



# **SERVICE MANUAL**

Number 28

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**BRAVO STERNDRIVES**

**MerCruiser #28 Bravo Sterndrives**


**90-863160**

**MerCruiser #28 Bravo Sterndrives**

**90-863160**

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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.

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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.

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.

## Engine Mechanical Components

Many of the engine mechanical components are designed for marine applications. Unlike automotive engines, marine engines are subjected to extended periods of heavy load and wide-open-throttle operation and, therefore, require heavy-duty components. Special marine engine parts have design and manufacturing specifications which are required to provide long life and dependable performance. Marine engine parts also must be able to resist the corrosive action of salt or brackish water that will rust or corrode standard automotive parts within a short period of time.

Failure to use recommended Quicksilver service replacement parts can result in poor engine performance and/or durability, rapid corrosion of parts subjected to salt water and possibly complete failure of the engine.

Use of parts other than recommended service replacement parts, will void the warranty on those parts which are damaged as a result of the use of other than recommended replacement parts.

## Replacement Parts

### **WARNING**

**Electrical, ignition and fuel system components on MerCruiser Engines and Stern-drives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.**

**Use of replacement electrical, ignition or fuel system components, which do not comply to these rules and regulations, could result in a fire or explosion hazard and should be avoided.**

**When servicing the electrical, ignition and fuel systems, it is extremely important that all components are properly installed and tightened. If not, any electrical or ignition component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they existed.**



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# IMPORTANT INFORMATION

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**1  
A**

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# How To Use This Manual

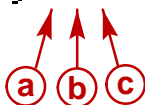
This manual is divided into sections that represent major components and systems. Some sections are further divided into parts that more fully describe the component. Sections and parts are listed at front of this manual.

## Page Numbering

Two number groups appear at the bottom of each page. Following is an example and description.

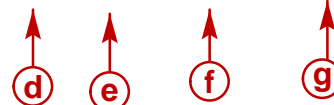
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Page 1A-2



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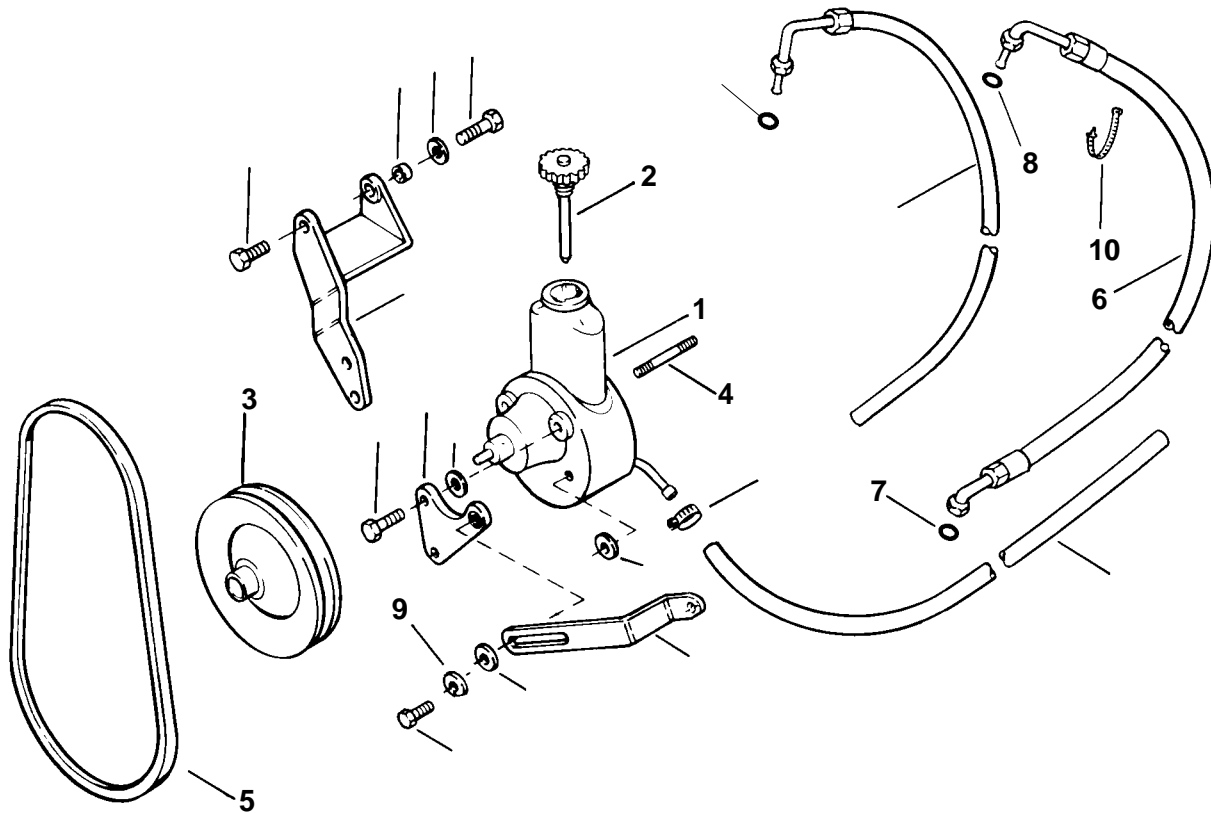
90-17431--4 FEBRUARY 1998



- a** - Section Number
- b** - Section Part
- c** - Page Number
- d** - Manual Part Number
- e** - Revision Number
- f** - Month Printed
- g** - Year Printed

# How to Read a Parts Manual

## Power Steering Pump Assembly



REF. NO.	PART NO.	SYM.	QTY.	DESCRIPTION
1	90507A12		1	PUMP ASSEMBLY-Power Steering
2	36- 95805		1	CAP
3	73873A1		1	PULLEY
4	16- 41877		1	STUD
5	57- 65607T		1	V-BELT
6	32- 806684		1	HOSE-Pressure <b>(FITTINGS ON BOTH ENDS)</b>
7	25- 89879		1	O-RING
8	25- 806232		1	O-RING
9	13- 35048		1	LOCKWASHER (3/8 in.)
10	61990		1	CABLE TIE

**REF. NO. :** Number shown next to part on exploded view

**PART NO. :** Mercury Part Number for ordering. If NSS (not sold separately) sometimes GM part number will be given in description column.

**QTY. :** The quantity that must be ordered.

**DESCRIPTION :** Description of part, what parts are included with a part (all indented items come with the main item above the indented parts), serial number information, and special information.

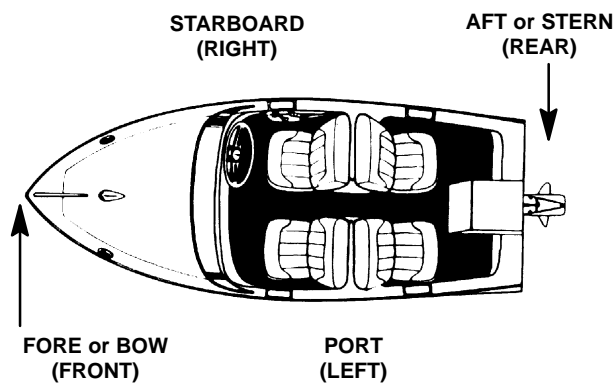
# Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the MerCruiser models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment, to enable dealers and service mechanics to repair these products.

Before attempting repairs, that procedure should first be read through to help understand the methods and tools used and the cautions and warnings required for safety.

## Directional References

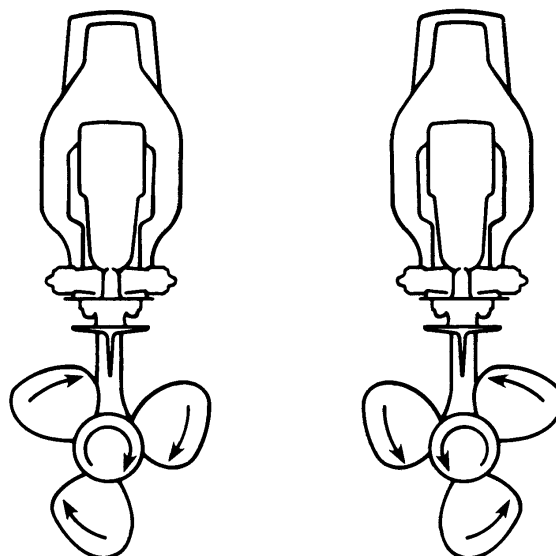
Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this service manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.



72000

## Propeller Rotation

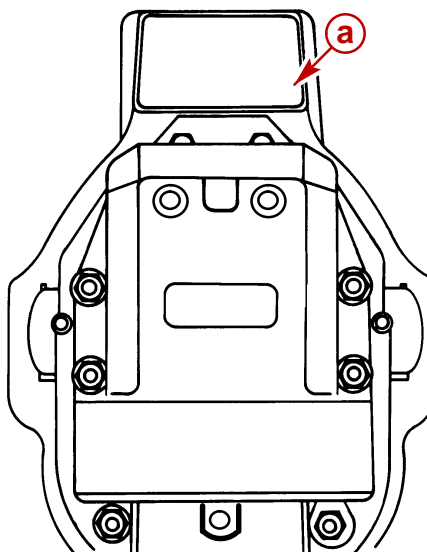
Propeller rotation for sterndrive can be right hand or left hand rotation as viewed from the aft end of the propeller.

