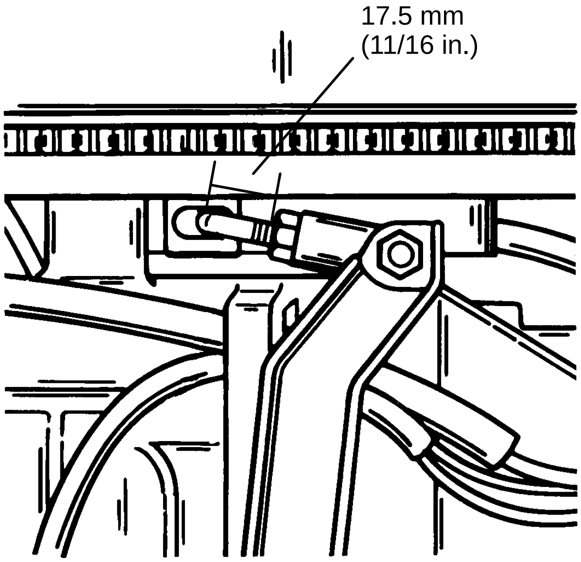
5. Remove dial indicator from cylinder.

ADJUSTMENTS

⚠ CAUTION

Engine is initially timed while cranking engine with starter motor. To prevent engine from starting when being cranked, all spark plugs must be removed, except No.1 cylinder (top cylinder starboard bank) plug.

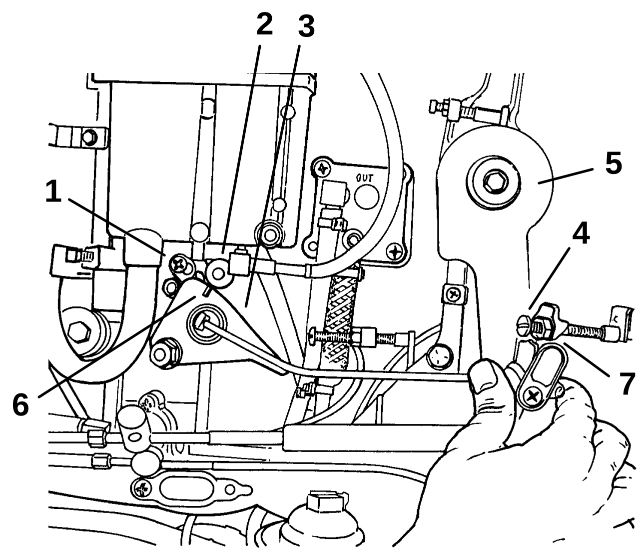
IMPORTANT: Control arm link rod (a) must maintain a length of 11/16 in. (17.5 mm). Make any necessary adjustments to link rod before proceeding with timing adjustments.



1. Remove all spark plugs except No.1 cylinder (top cylinder starboard bank) plug.
2. Disconnect remote fuel line from engine.
3. Connect remote control electrical harness to engine wiring harness.
4. Remove throttle cable barrel from barrel retainer.

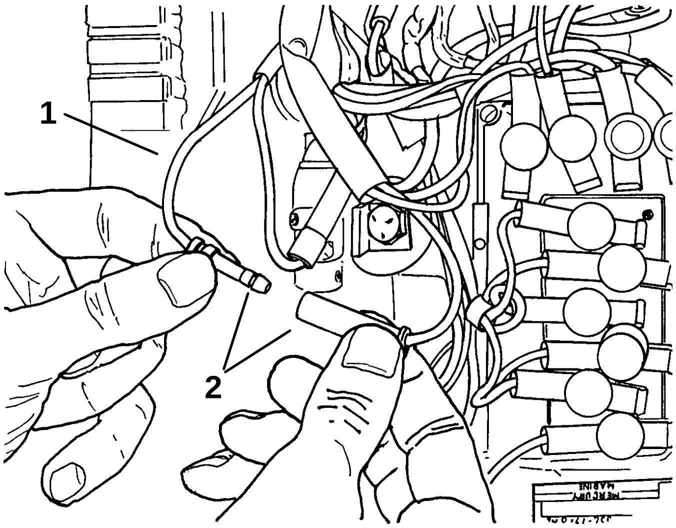
THROTTLE CAM ADJUSTMENT

1. Loosen cam follower screw (1) allowing cam follower to move freely.
2. Allow roller (2) to rest on throttle cam (3). Adjust idle stop screw (4) on throttle arm (5) to align mark (6) on throttle cam (3) with center of roller (2). Tighten jam nut (7).
3. While holding throttle arm against idle stop, tighten cam follower screw (1) with roller lightly touching cam (3).



STATIC IDLE TIMING ADJUSTMENT (CRANKING ENGINE WITH STARTER)

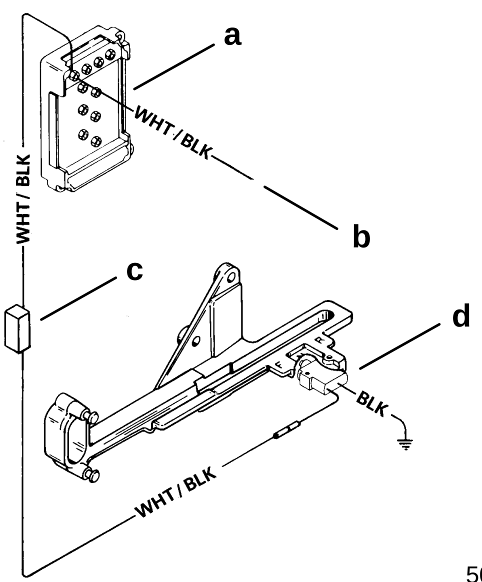
1. Disconnect WHITE/BLACK lead (1) from idle stabilizer box at bullet connector (2). Disconnect ECU harness for ignition timing procedure.



⚠ CAUTION

Models equipped with Idle Stabilizer Shift Kit Accessory (P/N 87-814281A1), excluding 175 EFI models, require maximum timing (cranking speed) to be retarded 3° from specifications listed on page 2C-2. Note, Stabilizer Shift Kit is standard on 175 EFI models and already has retarded timing degrees calibrated into specifications listed on page 2C-2.

Idle Stabilizer Shift System



a - Inner Switch Box
b - To Outer Switch Box
c - Diode
d - Shift Interrupt Switch

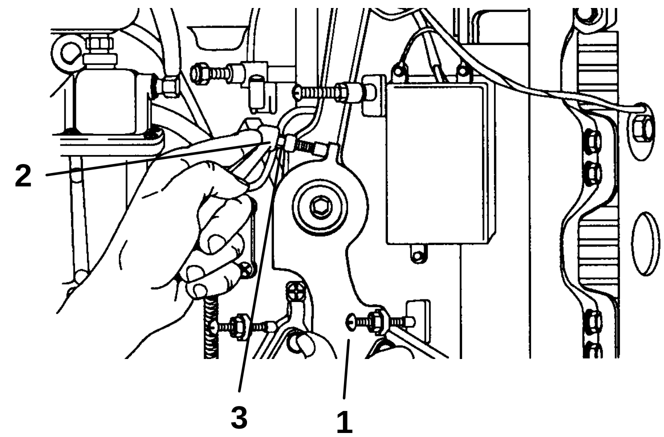
1. Connect timing light to No 1 spark plug lead (TOP STARBOARD BANK)

⚠ WARNING

While cranking engine, keep clear of propeller, as it may rotate.

IMPORTANT: To accurately time engine cranking speed, a fully charged battery must be used.

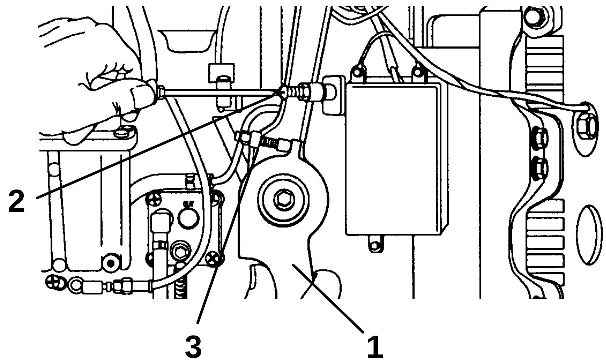
2. Connect timing light to no.1 cylinder spark plug lead. Crank engine with starter (about 300 RPM) while holding throttle arm (1) against idle stop. Adjust idle spark adjustment screw (2) to attain appropriate setting. Tighten locknut (3).



STATIC MAXIMUM TIMING ADJUSTMENT (CRANKING ENGINE WITH STARTER)

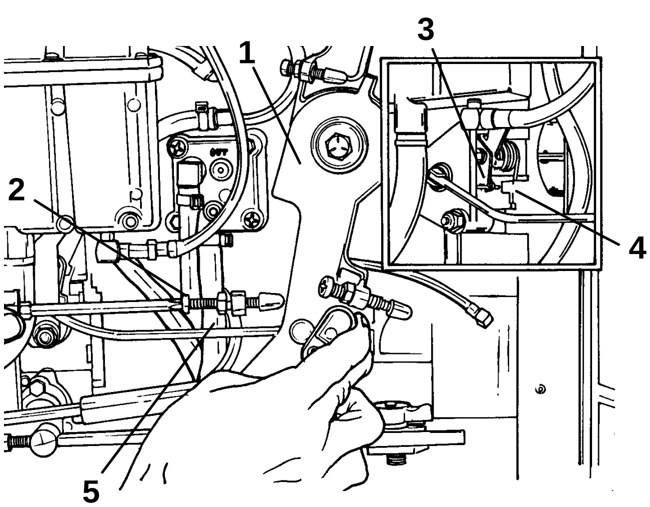
NOTE: *WHITE/BLACK lead and ECM harness remain disconnected for maximum timing adjustment. Timing light remains hooked up to no.1 cylinder.*

1. Hold throttle arm (1) so that maximum spark advance screw (2) is against stop. Crank engine with starter. Adjust maximum spark advance screw (2) to set timing to attain appropriate setting. Tighten maximum spark adjustment locknut (3).



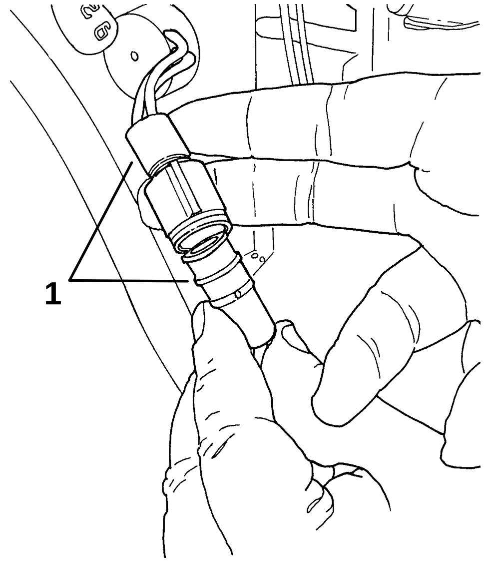
MAXIMUM THROTTLE

1. Hold throttle arm (1) against full throttle stop screw (2). Adjust full throttle stop screw to allow full throttle valve opening, while maintaining a clearance between arm (3) of throttle shaft and stop (4) on induction box. Tighten locknut (5).
2. Check for slight free play (roller lifter from cam) between roller and cam at full throttle to prevent linkage from binding. Readjust full throttle stop screw, if necessary.
3. Reconnect WHITE/BLACK lead from idle stabilizer box. Reconnect ECM harness. Disconnect timing light and install spark plugs and fuel line.

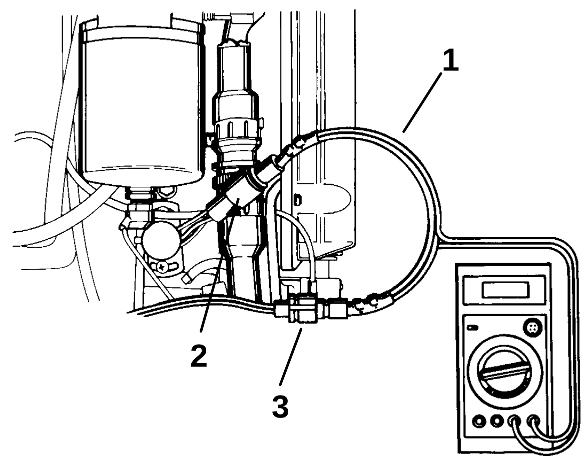


THROTTLE POSITION SENSOR (TPS) ADJUSTMENT

1. Disconnect TPS from EFI harness (1).



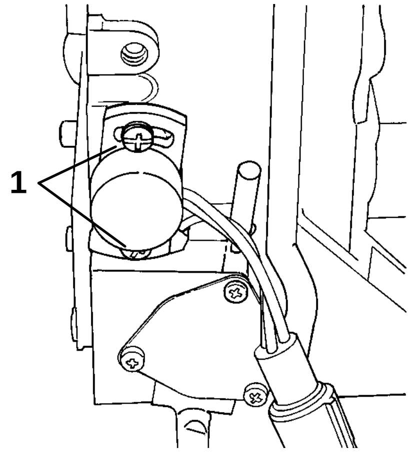
2. Connect digital using TPS Test Lead Assembly (1) (P/N 91-816085) between TPS connector (2) and EFI harness connector (3). Set voltmeter to 2 DC volts.



IMPORTANT: TAN/BLACK head temperature leads must be disconnected from port cylinder head before adjusting TPS.

3. Disconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.
4. Turn key to the “ON” position.

5. Loosen screws (1) securing TPS to manifold.



6. Rotate TPS fully clockwise (holding throttle shaft in closed position). On models with ECM P/N 14623A15 and above, voltmeter should read **.200 - .300**. If readout is not within specifications, adjust TPS to obtain readout of **.240 - .260**.

NOTE: *If engine appears to run too rich or too lean, TPS can be readjusted. Decreasing voltage yields leaner mixture. Increasing voltage yields richer mixture. Allowable TPS range: **.200 - .300** volts.*

7. Tighten TPS screws holding correct tolerance.

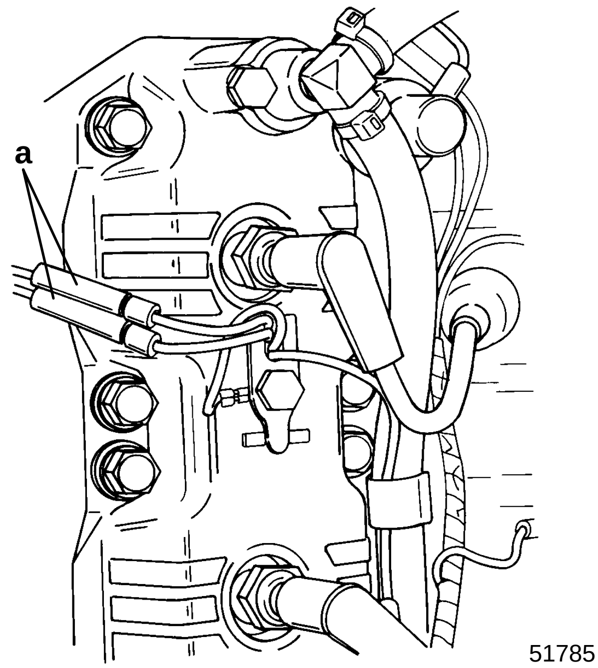
8. Disconnect remote control cable from throttle lever.

9. Slowly move throttle lever to full open position while monitoring voltage reading. Voltage reading should increase and decrease smoothly.

10. Set volt meter to 20 DC volts. Maximum voltage reading at full throttle is approximately 7.46 volts.

11. Remove test lead and reconnect TPS harness to EFI harness.

12. Reconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.



a - Head Temperature Sensor Leads

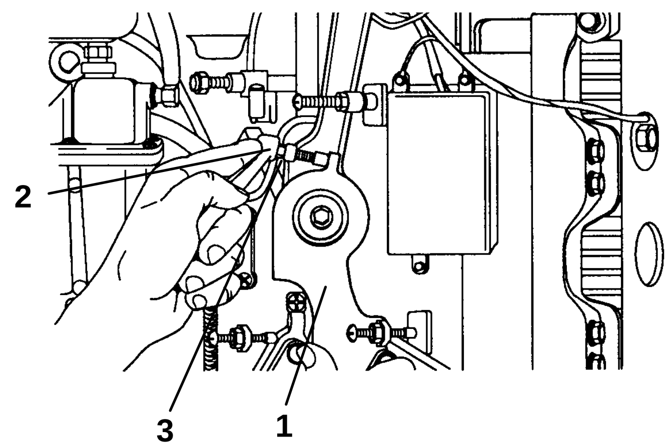
IDLE TIMING (ENGINE RUNNING)

1. WHITE/BLACK lead from idle stabilizer must be disconnected.

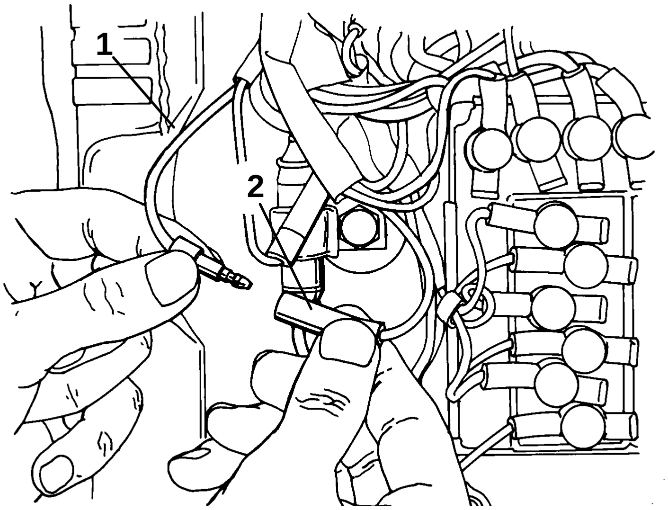
2. With engine in water, start engine and allow to warm up.

3. Shift engine into “FORWARD” gear.

4. Hold throttle arm (1) against idle stop (throttle cable barrel removed from barrel retainer). Adjust idle timing screw (2) to attain appropriate setting. Tighten locknut (3).

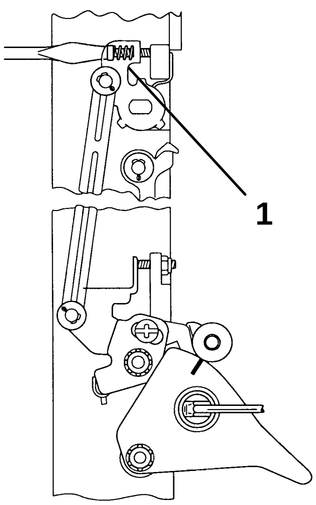


5. Reconnect WHITE/BLACK lead of idle stabilizer (1) at bullet connector (2).



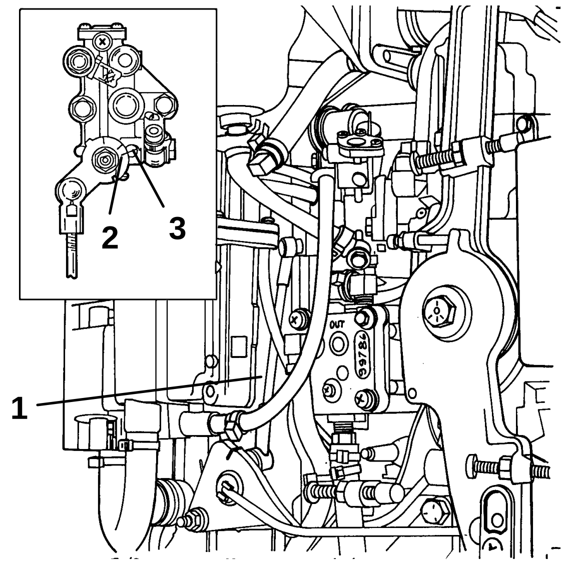
IDLE ADJUSTMENT

1. With outboard in water, start and allow to warm up.
2. Loosen cam follower screw, allowing free movement of cam. Hold throttle arm against idle stop. Adjust idle speed screw (1) by increasing or decreasing air valve opening to attain appropriate setting.



THROTTLE VALVE/OIL PUMP SYNCHRONIZATION

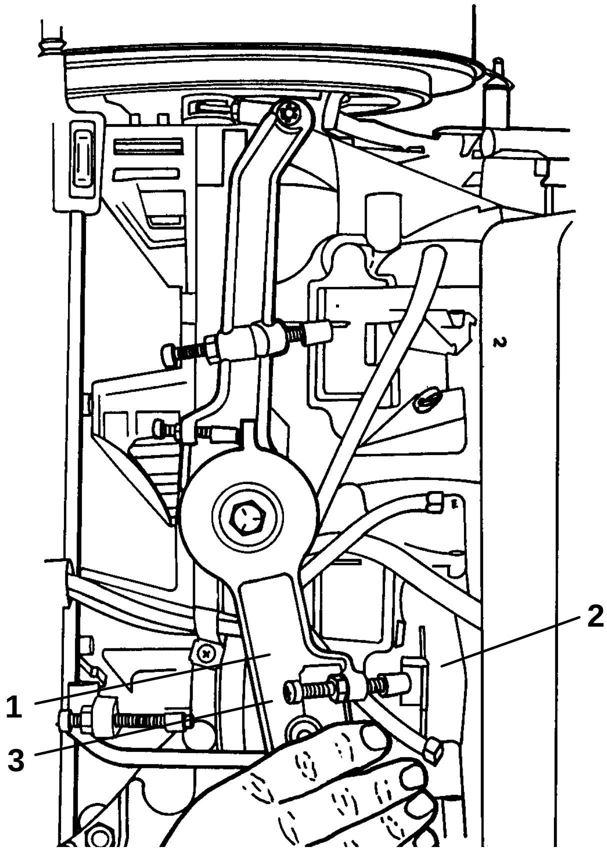
1. While holding throttle arm against idle stop, adjust length of link rod (1) so that stamped mark (2) of oil pump lever aligns with stamped mark (3) of oil pump body.



THROTTLE CABLE INSTALLATION

1. With end of throttle cable connected to throttle lever, hold throttle lever (1) against idle stop (2). Adjust throttle cable barrel to slip into barrel recess of control cable anchor bracket, with a light preload of throttle lever against idle stop. Lock barrel in place.

IMPORTANT: Excessive preload on throttle cable will cause difficulty when shifting from "FORWARD" to "NEUTRAL" (readjust throttle cable barrel, if necessary).



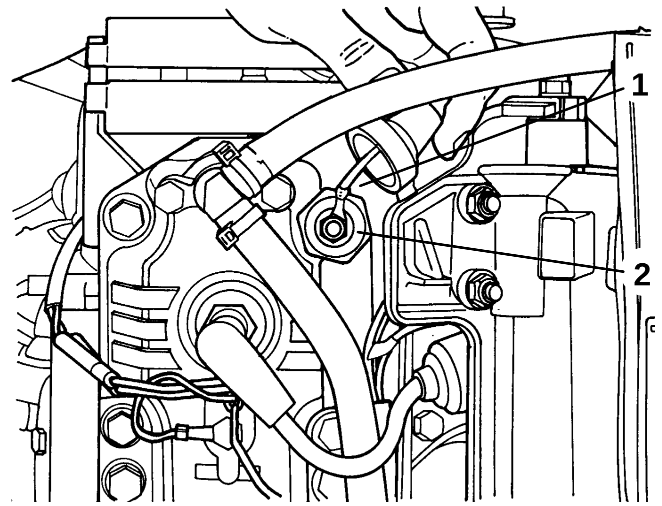
2. Check preload on throttle cable by placing a thin piece of paper between idle stop screw (3) and idle stop (2). Preload is correct when paper can be removed without tearing, but has some drag on it (readjust throttle barrel, if necessary).

DETONATION CONTROL (200 MODEL)

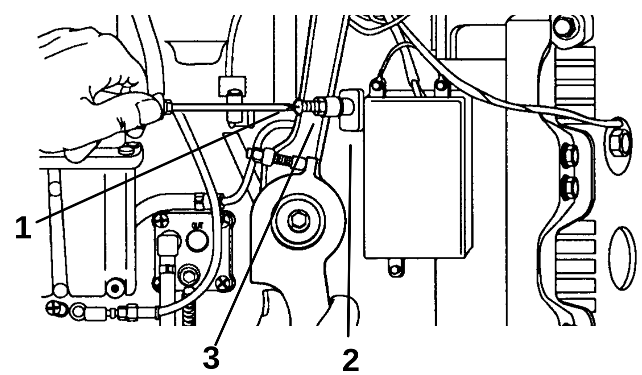
1. With outboard running in "FORWARD" gear, advance throttle to 3500 RPM and check that spark timing has electronically advanced timing to 26° BTDC. This indicates knock control circuit is functioning.

MAXIMUM TIMING ADJUSTMENT (ENGINE RUNNING)

1. Disconnect WHITE/BLUE lead (1) from detonation sensor (2). (200 model)



2. Outboard running in gear, advance throttle arm until maximum spark adjustment screw (1) contacts spark stop (2), at about 2500 RPM. Adjust maximum spark adjustment screw (see specifications) if necessary. Tighten locknut (3) and turn engine off.



3. Reconnect WHITE/BLUE lead to detonation sensor (200 model).

ELECTRICAL

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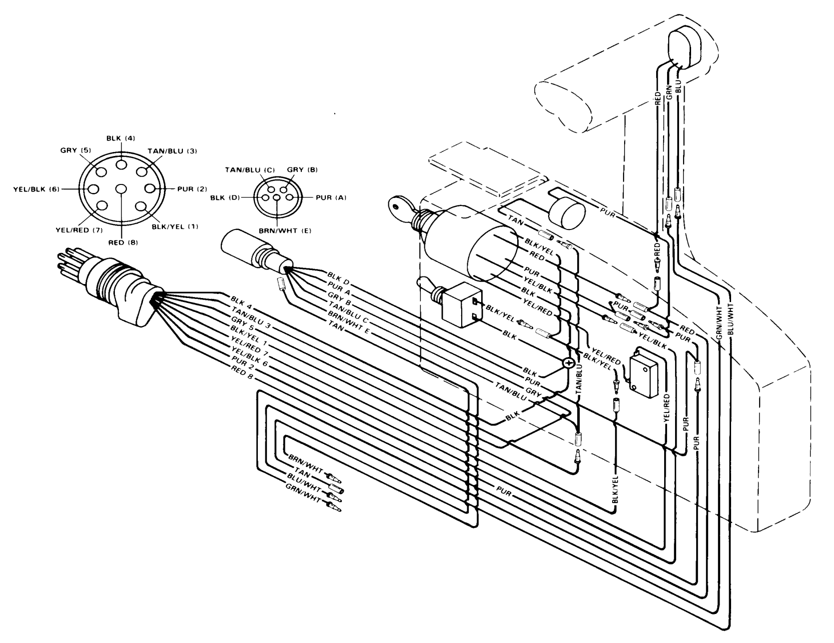
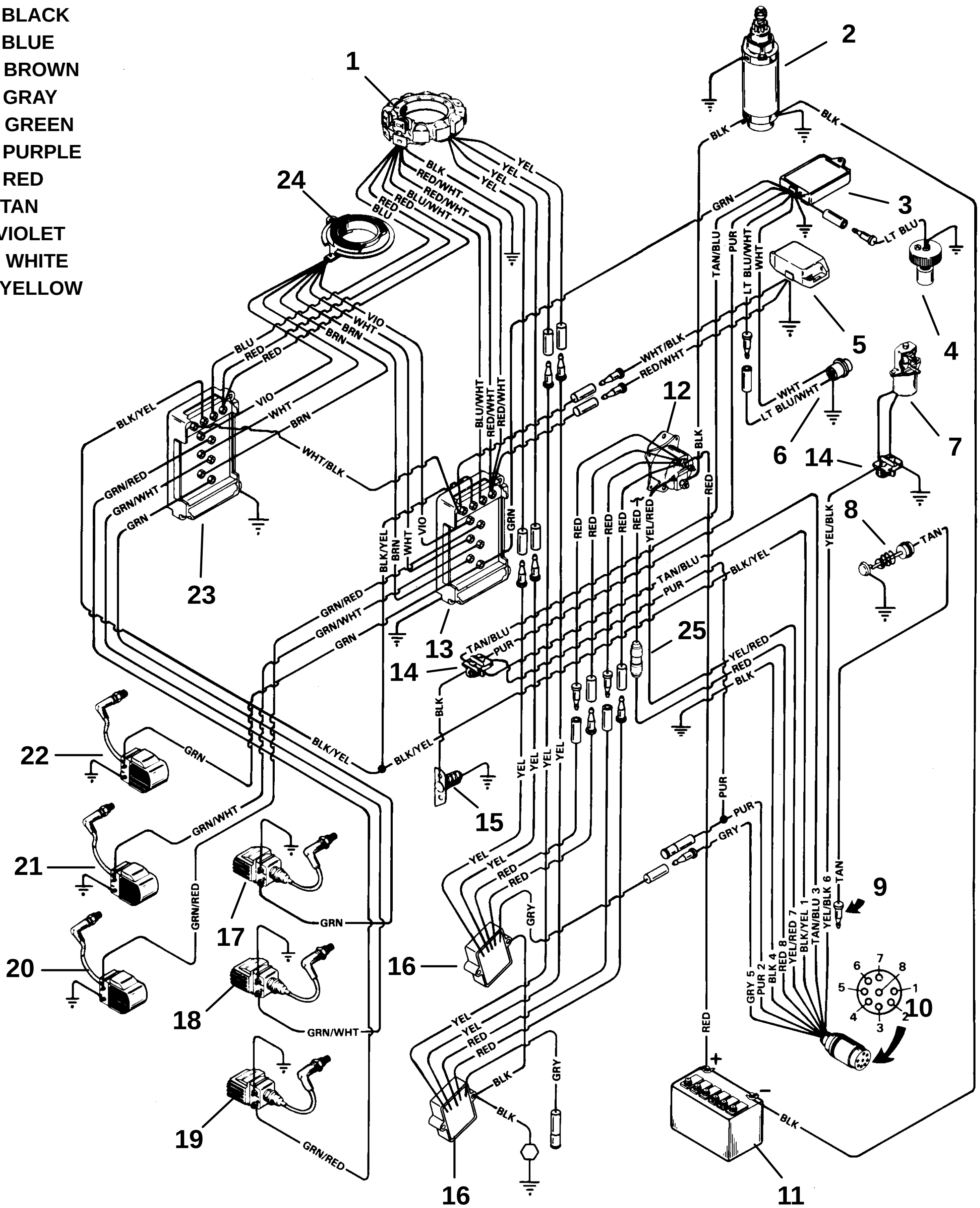


WIRING

Table of Contents

Wiring Diagram 135/150

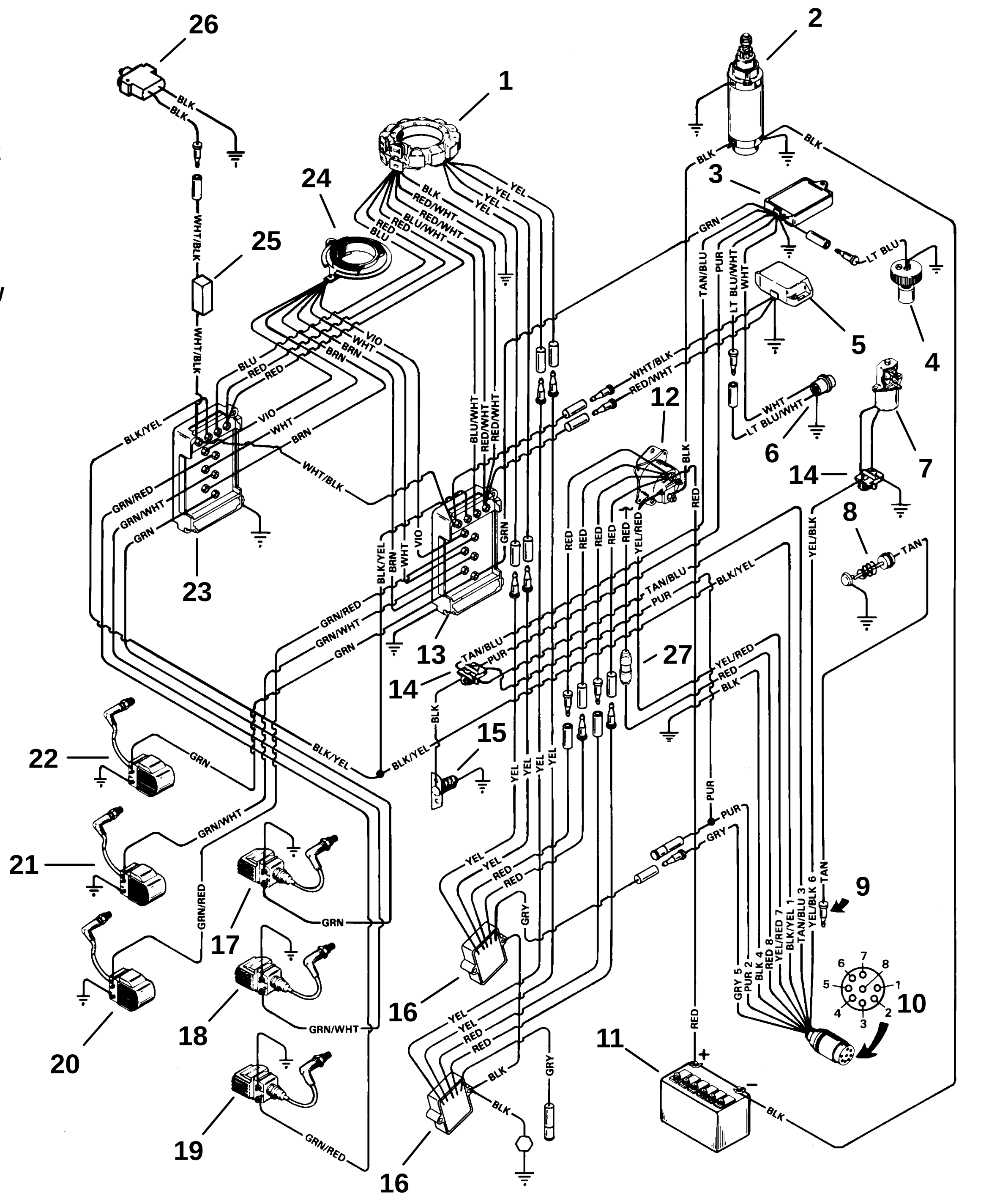
BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW



1 - 40 Ampere Stator
2 - Starter
3 - Lubalert
4 - Oil Tank Cap
5 - Idle Stabilizer
6 - Rotational Sensor
7 - Enrichment Valve
8 - Temperature Gauge Sender
9 - Control Box Instrument Connector
10- Engine Harness
11- 12V Battery
12- Starter Solenoid
13- Outer Switch Box
14- Terminal Block
15- Water Temperature Switch
16- Voltage Regulator
17- Coil # 1
18- Coil # 3
19- Coil # 5
20- Coil # 6
21- Coil # 4
22- Coil # 2
23- Inner Switch Box
24- Trigger
25- 20 Ampere Fuse

Wiring Diagram XR6/MAG III/175

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW



1 - 40 Ampere Stator
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4 - Oil Tank Cap
5 - Idle Stabilizer
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8 - Temperature Gauge Sender
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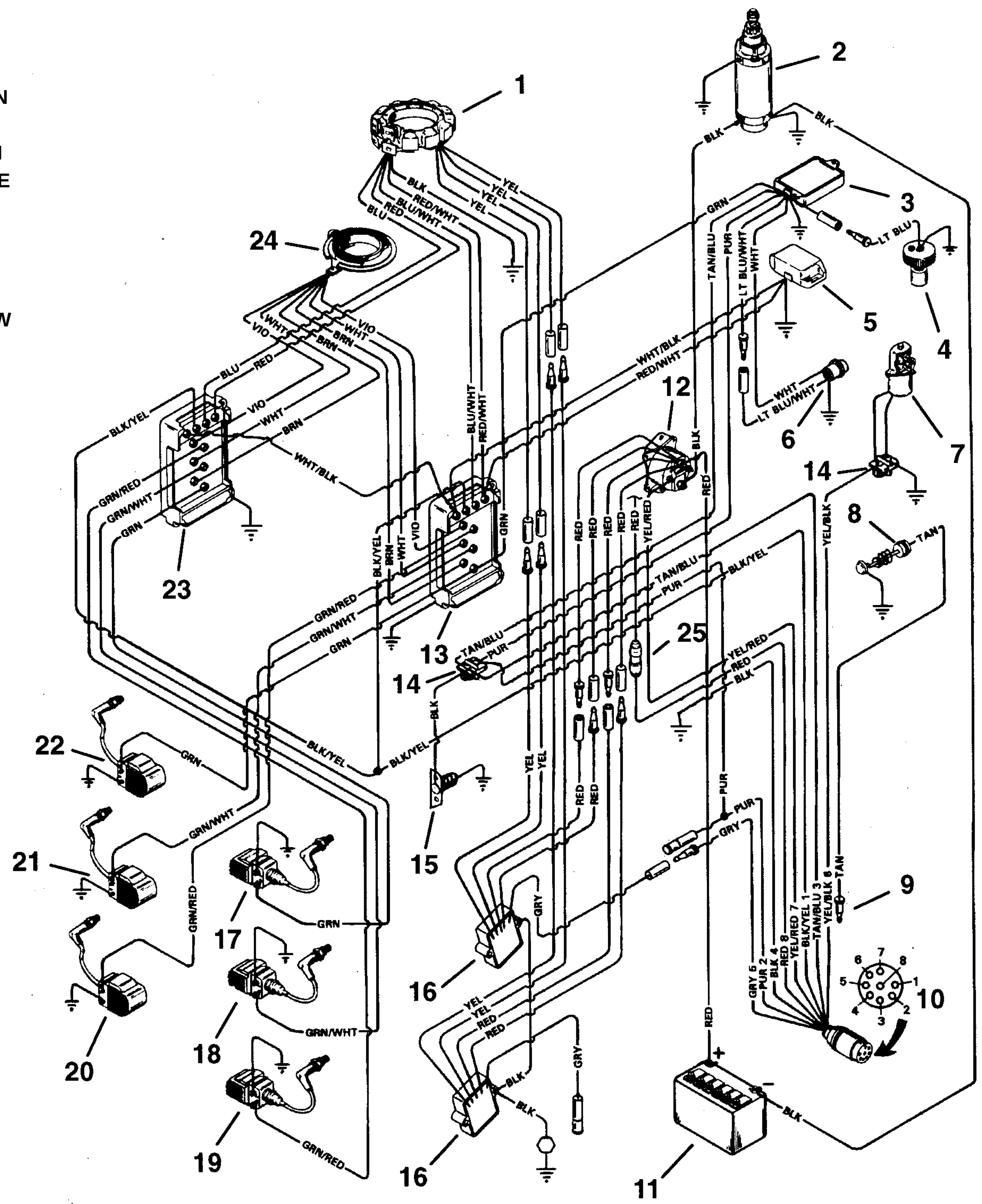
12- Starter Solenoid
13- Outer Switch Box
14- Terminal Block
15- Water Temperature Switch
16- Voltage Regulator
17- Coil # 1
18- Coil # 3
19- Coil # 5
20- Coil # 6
21- Coil # 4
22- Coil # 2
23- Inner Switch Box
24- Trigger
25- Resister
26- Shift Switch
27- 20 Ampere Fuse

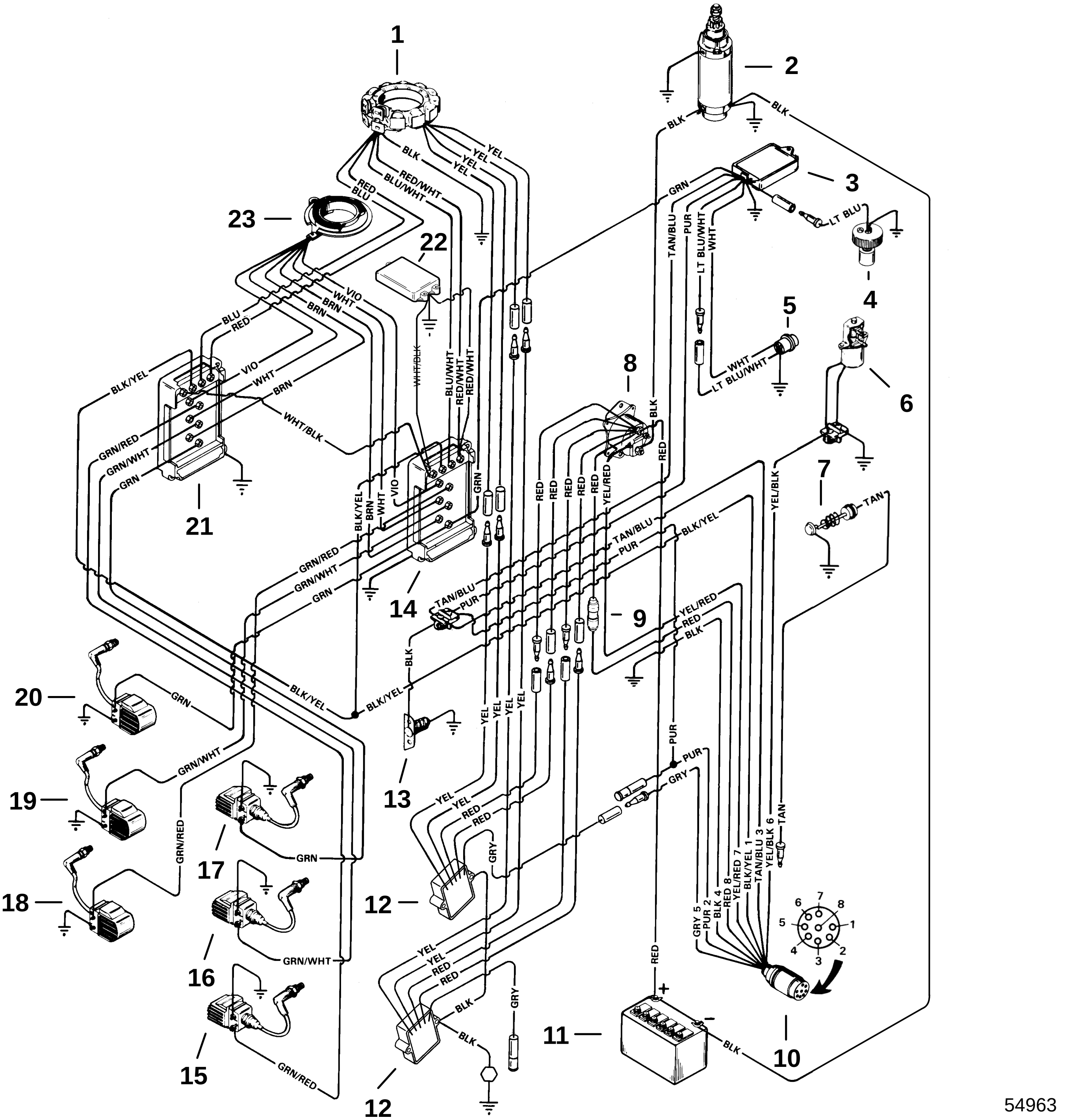
Wiring Diagram 200

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW



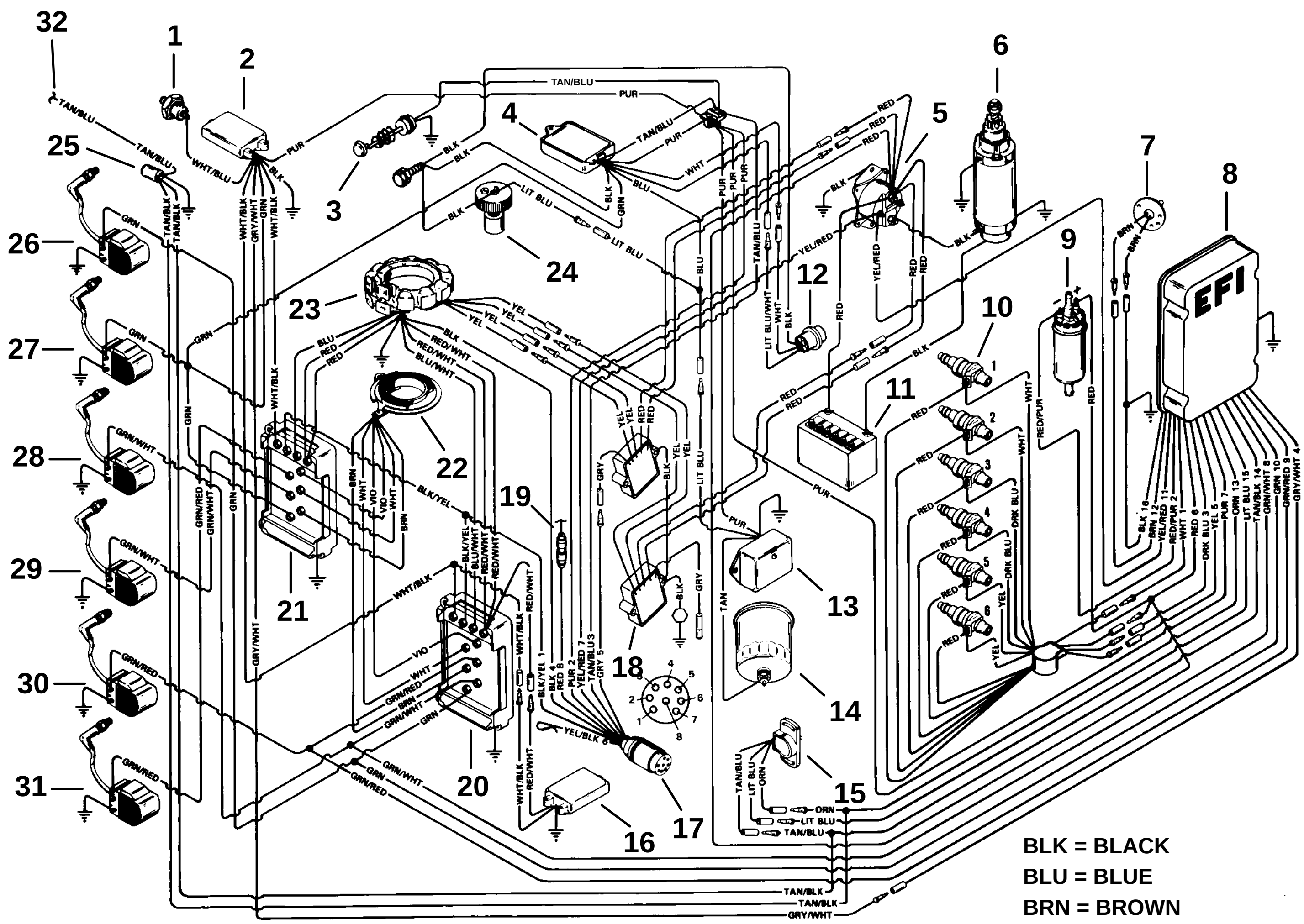
1 - 40 Ampere Stator
2 - Starter
3 - Warning Module
4 - Oil Tank Cap
5 - Idle Stabilizer
6 - Rotational Sensor
7 - Enrichment Valve
8 - Temperature Gauge Sender
9 - Control Box Instrument Connector
10- Engine Harness
11- 12 Volt Battery
12- Starter Solenoid
13- Outer Switch Box
14- Terminal Block
15- Water Temperature Switch
16- Voltage Regulator
17- Coil # 1
18- Coil # 3
19- Coil # 5
20- Coil # 6
21- Coil # 4
22- Coil # 2
23- Inner Switch Box
24- Trigger
25- 20 Ampere Fuse

Wiring Diagram 200 Carb Serial # 0D077248 thru Serial # 0D122746



1 - 40 Ampere Stator
2 - Starter
3 - Warning Module
4 - Oil Cap
5 - Motion Sensor
6 - Fuel Enrichment Valve
7 - Temperature Gauge Sender
8 - Starter Solenoid
9 - 20 Ampere Fuse
10- Engine Harness
11- Battery
12- Voltage Regulator
13- Water Temperature Switch
14- Outer Switch Box
15- #5 Coil
16- #3 Coil
17- #1 Coil
18- #6 Coil
19- #4 Coil
20- #2 Coil
21- Inner Switch Box
22- Advance Module*
23- Trigger
*Refer to Service Bulletin 91-35

Wiring Diagram 200 EFI and 200 Pro Max/Super Magnum (Early Models with Detonation Module) (1995 and Prior)



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BLK = BLACK
BLU = BLUE
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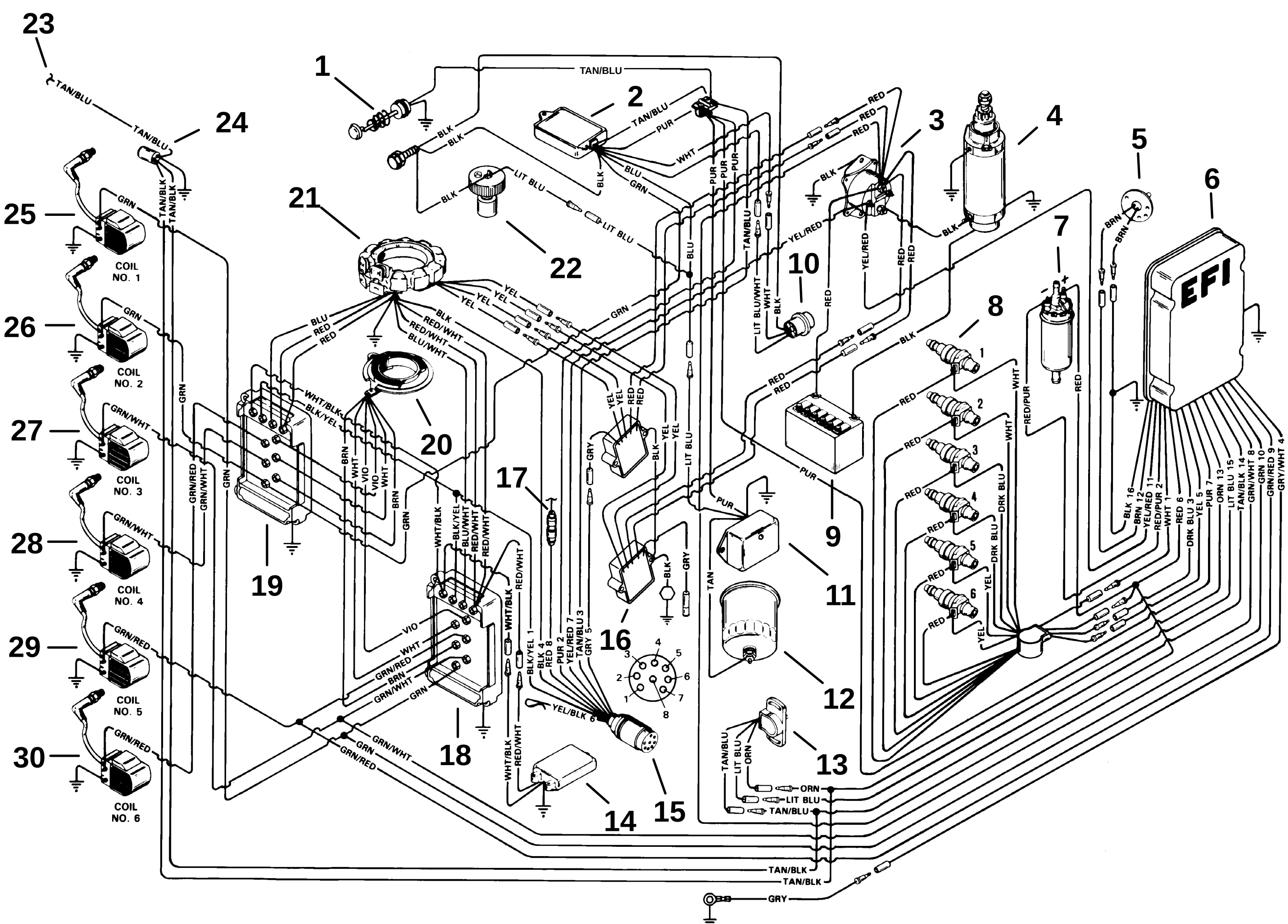
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW

1 - Detonation Sensor
2 - Detonation Module
3 - Water Temperature Switch
4 - Warning Module
5 - Starter Solenoid
6 - Starter Motor
7 - Air Temperature Sensor
8 - Electronic Control Unit
9 - Fuel Pump
10- Injectors
11- 12 Volt Battery
12- Rotational Sensor
13- Water Sensing Warning Module
14- Water Separating Filter
15- Throttle Position Sensor
16- Idle Stabilizer
17- Engine Harness Connector
18- Voltage Regulator
19- 20 Ampere Fuse (To Trim Solenoid)
20- Inner Switch Box
21- Outer Switch Box
22- Trigger
23- Stator
24- Oil Tank Cap
25- Temperature Sensor
26- Coil # 1
27- Coil # 2
28- Coil # 3
29- Coil # 4
30- Coil # 5
31- Coil # 6
32- To Temperature Gauge

Wiring Diagram 150/175 EFI and 150/200/225 Pro Max/Super Magnum (1995 and Prior)

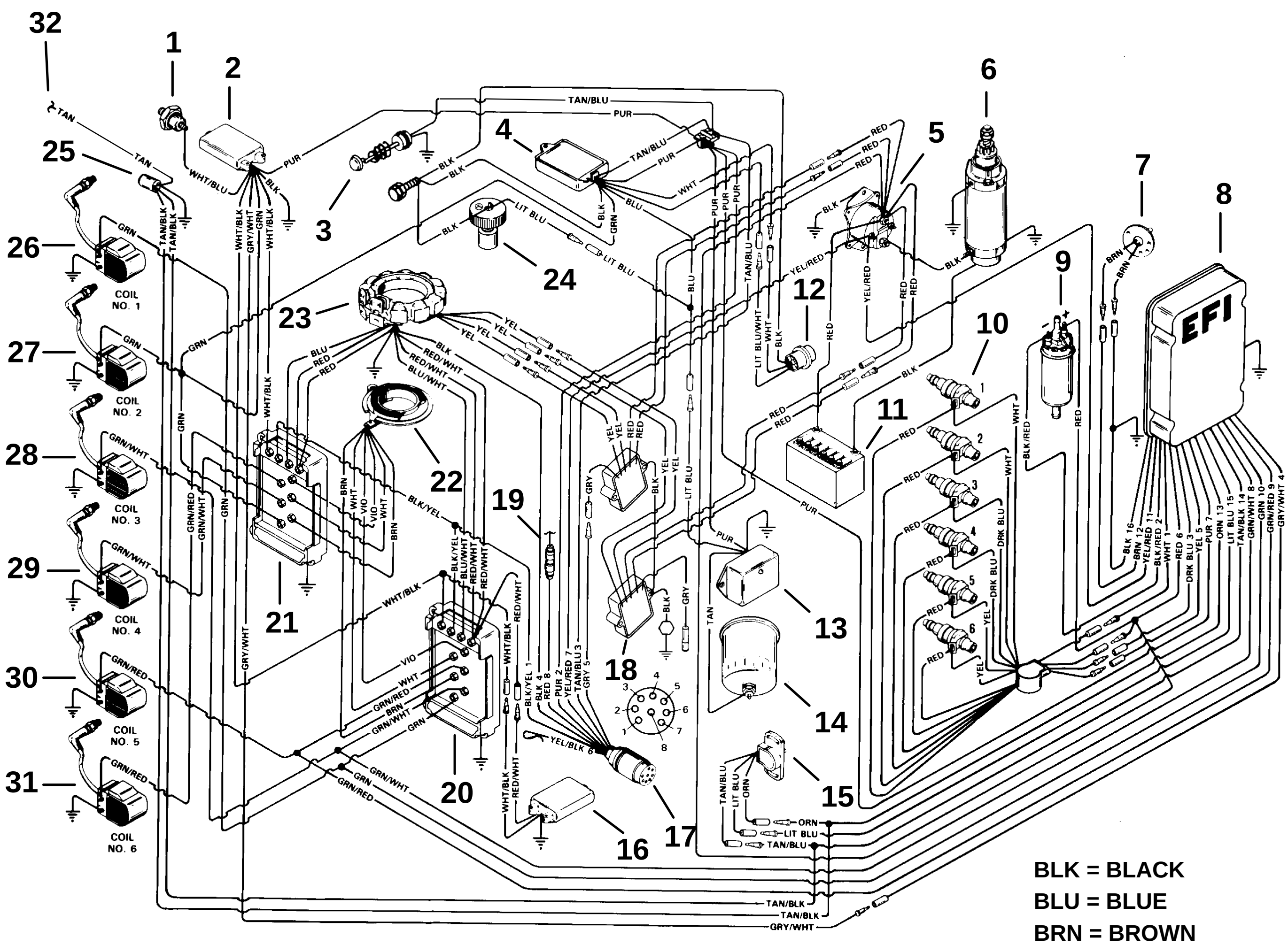
BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW



54352

1 - Water Temperature Switch
2 - Warning Module
3 - Starter Solenoid
4 - Starter Motor
5 - Air Temperature Sensor
6 - Electronic Control Unit
7 - Fuel Pump
8 - Injectors
9 - 12 Volt Battery
10- Rotational Sensor
11- Water Sensing Warning Module
12- Water Separating Filter
13- Throttle Position Sensor
14- Idle Stabilizer
15- Engine Harness Connector
16- Voltage Regulator (2)
17- 20 Ampere Fuse (To Trim Solenoid)
18- Inner Switch Box
19- Outer Switch Box
20- Trigger
21- Stator
22- Oil Tank Cap
23- To Temperature Gauge
24- Temperature Sensor
25- Coil # 1
26- Coil # 2
27- Coil # 3
28- Coil # 4
29- Coil # 5
30- Coil # 6

Wiring Diagram 200 EFI and 200 Pro Max/Super Magnum (Early Models with Detonation Module) (1996 and Newer)

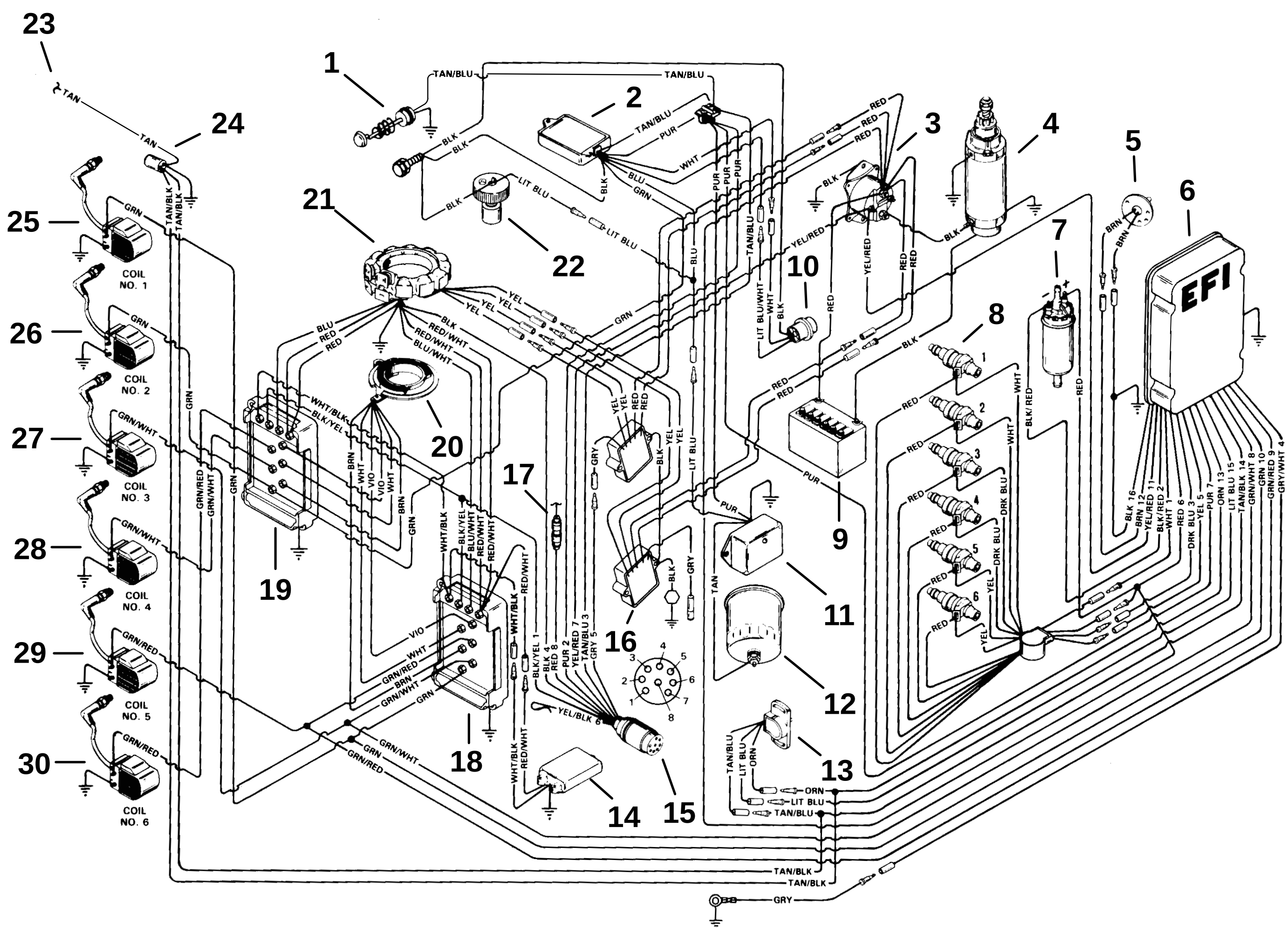


BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW

1 - Detonation Sensor
2 - Detonation Module
3 - Water Temperature Switch
4 - Warning Module
5 - Starter Solenoid
6 - Starter Motor
7 - Air Temperature Sensor
8 - Electronic Control Unit
9 - Fuel Pump
10- Injectors
11- 12 Volt Battery
12- Rotational Sensor
13- Water Sensing Warning Module
14- Water Separating Filter
15- Throttle Position Sensor
16- Idle Stabilizer
17- Engine Harness Connector
18- Voltage Regulator
19- 20 Ampere Fuse (To Trim Solenoid)
20- Inner Switch Box
21- Outer Switch Box
22- Trigger
23- Stator
24- Oil Tank Cap
25- Temperature Sensor
26- Coil # 1
27- Coil # 2
28- Coil # 3
29- Coil # 4
30- Coil # 5
31- Coil # 6
32- To Temperature Gauge

Wiring Diagram 150/175 EFI and 150/200/225 Pro Max/Super Magnum (1996 and Newer)

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW

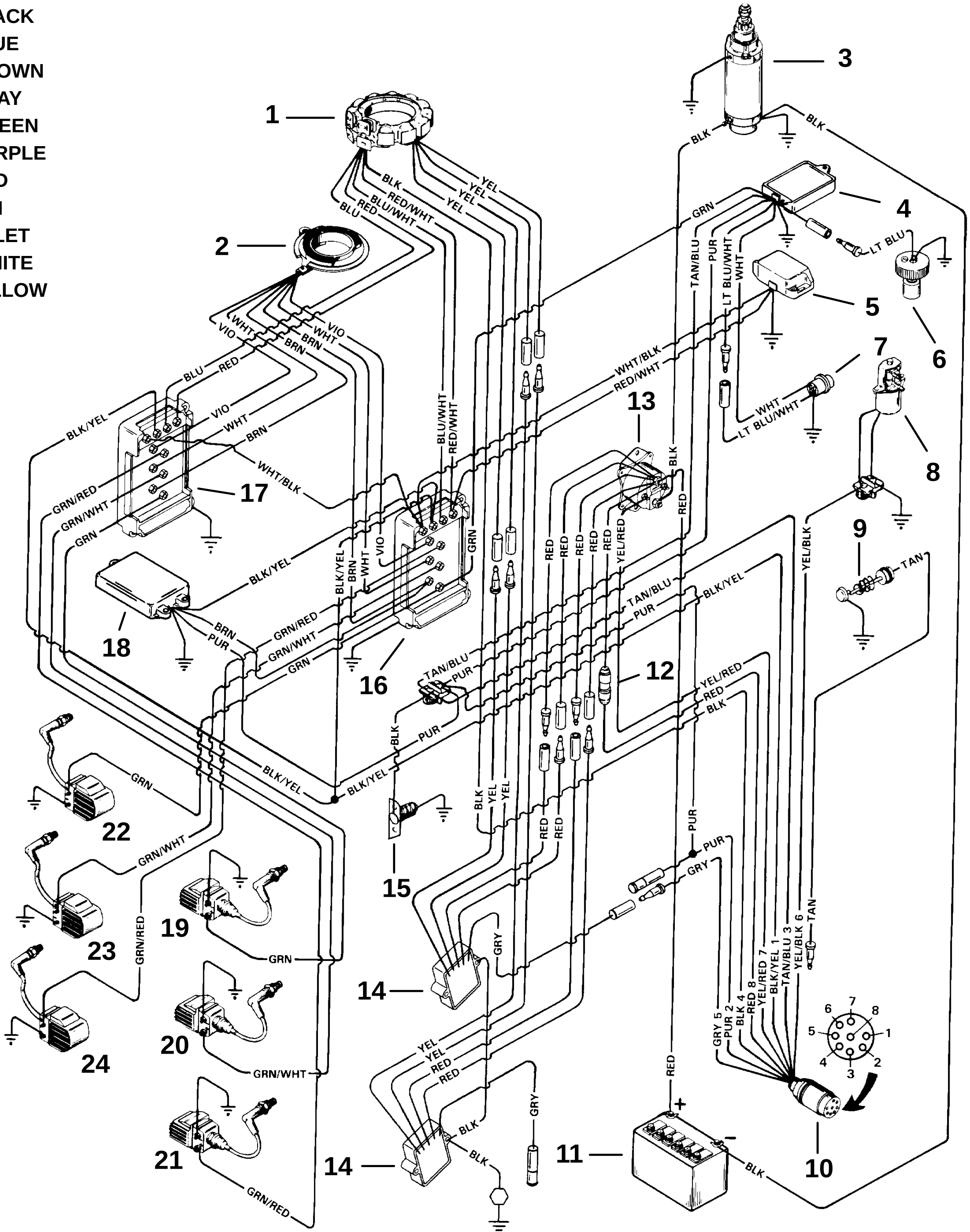


54352

1 - Water Temperature Switch
2 - Warning Module
3 - Starter Solenoid
4 - Starter Motor
5 - Air Temperature Sensor
6 - Electronic Control Unit
7 - Fuel Pump
8 - Injectors
9 - 12 Volt Battery
10- Rotational Sensor
11- Water Sensing Warning Module
12- Water Separating Filter
13- Throttle Position Sensor
14- Idle Stabilizer
15- Engine Harness Connector
16- Voltage Regulator (2)
17- 20 Ampere Fuse (To Trim Solenoid)
18- Inner Switch Box
19- Outer Switch Box
20- Trigger
21- Stator
22- Oil Tank Cap
23- To Temperature Gauge
24- Temperature Sensor
25- Coil # 1
26- Coil # 2
27- Coil # 3
28- Coil # 4
29- Coil # 5
30- Coil # 6

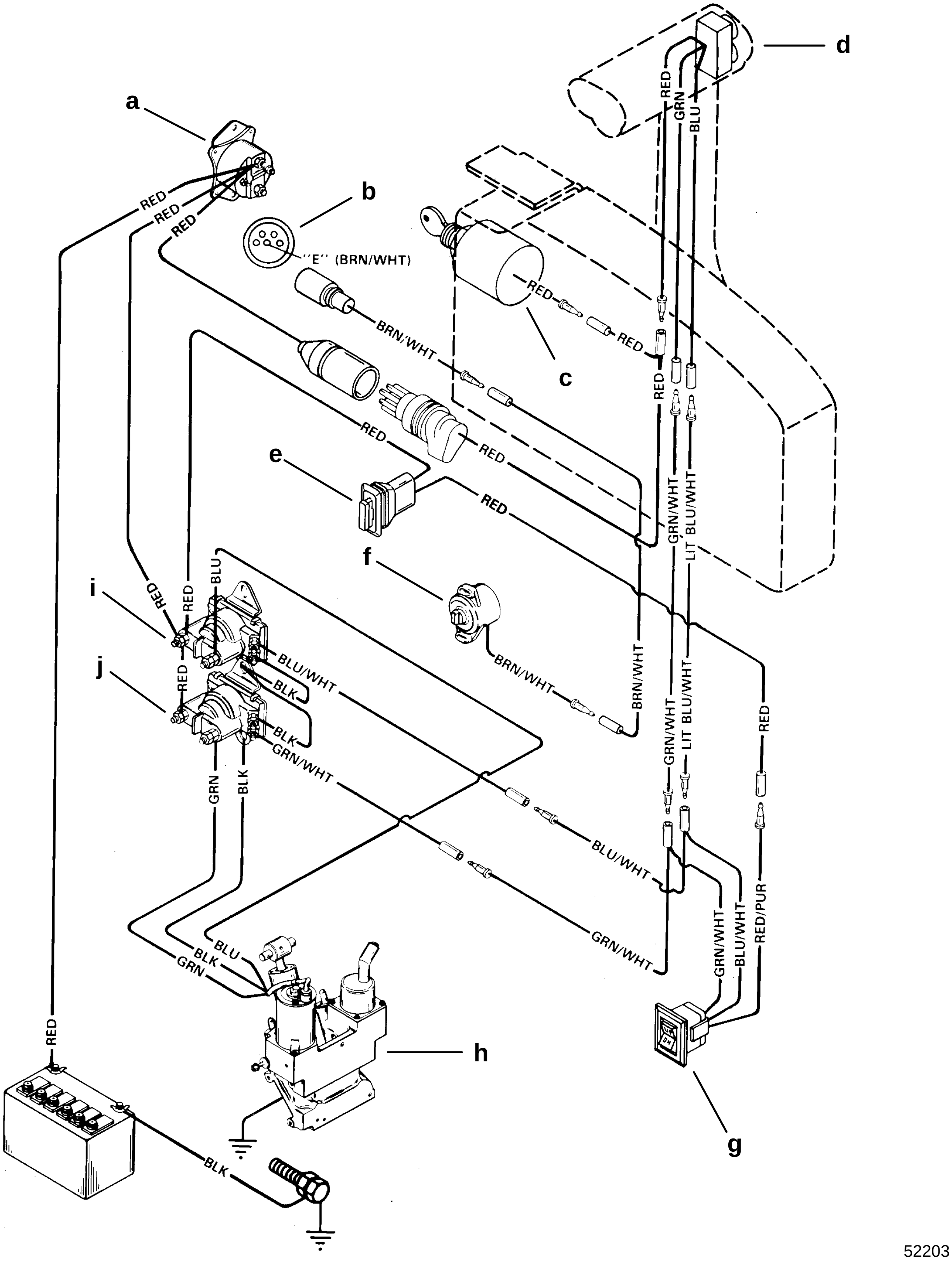
Wiring Diagram105/140 Jet

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW



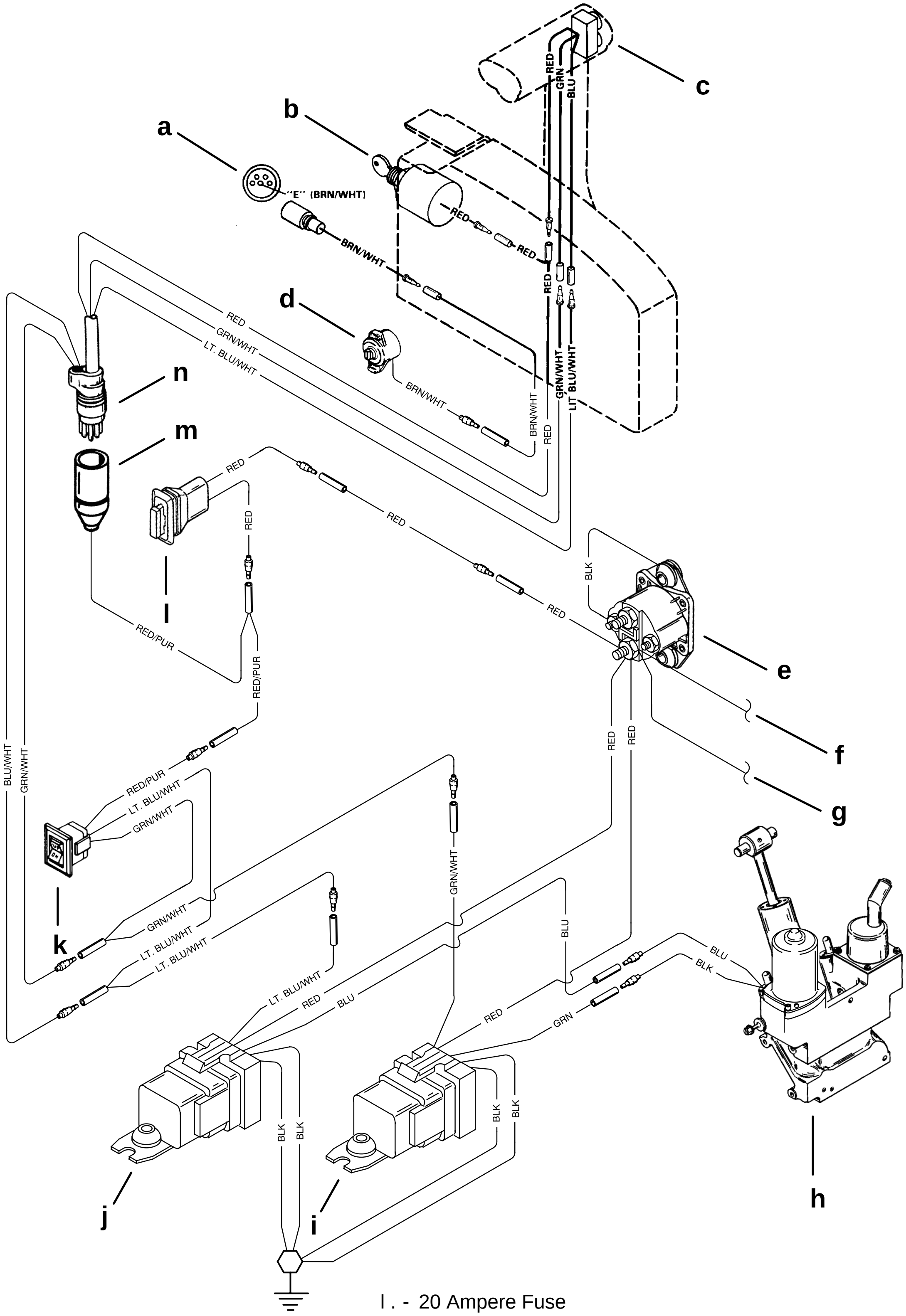
1 - Stator
2 - Trigger
3 - Starter
4 - Warning Module
5 - Idle Stabilizer
6 - Low Oil Sensor
7 - Rotational Sensor
8 - Enrichment Valve
9 - Temperature Gauge Sender
10- Engine Harness
11- Battery
12- 20 Ampere Fuse
13- Starter Solenoid
14- Voltage Regulator
15- Water Temperature Switch
16- Outer Switch Box
17- Inner Switch Box
18- RPM Limiter
19- Coil # 1
20- Coil # 3
21- Coil # 5
22- Coil # 2
23- Coil # 4
24- Coil # 6

Power Trim Wiring Diagram with Solenoids



a - Start Solenoid
b - Tach. Connector
c - Key Switch Assembly
d - Trim Switch
e - 20 Ampere Fuse
f - Trim Sender
g - Bottom Cowl Switch
h - Pump and Motor
i . - UP Solenoid
j . - DOWN Solenoid

Power Trim Wiring Diagram with Relays



a - Tach. Connector
b - Key Switch Assembly
c - Trim Switch
d - Trim Sender
e - Start Solenoid
f - To Battery
g - To Alternator
h - Trim Pump and Motor
i . - DOWN Solenoid
j . - UP Solenoid
k - Bottom Cowl Switch
l . - 20 Ampere Fuse
m - Engine Harness
n - Remote Control Harness

Instrument Wiring Connections

Figure 1
Without Light Switch

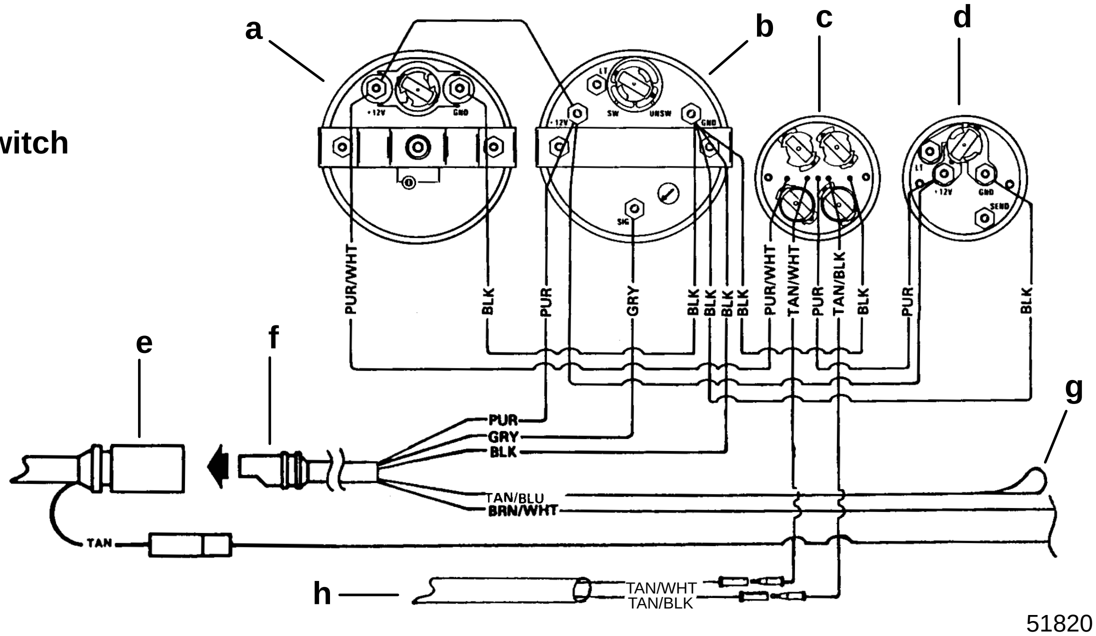
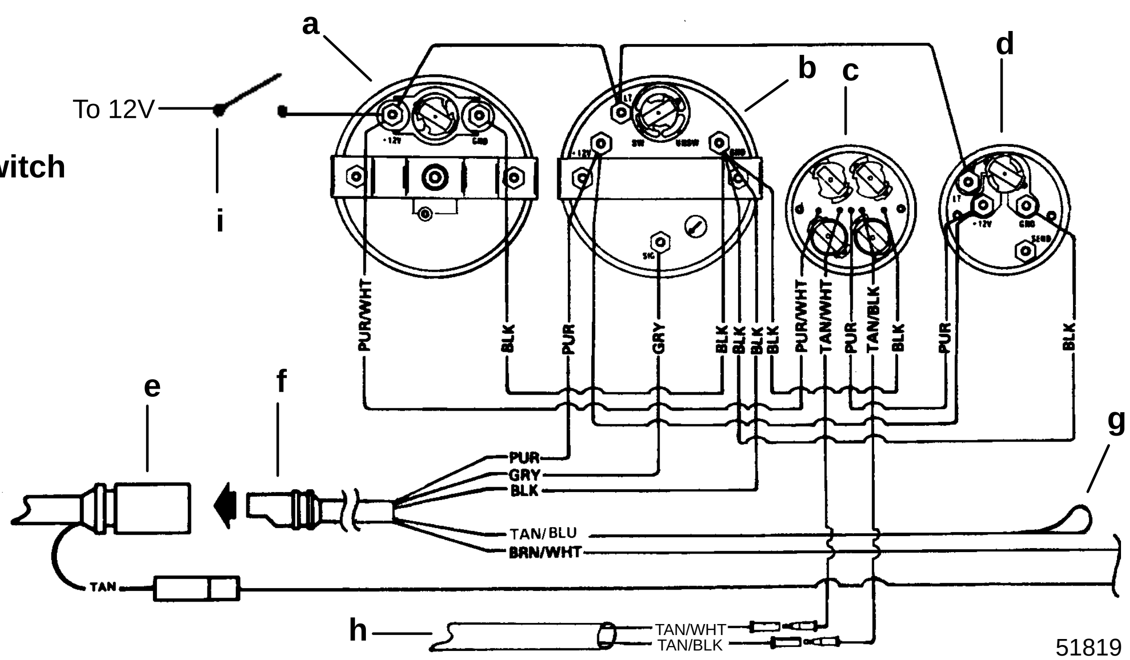


Figure 2
With Light Switch

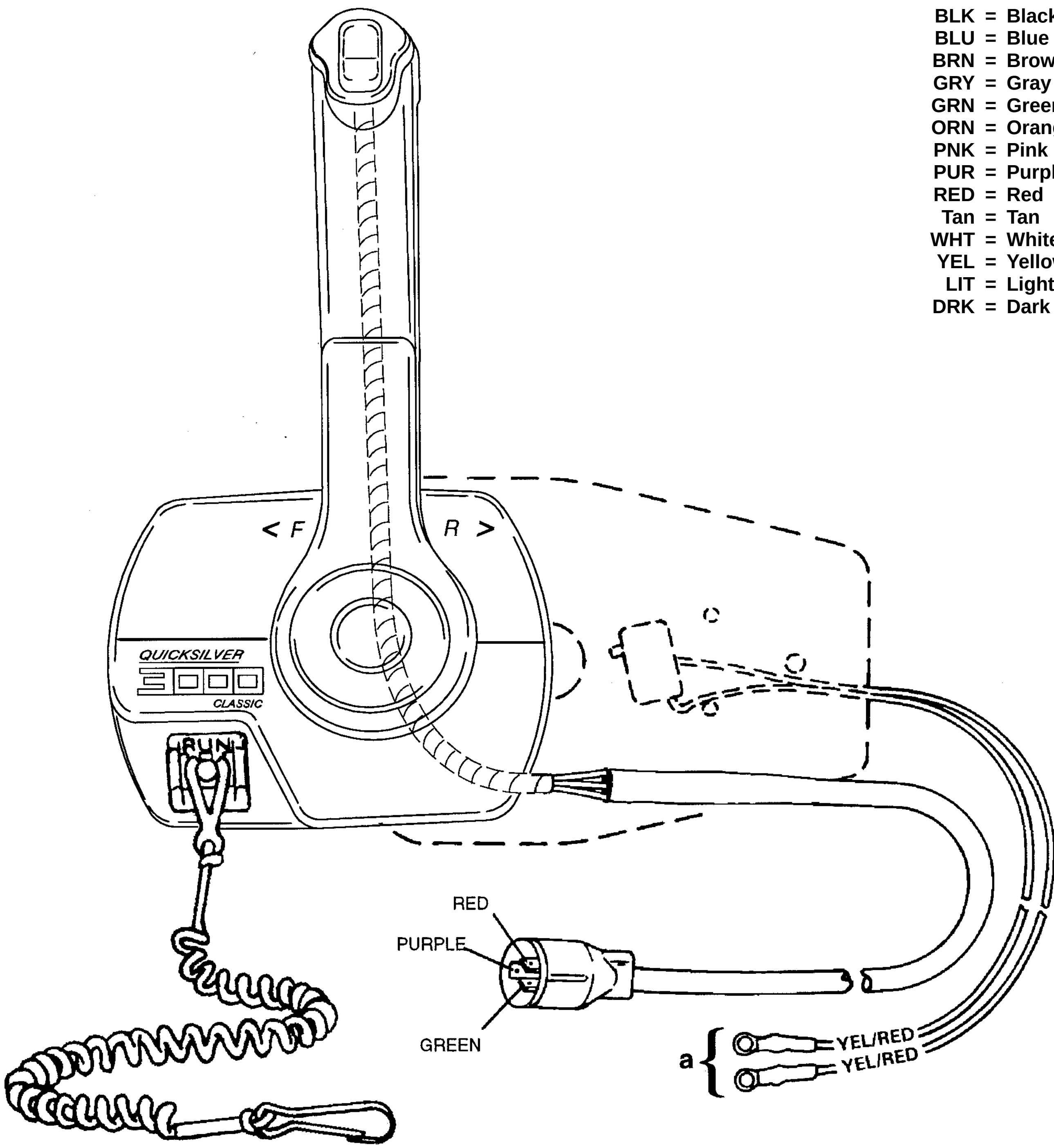


a - Speedometer
b - Tachometer
c - Temperature/Oil Warning Panel
d - Voltmeter
e - Tachometer Receptacle - From Control Box or Ignition/ Choke Switch
f - Tachometer Wiring Harness
g - Lead to Optional Visual Warning Kit (Taped Back to Harness)
h - Cable Extension (For Two Function Warning Panel)
i - Light Switch

Wire Color	Where To
BLK = BLACK	Ground
TAN/WHT = TAN/WHITE	Oil Light
TAN/BLK = TAN/BLACK	Temperature Light
TAN = TAN	Temperature Gauge
PUR = PURPLE	Ignition 12 Volt
GRY = GRAY	Tachometer
BRN/WHT = BROWN/WHITE	Trim Gauge
TAN/BLU = TAN/BLUE	Visual Warning Kit (Optional)

Commander 3000 Classic Panel Remote Control

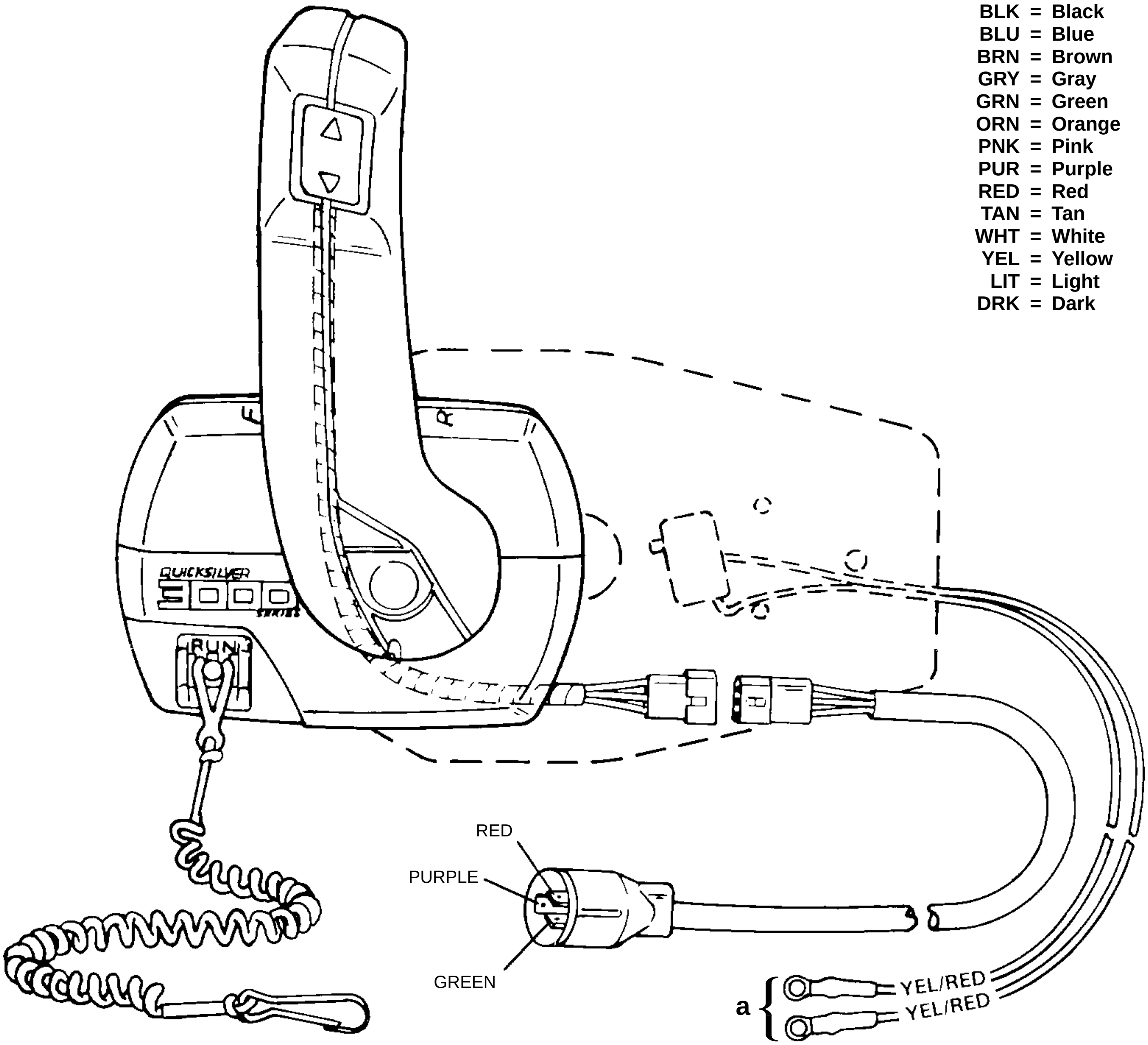
BLK	=	Black
BLU	=	Blue
BRN	=	Brown
GRY	=	Gray
GRN	=	Green
ORN	=	Orange
PNK	=	Pink
PUR	=	Purple
RED	=	Red
Tan	=	Tan
WHT	=	White
YEL	=	Yellow
LIT	=	Light
DRK	=	Dark



a - Neutral Interlock Switch

Commander 3000 Panel Remote Control

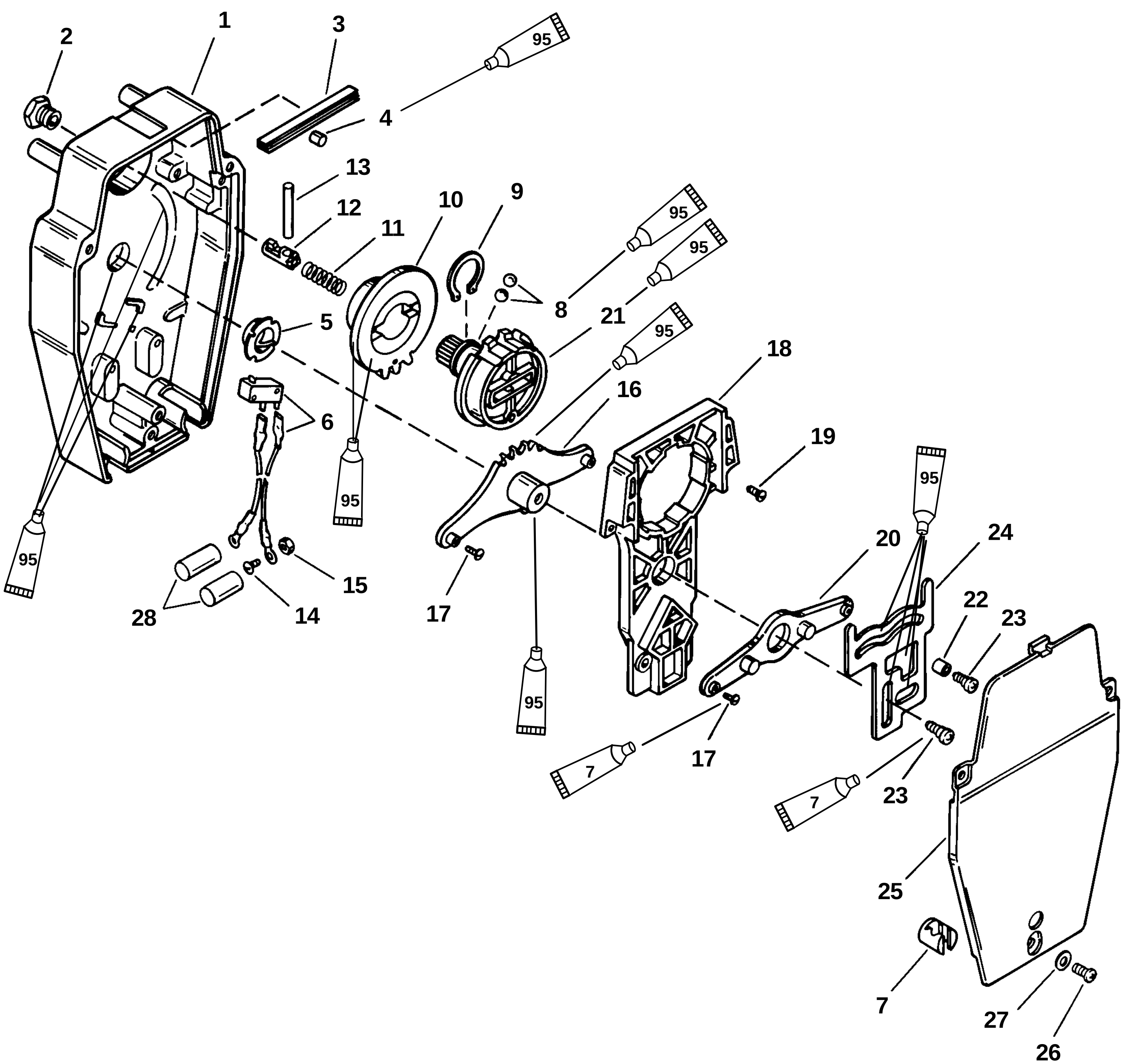
BLK	=	Black
BLU	=	Blue
BRN	=	Brown
GRY	=	Gray
GRN	=	Green
ORN	=	Orange
PNK	=	Pink
PUR	=	Purple
RED	=	Red
TAN	=	Tan
WHT	=	White
YEL	=	Yellow
LIT	=	Light
DRK	=	Dark



a - Neutral Interlock Switch

Notes:

Commander 3000/3000 Classic Components



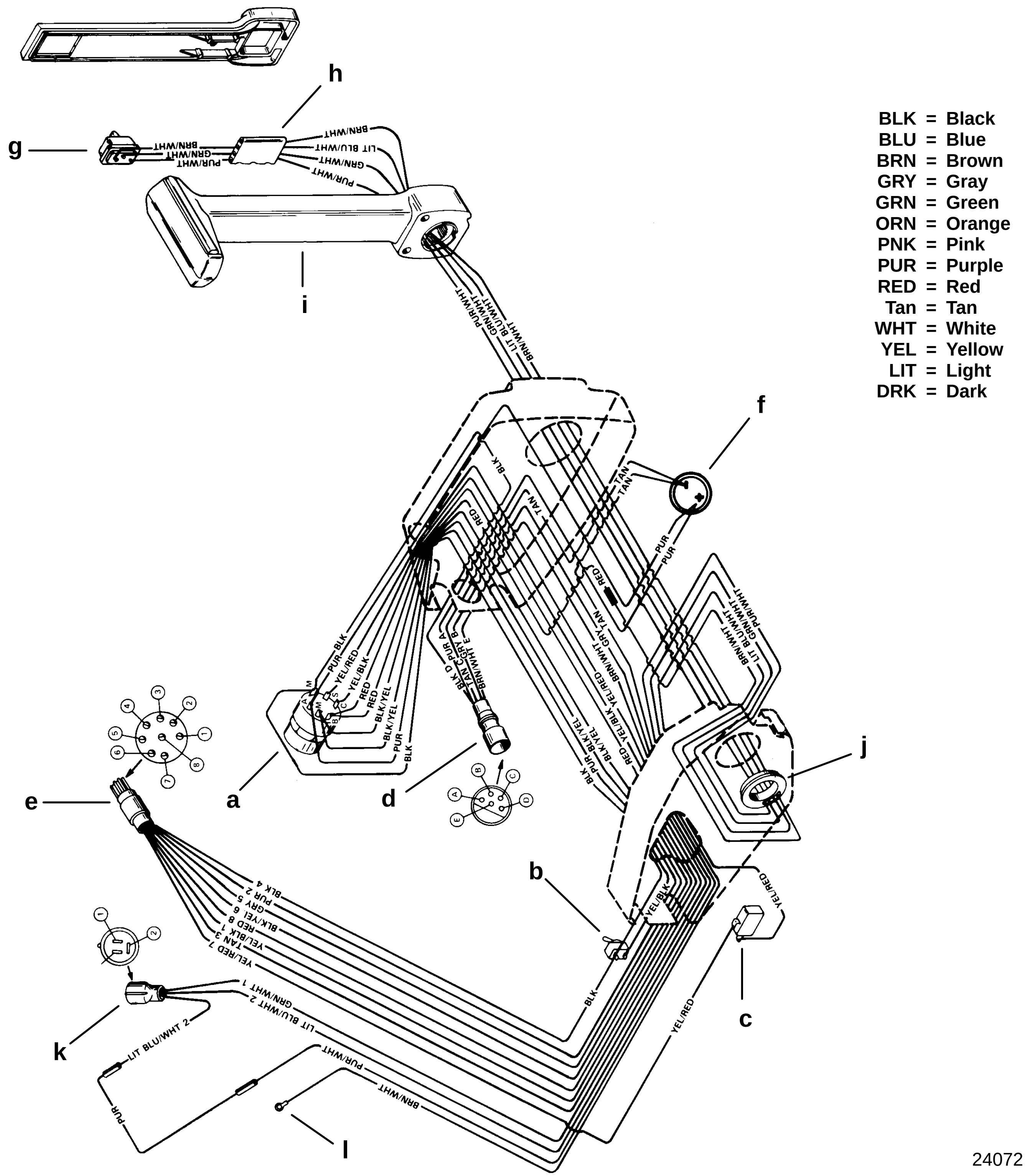
7 Loctite 271 (92-809820)

95 2-4-C With Teflon (92-825407A12)

Commander 3000/3000 Classic Components

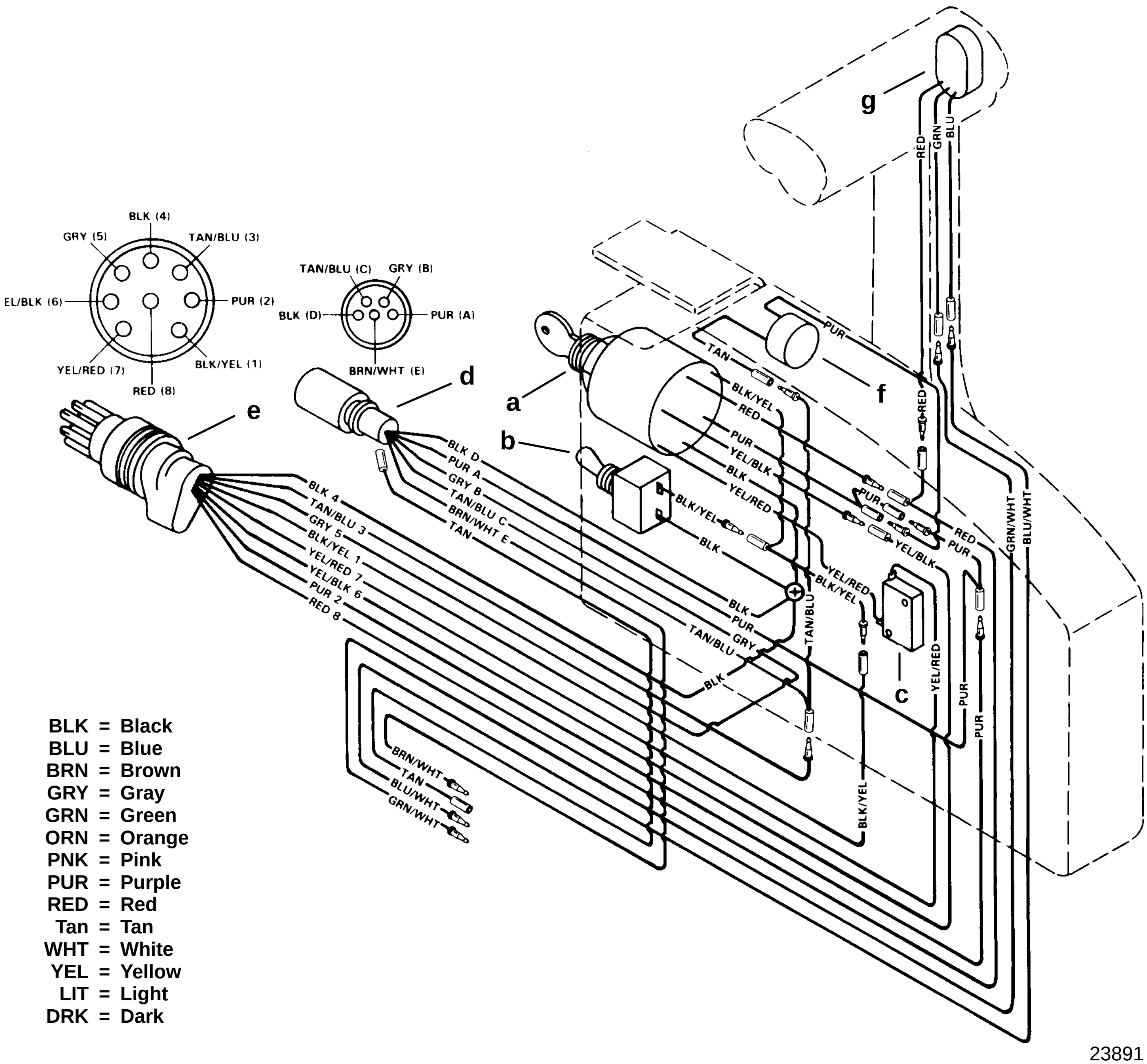
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	HOUSING-Control **(Panel Mount)**			
1	1	HOUSING-Control **(Console Mount)**			
2	1	BOLT-Locking (Special)	150	12.5	17.0
3	5	SPRING			
4	1	ROLLER			
5	1	BUSHING			
6	1	SWITCH ASSY-Neutral Start **(2 Ring Terminals)**			
6	1	SWITCH ASSY-Neutral Start **(No Terminals)**			
7	2	GROMMET			
8	2	BALL-Steel			
9	1	RING-Retaining			
10	1	GEAR-Shift			
11	1	SPRING			
12	1	SHAFT-Throttle Only			
13	1	PIN-Shift Gear			
14	2	SCREW (#10-32 x 1/4″)			
15	2	NUT (10-32)			
16	1	ARM ASSEMBLY-Shift			
17	2	SCREW (#8-32 x 3/8″)	25		3.0
18	1	SUPPORT ASSEMBLY-Shaft			
19	4	SCREW (#10-32 x 5/8″)	35		4.0
20	1	ARM ASSEMBLY-Throttle			
21	1	SHAFT KIT-Handle			
22	1	ROLLER-Throttle Plate			
23	2	BOLT-Shoulder (Special)	35		4.0
24	1	PLATE			
25	1	BACK PLATE			
26	3	SCREW (#10-32 x 5/8″)	10		1.0
27	1	WASHER			
28	2	INSULATOR (2″)			

COMMANDER Side Mount Remote Control (Power Trim/Tilt Electric Start with Warning Horn) Wiring Diagram



a - Ignition/Choke Switch
b - Emergency Stop
c - Neutral Start Switch
d - Tachometer/Accessories Harness Connector
e - Wiring Harness Connector
f - Warning Horn
g - Trim/Tilt Switch
h - Wire Retainer
i . - Control Handle
J - Trim Harness Bushing
k - Trim Harness Connector
l . - Lead to Trim Indicator Gauge

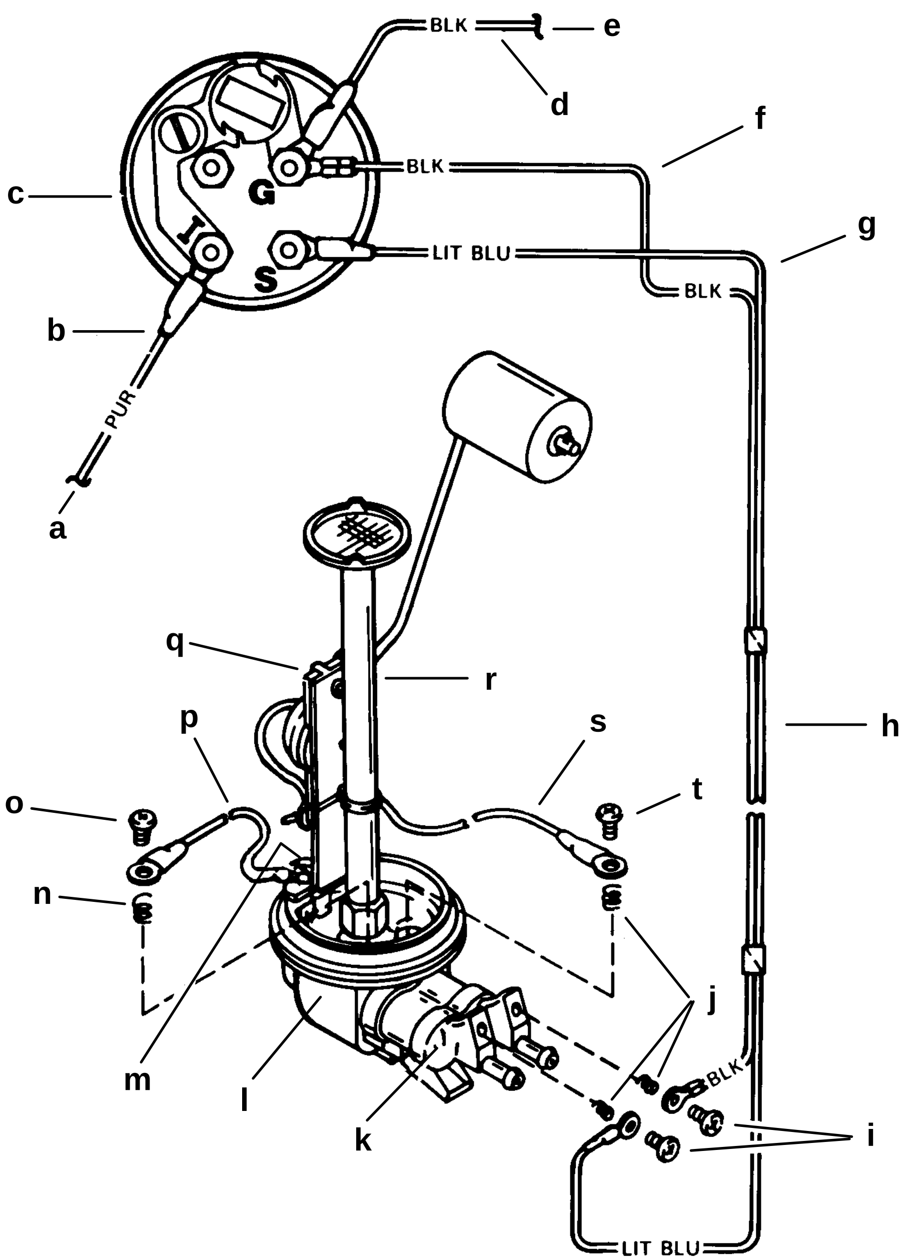
COMMANDER 2000 Side Mount Remote Control (Power Trim/Tilt Electric Start with Warning Horn) Wiring Diagram



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

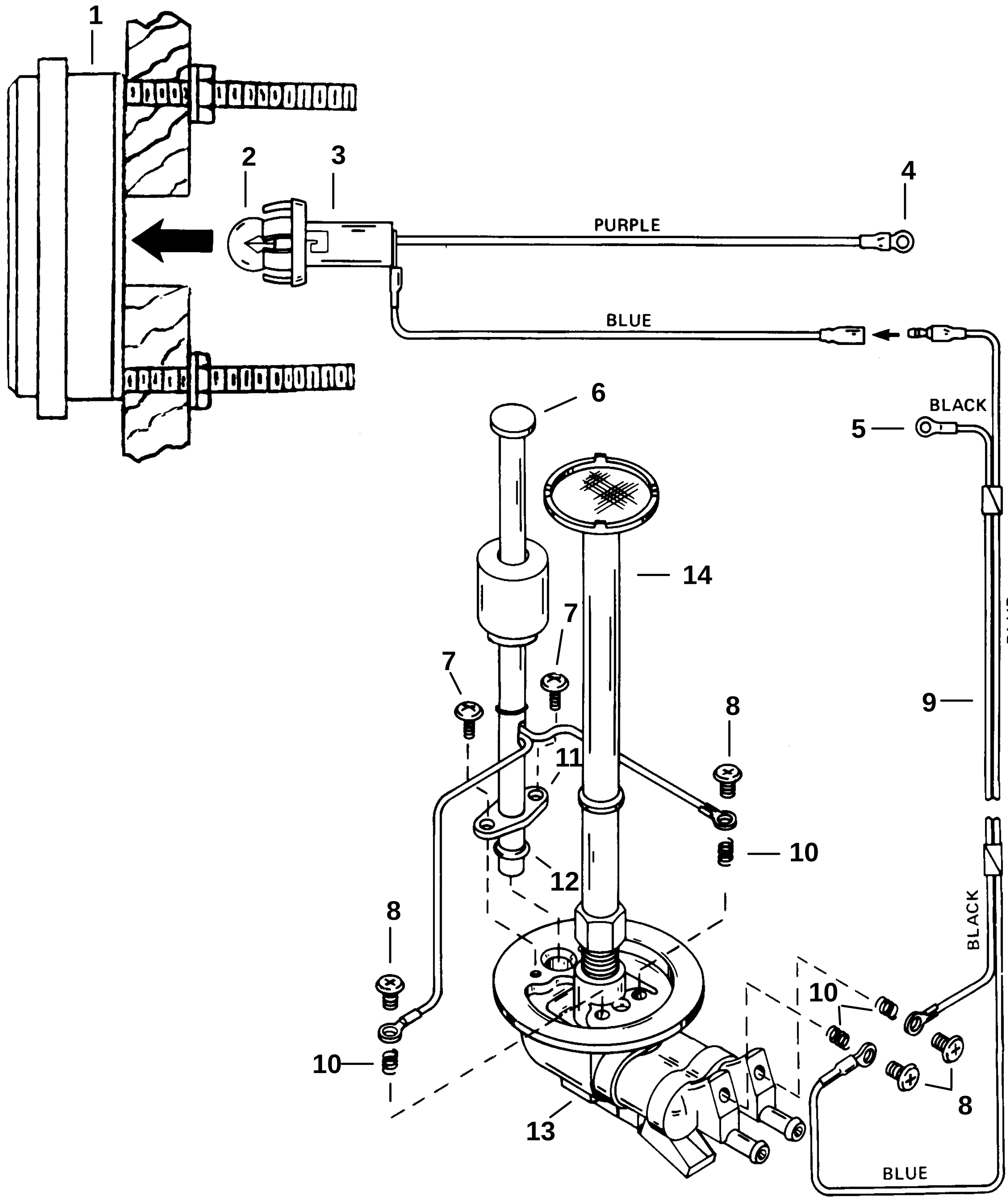
a - Ignition/Choke Switch
b - Emergency Stop Switch
c - Neutral Start Switch
d - Tachometer/Accessories Harness Connector
e - Wiring Harness Connector
f - Warning Horn
g - Trim/Tilt Switch

Oil Level Gauge Wiring Diagram



a - To 12 Volt Source
b - PURPLE Wire (Connect to Trim Indicator Gauge “I” [or POSITIVE (+) 12 Volt Source that is Turned “ON” and “OFF” with Ignition Switch])
c - Oil Level Gauge
d - BLACK Wire (Connects to NEGATIVE Ground)
e - To Ground
f - BLACK Wire (From Gauge to Oil Clip Connector)
g - LIGHT BLUE Sender Lead to Gauge
h - Wiring Harness (LT. BLU. and BLACK)
i - Screw (10-16 x 5/8 in.)
j - Spring
k - Oil Clip Connector
m - Screw (10-16 x 1/4 in.)
n - Spring
o - Screw (10-16 x 5/8 in.)
p - BLACK Wire
q - Oil Level Sender Unit
r - Oil Pick-Up Tube
s - WHITE Lead (from Oil Level Sender)
t - Screw (10-16 x 5/8 in.)

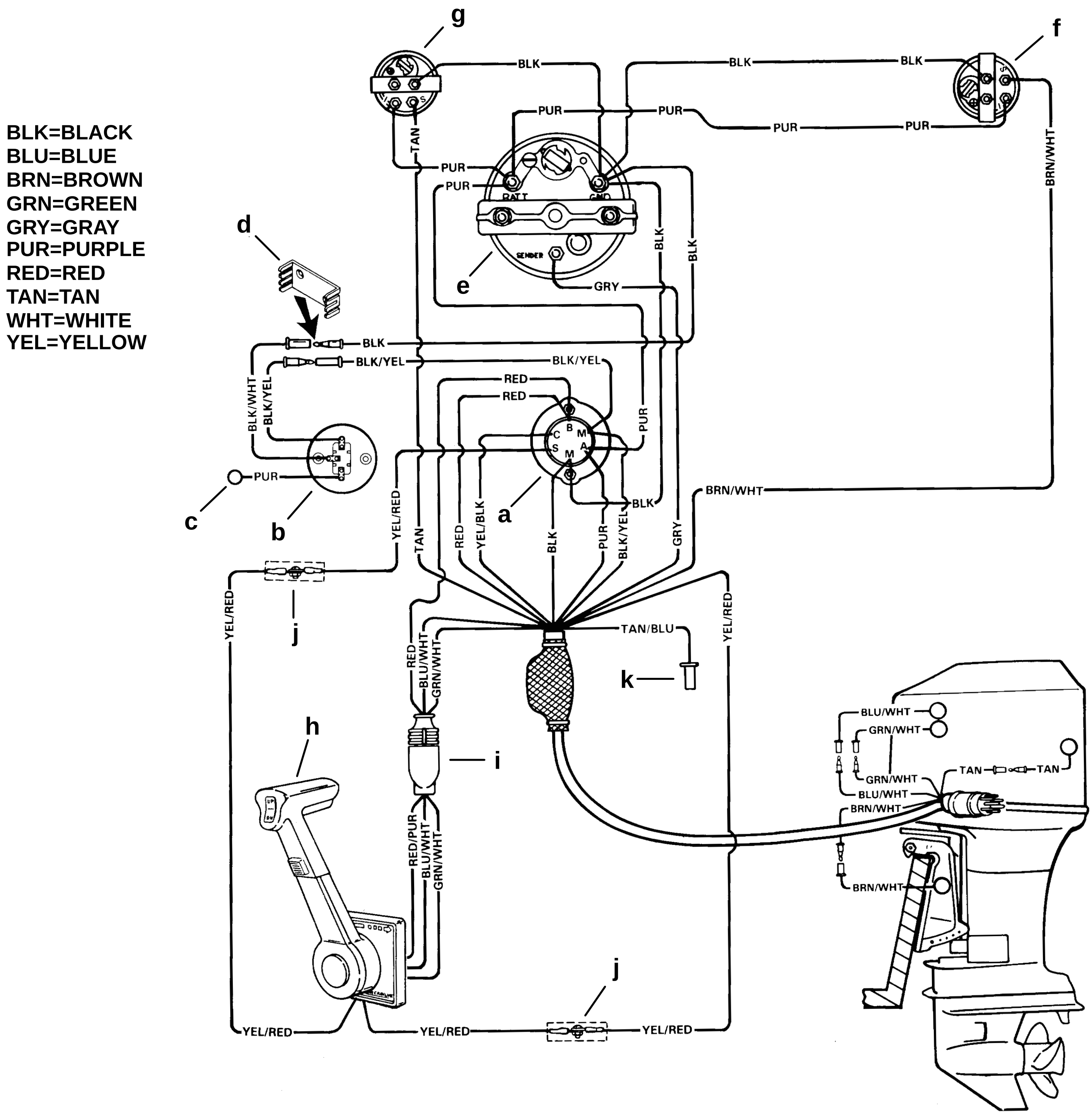
Visual Warning Wiring Diagram



1 - Bezel
2 - Lamp (GE #257)
3 - Socket Assembly
4 - Connect to Trim Indicator Gauge Terminal “I” or POSITIVE (+) 12 Volt Source that is turned “ON” and “OFF” with Ignition Switch.
5 - Connect to (–) NEGATIVE ground
6 - Float Tube Assembly
7 - Screw (Self Tapping) [5/8 in. (15.7mm) Long
8 - Screw [1/4 in. (6.3mm) Long

9 - Harness, 20 ft. (6m) Long
10- Spring
11- Retainer
12- O-Ring
13- Cap, Oil Tank

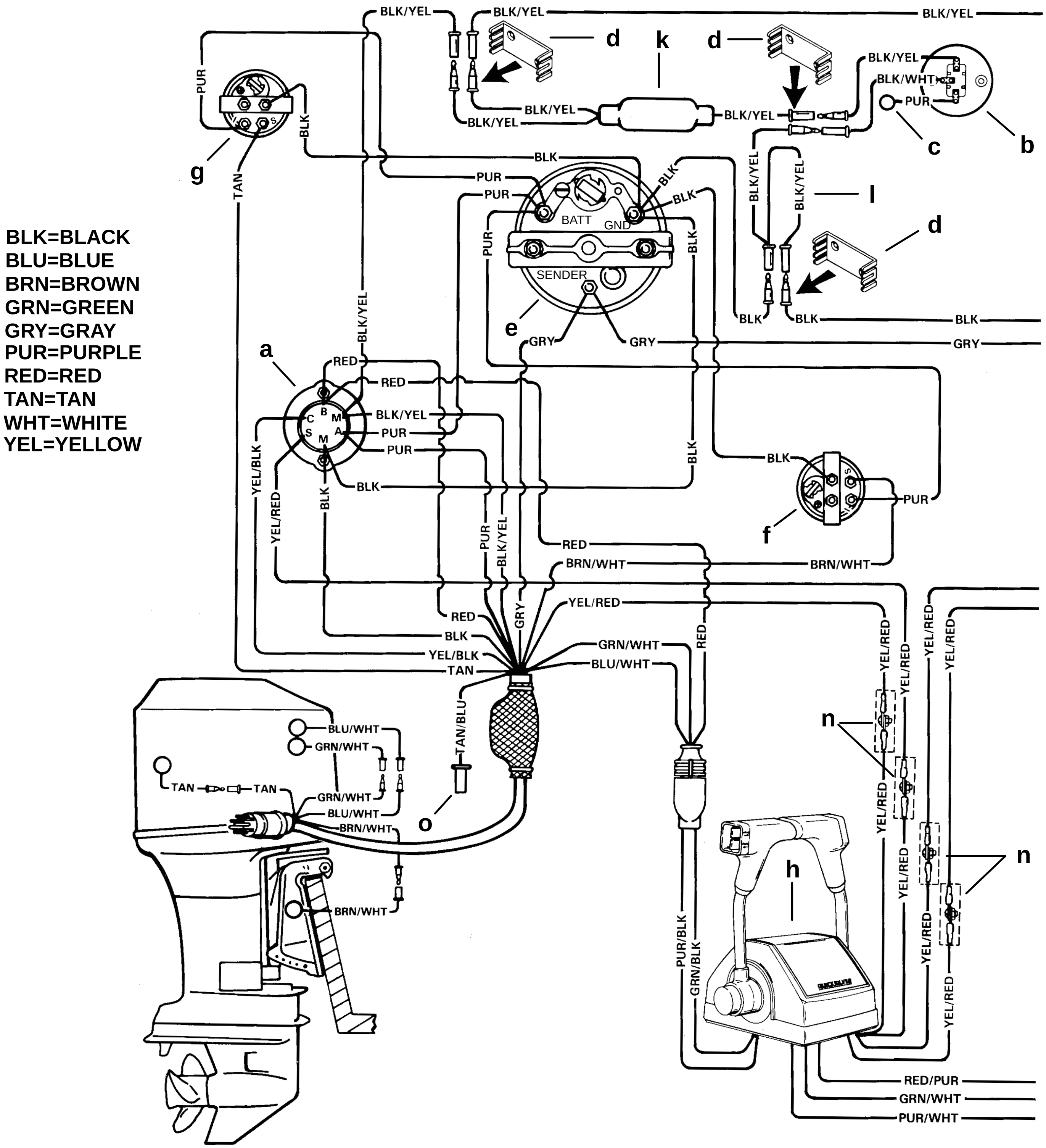
Instrument/Lanyard Stop Switch Wiring Diagram



52204

a - Ignition/Choke Switch
b - Lanyard Stop Switch
c - Lead Not Used on Outboard Installations
d - Retainer
e - Tachometer
f - Trim Indicator Gauge (Optional)
g - Temperature Gauge
h - Remote Control
i - Power Trim Harness Connector
j - Connect Wires Together w/Screw and Nut (2 Places); Apply Liquid Neoprene to Connections and Slide Rubber Sleeve over each Connection.
k - Lead to Optional Visual Warning Kit

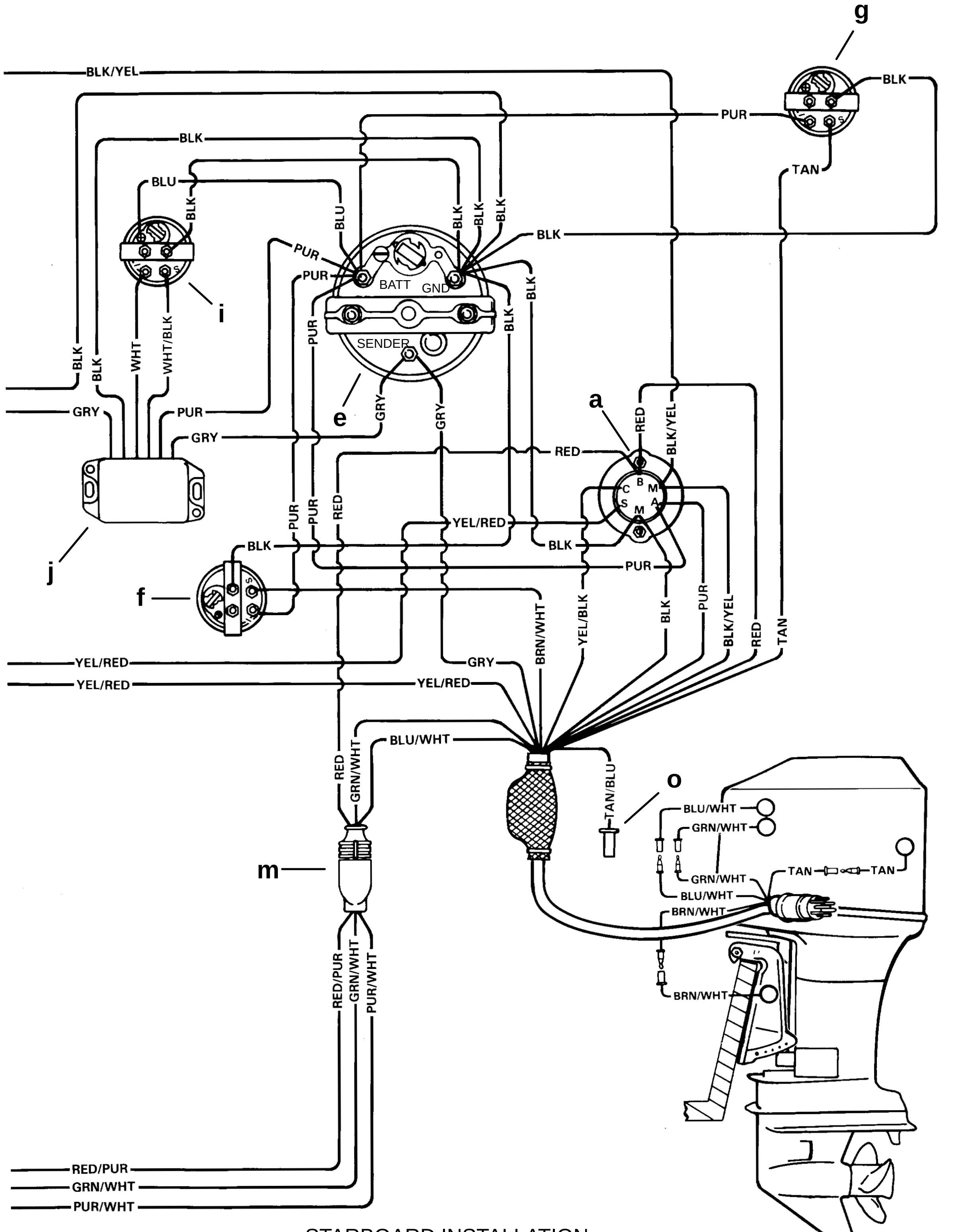
Instrument/Lanyard Stop Switch Wiring Diagram (Dual Outboard)



PORT INSTALLATION

a - Ignition/Choke Switch
b - Lanyard Stop Switch
c - Lead not used on Outboard Installations
d - Retainer
e - Tachometer
f - Trim Indicator Gauge
g - Temperature Gauge
h - Remote Control
i - Synchronizer Gauge
j - Synchronizer Module

IMPORTANT: On installations where gauge options will not be used, tape back and isolate unused wiring harness leads.



STARBOARD INSTALLATION

52206

k - Lanyard Switch (Isolation) Diode
l - Y Harness
m - Power Trim Harness Connector
n - Connect Wires together with Screw and Nut (4 Places); Apply Liquid Neoprene to Connections and slide Rubber Sleeve over each Connection.
o - Lead to Visual Warning Kit

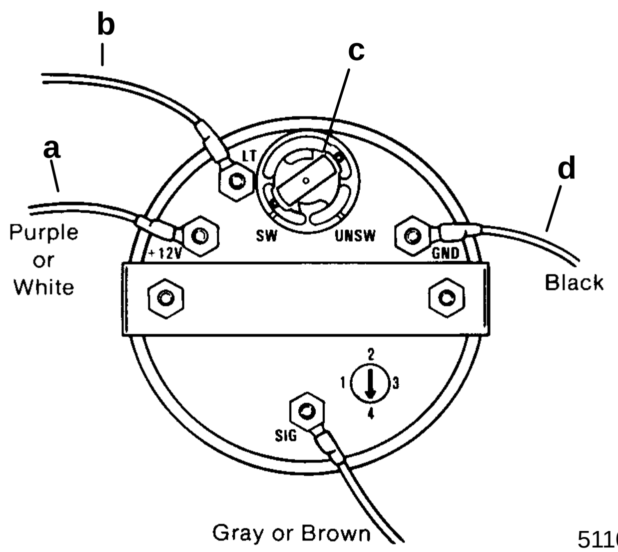
QSI Gauge Wiring Diagrams

Tachometer Wiring Diagram

Tachometer dial on back side of case must be set to position number 4.

WIRING DIAGRAM A

Use this wiring diagram when using a separate light switch for instrument lighting.

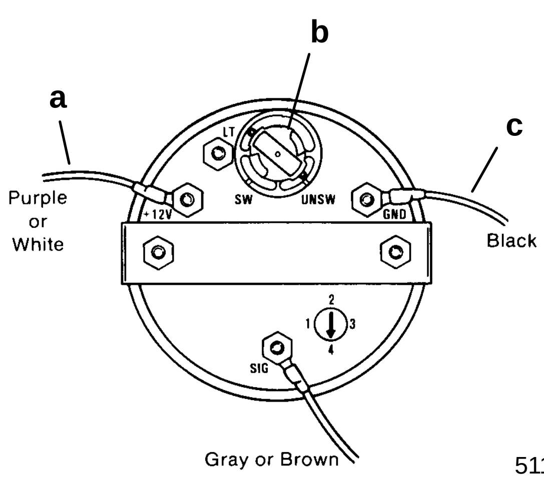


51106

a - Connect to + 12 Volt
b - +12 Volt Light Switch Wire
c - Position Light Bulb to the Switched Position
d - Connect to NEGATIVE (–) Ground

WIRING DIAGRAM B

Use this wiring diagram when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key switch is turned on.)



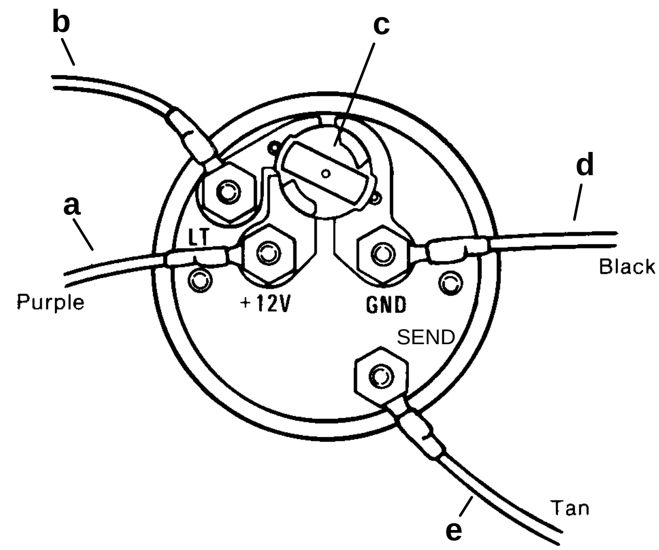
51106

a - Connect to +12 Volt
b - Position Light Bulb to the Unswitched Position
c - Connect to NEGATIVE (–) Ground

Water Temperature Gauge

WIRING DIAGRAM A

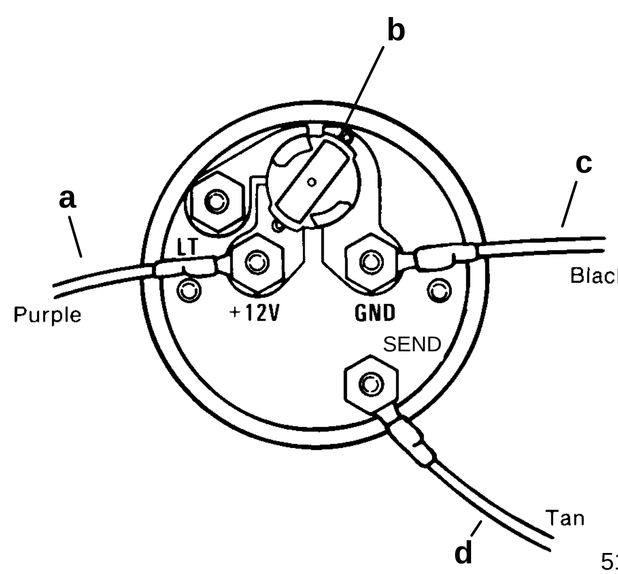
Use this wiring diagram when using a separate light switch for instrument lighting.



a - Connect to + 12 Volt
b - +12 Volt Light Switch Wire
c - Position Light Bulb to the Switched Position
d - Connect to NEGATIVE (–) Ground
e - Connect to TAN Lead located at the Tachometer Receptacle on Commander Side Mount Remote Control or TAN Lead coming from Accessory Ignition/Choke Assembly.

WIRING DIAGRAM B

Use this wiring diagram when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key is turned on.)

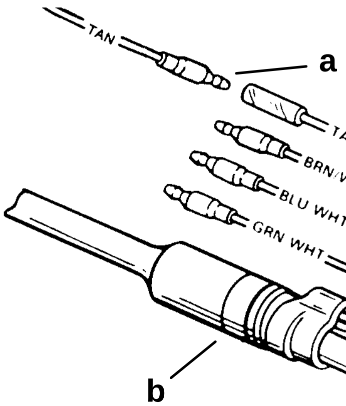


51105

a - Connect to +12 Volt
b - Position Light Bulb to the Unswitched Position
c - Connect to NEGATIVE (–) Ground
d - Connect to TAN Lead located at the Tachometer Receptacle on Commander Side Mount Remote Control or TAN Lead coming from Accessory Ignition/Choke Assembly

Route TAN lead on starboard side of engine to engine/remote control harness. Connect as shown.

IMPORTANT: Tape back and isolate any unused wiring harness leads.



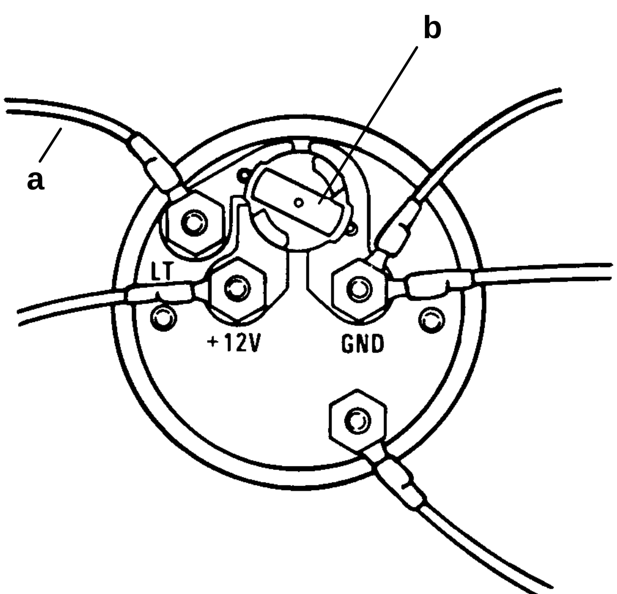
28086

a - Lead from Temperature Sender
b - Engine/Remote Control Harness

Oil Level Gauge Wiring

LIGHT BULB POSITION A

Use this position when using a separate light switch for instrument lighting.

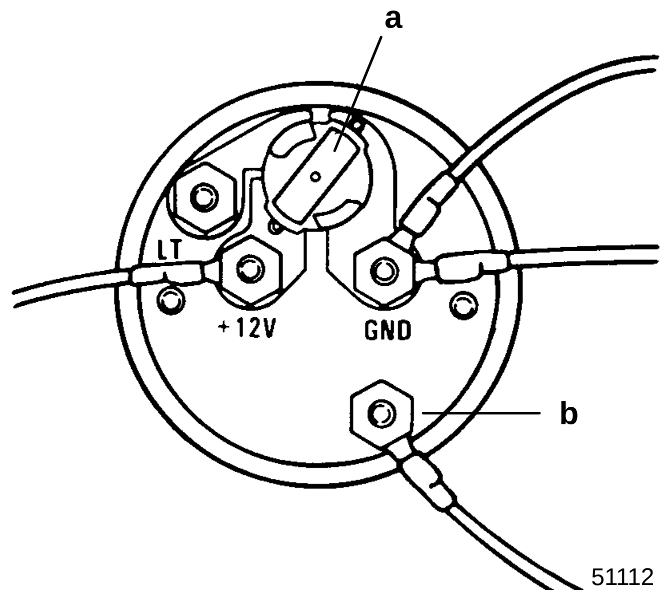


51109

a - +12 Volt Light Switch Wire
b - Position Light Bulb to the Switched Position

LIGHT BULB POSITION B

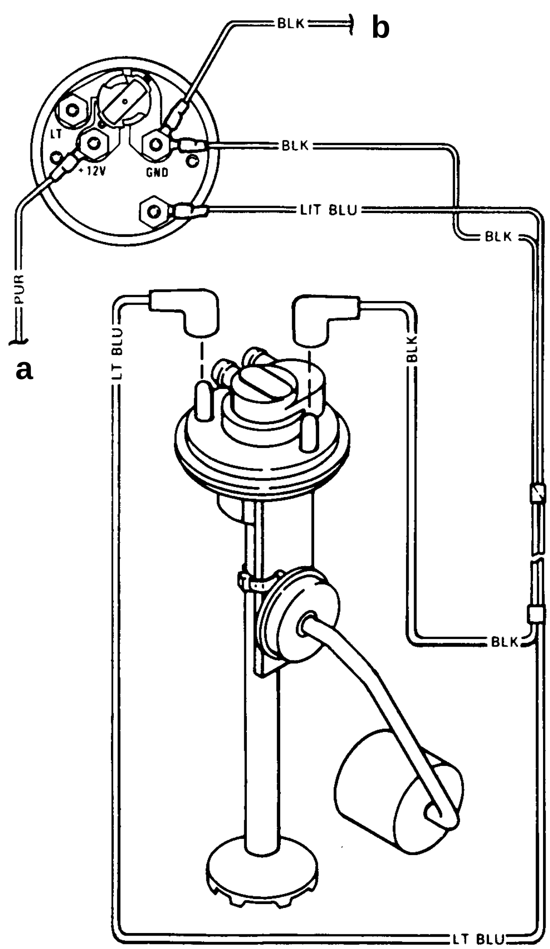
Use this position when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key switch is turned on.)



51112

a - Position Light Bulb to the Unswitched Position
b - Sender

SENDER WIRING



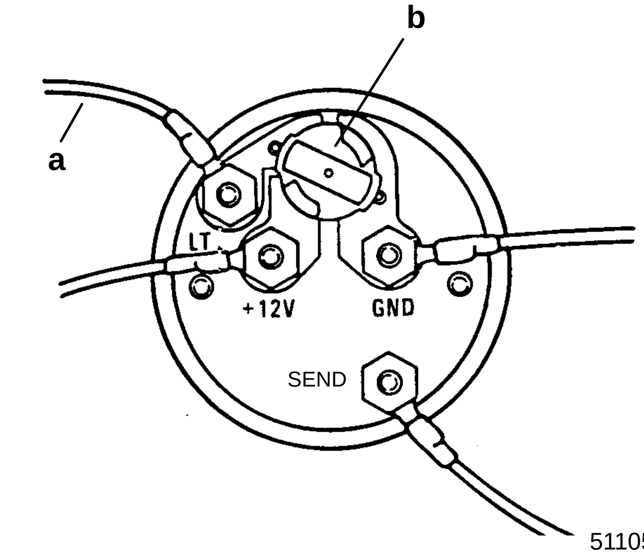
51108

a - Connect to +12 Volt
b - Connect to NEGATIVE (–) Ground

Engine Synchronizer Wiring Diagram

LIGHT BULB POSITION A

Use this position when using a separate light switch for instrument lighting.

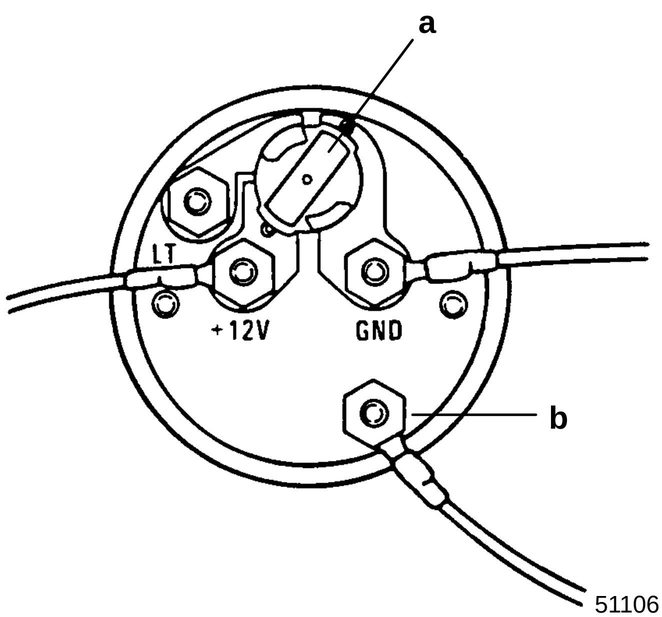


51105

a - +12 Volt Light Switch Wire
b - Position Light Bulb to the Unswitched Position

LIGHT BULB POSITION B

Use this position when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key switch is turned on.)

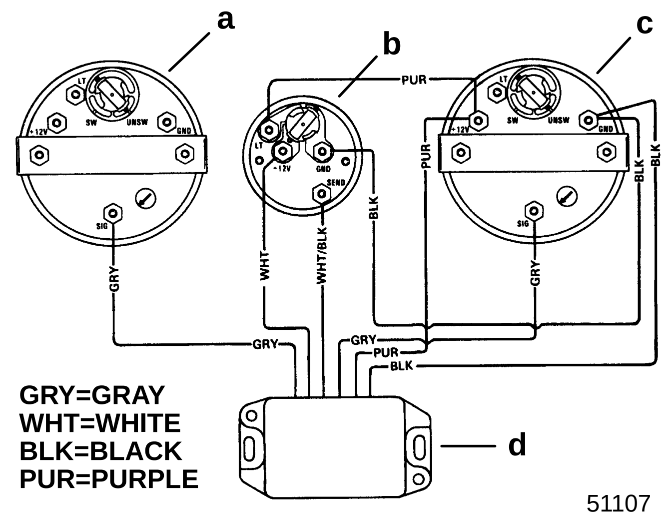


51106

a - Position Light Bulb to the Switched Position
b - Sender

Synchronizer wiring can be accomplished two different ways as an option to the user.

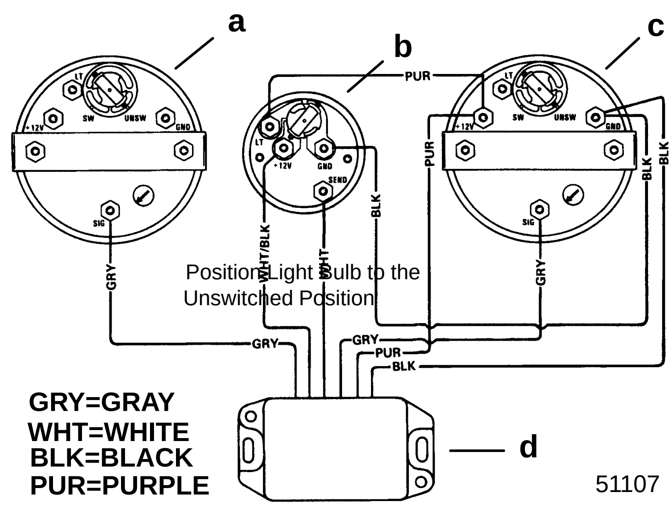
Wiring Diagram – Gauge needle to point toward slow running engine



51107

a - Tachometer Starboard Engine
b - Synchronizer Gauge
c - Tachometer Port Engine
d - Synchronizer Module

Wiring Diagram – Gauge needle to point toward fast running engine



51107

a - Tachometer Starboard Engine
b - Synchronizer Gauge
c - Tachometer Port Engine
d - Synchronizer Module

Maintenance

Clean gauge by washing with fresh water to remove sand and salt deposits. Wipe off with a soft cloth moistened with water. The gauge may be scored or damaged if wiped with abrasive material (sand, saline or detergent compounds, etc.) or washed with solvents such as trichloroethylene, turpentine, etc.

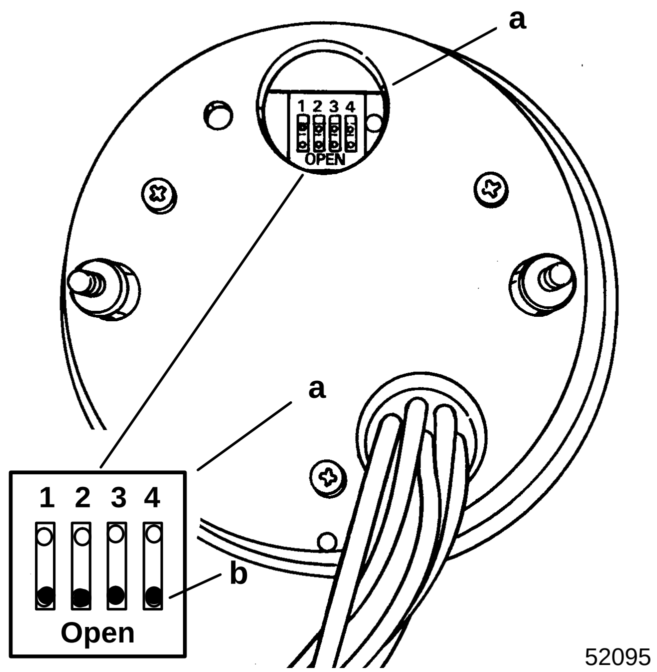
Multi-Function Gauge

Dip Switch Setting/Testing

NOTE: *The multi-function gauge "Dip Switch" must be set on the back of gauge prior to operation. Turn the ignition switch to the "OFF" position before setting dip switch. The guage will reset to selected settings when the ignition is turned "On".*

IMPORTANT: Test the gauge and related wiring BEFORE making final "Dip Switch" settings and BEFORE securing the gauge to dashboard of boat.

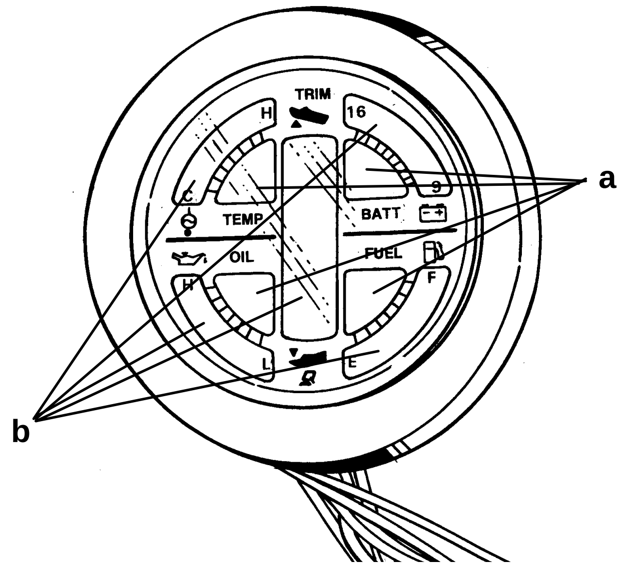
1. With the ignition switch in the "Off" position, set the multi-function gauge "Dip Switch" in (test) position as shown. (Black dot indicates switch position).



a - "Dip Switch" (shown in test position)
b - Black Dot - Switch in "Open" Position

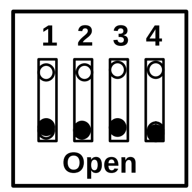
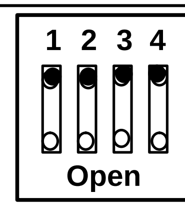
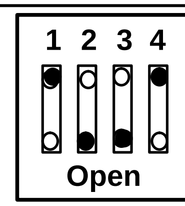
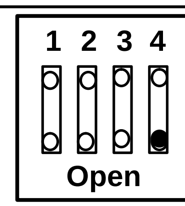
2. Turn ignition switch to the "Run" position. The multi-function gauge now is in the display test mode. The gauge Temp, Batt, Oil, and Fuel red warning lights should be alternately flashing "On" and "Off"; the Black L.C.D. bar graphs should be cycling. (This indicates that all gauge functions are operational).

3. Turn ignition switch to the "Off" position. Reset the gauge "Dip Switch" to the correct operating position for the outboard application.



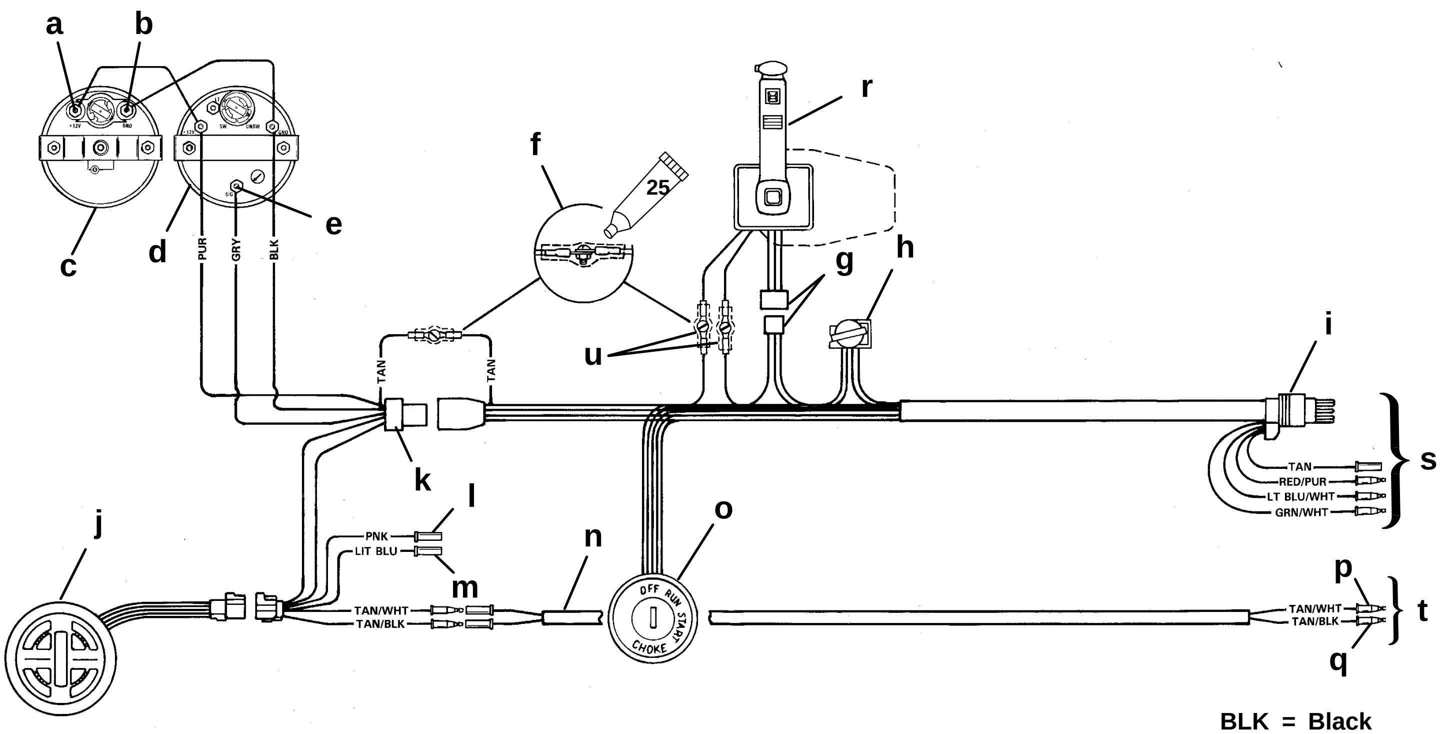
a - Gauge Lights (Red)
b - Gauge L.C.D. Bar Graph (Black)

Outboard Multi-Function Gauge Setting

Model	Dip Switch Setting
Test Display (All)	
275 hp (3.4 Litre) Out-boards (single engine)	
135-250 hp Outboards (single engine)	
"Note" On Dual Engine/Single Fuel Tank Applications: Position Dip Switch 4 "Open" *	

* Dip Switch (4) in "Open Position" For Dual Engine Single Fuel Tank Applications. Switches 1,2,3 Must Be In Specified Model Position.

Panel Mount Remote Control Wiring Installation

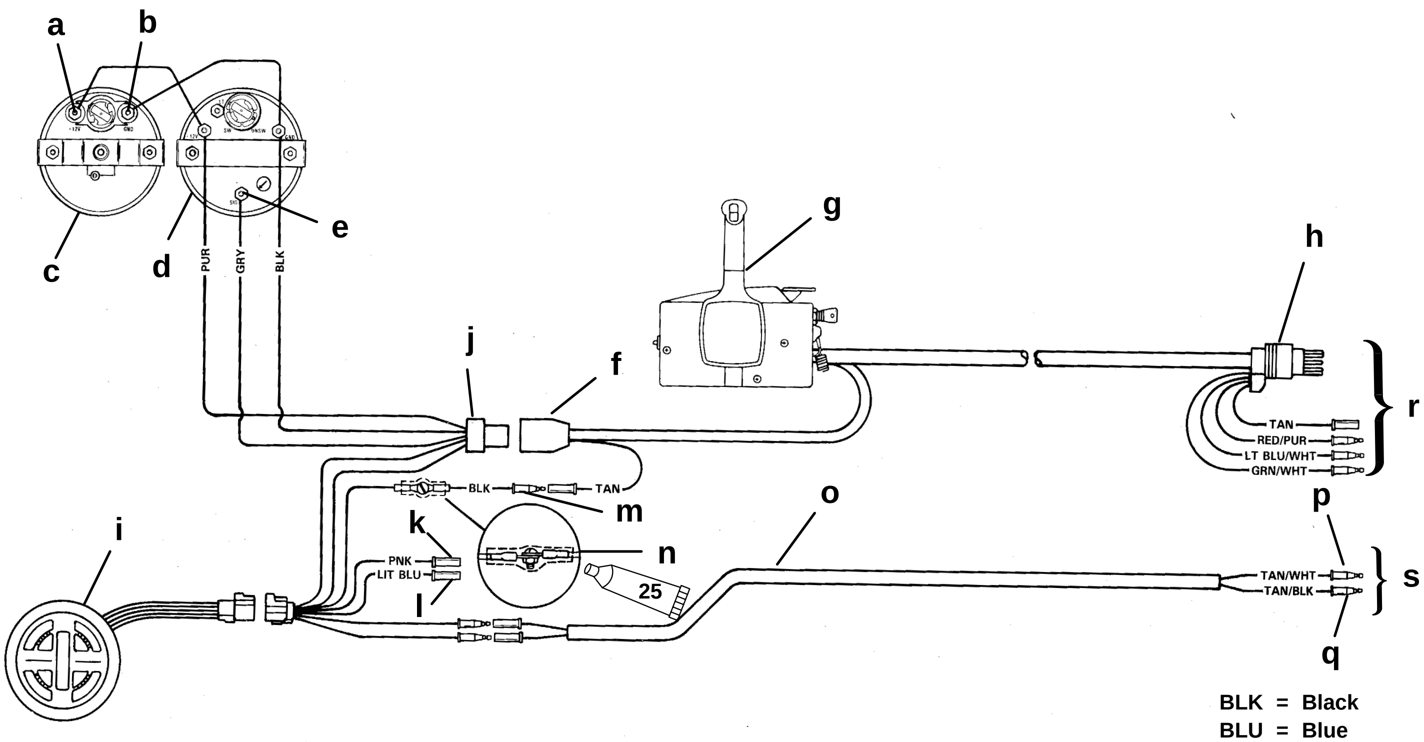


BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

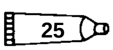
25 Liquid Neoprene (92-25711--2)

a - (+) 12 Volt Terminal
b - (–) Ground Terminal
c - Speedometer
d - Tachometer
e - Tachometer Signal Terminal
f - Connect Wires Together with Screw and Hex Nut (3 Places); Apply Quicksilver Liquid Neoprene to Connections and Slide Rubber Sleeve Over Each Connection.
g - Power Trim Connector
h - Horn
i - 8 Pin Harness Connector
j - Multi-Function Gauge
k - Multi-Function Adapter Harness
l - To Fuel Sender (Optional)
m - To Oil Sender (Optional)
n - Two Wire Harness
o - Ignition/Choke Switch
p - Low Oil Sender Lead
q - Over Temperature Switch Lead
r - Panel Mount Remote Control
s - To Engine
t - To Engine
u - Neutral Safety Switch Lead

Side Mount Remote Control Wiring Installation



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



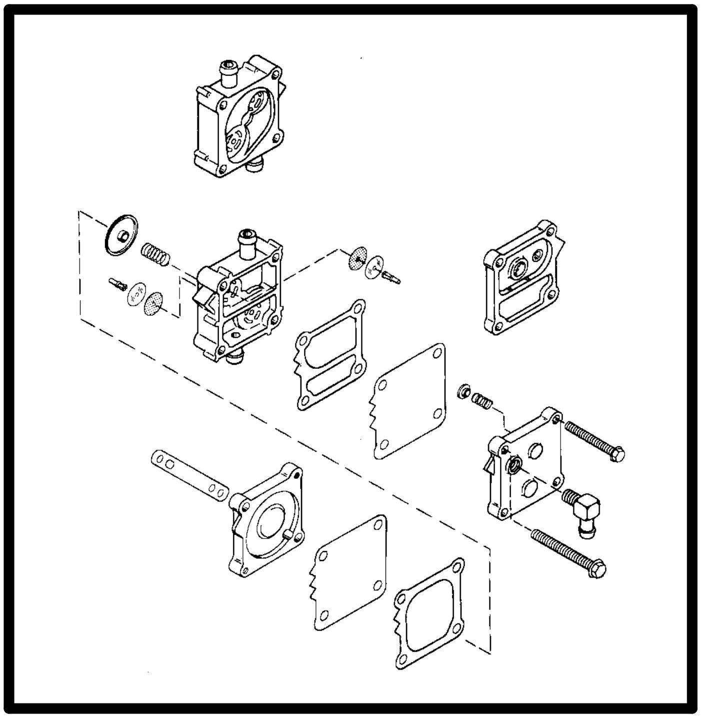
Liquid Neoprene (92-25711--2)

a - (+) 12 Volt Terminal
b - (–) Ground Terminal
c - Speedometer
d - Tachometer
e - Tachometer Signal Terminal
f - Tachometer Receptacle
g - Side Mount Remote Control
h - 8 Pin Harness Connector
i - Multi-Function Gauge
j - Multi-Function Adapter Harness
k - To Fuel Sender (Optional)
l - To Oil Sender (Optional)
m - Cable Lead (Jumper) (84-11149A3)
n - Connect Wires Together with Screw and Hex Nut; Apply Quicksilver Liquid Neoprene to Connections and Slide Rubber Sleeve Over Each Connection
o - Two Wire Harness
p - Low Oil Sender Lead
q - Over Temperature Switch Lead
r - To Engine
s - To Engine

FUEL SYSTEMS

3

A



FUEL PUMP

Table of Contents

Specifications

Fuel Pump Pressure @ W.O.T.

Maximum – 10 psi
Normal – 8-10 psi
Minimum – 3 psi

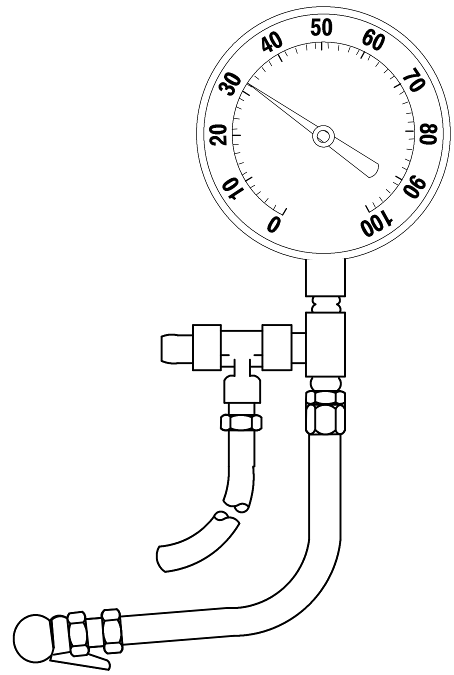
Fuel Pump Pressure @ Idle

Normal – 2-3 psi
Minimum – 1 psi

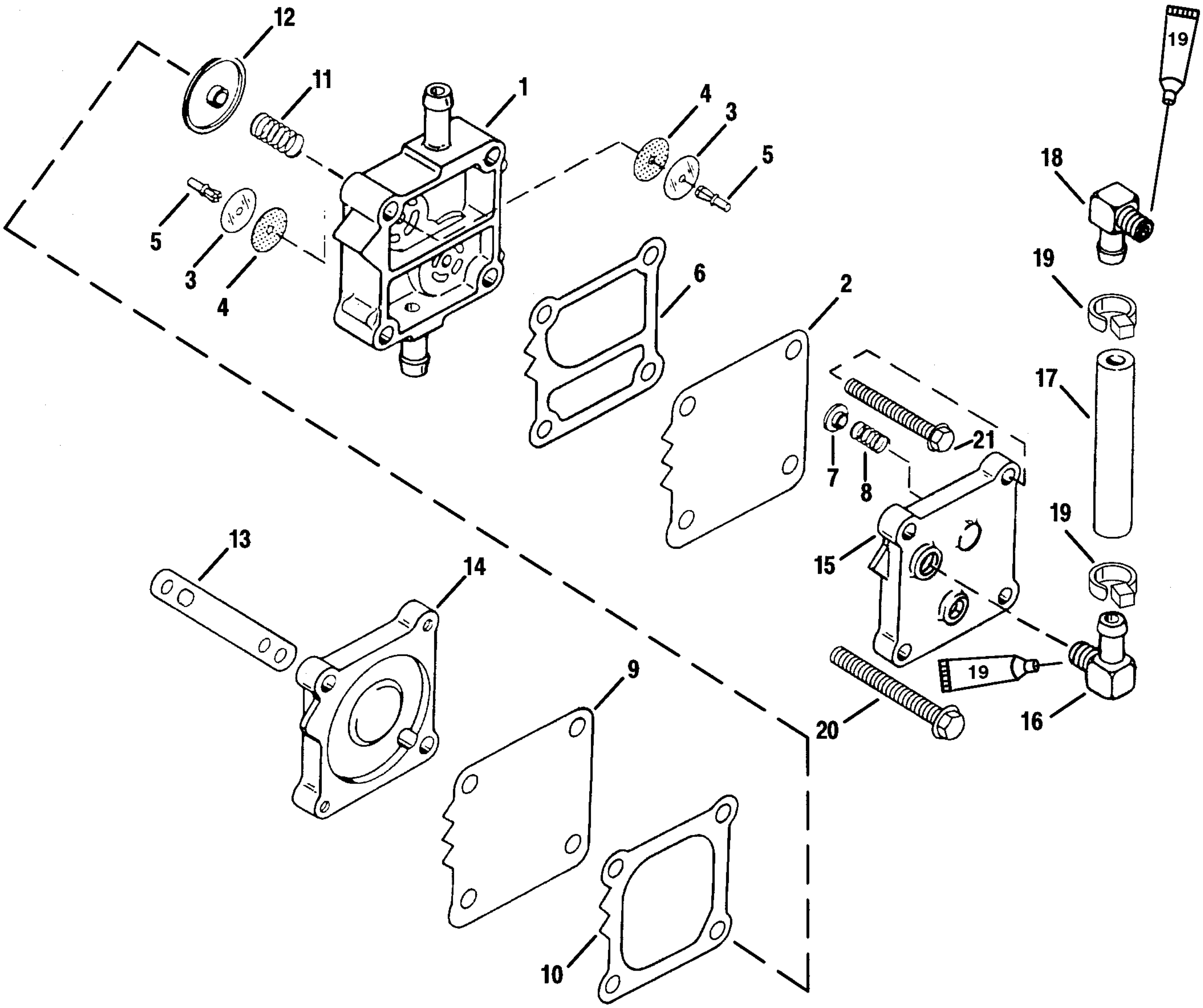
NOTE: *Electric fuel pump pressure, if used in conjunction with engine mechanical fuel pump, must be limited to no more than 4 psi.*

Special Tools

Fuel Pressure Gauge 91-16850



Fuel Pump



19 Perfect Seal (92-34227-1)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	CHECK VALVE-rubber			
4	2	CHECK VALVE			
5	2	RETAINER			
6	1	GASKET-boost			
7	1	CAP			
8	1	SPRING			
9	2	DIAPHRAGM			
10	1	GASKET-pulse			
11	1	SPRING			
12	1	CAP			
13	1	GASKET-base			
14	1	BASE-fuel pump			
15	1	PLATE-fuel pump			
16	1	ELBOW			
17	1	FUEL LINE (6 IN.)			
18	1	ELBOW			
19	2	STA STRAP			
20	2	SCREW-fuel pump to crankcase	55		6.0
21	2	SCREW-fuel pump	55		6.0

Fuel Pump

General Information

FUEL PUMP DESCRIPTION/OPERATION

The fuel pump is a crankcase-pressure-operated, diaphragm-type pump. Crankcase pulsating pressure (created by the up-and-down movement of piston) is transferred to fuel pump by way of a passage (hole) between crankcase and fuel pump.

When piston is in an upward motion, a vacuum is created in the crankcase, thus pulling in a fuel/air mixture (from carburetor) into crankcase. This vacuum also pulls in on the fuel pump diaphragm, thus the inlet check valve (in fuel pump) is opened and fuel (from fuel tank) is drawn into fuel pump.

Downward motion of the piston forces the fuel/air mixture out of the crankcase into the cylinder. This motion also forces out on the fuel pump diaphragm, which, in turn, closes the inlet check valve (to keep fuel from returning to fuel tank) and opens the outlet check valve, thus forcing fuel to the carburetors.

CHECKING FOR RESTRICTED FUEL FLOW CAUSED BY ANTI-SIPHON VALVES

While anti-siphon valves may be helpful from a safety stand-point, they clog with debris, they may be too small, or they may have too heavy a spring. Summarizing, the pressure drop across these valves can, and often does, create operational problems and/or power-head damage by restricting fuel to the fuel pump and carburetor(s). Some symptoms of restricted (lean) fuel flow, which could be caused by use of an anti-siphon valve, are:

1 - Loss of fuel pump pressure
2 - Loss of power
3 - High speed surging
4 - Preignition/detonation (piston dome erosion)
5 - Outboard cuts out or hesitates upon acceleration
6 - Outboard runs rough
7 - Outboard quits and cannot be restarted
8 - Outboard will not start
9 - Vapor lock

Since any type of anti-siphon device must be located between the outboard fuel inlet and fuel tank outlet, a simple method of checking [if such a device (or bad fuel) is a problem source] is to operate the outboard with a separate fuel supply which is known to be good, such as a remote fuel tank.

If, after using a separate fuel supply, it is found that the anti-siphon valve is the cause of the problem, there are 2 solutions to the problem; either 1) remove the anti- siphon valve or 2) replace it with a solenoid-operated fuel shut off valve.

Testing Fuel Pump

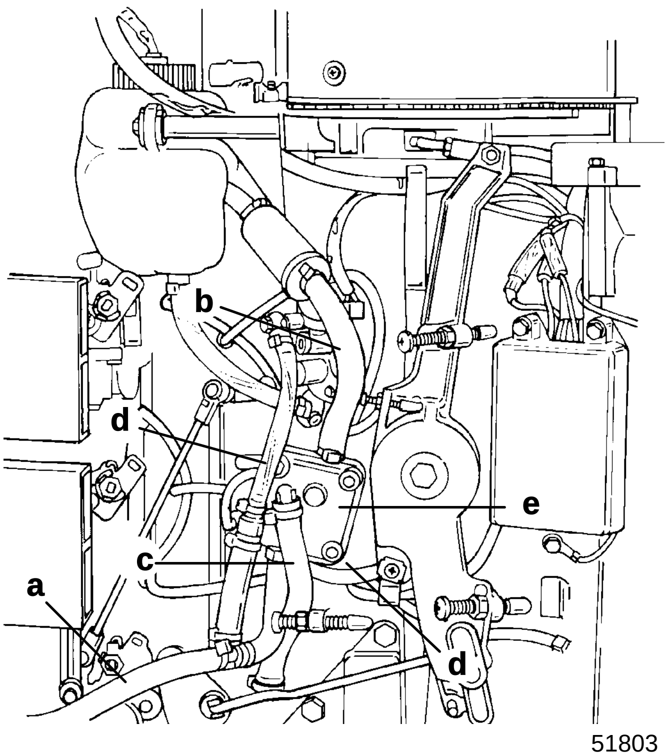
Install clear fuel hose(s) between fuel pump and carburetor(s). Run engine, and inspect fuel passing thru hose(s) for air bubbles. If air bubbles are found, see "Air Bubbles in Fuel Line," below. If air bubbles are NOT found, see "Lack of Fuel Pump Pressure," below.

Problem: Air Bubbles in Fuel Line	
Low fuel in tank.	Fill tank with fuel.
Loose fuel line connection.	Check and tighten all connectors.
Fuel pump fitting loose.	Tighten fitting.
A hole or cut in fuel line.	Check condition of all fuel lines and replace
Fuel Pump anchor screw(s) loose.	Tighten all screws evenly and securely.
Fuel Pump filter cover anchor screw loose.	Tighten screws securely.
Fuel pump filter gasket worn out.	Replace Gasket.
Fuel pump gasket(s) worn out.	Rebuild fuel pump.
Problem: Lack of Fuel Pump Pressure	
An anti-siphon valve.	See "Checking for Restricted Fuel Flow" preceding.
Air in fuel line.	See "Air Bubbles in Fuel Line", above.
A dirty or clogged fuel filter.	Clean or replace fuel filter.
The fuel pickup in fuel tank is clogged or dirty.	Clean or replace pickup.
Worn out fuel pump diaphragm.	Rebuild fuel pump.
Worn out check valve(s) in fuel pump.	Rebuild fuel pump.
A leaky check valve gasket.	Rebuild fuel pump.
Pulse hole(s) plugged.	Remove fuel pump and clean out holes.
Hole in pulse hose.	Replace pulse hose.
Loose pulse hose.	Tighten connection(s).
Excessive fuel hose length.	Cut fuel hose to proper length.
Fuel hose internal diameter too small.	Use 5/16 I.D. fuel hose.

Fuel Pump Removal/Disassembly

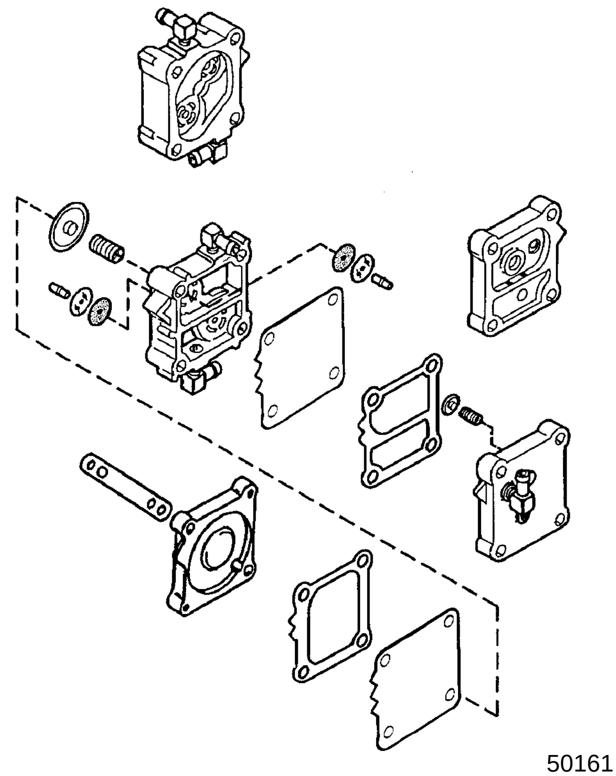
IMPORTANT: Fuel pump diaphragm and gaskets should not be re-used once fuel pump is disassembled.

1. Disconnect fuel hoses from fuel pump.
2. Disconnect pulse hose.
3. Remove two mounting screws.
4. Remove fuel pump from engine.



a - Fuel hose from tank to fuel pump
b - Fuel hose from fuel pump to carburetors
c - Pulse hose
d - Mounting screws
e - Fuel pump

5. Disassemble fuel pump.



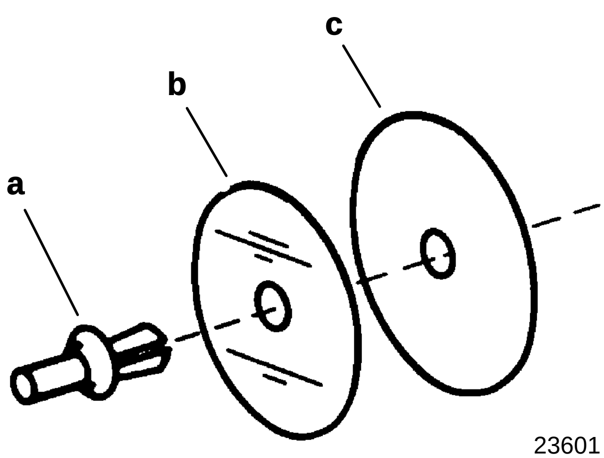
Cleaning/Inspection

1. Clean fuel pump housing, check valves, pulse chamber and pump base in solvent and dry all but check valves with compressed air.
2. Inspect each check valve for splits, chips and for proper sealing against pump housing.
3. Inspect boost springs for weakness or breakage.
4. Inspect fuel pump housing, pulse chamber and base for cracks or rough gasket surface and replace if any are found.
5. Inspect fitting on fuel pump housing for loosening or any signs of fuel or air leaks. Replace or tighten fitting if a leak is found.

Reassembly/Installation

ASSEMBLY

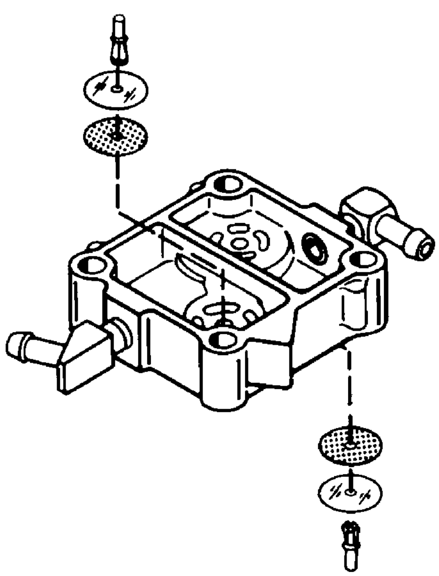
1. Insert retainer thru plastic disc and rubber check valve.



23601

a - Retainer
b - Plastic Disc
c - Rubber Check Valve

2. Install check valves and retainers into fuel pump body.



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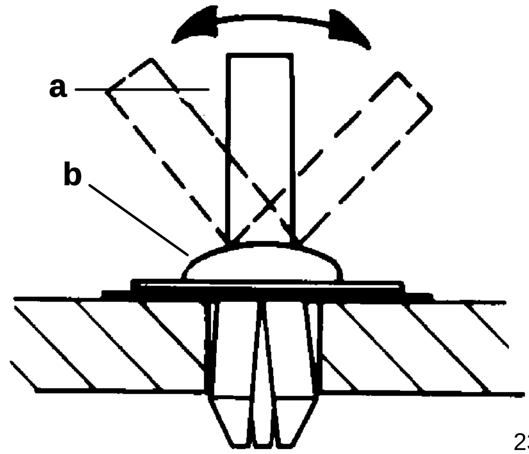
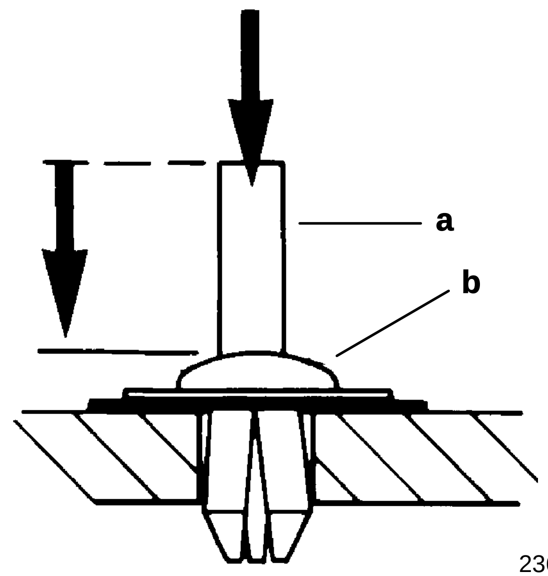
3. With retainer installed in pump body, break retainer rod from retainer by bending sideways.



23601

a - Rod
b - Retainer Cap

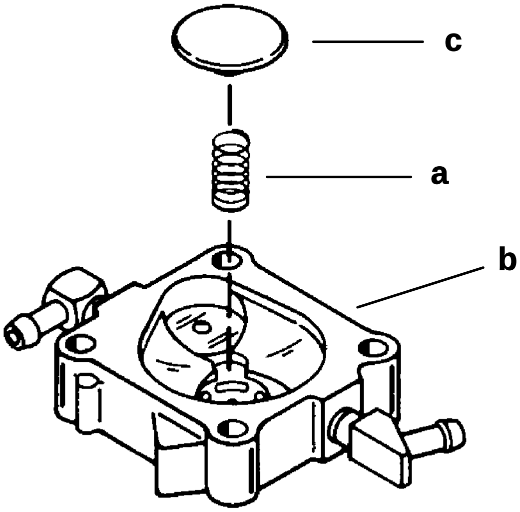
4. Reinstall rod into retainer cap and, use a small hammer or hammer and punch to tap rod down into retainer until flush with top of retainer.



23601

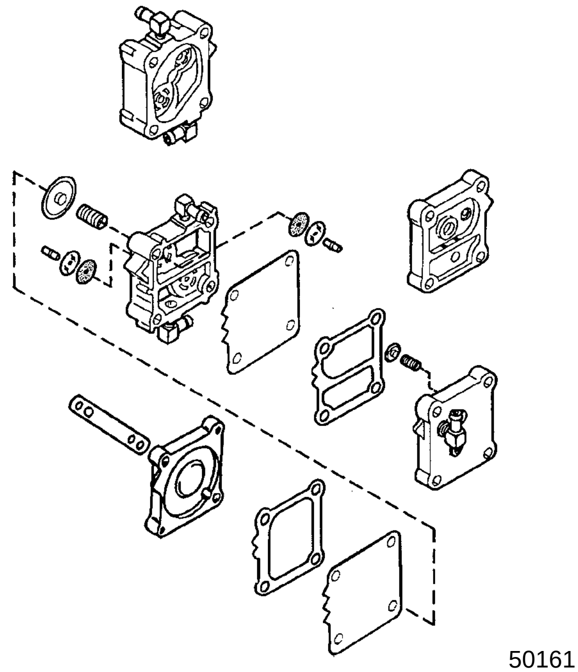
a - Rod
b - Retainer Cap

5. Place boost spring into pump body and place cap onto boost spring.



a - Boost Spring
b - Pump Body
c - Cap

6. Assemble remainder of components as shown and install retaining screws thru to align.



7. Install pump onto engine. Torque to 55 lb. in. (6.0 N·m).

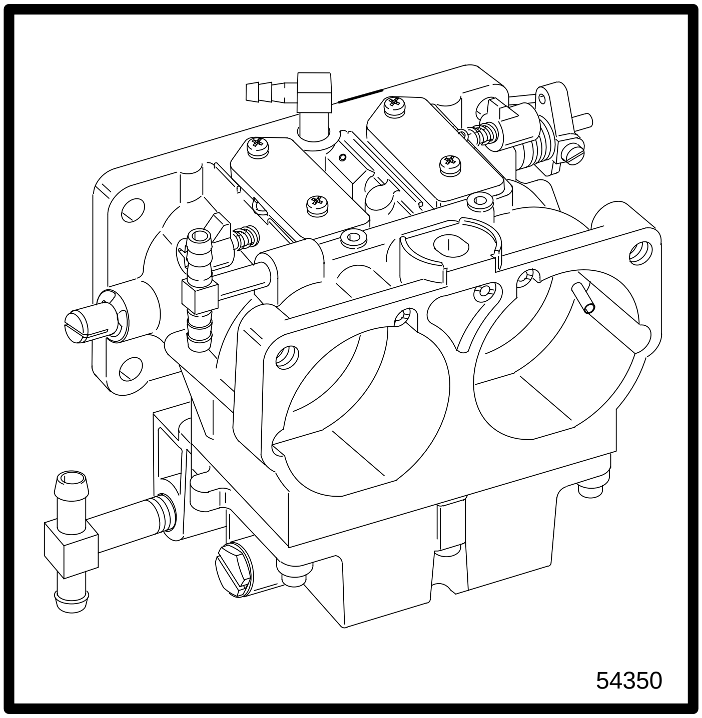
8. Install hoses onto proper fittings and secure with sta-straps.

9. Run engine and check for leaks.

FUEL SYSTEMS

3

B



CARBURETORS

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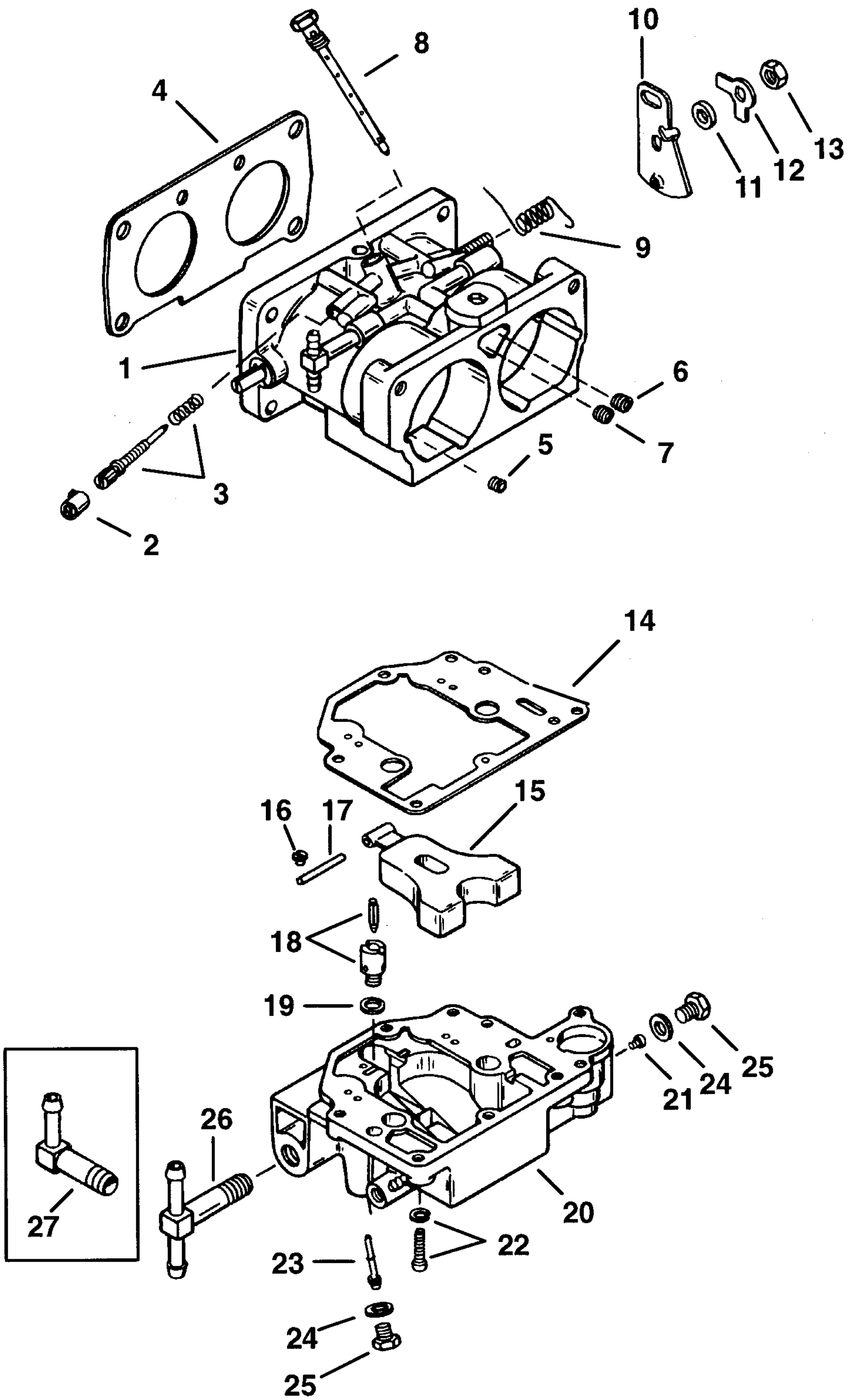
Notes:

WMH 1,2,3,4,5,6,7,8,9,10,11 Carburetor Assembly



WMH 1,2,3,4,5,6,7,8,9,10,11 Carburetor

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	CARBURETOR			
2	6	LIMITER CAP			
3	6	IDLE NEEDLE/SPRING			
4	3	GASKET			
5	2	JET – progression air	10		1.0
6	3	JET – bowl vent	15		1.5
7	1	JET – idle air bleed	15		1.5
8	3	EMULSION TUBE	33		3.5
9	3	SPRING – valve return			
10	2	THROTTLE LEVER			
11	3	SPACER			
12	3	WASHER			
13	3	NUT	50		5.5
14	3	GASKET – fuel bowl			
15	3	FLOAT			
16	3	SCREW – float pin	10		1.0
17	3	FLOAT SHAFT			
18	3	VALVE SEAT KIT	33		3.5
19	3	GASKET – valve seat			
20	1	FUEL BOWL			
21	3	JET – main fuel	14		1.5
22	18	SCREW – fuel bowl	26		3.0
23	6	JET – progression fuel	14		1.5
24	3	GASKET			
25	3	PLUG	33		3.5
26	2	TEE FITTING **(TOP/CENTER)**	45		5.0
27	1	ELBOW **(BOTTOM)**	45		5.0

WMH 1,2,3,4,5,6,7,8,9,10,11 Carburetor Specifications

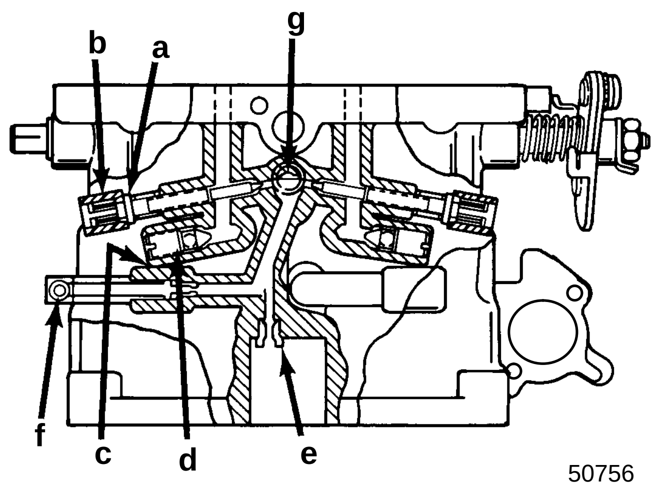
Carburetor	Year	Engine	Venturi	Main Jet	Progres-sion Jet	Idle Air Jet	Back Draft Vent Jet
WMH 1 1A–2A–3A	1990	150	1.312	.062	.044	.040	.084
WMH 2 1A–2A–3A	1990	175	1.312	.064	.044	.044	.080
WMH 3 1C–2C–3C	1990	200	1.312	.066	.034	.040	.082
WMH 4* 1–2–3	1990	XR-4 MAG II	1.312	.062	.030	.044	NONE
WMH 5 1A–2A–3A	1990	135	1.000	.050	.036	.048	.070
WMH 6* 1A–2A–3A	1990 -1/2	XR-4 MAG II	1.312	.062	.030	.042	NONE
WMH 7 1–2–3	1990-1/2	150	1.312	.062	.034	.040	NONE
WMH 8 1A–2A–3A	1990-1/2	135	1.000	.050	.040	.048	NONE
WMH 9 1C–2C–3C	1991	150	1.312	.062	.070	.046	.096
WMH 10 1–2–3	1991	XR-4 MAG II	1.312	.062	.040	.040	NONE
WMH 11 1A–2A–3A	1991	175	1.312	.064	.070	.048	.080

*Supercede WMH 4 and WMH 6 carburetors with WMH 26 carburetors.

NOTE: *All idle mixture settings are 1-1/2 turns ± 1/4 turn from a lightly seated position.*

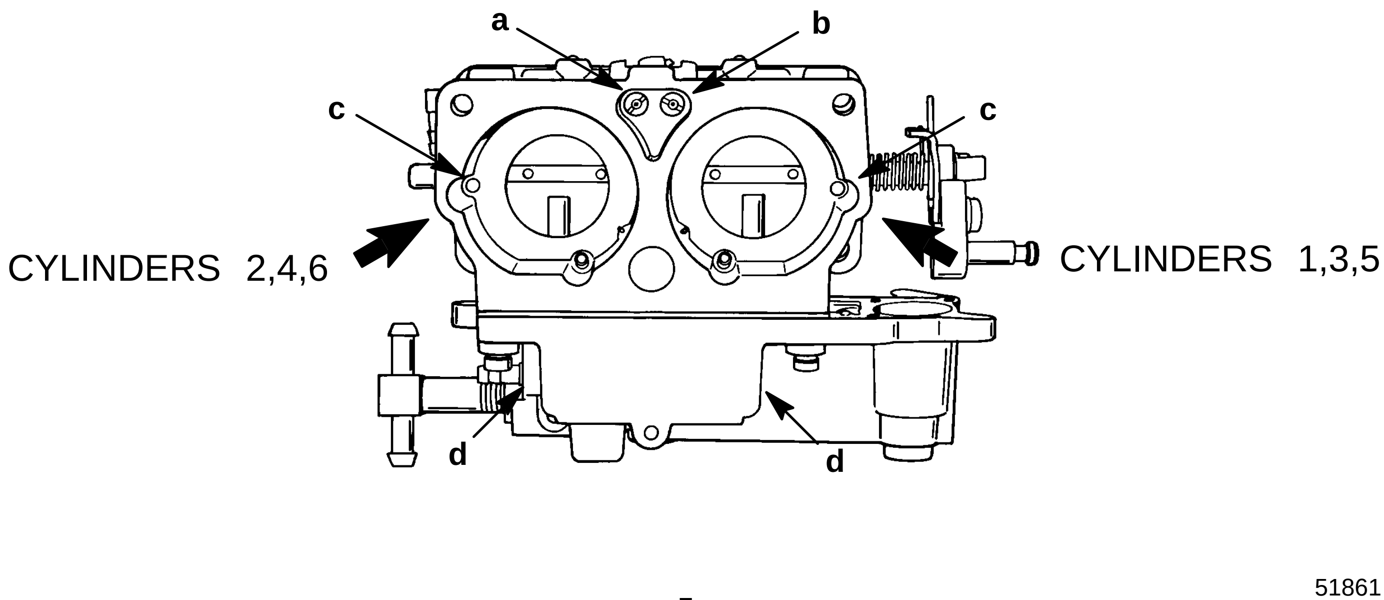
IMPORTANT: If welch plugs and air trim screws must be removed for carburetor cleaning, count number of turns air screw is turned in until seated, then remove. Apply Loctite 271 and set air screws to the same position (approx. 1-1/4 turns) prior to screw removal.

Top View



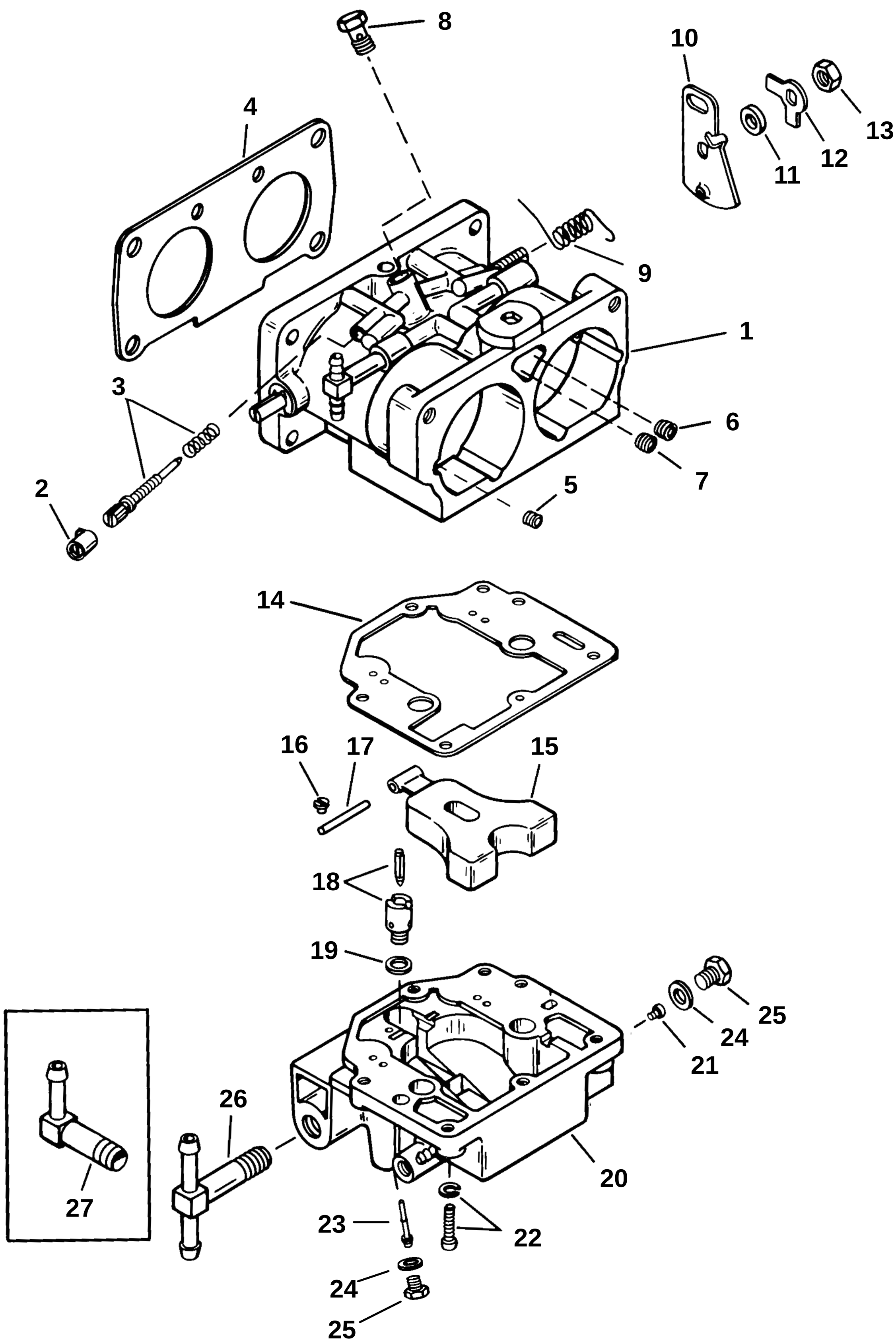
a - Fuel Mixture Adjustment
b - Screw Cap (two)
c - Welch Plug (two)
d - Air Trim Screw (two) - Apply Loctite 271
e - Idle Air Bleed Jet
f - Thermal Air Valve Air Inlet
g - Emulsion Tube

WMH 1,2,3,4,5,6,7,8,9,10,11
Carburetor Front View



a - Idle Air Jet
b - Back Draft Vent Jet
c - Progression Jet
d - Main Jet

WMH 12,13,14,15,16,27 Carburetor Assembly



WMH 12,13,14,15,16,27 Carburetor Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	CARBURETOR			
2	6	LIMITER CAP			
3	6	IDLE NEEDLE/SPRING			
4	3	GASKET			
5	2	JET – progression air	10		1.0
6	3	JET – bowl vent	15		1.5
7	1	JET – idle air bleed	15		1.5
8	3	EMULSION TUBE PLUG	33		3.5
9	3	SPRING – valve return			
10	2	THROTTLE LEVER			
11	3	SPACER			
12	3	WASHER			
13	3	NUT	50		5.5
14	3	GASKET – fuel bowl			
15	3	FLOAT			
16	3	SCREW – float pin	10		1.0
17	3	FLOAT SHAFT			
18	3	VALVE SEAT KIT	33		3.5
19	3	GASKET – valve seat			
20	1	FUEL BOWL			
21	3	JET – main fuel	14		1.5
22	18	SCREW – fuel bowl	26		3.0
23	6	JET – progression fuel	14		1.5
24	3	GASKET			
25	3	PLUG	33		3.5
26	2	TEE FITTING **(TOP/CENTER)**	45		5.0
27	1	ELBOW **(BOTTOM)**	45		5.0

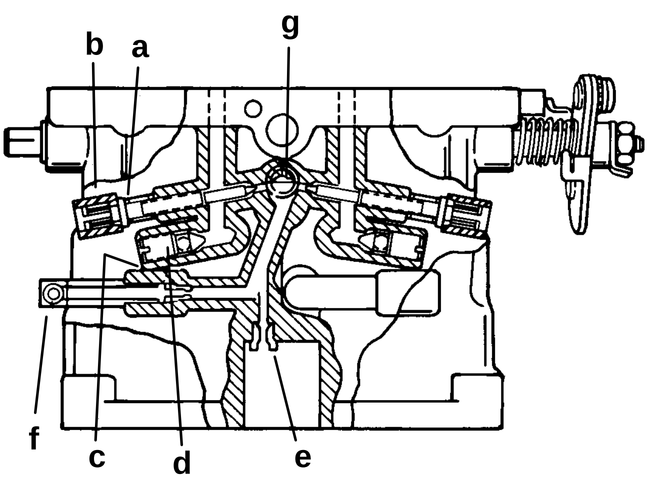
WMH 12,13,14,15,16,27 Carburetor Specifications

Carburetor	Year	Engine	Venturi	Main Jet	Progres-sion Jet	Idle Air Jet	Back Draft Vent Jet
WMH 12 1A–2A–3A	1992	135	1.312	.064	.048	.052	.090
WMH 13 1–2–3	1992	150	1.312	.064	.048	.050	.096
WMH 14 1A–2A–3A	1992	XR-6 MAG III	1.000	.054	.050	.052	.086
WMH 15 1–2–3	1992	175	1.312	.064	.070	.054	.080
WMH 16 1–2–3	1992	200	1.312	.066	.050	.058	.090
WMH 27 1–2–3	1992	200	1.312	.066	.060	.058	.090

NOTE: *All idle mixture settings are 1-1/2 turns ± 1/4 turn from a lightly seated position.*

IMPORTANT: If welch plugs and air trim screws must be removed for carburetor cleaning, count number of turns air screw is turned in until seated, then remove. Apply Loctite 271 and set air screws to the same position (approx. 1-1/4 turns) prior to screw removal.

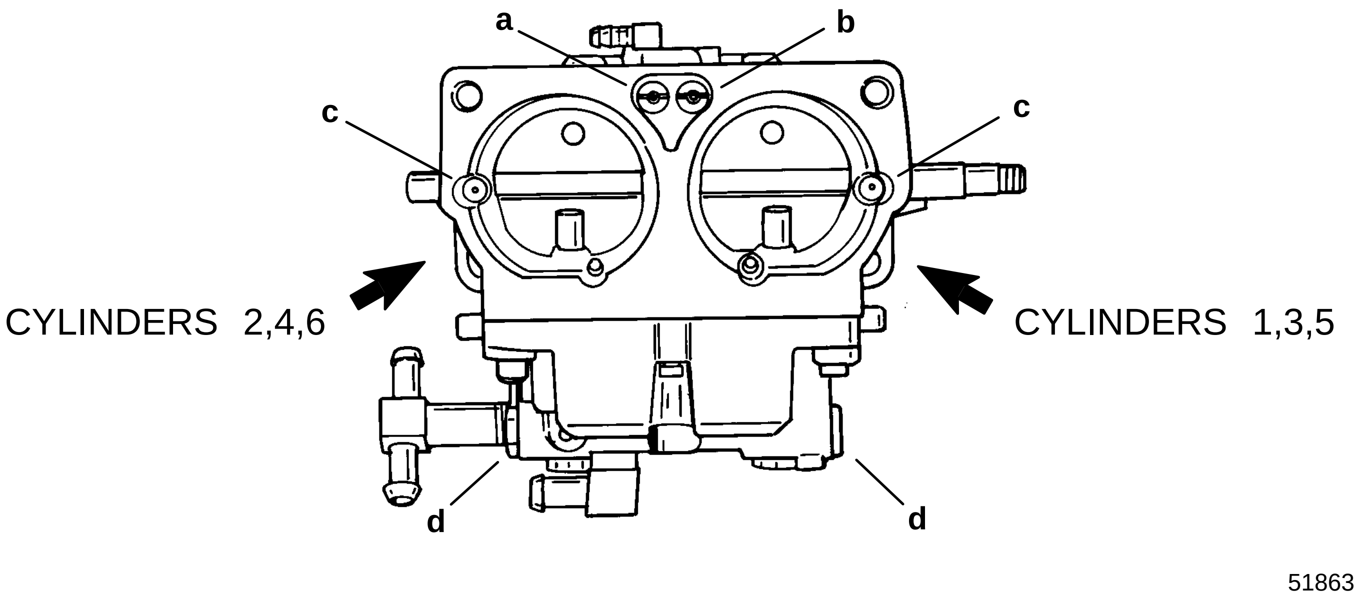
Top View



50756

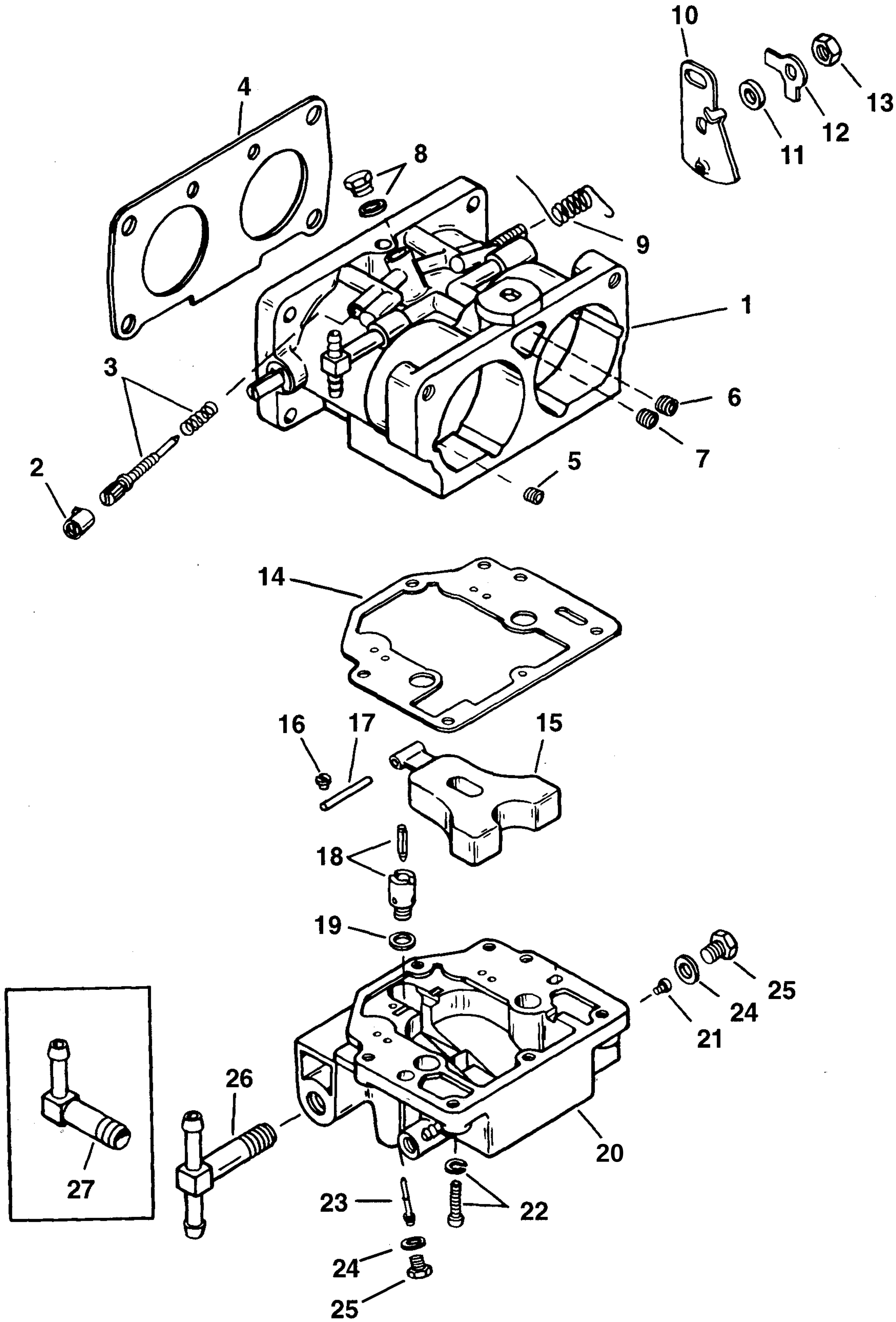
a - Fuel Mixture Adjustment
b - Screw Cap (two)
c - Welch Plug (two)
d - Air Trim Screw (two) - Apply Loctite 271 -
e - Idle Air Bleed Jet
f - Thermal Air Valve Air Inlet
g - Emulsion Tube

WMH 12,13,14,15,16,27
Carburetor Front View



a - Idle Air Jet
b - Back Draft Vent Jet
c - Progression Jet
d - Main Jet

WMH 21,22,23,25,26,28 Carburetor Assembly



WMH 21,22,23,25,26,28 Carburetor Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CARBURETOR			
2	6	LIMITER CAP			
3	6	IDLE NEEDLE/SPRING			
4	3	GASKET			
5	2	JET – progression air	10		1.0
6	3	JET – bowl vent	15		1.5
7	1	JET – idle air bleed	15		1.5
8	3	EMULSION TUBE PLUG and GASKET	33		3.5
9	3	SPRING – valve return			
10	2	THROTTLE LEVER			
11	3	SPACER			
12	3	WASHER			
13	3	NUT	50		5.5
14	3	GASKET – fuel bowl			
15	3	FLOAT			
16	3	SCREW – float pin	10		1.0
17	3	FLOAT SHAFT			
18	3	VALVE SEAT KIT	33		3.5
19	3	GASKET– valve seat			
20	1	FUEL BOWL			
21	3	JET – main fuel	14		1.5
22	18	SCREW – fuel bowl	26		3.0
23	6	JET – progression fuel	14		1.5
24	3	GASKET			
25	3	PLUG	33		3.5
26	2	TEE FITTING **(TOP/CENTER)**	45		5.0
27	1	ELBOW **(BOTTOM)**	45		5.0

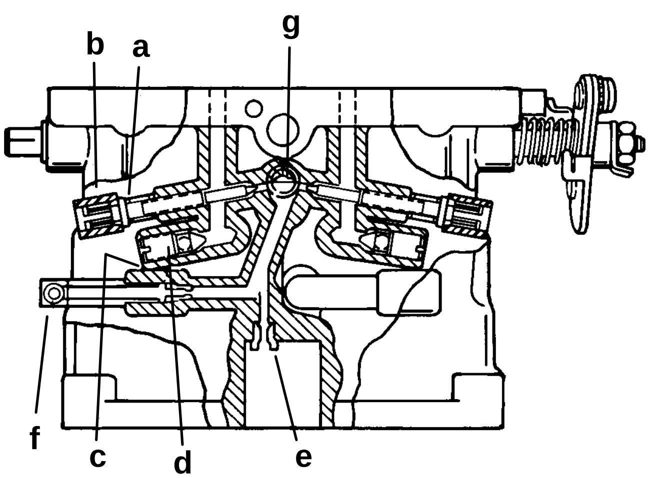
WMH 21,22,23,25,26,28 Carburetor Specifications

Carburetor	Year	Engine	Venturi	Main Jet	Progres-sion Jet	Idle Air Jet	Back Draft Vent Jet
WMH 21 1A–2–3	1993	200	1.312	1,2 = .066 3,4,5,6=.064	.050	.046	.096
WMH 22 1–2–3	1993	175	1.312	.064	.040	.050	.098
WMH 23 1–2–3	1993	150	1.312	.060	.050	.054	.094
WMH 25 1–2–3	1993	XR-6 MAG III	1.000	.054	.050	.050	.086
WMH 26 1–2–3	1993	XR-4 MAG II	1.312	.062	.050	.046	.090
WMH 28 1–2–3	1993	135	1.312	.062	.070	.056	NONE

NOTE: *All idle mixture settings are 1-1/2 turns ± 1/4 turn from a lightly seated position.*

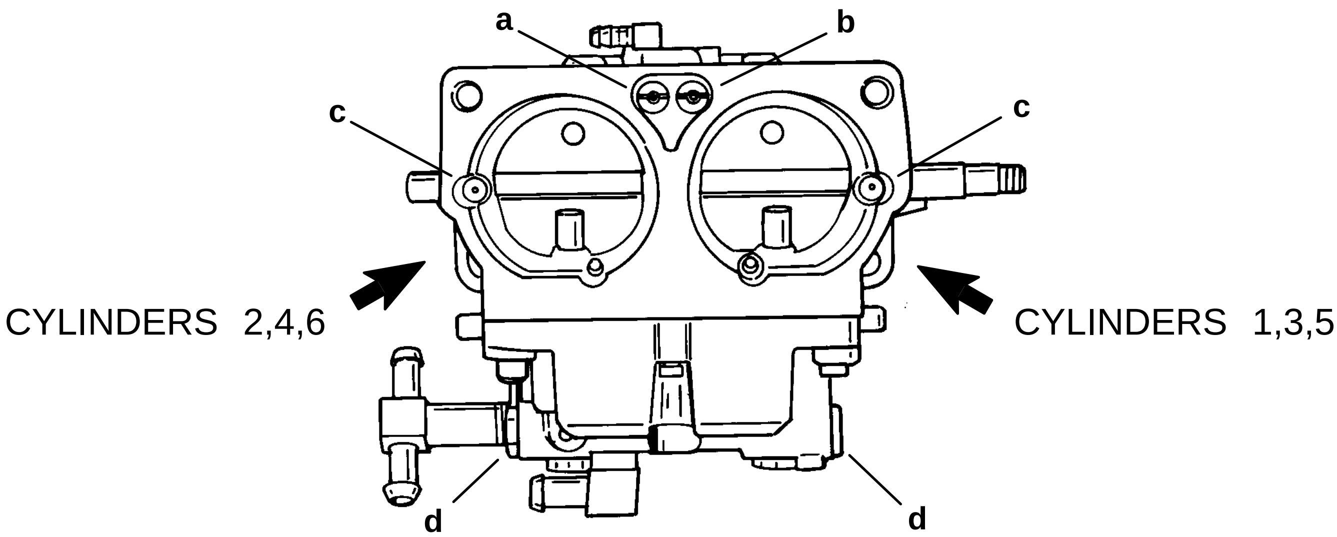
IMPORTANT: If welch plugs and air trim screws must be removed for carburetor cleaning, count number of turns air screw is turned in until seated, then remove. Apply Loctite 271 and set air screws to the same position (approx. 1-1/4 turns) prior to screw removal.

Top View



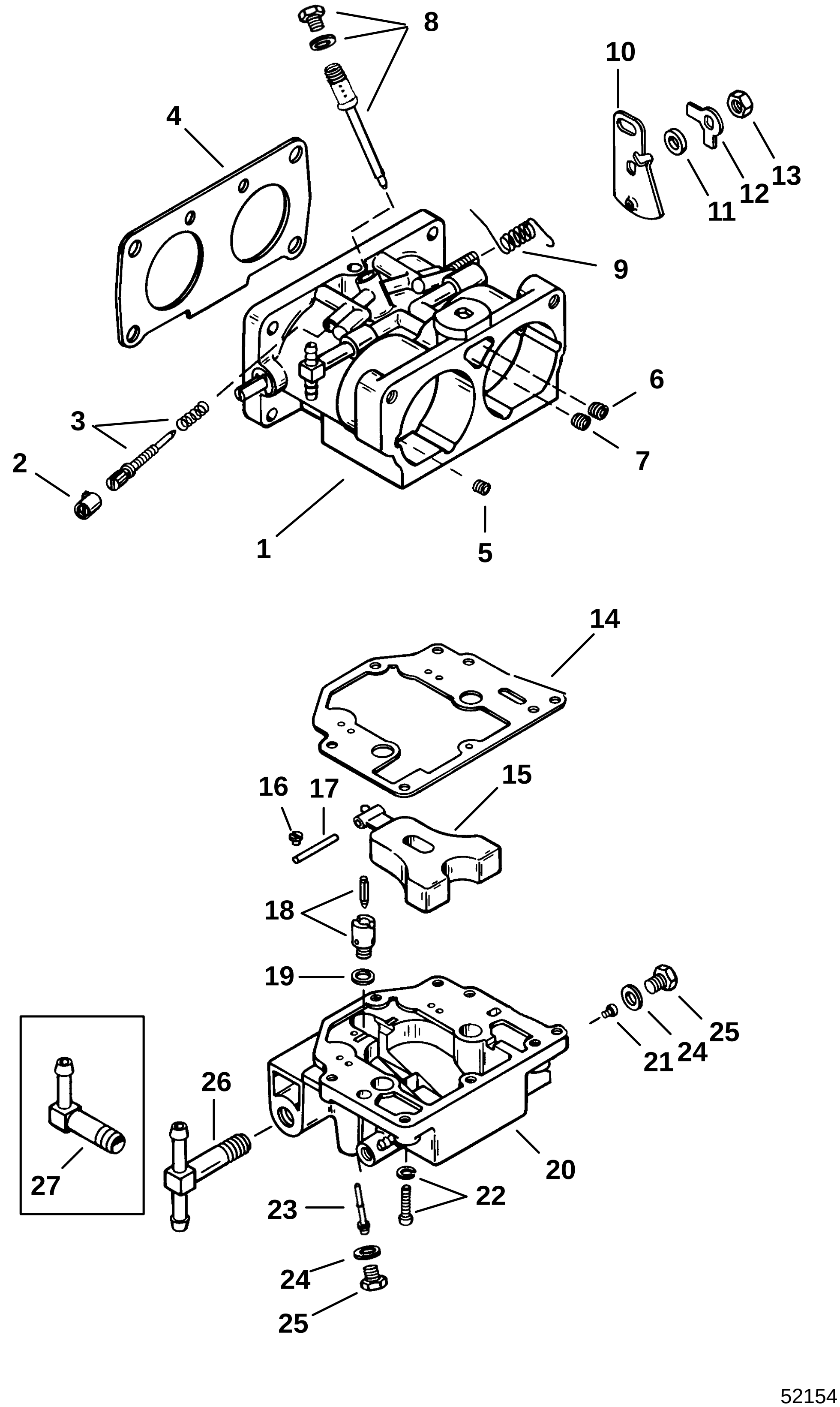
a - Fuel Mixture Adjustment
b - Screw Cap (two)
c - Welch Plug (two)
d - Air Trim Screw (two) - Apply Loctite 271
e - Idle Air Bleed Jet
f - Thermal Air Valve Air Inlet
g - Emulsion Tube

WMH 21,22,23,25,26,28
Carburetor Front View



a - Idle Air Jet
b - Back Draft Vent Jet
c - Progression Jet
d - Main Jet

WMH 30,31,32,33,34,39 Carburetor Assembly



WMH 30,31,32,33,34,39 Carburetor Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	CARBURETOR			
2	6	LIMITER CAP			
3	6	IDLE NEEDLE/SPRING			
4	3	GASKET			
5	2	JET – progression air	10		1.0
6	3	JET – bowl vent	15		1.5
7	1	JET – idle air bleed	15		1.5
8	3	EMULSION TUBE, PLUG and GASKET	33		3.5
9	3	SPRING – valve return			
10	2	THROTTLE LEVER			
11	3	SPACER			
12	3	WASHER			
13	3	NUT	50		5.5
14	3	GASKET – fuel bowl			
15	3	FLOAT			
16	3	SCREW – float pin	10		1.0
17	3	FLOAT SHAFT			
18	3	VALVE SEAT KIT	33		3.5
19	3	GASKET – valve seat			
20	1	FUEL BOWL			
21	3	JET – main fuel	14		1.5
22	18	SCREW – fuel bowl	26		3.0
23	6	JET – progression fuel	14		1.5
24	3	GASKET			
25	3	PLUG	33		3.5
26	2	TEE FITTING **(TOP/CENTER)**	45		5.0
27	1	ELBOW **(BOTTOM)**	45		5.0

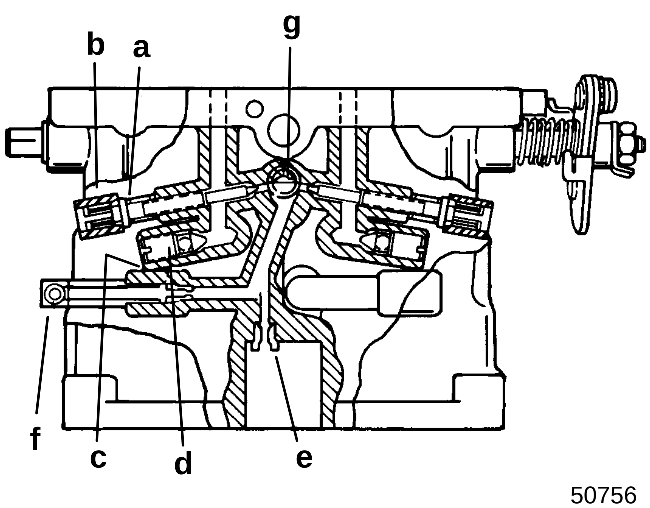
WMH 30,31,32,33,34,39 Carburetor Specifications

Carburetor	Year	Engine	Venturi	Main Jet	Progres-sion Jet	Idle Air Jet	Back Draft Vent Jet
WMH 30 1–2–3	1994-5	135	1.312	.066	.050	.054	.084
WMH 31 1–2–3	1994-5	105 JET 150	1.312	.062	.050	.052	.086
WMH 32 1–2–3	1994-5	XR-6 MAG III	1.312	.062	.040	.058	.090
WMH 33 1–2–3	1994-5	175	1.312	.064	.050	.048	.084
WMH 34 1A–2–3	1994-5	200	1.312	1,2=.066 3,4,5,6=.064	.050	.046	.084
WMH 39 1–2–3	1994-1/2 1995	140 JET 200	1.312	1,2=.066 3,4,5,6=.064	.050	046	.084

NOTE: *All idle mixture settings are 1-1/2 turns ± 1/4 turn from a lightly seated position.*

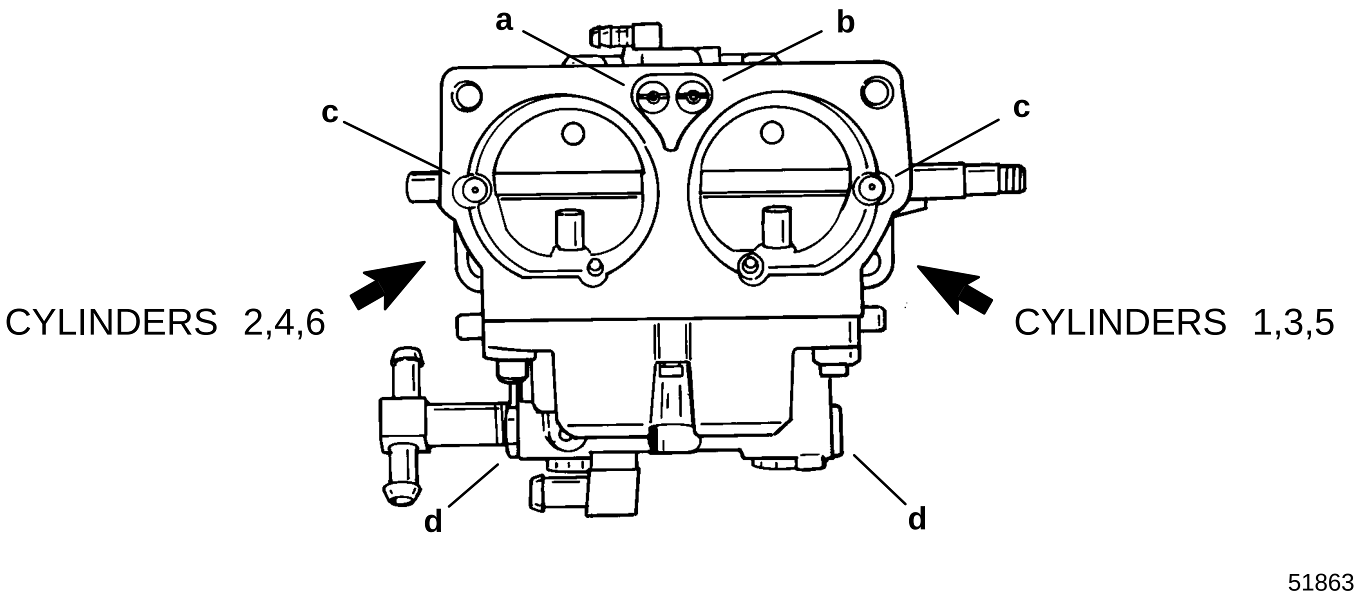
IMPORTANT: If welch plugs and air trim screws must be removed for carburetor cleaning, count number of turns air screw is turned in until seated, then remove. Apply Loctite 271 and set air screws to the same position (approx. 1-1/4 turns) prior to screw removal.

Top View



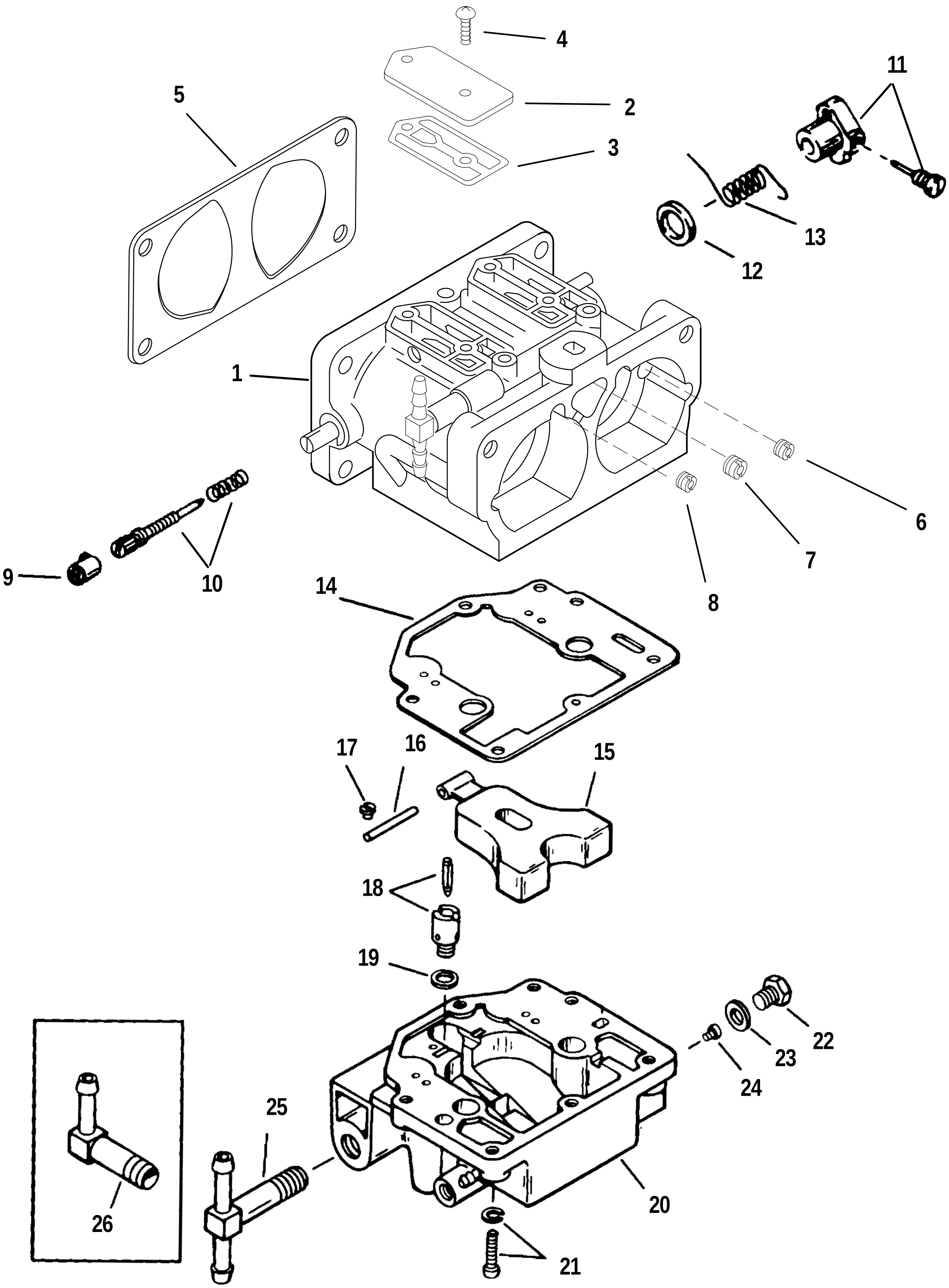
a - Fuel Mixture Adjustment
b - Screw Cap (two)
c - Welch Plug (two)
d - Air Trim Screw (two) - Apply Loctite 271
e - Idle Air Bleed Jet
f - Thermal Air Valve Air Inlet
g - Idle Tube

WMH 30,31,32,33,34,39
Carburetor Front View



a - Idle Air Jet
b - Back Draft Vent Jet
c - Progression Jet
d - Main Jet

WMV 1/1A, 2/2A, 3/3A, 4/4A, 5/5A

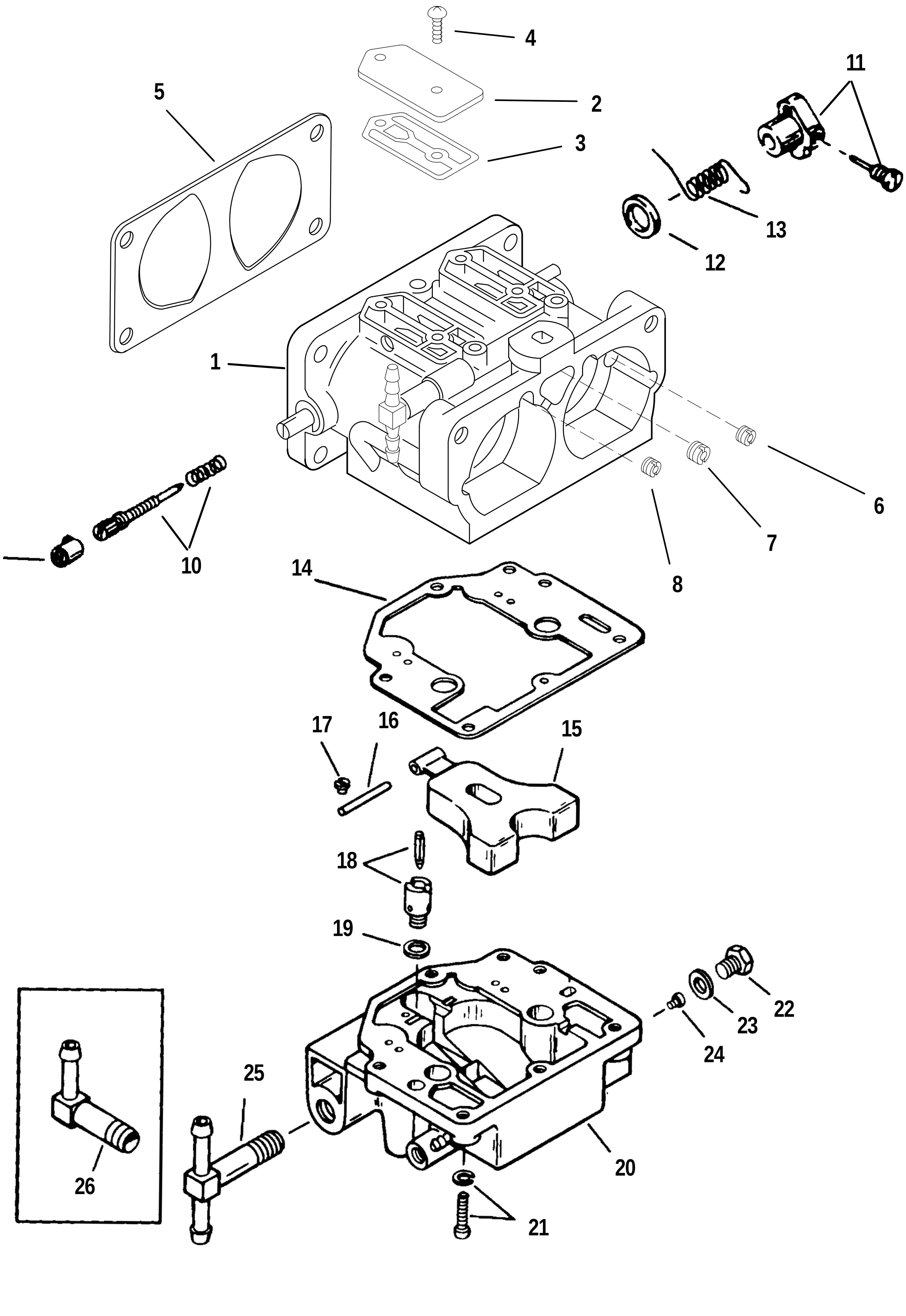


WMV 1/1A, 2/2A, 3/3A, 4/4A, 5/5A

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **135 - WMV-1**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **150 - WMMV-2**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **XR6/MAGNUM III**			
	1	BOTTOM CARBURETOR **WMV-3**			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **175 - WMV-4**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **200 - WMV-5**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **135 - WMV-1A**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **150 - WMMV-2A**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **XR6/MAGNUM III**			
	1	BOTTOM CARBURETOR **WMV-3A**			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **175 - WMV-4A**			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR			
	1	CENTER CARBURETOR **200 - WMV-5A**			
	1	BOTTOM CARBURETOR			
2	6	COVER			
3	6	GASKET			
4	12	SCREW	18		2.0
5	3	GASKET			
6	2	JET–idle air vent **(.036-Top/Center)(135)**	14		1.5
	1	JET–idle air vent **(.040 - Bottom)(135)**	14		1.5
	1	JET–idle air vent **(.034-Top)(150)**	14		1.5
	1	JET–idle air vent **(.034 - Center)(150)** **PORT**	14		1.5
	1	JET–idle air vent **(.038-Bottom)(150)**	14		1.5
	2	JET–idle air vent **(.042-Top/Center)(XR6/Magnum III)**	14		1.5
	1	JET–idle air vent **(.048-Bottom)(XR6/Magnum III)**	14		1.5
	2	JET–idle air vent **(.030-Top/Center)(175)**	14		1.5
	1	JET–idle air vent **(.038-Bottom)(175)**	14		1.5
	1	JET–idle air vent **(.052-Top)(200)**	14		1.5
	1	JET–idle air vent **(.028-Center)(200)**	14		1.5
	1	JET–idle air vent **(.032-Bottom)(200)**	14		1.5
–	**1**	**CARB GASKET KIT**			
–	**1**	**CARB REPAIR KIT**			
–	**1**	**ENGINE GASKET SET**			

■ = COMPONENT OF ENGINE GASKET SET
∆ = COMPONENT OF CARB GASKET SET
❑ = COMPONENT OF CARB REPAIR KIT

WMV 1/1A, 2/2A, 3/3A, 4/4A, 5/5A



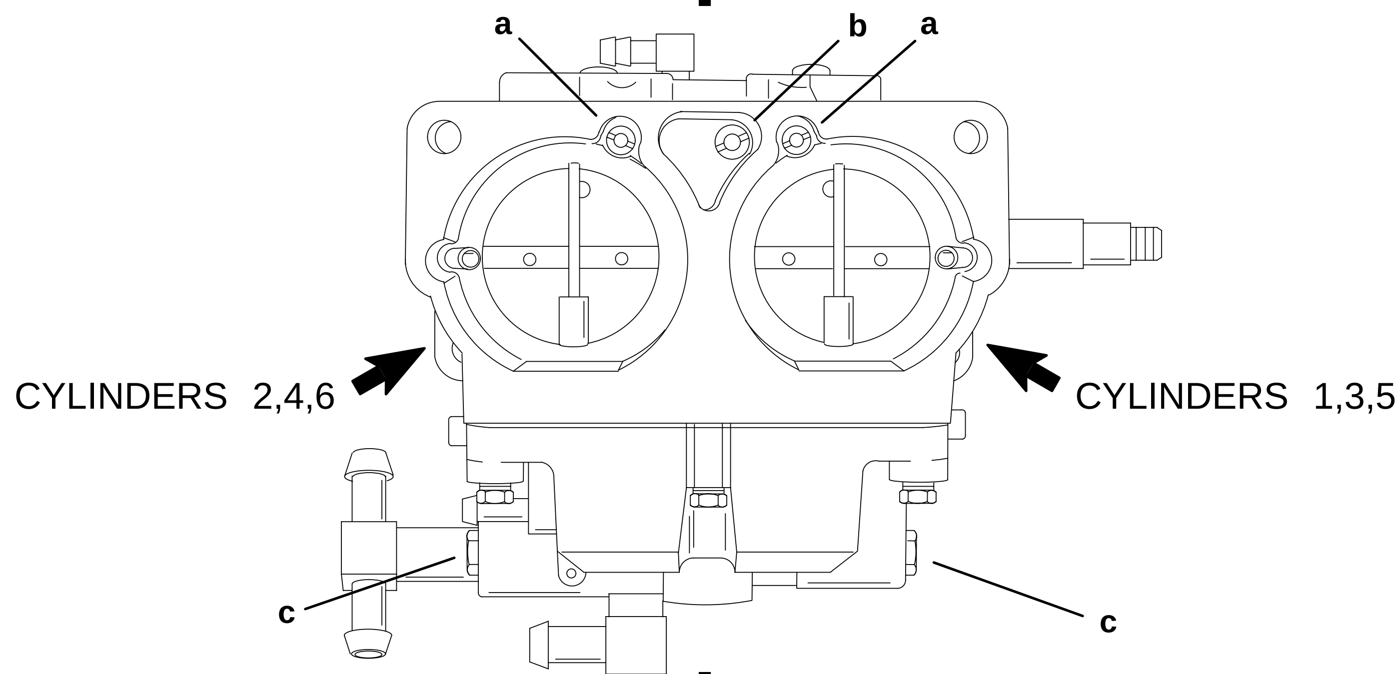
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
7	3	JET–bowl vent **(.086)(135/150/175)**	14		1.5
	3	JET–bowl vent **(.082**)**(XR6/Magnum III)**	14		1.5
	3	JET–bowl vent **(.096)(200)**	14		1.5
8	3	JET–idle air vent **(.036)(135)**	14		1.5
	3	JET–idle air vent **(.034)(150)** **STARBOARD**	14		1.5
	3	JET–idle air vent **(.044)(XR6/Magnum III)**	14		1.5
	3	JET–idle air vent **(.030)(175)**	14		1.5
	1	JET–idle air vent **(.052-Top)(200)**	14		1.5
	2	JET–idle air vent **(.028-Center/Bottom)(200)**	14		1.5
9	6	LIMITER CAP			
10	6	IDLE MIXTURE SCREW/SPRING			
11	3	LEVER KIT			
12	3	SPACER			
13	3	SPRING			
14	3	GASKET–fuel bowl			
15	3	FLOAT			
16	3	FLOAT SHAFT			
17	3	SCREW–float	10		1.0
18	3	VALVE SEAT KIT			
	3	VALVE SEAT KIT **(WMV-1 thru 5A)**			
19	3	GASKET–valve seat			
20	1	FUEL BOWL (TOP)			
	2	FUEL BOWL (CENTER/BOTTOM)			
21	18	SCREW–fuel bowl	26		3.0
22	6	PLUG KIT	33		3.5
23	6	GASKET			
24	6	JET–main fuel (.072)**(135)**	14		1.5
	6	JET–main fuel(.074)**(150/XR6/Magnum III)**	14		1.5
	6	JET–main fuel (.078)**(175)**	14		1.5
	4	JET–main fuel (.080)**(200)**	14		1.5
	2	JET–main fuel (.082)**(200-Top)**	14		1.5
25	2	TEE FITTING (TOP/CENTER)	45		5.0
26	1	ELBOW (BOTTOM)	45		5.0

WMV 1,2,3,4,5 Carburetor Specifications

Carburetor	Year	Engine	Venturi	Main Jet	Idle Air Jet	Back Draft Vent Jet
WMV 1/1A 1–2–3	1996-1998	135	1.312	.072	1,2,3,4,6=.036 5=.040	.086
WMV 2/2A 1–2–3	1996-1998	105 JET 150	1.312	.074	1,2,3,4,6=.034 5=.038	.086
WMV 3/3A 1–2–3	1996-1998	XR-6 MAG III	1.312	.074	1,2,3,4,6=.044 5=.048	.082
WMV 4/4A 1–2–3	1996-1998	175	1.312	.078	1,2,3,4,6=.030 5=.034	.086
WMV 5/5A 1–2–3	1996-1998	140 JET 200	1.312	1,2=.082 3,4,5,6=.080	1,2=.052 3,4,6=.028 5=.032	.096

NOTE: *All idle mixture settings for Models 135,105 Jet,150,XR6,MAGIII,175 are 1-1/2 turns ± 1/8 turn from a lightly seated position.*
Idle mixture settings for Models 140 Jet/200 are 1,2 = 1-1/2 ± 1/8 and 3,4,5,6 = 1-7/8 ± 1/8 turn from a lightly seated position.

WMV 1,2,3,4,5 Carburetor Front View



a - Idle Air Jet
b - Back Draft Vent Jet
c - Main Jet

Fuel System - Troubleshooting

General Information

Problems, that are thought to be caused by the fuel system, may be, in reality, something completely different. Items, that are shown in the list on the right, could give the impression that there is a problem in the fuel system.

1. Propeller
2. Spark plugs
3. Ignition timing
4. Ignition spark voltage
5. Cylinder compression
6. Reed valves

Problem: Engine Turns Over But Will Not Start Or Starts Hard When Cold.	
Possible Cause	**Corrective Action**
Improper starting procedure used.	Check proper starting procedure, as outlined in “Operation and Maintenance Manual.”
Fuel tank empty or too low. Improperly mixed fuel. Contaminants (water, dirt, etc.) in fuel	Check fuel in fuel tank and replace or add whichever is necessary.
Fuel tank air vent closed or restricted.	Check air vent on fuel tank. Air vent must be open all-the-way and free from any contaminants.
A pinched, cut or restricted fuel line. Also loose fuel line connection.	Check all fuel lines and replace as needed. Check and tighten all fuel line connections.
Dirty or restricted fuel filter.	Check and replace or clean all fuel filters.
Low fuel pump pressure.	Refer to Section 3A.
An anti-siphon valve.	Refer to “Checking for Restricted Fuel Flow” in this section.
Choke solenoid, or enrichment valve not operating.	Check choke solenoid or valve, and electrical wiring to solenoid or valve. Replace if necessary.
A needle and seat (in carburetor) that is either stuck open or closed. Open=Flooding - Closed=Starving	Refer to “Carburetor Disassembly” in this section.
Improper carburetor jets, restricted jet or idle mixture screw out of adjustment.	Refer to “Carburetor Adjustments” in this section.
Improper carburetor float level.	Refer to “Carburetor Adjustments” in this section.

Problem: Engine Idles Rough and Stalls. Problem: Engine Hesitates Upon Acceleration. Problem: Engine Runs Uneven or Surges.	
Possible Cause	**Corrective Action**
Improperly mixed fuel. Contaminants (water, dirt, etc.) in fuel.	Check fuel in fuel tank and replace if necessary.
Fuel tank air vent closed or restricted.	Check air vent on fuel tank. Air vent must be open all-the-way and free from restrictions.
A pinched, cut or restricted fuel line. Also loose fuel line connection.	Check all fuel lines and replace as needed. Check and tighten all fuel line connections.
A dirty or restricted fuel filter.	Check and replace or clean all fuel filters.

Possible Cause	Corrective Action
Low fuel pump pressure.	Refer to Section 3A.
An anti-siphon valve.	Refer to Section 3A.
A needle and seat (in carburetor) that is either stuck open or closed. (A needle and seat, that is stuck open, will cause a flooding condition. A needle and seat, that is stuck closed, will prevent fuel from entering carburetor.	Refer to "Carburetor Adjustments" in this section.
Improper carburetor jets, restricted jet or idle mixture screw out of adjustment.	Refer to "Carburetor Adjustments" in this section.
Improper carburetor float level.	Refer to "Carburetor Adjustments" in this section.
Carburetor loose on reed block housing.	Tighten carburetor nuts securely.
Reed block housing loose, or gaskets are defective.	Using a pressure oil can, spray 2-cycle oil around reed block housing/crankcase housing matching surfaces and carburetor base. If engine RPM changes, tighten or replace reed block housing gaskets or carburetor base gaskets, as needed.
Improperly routed or restricted bleed hose(s).	Refer to bleed line routing in Section 4.
Thermal relief valve not functioning.	Stuck Open: Poor cold start characteristics. Stuck Closed: Over rich at idle. Replace if necessary.

Reed Valve Leak Test

TOOLS NEEDED FOR TEST--

a) Fuel Pressure Gauge (0 to 15 psi)

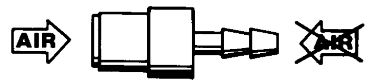
b) Hose (approx. 3 ft. x 1/8 in. ID), Same Diameter as Bleed Hoses.

1. Remove engine cowling.
2. Place outboard in water, start and allow to warm up.

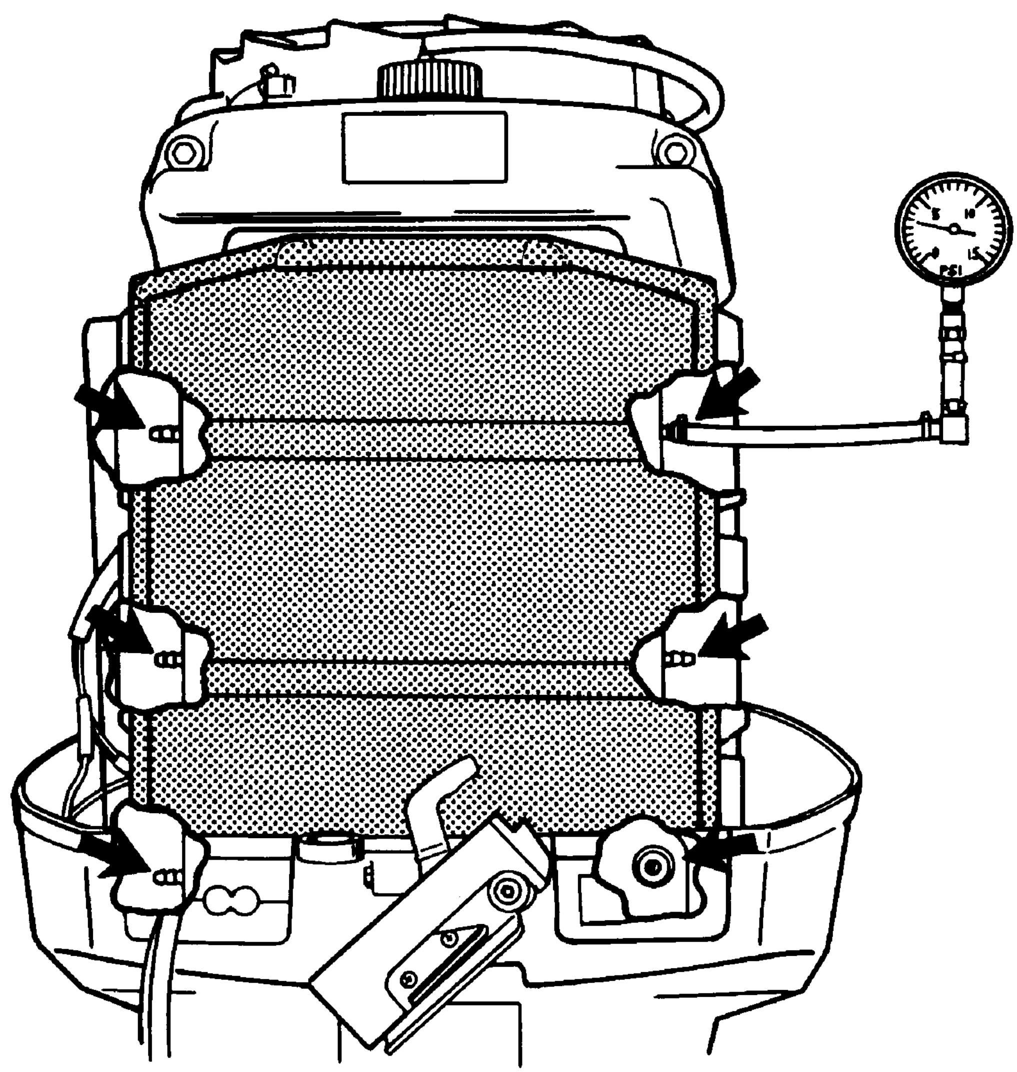
NOTE: *To gain access to cylinder #5 bleed fitting remove throttle cam from throttle linkage. Refer to 'Carburetor Removal/Installation" for cam removal and installation.*

3. Remove and plug bleed hoses (one at a time) from crankcase cover and connect fuel pressure gauge as shown.
4. With engine at idle, a reading of 3 to 6 psi must be attained. If reading falls below 3 psi inspect reed valves. Refer to induction manifold disassembly in Powerhead Section 4 of service manual. Replace reed valves or check valves as required.

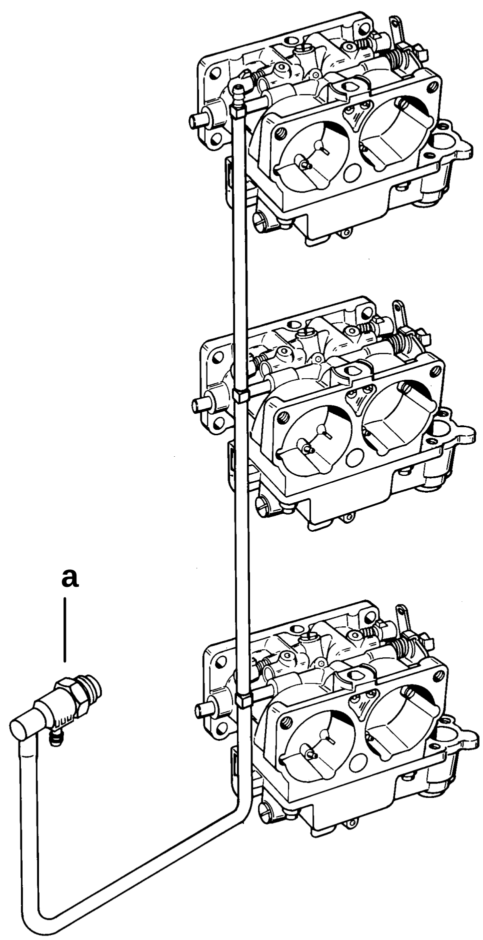
NOTE: *Check valve is functioning if air flows in one direction as shown.*



Fitting Location



Thermal Air Valve Circuit Description



a - Thermal Air Valve

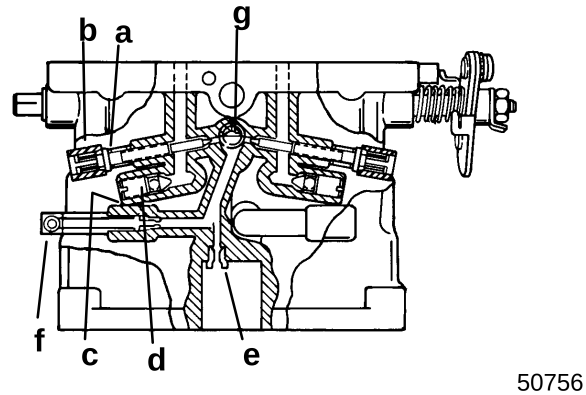
The thermal air valve circuit functions as an air restrictor for the idle circuit which is controlled by a thermal open/close valve monitoring engine temperature. The valve is located on the starboard cylinder head below no. 3 spark plug. When the engine temperature is below 100° F (38° C) the thermal air valve is closed. When a cold engine is running, the thermal air valve restricts air to the idle circuit causing the fuel mixture to be richer. When the engine warms sufficiently, the thermal valve opens allowing required fuel/air mixture for efficient operation.

WMH Carburetor Fuel Circuit Description

Idle Circuit Description

IMPORTANT: If welch plugs and air trim screws must be removed for carburetor cleaning, count number of turns air screw is turned in until seated, then remove. Apply Loctite 271 and set air screws to the same position (approx. 1-1/4 turns) prior to screw removal.

Top View



a - Fuel Mixture Adjustment
b - Screw Cap (two)
c - Welch Plug (two)
d - Air Trim Screw (two) - Apply Loctite 271
e - Idle Air Bleed Jet
f - Thermal Air Valve Air Inlet
g - Emulsion Tube

The idle circuit is independent of progression and main circuits. The idle circuit consists of externally adjustable fuel mixture screws, idle air bleed jet, and factory set air trim screws located beneath welch plugs.

IDLE CIRCUIT ADJUSTMENTS

a. Fuel mixture screws (2 per carb.) - When adjusting fuel mixture screws all screws must be turned the same amount and the same direction for engine to operate efficiently at idle speeds. DO NOT remove mixture screw caps to further richen or lean fuel flow.

Clockwise direction - leans mixture

Counterclockwise direction - richens mixture

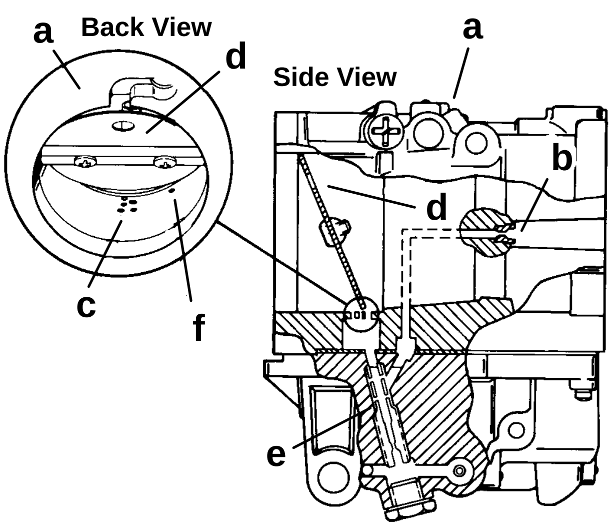
NOTE: *If caps are removed from mixture screws and screws are removed for carburetor cleaning refer to "IMPORTANT" preceding.*

b. Idle Air Bleed Jets (1 per carb.) - The idle air bleed jet meters air and is located next to the back drag vent jet. If a jet with a smaller orifice is installed the fuel/air ratio becomes richer. If a jet with a larger orifice is installed, fuel/air ratio becomes leaner.

c. Air Trim Screws (2 per carb.) - Located beneath welch plugs and are preset at factory. DO NOT remove welch plugs and adjust trim screws.

NOTE: *If welch plugs and trim screws are removed for carburetor cleaning, refer to “IMPORTANT” preceding.*

Off-Idle Circuit Description

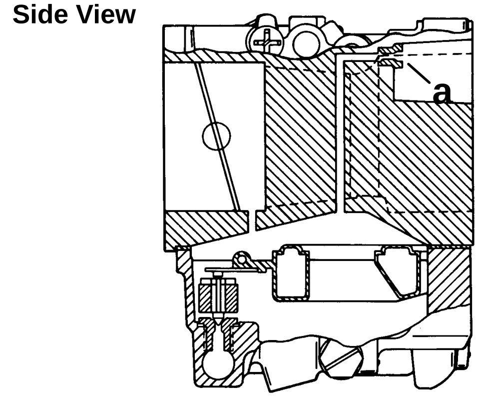


50756

a - Carburetor Body
b - Off-Idle Air Jet
c - Off-Idle Discharge Holes
d - Throttle Shutter
e - Off-Idle Tube
f - Back Draft Circuit Port (Port Bore Only)

The off-idle fuel flow circuit is controlled by an off-idle air jet located in each carburetor bore. Each venturi has one off-idle tube and one off-idle air jet. The circuit functions at off-idle speeds until full throttle operation occurs.

Back Draft Circuit Description

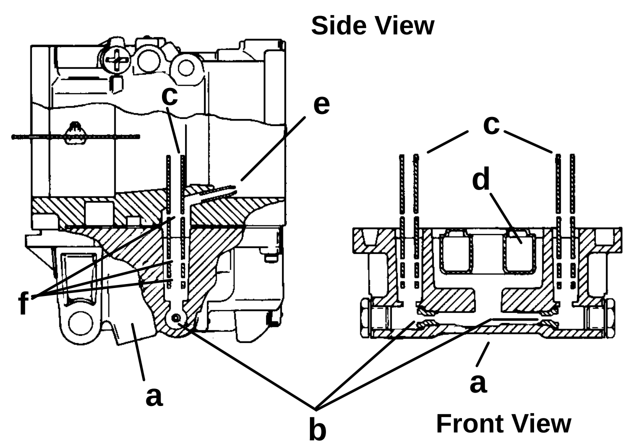


50755

a - Back Draft Jet (Bowl Vent)

The back draft circuit contains a vent jet, located next to the idle air jet, which supplies less than atmospheric pressure to the fuel bowl at mid-range which results in improved fuel economy.

High Speed Fuel Circuit Description



50755

a - Fuel Bowl
b - Main Fuel Jet
c - Main Discharge Tube
d - Float
e - Main Discharge Tube Air Inlet
f - Cross Hole Vents

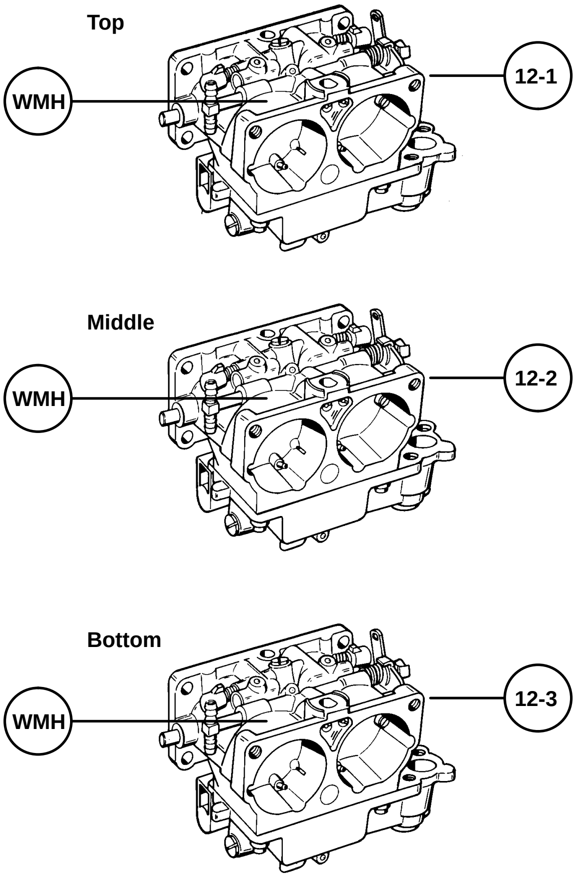
The high speed fuel flow is controlled by the main (high speed) jets and are located in the fuel bowl. A fuel/air mixture is drawn from the fuel bowl thru the main discharge tubes during full throttle operation.

HIGH SPEED FUEL CIRCUIT ADJUSTMENTS

Main (High Speed) Jet (2 per carb.) - If a jet with a smaller orifice is installed, the fuel/air ratio becomes leaner. If a jet with a larger orifice is installed, the ratio becomes richer.

Carburetor Placement

Example: 135 Model



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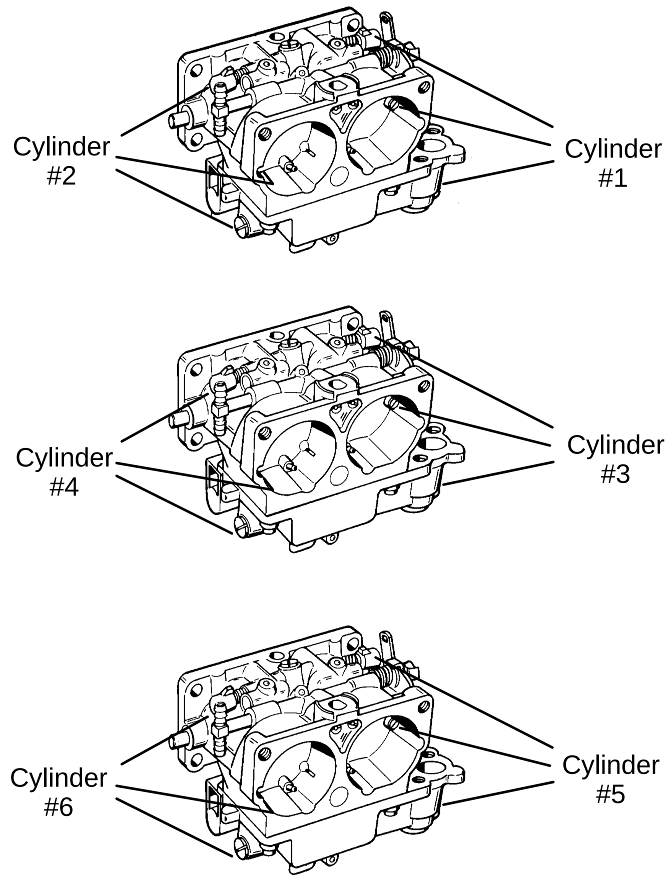
JET LOCATION FOR EACH CYLINDER



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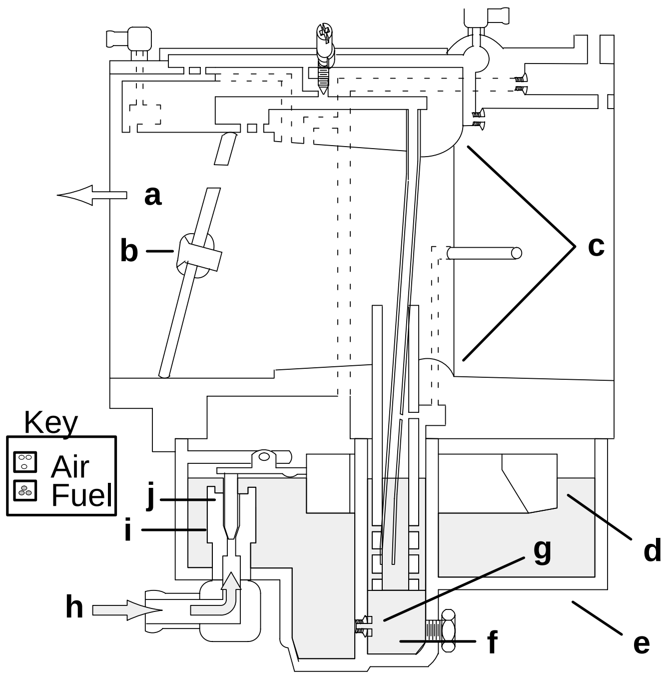
Carburetor jets and adjustment screw installed in the starboard side of the carburetor supply fuel to the port cylinder, jets and adjustment screw installed in the port side supply fuel to the starboard cylinder. The idle jet and back draft jet affect both cylinders.

WMV Carburetor Fuel Circuit Description

Float Bowl Circuit

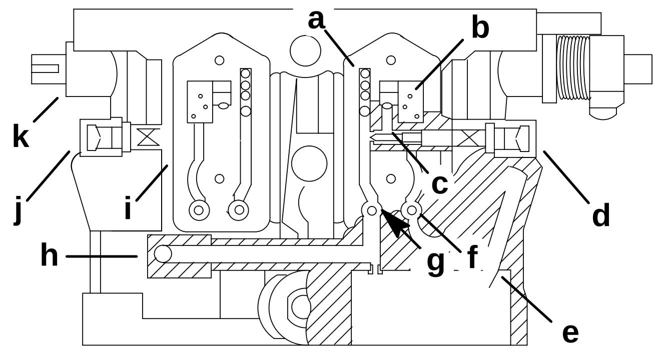


a - To Engine Crankcase
b - Throttle Plate
c - Carburetor Venturi
d - Float
e - Float Bowl
f - Main Fuel Well
g - Main Jet
h - Fuel from Fuel Pump
i - Inlet Seat
j - Inlet Needle

Fuel from the fuel pump enters the carburetor through the fuel inlet fitting and fills the bowl until the float moves the inlet needle against the fuel inlet seat. With the inlet needle against the inlet seat, the fuel inside the float bowl is at it's maximum level. Fuel inside the bowl flows through the main fuel jet and fills the main fuel well.

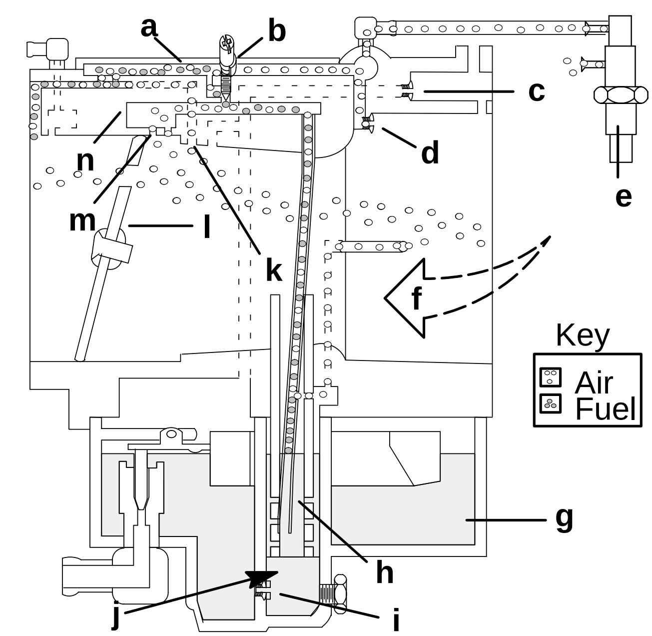
Idle Circuit

Top View –



a - Idle Discharge Ports
b - Off-Idle Discharge Ports
c - Idle Fuel Transfer Passage
d - Idle Mixture Screw
e - Main Discharge Vent Tube
f - Idle Pickup Tube
g - Idle Air Passage
h - Thermal Air Valve Air Inlet
i - Top Cover Mounting Flange
j - Idle Mixture Screw
k - Throttle Shaft

Side View –



a - Idle Passage
b - Idle Mixture Screw
c - Back Draft Jet
d - Idle Air Jet
e - Thermal Air Valve (open)
f - Air Flow
g - Float Bowl
h - Idle Pickup Tube
i - Main Fuel Jet
j - Main Fuel Well
k - Idle Air Bypass
l - Throttle Plate
m - Off-Idle Ports
n - Off-Idle Passage

As the engine rotates, the piston moves away from the crankcase. This movement creates a low pressure area behind the throttle plate. Atmospheric pressure pushes air through the carburetor throat (venturi), past the throttle plate (small hole in plate) and into the low pressure area inside the crankcase. Atmospheric pressure enters the float bowl chamber through the back draft jet. This pressure forces fuel toward the low pressure area behind the throttle plate. Fuel flows:

(1.) Through the main fuel jet into the main fuel well,

(2.) Up the idle tube,

(3.) Through the off-idle passages,

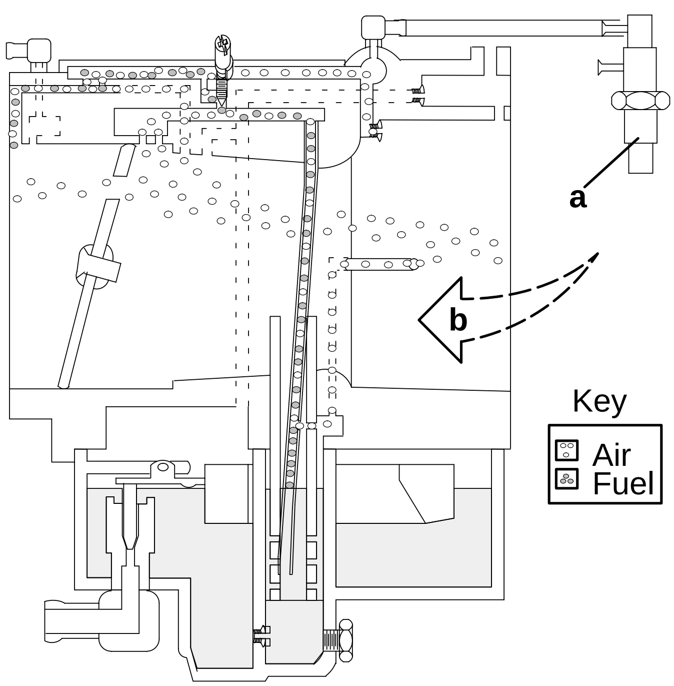
(4.) Past the idle mixture screw,

(5.) Into the idle passage

(6.) And into the carburetor throat.

Air enters the idle circuit through the idle air jet, (open) thermal air valve and secondary idle air bleed. This air mixes with the fuel inside the idle passage before the sir/fuel mixture is discharged into the engine. Rotating the idle mixture screw will change the air/fuel mixture at idle speeds.

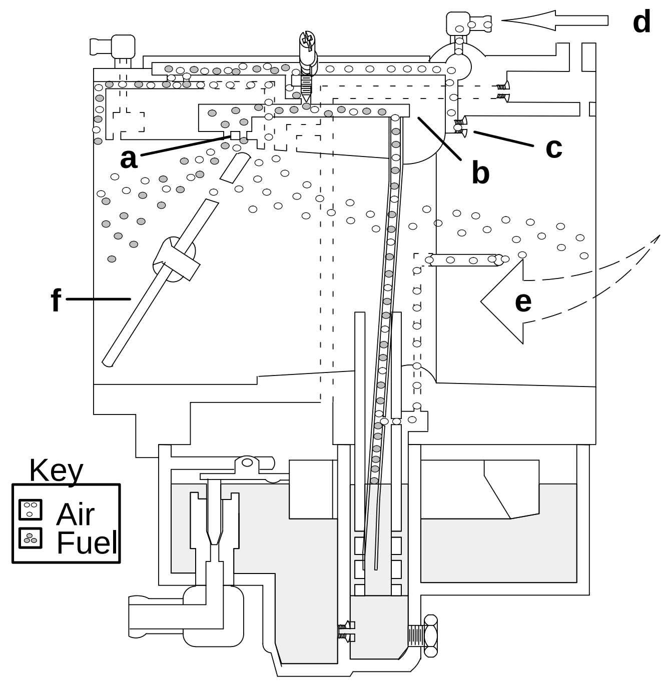
Cold Start Circuit



a - Thermal Air Valve (closed)
b - Air Flow

A cold engine will require a richer mixture. When the engine is cold, the thermal air valve (located on the cylinder head) is closed. Air is prevented from entering the idle circuit. Without this additional air, the idle mixture is richened. A failure in the thermal air valve (closed) will cause the idle circuit to be rich. To test the thermal air valve, plug the inlet fitting (located on the valve). With the fitting closed, the air flow is stopped, and the engine should run rich at idle speeds.

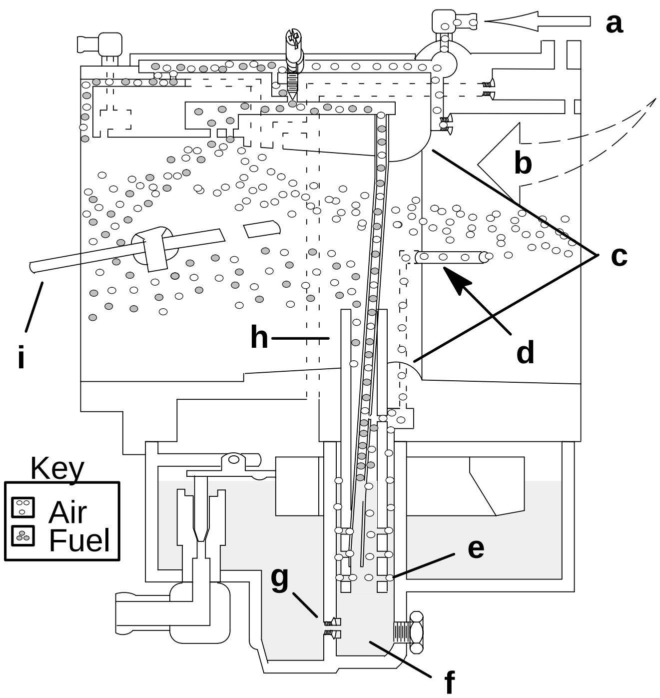
Off-Idle Circuit



a - Off-Idle Ports
b - Off-Idle Passage
c - Idle Air Jet
d - From Open Thermal Air Valve
e - Air Flow
f - Throttle Plate

As the throttle plates rotate past the off-idle ports, the ports are exposed to the low pressure area behind the throttle plate. Additional fuel flows through the off-idle passage; through the rear port; and as the throttle plate continues to rotate, through the forward port.

Main Circuit



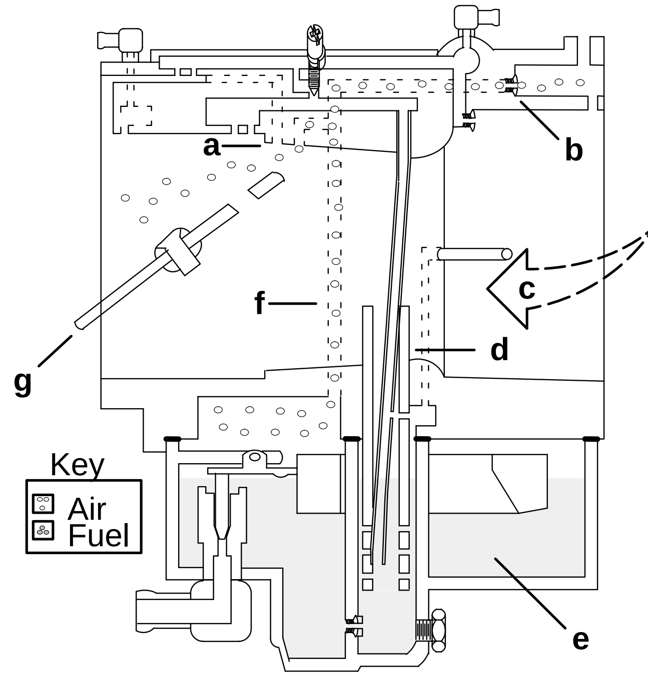
a - From Open Thermal Air Valve
b - Air Flow
c - Venturi
d - Main Discharge Air Inlet Tube
e - Cross Holes
f - Main Fuel Well
g - Main Fuel Jet
h - Main Discharge Nozzle
i - Throttle Plate

As the throttle plate rotates past the off-idle ports, the low pressure area extends to the main discharge nozzle. In addition, the increased air flow through the carburetor bore creates a low pressure area inside the venturi. These combined forces create a strong suction over the main discharge tube. Fuel flows:

1. Through the main fuel jet into the main fuel well.
2. Up the main discharge nozzle,
3. Into the venturi.

Air is mixed with the fuel to make it lighter, air enters the main fuel well through the main discharge air inlet tube. Cross holes are drilled in the main discharge tube, allowing the air to mix with the fuel inside the main well. As the throttle plate continues to open, additional fuel is drawn out of the main discharge tube, exposing additional cross holes. At full throttle, the fuel mixture is controlled by the size of the main fuel jet.

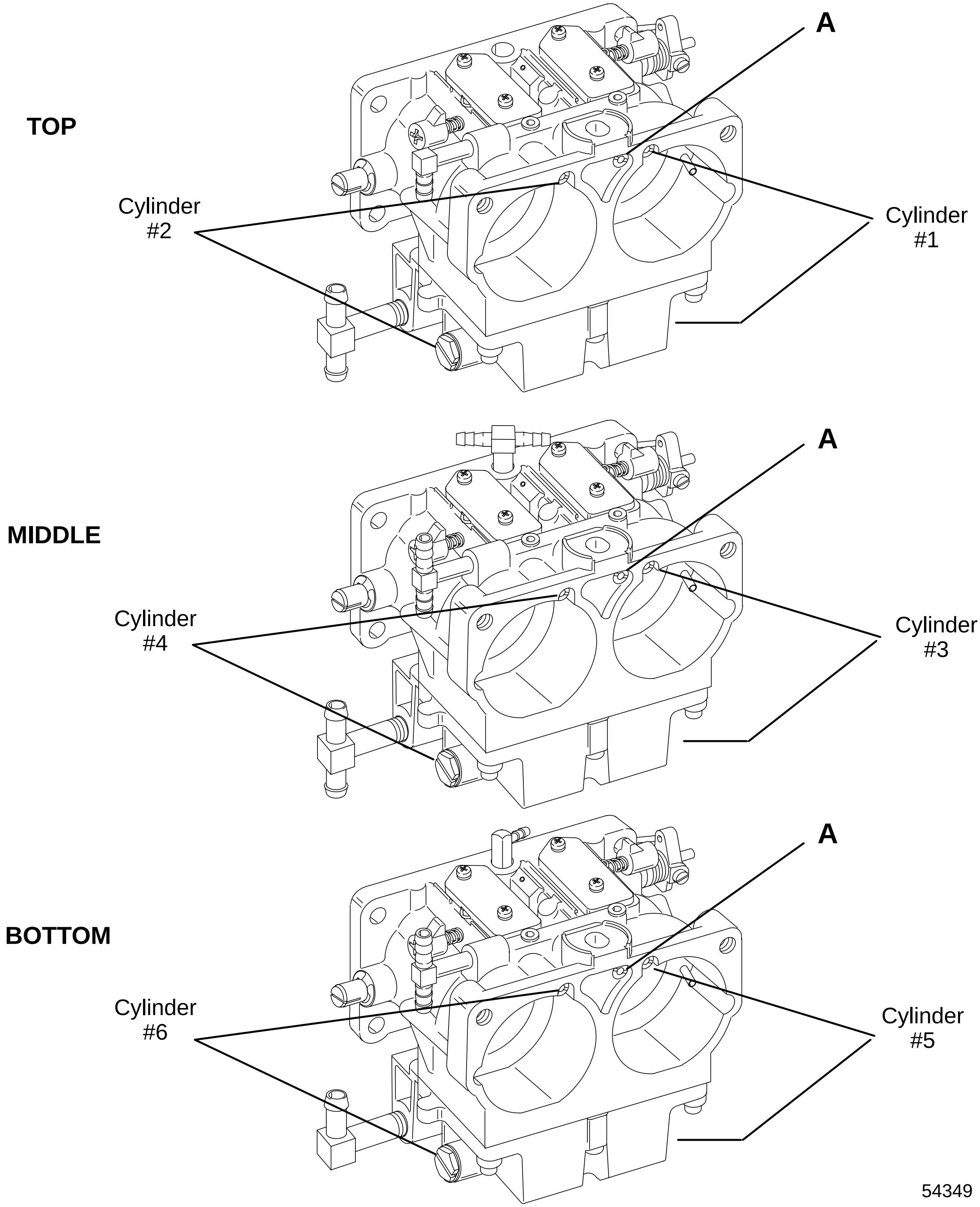
Back Draft Circuit



NOTE: *Fuel Flow Not Shown For Clarity*
a - Back Draft Port
b - Back Draft Jet
c - Air Flow
d - Main Discharge Tube
e - Fuel Bowl
f - Fuel Bowl Vent Passage
g - Throttle Plate

At partial throttle settings, the back draft circuit leans out the mixture for increased fuel economy. The back draft circuit uses the float bowl vent circuit and bowl vent jet to lean out the air/fuel mixture. The bowl vent jet limits the amount of air entering the float bowl vent circuit. With the throttle plate positioned correctly, the low pressure area is exposed to the back draft port inside the carburetor bore. The float bowl vent circuit is connected by passages to the back draft port. The low pressure area pulls air out of the bowl vent circuit. Due to the size of the vent jet and the air loss through the back draft port, the air pressure on the fuel inside the fuel bowl is lowered to below atmospheric pressure. Lower pressure on the fuel inside the float bowl, lowers the amount of fuel being forced out of the main discharge tube.

Carburetor Placement and Jet Location for Each Cylinder (WMV Carburetors)



A – Backdraft jet affects both cylinders.

High Altitude Recommendations

NOTE: *Refer to "Jet Charts" for jet sizes and part numbers.*

IMPORTANT: When operating outboard above 5000 ft. (1524m), it is recommended outboard gear ratio be reduced as shown in chart below:

Production Models –

Model	High Altitude Gear Ratio Change
135/150 with 2:1 Ratio	2.3:1 High Altitude Gear Kit
150 Mag III/XR6 with 1.78:1 Ratio	135/150 - 2:1 Complete Gearcase
150 Mag III,XR6,175,200 with 1.87:1 Ratio	135/150 - 2:1 Ratio Gear Set or Complete Gearcase

High Performance Models –

Model	High Altitude Gear Ratio Change
150 Pro Max/Super Magnum with 1.78:1 Ratio	135/150 - 2:1 Complete Gearcase or Torque-master 2:1 or CLE 2:1
150 Pro Max/Super Magnum with Torque-master 1.87:1 or CLE 1.87:1	2:1 Ratio Gear Set
200/225 Pro Max/Super Magnum with Torque-master/Sportmaster/ CLE with 1.87:1 Ratio	2:1 Ratio Gear Set

NOTE: *Thread size for V-6 model carburetor main, idle air and back draft jets are 10-32*

JET ORIFICE SIZE/PART NUMBER CHART 10-32							
Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number
.040	19266040	.058	1395-7831	.076	1399-3796	.094	1395-8423
.042	1399-5315	.060	1395-6487	.078	1395-6680	.096	1399-6249
.044	1395-7394	.062	1399-4217	.080	1395-6201	.098	1395-7355
.046	1399-5317	.064	1399-4216	.082	1399-3518		
.048	1395-6246	.066	1399-4215	.084	1399-3517		
.050	1395-6028	.068	1395-6029	.086	1395-5815		
.052	1395-6359	.070	1395-6030	.088	1395-6202		
.054	1399-5225	.072	1395-6207	.090	1395-6247		
.056	1399-5213	.074	1399-3794	.092	1395-5733		

NOTE: *Thread size for V-6 model carburetor progression jets are 8-32*

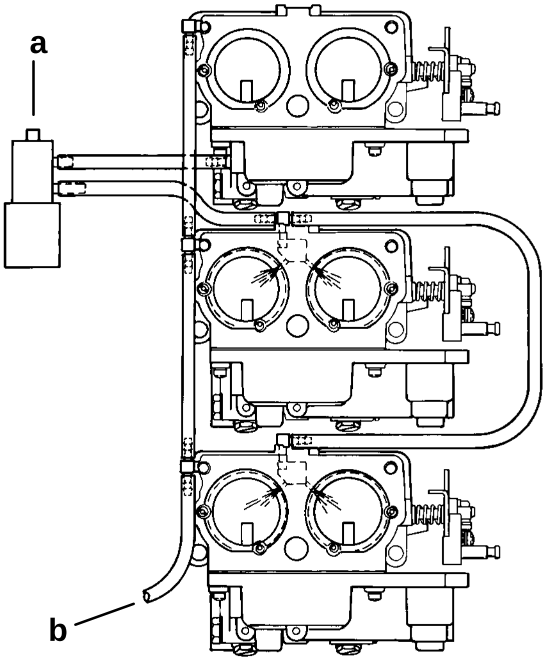
JET ORIFICE SIZE/PART NUMBER CHART 8-32							
Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number
.030	810741	.038	815633038	.046	815633046	.054	815633054
.032	1399-3252	.040	1399-7570	.048	815633048	.070	815633070
.034	1395-3251	.042	815633042	.050	815633050	.076	815633076
.036	1399-3026	.044	810742	.052	815633052		

High Altitude Jet Chart

Factory installed main fuel jets are normally adequate for proper performance up to approximately 5000 feet (1524m) above sea level. Between 2000 feet (609.6m) and 5000 feet (1524m) the reduction of the main fuel jet(s) may result in improved performance and fuel economy. Above 5000 feet, however, it is recommended that main jet size be reduced as shown per 1000 feet (304.8m) in the following chart.

Feet **Meter**	1000 304.8	2000 609.6	3000 914.4	4000 1219.2	5000 1524	6000 1828.8	7000 2133.6	8000 2438.4	9000 2743.2	10000 3048	11000 3352.8	12000 3657.6
Jet Size												
0.034	0.034	0.034	0.032	0.032	0.032	0.032	0.032	0.032	0.030	0.030	0.030	0.030
0.036	0.036	0.036	0.034	0.034	0.034	0.034	0.034	0.032	0.032	0.032	0.032	0.032
0.038	0.038	0.038	0.036	0.036	0.036	0.036	0.036	0.034	0.034	0.034	0.034	0.034
0.040	0.040	0.040	0.038	0.038	0.038	0.038	0.038	0.036	0.036	0.036	0.036	0.034
0.042	0.042	0.042	0.040	0.040	0.040	0.040	0.038	0.038	0.038	0.038	0.038	0.036
0.044	0.044	0.044	0.042	0.042	0.042	0.042	0.040	0.040	0.040	0.040	0.038	0.038
0.046	0.046	0.046	0.044	0.044	0.044	0.044	0.042	0.042	0.042	0.042	0.040	0.040
0.048	0.048	0.048	0.046	0.046	0.046	0.046	0.044	0.044	0.044	0.042	0.042	0.042
0.050	0.050	0.050	0.048	0.048	0.048	0.046	0.046	0.046	0.046	0.044	0.044	0.044
0.052	0.052	0.050	0.050	0.050	0.050	0.048	0.048	0.048	0.048	0.046	0.046	0.046
0.054	0.054	0.052	0.052	0.052	0.052	0.050	0.050	0.050	0.048	0.048	0.048	0.048
0.056	0.056	0.054	0.054	0.054	0.054	0.052	0.052	0.052	0.050	0.050	0.050	0.048
0.058	0.058	0.056	0.056	0.056	0.056	0.054	0.054	0.054	0.052	0.052	0.052	0.050
0.060	0.060	0.058	0.058	0.058	0.056	0.056	0.056	0.054	0.054	0.054	0.052	0.052
0.062	0.062	0.060	0.060	0.060	0.058	0.058	0.058	0.056	0.056	0.056	0.054	0.054
0.064	0.064	0.062	0.062	0.062	0.060	0.060	0.060	0.058	0.058	0.058	0.056	0.056
0.066	0.066	0.064	0.064	0.064	0.062	0.062	0.062	0.060	0.060	0.060	0.058	0.058
0.068	0.068	0.066	0.066	0.066	0.064	0.064	0.064	0.062	0.062	0.060	0.060	0.060
0.070	0.070	0.068	0.068	0.068	0.066	0.066	0.064	0.064	0.064	0.062	0.062	0.062
0.072	0.072	0.070	0.070	0.070	0.068	0.068	0.066	0.066	0.066	0.064	0.064	0.062
0.074	0.074	0.072	0.072	0.070	0.070	0.070	0.068	0.068	0.068	0.066	0.066	0.064
0.076	0.076	0.074	0.074	0.072	0.072	0.072	0.070	0.070	0.068	0.068	0.068	0.066
0.078	0.078	0.076	0.076	0.074	0.074	0.074	0.072	0.072	0.070	0.070	0.068	0.068
0.080	0.080	0.078	0.078	0.076	0.076	0.076	0.074	0.074	0.072	0.072	0.070	0.070
0.082	0.082	0.080	0.080	0.078	0.078	0.076	0.076	0.076	0.074	0.074	0.072	0.072
0.084	0.084	0.082	0.082	0.080	0.080	0.078	0.078	0.076	0.076	0.076	0.074	0.074
0.086	0.086	0.084	0.084	0.082	0.082	0.080	0.080	0.078	0.078	0.076	0.076	0.074
0.088	0.088	0.086	0.086	0.084	0.084	0.082	0.082	0.080	0.080	0.078	0.078	0.076
0.090	0.090	0.088	0.088	0.086	0.086	0.084	0.084	0.082	0.082	0.080	0.080	0.078
0.092	0.092	0.090	0.090	0.088	0.088	0.086	0.086	0.084	0.084	0.082	0.082	0.080
0.094	0.094	0.092	0.092	0.090	0.090	0.088	0.088	0.086	0.086	0.084	0.084	0.082
0.096	0.096	0.094	0.094	0.092	0.092	0.090	0.090	0.088	0.086	0.086	0.084	0.084
0.098	0.098	0.096	0.096	0.094	0.092	0.092	0.090	0.090	0.088	0.088	0.086	0.086

Enrichener System Description



a - Manual Primer Button
b - To Thermal Air Valve

The enrichener system provides the engine with a rich fuel charge for starting ease of a cold engine. The system consists of an electrically operated enrichener valve which is connected by hoses to the carburetors.

Fuel is gravity fed to the valve from the float bowl of the top carburetor via a hose. When the key (or choke button) is pushed in (and held in) current is sent to the valve causing it to open, which allows fuel to pass thru. The fuel passes thru a hose and is supplied to the engine via fittings located on top of the middle and bottom carburetors. When the key (or choke button) is released, the valve will return to the closed position. The valve can be operated manually if valve fails to operate electrically, refer to “Manual Operation of Enrichener Valve,” following.

MANUAL OPERATION OF ENRICHENER VALVE

IMPORTANT: Use of enrichener if engine is warm could result in engine flooding.

Squeeze primer bulb until bulb is firm. Press button in on enrichener valve and hold approximately five seconds. Release button. Start outboard.

ENRICHENER VALVE TEST

Push key (or choke button) in. Valve should click

No Click
Check for battery voltage to yellow/black wire at terminal block on engine when key (or choke button) is pushed in

Click
Squeeze primer bulb until bulb is firm. Remove hose from fitting on bottom of enrichener valve. Place a container under valve, then push key (or choke button). Check for fuel flow from fitting.

Battery Voltage Indicated
Check for loose or corroded connection between yellow/black wire and black wire (under same screw at terminal block).

Check that other black wire at terminal block is properly grounded.

Repair connection(s) as necessary, then push key (or choke button) in. If enrichment valve DOES NOT click, replace valve.

No Voltage Indicated
Check for open in yellow/black wire between key switch (or choke button) and terminal block.

Fuel Flow from Fitting
Valve is O.K. Check hoses and fittings from valve to middle and bottom carburetors for leads or obstructions.

No Fuel Flow from Fitting
Remove hose from top carburetor at valve. If fuel flows from hose, replace valve. If not, check hose and fitting for leaks or obstructions.

ENRICHENER VALVE REPLACEMENT

1. Disconnect enrichener valve leads at terminal block.
2. Disconnect hoses from valve.
3. Remove bolt that secures valve mounting bracket to engine, then lift valve from engine.
4. Reinstall hoses to valve.
5. Apply a drop of Loctite 271 (92-809820) to threads of mounting bracket retaining bolt, then secure valve to engine with bracket and bolt.
6. Ground black (valve) lead by inserting terminal block retaining screw thru lead end and terminal block, and then securing to engine using screw.
7. Connect yellow/black lead (from engine harness) to yellow/black valve lead by inserting screw thru lead ends, and securing to terminal block using screw.

Removing Carburetor(s) from Engine

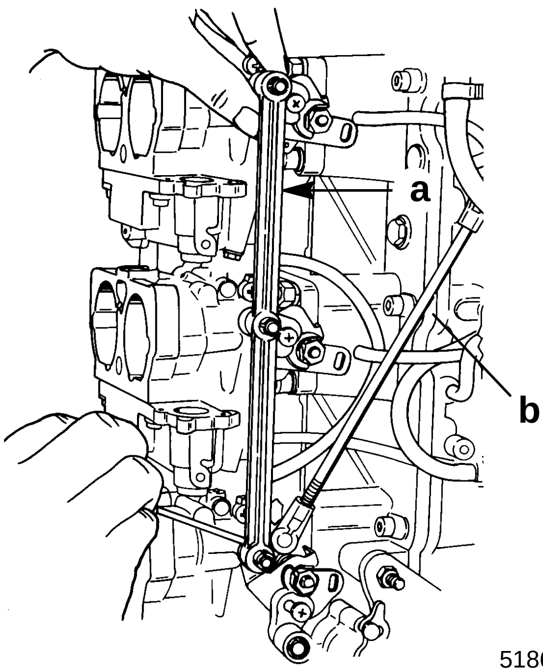
NOTE: *Removal,disassembly and reassembly of WMH and WMV carburetors are very similar.*

1. Remove top cowling.

IMPORTANT: Place an identifying mark on each carburetor before removal as each carburetor must be reinstalled in same location from which removed.

NOTE: *As each carburetor is removed from intake manifold, their respective fuel enrichener hose should be disconnected.*

2. Remove screws and air box cover from engine.
3. Remove throttle linkage from throttle levers as shown.
4. Remove oil pump link rod from throttle lever.



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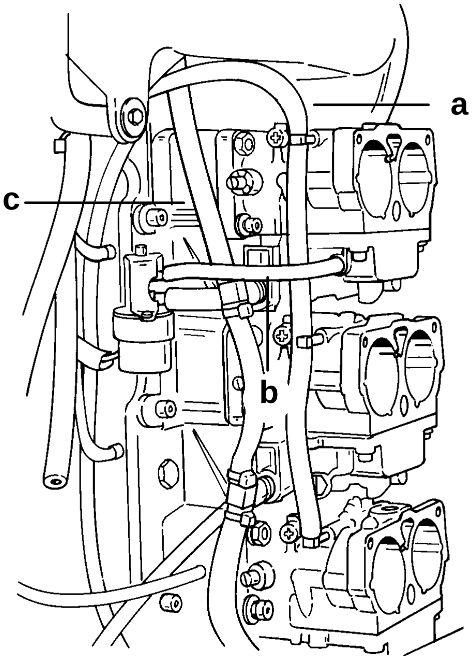
a - Throttle Linkage
b - Oil Pump Link Rod

5. Remove fuel hose, fuel enrichener valve hose and thermal valve hose from carburetors.



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a - Fuel Hose
b - Enrichment Valve Inlet Hose
c - Thermal Valve Hose

6. Carburetors may now be removed individually. Mark location of each carburetor and reinstall in same location. Remove carburetor(s) secured by two nuts and two allen head type bolts.

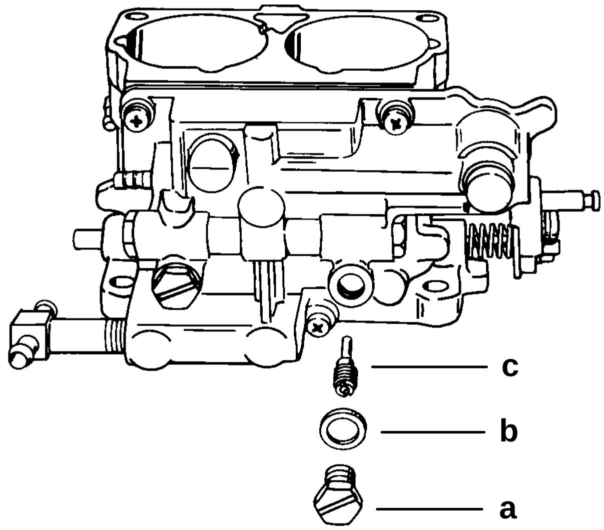
Carburetor Disassembly

Carburetor Jet Removal

IMPORTANT: When disassembling and reassembling carburetors, retain and reassemble components to their respective carburetors (i.e. float bowls, jets, emulsion tubes, etc.).

IMPORTANT: If welch plugs and air trim screws must be removed for carburetor cleaning, count number of turns air screw is turned in until seated, then remove. Apply Loctite 271 and set air screws to the same position (approx. 1-1/4 turns) during screw installation.

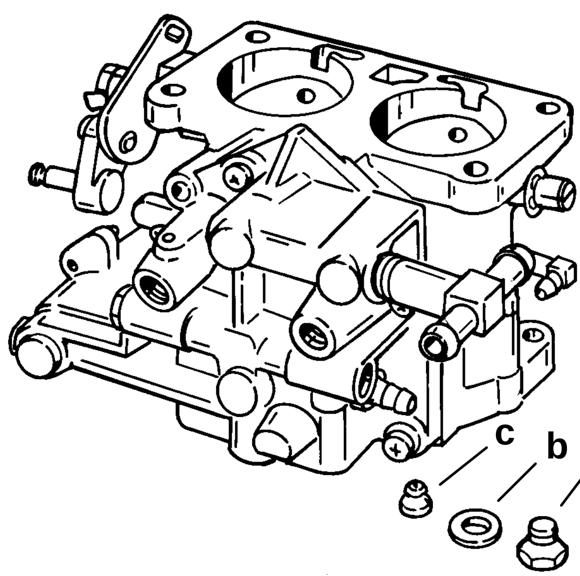
1. Remove off-idle tube access plugs and off-idle tubes from carburetor.



51859

a - Access Plug (2)
b - Gaskets (2)
c - Off-Idle Tube (2)

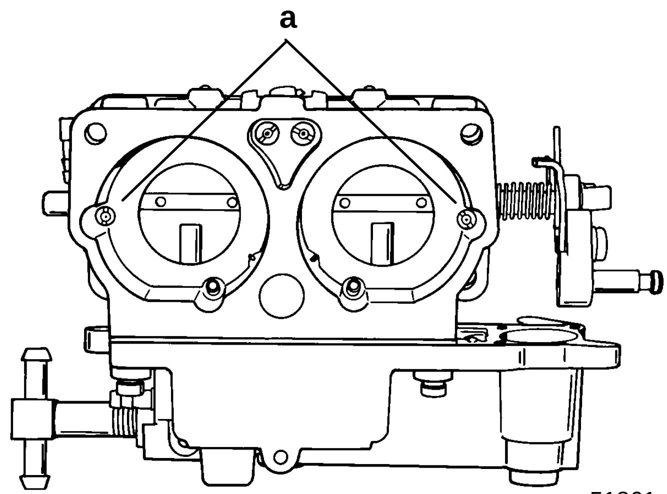
2. Remove high speed fuel jet access plugs and main (high speed) fuel jet from carburetor.



51859

a - Access Plug (2)
b - Gaskets (2)
c - Main Fuel Jets (2)

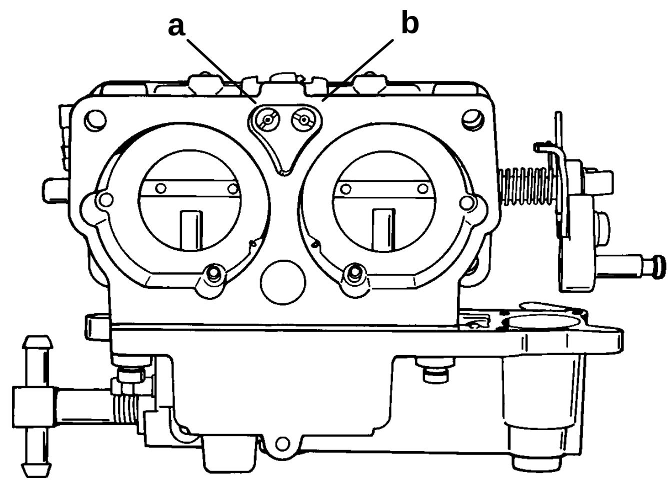
3. Remove off-idle air jets from carburetor.



51861

a - Off-Idle Jets (2)

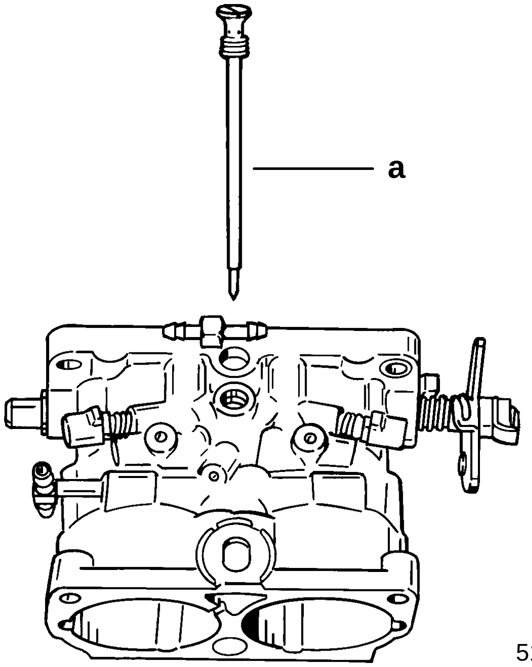
4. Remove idle air jet and back draft vent jet (if equipped) from carburetor.



51861

a - Idle Air Jet
b - Vent Jet

5. Remove emulsion tube from carburetor.

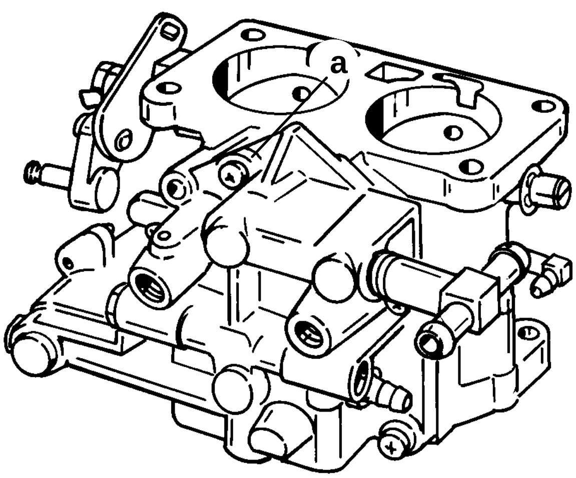


51862

a - Emulsion Tube

Fuel Bowl Removal and Disassembly

1. Remove five screws securing fuel bowl and gasket to carburetor body.



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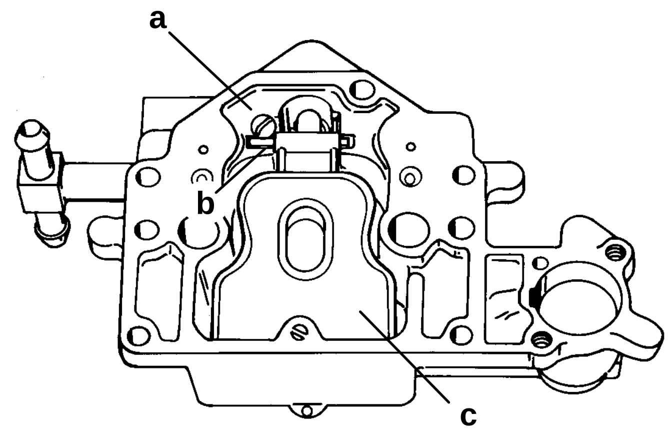
a - Screws

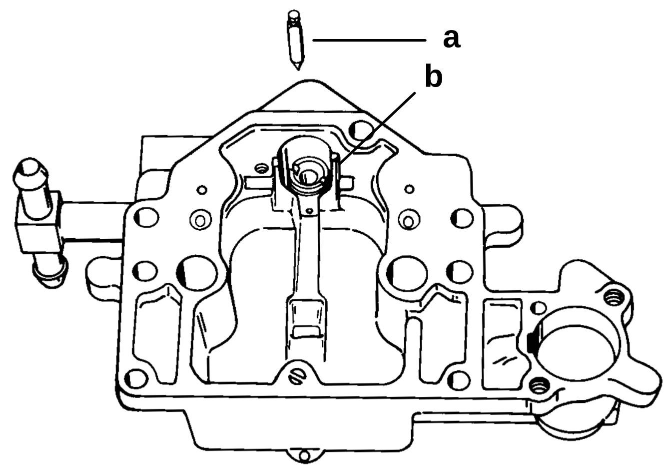
2. Remove screw securing float assembly in place.



51863

a - Screw
b - Float Pin
c - Float

3. Remove needle and seat from fuel bowl.

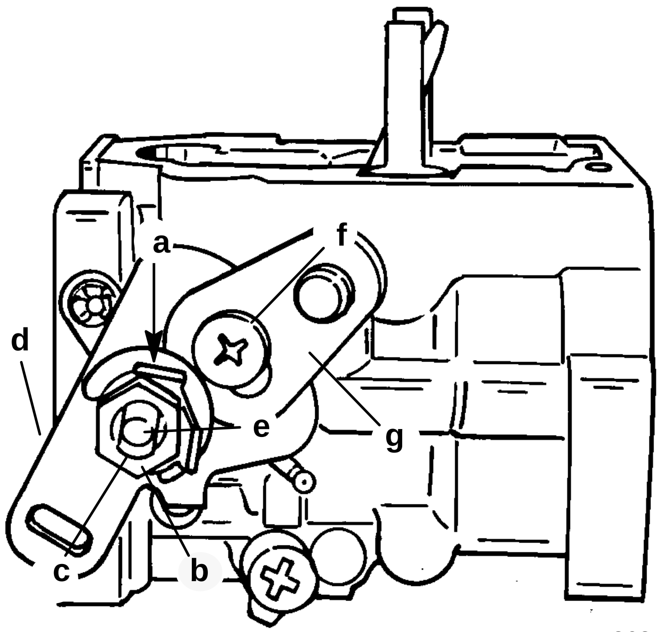


51859

a - Needle
b - Seat with Gasket

THROTTLE SHAFT COMPONENT REMOVAL

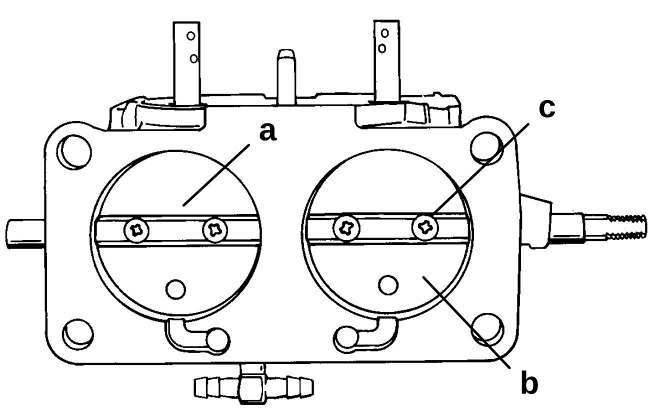
1. Bend tab washer away from nut. Remove nut, tab washer, spacer, throttle lever and spring from throttle shaft.
2. Remove screw and throttle link.



51863

a - Tab Washer
b - Nut
c - Spacer
d - Throttle Spacer
e - Throttle Shaft
f - Screw
g - Throttle Link

3. If necessary, remove four screws which secure two throttle shutter plates to throttle shaft. Remove throttle shutter plates from throttle shaft, then pull throttle shaft out of carburetor.



51860

a - Throttle Shaft
b - Throttle Shutter Plate
c - Screws

Carburetor Cleaning and Inspection

1. Place carburetor body, fuel bowl and metal parts in carburetor cleaning solution for a short period of time to remove all dirt, gum and varnish which has accumulated.

⚠ CAUTION

DO NOT place floats, inlet needles, idle screw adjusting caps, any rubber or plastic parts into carburetor cleaning solution. If adjusting caps must be removed and reinstalled, refer to "Idle Circuit Adjustments" preceding.

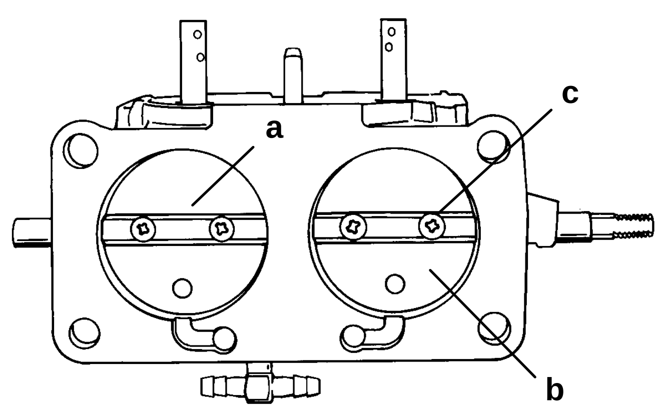
2. After soaking carburetor parts, rinse thoroughly with water, then solvent. Blow parts dry with compressed air. Be sure to blow thru all passages, orifices and nozzles.
3. Check for float deterioration (saturation).
4. Examine inlet needle and seat for wear. If worn, replace with new inlet needle and seat assembly.

Carburetor Reassembly

IMPORTANT: Make certain that all parts are kept clean during reassembly of carburetor.

Throttle Shaft Component Installation

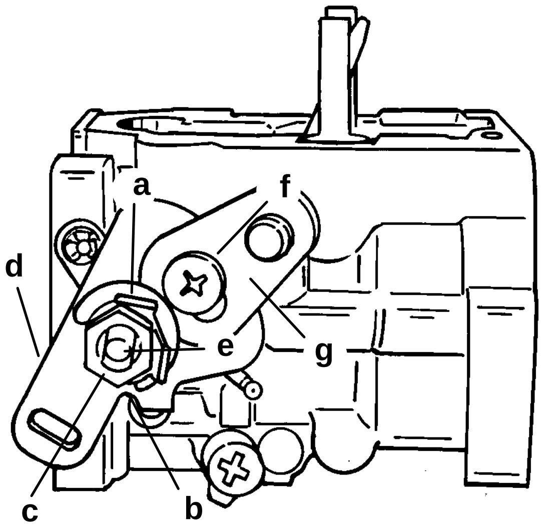
1. Install throttle shaft into carburetor body. Install throttle shutter plates to throttle shaft. Apply Loctite 271 to threads of screws and secure throttle shutters to throttle shaft.