**Right Hand Rotation****Left Hand Rotation**

## Sterndrive Unit 10-Hour Break-In Period (New or With Replacement Gears)

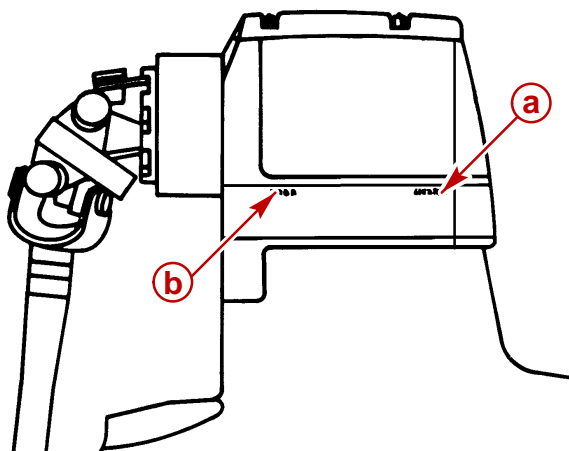
1. Avoid full throttle starts.
2. DO NOT operate at any one constant speed for extended periods of time.
3. DO NOT exceed 75% of full throttle during the first 5 hours. During the next 5 hours, operate at intermittent full throttle.
4. Drive unit should be shifted into forward gear a minimum of 10 times during break-in, with run-in time at moderate rpm after each shift.

## Serial Number Locations and Engine Designation Decal



**Transom Assembly Serial Number Location**

**a** - Transom Assembly Serial Number



**Sterndrive Unit Serial Number Location - Port Side Decal**

**a** - Sterndrive Unit Serial Number

**b** - Sterndrive Unit Gear Ratio

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# IMPORTANT INFORMATION

## Section 1B - Maintenance

**1  
B**

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## Lubricants / Sealants / Adhesives

Description	Part Number
Quicksilver 4-Cycle 25W-40 Marine Engine Oil	92-802837A1
SAE 20W, 30W Or 40W Engine Oil	Obtain Locally
Quicksilver High Performance Gear Lube	92-802854A1
Extended Life Ethylene Glycol Antifreeze	Obtain Locally
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver Engine Coupler Spline Grease	92-802869A1
Quicksilver Corrosion Guard Spray	92-802878 55
Quicksilver 2-4-C Marine Lubricant With Teflon	92-825407A3
Quicksilver U-Joint and Gimbal Bearing Grease	92-828052A2
Quicksilver Power Trim And Steering Fluid	92-802880A1
Exxon Unirex EP 2 Grease	Obtain Locally

Approved Hydraulic Steering Fluids	Quicksilver Hydraulic Fluid	64-826485A1
	Texaco® H015	92-862014A1
	SeaStar® Hydraulic Fluid HA5430	Obtain Locally
	Chevron® Aviation Fluid A	
	Mobil® Aero HFA	
	Shell® Aero 4	
	Fluid meeting MIL Specification H5606C	



# Maintenance Schedules

## Maintenance Intervals

Maintenance intervals and tasks, as shown in this schedule, or as found in previously printed schedules, are based on an average boating application and environment. However, individual operating habits and personal maintenance preferences can have an impact on the suggested intervals. In consideration of these factors, Mercury MerCruiser has adjusted some maintenance intervals and corresponding tasks to be performed. In some cases, this may allow for more tasks to be performed in a single visit to the servicing dealer, rather than multiple visits. Therefore, the boat owner and servicing dealer must discuss the current Maintenance Schedule and develop appropriate maintenance intervals to coincide with the individual operating habits, environment and maintenance requirements.

### CAUTION

**Always disconnect battery cables from battery BEFORE working around electrical systems components to prevent injury to yourself and damage to electrical system should a wire be accidentally shorted.**

## Gas Sterndrive

### Routine Maintenance \*

	Each Day Start	Each Day End	Weekly	Every Two Months
Check crankcase oil (interval can be extended based on experience).	●★			
If operating in salt, brackish or polluted waters, flush cooling system after each use.		●★		
Check sterndrive unit oil level, trim pump oil level and steering fluid level.			●★	
Check water pickups for debris or marine growth. Check water strainer and clean. Check coolant level.			●★	
Inspect sterndrive unit anodes and replace if 50 percent eroded.			●★	
Inspect fuel pump sight tube (if equipped) and have pump replaced if fuel is present.			●★	
Check battery connections and fluid level.				●★
Lubricate propeller shaft and the retorque nut (if operating in only freshwater, this maintenance may be extended to every four months).				●★
Operating in saltwater only: treat engine surface with corrosion guard.				●★

\* Only perform maintenance that applies to your particular power package

● Standard Models

★ Horizon Models

# Gas Sterndrive(Continued)

<b>Scheduled Maintenance *</b>						
	Annually	Every 100 hours or Annually	Every 200 hours or 3 years	Every 300 hours or 3 years	Every 2 years	Every 5 years
Touch-up power package paint and spray with Corrosion Guard.	●★					
Change crankcase oil and filter.		●★				
Change sterndrive unit oil and retorquing connection of gimbal ring to steering shaft.		●★				
Replace fuel filter(s).		●★				
Check steering system and remote control for loose, missing or damaged parts. Lubricate cables and linkages.		●★				
Inspect U-joints, splines and bellows. Check clamps. Check engine alignment. Lubricate U-joints splines.		●	★			
Lubricate gimbal bearing and engine coupler.		● <sup>8</sup>	★			
Check continuity circuit for loose or damaged connections. Test MerCathode® unit output on Bravo Models.		●	★			
Retorque engine mounts.		●		★		
Check spark plugs, wires, distributor cap and ignition timing. Check and adjust idle speed.		●		★		
Clean flame arrestor and crankcase ventilation hoses. Replace PCV valve.		●		★		
Check electrical system for loose, damaged or corroded fasteners.		●		★		
Inspect condition and tension of belts.		●		★		
Check cooling system and exhaust system hose clamps for tightness. Inspect both systems for damage or leaks.		●		★		
Disassemble and inspect seawater pump and replace worn components.		●		★		
Clean seawater section of closed cooling system. Clean, inspect and test pressure cap.		●		★		
Replace coolant.					♠	●★

\* Only perform maintenance that applies to your particular power package

● Standard Models

★ Horizon Models

◆ Whichever Occurs First

♠ Interval will be reduced if not using extended life coolant.

<sup>8</sup> Lubricate engine coupler every 50 hours if operated at idle for prolonged periods of time.

# Specifications

## Torque Specification

Fastener Location	lb-in.	lb-ft	Nm
Sterndrive Unit Fill/Drain Plug	40		4.5
Sterndrive Unit Vent Plug	40		4.5

We recommend the use of Quicksilver Maintenance Products where specified.

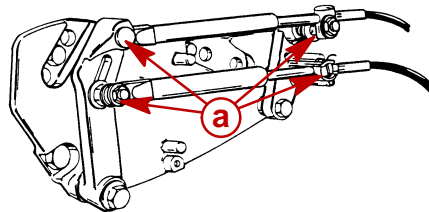
## Fluid Capacities

NOTICE			
Unit Of Measurement: U.S. Quarts (Liters)			
All capacities are approximate fluid measures.			

Model	Bravo One	Bravo Two	Bravo Three
Sterndrive Unit Oil Capacity	88 (2603)	104 (3076)	96 (2839)

## Lubrication

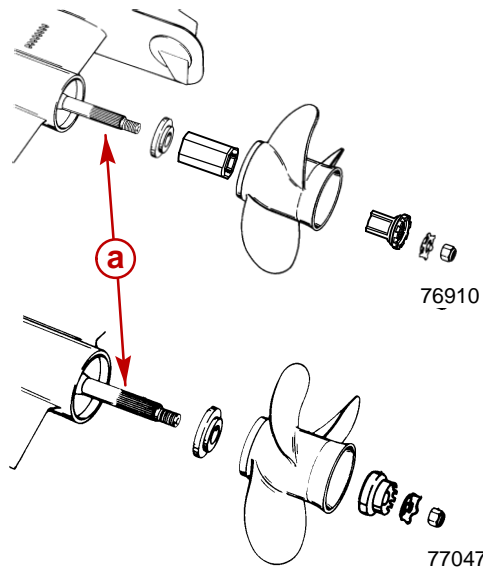
### Shift Cable Pivot Points



**a** - Pivot Points

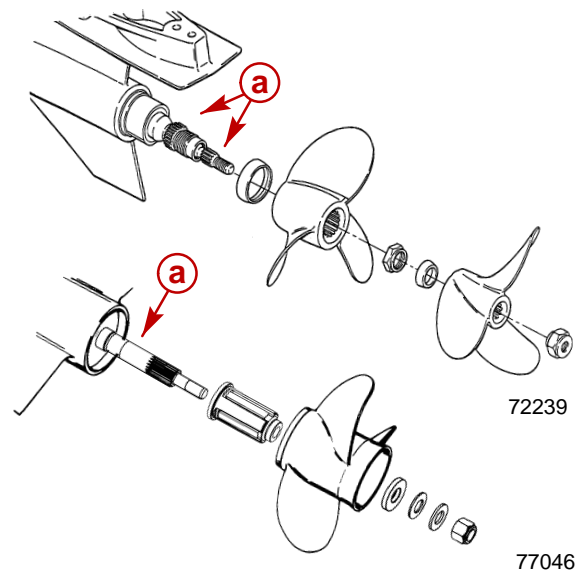
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## Propeller Shaft



**Bravo One / Bravo Two Sterndrives**

**a** - Propeller Shaft

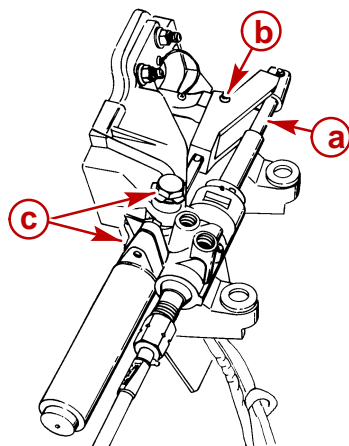


**Bravo Three Sterndrive/ Bravo XZ & XR**

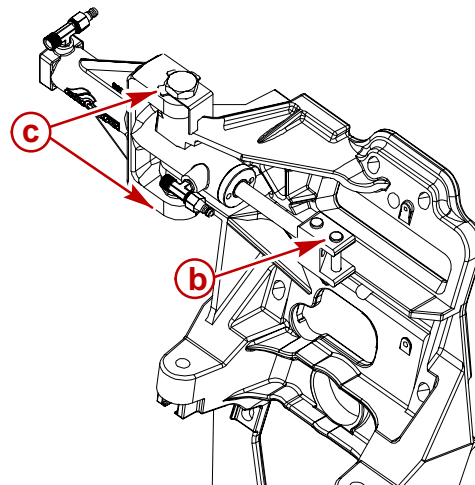
## Steering System

### ⚠ WARNING

Transom end 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.



71901



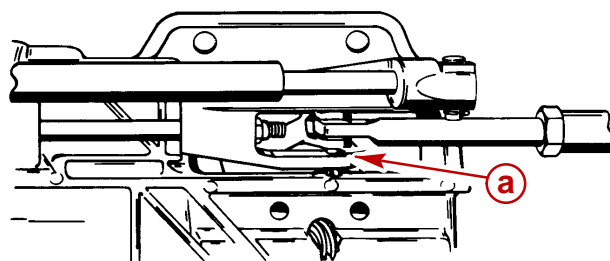
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### Control Valve

- a** - Steering Cable End
- b** - Pivot Point
- c** - Pivot Bolts
- d** - Adjusting Slots

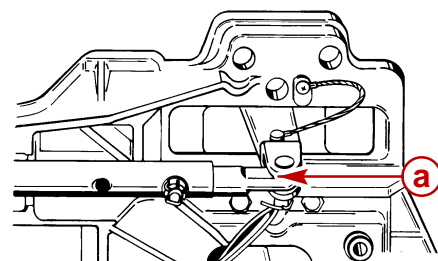
## Tie Bar Pivot Points

### MODELS WITH CONTROL VALVE MOUNTED ON STARBOARD TRANSOM ASSEMBLY



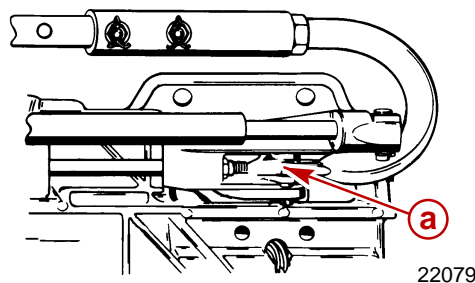
**Starboard Engine**

**a** - Pivot Point



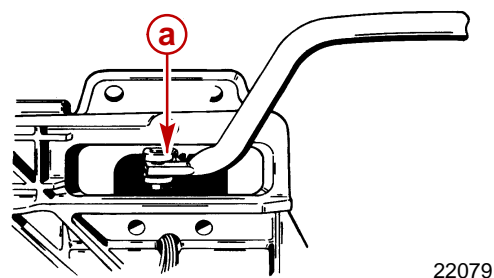
**Port Engine**

### MODELS WITH CONTROL VALVE MOUNTED ON PORT TRANSOM ASSEMBLY



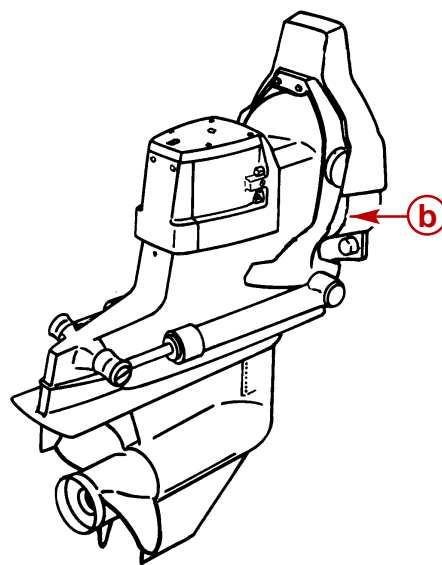
**Starboard Engine**

**a** - Pivot Point



**Port Engine**

## Transom Gimbal Housing Assembly Swivel Shaft and Gimbal Bearing



**a** - Gimbal Bearing Grease Fitting

50072

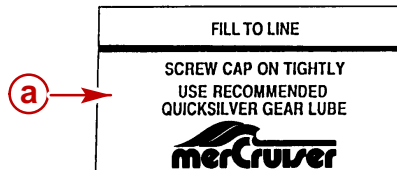
## Checking and Adding Sterndrive Oil

**IMPORTANT:** Position sterndrive unit in DOWN/IN position so that anti-ventilation plate is level.

### ⚠ CAUTION

If more than 2 fl. oz. (59 ml) of oil is required to fill sterndrive unit, an oil leak may exist. Find and correct cause of leak before unit is placed in operation.

**NOTE:** Sterndrive unit oil level is checked at gear lube monitor.

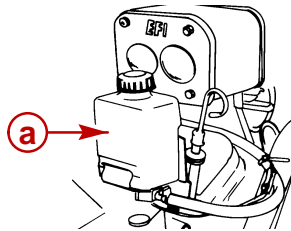


50323

**a** - Gear Lube Monitor Decal

**IMPORTANT:** Oil level in gear lube monitor will rise and fall during sterndrive operation; always check oil level when sterndrive is cool and engine is shut down.

**NOTE:** Drive oil will purge from gear lube monitor if rubber seal is not in cap.



71990

**a** - Gear Lube Monitor

1. Fill gear lube monitor to FULL line on decal.
2. Ensure rubber seal is in place on square gear lube monitor cap.
3. Install gear lube monitor cap. Tighten cap 1/4 turn after cap contacts seal.

**IMPORTANT:** Do **NOT** overtighten cap.

4. Check oil level in gear lube monitor.

## Inspection

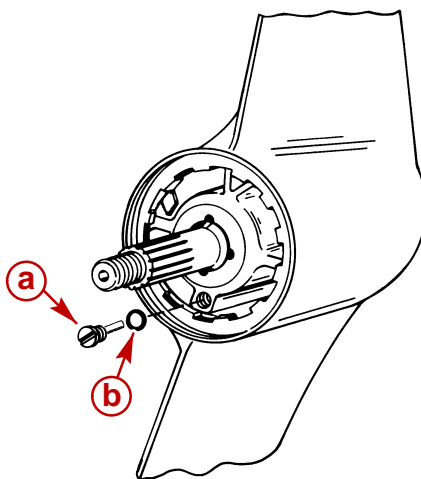
Periodically inspect lubricant for water to ensure that sterndrive unit seals are not leaking. Check for water at bottom of gear lube monitor. If a water leak is indicated the sterndrive unit must be resealed.

### ⚠ CAUTION

If more than 2 fl. oz. (59ml) of Quicksilver High Performance Gear Lube is required to fill gear lube monitor, a seal may be leaking. Find and correct cause of leak before unit is placed in operation.

**IMPORTANT:** If sterndrive unit has set overnight or longer, check for water in sterndrive unit, as follows:

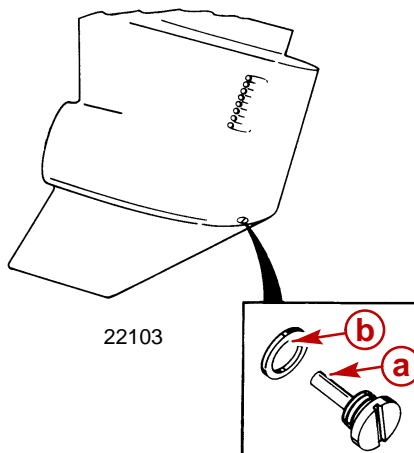
1. **Bravo I:** Trim sterndrive unit to full DOWN/IN position.



- a** - Oil Fill/Drain Plug
- b** - Sealing Washer

70023

2. **Bravo II and III:** Trim sterndrive unit to full UP/OUT position.



- a** - Oil Fill/Drain Plug
- b** - Sealing Washer

3. Remove fill/drain plug to sample lubricant. If water runs out sterndrive unit is leaking and **must** be resealed.
4. Reinstall fill/drain plug. Torque to 40 lb-in. (4.5 Nm).

# Changing Sterndrive Oil

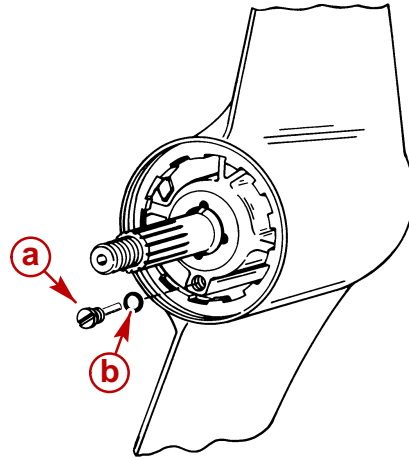
## ⚠ CAUTION

If any water drains from fill/drain hole a leak in sterndrive unit may exist. Find and correct cause of leak before placing unit back in operation.

## ⚠ CAUTION

DO NOT attempt to fill sterndrive unit through oil vent holes, as air will be trapped in sterndrive unit and unit will be damaged from lack of lubrication.

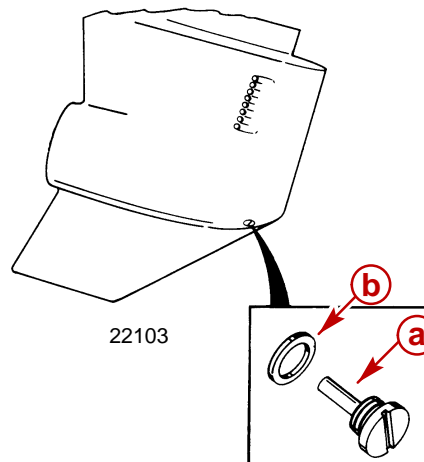
1. **Bravo I:** Trim sterndrive unit to full DOWN/IN position.