51860

a - Throttle Shaft
b - Throttle Shutter Plate
c - Screws (use Loctite 271)

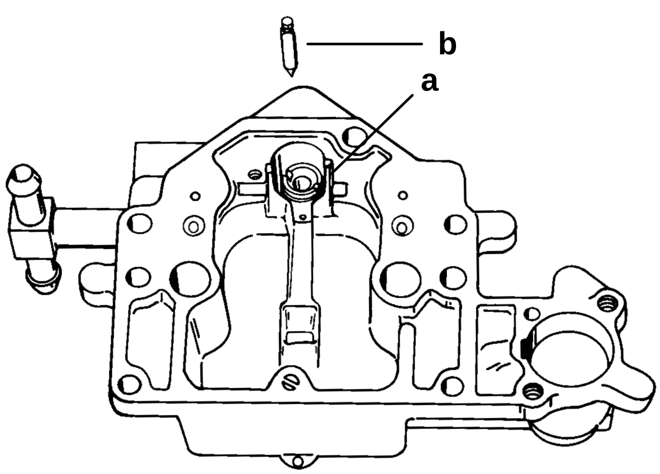
2. Install spring, throttle lever, spacer, tab washer and nut. Bend tab washer against flats of nuts.
3. Install throttle link and screw.



a - Tab Washer
b - Nut
c - Spacer
d - Throttle Lever
e - Throttle Shaft
f - Screw
g - Throttle Link

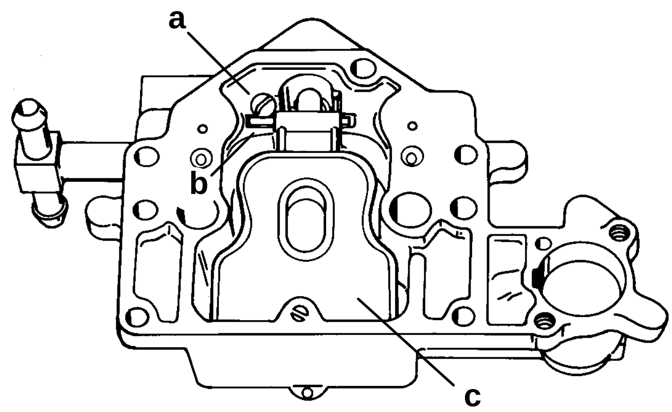
Fuel Bowl Reassembly

1. Install inlet needle seat with gasket into fuel bowl.
2. Install inlet needle into inlet needle seat as shown.



a - Inlet Needle Seat
b - Inlet Needle

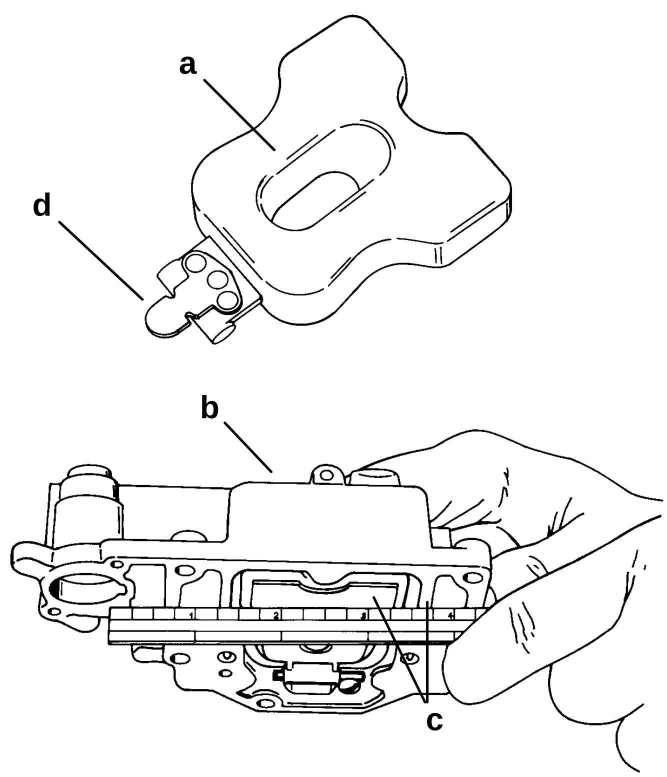
3. Install float with float pin to fuel bowl. Secure in place with retained screw.



a - Screw
b - Float Pin
c - Float

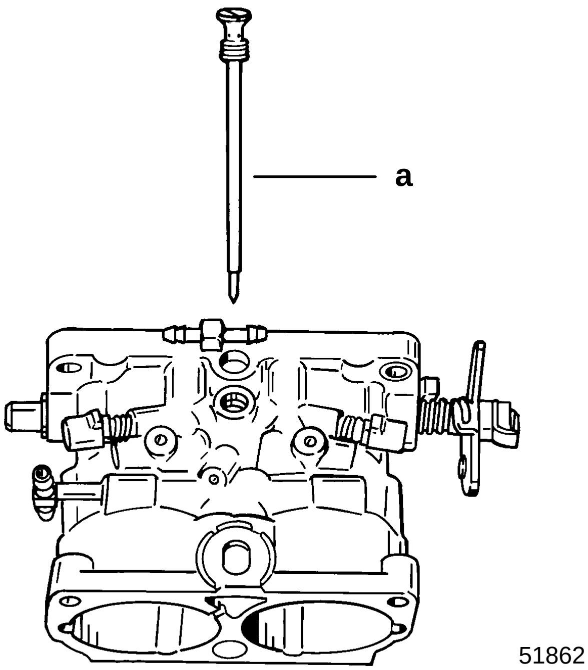
***NOTE:** Float height adjustment is the only adjustment made to adjust float setting.*

4. Adjust float height by turning fuel bowl upside-down, then adjust float tab until float is level with edge of fuel bowl. Adjust float tab if necessary.



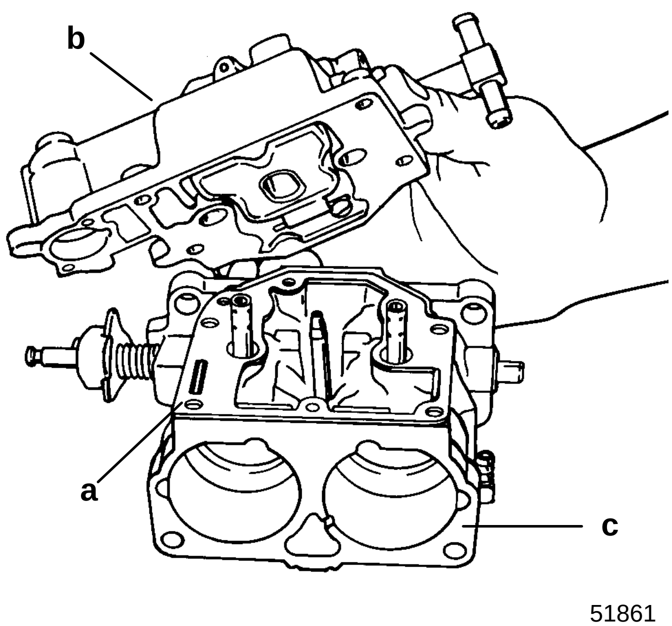
a - Float (Adjust by bending tab)
b - Fuel Bowl (Upside-Down)
c - Float Level Even with Bowl Edge
d - Float Tab

5. Install emulsion tube to carburetor.



a - Emulsion Tube

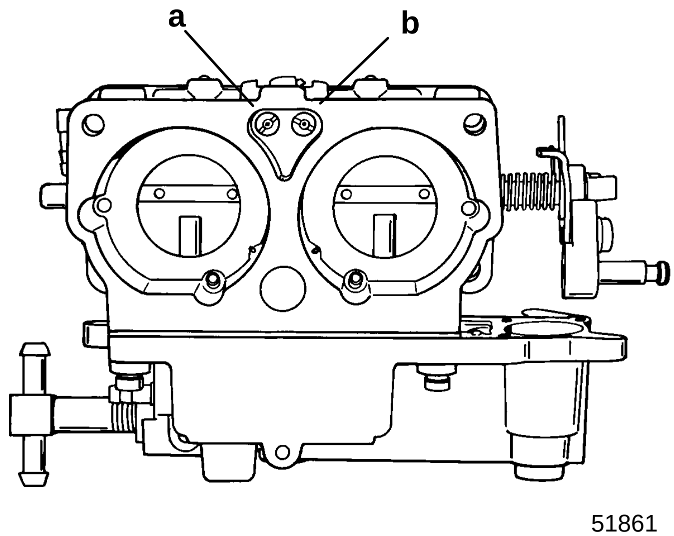
6. Install gasket and fuel bowl to carburetor body Secure in place with five retained screws.



a - Gasket
b - Fuel Bowl
c - Carburetor Body

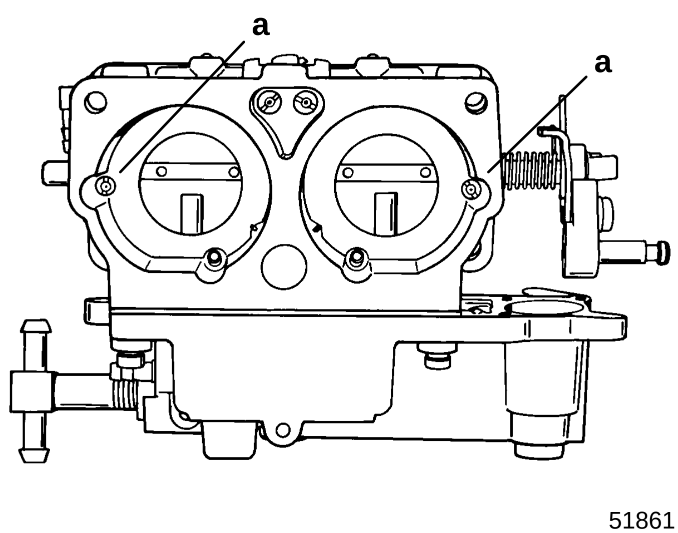
Carburetor Jet Installation

1. Install idle air jet and back draft vent jet (if equipped) to carburetor body.



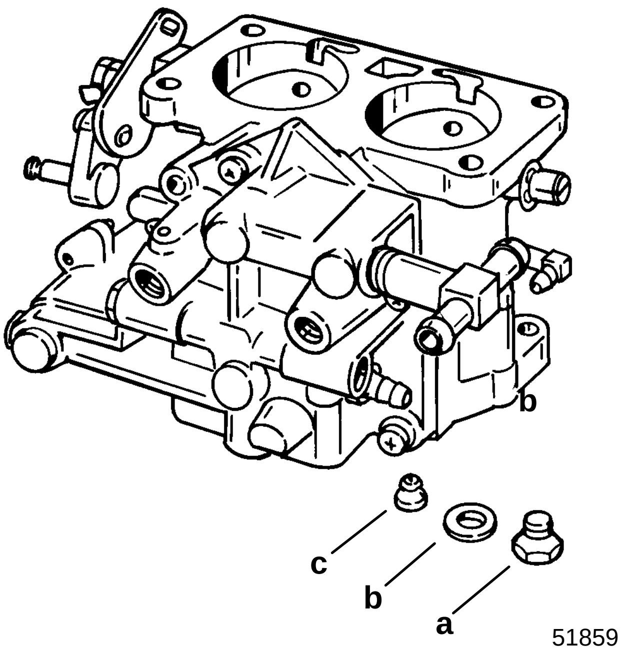
a - Idle Air Jet
b - Back Draft Jet

2. Install off-idle air jets to carburetor body.



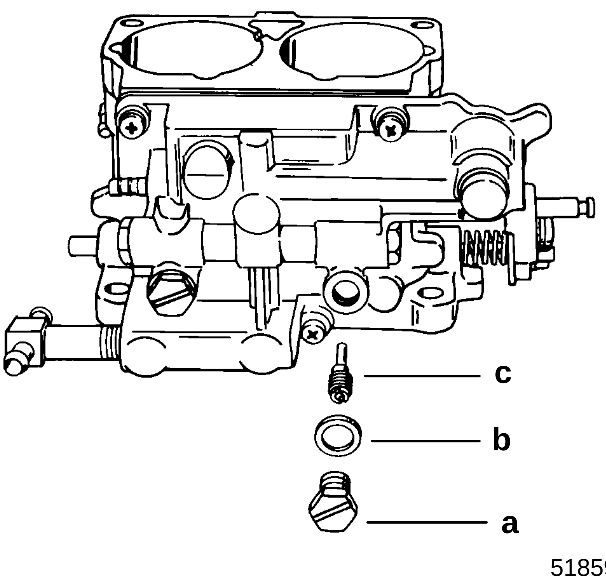
a - Off-Idle Jets

3. Install high speed fuel jet access plugs with gaskets and main (high speed) fuel jet to carburetor body.



a - Access Plugs (2)
b - Gaskets (2)
c - Main Fuel Jets (2)

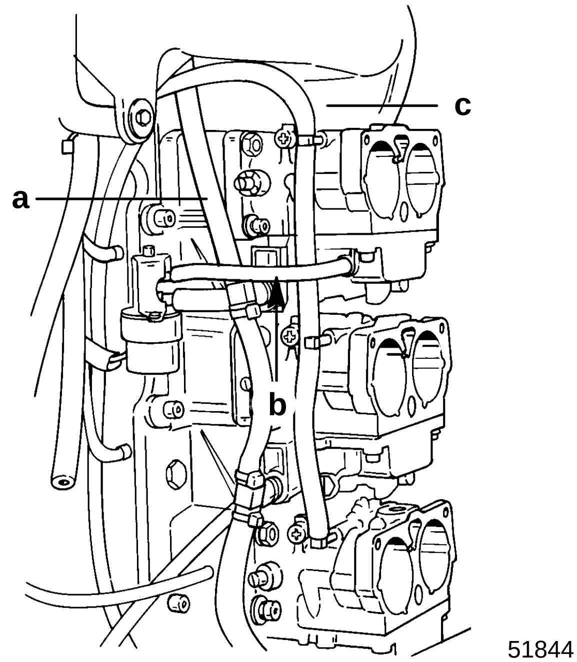
4. Install off-idle tubes and off-idle tube access plugs with gaskets to carburetor body.



a - Access Plugs (2)
b - Gaskets (2)
c - Off-Idle Tubes (2)

Installing Carburetor(s) to Engine

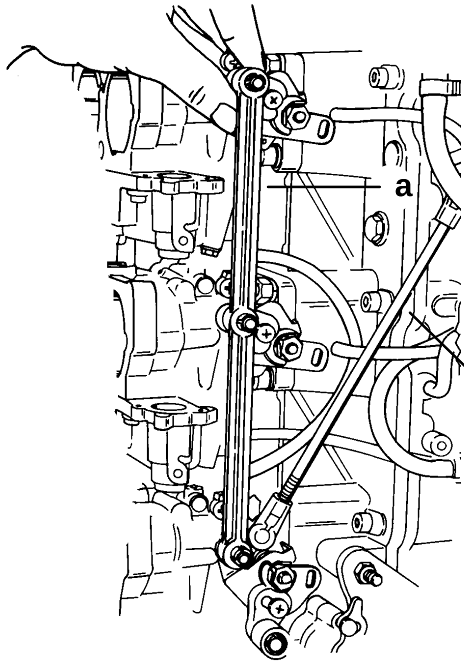
1. Place new carburetor gaskets onto carburetor mounting studs on intake manifold.



a - Fuel Hose
b - Enrichener Valve Inlet Hose
c - Thermal Valve Hose

2. Install carburetors (in respective locations) onto mounting studs and secure in place with nuts and allen type bolts.
3. Connect enrichener hoses, fuel hoses and thermal valve hoses to respective locations as shown. Secure fuel hoses in place using sta-straps.

4. Attach throttle linkage and oil pump link rod to carburetors as shown.



a - Throttle Linkage
b - Oil Pump Link Rod

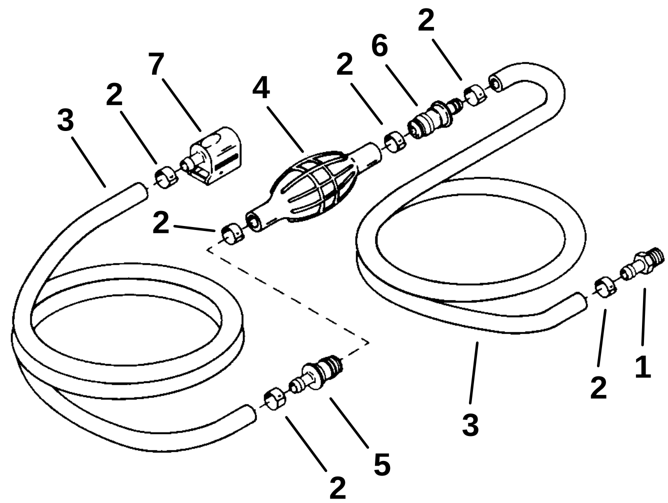
5. Re-synchronize carburetors following carburetor installation. Refer to “Timing/Synchronizing/Adjusting” Section 2.
6. Attach bleed hose to back of air box.
7. Secure air box to carburetors with bolts.

IMPORTANT: Inspect all fuel hose connections, and carburetor float bowl split lines for fuel leaks with outboard running. Also inspect each carburetor throat, with outboard running at low RPM, for fuel dribbling out of vent tube which would be indicative of a float and/or needle and seat assembly not functioning properly.

IMPORTANT: Outboard should not be operated above 3000 RPM with air box cover removed as outboard will run too lean and internal damage could result.

8. Reinstall outboard cowling.

Fuel Line and Primer Bulb Assembly



1 - Fitting (Fuel Line)
2 - Clamp
3 - Fuel Line
4 - Primer Bulb
5 - Check Valve (Black)
6 - Check Valve (White)
7 - Fuel Line Connector (Engine End)

MAINTENANCE

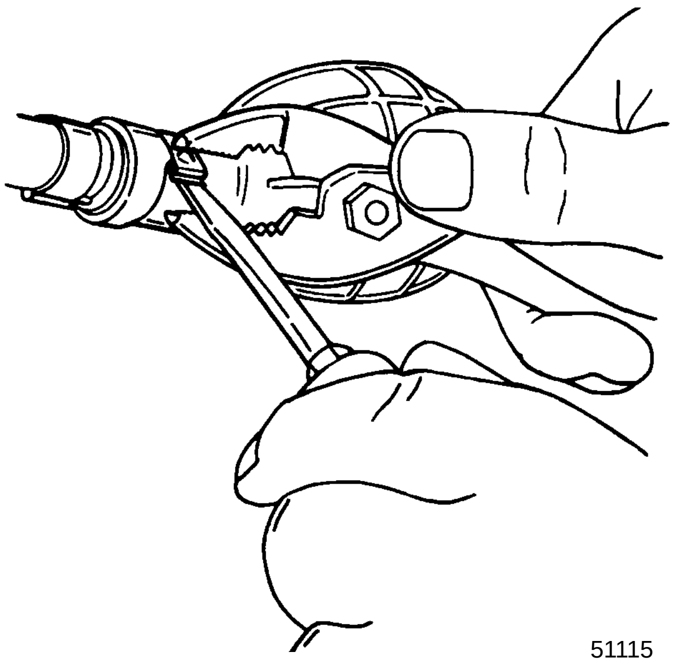
Periodically check fuel line and primer bulb for cracks, breaks, restrictions or chafing. Check all fuel line connections for tightness. All fuel line connections must be clamped securely.

Primer bulb assembly has 2 check valves: Fuel inlet (toward tank) and a fuel outlet (toward engine).

The fuel inlet valve allows fuel to fill primer bulb but closes to prevent fuel from returning to tank when bulb is squeezed. The fuel outlet valve opens when primer bulb is squeezed to allow fuel flow to carburetor, but closes as bulb is released to prevent fuel from returning to primer bulb.

FUEL LINE CLAMP REMOVAL AND INSTALLATION

1. To remove fuel line clamps, grip clamp with pliers and bend overlapping hook backward.



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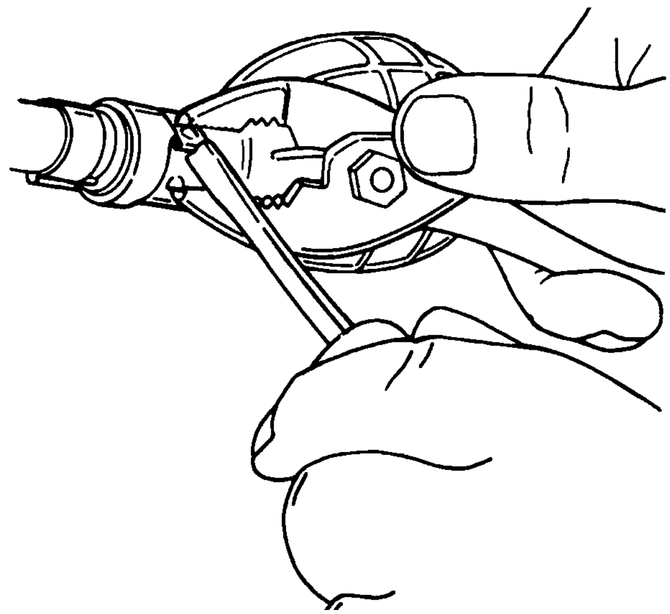
2. To install fuel line clamps, grip hose clamp with pliers and push down on hook with screwdriver until hooks interlock.



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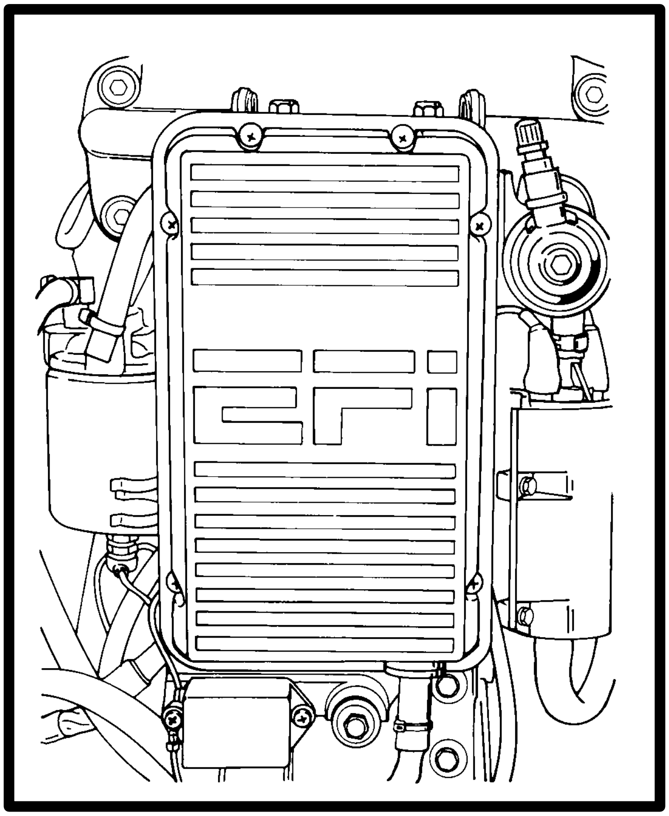
FUEL SYSTEMS



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C

FUEL INJECTION
SN 0G303045 AND BELOW

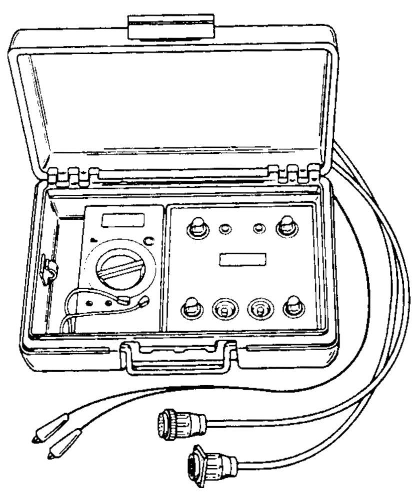
Table of Contents

Specifications

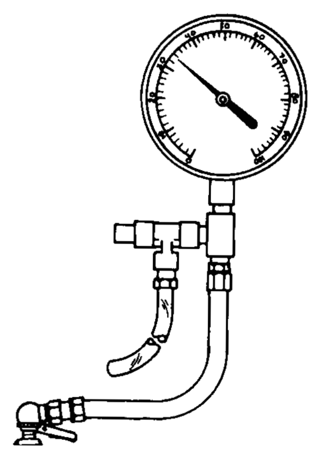
Electronic Fuel Injection	
Idle RPM – All Models	650 ± 50
Wide Open Throttle RPM – Model 150XRI/175XRI – Model 200XRI – Pro Max/Super Magnum 150/200/225	 5000 – 5600 5000 – 5800 6200 – 6500
Float Adjustment (Vapor Separator) – Float Level	 Preset @ Factory
Fuel Injectors –All Models (Quantity) – Inner Switch Box Controls: – #1 Primary Circuit – #3 Primary Circuit – #5 Primary Circuit	 6 #3 and #4 Injectors #5 and #6 Injectors #1 and #2 Injectors
Line Pressure @ Injectors	36 psi – 39 psi (248kPa – 269kPa)
ECM Amperage Draw with Ignition Switch in the ON or RUN Position	60 to 90 Milliamperes

Special Tools

Electronic Fuel Injection Tester 91-11001A2



Fuel Pressure Gauge 91-16850



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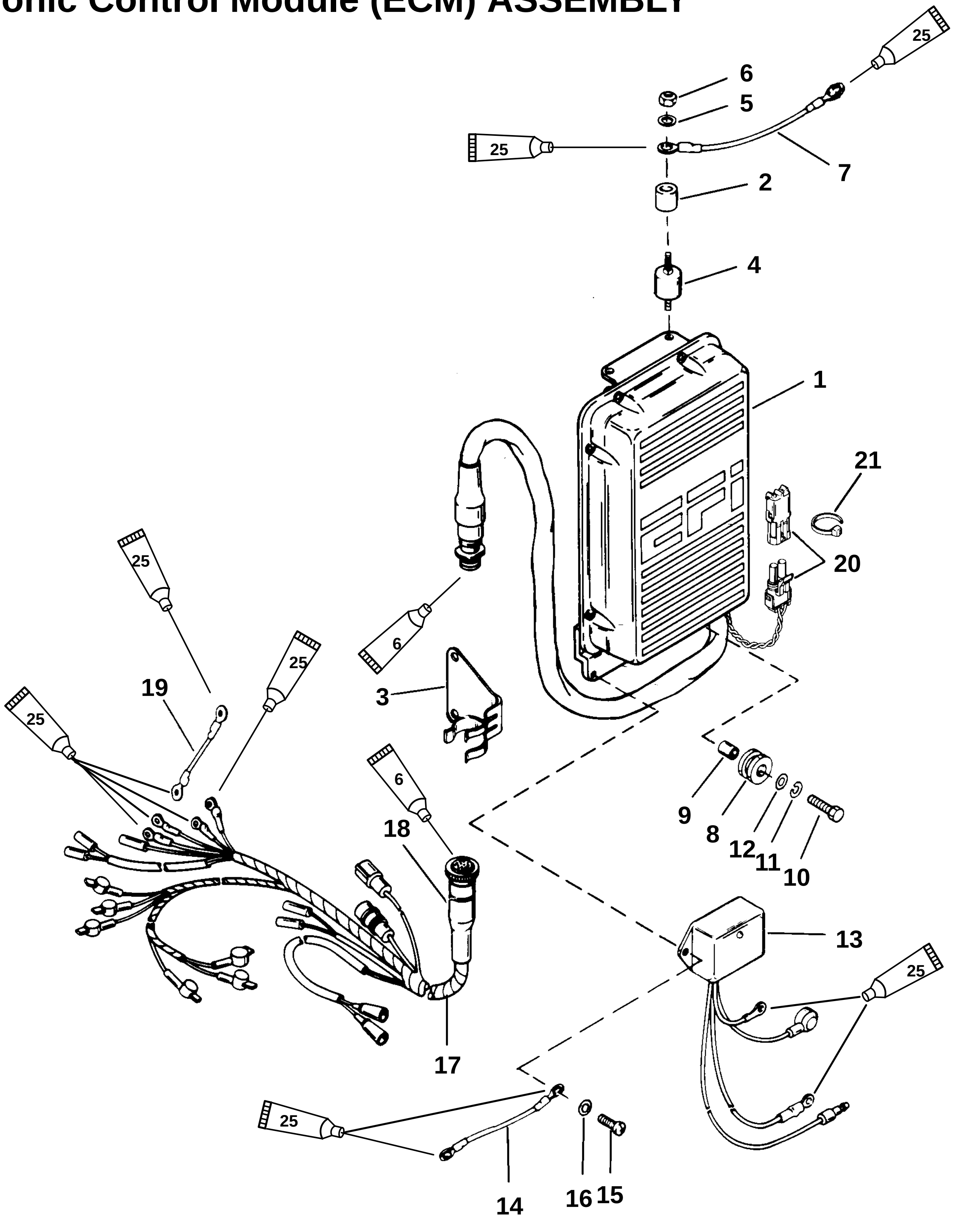
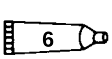
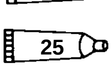
Electronic Control Module (ECM) ASSEMBLY



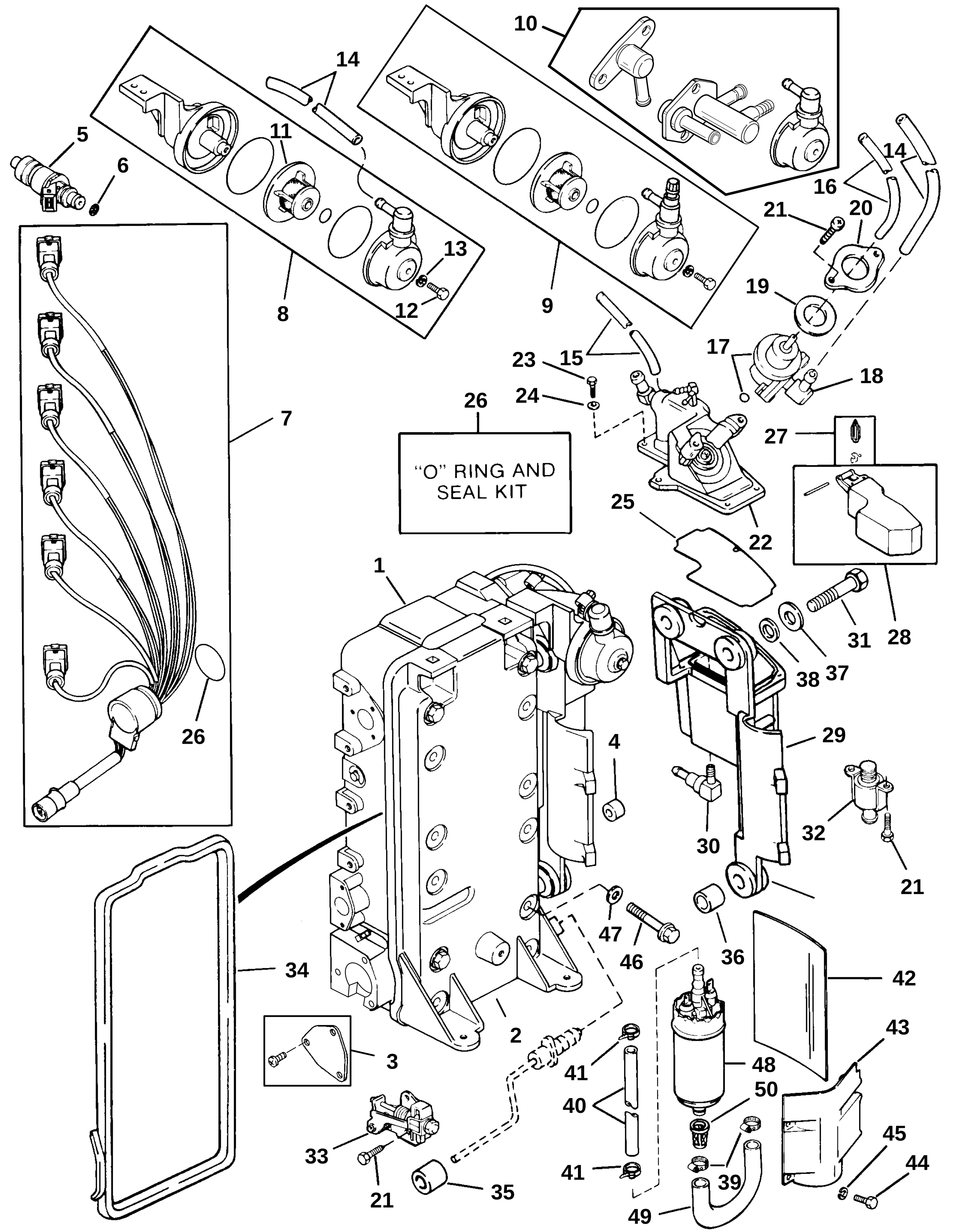
 Dielectric Grease (92-823506--1)

 Liquid Neoprene (92-25711--2)

Electronic Control Module (ECM) Assembly

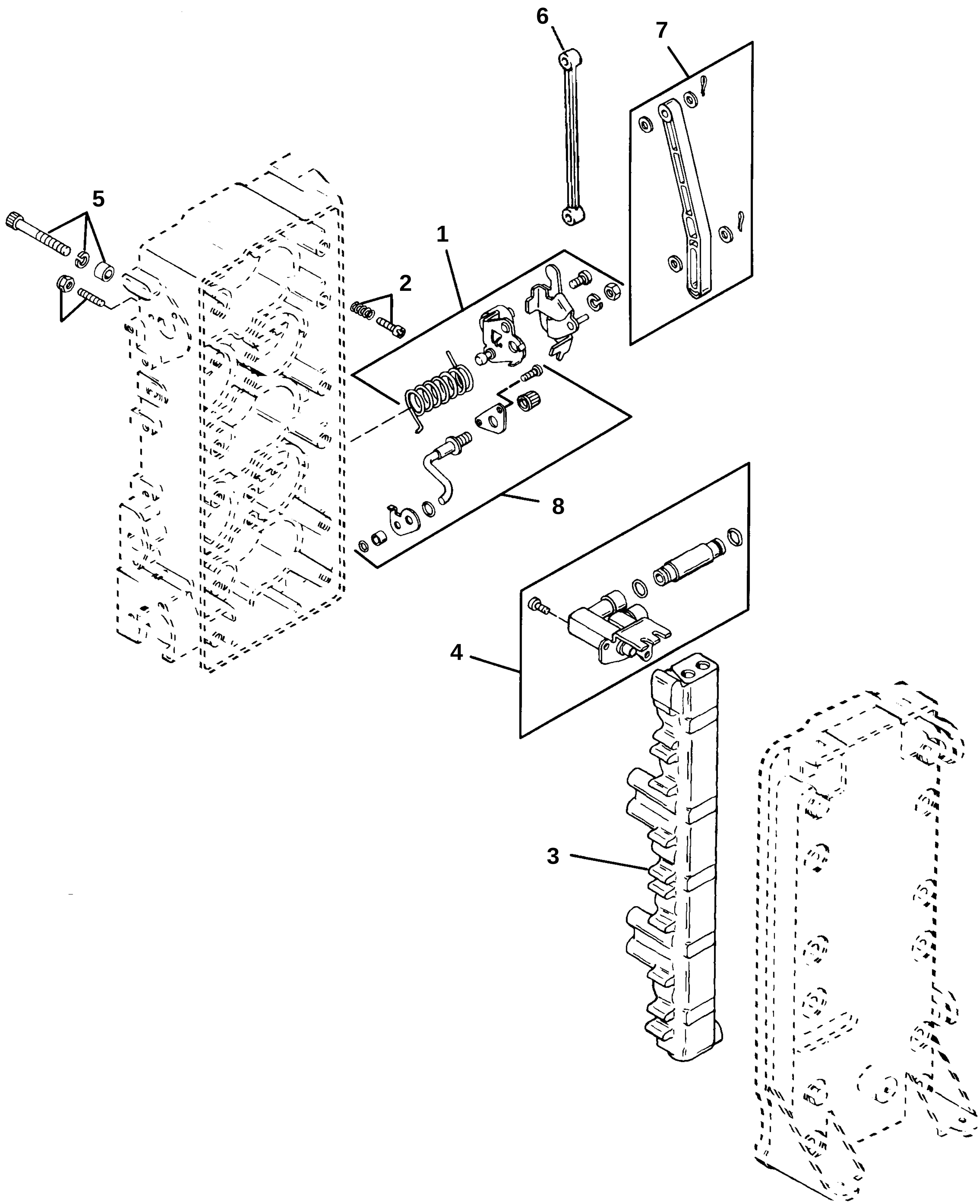
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	ECM ASSEMBLY			
2	2	SPACER			
3	1	CLIP			
4	2	MOUNT – cowl mounting bracket			
5	4	WASHER			
6	4	NUT	45		5.0
7	1	CABLE ASSEMBLY			
8	1	GROMMET			
9	1	BUSHING			
10	1	SCREW	45		5.0
11	1	LOCKWASHER			
12	1	WASHER			
13	1	WATER SENSOR MODULE ASSEMBLY			
14	1	WIRE ASSEMBLY (BLACK)			
15	2	SCREW	25		3.0
16	2	WASHER			
17	1	WIRING HARNESS – ECM and injectors			
18	1	COUPLER RING			
19	1	CABLE **(150/175)**			
20	1	CAVITY PLUG			
21	21	STA-STRAP			

FUEL MANAGEMENT SYSTEM



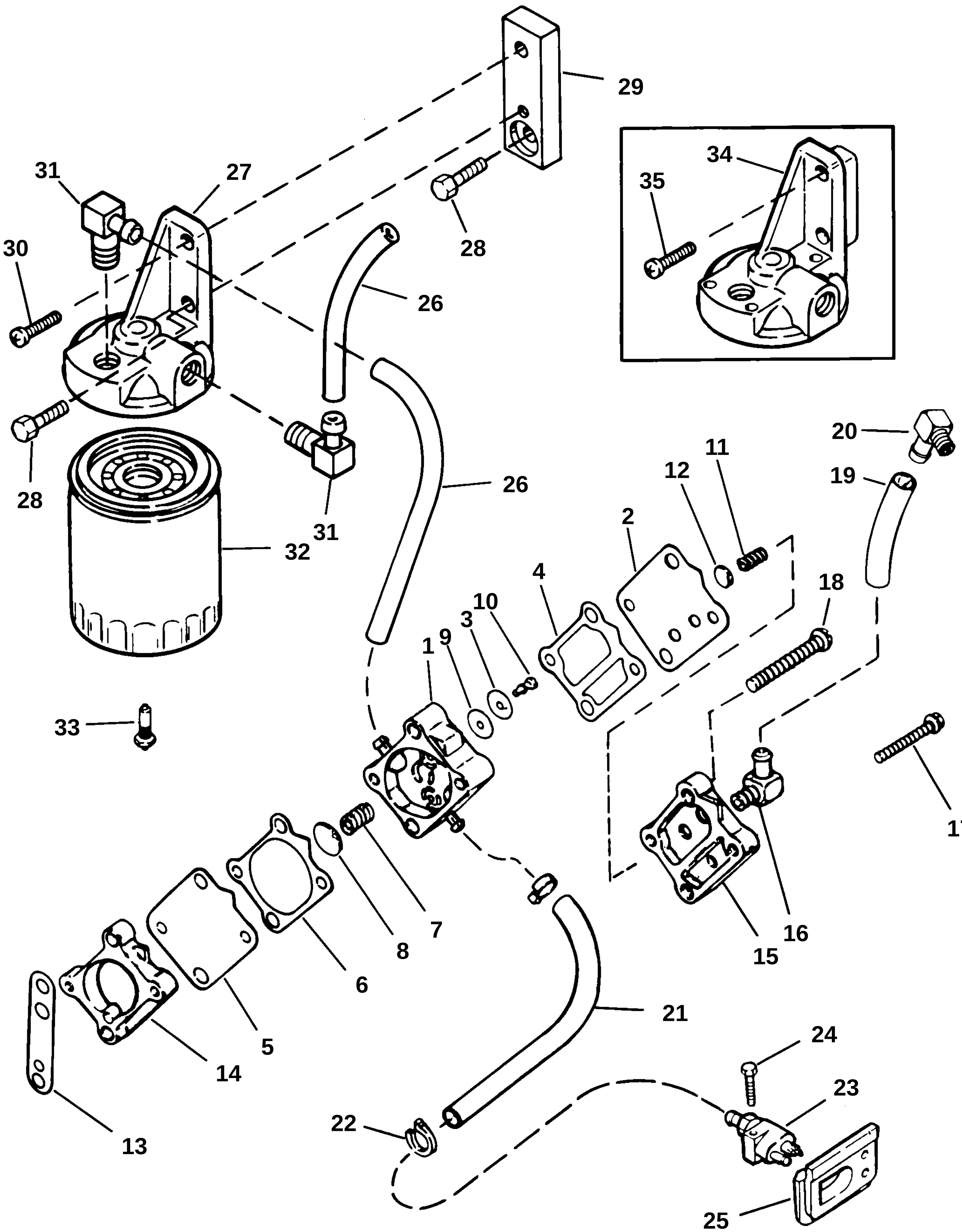
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
		FUEL MANAGEMENT ASSEMBLY			
1	1	THROTTLE BODY			
2	1	COVER			
3	1	RETAINING KIT			
4	1	ROLLER – cam			
5	6	FUEL INJECTOR			
6	1	FILTER – injector			
7	1	HARNESS KIT			
8	1	FUEL FILTER KIT **(DESIGN 1)**			
9	1	FUEL FILTER KIT **(DESIGN 2)**			
10	1	FUEL FILTER KIT **(DESIGN 3)**			
11	1	FUEL FILTER			
12	1	SCREW – filter cover			
13	1	LOCKWASHER – cover screw			
14	1	HOSE (1/2″ O.D.)			
15	1	HOSE (1/8″ O.D.)			
16	1	HOSE (3/32″ O.D.)			
17	1	REGULATOR – pressure			
18	1	ELBOW KIT			
19	1	GASKET – pressure regulator			
20	1	PLATE – pressure regulator			
21	AR	SCREW	30		3.5
22	1	COVER KIT			
23	6	SCREW – cover to separator			
24	6	LOCKWASHER – cover screw			
25	1	SEAL – vapor separator			
26	1	O-RING and SEAL KIT			
27	1	FLOAT VALVE KIT			
28	1	FLOAT KIT			
29	1	BODY KIT			
30	1	CHECK VALVE			
31	3	SCREW – separator	45		5.0
32	1	CHECK VALVE			
33	1	SHUT-OFF VALVE			
34	1	SEAL – injector manifold			
35	3	GROMMET			
36	3	SPACER			
37	3	WASHER (LARGE)			
38	3	WASHER (SMALL)			
39	2	CLAMP – hose			
40	1	TUBING (1-3/4″)			
41	2	STA-STRAP			
42	1	BLANKET – fuel pump			
43	1	COVER – fuel pump			
44	4	SCREW	45		5.0
45	4	LOCKWASHER			
46	12	SCREW			
47	10	WASHER			
48	1	FUEL PUMP			
49	1	HOSE			
50	1	FUEL FILTER			

Fuel Management System



REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	LINK LEVER KIT			
2	1	STOP SCREW KIT			
3	1	FUEL RAIL			
4	1	FUEL PIPE JOINT KIT	18		2.0
5	1	SCREW KIT – Fuel Rail	45		5.0
6	1	LINK **(DESIGN 1)**			
7	1	LINK **(DESIGN 2)**			
8	1	SCHRADER VALVE KIT			

Fuel Pump and Fuel Filter

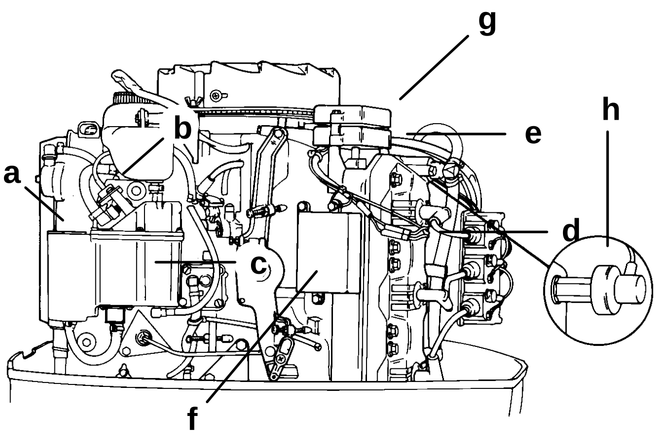


Fuel Pump and Fuel Filter

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	CHECK VALVE – rubber			
4	1	GASKET – boost			
5	2	DIAPHRAGM			
6	1	GASKET – pulse			
7	1	SPRING			
8	1	CAP			
9	2	CHECK VALVE			
10	2	RETAINER			
11	1	SPRING			
12	1	CAP			
13	1	GASKET – base			
14	1	BASE – fuel pump			
15	1	PLATE – fuel pump			
16	1	ELBOW			
17	2	SCREW – fuel pump	55		6.0
18	2	SCREW – fuel pump to crankcase	55		6.0
19	1	HOSE – pulse			
20	1	ELBOW			
21	1	TUBING			
22	AR	STA-STRAP – fuel tubing			
23	1	FUEL CONNECTOR			
24	1	SCREW	35		4.0
25	1	SEAL			
26	2	TUBING			
27	1	BASE – fuel filter			
28	2	SCREW – fuel filter base **DESIGN 1**	100		11.5
29	1	BRACKET			
30	1	SCREW	100		11.5
31	2	FITTING – base			
32	1	FUEL FILTER ASSEMBLY			
33	1	PROBE – water sensing			
34	1	FUEL FILTER BASE **DESIGN 2**			
35	1	SCREW (1/4-20 x 1-1/8″)	100		11.5

Outboard Powerhead View

Engine port view of EFI components.



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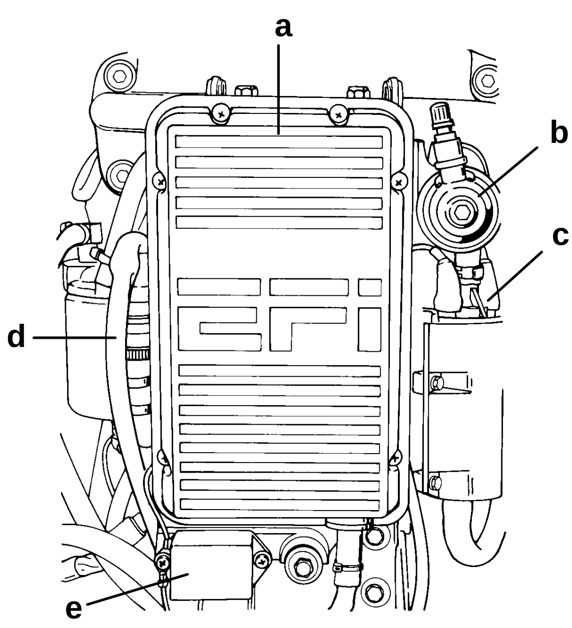
a - Electric Fuel Pump
b - Fuel Pressure Regulator
c - Vapor Separator
d - Engine Head Temperature Sensor
e - Lube Alert Module
f - Idle Stabilizer Module
g - Detonation Control Module (200)
h - Detonation Sensor (200)

Engine front view of EFI components.



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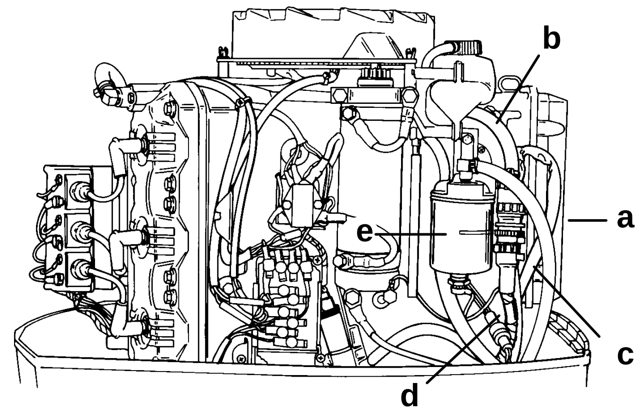
a - Electronic Control Module (ECM)
b - Final Filter
c - Electric Fuel Pump
d - ECU harness
e - Water Sensing Module

Engine starboard view of EFI components.



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a - Electronic Control Module (ECM)
b - ECM Harness
c - Engine Harness
d - Throttle Position Sensor Harness
e - Water Separating Filter

Electronic Fuel Injection (EFI) System

Introduction

The troubleshooting information provided here consists of preliminary checks (checks to be followed before proceeding with EFI tests), diagrams (fuel flow and electrical wiring), component description (from diagrams), flow charts (low pressure fuel delivery, high pressure fuel delivery, fuel delivery vs. electrical delivery), problem diagnosis, and a series of test and check procedures that will help isolate problems associated with the fuel injection system. Each test/check (listed) can be completed without major fuel system disassembly.

Using the Test Procedures

Each test procedure is divided into three parts. The first part “PURPOSE” tells what this test will accomplish. “PROCEDURE” provides detailed steps for performing the test. “RESULTS” discusses the results obtained by the test and how to correct the problem or where to go next in the troubleshooting procedure if more information is needed. Read the entire test before beginning to perform outlined procedures. Study the RESULTS material prior to testing. This will help in determining that each test is providing desired results.

EFI System Tests

- EFI Electrical System and ECM Check
- Fuel Gauge Connection/Pressure Test
- Vapor Separator Fuel Delivery Test
- Vapor Separator Float Test
- Water Separating Filter Flow Test
- Pulse Fuel Pump Delivery Test
- Final Filter Check
- Fuel Pressure Regulator Test
- Electric Fuel Pump Test
- Injector Electrical Test
- Injector Fuel Delivery Test
- Injector Operating Test (Manifold Cover Removed)
- Induction Manifold Leak Check (Manifold Cover Removed)
- Sensor Tests

Safety Precautions

⚠ CAUTION

Always use approved safety glasses or goggles when working on pressurized fuel systems.

⚠ DANGER

Outboard motor fuels are extremely flammable. Do not show open sparks or flames when working near fuel systems.

⚠ WARNING

To avoid potential fire hazards, use extreme caution when connecting and disconnecting fuel line connections and test adaptors. Do not allow fuel to spill on hot engine parts or on live electrical connections.

⚠ CAUTION

Wipe up fuel spills immediately.

⚠ CAUTION

Depressurize fuel system prior to opening line connections or removing fuel system components.

⚠ DANGER

Perform the tests in this section in a well ventilated area to avoid being overcome by fuel vapors or poisonous exhaust gases.

⚠ WARNING

Disable the ignition system by grounding mercury switch prior to performing any tests that require removal of the induction manifold cover.

Fuel Injection System Function

Fuel is delivered directly to the engine by way of fuel injectors. These injectors are provided with a constant supply of fuel (36 to 39 psi; 248 to 269 kPa) delivered to the fuel rail. The injectors are opened and closed electronically by the Electronic Control Module (ECM). The ECM receives input signals from various sensors in the EFI system which in turn transmits controlling outputs (open/close) to the injectors. The length of time the injectors stay open is considered pulse width. The pulse width will widen (richer) or narrow (leaner) depending on signals ECM receives from sensors, to allow efficient operation at all speeds and conditions.

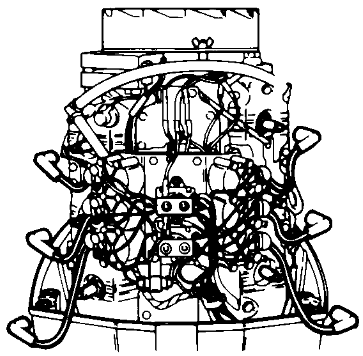
IMPORTANT: The following preliminary steps MUST BE FOLLOWED before attempting EFI problem diagnosis.

Preliminary Steps

Ignition Spark Check

Purpose: This test determines if the ignition system is delivering usable spark to the spark plugs. By performing this test, the probable cause can be isolated to either the ignition system or fuel system.

Procedure: STEP 1: Disconnect all spark plug wires from spark plugs.



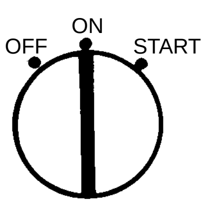
STEP 2: Connect spark gap tester Quicksilver (91-63998A1) to No. 1 spark plug wire and to good ground on engine.

STEP 3: Connect Remote Starter Switch Quicksilver (P/N 91-52024A1).

a. Connect red lead from switch to large positive (+) terminal with red banded cable attached [(+) cable from battery].

b. Connect YELLOW lead from switch to small terminal with yellow/red lead attached.

STEP 4: Turn ignition key switch to the “ON” position.



STEP 5: Turn over engine using remote starter switch.

STEP 6: Look at spark gap tester viewing port for presence of good quality spark. Complete steps 1 through 6 on each spark plug.

Results: **IMPORTANT: The presence of a good spark will not necessarily indicate condition of timing. Ignition timing may be off far enough to prevent the engine from starting, but still allow a good spark to be present in the spark gap tester.**

A steady, blue spark should be present at each spark plug wire. If a good spark is present, problem may not be ignition related. If good spark is not present, problem may be ignition related. Trouble shoot ignition system or make sure engine timing is set correctly. Refer to appropriate ignition section in this service manual.

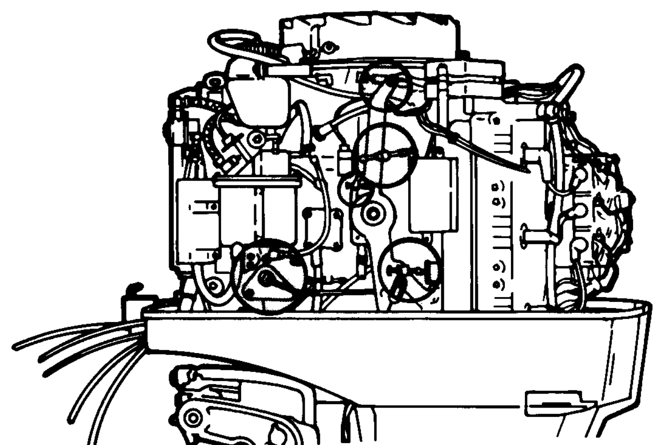
Ignition system failure (switch box, stator, trigger, etc.) can cause fuel delivery problems. Injectors are triggered in pairs by one, three, five primary circuits (inner switch box).

No. 1 Primary Triggers	No. 3 & 4 Injectors
No. 3 Primary Triggers	No. 5 & 6 Injectors
No. 5 Primary Triggers	No. 1 & 2 Injectors

Failure in one or more of these primary circuits will cause no spark and no fuel to respective cylinders (above). Check spark and spark plugs on all cylinders before attempting EFI tests.

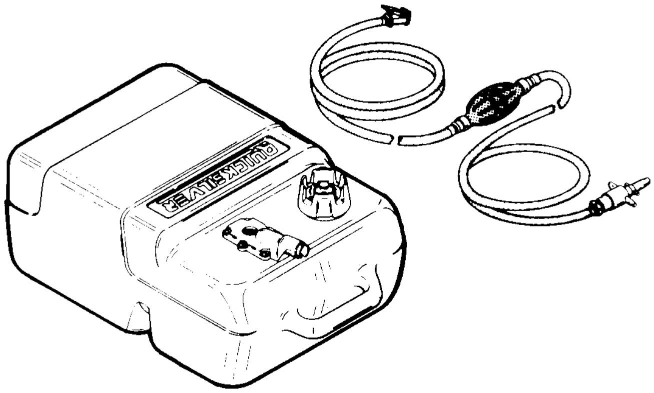
Electronic Fuel Injection Set Up

IMPORTANT: Follow EFI Timing/Synchronizing/Adjustment section 2C before attempting tests on EFI system.



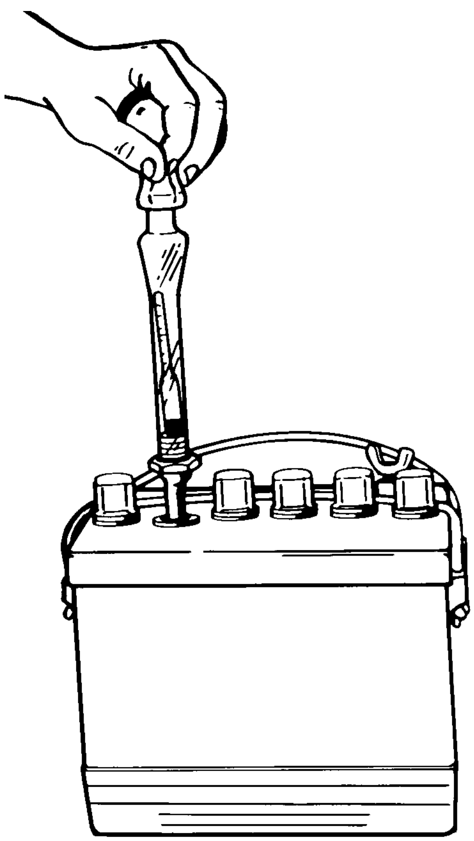
EFI set up procedures must be followed before tests on system are performed (refer to Section 2C). Improper set up can result in poor engine performance (i.e. uncontrollable idle speeds, lean sneezing, low power during acceleration or engine will simply not run.) Failure to properly set up the EFI system can lead to misdirections in solving simple problems in the EFI system.

Fresh Quality Fuel



Using a remote fuel tank containing a major brand of premium unleaded gasoline, test run the outboard to eliminate any problems related to restricted fuel supply (clogged lines, malfunctioning anti-siphon valve, etc.) and/or marginal gasoline.

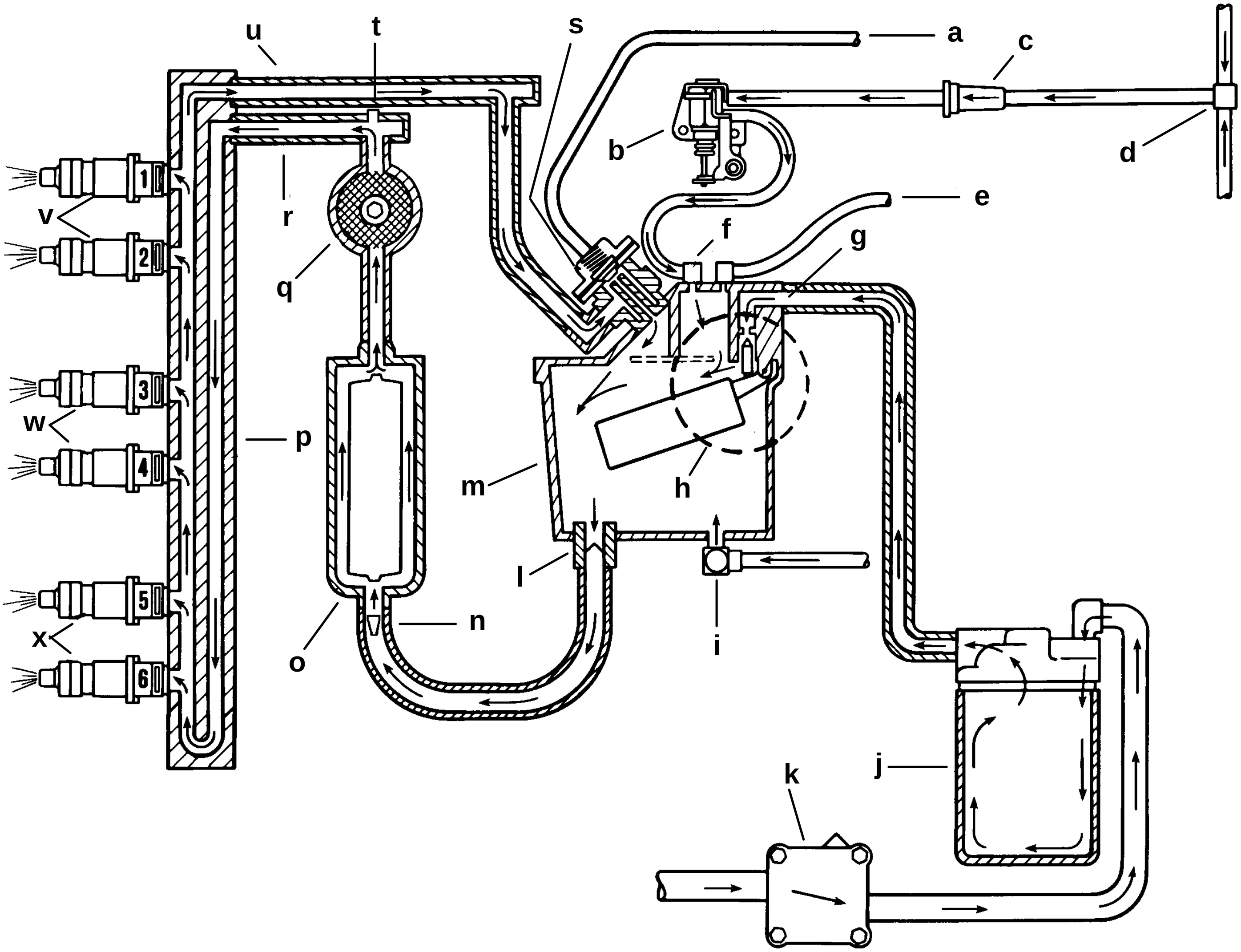
Low Battery Voltage



Low battery voltage can cause EFI system to deliver fuel in an inconsistent manner.

Inspect battery connections and charging system, refer to Section 2B. The EFI system requires a substantial amount of voltage to function properly. Operating engine at a low RPM for an extended period of time can cause low voltage.

Fuel Flow Diagram



a - To Upper Manifold Fitting
b - Bleed Shut Off Valve
c - Bleed Line Filter
d - Bleed System Circuit of Engine
e - To Upper Manifold Lower Fitting
f - Bleed Line Inlet
g - Fresh Fuel Inlet
h - Needle/Float Device
i . - Oil Supply Inlet
j . - Water Separating Filter
k - Pulse Fuel Pump
l . - Fuel Check Valve; Vapor Separator
m - Vapor Separator
n - Fuel Filter
o - Electric Fuel Pump
p - Fuel Rail
q - Final Filter
r - High Pressure Fuel (“IN” Line)
s - Fuel Pressure Regulator
t - FueL Rail Pressure Port
u - High Pressure Fuel (“OUT” Line)
v - #1 and #2 Injectors (Triggered by #5 Primary Circuit)
w - #3 and #4 Injectors (Triggered by #1 Primary Circuit)
x - #5 and #6 Injectors (Triggered by #3 Primary Circuit)

Fuel Flow Components (from Fuel Flow Diagram)

A description of each component (on diagrams) will aid in the diagnosis of EFI problems.

PULSE FUEL PUMP (K)

The pulse fuel pump, mounted on the crankcase, delivers fuel through the water separating filter to the vapor separator. Typical fuel pressure (at 5000 RPM) is 6 to 8 psi.

WATER SEPARATING FILTER (J)

The Water Separating Filter protects fuel system components from water and debris. The filter contains a sensor probe which monitors water level in the filter. If water is above sensor probe, a red light on water sensing module will illuminate triggering a series of beeps from the warning horn.

VAPOR SEPARATOR (M)

The vapor separator can be considered a fuel reservoir which continuously blends and circulates fresh fuel, oil, and unused fuel/oil from the fuel rail.

***** Fuel Inlet - fresh fuel delivered to system.

***** Oil Inlet - oil delivered from oil reservoir.

***** Crankcase bleed Inlet - recirculated fuel (unburned) delivered from bleed lines at low RPM.

***** Fuel pressure regulator Inlet - fuel being recirculated through the fuel rail loop.

The fresh fuel delivered to the vapor separator is controlled by a needle/float device (h) located in the vapor separator.

BLEED SYSTEM (F, C,B)

Unlike carbureted engines, the unburned excess fuel from crankcase is combined together through the bleed system to the vapor separator. The bleed system flow is closed off to the vapor separator during off idle speeds by the bleed shut off valve. The bleed shut off valve is activated by throttle linkage on the manifold. At idle speeds the flow can be close to 1000cc's of gasoline per hour. Also, a small filter (30 micron) is installed in the bleed line to keep contaminants from entering the vapor separator. If the filter becomes clogged the engine will be prone to load up at idle speeds and hesitate upon acceleration.

ELECTRIC FUEL PUMP (O)

The electric fuel pump is continually providing fuel in excess of engine demands. The excess fuel circulates through the fuel rail back to the vapor separator. With the key in "run" position (engine off), the ECM signals the pump to run for approximately 30 seconds then shut off. With the key in run position (engine running), the ECM determines pump speed (2 speeds) depending on RPM. During low speed operation pump is at low speed.

FINAL FILTER (Q)

The final filter is located above the electric fuel pump. The filter collects debris flowing from the electric fuel pump to the fuel rail and can withstand blockage up to 50% and still allow adequate fuel flow.

FUEL INJECTOR (V,W,X)

The fuel injectors are located inside the induction manifold on the fuel rail. The injector valve body consists of a solenoid actuated needle and seat assembly. The injector receives signals from the Electronic Control Module. These signals determine how long the needle is lifted from seat (pulse width) allowing measured fuel flow. The pulse width will widen (richer) or narrow (leaner) depending on various signals received from sensors connected to the ECM. The ECM receives signals from primary ignition circuit one, three and five to fire each "pair" of injectors accordingly.

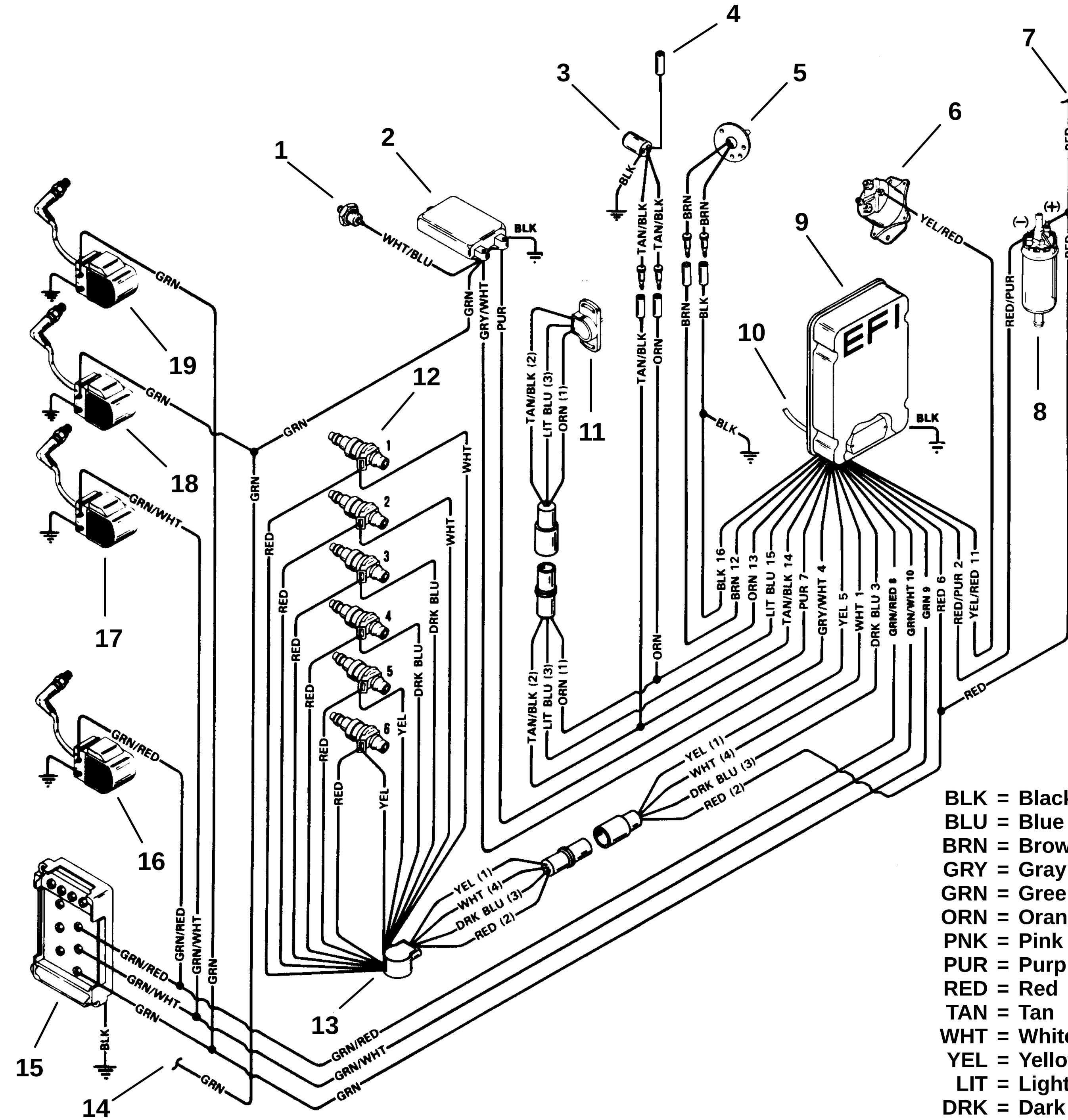
FUEL PRESSURE REGULATOR (S)

The fuel pressure regulator is located on top of the vapor separator and is continuously regulating fuel pressure from the electric fuel pump. The electric fuel pump is capable of producing 90 psi (621 kPa) of fuel pressure. The pressure regulator regulates fuel to injectors down to a usable 36 to 39 psi (248 to 269 kPa).

INDUCTION MANIFOLD

The induction manifold is a common plenum chamber for accurate pressure measurement. It contains four throttle shutters on two throttle shafts. The shutter opening (idle air opening) can be adjusted during EFI set-up procedure. The manifold contains the fuel rail, injectors, throttle position sensor and air temperature sensor. A fuel rail pressure port (q) is located on the final filter housing.

EFI Electrical Diagram



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

1 - Detonation Sensor*
2 - Detonation Module*
3 - Engine Head Temperature Sensor
4 - To Temperature Gauge
5 - Air Temperature Sensor
6 - Starter Solenoid
7 - 12 Volt Supply from Regulator
8 - Electric Fuel Pump
9 - Electronic Control Module
10- Manifold Absolute Pressure Sensor
11- Throttle Position Sensor
12- Fuel Injectors
13- Injector Wiring Harness
14- To Outer Switch Box
15- Inner Switch Box
16- #5 Ignition Coil
17- #3 Ignition Coil
18- #2 Ignition Coil
19- #1 Ignition Coil
*200 Models Only

EFI Electrical Components (from Electrical Component Diagram)

ELECTRONIC CONTROL MODULE (ECM)

The ECM is continually monitoring various engine conditions (engine temperature, engine detonation control, engine throttle opening) and climate conditions (induction air temperature, barometric pressure and altitude level) needed to calculate fuel delivery (pulse width length) of injectors. The pulse width is constantly adjusted (rich/lean conditions) to compensate for operating conditions, such as cranking, cold starting, climate conditions, altitude, acceleration and deceleration, allowing the outboard to operate efficiently at all engine speeds.

SENSOR INTERACTION WITH THE ECM

IMPORTANT: DO NOT run engine for extended periods of time with sensors disconnected or bypassed (shorted). Serious engine damage may result.

AIR TEMPERATURE SENSOR

The air temperature sensor transmits manifold absolute air temperature, through full RPM range, to the ECM. As air temperature increases “sensor” resistance decreases causing the ECM to decrease fuel flow (leaner mixture). Disconnecting the air temp sensor (open circuit) will increase fuel flow (richen mixture) by 10%. Bypassing air temp sensor (short in circuit) will cause fuel flow to decrease 10%.

The air temperature sensor circuit can be tested using the EFI tester. The air temperature sensor can be tested following air temperature sensor test on page 3C-34.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor is a non-serviceable sensor mounted in the ECM box. The MAP sensor is used to sense changes in manifold absolute pressure and is connected to the intake manifold by the way of a vacuum hose. The MAP sensor is functioning through the full RPM range and is continually signaling induction manifold pressure readings to the ECM. The ECM in turn determines fuel flow as signals are received. Drawing a vacuum on the MAP sensor hose will create a lean fuel condition altering engine operation. If no change occurs when drawing vacuum, MAP sensor is not functioning properly.

MAP sensor can be tested with the EFI tester.

ENGINE HEAD TEMPERATURE SENSOR

The Engine Head Temperature Sensor provides the ECM signals related to engine temperature to determine level of fuel enrichment during engine warm up. The ECM is receiving information at all engine temperatures but stops fuel enrichment at an engine temperature of 90° F (32° C). An open circuit on the temperature sensor will increase fuel flow up to 40% but will not be affected at wide open throttle. If no change occurs when sensor is disconnected, sensor may not be functioning properly. The engine head temperature sensor can be tested following Engine Head Temperature Sensor Test on page 3C-35.

NOTE: *If sensor does not make clean contact with cylinder head a rich condition may exist.*

THROTTLE POSITION SENSOR (TPS)

The TPS transmits information to the ECM during low speed and mid range operation, related to throttle angle under various load conditions. TPS adjustment is a critical step in engine set up (Section 2C). Disconnecting the TPS will increase fuel flow 40% at idle but does not effect WOT.

NOTE: *The higher the resistance the richer the fuel flow. Refer to TPS Adjustment (Section 2C).*

DETONATION CONTROL SYSTEM (200 MODEL)

The Detonation Control System consists of a detonation control sensor located on the port side cylinder head and a detonation control module mounted on the engine. The detonation control module has seven wires:

- **WHITE/BLUE -** Connects to knock sensor, transmits knock signal to control module.
- **GREEN -** Connects to #2 primary wire. The primary voltage signals the controller to monitor combustion “noise” during a window of time (See Detonation System Function following).
- **WHITE/BLACK -** Two of these wires connect to the switch boxes bias circuit terminals. A third wire is spliced in one bias circuit (inner switchbox) and connects to the idle stabilizer module. (See complete Engine Wiring Diagram - refer to Section 2D).
- **GRAY/WHITE -** Connects to the ECM; signals ECM to enrich fuel mixture when knocking occurs.
- **PURPLE -**12 Volt power supply.

DETONATION CONTROL SYSTEM FUNCTION

1. Combustion noise (or vibration) excites the piezoelectric circuit located inside the detonation sensor, which transmits a voltage to the control module.
2. When cylinder number two ignition primary fires, it signals the controller to look at a one millisecond window of sensor output, which it retains as a reference level of combustion “background noise.”
3. When “background noise” reaches a measurable value, usually between 2500 and 3500 RPM (it is dependent on load), the ignition timing is advanced 6 degrees beyond what the mechanical timing is set at. Timing advance is accomplished by lowering the bias voltage.
4. The controller continues to monitor sensor output. If the output exceeds a pre-determined threshold level over the “background noise” (which is indicative knock is occurring) ignition timing is retarded by up to 8 degrees and fuel flow is enriched by up to 15% until the sensor output is reduced below the threshold level.

The detonation control system actually acts as an ignition advance module, when knock occurs it takes away the advance. Ignition timing will not advance if:

a. Knock sensor fails.

b. Blue/White wire becomes disconnected.

c. Black wire has poor ground connection.

d. Purple power wire becomes disconnected.

NOTE: *Disconnected Gray/White wire will not affect ignition timing and will not allow fuel enrichment.*

Other components associated with the ECM.

12 Volt Battery -The 12 volt battery provides power to the ECM even with the ignition switch in the “OFF” position.

IMPORTANT: When disassembling EFI System DISCONNECT BATTERY CABLES.

Starter Solenoid - Provides 12 volt signal when key is in the “start” position. In the “start” position, injector pulse widths are tripled when engine head temperature is below 90° F (32.2° C) to provide adequate fuel for quick start up. When key is returned to the run position or engine head temperature is above 90° F (32.2° C), pulse widths return to normal value.

Fuel Injectors - A four wire harness connects the fuel injectors to the ECM. The red wire is at 12 volts and connects to all injectors. The blue, yellow and white wires each go to a pair of injectors and are normally at 12 volts for a zero differential. To fire the injectors this voltage is brought down to near ground creating a potential across the injectors.

Electric Fuel Pump - The ECM contains a fuel pump driver circuit that provides power to the electric fuel pump (2 speeds). The fuel pump does not have its negative terminal (-) “RED/PURPLE wire” grounded to the pump housing. The fuel pump positive terminal (+) “RED wire” and the negative terminal (-) are at 12 volts with the ignition switch in the off position for a zero differential. When the pump is on, the negative terminal is brought down to near ground (i.e. 1.5 volts at high speed).

WATER SENSING SYSTEM

The system consists of a water separating fuel filter (starboard side powerhead), sensing probe (bottom of filter) and a water sensing module (below ECM box). The water sensing module has four wires:

PURPLE - Connects to 12 volt power supply.

LIGHT BLUE - Connects to lube alert, which sounds the warning horn when activated.

TAN - Connects to sensing probe.

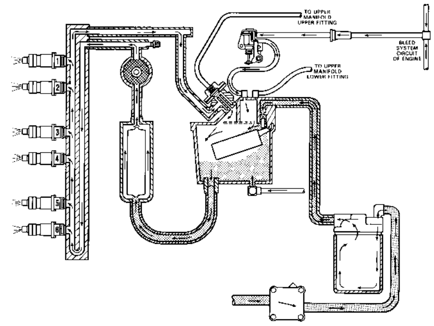
BLACK - Connects to ground.

WATER SENSING SYSTEM FUNCTION

1. The filter separates the accumulated water from the fuel.
2. A voltage is always present at sensing probe. When water reaches top of probe it completes the circuit to ground.
3. The completed circuit activates the warning. The warning has a 5-10 second delay, then the module’s red light illuminates and warning horn intermittently sounds.

The system can be tested by disconnecting the TAN wire from sensor probe and holding to a good engine ground connection for 10 seconds.

EFI Fuel Management (Low Pressure Fuel Route)



- Perform all preliminary checks
- Install fuel pressure gauge (P/N 91-16850A2) on to manifold pressure port.
- Place ignition switch in “OFF” position 30 seconds before testing.
- Place ignition switch in “ON” position and note pressure within 30 seconds (36 to 39 psi; 248 to 269 kPa).

Pump does not run

Follow High Pressure Fuel Route Flow Chart.

No or low fuel pressure

Perform Vapor Separator Fuel Delivery Test (page 3C-23).

Results

No or little fuel flow from vapor separator. Reconnect hose.

Check in-line Filter

Perform Vapor Separator Float Test (page 3C-23).

Results

Fuel flows from fresh fuel inlet hose.

Inspect float system of vapor separator.

Results

Little or no flow from fresh fuel inlet hose. Reconnect hose.

Perform Water Separating Filter Flow Test (page 3C-24).

Results

Low or no fuel flow from water separating inlet hose. Reconnect hose.

Perform Pulse Fuel Pump Delivery Test (page 3C-25).

Results

Fuel flows freely from pulse pump inlet hose.

See pulse pump removal and inspection section “3”. Locate all fragments of failed pump before reassembly.

Results

No fuel flow to pulse fuel pump.

Check for restrictions, holes or loose connections from fuel supply.

Results

Fuel flows freely from water separating filter inlet hose. Reconnect hose.

Replace water separating filter.

Results

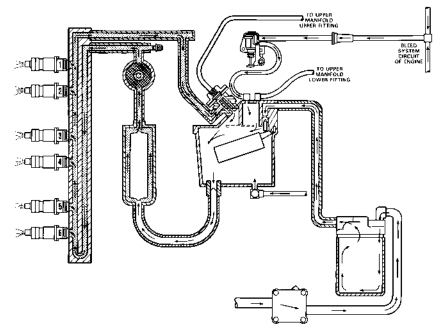
Fuel flows freely from vapor separator. Reconnect hose.

Follow High Pressure Fuel Route Flow Chart.

Fuel pressure above 39 psi (269 kPa)

Follow High Pressure Fuel Route Flow Chart.

EFI Fuel Management (High Pressure Fuel Route)



- Perform low pressure checks (3C-19) before performing checks on high pressure route.
- Install fuel pressure gauge (P/N 91-16850A2) on to manifold pressure port.
- Place ignition switch in “OFF” position 30 seconds before testing.
- Place ignition switch in “ON” position and note pressure within 30 seconds (36 to 39 psi; 248 to 269 kPa).

Fuel pressure above 39 psi (269 kPa)

Clogged or faulty fuel pressure regulator remove and replace.

No or low fuel pressure

Perform Final Filter Check (page 3C-26).

Results

Final filter OK.

Perform Fuel Pressure Regulator Test (page 3C-27).

Results

Steady stream of fuel (pressure still below 36 psi).

Replace fuel regulator.

Results

Low or no fuel flow.

Perform Electric Fuel Pump Test (page 3C-28).

Results

Voltage from ECM driver circuit OK.

Replace fuel pump.

Results

Low or inconsistent voltage from ECM driver circuit.

Replace ECM.

Results

Final filter clogged.

Clean or replace final filter.

Pump does not run

Perform Electric Fuel Pump “Procedure B” Test (page 3C-28).

Fuel Rail Electrical/Fuel Determination

- Perform all preliminary checks page 3C-12.
- Adequate fuel pressure (36 to 39 psi; 248 to 269 kPa) follow Low/High Fuel Route Flow Charts.
- Place outboard in water or on flush attachment (P/N 44357A2) run engine speed between 2000 and 2500 RPM.

With engine running (2000-2500 RPM) remove spark plug leads one at a time using insulated pliers.

- **Results**: No RPM change on cylinder(s), indicating problem in cylinder(s).
  - Perform Injector Electrical Harness Test (3C-31).
    - **Results**: Broken circuit to injector.
      - Perform induction manifold disassembly and inspection (3C-47).
    - **Results**: Injector circuit tests OK.
      - Perform Injector Fuel Delivery Test (page 3C-31).
        - **Results**: RPM increase occurs.
          - Perform induction manifold disassembly. Inspect injector and filter.
        - **Results**: No RPM change.
          - Perform compression check on problem cylinder see section “1”.
            - **Results**: Low or no compression on cylinder.
              - Inspect cylinder bore. Refer to section “4” for disassembly.

                NOTE: Injector filters must be inspected prior to reassembly.
            - **Results**: Compression OK.
              - Check 1) Damaged reeds
                2) End cap seals
                3) Crankcase split line leak
                4) Crankshaft sealing rings
- **Results**: RPM decreases (on each cylinder).
  - Fuel delivery OK.

EFI System Test Procedures

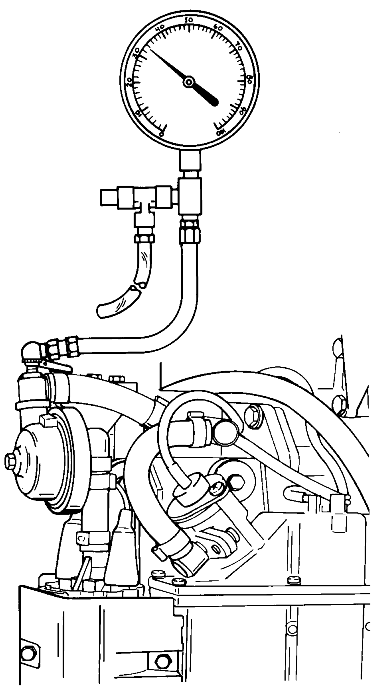
Fuel Gauge Connection/Pressure Test

IMPORTANT: When checking fuel pressure while engine is running, fuel pressure may fluctuate. Fuel pressure fluctuation (i.e. 34 to 39 psi "214 to 290 kPa") is common, as the regulated pressure is a differential between fuel rail and manifold vacuum.

Purpose: Checking fuel manifold pressure ensures that fuel under usable pressure is available to the fuel injectors. This test isolates the probable cause as either a fuel delivery or EFI electrical system failure.

IMPORTANT: Fuel pressure should be monitored through full RPM range to determine fuel supply problems at high engine speeds.

Procedure: STEP 1: Connect fuel pressure gauge to induction manifold pressure port.



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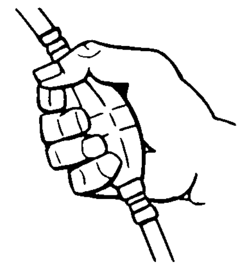
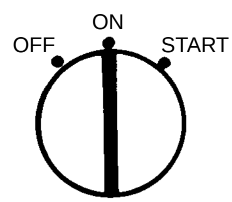
STEP 2: Prime engine using fuel primer bulb.



STEP 3: Turn ignition key switch to "On" position.



STEP 4: Operate electric fuel pump for approximately 10 seconds.

NOTE: *Fuel pump will only operate for approximately 30 seconds. By turning the key switch to "OFF" and then back to "ON" the pump will operate for 30 seconds more.*

STEP 5: Take reading on fuel pressure gauge.

Results: If pressure reading is 36 to 39 psi (248 to 269 kPa), the electric fuel pump is providing fuel with enough pressure to be used by the injectors. Pump malfunction is not the cause of EFI trouble.

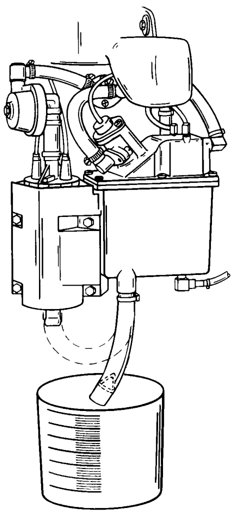
If fuel pressure is well below 36 psi (248 kPa), fuel delivery to electric fuel pump, fuel pump failure or other related problem exists. Follow low/high fuel pressure flow charts.

If fuel pressure is above 39 psi (269 kPa) go to fuel pressure regulator test.

Vapor Separator Fuel Delivery Test

Purpose: Verifying there is adequate fuel flow to the electric fuel pump (through full RPM range) will determine components in low pressure fuel system are functioning correctly.

Procedure: STEP 1: Remove hose from intake port of electric fuel pump and put disconnected end of hose in clean container.



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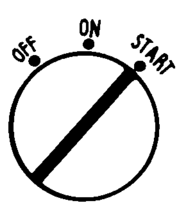
Results: If fuel flow is present, fuel is being delivered to electric fuel pump. Go to high pressure flow chart.

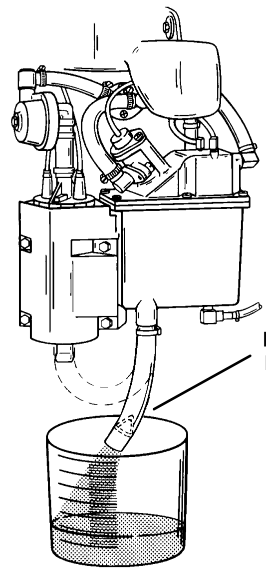
If fuel flow is not present, proceed to step 2.

STEP 2: Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW terminal on the switch box to engine ground.

STEP 3: Turn ignition key switch to “START” and operate starter motor for 10 to 20 seconds.



STEP 4: Look for fuel flow from hose.



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Results: If low or no fuel flow is present following inspection of in-line filter, perform Vapor Separator Float Test.

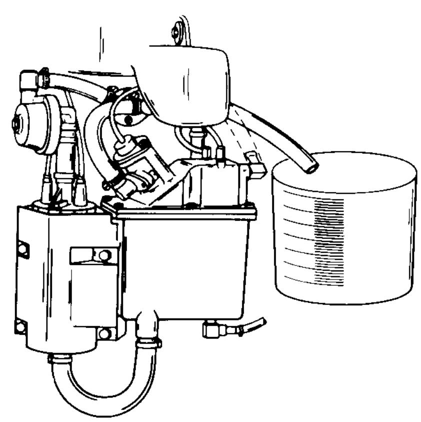
Vapor Separator Float Test

Purpose: This test will indicate if float is stuck in the up position.

***NOTE:** If float is stuck down vapor separator will over flow causing a rich condition.*

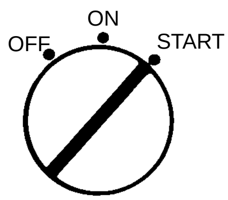
Procedure: If float is suspected of sticking in the up position:

STEP 1: Remove fuel inlet hose from vapor separator and put end of hose in clean container.

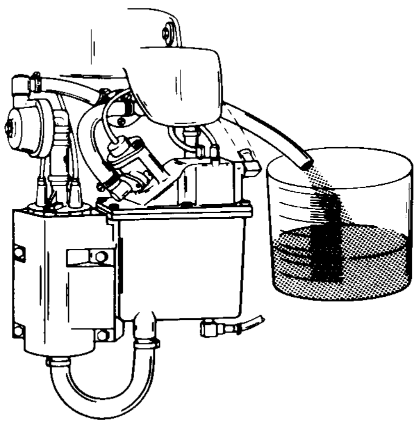


STEP 2: Remove all spark plugs from engine to prevent engine from starting.

STEP 3: Turn ignition key switch to "START" position and operate starter motor for 15 to 20 seconds.



STEP 4: Look for fuel flow from hose.



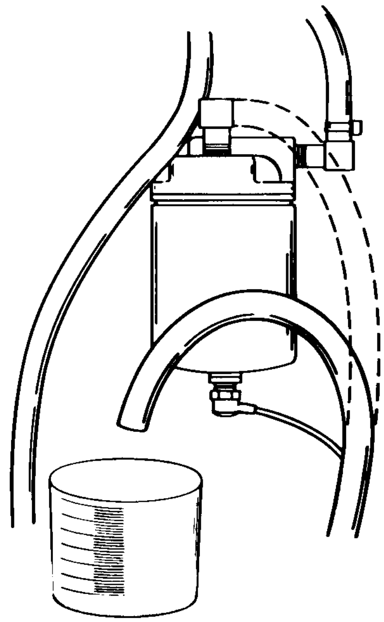
Results: If fuel flow is present at hose, remove, disassemble and inspect float assembly. See vapor separator disassembly.

If fuel flow is low or not present, perform Water Separating Filter Flow Test.

Water Separating Filter Flow Test

Purpose: This test will indicate if water separating filter is clogged.

Procedure: STEP 1: Remove fuel inlet hose to water separating filter. Put end of hose in clean container.



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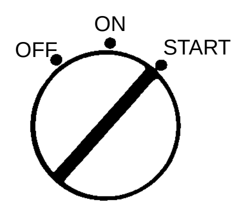
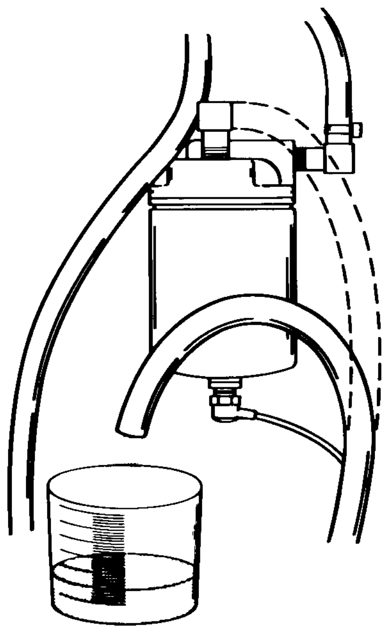
STEP 2: Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW terminal on the switch box to engine ground.

STEP3: Turn ignition key switch to "START" and operate starter motor for 10 to 20 seconds.



STEP 4: Look for fuel flow from hose.



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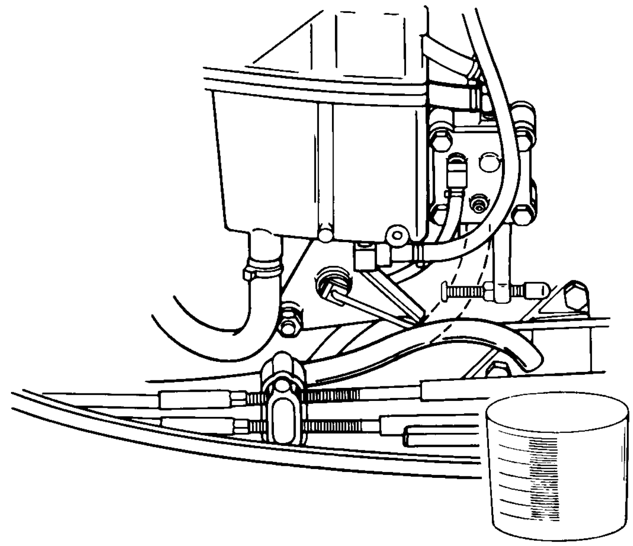
Results: Fuel flows from water separating inlet hose. Remove and replace clogged filter.

Low or no fuel flow from water separating inlet hose. Perform pulse fuel pump delivery test.

Pulse Fuel Pump Delivery Test

Purpose: This test will indicate pulse fuel pump is capable of supplying the low pressure fuel route with adequate fuel supply.

Procedure: STEP 1: Remove inlet hose to pulse fuel pump and put end into clean container.



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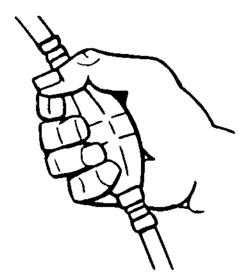
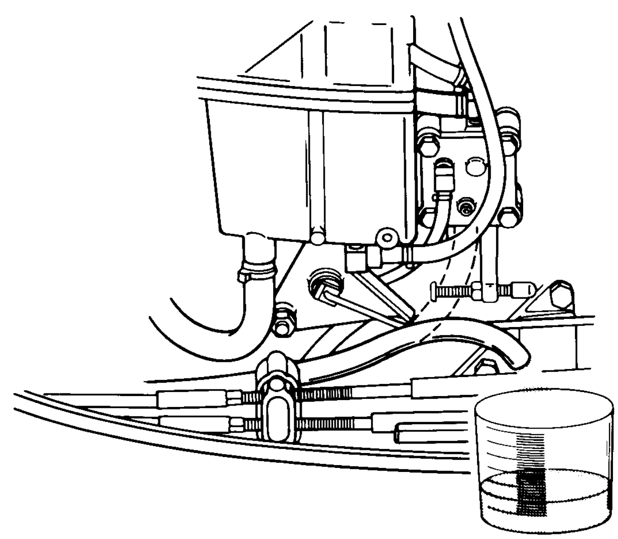
STEP 2: Squeeze primer bulb several times.



STEP 3: Look for fuel flow from hose.



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Results: Fuel flows freely from pulse pump inlet hose. Remove, disassemble, and inspect pulse fuel pump (section 3).

IMPORTANT: All fragments of tailed pump must be located before re-assembly.

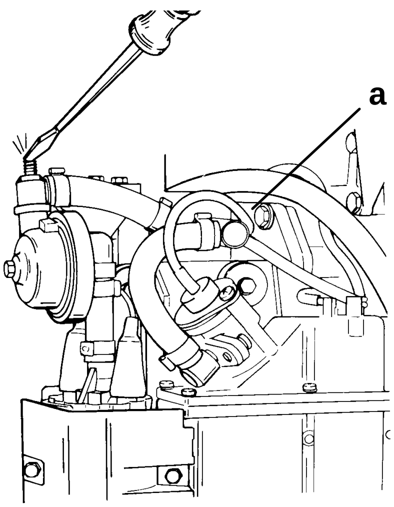
No or low fuel flow from pulse pump inlet hose. Check for restrictions, holes, or loose connections from fuel supply.

NOTE: *Inspect anti-siphon valve on tank.*

Final Filter Check and De-pressurizing EFI System Procedures

Purpose: Checking the final filter for obstructions, damage etc. eliminates this component as a possible source of restriction in the system .

Procedure: STEP 1: De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



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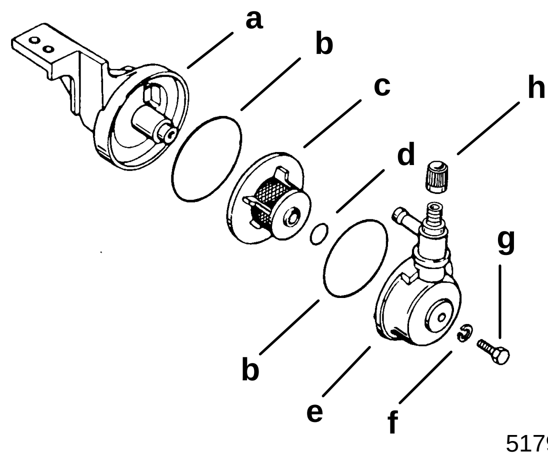
a - Pressure Port may be located at this location on some models.

NOTE: *Pressure port valve may be located on manifold fitting on some models.*

STEP 2: Remove filter cap.



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a - Filter Housing
b - Large O-ring
c - Filter Element
d - Small O-ring
e - Filter Cap
f - Lockwasher
g - Screw
h - Cap

STEP 3: Look at filter for plugging, damage or other signs of unusual condition.

Results: Filter is clogged with debris. Clean with carburetor cleaner and compressed air or replace. Recheck fuel pressure.

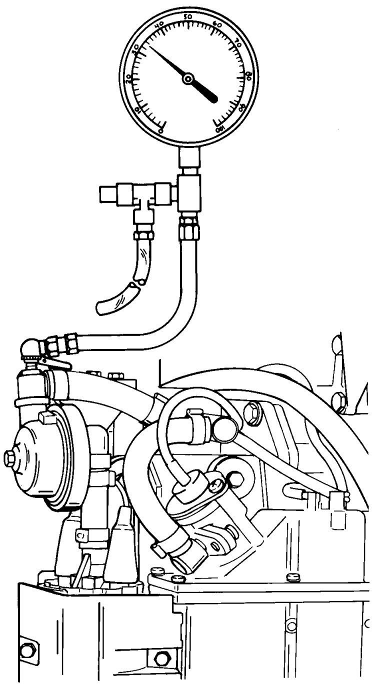
Filter is o.k. Pressure still below 36 psi (248 kPa). Perform fuel pressure regulator test.

Pressure Regulator Test

Purpose: This test will determine if a weak, plugged or open pressure regulator is causing inadequate fuel pressure in the system.

***NOTE:** Induction manifold cover shown removed for illustrative purposes only.*

Procedure: STEP 1: Connect pressure gauge to EFI test port.



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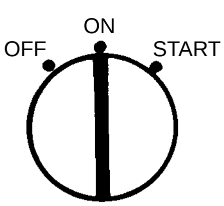
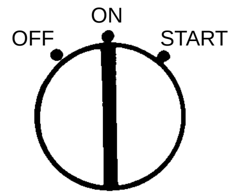
STEP 2: Turn ignition key switch to “ON” position and check fuel pressure reading on gauge. If pressure reading is below 36 psi (248 kPa) go to step 3 following.



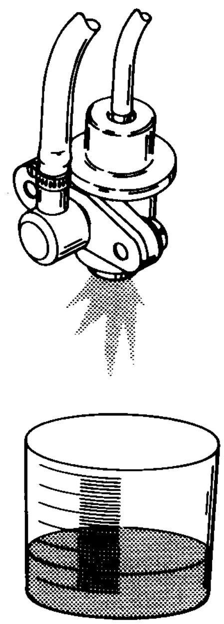
STEP 3: Remove fuel pressure regulator, but do not disconnect any hoses from regulator.

STEP 4: Put discharge end of regulator in clean container.

STEP 5: Turn ignition key switch to “ON” position.



STEP 6: Check for fuel flow out of regulator.



Results: If steady stream of fuel exits regulator into container and pressure is below 36 psi (248 kPa) replace pressure regulator.

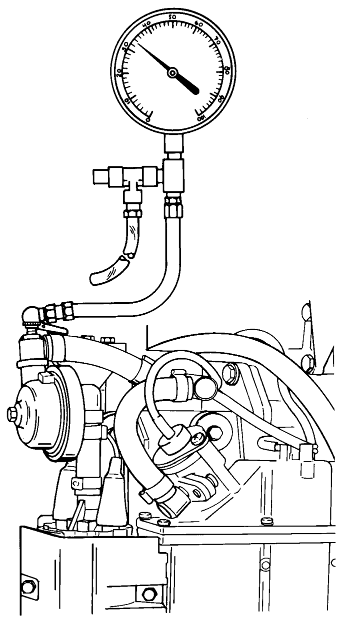
If low or no fuel exits regulator into container and pressure is below 36 psi (248 kPa) perform electric fuel pump “pressure” test.

If low or no fuel flow exits regulator into container and pressure is above 39 psi (269 kPa) replace regulator.

Electric Fuel Pump Test

Purpose: This test will determine if electric fuel pump is capable of producing adequate fuel “pressure” needed for normal engine operation, 36 to 39 psi (248 to 269 kPa).

Procedure A: STEP 1: Connect pressure gauge to pressure port.



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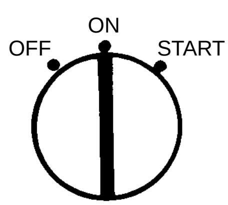
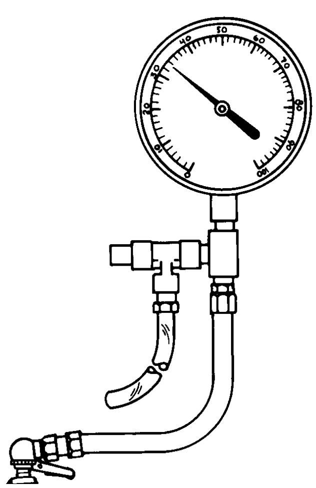
STEP 2: Put ignition key switch in “ON” position.



STEP 3: Take a fuel pressure reading, within 30 seconds.



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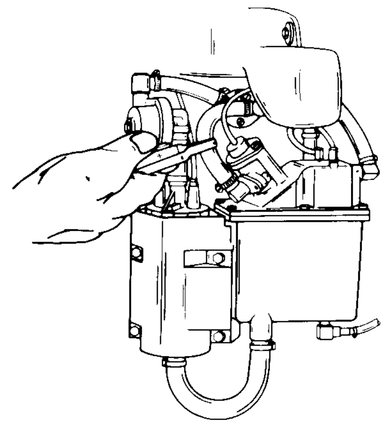
⚠ CAUTION

Do not close-off fuel hose completely in step 4, or damage could result to hose or pump.

STEP 4: Partially close off fuel hose to pressure regulator.



STEP 5: Look at pressure gauge for increase in pressure.

Results: Fuel pressure increases as hose is partially closed off. Electric fuel pump OK, perform Induction Manifold Leak Check (page 3C-33).

Fuel pressure does not increase when hose is partially closed off. This may indicate defective electric fuel pump. Before replacing, perform Procedure B following.

Procedure B:

⚠ CAUTION

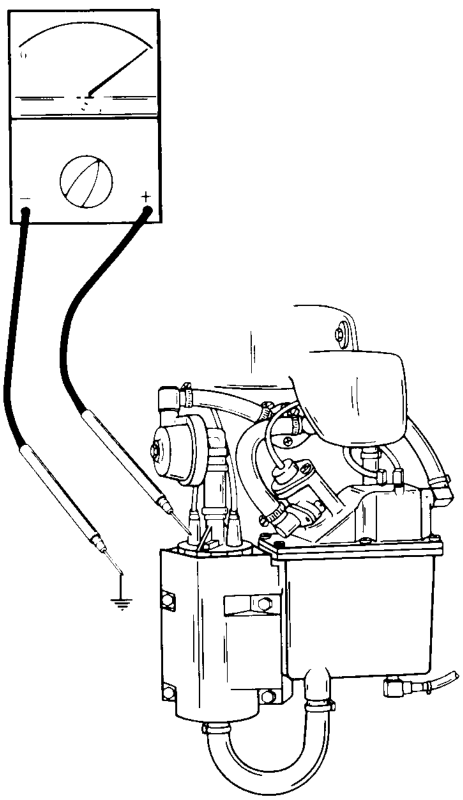
When checking voltage at pump, DO NOT pry boot covers off terminals with a metal object, as each terminal is at 12 volts when engine is off. Serious damage to electric fuel pump and/or ECM box can result.

Purpose: If insufficient electrical power is available at the pump, no or low fuel pressure will be developed.

Procedure: STEP 1: Set volt meter to read battery voltage and connect black test lead to ground, positive test lead to positive (+) post of fuel pump.

NOTE: *Positive test lead can be pierced through boot cover for testing. Refer to voltage test chart (page 3C-30) for voltage readings.*

Positive Test Terminal



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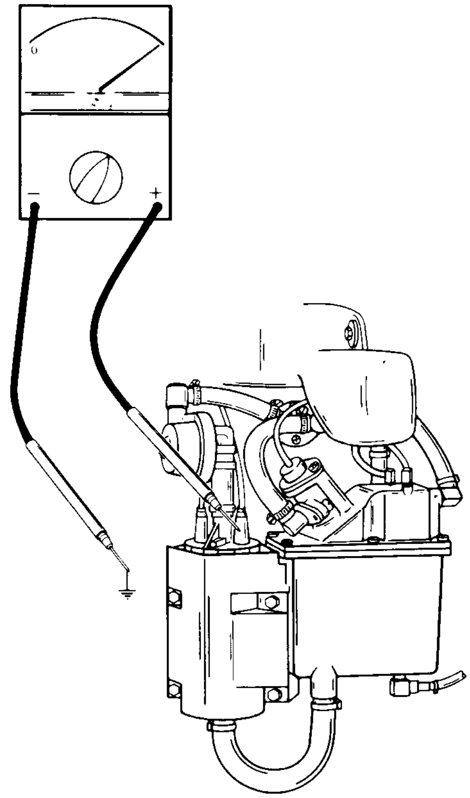
STEP 2: Set volt meter to read battery voltage and connect black test lead to ground, positive test lead to negative (-) post of fuel pump.

Negative Test Terminal



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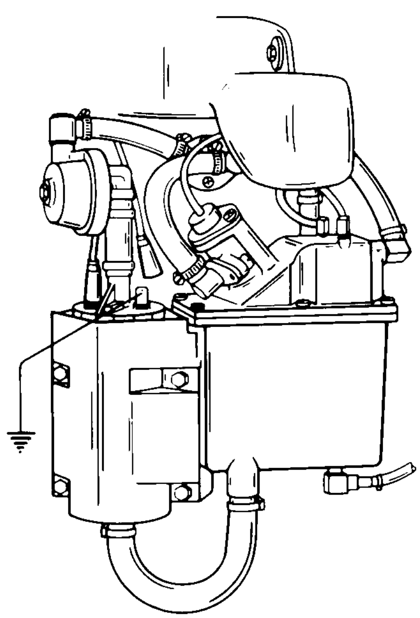
STEP 3: Perform voltage tests "all (1-6) engine modes" below.

VOLTAGE TEST CHART

Engine Mode	BLACK Meter Lead to Engine Ground; RED Meter Lead to:	Approximate Voltage Reading	If Approximate Voltage is not obtained, this indicates:
1. All models	(+) terminal of fuel pump	12 – 13.5 volts	If reading is below 12 volts, the battery is bad, discharged or has bad connection(s).
2. Ignition key in "OFF" position.	(–) terminal of fuel pump.	Same reading should be obtained as reading in check No. 1 (above)	If reading is lower than in check 1, the ECM is bad.
3. Ignition key in "ON" position and engine NOT running.	(–) terminal of fuel pump.	2 volts or less (voltage should rise to 12 – 13.5 volts after approximately 30 seconds.	Bad ECM or bad fuel pump*.
4. Engine being cranked.	(–) terminal of fuel pump.	2 volts or less.	Bad ECM or bad fuel pump.
5. Engine running below approximately 2000 RPM.	(–) terminal of fuel pump.	2 volts or less (for approximately 30 seconds and then switch to approximately 5 volts.	Bad ECM or bad fuel pump.
6. Engine running above approximately 2000 RPM.	(–) terminal of fuel pump.	2 volts or less.	Bad ECM or bad fuel pump.

*Check for proper electrical operation of electric fuel pump. (Step 4)

STEP 4: Disconnect RED/PURPLE wire to negative terminal on electric fuel pump. Connect a ground jumper wire from negative pump terminal to a good engine ground.



Results: Pump does not operate. Replace electric fuel pump.

Pump operates. But, pressure reading does not change when performing electric fuel pump "pressure" test. Replace electric fuel pump.

Pump operates. Check RED/PURPLE (-) lead and harness for good continuity.

NOTE: *RED/PURPLE lead is connected to pin 2 of EFI harness.*

Injector Electrical Harness Test

Purpose: This test will determine if electrical or fuel delivery problem exists during the fuel delivery process by checking for open circuits in injector harness.

Procedure: STEP 1: With outboard in water, start and allow to warm up. Raise engine speed to 2000-2500 RPM. Remove spark plug leads one at a time and note RPM change. Determine non-working (no RPM change) cylinder. Stop engine.

STEP 2: Disconnect injector harness (4 pin connector).

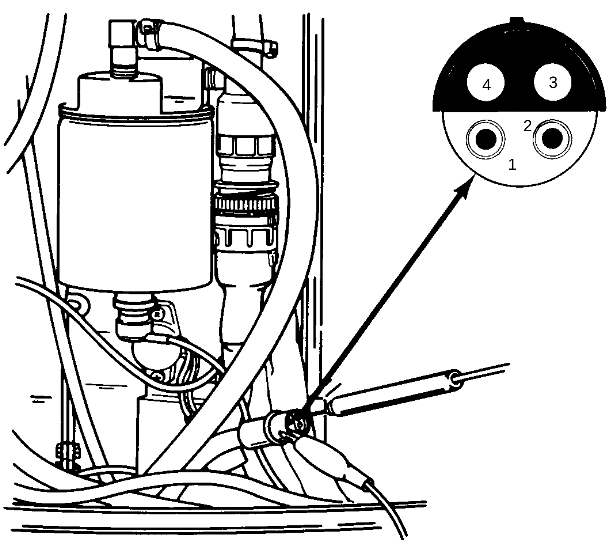
IMPORTANT: Use digital ohmmeter when testing injector harness.

STEP 3: Connect digital ohmmeter (dial set at 200 scale) leads. Positive lead from ohmmeter connects to positive prong "2" (red wire) of harness connector. Connect negative lead from ohmmeter to the remaining wires of harness connector as follows:

WHITE Lead = Injectors, Cylinders 1 and 2

DARK BLUE Lead = Injectors, Cylinders 3 and 4

YELLOW = Injectors, Cylinders 5 and 6



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(1) YELLOW
(2) RED
(3) DARK BLUE
(4) WHITE

Results: If readings are 1.1 ± .2 both injector circuits are complete. Perform Injector Fuel Delivery Test.

If readings are 2.2 ± .2 one injector does not have a complete circuit. Perform induction manifold disassembly and inspection following.

Injector Fuel Delivery Test

⚠ CAUTION

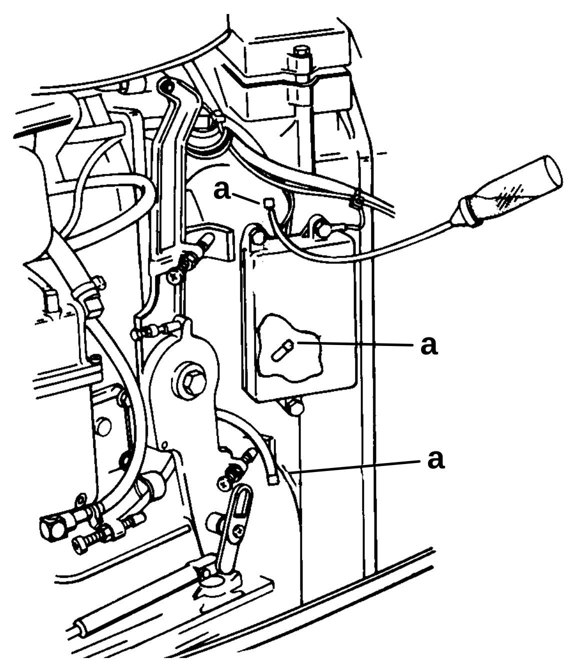
CAUTION: Switch boxes must be grounded to engine block if removed for fuel delivery test to prevent possible damage to ignition system.

Purpose: This test will determine if injector is delivering fuel when signal is received.

Procedure: STEP 1: Place outboard in water, start engine and allow to warm up. Raise engine speed to 2000-2500 RPM. Remove spark plug leads one at a time and note RPM change. Determine non-working cylinder (no RPM change).

STEP 2: Using squirt bottle of fuel and hose, inject small amount of fuel into cylinder bleed fitting (a) on non-working cylinder.

NOTE: *Switch box panel and lube alert control box may have to be shifted to the side to allow bleed fitting connection. Ground boxes to motor as required.*



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Results: If RPM increase occurs while injecting fuel into disabled cylinder, clogged injector filter or defective injector may be the problem. Perform Induction Manifold Disassembly (page 3C-38) for inspection.

NOTE: *Injector fuel delivery can be tested with manifold cover removed. See Injector Operation Test (manifold cover removed) below.*

RPM does not change when injecting fuel into bleed fittings could indicate lack of compression, damaged reeds, end cap seals, crankcase split line seal, or crankshaft sealing rings.

Remaining tests on EFI components may require some EFI disassembly. See EFI System Disassembly following.

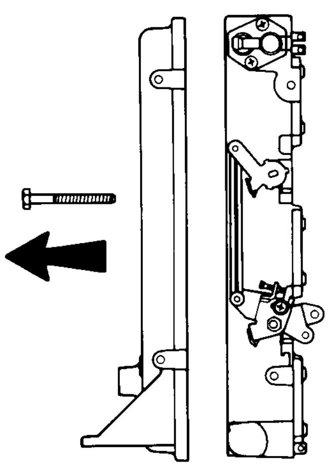
Injector Operation Test (Manifold Cover Removed)

Purpose: This test determines if the injectors are actually injecting fuel into the engine at a normal rate.

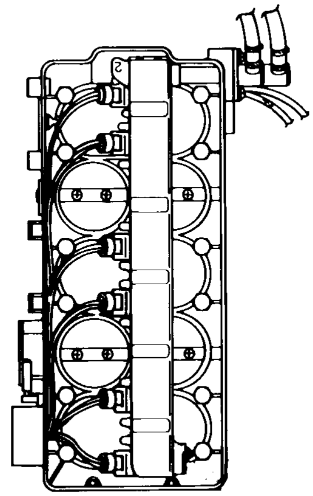
⚠ WARNING

Do not start engine with induction manifold cover removed. Disable ignition system prior to doing this test.

Procedure A: STEP 1: Remove induction manifold cover using procedures outlined under “Induction Manifold Removal.”



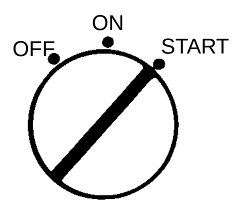
STEP 2: Re-attach induction manifold to engine using 1/4-20 x 2-3/4″ screws.



STEP 3: Connect a jumper wire between the ECM metal case and a good engine ground.

STEP 4: Disconnect all spark plug wires from spark plugs and seal leads with electrical tape to prevent sparking.

STEP 5: Put ignition key switch in “START” position.



STEP 6: Look at injector spray pattern using an explosive proof flashlight.

Results A: If fuel spray is not present in all injectors or spray pattern is extremely weak, check wiring harness to injector connectors, or injector filters for plugging.

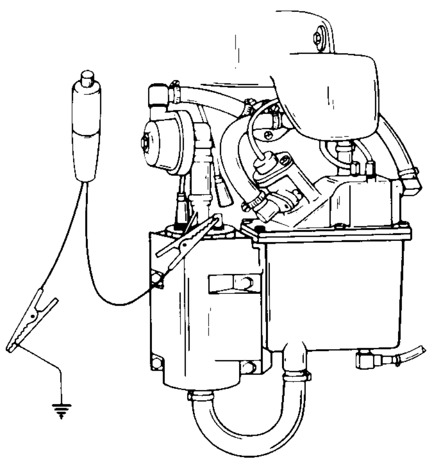
If spray patterns are available in most of the injectors, but not all, perform Procedure B.

Procedure B: STEP 1: Connect EFI tester. Steps outlined in electrical system and ECM check.

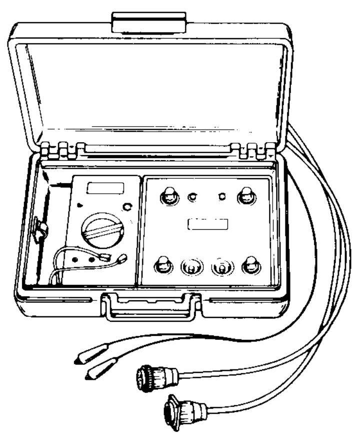
STEP 2: Connect remote starter Quicksilver (91-52024A1) to negative terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



STEP 3: Perform fuel injector test procedures (outlined) while depressing remote starter switch.



Results B: If fuel spray is present using EFI tester, but not present while cranking, perform switch box DVA tests Section 2A (1, 3, 5 switch box failure).

If fuel spray pattern is equal on all injectors system is functioning normally.

Induction Manifold Leak Check (Manifold Cover Removed)

Purpose: Lack of good fuel pressure may be caused by an internal leak in the fuel induction manifold and not caused by a weak pump. This test eliminates the possibility of induction manifold leaks as a probable cause.

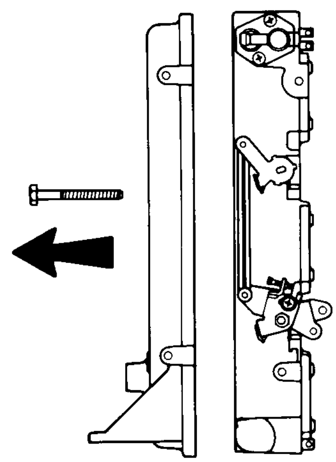
⚠ WARNING

Do not start engine with induction manifold cover removed. Disable ignition system prior to performing this test.

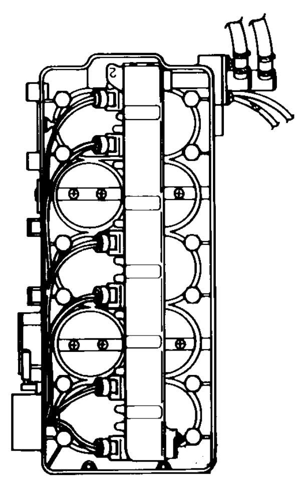
⚠ WARNING

Operation of EFI system with cover removed can allow fuel to spray components. Be extremely careful when operating the fuel system in this condition.

Procedure: STEP 1: Remove induction manifold cover using procedures outlined under “Induction Manifold Removal.”



STEP 2: Reattach manifold body without cover to engine using twelve 1/4-20 x 2-3/4″ screws in place of screws normally used.



STEP 3: Connect a jumper wire between the metal case of ECM and a good engine ground.

⚠ WARNING

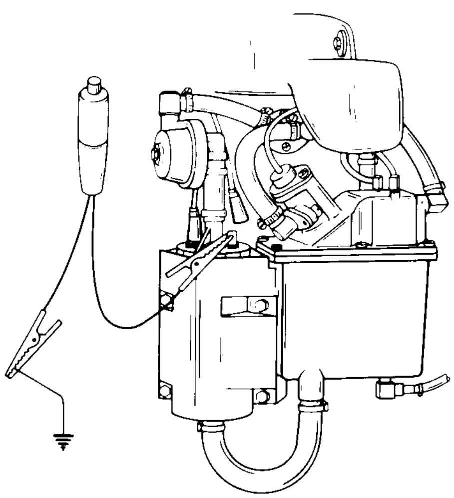
If a serious leak is present in the induction manifold, fuel may spray out of bad seal. Have clean up rags available to remove excess fuel from components.

STEP 4: Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW terminal on the switch box to engine ground.

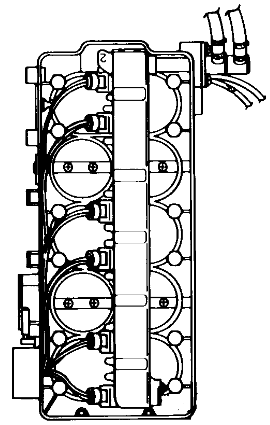
STEP 5: Connect remote starter Quicksilver (91-52024A1) to negative terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



STEP 6: Look for leak points on induction manifold while depressing remote starter switch.



Results: If no leaks are present, replace cover and gasket using normal length screws.

If fuel leak is present between sealing surfaces, rebuild system using new O-rings.

Air Temperature Sensor Test

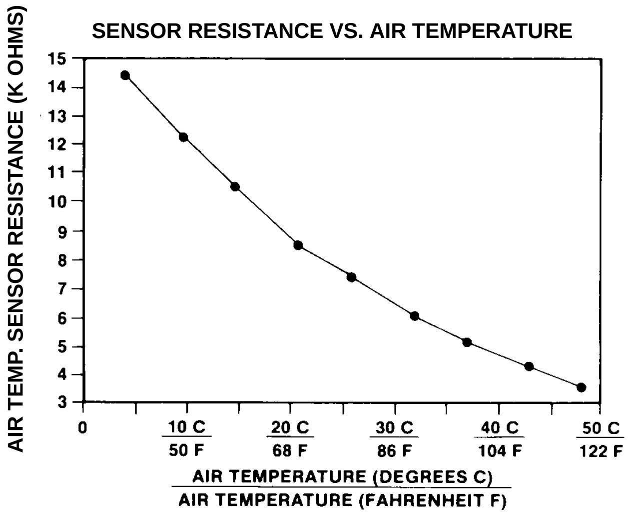
Purpose: This test eliminates possibilities of improper fuel delivery related to air temperature sensor.

Procedure: STEP 1: Disconnect and remove Air Temperature Sensor from induction manifold.

STEP 2: Connect digital meter set at “20K scale” (from EFI Tester P/N 91-11001A2) to leads of sensor.

STEP 3: Place sensor in ice water while monitoring meter reading. Use graph (following page) for reference.

NOTE: *Temperature/resistance reading may differ slightly from graph curve.*



Results: Resistance does not change inversely with temperature change. Replace defective Air Temperature Sensor.

Resistance changes inversely with temperature change. Air Temperature Sensor OK.

Engine Head Temperature Sensor Test

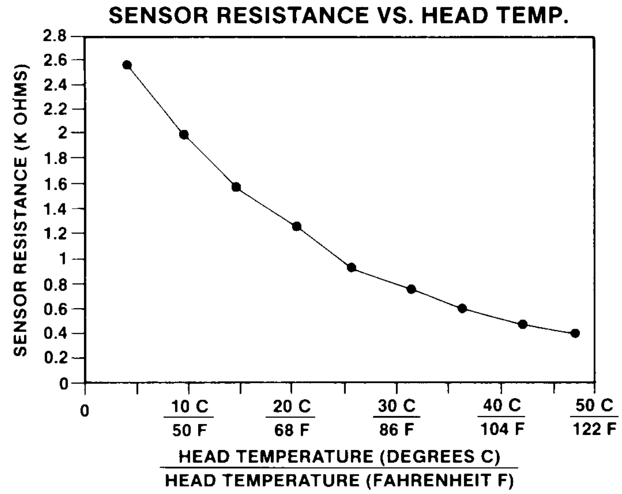
Purpose: This test eliminates possibilities of improper fuel delivery related to the water temperature sensor.

Procedure: STEP1: Disconnect and remove Engine Head Temperature Sensor (page 3C-40).

STEP 2: Connect Digital Meter set at “2K Scale” (from EFI Tester P/N 91-11001A2) to bullet leads of sensor.

STEP 3: Place sensor in ice water while monitoring meter reading. Use graph (below) for reference.

NOTE: *Temperature/resistance reading may differ slightly from graph curve.*



Results: Resistance does not change inversely with temperature change. Replace defective Engine Head Temperature Sensor.

Resistance changes inversely with temperature change. Engine Head Temperature Sensor OK.

Detonation Control System Test (200 Models Only)

Purpose: This test eliminates possibilities of improper fuel delivery due to failure in detonation control.

Procedure: STEP 1: Place outboard in water, install timing light to number one cylinder.

STEP 2: Start engine, allow to warm up. Advance throttle (between 3000-3500 RPM in gear). NOTE: Timing advancement.

Results: Timing advances from 19° to 25° BTDC system functioning properly.

Timing advance from 19° to 25° but retards while maintaining a steady throttle position. System functioning properly detonation may be occurring. See Detonation Sensor/Module Checks (following).

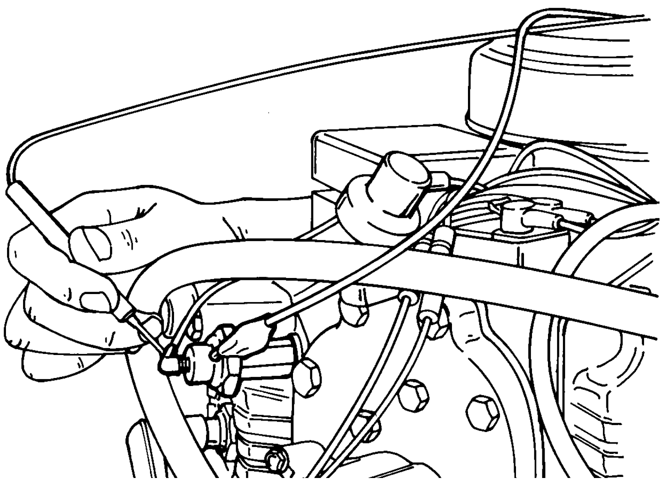
Timing advancement does not occur (19° to 25° BTDC). System functioning properly detonation may be occurring. See Detonation Sensor/Module Checks (following).

Detonation Sensor Check

IMPORTANT: When testing detonation control system keep all test leads away from high tension leads (i.e. spark plug lead, electrical wiring etc.) to avoid false readings.

Purpose: This check will determine if sensor is correctly signaling control module.

Procedure: STEP 1: Connect Digital Volt Meter (from EFI Tester P/N 91-11001 A2) to detonation sensor as shown. Red "V-Ω" test lead to sensor terminal, black "com" test lead to sensor housing (ground).



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STEP 2: Turn meter dial to 200 MV volts, AC position and power switch in on position. Place outboard in water.

STEP 3: Start and operate engine at idle speed.

STEP 4: Check meter reading. A typical reading of .075 to .120 volts AC should be present.

***NOTE:** As RPM increases volt readings will increase.*

Results: If voltage reading is not within .075 to .120 volts AC replace detonation sensor. Torque sensor to 144 lb. in. (16.2 N·m).

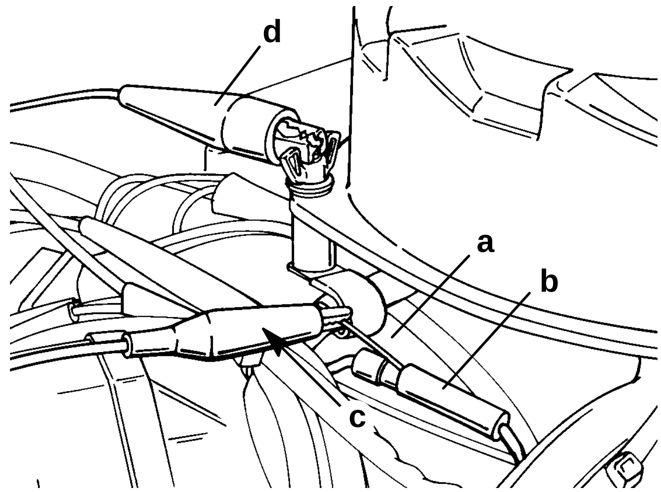
If voltage reading is within .075 to .120 volts AC perform check on detonation control module.

IMPORTANT: Handle detonation sensor with care when testing or replacing. Rough handling could cause undetectable internal damage causing false readings to be transmitted to detonation module.

Detonation Control Module Check

Purpose: This check will determine if control module is correctly signaling ECM when signals are received from sensor.

Procedure: STEP 1: Insert probe (a) (i.e. paper clip) to gray/white wire connector (b). Connect digital volt meter (from EFI tester 91-11001A2) positive clip (c) to probe and ground clip to engine ground (d) as shown.



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a - Probe
b - Connector
c - Positive Clip
d - Ground Clip

STEP 2: Turn meter dial to 20 volts DC position and power switch in ON position. Place outboard in water.

STEP 3: Start and operate engine at idle.

STEP 4: Check meter reading. A reading between 0.30 to 0.70 volts DC should be attained.

STEP 5: Increase engine speed (with engine in gear) between 3000-4000 RPM. Check meter reading. A typical reading should be .01 volts DC.

Results: If meter reading is .30 to .70 volt DC at idle and .01 volts DC at 3000-4000 RPM, detonation control unit is functioning properly (no detonation occurring).

If voltage reading does not fall within range (.30 to .70 volts DC) at idle, control module may be bad.

If voltage reading is above .01 volts DC and between 1.0 to 6.6 volts DC at 3000 to 4000 RPM detonation is occurring. A constant voltage of 6.6 volts DC would indicate bad detonation control module.

Throttle Position Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the throttle position indicator. Refer to EFI electrical system and ECM test.

Map Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery caused by the map sensor. Refer to EFI electrical system and ECM check.

Problem Diagnosis

Condition	Possible Source	Action
Engine Down On Power Or RPM.	– Failed Switch Box	Refer to Section 2 Electrical and Ignition Tests.
	– Failed Stator	Refer to Section 2 Electrical and Ignition Tests.
	– Failed Coil	Refer to Section 2 Electrical and Ignition Tests.
	– Low Compression	Refer to Section 4 Power Head.
	– Broken Reed	Perform Injector Fuel Delivery Test (page 3C-31)
	– Fuel Delivery Problem	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart.
	– Manifold Fuel Leak	Perform Induction Manifold Leak Check (page 3C-33).
	– Model 200 only – Detonation Control System Activated Or Failed.	Perform Detonation Control Module Check (page 3C-36).
	– Vapor Separator Flooding Over, Engine Running Rich.	Check for fuel coming out of vapor separator vent hose.
	– Cylinder Head Temperature Sensor Circuit Failed.	Check cylinder head temperature sensor (page 3C-35).
Poor Acceleration – Idles Ok, Top Speed Ok.	– Improper EFI Set Up.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– Water Covering Idle Relief Exhaust Ports.	Boats with extended transoms or low engine mount can cause engine to load up on acceleration.
	– T.P.S. Failure.	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.
	– MAP Sensor Failure	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.
	– R.F.I. Problem*	Install BUZ8H Spark Plugs.

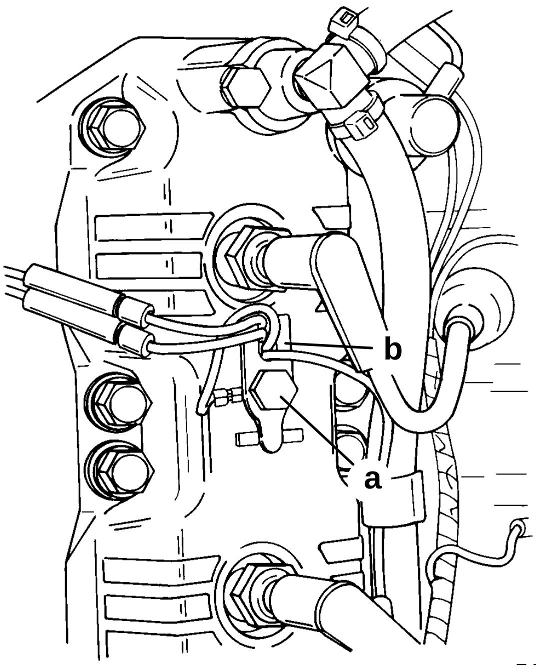
Condition	Possible Source	Action
Poor Acceleration – Idles Ok, Top Speed Ok. (Continued)	– Timing Not Advancing.	Check for stuck trigger.
Engine Surges Between 4000 And 5000 RPM	– Intermittant Switch Box Failure.	Refer to Section 2 Electrical and Ignition for tests.
	– Final Filter Clogging.	Perform Final Filter Check (page 3C-26).
	– T.P.S. – Improper Adjustment.	Refer to Section 2 Electrical and Ignition for T.P.S. adjustment.
	– Detonation Control (Model 200 Only).	Perform Detonation Test (page 3C-36)
	– Injector Connector Problem.	Perform Injector Fuel Delivery Test (page 3C-31).
	– Vapor Separator Flooding Over.	Check for fuel coming out of vapor separator vent hose.
	– Injector Filter Clogged.	Refer to Injector Fuel Delivery Test (page 3C-31)
Engine Idles Ok But Stumbles At Off Idle Speeds	– Improper EFI Setup.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– Failed Switch Box.	Refer to Section 2 Electrical and Ignition Tests.
	– Failed or Disconnected EFI Sensors.	Perform EFI sensor tests (pages 3C-35 thru 3C-37)
	– Fuel Delivery Problem.	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart (pages 3C-19 thru 3C-21).
	– Manifold Fuel Leak.	Perform Induction Manifold Leak Check (page 3C-33).
	– R.F.I* Problem.	Install BUZ8H Spark Plugs.
	– Stator (High Speed Winding).	Refer to Section 2 Electrical and Ignition for tests.
	– Induction Manifold Air Leak.	Check manifold cover gasket, manifold to reed block housing gasket and reed block housing to crankcase gasket.
Engine Idles Rough (May Lean Sneeze) – Acceleration Ok; Full Throttle Ok	– Improper EFI Setup.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– MAP Sensor Failure.	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.

Condition	Possible Source	Action
Engine Idles Rough (May Lean Sneeze) – Acceleration Ok; Full Throttle Ok. (continued)	– Improper EFI Set Up.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– MAP Sensor Failure.	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.
	– Low Speed Winding Failure.	Refer to Section 2 Electrical and Ignition Tests.
	– Broken Reed.	Perform Injector Fuel Delivery Test (page 3C-31).
Engine Runs but Slowly Drops RPM then Dies.	– Restrictions in Fuel System (Be tween Tank and Engine.	Install remote gas tank with fresh, high quality fuel.
	– Clogged Final Filter.	Perform Final Filter Check (page 3C-26).
	– Pulse Fuel Pump Failure.	Follow Low Pressure Fuel Route Flow Chart (page 3C-19).
	– Electric Fuel Pump Delivery Failure.	Follow High Pressure Fuel Route Flow Chart (page 3C-20).
Engine Stops for No Apparent Reason or Does Not Start.	– Battery Undercharged.	Check battery connections, under charged battery or worn out battery.
	– EFI Harness Connections.	Check EFI harness connector for improper connection.
	– Ignition System Failure.	Refer to Section 2 Electrical and Ignition Tests.
	– Pulse Fuel Pump Failure.	Follow Low Pressure Fuel Route Flow Chart (page 3C-19).
	– Electric Fuel Pump Failure.	Follow High Pressure Fuel Route Flow Chart (page 3C-20).
	– ECM Failure.	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.
Engine Stops for No Apparent Reason, but will Restart.	– Battery Overcharged.	Check battery voltage with engine running. Should be less than 15.5 volts. Refer to Service Bulletin 96-2.
	– Restriction in Fuel System	Check fuel pressure on fuel rail at the RPM that failure occurs.

*R.F.I. Radio Frequency Interference. High voltage can alter signals ECM receives from sensors causing improper fuel delivery. Route all sensor wires away from high voltage leads (i.e. spark plug leads)

Engine Head Temperature Sensor Removal

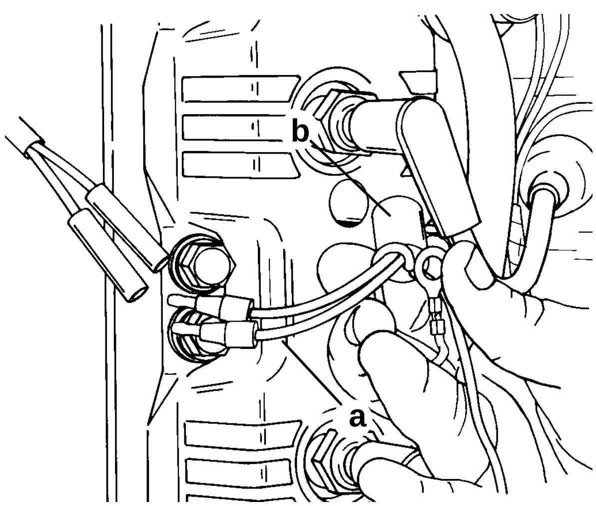
1. Remove screw and retaining plate.



51785

a - Screw
b - Retaining Plate

2. Disconnect wires and remove sensor.



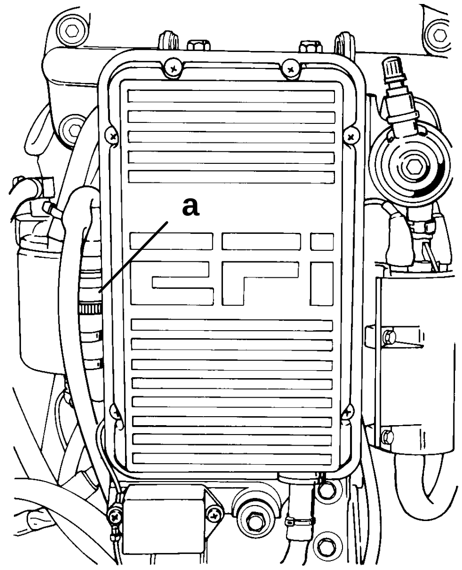
51785

a - Wires
b - Sensor

EFI Induction Manifold Removal

IMPORTANT: Remove battery cables from battery before Induction Manifold Removal and Disassembly.

1. Disconnect ECM at harness connector.



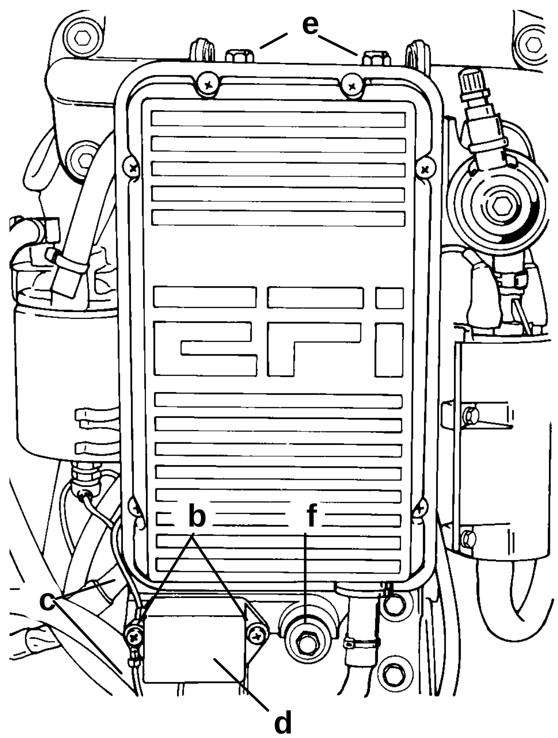
51793

a - Connector

a. Remove screws (b) and ground wires (c).

b. Remove water sensing module (d).

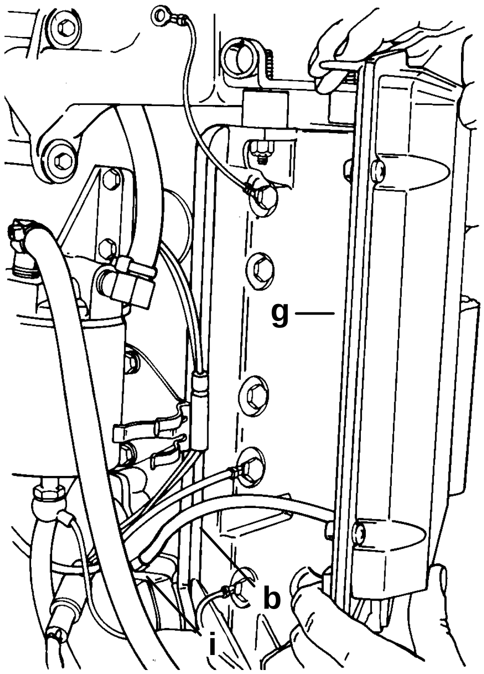
c. Remove nuts (e) and screw (f).



51793

b - Screws
c - Ground Wires
d - Water Sensing Module
e - Nuts
f - Screw

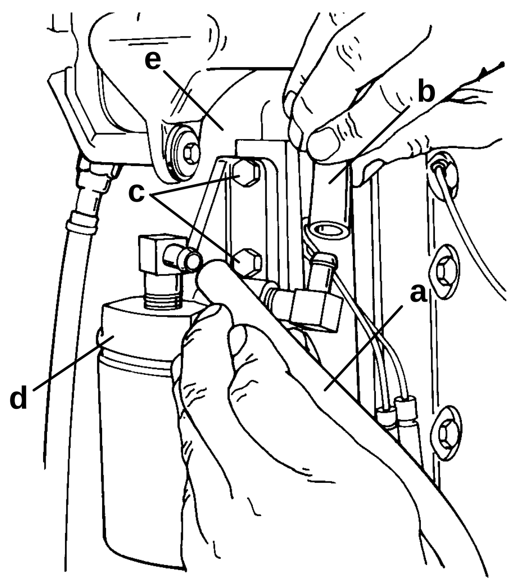
3. Carefully raise ECM (g) from studs. Disconnect MAP sensor hose (b) at manifold fitting (i) and remove ECM.



51793

Water Separating Filter Assembly Removal

1. Disconnect fuel inlet hose (a) and fuel delivery hose (b) from fittings.
2. Remove screws (c), filter base (d) and spacer block (e).

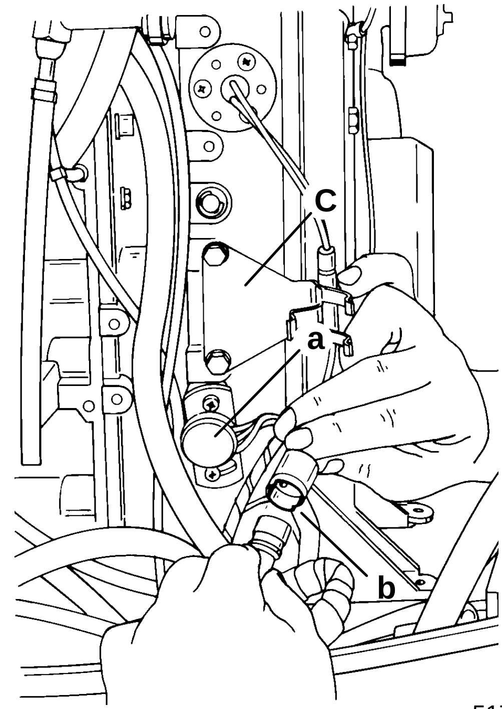


51793

a - Fuel Inlet Hose
b - Fuel Delivery Hose
c - Screws
d - Filter Base
e - Spacer Block

Throttle Position Sensor Temperature Sensor Fuel Injector Harness Disconnections

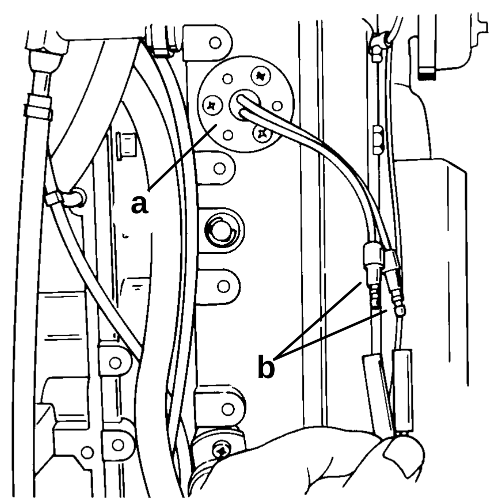
1. Disconnect throttle position sensor at 3 pin connector and remove ECM harness bracket.



51787

a - Throttle Position Sensor
b - 3 Pin Connector
c - Bracket

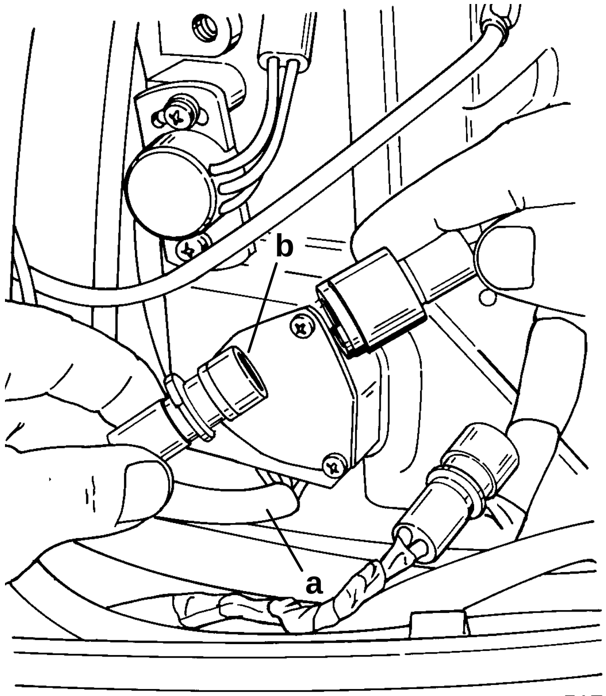
2. Disconnect air temperature sensor at connectors.



51788

a - Air Temperature Sensor
b - Connectors

3. Disconnect fuel injector harness at 4 pin connector.

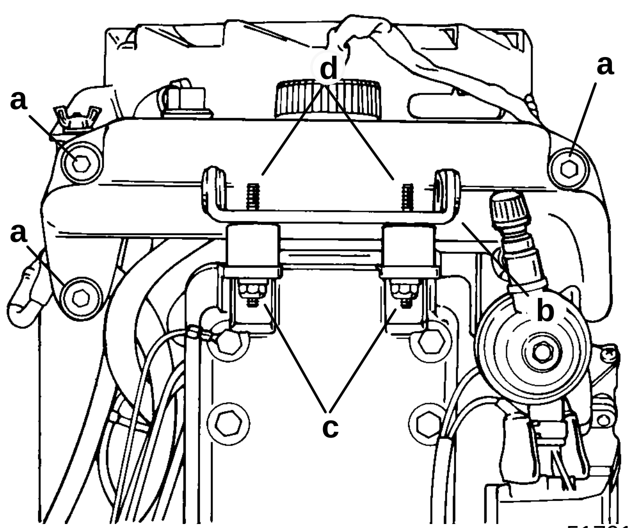


51787

a - Fuel Injector Harness
b - 4 Pin Connector

Oil Reservoir Removal

1. Remove screws, mounting bracket, nuts and studs.



51791

a - Screws
b - Bracket
c - Nuts
d - Studs

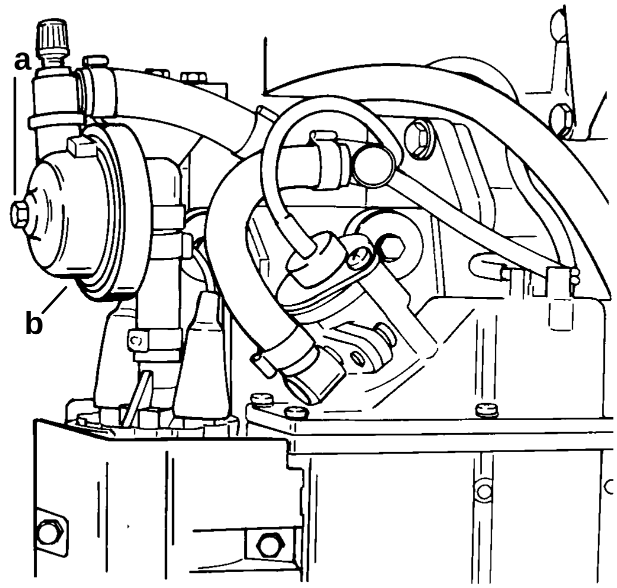
2. Remove hose clamp and lift oil reservoir from engine.

Final Filter Assembly Removal

⚠ CAUTION

De-pressurize EFI system prior to fuel filter removal. Refer to page 3C-26.

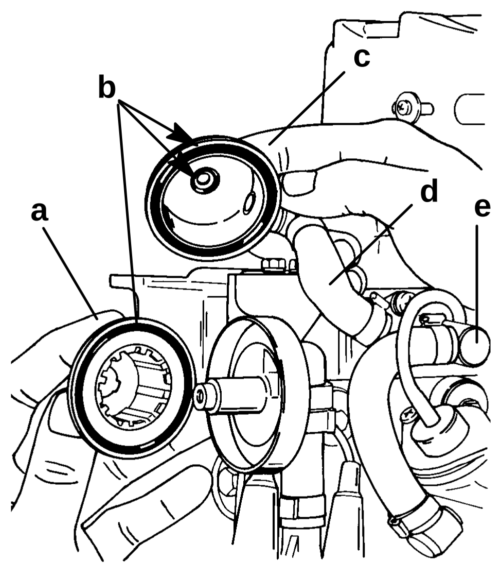
1. Remove screw from final filter housing assembly.



51785

a - Screw
b - Final Filter

2. Remove final filter.
3. Remove O-rings from filter and cap.
4. Remove cap with inlet hose from manifold fitting.

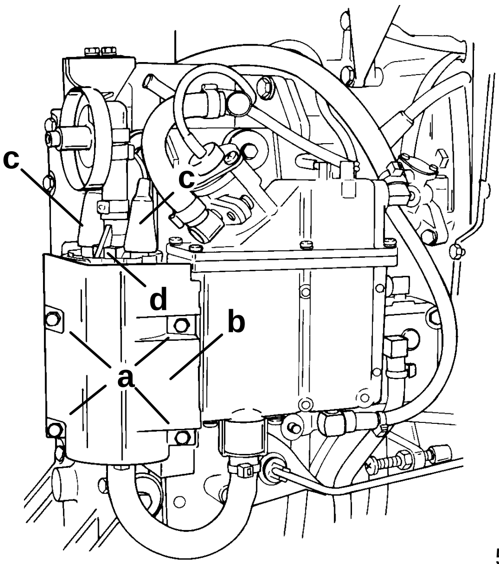


51786

a - Final Filter
b - O-Rings
c - Filter
d - Inlet Hose
e - Manifold Fitting

Electric Fuel Pump Removal

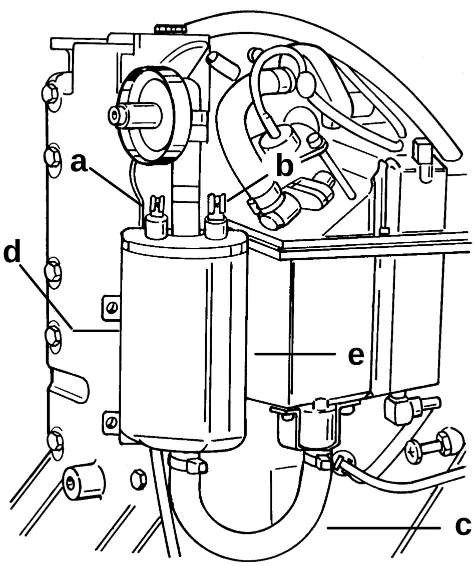
1. Remove 4 screws from cover plate.
2. Remove rubber boots from electric fuel pump cap.



51786

a - Screws (4)
b - Cover Plate
c - Rubber Boots
d - Cap

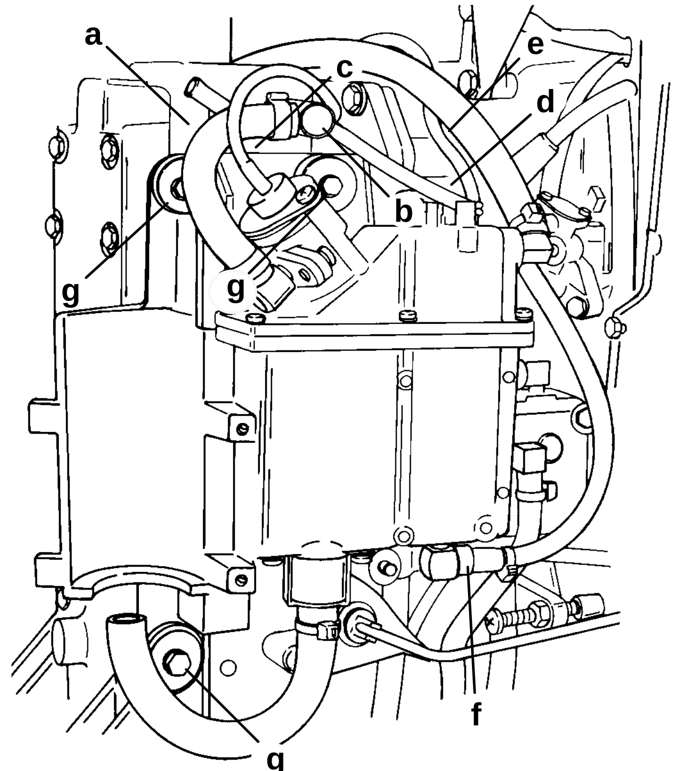
3. Remove mounting screws.
4. Disconnect positive lead and negative lead.
5. Remove fuel pump inlet hose.
6. Remove rubber blanket and electric fuel pump.



a - Positive Lead
b - Negative Lead
c - Inlet Hose
d - Rubber Blanket
e - Electric Fuel Pump

Vapor Separator Removal

1. Disconnect fuel rail re-circulation hose at manifold fitting.
2. Disconnect fuel pressure regulator vacuum hose.
3. Disconnect bleed hose and vapor separator vacuum hose.
4. Disconnect oil inlet hose.
5. Remove screw securing vapor separator to manifold.



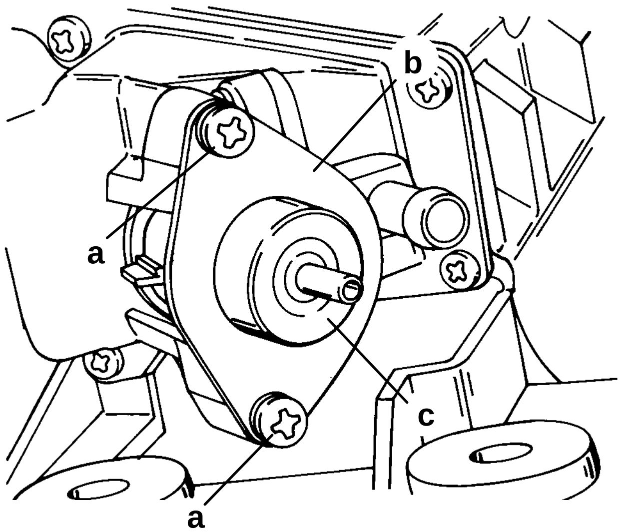
51786

a - Re-circulation Hose
b - Manifold Fitting
c - Regulator Vacuum Hose
d - Bleed Hose
e - Vapor Separator Vacuum Hose
f - Oil Inlet Hose
g - Screws

Vapor Separator Disassembly

PRESSURE REGULATOR REMOVAL AND DISASSEMBLY

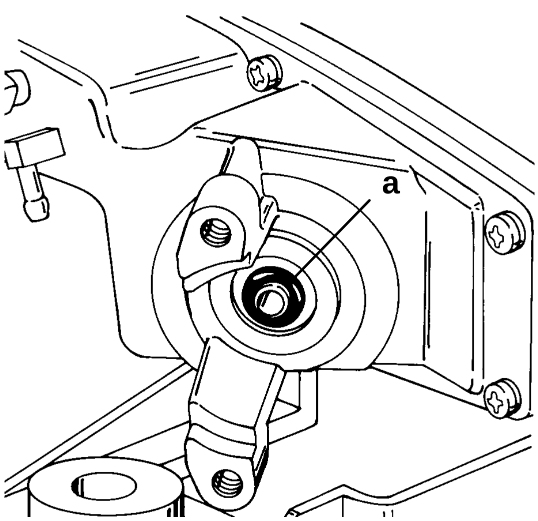
1. Remove screws, plate and grommet. Then remove regulator assembly.



51792

a - Screws
b - Plate
c - Regulator

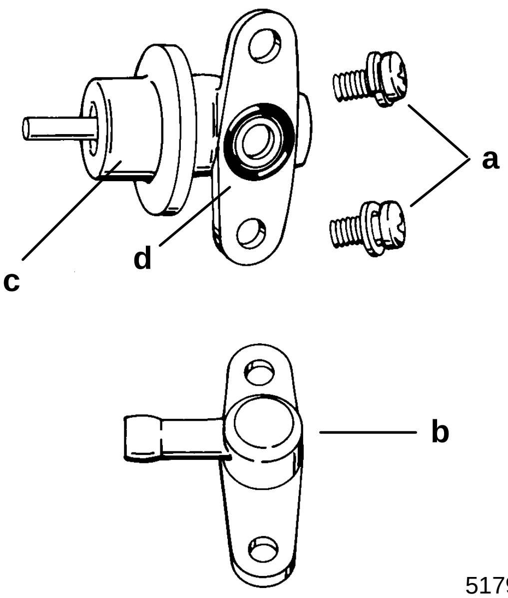
2. Remove O-ring.



51719

a - O-Ring

3. Remove screws and regulator fitting from regulator. Then remove O-ring from regulator.

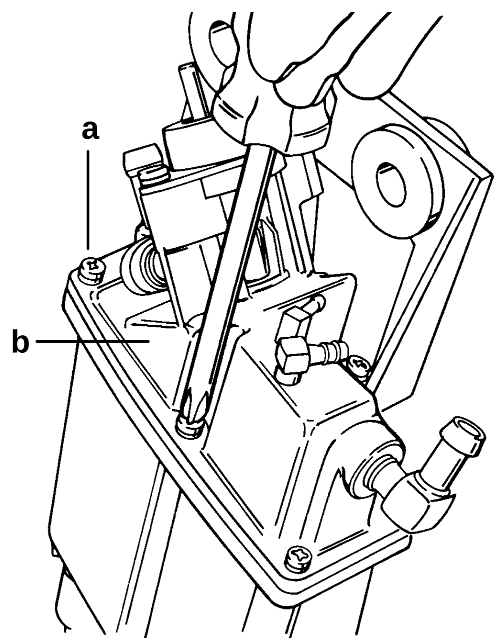


51794

a - Screws
b - Regulator Fitting
c - Regulator
d - O-ring

VAPOR SEPARATOR FLOAT REMOVAL

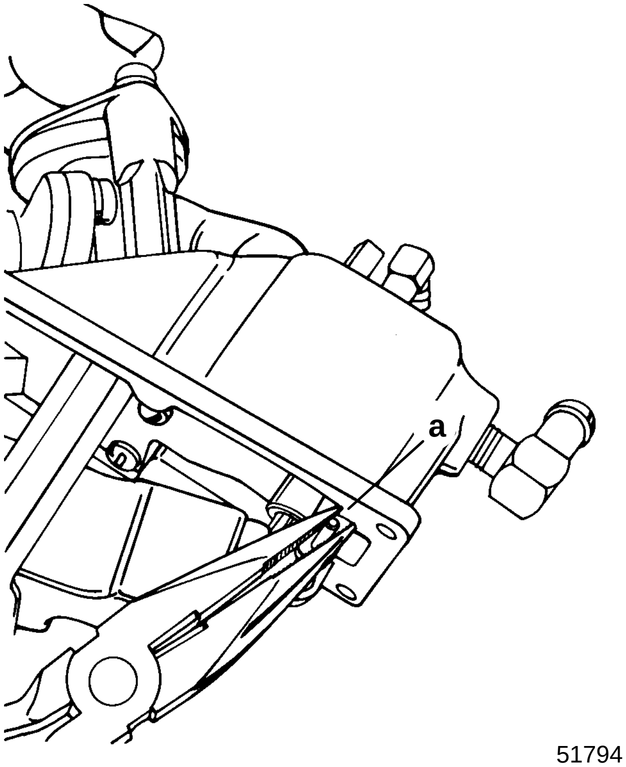
1. Remove screws and cover.



51794

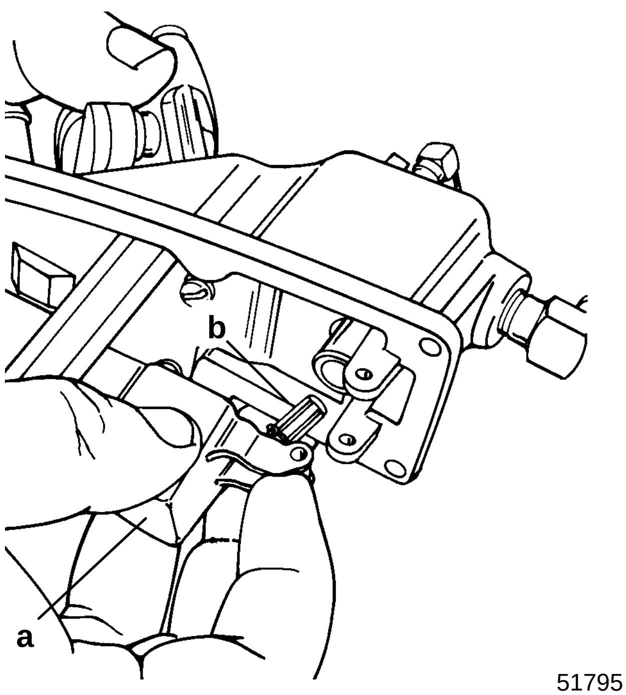
a - Screws
b - Cover

2. Remove pivot pin.



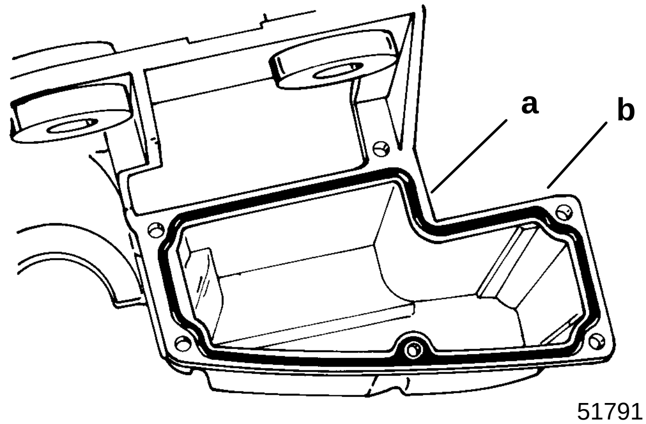
a - Pivot Pin

3. Remove float (a) and needle (b) and if necessary, remove needle from float. Do not change angle of brass tab that the needle is attached to.



a - Float
b - Needle

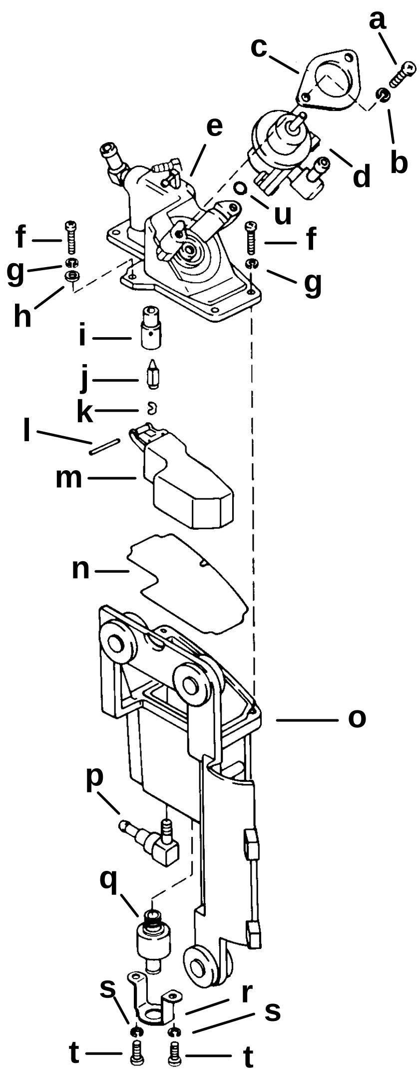
4. Remove O-ring from housing.



a - O-Ring
b - Housing

Vapor Separator Component Reassembly

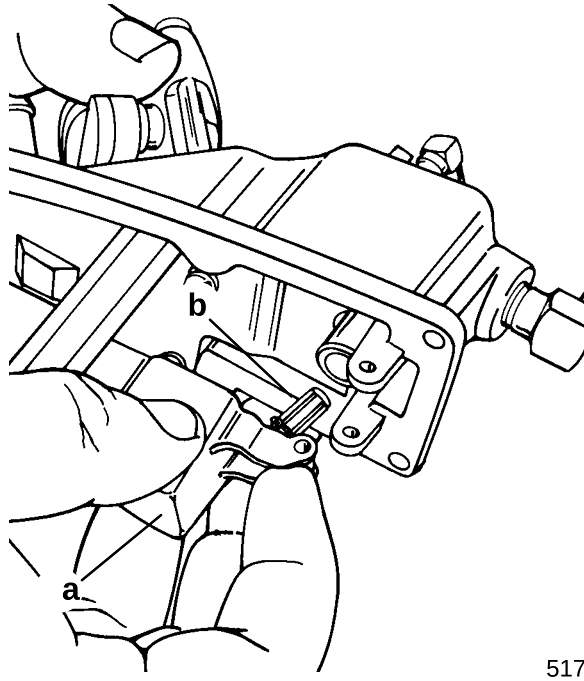
1. Assemble components as shown.



a - Screw
b - Lock Washer
c - Plate and Grommet
d - Pressure Regulator
e - Vapor Separator Cover
f - Screw
g - Lock Washer
h - Flat Washer
i - Seat
j - Needle
k - Retainer
l - Pin
m - Float
n - Seal
o - Bracket
p - Check Valve
q - Fuel Check Valve
r - Bracket
s - Lock Washer
t - Screw
u - O-Ring

Vapor Separator Float Installation

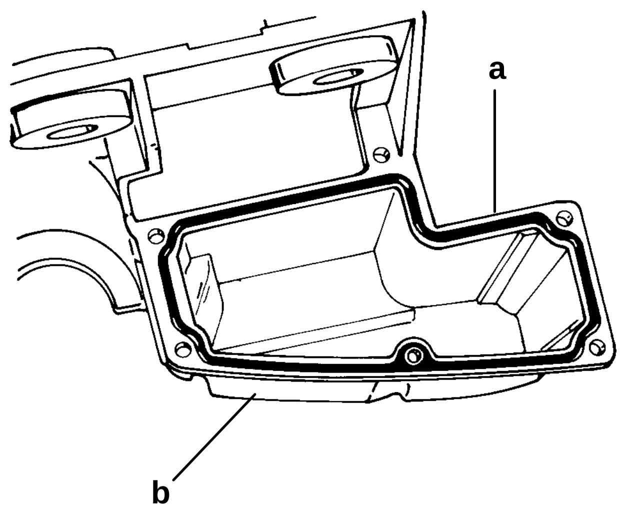
1. If removed, install needle on float and install float assembly.



51795

a - Float
b - Needle

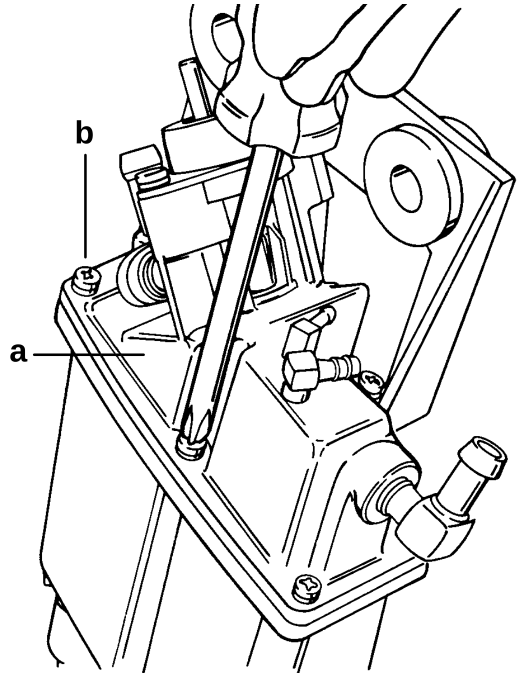
2. Install new O-ring in housing.



51791

a - O-Ring
b - Housing

3. Install cover using screws.

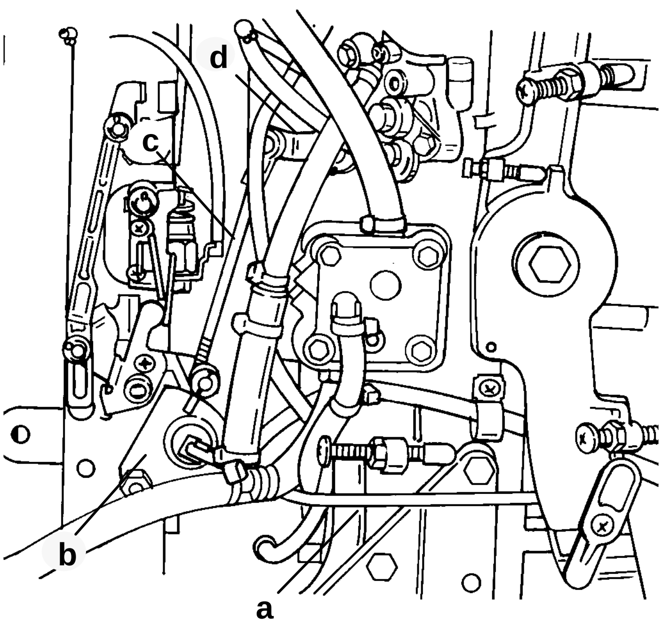


51794

a - Cover
b - Screws

Manifold Removal

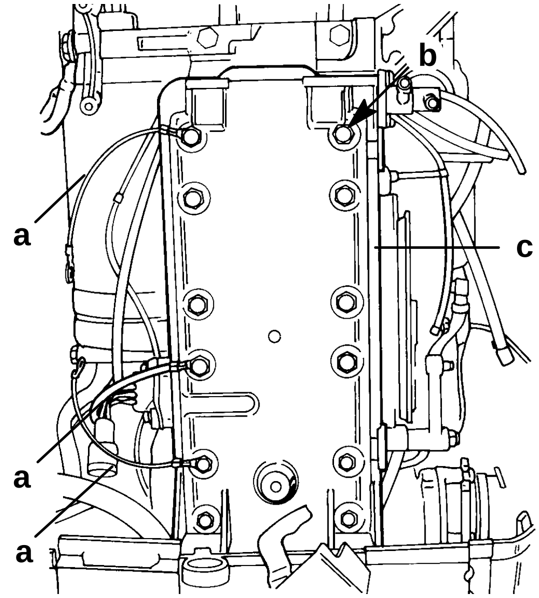
1. Disconnect throttle link rod from throttle cam.
2. Disconnect oil injection link rod from injector arm.



51811

a - Throttle Link Rod
b - Throttle Cam
c - Oil Injection Link Rod
d - Injector Arm

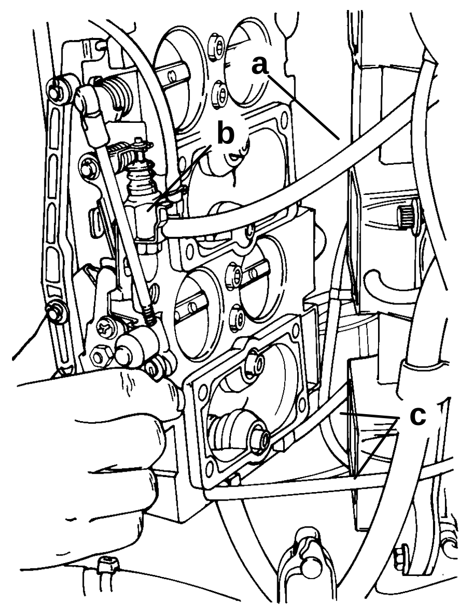
3. Identify location of 3 ground wires for reassembly purposes.
4. Remove12 screws securing manifold cover to manifold.
5. Remove manifold cover.



51795

a - Ground Wires
b - Screws (12)
c - Manifold Cover

6. Disconnect bleed line hose from bleed shut off.
7. Disconnect bleed line hoses from manifold fittings.
8. Remove manifold assembly and place on clean work surface.

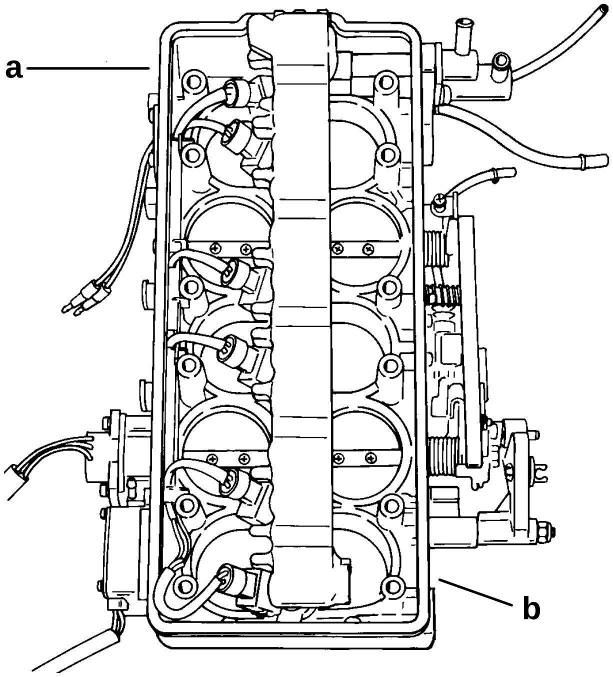


51795

a - Bleed Hose
b - Bleed Shut Off
c - Bleed Hoses

EFI Induction Manifold Disassembly

1. Remove manifold cover seal from manifold.

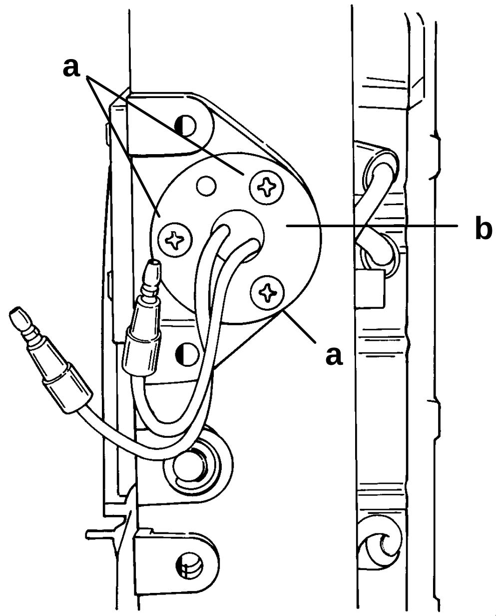


51785

a - Manifold Cover Seal
b - Manifold

Air Temperature Sensor Removal

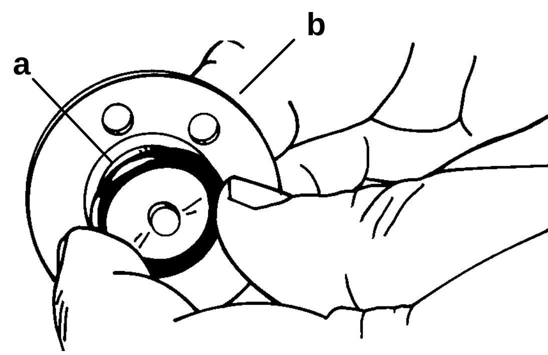
1. Remove screws and sensor.



51790

a - Screws
b - Sensor

2. Remove O-ring from sensor.



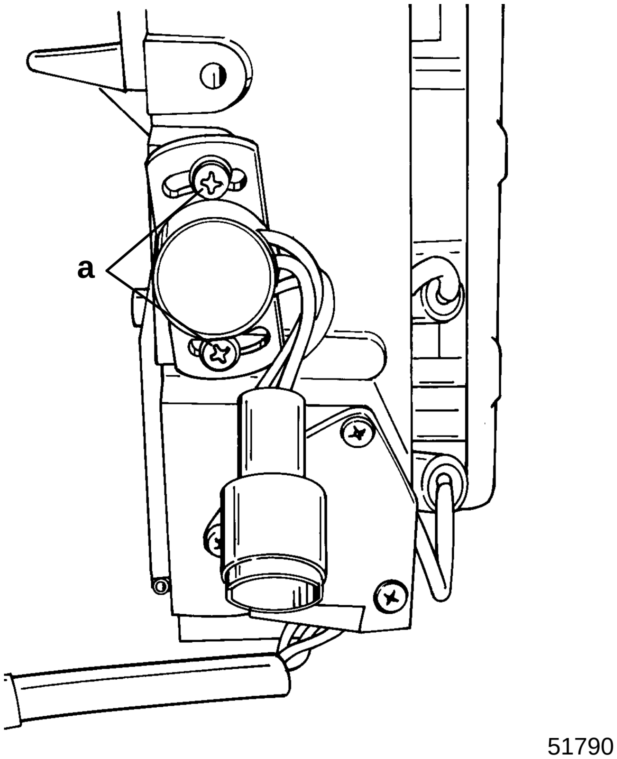
51791

a - O-Ring
b – Sensor

Throttle Position Sensor Removal

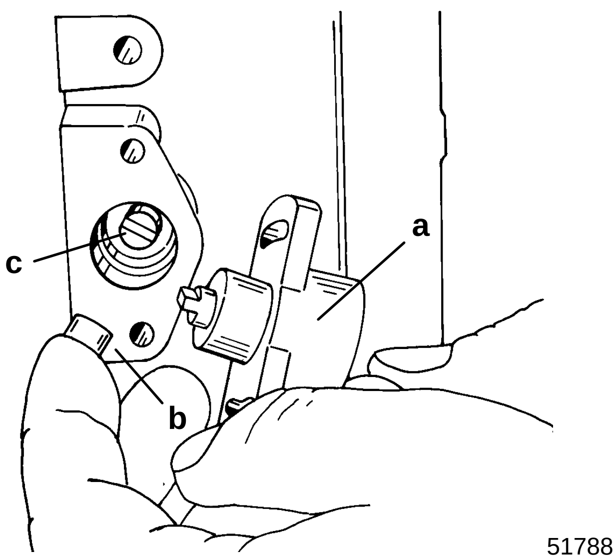
IMPORTANT: Sensor position will need to be set after induction manifold assembly has been installed.

1. Remove throttle position sensor screws.



a - Screws

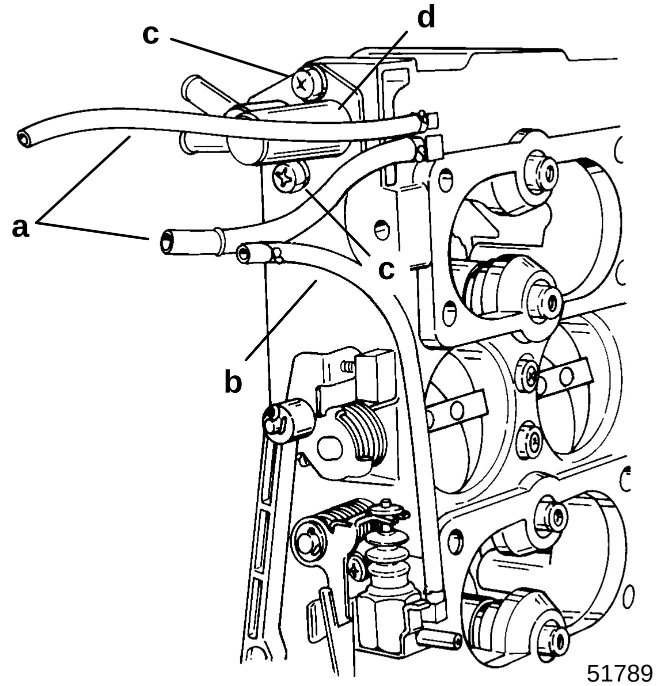
2. Remove sensor and sleeve from throttle shaft.



a - Sensor
b - Sleeve
c - Throttle Shaft

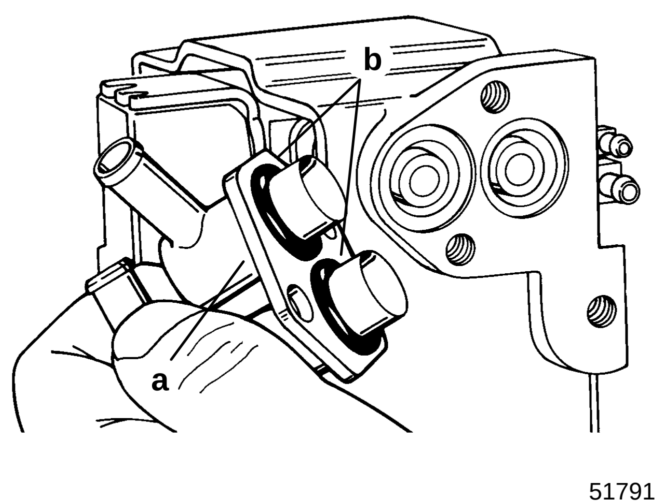
Fuel Rail Removal

1. Remove manifold vacuum hoses.
2. Remove engine bleed hose.
3. Remove screws securing manifold fitting to manifold.



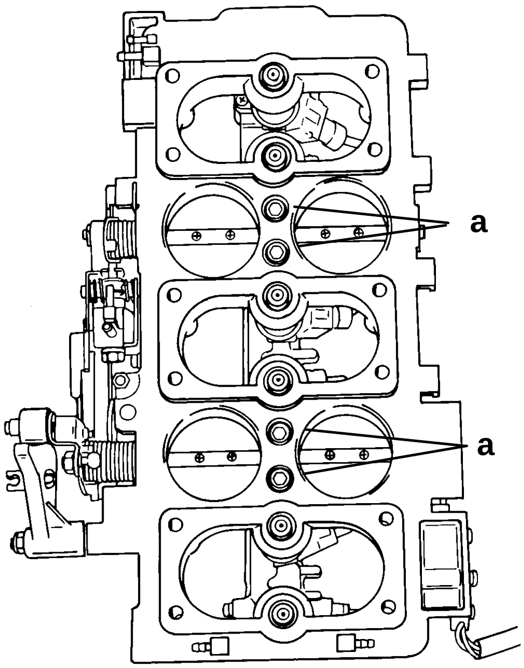
a - Vacuum Hoses
b - Bleed Hose
c - Screws
d - Manifold Fitting

4. Remove manifold fitting and O-rings.



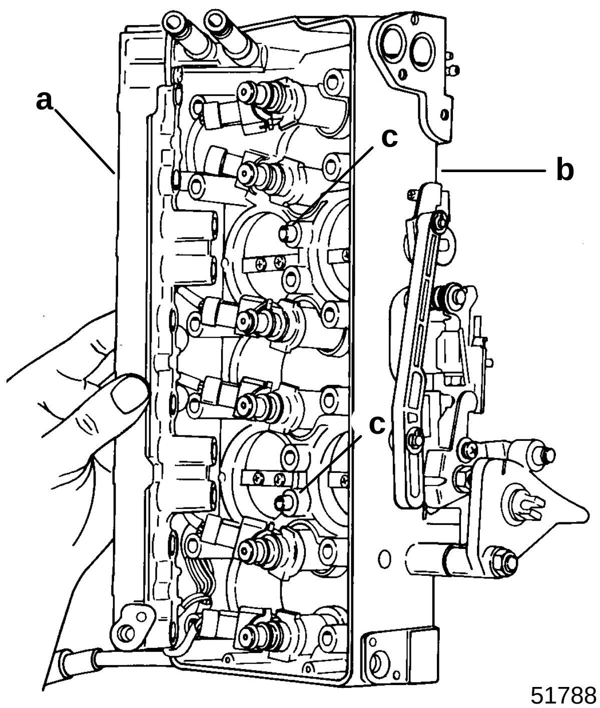
a - Manifold Fitting
b - O-Rings

5. Remove 4 screws securing fuel rail to manifold.



a - Screws (4)

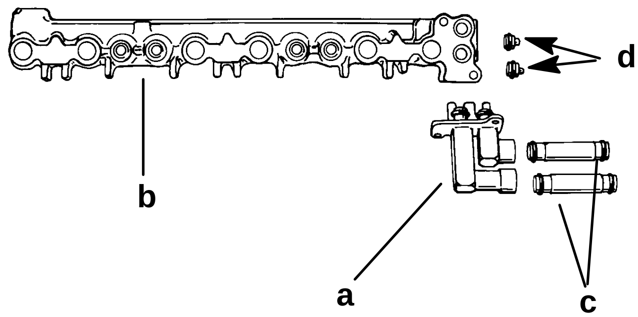
6. Lift fuel rail from manifold. Note fuel rail guides.



a - Fuel Rail
b - Manifold
c - Guides

Fuel Rail Disassembly

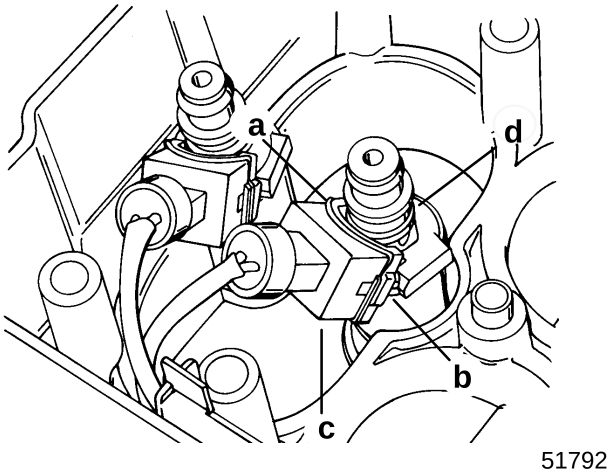
1. Remove tube support from fuel rail.
2. Remove plugs from fuel rail.
3. Remove tubes from tube support.
4. Remove O-rings from plugs, tube support and tubes.



a - Tube Support
b - Fuel Rail
c - Tubes
d - Plugs

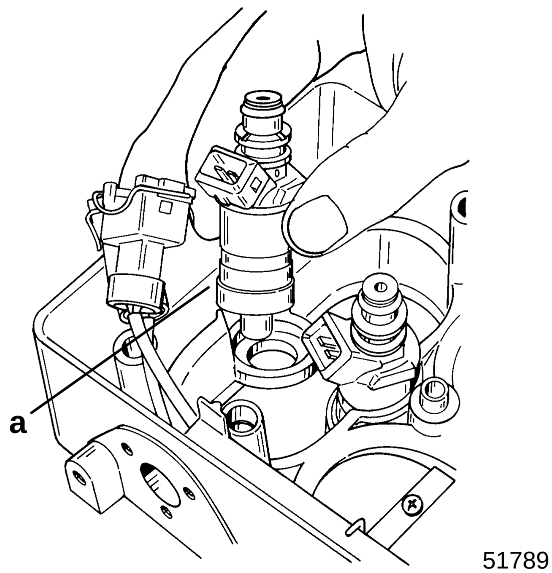
Fuel Injector Removal and Disassembly

1. Lift wire clamp from slot.
2. Disconnect connector from injector.



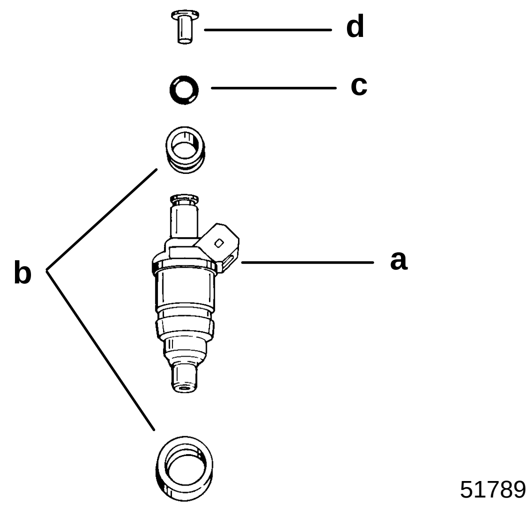
a - Clamp
b - Slot
c - Connector
d - Injector

3. Remove injector from manifold.



a - Injector

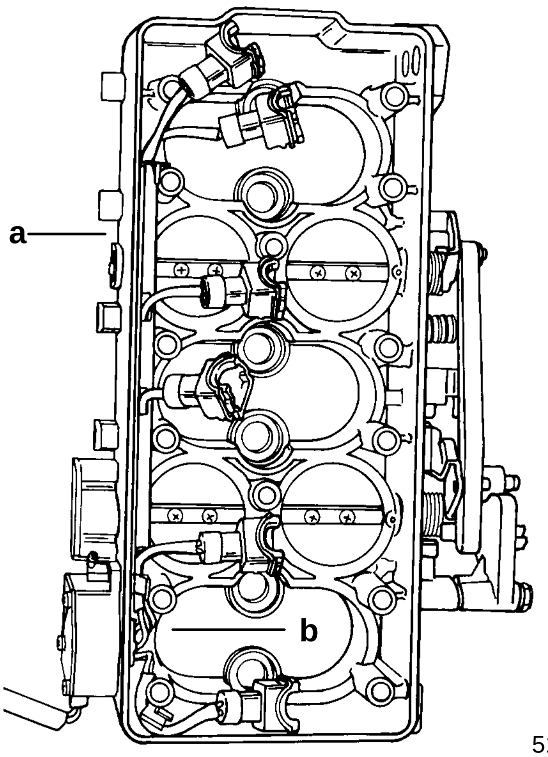
4. Place injector on clean work surface. Remove seals, O-ring and injector filter.



a - Injector
b - Seals
c - O-Ring
d - Filter

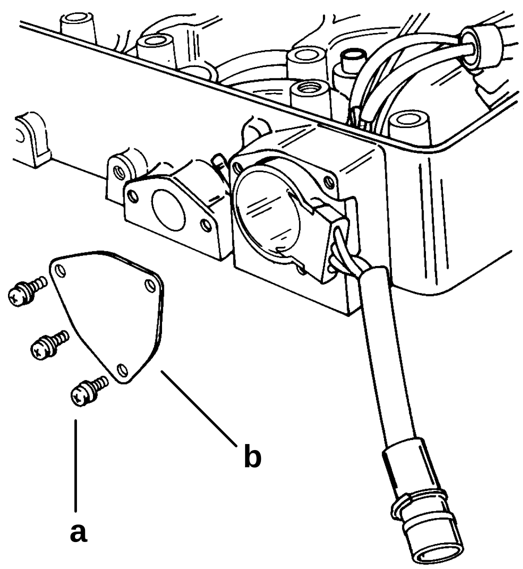
Injector Harness Removal

1. Remove protective casing from injector wiring harness. Note position of wires for reassembly.



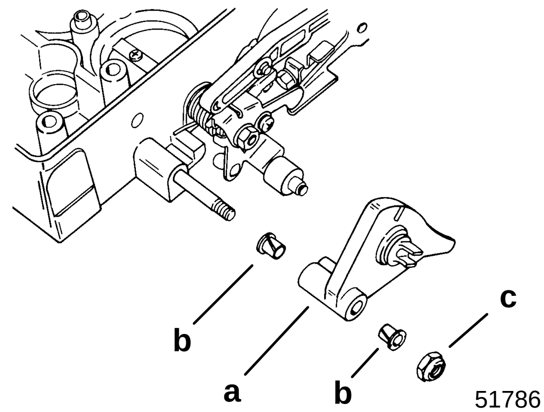
a - Casing
b - Harness

2. Remove screws and injector harness plate.

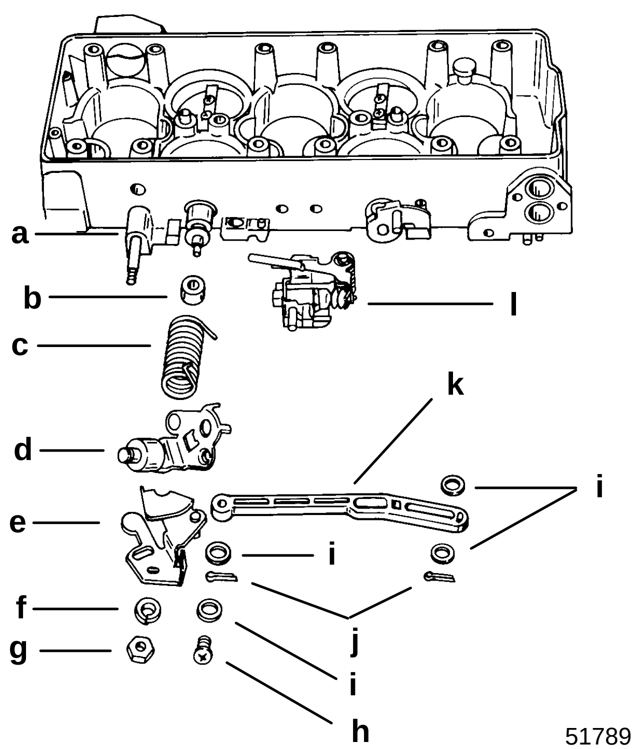


a - Screws
b - Plate

Throttle Linkage Removed



a - Throttle Cam
b - Bushings
c - Nut; Tighten until snug against cam, then back off 1/4 turn



a - Fiber Washer
b - Bushing
c - Spring
d - Roller Cam Bracket
e - Bracket (Shutter Link)
f - Lock Washer
g - Nut
h - Screw
i - Flat Washer
j - Cotter Key
k - Progressive Shutter Link
l - Bleed Shut Off

EFI System Cleaning and Inspection

Cleaning

1. Clean all non-electrical metal parts using a good grade solvent.
2. Use a soft bristle brush for removing large accumulations of dirt or grease and oil.
3. Varnish type coating of induction manifold parts may be removed using carburetor cleaner.
4. Wiring harnesses can be wiped down with a slightly solvent dampened rag.
5. Clean all fuel passages in induction manifold.
6. Dry all components using clean lint free cloths that are free of abrasives such as metal shavings or dirt.
7. Compressed air may be used to dry parts if the air used is free of moisture and un-lubricated.

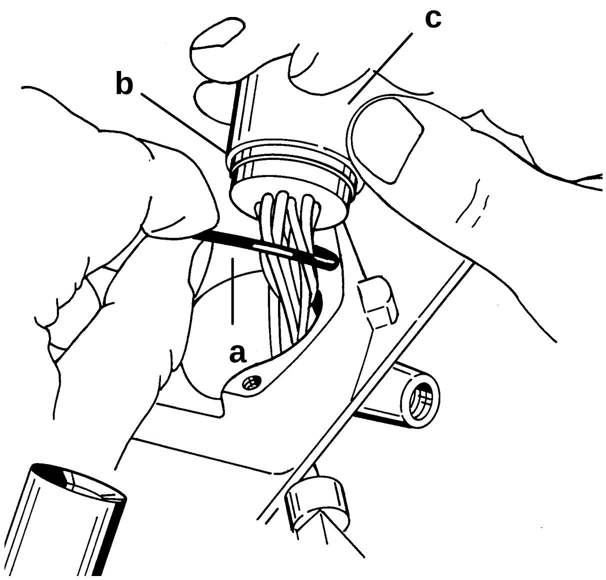
Inspection

1. Look at entire system for signs of an obvious problem such as poor condition of wire insulation, leaking fitting, cracked or loose hoses and lines.
2. Look for fuel or oil leaks wherever these fluids are used (i.e. fuel filter cap, fuel pump, vapor separator cap, etc.).
3. Check for signs of tampering or abuse such as modifications to wiring or hose routing.
4. Look at main connector between engine harness and ECM box for missing, corroded or bent contact pins and socket. Check for dislodged grommet in ECM where harness enters box.
5. Look at all sensors (throttle position, air temperature and water temperature) connectors and harnesses for bad connections or poor insulation conditions such as fraying, stripping, cracks or signs of abrasion wear.
6. Look for loose, missing or damaged mounting hardware such as stripped threads on screws.
7. Look at sensors for signs of wear or damage such as cracks, chips, etc.
8. Look at filter housing for cracks, holes or other damage. Check for secure mounting.
9. Look at vapor separator for leaks, cracks, pitting or other damage.
10. Check all rubber mounting grommets for swelling tears, cracks or other conditions that would render parts unserviceable.
11. Check vapor separator float for signs of fuel entry in the float. Look at needle for wear of point.
12. Look at injectors for signs of plugging or looseness in fit with induction manifold.
13. Look at throttle linkage for bends, kinking or binding. Check spring for kinks.
14. Inspect all rubber seals and gaskets for swelling, cracks or slices that would cause improper sealing.

Induction Manifold Assembly

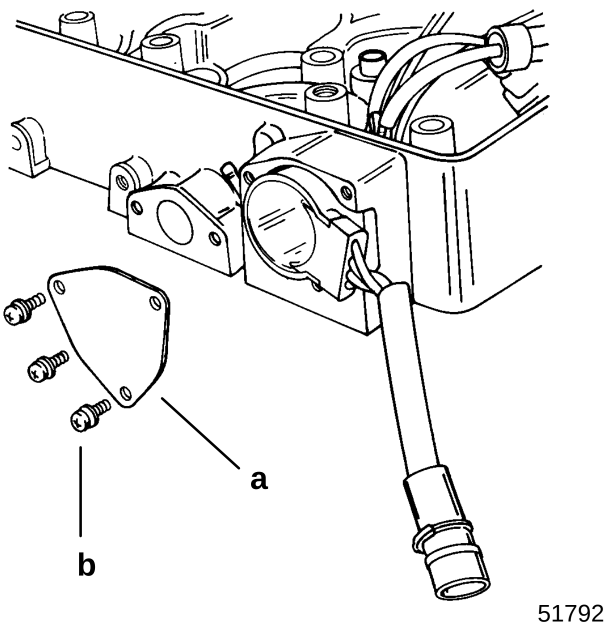
Injector Harness Installation

1. Carefully route injector harness into manifold.
2. Install O-ring into groove on injector harness insert. Install harness insert into manifold port.



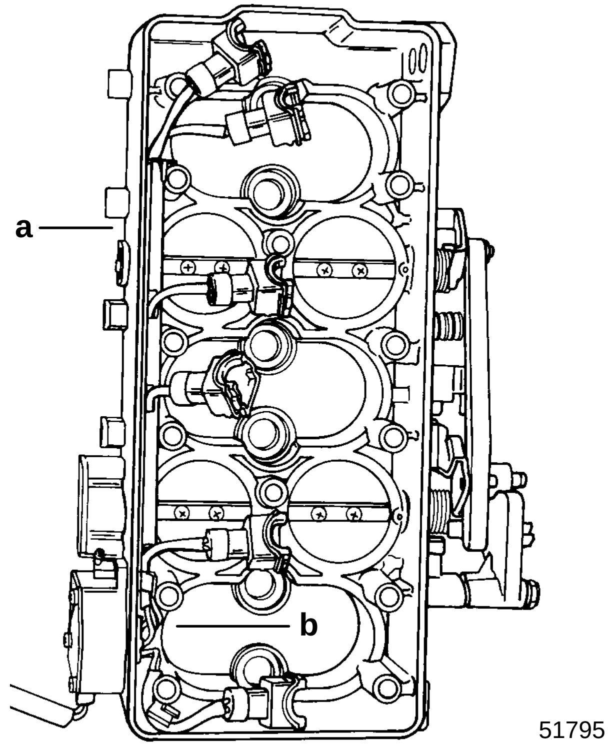
a - O-Ring
b - Groove
c - Insert

3. Install injector harness plate using screws. Tighten securely.



a - Plate
b - Screws

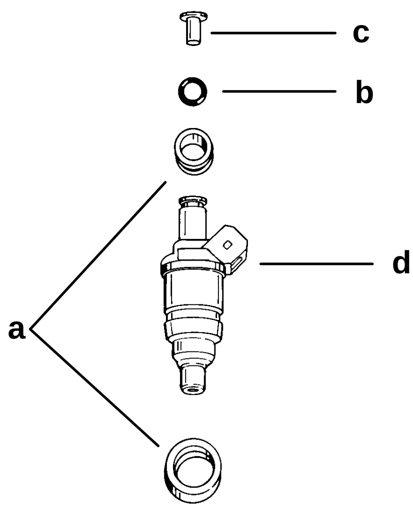
4. Install protective casing over positioned injector wiring harness and insert into manifold.



a - Casing
b - Harness

Fuel Injector Assembly and Installation

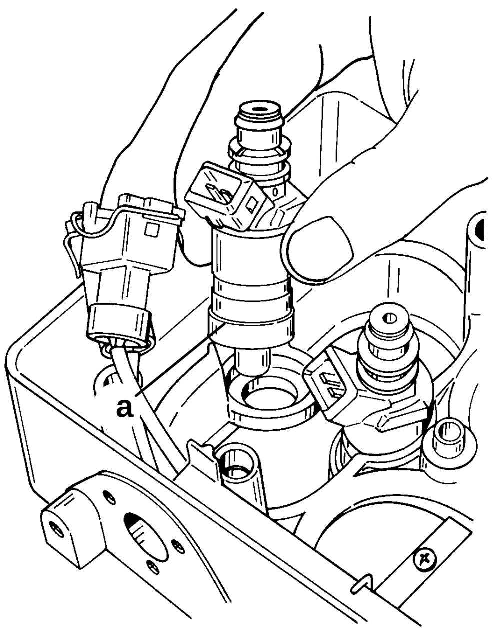
1. Install inspected seals, O-ring and injector filter to injector.



51789

a - Seals
b - O-Ring
c - Filter
d - Injector

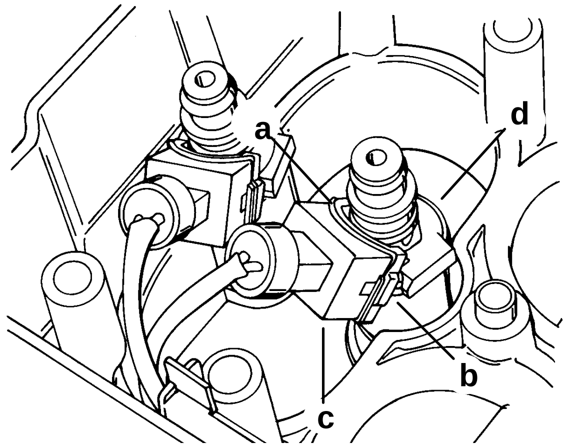
2. Install injector into manifold.



51789

a - Injector

3. Install wire clamp into slot on injector connector.
4. Connect to injector.

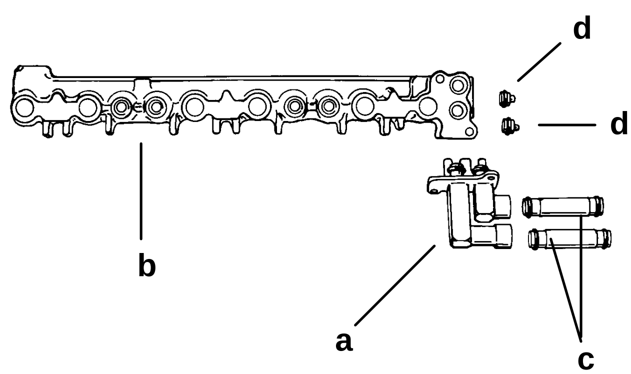


51792

a - Clamp
b - Slot
c - Connector
d - Injector

Fuel Rail Assembly

1. Install inspected O-rings to plugs. tube support and tubes.
2. Install tubes to tube support.
3. Install plugs to fuel rail.
4. Install tube support to fuel rail.

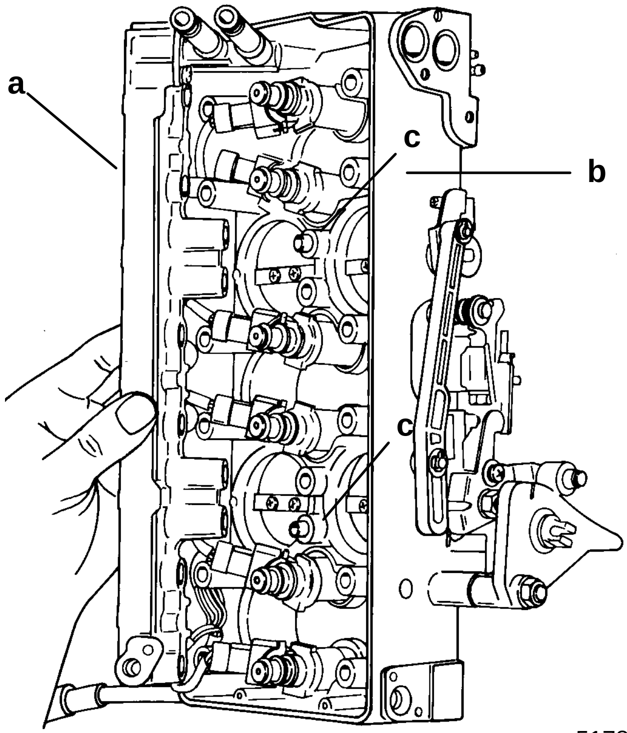


51795

a - Tube Support
b - Fuel Rail
c - Tubes
d - Plugs

Fuel Rail Installation

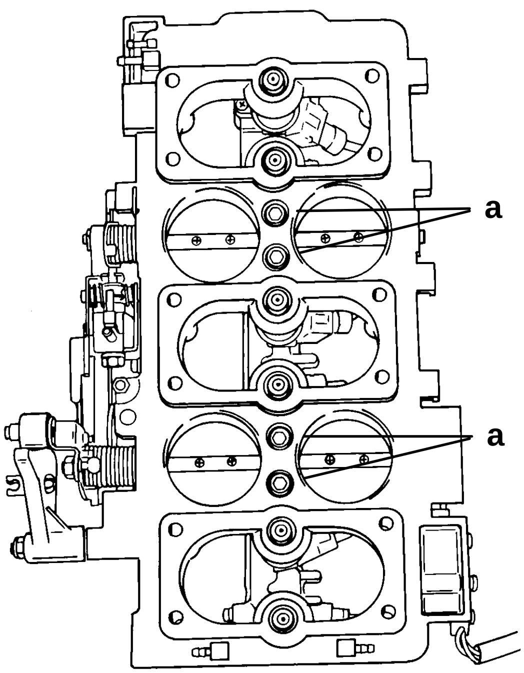
1. With fuel rail guides in place, install fuel rail to manifold.



51788

a - Fuel Rail
b - Manifold
c - Guides

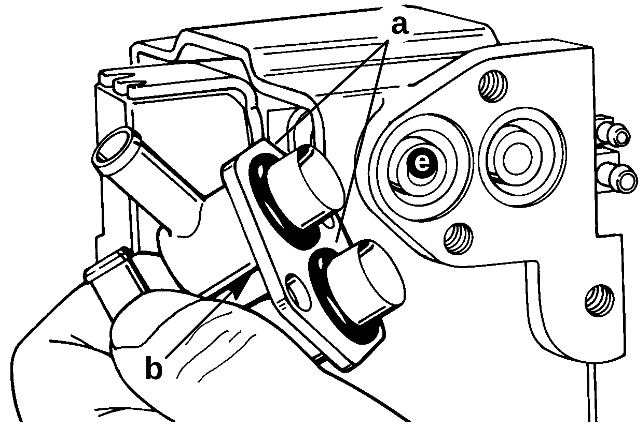
2. Install 4 screws securing fuel rail to manifold. Torque to 35 lb. in. (4.0 N·m).



51784

a - Screws (4)

3. Install O-rings to manifold fitting. Install fitting to manifold.



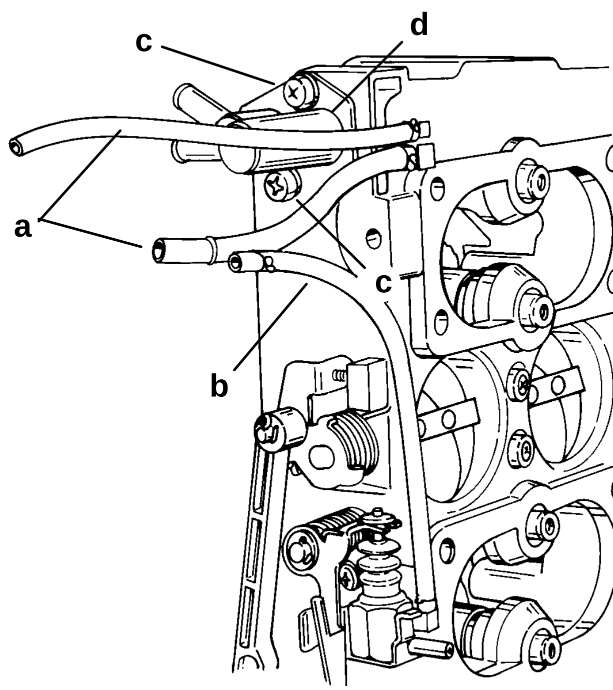
51791

a - O-Rings
b - Fitting

4. Install screws securing manifold fitting to manifold.

5. Install engine bleed hose.

6. Install manifold vacuum hoses.



51789

a - Vacuum Hoses
b - Bleed Hose
c - Screws
d - Manifold Fitting

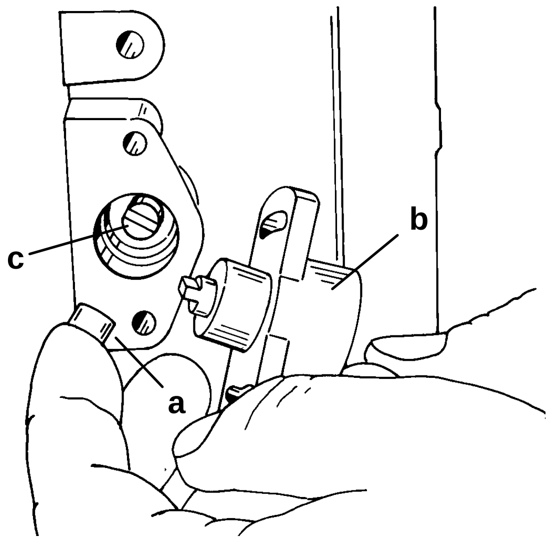
⚠ CAUTION

Use extreme care when installing induction manifold so as to eliminate any possibility for air leaks.

Throttle Position Sensor Installation

IMPORTANT: Throttle position sensor must be adjusted following reassembly (see Section 2C - Timing, Synchronizing, Adjustment).

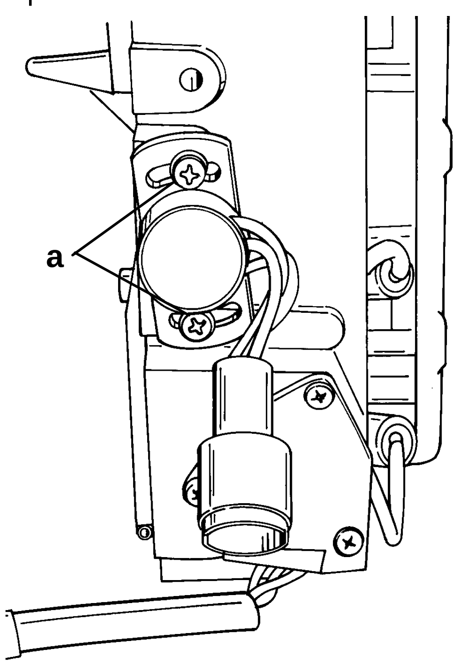
1. Install sleeve to throttle position sensor.
2. Install sensor into manifold. Sleeve must guide sensor to throttle shaft.



51788

a - Sleeve
b - Throttle Position Sensor
c - Throttle Shaft

3. Tighten screws after induction manifold installation and throttle position sensor adjustments are completed.

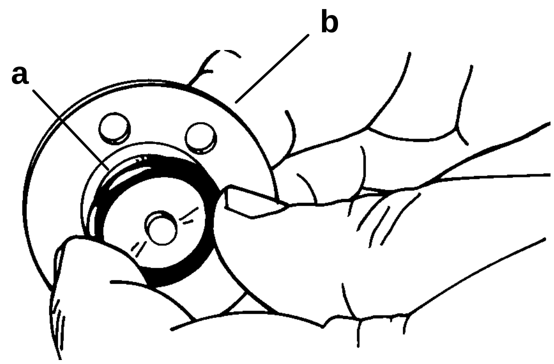


51790

a - Screws

Air Temperature Sensor Installation

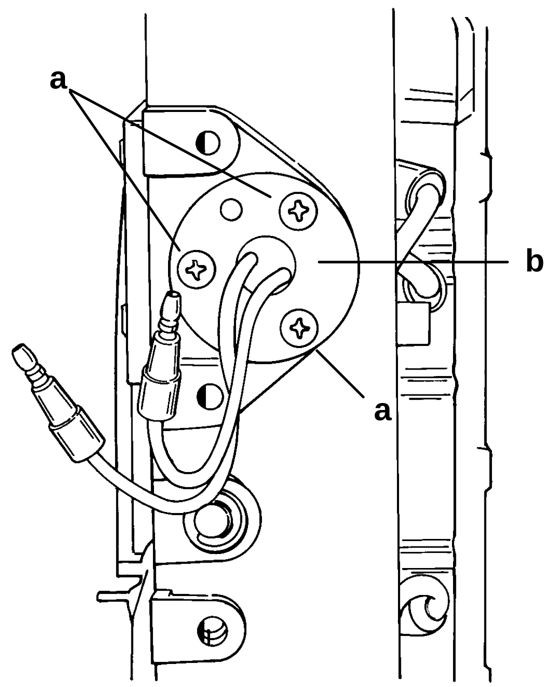
1. Install O-ring to air temperature sensor.



51791

a - O-Ring
b - Air Temperature Sensor

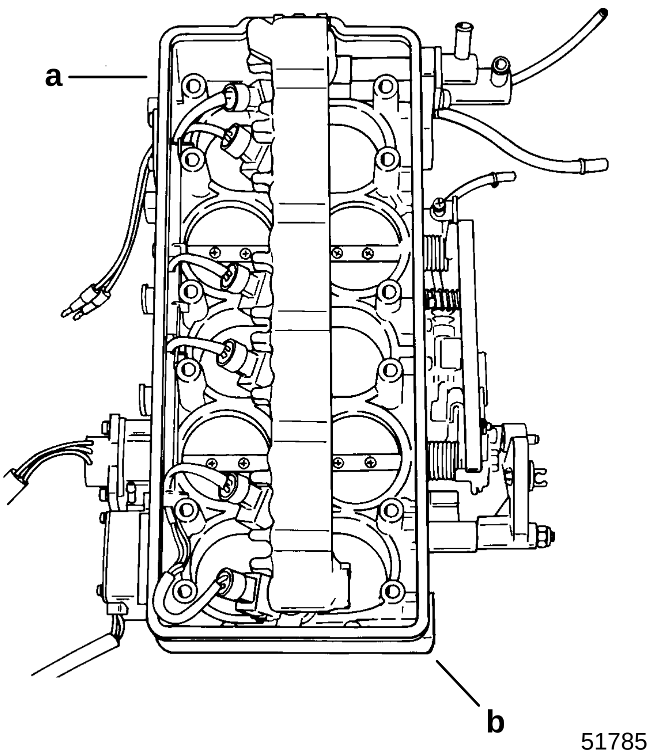
2. Install air temperature sensor and secure with screws. Tighten screws securely.



51790

a - Screws
b - Air Temperature Sensor

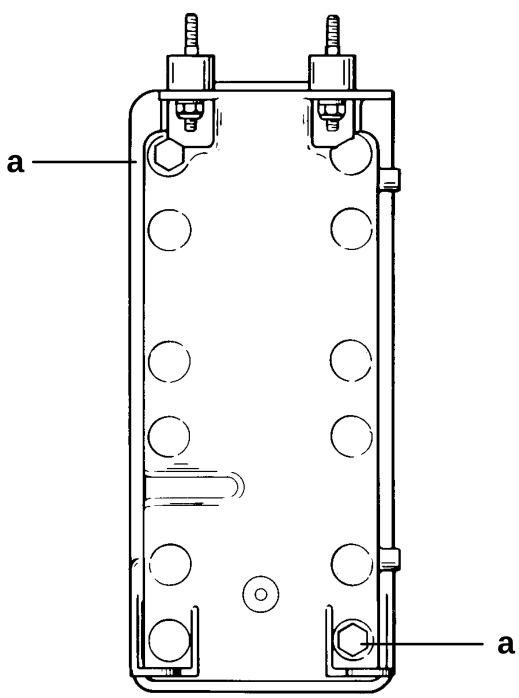
3. Carefully install manifold cover seal to manifold.



a - Cover Seal
b - Manifold

4. Install manifold cover to manifold and secure with M8 x 1.25 x 38mm long bolts through holes.

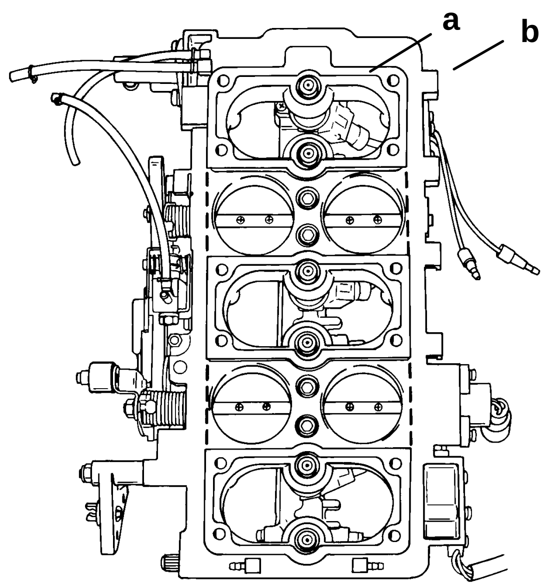
NOTE: *This will aid in induction manifold installation.*



a - Holes

EFI Induction Manifold Installation

1. Install new gasket on induction manifold as shown. Removing dotted line sections after manifold installation.

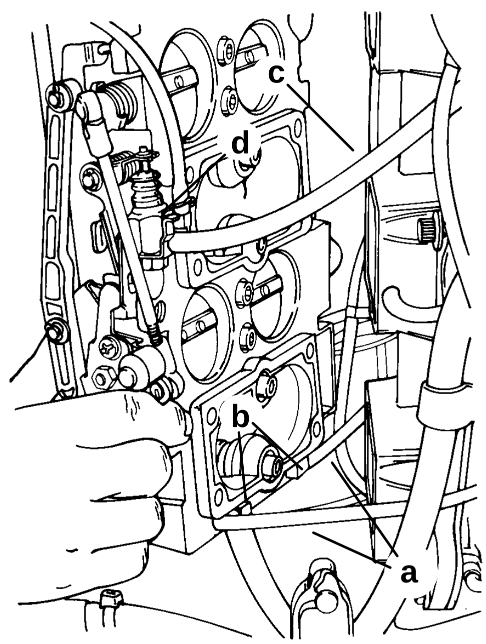


51784

a - Gasket
b - Induction Manifold

2. With induction manifold held in place, connect bleed line hoses to manifold fittings.

3. Connect bleed line hose to bleed shut off.

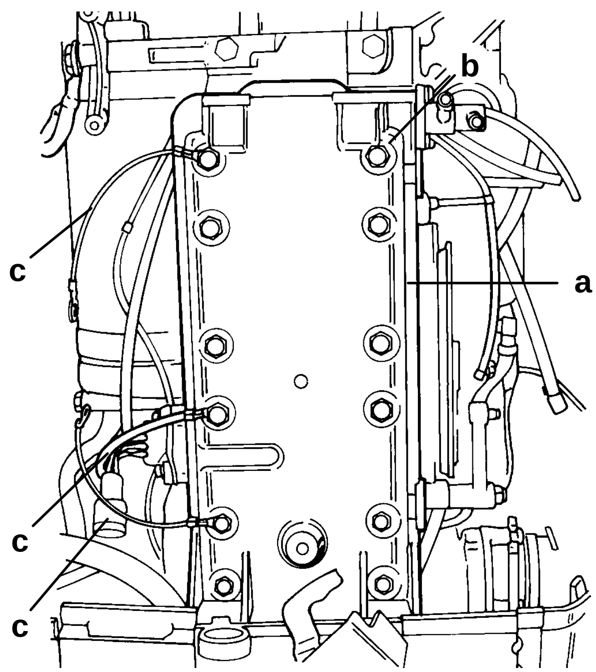


51795

a - Bleed Hoses
b - Manifold Fittings
c - Bleed Hose
d - Bleed Shut Off

4. Secure induction manifold assembly to engine with screws. Torque screws to 90 lb. in. (10.0 N·m) using torque sequence shown below.

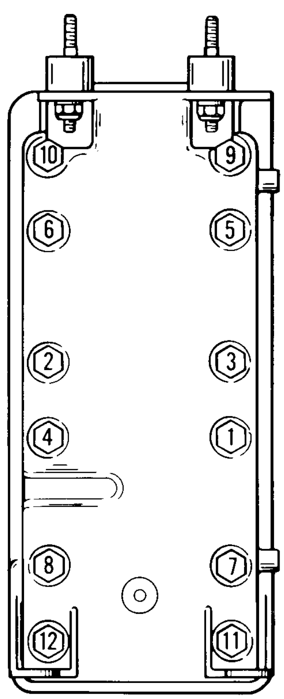
NOTE: *Remove M8 x 1.25 x 38mm long bolts used for reassembly and install remaining screws. Install ground wires to proper location.*



51795

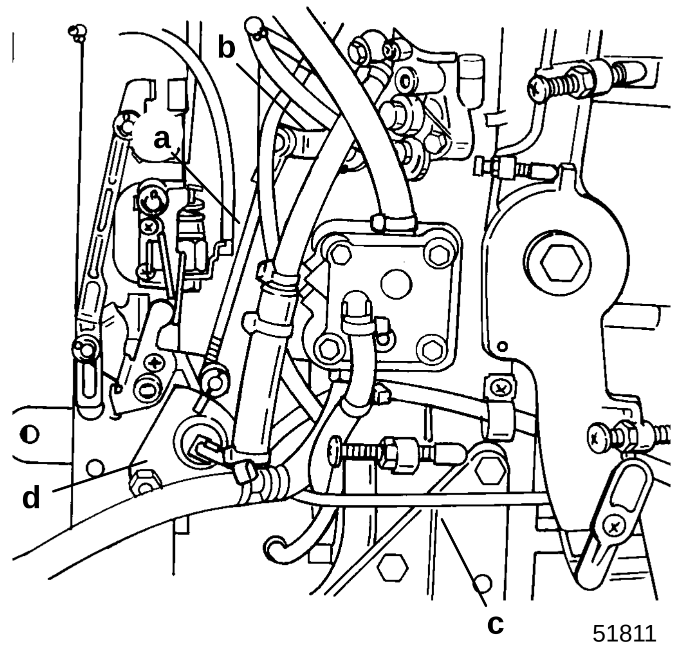
a - Manifold
b - Screws [Torque to 90 lb. in. (10.0 N·m)]
c - Ground Wires

Cover Screw Torque Sequence



IMPORTANT: Before connecting oil pump control rod verify pump quadrant is rotated to the clockwise of center.

5. Connect oil injection link rod to injector arm.
6. Connect throttle link rod to throttle cam.

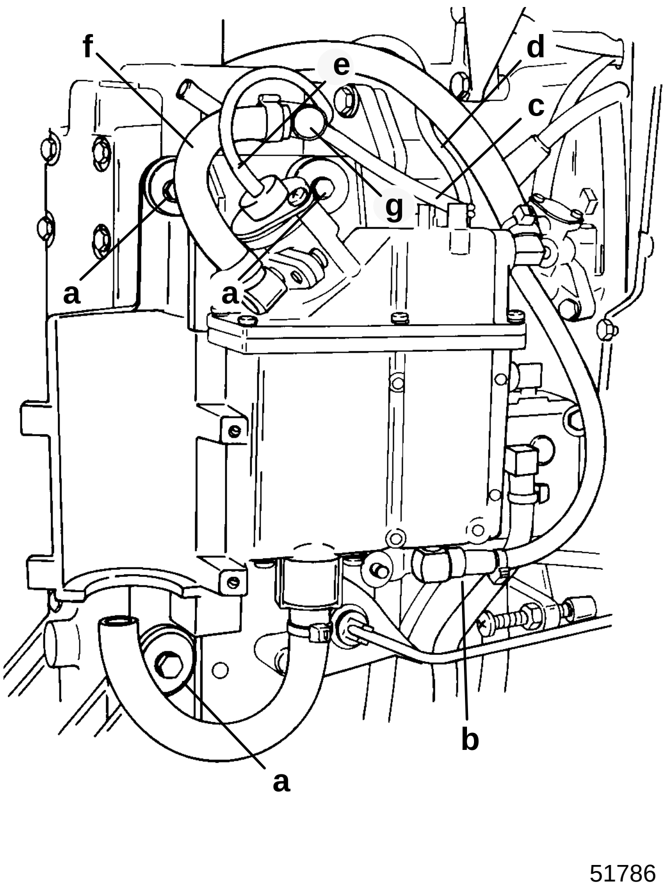


51811

a - Link Rod
b - Injector Arm
c - Throttle Link Rod
d - Throttle Cam

Vapor Separator Installation

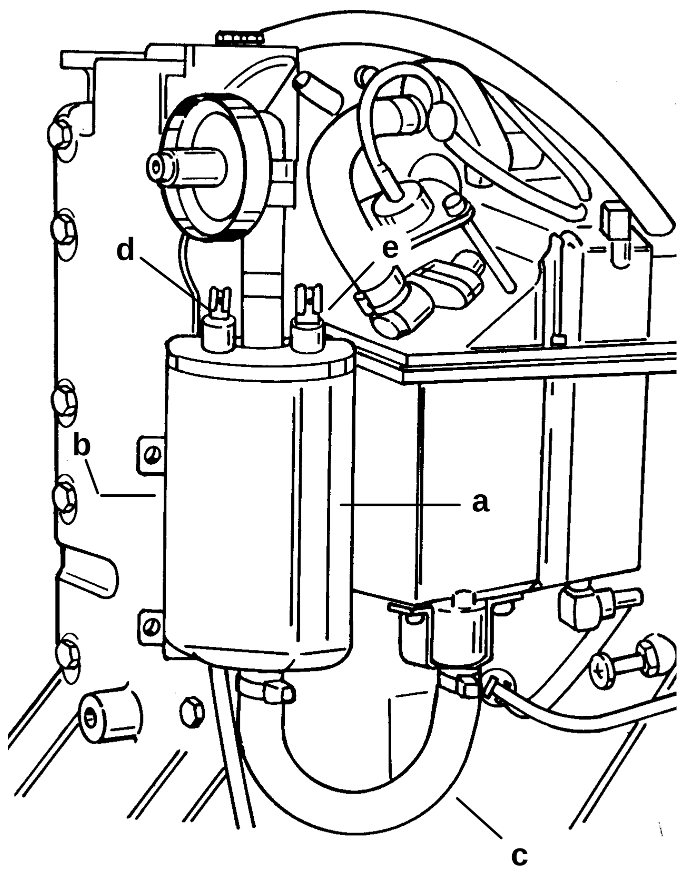
1. With vapor separator held in place install screws securing vapor separator to engine block. Torque screws to 45 lb. in. (5.0 N·m).
2. Connect oil inlet hose. Secure with hose clamp.
3. Connect bleed hose and vapor separator vacuum hose.
4. Connect fuel pressure regulator vacuum hose.
5. Connect fuel rail re-circulation hose to manifold fitting using hose clamp.



a - Screws [Torque to 45 lb. in. (5.0 N·m)
b - Oil Inlet Hose
c - Bleed Hose
d - Vapor Separator Vacuum Hose
e - Regulator Vacuum Hose
f - Recirculation Hose
g - Manifold Fitting

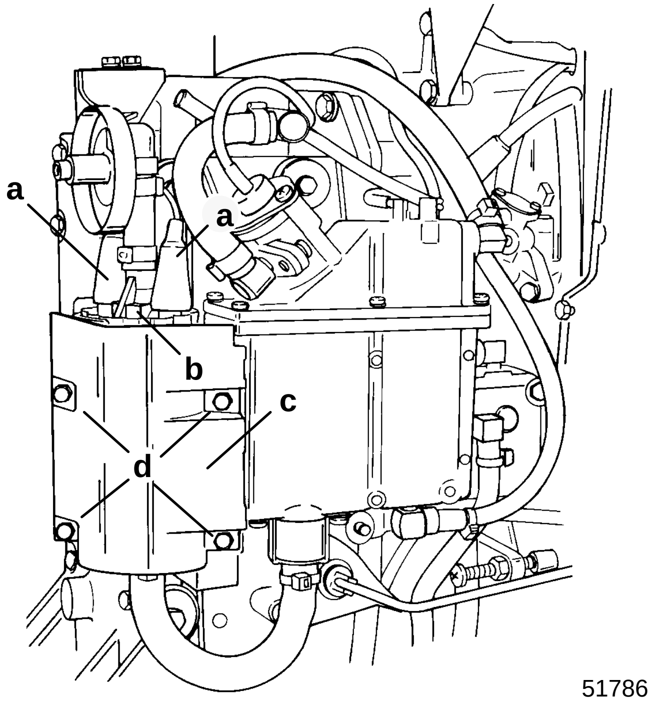
Electric Fuel Pump Installation

1. Install electric fuel pump with rubber blanket.
2. Connect fuel pump inlet hose. Secure with sta-strap.
3. Connect POSITIVE lead and NEGATIVE lead.
4. Install mounting screws.



a - Electric Fuel Pump
b - Rubber Blanket
c - Inlet Hose
d - POSITIVE Lead (RED)
e - NEGATIVE Lead (RED/BLUE)

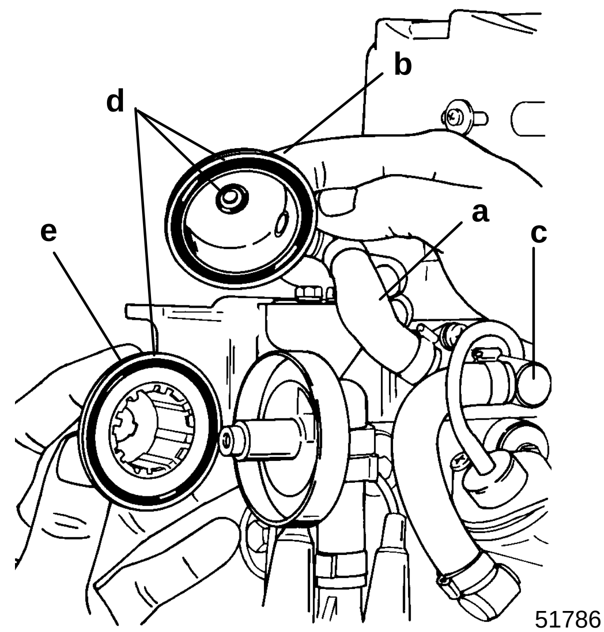
5. Install rubber boots on electric fuel pump cap.
6. Install cover plate using four (4) screws. Tighten securely.



a - Rubber Boots
b - Pump Cap
c - Cover Plate
d - Screws (4)

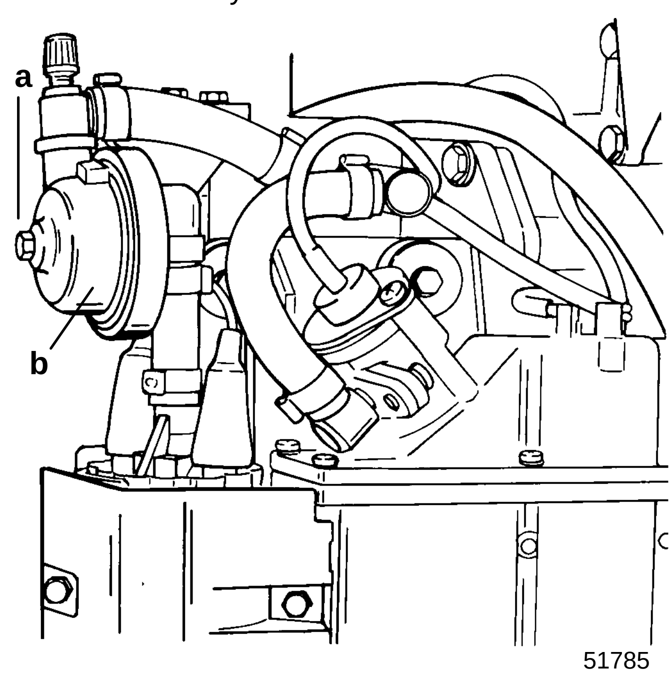
Final Filter Assembly Installation

1. Install fuel rail inlet hose and cap to manifold fitting.
2. Install O-ring to filter and cap as shown.
3. Install final filter.



a - Fuel Rail Inlet Hose
b - Cap
c - Manifold Fitting
d - O-Ring
e - Filter

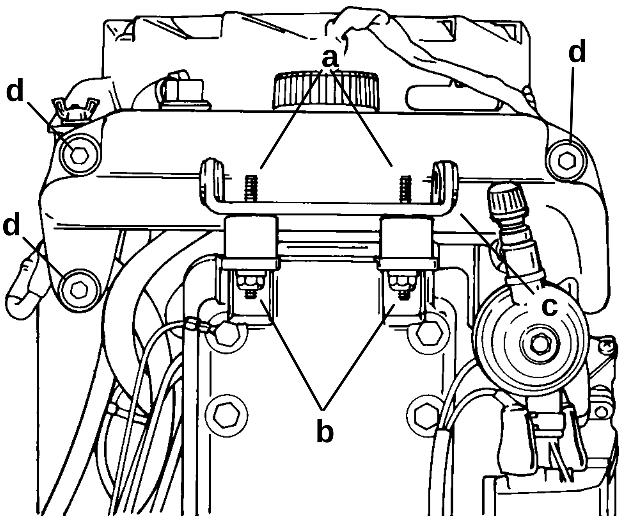
4. Install screw to final filter assembly. Tighten screw securely.



a - Screw
b - Final Filter

Oil Reservoir Installation

1. Install oil reservoir to engine. Connect hose to fitting and secure with hose clamp.
2. Install studs, nuts, and mounting bracket. Secure reservoir using screws.

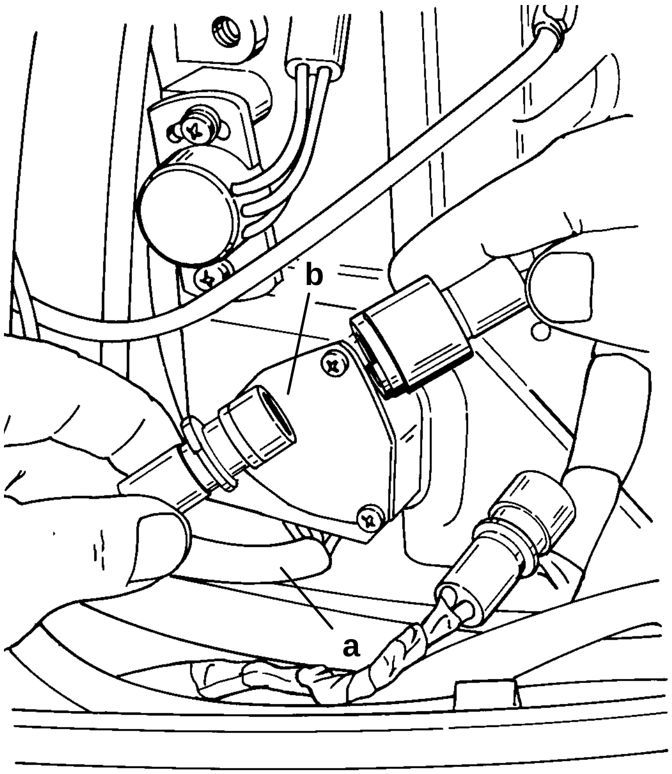


51791

a - Studs
b - Nuts
c - Bracket
d - Screws

Throttle Position Sensor and Temperature Sensor Fuel Injector Harness Connections

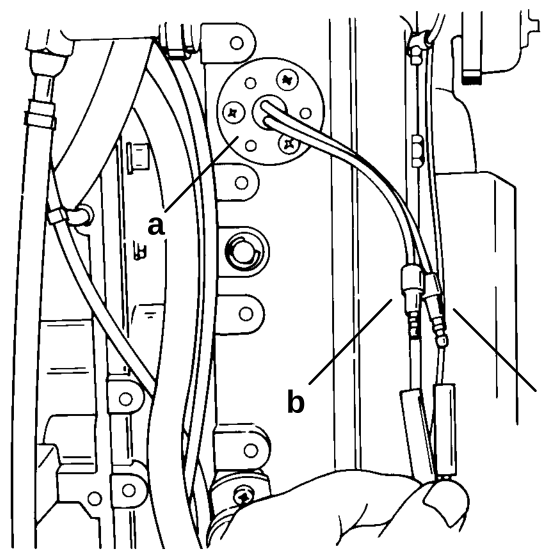
1. Connect fuel injector harness at 4 pin connector.



51787

a - Injector Harness
b - 4 Pin Connector

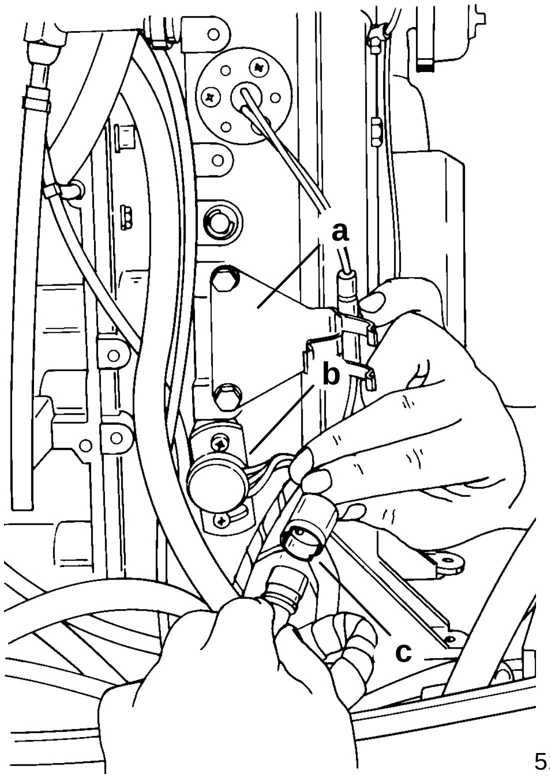
2. Connect air temperature sensor at connectors.



51788

a - Air Temperature Sensor
b - Connectors

3. Install ECM harness bracket and connect throttle position sensor at 3 pin connector.

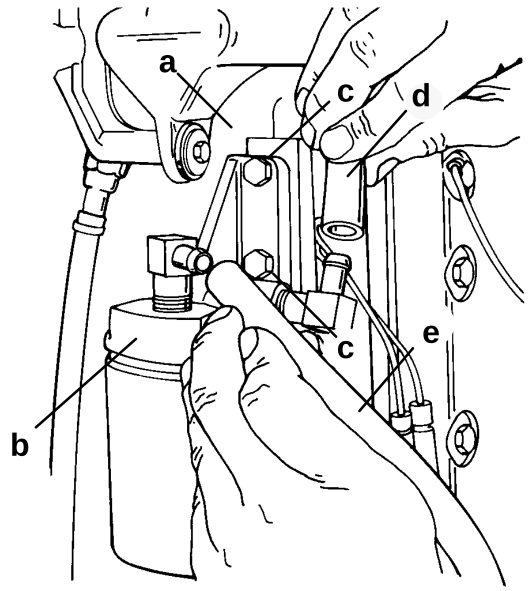


51787

a - Bracket
b - Throttle Position Sensor
c - 3 Pin Connector

Water Separating Filter Assembly Installation

1. Install spacer block to engine block.
2. Install filter base secure with screws. Tighten screws securely.
3. Connect fuel inlet hose and fuel inlet hose to fittings.

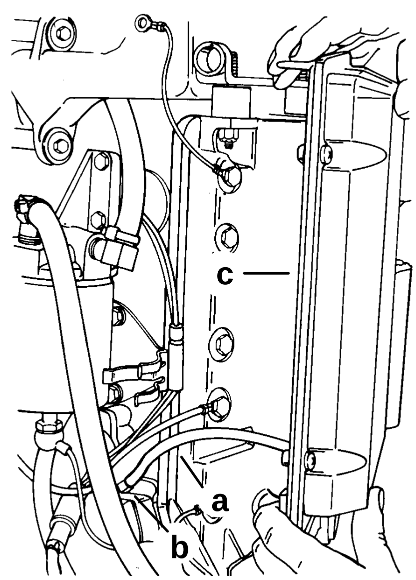


51793

a - Spacer Block
b - Filter Base
c - Screws
d - Fuel Outlet Hose
e - Fuel Inlet Hose

ECM Installation

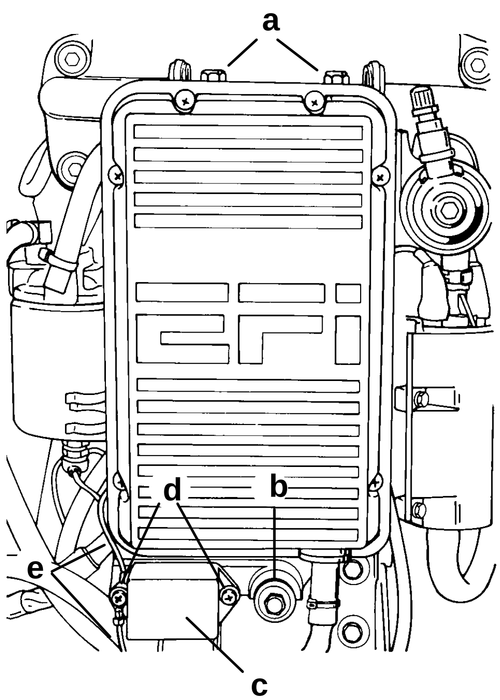
1. Connect MAP sensor hose from ECM to manifold fitting. Place ECM on manifold studs.



51793

a - MAP Sensor Hose
b - Fitting
c - ECM

2. Secure ECM to manifold using nuts and screw. Tighten securely.
3. Water sensing module and ground wires, tighten securely in place using screws.

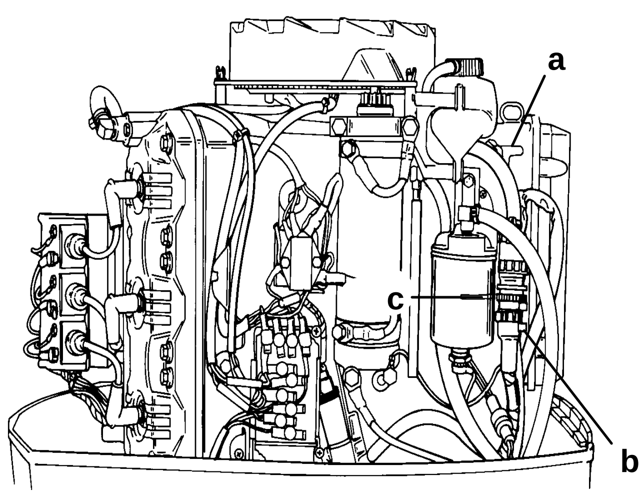


51793

a - Nuts
b - Screw
c - Water Sensing Module
d - Screws
e - Ground Wires

4. Connect ECM harness to engine harness at connector. Install harness into harness bracket with connecting ring below or above bracket arms.

IMPORTANT: DO NOT force connecting ring between bracket arms.



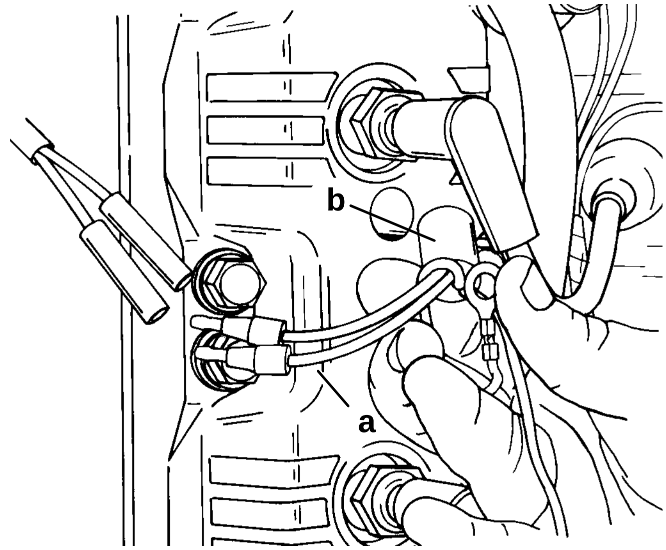
51793

a - ECM Harness
b - Engine Harness
c - Connector

Engine Head Temperature Sensor Installation

IMPORTANT: Engine Head Temperature Sensor must make clean contact with cylinder head for circuit to function properly.

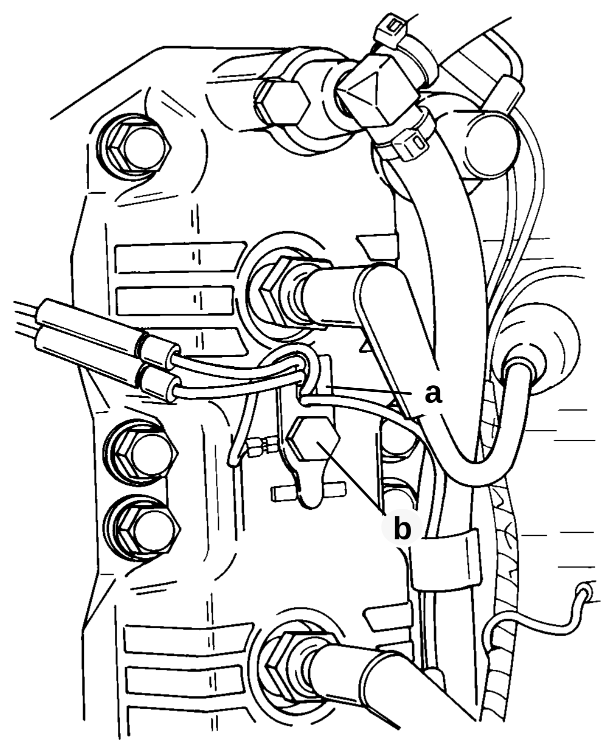
1. Connect wires and install sensor.



51785

a - Wires
b - Sensor

2. Install retaining plate and screw.



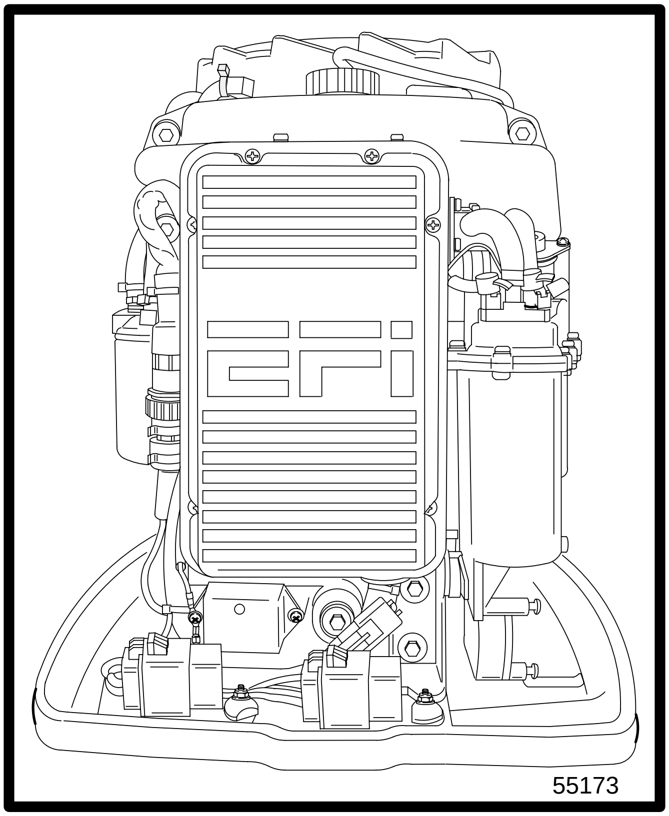
51785

a - Retainer
b - Screw

FUEL SYSTEMS

3

D



FUEL INJECTION
SN 0G303046 AND ABOVE

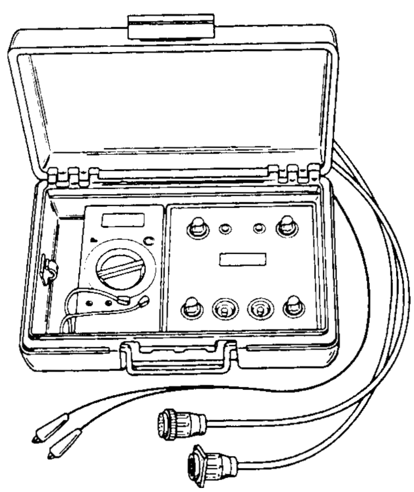
Table of Contents

Specifications

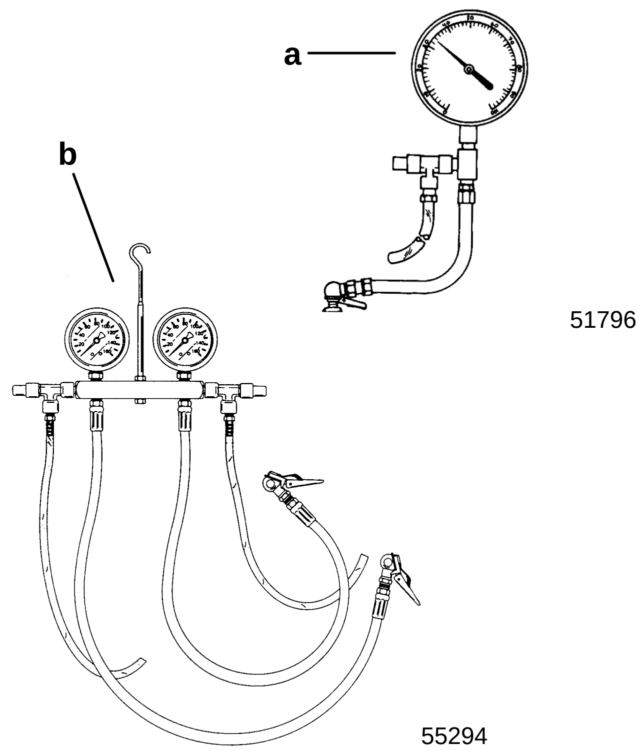
Electronic Fuel Injection	
Idle RPM – All Models	650 ± 50
Wide Open Throttle RPM – Model 150XRI/175XRI – Model 200XRI – Pro Max/Super Magnum 150/200/225	 5000 – 5600 5000 – 5800 6200 – 6500
Float Adjustment (Vapor Separator) – Float Level	 Preset @ Factory
Fuel Injectors –All Models (Quantity) – Inner Switch Box Controls: – #1 Primary Circuit – #3 Primary Circuit – #5 Primary Circuit	 6 #3 and #4 Injectors #5 and #6 Injectors #1 and #2 Injectors
Line Pressure @ Injectors	34 psi – 36 psi (234kPa – 248kPa)

Special Tools

Electronic Fuel Injection Tester 91-11001A2

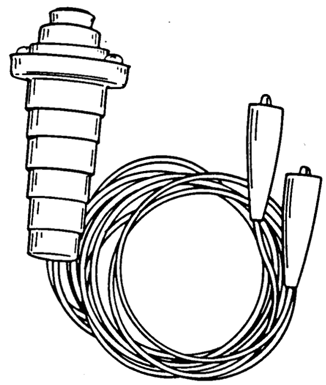


Fuel Pressure Gauge 91-16850 (a) or Fuel Pressure

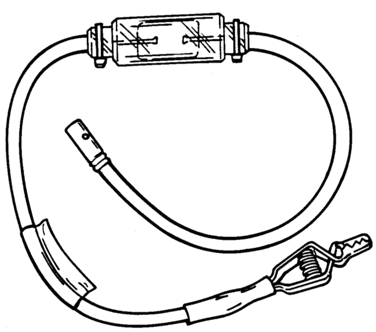


Gauge 91-852087A1 (b).

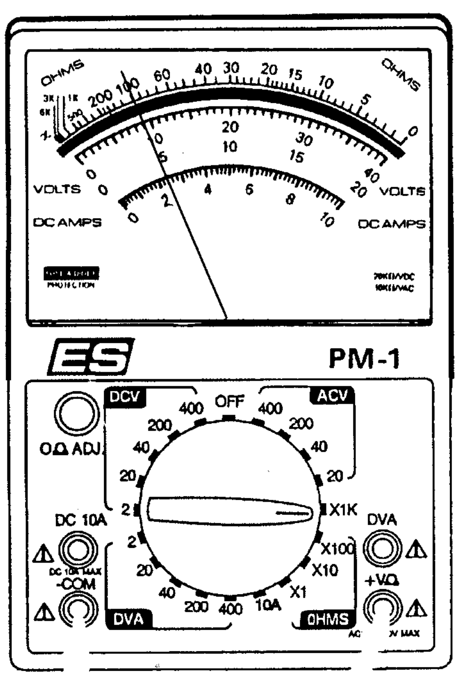
Remote Starter Switch 91-52024A1



Spark Gap Tester 91-63998A1



Multi-Meter DVA Tester 91-99750



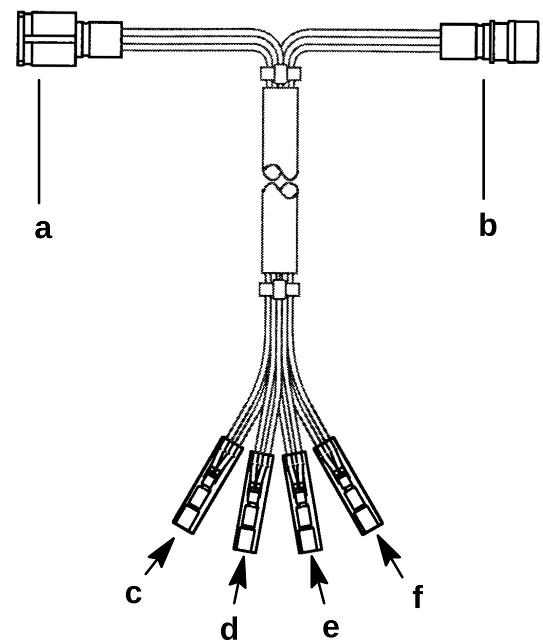
NOTE: *There are 3 different Multi-Meter DVA Testers using the part number 91-99750 or 91-99750A1 having a DVA built in. Any one of these testers will work with the small V-6 EFI system.*

Injector Test Harness 91-833169A1

– For Mercury/Mainer 150 thru 250 HP with Electronic Fuel Injection

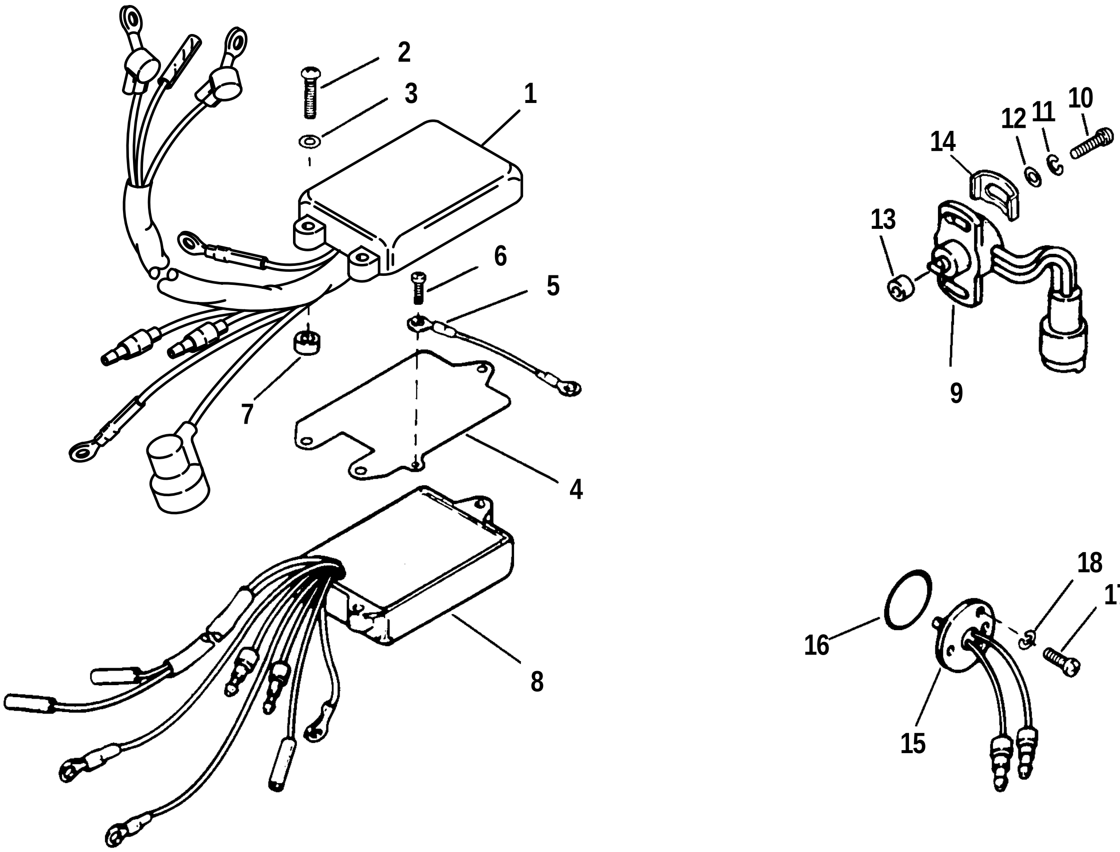
– For Hi-Performance 150 thru 300 HP PRO MAX/ SUPER MAGNUM models only

Can be used to verify that the ECM is supplying operating voltage to the injectors. Harness is connected between the injector harness and the engine harness. Harness is used in conjunction with DVA meter 91-99750A1. Harness will also serve as a convenient way to connect the injector harness to perform injector resistance test.



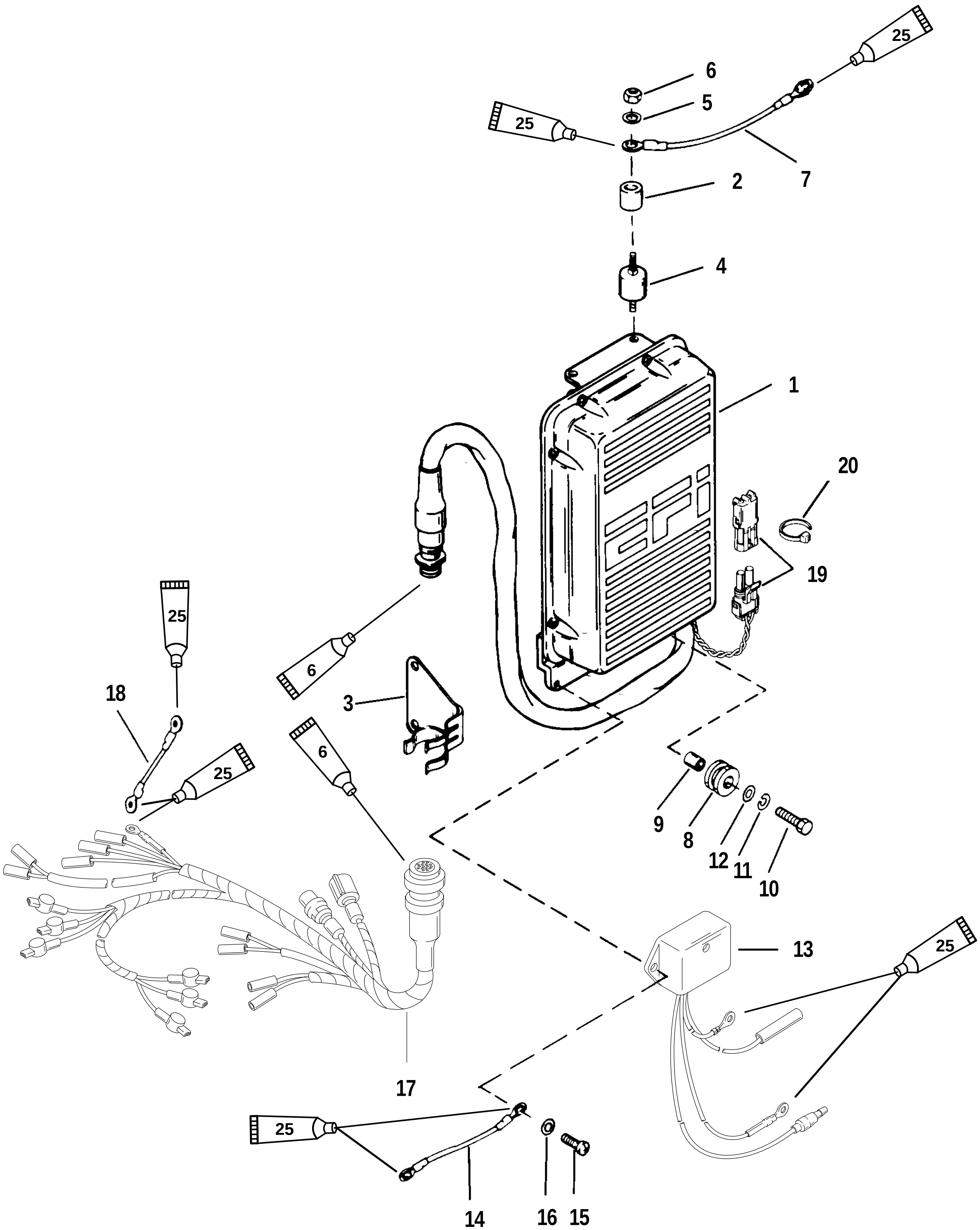
a - To Injector Manifold
b - To Engine Harness
c - RED
d - WHITE
e - BLUE
f - YELLOW

Detonation Controller/Air Temperature Sensor/Throttle Position Sensor



REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	DETONATION CONTROLLER ASSEMBLY			
2	3	SCREW	30		3.5
3	3	WASHER			
4	1	PLATE			
5	1	CABLE ASSEMBLY **200**			
6	1	SCREW			
7	3	BUSHING			
8	1	OIL INJECTION WARNING MODULE			
9	1	INDICATOR–throttle position			
10	2	SCREW	20		2.0
11	2	LOCKWASHER			
12	2	WASHER			
13	1	SLEEVE			
14	2	PLATE			
15	1	AIR TEMPERATURE SENSOR ASSEMBLY			
16	1	O-RING			
17	3	SCREW	Drive Tight		
18	3	LOCKWASHER			

Electronic Control Module (ECM) ASSEMBLY



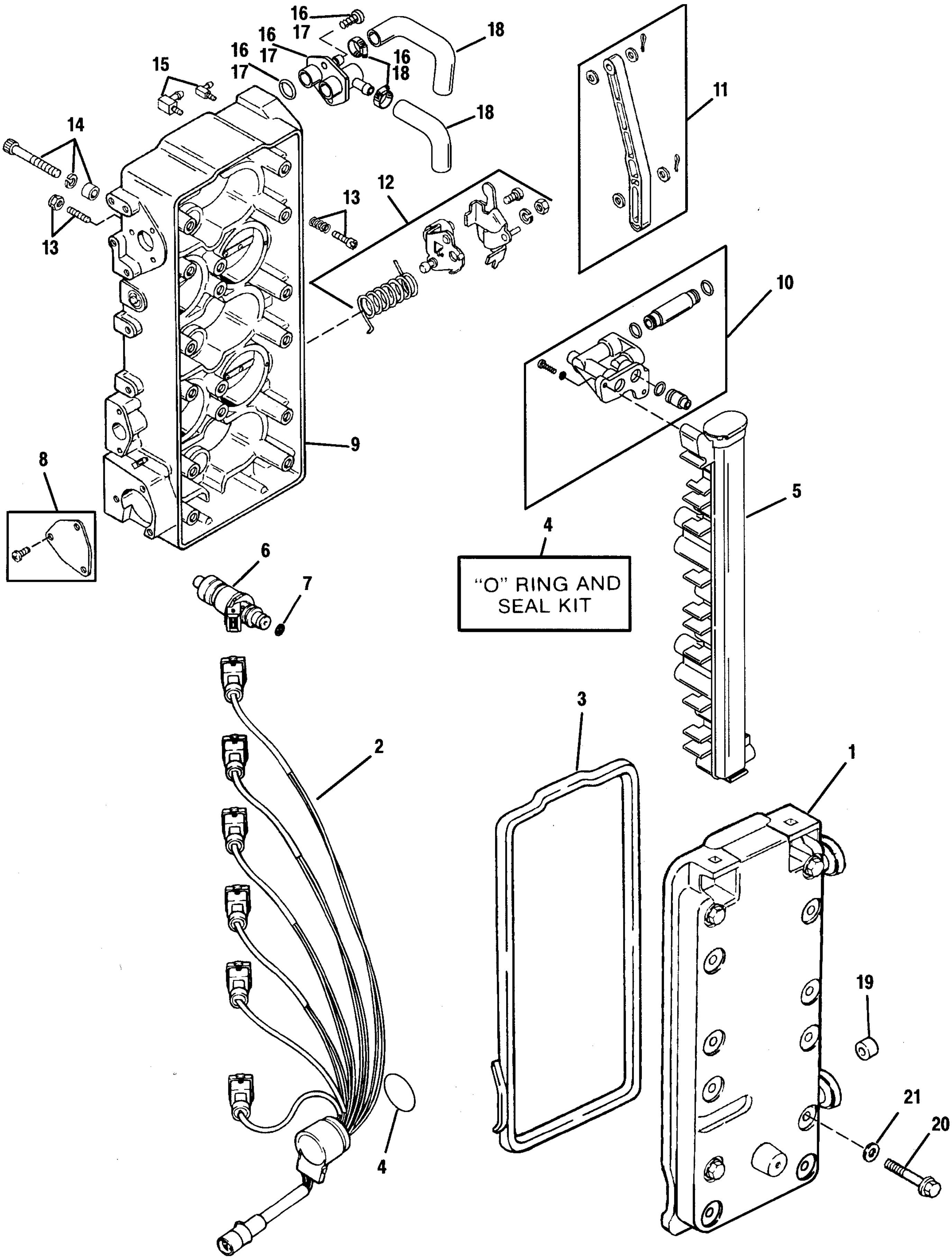
6 Dielectric Grease (92-823506--1)

25 Liquid Neoprene (92-25711--2)

Electronic Control Module (ECM) ASSEMBLY

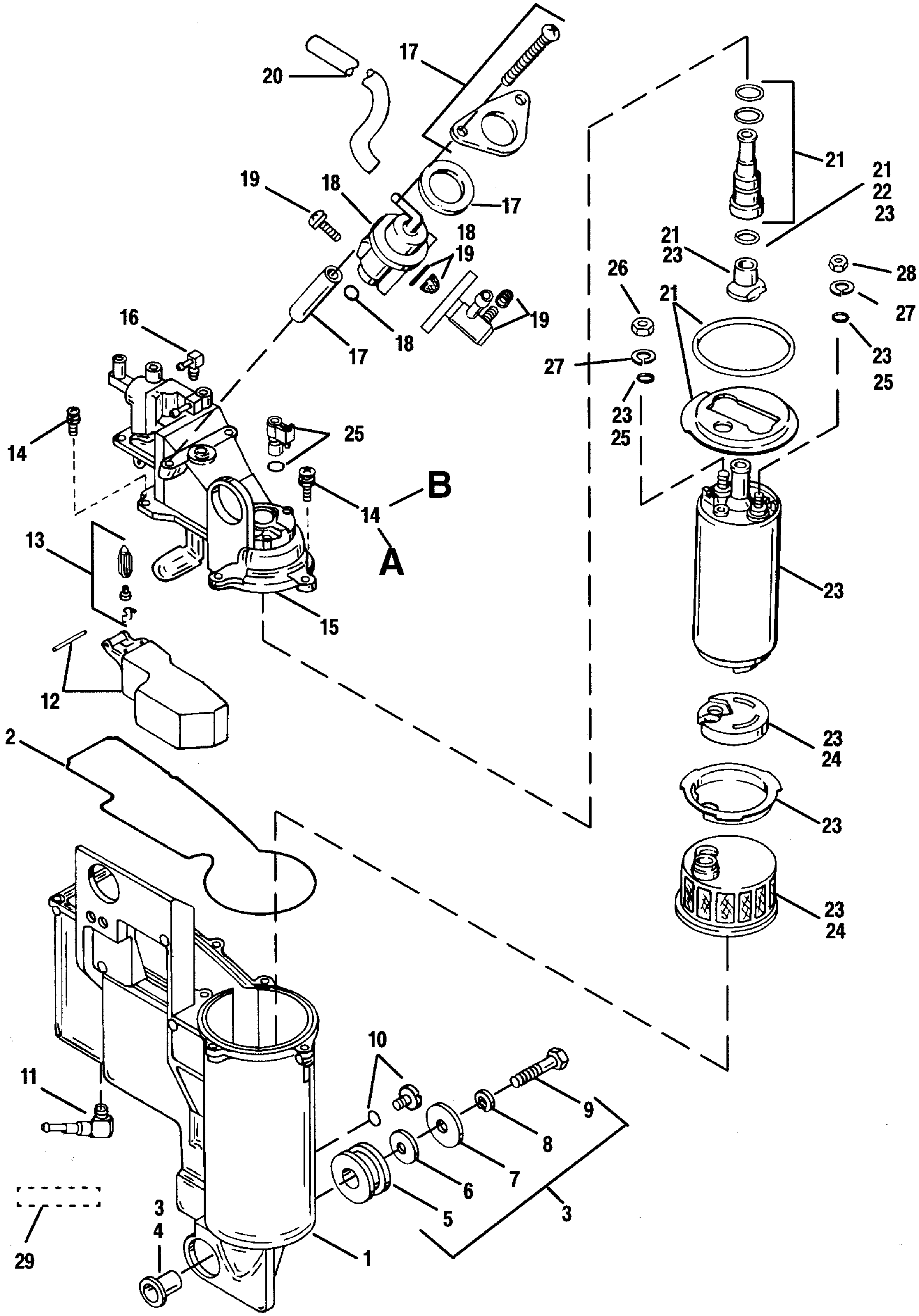
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	E.C.M. ASSEMBLY **(150)**			
	1	E.C.M. ASSEMBLY **(175)**			
	1	E.C.M. ASSEMBLY **(200)**			
2	2	SPACER			
3	1	CLIP			
4	2	MOUNT–cowl mounting bracket			
5	4	WASHER			
6	4	NUT	45		5.0
7	1	CABLE ASSEMBLY			
8	1	GROMMET			
9	1	BUSHING			
10	1	SCREW (1/4-20 x 1)	45		5.0
11	1	LOCKWASHER			
12	1	WASHER			
13	1	WATER SENSOR MODULE ASSEMBLY			
14	1	WIRE ASSEMBLY (BLACK)			
15	2	SCREW (3/16-32 x 1/2)	25		3.0
16	2	WASHER			
17	1	WIRING HARNESS–E.C.M. and injectors			
18	1	CABLE **(150/175)**			
19	1	CAVITY PLUG			
20	AR	STA–STRAP			

Fuel Management System



REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
–	1	FUEL MANAGEMENT ASSEMBLY			
1	1	COVER			
2	1	HARNESS KIT			
3	1	SEAL			
4	1	O RING/SEAL KIT			
5	1	FUEL RAIL			
6	1	FUEL INJECTOR			
7	1	FILTER			
8	1	RETAINING KIT			
9	1	THROTTLE BODY			
10	1	JOINT KIT			
11	1	LINK			
12	1	LINK LEVER KIT			
13	1	STOP SCREW KIT			
14	1	SCREW KIT	45		5.0
15	1	ELBOW KIT (Same as Ref. #16 on page 21)			
16	1	SCHRADER VALVE KIT			
17	1	FMA JOINT KIT			
18	1	HOSE KIT			
19	1	ROLLER			
20	12	SCREW (1/4-20 x 4 IN.)	90		10.0
21	12	WASHER			

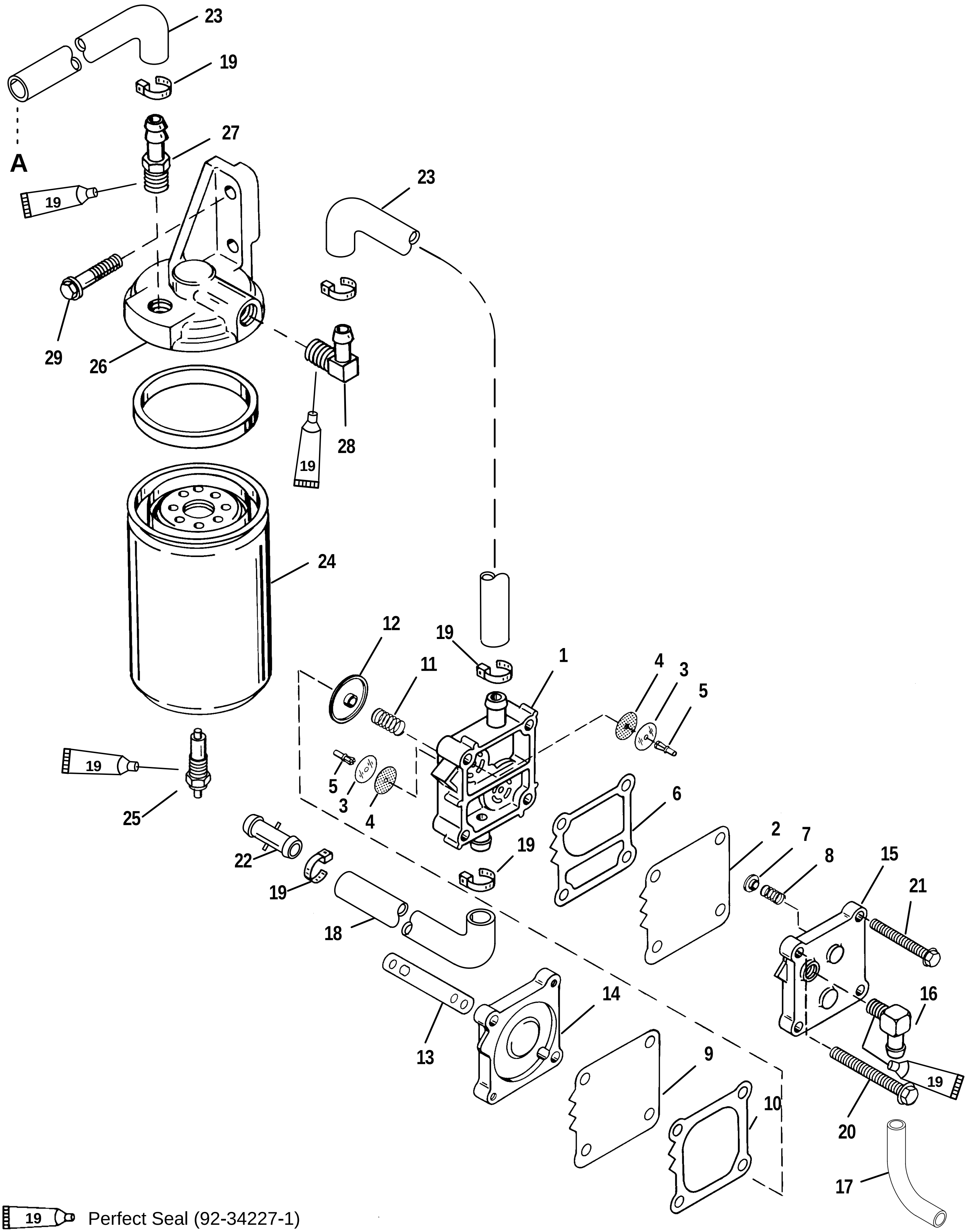
Fuel Management System



A = LARGE SCREW (5 MM) (TORGUE TO 30 LB. IN. (3.4 N.M)
B = SMALL SCREW (4MM)(TORQUE TO 20 LB. IN. (2.3 N.M)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
–	1	FUEL MANAGEMENT ASSEMBLY			
1	1	VAPOR SEPARATOR BODY KIT			
2	1	O RING			
3	1	MOUNTING SCREW KIT			
4	1	COLLAR			
5	3	GROMMET			
6	3	WASHER			
7	3	WASHER			
8	3	LOCKWASHER			
9	3	SCREW	45		5.0
10	1	DRAIN SCREW KIT			
11	1	CHECK VALVE			
12	1	FLOAT KIT			
13	1	FLOAT VALVE KIT			
14	1	SCREW KIT			
15	1	COVER KIT			
16	1	ELBOW KIT (Same as Ref. #15 on page 19)			
17	1	ATTACHING KIT	30		3.5
18	1	PRESSURE REGULATOR KIT			
19	1	SCHRADER VALVE KIT	45		5.0
20	1	TUBING KIT			
21	1	FUEL PUMP FITTING KIT			
22	1	O RING/SEAL KIT			
23	1	FUEL PUMP KIT			
24	1	FUEL STRAINER KIT			
25	1	ELECTRICAL CONNECTION KIT			
26	1	NUT (M4 x .7)	6		0.7
27	2	LOCKWASHER			
28	1	NUT (M5 x .8)	8		0.9
29	1	DECAL-EPA INFO **(1998)**			

Fuel Pump



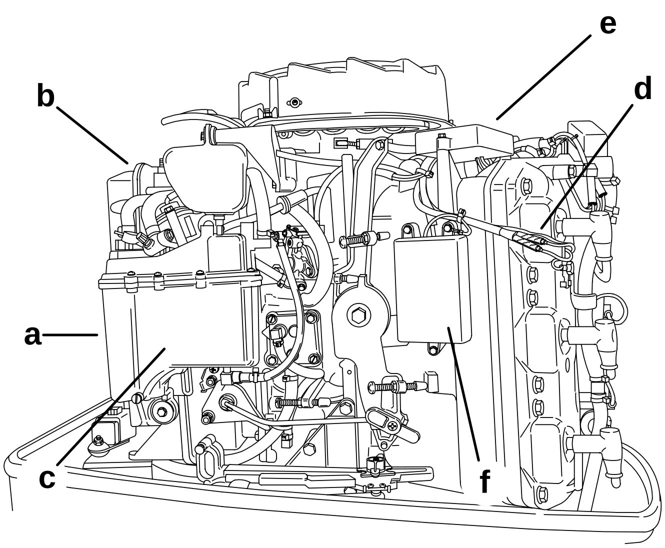
19 Perfect Seal (92-34227-1)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	CHECK VALVE–rubber			
4	2	CHECK VALVE			
5	2	RETAINER			
6	1	GASKET–boost			
7	1	CAP			
8	1	SPRING			
9	2	DIAPHRAGM			
10	1	GASKET–pulse			
11	1	SPRING			
12	1	CAP			
13	1	GASKET–base			
14	1	BASE–fuel pump			
15	1	PLATE–fuel pump			
16	1	ELBOW			
17	1	TUBING (6 IN.)			
18	1	FUEL LINE (10-1/2 IN.)			
19	AR	STA STRAP			
20	2	SCREW–fuel pump to crankcase	55		6.0
21	2	SCREW–fuel pump	55		6.0
22	1	CONNECTOR			
23	2	TUBING (15-1/2 IN.)(19 IN.)			
24	1	FUEL FILTER ASSEMBLY			
25	1	PROBE			
26	1	FUEL FILTER BASE			
27	1	CONNECTOR (STRAIGHT)			
28	1	ELBOW			
29	2	SCREW (1/4-20 x 1-1/8 IN.)	100		11.0

A – Input fuel to vapor separator.

Outboard Powerhead View

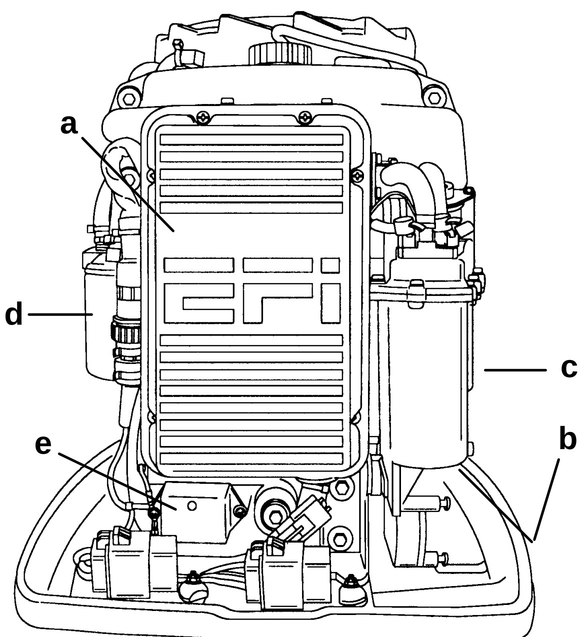
Engine port view of EFI components.



55174

a - Electric Fuel Pump
b - Fuel Pressure Regulator
c - Vapor Separator
d - Engine Head Temperature Sensor
e - Lube Alert Module
f - Idle Stabilizer Module

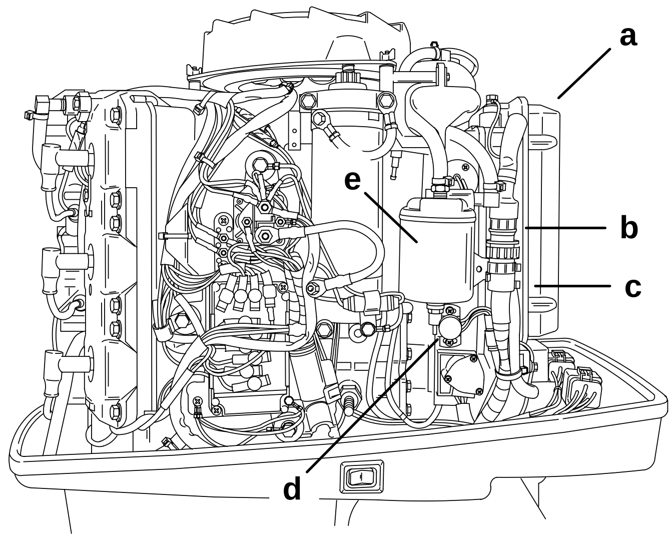
Engine front view of EFI components.



55173

a - Electronic Control Module (ECM)
b - Final Filter (Inside of Vapor Separator)
c - Electric Fuel Pump (Inside of Vapor Separator)
d - ECU harness
e - Water Sensing Module

Engine starboard view of EFI components.



55175

a - Electronic Control Module (ECM)
b - ECM Harness
c - Engine Harness
d - Throttle Position Sensor
e - Water Separating Filter

Electronic Fuel Injection (EFI) System

Introduction

The troubleshooting information provided here consists of preliminary checks (checks to be followed before proceeding with EFI tests), diagrams (fuel flow and electrical wiring), component description (from diagrams), flow charts (low pressure fuel delivery, high pressure fuel delivery, fuel delivery vs. electrical delivery), problem diagnosis, and a series of test and check procedures that will help isolate problems associated with the fuel injection system. Each test/check (listed) can be completed without major fuel system disassembly.

Using the Test Procedures

Read the entire test before beginning to perform outlined procedures. Study the RESULTS material prior to testing. This will help in determining that each test is providing desired results.

EFI System Tests

- EFI Electrical System and ECM Check
- Fuel Gauge Connection/Pressure Test
- Vapor Separator Fuel Delivery Test
- Vapor Separator Float Test
- Water Separating Filter Flow Test
- Pulse Fuel Pump Delivery Test
- Final Filter Check
- Fuel Pressure Regulator Test
- Electric Fuel Pump Test
- Injector Electrical Test
- Injector Fuel Delivery Test
- Injector Operating Test (Manifold Cover Removed)
- Induction Manifold Leak Check (Manifold Cover Removed)
- Sensor Tests

Safety Precautions

CAUTION

Always use approved safety glasses or goggles when working on pressurized fuel systems.

DANGER

Outboard motor fuels are extremely flammable. Do not show open sparks or flames when working near fuel systems.

WARNING

To avoid potential fire hazards, use extreme caution when connecting and disconnecting fuel line connections and test adaptors. Do not allow fuel to spill on hot engine parts or on live electrical connections.

CAUTION

Wipe up fuel spills immediately.

CAUTION

Depressurize fuel system prior to opening line connections or removing fuel system components.

DANGER

Perform the tests in this section in a well ventilated area to avoid being overcome by fuel vapors or poisonous exhaust gases.

WARNING

Disable the ignition system by grounding mercury switch prior to performing any tests that require removal of the induction manifold cover.

Fuel Injection System Function

Fuel is delivered directly to the engine by way of fuel injectors. These injectors are provided with a constant supply of fuel (34 to 36 psi; 234 to 238 kPa) delivered to the fuel rail. The injectors are opened and closed electronically by the Electronic Control Module (ECM). The ECM receives input signals from various sensors in the EFI system which in turn transmits controlling outputs (open/close) to the injectors. The length of time the injectors stay open is considered pulse width. The pulse width will widen (richer) or narrow (leaner) depending on signals ECM receives from sensors, to allow efficient operation at all speeds and conditions.

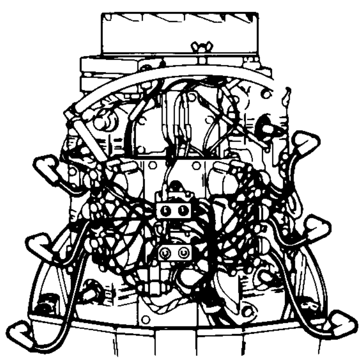
IMPORTANT: The following preliminary steps MUST BE FOLLOWED before attempting EFI problem diagnosis.

Preliminary Checks

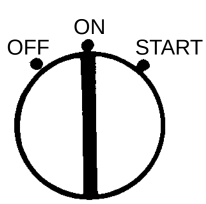
Ignition Spark Check

Purpose: This test determines if the ignition system is delivering usable spark to the spark plugs. By performing this test, the probable cause can be isolated to either the ignition system or fuel system.

1. Disconnect all spark plug wires from spark plugs.



2. Connect spark gap tester Quicksilver (91-63998A1) to No. 1 spark plug wire and to good ground on engine.
3. Connect Remote Starter Switch Quicksilver (91-52024A1).
   a. Connect RED lead from switch to large positive (+) terminal with RED banded cable attached [(+) cable from battery].
   b. Connect BLACK lead from switch to small terminal with YELLOW/RED lead attached.
4. Turn ignition key switch to the “ON” position.



5. Turn over engine using remote starter.
6. Look at spark gap tester viewing port for presence of good quality spark. Complete steps 1 through 6 on each spark plug.

Results: **IMPORTANT: The presence of a good spark will not necessarily indicate condition of timing. Ignition timing may be off far enough to prevent the engine from starting, but still allow a good spark to be present in the spark gap tester.**

A steady, blue spark should be present at each spark plug wire. If a good spark is present, problem may not be ignition related. If good spark is not present, problem may be ignition related. Trouble shoot ignition system or make sure engine timing is set correctly. Refer to appropriate ignition section in this service manual.

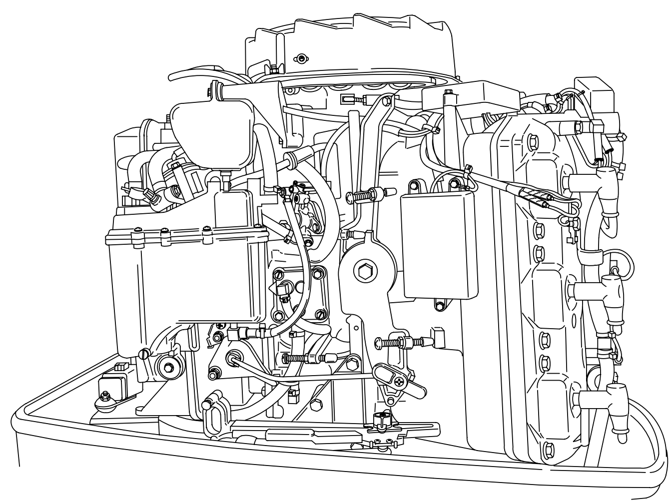
Ignition system failure (switch box, stator, trigger, etc.) can cause fuel delivery problems. Injectors are triggered in pairs by one, three, five primary circuits (inner switch box).

No. 1 Primary Triggers	No. 3 & 4 Injectors
No. 3 Primary Triggers	No. 5 & 6 Injectors
No. 5 Primary Triggers	No. 1 & 2 Injectors

Failure in one or more of these primary circuits will cause no spark and no fuel to respective cylinders (above). Check spark and spark plugs on all cylinders before attempting EFI tests.

Electronic Fuel Injection Set Up

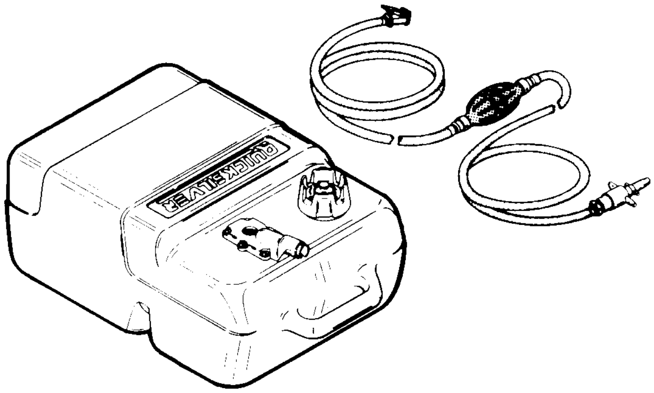
IMPORTANT: Follow EFI Timing/Synchronizing/Adjustment section 2C before attempting tests on EFI system.



55174

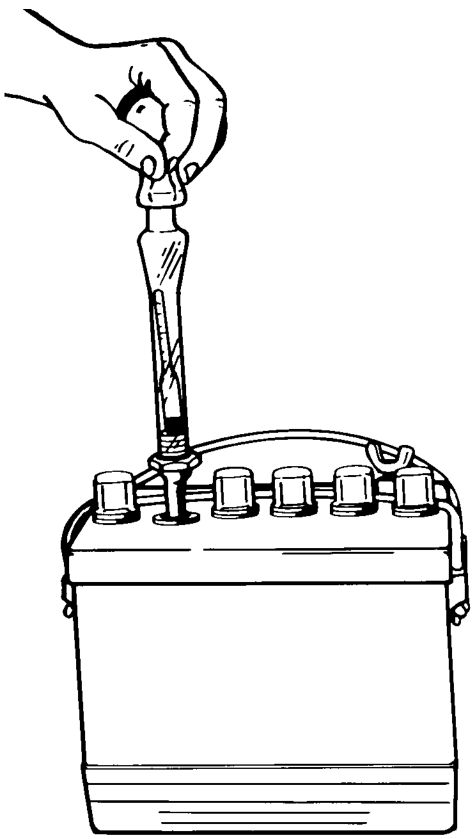
EFI set up procedures must be followed before tests on system are performed (refer to Section 2C). Improper set up can result in poor engine performance (i.e. uncontrollable idle speeds, lean sneezing, low power during acceleration or engine will simply not run.) Failure to properly set up the EFI system can lead to misdirections in solving simple problems in the EFI system.

Fresh Quality Fuel



Using a remote fuel tank containing a major brand of premium unleaded gasoline, test run the outboard to eliminate any problems related to restricted fuel supply (clogged lines, malfunctioning anti-siphon valve, etc.) and/or marginal gasoline.

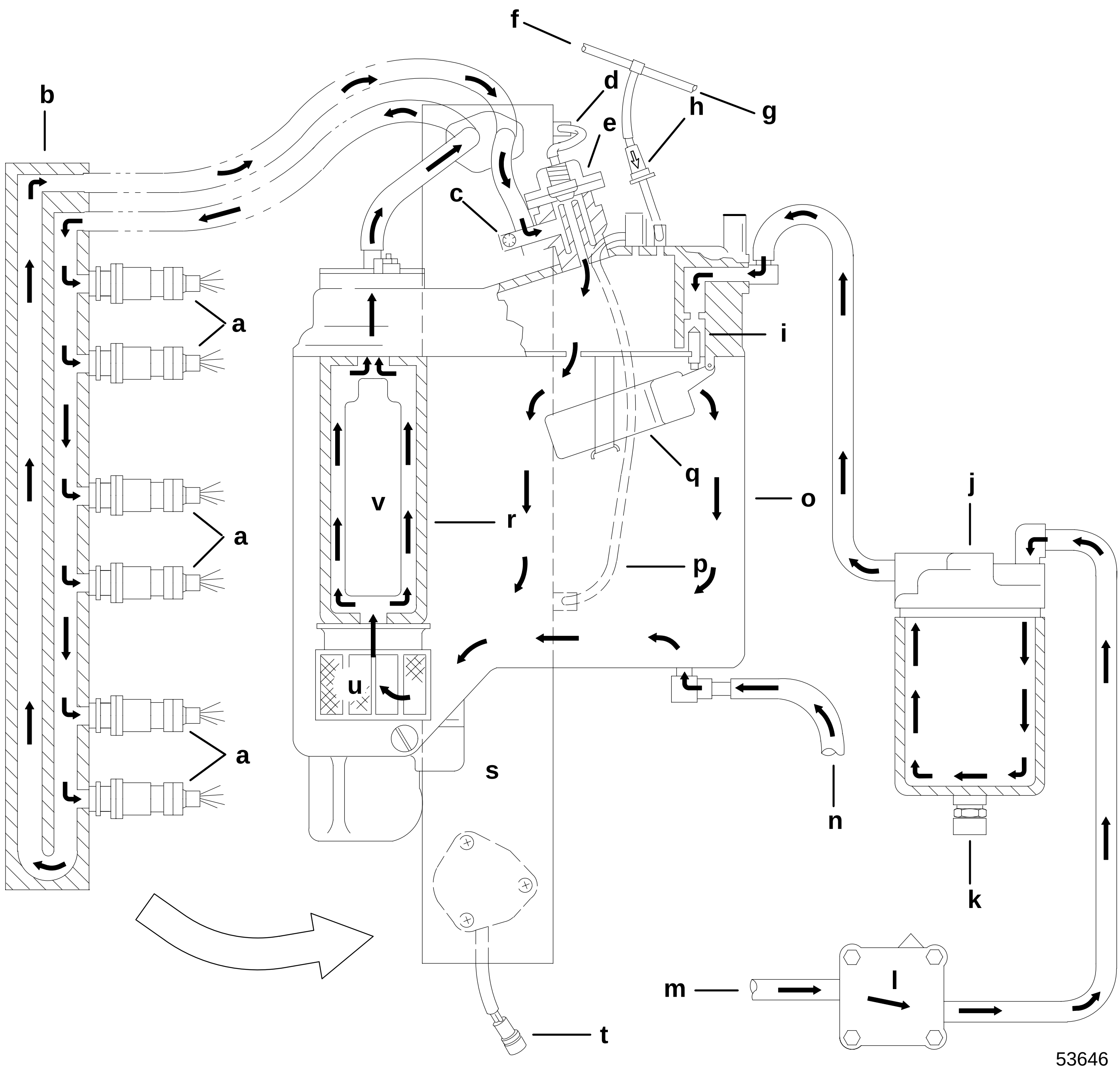
Low Battery Voltage



Low battery voltage can cause EFI system to deliver fuel in an inconsistent manner.

Inspect battery connections and charging system, refer to Section 2B. The EFI system requires a substantial amount of voltage to function properly. Operating engine at a low RPM for an extended period of time can cause low voltage.

Fuel Flow Diagram



a - Fuel Injectors (6)
b - Fuel Rail
c - Fuel Rail Pressure Port
d - Fuel Pressure Regulator Manifold Hose
e - Fuel Pressure Regulator
f - To Starboard Bleed Junction Block
g - To Port Bleed Junction Block
h - Bleed System Filter (Removed on later Models)
i - Needle and Seat
j - Water Separator
k - Water Sensor
l - Pulse Fuel Pump
m - From Fuel Tank
n - From Oil Pump
o - Vapor Separator
p - Vapor Separator to Manifold Vent Hose
q - Vapor Separator Float
r - Electric Fuel Pump
s - Manifold
t - Injector Wiring Harness
u - Final Filter
v - Armature

Fuel Flow Component Description

Pulse Fuel Pump

The pulse fuel pump operates through alternating crankcase pressure to deliver fuel through the water separating filter to the vapor separator.
Fuel pressure @ Idle – 2-3 psi (Minimum – 1 psi).
Fuel Pressure @ Wide-Open-Throttle – 6-8 psi (Minimum – 4 psi).

Water Separating Filter

The water separating filter protects the fuel injectors from water and debris. The filter contains a sensor probe which monitors water level in the filter. If water is above the sensor probe, the water detection light will come on and the warning horn will begin a series of beeps.

Vapor Separator

The vapor separator is a fuel reservoir which continuously blends and circulates fresh fuel, oil and unused fuel/oil from the fuel rail.

a. Fuel Inlet – Fresh fuel delivered from the water separator by the crankcase mounted pulse fuel pump. The amount of fuel allowed to enter the vapor separator is controlled by a needle/seat and float assembly mounted in the cover of the vapor separator.

b. Oil Inlet – Oil delivered by the crankshaft driven oil pump.

c. Crankcase Bleed Inlet – Recirculated (unburned) fuel/oil mixture delivered from the bleed lines through a filter into the vapor separator.

d. Fuel Pressure Regulator Inlet – Unused fuel/oil mixture being recirculated from the fuel rail back into the vapor separator.

Bleed System

On carbureted engines, excess fuel which collects in the crankcase is channeled into the transfer ports to be burned.

On EFI engines, excess crankcase fuel is directed through a filter (to eliminate contaminates) and emptied into the vapor separator. It mixes with fresh incoming fuel and is pumped to the fuel rail and fed through the injectors.

A 30 micron filter is installed in the bleed line to prevent contaminants from entering the vapor separator. If the filter becomes clogged, the engine will load up at idle and hesitate upon acceleration.

Final Filter

The final filter is located below the electric fuel pump in the vapor separator. The filter collects debris and prevents them from flowing through the electric pump and into the fuel rail and injectors.

Electric Fuel Pump

The electric fuel pump runs continuously while providing fuel in excess of engine demands. The excess fuel is circulated through the fuel rail to the fuel pressure regulator and back to the vapor separator.

Fuel Injectors

The fuel injectors are located inside the induction manifold on the fuel rail. The injector valve body consists of a solenoid actuated needle and seat assembly. The injector receives signals from the EFI Electronic Control Module. These signals determine how long the needle is lifted from the seat (pulse width) allowing a measured fuel flow. The pulse width will widen (richer) or narrow (leaner) depending on various signals received from sensors connected to the EFI ECM. The ECM receives signals from the primary ignition circuit of cylinders #1, #3 and #5 to fire each pair of injectors accordingly.

A four wire harness connects the fuel injectors to the ECM. The RED wire is at 12 volts and connects to all injectors. The BLUE, YELLOW and WHITE wires each go to a pair of injectors and are normally at 12 volts for a zero differential. To fire the injectors this voltage is brought down to near ground creating a potential across the injectors.

Induction Manifold

The induction manifold is a common plenum chamber for accurate pressure measurement. It contains 4 throttle shutters on 2 throttle shafts. The shutter opening (idle air opening) can be adjusted during EFI set-up procedure. The manifold contains the fuel rail, injectors, throttle position sensor and air temperature sensor. A fuel rail pressure port is located on the fuel pressure regulator.

Fuel Pressure Regulator

The fuel pressure regulator is located on top of the vapor separator and is continuously regulating fuel pressure produced by the electric fuel pump. The electric pump is capable of producing 90 psi (621 kPa) of fuel pressure. The pressure regulator limits fuel pressure at the injectors to 34 to 36 psi (234 to 248 kPa).

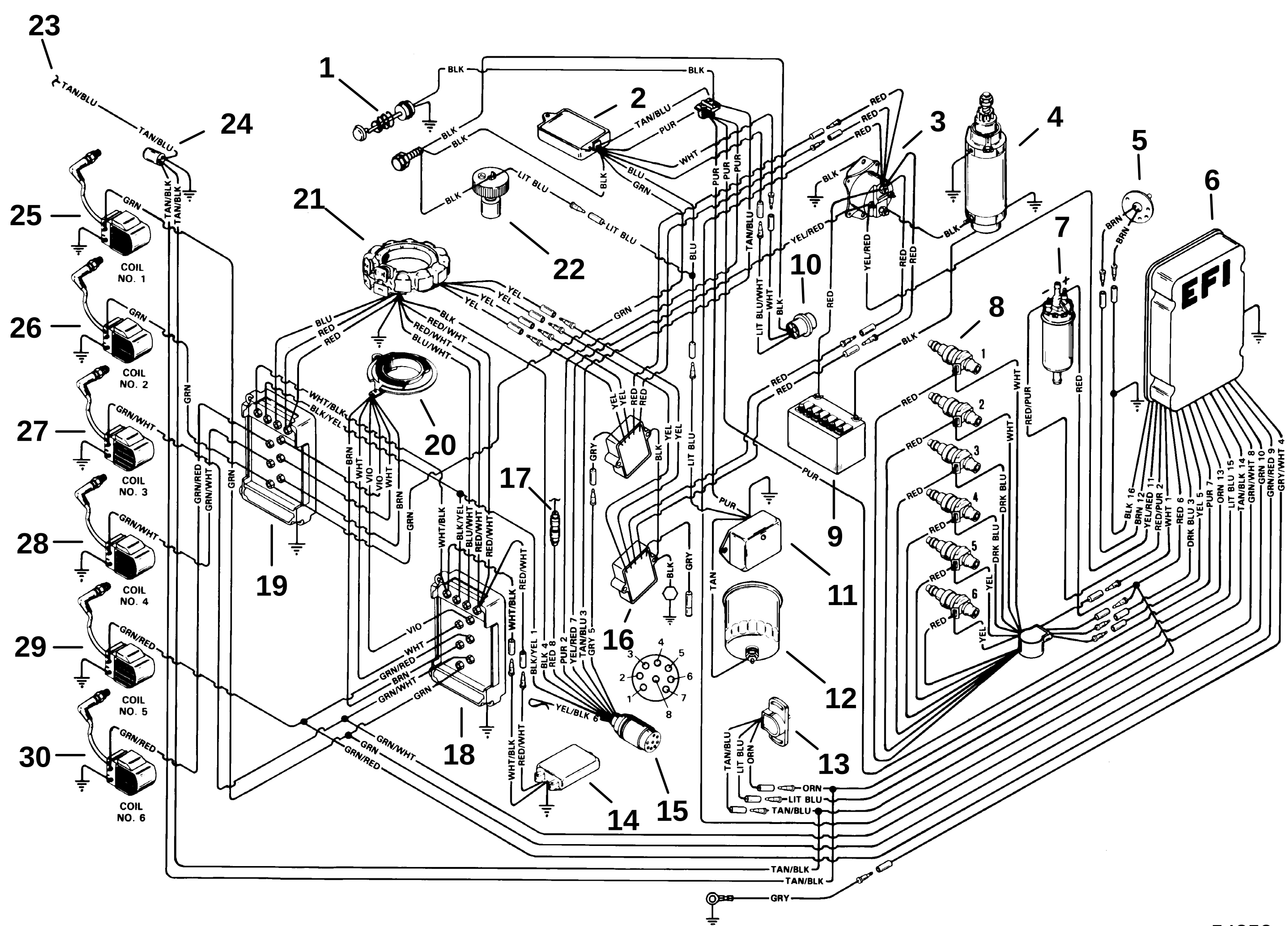
FUEL PRESSURE REGULATOR (S)

The fuel pressure regulator is located on top of the vapor separator and is continuously regulating fuel pressure from the electric fuel pump. The electric fuel pump is capable of producing 90 psi (621 kPa) of fuel pressure. The pressure regulator regulates fuel to injectors down to a usable 34 to 36 psi (234 to 248 kPa).

INDUCTION MANIFOLD

The induction manifold is a common plenum chamber for accurate pressure measurement. It contains four throttle shutters on two throttle shafts. The shutter opening (idle air opening) can be adjusted during EFI set-up procedure. The manifold contains the fuel rail, injectors, throttle position sensor and air temperature sensor.

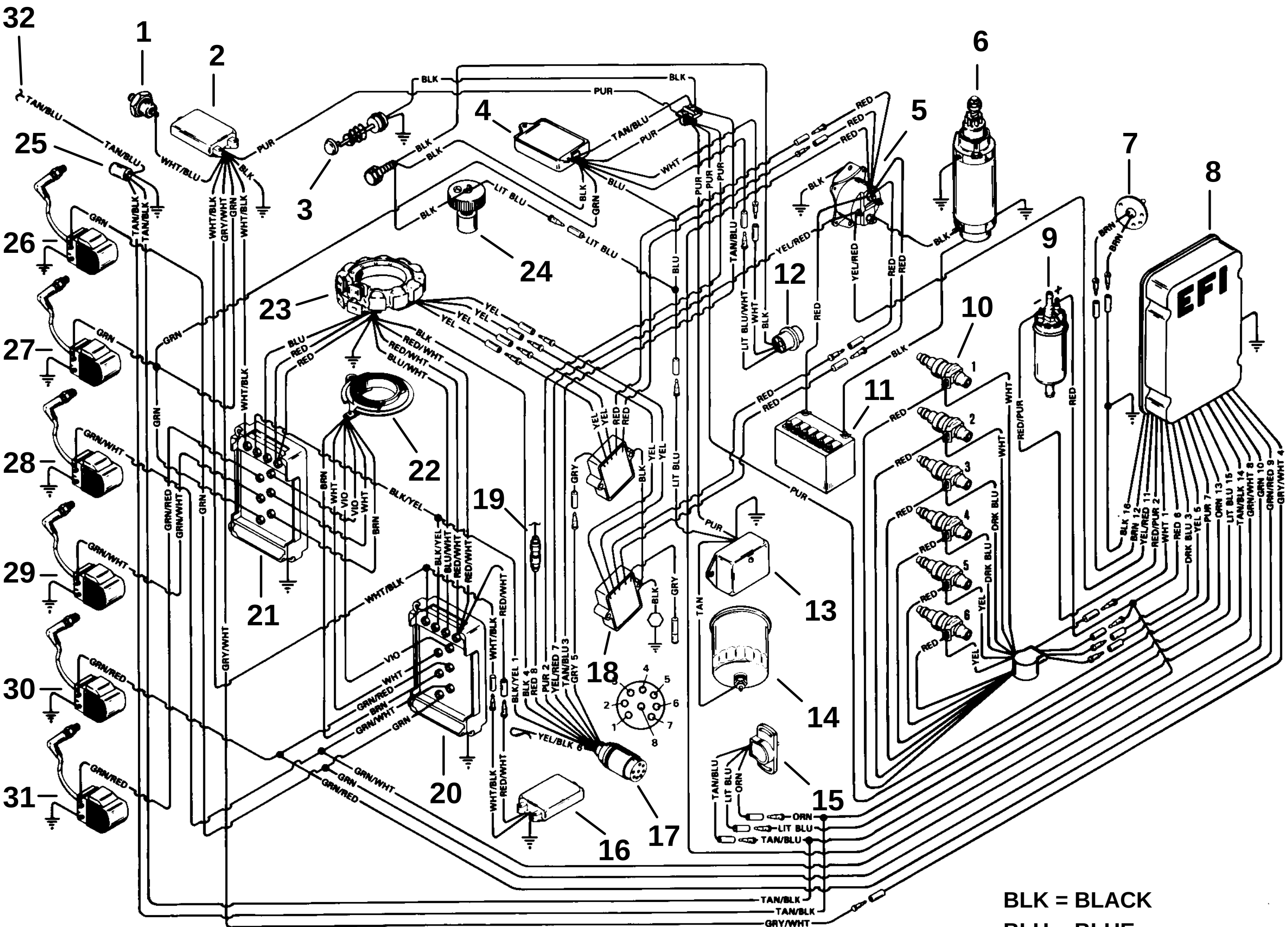
BLK = BLACK	**RED = RED**
BLU = BLUE	**TAN = TAN**
BRN = BROWN	**VIO = VIOLET**
GRY = GRAY	**WHT = WHITE**
GRN = GREEN	**YEL = YELLOW**
PUR = PURPLE	



54352

1 - Water Temperature Switch
2 - Warning Module
3 - Starter Solenoid
4 - Starter Motor
5 - Air Temperature Sensor
6 - Electronic Control Unit
7 - Fuel Pump
8 - Injectors
9 - 12 Volt Battery
10- Rotational Sensor
11- Water Sensing Warning Module
12- Water Separating Filter
13- Throttle Position Sensor
14- Idle Stabilizer
15- Engine Harness Connector
16- Voltage Regulator (2)
17- 20 Ampere Fuse
18- Outer Switch Box
19- Inner Switch Box
20- Trigger
21- Stator
22- Oil Tank Cap/Oil Level Sensor
23- To Temperature Gauge
24- Temperature Sensor
25- Coil # 1
26- Coil # 2
27- Coil # 3
28- Coil # 4
29- Coil # 5
30- Coil # 6

Wiring Diagram 200 EFI/200 & 225 Pro Max/Super Magnum



BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
PUR = PURPLE
RED = RED
TAN = TAN
VIO = VIOLET
WHT = WHITE
YEL = YELLOW

54353

1 - Detonation Sensor
2 - Detonation Module
3 - Water Temperature Switch
4 - Warning Module
5 - Starter Solenoid
6 - Starter Motor
7 - Air Temperature Sensor
8 - Electronic Control Module
9 - Fuel Pump
10- Injectors
11- 12 Volt Battery
12- Rotational Sensor
13- Water Sensing Warning Module
14- Water Separating Filter
15- Throttle Position Sensor
16- Idle Stabilizer
17- Engine Harness Connector
18- Voltage Regulator (2)
19- 20 Ampere Fuse
20- Outer Switch Box
21- Inner Switch Box
22- Trigger
23- Stator
24- Oil Tank Cap/Oil Level Sensor
25- Temperature Sensor
26- Coil # 1
27- Coil # 2
28- Coil # 3
29- Coil # 4
30- Coil # 5
31- Coil # 6
32- To Temperature Gauge

EFI Electrical Components (from Electrical Component Diagram)

ELECTRONIC CONTROL MODULE (ECM)

The ECM is continually monitoring various engine conditions (engine temperature, engine detonation control, engine throttle opening) and climate conditions (induction air temperature, barometric pressure and altitude level) needed to calculate fuel delivery (pulse width length) of injectors. The pulse width is constantly adjusted (rich/lean conditions) to compensate for operating conditions, such as cranking, cold starting, climate conditions, altitude, acceleration and deceleration, allowing the outboard to operate efficiently at all engine speeds.

SENSOR INTERACTION WITH THE ECM

IMPORTANT: DO NOT run engine for extended periods of time with sensors disconnected or bypassed (shorted). Serious engine damage may result.

AIR TEMPERATURE SENSOR

The air temperature sensor transmits manifold absolute air temperature, through full RPM range, to the ECM. As air temperature increases “sensor” resistance decreases causing the ECM to decrease fuel flow (leaner mixture). Disconnecting the air temp sensor (open circuit) will increase fuel flow (richen mixture) by 10%. Bypassing air temp sensor (short in circuit) will cause fuel flow to decrease 10%.

The air temperature sensor circuit can be tested using the EFI tester. The air temperature sensor can be tested following air temperature sensor test on page 3D-37.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The map sensor is a non-serviceable sensor mounted in the ECM box. The MAP sensor is used to sense changes in manifold absolute pressure and is connected to the intake manifold by the way of a vacuum hose. The MAP sensor is functioning through the full RPM range and is continually signaling induction manifold pressure readings to the ECM. The ECM in turn determines fuel flow as signals are received. Drawing a vacuum on the MAP sensor hose will create a lean fuel condition altering engine operation. If no change occurs when drawing vacuum, MAP sensor is not functioning properly.

MAP sensor can be tested with the EFI tester.

ENGINE HEAD TEMPERATURE SENSOR

The Engine Head Temperature Sensor provides the ECM signals related to engine temperature to determine level of fuel enrichment during engine warm up. The ECM is receiving information at all engine temperatures but stops fuel enrichment at an engine temperature of 90° F (32° C). An open circuit on the temperature sensor will increase fuel flow up to 40% but will not be affected at wide open throttle. If no change occurs when sensor is disconnected, sensor may not be functioning properly. The engine head temperature sensor can be tested following Engine Head Temperature Sensor Test on page 3D-37.

NOTE: *If sensor does not make clean contact with cylinder head a rich condition may exist.*

THROTTLE POSITION SENSOR (TPS)

The TPS transmits information to the ECM during low speed and mid range operation, related to throttle angle under various load conditions. TPS adjustment is a critical step in engine set up (Section 2C). Disconnecting the TPS will increase fuel flow 40% at idle but does not effect WOT.

NOTE: *The higher the resistance the richer the fuel flow. Refer to TPS Adjustment (Section 2C).*

DETONATION CONTROL SYSTEM (200 MODEL)

The Detonation Control System consists of a detonation control sensor located on the port side cylinder head and a detonation control module mounted on the engine. The detonation control module has seven wires:

- **WHITE/BLUE -** Connects to knock sensor, transmits knock signal to control module.
- **GREEN -** Connects to #2 primary wire. The primary voltage signals the controller to monitor combustion “noise” during a window of time (See Detonation System Function following).
- **WHITE/BLACK -** Two of these wires connect to the switch boxes’ bias circuit terminals. A third wire is spliced in one bias circuit (inner switchbox) and connects to the idle stabilizer module. (See complete Engine Wiring Diagram - refer to Section 2D).
- **GRAY/WHITE -** Connects to the ECM; signals ECM to enrich fuel mixture when knocking occurs.
- **PURPLE -**12 Volt power supply.

DETONATION CONTROL SYSTEM FUNCTION

1. Combustion noise (or vibration) excites the piezoelectric circuit located inside the detonation sensor, which transmits a voltage to the control module.
2. When cylinder number two ignition primary fires, it signals the controller to look at a one millisecond window of sensor output, which it retains as a reference level of combustion "background noise."
3. When "background noise" reaches a measurable value, usually between 2500 and 3500 RPM (it is dependent on load), the ignition timing is advanced 6 degrees beyond what the mechanical timing is set at. Timing advance is accomplished by lowering the bias voltage.
4. The controller continues to monitor sensor output. If the output exceeds a pre-determined threshold level over the "background noise" (which is indicative knock is occurring) ignition timing is retarded by up to 8 degrees and fuel flow is enriched by up to 15% until the sensor output is reduced below the threshold level.

The detonation control system actually acts as an ignition advance module, when knock occurs it takes away the advance. Ignition timing will not advance if:

a. Knock sensor fails.

b. BLUE/WHITE wire becomes disconnected.

c. BLACK wire has poor ground connection.

d. PURPLE power wire becomes disconnected.

NOTE: *Disconnected GRAY/WHITE wire will not affect ignition timing and will not allow fuel enrichment.*

Other components associated with the ECM.

12 Volt Battery - The 12 volt battery provides power to the ECM even with the ignition switch in the "OFF" position.

IMPORTANT: When disassembling EFI System DISCONNECT BATTERY CABLES.

Starter Solenoid - Provides 12 volt signal when key is in the "start" position. In the "start" position, injector pulse widths are tripled when engine head temperature is below 90° F (32.2° C) to provide adequate fuel for quick start up. When key is returned to the run position or engine head temperature is above 90° F (32.2° C), pulse widths return to normal value.

Fuel Injectors - A four wire harness connects the fuel injectors to the ECM. The red wire is at 12 volts and connects to all injectors. The blue, yellow and white wires each go to a pair of injectors and are normally at 12 volts for a zero differential. To fire the injectors this voltage is brought down to near ground creating a potential across the injectors.

Electric Fuel Pump - The ECM contains a fuel pump driver circuit that provides power to the electric fuel pump. The fuel pump does not have its negative terminal (-) "BLACK/RED wire" grounded to the pump housing. The fuel pump positive terminal (+) "RED wire" and the negative terminal (-) are at 12 volts with the ignition switch in the off position for a zero differential. When the pump is on, the negative terminal is brought down to near ground (i.e. 1.5 volts).

WATER SENSING SYSTEM

The system consists of a water separating fuel filter (starboard side powerhead), sensing probe (bottom of filter) and a water sensing module (below ECM box). The water sensing module has four wires:

PURPLE - Connects to 12 volt power supply.

LIGHT BLUE - Connects to lube alert, which sounds the warning horn when activated.

TAN - Connects to sensing probe.

BLACK - Connects to ground.

WATER SENSING SYSTEM FUNCTION

1. The filter separates the accumulated water from the fuel.
2. A voltage is always present at sensing probe. When water reaches top of probe it completes the circuit to ground.
3. The completed circuit activates the warning. The warning has a 5-10 second delay, then the module's red light illuminates and warning horn intermittently sounds.

The system can be tested by disconnecting the TAN wire from sensor probe and holding to a good engine ground connection for 10 seconds.

EFI Fuel Management (Low Pressure Fuel Route)

- Perform all preliminary checks 3D-13.
- Install fuel pressure gauge (P/N 91-16850A2) on to manifold pressure port.
- Place ignition switch in "OFF" position 30 seconds before testing.
- Place ignition switch in "ON" position and note pressure within 30 seconds (34 to 36 psi; 234 to 248 kPa).

Pump does not run
- Follow High Pressure Fuel Route Flow Chart.

No or low fuel pressure
- Perform Vapor Separator Fuel Delivery Test (page 3D-27).
  - **Results**: No or little fuel flow from vapor separator. Reconnect hose.
    Check in-line Filter
    Perform Vapor Separator Float Test (page 3D-28).
    - **Results**: Fuel flows from fresh fuel inlet hose.
      - Inspect float system of vapor separator.
    - **Results**: Little or no flow from fresh fuel inlet hose. Reconnect hose.
      - Perform Water Separating Filter Flow Test (page 3D-28).
        - **Results**: Low or no fuel flow from water separating inlet hose. Reconnect hose.
          - Perform Pulse Fuel Pump Delivery Test (page 3D-29).
            - **Results**: Fuel flows freely from pulse pump inlet hose.
              - See pulse pump removal and inspection section 3A. Locate all fragments of failed pump before reassembly.
            - **Results**: No fuel flow to pulse fuel pump.
              - Check for restrictions, holes or loose connections from fuel supply.
        - **Results**: Fuel flows freely from water separating filter inlet hose. Reconnect hose.
          - Replace water separating filter.
  - **Results**: Fuel flows freely from vapor separator. Reconnect hose.
    - Follow High Pressure Fuel Route Flow Chart.

Fuel pressure above 36 psi (248 kPa)
- Follow High Pressure Fuel Route Flow Chart.

EFI Fuel Management (High Pressure Fuel Route)

- Perform low pressure checks (page 3D-23) before performing checks on high pressure route.
- Install fuel pressure gauge (P/N 91-16850A2) on to manifold pressure port.
- Place ignition switch in “OFF” position 30 seconds before testing.
- Place ignition switch in “ON” position and note pressure within 30 seconds (34 to 36 psi; 234 to 248 kPa).

Fuel pressure above 36 psi (248 kPa)

Clogged or faulty fuel pressure regulator remove and replace.

No or low fuel pressure

Perform Final Filter Check (page 3D-29).

Results

Final filter OK.

Perform Fuel Pressure Regulator Test (page 3D-31).

Results

Steady stream of fuel (pressure still below 34 psi).

Replace fuel regulator.

Results

Low or no fuel flow.

Perform Electric Fuel Pump VoltageTest (page 3D-31).

Results

Voltage from ECM driver circuit OK.

Replace fuel pump.

Results

Low or inconsistent voltage from ECM driver circuit.

Replace ECM.

Results

Final filter clogged.

Clean or replace final filter.

Pump does not run

Perform Electric Fuel Pump Voltage Test (page 3D-31).

Fuel Rail Electrical/Fuel Determination

- Perform all preliminary checks page 3D-14.
- Adequate fuel pressure (34 to 36 psi; 234 to 248 kPa) follow Low/High Fuel Route Flow Charts.
- Place outboard in water or on flush attachment (P/N 44357A2) run engine speed between 2000 and 2500 RPM.

With engine running (2000-2500 RPM) remove spark plug leads one at a time using insulated pliers.

Results

No RPM change on cylinder(s), indicating problem in cylinder(s).

Perform Injector Electrical Harness Test (page 3D-34).

Results

Broken circuit to injector.

Perform Induction Manifold Disassembly and inspection (page 3D-55/60).

Results

Injector circuit tests OK.

Perform Injector Fuel Delivery Test (page 3D-34).

Results

RPM increase occurs.

Perform induction manifold disassembly. Inspect injector and filter.

Results

No RPM change.

Perform compression check on problem cylinder see section “1”.

Results

Low or no compression on cylinder.

Inspect cylinder bore. Refer to Section 4 for disassembly.

NOTE: Injector filters must be inspected prior to reassembly.

Results

Compression OK.

Check 1) Damaged reeds
2) End cap seals
3) Crankcase split line leak
4) Crankshaft sealing rings

Results

RPM decreases (on each cylinder).

Fuel delivery OK.

EFI System Test Procedures

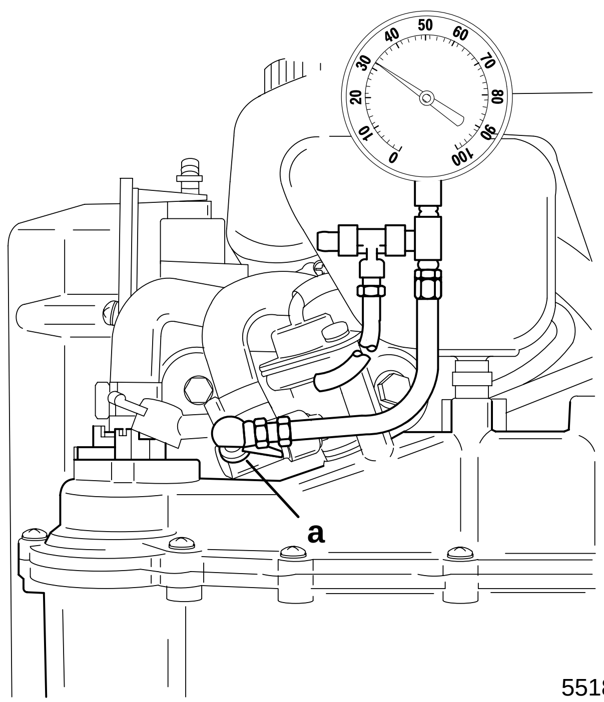
Fuel Gauge Connection/Pressure Test

IMPORTANT: When checking fuel pressure while engine is running, fuel pressure may fluctuate. Fuel pressure fluctuation (i.e. 34 to 36 psi "234 to 248 kPa") is common, as the regulated pressure is a differential between fuel rail and manifold vacuum.

Purpose: Checking fuel manifold pressure ensures that fuel under usable pressure is available to the fuel injectors. This test isolates the probable cause as either a fuel delivery or EFI electrical system failure.

IMPORTANT: Fuel pressure should be monitored through full RPM range to determine fuel supply problems at high engine speeds.

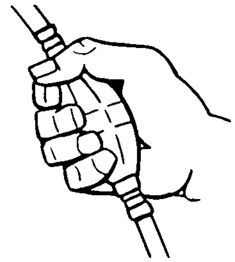
1. Connect fuel pressure gauge to induction manifold pressure port.



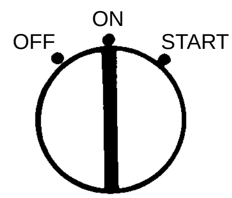
55180

a - Pressure Port

2. Prime engine using fuel primer bulb.



3. Turn ignition key switch to "On" position.



4. Operate electric fuel pump for approximately 10 seconds.

NOTE: *Fuel pump will only operate for approximately 30 seconds. By turning the key switch to "OFF" and then back to "ON" the pump will operate for 30 seconds more.*

5. Take reading on fuel pressure gauge.

Results: If pressure reading is 34 to 36 psi (234 to 248 kPa), the electric fuel pump is providing fuel with enough pressure to be used by the injectors. Pump malfunction is not the cause of EFI trouble.

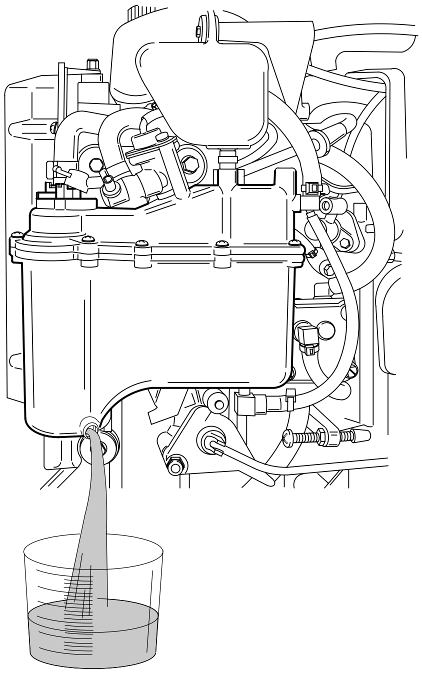
If fuel pressure is well below 34 psi (234 kPa), fuel delivery to electric fuel pump, fuel pump failure or other related problem exists. Follow low/high fuel pressure flow charts.

If fuel pressure is above 36 psi (248 kPa) go to fuel pressure regulator test.

Vapor Separator Fuel Delivery Test

Purpose: Verifying there is adequate fuel flow to the electric fuel pump (through full RPM range) will determine components in low pressure fuel system are functioning correctly.

1. Remove vapor separator drain plug and place a clean container under drain.



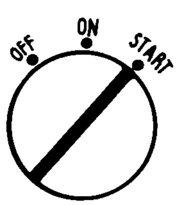
55177

Results: If fuel flow is present, fuel is being delivered to electric fuel pump. Go to high pressure flow chart.

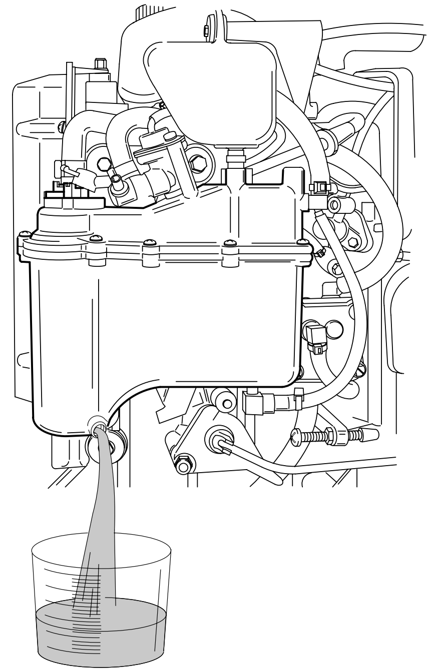
If fuel flow is not present, proceed to step 2.

2. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW terminal on the switch box to engine ground.

3. Turn ignition key switch to “START” and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



55177

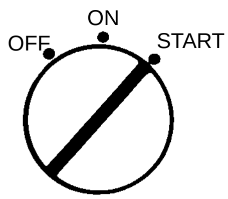
Results: If low or no fuel flow is present, inspect water separating fuel filter and perform Vapor Separator Float Test.

Vapor Separator Float Test

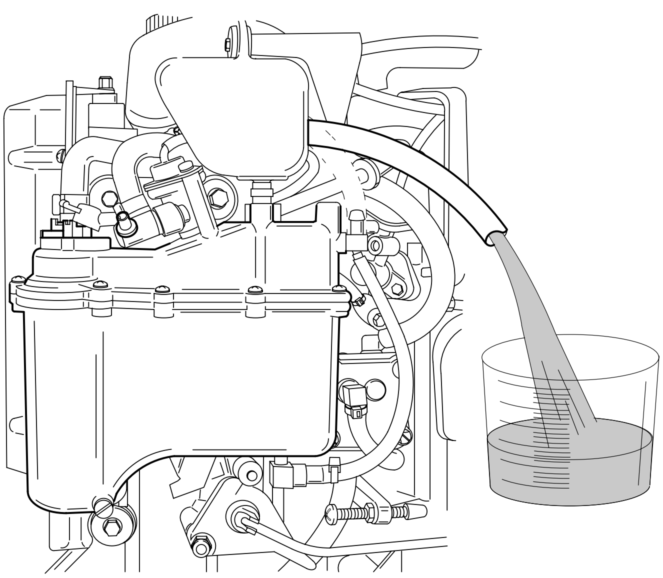
Purpose: This test will indicate if float is stuck in the up position.

NOTE: *If float is stuck down, vapor separator will over flow causing a rich condition.*

1. Remove fuel inlet hose from vapor separator and put end of hose in clean container.
2. Remove all spark plugs from engine to prevent engine from starting.
3. Turn ignition key switch to “START” position and operate starter motor for 15 to 20 seconds.



4. Look for fuel flow from hose.



55178

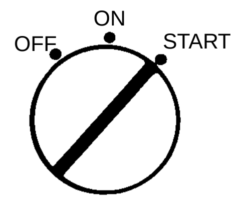
Results: If fuel flow is present at hose, remove, disassemble and inspect float assembly. See vapor separator disassembly.

If fuel flow is low or not present, perform Water Separating Filter Flow Test.

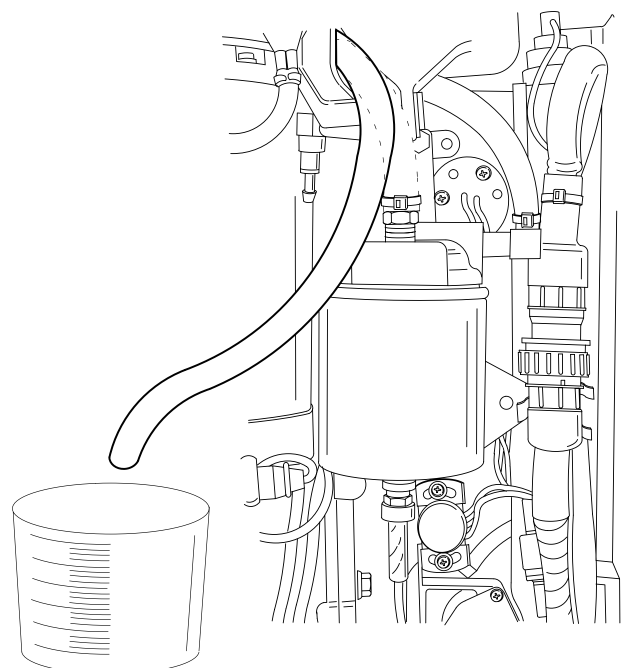
Water Separating Filter Flow Test

Purpose: This test will indicate if water separating filter is clogged.

1. Remove fuel inlet hose to water separating filter. Put end of hose in clean container.
2. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW terminal on the switch box to engine ground.
3. Turn ignition key switch to “START” and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



55183

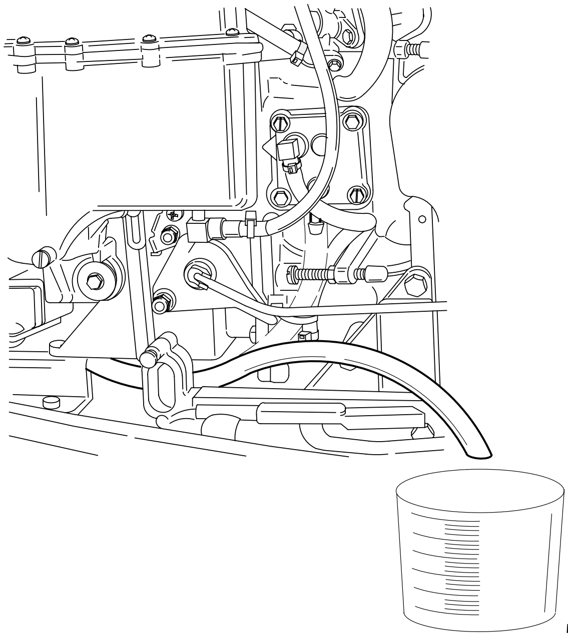
Results: Fuel flows from water separating inlet hose. Remove and replace clogged filter.

Low or no fuel flow from water separating inlet hose. Perform pulse fuel pump delivery test.

Pulse Fuel Pump Delivery Test

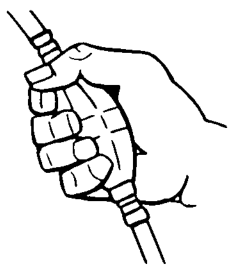
Purpose: This test will indicate pulse fuel pump is capable of supplying the low pressure fuel route with adequate fuel supply.

1. Remove inlet hose to pulse fuel pump and put end into clean container.

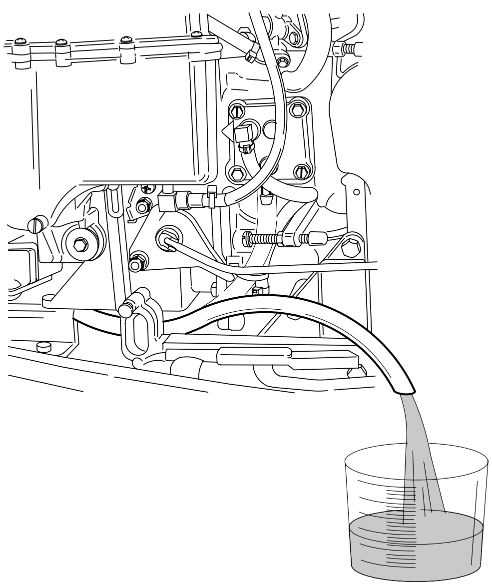


55188

2. Squeeze primer bulb several times.



3. Look for fuel flow from hose.



55187

Results: Fuel flows freely from pulse pump inlet hose. Remove, disassemble, and inspect pulse fuel pump (section 3).

IMPORTANT: All fragments of tailed pump must be located before re-assembly.

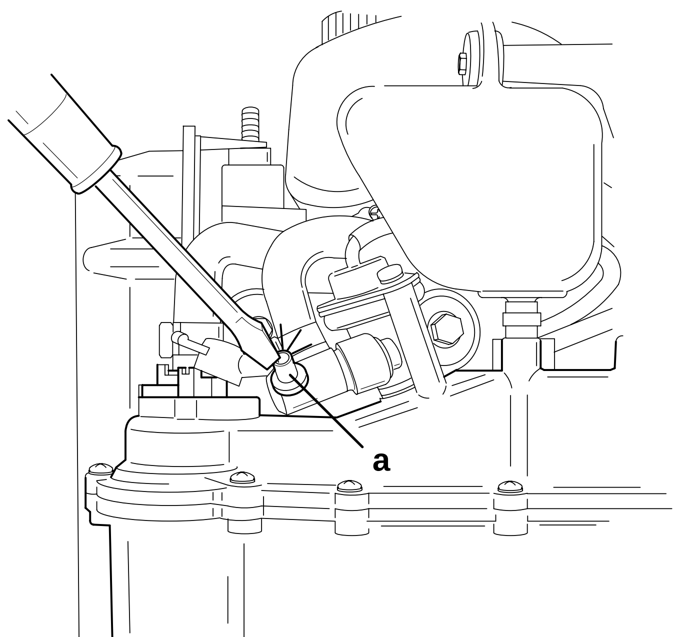
No or low fuel flow from pulse pump inlet hose. Check for restrictions, holes, or loose connections from fuel supply.

NOTE: *Inspect anti-siphon valve on tank.*

Final Filter Check and De-pressurizing EFI System Procedures

Purpose: Checking the final filter for obstructions, damage etc. eliminates this component as a possible source of restriction in the system.

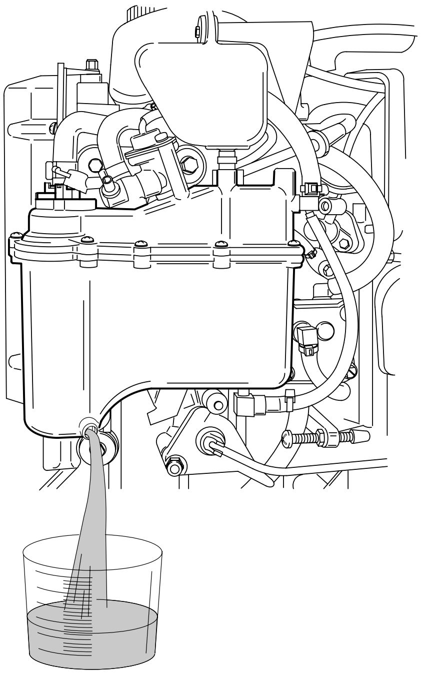
1. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

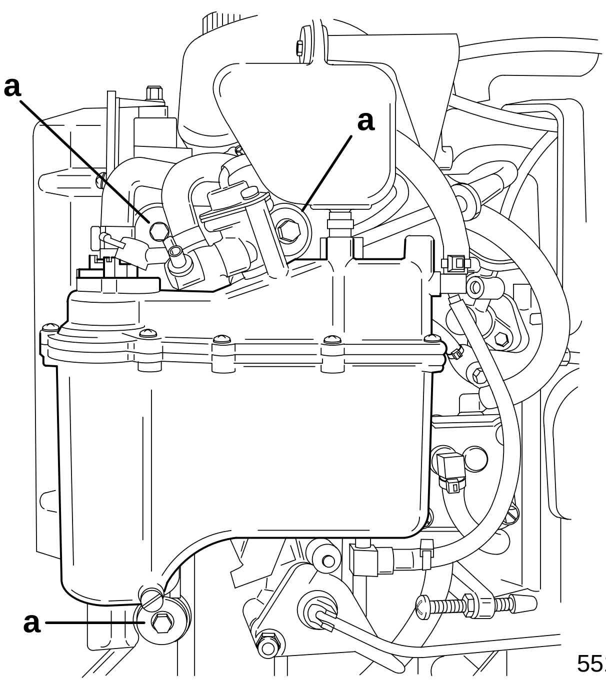
a - Pressure Port

2. Remove drain plug from vapor separator and allow fuel to drain into suitable container.



55177

3. Remove 3 bolts securing vapor separator assembly to manifold.



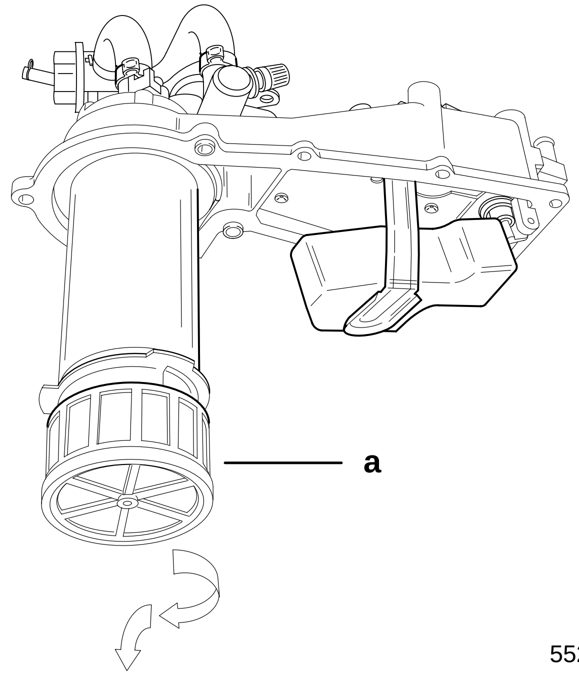
55176

a - Bolts

4. Tilt vapor separator assembly out from manifold and remove 9 screws securing cover.

5. Remove vapor separator tank from cover.

6. Rotate inlet filter counterclockwise and pull downward to remove filter from fuel pump.



55205

a - Inlet Filter

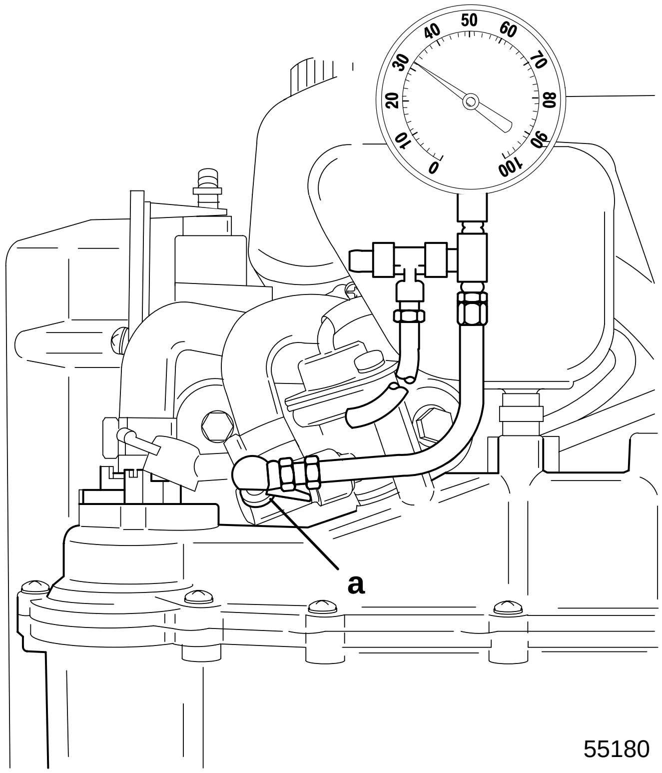
7. Inspect filter for debris or damage.

Results: If filter is clogged with debris, clean filter with solvent and compressed air or replace filter. Reassemble vapor separator to manifold and recheck fuel pressure. If pressure is still below 34 psi (234 kPa), perform fuel pressure regulator test.

Pressure Regulator Test

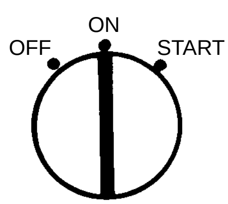
Purpose: This test will determine if a weak, plugged or open pressure regulator is causing inadequate fuel pressure in the system.

1. Connect pressure gauge to EFI test port.

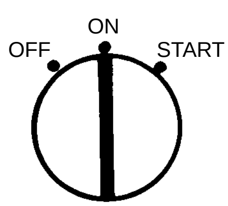


a - Test Port

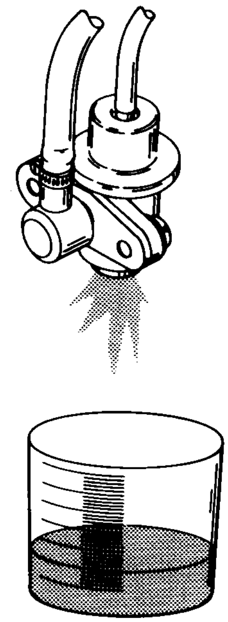
2. Turn ignition key switch to “ON” position and check fuel pressure reading on gauge. If pressure reading is below 34 psi (234 kPa) go to step 3 following.



3. Remove fuel pressure regulator, but do not disconnect any hoses from regulator.
4. Put discharge end of regulator in clean container.
5. Turn ignition key switch to “ON” position.



6. Check for fuel flow out of regulator.



Results: If steady stream of fuel exits regulator into container and pressure is below 34 psi (234 kPa), replace pressure regulator.

If low or no fuel exits regulator into container and pressure is below 34 psi (234 kPa), perform voltage checks on electric fuel pump, following.

If low or no fuel flow exits regulator into container and pressure is above 36 psi (248 kPa), replace regulator.

Electric Fuel Pump Voltage Test

⚠ CAUTION

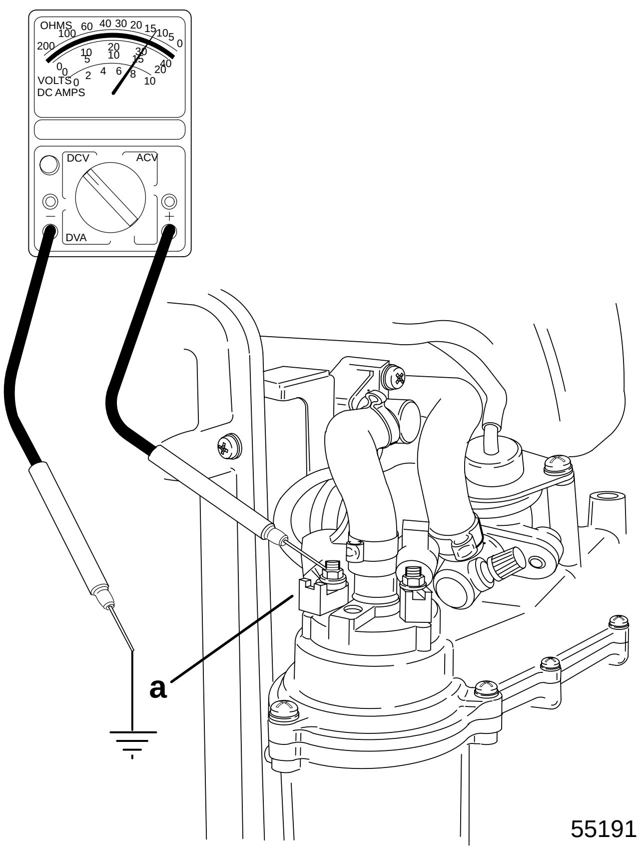
When checking voltage at pump, DO NOT pry boot covers off terminals with a metal object, as each terminal is at 12 volts when engine is off. Serious damage to electric fuel pump and/or ECM box can result.

Purpose: If insufficient electrical power is available at the pump, no or low fuel pressure will be developed.

1. Set volt meter to read battery voltage and connect black test lead to ground, positive test lead to positive (+) post of fuel pump.

NOTE: *Positive test lead can be pierced through boot cover for testing. Refer to voltage test chart (page 3D-33) for voltage readings.*

Positive Test Terminal

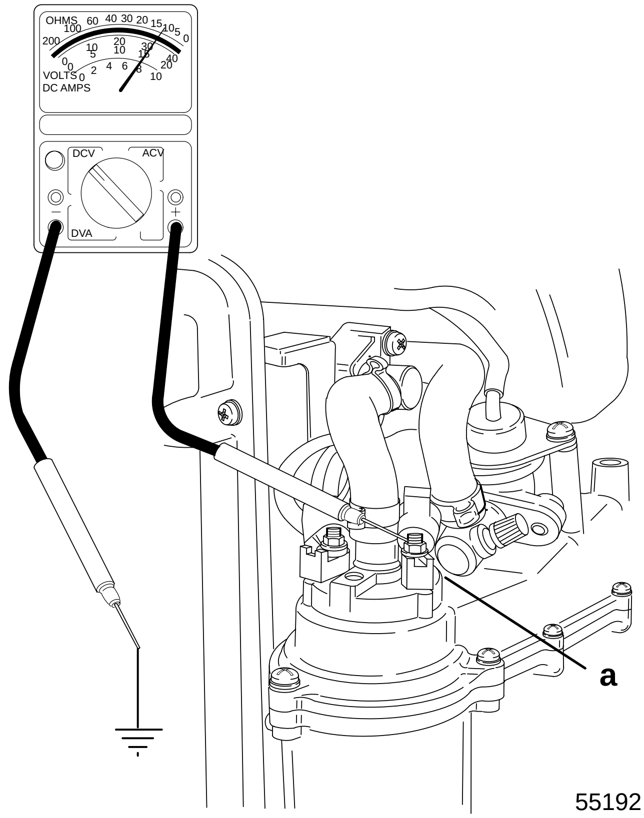


55191

a - POSITIVE (+) Terminal

2. Set volt meter to read battery voltage and connect BLACK test lead to ground, POSITIVE test lead to NEGATIVE (–) post of fuel pump.

Negative Test Terminal



55192

a - NEGATIVE (–) Terminal

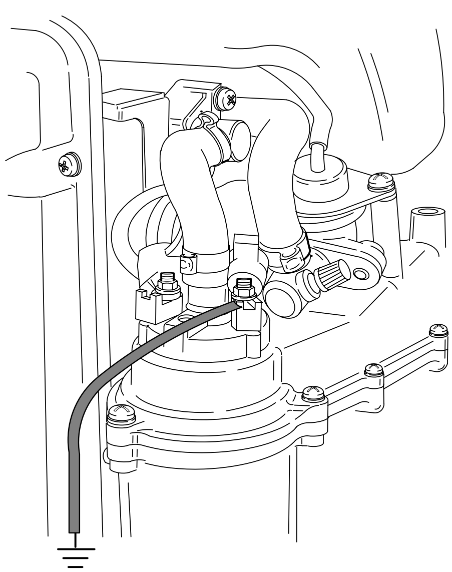
3. Perform voltage tests “all (1-6) engine modes” below.

VOLTAGE TEST CHART

Engine Mode	BLACK Meter Lead to Engine Ground; RED Meter Lead to:	Approximate Voltage Reading	If Approximate Voltage is not obtained, this indicates:
1. All models	(+) terminal of fuel pump	12 – 13.5 volts	If reading is below 12 volts, the battery is bad, discharged or has bad connection(s). If reading is higher than 13.5 volts, the battery is overcharged
2. Ignition key in “OFF” position.	(–) terminal of fuel pump.	Same reading should be obtained as reading in check No. 1 (above)	If reading is lower than in test 1, the ECM is bad or there is an open circuit in fuel pump.
3. Ignition key in “ON” position and engine NOT running.	(–) terminal of fuel pump.	1.5 volt or less (voltage should rise to 12 – 13.5 volts after approximately 30 seconds.	Bad ECM or bad fuel pump*.
4. Engine being cranked.	(–) terminal of fuel pump.	1.5 volt or less.	Bad ECM or bad fuel pump.*

*Check for proper electrical operation of electric fuel pump. (Step 4)

4. Disconnect BLACK/RED wire to negative terminal on electric fuel pump. Connect a ground jumper wire from negative pump terminal to a good engine ground.



Results: Pump does not operate. Replace electric fuel pump.

Pump operates. But, pressure reading does not change when performing electric fuel pump “pressure” test. Replace electric fuel pump.

Pump operates. Check BLACK/RED (–) lead and harness for good continuity.

NOTE: *BLACK/RED lead is connected to pin 2 of EFI harness.*

Injector Electrical Harness Test

Purpose: This test will determine if electrical or fuel delivery problem exists during the fuel delivery process by checking for open circuits in injector harness.

1. With outboard in water, start and allow to warm up. Raise engine speed to 2000-2500 RPM. Remove spark plug leads one at a time and note RPM change. Determine non-working (no RPM change) cylinder. Stop engine.
2. Disconnect injector harness (4 pin connector).

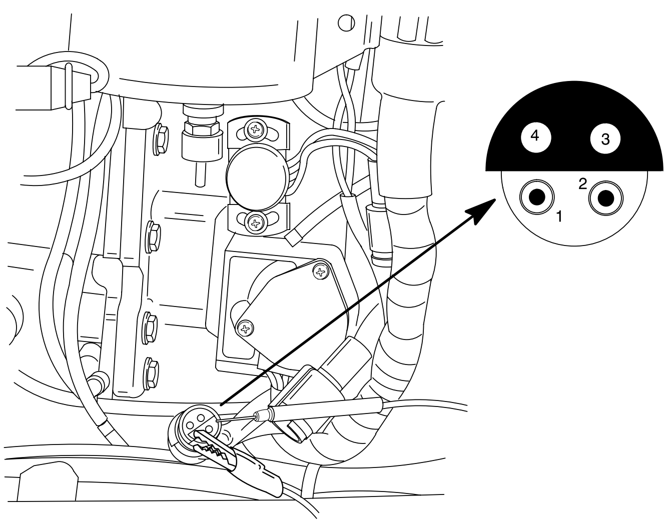
IMPORTANT: Use digital ohmmeter when testing injector harness.

3. Connect digital ohmmeter (dial set at 200 scale) leads. POSITIVE lead from ohmmeter connects to POSITIVE prong "2" (RED wire) of harness connector. Connect NEGATIVE lead from ohmmeter to the remaining wires of harness connector as follows:

   WHITE Lead = Injectors, Cylinders 1 and 2

   DARK BLUE Lead = Injectors, Cylinders 3 and 4

   YELLOW = Injectors, Cylinders 5 and 6



55194

(1) YELLOW
(2) RED
(3) DARK BLUE
(4) WHITE

Results: If readings are 1.1 ± .2 both injector circuits are complete. Perform Injector Fuel Delivery Test.

If readings are 2.2 ± .2 one injector does not have a complete circuit. Perform induction manifold disassembly and inspection following.

ECM Injector Driver Test

To verify that the ECM is operating the injector pairs, connect test harness between manifold connector and engine harness. Start engine.

Use DVA meter (91-99750). Set DVA to 200 scale. Connect BLACK meter lead to engine ground and RED test lead to each BLUE, WHITE or YELLOW female bullet connector.

Normal voltage for a 2.4L – 2.5L engines will be 25 to 60 volts. Voltage will vary with RPM.

Injector Fuel Delivery Test

⚠ CAUTION

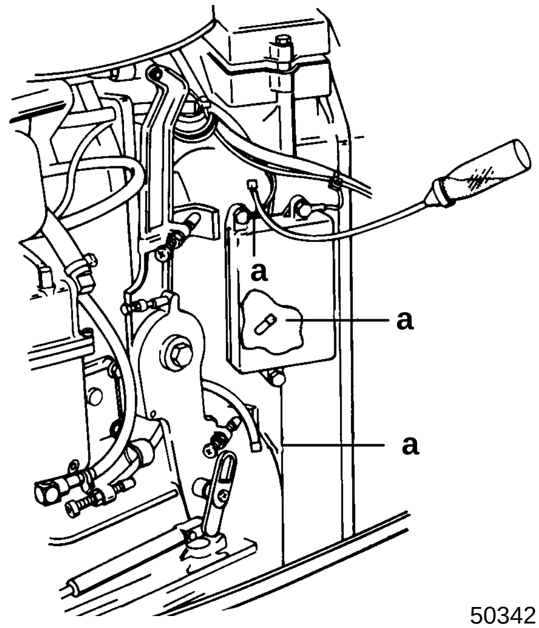
CAUTION: Switch boxes must be grounded to engine block if removed for fuel delivery test to prevent possible damage to ignition system.

Purpose: This test will determine if injector is delivering fuel when signal is received.

NOTE: *Pro Max and Super Magnum high performance engines do not have bleed fittings in the transfer ports of each cylinder and the following method of the fuel delivery test is not applicable. It is recommended that the Digital Diagnostic Terminal 91-823686A2 be utilized following the procedure listed with its' instruction manual.*

1. Place outboard in water, start engine and allow to warm up. Raise engine speed to 2000-2500 RPM. Remove spark plug leads one at a time and note RPM change. Determine non-working cylinder (no RPM change).
2. Using squirt bottle of fuel and hose, inject small amount of fuel into cylinder bleed fitting (a) on non-working cylinder.

NOTE: *Switch box panel and lube alert control box may have to be shifted to the side to allow bleed fitting connection. Ground boxes to engine as required.*



50342

a - Bleed Line Fitting (inject fuel at this location)

Results: If RPM increase occurs while injecting fuel into disabled cylinder, clogged injector filter or defective injector may be the problem. Perform Induction Manifold Disassembly (page 3D-55) for inspection.

NOTE: *Injector fuel delivery can be tested with manifold cover removed. See Injector Operation Test (manifold cover removed) below.*

RPM does not change when injecting fuel into bleed fittings could indicate lack of compression, damaged reeds, end cap seals, crankcase split line seal, or crankshaft sealing rings.

Remaining tests on EFI components may require some EFI disassembly. See EFI System Disassembly following.

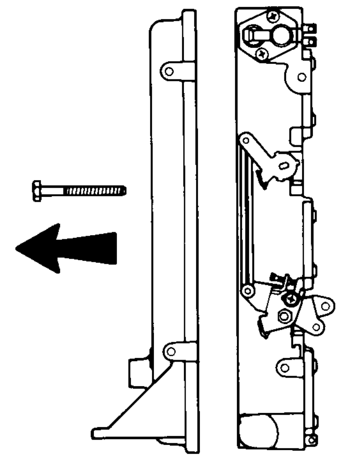
Injector Operation Test (Manifold Cover Removed)

Purpose: This test determines if the injectors are actually injecting fuel into the engine at a normal rate.

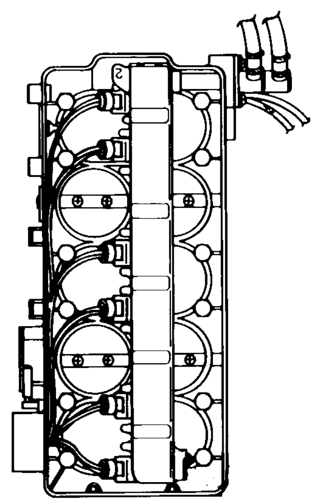
⚠ WARNING

Do not start engine with induction manifold cover removed. Disable ignition system prior to doing this test.

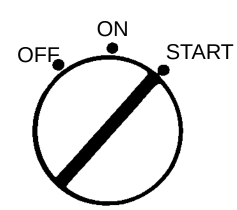
1. Remove induction manifold cover using procedures outlined under "Induction Manifold Removal."



2. Re-attach induction manifold to engine using 1/4-20 x 2-3/4″ screws.



3. Connect a jumper wire between the ECU metal case and a good engine ground.
4. Disconnect all spark plug wires from spark plugs and seal leads with electrical tape to prevent sparking.
5. Put ignition key switch in "START" position.



6. Look at injector spray pattern using an explosive proof flashlight.

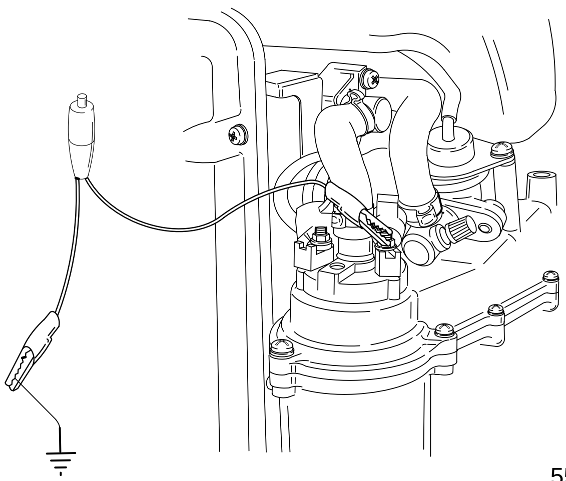
Results A: If fuel spray is not present in all injectors or spray pattern is extremely weak, check wiring harness to injector connectors, or injector filters for plugging.

If spray patterns are available in most of the injectors, but not all, perform Procedure B.

7. Connect EFI tester. Steps outlined in electrical system and ECM check.
8. Connect remote starter Quicksilver (91-52024A1) to NEGATIVE terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

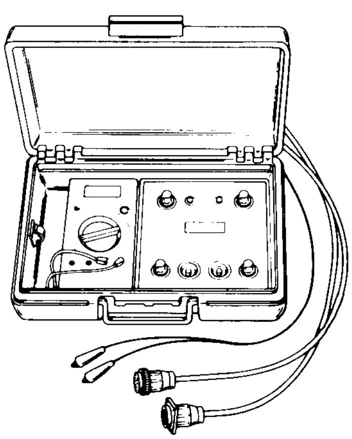
⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



55197

9. Perform fuel injector test procedures (outlined) while depressing remote starter switch.



Results B: If fuel spray is present using EFI tester, but not present while cranking, perform switch box DVA tests Section 2A (1, 3, 5 switch box failure).

If fuel spray pattern is equal on all injectors, system is functioning normally.

Induction Manifold Leak Check (Manifold Cover Removed)

Purpose: Lack of good fuel pressure may be caused by an internal leak in the fuel induction manifold and not caused by a weak pump. This test eliminates the possibility of induction manifold leaks as a probable cause.

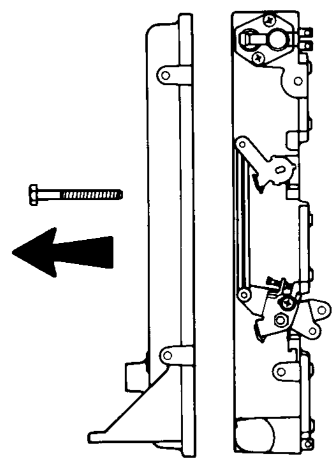
⚠ WARNING

Do not start engine with induction manifold cover removed. Disable ignition system prior to performing this test.

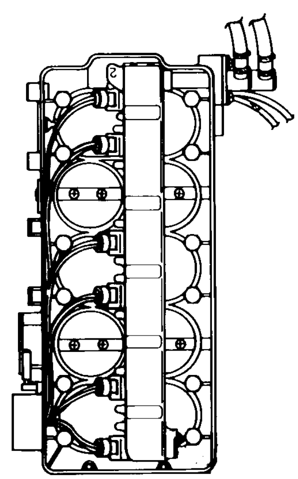
⚠ WARNING

Operation of EFI system with cover removed can allow fuel to spray components. Be extremely careful when operating the fuel system in this condition.

1. Remove induction manifold cover using procedures outlined under “Induction Manifold Removal.”



2. Reattach manifold body without cover to engine using twelve 1/4-20 x 2-3/4″ screws in place of screws normally used.



3. Connect a jumper wire between the metal case of ECM and a good engine ground.

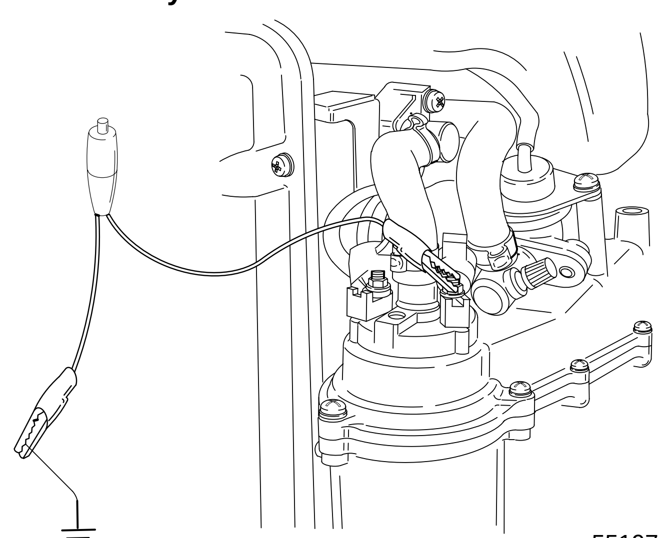
⚠ WARNING

If a serious leak is present in the induction manifold, fuel may spray out of bad seal. Have clean up rags available to remove excess fuel from components.

4. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW terminal on the switch box to engine ground.
5. Connect remote starter Quicksilver (91-52024A1) to NEGATIVE terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



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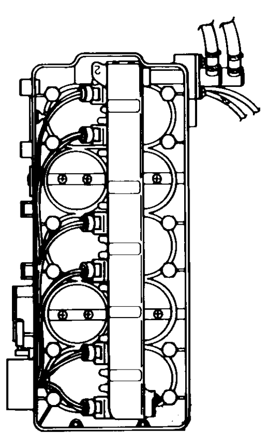
6. Look for leak points on induction manifold while depressing remote starter switch.



Results: If no leaks are present, replace cover and gasket using normal length screws.

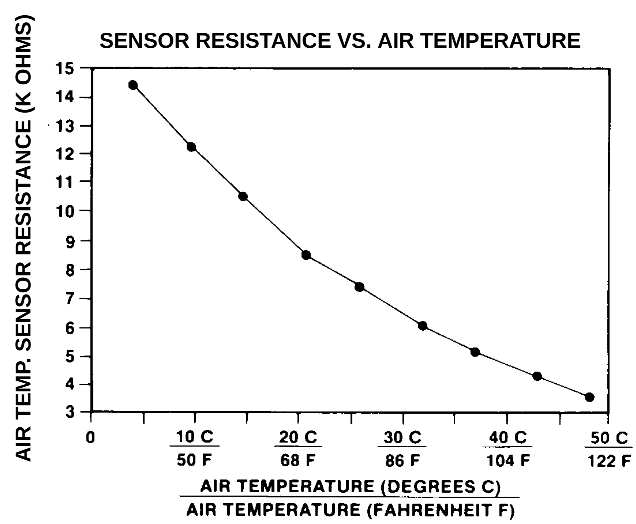
If fuel leak is present between sealing surfaces, rebuild system using new O-rings.

Air Temperature Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to air temperature sensor.

1. Disconnect and remove Air Temperature Sensor from induction manifold.
2. Connect digital meter set at "20K scale" (from EFI Tester P/N 91-11001A2) to leads of sensor.
3. Place sensor in ice water while monitoring meter reading. Use graph (below) for reference.

NOTE: *Temperature/resistance reading may differ slightly from graph curve.*



Results: Resistance does not change inversely with temperature change. Replace defective Air Temperature Sensor.

Resistance changes inversely with temperature change. Air Temperature Sensor OK.

Engine Head Temperature Sensor Test

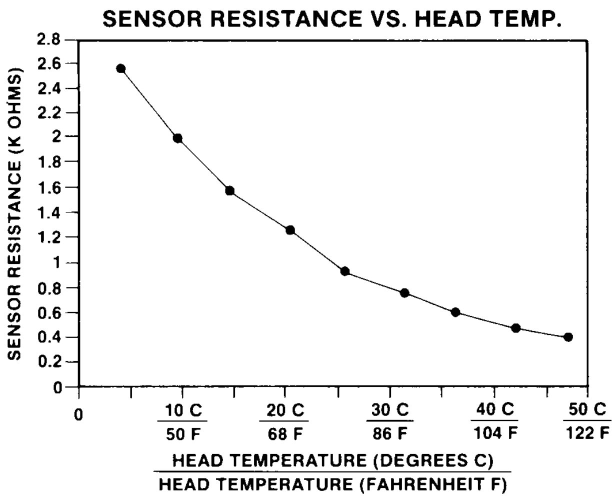
Purpose: This test eliminates possibilities of improper fuel delivery related to the water temperature sensor.

1. Disconnect and remove Engine Head Temperature Sensor (see page 3D-44).

2. Connect Digital Meter set at "2K Scale" (from EFI Tester P/N 91-11001A2) to bullet leads of sensor.

3. Place sensor in ice water while monitoring meter reading. Use graph (below) for reference.

NOTE: *Temperature/resistance reading may differ slightly from graph curve.*



Results: Resistance does not change inversely with temperature change. Replace defective Engine Head Temperature Sensor.

Resistance changes inversely with temperature change. Engine Head Temperature Sensor OK.

Detonation Control System Test (200 Models Only)

Purpose: This test eliminates possibilities of improper fuel delivery due to failure in detonation control.

1. Place outboard in water, install timing light to number one cylinder.

2. Start engine, allow to warm up. Advance throttle (between 3000-3500 RPM in gear). NOTE: Timing advancement.

Results: Timing advances from 19° to 25° BTDC system functioning properly.

Timing advance from 19° to 25° but retards while maintaining a steady throttle position. System functioning properly detonation may be occurring. See Detonation Sensor/Module Checks (following).

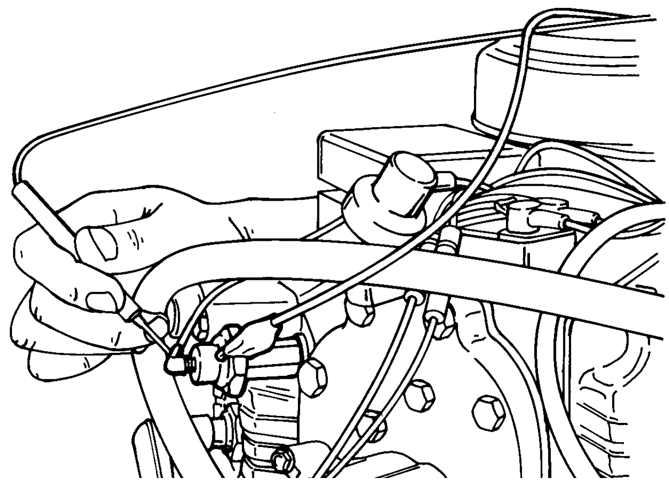
Timing advancement does not occur (19° to 25° BTDC). System functioning properly detonation may be occurring. See Detonation Sensor/Module Checks (following).

Detonation Sensor Check

IMPORTANT: When testing detonation control system keep all test leads away from high tension leads (i.e. spark plug lead, electrical wiring etc.) to avoid false readings.

Purpose: This check will determine if sensor is correctly signaling control module.

1. Connect Digital Volt Meter (from EFI Tester P/N 91-11001A2) to detonation sensor as shown. RED "V-Ω" test lead to sensor terminal, BLACK "com" test lead to sensor housing (ground).



51794

2. Turn meter dial to 200 MV volts, AC position and power switch in ON position. Place outboard in water.

3. Start and operate engine at idle speed.

4. Check meter reading. A typical reading of 0.075 to 0.120 volts AC should be present.

NOTE: *As RPM increases, volt readings will increase.*

Results: If voltage reading is not within 0.075 to 0.120 volts AC replace detonation sensor. Torque sensor to 144 lb. in. (16.0 N·m).

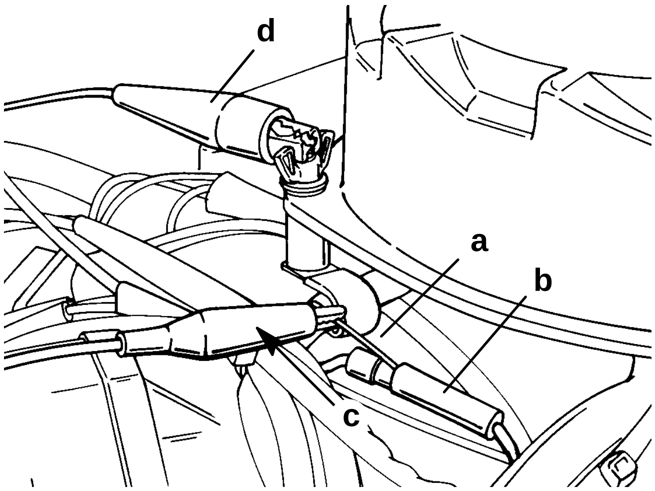
If voltage reading is within 0.075 to 0.120 volts AC perform check on detonation control module.

IMPORTANT: Handle detonation sensor with care when testing or replacing. Rough handling could cause undetectable internal damage causing false readings to be transmitted to detonation module.

Detonation Control Module Check

Purpose: This check will determine if control module is correctly signaling ECM when signals are received from sensor.

1. Insert probe (a) (i.e. paper clip) to gray/white wire connector (b). Connect digital volt meter (from EFI tester 91-11001A2) positive clip (c) to probe and ground clip to engine ground (d) as shown.



51795

a - Probe
b - Connector
c - Positive Clip
d - Ground Clip

2. Turn meter dial to 20 volts DC position and power switch in ON position. Place outboard in water.
3. Start and operate engine at idle.
4. Check meter reading. A reading between 0.30 to 0.70 volts DC should be attained.
5. Increase engine speed (with engine in gear) between 3000-4000 RPM. Check meter reading. A typical reading should be 0.01 volts DC.

Results: If meter reading is 0.30 to 0.70 volt DC at idle and 0.01 volts DC at 3000-4000 RPM, detonation control unit is functioning properly (no detonation occurring).

If voltage reading does not fall within range (0.30 to 0.70 volts DC) at idle, control module may be bad.

If voltage reading is above 0.01 volts DC and between 1.0 to 6.6 volts DC at 3000 to 4000 RPM detonation is occurring. A constant voltage of 6.6 volts DC would indicate bad detonation control module.

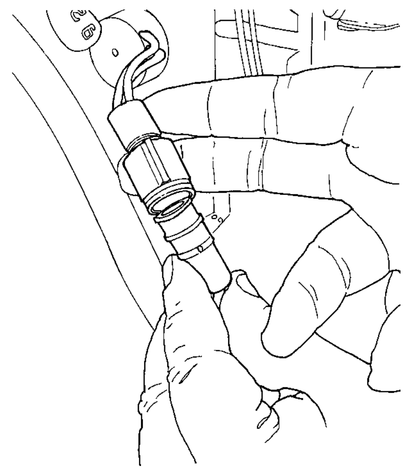
Throttle Position Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the throttle position indicator. Refer to EFI electrical system and ECM test.

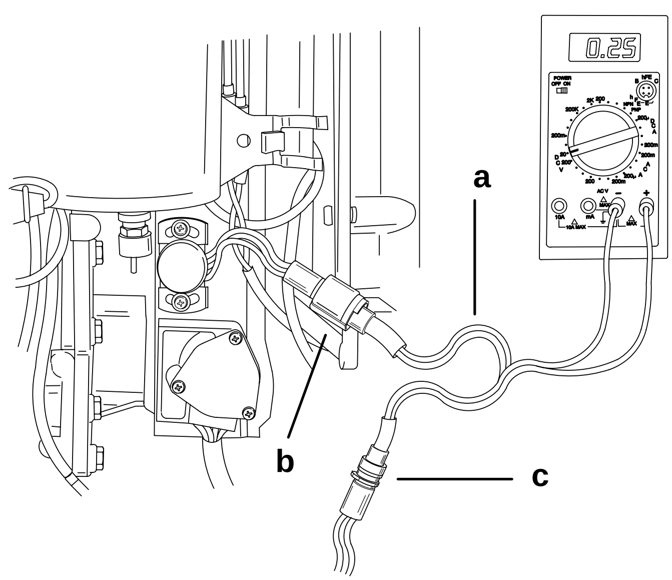
NOTE: *Engine harness MUST BE disconnected from the EFI tester 91-11001A2 and reconnected in the normal running configuration in order to test or adjust the throttle position sensor.*

IMPORTANT: TPS can be adjusted using a digital meter. Analog (needle) type may be used although it may be difficult to read the low voltage setting accurately with most meters.

1. Disconnect TPS from EFI harness.



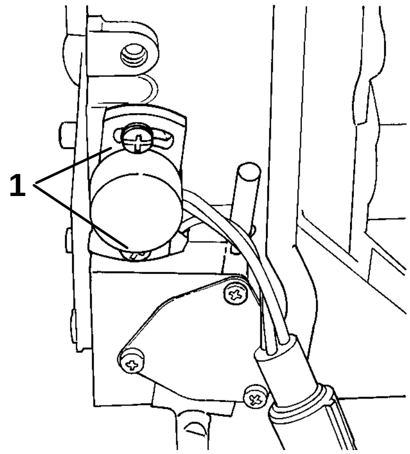
2. Connect digital using TPS Test Lead Assembly (a) (P/N 91-816085) between TPS connector (b) and EFI harness connector (c). Set voltmeter to 2 DC volts.



55198

IMPORTANT: TAN/BLK head temperature leads must be disconnected from port cylinder head before adjusting TPS.

3. Disconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.
4. Turn key to the “ON” position.
5. Loosen screws (1) securing TPS to manifold.



6. Rotate TPS fully clockwise (holding throttle shaft in closed position). Voltmeter should read **.200 - .300**. If readout is not within specifications, adjust TPS to obtain readout of **.240 - .260.**
7. Tighten TPI screws to 20 lb. in. (2.0 N·m) holding correct tolerance.
8. Disconnect remote control cable from throttle lever.
9. Slowly move throttle lever to full open position while monitoring voltage reading. Voltage reading should increase and decrease smoothly.
10. Set volt meter to 20 DC volts. Maximum voltage reading at full throttle is approximately 7.46 volts.
11. Remove test lead and reconnect TPI harness to EFI harness.
12. Reconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.

NOTE: *If engine appears to run too rich or too lean, TPI can be readjusted. Decreasing voltage yields leaner mixture. Increasing voltage yields richer mixture.*

Map Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery caused by the map sensor. Refer to Electronic Fuel Injection Tester (91-11001A2) and its test manual. The Digital Diagnostic Terminal (91-823686A2) may also be used to test the MAP Sensor. It will display an LED failure light, a PASS/NO operational indication as well as a numeric display value.

Problem Diagnosis

Condition	Possible Source	Action
Engine Down On Power Or RPM	– Failed Switch Box	Refer to Section 2 Electrical and Ignition Tests.
	– Failed Stator	Refer to Section 2 Electrical and Ignition Tests.
	– Failed Coil	Refer to Section 2 Electrical and Ignition Tests.
	– Low Compression	Refer to Section 4 Power Head.
	– Broken Reed	Perform Injector Fuel Delivery Test (page 3D-34)
	– Fuel Delivery Problem	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart.
	– Manifold Fuel Leak	Perform Induction Manifold Leak Check (page 3D-36).
	– Model 200 only – Detonation Control System Activated Or Failed.	Perform Detonation Control Module Check (page 3D-38).
	– Vapor Separator Flooding Over, Engine Running Rich.	Check for fuel coming out of vapor separator vent hose.
	– Cylinder Head Temperature Sensor Circuit Failed.	Check cylinder head temperature sensor (page 3D-37).
Poor Acceleration – Idles Ok, Top Speed Ok	– Improper EFI Set Up.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– Water Covering Idle Relief Exhaust Ports.	Boats with extended transoms or low engine mount can cause engine to load up on acceleration.
	– T.P.S. Failure.	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.
	– MAP Sensor Failure	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.
	– R.F.I. Problem*	Install BUZ8H Spark Plugs.

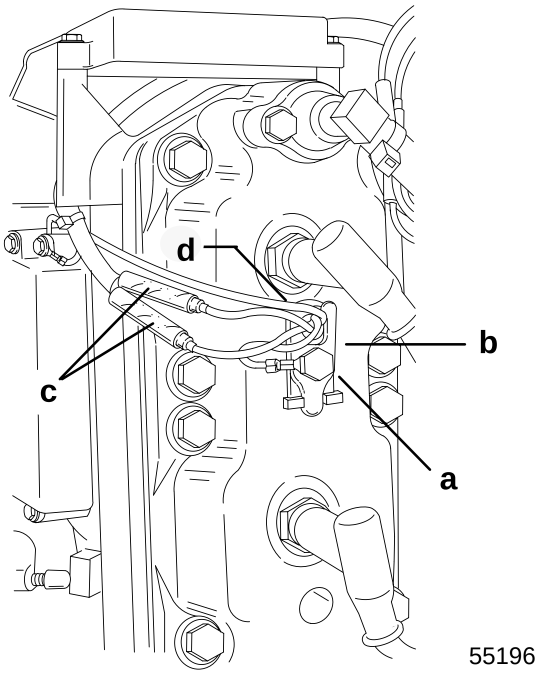
Condition	Possible Source	Action
Poor Acceleration – Idles Ok, Top Speed Ok (Continued)	– Timing Not Advancing.	Check for stuck trigger.
Engine Surges Between 4000 And 5000 RPM	– Intermittant Switch Box Failure.	Refer to Section 2 Electrical and Ignition for tests.
	– Final Filter Clogging.	Perform Final Filter Check (page 3D-29).
	– T.P.S. – Improper Adjustment.	Refer to Section 2 Electrical and Ignition for T.P.S. adjustment.
	– Detonation Control (Model 200 Only).	Perform Detonation Test (page 3D-38).
	– Injector Connector Problem.	Perform Injector Fuel Delivery Test (page 3D-34).
	– Vapor Separator Flooding Over.	Check for fuel coming out of vapor separator vent hose.
	– Injector Filter Clogged.	Refer to Injector Fuel Delivery Test (page 3D-34).
Engine Idles Ok But Stumbles At Off Idle Speeds	– Improper EFI Setup.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– Failed Switch Box.	Refer to Section 2 Electrical and Ignition Tests.
	– Failed Or Disconnected EFI Sensors.	Perform EFI sensor tests (pages 3D-35 thru 3D-40).
	– Fuel Delivery Problem.	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart (pages 3D-23 thru 3D-25).
	– Manifold Fuel Leak.	Perform Induction Manifold Leak Check (page 3D-36).
	– R.F.I.* Problem.	Install BUZ8H Spark Plugs.
	– Stator (High Speed Winding).	Refer to Section 2 Electrical and Ignition for tests.
	– Induction Manifold Air Leak.	Check manifold cover gasket, manifold to reed block housing gasket and reed block housing to crankcase gasket.
Engine Idles Rough (May Lean Sneeze) – Acceleration Ok; Full Throttle Ok	– Improper EFI Setup.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– MAP Sensor Failure.	Refer to Electronic Fuel Injection Tester Manual 91-11001A2.

Condition	Possible Source	Action
Engine Idles Rough (May Lean Sneeze) – Acceleration Ok; Full Throttle Ok. (continued)	– Low Speed Winding Failure. – Broken Reed.	Refer to Section 2 Electrical and Ignition Tests. Perform Injector Fuel Delivery Test (page 3D-34).
Engine Runs but Slowly Drops RPM then Dies.	– Restrictions in Fuel System (Be tween Tank and Engine. – Clogged Final Filter. – Pulse Fuel Pump Failure. – Electric Fuel Pump Delivery Failure.	Install remote gas tank with fresh, high quality fuel. Perform Final Filter Check (page 3D-29). Follow Low Pressure Fuel Route Flow Chart (page 3D-23). Follow High Pressure Fuel Route Flow Chart (page 3D-24).
Engine Stops for No Apparent Reason or Does Not Start.	– Battery Undercharged. – EFI Harness Connections. – Ignition System Failure. – Pulse Fuel Pump Failure. – Electric Fuel Pump Failure. – ECM Failure.	Check battery connections, under charged battery or worn out battery. Check EFI harness connector for improper connection. Refer to Section 2 Electrical and Ignition Tests. Follow Low Pressure Fuel Route Flow Chart (page 3D-23). Follow High Pressure Fuel Route Flow Chart (page 3D-24). Refer to Electronic Fuel Injection Tester Manual 91-11001A2.
Engine Stops for No Apparent Reason , but will Restart.	– Battery Overcharged. – Restriction in Fuel System	Check battery voltage with engine running. Should be less than 15.5 volts. Refer to Service Bulletin 96-2. Check fuel pressure on fuel rail at the RPM that failure occurs.

*R.F.I. Radio Frequency Interference. High voltage can alter signals ECM receives from sensors causing improper fuel delivery. Route all sensor wires away from high voltage leads (i.e. spark plug leads)

Engine Head Temperature Sensor Removal

1. Remove screw and retaining plate.
2. Disconnect wires and remove sensor.

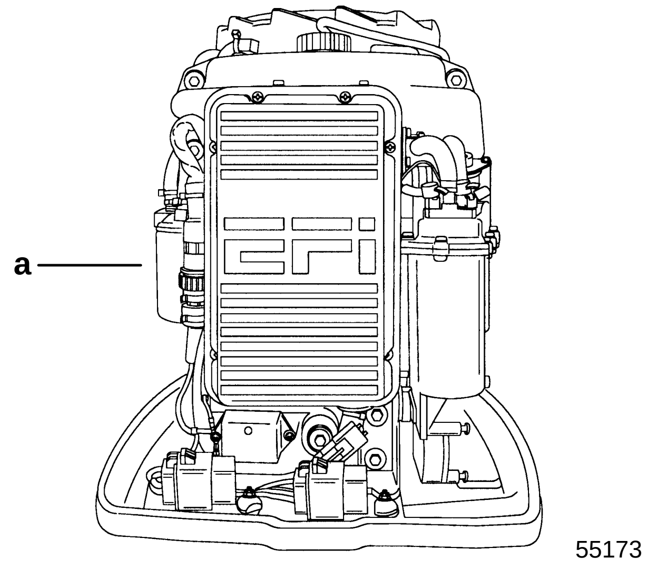


a - Screw
b - Retaining Plate
c - Wires
d - Sensor

EFI Induction Manifold Removal

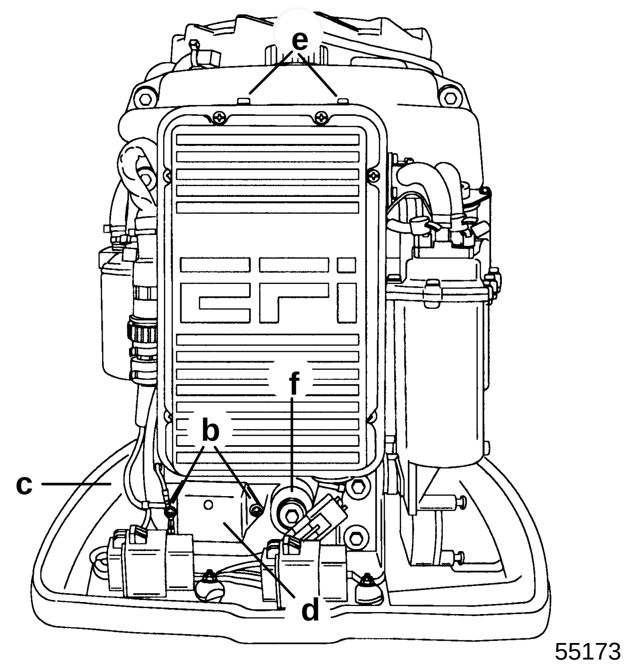
IMPORTANT: Remove battery cables from battery before Induction Manifold Removal and Disassembly.

1. Disconnect ECM at harness connector.



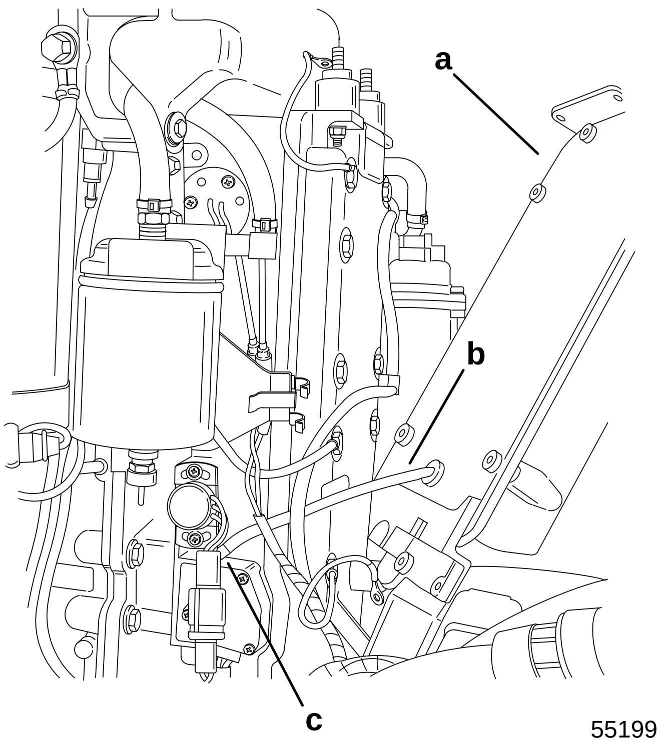
a - Connector

   a. Remove screws (b) and ground wires (c).
   b. Remove water sensing module (d).
   c. Remove nuts (e) and screw (f).



b - Screws
c - Ground Wires
d - Water Sensing Module
e - Nuts
f - Screw

2. Carefully raise ECM from studs. Disconnect MAP sensor hose at manifold fitting and remove ECM.

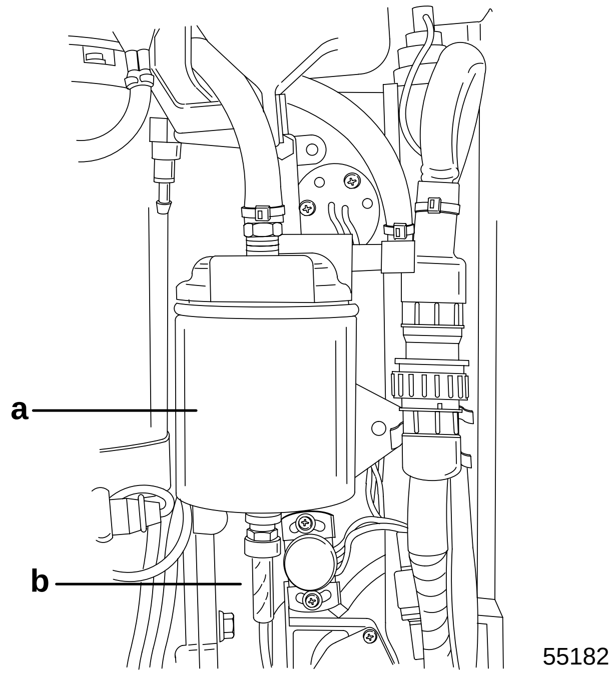


a - ECM
b - MAP Sensor Hose
c - Manifold Fitting

Water Separating Filter Assembly Removal

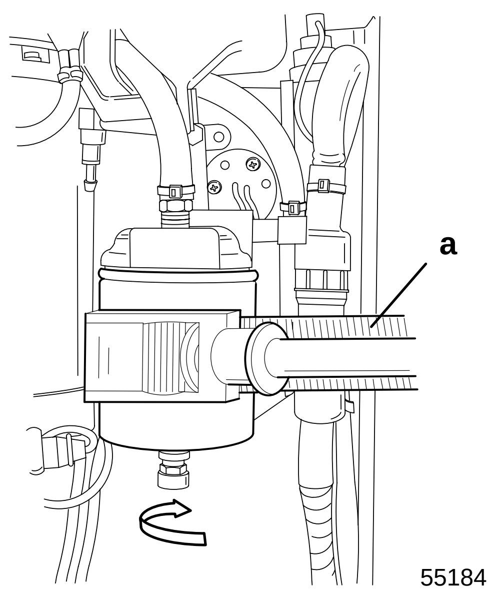
NOTE: *To inspect or replace water separator, it is not necessary to remove inlet and outlet fuel lines or to unbolt bracket from manifold.*

1. Remove water sensor lead from bottom of separator.



a - Water Separator
b - Water Sensor Lead

2. With wipe towels available, use Strap Wrench (91-24937A1) to remove water separator.

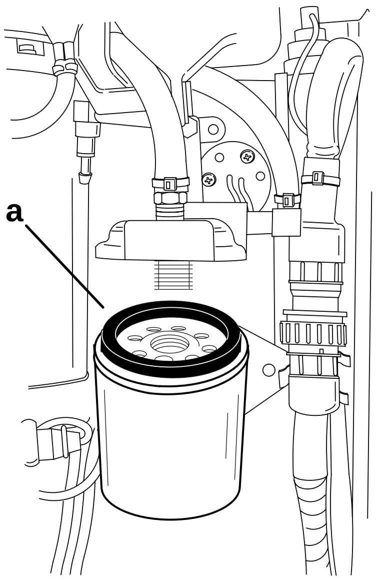


a - Strap Wrench (91-24937A1)

Water Separating Filter Assembly Installation

IMPORTANT: Apply a light coat of outboard oil to the rectangular sealing ring on the water separator before installation.

1. After applying oil to sealing ring of water separator, install separator onto bracket.
2. HAND TIGHTEN SEPARATOR. DO NOT use strap wrench or other tool to tighten separator.
3. Reconnect water sensor lead to bottom of separator.

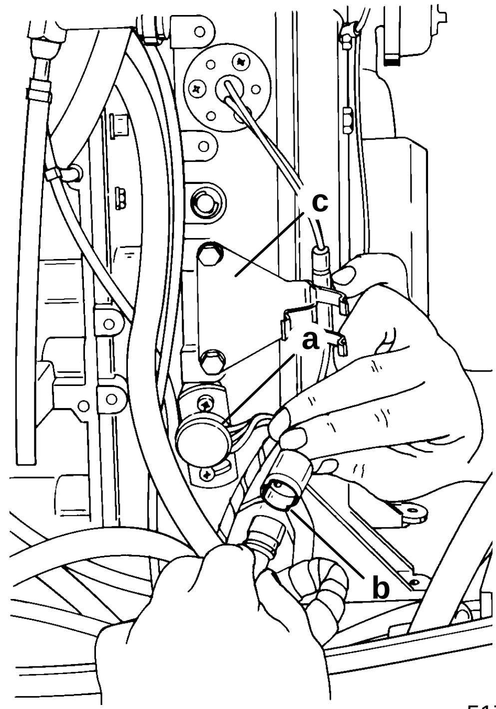


55185

a - Sealing Ring

Throttle Position Sensor and Temperature Sensor Fuel Injector Harness Disconnections

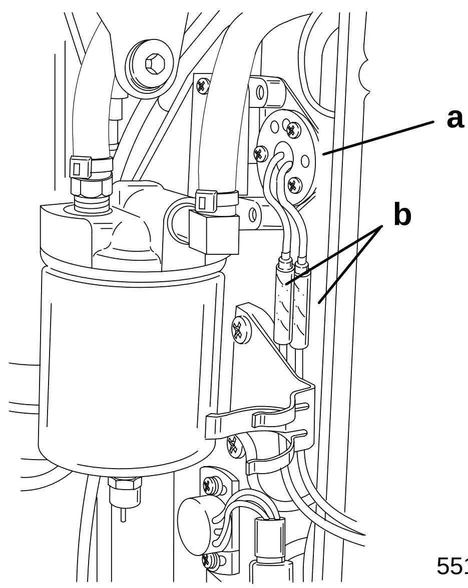
1. Disconnect throttle position sensor at 3 pin connector and remove ECM harness bracket.



51787

a - Throttle Position Sensor
b - 3 Pin Connector
c - Bracket

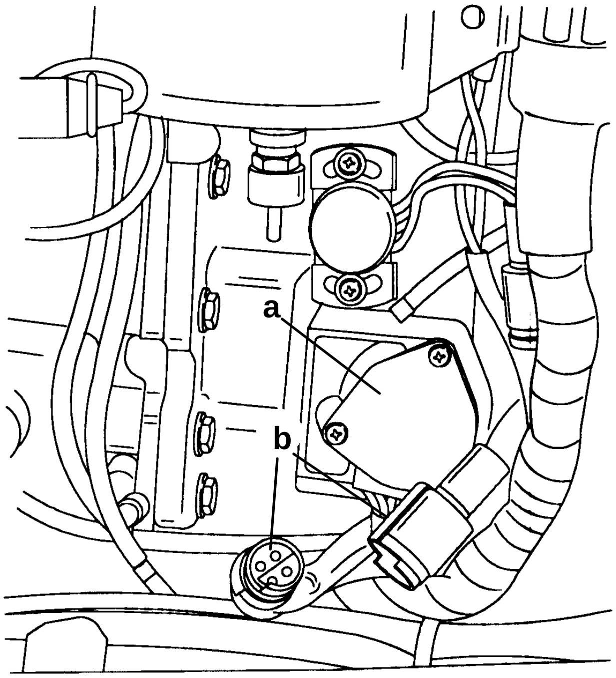
2. Disconnect air temperature sensor at connectors.



55195

a - Air Temperature Sensor
b - Connectors

3. Disconnect fuel injector harness at 4 pin connector.

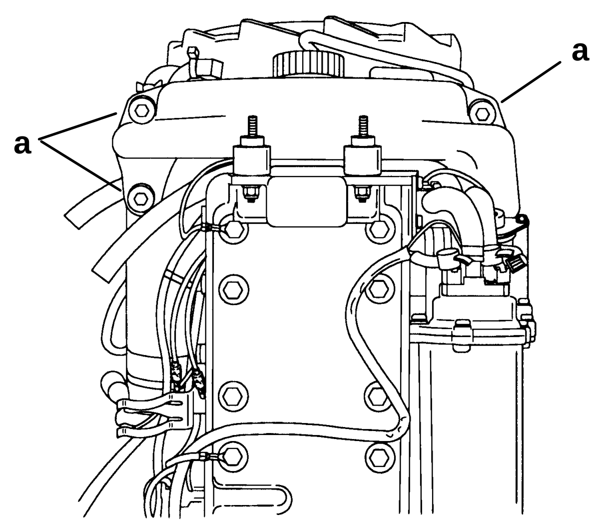


55193

a - Fuel Injector Harness
b - 4 Pin Connector

Oil Reservoir Removal

1. Remove 3 screws.



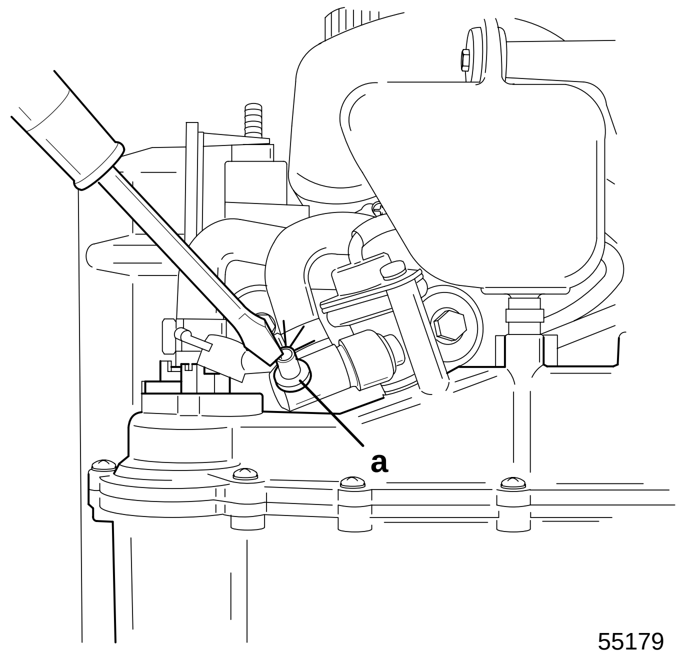
55201

a - Screws

2. Remove hose clamp and lift oil reservoir from engine.

Fuel Pressure Regulator Removal

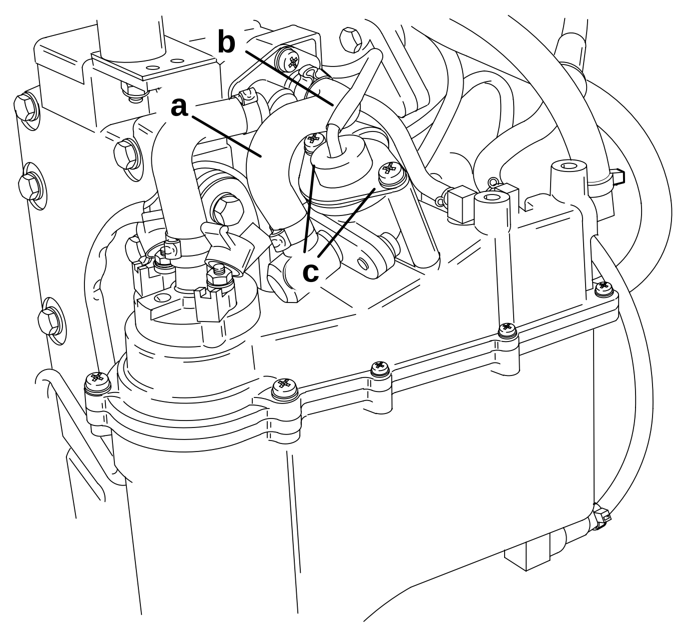
1. Disconnect boat battery from engine harness.
2. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

a - Pressure Port

3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.

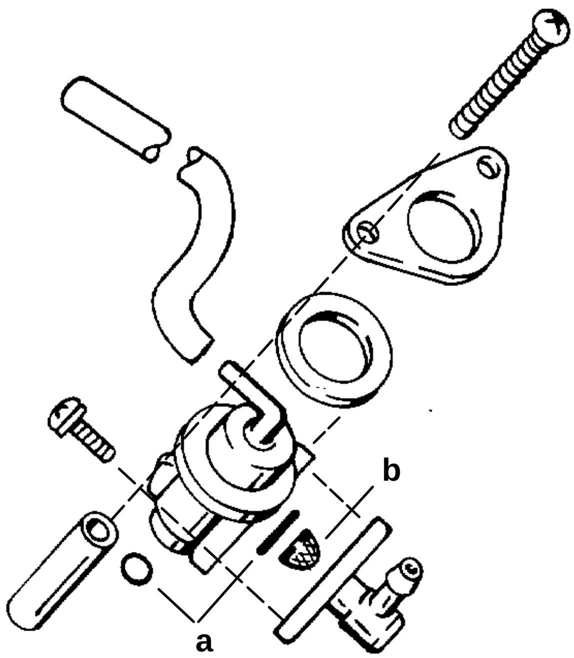


55204

a - Return Fuel Line
b - Regulator Hose
c - Screws

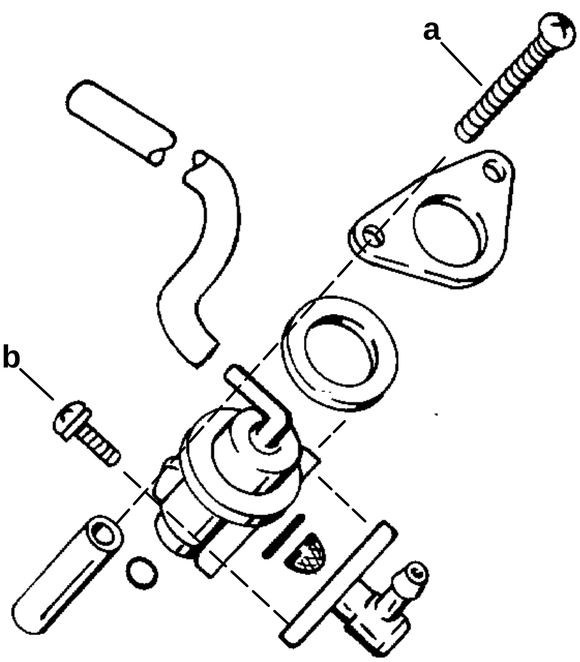
Fuel Pressure Regulator Disassembly

1. Inspect O-rings for cuts and abraisions. Replace as required.
2. Inspect fuel filter for debris. Clean with solvent as required.



a - O-rings
b - Filter

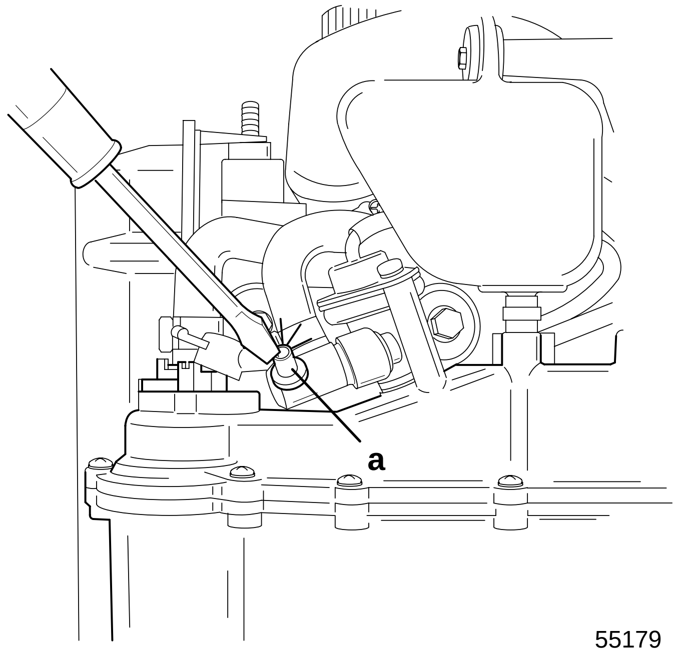
Fuel Pressure Regulator Reassembly



a - Screw (2) [Torque to 30 lb. in. (3.5 N·m)]
b - Screw (2) [Torque to 45 lb. in. (5.0 N·m)]

Vapor Separator Removal

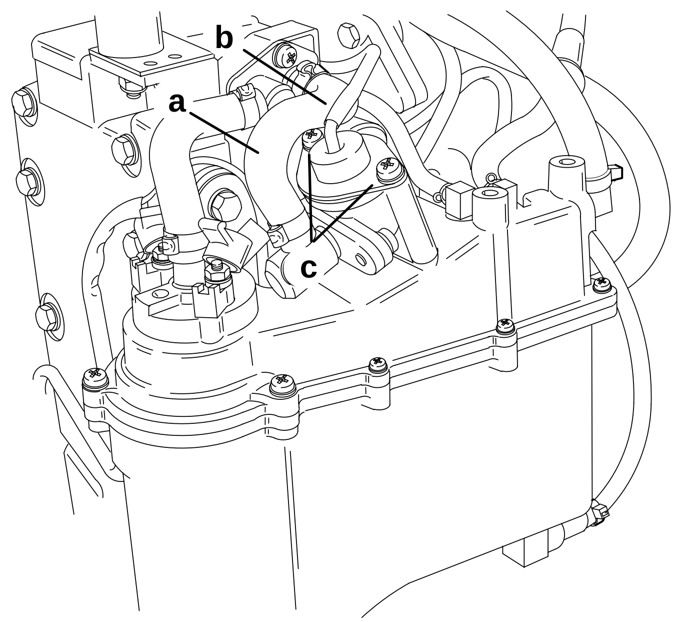
1. Disconnect boat battery from engine harness.
2. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

a - Pressure Port

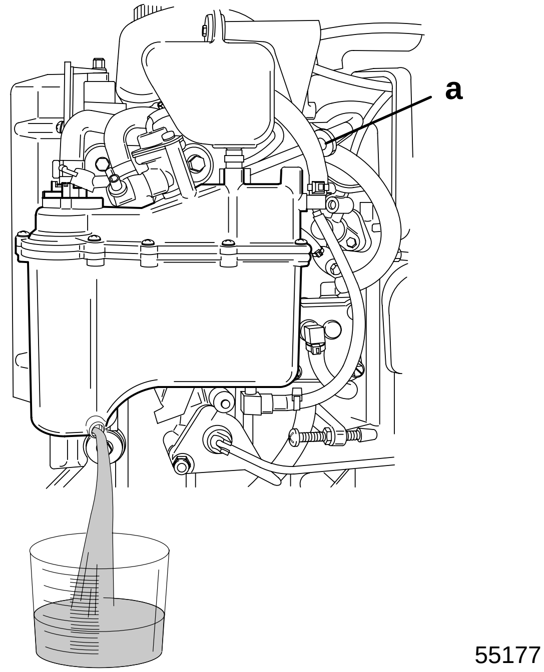
3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.



55204

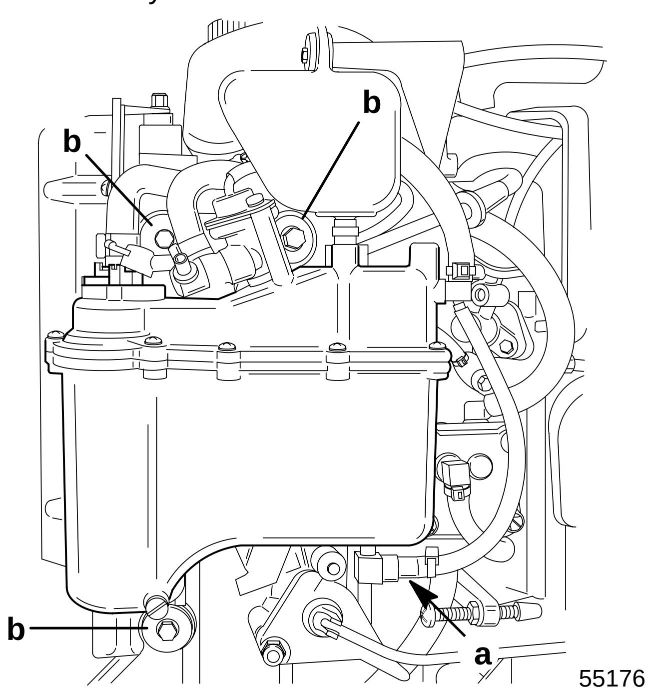
a - Return Fuel Line
b - Regulator Hose
c - Screws

6. Remove drain screw from separator and drain fuel into suitable container.
7. Remove fuel inlet hose to vapor separator.



a - Fuel Inlet Hose

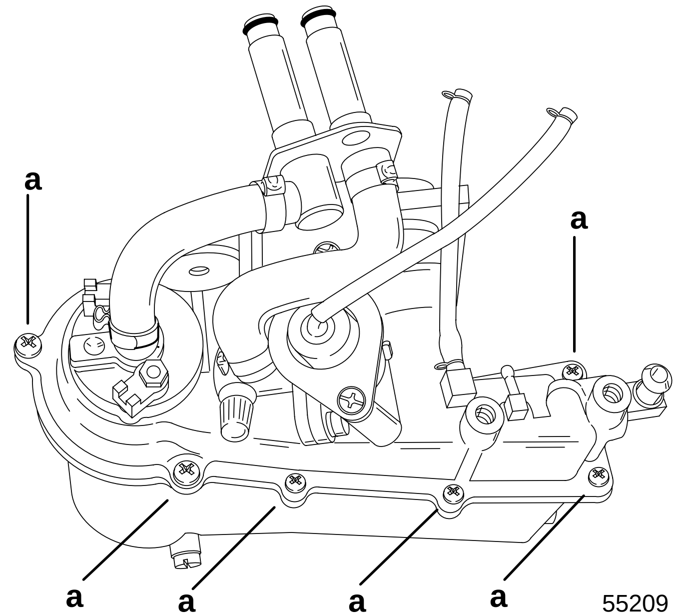
8. Disconnect and plug oil inlet hose to vapor separator.
9. Remove 3 bolts securing separator to manifold assembly.



a - Oil Inlet Hose
b - Bolts

Vapor Separator Disassembly

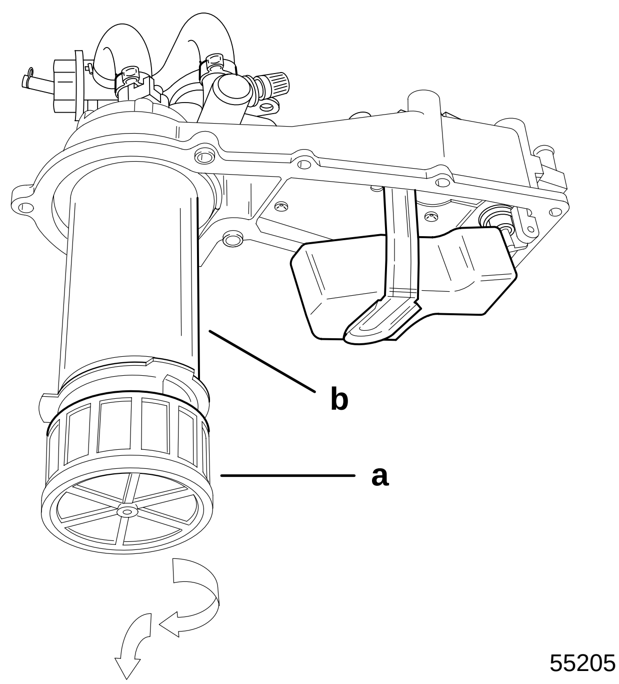
Remove 9 screws securing cover to vapor separator and remove separator tank.



a - Screws (4 screws are hidden on back side)

FINAL FILTER REMOVAL

Rotate final filter counterclockwise and pull down.

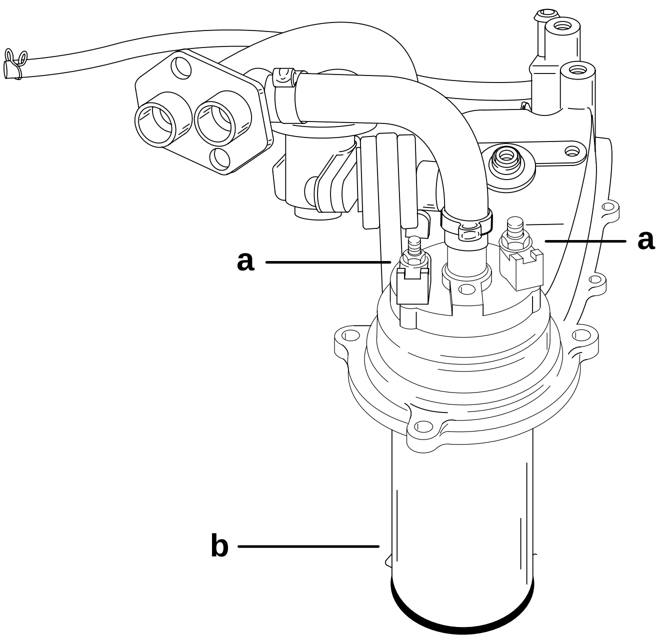


a - Final Filter
b - Electric Fuel Pump

ELECTRIC FUEL PUMP REMOVAL

NOTE: *There are no individually replaceable parts within the electric pump. If brushes or armature fails, entire pump must be replaced.*

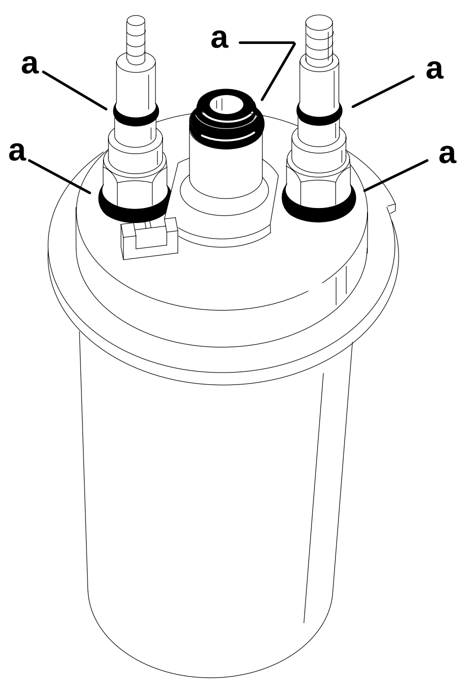
1. Remove 2 nuts on POSITIVE and NEGATIVE terminals. Remove pump from separator cover.



55206

a - Nuts
b - Pump

2. Inspect pump O-rings for cuts or abraisions. Replace O-rings as required.



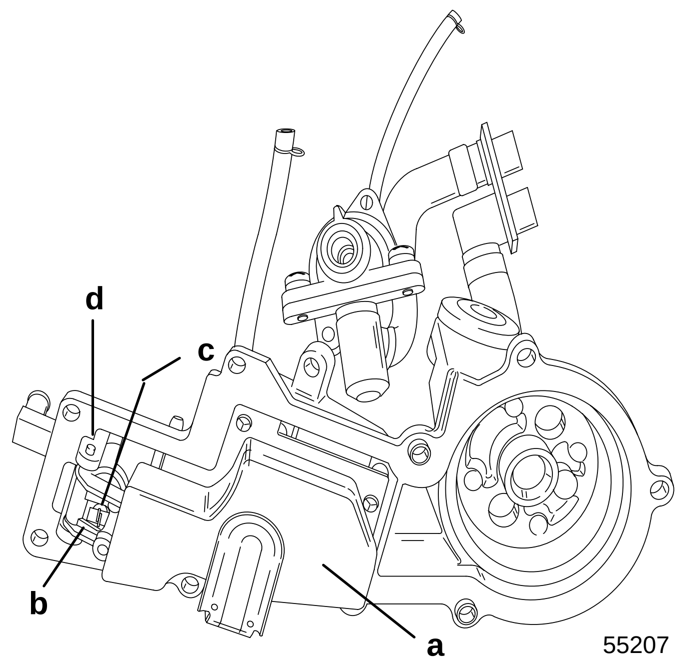
53702

a - O-rings

VAPOR SEPARATOR FLOAT REMOVAL

NOTE: *Inspect float for fuel absorbtion or deterioration. DO NOT attempt to bend float arm to adjust float height. Float height is preset at factory. Inspect float needle for grooves. Inspect needle seat for debris or corrosion. Replace float, needle and seat* as required.*

1. Remove float pivot pin.
2. Remove float and needle for inspection. Replace as required.



55207

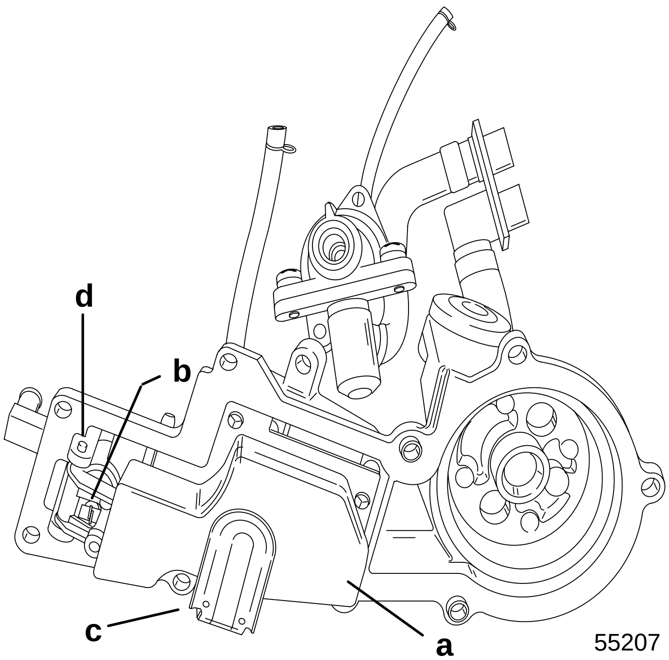
a - Float
b - Float Arm
c - Float Needle (Hidden)
d - Pivot Pin

*Seat and separator cover must be replaced as an assembly.

Vapor Separator Reassembly

VAPOR SEPARATOR FLOAT INSTALLATION

1. Attach float needle to float arm.
2. Guide float/needle assembly under float drop limit bracket and place needle into seat.
3. Slide pivot pin through float arms.
4. Verify float's freedom of movement through pivot range.



a - Float
b - Float Needle (Hidden)
c - Float Drop Limit Bracket
d - Pivot Pin

ELECTRIC FUEL PUMP INSTALLATION

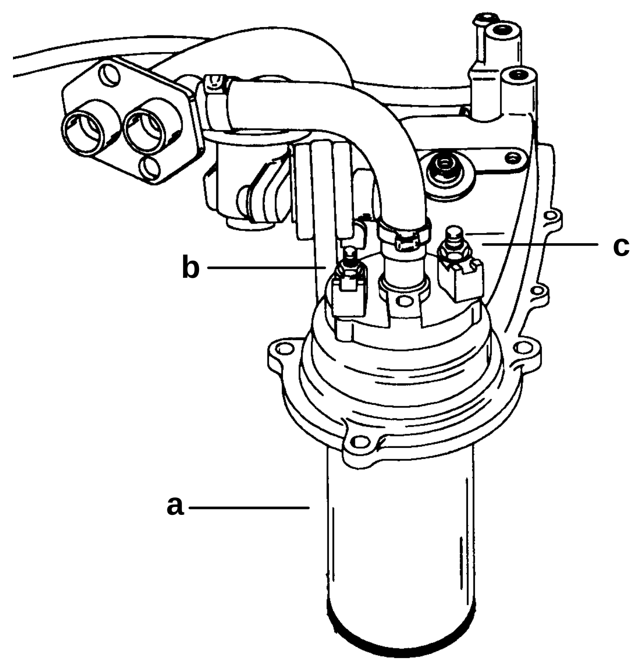
1. Slide fuel pump into separator cover.

NOTE: *Fuel pump electrical studs are different diameters. Pump will install properly into cover only one way.*

CAUTION

DO NOT over torque fuel pump POSITIVE and NEGATIVE attaching nuts as damage to fuel pump will result.

2. Secure pump to cover with 2 nuts. Torque POSITIVE nut to 6 lb. in. (0.7 N·m). Torque NEGATIVE nut to 8 lb. in. (0.9 N·m).



a - Electric Pump
b - POSITIVE (+) Stud (Small Diameter)
c - NEGATIVE (–) Stud (Large Diameter)

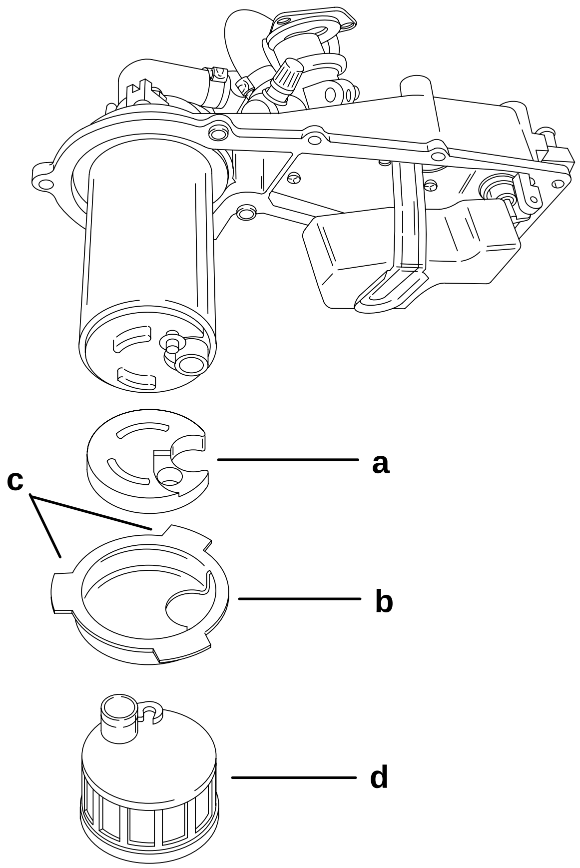
3. Install rubber pad on bottom of pump.

NOTE: *Rubber pad is molded to fit flush on bottom of pump on one side only.*

4. Install pump support ring.

NOTE: *Pump support ring fits over pad onto pump properly only one way (Tabs face up).*

5. Install final filter into pump bottom. Rotate filter clockwise to lock filter onto pump.

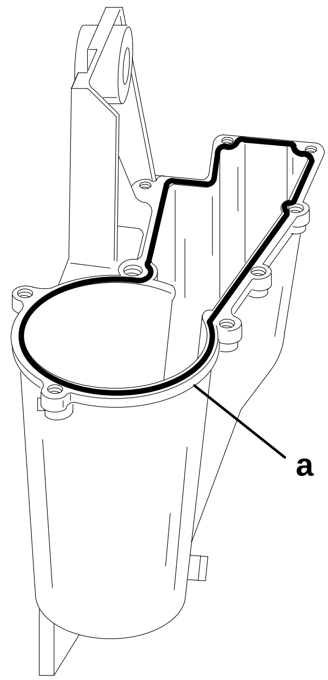


a - Rubber Pad
b - Support Ring
c - Tabs (face up)
d - Final Filter

INSTALLING SEPARATOR COVER ASSEMBLY ONTO SEPARATOR TANK

1. Inspect separator tank sealing O-ring for cuts or abraisions. Replace O-ring as required.

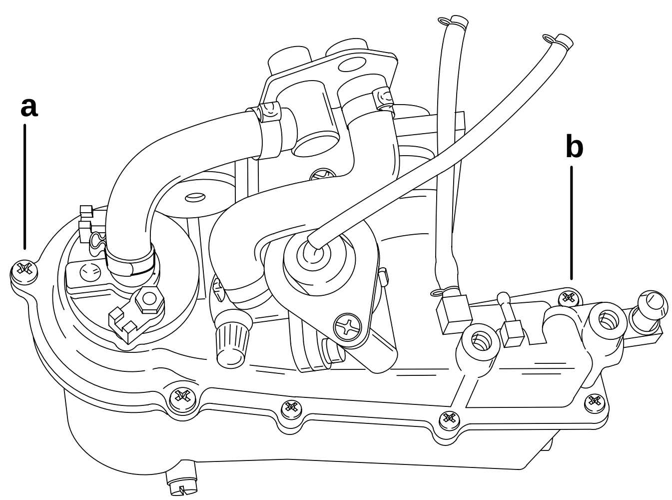
NOTE: *If O-ring swells due to fuel and air exposure and will not fit in tank O-ring groove, replace O-ring. DO NOT cut O-ring to make it fit as fuel leakage will result.*



53701

a - O-ring

2. Install cover assembly onto separator tank. Secure cover to tank with 9 screws. Torque 5mm screws to 30 lb. in. (3.5 N·m). Torque 4mm screws to 20 lb. in. (2.5 N·m).

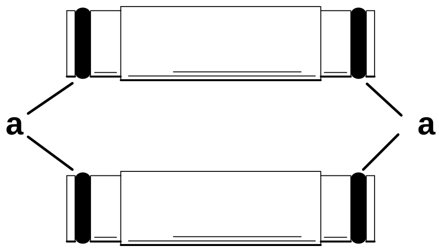


55209

a - Large Screws (4) (5mm) Torque to 30 lb. in. (3.5 N·m)
b - Small Screws (5) (4mm) Torque to 20 lb. in. (2.5 N·m)

Installing Vapor Separator Assembly to Induction Manifold

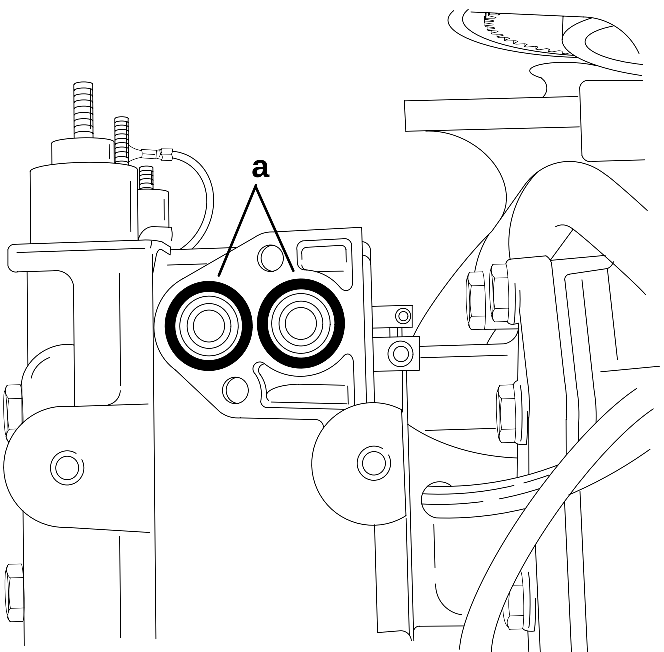
1. Inspect O-rings on ends of separator fuel tubes for cuts or abraisions. Replace O-rings as required.



55217

a - O-rings

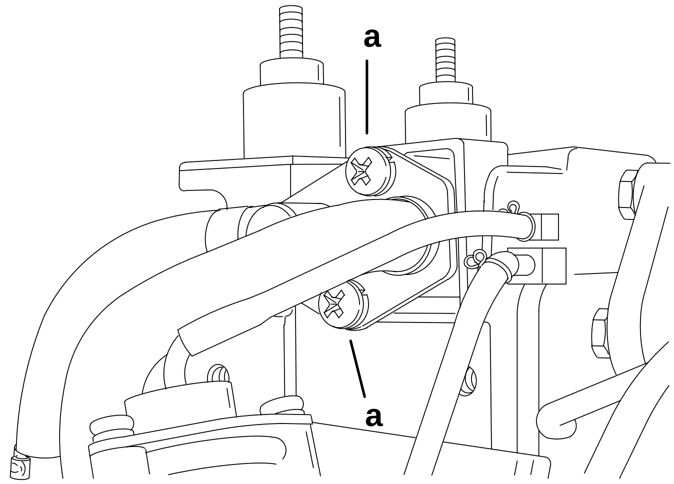
2. Install fuel tubes into manifold. Inspect adaptor plate O-rings for cuts or abraisions. Replace O-rings as required.



55215

a - O-rings

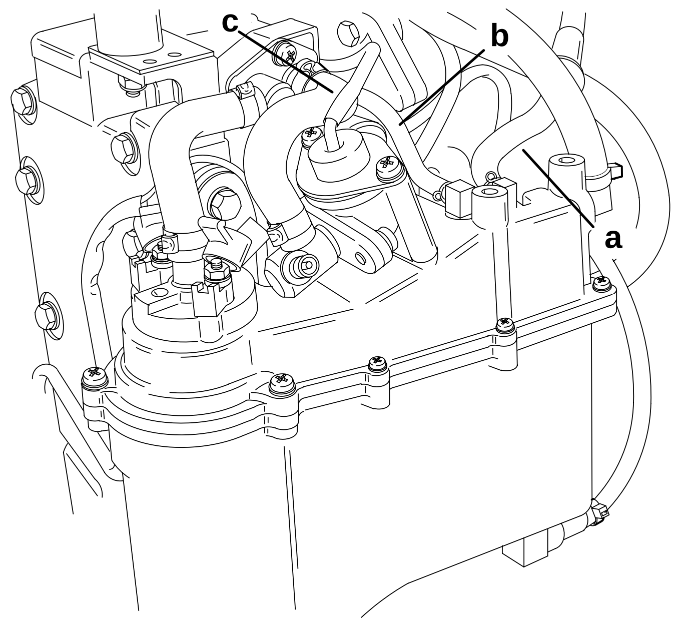
3. Secure adaptor plate to manifold with 2 screws. Torque screws to 45 lb. in. (5.0 N·m).



55216

a - Screws [Torque to 45 lb. in. (5.0 N·m)]

4. Reconnect engine bleed hose (with filter) to fitting on vapor separator.
5. Reconnect vapor separator over flow hose between separator and manifold.
6. Reconnect pressure regulator hose to top fitting on regulator.

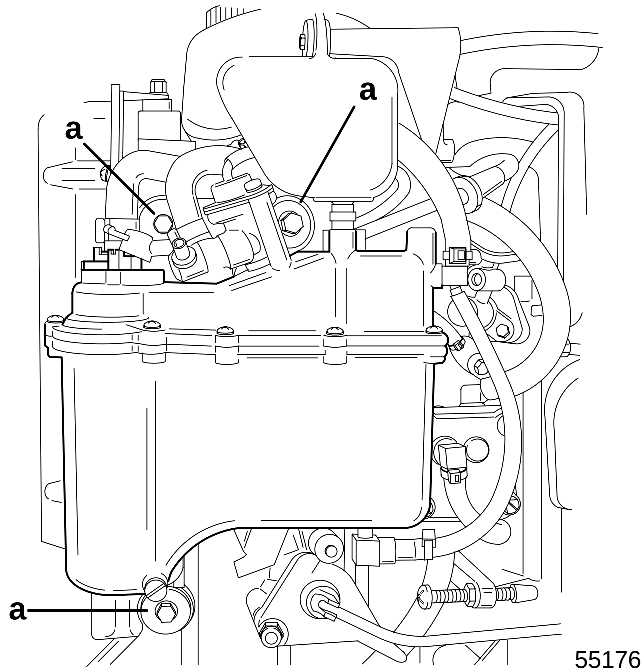


55204

a - Bleed Hose
b - Separator Over Flow Hose
c - Pressure Regulator Hose

NOTE: *For ease of reassembly, reinstall oil reservoir on engine BEFORE installing vapor separator.*

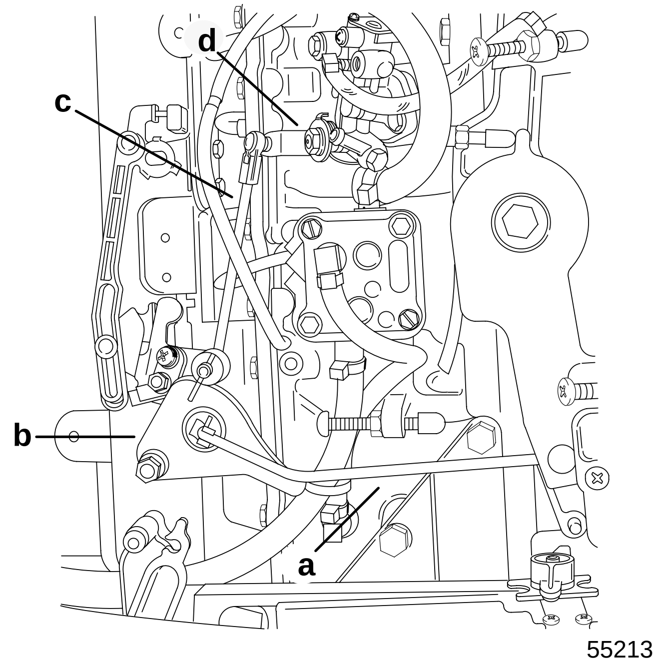
7. Secure separator to manifold with 3 bolts and washers. Torque bolts to 45 lb. in. (5.0 N·m).



a - Bolts and Washers [Torque bolts to 45 lb. in. (5.0 N·m)]

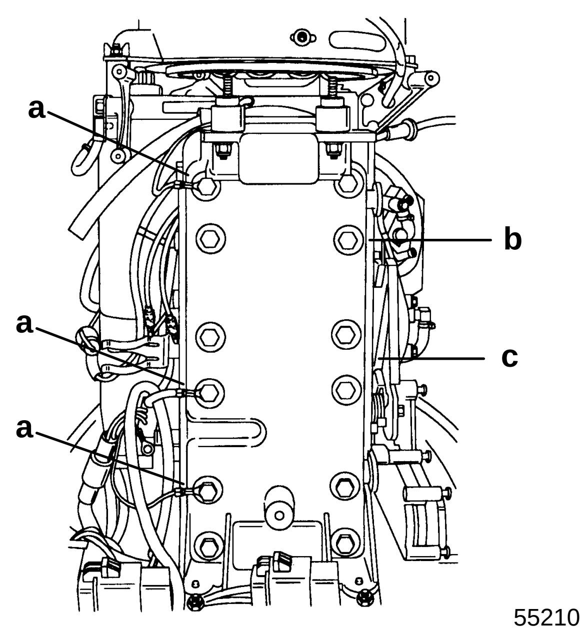
Manifold Removal

1. Disconnect throttle link rod from throttle cam.
2. Disconnect oil injection link rod from injector arm.



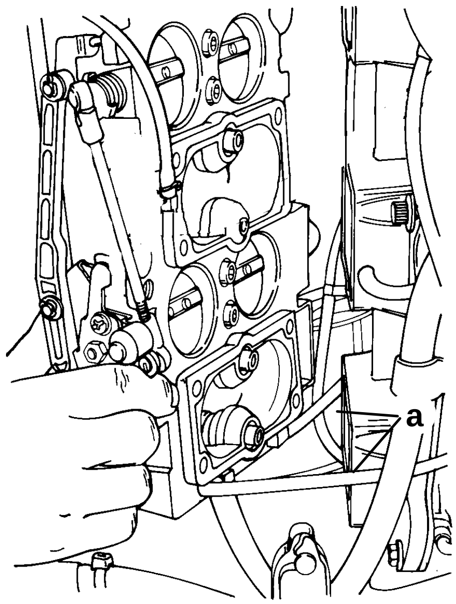
a - Throttle Link Rod
b - Throttle Cam
c - Oil Injection Link Rod
d - Injector Arm

3. Identify location of 3 ground wires for reassembly purposes.
4. Remove12 screws securing manifold cover to manifold.
5. Remove manifold cover.



a - Ground Wires
b - Screws (12)
c - Manifold Cover

6. Disconnect bleed line hoses from manifold fittings.
7. Remove manifold assembly and place on clean work surface.

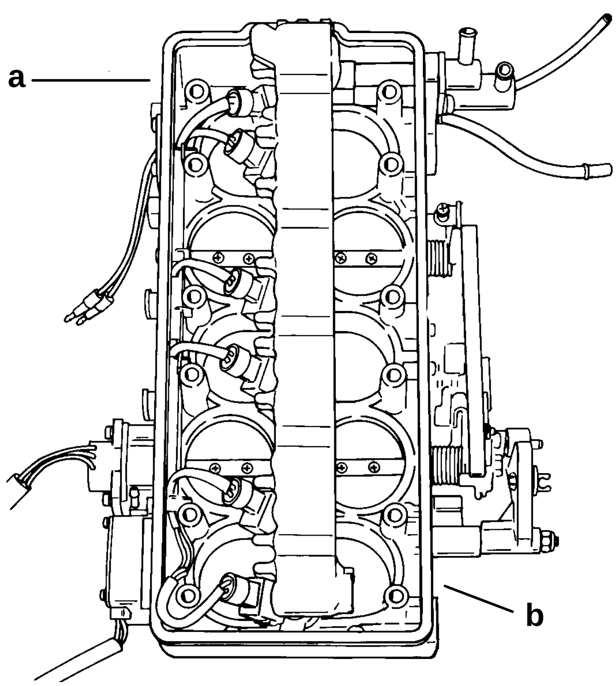


51795

a - Bleed Hoses

EFI Induction Manifold Disassembly

1. Remove manifold cover seal from manifold.

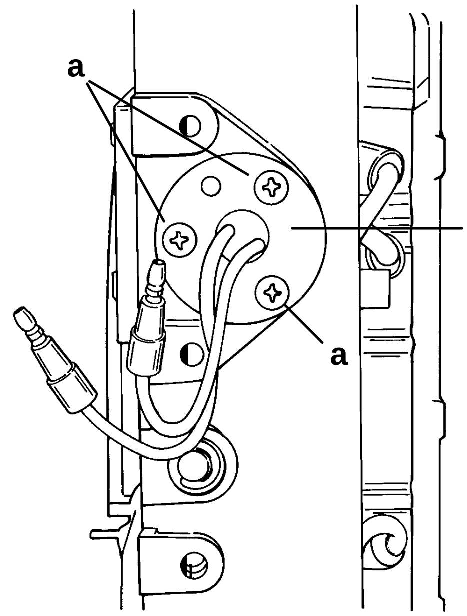


51785

a - Manifold Cover Seal
b - Manifold

Air Temperature Sensor Removal

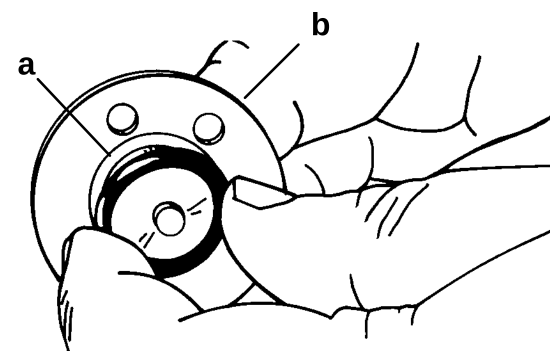
1. Remove screws and sensor.



51790

a - Screws
b - Sensor

2. Remove O-ring from sensor.



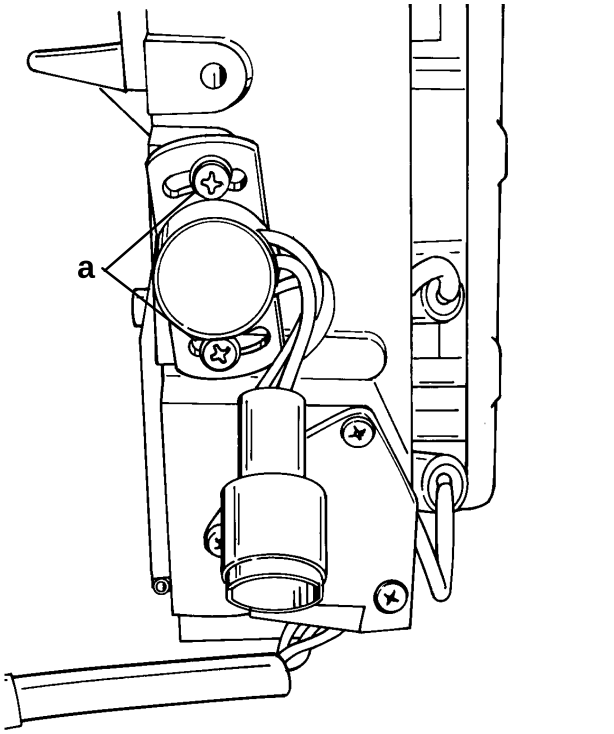
51791

a - O-Ring
b – Sensor

Throttle Position Sensor Removal

IMPORTANT: Sensor position will need to be set after induction manifold assembly has been installed.

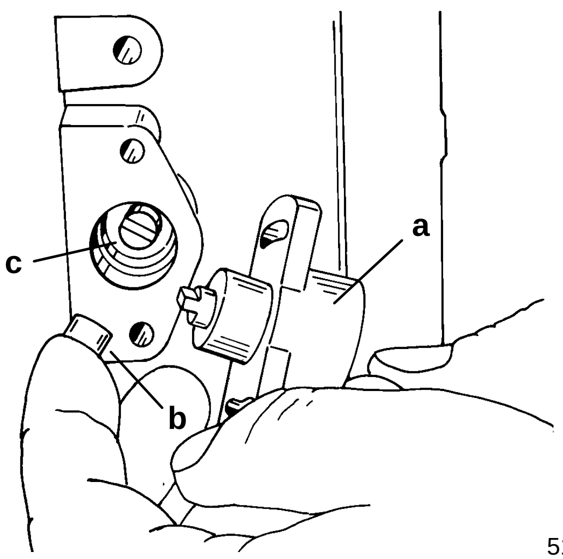
1. Remove throttle position sensor screws.



51790

a - Screws

2. Remove sensor and sleeve from throttle shaft.

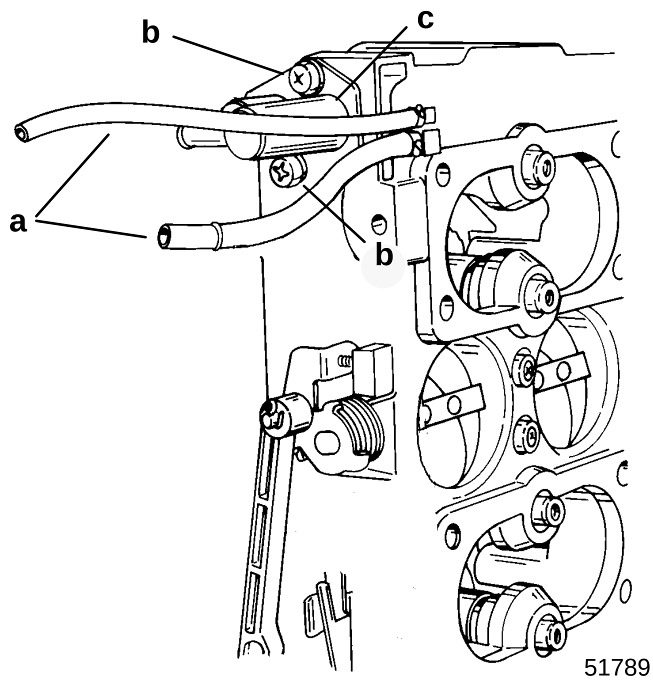


51788

a - Sensor
b - Sleeve
c - Throttle Shaft

Fuel Rail Removal

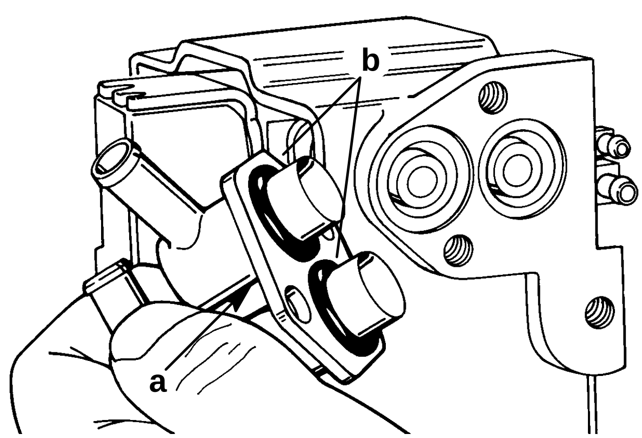
1. Remove manifold vacuum hoses.
2. Remove engine bleed hose.
3. Remove screws securing manifold fitting to manifold.



51789

a - Vacuum Hoses
b - Screws
c - Manifold Fitting

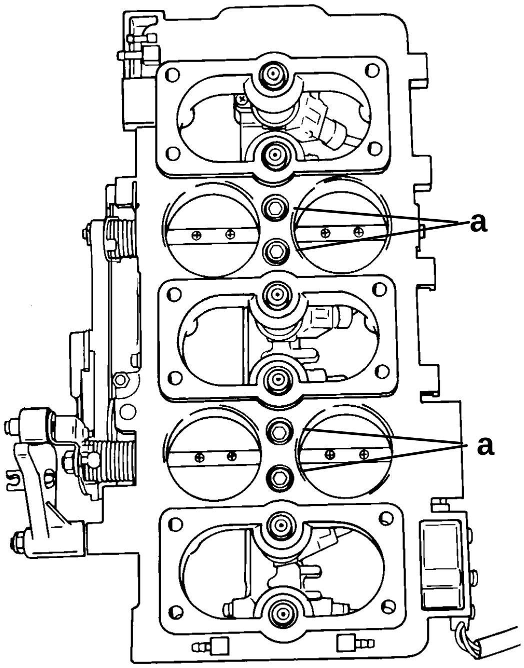
4. Remove manifold fitting and O-rings.



51791

a - Manifold Fitting
b - O-Rings

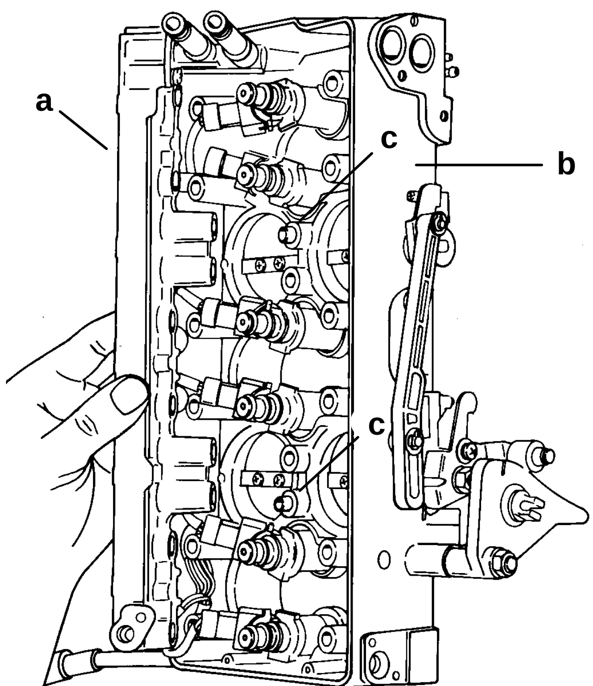
5. Remove 4 screws securing fuel rail to manifold.



51784

a - Screws (4)

6. Lift fuel rail from manifold. Note fuel rail guides.

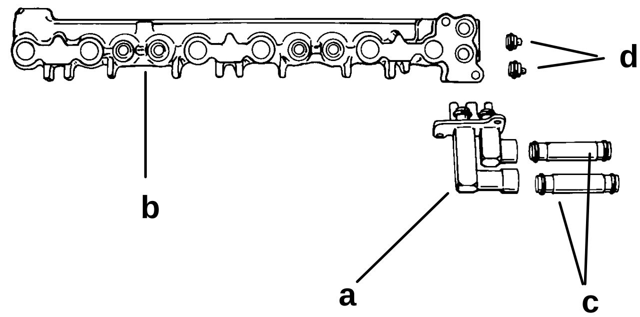


51788

a - Fuel Rail
b - Manifold
c - Guides

Fuel Rail Disassembly

1. Remove tube support from fuel rail.
2. Remove plugs from fuel rail.
3. Remove tubes from tube support.
4. Remove O-rings from plugs, tube support and tubes.

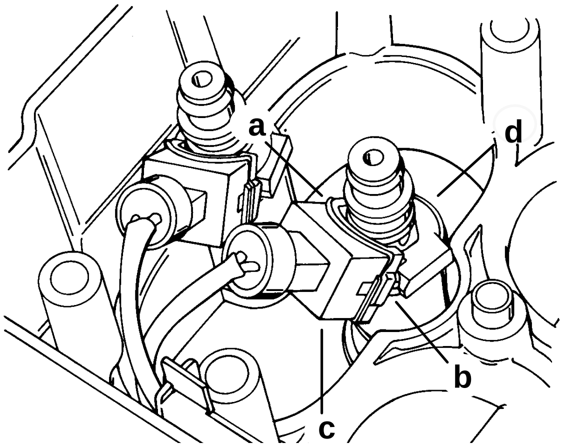


51795

a - Tube Support
b - Fuel Rail
c - Tubes
d - Plugs

Fuel Injector Removal and Disassembly

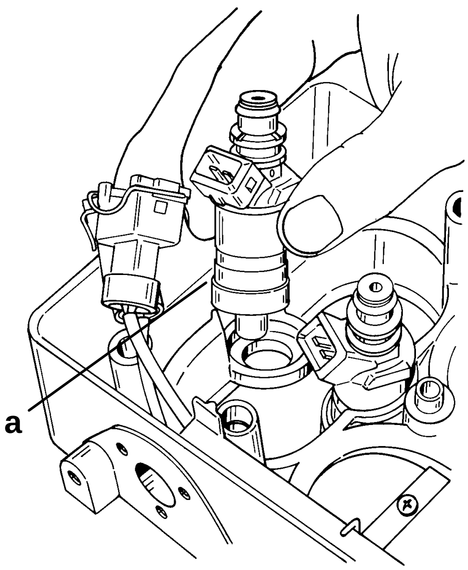
1. Lift wire clamp from slot.
2. Disconnect connector from injector.



51792

a - Clamp
b - Slot
c - Connector
d - Injector

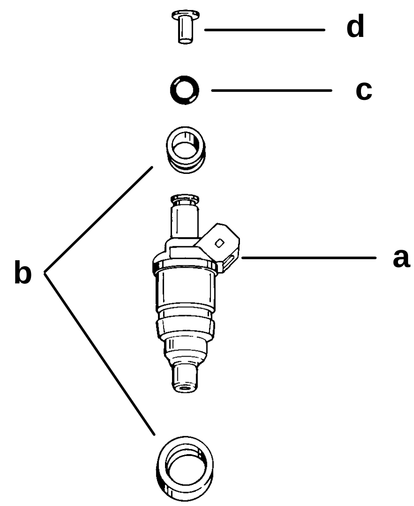
3. Remove injector from manifold.



51789

a - Injector

4. Place injector on clean work surface. Remove seals, O-ring and injector filter.

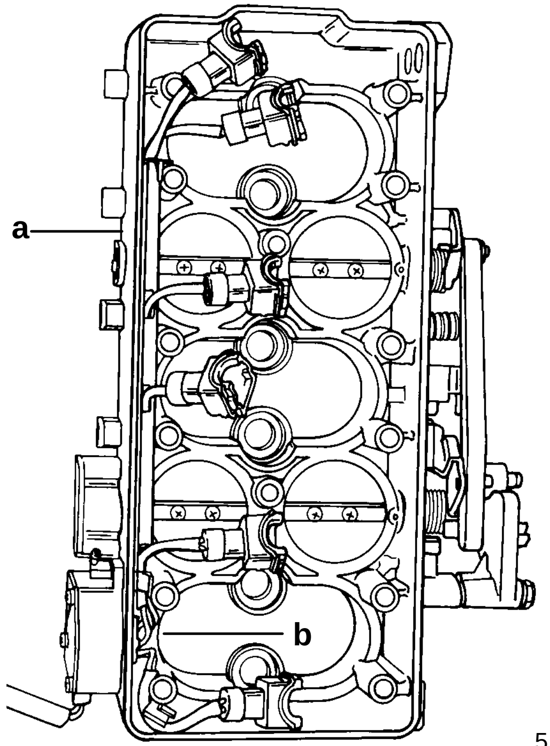


51789

a - Injector
b - Seals
c - O-Ring
d - Filter

Injector Harness Removal

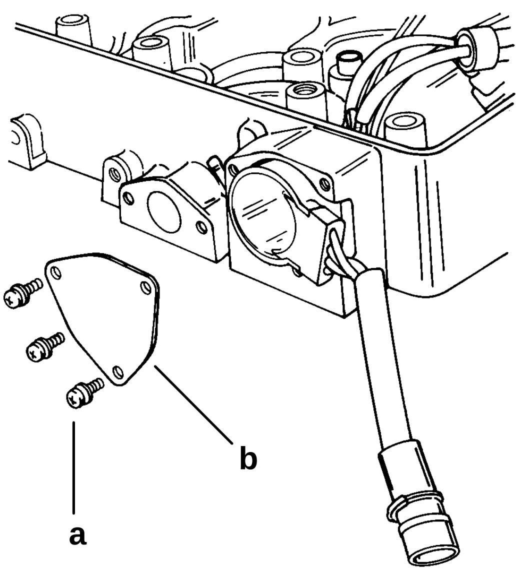
1. Remove protective casing from injector wiring harness. Note position of wires for reassembly.



51795

a - Casing
b - Harness

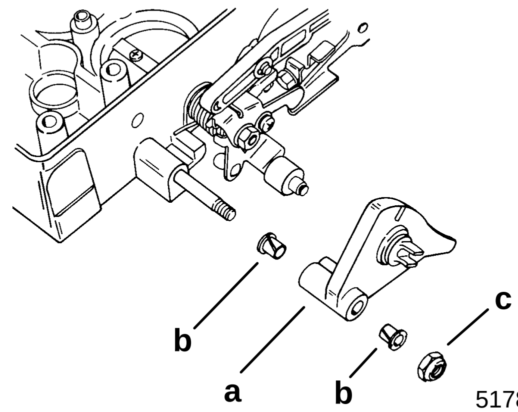
2. Remove screws and injector harness plate.



51792

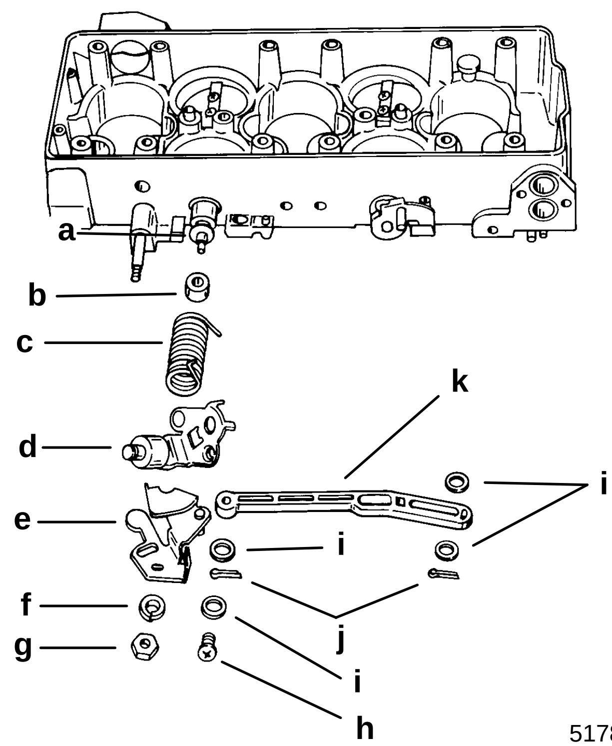
a - Screws
b - Plate

Throttle Linkage Removal



51786

a - Throttle Cam
b - Bushings
c - Nut; Tighten until snug against cam, then back off 1/4 turn



51789

a - Fiber Washer
b - Bushing
c - Spring
d - Roller Cam Bracket
e - Bracket (Shutter Link)
f - Lock Washer
g - Nut
h - Screw
i - Flat Washer
j - Cotter Key
k - Progressive Shutter Link

EFI System Cleaning and Inspection

Cleaning

1. Clean all non-electrical metal parts using a good grade solvent.
2. Use a soft bristle brush for removing large accumulations of dirt or grease and oil.
3. Varnish type coating of induction manifold parts may be removed using carburetor cleaner.
4. Wiring harnesses can be wiped down with a slightly solvent dampened rag.
5. Clean all fuel passages in induction manifold.
6. Dry all components using clean lint free cloths that are free of abrasives such as metal shavings or dirt.
7. Compressed air may be used to dry parts if the air used is free of moisture and un-lubricated.

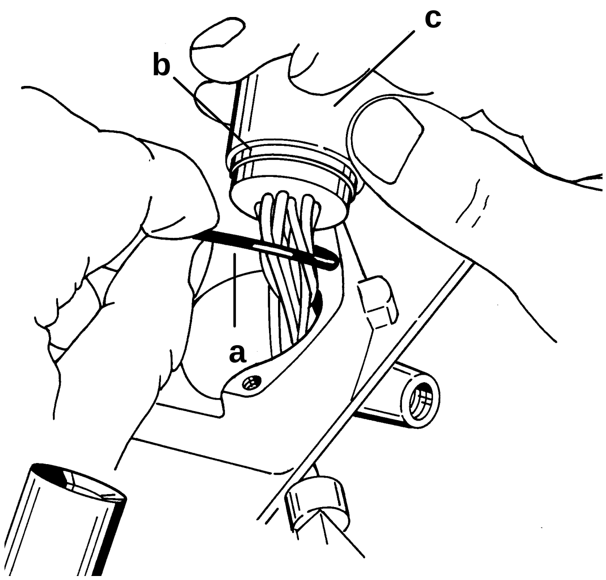
Inspection

1. Look at entire system for signs of an obvious problem such as poor condition of wire insulation, leaking fitting, cracked or loose hoses and lines.
2. Look for fuel or oil leaks wherever these fluids are used (i.e. fuel filter cap, fuel pump, vapor separator cap, etc.).
3. Check for signs of tampering or abuse such as modifications to wiring or hose routing.
4. Look at main connector between engine harness and ECM box for missing, corroded or bent contact pins and socket. Check for dislodged grommet in ECM where harness enters box.
5. Look at all sensors (throttle position, air temperature and water temperature) connectors and harnesses for bad connections or poor insulation conditions such as fraying, stripping, cracks or signs of abrasion wear.
6. Look for loose, missing or damaged mounting hardware such as stripped threads on screws.
7. Look at sensors for signs of wear or damage such as cracks, chips, etc.
8. Look at filter housing for cracks, holes or other damage. Check for secure mounting.
9. Look at vapor separator for leaks, cracks, pitting or other damage.
10. Check all rubber mounting grommets for swelling tears, cracks or other conditions that would render parts unserviceable.
11. Check vapor separator float for signs of fuel entry in the float. Look at needle for wear of point.
12. Look at injectors for signs of plugging or looseness in fit with induction manifold.
13. Look at throttle linkage for bends, kinking or binding. Check spring for kinks.
14. Inspect all rubber seals and gaskets for swelling, cracks or slices that would cause improper sealing.

Induction Manifold Assembly

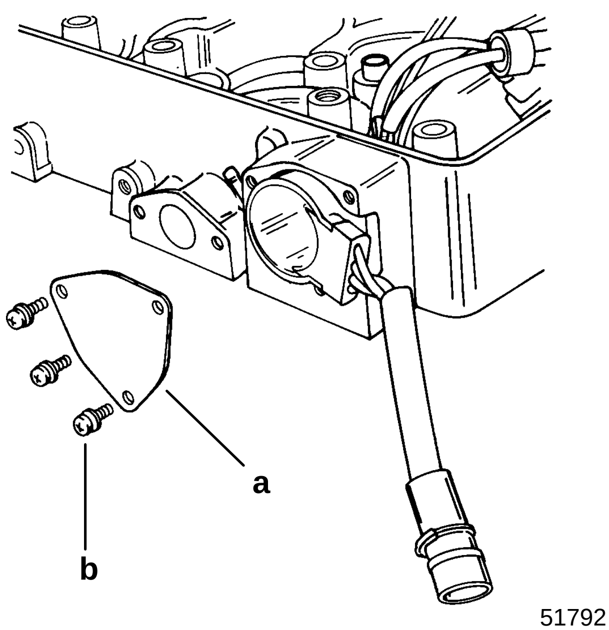
Injector Harness Installation

1. Carefully route injector harness into manifold.
2. Install O-ring into groove on injector harness insert. Install harness insert into manifold port.



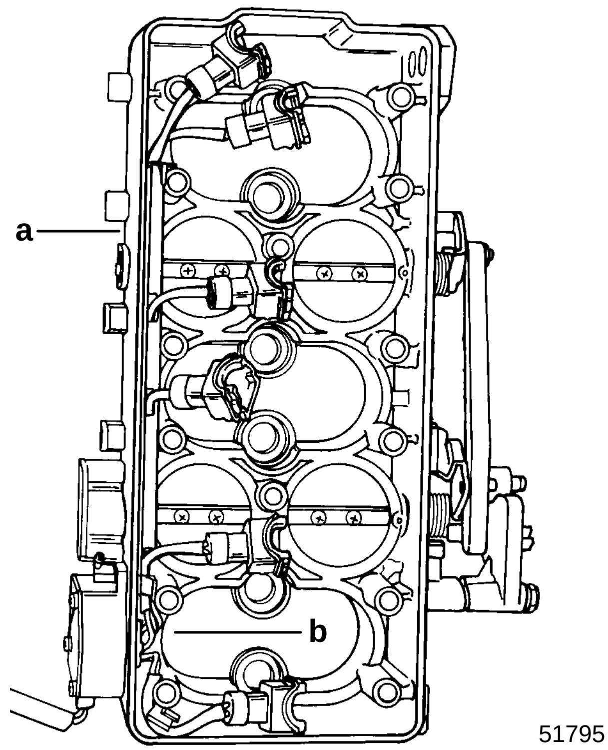
a - O-Ring
b - Groove
c - Insert

3. Install injector harness plate using screws. Tighten securely.



a - Plate
b - Screws

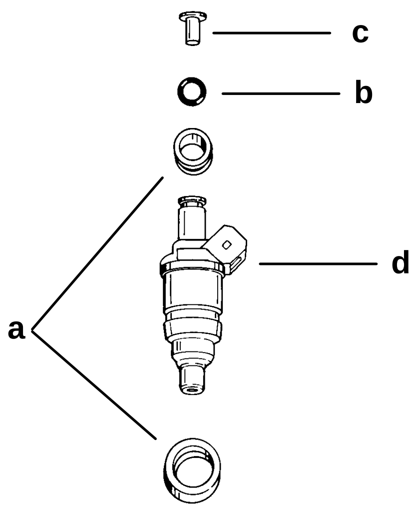
4. Install protective casing over positioned injector wiring harness and insert into manifold.



a - Casing
b - Harness

Fuel Injector Assembly and Installation

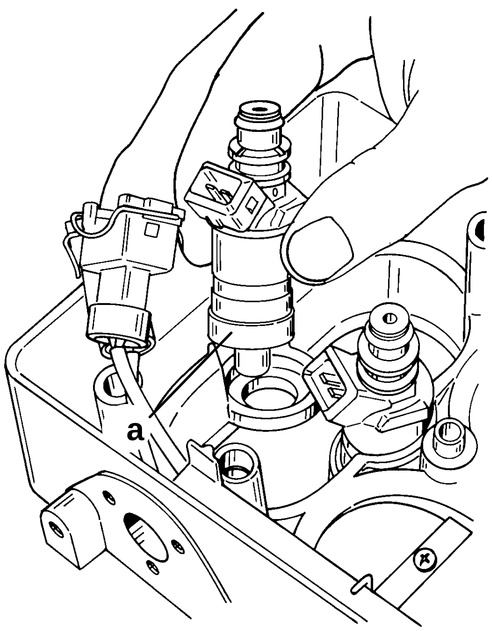
1. Install inspected seals, O-ring and injector filter to injector.



51789

a - Seals
b - O-Ring
c - Filter
d - Injector

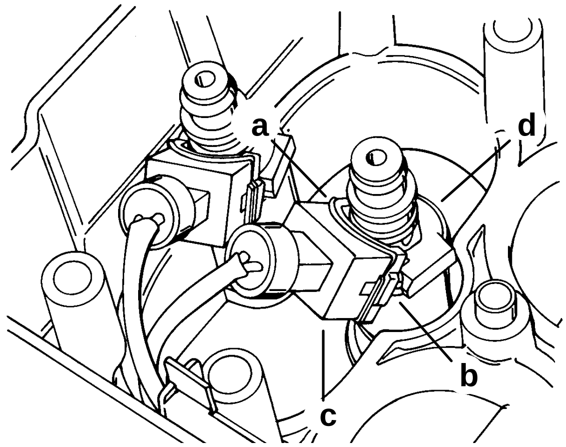
2. Install injector into manifold.



51789

a - Injector

3. Install wire clamp into slot on injector connector.
4. Connect to injector.

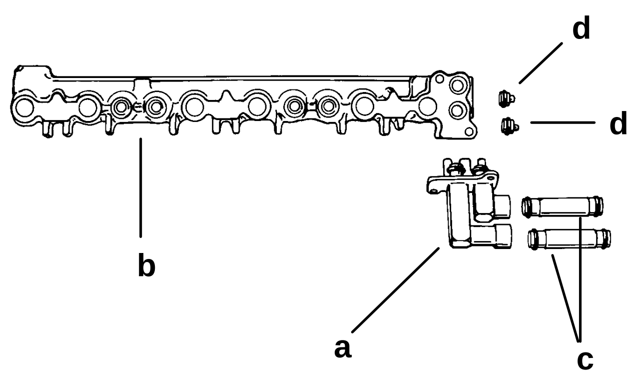


51792

a - Clamp
b - Slot
c - Connector
d - Injector

Fuel Rail Assembly

1. Install inspected O-rings to plugs. tube support and tubes.
2. Install tubes to tube support.
3. Install plugs to fuel rail.
4. Install tube support to fuel rail.

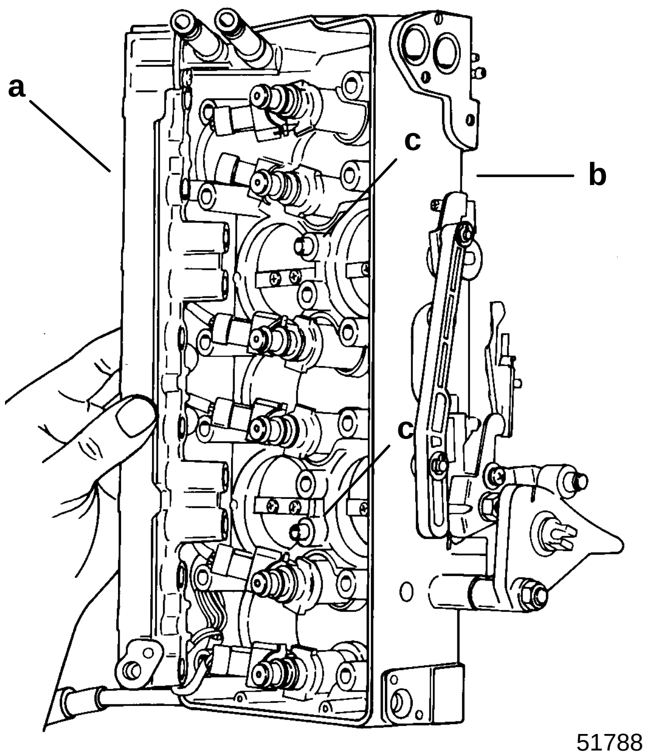


51795

a - Tube Support
b - Fuel Rail
c - Tubes
d - Plugs

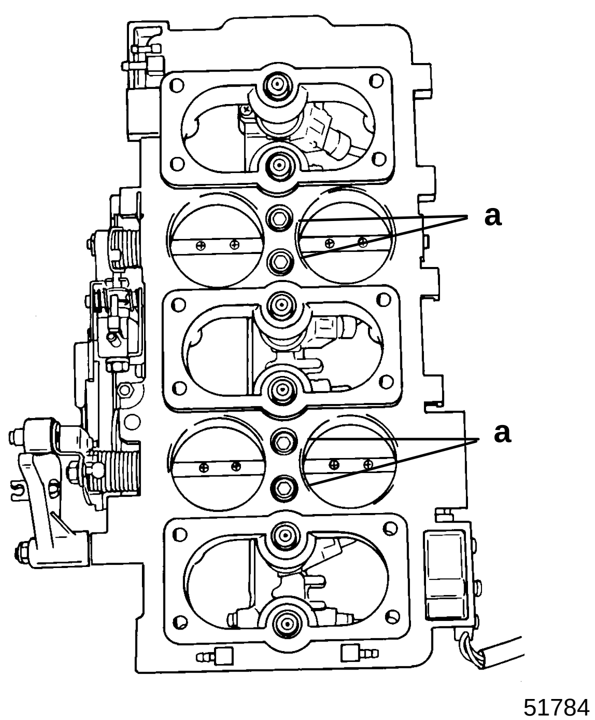
Fuel Rail Installation

1. With fuel rail guides in place, install fuel rail to manifold.



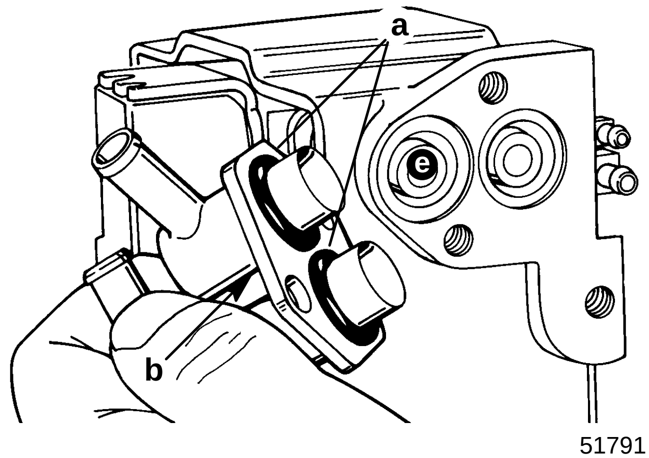
a - Fuel Rail
b - Manifold
c - Guides

2. Install 4 screws securing fuel rail to manifold. Torque to 35 lb. in. (4.0 N·m).



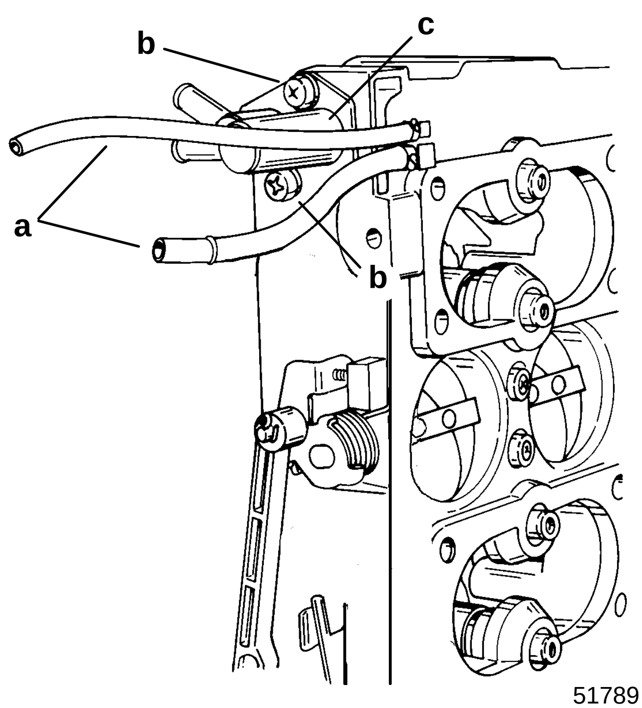
a - Screws (4)

3. Install O-rings to manifold fitting. Install fitting to manifold.



a - O-Rings
b - Fitting

4. Install screws securing manifold fitting to manifold. Torque screws to 45 lb. in. (5.0 N·m).
5. Install engine bleed hose.
6. Install manifold vacuum hoses.



a - Vacuum Hoses
b - Screws [Torque screws to 45 lb. ft. (5.0 N·m)]
c - Manifold Fitting

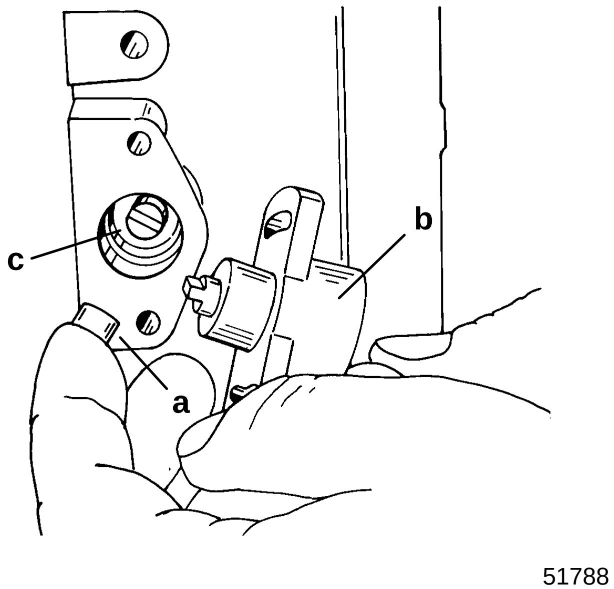
⚠ CAUTION

Use extreme care when installing induction manifold so as to eliminate any possibility for air leaks.

Throttle Position Sensor Installation

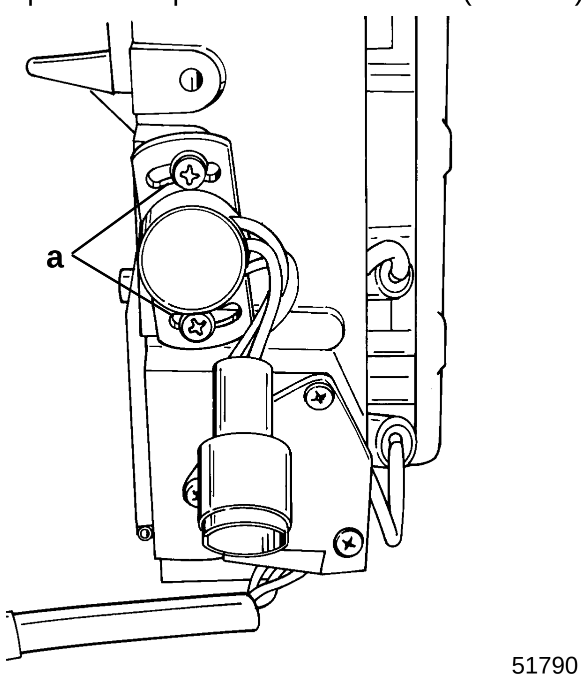
IMPORTANT: Throttle position sensor must be adjusted following reassembly (see Section 2C - Timing, Synchronizing, Adjustment).

1. Install sleeve to throttle position sensor.
2. Install sensor into manifold. Sleeve must guide sensor to throttle shaft.



a - Sleeve
b - Throttle Position Sensor
c - Throttle Shaft

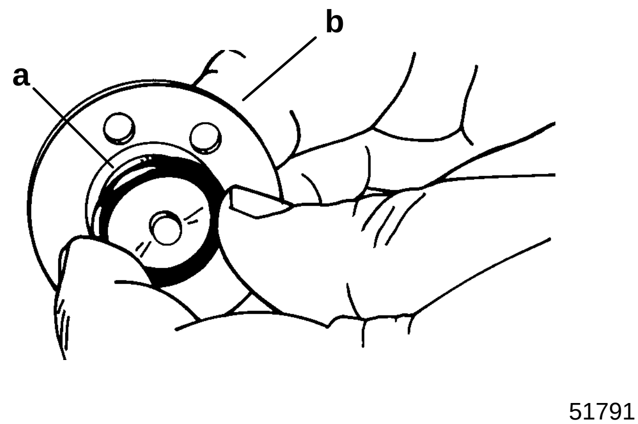
3. Tighten screws after induction manifold installation and throttle position sensor adjustments are completed. Torque screws to 20 lb. in. (2.0 N·m).



a - Screws

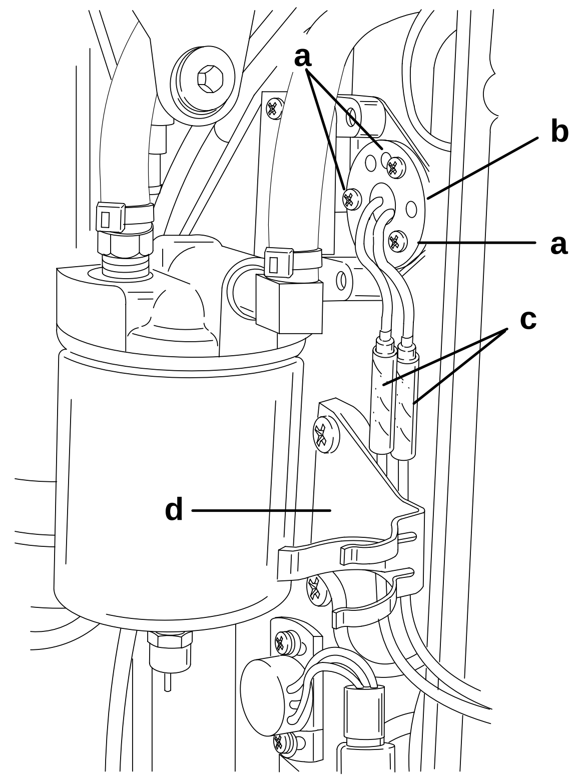
Air Temperature Sensor Installation

1. Install O-ring to air temperature sensor.



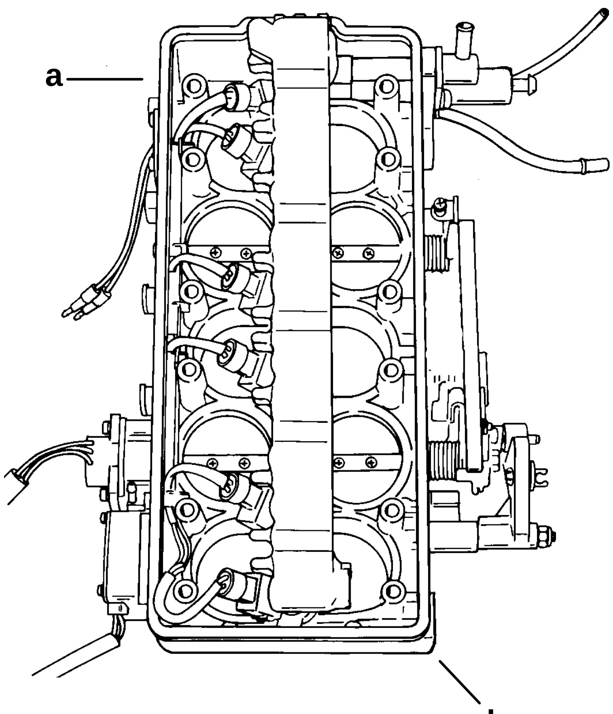
a - O-Ring
b - Air Temperature Sensor

2. Install air temperature sensor and secure with screws. Tighten screws securely. Route sensor harness behind engine harness bracket.



a - Screws
b - Air Temperature Sensor
c - Harness
d - Bracket

3. Carefully install manifold cover seal to manifold.

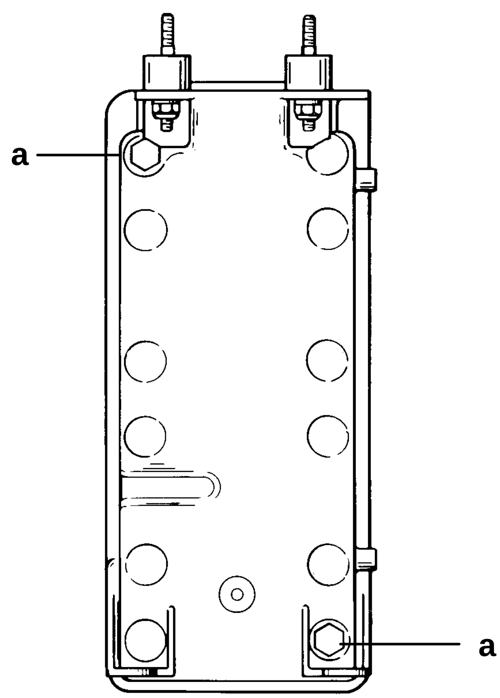


51785

a - Cover Seal
b - Manifold

4. Install manifold cover to manifold and secure with M8 x 1.25 x 38mm long bolts through holes.

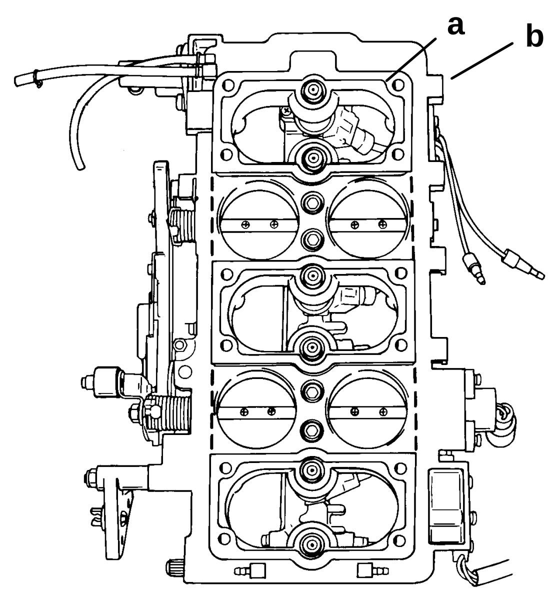
NOTE: *This will aid in induction manifold installation.*



a - Holes

EFI Induction Manifold Installation

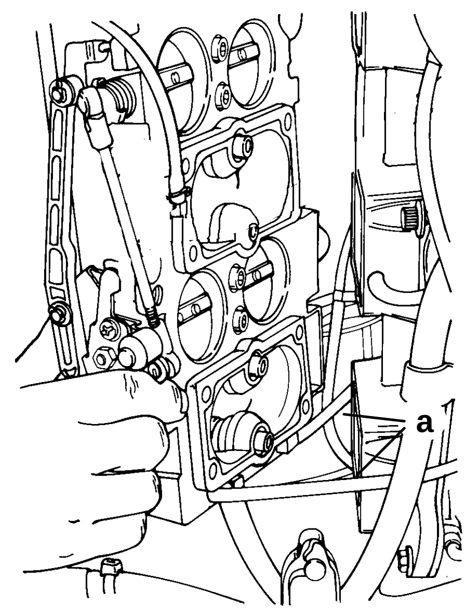
1. Install new gasket on induction manifold as shown. Removing dotted line sections after manifold installation.



51784

a - Gasket
b - Induction Manifold

2. With induction manifold held in place, connect bleed line hoses to manifold fittings.

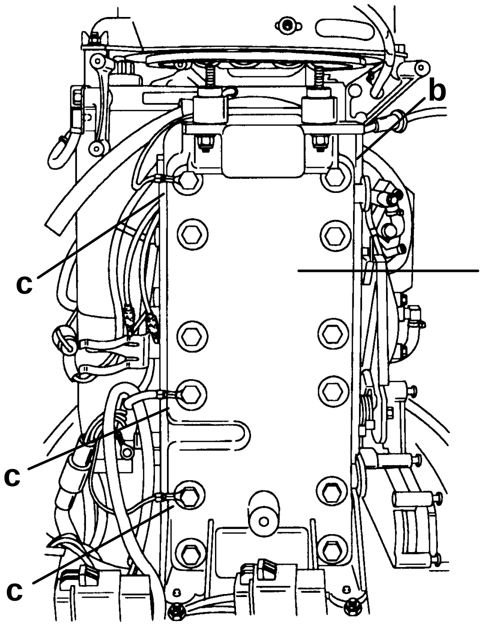


51795

a - Bleed Hoses

3. Secure induction manifold assembly to engine with screws. Torque screws to 90 lb. in. (10.0 N·m) using torque sequence shown below.

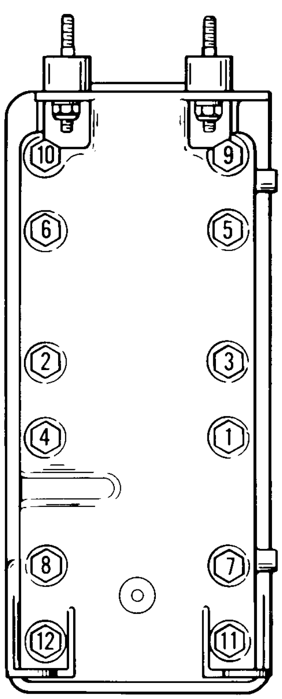
NOTE: *Remove M8 x 1.25 x 38mm long bolts used for reassembly and install remaining screws. Install ground wires to proper location.*



55210

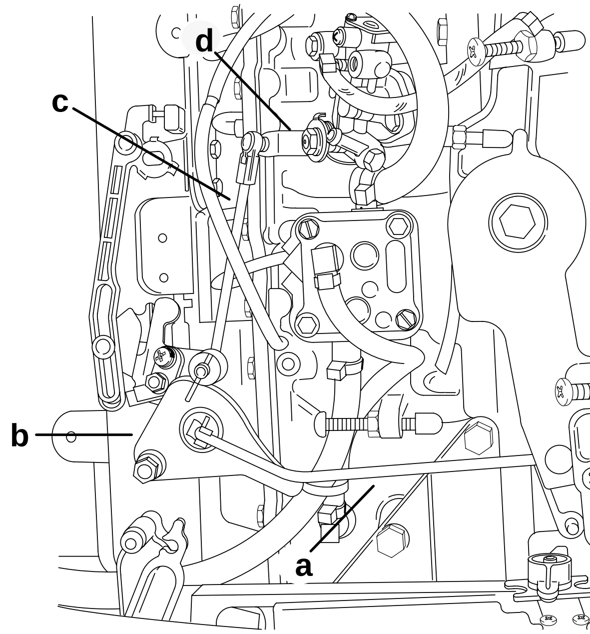
a - Manifold
b - Screws [Torque to 90 lb. in. (10.0 N·m)]
c - Ground Wires

Cover Screw Torque Sequence



IMPORTANT: Before connecting oil pump control rod verify pump quadrant is rotated to the clockwise of center.

4. Connect oil injection link rod to injector arm.
5. Connect throttle link rod to throttle cam.

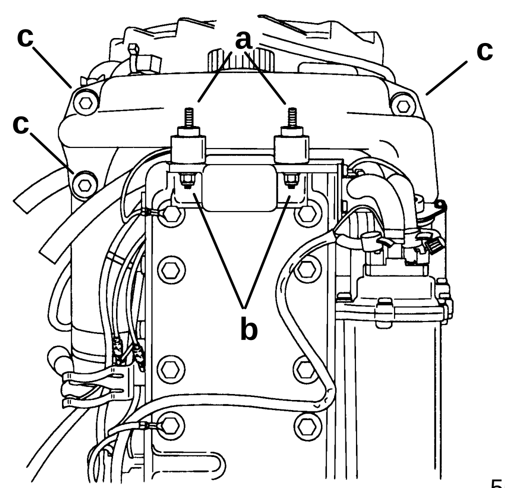


55213

a - Throttle Link Rod
b - Throttle Cam
c - Oil Injection Link Rod
d - Oil Injection Arm

Oil Reservoir Installation

1. Install oil reservoir to engine. Connect hose to fitting and secure with hose clamp.
2. Install studs, nuts, and mounting bracket. Secure reservoir using screws. Torque screws to 25 lb. in. (3.0 N·m).

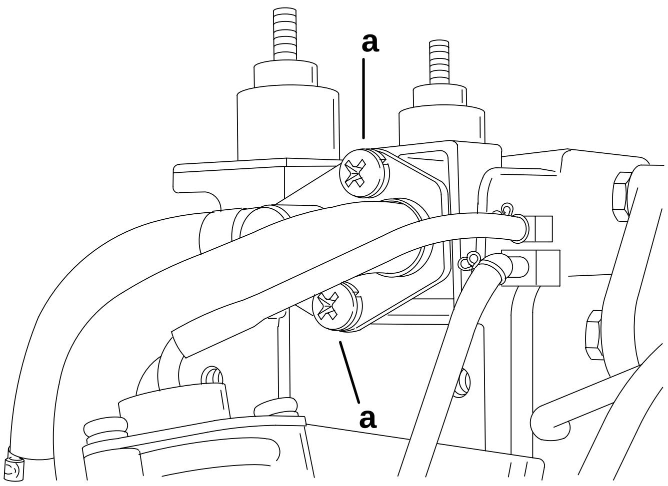


55201

a - Studs
b - Nuts
c - Screws [Torque 25 lb. in. (3.0 N·m)]

Vapor Separator Installation

1. Secure adaptor plate to manifold with 2 screws. Torque screws to 45 lb. in. (5.0 N·m).



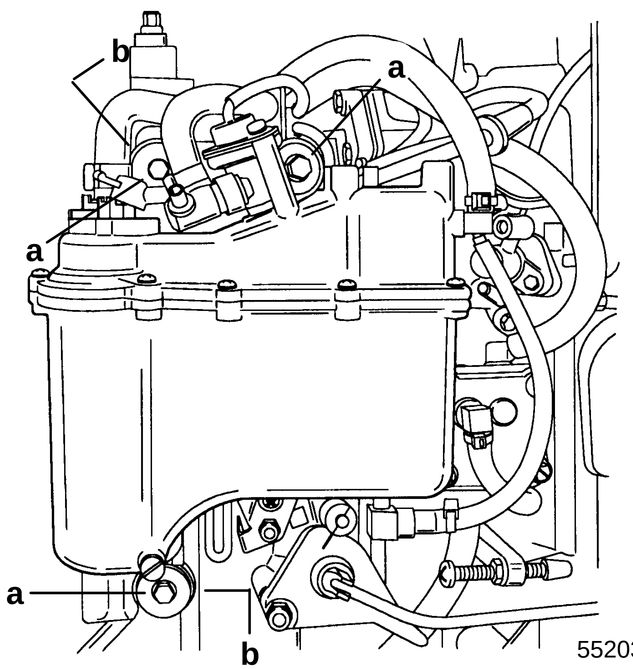
55216

a - Screws [Torque to 45 lb. in. (5.0 N·m)]

NOTE: *For ease of reassembly, reinstall oil reservoir on engine BEFORE installing vapor separator.*

2. Secure vapor separator to manifold with 3 screws and washers. Torque screws to 45 lb. in. (5.0 N·m).

NOTE: *Spacers are positioned between separator and manifold at the top front and bottom attaching screw locations.*

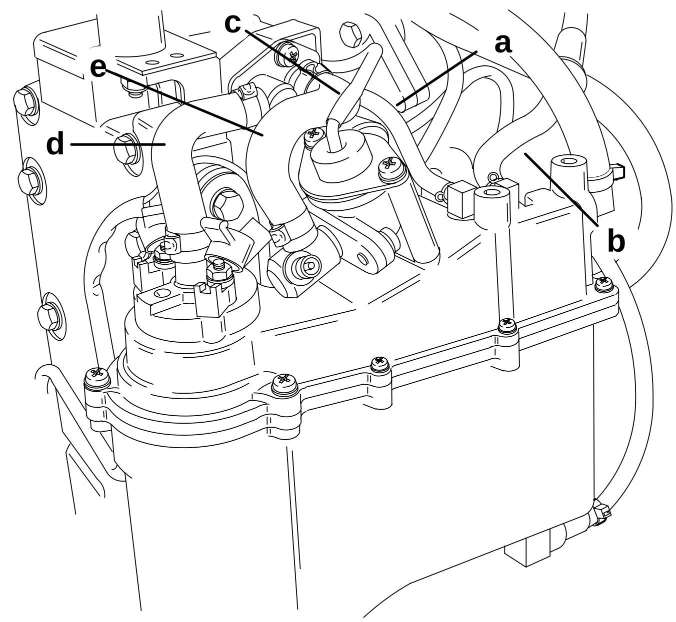


55203

a - Screws [Torque to 45 lb. in. (5.0 N·m)]
b - Spacers

IMPORTANT: If fuel outlet hose from electric fuel pump or fuel return hose from manifold to pressure regulator was disconnected, stainless steel hose clamps MUST BE USED to secure connections. If outlet/return hoses are to be replaced, replacement tubing kit (32-827694) MUST BE INSTALLED to prevent rupturing or leakage. DO NOT use sta-straps to secure high pressure fuel lines as leakage will occur.

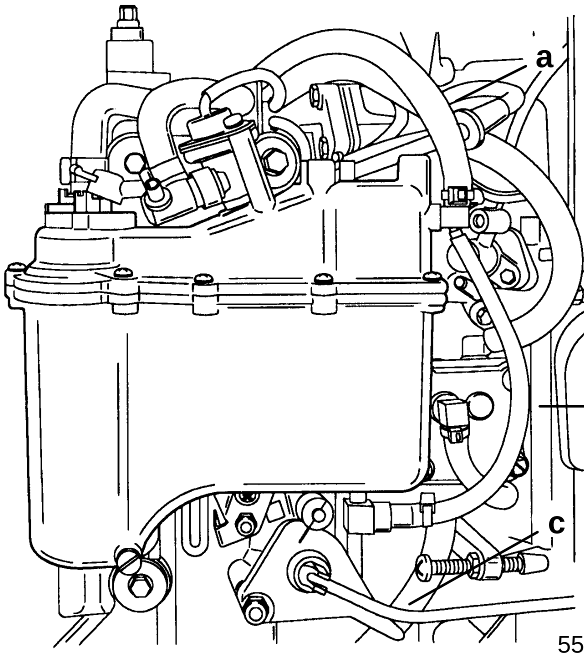
3. Connect vapor separator over flow hose between manifold and separator.
4. Connect engine bleed hose (with white filter) to separator.
5. Connect fuel pressure regulator hose to top fitting on manifold.



55204

a - Over Flow Hose
b - Bleed Hose
c - Pressure Regulator Hose
d - Fuel Outlet Hose
e - Fuel Return Hose

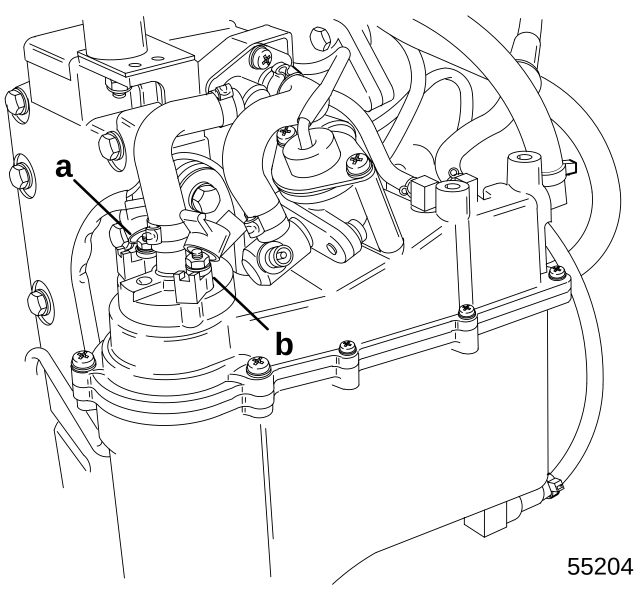
6. Connect fuel inlet hose to vapor separator. Secure hose with sta-strap.
7. Connect oil inlet hose to vapor separator. Secure hose with sta-strap.
8. Install throttle link arm to throttle cam.



55203

a - Fuel Inlet Hose
b - Oil Inlet Hose
c - Throttle Link Arm

9. Connect RED (POSITIVE) lead to STARBOARD terminal of electric fuel pump and BLACK/RED (NEGATIVE) lead to PORT terminal of fuel pump. Torque POSITIVE nut to 6 lb. in. (0.7 N·m) and the NEGATIVE nut to 8 lb. in. (0.9 N·m).

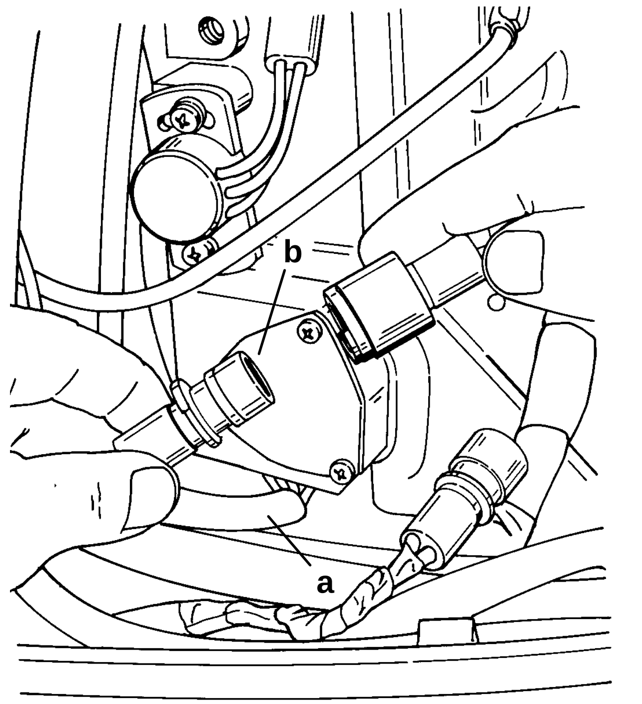


55204

a - RED (+) Terminal [Torque nut to 6 lb. in. (0.7 N·m)]
b - BLACK/RED (–) Terminal [Torque nut to 8 lb. in. (0.9 N·m)]

Throttle Position Sensor, Air Temperature Sensor and Fuel Injector Harness Connections

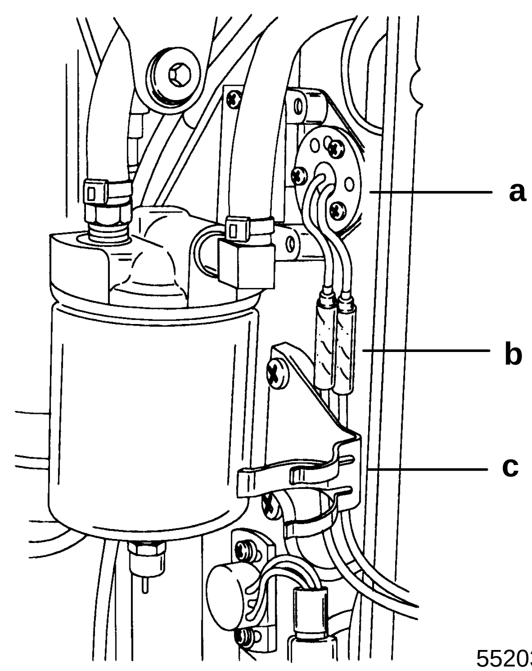
1. Connect fuel injector harness at 4 pin connector.



51787

a - Injector Harness
b - 4 Pin Connector

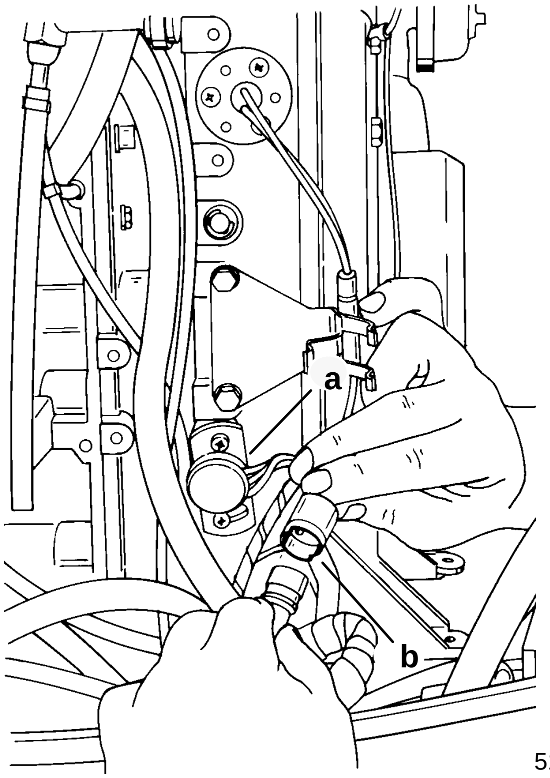
2. Connect air temperature sensor leads to bullet connectors. Position sensor leads behind harness clamp.



55203

a - Air Temperature Sensor
b - Connectors
c - Harness Clamp

3. Connect throttle position sensor at 3 pin connector.

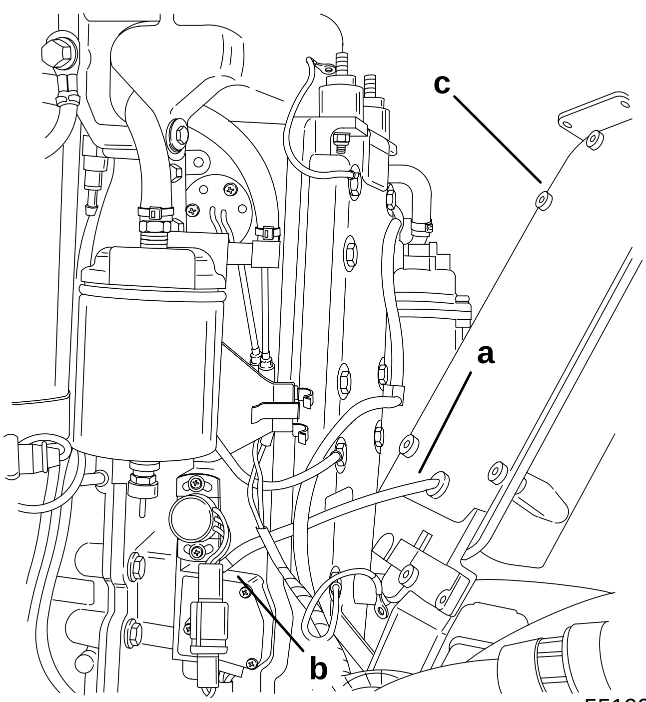


51787

a - Throttle Position Sensor
b - 3 Pin Connector

ECM Installation

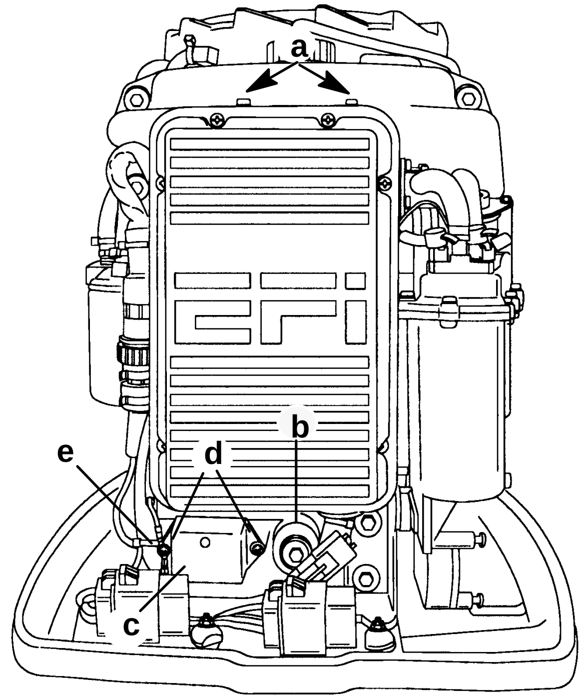
1. Connect MAP sensor hose from ECM to manifold fitting. Place ECM on manifold studs.



55199

a - MAP Sensor Hose
b - Fitting
c - ECM

2. Secure ECM to manifold using nuts and screw. Torque nuts and screw to 45 lb. in. (5.0 N·m).
3. Secure water sensing module and ground wires with screws. Torque screws to 25 lb. in. (3.0 N·m).

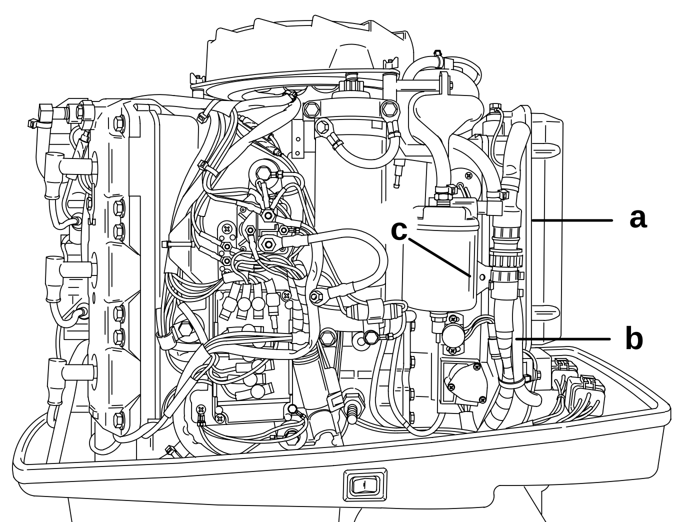


55173

a - Nuts
b - Screw
c - Water Sensing Module
d - Screws
e - Ground Wires

4. Connect ECM harness to engine harness at connector. Install harness into harness bracket with connecting ring below or above bracket arms.

IMPORTANT: DO NOT force connecting ring between bracket arms.



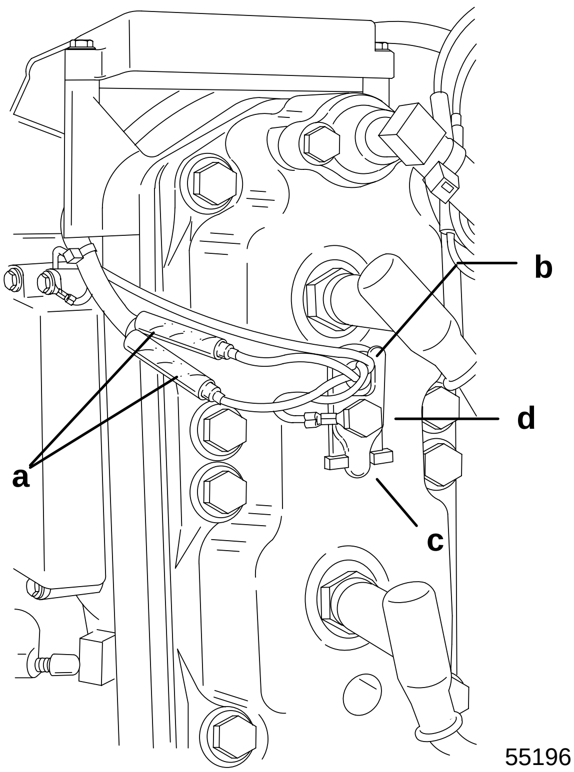
55175

a - ECM Harness
b - Engine Harness
c - Bracket

Engine Head Temperature Sensor Installation

IMPORTANT: Engine Head Temperature Sensor must make clean contact with cylinder head for circuit to function properly.

1. Connect wires and install sensor.
2. Install retaining plate and screw. Torque screw to 200 lb. in. (22.5 N·m).

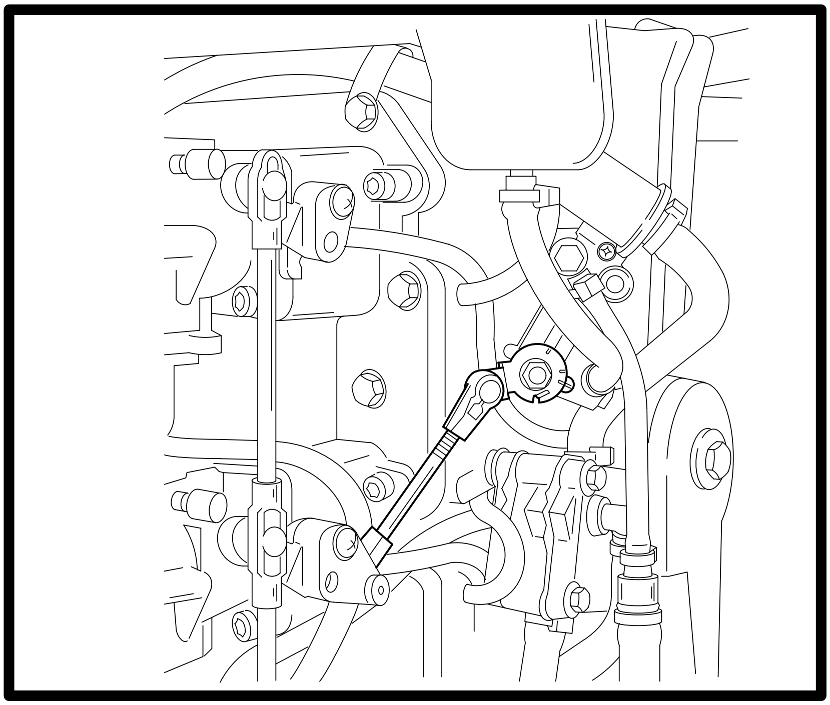


a - Wires
b - Sensor
c - Retainer
d - Screw [Torque to 200 lb. in. (22.5 N·m)]

FUEL SYSTEMS

3

E



OIL INJECTION

Table of Contents

⚠ CAUTION

Be careful not to get dirt or other contamination in tanks, hoses or other components of the oil injection system during installation.

⚠ CAUTION

Engines with oil injection must be run on a fuel mixture of 50:1 for the first 30 gallons of fuel. Refer to engine break-in procedure in the Operation and Maintenance Manual.

⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 4 psi. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psi maximum.

Operation of the Oil Injection System

The oil injection system delivers oil mixture on engine demand, from 100 to 1 at idle to 50 to 1 at wide open throttle.

The remote oil tank can be removed from the boat for easy refilling. The remote 3 gallon tank holds enough oil for over 150 gallons of fuel at wide open throttle.

The remote oil tank supplies the oil reservoir mounted on the engine. The oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

The oil injection pump feeds oil into the fuel just before the fuel pump on carb models and into the vapor separator on EFI models. The oil injection pump is driven by the crankshaft and is connected to the throttle linkage for metering the varied flow of oil per engine RPM. The motion sensor will sound the warning horn if the drive system for the injection pump becomes inoperative.

FINAL CHECKS BEFORE OPERATION OF ENGINE

- Make sure fill cap gaskets are in place and caps are tight on engine oil reservoir and remote oil tank.
- Mix a gasoline and oil mixture of 50:1 in the remote fuel tank during the initial break-in of the engine.
- Be certain the warning horn is installed and is operational. Refer to Instrument and Warning Horn Installation.
- Each time the key switch is turned from the “off” to “on” position (engine not running); the warning horn will sound momentarily. This tells you the oil injection module and warning horn is operational. If warning horn does not sound or horn stays on when key is turned to the “ON” position, refer to oil injection system troubleshooting chart following to correct the problem.

CHECKING OPERATION OF THE OIL INJECTION SYSTEM (ENGINE RUNNING)

1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual. If warning horn should sound an intermittent “beep,” “beep,” “beep” during operation, this indicates a problem occurred in the oil injection system. Refer to troubleshooting following, to correct the problem.
2. After engine has been run for a short time, open cowl and check that no oil is leaking out of engine oil reservoir fill cap.

Oil Injection Components (See Page 3 for Location)

1 REMOTE OIL TANK

Holds 3 gallons (11.5 liters) of oil.

NOTE: *Some boats may be equipped with optional 1.8 gallon (7.0 liters) oil tank.*

The tank is pressurized by air from crankcase pressure thus forcing oil up the outlet hose to the oil reservoir on engine.

2 OIL PICK UP TUBE

A filter screen is located in end of tube to prevent dirt or other particles from entering the system.

6 VENT HOSE

Hose is only used to keep check valve clean. Other end of hose is not connected.

7 4 PSI CHECK VALVE

If oil flow to reservoir is obstructed and injection pump continues to pump oil, the 4 PSI valve will open to allow air to enter reservoir to prevent a vacuum.

8 LOW OIL (FLOAT) SENSOR

If oil level drops in oil reservoir, the sensor will signal the warning module to sound the warning horn.

9 OIL RESERVOIR

The oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

10 MOTION SENSOR

Senses the rotation of the oil injection pump drive system. If the drive system for the injection pump becomes inoperative, the sensor will signal the warning module to sound the warning horn.

11 OIL INJECTION PUMP

Injection pump is driven off the crankshaft. See illustration on page 4.

The oil injection pump is a variable metering pump. At idle the pump will meter the oil at approximately 100 to 1 gasoline to oil ratio and at WOT, 50 to 1 ratio.

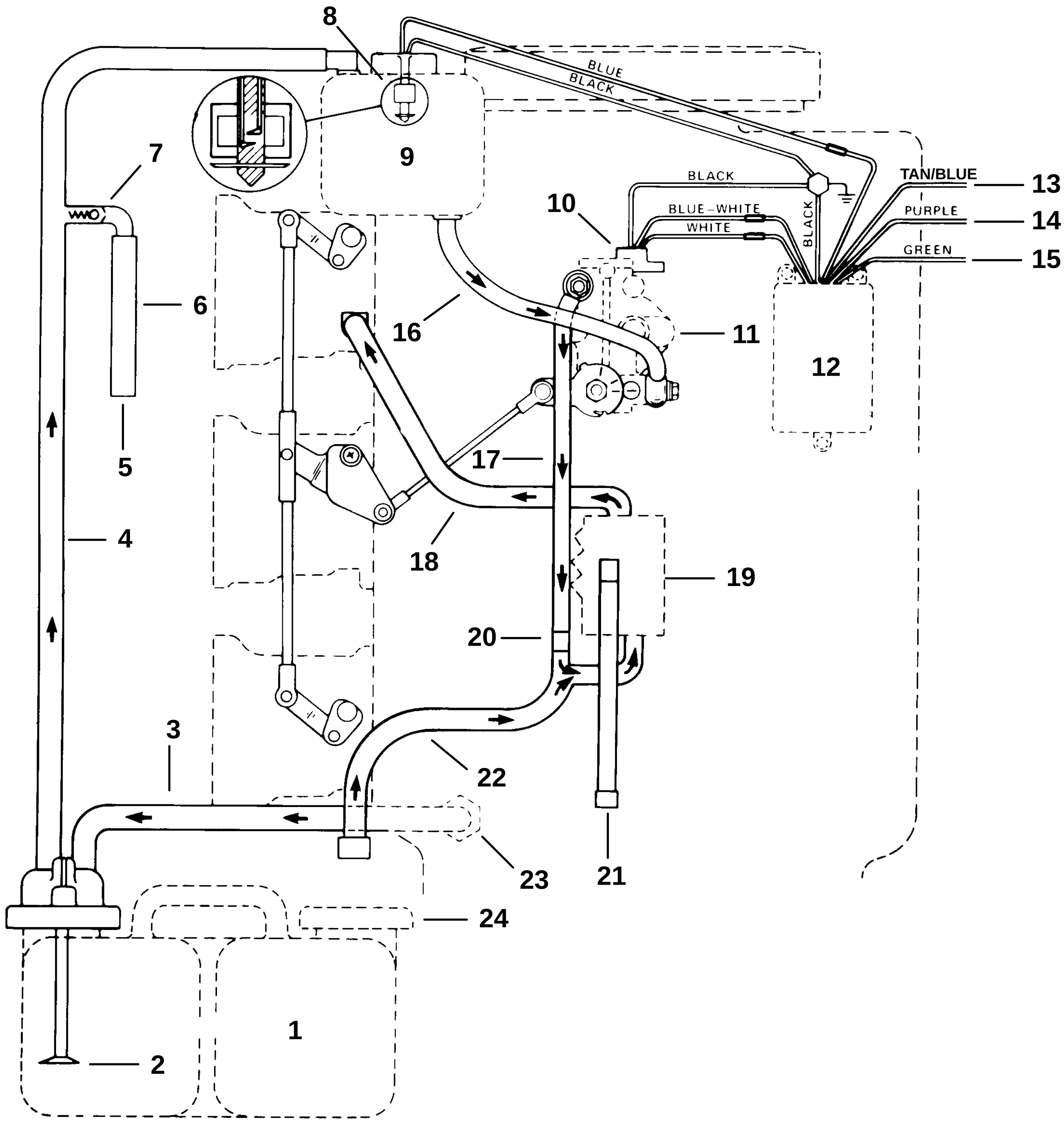
12 WARNING MODULE

- Sounds the warning horn briefly when key switch is turned on, to indicate that the system is operational.
- While engine is running, the module continuously monitors the rotation of the drive system for the oil injection pump by picking up pulses from the motion sensor. If drive system becomes inoperative, the module will sound the warning horn.
- If oil level drops in the engine oil reservoir, the low oil (float) sensor will signal the module to sound the warning horn.

20 2 PSI CHECK VALVE

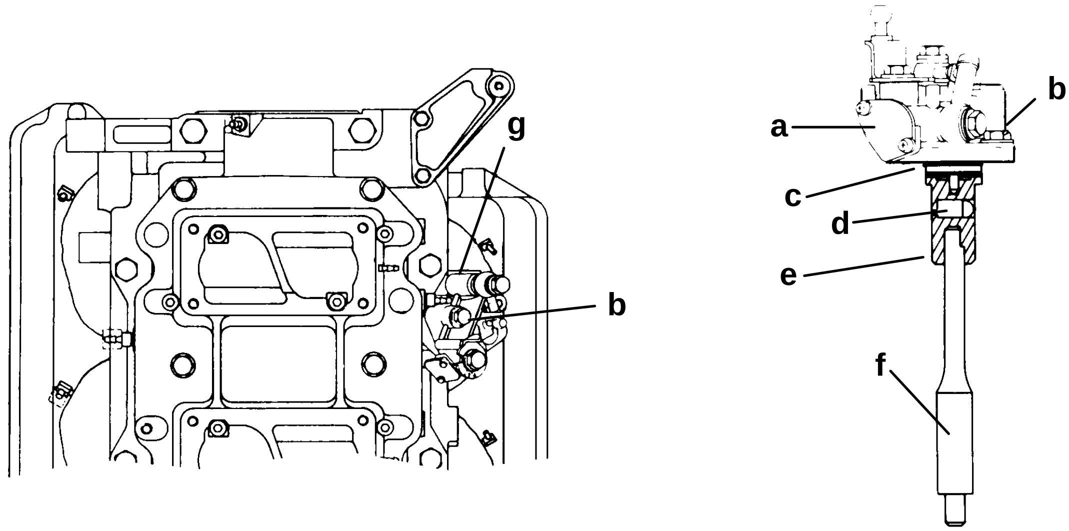
This valve prevents gasoline from being forced into the oil lines.

Oil Injection Flow System



1 - Remote Oil Tank
2 - Oil Pick Up Tube
3 - Air Pressure
4 - Oil Line (Blue Stripe)
5 - Open
6 - Vent Hose
7 - 4 PSI Check Valve
8 - Low Oil (Magnetic Float) Sensor
9 - Oil Reservoir
10- Motion Sensor
11- Oil Injection Pump
12- Warning Module
13- To Terminal Block
14- To 12 Volt Supply
15- To Switch Box
16- Oil Hose to Pump
17- Oil Inlet
18- Fuel/Oil Mixture
19- Fuel Pump
20- 2 PSI Check Valve
21- Crankcase Outlet Fuel Pump
22- Fuel Inlet
23- Crankcase Pressure w/One Way Check Valve
24- Filler Cap

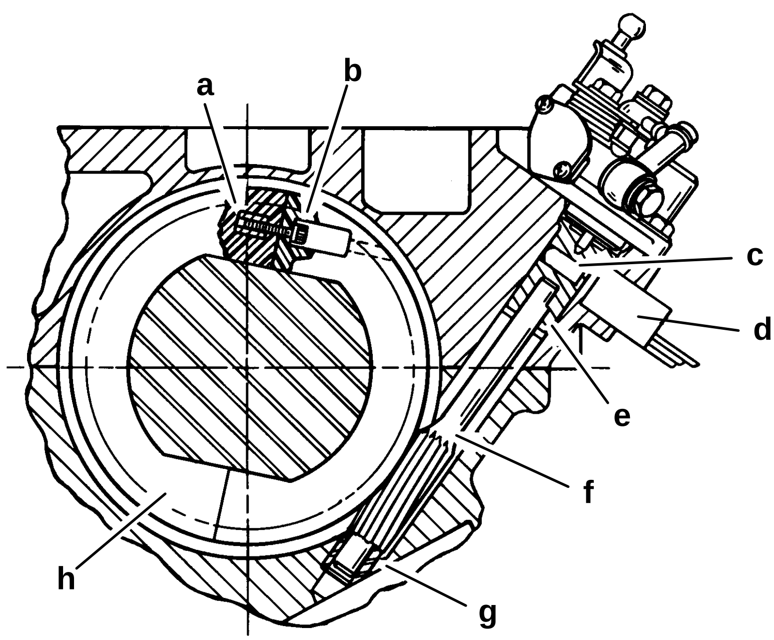
Pump Drive Assembly



a - Oil Pump
b - Retaining Bolts (2)
c - O-ring
d - Magnet
e - Coupler
f - Driven Gear
g - Oil Pump (Installed)

NOTE: *If magnet should fall out of the coupler, using a directional compass, locate end of magnet that attracts the North Arrow of the compass. Insert this end of magnet into coupler first.*

Pump Drive System



a - Retaining Nut (2)
b - Retaining Screw (2)
c - Magnet
d - Motion Sensor
e - Coupler Bushing
f - Driven Gear
g - Bushing
h - Drive Gear

Set Up Instructions for Oil Injection System

⚠ CAUTION

Be careful not to get dirt or other contamination in tanks, hoses or other components of the oil injection system during installation.

⚠ CAUTION

Oil injected engines additionally, must be run on a 50:1 gasoline/oil mixture in the fuel tank for the first 30 gallons of fuel. Refer to engine break-in procedures in the Operation & Maintenance Manual.

⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 4 psi. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psi maximum.

INSTALLING REMOTE OIL TANK

1. The remote oil tank should be installed in an area in the boat where there is access for refilling.

The tank should be restrained to keep it from moving around, causing possible damage.

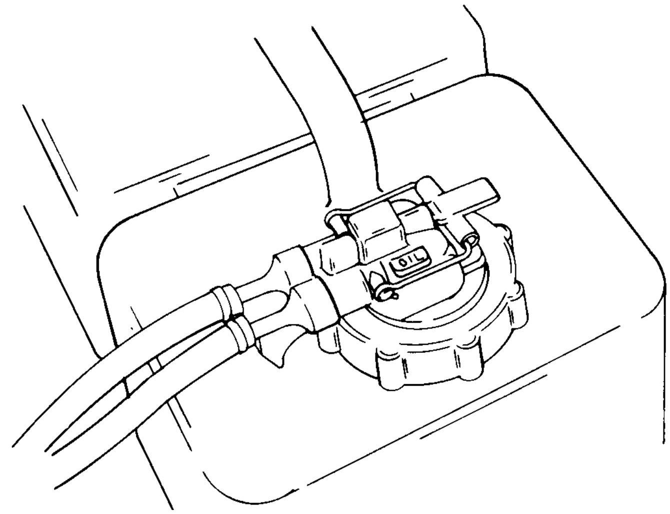
An acceptable means of restraining the tank would be the use of eye bolts and an elastic retaining strap about the mid-section of the tank taking care that any metal hooks do not puncture the tank.

Keep in mind, when installing in tight areas, that this tank will be under pressure when the engine is operating and will expand slightly.

2. Oil hoses when routed thru engine well, must be able to extend to the hose fittings on engine.

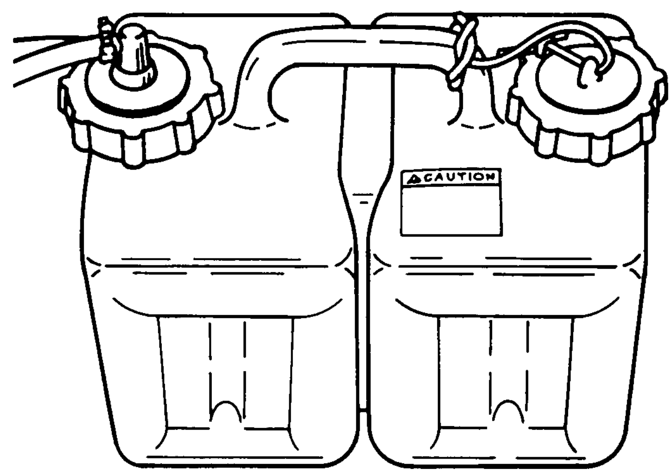
3. Oil hoses must be arranged so they cannot become pinched, kinked, sharply bent or stretched during operation of the outboard.

NOTE: *An oil hose extension kit (41729A3) is available for the remote oil tank.*



22750

Quick Disconnect Type Hose Connection



27733

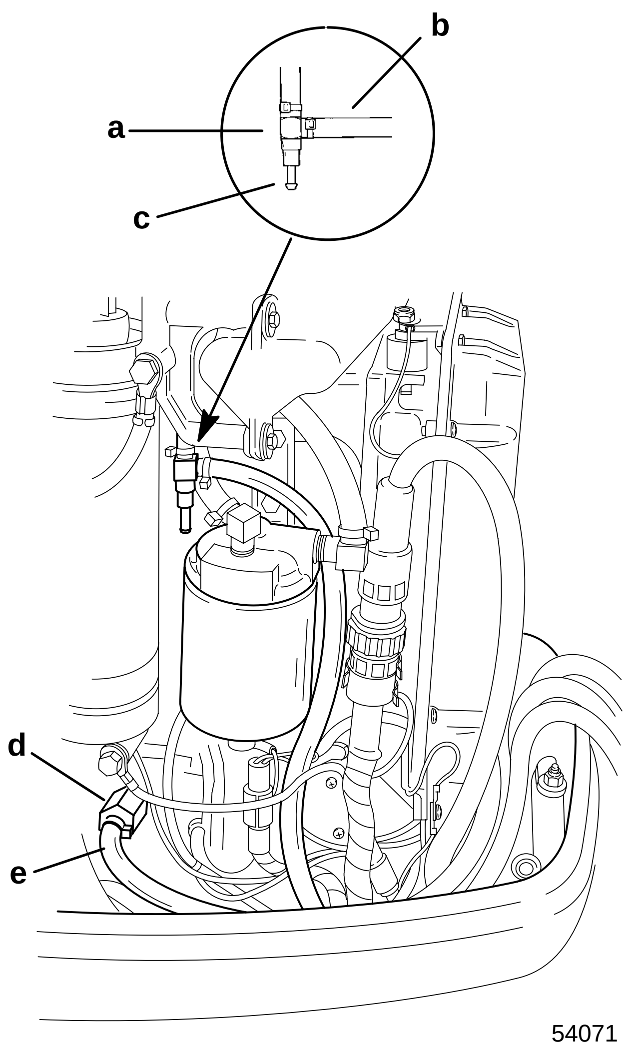
One Piece Type Hose Connection

INSTALLING OIL HOSES TO ENGINE

1. Remove shipping cap from hose fitting (a).
2. Connect oil hose (“b” with blue stripe) to fitting as shown. Secure with sta-strap.

NOTE: *The third fitting (c) is a vent and does not get connected.*

3. Remove (and discard) shipping cap from pulse fitting (d).
4. Connect the second oil hose (e) to pulse fitting as shown. Secure with sta-strap.
5. Refer to Section 7 page 32 for proper routing of oil hoses thru clamp in the bottom cowl.



FILLING THE OIL INJECTION SYSTEM

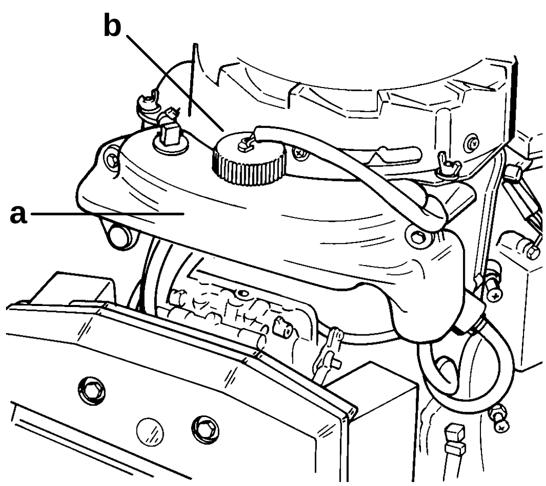
Use Quicksilver NMMA Certified TC-W3 or TC–WII 2-Cycle Outboard Oil.

Quicksilver Certified TC-W3 Outboard Oil is a higher grade oil that provides increased lubrication and extra resistance to carbon buildup when used with good or varying grades of gasoline.

Quicksilver Certified TC-WII Outboard Oil is an industry-leading oil that provides superior outboard lubrication and resistance to carbon build up when used with good grades of gasoline.

1. Fill remote oil tank to the 3 gal. mark with oil. Tighten fill cap.
2. Remove fill cap from the engine reservoir tank and fill the tank with oil. Re-tighten the fill cap.
3. Loosen (1/2 turn) the engine reservoir tank fill cap. Run the engine until air from inside the oil inlet hose has been purged out of the reservoir and oil starts to flow out of reservoir tank. Re-tighten cap.

> **⚠ CAUTION**
>
> **Be certain that all reservoir and remote oil tank caps are installed tightly. An air leak, on the remote oil tank cap, will prevent oil from moving from the remote oil tank to the oil reservoir. A leak at the engine reservoir will cause oil spillage.**



50047

a - Engine Reservoir Tank
b - Fill Cap

BLEEDING AIR FROM OIL INJECTION PUMP AND OIL INJECTION OUTLET HOSE

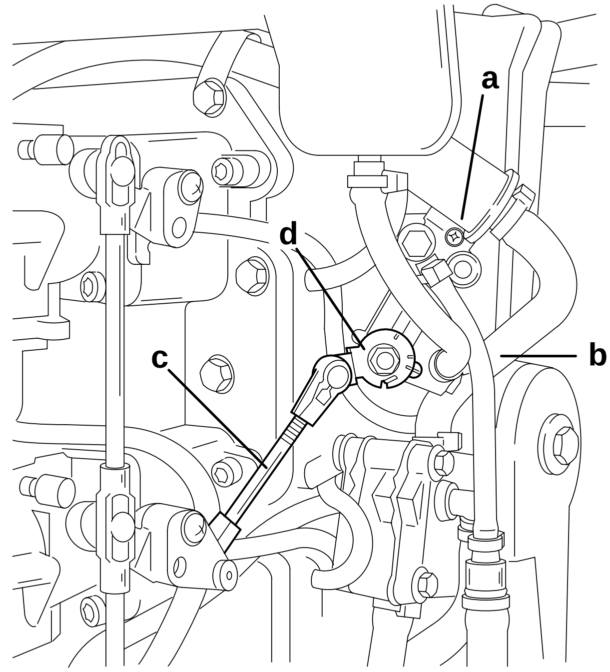
Bleeding Air from Oil Injection Pump

With engine not running, place a shop towel below the oil injection pump. Loosen bleed screw three to four turns and allow oil to flow from bleed hole. Retighten bleed screw. This procedure allows the pump to fill with oil.

Bleeding Air from Oil Injection Pump Outlet Hose

Any air bubbles in outlet hose, in most cases, will be purged out of the system during operation of the engine.

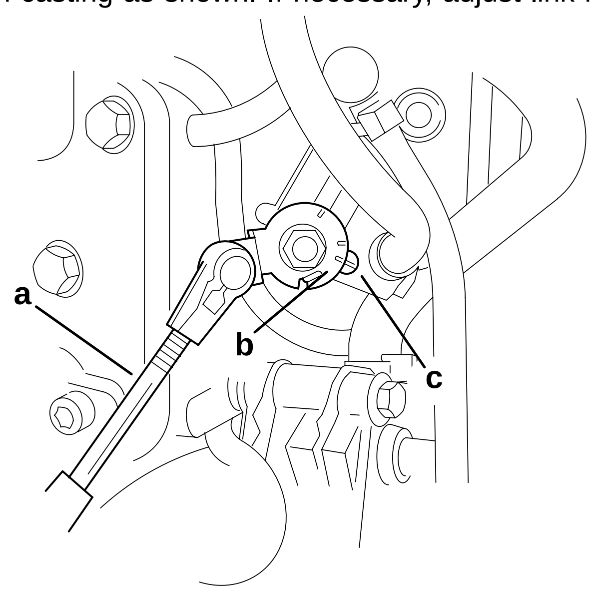
NOTE: *If air bubbles persist, they can be purged out of the hose by removing link rod and rotating the pump arm full clockwise while operating engine at 1000 to 1500 RPM: If necessary, gently pinch the fuel line between the remote fuel line connector and the oil injection pump "Tee" fitting. This will cause the fuel pump to provide a partial vacuum which will aid in removal of the air. Reinstall link rod.*



a - Bleed Screw
b - Outlet Hose
c - Link Rod
d - Pump Arm

ADJUSTING OIL INJECTION PUMP

When carburetor linkage is at idle position, alignment mark on oil injection arm should be in-line with mark on casting as shown. If necessary, adjust link rod.



a - Link Rod
b - Alignment Mark
c - Casting Mark

OPERATION OF THE OIL INJECTION SYSTEM

1. Make sure fill cap gaskets or O-rings are in place and caps are tight on engine reservoir tank and remote oil tank.
2. Make sure a remote gasoline and oil mixture of 50:1 is used during the initial break-in of the engine or after extended storage.
3. Be certain the warning horn is operational.

Each time the key switch is turned from the “off” to “on” position (engine not running); the warning horn will sound momentarily. This tells you the injection system module and warning horn is operational. If warning horn does not sound or horn stays on when key is turned to the “ON” position, refer to oil injection system troubleshooting chart following to correct the problem.

The oil injection warning sound is an intermittent “beep”, “beep”, “beep”, etc. The overheat warning sound is a continuous “beep” (not intermittent).

CHECK OPERATION OF THE OIL INJECTION SYSTEM (ENGINE RUNNING)

1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual. If warning horn should sound an intermittent “beep”, “beep”, “beep” during operation, this indicates a problem occurred in the oil injection system. Refer to troubleshooting following, to correct the problem.
2. After engine has been run for a short time, open cowl and check that no oil is leaking out of engine oil reservoir fill cap.

REQUIRED SIDE MOUNT REMOTE CONTROL OR IGNITION KEY ASSEMBLY TO BE USED WITH ENGINES WITH OIL INJECTION

Boats Equipped with a Side Mount Remote Control

A Quicksilver Commander Series Side Mount Remote Control equipped with a warning horn, must be used with this outboard. This warning horn is necessary for both the oil injection warning system and the engine overheat warning system.

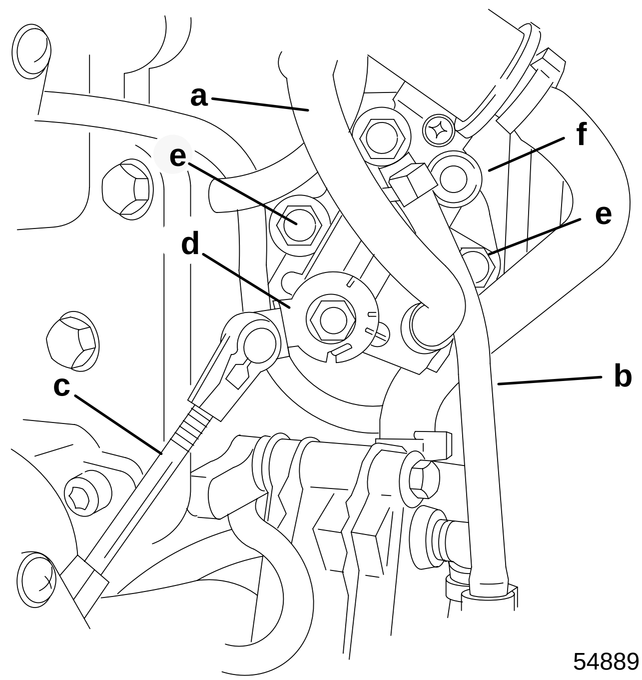
Boats Equipped with Panel or Console Mount Remote Controls

A Quicksilver Ignition Key/Choke Assembly equipped with a warning horn, must be used with this outboard. This warning horn is necessary for both the oil injection warning system and the engine overheat warning system.

Oil Injection Pump

Oil Pump Removal

1. Disconnect and plug inlet hose to oil pump.
2. Disconnect outlet hose on oil pump.
3. Disconnect link arm from oil pump injection arm.
4. Remove two bolts securing oil pump to powerhead and remove pump.



54889

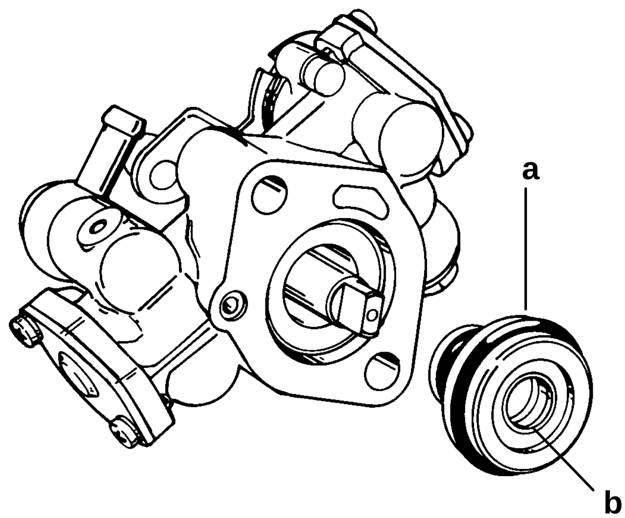
a - Inlet Hose
b - Outlet Hose
c - Link Arm
d - Injection Arm
e - Bolts
f - Oil Pump

Worm Bushing

Worm Bushing Removal

1. Grasp bushing and remove from oil pump.

NOTE: *If seal is defective, seal and bushing are replaced as an assembly.*

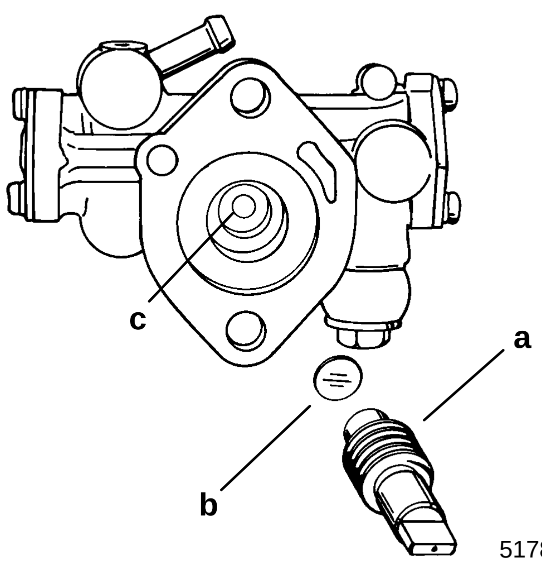


51782

a - Bushing
b - Seal

Worm Bushing Installation

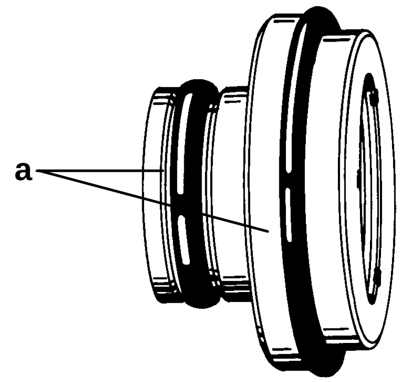
IMPORTANT: If worm shaft is removed from oil pump with worm bushing, verify thrust washer is positioned in center of worm shaft pocket before reinstalling worm shaft.



51782

a - Worm Shaft
b - Thrust Washer
c - Pocket

1. Inspect bushing O-rings for cuts and abrasions. Replace O-rings if necessary.



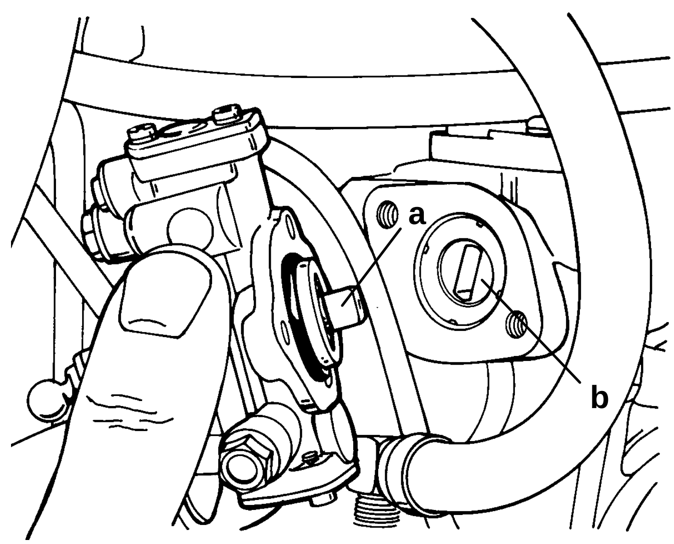
51782

a - O-rings

2. Reinstall bushing/seal assembly.

Oil Injection Pump Installation

1. Align oil pump worm shaft with coupler in powerhead.



51782

a - Worm Shaft
b - Coupler

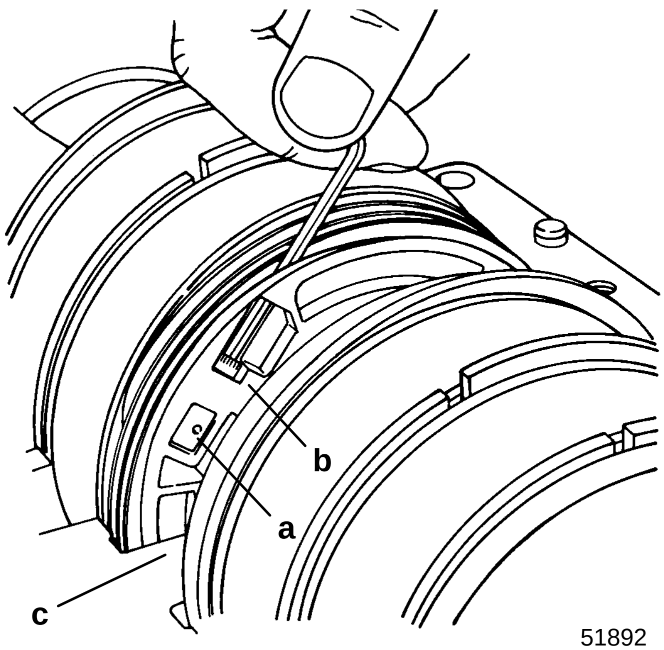
2. Apply Loctite 271 to threads of attaching bolts and secure oil pump to powerhead. Torque bolts to 25 lb. in. (3.0 N ·m).
3. Connect inlet and outlet hoses to oil pump. Secure hoses with clamps.
4. Connect link arm to oil pump arm.
5. Prior to starting outboard, refer to "**BLEEDING AIR FROM OIL INJECTION PUMP**" and "**ADJUSTING OIL INJECTION PUMP**," page 3B-7 for proper procedures.

Installing Drive Gear (for Oil Injection Pump) Onto Crankshaft

IMPORTANT: Oil pump drive gear retaining screws ARE STAKED after installation. DO NOT remove drive gear from crankshaft unless gear is damaged or shows signs of excessive wear.

REMOVAL OF DRIVE GEAR

1. Rotate crankshaft to gain access to two drive gear retaining allen screws.
2. Remove two screws and remove drive gear from crankshaft. DO NOT reuse retaining screws as screw threads may be damaged by factory staking process.



51892

a - Retaining Nut
b - Allen Screw
c - Center Main Bearing (Hidden)

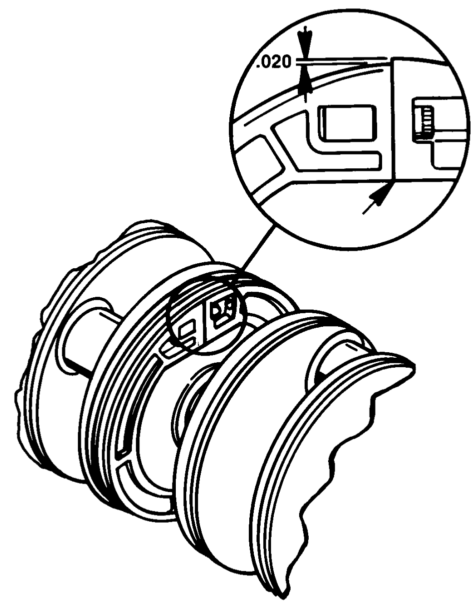
INSTALLATION OF NEW DRIVE GEAR

NOTE: *If drive gear must be replaced, it is recommended that the oil pump be inspected for operating smoothness; plastic bearing, bronze bushing and oil pump drive shaft be inspected for wear, gauling or damage. Replace parts as required.*

1. Align drive gear halves on crankshaft with retaining screw access holes towards center main bearing.
2. Clean retaining screw threads with Loctite Primer T (92-59327-1). Apply Loctite 680 (obtain locally) to screw threads.
3. Secure drive gear halves together with retaining nuts and allen screws. Torque screws to 8 lb. in. (1.0 N·m)
4. Check gear halve split lines. Split should be drawn tight together (zero clearance) if gear halves are properly installed.

⚠ CAUTION

Gear tooth mismatch at split line must not exceed 0.020 in. (0.50mm) or gear failure will result.



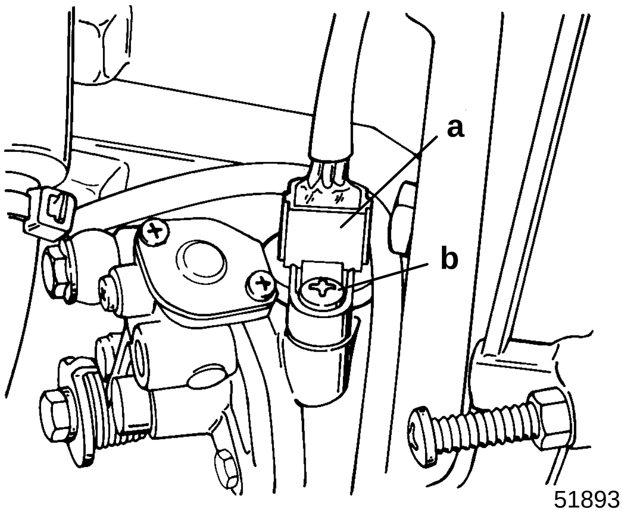
50755

Motion Sensor

Testing Procedure--Refer to “Oil Injection System Trouble Shooting Chart,” following:

Removal--Remove screw securing sensor to oil pump. Disconnect WHITE and BLUE/WHITE leads from WARNING MODULE. Remove BLACK LEAD from engine ground. Remove MOTION SENSOR from powerhead.

Installation--Insert MOTION SENSOR into pocket behind oil pump. Secure sensor with screw. Torque screw to 30 lb. in. (3.5 N·m). Connect WHITE and BLUE/WHITE leads to respective leads of WARNING MODULE. Secure BLACK sensor lead to engine ground.



a - Motion Sensor
b - Screw [Torque to 30 lb. in. (3.5 N·m)]

Oil Injection System Trouble Shooting Chart

TROUBLE SHOOTING THE OIL INJECTION SYSTEM

If a problem occurs with the oil injection system and the warning horn sounds in a pulsating manner, stop engine and check if problem is caused by (1) low oil level, (2) the oil injection pump, (3) water in fuel filter – EFI only or (4) a faulty warning sensor or module.

1. Open the cowling on engine and check oil level in engine reservoir tank. If oil level is not to the top of tank the problem is low oil level. There is a safety reserve of oil left in the reservoir after the low oil warning is sounded that allows you enough oil for 30 to 40 minutes of full throttle operation. Refer to trouble shooting chart to correct the problem.
2. Check if water module RED light is on. If light is on, empty the water separating fuel filter.
3. If engine reservoir is full of oil, then the problem may be in the oil injection pump. DO NOT run engine on straight gas when a problem may be in the oil injection pump. Engine can be run by connecting a remote tank of 50:1 fuel and oil mixture to engine or in an emergency add (approx. a 50:1 ratio) of oil from the 3 gallon remote oil tank to the straight gas. Refer to trouble shooting chart to correct the problem.

Problem: Oil Level in Engine Oil Reservoir Tank is Low but NOT Low in Remote Oil Tank

Possible Cause	Corrective Action
Fill cap is leaking air on the remote tank.	Verify o-rings or gaskets are in place and caps are tight.
Quick disconnect on remote oil tank is not fully connected.	Reconnect.
Remote oil hose (BLUE stripe) is blocked.	Check length of hose for a kink.
Remote pulse hose (second hose) is blocked or punctured.	Check length of hose for kink or damage.
Remote pulse hose check valve is faulty (valve is located at the engine end of the hose.	Replace check valve.
A restricted oil outlet filter in the remote tank	Remove filter and clean.
Leak at the upper end of remote oil tank pick-up tube.	Check tube for cracks or leaks.
Oil and Pulse hoses reversed.	Check hose connections.
Low crankcase pressure.	Check pressure from pulse hose check valve (2 psi minimum.

Problem: Warning Horn does NOT sound when Ignition Key is turned to “ON” Position

Possible Cause	Corrective Action
Horn malfunction or open (TAN/BLUE) wire between horn and engine.	Use a jumper wire to ground TAN lead (at engine terminal block) to to engine ground. Warning horn should sound. If not, check TAN wire between horn and engine for open circuit and check horn.
Warning Module.	Verify all warning module leads are connected to harness leads. If leads are connected, replace warning module.
Using incorrect side mount remote control or ignition/choke assembly.	Refer to required remote control/ignition key assembly on page 3E-8.

Problem: Warning Horn stays ON when Ignition Key is turned to “ON” Position.

Possible Cause	Corrective Action
Engine overheat sensor.	If horn sounds a continuous signal, the engine overheat sensor may be faulty. Disconnect overheat sensor and turn ignition key to “ON” position. If horn still sounds a continuous signal, the warning module is faulty. Replace module and re-test. If horn does not sound, then engine overheat sensor is faulty. Replace and re-test.
No battery voltage to warning horn (+) terminal.	Check PURPLE wire from key switch to horn for open and check key switch for open.
Open PURPLE wire going to warning module	Check for battery voltage on PURPLE wire at warning module with key in “ON” position.
Faulty warning module.	Check connections – replace module

TAN/BLUE wire between warning horn and module shorted to ground.	With key switch in “OFF” position and TAN/BLUE wire disconnected from terminal block, check between end of disconnected wire and engine ground. There should be no continuity.

Problem: Oil Level in Engine Oil Reservoir Tank is Low but NOT Low in Remote Oil Tank

Possible Cause	Corrective Action
Fill cap is leaking air on the remote tank.	Verify o-rings or gaskets are in place and caps are tight.
Quick disconnect on remote oil tank is not fully connected.	Re-connect.
Remote oil hose (blue stripe) is blocked.	Check length of hose for a kink.
Remote pulse hose (second hose) is blocked or punctured.	Check length of hose for a kink.
Remote pulse hose check valve is faulty (this valve is located at the engine end of the hose).	Replace check valve.
A restricted oil outlet filter in the remote tank.	Remove filter and clean.

Problem: Warning Horn sounds when Engine is Running and Oil Level in Engine Reservoir is Full.

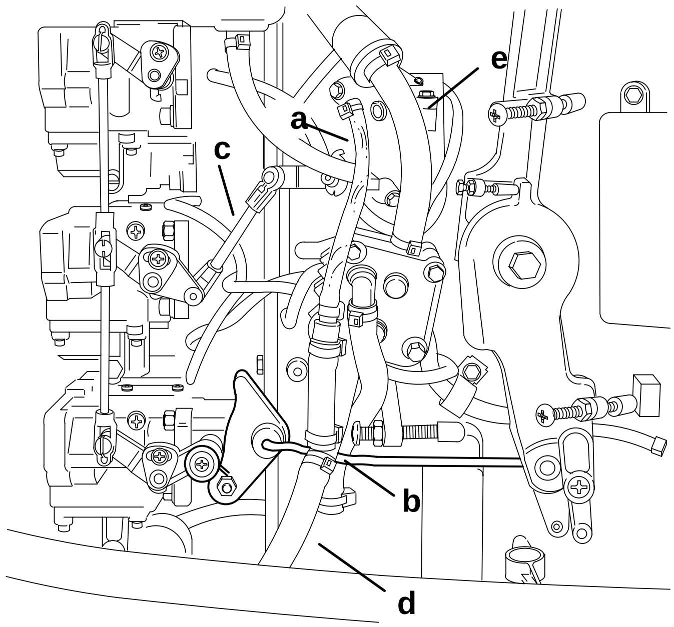
Possible Cause	Corrective Action
Faulty engine ignition system (incorrect voltage pulse being sent to the warning module).	Inspect ignition coil lead connections on the ignition switch box and determine what coil lead has the GREEN lead from the warning module connected to it. Check that coil for correct voltage using DVA. If the voltage to the coil is correct, then the voltage to the warning module is correct.
Defective low oil sensor (located in fill cap of engine oil reservoir).	DO NOT remove cap from oil reservoir. Disconnect both low oil sensor leads from terminal connectors. Connect an ohmmeter between leads. There should be NO continuity through sensor. If continuity exists, sensor is faulty. Replace cap assembly.

Defective motion sensor at the oil injection pump.	**All spark plugs must be removed and spark leads grounded to prevent engine from starting when checking motion sensor.** 1. Disconnect WHITE lead from module assembly. Check voltage from the WHITE lead from module. Voltage should be 12 volts ± 1 volt. 2. Re-connect WHITE lead from module. Sensor leads must be connected to module for remaining checks. Insert probe into wire connection for voltage checks. 3. Check output voltage to the sensor by connecting voltmeter to BLUE/WHITE sensor lead. Remove spark plugs and ground spark plug leads. Turn ignition to “ON”. Use emergency start rope and rotate flywheel while observing voltmeter. Output voltage should peak at 5 volts ±1 volt and then drop to less than 1.0 volt during every 2 revolutions of the engine. 4. If NO voltage is present, then one of two possibilities exists: a. Motion sensor is defective – replace and repeat test for voltage. b. Drive system defective – test as follows:

Drive system of the oil injection pump	Check drive system as follows: 1. Use a 50:1 gas and oil mixture and start engine. Verify engine has proper cooling water. 2. Disconnect link rod connected between oil injection pump and carburetor linkage. 3. Disconnect outlet hose of oil injection pump and observe if injection pump is pumping oil. If pump is not pumping oil, the drive system to the pump is faulty.

Oil Pump Volume (Flow) Test

NOTE: *The following specifications are determined with the outboard running off a remote fuel supply with pre-mix fuel. The oil pump output hose (clear) must be disconnected from the input fuel line TEE fitting and directed into a graduated container. The input fuel line TEE fitting from which the oil line was removed MUST BE CAPPED OFF to prevent fuel leakage while the engine is running.*



54388

a - Oil Pump Output Hose (Clear)
b - Tee Fitting
c - Link Arm
d - Input Fuel Line
e - Oil Pump

Two different capacity oil pumps are utilized on V-6 outboards.

Flow specifications are as follows:

135 thru 175 Models including Pro Max/Super Magnum Model 150:

@ 1500 RPM with oil pump link arm ATTACHED = 6.8cc ± 10% in 3 MINUTES

@ 1500 RPM with oil pump link arm DISCONNECTED =17cc ± 10%in 3 minutes

200 Model including 200/225 Pro Max/Super Magnum Models:

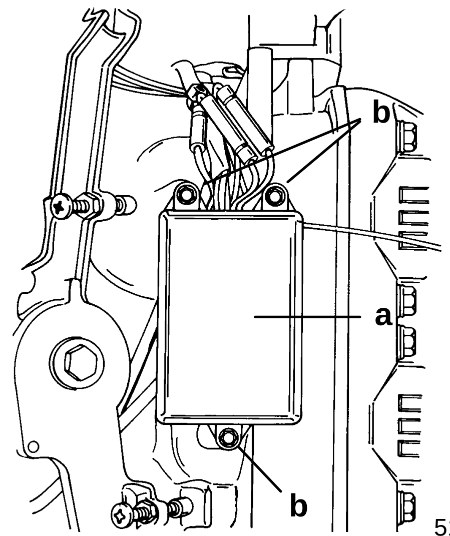
@ 1500 RPM with oil pump link arm ATTACHED =8.2cc ± 10% in 3 MINUTES

@ 1500 RPM with oil pump link arm DISCONNECTED =19.2cc ± 10% in 3 minutes

Oil Warning Module

REMOVAL

1. Disconnect PURPLE and TAN leads from terminal block above ignition plate on starboard side of powerhead .
2. Disconnect BLUE, BLUE/WHITE and WHITE from their respective bullet connectors.
3. Disconnect GREEN lead from switch box.
4. Disconnect BLACK lead from engine ground.
5. Remove 3 bolts securing module.



51892

a - Oil Warning Module
b - Bolts

INSTALLATION

1. Apply Loctite 222 (FT2962-2) to bolt threads and secure oil warning module to powerhead with 3 bolts. Torque bolts to 25 Ib. in. (3.0 N·m).
2. Refer to Section 2D, “WIRING DIAGRAMS” for proper connection of module wiring harness.

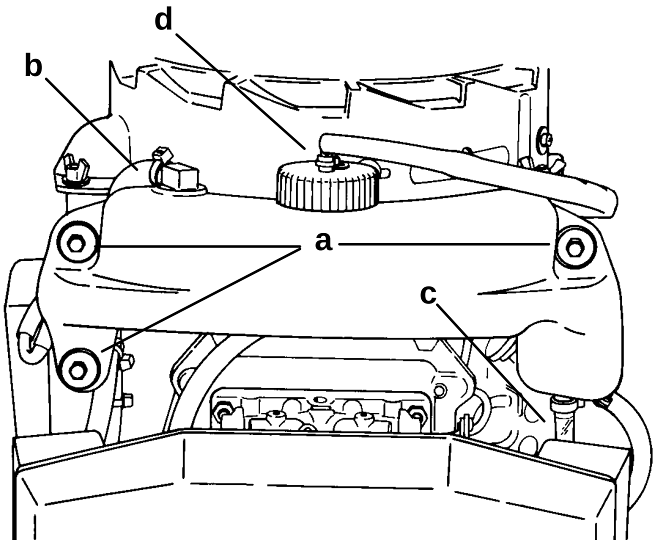
Engine Mounted Oil Reservoir

REMOVAL

NOTE: *If oil reservoir contains oil, the clear oil hose going to the oil pump should be plugged upon removal to prevent oil spillage.*

1. Disconnect input oil hose to oil reservoir.
2. Remove oil reservoir cap BLACK and LIGHT BLUE leads from their respective connections.
3. Disconnect clear input hose to oil pump and plug off hose.

4. Remove three bolts securing oil reservoir to powerhead and remove reservoir.



51893

a - Bolts
b - Input Oil Hose from boat mounted oil tank
c - Input Hose (Clear) to Oil Pump
d - Oil Cap

INSTALLATION

1. Apply Loctite 222 (FT2962-2) to threads of 3 attaching bolts and secure oil reservoir to powerhead. Torque bolts to 25 Ib. in. (3.0 N·m).
2. Install input oil hose to top of oil reservoir and secure with sta-strap.
3. Connect oil cap BLACK lead to engine ground and LIGHT BLUE LEAD to oil warning module.
4. Connect clear output hose from oil reservoir to oil pump. Secure hose with STA-STRAPS.

FUEL SYSTEM

3

F

MERCURY MARINE

Emission Control Information

1998

PART # 37–855211 12

This engine conforms to 1998 Model Year U.S. EPA regulations for marine SI engines.	This engine is certified to operate on regular 87 octane unleaded fuel (R+M)/2
Refer to Owners Manual for required maintenance. Exhaust Emission Control Systems: None	Idle Speed (in gear): 650 RPM
Engine Lubricants: Quicksilver Premium Plus TC-W3 2-Cycle Outboard Oil Fuel/Oil Ratio: 50:1 Oil Injection Variable	Timing: Idle: 5° ATDC WOT:19° BTDC
Family: WM9XM02.0210	Spark Plug: NGK BU8H — Gap: N/A
FEL: 145.00 GM/KW-HR	Valve Clearance (Cold) mm Intake: N/A Exhaust: N/A
1998 cc	135 - 150 HP

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC

EMISSIONS

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Exhaust Emissions Standards

Through the Environmental Protection Agency (EPA), the federal government has established exhaust emissions standards for all new marine engines sold in the U.S.

What Are Emissions?

Emissions are what comes out of the exhaust system in the exhaust gas when the engine is running. They are formed as a result of the process of combustion or incomplete combustion. To understand exhaust gas emissions, remember that both air and fuel are made of several elements. Air contains oxygen and nitrogen among other elements; gasolene contains mainly hydrogen and carbon. These four elements combine chemically during combustion. If combustion were complete, the mixture of air and gasoline would result in these emissions: water, carbon dioxide and nitrogen, which are not harmful to the environment. But combustion is not usually complete. Also, potentially harmful gases can be formed during and after combustion.

All marine engines must reduce the emission of certain pollutants, or potentially harmful gases, in the exhaust to conform with levels legislated by the EPA. Emissions standards become more stringent each year. Standards are set primarily with regard to three emissions: hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx).

Hydrocarbons – HC

Gasoline is a hydrocarbon fuel. The two elements of hydrogen and carbon are burned during combustion in combination with oxygen. But they are not totally consumed. Some pass through the combustion chamber and exit the exhaust system as unburned gases known as hydrocarbons.

Carbon Monoxide – CO

Carbon is one of the elements that make up the fuel burned in the engine along with oxygen during the combustion process. If the carbon in the gasoline could combine with enough oxygen (one carbon atom with two oxygen atoms), it would come out of the engine in the form of carbon dioxide (CO_2). CO_2 is a harmless gas. But carbon often combines with insufficient oxygen (one carbon atom with one oxygen atom). This forms carbon monoxide, CO. Carbon monoxide is the product of incomplete combustion and is a dangerous, potentially lethal gas.

Oxides of Nitrogen - NOx

NOx is a slightly different byproduct of combustion. Nitrogen is one of the elements that makes up the air going into the engine. Under extremely high temperatures it combines with oxygen to form oxides of nitrogen (NOx). This happens in the engine's combustion chambers when temperatures are too high. NOx itself is not harmful, but when exposed to sunlight it combines with unburned hydrocarbons to create the visible air pollutant known as smog. Smog is a serious problem in California as well as many other heavily populated areas of the United States.

Controlling Emissions

There are two principle methods of reducing emissions from a two-stroke-cycle marine engine. The first method is to control the air/fuel ratio that goes into the combustion chamber. The second is to control the time when this air/fuel mixture enters the combustion chamber. Timing is important, to prevent any unburned mixture from escaping out of the exhaust port.

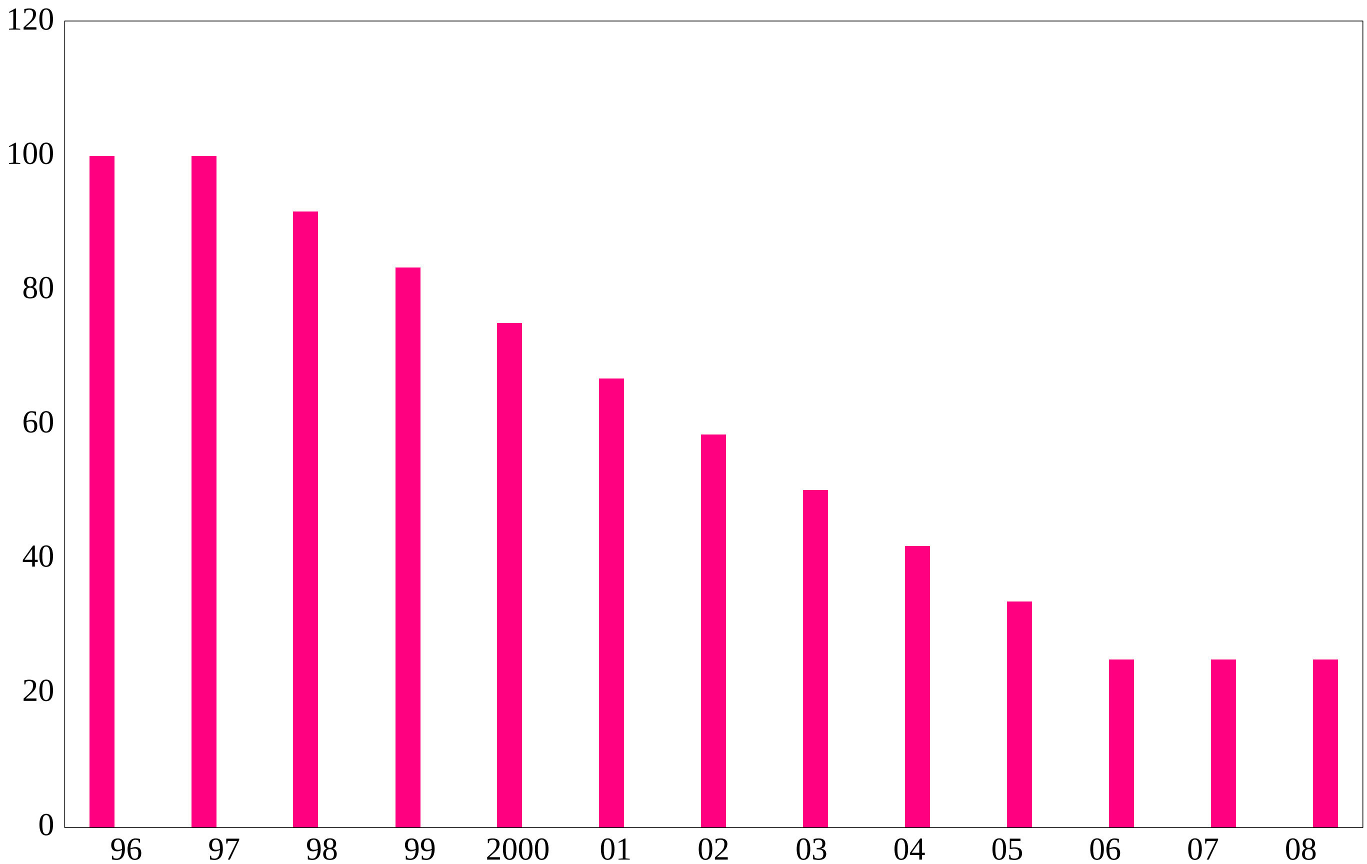
Stoichiometric (14.7:1) Air/Fuel Ratio

In the search to control pollutants and reduce exhaust emissions, engineers have discovered that they can be reduced effectively if a gasoline engine operates at an air/fuel ratio of 14.7:1. the technical term for this ideal ratio is stoichiometric. An air/fuel ratio of 14.7:1 provides the best control of all three elements in the exhaust under almost all conditions. The HC and CO content of the exhaust gas is influenced significantly by the air/fuel ratio. At an air/fuel ratio leaner than 14.7:1, HC and CO levels are low, but with a ratio richer than 14.7:1 they rise rapidly. It would seem that controlling HC and CO by themselves might not be such a difficult task; the air/fuel ratio only needs to be kept leaner than 14.7:1. However, there is also NOx to consider.

As the air/fuel ratio becomes leaner, combustion temperatures increase. Higher combustion temperatures raise the NOx content of the exhaust. But, enrichening the air/fuel ratio to decrease combustion temperatures and reduce NOx also increases HC and CO, as well as lowering fuel economy. So the solution to controlling NOx - as well as HC and CO - is to keep the air/fuel ratio as close to 14.7:1 as possible.

OUTBOARD HYDROCARBON EMISSIONS REDUCTIONS

8 1/3% ↓ PER YEAR OVER 9 MODEL YEARS



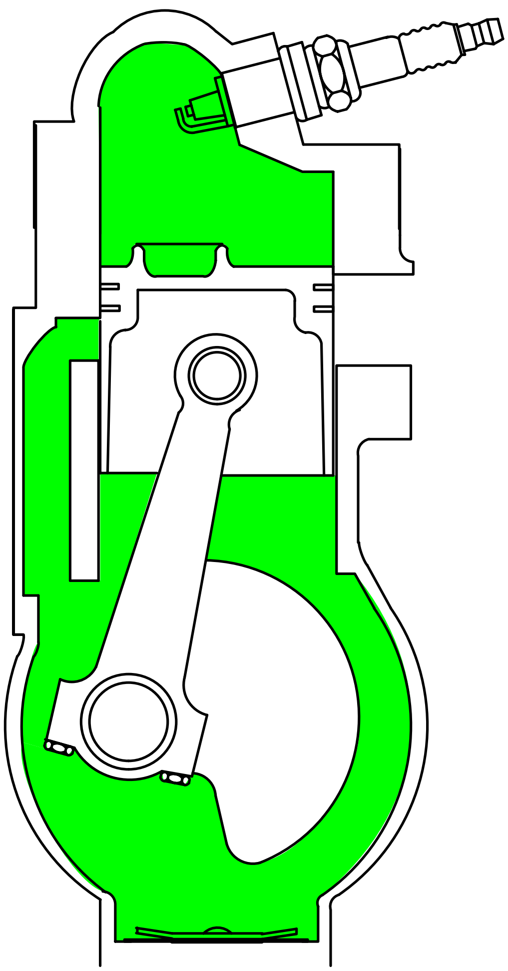
STRATIFIED VS HOMOGENIZED CHARGE

DFI engines use a stratified charge inside the combustion chamber to aid in reducing emissions. All other models use a homogenized charge. The difference between the two is:

Homogenized Charge

A homogenized charge has the fuel/air particles mixed evenly throughout the cylinder. This mixing occurs inside the carburetor venturi, reed blocks and crankcase. Additional mixing occurs as the fuel is forced through the transfer system into the cylinder.

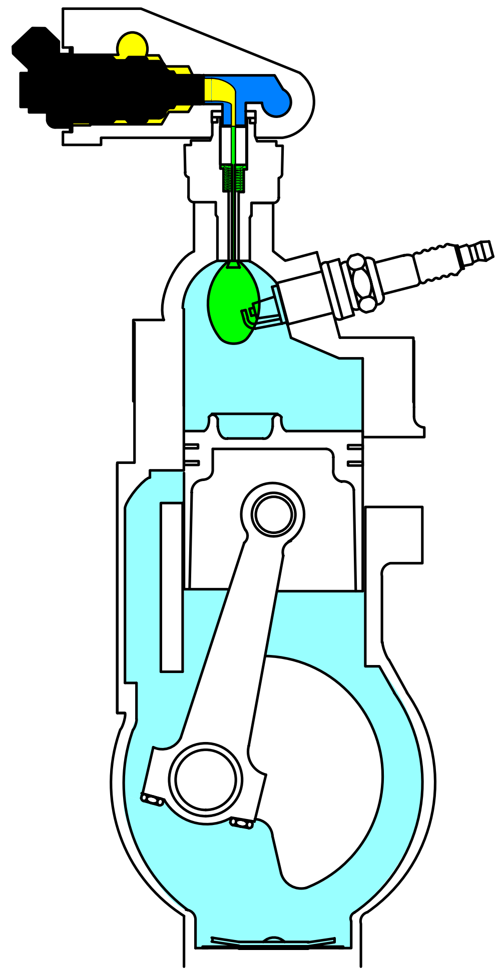
The homogenized charge is easy to ignite as the air/fuel ratio is approximately 14.7:1.



Stratified Charge

A stratified charge engine only pulls air through the transfer system. The fuel required for combustion is forced into the cylinder through an injector placed in the top of the cylinder (head). The injector sprays a fuel/air mixture in the form of a bubble into the cylinder. Surrounding this bubble is air supplied by the transfer system. As the bubble is ignited and burns, the surrounding air provides almost complete combustion before the exhaust port opens.

A stratified charge is hard to ignite, the fuel/air bubble is not evenly mixed at 14.7:1 and not easily ignited.



Emissions Information

Manufacturer's Responsibility:

Beginning with 1998 model year engines, manufacturers of all marine propulsion engines must determine the exhaust emission levels for each engine horsepower family and certify these engines with the United States Environmental Protection Agency (EPA). A certification decal/emissions control information label, showing emission levels and engine specifications directly related to emissions, **must** be placed on each engine at the time of manufacture.

Dealer Responsibility:

When performing service on all 1998 and later outboards that carry a certification, attention must be given to any adjustments that are made that affect emission levels.
Adjustments must be kept within published factory specifications.
Replacement or repair of any emission related component must be executed in a manner that maintains emission levels within the prescribed certification standards.
Dealers are **not** to modify the engine in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.
Exceptions include manufacturers prescribed changes, such as that for altitude adjustments.

Owner Responsibility:

The owner/operator is required to have engine maintenance performed to maintain emission levels within prescribed certification standards.
The owner/operator is **not** to modify the engine in any manner that would alter the horsepower or allow emissions levels to exceed their predetermined factory specifications.

Exceptions:

- Carburetor jets may be changed for high altitude use in accordance with factory recommendations.
- Single engine exceptions may be allowed with permission from the EPA for racing and testing.

EPA Emission Regulations:

All new 1998 and later outboards manufactured by Mercury Marine are certified to the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new outboard motors. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.
The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA laws on exhaust emissions for marine products. For more detailed information on this subject, you may contact the following locations:

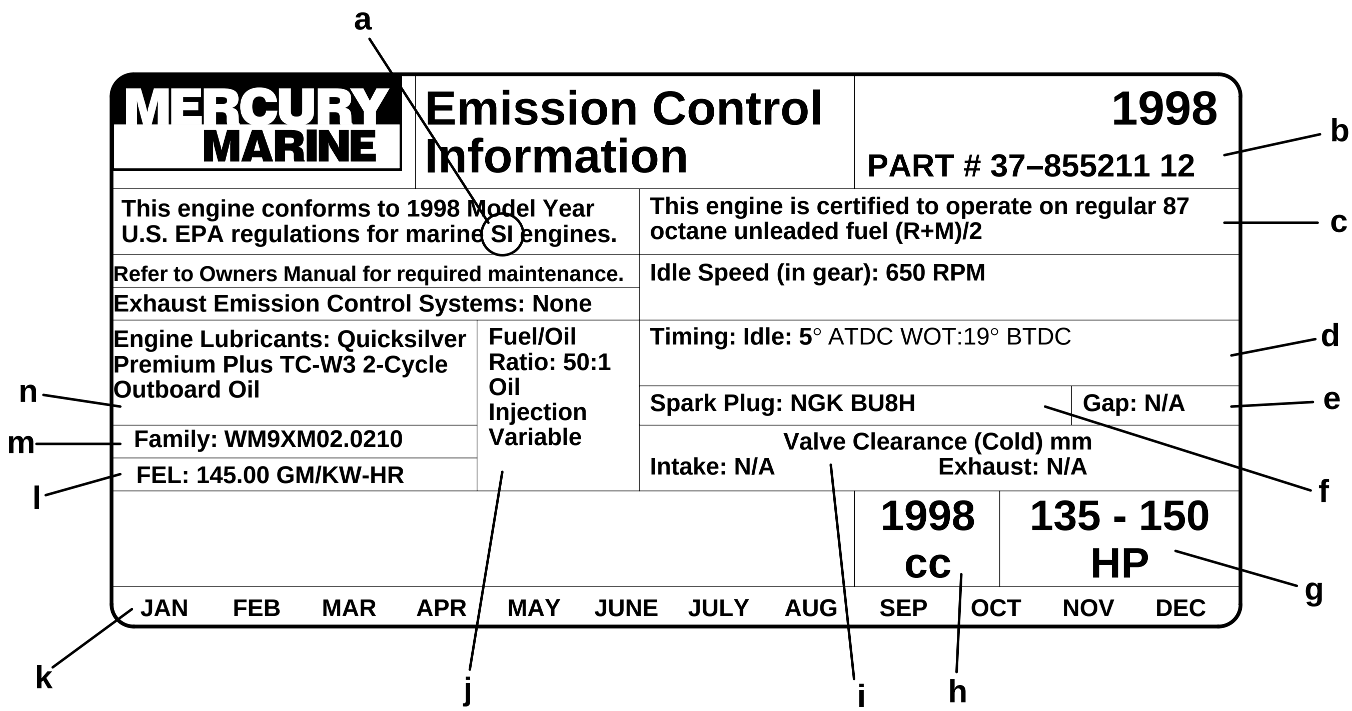
VIA U.S. POSTAL SERVICE:
Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
401 M St. NW
Washington, DC 20460

VIA EXPRESS or COURIER MAIL:
Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
501 3rd St. NW
Washington, DC 20001

EPA INTERNET WEB SITE:
http:/www.epa.gov/omswww

CERTIFICATION LABEL:

The certification label must be placed on each engine at the time of manufacture and must be replaced in the same location if damaged or removed. Shown below is a typical certification label and is not representative of any one model. Label shown below is not to scale; (shown at twice the normal size).



a - Spark Ignition (SI)
b - Model year of engine and production decal part number
c - Type and octane of fuel used to establish emission levels
d - Timing specifications when adjustable
e - Spark plug gap in thousandths of an inch
f - Recommended spark plug for best engine performance
g - Engine Horsepower rating
h - Cubic Centimeter
i - Valve Clearance (Four Stroke engines only)
j - Recommended oil/fuel ratio for best engine performance and minimal emissions
k - Month of production (Boxing month will punched)
l - FEL: Represents (Mercury Marine) statement of the maximum emissions output for the engine family
m - Family example:

W M9X M 03.0 2 2 0

Model Year
W=1998
X=1999

Manufacturer
Mercury Marine

Regulation
M=Marine

Displacement
Liter
Cubic Inch

Application
1=PWC
2=OB

Technology type
1=Existing
2=New

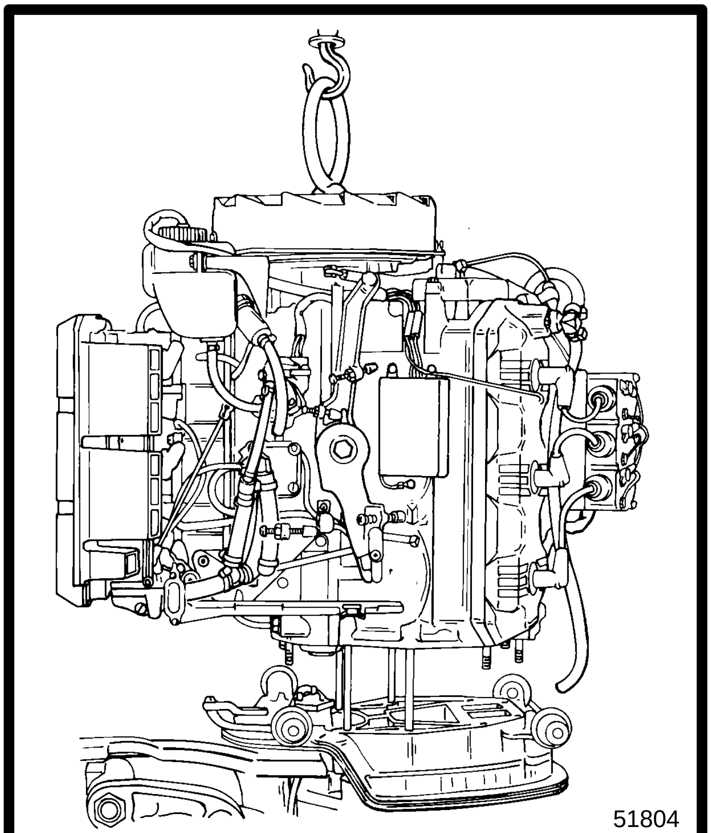
Unspecified

n - Engine lubricants recommended by the manufacturer

Decal Location for 1998 Models:

Model	Production Part No.	Service Part No.	Location on Engine
Merc/Mar 2.0 L V6 Carb (135 – 150 H.P.)	37-855211 12	37-855577 12	Air Cover
Merc/Mar 2.5 L 1998 V6 EFI/Carb (150 – 200 H.P.)	37-855211 13	37-855577 13	Vapor Separator (EFI) Air Cover (Carb)
Merc/Mar 2.5L Promax (150 – 225 H.P.)	37-855211 28	37-855577 28	Top of Flywheel Cover
Merc/Mar 2.5L EFI (260 H.P.)	37-855211 29	37-855577 29	Top of Flywheel Cover
Merc/Mar XR2 2.0L Carb	37-855211 30	37-855577 30	Top of Flywheel Cover

POWERHEAD



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Powerhead Specifications

Block

Type . . . . 60° V, 2 Cycle
Displacement
135 and 150 . . . . 122 cu. in. (2.0 Litre)
175, XR6/Mag III, 200 . . . . 153 cu. in. (2.5 Litre)

Reed Valve Opening

Reed Stand Open (Max.) . . . 0.020 in. (0.50 mm)

Cylinder Bore

(105 Jet, 135, 150)
Dia. Standard . . . . 3.125 in. (79.375 mm)
Dia. .015 in. Oversize . . . 3.140 in. (79.756 mm)
Dia. .030 in. Oversize . . . 3.155 in. (80.137 mm)

(140 Jet, 175, XR6/Mag III, 200, 150XRI, 175XRI, 200XRI,Pro Max/Super Magnum 150,200,225)
Dia. Standard . . . . 3.501 in. (88.925 mm)
Dia. .015 in. Oversize . . . 3.516 in. (89.306 mm)
Taper/Out of Round Max. 0.006 in. (0.152 mm)

Piston

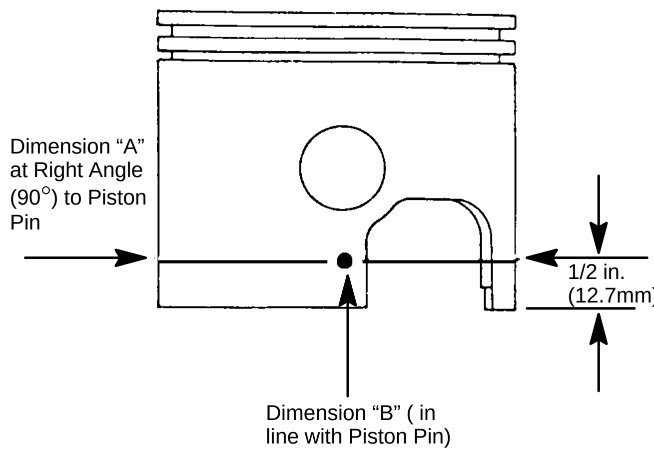
(105 Jet, 135, 150)
Dia. Standard . . . . 3.115 in. ± .002 in. (79.121 mm ± .051 mm)
Dia. .015 in. Oversize . 3.130 in. ± .002 in. (79.502 mm ± .051 mm)
Dia. .030 in. Oversize . 3.145 in. ± .002 in. (79.883 mm ± .051 mm)

(140 Jet, 175, XR6/Mag III, 200, 150XRI, 175XRI, 200XRI, Pro Max/Super Magnum 150.200,225)
Dia. Standard . . . . 3.494 in. ± .001 in. (88.748 mm ± .025 mm)
Dia. .015 in. Oversize . 3.509 in. ± .001 in. (89.129 mm ± .025 mm)

Compression

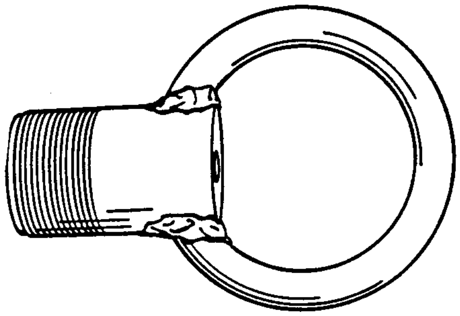
All Models – Using a fully charged battery, throttle shutters wide open and cylinder block warm – 110 – 135 psi (753.3 – 924.5 kPa) Variance between cylinders should not exceed 15 psi (102.7 kPa)

IMPORTANT: Using a micrometer, measure dimension "B" at location shown. Dimension "B" should be .008 in. or less than dimension "A".

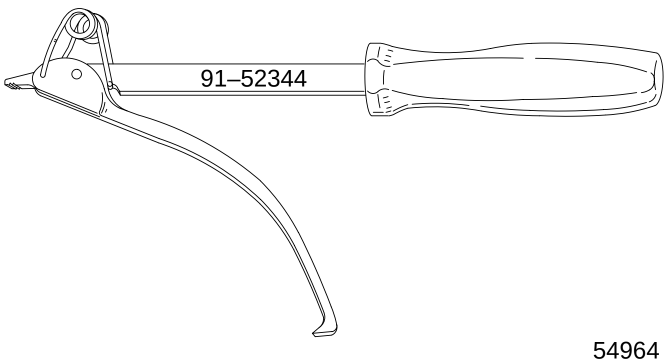


Special Tools

Lifting Eye 91-90455

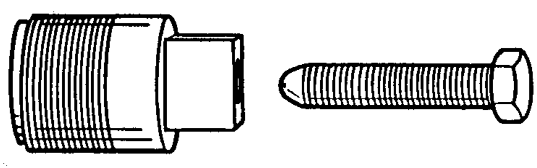


Flywheel Holder 91-52344

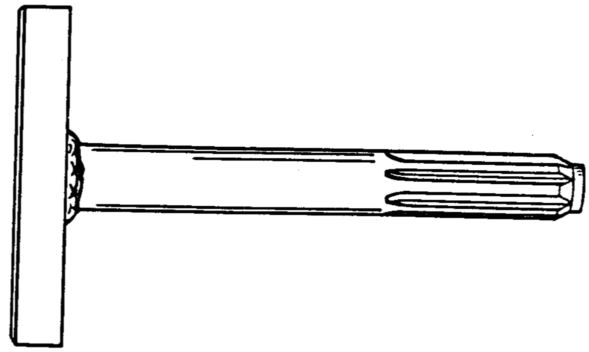


Protector Cap 91-24161

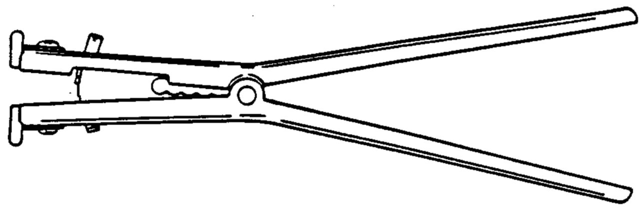
Flywheel Puller 91-73687A1



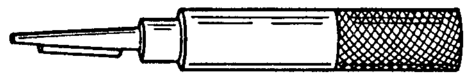
Powerhead Stand 91-30591A1



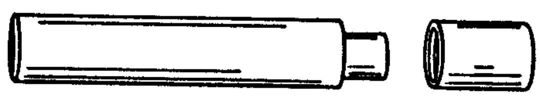
Piston Ring Expander 91-24697



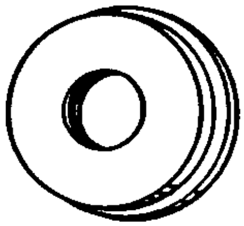
Lockring Removal Tool 91-52952A1



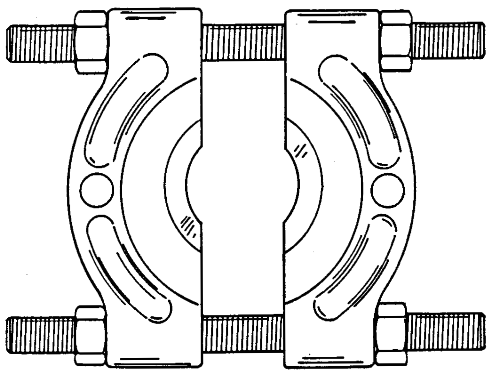
Piston Pin Tool 91-74607A1



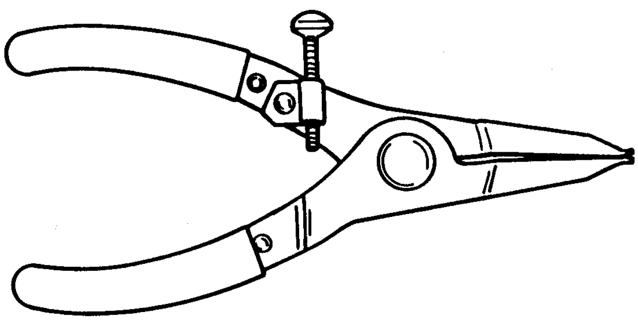
Driver Head 91-55919



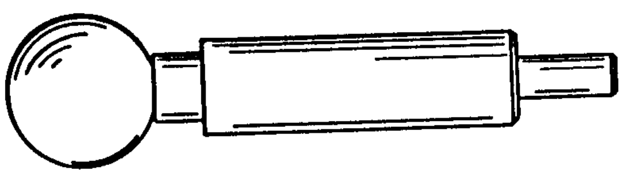
Universal Puller Plate 91-37241



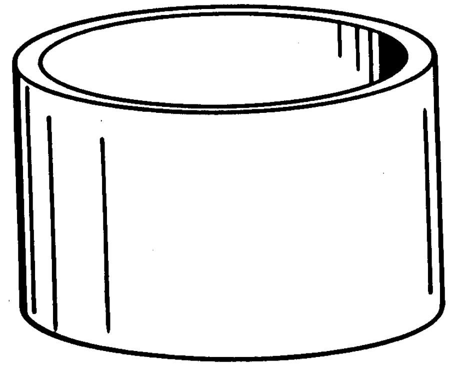
Snap Ring Pliers 91-24283



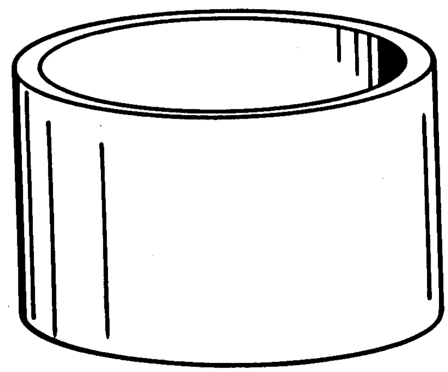
Lockring Installation Tool 91-91-77109A1



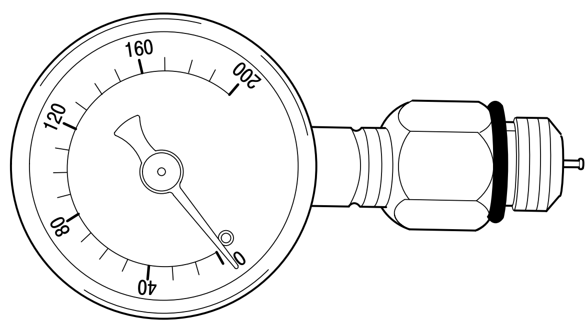
Piston Ring Compressor for 2 Litre (122 cu. in.) 91-65494



Piston Ring Compressor for 2.5 Litre (153 cu. in.) 91-818773



Compression Tester 91-29287



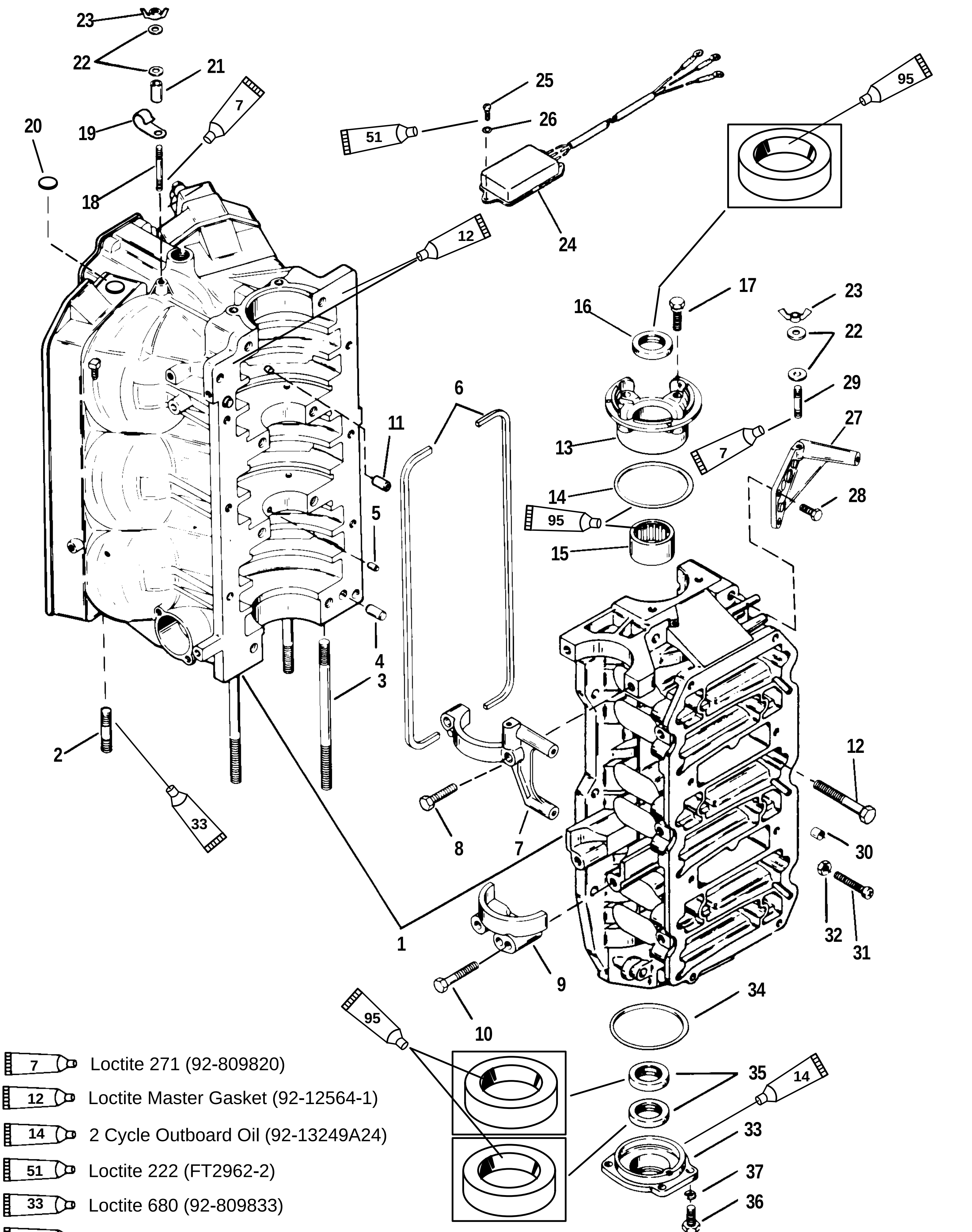
54965

Powerhead Repair Stand

A powerhead repair stand may be purchased from:

Bob Kerr's Marine Tool Co.
P.O. Box 1135
Winter Garden, FL 32787
Telephone: (305) 656-2089

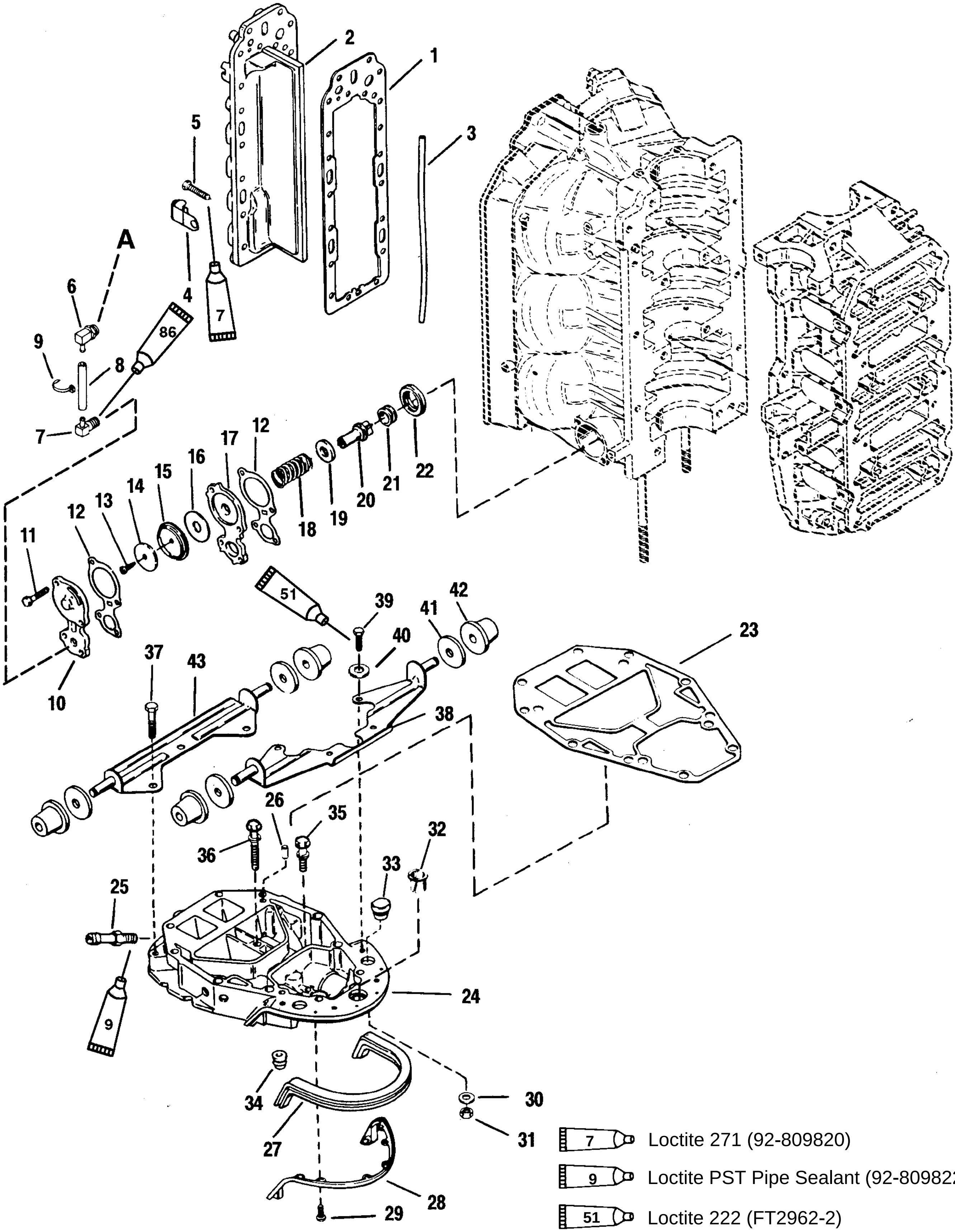
Cylinder Block and End Caps



7	Loctite 271 (92-809820)
12	Loctite Master Gasket (92-12564-1)
14	2 Cycle Outboard Oil (92-13249A24)
51	Loctite 222 (FT2962-2)
33	Loctite 680 (92-809833)
95	2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	CYLINDER BLOCK **(135/150)**			
	1	CYLINDER BLOCK **(XR6/MAG. III)**			
	1	CYLINDER BLOCK **(175)**			
	1	CYLINDER BLOCK **(200)**			
2	6	STUD–powerhead (1-3/4 IN.)			
3	2	STUD–powerhead (5-1/2 IN.)			
	2	STUD–powerhead (6-3/4 IN.)			
4	2	DOWEL PIN–locating			
5	2	DOWEL PIN (BEARING RACE)			
6	2	GASKET–sealing			
7	1	COVER–starter motor (UPPER)			
8	2	SCREW (1-1/2 IN.) (HEX FLANGE)	210	17.5	23.5
9	1	COVER (LOWER)			
10	2	SCREW (2 IN.)(HEX HEAD FLANGE)	210	17.5	23.5
11	1	BUSHING			
12	8	SCREW (3-1/4 IN.)		38	51.5
	6	SCREW (1-1/4 IN.)		38	51.5
13	1	UPPER END CAP ASSEMBLY			
14	1	O-RING			
15	1	ROLLER BEARING			
16	1	OIL SEAL			
17	4	SCREW (1 IN.)	150	12.5	17.0
18	1	STUD (1-7/8 IN.)			
19	1	J-CLIP			
20	1	PLUG–Serial Number			
21	1	SPACER			
22	3	WASHER			
23	3	NUT	25		3.0
24	1	IDLE CONTROL			
25	3	SCREW	30		3.5
26	3	WASHER			
27	1	BRACKET			
28	2	SCREW (3/4 IN.)	80		9.0
29	2	STUD (1 IN.)			
30	1	CAP			
31	1	ADJUSTING SCREW			
32	1	JAM NUT			
33	1	LOWER END CAP			
34	1	O-RING (3-1/4 IN. I.D.)			
35	2	OIL SEAL			
36	4	SCREW (3/4 IN.)	80		9.0
37	4	LOCKWASHER			

Exhaust Manifold and Exhaust Plate



7 Loctite 271 (92-809820)

9 Loctite PST Pipe Sealant (92-809822)

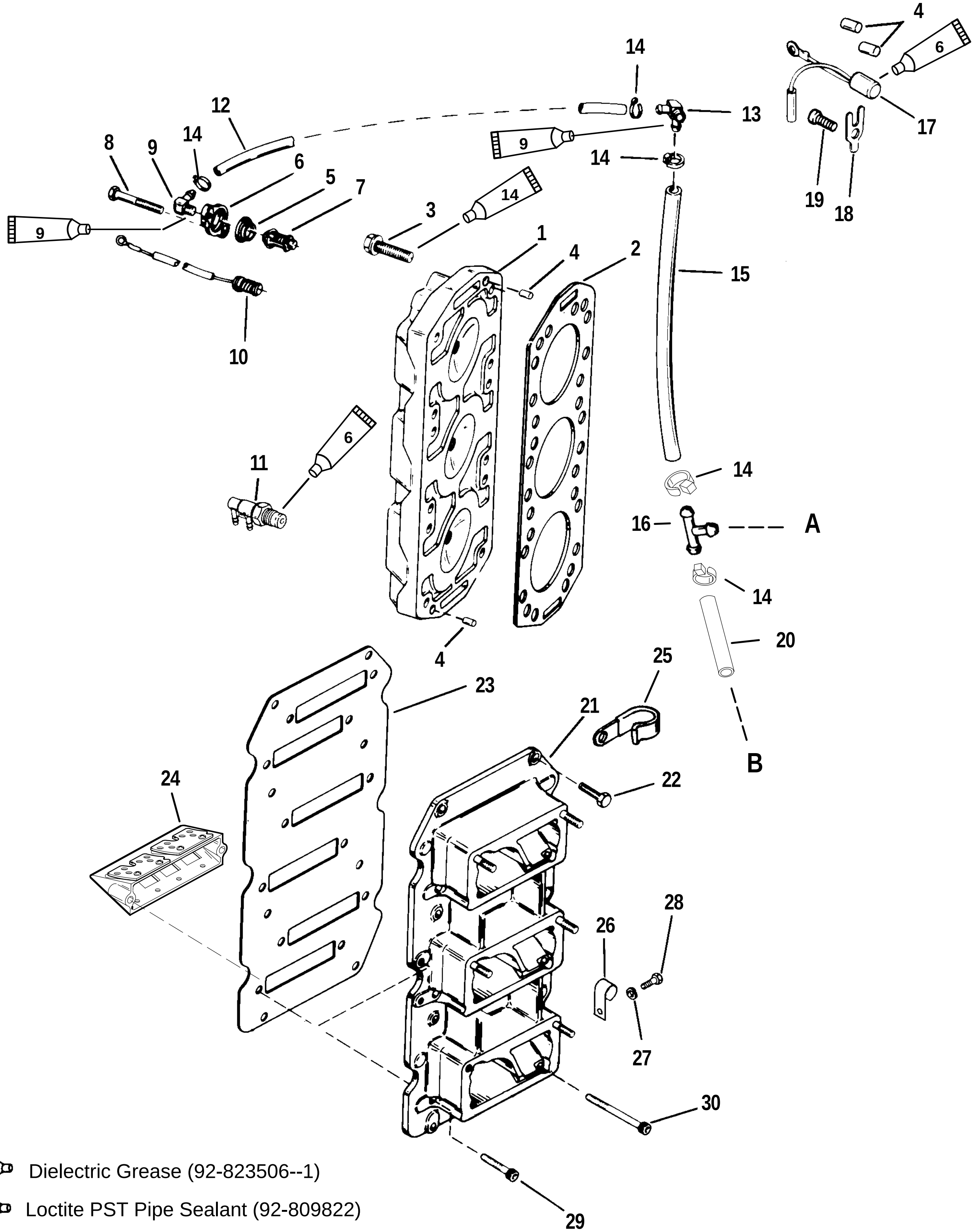
51 Loctite 222 (FT2962-2)

86 Loctite 262 (Obtain Locally)

A = TO BLOCK

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GASKET			
2	1	DIVIDER PLATE **(S/N-0G437999 & BELOW)**			
	1	DIVIDER PLATE **(S/N-0G438000 & UP)**			
3	1	SEAL			
4	4	J-CLAMP			
5	20	SCREW	200	16.5	22.5
6	1	FITTING			
7	1	FITTING (90°)			
8	1	HOSE (23-1/2 IN.)			
9	2	STA-STRAP			
10	1	COVER–relief valve			
11	4	SCREW (1-1/4 IN.)	150	12.5	17.0
12	2	GASKET			
13	1	SCREW (3/4 IN.)	25		3.0
14	1	WASHER			
15	1	DIAPHRAGM			
16	1	WATER DEFLECTOR			
17	1	PLATE			
18	1	SPRING			
19	1	WASHER			
20	1	POPPET			
21	1	GROMMET			
22	1	CARRIER			
23	1	GASKET			
24	1	EXHAUST PATE			
25	1	CONNECTOR (STRAIGHT)			
26	2	DOWEL PIN			
27	1	SEAL			
28	1	BRACKET			
29	8	SCREW (1/2 IN.)			
30	6	WASHER			
31	6	NUT	240	20	27.0
32	1	BUSHING			
33	1	GROMMET			
34	1	GROMMET			
35	1	SCREW (1-1/4 IN.)	300	25	34.0
36	1	SCREW (2-1/2 IN.)	300	25	34.0
37	3	SCREW (3-1/2 IN.)		50	68.0
38	1	FRONT BRACKET ASSEMBLY			
39	4	SCREW (1/2 IN.)			
	4	SCREW (5/8 IN.)	216	18	24.5
40	4	WASHER (Use with 5/8 IN. ref. #39)			
41	4	WASHER			
42	4	GROMMET			
43	1	REAR BRACKET ASSEMBLY			

Reed Block and Cylinder Head



6 Dielectric Grease (92-823506--1)

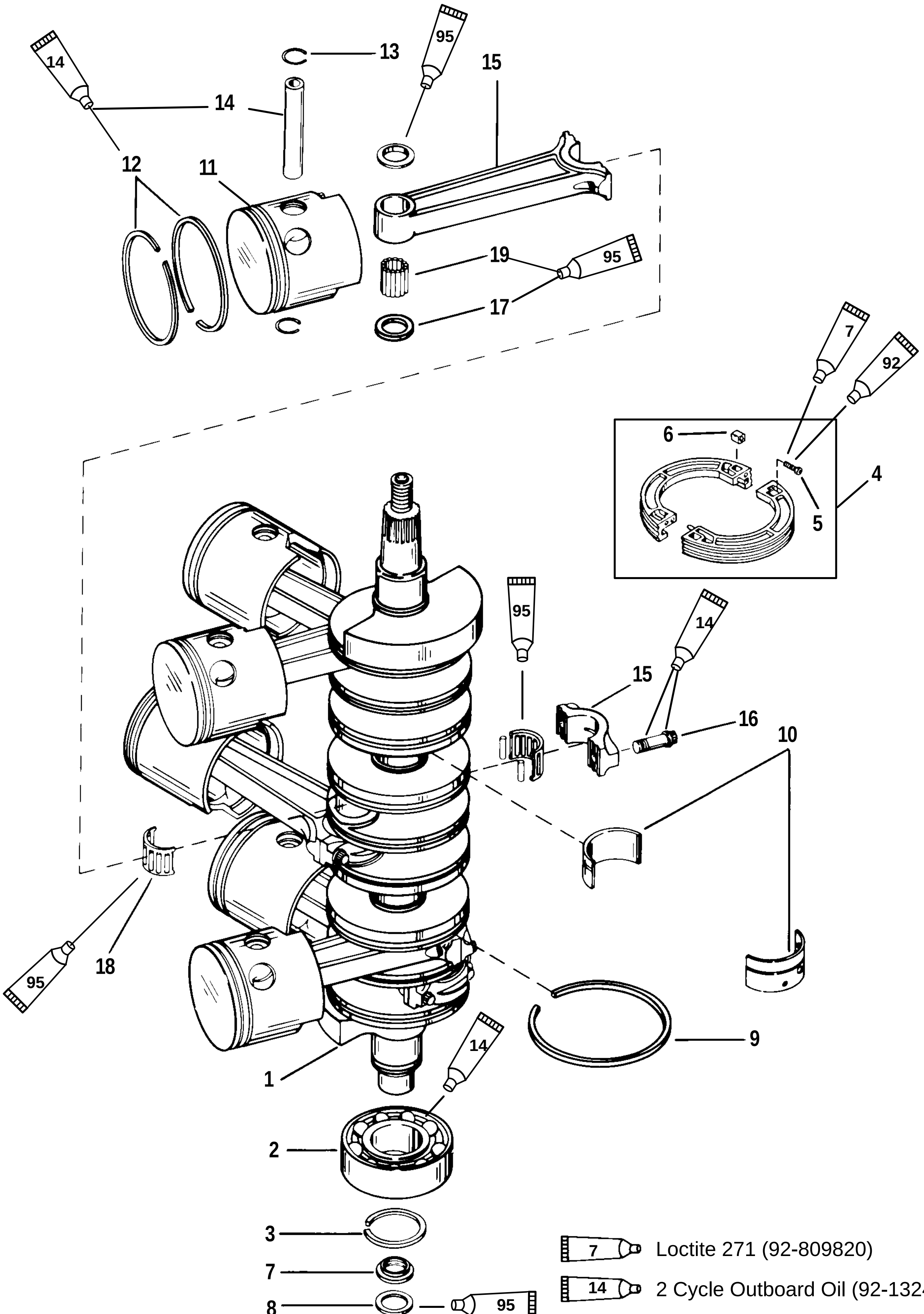
9 Loctite PST Pipe Sealant (92-809822)

14 2 Cycle Outboard Oil (92-13249A24)

A = TO TELL-TALE HOSE
B = TO ADAPTOR PLATE

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	2	CYLINDER HEAD **135/150**			
2	2	GASKET			
1	2	CYLINDER HEAD **XR6/ Magnum III**			
2	2	GASKET **175**			
1	2	CYLINDER HEAD **200**			
2	2	GASKET			
3	24	SCREW (2 IN.)	30 lb. ft. (40.5 N·m); Then Turn Additional 90°		
4	4	DOWEL PIN			
5	2	GASKET			
6	2	COVER			
7	2	THERMOSTAT			
8	4	SCREW (1 IN.)	200	16.5	22.5
9	1	ELBOW			
10	1	TEMPERATURE SENDER (STBD.)			
11	1	THERMAL AIR VALVE			
12	1	HOSE (12-3/4 IN.)			
13	1	FITTING			
14	10	STA-STRAP			
15	1	HOSE (11-1/2 IN.)			
16	1	T-FITTING			
17	1	TEMPERATURE SENSOR (PORT) (2-WIRE)			
18	2	RETAINER			
19	2	SCREW	200	16.5	22.5
20	1	HOSE (7-1/2 IN.)			
21	1	ADAPTOR PLATE			
22	8	SCREW	105	9.0	12.0
23	1	GASKET			
24	6	REED BLOCK			
25	1	J-CLAMP			
26	1	CLIP			
27	1	C-WASHER			
28	1	SCREW	85	7.0	9.5
29	6	SCREW (7/8 IN.)	105	9.0	12.0
30	6	SCREW (1-1/8 IN.)	80	6.5	9.0

Crankshaft, Pistons and Connecting Rods

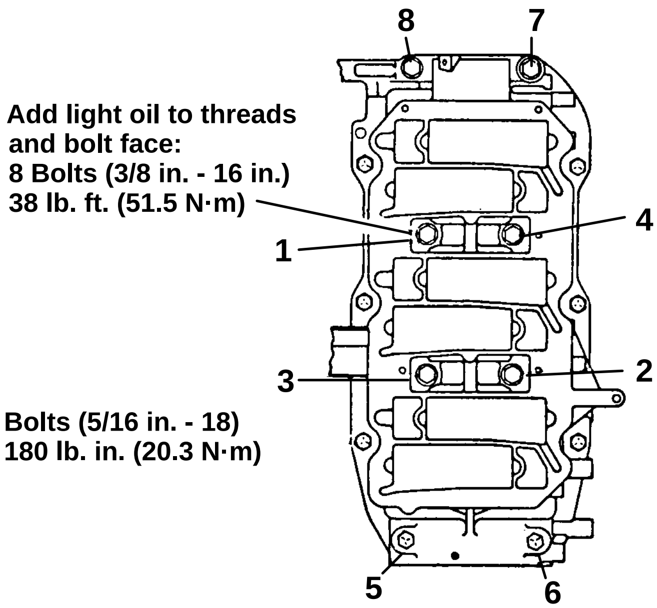


7	Loctite 271 (92-809820)
14	2 Cycle Outboard Oil (92-13249A24)
92	Loctite 7649 Primer (92-809824)
95	2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CRANKSHAFT ASSEMBLY			
2	1	BALL BEARING (LOWER)			
3	1	RETAINING RING			
4	1	DRIVE GEAR			
5	2	SCREW	8		1.0
6	2	NUT			
7	1	CARRIER ASSEMBLY			
8	1	SEAL			
9	7	RING–sealing - crankshaft			
10	2	ROLLER BEARING–crankshaft			
11	3	PISTON **(STARBOARD-STANDARD)**			
	AR	PISTON **(STARBOARD-.015 O.S.)**			
	AR	PISTON **(STARBOARD-.030 OS.)**			
	3	PISTON **(PORT-STANDARD)**			
	AR	PISTON **(PORT-.015 O.S.)** **135/150**			
	AR	PISTON **(PORT-.030 O.S.)**			
12	1	PISTON RING **(STANDARD)**			
	AR	PISTON RING **(.015 O.S.)**			
	AR	PISTON RING **(.030 O.S.)**			
13	12	LOCK RING			
14	6	PISTON PIN			
11	3	PISTON **(STARBOARD-STANDARD)**			
	AR	PISTON **(STARBOARD-.015 O.S.)** **XR6**			
	3	PISTON **(PORT-STANDARD)** **Magnum III**			
	AR	PISTON **(PORT-.015 O.S.)** **175/200**			
12	1	PISTON RING **(STD.)**			
	2	PISTON RING **(.015 O.S.)**			
13	12	LOCK RING			
14	6	PISTON PIN			
15	6	CONNECTING ROD ASSEMBLY			
16	12	SCREW–connecting rod	1st Torque - 15 lb. in. (1.5 N·m) 2nd Torque - 30 lb. ft. (40.5 N·m) Turn bolt additional 90° after 2nd torque		
17	12	WASHER–needle locating			
18	6	ROLLER BEARING ASSEMBLY			
19	174	NEEDLE BEARING–piston end			

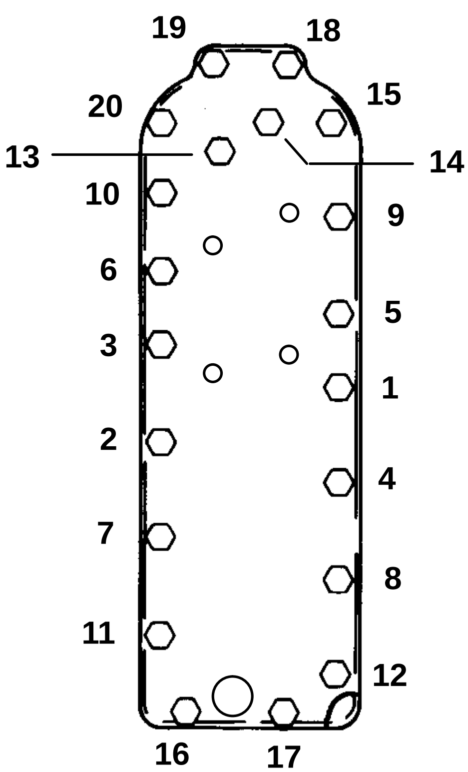
Torque Sequence

CRANKCASE COVER BOLTS (AND TORQUE SEQUENCE)



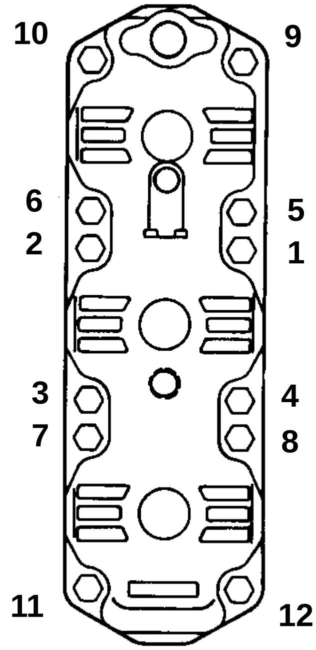
EXHAUST DIVIDER PLATE BOLTS

200 lb. in. (22.6 N·m)
Apply Loctite 271 to threads



CYLINDER HEAD BOLTS

Add light oil to threads and bolt face:
30 lb. ft. (40.5 N·m) then turn an additional 90°.