70023

- a** - Oil Fill/Drain Plug  
**b** - Sealing Washer

2. **Bravo II and III:** Trim sterndrive unit to full UP/OUT position.



22103

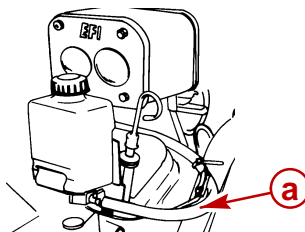
22101

- a** - Oil Fill/Drain Plug  
**b** - Sealing Washer

3. Remove sterndrive unit gear lube monitor from bracket.
4. Remove cap, empty contents of gear lube monitor into suitable container and discard.
5. Clean gear lube monitor thoroughly.
6. Return gear lube monitor to bracket. Do not refill at this time.



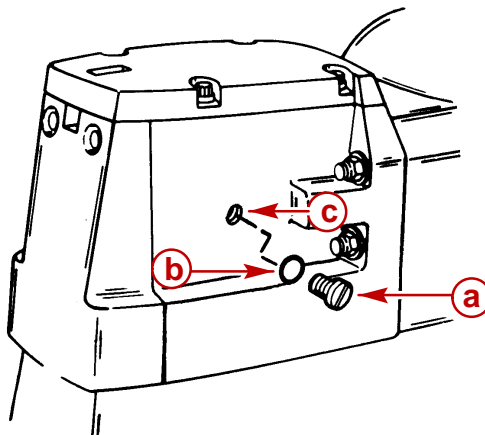
7. Check condition of hose and hose connections. Replace as necessary.



71990

**a** - Gear Lube Monitor

8. Remove sterndrive unit vent plug and fill/drain plug. Allow lubricant to drain completely.
9. If sterndrive unit is draining in full DOWN/IN position, trim to full UP/OUT position after draining drain any remaining oil from internal driveshaft housing ledges.
10. Trim sterndrive unit to full DOWN/IN position (with anti-ventilation plate level) to complete draining process.



**a** - Oil Vent Plug  
**b** - Sealing Washer  
**c** - Vent Hole

11. Using lubricant pump, fill sterndrive unit through fill/drain hole with lubricant until oil is even with bottom edge of vent hole.
12. Without removing lubricant pump fitting from fill/drain hole, reinstall oil vent plug and sealing washer. Torque to 40 lb-in. (4.5 Nm).
13. Continue filling drive until there is one inch of oil in the gear lube monitor.
14. Remove lubricant pump fitting and quickly reinstall fill/drain plug and sealing washer. Torque to 40 lb-in. (4.5 Nm).

**NOTE:** Drive oil will purge from square gear lube monitor if rubber seal is not in cap.

15. Fill gear lube monitor to FULL line on decal.
16. Ensure rubber seal is in place on gear lube monitor cap.
17. Install gear lube monitor cap.

**IMPORTANT:** Do **NOT** overtighten cap.

18. Check oil level in gear lube monitor.
19. Recheck oil level after first use.

# General Maintenance

## Maintaining Power Package Exterior Surfaces

Entire power package should be sprayed at recommended intervals with Quicksilver Corrosion Guard. Follow instructions on can for proper application.

Entire power package should be cleaned and external surfaces that have become bare should be repainted with Quicksilver Primer and Spray Paint at recommended intervals.

## Steering Head and Remote Control Maintenance

Lubricate steering head and remote control with 2-4-C Marine Lubricant with Teflon. Inspect steering head and remote control for ease of operation.

## Checking Quicksilver MerCathode System

If boat is equipped with a Quicksilver MerCathode System, system should be tested to ensure that it is providing adequate output to protect underwater metal parts on boat. Test should be made where boat is moored, using Quicksilver Reference Electrode and Test Meter. Refer to SECTION 7.

## Maintaining Anodic Plate

Each sterndrive unit is equipped with a sacrificial anodic plate to help protect underwater metal parts from galvanic corrosion. Because of its self-sacrificing nature, anodic plate **MUST BE** replaced if eroded 50% or more. Refer to SECTION 7.

## Boat Bottom Care

To achieve maximum performance and fuel economy, boat bottom **MUST BE** kept clean. Accumulation of marine growth or other foreign matter can greatly reduce boat speed and increase fuel consumption. To ensure best performance and efficiency, periodically clean boat bottom in accordance with manufacturer's recommendations.

In some areas, it may be advisable to paint the bottom to help prevent marine growth. Refer to the following information for special notes about the use of anti-fouling paints.

## Anti-fouling Paint

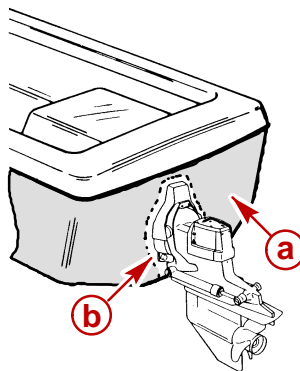
**IMPORTANT: Corrosion damage that results from the improper application of anti-fouling paint will not be covered by the limited warranty.**

**Painting Boat Hull or Boat Transom:** Anti-fouling paint may be applied to boat hull and boat transom but you must observe the following precautions:

**IMPORTANT: DO NOT paint anodes or MerCathode System reference electrode and anode, as this will render them ineffective as galvanic corrosion inhibitors.**

**IMPORTANT:** If anti-fouling protection is required for boat hull or boat transom, copper or tin base paints, if not prohibited by law, can be used. If using copper or tin based anti-fouling paints, observe the following:

- Avoid an electrical interconnection between the Mercury MerCruiser Product, Anodic Blocks, or MerCathode System and the paint by allowing a minimum of 1-1/2 in. (40 mm) UNPAINTED area on transom of the boat around these items.



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**a** - Painted Boat Transom

**b** - Minimum 1-1/2 in (40 mm) UNPAINTED Area Around Transom Assembly

**NOTE:** Sterndrive unit and transom assembly can be painted with a good quality marine paint or an anti-fouling paint that DOES NOT contain copper, tin, or any other material that could conduct electrical current. Do not paint drain holes, anodes, MerCathode system and items specified by boat manufacturer.

## Maintaining Ground Circuit Continuity

The transom assembly and sterndrive unit are equipped with a ground wire circuit to ensure good electrical continuity between engine, transom assembly and sterndrive components. Good continuity is essential for the MerCathode System to function effectively. Refer to SECTION 7.

## Power Package Layup

### Engine

Refer to appropriate Engine Service Manual.

### Sterndrive

1. Lubricate steering system. Refer to SECTION 6.
2. Lubricate transom gimbal bearing and propeller shaft. Refer to SECTION 4 and SECTION 1B.
3. Lubricate sterndrive unit U-joint shaft splines and cross bearings. Refer to SECTION 3A.
4. Inspect U-joint bellows for cracks or other signs of deterioration. Check bellows clamps for tightness. Refer to SECTION 4.
5. Check engine alignment. Refer to Engine Service Manual.
6. Change sterndrive unit oil. Refer to SECTION 1B.
7. Inspect sterndrive for damage. Repair or replace damaged components.
8. Clean sterndrive exterior surfaces and repaint any bare metal surfaces with Quicksilver Primer and Spray Paint. Refer to SECTION 1B.

9. After paint has dried, spray entire sterndrive with Quicksilver Corrosion Guard. Refer to SECTION 1B.

### CAUTION

**Store sterndrive unit in the full trim DOWN/IN position. U-joint bellows may develop a “set” if unit is stored in raised position and may fail when unit is returned to service.**

10. If not already done, place sterndrive unit in the full trim DOWN/IN position.
11. Store battery. Refer to battery manufacturer's instructions.

## Power Package Recommissioning

### Engine

Refer to appropriate Engine Service Manual.

### Sterndrive

1. Perform ALL maintenance specified for completion “Annually” in “Maintenance Chart” except items which were performed at the time of sterndrive layup.
2. Install fully-charged battery.
3. Clean battery cable clamps and terminals.
4. Reconnect battery cables. Be sure to tighten clamps securely.
5. Apply a thin coat of petroleum based grease to clamps and terminals to help retard corrosion.
6. After recommissioning and starting engine, check steering system and shift control for proper operation.

# IMPORTANT INFORMATION

## Section 1C - Troubleshooting

**1  
C**

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# Troubleshooting

This section is a guide for performance and product troubleshooting. Referrals to specific sections of this manual are made where special tests or repair procedure are to be performed.

Because of the relationship between Power Package components (engine and sterndrive), it will be necessary in some cases to simultaneously refer to the appropriate Engine Service Manual for further troubleshooting information.

Effective troubleshooting is best enhanced by:

- Personal product knowledge and experience of the trained mechanic/technician.
- Allowing adequate time for testing and analysis.
- Utilizing these charts as a “guide” - a starting point.

## Sterndrive Unit Troubleshooting

### Sterndrive Unit Will Not Slide Into Bell Housing

Cause	Special Instructions
U-joint shaft splines not aligned with engine coupler splines.	Rotate propeller shaft COUNTERCLOCKWISE to align splines.
Engine not aligned.	Check engine alignment.
Gimbal bearing not properly installed.	Check engine alignment to determine if gimbal bearing is cocked or improperly installed in gimbal housing.
Damaged U-joint shaft splines and/or engine coupler splines.	Inspect and replace if necessary.

### Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Moves

**NOTE:**For additional information on troubleshooting, refer to SECTION 2A and see “Troubleshooting Shift Problems.”

Cause	Special Instructions
Shift cables improperly adjusted.	Adjust shift cables.
Shift cables not connected.	Install and adjust shift cables.
Inner core wire broken or loose.	Reconnect or replace inner core wire.

## Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Does Not Move

**NOTE:**For additional information on troubleshooting, refer to SECTION 2A and see "Troubleshooting Shift Problems."

Cause	Special Instructions
Control box not properly assembled.	Properly reassemble control box.
Broken or damaged linkage in control box.	Repair linkage.
Controls improperly adjusted-cable end guide hitting brass barrel.	Adjust shift cables.

## Drive Unit Shifts Hard

**NOTE:**For additional information on troubleshooting, refer to SECTION 2A and see "Troubleshooting Shift Problems."

Cause	Special Instructions
Shift cables improperly adjusted.	Adjust shift cables.
Damaged remote control or drive unit shift cable.	Replace cable(s) and adjust.
Shift cable too short (sharp bends) or too long (loops and long bends).	Select and install proper length cable.
Corroded shift cables.	Replace, adjust and check for water leakage.
Internal wear in remote control box.	Repair as needed.
Shift cable attaching nuts too tight (end cannot pivot).	Properly install nuts.
Shift cable pivot ends are corroded or not lubricated.	Clean and lubricate.

## Drive Unit In Gear, Will Not Shift Out Of Gear

**NOTE:**For additional information on troubleshooting, refer to SECTION 2A and see "Troubleshooting Shift Problems."

Cause	Special Instructions
Shift cable broken.	Replace cable and adjust.
Cable end not connected in drive unit.	Remove and reinstall drive unit.
Remote control damaged.	Repair or replace remote control.
Internal shift mechanism damage.	Repair or replace as necessary.

## Gear Housing Noise

Cause	Special Instructions
Metal particles in drive unit lubricant.	Disassemble, clean and inspect and replace necessary components. (Refer to SECTION 3B, 3C or 3D)
Propeller incorrectly installed.	Inspect mounting hardware. Install propeller correctly.
Propeller shaft bent.	Inspect and replace if necessary. (Refer to SECTION 3B, 3C or 3D)
Incorrect gear shimming.	Check gear housing backlash and pinion gear height. (Refer to SECTION 3B, 3C or 3D)
Worn or damaged gears and/or bearings caused by impact, overheating or improper shimming.	Disassemble, inspect and replace. (Refer to SECTION 3B, 3C or 3D)

## Drive Shaft Housing Noise

Cause	Special Instructions
Engine flywheel housing contacting inner transom plate or exhaust pipe.	Determine cause for interference (loose engine mounts, transom too thin, etc.) and correct as necessary.
Propeller with untrue or out-of-balance blades.	Repair or replace, as required.
Abnormal sterndrive operation.	Instruct operator on proper operating technique.
U-joint cross and bearing assembly retaining rings improperly installed or of incorrect size.	Make sure that proper thickness retaining rings are used and that rings are fully seated in u-joint bearing cap grooves. (Refer to SECTION 3A)
Excessive side-to-side play in U-joint cross and bearing assemblies.	Replace cross and bearing assembly.
U-joint bearing caps contacting U-joint bellows retention sleeve.	Make sure proper cross and bearing assemblies are used. If interference is severe, replace cross and bearing assembly and / or sleeve assembly.
U-joint cross and bearings rough.	Replace assemblies. Signs of scoring, galling or roughness are the result of lack of lubricant. (Refer to SECTION 3A)
O-rings missing or flattened out on U-joint shaft causing shaft to rattle against ID of gimbal bearing.	Install new o-rings. (Refer to SECTION 3A)



## Drive Shaft Housing Noise (Continued)

Cause	Special Instructions
Worn U-joint shaft splines and/or engine coupler splines.	Remove U-joint coupling end yoke and insert into gimbal bearing and engine coupling. Rotate shaft back and forth. If play is excessive, replace U-joint coupling end yoke and/or engine coupler, as necessary.
Engine alignment incorrect or engine coupler crooked.	Adjust alignment. Ensure that alignment tool moves in and out of coupler freely. After proper alignment has been obtained, check for a crooked coupler by rotating engine coupler 1/2 turn and rechecking alignment. If proper alignment is no longer observed, coupler is crooked and must be replaced. (Refer to SECTION 2)
Gimbal bearing rough.	Replace gimbal bearing. (Refer to SECTION 4) <b>IMPORTANT: Gimbal bearing and carrier MUST BE replaced as an assembly because they are a matched set. Failure to do this may result in a loose bearing fit in carrier.</b>
Loose gimbal bearing.	Reinstall bearing assembly using a new tolerance ring if carrier is loose in gimbal housing. If bearing is loose in carrier, bearing assembly must be replaced. (Refer to SECTION 4)
Gimbal bearing not fully seated in gimbal housing.	Drive bearing assembly into place.
Excessive clearance between gimbal ring and gimbal housing. This could cause misalignment between bell housing and gimbal housing and also may allow gimbal ring to vibrate up and down.	Check and adjust clearance. (Refer to SECTION 4)
Improperly installed or failed rear engine mounts. This will affect engine alignment, but usually is not detectable with engine alignment tool.	Check for uneven mount height, or loose or soft mounts. Make sure there is clearance between flywheel housing and fiber washer. If no clearance exists, mounts have probably sagged. Install mounts correctly or replace, as necessary.

## Drive Shaft Housing Noise (Continued)

Cause	Special Instructions
Boat transom too thin. <b>Thickness:</b> 2 in. (51mm) minimum, 2-1/4 in. (57mm) maximum.	Add thickness to transom.
Boat transom thickness uneven. This could affect engine to transom assembly alignment and is usually not detectable with alignment tool. <b>Variation:</b> 1/8 in. (3mm) maximum.	Repair boat as necessary.
Bell housing contacting gimbal ring. This would cause knocking in the fully trimmed IN position only.	Check for soft or split trim cylinder bushings and loose or worn hinge pin bushings. (Refer to SECTION 5B)
Stringer height uneven or transom assembly installed cocked on boat transom. This will affect engine alignment, but is usually not detectable with alignment tool.	Measure the distance between the engine flywheel housing and the inner transom plate on both sides. If distances are uneven, the problem may be due to uneven stringer height or a cocked transom assembly. Adjust the stringer height or relocate the transom cutout as required.
Weak boat transom or boat bottom that flexes under power and causes engine misalignment - this condition will usually cause engine coupler failure.	This condition can sometimes be detected by having someone apply force to the top of the drive unit while watching the inner transom plate. If movement can be observed, the transom is weak and must be repaired.
Rear engine mount attaching hardware improperly installed or missing.	Reinstall hardware correctly.
Engine mounting holes drilled off-center in inner transom plate engine supports or engine flywheel housing	Make sure the holes are equally spaced fore and aft and are equal distance from the centerline.
Misalignment between bell housing, gimbal housing and engine coupler.	Contact your service center and arrange to have a technical service representative check the unit using a special gauge.

# Power Shift

## System Does Not React

Cause	Special Instructions
Vacuum leaks.	With engine running, check for vacuum leaks. Squirt oil on fitting and hose connections and on the shift cylinder-to-end plate joint. If oil is sucked in at any point, a vacuum leak exists. Repair leak.
Improper installation.	Reinstall.

## System Binds

Cause	Special Instructions
Remote control.	Disconnect input cable at power shift cylinder. Disconnect throttle cable at carburetor or injector pump. Operate remote control. If binding occurs, find cause of binding in either cable or remote control and correct binding. If no binding occurs, check vacuum.
Slow or no shift.	Check vacuum drop-off. If vacuum drops off to "0" psi in less than 5 seconds, install repair kit.
Cable movement.	Check movement of cable from shift plate to drive unit including shifting linkage movement in drive unit for binding. Replace or adjust shift cable following procedures in SECTION 2A.

# Performance Troubleshooting

## Low WOT Engine RPM

Cause	Special Instructions
Improper drive unit trim angle.	Properly adjust drive unit trim angle.
Damaged propeller.	Repair or replace.
Improper propeller pitch.	Water test boat using a lower pitch propeller.
Dirty or damaged boat bottom.	Clean and/or resurface boat bottom.
Drive installation too low on transom.	Contact boat manufacturer for installation specifications.
Permanent "hook" in boat bottom (some boats are built with a slight "hook" for correct boat performance).	Check for a hook in the boat bottom by placing a straight edge, at least 6 ft. (2m) long, under the bottom edge of the transom. If a hook is found, contact the boat manufacturer.
"Power hook" or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

## High WOT Engine RPM

Cause	Special Instructions
Propeller ventilating.	Determine cause for ventilation.
Improper propeller pitch.	Water test boat using a higher pitch propeller.
Propeller hub slipping.	Replace hub or replace propeller.
Drive installation too high on transom.	Contact boat manufacturer for installation specifications.
Engine coupler hub spun.	Replace coupler.

## Propeller Ventilating/Cavitating

Cause	Special Instructions
Drive unit trimmed too high.	Trim drive unit IN/DOWN.
Incorrect propeller.	Install correct propeller.

## Poor Boat Performance And/Or Poor Maneuverability-Bow Too Low

Cause	Special Instructions
Improper drive unit trim angle.	Properly adjust drive unit trim angle.
Boat is bow heavy.	Redistribute boat load to stern. If bow overweight is caused by permanently installed fuel tank(s), contact the boat manufacturer.
Boat is underpowered.	Check horsepower to weight ratio. Contact the boat manufacturer.
Permanent hook in boat bottom (some boats are built with a slight hook for correct boat performance).	Check for a hook in the boat bottom by placing a straight edge, at least 6 ft. (2m) long, under the bottom edge of the transom. If a hook is found, contact the boat manufacturer.
Power hook or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

## Poor Boat Performance And/Or Poor Maneuverability-Bow Too High

Cause	Special Instructions
Improper drive unit trim angle.	Properly adjust drive unit trim angle.
Boat is stern heavy.	Redistribute boat load to bow. If stern overweight is caused by permanently installed fuel tank(s), contact the boat manufacturer.
Propeller pitch too high.	Water test the boat using a lower pitch propeller.
Permanent rocker in boat bottom (some boats are built with a slight rocker for correct boat performance).	Check for a rocker in the boat bottom by placing a straight edge, at least 6 ft. (2m) long, under bottom edge of the transom. If a rocker is found, contact the boat manufacturer.
Power hook or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

## Power Steering

### Hard Steering - Helm And Cable

Cause	Special Instructions
Damaged steering cable.	Replace cable. (Refer to SECTION 2)
Steering cable too short (sharp bends) or too long (loops and long bends).	Select and install proper length cable. (Refer to SECTION 2A)
Steering cable corroded or not lubricated.	Lubricate or replace the cable.
Over-lubed cable.	Replace cable.
RideGuide™ rack or rotary head not lubricated.	Disassemble and lubricate.