General Information

NOTE: *Throughout this section,* ***STANDARD MODELS*** *will refer to 135/150/175/200 carbureted and EFI outboards.* ***HIGH PERFORMANCE MODELS*** *will refer to PRO MAX and SUPER MAGNUM 150/200/225 outboards.*

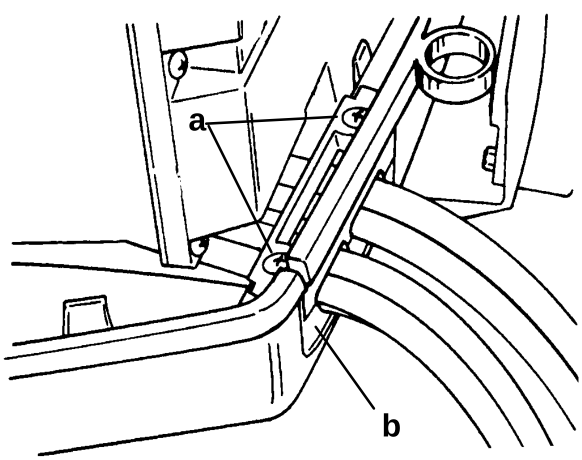
Powerhead "Disassembly" and "Reassembly" instructions are printed in a sequence that should be followed to assure best results when removing or replacing powerhead components. If complete disassembly is not necessary, start reassembly at point disassembly was stopped. (Refer to "Table of Contents," preceding.) Usually, complete disassembly of powerhead will be required.

If major powerhead repairs are to be performed, remove powerhead from drive shaft housing. Removal of powerhead is not required for 1) inspection of cylinder walls and pistons (refer to "Powerhead Removal and Disassembly," following, and remove cylinder heads and exhaust cover), 2) minor repairs on components, such as ignition system, carburetors, reed blocks and cylinder heads and checking operation of thermostats.

Powerhead Removal from Driveshaft Housing

1. Disconnect battery cables from battery terminals.
2. Disconnect fuel tank hose from outboard.
3. Remove top cowling.
4. Remove two screws which secure remote control harness retainer and remove retainer.

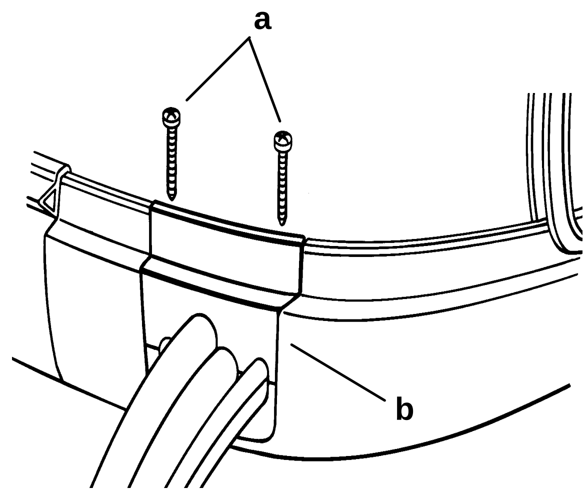
1994-1995 Standard Models –



51854

a - Screws
b - Retainer

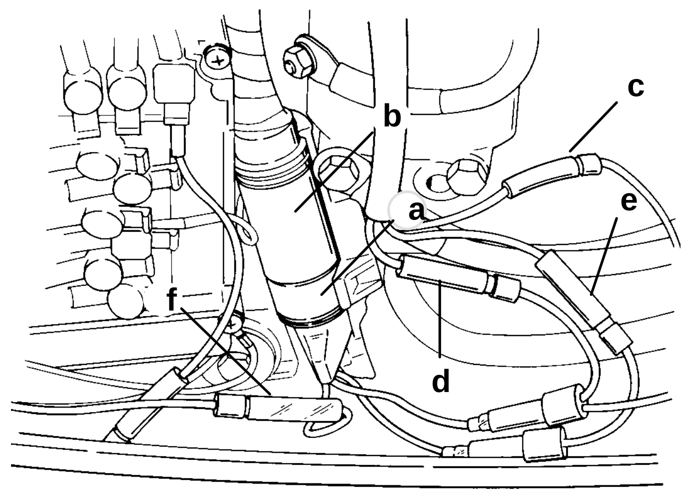
1996 Standard Models –



52188

a - Screws
b - Retainer

5. Disconnect remote oil tank hose connector.
6. Disconnect remote control harness from powerhead harness connector and wires as shown.

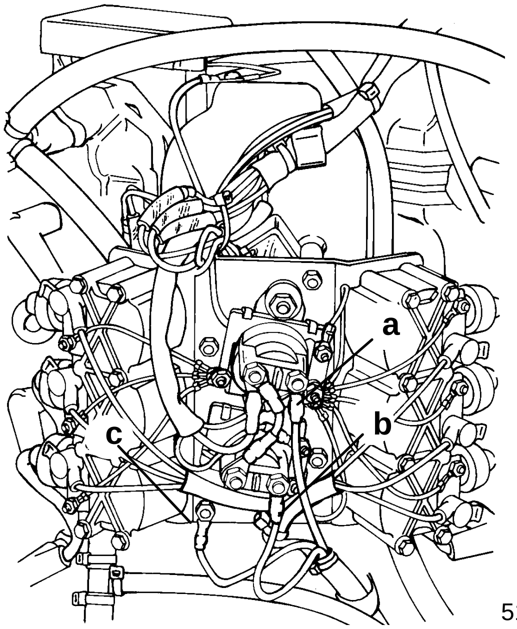


51851

a - Control Harness
b - Powerhead Harness
c - Trim 12 Volt Power Supply (RED)
d - Trim Up Lead (BLUE/WHITE)
e - Trim Down Lead (GREEN/WHITE)
f - Overheat Lead (TAN)

7. Remove sta-strap which secures "TELL-TALE" hose to fitting on lower cowl and remove hose from fitting.

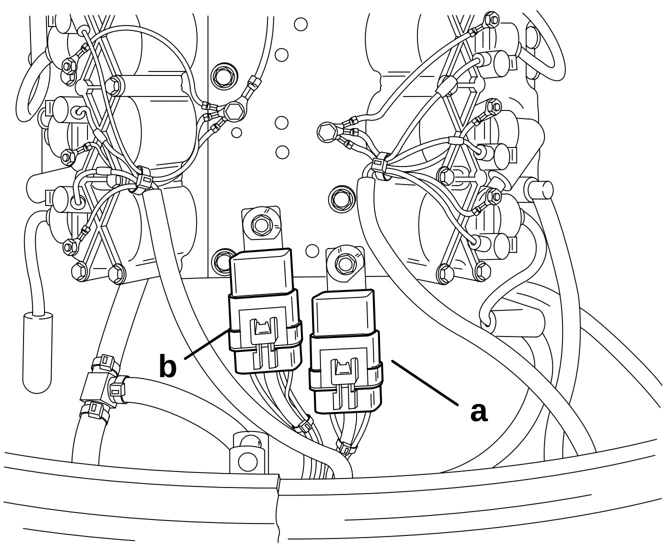
8. **1994 - 1995 Standard Models –** Remove BLUE, GREEN and BLACK trim harness leads from trim solenoids. Remove trim harness from J-clip on exhaust cover.



51809

a - Blue Trim Lead
b - Green Trim Lead
c - Black Trim Lead

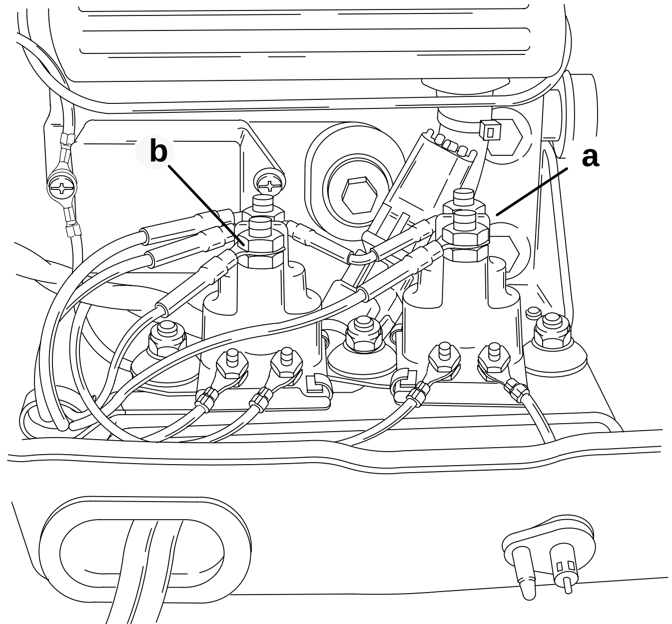
1996 Standard Models – Disconnect trim relay harnesses from each relay.



54938

a - UP Trim Relay
b - DOWN Trim Relay

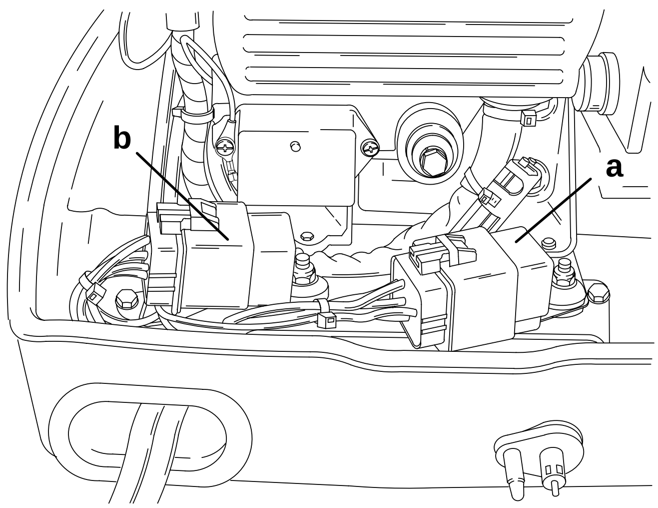
1994 - 1995 High Performance Models –



55007

a - Blue Trim Lead
b - Green Trim Lead

1996 High Performance Models –

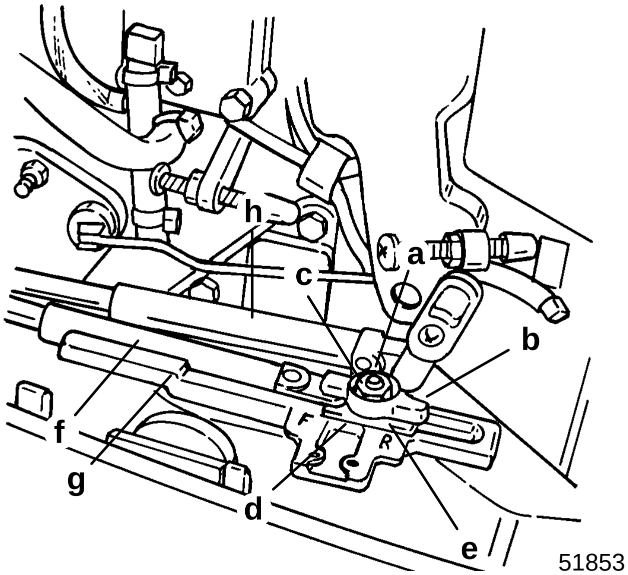


55006

a - UP Trim Relay
b - DOWN Trim Relay

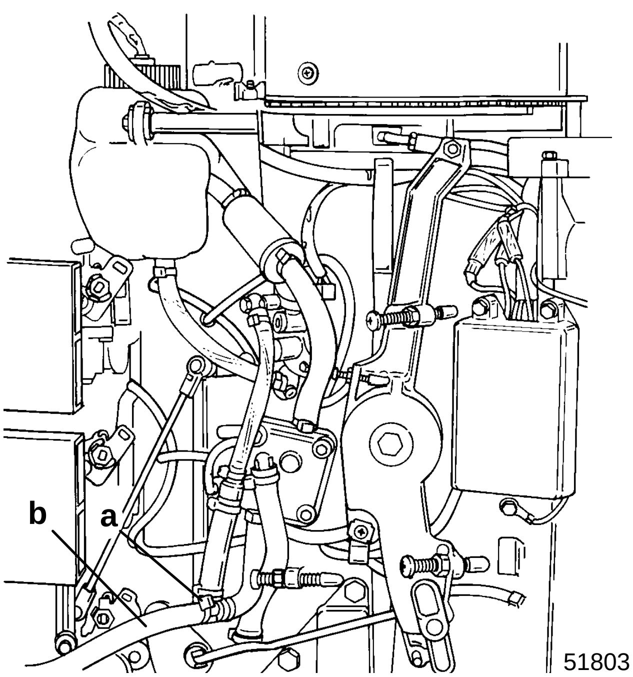
9. Slide outboard shift lever into neutral position.
10. Remove throttle cable.

11. Remove locknut that secures shift cable latch assembly and remove latch, flat washer, nylon wear plate, spring and shift cable from control cable anchor bracket.



a - Lock Nut
b - Shift Cable Latch
c - Flat Washer (Hidden)
d - Nylon Wear Plate
e - Spring (Hidden)
f - Shift Cable
g - Anchor Bracket
h - Throttle Cable

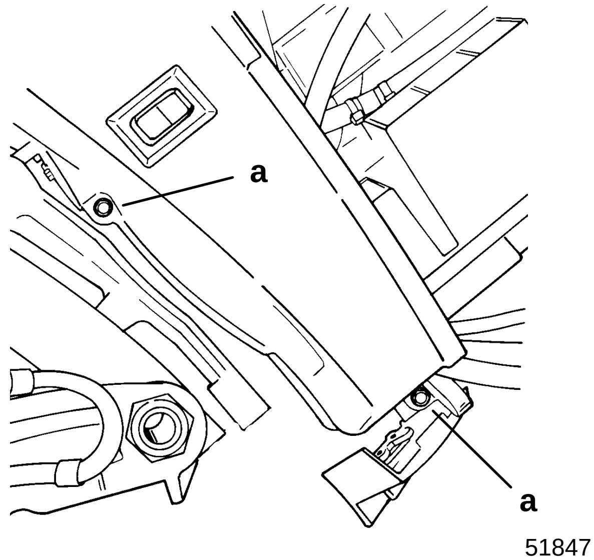
12. Disconnect input fuel line.



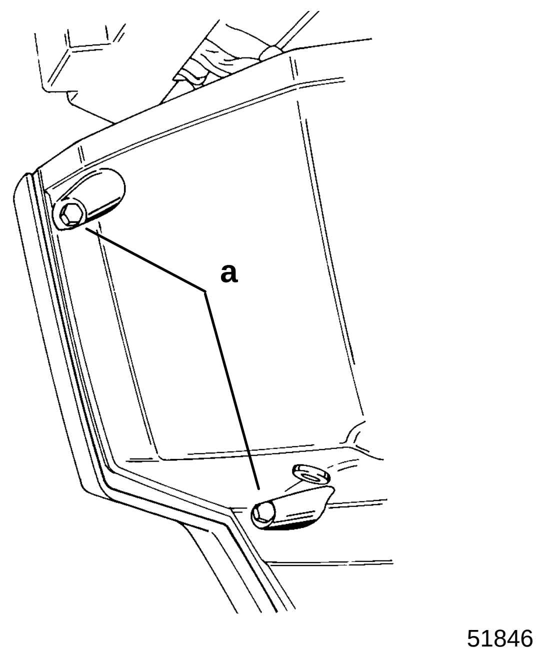
a - Sta-Strap
b - Fuel Line

13. Remove four bolts which secure bottom cowl halves together and remove bottom cowling.

1994-1995 Standard Models –

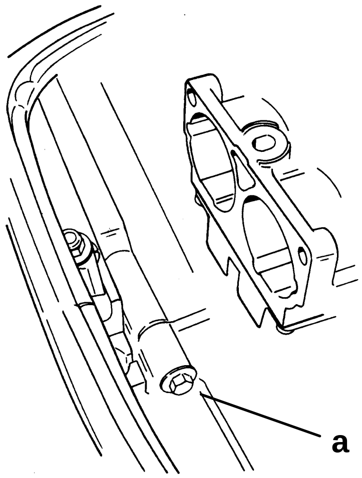


a - Bolts



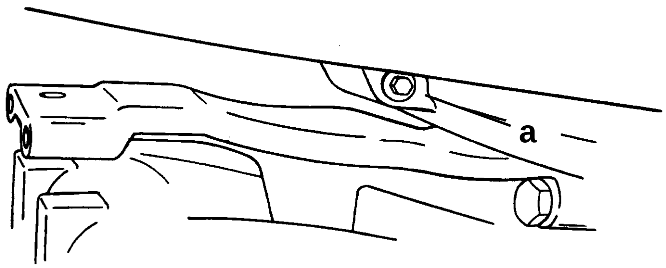
a - Bolts

1996 Standard Models –



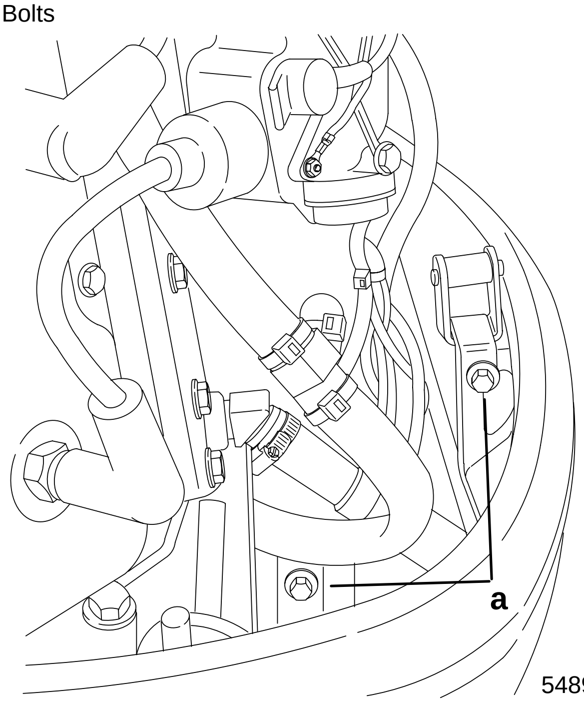
52354

a - Bolts



52352

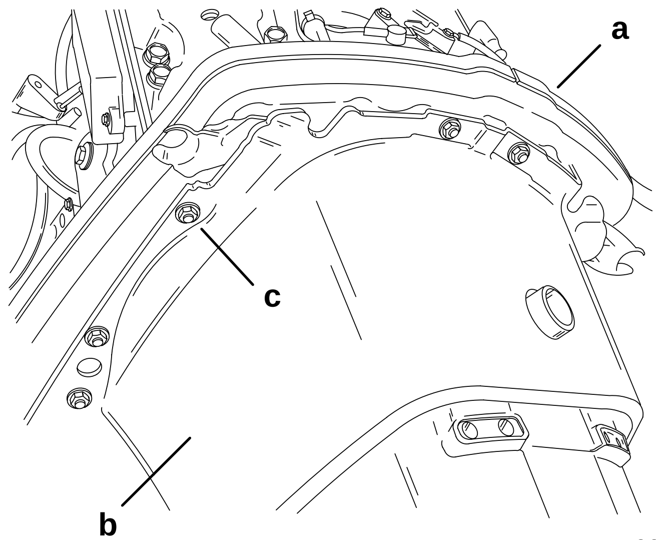
a - Bolts



54896

a - Bolts

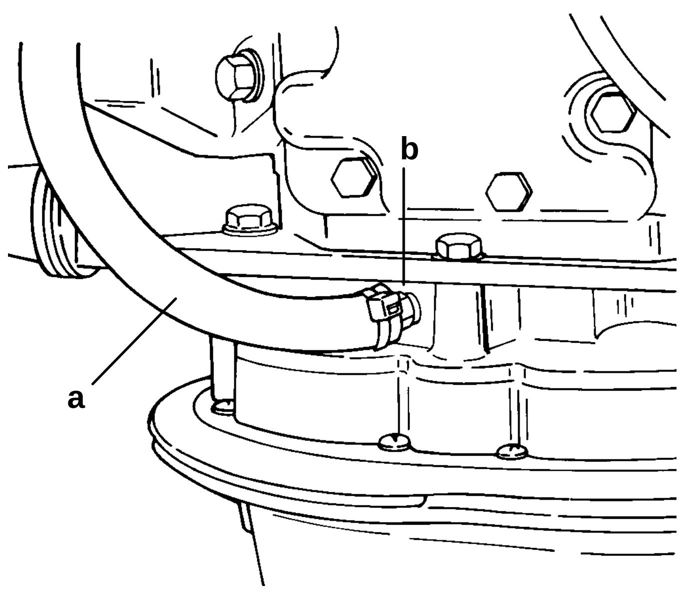
All High Performance Models –



55005

a - Bottom Pan (The bottom pan does not have to be removed to remove the powerhead)
b - Skirt
c - Bolts, Washers, Nuts (8 each)

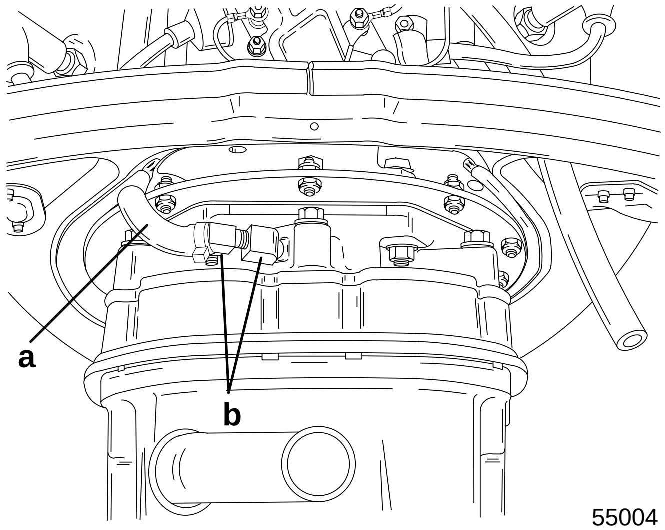
14. **All Standard Models –** Remove water hose from fitting on exhaust adaptor plate.



51851

a - Water Hose
b - Fitting

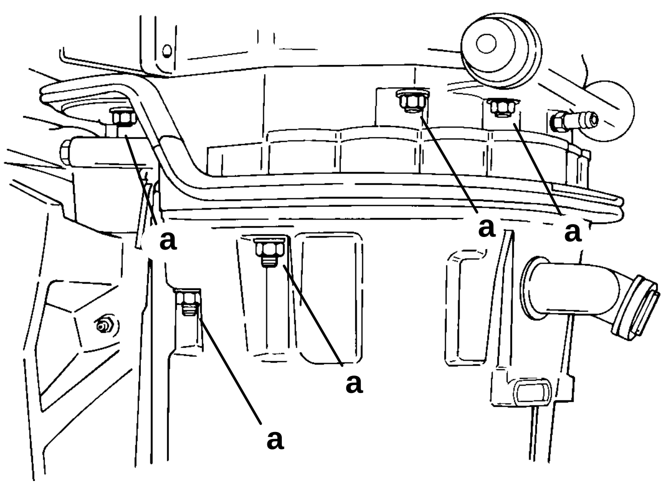
15. **All High Performance Models –** Remove water hose from fitting on exhaust adaptor plate and pull hose through bottom pan.



55004

a - Hose
b - Fittings – Fittings must be turned to allow clearance for bottom pan

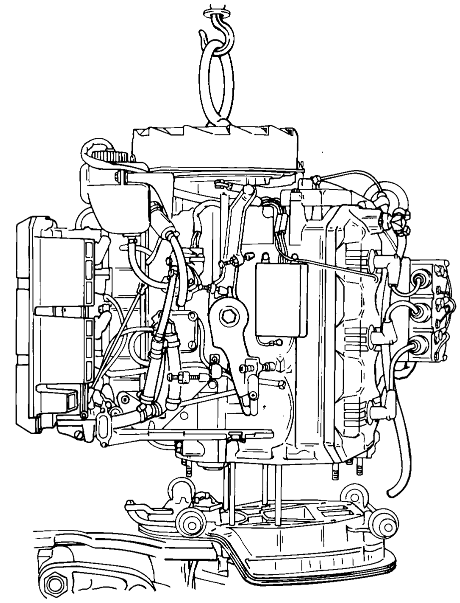
16. **All Models –** Remove 10 nuts and 10 washers (5 each side) from powerhead base.



51846

a - Nuts and Washers (5 Each Side)

17. Remove plastic cap from center of flywheel and install LIFTING EYE (91-90455) into flywheel at least five full turns. Using a hoist, lift powerhead assembly from driveshaft housing.



51804

REMOVING ENGINE COMPONENTS

Remove the following engine components:

Section 2 Starter Motor
Starter Motor
*Ignition Switch Boxes
*Ignition Coil
*Starter Solenoid
Voltage regulator/rectifier
Flywheel
*Stator Assembly
*Trigger Assembly
*Low speed/high speed spark advance module
*Idle Stabilizer

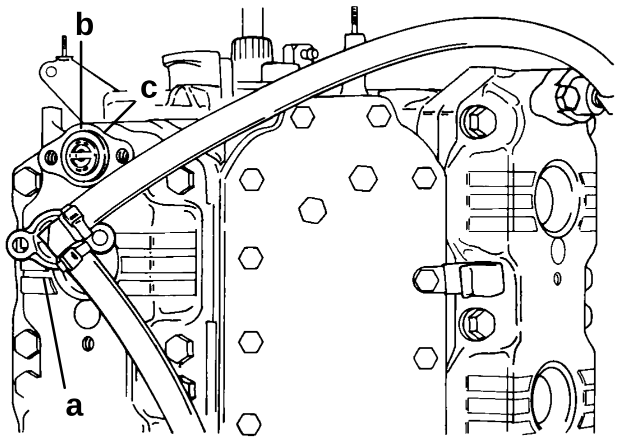
Section 3
Air Silencer
Carburetors and Linkage
Fuel Pump
*Fuel Enrichment Valve
Fuel Injection Assembly
*Warning Module
On-Board Oil Tank
Oil Pump

Section 7
Shift Cable Latch Assembly
Control Cable Anchor Bracket

***All ignition and electrical components should remain attached to electrical plate. Plate with components can be removed as an assembly.**

Powerhead Disassembly

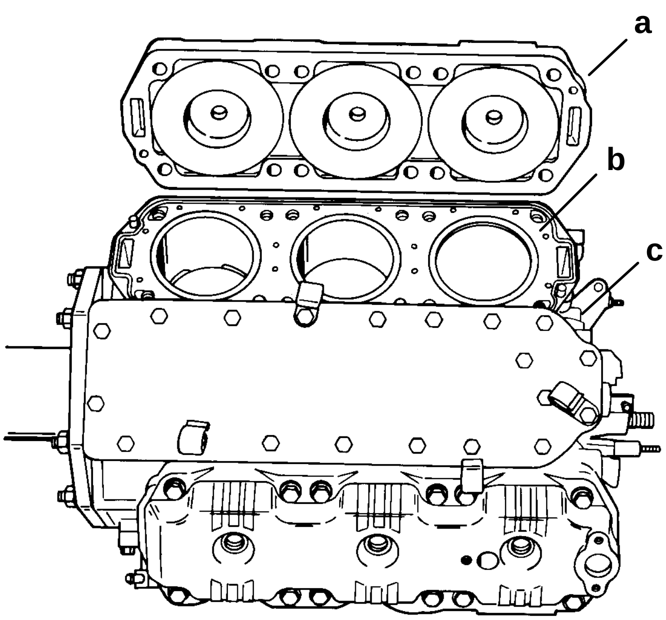
1. Place powerhead in repair stand or on a bench.
2. Remove thermostat covers, thermostats and gaskets.



51852

a - Thermostat Cover
b - Thermostat
c - Gasket

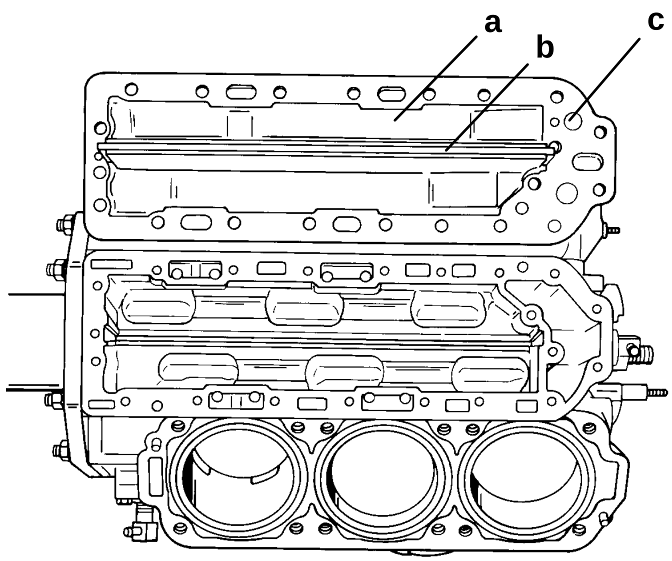
3. Remove cylinder heads from engine block.



51847

a - Cylinder Head
b - Gasket
c - Engine Block

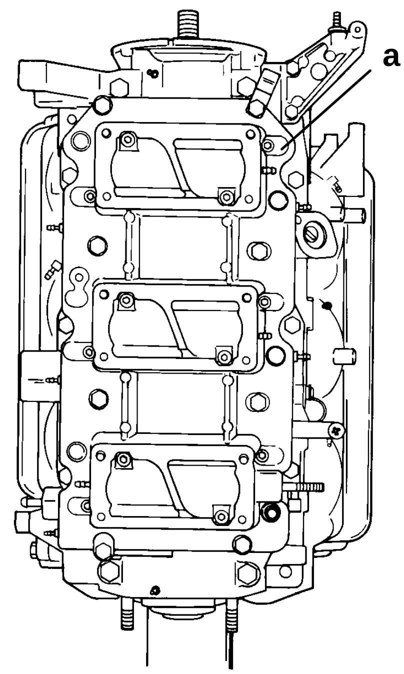
4. Remove exhaust manifold cover and seal.



51852

a - Exhaust Manifold Cover
b - Seal
c - Gasket

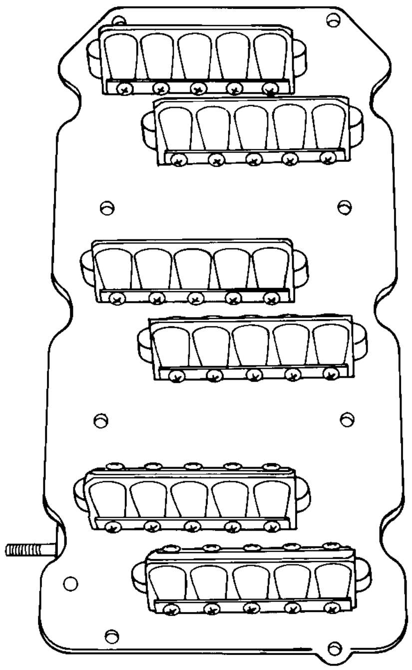
5. Remove reed block housing from cylinder block.



51845

a - Reed Block Housing

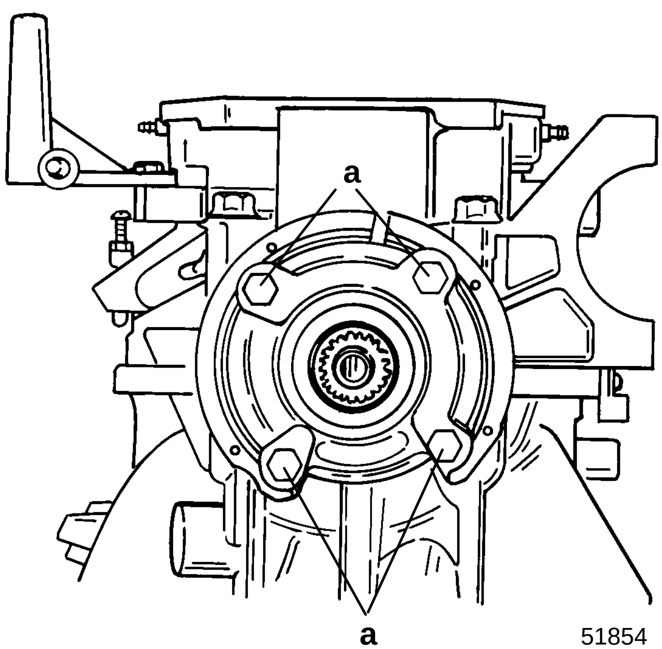
6. Inspect reeds as outlined in “Cleaning and Inspection”.



51850

7. Remove bolts from end caps.

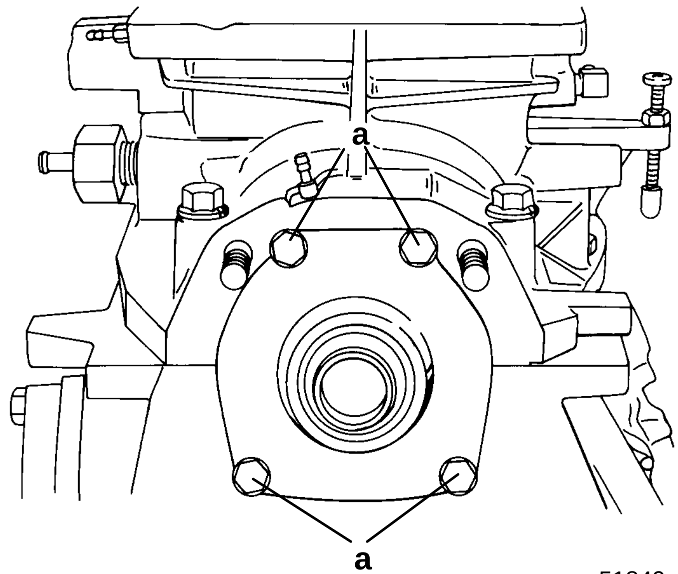
UPPER END CAP



51854

a - Crankcase Attaching End Cap Bolts

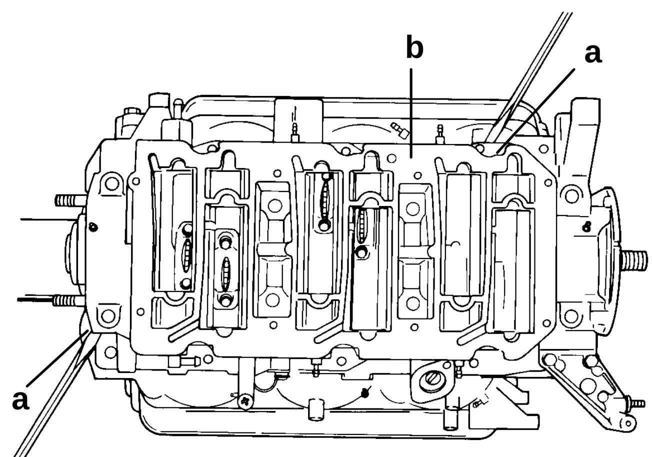
LOWER END CAP



51849

a - Crankcase Attaching End Cap Bolts

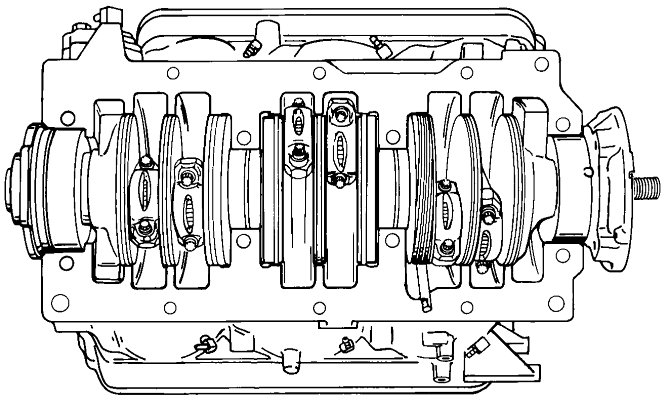
8. Remove bolts which secure crankcase cover to cylinder block.
9. Pry crankcase cover off cylinder block using pry bars in locations shown.



51845

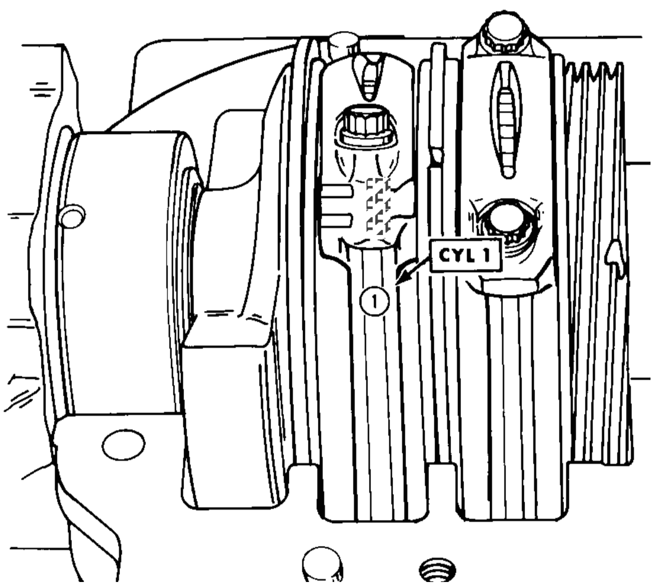
a - Pry Points
b - Crankcase Cover

CRANKCASE COVER REMOVED



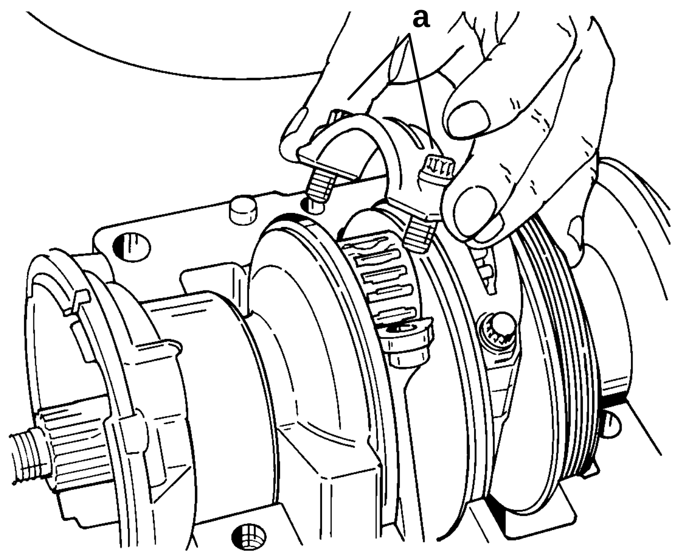
51848

10. Use Powerhead Stand (91-30591A1) for rotating crankshaft to desired position for removal of connecting rods.
11. Using an awl or electric pencil, scribe the cylinder identification number on each connecting rod as shown. Reassemble connecting rods in same cylinder.



51849

12. Use a 5/16 in. 12 point socket to remove connecting rod bolts, then remove rod cap, roller bearings and bearing cage from connecting rod.



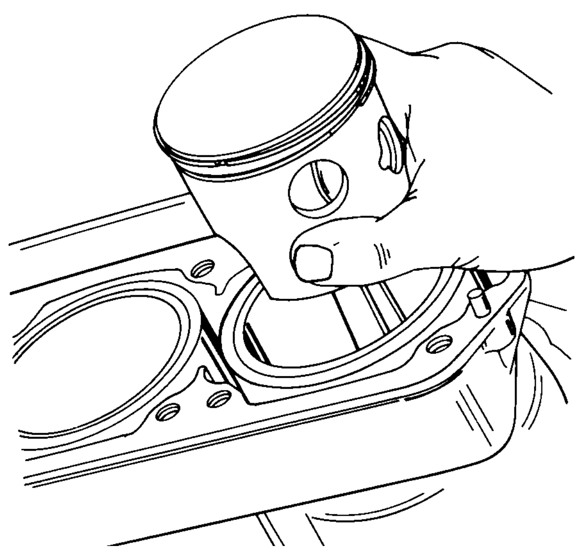
51850

a - Connecting Rod Bolts

13. Push piston out of cylinder block.
14. After removal, reassemble each piston and connect- ing rod assembly.

⚠ CAUTION

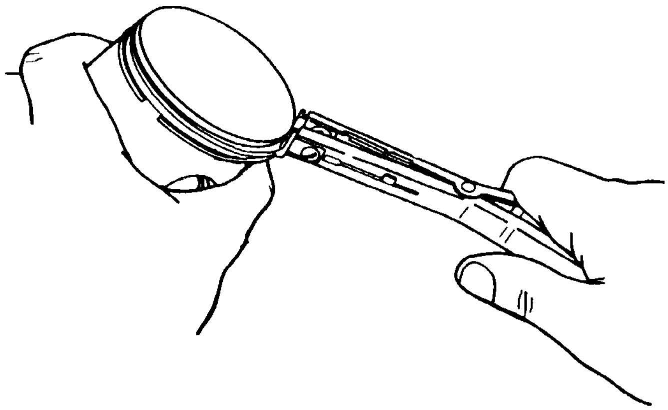
Each connecting rod and end cap are a matched machined set and must never be mismatched.



51849

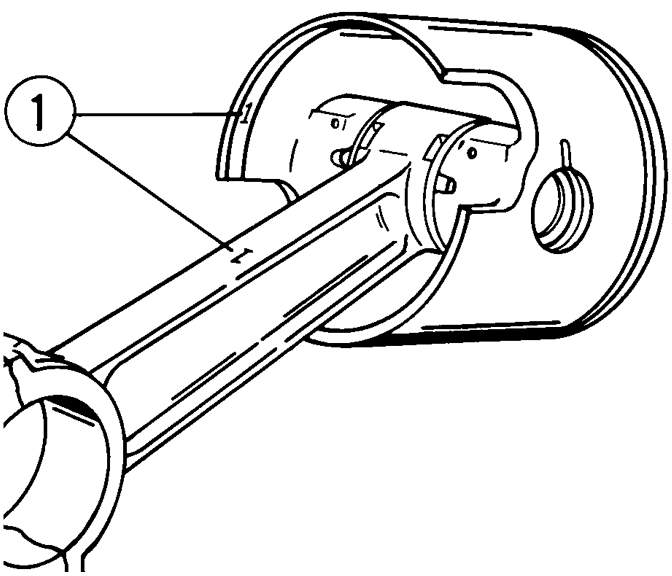
15. Inspect pistons as outlined in “Cleaning and Inspection,” following.

16. Use Piston Ring Expander (91-24697) to remove piston rings. Always install new piston rings.



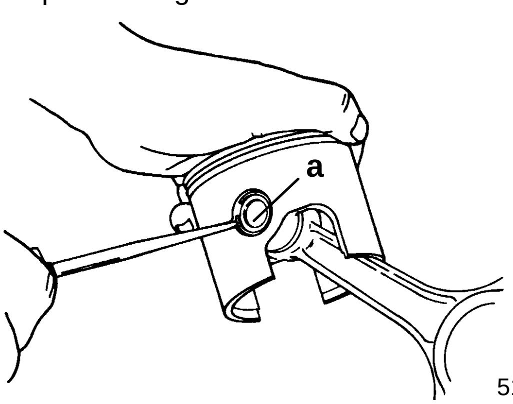
51081

17. Using an awl, scribe identification number of connecting rod on inside of piston (1). Reassemble pis- ton on same connecting rod.



51851

18. Using tool (91-52952A1), remove piston pin lockrings from both ends of piston pin. Never re-use piston pin lockrings.

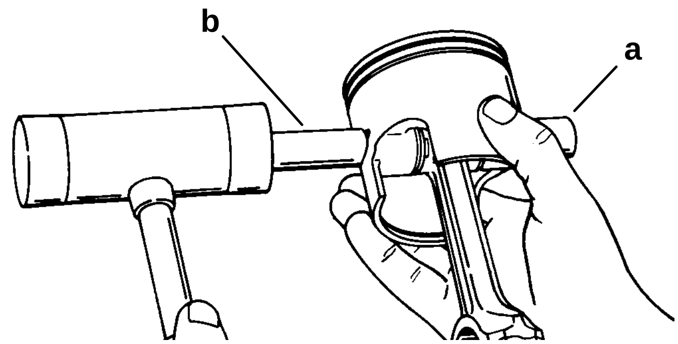


51083

a - Lockring

IMPORTANT: Warming the piston dome using a torch lamp will ease removal and installation of piston pin.

19. Support piston and tap out piston pin using service tool (91-76159A1) as shown.

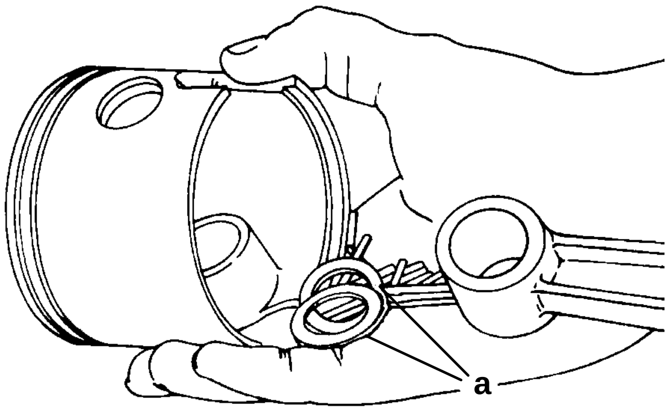


51853

a - Piston Pin
b - Piston Pin Tool (91-76159A1)

20. Remove piston pin needle bearings (29 per piston) and locating washers (2 per piston) as shown.

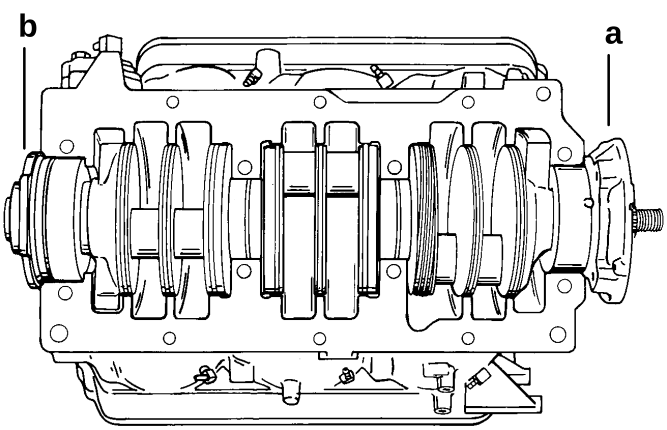
IMPORTANT: We recommend that you use new needle bearings at reassembly for lasting repair. However, if needle bearings must be re-used, keep each set of bearings identified for reassembly on same connecting rod.



51088

a - Needle Bearing Locating Washers

21. Remove upper end cap and lower end cap from crankshaft.



51848

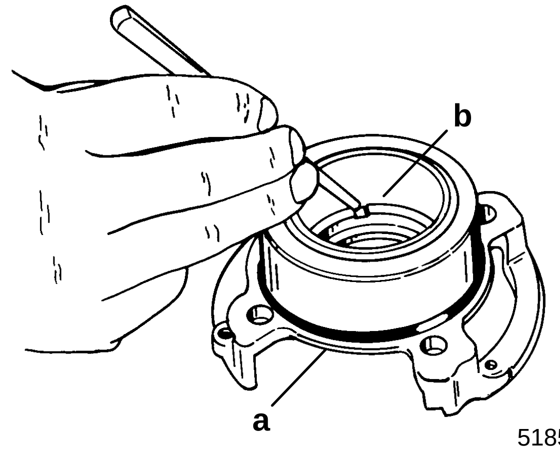
a - Upper End Cap
b - Lower End Cap

22. Remove and discard O-ring seals from each end cap.

23. Remove oil seal(s) from end of each end cap by driving seal out with a punch and hammer.

24. Inspect roller bearing in upper end cap as outlined in “Cleaning and Inspection”.

NOTE: *If roller bearing is damaged, replace upper end cap and roller bearings as an assembly.*



51853

a - O-Ring
b - Seal

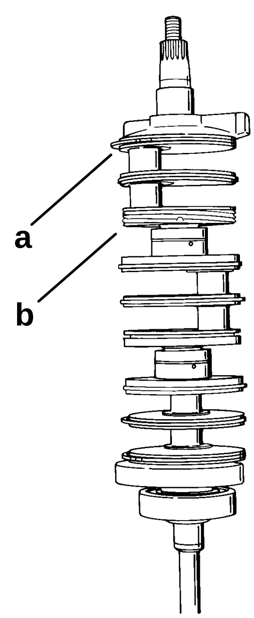
25. Remove crankshaft and place in powerhead stand as shown.

IMPORTANT: DO NOT remove crankshaft sealing rings from crankshaft, unless replacement of a sealing ring(s) is necessary. Usually, crankshaft sealing rings do not require replacement, unless broken.

⚠ CAUTION

Safety glasses should be worn when removing or installing crankshaft sealing rings.

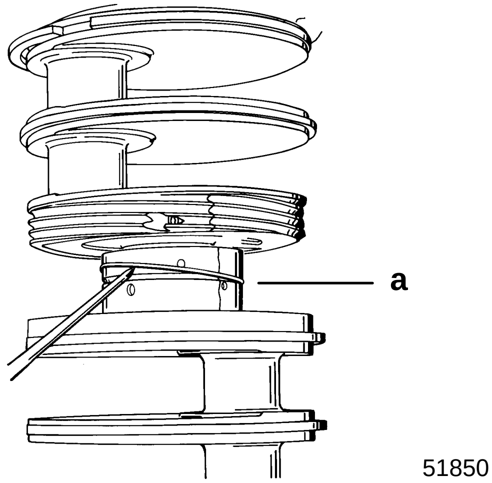
IMPORTANT: DO NOT remove oil pump drive gear on crankshaft unless gear is damaged; i.e. cracked, gear teeth chipped or fretting, or excessive looseness. Refer to “Section 3E” for proper oil drive gear installation procedures.



51847

a - Sealing Rings
b - Oil Pump Drive Gear

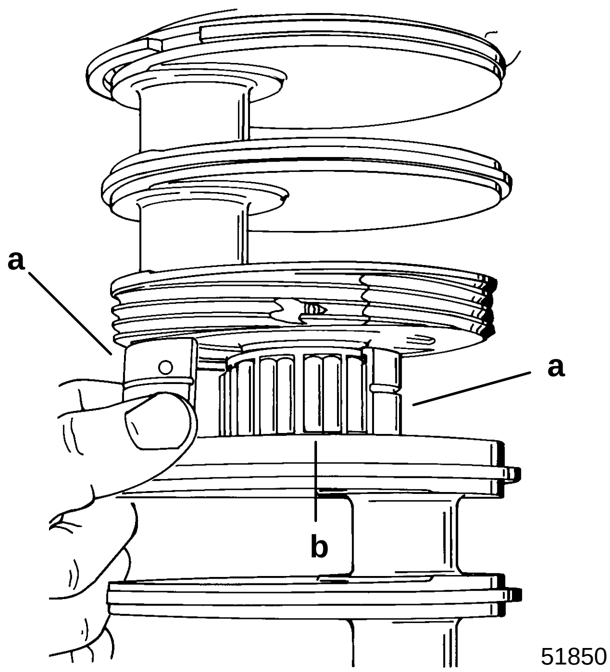
26. Remove retaining ring as shown.



a - Retaining Ring

27. Remove bearing race halves and roller bearings from crankshaft.

IMPORTANT: Keep same bearing races and roller bearings together.



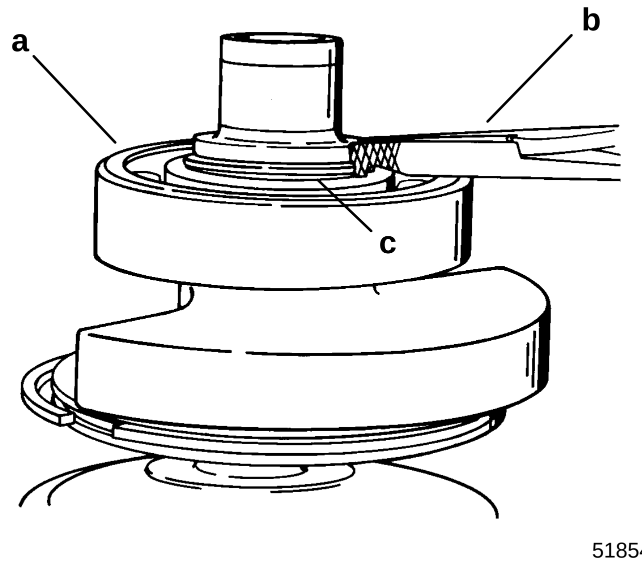
a - Bearing Race Halves
b - Roller Bearings

Inspect crankshaft ball bearing as outlined in "Cleaning and Inspection," following.

IMPORTANT: DO NOT remove crankshaft ball bearing, unless replacement is required.

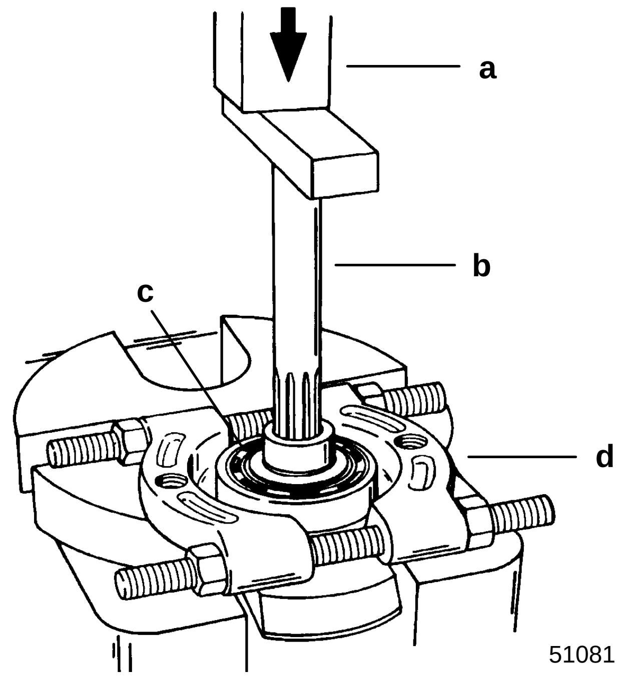
28. Remove lower ball bearing from crankshaft as follows:

a. Remove retaining ring using a pair of snap ring pliers.



a - Crankshaft Ball Bearing
b - Pliers
c - Retaining Ring

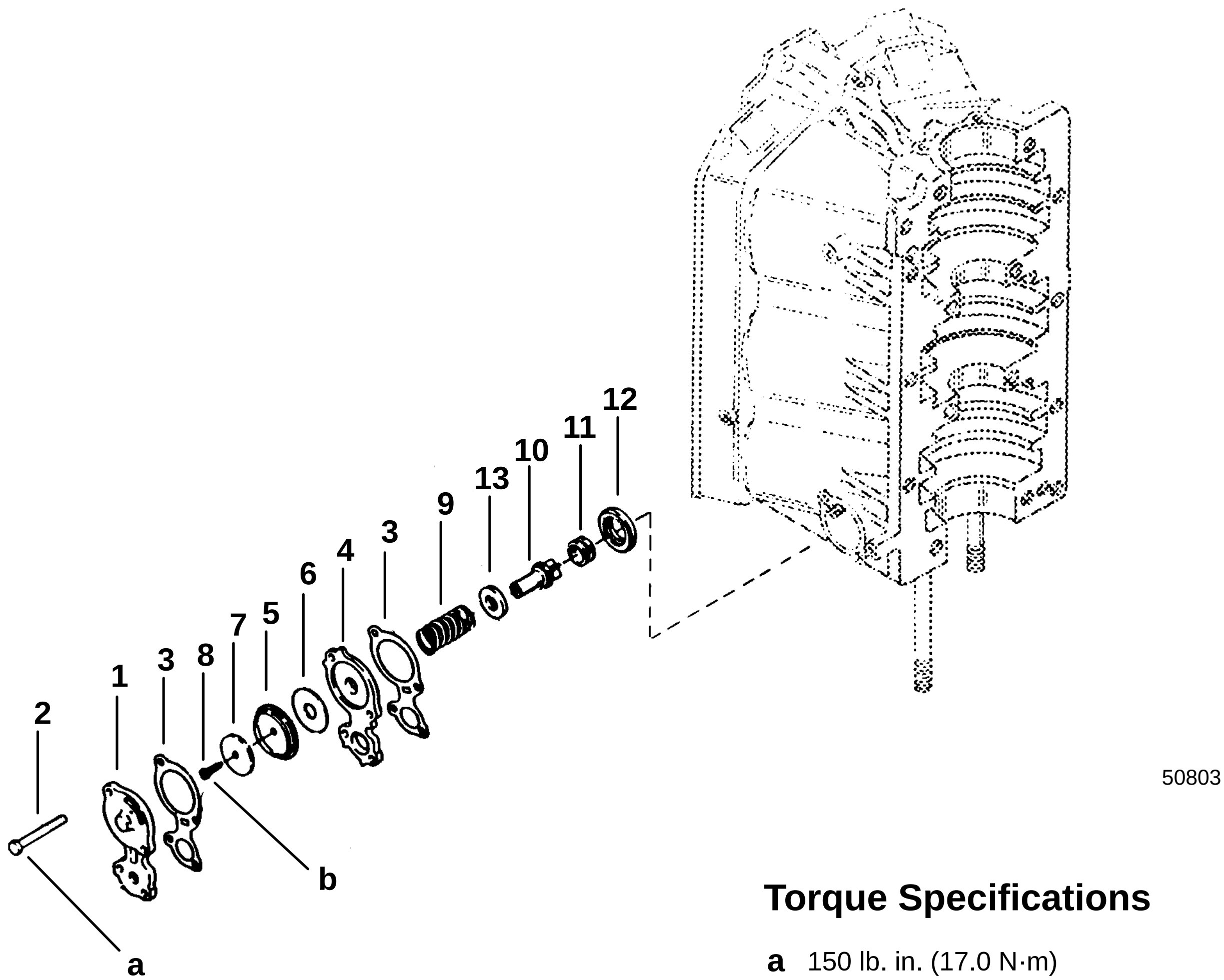
b. Press crankshaft out of lower ball bearing as shown.



a - Press
b - Powerhead Stand (91-30591A1)
c - Crankshaft Ball Bearing
d - Universal Puller Plate (91-37241)

Water Pressure Relief Valve Components

29. If necessary, remove water pressure relief valve components as shown.



Torque Specifications

a 150 lb. in. (17.0 N·m)

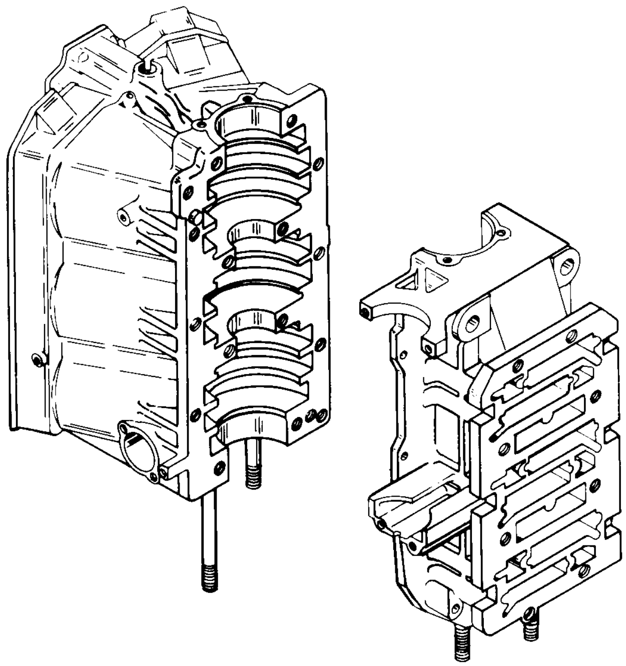
b 25 lb. in. (3.0 N·m)

1 - Cover
2 - Bolt
3 - Gasket
4 - Relief Valve Plate
5 - Diaphragm
6 - Water Deflector
7 - Washer
8 - Screw
9 - Spring
10- Poppet Valve
11- Carrier
12- Grommet
13- Washer

Cleaning and Inspection

Cylinder Block and Crankcase Cover

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



⚠ CAUTION

It crankcase cover or cylinder block is to be submerged in a very strong cleaning solution, it will be necessary to remove the crankcase cover/cylinder block bleed system from crankcase cover/cylinder block to prevent damage to hoses and check valves.

1. Thoroughly clean cylinder block and crankcase cover. Be sure that all sealant and old gaskets are removed from matching surfaces. Be sure that carbon deposits are removed from exhaust ports.
2. Inspect cylinder block and crankcase cover for cracks or fractures.
3. Check gasket surfaces for nicks, deep grooves, cracks and distortion that could cause compression leakages.
4. Check all water and oil passages in cylinder block and crankcase cover to be sure that they are not obstructed and that plugs are in place and tight.

Special Service Information

Grooves in Cylinder Block Caused By Crankshaft Sealing Rings

Grooves in cylinder block caused by crankshaft sealing rings are not a problem, except if installing a new crank- shaft and the new sealing rings on crankshaft do not line up with existing grooves in cylinder block. If installing a new crankshaft, refer to crankshaft installation, Powerhead Reassembly section to determine if powerhead can be used.

Cylinder Bores

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 bore(s) 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.

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.

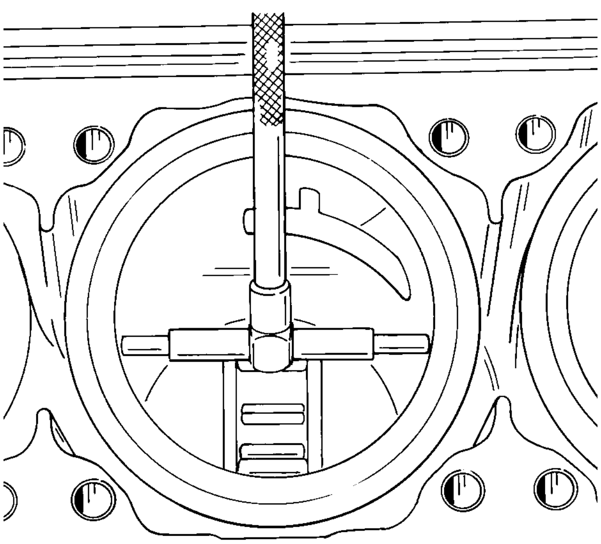
c. Start stroking at smallest diameter. Maintain firm stone pressure against cylinder wall to assure fast stock removal and accurate results.

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.

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

3. Measure cylinder bore diameter (with a snap gauge micrometer) of each cylinder, as shown below. Check for tapered, out-of-round (egg-shaped) and oversize bore.



51846

135 and 150 (carbureted) Models

Models	Cylinder Block Finish Hone
135 and 150 with a Standard Piston	3.125 in. (79.375mm)
135 and 150 with a .015 in. (0.381mm) Oversize Piston	3.140 in. (79.756mm)
135 and 150 with a .030 in. (0.762mm) Oversize Piston	3.155 in. (80.137mm)

175, XR6, Magnum III, 150 EFI and 200 Models

Models	Cylinder Block Finish Hone
175, XR6, Mag. III, 150 EFI and 200 with a Standard Piston	3.501 in. (88.93mm)
175, XR6, Mag. III, 150 EFI and 200 with a .015 in. (0.381mm) Oversize Piston	3.516 in. (89.31mm)

4. If a cylinder bore is tapered, out-of-round or worn more than .006 in. (0.152mm) from standard "Cylinder Block Finish Hone" diameter (refer to chart, preceding), it will be necessary to re-bore that cylinder(s) to .015 in. (0.381mm) or .030 in. (0.762mm) oversize or re-sleeve and install oversize piston(s) and piston rings during reassembly.

NOTE: *The weight of an oversize piston is approximately the same as a standard size piston; therefore, it is not necessary to re-bore all cylinders in a block just because one cylinder requires re-boring.*

5. After honing and thoroughly cleaning cylinder bores, apply light oil to cylinder walls to prevent rusting .

Pistons and Piston Rings

IMPORTANT: If engine was submerged while engine was running, piston pin and/or connecting rod may be bent. If piston pin is bent, piston must be replaced. (Piston pins are not sold separately because of matched fit into piston.) If piston pin is bent, connecting rod must be checked for straightness (refer to "Connecting Rods," following, for checking 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 remove solution. Do not burr or round off machined edges.

Inspect piston ring grooves for wear and carbon accumulation. If necessary, scrape carbon from piston ring grooves **being careful not to scratch sides of grooves**. Refer to procedure following for cleaning piston ring grooves.

CLEANING PISTON RING GROOVES

NOTE: *Cleaning instructions differ between the rectangular ring groove and keystone (tapered) ring groove. Pistons may have two keystone ring grooves or one keystone ring groove and one rectangular ring groove as shown.*

Rectangular ring grooves

1. A broken rectangular piston ring can be used as a tool for scraping carbon from ring grooves. Carefully scrape carbon from ring grooves without scratching the side surfaces of grooves.

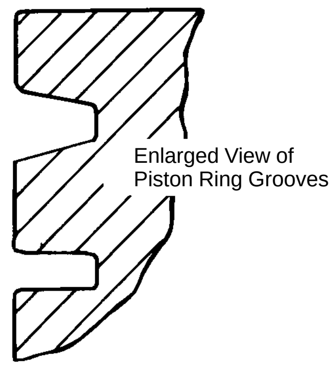
Keystone (tapered) ring grooves

⚠ CAUTION

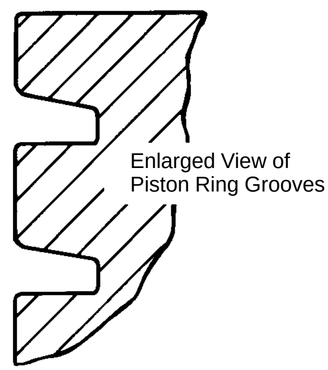
Care must be taken not to scratch the side surfaces of the ring groove. Scratching the side surface of the ring groove will damage the ring groove.

1. Use a bristle brush and carbon remover solution to remove carbon from side surfaces.
2. A tool can be made for cleaning the inner diameter of the tapered ring grooves. The tool can be made from a broken tapered piston ring with the side taper removed to enable the inside edge of the ring to reach the inner diameter of the groove. 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 keystone (tapered) ring on top and one rectangular ring on bottom (135 & 150 "carbureted" Models)



Piston with two half keystone (half tapered) rings (XR6, Mag III,175, 200 and all EFI Models)



MEASURING PISTON ROUNDNESS

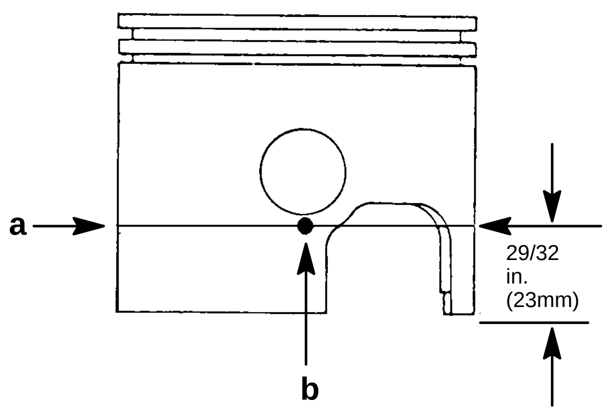
Piston has a barrel profile shape and is not a true diameter.

Standard 135 and 150 (carbureted) Models - 122 cu. in. (1999cc)

1. Using a micrometer, measure dimension “A” at location shown. Dimension “A” should be as indicated in chart following.

Piston	Dimension “A”
Standard Piston	3.115 in. ± .002 in.
.015 in. Oversize Piston	3.130 in. ± .002 in.
.030 in. Oversize Piston	3.145 in. ± .002 in.

2. Using a micrometer, measure dimension “B” at location shown. Dimension “B” should be within .008 in. of dimension “A”.



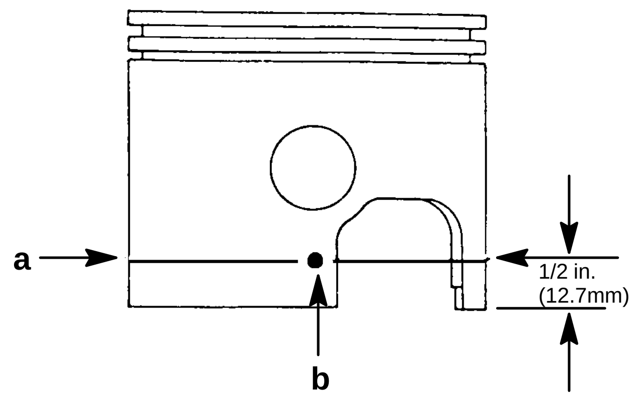
a - Dimension “A” at Right Angle (90°) to Piston Pin
b - Dimension “B” (in line with Piston Pin)

Standard 175, XR6, Magnum III, 150 EFI, 200 EFI Models and High Performance Pro Max/Super Magnum 150, 200, 225 Models - 153 cu. in. (2508 cc)

1. Using a micrometer, measure dimension “A” at location shown. Dimension “A” should be as indicated in chart following.

Piston	Dimension “A”
Standard Piston	3.494 in. ± 0.001 in.
.015 in. Oversize Piston	3.509 in. ± 0.001 in.

2. Using a micrometer, measure dimension “B” at location shown. Dimension “B” should be within 0.008 in. of dimension “A.”



a - Dimension “A” at RIGHT Angle (90°) to Piston Pin
b - Dimension “B” (in line with Piston Pin)

Cylinder Heads and Exhaust Divider Plate

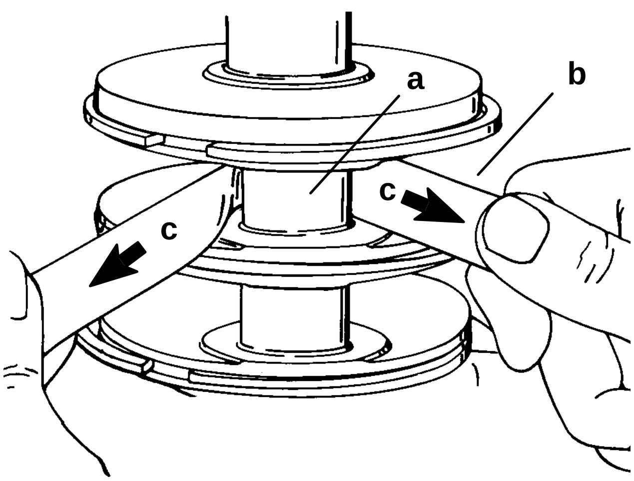
1. Inspect internal surface of cylinder heads for possible damage (as a result of piston or foreign material striking cylinder heads).

IMPORTANT: Cylinder head warpage should not exceed 0.004 in. (0.1mm) over the ENTIRE length of the cylinder head. If measured warpage, as determined on a surface block, exceeds 0.004 in. (0.1mm) or a discontinuity of up to 0.004 in. (0.1 mm) exists in a narrow portion of the cylinder head’s surface length, then the cylinder head may be re-surfaced up to 0.010 in. (0.25mm).

2. Replace cylinder head(s) as necessary.
3. Thoroughly clean gasket surfaces of exhaust divider plate.
4. Inspect exhaust divider plate for deep grooves, cracks or distortion that could cause leakage. Replace parts as necessary.

Crankshaft

1. Inspect crankshaft to drive shaft splines for wear. (Replace crankshaft, if necessary.)
2. Check crankshaft for straightness. (Replace as necessary.)
3. Inspect crankshaft oil seal surfaces. Sealing surfaces must not be grooved, pitted or scratched. (Replace as necessary.)
4. Check all crankshaft bearing surfaces for rust, water marks, chatter marks, uneven wear and/or overheating. (Refer to "Connecting Rods".)
5. If necessary, clean crankshaft surfaces with crocus cloth .



51847

a - Crankshaft Journals
b - Crocus Cloth
c - Work Cloth "Back-and-Forth"

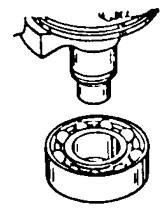
⚠ WARNING

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

6. Thoroughly clean (with solvent) and dry crankshaft and crankshaft ball bearing. Recheck surfaces of crankshaft. Replace crankshaft, if surfaces cannot be properly "cleaned up." If crankshaft will be re-used, lubricate surfaces of crankshaft with light oil to prevent rust. DO NOT lubricate crankshaft ball bearing at this time.

Crankshaft (and End Cap) Bearings

1. After cleaning crankshaft, grasp outer race of crankshaft ball bearing (installed on lower end of crankshaft) and attempt to work race back-and-forth. There should not be excessive play.
2. Lubricate ball bearing with light oil. Rotate outer 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. (Refer to "Powerhead Removal and Disassembly - Crankshaft Removal and Disassembly").



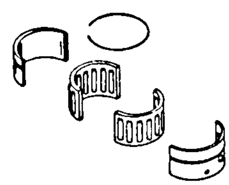
Lower Ball Bearing

3. Thoroughly clean (with solvent) and dry crankshaft center main roller bearings. Lubricate bearings with 2-Cycle Outboard Oil.

⚠ CAUTION

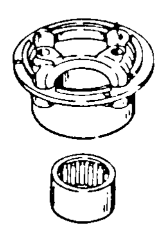
DO NOT intermix halves of upper and lower crank- shaft center main roller bearings. Replace bearings in pairs only.

4. Thoroughly inspect center main roller bearings. Replace bearings if they are rusted, fractured, worn, galled or badly discolored.



Center main Roller Bearing

5. Clean (with solvent) and dry crankshaft roller bearing that is installed in upper end cap. Lubricate bearing with light oil.
6. Thoroughly inspect upper end cap roller bearing. If roller bearing is rusted, fractured, worn, galled, badly discolored or loose inside of end cap replace end cap and roller bearing as an assembly.

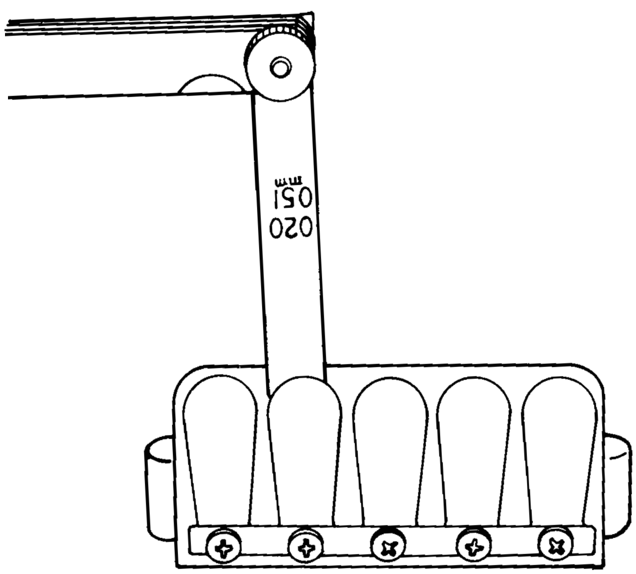


Upper Roller Bearing

Reed Block Assembly

IMPORTANT: DO NOT remove reeds from reed blocks, unless replacement is necessary. DO NOT turn used reeds over for re-use. Replace reeds in sets only.

1. Thoroughly clean gasket surfaces of reed blocks and reed block housing. Check for deep grooves, cracks and distortion that could cause leakage. Replace parts as necessary.
2. Check for wear (indentations) on face of each reed block. Replace block(s), if reeds have made indentations.
3. Check for chipped and broken reeds.

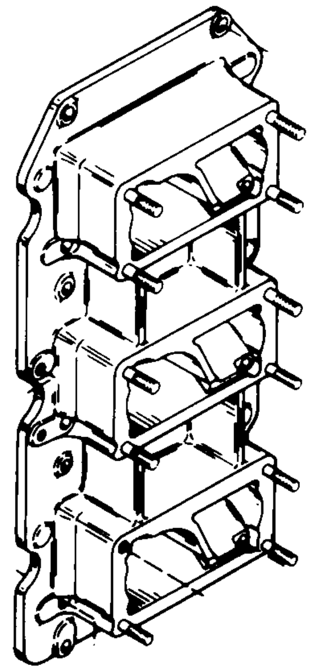


51851

Allowable reed opening is 0.020 in. (0.51mm) or less. Replace reeds if either reed is standing open more than 0.020 in. (0.51mm).

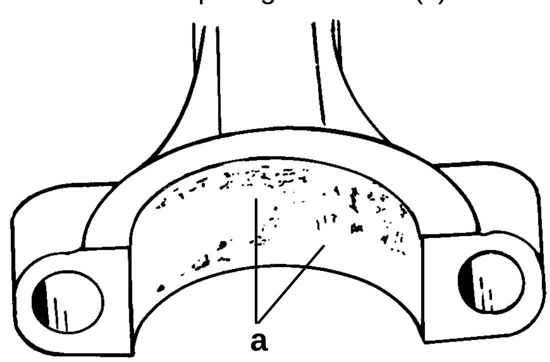
Reed Block Housing

1. Check rubber bleed hoses. Replace any hose that is cracked, cut or deteriorating.
2. Check operation of bleed system check valves in reed block housing. If valves are working properly, air can be drawn thru check valves "one way" only. If air can pass thru a check valve both ways, valve is not working properly and must be replaced.
3. Check that bleed system check valves are pressed tight into reed housing.
4. Inspect passages in reed block housing to be sure that they are not obstructed.



Connecting Rods

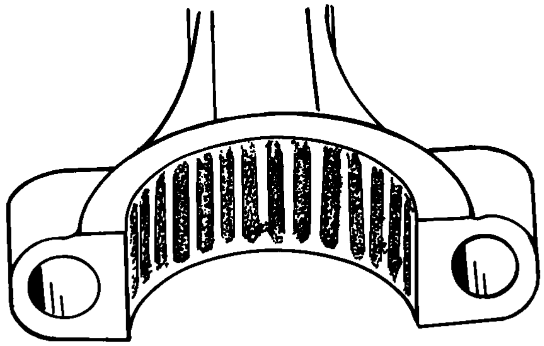
1. Check connecting rods for alignment by placing rods on a surface plate. If light can be seen under any portion of machined surfaces, if rod has a slight wobble on plate, or if a 0.002 in. (0.051mm) feeler gauge can be inserted between any machined surface and surface plate, rod is bent and must be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



51853

a - Pitting

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



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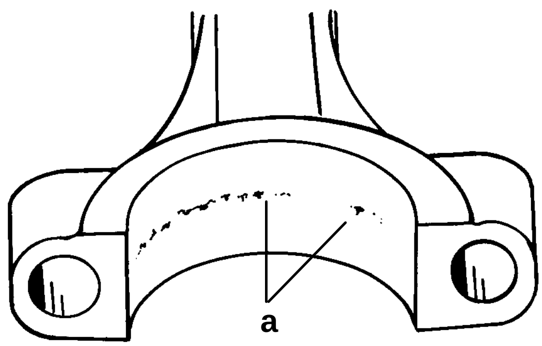
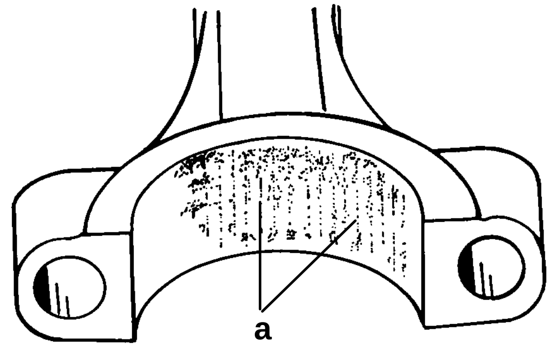
5. **Spalling:** Spalling is the loss of bearing surface, and it resembles flaking or chipping. Spalling will be most evident on the thrust portion of the connecting rod in line with the "I" beam. General bearing surface deterioration could be caused by or accelerated by improper lubrication.



51853

a - Spalling

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



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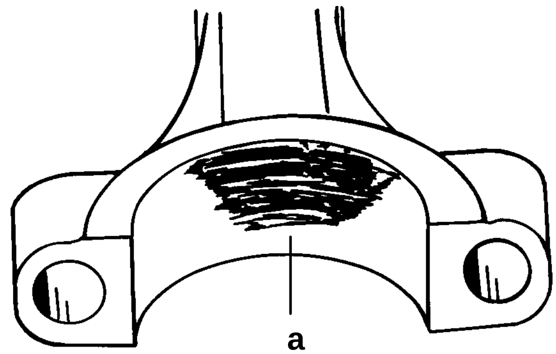
a - Chatter Marks Between Arrows

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



51853

a - Uneven Wear Between Arrows

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

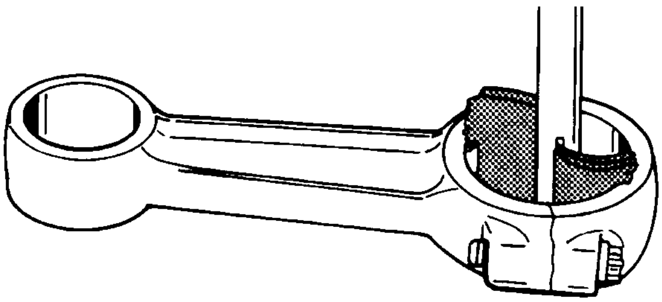
   a. Be sure that "etched" marks on connecting rod (crankshaft end) are perfectly aligned with "etched" marks on connecting rod cap. Tighten connecting rod cap attaching bolts securely.

⚠ CAUTION

Crocus cloth MUST BE USED to clean bearing surface at crankshaft end of connecting rod. DO NOT use any other type of abrasive cloth.

   b. **Clean CRANKSHAFT END of connecting rod by using CROCUS CLOTH** placed in a slotted 3/8 in. (9.5mm) diameter shaft, as shown. Chuck shaft in a drill press and operation press at high speed while keeping connecting rod at a 90° angle to slotted shaft.

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



51083

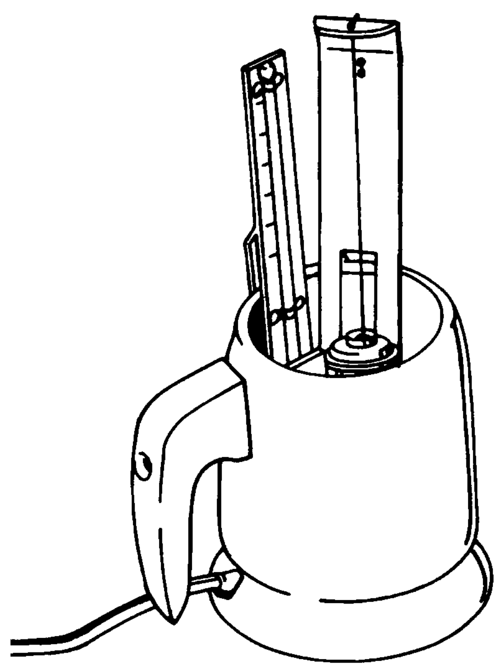
c. **Clean PISTON PIN END of connecting rod**, using same method as in Step “b”, preceding, but using 320 grit carborundum cloth instead of crocus cloth.

d. Thoroughly wash connecting rods to remove abrasive grit. Recheck bearing surfaces of connecting rods. Replace any connecting rod(s) that cannot be properly “cleaned up.” Lubricate bearing surfaces of connecting rods (which will be re-used) with light oil to prevent rust.

Thermostats

1. Inspect thermostat covers and cylinder head covers (thermostat opening) for cracks and corrosion dam- age that could cause leakage. Replace parts as necessary.
2. Remove and discard gasket from each thermostat.
3. Wash thermostats with clean water.
4. Using a thermostat tester, similar to the one shown, test each thermostat as follows:
   a. Open thermostat valve, then insert a thread between valve and thermostat body. Allow valve to close against thread.
   b. 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 temperature of thermostat opening.
   c. Fill thermostat tester with water to cover thermostat.
   d. Plug tester into electrical outlet.
   e. Observe temperature at which thermostat begins to open. (Thermostat will drop off thread, that was installed in Step “a”, when it starts to open.) Thermostat must begin to open when temperature reaches 140°-145° F (60°-63° C).
   f. Continue to heat water until thermostat is completely open.
   g. Unplug thermostat tester.
   h. Replace thermostat, if it fails to open at the specified temperature, or if it does not fully open.

NOTE: *BE SURE that water in thermostat tester is allowed to cool sufficiently [below 130° F (56° C)] before testing the other thermostat.*



51087

Powerhead Reassembly and Installation

General

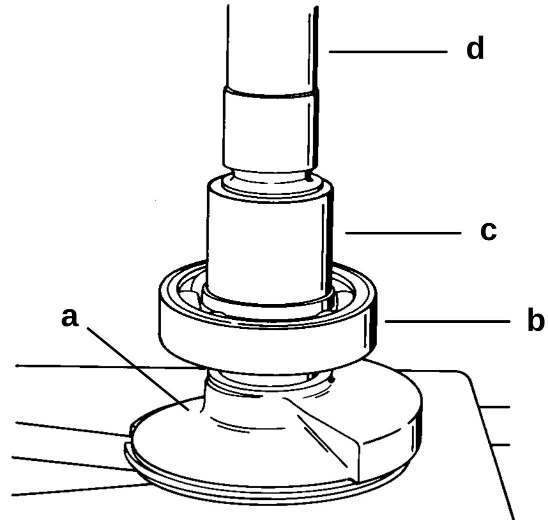
Before proceeding with powerhead reassembly, be sure that all parts to be re-used have been carefully cleaned and thoroughly inspected, as outlined in “Cleaning and Inspection,” preceding. Parts, which have not been properly cleaned (or which are questionable), can severely damage an otherwise perfectly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

During reassembly, lubricate parts with Quicksilver 2-Cycle Outboard Lubricant whenever “light oil” is specified. Quicksilver part numbers of lubricants, sealers and locking compounds and tools are listed in “Powerhead General Information,” preceding.

A torque wrench is **essential** for correct reassembly of powerhead. DO NOT attempt to reassemble powerhead without using a torque wrench. Attaching bolts for covers, housings and cylinder heads MUST BE torqued by tightening bolts in 3 progressive steps (following specified torque sequence) until specified torque is reached (see “Example,” following).

EXAMPLE: If cylinder head attaching bolts require a torque of 40 lb. ft. (54.0 N·m), a) tighten all bolts to **10 lb. ft. (13.5 N·m)**, following specified torque sequence, b) tighten all bolts to **20 lb. ft. (27.0 N·m)**, following torque sequence, then finally c) tighten all bolts to **40 lb. ft. (54.0 N·m)**, following torque sequence.

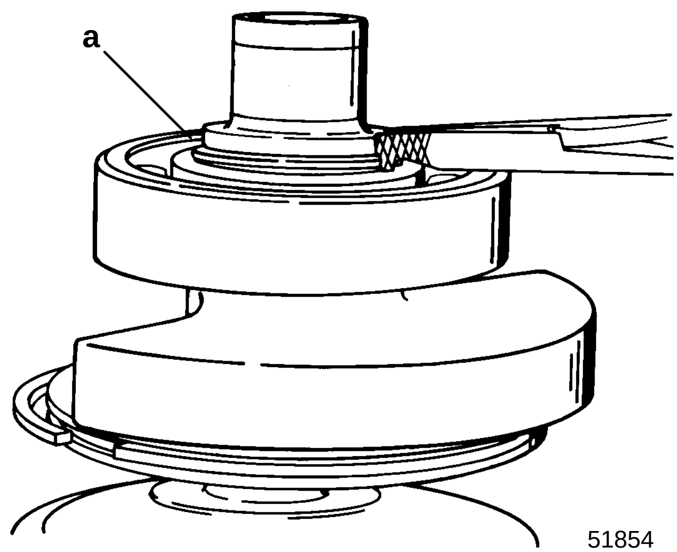
1. If removed, press lower crankshaft ball bearing onto crankshaft as shown. Be sure bearing is pressed firmly against counterweight.



51852

a - Crankshaft
b - Crankshaft Ball Bearing
c - Suitable Mandrel
d - Press

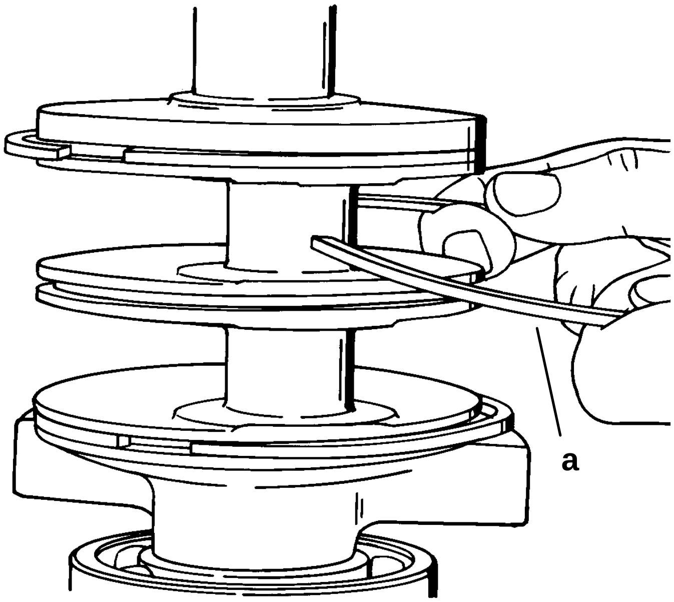
2. Reinstall retaining ring using a suitable pair of Snap Ring Pliers.



51854

a - Retaining Ring

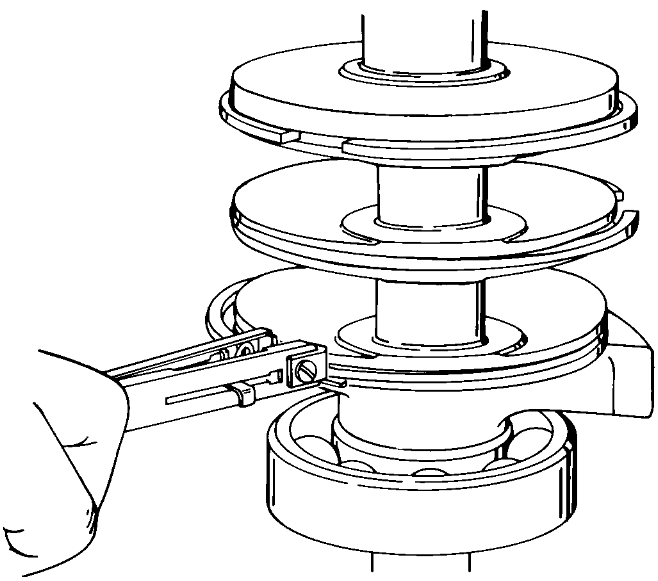
3. If removed, spread new crankshaft sealing rings just enough to slide over crankshaft journal.



51854

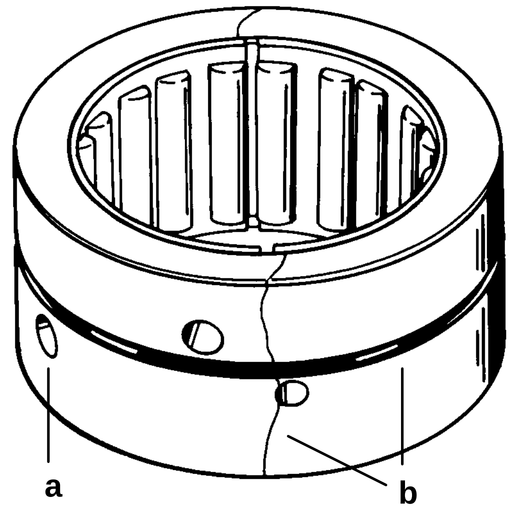
a - Crankshaft Sealing Rings

4. Use Piston Ring Expander (91-24697) and install crankshaft sealing rings into groove.



51849

5. Lubricate center main crankshaft roller bearings and races with light oil.

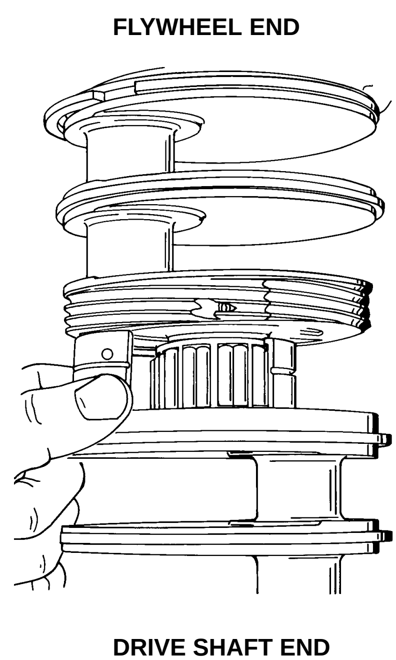


51854

a - Install so LARGER of the 3 holes is toward DRIVE SHAFT end of crankshaft
b - Verify retaining ring bridges the separating lines of the bearing race

6. Place center main crankshaft roller bearings on upper and lower main bearing journals as shown.

7. Install center main bearing races as shown.



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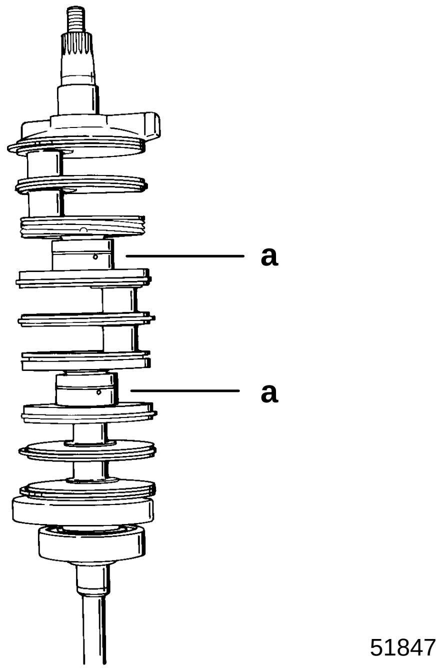
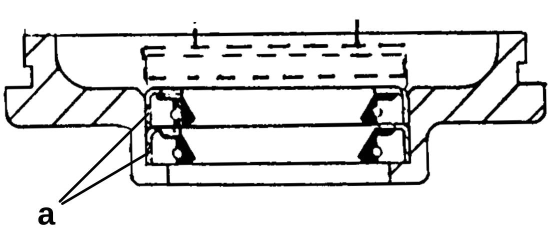
8. Secure center main bearing races together with retaining rings. Make sure retaining ring bridges the separating lines of the bearing race.

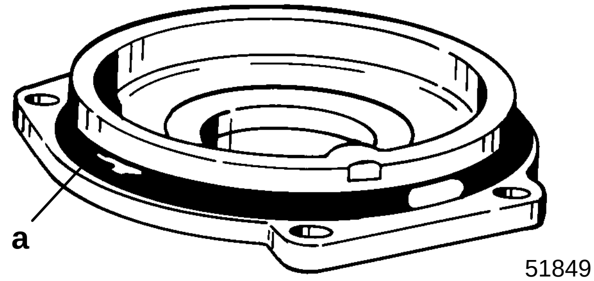


a - Center main Bearing Races

9. Install oil seals into lower end cap as follows:
   a. Apply a thin bead of Loctite 271 (obtain locally) to outer diameter on 2 lower end cap oil seals (a).
   b. Using driver head (91-55919) press one oil seal (lip facing down) into lower end cap until firmly seated. Remove any excess Loctite.
   c. Press second oil seal (lip facing down) until firmly seated on first oil seal. Remove any excess Loctite.
   d. Lubricate oil seal lips with Quicksilver 2-4-C w/Teflon (92-825407A12).
   e. Lubricate O-ring seal surface on end cap with 2 cycle oil. Install o-ring over lower end cap.

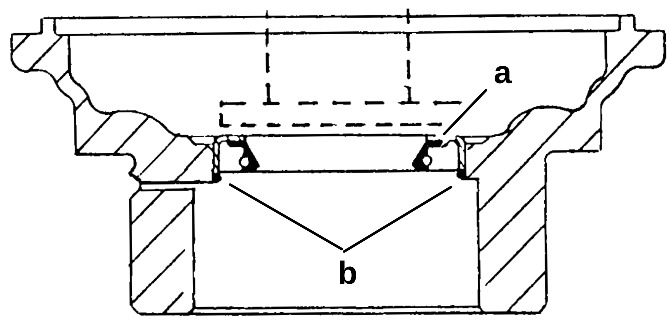


a - Oil Seal

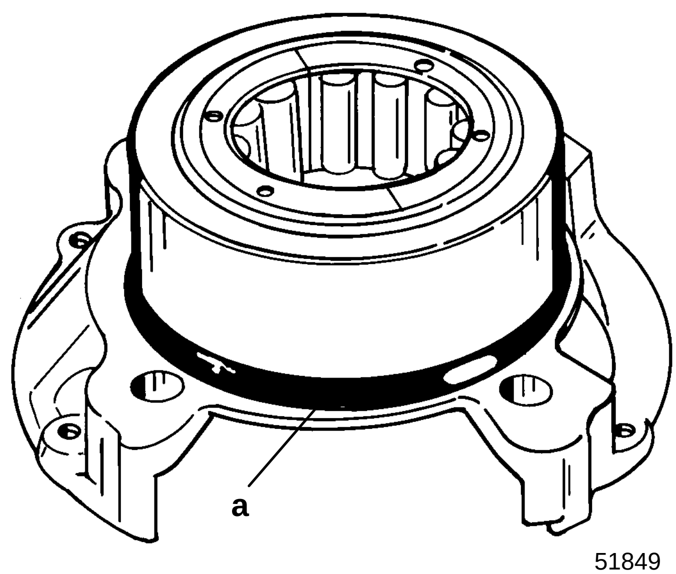


a - O-ring

10. Install oil seal into upper end cap as follows:
   a. Apply a thin bead of Loctite 271 (obtain locally) to outer diameter of upper end cap oil seal.
   b. Use a suitable mandrel, press oil seal into upper end cap (lip facing down) until bottomed out on lip of end cap. Remove any excess Loctite.
   c. Lubricate oil seal lip with Quicksilver 2-4-C w/ Teflon (92-825407A12).
   d. Lubricate O-ring seal surface on end cap with Quicksilver 2-4-C w/Teflon (92-825407A12). Install O-ring on end cap.



a - Oil Seal
b - Lip of End Cap



a - O-ring

Crankshaft Installation

SPECIAL INFORMATION

Installing A New Crankshaft Assembly Into Cylinder Block

Check the crankshaft sealing ring mating surfaces in the cylinder block and crankcase cover for wear grooves that were caused by the crankshaft sealing rings from the previous crankshaft. If wear grooves are present, the sealing rings on the new crankshaft will have to fit into the grooves without binding the crankshaft.

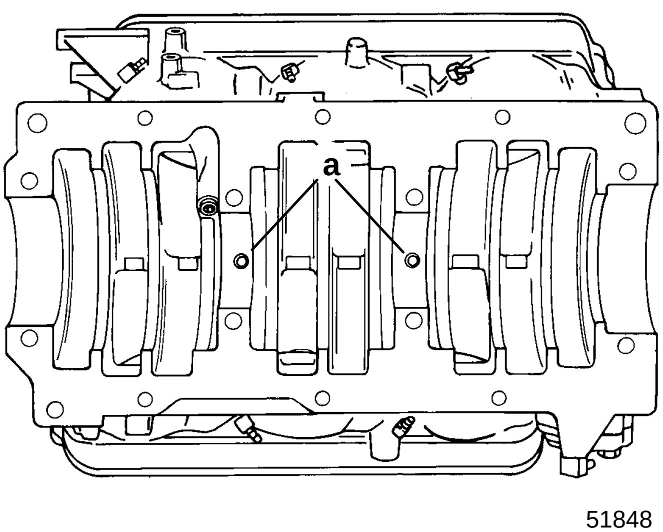
Before installing crankshaft, remove any burrs that may exist on groove edges.

Lubricate sealing rings with light oil and install new crankshaft as instructed.

Install upper and lower end caps and then inspect fit between sealing rings and grooves. Temporarily install crankcase cover and rotate crankshaft several times to check if sealing rings are binding against crankshaft. (You will feel a drag on the crankshaft.) If sealing rings are binding, recheck grooves for burrs. If this does not correct the problem, it is recommended that the cylinder block be replaced.

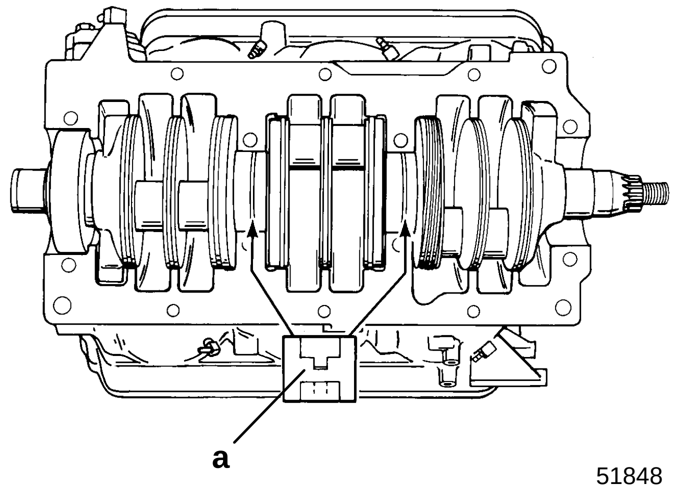
Install crankshaft as follows:

1. Lubricate crankshaft sealing rings with light oil.
2. Check cylinder block to be sure that dowel pins are in place.



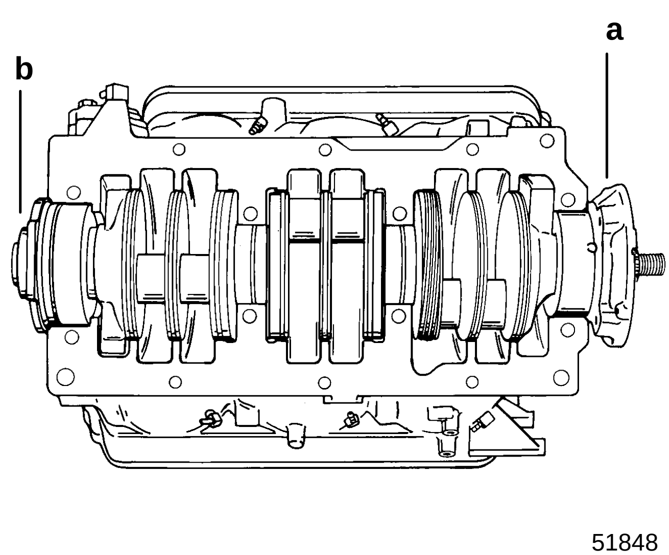
a - Dowel Pins

3. Position all crankshaft seal ring gaps straight up.
4. Align hole in each center main bearing race with dowel pin.
5. Gently push crankshaft down into position making sure that the dowel pins are lined up with the holes in center main bearings and crankshaft seal rings are in place.



a - Dowel Pin

6. Lubricate crankshaft ends (oil seal areas) with light oil, then install upper and lower end caps (“a” and “b”). Secure end caps to cylinder block with attaching bolts. DO NOT tighten end cap bolts at this time.



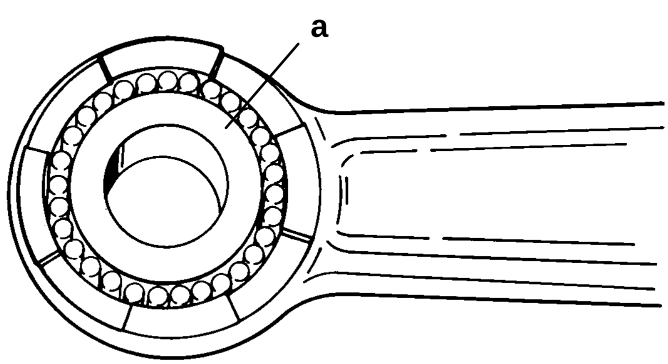
a - Upper End Cap
b - Lower End Cap

Piston and Connecting Rod Reassembly

1. Place needle bearings on a clean piece of paper and lubricate with Quicksilver 2-4-C w/Teflon Marine Lubricant (92-825407A12).

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

2. Place sleeve which is part of piston pin tool (91-74607A1) into connecting rod and install needle bearings around sleeve as shown.



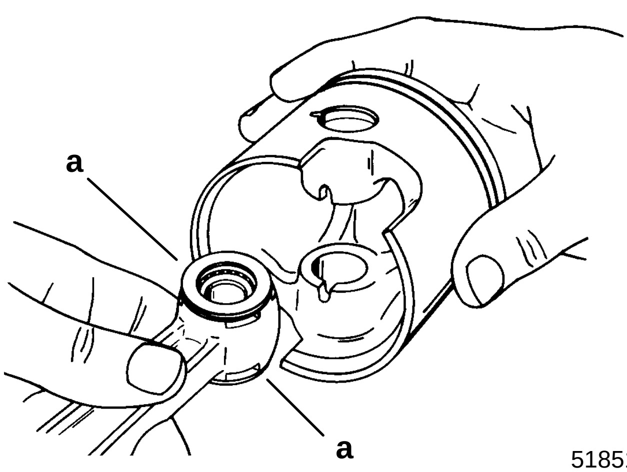
51851

a - Sleeve (Part of Tool Assy. 91-74607A1)

3. Place locating washers on connecting rod.

IMPORTANT: Position connecting rod part number facing towards flywheel.

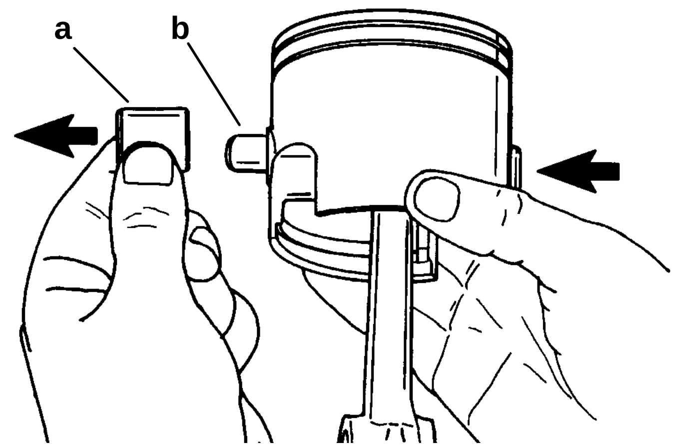
Carefully position piston over end of rod. Make sure locating washers remain in place.



51851

a - Locating Washers

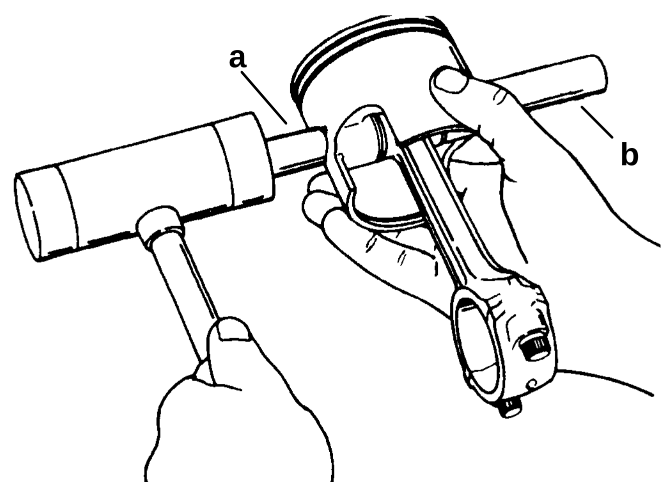
4. Insert piston pin tool (91-74607A1) and push sleeve out of piston. Keep piston pin tool in piston.



51080

a - Piston Pin Tool (91-74607A1)
b - Sleeve

5. Use a mallet and tap piston pin into piston and push piston pin tool out.

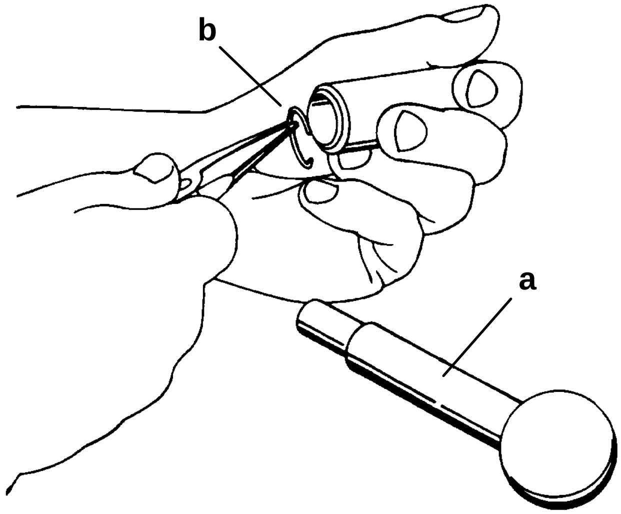


51086

a - Piston Pin
b - Piston Pin Tool

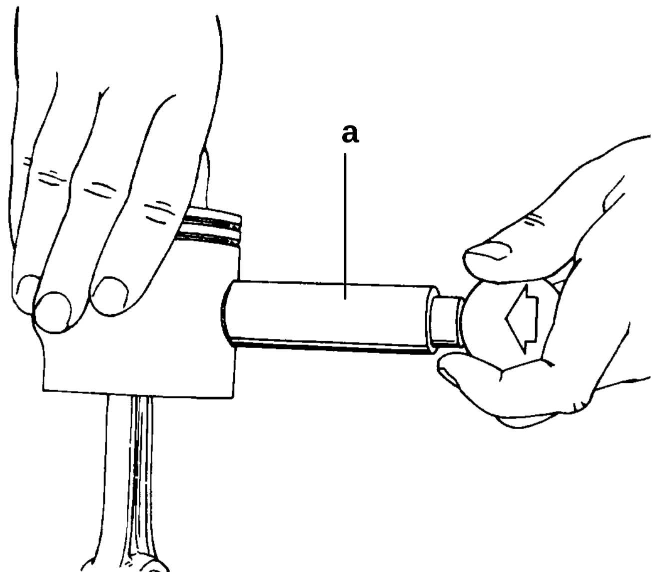
6. Install new piston pin lockrings (one each end of piston pin) with Lockring Installation Tool (91-77109A1).

7. Make sure lockrings are properly seated in piston grooves.



51086

a - Lockring Installation Tool (91-77109A1)
b - Lockring



51086

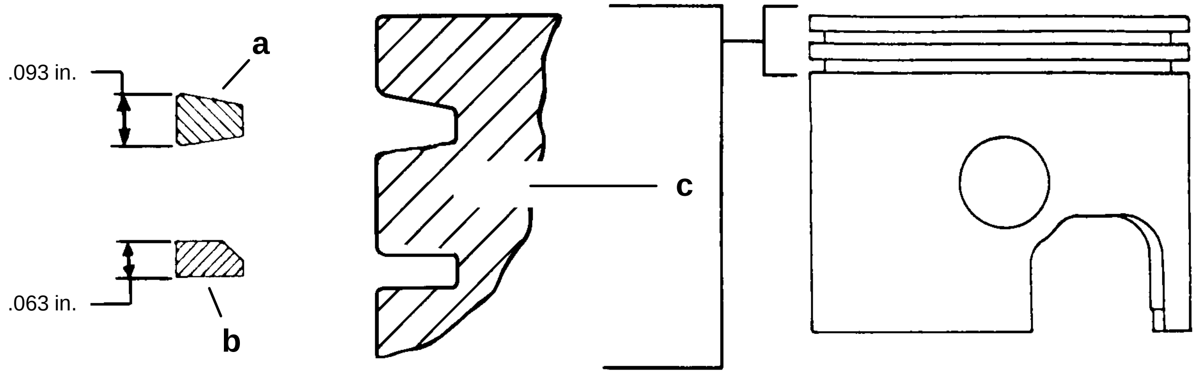
a - Lockring Installation Tool

Piston and Piston Ring Combinations

122 CU. IN. (1999cc) MODELS

All 122 cu in. (1999cc) models have one keystone (tapered) ring on top and one rectangular ring on bottom.

Piston with one keystone (tapered) ring on top and one rectangular ring on bottom

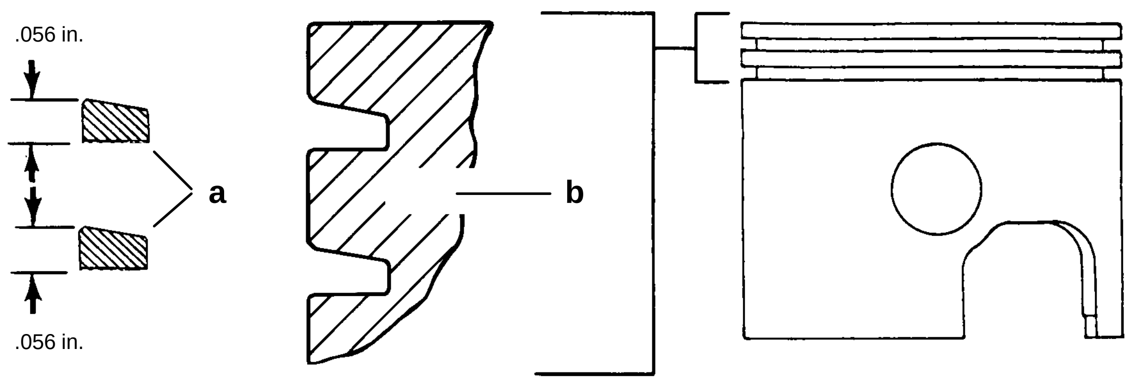


a - Keystone (tapered) Piston Ring
b - Rectangular Piston Ring
c - Enlarged View of Piston Ring Grooves

153 CU. IN. (2508cc) MODELS

All 153 cu. in. (2508cc) models have two half keystone (half tapered) rings.

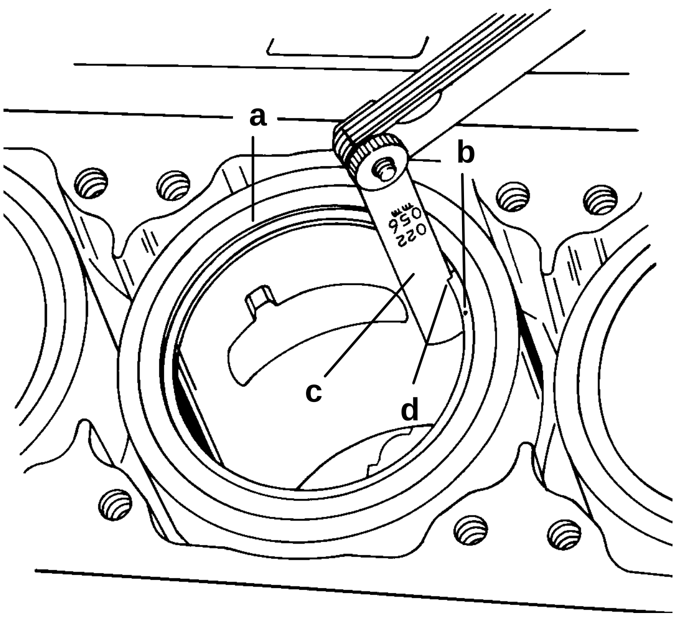
Pistons with two half keystone (half tapered) rings



a - Half Keystone (half tapered) Piston Ring
b - Enlarged View of Piston Ring Grooves

Piston Installation (Standard and High Performance Models)

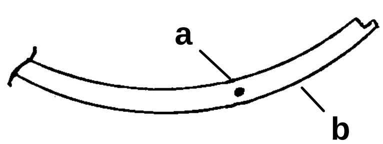
1. Before installing new piston rings, check gap between ring ends by placing each ring in its respective cylinder, then pushing ring about 1/2 in. (12.7mm) into cylinder using piston to assure proper position.
2. Check end gap of each new piston ring with a feeler gauge. End gap must be within .018 in. to .025 in. (0.45mm to 0.64mm). If end gap is greater, check other piston rings in cylinder bore, until rings (within tolerance) are found.



51852

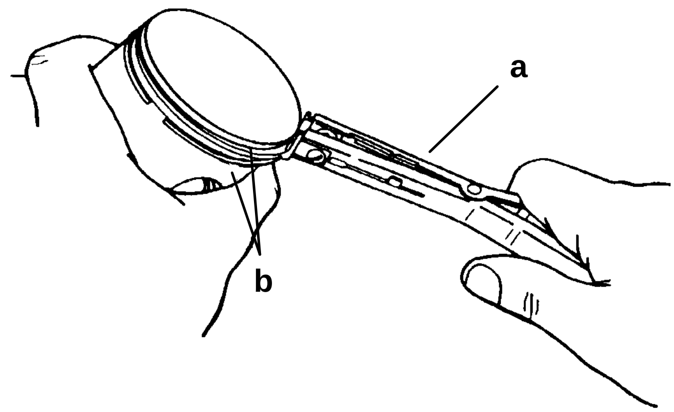
a - Piston Ring
b - Dots (Faces Up)
c - Feeler Gauge
d - Ring End Gap

IMPORTANT: Piston ring side with dot or letter must be facing up.



a - Dot or Letter
b - Piston Ring

3. Use Piston Ring Expander (91-24697) and install piston rings (dot side up) on each piston. Spread rings just enough to slip over piston.
4. Check piston rings to be sure that they fit freely in ring groove.
5. Lubricate piston, rings and cylinder wall with 2-Cycle Outboard Oil.



51081

a - Piston Ring Expander
b - Dot Side “Up” on Piston Ring

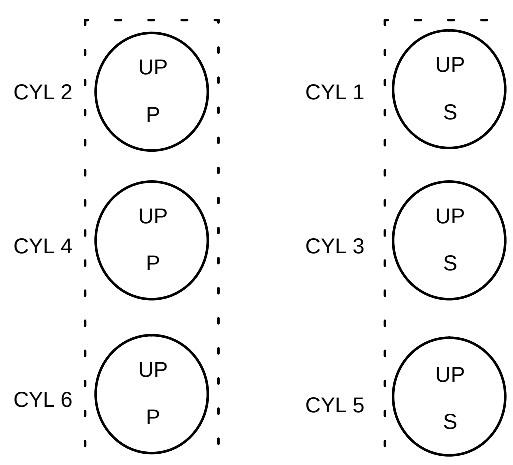
6. Rotate each piston ring so end of ring is aligned with locating pin as shown.
7. Install Piston Ring Compressor.
8. Remove screws and connecting rod cap from piston rod assembly being installed.

IMPORTANT: Piston must be correctly installed and positioned as shown.

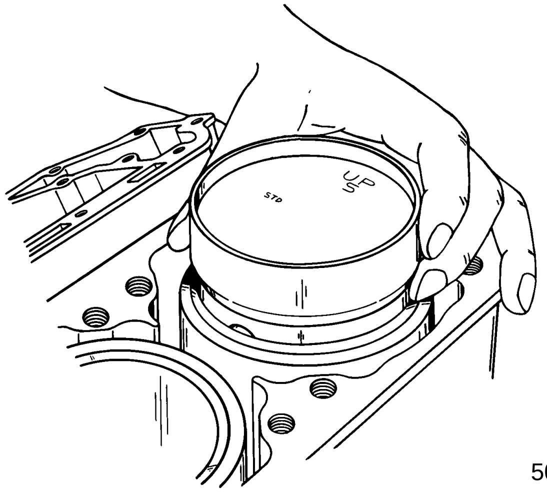
Pistons marked with the word “UP” and with the letter “P” or “S” on top of piston.

Pistons with the letter “P” must be installed in the port side of engine and the word “UP” facing toward top of engine.

Pistons with the letter “S” must be installed in the starboard side of engine and the word “UP” toward top of engine.



9. Coat cylinder bore with 2-cycle oil. Match piston assembly with cylinder it was removed from, and position piston as described below. Push piston into cylinder.



50802

10. Apply Quicksilver Needle Bearing Assembly Lubricant to bearing surface of connecting rod and install bearing assembly, as shown.

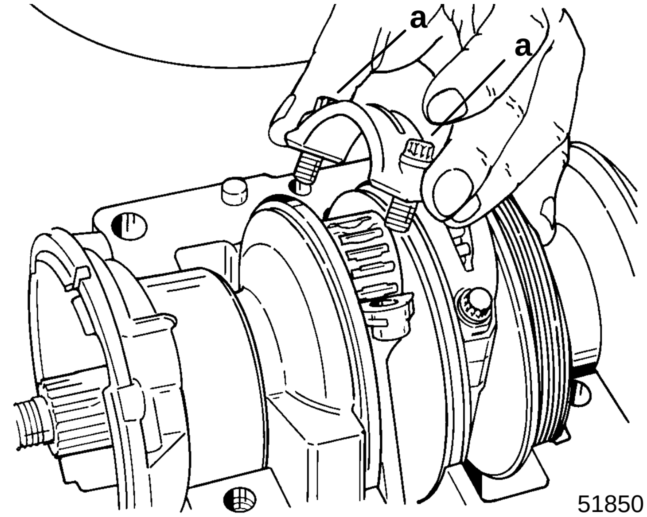
11. Place connecting rod cap on connecting rod. Apply light oil to threads and face of connecting rod bolts. Thread connecting rod bolts finger-tight while checking for correct alignment of the rod cap as shown.

IMPORTANT: Connecting rod and connecting rod caps are matched halves. Do not torque screws before completing the following procedure.

- Run a pencil lightly over ground area.
- If pencil stops at fracture point, loosen bolts, retighten, and check again.

NOTE: *If you still feel the fracture point, discard the rod.*

12. Tighten connecting rod bolts (using a 5/16 in. - 12 point socket). First torque to 15 lb. in. (1.5 N·m) then 30 lb. ft. (40.5 N·m). Turn each bolt an additional 90° after 2nd torque is attained. Recheck alignment between rod cap and rod as shown.



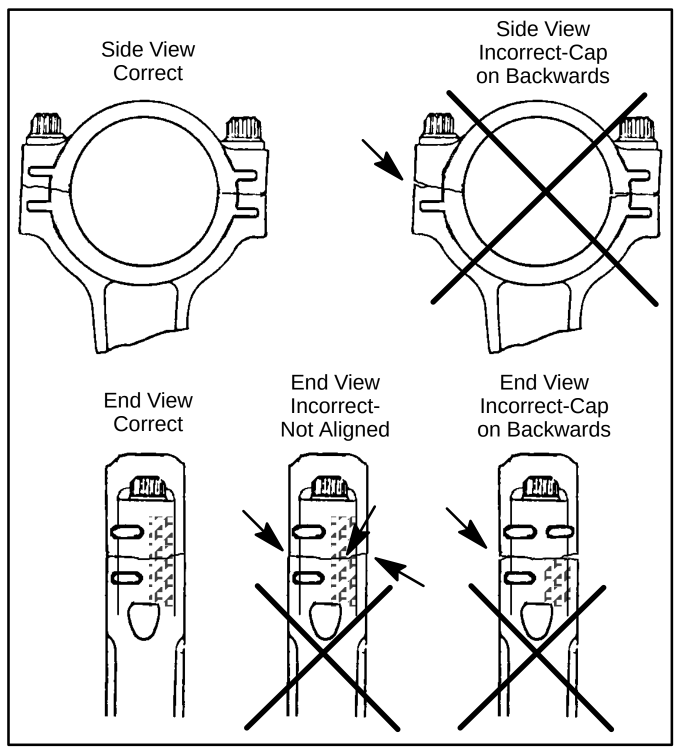
51850

a - Connecting Rod Screws

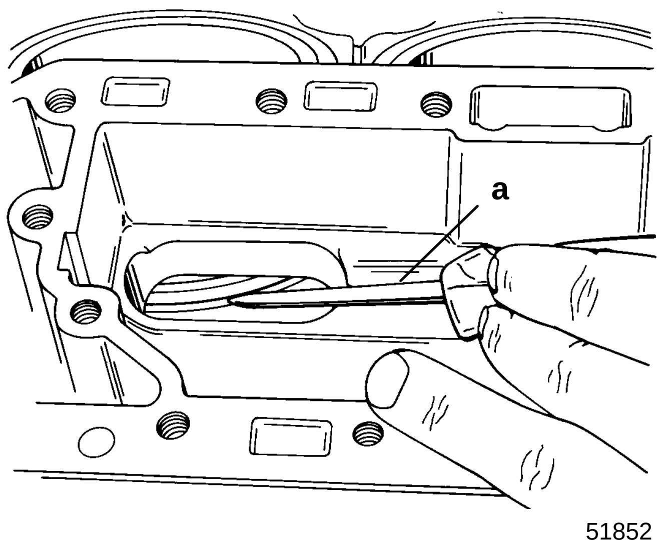
13. Rotate crankshaft several times (using powerhead stand) to assure free operation (no binds and catching).

Connecting Rod Cap Alignment

Check each connecting rod cap for correct alignment. If not aligned, a ridge can be seen or felt at the separating line as shown below. Correct any misalignment.



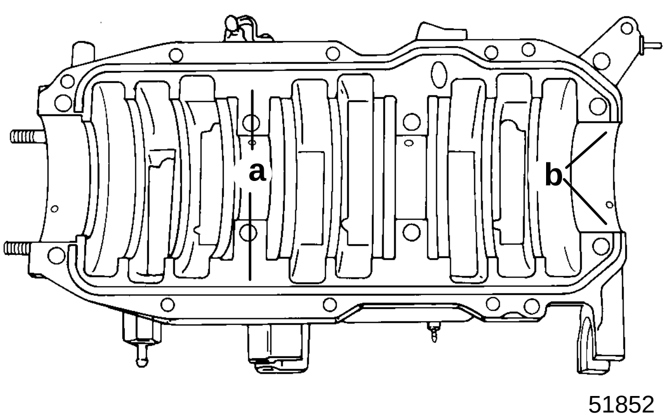
14. Verify that no piston rings were broken during installation by pressing in on each piston ring thru exhaust port using a screwdriver. If no spring tension exists (ring fails to return to position), it's likely ring is broken and must be replaced.



a - Screwdriver

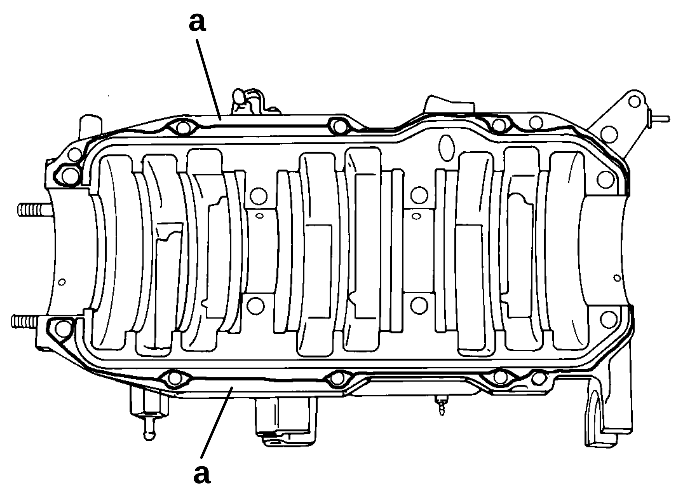
Crankcase Cover Installation (Standard and High Performance Models)

1. Thoroughly remove all oil from mating surfaces of crankcase cover and cylinder block with Loctite Primer 'T' (92-59327-1).
2. Install gasket strips into grooves in crankcase cover. Trim end of each gasket strip flush with edge of cover as shown.



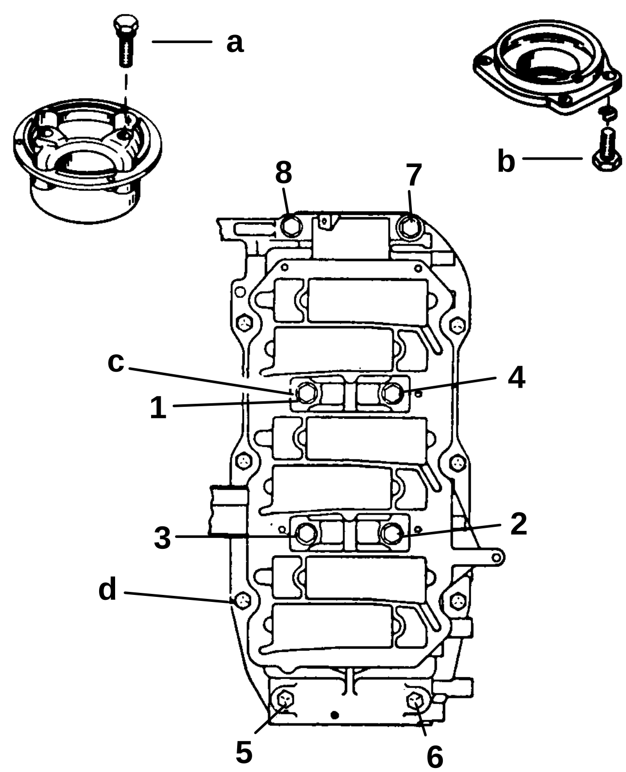
a - Gasket Strips
b - Edge of Cover

3. Apply a thin, even coat of Loctite Master Gasket #203 on mating surfaces of crankcase cover and cylinder block.



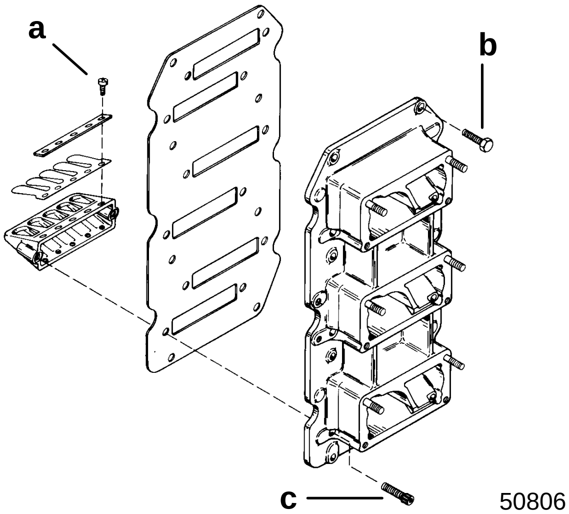
a - Loctite Master Gasket (92-12564-1)

4. Place crankcase cover in position on cylinder block. Turn the 8 center main bolts in a LITTLE at a time, (following torque sequence) compressing crankshaft seal rings until crankshaft cover has been drawn down to cylinder block. Tighten eight bolts (a) evenly in three progressive steps (following torque sequence).
5. Install remaining crankcase cover flange bolts.
6. Tighten end cap bolts to specified torque.



a - Upper End Cap Bolts – Torque to 150 lb. in. (17.0 N·m)
b - Lower End Cap Bolts – Torque to 80 lb. in. (9.0 N·m)
c - Add Light Oil to Threads and Bolt Face – 8 Bolts (3/8 in.-18) Torque to 38 lb. ft. (51.5 N·m)
d - Bolts (5/16 in.-18) Torque to 15 lb. ft. (20.5 N·m)

Assembly of Reed Blocks to Intake Manifold (Standard and High Performance Models)

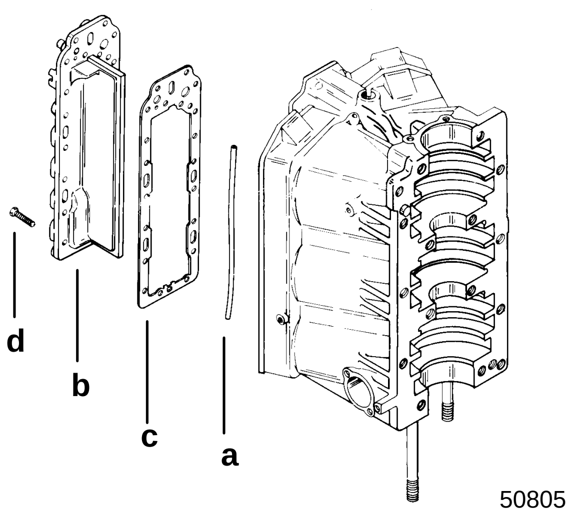


50806

a - Torque to 25 lb. in. (3.0 N·m)
b - Torque to 105 lb. in. (12.0 N·m)
c - Torque to 80 lb. in. (9.0 N·m)

Assembly of Exhaust Divider Plate to Block(Standard and High Performance Models

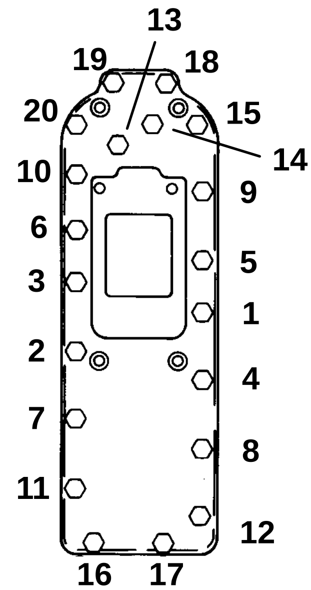
1. Place exhaust divider seal into slot in block.
2. Install exhaust divider plate with gasket.
3. Clean bolt threads with Loctite 7649 Primer (92-809824).
4. Apply Loctite 271 (obtain locally) to bolt threads and torque bolts to 16.5 lb. ft. (22.5 N·m).



50805

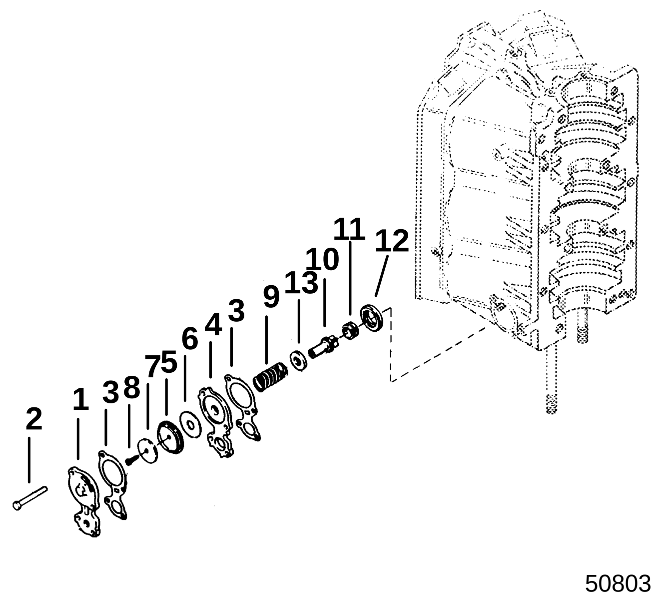
a - Divider Seal
b - Exhaust Divider Plate
c - Gasket
d - Attaching Bolt

5. Torque exhaust divider plate bolts in following sequence. Torque bolts to 16.5 lb. ft. (22.5 N·m). Add Loctite 271 to threads.



50806

6. If removed, install water pressure relief valve components as shown. Torque bolts to specifications.

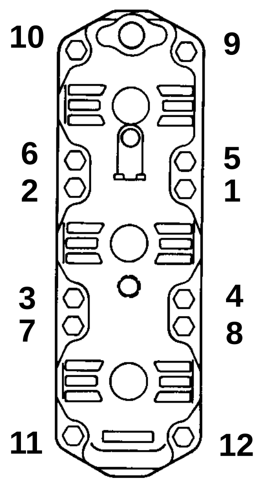


50803

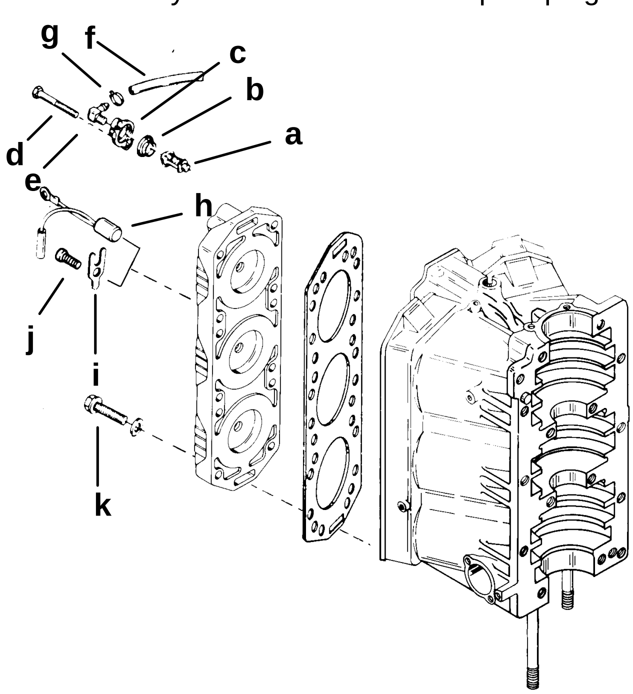
1 - Cover
2 - Bolt - 150 lb. in. (17.0 N·m)
3 - Gasket
4 - Relief Valve Plate
5 - Diaphragm
6 - Water Deflector
7 - Washer
8 - Screw - 25 lb. in. (3.0 N·m)
9 - Spring
10- Poppet Valve
11- Grommet
12- Carrier
13- Washer

CYLINDER HEAD INSTALLATION (STANDARD AND HIGH HIGH PERFORMANCE MODELS)

1. Install each cylinder head to engine block with thermostat pocket "UP". Apply light oil to cylinder head bolt threads and torque bolts to 30 lb. ft. (40.5 N·m) then turn an additional 90°.



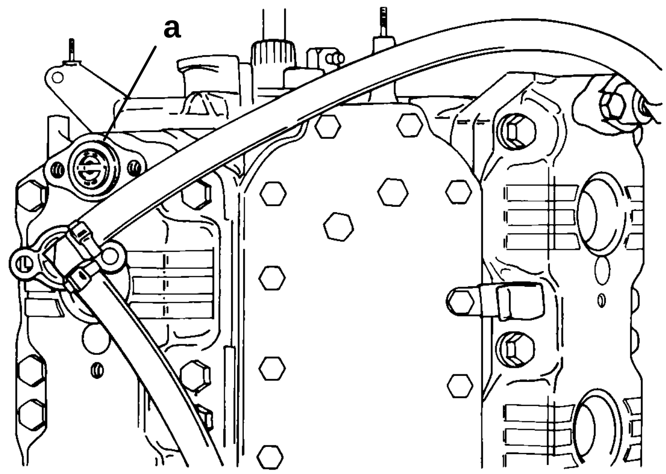
2. Install thermostat assembly into each cylinder head.
3. Install overheat temperature sensor into STARBOARD cylinder head below #1 spark plug.



a - Thermostat (143° F - 61.7° C)
b - Gasket
c - Thermostat Cover
d - Bolt (Torque to 16.5 lb. ft. - 22.5 N · m)
e - 90° Elbow
f - Hose
g - Sta-Strap
h - Temperature Sensor
i - Retainer
j - Bolt (Torque to 16.5 lb. ft. - 22.5 N m)
k - Bolt [Apply Light Oil to Threads - Torque to 30 lb. ft. (40.5 N·m) and turn additional 90°]

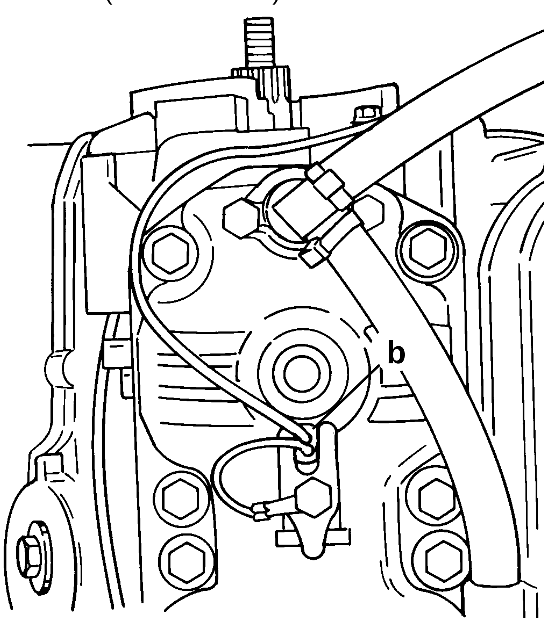
NOTE: *During normal engine operating temperature, the sender electrical circuit is open and will close if temperature reaches 240° F ± 8° F (116.0° C ± 13.3° C) thus activating the overheat alarm.*

4. Thermostat and temperature sensor installed.



51852

a - Thermostat (143° F 16.7° C)

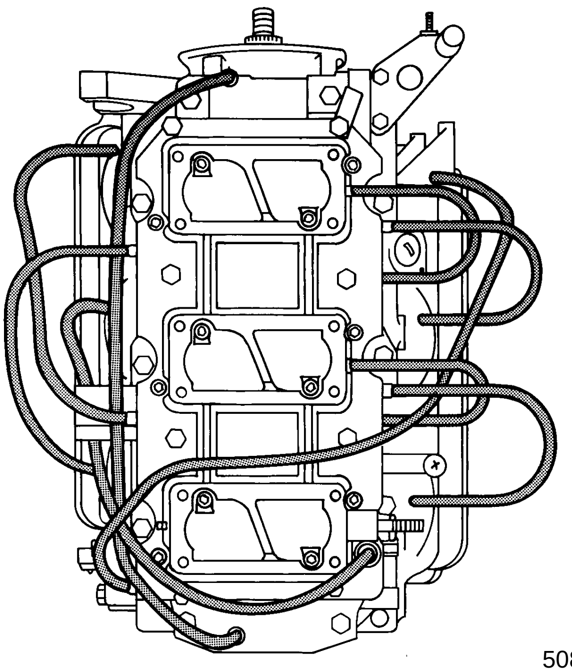


51846

b - Overheat Temperature Sensor

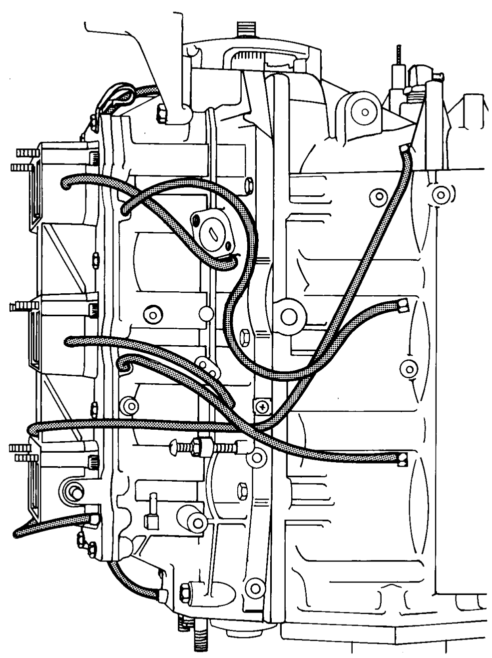
Bleed Line Routing (Carbureted Models)

FRONT VIEW



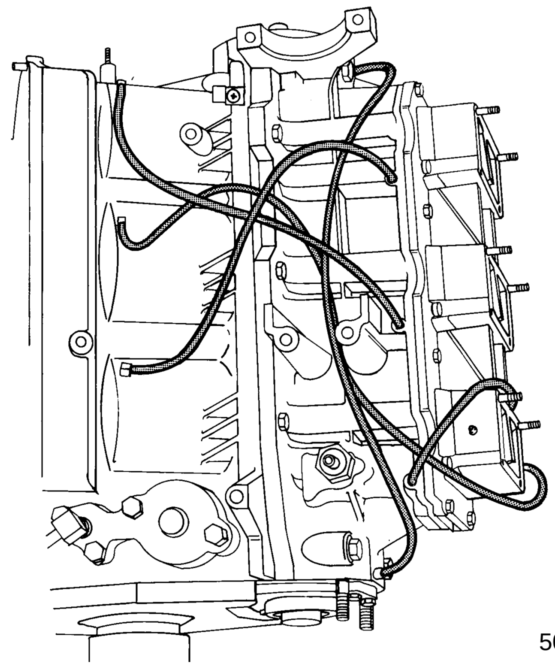
50801

PORT SIDE VIEW



50802

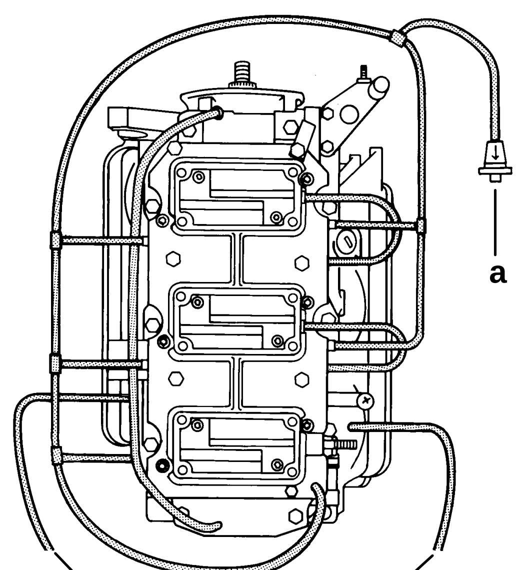
STARBOARD SIDE VIEW



50801

Bleed Line Routing (Fuel Injected Models)

FRONT VIEW

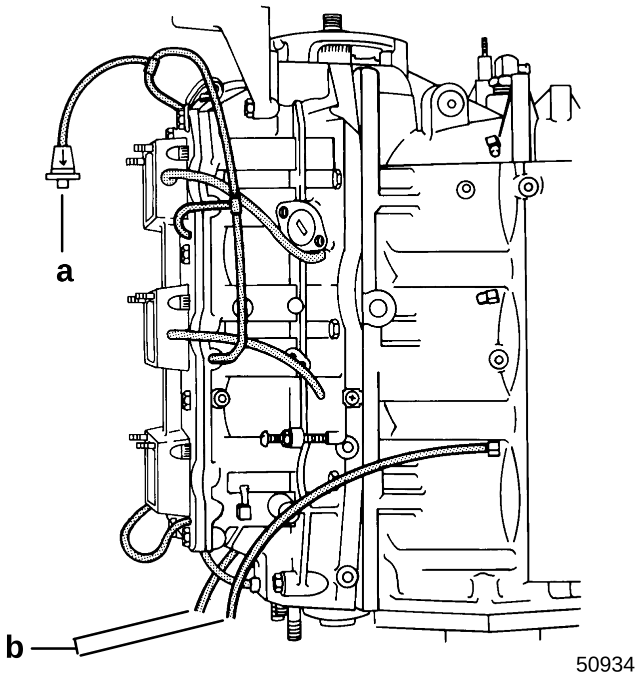


50935

a - To Vapor Separator Thru Bleed Shut-Off Valve (0G303045 and Below) – Direct to Vapor Separator (0G303046 and Above)

b - To Bottom of EFI Manifold if Equipped

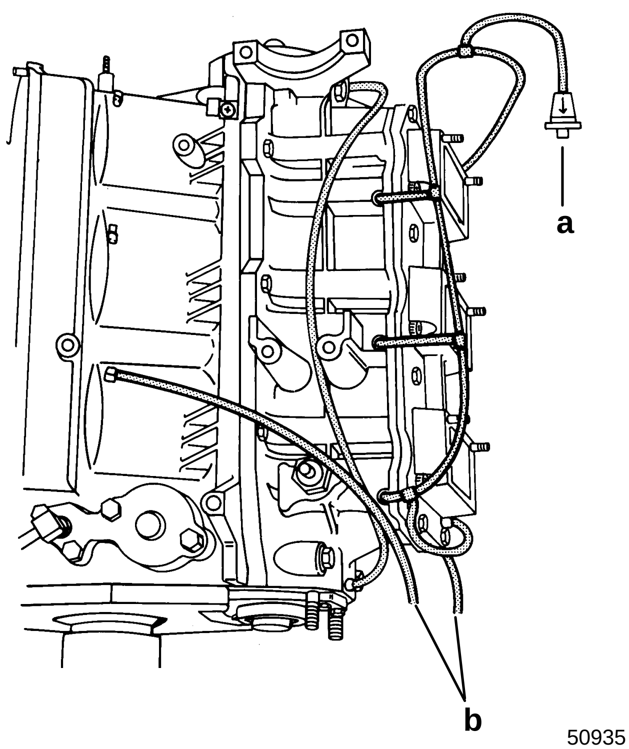
PORT SIDE VIEW



a - To Vapor Separator Thru Bleed Shut-Off Valve (0G303045 and Below) – Direct to Vapor Separator (0G303046 and Above)

b - To Bottom of EFI Manifold if Equipped

STARBOARD SIDE VIEW



a - To Vapor Separator Thru Bleed Shut-Off Valve (0G303045 and Below) – Direct to Vapor Separator (0G303046 and Above)

b - To Bottom of EFI Manifold if Equipped

Reinstalling Engine Components

Reinstall the following engine components:

Section 2

Starter Motor
Ignition Switch Boxes
Ignition Coil
Starter Solenoid
Voltage regulator/rectifier
Flywheel
Stator Assembly
Trigger Assembly
Low speed/high speed spark advance module
Idle Stabilizer

Section 3

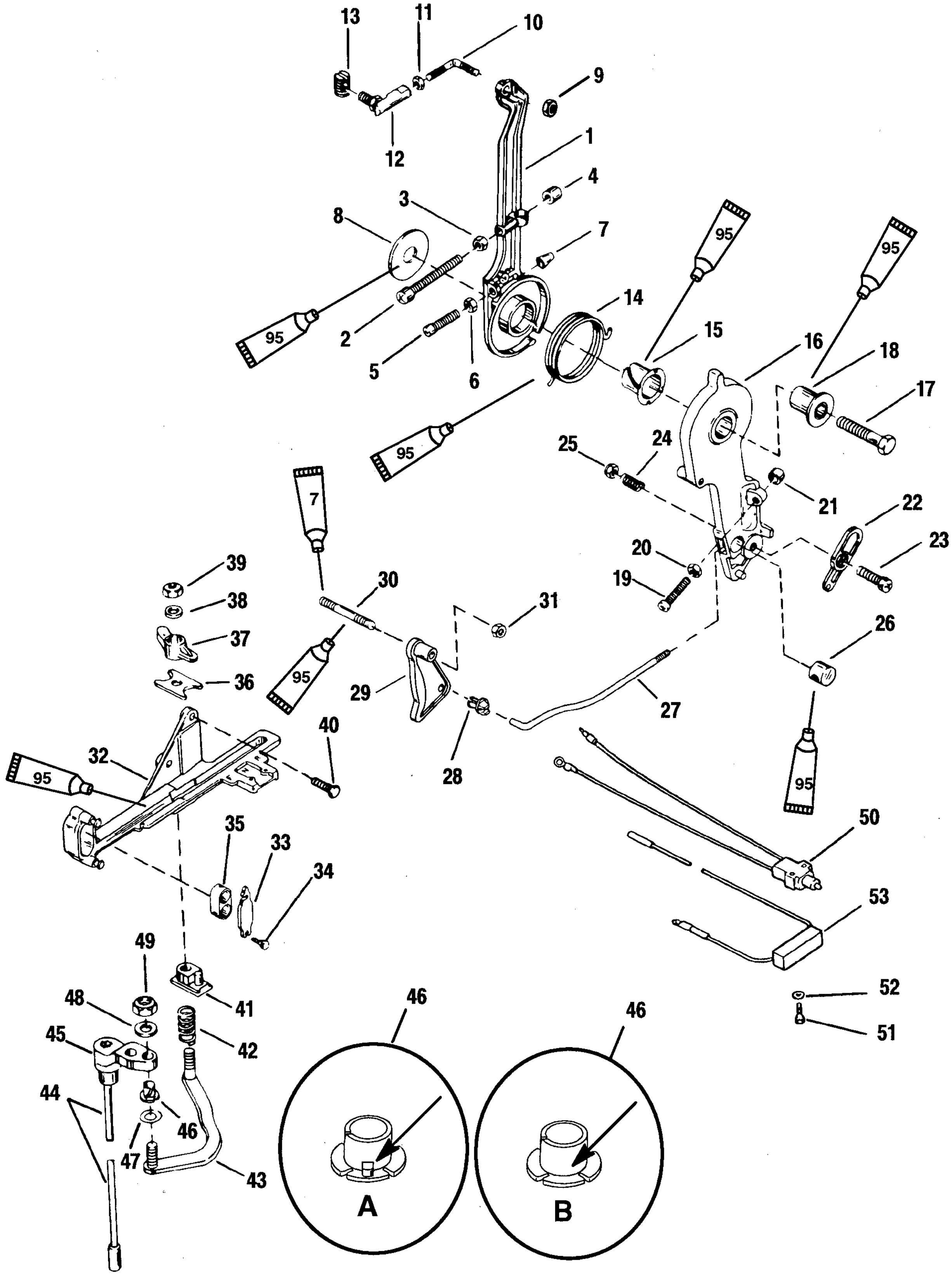
Air Silencer
Carburetors and Linkage
Fuel Pump Fuel
Enrichment Valve
Warning Module
On-Board Oil Tank
Oil Pump
Fuel Injection Assembly

Section 7

Shift Cable Latch Assembly
Control Cable Anchor Bracket

Notes:

Throttle Lever and Shift Shaft



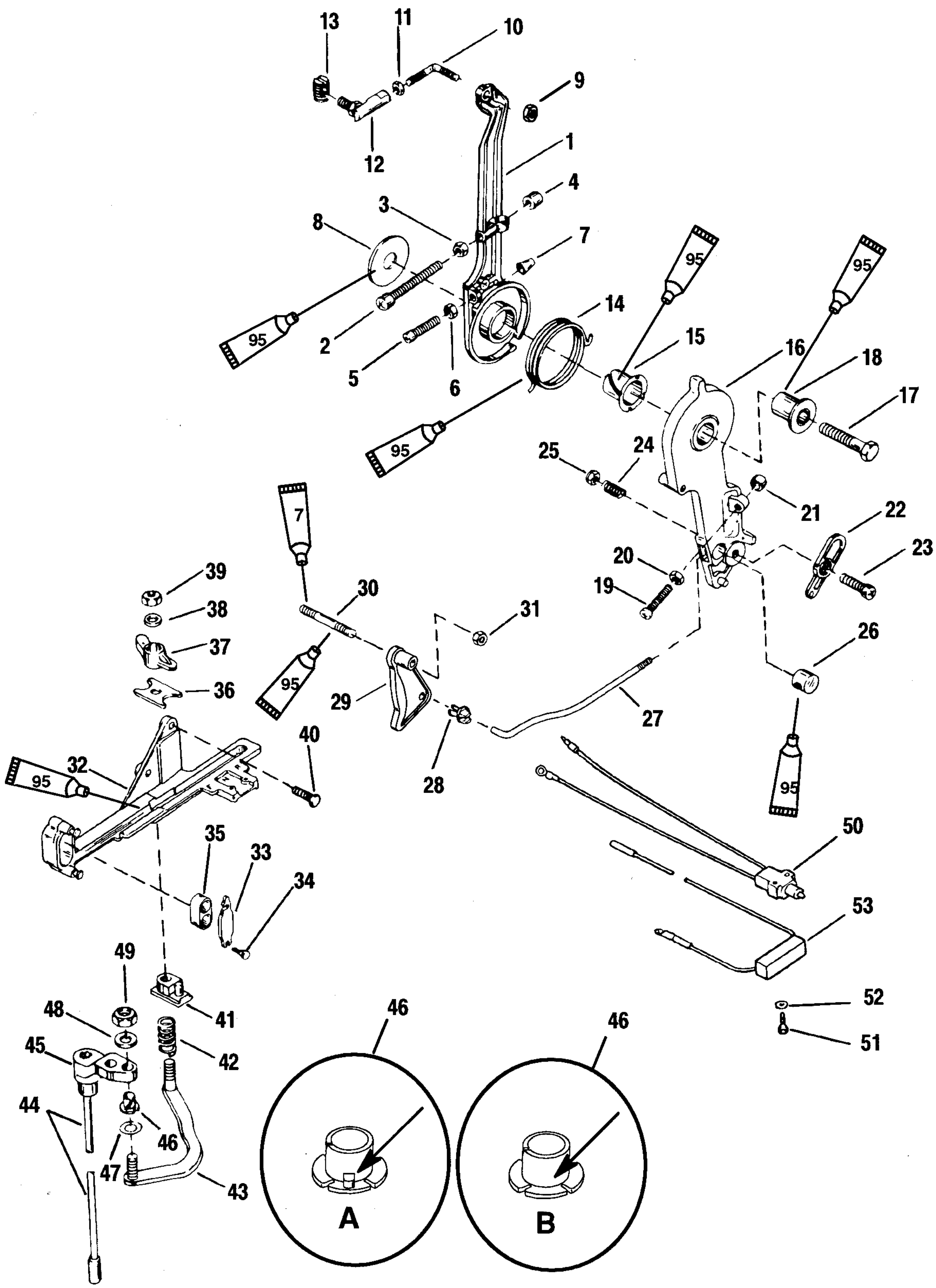
7 Loctite 271 (92-809820)

95 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	SPARK ADVANCE LEVER			
2	1	SCREW			
3	1	NUT			
4	1	CAP			
5	1	SCREW (1-1/4 IN.)			
6	1	NUT			
7	1	CAP			
8	1	WASHER			
9	1	NUT	35		4.0
10	1	LINK ROD			
11	1	NUT			
12	1	BALL JOINT			
13	1	PIVOT			
14	1	SPRING			
15	1	BUSHING			
16	1	THROTTLE CONTROL LEVER			
17	1	SCREW (1-3/4 IN.)			
18	1	BUSHING			
19	1	SCREW (2-1/8 IN.)			
20	1	NUT (1/4-20)			
21	1	CAP			
22	1	LATCH			
23	1	SCREW			
24	1	SPRING			
25	1	NUT			
26	1	BARREL			
27	1	THROTTLE CONTROL ROD			
28	1	SWIVEL BUSHING			
29	1	THROTTLE CAM **(135)**			
	1	THROTTLE CAM **(150 THRU 200)**			
30	1	STUD			
31	1	NUT	Tighten until snug then back off 1/4 turn		

A = WITH TAB **B = WITHOUT TAB**

Throttle Lever and Shift Shaft



7 Loctite 271 (92-809820)

95 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
32	1	ANCHOR BRACKET			
33	1	LATCH			
34	2	SCREW			
35	1	CAP			
36	1	WEAR PLATE			
37	1	LATCH			
38	1	WASHER			
39	1	NUT			
40	3	SCREW	160	13.5	18.0
41	1	GUIDE BLOCK			
42	1	SPRING			
43	1	LINK ROD ASSEMBLY			
44	1	SHIFT SHAFT ASSEMBLY **(LONG)**			
	1	SHIFT SHAFT ASSEMBLY **(X-LONG)** **USE WITH REF #46**			
45	1	SHIFT SHAFT LEVER–UPPER **WITH TAB** (**SEE BUBBLE A)**			
46	1	BUSHING			
44	1	SHIFT SHAFT ASSEMBLY **(LONG)**			
	1	SHIFT SHAFT ASSEMBLY **(X-LONG)** **USE WITH REF #46**			
45	1	SHIFT SHAFT LEVER–UPPER **WITHOUT TAB**			
46	1	BUSHING (**SEE BUBBLE B)**			
47	1	WAVE WASHER			
48	1	WASHER			
49	1	NUT			
50	1	IDLE STABILIZING SHIFT KIT			
51	2	SCREW **XR6/175**			
52	2	WASHER **MAGNUM III**			
53	1	RESISTOR MODULE			

A = WITH TAB **B = WITHOUT TAB**

Powerhead Installation on Driveshaft Housing

1. Install Lifting Eye (91-90455) into flywheel.

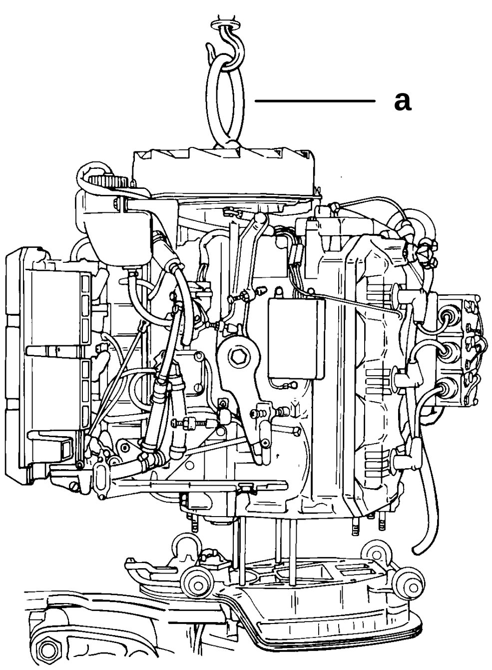
⚠ WARNING

BE SURE that Lifting Eye is threaded into flywheel as far as possible BEFORE lifting powerhead.

2. Using a hoist, lift powerhead high enough to allow removal of powerhead from repair stand. Remove powerhead from repair stand, being careful not to damage drive shaft housing gasket surface of powerhead.
3. Place a new gasket around powerhead studs and into position on base of powerhead.

IMPORTANT: DO NOT apply lubricant to top of driveshaft as this will prevent driveshaft from fully engaging into crankshaft.

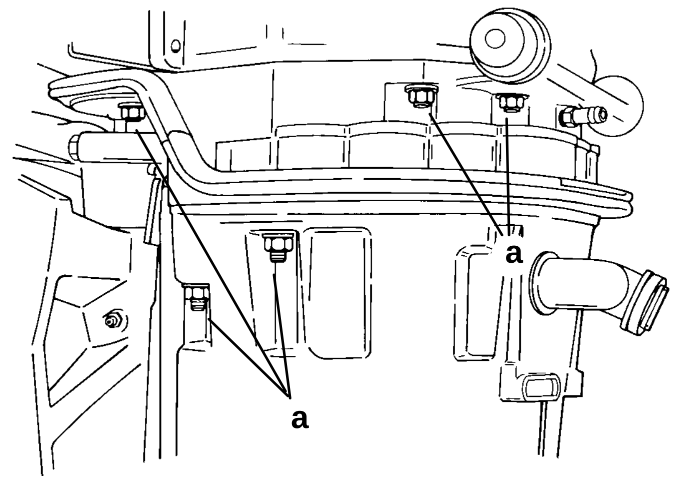
4. Apply a small amount of 2-4-Cw/Teflon Marine Lubricant (92-90018A12) onto driveshaft splines.
5. Use hoist to lower powerhead onto driveshaft housing. It may be necessary to turn flywheel (aligning crankshaft splines with driveshaft splines) so that powerhead will be fully installed.



51804

a - Lifting Eye (91-90455)

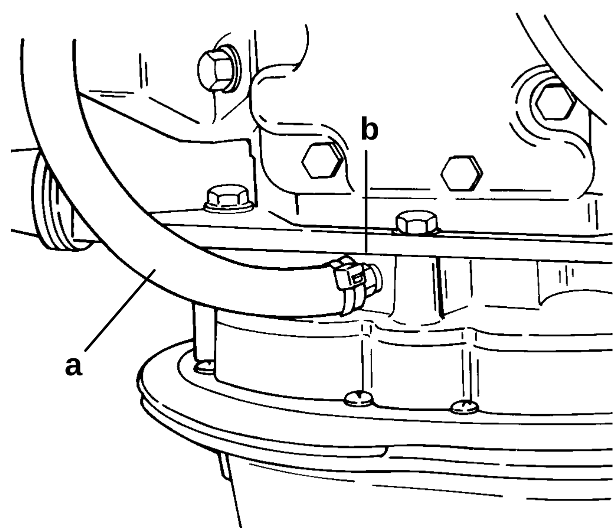
6. Install 10 flat washers,and10 locknuts which secure powerhead to exhaust extension plate/driveshaft housing. Torque locknuts in 3 progressive steps until secured.
7. Disconnect hoist from Lifting Eye and remove Lifting Eye from flywheel.
8. Reinstall plastic cap into center of flywheel cover.



51846

a - Powerhead Attaching Locknuts and Flat Washers – Torque Nuts to 20 lb. ft. (27.0 N·m)

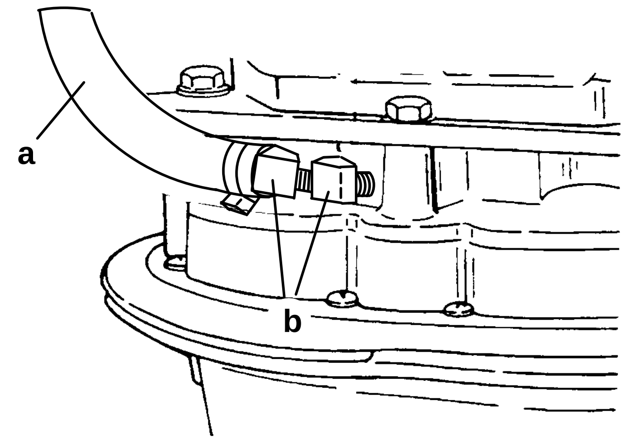
9. **Standard Models –** Connect water hose to fitting on exhaust adaptor plate.



51851

a - Water Hose
b - Fitting

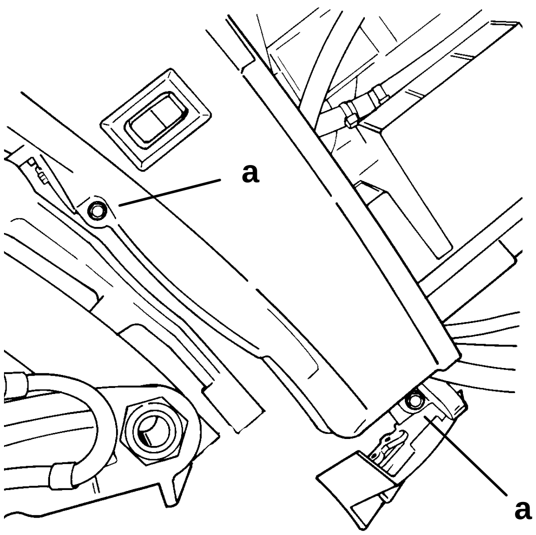
10. **All High Performance Models –** Install water hose through bottom pan and secure hose to fitting.



51851

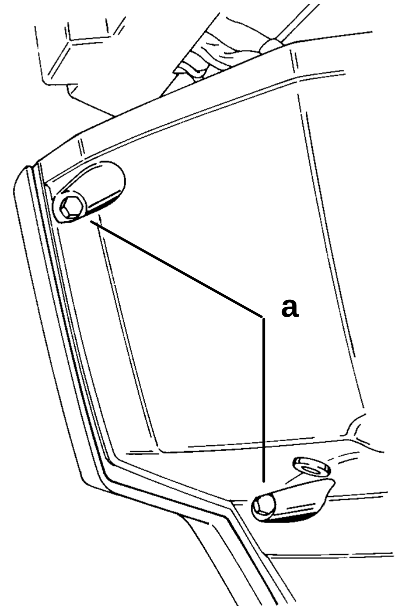
a - Hose
b - Fittings – Fittings must be turned to allow clearance for bottom pan

11. **1994 - 1995 Standard Models –** Install four bolts which secure bottom cowl halves together.



51847

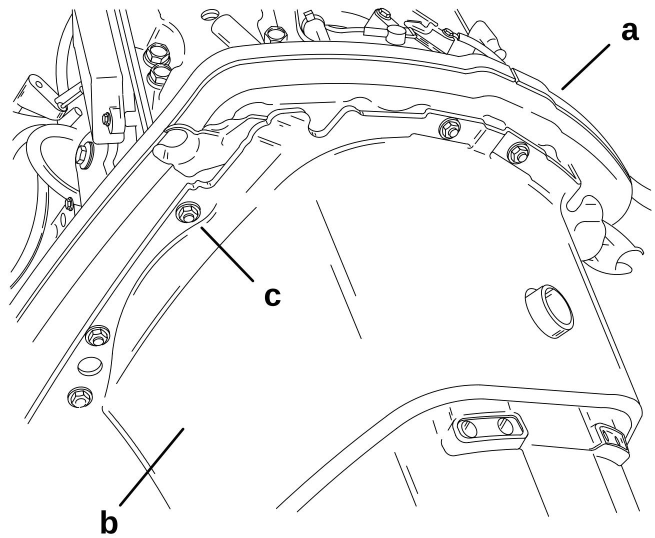
a - Bolts



51846

a - Bolts

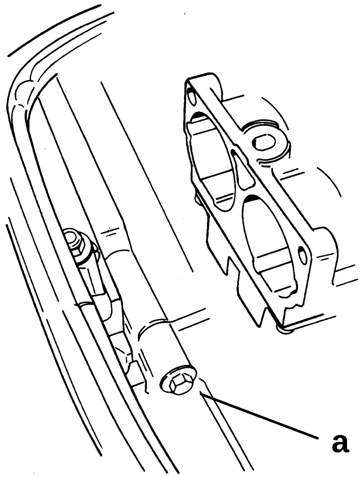
All High Performance Models –



55005

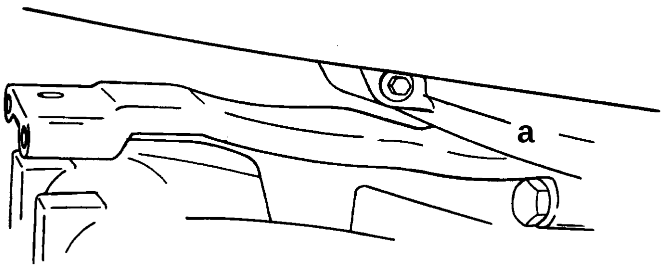
a - Bottom Pan
b - Skirt
c - Bolts, Washers, Nuts (8 each)

1996 Standard Models –



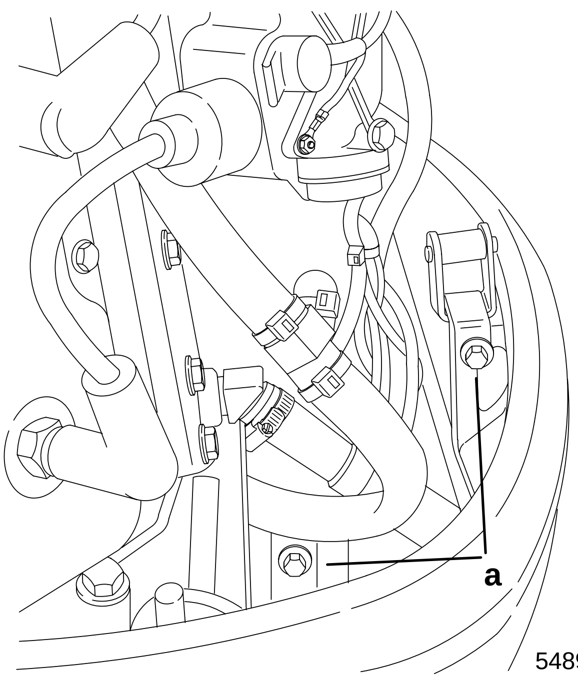
52354

a - Bolts



52352

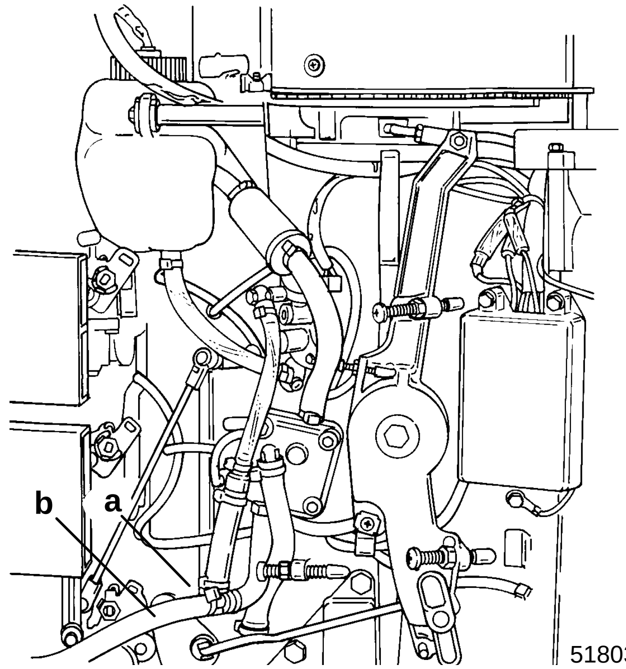
a - Bolts



54896

a - Bolts

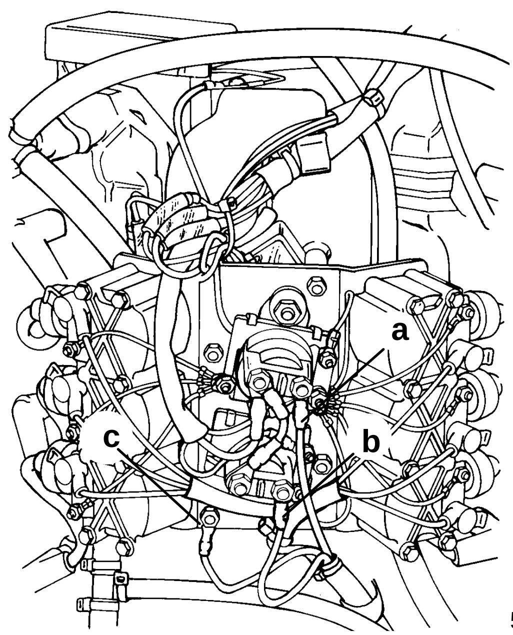
12. Reconnect input fuel line.



51803

a - Sta-Strap
b - Fuel Line

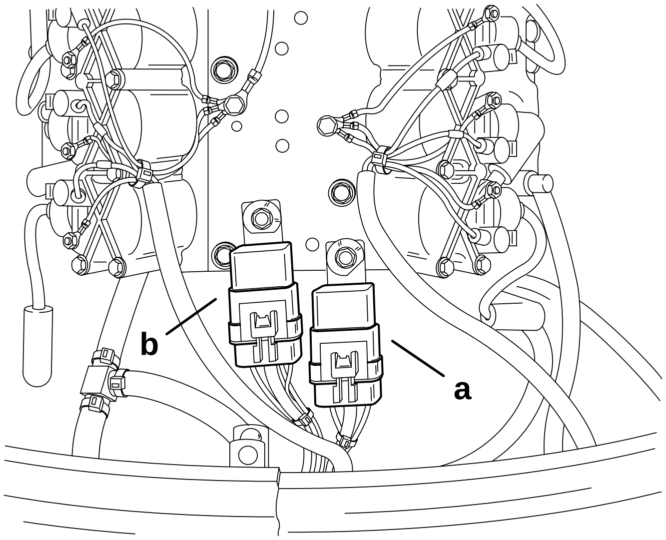
13. **1994 - 1995 Standard Models –** Connect BLUE, GREEN and BLACK trim harness leads to trim solenoids. Install trim harness to J-clip on exhaust cover.



51809

a - Blue Trim Lead
b - Green Trim Lead
c - Black Trim Lead

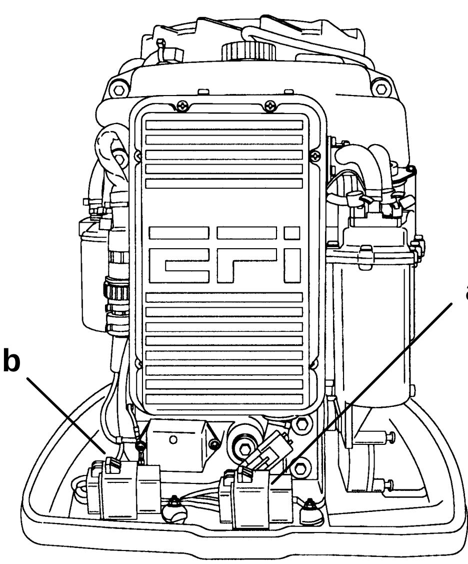
14. **1996/1997 Standard Models –** Reconnect trim relay harnesses.



54938

a - UP Trim Relay
b - DOWN Trim Relay

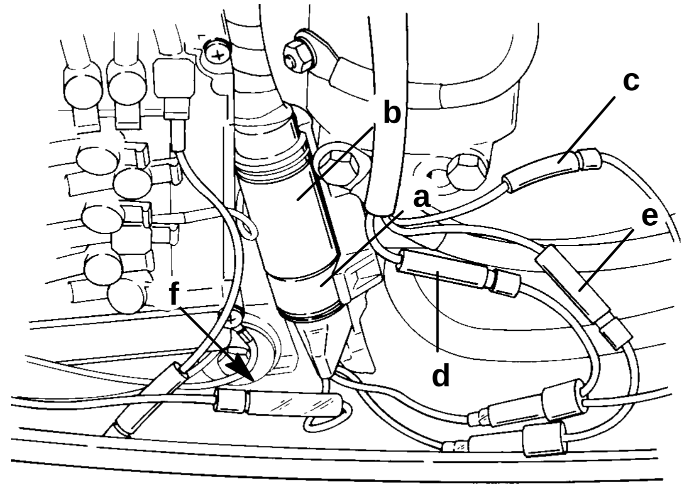
1994 -1997 High Performance Models –



55173

a - UP Trim Relay
b - DOWN Trim Relay

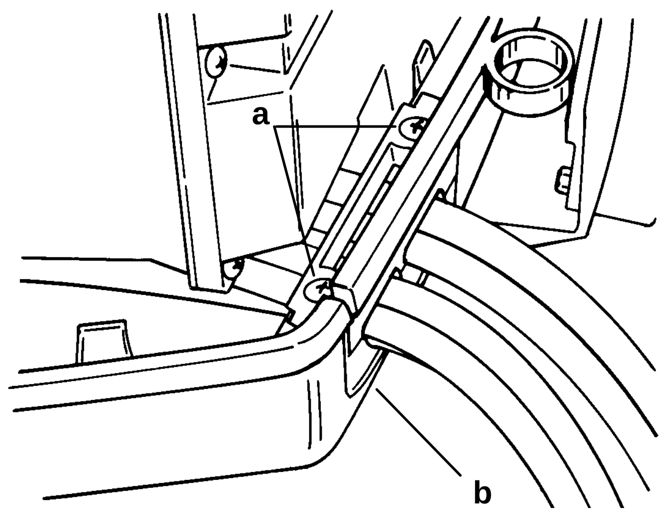
15. Reconnect remote control harness to powerhead harness connector and wires as shown.



51851

a - Control Harness
b - Powerhead Harness
c - Trim 12 Volt Power Supply (RED)
d - Trim Up Lead (BLUE/WHITE)
e - Trim Down Lead (GREEN/WHITE)
f - Overheat Lead (TAN)

16. Install two screws which secure remote control harness retainer.



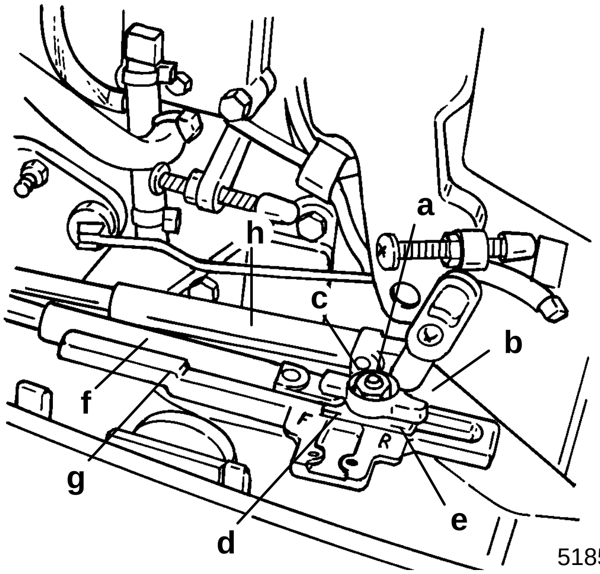
51854

a - Screws
b - Retainer

17. Slide outboard shift lever into neutral position.

18. Install throttle cable.

19. Install shift cable assembly as shown Refer to "Cable Adjustment" Section 7.



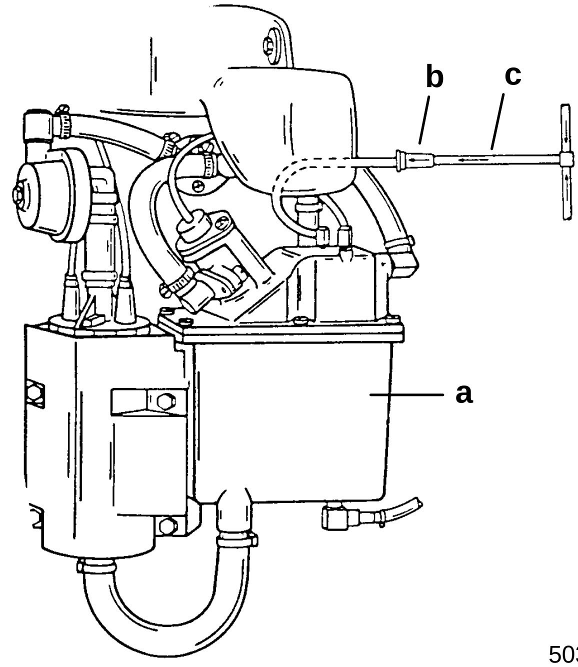
a - Lock Nut
b - Shift Cable Latch
c - Flat Washer (Hidden)
d - Nylon Wear Plate
e - Spring (Hidden)
f - Shift Cable
g - Anchor Bracket
h - Throttle Cable

Refer to Section 2 of this Service Manual "Timing/ Synchronizing/Adjusting" for engine set-up procedures.

IMPORTANT: E.F.I. POWERHEADS--

1. It is recommended that the bleed hose going to the vapor separator be disconnected prior to the bleed hose in-line filter. Place disconnected bleed hose in a refuse container.
2. With engine on flush attachment or with boat in water, start engine and run at 1500 RPM for approximately 1/2 hour. This should remove any debris from bleed system and prevent premature clogging of bleed filter.
3. Stop engine. Re-connect bleed hose to bleed filter. Discard flushed fluid in a correct waste material handling facility.

NOTE: *Diagram shown without bleed shut-off valve SN. 0G303046 and Above.*



a - Vapor Separator
b - Bleed Hose In-Line Filter
c - Bleed Hose

Break-In Procedure

Break-in Fuel Mixture

Use a 50:1 (2%) gasoline/oil mixture in the first tank of fuel. Follow the table below for mixing ratios. Use of this fuel mixture combined with oil from the oil injection system will supply adequate lubrication during engine break-in.

After the break-in fuel mixture is used up, it is no longer necessary to add oil with the gasoline.

***NOTE:** At the end of the break-in period, visually check to see if the oil level in the oil injection tank has dropped. Oil usage indicates the oil injection system is functioning correctly.*

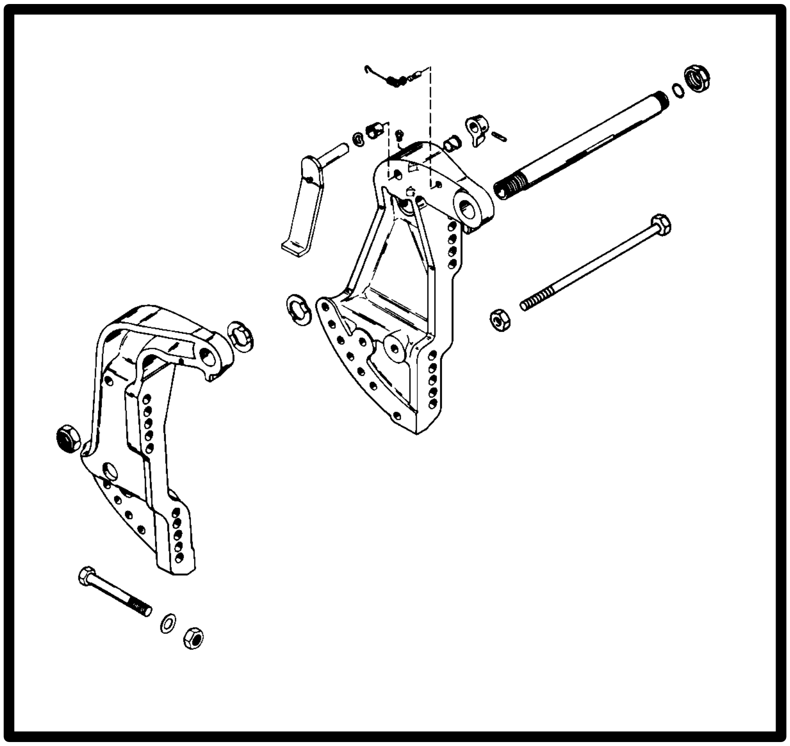
GASOLINE/OIL MIXING RATIO CHART

GAS/OIL RATIO	1 GALLON GAS (3.8 LITERS)	3 GALLONS GAS (11.5 LITERS)	6 GALLONS GAS (23 LITERS)
50:1 (2%)	3 FL. OZ. (89 ML) OIL	8 FL. OZ. (237 ML) OIL	16 FL. OZ. (473 ML) OIL

ENGINE BREAK-IN PROCEDURE (ALL MODELS)

Vary the throttle setting during the first hour of operation. Avoid remaining at a constant speed for more than two minutes and avoid sustained wide open throttle.

MID-SECTION



CLAMP/SWIVEL BRACKET AND DRIVESHAFT HOUSING

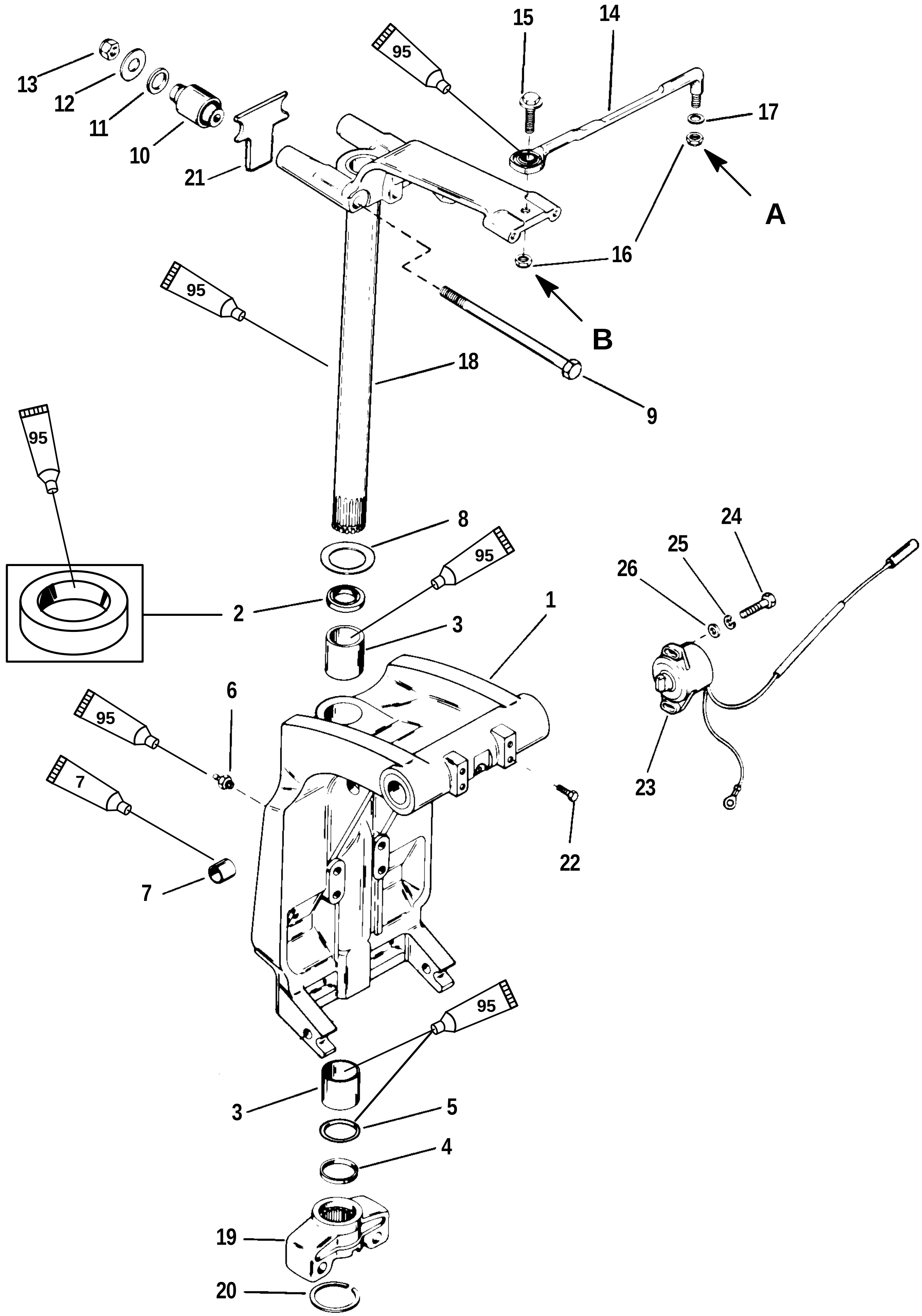
5

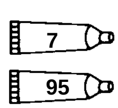
A

Table of Contents

Notes:

Swivel Bracket and Steering Arm





Loctite 271 (92-809820)

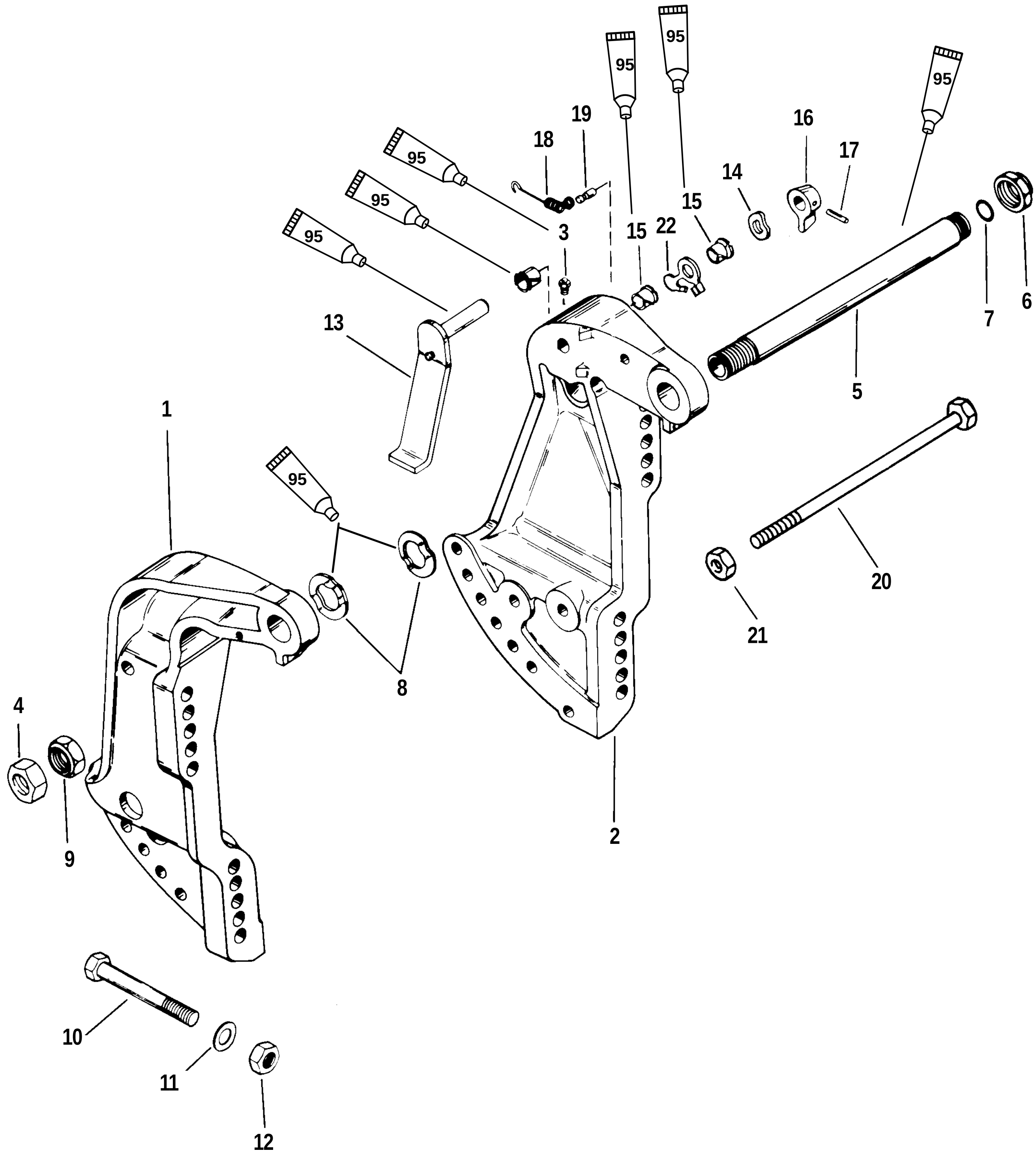
2-4-C With Teflon (92-825407A12)

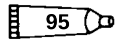
REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	SWIVEL BRACKET ASSEMBLY			
2	1	OIL SEAL (LOWER)			
3	2	BUSHING			
4	1	SPACER			
5	1	O-RING			
6	2	GREASE FITTING	85	7	9.5
7	2	BUSHING			
8	1	THRUST WASHER			
9	2	SCREW			
10	2	MOUNT **(135/150/175LONG)(JET)**			
10	2	MOUNT **(ALL OTHER MODELS)**			
11	2	WASHER			
12	2	WASHER			
13	2	NUT		50	68.0
14	1	STEERING LINK ASSEMBLY			
15	1	SCREW	240	20	27.0
16	2	NUT			
17	2	WASHER			
18	1	SWIVEL PIN AND STEERING ARM			
19	1	BOTTOM YOKE			
20	1	RETAINING RING			
21	1	BUMPER			
22	2	SCREW	100		11.5
23	1	TRIM SENDER ASSEMBLY			
24	2	SCREW	15		1.5
25	2	LOCKWASHER			
26	2	WASHER			

A – Torque nut to 120 lb. in. (13.5 N·m) and then BACK OFF 1/4 turn.

B – Torque nut to 20 lb. ft. (27.0 N·m)

Transom Brackets(S/N-0G589999 & BELOW)



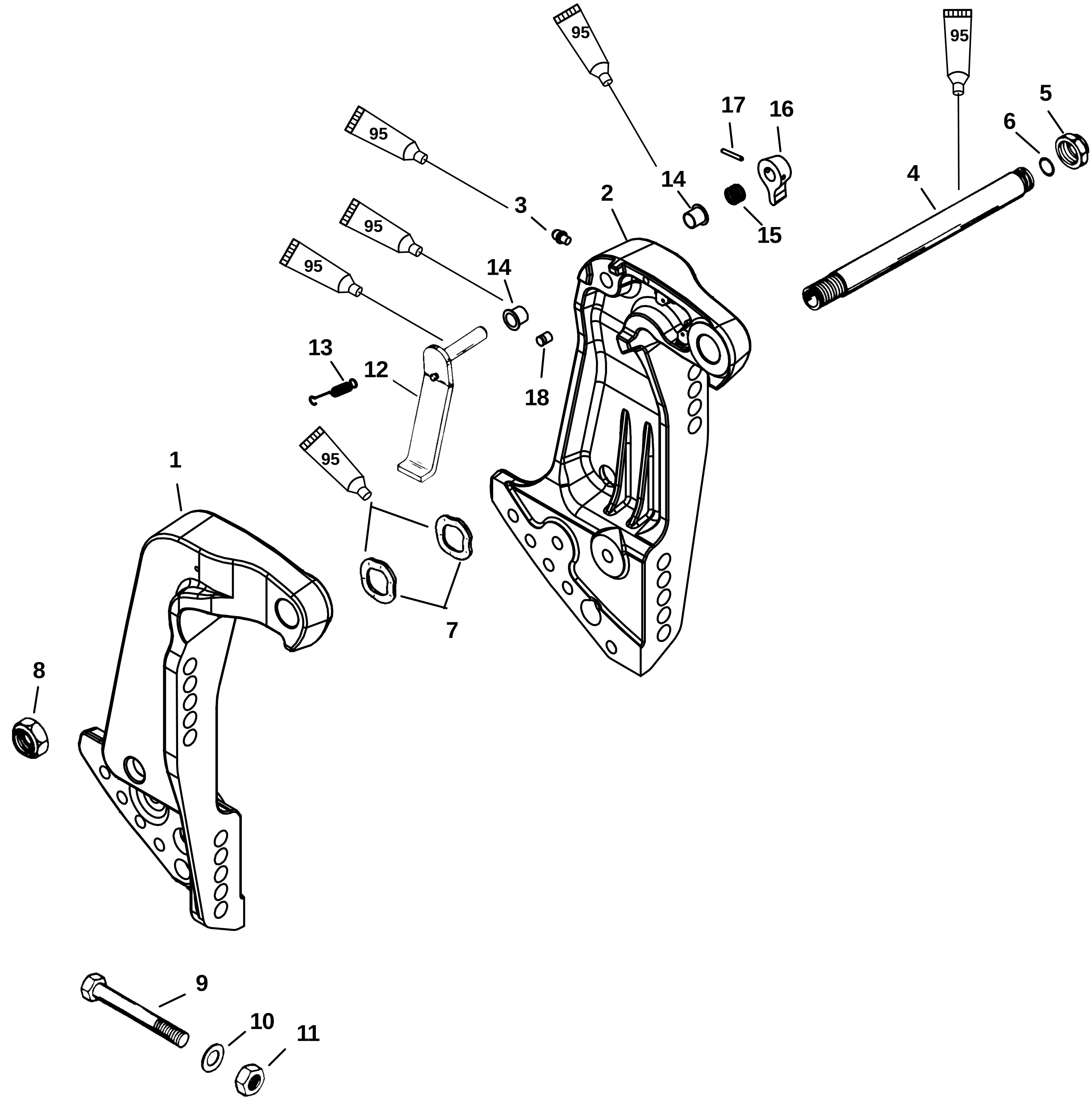


2-4-C With Teflon (92-825407A12)

Transom Brackets(S/N-0G589999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	TRANSOM BRACKET **(STARBOARD)**			
2	1	TRANSOM BRACKET **(PORT)**			
3	1	GREASE FITTING **(PORT)**	85	7.0	9.5
4	1	JAM NUT			
5	1	TILT TUBE			
6	1	NUT (1″-14)		45	61
7	1	O-RING			
8	2	WAVE WASHER			
9	1	NUT (7/8-14)		45	61
10	4	BOLT			
11	4	WASHER			
12	4	NUT			
13	1	TILT LOCK LEVER ASSEMBLY			
14	1	WAVE WASHER			
15	2	BUSHING			
16	1	KNOB			
17	1	GROOVE PIN			
18	1	SPRING			
19	1	GROOVE PIN			
20	1	BOLT			
21	1	NUT			
22	1	STOP			

TRANSOM BRACKETS (S/N-0G590000 & UP)

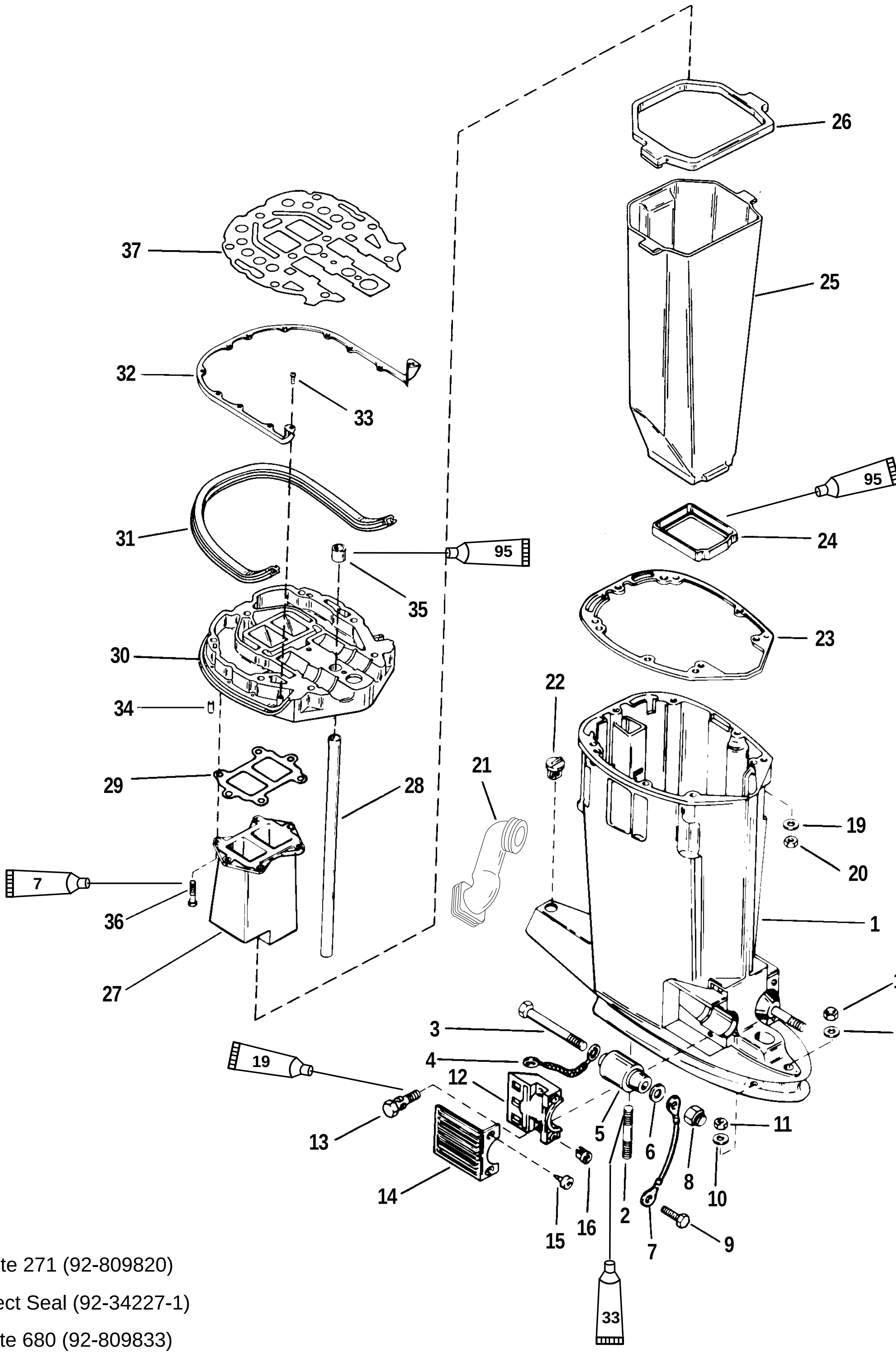


95 2-4-C With Teflon (92-825407A12)

TRANSOM BRACKETS (S/N-0G590000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	TRANSOM BRACKET **(BLACK)** **STARBOARD**			
	1	TRANSOM BRACKET **(GRAY)**			
2	1	TRANSOM BRACKET **(BLACK)** **PORT**			
	1	TRANSOM BRACKET **(GRAY)**			
3	1	GREASE FITTING **(PORT)**	85	7.0	9.5
4	1	TILT TUBE			
5	1	NUT (1 IN.-14)		45	61.0
6	1	O-RING			
7	2	WAVE WASHER			
8	1	NUT (7/8-14)		45	61.0
9	4	BOLT			
10	4	WASHER			
11	4	NUT			
12	1	TILT LOCK LEVER ASSEMBLY			
13	1	SPRING			
14	2	BUSHING			
15	1	SPRING			
16	1	KNOB			
17	1	GROOVE PIN			
18	1	PIN			

Drive Shaft Housing and Exhaust Tube



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

33 Loctite 680 (92-809833)

95 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	DRIVE SHAFT HOUSING			
2	2	STUD			
3	2	SCREW			
4	1	GROUND WIRE			
5	2	LOWER MOUNT **(135/150/175 LONG)(JET)**			
6	2	WASHER			
7	1	GROUND WIRE			
8	2	NUT		48	65
9	1	SCREW			
10	2	WASHER			
11	2	NUT		50	68.0
12	2	CLAMP			
13	4	SCREW (1-1/4″)	156	13	17.5
14	2	COVER			
15	4	SCREW (5/8″)	25		3.0
16	4	NUT	156	13	17.5
17	1	WASHER			
18	1	NUT		55	74.5
19	4	WASHER			
20	4	NUT	240	20	27.0
21	1	IDLE EXHAUST BOOT			
22	1	PLUG			
23	1	GASKET			
24	1	SEAL (LOWER)			
25	1	EXHAUST TUBE			
26	1	SEAL (UPPER)			
27	1	EXHAUST EXTENSION **(135/175/XR6/Magnum III)**			
27	1	EXHAUST EXTENSION **(150/200) (JET)**			
28	1	WATER TUBE			
29	1	GASKET			
30	1	PLATE ASSEMBLY			
31	1	SEAL*			
32	1	BRACKET*			
33	12	SCREW (1/2″)*	80	6.7	9.0
34	2	DOWEL PIN			
35	1	SEAL			
36	6	SCREW	60	5	7.0
37	1	GASKET			

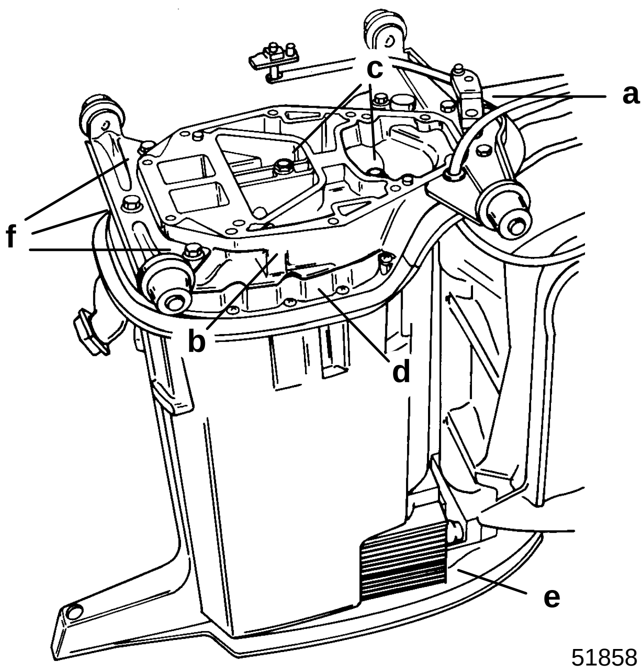
*Components not used on Pro Max and Super Magnum Models.

Drive Shaft Housing and Dyna-Float Suspension

Refer to "Powerhead Removal" Section to Remove Powerhead. Refer to "Lower Unit Removal" in This Section to Remove Lower Unit.

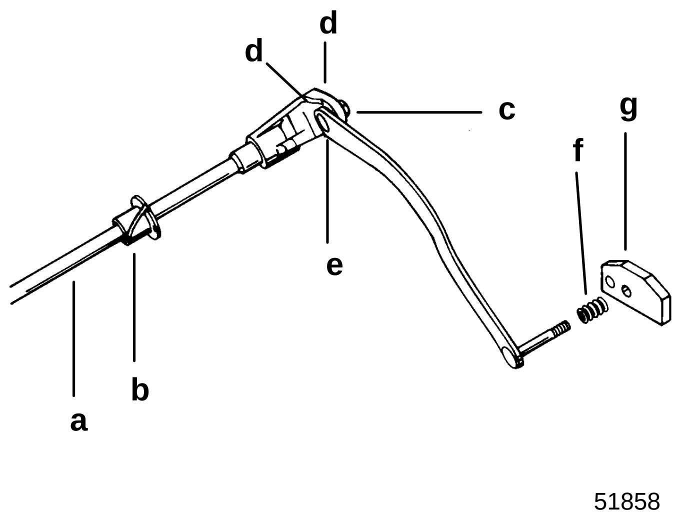
Removal and Disassembly

1. Remove shift shaft from driveshaft housing by pulling straight up on shaft.
2. Remove 5 bolts which secure exhaust extension plate to drive shaft housing. After bolts are removed, lift exhaust extension plate off drive shaft housing.
3. Remove screws, which secure lower mount covers to drive shaft housing, then remove covers.



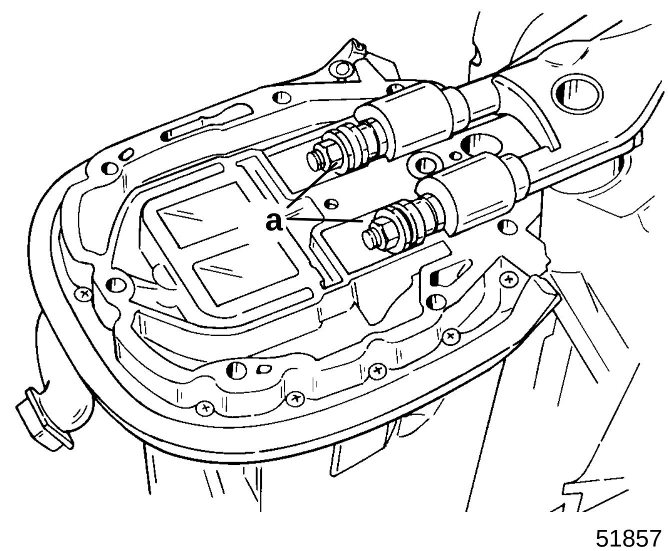
a - Shift Shaft Linkage
b - Exhaust Extension Plate
c - Exhaust Plate to Drive Shaft Housing Bolts
d - Driveshaft Housing Plate
e - Lower Mount Cover (One Each Side)
f - Mounting Bracket Bolts

SHIFT LINKAGE ASSEMBLY



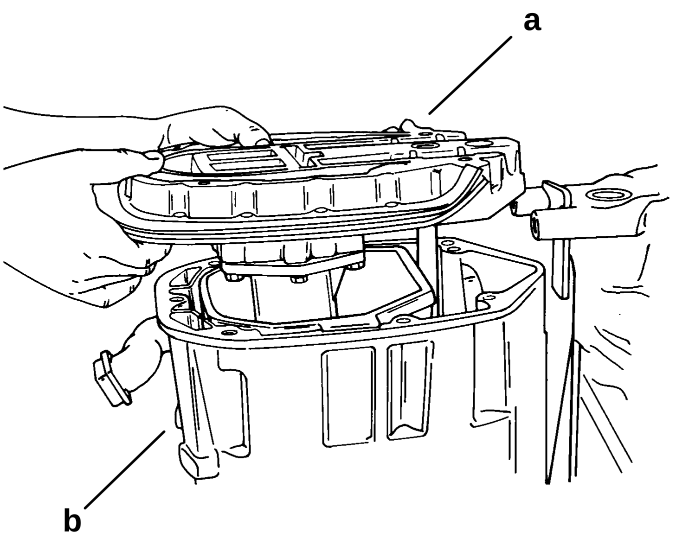
a - Shift Shaft Assembly
b - Bushing
c - Lock Nut
d - Washer (2)
e - Bushing (Hidden)
f - Spring
g - Guide Block

4. Remove upper mount nuts and flat washers.



a - Upper Mount Nuts

5. Lift driveshaft housing plate off housing.

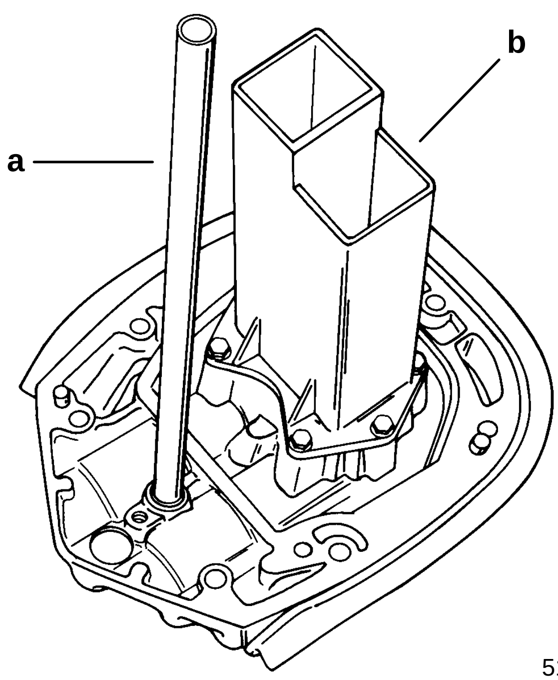


51850

a - Drive Shaft Housing Plate
b - Drive Shaft Housing

6. Remove water tube from driveshaft housing plate.

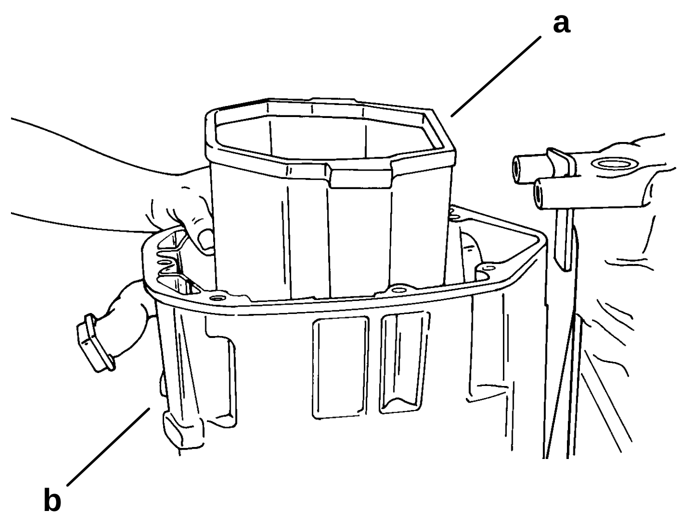
7. Exhaust diffuser is secured to housing plate with 6 bolts. Remove bolts, then remove diffuser.



51857

a - Water Tube
b - Exhaust Diffuser

8. Pull exhaust tube out of drive shaft housing.



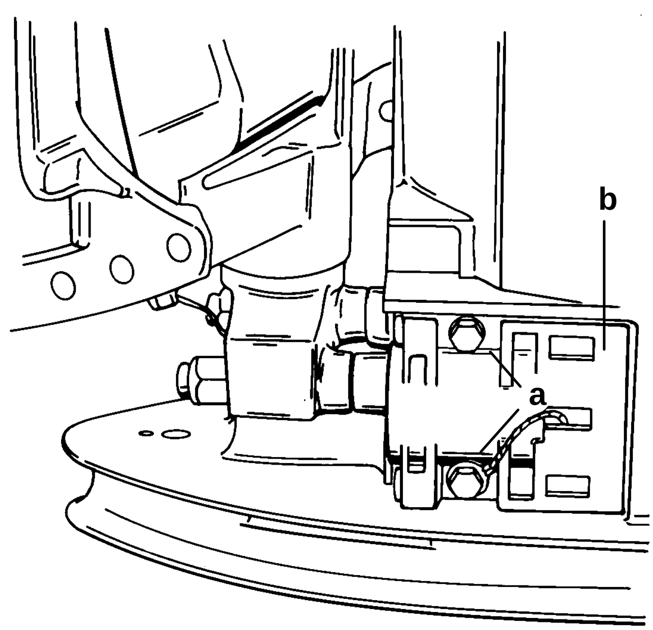
51850

a - Exhaust Tube
b - Drive Shaft Housing

9. Remove all gasket and gasket material from driveshaft housing and related components.

10. Remove bolts, which secure lower mount retainers to drive shaft housing, and remove retainers.

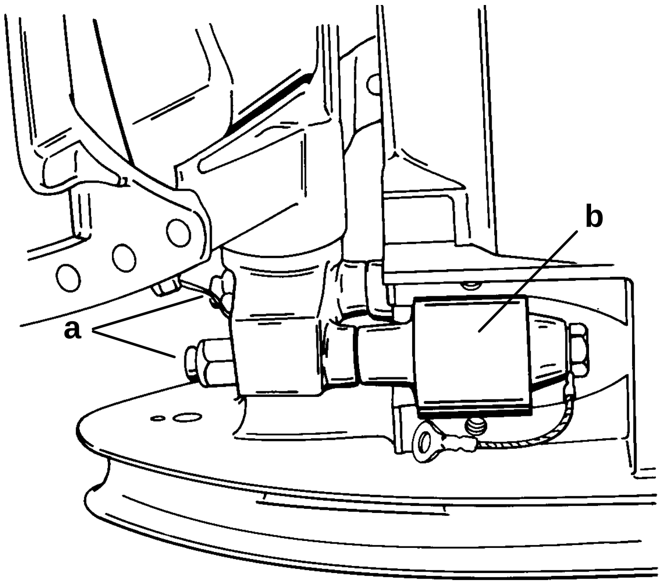
11. Remove rubber caps from lower mount bolts.



51855

a - Bolts
b - Lower Mount Retainer (One Each Side)

12. Remove lower mount nuts.



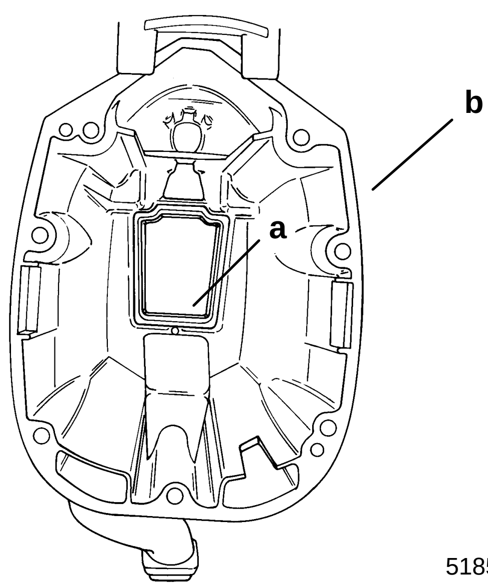
51855

a - Lower Mount Nuts
b - Lower Mount

13. Remove driveshaft housing from swivel bracket by pulling alternately from top to bottom on housing.
14. Remove upper and lower mounts by lifting them out of driveshaft housing.

Reassembly and Installation

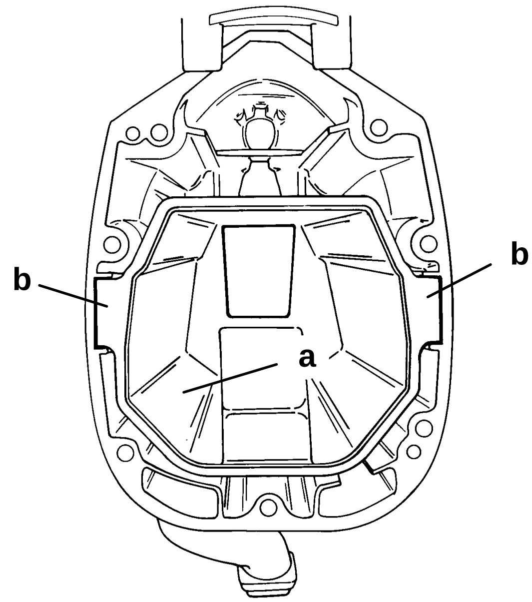
1. Apply a thin coat of 2-4-C w/Teflon Marine Lubricant onto inside portion of exhaust tube seal.
2. Install exhaust tube seal into driveshaft housing with tapered side of seal facing up.



51856

a - Exhaust Tube Seal
b - Driveshaft Housing

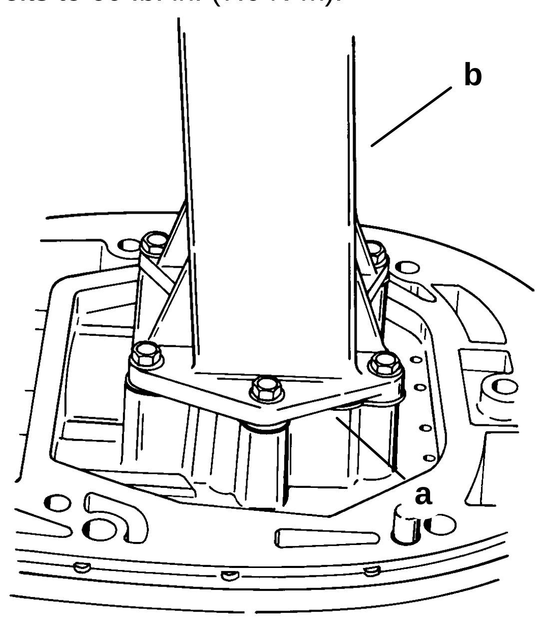
3. Push exhaust tube boots onto tabs on each side of exhaust tube.
4. Position exhaust tube in drive shaft housing and push down on tube until boots rest in grooves on inside of housing.
5. Position driveshaft housing to plate gasket on top of housing.



51856

a - Exhaust Tube
b - Exhaust Tube Boots

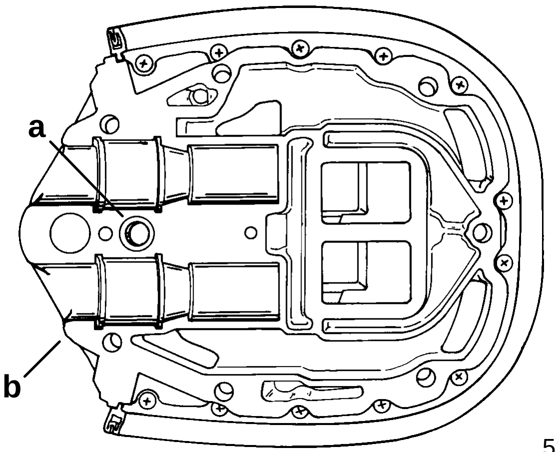
6. Install an exhaust diffuser gasket and exhaust diffuser onto plate, then secure both to plate with 6 bolts. Clean bolts with Loctite 7649 Primer and then apply Loctite 271 to bolt threads. Torque bolts to 60 lb. in. (7.0 N·m).



51857

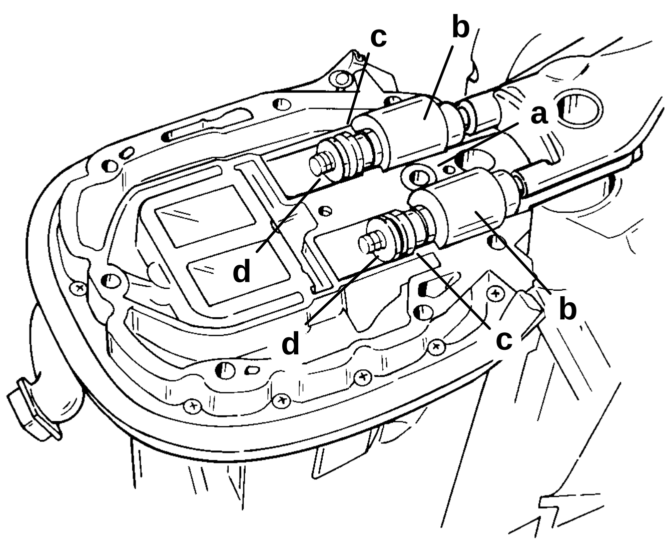
a - Exhaust Diffuser Gasket
b - Exhaust Diffuser

7. Apply a small amount of 2-4-C w/Teflon Marine Lubricant onto water tube seal.
8. Install water tube seal into driveshaft housing plate with plastic end of seal facing up and install water tube.



a - Water Tube Seal
b - Driveshaft Housing Plate

9. Position drive shaft housing plate on top of housing.
10. Apply a thin coat of Perfect Seal onto metal portion of upper dyna-float mounts.
11. Position mounts on drive shaft housing plate.
12. Install a rubber washer onto each upper mount, followed by a metal washer.

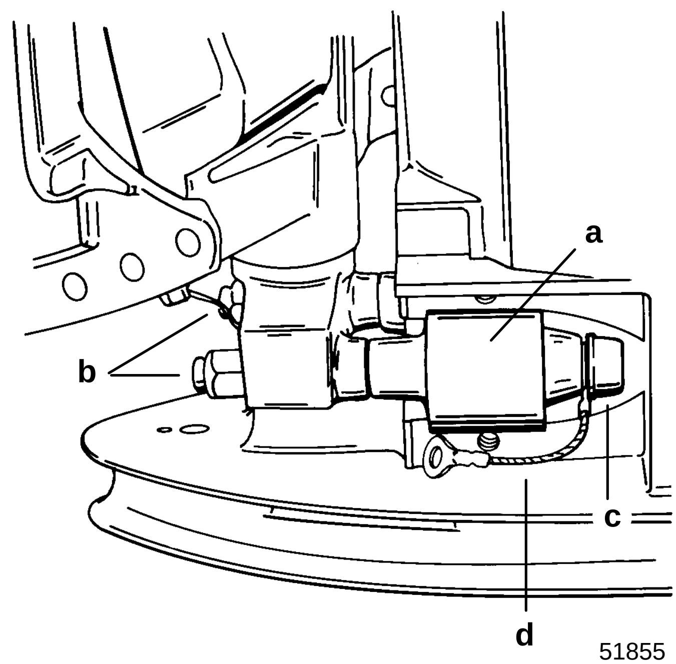


a - Water Tube Seal (Plastic End)
b - Dyna-Float Mounts
c - Rubber Washers
d - Metal Washer

13. Install a ground strap onto one of the lower mount mounting bolts.

NOTE: *Apply Perfect Seal along length of lower mount bolts.*

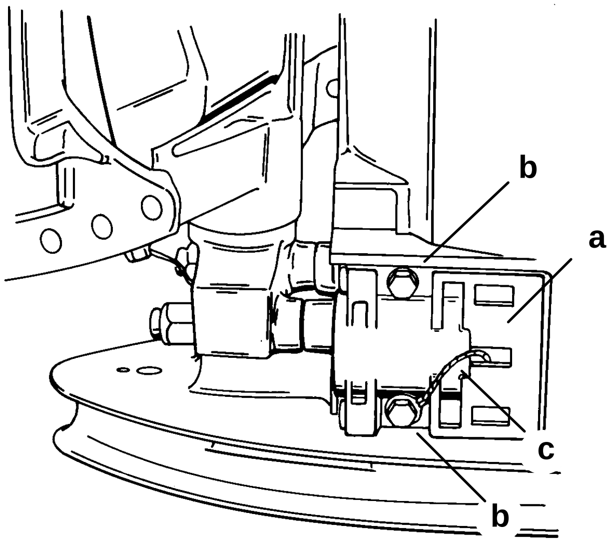
14. Insert a mounting bolt thru the short end of each lower mount.
15. Position a mount on each lower side of driveshaft housing.
16. Install a flat washer over each lower mounting bolt.
17. Position a bumper on steering arm between mounting bolts.
18. Start upper mounting bolts in upper mounts and align lower mounting bolts with holes in swivel pin yoke. Slide driveshaft housing up against yoke and bumper.
19. Secure upper mounts to steering arm with flat washers and self-locking nuts. Torque nuts to 50 lb. ft. (67.5 N·m).
20. Install ground strap (if equipped) between port lower mount bolt and swivel bracket.
21. Secure lower mounts to swivel pin yoke with self-locking nuts. Torque nuts to 50 lb. ft. (67.5 N·m). Place a rubber cap over each lower mounting bolt head.



a - Lower Mount
b - Nut [Torque to 50 lb. ft. (67.5 N·m)]
c - Rubber Cap
d - Ground Strap (only one side)

NOTE: *If ground strap on lower mount is burned off, inspect ground lead for trim motor for tightness and/or continuity.*

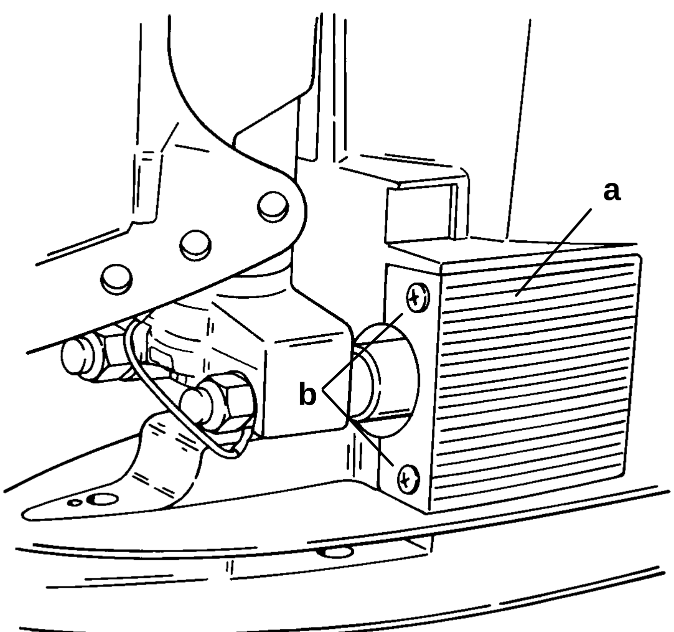
22. Install lower mount retainers and secure each retainer with 2 bolts. (Secure ground strap with the nearest retainer bolt.) Torque bolts to 160 lb. in. (18.0 N·m).



51855

a - Lower Mount Retainer
b - Bolts [Torque to 160 lb. in. (18.0 N·m)]
c - Ground Strap

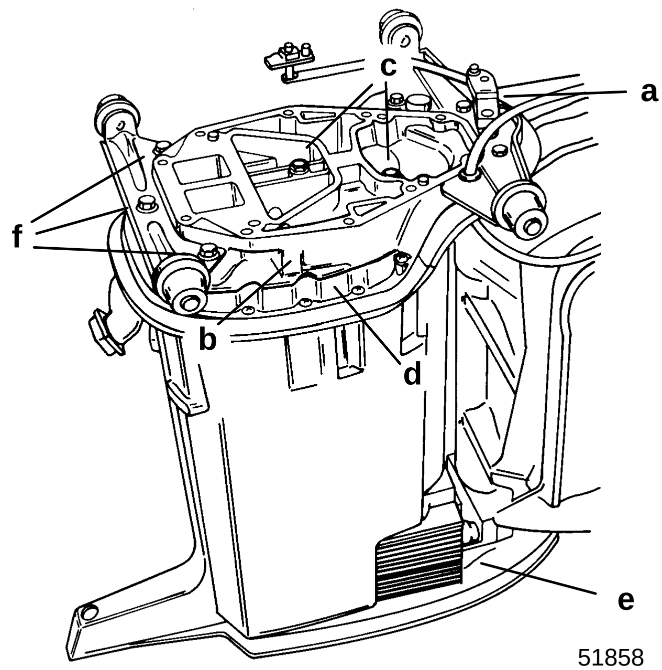
23. Install lower mount covers and secure each cover with 2 screws.



51855

a - Cover (One Each Side)
b - Screws (Two for Each Cover)

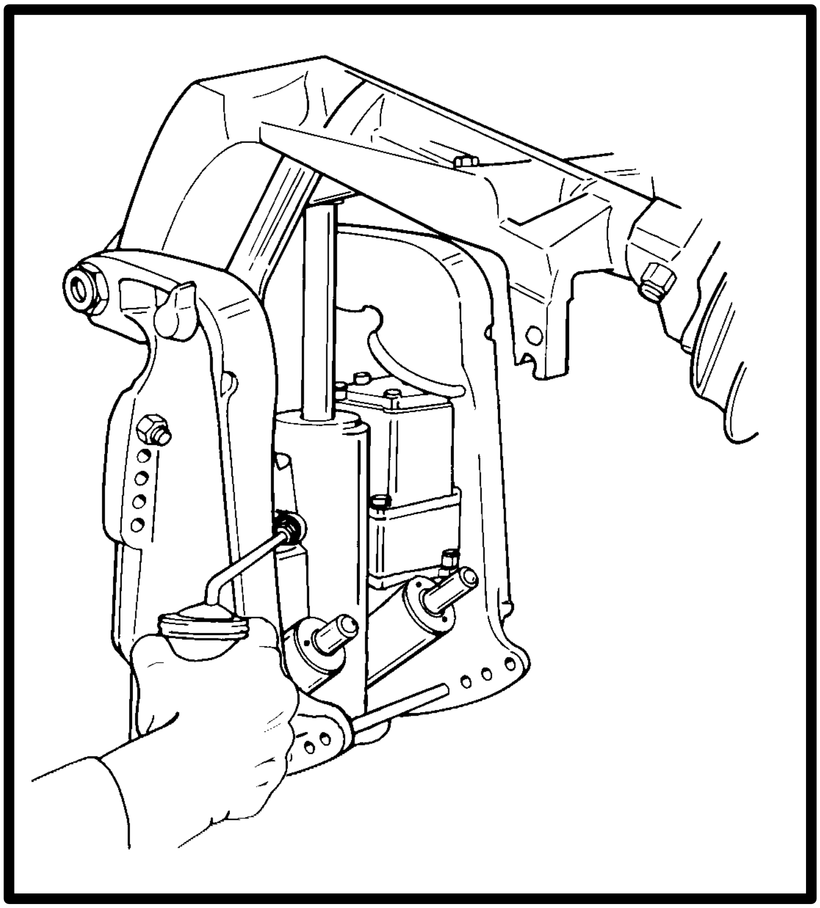
24. Install exhaust extension plate on driveshaft housing with shift shaft assembly. Secure extension plate to drive shaft housing with 5 bolts.



51858

a - Shift Shaft Linkage
b - Exhaust Extension Plate
c - Exhaust Plate to Driveshaft Housing Bolts, Torque to 25 lb. ft. (34.0 N·m)
d - Drive Shaft Housing Plate
e - Lower Mount Cover (One Each Side)
f - Mounting Bracket Bolts, Torque to 40 lb. ft. (54.0 N·m)

MID-SECTION



POWER TRIM
SQUARE MOTOR AND
ROUND MOTOR DESIGN

5

B

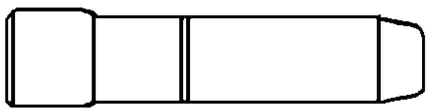
Table of Contents

Power Trim Specifications

Test	Reading
Trim "UP"	1300 PSI (91kg/cm^2) Maximum Pressure
Trim "DOWN"	500 PSI (35kg/cm^2) Minimum Pressure

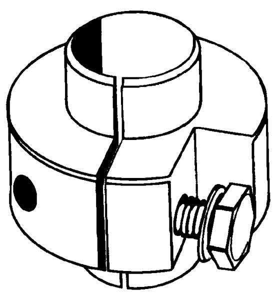
Special Tools

Alignment Tool 91-11230



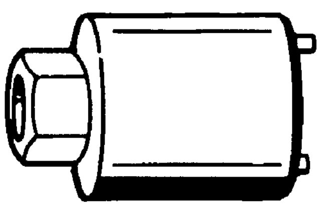
17238

Trim Rod Removal Tool 91-44486A1



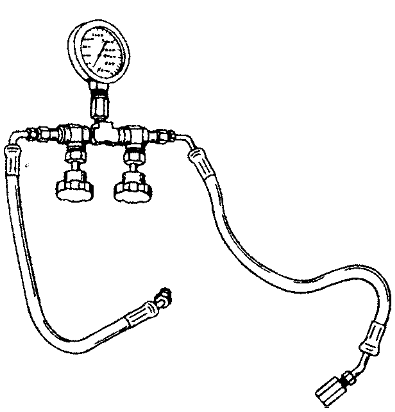
51337

Trim Rod Guide Removal Tool 91-44487A1



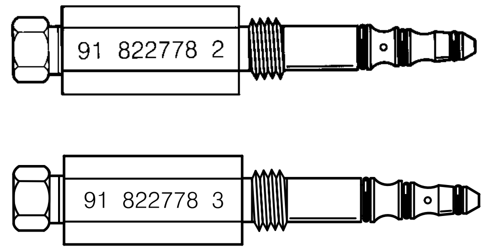
51337

Power Trim Test Gauge Kit 91-52915A6



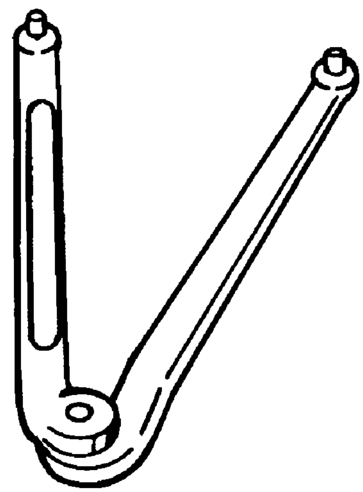
73835

Adaptor Fitting 91-822778A2 and 91-822778A3



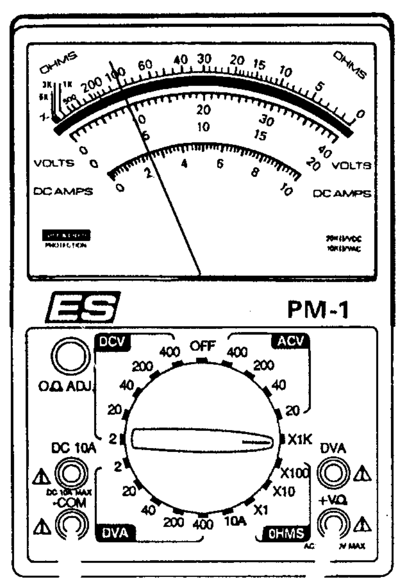
54458

Spanner Wrench 91-74951

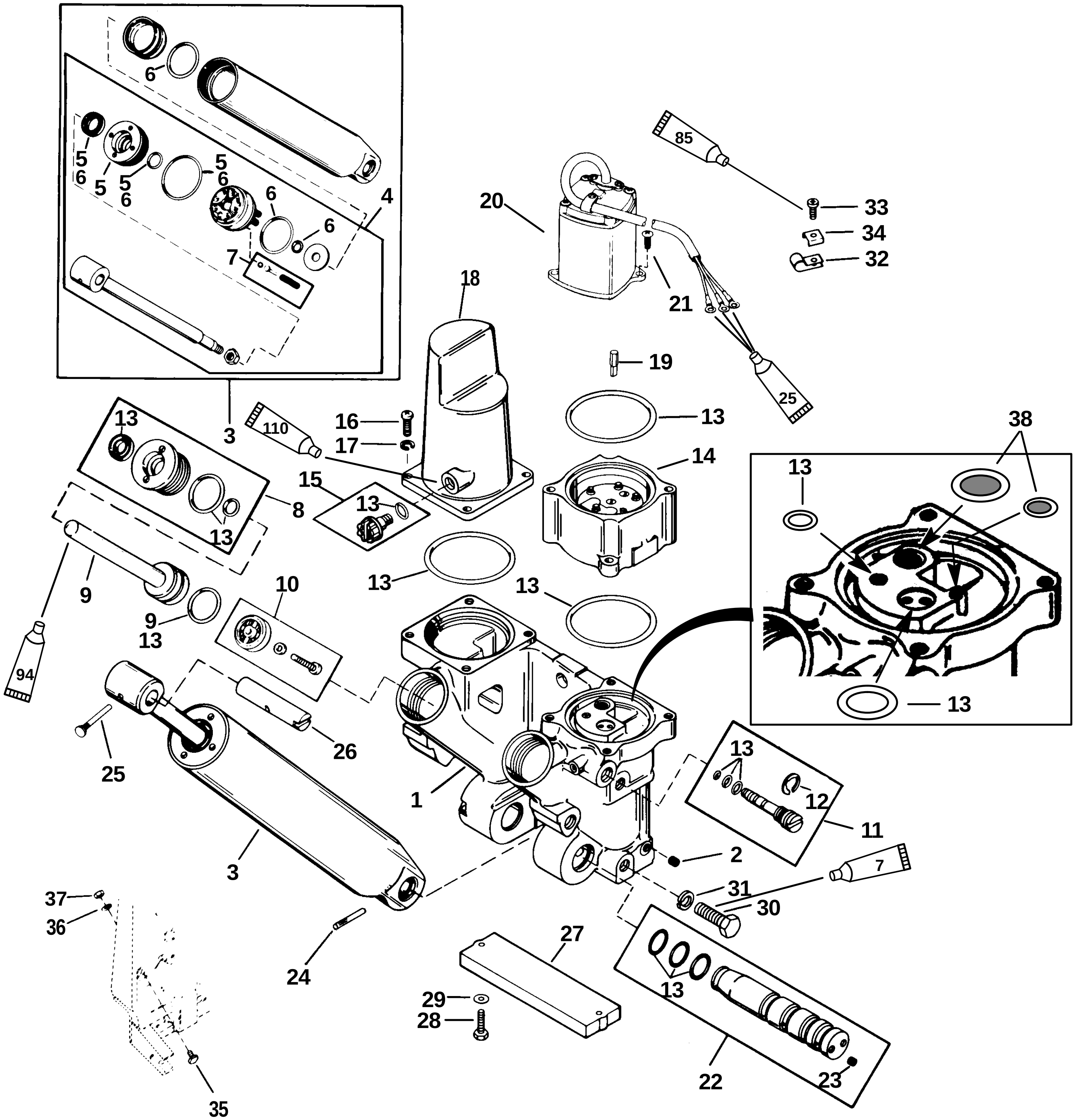


51337

Multi-Meter DVA Tester 91-99750A1



POWER TRIM COMPONENTS (Square Motor)



7 Loctite 271 (92-809820)

25 Liquid Neoprene (92-25711--2)

85 RTV Silicone Sealer (92-91601-1)

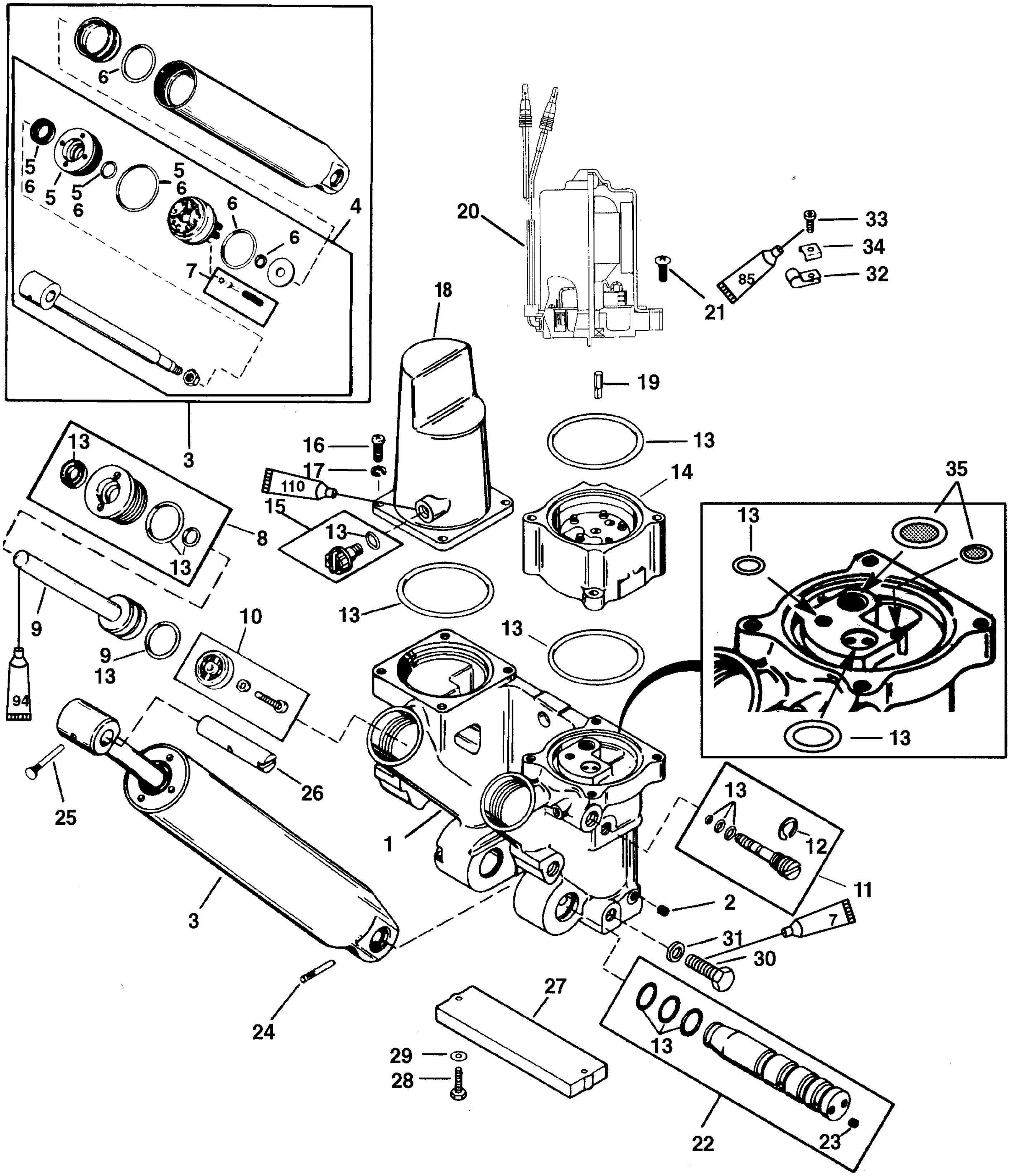
94 Anti-Corrosion Grease (92-78376A6)

110 Power Trim and Steering Fluid (92-90100A12)

POWER TRIM COMPONENTS (Square Motor)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
–	1	POWER TRIM ASSEMBLY–Complete			
1	1	MANIFOLD ASSEMBLY			
2	9	PIPE PLUG			
3	1	TILT CYLINDER ASSEMBLY			
4	1	PISTON ROD			
5	1	GUIDE KIT			
6	1	REPAIR KIT			
7	1	CHECK VALVE KIT			
8	2	GUIDE ASSEMBLY			
9	1	PISTON/ROD ASSEMBLY **(PORT)**			
	1	PISTON/ROD ASSEMBLY **(STBD.)**			
10	1	TRIM FILTER ASSEMBLY			
11	1	VALVE ASSEMBLY			
12	1	E RING			
13	1	O RING KIT			
14	1	PUMP			
15	1	PLUG ASSEMBLY			
16	4	SCREW			
17	4	WASHER			
18	1	COVER			
19	1	DRIVE SHAFT			
20	1	TRIM MOTOR			
21	2	SCREW **(LONG)**	80		9.0
	2	SCREW **(SHORT)**	80		9.0
22	1	SHAFT ASSEMBLY			
23	2	PIPE PLUG			
24	1	GROOVE PIN			
25	1	GROOVE PIN			
26	1	SHAFT			
27	1	ANODE ASSEMBLY			
28	2	SCREW (M6 x 1 x 25)	60	5	7.0
29	2	WASHER			
30	6	SCREW (M10 x 1.5 x 30)		40	54.0
31	6	WASHER			
32	2	CLIP			
33	2	SCREW (10-16 x .44)			
34	2	C WASHER			
35	2	STRIKER PLATE			
36	2	LOCKWASHER			
37	2	NUT	80	6.5	9.0
38	2	FILTER SCREENS			

Power Trim Components (Round Motor)



7 Loctite 271 (92-809820)

85 RTV Silicone Sealer (92-91601-1)

94 Anti-Corrosion Grease (92-78376A6)

110 Power Trim and Steering Fluid (92-90100A12)

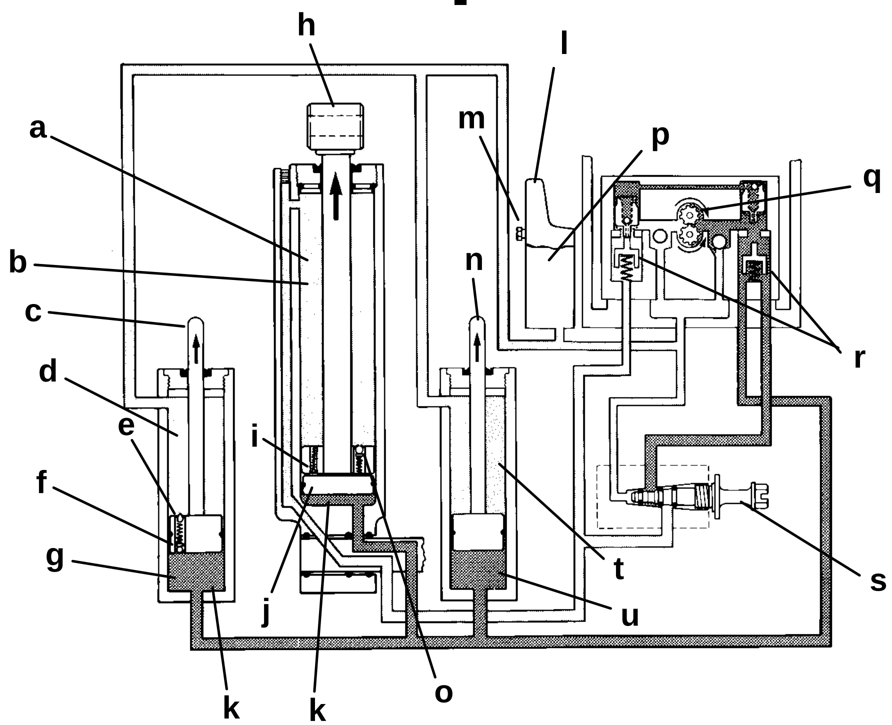
Power Trim Components (Round Motor)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	MANIFOLD ASSEMBLY			
2	9	PIPE PLUG			
3	1	TILT CYLINDER ASSEMBLY			
4	1	PISTON ROD			
5	1	GUIDE KIT			
6	1	REPAIR KIT			
7	1	CHECK VALVE KIT			
8	2	GUIDE ASSEMBLY			
9	1	PISTON/ROD ASSEMBLY **(PORT)**			
9	1	PISTON/ROD ASSEMBLY **(STBD.)**			
10	1	TRIM FILTER ASSEMBLY			
11	1	VALVE ASSEMBLY			
12	1	E RING			
13	1	O RING KIT			
14	1	PUMP			
15	1	PLUG ASSEMBLY			
16	4	SCREW			
17	4	WASHER			
18	1	COVER			
19	1	DRIVE SHAFT **S/N–0G217420 & UP**			
20	1	TRIM MOTOR			
19	1	DRIVE SHAFT **S/N–0G217419 & BELOW**			
20	1	TRIM MOTOR			
21	2	SCREW **(LONG)(S/N–0G217420 & UP)**	80		9.0
21	2	SCREW **(LONG)(S/N–0G217419 & BELOW)**	80		9.0
21	2	SCREW **(SHORT)**	80		9.0
22	1	SHAFT ASSEMBLY			
23	2	PIPE PLUG			
24	1	GROOVE PIN			
25	1	GROOVE PIN			
26	1	SHAFT			
27	1	ANODE ASSEMBLY			
28	2	SCREW (M6 x 1 x 25)	70		8.0
29	2	WASHER			
30	6	SCREW (M10 x 1.5 x 30)		40	54.0
31	6	WASHER			
32	2	CLIP**(S/N–0G217419 & BELOW)**			
32	2	CLIP**(S/N–0G217420 & UP)**			
33	2	SCREW (10-16 x .44)	Drive Tight		
34	2	C WASHER			
35	2	FILTER SCREEN			

NOTE: *Lubricate all o-rings with Power Trim and Steering Fluid.*

3 Ram Power Trim (External Mounted - Aft Fill) Hydraulic System

Trim Up

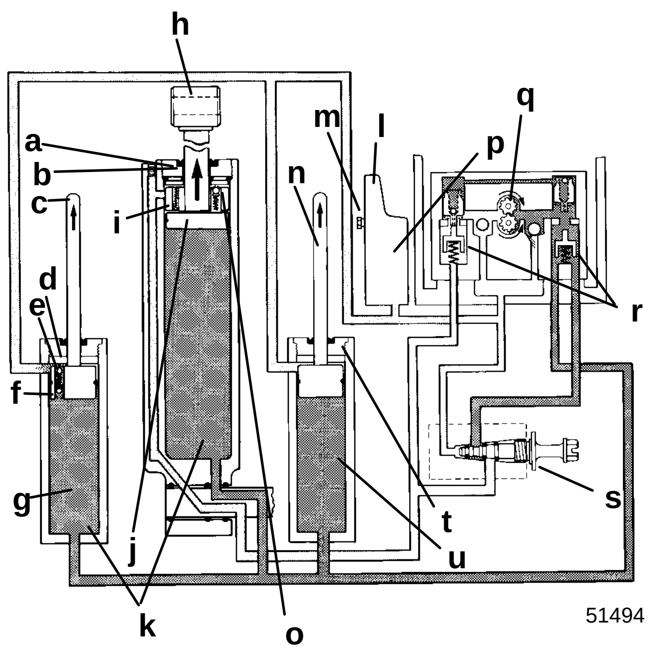


51492

a - Down Pressure 500 PSI
b - Down Cavity
c - Trim Ram
d - Down Cavity
e - Mechanical Check Valve
f - Tilt Relief 850-1150 PSI
g - Up Pressure 1300 PSI
h - Tilt and Shock Ram
i - Siphon Valve
j - Memory Piston
k - Up Cavity
l - Reservoir
m - Fill Cap
n - Trim ram
o - Impact Relief Valve 1 Opens at 600 PSI, the Remaining at 3200 PSI
p - Reservoir Pressure 6 PSI
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

3 Ram Power Trim (External Mounted - Aft Fill) Hydraulic System

Hydraulic Tilt



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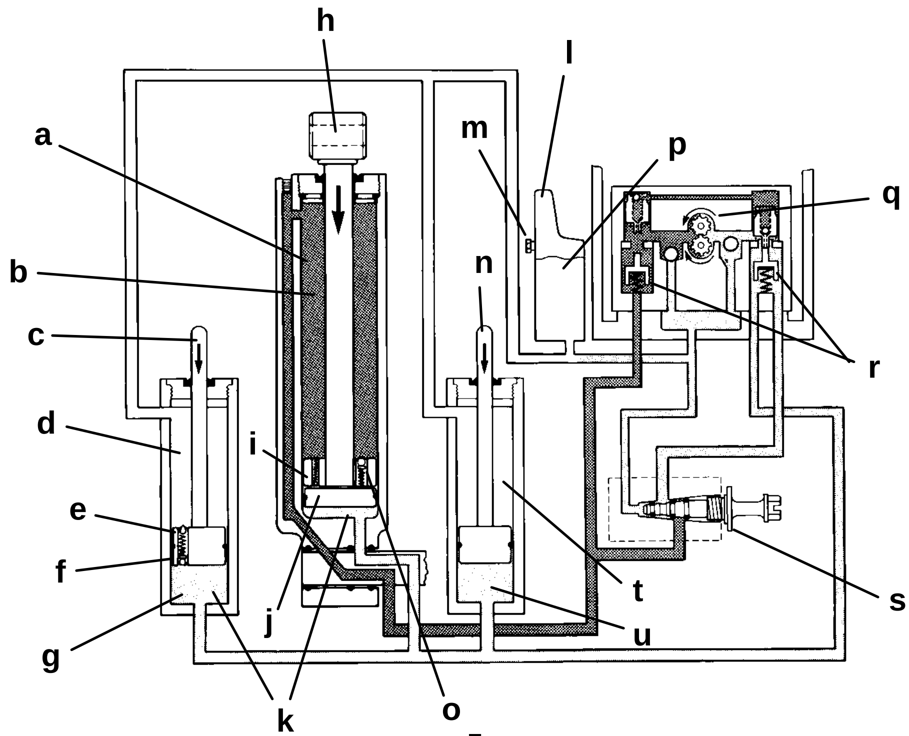
u - Up Cavity

UP CIRCUIT

When the up button is activated the electric motor will rotate the oil pump gears. As the oil pump gears begin to rotate, oil is drawn through the up circuit pick up and into the pump, supplying pressure for the up circuit. Oil is blocked from returning into the reservoir by the closed check ball inside the down circuit pick up. Oil, under pressure moves the (up) shuttle valve up, oil also flows through the (up) shuttle valve center pin. Oil flows past the check ball and through a connecting passage into a chamber above the down shuttle valve. The down shuttle valve and check ball are forced against the spring loaded down circuit pilot check valve, opening the pilot check valve and allowing oil to return into the pump from the down side cavity of the tilt cylinder, which supplies oil to operate the “up circuit”. Oil under pressure opens the up circuit pilot check valve, allowing oil to exit through the up pressure port, and into the manifold casting. The oil then continues on through the up passage into the up cavities below the trim and tilt ram pistons, pushing the rams up and out. Oil returns into the reservoir, from the trim rams, through passages cast inside of the manifold. Oil returning from above the tilt cylinder piston exits the down cavity through an interconnecting passage cast located along side of the cylinder. Oil returns through the lower pivot pin and past the open pilot valve, into the pump, suppling some of the oil required for the up circuit. Due to the surface area of their pistons, the small outer trim rams move first. As the trim rams reach the limit of their travel, the mechanical check valve, on the top of the port trim ram piston, contacts the trim ram cover. The “pin” contact with the cover mechanically opens the shut off valve, allowing oil, to flow through the piston. The oil flowing through the port trim ram lowers the pressure available for the tilt ram (850-1150 psi). However, due to the smaller diameter of the tilt cylinder, the engine will move at a faster rate. The tilt cylinder will continue to raise the outboard engine, until reaching its maximum limit. At full travel, the only passage for the oil from the pump is through the port trim ram, at a very slow rate. To supply oil into the pump at this time, a small amount of oil is drawn up through the oil pick up. If the up button is not released, the electric motor will heat up and the thermal overload switch, inside the electric motor will open, stopping the motor. To prevent the high oil “up” pressure from continuing to move the engine, after the trim button is released, the “system” pressure must be bleed off. A small bleed passage past the down circuit oil pick up will allow the up pressure to bleed out of the pump.

3 Ram Power Trim Hydraulic System

Trim Down



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q - Oil Pump
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s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

Reservoir and Feed Oil

Return Oil

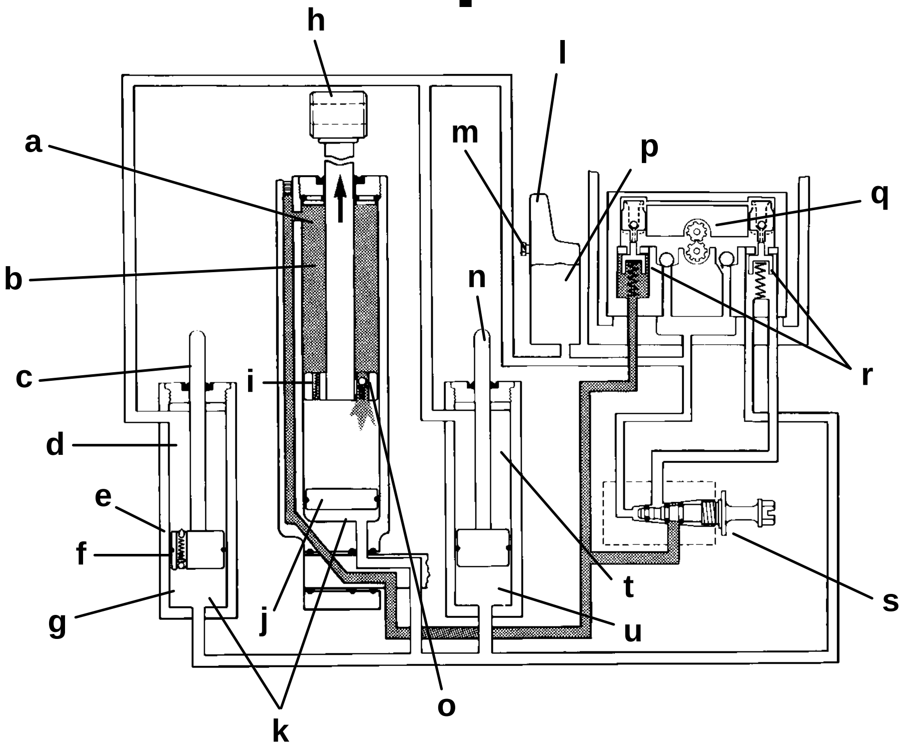
Oil Under Pressure

Down Circuit

When you depress the down button, the power trim pump is activated in the opposite direction. As the oil pump gears begin to rotate, oil is drawn through the down circuit pickup and into the pump, suppling pressure for the down circuit. Oil is blocked from returning into the reservoir by the closed check ball inside the up circuit pickup. Oil under pressure then moves the down shuttle valve up. Oil also flows around the down shuttle valve center “pin”, around the check ball and into a connecting passage to the chamber above the “up” shuttle valve. The check ball inside the “up” shuttle valve closes. The “up” shuttle valve then moves down and opens the up circuit pilot check valve. The oil pump draws returning oil from the up circuit trim and tilt cylinders cavities to supply oil to the trim pump for the down circuit.At this same time, oil under pressure opens the down circuit pilot valve allowing oil to exit through the down pressure port. The oil then continues through the down pressure passage, through the pivot pin, and into the interconnecting passage of the cylinder leading to the cavity above the tilt ram piston, and pushes the piston rod in and down. As the outboard engine contacts the extended ends of the trim rams, the weight of the motor, propeller thrust and pump down pressure will force the trim rams to retract.

3 Ram Power Trim Hydraulic System

Bounce and Shock Absorber



51495

a - Down Pressure 500 PSI
b - Down Cavity
c - Trim Ram
d - Down Cavity
e - Mechanical Check Valve
f - Tilt Relief 850-1150 PSI
g - Up Pressure 1300 PSI
h - Tilt and Shock Ram
i - Siphon Valve
j - Memory Piston
k - Up Cavity
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p - Reservoir Pressure 6 PSI
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

Oil Under Pressure

Bounce System

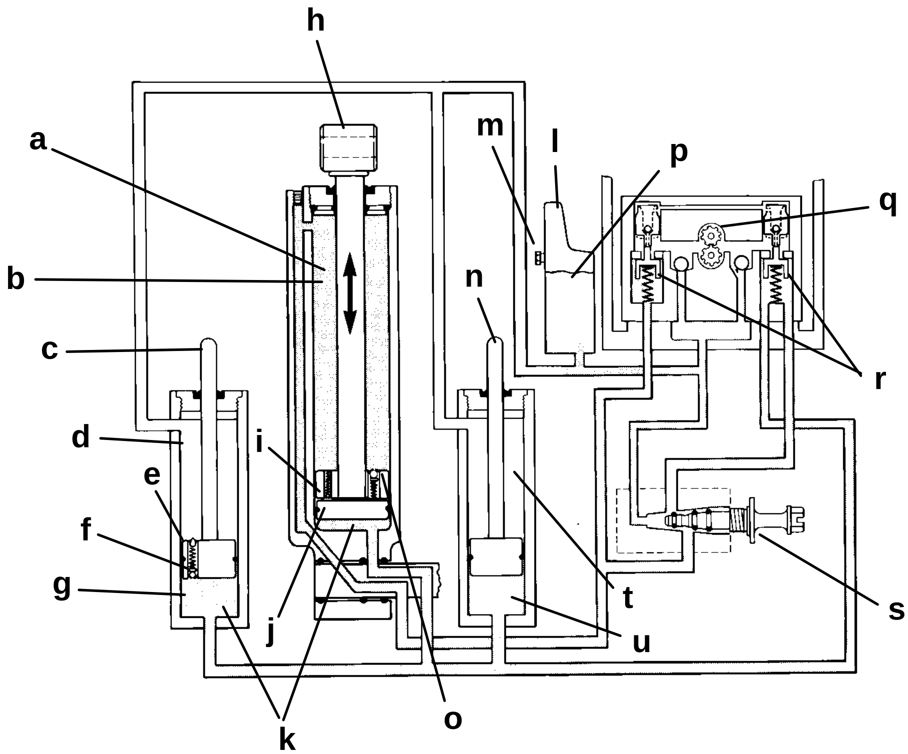
Should the outboard motor strike a submerged object with light steady pressure, while in forward motion, the oil in the trim system is locked in a static position by the up and down circuit pilot check valves and the manual tilt valve. Due to no oil movement in the up side of the trim cylinder, the tilt rod and piston move outward and will create a vacuum between the tilt ram shock piston and the floating piston, until the outboard engine returns to its normal running position.

Shock System

When a submerged object is hit with great force, oil will build up sufficient pressure in the tilt cylinder down side cavity to open the piston impact relief valve. Oil in the “up” side cavity is locked in by the up circuit pilot check valve and manual tilt valve. Therefore, the piston impact relief valve allows the oil from the down side cavity of the trim cylinder to pass through the piston impact relief valve, into the vacuum area between the tilt ram piston and the floating piston. The siphon valve allows the oil to return through the piston, back to the down side cavity as the outboard returns to its normal running position. Propeller thrust and the weight of the outboard provides the return motion for the engine.

3 Ram Power Trim Hydraulic System

Manual Tilt



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n - Trim ram
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p - Reservoir Pressure 6 PSI
q - Oil Pump
r - Pilot Valve
s - Manual Tilt Valve
t - Down Cavity
u - Up Cavity

Return Oil

Manual Tilt System

If the outboard motor is to be raised manually, turn the manual release (tilt) valve counterclockwise to the full out position. When in the full (out) position, oil in the trim cylinder can flow freely from the up side to the down side or from the down side to the up side. The oil return line into the reservoir is also open, allowing free oil flow to either side of the tilt cylinder to accommodate the differential oil capacities between the tilt cylinder up side and down side cavities.

When trimming the outboard in either the up or down position, with the manual tilt valve open or leaking, little or no movement will occur. Oil pressure from the pump will move to both, the up cavity and through the manual tilt valve into the down cavity, each cavity would have equal pressure resulting in little or no movement.

Reverse Operation

To prevent the outboard from coming up or trailing out, when shifted into reverse and/or throttling back rapidly, oil in the trim system must be locked in a static position. This is accomplished with the up and down pilot check valves. Thus, not allowing oil in the system to move in either direction.

Power Trim - General Information

Description

The Power Trim System consists of an electric motor, pressurized fluid reservoir, pump, tilt cylinder, and two trim rams.

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 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. When trimming from a mid-trim position (with outboard trim tab in a straight fore and aft position), expect the following:*

TRIMMING OUTBOARD "UP" (OUT):

⚠ WARNING

Excessive trim "Out" may reduce the stability of some high speed hulls. To correct instability, reduce the power gradually and trim the outboard "In" slightly before resuming high speed operation. A rapid reduction in power will result in a sudden change of steering torque and may cause additional boat instability.

Will lift boat bow, increasing top speed.

Transfers steering torque harder to port (left) on installations above 23 in. transom height.

Increases gearcase clearance over submerged objects.

Excess trim can cause "porpoising" and/or ventilation.

⚠ WARNING

Excessive outboard trim angle will result in insufficient water supply causing water pump and/or powerhead overheating damage. Insure water level is above water intake holes whenever outboard is running.

The "Up" circuit actuates the "up" solenoid (under outboard cowl) and closes the motor circuit. The electric motor drives the pump, forcing fluid thru passageways into the "up" side of the trim cylinders.

The trim cylinders position the outboard at the desired trim angle in the 20 degree maximum trim range. The system will not allow the outboard to be trimmed above the 20 degree trim range as long as the engine RPM is above approximately 2000 RPM.

The outboard can be trimmed above the 20 degree maximum trim angle (for shallow water operation, etc.), by keeping the engine RPM below 2000. If the RPM increases over 2000, propeller thrust (if propeller is deep enough) will result in the trim system to return the outboard to the 20 degree maximum trim position.

TRIMMING OUTBOARD "DOWN" (IN):

⚠ WARNING

Excessive speed at minimum trim "In" may result in undesirable and/or unsafe steering conditions. Test for handling characteristics after any adjustment is made to the trim angle (and tilt pin location).

Aids planing, particularly with heavy loads.

Improves ride in choppy water conditions.

Excess trim "In" can cause "bow steer" (boat veers to left or right).

Transfers steering torque to starboard (right).

Improves acceleration to planing speed.

The "Down" circuit actuates the "down" solenoid (under engine cowl) and closes the motor circuit. The electric motor drives the pump in the opposite direction as the "up" circuit, forcing fluid thru passageways into the "down" side of the tilt ram. The tilt ram moves the engine down to the desired position.

Trailering Outboard

The "Up" circuit first moves the trim cylinders; when the trim cylinders extend fully, the tilt ram extends to tilt the outboard to the full "Up" position for trailering.

Before the boat is trailered, the operator should check for clearance between the outboard skeg and pavement to prevent damage to skeg from striking pavement.

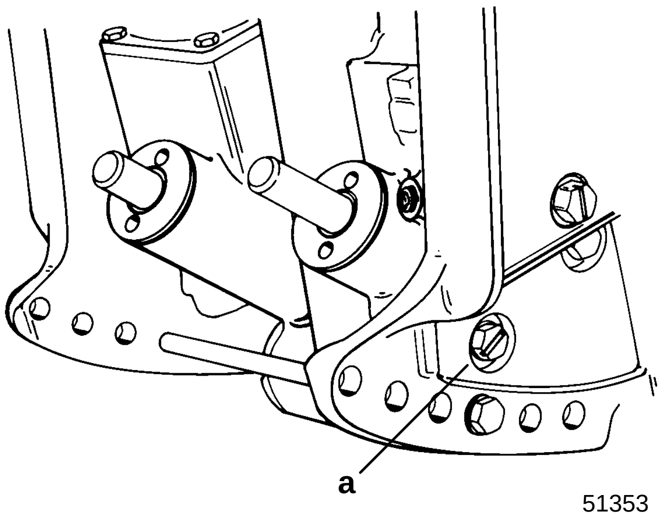
If the outboard must be tilted for clearance between skeg and pavement, a device such as a "Transom Saver" should be installed to prevent stress to boat transom from outboard weight while the boat/outboard are being trailered.

Tilting Outboard Manually

⚠ WARNING

Before opening the manual release valve knob, insure all persons are clear of outboard as outboard will drop to full "Down" when valve is opened.

The outboard can be raised or lowered manually by opening the manual release valve 3 to 4 turns counterclockwise. Close manual release valve to hold outboard at the desired tilt position.



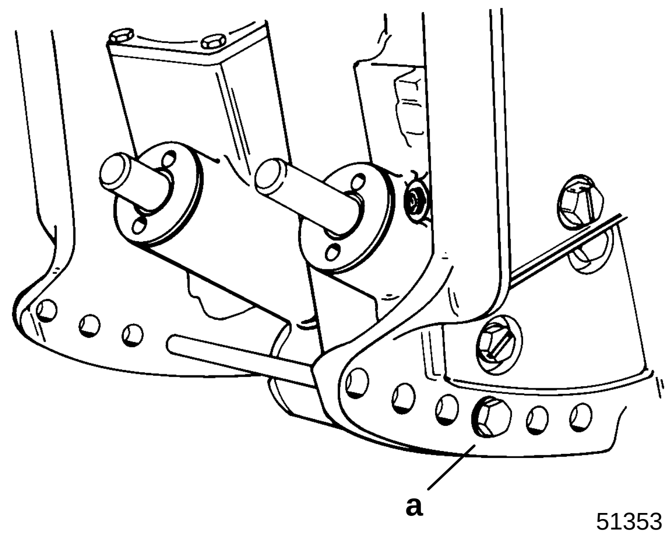
a - Manual Release Valve

Trim "In" Angle Adjustment

⚠ WARNING

Boat operation with outboard trimmed to the full "In" trim angle [not using the trim angle adjustment bolt (a)] at planing speed may result in undesirable and/or unsafe steering conditions. A water test for handling/steering conditions is required after any trim angle adjustments.

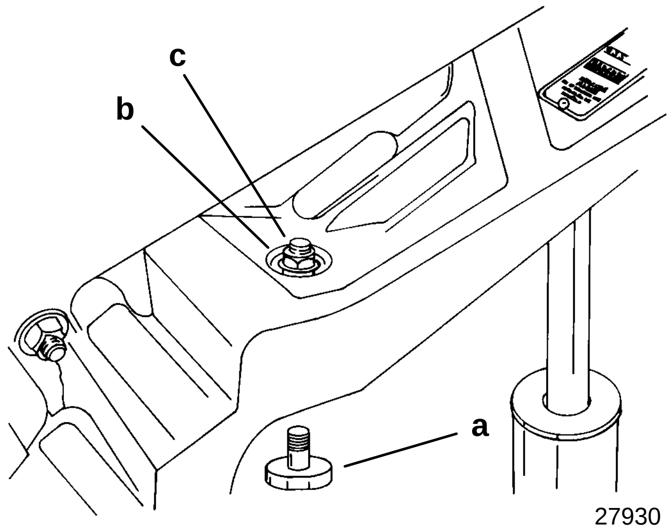
IMPORTANT: Some boat/motor combinations not using the trim angle adjustment pin (a) and trimmed to the full "In" trim angle position may not exhibit any undesirable and/or unsafe handling and/or steering characteristics at planing speed. If so, not using the trim angle adjustment bolt (a) may be advantageous to acceleration and planing. A water test is required to determine if these characteristics apply to a particular boat/motor combination.



a - Trim Angle Adjustment Bolt

Striker Plate Replacement

Visually inspect striker plates (a) and replace if worn excessively.

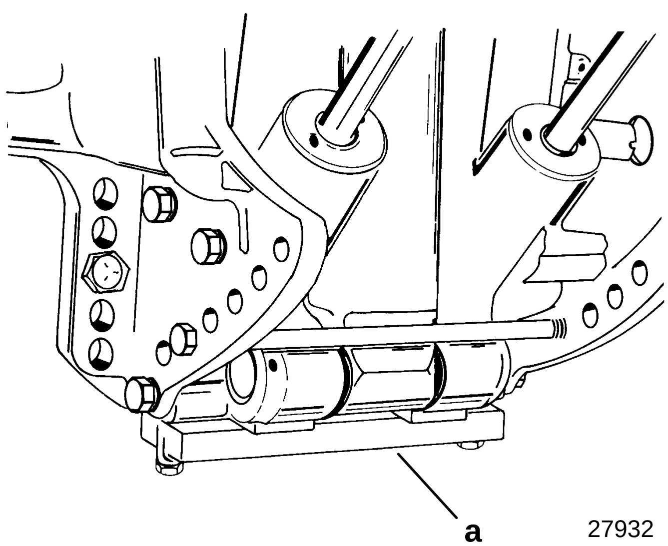


27930

a - Striker Plate (2)
b - Lockwasher
c - Locknut. Torque to 80 lb. in. (9.0 N·m)

Anode Plate

Anode plate (a) is a self-sacrificing alloy plate that is consumed gradually by corrosion while providing protection to the midsection and power trim from galvanic corrosion. Replace anode plate when it is 50% consumed.



27932

a - Anode Plate

IMPORTANT: Do not paint or place protective coating on anode plate, or corrosion protection function will be lost.

Trim Indicator Gauge

A Quicksilver Trim Indicator Gauge accessory kit is available for the power trim sender (if not previously installed).

Check, Fill and Purge - Power Trim System

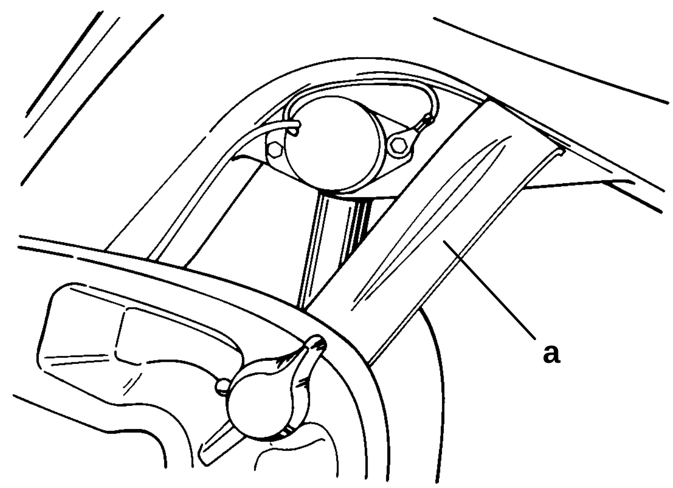
TO CHECK:

⚠ CAUTION

Tilt outboard to full "Up" position and engage tilt lock lever before checking fluid level. System is pressurized. Extend trim and tilt rams fully to depressurize system.

Remove fill plug and O-ring. System is full when oil level is present at filler hole. Tighten fill plug securely.

NOTE: *Automatic Transmission Fluid (ATF) Type F, FA, Dexron II or Dexron III may be used.*



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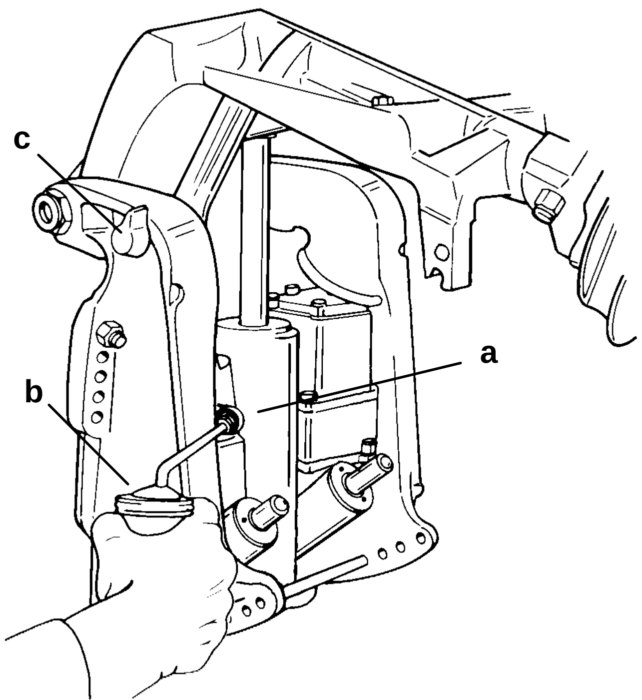
a - Tilt Lock Lever

TO FILL:

IMPORTANT: This trim system is pressurized. Remove "Fill" plug only when outboard is tilted to the full "Up" position or the trim/tilt rams are fully extended. Retighten "Fill" plug before tilting outboard down or retracting tilt/trim rams.
Remove "Fill" plug and O-ring. System is full when oil level is present at fill hole. Tighten "Fill" plug securely.



a - Fill Plug and O-ring (remove to fill system, tighten securely)
b - Oil Can (fill system with Quicksilver Power Trim and Steering Fluid)
c - Tilt Lock Lever (engage to support engine in "Up" position)

TO PURGE:

IMPORTANT: Fill plug and O-ring must be tightened securely before purging system.

IMPORTANT: Run Trim System in short "jogs" until pump is primed and trim system moves. If trim motor is run without priming pump, driveshaft failure could result.

Cycle outboard through entire trim/tilt range 4 times. Check fluid level after purging system.

Push down on outboard when trim rams are slightly extended. If rams retract more than 1/8 in. (3.2 mm), air is present in system. Cycle system again and check fluid level.

Hydraulic System Troubleshooting

IMPORTANT: Operate Power Trim System after each check to see if problem is corrected. If problem has not been corrected, proceed to next check.

1. Check that Manual Release Valve knob is tightened to full right (clockwise) position.
2. Check trim pump fluid level and fill if necessary. (Refer to "**Check, Fill and Purge - Power Trim System**") preceding.
3. Check for external leaks in the system. Replace defective parts if leak is found.
4. Check for air in the system and purge if necessary. (Refer to "**Check, Fill and Purge - Power Trim System"**) preceding.

NOTE: *When troubleshooting the hydraulic system, cleanliness, and inspection of sealing surfaces, seals, O-rings, and moving parts is important. The internal pressures required for proper operation of the Power Trim System require these parts to be in excellent condition. Replace any parts that may be suspect of failure.*

Troubleshooting (Square Motor)

IMPORTANT: Determine if Electrical or Hydraulic problem exists.

HYDRAULIC SYSTEM TROUBLESHOOTING

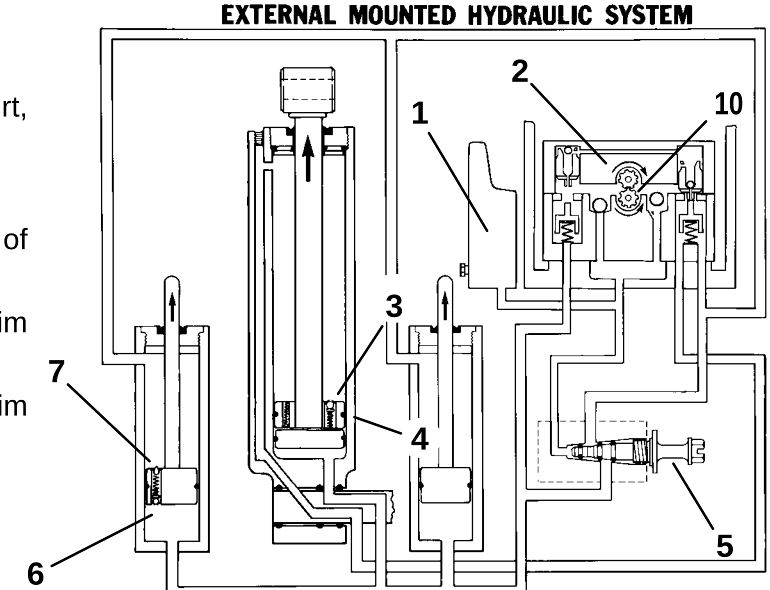
IMPORTANT: Make one correction at a time. Check operation of trim system before proceeding to the next check.

CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor runs; trim system does not move up or down.	1, 2, 5, 10
B. Does not trim full down. Up trim OK.	2, 3, 4
C. Does not trim full up. Down trim OK.	1, 6
D. Partial or “Jerky” down/up.	1
E. “Thump” noise when shifting.	2, 3, 6, 7
F. Does not trim under load.	8, 9
G. Does not hold trim position under load.	2, 5, 6
H. Trail out when backing off from high speed.	3, 4
I. Leaks down and does not hold trim.	2, 5, 7
J. Trim motor working hard and trims slow up and down.	8, 9
K. Trims up very slow.	1, 2, 8, 9
L. Starts to trim up from full down position when “IN” trim button is depressed.	3, 4
M. Trim position will not hold in reverse.	3, 4

PROBLEM

1. Low oil Level.
2. Pump Assembly faulty.
3. Tilt ram piston ball not seated (displaced, dirt, nickel seat).
4. Tilt ram piston O-ring leaking or cut.
5. Manual release valve leaking (check condition of O-rings) (Valve not fully closed.)
6. Lower check valve not seating in port side trim ram.
7. Upper check valve not seating in port side trim ram.
8. Check condition of battery.
9. Replace motor assembly.
10. Broken motor/pump driveshaft.

EXTERNAL MOUNTED HYDRAULIC SYSTEM



51491

ELECTRICAL SYSTEM TROUBLESHOOTING (SQUARE MOTOR)

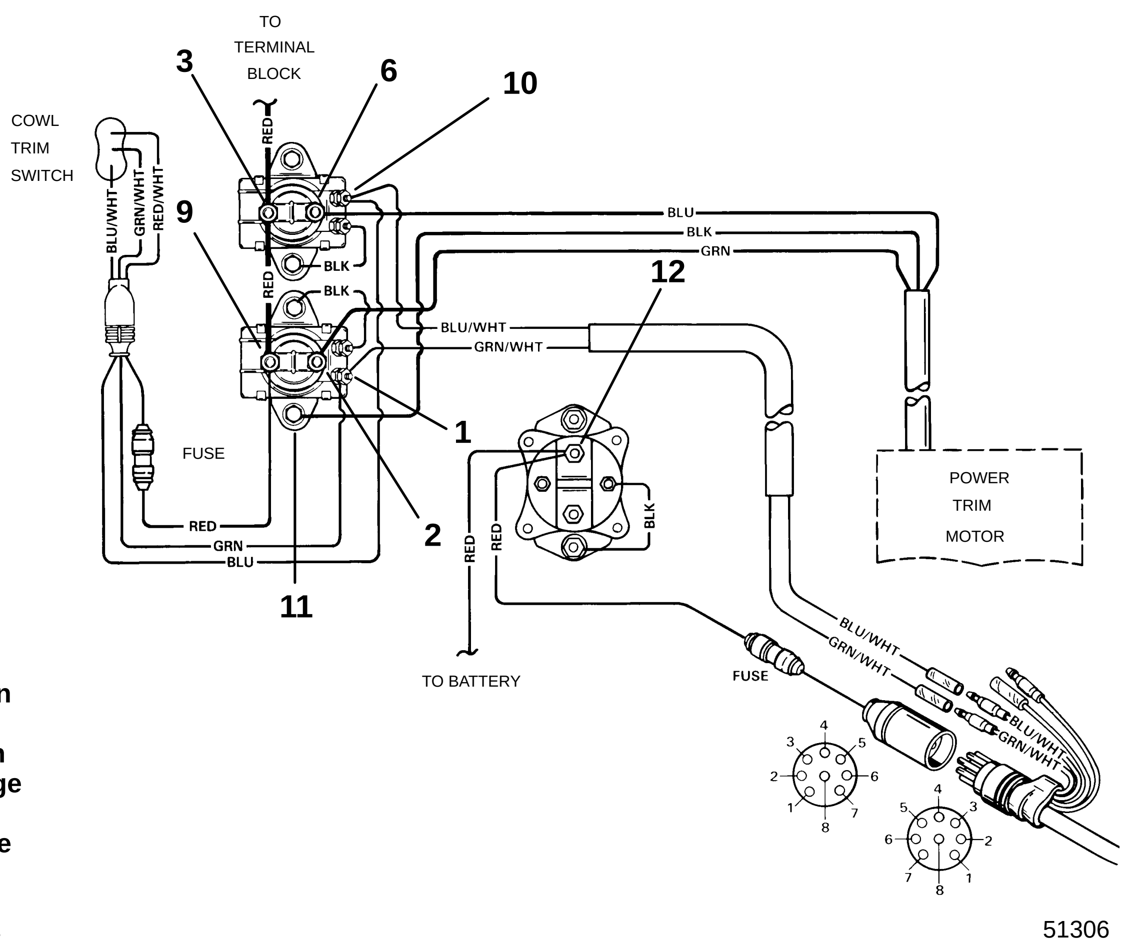
CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor does not run when trim button is depressed.	1, 2, 4, 5, 6
B. Trim system trims opposite of buttons.	3
C. Cowl mounted trim buttons do not activate trim system.	2, 4, 5, 6

PROBLEM

1. Battery low or discharged.
2. Open circuit in trim wiring.
3. Wiring reversed in remote control.
4. Wire harness corroded through.
5. Internal motor problem (brushes, shorted armature).
6. Blown fuse(s).

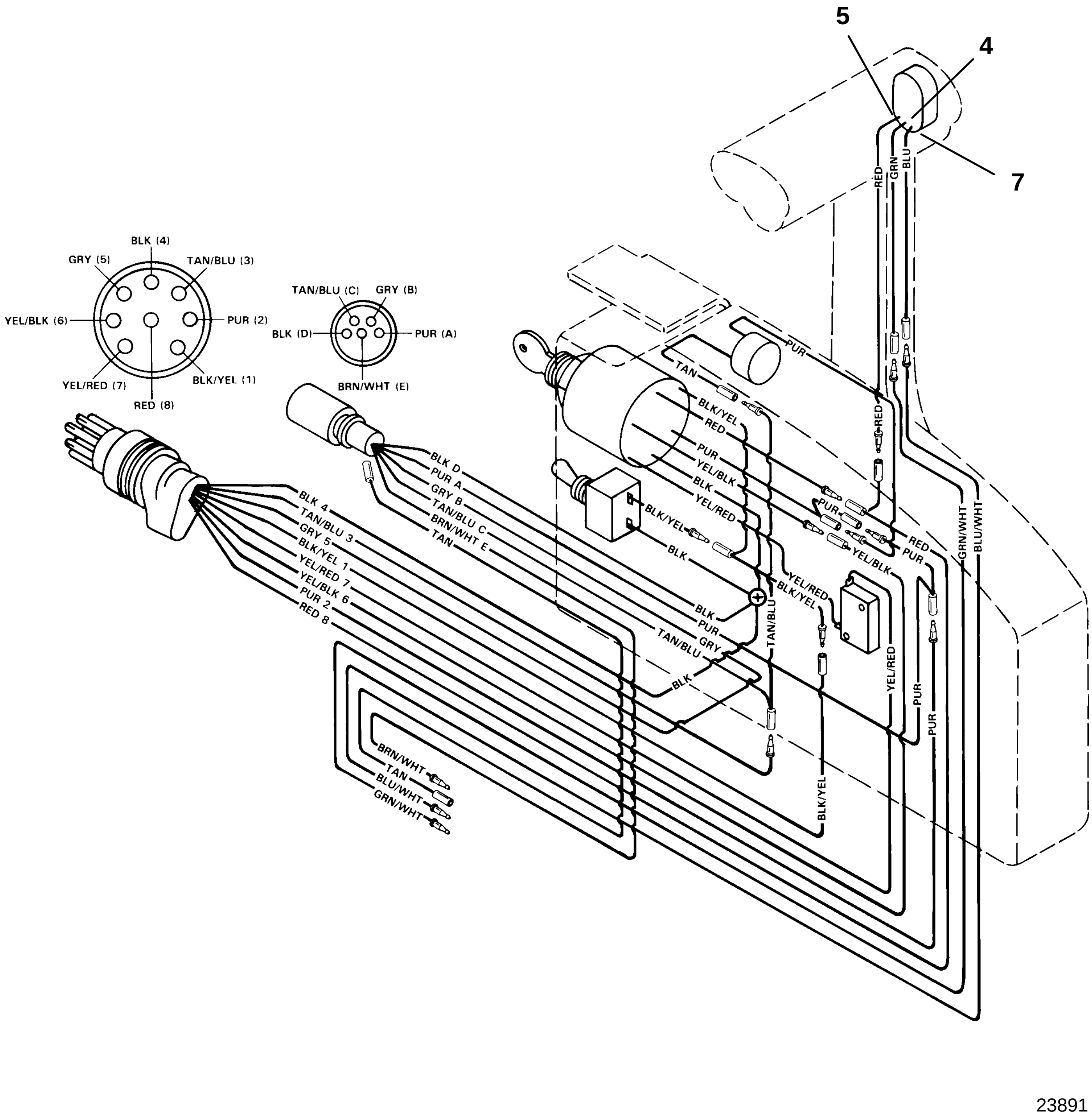
NOTE: *Refer to following pages to troubleshoot Power Trim Electrical System.*

POWER TRIM SYSTEM WITH SOLENOIDS AND 3 WIRE TRIM MOTOR



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

Side Mount Remote Control Wiring Diagram (Test Points for Electrical Troubleshooting)



Electrical System Troubleshooting

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 four wiring diagrams for connection points when troubleshooting the electrical systems (Connection points are specified by number.)

Troubleshooting the "Down" Circuit (When "Up" Circuit is OK)

Connect Voltmeter RED lead to Point 1 and BLACK lead to ground.
Depress the "Down" trim button.

Battery Voltage Indicated:
Connect Voltmeter RED lead to Point 9.

No Voltage Indicated:
Connect Voltmeter RED lead to Point 4 and BLACK lead to ground. Depress "Down" trim button. If battery voltage is indicated, wire is open between Points 4 and 1.

Battery Voltage Indicated:
- Connect Voltmeter RED lead to Point 2.
- Depress "Down" trim button.

No Voltage Indicated:
There is an open circuit between Point 9 and POSITIVE (+) battery terminal.
- Check for loose or corroded connections.
- Check wires for open.

Battery voltage indicated:
- Test UP relay – refer to relay test procedure

Relay Good:
- Check "Down" solenoid terminals for loose or corroded connections.
- Check BLACK ground wire (on "Down" solenoid) for corrosion or open.
- Test "Down" solenoid. Refer to "Motor and Electrical Tests", see Index.

No Voltage Indicated:
Solenoid is defective.

No Voltage Indicated:
Connect Voltmeter RED lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the "Up" Circuit (When "Down" Circuit Is OK)

Connect Voltmeter RED lead to Point 10 and BLACK lead to ground.
Depress the "Up" trim button.

Battery Voltage Indicated:
Connect Voltmeter RED lead to Point 3.

Battery Voltage Indicated:
- Connect Voltmeter RED lead to Point 6.
- Depress "Up" trim button.

Battery voltage indicated:
- Test DOWN relay – refer to relay test procedure

Relay Good:
- Check "Up" solenoid terminals for loose or corroded connections.
- Check BLACK ground wire (on "Up" solenoid) for corrosion or open.
- Test "Up" solenoid. Refer to "Motor and Electrical Tests/Repair", following.

No Voltage Indicated:
Solenoid is defective.

No Voltage Indicated:
- Check for loose or corroded connection at Point 9 or Point 3.
- Check RED lead between Point 9 and Point 3 for open.

No Voltage Indicated:
Connect voltmeter RED lead to Point 7 and BLACK lead to ground. Depress "UP" button. If battery voltage is indicated, wire is open between Points 10 and 7.

No Voltage Indicated:
Connect voltmeter RED lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the "Down" and "Up" Circuits (All Circuits Inoperative)

Check in-line fuses (under cowl) to see if fuses are blown.

Blown Fuse:
- Correct problem that caused fuse to blow.
- Replace fuse.

Fuse Not Blown:
Connect Voltmeter RED lead to Point 3 and BLACK lead to ground. Battery voltage should be indicated.

No Voltage Indicated:
- Check battery leads and RED leads (between engine starter motor solenoid and Point 3) for poor connections or open circuits.
- Check battery charge.

Battery Voltage Indicated:
- Connect Voltmeter RED lead to Point 10.
- Depress "Up" trim button and check for battery voltage.

No Voltage Indicated:
Connect RED Voltmeter lead to Point 5, and BLACK lead to ground.

Battery Voltage Indicated:
- Check BLACK ground wires at solenoids for poor connection or poor ground.
- Check BLACK motor lead for poor ground at Point 11. If wire is grounded, the pump motor is faulty. Refer to "Motor and Electrical Tests/ Repair", following.

No Voltage Indicated:
Check that voltage is being supplied to control by performing the following checks:
- DO NOT start engine.
- Turn ignition switch to "Run" position.
- Check for voltage at any instrument, using a Voltmeter.

Battery Voltage Indicated:
Trim switch is faulty or there is an open circuit in wires [GREEN-WHITE, BLUE-WHITE and PURPLE-WHITE (OR PURPLE)] between trim buttons and trim pump.
- Check trim switch.
- Check all trim harness connectors for loose or corroded connections.
- Check for pinched or severed wires.

No Voltage Indicated:
RED wire is open between Point 12 and red terminal on back of the ignition switch.
- Check for loose or corroded connections.
- Check for open in wire.

Battery Voltage Indicated:
There is an open circuit in wire between Point 5 and RED lead terminal on the back of the ignition switch.

Troubleshooting (Round Motor)

IMPORTANT: Determine if Electrical or Hydraulic problem exists.

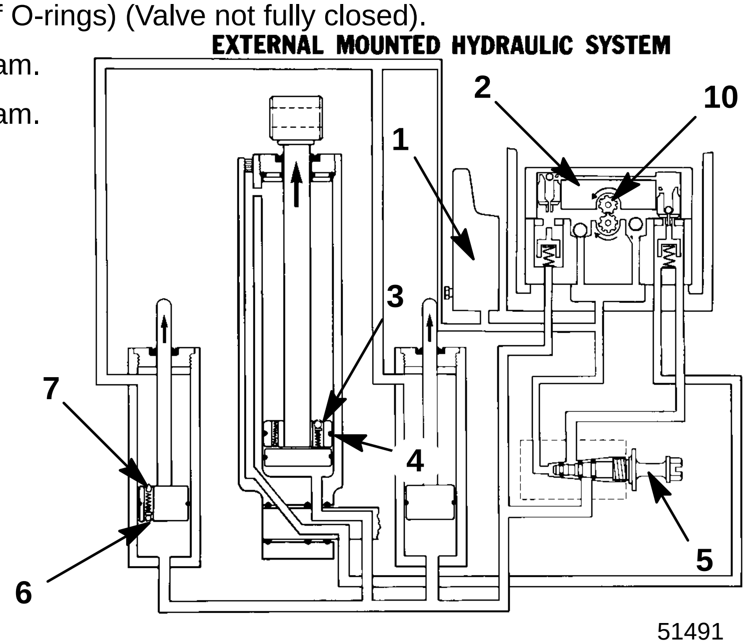
HYDRAULIC SYSTEM TROUBLESHOOTING

IMPORTANT: Make one correction at a time. Check operation of trim system before proceeding to the next check.

CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor runs; trim system does not move up or down.	1, 2, 5, 10
B. Does not trim full down. Up trim OK.	2, 3, 4
C. Does not trim full up. Down trim OK.	1, 6
D. Partial or “Jerky” down/up.	1, 3
E. “Thump” noise when shifting.	2, 3, 6, 7
F. Does not trim under load.	5,8, 9,10
G. Does not hold trim position under load.	2, 5, 6
H. Trail out when backing off from high speed.	3, 4
I. Leaks down and does not hold trim.	2, 5, 7
J. Trim motor working hard and trims slow up and down.	8, 9
K. Trims up very slow.	1, 2, 8, 9
L. Starts to trim up from full down position when “IN” trim button is depressed.	3, 4
M. Trim position will not hold in reverse.	3, 4

PROBLEM

1. Low oil level.
2. Pump assembly faulty.
3. Tilt ram piston ball not seated (displaced, dirt, nickel seat).
4. Tilt ram piston O-ring leaking or cut.
5. Manual release valve leaking (check condition of O-rings) (Valve not fully closed).
6. Lower check valve not seating in port side trim ram.
7. Upper check valve not seating in port side trim ram.
8. Check condition of battery.
9. Replace motor assembly.
10. Broken motor/pump drive shaft.



ELECTRICAL SYSTEM TROUBLESHOOTING (ROUND MOTOR)

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
C. Cowl mounted trim buttons do not activate trim system.	2, 4, 5, 6, 7

PROBLEM

1. Battery low or discharged.
2. Open circuit in trim wiring.
3. Wiring reversed in remote control.
4. Wire harness corroded through.
5. Internal motor problem (brushes, shorted armature).
6. Blown fuse(s).
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 connect 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 in 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:

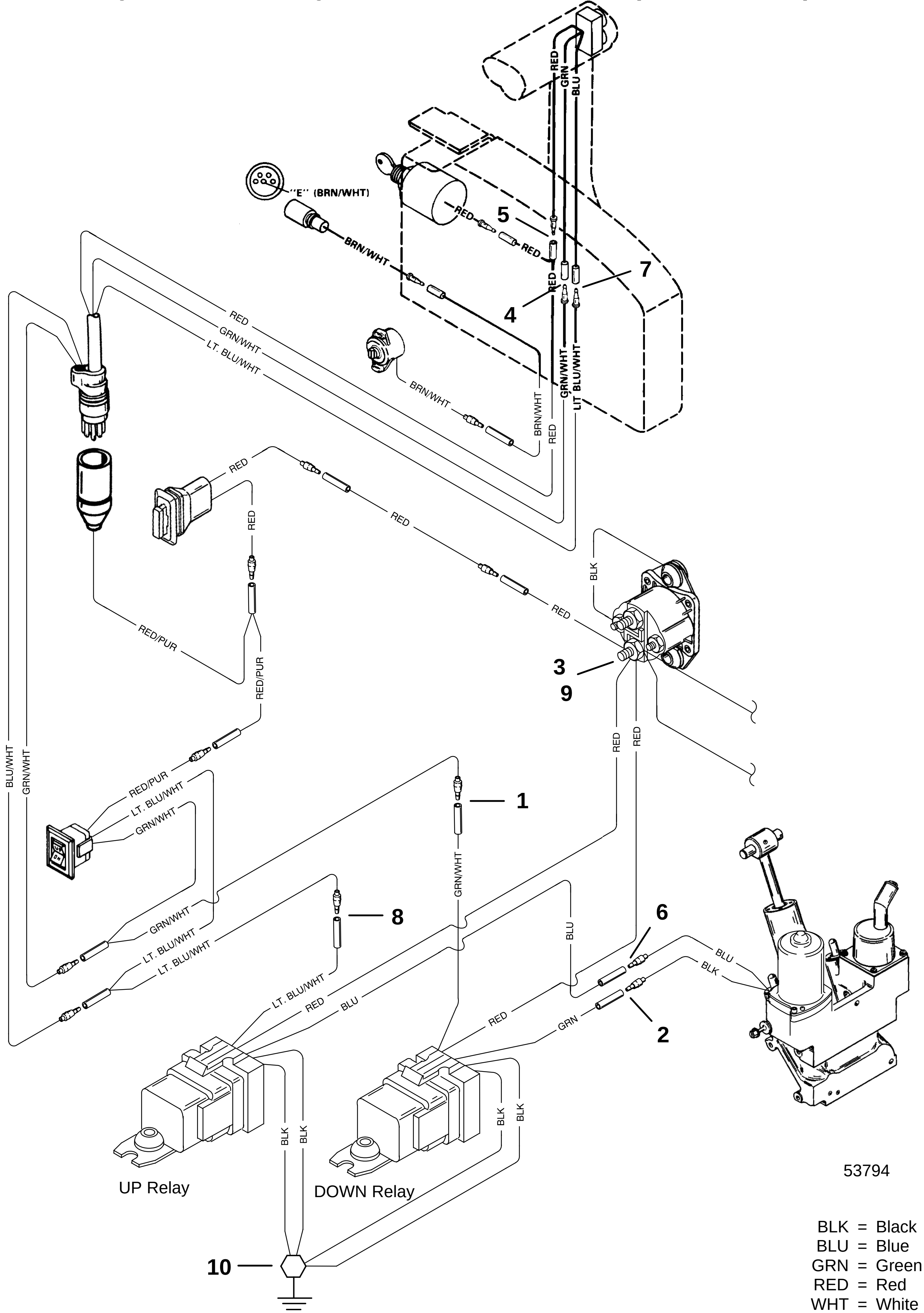
1. Disconnect the heavy gauge pump wires from the trim control relay.
2. Check for continuity between the heavy leads from the trim relays to ground.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x____________)
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.