### Hard Steering (Engine Running) - Power Steering System

Cause	Special Instructions
Low power steering pump fluid level.	Check fluid level. (Refer to SECTION 6A)
Loose power steering pump drive belt.	Adjust belt tension. (Refer to SECTION 6A)
Air in system.	Cycle to remove air. (Refer to SECTION 6A)
Fluid leak.	Locate and correct source of leak. (Refer to SECTION 6A)
If the above 4 steps do not solve the problem, test the power steering system.	Test power steering system. (Refer to SECTION 6A)

### Power Steering System External Fluid Leaks

Cause	Special Instructions
Pump reservoir leaking at fill cap (reservoir too full).	Remove fluid to bring to proper level.
Pump reservoir leaking at fill cap (air or water in fluid).	Locate source of air or water and correct. Air may enter because of low reservoir fluid level or internal pump leak. Test pump. (Refer to SECTION 6A)
Loose hose connections.	Tighten hose connections.
Damaged hose.	Replace hose.
Bad cylinder piston rod seal.	Replace cylinder.
Damaged or worn control valve seals.	Replace cylinder.
Bad power steering pump seals and O-rings.	Repair pump. (Refer to SECTION 6A)
Cracked or porous metal parts.	Replace part(s).

# Compact Hydraulic Steering

## Important Information

Whenever a troubleshooting solution calls for removal from vessel and/or dismantling of steering system components, such work must be carried out by a qualified marine mechanic. The following is offered as a guide only and neither Mercury MerCruiser nor the helm manufacturer are responsible for any consequences resulting from incorrect repairs.

Most faults occur when the installation instructions are not followed and usually show up immediately upon filling the system. The most common faults encountered and their likely cause and solution are provided in the following.

Sometimes when returning the steering wheel from a locked position, a slight resistance may be felt and a clicking noise may be heard. This should not be mistaken as a fault, as it is a completely normal situation caused by the releasing of the lockspool in the system.

### WARNING

**Avoid serious injury or death due to FIRE or EXPLOSION. Be sure that engine compartment is well ventilated and that no gasoline vapors are present to prevent the possibility of a FIRE or EXPLOSION.**

## Helm Becomes Jammed During Filling

Cause	Special Instructions
Blockage in the line between the helm(s) and the cylinder(s).	Make certain that hoses were not kinked or pinched during installation. If so, the hose must be removed and replaced.

## System Difficult To Fill

Cause	Special Instructions
Air in system.	Review filling instructions.

## Steering Hard To Turn

Cause	Special Instructions
Steering cylinder pivot bushings are too tight or trunion is bent, causing mechanical binding.	To test, disconnect clevis from steering lever and turn the steering wheel. If it now turns easy, correct cause of mechanical binding. Please note that excessively loose connections to steering cylinder or steering lever can also cause mechanical binding.
Restrictions in hoses.	Find restrictions and correct.
Air in hydraulic fluid.	See filling and purging instructions.
Wrong hydraulic fluid has been used to fill steering system.	Drain system and fill with approved hydraulic fluid.

## Helm Unit Bumpy - Requires Too Many Turns

Cause	Special Instructions
Dirt in inlet check of helm pump.	Replace helm unit.

# Power Trim Electrical System

**NOTE:** Refer to “Power Trim System Wiring Diagram.”

## Power Trim Pump Motor Will Not Run In The OUT/UP Or IN/DOWN Direction

### SOLENOIDS DO NOT CLICK

Cause	Special Instructions
Bad electrical connection at the 110 amp fuse or at the battery or the harness came unplugged from the pump	Check all electrical connection points
20 amp fuse blown.	Determine cause for the blown fuse and correct before replacing fuse. <b>NOTE:</b> If fuse blows while trimming OUT/UP or raising drive unit, problem may be due to grounded trim limit switch leads. To check for grounded condition, disconnect trim limit switch leads at bullet connector <b>14</b> , <b>15</b> , <b>16</b> and <b>17</b> . If drive unit can now be raised (using “Trailer” switch), trim limit switch or leads are grounded.
Power trim pump battery cables or wiring harness connections corroded or loose.	Clean and/or tighten connections <b>1</b> , <b>2</b> , <b>4</b> , <b>10</b> , <b>11</b> , <b>12</b> and <b>18</b> as necessary.
Trim control wiring harness connector loose or corroded.	Clean and secure connection <b>13</b> as necessary.
110 amp fuse blown (does not apply to intermittent problem).	Check for voltage at terminal <b>4</b> . If no voltage indicated, determine cause of blown fuse.
Open circuit in trim control wiring harness.	Check for battery voltage at terminal <b>8</b> while trimming OUT/UP and at terminal <b>6</b> while trimming OUT/UP. If no voltage is indicated, check trim control for a loose or corroded connection or a damaged power supply lead in harness.
Thermal circuit breaker in pump motor open.	Replace commutator end plate assembly.



## Power Trim Pump Motor Will Not Run In The OUT/UP Or IN/DOWN Direction

### BOTH SOLENOIDS CLICK

Cause	Special Instructions
Faulty solenoids or loose or corroded connections.	Check for battery voltage at terminals <b>5</b> while trimming OUT/UP. If no voltage is indicated, check connections <b>2, 3, 4</b> and <b>5</b> and/or replace solenoids.
Pump motor brushes stuck, corroded or worn out.	Clean or replace as required.
Armature commutator dirty.	Clean or replace armature as required.
Armature faulty.	Test for shorted, open or grounded condition and replace if needed.
Field and frame faulty.	Check for open or grounded condition. Replace field and frame assembly if needed.
Water or oil in motor.	Replace motor assembly.
Pump gears frozen.	Replace pump valve body and gear assembly.
Power trim pump harness or trim control harness shorted between OUT/UP and IN/DOWN circuit (pump trying to run in OUT/UP and IN/DOWN direction simultaneously).	Disconnect BLU/WHI lead from solenoid terminal <b>8</b> . If pump motor will now run in the OUT/UP direction, a short in the harness exists. Repair or replace harness as needed.

## Power Trim Pump Motor Runs In The OUT/UP Direction, But Not In The IN/DOWN Direction

### IN/DOWN SOLENOID DOES NOT CLICK

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections <b>6</b> and <b>7</b> and clean and/or tighten as required.
Open IN/DOWN circuit in trim control or pump wiring harness.	Check for battery voltage at terminal <b>6</b> while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead or a faulty OUT/UP trim switch. Repair or replace as required.
Solenoid faulty.	Replace solenoid.

## Power Trim Pump Motor Runs In The OUT/UP Direction, But Not In The IN/DOWN Direction

### IN/DOWN SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections <b>4</b> and <b>5</b> . Clean and/or tighten as necessary.
Faulty solenoid.	Check for battery voltage at terminal <b>5</b> while trimming IN/DOWN. If no voltage is indicated, replace solenoid.
Faulty IN/DOWN field winding.	Replace field and frame assembly.

## Power Trim Pump Motor Runs In The IN/DOWN Direction, But Not In The OUT/UP Direction-Both Trim And Trailer Switches Inoperative-

### OUT/UP SOLENOID DOES NOT CLICK

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections <b>8</b> and <b>9</b> . Clean and/or tighten as necessary.
Open OUT/UP circuit trim control or pump wiring harness.	Check for battery voltage at terminal <b>8</b> while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, blown fuse (if trim control is equipped), damaged OUT/UP circuit lead or a faulty OUT/UP trim switch. Repair or replace as necessary.
Faulty solenoid.	Replace solenoid.

## Power Trim Pump Motor Runs In The IN/DOWN Direction, But Not In The OUT/UP Direction-Both Trim And Trailer Switches Inoperative

### OUT/UP SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections <b>2</b> and <b>3</b> . Clean and/or tighten as necessary.
Faulty solenoid.	Check for battery voltage at terminal <b>3</b> while trimming OUT/UP. If no voltage is indicated, replace solenoid.
Faulty OUT/UP field winding.	Replace solenoid.

## Trim Control OUT/UP Trim Switch Inoperative

### TRAILER SWITCH OPERATES

Cause	Special Instructions
Trim limit switch lead bullet connectors loose or corroded.	Clean and/or tighten connections <b>14</b> , <b>15</b> , <b>16</b> and <b>17</b> as necessary.
Faulty trim limit switch or leads.	Disconnect trim limit switch leads from trim harness. Connect a continuity meter between leads <b>16</b> and <b>17</b> . Continuity should be indicated with drive unit in full IN/DOWN position. If not, check for damaged leads or poor connections. If this is not the cause, replace limit switch.
Open trim control OUT/UP circuit.	Check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead or faulty OUT/UP trim switch. Repair or replace as necessary.

## Trim Control Trailer Switch Inoperative

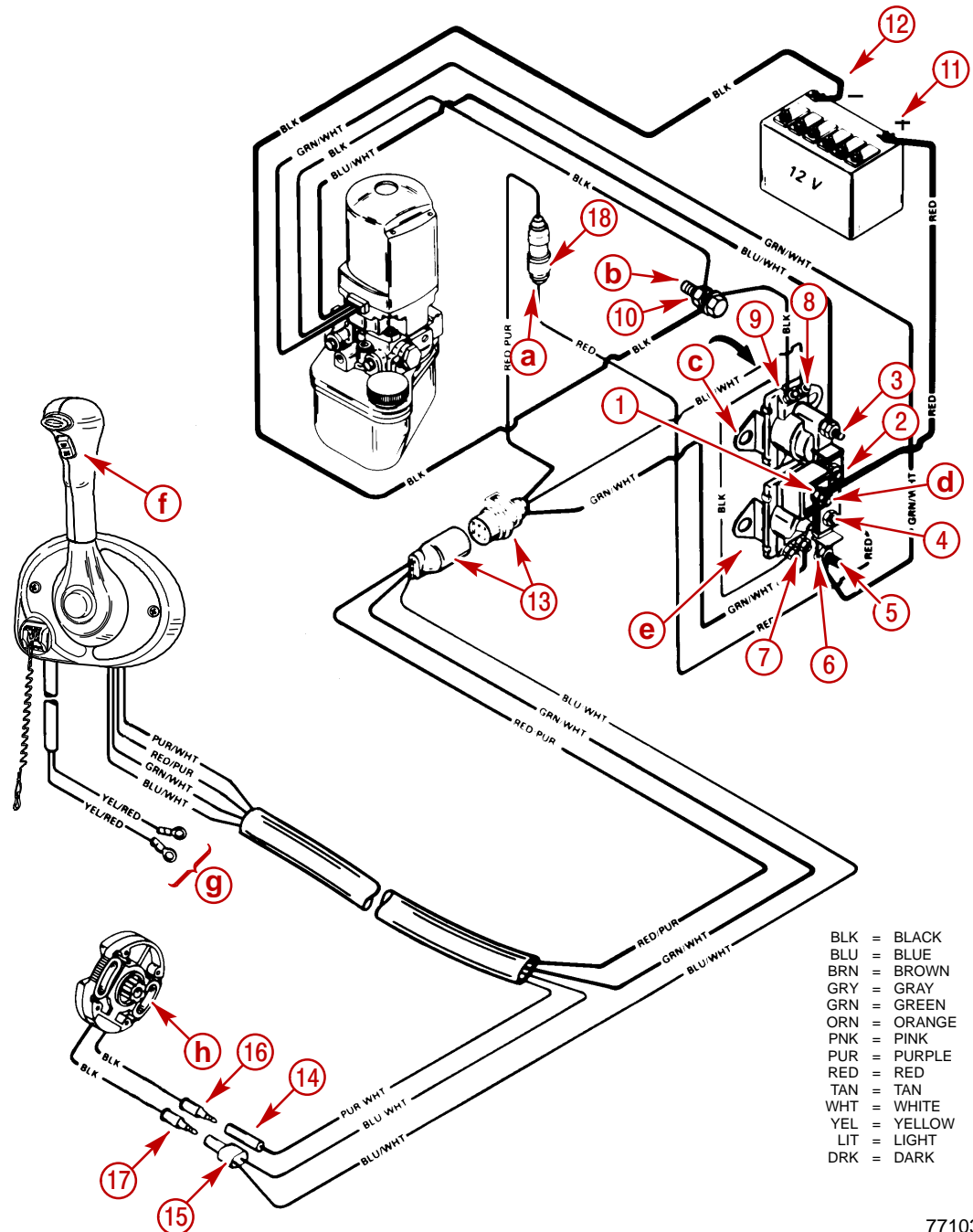
### TRIM OUT/UP SWITCH FUNCTIONS

Cause	Special Instructions
Open trim control trailer circuit.	Check for a faulty trailer switch, loose or corroded connections or damaged trailer circuit lead.

## Trim System Functions While Unattended

Cause	Special Instructions
Faulty trim or trailer switch.	Replace switch.
Shorted trim pump harness or trim control harness.	Repair or replace as required.

# Power Trim System Wiring Diagram



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**NOTE:** Numbered callouts refer to Power Trim Electrical System Troubleshooting Chart.

- a** - 20 Amp Fuse
- b** - Ground Bolt (Floor Mount)
- c** - UP Solenoid
- d** - 110 Amp Fuse
- e** - DOWN Solenoid
- f** - Trim/Trailer Switch
- g** - Neutral Switch to Instrument Wiring Harness
- h** - Trim Limit Switch

# Power Trim Hydraulic System

**NOTE:** Refer to "Power Trim Hydraulic Schematic."

## Drive Unit Cannot Be Trimmed OUT/UP Or Trims Slowly Or With Jerky Movements

Cause	Special Instructions
Power trim pump oil level low.	Check for cause of low oil level and correct. Add oil and bleed trim system.
Air in trim system.	Check for cause of entry and correct. Add oil to pump and bleed air from system.
O-rings damaged on Manual Release Valve (if equipped) or valve not completely closed.	Replace valve and/or close completely.
Insufficient pump pressure or pump. shuttle valve stuck.	Test. If shuttle <b>1</b> is stuck, replace pump adaptor (Refer to SECTION 5A). If pressure is low, replace adaptor or attempt to repair by replacing the following components: <ul style="list-style-type: none"> <li>● OUT/UP Pressure Relief Valve</li> <li>● Thermal Relief Valve</li> </ul>
Hoses reversed on one cylinder only.	Connect hoses <b>7</b> and <b>8</b> correctly.
Trim cylinder(s) binding.	Check for cause of binding (bent piston rod, scored cylinder). Repair or replace as necessary.
Gimbal housing-to-trim pump hydraulic hose pinched.	Replace hose <b>7</b> .
Up pressure relief valve has dirt particles under check ball.	Replace with a new valve kit.

## Drive Unit Will Not Stay In Trimmed OUT/UP Position

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed system.
Shuttle valve (poppet valve).	Check for dirt. Install new poppet valve.

## Sterndrive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse

### UNIT THUMPS WHEN SHIFTING

Cause	Special Instructions
Trim pump IN/DOWN circuit leaking internally.	Test according to appropriate service manual. Replace adaptor or attempt to repair by replacing the pilot check valves or seals. (Install Trim Pump Rebuild Kit)

## Oil Foams Out Of Pump Fill/Vent Screw

Cause	Special Instructions
Contaminated oil.	Flush system with clean oil refill pump and bleed trim system.
Oil level low.	Check for cause of low oil level and correct. Add oil to pump and bleed system.

## Sterndrive Unit Cannot Be Lowered From UP Position Or Lowers With Jerky Movements

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed trim system.
Low oil level.	Add oil.
Insufficient IN/DOWN pressure or shuttle valve stuck.	Test. If shuttle <b>1</b> is stuck, replace pump adaptor. (Refer to SECTION 5A) If pressure is low, replace adaptor or attempt to repair by replacing the following items: ● IN/DOWN pressure relief valve <b>1</b>
Trim cylinder(s) binding.	Check for cause of binding. Repair or replace as necessary.
Gimbal housing-to-trim pump hydraulic hose pinched.	Replace hose <b>8</b> .
Hoses reversed on one trim cylinder only.	Reconnect hoses correctly.
Drive unit binding in gimbal ring.	Check for cause of binding and replace.
Down pressure relief valve (6) has dirt particles under check ball.	Replace with a new valve kit.

## Sterndrive Unit Will Not Stay In Full UP Position For Extended Periods

Cause	Special Instructions
External leakage.	Check for cause and correct. Add oil to pump and bleed trim system.
Pump OUT/UP circuit leaking internally.	Test. (Refer to SECTION 5A) Replace adaptor <b>2</b> or attempt to repair by replacing the following: ● Thermal relief valve <b>4</b> ● Poppet valve seals <b>9</b>
Trim cylinder(s) leaking internally and pump DOWN circuit leaking internally (both must be faulty to cause this problem).	Rebuild cylinders <b>5</b> Repair or replace adaptor <b>2</b> as required.

## Sterndrive Will Not Stay In The Trimmed OUT/UP Position When Underway

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed system.
Leaky poppet valve.	Install repair kit for poppet valve <b>1</b> .

## Sterndrive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse

### UNIT THUMPS WHEN SHIFTING

Cause	Special Instructions
Trim cylinders(s) leaking internally.	Test. (Refer to SECTION 5A) Rebuild or replace cylinders as necessary.
Trim pump IN/DOWN circuit leaking internally.	Test. (Refer to SECTION 5A) Replace adaptor or attempt to repair by replacing the following: <ul style="list-style-type: none"> <li>● Pilot check valves or seals <b>9</b></li> <li>● Install trim pump rebuild kit</li> </ul>

## Oil Foams Out Of Pump Fill/Vent Screw

Cause	Special Instructions
Contaminated oil.	Flush system with clean oil refill pump and bleed trim system.
Oil level low.	Check for cause of low oil level and correct. Add oil to pump and bleed system.

## Trim Motor Runs But Does Not Pump Oil

Cause	Special Instructions
Broken coupler between the pump and the motor.	Replace the coupler.
Plugged pick-up screens.	Replace pick-up screens.