Power Trim System with Relays and 2 Wire Trim Motor (Round Motor)



BLK = Black
BLU = Blue
GRN = Green
RED = Red
WHT = White

Electrical System Troubleshooting (Round Motor)

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 four wiring diagrams for connection points when troubleshooting the electrical systems (Connection points are specified by number.)

Troubleshooting the "Down Circuit"

Connect Voltmeter red lead to Point 1 and black lead to ground.

Depress the "Down" trim button.

Battery Voltage Indicated:
Connect Voltmeter red lead to Point 3.

Battery Voltage Indicated:

•Connect Voltmeter red lead to Point 2.

•Depress "Down" trim button.

Battery Voltage Indicated:

•Pump motor wiring is defective.

•Pump motor is defective.

No Voltage Indicated:

Relay Switch is defective.

No Voltage Indicated:

There is an open circuit between Point 3 and positive (+) battery terminal.
•Check for loose or corroded connections.
•Check wires for open.

No Voltage Indicated:
Connect Voltmeter red lead to Point 4 and black lead to ground. Depress "Down" trim button. If battery voltage is indicated, wire is open between Points 4 and 1.

No Voltage Indicated:

Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Up” Circuit

Connect Voltmeter red lead to Point 8 and black lead to ground.

Depress the “Up” trim button.

Battery Voltage Indicated:
Connect Voltmeter red lead to Point 9.

No Voltage Indicated:
Connect Voltmeter red lead to Point 7 and black lead to ground. Depress “Up” trim button. If battery voltage is indicated, wire is open between Points 7 and 8.

Battery Voltage Indicated:
- •Connect Voltmeter red lead to Point 6.
- •Depress “Up” trim button.

No Voltage Indicated:

There is an open circuit between Point 9 and positive (+) battery terminal.
- •Check for loose or corroded connections.
- •Check wires for open.

Battery Voltage Indicated:
- •Pump motor wiring is defective.
- •Pump motor is defective.

No Voltage Indicated:

Relay Switch is defective.

No Voltage Indicated:

Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the "Down" and "Up" Circuits (All Circuits Inoperative)

Check in-line fuse (under cowl) to see if fuse is blown.

Blown Fuse:
- Correct problem that caused fuse to blow.
- Replace fuse.

Fuse Not Blown:
Connect Voltmeter red lead to Point 3 and black lead to ground. Battery voltage should be indicated.

No Voltage Indicated:
- Check battery leads for poor connections or open circuits.
- Check battery charge.

Battery Voltage Indicated:
- Connect Voltmeter red lead to Point 8 and black lead to ground.
- Depress "Up" trim button and check for battery voltage.

No Voltage Indicated:
Connect red Voltmeter lead to Point 5, and black lead to ground.

Battery Voltage Indicated:
- Check black ground wires for poor connection or poor ground, Point 10.
- Pump motor is faulty. Refer to "Motor and Electrical Tests/Repair", following.

No Voltage Indicated:
Check that voltage is being supplied to control by performing the following checks:
- DO NOT start engine.
- Turn ignition switch to "Run" position.
- Check for voltage at any instrument, using a Voltmeter.

Battery Voltage Indicated:
Trim switch is faulty or there is an open circuit in wires (green-white, blue-white) between trim buttons and trim pump.
- Check trim switch.
- Check all trim harness connectors for loose or corroded connections.
- Check for pinched or severed wires.

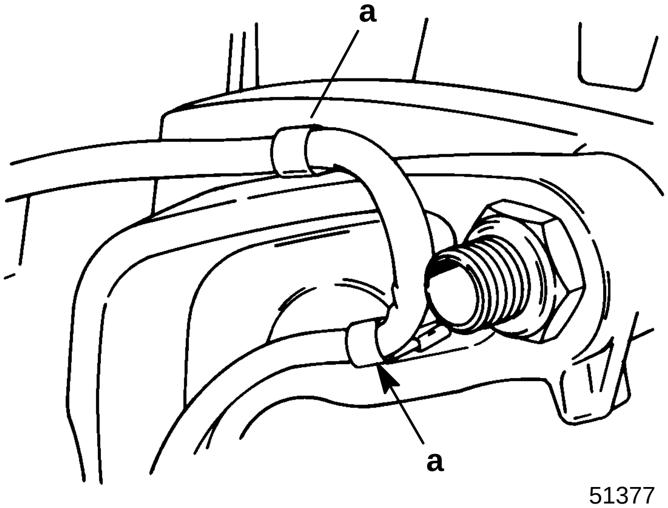
No Voltage Indicated:
Red wire is open between Point 3 and red terminal on back of the ignition switch.
- Check for loose or corroded connections.
- Check for open in wire.

Battery Voltage Indicated:
There is an open circuit in wire between Point 5 and Red terminal on the back of the ignition switch.

Power Trim Assembly Removal and Installation (All Models)

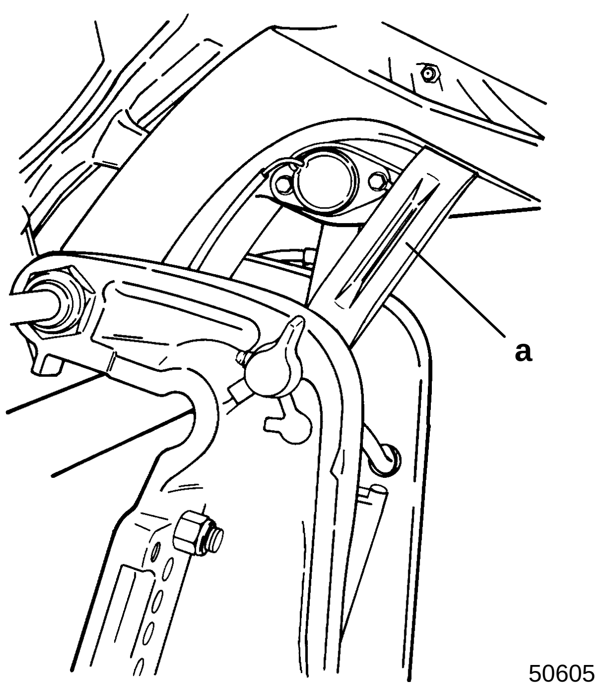
Removal

1. Remove clamps on transom bracket to free power trim wiring.



a - Clamps

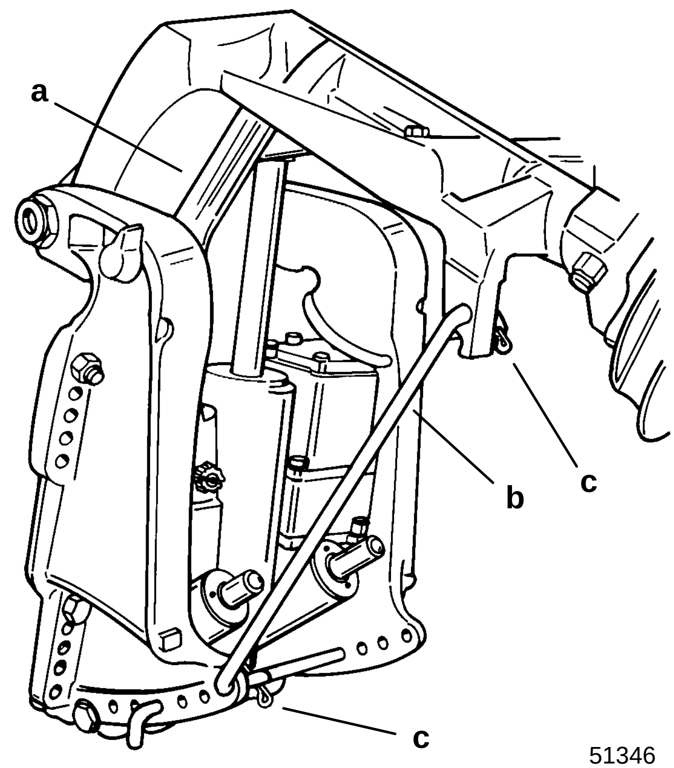
2. Raise outboard to full "Up" position and engage tilt lock lever.



a - Tilt Lock Lever

⚠ WARNING

Failure to support outboard as shown could result in personal injury and/or damage to outboard or boat.

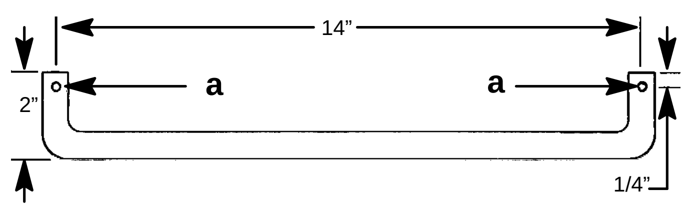


a - Tilt Lock Lever
b - Support Tool
c - Retaining Clips

IMPORTANT: Support outboard as shown above to prevent engine from tipping when power trim retaining pin is removed.

SUPPORT TOOL

3/8 in. diameter metal rod (a used shift shaft works well)



a - Drill holes for retaining clips

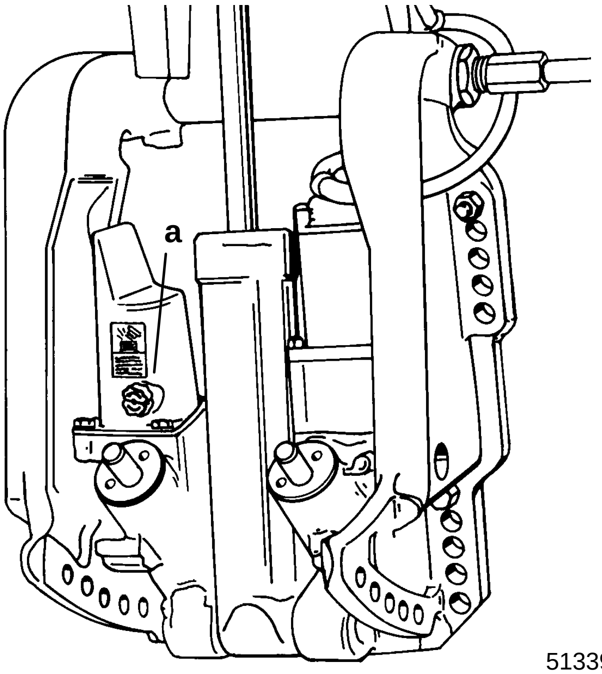
METRIC CONVERSION

14 in. = 35.56 cm.	2 in. = 50.8 mm
3/8 in. = 9.5 mm.	1/4 in. = 6.35 mm.

⚠ CAUTION

Disconnect battery cables at battery before removing power trim wires from solenoids.

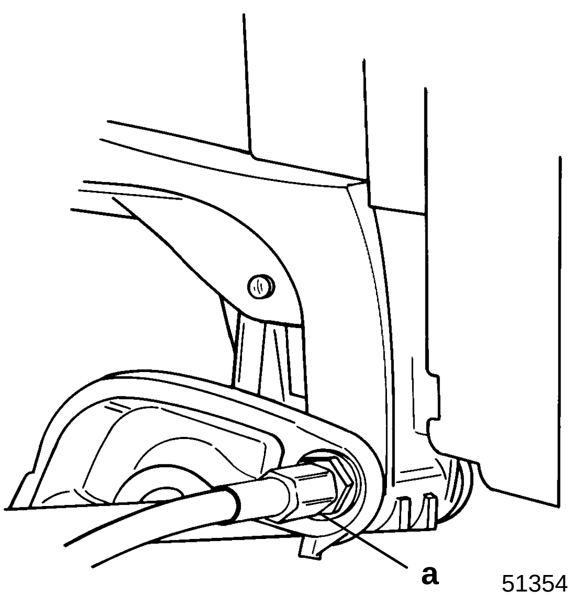
3. Disconnect power trim wires at solenoids (BLUE, GREEN, and BLACK) or if relay style, disconnect (BLUE and GREEN) bullet connector harness.
4. Open filler cap and release any remaining pressure in the system.



51339

a - Filler Cap

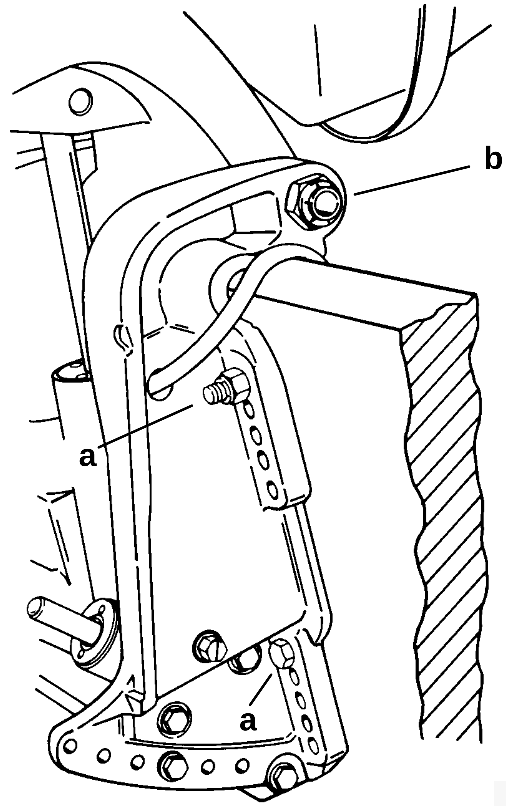
IMPORTANT: Outboards equipped with thru-the-tilt-tube steering - remove steering link arm from end of steering cable and cable retaining nut from tilt tube.



51354

a - Retaining Nut

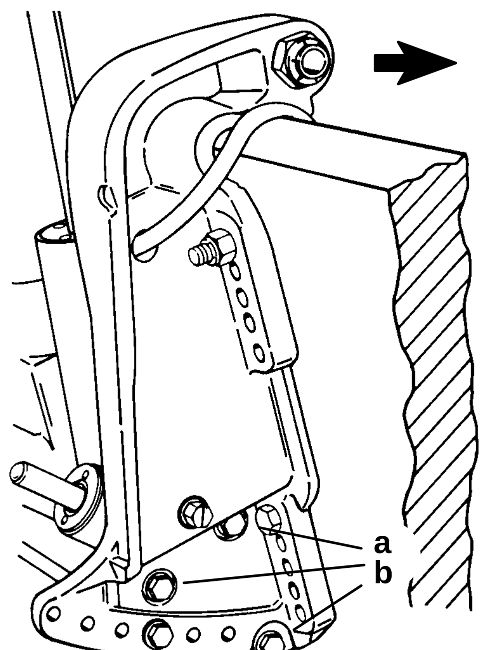
5. Remove outboard transom mounting bolts, and loosen tilt tube nut until nut is flush with end of tilt tube thread.



51375

a - Transom Mount Bolts (2)
b - Tilt Tube Nut (flush with end of thread)

6. Remove 3 screws and washers and move starboard transom bracket.

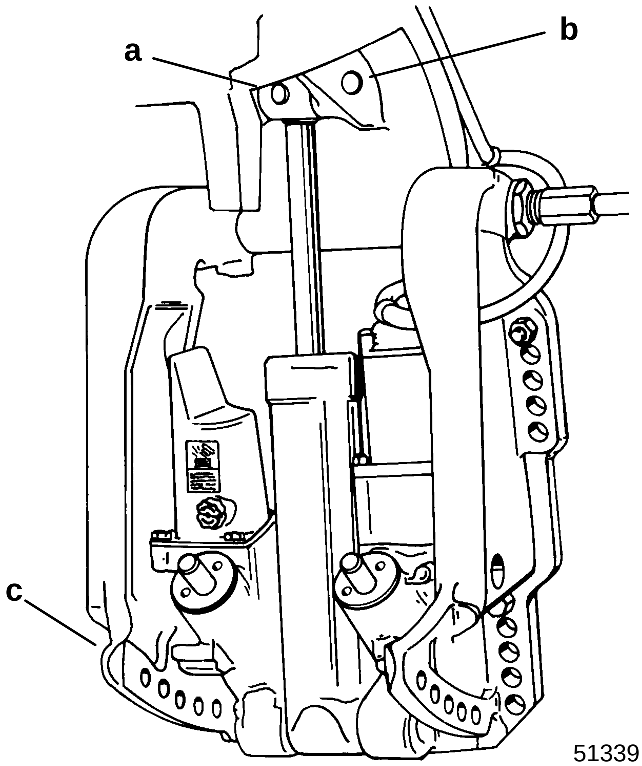


51375

a - Screws (3)
b - Washers (3)

IMPORTANT: Cross pin (a) should not be reused. Replace with new cross pin.

7. Drive out cross pin, push out upper swivel pin, and remove 3 screws and washers retaining trim system. Remove system from outboard.

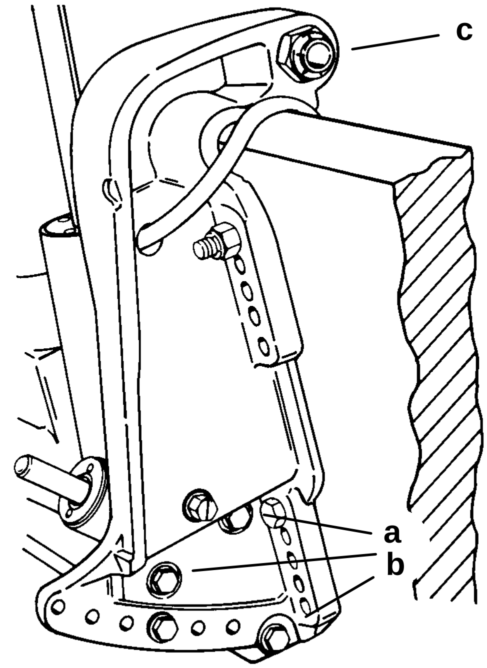


51339

a - Cross Pin
b - Upper swivel pin
c - Port transom bracket screws and washers (3). Remove to release trim system from outboard.

Installation

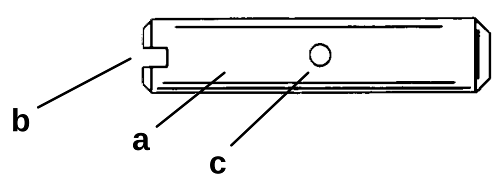
1. Paint any exposed metal surfaces to prevent corrosion.
2. Apply Loctite 271 to screws. Install trim system, starboard transom bracket, and tilt tube nut.



51375

a - Screw (6) Torque to 40 lb. ft. (54.0 N·m)
b - Lockwasher (6) Install one per screw
c - Tilt Tube Nut

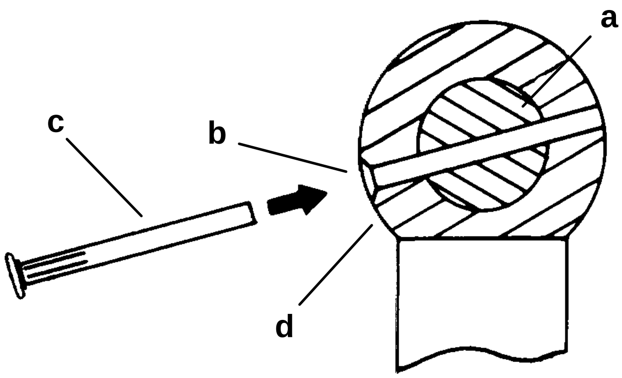
3. Use a 12 volt power source to extend tilt ram up to align upper swivel shaft hole and end of ram. Connect trim motor wires [BLUE wire to POSITIVE (+), BLACK wire to NEGATIVE (–)]. If ram extends too far, retract ram by connecting GREEN wire to POSITIVE (+).
4. Install Upper Swivel Pin with slotted end to left (port) side of engine.



a - Upper Swivel Pin
b - Slotted end
c - Cross hole (in line with slotted end)

IMPORTANT: Cross pin should not be reused. Install a new pin.

5. Position slot on end of swivel shaft in line with hole in tilt ram end. Insert a punch into tilt ram hole to align cross hole in upper swivel shaft. Tap new cross pin in until flush.



a - Upper Swivel Shaft (Slot is in line with cross hole)
b - Chamfered end of hole (Faces away from transom)
c - Retaining pin
d - Tilt ram end

6. Connect trim motor wires to solenoids. Refer to Wiring Diagrams in this manual. Route trim wires as specified in this manual.

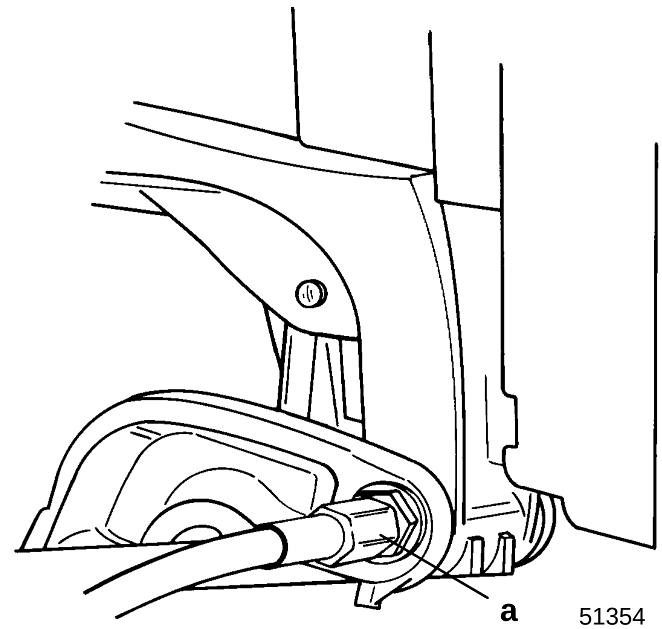
7. Apply marine sealer to shanks of mount bolts and install transom mount bolts.

IMPORTANT: Do not use an impact driver to tighten transom mount bolts.

Apply marine sealer to threads of mount bolts. Secure with flat washers and locknuts. Be sure installation is watertight.

8. Tighten tilt tube nut securely.

IMPORTANT: Outboards equipped with thru-the-tilt-tube steering: Tighten steering cable retaining nut securely to tilt tube.



a - Steering Cable Retaining Nut

9. Apply Quicksilver Liquid Neoprene (91-25511--2) on all electrical connections.

⚠ WARNING

Electrical wires passing through cowl openings must be protected from chafing or being cut. Follow the recommended procedures outlined in Section 1 of this Manual. Failure to protect wires as described could result in electrical system failure and/or injury to occupants of boat.

Testing Power Trim System With Test Gauge Kit (91-52915A6)

IMPORTANT: This test will not locate problems in the trim system. The test will show if the system is correct after a repair. If minimum pressures are not obtainable, the trim system requires additional repair.

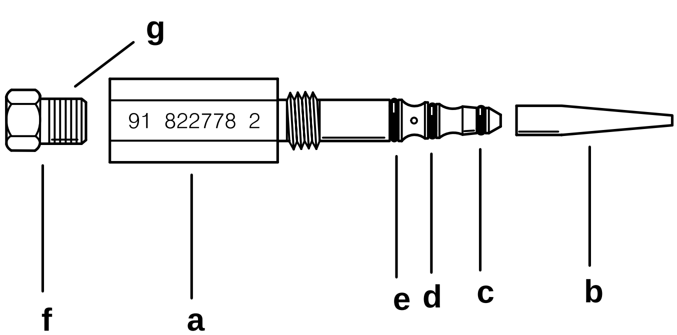
"UP" Pressure Check

IMPORTANT: Insure battery is fully charged before performing tests.

1. Tilt outboard to full "Up" position and engage tilt lock lever.
2. Slowly remove "Fill" plug to bleed pressure from reservoir.
3. Remove circlip securing manual release valve and unscrew release valve from trim assembly.

NOTE: *A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.*

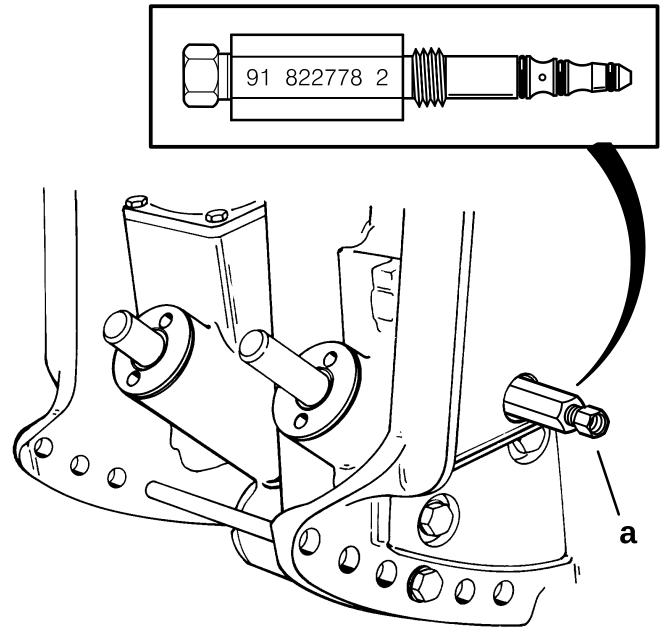
NOTE: *Assemble test adaptor by using O-ring installation tool to position small O-ring onto adaptor 1st, then install medium O-ring and lastly large O-ring. Thread brass fitting into test adaptor securely using teflon tape on threads.*



54457

a - Test Adaptor (91-822778A2)
b - O-ring Installation Tool
c - Small O-ring (Install 1st)
d - Medium O-ring (Install 2nd)
e - Large O-ring (Install Last)
f - Brass Fitting
g - Apply Teflon Tape

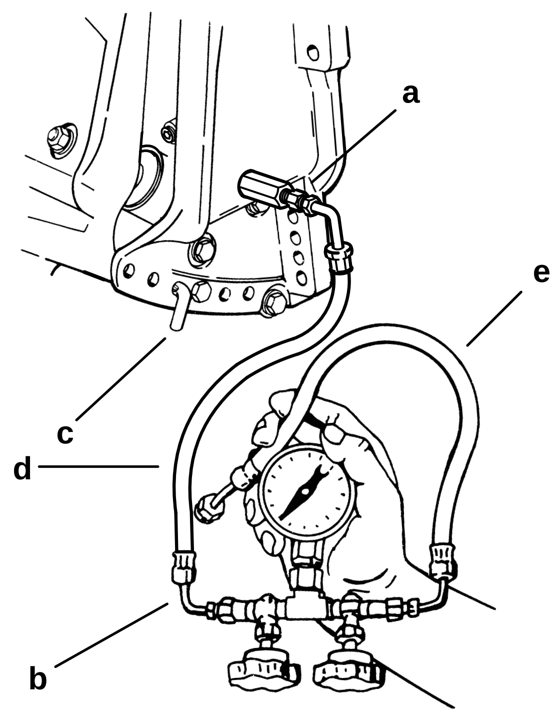
4. Install test adaptor 91-822778A2 into manual release valve hole.



54458

a - Test Adaptor (91-822778A2)

5. Thread hose from Test Gauge Kit (91-52915A6) into brass fitting on adaptor.



54459

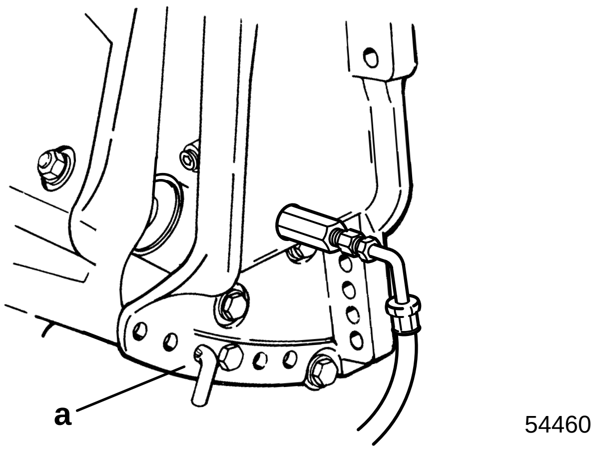
a - Brass Fitting
b - Test Gauge Assembly
c - Tilt Pin (Position in Hole Shown)
d - Hose
e - Hose (Not Used)

6. Reinstall fill plug.
7. Disengage tilt lock lever.

⚠ CAUTION

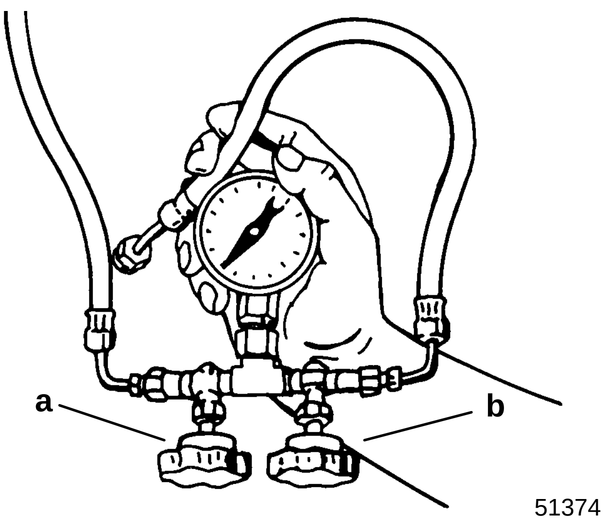
Failure to install spare tilt pin (or hardened bolts and nuts) in hole shown could result in transom bracket failure and possible injury.

8. Move outboard "IN" until hole in swivel bracket "ear" aligns with the 3rd tilt hole in transom bracket. Lock engine in trim range by installing a 3/8 in. (9.5 mm) diameter tilt pin or two 3/8 in. (9.5 mm) hardened bolts and nuts thru the transom brackets and swivel bracket in the hole shown.



a - Tilt Pin Hole (Install Spare Tilt Pin or Hardened Bolts and Nuts)

9. Open valve (a) and close valve (b).



10. Run trim "UP". The minimum pressure should be 1300 P.S.I. (91 kg/cm^2).
11. Run trim "DOWN" to release pressure and remove spare tilt pin or bolts and nuts.
12. Tilt outboard full "UP" and engage tilt lock lever.
13. Slowly remove "Fill" plug to bleed pressure.
14. Remove test gauge hose and adapter.
15. Reinstall Manual Release Valve and secure valve with circlip.
16. Retighten "Fill" plug.

NOTE: *If pressure is less than 1300 PSI (91 kg/cm^2), troubleshoot system per instructions on page 5B-9.*

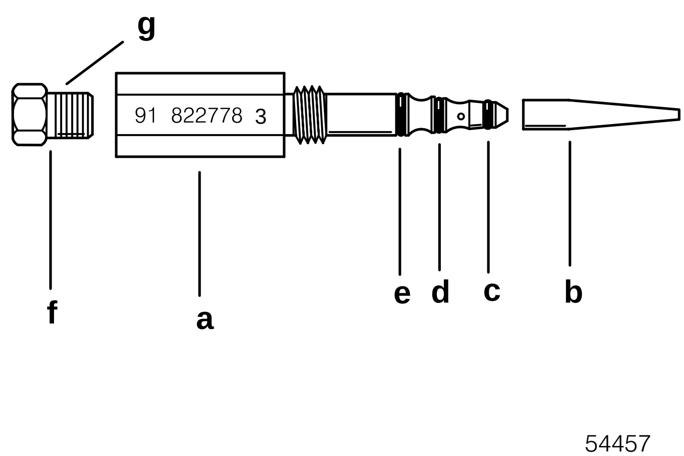
"DOWN" Pressure Check

IMPORTANT: Insure battery is fully charged before performing tests.

1. Tilt outboard to full "Up" position and engage tilt lock lever.
2. Slowly remove "Fill" plug to bleed pressure from reservoir.
3. Remove circlip securing manual release valve and unscrew release valve from trim assembly.

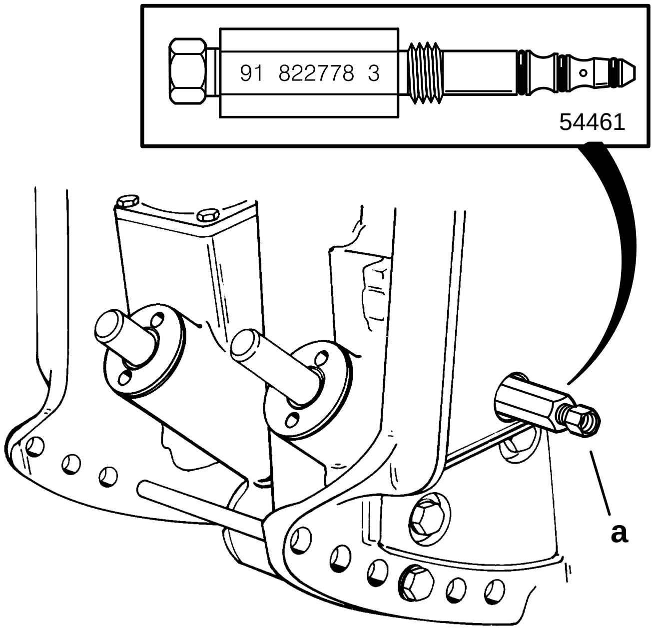
NOTE: *A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.*

NOTE: *Assemble test adaptor by using O-ring installation tool to position small O-ring onto adaptor 1st, then install medium O-ring and lastly large O-ring. Thread brass fitting into test adaptor securely using teflon tape on threads.*



a - Test Adaptor (91-822778A3)
b - O-ring Installation Tool
c - Small O-ring (Install 1st)
d - Medium O-ring (Install 2nd)
e - Large O-ring (Install Last)
f - Brass Fitting
g - Apply Teflon Tape

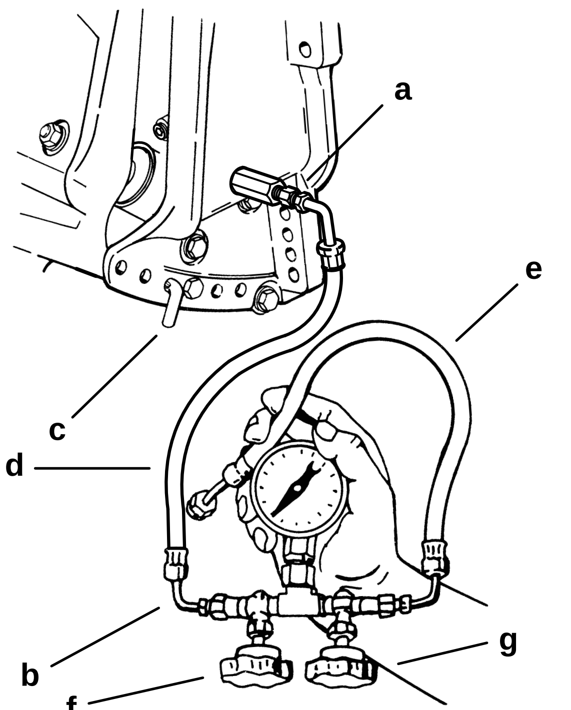
4. Install test adaptor 91-822778A3 into manual release valve hole.



54458

a - Test Adaptor (91-822778A3)

5. Thread hose from Test Gauge Kit (91-52915A6) into brass fitting on adaptor.



54459

a - Brass Fitting
b - Test Gauge Assembly
c - Tilt Pin (Position in Hole Shown)
d - Hose
e - Hose (Not Used)
f - OPEN Valve
g - CLOSE Valve

6. Reinstall fill plug.
7. Disengage tilt lock lever.
8. Open valve (f) and close valve (g).
9. Run trim “DOWN”. Minimum pressure should be 500 P.S.I. (35 kg/cm^2).
10. Tilt outboard full “UP” and engage tilt lock lever.
11. Slowly remove “Fill” plug to bleed pressure.
12. Remove test gauge hose and adaptor.
13. Reinstall manual release valve and secure valve with circlip.
14. Retighten “Fill” plug.

NOTE: *If pressure is less than 500 PSI (35 kg/cm^2), troubleshoot system per instructions on Page 5B-9.*

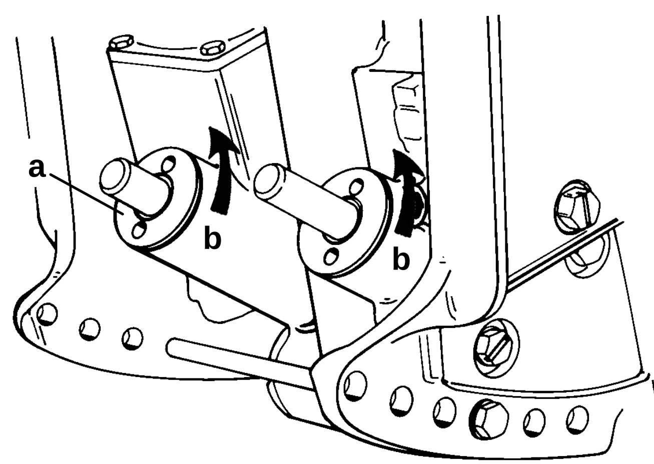
Hydraulic Repair

TRIM ROD REMOVAL AND REPAIR

Note: Power Trim does not have to be removed from outboard to remove trim rods.

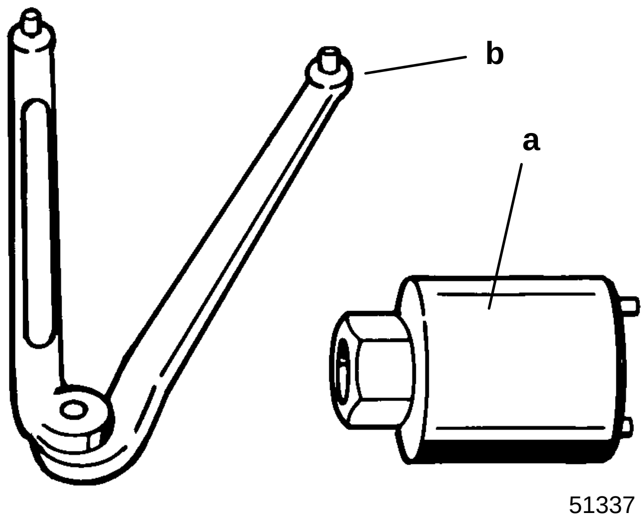
1. Tilt outboard to full “UP” position and engage tilt lock lever.
2. Slowly remove “Fill” plug to bleed reservoir pressure.
3. Turn Manual Release Valve 3 to 4 turns (counterclockwise) to bleed remaining pressure.
4. Remove trim rod cylinder caps.

NOTE: *Place a clean pan under trim system to catch fluid.*



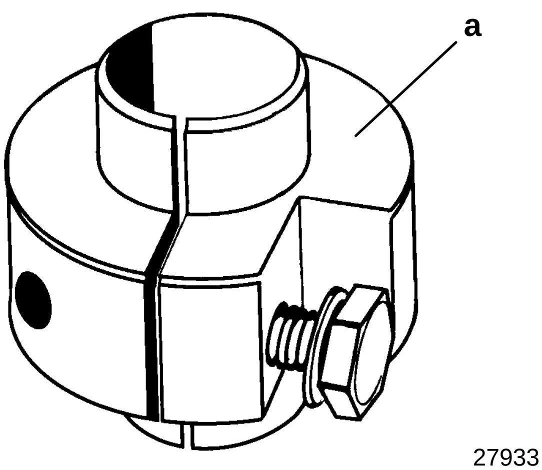
51353

a - Trim Rod Cylinder Cap
b - Turn counterclockwise to remove



a - Removal Tool (91-44487A1)
b - Spanner Wrench (91-74951)

5. Install trim rod removal tool and pull trim rod from cylinder.



a - Trim Rod Removal Tool (91-44486A1)

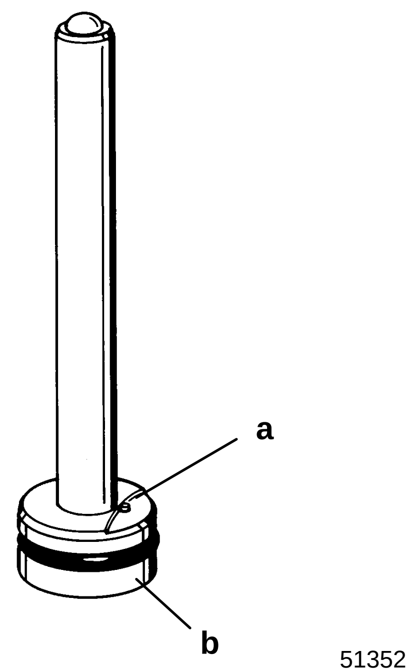
CLEANING AND INSPECTION - TRIM RODS AND CAPS

⚠ CAUTION

Do not remove check valve (a). Check valve is preset to operate at a specific pressure. Removal and installation of check valve could result in improper operating pressure and possible system damage.

NOTE: *Check valve is in port side trim rod only.*

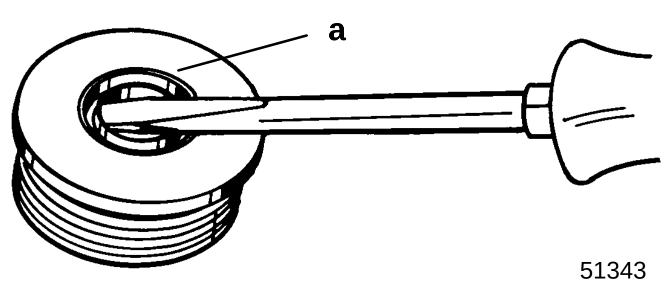
1. Inspect check valve and check valve screen for debris; if debris cannot be removed, replace trim rod assembly. Clean trim rod with parts cleaner and dry with compressed air.



a - Check valve
b - Check valve screen

Trim Rod End Cap Seal

1. Inspect trim cap end seal and replace if damaged or if seal does not keep trim rod clean.



a - Seal (Remove as shown)

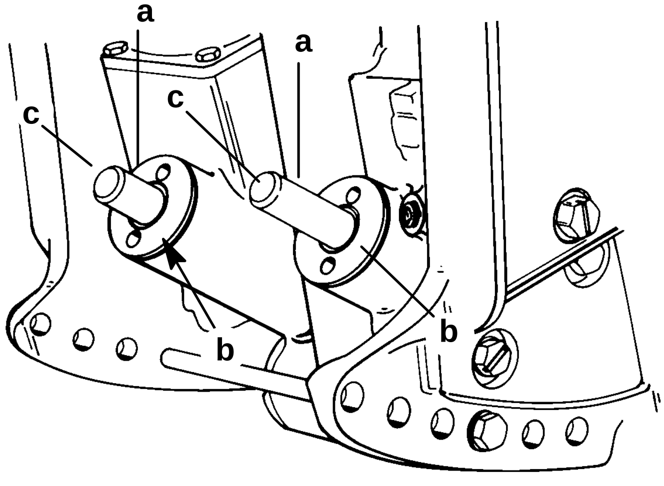
2. Install new seal with seal lip up.

TRIM ROD INSTALLATION

IMPORTANT: Components must be free of dirt and lint. Any debris in the system can cause system to malfunction.

NOTE: *Install trim rod with check valve in the port (left) cylinder.*

1. Apply Quicksilver Power Trim and Steering Fluid on all O-rings and seals before installation.
2. Install trim rods and caps. Use installation tool (91-44487A1) or spanner wrench (91-74951) to tighten caps securely.



51353

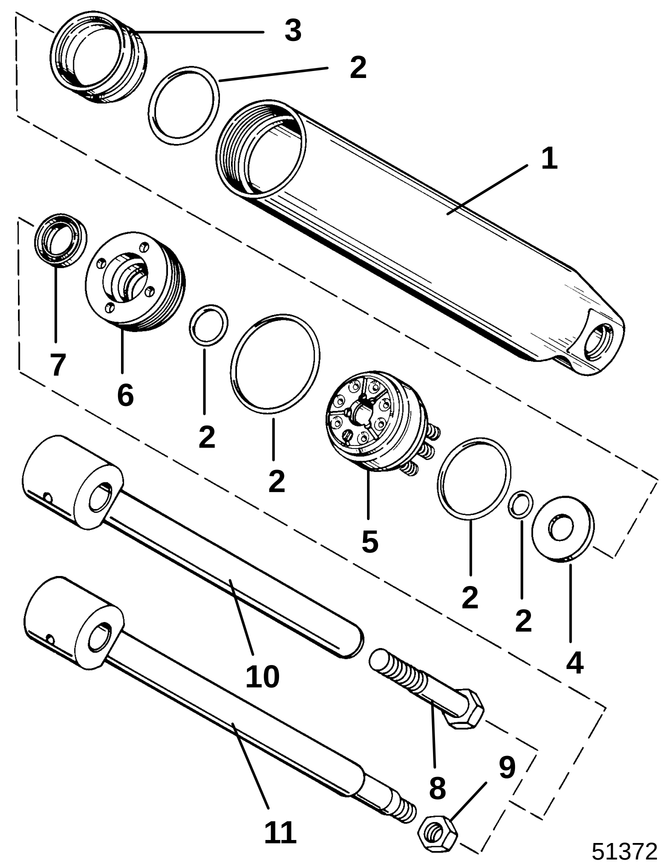
a - Trim rods
b - Cylinder end caps
c - Rod end rollers (lubricate with Quicksilver Anti-Corrosion Grease or Special Lubricant 101)

Tilt Ram

REMOVAL - TILT ROD ASSEMBLY ONLY

NOTE: *Tilt Rod Assembly can be removed from cylinder without removing entire power trim system from outboard.*

TILT RAM COMPONENTS



51372

1 - Housing - Tilt Ram
2 - O-ring* (5)
3 - Memory Piston**
4 - Washer
5 - Piston Assembly
6 - End Cap
7 - Oil Seal
8 - Bolt (Design 1)
9 - Nut (Design 2)
10- Tilt Rod (Design 1)
11- Tilt Rod (Design 2)

*O-ring Repair Kit Available, P.N. 811607A1 (Includes item 7, Oil Seal)

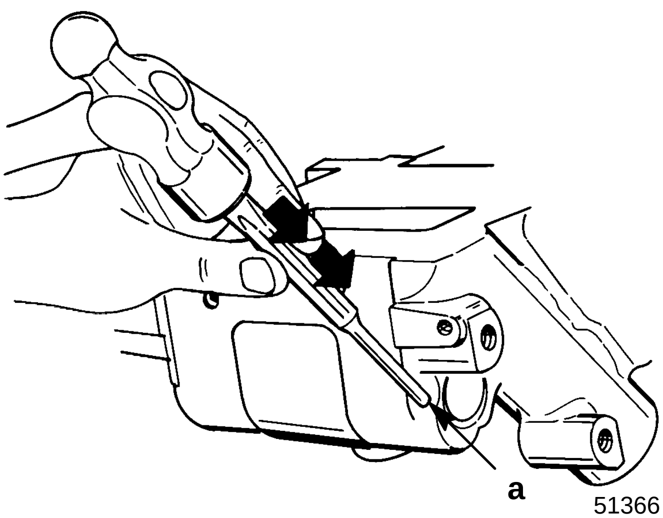
**Memory piston (3) for tilt rods (j and k) are different and must be used with correct tilt rod/cylinder assembly. Memory piston for Design 1 tilt rod is flat, Design 2 is dished to clear nut and thread.

TILT RAM REMOVAL - POWER TRIM SYSTEM REMOVED FROM OUTBOARD

⚠ CAUTION

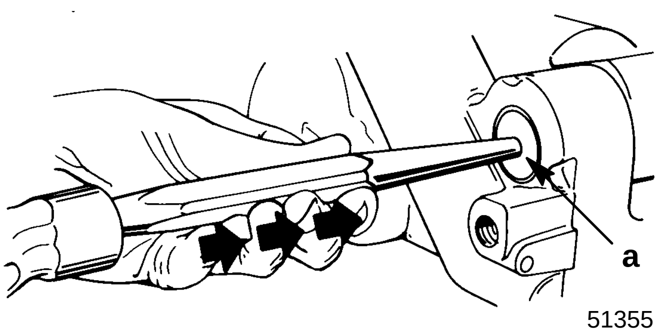
Insure trim system is depressurized prior to tilt ram removal.

1. Remove cross pin.



a - Cross Pin (Remove as shown)

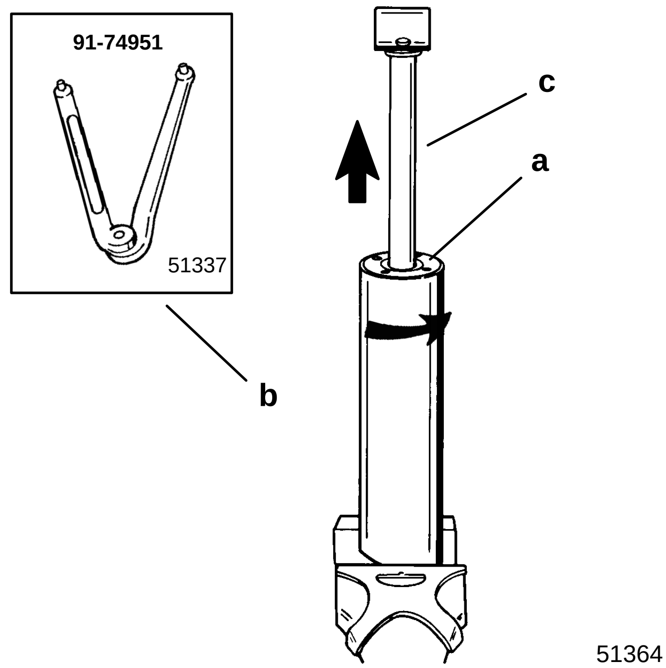
2. Remove lower swivel pin.



a - Lower Swivel Pin (Remove as shown)

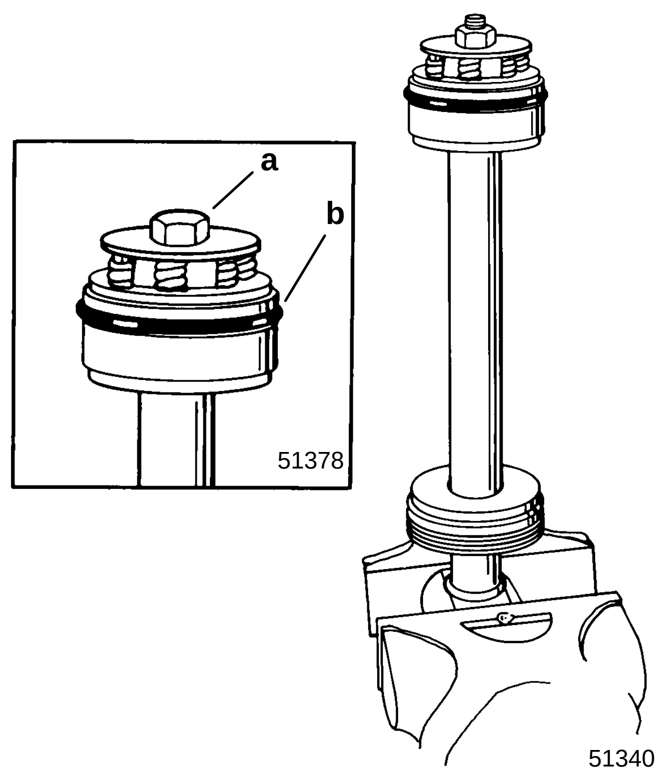
Disassembly

1. Secure tilt ram in a soft jawed vise. Remove tilt rod and cap.



a - Cap (Turn counterclockwise to remove)
b - Spanner wrench (91-74951)
c - Tilt Rod - Pull to remove

2. Clamp tilt rod in a soft jawed vise. Remove bolt or nut as applicable to disassemble rod assembly. Remove O-ring.

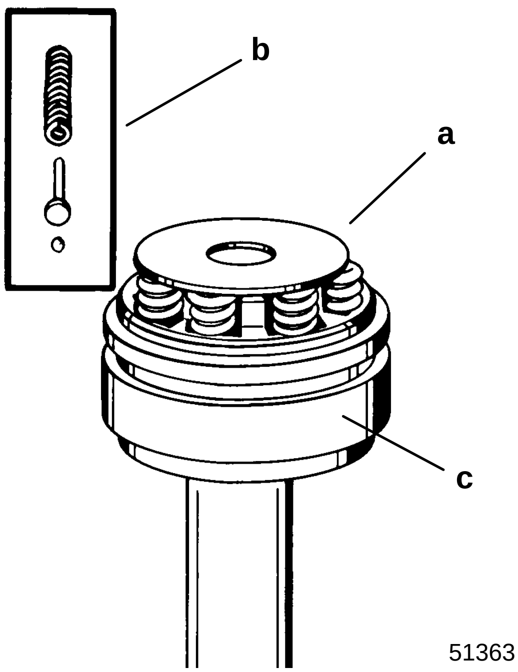


a - Bolt (Design 1) or Stud/Nut (Design 2)
b - O-Ring

IMPORTANT: Note Design 1 and 2 on page 5B-30. Design 1 tilt rod assembly replaces either tilt rod assembly. Either design will fit as a (replace) cylinder assembly complete.
Design 2 will NOT fit a cylinder originally using a Design 1 tilt rod assembly.
Memory Pistons for Design 1 and 2 differ also and must be used only on the cylinder the piston was removed from.

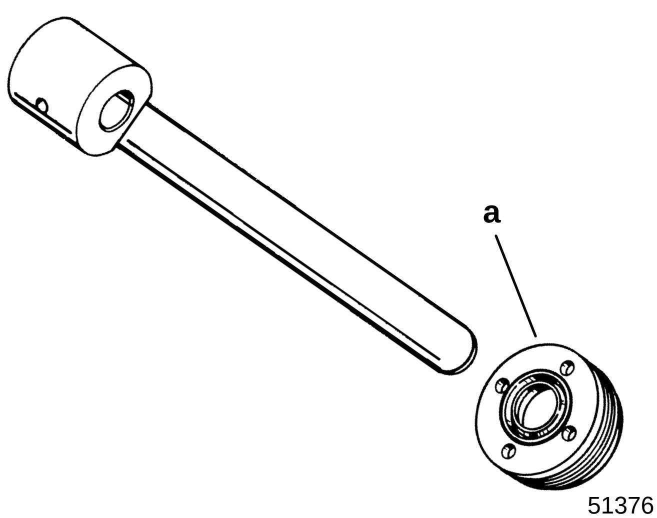
3. Remove washer, check valve assemblies, and piston.

NOTE: *Check valve held in by roll pin can be cleaned but not removed.*



a - Washer
b - Check valve assembly (7)
c - Piston

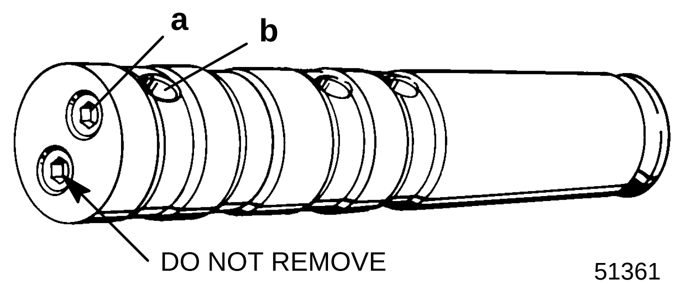
4. Remove end cap from tilt rod.



a - End cap

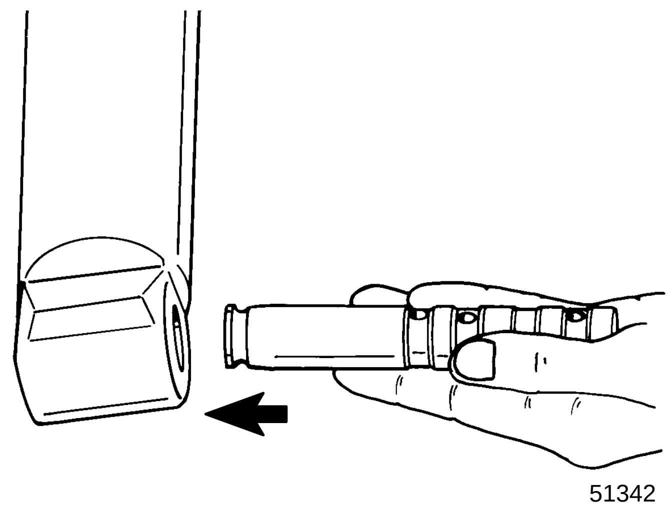
5. Remove allen plug.

IMPORTANT: Remove plug from same side as holes in shaft.

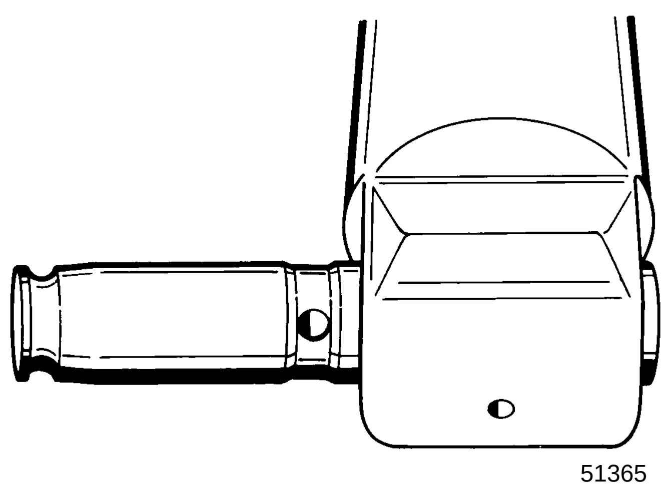


a - Allen plug
b - Hole in shaft

6. Lubricate shaft with Quicksilver Power Trim and Steering Fluid. Insert shaft into cylinder.



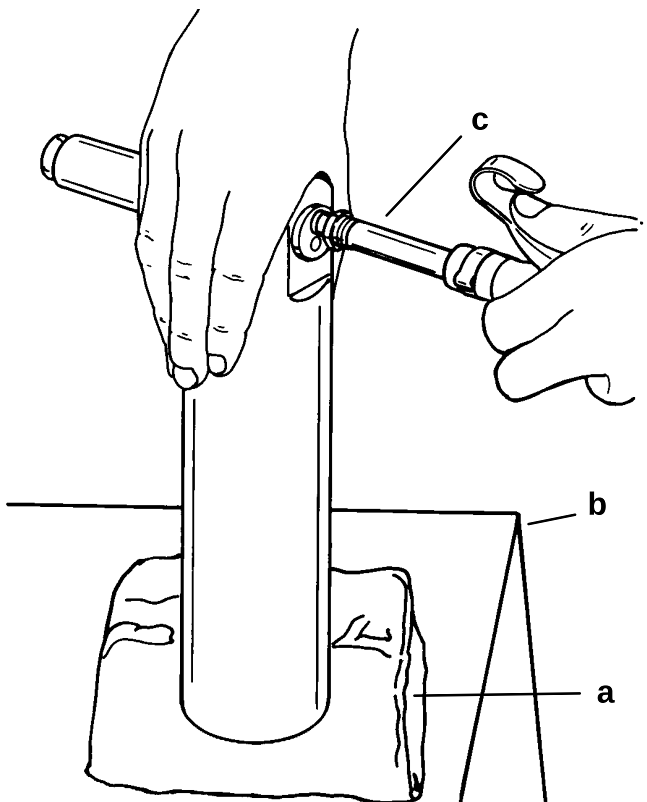
7. Tap shaft into cylinder until shaft is positioned as shown.



⚠ WARNING

Memory Piston Cup may be expelled at a high velocity when air pressure is applied. Failure to place cylinder as shown below could result in personal injury.

8. Place cylinder as shown. Hold down on cylinder and inject air into shaft opening.



51353

a - Shop Cloth
b - Solid surface
c - Air nozzle

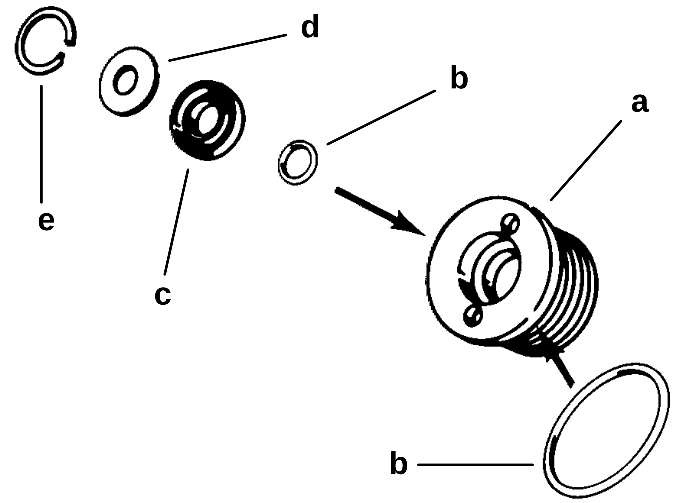
9. Remove shaft after Memory Piston Cup has been expelled. Replace allen plug removed in Step 5 and tighten securely.

CLEANING AND INSPECTION

1. Inspect all internal parts for damage or wear. Clean and replace parts as necessary.
2. Inspect tilt rod for scratches. Replace scraper seal in rod end cap if tilt rod is scratched or worn.
3. Slight scratches or tool marks less than 0.005 in. (0.1 mm) deep in cylinder are acceptable.

Scraper Seal Replacement

1. Remove components from end cap.



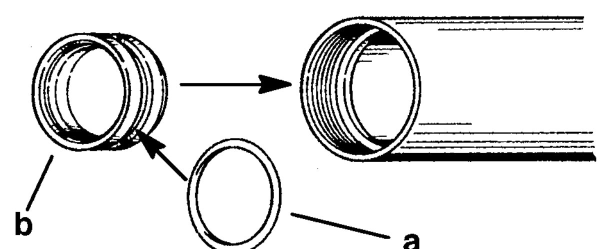
a - Cap
b - O-ring (2)
c - Scraper seal
d - Washer
e - Retaining ring

REASSEMBLY

IMPORTANT: Components must be clean for reassembly. Any debris in the system can cause the system to malfunction.

NOTE: *Refer to "Tilt Ram Components" for proper O-ring sizes.*

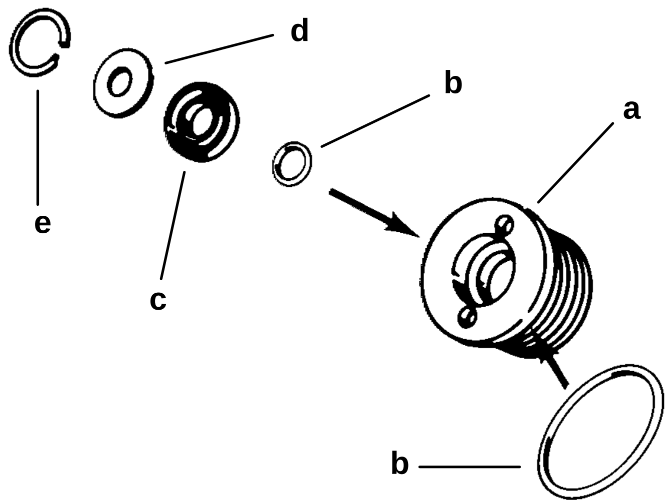
1. Apply Quicksilver Power Trim and Steering Fluid on O-rings prior to reassembly.
2. Install O-ring on Memory Piston Cup and install in cylinder.



51372

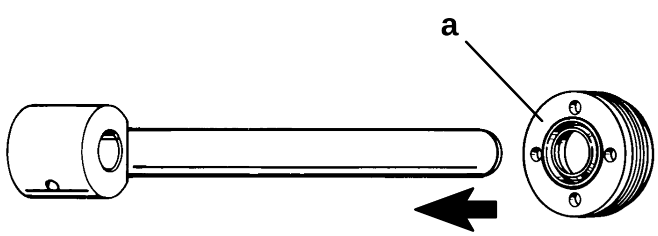
a - O-ring
b - Memory piston cup (Design 1 shown)

3. Assemble end cap.



a - End Cap
b - O-ring (2)
c - Scraper seal
d - Washer
e - Retaining ring

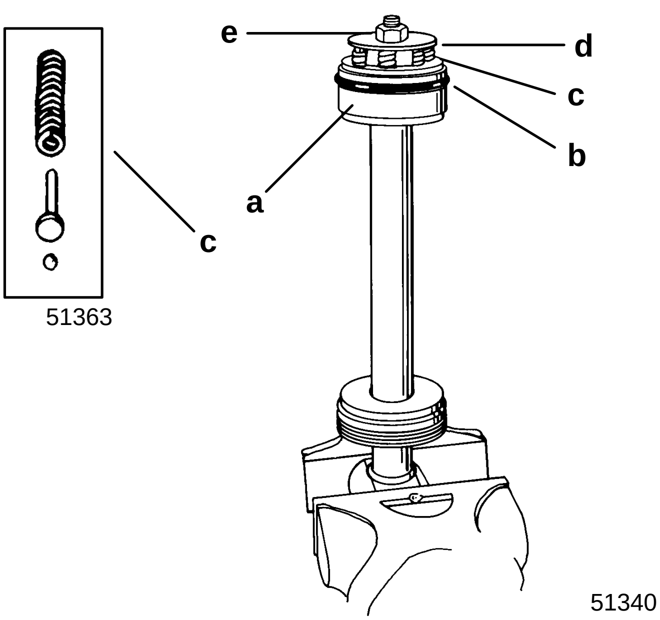
4. Install end cap.



51376

a - End Cap

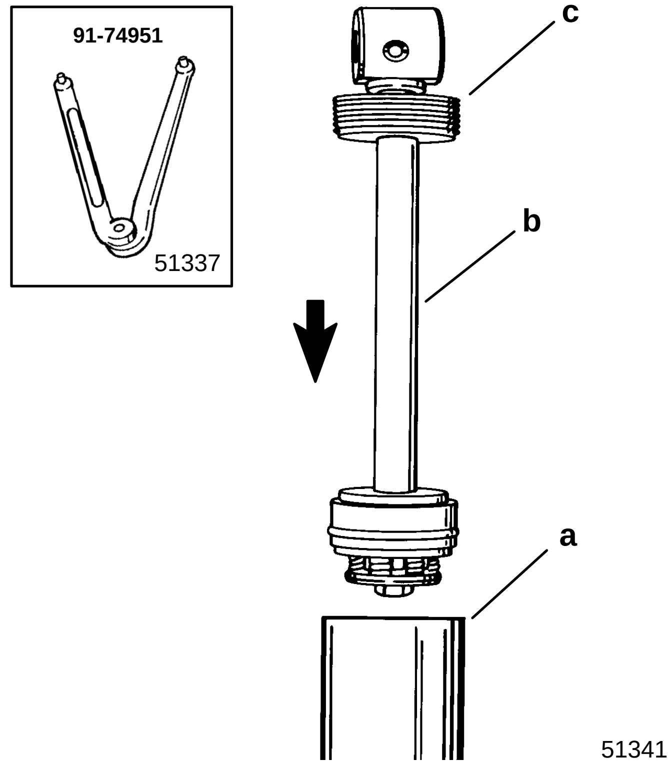
5. Install components on rod.



51340

a - Piston
b - O-ring
c - Check valve assembly (7)
d - Washer
e - Bolt or Locknut. (Tighten securely)

6. Clamp cylinder in a soft jawed vise and install tilt rod assembly. Use spanner wrench and tighten end cap securely.

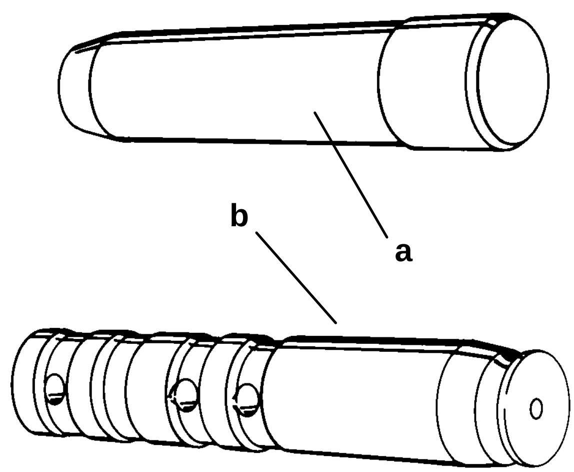


51341

a - Cylinder
b - Tilt rod assembly
c - End cap (Tighten securely.) Use spanner wrench.

TILT RAM ASSEMBLY INSTALLATION

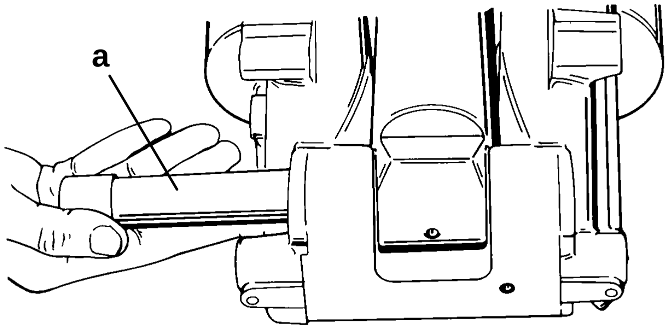
1. Lubricate alignment tool (91-11230) and shaft. Use Quicksilver Power Trim and Steering Fluid.



51369

a - Alignment Tool (91-11230)
b - Shaft

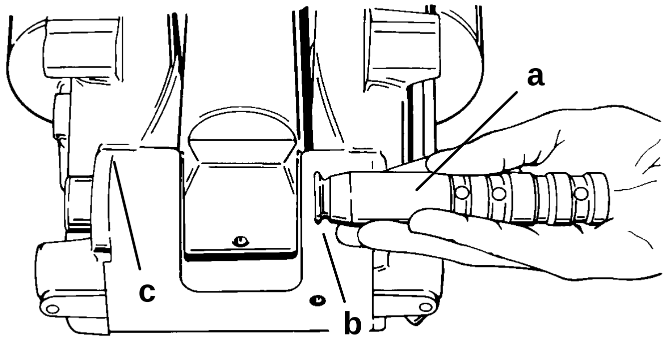
2. Align tilt ram and housing using alignment tool.



51348

a - Alignment Tool (91-11230)

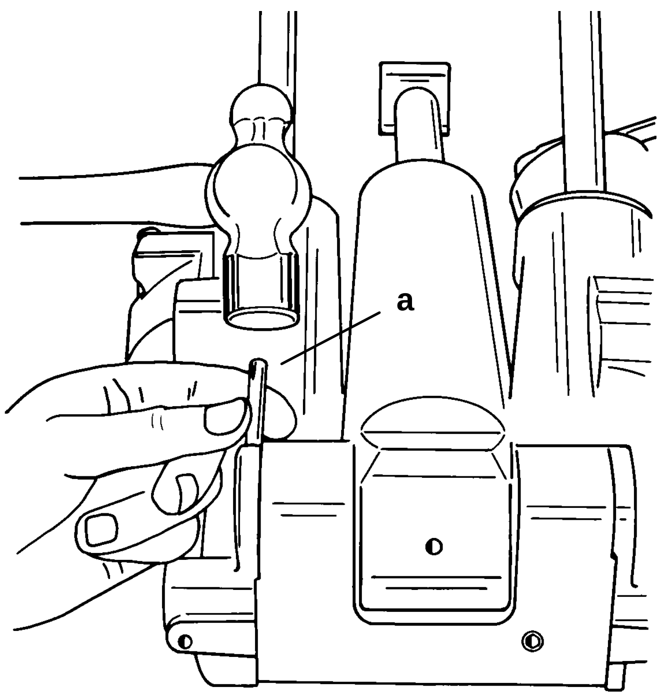
3. Install shaft.



51352

a - Shaft
b - Groove
c - Hole [groove (b) will align with this hole]

4. Drive pin in until flush.



51356

a - Pin (Drive Against Knurled End)

5. Install Power Trim Assembly on outboard. Refer to “Installation” instructions on page 5B-24.

MOTOR AND PUMP REPLACEMENT (SQUARE MOTOR)

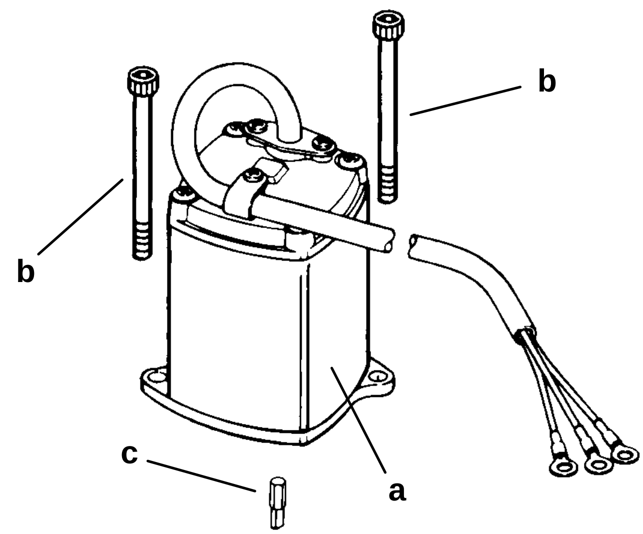
IMPORTANT: The pump is not rebuildable. If pump is defective, replace as an assembly.

NOTE: *Power Trim System does not have to be removed from outboard to replace pump or motor.*

1. Tilt outboard to full “UP” position. Depressurize power trim system, and loosen starboard transom bracket as outlined in **“Removal and Installation”** on page 5B-22.

2. Remove 2 screws to remove motor from system.

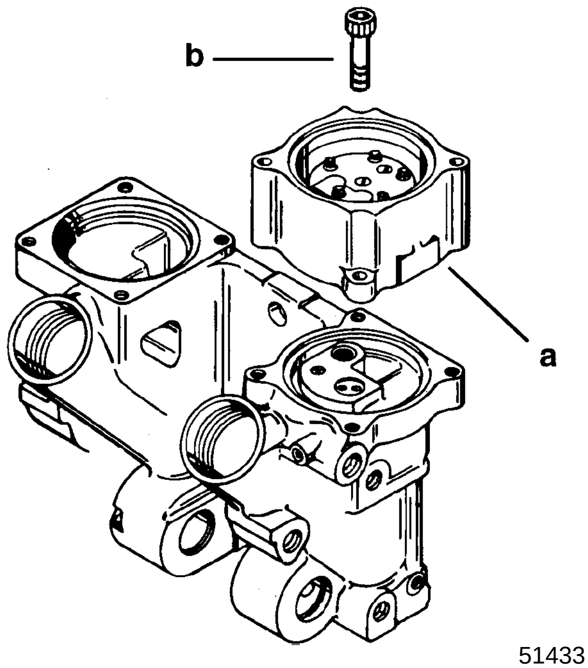
NOTE: *Driveshaft is a loose part and may fall out of motor when motor is removed.*



51433

a - Motor
b - Screw (2)
c - Driveshaft

3. Remove two screws to remove pump.



a - Pump
b - Screw (2)

Motor and Electrical Tests/ Repair (Square Motor)

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammable materials, as a spark may occur while making electrical connections.

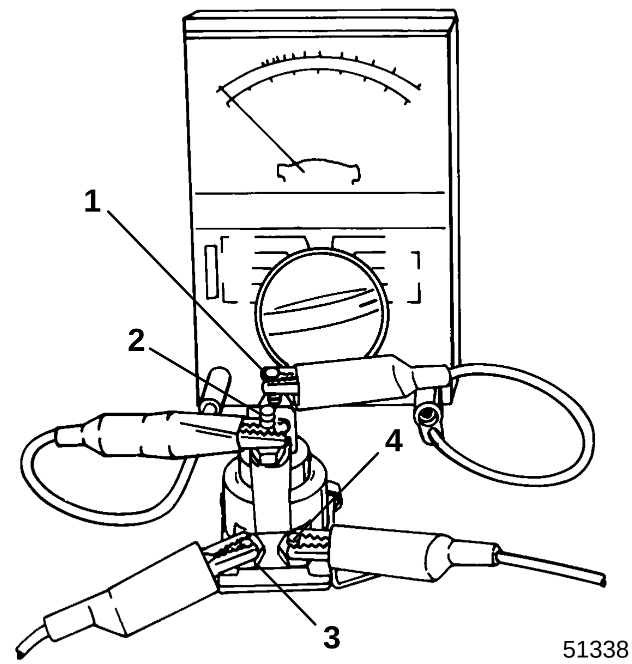
1. Connect a 12 volt power supply to motor wires [positive (+) to blue wire and negative (-) to black wire]. Motor should run. Disconnect blue wire and connect green wire to positive (+) terminal of power supply. Motor should run.
2. If motor does not run, disassemble and check components.

Solenoid Test

⚠ WARNING

Do not perform this test near flammable materials, as a spark may occur while making electrical connections.

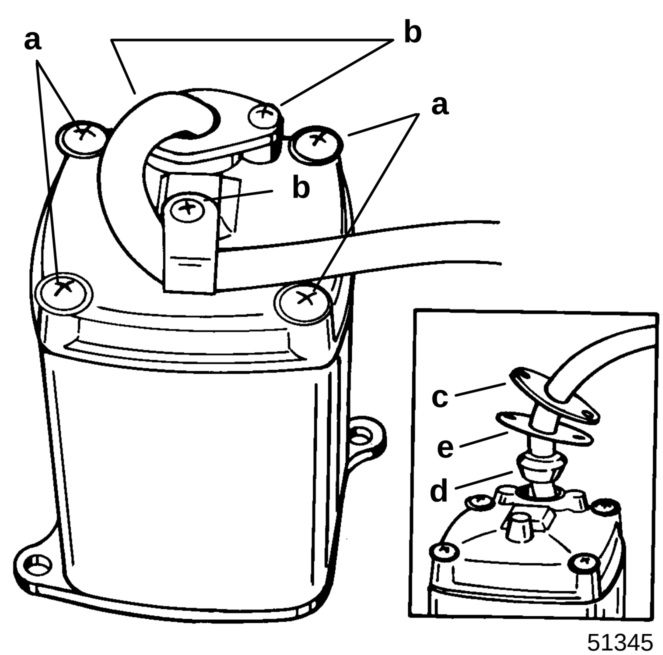
1. Disconnect all wires from solenoid terminals.
2. Set an Ohmmeter to Rx1 scale and connect meter leads to solenoid terminals 1 and 2.
3. Connect a 12 volt power supply to terminals 3 and 4. Solenoid should click and meter should read zero (0) ohms (full continuity).



4. If meter does not read zero (0) ohms, replace solenoid.

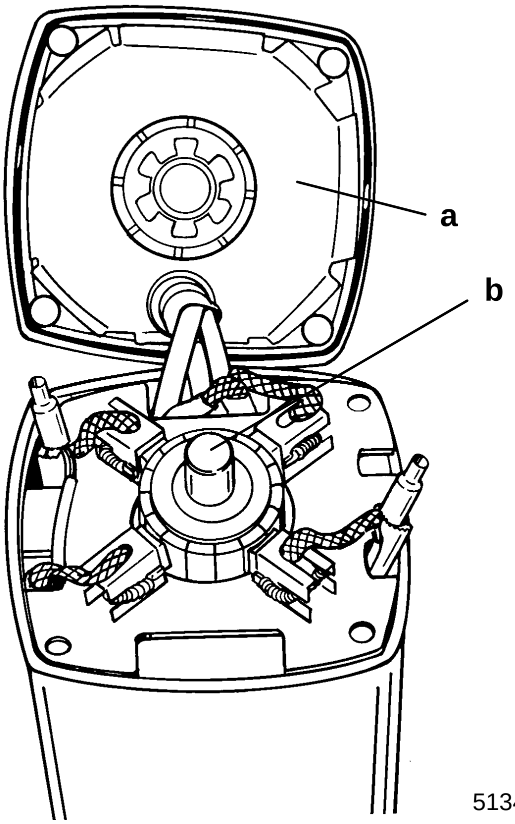
Motor Disassembly

1. Remove screws and clamp.



a - Screw (4)
b - Screw (3)
c - Clamp
d - Grommet
e - Gasket

2. Lift motor from end cap. Use care not to drop armature.



51349

a - End Cap
b - Armature

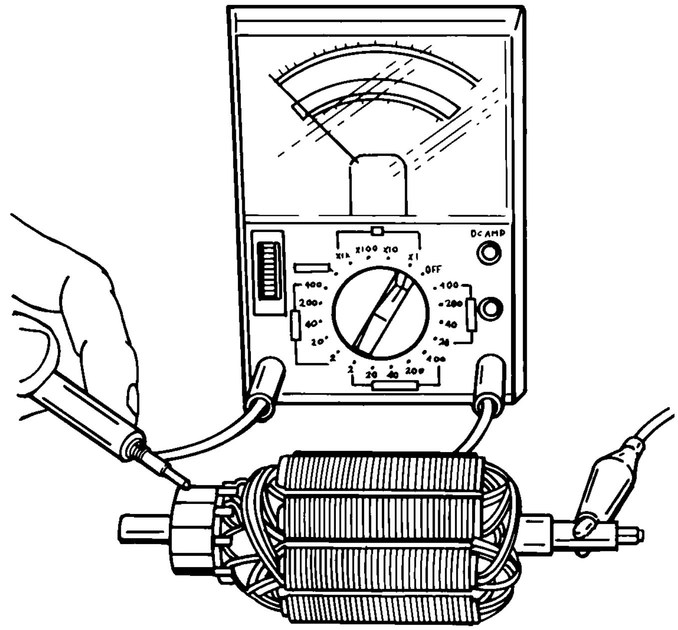
Armature Tests

TEST FOR SHORTS

Check armature on a Growler per the Growler manufacturer's instructions. Replace armature if a short is indicated.

TEST FOR GROUND

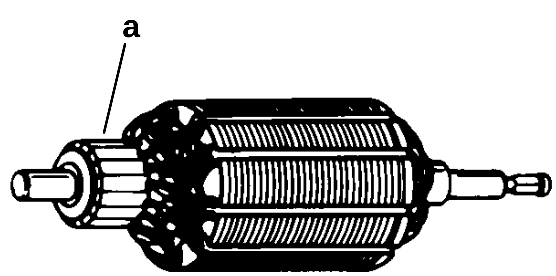
1. Use an Ohmmeter (Rx1 scale). Connect one lead on armature shaft and other lead on commutator. If continuity is indicated, armature is grounded. Replace armature.



51359

CHECKING AND CLEANING COMMUTATOR

1. If commutator is worn it may be turned on an armature conditioner or a lathe.
2. Clean commutator with "OO" sandpaper.



a - Commutator

FIELD TESTS

IMPORTANT: Commutator end of armature must be installed in brushes when performing the following tests.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x________)
Green and Blue Motor Wires	0	Full Continuity (Rx1)
Green and Black Motor Wires	0	Full Continuity (Rx1)
Blue and Black Motor Wires	0	Full Continuity (Rx1)
Black Motor Wire, and Frame (Motor Housing	No Continuity	Full Continuity (Rx1)
Green Motor Wire, and Frame	No Continuity	Full Continuity (Rx1)
Blue Motor Wire, and Frame	No Continuity	Full Continuity (Rx1)

*If specified readings are not obtained, check for:

- defective armature
- dirty or worn brushes
- dirty or worn commutator

If defective components are found, repair or replace component(s) and retest.

Motor Repair

REMOVAL

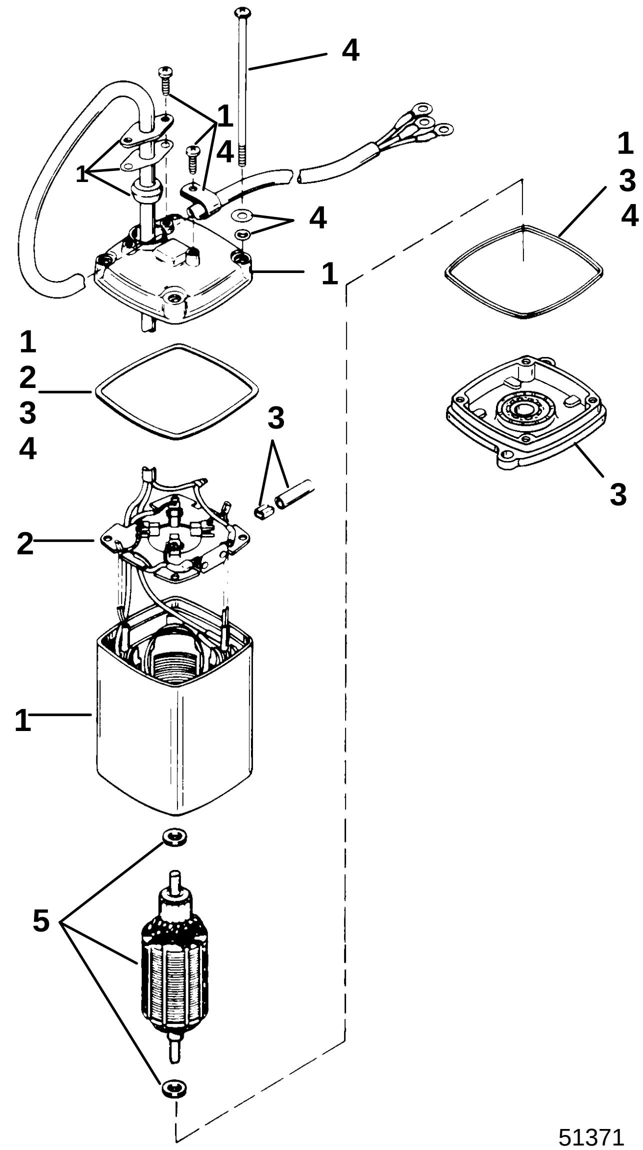
NOTE: *Power Trim System does not have to be removed from outboard to repair/replace motor.*

DISASSEMBLY

Refer to **"Motor and Pump Replacement"** on page 5B-22 to disassemble motor from pump.

CLEANING AND INSPECTION

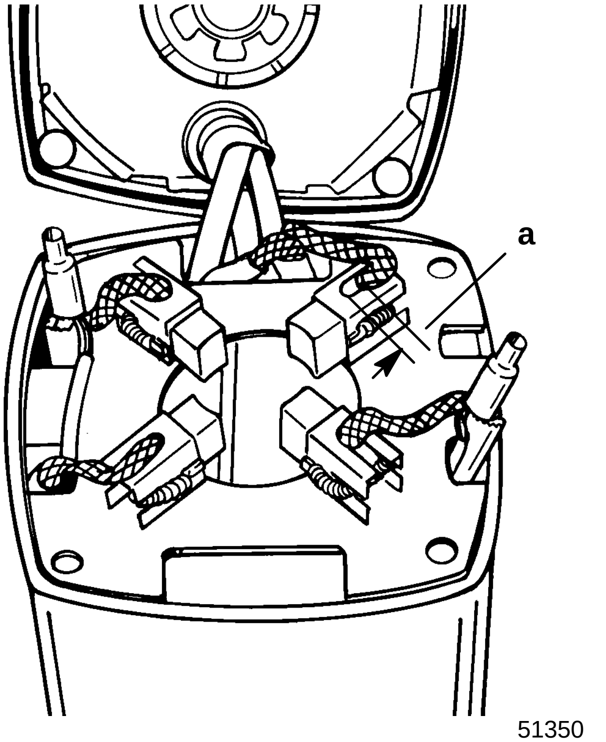
Inspect O-rings and replace if necessary. Clean, inspect, and test motor components. Refer to **"Brush Replacement"**, **"Armature Test"**, and **"Field Tests"** for inspection and test procedures.



Power Trim Motor
1. Frame and Field Kit
2. Brush Card Kit
3. End Frame Kit
4. Seal Kit
5. Armature Kit

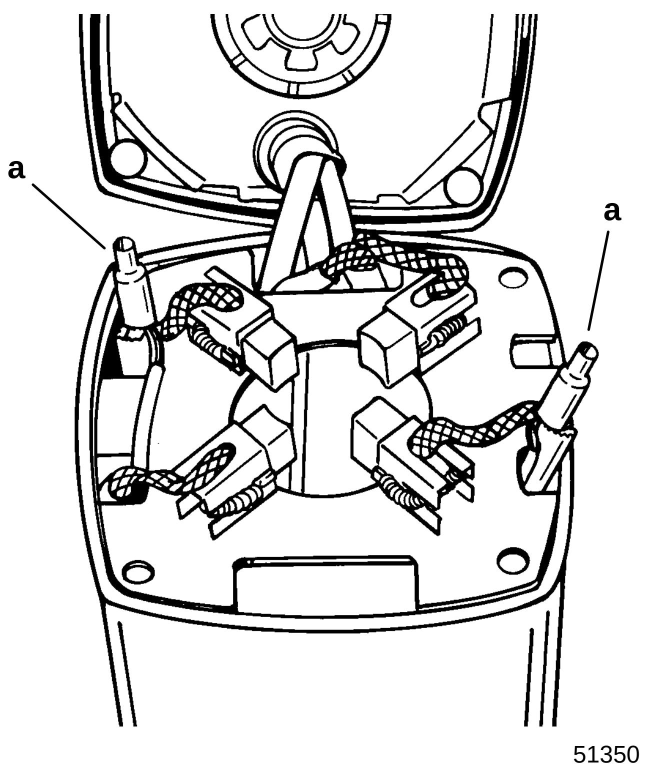
BRUSH REPLACEMENT

1. Brush replacement is required if brushes are pitted, chipped, or if distance (a) between the brush pigtail and end of brush holder slot is 1/16 in. or less. Check distance with armature installed.



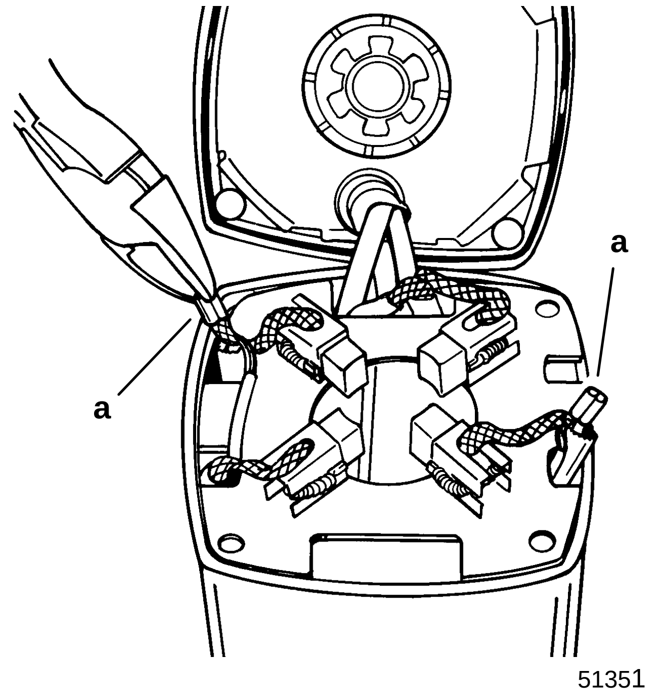
a - 1/16 in.

2. To replace brush card, remove insulators.



a - Insulators

3. Remove metal connectors.



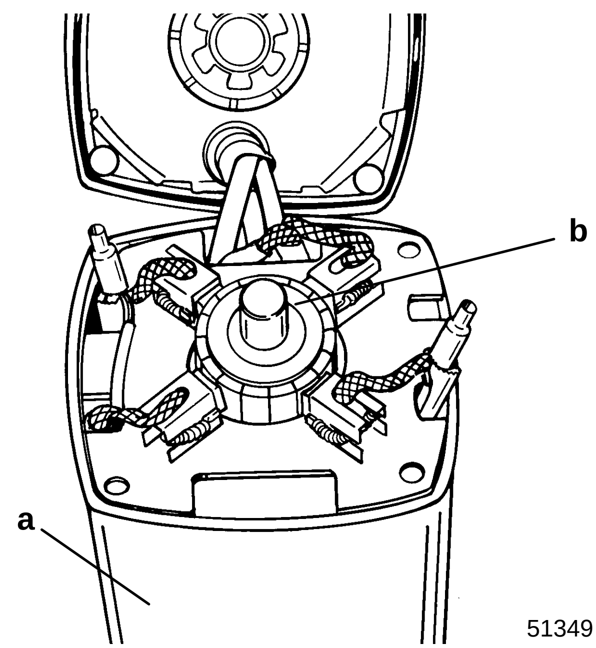
a - Metal Connectors

4. Install new brush card.
5. Crimp new metal connectors onto wires.
6. Insulate connections with heat shrink tubing.

Reassembly

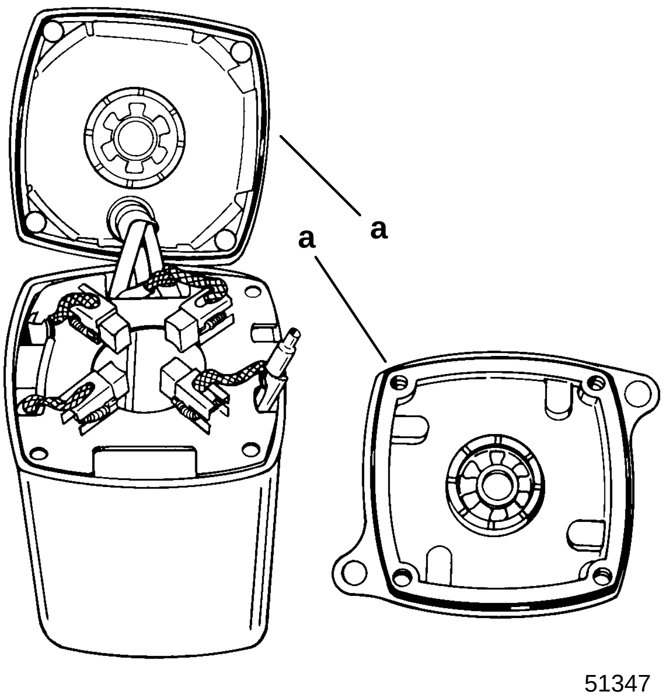
IMPORTANT: Components must be clean. Any debris in power trim system can cause system to malfunction.

1. Install armature in motor housing.



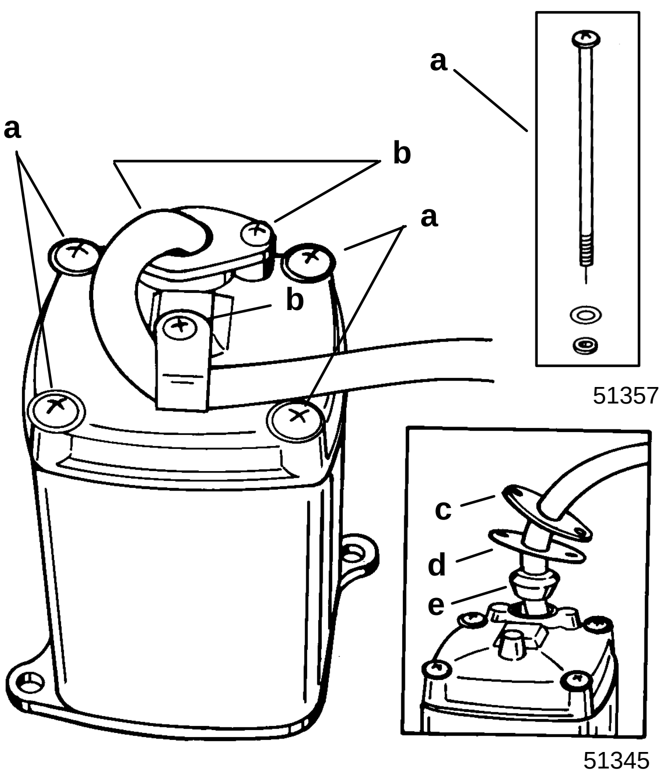
a - Motor Housing
b - Armature (Spread brushes to insert commutator.)

2. Install O-rings in end caps.



a - O-rings

3. Install screws and clamp. Tighten screws securely.



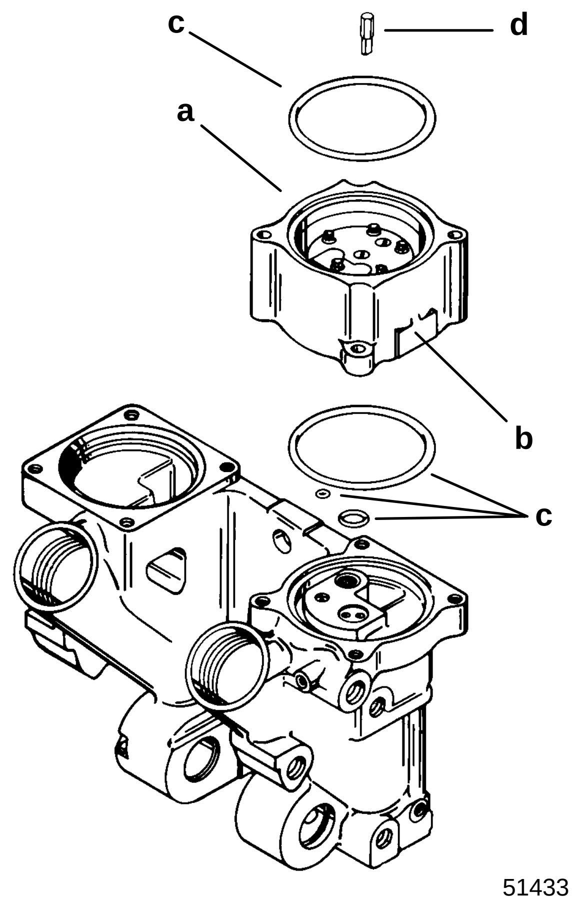
a - Screw (4) Contains flat washer and O-ring. Torque screws to 60 lb. in. (7.0 N·m).
b - Screw (3)
c - Clamp
d - Gasket
e - Grommet

Reassembly - Motor and Pump

NOTE: *Driveshaft is a loose part and may fall out of position.*

1. Install pump onto power trim manifold. Insure O-rings are in proper locations. Secure with two (2) screws. Torque screws to 80 lb. in. (9.0 N·m).

IMPORTANT: Install pump with location flat facing towards starboard transom bracket.

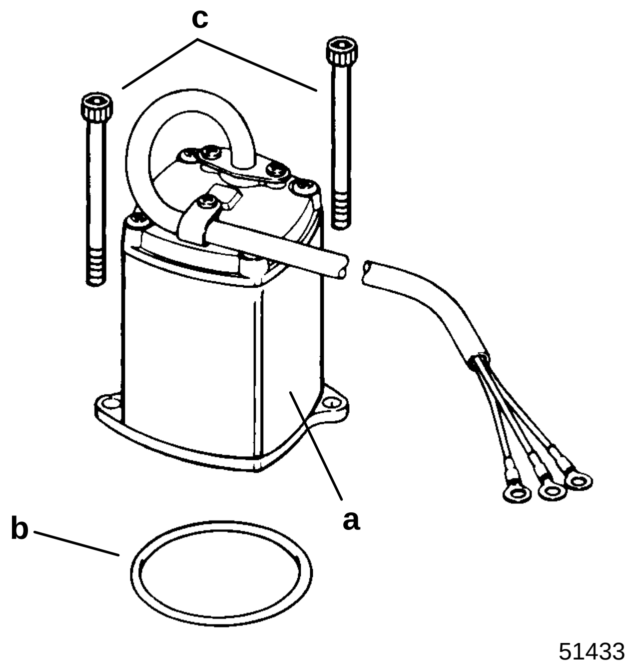


a - Pump (Flat towards starboard transom bracket)
b - Flat - faces starboard transom bracket)
c - O-rings (4)
d - Driveshaft (Install in **center** hole in pump)

2. Fill pump with Quicksilver Power Trim and Steering Fluid prior to installing motor.

3. Install motor, secure with two (2) screws. Torque screws to 80 lb. in. (9.0 N·m). Route wiring; refer to Wiring Diagrams in this service manual.

NOTE: Insure motor and driveshaft are aligned.



a - Motor
b - O-ring
c - Screw (2) – Torque to 80 lb. in. (9.0 N·m)

4. Complete reassembly of Power Trim System as outlined in **"Installation"** on page 5B-24.

Priming Power Trim System

1. Fill system with Quicksilver Power Trim and Steering Fluid or Automatic Transmission Fluid (ATF) Type F, FA Dexron II or Dexron III. Refer to **"Fill, Check, and Purge"** on page 5B-8.

IMPORTANT: Run Trim System in short "jogs" until pump motor primes and trim system moves. If trim motor is run without priming pump, drive-shaft failure could result.

MOTOR AND PUMP REPLACEMENT

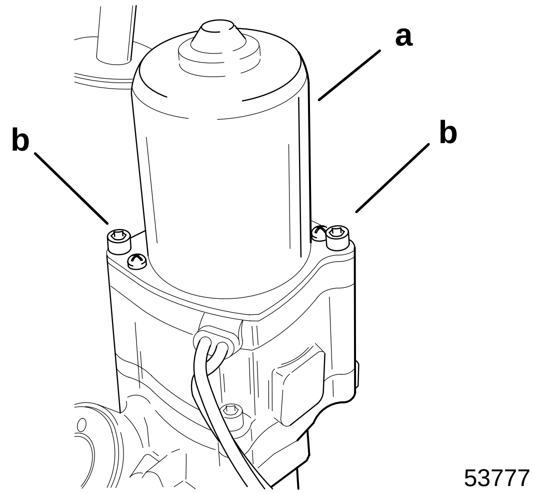
IMPORTANT: The pump is not rebuildable. If pump is defective, replace as an assembly.

***NOTE:** Power Trim System does not have to be removed from outboard to replace pump or motor.*

1. Tilt outboard to full "UP" position. Depressurize power trim system, and loosen starboard transom bracket as outlined in **"Removal and Installation"** on page 5B-22.

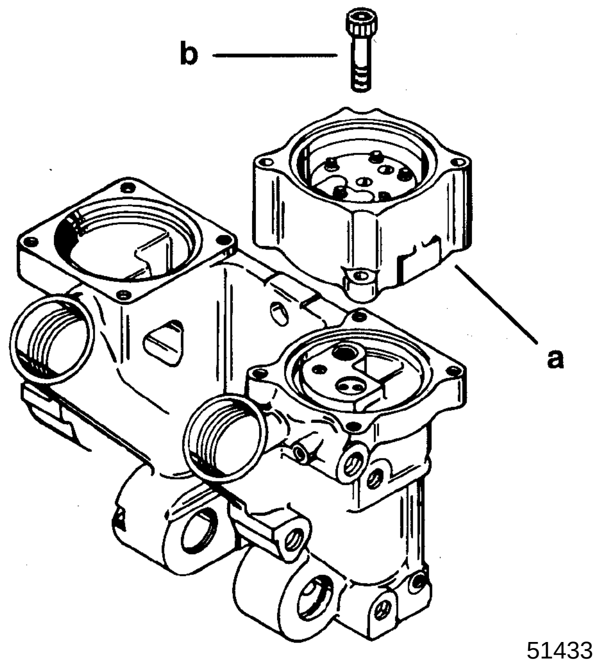
2. Remove 2 allen screws to remove motor from system.

***NOTE:** Drive shaft is a loose part and may fall out of motor when motor is removed.*



a - Motor
b - Screw (2)

3. Remove two screws to remove pump.



a - Pump
b - Screw (2)

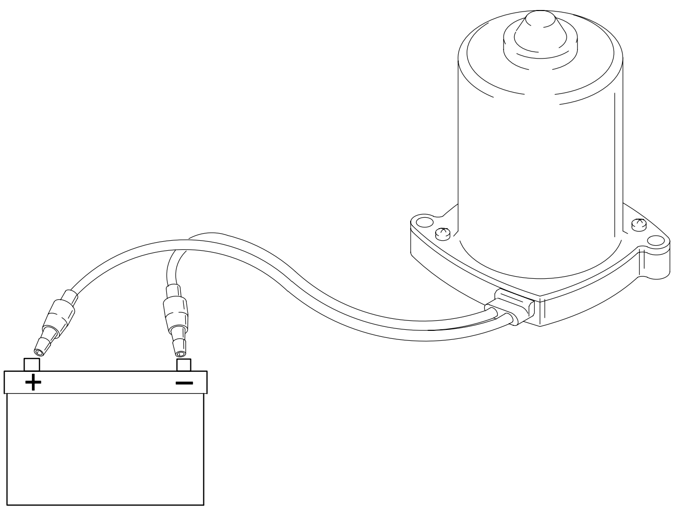
Motor and Electrical Tests/ Repair (Round Motor)

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammable materials, as a spark may occur while making electrical connections.

1. Connect a 12 volt power supply to motor wires; one motor lead to POSITIVE (+) battery terminal and the other motor lead to the NEGATIVE (–) battery terminal. Motor should run. Reverse motor leads between battery terminals. Motor should run.

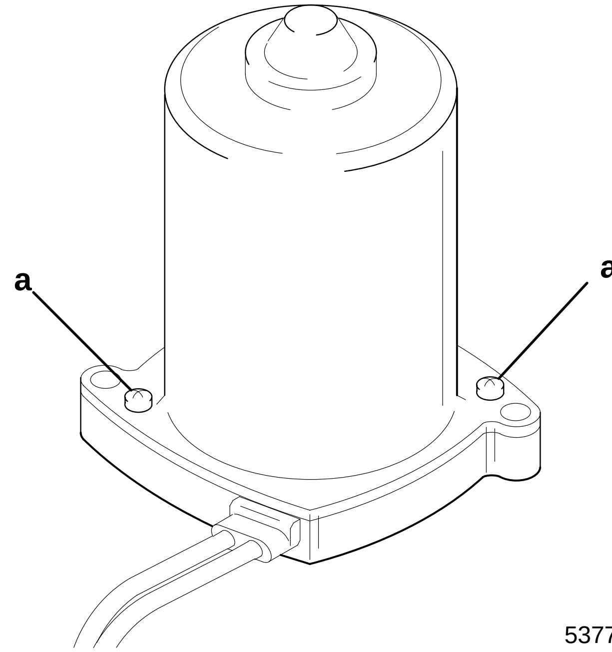


53774

2. If motor does not run, disassemble and check components.

Motor Disassembly

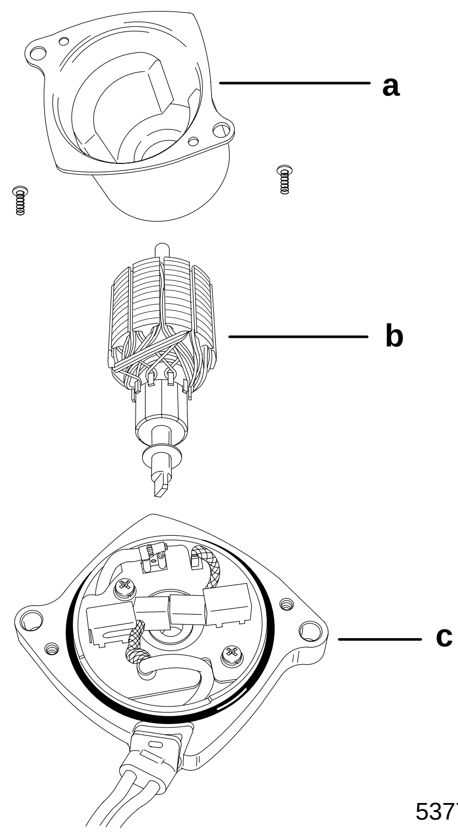
1. Remove 2 screws.



53774

a - Screw (2)

2. Remove frame and armature from end cap. Use care not to drop armature.



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a - Frame
b - Armature
c - End Cap

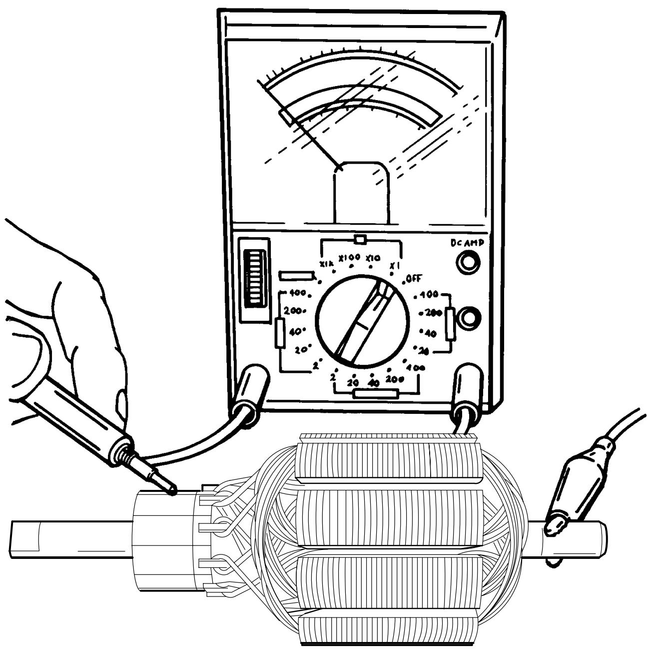
Armature Tests

TEST FOR SHORTS

Check armature on a Growler per the Growler manufacturer's instructions. Replace armature if a short is indicated.

TEST FOR GROUND

1. Use an Ohmmeter (Rx1 scale). Connect one lead on armature shaft and other lead on commutator. If continuity is indicated, armature is grounded. Replace armature.



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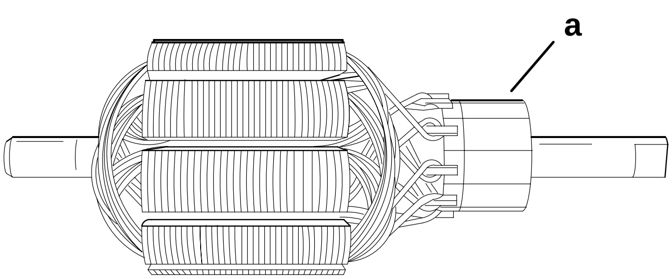
CHECKING AND CLEANING COMMUTATOR

1. If commutator is worn it may be turned on an armature conditioner or a lathe.
2. Clean commutator with "OO" sandpaper.



53775

a - Commutator

FIELD TESTS

IMPORTANT: Commutator end of armature must be installed in brushes when performing the following tests.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x______)
BLUE and BLACK Motor Wires	0	(Rx1)
BLACK Motor Wire, and Frame (Motor Housing)	No Continuity	(Rx1)
BLUE Motor Wire and Frame	No Continuity	(Rx1)

*If specified readings are not obtained, check for:

- defective armature
- dirty or worn brushes
- dirty or worn commutator

If defective components are found, repair or replace component(s) and retest.

Motor Repair

REMOVAL

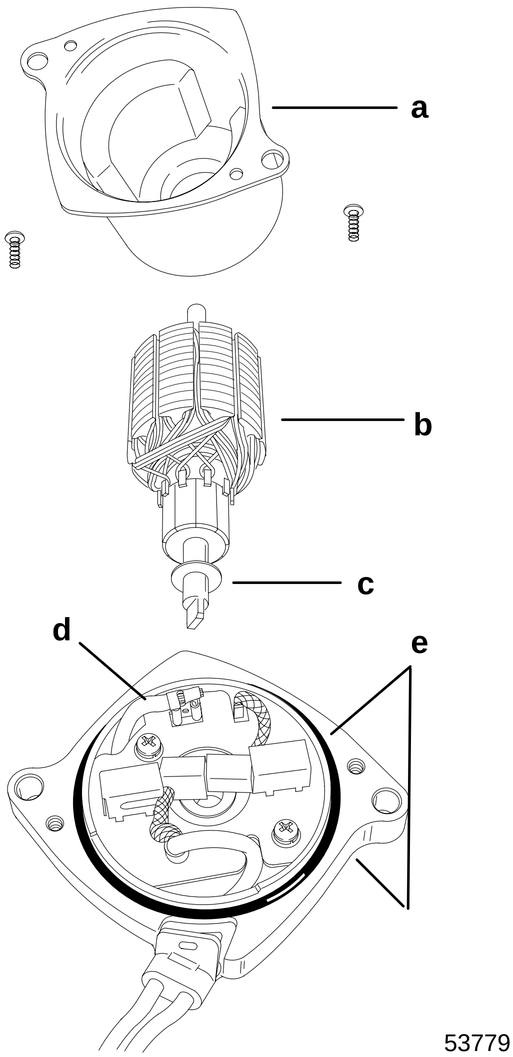
NOTE: *Power Trim System does not have to be removed from outboard to repair/replace motor.*

DISASSEMBLY

Refer to **"Motor Disassembly"** on page 5B-22 to disassemble motor from pump.

CLEANING AND INSPECTION

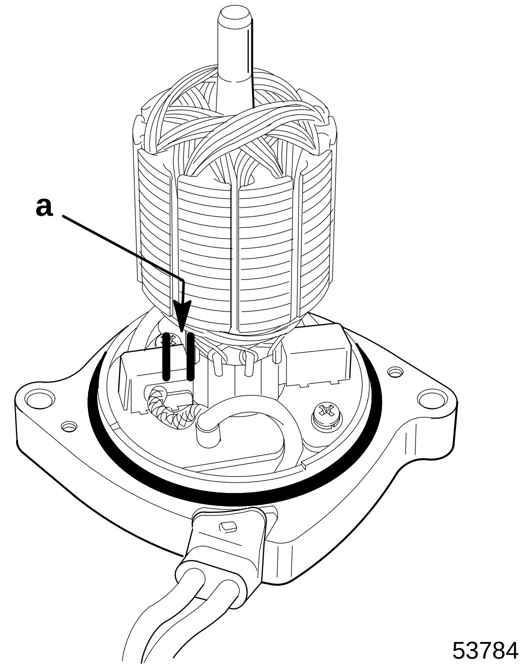
Inspect O-rings and replace if necessary. Carefully inspect power cord for cuts or tears which will allow water to enter motor. Replace cord if cut or torn. Clean, inspect, and test motor components. Refer to **"Brush Replacement"**, **"Armature Test"**, and **"Field Tests"** for inspection and test procedures.



a - Frame
b - Armature
c - Shim
d - Brush Card Assembly
e - O-rings

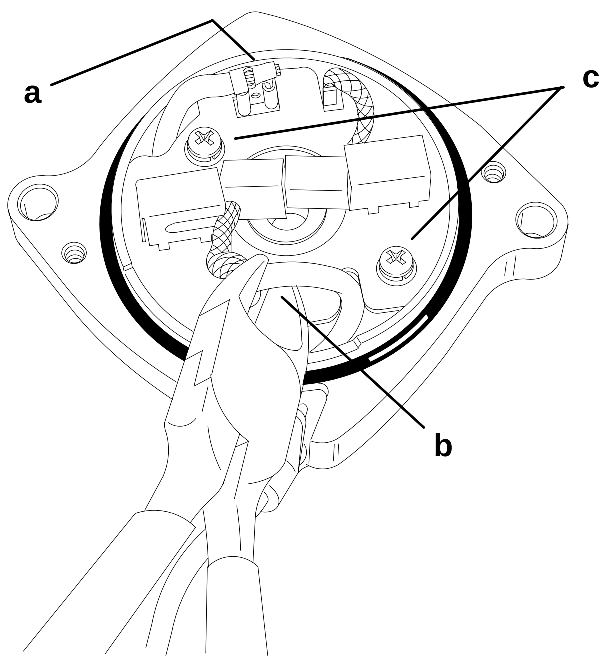
BRUSH REPLACEMENT

1. Brush replacement is required if brushes are pitted, chipped, or if distance (a) between the brush pigtail and end of brush holder slot is 1/16 in. or less. Check distance with armature installed.



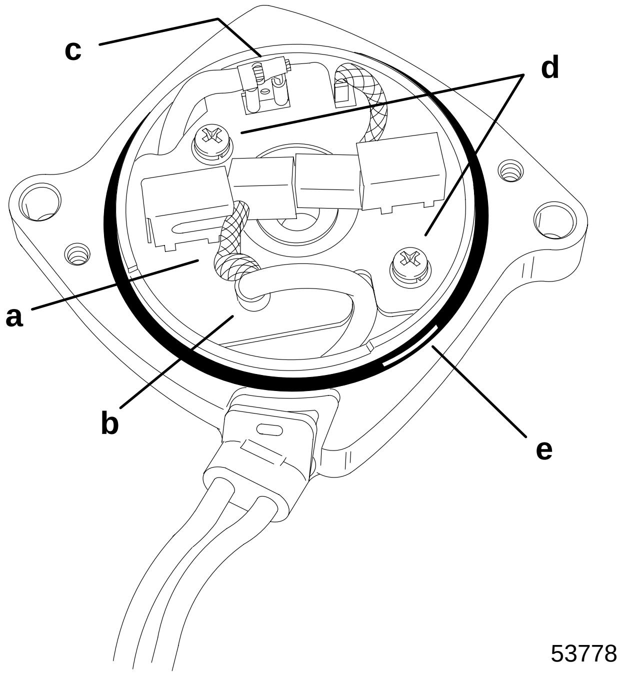
a - 1/16 in.

2. To replace brush card, disconnect spade terminal.
3. Cut crimped brush lead.
4. Remove 2 screws securing brush card to end cap.



a - Spade Terminal
b - Crimped Brush Lead
c - Screws

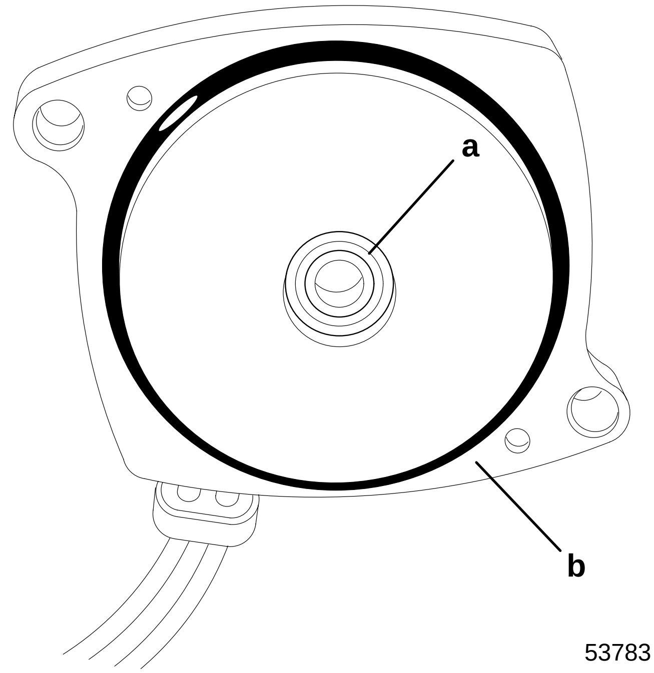
5. Install new brush card (BRUSH and SEAL KIT 828714A1).
6. Crimp metal connector onto motor lead and new brush lead.
7. Connect spade connector motor lead to brush card connector.
8. Secure brush card to end cap with 2 screws and lockwashers.
9. Inspect O-ring for cuts and abraisions. Replace O-ring as required (BRUSH and SEAL KIT 828714A1).



a - Brush Card
b - Metal Connector
c - Spade Connector
d - Screws and Lockwashers
e - O-ring

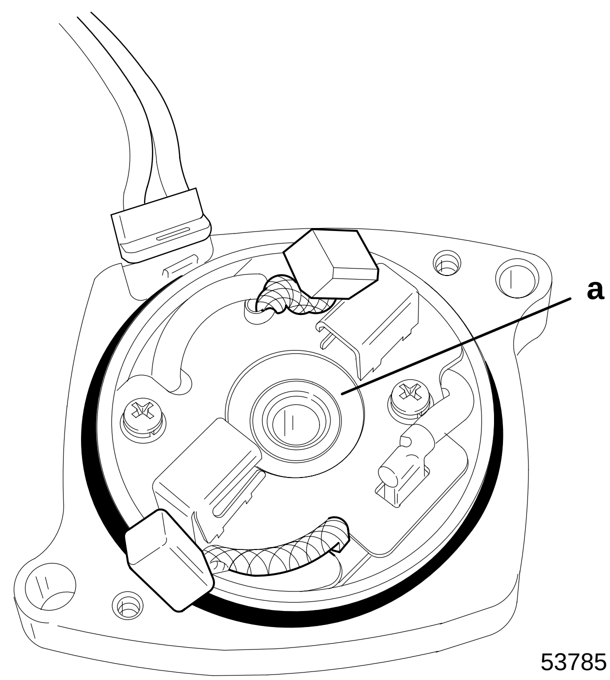
END CAP INSPECTION

1. Inspect seal and O-ring for cuts and abraisions. If replacement is required, install BRUSH and SEAL KIT 828714A1.



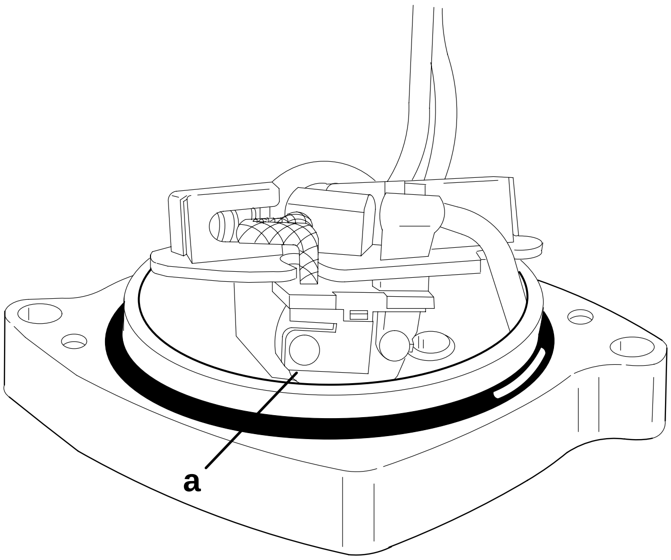
a - Seal (Apply 2-4-C w/Teflon to seal lips)
b - O-ring

2. Inspect bushing for wear. If bushing appears to be excessively worn – grooves, scratches, etc. – install END FRAME ASSEMBLY (COMPLETE) 828715A1.



a - Bushing

3. If trim motor is overheated, a thermoswitch located under brush card will open. Normally, this switch will reset itself within 1 minute.



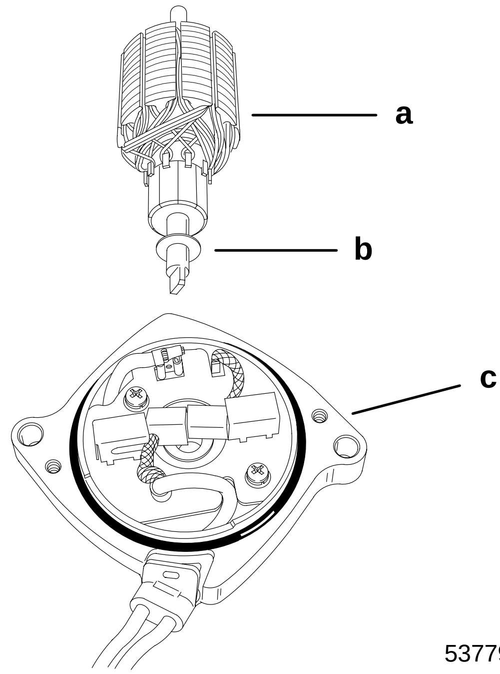
53781

a - Thermoswitch

Reassembly

IMPORTANT: Components must be clean. Any debris in power trim system can cause system to malfunction.

1. Install armature into end cap/brush card assembly.



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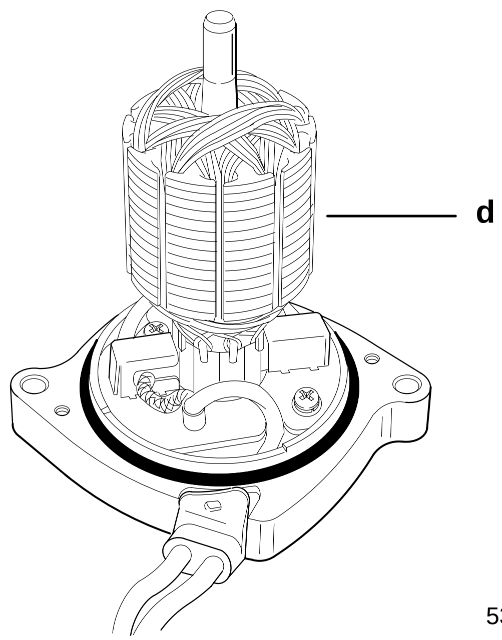
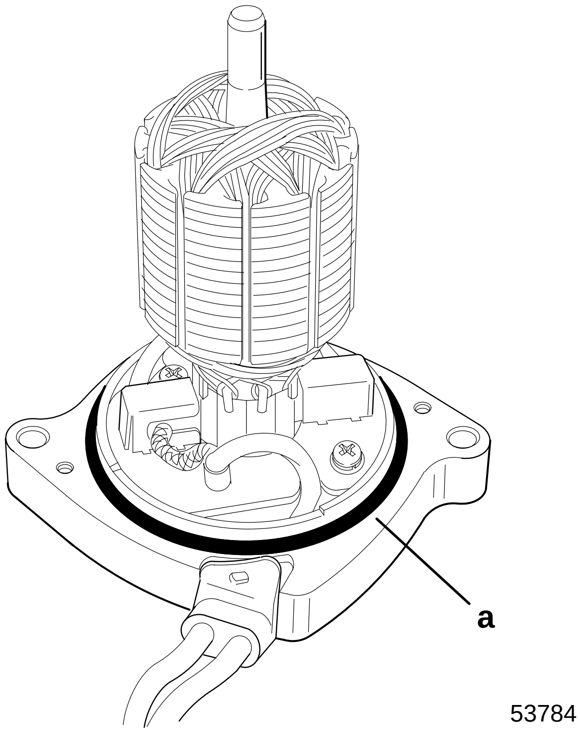
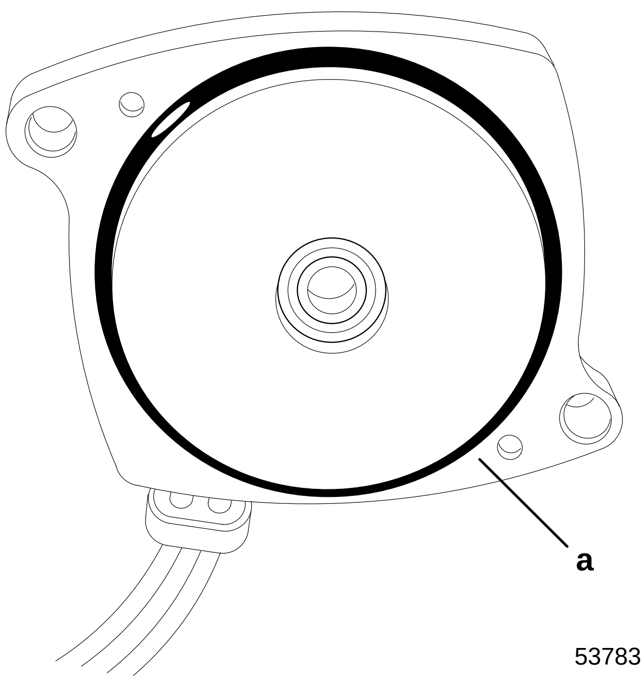


53784

a - Armature
b - Shim
c - End Cap Assembly
d - Armature (Spread brushes to install armature into end cap)

2. Install O-rings in end cap.

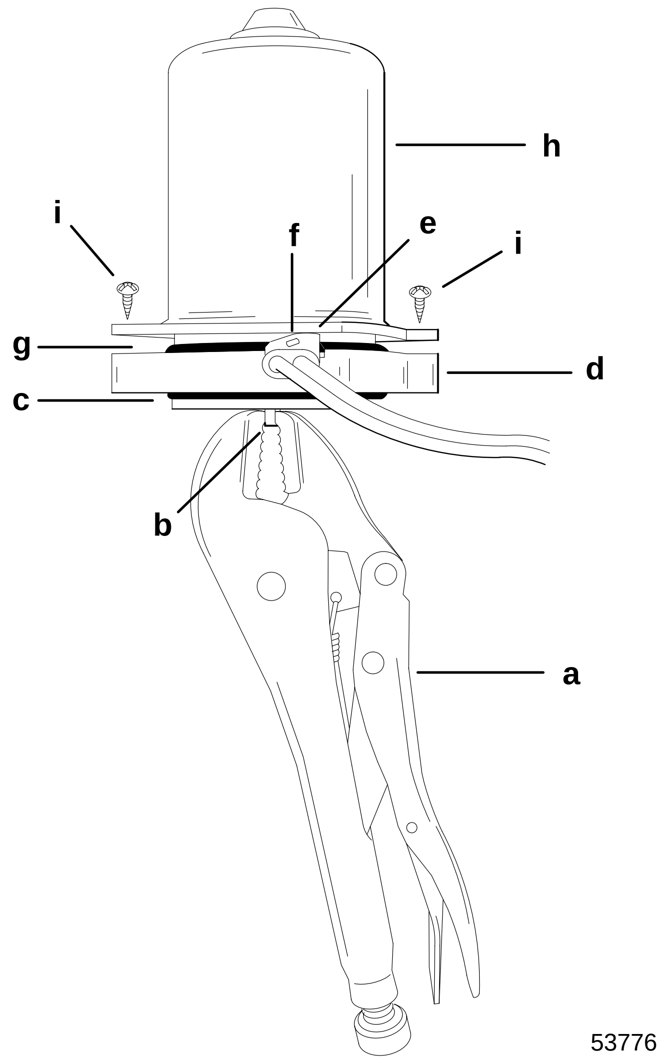




a - O-rings

IMPORTANT: Attach Vise Grip® pliers to armature shaft before installing frame assembly. The Vise Grip® pliers will prevent the armature from being drawn out of the brush card assembly by the frame magnets while installing the frame assembly.

3. Install Vise Grip® pliers on armature shaft.
4. Carefully install frame assembly over armature.
5. Position harness retainer hole over tab in end cap.
6. Secure frame assembly to end cap with 2 screws.



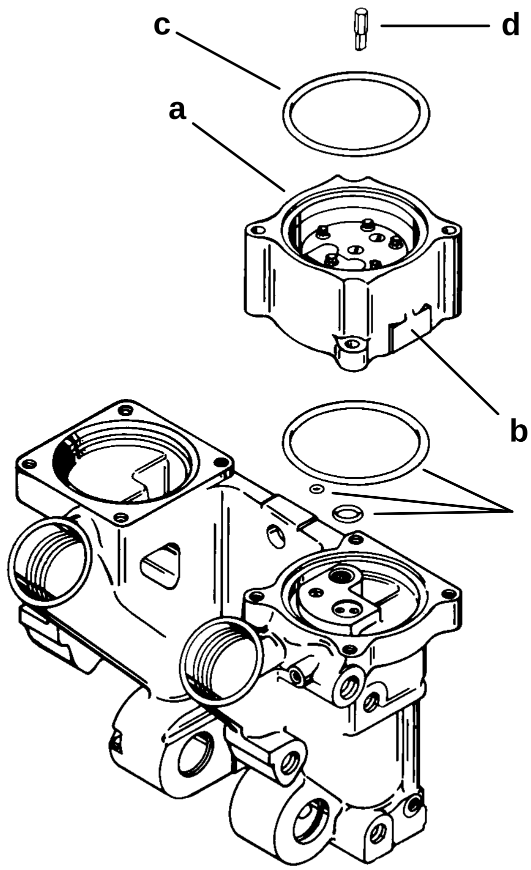
a - Vise Grip® Pliers
b - Armature Shaft
c - O-ring
d - End Cap
e - Harness Retainer
f - Retainer Hole
g - O-ring
h - Frame Assembly
i - Screws

Reassembly - Motor and Pump

NOTE: *Drive shaft is a loose part and may fall out of position.*

1. Install pump onto power trim manifold. Insure O-rings are in proper locations. Secure with two (2) screws. Torque screws to 80 lb. in. (9.0 N·m).

IMPORTANT: Install pump with location flat facing towards starboard transom bracket.

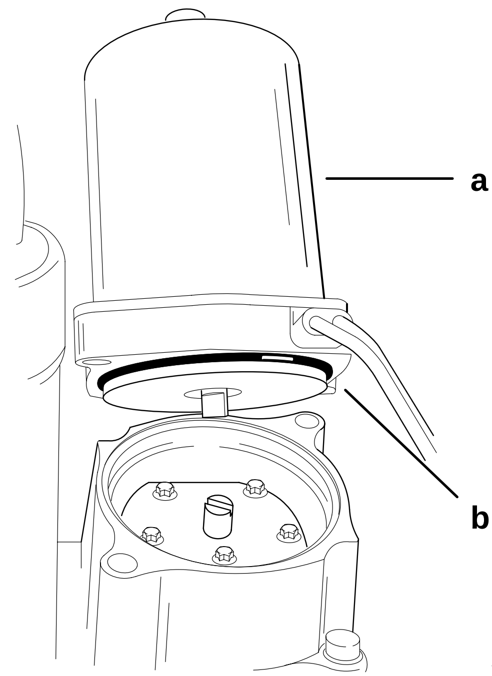


51433

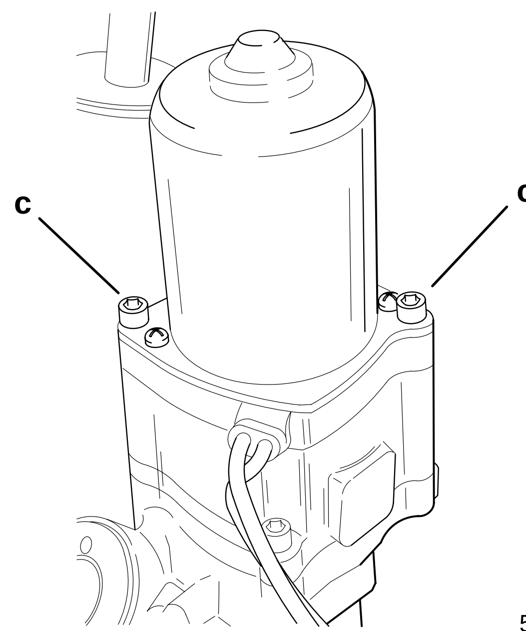
a - Pump (Flat towards starboard transom bracket)
b - Flat - faces starboard transom bracket)
c - O-rings (4)
d - Drive Shaft (Install in **center** hole in pump)

2. Fill pump with Quicksilver Power Trim and Steering Fluid prior to installing motor.
3. Install motor, secure with two (2) screws. Route wiring; refer to Wiring Diagrams in this service manual.

NOTE: *Verify motor and drive shaft are aligned.*



53782



53777

a - Motor
b - O-ring
c - Screw (2) Tighten securely.

4. Complete reassembly of Power Trim System as outlined in **"Installation"** on page 5B-24.

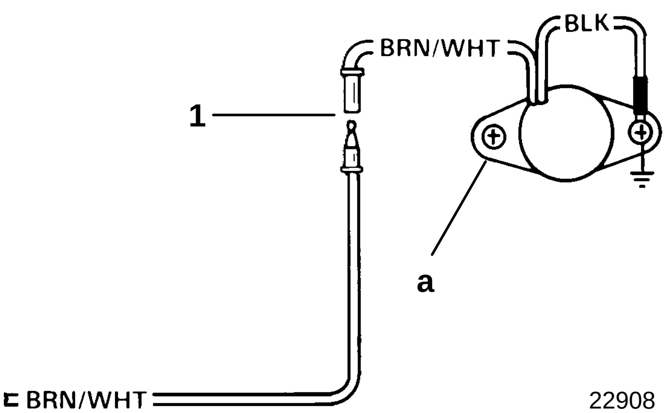
Priming Power Trim System

1. Fill system with Quicksilver Power Trim and Steering Fluid or Automatic Transmission Fluid (ATF) Type F,FA, Dexron II or Dexron III. Refer to **“Fill, Check, and Purge”** on page 5B-8.

IMPORTANT: Run Trim System in short “jogs” until pump motor primes and trim system moves. If trim motor is run without priming pump, drive shaft failure could result.

Trim Sender (Optional Accessory) Test

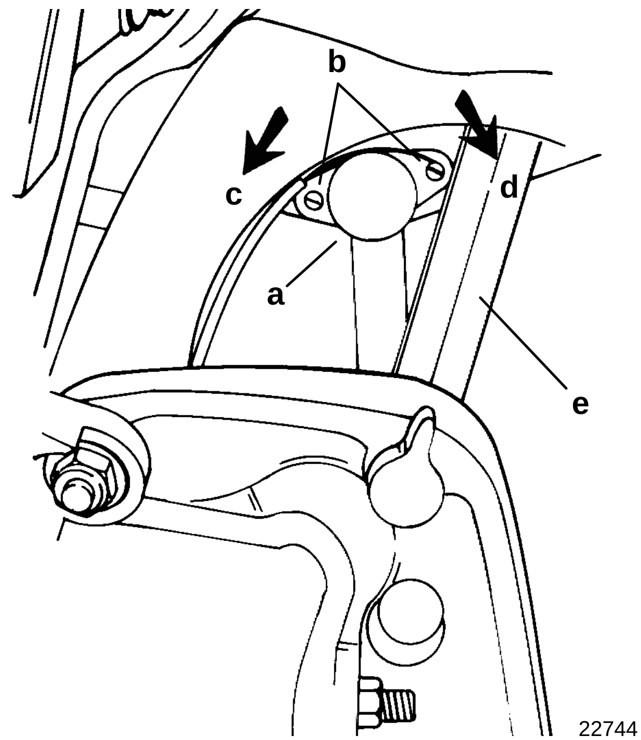
1. Check trim sender black lead for proper ground.
2. Trim outboard to full “DOWN” position.
3. Place ignition switch to “ON” position.
4. Disconnect BRN/WHT trim sender wire from trim sender harness.
5. Connect Ohmmeter (Rx1 scale) leads between outboard ground and Point 1 (trim sender end).
6. Depress “UP” button. Ohmmeter needle should move as the outboard is trimmed up. If needle does not move, trim sender is defective.



a - Trim sender

Trim Indicator Gauge Needle Adjustment

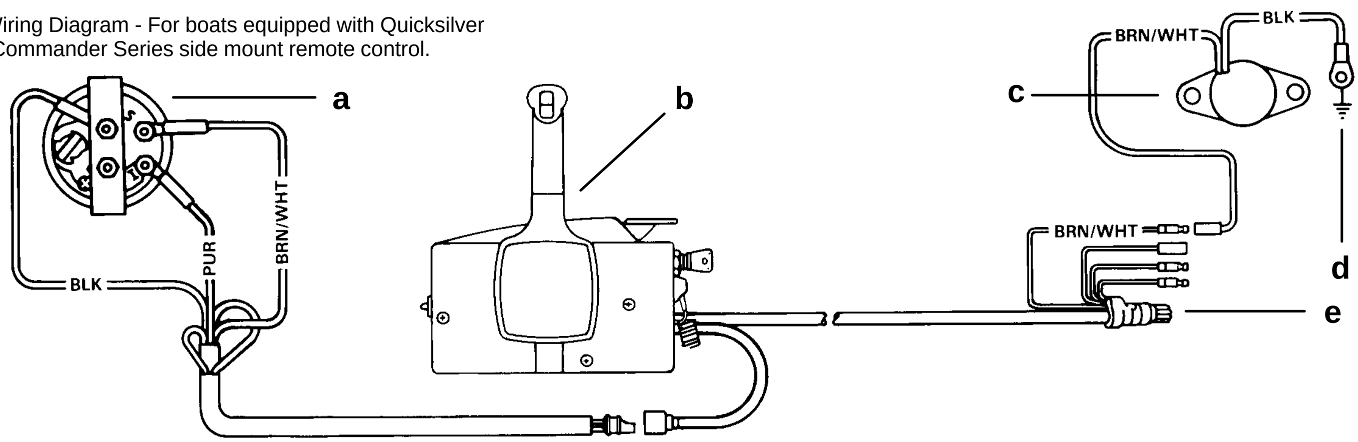
1. Turn ignition key to “RUN” position.
2. Tilt outboard to full “IN” position. Needle of trim indicator gauge should be in full “IN” position.
3. If not, tilt outboard to full “OUT” position to gain access to trim sender and engage tilt lock lever.
4. Loosen trim sender screws and reposition trim sender.
5. Tighten trim sender screws.



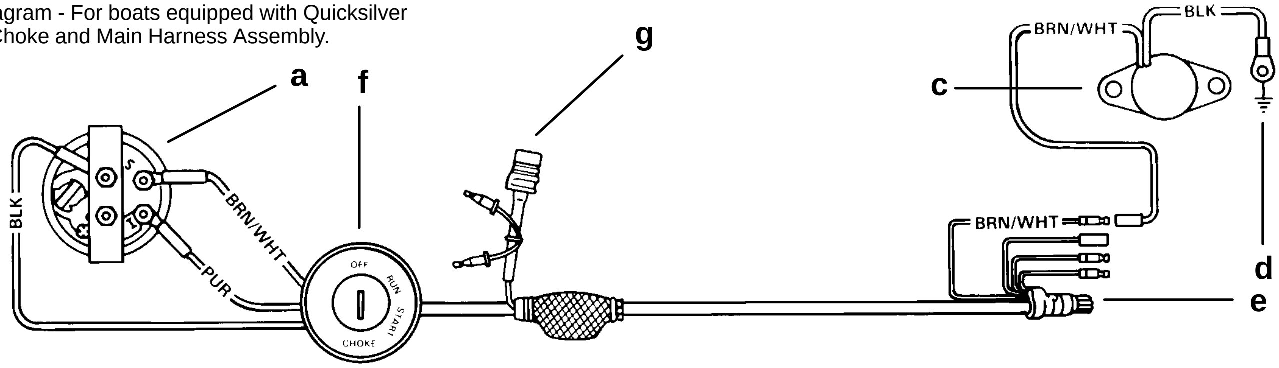
a - Trim Sender
b - Screws, loosen to rotate sender
c - Turn sender **counterclockwise** to raise needle reading
d - Turn sender **clockwise** to lower needle reading
e - Tilt lock lever

Trim Indicator Wiring Diagrams

Wiring Diagram - For boats equipped with Quicksilver Commander Series side mount remote control.



Wiring Diagram - For boats equipped with Quicksilver Ignition/Choke and Main Harness Assembly.



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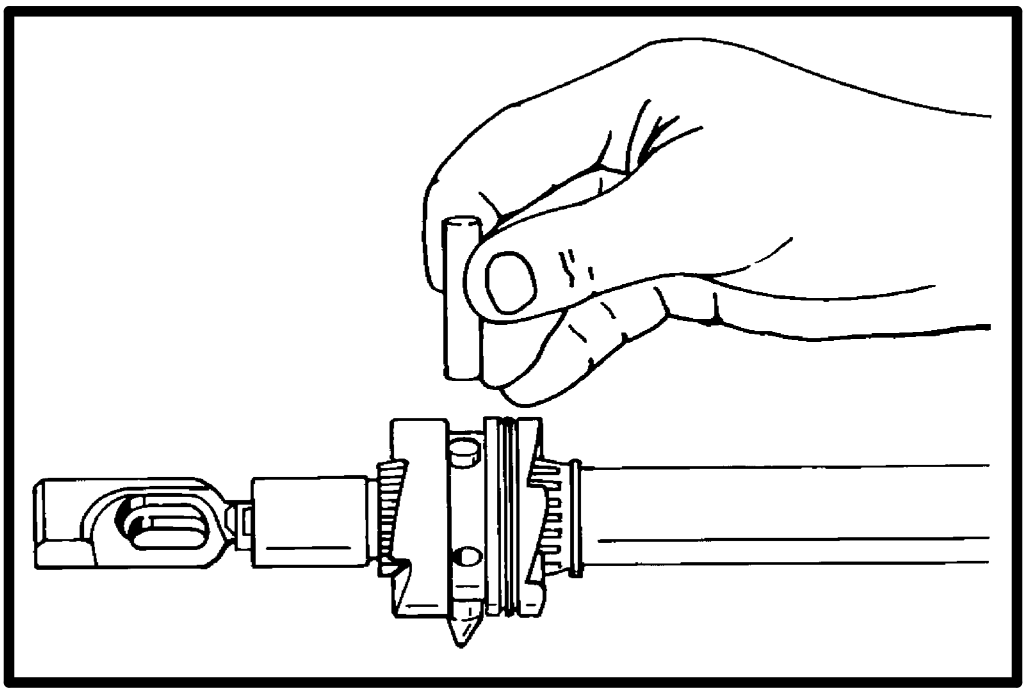
a - Trim Indicator
b - Remote Control
c - Trim Sender
d - Engine Ground
e - To Engine
f - Ignition Switch
g - Power Trim Harness

LOWER UNIT



E-Z SHIFT GEAR HOUSING (STANDARD ROTATION)

6
A

Table of Contents

Gear Housing Specifications (Standard Rotation)

PINION DEPTH

Gear Case	Pinion Depth
1.87:1 (15/28 teeth) and 2.00:1 (15/30 teeth) Ratios	0.025 in. (0.635mm) With Tool 91-12349A2 using Disc #2 and Flat #7
2.3:1 (13/30 teeth) Ratio	0.050 in. (1.27mm) With Tool 91-12349A2 using Disc #2 and Flat #7

REVERSE GEAR BACKLASH

Gear Case	Reverse Gear Backlash
All Ratios	0.030 in. to 0.050 in. (0.762mm to 1.27mm)

FORWARD GEAR BACKLASH

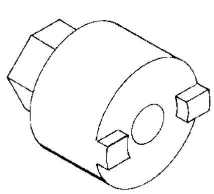
Gear Case & Ratio	Backlash Inches (mm)	Dial Indicator Pointer on Line Mark
Production 1.87:1	.018-.027 (.46-.69)	#1 91-78473
CLE/Torque Master/Sport Master 1.87:1	.021-.026 (.53-.66)	#1 91-78473
All 2.00:1	.015-.022 (.38-.56)	#2 91-78473
All High Altitude 2.3:1	.018-.023 (.46-.58)	#1 91-19660

LUBRICANT CAPACITY

Gearcase Lubricant Capacity	
All Ratios	22.5 fl. oz. (665.4ml)

Special Tools

Shift Shaft Bushing Tool 91-31107



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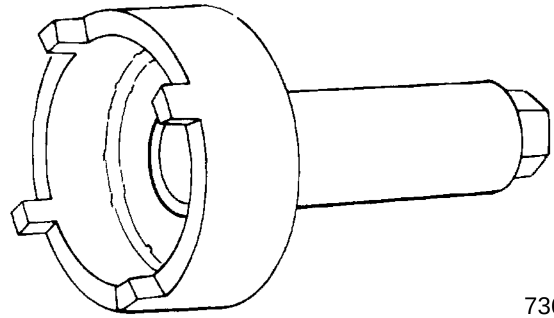
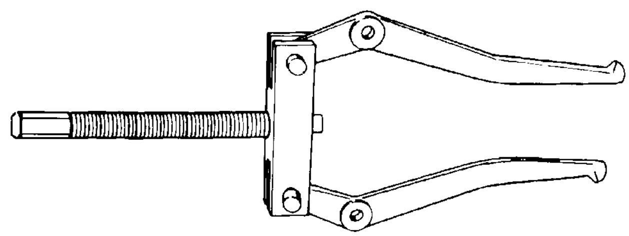
Gear Housing Cover Nut Tool 91-61069



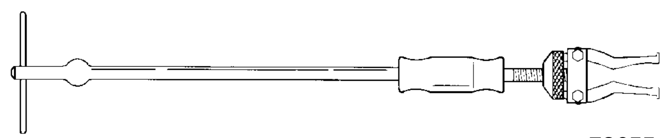
73605

Bearing Carrier Removal Tool 91-46086A1 and Puller Bolt 91-85716



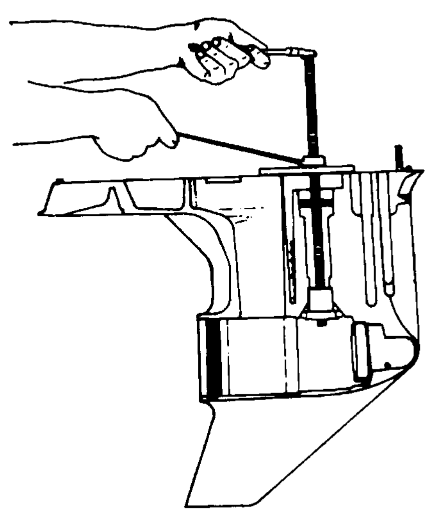
73599

Slide Hammer Puller 91-34569A1



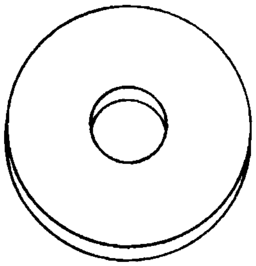
73655

Bearing Removal and Installation Kit 91-31229A5. This kit contains the following tools: Pilot 91-36571; Puller Rod 91-31229; Nut 11-24156; Puller Plate 91-29310; Mandrel 91-38628; and Driver Rod 91-37323.



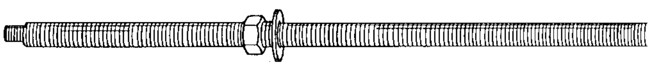
70615

Pilot 91-36571

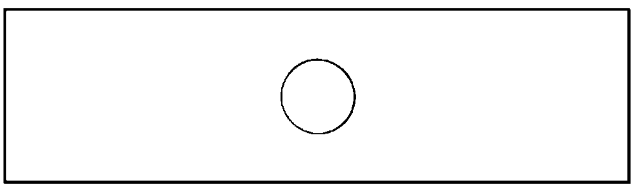


74187

Puller Rod 91-31229 and Nut 91-24156

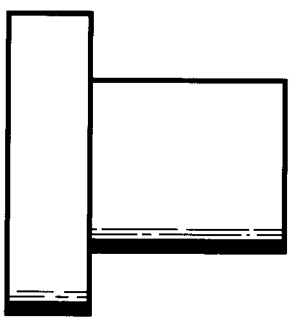


Puller Plate 91-29310



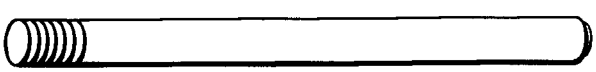
74190

Mandrel 91-38628



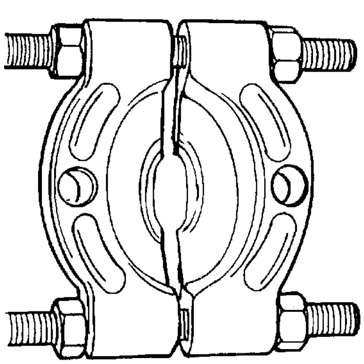
74193

Driver Rod 91–37323



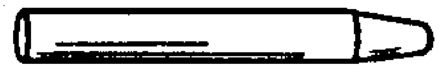
74184

Universal Puller Plate 91-37241

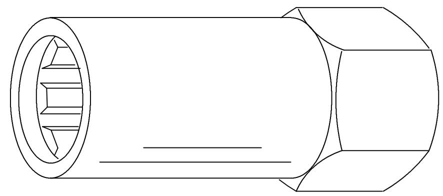


73652

Cross Pin Tool 91-86642

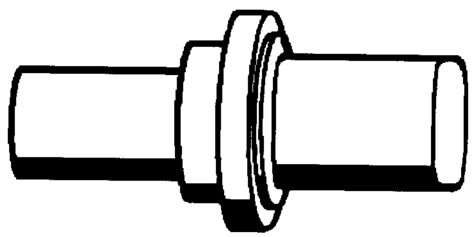


Driveshaft Holding Tool 91-34377A1



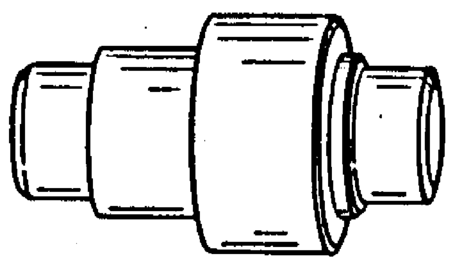
55079

Oil Seal Driver 91-31108

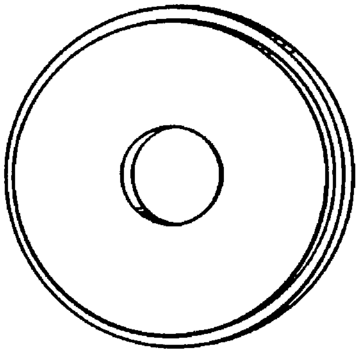


73651

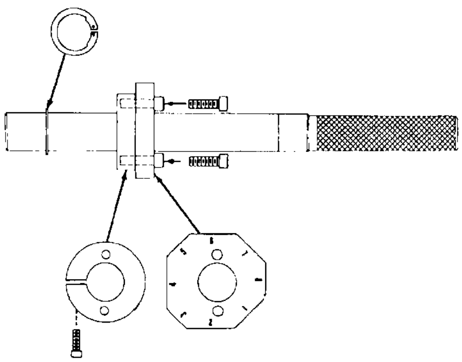
Forward Gear Bearing Tool 91-86943

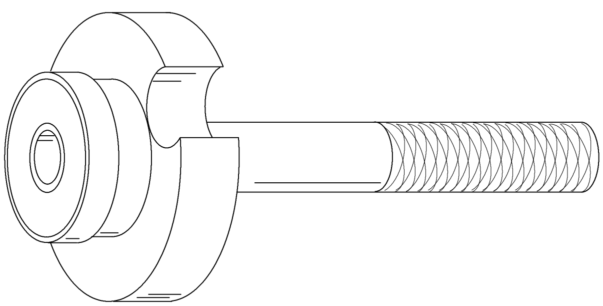


Bearing Driver Cup 91-87120



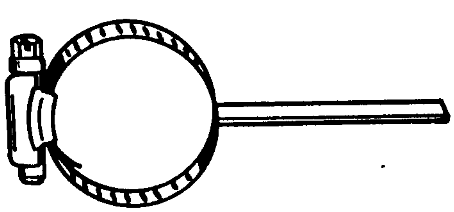
Pinion Locating Gear Tool 91-12349A2 or 91-74776



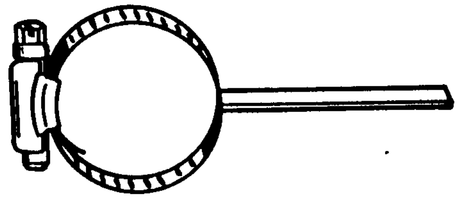


55079

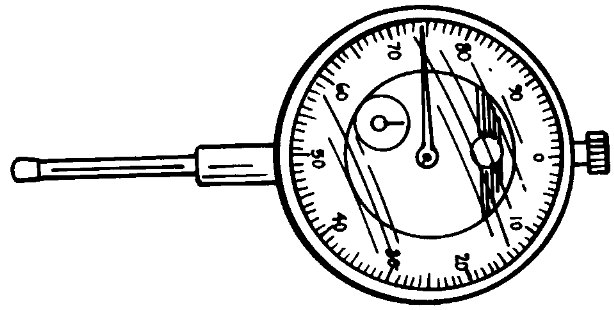
Backlash Indicator Rod 91-19660



Backlash Indicator Rod 91-78473

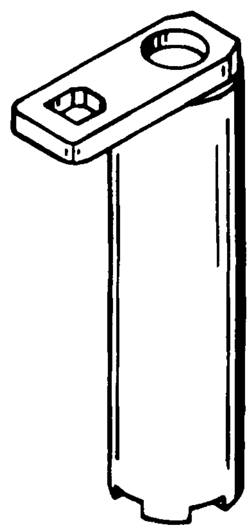


Dial Indicator 91-58222A1



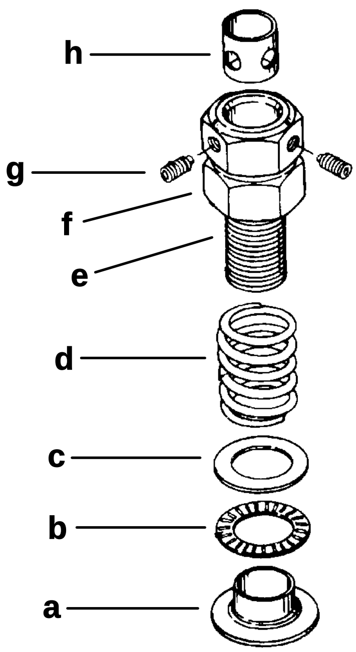
73429

Bearing Retainer Tool 91-43506



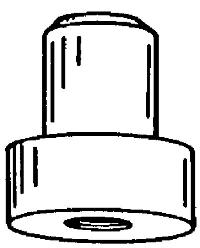
73600

Bearing Preload Tool 91-14311A1

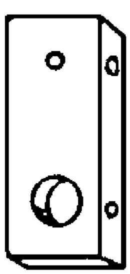


a - Adaptor (N.S.S.)
b - Bearing (N.S.S.)
c - Washer (N.S.S.)
d - Spring (24-14111)
e - Bolt (10-12580)
f - Nut (11-13953)
g - Set Screw (10-12575)
h - Sleeve (23-13946)

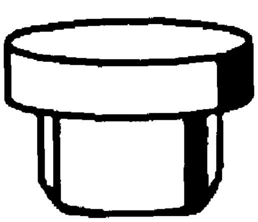
Mandrel 91-92788



Dial Indicator Holder 91-89897

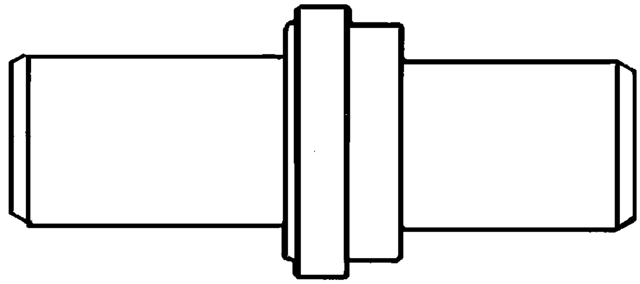


Mandrel 91-15755



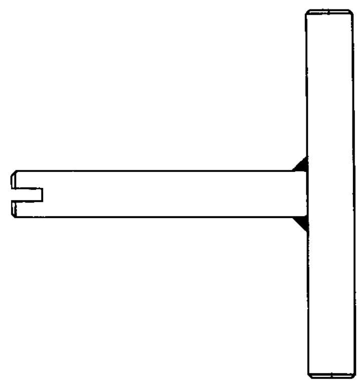
73815

Seal Driver 91-816294

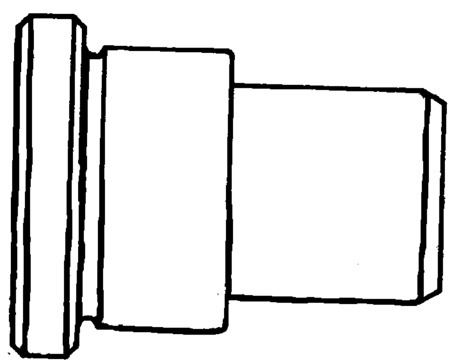


Slotted Cross Pin Tool 91-86642-1

Threaded Cross Pin Tool 91-86642-2

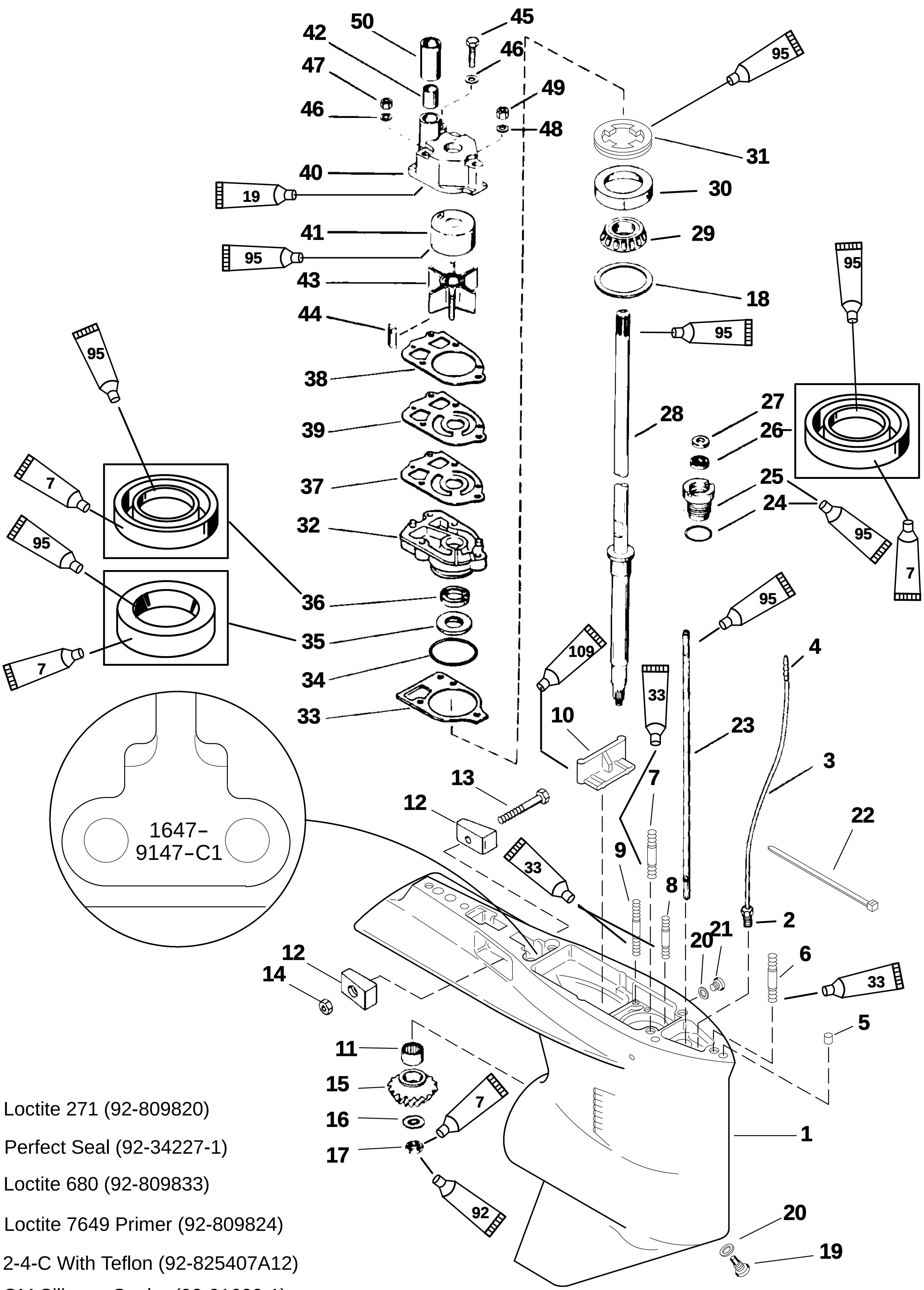


Propeller Shaft Bearing Installer 91-816292



Notes:

Gear Housing (Drive Shaft) (Standard Rotation) (S/N-0G437999 & BELOW)

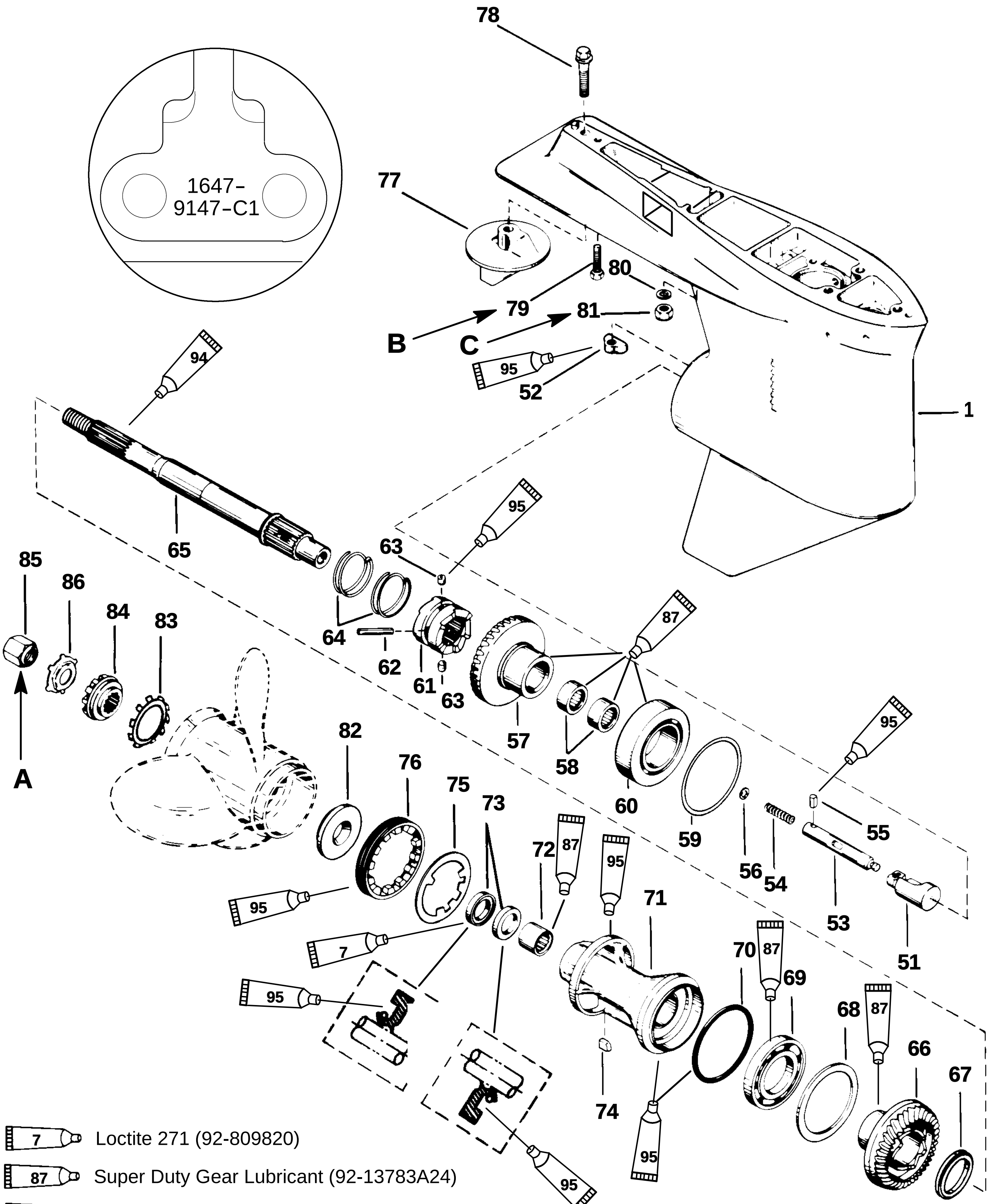


- 7 Loctite 271 (92-809820)
- 19 Perfect Seal (92-34227-1)
- 33 Loctite 680 (92-809833)
- 92 Loctite 7649 Primer (92-809824)
- 95 2-4-C With Teflon (92-825407A12)
- 109 GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft) (Standard Rotation) (S/N-0G437999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	**lb. ft.**	**N·m**
1	1	GEAR HOUSING			
2	1	CONNECTOR ASSEMBLY			
3	1	TUBING			
4	1	CONNECTOR			
5	2	DOWEL PIN			
6	1	STUD (3-1/8 IN.) **(LONG)**			
	1	STUD (3-11/16 IN.) **(X-LONG)**			
7	2	STUD (2-1/16 IN.)			
8	1	STUD (3-3/8 IN.)			
9	2	STUD (3-1/8 IN.)			
10	1	FILLER BLOCK			
11	1	ROLLER BEARING			
12	2	ANODE			
13	1	SCREW			
14	1	NUT	60	5.0	7.0
15	1	PINION GEAR (Part of 43-44102A7 or 43-44104A8			
	1	PINION GEAR (Part of 43-16294A2)**(HIGH ALTITUDE – 2.3:1)**			
16	1	WASHER **(NOT USED W/HIGH ALTITUDE)**			
17	1	NUT **Included with Forward Gear Set**			
	1	NUT **(HIGH ALTITUDE)**			
18	AR	SHIM SET			
19	1	SCREW–drain & fill (MAGNETIC)	55		6.0
20	2	WASHER			
21	1	SCREW–vent	55		6.0
22	1	STA–STRAP			
23	1	SHIFT SHAFT			
24	1	O-RING			
25	1	BUSHING ASSEMBLY		30	40.5
26	1	OIL SEAL			
27	1	WASHER–rubber			
28	1	DRIVE SHAFT **(LONG)**			
	1	DRIVE SHAFT **(X-LONG)**			
	1	DRIVE SHAFT **(HIGH ALTITUDE)**			
29	1	ROLLER BEARING ASSEMBLY			
30	1	CUP-Tapered			
31	1	RETAINER		100	135
32	1	WATER PUMP BASE			
33	1	GASKET			
34	1	O-RING			
35	1	OIL SEAL			
36	1	OIL SEAL			
37	1	GASKET–lower			
38	1	GASKET–upper			
39	1	FACE PLATE			
40	1	WATER PUMP BODY ASSEMBLY			
41	1	INSERT			
42	1	SEAL–rubber			
43	1	IMPELLER			
44	1	KEY			
45	1	SCREW (2-1/4 IN.)	50		5.5
46	2	WASHER			
47	2	NUT	50		5.5
48	1	WASHER			
49	1	NUT	50		5.5
50	1	SLEEVE			

Gear Housing (Prop Shaft) (Standard Rotation) (S/N-0G437999 & BELOW)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft) (Standard Rotation) (S/N-0G437999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
51	1	CAM FOLLOWER			
52	1	SHIFT CAM			
53	1	ROD ASSEMBLY			
54	1	SPRING			
55	1	PIN			
56	AR	WASHER			
57	1	GEAR SET **(XR6/MAG. III/175/200)(1.87:1 – 15/28)**			
	1	GEAR SET **(135/150)(2.0:1 – 14/28)**			
	1	GEAR SET **(HIGH ALTITUDE)(2.3:1)**			
58	1	NEEDLE BEARING			
59	AR	SHIM (.002–3–5–10)			
60	1	TAPERED ROLLER BEARING			
61	1	CLUTCH			
62	1	CROSS PIN			
63	2	DETENT PIN			
64	2	SPRING			
65	1	PROPELLER SHAFT			
66	1	REVERSE GEAR **(XR6/MAG. III/175/200)(1.87:1 – 15/28)**			
	1	REVERSE GEAR **(135/150)(2.0:1 – 14/28)**			
	1	REVERSE GEAR **(HIGH ALTITUDE–PART OF 43-16294A2)**			
67	1	THRUST SPACER **(NOT USED W/HIGH ALTITUDE)**			
68	1	THRUST RING			
69	1	BALL BEARING			
70	1	O-RING			
71	1	BEARING CARRIER ASSEMBLY			
72	1	ROLLER BEARING			
73	2	OIL SEAL			
74	1	KEY			
75	1	TAB WASHER			
76	1	COVER		210	285
77	1	TRIM TAB			
78	1	SCREW (1-5/8 IN.)		40	54.0
79	1	SCREW			
80	2	WASHER			
81	2	NUT			
82	1	THRUST HUB			
83	1	LOCKWASHER			
84	1	WASHER			
85	1	PROPELLER NUT			
86	1	TAB WASHER			

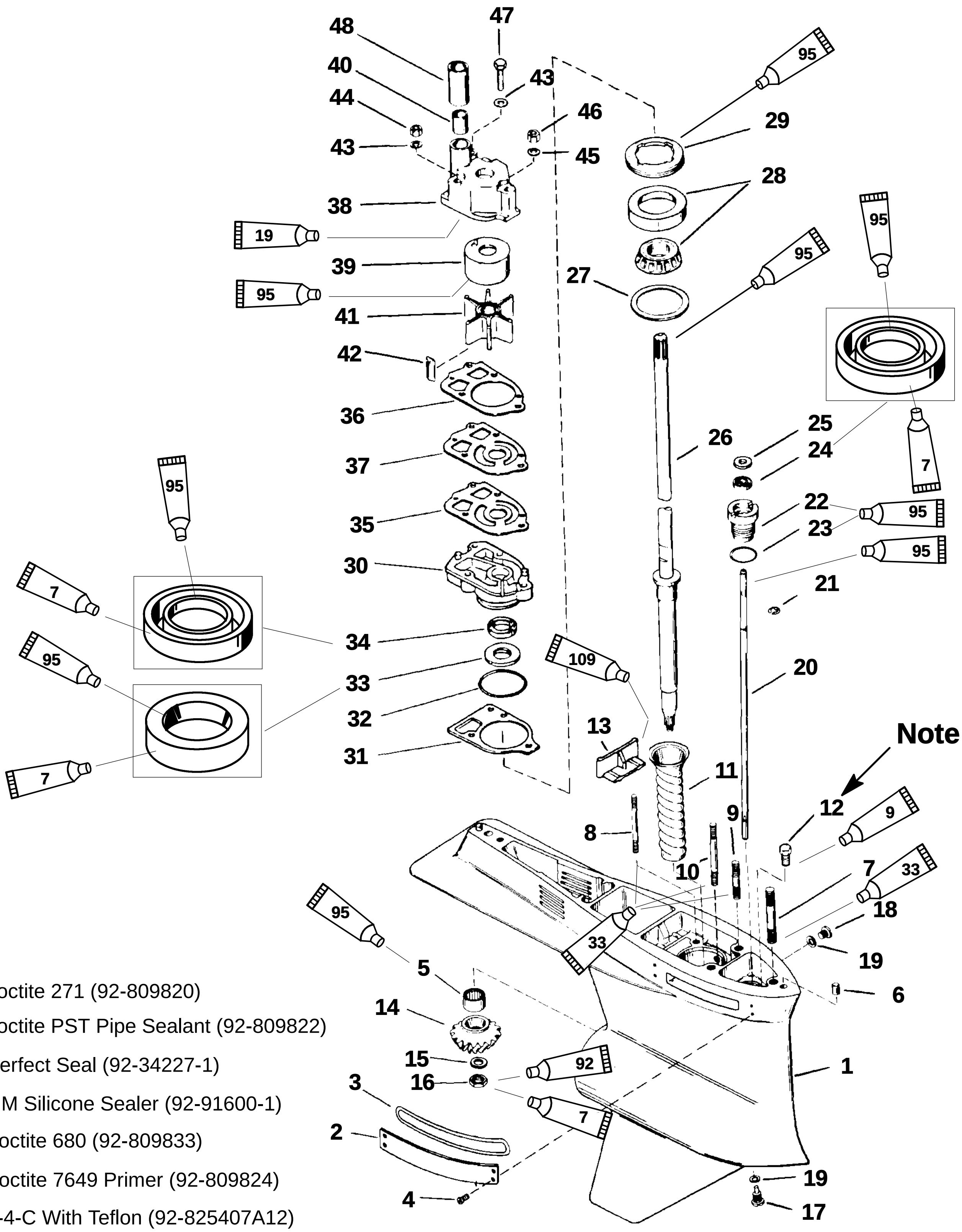
These replacement parts ARE NOT included with Complete Gear Housing Replacement (refs. 79–86)

A – Torque propeller nut to 55 lb. ft. (74.5 N·m)

B – Torque screw to 35 lb. ft. (47.5 N·m)

C – Torque nut to 55 lb. ft. (74.5 N·m)

Gear Housing (Drive Shaft) (CLE) (Standard Rotation) (Pro Max/Super Magnum Models)



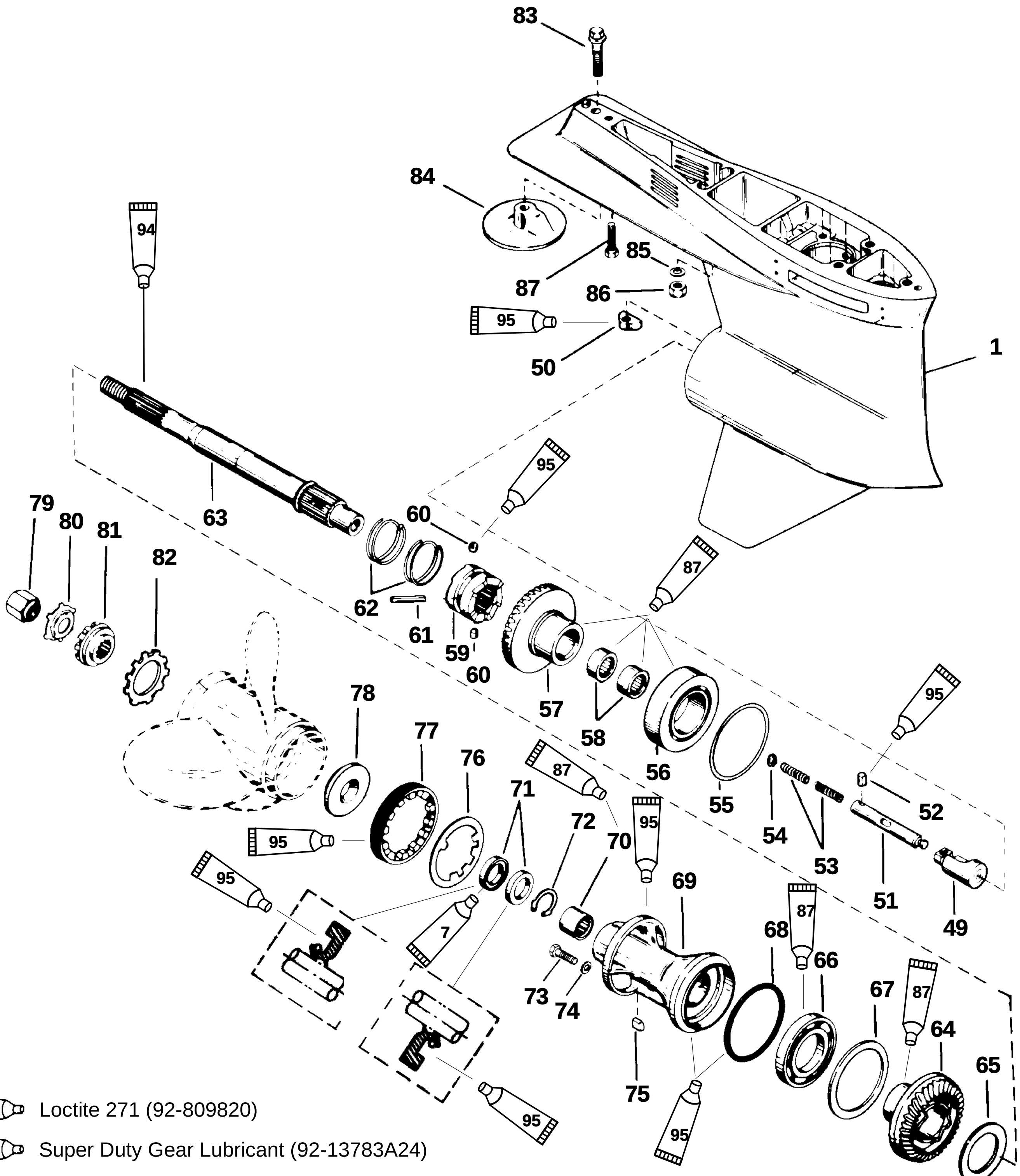
- 7 Loctite 271 (92-809820)
- 9 Loctite PST Pipe Sealant (92-809822)
- 19 Perfect Seal (92-34227-1)
- 109 GM Silicone Sealer (92-91600-1)
- 33 Loctite 680 (92-809833)
- 92 Loctite 7649 Primer (92-809824)
- 95 2-4-C With Teflon (92-825407A12)

Gear Housing (Driveshaft) (CLE) (Standard Rotation) (Pro Max/Super Magnum)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
2	2	COVER			
3	2	O-RING			
4	12	SCREW			
5	1	ROLLER BEARING			
6	2	DOWEL PIN			
7	1	STUD (3-1/8 IN.)			
8	2	STUD (2-1/16 IN.)			
9	1	STUD (3-3/8 IN.)			
10	2	STUD (3-1/4 IN.)			
11	1	SLEEVE			
12	1	PLUG			
13	2	FILLER BLOCK			
14	1	PINION GEAR			
15	1	WASHER			
16	1	PINION NUT		85	115
17	1	SCREW - drain & fill (MAGNETIC)	55		6.0
18	1	SCREW - vent	55		6.0
19	2	WASHER			
20	1	SHIFT SHAFT			
21	1	E-RING (Use where applicable)			
22	1	BUSHING ASSEMBLY		50	68
23	1	O-RING			
24	1	OIL SEAL			
25	1	WASHER-rubber			
26	1	DRIVE SHAFT			
27	AR	SHIM ASSEMBLY			
28	1	ROLLER BEARING ASSEMBLY			
29	1	RETAINER		100	135
30	1	WATER PUMP BASE			
31	1	GASKET			
32	1	O-RING			
33	1	OIL SEAL			
34	1	OIL SEAL			
35	1	GASKET-lower			
36	1	GASKET-upper			
37	1	FACE PLATE			
38	1	WATER PUMP BODY ASSEMBLY			
39	1	INSERT			
40	1	SEAL-rubber			
41	1	IMPELLER			
42	1	KEY			
43	2	WASHER			
44	2	NUT	50		5.5
45	1	WASHER			
46	1	NUT	50		5.5
47	1	SCREW (2-1/4 IN.)	35		4.0
48	1	SLEEVE			

Note – This plug acts as a water diverter. The screw slot in the plug head MUST BE ALIGNED FORE AND AFT with the gearcase for cooling water to be routed properly.

Gear Housing (Prop Shaft) (CLE) (Standard Rotation) (Pro Max/Super Magnum Models)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

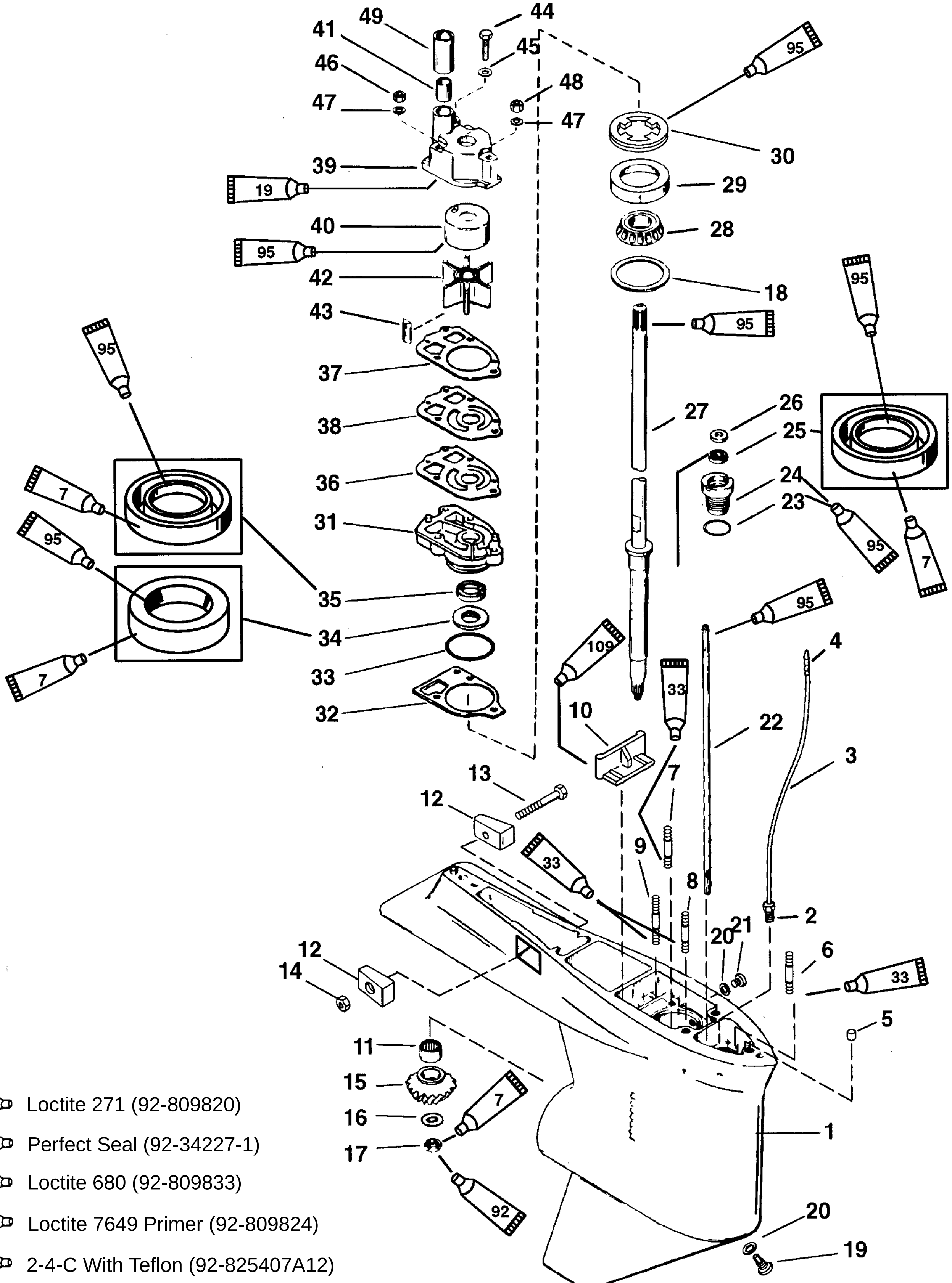
94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft) (CLE) (Standard Rotation) (Pro Max/Super Magnum Models)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
49	1	CAM FOLLOWER			
50	1	SHIFT CAM			
51	1	ROD ASSEMBLY			
52	1	PIN			
53	2	SPRING			
54	2	WASHER			
55	AR	SHIM			
56	1	TAPERED ROLLER BEARING			
57	1	GEAR SET			
58	2	ROLLER BEARING			
59	1	CLUTCH			
60	2	DETENT PIN			
61	1	CROSS PIN			
62	2	SPRING			
63	1	PROPELLER SHAFT			
64	1	REVERSE GEAR			
65	1	THRUST RING			
66	1	BALL BEARING			
67	1	THRUST RING			
68	1	O-RING			
69	1	BEARING CARRIER ASSEMBLY			
70	1	ROLLER BEARING			
71	2	OIL SEAL			
72	1	SNAP RING			
73	1	DRAIN SCREW (MAGNETIC)			
74	1	SEALING WASHER			
75	1	KEY			
76	1	TAB WASHER			
77	1	COVER NUT		250	339
78	1	THRUST HUB			
79	1	PROPELLER NUT		55	74.5
80	1	TAB WASHER			
81	1	WASHER			
82	1	LOCKWASHER			
83	1	SCREW		25	34.0
84	1	ANODIC PLATE			
85	2	WASHER			
86	2	NUT		65	88.0
87	1	SCREW (1-5/8 IN.)		35	47.5

Gear Housing (Driveshaft) (Standard Rotation) (Torque Master) (Pro Max/Super Magnum Models)

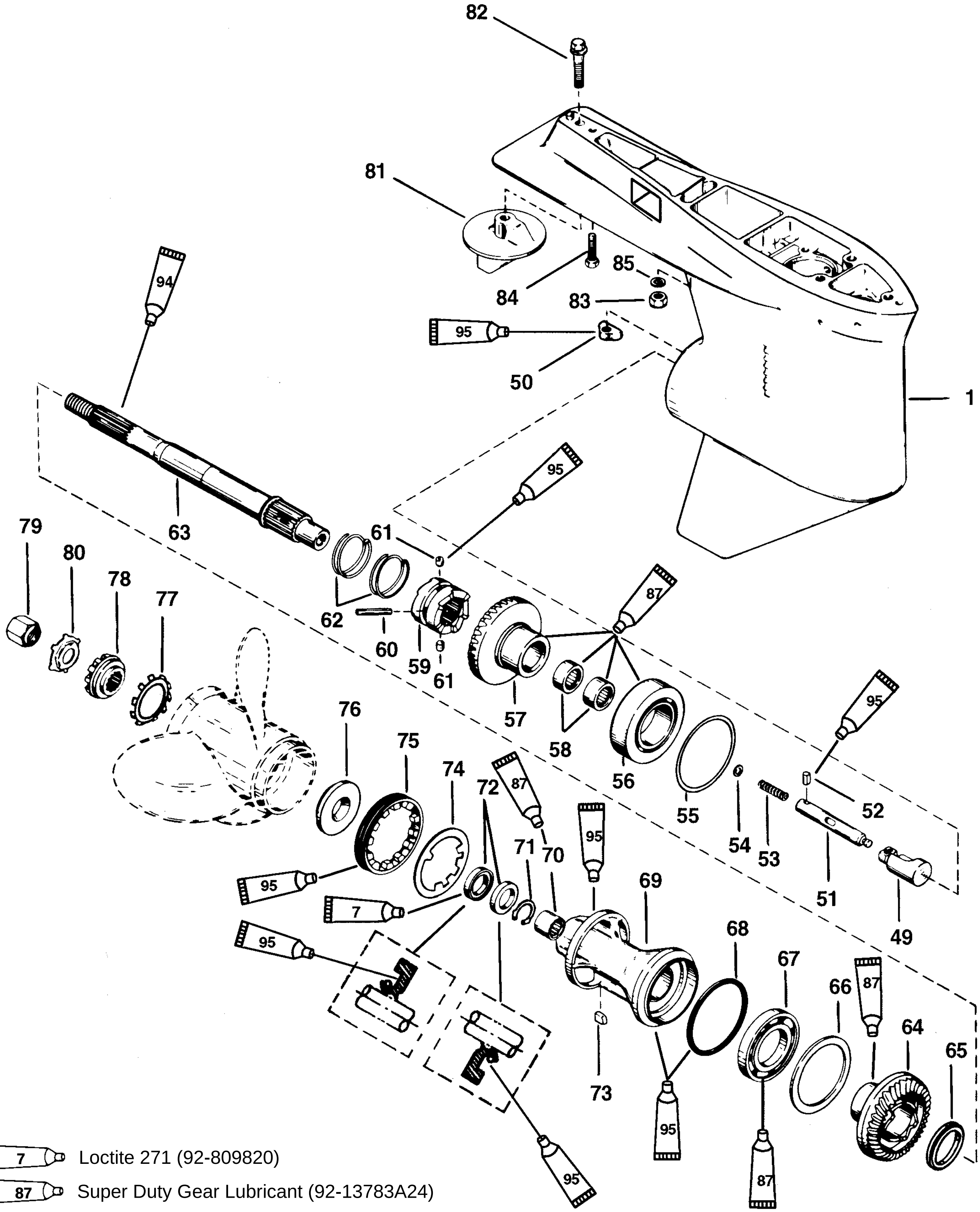


- 7 Loctite 271 (92-809820)
- 19 Perfect Seal (92-34227-1)
- 33 Loctite 680 (92-809833)
- 92 Loctite 7649 Primer (92-809824)
- 95 2-4-C With Teflon (92-825407A12)
- 109 GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft) (Standard Rotation) (Torque Master) (Pro Max/Super Magnum Models)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
2	1	CONNECTOR ASSEMBLY			
3	1	TUBING			
4	1	CONNECTOR			
5	2	DOWEL PIN			
	1	STUD (3-1/8 IN.)			
6	2	STUD (2-1/16 IN.)			
7	1	STUD (3-3/8 IN.)			
8	2	STUD (3-1/8 IN.)			
9	1	FILLER BLOCK			
10	1	ROLLER BEARING			
11	2	ANODE			
12	1	SCREW			
13	1	NUT	60	5	7.0
14	1	PINION GEAR (Part of 43-44102A7)			
15	1	WASHER			
16	1	PINION NUT **Included With Forward Gear Set**		85	115
17	AR	SHIM SET			
18	1	SCREW-drain (MAGNETIC)	55		6.0
19	2	WASHER			
20	1	SCREW-grease filler	55		6.0
21	1	SHIFT SHAFT			
22	1	O-RING			
23	1	BUSHING ASSEMBLY		50	68
24	1	OIL SEAL			
25	1	WASHER-rubber			
26	1	DRIVE SHAFT			
27	1	ROLLER BEARING ASSEMBLY			
28	1	CUP-Tapered			
29	1	RETAINER		100	135
30	1	WATER PUMP BASE			
31	1	GASKET			
32	1	O-RING			
33	1	OIL SEAL			
34	1	OIL SEAL			
35	1	GASKET-lower			
36	1	GASKET-upper			
37	1	FACE PLATE			
38	1	WATER PUMP BODY ASSEMBLY			
39	1	INSERT			
40	1	SEAL-rubber			
41	1	IMPELLER			
42	1	KEY			
43	1	SCREW (2-1/4 IN.)	50		5.5
44	2	WASHER			
45	2	NUT	50		5.5
46	1	WASHER			
47	1	NUT	50		5.5
48	1	SLEEVE			

Gear Housing (Prop Shaft) (Standard Rotation) (Torque Master)(Pro Max/Super Magnum Models)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

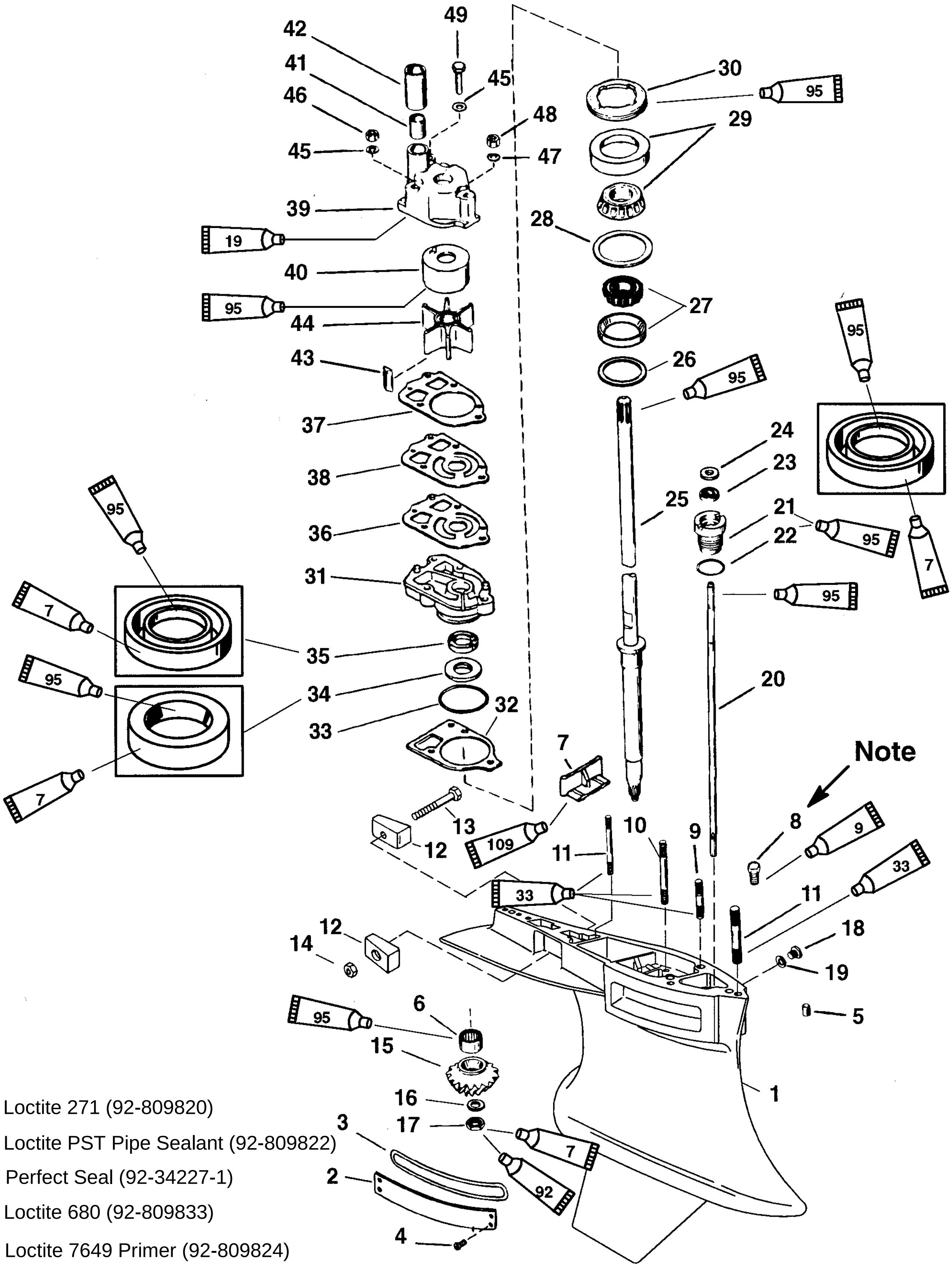
94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft) (Standard Rotation) (Torque Master) (Pro Max/Super Magnum Models)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
49	1	CAM FOLLOWER			
50	1	SHIFT CAM			
51	1	ROD ASSEMBLY			
52	1	PIN			
53	1	SPRING			
54	AR	WASHER			
55	AR	SHIM (.002-3-5-10)			
56	1	TAPERED ROLLER BEARING			
57	1	GEAR SET			
58	2	ROLLER BEARING			
59	1	CLUTCH			
60	1	CROSS PIN			
61	2	DETENT PIN			
62	2	SPRING			
63	1	PROPELLER SHAFT			
64	1	REVERSE GEAR			
65	1	THRUST SPACER **(NOT USED W/HIGH ALTITUDE)**			
66	1	THRUST RING			
67	1	BALL BEARING			
68	1	O-RING			
69	1	BEARING CARRIER ASSEMBLY			
70	1	ROLLER BEARING			
71	1	RETAINING RING			
72	2	OIL SEAL			
73	1	KEY			
74	1	TAB WASHER			
75	1	COVER NUT		250	339
76	1	THRUST HUB			
77	1	LOCKWASHER			
78	1	SPLINED WASHER			
79	1	PROPELLER NUT		55	74.5
80	1	TAB WASHER			
81	1	ANODIC PLATE			
82	1	SCREW		25	34.0
83	2	NUT		65	88
84	1	SCREW		35	47.5
85	2	WASHER			

Gear Housing (Driveshaft) (Standard Rotation) (Sportmaster)



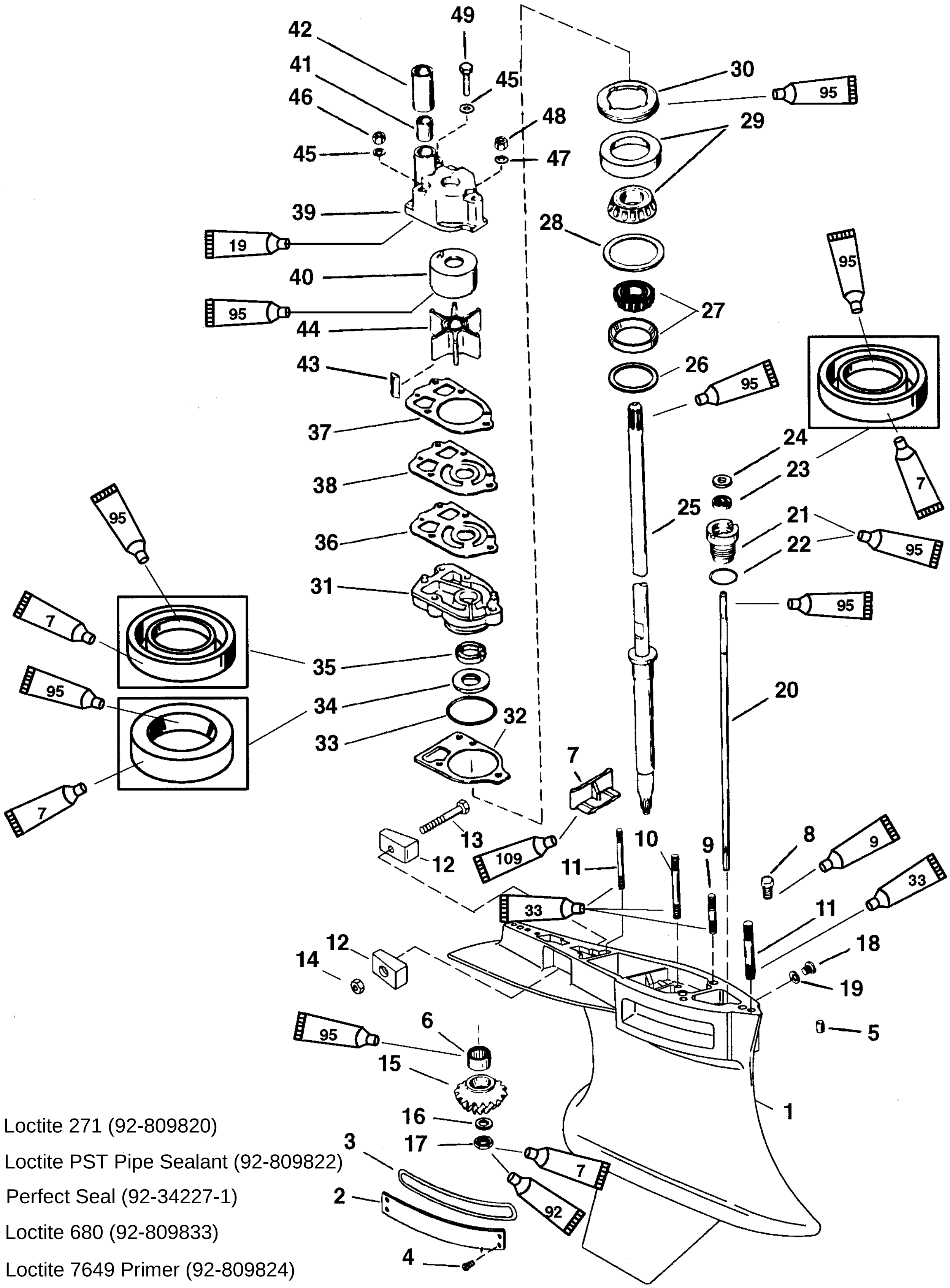
- 7 — Loctite 271 (92-809820)
- 9 — Loctite PST Pipe Sealant (92-809822)
- 19 — Perfect Seal (92-34227-1)
- 33 — Loctite 680 (92-809833)
- 92 — Loctite 7649 Primer (92-809824)
- 95 — 2-4-C With Teflon (92-825407A12)
- 109 — GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft) (Standard Rotation) (Sportmaster)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(WITH TORQUE TAB)** **BASIC**			
	1	GEAR HOUSING **(WITHOUT TORQUE TAB)**			
2	2	COVER			
3	2	O RING			
4	12	SCREW			
5	2	DOWEL PIN			
6	1	ROLLER BEARING			
7	1	FILLER BLOCK			
8	1	PLUG			
9	1	STUD (5/16 x 3-3/8 IN.)			
10	1	STUD (5/16 x 3-1/4 IN.)			
11	3	STUD (7/16 x 2-11/16 IN.)**(SHORT/LONG)**			
	1	STUD (7/16 x 3-1/8 IN.) **LONG**			
	2	STUD (7/16 x 2-1/16 IN.)			
	2	STUD (7/16 x 7.06 IN.)			
	3	STUD (7/16 x 7.69 IN.) **X-LONG**			
	1	STUD (7/16 x 8-1/8 IN.)			
12	2	ANODE			
13	1	SCREW			
14	1	NUT	60	5.0	7.0
15	1	PINION GEAR (Part of 43-13742A2 or 43-44102A5)			
16	1	WASHER			
17	1	PINION NUT		85	115
18	1	SCREW PLUG	55		6.0
19	1	SEALING WASHER			
20	1	SHIFT SHAFT (LOWER)			
21	1	BUSHING ASSEMBLY		30	40.5
22	1	O RING			
23	1	OIL SEAL			
24	1	RUBBER WASHER			
25	1	DRIVE SHAFT			
26	1	SHIM SET			
27	1	ROLLER BEARING			
28	AR	SHIM SET			
29	1	ROLLER BEARING			
30	1	RETAINER		100	135

Note – This plug acts as a water diverter. The screw slot in the plug head MUST BE ALIGNED FORE AND AFT with the gearcase for cooling water to be routed properly.

Gear Housing (Driveshaft) (Standard Rotation) (Sportmaster)

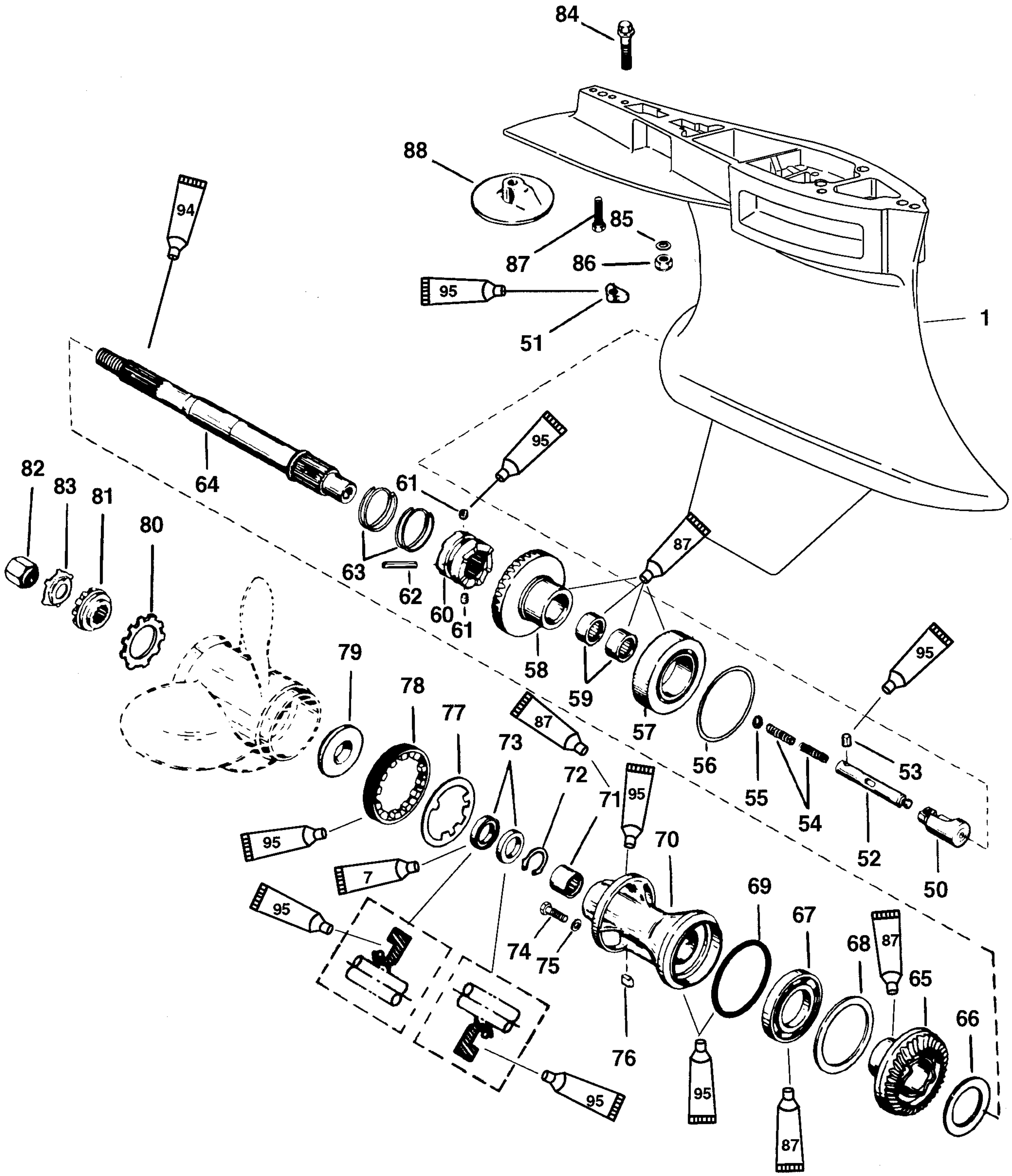


- 7 Loctite 271 (92-809820)
- 9 Loctite PST Pipe Sealant (92-809822)
- 19 Perfect Seal (92-34227-1)
- 33 Loctite 680 (92-809833)
- 92 Loctite 7649 Primer (92-809824)
- 95 2-4-C With Teflon (92-825407A12)
- 109 GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft) (Standard Rotation) (Sportmaster)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(WITH TORQUE TAB)** **BASIC**			
	1	GEAR HOUSING **(WITHOUT TORQUE TAB)**			
31	1	WATER PUMP BASE ASSEMBLY			
32	1	GASKET			
33	1	O RING			
34	1	OIL SEAL			
35	1	OIL SEAL			
36	1	GASKET (LOWER)			
37	1	GASKET (UPPER)			
38	1	FACE PLATE			
39	1	WATER PUMP BODY ASSEMBLY			
40	1	INSERT			
41	1	SEAL			
42	1	SLEEVE			
43	1	KEY			
44	1	IMPELLER			
45	2	WASHER			
46	2	NUT	50		5.5
47	1	WASHER			
48	1	NUT	50		5.5
49	1	SCREW (2-1/4 IN.)	50		5.5

Gear Housing (Prop Shaft) (Standard Rotation) (Sportmaster)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft) (Standard Rotation) (Sportmaster)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(WITH TORQUE TAB)** **BASIC**			
1	1	GEAR HOUSING **(WITHOUT TORQUE TAB)**			
50	1	CAM FOLLOWER			
51	1	SHIFT CAM			
52	1	ROD			
53	1	PIN			
54	2	SPRING			
55	2	WASHER			
56	AR	SHIM SET			
57	1	TAPERED ROLLER BEARING			
58	1	FORWARD GEAR SET (Includes Pinion)			
59	1	ROLLER BEARING			
60	1	RATCHET			
61	2	DETENT PIN			
62	1	CROSS PIN			
63	2	SPRING			
64	1	PROPELLER SHAFT			
65	1	REVERSE GEAR			
66	1	THRUST RING			
67	1	BALL BEARING			
68	1	THRUST RING			
69	1	O RING			
70	1	BEARING CARRIER			
71	1	ROLLER BEARING			
72	1	SNAP RING			
73	2	OIL SEAL			
74	1	MAGNETIC DRAIN SCREW			
75	1	SEALING WASHER			
76	1	KEY			
77	1	TAB WASHER			
78	1	COVER NUT		250	339
79	1	THRUST HUB			
80	1	LOCKWASHER			
81	1	WASHER			
82	1	PROPELLER NUT		55	74.5
83	1	TAB WASHER			
84	1	SCREW		25	34.0
85	2	WASHER			
86	2	NUT		65	88.0
87	1	SCREW		35	47.5
88	1	ANODIC PLATE			

General Service Recommendations

There may be more than one way to "disassemble" or "reassemble" a particular part(s), therefore, it is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

In many cases, disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure order in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to "reassembly and installation" of that component in the reassembly part of this section. Use the "Table of Contents" (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, be sure that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced, if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly, as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply Quicksilver 2-4-C w/Teflon Marine Lubricant on all O-rings. To prevent wear, apply Quicksilver 2-4-C w/ Teflon Marine Lubricant on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply Quicksilver 2-4-C w/Teflon Marine Lubricant to external surfaces of bearing carrier and cover nut threads prior to installation.

Removal, Disassembly, Cleaning and Inspection - Standard Rotation

REMOVAL

⚠ WARNING

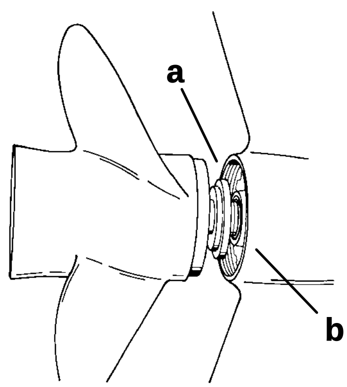
Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from drive shaft housing.

1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.

⚠ CAUTION

Gear housing MUST BE in NEUTRAL position and shift shaft MUST BE removed from gear housing BEFORE propeller shaft can be removed from gear housing.

2. Shift engine into neutral position.
3. Tilt engine to full up position and engage tilt lock lever.
4. Bend tabs of propeller tab washer away from thrust hub (rear), then remove propeller locknut, tab washer, thrust hub (rear), propeller and thrust hub (forward) from propeller shaft.



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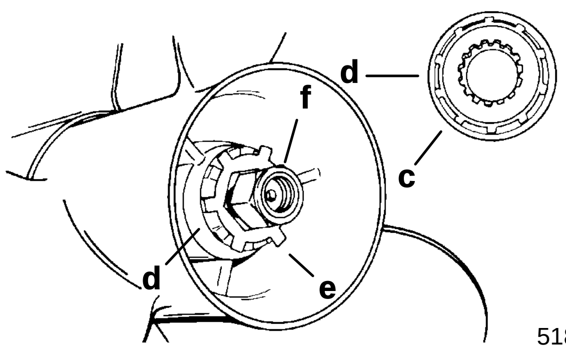
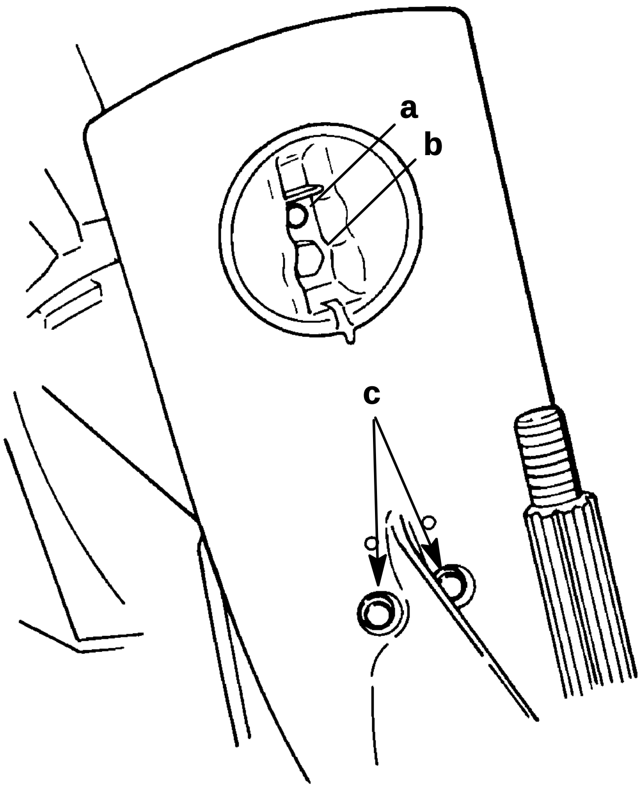


51871

a - Thrust Hub (Forward)
b - Propeller Shaft
c - Continuity Washer (If Equipped)
d - Rear Thrust Hub
e - Tab Washer
f - Propeller Nut

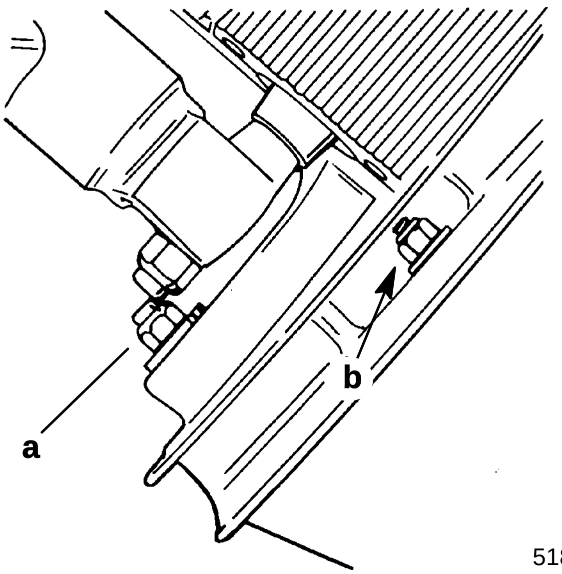
5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of drive shaft housing, then unthread bolt that secures trim tab and remove trim tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.
7. Remove 2 locknuts from bottom middle of anti-cavitation plate.



51866

a - Bolt (Secures Trim Tab)
b - Bolt (Inside Trim Tab Cavity)
c - Locknuts and Washers

8. Remove locknut from the front gear housing mounting stud.
9. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or driveshaft housing could be damaged.)
10. Pull gear housing away from driveshaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)
11. Pull gear housing from driveshaft housing.

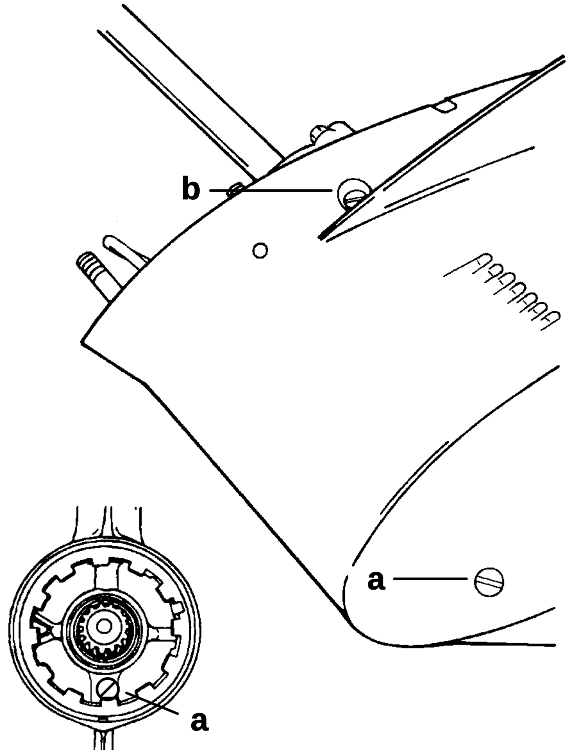


51879

a - Front Mounting Locknut
b - Side Mounting Locknut (One Each Side)

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the drive shaft in a vertical position.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing.



51871

a - "Fill" Screw (Sport Master Gear Case has Drain/Fill Screw Located in the Bearing Carrier)
b - "Vent" Screw

3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. 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, O-rings and gear housing components.

NOTE: *Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.*

Water Pump

CLEANING AND INSPECTION

1. Clean all water pump parts with solvent and dry with compressed air.
2. Inspect water pump cover and base for cracks and distortion (from overheating).
3. Inspect face plate and water pump insert for grooves and/or rough surfaces.

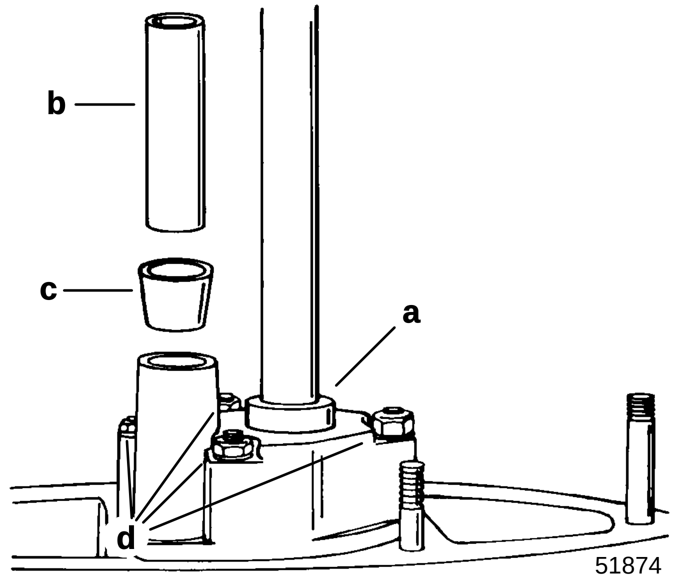
IMPORTANT: When completing gear housing repairs, that require removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to re-use impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur.

4. Inspect impeller side seal surfaces and ends of impeller blades for cracks, tears and wear. Replace impeller if any of these conditions are found.
5. Inspect impeller bonding to impeller hub.
6. Inspect impeller for glazed or melted appearance (caused by operation without sufficient water supply). Replace impeller if any of these conditions exist.

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

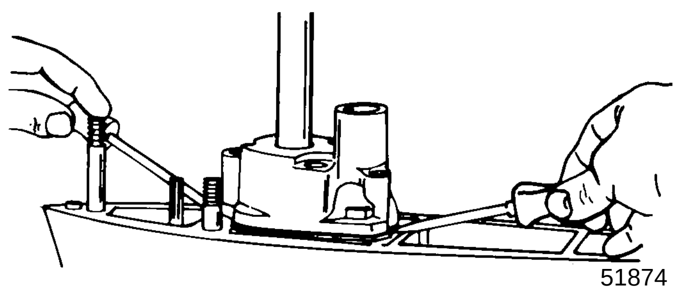
REMOVAL AND DISASSEMBLY

1. Slide rubber centrifugal slinger up and off drive shaft (If equipped).
2. Remove water tube guide and seal from water pump cover. (Retain guide for reassembly and discard seal.)
3. Remove (and retain) 3 nuts, one bolt and all washers which secure water pump cover to gear housing.



a - Centrifugal Slinger (if equipped)
b - Water Tube Guide
c - Water Tube Seal
d - Nuts, Bolt and Washers To Be Removed

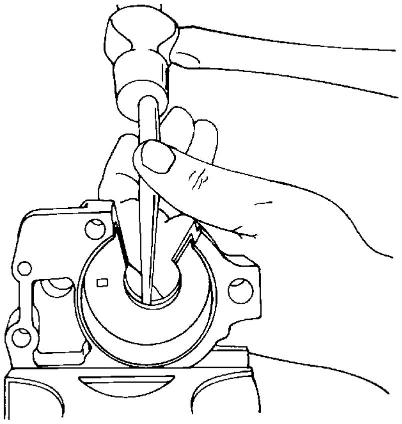
4. Using 2 pry bars, lift water pump cover up and off drive shaft.



5. Inspect water pump cover and insert, as outlined in **"Cleaning and Inspection,"** previous.
6. If inspection of water pump insert determines that replacement is required, follow Step "a" or "b" (immediately following) to remove insert from water pump cover.

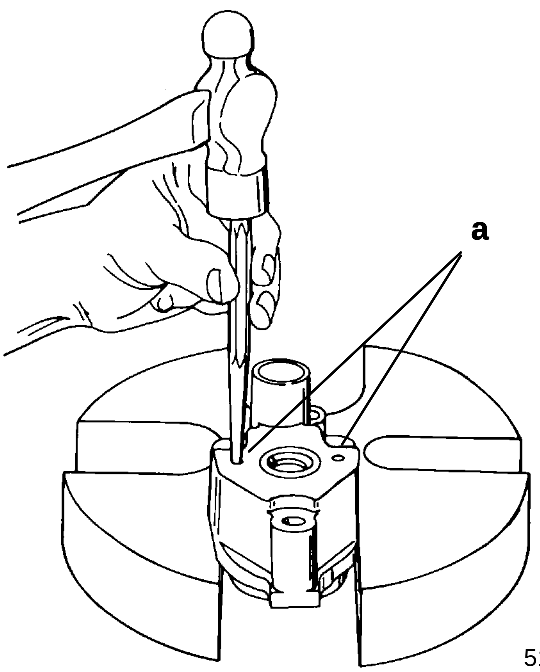
NOTE: *Try Step "a" first. If insert cannot be removed with Step "a," use Step "b".*

a. Drive water pump insert out of water pump cover with a punch and hammer.



51874

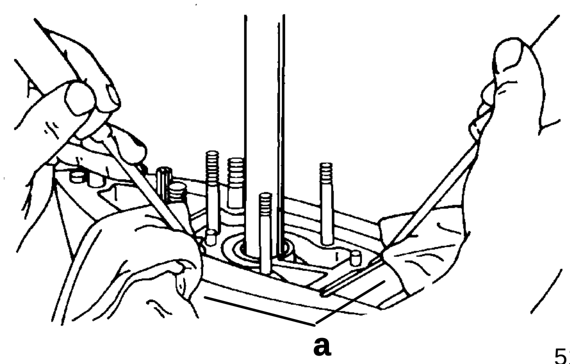
b. Drill two $3/16^{2}$ (4.8mm) diameter holes thru the top of water pump cover (but not thru insert). Drive insert out of cover with a punch and hammer.



51873

a - Drill Two Holes at These Locations

7. Remove impeller from driveshaft. (It may be necessary to use a punch and hammer to drive impeller upward on driveshaft. In extreme cases, it may be necessary to split hub of impeller with a hammer and chisel.)
8. Once impeller is removed, remove impeller drive key from driveshaft.
9. Remove water pump face plate and both gaskets (one above and below face plate) from water pump base.
10. Using 2 pry bars, positioned and padded as shown, lift water pump base up and off drive shaft.



51874

a - Pads

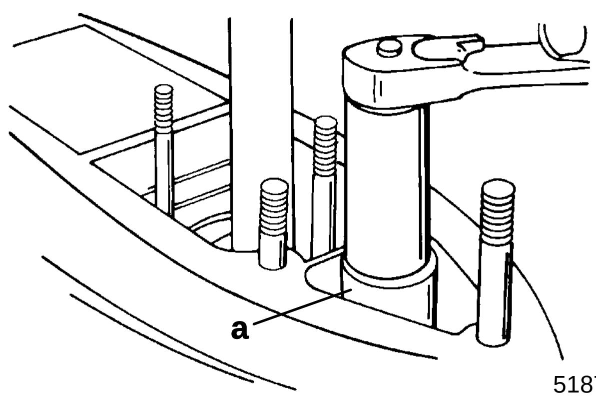
11. Remove (and discard) O-ring from O-ring groove on water pump base.
12. Using a screwdriver, pry oil seals out of water pump base from gear housing side of base.

Bearing Carrier and Propeller Shaft Removal

⚠ CAUTION

Gear housing MUST BE in NEUTRAL position, and shift shaft MUST BE removed from gear housing before propeller shaft can be removed from gear housing.

1. Place gear housing in a suitable holding fixture with propeller shaft in a horizontal position.
2. Use Shift Shaft Bushing Tool (91-31107) to unthread shift shaft bushing. (DO NOT remove bushing from shift shaft at this time.)

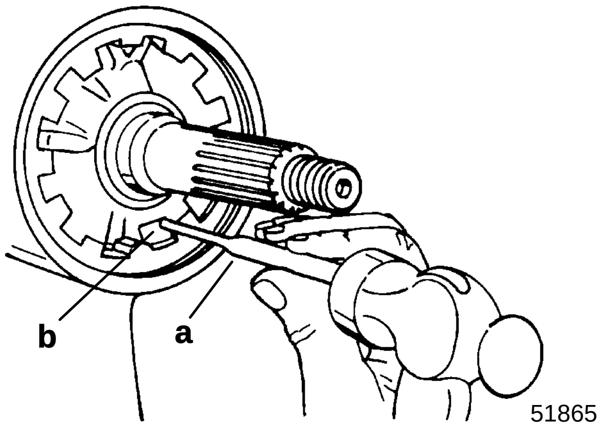


51874

a - Shift Shaft Bushing Tool (91-31107)

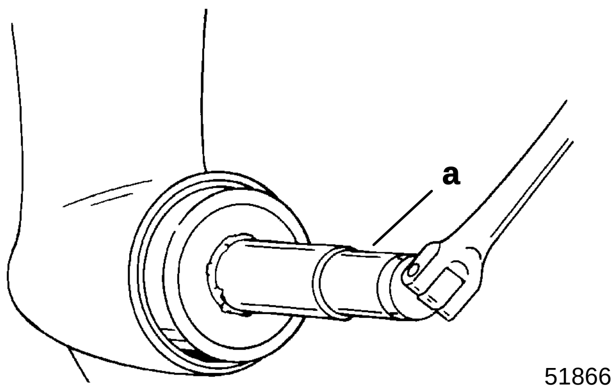
IMPORTANT: Prior to removal of shift shaft from gear housing, recheck that gear housing is in NEUTRAL position.

3. Bend cover nut lock tab out of cover nut recess.



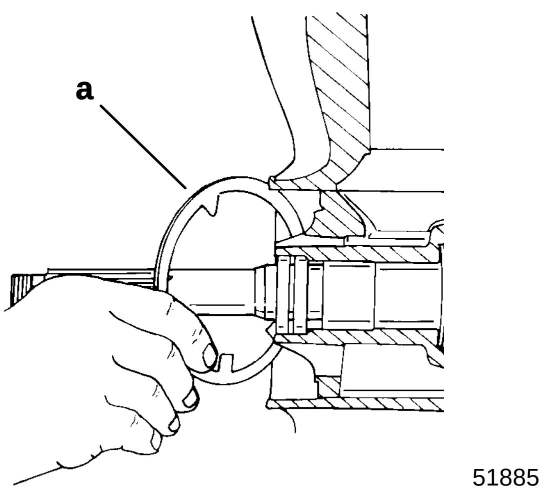
a - Punch
b - Tab of Tab Washer

4. Remove gear housing cover nut with Cover Nut Tool (91-61069).



a - Cover Nut Tool (91-61069)

5. After cover nut has been removed, remove lock tab washer from gear housing.



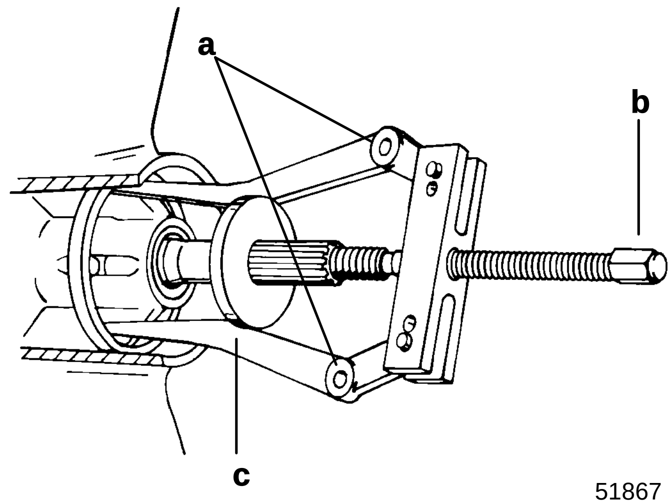
a - Tab Washer

CAUTION

Once bearing carrier is removed from gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

6. Use long Puller Jaws (91-46086A1) and Puller Bolt (91-85716) to remove bearing carrier. (Use propeller thrust hub to maintain outward pressure on puller jaws.)

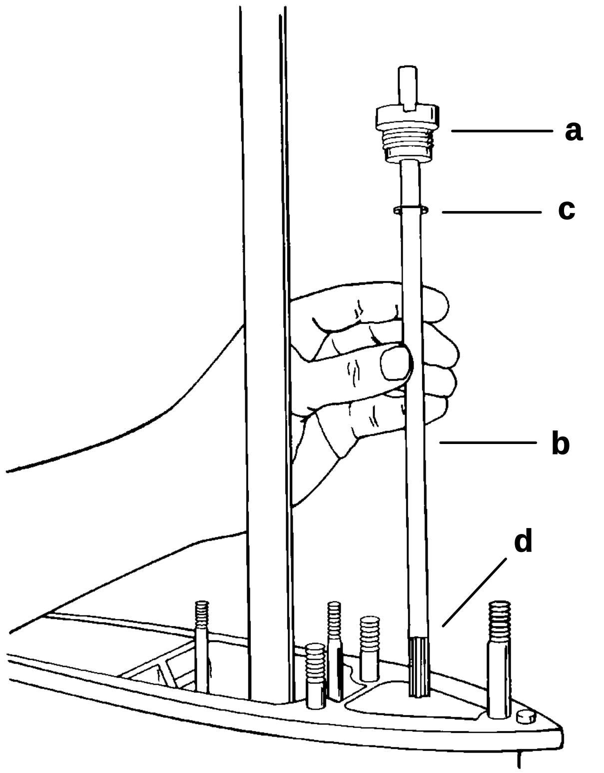
NOTE: *When bearing carrier is removed from gear housing, the bearing carrier alignment key will come out with it.*



a - Long Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)
c - Thrust Hub

IMPORTANT: Prior to removal of shift shaft from gear housing, recheck that gear housing is in neutral position.

7. With gear housing in NEUTRAL, pull shift shaft out of gear housing. If necessary, use a pliers to pull shift shaft out of gear housing. If pliers are used to pull shift shaft out, wrap a strip of soft metal (aluminum) around splines before clamping pliers. DO NOT turn shaft (clockwise OR counterclockwise) while pulling shaft out. (For further information on shift shaft, see "Shift Shaft Cleaning/Inspection and Disassembly.")



51867

a - Shift Shaft Bushing
b - Shift Shaft
c - "E" Ring (If Equipped)
d - Retaining Ring (If Equipped)

⚠ CAUTION

Propeller shaft, cam follower and shift cam, in most cases, will come out of gear housing by simply pulling outward on propeller shaft. DO NOT FORCE shaft sideways or ATTEMPT TO PULL with a slide hammer or any mechanical puller.

8. Remove propeller shaft, cam follower and shift cam by pulling shaft straight out of gear housing. (DO NOT JERK propeller shaft.) If propeller shaft will not come out, proceed with Step "a" or "b", following:
   a. Push propeller shaft back into place against the forward gear. Visually inspect location of shift cam by looking down shift shaft hole (illuminated with a flashlight). If splined hole in shift cam is visible, reinstall shift shaft and rotate shift shaft to neutral position. Remove shift shaft, then remove propeller shaft as instructed in Step 8, immediately preceding.
   b. Push propeller shaft back into place against forward gear. Slide bearing carrier back into gear housing (to support propeller shaft). Place gear housing on its left side (viewed from rear) and strike upper leading end of gear housing with a rubber mallet. This will dislodge the shift cam from cam follower into a clearance pocket in left side of gear housing. Remove bearing carrier and pull propeller shaft out of gear housing.

NOTE: *If Step 8-b was used to remove propeller shaft, the shift cam can be retrieved after removal of forward gear.*

Shift Shaft

CLEANING AND INSPECTION

1. Clean shift shaft and bushing with solvent and dry with compressed air.
2. Check shift shaft splines on both ends for wear and/or corrosion damage.
3. Inspect shift shaft for groove(s) at shift shaft bushing seal surface.
4. Inspect shift shaft bushing for corrosion damage.
5. Inspect shift shaft bushing oil seal for wear and/or cuts.

NOTE: *Oil seal in shift shaft bushing should be replaced as a normal repair procedure.*

6. Check "E" clip and retaining ring (if equipped) for damage. Replace if damaged.

DISASSEMBLY

1. Remove (and discard) shift shaft bushing oil seal by prying it out or driving it out with a punch and hammer.
2. Remove "E" clip and retaining ring if inspection determines that replacement of shift shaft is required.

CLEANING/INSPECTION - BEARING CARRIER

IMPORTANT: It is recommended that all seals and O-rings be replaced (as a normal repair procedure) to assure effective repair.

1. Clean bearing carrier with solvent and dry with compressed air.

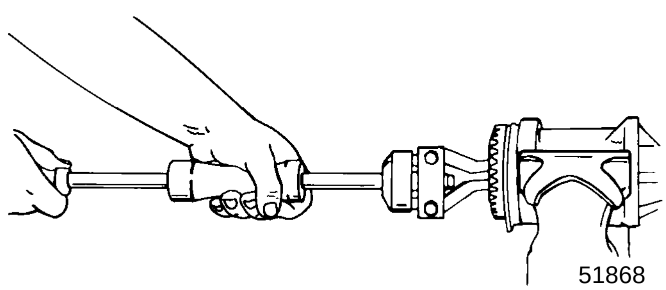
⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

2. Bearing carrier propeller shaft needle bearing condition is determined by propeller shaft bearing surface condition. (See "Propeller Shaft Inspection.")
3. Inspect reverse gear to pinion gear wear pattern (should be even and smooth). If not, replace reverse gear and pinion gear.
4. Check clutch jaws on reverse gear for damage. Replace reverse gear, if damage is found on clutch jaws.
5. Apply light oil to reverse gear bearing. Rotate reverse gear bearing while checking bearing for rough spots and/or catches. Push in and pull out on reverse gear to check for bearing side wear. Replace bearing if any of the listed conditions exist.

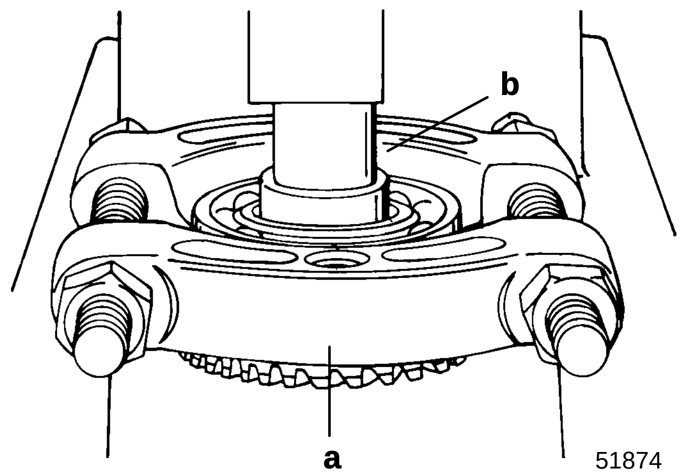
DISASSEMBLY- BEARING CARRIER

1. Remove and discard O-ring from between bearing carrier and thrust washer.
2. If inspection of reverse gear or reverse gear bearing determines that replacement of gear or bearing is required, remove gear and bearing as follows:
   a. Position bearing carrier in a soft jaw vise.
   b. Use Slide Hammer (91-34569A1) and remove reverse gear.



51868

   c. If reverse gear bearing remains attached to reverse gear, install Universal Puller Plate (91-37241) and position puller plate, gear and bearing on a press with gear side down. Use a suitable mandrel and press gear out of bearing.

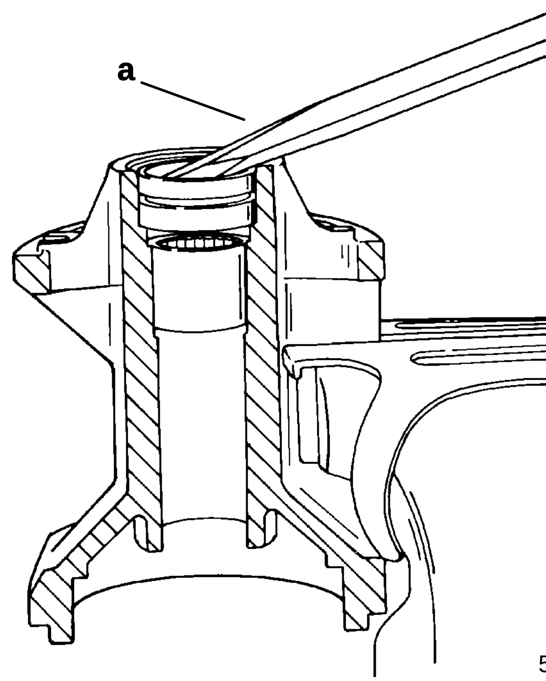


51874

a - Universal Puller Plate
b - Mandrel

   d. If reverse gear bearing has remained in bearing carrier, use slide hammer to remove bearing in the same methods as was used to remove reverse gear (Step "b").

3. Propeller shaft oil seals can be removed by (a) using a pry bar, or (b) pressing seals out when propeller shaft needle bearing is pressed out of bearing carrier.



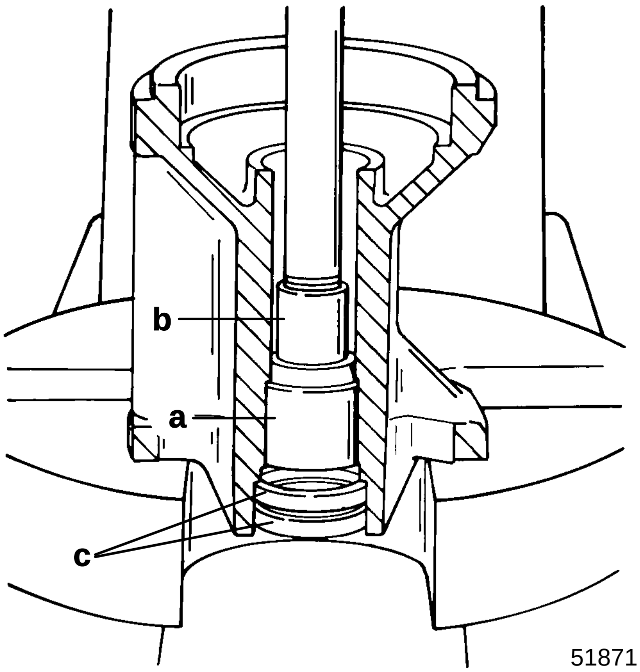
51868

a - Pry Bar

NOTE: *Unless propeller shaft needle bearing is going to be replaced, do not use Step 2-b. High Performance CLE, Sport Master and Torque Master gearcases have a retaining ring between the 2nd seal and the needle bearing. This retaining ring must be removed before the needle bearing can be removed from the bearing carrier.*

4. If inspection of propeller shaft needle bearing determines that replacement of bearing is required, use Universal Bearing Removal and Installation Tool (91-31 229A1) to press bearing and seals out of bearing carrier.

NOTE: *Reverse gear must be removed from bearing carrier before propeller shaft needle bearing can be removed.*



51871

a - Propeller Shaft Needle Bearing
b - Mandrel
c - Oil Seals (Seals and snap ring Must be removed prior to pressing out bearing on CLE, Sport Master and Torque Master gearcases)

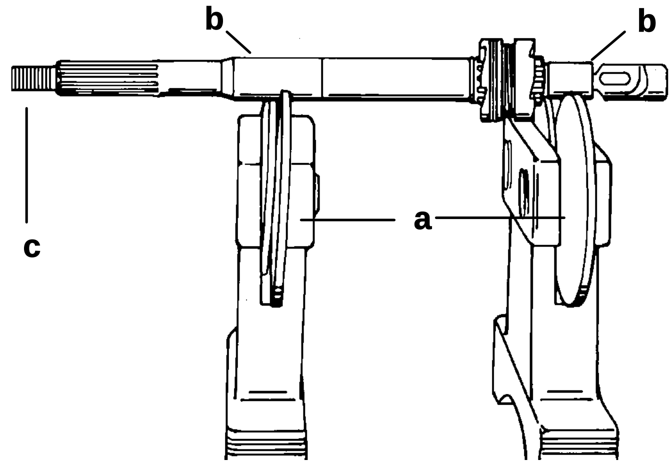
Propeller Shaft

INSPECTION

1. Clean propeller shaft assembly with solvent and dry with compressed air.
2. Inspect bearing carrier oil seal surfaces for grooves. Run fingernail across seal surface to check for groove. Replace shaft if groove is found.
3. Visually check bearing surfaces of propeller shaft for pitting, grooves, scoring, uneven wear or discoloration (bluish color) from overheating. Replace shaft and corresponding needle bearing if any of the above conditions are found. (Bearing carrier needle bearing contacts propeller shaft just in front of oil seal surface. Forward gear bearing contacts propeller shaft in front of sliding clutch splines.)
4. Inspect propeller shaft splines for wear and/or corrosion damage.
5. Check propeller shaft for straightness. Use either method, following:

BALANCE WHEELS

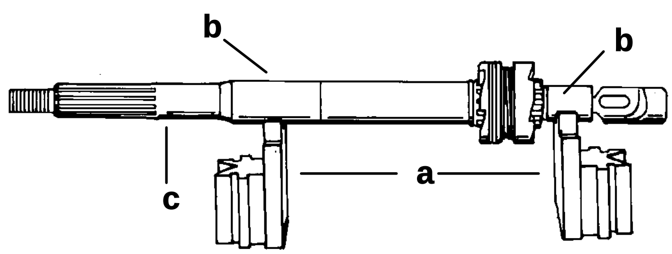
Place propeller shaft on balance wheels. Rotate propeller shaft and observe propeller end of shaft for "wobble." Replace shaft if any "wobble" is observed.



51872

a - Balance Wheels
b - Bearing Surfaces
c - Watch for "Wobble"

Position propeller shaft roller bearing surfaces on "vee" blocks. Mount a dial indicator at front edge of propeller splines. Rotate propeller shaft. Dial indicator movement of more than .006" (.152mm) (or noticeable "wobble") is reason for replacement.

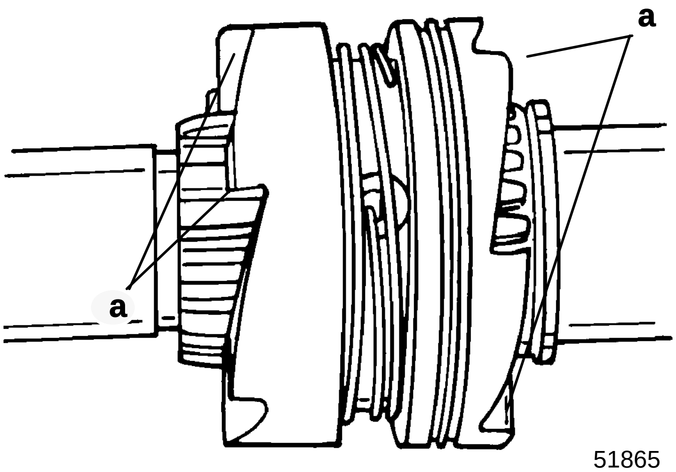


51872

a - "Vee" Blocks
b - Bearing Surfaces
c - Measure with Dial Indicator at this Point

6. Inspect sliding clutch. Check reverse gear and forward gear clutch "jaws." Rounded "jaws" indicate one or more of the following:
   a. Improper shift cable adjustment.
   b. Improper shift habits of operator(s) (shift from NEUTRAL to REVERSE gear too slowly).

c. Engine idle speed too high (while shifting).

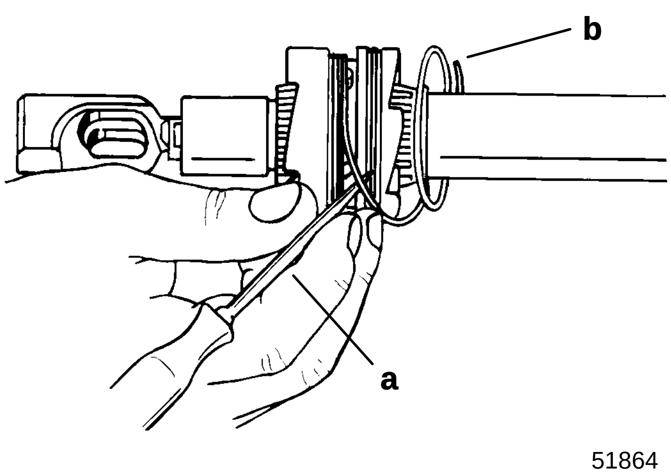


a - Clutch “Jaws”

7. Check condition of cam follower. If it shows wear (pitting, scoring or rough surface), replace cam follower and shift cam.

DISASSEMBLY

1. Remove shift cam from cam follower.
2. Insert a thin blade screwdriver or awl under first coil of cross pin retainer spring and rotate propeller shaft to unwind spring from sliding clutch. DO NOT over-stretch spring.



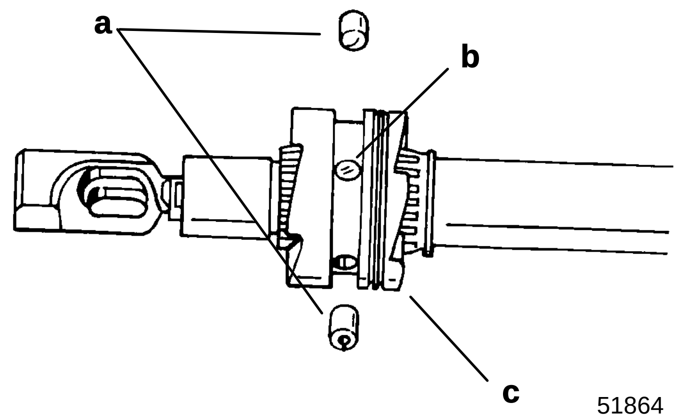
a - Awl
b - Cross Pin Retainer Spring

3. Remove the second cross pin retainer spring from sliding clutch in the same way as in Step 2.

⚠ CAUTION

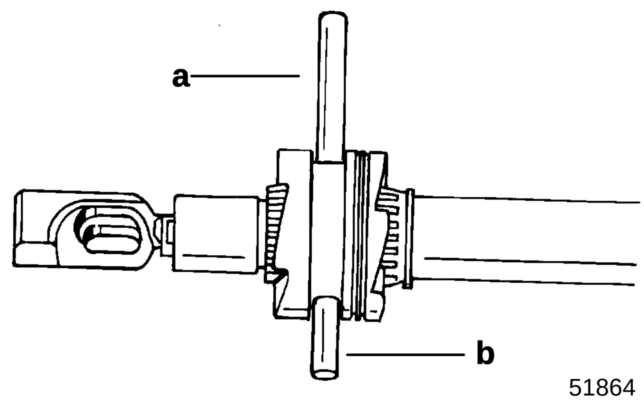
Detent pins are free and can fall out of sliding clutch. Care MUST BE taken not to lose pins.

4. Detent pins are free and can be removed from sliding clutch at this time.



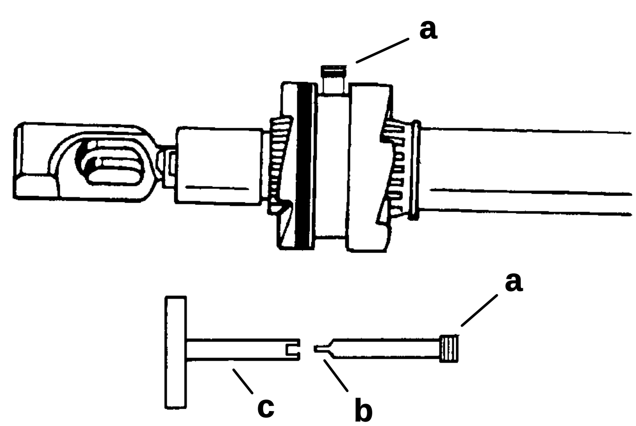
a - Detent Pins
b - Cross Pin
c - Sliding Clutch

5. Push cross pin out of sliding clutch and propeller shaft with Cross Pin Tool (91-86642).



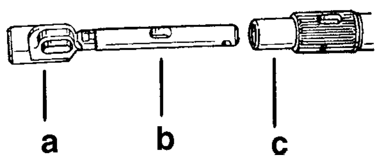
a - Cross Pin Tool (91-86642)
b - Cross Pin

NOTE: *Pro Max and Super Magnum models use a threaded cross pin. Use Cross Pin Tool 91-86642-2 to remove cross pin. Turn tool CLOCKWISE to remove threaded cross pin.*



a - Cross Pin
b - Cross Pin Tang
c - Cross Pin Tool 91-86642-2

6. Pull sliding clutch off propeller shaft.
7. Pull cam follower and clutch actuator rod out of propeller shaft. DO NOT force cam follower up-or-down or side-to-side when pulling from propeller shaft.



51864

a - Cam Follower
b - Clutch Actuator Rod
c - Propeller Shaft

8. Once cam follower and clutch actuator rod are removed from propeller shaft, lift rod out of cam follower.

Clutch Actuator Rod

CLEANING AND INSPECTION

⚠ CAUTION

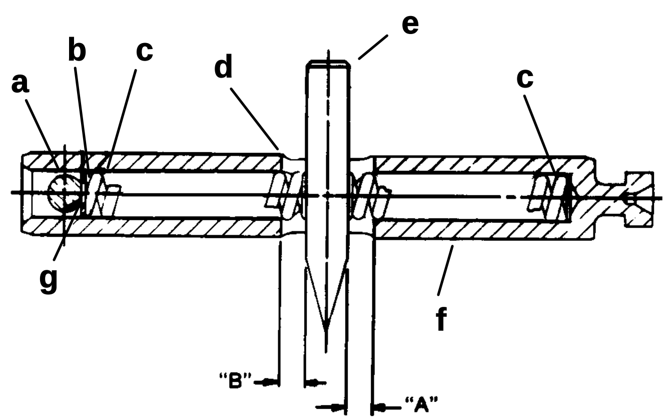
Care MUST BE taken when handling clutch actuator rod. The locating pin is free and will fall out, allowing compression spring and washer to fall out.

NOTE: *CLE, Torque Master and Sport Master gear cases have two (2) springs in clutch actuator.*

1. Clean clutch actuator rod in solvent and dry with compressed air.
2. Insert Cross Pin Tool (91-86642) between compression spring in elongated slot in clutch rod.
3. Compress spring (s) by forcing cross pin tool back-and-forth in elongated slot. This will release any initial set from spring.

Steps 4 thru 6 are for the Hi-Performance gear cases with two (2) springs.

4. Measure distance from each end of elongated slot to the near side of cross pin tool. The measurement taken must be equal within 1/64^2 0.016^2 (0.4mm).
5. If measurements (taken in Step 4) are not equal to within 1/64^2, disassembly of clutch actuator rod must be performed to determine the reason. [Reasons for unequal measurements may be a broken spring, a spring of reduced length (see Step 6) or the wrong spring shimming.]
6. If disassembly is performed on clutch actuator rod, spring length must be 1.535^2 to 1.560^2 1-17/32^2 to 1-9/16^2 (38.9mm to 39.7mm).

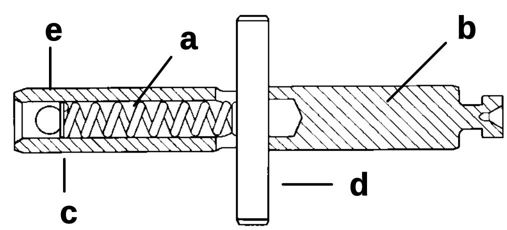


a - Spring Locating Pin
b - Shim Washer
c - Compression Spring
d - Elongated Slot
e - Cross Pin Tool (91-86642)
f - Clutch Actuator Rod
g - Shim Washer Must Lie Flat on Spring Locating Pin

NOTE: *"A" and "B" Measurements Must Be Equal within 1/64^2 0.016^2 (0.4mm).*

DISASSEMBLY (STD. GEAR CASES)

1. Push retaining pin out of clutch actuator rod.
2. After retaining pin is removed, compression spring and washer are free to fall out of clutch actuator rod.



51543

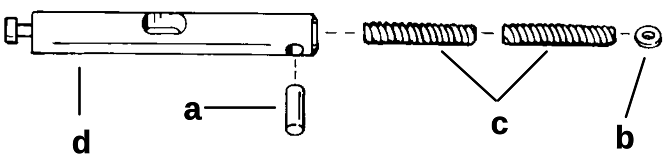
a - Spring
b - Clutch Actuator
c - Washer
d - Clutch Cross Pin
e - Retaining Pin

3. Inspect actuator components for wear or damage. Replace components as required.

DISASSEMBLY (HI-PERFORMANCE GEAR CASES)

IMPORTANT: Keep a record of shim amounts and location during disassembly of clutch actuator rod to aid in reassembly.

1. Push locating pin out of clutch actuator rod.
2. After locating pin is removed, compression springs and shim(s) are free to fall out of clutch actuator rod.



51864

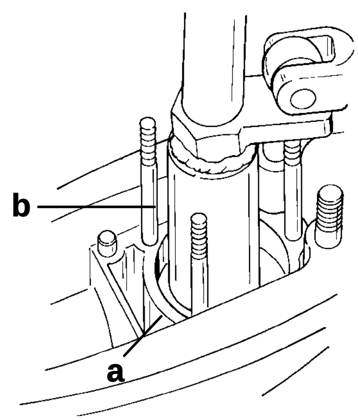
a - Locating Pin
b - Shim Washer(s)
c - Compression Springs
d - Clutch Actuator Rod

3. Refer to Step 6 in "Clutch Actuator Rod Inspection" for spring length requirements.

Pinion Gear and Drive Shaft

REMOVAL

1. Remove bearing retainer using Bearing Retainer Tool (91-43506).



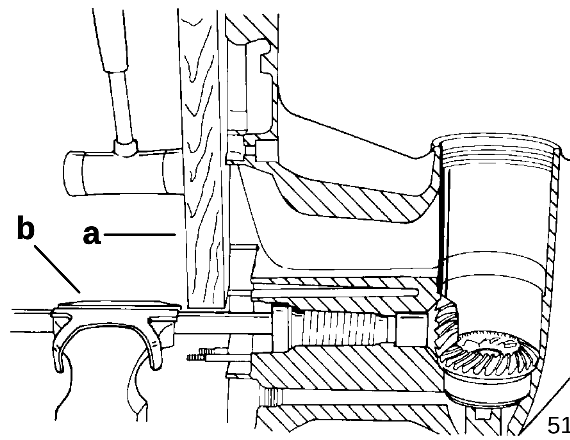
51865

a - Bearing Retainer
b - Bearing Retainer Tool (91-43506)

2. Place Driveshaft Holding Tool (91-34377A1) over drive shaft splines.
3. Use a socket and flex handle to hold pinion nut. (Pad area of gear housing where flex handle will make contact to prevent damage to gear housing.)
4. Use a socket and flex handle on Driveshaft Holding Tool to loosen pinion nut. Remove pinion nut and Drive Shaft Holding Tool.
5. Remove gear housing from vise and re-position it as shown. Be sure to use soft jaw vise covers and clamp as close as possible to water pump studs.
6. Place a block of wood on gear housing mating surface. Use a mallet and carefully tap gear housing away from drive shaft.

⚠ CAUTION

DO NOT strike gear housing hard with the mallet or allow gear housing to fall.



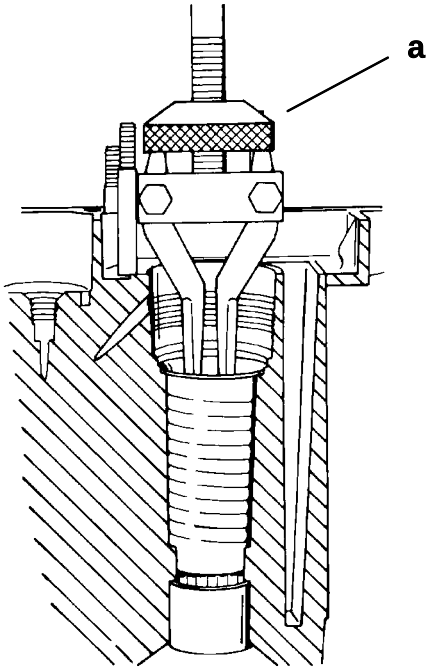
51870

a - Wooden Block
b - Soft Jaw Vise Covers

7. Reach into gear housing and remove pinion gear and forward gear assembly.
8. After driveshaft is removed from gear case, remove and retain shim(s) that were located under upper tapered drive shaft bearing.

NOTE: *Gear housings above serial number OD154836 have a larger oil passage way and do not have a lubrication sleeve installed. Sportmaster gear cases also do not use the lubrication sleeve.*

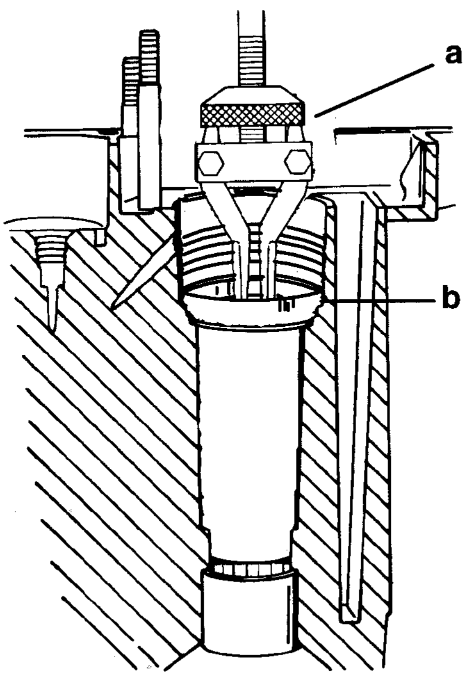
9. If necessary, carefully use a slide hammer (91-34569A1) to remove lubrication sleeve (if equipped) from gear housing.



51865

a - Side Hammer (91-34569A1)

10. **Sport Master Gear Case Only -** Remove lower drive shaft bearing cup and shims using slide hammer puller (91-34569A1).

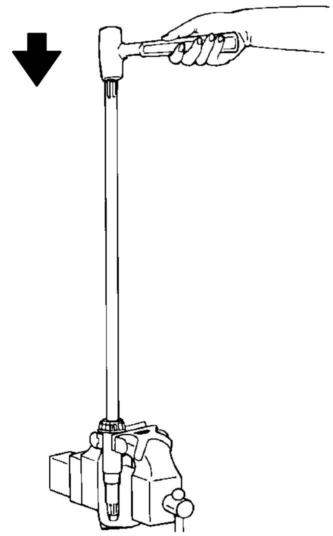


a - Slide Hammer Puller (91-34569)
b - Lower Driveshaft Bearing Cup

11. **All gear cases except Sport Master -** If inspection determines that replacement of driveshaft tapered bearing is required, remove bearing from drive shaft as follows:

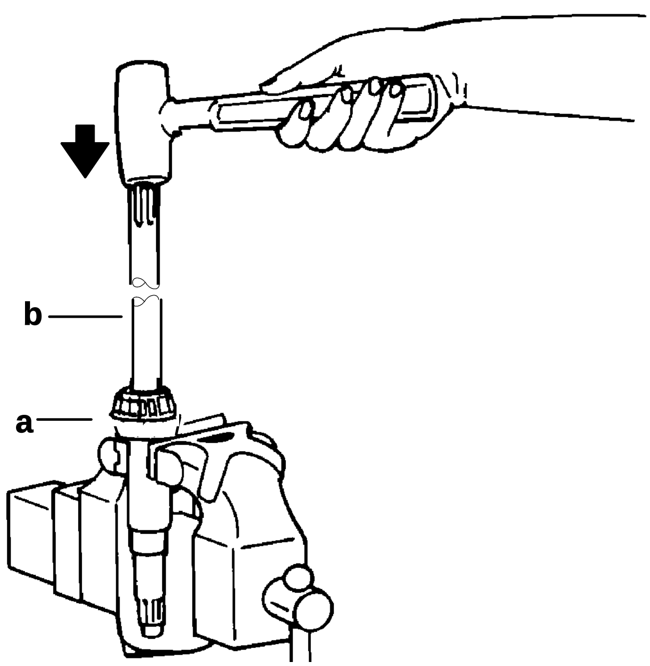
   a. Position driveshaft in a vise; DO NOT tighten vise jaws against shaft.

   b. Strike shaft with a lead hammer; take care not to drop shaft.



51866

12. **Sport Master Gear Case -** Both upper and lower tapered roller bearings can be removed from the driveshaft in one operation. Using the bottom bearing cup removed from the gearcase, place the cup on top of a vise leaving the vise jaws open enough to allow the driveshaft to slide through. Place the driveshaft through the cup and vise until the bottom bearing is resting in the cup. While holding the driveshaft, tap on the top of the shaft with a lead hammer until the bearings are free. **Do not drop the shaft when performing this operation.**



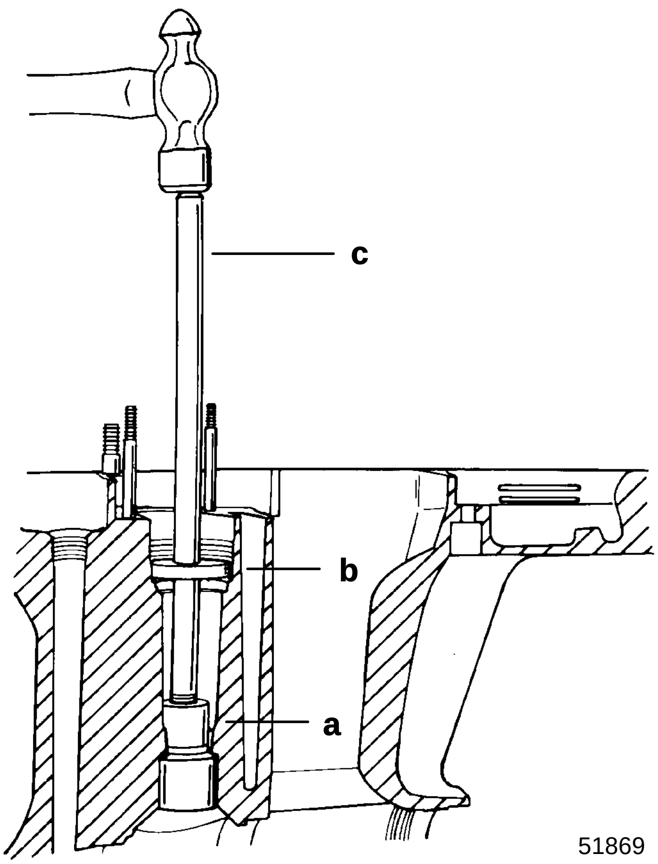
a - Lower Bearing Cup Removed from Gear Case
b - Driveshaft with Both Upper and Lower Bearings

13. Remove 18 loose needles from outer race of driveshaft needle bearing.

14. If inspection of driveshaft needle bearing surface determines that replacement of needle bearing is required, the 18 loose needle bearings previously removed must be reinstalled in bearing race to provide surface for mandrel to drive against.

NOTE: *FORWARD gear must be removed first BEFORE removing driveshaft needle bearing.*

IMPORTANT: Discard driveshaft needle bearing after removal. (Bearing cannot be reused.)



a - Mandrel (91-37263)
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)

*From Bearing Removal and Installation Kit (91-31229A5)

CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air. DO NOT allow drive shaft bearing to spin while drying.

2. Inspect pinion gear for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace pinion gear, if any of the above conditions are found.

3. Inspect driveshaft needle bearing surface (area just above pinion gear splines) for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace driveshaft and driveshaft needle bearing, if any of the preceding conditions are found.

4. Inspect drive shaft to crankshaft splines for wear. Replace drive shaft if wear is excessive.

5. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing and race as a set, if any of the preceding conditions are found.

6. Inspect driveshaft for groove(s) where water pump base oil seals contact shaft. Replace driveshaft if groove(s) are found.

Forward Gear

REMOVAL AND DISASSEMBLY

NOTE: *Forward gear can only be removed from gear housing after drive shaft and pinion gear have been removed .*

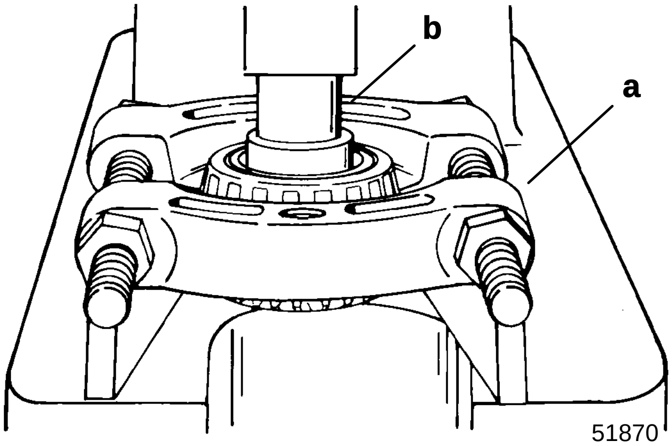
1. Reach into gear housing and lift out forward gear.

IMPORTANT: DO NOT remove tapered bearing or needle bearings from forward gear, unless replacement of bearings is required. (Bearings cannot be reused after they have been removed.)

2. If inspection determines that replacement of forward gear tapered bearing is required, remove bearing from gear and bearing race from gear housing (tapered bearing and race MUST BE replaced as a set), as follows:

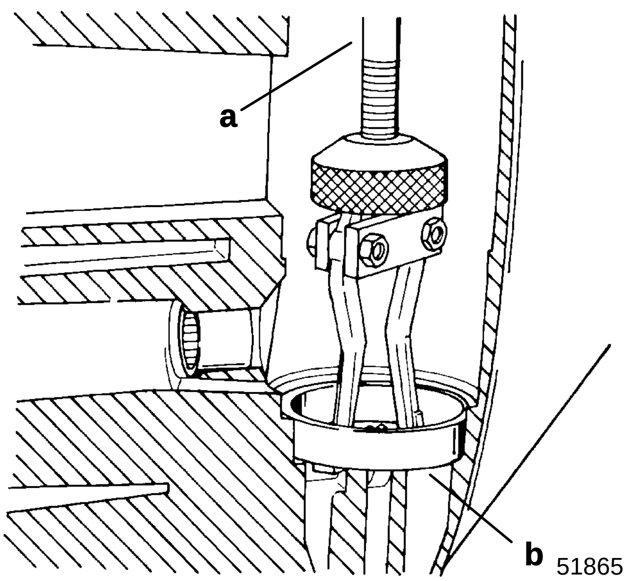
    a. Install Universal Puller Plate (91-37241) between forward gear and tapered bearing.

b. Place forward gear, bearing and puller plate on a press and press gear out of bearing with a suitable mandrel.



a - Universal Puller Plate
b - Mandrel

c. Use Slide Hammer (91-34569A1) to remove forward gear tapered bearing race.



a - Slide Hammer
b - Tapered Bearing Race

d. After forward gear tapered bearing race is removed from gear housing, lift out and retain shims which were behind bearing race.

3. If inspection determines that replacement of propeller shaft needle bearings in forward gear is required, remove bearing from gear as follows:

   a. Clamp forward gear in a soft jaw vise securely.

   b. From toothed-side of gear, drive propeller shaft needle bearings out of gear with a punch and hammer.

CLEANING AND INSPECTION

⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean forward gear and bearings with solvent and dry with compressed air.
2. Inspect gear teeth for pitting, grooves, scoring, uneven wear and for discoloration (from overheating). Replace gear if any of these conditions are found.
3. Check clutch jaws on forward gear for damage. Replace forward gear if damage is found.
4. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration (from overheating). Replace tapered bearing (on forward gear) and race if any of these conditions are found. (Always replace tapered bearing and race as a set.)
5. To determine condition of propeller shaft needle bearings (in forward gear), inspect propeller shaft forward gear needle bearing surface as outlined in "Propeller Shaft Inspection."

Gear Housing

CLEANING AND INSPECTION

1. Clean gear housing with solvent and dry with compressed air.
2. Check gear housing carefully for impact damage.
3. Check for loose fitting bearing cups and needle bearings.
4. Inspect bearing carrier cover nut retainer threads in gear housing for corrosion damage and/or stripped threads.

Reassembly and Installation Standard Rotation

Driveshaft Needle Bearing

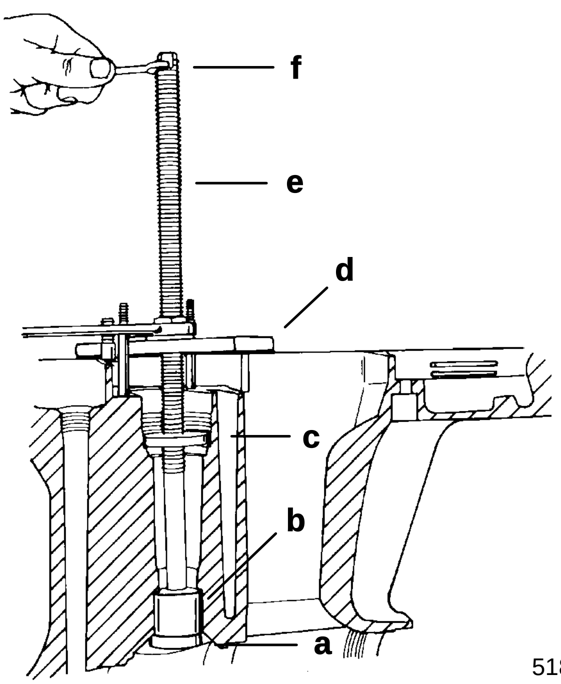
REASSEMBLY/INSTALLATION

⚠ CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing MUST be replaced. Loose fitting needle bearing will move out of position and cause repeated failures.

1. Apply a thin coat of Quicksilver Needle Bearing Assembly Lubricant to driveshaft needle bearing bore in gear housing.
2. By way of propeller shaft cavity, place needle bearing in drive shaft bore with numbered side of bearing facing up drive shaft bore.
3. Install and seat needle bearing with the following tools: Puller Rod* (91-31229), Nut* (11-24156), Pilot* (91-36571), Plate* (91-29310), and Mandrel (models with preloaded driveshaft use 91-38628*; models with standard driveshaft use 91-92788). Pull bearing up into bore until it bottoms on gear housing shoulder. (DO NOT use excessive force.)

*From Bearing Removal and Installation Kit (91-31229A5)



a - Mandrel
b - Bearing
c - Pilot
d - Plate
e - Puller Rod
f - Hold

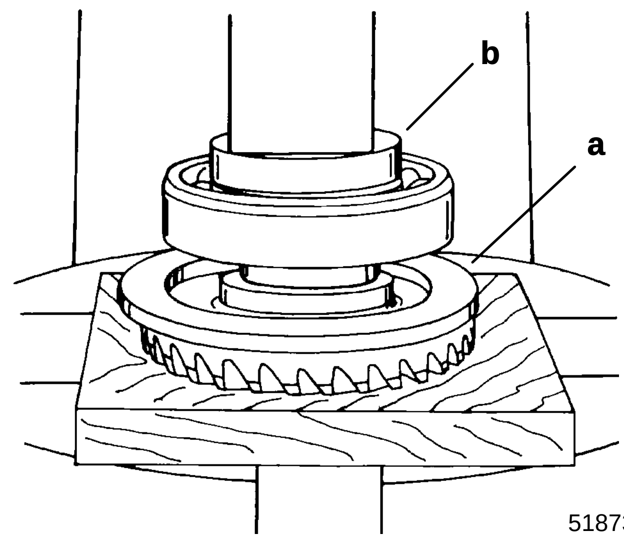
Bearing Carrier

REASSEMBLY

1. Place reverse gear on a press with gear teeth facing down.

IMPORTANT: The reverse gear thrust washer has a tapered outside diameter so that one side is larger than the other. The larger outside diameter of washer must be toward reverse gear.

2. Place thrust washer over gear with the larger outside diameter down toward gear.
3. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto inside diameter of reverse gear ball bearing.
4. Position ball bearing over gear (with numbered side of bearing up).
5. Press ball bearing onto gear with a suitable mandrel until firmly seated. (Be sure to press only on inner race of bearing and that bearing is firm against gear.)

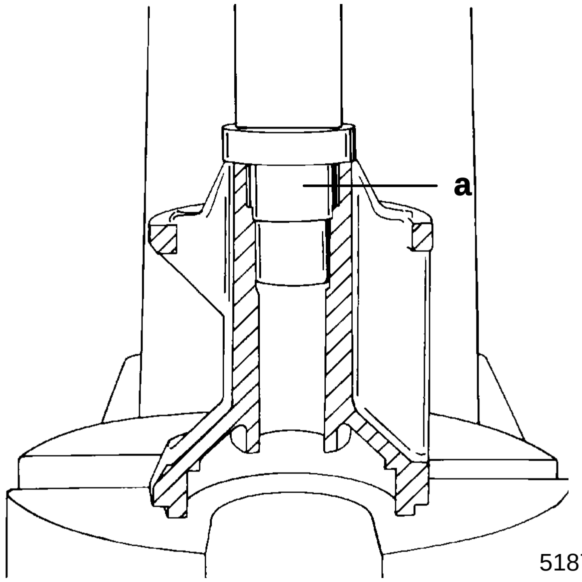


a - Thrust Washer
b - Mandrel

6. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto outside diameter of propeller shaft needle bearing.
7. Place propeller shaft needle bearing into aft end of bearing carrier with numbered side toward aft end.

NOTE: *On high performance CLE, Sport Master and Torque Master gearcases, a retaining ring is installed after propeller shaft needle bearing is installed in bearing carrier.*

8. Use Mandrel 91-15755 and press needle bearing into bearing carrier.



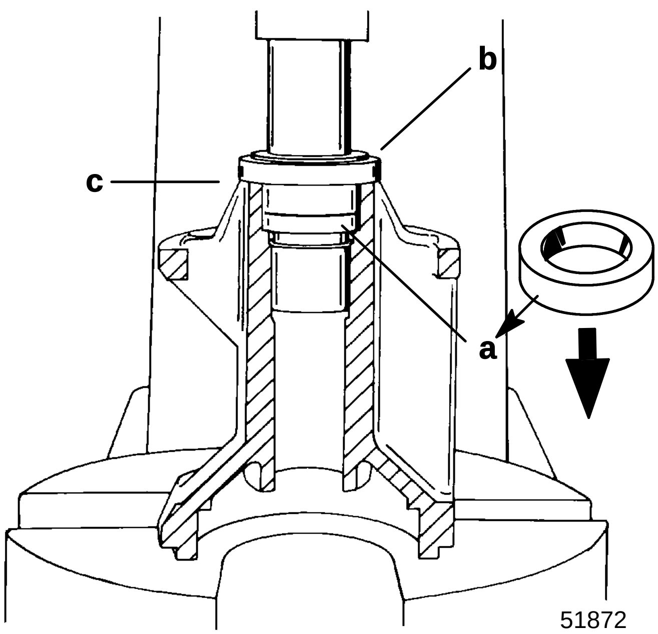
51872

a - Mandrel (91-15755)

9. **CLE, Sport Master and Torque Master Gear Cases Only -** Install snap ring to retain bearing.

10. Apply Loctite 271 to outer diameter of propeller shaft oil seals.

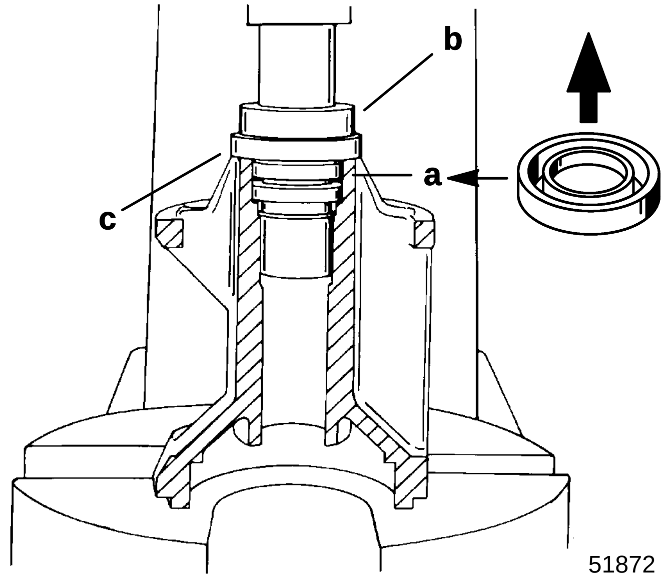
11. Place one seal on longer shoulder side of Oil Seal Driver (91-31108) with lip of seal away from shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.



51872

a - Oil Seal (Lip of Seal Down)
b - Oil Seal Driver
c - Seated

12. Place second seal on short shoulder side of seal driver with lip of seal toward shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.



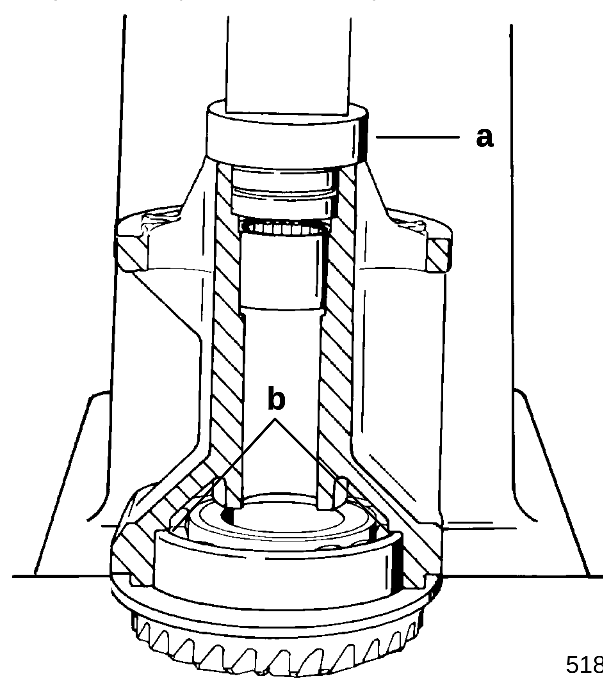
51872

a - Oil Seal (Lip of Seal Up)
b - Oil Seal Driver
c - Seated

13. Wipe off excess Loctite.

14. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto the outside diameter of reverse gear ball bearing.

15. Place bearing carrier over reverse gear and bearing assembly. Press bearing carrier onto bearing.



51870

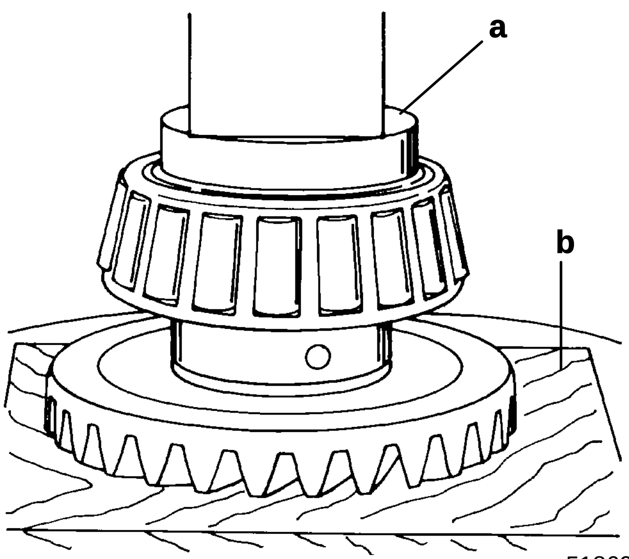
a - Mandrel
b - Seated

16. Place O-ring over bearing carrier and position it between bearing carrier and thrust washer.
17. Lubricate oil seals and O-ring with Quicksilver 2-4-C w/Teflon Marine Lubricant.

Forward Gear

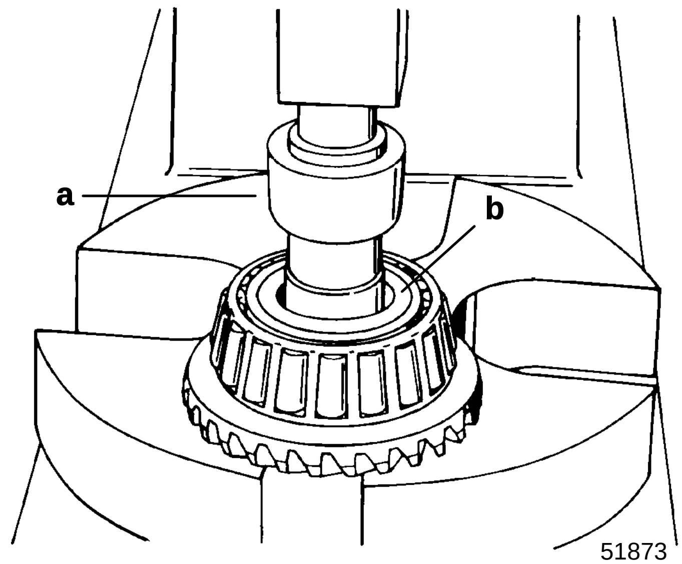
REASSEMBLY

1. Place forward gear on a press with gear teeth down.
2. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto the inside diameter of forward gear tapered bearing.
3. Position forward gear tapered bearing over gear.
4. Press bearing onto gear until firmly seated. (Be sure to press only on inner race of bearing and that bearing is firm against the gear.)



a - Mandrel
b - Wooden Block

5. Apply a light coat of Quicksilver Super Duty Gear Lubricant to bore in center of forward gear.
6. Place one forward gear needle bearing on longer shoulder side of Forward Gear Bearing Tool (91-86943) with numbered side of bearing toward shoulder. Press bearing into forward gear until bearing tool bottoms against gear.



a - Forward Gear Bearing Tool (91-86943)
b - Numbered Side of Needle Bearing

7. Place second needle bearing on short shoulder side of bearing tool with numbered side of bearing toward shoulder. Press bearing into forward gear until bearing tool bottoms against gear.

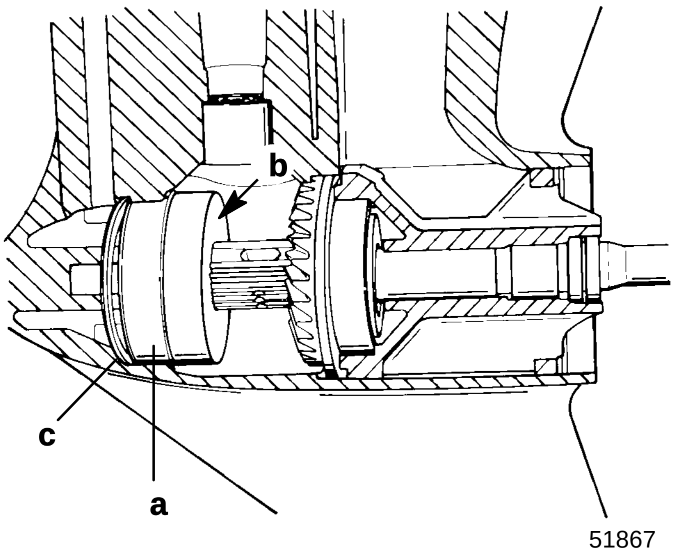
Forward Gear Bearing Race

INSTALLATION

1. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or a new gear housing is being used, start with approximately 0.010² (0.254mm).
2. Apply a light coat of Quicksilver Super Duty Gear Lubricant to forward gear bearing race bore in gear housing.
3. Position tapered bearing race squarely over bearing bore in front portion of gear housing.
4. Place Bearing Driver Cup (91-87120) over tapered bearing race.

NOTE: *A used propeller shaft is recommended for use in Step 5. If it is necessary, however, to use the propeller shaft that will be installed in gear housing, the propeller shaft must be disassembled. (Refer to "Propeller Shaft Disassembly," preceding.)*

5. Place propeller shaft into hole in center of bearing driver cup.
6. Install bearing carrier assembly over propeller shaft and lower it into gear housing. Bearing carrier acts as a pilot to assure proper bearing race alignment.
7. Thread a nut onto propeller shaft to protect propeller shaft threads.
8. Use a mallet to drive propeller shaft against bearing driver cup until tapered bearing race is seated against shim(s).



a - Tapered Bearing Race
b - Bearing Driver Cup (91-87120)
c - Shim(s)

9. Remove nut from propeller shaft, then remove bearing carrier and propeller shaft from gear housing. Lift bearing driver cup out of gear housing.
10. Apply a light coat of oil on tapered bearing race, then place forward gear assembly into forward bearing race.

Driveshaft and Pinion Gear

REASSEMBLY/INSTALLATION

1. Apply a light coat of Quicksilver Super Duty Gear Lubricant on I.D. of driveshaft tapered bearing. **Sport Master only -** Apply High Pressure Grease (such as Chicago Manufacturing and Distributing Lube #3) to the I.D. of both bearings.
2. Thread a used pinion nut onto end of drive shaft. Leave approximately 1/16² (2mm) of nut threads exposed. Drive shaft threads MUST NOT extend beyond nut or thread damage could result while pressing.
3. Place bearing over driveshaft. **Sport Master only -** Both bearings can be installed on the driveshaft in one operation. Place the smaller bottom bearing over the driveshaft with the numbers on the bearing facing the top of the shaft. Place the larger top bearing exactly opposite by having the numbers facing the pinion end of the shaft. While holding bearings in place, invert the driveshaft and place assembly in a press.
4. Using an old driveshaft bearing inner race or other suitable mandrel (which applies pressing force on center bearing race only), press bearing(s) onto shaft until seated.

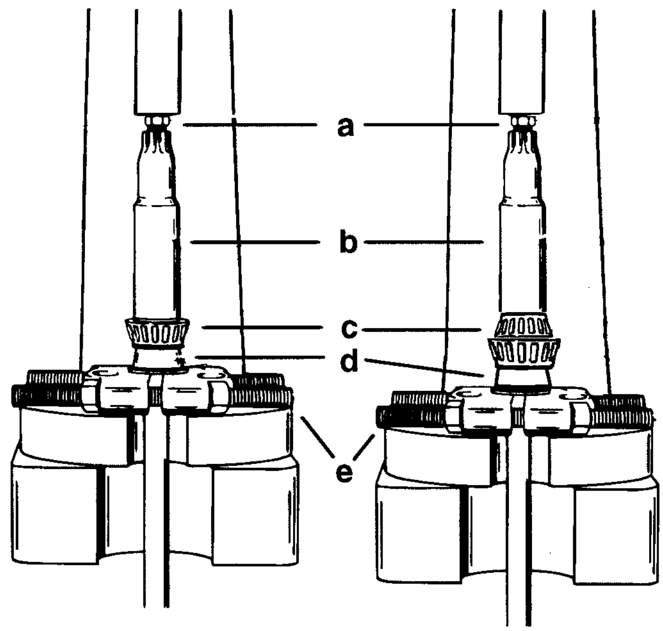
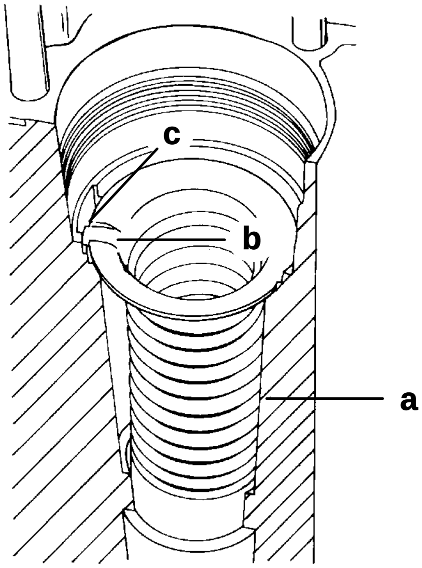


Illustration on Left is for all gear cases except Sport Master. Right illustration is for Sport Master

a - Used Pinion Nut
b - Driveshaft
c - Tapered Bearing (s)
d - Old Bearing Inner Race
e - Universal Puller Plate

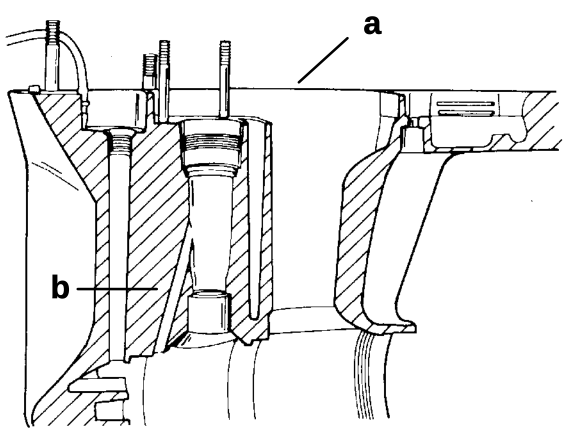
5. Position lubrication sleeve (if equipped) in drive-shaft bore.



51870

a - Lubrication Sleeve (if equipped)
b - Tab (MUST align with slot)
c - Slot

NOTE: *Late model and Sport Master gear cases DO NOT use a lubrication sleeve. A larger diameter oil flow passage way [3/8" (9.5mm) vs. 1/4" (6.4mm)] is used to provide oil to the upper driveshaft tapered bearing.*



51726

a - Late Model Gearcase Without Lubrication Sleeve
b - 3/8" (9.5mm) Oil Flow Passage

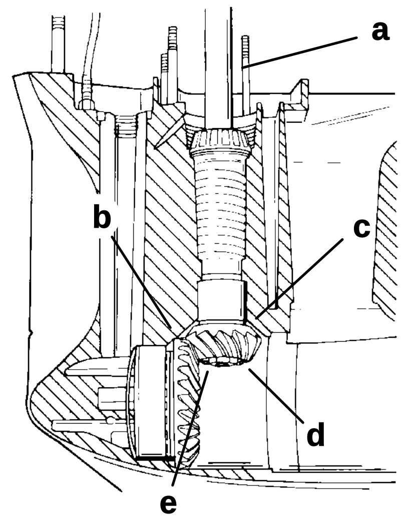
6. **Sport Master gear case only:** Do not install driveshaft lower bearing cup until pinion height is determined.

7. Position pinion gear in gear housing below drive-shaft bore with teeth of pinion gear meshed with teeth of forward gear.

8. Insert drive shaft into drive shaft bore while holding pinion gear. Rotate driveshaft to align and engage driveshaft splines with pinion gear splines. Continue to insert driveshaft into gear housing until driveshaft tapered bearing is against bearing race.

NOTE: *It is recommended that after final pinion depth is obtained, a new pinion nut be installed. Clean pinion nut threads with Loctite Primer N (92-59327-1) before applying Loctite 271.*

9. Place a small amount of Loctite 271 onto threads of pinion gear nut and install flat washer and nut on driveshaft with flat side of nut away from pinion gear. Hand tighten pinion nut.



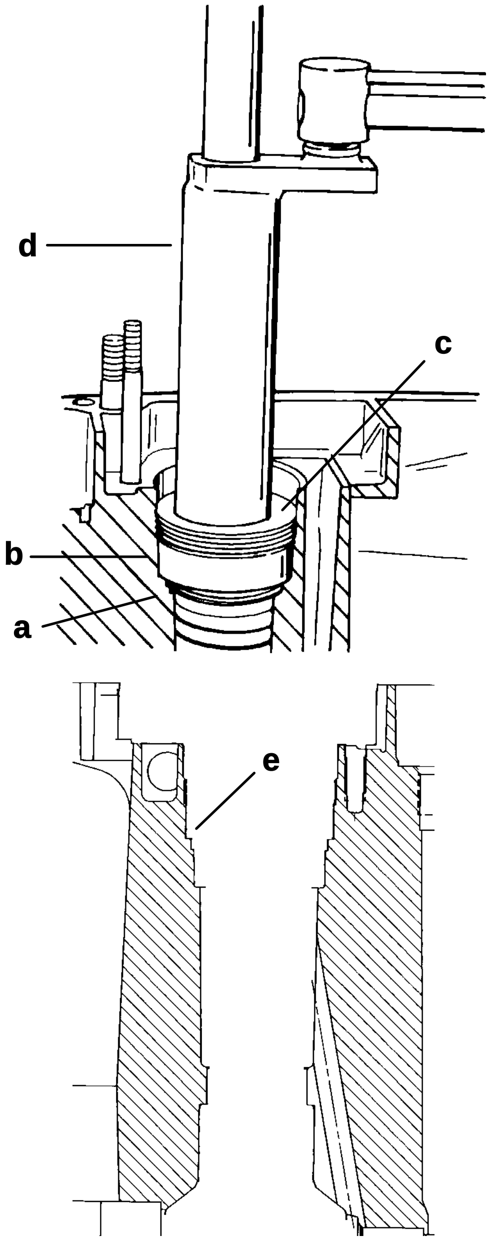
51867

a - Drive Shaft (rotate to engage splines with pinion gear)
b - Forward Gear Assembly
c - Pinion Gear
d - Washer (located above pinion nut)
e - Pinion Nut [apply Loctite 271 on threads and install with flat side away from pinion gear.]

10. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or are not reusable (damaged), start with approximately 0.010" (0.254mm).

NOTE: Sport Master Only, *Lower bearing race cannot be installed until pinion gear height is set.*

11. Install bearing race and bearing retainer.

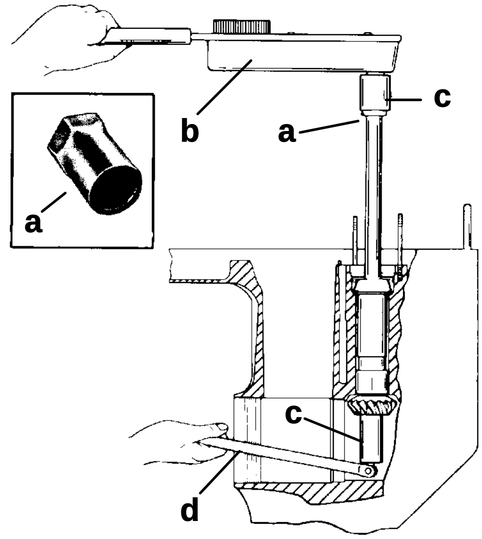


51880

a - Shim(s)
b - Bearing Race
c - Bearing Retainer (Word "OFF" must be visible)
Torque to 100 lb. ft. (135.5 N·m)
d - Bearing Retainer Tool (91-43506)
e - Sport Master Gear Case Upper Bearing Shim Location

12. Use a socket and flex handle to hold pinion nut (pad area where flex handle will contact gear housing while torquing nut).

13. Place Driveshaft Holding Tool (91-34377A1) over crankshaft end of driveshaft. Torque pinion nut to 75 lb. ft. (101.5 N·m) on standard gear cases. Torque pinion nut on CLE, Torque Master and Sportmaster to 85 lb. ft. (115 N·m).



a - Driveshaft Holding Tool (91-34377A1)
b - Torque Wrench; Torque Nut to 75 lb. ft. (101.5 N·m).
CLE, Torque Master & Sportmaster Torque Nut to
85 lb. ft. (115 N·m)
c - Socket
d - Breaker Bar

IMPORTANT: Wipe any excess Loctite from pinion nut and pinion gear.

Pinion Gear Depth/Drive Shaft End Play (Sport Master)/Forward Gear Backlash/Reverse Gear Backlash

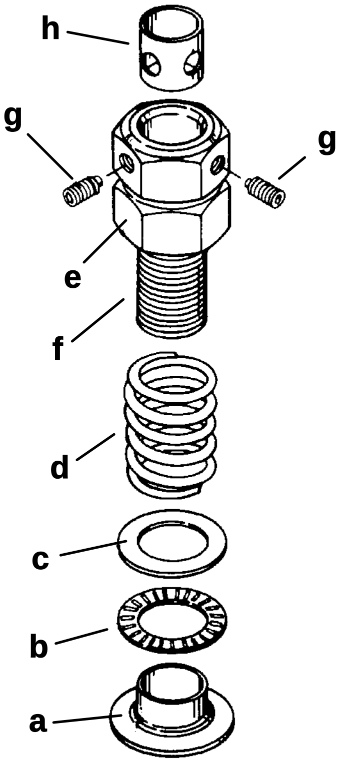
DETERMINING PINION GEAR DEPTH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Forward gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

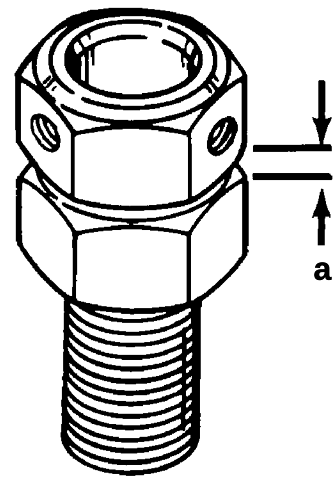
1. Clean the gear housing bearing carrier shoulder.
2. Install Bearing Preload Tool (91-14311A1) over driveshaft in sequence shown.

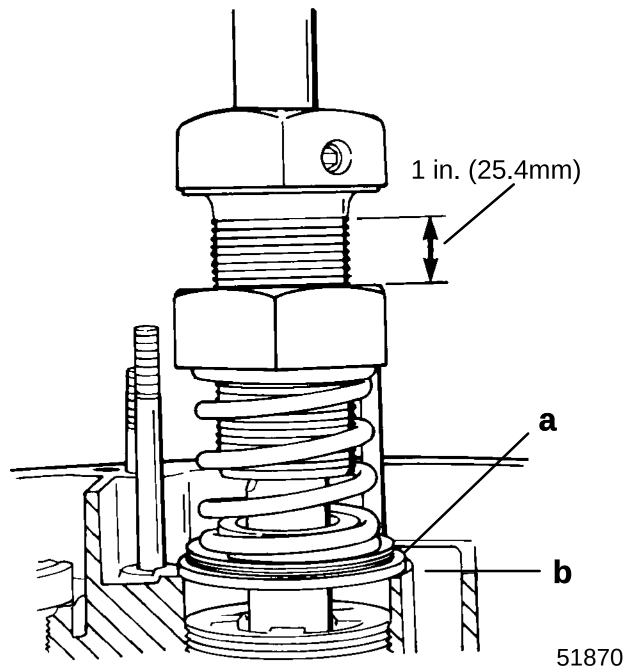
__NOTE:__ Bearing Preload Tool (91-44307A1) may also be used. Follow instructions provided with tool for proper installation.



a - Adaptor
b - Bearing
c - Washer
d - Spring
e - Nut; Thread Nut ALL-the-Way Onto Bolt
f - Bolt
g - Set Screw
h - Sleeve; Holes in Sleeve Must Align with Set Screw

3. Align adaptor on driveshaft bearing pocket ledge.
4. With tool installed over driveshaft, tighten both set screws securely, making certain to align sleeve holes to allow set screws to pass thru.
5. Measure distance (a) and increase that distance by 1" (25.4mm) by turning bottom nut away from top nut.





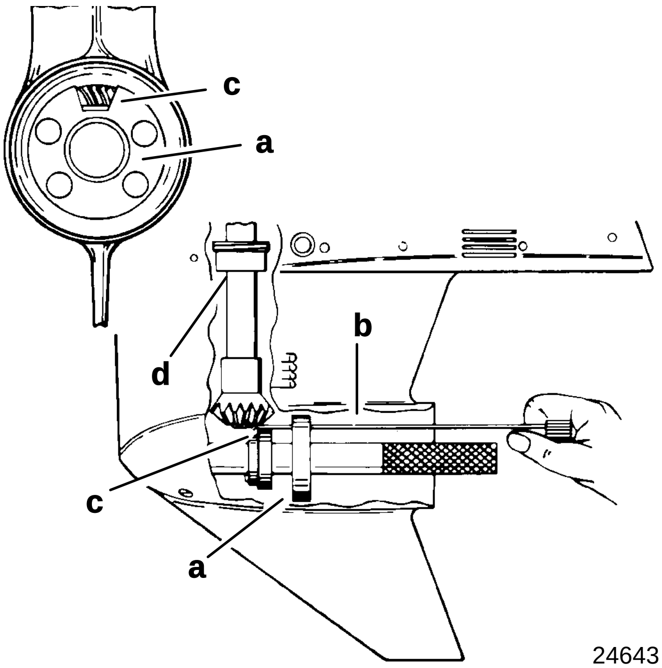
a - Adaptor
b - Ledge

6. Turn drive shaft clockwise 2 or more turns to seat drive shaft bearings.
7. Insert Pinion Gear Locating Tool* (91-74776) into gear housing until it bottoms out on bearing carrier shoulder.

*Pinion Gear Locating Tool (91-12349A2) can be used. Use flat #7 and disc #2. Follow instructions supplied with tool.

8. Determine pinion gear depth by inserting a feeler gauge thru access slot in pinion gear shimming tool.
9. Clearance between shimming tool and pinion gear should be 0.025" (0.64mm).

10. If clearance is correct, leave Bearing Preload Tool on drive shaft for "Determining Forward Gear Backlash," following.
11. If clearance is not correct, add (or subtract) shims at location shown (Sport Master - place shims under upper bearing race) to raise (or lower) pinion gear. When reinstalling pinion nut, apply Loctite 271 on threads of nut and re-torque pinion nut.



a - Pinion Gear Tool (91-74776 or 91-12349A2)
b - Feeler Gauge
c - Obtain 0.025² (0.64mm) Clearance between Shimming Tool and Pinion Gear
d - Add or Subtract Shim(s) Here

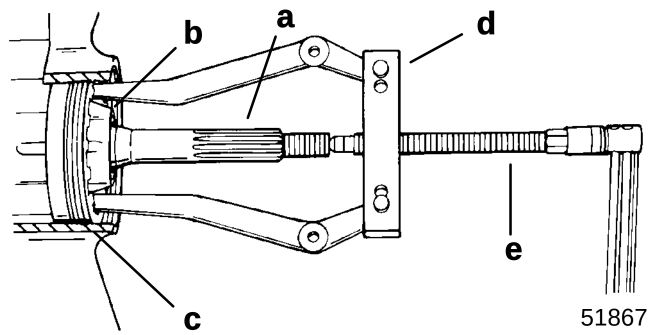
NOTE: *Bearing Preload Tool (91-14311A1) should remain installed on driveshaft after setting pinion gear depth as it is required to properly check forward gear and reverse gear backlash.*

DETERMINING FORWARD GEAR BACKLASH

NOTE: *If working on a Sport Master gear case, you may want to proceed to* ***Determining Drive Shaft End Play*** *before checking forward gear backlash. However, Forward and Reverse gear backlash can be set before checking drive shaft end play.*

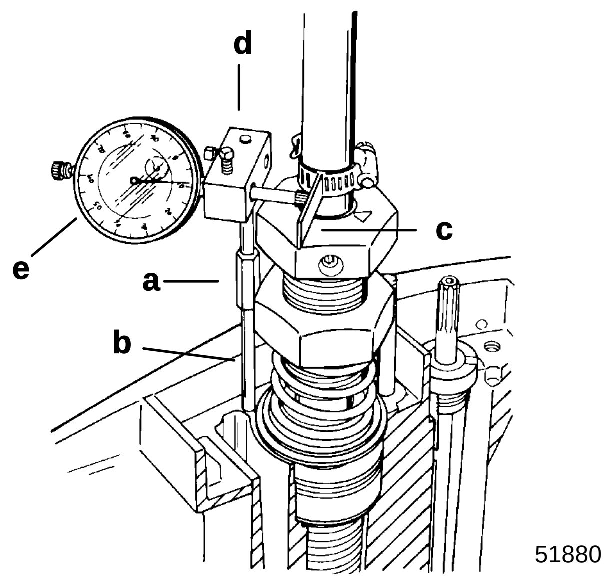
IMPORTANT: Bearing carrier must be assembled to provide a pilot for propeller shaft.

1. Insert propeller shaft into position in gear housing. (DO NOT place shift cam on propeller shaft.)
2. Place bearing carrier into gear housing and thread cover nut tightly against bearing carrier. (It is not necessary to torque cover nut against bearing carrier.)
3. Attach Bearing Carrier Removal Tool (91-46086A1) and Puller Bolt (91-85716) onto gear housing.
4. Torque puller bolt against propeller shaft to 45 lb. in. (5.0 N·m). Turn drive shaft 10 revolutions with the load applied to propeller shaft. This will seat forward gear bearing.



a - Propeller Shaft (DO NOT install shift cam)
b - Bearing Carrier (assembled)
c - Cover Nut (Tighten; DO NOT torque)
d - Bearing Carrier Removal Tool (91-46086A1)
e - Puller Bolt (91-85716); Torque to 45 lb. in. (5.0 N·m)

5. Fasten dial indicator to gear housing and Backlash Indicator Tool (91-78473) to driveshaft.
6. Recheck torque on puller bolt [45 lb. in. (5.0 N·m)].
7. Position dial indicator pointer on line marked "1" on Backlash Indicator Tool 91-78473, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked "2" on Indicator Tool 91-78473, if gear ratio is 2:1 (14 teeth on pinion gear). Position pointer on line #1 of Indicator Tool 91-19660 if gear ratio is 2.3:1 (13 teeth on pinion gear).



a - Thread Stud Adaptor (from 91-14311A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)

8. Lightly turn driveshaft back-and-forth (no movement should be noticed at propeller shaft).
9. Backlash specifications:

Gear Case & Ratio	Backlash Inches (mm)	Dial Indicator Pointer on Line Mark
Production 1.87:1	.018-.027 (.46-.69)	#1 91-78473
CLE/Torque Master/Sport Master 1.87:1	.021-.026 (.53-.66)	#1 91-78473
All 2.00:1	.015-.022 (.38-.56)	#2 91-78473
All High Altitude 2.3:1	.018-.023 (.46-.58)	#1 91-19660

10. If backlash is LESS than the specified minimum, REMOVE shim(s) from in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.
11. If backlash is MORE than the specified MAXIMUM, add shim(s) in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.

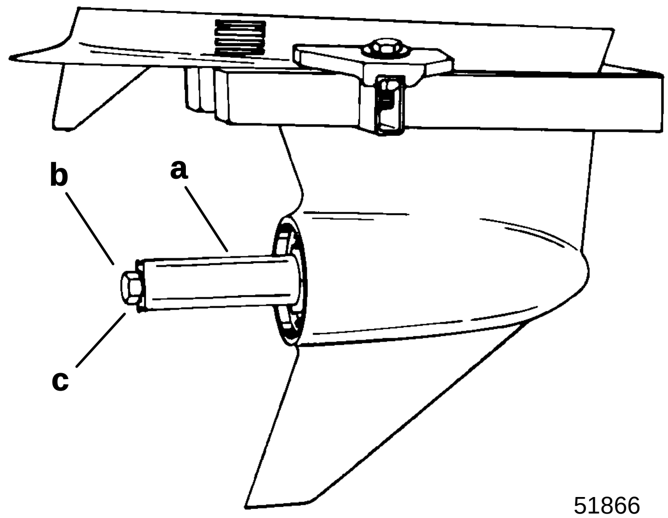
NOTE: *By adding or subtracting 0.001″ (0.025mm) shim, the backlash will change approximately 0.001″ (0.025mm).*

REVERSE GEAR

Determining Reverse Gear Backlash

Although reverse gear backlash is not adjustable, it may be checked as follows:

1. Propeller shaft and bearing carrier must be completely assembled and installed in gearcase.
2. Install shift shaft in gearcase.
3. Shift gearcase into reverse.
4. Slide 6 in. x 1.5 in. I.D. (152.5mm x 38.0mm) piece of PVC pipe over propeller shaft and position pipe against bearing carrier.
5. Secure pipe against carrier with propeller nut and tab washer.



a - Pipe [6 in. x 1.5 in. (152.4mm x 38.1mm)]
b - Propeller Nut
c - Tab Washer

6. Torque propeller nut to 45 lb. in. (5.0 N·m).
7. Gently rock driveshaft. Dial indicator should show backlash of 0.030″-0.050″ (0.762mm-01.27mm).

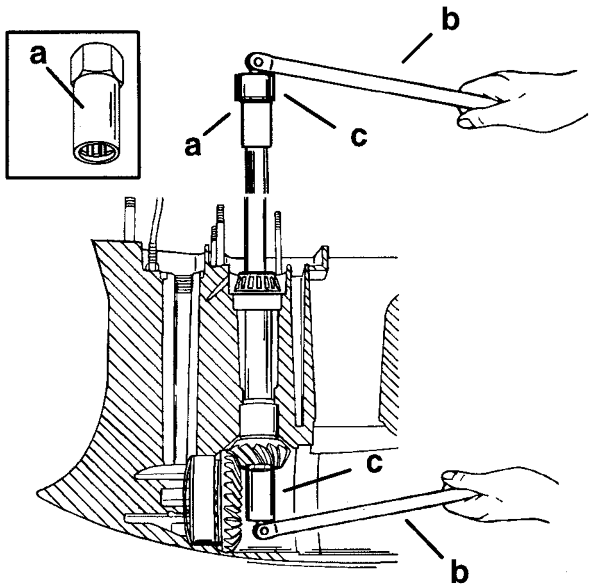
If backlash is not as indicated, gear case is not properly assembled or parts are excessively worn and must be replaced before returning gear case to service.

DRIVE SHAFT END PLAY (SPORT MASTER ONLY)

IMPORTANT: Pinion depth MUST BE DETERMINED BEFORE setting drive shaft lower tapered bearing shim height.

1. With pinion height set in previous steps, remove the preload tool from the driveshaft.
2. Remove the upper bearing cup retainer with tool 91-43506, and remove cup [leave upper cup shim(s) in place].

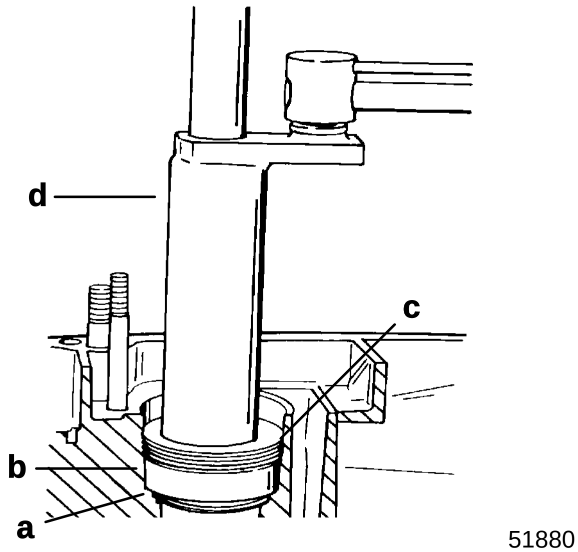
3. Place Driveshaft Holding Tool (91-34377A1) over crankshaft end of drive shaft. Use a socket and breaker bar to hold pinion nut and remove the pinion nut, washer, pinion gear and driveshaft.



a - Driveshaft Holding Tool (91-34377A1)
b - Breaker Bar
c - Socket

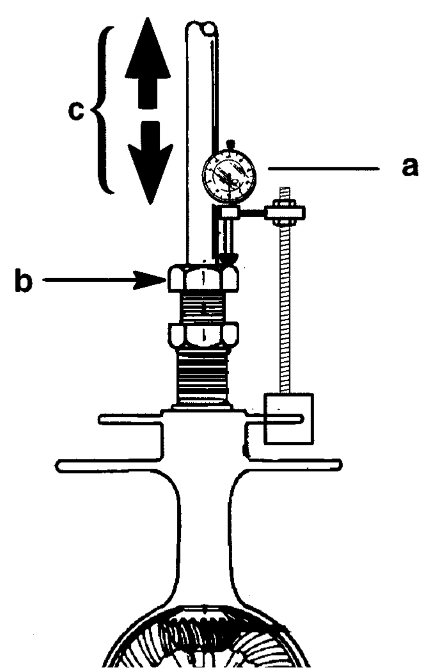
NOTE: *Do not install any shims below lower bearing cup at initial installation.*

4. Apply High Pressure Grease (such as Chicago Manufacturing and Distributing Lube #3) to the O.D. of the driveshaft lower bearing cup and install cup into the gear case.
5. Reinstall driveshaft assembly into gear case. It is not necessary to reinstall the pinion gear for this procedure.
6. Install the upper drive shaft bearing cup and install and torque the upper bearing retainer to 100 lb. ft. (135.5 N·m).



a - Pinion Height Adjusting Shim(s)
b - Upper Bearing Race
c - Bearing Retainer (Word "OFF" must be visible) Torque to 100 lb. ft. (135.5 N·m)
d - Bearing Retainer Tool (91-43506)

7. Install the adjustable nut part of the pre-load tool (with the set screws) onto the driveshaft to use as a surface for checking driveshaft end play. Tighten set screws and position a dial indicator so that dial indicator arm touches the top surface of the upper nut.



a - Dial Indicator Touching Top of Preload Tool
b - Nut Portion of Preload Tool
c - Move Drive Shaft UP and DOWN to Determine End Play

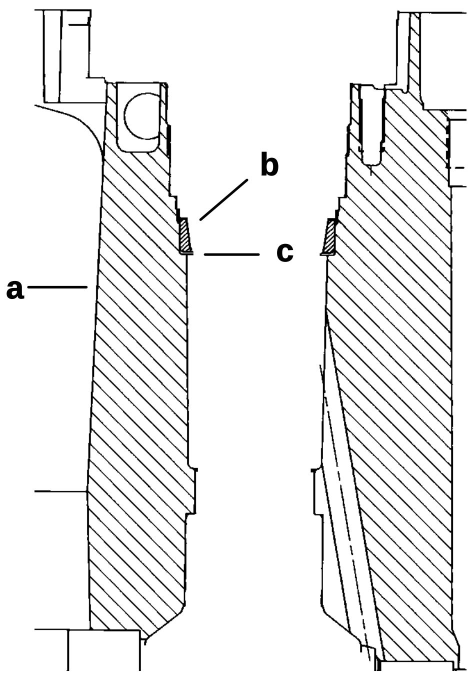
8. Move driveshaft up and down to determine end play. Total up and down movement should be 0.00^{2} to 0.001^{2} (0.025mm). There should be no preload on the bearing and the driveshaft must rotate freely.

NOTE: *DO NOT change shims under upper bearing cup or pinion height will be changed.*

9. Maintain the shims as previously set under the upper driveshaft bearing cup.
10. Remove the upper bearing cup retainer with tool 91-43506, and remove cup [leave upper cup shim(s) in place].

NOTE: *A 0.001^{2} (.025mm) change of shims under the lower bearing cup will result in a 0.001^{2} (0.025mm) change in driveshaft end play.*

11. Place driveshaft end play shim(s), determined from step 8, into gear housing and reinstall the lower bearing cup.



a - Driveshaft Housing
b - Lower Driveshaft Bearing Cup
c - Location of Driveshaft End Play Shims

12. Clean threads of driveshaft and apply Loctite #271.
13. Apply gear oil to all bearing surfaces and install driveshaft assembly, upper bearing cup and retainer into the gear case. Tighten upper cup retainer to a torque of 100 lb. ft. (135.5 N·m).

NOTE: *If forward gear backlash has not yet been determined, do not use a new pinion nut until final assembly.*

14. Apply #271 Loctite to a **NEW** pinion nut and install the pinion gear, washer and nut using procedures detailed earlier in this section. Tighten pinion nut to a torque of 85 lb. ft. (115 N·m).
15. Rotate driveshaft a few turns to verify that it turns freely and recheck driveshaft end play.

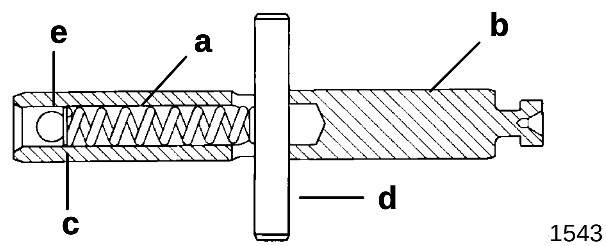
Clutch Actuator Rod

REASSEMBLY/SHIMMING (STD. GEAR CASE)

NOTE: *V-6 models 135 thru 200 SN 0D044293 and ABOVE gear cases will have only ONE compression spring.*

NOTE: *High Performance (CLE) gearcases have 2 compression springs in clutch actuator. See reassembly/shimming procedure for those gear cases.*

1. Place a small amount of Quicksilver 2-4-C w/Teflon Lubricant on locating pin.



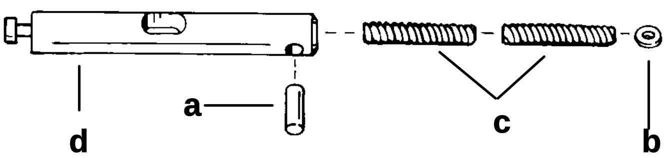
a - Spring
b - Clutch Actuator
c - Washer
d - Clutch Cross Pin
e - Locating Pin

2. Position pin in cross-hole in end of clutch actuator rod with flat side of pin toward shim washer.
3. Insert Cross Pin Tool (91-86642) between compression spring in elongated slot in clutch actuator rod.
4. Compress spring by forcing cross pin tool back-and-forth in elongated slot. This will release any initial set from spring.

NOTE: *Single spring actuators DO NOT require shimming the spring to center the clutch cross pin.*

REASSEMBLY/SHIMMING (HIGH-PERFORMANCE GEAR CASES CLE, TORQUE MASTER, & SPORT MASTER.)

1. Insert 2 compression springs into clutch actuator rod, followed by a shim washer.
2. Place a small amount of Quicksilver Needle Bearing Assembly Lubricant on retaining pin. Position pin in cross-hole in end of clutch actuator rod with flat side of pin toward shim washer.



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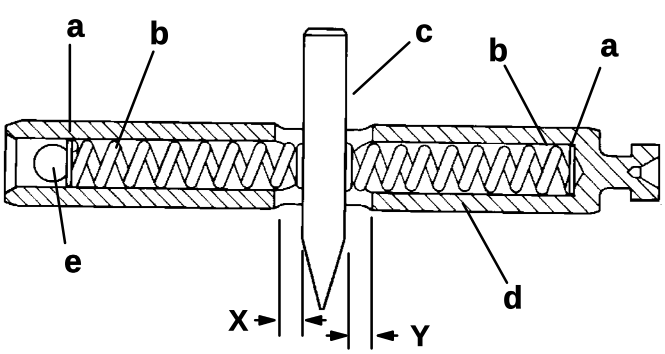
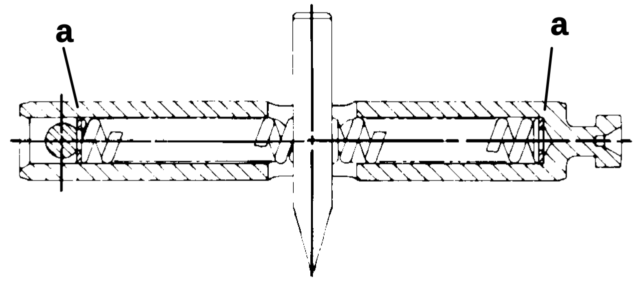
a - Retaining Pin
b - Shim Washer(s)
c - Compression Springs
d - Clutch Actuator Rod

3. Compress both springs by forcing cross pin tool back-and-forth in elongated slot. This will release any initial set from springs.
4. Measure distance from each end of elongated slot to the near side of cross pin tool. The measurements taken (**X** and **Y**) must be equal within $1/64^{2}$ (0.4mm).



a - Shim Washer
b - Compression Spring
c - Cross Pin Tool 91-86642
d - Clutch Actuator Rod
e - Retaining Pin (Shim washer must rest against flat)

5. If measurements (**X** and **Y**) taken in Step 4 are not equal to within $1/64^{2}$, remove retaining pin and re-shim compression spring, to obtain the measurement needed. If shims are required, install only at the outer ends of the springs.



a - Shim only at outer ends of springs as required

Shift Shaft Bushing

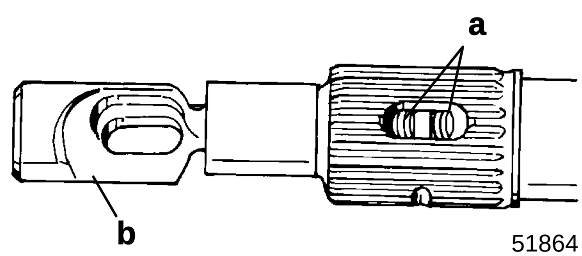
REASSEMBLY

1. Position shift shaft bushing on a press with threaded side down.
2. Apply Loctite 271 to outside diameter of oil seal.
3. Press oil seal into shift shaft bushing with lip of seal up.
4. Wipe any excess Loctite from oil seal and bushing.
5. Place rubber washer against oil seal.
6. Install O-ring over threads and up against shoulder of bushing.
7. Lubricate O-ring and oil seal with Quicksilver 2-4-C w/Teflon Marine Lubricant.

Propeller Shaft

REASSEMBLY/INSTALLATION

1. Insert clutch actuator rod part way into end of propeller shaft, then install cam follower onto the end of rod and push rod the rest of the way into propeller shaft. Align cross pin slot in actuator rod with cross pin slot in propeller shaft.



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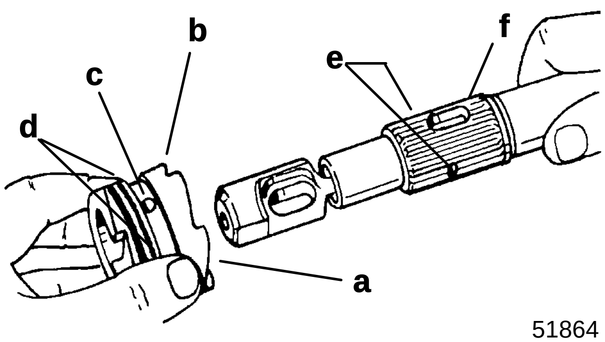
a - Compression Springs
b - Cam Follower

2. On PRODUCTION MODEL GEAR CASES, position sliding clutch onto propeller shaft with GROOVED RINGS (ON SLIDING CLUTCH) TOWARD PROPELLER END OF PROPELLER SHAFT. Cross pin hole and detent holes (in sliding clutch) must line up with cross pin slot and detent notches on propeller shaft.

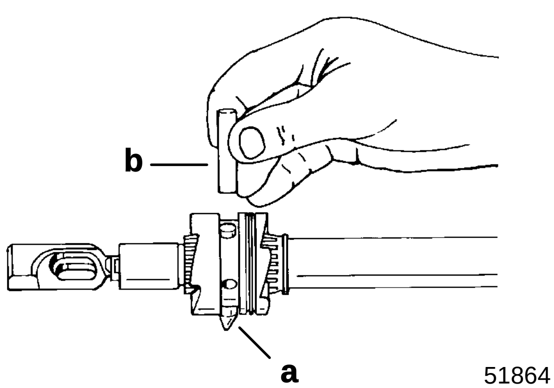
IMPORTANT: On high performance gearcases - CLE, Sport Master and Torque Master - sliding clutch MUST BE INSTALLED with GROOVED RINGS FACING FORWARD GEAR or full engagement of reverse gear clutch dogs will not occur.



a - Sliding Clutch
b - Grooved Rings
c - Cross Pin Hole
d - Detent Hole (Behind Finger and Thumb)
e - Detent Notch (One on Each Side)
f - Cross Pin Slot

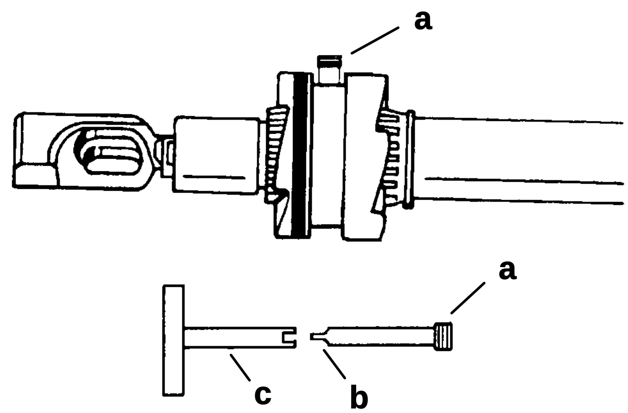
3. Insert Cross Pin Tool (91-86642) thru sliding clutch, propeller shaft and actuator rod. (Be sure that cross pin tool is between compression springs.)

4. Insert cross pin thru sliding clutch, propeller shaft and actuator rod, forcing cross pin tool out. Be sure that flat sides of cross pin are toward compression springs. Cross pin must be flush on both ends with sliding clutch.



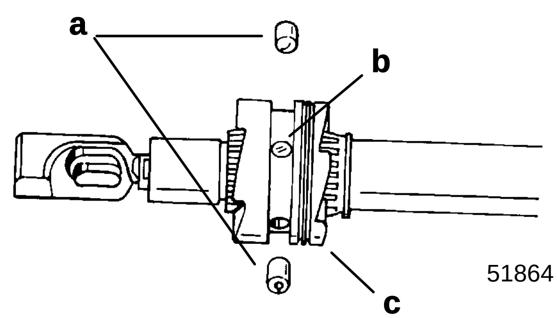
a - Cross Pin Tool (91-86642)
b - Cross Pin

NOTE: *Pro Max and Super Magnum models use a slotted cross pin 91-86642-1 and Cross Pin Handle 91-86642-2 to assemble clutch onto propshaft. Turn handle COUNTERCLOCKWISE to install cross pin.*



a - Cross Pin
b - Cross Pin Tang
c - Cross Pin Tool 91-86642-2

5. Apply a small amount of 2-4-C w/Teflon Marine Lubricant on each detent pin. Position a detent pin in each detent pin hole of sliding clutch with rounded end of pins toward propeller shaft.



a - Detent Pins
b - Cross Pin
c - Sliding Clutch

6. Install cross pin retaining springs onto sliding clutch as follows:

IMPORTANT: DO NOT over-stretch retaining springs when installing them onto sliding clutch.

a. Installing first spring

(1.) Insert tang end of spring into a detent pin.

(2.) Spirally wrap spring into groove on sliding clutch.

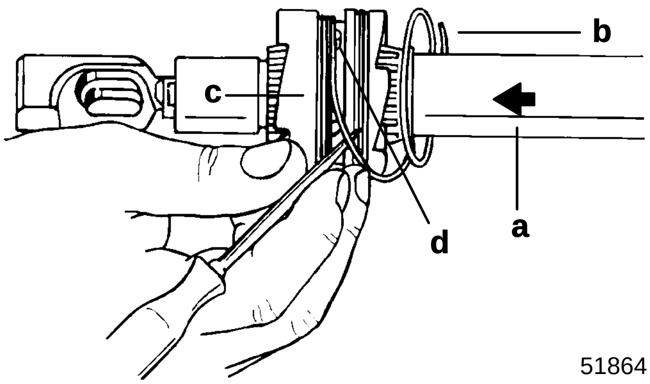
(3.) Position spring in groove so that straight end of spring is against the side of groove.

b. Installing second spring

(1.) Insert tang end of spring into the opposite detent pin that was used in Step a-1.

(2.) Spirally wrap spring into groove on sliding clutch in the opposite direction that the first spring was wound.

(3.) Position spring in groove so that straight end of spring is against the side of groove and not over-lapping the first spring.



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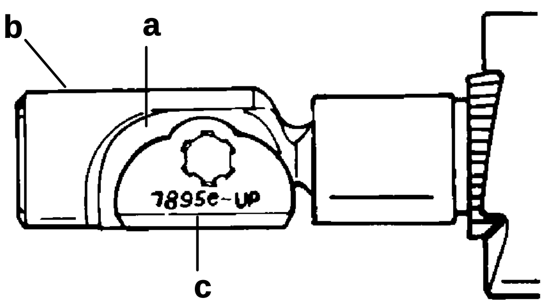
a - The Line of "Sight"
b - Forward Retaining Spring (Wound Counterclockwise around Clutch)
c - Rear Retaining Spring (Wound Clockwise around Clutch)
d - Tang End of Spring

IMPORTANT: One Spring Must Be on Each SIde of Cross Pin Tang and Springs MUST NOT Over-lap Each Other.

7. Place gear housing in a soft jaw vise with the driveshaft in a vertical position.
8. Coat cam pocket of cam follower with 2-4-C w/ Teflon Marine Lubricant.
9. Place shift cam into cam pocket of cam follower with numbered side of cam facing up.



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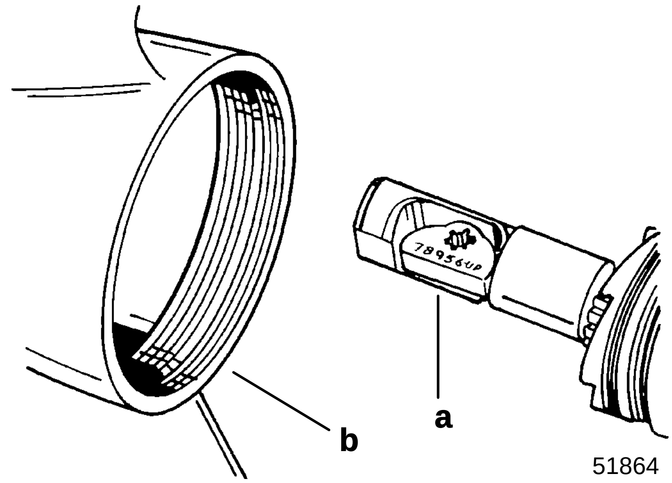
a - Cam Pocket
b - Cam Follower
c - Shift Cam

10. With shift cam positioned as shown, insert propeller shaft thru forward gear until shaft bottoms out.



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a - Shift Cam (Position as Shown)
b - Gear Housing

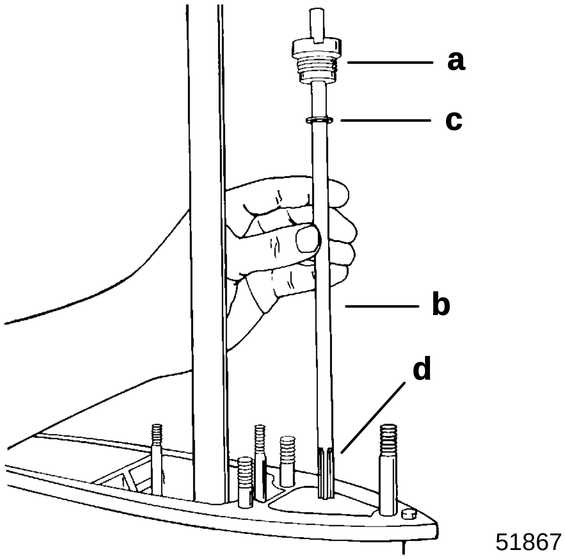
⚠ CAUTION

Until bearing carrier is installed into gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

IMPORTANT: Prior to installation of shift shaft, verify that the round retaining ring and "E" ring (if equipped) are in position and secure.

11. Insert shift shaft down shift shaft hole (of gear housing) and thru shift cam and cam follower. (It may be necessary to rotate shift shaft back-and-forth slightly for it to enter shift cam.)

12. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to threads of shift shaft bushing. (Thread bushing into position, but do not tighten down at this time.)



a - Shift Shaft Bushing
b - Shift Shaft
c - "E" Ring (If Equipped)
d - Round Retaining Ring (If Equipped)

13. Lubricate O-ring on bearing carrier with Quicksilver 2-4-C w/Teflon Marine Lubricant.
14. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to outside diameter of bearing carrier (where carrier contacts gear housing).

NOTE: *When performing Step 16, rotate driveshaft clockwise (viewed from top) to mesh pinion gear with reverse gear.*

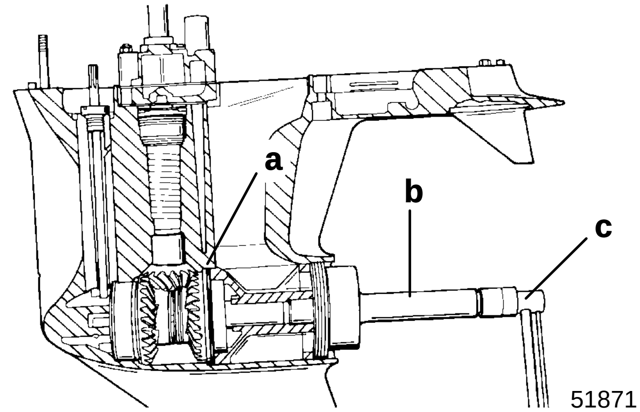
NOTE: *DO NOT reinstall thrust spacer onto propeller shaft if installing high altitude 2.3:1 gear set.*

15. Install thrust spacer onto propeller shaft.
16. Position bearing carrier over propeller shaft and slide it into gear housing. (Be sure to align bearing carrier keyway with gear housing keyway.)
17. Push bearing carrier in as far as possible by hand, then install bearing carrier key.
18. Place tab washer against bearing carrier.
19. Apply Quicksilver 2-4-C w/Teflon Marine Lubricant to threads of cover nut and install cover nut in gear housing (verify that the word "OFF" and arrow are visible).

CAUTION

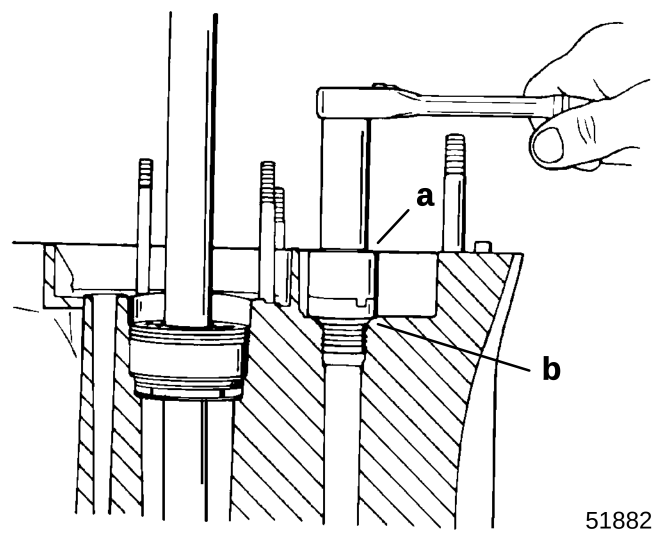
Before torquing bearing carrier cover nut, gear case should either be mounted in a stand specifically designed for holding gear cases or bolted to a driveshaft housing to avoid possible damage to the gear case.

20. Start cover nut a few turns by hand, then using Cover Nut Tool (91-61069) and torque wrench, torque cover nut to 210 lb. ft. (284.5 N·m) for production models and 250 lb. ft. (339.0 N·m) for high performance Pro Max and Super Magnum models.



a - O-ring
b - Cover Nut Tool
c - Torque Wrench

21. Bend one lock tab of tab washer into cover nut (only one will align).
22. Bend remaining tabs of tab washer toward front of gear housing.
23. Use Shift Shaft Bushing Tool (91-31107) and torque shift shaft bushing to 50 lb. ft. (67.5 N·m).



a - Shift Shaft Bushing Tool (91-31107)
b - Shift Shaft Bushing

Water Pump

REASSEMBLY/INSTALLATION

1. Install oil seals into water pump base, as follows:

a. Place water pump base on a press.

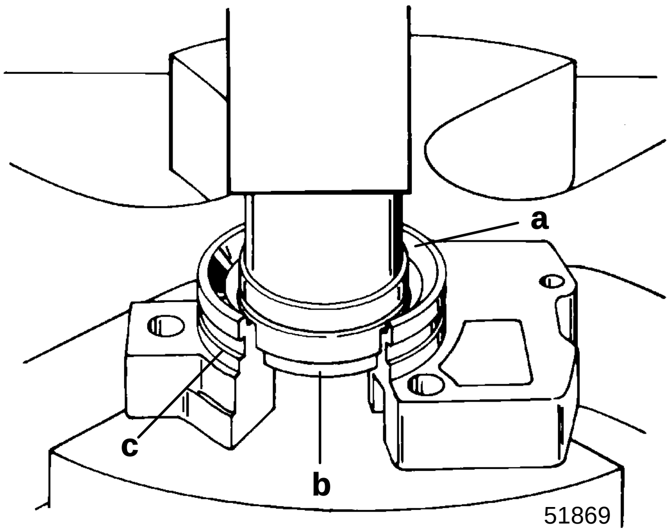
b. Just before installing each seal apply Loctite 271 on outside diameter of oil seal.

c. With a suitable mandrel, press the smaller diameter oil seal into pump base with lip of oil seal toward impeller side of base.

d. With a suitable mandrel, press the larger diameter oil seal into pump base with lip of oil seal toward gear housing side of base.

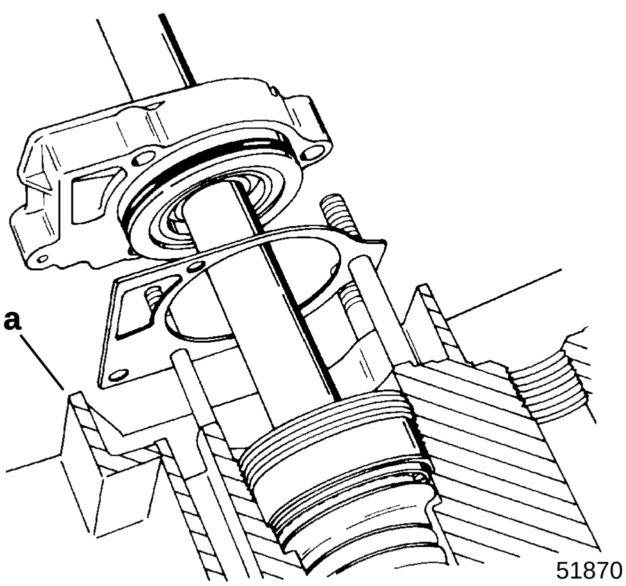
e. Wipe any excess Loctite from oil seals and water pump base.

2. Install O-ring into O-ring groove of water pump base. Lubricate O-ring and oil seals with 2-4-C w/ Teflon Marine Lubricant (92-90018A12).



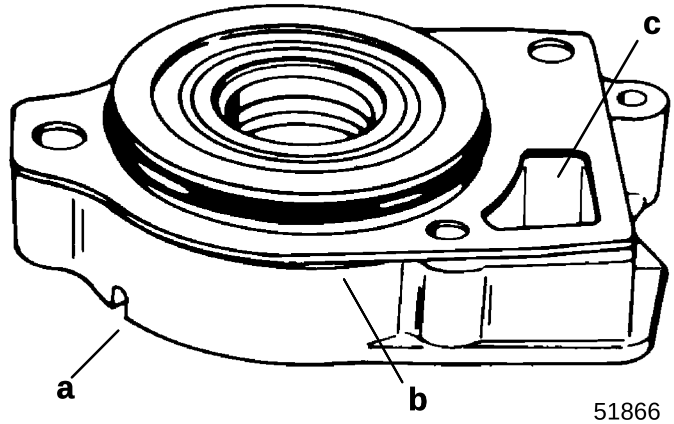
a - Mandrel
b - Oil Seal (Smaller OD)
c - O-ring Groove

3. Install divider block if removed. Use RTV Sealer to seal seams between divider block and gear housing.



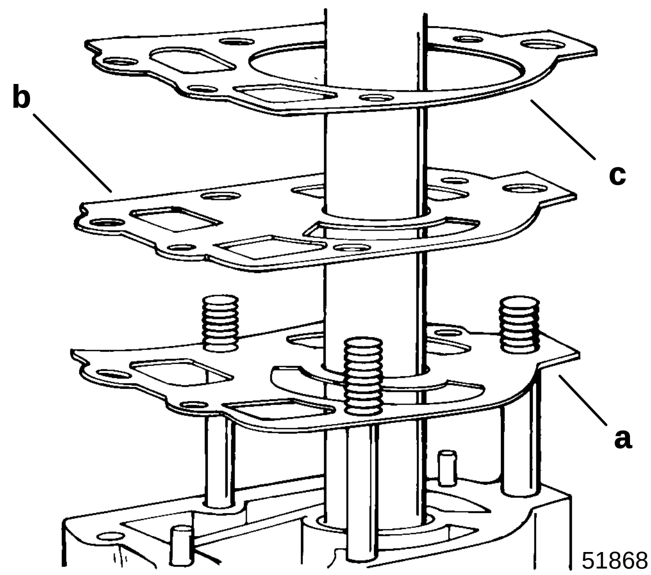
a - Divider Block

4. Install a new water pump base gasket and install water pump base.



a - Water Pump Base
b - Gasket
c - Hole (MUST be positioned as shown)

5. Install the following in order: Pump base to face plate gasket, face plate gasket and face plate to pump cover gasket. Gaskets and face plate are indexed by dowel pin location and must be installed correctly.



a - Gasket (Water Pump Base to Face Plate)
b - Face Plate
c - Gasket (Face Plate to Water Pump Cover)

6. Place impeller drive key on flat of drive shaft. Hold key on driveshaft with a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant.

IMPORTANT: When completing gear housing repair, that requires removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to reuse the impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur. Original rotation is clockwise.

⚠ CAUTION

A visual inspection of impeller drive key MUST BE made to determine that drive key is on flat of driveshaft after impeller is installed. If key has moved off flat of driveshaft, repeat Steps 7 and 8.

7. Slide impeller down driveshaft to impeller drive key. Align drive key with keyway in the center hub of impeller, and slide impeller over drive key.
8. If removed, install new water pump insert into pump cover as follows:
   a. Apply Perfect Seal to water pump insert area of pump cover.
   b. Install water pump insert into pump cover. Verify that tab on insert enters recess in pump cover.
   c. Wipe any excess Perfect Seal from insert and cover.

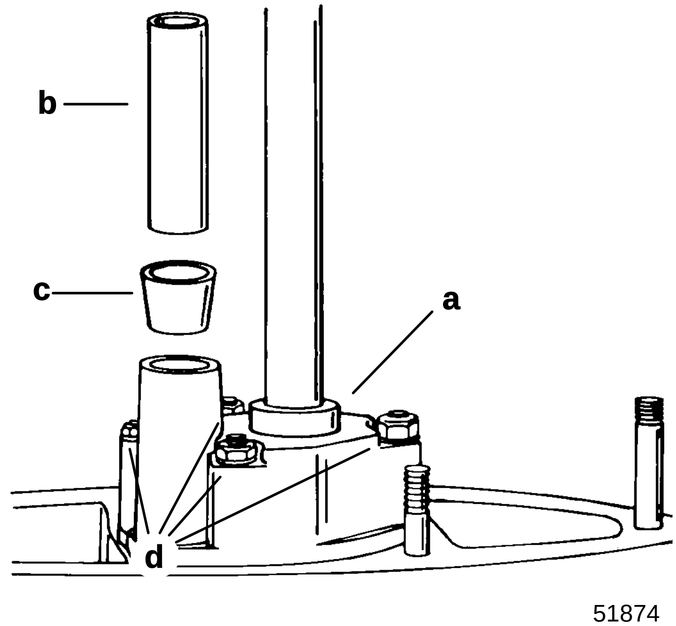
NOTE: *If 2 holes were drilled in top of water pump cover to aid in removal of insert, fill holes with RTV Sealer or equivalent. Allow to cure, 24 hours prior to operating engine.*

9. Install water tube seal into pump cover, being sure that plastic side of seal goes into cover first.
10. Reinstall water tube guide into water pump cover.
11. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant inside of water pump insert.
12. Position assembled water pump cover over driveshaft and lower over water pump studs. Rotate driveshaft in a clockwise direction (viewed from top), while pushing down on pump cover to ease impeller entry into cover.
13. Install water pump cover retainer washers, nuts and bolt.

⚠ CAUTION

DO NOT over-torque nuts and bolt, as this could cause cover to crack during operation.

14. Torque water pump nuts to 50 lb. in. (5.5 N·m), and water pump bolt to 35 lb. in. (4.0 N·m).
15. Install centrifugal slinger over drive shaft and down against pump cover.



a - Centrifugal Slinger (if equipped)
b - Water Tube Guide
c - Water Tube Seal
d - Nuts, Bolts and Washers

Gear Lubricant Filling Instructions

1. Remove any gasket material from "Fill" and "Vent" screws and gear 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.

IMPORTANT: All CLE, Sport Master and Torque Master gear cases should use Quicksilver Hi-Performance Gear Lube (92-816026A4).

3. Slowly fill housing thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.
4. Install "Vent" screw into "Vent" hole.

IMPORTANT: DO NOT lose more than one fluid ounce (30cc) of gear lubricant while reinstalling "Fill" screw.

5. Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Drive Shaft Housing

⚠ WARNING

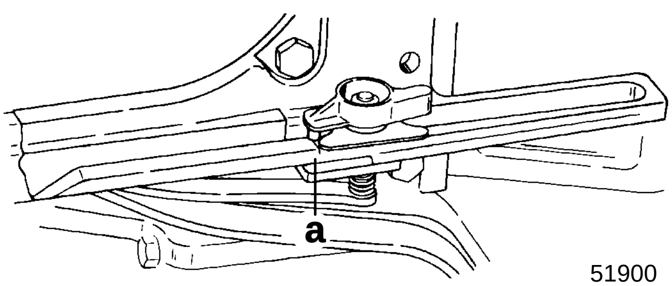
Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing onto driveshaft housing.

1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto driveshaft splines.

⚠ CAUTION

DO NOT allow lubricant on top of drive shaft. Excess lubricant, that is trapped in clearance space, will not allow driveshaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of drive shaft) will load the driveshaft/crankshaft and damage either or both the powerhead and gear housing. Top of driveshaft is to be wiped free of lubricant.

3. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Apply a thin bead of G.E. Silicone Sealer (obtained locally) against the top of divider block.
5. Insert trim tab bolt into hole in rear of gear housing to driveshaft housing machined surface.
6. Shift gear housing into forward gear and place guide block anchor pin into forward gear position.



a - Guide Block Anchor Pin

7. Position gear housing so that the driveshaft is protruding into driveshaft housing.

NOTE: *If, while performing Step 8, the driveshaft splines will not align with crankshaft splines, place a propeller onto propeller shaft and turn it counterclockwise as the gear housing is being pushed toward driveshaft housing.*

8. Move gear housing up toward driveshaft housing, while aligning shift shaft splines and water tube with water tube guide (in water pump cover).
9. Place flat washers onto studs (located on either side of driveshaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gearcase up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to listing in **"Torque Specifications,"** preceding.
13. After 2 nuts (located on either side of driveshaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into neutral position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into reverse gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

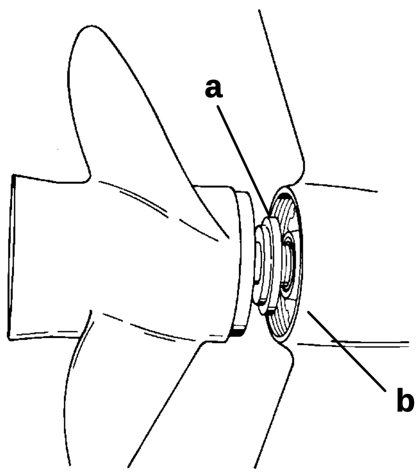
14. Install washers and nuts onto studs (located on bottom center of anti-cavitation plate). Torque to listing in **"Torque Specifications,"** preceding.
15. Install special flat washer and nut on stud at leading edge of driveshaft housing. Torque to listing in **"Torque Specifications,"** preceding.
16. Torque bolt (started in Step 10) to listing in **"Torque Specifications,"** preceding.
17. Install trim tab, adjust to position in which it had previously been installed, and tighten securely.
18. Install plastic cap into trim tab bolt opening at rear edge of driveshaft housing.

Propeller Installation

⚠ WARNING

When installing or removing propeller, because of the engine's ease in starting, be sure that the remote control is in neutral position and that the key switch is "OFF." Place a block of wood between the anti-cavitation plate and propeller to prevent accidental starting and to protect hands from propeller blades while removing or installing nut.

1. To aid in future removal of the propeller, liberally coat the propeller shaft splines with one of the following Quicksilver products:
   - Anti-Corrosion Grease (92-78376A6)
   - Special Lubricant 101 (92-13872A1)
   - 2-4-C Marine Lubricant (92-90018A12)
   - Perfect Seal (92-34227--1)
2. Place forward thrust hub over propeller shaft with shoulder side toward propeller.
3. Place propeller on propeller shaft and slide it up against thrust hub.



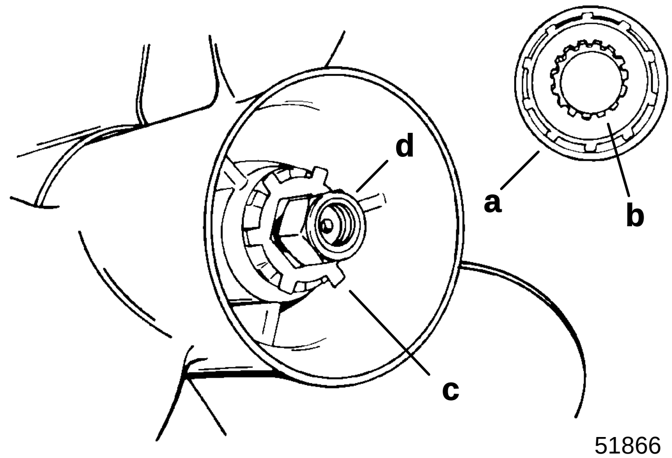
a - Forward Thrust Hub
b - Propeller Shaft

4. Place continuity washer (if equipped) onto shoulder of rear thrust hub.
5. Place rear thrust hub, tab washer and propeller nut on propeller shaft.
6. Thread propeller nut onto propeller shaft until nut is recessed into tab washer.
7. After propeller nut is recessed into tab washer, tighten nut securely [minimum of 55 lb. ft. (74.5 N·m) torque].
8. Bend 3 of the tabs of tab washer down in grooves of rear thrust hub to secure propeller nut. (If tab washer tabs do not align with slots, continue to tighten propeller nut to obtain alignment. DO NOT loosen nut to align tabs.)

⚠ CAUTION

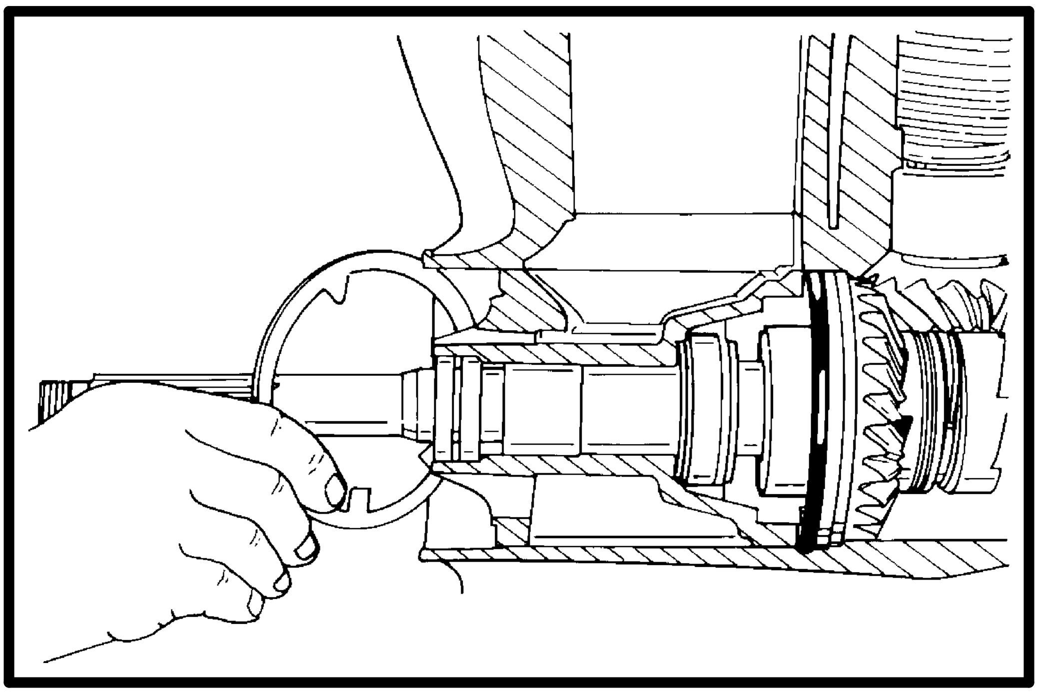
DO NOT misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; how- ever, propeller should not move forward-and-aft on propeller shaft.

9. After first use, retighten propeller nut and again secure with tab washer (Steps 7 and 8, preceding). Propeller should be checked periodically for tightness, particularly if a stainless steel propeller is used.



a - Continuity Washer (if Equipped)
b - Rear Thrust Hub
c - Tab Washer
d - Propeller Nut

LOWER UNIT



COUNTER ROTATING (LEFT HAND) GEAR CASE

6

B

Table of Contents

Gear Housing Specifications (Counter Rotation)

PINION DEPTH

Gear Case	Pinion Depth
All Ratios	0.025 in. (0.635mm) With Tool 91-12349A2 using Disc #2 and Flat #7

REVERSE GEAR BACKLASH

Gear Case	Reverse Gear Backlash
All Ratios	0.030 in. to 0.050 in. (0.762mm to 1.27mm)

FORWARD GEAR BACKLASH

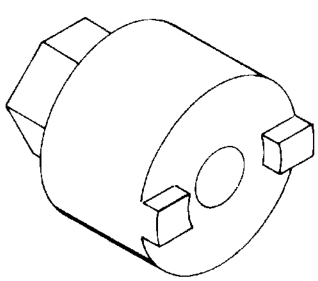
Gear Case & Ratio	Backlash Inches (mm)	Dial Indicator Pointer on Line Mark
Production 1.87:1 (15/28 teeth)	0.018-0.027 (0.46-0.69)	#1
Sport Master 1.87:1 (15/28 teeth)	0.021-0.026 (0.53-0.66)	#1
All 2.00:1 (15/30 teeth)	0.015-0.022 (0.38-0.56)	#2

LUBRICANT CAPACITY

Gearcase Lubricant Capacity	
All Ratios	21.0 fl. oz. (620.0ml)

Special Tools

Shift Shaft Bushing Tool 91-31107



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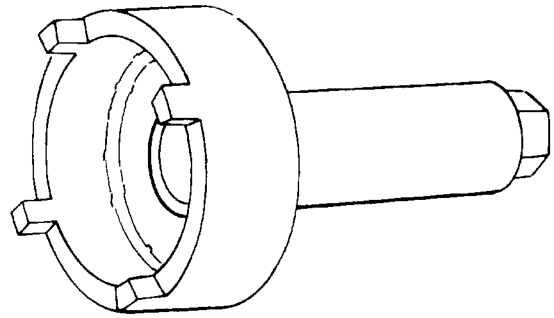
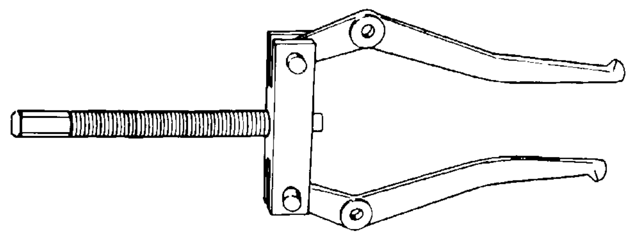
Gear Housing Cover Nut Tool 91-61069



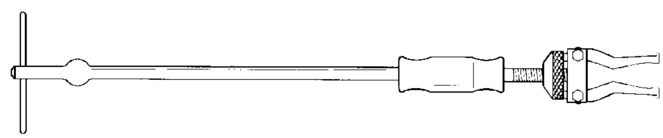
73605

Bearing Carrier Removal Tool 91-46086A1 and Puller Bolt 91-85716



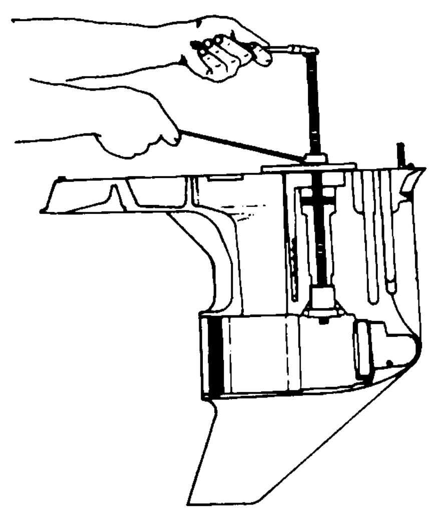
73599

Slide Hammer Puller 91-34569A1



73655

Bearing Removal and Installation Kit 91-31229A5. This kit contains the following tools: Pilot 91-36571; Puller Rod 91-31229; Nut 11-24156; Puller Plate 91-29310; Mandrel 91-38628; and Driver Rod 91-37323.



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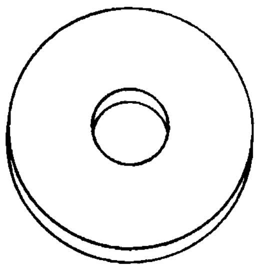
Pilot 91-36571



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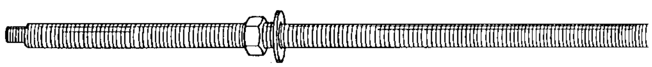
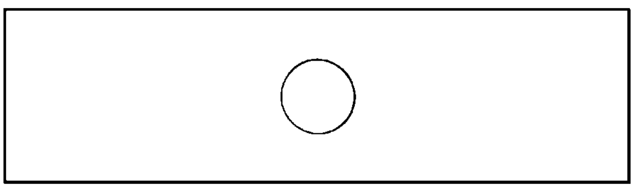
Puller Rod 91-31229 and Nut 91-24156



Puller Plate 91-29310



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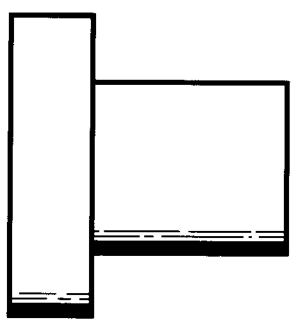
Mandrel 91-38628



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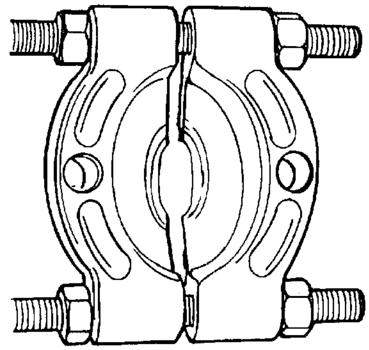
Driver Rod 91–37323

74184

Universal Puller Plate 91-37241



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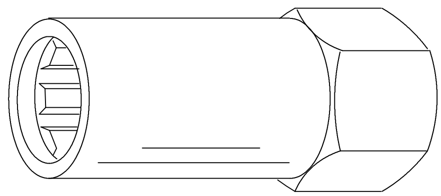
Cross Pin Tool 91-86642

Driveshaft Holding Tool 91-34377A1



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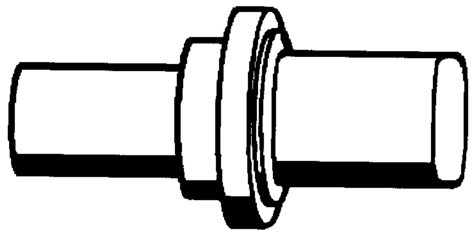
Oil Seal Driver 91-31108



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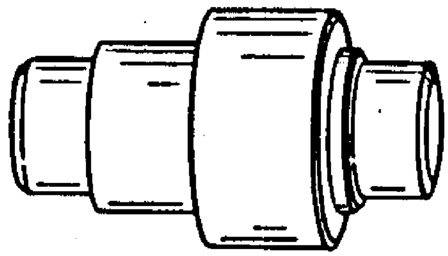
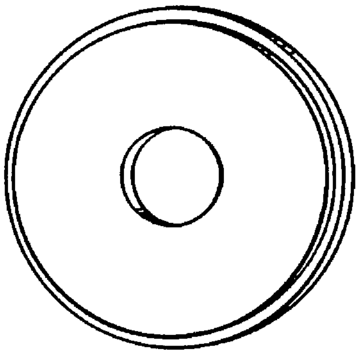
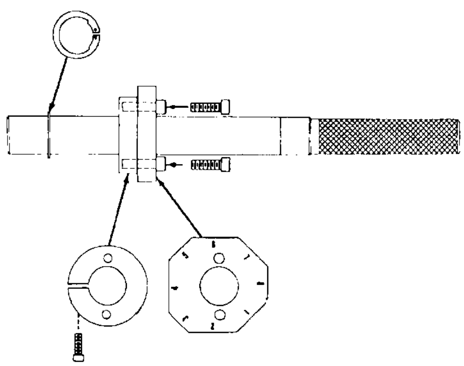
Forward Gear Bearing Tool 91-86943

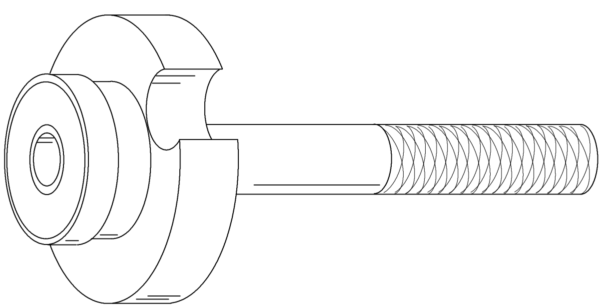


Bearing Driver Cup 91-87120



Pinion Locating Gear Tool 91-12349A2 or 91-74776





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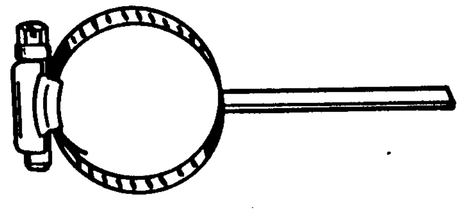
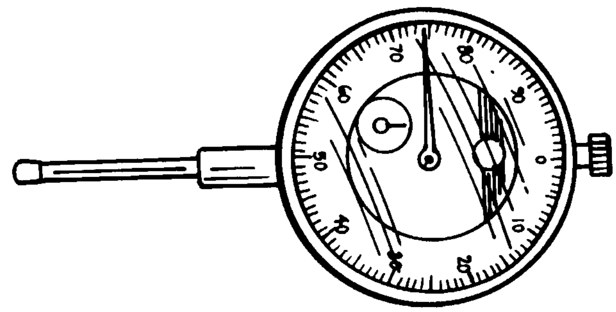
Backlash Indicator Rod 91-78473

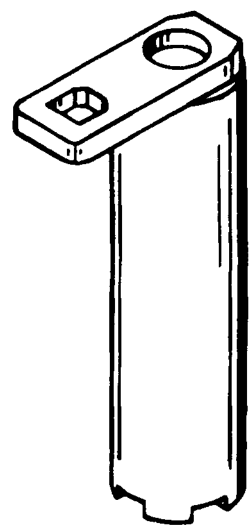


Dial Indicator 91-58222A1



73429

Bearing Retainer Tool 91-43506



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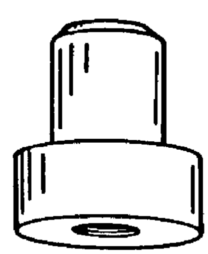
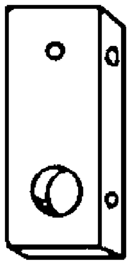
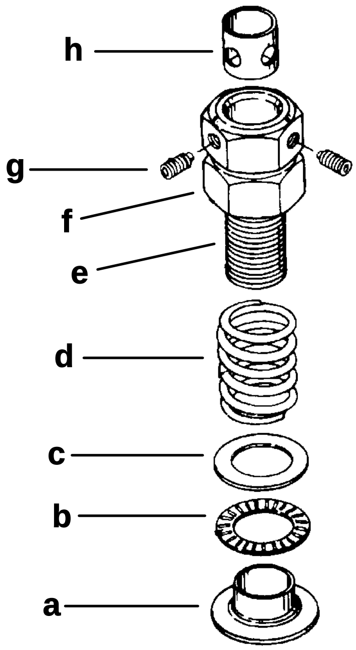
Mandrel 91-92788



Dial Indicator Holder 91-89897

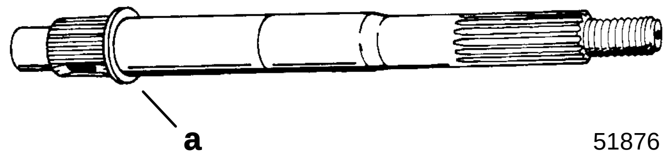


Bearing Preload Tool 91-14311A1

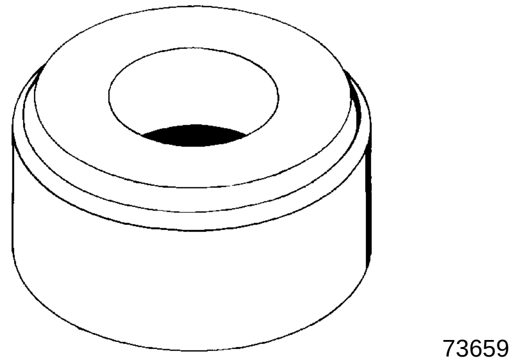


a - Adaptor (N.S.S.)
b - Bearing (N.S.S.)
c - Washer (N.S.S.)
d - Spring (24-14111)
e - Bolt (10-12580)
f - Nut (11-13953)
g - Set Screw (10-12575)
h - Sleeve (23-13946)

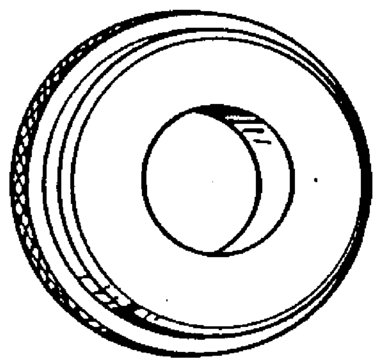
Propeller Shaft 44-93003 and Load Washer(a) 12-37429



Bearing Cup Driver 91-34379

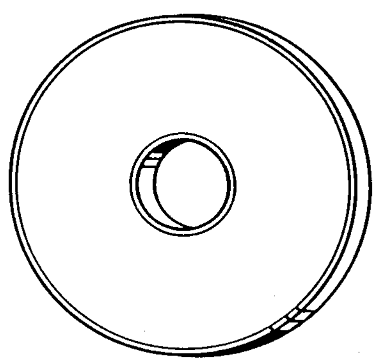


Bearing Installation Tool 91-18601

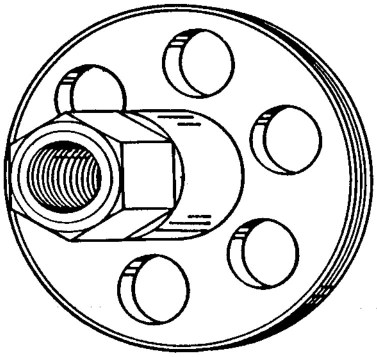


Reverse Gear Installation Kit 91-18605A1 includes Pilot 91-18603; Retainer 91-18604; Shaft 91-18605 and Screw 10-18602.

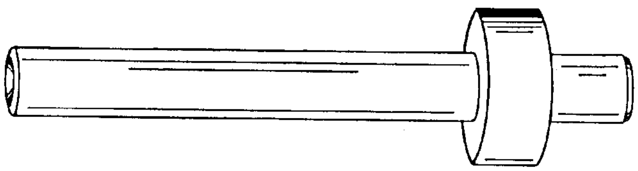
Pilot 91-18603



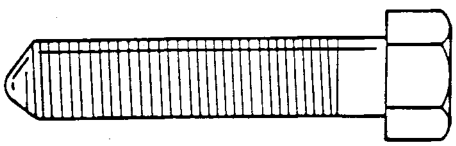
Retainer 91-18604



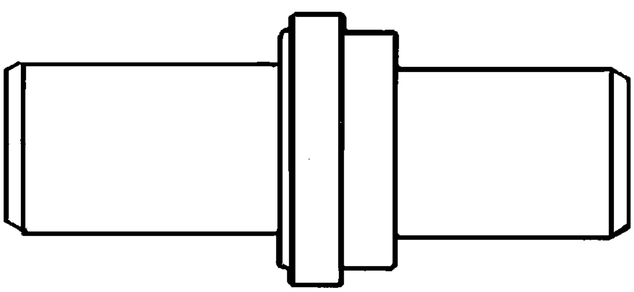
Shaft 91-18605



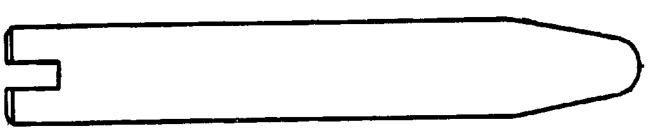
Screw 10-18602



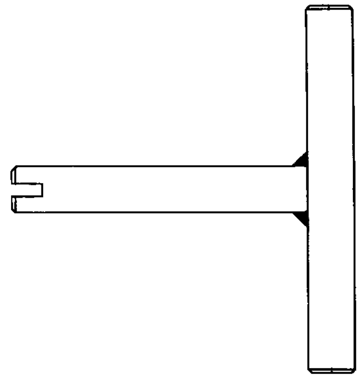
Seal Driver 91-816294



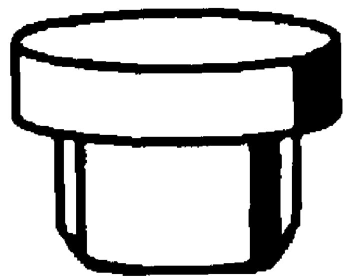
Slotted Cross Pin Tool 91-86642-1



Threaded Cross Pin Tool 91-86642-2



Mandrel 91-15755



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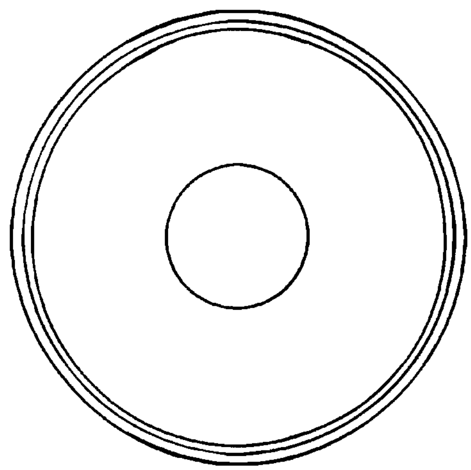
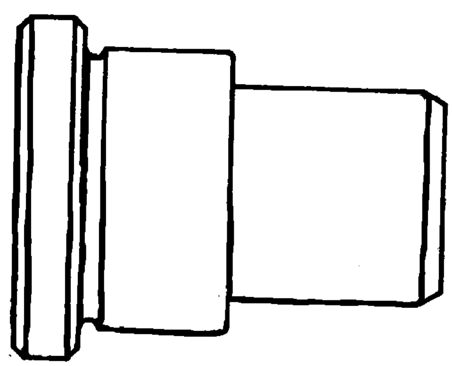
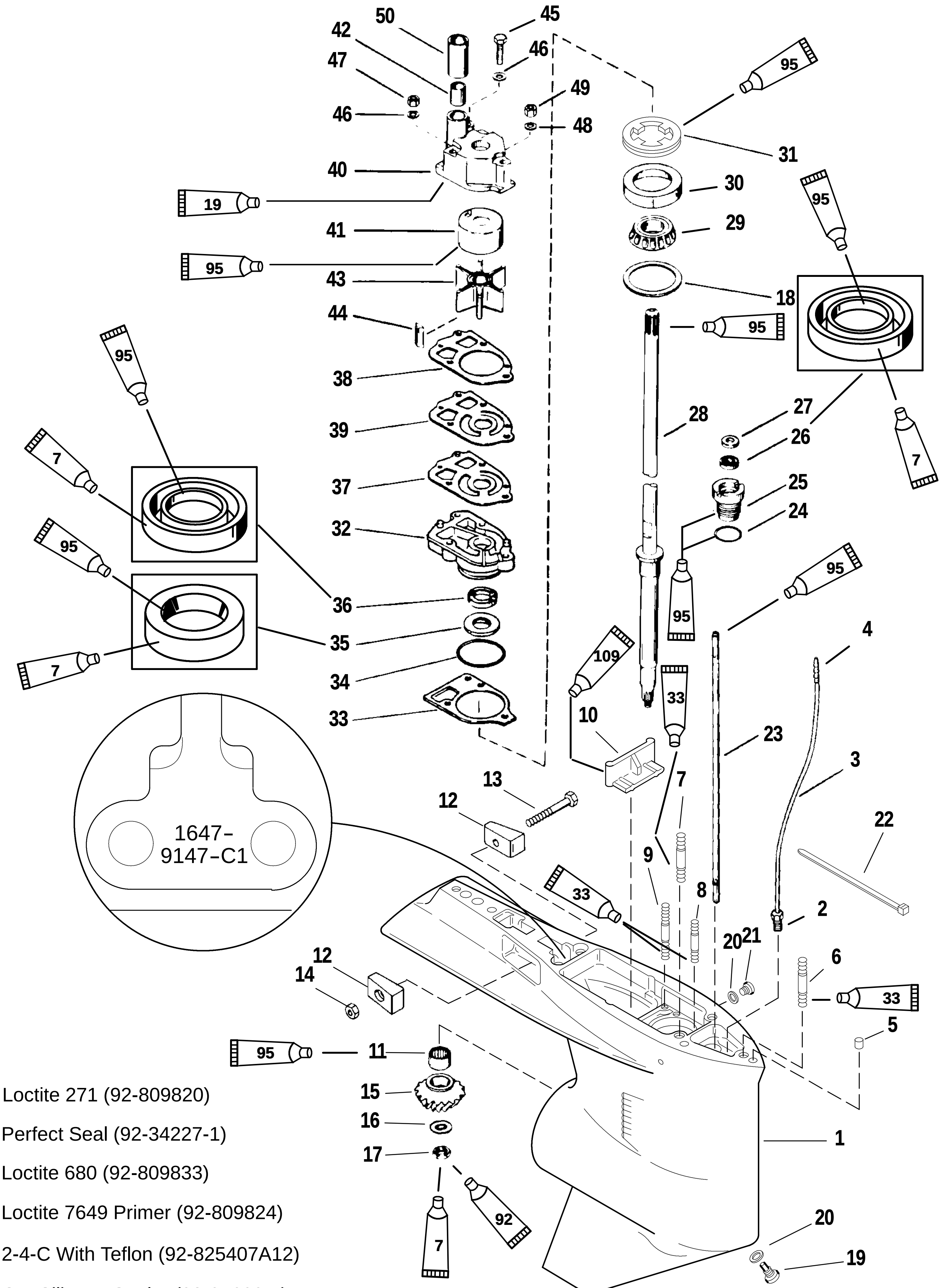
Mandrel 91-31106



Propeller Shaft Bearing Installer 91-816292



Gear Housing (Driveshaft)(Counter Rotation) (S/N-0G437999 & BELOW)

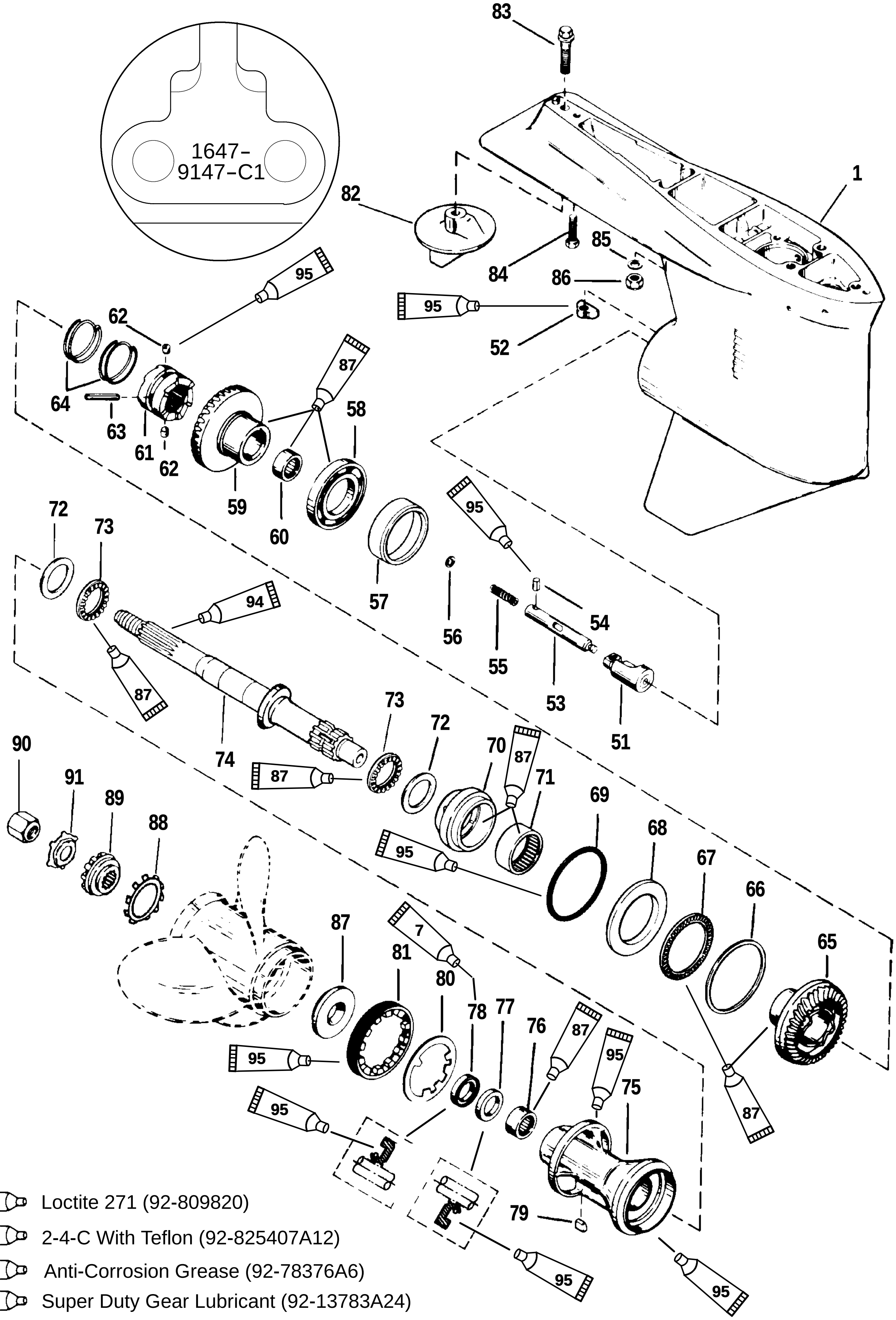


- 7 Loctite 271 (92-809820)
- 19 Perfect Seal (92-34227-1)
- 33 Loctite 680 (92-809833)
- 92 Loctite 7649 Primer (92-809824)
- 95 2-4-C With Teflon (92-825407A12)
- 109 GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft)(Counter Rotation) (S/N-0G437999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(BLACK)(BASIC)**			
	1	GEAR HOUSING **(GRAY)(BASIC)**			
2	1	CONNECTOR ASSEMBLY			
3	1	TUBING			
4	1	CONNECTOR			
5	2	DOWEL PIN			
6	1	STUD (3-11/16 IN.)			
7	2	STUD (2-1/16 IN.)			
8	1	STUD (3-3/8 IN.)			
9	2	STUD (3-1/8 IN.)			
10	1	FILLER BLOCK			
11	1	ROLLER BEARING			
12	2	ANODE			
13	1	SCREW			
14	1	PINION NUT	60	5	7.0
15	1	PINION GEAR (Part of 43-18572A1 or 43-18475A1)			
16	1	WASHER			
17	1	NUT		75	102
18	AR	SHIM SET			
19	1	SCREW–drain (MAGNETIC)	55		6.0
20	2	WASHER			
21	1	SCREW–grease filler	55		6.0
22	1	STA–STRAP			
23	1	SHIFT SHAFT			
24	1	O-RING			
25	1	BUSHING ASSEMBLY-SHIFT SHAFT		30	40.5
26	1	OIL SEAL			
27	1	WASHER–rubber			
28	1	DRIVESHAFT			
29	1	ROLLER BEARING ASSEMBLY			
30	1	CUP			
31	1	RETAINER		100	136
32	1	WATER PUMP BASE			
33	1	GASKET			
34	1	O-RING			
35	1	OIL SEAL			
36	1	OIL SEAL			
37	1	GASKET–lower			
38	1	GASKET–upper			
39	1	FACE PLATE			
40	1	WATER PUMP BODY ASSEMBLY			
41	1	INSERT			
42	1	SEAL–rubber			
43	1	IMPELLER			
44	1	KEY			
45	1	SCREW (2-1/4 IN.)	35		4.0
46	2	WASHER			
47	2	NUT	50		5.5
48	1	WASHER			
49	1	NUT	50		5.5
50	1	SLEEVE			

Gear Housing (Prop Shaft)(Counter Rotation)
(S/N-0G437999 & BELOW)



7 Loctite 271 (92-809820)

95 2-4-C With Teflon (92-825407A12)

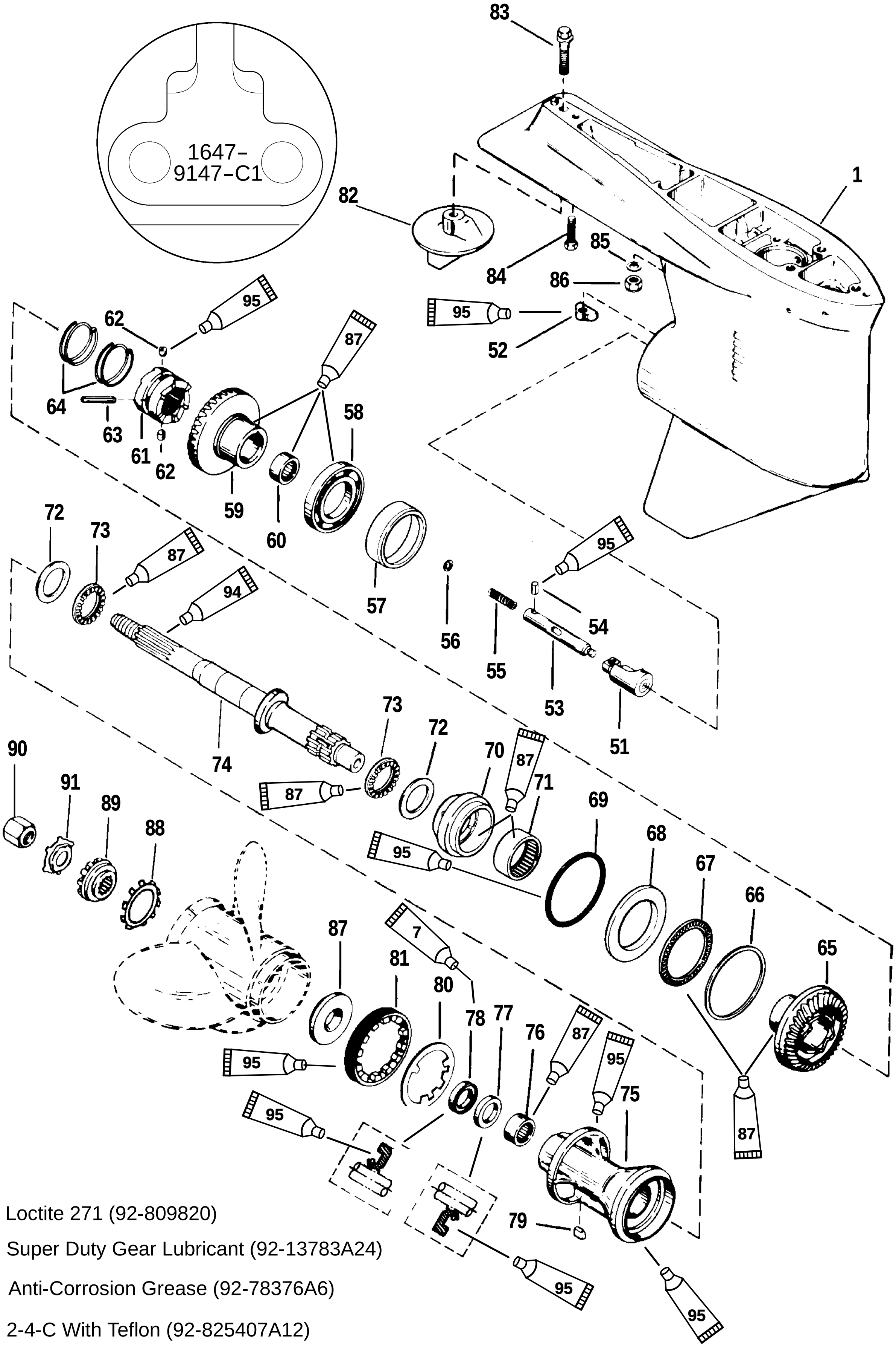
94 Anti-Corrosion Grease (92-78376A6)

87 Super Duty Gear Lubricant (92-13783A24)

Gear Housing (Prop Shaft)(Counter Rotation) (S/N-0G437999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(BASIC-BLACK)**			
	1	GEAR HOUSING **(BASIC-GRAY)**			
51	1	CAM FOLLOWER			
52	1	SHIFT CAM			
53	1	ROD			
54	1	PIN			
55	2	SPRING			
56	AR	WASHER			
57	1	BEARING CUP			
58	1	BALL BEARING			
59	1	REVERSE GEAR (PART OF 43-18572A1 or 43-18475A1)			
60	1	ROLLER BEARING			
61	1	CLUTCH			
62	2	DETENT PIN			
63	1	CROSS PIN			
64	2	SPRING			
65	1	FORWARD GEAR **(135/150)**			
	1	FORWARD GEAR **(175/200)**			
66	AR	SPACER SHIM .125 IN.			
	AR	SPACER SHIM .127 IN.			
	AR	SPACER SHIM .129 IN.			
	AR	SPACER SHIM .131 IN.			
	AR	SPACER SHIM .133 IN.			
	AR	SPACER SHIM .135 IN.			
	AR	SPACER SHIM .137 IN.			
	AR	SPACER SHIM .139 IN.			
	AR	SPACER SHIM .141 IN.			
	AR	SPACER SHIM .143 IN.			
	AR	SPACER SHIM .145 IN.			
	AR	SPACER SHIM .147 IN.			
	AR	SPACER SHIM .149 IN.			

Gear Housing (Prop Shaft)(Counter Rotation) (S/N-0G437999 & BELOW)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

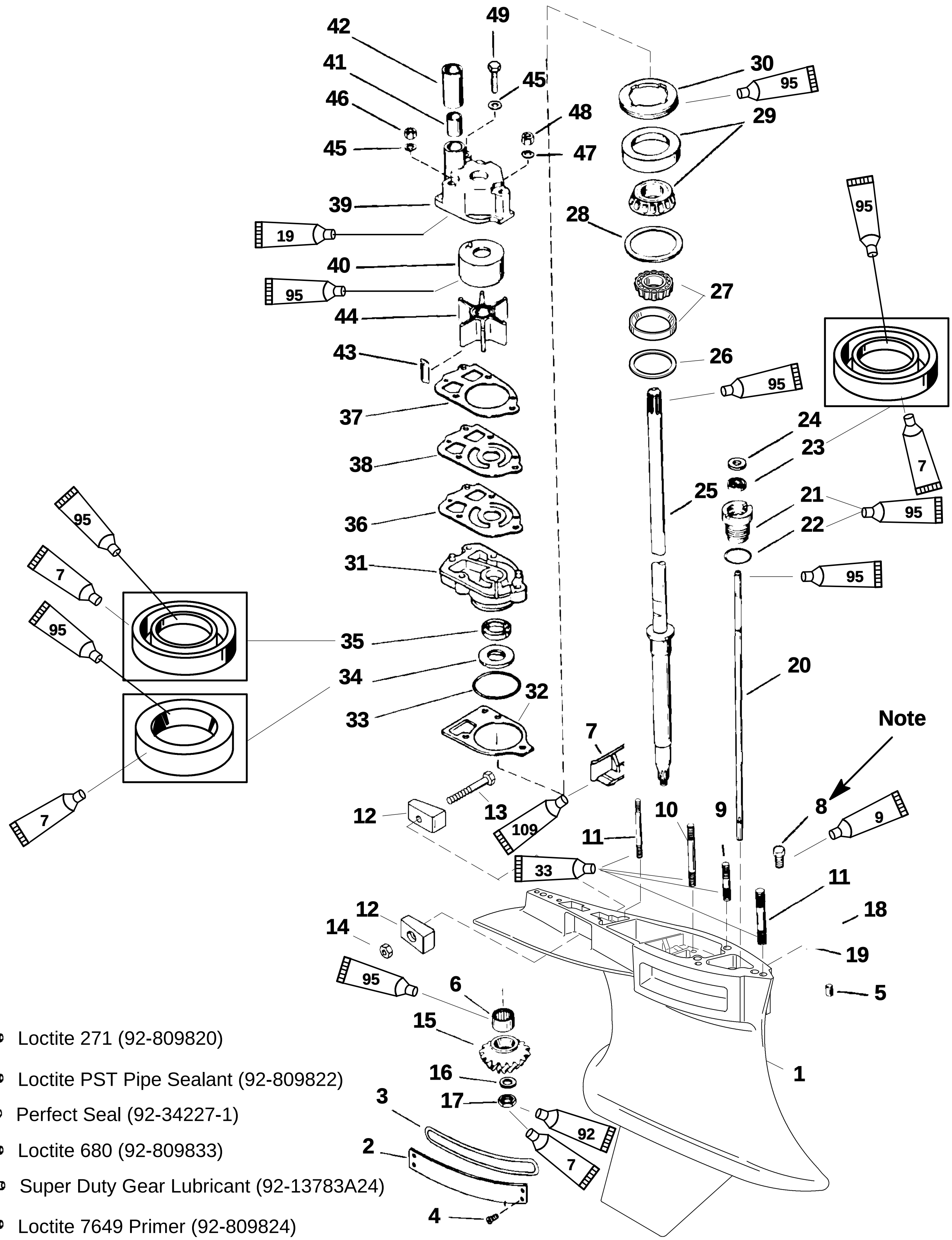
94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft)(Counter Rotation) (S/N-0G437999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING **(BASIC-BLACK)**			
	1	GEAR HOUSING **(BASIC-GRAY)**			
67	1	ROLLER BEARING			
68	1	THRUST RING			
69	1	O RING			
70	1	BEARING ADAPTOR			
71	1	ROLLER BEARING			
72	2	THRUST WASHER			
73	2	THRUST BEARING			
74	1	PROPELLER SHAFT			
75	1	BEARING CARRIER ASSEMBLY			
76	1	ROLLER BEARING			
77	1	OIL SEAL (INSIDE)			
78	1	OIL SEAL (OUTSIDE)			
79	1	KEY			
80	1	TAB WASHER			
81	1	COVER NUT		210	285
82	1	TRIM TAB			
83	1	SCREW		40	54.0
84	1	SCREW (.375-16 x 1)		55	75.0
85	2	WASHER			
86	2	NUT		55	75.0
87	1	THRUST HUB			
88	1	LOCKWASHER **These replacement parts**			
89	1	WASHER **ARE NOT included with**			
90	1	PROPELLER NUT **Complete**		55	75.0
91	1	TAB WASHER **Gear Housing replacement**			

Gear Housing (Driveshaft)(Counter Rotation) (Sportmaster)



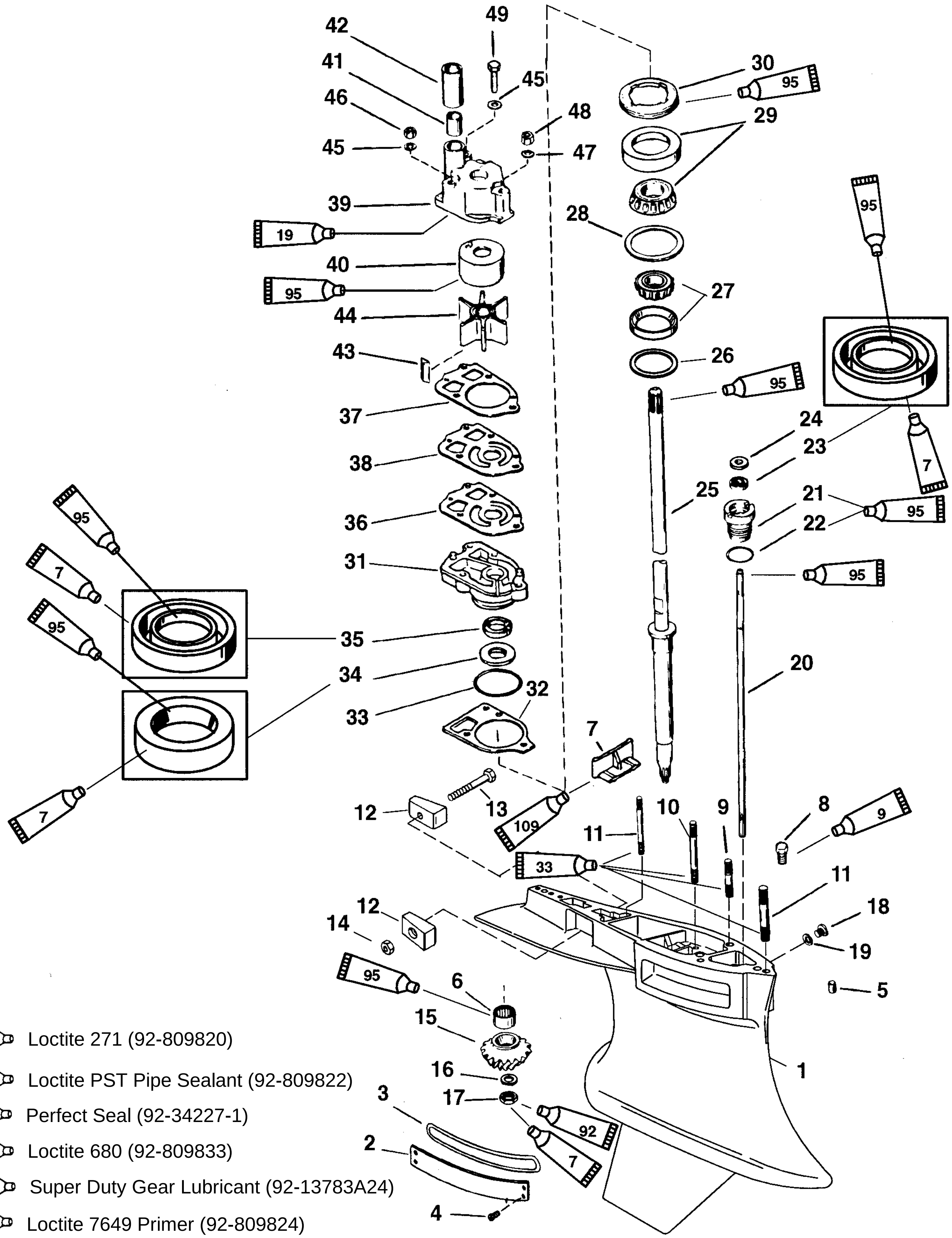
7	Loctite 271 (92-809820)
9	Loctite PST Pipe Sealant (92-809822)
19	Perfect Seal (92-34227-1)
33	Loctite 680 (92-809833)
87	Super Duty Gear Lubricant (92-13783A24)
92	Loctite 7649 Primer (92-809824)
95	2-4-C With Teflon (92-825407A12)
109	GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft)(Counter Rotation) (Sportmaster)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING **(BASIC)**			
2	2	COVER			
3	2	O RING			
4	12	SCREW	Drive Tight		
5	2	DOWEL PIN			
6	1	ROLLER BEARING			
7	1	FILLER BLOCK			
8	1	PLUG (See Note Below)			
9	1	STUD (5/16 x 3-3/8 IN.)			
10	1	STUD (5/16 x 3-1/4 IN.)			
11	3	STUD (7/16 x 2-11/16 IN.)**(SHORT/LONG)**			
	1	STUD (7/16 x 3-1/8 IN.) **LONG**			
	2	STUD (7/16 x 2-1/16 IN.)			
	2	STUD (7/16 x 7.06 IN.)			
	3	STUD (7/16 x 7.69 IN.) **X-LONG**			
	1	STUD (7/16 x 8-1/8 IN.)			
12	2	ANODE			
13	1	SCREW			
14	1	NUT	60	5.0	7.0
15	1	PINION GEAR (Part of 43-15845A2 or 43-817515A2)			
16	1	WASHER			
17	1	PINION NUT		85	115
18	1	SCREW PLUG	55		6.0
19	1	SEALING WASHER			
20	1	SHIFT SHAFT (LOWER)			
21	1	BUSHING ASSEMBLY		50	67.5
22	1	O RING			
23	1	OIL SEAL			
24	1	RUBBER WASHER			
25	1	DRIVESHAFT			
26	1	SHIM SET			
27	1	ROLLER BEARING			
28	AR	SHIM SET			
29	1	ROLLER BEARING			
30	1	RETAINER		100	135

Note: This plug acts as a water diverter. The screw slot in the plug head MUST BE ALIGNED FORE AND AFT with the gearcase for cooling water to be routed properly.

Gear Housing (Driveshaft)(Counter Rotation) (Sportmaster)

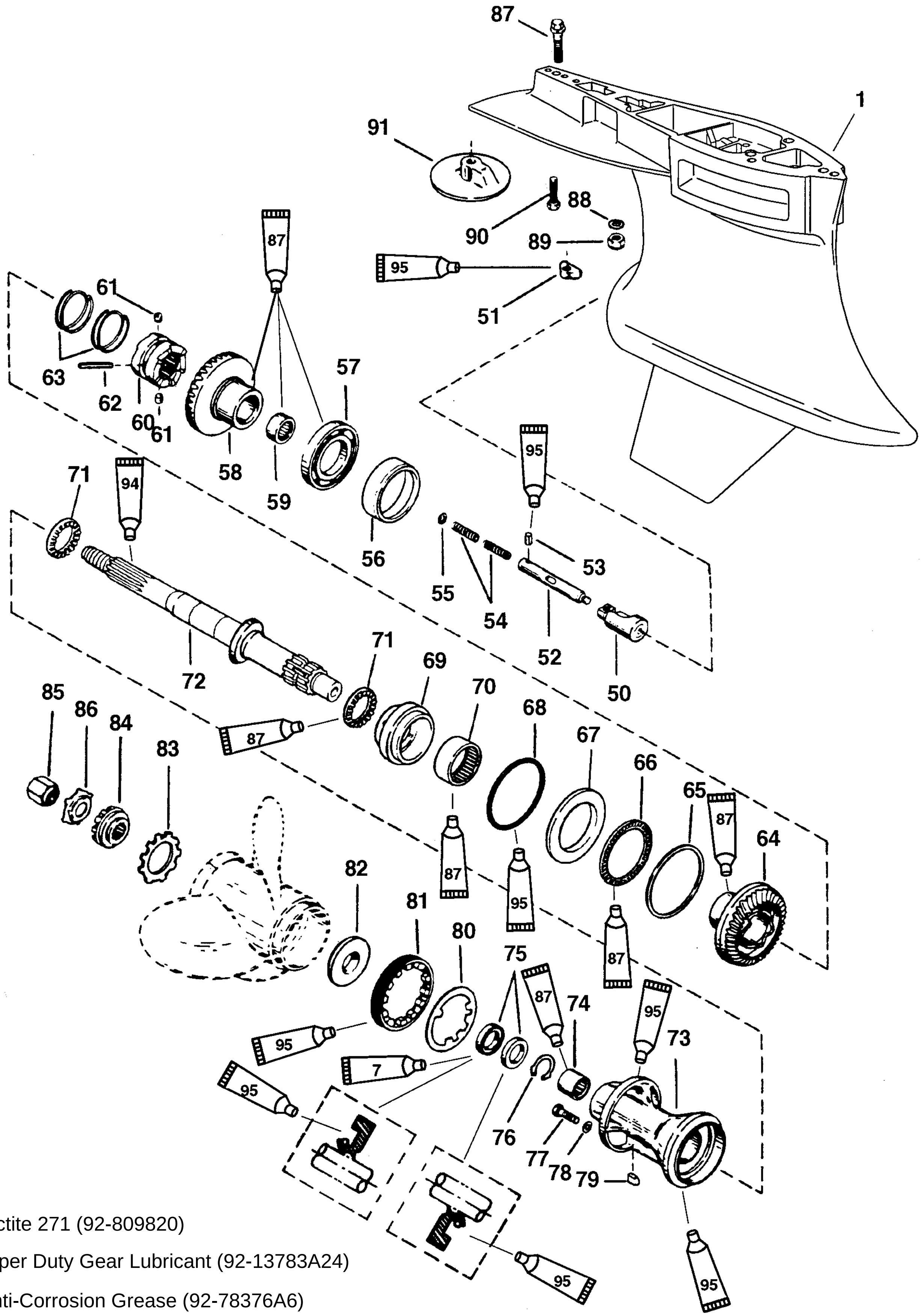


7	Loctite 271 (92-809820)
9	Loctite PST Pipe Sealant (92-809822)
19	Perfect Seal (92-34227-1)
33	Loctite 680 (92-809833)
87	Super Duty Gear Lubricant (92-13783A24)
92	Loctite 7649 Primer (92-809824)
95	2-4-C With Teflon (92-825407A12)
109	GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft)(Counter Rotation) (Sportmaster)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(BASIC)**			
31	1	WATER PUMP BASE ASSEMBLY			
32	1	GASKET			
33	1	O RING			
34	1	OIL SEAL			
35	1	OIL SEAL			
36	1	GASKET (LOWER)			
37	1	GASKET (UPPER)			
38	1	FACE PLATE			
39	1	WATER PUMP BODY ASSEMBLY			
40	1	INSERT			
41	1	SEAL			
42	1	SLEEVE			
43	1	KEY			
44	1	IMPELLER			
45	2	WASHER			
46	2	NUT	50		5.5
47	1	WASHER			
48	1	NUT	50		5.5
49	1	SCREW (2-1/4 IN.)	50		5.5

Gear Housing (Prop Shaft)(Counter Rotation) (Sportmaster)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

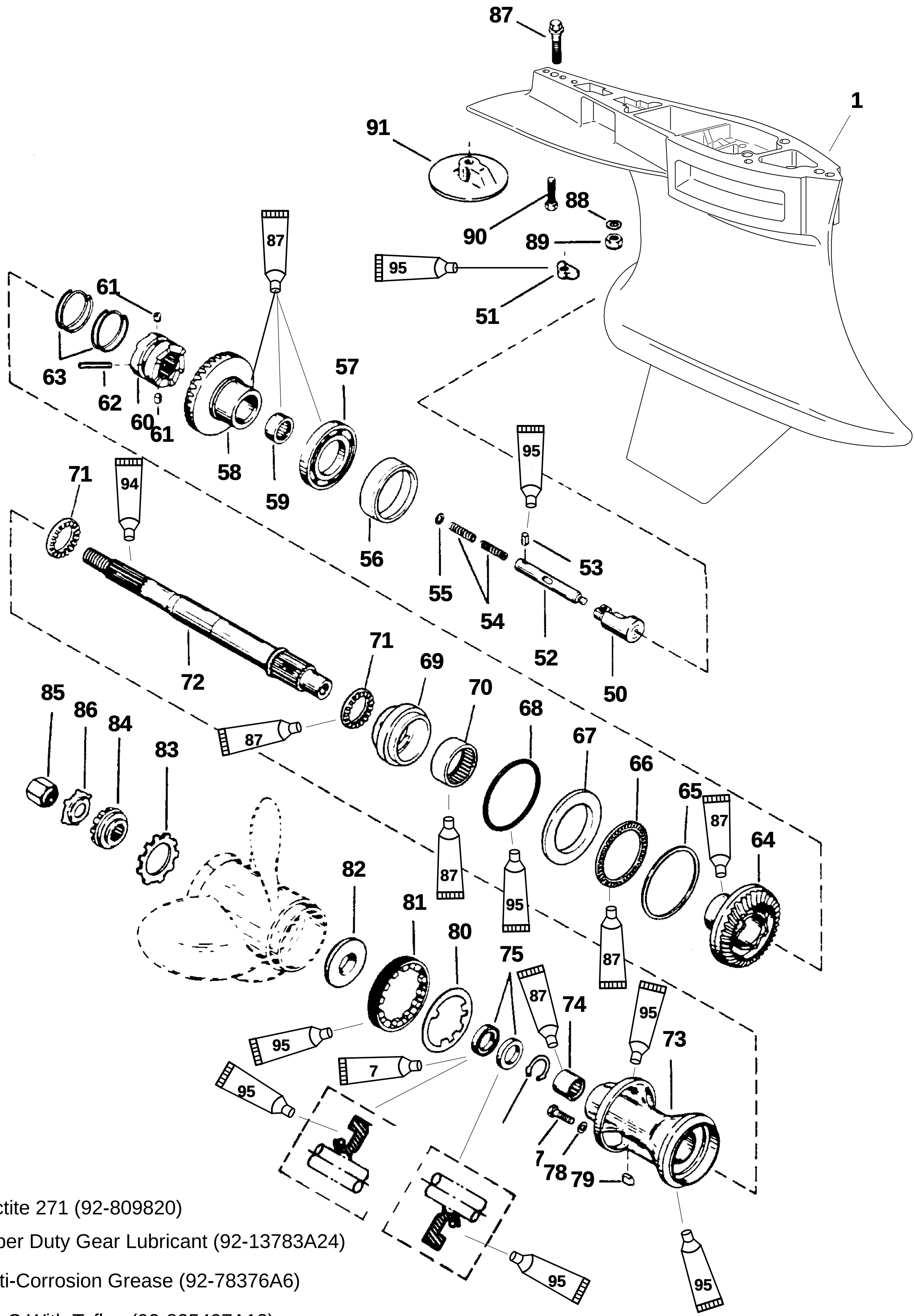
94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft)(Counter Rotation) (Sportmaster)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING **(BASIC)**			
50	1	CAM FOLLOWER			
51	1	SHIFT CAM			
52	1	ROD			
53	1	PIN			
54	2	SPRING			
55	AR	WASHER			
56	1	BEARING CUP			
57	1	BALL BEARING			
58	1	REVERSE GEAR (Part of 43-15845A2)**(1.87:1 GEAR RATIO)**			
	1	REVERSE GEAR **(2:1 GEAR RATIO)**			
59	1	ROLLER BEARING			
60	1	RATCHET			
61	2	DETENT PIN			
62	1	CROSS PIN			
63	2	SPRING			
64	1	FORWARD GEAR SET			
65	AR	SPACER SHIM (.125 IN.)			
	AR	SPACER SHIM (.127 IN.)			
	AR	SPACER SHIM (.129 IN.)			
	AR	SPACER SHIM (.131 IN.)			
	AR	SPACER SHIM (.133 IN.)			
	AR	SPACER SHIM (.135 IN.)			
	AR	SPACER SHIM (.137 IN.)			
	AR	SPACER SHIM (.139 IN.)			
	AR	SPACER SHIM (.141 IN.)			
	AR	SPACER SHIM (.143 IN.)			
	AR	SPACER SHIM (.145 IN.)			
	AR	SPACER SHIM (.147 IN.)			
	AR	SPACER SHIM (.149 IN.)			

Gear Housing (Prop Shaft)(Counter Rotation) (Sportmaster)



7	Loctite 271 (92-809820)
87	Super Duty Gear Lubricant (92-13783A24)
94	Anti-Corrosion Grease (92-78376A6)
95	2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft)(Counter Rotation) (Sportmaster)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING **(BASIC)**			
66	1	ROLLER BEARING			
67	1	THRUST RING			
68	1	O RING			
69	1	BEARING ADAPTOR			
70	1	ROLLER BEARING			
71	2	THRUST BEARING			
72	1	PROPELLER SHAFT			
73	1	BEARING CARRIER			
74	1	ROLLER BEARING			
75	2	OIL SEAL			
76	1	SNAP RING			
77	1	MAGNETIC DRAIN SCREW	55		6.0
78	1	SEALING WASHER			
79	1	KEY			
80	1	TAB WASHER			
81	1	COVER NUT		250	339
82	1	THRUST HUB			
83	1	LOCKWASHER			
84	1	WASHER			
85	1	PROPELLER NUT		55	74.5
86	1	TAB WASHER			
87	1	SCREW **(SHORT)**		25	34.0
	1	SCREW **(LONG/X-LONG)**		25	34.0
88	2	WASHER			
89	2	NUT		65	88
90	1	SCREW **(SHORT/LONG)**		35	47.5
	1	SCREW **(X-LONG)**		35	47.5
91	1	ANODIC PLATE **(SHORT)**			
	1	ANODIC PLATE **(LONG)**			
	1	ANODIC PLATE **(X-LONG)**			

General Service Recommendations

There may be more than one way to "disassemble" or "reassemble" a particular part(s), therefore, it is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

In many cases, disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure order in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to "reassembly and installation" of that component in the reassembly part of this section. Use the "Index" (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, verify that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear. When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from over-heating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced, if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly, as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply 2-4-C Marine Lubricant on all O-rings. To prevent wear, apply 2-4-C w/Teflon Marine Lubricant on I.D. of oil seals. To prevent corrosion damage after reassembly, apply Quicksilver 2-4-C w/Teflon to external surfaces of bearing carrier and cover nut threads prior to installation.

Removal, Disassembly, Cleaning and Inspection of Counter Rotation (Left Hand) Gear Housing

REMOVAL

⚠ WARNING

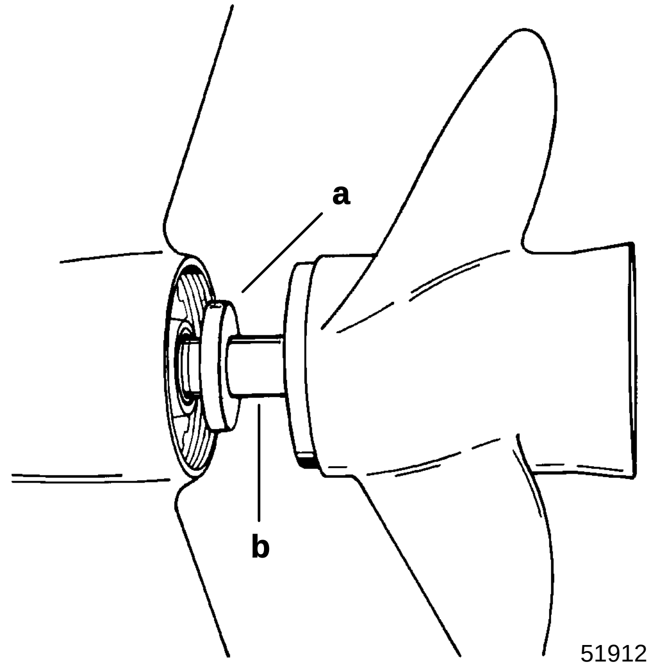
Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from driveshaft housing.

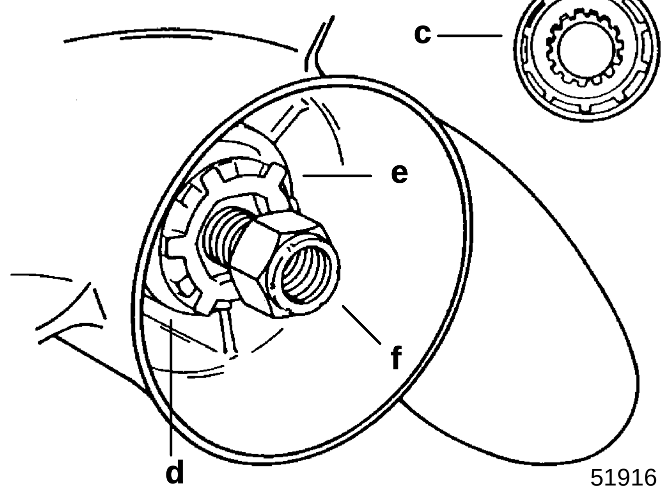
1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.

⚠ CAUTION

Gear housing MUST BE in NEUTRAL position and shift shaft MUST BE removed from gear housing BEFORE propeller shaft can be removed from gear housing.

2. Shift engine into NEUTRAL position.
3. Tilt engine to full up position and engage tilt lock lever.
4. Bend tabs of propeller tab washer away from thrust hub (rear), then remove propeller locknut, tab washer, thrust hub (rear), propeller and thrust hub (forward) from propeller shaft.

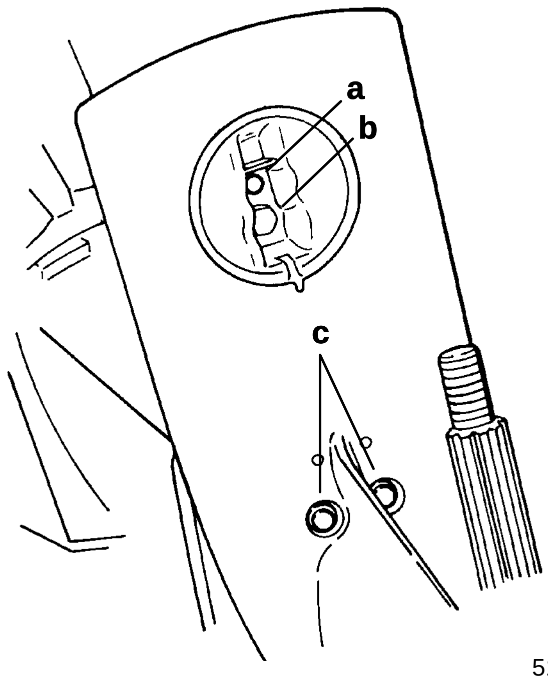




a - Thrust Hub (Forward)
b - Propeller Shaft
c - Continuity Washer (If Equipped)
d - Rear Thrust Hub
e - Tab Washer
f - Propeller Nut

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of driveshaft housing. Remove bolt that secures trim tab and remove tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.

7. Remove 2 locknuts from bottom middle of anti-cavitation plate.



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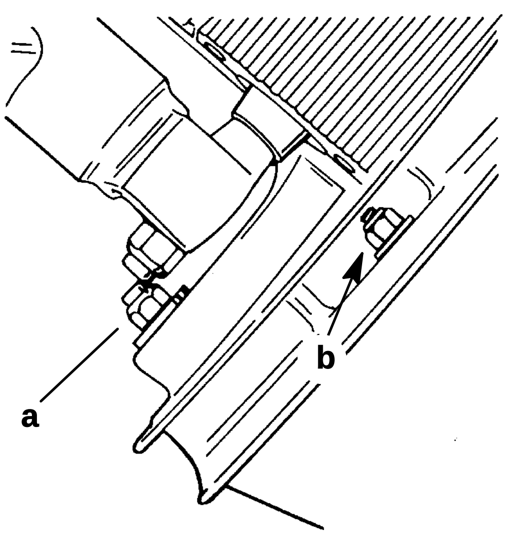
a - Bolt (Secures Trim Tab)
b - Bolt (Inside Trim Tab Cavity)
c - Locknuts and Washers

8. Remove locknut from the front gear housing mounting stud.
9. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or driveshaft housing could be damaged.)



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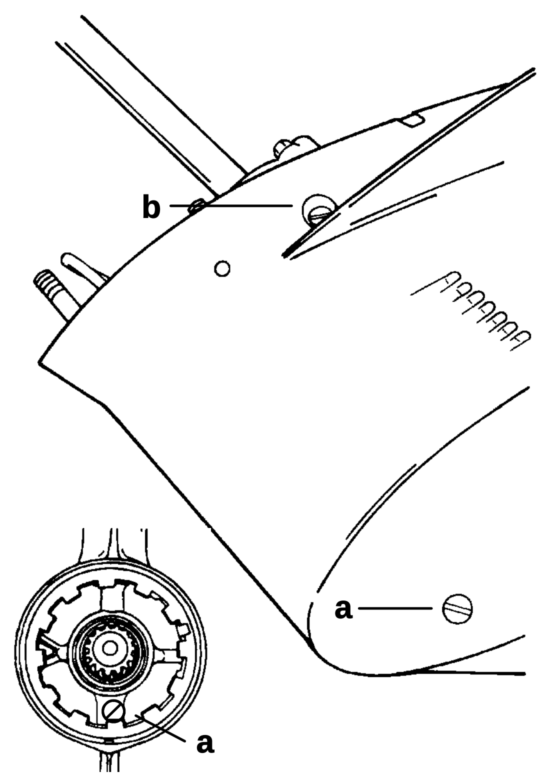
a - Front Mounting Locknut
b - Side Mounting Locknut (One Each Side)

10. Pull gear housing away from driveshaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)
11. Pull gear housing from driveshaft housing.

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the driveshaft in a vertical position, as shown.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing.
3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. 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, O-rings and gear housing components.

IMPORTANT: Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.



51871

a - "Fill" Screw (Sport Master Gear Case has Drain/Fill Screw Located in the Bearing Carrier)
b - "Vent" Screw

Water Pump

CLEANING AND INSPECTION

1. Clean all water pump parts with solvent and dry with compressed air.
2. Inspect water pump cover and base for cracks and distortion (from overheating).
3. Inspect face plate and water pump insert for grooves and/or rough surfaces.

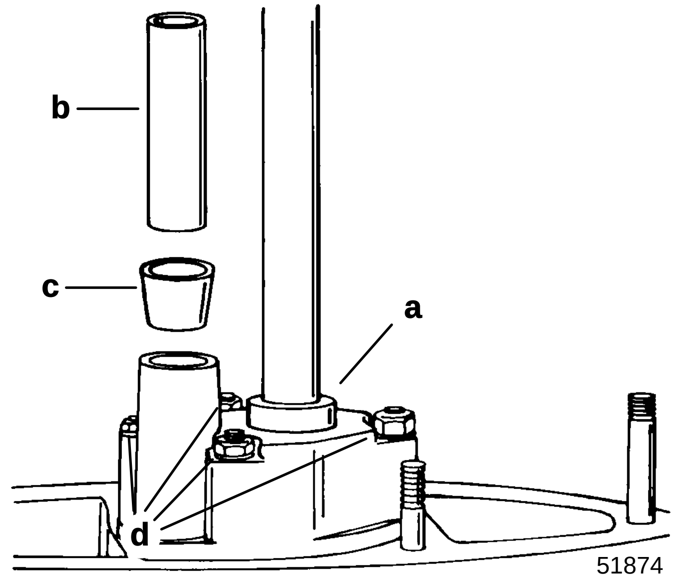
IMPORTANT: When completing gear housing repairs, that require removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to re-use impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur.

4. Inspect impeller side seal surfaces and ends of impeller blades for cracks, tears and wear. Replace impeller if any of these conditions are found.
5. Inspect impeller bonding to impeller hub.
6. Inspect impeller for glazed or melted appearance (caused by operation without sufficient water supply). Replace impeller if any of these conditions exist.

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

REMOVAL AND DISASSEMBLY

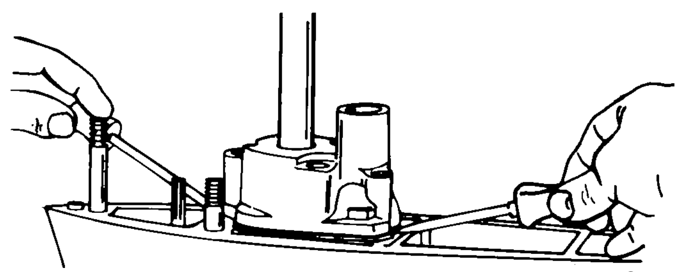
1. Slide rubber centrifugal slinger up and off driveshaft.
2. Remove water tube guide and seal from water pump cover. (Retain guide for reassembly and discard seal.)
3. Remove (and retain) 3 nuts, one bolt and all washers which secure water pump cover to gear housing.



51874

a - Centrifugal Slinger (if equipped)
b - Water Tube Guide
c - Water Tube Seal
d - Nuts, Bolt and Washers To Be Removed

4. Using 2 pry bars, lift water pump cover up and off driveshaft.

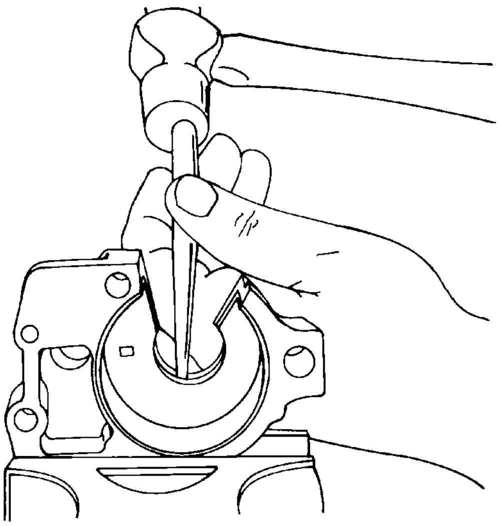


51874

5. Inspect water pump cover and insert, as outlined in "Cleaning and Inspection," previous.
6. If inspection of water pump insert determines that replacement is required, follow Step "a" or "b" (immediately following) to remove insert from water pump cover.

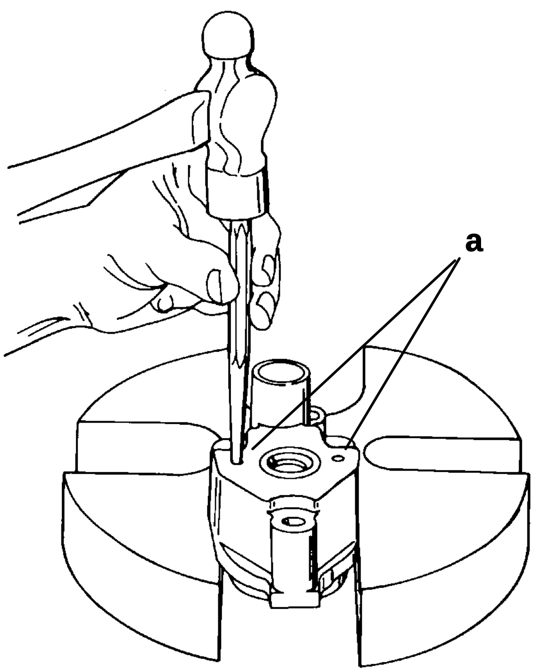
***NOTE:** Try Step "a" first. If insert cannot be removed with Step "a," use Step "b."*

a. Drive water pump insert out of water pump cover with a punch and hammer.



51874

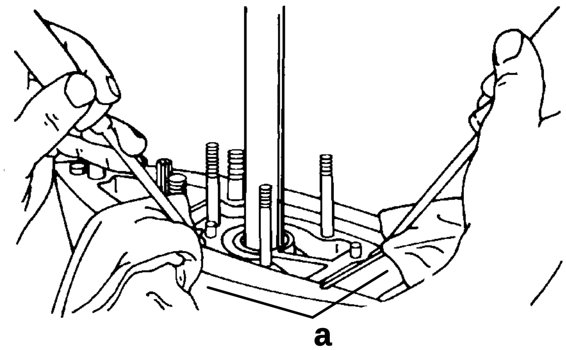
b. Drill two 3/16" (4.8mm) diameter holes thru the top of water pump cover (but not thru insert). Drive insert out of cover with a punch and hammer.



51873

a - Drill Two Holes at These Locations

7. Remove impeller from driveshaft. (It may be necessary to use a punch and hammer to drive impeller upward on driveshaft. In extreme cases, it may be necessary to split hub of impeller with a hammer and chisel.)
8. Once impeller is removed, remove impeller drive key from driveshaft.
9. Remove water pump face plate and both gaskets (one above and below face plate) from water pump base.
10. Using 2 pry bars, positioned and padded as shown, lift water pump base up and off driveshaft.



51874

a - Pads

11. Remove (and discard) O-ring from O-ring groove on water pump base.
12. Using a screwdriver, pry oil seals out of water pump base from gear housing side of base. \

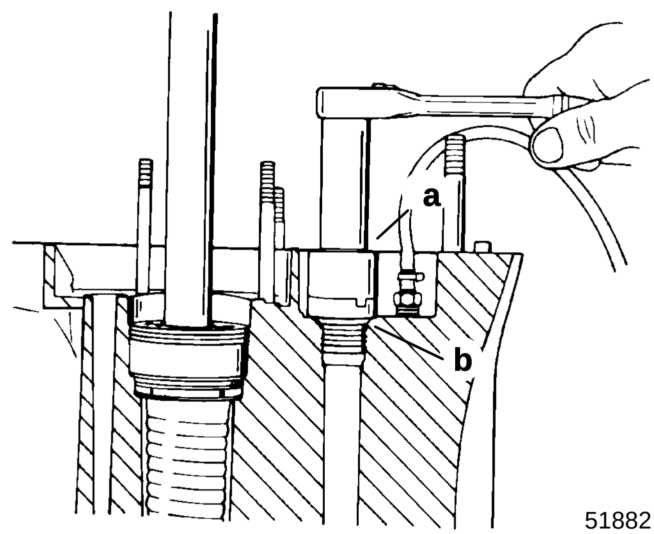
Bearing Carrier and Propeller Shaft

REMOVAL

⚠ CAUTION

Gear housing MUST BE in neutral position, and shift shaft MUST BE removed from gear housing before propeller shaft can be removed from gear housing.

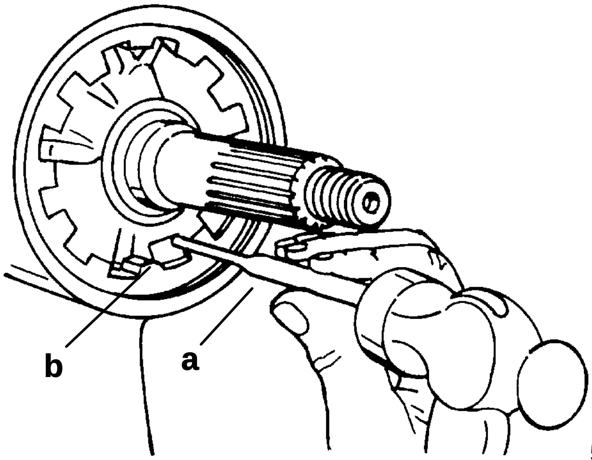
1. Place gear housing in a suitable holding fixture or vise with propeller shaft in a horizontal position.
2. Use Shift Shaft Bushing Tool (91-31107) to unthread shift shaft bushing. (DO NOT remove bushing from shift shaft at this time.)



51882

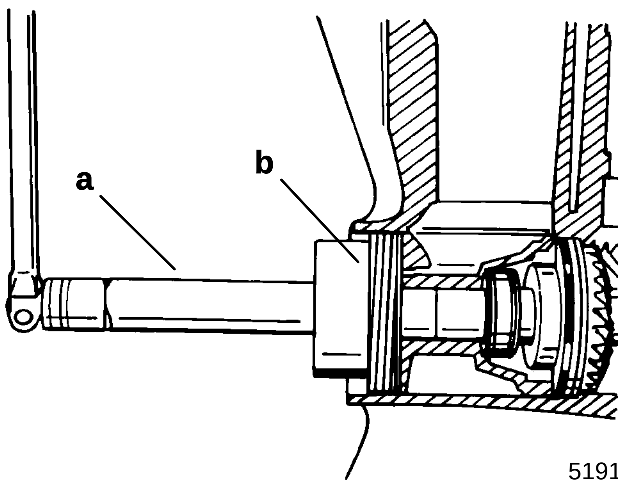
a - Shift Shaft Bushing Tool (91-31107)
b - Shift Shaft Bushing

3. Bend retainer nut lock tab out of retainer nut recess.



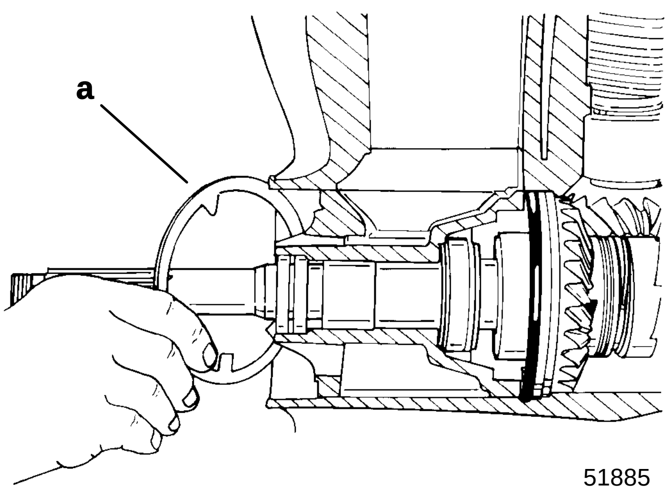
a - Punch
b - Tab of Tab Washer

4. Remove gear housing retainer nut with Retainer Nut Tool (91-61069).



a - Retainer Nut Tool (91-61069)
b - Retainer Nut

5. After retainer nut has been removed, remove lock tab washer from gear housing.



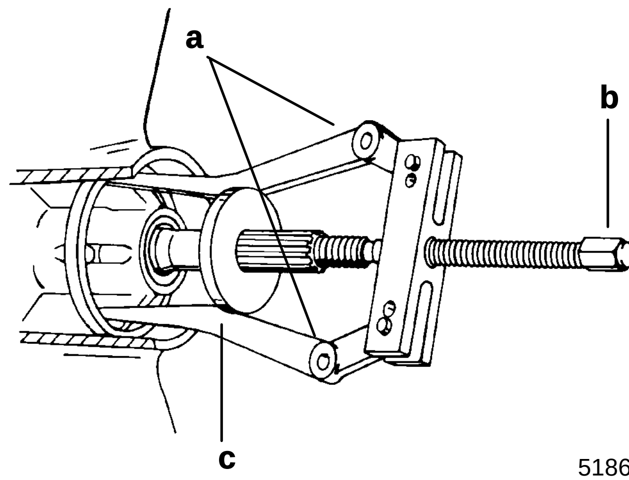
a - Tab Washer

⚠ CAUTION

Once bearing carrier is removed from gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

6. Use long Puller Jaws (91-46086A1) and Puller Bolt (91-85716) to remove bearing carrier. (Use propeller thrust hub to maintain outward pressure on puller jaws.)

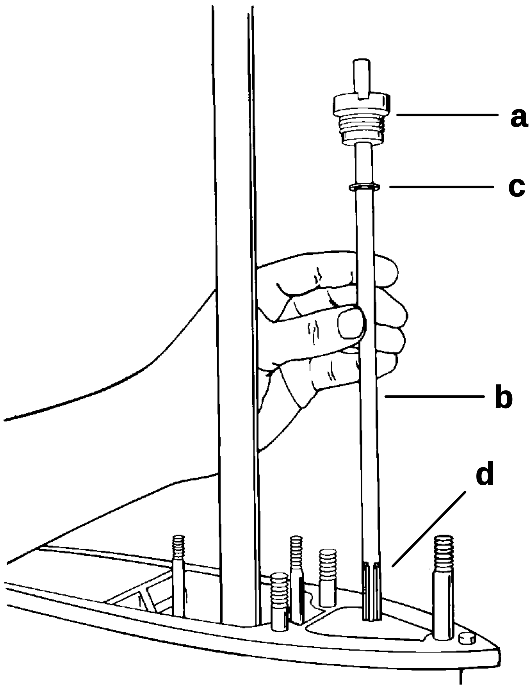
NOTE: *When bearing carrier is removed from gear housing, the bearing carrier alignment key will come out with it.*



a - Long Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)
c - Thrust Hub

IMPORTANT: Prior to removal of shift shaft from gear housing, recheck that gear housing is in neutral position.

7. With gear housing in neutral, pull shift shaft out of gear housing. If necessary, use a pliers to pull shift shaft out of gear housing. If pliers are used to pull shift shaft out, wrap a strip of soft metal (aluminum) around splines before clamping pliers. DO NOT turn shaft (clockwise OR counterclockwise) while pulling shaft out. (For further information on shift shaft, see "Shift Shaft Cleaning/Inspection and Disassembly.")



51867

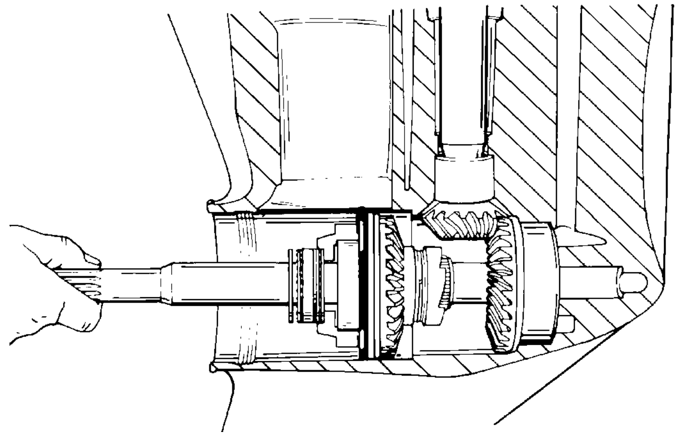
a - Shift Shaft Bushing
b - Shift Shaft
c - "E" Ring (if equipped)
d - Retaining Ring (if equipped)

CAUTION

Propeller shaft, cam follower and shift cam, in most cases, will come out of gear housing by simply pulling outward on propeller shaft. DO NOT FORCE shaft sideways or ATTEMPT TO PULL with a slide hammer or any mechanical puller.

8. Remove propeller shaft, cam follower and shift cam by pulling shaft straight out of gear housing. (DO NOT JERK propeller shaft.)

NOTE: *Sliding clutch, forward gear assembly, bearing adaptor, thrust washer and thrust bearings will be removed from gearcase with propeller shaft.*



51877

9. If propeller shaft will not come out, proceed with Step "a" or "b," following:
   a. Push propeller shaft back into place against the reverse gear. Visually inspect location of shift cam by looking down shift shaft hole (illuminated with a flashlight). If splined hole in shift cam is visible, reinstall shift shaft and rotate shift shaft to neutral position. Remove shift shaft, then remove propeller shaft as instructed in Step 8, immediately preceding.
   b. Push propeller shaft back into place against reverse gear. Slide bearing carrier back into gear housing (to support propeller shaft). Place gear housing on its left side (viewed from rear) and strike upper leading end of gear housing with a rubber mallet. This will dislodge the shift cam from cam follower into a clearance pocket in left side of gear housing. Remove bearing carrier and pull propeller shaft out of gear housing.

NOTE: *If Step 9-b was used to remove propeller shaft, the shift cam can be retrieved after removal of reverse gear.*

CLEANING AND INSPECTION

1. Clean shift shaft and bushing with solvent and dry with compressed air.
2. Check shift shaft splines on both ends for wear and/or corrosion damage.
3. Inspect shift shaft for groove(s) at shift shaft bushing seal surface.
4. Inspect shift shaft bushing for corrosion damage.
5. Inspect shift shaft bushing oil seal for wear and/or cuts.
6. Check "E" clip and retaining ring for damage. Replace if damaged (if equipped).

DISASSEMBLY

1. Remove (and discard) shift shaft bushing oil seal by prying it out or driving it out with a punch and hammer.
2. Remove "E" clip and retaining ring if inspection determines that replacement is required (if equipped).

CLEANING/INSPECTION - BEARING CARRIER

IMPORTANT: It is recommended that all seals and O-rings be replaced (as a normal repair procedure) to assure effective repair.

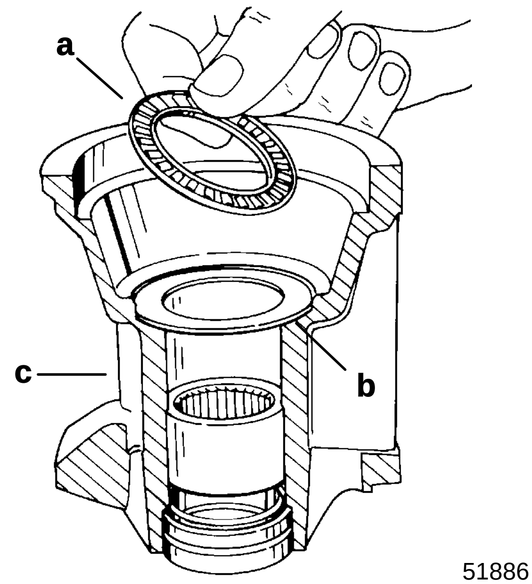
⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean bearing carrier with solvent and dry with compressed air.
2. Bearing carrier propeller shaft needle bearing condition is determined by propeller shaft bearing surface condition. (See **"Propeller Shaft Inspection."**)

DISASSEMBLY- BEARING CARRIER

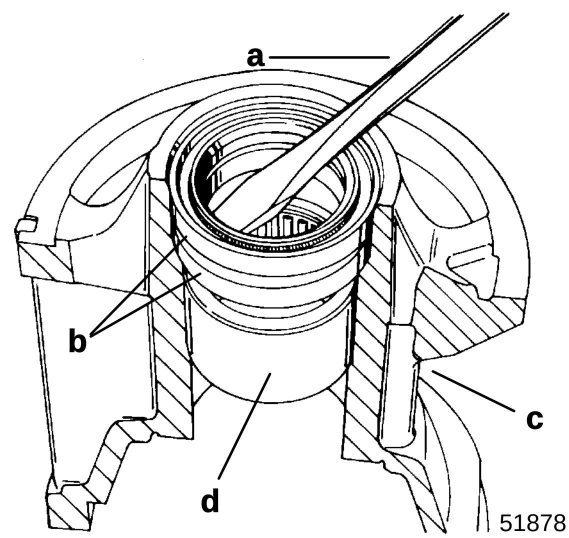
1. Remove thrust bearing and thrust washer (not used in Sport Master gear case) from bearing carrier.



a - Thrust Bearing
b - Thrust Washer (Not Used In Sport Master Gear Case)
c - Bearing Carrier

2. If thrust bearing, thrust washer or thrust bearing surface on propeller shaft shows signs of rust, pitting or blueing from lack of lubricant, component(s) should be discarded.
3. Remove bearing carrier oil seals.

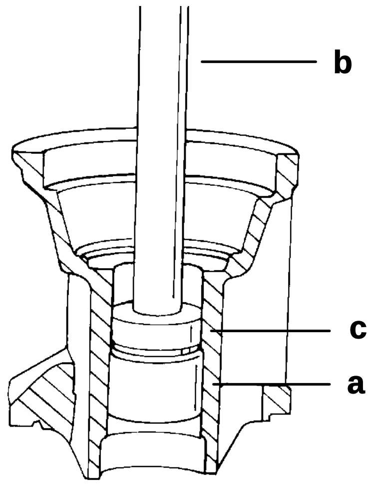
NOTE: *High Performance models have a retaining ring between the 2nd seal and the needle bearing. This retaining ring must be removed before the needle bearing can be removed from the bearing carrier.*



a - Pry Bar
b - Oil Seals
c - Bearing Carrier
d - Bearing Carrier Needle Bearing

NOTE: *Do not remove bearing carrier needle bearing unless replacement is needed.*

4. Use bearing removal and replacement tool (91-31229A5) or equivalent to press bearings out of bearing carrier.



51885

a - Needle Bearing
b - Push Rod
c - Mandrel

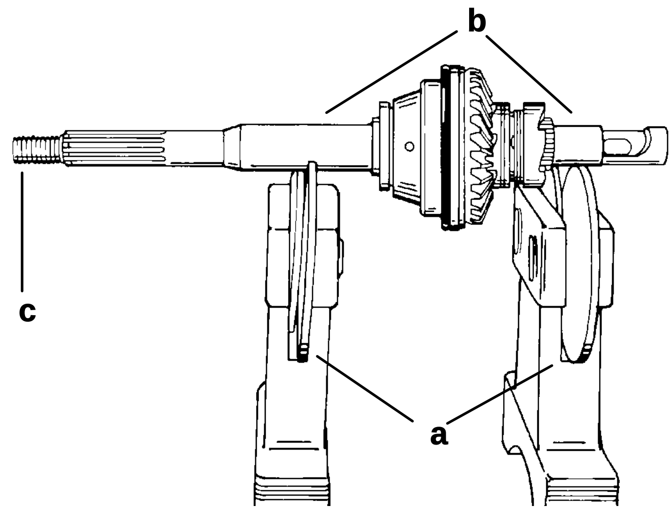
Propeller Shaft

INSPECTION

1. Clean propeller shaft assembly with solvent and dry with compressed air.
2. Inspect bearing carrier oil seal surfaces for grooves. Run fingernail across seal surface to check for groove. Replace shaft if groove is found.
3. Visually check bearing surfaces of propeller shaft for pitting, grooves, scoring, uneven wear or discoloration (bluish color) from overheating. Replace shaft and corresponding needle bearing if any of the above conditions are found. (Bearing carrier needle bearing contacts propeller shaft just in front of oil seal surface. Reverse gear bearing contacts propeller shaft in front of sliding clutch splines.)
4. Inspect propeller shaft splines for wear and/or corrosion damage.
5. Check propeller shaft for straightness. Use either method, following:

Balance Wheels

Place propeller shaft on balance wheels, as shown. Rotate propeller shaft and observe propeller end of shaft for "wobble." Replace shaft if any "wobble" is observed.



51877

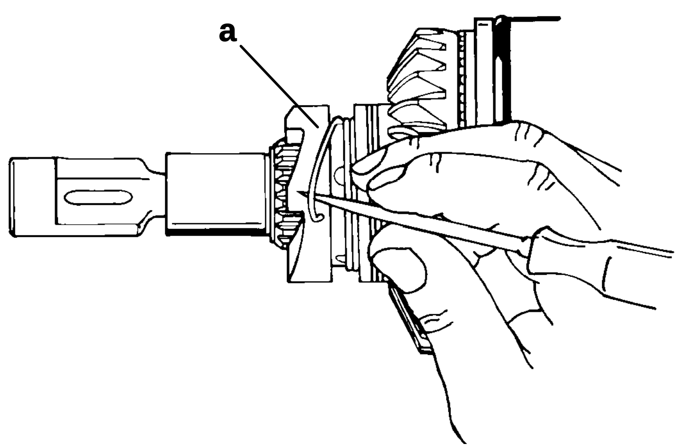
a - Balance Wheels
b - Bearing Surfaces
c - Watch for "Wobble"

"Vee" Blocks and Dial Indicator

Position propeller shaft roller bearing surfaces on "vee" blocks. Mount a dial indicator at front edge of propeller splines. Rotate propeller shaft. Dial indicator movement of more than 0.006" (0.152mm) (or noticeable "wobble") is reason for replacement.

DISASSEMBLY

1. Remove shift cam from cam follower.
2. Insert a thin blade screwdriver or awl under first coil of cross pin retainer spring and rotate propeller shaft to unwind spring from sliding clutch. DO NOT over stretch spring.



51875

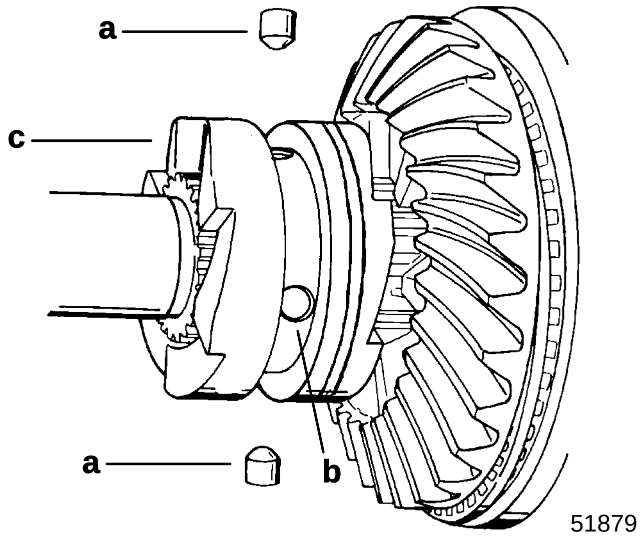
a - Cross Pin Retainer Spring

3. Remove the second cross pin retainer spring from sliding clutch in the same way as in Step 2.

⚠ CAUTION

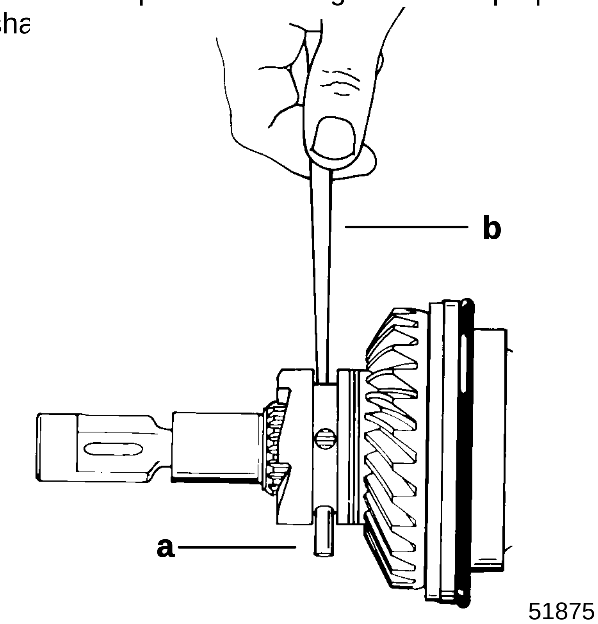
Detent pins are free and can fall out of sliding clutch. Care MUST BE taken not to lose pins.

4. Detent pins are free and can be removed from sliding clutch at this time.



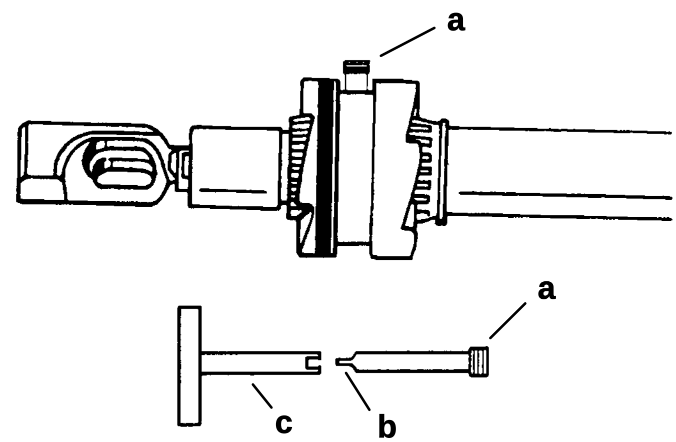
a - Detent Pins
b - Cross Pin
c - Sliding Clutch

5. Push cross pin out of sliding clutch and propeller sha



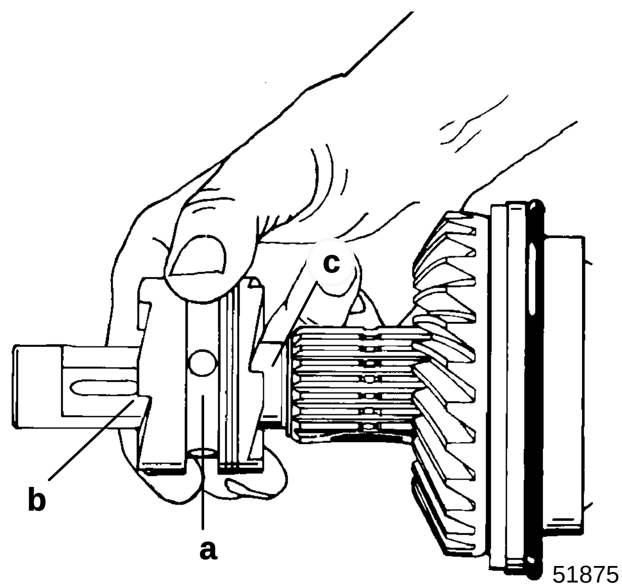
a - Cross Pin
b - Punch

NOTE: *Sport Master gear cases use a threaded cross pin. Use Cross Pin Tool 91-86642-2 to remove cross pin. Turn tool CLOCKWISE to remove threaded cross pin.*



a - Cross Pin
b - Cross Pin Tang
c - Cross Pin Tool 91-86642-2

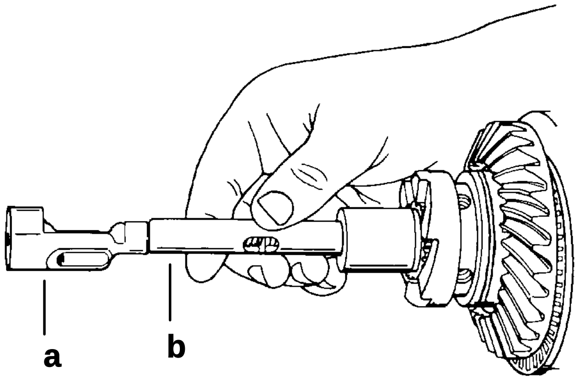
6. Pull sliding clutch off propeller shaft.
7. Inspect sliding clutch. Check reverse gear clutch "jaws" and forward gear clutch "jaws." Rounded "jaws" indicate one or more of the following:
   a. Improper shift cable adjustment.
   b. Improper shift habits of operator(s) (shift from neutral to reverse gear or forward gear too slowly).
   c. Engine idle speed too high (while shifting).



a - Sliding Clutch
b - Reverse Gear Clutch Jaws
c - Forward Gear Clutch Jaws

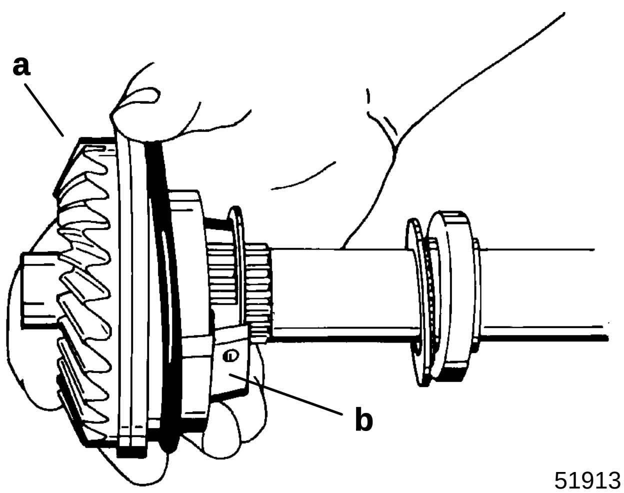
8. Pull cam follower and clutch actuator rod out of propeller shaft. DO NOT force cam follower up-or-down or side-to-side when pulling from propeller shaft.

9. Once cam follower and clutch actuator rod are removed from propeller shaft, lift rod out of cam follower.



a - Cam Follower
b - Clutch Actuator Rod

10. Check condition of cam follower. If it shows wear (pitting, scoring or rough surface), replace cam follower and shift cam.
11. Remove forward gear and bearing adaptor assembly.



a - Forward Gear
b - Bearing Adaptor Assembly

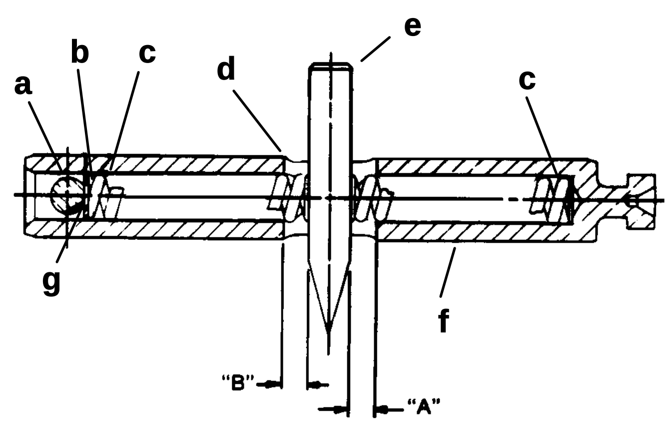
Clutch Actuator Rod

CLEANING AND INSPECTION

⚠ CAUTION

Care MUST BE taken when handling clutch actuator rod. The locating pin is free and will fall out, allowing compression springs and shims to fall out.

1. Clean clutch actuator rod in solvent and dry with compressed air.
2. Insert Cross Pin Tool (91-86642) between compression springs in elongated slot in clutch rod.
3. Compress both springs by forcing cross pin tool back-and-forth in elongated slot. This will release any initial set from springs.
4. Measure distance from each end of elongated slot to the near side of cross pin tool. The measurement taken must be equal within 1/64" [.016" (0.4mm)].
5. If measurements (taken in Step 4) are not equal to within 1/64", disassembly of clutch actuator rod must be performed to determine the reason. [Reasons for unequal measurements may be a broken spring, a spring of reduced length (see Step 6) or the wrong spring shimming.]
6. If disassembly is performed on clutch actuator rod, spring length must be 1.535" to 1.560" [1-17/32" to 1-9/16" (38.9mm to 39.7mm)].



a - Spring Locating Pin
b - Shim Washer
c - Compression Spring
d - Elongated Slot
e - Cross Pin Tool (91-86642)
f - Clutch Actuator Rod
g - Shim Washer Must Rest on Flat Side of Spring Locating Pin

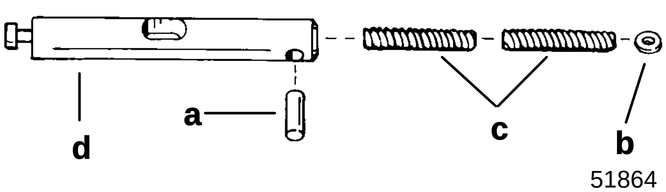
***NOTE:** "A" and "B" Measurements Must Be Equal within 1/64" [.016" (0.4mm)].*

DISASSEMBLY

IMPORTANT: Keep a record of shim amounts and location during disassembly of clutch actuator rod to aid in reassembly.

1. Push locating pin out of clutch actuator rod.

2. After locating pin is removed, compression springs and shim(s) are free to fall out of clutch actuator rod.



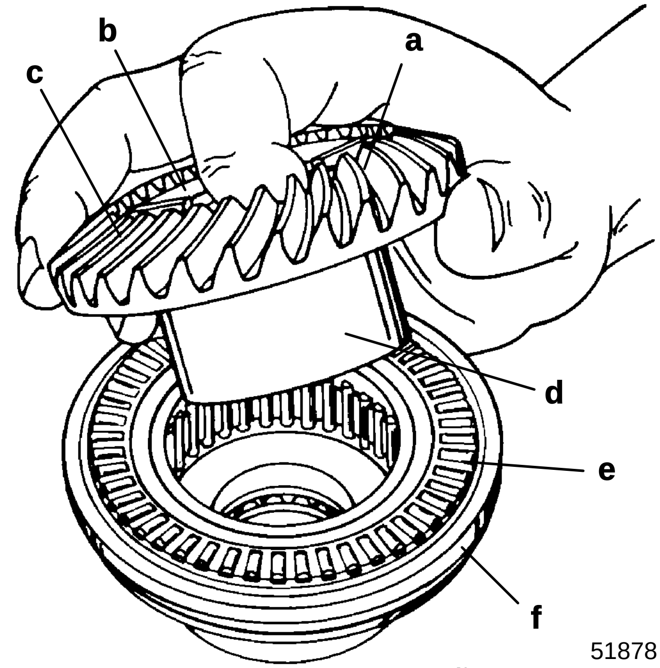
a - Locating Pin
b - Shim Washer(s)
c - Compression Springs
d - Clutch Actuator Rod

3. Refer to Step 6 in "Clutch Actuator Rod Inspection" for spring length requirements.

Forward Gear and Bearing Adapter

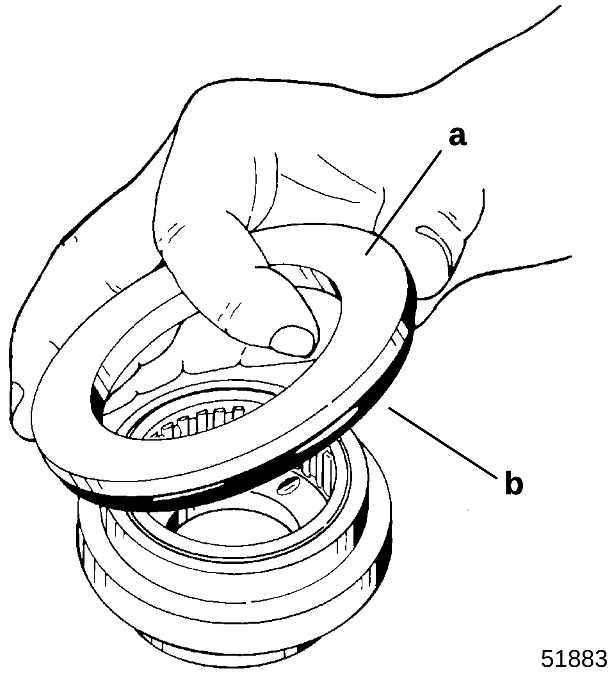
DISASSEMBLY/CLEANING/INSPECTION

1. Remove forward gear from bearing adapter.
2. Inspect forward gear clutch teeth for signs of wear. If clutch teeth are worn, sliding clutch should be replaced also.
3. Inspect forward gear teeth for full tooth contact, chips, pits and signs of rust. If forward gear teeth are damaged, pinion gear must be inspected and replaced if necessary.
4. Inspect forward gear hub for signs of pitting, rust, scoring or discoloration (blueing) due to lack of lubricant.
5. Remove thrust bearing and spacer shim. Inspect thrust bearing for pits, rust, or discoloration (blueing) due to lack of lubricant.



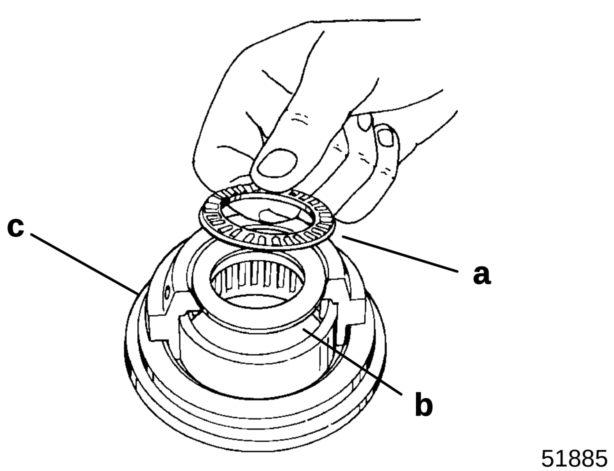
a - Forward Gear
b - Forward Gear Clutch Teeth
c - Forward Gear Teeth
d - Forward Gear Hub
e - Thrust Bearing
f - Spacer Shim

6. Remove thrust washer and O-ring. The thrust washer acts as a bearing surface for the thrust bearing and it should be inspected for pits, rust, scoring or discoloration due to lack of lubricant. O-ring should be inspected for cuts or abrasions and replaced if necessary.



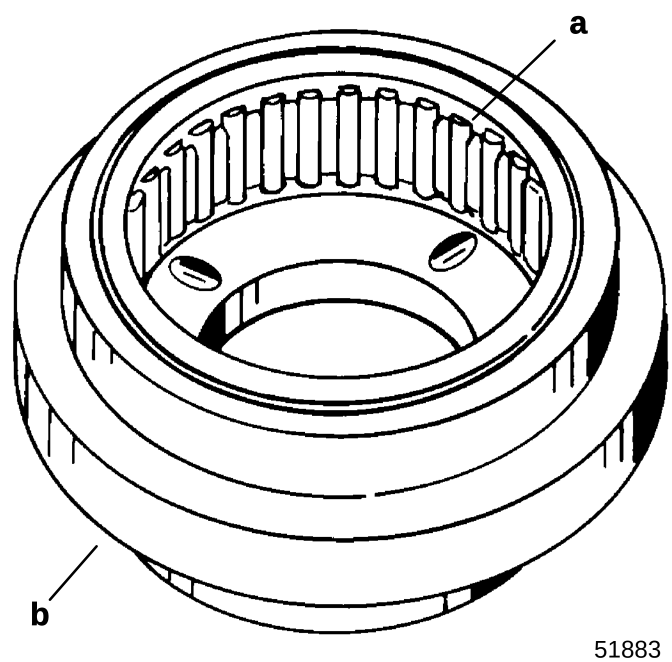
a - Thrust Washer
b - O-Ring

7. Remove thrust bearing and thrust washer (not used on Sport Master gear cases) from bearing adaptor. Thrust roller bearing should be inspected for pitting, rust or signs of discoloration (blueing) due to lack of lubricant. If thrust roller bearing must be replaced, the bearing surfaces on the thrust washer and propeller shaft where the thrust roller bearing rides should also be inspected for signs of wear.



a - Thrust Bearing
b - Thrust Washer (Not Used on Sport Master Gear Cases
c - Bearing Adaptor

8. The forward gear bearing should be carefully inspected for smoothness of movement, pits, rust, or signs of discoloration (blueing) due to lack of lubricant. If the bearing must be replaced, it is recommended that a hammer and cape chisel be used to break the bearing loose from the bearing adapter. Be careful not to damage bearing adapter when removing roller bearing.

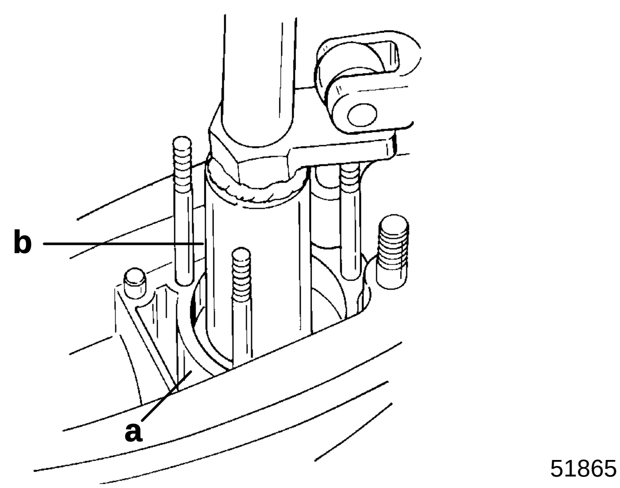


a - Forward Gear Bearing
b - Bearing Adaptor

Pinion Gear and Driveshaft

REMOVAL

1. Remove bearing retainer using Bearing Retainer Tool (91-43506).

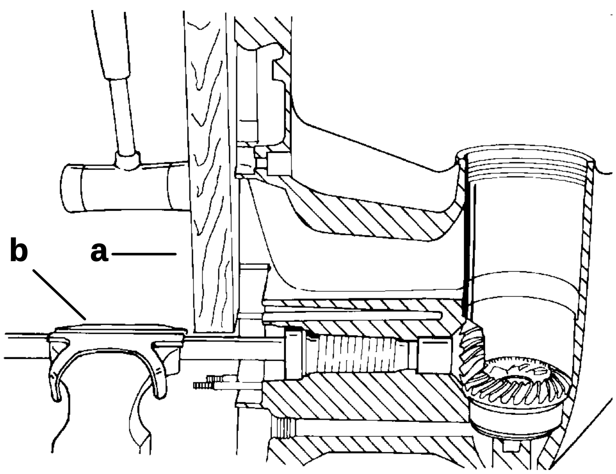


a - Bearing Retainer
b - Bearing Retainer Tool (91-43506)

2. Place Driveshaft Holding Tool (91-34377A1) over driveshaft splines.
3. Use a socket and flex handle to hold pinion nut. (Pad area of gear housing, where flex handle will make contact, to prevent damage to gear housing.)
4. Use a socket and flex handle on Driveshaft Holding Tool to loosen pinion nut. Remove pinion nut and Driveshaft Holding Tool.
5. Remove gear housing from vise and re-position it as shown. Be sure to use soft jaw vise covers and clamp as close as possible to water pump studs.
6. Place a block of wood on gear housing mating surface. Use a mallet and carefully tap gear housing away from driveshaft.

⚠ CAUTION

DO NOT strike gear housing hard with the mallet or allow gear housing to fall.



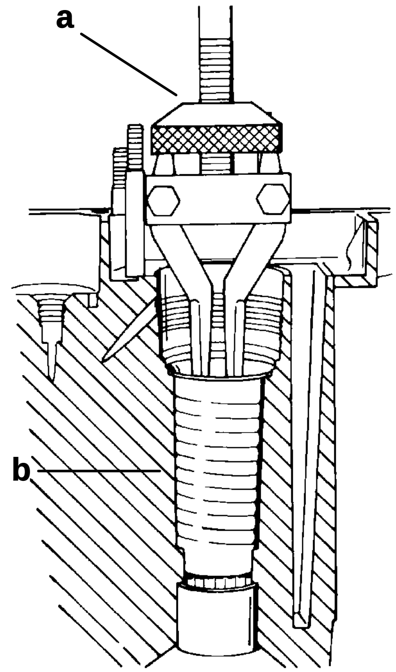
51878

a - Wooden Block
b - Soft Jaw Vise Covers

7. Reach into gear housing and remove pinion gear.
8. After driveshaft is removed from gear case, remove and retain shim(s) that were located under upper tapered driveshaft bearing.

NOTE: *Sport Master gear cases do not use a lubrication sleeve.*

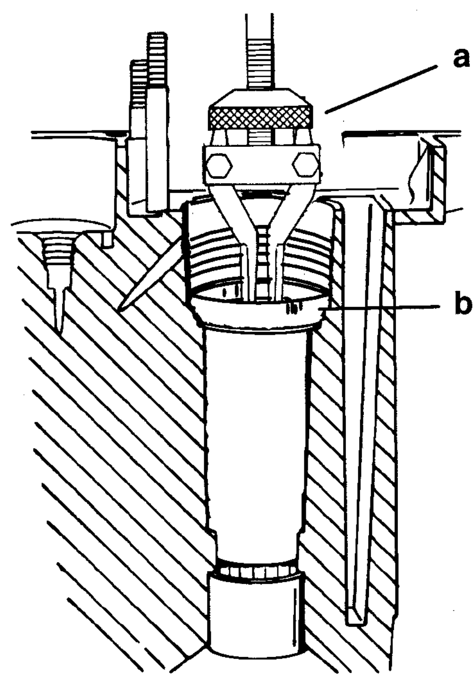
9. If necessary, carefully use a slide hammer (91-34569A1) to remove lubrication sleeve (if equipped) from gear housing.



51865

a - Slide Hammer
b - Lubrication Sleeve (if equipped)

10. **Sport Master Gear Case Only -** Remove lower driveshaft bearing cup and shims using slide hammer puller (91-34569A1).

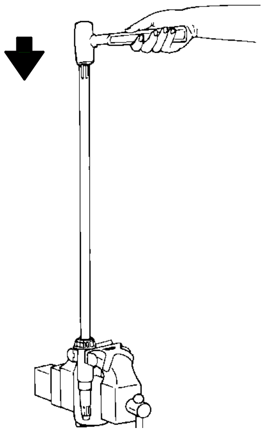


a - Slide Hammer Puller (91-34569A1)
b - Lower Driveshaft Bearing Cup

11. **All gear cases except Sport Master -** If inspection determines that replacement of driveshaft tapered bearing is required, remove bearing from driveshaft as follows:

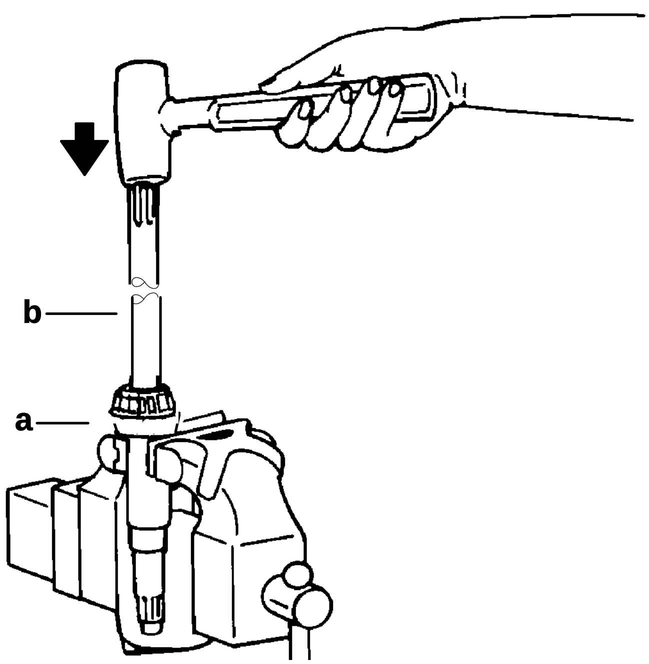
a. Position driveshaft in a vise; DO NOT tighten vise jaws against shaft.

b. Strike shaft with a lead hammer; take care not to drop shaft.



51866

12. **Sport Master Gear Case -** Both upper and lower tapered roller bearings can be removed from the driveshaft in one operation. Using the bottom bearing cup removed from the gearcase, place the cup on top of a vise leaving the vise jaws open enough to allow the driveshaft to slide through. Place the driveshaft through the cup and vise until the bottom bearing is resting in the cup. While holding the driveshaft, tap on the top of the shaft with a lead hammer until the bearings are free. **Do not drop the shaft when performing this operation.**



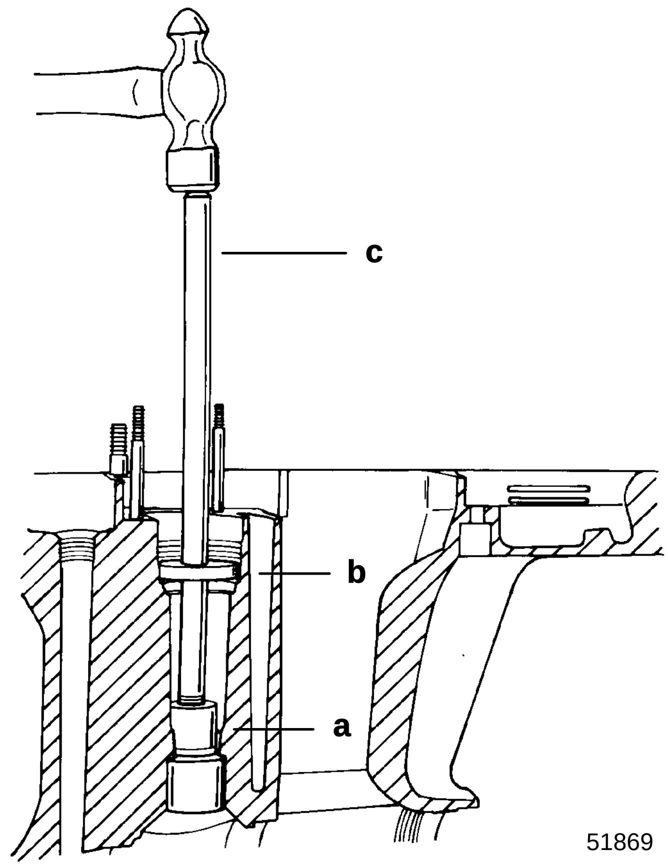
a - Lower Bearing Cup Removed from Gear Case
b - Driveshaft with Both Upper and Lower Bearings

13. Remove 18 loose needles from outer race of driveshaft needle bearing.

14. If inspection of driveshaft needle bearing surface determines that replacement of needle bearing is required, the 18 loose needle bearings previously removed must be reinstalled in bearing race to provide surface for mandrel to drive against.

NOTE: *Reverse gear must be removed first before removing driveshaft needle bearing.*

IMPORTANT: Discard driveshaft needle bearing after removal. (Bearing cannot be reused.)



51869

a - Mandrel (91-37263)
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)

*From Bearing Removal and Installation Kit (91-31229A5)

CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air. DO NOT allow driveshaft bearing to spin while drying.

2. Inspect pinion gear for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace pinion gear, if any of the above conditions are found.

3. Inspect driveshaft needle bearing surface (area just above pinion gear splines) for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace driveshaft and driveshaft needle bearing, if any of the preceding conditions are found.
4. Inspect driveshaft to crankshaft splines for wear. Replace driveshaft if wear is excessive.
5. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing and race as a set, if any of the preceding conditions are found.
6. Inspect driveshaft for groove(s) where water pump base oil seals contact shaft. Replace driveshaft if groove(s) are found.

Reverse Gear

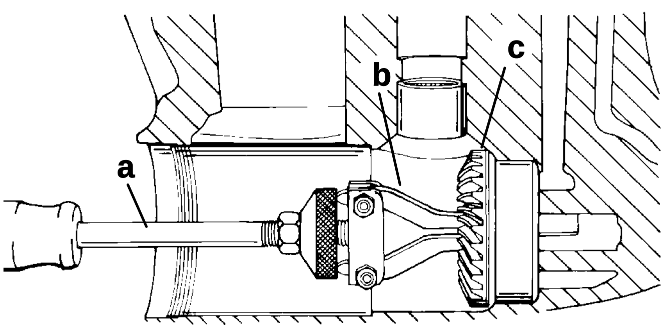
REMOVAL AND DISASSEMBLY

NOTE: *Reverse gear can be removed from gear housing only after driveshaft and pinion gear have been removed.*

NOTE: *Cautiously applying heat to both sides of gearcase where reverse gear assembly is located will aid in removal of reverse gear assembly and bearing cup adapter.*

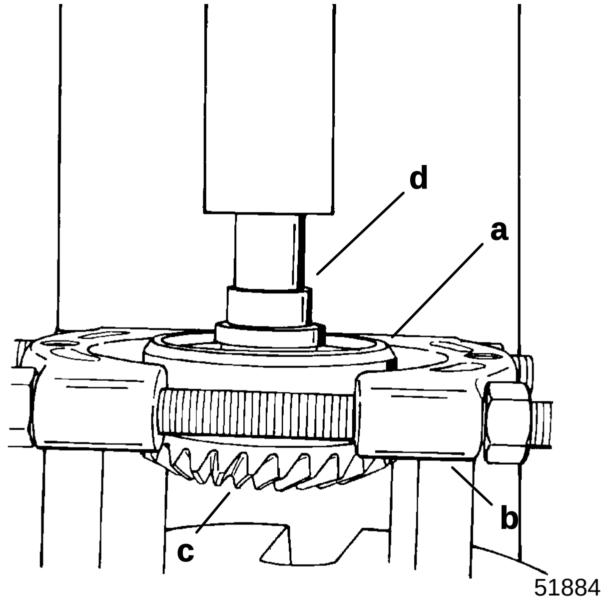
1. Use a slide hammer and two-jaw puller to remove reverse gear bearing assembly.

IMPORTANT: DO NOT remove ball bearing or needle bearing from reverse gear unless replacement of bearings is required. Bearings cannot be reused after they have been removed.



a - Slide Hammer
b - Two-Jaw Puller
c - Reverse Gear Bearing Assembly

2. If inspection determines that replacement of reverse gear ball bearing is required, then:
   a. Install Universal Puller Plate (91-37241) between reverse gear and ball bearing.
   b. Place reverse gear, bearing and puller plate on a press and press gear out of bearing using a suitable mandrel.



a - Reverse Gear Ball Bearing
b - Universal Puller Plate
c - Reverse Gear
d - Mandrel

3. If inspection determines that replacement of propeller shaft needle bearing in REVERSE gear is required, place REVERSE gear in press and use mandrel 91-36569 to press bearing out of gear.

CLEANING AND INSPECTION

⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean reverse gear and bearing with solvent and dry with compressed air.
2. Inspect gear teeth for pitting, grooves, scoring, uneven wear and for discoloration (from overheating). Replace gear if any of these conditions are found.
3. Check clutch jaws on reverse gear for damage. Replace reverse gear if damage is found.
4. Inspect ball bearing race for pitting, grooves, scoring, uneven wear and discoloration (from overheating). Replace ball bearing (on reverse gear) if any of these conditions are found.
5. To determine condition of propeller shaft needle bearings (in reverse gear), inspect propeller shaft reverse gear needle bearing surface as outlined in "Propeller Shaft Inspection."

IMPORTANT: Removing reverse gear assembly from gearcase with slide hammer may damage reverse gear needle bearing.

Gear Housing

CLEANING AND INSPECTION

1. Clean gear housing with solvent and dry with compressed air.
2. Check gear housing carefully for impact damage.
3. Check for loose fitting bearing cups and needle bearings.
4. Inspect bearing carrier cover nut retainer threads in gear housing for corrosion damage and/or stripped threads.

Reassembly and Installation of Counter Rotation Gear Housing

Driveshaft Needle Bearing

REASSEMBLY/INSTALLATION

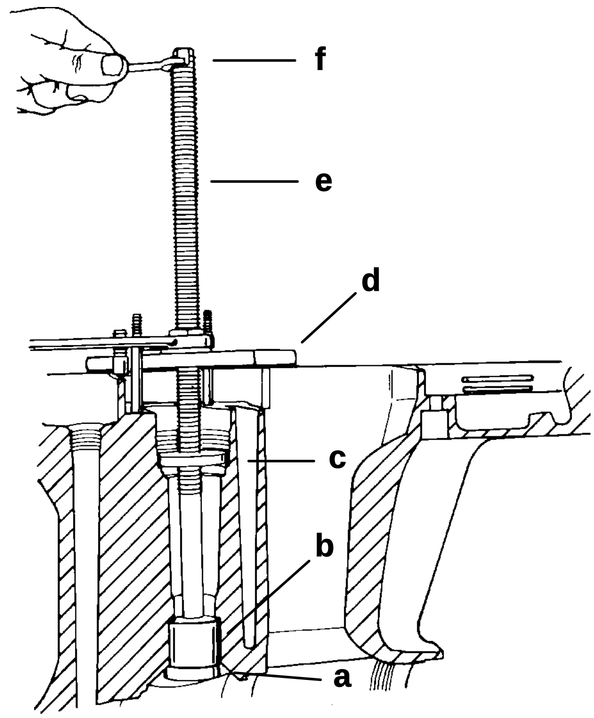
⚠ CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing must be replaced. Loose fitting needle bearing will move out of position and cause repeated failures.

NOTE: *Driveshaft needle bearing must be installed prior to installation of reverse gear.*

1. Apply a thin coat of Quicksilver Needle Bearing Assembly Lubricant to driveshaft needle bearing bore in gear housing.
2. By way of propeller shaft cavity, place needle bearing in driveshaft bore with numbered side of bearing facing up driveshaft bore.
3. Install and seat needle bearing with the following tools: Puller Rod* (91-31229), Nut* (91-24156), Pilot* (91-36571), Plate* (91-29310), and Mandrel* (91-92788). Pull bearing up into bore until it bottoms on gear housing shoulder. (DO NOT use excessive force.)

*From Bearing Removal and Installation Kit (91-31229A5)



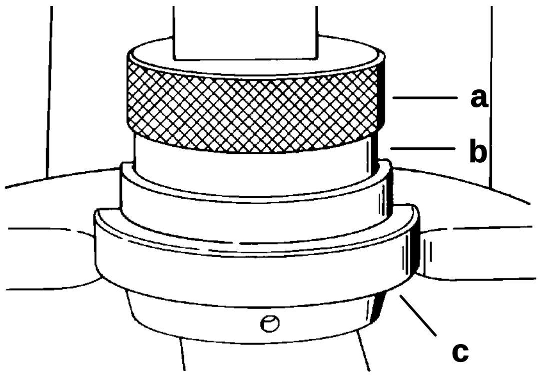
51869

a - Mandrel
b - Bearing
c - Pilot
d - Plate
e - Puller Rod
f - Hold

Bearing Carrier, Forward Gear and Bearing Adaptor

REASSEMBLY

1. Using Installation Tool (91-18601), press forward gear bearing into bearing adaptor until bearing is flush with lip of adaptor.



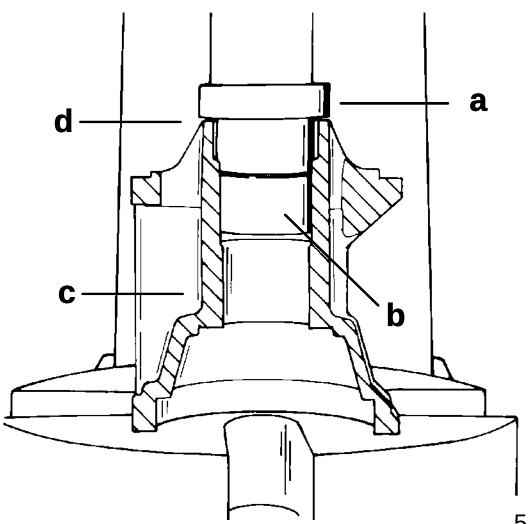
51880

a - Installation Tool
b - Forward Gear Bearing
c - Bearing Adaptor

PROPELLER SHAFT NEEDLE ROLLER BEARING AND OIL SEAL INSTALLATION

1. Using mandrel 91-15755, press bearing carrier needle bearing (number side up) into bearing carrier until mandrel shoulder contacts bearing carrier.

NOTE: *Sport Master models use Mandrel 91-816292 to install bearing carrier needle bearing. Install snap ring above needle bearing to retain bearing.*



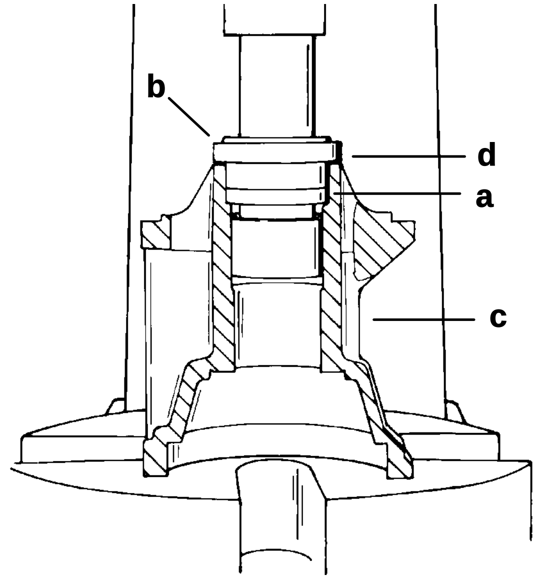
51881

a - Mandrel (91-15755)
b - Bearing Carrier Needle Bearing
c - Bearing Carrier
d - Shoulder

2. Apply Loctite 271 (92-32609-1) to outside diameter of oil seals.

3. With seal lip facing towards bearing, press inner seal (a) using long end of mandrel (b) (91-31108) into bearing carrier (c) until mandrel shoulder (d) bottoms out on bearing carrier.

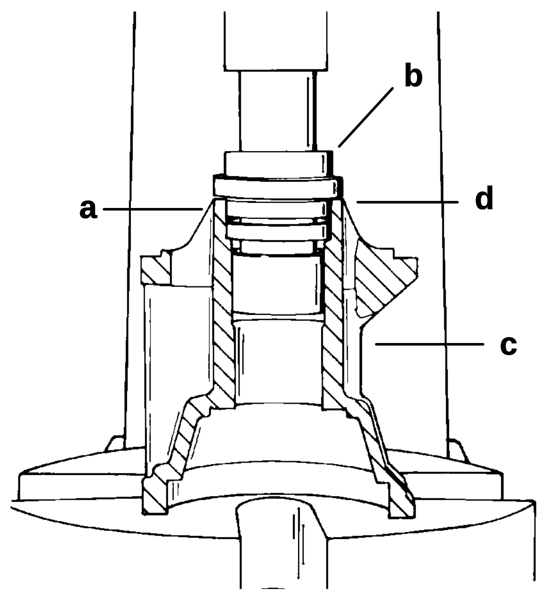
NOTE: *Sport Master gear cases use Driver 91-816294 to install oil seals in bearing carrier.*



51881

a - Inner Seal
b - Mandrel (91-31108)
c - Bearing Carrier
d - Mandrel Shoulder

4. With seal lip facing towards mandrel, press outer seal (a) using short end of mandrel (b) (91-31108) into bearing carrier (c) until mandrel shoulder (d) bottoms out on bearing carrier.



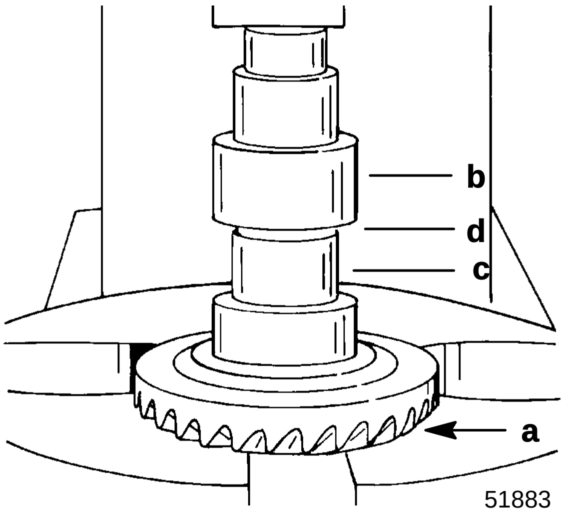
51881

a - Outer Seal
b - Mandrel (91-31108)
c - Bearing Carrier
d - Mandrel Shoulder

5. Lubricate both seal lips with 2-4-C w/Teflon Marine Lubricant (92-9001 8A12) .

REVERSE GEAR AND BEARING CUP ADAPTOR REASSEMBLY

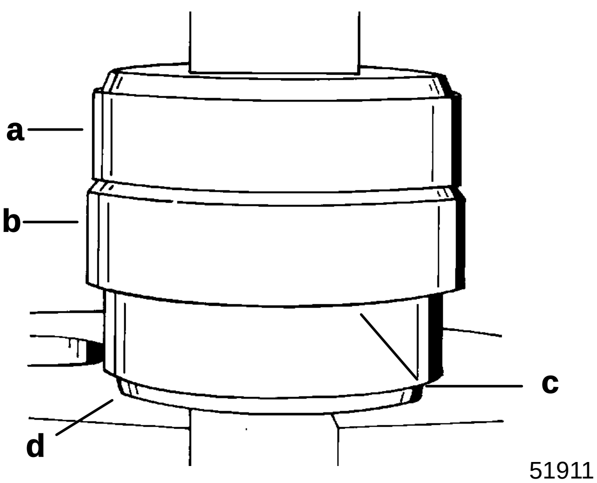
1. With reverse gear teeth facing down, use mandrel (91-86943) to press propeller shaft needle bearing (NUMBERS/LETTERS UP) into reverse gear until short shoulder on mandrel bottoms on reverse gear.



a - Reverse Gear Teeth
b - Mandrel (91-86943)
c - Propeller Shaft Needle Bearing
d - Shoulder

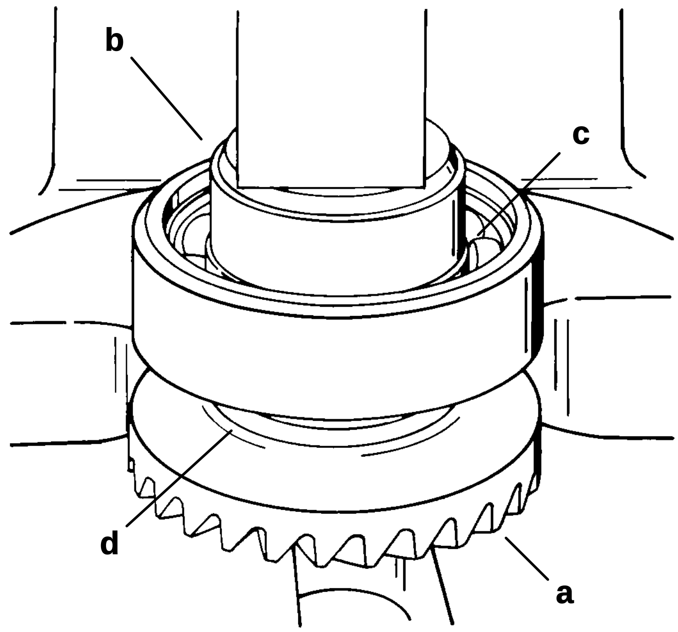
NOTE: *If gear housing has been replaced or inspection determines that reverse gear bearing adapter must be replaced, assemble and install as follows:*

2. Place reverse gear ball bearing (NUMBER/LETTERS UP) on top of mandrel 91-31106. Using suitable mandrel, press bearing cup adapter onto reverse gear bearing. The purpose of mandrel 91-31106 is to ensure that reverse gear ball bearing is fully seated into bearing cup adapter.



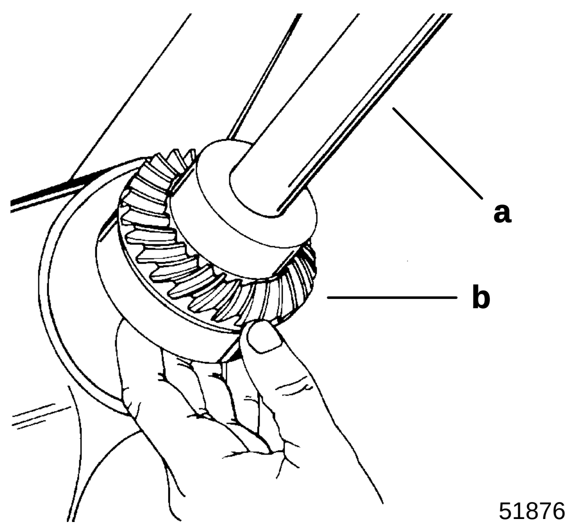
a - Mandrel
b - Bearing Cup Adapter
c - Reverse Gear Ball Bearing
d - Mandrel (91-31106)

3. With reverse gear teeth facing down, use a suitable mandrel which contacts the INNER RACE DIAMETER of the reverse gear ball bearing, to press bearing and adapter onto reverse gear until the bearing seats against gear shoulder.



a - Reverse Gear Teeth
b - Mandrel
c - Inner Race Diameter
d - Shoulder

4. With Driver Tool (91-18605) installed in reverse gear assembly, place entire assembly into gear case.

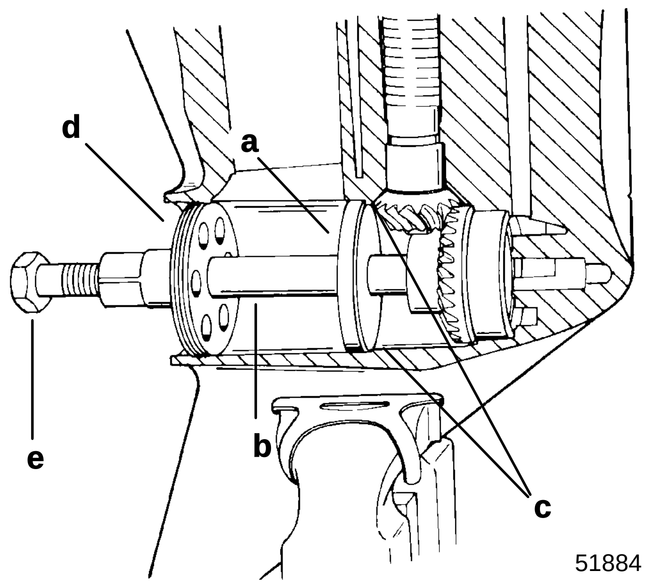


a - Driver Tool (91-18605)
b - Reverse Gear Assembly

5. Install pilot ring (91-18603) over driver tool (91-18605) and seat pilot ring in gearcase against inner ledge. Thread retainer (91-18604) into bearing carrier threads. Install screw (10-18602) into retainer and gently tighten screw against driver

tool while holding retainer securely. Continue to apply pressure against driver rod until reverse gear/bearing cup adaptor JUST SEATS in gearcase. DO NOT OVER-SEAT the adaptor as the reverse gear bearing will be damaged.

NOTE: *As Bearing Cup Adaptor begins to seat, the effort required to turn screw will increase considerably.*



a - Pilot Ring (91-18603)
b - Driver Tool (91-18605)
c - Inner Ledge
d - Retainer (91-18604)
e - Screw (10-18602)

Driveshaft and Pinion Gear

REASSEMBLY/INSTALLATION

1. Apply a light coat of Quicksilver Heavy Duty Gear Lubricant on I.D. of driveshaft tapered bearing. **Sport Master only -** Apply High Pressure Grease (such as Chicago Manufacturing and Distributing Lube #3) to the O.D. of both bearings.
2. Thread a used pinion nut onto end of driveshaft. Leave approximately 1/16² (2mm) of nut threads exposed. Driveshaft threads MUST NOT extend beyond nut or thread damage could result while pressing.
3. Place bearing over driveshaft. **Sport Master only -** Both bearings can be installed on the driveshaft in one operation. Place the smaller bottom bearing over the driveshaft with the numbers on the bearing facing the top of the shaft. Place the larger top bearing exactly opposite by having the numbers facing the pinion end of the shaft. While holding bearings in place, invert the driveshaft and place assembly in a press.
4. Using an old driveshaft bearing inner race or other suitable mandrel (which applies pressing force on center bearing race only), press bearing onto shaft until seated.

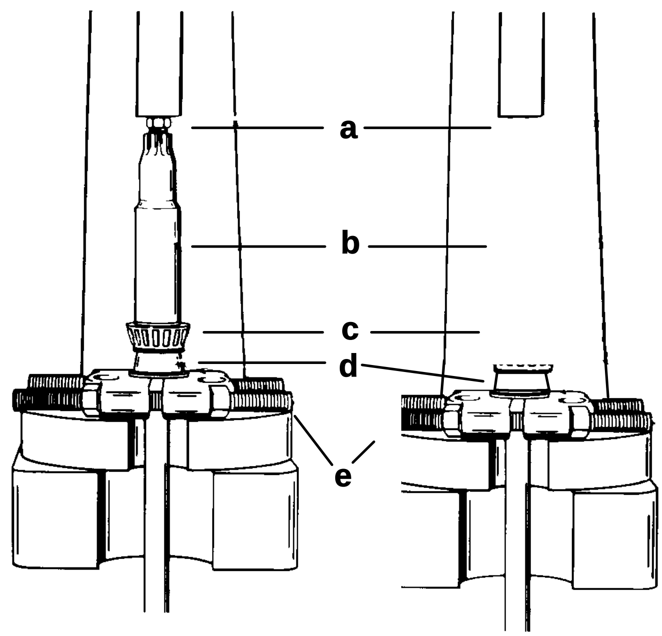
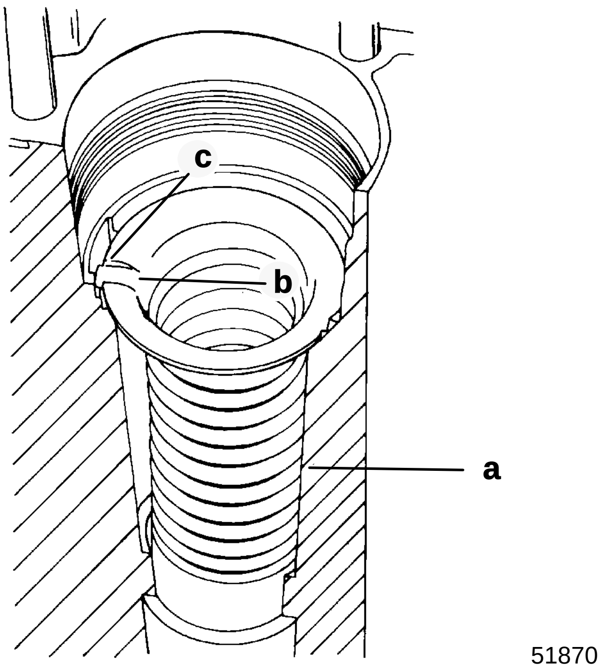


Illustration on Left is for all gear cases except Sport Master. Right illustration is for Sport Master

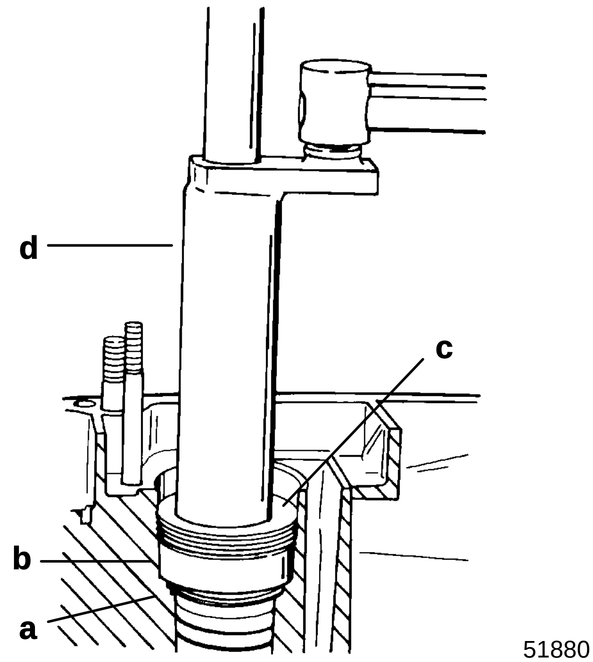
a - Used Pinion Nut
b - Driveshaft
c - Tapered Bearing(s)
d - Old Bearing Inner Race
e - Universal Puller Plate

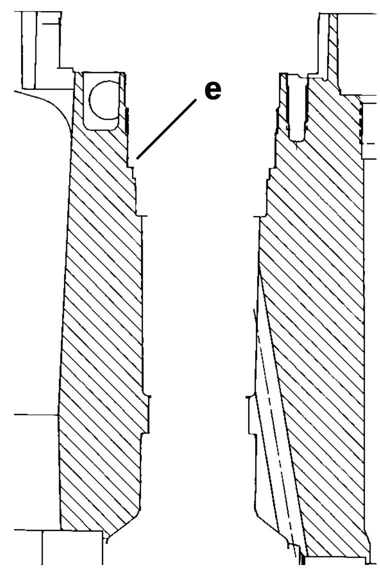
5. Position lubrication sleeve (if equipped) in drive-shaft bore.



a - Lubrication Sleeve
b - Tab (MUST align with slot)
c - Slot

6. **Sport Master only: Do not** install lower bearing cup shims or cup at this time. Lower cup and shims coud interfer in achieving an accurate pinion height.
7. Position pinion gear in gear housing below drive-shaft bore with teeth of pinion gear meshed with teeth of reverse gear.
8. Insert driveshaft into driveshaft bore while holding pinion gear. Rotate driveshaft to align and engage driveshaft splines with pinion gear splines. Continue to insert driveshaft into gear housing until driveshaft tapered bearing is against bearing race.
9. Place a small amount of Loctite 271 onto threads of pinion gear nut and install flat washer and nut on driveshaft with flat side of nut away from pinion gear. Hand tighten pinion nut.
10. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or are not reusable (damaged), start with approximately 0.010² (0.254mm).
11. Install bearing race and bearing retainer.

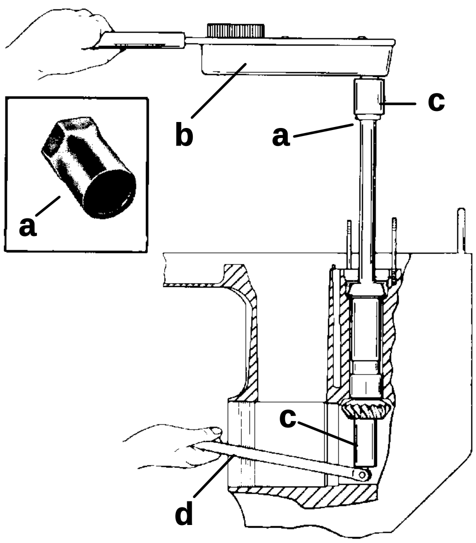




a - Shim(s)
b - Bearing Race
c - Bearing Retainer (Word "OFF" must be visible); Torque to 100 lb. ft. (135.5 N·m)
d - Bearing Retainer Tool (91-43506)
e - Sport Master Gear Case Upper Bearing Shim Location

12. Use a socket and flex handle to hold pinion nut (pad area where flex handle will contact gear housing while torquing nut).

13. Place Driveshaft Holding Tool (91-34377A1) over crankshaft end of driveshaft. Torque pinion nut to 75 lb. ft. (101.5 N·m). For Sportmaster gearcases, torque pinion nut to 85 lb. ft. (115.0 N·m).



a - Driveshaft Holding Tool (91-34377A1)
b - Torque Wrench; Torque Nut to 75 lb. ft. (101.5 N·m); 85 lb. ft. (115.0 N·m) for Torquemaster
c - Socket
d - Breaker Bar

IMPORTANT: Wipe any excess Loctite from pinion nut and pinion gear.

Pinion Gear Depth

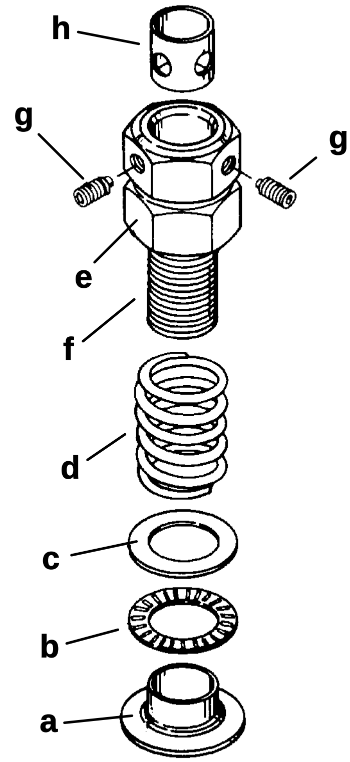
DETERMINING PINION GEAR DEPTH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Reverse gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

1. Clean gear housing bearing carrier shoulder.
2. Install Bearing Preload Tool (91-14311A1) over driveshaft in sequence shown.

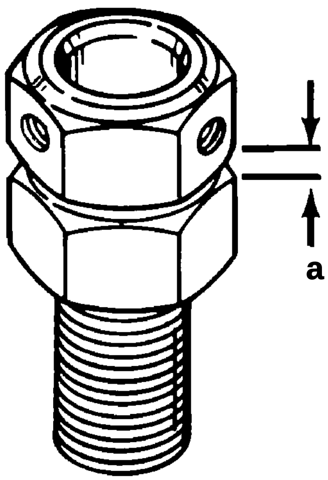
NOTE: *Bearing Preload Tool (91-44307A1) may also be used. Follow instructions provided with tool for proper installation.*

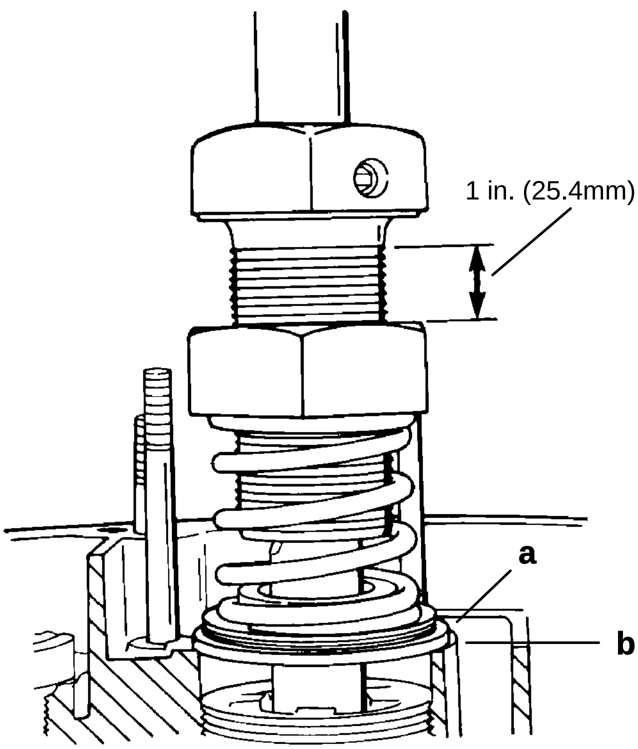


a - Adaptor
b - Bearing
c - Washer
d - Spring
e - Nut; Thread Nut All-The-Way Onto Bolt
f - Bolt
g - Set Screw
h - Sleeve; Holes in Sleeve Must Align With Set Screws

3. Align adaptor on driveshaft bearing pocket ledge.
4. With tool installed over driveshaft, tighten both set screws securely, making certain to align sleeve holes to allow set screws to pass thru.

5. Measure distance (a) and increase that distance by 1^2 (25.4mm) by turning bottom nut away from top nut.





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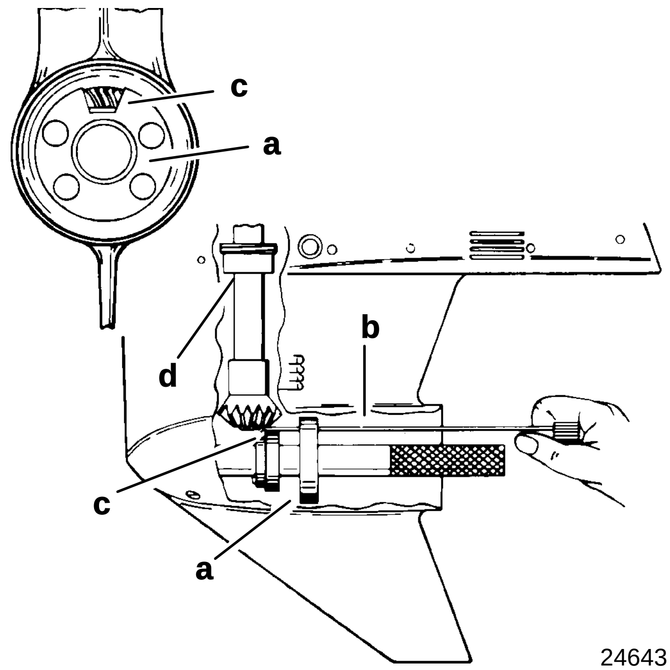
a - Adaptor
b - Ledge

6. Turn driveshaft clockwise 2 or more turns to seat driveshaft bearings.
7. Insert Pinion Gear Locating Tool* (91-74776) into gear housing until it bottoms out on bearing carrier shoulder.

*Pinion Gear Locating Tool (91-12349A2) can be used. Use flat #7 and disc #2. Follow instructions supplied with tool.

8. Determine pinion gear depth by inserting a feeler gauge thru access slot in pinion gear shimming tool.
9. Clearance between shimming tool and pinion gear should be 0.025^2 (0.64mm).
10. If clearance is correct, leave Bearing Preload Tool on driveshaft for **"Determining Forward Gear Backlash,"** following.
11. If clearance is not correct, add (or subtract) shims at location shown to raise (or lower) pinion gear. When reinstalling pinion nut, apply Loctite 271 on threads of nut and re-torque pinion nut.



24643

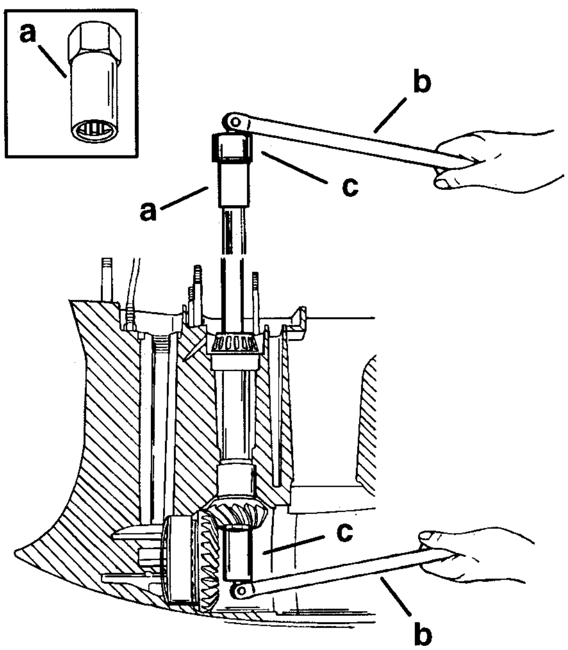
a - Pinion Gear Shimming Tool (91-74776 or 91-12349A2)
b - Feeler Gauge
c - Obtain 0.025^2 (0.64mm) Clearance between Shimming Tool and Pinion Gear
d - Add or Subtract Shim(s) Here

NOTE: *Bearing Preload Tool (91-14311A1) should remain installed on driveshaft after setting pinion gear depth as it is required to properly check forward gear and reverse gear backlash. However, if rebuilder wants to set driveshaft end play next, the preload tool will need to be removed.*

SETTING/CHECKING DRIVESHAFT END PLAY (SPORT MASTER ONLY)

1. With pinion height set in previous step, remove the preload tool from the driveshaft.
2. Remove the upper bearing cup retainer with tool 91-43506, and remove cup [leave upper cup shim(s) in place].

3. Place Driveshaft Holding Tool (91-34377A1) over crankshaft end of driveshaft. Use a socket and breaker bar to hold pinion nut and remove the pinion nut, washer, pinion gear and driveshaft.



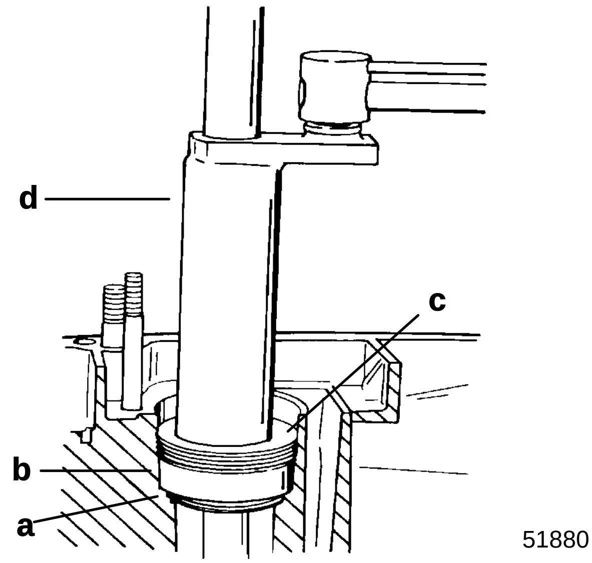
a - Driveshaft Holding Tool (91-34377A1)
b - Breaker Bar
c - Socket

NOTE: *Do not install any shims below lower bearing cup at initial installation.*

4. Apply High Pressure Grease (such as Chicago Manufacturing and Distributing Lube #3) to the O.D. of the driveshaft lower bearing cup and install cup into the gear case.

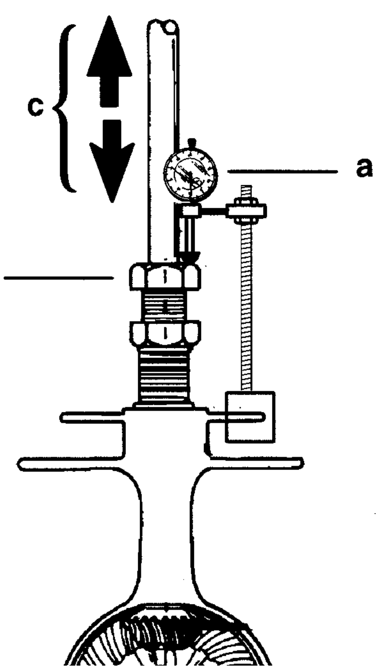
5. Reinstall driveshaft assembly into gear case. It is not necessary to reinstall the pinion gear for this procedure.

6. Install the upper driveshaft bearing cup and install and torque the upper bearing retainer to 100 lb. ft. (135.5 N·m).



a - Shim(s)
b - Upper Bearing Race
c - Bearing Retainer (Word "OFF" must be visible) Torque to 100 lb. ft. (135.5 N·m)
d - Bearing Retainer Tool (91-43506)

7. Install the adjustable nut part of the pre-load tool (with the set screws) onto the driveshaft to use as a surface for checking driveshaft end play. Tighten set screws and position a dial indicator so that dial indicator arm touches the top surface of the upper nut.



a - Dial Indicator Touching Top of Preload Tool
b - Nut Portion of Preload Tool
c - Move Driveshaft UP and DOWN to Determine End Play

8. Move driveshaft up and down to determine end play. Total up and down movement should be 0.00″ to 0.001″ (0.025mm). There should be no preload on the bearing and the driveshaft must rotate freely.

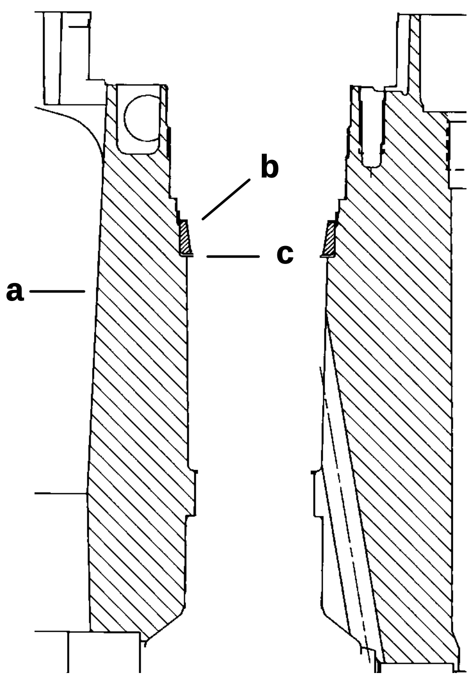
NOTE: *DO NOT change shims under upper bearing cup or pinion height will be changed.*

9. Maintain the shims as previously set under the upper driveshaft bearing cup.

10. Remove the upper bearing cup retainer with tool 91-43506, and remove cup [leave upper cup shim(s) in place].

NOTE: *A 0.001″ (.025mm) change of shims under the lower bearing cup will result in a 0.001″ (0.025mm) change in driveshaft end play.*

11. Place driveshaft end play shim(s), determined from step 8, into gear housing and reinstall the lower bearing cup.



a - Driveshaft Housing
b - Lower Driveshaft Bearing Cup
c - Location of Driveshaft End Play Shims

12. Clean threads of driveshaft and apply Loctite #271.

13. Apply gear oil to all bearing surfaces and install driveshaft assembly, upper bearing cup and retainer into the gear case. Tighten upper cup retainer to a torque of 100 lb. ft. (135.5 N·m).

NOTE: *If reverse gear backlash has not yet been determined, do not use a new pinion nut until final assembly.*

14. Apply #271 Loctite to a **NEW** pinion nut and install the pinion gear, washer and nut using procedures detailed earlier in this section. Tighten pinion nut to a torque of 85 lb. ft. (115 N·m).

15. Rotate driveshaft a few turns to verify that it turns freely and recheck driveshaft end play.

Reverse Gear

DETERMINING REVERSE GEAR BACKLASH

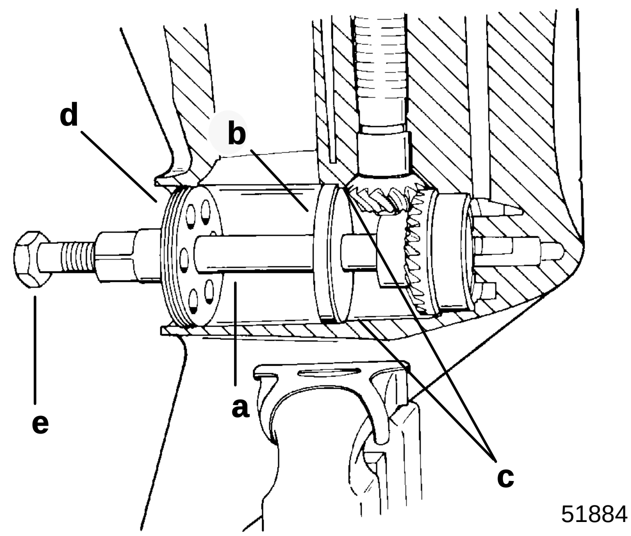
NOTE: *Although reverse gear backlash is not adjustable, it can be checked as follows:*

1. Install Driver Tool (91-18605) into reverse gear assembly.

2. Slide Pilot Ring (91-18603) over driver tool and seat pilot ring against inner ledge in gear case.

3. Thread Retainer (91-18604) into gear case cover nut threads.

4. Torque Screw (91-18602) to 45 lb. in. (5.0 N·m) against driver tool.



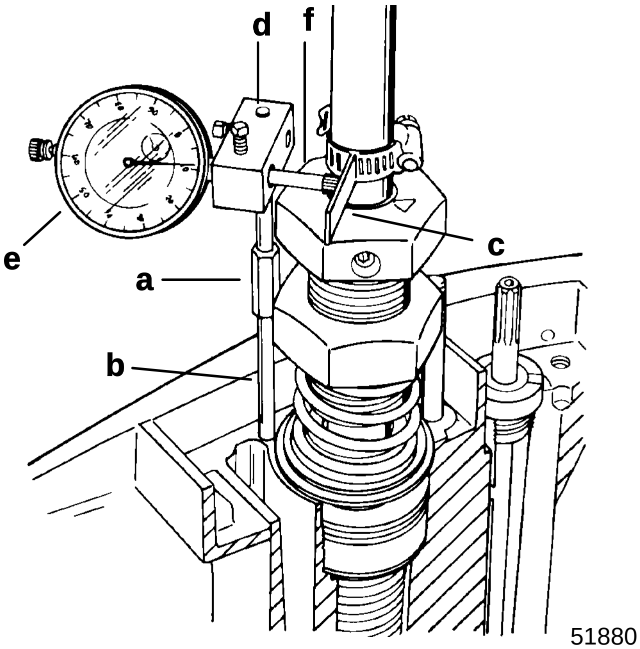
a - Driver Tool (91-18605)
b - Pilot Ring (91-18603)
c - Inner Ledge
d - Retainer (91-18604)
e - Screw (91-18602) [Torque to 45 lb. in. (5.0 N·m)]

5. Thread stud adapter [from Bearing Preload Tool (91-14311A1)] all the way onto stud.

6. Install: Backlash Indicator Tool (91-78473)
Dial Indicator Holder (91-89897)
Dial Indicator (91-58222A1)

7. Position dial indicator pointer on line marked "1" on Backlash Indicator Tool, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked "2" on Backlash Indicator Tool, if gear ratio is 2:1 (14 teeth on pinion gear).

8. Lightly turn driveshaft back-and-forth (no movement should occur at propeller shaft).
9. Dial Indicator registers amount of backlash, which should be 0.030" to 0.050" (0.76mm to 1.27mm).



51880

a - Stud Adaptor (from 91-14311A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)
f - Dial Indicator Pointer

NOTE: *If reverse gear backlash is not within specifications, then gear case is not properly assembled or component(s) within gear case are excessively worn and must be replaced before returning gear case to service.*

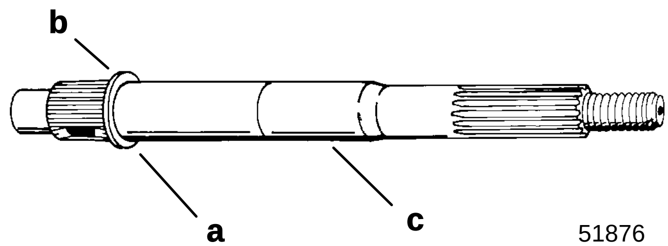
10. Remove Driver Tool, Pilot Ring, Retainer and Screw from gear case.

Forward Gear

DETERMINING FORWARD GEAR BACKLASH

NOTE: *Propeller Shaft 44-93003 is for used for checking forward gear backlash only. Propeller shaft will be removed after adjustments have been made.*

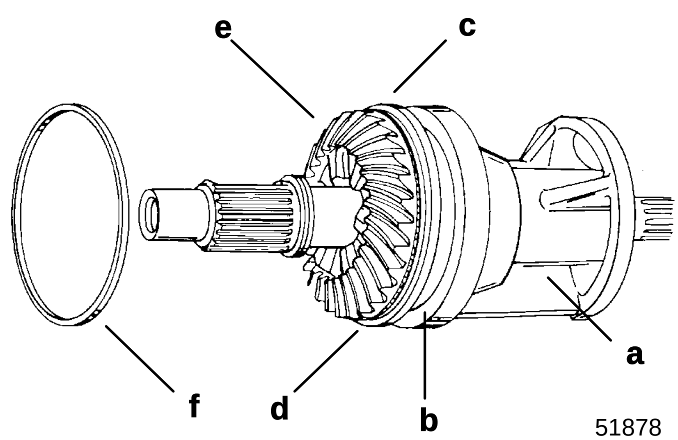
1. Install a load washer (12-37429) over a 44-93003 propeller shaft so that it seats against the REAR shoulder of the clutch spline teeth.



51876

a - Load Washer (12-37429)
b - Shoulder
c - Propeller Shaft (44-93003)

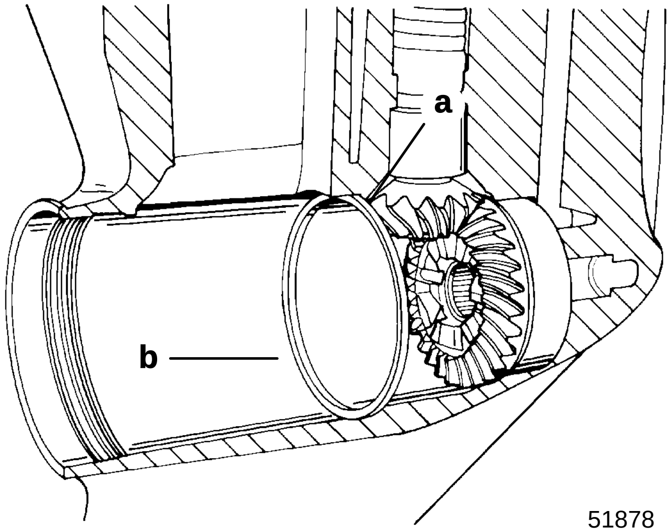
2. Assemble BEARING CARRIER, BEARING ADAPTOR, THRUST WASHER, THRUST BEARING, and FORWARD GEAR onto propeller shaft.



51878

a - Bearing Carrier
b - Bearing Adaptor
c - Thrust Washer
d - Thrust Bearing
e - Forward Gear
f - Shim (PLACE IN GEARCASE FIRST)

3. Position shim against shoulder in gear case.



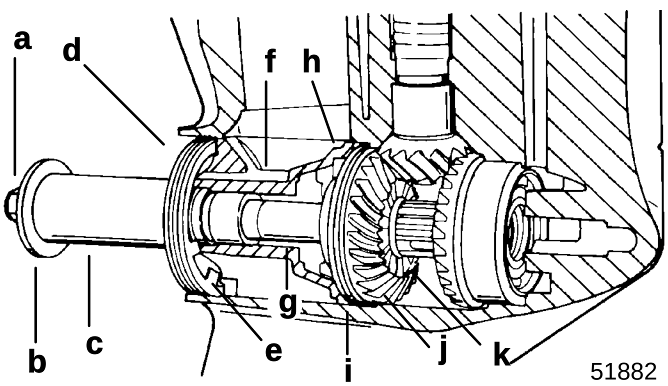
51878

a - Shoulder
b - Shim

4. Insert entire propeller assembly into gear case.
5. Install tab washer and cover nut. Torque cover nut to 100 lb. ft. (135.5 N·m) to seat forward gear assembly in gear case.

NOTE: *Drill a 3/8^2 (22.2mm) diameter hole through the side (PROPELLER NUT END) of a 5^2 x 2^2 (127mm x 50.8mm) long piece of PVC pipe. A screwdriver may be inserted thru pipe into propeller shaft splines to prevent PVC pipe from turning while tightening retaining nut.*

6. Install a 5^2 x 2^2 (127mm x 50.8mm) long piece of PVC pipe (obtain locally) over propeller shaft and secure it against the bearing carrier with a flat washer and nut.



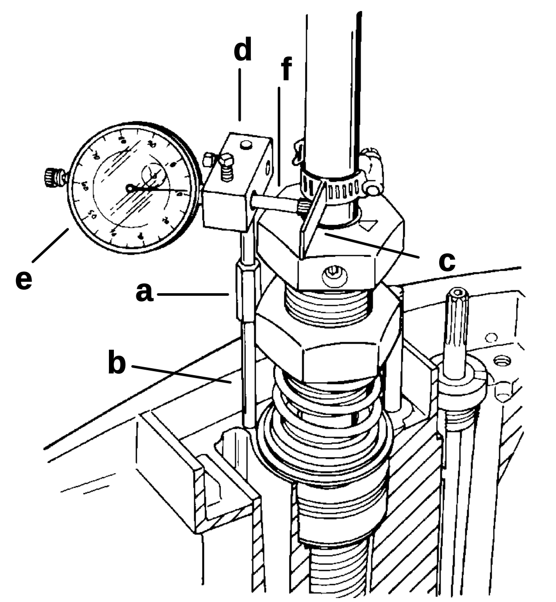
51882

a - Prop Nut
b - Flat Washer
c - PVC Pipe [5^2 x 2^2 (127mm x 50.8mm)]
d - Cover Nut
e - Tab Washer
f - Bearing Carrier
g - Prop Shaft
h - Bearing Adaptor
i - Shim
j - Forward Gear
k - Load Washer

7. Tighten nut to 45 lb. in. (5.0 N·m). This will seat the forward gear against the forward thrust bearing and tends to hold the propeller shaft from moving when measuring backlash.

NOTE: *Bearing Preload Tool (91-44307A1) should still be installed from having previously been used to determine pinion gear depth and reverse gear backlash. If it is not still installed on gear case, refer to* ***"DETERMINING PINION GEAR DEPTH,"*** *previously, for proper installation procedure.*

8. With the proper preload applied to the propeller shaft and the driveshaft, rotate the driveshaft clockwise 5 to 10 complete revolutions. This will seat the forward gear and upper driveshaft bearings and thus provide the most accurate backlash readings.
9. If not previously installed:
   a. Thread stud adaptor [from Bearing Preload Tool (91-44307A1)] all the way onto stud.
   b. Install: Backlash Indicator Tool (91-78473)
   Dial Indicator Holder (91-89897)
   Dial Indicator (91-58222A1)
10. Position dial indicator pointer on line marked "1" on BACKLASH INDICATOR TOOL, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked "2" on BACKLASH INDICATOR TOOL, if gear ratio is 2:1 (14 teeth on pinion gear).



51880

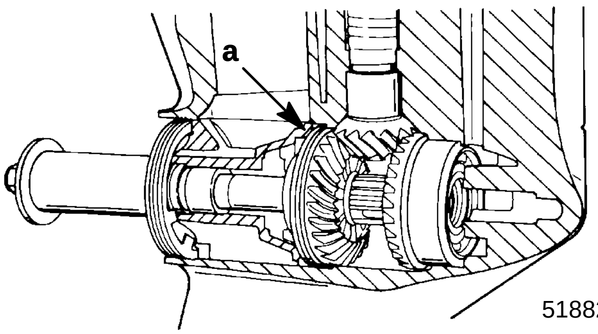
a - Stud Adaptor (from 91-44307A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)
f - Dial Indicator Pointer

11. Gently rock driveshaft back and forth to determine forward gear backlash.

ENGINE MODEL	GEAR CASE & RATIO	BACK-LASH (INCHES)	BACK-LASH (METRIC)
175/200	Production 1.87:1	.018-.027	.46-.69mm
225 Pro Max/Super Magnum	Sport Master 1.87:1	.021-.026	.53-.66mm
135/150	Production 2.00:1	.015-.022	.38-.56mm

12. If backlash is less than the specifications, then a larger shim should be installed. Conversely, if the backlash indicated is greater than specifications, then a smaller shim should be installed.

NOTE: *By adding or subtracting 0.002^2 (0.051 mm) shim, the backlash will change approximately 0.002^2 (0.051 mm).*



51882

a - Shim

13. If forward gear backlash is within specifications, then Bearing Preload Tool, Dial Indicator, Backlash Indicator Tool/Dial Indicator Holder, PVC pipe, forward gear assembly, bearing adaptor, bearing carrier and test propeller shaft can all be removed from the gear case.

Propeller Shaft/Forward Gear Bearing Adapter/Bearing Carrier

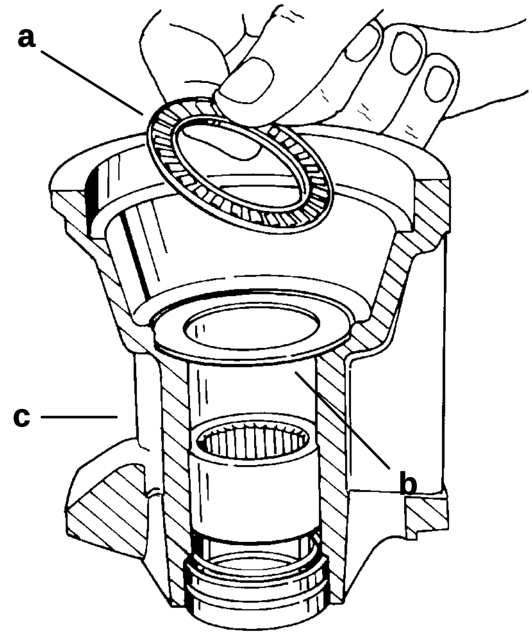
REASSEMBLY

NOTE: *Applying a light coat of 2-4-C w/Teflon Marine Lubricant (92-90018A12) to the surfaces of both thrust washers and thrust bearings will aid in keeping them in place during assembly of bearing carrier into gear case.*

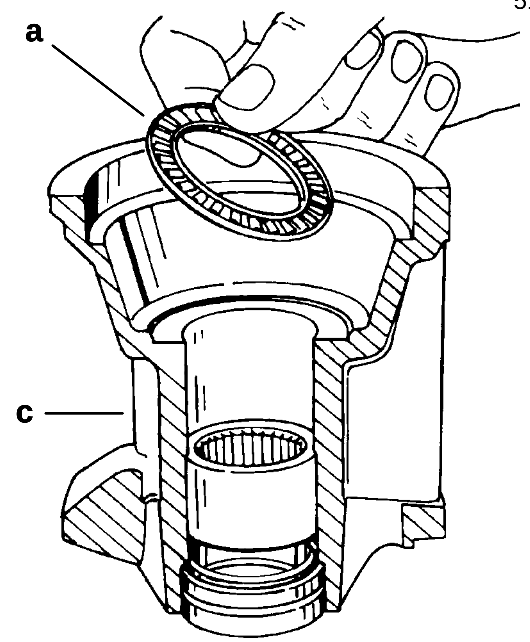
1. Install thrust bearing and thrust washer into bearing carrier.
   Sport Master Gear Cases - Install thrust bearing (no thrust washer) into bearing carrier with the smooth surface (back) of the bearing against the bearing carrier.

⚠ CAUTION

Sport Master Gear Cases - Thrust bearing must be installed with the smooth surface (back) against the bearing carrier or sever damage will occur.



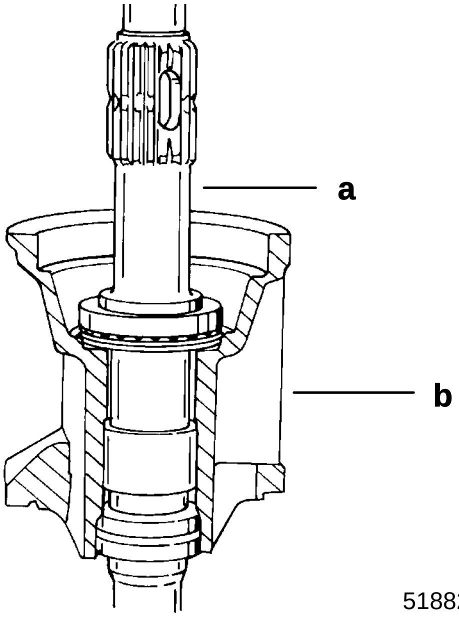
51886



Top illustration: Production Gear Cases.
Bottom illustration: Sport Master gear cases.

a - Thrust Bearing
b - Thrust Washer (Not Used in Sport Master Gear Cases)
c - Bearing Carrier

2. Install propeller shaft into bearing carrier.



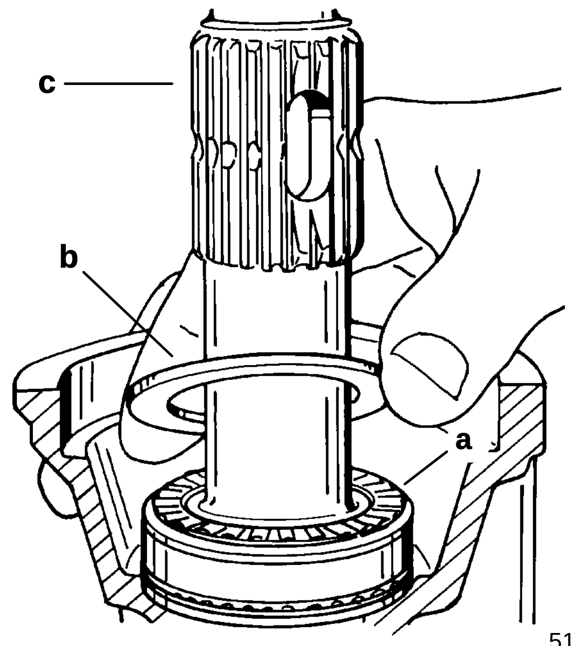
51882

a - Propeller Shaft
b - Bearing Carrier

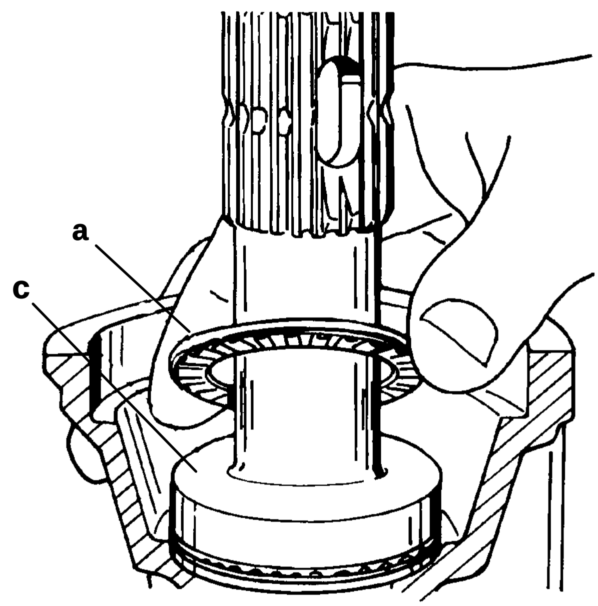
⚠ CAUTION

On Sport Master gear cases, the thrust bearing installed in the following step must be installed with the bearing rollers against the flange of the prop shaft or sever damage will occur.

3. Install thrust bearing and thrust washer onto propeller shaft.
   Sport Master Gear Cases - Install thrust bearing onto propeller shaft with the bearing rollers against the flange of the prop shaft.



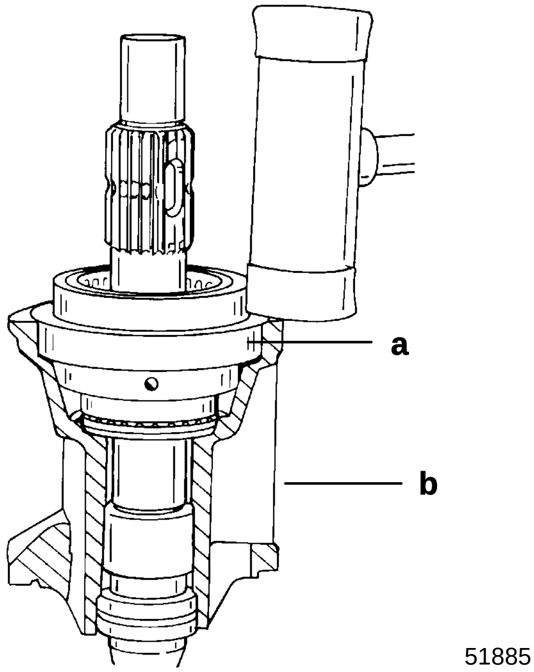
51913



Top illustration: Production Gear Cases
Bottom illustration: Sport Master Gear Case.

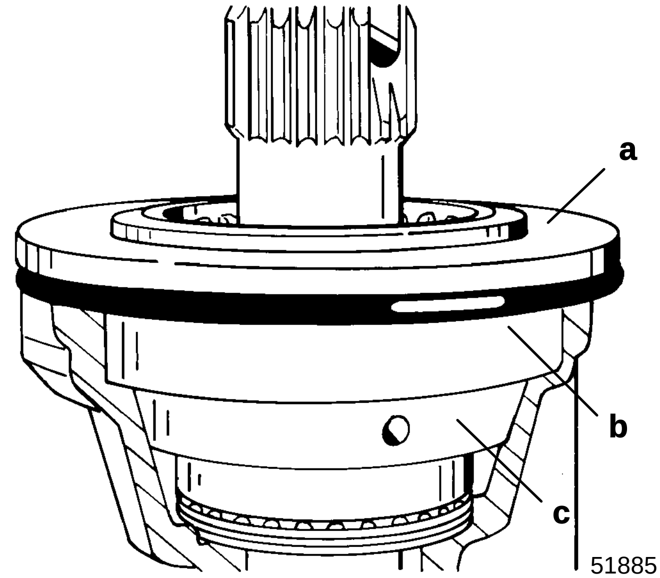
a - Thrust Bearing
b - Thrust Washer (Not Used in Sport Master Gear Case)
c - Propeller Shaft

4. Install forward gear bearing adaptor into bearing carrier. Tap gently around circumference of adaptor to seat adaptor into bearing carrier.



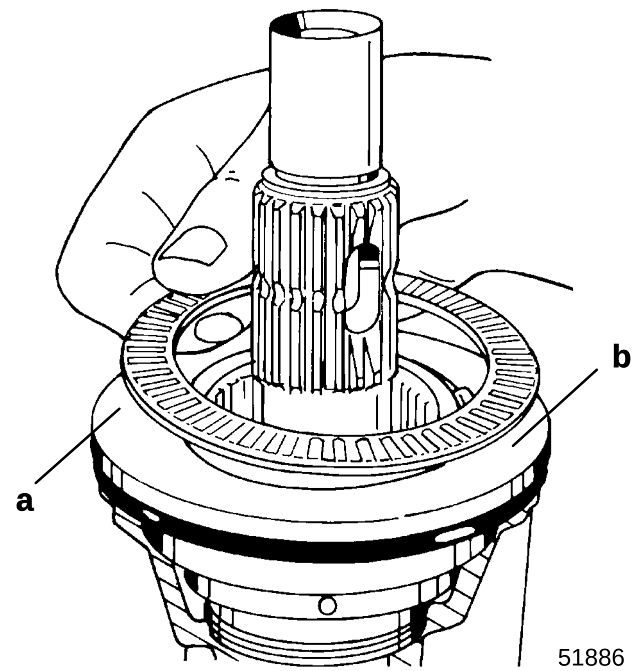
a - Forward Gear Bearing Adaptor
b - Bearing Carrier

5. Install thrust washer and O-ring onto bearing adaptor. Lubricate O-ring with 2-4-C w/Teflon Marine Lubricant (92-9001 8A1 2).



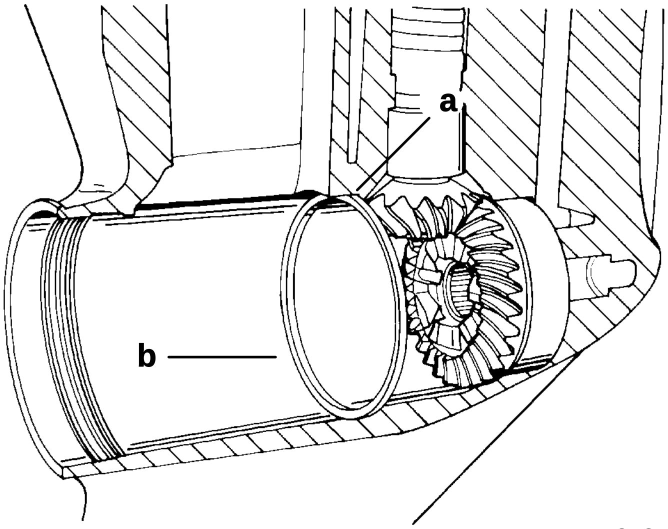
a - Thrust Washer
b - O-Ring
c - Bearing Adaptor

6. Install thrust bearing onto thrust washer.



a - Thrust Bearing
b - Thrust Washer

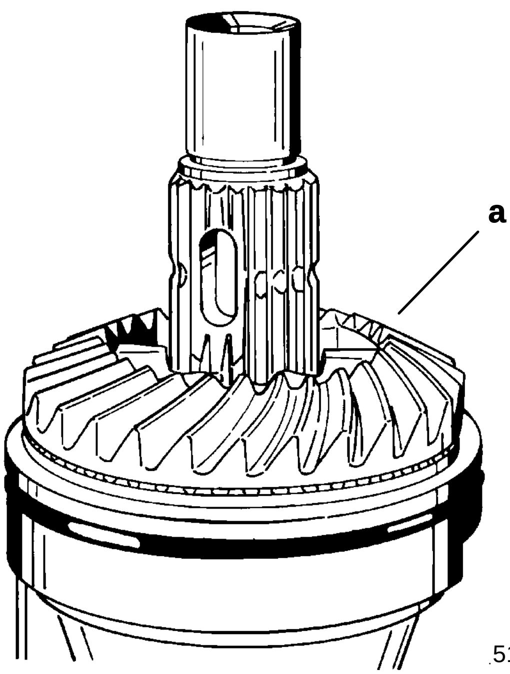
7. Position shim against shoulder in gear case.



51878

a - Shoulder
b - Shim

8. Install forward gear onto bearing adaptor.



51913

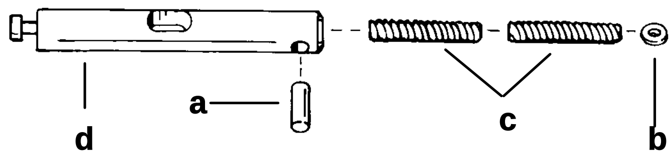
a - Forward Gear

Clutch Actuator Rod

REASSEMBLY/SHIMMING

1. Insert 2 compression springs into clutch actuator rod, followed by a shim washer.

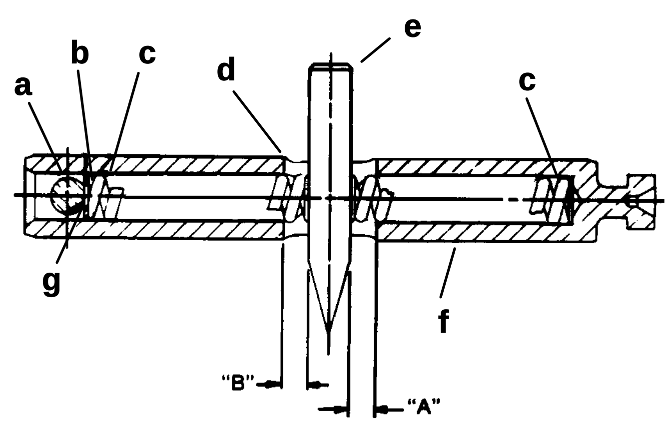
2. Place a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant on locating pin. Position pin in cross-hole in end of clutch actuator rod with flat side of pin toward shim washer.



51864

a - Locating Pin
b - Shim Washer(s)
c - Compression Springs
d - Clutch Actuator Rod

Clutch Actuator Rod Sub-Assembly Sequence



a - Spring Locating Pin
b - Shim Washer
c - Compression Spring
d - Elongated Slot
e - Cross Pin Tool (91-86642)
f - Clutch Actuator Rod
g - Shim Washer Must Rest on Flat Side of Spring Locating Pin

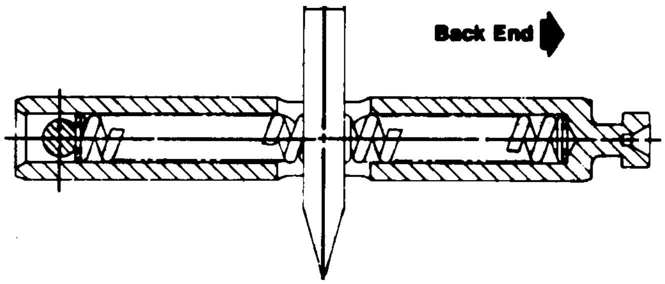
NOTE: *"A" and "B" Measurements MUST BE Equal within 1/64" [.016" (0.4mm)].*

Clutch Actuator Rod Assembly

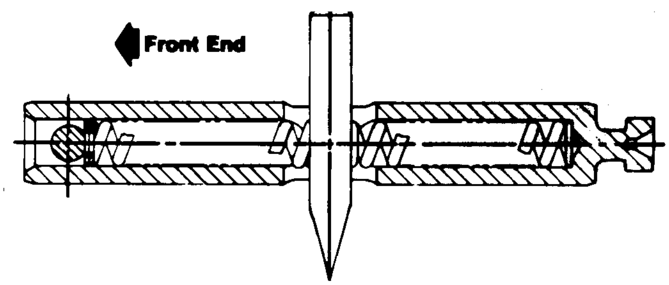
3. Insert Cross Pin Tool (91-86642) – for production models and Cross Pin Tool (91-86642-1) – for Pro Max and Super Magnum models – between compression springs in elongated slot in clutch actuator rod.

4. Compress both springs by forcing cross pin tool back-and-forth in elongated slot. This will release any initial set from springs.

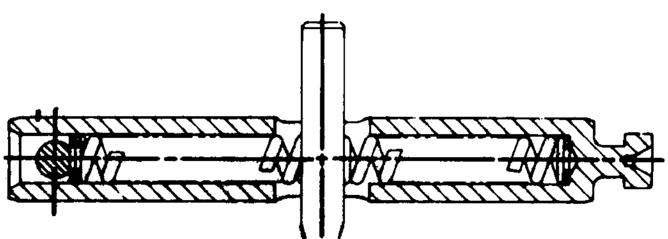
5. Measure distance from each end of elongated slot to the near side of cross pin tool. The measurements taken must be equal within 1/64^2 (0.4mm).
6. If measurements (taken in Step 5) are not equal to within 1/64^2, remove locating pin and re-shim compression spring.



Clutch Actuator Rod with One Additional Shim Washer Added to Back End



Clutch Actuator Rod with One Additional Shim Washer Added to Front End



Clutch Actuator Rod with One Additional Shim Washer Added to Each End

Shift Shaft Bushing

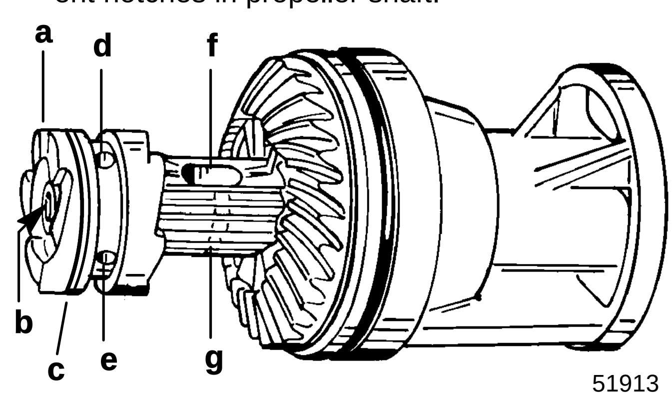
REASSEMBLY

1. Position shift shaft bushing on a press with threaded side down.
2. Apply Loctite 271 (92-32609-1) to out- side diameter of oil seal.
3. Press oil seal into shift shaft bushing with lip of seal up.
4. Wipe any excess Loctite from oil seal and bushing.
5. Place rubber washer against oil seal.
6. Install O-ring over threads and up against shoulder of bushing.
7. Lubricate O-ring and oil seal with Quicksilver 2-4-C w/Teflon Marine Lubricant (92-809820).

Propeller Shaft

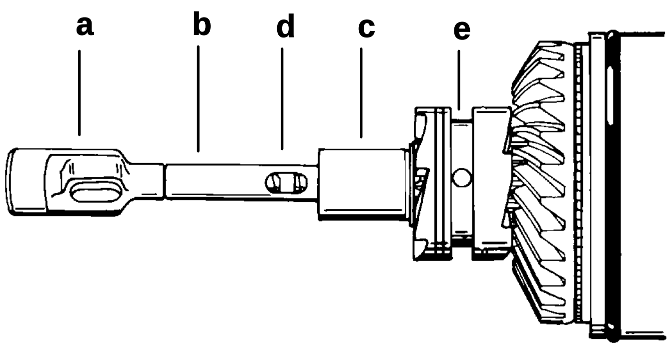
REASSEMBLY/INSTALLATION

1. Position sliding clutch onto propeller shaft. The "GROOVED RINGS" on the Sport Master gear cases should be installed with the grooves toward the front of the gear housing. On all other gear cases, the grooves are for manufacturing purposes only and may be positioned towards either gear. Cross pin hole and detent holes in sliding clutch must line up with cross pin slot and detent notches in propeller shaft.



a - Sliding Clutch
b - Propeller Shaft
c - Grooved Rings (Toward Front of Gear Case for Hi-Performance Applications)
d - Cross Pin Hole
e - Detent Holes
f - Cross Pin Slot
g - Detent Notches

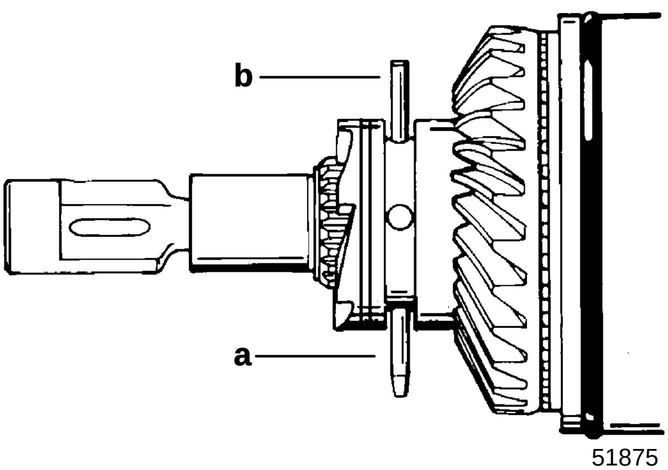
2. Attach cam follower to clutch actuator rod and slide assembly into propeller shaft. Align cross pin slot in actuator rod with cross pin slot in clutch/propeller shaft.



a - Cam Follower
b - Clutch Actuator Rod
c - Propeller Shaft
d - Cross Pin Slot
e - Clutch/Propeller Shaft

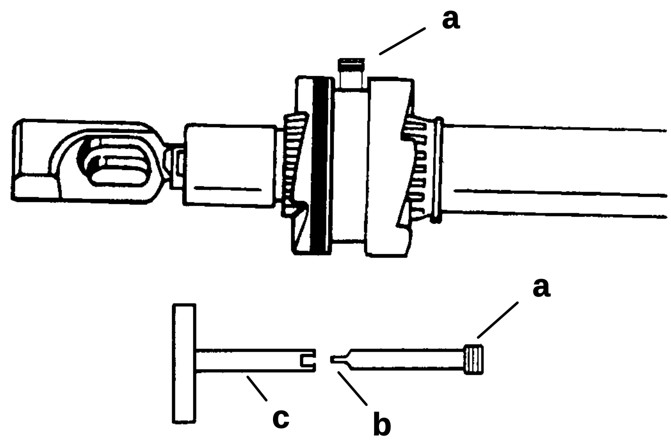
3. Insert Cross Pin Tool (91-86642) through sliding clutch, propeller shaft and actuator. The cross pin tool must pass between the compression springs.

4. Insert cross pin through sliding clutch, propeller shaft and actuator rod forcing cross pin tool out.



a - Cross Pin Tool
b - Cross Pin

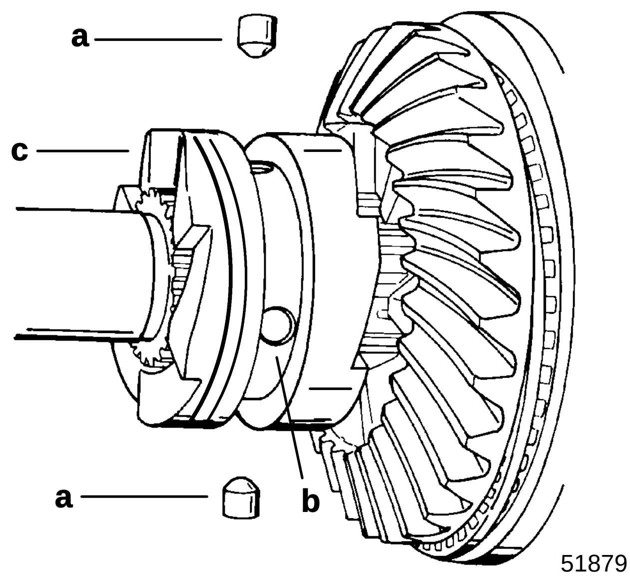
NOTE: *Sport Master models use a slotted cross pin 91-86642-1 and Cross Pin Handle 91-86642-2 to assemble clutch onto propshaft. Turn handle COUNTERCLOCKWISE to install cross pin and thread pin into sliding clutch until the head is flush or recessed and flat sides of tang are parallel with the spring slot. (Springs will retain cross pin from turning).*



a - Cross Pin
b - Cross Pin Tang
c - Cross Pin Tool 91-86642-2

5. Verify that flat sides of cross pin are toward compression springs. Cross pin must be flush on both ends with sliding clutch.

6. Apply a small amount of 2-4-C w/Teflon Marine Lubricant (92-90018A12) to the rounded end of each detent pin. Position a detent pin in each detent pin hole of sliding clutch with rounded end of pins toward propeller shaft.



a - Detent Pin
b - Detent Pin Hole
c - Sliding Clutch

7. Install cross pin retaining springs onto sliding clutch as follows:

IMPORTANT: DO NOT over-stretch retaining springs when installing them onto sliding clutch.

a. Installing first spring

(1.) Insert tang end of spring into a detent pin.

(2.) Spirally wrap spring into groove on sliding clutch.

(3.) Position spring in groove so that straight end of spring is against the side of groove.

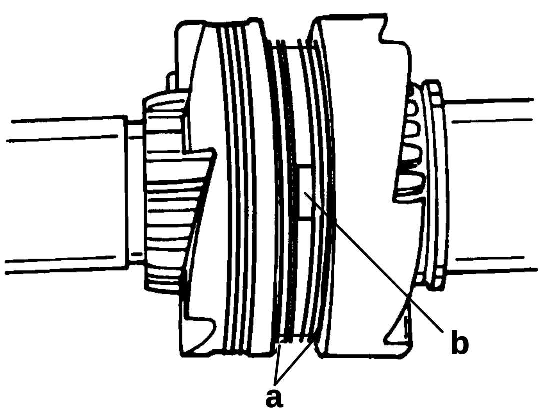
b. Installing second spring

(1.) Insert tang end of spring into the opposite detent pin that was used in Step a-1.

(2.) Spirally wrap spring into groove on sliding clutch in the opposite direction that the first spring was wound.

(3.) Position spring in groove so that straight end of spring is against the side of groove and not over-lapping the first spring.

IMPORTANT: One spring must be on each side of cross pin tang and springs MUST NOT overlap each other.

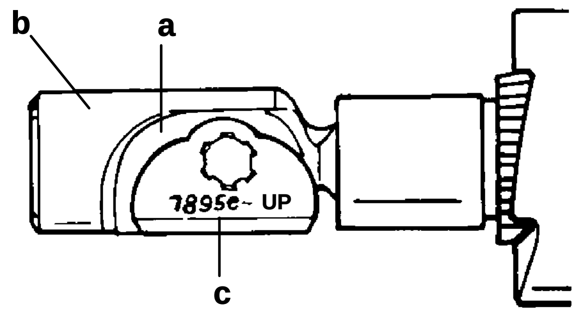


a - Cross Pin Tang
b - Spring (One on Each Side of Cross Pin Tang)

8. Place gear housing in a soft jaw vise with the driveshaft in a vertical position.

9. Coat cam pocket of cam follower with 2-4-C w/Teflon Marine Lubricant (92-90018A12).

10. Place shift cam into cam pocket of cam follower with numbered side of cam facing up.

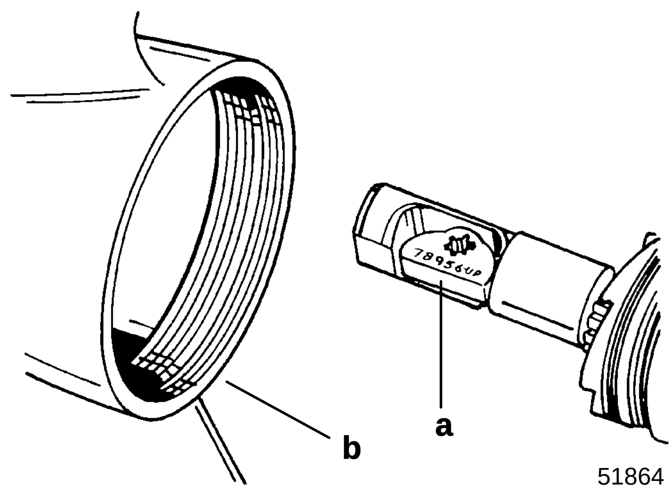


51864

a - Cam Pocket
b - Cam Follower
c - Shift Cam

11. Apply a light coat of 2-4-C w/Teflon Marine Lubricant (92-90018A12) to outside diameter of bearing carrier where carrier contacts gear case.

12. With SHIFT CAM positioned as shown and while holding BEARING CARRIER against FORWARD GEAR assembly, insert propeller shaft, with forward gear and bearing carrier, into gear housing through REVERSE GEAR until shaft bottoms out.



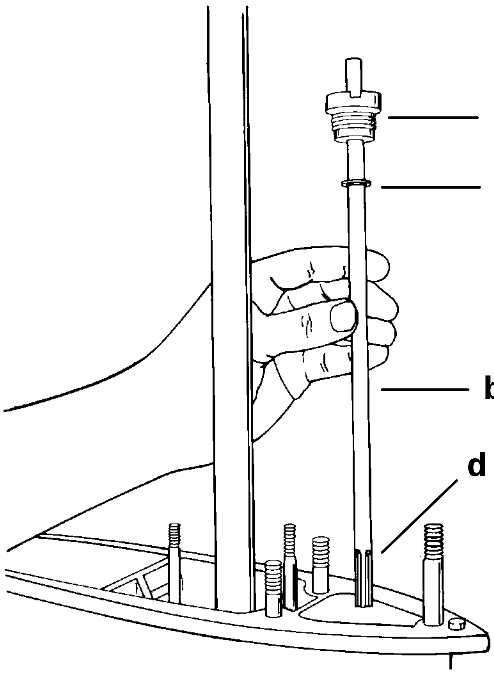
51864

a - Shift Cam (Position as Shown)
b - Gear Housing

13. Rotate driveshaft to verify PINION GEAR and FORWARD GEAR are meshing properly and propeller shaft/bearing carrier assembly are fully seated in gear housing.

IMPORTANT: Do Not rotate the PROPSHAFT until the shift shaft is installed or shift cam will become dislocated.

IMPORTANT: Prior to installation of shift shaft, verify that the round retaining ring and "E" ring (if equipped) are in position and secure.



51867

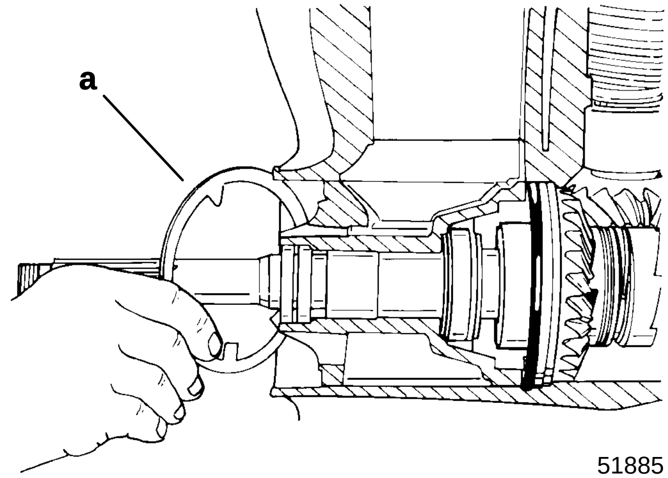
a - Shift Shaft Bushing
b - Shift Shaft
c - "E" Ring (if equipped)
d - Round Retaining Ring (if equipped)

14. Apply a light coat of 2-4-Cw/Teflon to the threads of the shift shaft bushing.

15. Insert shift shaft down shift shaft hole in gear housing and into shift cam. It may be necessary to rotate shift shaft back-and-forth slightly in order for splines of shift shaft to match up with splines of shift cam. Thread bushing into position, but do not tighten down at this time.

16. Verify bearing carrier key way is aligned with gear housing key way and install bearing carrier key.

17. Place tab washer against bearing carrier.



51885

a - Tab Washer

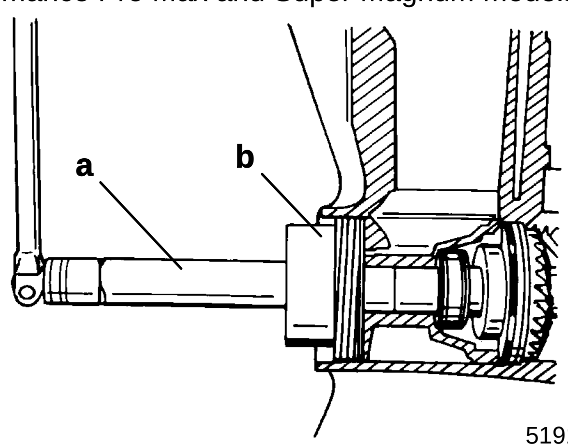
IMPORTANT: Ensure that the "V" shaped tab on cover nut tab washer locates in the "V" slot of the bearing carrier.

18. Apply 2-4-C w/Teflon to threads of cover nut and install cover nut in gear housing. Verify that the word "OFF" and arrow are visible.

⚠ CAUTION

Before torquing bearing carrier cover nut, gear case should either be mounted in a stand specifically designed for holding gear cases or bolted to a driveshaft housing to avoid possible damage to the gear case.

19. Using Cover Nut Tool (91-61069), torque cover nut to 210 lb. ft. (284.5 N·m) for production models and 250 lb. ft. (339.0 N·m) for high performance Pro Max and Super Magnum models.



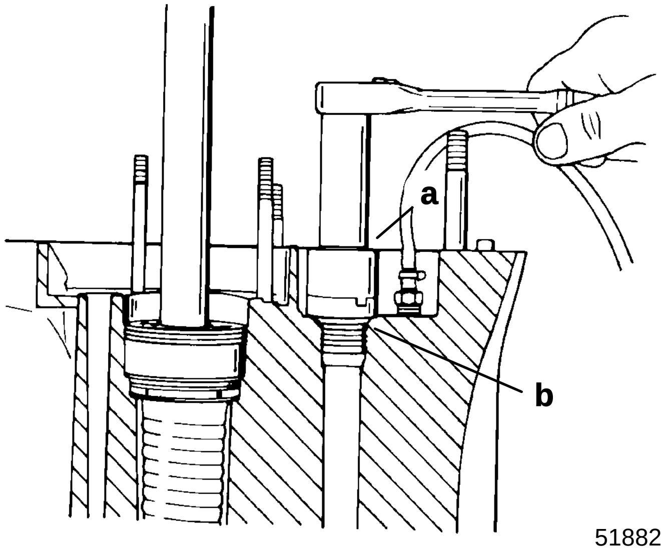
51911

a - Retainer Nut Tool (91-61069)
b - Retainer Nut

20. Bend one lock tab of tab washer into cover nut (only one will align).

21. Bend remaining tabs of tab washer toward front of gear housing.

22. Use Shift Shaft Bushing Tool (91-31107) and torque shift shaft bushing to 50 lb. ft. (67.5 N·m).



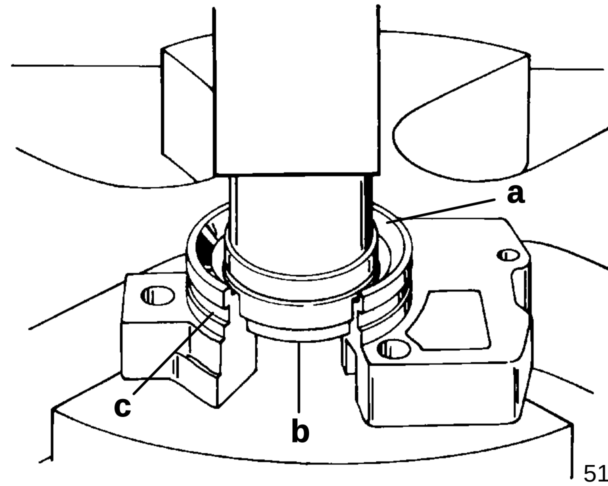
51882

a - Shift Shaft Bushing Tool (91-31107)
b - Shift Shaft Bushing

Water Pump

REASSEMBLY/INSTALLATION

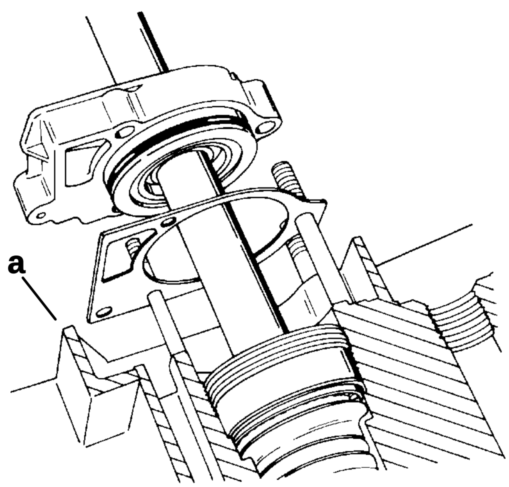
1. Install oil seals into water pump base, as follows:
   a. Place water pump base on a press.
   b. Just before installing each seal apply Loctite 271 on outside diameter of oil seal.
   c. With a suitable mandrel, press the smaller diameter oil seal into pump base with lip of oil seal toward impeller side of base.
   d. With a suitable mandrel, press the larger diameter oil seal into pump base with lip of oil seal toward gear housing side of base.
   e. Wipe any excess Loctite from oil seals and water pump base.
2. Install O-ring into O-ring groove of water pump base. Lubricate O-ring and oil seals with 2-4-C w/ Teflon Marine Lubricant (92-90018A12).



51869

a - Mandrel
b - Oil Seal (Smaller OD)
c - O-Ring Groove

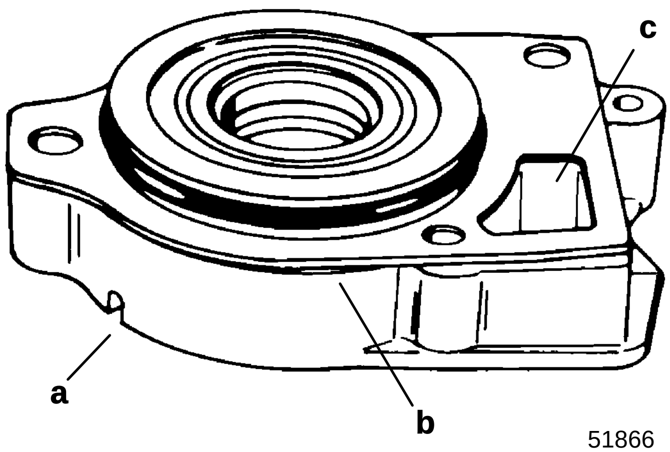
3. Install divider block if removed. Use RTV Sealer to seal seams between divider block and gear housing.



51878

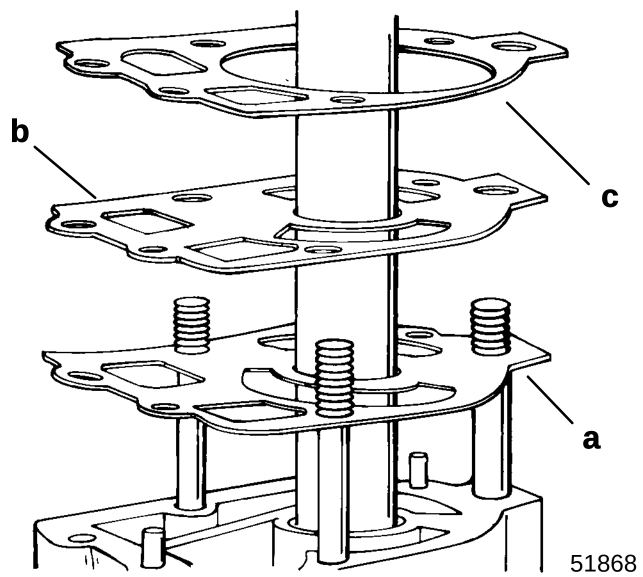
a - Divider Block

4. Install a new water pump base gasket and install water pump base.



a - Water Pump Base
b - Gasket
c - Hole (MUST be positioned as shown)

5. Install the following in order: Pump base to face plate gasket, face plate to pump cover gasket. Gaskets and face plate are indexed by dowel pin location and must be installed correctly.



a - Gasket (Water Pump Base to Face Plate)
b - Face Plate
c - Gasket (Face Plate to Water Pump Cover)

6. Place impeller drive key on flat of driveshaft. Hold key on driveshaft with a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant (92-90018A12).

IMPORTANT: When completing gear housing repair that requires removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary to reuse the impeller, DO NOT install in reverse to original rotation or premature impeller failure will occur. Original rotation is clockwise.

⚠ CAUTION

A visual inspection of impeller drive key MUST BE made to determine that drive key is on flat of driveshaft after impeller is installed. If key has moved off flat of driveshaft, repeat Steps 7 and 8.

7. Slide impeller down driveshaft to impeller drive key. Align drive key with key way in the center hub of impeller, and slide impeller over drive key.
8. If removed, install new water pump insert into pump cover as follows:
   a. Apply Quicksilver Perfect Seal to water pump insert area of pump cover.
   b. Install water pump insert into pump cover, being sure that tab on insert enters recess in pump cover.
   c. Wipe any excess Quicksilver Perfect Seal from insert and cover.

NOTE: *If 2 holes were drilled in top of water pump cover to aid in removal of insert, fill holes with RTV Sealer or equivalent. Allow to cure 24 hours prior to operating engine.*

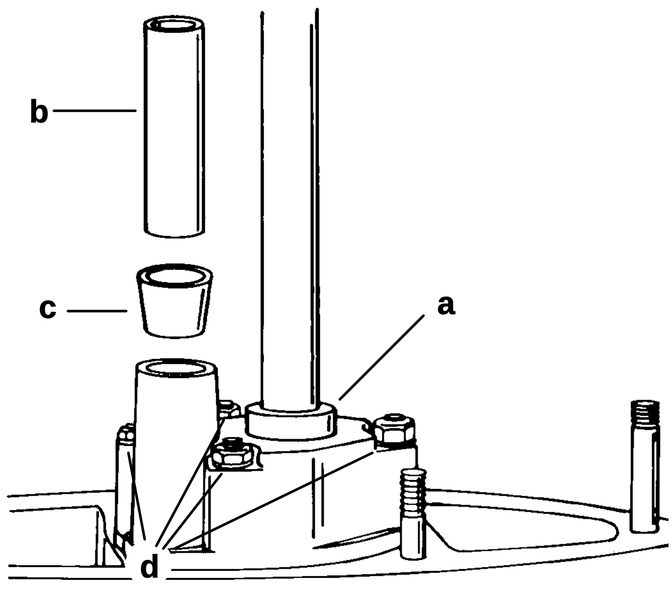
9. Install water tube seal into pump cover. Plastic side of seal goes into cover first.
10. Reinstall water tube guide into water pump cover.
11. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to inside of water pump insert.
12. Position assembled water pump cover over driveshaft and lower over water pump studs. Rotate driveshaft in a clockwise direction (viewed from top), while pushing down on pump cover to ease impeller entry into cover.
13. Install water pump cover retainer washers, nuts and bolt.

⚠ CAUTION

DO NOT over-torque nuts and bolt, as this could cause cover to crack during operation.

14. Torque water pump nuts to 50 lb. in. (5.5 N·m), and water pump bolt to 35 lb. in. (4.0 N·m).

15. Install centrifugal slinger over driveshaft and down against pump cover.



a - Centrifugal Slinger
b - Water Tube Guide
c - Water Tube Seal
d - Nuts, Bolts and Washers

Gear Lubricant Filling Instructions

1. Remove any gasket material from "Fill" and "Vent" screws and gear 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 thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.
4. Install "Vent" screw into "Vent" hole.

IMPORTANT: DO NOT lose more than one fluid ounce (30cc) of gear lubricant while reinstalling "Fill" screw.

5. 5. Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Driveshaft Housing

WARNING

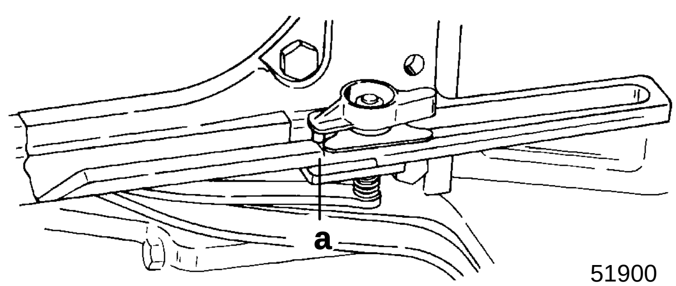
Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing onto driveshaft housing.

1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto driveshaft splines.

CAUTION

DO NOT allow lubricant on top of driveshaft. Excess lubricant, that is trapped in clearance space, will not allow driveshaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of driveshaft) will load the driveshaft/crankshaft and damage either or both the powerhead and gear housing. Top of driveshaft is to be wiped free of lubricant.

3. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Apply a thin bead of G.E. Silicone Sealer (obtained locally) against the top of divider block.
5. Insert trim tab bolt into hole in rear of gear housing to driveshaft housing machined surface.
6. Shift gear housing into forward gear and place guide block anchor pin into forward gear position.



a - Guide Block Anchor Pin

7. Position gear housing so that the driveshaft is protruding into driveshaft housing.

NOTE: *If, while performing Step 8, the driveshaft splines will not align with crankshaft splines, place a propeller onto propeller shaft and turn it counterclockwise as the gear housing is being pushed toward driveshaft housing.*

8. Move gear housing up toward driveshaft housing while aligning shift shaft splines and water tube with water tube guide (in water pump cover).

9. Place flat washers onto studs (located on either side of driveshaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gear case up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to listing in **"Torque Specifications,"** preceding.
13. After 2 nuts (located on either side of driveshaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

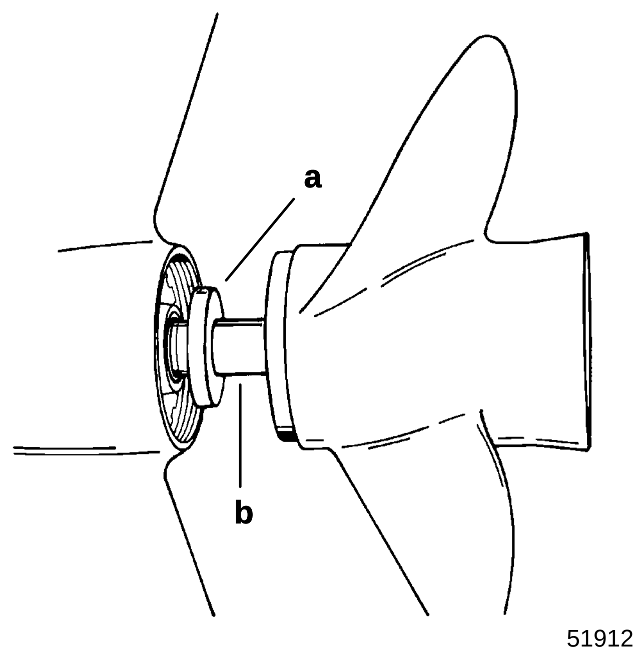
14. Install washers and nuts onto studs (located on bottom center of anti-cavitation plate). Torque to listing in **"Torque Specifications,"** preceding.
15. Install special flat washer and nut on stud at leading edge of driveshaft housing. Torque to listing in **"Torque Specifications,"** preceding.
16. Torque bolt (started in Step 10) to listing in **"Torque Specifications,"** preceding.
17. Install trim tab, adjust to position in which it had previously been installed, and tighten securely.
18. Install plastic cap into trim tab bolt opening at rear edge of driveshaft housing.

Propeller Installation

⚠ WARNING

When installing or removing propeller, because of the engine's ease in starting, VERIFY that the remote control is in NEUTRAL position and that the key switch is "OFF." Place a block of wood between the anti-cavitation plate and propeller to prevent accidental starting and to protect hands from propeller blades while removing or installing nut.

1. To aid in future removal of the propeller, liberally coat the propeller shaft splines with one of the following Quicksilver products:
   -- Anti-Corrosion Grease (92-78376A6)
   --Special Lubricant 101 (92-13872A1)
   --2-4-C Marine Lubricant (92-90018A12)
   --Perfect Seal (92-34227--1)
2. Place forward thrust hub over propeller shaft with shoulder side toward propeller.
3. Place propeller on propeller shaft and slide it up against thrust hub.



a - Forward Thrust Hub
b - Propeller Shaft

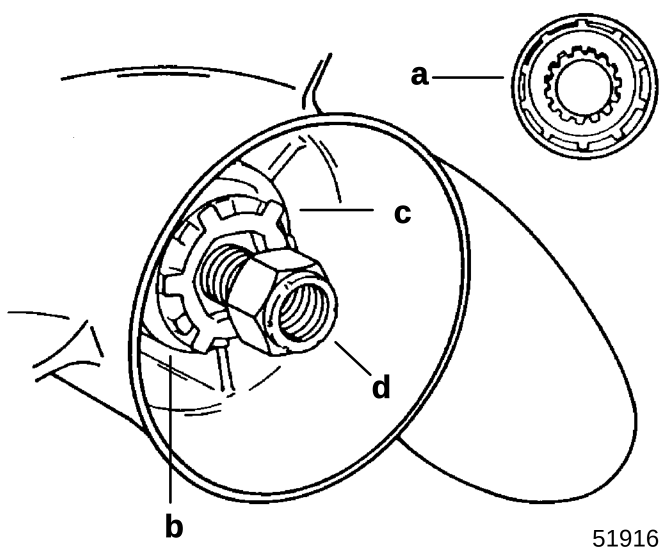
4. Place continuity washer (if equipped) onto shoulder of rear thrust hub.
5. Place rear thrust hub, tab washer and propeller nut on propeller shaft.
6. Thread propeller nut onto propeller shaft until nut is recessed into tab washer.

7. After propeller nut is recessed into tab washer, tighten nut securely [minimum of 55 lb. ft. (74.5 N·m) torque].
8. Bend 3 of the tabs of tab washer down in grooves of rear thrust hub to secure propeller nut. (If tab washer tabs do not align with slots, continue to tighten propeller nut to obtain alignment. DO NOT loosen nut to align tabs.)

⚠ CAUTION

DO NOT misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; however, propeller should not move forward-and-aft on propeller shaft.

9. After first use, re-tighten propeller nut and again secure with tab washer (Steps 7 and 8, preceding). Propeller should be checked periodically for tightness, particularly if a stainless steel propeller is used.



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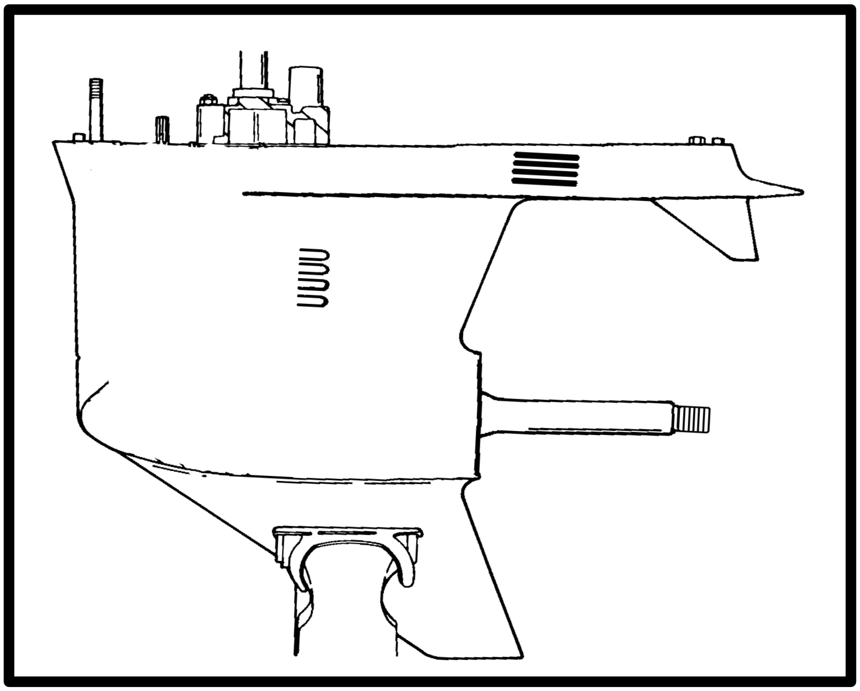
a - Continuity Washer (If Equipped)
b - Rear Thrust Hub
c - Tab Washer
d - Propeller Nut

LOWER UNIT



MERCURY XR6/MARINER MAGNUM III GEAR HOUSING

6

C

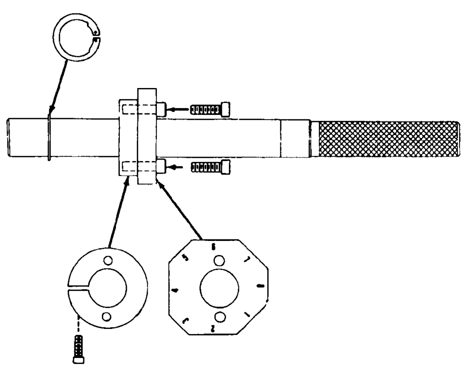
Table of Contents

Gear Housing Specifications (1.78:1 Ratio)

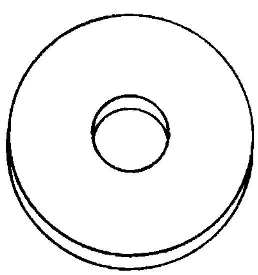
Ratio	Pinion Depth	Forward Gear Backlash	Reverse Gear Backlash
1.78:1 (14/25 teeth)	0.025 in. (0.635mm) With Tool 91-12349A2 Using Disc #1 and Flat #1	0.016 in. to 0.019 in. (0.41mm to 0.48mm) Pointer on line mark #1	0.030 in. to 0.050 in. (0.762mm to 1.27mm)
Gearcase Lubricant Capacity			
1.78:1 Ratio	21.0 fl. oz. (621.0ml)		

Special Tools

Pinion Gear Locating Tool 91-12349A2



Pilot 91-36571



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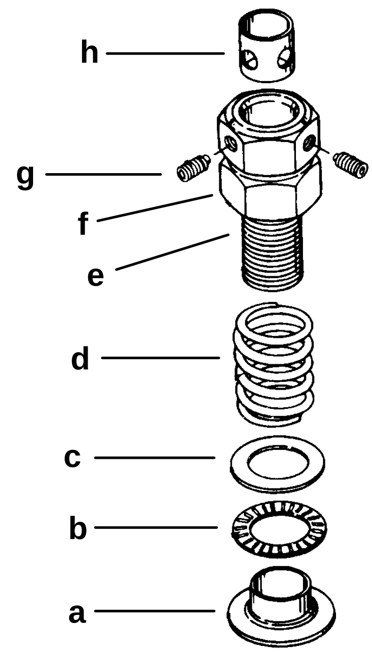
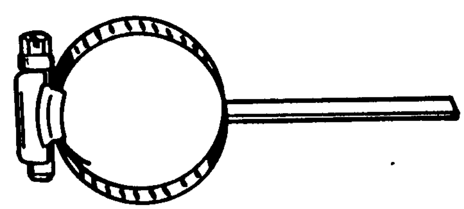
Bearing Preload Tool 91-14311A1

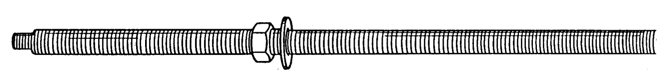


a - Adaptor (N.S.S.)
b - Bearing (N.S.S.)
c - Washer (N.S.S.)
d - Spring (24-14111)
e - Bolt (10-12580)
f - Nut (11-13953)
g - Set Screw (10-12575)
h - Sleeve (23-13946)

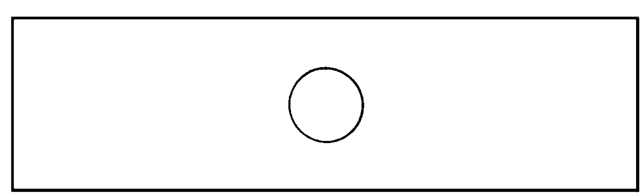
Backlash Indicator Tool 91-19660



Puller Rod 91-31229 and Nut 91-24156

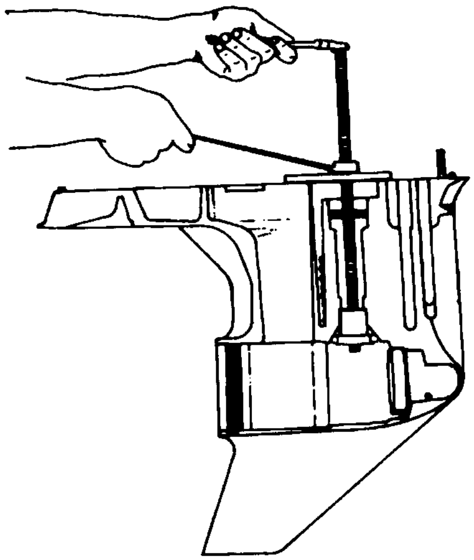


Puller Plate 91-29310



74190

Bearing Removal and Installation Kit 91-31229A5. This kit contains the following tools: Pilot 91-36571; Puller Rod 91-31229; Nut 11-24156; Puller Plate 91-29310; Mandrel 91-38628; and Driver Rod 91-37323.



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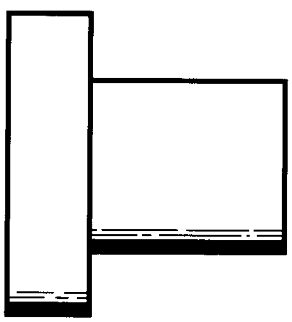
Mandrel 91-38628

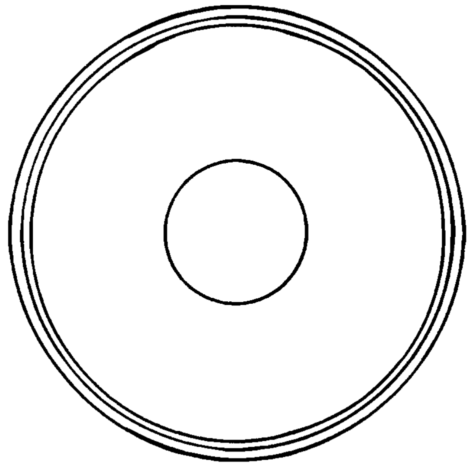


74193

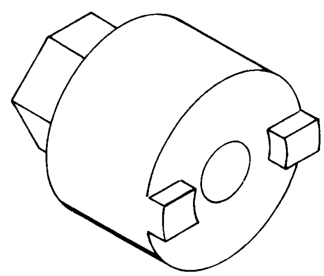
Driver Rod 91-37323

74184

Mandrel 91-31106



Shift Shaft Bushing Tool 91-31107



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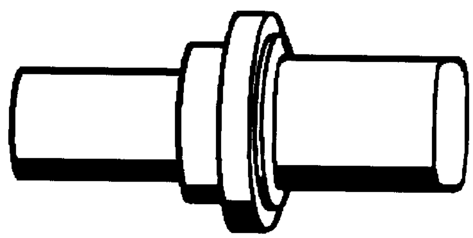
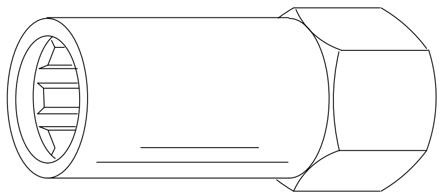
Oil Seal Driver 91-31108



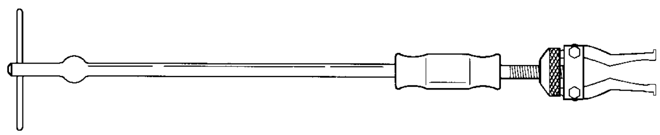
73651

Driveshaft Holding Tool 91-34377A1



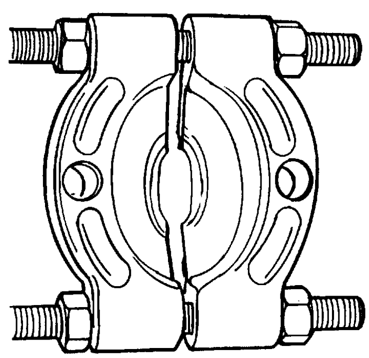
55079

Slide Hammer Puller 91-34569A1



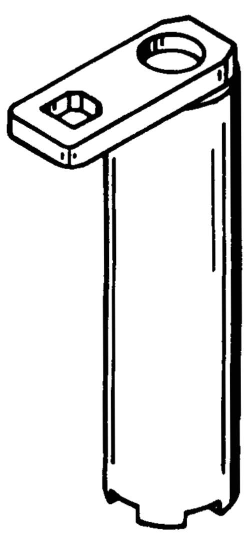
73655

Universal Puller Plate 91-37241



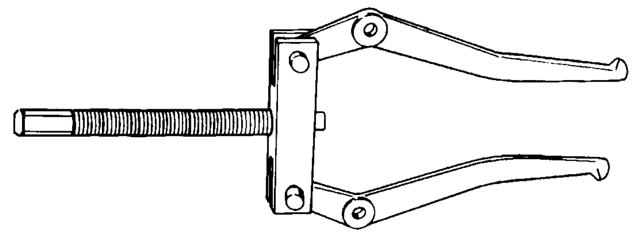
73652

Bearing Retainer Tool 91-43506



73600

Bearing Carrier Removal Tool 91-46086A1 and Puller Bolt 91-85716



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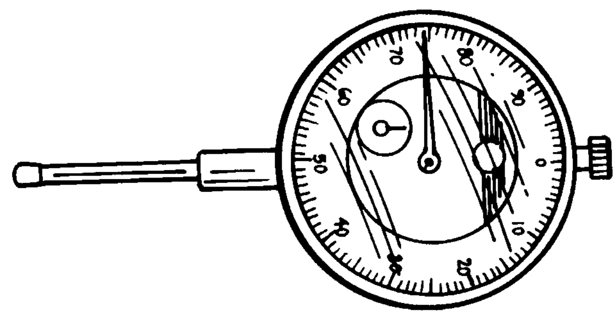
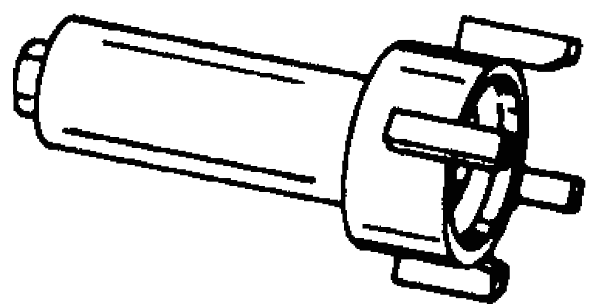
Dial Indicator 91-58222A1



73429

Cover Nut Tool 91-73688



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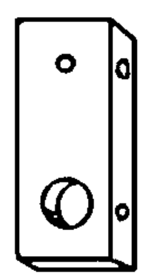
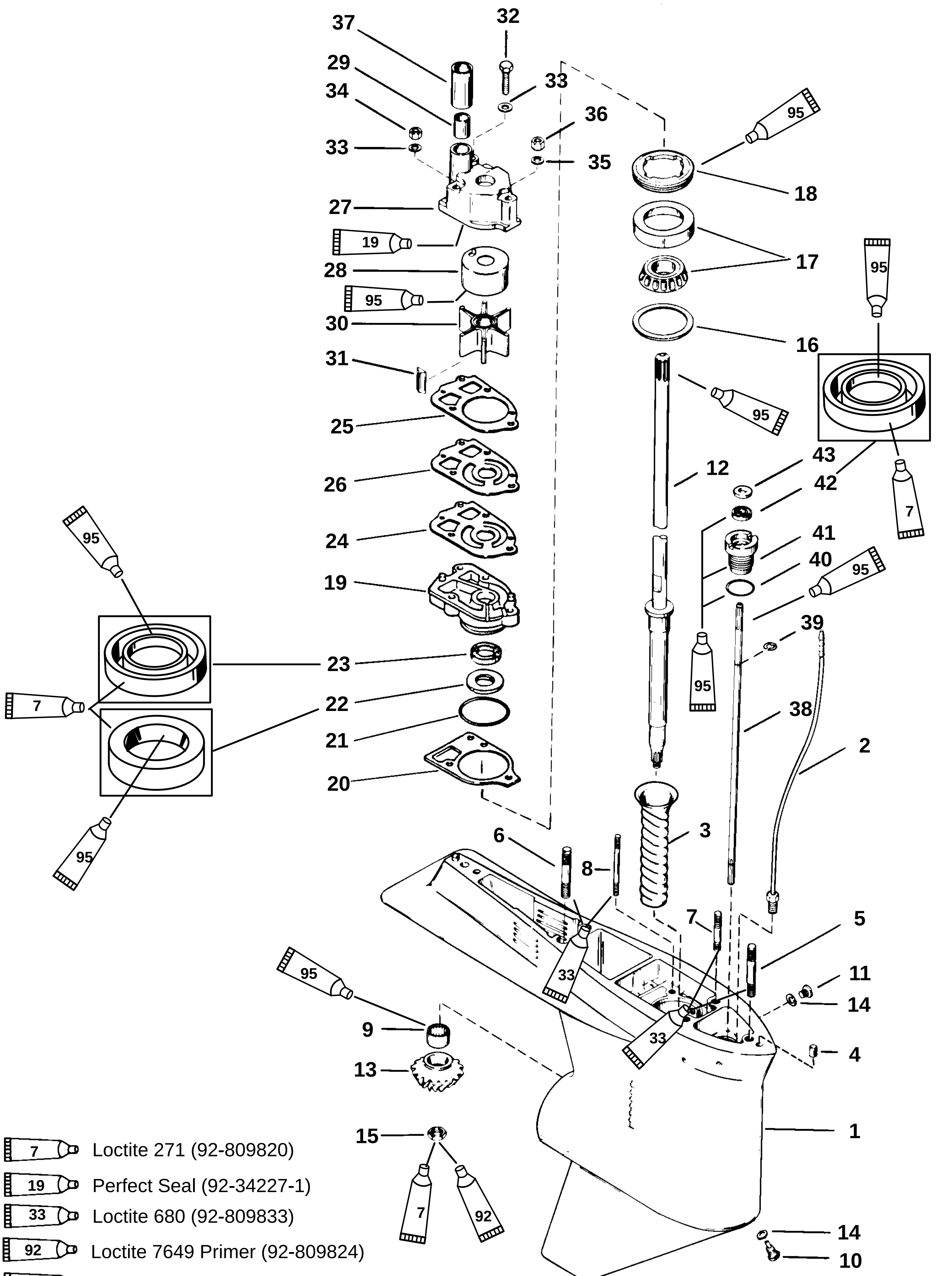
Dial Indicator Holder 91-89897



Gear Housing (Driveshaft) - XR6/Magnum III - 1.78:1 Ratio



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

33 Loctite 680 (92-809833)

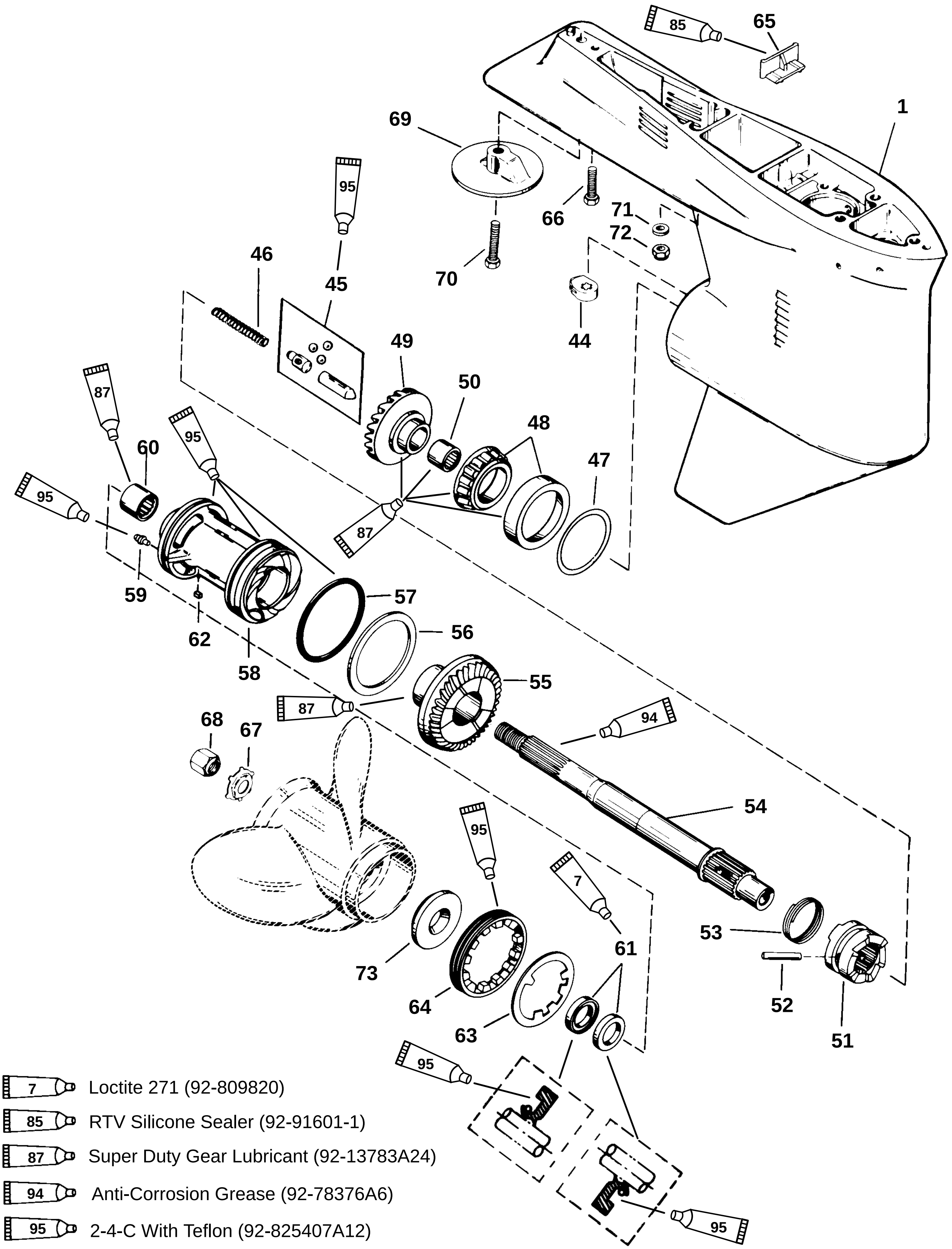
92 Loctite 7649 Primer (92-809824)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Driveshaft) - XR6/Magnum III - 1.78:1 Ratio

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
2	1	CONNECTOR ASSEMBLY			
3	1	LUBRICATION SLEEVE (OLD DESIGN)			
4	2	DOWEL PIN			
5	1	STUD (3-1/8″)			
6	2	STUD (2-1/16″)			
7	1	STUD (3-3/8″)			
8	2	STUD (3-1/8″)			
9	1	ROLLER BEARING			
10	2	SCREW - grease filler	55		6.0
11	1	SCREW - drain (MAGNETIC)	55		6.0
12	1	DRIVESHAFT			
13	1	PINION GEAR			
14	2	WASHER			
15	1	NUT **Included With Forward Gear Set**		80	108.5
16	AR	SHIM SET			
17	1	ROLLER BEARING			
18	2	RETAINER		100	135.5
19	1	WATER PUMP BASE			
20	1	GASKET			
21	1	O-RING			
22	1	OIL SEAL			
23	1	OIL SEAL			
24	1	GASKET - lower			
25	1	GASKET - upper			
26	1	FACE PLATE			
27	1	WATER PUMP BODY ASSEMBLY			
28	1	INSERT			
29	1	SEAL - rubber			
30	1	IMPELLER			
31	1	KEY			
32	1	SCREW (2-1/4 in.)	35		4.0
33	2	WASHER			
34	2	NUT	50		5.5
35	1	WASHER			
36	1	NUT	50		5.5
37	1	SLEEVE			
38	1	SHIFT SHAFT (use w/o E-ring)			
38	1	SHIFT SHAFT - lower (use with E-ring)			
39	1	E-RING			
40	1	O-RING			
41	1	BUSHING ASSEMBLY			
42	1	OIL SEAL			
43	1	WASHER - rubber - shift shaft bushing			

Gear Housing (Prop Shaft) - XR6/Magnum III - 1.78:1 Ratio



7 Loctite 271 (92-809820)

85 RTV Silicone Sealer (92-91601-1)

87 Super Duty Gear Lubricant (92-13783A24)

94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft) - XR6/Magnum III - 1.78:1 Ratio

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING **(BLACK)(BASIC)**			
	1	GEAR HOUSING **(GRAY)(BASIC)**			
44	1	SHIFT CAM			
45	1	CAM FOLLOWER			
46	1	SPRING			
47	AR	SHIM			
48	1	TAPERED ROLLER BEARING			
49	1	FORWARD GEAR			
50	1	ROLLER BEARING			
51	1	CLUTCH			
52	1	CROSS PIN			
53	1	SPRING			
54	1	PROPELLER SHAFT			
55	1	REVERSE GEAR			
56	1	THRUST WASHER			
57	1	O-RING			
58	1	BEARING CARRIER ASSEMBLY			
59	2	GREASE FITTING			
60	1	ROLLER BEARING			
61	2	OIL SEAL			
62	1	KEY			
63	1	TAB WASHER			
64	1	COVER NUT		210	285
65	1	FILLER BLOCK			
66	1	SCREW		65	88.0
67	1	TAB WASHER			
68	1	PROPELLER NUT		55	74.5
69	1	TRIM TAB			
70	1	SCREW	288	24	32.5
71	2	WASHER			
72	2	NUT		55	74.5
73	1	THRUST HUB			

General Service Recommendations

There may be more than one way to “disassemble” or “reassemble” a particular part(s), therefore, it is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

In many cases, disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure order in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to “reassembly and installation” of that component in the reassembly part of this section. Use the **“Table of Contents**” (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, verify that no water is present in air line.

Bearings

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lube. DO NOT lubricate tapered bearing cups until after inspection. Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced, if the conditions described are found.

Shims

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly, as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and gear failure.

Seals

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply 2-4-C w/Teflon Marine Lubricant on all O-rings. To prevent wear, apply 2-4-C w/Teflon on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply 2-4-C w/Teflon Marine Lubricant to external surfaces of bearing carrier and cover nut threads prior to installation.

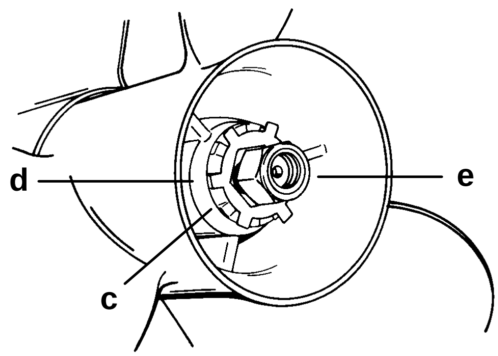
Removal, Disassembly, Cleaning and Inspection

REMOVING GEAR HOUSING FROM DRIVESHAFT HOUSING

⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from driveshaft housing.

1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.
2. Shift outboard into forward gear position.
3. Tilt outboard to full up position and engage tilt lock lever.
4. Bend tabs of propeller tab washer away from propeller hub, then remove propeller locknut, tab washer, propeller and thrust hub from propeller shaft.



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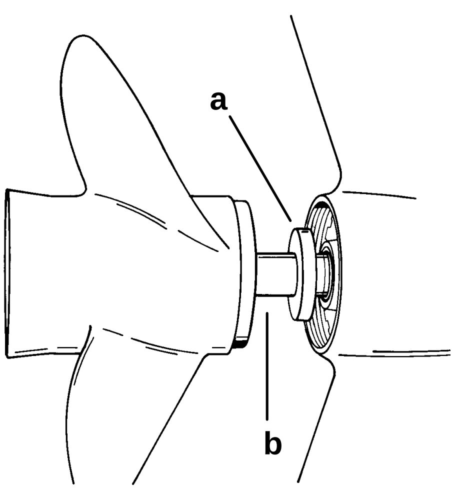
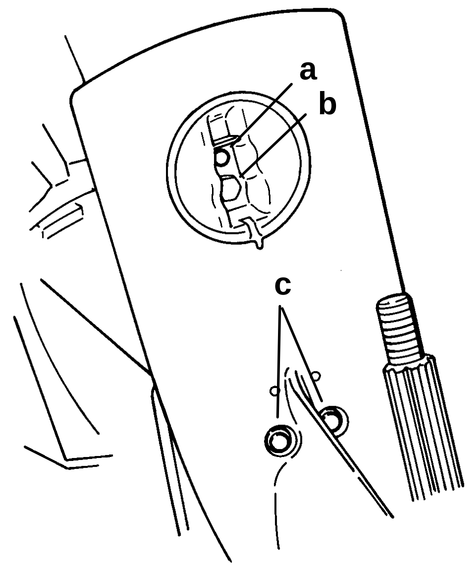


a - Thrust Hub
b - Propeller Shaft
c - Propeller Hub
d - Tab Washer
e - Propeller Nut

5. Remove plastic cap at rear edge of driveshaft housing. Using a 12-point socket, un-thread bolt that secures anodic plate gear housing and remove tab. (It is not necessary to remove bolt at this time.)
6. Once anodic plate is removed, remove bolt from inside of anodic plate cavity.
7. Remove 2 locknuts and washers from bottom center of anti-cavitation plate.
8. Remove locknut and flat washer from the front gear housing mounting stud.



51866

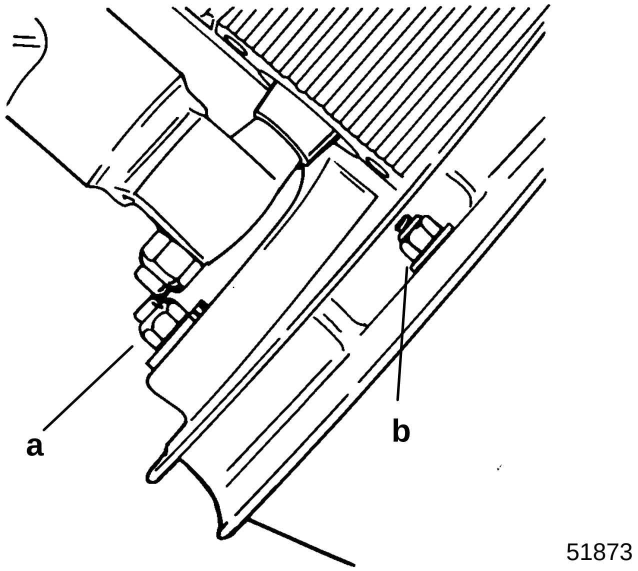
a - Bolt Location (Secures Anodic Plate)
b - Bolt (Inside Anodic Plate Cavity)
c - Locknuts and Washers

⚠ CAUTION

DO NOT attempt to remove one of the side mounting locknuts before opposite side locknut is loosened sufficiently, or driveshaft housing could be damaged.

9. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side nut is loosened sufficiently.)
10. Pull gear housing away from driveshaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it is now free.)

11. Pull gear housing from driveshaft housing.

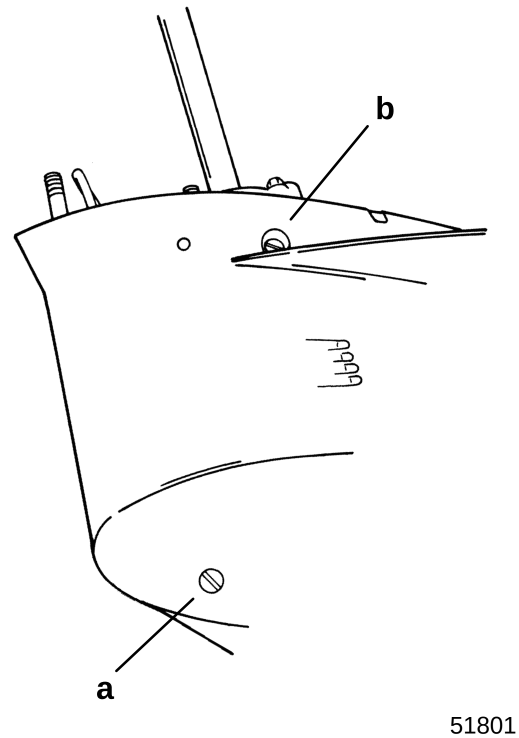


a - Front Mounting Locknut
b - Side Mounting Locknut (One Each Side)

Draining Lubricant from Gear Housing

1. Place gear housing in a suitable holding fixture or vise with the driveshaft in a vertical position.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing.
3. Catch a small amount of gear lubricant on a finger, then rub finger and thumb together to check for metal particles. Also check magnet "Fill" plug for metal particles. A small amount of metal "fuzz" on magnet is normal. A large amount of metal "fuzz" or the presence of metal chips on the magnet indicate the need for complete disassembly and inspection of gear housing.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. Check drain pan for water separation from lubricant. (Presence of water in gear lubricant indicates the need for complete disassembly and inspection of oil seal, seal surfaces, O-rings and gear housing.)

NOTE: *Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.*



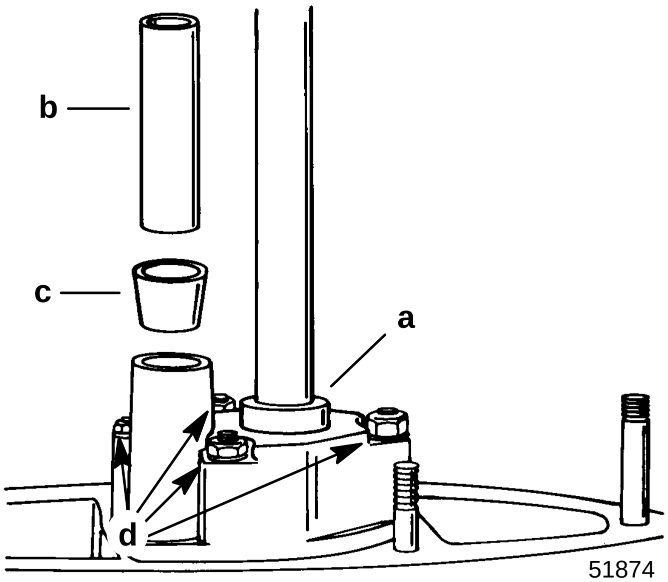
a - "Fill" Screw
b - "Vent" Screw

Water Pump

REMOVAL AND DISASSEMBLY

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

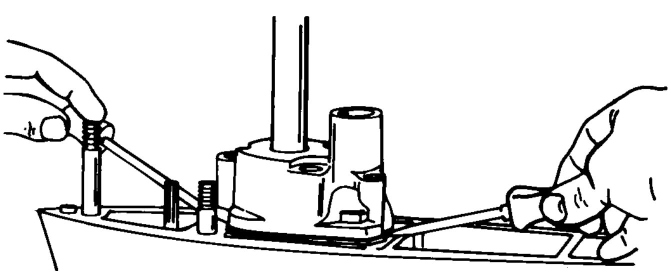
1. Slide rubber centrifugal slinger up and off driveshaft.
2. Remove water tube guide and seal from water pump cover. (Retain guide for reassembly and discard seal).
3. Remove (and retain) 3 nuts, one bolt and all washers which secure water pump cover to gear housing.



51874

a - Centrifugal Slinger
b - Water Tube Guide
c - Water Tube Seal
d - Nuts, Bolt and Washers to be Removed

4. Using 2 pry bars, positioned as shown, lift water pump cover up and off driveshaft.
5. Inspect water pump cover and insert, as outlined in **"Cleaning and Inspection"**, following.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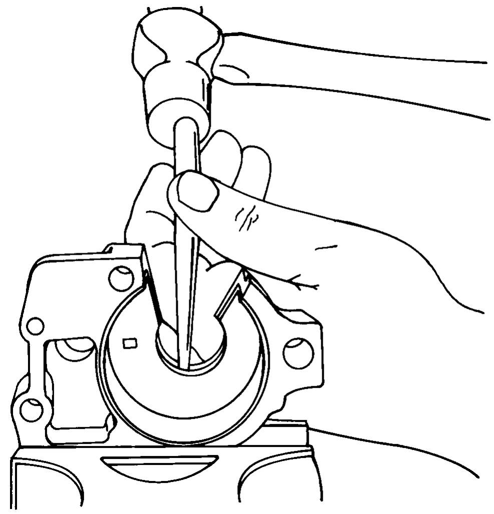
6. If inspection of water pump insert determines that replacement is required, follow Step "a" or "b" (immediately following) to remove insert from water pump cover.

NOTE: *Try Step "a" first. If insert cannot be removed with Step "a", use Step "b".*

a. Drive water pump insert out of water pump cover with a punch and hammer, as shown.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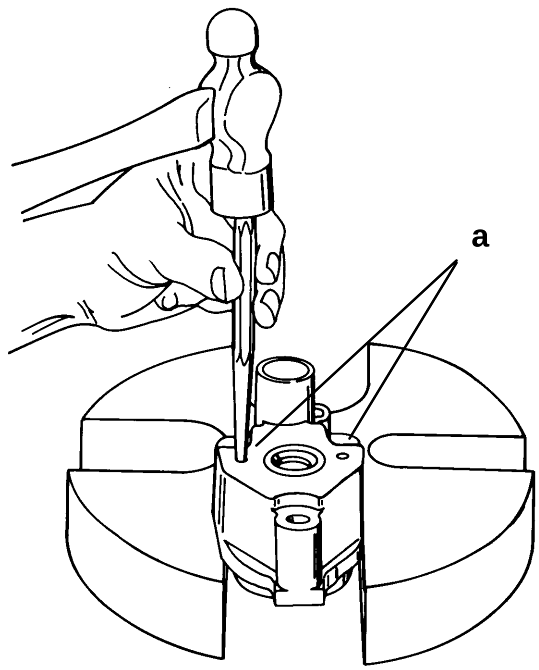
b. Drill two 3/16″ (4.8mm) diameter holes thru the top of water pump cover (but not thru insert) at locations shown. Drive insert out of cover with a punch and hammer.



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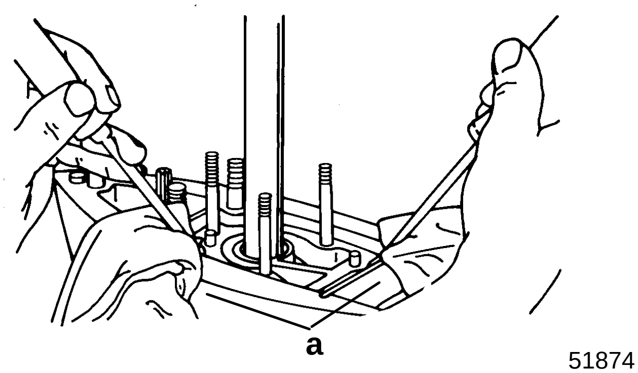
a - Drill 2 Holes at These Locations

7. Remove impeller from driveshaft. (It may be necessary to use a punch and hammer to drive impeller upward on driveshaft. In extreme cases, it may be necessary to split hub of impeller with a hammer and chisel.)
8. Once impeller is removed, remove impeller drive pin from driveshaft.

9. Remove water pump face plate and both gaskets (one above and below face plate) from water pump base.
10. Remove the flush plug from gear housing, if so equipped.
11. Using 2 pry bars, positioned and padded as shown, lift water pump base up and off driveshaft.
12. Remove (and discard) O-ring from O-ring groove on water pump base.
13. Using a screwdriver, pry oil seals out of water pump base from gear housing side of base.



a - Pads

Cleaning and Inspection

1. Clean all water pump parts with solvent and dry with compressed air.
2. Inspect water pump cover and base for cracks and distortion (from overheating).
3. Inspect face plate and water pump insert for grooves and/or rough surfaces.

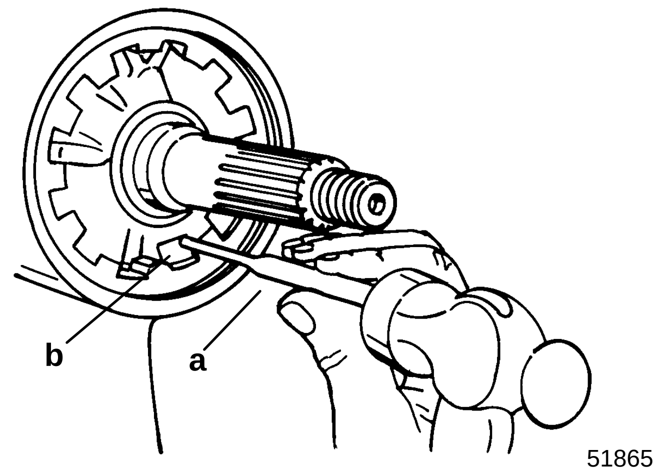
IMPORTANT: When completing gear housing repairs that require removal of water pump impeller, it is recommended that the impeller be replaced. It it is necessary, however, to re-use impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur.

4. Inspect impeller side seal surfaces and ends of impeller blades for cracks, tears and wear. Replace impeller if any of these conditions are found.
5. Inspect impeller bonding to impeller hub.
6. Inspect impeller for glazed or melted appearance (caused by operation without sufficient water supply). Replace impeller if any of these conditions exist.

Bearing Carrier and Propeller Shaft

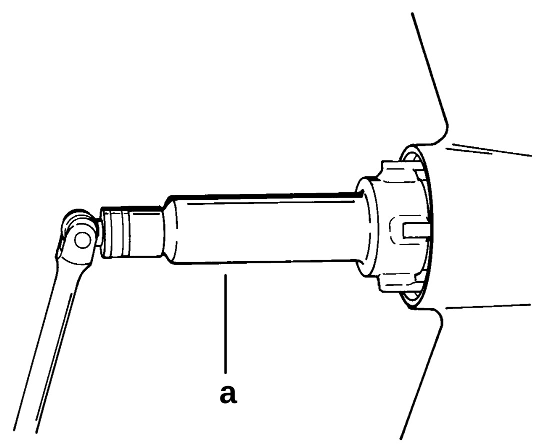
REMOVAL

1. Bend cover nut lock tab out of cover nut recess.



a - Punch
b - Tab of Tab Washer

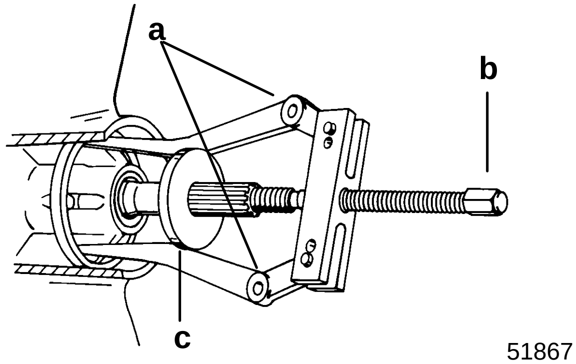
2. Remove gear housing cover nut with Cover Nut Tool (91-73688).



a - Cover Nut Tool (91-73688) 51879

3. After cover nut has been removed, remove lock tab washer from gear housing.

4. Use Long Puller Jaws (C-91-46086A1) and Puller Bolt (C-91-85716), as shown, to remove bearing carrier. (Use propeller thrust hub to maintain outward pressure on puller jaws).



a - Long Puller Jaws
b - Puller Bolt (91-85716)
c - Thrust Hub

NOTE: *When bearing carrier is removed from gear housing, the bearing carrier alignment key will come out with it.*

5. Propeller shaft now is free and can be lifted out of gear housing.

BEARING CARRIER CLEANING AND INSPECTION

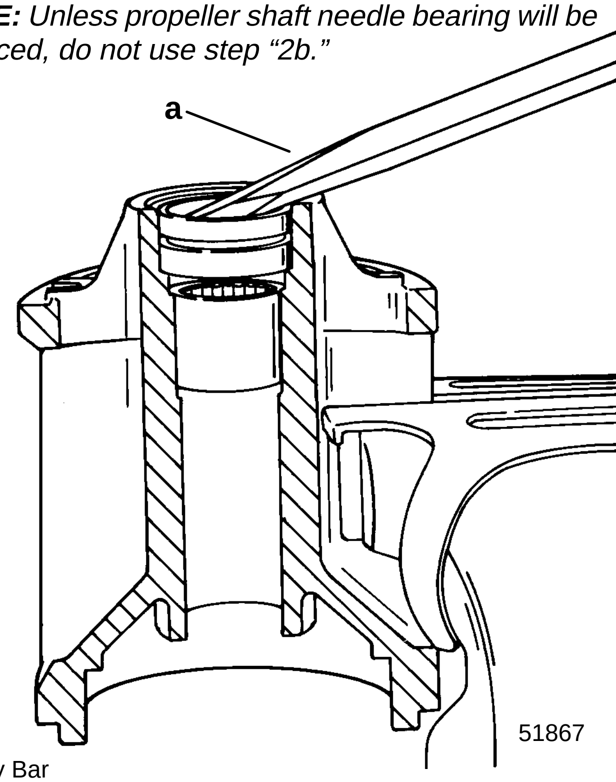
IMPORTANT: It is recommended that all seals and O-rings be replaced (as a normal repair procedure) to assure effective repair.

1. Clean the bearing carrier assembly with clean sol- vent and dry with compressed air.
2. Before replacing propeller shaft oil seals, inspect seals for wear or damage. A worn or damaged propeller shaft oil seal may be an indication of other potential problems.
3. Bearing carrier propeller shaft needle bearing condition is determined by propeller shaft surface condition (See **"Propeller Shaft Cleaning and Inspection"**, following.)
4. Inspect the reverse gear to pinion gear wear pattern. If it is not even and smooth. replace the reverse gear and pinion gear.
5. Check clutch jaws on reverse gear for damage. Replace reverse gear, if damage is found on clutch jaws.
6. Inspect reverse gear journal for scoring, galling, or discoloration (BLUEING) due to lack of oil. Replace reverse gear if such conditions exist.
7. Inspect bearing carrier reverse gear bearing surface for scoring or galling due to lack of oil or presence of metal chips in oil. Replace carrier if such conditions exist.

BEARING CARRIER DISASSEMBLY

1. Remove and discard O-ring from between bearing carrier and thrust washer.
2. Propeller shaft oil seals can be removed either by (a) using a pry bar, as shown, or (b) pressing seals out when propeller shaft needle bearing is pressed out of bearing carrier.

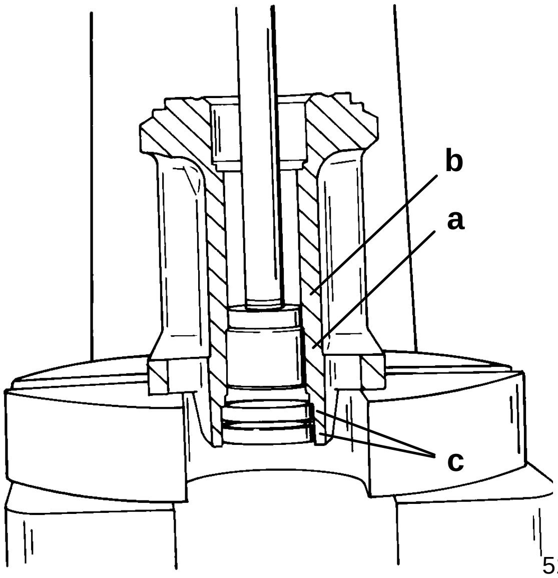
NOTE: *Unless propeller shaft needle bearing will be replaced, do not use step "2b."*



a - Pry Bar

3. If inspection of propeller shaft needle bearing determines that replacement of bearing is required, use Universal Bearing Removal and Installation Tool (C-91-31229A1), to press bearing and seals out of bearing carrier.

NOTE: *Reverse gear must be removed from bearing carrier before propeller shaft needle bearing can be removed.*



a - Propeller Shaft Needle Bearing
b - Mandrel
c - Oil Seals

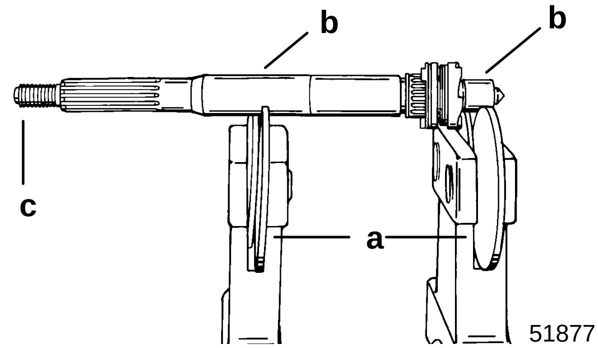
PROPELLER SHAFT CLEANING AND INSPECTION

NOTE: *Cam follower and 3 metal balls (in end of propeller shaft) are free and will fall out. Care should be taken not to lose cam follower or 3 balls.*

1. Clean propeller shaft assembly with solvent and dry with compressed air.
2. Inspect bearing carrier oil seal surfaces for grooves. Run fingernail across seal surface to check for grooves. Replace shaft, if a groove is found.
3. Visually check bearing surfaces of propeller shaft for pitting, grooves, scoring, uneven wear or discoloration (bluish color) from overheating. Replace shaft and corresponding needle bearing if any of the above conditions are found. (Bearing carrier needle bearing contacts propeller shaft just in front of oil seal surface. Forward gear bearing contacts propeller shaft in front of sliding clutch splines).
4. Inspect propeller shaft splines for wear and/or corrosion damage.
5. Check propeller shaft for straightness. Use either method, following:

Balance Wheels

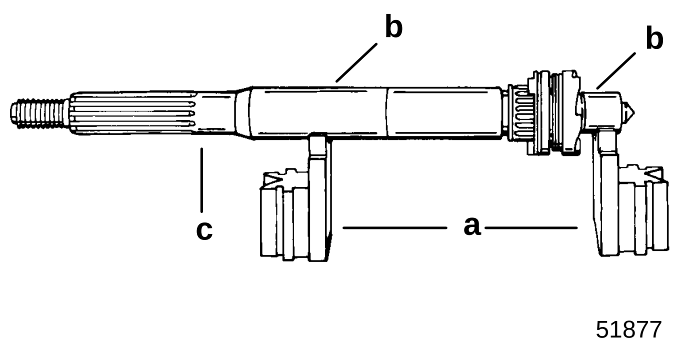
Place propeller shaft on balance wheels. Rotate propeller shaft, observe propeller end of shaft for “wobble” and replace shaft if any “wobble” is observed.



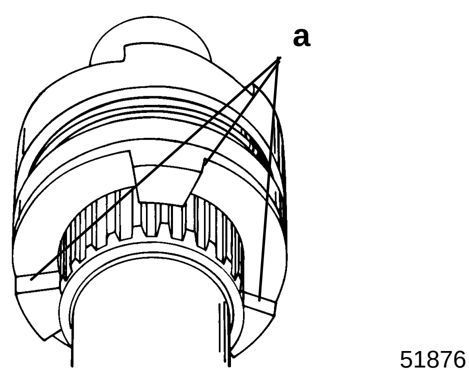
a - Balance Wheels
b - Bearing Surfaces
c - Watch for “Wobble”

“Vee” Blocks and Dial Indicator

Position propeller shaft needle bearing surfaces on “Vee” blocks. Mount a dial indicator at front edge of propeller splines (“c”). Rotate propeller shaft. Dial indicator movement of more than 0.006″ (0.152mm) (or noticeable “wobble”) is reason for replacement.



a - “Vee” Blocks
b - Bearing Surfaces
c - Measure with Dial Indicator at This Point

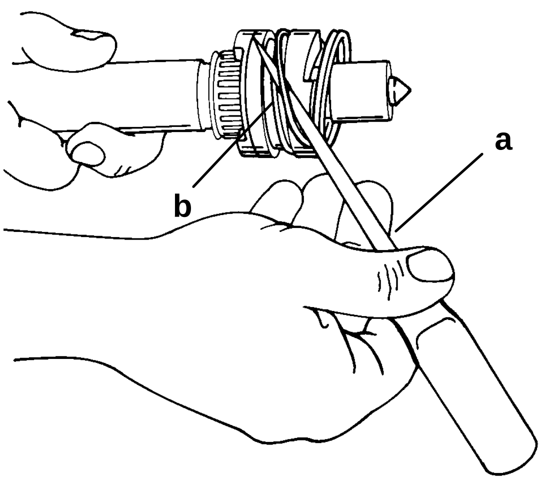


a - Clutch “Dogs”

6. Check the reverse gear shift "dogs". Rounded shift "dogs" indicate improper shift cable adjustment, improper shift habits of operator(s), shifting from NEUTRAL to REVERSE gear too slowly or engine idle speed too high (while shifting). Rounded clutch "dogs" on either the reverse side or forward side of sliding clutch is reason for replacement.
7. Check condition of cam follower. If it shows wear (pitting, scoring or rough surface), replace cam follower and shift cam.

PROPELLER SHAFT DISASSEMBLY

1. Position the propeller shaft cam follower against a solid surface.
2. Insert a thin blade screwdriver or awl under the first coil (from front) of cross pin retaining spring.



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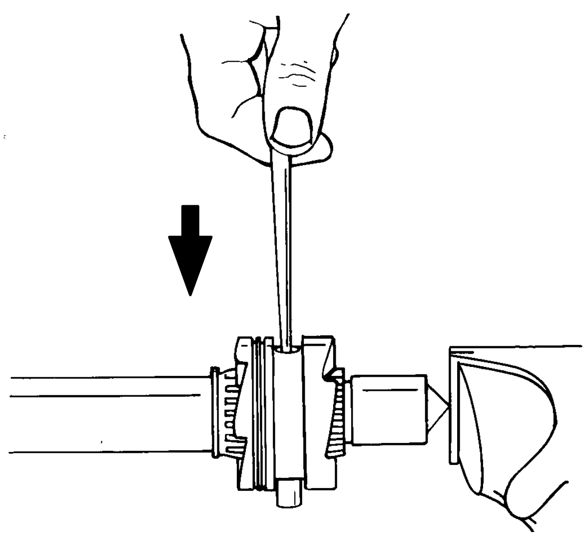
a - Awl
b - Cross Pin Retaining Spring



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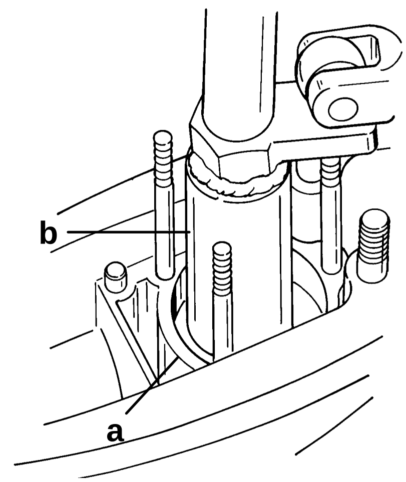
3. Rotate propeller shaft to unwind spring from sliding clutch. (DO NOT over-stretch spring.)
4. Push against cam follower. Use a punch or awl to push cross pin out of sliding clutch.
5. Release pressure against cam follower.
6. Tip propeller shaft to allow cam follower, 3 metal balls, guide block and spring to slide out of propeller shaft.

Pinion Gear and Driveshaft

REMOVAL

1. Remove bearing retainer.



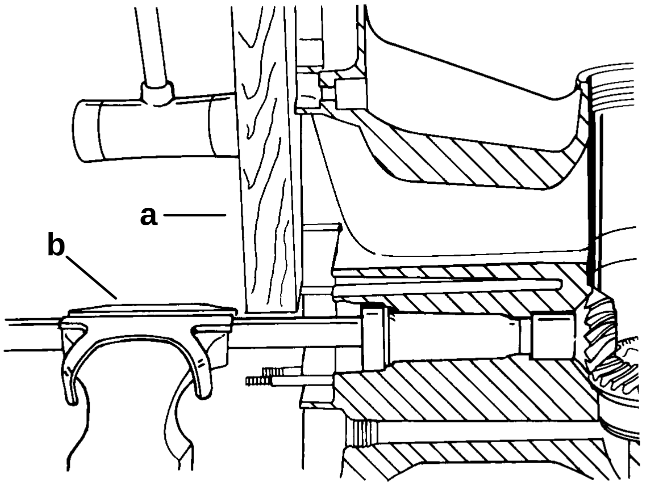
51875

a - Bearing Retainer
b - Bearing Retainer Tool (91-43506)

2. Place Driveshaft Holding Tool (91-34377A1) over driveshaft splines.
3. Use a socket and flex handle to hold pinion nut. (Pad area of gear housing, where flex handle will make contact, to prevent damage to gear housing.)
4. Use a socket and flex handle on Driveshaft Holding Tool to loosen pinion nut. Remove pinion nut and Driveshaft Holding Tool.
5. Remove gear housing from vise and reposition it as shown. Be sure to use soft jaw vise covers and clamp as close as possible to water pump studs.
6. Place a block of wood on gear housing mating surface. Use a mallet and carefully tap gear housing away from driveshaft.

⚠ CAUTION

DO NOT strike gear housing hard with the mallet or allow gear housing to fall.



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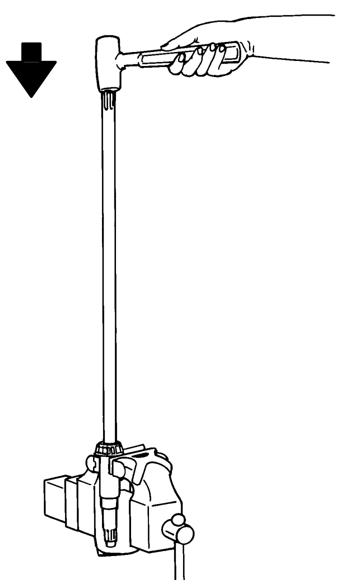
a - Wooden Block
b - Soft Jaw Vise Covers

7. If inspection determines that replacement of driveshaft tapered bearing is required (refer to **"Cleaning and Inspection"**, following), remove bearing from driveshaft as follows:
   a. Position driveshaft in a vise. DO NOT tighten vise jaws against shaft.
   b. Strike shaft with lead hammer; take care not to drop shaft.



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CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air. DO NOT allow driveshaft bearing to spin while drying.
2. Inspect pinion gear for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace pinion gear if any of the above conditions are found.
3. Inspect driveshaft needle bearing surface (area just above pinion gear splines) for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace driveshaft and driveshaft needle bearing if any of the preceding conditions are found.
4. Inspect driveshaft to crank shaft splines for wear. Replace driveshaft if wear is excessive.
5. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing and race as a set, if any of the preceding conditions are found.
6. Inspect driveshaft for groove(s) where water pump base oil seals contact shaft. Replace driveshaft if groove(s) are found.

Forward Gear and Bearings

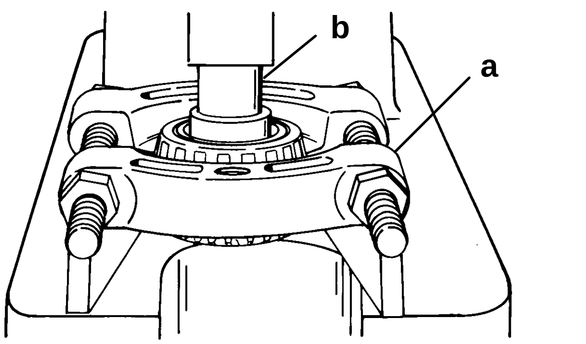
REMOVAL AND DISASSEMBLY

NOTE: *Forward gear can only be removed from gear housing after driveshaft and pinion gear have been removed.*

1. Reach into gear housing and lift out forward gear.

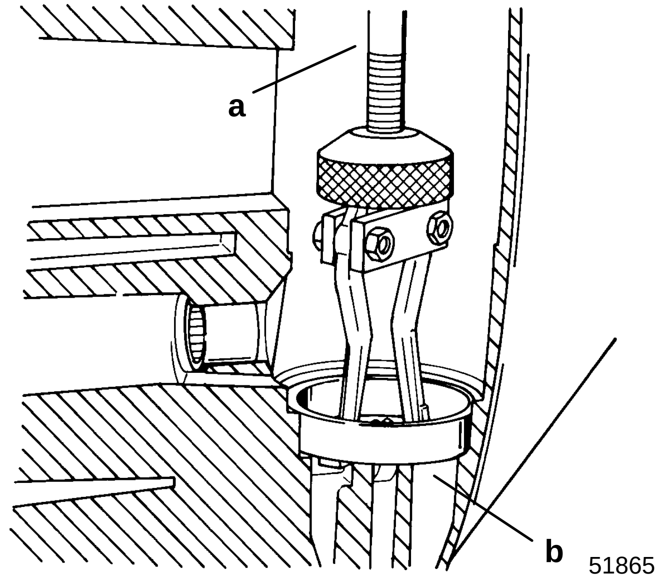
IMPORTANT: DO NOT remove tapered bearing or needle bearing from forward gear, unless replacement of bearings is required. (Bearings cannot be reused after they have been removed.)

2. If inspection determines that replacement of forward gear tapered bearing is required (Refer to **"Cleaning and Inspection"**, following), remove bearing from gear housing (tapered bearing MUST BE replaced as a set), as follows:
   a. Install Universal Puller Plate (91-37241) between forward gear and tapered bearing.
   b. Place forward gear, bearing and puller plate on a press and press gear out of bearing with a suitable mandrel.



a - Universal Puller Plate
b - Mandrel

   c. Use Slide Hammer (C-91-34569A1) to remove forward gear tapered bearing race.
   d. After forward gear tapered bearing race is removed from gear housing, lift out and retain shim(s) which were behind bearing race.



a - Slide Hammer
b - Tapered Bearing Race

3. If inspection determines that replacement of propeller shaft needle bearing in forward gear is required (refer to **"Cleaning and Inspection"**, following), remove bearing from gear, as follows:
   a. Clamp forward gear securely in soft jaw vise.
   b. From tooth-side of gear, drive propeller shaft needle bearing out of gear with a punch-and-hammer.

CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air.

⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearings to score.

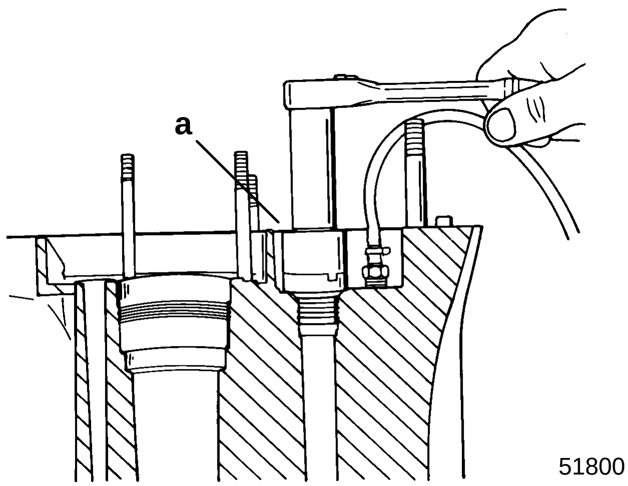
2. Inspect gear teeth for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace gear, if any of these conditions are found.
3. Check clutch jaws on forward gear for damage. Replace forward gear, if damage is found.
4. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing (on forward gear) and race, if any of these conditions are found. (Always replace tapered bearings as a set.)
5. To determine condition of propeller shaft needle bearing (in forward gear), inspect propeller shaft forward gear needle bearing surface, as outlined in "Propeller Shaft Inspection", preceding.

Shift Shaft, Bushing and Cam

SHIFT SHAFT REMOVAL

NOTE: *The propeller shaft, driveshaft and forward gear assembly must be removed before removal of shift shaft and shift cam.*

1. Use Shift Shaft Bushing Tool (91-31107) to unthread shift shaft bushing, then lift shift shaft bushing off shift shaft.



a - Shift Shaft Bushing Tool (91-31107)

2. After bushing is removed, lift shift shaft out of gear housing.
3. Once shift shaft is removed, the shift cam is free and can be removed from propeller shaft cavity.

SHIFT SHAFT, BUSHING, CAM CLEANING AND INSPECTION

1. Clean all parts (shift shaft, bushing and cam) with solvent and dry with compressed air.
2. Inspect shift cam for wear on shift ramps.
3. Inspect shift shaft for grooves at shift shaft bushing seal surface. Also check for wear and/or corrosion damage on upper and lower splines.
4. Inspect shift shaft bushing for corrosion damage.
5. Inspect shift shaft bushing oil seal for wear or cuts.

NOTE: *If shift shaft bushing is equipped with 2 oil seals, and seals need to be replaced, order a new shift shaft bushing assembly. Seals in a 2 seal shift shaft bushing assembly are not replaceable.*

6. Check "E" clip (if equipped) for damage. Replace clip if damaged.

SHIFT SHAFT AND BUSHING DISASSEMBLY

1. Remove (and discard) O-ring from shift shaft bushing.
2. Remove (and discard) oil seal by prying out or driving it out with a punch and hammer.
3. Remove (and discard) "E" ring, (if equipped) if inspection determines that replacement is required.

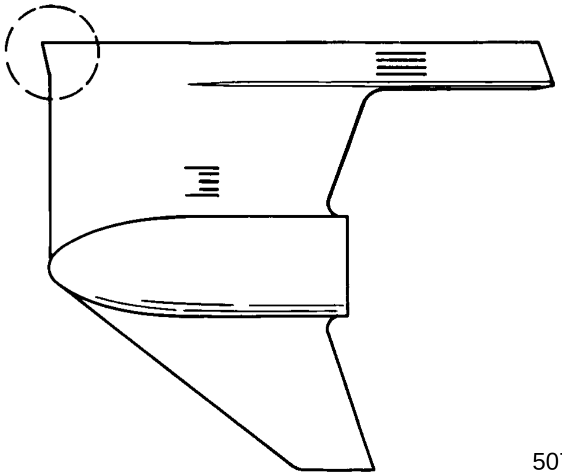
Gear Housing

CLEANING AND INSPECTION

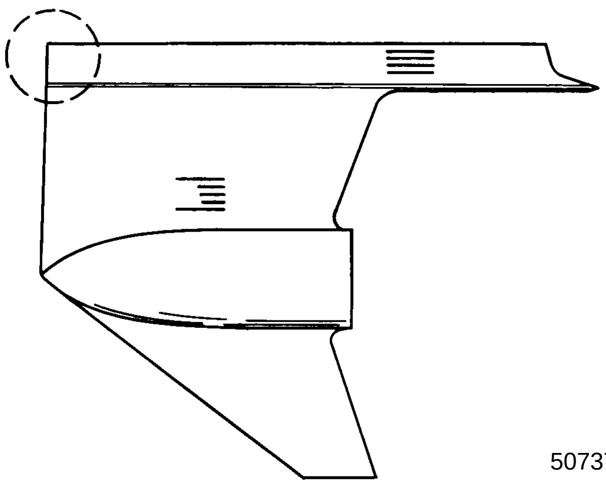
1. Clean gear housing with solvent and dry with compressed air.
2. Check gear housing carefully for impact damage.
3. Check for loose fitting bearing cups and needle bearings.
4. Inspect bearing carrier cover nut retainer threads in gear housing for corrosion damage and/or stripped threads.

Driveshaft Needle Bearing

NOTE: *Two different sized driveshaft needle bearings may be found in XR6 and MAGNUM III gearcases. Externally, these gearcases may be identified as follows:*



EARLY MODEL

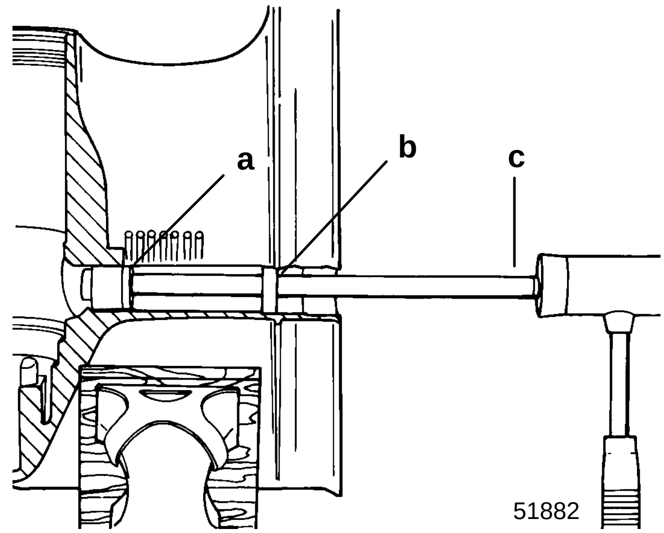


LATE MODEL

After identity of gear case has been established, refer to the appropriate driveshaft needle bearing removal and installation procedure.

REMOVAL OF DRIVESHAFT NEEDLE BEARING - EARLY MODEL

1. If inspection of driveshaft needle bearing surface (refer to **"CLEANING and INSPECTION,"** following) determines that replacement of needle bearing is required, remove bearing from gear housing, following.
2. Remove forward gear from gear housing.
3. Using suitable mandrel, PILOT (91-36571), and DRIVER ROD (91-37323), remove race from gear housing.



a - Suitable Mandrel
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)

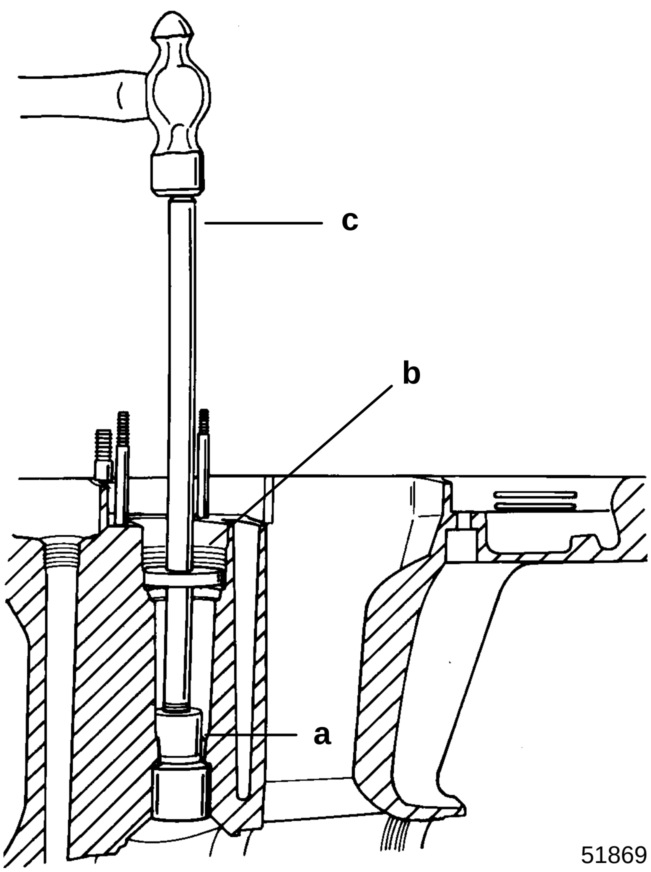
*From Bearing Removal and Installation Kit (91-31229A5)

IMPORTANT: Discard driveshaft needle bearing after removal (bearing cannot be reused).

IMPORTANT: If DRIVESHAFT NEEDLE BEARING RACE has spun in bore in gear housing, gear housing MUST BE REPLACED as reinstalling new bearing in old housing will result in repeat bearing failure.

REMOVAL OF DRIVESHAFT NEEDLE BEARING - LATE MODEL

1. If inspection of driveshaft needle bearing surface (refer to **"CLEANING and INSPECTION,"** following) determines that replacement of needle bearing is required, remove bearing from gear housing, following.
2. Remove forward gear from gear housing.
3. Verify 18 loose needle bearings are in place in bearing race to provide a surface for mandrel to drive against.
4. Using MANDREL (91-37263), PILOT (91-36571), and DRIVER ROD (91-37323), remove race from gear housing.



a - Mandrel (91-37263)
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)

*From Bearing Removal and Installation Kit (91-31229A5)

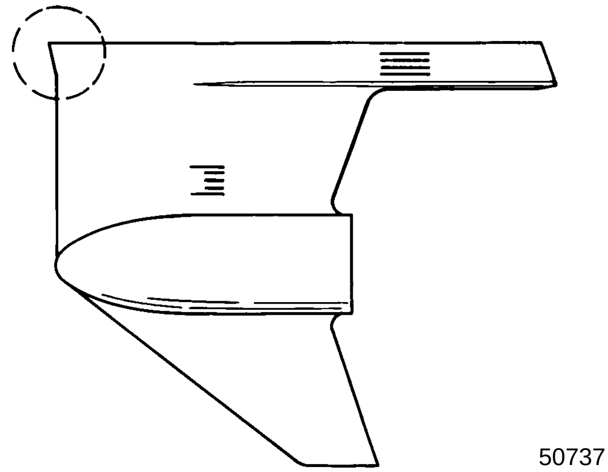
IMPORTANT: Discard driveshaft needle bearing after removal (bearing cannot be reused).

IMPORTANT: If DRIVESHAFT NEEDLE BEARING RACE has spun in bore in gear housing, gear housing MUST BE REPLACED as reinstalling new bearing in old housing will result in repeat bearing failure.

Reassembly and Installation

Driveshaft Needle Bearing

INSTALLATION - EARLY MODEL



EARLY MODEL

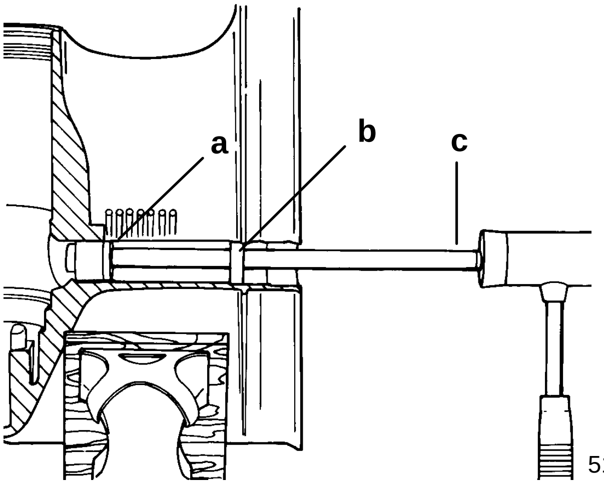
NOTE: *New gear housings have a driveshaft needle bearing already installed.*

⚠ CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing must be replaced. Loose fitting needle bearing will move out of position and cause repeated failure.

1. Position driveshaft needle bearing over driver head (from Bearing Removal and Installation Kit 91-31229A1) with numbered side of bearing toward shoulder of driver head.
2. Thread driver rod from kit into driver head.
3. Lubricate needle bearing area of driveshaft cavity with a thin coat of Quicksilver 2-4-C w/Teflon Marine Lubricant.
4. Position rod, driver head and bearing into gear housing driveshaft cavity.
5. Place pilot washer (from kit) over driver rod and slide it down into driveshaft bearing cavity.

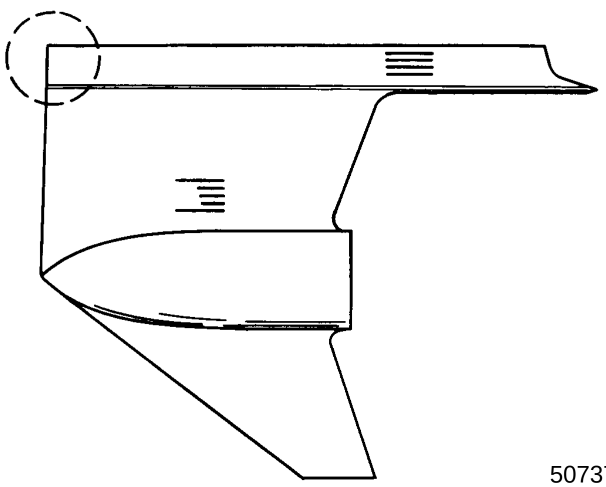
6. Use a mallet to drive needle bearing downward until it is approximately 1/16″ (1 .6mm) above bottom end of driveshaft cavity. Remove driver rod, mandrel and pilot washer.



a - Mandrel (91-37263)
b - Pilot Washer (91-36571)
c - Driver Rod (91-37323)

Driveshaft Needle Bearing

INSTALLATION - LATE MODEL



LATE MODEL

NOTE: *New gear housings have a driveshaft needle bearing already installed.*

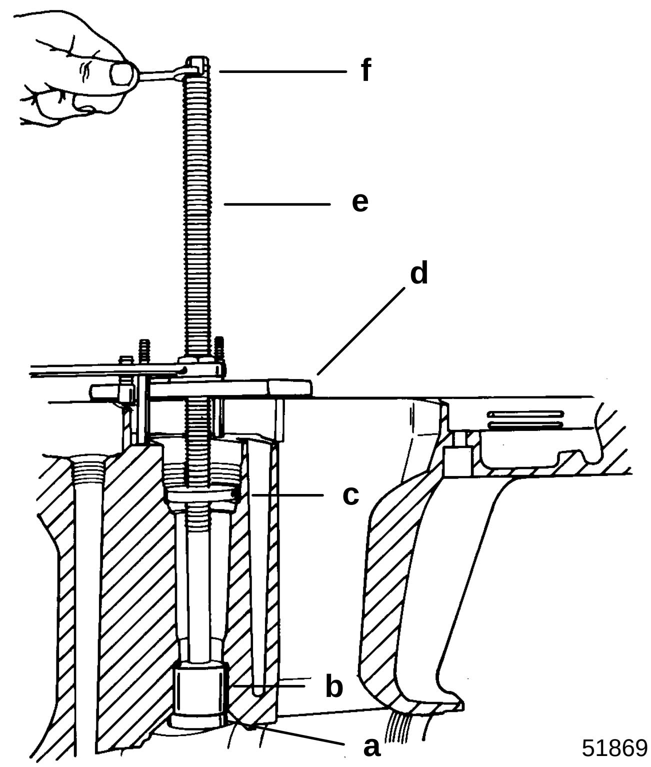
⚠ CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing must be replaced. Loose fitting needle bearing will move out of position and cause repeated failures.

1. Apply a thin coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to driveshaft needle bearing bore in gear housing.
2. By way of propeller shaft cavity, place needle bearing in driveshaft bore with numbered side of bearing facing up driveshaft bore.
3. Install and seat needle bearing with the following tools: Puller Rod* (91-31229), Nut* (91-24156), Pilot* (91-36571), Plate* (91-29310), and Mandrel (91-38628).

Pull bearing up into bore until it bottoms on gear housing shoulder. (DO NOT use excessive force.)

*From Bearing Removal and Installation Kit (91-31229A5)

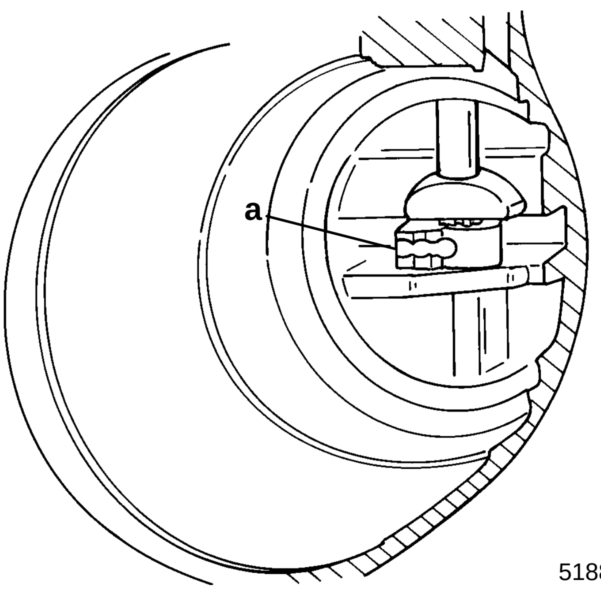


a - Mandrel (91-38628)
b - Bearing
c - Pilot (91-36571)
d - Plate (91-29310)
e - Puller Rod (91-31229)
f - Hold

Lower Shift Shaft and Bushing

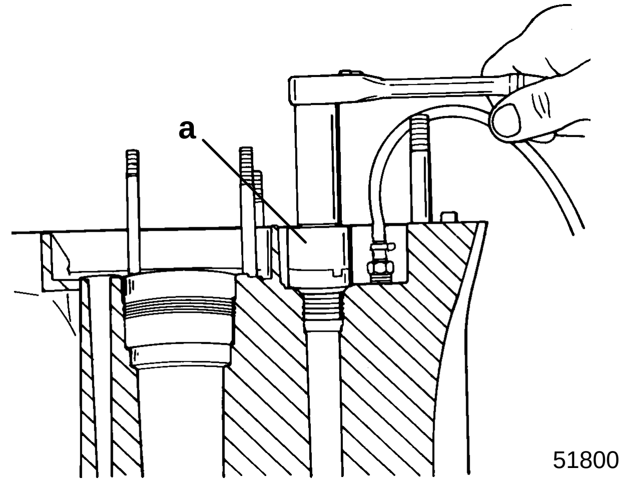
REASSEMBLY AND INSTALLATION

1. Position shift shaft bushing on a press with threaded side down.
2. Apply a small amount of Loctite 271 to outside diameter of oil seal.
3. Press oil seal into shift shaft bushing with lip of seal up.
4. Wipe off any excess Loctite from oil seal and bushing.
5. Place rubber washer against oil seal.
6. Install O-ring over threads and up against shoulder of bushing.
7. Lubricate O-ring and oil seal with 2-4-C w/Teflon Marine Lubricant.
8. Install “E” clip (if equipped) into groove in lower shift shaft.
9. Position shift cam (with word “UP” facing up towards powerhead) into forward portion of gear housing between cast webbing. Ramps on shift cam must be visible from rear of gear housing [longer side of cam (reverse ramp) must be toward left side of gear housing (fill screw hole side)].
10. Place lower shift shaft (short spline end) into shift shaft cavity. Rotate shift shaft to engage splines into splines of shift cam.



a - Longer Side

11. Apply a light coat of 2-4-C w/Teflon to threads of shift shaft bushing.
12. Place shift shaft bushing over shift shaft and start threads of bushing into gear housing by hand.
13. Finish tightening shift shaft bushing with Shift Shaft Bushing Tool (91-31107).
14. Torque Bushing to 50 lb. ft. (67.5 N·m).

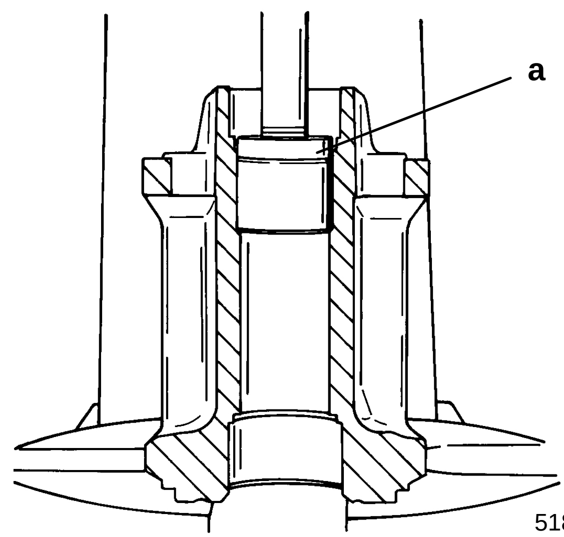


a - Shift Shaft Bushing Tool (91-31107)

Bearing Carrier

REASSEMBLY

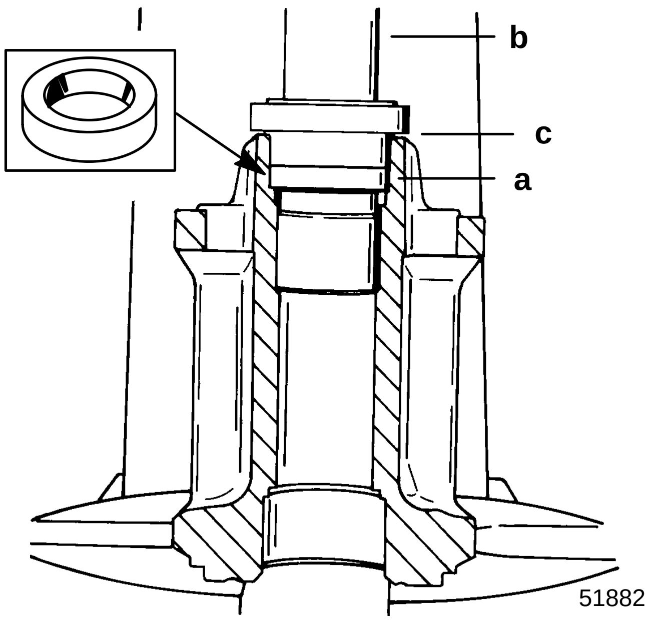
1. Apply a light coat of Needle Bearing Assembly Lubricant onto outside diameter of propeller shaft needle bearing.
2. Place propeller shaft needle bearing into aft end of bearing carrier with numbered side toward aft end.
3. Use a suitable mandrel and press needle bearing into bearing carrier.



a - Mandrel

4. Apply Loctite 271 to outer diameter of propeller shaft oil seals.

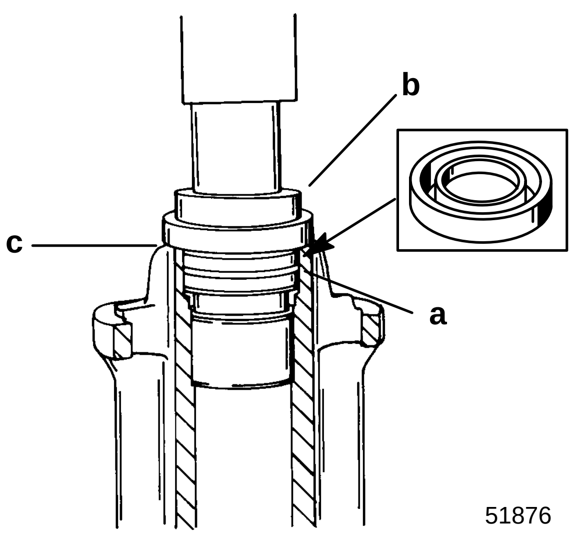
5. Place one seal on longer shoulder side of Oil Seal Driver (91-31108) with lip of seal away from shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.



a - Oil Seal (Lip of Seal Down)
b - Oil Seal Driver (91-31108)
c - Seated

6. Place second seal on short shoulder side of seal driver with lip of seal toward shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.

7. Wipe off excess Loctite.



a - Oil Seal (Lip of Seal Up)
b - Oil Seal Driver
c - Seated

8. Assemble bearing carrier, as follows:

   a. Install O-ring onto groove on bearing carrier.

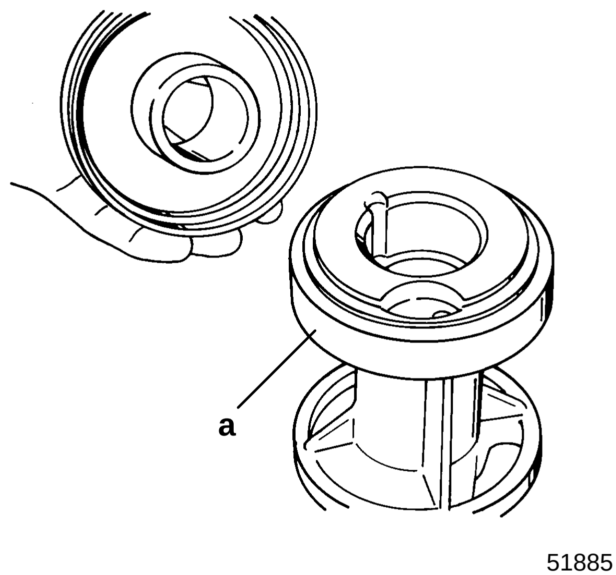
IMPORTANT: The reverse gear thrust washer has a tapered outside diameter so that one side is larger than the other. The smaller diameter of washer must be toward bearing carrier.

   b. Place thrust washer onto bearing carrier with the smaller outside diameter down toward bearing carrier.

   c. Apply Super Duty Gear Lubricant onto reverse gear journal and on bearing surface of bearing carrier where reverse gear rides.

   d. Install reverse gear into bearing carrier.

   e. Lubricate oil seals and O-ring with 2-4-C w/ Teflon Marine Lubricant.



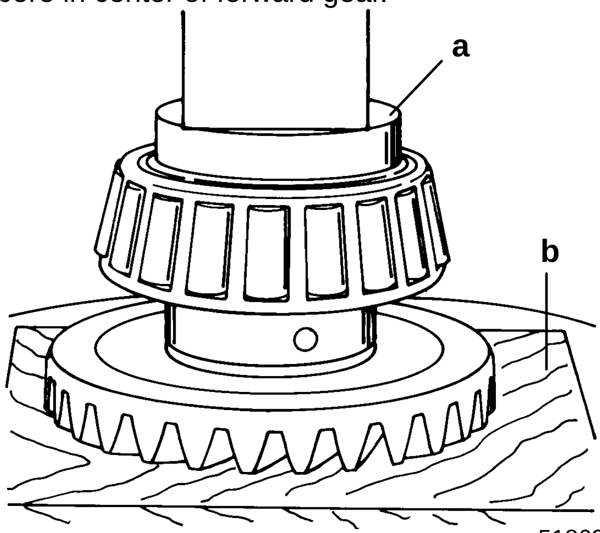
a - O-ring Groove

Forward Gear and Race

REASSEMBLY

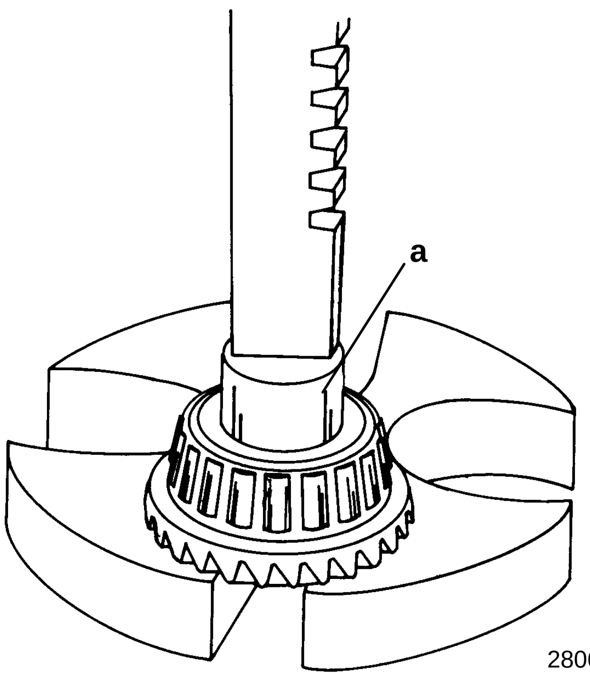
1. Place forward gear on a press with gear teeth down.
2. Apply Super Duty Gear Lubricant onto the inside diameter of forward gear tapered bearing.
3. Position forward gear tapered bearing over gear, as shown.
4. Press bearing onto gear until firmly seated. (Be sure to press only on inner race of bearing that bearing is firm against the gear.)

5. Apply Quicksilver Super Duty Gear Lubricant to bore in center of forward gear.



a - Mandrel
b - Wooden Block

6. Position forward needle bearing (numbered side up) over center bore of forward gear. Use Forward Gear Needle Bearing Installation Tool (91-818149) to press needle bearing into gear.



a - Forward Gear Needle Bearing Installation Tool (91-818149)

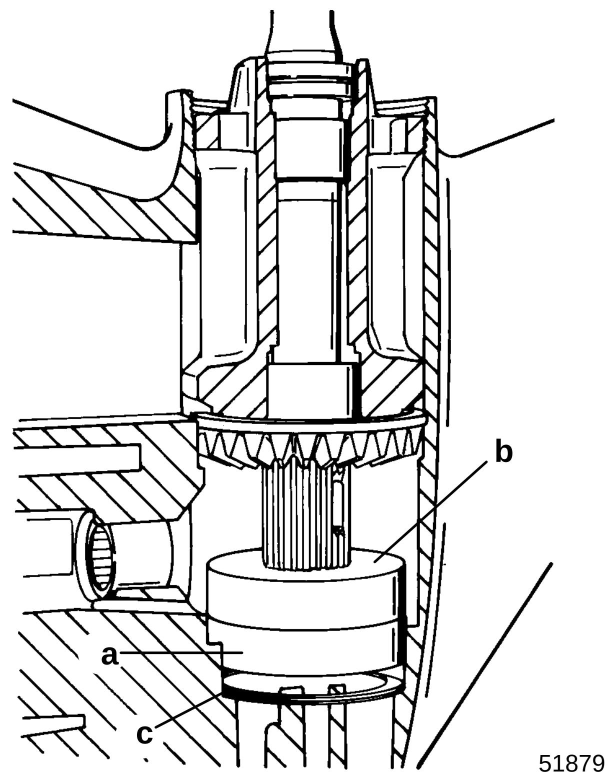
7. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost, or are not reusable (damaged), start with approximately 0.010″ (0.254mm).
8. Apply a light coat of Quicksilver Super Duty Gear Lubricant to forward gear bearing race bore in gear housing.
9. Position tapered bearing race squarely over bearing bore in front portion of gear housing.
10. Place Bearing Driver Cup (91-31106) over tapered bearing race.

NOTE: *A used propeller shaft is recommended for use in Step 11.*

11. Place propeller shaft into hole in center of bearing driver cup.

NOTE: *The bearing carrier is used as a pilot while installing forward gear bearing race, and it must be completely assembled.*

12. Install bearing carrier assembly over propeller shaft and lower it into gear housing. Bearing carrier acts as a pilot to assure proper bearing race alignment.
13. Thread a nut onto propeller shaft to protect propeller shaft threads.
14. Use a mallet to drive propeller shaft against bearing driver cup until tapered bearing race is seated against shim(s).



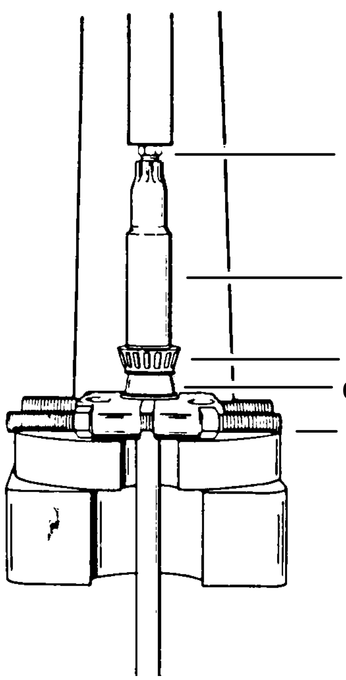
a - Tapered Bearing Race
b - Bearing Driver Cup (91-31106)
c - Shims

15. Remove nut from propeller shaft, then remove bearing carrier and propeller shaft from gear housing. Lift bearing driver cup out of gear housing.
16. Apply a light coat of oil on tapered bearing race. Place forward gear assembly into forward bearing race.

Driveshaft and Pinion Gear

REASSEMBLY/INSTALLATION

1. Apply Quicksilver Super Duty Gear Lubricant on I.D. of driveshaft tapered bearing.
2. Thread a used pinion nut onto end of driveshaft. Leave approximately 1/16″ (2mm) of nut threads exposed. Driveshaft threads MUST NOT extend beyond nut or thread damage could result while pressing.
3. Place bearing over driveshaft.
4. Using an old driveshaft bearing inner race or other suitable mandrel (which applies pressing force on center bearing race only), press bearing onto shaft until seated.
5. Remove used pinion nut from driveshaft.



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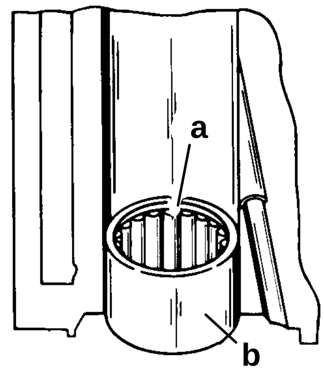
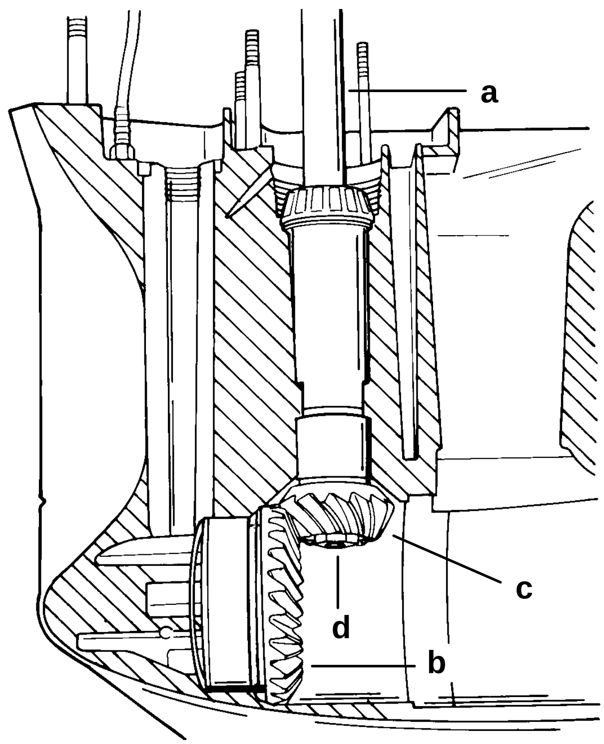
a - Used Pinion Nut
b - Driveshaft
c - Tapered Bearing
d - Old Bearing Inner Race
e - Universal Puller Plate (91-37241)

6. Install 18 needles into race of driveshaft needle bearing, using Quicksilver 2-4-C w/Teflon Marine Lubricant to retain needles.



a - (18) Needles
b - Bearing Race

7. Place forward gear assembly into forward gear bearing race.
8. Place pinion gear into gear housing.
9. Insert driveshaft into gear housing.
10. Install pinion nut. Hand tighten pinion nut.



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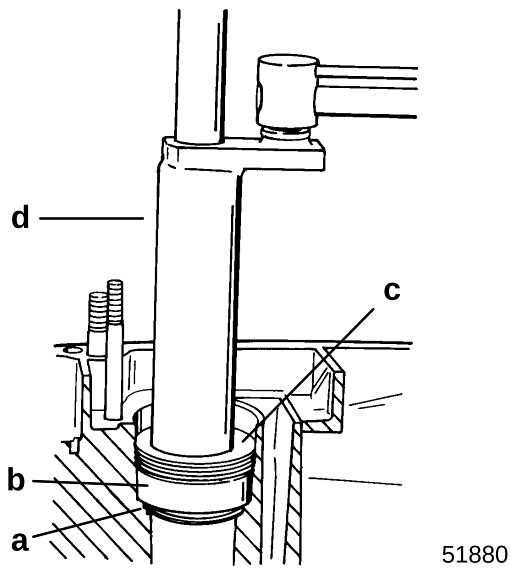
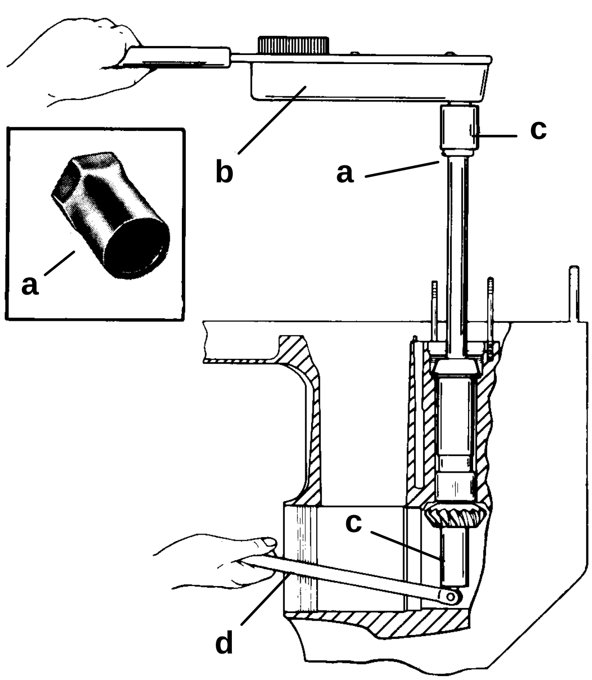
a - Driveshaft (Rotate to Engage Splines with Pinion Gear)
b - Forward Gear Assembly
c - Pinion Gear
d - Pinion Nut (Apply Loctite 271 on Threads and Install with Flat Side Away from Pinion Gear)

11. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost, or are not reusable (damaged), start with approximately 0.010″ (0.254mm).
12. Install bearing race and bearing retainer.



a - Shim(s)
b - Bearing Race
c - Bearing Retainer (Word “OFF” Must Be Visible); Torque to 100 lb. ft. ((135.5 N·m)
d - Bearing Retainer Tool (91-43506)

13. Torque pinion nut.



a - Driveshaft Holding Tool (91-34377A1)
b - Torque Wrench; Torque Nut to 80 lb. ft. (108.5 N·m)
c - Socket
d - Breaker Bar

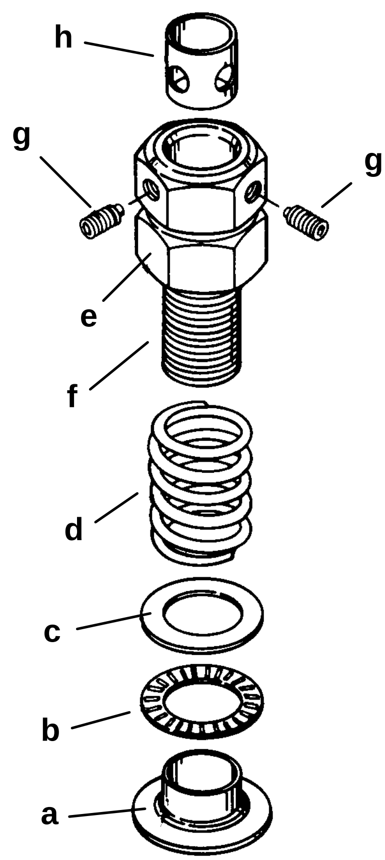
Determining Pinion Gear Depth

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Forward gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

1. Clean the gear housing bearing carrier shoulder and diameter.
2. Install Bearing Preload Tool (91-14311A1) over driveshaft in sequence shown.

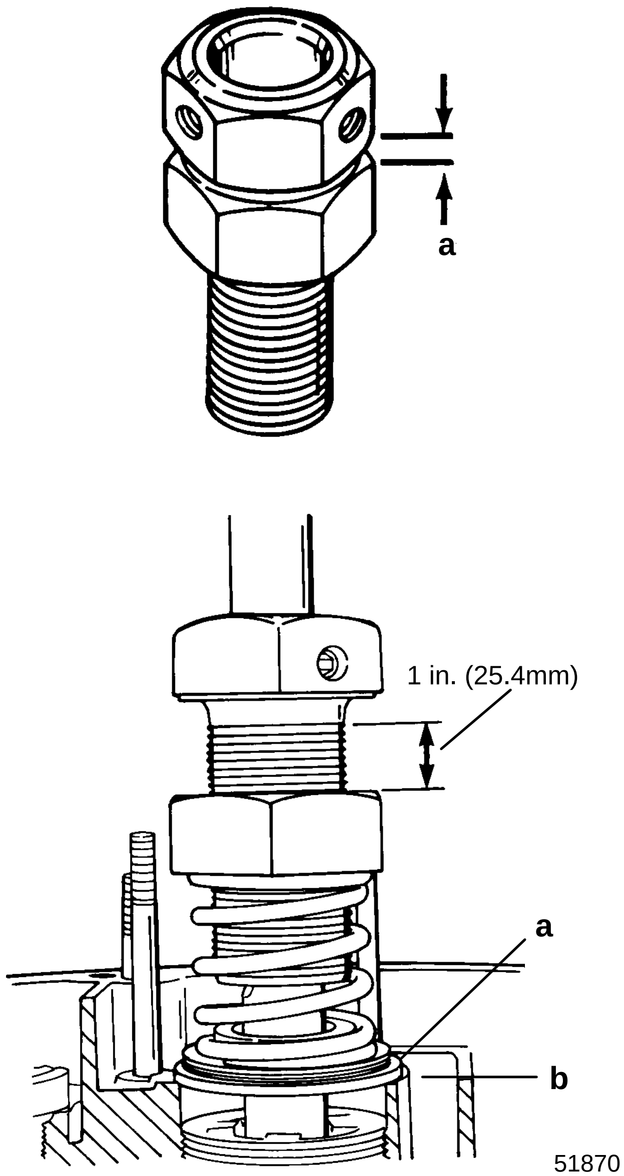
NOTE: *Bearing Preload Tool (91-44307A1) may also be used. Follow instructions provided with tool for proper installation.*



a - Adaptor
b - Bearing
c - Washer
d - Spring
e - Nut; Thread Nut All-The-Way onto Bolt
f - Bolt
g - Set Screw
h - Sleeve; Holes in Sleeve Must Align With Set Screw

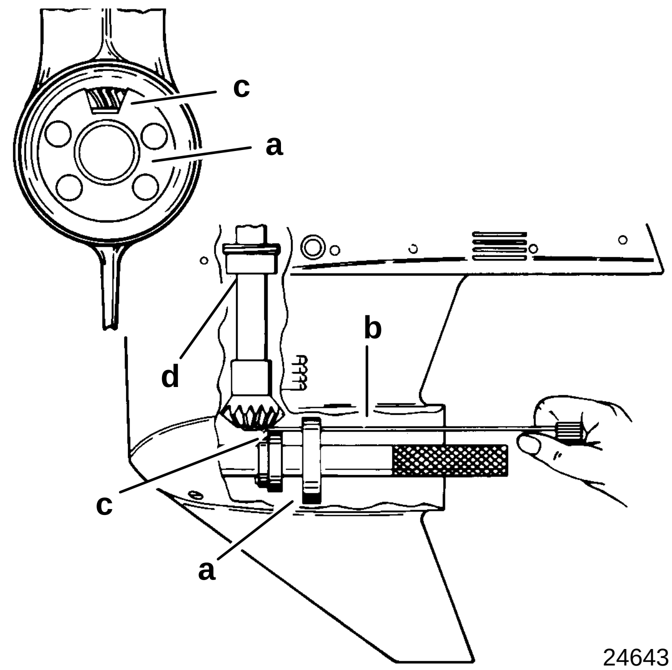
3. Align adaptor on driveshaft bearing pocket ledge.
4. With tool installed over driveshaft tighten both set screws securely, making certain to align sleeve holes to allow set screws to pass thru.

5. Measure distance (a) and increase that distance by 1″ (25.4mm) by turning bottom nut away from top nut.



a - Adaptor
b - Ledge

6. Turn driveshaft clockwise 2 or more turns to seat driveshaft bearings.
7. Insert Pinion Gear Locating Tool 91-12349A2 into gear housing until it bottoms-out on bearing carrier shoulder. Use Disc #1 and Flat #1. Follow instructions provided with tool.
8. Determine pinion gear depth by inserting a feeler gauge thru access slot in pinion gear shimming tool.
9. Clearance between shimming tool and pinion gear should be 0.025″ (0.64mm).
10. If clearance is correct, leave Bearing Preload Tool on driveshaft and proceed to **"Determining Forward Gear Backlash,"** following.
11. If clearance is not correct, add (or subtract) shims at location shown to raise (or lower) pinion gear. When reinstalling pinion nut, apply Loctite 271 on threads of nut.



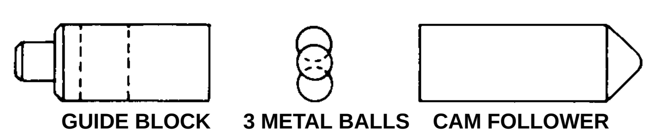
a - Pinion Gear Shimming Tool
b - Feeler Gauge
c - Obtain 0.025″ (0.64mm) Clearance between Shimming Tool and Pinion Gear
d - Add or Subtract Shim(s) Here

Propeller Shaft

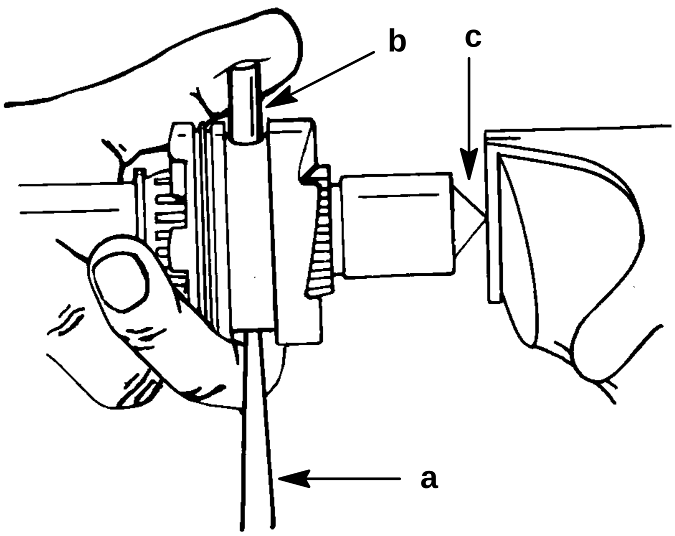
REASSEMBLY

1. Position sliding clutch over clutch splines with cross pin hole aligned with cross pin slot in propeller shaft.
2. Insert spring into end of propeller shaft.
3. Insert guide block (stepped end) into front end of propeller shaft with cross pin hole aligned with cross pin hole in sliding clutch.

CAM FOLLOWER COMPONENTS

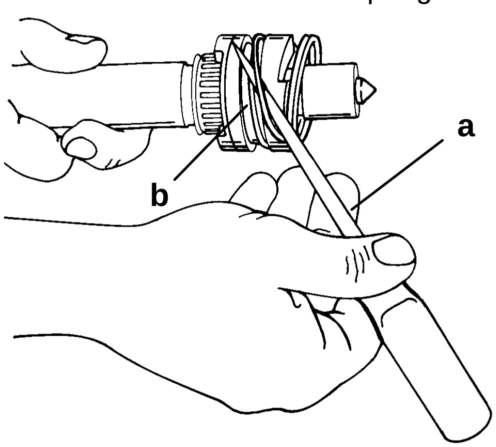


4. Lubricate 3 metal balls with Quicksilver 2-4-C w/ Teflon Marine Lubricant; insert balls into propeller shaft.
5. Place a small amount of 2-4-C w/Teflon into end of propeller shaft and insert cam follower into propeller shaft (flat end first).
6. Place cam follower against a solid object and push against cam follower to compress spring. Hold propeller shaft in this position.
7. Use a punch to align guide block cross pin opening with sliding clutch cross pin hole. Remove punch and insert cross pin. Release pressure on spring.



a - Punch
b - Cross Pin
c - Cam Follower

8. Install cross pin retainer spring over sliding clutch. DO NOT over-stretch spring.



a - Awl
b - Spring

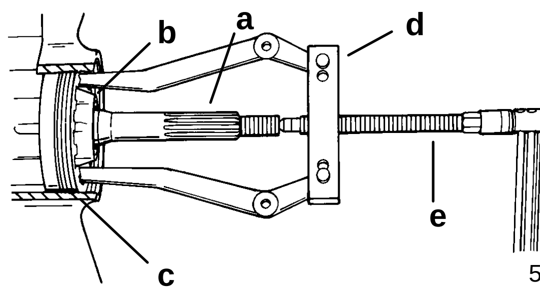
INSTALLATION

Place propeller shaft into center of forward gear assembly.

Determining Forward Gear Backlash

NOTE: *Read entire procedure before attempting any change in shim thickness.*

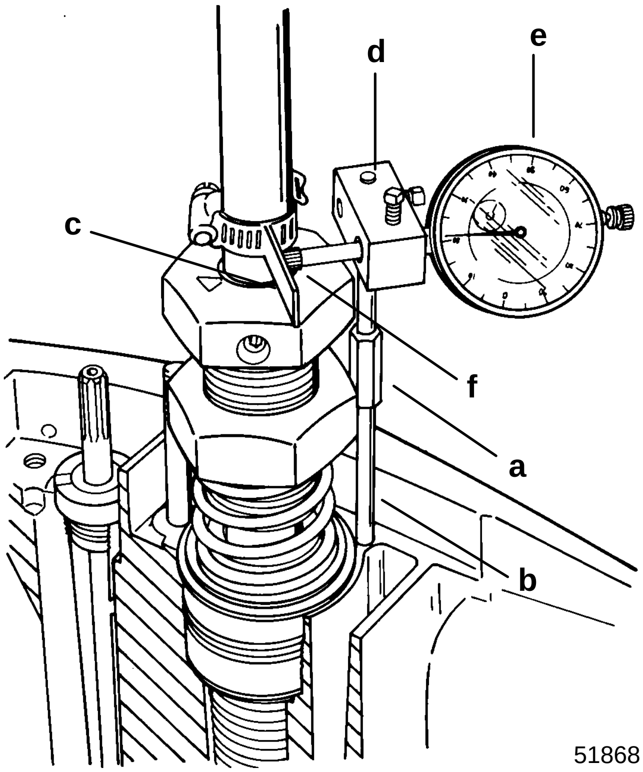
1. Obtain correct pinion gear depth; refer to **"Determining Pinion Gear Depth"** procedure.
2. Install Bearing Preload Tool (91-14311A1) on driveshaft; refer to **"Determining Pinion Gear Depth,"** preceding.
3. Install components as shown.



a - Propeller Shaft (Horizontal Position)
b - Bearing Carrier (Assembled and Bearing Carrier Key Installed)
c - Cover Nut (Tighten; DO NOT Torque)
d - Bearing Carrier Removal Tool (91-46086A1)
e - Puller Bolt (91-85716); Torque to 45 lbs. in. (5.0 N·m)

4. Thread Stud Adaptor [from Bearing Preload Tool (91-14311A1)] all the way onto stud.
5. Install: Backlash Indicator Tool (91-19660)
   Dial Indicator Holder (91-89897)
   Dial Indicator (91-58222A1)
6. Position dial indicator pointer on line marked "2" on Backlash Indicator Tool.
7. Lightly turn driveshaft back-and-forth (no movement should be noticed at propeller shaft).
8. Dial Indicator (e) registers amount of backlash which MUST BE 0.016″ to 0.019″ (0.41 mm to 0.48mm).
9. If backlash is **less** than 0.16″ (0.41mm) **remove** shim(s) from in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite Grade 271 on threads of nut.
10. If backlash is **more** than 0.019″ (0.48mm), **add** shim(s) in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.

NOTE: *By adding or subtracting 0.001″ (0.025mm) shim, the backlash will change approximately 0.001″ (0.025mm).*



a - Stud Adaptor
b - Stud
c - Backlash Indicator Tool (91-19660)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)
f - Dial Indicator Pointer

11. Remove bearing carrier removal tool and puller bolt from gearcase assembly.
12. Remove cover nut and apply 2-4-C w/Teflon Marine Lubricant to cover nut threads in gearcase.
13. Install tab washer against bearing carrier.

NOTE: *Gearcase should be mounted in a suitable gearcase stand or bolted to engine driveshaft housing before attempting to torque cover nut.*

14. Start cover nut a few turns by hand, then, using Cover Nut Tool (91-73688) and torque wrench, torque cover nut to 210 lb. ft. (285.0 N·m).
15. Bend one lock tab of tab washer into cover nut (only one will align).
16. Bend remaining tabs of tab washer toward front of gear housing.

NOTE: *Reverse gear backlash is not adjustable. However, reverse gear backlash which should be 0.030″ - 0.048″ (0.76mm - 1.21 mm) can be measured to determine proper assembly of gearcase as follows:*

a. With dial indicator and backlash indicator installed as previously shown, shift gearcase into reverse gear.
b. While holding propeller shaft, shift gearcase into NEUTRAL and rotate propeller shaft approximately 1/24 of a turn or 3° - 5° of rotation.
c. Shift gearcase into REVERSE. Clutch dog teeth and reverse gear clutch teeth should not engage but strike against one another.
d. While holding shift mechanism in this position, gently rock driveshaft back and forth to determine reverse gear backlash.

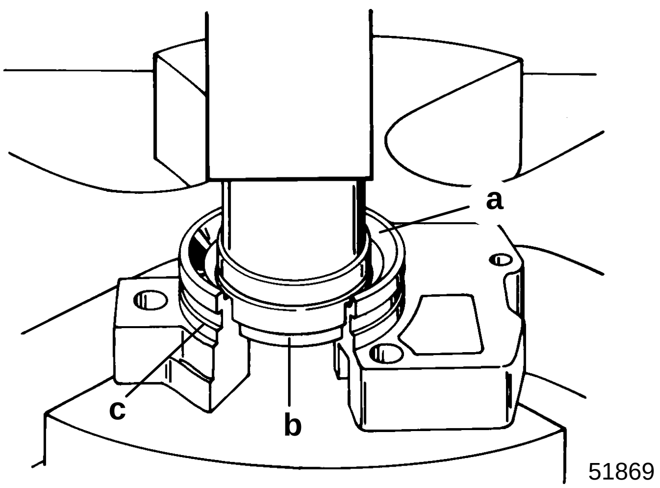
If reverse gear backlash is not within the specified tolerance, then gearcase is not properly assembled or parts are excessively worn .In either case, the gearcase will have to be disassembled and corrections made before gearcase is returned to service.

e. Remove bearing preload tool, backlash indicator tool, dial indicator holder and dial indicator from gear housing assembly.

Water Pump

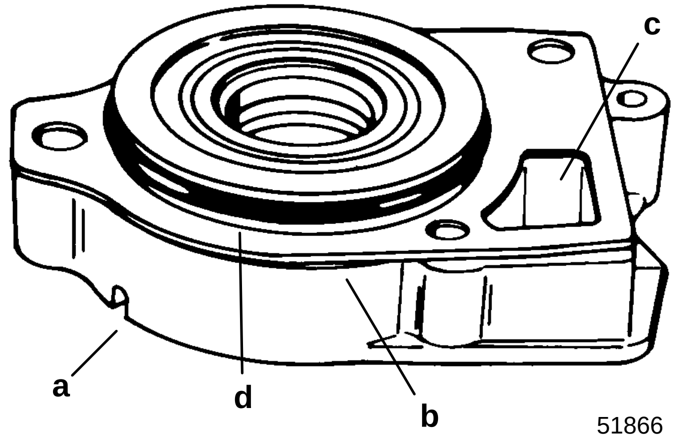
REASSEMBLY/INSTALLATION

1. Install divider block; use RTV Sealer to seal seams between divider block and gear housing.
2. Install oil seals into water pump base, as follows:
   a. Place water pump base on a press.
   b. Just before installing each seal apply Loctite 271 on outside diameter of oil seal.
   c. With a suitable mandrel, press the smaller diameter oil seal into pump base with lip of oil seal toward impeller side of base.
   d. With a suitable mandrel, press the larger diameter oil seal into pump base with lip of oil seal toward gear housing side of base.
   e. Wipe any excess Loctite from oil seals and water pump base.



a - Mandrel
b - Oil Seal (Smaller OD)
c - O-ring Groove

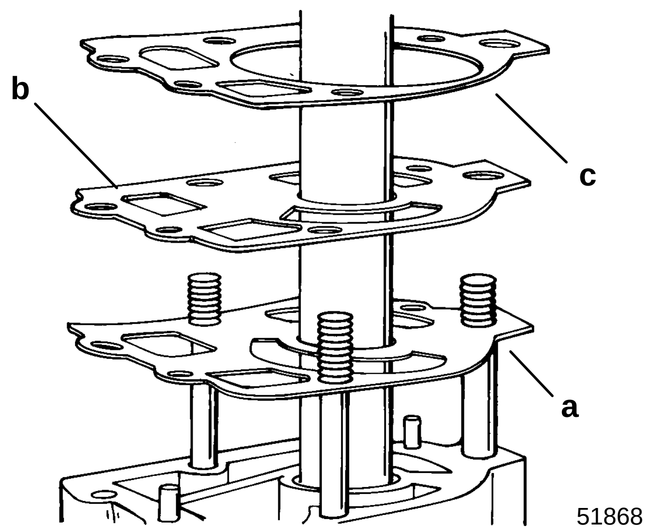
3. Install O-ring into O-ring groove of water pump base.
4. Lubricate O-ring and oil seals with 2-4-C w/Teflon Marine Lubricant (92-90018A12).
5. Install a new water pump base gasket and install water pump base.



a - Water Pump Base
b - Gasket
c - Hole
d - O-ring

6. Install the following in order:
   1. Pump base to face plate gasket
   2. Face plate to pump cover gasket.

   Gaskets and face plate are indexed by dowel pin location and must be installed correctly.



a - Gasket (Water Pump Base to Face Plate)
b - Face Plate
c - Gasket (Face Plate to Water Pump Cover)

7. Place impeller drive key on flat of driveshaft. Hold key on driveshaft with a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant.

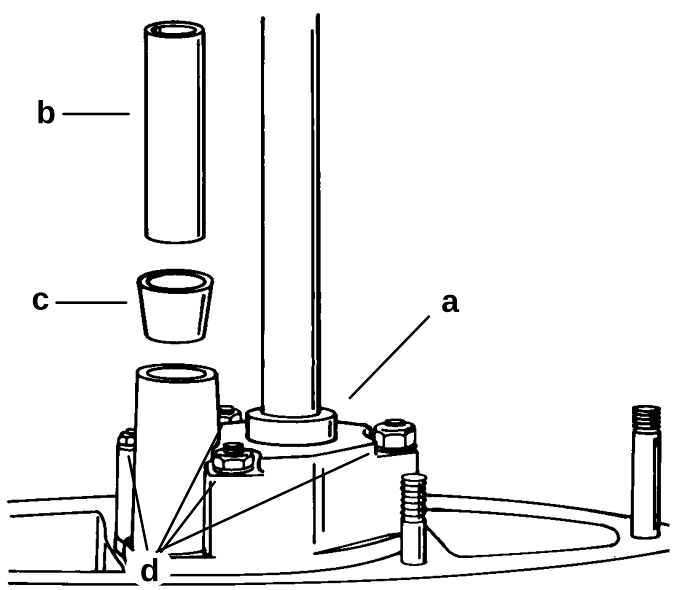
IMPORTANT: When completing gear housing repair, that requires removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to reuse the impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur. Original rotation is clockwise.

CAUTION

A visual inspection of impeller drive key MUST BE made to determine that drive key is on flat of driveshaft after impeller is installed. It key has moved off flat of driveshaft, repeat Steps 7 and 8.

8. Slide impeller down driveshaft to impeller drive key. Align drive key with keyway in the center hub of impeller, and slide impeller over drive key.
9. If removed, install new water pump insert into pump cover as follows:
   a. Apply Quicksilver Perfect Seal to water pump insert area of pump cover.
   b. Install water pump insert into pump cover. Verify that tab on insert enters recess in pump cover.
   c. Wipe any excess Quicksilver Perfect Seal from insert and cover.

***NOTE:** If 2 holes were drilled in top of water pump cover to aid in removal of insert, fill holes with RTV Sealer or equivalent. Allow to cure 24 hours prior to operating engine.*



a - Centrifugal Slinger
b - Water Tube Guide
c - Water Tube Seal
d - Nuts, Bolts and Washers

10. Install water tube seal into pump cover. Verify that plastic side of seal goes into cover first.
11. Reinstall water tube guide into water pump cover.
12. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant on inside of water pump insert.
13. Position assembled water pump cover over driveshaft and lower over water pump studs. Rotate driveshaft in a clockwise direction (viewed from top), while pushing down on pump cover to ease impeller entry into cover.
14. Install water pump cover retainer washers, nuts and bolt.

CAUTION

DO NOT over-torque nuts and bolt, as this could cause cover to crack during operation.

15. Torque water pump nuts to 50 lb in. (5.5 N·m), and water pump bolt to 35 lb. in. (4.0 N·m).
16. Install centrifugal slinger over driveshaft and down against pump cover.

Filling Gear Housing With Lubricant

1. Remove any gasket material from “Fill” and “Vent” screws and gear 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 thru “Fill” hole with Quicksilver Gear Lubricant until lubricant flows out of “Vent” hole and no air bubbles are visible.
4. Install “Vent” screw into “Vent” hole.

IMPORTANT: DO NOT lose more than one fluid ounce (30cc) of gear lubricant while reinstalling “Fill” screw.

5. Remove grease tube (or hose) from “Fill” hole and quickly install “Fill” screw into “Fill” hole.

Installing Gear Housing to Driveshaft Housing

WARNING

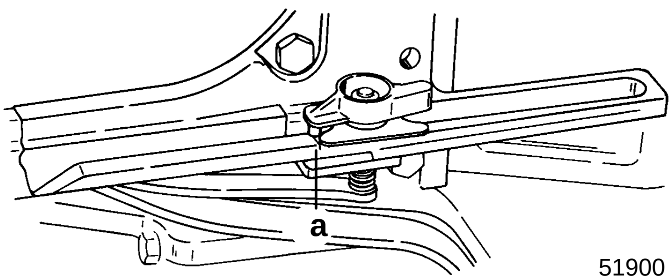
Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing onto driveshaft housing.

1. Tilt outboard to full up position and engage the tilt lock lever.
2. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto driveshaft splines.

⚠ CAUTION

DO NOT allow lubricant on top of driveshaft. Excess lubricant, that is trapped in clearance space, will not allow driveshaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of driveshaft) will load the driveshaft/crankshaft and damage either or both the powerhead and gear housing. Top of driveshaft is to be wiped tree of lubricant.

3. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Apply a thin bead of G.E. Silicone Sealer (obtained locally) against the top of divider block.
5. Insert trim tab bolt into hole in rear of gear housing and place guide block anchor pin into forward gear position.
6. Shift gear housing into forward gear and place guide block anchor pin into forward gear position.



a - Guide Block Anchor Pin

7. Position gear housing so that the driveshaft is protruding into driveshaft housing.

NOTE: *If, while performing Step 8, the driveshaft splines will not align with crankshaft splines, place a propeller onto propeller shaft and turn it counterclockwise as the gear housing is being pushed toward driveshaft housing.*

8. Move gear housing up toward driveshaft housing, while aligning shift shaft splines and water tube with water tube guide (in water pump cover).
9. Place flat washers onto studs (located on either side of driveshaft housing). Start nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside anodic plate recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gearcase up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to listing in **"Torque Specifications,"** preceding.
13. After 2 nuts (located on either side of driveshaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into reverse gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shift operation is not as described, preceding, the gear housing must be removed and the cause corrected.

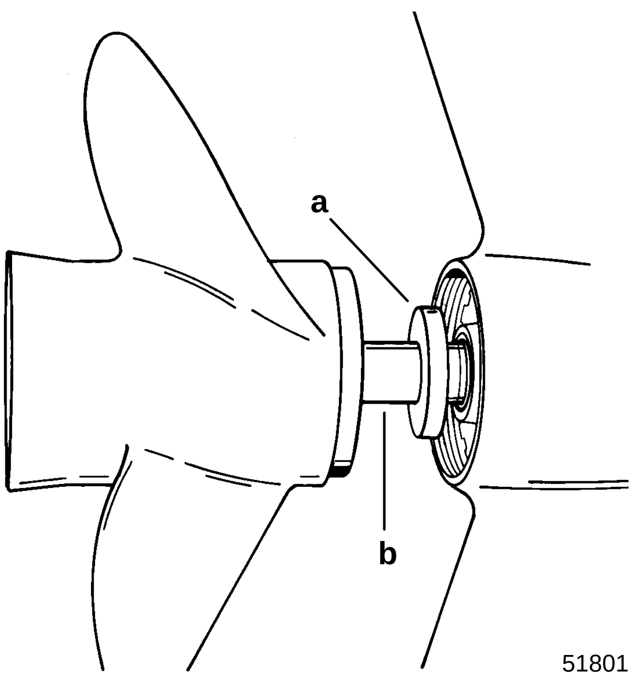
14. Install washers and nuts onto studs (located on bottom center of anti-cavitation plate). Torque to listing in **"Torque Specifications"**, preceding.
15. Install special flat washer and nut on stud at leading edge of driveshaft housing. Torque to listing in **"Torque Specifications"**, preceding.
16. Torque bolt (Started in Step 10) to listing in **"Torque Specifications"**, preceding.
17. Install trim tab, adjust to position in which it had previously been installed, and tighten securely.
18. Install plastic cap into trim tab bolt opening at rear edge of driveshaft housing.

Propeller Installation

⚠ WARNING

When installing or removing the propeller on all models, because of the motor's ease in starting, verify that the remote control is in NEUTRAL position and that the key switch is "OFF". Place a block of wood between the anti-cavitation plate and propeller to prevent accidental motor starting and to protect hands from propeller blades while removing propeller nut.

1. Apply a liberal coat of Anti-Corrosion Grease (92-78376A6) on propeller shaft splines.
2. Place thrust hub onto propeller shaft.
3. While aligning splines, place propeller onto propeller shaft.



51801

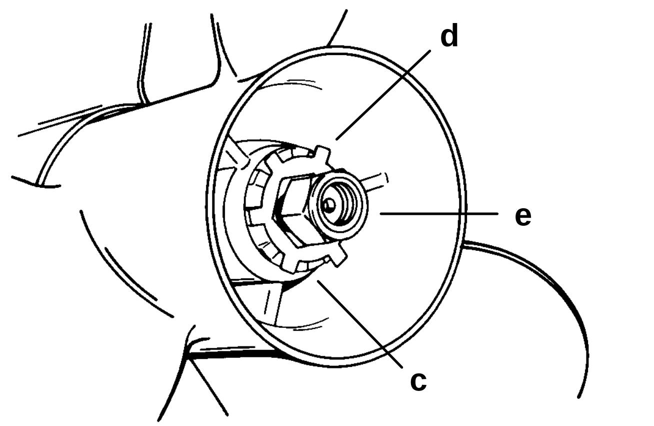
a - Thrust Hub
b - Propeller Shaft

4. Place propeller nut in tab washer groove.
5. Thread propeller nut onto propeller shaft.
6. After propeller nut is recessed into tab washer, tighten nut securely [minimum of 55 lb. ft. (74.5 N·m) torque].
7. Bend 3 of the tabs of tab washer down in grooves of propeller hub to secure propeller nut. (If tab washer tabs do not align with slots, continue to tighten propeller nut to obtain alignment. DO NOT loosen nut to align tabs.)

⚠ CAUTION

DO NOT misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; however, propeller should not move forward-and-aft on propeller shaft.

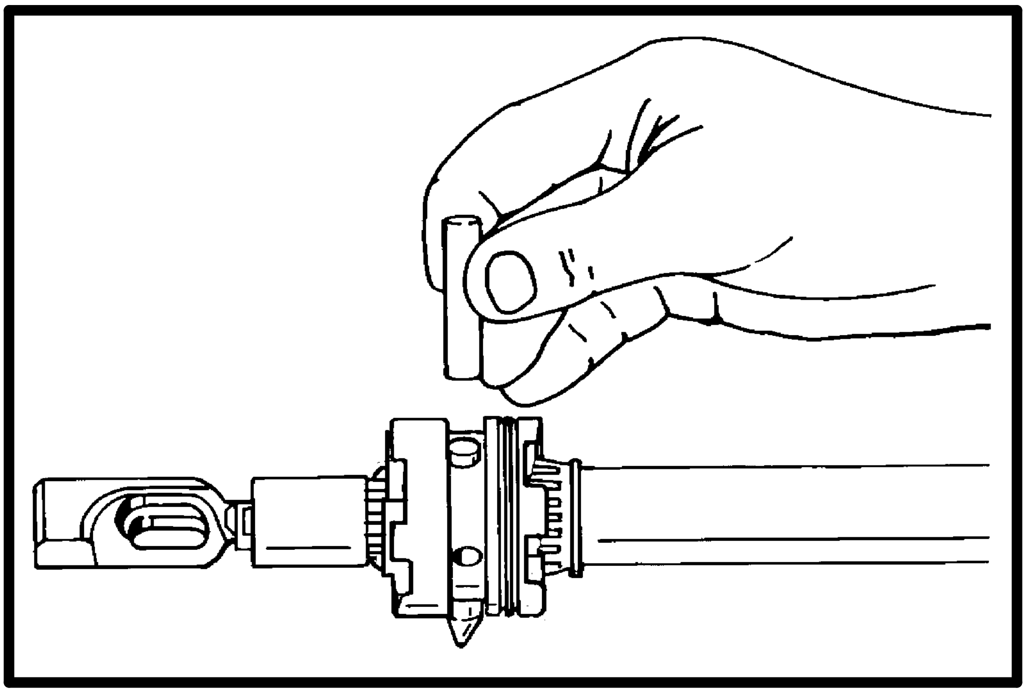
8. After first use, retighten propeller nut and again secure with tab washer (Steps 6 and 7, above). Propeller should be checked periodically for tightness, particularly if stainless steel propellers are used.



51866

c - Propeller Hub
d - Tab Washer
e - Propeller Nut

LOWER UNIT



E-Z SHIFT GEAR HOUSING
(NON-RATCHETING)
(STANDARD ROTATION)

6

D

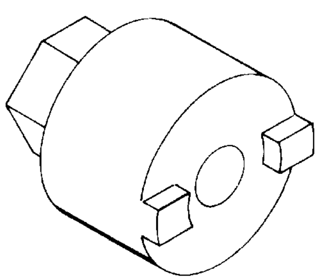
Table of Contents

Gear Housing Specifications (Standard Rotation)

Ratio	Pinion Depth	Forward Gear Backlash	Reverse Gear Backlash
1.87:1 (15/28 teeth)	0.025 in. (0.635mm) With Tool 91-12349A 2 using Disc #2 and Flat #7	0.018 in. to 0.027 in. (0.460mm to 0.686mm) Pointer on line mark #1	0.030 in. to 0.050 in. (0.762mm to 1.27mm)
2.0:1 (15/30 teeth)	0.025 in. (0.635mm) With Tool 91-12349A 2 using Disc #2 and Flat #7	0.015 in. to 0.022 in. (0.38mm to 0.56mm) Pointer on line mark #2	0.030 in. to 0.050 in. (0.762mm to 1.27mm)
2.3:1 (13/30 teeth)	0.025 in. (0.635mm) With Tool 91-12349A 2 using Disc #2 and Flat #7	0.018 in. to 0.023 in. (0.46mm to 0.58mm) Pointer on line mark #4	0.030 in. to 0.050 in. (0.762mm to 1.27mm)
Gearcase Lubricant Capacity			
All Ratios		22.5 fl. oz. (665.4ml)	

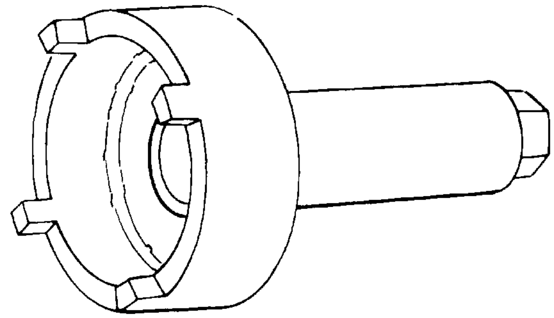
Special Tools

Shift Shaft Bushing Tool 91-31107



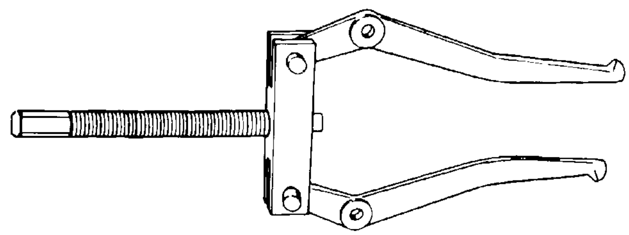
73658

Gear Housing Cover Nut Tool 91-61069



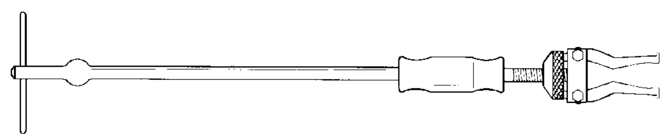
73605

Bearing Carrier Removal Tool 91-46086A1 and Puller Bolt 91-85716



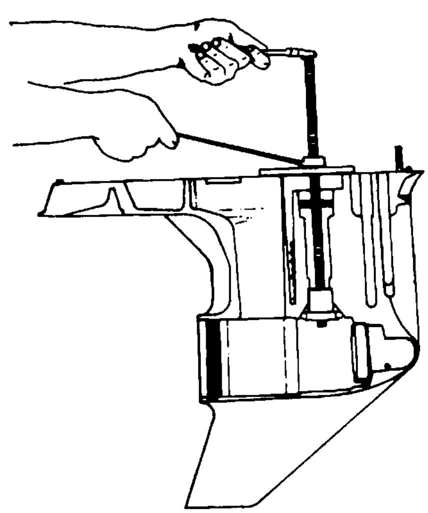
73599

Slide Hammer Puller 91-34569A1



73655

Bearing Removal and Installation Kit 91-31229A5. This kit contains the following tools: Pilot 91-36571; Puller Rod 91-31229; Nut 11-24156; Puller Plate 91-29310; Mandrel 91-38628; and Driver Rod 91-37323.



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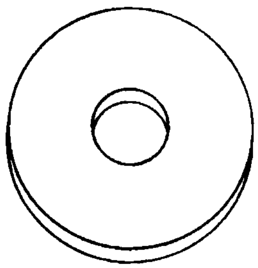
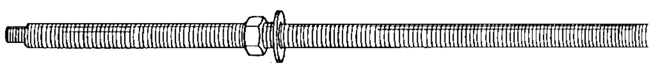
Pilot 91-36571

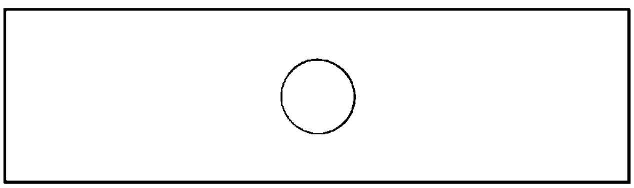


74187

Puller Rod 91-31229 and Nut 91-24156

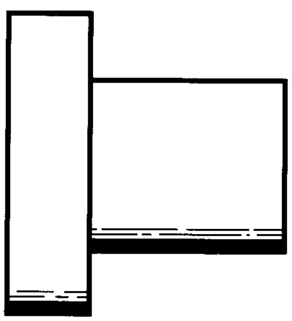


Puller Plate 91-29310



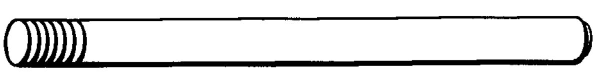
74190

Mandrel 91-38628



74193

Driver Rod 91-37323



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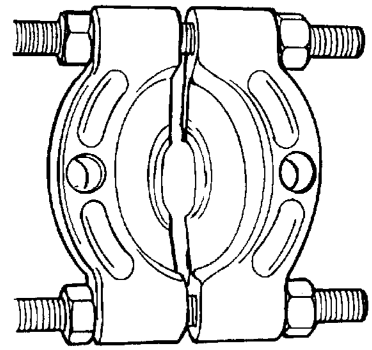
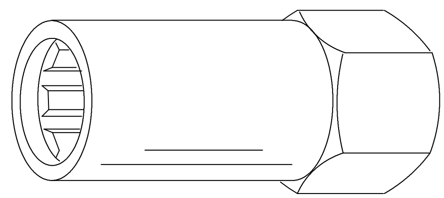
Universal Puller Plate 91-37241



73652

Cross Pin Tool 91-86642

Driveshaft Holding Tool 91-34377A1



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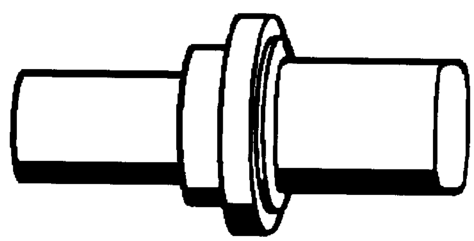
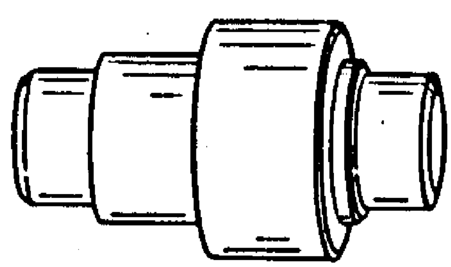
Oil Seal Driver 91-31108

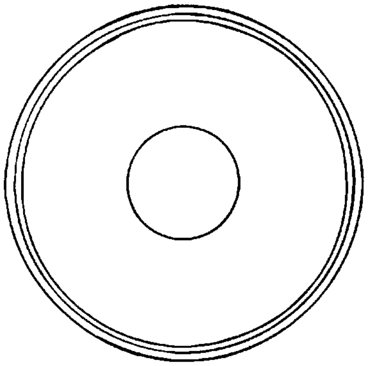


73651

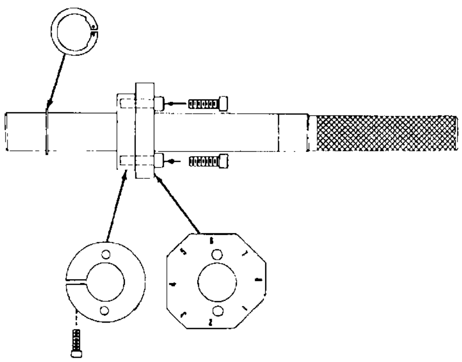
Forward Gear Bearing Tool 91-86943

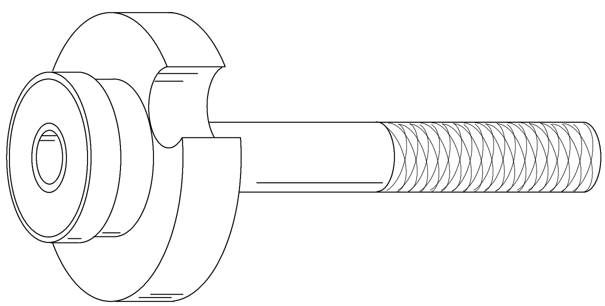


Bearing Driver Cup 91-31106



Pinion Locating Gear Tool 91-12349A2 or 91-74776





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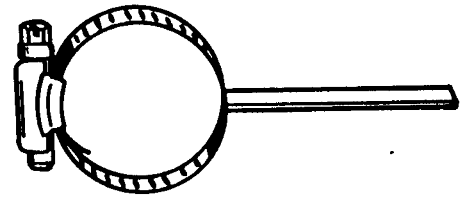
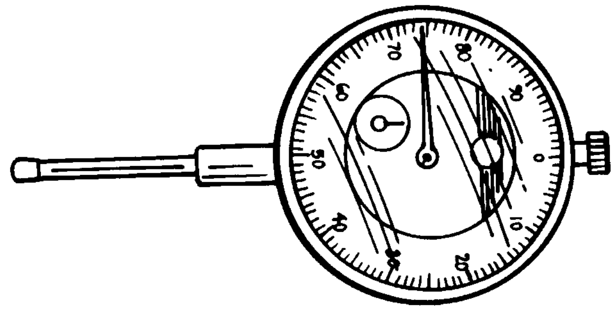
Backlash Indicator Rod 91-78473

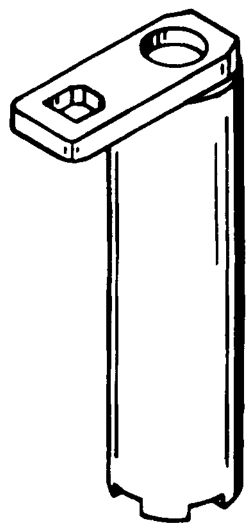


Dial Indicator 91-58222A1



73429

Bearing Retainer Tool 91-43506



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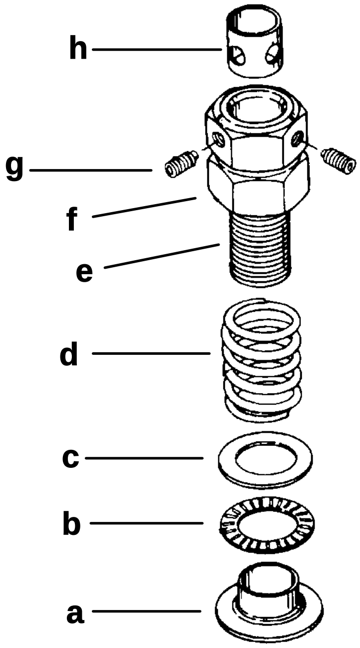
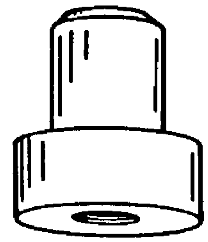
Bearing Preload Tool 91-14311A1

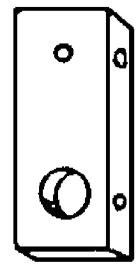


a - Adaptor (N.S.S.)
b - Bearing (N.S.S.)
c - Washer (N.S.S.)
d - Spring (24-14111)
e - Bolt (10-12580)
f - Nut (11-13953)
g - Set Screw (10-12575)
h - Sleeve (23-13946)

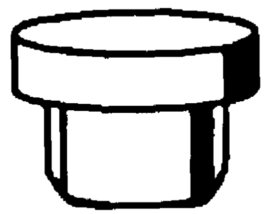
Mandrel 91-92788



Dial Indicator Holder 91-89897



Mandrel 91-15755



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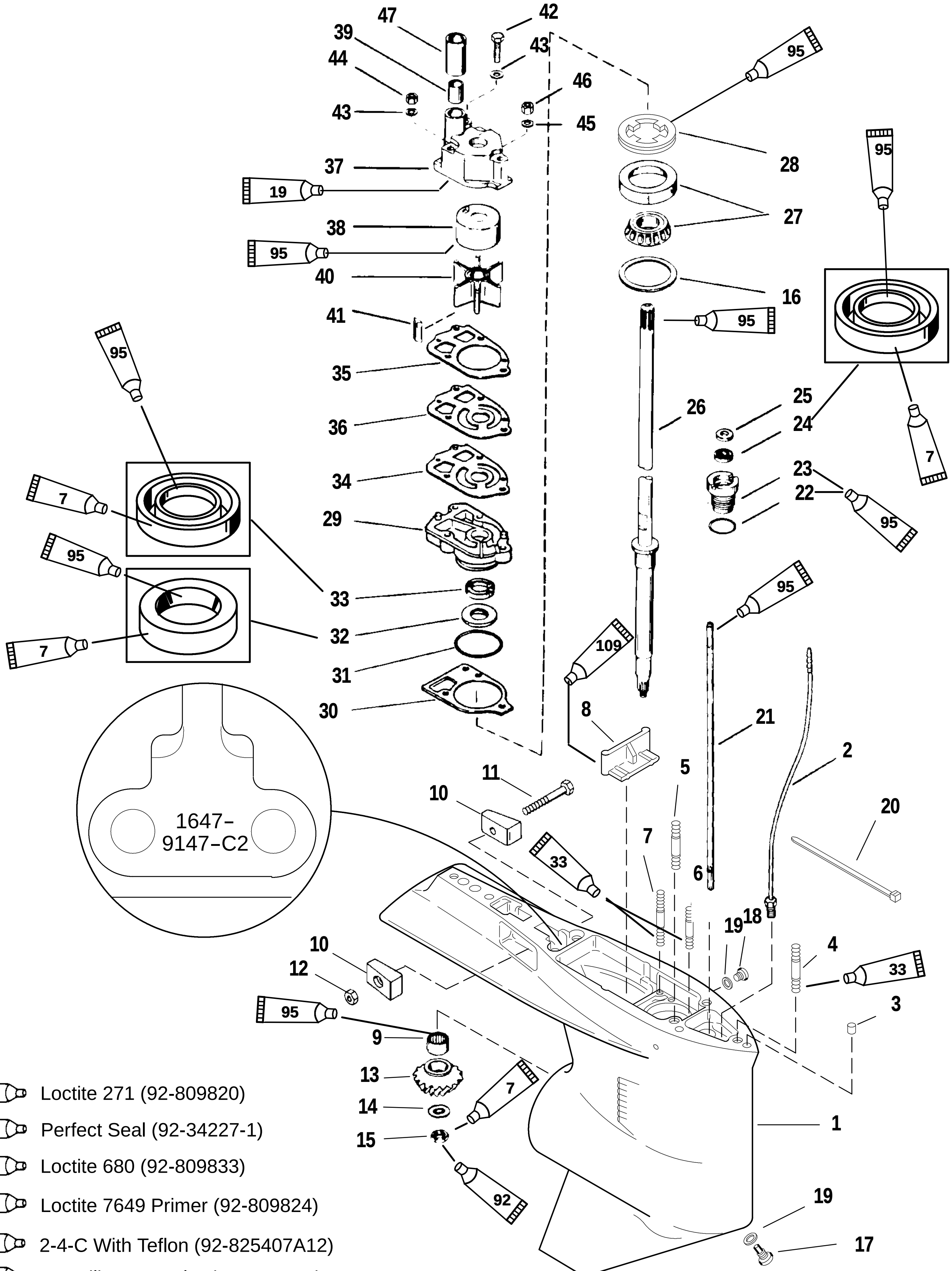
Notes:

Gear Housing (Driveshaft)(Standard Rotation) (S/N-0G438000 & UP)

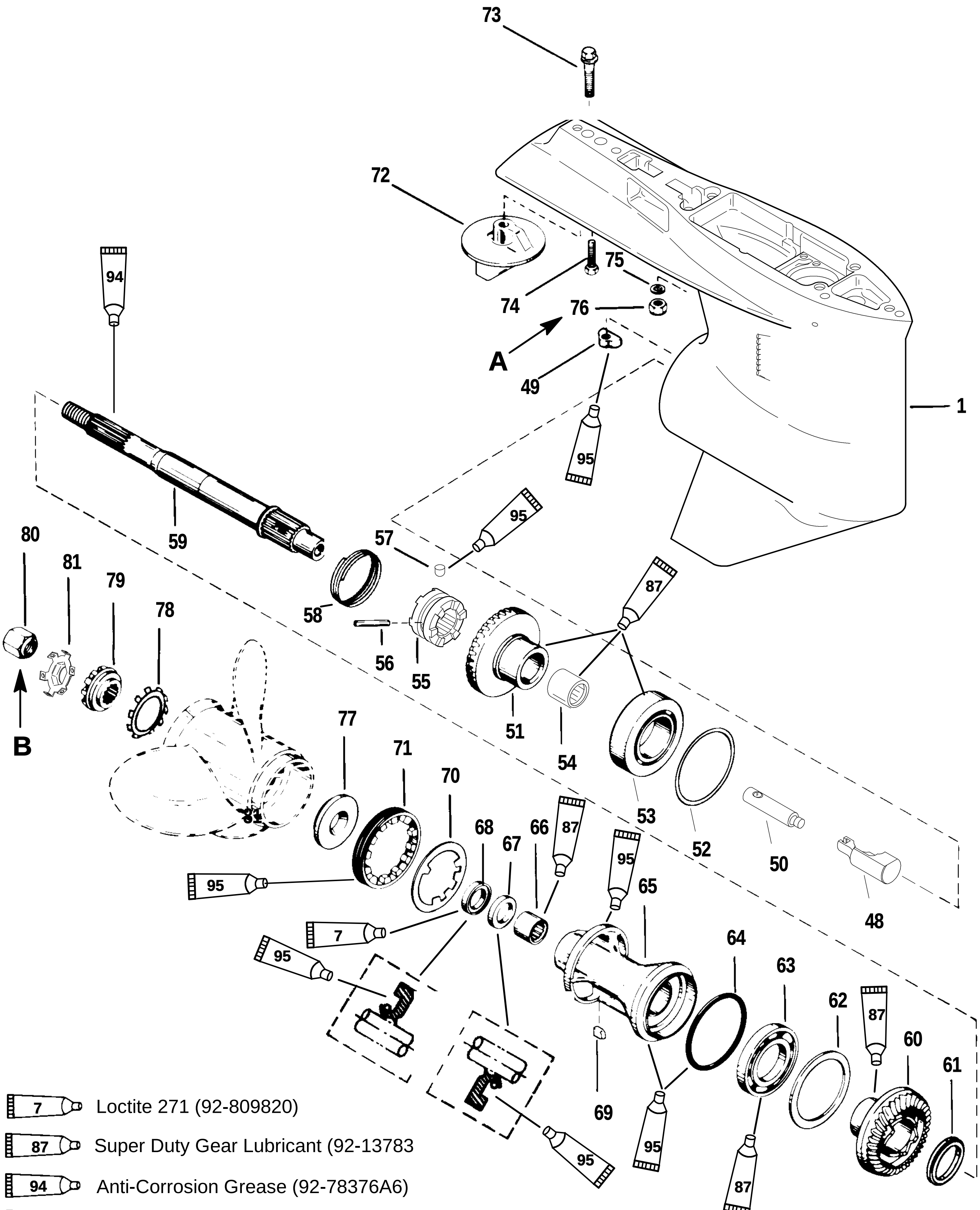


- 7 — Loctite 271 (92-809820)
- 19 — Perfect Seal (92-34227-1)
- 33 — Loctite 680 (92-809833)
- 92 — Loctite 7649 Primer (92-809824)
- 95 — 2-4-C With Teflon (92-825407A12)
- 109 — GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft)(Standard Rotation) (S/N-0G438000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
2	1	CONNECTOR ASSEMBLY			
3	2	DOWEL PIN			
4	1	STUD (3-1/8 IN.) **(LONG)**			
	1	STUD (3-11/16 IN.) **(X-LONG)**			
5	2	STUD (2-1/16 IN.)			
6	1	STUD (3-3/8 IN.)			
7	2	STUD (3-1/8 IN.)			
8	1	FILLER BLOCK			
9	1	ROLLER BEARING			
10	2	ANODE			
11	1	SCREW			
12	1	NUT	60		7.0
13	1	PINION GEAR (Part of 43-828176A2 or 43-828174A2			
14	1	WASHER			
15	1	NUT **Included With Forward Gear Set**		75	102
16	AR	SHIM SET			
17	1	SCREW-drain (MAGNETIC)	55		6.0
18	1	SCREW-grease filler	55		6.0
19	2	WASHER			
20	1	STA-STRAP			
21	1	SHIFT SHAFT			
22	1	O-RING			
23	1	BUSHING ASSEMBLY		30	40.5
24	1	OIL SEAL			
25	1	WASHER-rubber			
26	1	DRIVESHAFT **(LONG)**			
	1	DRIVESHAFT **(X-LONG)**			
27	1	ROLLER BEARING			
28	1	RETAINER		100	135
29	1	WATER PUMP BASE			
30	1	GASKET			
31	1	O-RING			
32	1	OIL SEAL			
33	1	OIL SEAL			
34	1	GASKET-lower			
35	1	GASKET-upper			
36	1	FACE PLATE			
37	1	WATER PUMP BODY ASSEMBLY			
38	1	INSERT			
39	1	SEAL-rubber			
40	1	IMPELLER			
41	1	KEY			
42	1	SCREW (2-1/4 IN.)	35		4.0
43	2	WASHER			
44	2	NUT	50		5.5
45	1	WASHER			
46	1	NUT	50		5.5
47	1	SLEEVE			

Gear Housing (Prop Shaft)(Standard Rotation) (S/N-0G438000 & UP)



7	Loctite 271 (92-809820)
87	Super Duty Gear Lubricant (92-13783
94	Anti-Corrosion Grease (92-78376A6)
95	2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft)(Standard Rotation) (S/N-0G438000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
48	1	CAM FOLLOWER			
49	1	SHIFT CAM			
50	1	ROD			
51	1	GEAR SET **(XR6/MAG. III/175/200)(1.87:1 – 15/28)**			
	1	GEAR SET **(135/150)(2.0:1 – 14/28)**			
52	AR	SHIM (.006-7-9-10-20)			
53	1	TAPERED ROLLER BEARING			
54	1	NEEDLE BEARING			
55	1	CLUTCH			
56	1	CROSS PIN			
57	1	DETENT PIN			
58	1	SPRING			
59	1	PROPELLER SHAFT			
60	1	REVERSE GEAR **(XR6/MAG. III/175/200)(1.87:1 – 15/28)**			
	1	REVERSE GEAR **(135/150)(2.0:1 – 14/28)**			
61	1	THRUST SPACER			
62	1	THRUST RING			
63	1	BALL BEARING			
64	1	O-RING			
65	1	BEARING CARRIER ASSEMBLY			
66	1	ROLLER BEARING			
67	1	OIL SEAL **(INSIDE)**			
68	1	OIL SEAL **(OUTSIDE)**			
69	1	KEY			
70	1	TAB WASHER			
71	1	COVER NUT		210	285
72	1	TRIM TAB			
73	1	SCREW (1-5/8 IN.)		40	54.0
74	1	SCREW		55	74.5
75	2	WASHER			
76	2	NUT			
77	1	THRUST HUB **These replacement parts ARE NOT**			
78	1	LOCKWASHER **included with Complete**			
79	1	WASHER **Gear Housing Replacement**			
80	1	PROPELLER NUT			
81	1	TAB WASHER			

A – Torque nut to 55 lb. ft. (74.5 N·m)

B – Torque propeller nut to 55 lb. ft. (74.5 N·m)

General Service Recommendations

There may be more than one way to "disassemble" or "reassemble" a particular part(s), therefore, it is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

In many cases, disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure order in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to "reassembly and installation" of that component in the reassembly part of this section. Use the "Table of Contents" (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, be sure that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced, if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly, as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply Quicksilver 2-4-C w/Teflon Marine Lubricant on all O-rings. To prevent wear, apply Quicksilver 2-4-C w/ Teflon Marine Lubricant on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply Quicksilver 2-4-C w/Teflon Marine Lubricant to external surfaces of bearing carrier and cover nut threads prior to installation.

Removal, Disassembly, Cleaning and Inspection – Standard Rotation

REMOVAL

⚠ WARNING

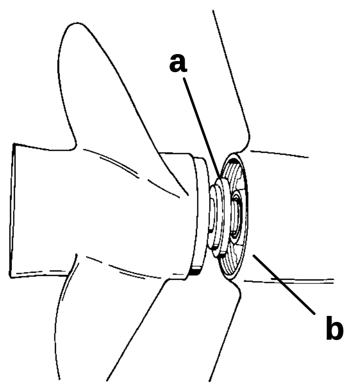
Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from driveshaft housing.

1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.

⚠ CAUTION

Gear housing MUST BE in NEUTRAL position and shift shaft MUST BE removed from gear housing BEFORE propeller shaft can be removed from gear housing.

2. Shift engine into neutral position.
3. Tilt engine to full up position and engage tilt lock lever.
4. Bend tabs of propeller tab washer away from thrust hub (rear), then remove propeller locknut, tab washer, thrust hub (rear), propeller and thrust hub (forward) from propeller shaft.



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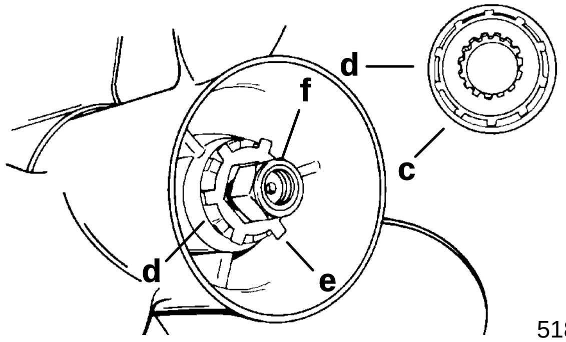

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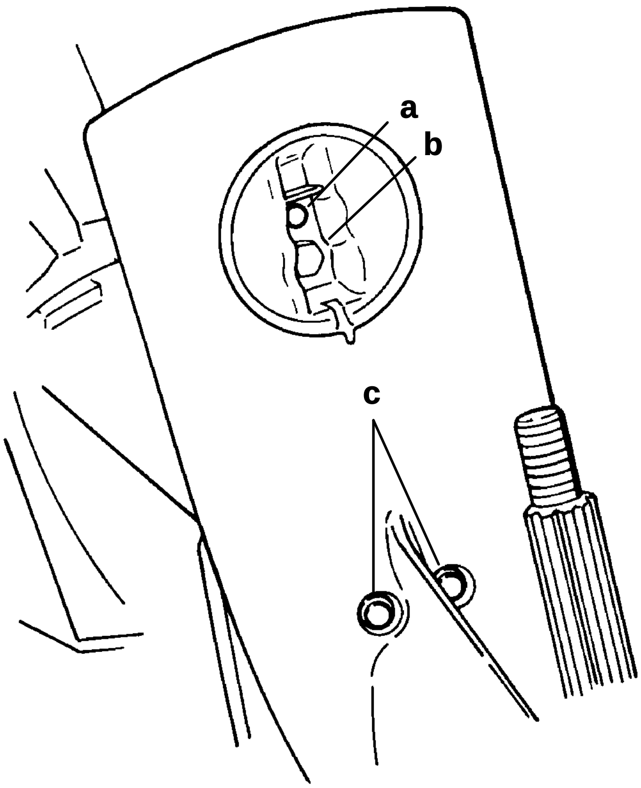
a - Thrust Hub (Forward)
b - Propeller Shaft
c - Continuity Washer (If Equipped)
d - Rear Thrust Hub
e - Tab Washer
f - Propeller Nut

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of driveshaft housing, then unthread bolt that secures trim tab and remove trim tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.
7. Remove 2 locknuts from bottom middle of anti-cavitation plate.



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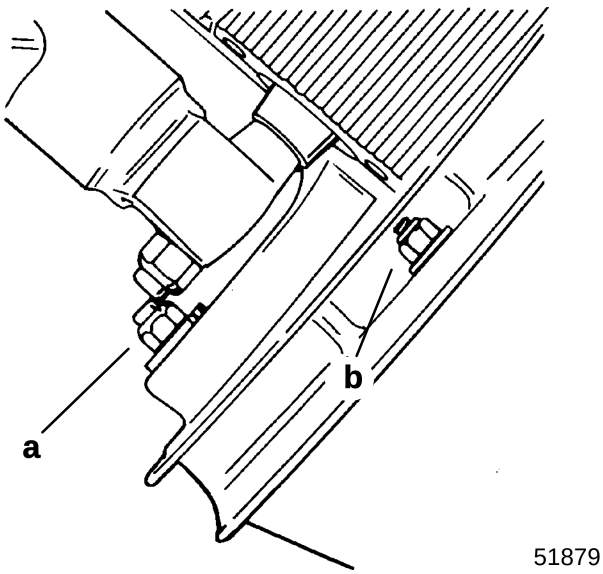
a - Bolt (Secures Trim Tab)
b - Bolt (Inside Trim Tab Cavity)
c - Locknuts and Washers

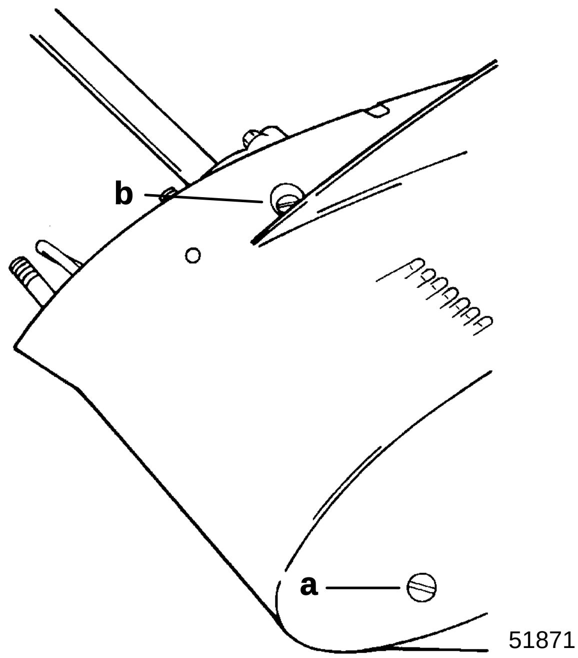
8. Remove locknut from the front gear housing mounting stud.
9. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or driveshaft housing could be damaged.)
10. Pull gear housing away from driveshaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)
11. Pull gear housing from driveshaft housing.



a - Front Mounting Locknut
b - Side Mounting Locknut (One Each Side)

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the driveshaft in a vertical position.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing.



a - "Fill" Screw
b - "Vent" Screw

3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. 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, O-rings and gear housing components.

NOTE: *Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.*

Water Pump

CLEANING AND INSPECTION

1. Clean all water pump parts with solvent and dry with compressed air.
2. Inspect water pump cover and base for cracks and distortion (from overheating).
3. Inspect face plate and water pump insert for grooves and/or rough surfaces.

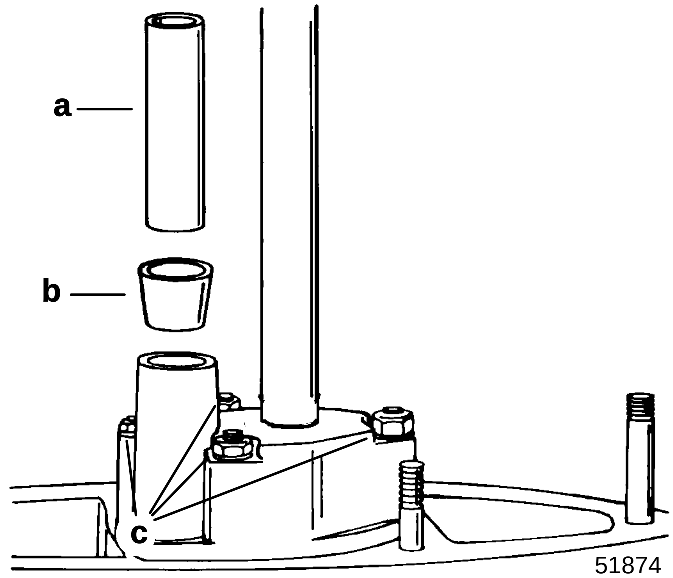
IMPORTANT: When completing gear housing repairs, that require removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to re-use impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur.

4. Inspect impeller side seal surfaces and ends of impeller blades for cracks, tears and wear. Replace impeller if any of these conditions are found.
5. Inspect impeller bonding to impeller hub.
6. Inspect impeller for glazed or melted appearance (caused by operation without sufficient water supply). Replace impeller if any of these conditions exist.

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

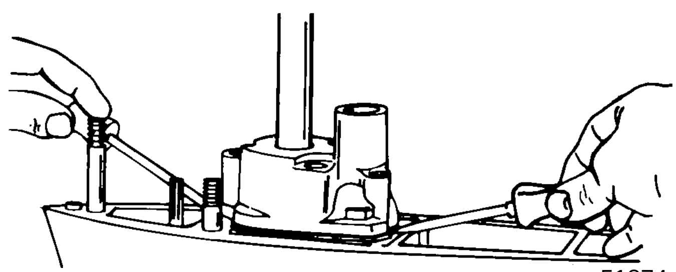
REMOVAL AND DISASSEMBLY

1. Slide rubber centrifugal slinger up and off driveshaft.
2. Remove water tube guide and seal from water pump cover. (Retain guide for reassembly and discard seal.)
3. Remove (and retain) 3 nuts, one bolt and all washers which secure water pump cover to gear housing.



a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolt and Washers To Be Removed

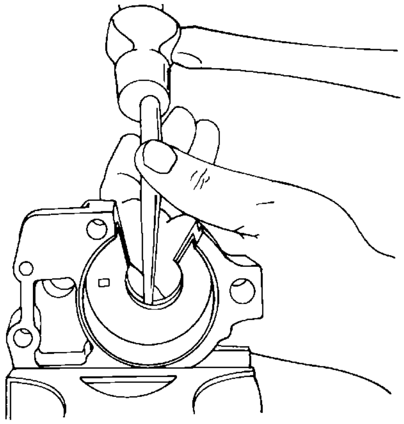
4. Using 2 pry bars, lift water pump cover up and off driveshaft.



5. Inspect water pump cover and insert, as outlined in **"Cleaning and Inspection,"** previous.
6. If inspection of water pump insert determines that replacement is required, follow Step "a" or "b" (immediately following) to remove insert from water pump cover.

NOTE: *Try Step "a" first. If insert cannot be removed with Step "a," use Step "b".*

a. Drive water pump insert out of water pump cover with a punch and hammer.



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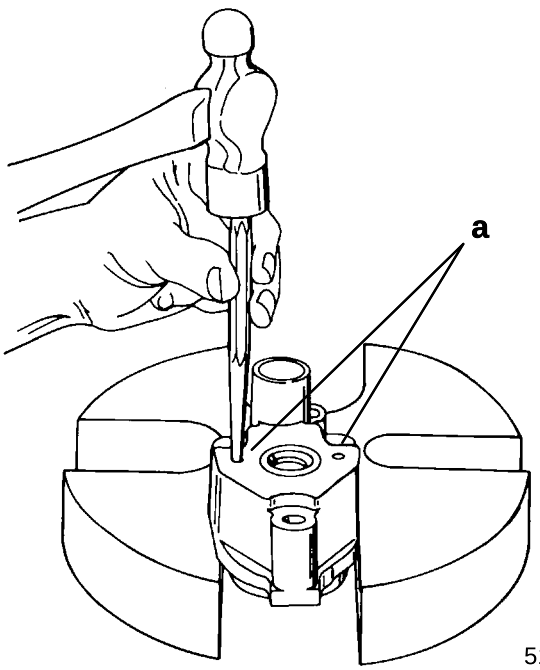
b. Drill two 3/16² (4.8mm) diameter holes thru the top of water pump cover (but not thru insert). Drive insert out of cover with a punch and hammer.



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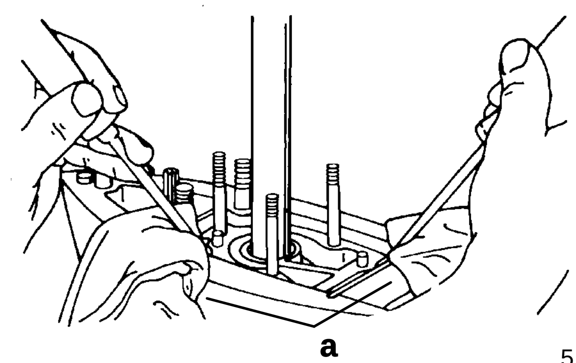
a - Drill Two Holes at These Locations

7. Remove impeller from driveshaft. (It may be necessary to use a punch and hammer to drive impeller upward on driveshaft. In extreme cases, it may be necessary to split hub of impeller with a hammer and chisel.)
8. Once impeller is removed, remove impeller drive key from driveshaft.
9. Remove water pump face plate and both gaskets (one above and below face plate) from water pump base.
10. Using 2 pry bars, positioned and padded as shown, lift water pump base up and off driveshaft.



51874

a - Pads

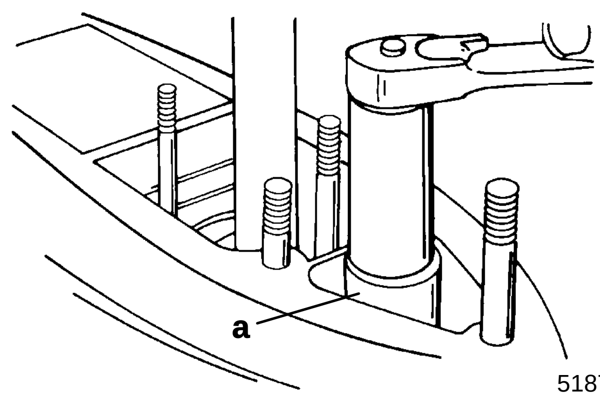
11. Remove (and discard) O-ring from O-ring groove on water pump base.
12. Using a screwdriver, pry oil seals out of water pump base from gear housing side of base.

Bearing Carrier and Propeller Shaft Removal

⚠ CAUTION

Gear housing MUST BE in NEUTRAL position, and shift shaft MUST BE removed from gear housing before propeller shaft can be removed from gear housing.

1. Place gear housing in a suitable holding fixture with propeller shaft in a horizontal position.
2. Use Shift Shaft Bushing Tool (91-31107) to unthread shift shaft bushing. (DO NOT remove bushing from shift shaft at this time.)



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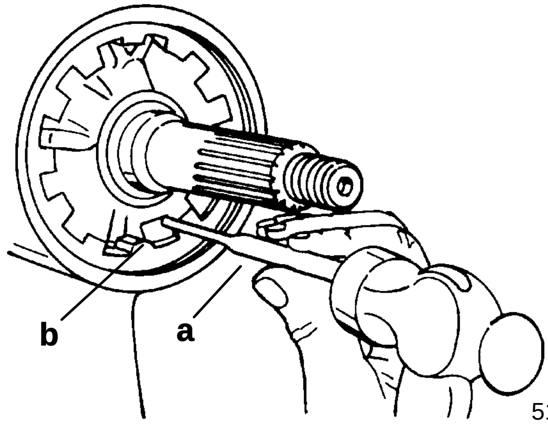
a - Shift Shaft Bushing Tool (91-31107)

IMPORTANT: Prior to removal of shift shaft from gear housing, recheck that gear housing is in NEUTRAL position.

3. Bend cover nut lock tab out of cover nut recess.



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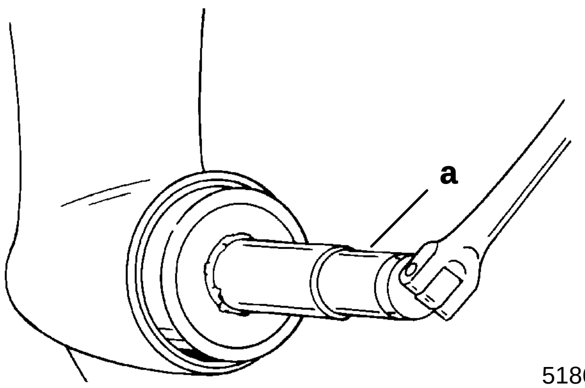
a - Punch
b - Tab of Tab Washer

4. Remove gear housing cover nut with Cover Nut Tool (91-61069).



51866

a - Cover Nut Tool (91-61069)

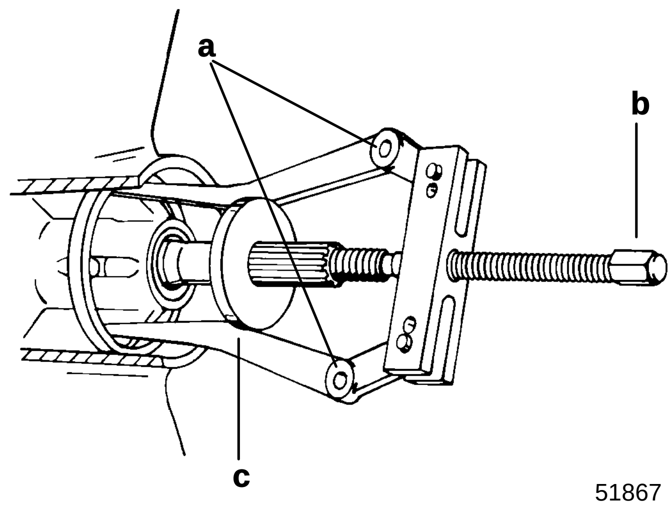
5. After cover nut has been removed, remove lock tab washer from gear housing.

⚠ CAUTION

Once bearing carrier is removed from gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

6. Use long Puller Jaws (91-46086A1) and Puller Bolt (91-85716) to remove bearing carrier. (Use propeller thrust hub to maintain outward pressure on puller jaws.)

NOTE: *When bearing carrier is removed from gear housing, the bearing carrier alignment key will come out with it.*



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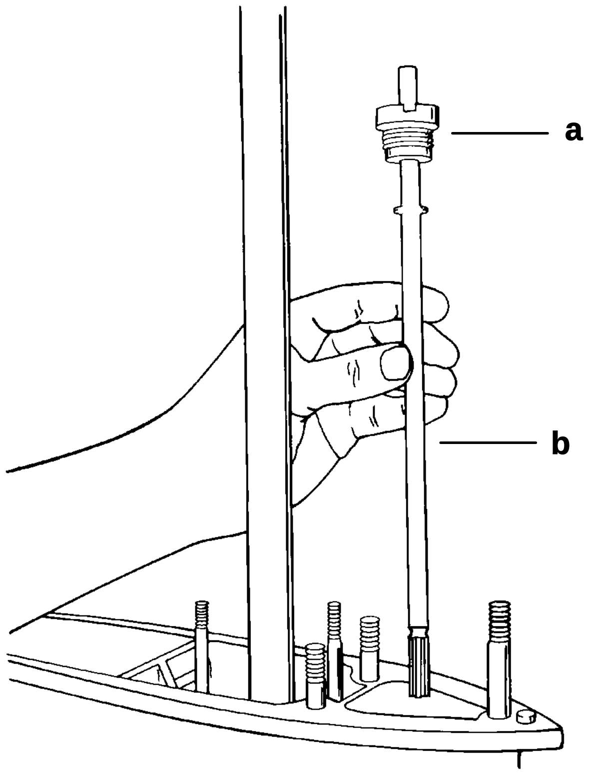
a - Long Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)
c - Thrust Hub

7. With gear housing in NEUTRAL, pull shift shaft out of gear housing. If necessary, use a pliers to pull shift shaft out of gear housing. If pliers are used to pull shift shaft out, wrap a strip of soft metal (aluminum) around splines before clamping pliers. DO NOT turn shaft (clockwise OR counterclockwise) while pulling shaft out. (For further information on shift shaft, see "Shift Shaft Cleaning/Inspection and Disassembly.")



a - Shift Shaft Bushing
b - Shift Shaft

⚠ CAUTION

Propeller shaft, cam follower and shift cam, in most cases, will come out of gear housing by simply pulling outward on propeller shaft. DO NOT FORCE shaft sideways or ATTEMPT TO PULL with a slide hammer or any mechanical puller.

8. Remove propeller shaft, cam follower and shift cam by pulling shaft straight out of gear housing. (DO NOT JERK propeller shaft.) If propeller shaft will not come out, proceed with Step "a" or "b", following:

    a. Push propeller shaft back into place against the forward gear. Visually inspect location of shift cam by looking down shift shaft hole (illuminated with a flashlight). If splined hole in shift cam is visible, reinstall shift shaft and rotate shift shaft to neutral position. Remove shift shaft, then remove propeller shaft as instructed in Step 8, immediately preceding.

    b. Push propeller shaft back into place against forward gear. Slide bearing carrier back into gear housing (to support propeller shaft). Place gear housing on its left side (viewed from rear) and strike upper leading end of gear housing with a rubber mallet. This will dislodge the shift cam from cam follower into a clearance pocket in left side of gear housing. Remove bearing carrier and pull propeller shaft out of gear housing.

NOTE: *If Step 8-b was used to remove propeller shaft, the shift cam can be retrieved after removal of forward gear.*

Shift Shaft

CLEANING AND INSPECTION

1. Clean shift shaft and bushing with solvent and dry with compressed air.
2. Check shift shaft splines on both ends for wear and/or corrosion damage.
3. Inspect shift shaft for groove(s) at shift shaft bushing seal surface.
4. Inspect shift shaft bushing for corrosion damage.
5. Inspect shift shaft bushing oil seal for wear and/or cuts.

NOTE: *Oil seal in shift shaft bushing should be replaced as a normal repair procedure.*

DISASSEMBLY

1. Remove (and discard) shift shaft bushing oil seal by prying it out or driving it out with a punch and hammer.

CLEANING/INSPECTION - BEARING CARRIER

IMPORTANT: It is recommended that all seals and O-rings be replaced (as a normal repair procedure) to assure effective repair.

1. Clean bearing carrier with solvent and dry with compressed air.

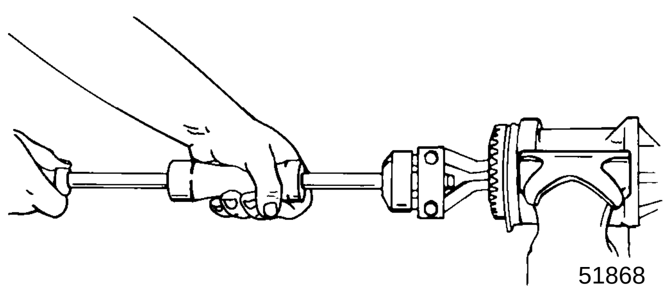
⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

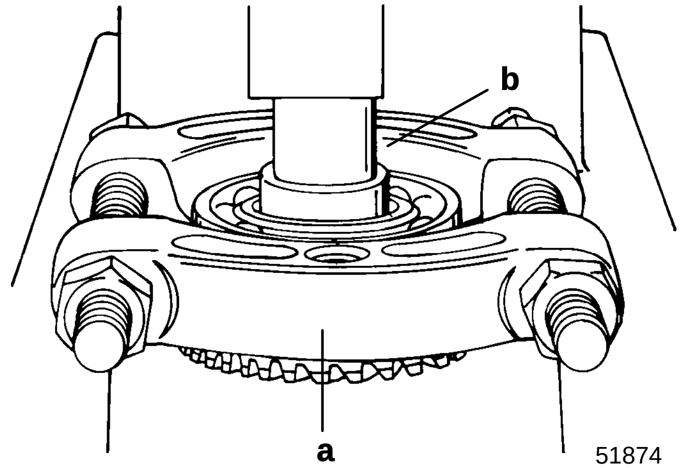
2. Bearing carrier propeller shaft needle bearing condition is determined by propeller shaft bearing surface condition. (See "Propeller Shaft Inspection.")
3. Inspect reverse gear to pinion gear wear pattern (should be even and smooth). If not, replace reverse gear and pinion gear.
4. Check clutch jaws on reverse gear for damage. Replace reverse gear, if damage is found on clutch jaws.
5. Apply light oil to reverse gear bearing. Rotate reverse gear bearing while checking bearing for rough spots and/or catches. Push in and pull out on reverse gear to check for bearing side wear. Replace bearing if any of the listed conditions exist.

DISASSEMBLY - BEARING CARRIER

1. Remove and discard O-ring from between bearing carrier and thrust washer.
2. If inspection of reverse gear or reverse gear bearing determines that replacement of gear or bearing is required, remove gear and bearing as follows:
   a. Position bearing carrier in a soft jaw vise.
   b. Use Slide Hammer (91-34569A1) and remove reverse gear.



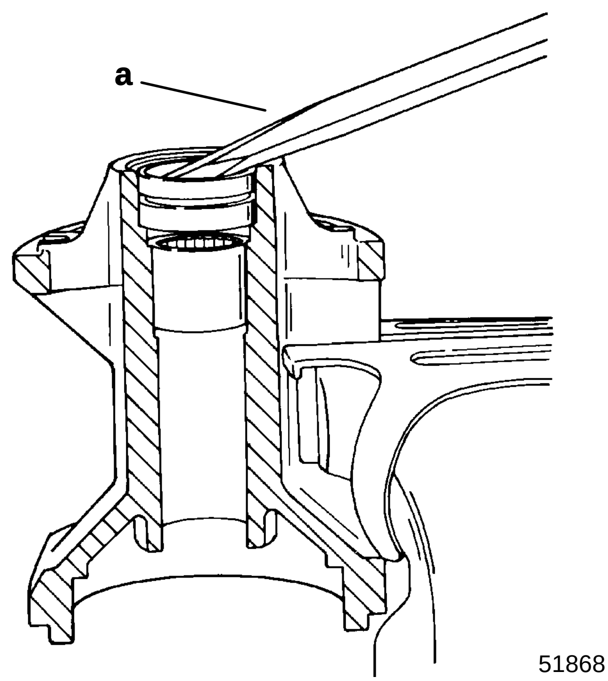
   c. If reverse gear bearing remains attached to reverse gear, install Universal Puller Plate (91-37241) and position puller plate, gear and bearing on a press with gear side down. Use a suitable mandrel and press gear out of bearing.



a - Universal Puller Plate
b - Mandrel

   d. If reverse gear bearing has remained in bearing carrier, use slide hammer to remove bearing in the same methods as was used to remove reverse gear (Step "b").

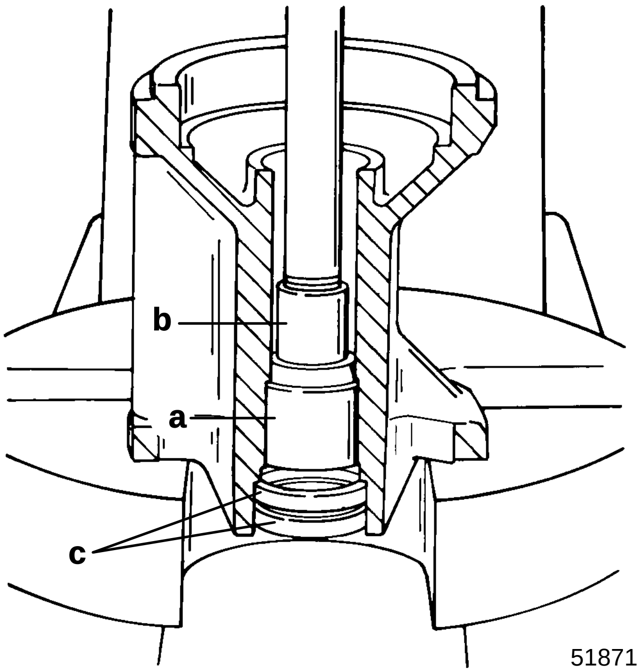
3. Propeller shaft oil seals can be removed by (a) using a pry bar, or (b) pressing seals out when propeller shaft needle bearing is pressed out of bearing carrier.



a - Pry Bar

4. If inspection of propeller shaft needle bearing determines that replacement of bearing is required, use Universal Bearing Removal and Installation Tool (91-31229A1) to press bearing and seals out of bearing carrier.

NOTE: *Reverse gear must be removed from bearing carrier before propeller shaft needle bearing can be removed.*



a - Propeller Shaft Needle Bearing
b - Mandrel
c - Oil Seals

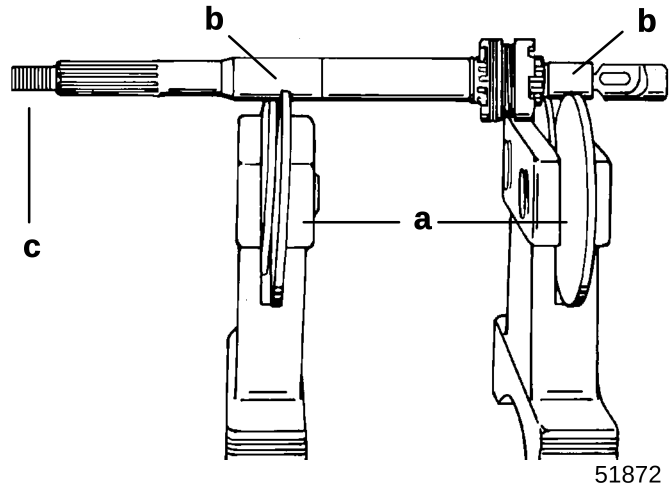
Propeller Shaft

INSPECTION

1. Clean propeller shaft assembly with solvent and dry with compressed air.
2. Inspect bearing carrier oil seal surfaces for grooves. Run fingernail across seal surface to check for groove. Replace shaft if groove is found.
3. Visually check bearing surfaces of propeller shaft for pitting, grooves, scoring, uneven wear or discoloration (bluish color) from overheating. Replace shaft and corresponding needle bearing if any of the above conditions are found. (Bearing carrier needle bearing contacts propeller shaft just in front of oil seal surface. Forward gear bearing contacts propeller shaft in front of sliding clutch splines.)
4. Inspect propeller shaft splines for wear and/or corrosion damage.
5. Check propeller shaft for straightness. Use either method, following:

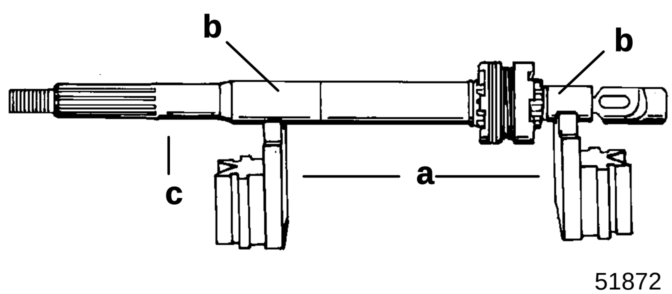
BALANCE WHEELS

Place propeller shaft on balance wheels. Rotate propeller shaft and observe propeller end of shaft for "wobble." Replace shaft if any "wobble" is observed.



a - Balance Wheels
b - Bearing Surfaces
c - Watch for "Wobble"

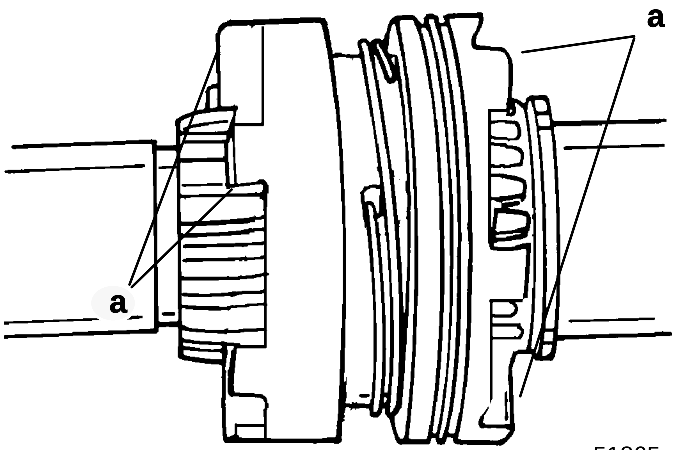
Position propeller shaft roller bearing surfaces on "vee" blocks. Mount a dial indicator at front edge of propeller splines. Rotate propeller shaft. Dial indicator movement of more than 0.006" (.152mm) (or noticeable "wobble") is reason for replacement.



a - "Vee" Blocks
b - Bearing Surfaces
c - Measure with Dial Indicator at this Point

6. Inspect sliding clutch. Check reverse gear and forward gear clutch "jaws." Rounded "jaws" indicate one or more of the following:
   a. Improper shift cable adjustment.
   b. Improper shift habits of operator(s) (shift from NEUTRAL to REVERSE gear too slowly).

c. Engine idle speed too high (while shifting).

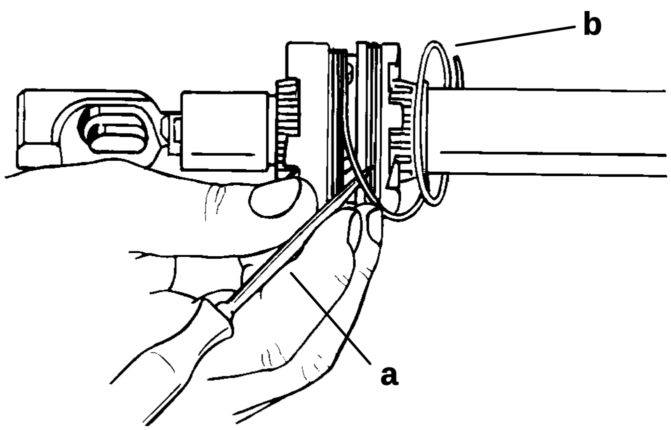


a - Clutch “Jaws”

7. Check condition of cam follower. If it shows wear (pitting, scoring or rough surface), replace cam follower and shift cam.

DISASSEMBLY

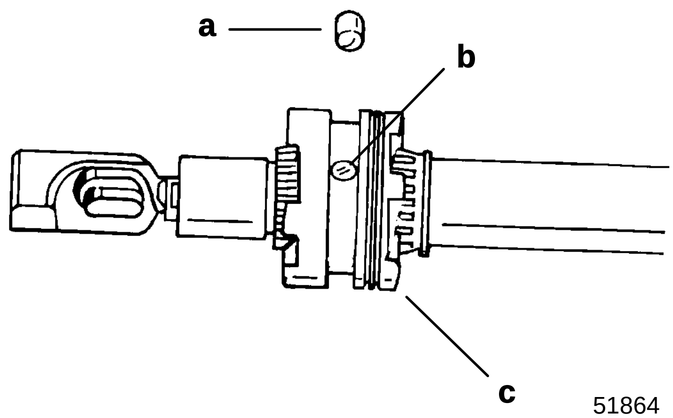
1. Remove shift cam from cam follower.
2. Insert a thin blade screwdriver or awl under first coil of cross pin retainer spring and rotate propeller shaft to unwind spring from sliding clutch. DO NOT over-stretch spring.



a - Awl
b - Cross Pin Retainer Spring

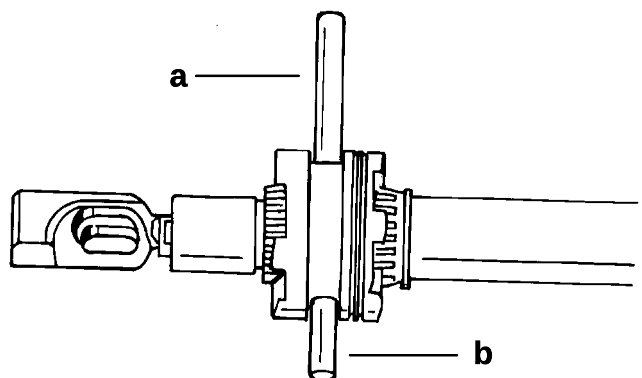
> ⚠ **CAUTION**
>
> **Detent pin is free and can fall out of sliding clutch. Care MUST BE taken not to lose pin.**

3. Detent pin is free and can be removed from sliding clutch at this time.



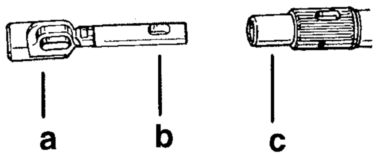
a - Detent Pin
b - Cross Pin
c - Sliding Clutch

4. Push cross pin out of sliding clutch and propeller shaft with Cross Pin Tool (91-86642).



a - Cross Pin Tool (91-86642)
b - Cross Pin

5. Pull sliding clutch off propeller shaft.
6. Pull cam follower and clutch actuator rod out of propeller shaft. DO NOT force cam follower up-or-down or side-to-side when pulling from propeller shaft.



a - Cam Follower
b - Clutch Actuator Rod
c - Propeller Shaft

7. Once cam follower and clutch actuator rod are removed from propeller shaft, lift rod out of cam follower.

Clutch Actuator Rod

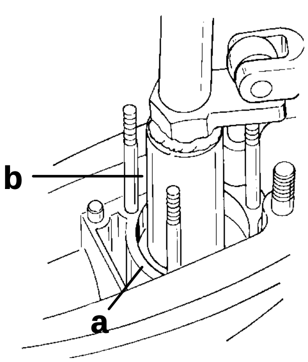
CLEANING AND INSPECTION

1. Clean clutch actuator rod in solvent and dry with compressed air.
2. Inspect actuator components for wear or damage. Replace components as required.

Pinion Gear and Driveshaft

REMOVAL

1. Remove bearing retainer using Bearing Retainer Tool (91-43506).

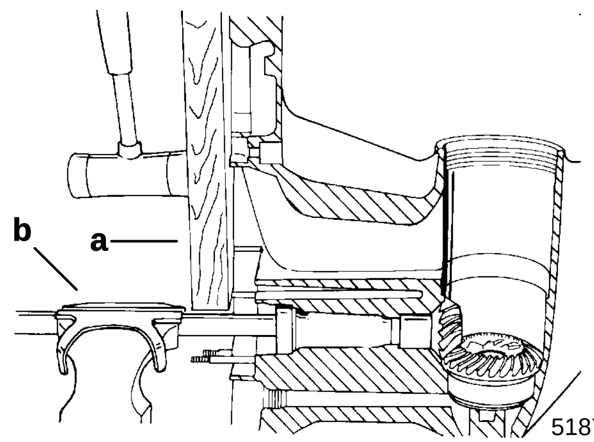


a - Bearing Retainer
b - Bearing Retainer Tool (91-43506)

2. Place Driveshaft Holding Tool (91-34377A1) over driveshaft splines.
3. Use a socket and flex handle to hold pinion nut. (Pad area of gear housing where flex handle will make contact to prevent damage to gear housing.)
4. Use a socket and flex handle on Driveshaft Holding Tool to loosen pinion nut. Remove pinion nut and Driveshaft Holding Tool.
5. Remove gear housing from vise and re-position it as shown. Be sure to use soft jaw vise covers and clamp as close as possible to water pump studs.
6. Place a block of wood on gear housing mating surface. Use a mallet and carefully tap gear housing away from driveshaft.

CAUTION

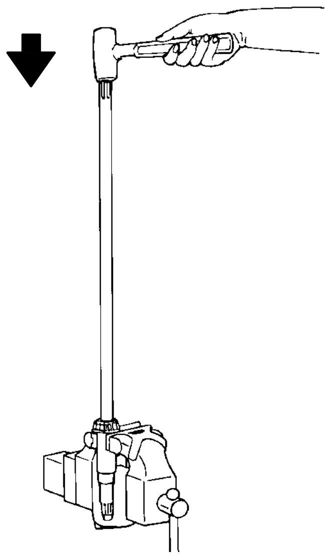
DO NOT strike gear housing hard with the mallet or allow gear housing to fall.



a - Wooden Block
b - Soft Jaw Vise Covers

7. Reach into gear housing and remove pinion gear and forward gear assembly.
8. After driveshaft is removed from gear case, remove and retain shim(s) that were located under upper tapered driveshaft bearing.
9. If inspection determines that replacement of driveshaft tapered bearing is required, remove bearing from driveshaft as follows:
   a. Position driveshaft in a vise; DO NOT tighten vise jaws against shaft.

b. Strike shaft with a lead hammer; take care not to drop shaft.

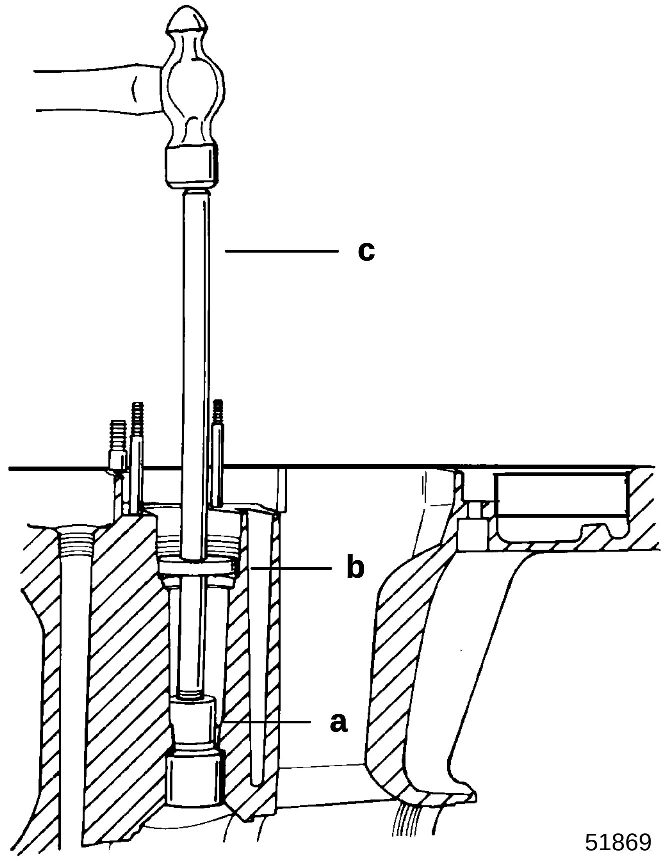


51866

10. Remove 18 loose needles from outer race of driveshaft needle bearing.
11. If inspection of driveshaft needle bearing surface determines that replacement of needle bearing is required, the 18 loose needle bearings previously removed must be reinstalled in bearing race to provide surface for mandrel to drive against.

NOTE: *FORWARD gear must be removed first BEFORE removing driveshaft needle bearing.*

IMPORTANT: Discard driveshaft needle bearing after removal. (Bearing cannot be reused.)



51869

a - Mandrel (91-37263)
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)

*From Bearing Removal and Installation Kit (91-31229A5)

CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air. DO NOT allow driveshaft bearing to spin while drying.
2. Inspect pinion gear for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace pinion gear, if any of the above conditions are found.
3. Inspect driveshaft needle bearing surface (area just above pinion gear splines) for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace driveshaft and driveshaft needle bearing, if any of the preceding conditions are found.
4. Inspect driveshaft to crankshaft splines for wear. Replace driveshaft if wear is excessive.

5. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing and race as a set, if any of the preceding conditions are found.
6. Inspect driveshaft for groove(s) where water pump base oil seals contact shaft. Replace driveshaft if groove(s) are found.

Forward Gear

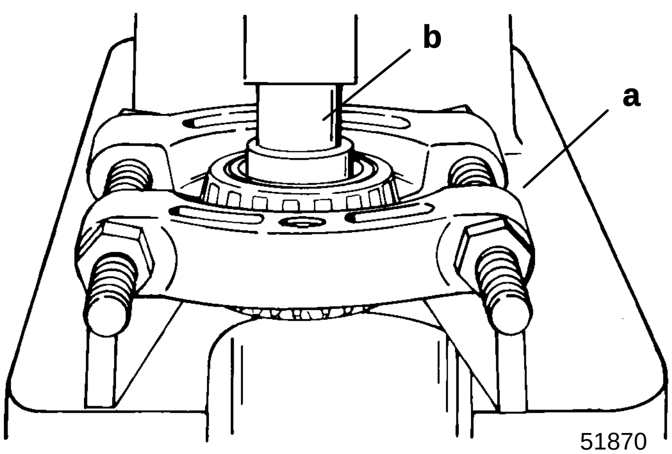
REMOVAL AND DISASSEMBLY

NOTE: *Forward gear can only be removed from gear housing after driveshaft and pinion gear have been removed.*

1. Reach into gear housing and lift out forward gear.

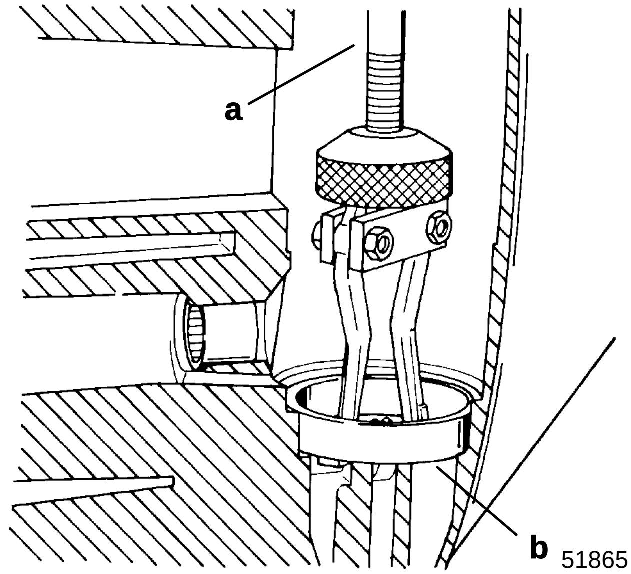
IMPORTANT: DO NOT remove tapered bearing or needle bearings from forward gear, unless replacement of bearings is required. (Bearings cannot be reused after they have been removed.)

2. If inspection determines that replacement of forward gear tapered bearing is required, remove bearing from gear and bearing race from gear housing (tapered bearing and race MUST BE replaced as a set), as follows:
   a. Install Universal Puller Plate (91-37241) between forward gear and tapered bearing.
   b. Place forward gear, bearing and puller plate on a press and press gear out of bearing with a suitable mandrel.



a - Universal Puller Plate
b - Mandrel

   c. Use Slide Hammer (91-34569A1) to remove for- ward gear tapered bearing race.



a - Slide Hammer
b - Tapered Bearing Race

   d. After forward gear tapered bearing race is removed from gear housing, lift out and retain shims which were behind bearing race.
3. If inspection determines that replacement of propeller shaft needle bearings in forward gear is required, remove bearing from gear as follows:
   a. Clamp forward gear in a soft jaw vise securely.
   b. From toothed-side of gear, drive propeller shaft needle bearings out of gear with a punch and hammer.

CLEANING AND INSPECTION

⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean forward gear and bearings with solvent and dry with compressed air.
2. Inspect gear teeth for pitting, grooves, scoring, uneven wear and for discoloration (from overheating). Replace gear if any of these conditions are found.
3. Check clutch jaws on forward gear for damage. Replace forward gear if damage is found.

4. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration (from overheating). Replace tapered bearing (on forward gear) and race if any of these conditions are found. (Always replace tapered bearing and race as a set.)
5. To determine condition of propeller shaft needle bearings (in forward gear), inspect propeller shaft forward gear needle bearing surface as outlined in "Propeller Shaft Inspection."

Gear Housing

CLEANING AND INSPECTION

1. Clean gear housing with solvent and dry with compressed air.
2. Check gear housing carefully for impact damage.
3. Check for loose fitting bearing cups and needle bearings.
4. Inspect bearing carrier cover nut retainer threads in gear housing for corrosion damage and/or stripped threads.

Reassembly and Installation Standard Rotation

Driveshaft Needle Bearing

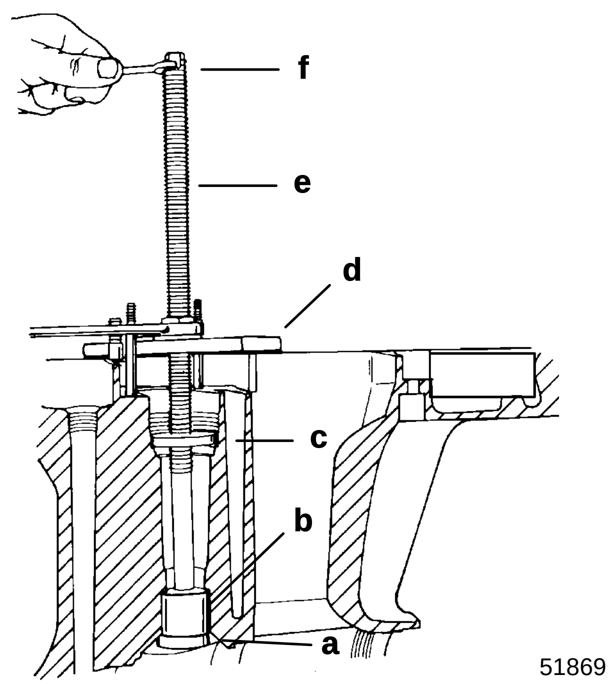
REASSEMBLY/INSTALLATION

⚠ CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing MUST be replaced. Loose fitting needle bearing will move out of position and cause repeated failures.

1. Apply a thin coat of Quicksilver Needle Bearing Assembly Lubricant to driveshaft needle bearing bore in gear housing.
2. By way of propeller shaft cavity, place needle bearing in driveshaft bore with numbered side of bearing facing up driveshaft bore.
3. Install and seat needle bearing with the following tools: Puller Rod* (91-31229), Nut* (11-24156), Pilot* (91-36571), Plate* (91-29310), and Mandrel (models with preloaded driveshaft use 91-38628*; models with standard driveshaft use 91-92788). Pull bearing up into bore until it bottoms on gear housing shoulder. (DO NOT use excessive force.)

*From Bearing Removal and Installation Kit (91-31229A5)



a - Mandrel
b - Bearing
c - Pilot
d - Plate
e - Puller Rod
f - Hold

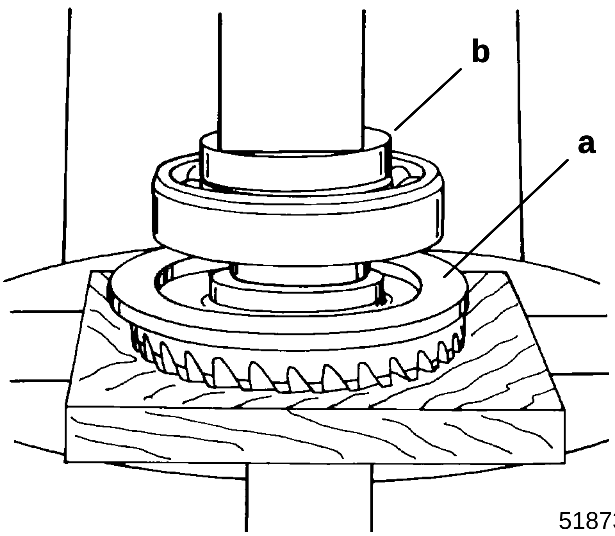
Bearing Carrier

REASSEMBLY

1. Place reverse gear on a press with gear teeth facing down.

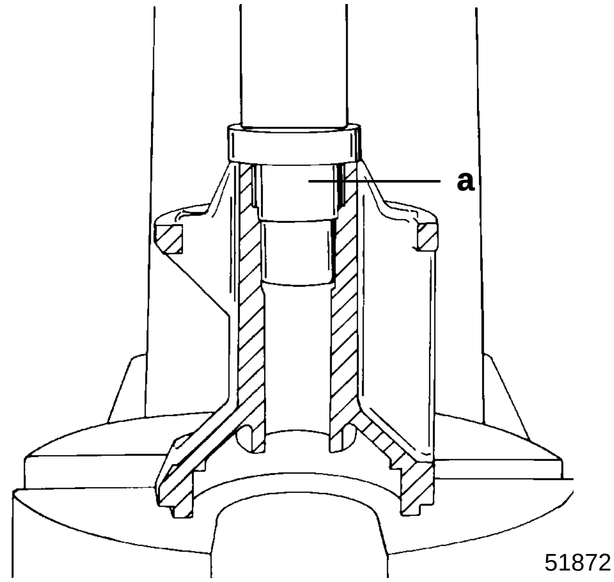
IMPORTANT: The reverse gear thrust washer has a tapered outside diameter so that one side is larger than the other. The larger outside diameter of washer must be toward reverse gear.

2. Place thrust washer over gear with the larger outside diameter down toward gear.
3. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto inside diameter of reverse gear ball bearing.
4. Position ball bearing over gear (with numbered side of bearing up).
5. Press ball bearing onto gear with a suitable mandrel until firmly seated. (Be sure to press only on inner race of bearing and that bearing is firm against gear.)



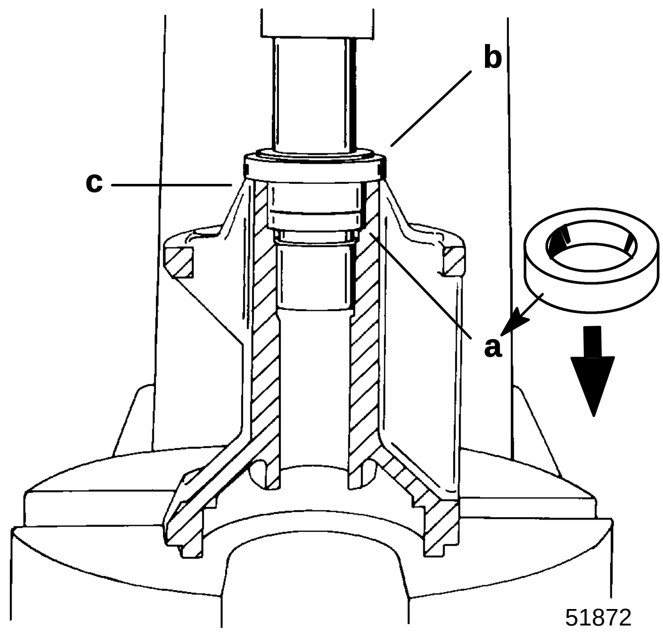
a - Thrust Washer
b - Mandrel

6. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto outside diameter of propeller shaft needle bearing.
7. Place propeller shaft needle bearing into aft end of bearing carrier with numbered side toward aft end.
8. Use Mandrel 91-15755 and press needle bearing into bearing carrier.



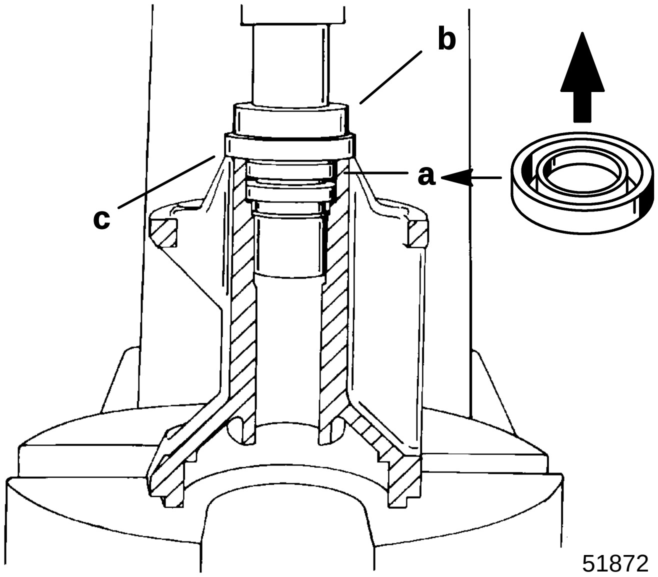
a - Mandrel (91-15755)

9. Apply Loctite 271 to outer diameter of propeller shaft oil seals.
10. Place one seal on longer shoulder side of Oil Seal Driver (91-31108) with lip of seal away from shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.



a - Oil Seal (Lip of Seal Down)
b - Oil Seal Driver
c - Seated

11. Place second seal on short shoulder side of seal driver with lip of seal toward shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.



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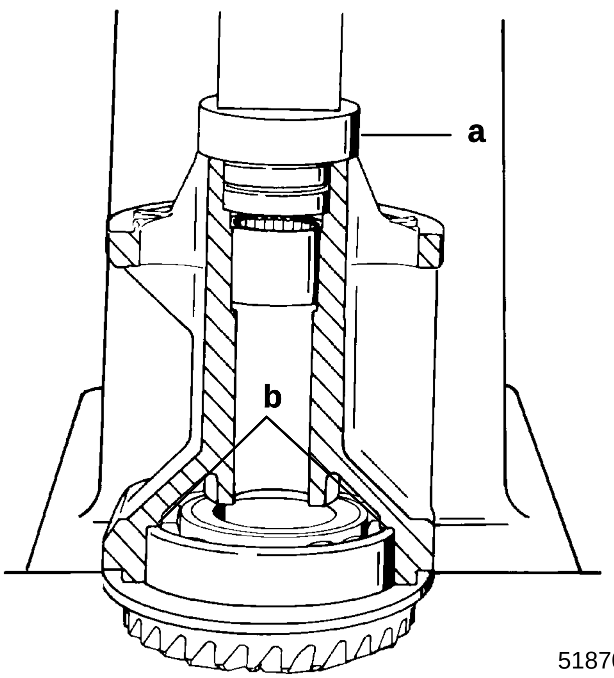
a - Oil Seal (Lip of Seal Up)
b - Oil Seal Driver
c - Seated

12. Wipe off excess Loctite.
13. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto the outside diameter of reverse gear ball bearing.
14. Place bearing carrier over reverse gear and bearing assembly. Press bearing carrier onto bearing.



51870

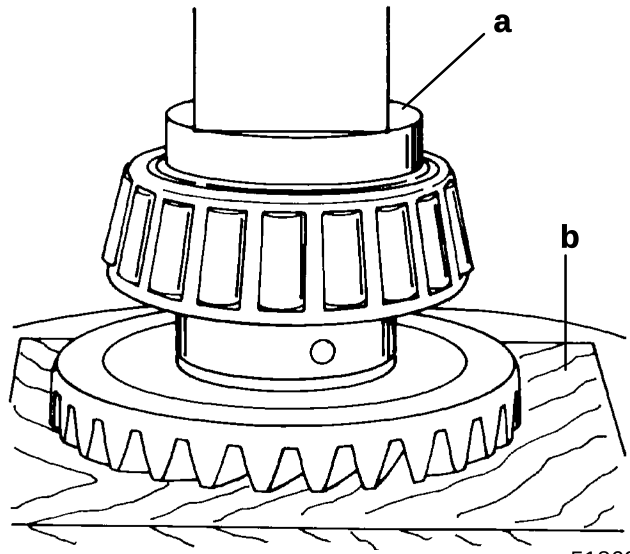
a - Mandrel
b - Seated

15. Place O-ring over bearing carrier and position it between bearing carrier and thrust washer.
16. Lubricate oil seals and O-ring with Quicksilver 2-4-C w/Teflon Marine Lubricant.

Forward Gear

REASSEMBLY

1. Place forward gear on a press with gear teeth down.
2. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto the inside diameter of forward gear tapered bearing.
3. Position forward gear tapered bearing over gear.
4. Press bearing onto gear until firmly seated. (Be sure to press only on inner race of bearing and that bearing is firm against the gear.)

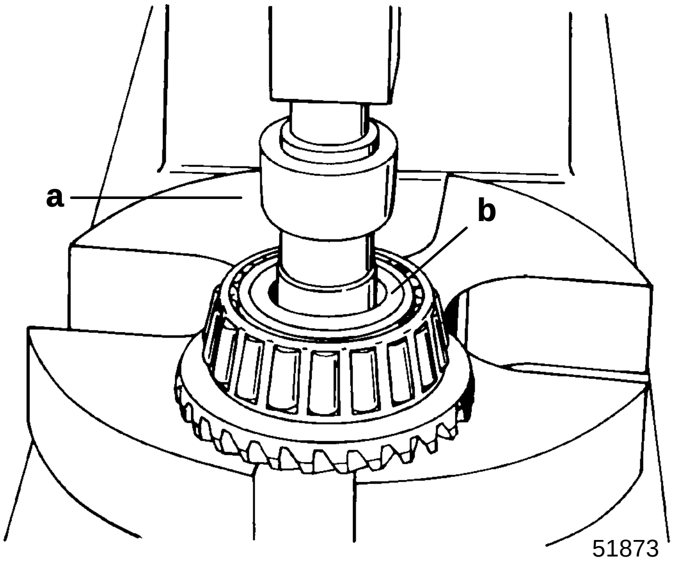


51869

a - Mandrel
b - Wooden Block

5. Apply a light coat of Quicksilver Super Duty Gear Lubricant to bore in center of forward gear.

6. Place one forward gear needle bearing on longer shoulder side of Forward Gear Bearing Tool (91-86943) with numbered side of bearing toward shoulder. Press bearing into forward gear until bearing tool bottoms against gear.



51873

a - Forward Gear Bearing Tool (91-86943)
b - Numbered Side of Needle Bearing

7. Place second needle bearing on short shoulder side of bearing tool with numbered side of bearing toward shoulder. Press bearing into forward gear until bearing tool bottoms against gear.

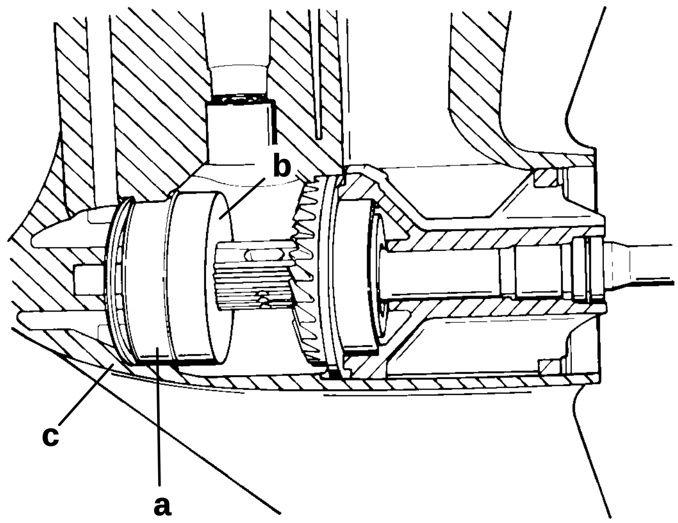
Forward Gear Bearing Race

INSTALLATION

1. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or a new gear housing is being used, start with approximately 0.010^2 (0.254mm).
2. Apply a light coat of Quicksilver Super Duty Gear Lubricant to forward gear bearing race bore in gear housing.
3. Position tapered bearing race squarely over bearing bore in front portion of gear housing.
4. Place Bearing Driver Cup (91-87120) over tapered bearing race.

NOTE: *A used propeller shaft is recommended for use in Step 5. If it is necessary, however, to use the propeller shaft that will be installed in gear housing, the propeller shaft must be disassembled. (Refer to "Propeller Shaft Disassembly," preceding.)*

5. Place propeller shaft into hole in center of bearing driver cup.
6. Install bearing carrier assembly over propeller shaft and lower it into gear housing. Bearing carrier acts as a pilot to assure proper bearing race alignment.
7. Thread a nut onto propeller shaft to protect propeller shaft threads.
8. Use a mallet to drive propeller shaft against bearing driver cup until tapered bearing race is seated against shim(s).



51867

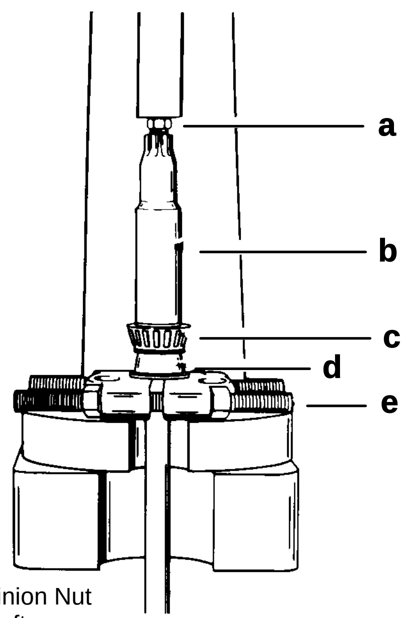
a - Tapered Bearing Race
b - Bearing Driver Cup (91-31106)
c - Shim(s)

9. Remove nut from propeller shaft, then remove bearing carrier and propeller shaft from gear housing. Lift bearing driver cup out of gear housing.
10. Apply a light coat of oil on tapered bearing race, then place forward gear assembly into forward bearing race.

Driveshaft and Pinion Gear

REASSEMBLY/INSTALLATION

1. Apply a light coat of Quicksilver Super Duty Gear Lubricant on I.D. of driveshaft tapered bearing.
2. Thread a used pinion nut onto end of driveshaft. Leave approximately 1/16² (2mm) of nut threads exposed. Driveshaft threads MUST NOT extend beyond nut or thread damage could result while pressing.
3. Place bearing over driveshaft.
4. Using an old driveshaft bearing inner race or other suitable mandrel (which applies pressing force on center bearing race only), press bearing onto shaft until seated.

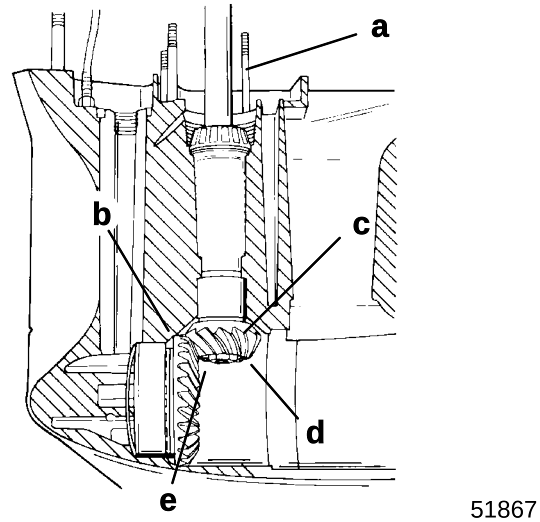


a - Used Pinion Nut
b - Driveshaft
c - Tapered Bearing
d - Old Bearing Inner Race
e - Universal Puller Plate

5. Position pinion gear in gear housing below driveshaft bore with teeth of pinion gear meshed with teeth of reverse gear.
6. Insert driveshaft into driveshaft bore while holding pinion gear. Rotate driveshaft to align and engage driveshaft splines with pinion gear splines. Continue to insert driveshaft into gear housing until driveshaft tapered bearing is against bearing race.

NOTE: *It is recommended that after final pinion depth is obtained, a new pinion nut be installed. Clean pinion nut threads with Loctite Primer N (92-59327-1) before applying Loctite 271.*

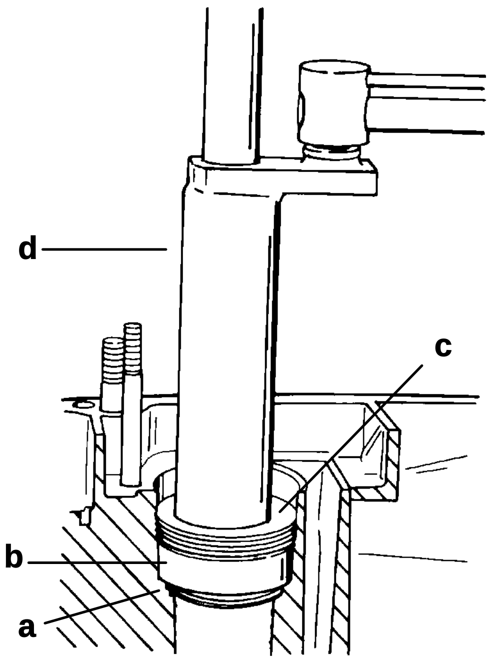
7. Place a small amount of Loctite 271 onto threads of pinion gear nut and install flat washer and nut on driveshaft with flat side of nut away from pinion gear. Hand tighten pinion nut.



51867

a - Driveshaft (rotate to engage splines with pinion gear)
b - Forward Gear Assembly
c - Pinion Gear
d - Washer (located above pinion nut)
e - Pinion Nut [apply Loctite 271 on threads and install with flat side away from pinion gear.]

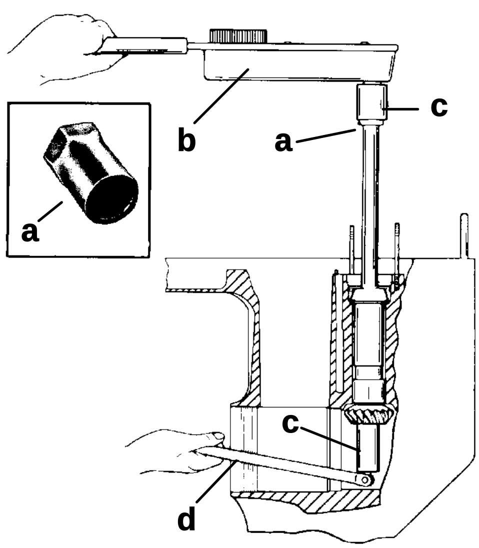
8. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or are not reusable (damaged), start with approximately 0.010" (0.254mm).
9. Install bearing race and bearing retainer.



51880

a - Shim(s)
b - Bearing Race
c - Bearing Retainer (Word "OFF" must be visible) Torque to 100 lb. ft. (135.5 N·m)
d - Bearing Retainer Tool (91-43506)

10. Use a socket and flex handle to hold pinion nut (pad area where flex handle will contact gear housing while torquing nut).
11. Place Driveshaft Holding Tool (91-34377A1) over crankshaft end of driveshaft. Torque pinion nut to 75 lb. ft. (101.5 N·m).



a - Driveshaft Holding Tool (91-34377A1)
b - Torque Wrench; Torque Nut to 75 lb. ft. (101.5 N·m)
c - Socket
d - Breaker Bar

IMPORTANT: Wipe any excess Loctite from pinion nut and pinion gear.

Pinion Gear Depth/Forward Gear Backlash/Reverse Gear Backlash

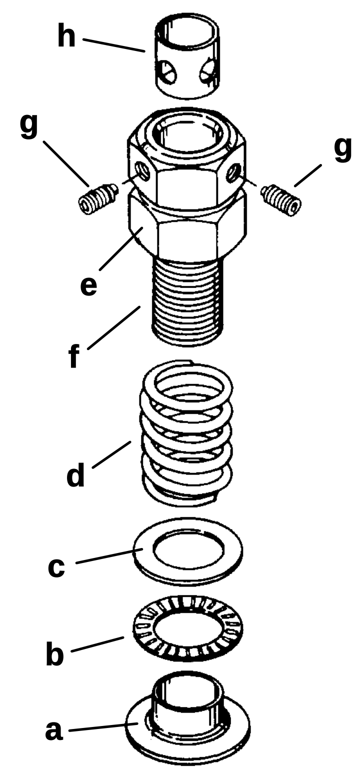
DETERMINING PINION GEAR DEPTH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Forward gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

1. Clean the gear housing bearing carrier shoulder.
2. Install Bearing Preload Tool (91-14311A1) over driveshaft in sequence shown.

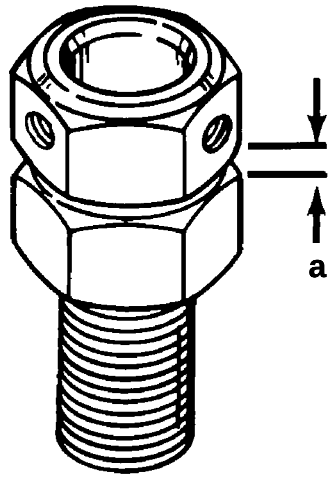
NOTE: *Bearing Preload Tool (91-44307A1) may also be used. Follow instructions provided with tool for proper installation.*

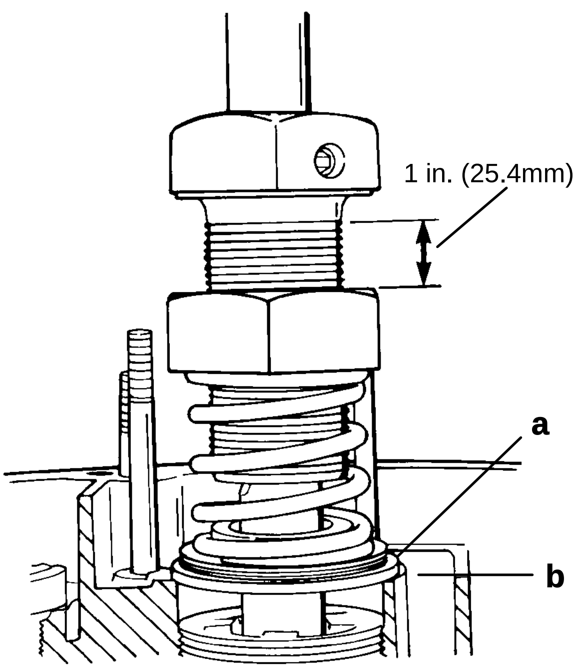


a - Adaptor
b - Bearing
c - Washer
d - Spring
e - Nut; Thread Nut ALL-the-Way Onto Bolt
f - Bolt
g - Set Screw
h - Sleeve; Holes in Sleeve Must Align with Set Screw

3. Align adaptor on driveshaft bearing pocket ledge.

4. With tool installed over driveshaft, tighten both set screws securely, making certain to align sleeve holes to allow set screws to pass thru.
5. Measure distance (a) and increase that distance by 1″ (25.4mm) by turning bottom nut away from top nut.



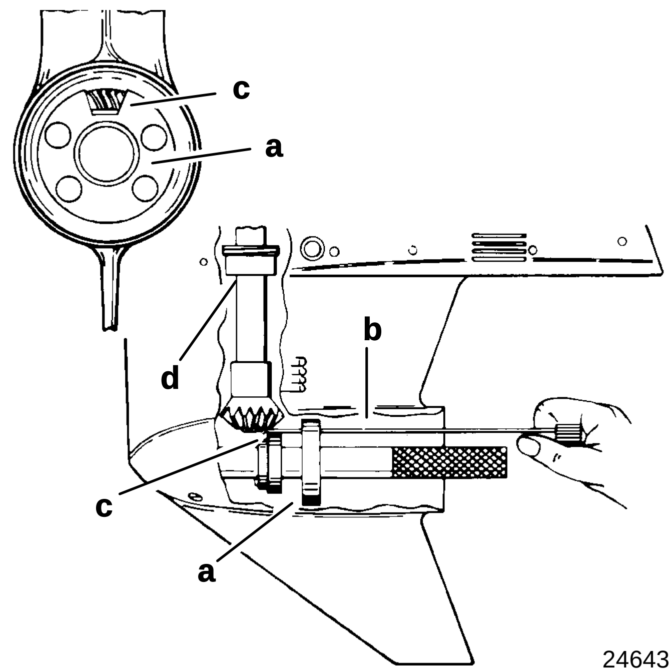


a - Adaptor
b - Ledge

6. Turn driveshaft clockwise 2 or more turns to seat driveshaft bearings.
7. Insert Pinion Gear Locating Tool* (91-74776) into gear housing until it bottoms out on bearing carrier shoulder.

*Pinion Gear Locating Tool (91-12349A2) can be used. Use flat #7 and disc #2. Follow instructions supplied with tool.

8. Determine pinion gear depth by inserting a feeler gauge thru access slot in pinion gear shimming tool.
9. Clearance between shimming tool and pinion gear should be 0.025″ (0.64mm).
10. If clearance is correct, leave Bearing Preload Tool on driveshaft for "Determining Forward Gear Backlash," following.
11. If clearance is not correct, add (or subtract) shims at location shown to raise (or lower) pinion gear. When reinstalling pinion nut, apply Loctite 271 on threads of nut and re-torque pinion nut.



a - Pinion Gear Tool (91-74776 or 91-12349A2)
b - Feeler Gauge
c - Obtain 0.025″ (0.64mm) Clearance between Shimming Tool and Pinion Gear
d - Add or Subtract Shim(s) Here

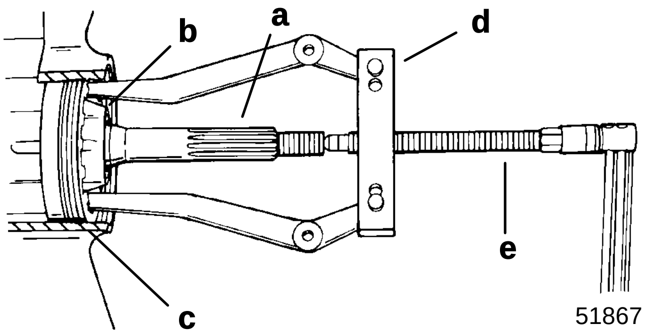
NOTE: *Bearing Preload Tool (91-14311A1) should remain installed on driveshaft after setting pinion gear depth as it is required to properly check forward gear and reverse gear backlash.*

DETERMINING FORWARD GEAR BACKLASH

IMPORTANT: Bearing carrier must be assembled to provide a pilot for propeller shaft.

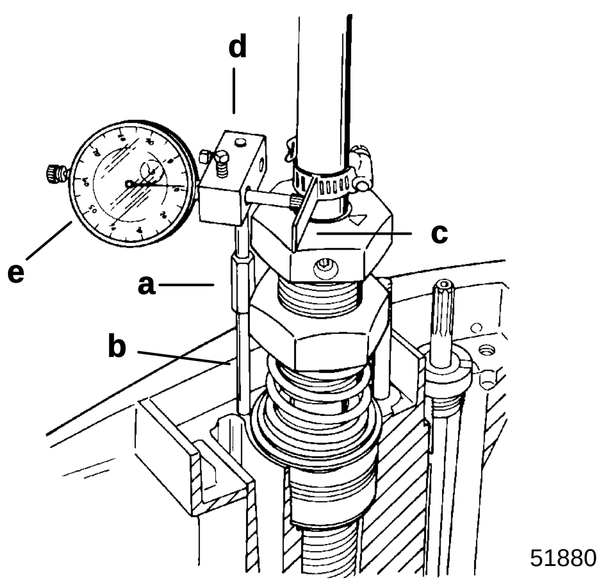
1. Insert propeller shaft into position in gear housing. (DO NOT place shift cam on propeller shaft.)
2. Place bearing carrier into gear housing and thread cover nut tightly against bearing carrier. (It is not necessary to torque cover nut against bearing carrier.)

3. Attach Bearing Carrier Removal Tool (91-46086A1) and Puller Bolt (91-85716) onto gear housing.
4. Torque puller bolt against propeller shaft to 45 lb. in. (5.0 N·m). Turn driveshaft 10 revolutions with the load applied to propeller shaft. This will seat forward gear bearing.



a - Propeller Shaft (DO NOT install shift cam)
b - Bearing Carrier (assembled)
c - Cover Nut (Tighten; DO NOT torque)
d - Bearing Carrier Removal Tool (91-46086A1)
e - Puller Bolt (91-85716); Torque to 45 lb. in. (5.0 N·m)

5. Fasten dial indicator to gear housing and Backlash Indicator Tool (91-78473) to driveshaft.
6. Recheck torque on puller bolt [45 lb. in. (5.0 N·m)].
7. Position dial indicator pointer on line marked "1" on Backlash Indicator Tool, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked "2" on Backlash Indicator Tool, if gear ratio is 2:1 (14 teeth on pinion gear) or on line marked "4" if gear ratio is 2.3:1 (13 teeth on pinion gear).



a - Thread Stud Adaptor (from 91-14311A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)

8. Lightly turn driveshaft back-and-forth (no movement should be noticed at propeller shaft).
9. Dial indicator registers amount of backlash which must be 0.018" to 0.027" (0.46mm to 0.69mm) for the 1.87:1 gear ratio, 0.015" to 0.022" (.38mm to .56mm) for the 2:1 gear ratio and 0.018" to 0.023" (0.46mm to 0.58mm) for the 2.3:1 gear ratio.
10. If backlash is LESS than the specified minimum, REMOVE shim(s) from in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.
11. If backlash is MORE than the specified MAXIMUM, add shim(s) in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.

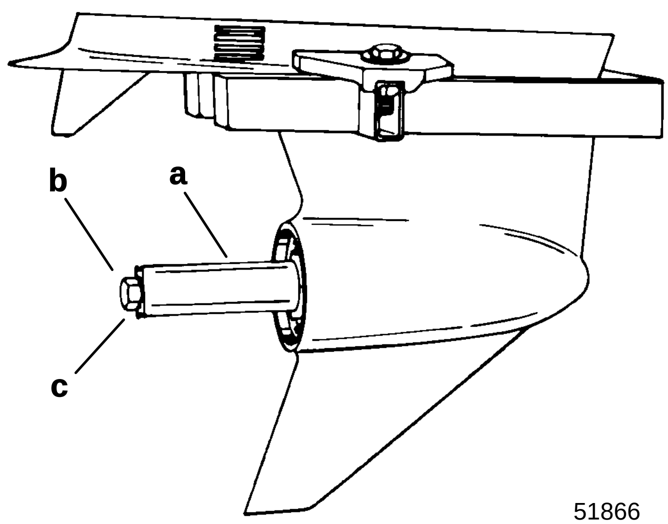
NOTE: *By adding or subtracting 0.001" (0.025mm) shim, the backlash will change approximately 0.001" (0.025mm).*

REVERSE GEAR

Determining Reverse Gear Backlash

Although reverse gear backlash is not adjustable, it may be checked as follows:

1. Propeller shaft and bearing carrier must be completely assembled and installed in gearcase.
2. Install shift shaft in gearcase.
3. Shift gearcase into reverse.
4. Slide 6 in. x 1.5 in. I.D. (152.5mm x 38.0mm) piece of PVC pipe over propeller shaft and position pipe against bearing carrier.
5. Secure pipe against carrier with propeller nut and tab washer.



a - Pipe [6 in. x 1.5 in. (152.4mm x 38.1mm)]
b - Propeller Nut
c - Tab Washer

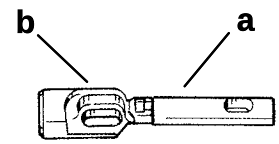
6. Torque propeller nut to 45 lb. in. (5.0 N·m).
7. Gently rock driveshaft. Dial indicator should show backlash of 0.030^2-0.050^2 (0.762mm-01.27mm).

If backlash is not as indicated, gear case is not properly assembled or parts are excessively worn and must be replaced before returning gear case to service.

Clutch Actuator Rod

REASSEMBLY

1. Place a small amount of Quicksilver 2-4-C w/Teflon Lubricant on actuator rod and install cam follower.



a - Actuator Rod
b - Cam Follower

Shift Shaft Bushing

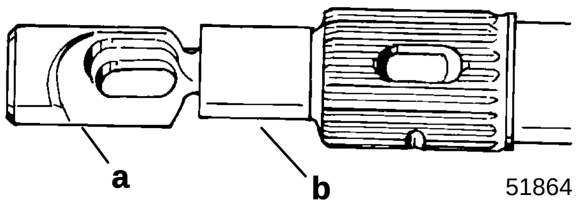
REASSEMBLY

1. Position shift shaft bushing on a press with threaded side down.
2. Apply Loctite 271 to outside diameter of oil seal.
3. Press oil seal into shift shaft bushing with lip of seal up.
4. Wipe any excess Loctite from oil seal and bushing.
5. Place rubber washer against oil seal.
6. Install O-ring over threads and up against shoulder of bushing.
7. Lubricate O-ring and oil seal with Quicksilver 2-4-C w/Teflon Marine Lubricant.

Propeller Shaft

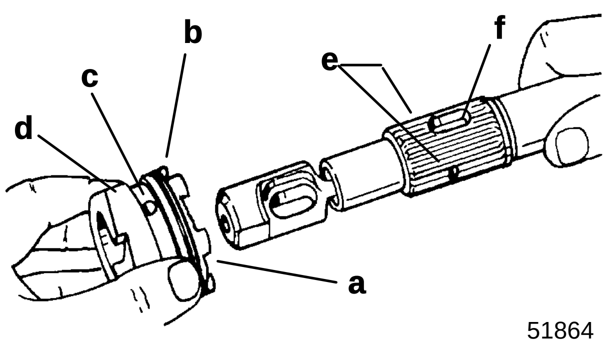
REASSEMBLY/INSTALLATION

1. Insert clutch actuator rod assembly into end of propeller shaft. Align cross pin slot in actuator rod with cross pin slot in propeller shaft.



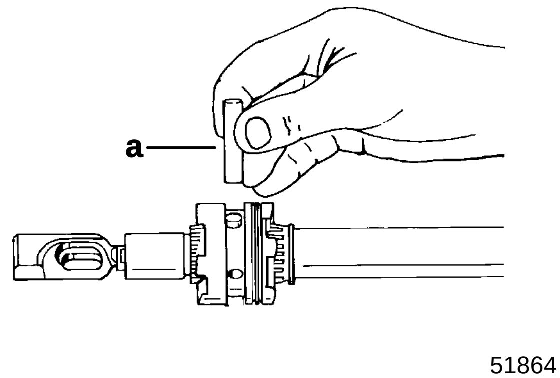
a - Cam Follower
b - Propeller Shaft

2. On PRODUCTION MODEL GEAR CASES, position sliding clutch onto propeller shaft with GROOVED RINGS (ON SLIDING CLUTCH) TOWARD PROPELLER END OF PROPELLER SHAFT. Cross pin hole and detent holes (in sliding clutch) must line up with cross pin slot and detent notches on propeller shaft.



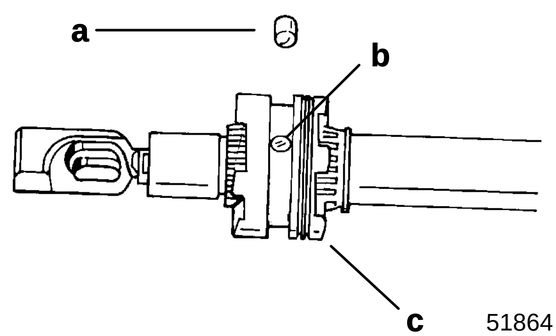
a - Sliding Clutch
b - Grooved Rings
c - Cross Pin Hole
d - Detent Hole (Behind Finger and Thumb)
e - Detent Notch (One on Each Side)
f - Cross Pin Slot

3. Insert cross pin thru sliding clutch, propeller shaft and actuator rod, forcing cross pin tool out.



a - Cross Pin

4. Apply a small amount of 2-4-C w/Teflon Marine Lubricant on detent pin. Position a detent pin in detent pin hole of sliding clutch with rounded end of pin toward propeller shaft.



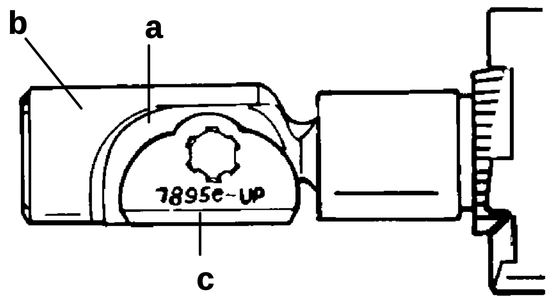
a - Detent Pin
b - Cross Pin
c - Sliding Clutch

5. Install cross pin retaining spring onto sliding clutch as follows:

IMPORTANT: DO NOT over-stretch retaining spring when installing onto sliding clutch.

6. Spirally wrap spring into groove on sliding clutch.
7. Place gear housing in a soft jaw vise with the driveshaft in a vertical position.
8. Coat cam pocket of cam follower with 2-4-C w/Teflon Marine Lubricant.

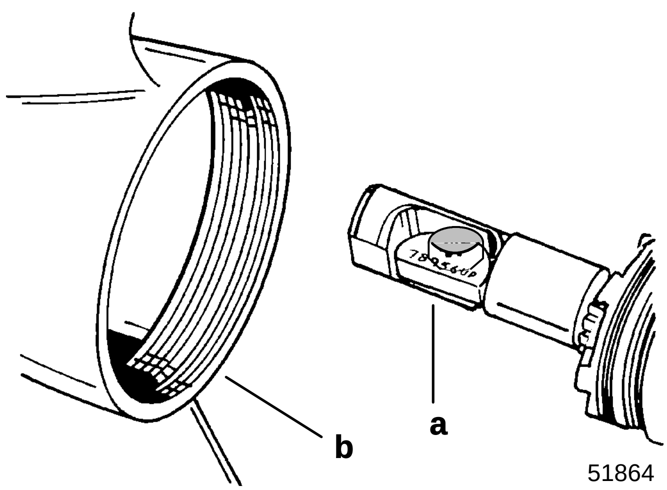
9. Place shift cam into cam pocket of cam follower with numbered side of cam facing up.



51864

a - Cam Pocket
b - Cam Follower
c - Shift Cam

10. With shift cam positioned as shown, insert propeller shaft thru forward gear until shaft bottoms out.



51864

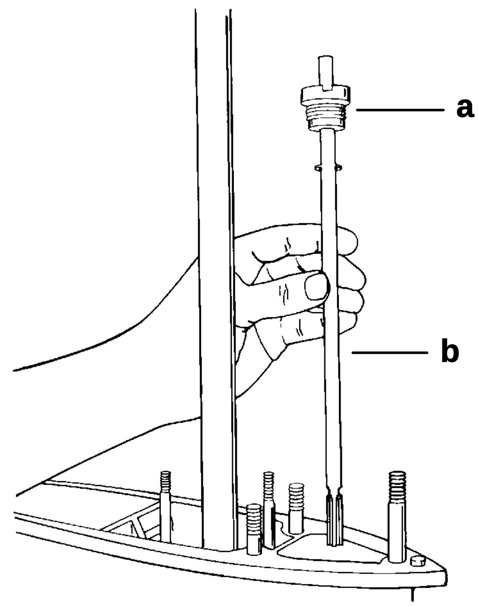
a - Shift Cam (Position as Shown)
b - Gear Housing

⚠ CAUTION

Until bearing carrier is installed into gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

11. Insert shift shaft down shift shaft hole (of gear housing) and thru shift cam and cam follower. (It may be necessary to rotate shift shaft back-and-forth slightly for it to enter shift cam.)

12. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to threads of shift shaft bushing. (Thread bushing into position, but do not tighten down at this time.)



51867

a - Shift Shaft Bushing
b - Shift Shaft

13. Lubricate O-ring on bearing carrier with Quicksilver 2-4-C w/Teflon Marine Lubricant.

14. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to outside diameter of bearing carrier (where carrier contacts gear housing).

NOTE: *When performing Step 15, rotate driveshaft clockwise (viewed from top) to mesh pinion gear with reverse gear.*

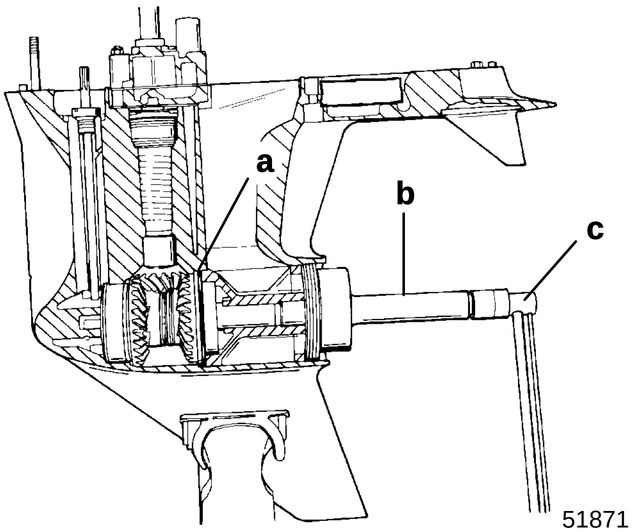
15. Position bearing carrier over propeller shaft and slide it into gear housing. (Be sure to align bearing carrier keyway with gear housing keyway.)

16. Push bearing carrier in as far as possible by hand, then install bearing carrier key.

17. Place tab washer against bearing carrier.

18. Apply Quicksilver 2-4-C w/Teflon Marine Lubricant to threads of cover nut and install cover nut in gear housing (verify that the word "OFF" and arrow are visible).

19. Start cover nut a few turns by hand, then using Cover Nut Tool (91-61069) and torque wrench, torque cover nut to 210 lb. ft. (284.5 N·m).



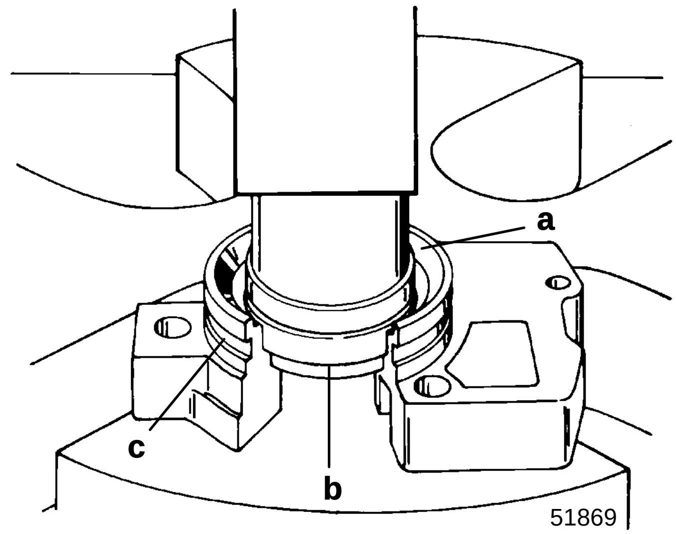
a - O-ring
b - Cover Nut Tool
c - Torque Wrench

20. Bend one lock tab of tab washer into cover nut (only one will align).
21. Bend remaining tabs of tab washer toward front of gear housing.
22. Use Shift Shaft Bushing Tool (91-31107) and torque shift shaft bushing to 30 lb. ft. (40.5 N·m).

Water Pump

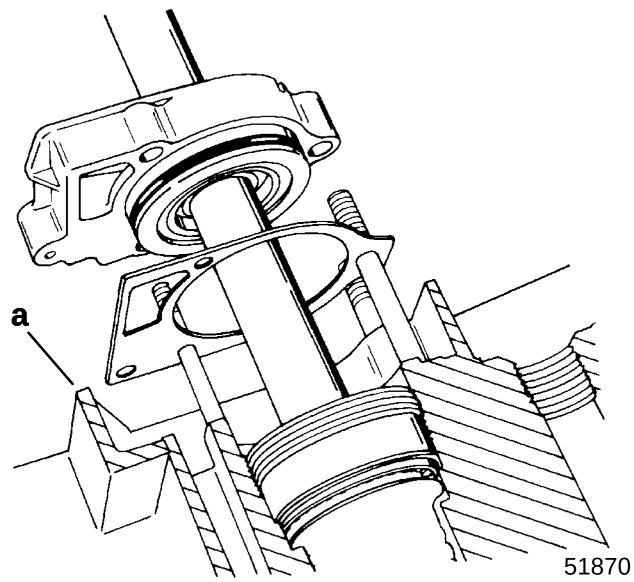
REASSEMBLY/INSTALLATION

1. Install oil seals into water pump base, as follows:
   a. Place water pump base on a press.
   b. Just before installing each seal apply Loctite 271 on outside diameter of oil seal.
   c. With a suitable mandrel, press the smaller diameter oil seal into pump base with lip of oil seal toward impeller side of base.
   d. With a suitable mandrel, press the larger diameter oil seal into pump base with lip of oil seal toward gear housing side of base.
   e. Wipe any excess Loctite from oil seals and water pump base.
2. Install O-ring into O-ring groove of water pump base. Lubricate O-ring and oil seals with 2-4-C w/ Teflon Marine Lubricant (92-90018A12).



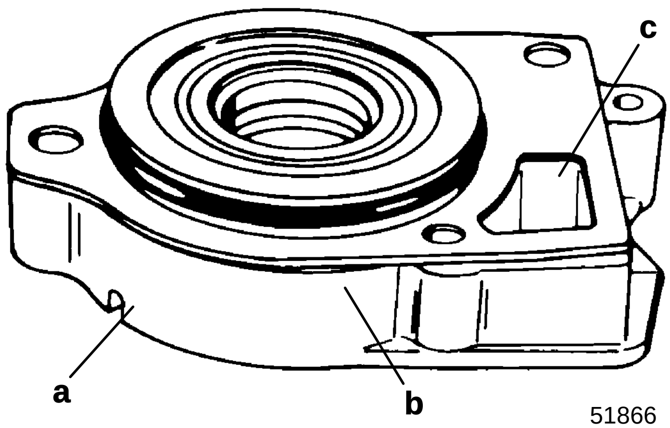
a - Mandrel
b - Oil Seal (Smaller OD)
c - O-ring Groove

3. Install divider block if removed. Use RTV Sealer to seal seams between divider block and gear housing.



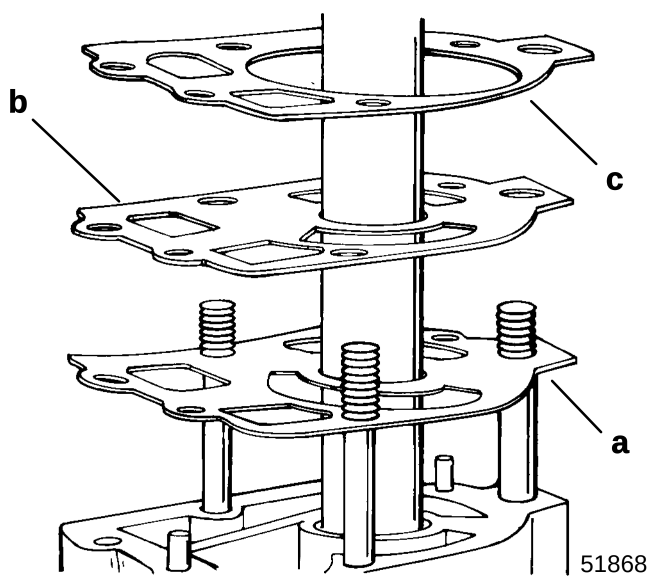
a - Divider Block

4. Install a new water pump base gasket and install water pump base.



a - Water Pump Base
b - Gasket
c - Hole (MUST be positioned as shown)

5. Install the following in order: Pump base to face plate gasket, face plate gasket and face plate to pump cover gasket. Gaskets and face plate are indexed by dowel pin location and must be installed correctly.



a - Gasket (Water Pump Base to Face Plate)
b - Face Plate
c - Gasket (Face Plate to Water Pump Cover)

6. Place impeller drive key on flat of driveshaft. Hold key on driveshaft with a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant.

IMPORTANT: When completing gear housing repair, that requires removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to reuse the impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur. Original rotation is clockwise.

⚠ CAUTION

A visual inspection of impeller drive key MUST BE made to determine that drive key is on flat of driveshaft after impeller is installed. If key has moved off flat of driveshaft, repeat Steps 7 and 8.

7. Slide impeller down driveshaft to impeller drive key. Align drive key with keyway in the center hub of impeller, and slide impeller over drive key.
8. If removed, install new water pump insert into pump cover as follows:
   a. Apply Perfect Seal to water pump insert area of pump cover.
   b. Install water pump insert into pump cover. Verify that tab on insert enters recess in pump cover.
   c. Wipe any excess Perfect Seal from insert and cover.

NOTE: *If 2 holes were drilled in top of water pump cover to aid in removal of insert, fill holes with RTV Sealer or equivalent. Allow to cure, 24 hours prior to operating engine.*

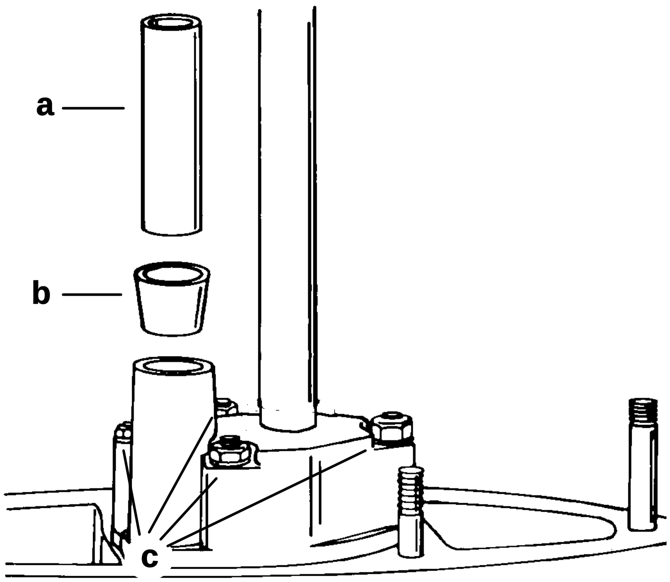
9. Install water tube seal into pump cover, being sure that plastic side of seal goes into cover first.
10. Reinstall water tube guide into water pump cover.
11. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant inside of water pump insert.
12. Position assembled water pump cover over driveshaft and lower over water pump studs. Rotate driveshaft in a clockwise direction (viewed from top), while pushing down on pump cover to ease impeller entry into cover.
13. Install water pump cover retainer washers, nuts and bolt.

⚠ CAUTION

DO NOT over-torque nuts and bolt, as this could cause cover to crack during operation.

14. Torque water pump nuts to 50 lb. in. (5.5 N·m), and water pump bolt to 35 lb. in. (4.0 N·m).

15. Install centrifugal slinger over driveshaft and down against pump cover.



51874

a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolts and Washers

Gear Lubricant Filling Instructions

1. Remove any gasket material from "Fill" and "Vent" screws and gear 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 thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.
4. Install "Vent" screw into "Vent" hole.

IMPORTANT: DO NOT lose more than one fluid ounce (30cc) of gear lubricant while reinstalling "Fill" screw.

5. Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Driveshaft Housing

WARNING

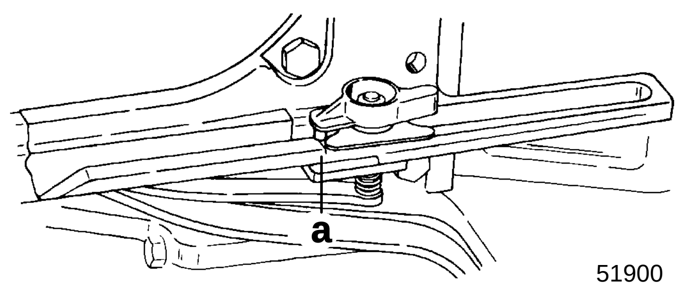
Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing onto driveshaft housing.

1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto driveshaft splines.

CAUTION

DO NOT allow lubricant on top of driveshaft. Excess lubricant, that is trapped in clearance space, will not allow driveshaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of driveshaft) will load the driveshaft/crankshaft and damage either or both the powerhead and gear housing. Top of driveshaft is to be wiped free of lubricant.

3. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Apply a thin bead of G.E. Silicone Sealer (obtained locally) against the top of divider block.
5. Insert trim tab bolt into hole in rear of gear housing to driveshaft housing machined surface.
6. Shift gear housing into forward gear and place guide block anchor pin into forward gear position.



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a - Guide Block Anchor Pin

7. Position gear housing so that the driveshaft is protruding into driveshaft housing.

NOTE: *If, while performing Step 8, the driveshaft splines will not align with crankshaft splines, place a propeller onto propeller shaft and turn it counterclockwise as the gear housing is being pushed toward driveshaft housing.*

8. Move gear housing up toward driveshaft housing, while aligning shift shaft splines and water tube with water tube guide (in water pump cover).

9. Place flat washers onto studs (located on either side of driveshaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gearcase up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to listing in **"Torque Specifications,"** preceding.
13. After 2 nuts (located on either side of driveshaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into neutral position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into reverse gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

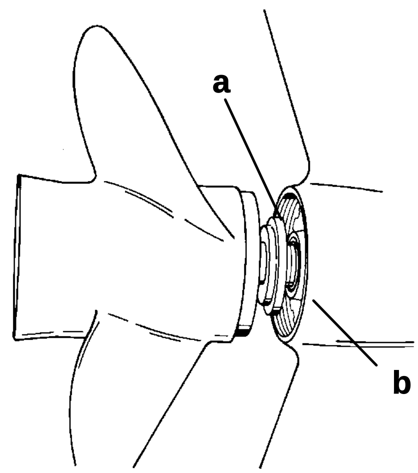
14. Install washers and nuts onto studs (located on bottom center of anti-cavitation plate). Torque to listing in **"Torque Specifications,"** preceding.
15. Install special flat washer and nut on stud at leading edge of driveshaft housing. Torque to listing in **"Torque Specifications,"** preceding.
16. Torque bolt (started in Step 10) to listing in **"Torque Specifications,"** preceding.
17. Install trim tab, adjust to position in which it had previously been installed, and tighten securely.
18. Install plastic cap into trim tab bolt opening at rear edge of driveshaft housing.

Propeller Installation

⚠ WARNING

When installing or removing propeller, because of the engine's ease in starting, be sure that the remote control is in neutral position and that the key switch is "OFF." Place a block of wood between the anti-cavitation plate and propeller to prevent accidental starting and to protect hands from propeller blades while removing or installing nut.

1. To aid in future removal of the propeller, liberally coat the propeller shaft splines with one of the following Quicksilver products:
    -- Anti-Corrosion Grease (92-78376A6)
    -- Special Lubricant 101 (92-13872A1)
    -- 2-4-C Marine Lubricant (92-90018A12)
    -- Perfect Seal (92-34227--1)
2. Place forward thrust hub over propeller shaft with shoulder side toward propeller.
3. Place propeller on propeller shaft and slide it up against thrust hub.



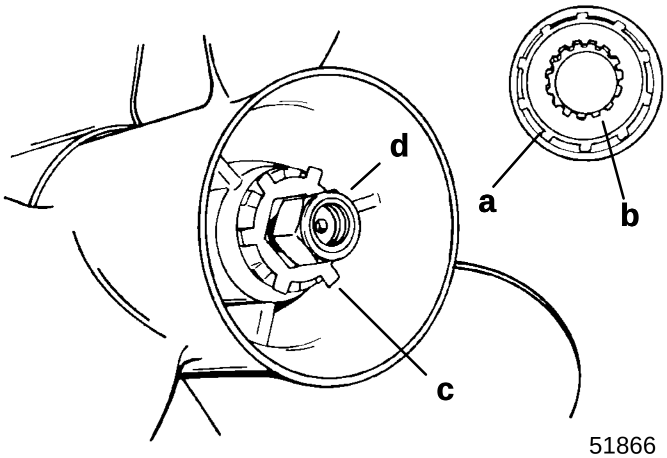
a - Forward Thrust Hub
b - Propeller Shaft

4. Place continuity washer (if equipped) onto shoulder of rear thrust hub.
5. Place rear thrust hub, tab washer and propeller nut on propeller shaft.
6. Thread propeller nut onto propeller shaft until nut is recessed into tab washer.
7. After propeller nut is recessed into tab washer, tighten nut securely [minimum of 55 lb. ft. (74.5 N·m) torque].
8. Bend 3 of the tabs of tab washer down in grooves of rear thrust hub to secure propeller nut. (If tab washer tabs do not align with slots, continue to tighten propeller nut to obtain alignment. DO NOT loosen nut to align tabs.)

⚠ CAUTION

DO NOT misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; how- ever, propeller should not move forward-and-aft on propeller shaft.

9. After first use, retighten propeller nut and again secure with tab washer (Steps 7 and 8, preceding). Propeller should be checked periodically for tightness, particularly if a stainless steel propeller is used.



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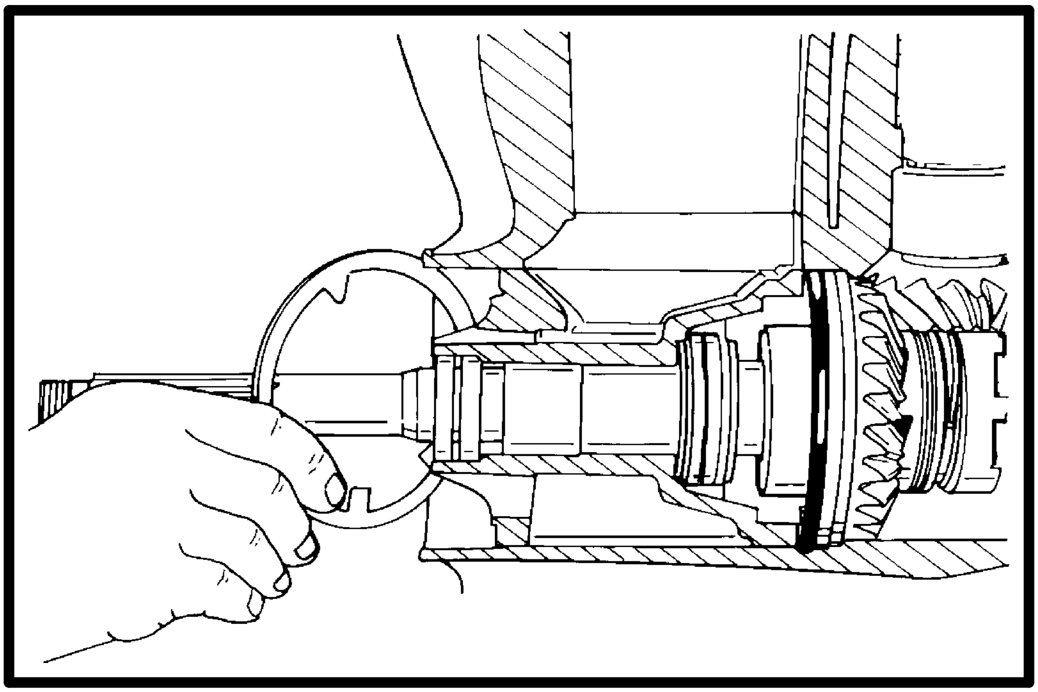
a - Continuity Washer (if Equipped)
b - Rear Thrust Hub
c - Tab Washer
d - Propeller Nut

LOWER UNIT



6
E

COUNTER ROTATING (NON-RATCHETING) (LEFT HAND) GEAR CASE

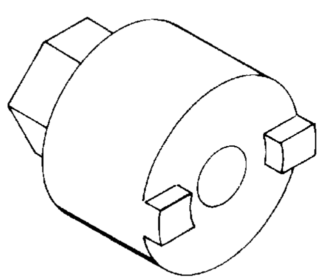
Table of Contents

Gear Housing Specifications (Counter Rotation)

Ratio	Pinion Depth	Forward Gear Backlash	Reverse Gear Backlash
1.87:1 (15/28 teeth)	0.025 in. (0.635mm) With Tool 91-12349A 2 using Disc #2 and Flat #7	0.018 in. to 0.027 in. (0.460mm to 0.686mm) Pointer on line mark #1	0.030 in. to 0.050 in. (0.762mm to 1.27mm)
2.0:1 (15/30 teeth)	0.025 in. (0.635mm) With Tool 91-12349A 2 using Disc #2 and Flat #7	0.015 in. to 0.022 in. (0.38mm to 0.56mm) Pointer on line mark #2	0.030 in. to 0.050 in. (0.762mm to 1.27mm)
Gearcase Lubricant Capacity			
All Ratios		21.0 fl. oz. (650.0ml)	

Special Tools

Shift Shaft Bushing Tool 91-31107



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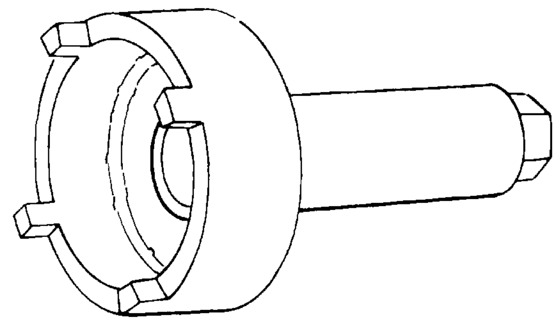
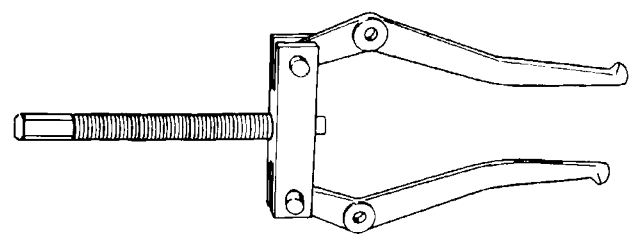
Gear Housing Cover Nut Tool 91-61069



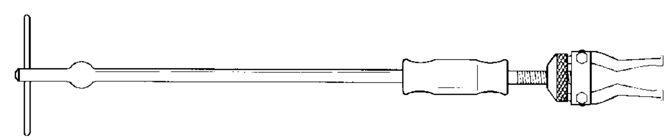
73605

Bearing Carrier Removal Tool 91-46086A1 and Puller Bolt 91-85716



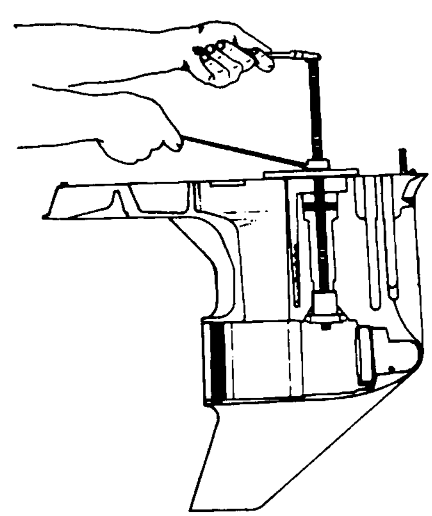
73599

Slide Hammer Puller 91-34569A1



73655

Bearing Removal and Installation Kit 91-31229A5. This kit contains the following tools: Pilot 91-36571; Puller Rod 91-31229; Nut 11-24156; Puller Plate 91-29310; Mandrel 91-38628; and Driver Rod 91-37323.



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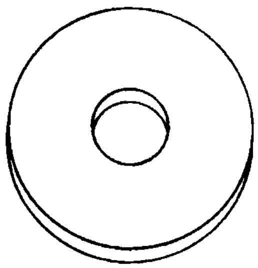
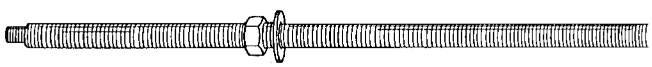
Pilot 91-36571

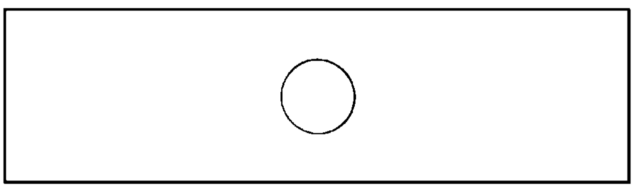


74187

Puller Rod 91-31229 and Nut 91-24156

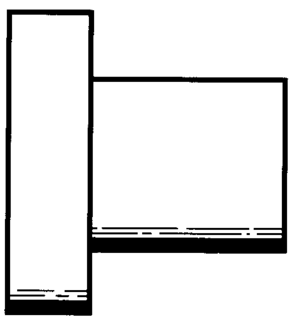


Puller Plate 91-29310



74190

Mandrel 91-38628

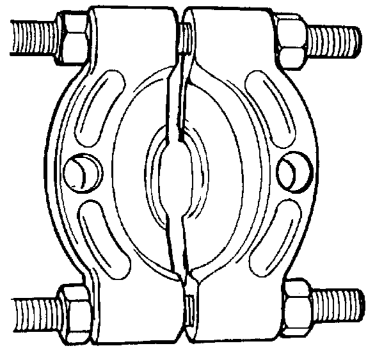


74193

Driver Rod 91-37323

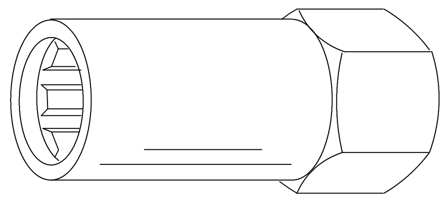
74184

Universal Puller Plate 91-37241



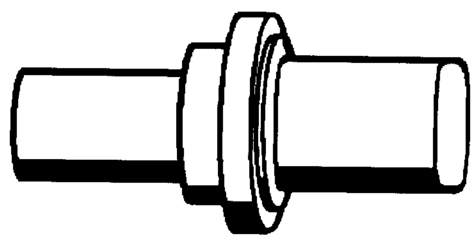
73652

Driveshaft Holding Tool 91-34377A1



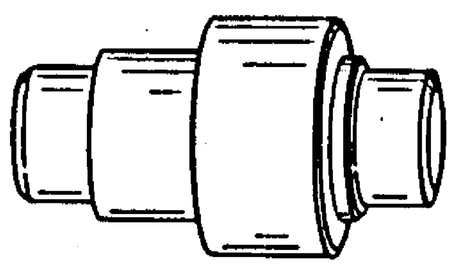
55079

Oil Seal Driver 91-31108

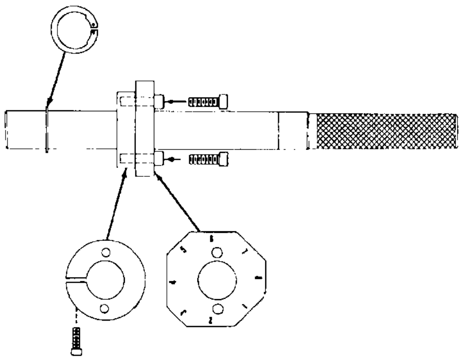


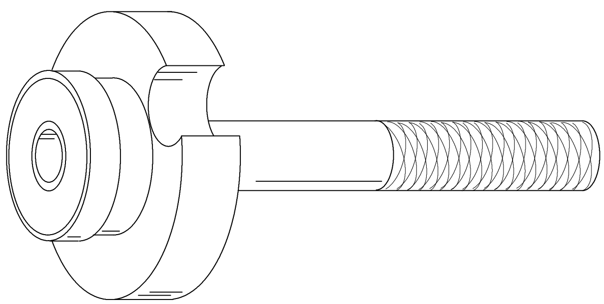
73651

Forward Gear Bearing Tool 91-86943



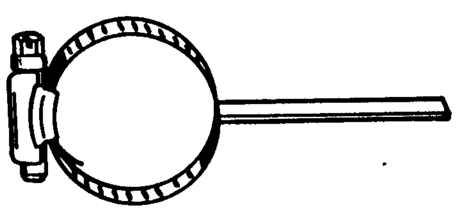
Pinion Locating Gear Tool 91-12349A2 or 91-74776



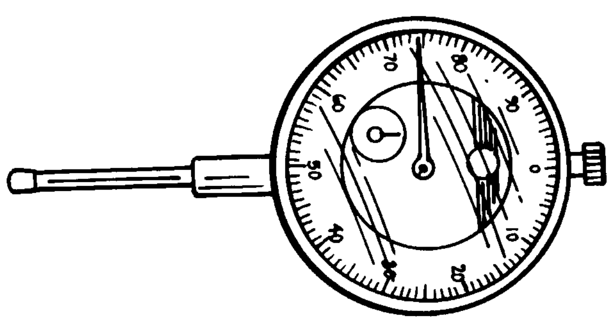


55079

Backlash Indicator Rod 91-78473

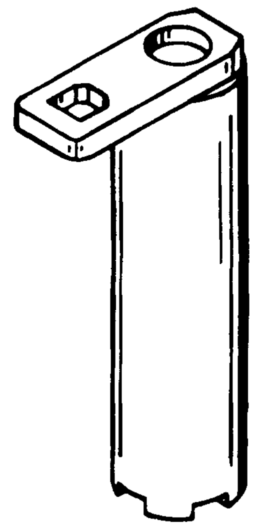


Dial Indicator 91-58222A1



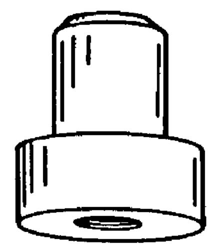
73429

Bearing Retainer Tool 91-43506

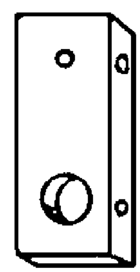


73600

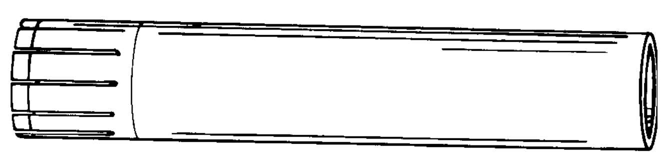
Mandrel 91-92788



Dial Indicator Holder 91-89897

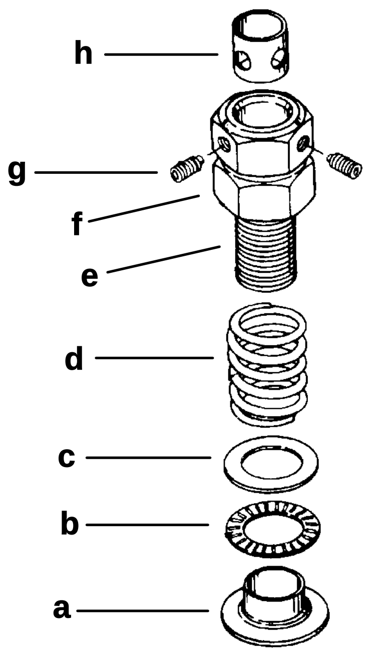


Forward Gear Installation Tool 91-815850



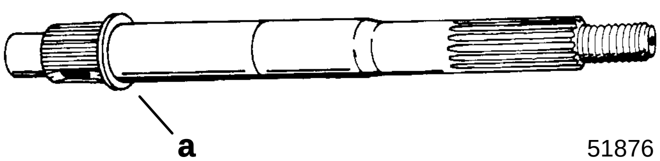
72486

Bearing Preload Tool 91-14311A1



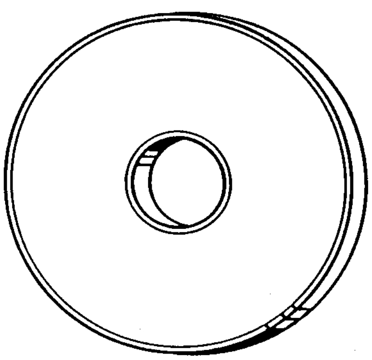
a - Adaptor (N.S.S.)
b - Bearing (N.S.S.)
c - Washer (N.S.S.)
d - Spring (24-14111)
e - Bolt (10-12580)
f - Nut (11-13953)
g - Set Screw (10-12575)
h - Sleeve (23-13946)

Propeller Shaft 44-93003 and Load Washer (a) 12-37429

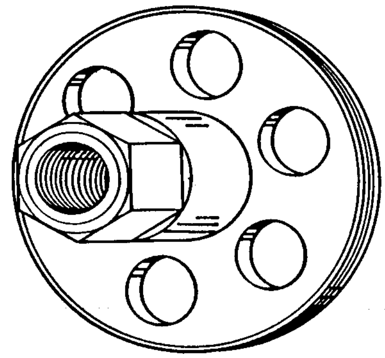


Reverse Gear Installation Kit 91-18605A1 includes Pilot 91-18603; Retainer 91-18604; Shaft 91-18605 and Screw 10-18602.

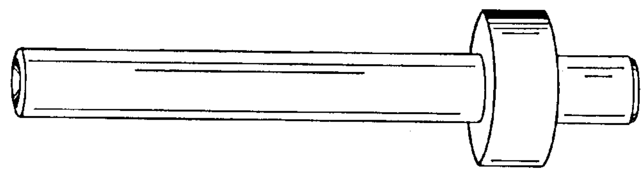
Pilot 91-18603



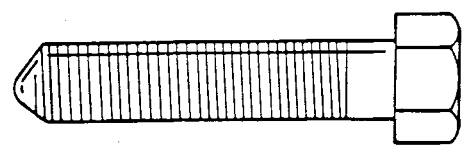
Retainer 91-18604



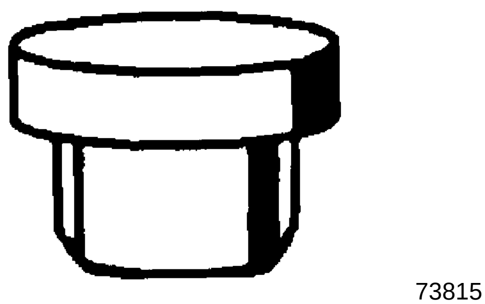
Shaft 91-18605



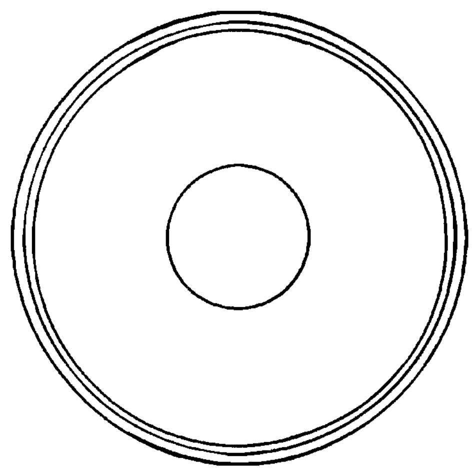
Screw 10-18602



Mandrel 91-15755

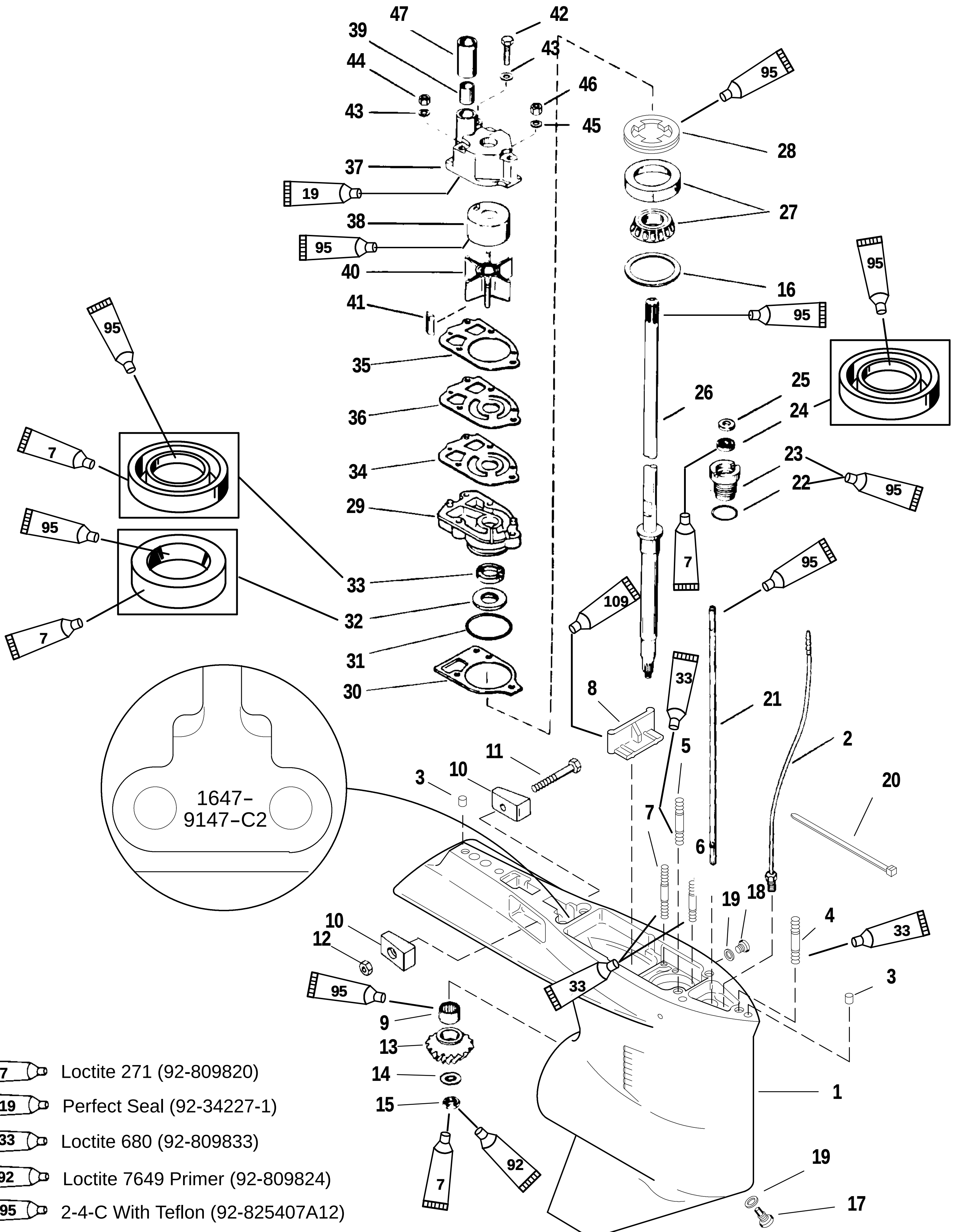


Mandrel 91-31106



Notes:

Gear Housing (Driveshaft)(Counter Rotation)
(S/N-0G438000 & UP)



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

33 Loctite 680 (92-809833)

92 Loctite 7649 Primer (92-809824)

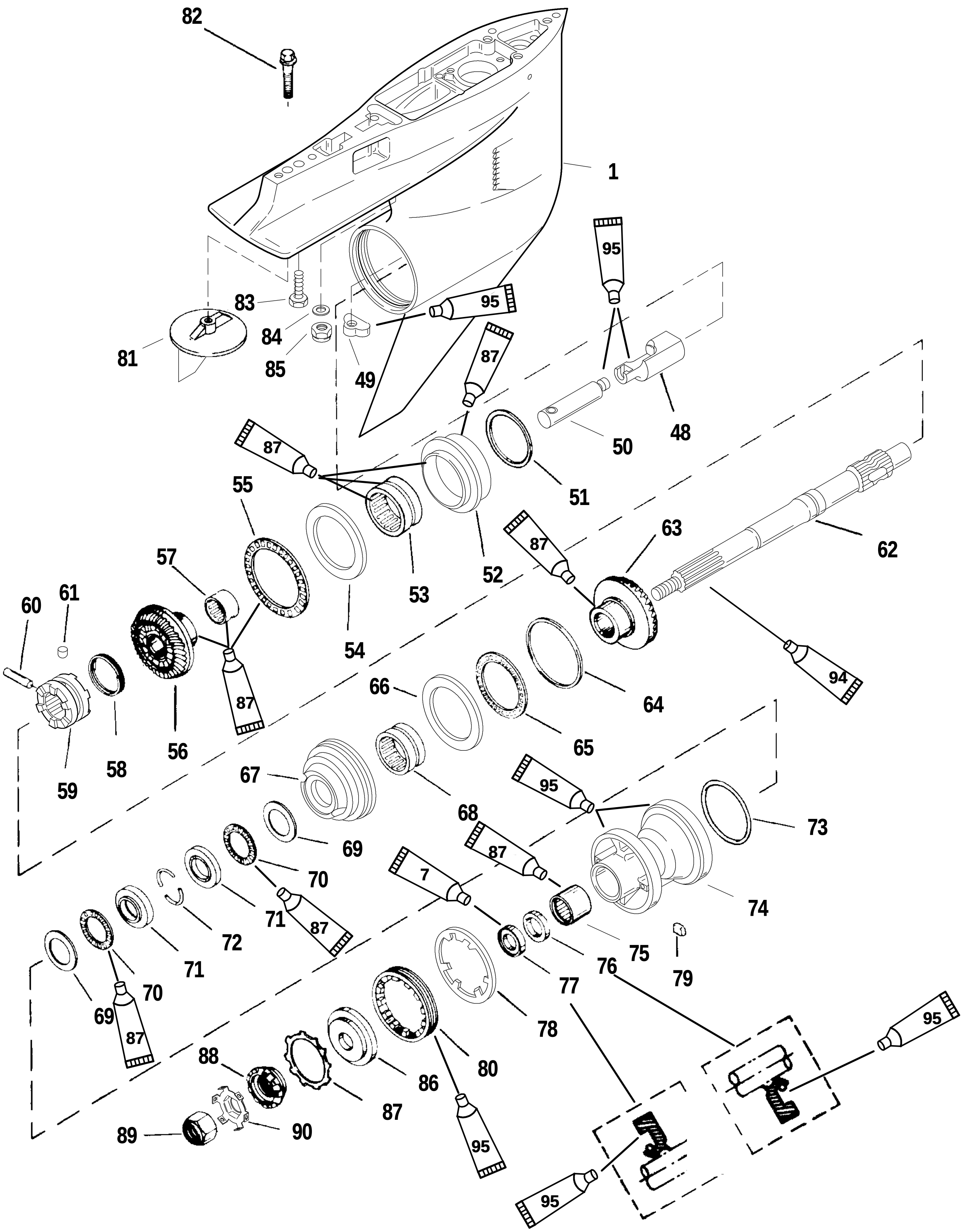
95 2-4-C With Teflon (92-825407A12)

GM Silicone Sealer (92-91600-1)

Gear Housing (Driveshaft)(Counter Rotation) (S/N-0G438000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
2	1	CONNECTOR ASSEMBLY			
3	2	DOWEL PIN			
4	1	STUD (3-11/16^{2})			
5	2	STUD (2-1/16^{2})			
6	1	STUD (3-3/8^{2})			
7	2	STUD (3-1/8^{2})			
8	1	FILLER BLOCK			
9	1	ROLLER BEARING			
10	2	ANODE			
11	1	SCREW			
12	1	NUT	60	5.0	7.0
13	1	PINION GEAR (Part of 43-828703A1 or 43-828701A1)			
14	1	WASHER			
15	1	NUT **Included With Forward Gear Set**		75	102
16	AR	SHIM SET			
17	1	SCREW-drain (MAGNETIC)	55		6.0
18	1	SCREW-grease filler	55		6.0
19	2	WASHER			
20	1	STA-STRAP			
21	1	SHIFT SHAFT			
22	1	O-RING			
23	1	BUSHING ASSEMBLY		30	40.5
24	1	OIL SEAL			
25	1	WASHER-rubber			
26	1	DRIVESHAFT			
27	1	ROLLER BEARING			
28	1	RETAINER		100	136
29	1	WATER PUMP BASE			
30	1	GASKET			
31	1	O-RING			
32	1	OIL SEAL			
33	1	OIL SEAL			
34	1	GASKET-lower			
35	1	GASKET-upper			
36	1	FACE PLATE			
37	1	WATER PUMP BODY ASSEMBLY			
38	1	INSERT			
39	1	SEAL-rubber			
40	1	IMPELLER			
41	1	KEY			
42	1	SCREW (2-1/4^{2})	35		4.0
43	2	WASHER			
44	2	NUT	50		5.5
45	1	WASHER			
46	1	NUT	50		5.5
47	1	SLEEVE			

Gear Housing (Prop Shaft)(Counter Rotation)
(S/N-0G438000 & UP)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

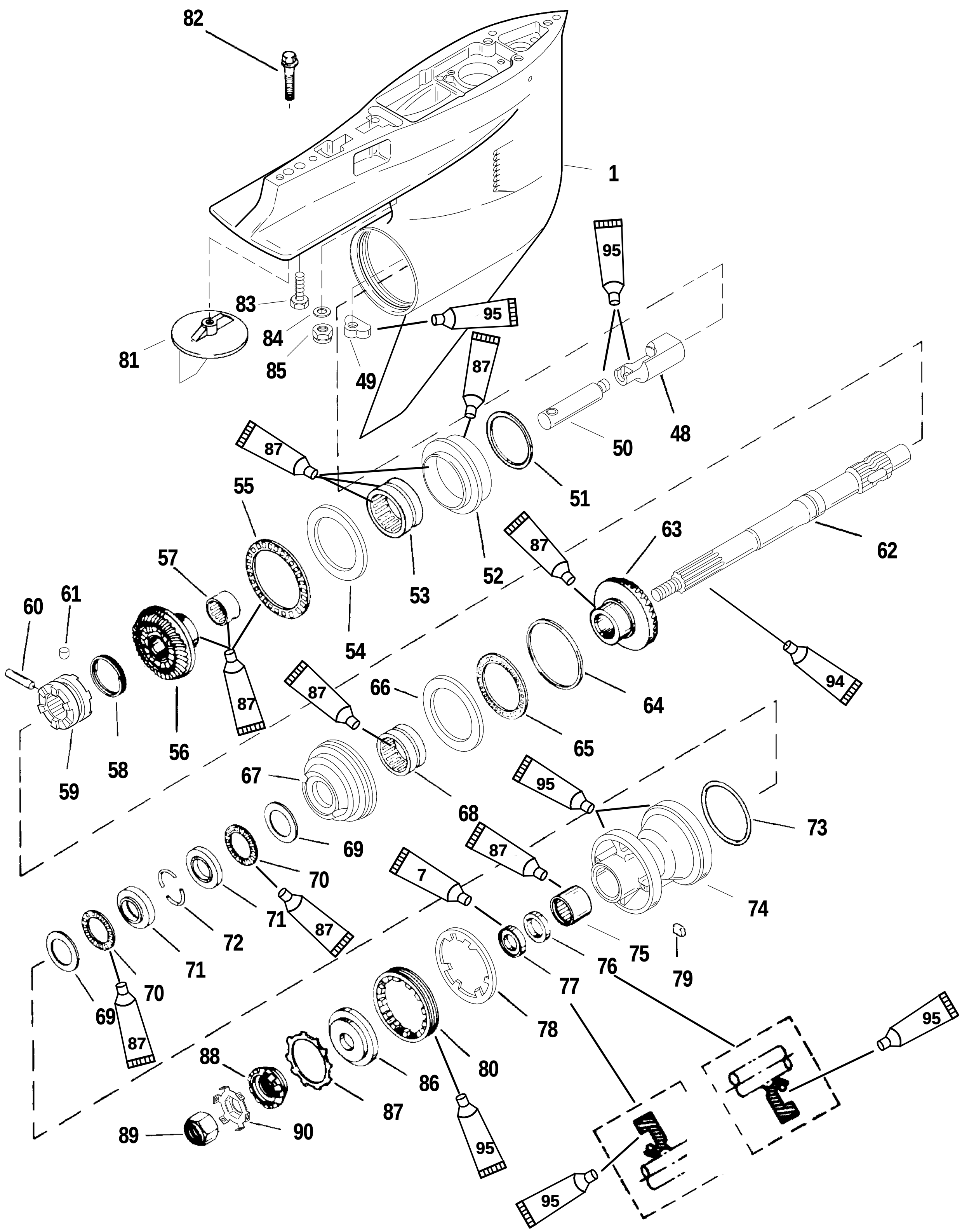
94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft)(Counter Rotation) (S/N-0G438000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
48	1	CAM FOLLOWER			
49	1	SHIFT CAM			
50	1	ROD			
51	AR	SHIM			
52	1	BEARING ADAPTOR ASSEMBLY			
53	1	ROLLER BEARING			
54	1	THRUST WASHER			
55	1	THRUST BEARING			
56	1	REVERSE GEAR **(135/150)**			
	1	REVERSE GEAR **(175/200)**			
57	1	ROLLER BEARING			
58	1	SPRING			
59	1	SLIDING CLUTCH			
60	1	CROSS PIN			
61	1	DETENT PIN			
62	1	PROPELLER SHAFT			
63	1	FORWARD GEAR **(135/150)**			
	1	FORWARD GEAR **(175/200)**			
64	AR	SPACER SHIM .206[2]			
	AR	SPACER SHIM .208[2]			
	AR	SPACER SHIM .210[2]			
	AR	SPACER SHIM .212[2]			
	AR	SPACER SHIM .214[2]			
	AR	SPACER SHIM .216[2]			
	AR	SPACER SHIM .218[2]			
	AR	SPACER SHIM .220[2]			
	AR	SPACER SHIM .222[2]			
	AR	SPACER SHIM .224[2]			
	AR	SPACER SHIM .226[2]			
	AR	SPACER SHIM .228[2]			
	AR	SPACER SHIM .230[2]			

Gear Housing (Prop Shaft)(Counter Rotation) (S/N-0G438000 & UP)



7 Loctite 271 (92-809820)

87 Super Duty Gear Lubricant (92-13783A24)

94 Anti-Corrosion Grease (92-78376A6)

95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft)(Counter Rotation) (S/N-0G438000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	1	GEAR HOUSING			
65	1	ROLLER BEARING			
66	1	THRUST WASHER			
67	1	BEARING ADAPTOR ASSEMBLY			
68	1	ROLLER BEARING			
69	2	THRUST WASHER			
70	2	THRUST BEARING			
71	2	THRUST RACE			
72	2	KEEPER			
73	1	O RING			
74	1	BEARING CARRIER ASSEMBLY			
75	1	ROLLER BEARING			
76	1	OIL SEAL (INSIDE)			
77	1	OIL SEAL (OUTSIDE)			
78	1	TAB WASHER			
79	1	KEY			
80	1	COVER			
81	1	TRIM TAB			
82	1	SCREW		40	54.0
83	1	SCREW (.375-16 x 1)		55	75.0
84	2	WASHER			
85	2	NUT		55	75.0
86	1	THRUST HUB			
87	1	LOCKWASHER **These replacement parts**			
88	1	WASHER **ARE NOT included with**			
89	1	PROPELLER NUT **Complete**		55	75.0
90	1	TAB WASHER **Gear Housing replacement**			

General Service Recommendations

There may be more than one way to "disassemble" or "reassemble" a particular part(s), therefore, it is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

In many cases, disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure order in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to "reassembly and installation" of that component in the reassembly part of this section. Use the "Index" (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, verify that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear. When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from over-heating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced, if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly, as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply 2-4-C w/Teflon Marine Lubricant on all O-rings. To prevent wear, apply 2-4-C w/Teflon Marine Lubricant on I.D. of oil seals. To prevent corrosion damage after reassembly, apply Quicksilver 2-4-C w/Teflon to external surfaces of bearing carrier and cover nut threads prior to installation.

Removal, Disassembly, Cleaning and Inspection of Counter Rotation (Left Hand) Gear Housing

REMOVAL

⚠ WARNING

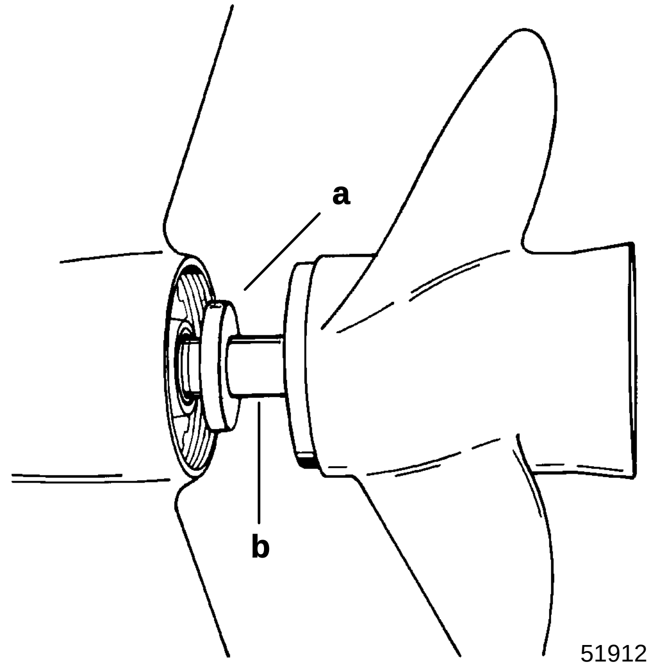
Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from driveshaft housing.

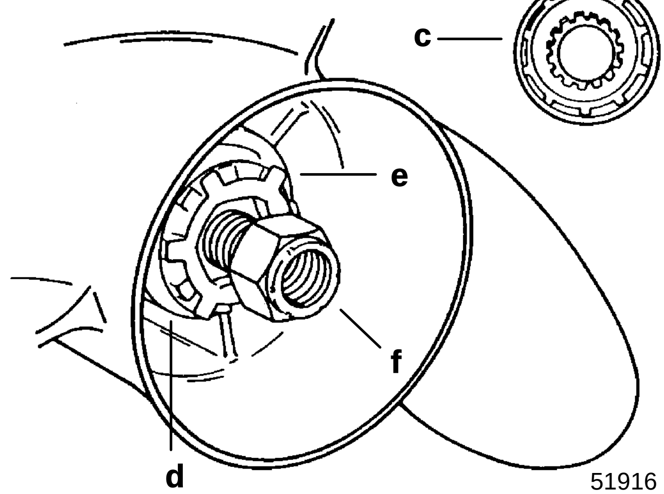
1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.

⚠ CAUTION

Gear housing MUST BE in NEUTRAL position and shift shaft MUST BE removed from gear housing BEFORE propeller shaft can be removed from gear housing.

2. Shift engine into NEUTRAL position.
3. Tilt engine to full up position and engage tilt lock lever.
4. Bend tabs of propeller tab washer away from thrust hub (rear), then remove propeller locknut, tab washer, thrust hub (rear), propeller and thrust hub (forward) from propeller shaft.

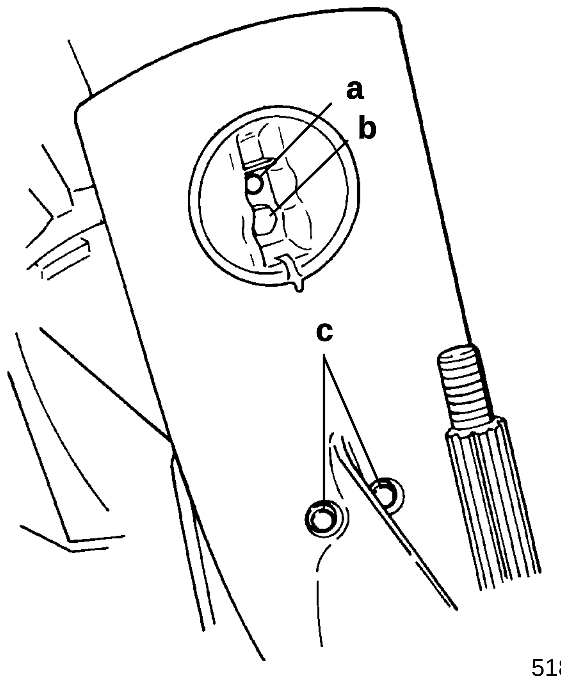




a - Thrust Hub (Forward)
b - Propeller Shaft
c - Continuity Washer (If Equipped)
d - Rear Thrust Hub
e - Tab Washer
f - Propeller Nut

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of driveshaft housing. Remove bolt that secures trim tab and remove tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.

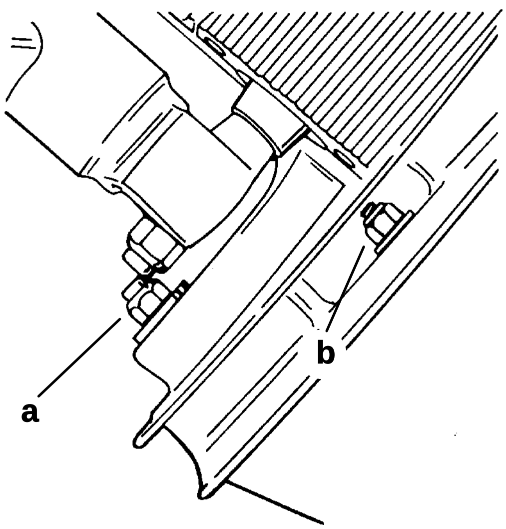
7. Remove 2 locknuts from bottom middle of anti-cavitation plate.



51866

a - Bolt (Secures Trim Tab)
b - Bolt (Inside Trim Tab Cavity)
c - Locknuts and Washers

8. Remove locknut from the front gear housing mounting stud.
9. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or driveshaft housing could be damaged.)



51873

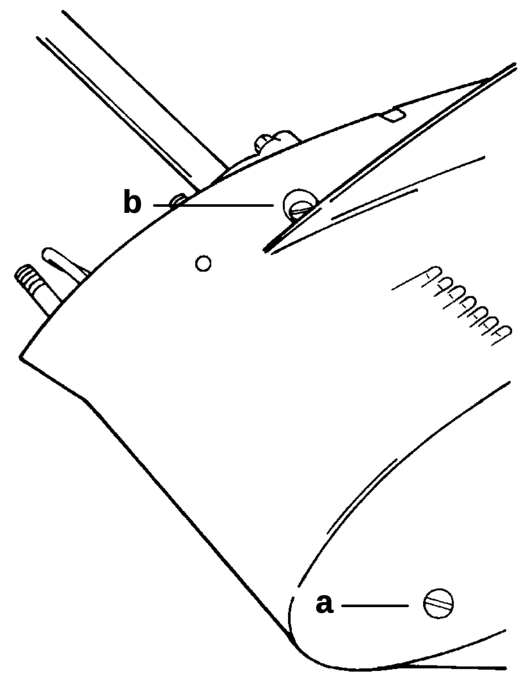
a - Front Mounting Locknut
b - Side Mounting Locknut (One Each Side)

10. Pull gear housing away from driveshaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)
11. Pull gear housing from driveshaft housing.

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the driveshaft in a vertical position, as shown.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing.
3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. 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, O-rings and gear housing components.

IMPORTANT: Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.



51871

a - "Fill" Screw
b - "Vent" Screw

Water Pump

CLEANING AND INSPECTION

1. Clean all water pump parts with solvent and dry with compressed air.
2. Inspect water pump cover and base for cracks and distortion (from overheating).
3. Inspect face plate and water pump insert for grooves and/or rough surfaces.

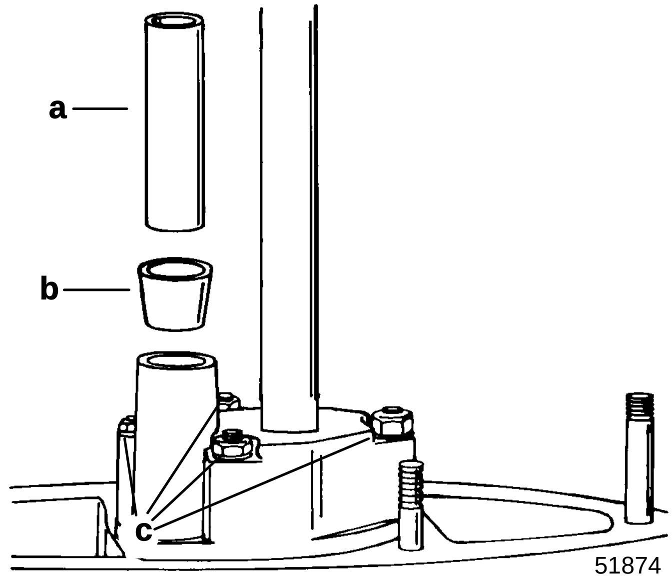
IMPORTANT: When completing gear housing repairs, that require removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to re-use impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur.

4. Inspect impeller side seal surfaces and ends of impeller blades for cracks, tears and wear. Replace impeller if any of these conditions are found.
5. Inspect impeller bonding to impeller hub.
6. Inspect impeller for glazed or melted appearance (caused by operation without sufficient water supply). Replace impeller if any of these conditions exist.

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

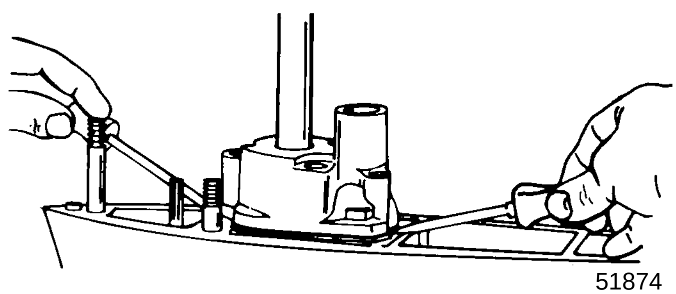
REMOVAL AND DISASSEMBLY

1. Slide rubber centrifugal slinger up and off driveshaft.
2. Remove water tube guide and seal from water pump cover. (Retain guide for reassembly and discard seal.)
3. Remove (and retain) 3 nuts, one bolt and all washers which secure water pump cover to gear housing.



a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolt and Washers to be Removed

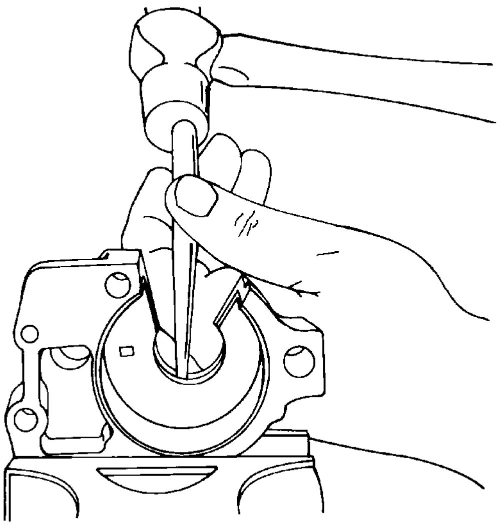
4. Using 2 pry bars, lift water pump cover up and off driveshaft.



5. Inspect water pump cover and insert, as outlined in "Cleaning and Inspection," previous.
6. If inspection of water pump insert determines that replacement is required, follow Step "a" or "b" (immediately following) to remove insert from water pump cover.

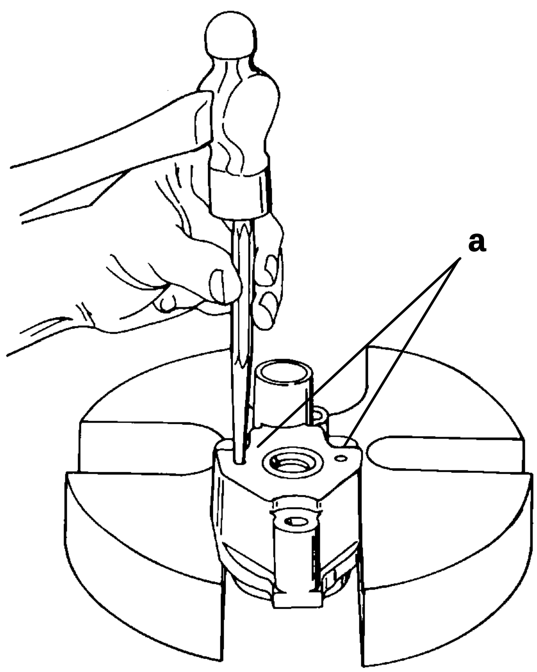
NOTE: *Try Step "a" first. If insert cannot be removed with Step "a," use Step "b."*

a. Drive water pump insert out of water pump cover with a punch and hammer.



51874

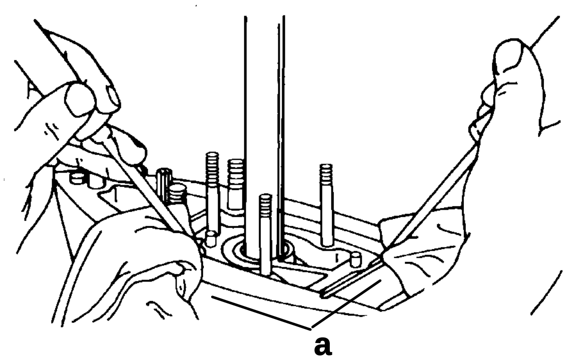
b. Drill two 3/16" (4.8mm) diameter holes thru the top of water pump cover (but not thru insert). Drive insert out of cover with a punch and hammer.



51873

a - Drill Two Holes at These Locations

7. Remove impeller from driveshaft. (It may be necessary to use a punch and hammer to drive impeller upward on driveshaft. In extreme cases, it may be necessary to split hub of impeller with a hammer and chisel.)
8. Once impeller is removed, remove impeller drive key from driveshaft.
9. Remove water pump face plate and both gaskets (one above and below face plate) from water pump base.
10. Using 2 pry bars, positioned and padded as shown, lift water pump base up and off driveshaft.



51874

a - Pads

11. Remove (and discard) O-ring from O-ring groove on water pump base.
12. Using a screwdriver, pry oil seals out of water pump base from gear housing side of base.

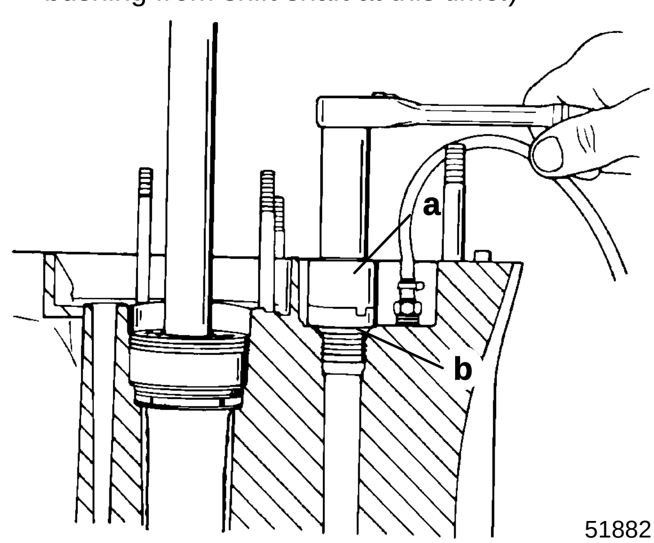
Bearing Carrier and Propeller Shaft

REMOVAL

⚠ CAUTION

Gear housing MUST BE in neutral position, and shift shaft MUST BE removed from gear housing before propeller shaft can be removed from gear housing.

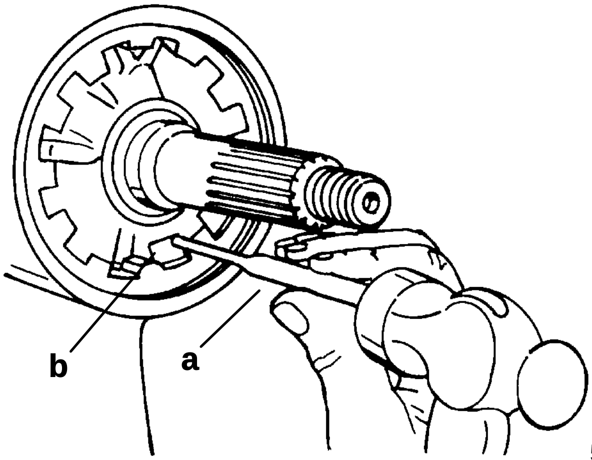
1. Place gear housing in a suitable holding fixture or vise with propeller shaft in a horizontal position.
2. Use Shift Shaft Bushing Tool (91-31107) to unthread shift shaft bushing. (DO NOT remove bushing from shift shaft at this time.)



51882

a - Shift Shaft Bushing Tool (91-31107)
b - Shift Shaft Bushing

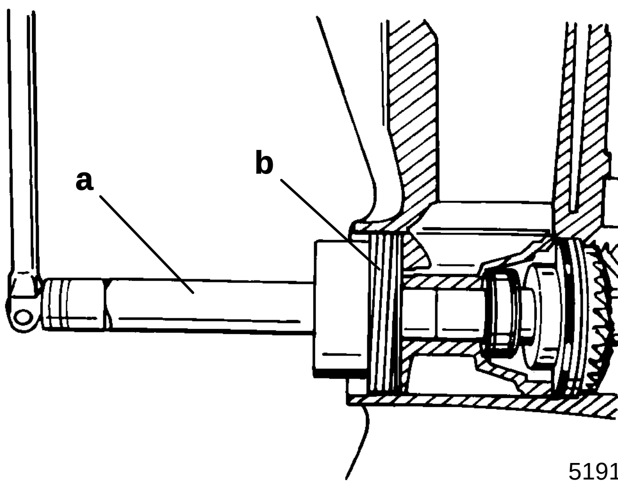
3. Bend retainer nut lock tab out of retainer nut recess.



51865

a - Punch
b - Tab of Tab Washer

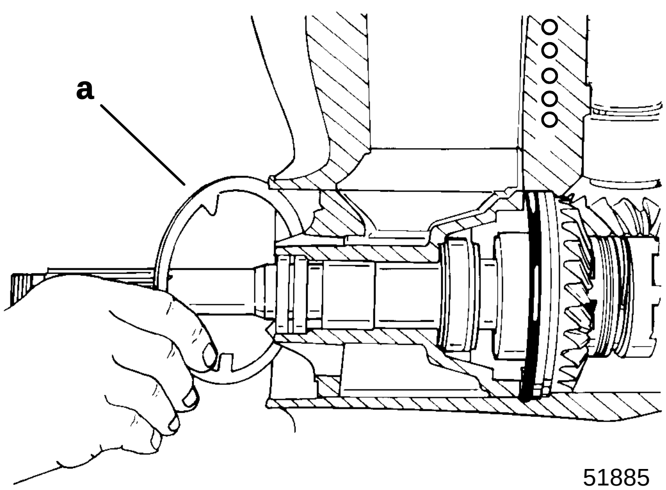
4. Remove gear housing retainer nut with Retainer Nut Tool (91-61069).



51911

a - Retainer Nut Tool (91-61069)
b - Retainer Nut

5. After retainer nut has been removed, remove lock tab washer from gear housing.



51885

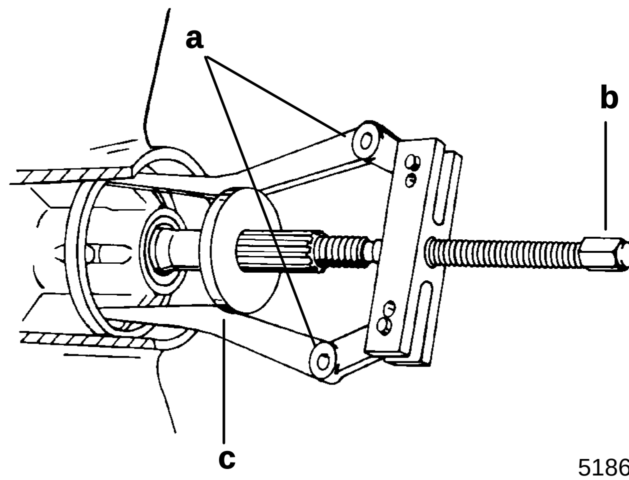
a - Tab Washer

⚠ CAUTION

Once bearing carrier is removed from gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

6. Use long Puller Jaws (91-46086A1) and Puller Bolt (91-85716) to remove bearing carrier. (Use propeller thrust hub to maintain outward pressure on puller jaws.)

NOTE: *When bearing carrier is removed from gear housing, the bearing carrier alignment key will come out with it.*

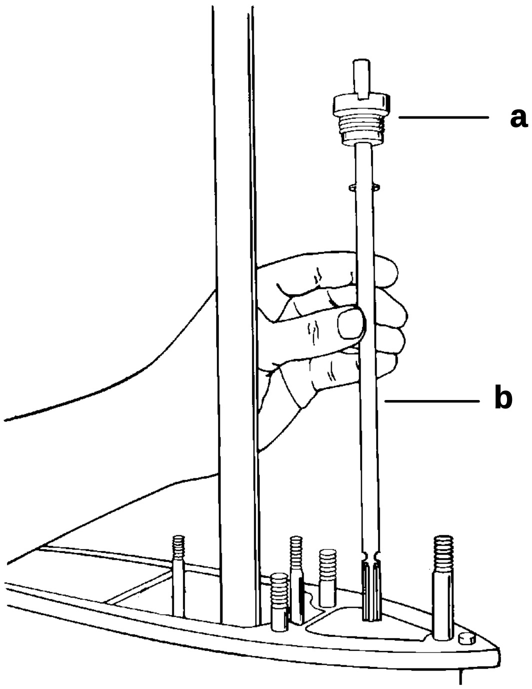


51867

a - Long Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)
c - Thrust Hub

IMPORTANT: Prior to removal of shift shaft from gear housing, recheck that gear housing is in neutral position.

7. With gear housing in neutral, pull shift shaft out of gear housing. If necessary, use a pliers to pull shift shaft out of gear housing. If pliers are used to pull shift shaft out, wrap a strip of soft metal (aluminum) around splines before clamping pliers. DO NOT turn shaft (clockwise OR counterclockwise) while pulling shaft out. (For further information on shift shaft, see "Shift Shaft Cleaning/Inspection and Disassembly.")



51867

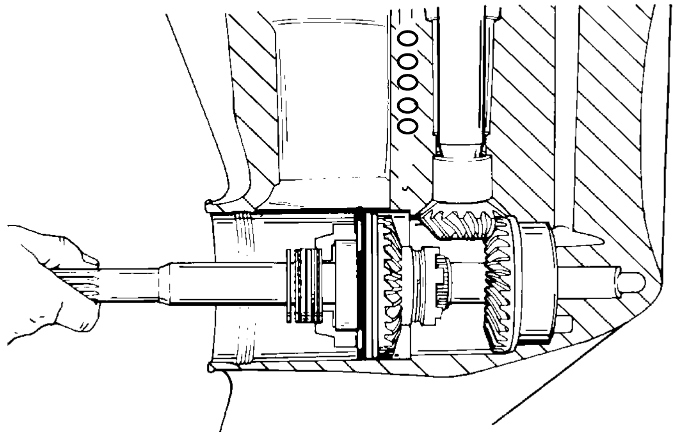
a - Shift Shaft Bushing
b - Shift Shaft

⚠ CAUTION

Propeller shaft, cam follower and shift cam, in most cases, will come out of gear housing by simply pulling outward on propeller shaft. DO NOT FORCE shaft sideways or ATTEMPT TO PULL with a slide hammer or any mechanical puller.

8. Remove propeller shaft, cam follower and shift cam by pulling shaft straight out of gear housing. (DO NOT JERK propeller shaft.)

NOTE: *Sliding clutch, forward gear assembly, bearing adaptor, thrust washer and thrust bearings will be removed from gearcase with propeller shaft.*



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9. If propeller shaft will not come out, proceed with Step "a" or "b," following:
   a. Push propeller shaft back into place against the reverse gear. Visually inspect location of shift cam by looking down shift shaft hole (illuminated with a flashlight). If splined hole in shift cam is visible, reinstall shift shaft and rotate shift shaft to neutral position. Remove shift shaft, then remove propeller shaft as instructed in Step 8, immediately preceding.
   b. Push propeller shaft back into place against reverse gear. Slide bearing carrier back into gear housing (to support propeller shaft). Place gear housing on its left side (viewed from rear) and strike upper leading end of gear housing with a rubber mallet. This will dislodge the shift cam from cam follower into a clearance pocket in left side of gear housing. Remove bearing carrier and pull propeller shaft out of gear housing.

NOTE: *If Step 9-b was used to remove propeller shaft, the shift cam can be retrieved after removal of reverse gear.*

Shift Shaft

CLEANING AND INSPECTION

1. Clean shift shaft and bushing with solvent and dry with compressed air.
2. Check shift shaft splines on both ends for wear and/or corrosion damage.
3. Inspect shift shaft for groove(s) at shift shaft bushing seal surface.
4. Inspect shift shaft bushing for corrosion damage.
5. Inspect shift shaft bushing oil seal for wear and/or cuts.

DISASSEMBLY

1. Remove (and discard) shift shaft bushing oil seal by prying it out or driving it out with a punch and hammer.

CLEANING/INSPECTION - BEARING CARRIER

IMPORTANT: It is recommended that all seals and O-rings be replaced (as a normal repair procedure) to assure effective repair.

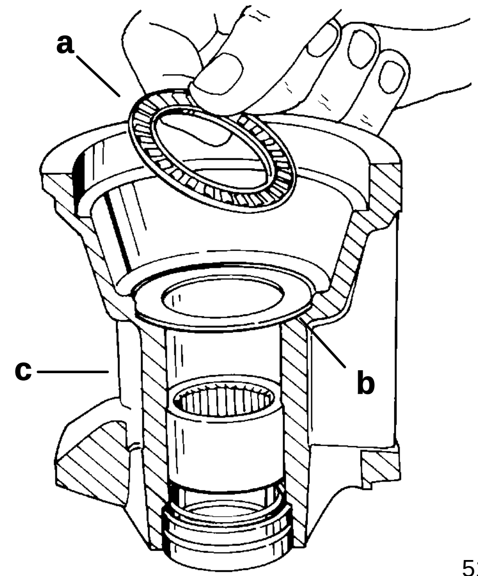
⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean bearing carrier with solvent and dry with compressed air.
2. Bearing carrier propeller shaft needle bearing condition is determined by propeller shaft bearing surface condition. (See **"Propeller Shaft Inspection."**)

DISASSEMBLY- BEARING CARRIER

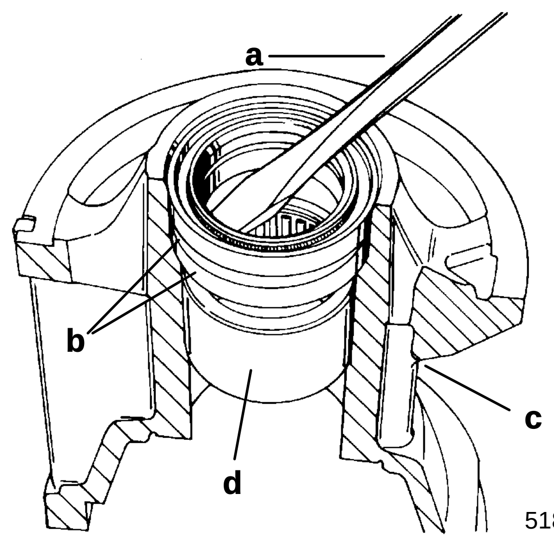
1. Remove thrust bearing and thrust washer from bearing carrier.



51886

a - Thrust Bearing
b - Thrust Washer
c - Bearing Carrier

2. If thrust bearing, thrust washer or thrust bearing surface on propeller shaft shows signs of rust, pitting or blueing from lack of lubricant, component(s) should be discarded.
3. Remove bearing carrier oil seals.

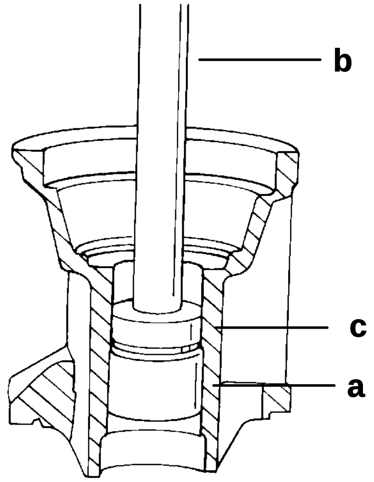


51878

a - Pry Bar
b - Oil Seals
c - Bearing Carrier
d - Bearing Carrier Needle Bearing

NOTE: *Do not remove bearing carrier needle bearing unless replacement is needed.*

4. Use bearing removal and replacement tool (91-31229A5) or equivalent to press bearings out of bearing carrier.



51885

a - Needle Bearing
b - Push Rod
c - Mandrel

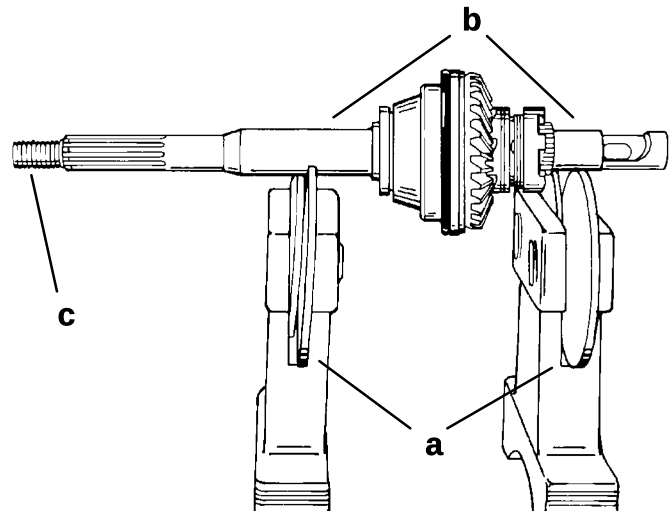
Propeller Shaft

INSPECTION

1. Clean propeller shaft assembly with solvent and dry with compressed air.
2. Inspect bearing carrier oil seal surfaces for grooves. Run fingernail across seal surface to check for groove. Replace shaft if groove is found.
3. Visually check bearing surfaces of propeller shaft for pitting, grooves, scoring, uneven wear or discoloration (bluish color) from overheating. Replace shaft and corresponding needle bearing if any of the above conditions are found. (Bearing carrier needle bearing contacts propeller shaft just in front of oil seal surface. Reverse gear bearing contacts propeller shaft in front of sliding clutch splines.)
4. Inspect propeller shaft splines for wear and/or corrosion damage.
5. Check propeller shaft for straightness. Use either method, following:

Balance Wheels

Place propeller shaft on balance wheels, as shown. Rotate propeller shaft and observe propeller end of shaft for "wobble." Replace shaft if any "wobble" is observed.



51877

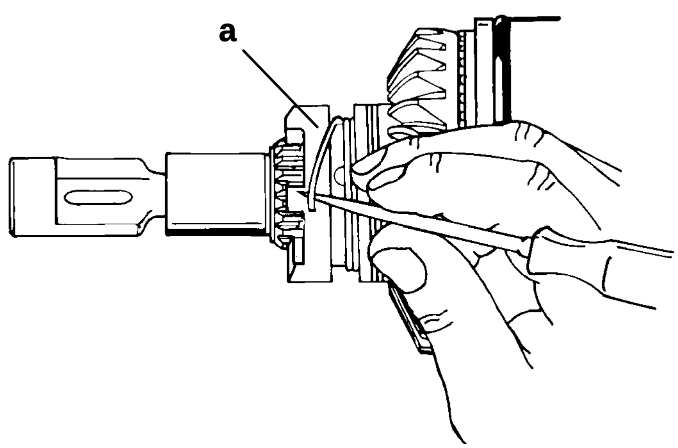
a - Balance Wheels
b - Bearing Surfaces
c - Watch for "Wobble"

"Vee" Blocks and Dial Indicator

Position propeller shaft roller bearing surfaces on "vee" blocks. Mount a dial indicator at front edge of propeller splines. Rotate propeller shaft. Dial indicator movement of more than 0.006" (0.152mm) (or noticeable "wobble") is reason for replacement.

DISASSEMBLY

1. Remove shift cam from cam follower.
2. Insert a thin blade screwdriver or awl under first coil of cross pin retainer spring and rotate propeller shaft to unwind spring from sliding clutch. DO NOT overstretch spring.



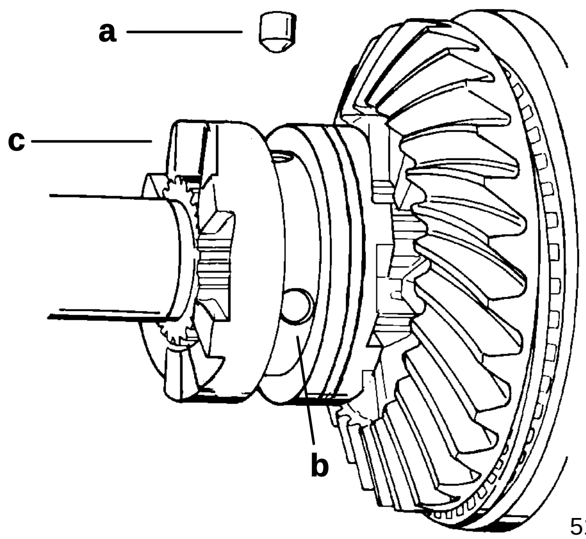
51875

a - Cross Pin Retainer Spring

⚠ CAUTION

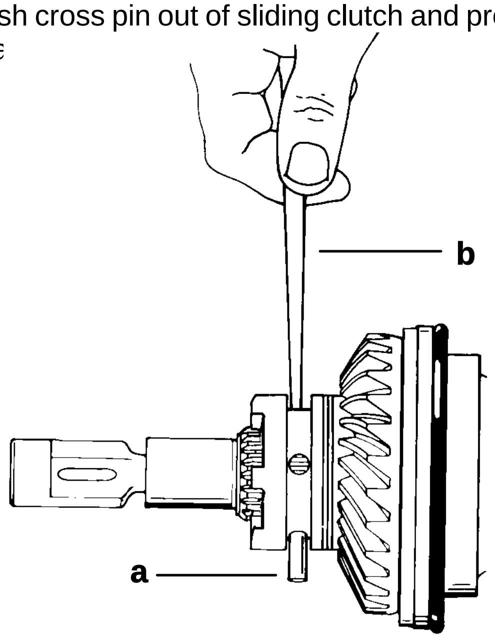
Detent pin is free and can fall out of sliding clutch. Care MUST BE taken not to lose pin.

3. Detent pin is free and can be removed from sliding clutch at this time.



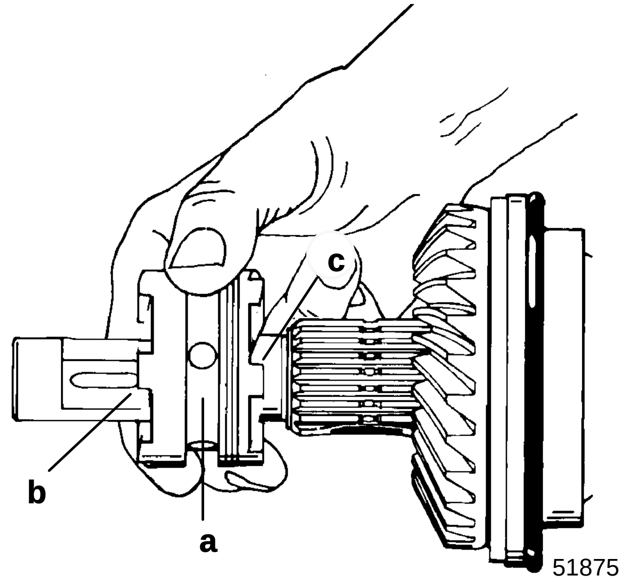
a - Detent Pin
b - Cross Pin
c - Sliding Clutch

4. Push cross pin out of sliding clutch and propeller sha



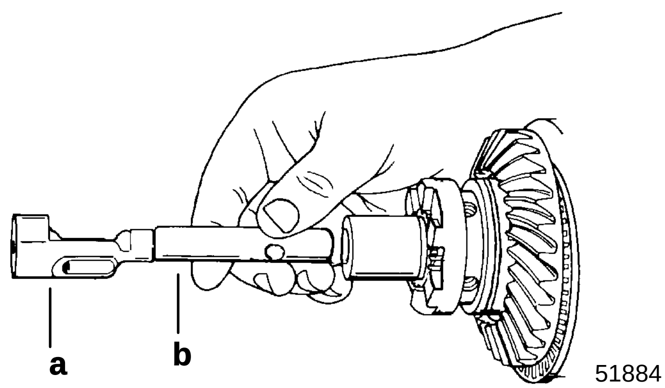
a - Cross Pin
b - Punch

5. Pull sliding clutch off propeller shaft.
6. Inspect sliding clutch. Check reverse gear clutch "jaws" and forward gear clutch "jaws." Rounded "jaws" indicate one or more of the following:
    a. Improper shift cable adjustment.
    b. Improper shift habits of operator(s) (shift from neutral to reverse gear or forward gear too slowly).
    c. Engine idle speed too high (while shifting).



a - Sliding Clutch
b - Reverse Gear Clutch Jaws
c - Forward Gear Clutch Jaws

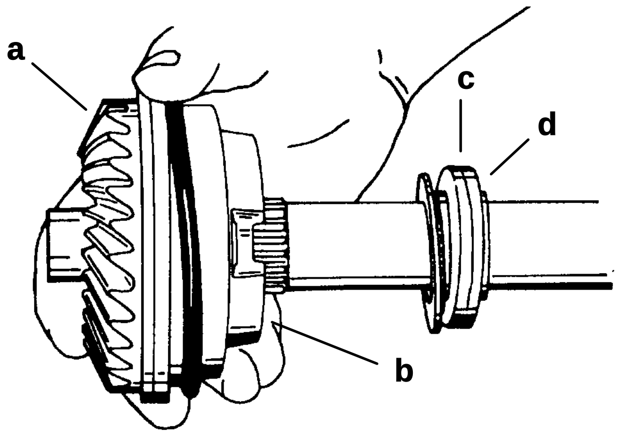
7. Pull cam follower and clutch actuator rod out of propeller shaft. DO NOT force cam follower up-or-down or side-to-side when pulling from propeller shaft.
8. Once cam follower and clutch actuator rod are removed from propeller shaft, lift rod out of cam follower.



a - Cam Follower
b - Clutch Actuator Rod

9. Check condition of cam follower. If it shows wear (pitting, scoring or rough surface), replace cam follower and shift cam.

10. Remove forward gear and bearing adaptor assembly.
11. Remove 2 thrust races and 2 keepers from prop shaft.



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a - Forward Gear
b - Bearing Adaptor Assembly
c - Thrust Races (2)
d - Keepers (hidden) (2)

Clutch Actuator Rod

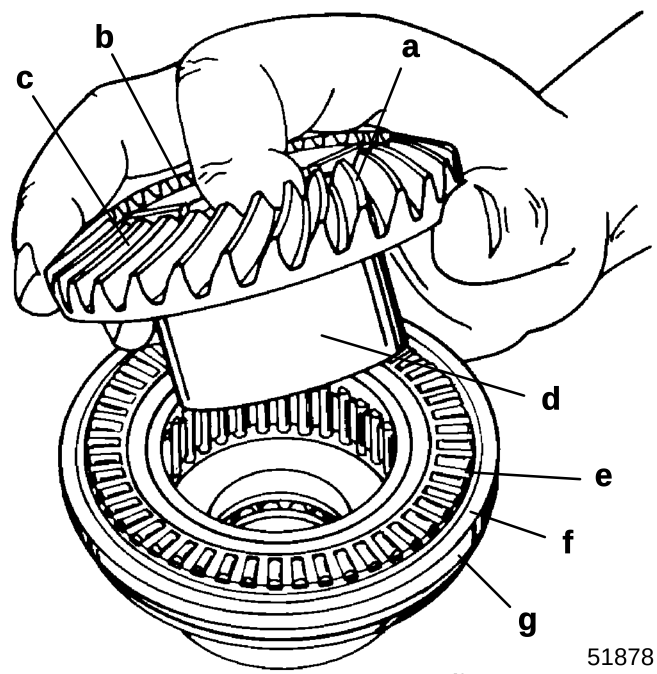
CLEANING AND INSPECTION

1. Clean clutch actuator rod in solvent and dry with compressed air.
2. Inspect actuator components for wear or damage. Replace components as required.

Forward Gear and Bearing Adapter

DISASSEMBLY/CLEANING/INSPECTION

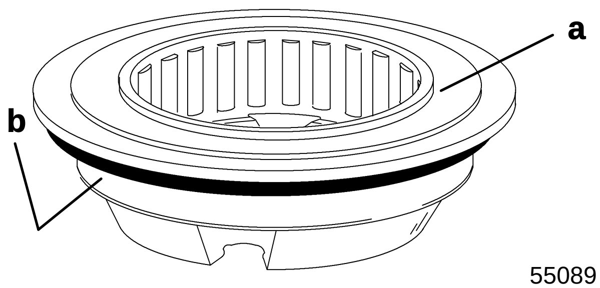
1. Remove forward gear from bearing adapter.
2. Inspect forward gear clutch teeth for signs of wear. If clutch teeth are worn, sliding clutch should be replaced also.
3. Inspect forward gear teeth for full tooth contact, chips, pits and signs of rust. If forward gear teeth are damaged, pinion gear must be inspected and replaced if necessary.
4. Inspect forward gear hub for signs of pitting, rust, scoring or discoloration (blueing) due to lack of lubricant.
5. Remove thrust bearing and spacer shim. Inspect thrust bearing for pits, rust, or discoloration (blueing) due to lack of lubricant.



51878

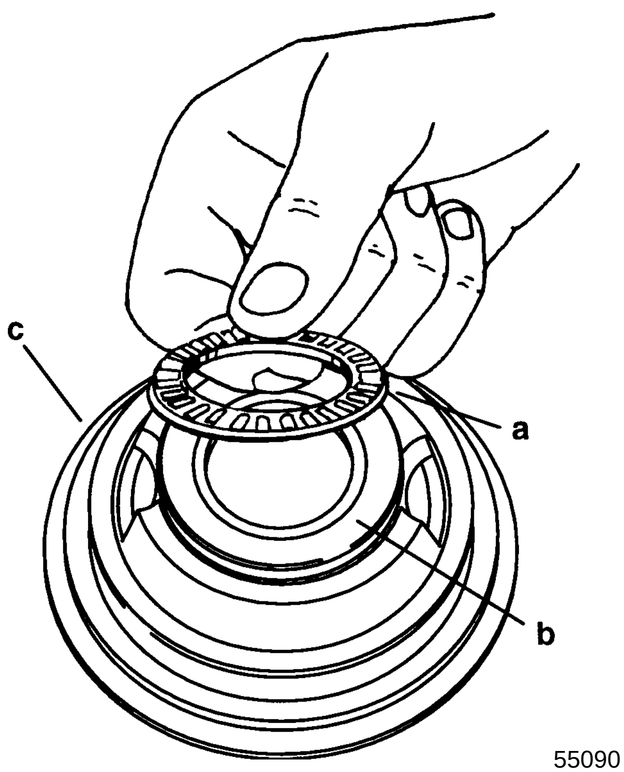
a - Forward Gear
b - Forward Gear Clutch Teeth
c - Forward Gear Teeth
d - Forward Gear Hub
e - Thrust Bearing
f - Thrust Washer
g - Spacer Shim

6. Remove thrust washer and O-ring. The thrust washer acts as a bearing surface for the thrust bearing and it should be inspected for pits, rust, scoring or discoloration due to lack of lubricant. O-ring should be inspected for cuts or abrasions and replaced if necessary.



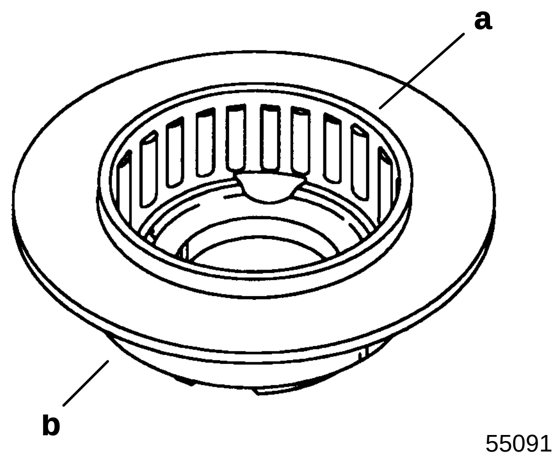
a - Thrust Washer
b - O-Ring (hidden)

7. Remove thrust bearing and thrust washer from bearing adaptor. Thrust roller bearing should be inspected for pitting, rust or signs of discoloration (blueing) due to lack of lubricant. If thrust roller bearing must be replaced, the bearing surfaces on the thrust washer and propeller shaft where the thrust roller bearing rides should also be inspected for signs of wear.



a - Thrust Bearing
b - Thrust Washer
c - Bearing Adaptor

8. The forward gear bearing should be carefully inspected for smoothness of movement, pits, rust, or signs of discoloration (blueing) due to lack of lubricant. If the bearing must be replaced, it is recommended that a hammer and cape chisel be used to break the bearing loose from the bearing adapter. Be careful not to damage bearing adapter when removing roller bearing.

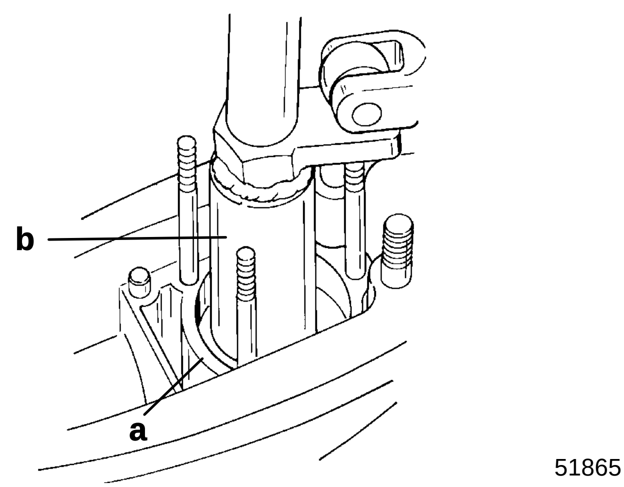


a - Forward Gear Bearing
b - Bearing Adaptor

Pinion Gear and Driveshaft

REMOVAL

1. Remove bearing retainer using Bearing Retainer Tool (91-43506).

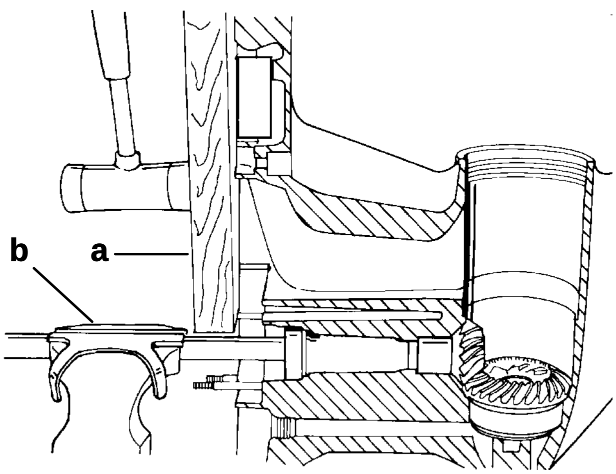


a - Bearing Retainer
b - Bearing Retainer Tool (91-43506)

2. Place Driveshaft Holding Tool (91-34377A1) over driveshaft splines.
3. Use a socket and flex handle to hold pinion nut. (Pad area of gear housing, where flex handle will make contact, to prevent damage to gear housing.)
4. Use a socket and flex handle on Driveshaft Holding Tool to loosen pinion nut. Remove pinion nut and Driveshaft Holding Tool.
5. Remove gear housing from vise and re-position it as shown. Be sure to use soft jaw vise covers and clamp as close as possible to water pump studs.
6. Place a block of wood on gear housing mating surface. Use a mallet and carefully tap gear housing away from driveshaft.

⚠ CAUTION

DO NOT strike gear housing hard with the mallet or allow gear housing to fall.



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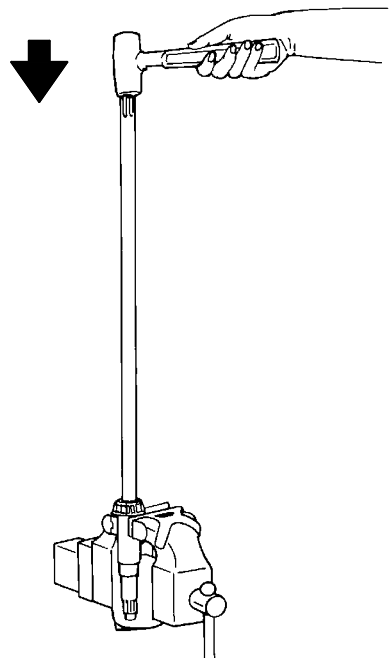
a - Wooden Block
b - Soft Jaw Vise Covers

7. Reach into gear housing and remove pinion gear.
8. After driveshaft is removed from gear case, remove and retain shim(s) that were located under upper tapered driveshaft bearing.
9. If inspection determines that replacement of driveshaft tapered bearing is required, remove bearing from driveshaft as follows:
   a. Position driveshaft in a vise; DO NOT tighten vise jaws against shaft.
   b. Strike shaft with a lead hammer; take care not to drop shaft.



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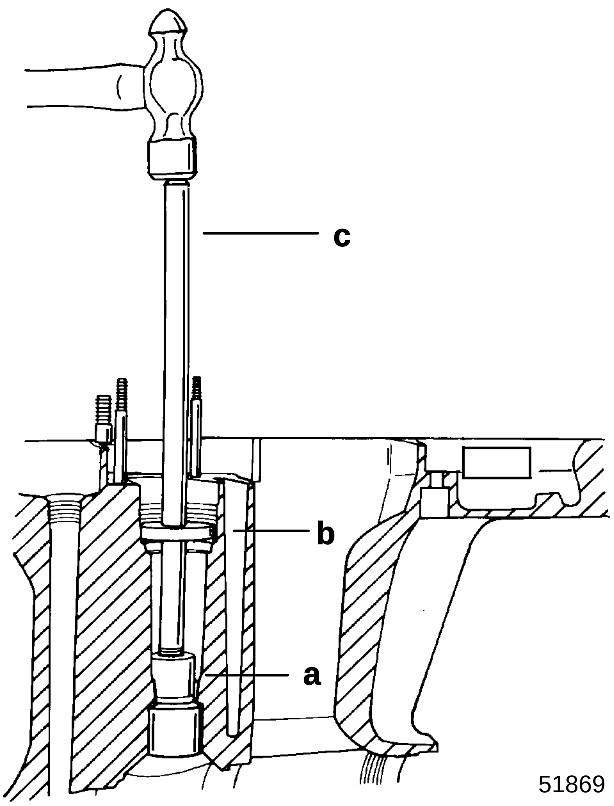
10. Remove 18 loose needles from outer race of driveshaft needle bearing.

11. If inspection of driveshaft needle bearing surface determines that replacement of needle bearing is required, the 18 loose needle bearings previously removed must be reinstalled in bearing race to provide surface for mandrel to drive against.

NOTE: *Reverse gear must be removed first before removing driveshaft needle bearing.*

IMPORTANT: Discard driveshaft needle bearing after removal. (Bearing cannot be reused.)



a - Mandrel (91-37263)
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)

*From Bearing Removal and Installation Kit (91-31229A5)

CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air. DO NOT allow driveshaft bearing to spin while drying.
2. Inspect pinion gear for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace pinion gear, if any of the above conditions are found.
3. Inspect driveshaft needle bearing surface (area just above pinion gear splines) for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace driveshaft and driveshaft needle bearing, if any of the preceding conditions are found.
4. Inspect driveshaft to crankshaft splines for wear. Replace driveshaft if wear is excessive.
5. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing and race as a set, if any of the preceding conditions are found.
6. Inspect driveshaft for groove(s) where water pump base oil seals contact shaft. Replace driveshaft if groove(s) are found.

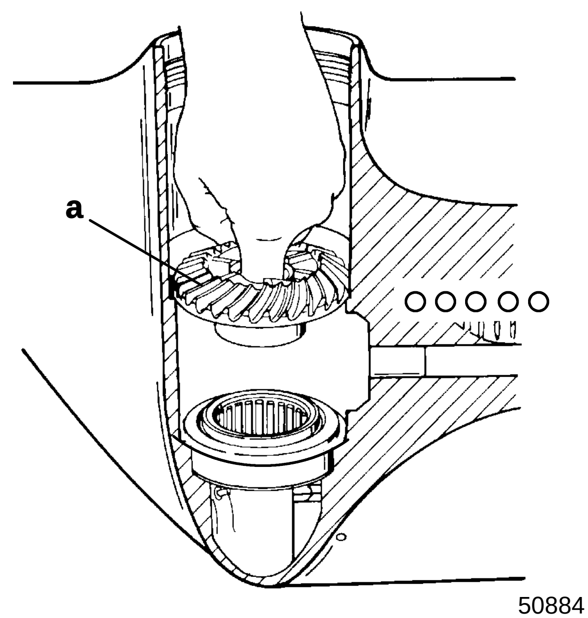
Reverse Gear

REMOVAL AND DISASSEMBLY

NOTE: *Reverse gear can be removed from gear housing only after driveshaft and pinion gear have been removed.*

NOTE: *Cautiously applying heat to both sides of gearcase where reverse gear assembly is located will aid in removal of bearing cup adapter.*

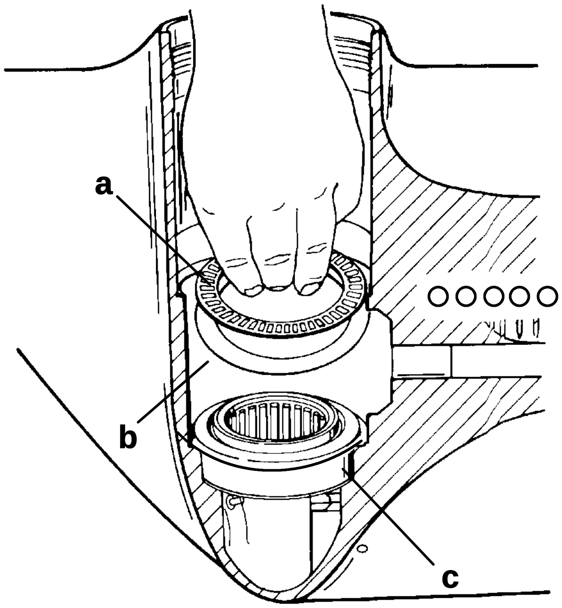
1. Remove reverse gear by hand.



a - Reverse Gear

IMPORTANT: DO NOT remove needle bearing from reverse gear unless replacement of bearing is required. Bearing cannot be reused after it has been removed.

2. Remove thrust bearing and thrust washer from reverse gear bearing cup.



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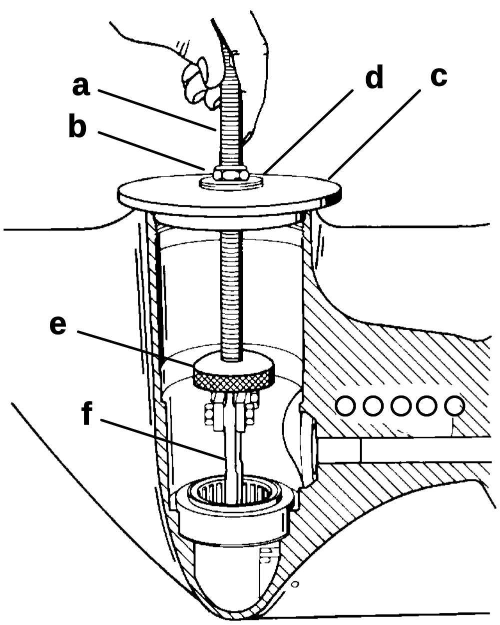
a - Thrust Bearing
b - Thrust Washer
c - Reverse Gear Bearing Adaptor

3. Remove reverse gear bearing adaptor. Remove, measure and make note of the shim thickness and **discard (DO NOT reuse) the shims.**



50780

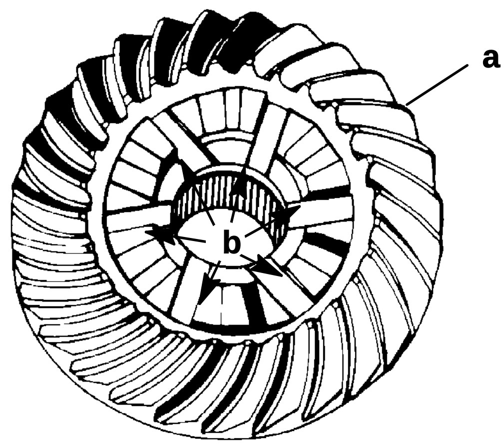
a - Bolt (91-31229)
b - Nut (91-11-24156)
c - Guide Plate (91-816243)
d - Washer (91-34961)
e - Puller Head (from Slide Hammer Puller Kit 91-34569A1)
f - Jaws (91-816242)

CLEANING AND INSPECTION

⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean reverse gear and bearing with solvent and dry with compressed air. DO NOT spin the bearing.
2. Inspect gear teeth for pitting, grooves, scoring, uneven wear and for discoloration (from overheating). Replace gear if any of these conditions are found.
3. Check clutch jaws on reverse gear for damage. Replace reverse gear if damage is found.

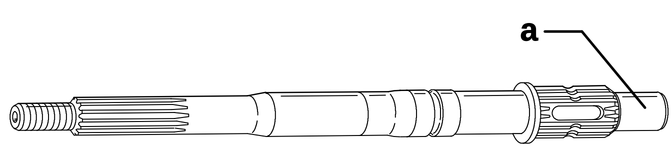


23351

a - Reverse Gear Teeth
b - Clutch Jaws

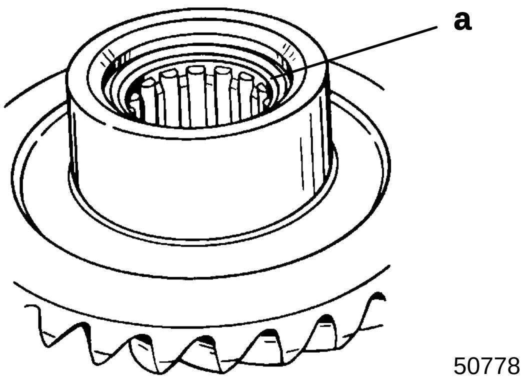
NOTE: *The needle bearings in the reverse gear should not be removed unless damage has been found. Inspect to ensure that all of the needles are present and in position. Needles that have been dislodged may be snapped back into place as long as no damage has occurred to the bearing cage.*

4. Inspect the needle bearings on the inside of the reverse gear and the bearing surface on the propeller shaft. If either the needle bearings or the bearing surface of the propeller shaft is pitted grooved, worn unevenly, discolored from overheating or has embedded particles, replace the propeller shaft and needle bearing in the reverse gear.



a - Reverse Gear Needle Bearing Contact Area

5. If reverse gear needle bearing is found to be damaged, place reverse gear in a press and use mandrel 91-63569 to press bearing out of gear.



a - Bearing

Gear Housing

CLEANING AND INSPECTION

1. Clean gear housing with solvent and dry with compressed air.
2. Check gear housing carefully for impact damage.
3. Check for loose fitting bearing adaptors and needle bearings.

NOTE: *If bearing adaptors have spun in gear case, gear housing must be replaced.*

4. Inspect bearing carrier cover nut retainer threads in gear housing for corrosion damage and/or stripped threads.

Reassembly and Installation of Counter Rotation Gear Housing

Driveshaft Needle Bearing

REASSEMBLY/INSTALLATION

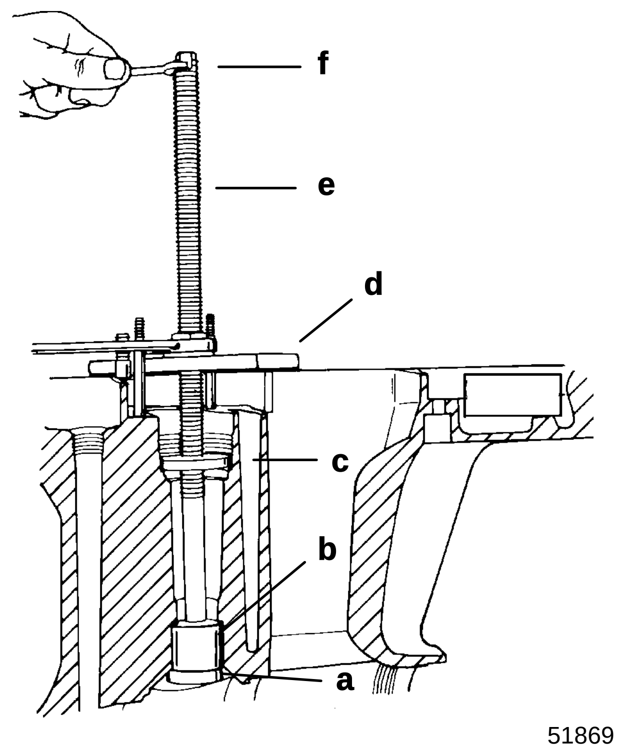
⚠ CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing must be replaced. Loose fitting needle bearing will move out of position and cause repeated failures.

NOTE: *Driveshaft needle bearing must be installed prior to installation of reverse gear.*

1. Apply a thin coat of Quicksilver 2-4-C w/Teflon Lubricant to driveshaft needle bearing bore in gear housing.
2. By way of propeller shaft cavity, place needle bearing in driveshaft bore with numbered side of bearing facing up driveshaft bore.
3. Install and seat needle bearing with the following tools: Puller Rod* (91-31229), Nut* (91-24156), Pilot* (91-36571), Plate* (91-29310), and Mandrel* (91-92788). Pull bearing up into bore until it bottoms on gear housing shoulder. (DO NOT use excessive force.)

*From Bearing Removal and Installation Kit (91-31229A5)

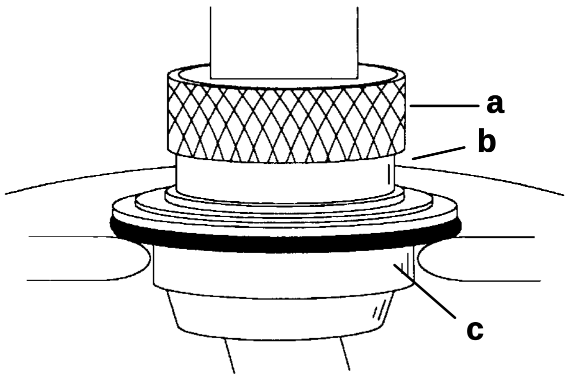


a - Mandrel
b - Bearing
c - Pilot
d - Plate
e - Puller Rod
f - Hold

Bearing Carrier, Forward Gear and Bearing Adaptor

REASSEMBLY

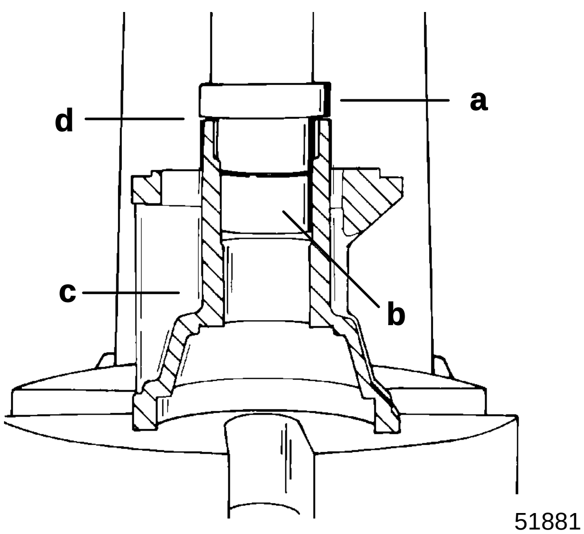
1. Using suitable mandrel, press forward gear bearing into bearing adaptor until bearing is flush with lip of adaptor.



a - Suitable Mandrel
b - Forward Gear Bearing
c - Bearing Adaptor

PROPELLER SHAFT NEEDLE ROLLER BEARING AND OIL SEAL INSTALLATION

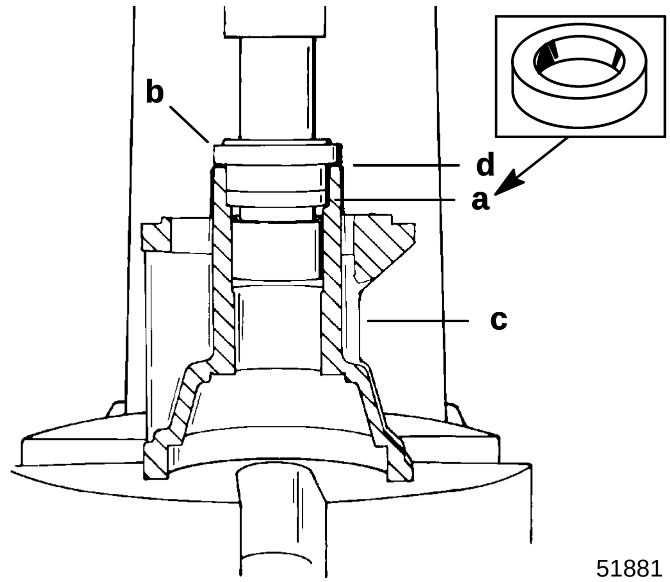
1. Using mandrel 91-15755, press bearing carrier needle bearing (number side up) into bearing carrier until mandrel shoulder contacts bearing carrier.



a - Mandrel (91-15755)
b - Bearing Carrier Needle Bearing
c - Bearing Carrier
d - Shoulder

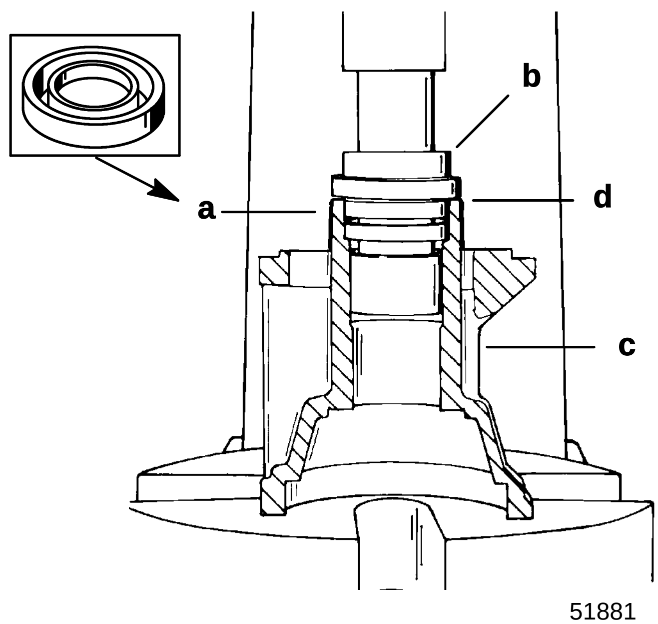
2. Apply Loctite 271 (92-809820) to outside diameter of oil seals.

3. With seal lip facing towards bearing, press inner seal (a) using long end of mandrel (b) (91-31108) into bearing carrier (c) until mandrel shoulder (d) bottoms out on bearing carrier.



a - Inner Seal
b - Mandrel (91-31108)
c - Bearing Carrier
d - Mandrel Shoulder

4. With seal lip facing towards mandrel, press outer seal (a) using short end of mandrel (b) (91-31108) into bearing carrier (c) until mandrel shoulder (d) bottoms out on bearing carrier.

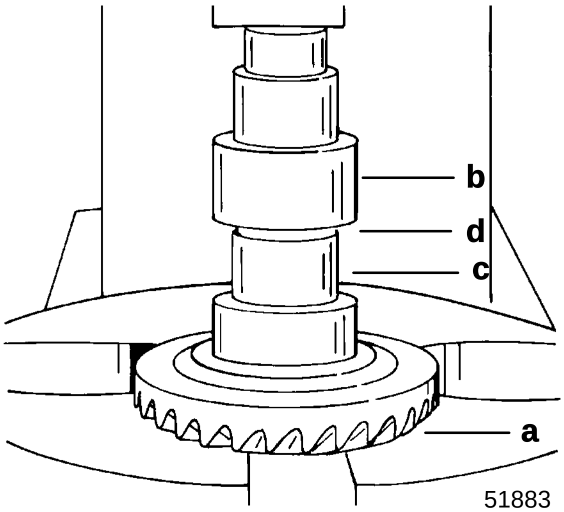


a - Outer Seal
b - Mandrel (91-31108)
c - Bearing Carrier
d - Mandrel Shoulder

5. Lubricate both seal lips with 2-4-C w/Teflon Marine Lubricant (92-90018A12).

REVERSE GEAR AND BEARING CUP ADAPTOR REASSEMBLY

1. With reverse gear teeth facing down, use mandrel (91-86943) to press propeller shaft needle bearing (NUMBERS/LETTERS UP) into reverse gear until short shoulder on mandrel bottoms on reverse gear.

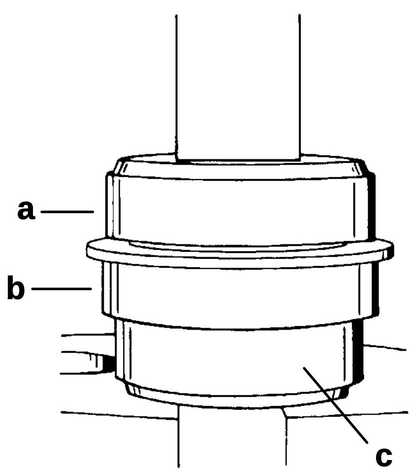


51883

a - Reverse Gear Teeth
b - Mandrel (91-86943)
c - Propeller Shaft Needle Bearing
d - Shoulder

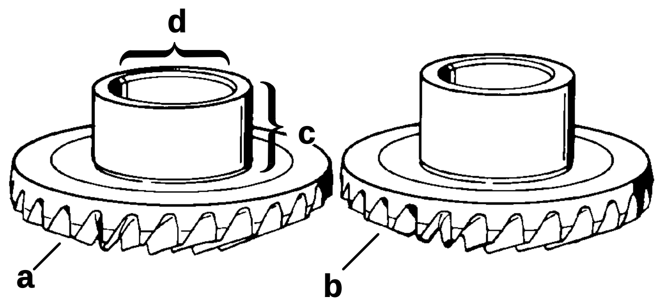
***NOTE:** If gear housing has been replaced or inspection determines that reverse gear bearing adapter must be replaced, assemble and install as follows:*

2. Place reverse gear roller bearing (NUMBER/LETTERS UP) in press. Using suitable mandrel, press bearing cup adapter onto reverse gear bearing.



a - Mandrel
b - Bearing Cup Adapter
c - Reverse Gear Roller Bearing

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a smaller inner diameter needle bearing bore.



50885

a - Reverse Gear
b - Forward Gear
c - Shorter Length Hub
d - Smaller Diameter Bearing Bore

Reverse Gear Bearing Adaptor Assembly

INSTALLATION

***NOTE:** If the reverse gear, reverse gear adaptor, large thrust bearing, or bearing race in the gear housing were not replaced, install the same shim(s) (or the same thickness of shim(s)) that were taken out when adaptor was removed. If the reverse gear, reverse gear adaptor, large thrust bearing, bearing race, or gear housing were replaced, install 0.008 in. (0.51 mm) of shims.*

***NOTE:** If backlash has already been checked and it has determined that it needs to be adjusted, (see Checking Reverse Gear Backlash), adding 0.001 in. (0.025 mm) shims will **reduce** the gear backlash by approximately 0.001 in. (0.025 mm). Subtracting .001 in. (0.025 mm) shims will **increase** backlash by approximately the same amount.*

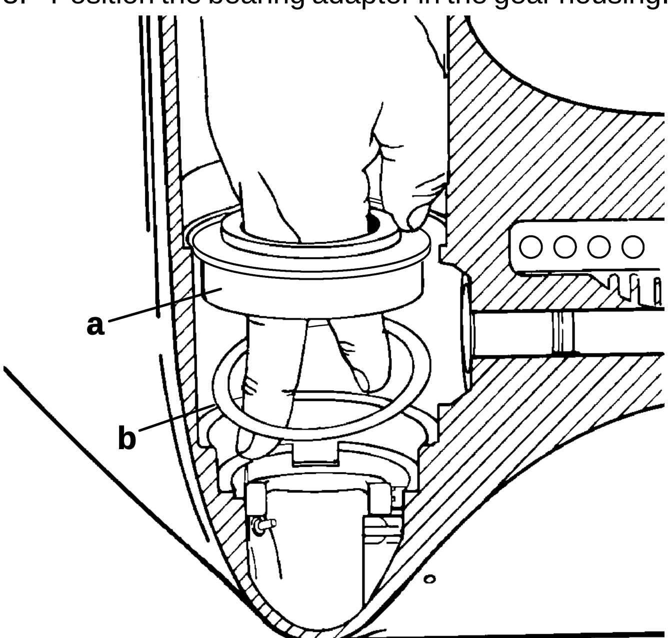
Example 1 (if backlash is too high)

Backlash checks:	.045 in.	(1.14 mm)
(subtract) middle of specification:	.025 in.	(0.64 mm)
You get:	.020 in.	(0.51 mm)
add this quantity of shims:		

Example 2 (if backlash is too low)

middle of specification:	.025 in.	(0.64 mm)
Backlash checks:	.009 in.	(0.23 mm)
(subtract) You get:	.016 in.	(0.41 mm)
subtract this quantity of shims:		

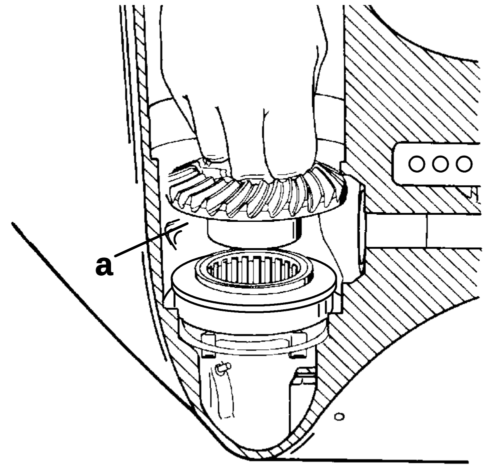
1. Lubricate the bore into which the reverse gear bearing adaptor is to be installed with Quicksilver Super Duty Gear Lubricant.
2. Place the shim(s) into reverse bore of gear housing.
3. Position the bearing adaptor in the gear housing.



55099

a - Bearing Adaptor
b - Shims

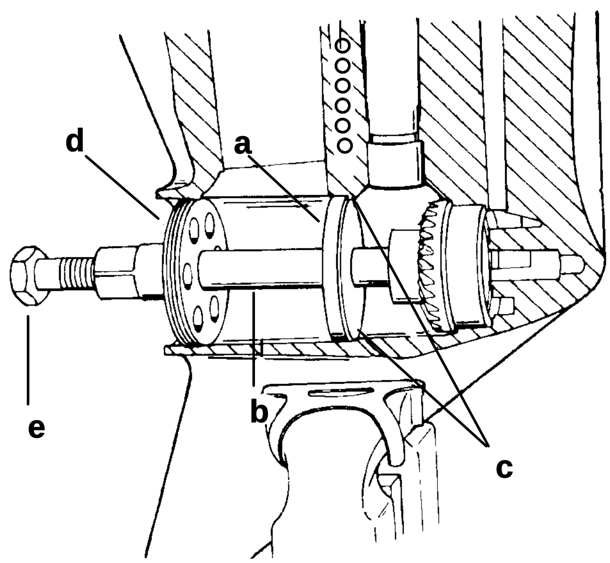
4. Position the reverse gear (without the thrust race or thrust bearing) into the gear housing and into the adaptor.



55100

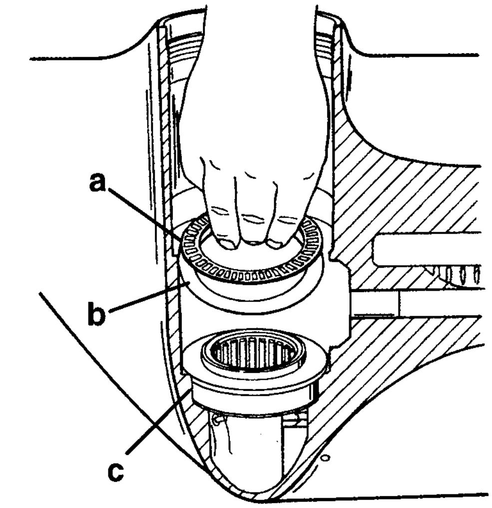
a - Reverse Gear

5. Install PILOT RING (91-18603) over DRIVER TOOL (91-18605) and seat pilot ring in gearcase against inner ledge. Thread RETAINER (91-18604) into bearing carrier threads. Install SCREW (10-18602) into retainer and gently tighten screw against driver tool while holding retainer securely. Continue to apply pressure against driver rod until reverse gear/bearing cup adaptor JUST SEATS in gearcase. DO NOT OVER-SEAT the adaptor as the reverse gear bearing will be damaged. As bearing adaptor begins to seat, the effort required to turn screw will increase considerably.



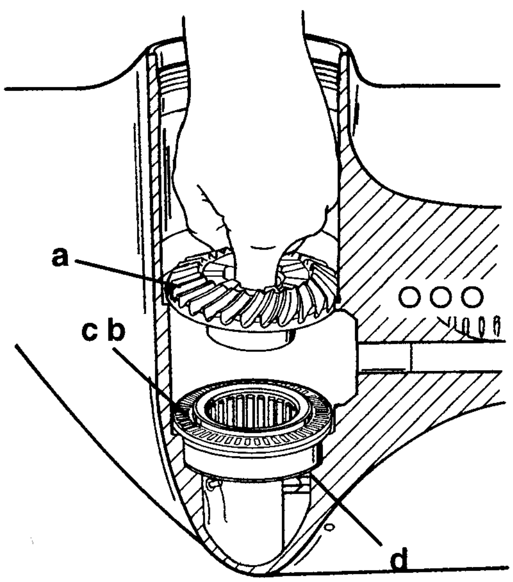
a - Pilot Ring (91-18603)
b - Driver Tool (91-18605)
c - Inner Ledge
d - Retainer (91-18604)
e - Screw (10-18602)

6. After reverse bearing adaptor is seated, remove screw, retainer, driver tool, pilot ring and reverse gear. Apply Quicksilver Super Duty Gear Lubricant to thrust bearing and install thrust race and bearing onto bearing adaptor.



a - Thrust Bearing
b - Thrust Washer
c - Bearing Adaptor

7. Reinstall reverse gear into bearing adaptor.

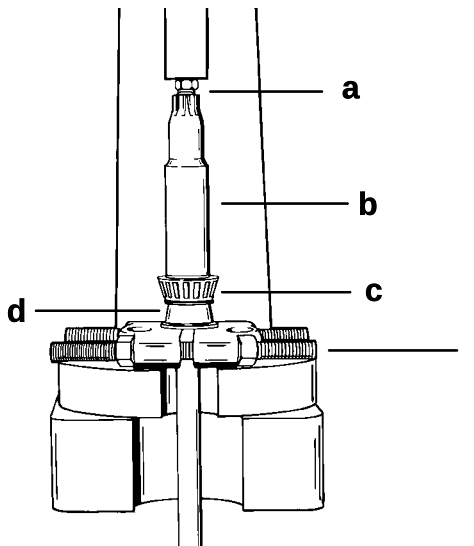


a - Reverse Gear
b - Thrust Bearing
c - Thrust Washer (under thrust bearing)
d - Bearing Adaptor

Driveshaft and Pinion Gear

REASSEMBLY/INSTALLATION

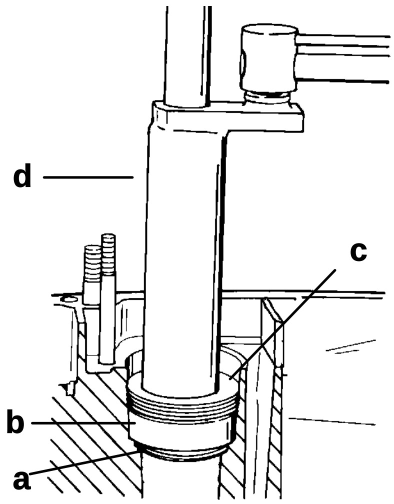
1. Apply a light coat of Quicksilver Super Duty Gear Lubricant on I.D. of driveshaft tapered bearing.
2. Thread a used pinion nut onto end of driveshaft. Leave approximately 1/16² (2mm) of nut threads exposed. Driveshaft threads MUST NOT extend beyond nut or thread damage could result while pressing.
3. Place bearing over driveshaft.
4. Using an old driveshaft bearing inner race or other suitable mandrel (which applies pressing force on center bearing race only), press bearing onto shaft until seated.



a - Used Pinion Nut
b - Driveshaft
c - Tapered Bearing
d - Old Bearing Inner Race
e - Universal Puller Plate

5. Position pinion gear in gear housing below driveshaft bore with teeth of pinion gear meshed with teeth of reverse gear.
6. Insert driveshaft into driveshaft bore while holding pinion gear. Rotate driveshaft to align and engage driveshaft splines with pinion gear splines. Continue to insert driveshaft into gear housing until driveshaft tapered bearing is against bearing race.
7. Apply Loctite 271 to threads of pinion gear nut and install flat washer and nut on driveshaft with flat side of nut away from pinion gear.

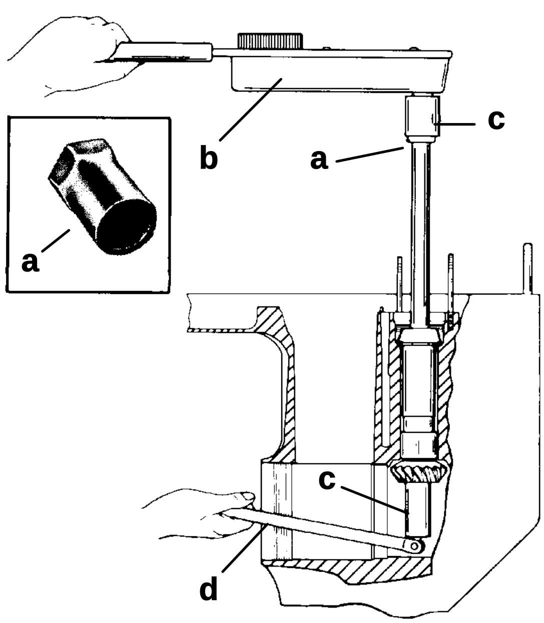
8. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or are not reusable (damaged), start with approximately 0.010² (0.254mm).
9. Install bearing race and bearing retainer.



51880

a - Shim(s)
b - Bearing Race
c - Bearing Retainer (Word "OFF" must be visible); Torque to 100 lb. ft. (135.5 N·m)
d - Bearing Retainer Tool (91-43506)

10. Use a socket and breaker bar to hold pinion nut (pad area where flex handle will contact gear housing while torquing nut).
11. Place Driveshaft Holding Tool (91-34377A1) over crankshaft end of driveshaft. Torque pinion nut to 75 lb. ft. (101.5 N·m).



a - Driveshaft Holding Tool (91-34377A1)
b - Torque Wrench; Torque Nut to 75 lb. ft. (101.5 N·m)
c - Socket
d - Breaker Bar

IMPORTANT: Wipe any excess Loctite from pinion nut and pinion gear.

Pinion Gear Depth

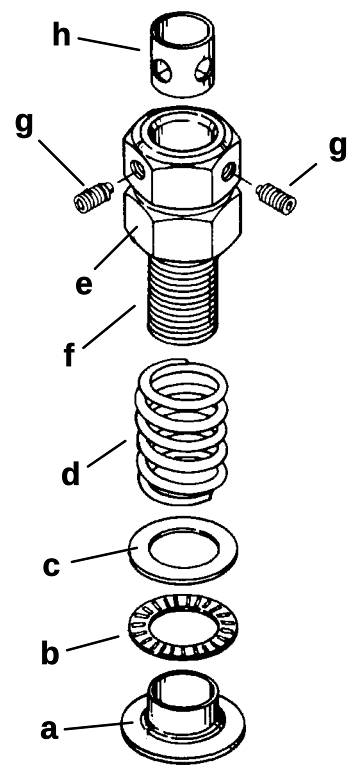
DETERMINING PINION GEAR DEPTH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Reverse gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

1. Clean gear housing bearing carrier shoulder.
2. Install Bearing Preload Tool (91-14311A1) over driveshaft in sequence shown.

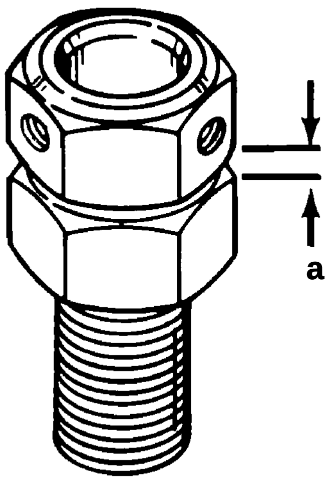
NOTE: *Bearing Preload Tool (91-44307A1) may also be used. Follow instructions provided with tool for proper installation.*

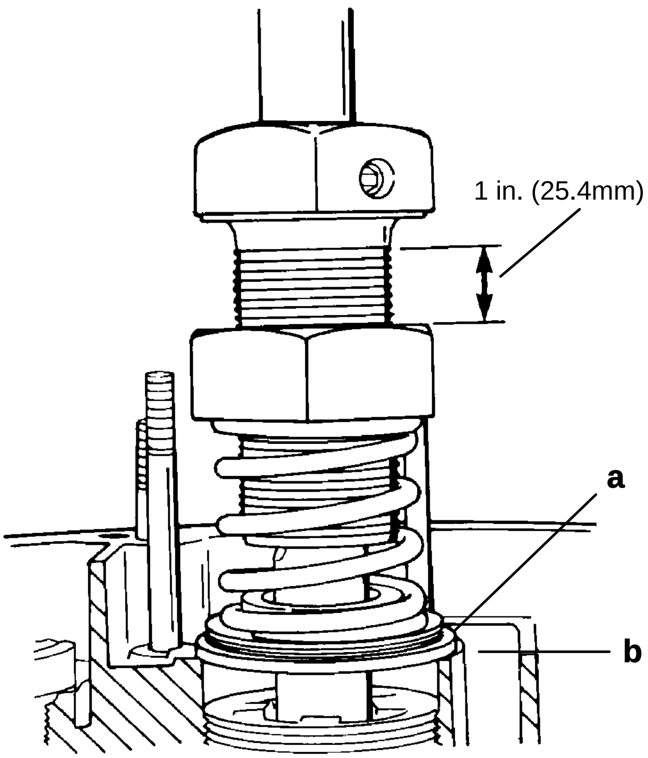


a - Adaptor
b - Bearing
c - Washer
d - Spring
e - Nut; Thread Nut All-The-Way Onto Bolt
f - Bolt
g - Set Screw
h - Sleeve; Holes in Sleeve Must Align With Set Screws

3. Align adaptor on driveshaft bearing pocket ledge.
4. With tool installed over driveshaft, tighten both set screws securely, making certain to align sleeve holes to allow set screws to pass thru.

5. Measure distance (a) and increase that distance by 1^2 (25.4mm) by turning bottom nut away from top nut.





a - Adaptor
b - Ledge

6. Turn driveshaft clockwise 2 or more turns to seat driveshaft bearings.

7. Insert Pinion Gear Locating Tool* (91-74776) into gear housing until it bottoms out on bearing carrier Shoulder.

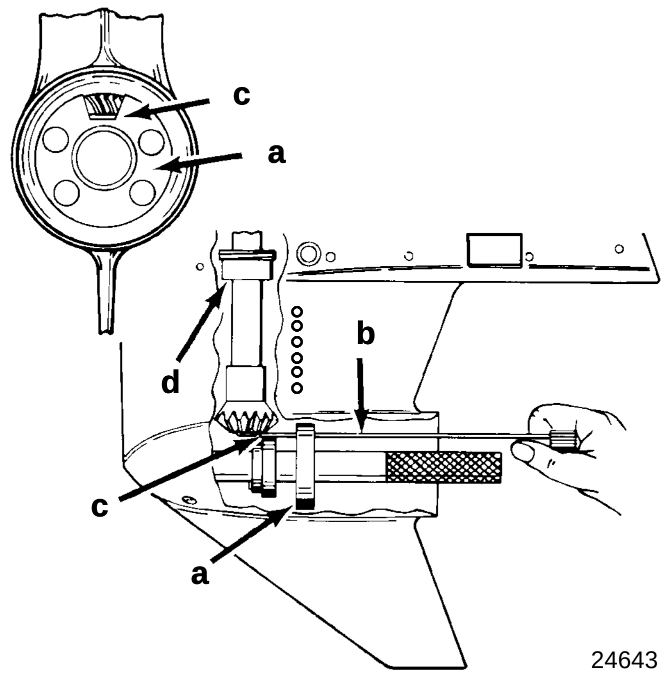
*Pinion Gear Locating Tool (91-12349A2) can be used. Use flat #7 and disc #2. Follow instructions supplied with tool.

8. Determine pinion gear depth by inserting a feeler gauge thru access slot in pinion gear shimming tool.

9. Clearance between shimming tool and pinion gear should be 0.025^2 (0.64mm).

10. If clearance is correct, leave Bearing Preload Tool on driveshaft for **“Determining Forward Gear Backlash,”** following.

11. If clearance is not correct, add (or subtract) shims at location shown to raise (or lower) pinion gear. When reinstalling pinion nut, apply Loctite 271 on threads of nut and retorque pinion nut.



a - Pinion Gear Shimming Tool (91-74776 or 91-12349A2)
b - Feeler Gauge
c - Obtain 0.025^2 (0.64mm) Clearance between Shimming Tool and Pinion Gear
d - Add or Subtract Shim(s) Here

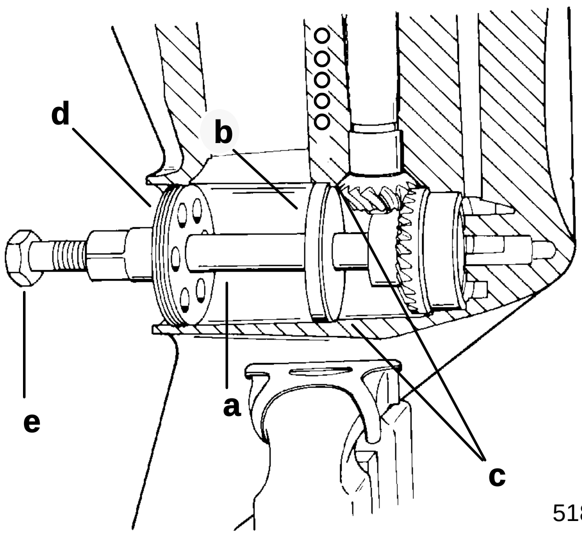
NOTE: *Bearing Preload Tool (91-14311A1) should remain installed on driveshaft after setting pinion gear depth as it is required to properly check forward gear and reverse gear backlash.*

Reverse Gear

DETERMINING REVERSE GEAR BACKLASH

NOTE: *Reverse gear backlash is adjustable using shims; it can be checked as follows:*

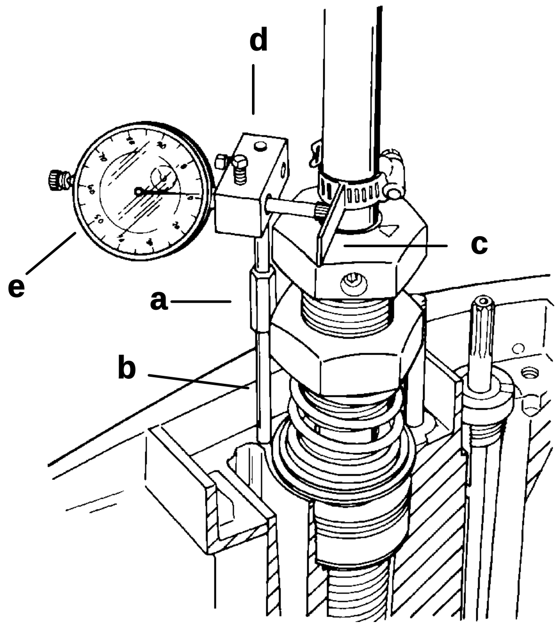
1. Install Driver Tool (91-18605) into reverse gear assembly.
2. Slide Pilot Ring (91-18603) over driver tool and seat pilot ring against inner ledge in gear case.
3. Thread Retainer (91-18604) into gear case cover nut threads.
4. Torque Screw (91-18602) to 45 lb. in. (5.0 N·m) against driver tool.



51884

a - Driver Tool (91-18605)
b - Pilot Ring (91-18603)
c - Inner Ledge
d - Retainer (91-18604)
e - Screw (91-18602) [Torque to 45 lb. in. (5.0 N·m)]

5. Thread stud adapter [from Bearing Preload Tool (91-14311A1)] all the way onto stud.
6. Install: Backlash Indicator Tool (91-78473)
   Dial Indicator Holder (91-89897)
   Dial Indicator (91-58222A1)
7. Position dial indicator pointer on line marked "1" on Backlash Indicator Tool, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked "2" on Backlash Indicator Tool, if gear ratio is 2:1 (14 teeth on pinion gear).
8. Lightly turn driveshaft back-and-forth (no movement should occur at propeller shaft).
9. Dial Indicator registers amount of backlash, which should be 0.030" to 0.050" (0.76mm to 1.27mm).



51880

a - Stud Adaptor (from 91-14311A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)
f - Dial Indicator Pointer

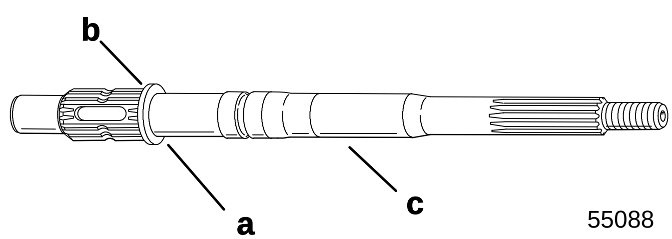
NOTE: *If reverse gear backlash is not within specifications, then gear case is not properly assembled or component(s) within gear case are excessively worn and must be replaced before returning gear case to service.*

10. Remove Driver Tool, Pilot Ring, Retainer and Screw from gear case.

Forward Gear

DETERMINING FORWARD GEAR BACKLASH

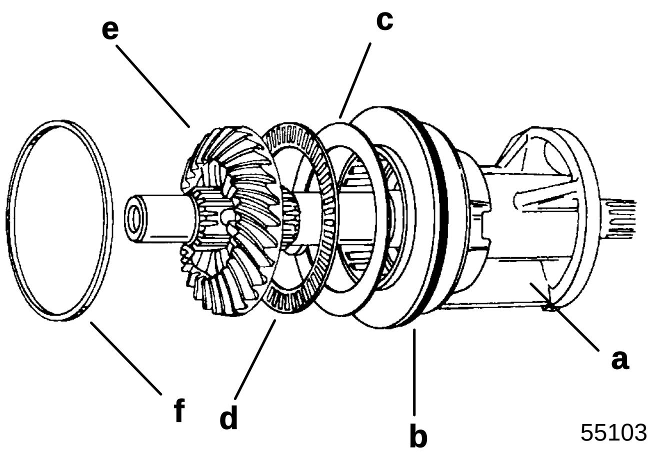
1. Install a load washer (12-37429) over a 44-93003 propeller shaft so that it seats against the REAR shoulder of the clutch spline teeth.



55088

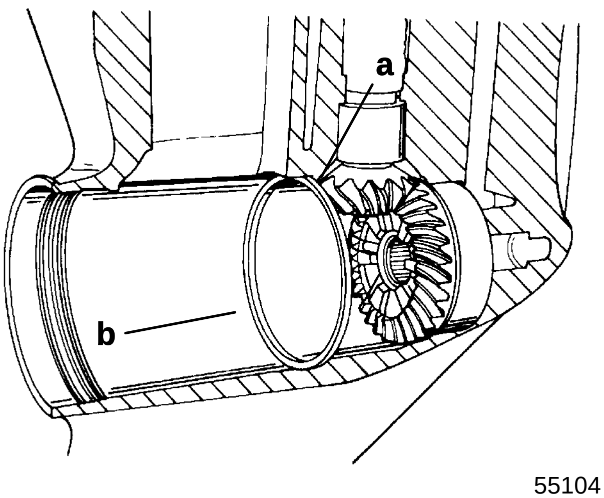
a - Load Washer (12-37429)
b - Shoulder
c - Propeller Shaft (44-93003)

2. Assemble BEARING CARRIER, BEARING ADAPTOR, THRUST WASHER, THRUST BEARING, and FORWARD GEAR onto propeller shaft.



a - Bearing Carrier
b - Bearing Adaptor
c - Thrust Washer
d - Thrust Bearing
e - Forward Gear
f - Shim (PLACE IN GEARCASE FIRST)

3. Position shim against shoulder in gear case.



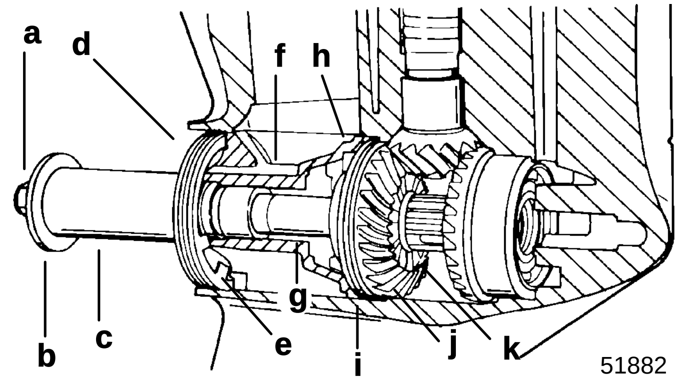
a - Shoulder
b - Shim

4. Insert entire propeller assembly into gear case.

5. Install tab washer and cover nut. Torque cover nut to 100 lb. ft. (135.5 N m) to seat forward gear assembly in gear case.

NOTE: *Drill a 3/8" (22.2mm) diameter hole through the side (PROPELLER NUT END) of a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe. A screwdriver may be inserted thru pipe into propeller shaft splines to prevent PVC pipe from turning while tightening retaining nut.*

6. Install a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe (obtain locally) over propeller shaft and secure it against the bearing carrier with a flat washer and nut.



a - Prop Nut
b - Flat Washer
c - PVC Pipe [5" x 2" (127mm x 50.8mm)]
d - Cover Nut
e - Tab Washer
f - Bearing Carrier
g - Prop Shaft
h - Bearing Adaptor
i - Shim
j - Forward Gear
k - Load Washer

7. Tighten nut to 45 lb. in. (5.0 N·m). This will seat the forward gear against the forward thrust bearing and tends to hold the propeller shaft from moving when measuring backlash.

NOTE: *Bearing Preload Tool (91-44307A1) should still be installed from having previously been used to determine pinion gear depth and reverse gear backlash. If it is not still installed on gear case, refer to* ***"DETERMINING PINION GEAR DEPTH,"*** *previously, for proper installation procedure.*

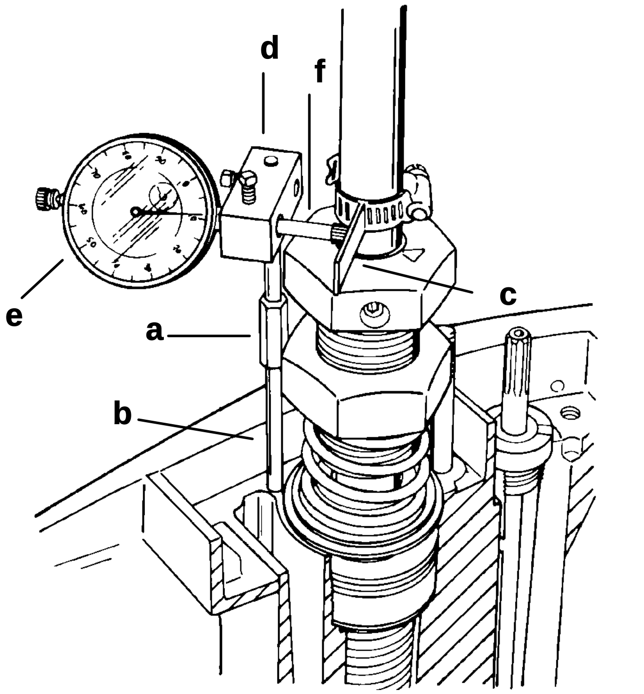
8. With the proper preload applied to the propeller shaft and the driveshaft, rotate the driveshaft clockwise 5 to 10 complete revolutions. This will seat the forward gear and upper driveshaft bearings and thus provide the most accurate backlash readings.

9. If not previously installed:

   a. Thread stud adaptor [from bearing preload tool (91-44307A1) all the way onto stud.

   b. Install: Backlash Indicator Tool (91-78473)
   Dial Indicator Holder (91-89897)
   Dial Indicator (91-58222A1)

10. Position dial indicator pointer on line marked "1" on BACKLASH INDICATOR TOOL, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked "2" on BACKLASH INDICATOR TOOL, if gear ratio is 2:1 (14 teeth on pinion gear).



51880

a - Stud Adaptor (from 91-44307A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)
f - Dial Indicator Pointer

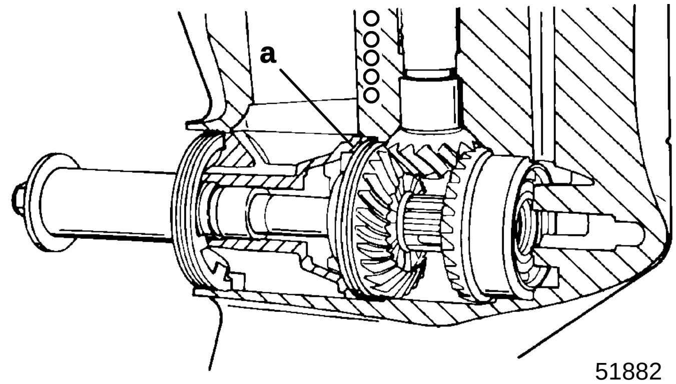
11. Gently rock driveshaft back and forth to determine forward gear backlash.

175 and 200 HP models with 1.87:1 Ratio = 0.018" to 0.027" (0.46mm - 0.69mm) backlash.

135 and 150 HP models with 2.00:1 Ratio = 0.015" to 0.022" (0.38mm - 0.56mm) backlash.

12. If backlash is less than the specifications, then a larger shim should be installed. Conversely, if the backlash indicated is greater than specifications, then a smaller shim should be installed.

NOTE: *By adding or subtracting 0.002" (0.051 mm) shim, the backlash will change approximately 0.002" (0.051 mm).*



51882

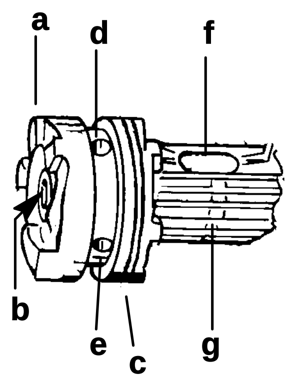
a - Shim

13. If forward gear backlash is within specifications, then Bearing Preload Tool, Dial Indicator, Backlash Indicator Tool/Dial Indicator Holder, PVC pipe, forward gear assembly, bearing adaptor, bearing carrier and test propeller shaft can all be removed from the gear case.

Propeller Shaft/Forward Gear Bearing Adapter/Bearing Carrier

REASSEMBLY

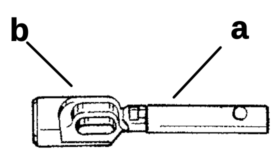
1. Position sliding clutch onto propeller shaft. "GROOVED RINGS" are for manufacturing purposes only and may be positioned towards either gear. Cross pin hole and detent hole in sliding clutch must line up with cross pin slot and detent notch in propeller shaft.



51913

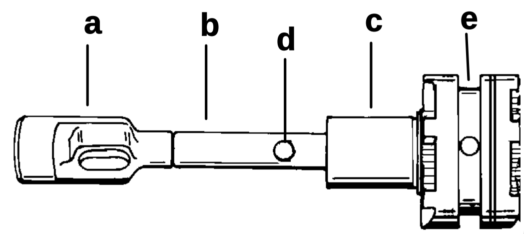
a - Sliding Clutch
b - Propeller Shaft
c - Grooved Rings
d - Cross Pin Hole
e - Detent Hole
f - Cross Pin Slot
g - Detent Notches

2. Place a small amount of Quicksilver 2-4-C w/Teflon Lubricant on actuator rod and install cam follower.



a - Actuator Rod
b - Cam Follower

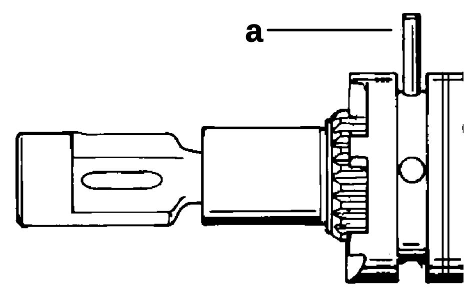
3. Slide clutch actuator assembly into propeller shaft. Align cross pin slot in actuator rod with cross pin slot in clutch/propeller shaft.



51875

a - Cam Follower
b - Clutch Actuator Rod
c - Propeller Shaft
d - Cross Pin Slot
e - Clutch/Propeller Shaft

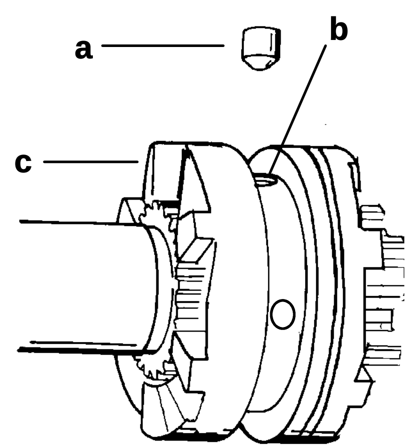
4. Insert cross pin through sliding clutch, propeller shaft and actuator rod forcing cross pin tool out.



51875

a - Cross Pin

5. Apply a small amount of 2-4-C w/Teflon Marine Lubricant (92-90018A12) to the rounded end of detent pin. Position detent pin in detent pin hole of sliding clutch with rounded end of pin toward propeller shaft.



51879

a - Detent Pin
b - Detent Pin Hole
c - Sliding Clutch

6. Install cross pin retaining spring onto sliding clutch as follows:

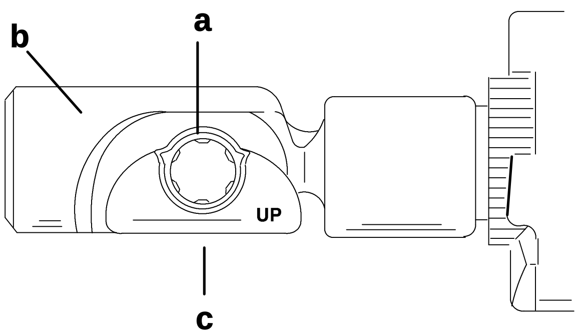
IMPORTANT: DO NOT over-stretch retaining spring when installing onto sliding clutch.

   a. Install spring.

      (1.) Spirally wrap spring into groove on sliding clutch.

      (2.) Position spring in groove so that straight end of spring is against the side of groove.

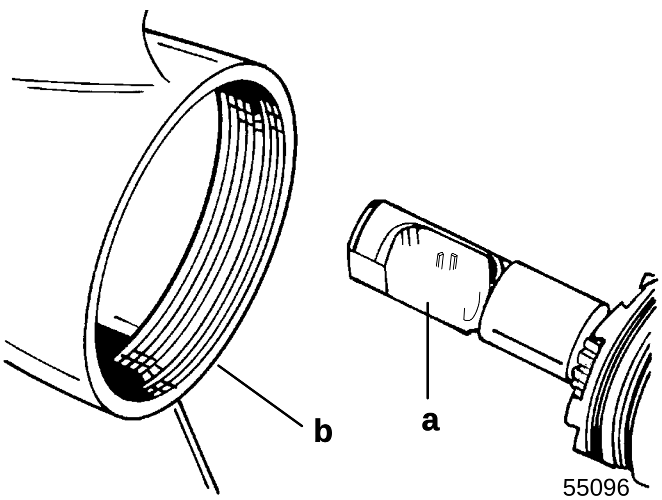
7. Place gear housing in a soft jaw vise with the driveshaft in a vertical position.
8. Coat cam pocket of cam follower with 2-4-C w/Teflon Marine Lubricant (92-90018A12).
9. Place shift cam into cam pocket of cam follower with numbered side of cam facing up.



55095

a - Cam Pocket
b - Cam Follower
c - Shift Cam

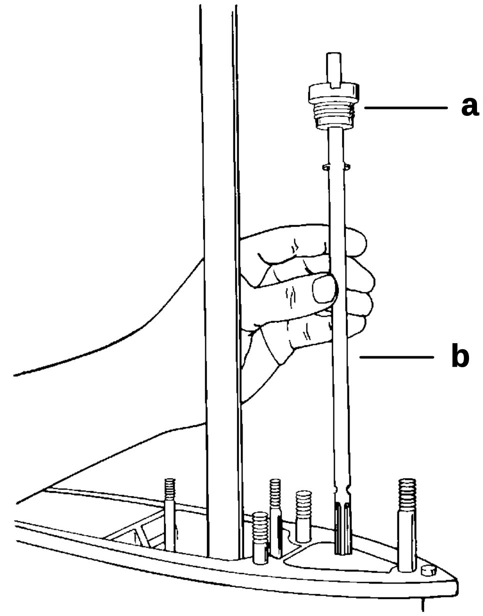
10. Slide propeller shaft assembly into reverse gear assembly.



55096

a - Shift Cam (Position as Shown)
b - Gear Housing

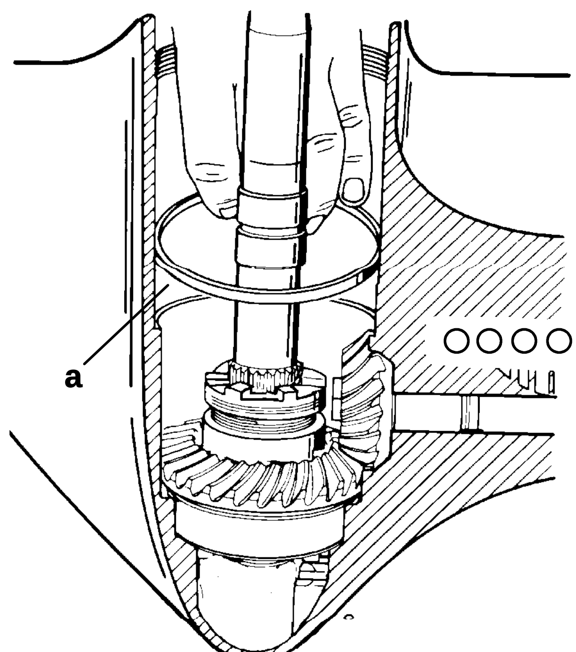
11. Apply a light coat of 2-4-C w/Teflon to the threads of the shift shaft bushing.
12. Insert shift shaft down shift shaft hole in gear housing and into shift cam. It may be necessary to rotate shift shaft back-and-forth slightly in order for splines of shift shaft to match up with splines of shift cam. Thread bushing into position, but do not tighten down at this time.



51867

a - Shift Shaft Bushing
b - Shift Shaft

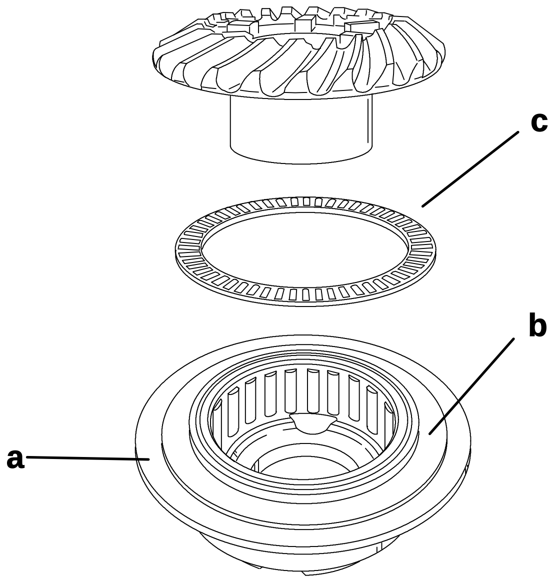
13. Install appropriate spacer shim into the gear housing.



50782

a - Shim

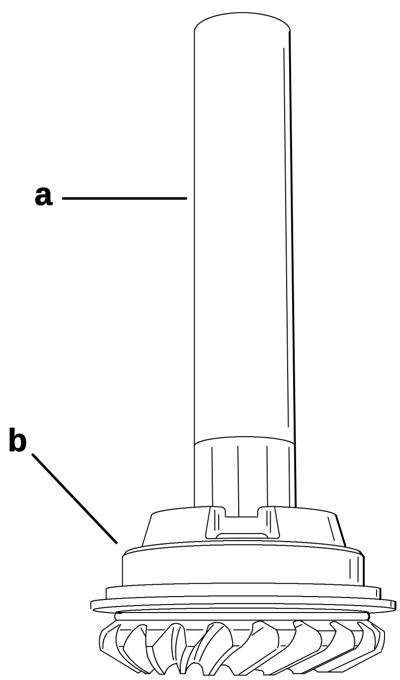
14. Apply Quicksilver Super Duty Gear Lubricant to to thrust bearing and install thrust bearing and thrust race onto forward gear bearing adaptor.



55220

a - Bearing Adaptor
b - Thrust Washer
c - Thrust Bearing

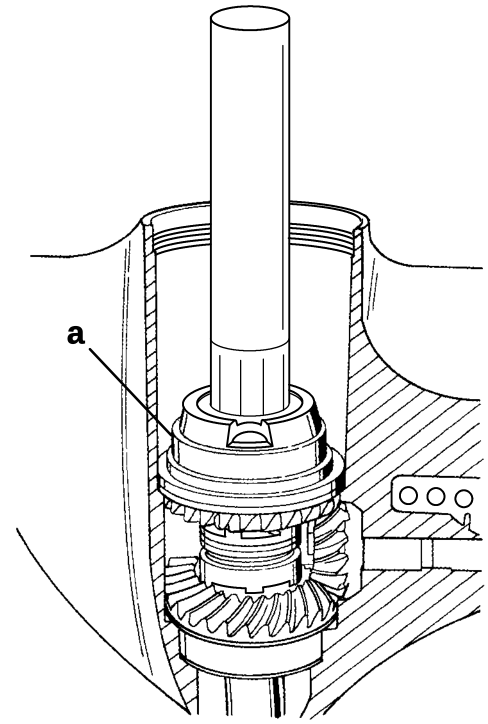
15. Insert Forward Gear Installation Tool (91-815850) into forward gear/bearing adaptor assembly.



55221

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear/Bearing Adaptor Assembly

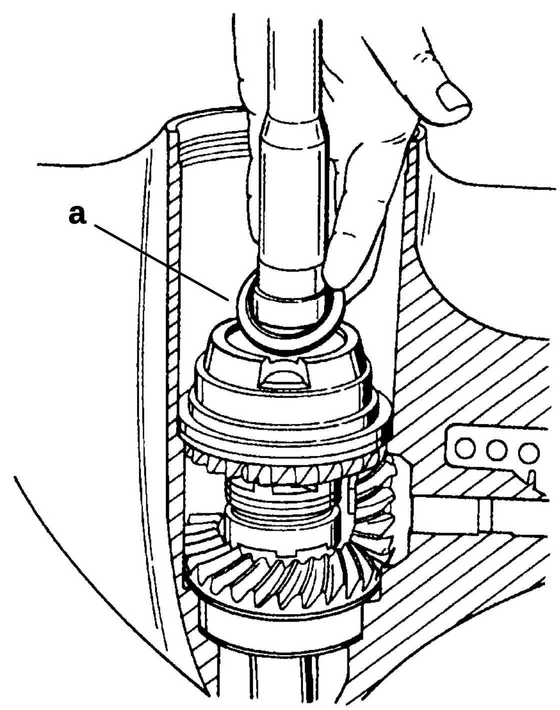
16. Install tool with adaptor assembly over propeller shaft and into gear housing. Applying downward pressure to bearing adaptor, remove installation tool from assembly.



55202

a - Forward Gear Bearing Adaptor

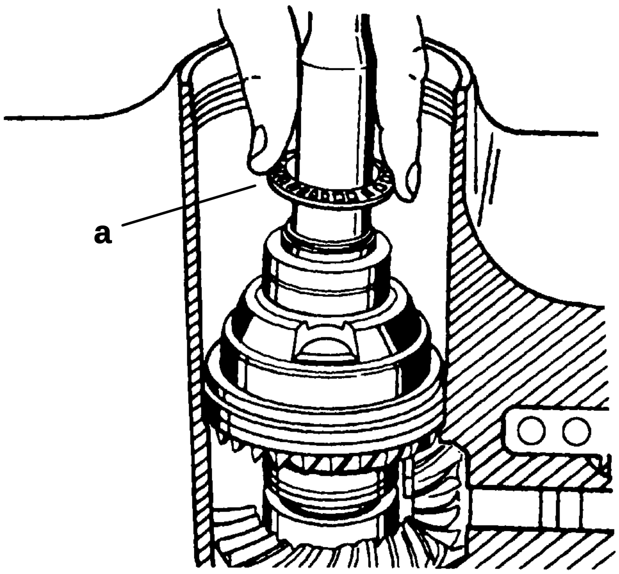
17. Install thrust race on top of bearing adaptor.



55107

a - Thrust Race

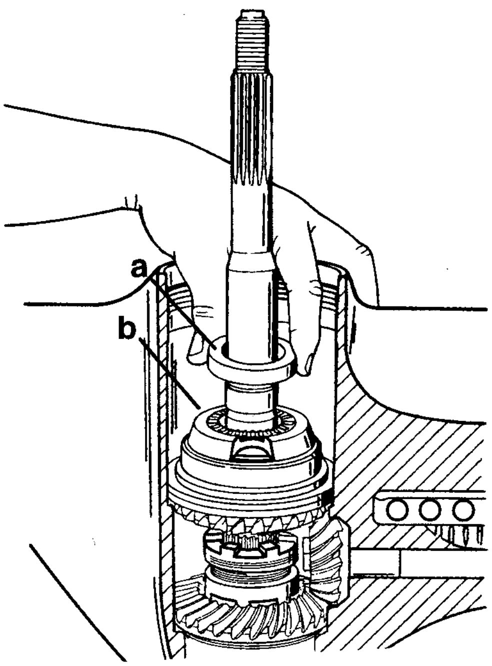
18. Apply Quicksilver Super Duty Gear Lubricant to small thrust bearing and install bearing on thrust race.



55108

a - Thrust Bearing

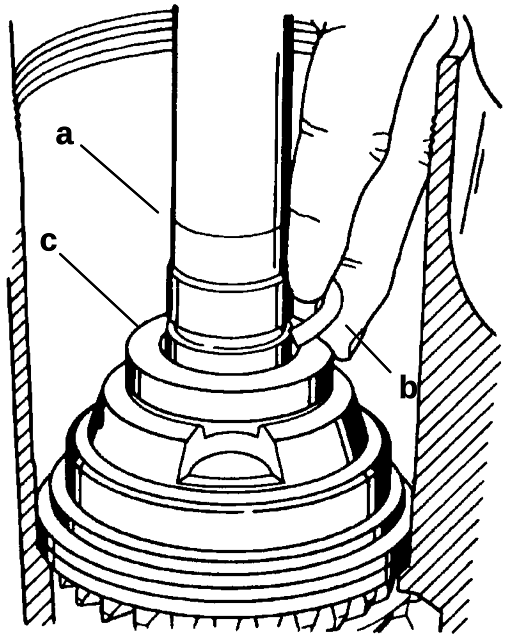
19. Install thrust collar with its **STEPPED SIDE DOWN** toward the small thrust bearing.



55109

a - Thrust Collar
b - Thrust Bearing

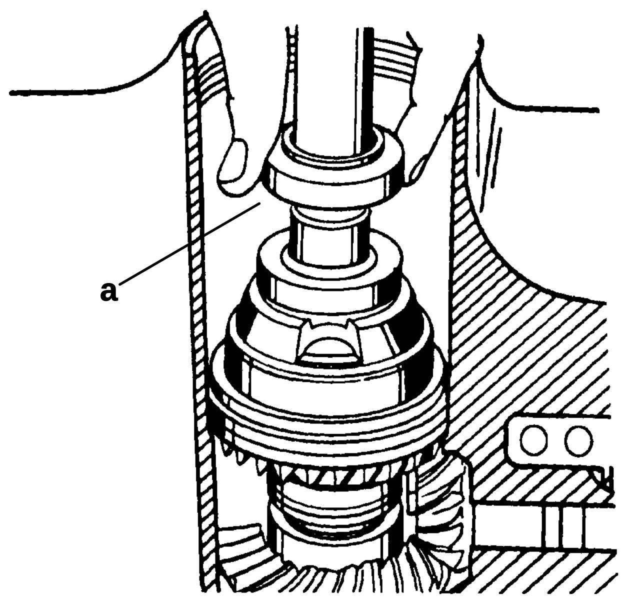
20. Pull up slightly on the propeller shaft to gain access to the groove on the shaft for the keepers. Install the 2 keepers into the groove and lower the propeller shaft.



55110

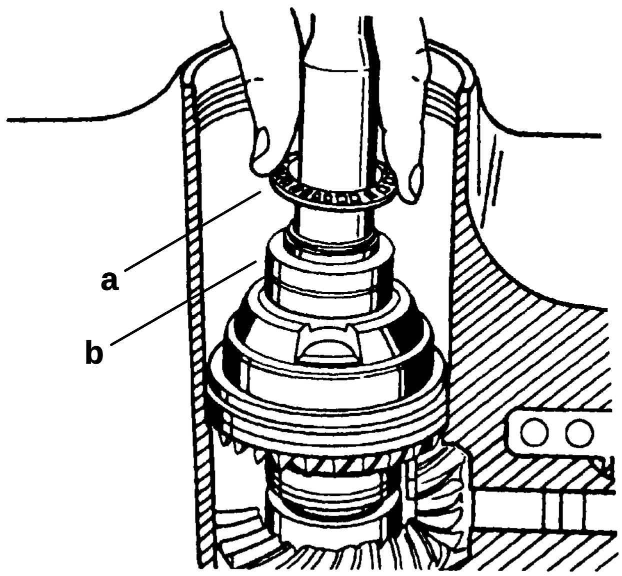
a - Propeller Shaft
b - Keepers (2)
c - Thrust Collar

21. Install second thrust collar with its stepped side **UP**.



a - Thrust Collar

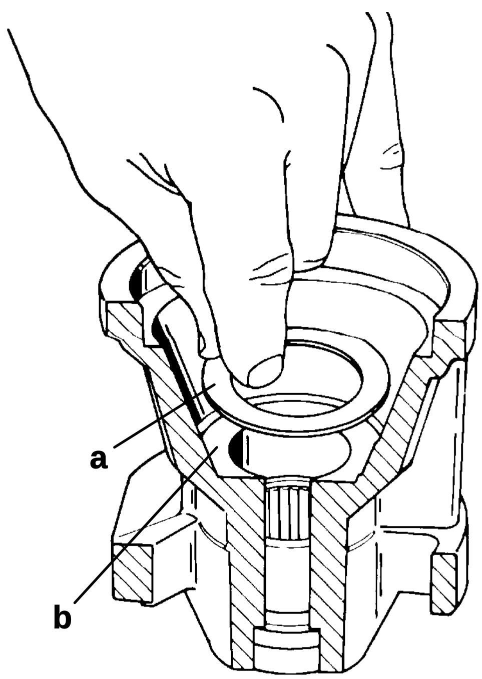
22. Apply Quicksilver Super Duty Gear Lubricant to the second thrust bearing and install it on top of the second thrust collar.



55112

a - Thrust Bearing
b - Thrust Collar

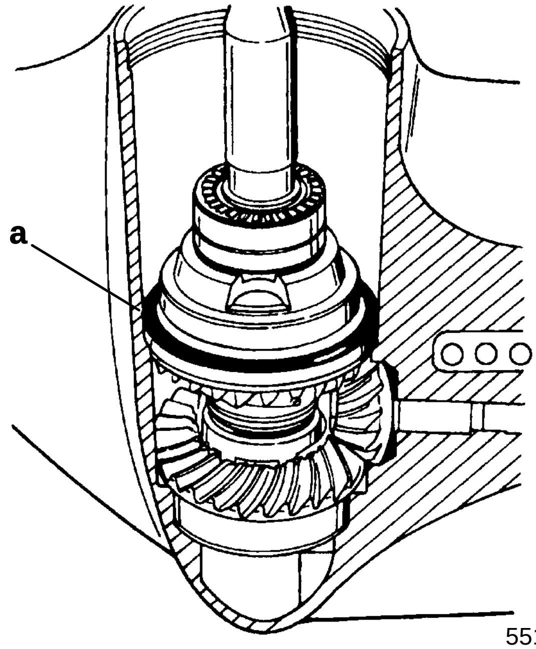
23. Apply Quicksilver Super Duty Gear Lubricant to to second small thrust bearing race and install race to the surface inside of the bearing carrier.



50779

a - Thrust Race
b - Bearing Carrier Race Surface

24. Apply Quicksilver 2-4-C w/Teflon Marine Lubricant to bearing carrier O-ring. Install O-ring onto bearing adaptor.



55113

a - O-ring

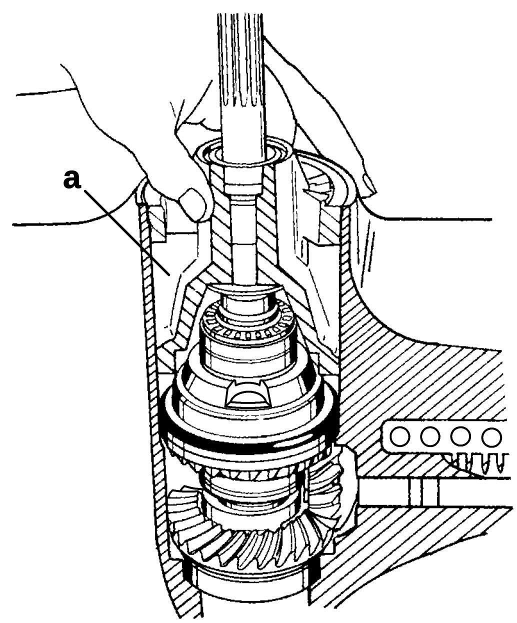
25. Apply Quicksilver 2-4-C w/Teflon Marine Lubricant to:

    a. Outer diameter of bearing carrier which contacts gear case.

    b. Space between carrier oil seals.

26. Apply Quicksilver Super Duty Gear Lubricant to bearing carrier needle bearing.

27. Install bearing carrier into gear housing.

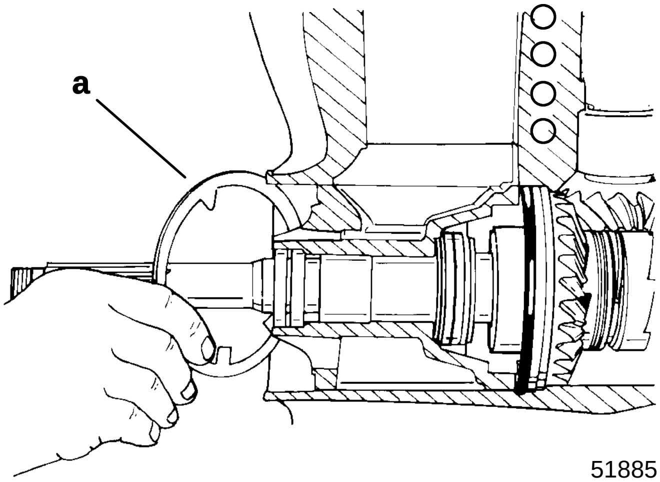


55114

a - Bearing Carrier

28. Verify bearing carrier keyway is aligned with gear housing keyway and install bearing carrier key.

29. Place tab washer against bearing carrier.

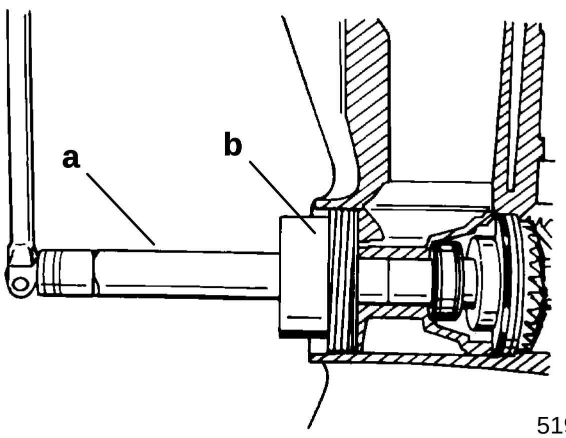


a - Tab Washer

30. Apply 2-4-C w/Teflon to threads of cover nut and install cover nut in gear housing. Verify that the word "OFF" and arrow are visible.

NOTE: *Before torquing bearing carrier cover nut, gear case should either be mounted in a stand specifically designed for holding gear cases or bolted to a driveshaft housing to avoid possible damage to the gear case.*

31. Using Cover Nut Tool (91-61069), torque cover nut to 210 lb. ft. (284.5 N·m).

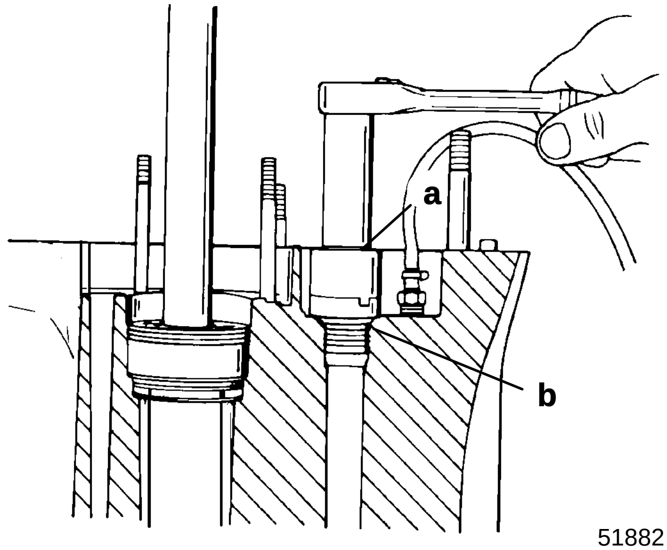


a - Retainer Nut Tool (91-61069)
b - Retainer Nut

32. Bend one lock tab of tab washer into cover nut (only one will align).

33. Bend remaining tabs of tab washer toward front of gear housing.

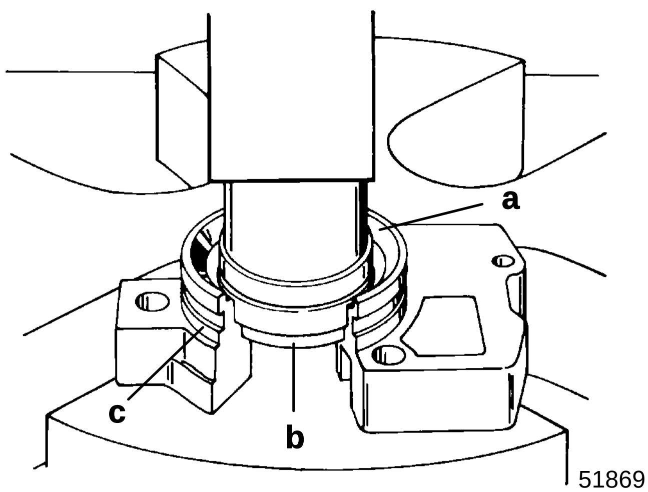
34. Use Shift Shaft Bushing Tool (91-31107) and torque shift shaft bushing to 50 lb. ft. (67.5 N·m).



a - Shift Shaft Bushing Tool (91-31107)
b - Shift Shaft Bushing

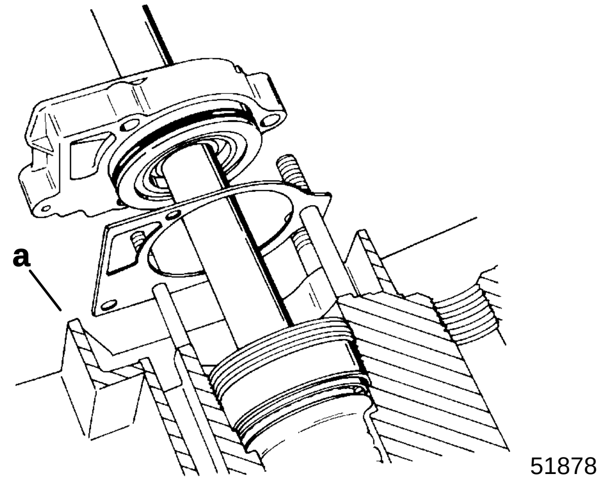
REASSEMBLY/INSTALLATION

1. Install oil seals into water pump base, as follows:
   a. Place water pump base on a press.
   b. Just before installing each seal apply Loctite 271 on outside diameter of oil seal.
   c. With a suitable mandrel, press the smaller diameter oil seal into pump base with lip of oil seal toward impeller side of base.
   d. With a suitable mandrel, press the larger diameter oil seal into pump base with lip of oil seal toward gear housing side of base.
   e. Wipe any excess Loctite from oil seals and water pump base.
2. Install O-ring into O-ring groove of water pump base. Lubricate O-ring and oil seals with 2-4-C w/ Teflon Marine Lubricant (92-90018A12).



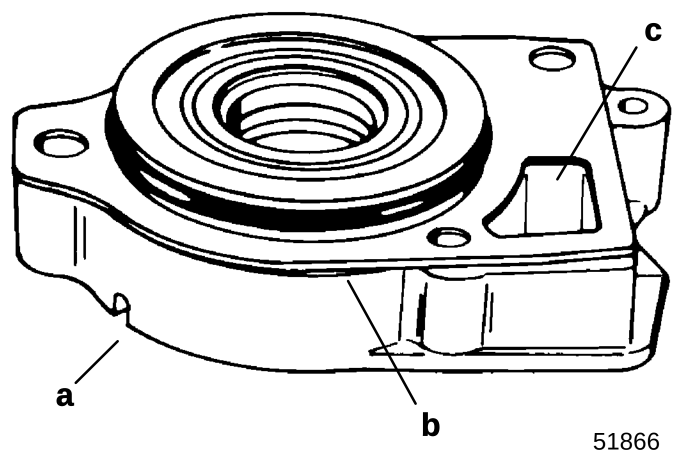
a - Mandrel
b - Oil Seal (Smaller OD)
c - O-Ring Groove

3. Install divider block if removed. Use RTV Sealer to seal seams between divider block and gear housing.



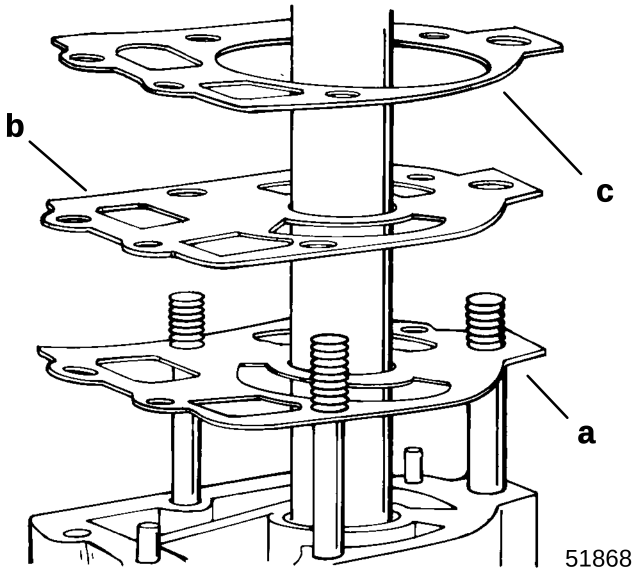
a - Divider Block

4. Install a new water pump base gasket and install water pump base.



a - Water Pump Base
b - Gasket
c - Hole (MUST be positioned as shown)

5. Install the following in order: Pump base to face plate gasket, face plate to pump cover gasket. Gaskets and face plate are indexed by dowel pin location and must be installed correctly.



51868

a - Gasket (Water Pump Base to Face Plate)
b - Face Plate
c - Gasket (Face Plate to Water Pump Cover)

6. Place impeller drive key on flat of driveshaft. Hold key on driveshaft with a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant (92-90018A12).

IMPORTANT: When completing gear housing repair that requires removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary to reuse the impeller, DO NOT install in reverse to original rotation or premature impeller failure will occur. Original rotation is clockwise.

⚠ CAUTION

A visual inspection of impeller drive key MUST BE made to determine that drive key is on flat of driveshaft after impeller is installed. If key has moved off flat of driveshaft, repeat Steps 7 and 8.

7. Slide impeller down driveshaft to impeller drive key. Align drive key with keyway in the center hub of impeller, and slide impeller over drive key.

8. If removed, install new water pump insert into pump cover as follows:

   a. Apply Quicksilver Perfect Seal to water pump insert area of pump cover.

   b. Install water pump insert into pump cover, being sure that tab on insert enters recess in pump cover.

   c. Wipe any excess Quicksilver Perfect Seal from insert and cover.

NOTE: *If 2 holes were drilled in top of water pump cover to aid in removal of insert, fill holes with RTV Sealer or equivalent. Allow to cure 24 hours prior to operating engine.*

9. Install water tube seal into pump cover. Plastic side of seal goes into cover first.

10. Reinstall water tube guide into water pump cover.

11. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to inside of water pump insert.

12. Position assembled water pump cover over driveshaft and lower over water pump studs. Rotate driveshaft in a clockwise direction (viewed from top), while pushing down on pump cover to ease impeller entry into cover.

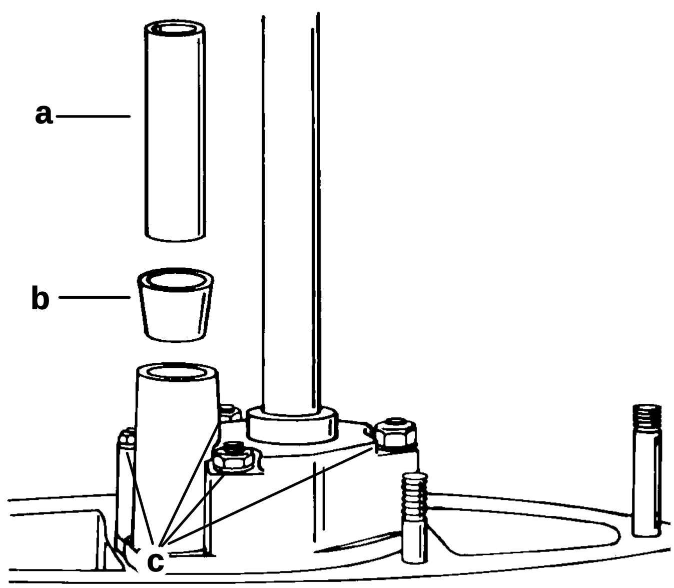
13. Install water pump cover retainer washers, nuts and bolt.

⚠ CAUTION

DO NOT over-torque nuts and bolt, as this could cause cover to crack during operation.

14. Torque water pump nuts to 50 lb. in. (5.5 N·m), and water pump bolt to 35 lb. in. (4.0 N·m).

15. Install centrifugal slinger over driveshaft and down against pump cover.



51874

a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolts and Washers

Gear Lubricant Filling Instructions

1. Remove any gasket material from "Fill" and "Vent" screws and gear 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 thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.
4. Install "Vent" screw into "Vent" hole.

IMPORTANT: DO NOT lose more than one fluid ounce (30cc) of gear lubricant while reinstalling "Fill" screw.

5. 5. Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Driveshaft Housing

⚠ WARNING

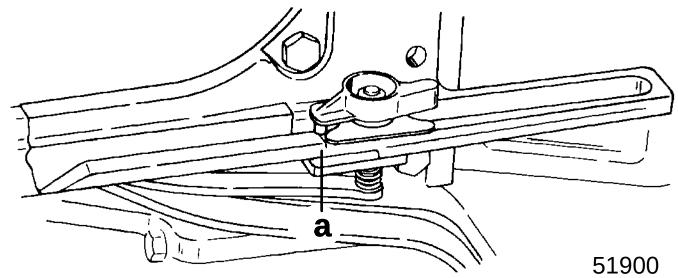
Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing onto driveshaft housing.

1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto driveshaft splines.

⚠ CAUTION

DO NOT allow lubricant on top of driveshaft. Excess lubricant, that is trapped in clearance space, will not allow driveshaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of driveshaft) will load the driveshaft/crankshaft and damage either or both the powerhead and gear housing. Top of driveshaft is to be wiped free of lubricant.

3. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Apply a thin bead of G.E. Silicone Sealer (92-90113--2) against the top of divider block.
5. Insert trim tab bolt into hole in rear of gear housing to driveshaft housing machined surface.
6. Shift gear housing into forward gear and place guide block anchor pin into forward gear position.



a - Guide Block Anchor Pin

7. Position gear housing so that the driveshaft is protruding into driveshaft housing.

NOTE: *If, while performing Step 8, the driveshaft splines will not align with crankshaft splines, place a propeller onto propeller shaft and turn it counterclockwise as the gear housing is being pushed toward driveshaft housing.*

8. Move gear housing up toward driveshaft housing while aligning shift shaft splines and water tube with water tube guide (in water pump cover).
9. Place flat washers onto studs (located on either side of driveshaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gear case up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to listing in **"Torque Specifications,"** preceding.
13. After 2 nuts (located on either side of driveshaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position while turning prop shaft. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

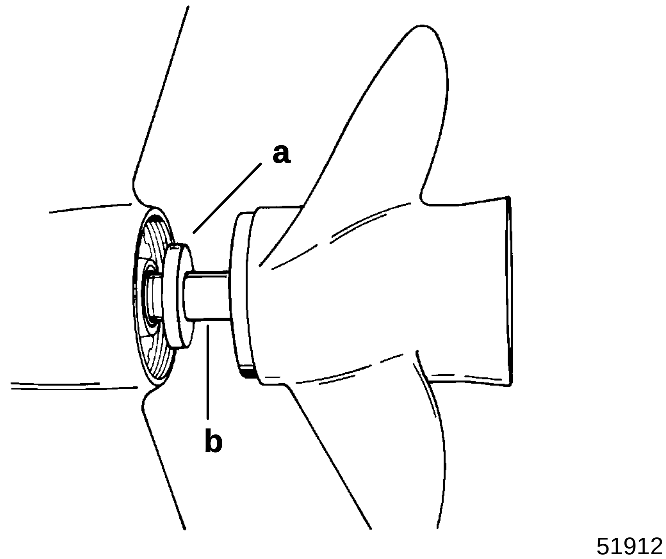
14. Install washers and nuts onto studs (located on bottom center of anti-cavitation plate). Torque to listing in **"Torque Specifications,"** preceding.
15. Install special flat washer and nut on stud at leading edge of driveshaft housing. Torque to listing in **"Torque Specifications,"** preceding.
16. Torque bolt (started in Step 10) to listing in **"Torque Specifications,"** preceding.
17. Install trim tab, adjust to position in which it had previously been installed, and tighten securely.
18. Install plastic cap into trim tab bolt opening at rear edge of driveshaft housing.

Propeller Installation

⚠ WARNING

When installing or removing propeller, because of the engine's ease in starting, VERIFY that the remote control is in NEUTRAL position and that the key switch is "OFF." Place a block of wood between the anti-cavitation plate and propeller to prevent accidental starting and to protect hands from propeller blades while removing or installing nut.

1. To aid in future removal of the propeller, liberally coat the propeller shaft splines with one of the following Quicksilver products:
   - -- Anti-Corrosion Grease (92-78376A6)
   - -- Special Lubricant 101 (92-13872A1)
   - -- 2-4-C Marine Lubricant (92-90018A12)
   - -- Perfect Seal (92-34227--1)
2. Place forward thrust hub over propeller shaft with shoulder side toward propeller.
3. Place propeller on propeller shaft and slide it up against thrust hub.



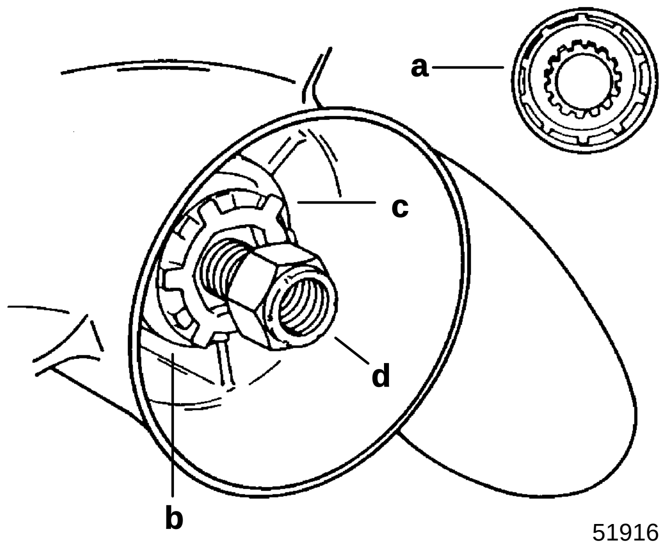
a - Forward Thrust Hub
b - Propeller Shaft

4. Place continuity washer (if equipped) onto shoulder of rear thrust hub.
5. Place rear thrust hub, tab washer and propeller nut on propeller shaft.
6. Thread propeller nut onto propeller shaft until nut is recessed into tab washer.
7. After propeller nut is recessed into tab washer, tighten nut securely [minimum of 55 lb. ft. (74.5 N·m) torque].
8. Bend 3 of the tabs of tab washer down in grooves of rear thrust hub to secure propeller nut. (If tab washer tabs do not align with slots, continue to tighten propeller nut to obtain alignment. DO NOT loosen nut to align tabs.)

⚠ CAUTION

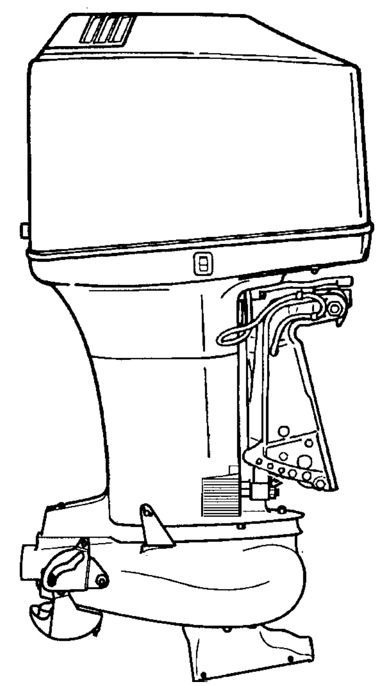
DO NOT misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; however, propeller should not move forward-and-aft on propeller shaft.

9. After first use, retighten propeller nut and again secure with tab washer (Steps 7 and 8, preceding). Propeller should be checked periodically for tightness, particularly if a stainless steel propeller is used.



a - Continuity Washer (If Equipped)
b - Rear Thrust Hub
c - Tab Washer
d - Propeller Nut

JET OUTBOARDS



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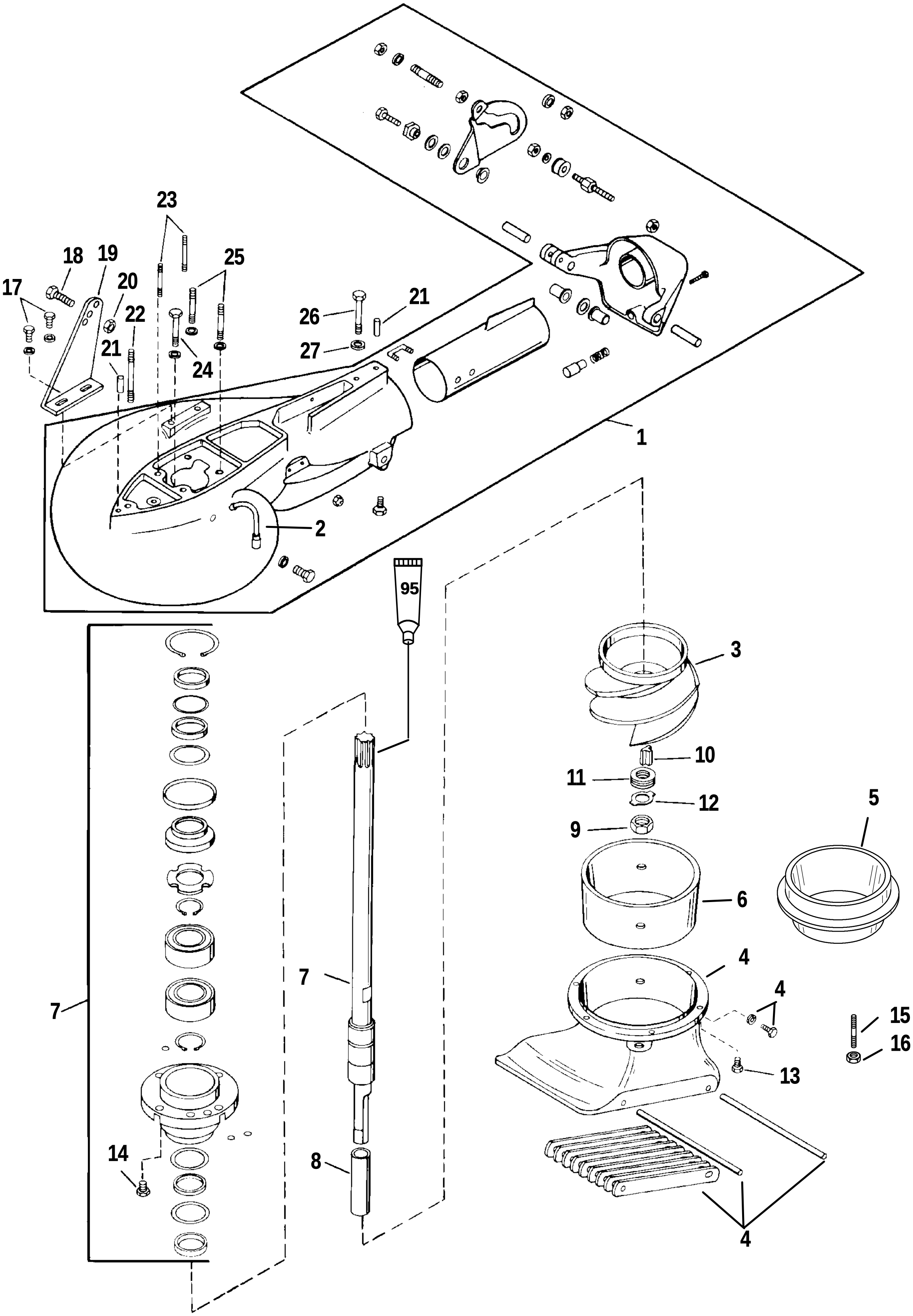
Notes:

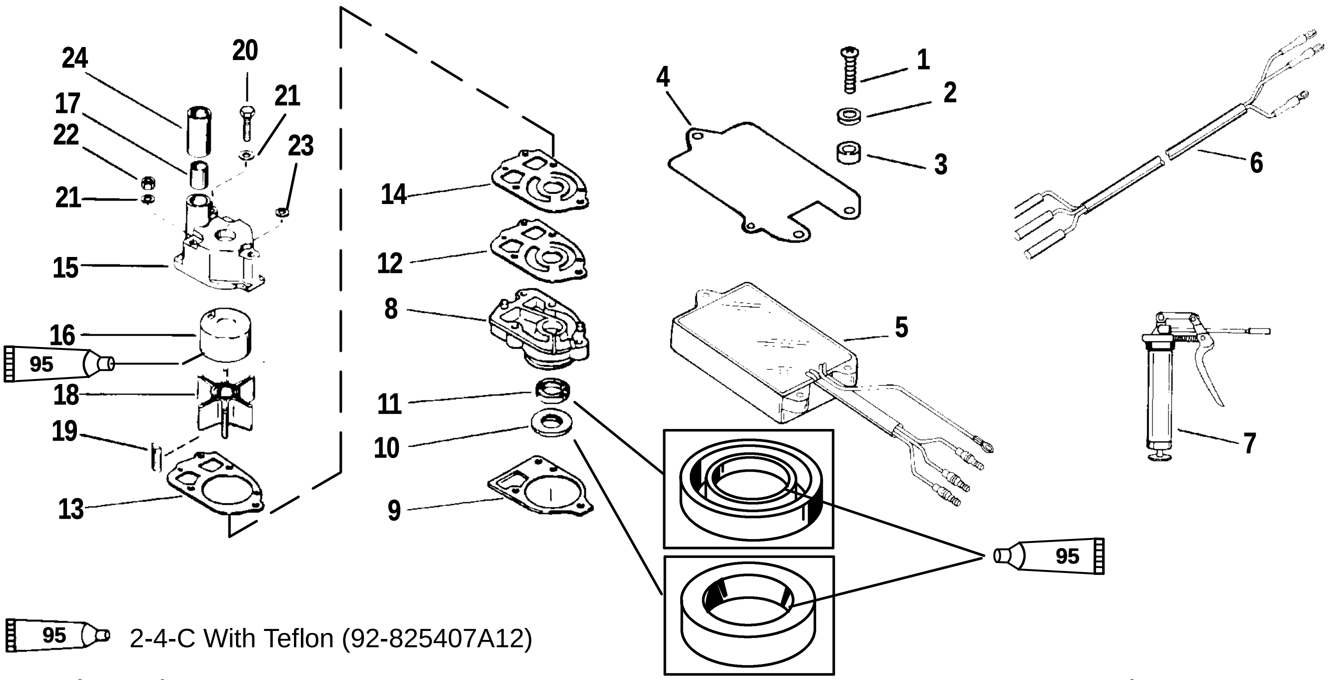
Jet Pump Assembly



95 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
–	1	JET PUMP **(BLACK) S/N-0G605661 & BELOW**			
–	1	JET PUMP **(GRAY)**			
–	1	JET PUMP **(S/N-0G605662 & UP - W/ALUMINUM IMPELLER)**			
–	1	JET PUMP **(JET 105 - W/STAINLESS STEEL IMPELLER)**			
–	1	JET PUMP **(JET 140 - W/STAINLESS STEEL IMPELLER)**			
1	1	HOUSING–Pump **(S/N-0G605662 & UP)**			
	1	HOUSING–Pump **(S/N-0G605661 & BELOW)**			
2	1	HOSE–Lube			
3	1	IMPELLER **(S/N-0G605662 & UP - ALUMINUM)**			
	1	IMPELLER **(JET 105 - STAINLESS STEEL)**			
	1	IMPELLER **(JET 140 - STAINLESS STEEL)**			
	1	IMPELLER **(S/N-0G605661 & BELOW)**			
4	1	HOUSING–Intake **(S/N-0G605662 & UP)**			
	1	HOUSING–Intake **(S/N-0G605661 & BELOW)**			
5	1	LINER **(S/N-0G605662 & UP)**			
6	1	LINER **(S/N-0G605661 & BELOW)**			
7	1	SHAFT–Drive **(S/N-0G605662 & UP)**			
	1	SHAFT–Drive **(S/N-0G605661 & BELOW)**			
8	1	SLEEVE			
9	1	NUT	Drive Tight		
10	1	KEY–Impeller			
11	8	SHIM			
12	1	TAB WASHER			
13	6	SCREW (.312-18 x 1) **(S/N-0G605661 & BELOW)**	144	12	16.5
14	4	SCREW (1/4-20 x .875)	70		8.0
	4	SCREW (.312-18 x 1)	144	12	16.5
15	6	STUD (.312-18 x 1.81) **(S/N-0G605662 & UP)**	144	12	16.5
16	6	NUT	144	12	16.5
17	2	SCREW (1/4-20 x .625)	70		8.0
18	1	SCREW (.312-18 x 1.25)	160	13.5	18.0
19	1	BRACKET			
20	1	NUT (.312-18)	160	13.5	18.0
21	2	PIN–Dowel			
22	1	STUD (.438 x 3.12)			
23	2	STUD (.44 x 2)			
24	1	SCREW (.312-18 x 2-3/4)			
25	2	STUD (1/4-20 x .875)			
26	1	SCREW (3/8-16 x 3)		22.5	30.5
27	1	WASHER			

Jet Components



95 2-4-C With Teflon (92-825407A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
1	3	SCREW (.190-32 x 1.62)	30		3.5
2	3	WASHER			
3	3	BUSHING			
4	1	PLATE			
5	1	REV LIMITER			
6	1	HARNESS–Adaptor-rev limiter			
7	1	GREASE KIT			
8	1	WATER PUMP BASE			
9	1	GASKET			
10	1	OIL SEAL			
11	1	OIL SEAL			
12	1	GASKET–lower			
13	1	GASKET–upper			
14	1	FACE PLATE			
15	1	WATER PUMP BODY ASSEMBLY			
16	1	INSERT			
17	1	SEAL–rubber			
18	1	IMPELLER			
19	1	KEY			
20	1	SCREW (2-1/4 IN.)	50		5.5
21	2	WASHER			
22	2	NUT	50		5.5
23	1	WASHER			
24	1	SLEEVE			

Selecting A Boat That Is Best Suited For Jet Power

To obtain the best performance from the jet drive, the boat should have the following features:

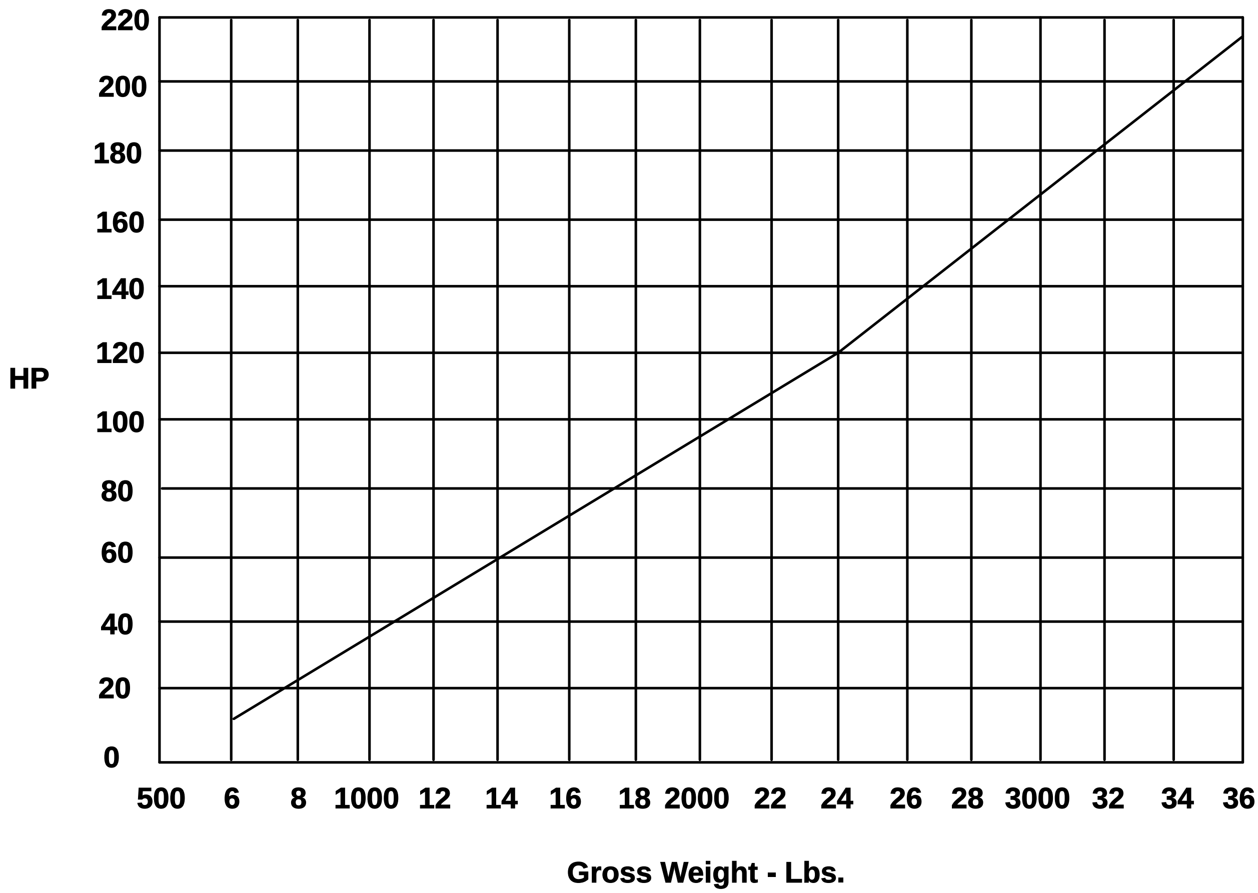
1. The boat should be as light as possible.
2. The boat should have hull and transom that is designed for use with a jet drive.
3. The boat should be at least 13 feet in length.

Engine Horsepower Selection

A boat operating at slow speed requires considerably more depth than one which is planing on the surface of the water. It is important therefore to use sufficient horsepower and not to overload your boat beyond its ability to plane. See the following table.

The following table is based on experience obtained with sled-type boats using outboard jets. The gross weights shown includes the outboard, boat people and all the gear carried. For a given horsepower, loading beyond these weights will give less than satisfactory performance.

Engine Horsepower Selection



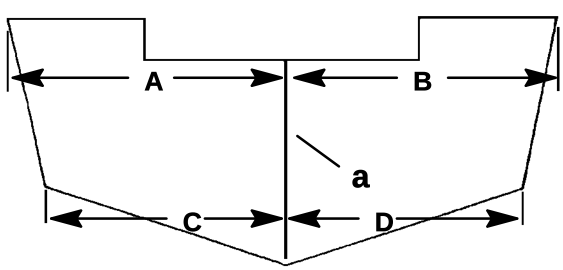
Transom Height of the Boat

Outboards with jet drives will be mounted approximately 7 inches higher on the transom than propeller driven outboards. This requires outboards that have a 15 in. shaft length to be installed on boats having a 22 in. transom height and outboards that have a 20 in. shaft length to be installed on boats having a 27 in. transom height.

If the boat transom is of insufficient height, and the outboard cannot be installed to the recommended height, contact the boat manufacturer for recommended procedure to build up the boat transom.

Locate Centerline of the Outboard

Locate (and mark with pencil) the vertical centerline (a) of boat transom.



a - Centerline of Transom

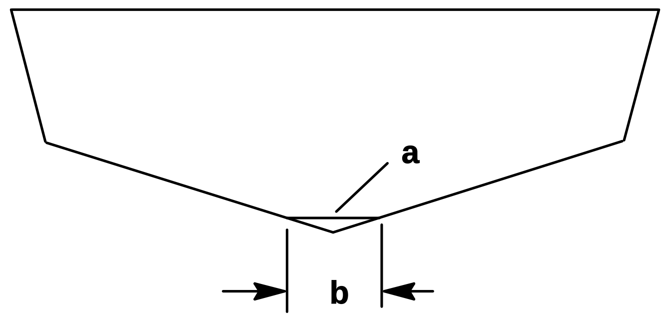
Outboard Mounting Height

The initial outboard mounting height setting will work good for most applications, however, because of different boat/hulls designs, the setting should be rechecked by test-running the boat. Refer to Water Testing.

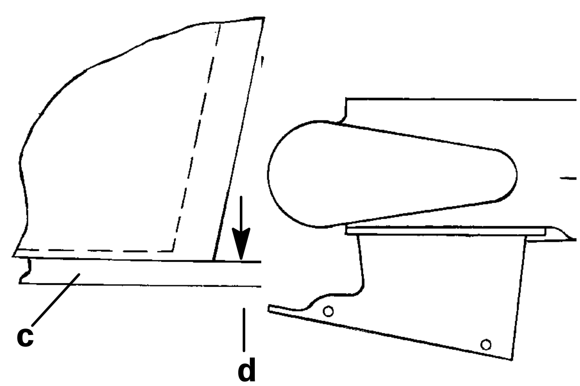
- Installing the outboard too high on the transom will allow the water intake to suck in air and cause cavitation (cavitation will cause the engine to overspeed in spurts and reduce thrust). This condition should be avoided by proper height setting.
- Installing the outboard too low on the transom will allow excessive drag.

SETTING OUTBOARD MOUNTING HEIGHT ON BOATS WITH "V" BOTTOM HULLS

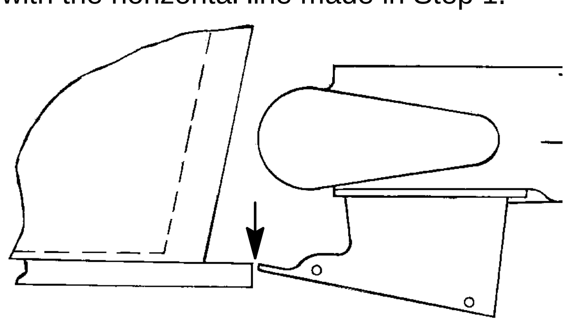
1. Measure the width of the leading edge on the water intake housing. Make a horizontal line (a) on the transom up from the "V" bottom the same length as the width of the water intake housing (b).



2. Place (center) the outboard on the boat transom so that the transom brackets are resting on top of the transom. Temporally fasten the outboard to the transom using two C-clamps.
3. Position the outboard in a vertical position.
4. Line-up a straight edge (c) along the bottom of the boat with the horizontal line made in Step 1 and measure the distance between the horizontal line and top front edge of the water intake housing (d).



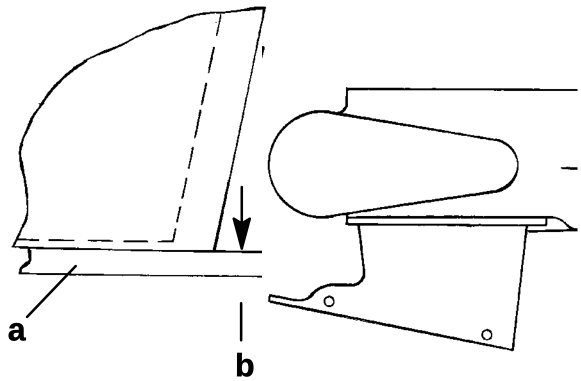
5. Raise the outboard up on the transom the distance measured in Step 4. Use a straight edge and recheck the mounting height. The top edge of the water intake housing should be lined-up with the horizontal line made in Step 1.



6. Fasten outboard to the transom at this height.

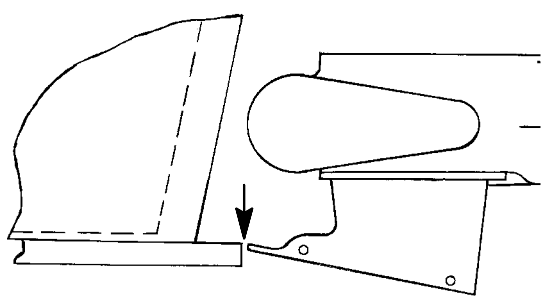
SETTING OUTBOARD MOUNTING HEIGHT ON BOATS WITH FLAT BOTTOM HULLS

1. Place (center) the outboard on the boat transom so that the transom brackets are resting on top of the transom. Temporally fasten the outboard to the transom using two C-clamps.
2. Position the outboard in a vertical position.
3. Place a straight edge (a) along the bottom of the boat as shown and measure the distance between the bottom of the boat and top front edge of the water intake housing (b).



a - Straight Edge
b - Top Edge of Water Intake Housing

4. Raise the outboard up on the transom the distance measured in Step 3. Use a straight edge and recheck the mounting height. The top edge of the water intake housing should be in line with the bottom of the boat as shown.



5. Fasten outboard to the transom at this height.

Water testing

Checking for Cavitation

Making the initial outboard height setting should be close to the optimum setting for the outboard. However because of the hull design of some boats, obstructions or imperfections in the hull ahead of the water intake may require this setting to change in order to prevent cavitation at running speeds.

When operating the boat, the outboard driveshaft should be vertical when planing or tilted toward the boat in order to provide a scooping angle on the water intake. Tilting the outboard out beyond a vertical position reduces the scoop angle and can cause impeller slippage and cavitation. If the angle of the boat transom does not allow the driveshaft to be positioned vertical a Wedge kit should be installed behind the transom brackets to increase the tilt-in angle.

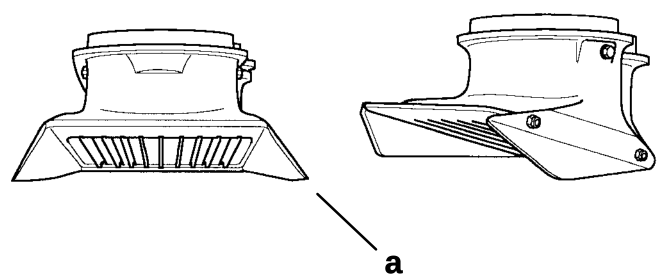
NOTE: *Slight cavitation in sharp turns and rough water is acceptable but excessive cavitation is harmful to the outboard and should be avoided.*

Test run the boat. If cavitation occurs (air enters the pump causing loss of thrust, engine over-speeds erratically), the first thing to try is lowering the outboard height 1/4 in. This can be accomplished by elongating the drilled mounting holes in the boat transom by 1/4 in.

If cavitation still exists after lowering the outboard 1/4 in., it maybe helpful to seek advice from the boat manufacturer.

A number of other options are available to further reduce cavitation.

1. Water intake fin kit (a) – Available from Quicksilver Accessories for the Jet 20 and the Specialty Mfg. Co. for jet models 30 thru 140. The purpose of these fins is to ram more water into the intake and shield the forward sides of the intake from the entrance of air. This kit will help reduce cavitation when running with the wind in a chop.



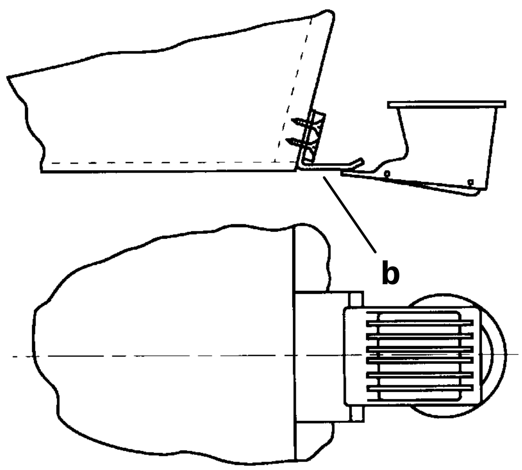
a - Intake Fin Kit

Jet 105 and 140 – Water Intake Fin Kit Part No.1186 for jet models 105 and 140 is available from:
Specialty Mfg. Co.
2035 Edison Ave.
San Leandro, CA 94577

Water testing

Checking for Cavitation (Continued)

2. Rough Water Plate (b) – Using this type of plate may be helpful in reducing cavitation when running in windy rough water conditions where air is sucked-in the water intake when jumping waves. Install a 1/32 in. metal plate that extends from the hull bottom to the top of the water intake housing. This plate tends to reduce air intake as well as reduce spray.



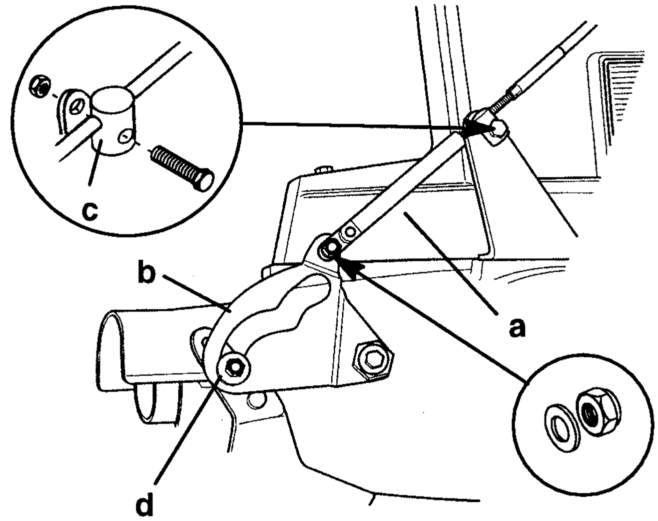
b - Rough Water Plate

Shift Cable Installation Jet 105 and 140

⚠ WARNING

The shift cable must be adjusted to lock the reverse gate against unexpected engagement (caused by water pressure hitting the gate) while operating the boat in forward. Activation of the reverse gate will cause sudden unexpected stopping of the boat. Sudden stopping may cause occupants to be thrown within the boat or even out of the boat. This action may result in serious injury or death.

1. Attach shift cable (a) to the shift cam (b) with flat washer and locknut as shown. Tighten locknut against the flat washer, then back-off the locknut 1/4 turn.
2. Place remote control handle into full forward position.
3. Adjust the brass barrel (c) on the shift cable so that roller (d) is at the full end of travel (bottom) in the shift cam when the remote control is in full forward.
4. Attach the brass barrel (c) to the bracket with bolt and locknut. Tighten the bolt until it seats against the barrel, then back-off the bolt 1/4 turn. Hold bolt from turning, and tighten locknut on bolt. The barrel must be free to pivot.



a - Shift Cable
b - Shift Cam
c - Barrel
d - Roller

5. Recheck the shift cable adjustment in forward shift position. The correct shift adjustment will position the cam far enough on the roller in order to lock the the reverse gate into forward position. You should not be able to forcibly push up the reverse gate toward neutral. Pull on the reverse gate by hand to verify this.

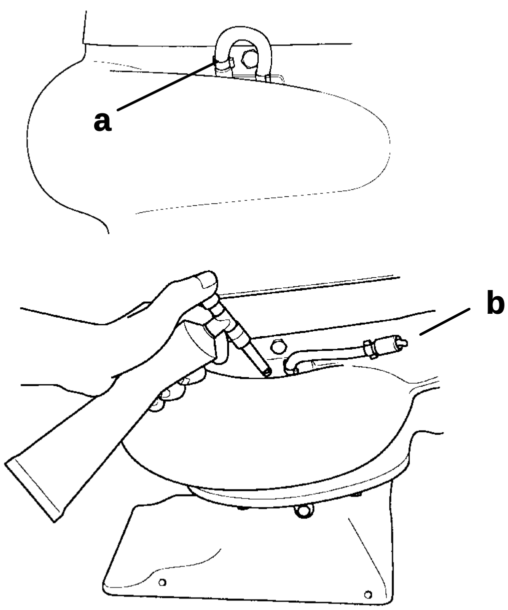
IMPORTANT: The forward locking of the reverse gate must be met. If not, readjust the shift cable.

Lubricating the Driveshaft Bearing

Recommended Lubrication - Use Quicksilver 2-4-C w/Teflon, or Lubriplate 630-AA Grease.

IMPORTANT: It is important that you do not use a general-all-purpose grease for this bearing. The lubricant we recommend is a water resistant grease of the proper consistency for this application. If you use a substitute grease, be sure that it is water resistant and of the same consistency.

Frequency of lubrication - We recommend lubricating the driveshaft bearing after each day's use and after every 10 hours of operation. After every 30 hours of operation, pump in extra grease to purge out any moisture.



a - Vent Hose
b - Grease Exiting Vent Hose

Lubricating Procedure - Pull vent hose (a) off the grease fitting. Pump in grease through the grease fitting until excess grease starts to exit the vent hose (b).

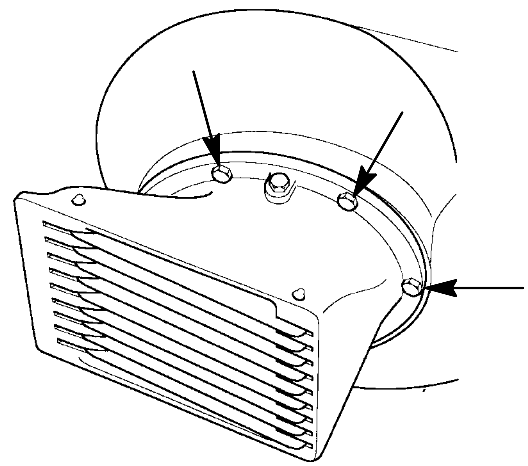
Reconnect the vent hose (a) onto the grease fitting after greasing.

After 30 hours of operation, pump in extra grease to purge out any moisture. Visually inspecting the purged grease at this time will give you an indication of conditions inside the bearing housing. A gradual increase in moisture content, indicates seal wear. If the grease begins to turn dark, dirty gray, the driveshaft bearing and seals should be inspected and replaced if necessary. Some discoloration of the grease is normal during the break-in period on a new set of seals.

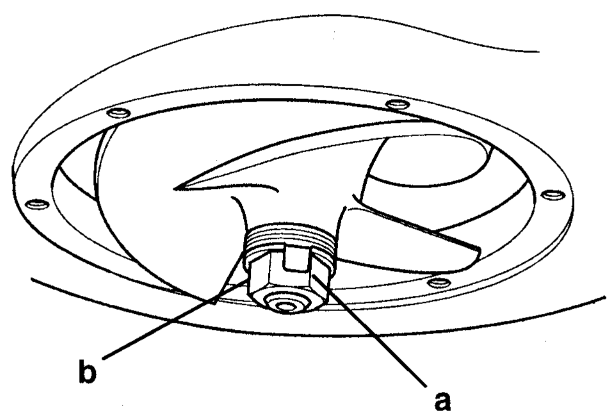
Impeller Removal and Installation

REMOVAL

1. Shift outboard to NEUTRAL (N) position.
2. Remove spark plug leads to prevent engine from starting.
3. Remove the water intake housing that is fastened with six screws.



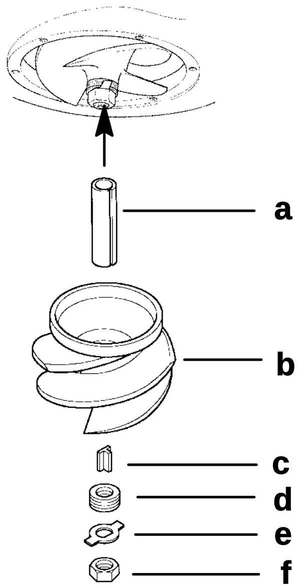
4. Straighten the bent tabs (a) on the impeller nut retainer and remove the impeller nut (b).
5. Pull impeller straight off the shaft. If the impeller is tight, use a hammer and block of wood to rotate the impeller (clockwise) on the shaft until the keyway is directly above the flat on the shaft. This will free the jammed key and allow removal.



a - Tab
b - Nut

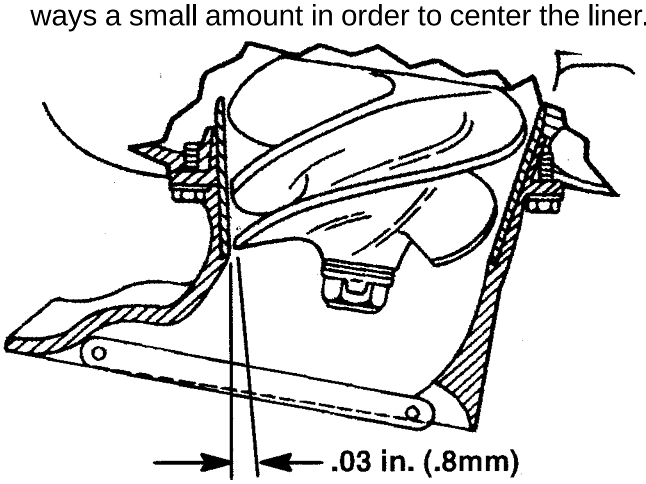
INSTALLATION

1. Grease the driveshaft, shear key, and impeller bore. Place the plastic sleeve (a) inside the impeller (b) and install impeller, shear key (c), shims (d) tab washer (e), and impeller nut (f). Turn the nut tight on the shaft to remove any play between the impeller and shaft. If the tabs on the retainer do not line up with the flats on the nut, remove the nut and turn the retainer over and re-tighten the nut again.

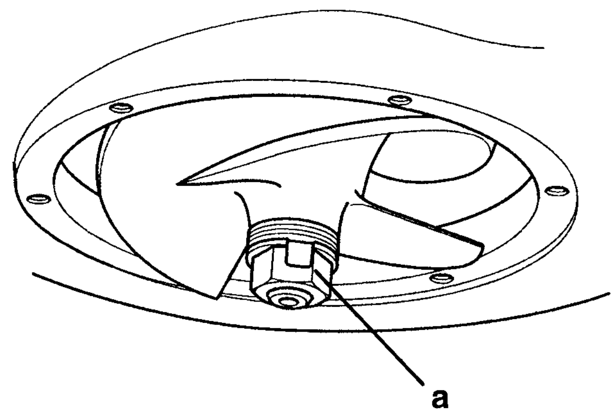


a - Plastic Sleeve
b - Impeller
c - Shear Key
d - Shims
e - Tab Washer
f - Impeller Nut

2. Temporarily reinstall the water intake housing in order to check for impeller clearance. The clearance between the impeller and liner should be 0.030 in. (0.8 mm). Shim washers can be transferred to either side of the impeller to raise or lower the impeller to the correct clearance setting. The water intake housing can be shifted side ways a small amount in order to center the liner.



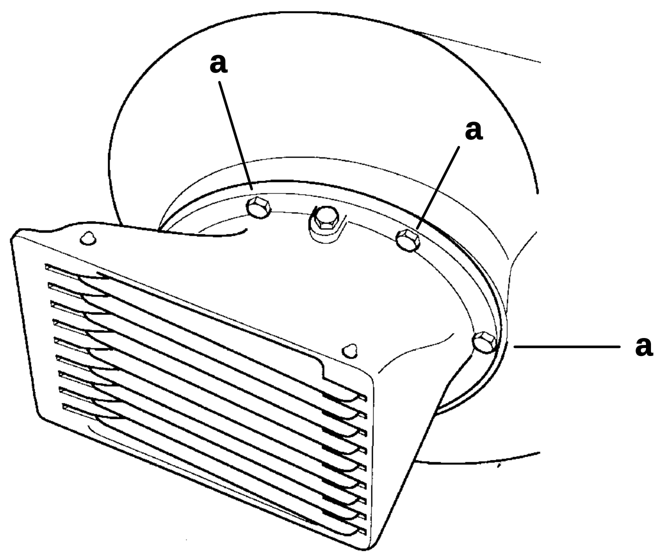
3. After setting the impeller height, tighten the impeller nut snug with a wrench. Secure impeller nut by bending tabs (a) against the flats on the impeller nut.



a - Tabs

4. Reinstall the water intake housing with six bolts. Check clearance around the impeller to make sure the water intake housing is centered and not rubbing against the liner. Torque mounting bolts to 100 lb. in. (11.0 N·m).

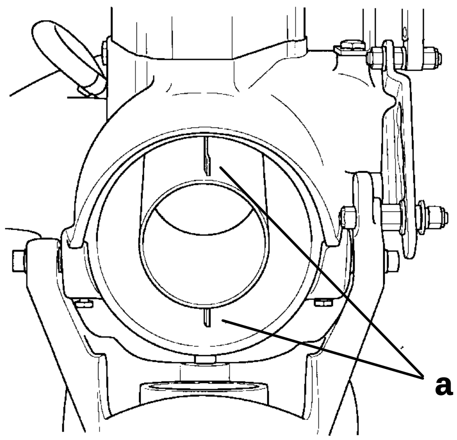
NOTE: *If the outboard is used in salt water, apply Quicksilver Anti-Corrosion Grease around the entire mounting flange on the water intake housing and also to the threads on the six mounting bolts.*



a - Bolts [Torque bolts to 100 lb. in. (11.0 N·m)]

Steering Pull Adjustment

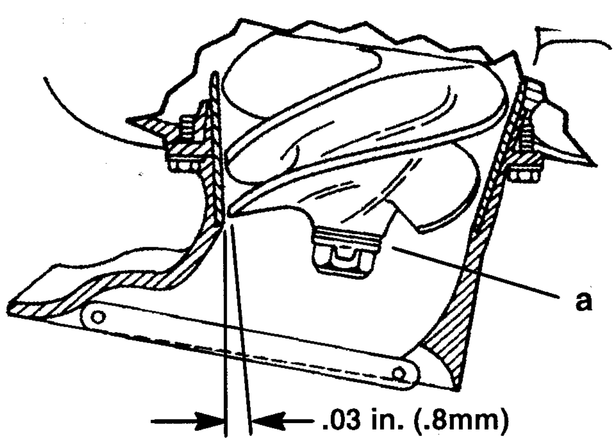
The steering on some boats will have the tendency to pull towards starboard. This pulling condition can be corrected by using a pliers and bending the ends of the exhaust fins (a) 1/16 in. (1.5mm) toward the starboard side of the outboard.



a - Exhaust Fins

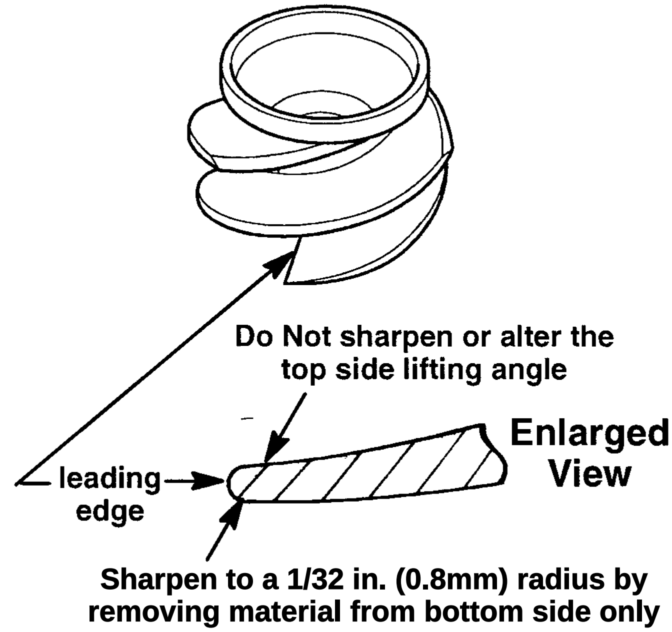
Impeller Clearance Adjustment

1. The impeller should be adjusted so there is approximately 0.030 in. (0.8mm) clearance between the impeller edge and liner. Operating the jet drive in waters that contain sand and gravel can cause wear to the impeller blades, and the clearance will start to exceed 0.030 in. (0.8mm). As the blades wear, shims (a) located in the stack outside of the impeller can be transferred behind the impeller. This will move the impeller further down into the tapered liner to reduce the clearance.
2. Check the impeller clearance by sliding a feeler gauge through the intake grate and measure the clearance between the impeller edge and liner. If adjustment is required, refer to Impeller Removal and Installation.



a - Shims

Worn (Dull) Impeller



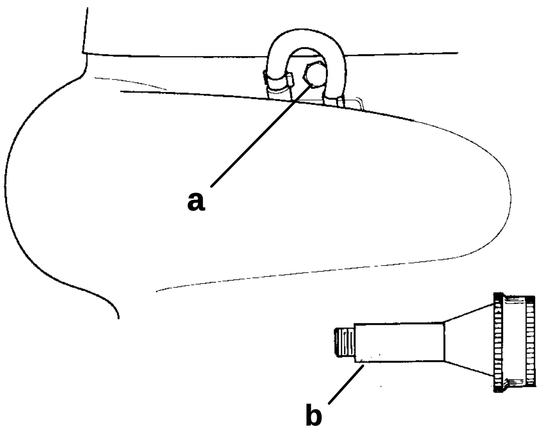
The intake of gravel through the pump can round off and wear the leading edges on the impeller. Some conditions you may experience from a worn impeller are (1) a noticeable performance loss, especially on acceleration, (2) difficulty getting the boat on plane, or (3) an increase in engine RPM at wide open throttle. Check the impeller blades occasionally for damage. Use a flat file to resharpen the leading edges as shown.

Flushing the Cooling System

Use Quicksilver accessory hose coupling Part Number 24789A1.

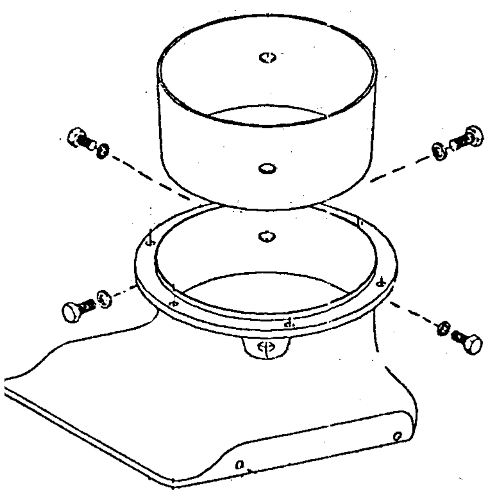
1. Remove plug and gasket (a) and thread-in hose coupling (b).
2. Attach a water hose to the hose coupling. Turn on the water gently, start the engine, and run it at idle speed only.
3. Check for a steady stream of water flowing out of the water pump indicator hole. Continue flushing the outboard for 3 to 5 minutes; adjust water pressure if needed.

4. Stop the engine, turn off the water, and remove the hose coupling. Reinstall the plug and gasket.



a - Plug and Gasket
b - Hose Coupling

Liner Replacement



1. Mark the liner mounting bolts for reassembly into the same holes. Remove the bolts.
2. Remove the liner. If the liner is tight, tap on the inner edge of the liner with a long drift punch through the intake grate.

NOTE: *Apply grease to the liner mounting bolt threads before assembly.*

3. Position the liner into the water intake housing. Line up one of the liner bolts and lightly thread it in. It may be necessary to tap or press the liner into the water intake housing to locate the liner for installation of the remaining bolts. Torque bolts to 100 lbs. in. (11.0 N·m).
4. Grind off the ends of any bolts that may extend beyond the inner liner surface.

Jet Drive Removal and Installation

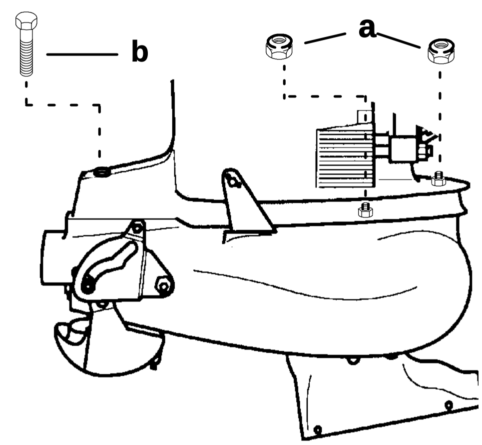
Jet 105,140

REMOVAL

1. Remove 3 locknuts and one bolt securing jet drive to driveshaft housing and remove jet drive.

INSTALLATION

2. Install jet drive with bolt and locknuts shown. Torque.



a - Locknut (3) - Torque to 50 lb. ft. (68.0 N·m)
b - Bolt (1) - Apply Loctite 271 to Threads and Torque to 22.5 lb.ft. (30.5 N·m)

Jet 105, 140

REMOVAL

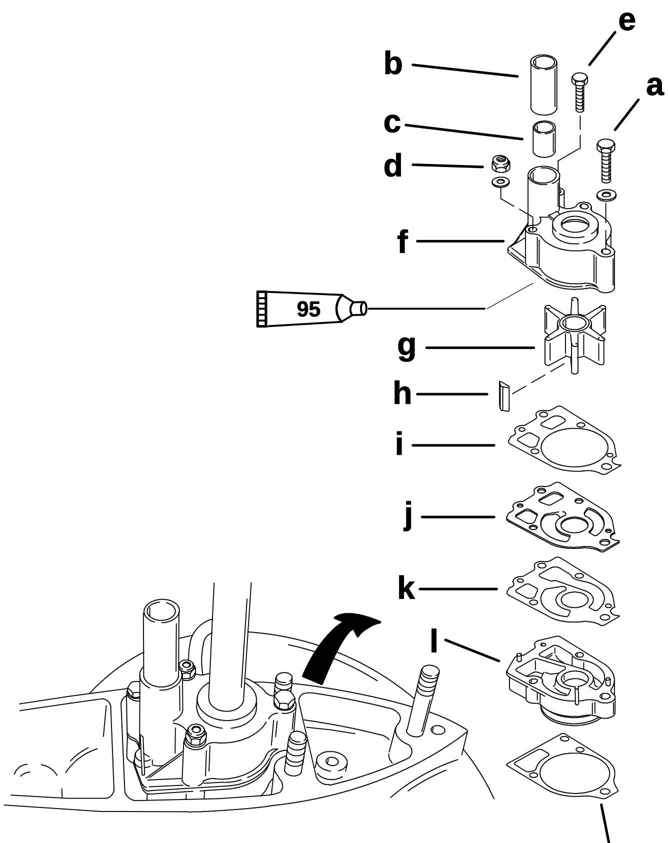
1. Remove water pump assembly as shown.

INSTALLATION

IMPORTANT: If impeller being installed has been previously used and vanes have taken a "set," do not install the impeller with the vanes reversed from their previous "set" as vane breakage will occur shortly after unit is returned to service.

NOTE: *Apply a light coat of 2-4-C w/Teflon to inside of pump cover to ease installation of cover over impeller.*

1. Reassemble water pump assembly as shown. Install pump cover. Rotate driveshaft CLOCKWISE while pressing cover down over impeller.



95 2-4-C With Teflon (92-825407A12)

a - Bolt and Flat Washer - Apply Loctite 271 to threads,Torque to 50 lb. in. (5.5 N·m)
b - Sleeve
c - Seal Water Tube
d - Locknut and washer (2) - Torque to 50 lb. in. (5.6 N·m)
e - Bolt (2-1/4 in.) - Apply Loctite 271 to threads, Torque to 35 lb. in. (4.0 N·m)
f - Pump Body
g - Impeller
h - Key
i - Upper Gasket
j - Face Plate
k - Lower Gasket
l - Pump Base
m - Gasket

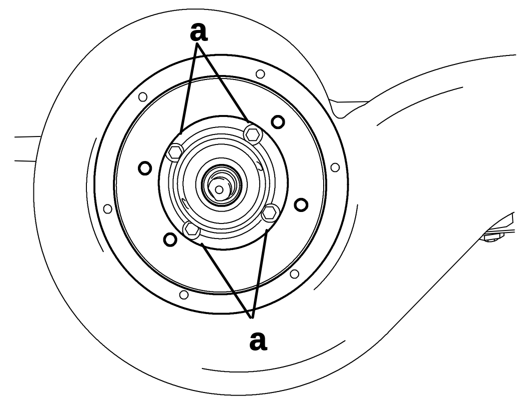
Jet 105 and 140

REMOVAL

1. Remove water pump assembly.
2. Remove 4 bolts securing bearing carrier to jet drive, and remove bearing carrier.

INSTALLATION

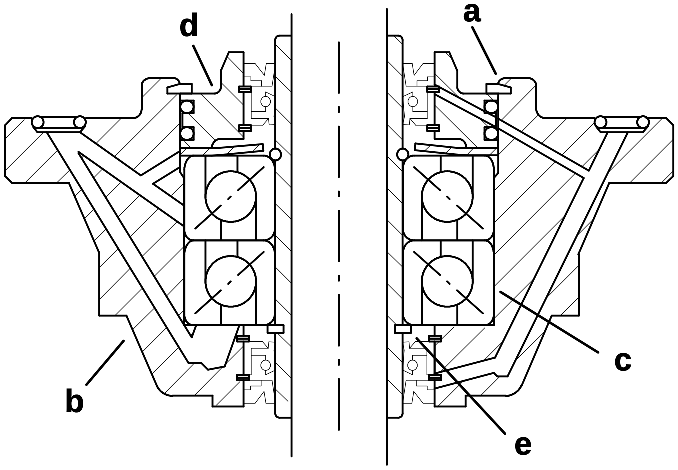
1. Reinstall bearing carrier as shown.



a - Bolts (4) Apply Loctite 271 to Threads, Torque to 70 lb. in. (8.0 N·m)

Bearing Carrier Disassembly

1. Remove the large beveled snap ring (a) from the bearing carrier.
2. Heat the bearing carrier (b) with a torch only until you can barely touch it.
3. Hold the driveshaft vertical and bump the impeller end of the driveshaft against a wooden block causing the bearing carrier to slide down off the bearing.
4. Remove snap ring (e). Press the ball bearing(s) (c) off the driveshaft.
5. Remove the seals and spiral retaining rings from the bearing carrier and the upper seal housing (d).
6. Clean all parts thoroughly and remove any burrs.



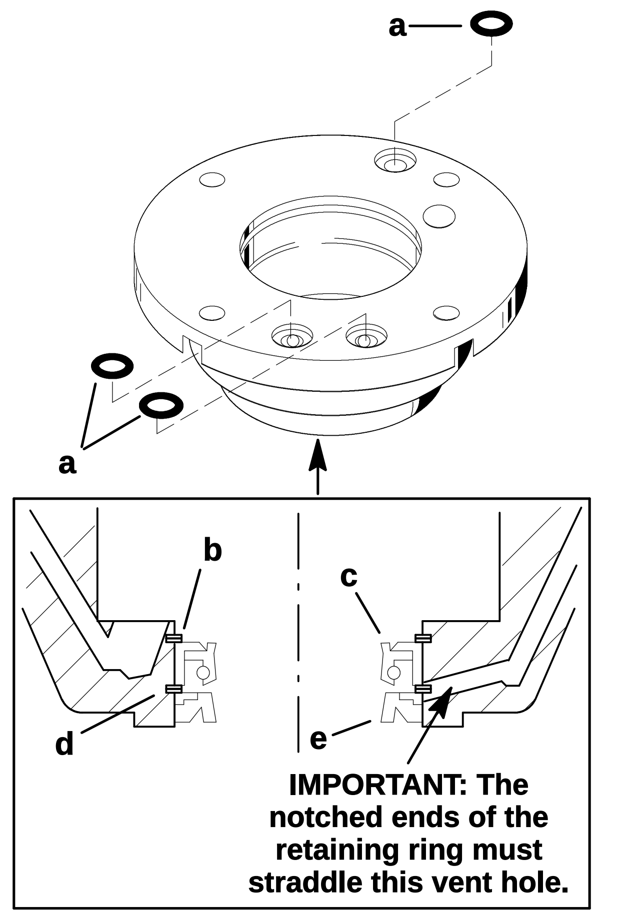
a - Snap Ring
b - Bearing Carrier
c - Ball Bearing
d - Upper Seal Housing
e - Snap Ring

Bearing Carrier Reassembly

Installing Seals

Install seals into bearing carrier as follows:

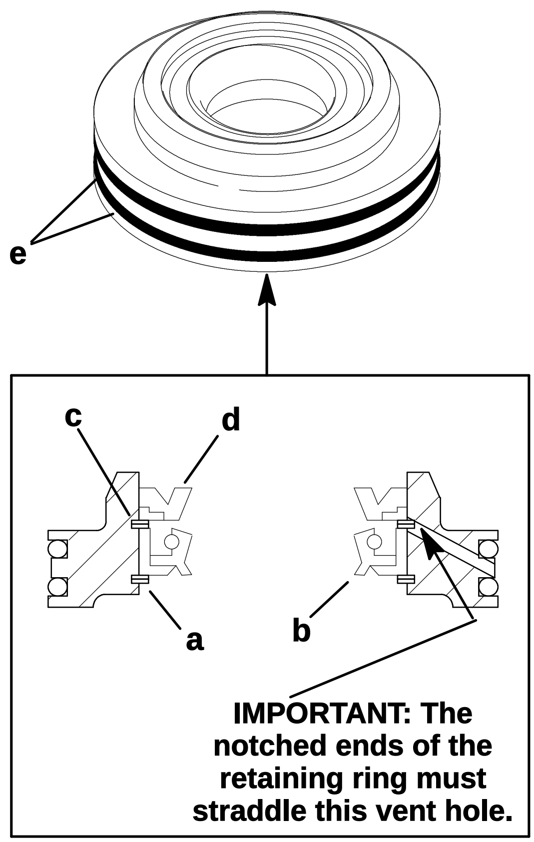
1. Install O-ring seals (a) into the top seats of the three passage holes.
2. Install spiral retaining ring (b) into the inner ring groove.
3. Spread a film of grease around the inside bore of the seal surface before pressing in the seals.
4. Press in the garter spring seal (c) against the inner retaining ring as shown. Fill the garter spring cavity in the seal with grease.
5. Install spiral retaining ring (d) into the outer ring groove. Align the notched ends of the retaining ring to straddle the small vent hole drilled in the ring groove.
6. Press in the outer seal (e) against the retaining ring as shown.
7. Grease all the seal lips.



a - O-rings
b - Retaining Ring
c - Spring Seal
d - Retaining Ring
e - Outer Seal

Installing Upper Seals

1. Install spiral retaining ring (a) into the inner ring groove of the upper seal housing.
2. Spread a film of grease around the inside bore of the seal surface before pressing in the seals.
3. Press in the garter spring seal (b) against the inner retaining ring as shown. Fill the garter spring cavity in the seal with grease.
4. Install spiral retaining ring (c) into the outer ring groove. Align the notched ends of the retaining ring to straddle the small vent hole drilled in the ring groove.
5. Press in the outer seal against the retaining ring as shown.
6. Grease all the seal lips.
7. Grease the two O-ring seals (e) and install then into the outer ring grooves.

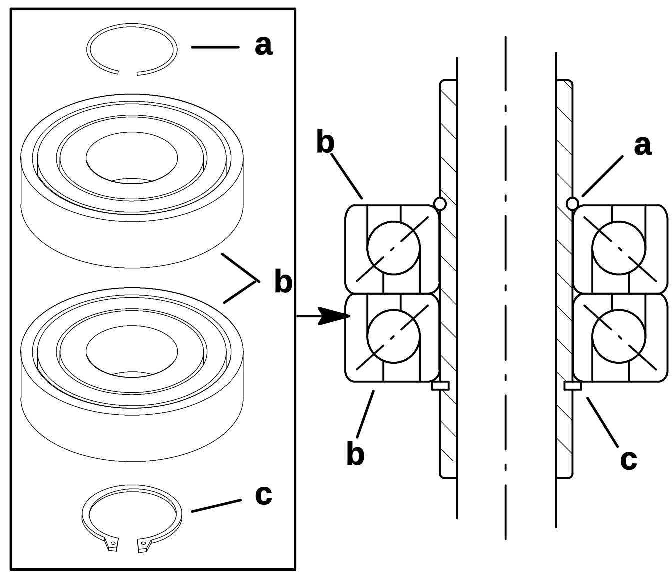


a - Retaining Ring
b - Spring Seal
c - Retaining Ring
d - Outer Seal
e - O-rings

Installing Driveshaft Bearing(s)

DOUBLE BEARING SYSTEM

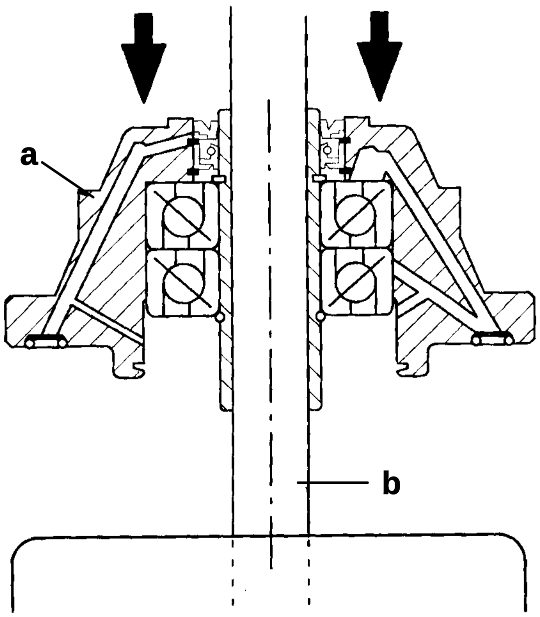
1. If removed, install the bearing thrust ring (a) into the groove on the driveshaft.
2. Press new ball bearings (b) onto the driveshaft, **pressing against the inner races only**. press bearings against the thrust ring , locking it in its groove. Install snap ring (c) into driveshaft below the lower bearing.



Installing Driveshaft

1. Lubricate the seals and inside bore of the bearing carrier (a).
2. Place the driveshaft (“b” impeller end facing up) into a vise.
3. Heat the bearing carrier (a) until it feels warm to the touch.
4. Place the bearing carrier (a) onto the driveshaft. Square up the inner bore with the ball bearings and push the bearing carrier down until it bottoms out against the bearing.

NOTE: *Only a light pressing force is needed to press on the bearing carrier. It may be necessary to lightly tap the bearing carrier onto the bearing using a rubber hammer.*

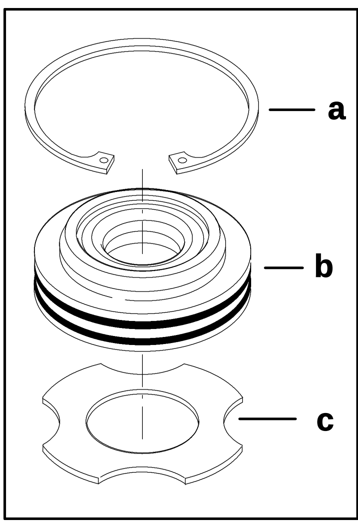


a - Bearing Carrier
b - Driveshaft

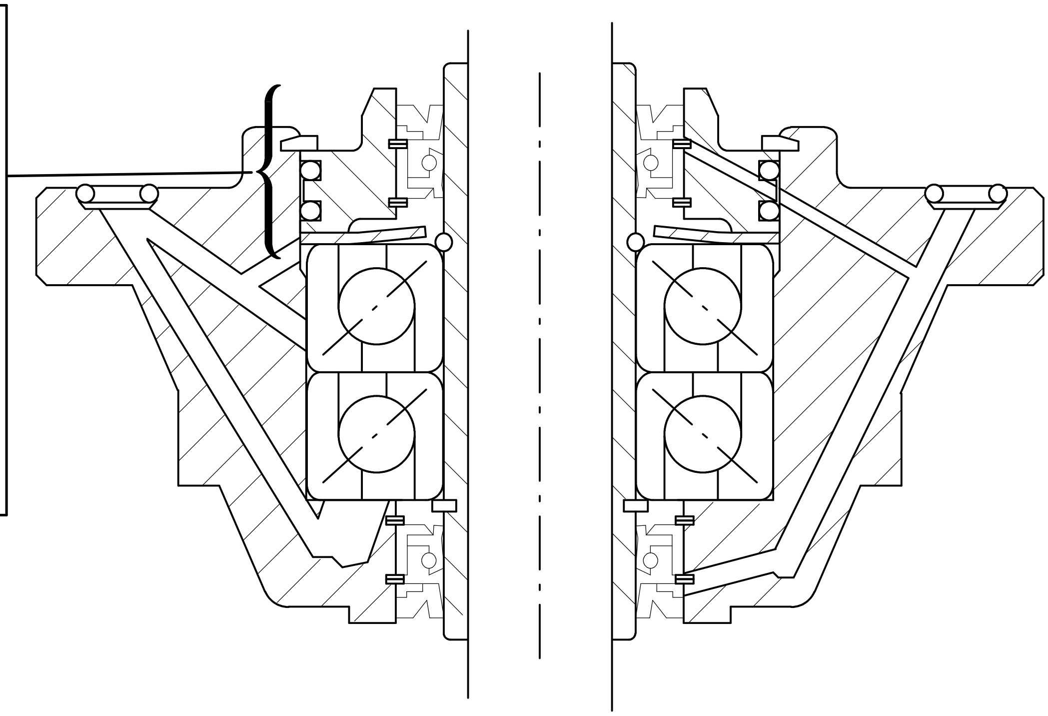
Installing Upper Seal Housing

DOUBLE BEARING SYSTEM

1. Grease the upper O-ring seals and inside bore of the bearing carrier to ease entry of the seal housing.
2. Install the thrust washer (c) against the upper ball bearing, <u>with the dished center section facing up.</u>
3. Install the upper seal housing (b) being careful not to damage the O-ring seals as they pass the snap ring groove. Only finger pressure should be necessary to push in the housing.
4. Install the beveled snap ring (a), <u>beveled side facing up</u> into the ring groove. <u>Make sure the snap ring is fully seated into groove.</u>
5. Install the bearing carrier into the jet drive and fill with grease, using a grease gun. If using a hand lever gun, pump very slowly so as to not build up internal grease pressure and damage the seals or housing.



Double Bearing Type



ATTACHMENTS/CONTROL LINKAGE

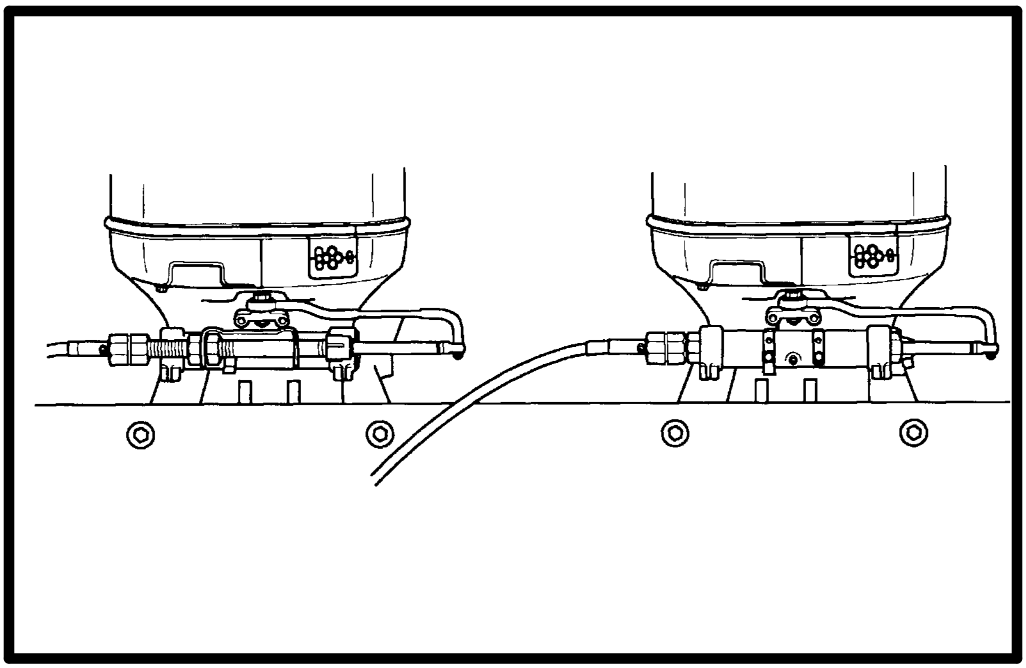


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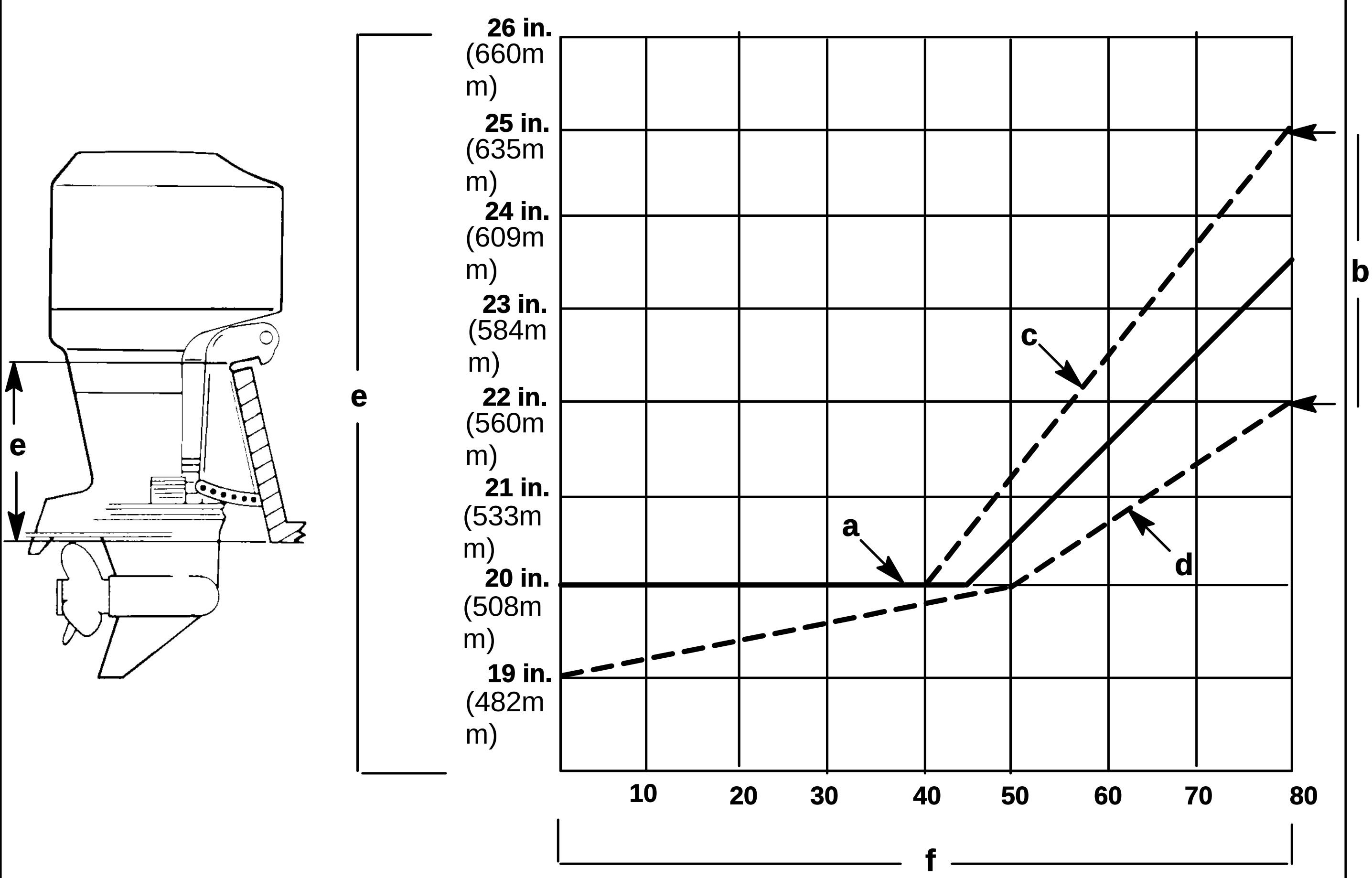
Table of Contents

Installing Production Outboards

Determining Recommended Outboard Mounting Height

⚠ WARNING
Boat instability can occur at high speeds by installing engine at the wrong transom height. Contact the boat manufacturer for their recommendations for a specific engine installation.



***NOTE:** Add 5 in. (127mm) for XL models and 10 in. (254mm) for XXL models to listed outboard mounting height.*

a. This solid line is recommended to determine the outboard mounting height.

IMPORTANT: Increasing the height of outboard generally will provide the following: 1) Less steering torque, 2) more top speed, 3) greater boat stability, but, 4) will cause more prop "break loose" which may be particularly noticeable when planing off or with heavy load.

b. These broken lines represent the extremes of known successful outboard mounting height dimensions.

c. This line may be preferred to determine outboard mounting height dimension, if maximum speed is the only objective.

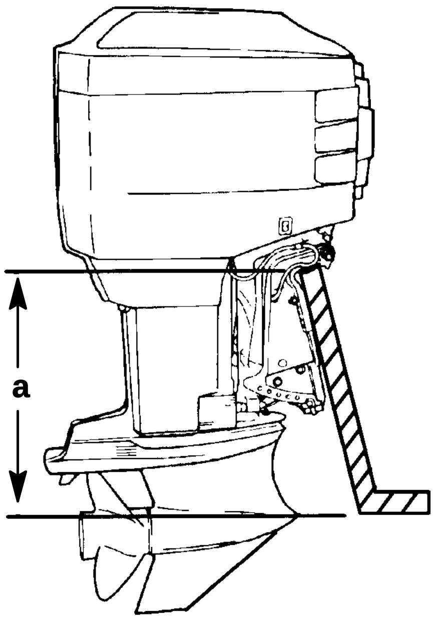
d. This line may be preferred to determine outboard mounting height dimension for dual outboard installation.

e. Outboard mounting height (height of outboard transom brackets from bottom of boat transom). For heights over 22 in. (560mm), a propeller, that is specifically designed for surfacing operation, such as the "Laser", "Mirage", "Trophy" and "Tempest" series, usually are preferred.

f. Maximum boat speed anticipated.

Installing High Performance Outboards - Pro Max/Super Magnum Models

Outboard mounting height is measured in a vertical line from the top of the transom clamping bracket to the bottom of the boat.



Recommended Outboard Mounting Height		
Gearcase Application	**a - Minimum Height**	**a - Maximum Height**
Sportmaster/ CLE	**27^{2} (68cm)**	**30^{2} (76cm)**
Torquemaster	**25^{2} (64cm)**	**27^{2} (68cm)**
4-1/4" XR	**20^{2} (51cm)**	**25^{2} (64cm)**

IMPORTANT: The optimum height for each application will need to be determined by individual boat testing. Some generalities may apply when increasing the transom height:

- More top speed
- Greater boat stability
- Possibly cause more prop "break loose" which may be noticeable during planing or with heavy loads.

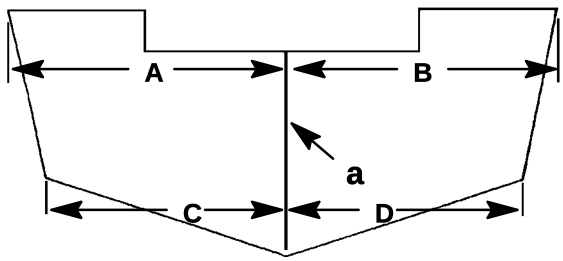
⚠ CAUTION

Prevent engine damage. If outboard is mounted too high, engine damage could occur due to a lack of water flow and pressure; this particularly evident on 4-1/4 in. XR and Torque Master gearcases.

NOTE: *Only propellers designed for surface type applications should be used with Pro Max and Super Magnum outboards.*

INSTALLING OUTBOARD ON TRANSOM

Locate (and mark with pencil) vertical centerline (a) of boat transom.



a - Centerline of Transom

NOTE: *Dimensions "A" & "B" and "C" & "D" are equal length.*

DRILLING OUTBOARD MOUNTING HOLES

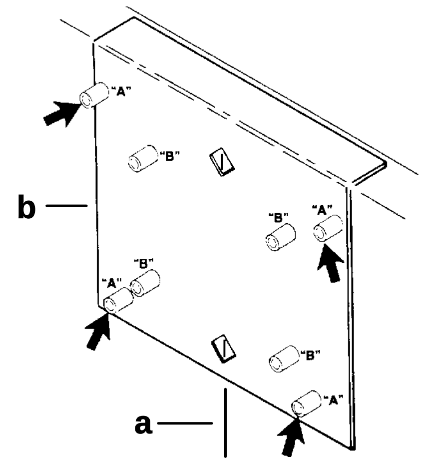
IMPORTANT: Before drilling any mounting holes, carefully read "Determining Recommended Outboard Mounting Height," preceding. There is a 3/4 in. (19 mm) difference between outboard mounting holes in transom brackets.

⚠ WARNING

DO NOT, under any circumstances, allow upper outboard mounting bolts to be closer than 1 in. (25.4 mm) from top of boat transom. Upper mounting bolts must never be installed thru shims.

NOTE: *When drilling into a fiberglass boat, place masking tape directly onto boat where mounting holes will be drilled to help prevent fiberglass from chipping.*

IMPORTANT: If using "Transom Drilling Fixture" (part number 91-98234A2), use drill guide holes marked "A" when drilling outboard mounting holes.



a - Centerline of Transom
b - Transom Drilling Fixture (91-98234A2)

IMPORTANT: During installation of dual or multiple production model V-6 product, the following is recommended. A minimum of 26 inches (660mm) centerline to centerline width is recommended. On high performance engines - Pro Max/Super Magnum models - a minimum of 20.5 (521mm) centerline to centerline width is recommended. This is required to alleviate cowling interference during lock to lock turns if one outboard would be in the full tilt position, while the other outboard(s) are in the vertical running position.

1. Secure (tape) "Outboard Mounting Template" (located in **"Outboard Installation Manual"**) to the outside of the boat transom.
2. Align "Top of Boat Transom Line" on template with top edge of (real) boat transom, not shims.
3. <u>Single Outboard Installation:</u> Align vertical centerline of template with centerline of transom.
4. <u>Dual Outboard Installation:</u> Align vertical centerline of template with each outboards (one at a time) selected centerline on boat transom. Refer to caution, preceding.
5. Use a 17/32 in. (13.5 mm) diameter drill bit and drill 4 mounting holes perpendicular to and thru transom at marked holes' centers on template.
6. Align **"Top of Boat Transom Line"** of template with top edge of (real) boat transom, not shim(s).
7. **Single Outboard Installations:** Align vertical centerline of template with centerline of transom.

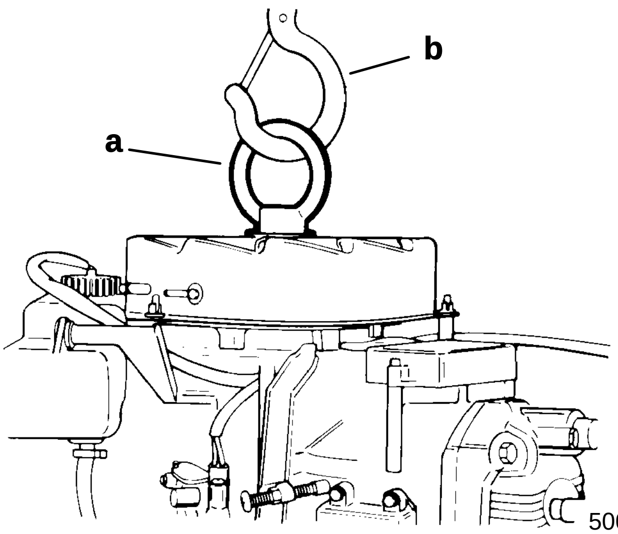
8. **Dual Outboard Installations:** Align vertical centerline of template with each outboards' selected centerline on boat transom. Refer to caution, preceding.
9. Use a 17/32 in. (13.5mm) diameter drill bit and drill 4 mounting holes perpendicular to and thru transom at marked hole centers on template.

Lifting Outboard

⚠ WARNING

Make sure that lifting eye is threaded into flywheel a minimum of 5 turns and that hoist has a minimum lift capacity of at least 500 lbs. (227 kg.) BEFORE lifting outboard.

Remove cowling from outboard and plastic cap from center of flywheel. Thread lifting eye (a) into flywheel hub a minimum of 5 turns. Replace plastic cap after installation. Connect hoist [minimum lift capacity of 500 Ibs. (227 kg)] to lifting eye (a). Lift outboard and place on boat transom.

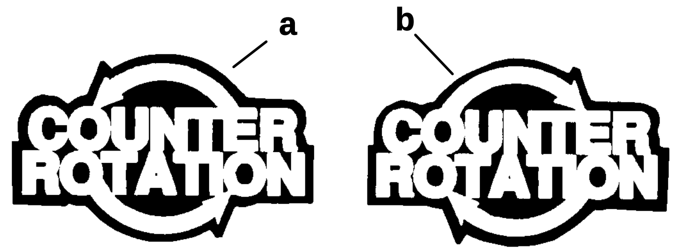


50048

a - Lifting Eye (91-90455)
b - Hoist

IMPORTANT: For dual outboard counter rotation installations, the left-hand rotation outboard is generally placed on the port side of boat transom.

Apply "COUNTER ROTATION" decal (supplied with left hand rotation outboard) onto bottom cowl (rear) of right hand rotation outboard. Match decal placement with left hand rotation outboard.



a - Counter Rotation Decal (Left-Hand Rotation Outboard)
b - Counter Rotation Decal (Right-Hand Rotation Outboard)

SECURING OUTBOARD TO BOAT TRANSOM

IMPORTANT: If boat is equipped with thru tilt tube steering, steering cable end must be installed into tilt tube of outboard (port outboard only for dual outboard installations) before securing outboard to transom. Refer to "Steering Cable and Steering Link Rod Installation" following.

Refer to "Determining Recommended Outboard Motor Mounting Height", preceding and position outboard on boat transom, to align mounting holes in transom bracket that will place the outboard nearest to the recommended mounting height.

⚠ CAUTION

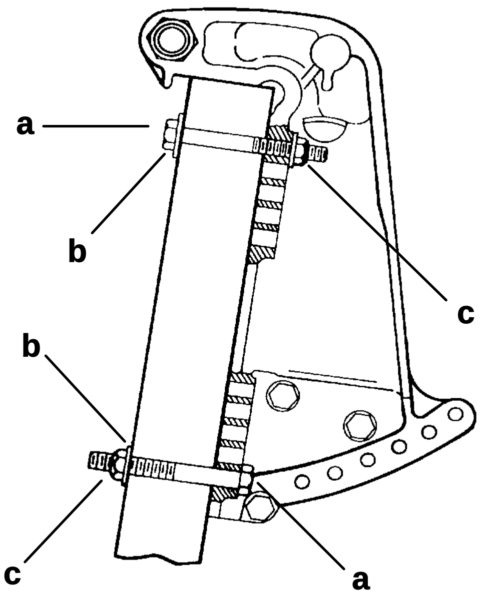
Marine sealer must be used on shanks bolts to make a water-tight installation.

IMPORTANT: DO NOT use an impact driver when tightening transom bolts.

Apply marine sealer to shanks of mounting bolts (not threads) and secure outboard to transom with 4 bolts, flat washers and locknuts, as shown. Be sure that installation is water-tight.

⚠ WARNING

Before operating, outboard(s) MUST BE SECURED to boat transom with four 1/2 in. diameter bolts and lock-nuts, as follows: 2 bolts must be installed thru upper mounting holes and 2 bolts thru lower mounting holes. Installation must be water-tight, and outboard should be checked for tightness on the transom during operation. Failure to bolt outboard to transom (using 4 bolts and locknuts, as shown) may result in damage to boat and/or loss of outboard and possible injury to occupants of boat.



a - 1/2 in. Diameter Bolts
b - Flat Washers
c - Locknuts

Ride Guide Steering Cable/ Attaching Kit Installation (92876A1)

Single Cable - Single High Performance Outboard

Single cable steering installations for high performance outboards - Pro Max/Super Magnum models - **ARE NOT RECOMMENDED.**

⚠ CAUTION

It is recommended that boats capable of going over 50 MPH be equipped with dual cable steering and adjusted so that there is a minimum of steering backlash. The more steering backlash that exists, the more difficult it is to control a high performance boat, particularly if the hull has chine walking tendencies.

⚠ WARNING

Quicksilver Rideguide Outboard power Steering is limited to 200 H.P. engines and CANNOT BE USED ON ENGINES OVER 200 H.P. External hydraulic steering systems are available from after-market suppliers.

Single Cable - Single Production Outboard

Refer to **"Quicksilver Accessories Guide"** to determine correct length of steering cable and remote control cables.

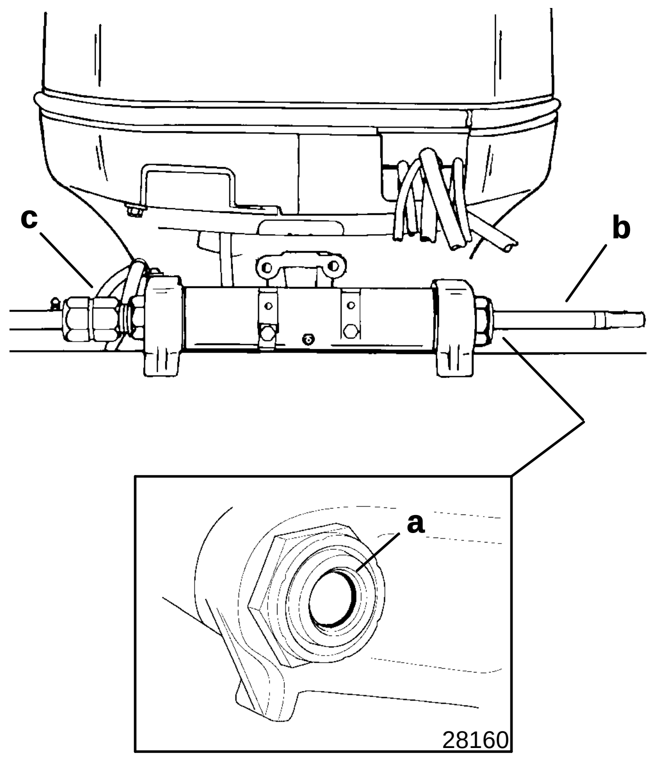
IMPORTANT: Steering cable and remote control cables must be the correct length, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and will reduce the performance of the steering system.

INSTALLING RIDE GUIDE CABLE TO OUTBOARD TILT TUBE

IMPORTANT: Before installing steering cable in tilt tube, lubricate entire cable end with Quicksilver 2-4-C w/Teflon.

NOTE: *Ride Guide steering cable is lubricated at the factory and requires no additional lubrication at initial installation.*

1. Lubricate seal (a) inside of outboard tilt tube and entire cable end (b) with Quicksilver 2-4-C w/Teflon.
2. Insert steering cable end thru outboard tilt tube and secure steering cable to tilt tube with steering cable attaching nut (c), as shown. Torque nut to 35 lb. ft. (47.5 N·m).



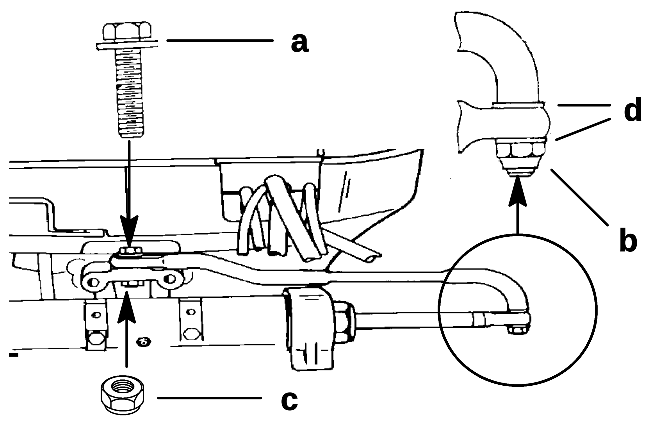
STEERING LINK ROD INSTALLATION

IMPORTANT: The steering link rod that connects the steering cable to the engine must be fastened using special washer head bolt ("a" - Part Number 10-14000) and self locking nuts ("b" & "c" - Part Number 11-34863). These locknuts must never be replaced with common nuts (non locking) as they will work loose and vibrate off freeing the link rod to disengage.

⚠ WARNING

Disengagement of a steering link rod can result in the boat taking a full, sudden, sharp turn. This potentially violent action can cause occupants to be thrown overboard exposing them to serious injury or death.

3. Assemble steering link rod to steering cable with two flat washers (d) and nylon insert locknut ("b" - Part Number 11-34863). Tighten locknut (b) until it seats, then back nut off 1/4 turn.
4. **Production Outboards -** Assemble steering link rod to engine with special washer head bolt ("a" - Part Number 10-14000) and nylon insert locknut ("c" - Part Number 11-34863). First torque bolt (a) to 20 lb. ft. (27.0 N·m), then torque locknut (c) to 20 lb. ft. (27.0 N·m).
   High Performance Outboards - An access hole is provided through the bottom cowl to ease installation of the link rod connecting bolt. Remove the **BACK** plug for installation and reinstall after installation.



⚠ WARNING

After installation is complete (and before operating outboard), check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) and at all tilt angles to assure interference-free movement.

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service -** Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

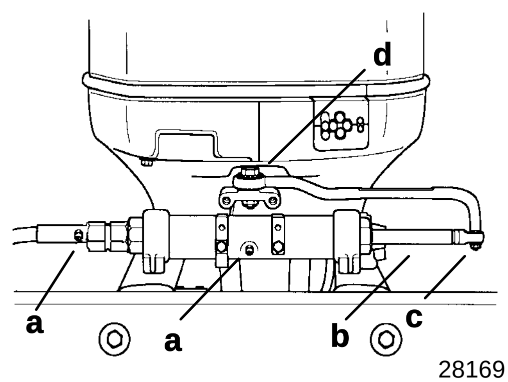
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

***NOTE:** Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

Core of each steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable end (b) with 2-4-C w/Teflon.
4. Lubricate pivot point (c) of steering link rod and ball joint (d) of link rod with SAE 30 Weight Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon. Ride Guide Steering Cable / Attaching Kit Installation (92876A3).



Ride Guide Steering Cable/ Attaching Kit Installation (92876A3)

Dual Cable - Single Outboard

⚠ WARNING

Quicksilver Super Ride-Guide Steering (dual cables) MUST BE USED with this attaching kit. Failure to adhere to this requirement could result in steering system failure.

Refer to **"Quicksilver Accessories Guide"** to determine correct length of steering cables and remote control cables.

IMPORTANT: Steering cables and remote control cables MUST BE THE CORRECT LENGTH, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and will reduce the performance of the steering system.

⚠ CAUTION

With this kit installed, the upper (outboard) mounting bolts MUST BE installed so that hex head end of bolts is on the inside of boat transom, as illustrated. Failure to install upper mounting bolts, as shown in illustration, could result in interference between steering cable nut and ends of mounting bolts when outboard is tilted up.

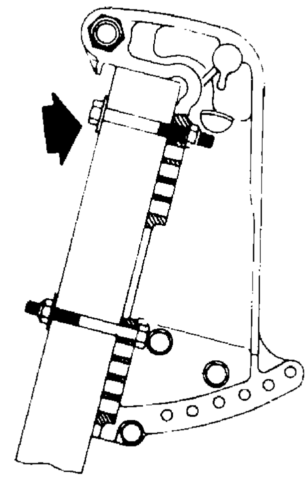
⚠ CAUTION

Marine sealer must be used on shanks bolts to make a water-tight installation.

IMPORTANT: DO NOT use an impact driver when tightening transom bolts.

Apply marine sealer to shanks of mounting bolts (not threads) and secure outboard to transom with 4 bolts, flat washers and locknuts, as shown. Be sure that installation is water-tight.

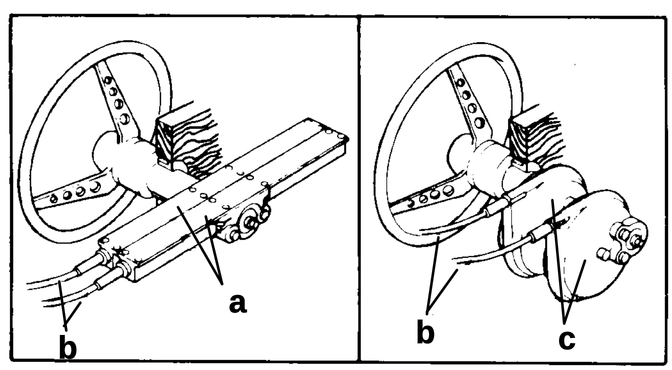
Install upper bolts so that hex head end of bolts is on the inside of boat transom.



Super Ride-Guide Steering Kit Installation

IMPORTANT: Both gear racks or rotary steering heads must be installed so that both steering cables will be routed together on the same side of the boat and will push-and-pull together.

1. Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.
2. Make sure that both gear racks or rotary steering heads are installed so that both steering cables are routed together down starboard side of boat and will push-and-pull together.

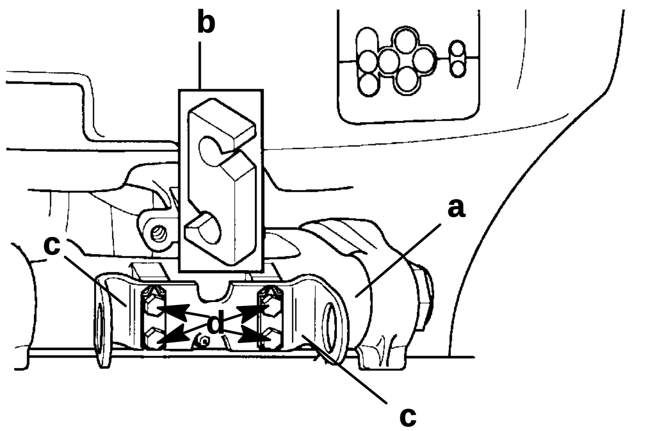


a - Gear Rack
b - Steering Cables
c - Rotary Steering Heads

Steering Cable Mounting Tube Installation

IMPORTANT: Spacers (b) must be installed between outboard swivel bracket and mounting bracket for steering cable mounting tube to provide proper spacing between steering cables.

Secure mounting bracket for steering cable mounting tube on to swivel bracket of outboard.



28163

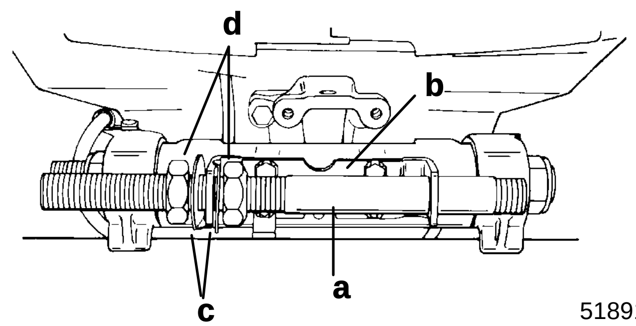
a - Mounting Bracket for Steering Cable Mounting Tube
b - Spacer (2)
c - Locking Retainer (2)
d - Bolts (4) - 7/8 in. (22mm) Long - Torque to 100 lb. in. (11.5N·m), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs, MUST BE bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube to outboard swivel bracket to prevent bolts from turning out.

Install steering cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Verify longer threaded end of tube is toward starboard side of boat.

Temporarily adjust tube so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



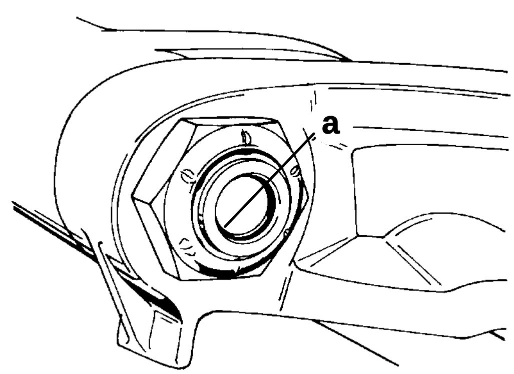
51891

a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

Installing Steering Cables

IMPORTANT: Lubricate inside of outboard tilt tube, inside of steering cable mounting tube and rubber O-ring seal (located in outboard tilt tube) with Quicksilver 2-4-C w/Teflon before installing steering cables.

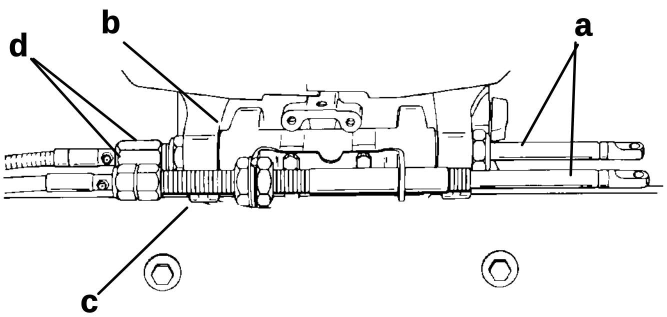
Lubricate inside of outboard tilt tube and inside of steering cable mounting tube with Quicksilver 2-4-C w/Teflon. Verify rubber O-ring seal (a) (located in outboard tilt tube) is lubricated.



51890

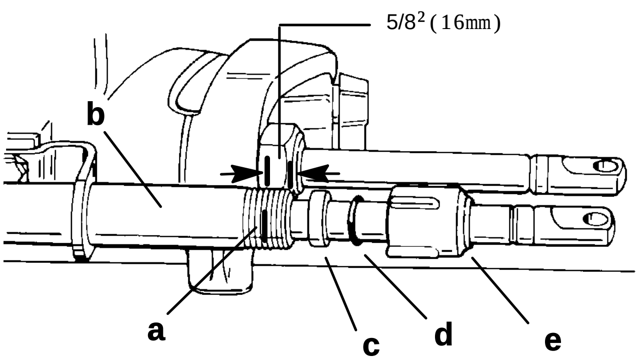
Insert steering cable ends (a) thru outboard tilt tube (b) and cable mounting tube (c). Thread steering cable attaching nuts (d) on to tubes hand tight.

NOTE: *Torque steering cable attaching nuts only after final steering adjustments have been made.*



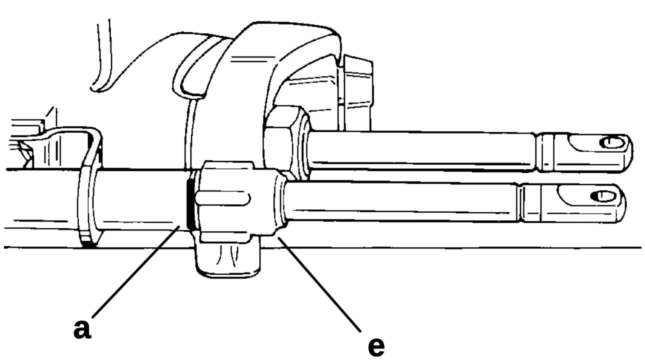
51891

Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



51890

Thread cap (e) onto steering cable mounting tube, up to mark (a).



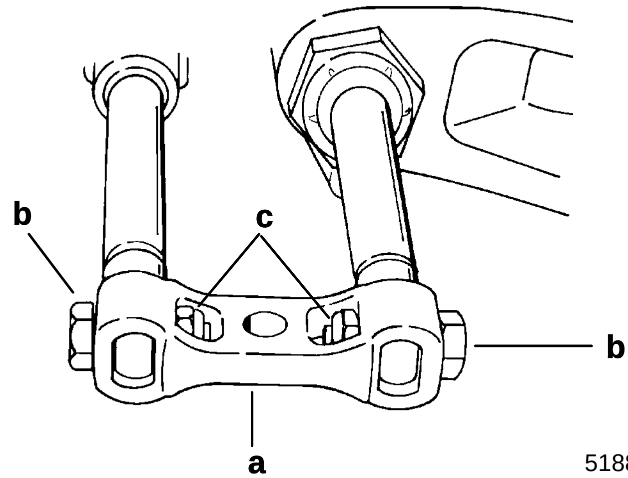
51890

Coupler Installation

⚠ WARNING

Locknuts must be used with bolts to secure steering cables to coupler. Failure to adhere to this requirement could result in steering system failure.

Slide coupler (a) onto steering cable ends and secure each steering cable to coupler with bolt (b) and locknut (c) as shown. Tighten to a torque of 20 lb. ft. (27.0 N·m).



51888

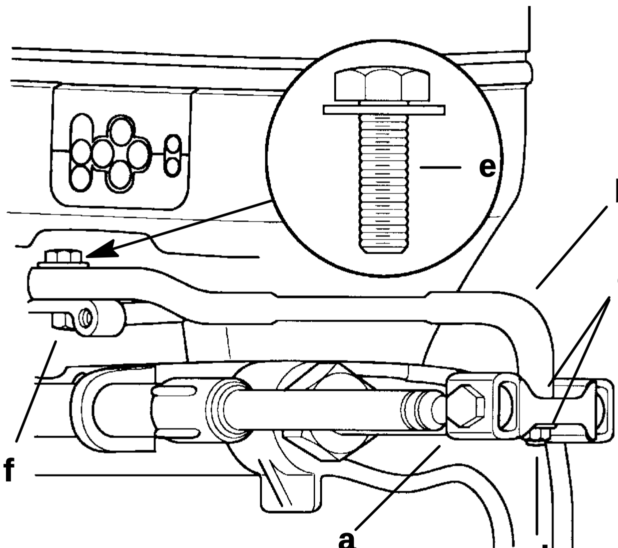
Installing Link Rod

⚠ WARNING

Steering link rod MUST BE secured between outboard steering arm and steering coupler, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.

Lubricate hole in steering coupler, with Quicksilver 2-4-C w/Teflon. Assemble steering link rod to steering coupler, using 2 flat washers (one each side of coupler) and nylon insert locknut. Tighten locknut until it seats [DO NOT exceed 120 lb. in. (13.5 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joint in steering link rod with SAE 30W Motor Oil. Secure link rod to outboard steering arm, using special washer head bolt (10-14000) provided and nylon insert locknut as shown. Torque special bolt to 20 lb. ft. (27.0 N·m), then torque locknut to 20 lb. ft. (27.0 N·m).

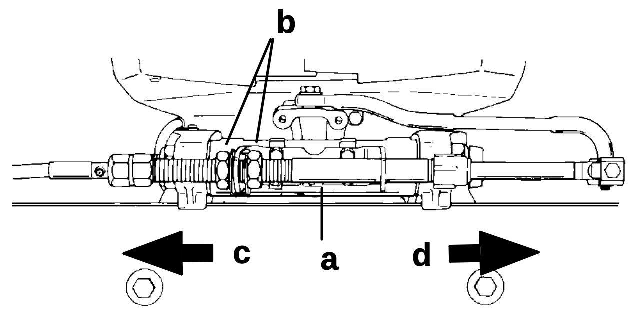


a - Steering Coupler
b - Steering Link Rod
c - Flat Washer (2)
d - Nylon Insert Locknut - Torque until it seats [DO NOT exceed 120 lb. in. (13.5 N·m) of torque], then back nut off 1/4 turn
e - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27.0 N·m)
f - Nylon Insert Locknut - Torque to 20 lb. ft. (27.0 N·m)

STEERING SYSTEM TENSION ADJUSTMENT

IMPORTANT: After this dual steering cable attachment kit is installed, there must be proper tension in forward mounted steering cable tor this attachment kit to operate properly. Not enough tension will cause slack (or play) in steering system. Too much tension will cause steering cables to bind. Perform the following steps to adjust for correct tension.

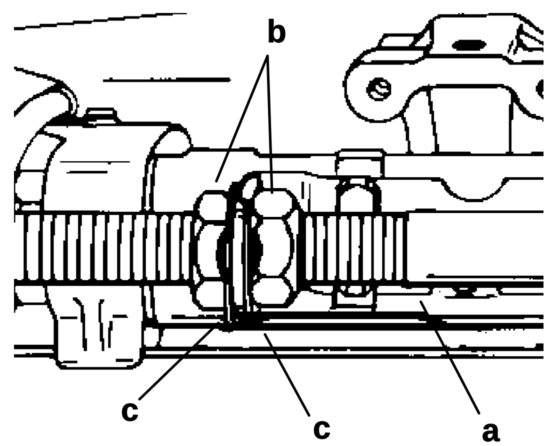
Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play.) If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



51887

a - Steering Cable Mounting Tube
b - Adjustment Nuts
c - Adjust Tube in This Direction to Remove Slack from Steering System
d - Adjust Tube in This Direction to Reduce Tension from Steering System

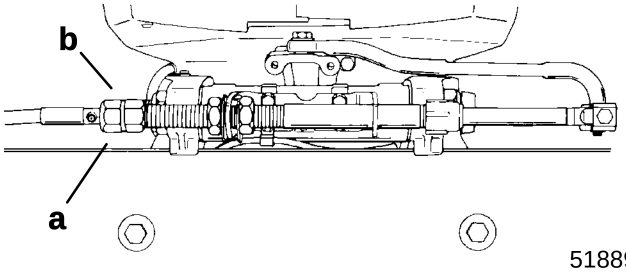
After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.5 N·m) and bend a tab lock washer against flat on each adjustment nut.



51887

a - Steering Cable Mounting Tube
b - Adjustment Nuts; Torque to 35 lb. ft. (47.5 N·m)
c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).



a - Cable Attaching Nut
b - "V" Groove

NOTE: *Cable attaching nuts with a "V" groove around the outer circumference of the nut are self locking and do not require locking sleeves.*

⚠ WARNING

After installation is complete [and before operating outboard(s)], check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) at all tilt angles to assure interference-free movement.

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "Severe Service."

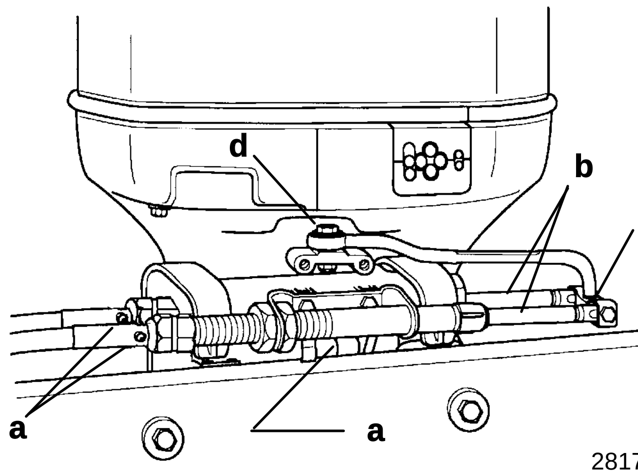
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

NOTE: *Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

Core of each steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock could occur.

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A2). Lubricate exposed portion of cable ends (b) with 2-4-C w/Teflon.
4. Lubricate pivot point (c) of steering link rod and ball joint (d) of link rod/steering coupler with SAE 30W Motor Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



Ride Guide Steering Cable/ Attaching Kit Installation (92876A6)

Dual Cable - Dual Outboard

⚠ WARNING

Quicksilver Super Ride-Guide Steering (dual cables) MUST BE USED with this attaching kit. Failure to adhere to this requirement could result in steering system failure.

Refer to **"Quicksilver Accessories Guide"** to determine correct length of steering cable and remote control cables.

IMPORTANT: Steering cable and remote control cables MUST BE THE CORRECT LENGTH, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/ or loops. Both conditions place extra stress on the cables and reduce the performance of the steering system.

Installation Requirements

IMPORTANT: The distance from each outboard's centerline to the side of transom opening MUST BE a minimum of 16 in. (406mm).

This kit contains all necessary parts to connect both outboards to Ride-Guide Steering Cables for 23-1/2 in. thru 27-1/2 in. (597mm thru 699mm) outboard centerline spacing. If outboard centerline distance is other then specified, refer to end of this instruction manual for optional extension couplers.

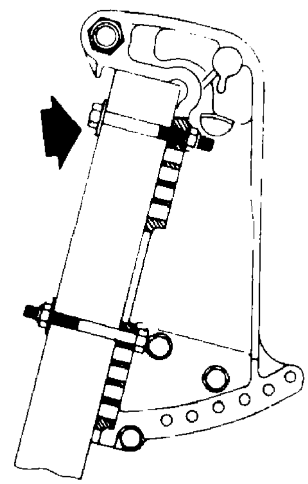
DETERMINE ROUTING OF STEERING CABLES

Use "1" or "2", following, to route steering cables:

1. **Parallel cable routing:** Cables routed together down starboard side of boat Refer to **"Parallel Routed Steering Cables and Attaching Kit Installation,"** immediately following.
2. **Opposite side cable routing:** One cable routed down starboard side of boat and one cable routed down port side of boat. Refer to **"Opposite Side Routed Steering Cables and Attaching Kit Installation,"** located on page 20 of this instruction manual.

⚠ CAUTION

With this kit installed, the upper (outboard) mounting bolts MUST BE installed so that hex head end of bolts is on the inside of boat transom, as illustrated. Failure to install upper mounting bolts, as shown in illustration, could result in interference between steering cable nut and ends of mounting bolts when outboard is tilted up.



Install upper bolts so that hex head end of bolts is on the inside of boat transom.

Parallel Routed Steering Cables and Attaching Kit Installation

(Both Steering Cables Routed Together Down Starboard Side of Boat)

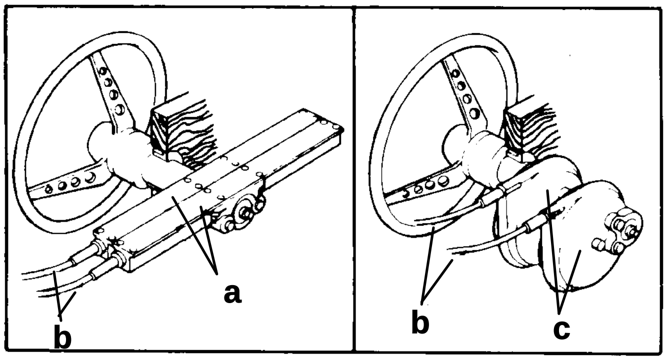
SUPER RIDE-GUIDE STEERING KIT INSTALLATION

IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

Both gear racks or rotary steering heads must be installed so that both steering cables will be routed together on the same side of the boat and will push- and-pull together.

1. Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.

2. Make sure that both gear racks or rotary steering heads are installed so that both steering cables are routed together and will push-and-pull together.

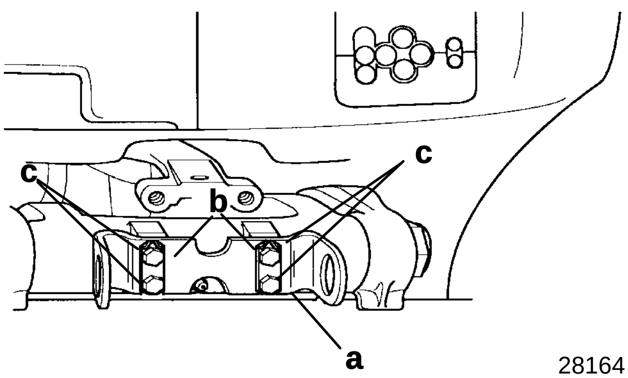


a - Straight Rack (Left); Rotary Steering (Right)
b - Steering Cables (Install so that Both Cables Will Push and Pull Together)

STEERING CABLE INSTALLATION STARBOARD OUTBOARD

IMPORTANT: Mounting bracket for steering cable mounting tube MUST BE secured to outboard swivel bracket, using 5/8 in. (16mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



28164

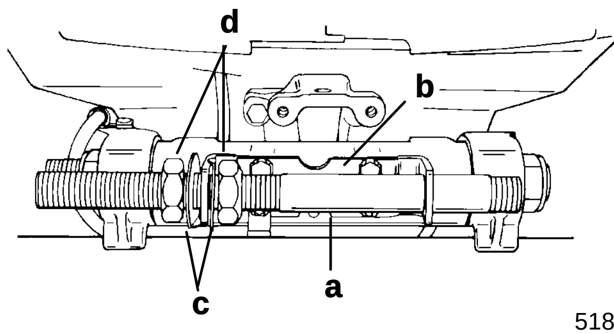
a - Mounting Bracket for Steering Cable Mounting Tube
b - Locking Retainers (2)
c - Bolts (4) - 5/8 in. (16mm) Long - Torque to 100 lb. in. (11.5 N·m), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs, MUST BE bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube to outboard swivel bracket, to prevent bolts from turning out.

Install steering cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Be sure longer threaded end of tube is toward starboard side of boat.

Temporarily adjust tube, so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



51891

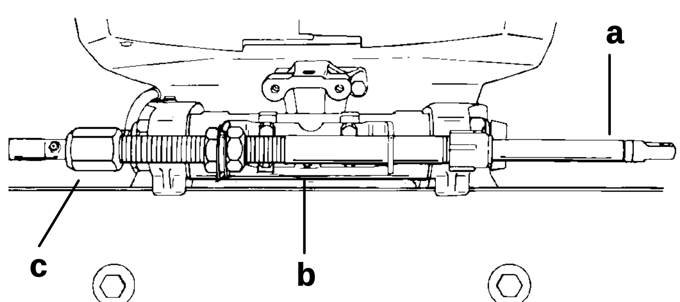
a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

IMPORTANT: Lubricate inside of steering cable mounting tube with 2-4-C w/Teflon before installing steering cable.

Lubricate inside of steering cable mounting tube (starboard outboard) with 2-4-C w/Teflon.

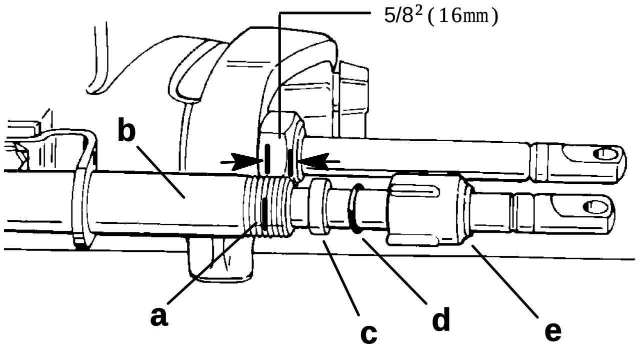
Insert steering cable end (a) thru cable mounting tube (b) and thread steering cable attaching nut (c) onto tube hand tight.

NOTE: *Torque steering cable attaching nut only after final steering adjustments have been made.*



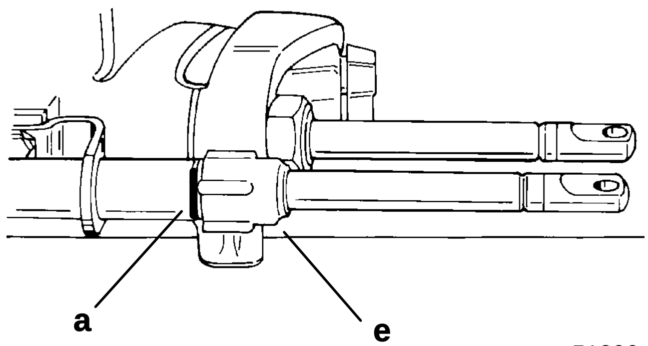
51887

Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



51890

Thread cap (e) onto steering cable mounting tube, up to mark (a).

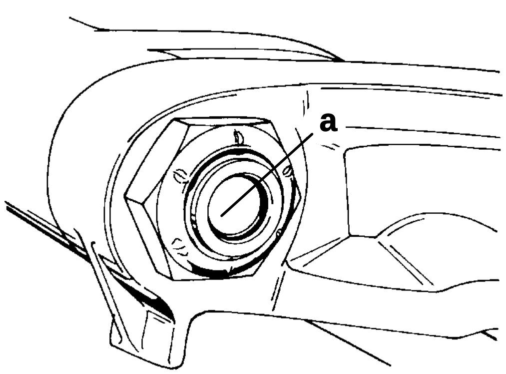


51890

STEERING CABLE INSTALLATION - PORT OUTBOARD

IMPORTANT: Lubricate inside of port outboard's tilt tube and rubber O-ring seal located inside tilt tube with 2-4-C w/Teflon, before installing steering cable.

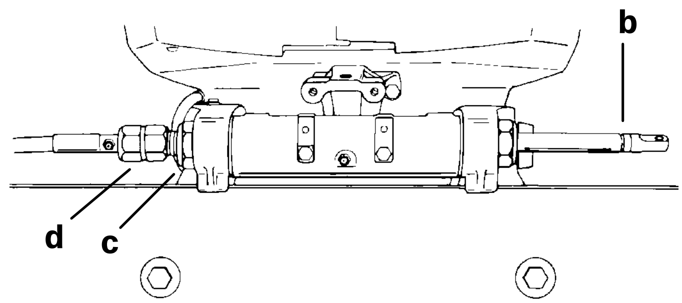
Lubricate inside of port outboard's tilt tube and rubber O-ring seal (a) with 2-4-C w/Teflon.



51890

Insert steering cable end (b) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

NOTE: *Torque steering cable attaching nuts only after final steering adjustments have been made.*



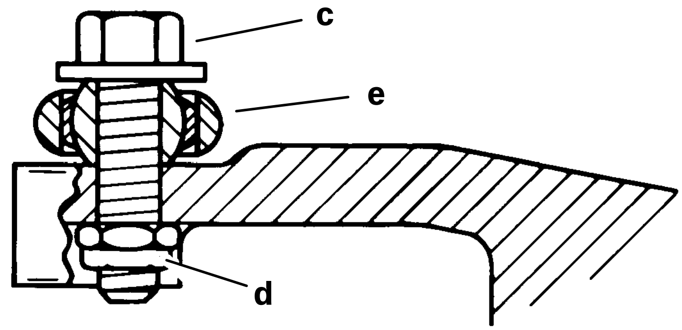
51887

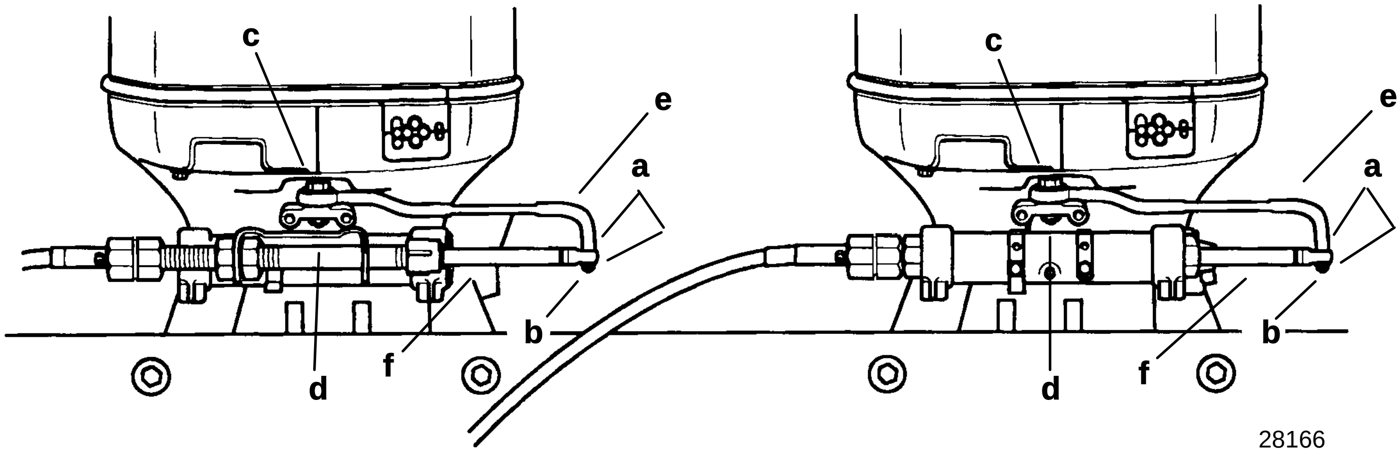
STEERING LINK ROD INSTALLATION

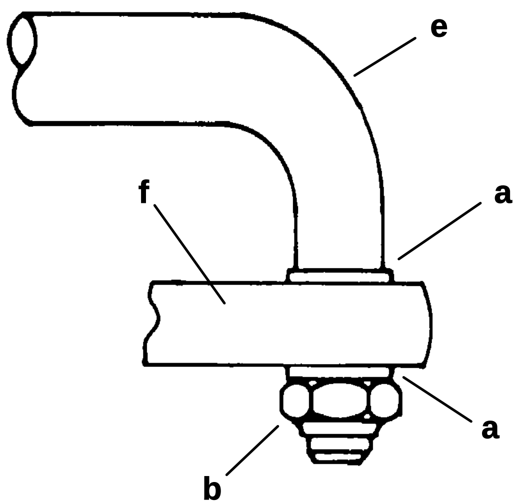
⚠ WARNING

Steering link rods MUST BE secured between outboard steering arm and steering cable end, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown.

Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.







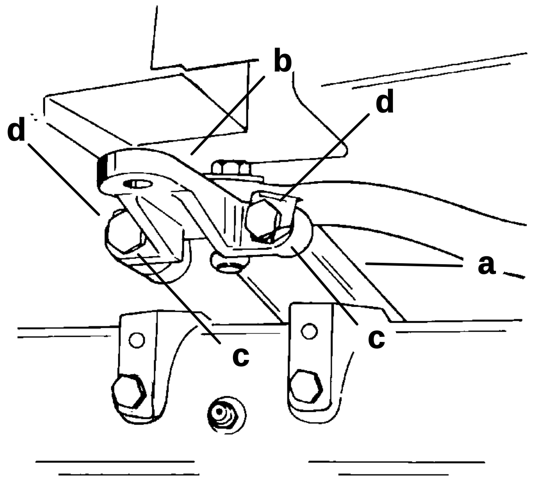
a - Flat Washer (2 Each Link Rod)
b - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.5 N·m) of Torque], Then Back Off 1/4 Turn
c - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27.0 N·m)
d - Nylon Insert Locknut - Torque to 20 lb. ft. (27.0 N·m)
e - Steering Link Rod
f - Steering Cable End

Lubricate holes in ends of steering cables, with Quicksilver 2-4-C w/Teflon Marine Lubricant. Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 Ib. in. (13.5 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joints in steering link rods with SAE 30W Motor Oil. Secure link rods to outboard steering arms, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown. Torque special bolts to 20 Ib. ft. (27.0 N·m) then torque locknuts to 20 Ib. ft. (27.0 N·m).

STEERING ARM EXTENSION BRACKET INSTALLATION

Secure a steering arm extension bracket to each outboard's steering arm.



51889

a - Steering Arm (Port Outboard Shown)
b - Extension Bracket
c - Locking Retainer (2 Each Bracket)
d - Bolts (2 Each Bracket) 1-1/4 in. (31.8mm) Long - Torque to 280 lb. in. (31.5 N·m), Then Bend Corner Tabs of Locking Retainers Up Against Flats on Each Bolt

WARNING

Locking retainer corner tabs MUST BE bent up and against flats on each bolt that secures extension bracket to outboard steering arm to prevent bolts from turning out.

STEERING COUPLER ASSEMBLY AND INSTALLATION

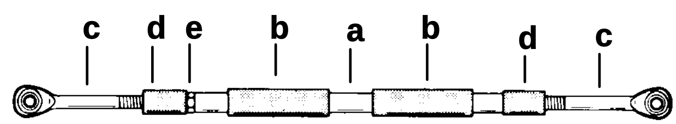
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions MUST BE equal to distance between propeller shaft centerlines.)

Lubricate inside of rubber sleeves with 2-4-C w/Teflon and slide sleeves on steering coupler.

Work rubber bushings onto threaded ends of steering eyes.

Thread jam nut on starboard steering eye.

Thread steering eyes equally into coupler, so that distance between hole centers of steering eye ball joints is equal to distance between threaded hole centers of steering arm extensions. Exposed threads of steering eyes MUST BE of equal length and threads MUST NOT extend out from coupler more than 2-3/4 in. (70mm).



50061

a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut

WARNING

Both steering eyes must be threaded into coupler 3/4 in. (19mm) minimum. Thread length of steering eye is 3-1/2 in. (89mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (70mm). Failure to adhere to this requirement could result in steering system failure.

Lubricate ball joint in steering eyes, with SAE 30W Motor Oil.

Assemble steering coupler between outboard steering arm extension brackets, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown.

IMPORTANT: With assembled steering coupler installed and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts MUST BE equal to distance between propeller shaft center lines, for proper steering. It adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

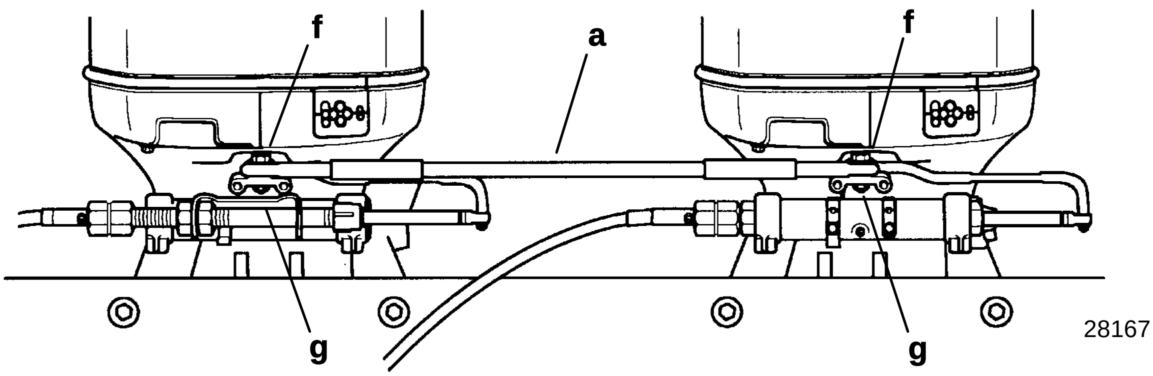
Torque special washer head bolts to 20 lb. ft. (27.0 N·m), then torque locknuts to 20 lb. ft. (27.0 N·m).

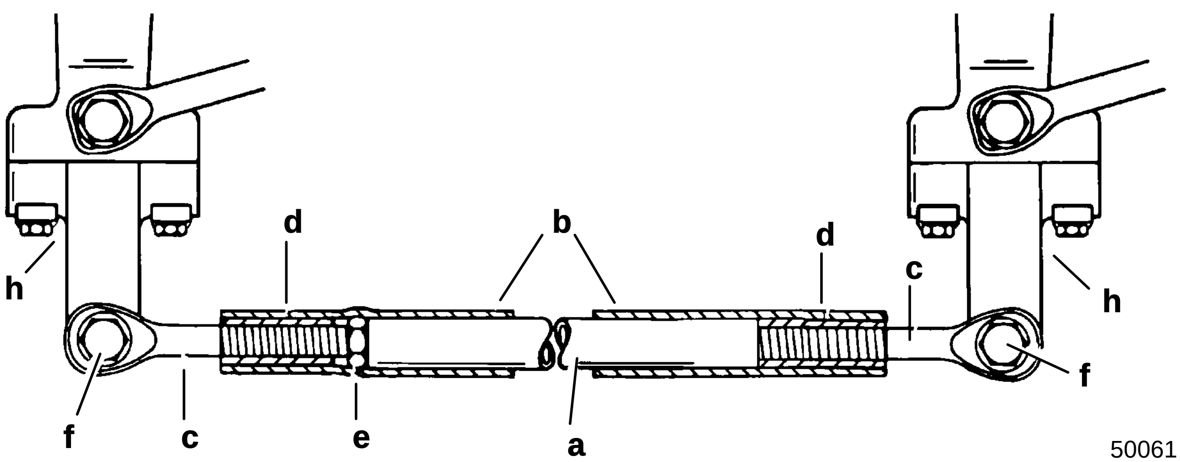
⚠ WARNING

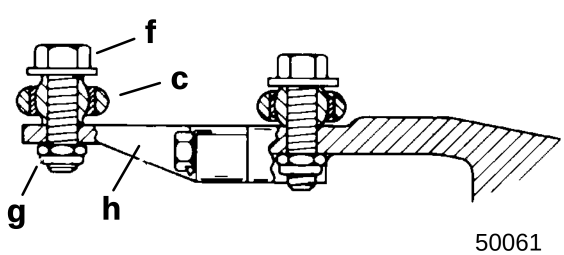
Both steering eyes MUST BE threaded into coupler 3/4 in. (19mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque "jam" nut to 20 lb. ft. (27.0 N·m).

Tighten "jam" nut against coupler. Torque "jam" nut to 20 lb. ft. (27.0 N·m).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.





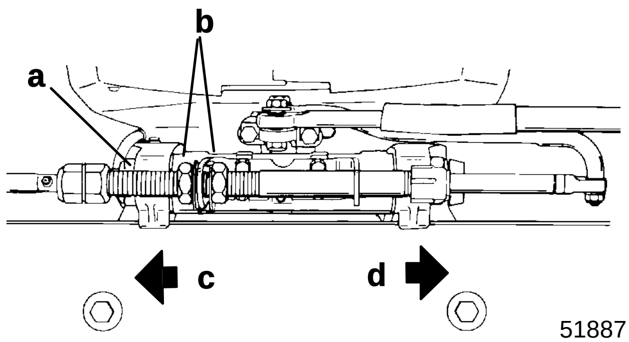


a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27.0 N·m)
f - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27.0 N·m)
g - Nylon Insert Locknut - Torque to 20 lb. ft. (27.0 N·m)
h - Steering Arm Extension Bracket

STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

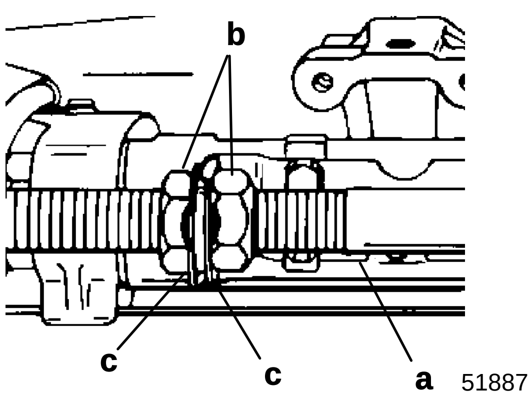
IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there MUST BE proper tension in the steering system. NOT ENOUGH tension will cause slack (play) in steering system. TOO MUCH tension will cause steering cables to bind. Perform the following steps to correctly adjust tension.

Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play). If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



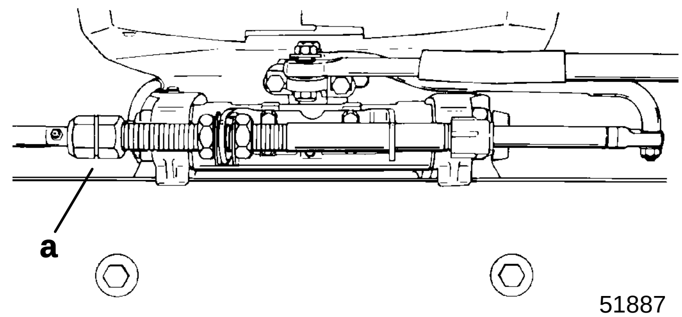
a - Steering Cable Mounting Tube
b - Adjustment Nuts
c - Adjust Tube in This Direction to Remove Slack from Steer ing System
d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.5 N·m) and bend a tab lock washer against a flat on each nut.



a - Steering Cable Mounting Tube
b - Adjustment Nuts Torque to 35 lb. ft. (47.5 N·m)
c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).



a - Cable Attaching Nut

⚠ WARNING

After installation is complete (and before operating outboard(s), check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) at all tilt angles to assure interference-free movement.

Adjust trim tabs of both outboards, as outlined in **"Trim Tab Adjustment"**, following.

Opposite Side Routed Steering Cables and Attaching Kit Installation

(One Cable Routed down Starboard Side of Boat and One Cable Routed down Port Side of Boat)

SUPER RIDE-GUIDE STEERING KIT INSTALLATION

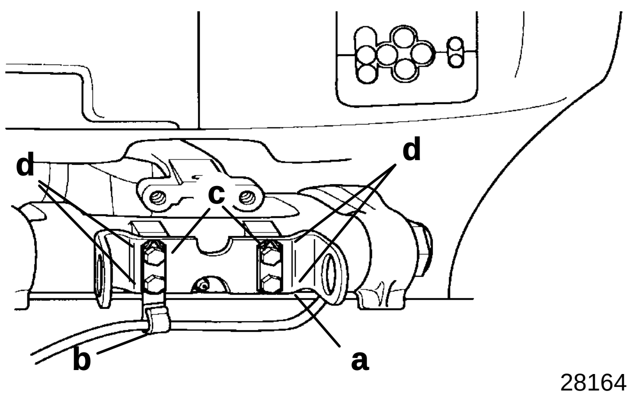
IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.

STEERING CABLE INSTALLATION - STARBOARD OUTBOARD

IMPORTANT: Mounting bracket for steering cable mounting tube MUST BE secured to outboard swivel bracket, using 5/8 in. (16mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



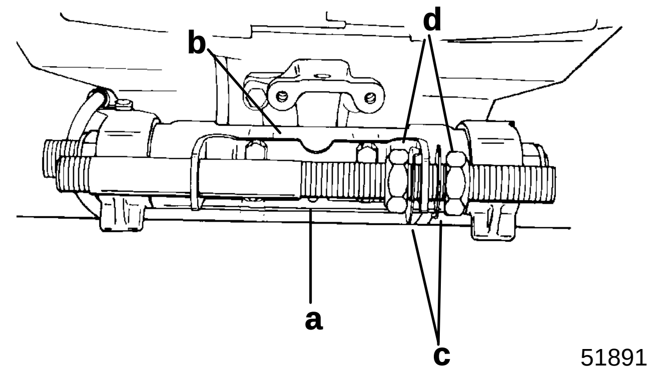
a - Mounting Bracket for Steering Cable Mounting Tube
b - "J" Clip - Supplied with Outboard
c - Locking Retainers (2)
d - Bolts (4) - 5/8 in. (16mm) Long - Torque to 100 lb. in. (11.3N·m), Then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt.

⚠ WARNING

Locking retainer corner tabs MUST BE bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube, to prevent bolts from turning out.

Install Steering Cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Verify longer threaded end of tube is toward center of boat transom.

Temporarily adjust tube, so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



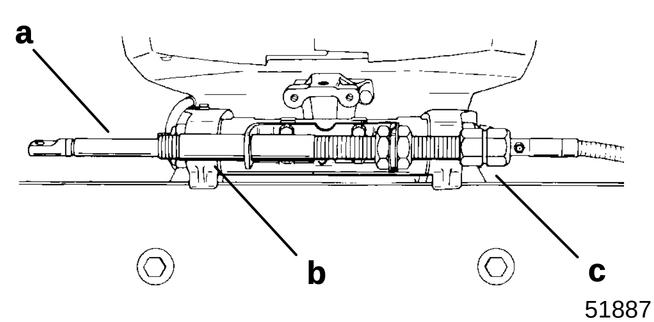
a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Center of Boat Transom)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

IMPORTANT: Lubricate inside of steering mounting tube with 2-4-C w/Teflon (92-825407A12) before installing steering cable.

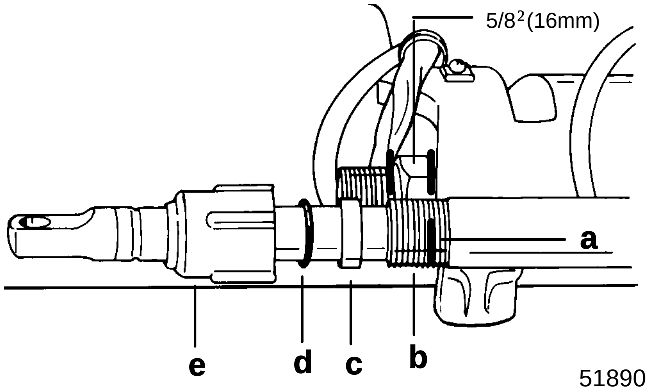
Lubricate inside of steering cable mounting tube (starboard outboard) with 2-4-C w/Teflon.

Insert steering cable end (a) (steering cable routed down port side of boat) thru cable mounting tube (b) and thread steering cable attaching nut (c) onto tube hand tight.

NOTE: *Torque steering cable attaching nut only after final steering adjustments have been made.*



Place a mark (a) on steering cable mounting tube (b) 5/8 in (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



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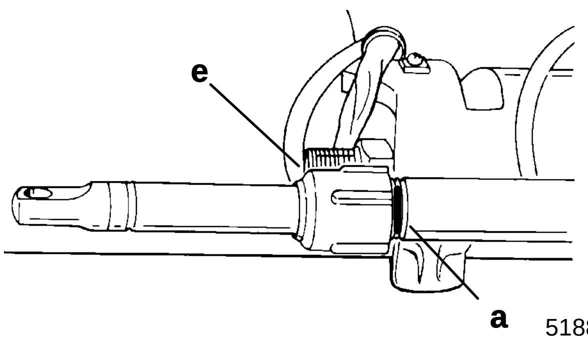
Thread cap (e) onto steering cable mounting tube, up to mark (a).



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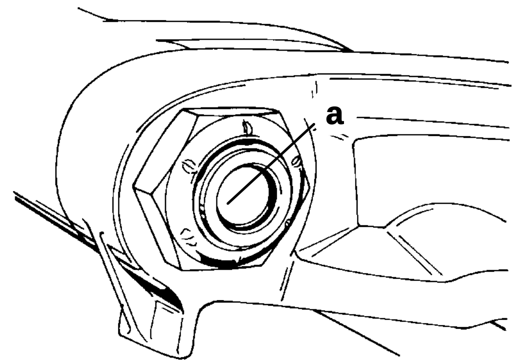
STEERING CABLE INSTALLATION - PORT OUTBOARD

IMPORTANT: Lubricate inside of port outboard's tilt tube and rubber O-ring seal located inside tilt tube with 2-4-C w/Teflon, before installing steering cable.

Lubricate inside of port outboard's tilt tube and rubber O-ring seal (a) with 2-4-C w/Teflon.



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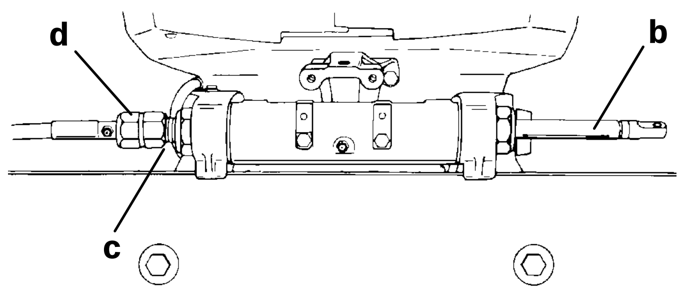
Insert steering cable end (b) (steering cable routed down starboard side of boat) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

NOTE: *Torque steering cable attaching nut only after final steering adjustments have been made.*



51887

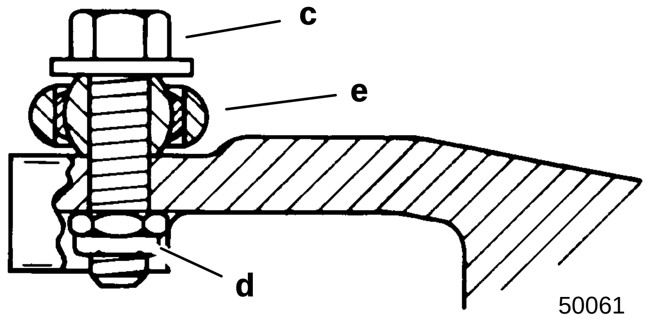
STEERING LINK ROD INSTALLATION

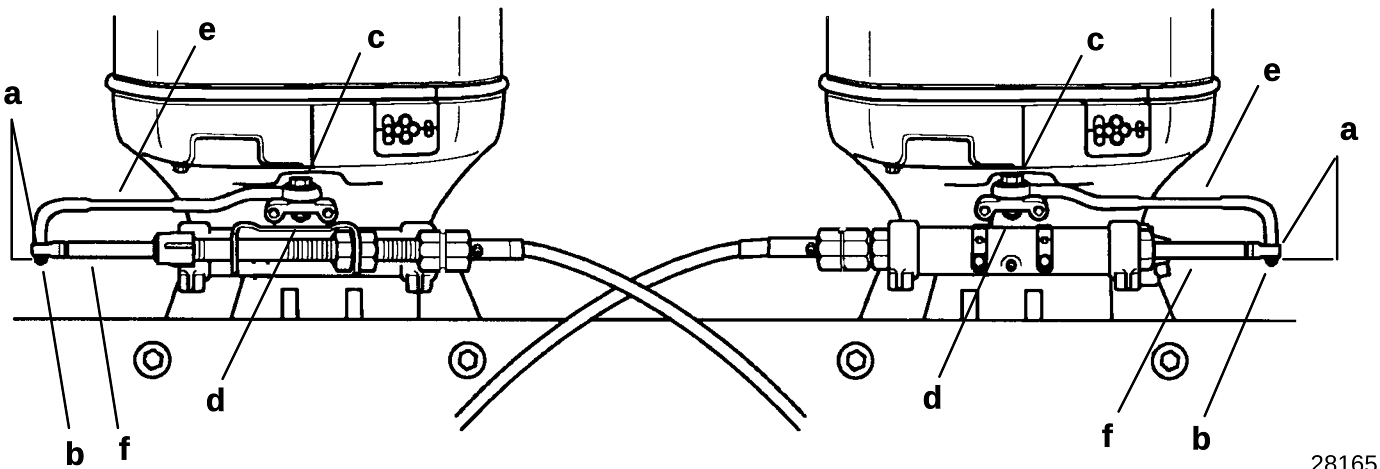
⚠ WARNING

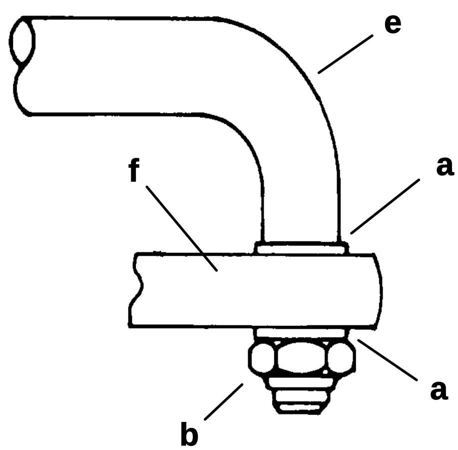
Steering link rods MUST BE secured between outboard steering arm and steering cable end, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.

Lubricate holes in ends of steering cables, with Quicksilver 2-4-C w/Teflon (92-825407A12). Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 lb. in. (13.5 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joints in steering link rods with SAE 30W Motor Oil. Secure link rods to outboard steering arms, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown. Torque special bolts to 20 lb. ft. (27.0 N·m) then torque locknuts to 20 lb. ft. (27.0 N·m).



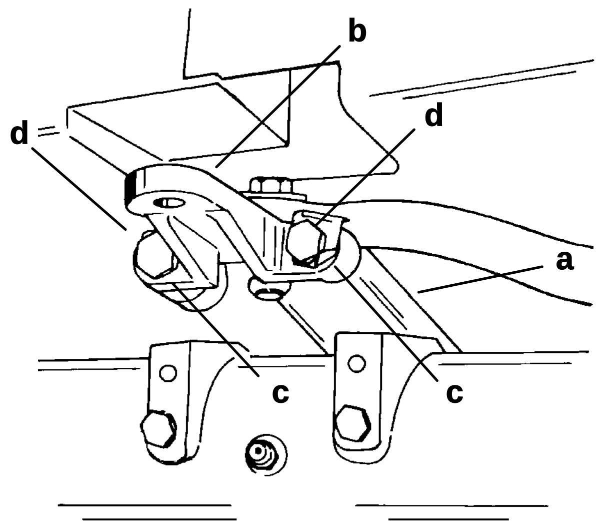




a - Flat Washer (2 Each Link Rod)
b - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.5 N·m) of Torque], Then Back Off 1/4 Turn
c - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.0 N·m)
d - Nylon Insert Locknut - Torque to 20 lb. ft. (27.0 N·m)
e - Steering Link Rod
f - Steering Cable End

STEERING ARM EXTENSION BRACKET INSTALLATION

Secure a steering arm extension bracket to each outboard's steering arm.



51889

a - Steering Arm (Port Outboard Shown)
b - Extension Bracket
c - Locking Retainer (2 Each Bracket)
d - Bolts (2 Each Bracket) 1-1/4 in. (31.8mm) Long - Torque to 280 lb. in. (31.5 N·m), Then Bend Corner Tabs of Locking Retainers Up Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs, MUST BE bent up and against flats on each bolt that secures extension bracket to outboard steering arm, to prevent bolts from turning out.

STEERING COUPLER ASSEMBLY AND INSTALLATION

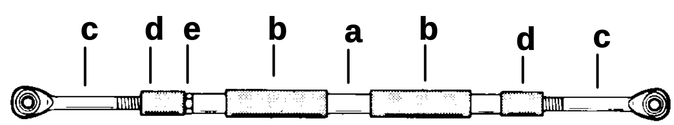
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions MUST BE equal to distance between propeller shaft centerlines.)

Lubricate inside of rubber sleeves with 2-4-C w/Teflon and slide sleeves on steering coupler.

Work rubber bushings onto threaded ends of steering eyes.

Thread jam nut on starboard steering eye.

Thread steering eyes equally into coupler, so that distance between hole centers of steering eye ball joints is equal to distance between threaded hole centers of steering arm extensions. Exposed threads of steering eyes MUST BE of equal length and threads MUST NOT extend out from coupler more than 2-3/4 in. (70mm).



50061

a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut

⚠ WARNING

Both steering eyes must be threaded into coupler 3/4 in. (19mm) minimum. Thread length of steering eye is 3-1/2 in. (89mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (70mm). Failure to adhere to this requirement could result in steering system failure.

Lubricate ball joint in steering eyes with SAE 30W Motor Oil.

Assemble steering coupler between outboard steering arm extension brackets, using special washer head bolts (10-14000) provided and nylon insert locknuts, as shown.

IMPORTANT: With assembled steering coupler in- stalled and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts MUST BE equal to distance between propeller shaft center lines, for proper steering. If adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

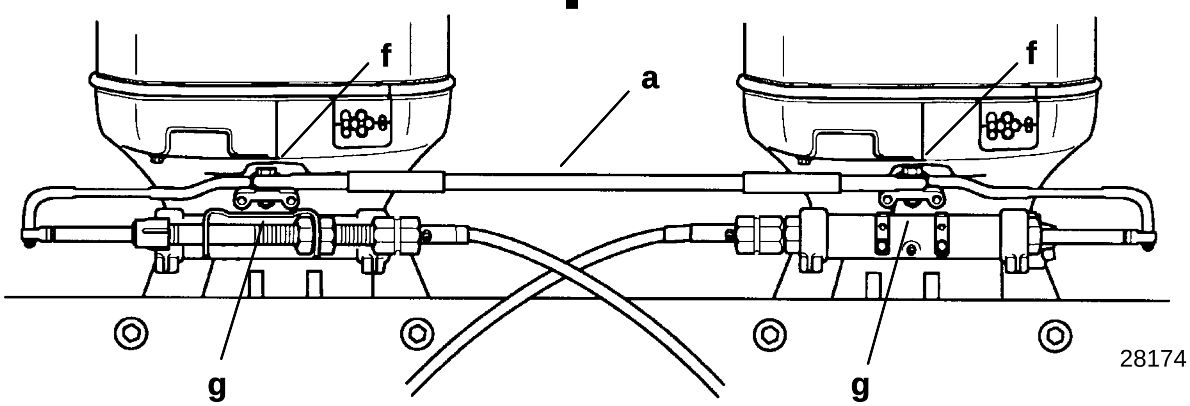
Torque special washer head bolts to 20 lb. ft. (27.0 N·m), then torque locknuts to 20 lb. ft. (27.0 N·m).

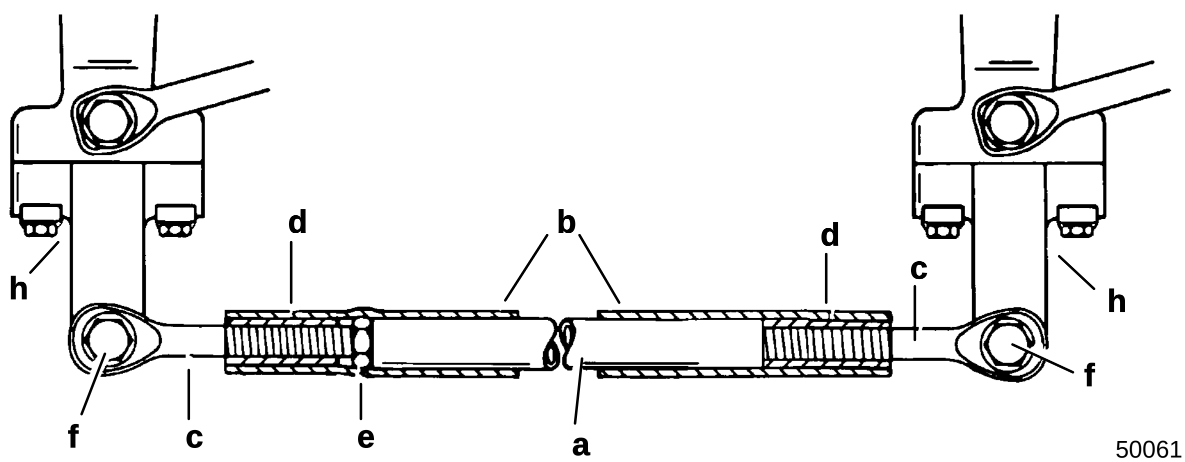
⚠ WARNING

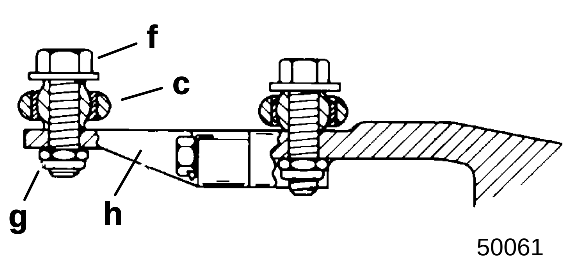
Both steering eyes MUST BE threaded into coupler 3/4 in. (19mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque "jam" nut to 20 lb. ft. (27.0 N·m).

Tighten "jam" nut against coupler. Torque "jam" nut to 20 lb. ft. (27.0 N·m).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.





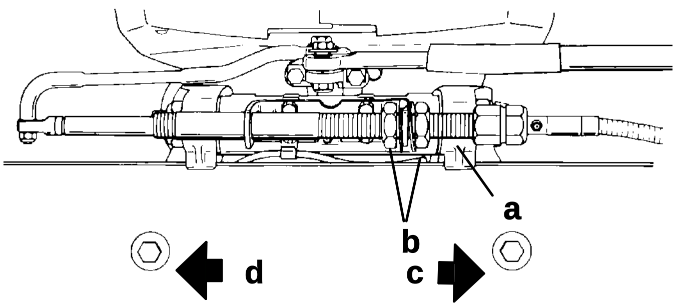


a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27.0 N·m)
f - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.0 N·m)
g - Nylon Insert Locknut - Torque to 20 lb. ft. (27.0 N·m)
h - Steering Arm Extension Bracket

STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

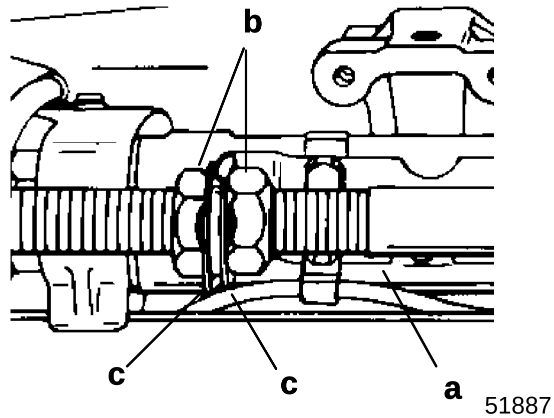
IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there MUST BE proper tension in the steering system. NOT ENOUGH tension will cause slack (play) in steering system. TOO MUCH tension will cause steering cables to bind. Perform the following steps to correctly adjust tension.

Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play). If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



a - Steering Cable Mounting Tube
b - Adjustment Nuts
c - Adjust Tube in This Direction to Remove Slack from Steering System
d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket to a torque of 35 lb. ft. (47.5 N·m) and bend a tab lock washer against a flat on each nut.



a - Steering Cable Mounting Tube
b - Adjustment Nuts; Torque to 35 lb. ft. (47.5 M·m)
c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).

NOTE: *Cable attaching nuts with a "V" groove around outer circumference are self locking and do not require locking sleeves.*

⚠ WARNING

After installation is complete [and before operating outboard(s)], check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) at all tilt angles to assure interference-free movement.

Adjust trim tabs of both outboards, as outlined in **"Trim Tab Adjustment,"** following.

Trim Tab Adjustment

DUAL OUTBOARD - COUNTER ROTATION INSTALLATION

1. Shift outboard into neutral and make sure ignition key is at "OFF" position.
2. Remove plastic cap from rear of driveshaft housing and loosen bolt and trim tab.
3. Position trim tabs of both outboards straight to rear of outboard, so that tabs are aligned with gear housing centerline.
4. Tighten both trim tab bolts securely and replace plastic caps. No further adjustment will be required.

DUAL OUTBOARD - NON COUNTER ROTATION INSTALLATION

1. Check trim tab position as follows:

IMPORTANT: Initial trim tab setting for both outboards should be straight to rear of outboard, so that tabs are aligned with gear housing center line. Refer to "If necessary, adjust trim tab as follows," following.

   a. Operate boat at normal cruise throttle setting and adjust trim to optimum setting.

   b. If boat pulls to the right (starboard), trailing edge of trim tab must be moved to the right (when viewing outboard from behind). If boat pulls to the left (port), trailing edge of trim tab must be moved to the left.

2. If necessary, adjust trim tab as follows:

   a. Shift outboard into NEUTRAL and make sure ignition key is at "OFF" position.

   b. Remove plastic cap from rear of driveshaft housing and loosen bolt and trim tab.

IMPORTANT: Trim tabs MUST BE set in the same position on both outboards.

   c. If boat pulls to the right, adjust trailing edges of both trim tabs to the right. If boat pulls to the left, adjust trailing edges of both trim tabs to the left.

   d. Tighten both trim tab bolts securely and replace plastic caps.

   e. Operate boat per **"Check trim tab position as follows,"** preceding, to check trim tab setting. Readjust trim tabs, if necessary.

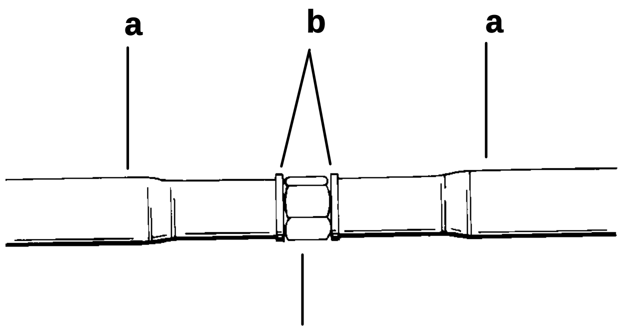
Ride Guide Steering Attachment Extension Couplers

Listed below are typical couplers available. Refer to the current Quicksilver Accessory Guide for specific coupler lengths and part numbers.

Outboard Center Line Distance	Required Coupler(s) Between Steering Eyes
22-1/2 in. thru 24-1/2 in. (572mm thru 622mm)	12^2 (305mm) Coupler
23-1/2 in. thru 27-1/2 in. (597mm thru 699mm)	15^2 (381mm) Coupler (Supplied with this kit)
26-1/2 in. thru 30-1/2 in. (673mm thru 755mm)	18^2 (457mm) Coupler
30 in. thru 34 in. (763mm thru 864mm)	9^2 (229mm) Coupler and 12^2 (305mm) Coupler (Connected together with coupler link rod)
33 in. thru 37 in.	12^2 (305mm) Coupler and 12^2 (305mm) Coupler (Connected together with coupler link rod)

⚠ WARNING

When 2 couplers are connected together with coupler link rod, a lock washer must be used on each side of coupler link rod, and link rod must be torqued to 20 lb. ft. (27.0 N·m) into end of each coupler.



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a - Couplers Connected Together
b - Lock washers
c - Coupler Link Rod [Torque to 20 lb. ft. (27.0 N·m) into End of Each Coupler]

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

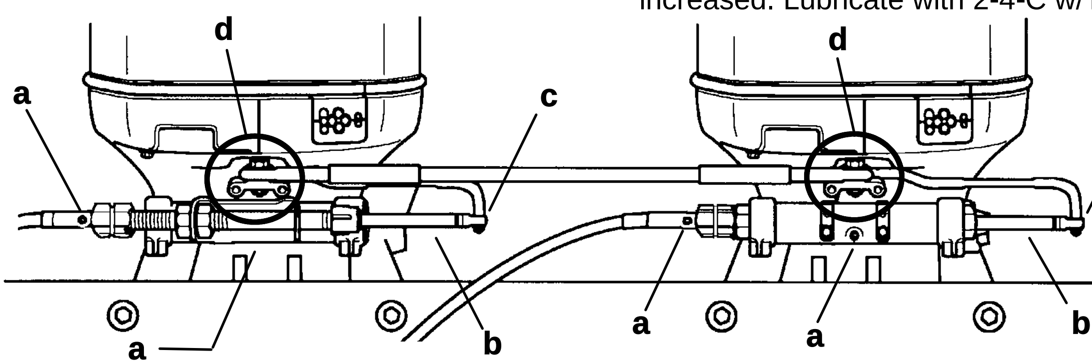
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

***NOTE:** Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

Core of each steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable ends (b) with 2-4-C w/Teflon.
4. Lubricate pivot points (c) of steering link rods and ball joints (d) of link rods/steering coupler with SAE 30W Motor Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



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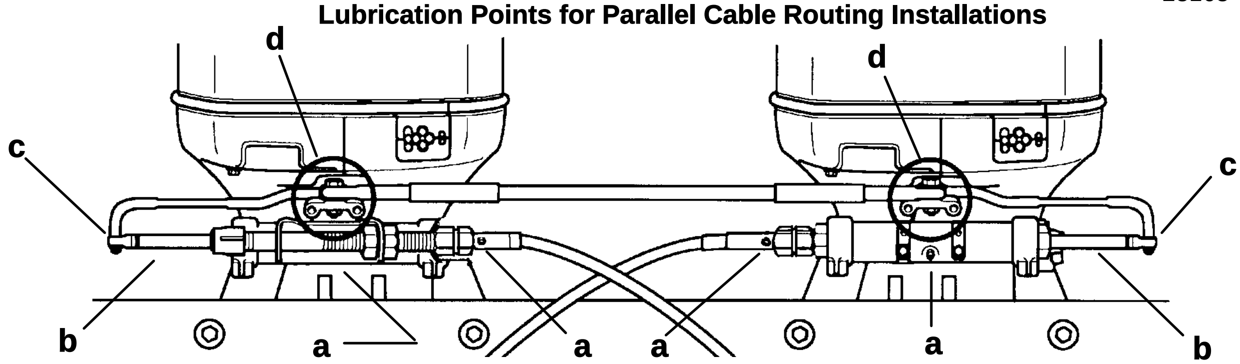
Lubrication Points for Parallel Cable Routing Installations



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Lubrication Points for Opposite Side Cable Routing Installations

Transom Mounted Ride Guide Attaching Kit Installation (73770A1)

Attaching Kit Installation

1. Lubricate both holes in pivot block (Figure 1) with Quicksilver 2-4-C w/Teflon.
2. Place pivot block on pivot spacer and secure to transom bracket with 3/8 in. x 2-1/2 in. (9.5mm x 63.5mm) bolt, flat washer and locknut, as shown in Figure 1. Torque locknut to 20 lb. ft. (27.0 N·m).

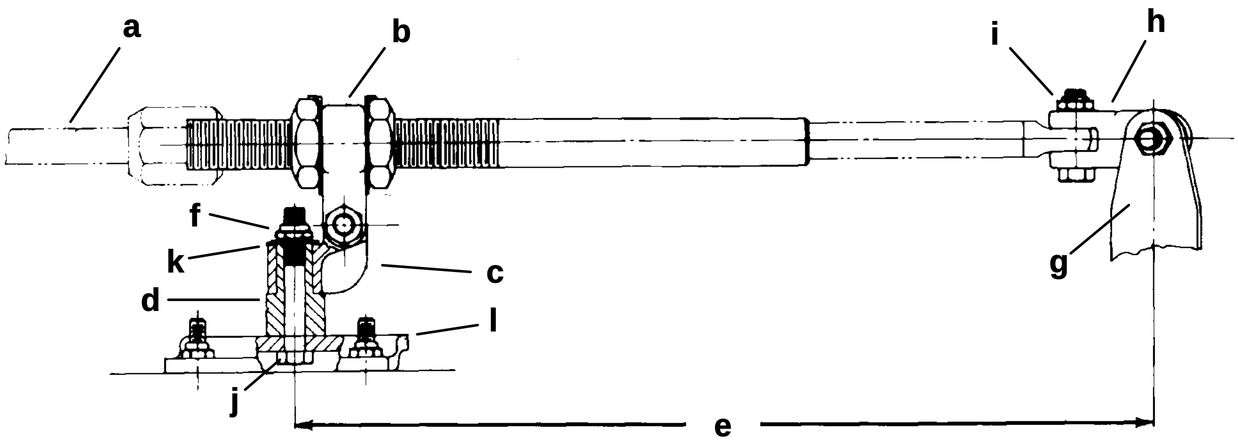


Figure 1

a - Ride-Guide Cable
b - Ride-Guide Yoke
c - Pivot Block
d - Pivot Spacer
e - 15 in. (381mm) (Centerline of Attaching Kit Pivot to Centerline of Outboard)
f - Pivot Attaching Locknut [Torque to 20 lb. ft. (27.0 N·m)]
g - Outboard Steering Arm
h - "Clevis Kit"
i - Ride-Guide Cable Attaching Locknut [Torque to 10 lb. ft. (13.6 N·m)]
j - Bolt [3/8 in. x 2-1/2 in. (9.5mm x 63.5mm)]
k - Flat Washer
l - Transom Bracket

3. Place Ride-Guide yoke on pivot block and secure with 7/16 in. x 1-3/4 in. (11.1mm x 44.5mm) bolt and locknut, as shown in Figures 1 and 2. Torque locknut to 10 lb. ft. (13.5 N·m), **then back off 1/4-turn.**

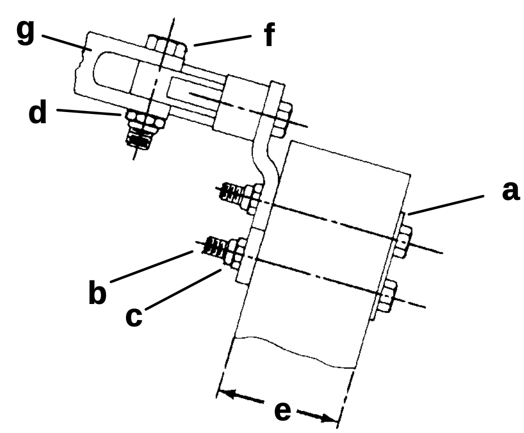


Figure 2

a - Transom Backing Plate
b - Bolt [5/16 in. x 3-1/4 in. (7.9mm x 82.5)]
c - Locknut [Torque to 10 lb. ft. (13.5 N·m)]
d - Ride-Guide Yoke Attaching Locknut [Torque to 10 lb. ft. (13.5 N·m)] **Then Back Off 1/4-Turn**
e - 2-3/8 in. (60.3mm) Maximum Transom Thickness
f - Bolt [7/16 in. x 1-3/4 in. (11.1mm x 44.5mm)]
g - Ride-Guide Yoke

4. Install one cable tube jam nut onto steering cable tube. Place tab washer over Ride-Guide yoke, then insert cable tube thru tab washer and yoke. Install second cable tube jam nut onto cable tube but do not tighten at this time. (Figure 3)
5. Position transom attaching kit on transom as
   a. Determine centerline of outboard, then measure 15 in. (38.1cm) over from this centerline and draw a vertical line on transom. (Figure 1)
   b. Position attaching kit on transom so that **transom bracket is centered on the 15 in. (38.1mm)** (Figure 1) at a height where the **center of Ride-Guide yoke is even with, or not more than 1/2 in. (12.7mm)** above top edge of transom. (Figure 3)

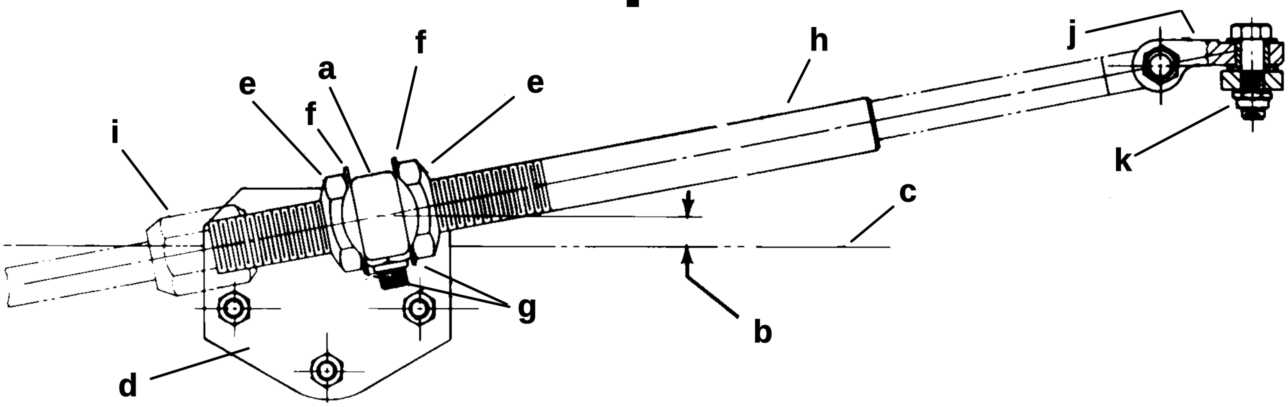


Figure 3

a - Ride-Guide Yoke
b - 0 in. to 1/2 in. (0mm to 12.8mm) (Center of Ride-Guide Yoke to Top of Transom
c - Top of Transom
d - Transom Bracket
e - Cable Tube Jam Nuts [Torque to 35 lb. ft. (47.5 N·m)]
f - Tab Washer
g - After Jam Nuts Are Torqued to Specification, Bend Lock ing Tabs against Nuts
h - Cable Guide Tube
i - Ride-Guide Cable Attaching Nut [Torque to 35 lb. ft. (47.5N·m)]
j - "Clevis Kit"
k - Clevis Attaching Locknut [Torque to 20 lb. ft. (27.0 N·m)]

***NOTE:** When drilling thru transom, be sure that holes are drilled perpendicular to transom.*

6. With attaching kit positioned as outlined preceding, use 3 holes in transom bracket as a guide and drill three 11/32 in. (8.7mm) holes thru transom.
7. Use a marine-type sealer on three 5/16 in. x 3-1/4in. (7.9mm x 82.6mm) bolts. Secure attaching kit to transom, using transom backing plate, 3 bolts (with sealer) and 3 locknuts, installed as shown in Figure 2. Torque lock nuts to 10 Ib. ft. (13.5 N·m).

STEERING CABLE INSTALLATION

1. Lubricate steering cable end with Quicksilver 2-4-C w/Teflon (92-825407A12).
2. Install steering cable thru steering cable tube and secure to cable tube with cable attaching nut. (Figure 3) Do not tighten cable attaching nut at this time.
3. Attach Ride-Guide cable to outboard steering arm, using the proper "Clevis Kit." Installation instructions for clevis are with "Clevis Kit."
4. Adjust 2 large jam nuts on cable tube of attaching kit, so that **steering wheel** is in normal straight-driving position with outboard in straight-running position. Torque each jam nut to 35 Ib. ft. (47.5 N·m), then bend a side of tab washer against flat of each jam nut. (Figure 3)
5. Torque Ride-Guide cable attaching nut (which secures cable to guide tube) to 35 Ib. ft. (47.5 N·m). (Figure 3)

WARNING

After installation is completed (and before operating outboard), check that boat will turn right when steering wheel is turned right and that boat will turn left when steering wheel is turned left. Check steering thru full range (left and right) at all tilt angles to assure interference-free movement.

Maintenance Instructions

Lubrication and maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

⚠ CAUTION

Core of steering cable must be fully retracted into cable housing when lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

1. Lubricate outboard end of Ride-Guide steering cable (thru grease fitting - if equipped - next to cable attaching nut) with Quicksilver 2-4-C w/ Teflon.

NOTE: *Ride-Guide steering cable is lubricated at the factory and requires no additional lubrication at initial installation.*

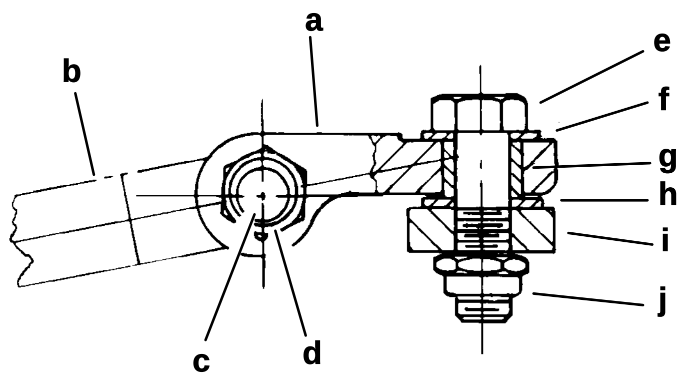
2. Lubricate all steering system pivot points (and exposed portion of steering cable core) with Quicksilver 2-4-C w/Teflon. Lubricate at intervals specified preceding.
3. Carefully check steering system components for wear (at intervals specified, preceding). Replace worn parts.
4. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications. (Figures 1, 2 and 3)

Clevis Attaching Kit Installation (A-70599A2)

NOTE: *This kit is used to attach Ride-Guide cable to outboard steering arm ONLY when **"Transom Mounted Ride-Guide Attaching Kit"** is being used. If Ride-Guide cable is installed thru outboard tilt tube, then "Steering Link Rod" must be used.*

Installation Instructions

1. Install clevis to steering cable as shown.
2. Lubricate 3/8 in. x 1-3/8 in. (9.5mm x 34.9mm) bolt (area without threads) with 2-4-C w/Teflon, then secure clevis to steering cable with this bolt and a locknut. Torque locknut (item "d") to 10 lb. ft. (13.5 N·m).



a - Clevis
b - Steering Cable
c - Bolt [3/8 in. x 1-3/8 in. (9.5mm x 34.9mm)]
d - Clevis to Steering Cable Locknut [Torque to 10 lb. ft. (13.5 N·m)]
e - Bolt [3/8 in. x 1-1/4 in. (9.5mm x 31.8mm)] [Torque to 20 lb. ft. (27.0 N·m)]
f - Thin Washer [1/16 in. (1.6mm) Thick]
g - Spacer
h - Thick Washer [1/8 in. (3.2mm) Thick]
i - Engine Steering Arm
j - Clevis to Engine Locknut [Torque to 20 lb. ft. (27.0 N·m)]

3. Lubricate spacer (supplied with this kit) with 2-4-C w/Teflon.
4. Attach clevis to top of outboard steering arm with a 3/8 in. x 1-1/4 in. (9.5mm x 31.8mm) bolt, thin washer, spacer, thick washer (thick washer must be installed between clevis and steering arm) and locknut, as shown. Torque bolt (item "e") to 20 lb. ft. (27.0 N·m), then torque locknut (item "j") to 20 lb. ft. (27.0 N·m).

Maintenance Instructions

Lubrication and maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

1. Carefully check steering system components (at intervals specified, preceding) for wear. Replace worn parts.
2. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications.
3. Lubricate clevis pivot points with a drop of light oil. Lubricate at intervals specified, preceding.

Remote Control Installation

Refer to "Quicksilver Accessories Guide" to determine correct length of remote control cables.

⚠ WARNING

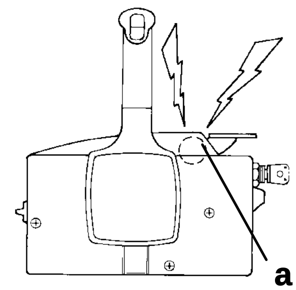
Remote control cables must be correct length. Sharp bends on too-short cables result in "kinks;" too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables. Failure of remote control cables at high speeds could result in possible serious injury or death.

IMPORTANT: Install control cables to remote control and mount remote control BEFORE attaching control cables to engine. Refer to installation instructions included with remote control.

Required Side Mount Remote Control or Ignition Key Switch Assembly

Boats Equipped with Side Mount Remote Control

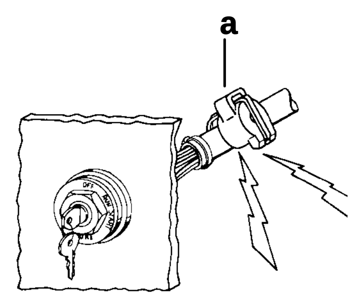
A Quicksilver Commander 2000 or 3000 series Side Mount Remote Control equipped with a warning horn must be used with this outboard. This warning horn is necessary for the engine warning system.



a -Warning Horn

Boats equipped with Panel or Console Mount Remote Control

A Quicksilver Ignition Key/Choke Assembly equipped with a warning horn must be used with this engine. This warning horn is necessary for the engine warning system.



a - Warning Horn

Connecting Engine Wiring Harness Engine Battery Cables and Trim Wires

Route remote control harness or key switch harness down side of boat to engine, fastening harness to boat. Verify harness does not rub, get pinched or come in contact with bilge water.

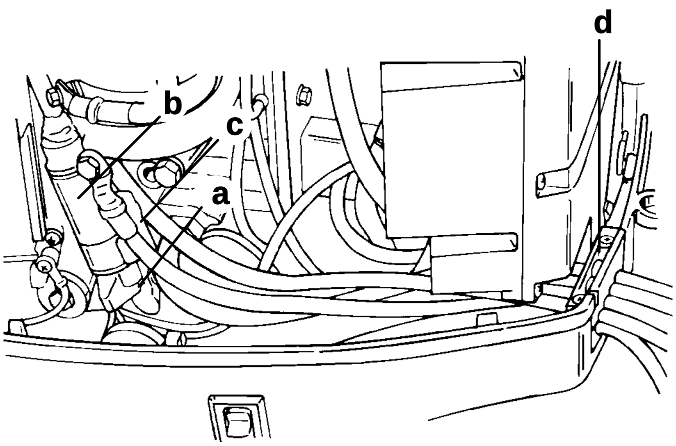
Plug remote control harness or key switch harness connector (a) into engine harness connector (b) and push connection securely into retainer (c).

Routing Location for Wiring and Hoses thru Clamp in Bottom Cowl

IMPORTANT: Sufficient slack must exist in wiring harness, battery cables, fuel hose, and oil hoses routed between clamp and engine attachment point, to relieve stress and prevent hoses from being kinked or pinched.

1. Route wiring harness, battery cables, fuel hose, oil hoses and control cables thru clamp in bottom cowl at locations shown.

1995 Models and Older Production Outboards



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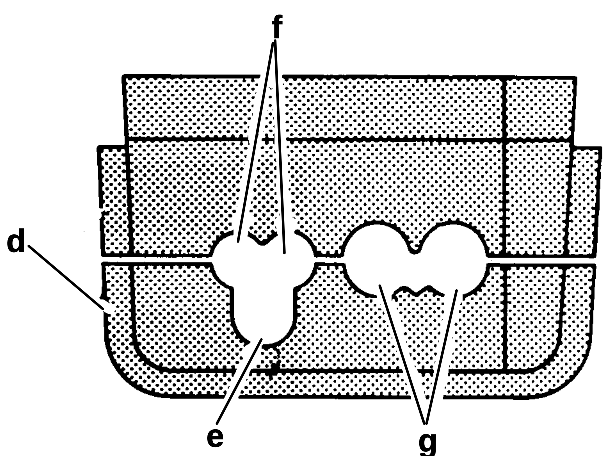
a - Remote Control Harness
b - Engine Harness
c - Harness Retainer
d - Wiring Clamp



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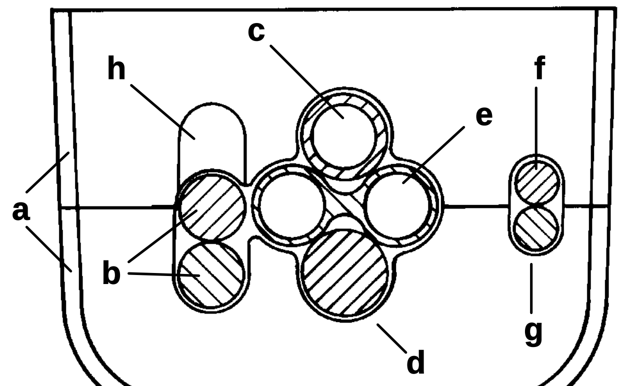
d - Wiring Clamp (2 Halves)
e - Remote Control Wiring Harness/Key Switch Wiring Harness Opening
f - Battery Cable Openings
g - Oil Hose Openings

1996 Models and Newer Production Outboards



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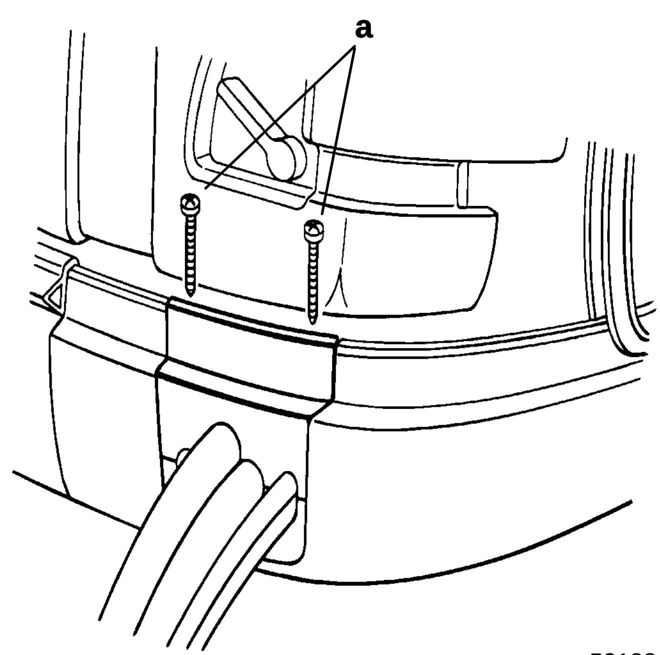
a - Clamp (2 Halves)
b - Battery Cables
c - Engine Wiring Harness Adaptor
d - Fuel Line
e - Oil Hose
f - Throttle Cable
g - Shift Cable
h - Accessory (Knock Out)

2. Secure clamp halves together with 2 screws.



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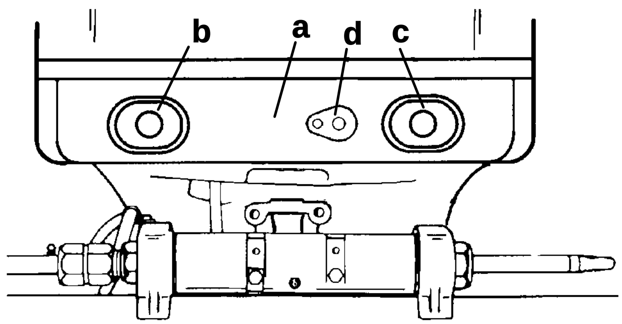
a - Screws

High Performance Outboards - Pro Max/Super Magnum Models

1. Route wiring harness, battery cables, oil hoses and control cables through rubber boots in bottom cowl at locations shown.

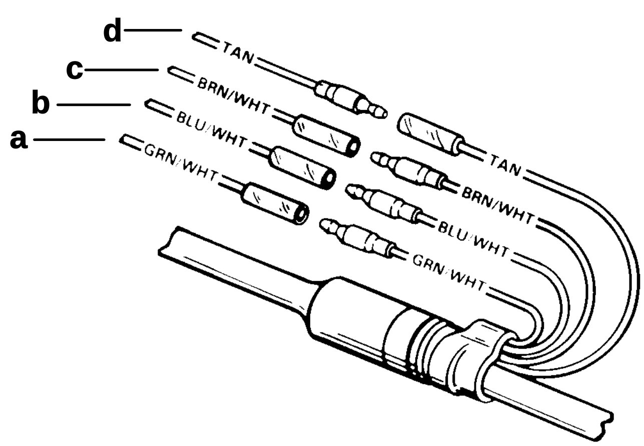


a - Bottom Cowl
b - Route Wiring Harness, Battery Cables and Oil Hoses through STARBOARD Rubber Boot
c - Route Control Cables through PORT Rubber Boot
d - Connection for Fuel Line

2. Connect the remote wiring harness from the remote control or key switch assembly into the engine wiring harness connector.

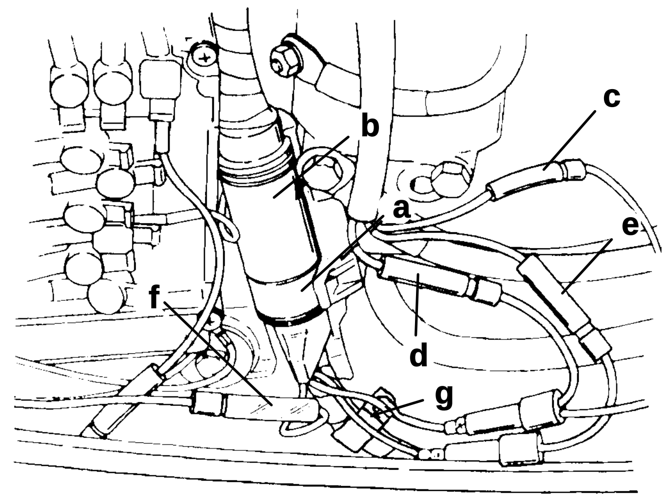
Make bullet connector wiring connection between remote control wiring harness/key switch wiring harness and engine wiring.

IMPORTANT: Tape back and isolate any unused wiring harness leads.



a - Lead From Trim Solenoid (Down Solenoid/Relay)
b - Lead From Trim Solenoid (Up Solenoid/Relay)
c - Lead From Trim Sender
d - Lead From Temperature Sender

3. Place the remote control harness and battery cables behind the "J" clamp.



a - Remote Control Wiring Harness
b - Engine Wiring Harness
c - RED Trim 12 Volt Power Supply
d - BLUE/WHITE Trim UP Lead
e - GREEN/WHITE Trim DOWN Lead
f - TAN Overheat Warning Lead
g - "J" Clamp

Remote Control Installation

IMPORTANT: Install control cables to remote control and mount remote control BEFORE attaching control cables to engine.

Install throttle and shift cables to remote control and mount remote control as outlined in the installation instructions which accompany the remote control.

Shift Cable Adjustment and Installation to the Engine

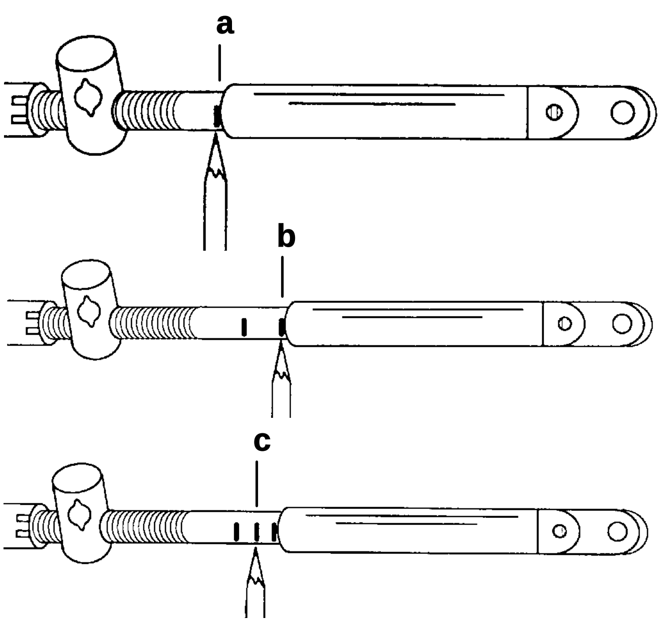
1. Install the shift cable to the remote control. Refer to installation instructions included with the remote control.
2. Before installing the shift cable to the engine, locate the center point of the slack or lost motion that exists in the remote control and shift cable as follows.

NOTE: *On counter rotation outboards, the location of marks "a" and "b" below on the shift cable will be reversed.*

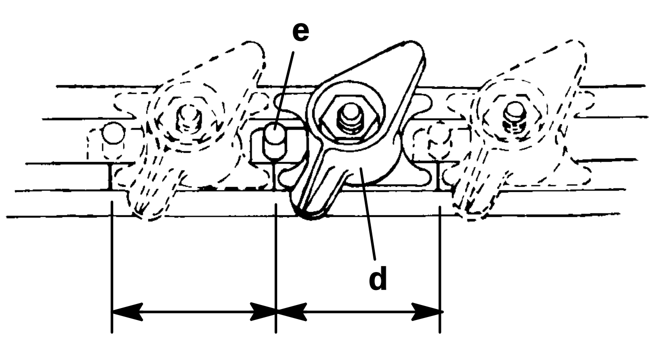
   a. Move the remote control handle into forward and advance the handle to the full speed position. Slowly return the handle back to the neutral detent position. Place a mark on the shift cable against the cable end guide at location (a).

b. Move the remote control handle into reverse and advance the handle to the full speed position. Slowly return the handle back to the neutral detent position. Place a mark on the shift cable against the cable end guide at location (b).

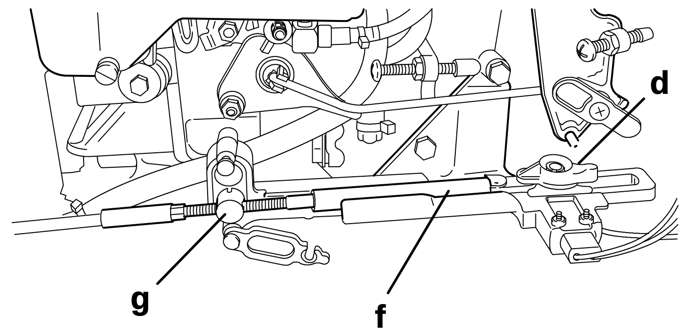
c. Make a center mark (c) on the shift cable, midway between marks (“a” and “b”). Align the cable end guide against this center mark (c) when installing cable to the engine.



3. Position remote control into NEUTRAL detent.
4. Manually shift outboard into NEUTRAL position.
5. Slide the shift cable retainer (d) forward until resistance is felt, then slide cable anchor toward rear until resistance is felt. Center the anchor pin (e) between resistance points.



6. Align the shift cable end guide with the center mark as instructed in Step 2.
7. Place shift cable end guide (f) on anchor pin and adjust cable barrel (g) so that the barrel slips freely into the plastic barrel retainer.
8. Secure shift cable with shift cable retainer (d).



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9. Check shift cable adjustments as follows:

⚠ WARNING

Remove spark leads from spark plugs to prevent accidental starting while working on engine.

NOTE: *Turn propeller shaft by hand while shifting to ensure positive engagement of clutch with forward and reverse gears.*

a. With remote control in forward, the propshaft should lock solidly in gear. If it does not, adjust cable barrel closer to cable end guide.

b. Shift remote control into neutral. The propshaft should turn freely without drag. If not, adjust barrel away from cable end guide. Repeat steps a and b.

c. Shift remote control into reverse while turning propeller. The propshaft should lock solidly in gear. If not, adjust barrel away from cable end guide. Repeat steps a thru c.

d. Return remote control handle to neutral. The propeller should turn freely without drag. If not, adjust barrel closer to cable end guide. Repeat steps a thru d.

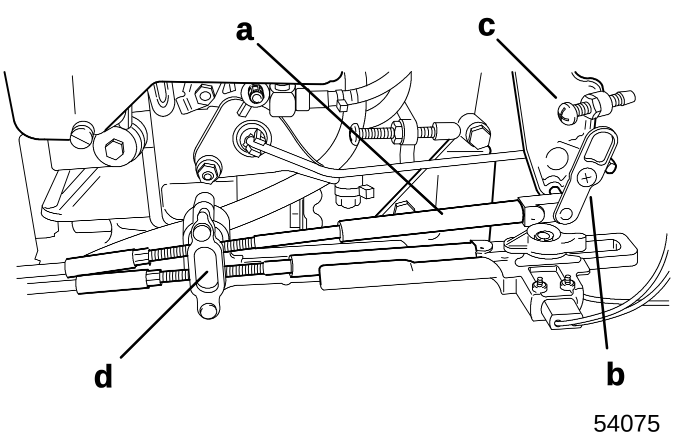
Throttle Cable Adjustment and Installation to the Engine

NOTE: *Attach Shift cable to engine prior to attaching throttle cable.*

1. Start engine and adjust engine RPM to 600-700 RPM in forward gear. Stop the engine.
2. Shift remote control into NEUTRAL position.

3. Attach throttle cable end to throttle lever anchor pin and secure with latch (b).
4. With end of throttle cable connected to throttle lever, hold idle screw (c) against the stop. Adjust throttle cable barrel to slip into barrel receptacle with a very light pre-load of the idle screw against the stop.
5. Lock barrels in place with cable retainer (d).
6. Check pre-load on throttle cable by placing a thin piece of paper between idle stop screw and the stop. Pre-load is correct when paper can be removed without tearing, but has some drag on it. Readjust cable barrel, if necessary.

IMPORTANT: Excessive pre-load on throttle cable will cause difficulty when shifting from FORWARD to NEUTRAL. (Readjust throttle cable barrel if necessary).



Battery Connections

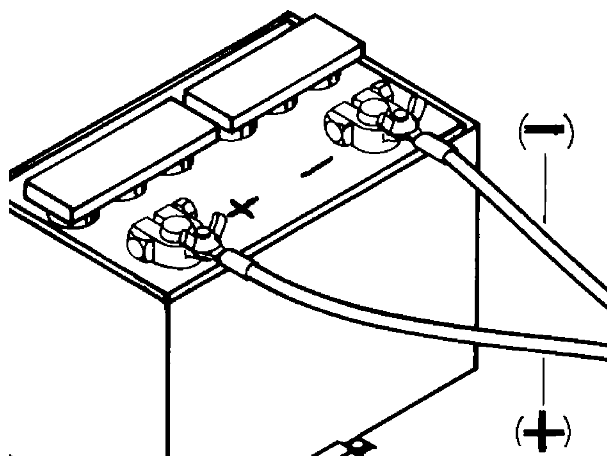
⚠ CAUTION

For dual outboard installations, the negative (-) battery cable of each engines starter motor ground circuit, MUST BE connected together by a common circuit (cable) capable of carrying the starting current of each engines' starter motor. [i.e. A locally obtained battery cable connected between the negative (-) terminal of each outboards cranking battery.]

⚠ CAUTION

Failure to observe correct polarity when connecting battery cables to battery, will result in damage to the charging system.

1. Connect battery cables (from engine) to battery. Connect POSITIVE (+) battery cable to POSITIVE terminal and NEGATIVE (–) battery cable to NEGATIVE (–) battery terminal.



Fuel Connections

⚠ WARNING

Avoid serious injury or death from a gasoline fire or explosion. All fuel lines must meet U.S. Coast Guard approval for class "A" fuel lines.

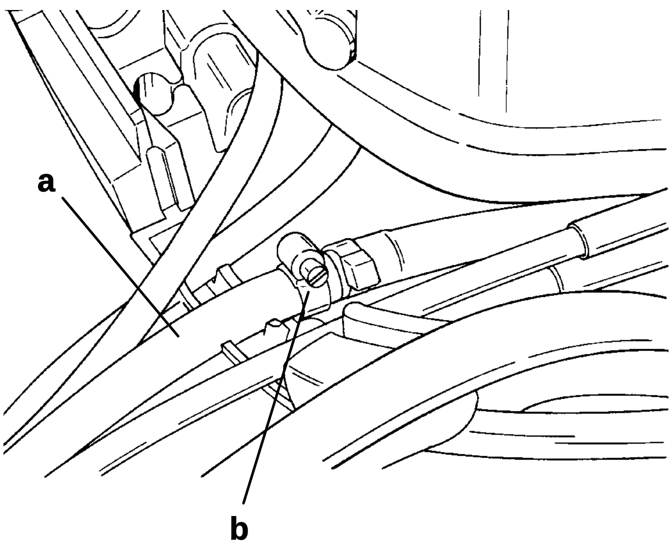
FUEL LINE

Minimum fuel line inside diameter (I.D.) is 5/16 in. (8mm), with separate fuel line/fuel tank pickup for each engine.

Connecting Fuel Hose to Engine

PRODUCTION EFI MODELS

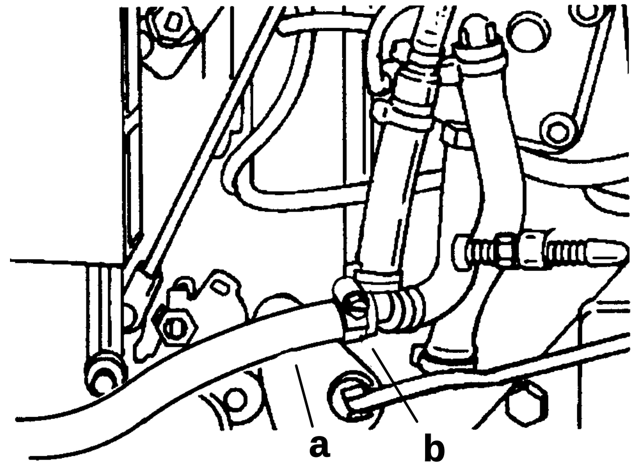
1. Connect fuel hose to fitting inside of bottom cowl as shown. Secure with hose clamp.
2. Refer to page 32 for proper routing of fuel hose thru clamp in bottom cowl.



a - Fuel Hose
b - Hose Clamp

PRODUCTION CARBURETOR MODELS

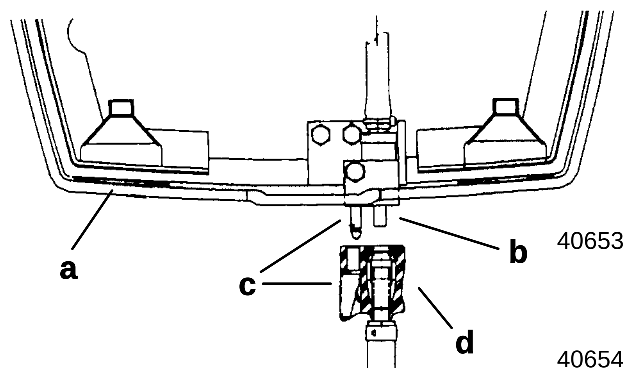
1. Connect fuel hose to "T" fitting as shown. Secure with hose clamp.
2. Refer to page 32 for proper routing of fuel hose thru clamp in bottom cowl.



a - Fuel Hose
b - Hose Clamp

HIGH PERFORMANCE MODELS - PRO MAX/SUPER MAGNUM

Connect inlet fuel line connector (d) from the fuel tank to the inlet fuel connector on the front of the bottom cowl. Hose connection is retained by the bayonet connecting device (c).



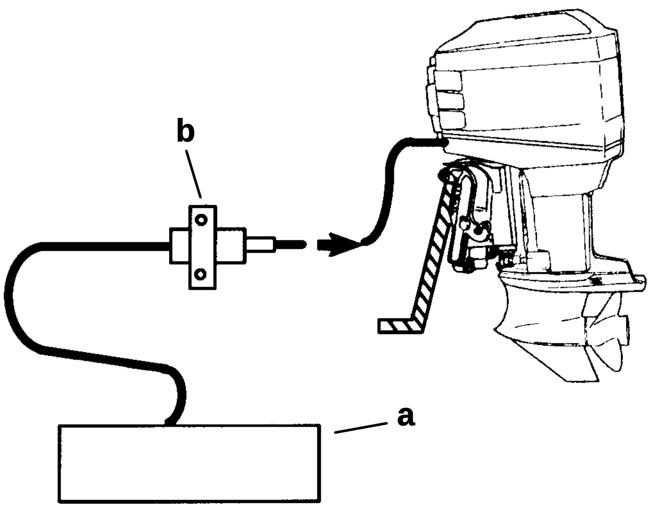
a - Bottom Cowl
b - Fuel Inlet Connection on Cowl
c - Bayonet Locking Device for Fuel Connection
d - Fuel Line Connector from Fuel Tank

AUXILIARY FUEL PUMP

⚠ WARNING

Avoid serious injury or death from a gasoline fire or explosion. If an auxiliary electrical fuel pump is used to feed the mechanical pump on the engine, fuel pressure to the engine must not exceed 4 psi. If necessary, install a pressure regulator between between the electric fuel pump and the oil injection outlet check valve. Set regulator at 4 psi maximum. The fuel pump can be mounted vertically with the electrical connections on top or sideways with the connections on either end. DO NOT MOUNT PUMP VERTICALLY WITH THE ELECTRICAL CONNECTIONS ON THE BOTTOM.

1. Install in-line auxiliary fuel pump in fuel system as shown.



a - Fuel Tank
b - Auxiliary Electric Fuel Pump

2. Start engine and check for any fuel leaks.

PORTABLE FUEL TANK

Select a suitable location in boat within engine fuel line length limitations and secure tank in place.

PERMANENT FUEL TANK

These should be installed in accordance with industry and federal safety standards which include recommendations applicable to grounding, anti-siphon protection, ventilation, etc.