## Trim Pump Runs Slowly In Both Directions

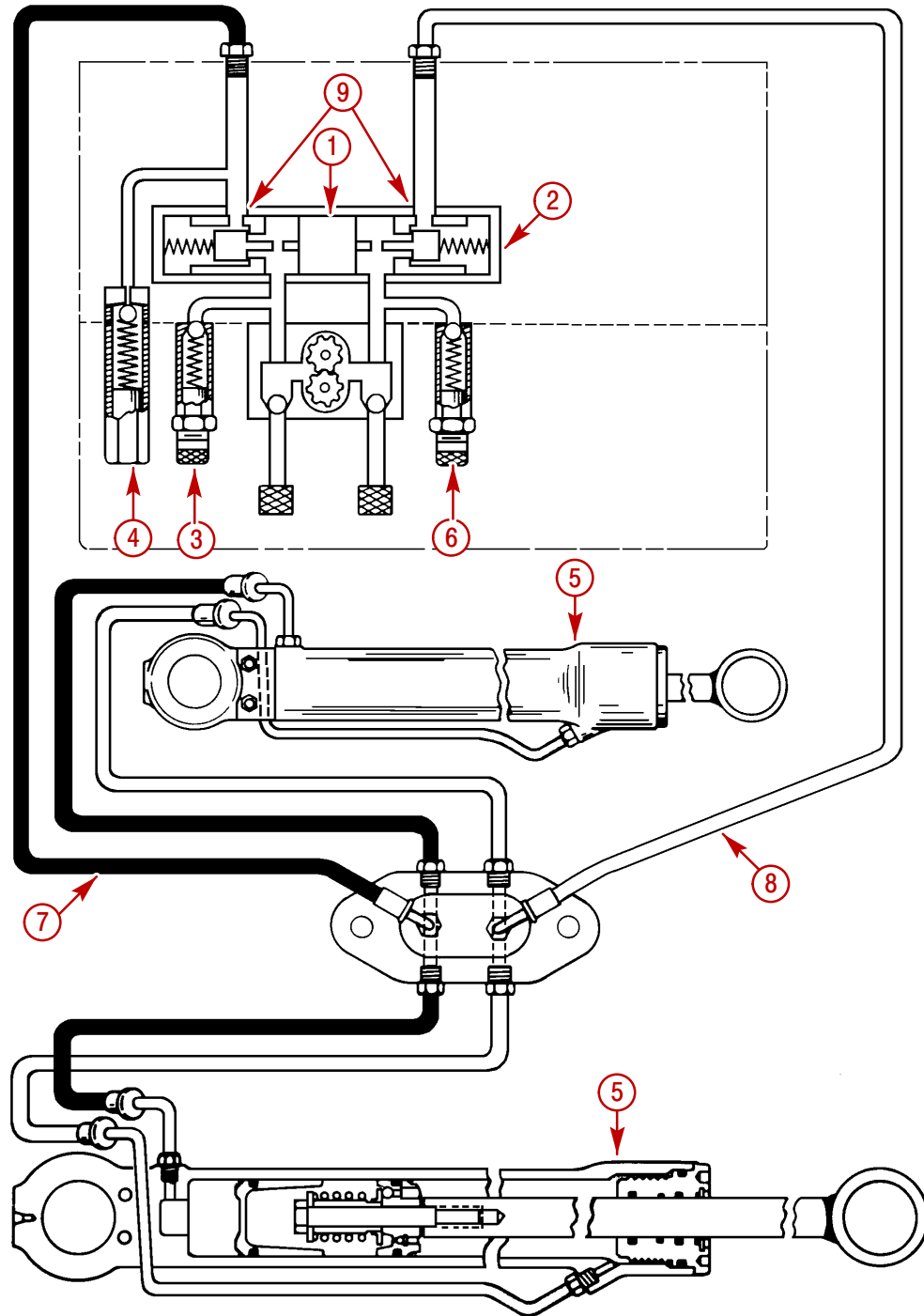
Cause	Special Instructions
Check the condition of the oil It may be contaminated and thick like honey.	Remove the reservoir and clean out the contaminated oil.

## Trim Pump Runs Slowly With A Laboring Sound

Cause	Special Instructions
A possible tight adaptor pump gear or water or oil in the motor.	Replace the pump assembly in the adaptor or replace the electric motor assembly.



# Power Trim Hydraulic Schematic



73552

- 1 - Shuttle
- 2 - Pump Adaptor
- 3 - UP/OUT Pressure Relief Valve
- 4 - Thermal Relief Valve
- 5 - Trim Cylinder
- 6 - IN/DOWN Pressure Relief Valve
- 7 - UP/OUT Hose
- 8 - IN/DOWN Hose
- 9 - Poppet Valves

## Auto Trim II Electrical System

**NOTE:**Refer to “Auto Trim II System Wiring Diagram.”

### Pump Motor Will Not Run UP Or DOWN In Either Manual Or Auto Mode

#### SOLENOIDS CLICK

Cause	Special Instructions
Pump positive battery cable connection loose or corroded.	Check cable <b>14</b> .
110 amp fuse blown or loose or corroded solenoid connection.	Check for voltage at terminal <b>5</b> .
Pump motor brushes stuck, corroded or worn out.	Clean or replace.
Armature commutator dirty.	Clean or replace.
Armature faulty.	Test and replace if bad.
Field and frame faulty.	Test and replace if bad.
Pump gears frozen.	Replace pump.
Trim harness shorted between UP and DOWN circuit.	Disconnect blue-white lead <b>2</b> from solenoid terminal. If pump motor will now run in the DOWN direction, a short in the harness is indicated.

**SOLENOIDS DO NOT CLICK**

<b>Cause</b>	<b>Special Instructions</b>
Pump negative battery cable loose, corroded or damaged.	Check cable <b>13</b> for damage or a loose or corroded connection.
Mode switch wiring harness connector is loose at pump.	Secure connection <b>47</b> .
Faulty thermal circuit breaker in pump motor.	Connect a jumper wire between terminals <b>1</b> and <b>7</b> . If pump now operates, circuit breaker is faulty and field and frame assembly must be replaced.
Open circuit in mode switch wiring harness.	With ignition switch in RUN position and mode switch in MANUAL mode, check for voltage at terminal <b>8</b> while trimming UP and terminal <b>12</b> while trimming DOWN. If no voltage is indicated, refer to items <b>5</b> and <b>6</b> immediately following.
No power to mode switch.	Check for voltage at terminal <b>25</b> (with ignition switch in RUN position). If no voltage is indicated, check power lead for a poor connection.
Faulty mode switch.	Check for voltage at terminal <b>24</b> (with mode switch in AUTO mode) and terminal <b>26</b> (with switch in the MANUAL mode). Replace switch if no voltage is indicated.

## Pump Motor Will Not Stop Running Down In Auto Mode

### TRIM UP/OUT SWITCH AND TRAILER SWITCH INOPERATIVE IN MANUAL MODE

**NOTE:** An internal timer in the control module stops the pump motor 50 seconds after this problem condition occurs.

Cause	Special Instructions
Loose or dirty solenoid connection.	Check connections <b>7</b> and <b>8</b> .
Faulty solenoid.	Check for voltage at terminal <b>8</b> while trimming UP (in MANUAL mode). If voltage exists, an open condition in solenoid is indicated and solenoid must be replaced. If no voltage is indicated, refer to steps 3 through 6 following.
Loose or corroded trim limit switch lead connections.	Check connections <b>32</b> and <b>36</b> .
Faulty trim limit switch.	Disconnect trim limit switch leads <b>32</b> and <b>36</b> and connect a continuity meter between leads. Continuity should exist with drive unit in DOWN position. If not, readjust or replace switch as necessary.
Open circuit in wiring harness.	Check leads <b>30</b> , <b>35</b> , <b>46</b> and <b>2</b> for loose or corroded connections or damage.
Faulty control module.	Replace.

## Pump Motor Will Not Run Up Or Down In Auto Mode

### MANUAL MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Control module 20 amp fuse blown.	Determine cause for blown fuse and correct before replacing fuse.
Open in control module battery cables or wiring harness.	Check cables <b>16</b> and <b>18</b> and lead <b>20</b> .
Faulty mode switch.	Check for voltage at terminal <b>24</b> and <b>25</b> with switch in AUTO mode. If voltage exists at terminal <b>25</b> , but not <b>24</b> , switch is faulty.
Faulty control module.	Replace.

## Trim System Completely Inoperative In Manual Mode

### AUTO MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Faulty mode switch.	Check for voltage at terminal <b>26</b> with mode switch in MANUAL mode. If no voltage is indicated, replace switch.
Open circuit in wiring harness.	Check leads <b>27</b> and <b>33</b> for loose or corroded connections or damage.

## Pump Motor Will Run UP, But Not DOWN In Both Manual And Auto Modes

### DOWN SOLENOID DOES NOT CLICK

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections <b>4</b> , <b>7</b> and <b>12</b> .
Faulty mode switch or open in DOWN circuit.	Check for voltage at terminal <b>12</b> while trimming Down (in MANUAL mode). If no voltage is indicated, repeat test at terminal <b>22</b> and <b>23</b> . If voltage exists at terminal <b>23</b> , but not at <b>22</b> , switch is faulty. If voltage is present at terminal <b>22</b> , check leads <b>3</b> and <b>48</b> and connector <b>47</b> for an open condition.
Faulty DOWN solenoid.	Replace.

### DOWN SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections <b>10</b> and <b>11</b> .
Faulty solenoid.	Check for voltage at terminal <b>11</b> while trimming Down (in MANUAL mode). If no voltage is indicated, replace solenoid.
Faulty DOWN field winding.	Replace field and frame.

## Pump Motor Runs DOWN, But Not UP In Both The Manual And Auto Modes

### UP SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections <b>5</b> and <b>6</b> .
Faulty solenoid.	Check for voltage at terminal <b>6</b> while trimming UP. If no voltage is indicated, replace solenoid.
Faulty UP field winding.	Replace field and frame.

## Pump Motor Will Run DOWN, But Not UP In Auto Mode

### MANUAL MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Open circuit in control module sense lead.	Check lead <b>17</b> for loose or corroded connections or damage.
Faulty control module.	Replace.

## Pump Motor Will Run UP, But Not DOWN In Auto Mode

### MANUAL MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Faulty mode switch.	Check for voltage at terminal <b>21</b> and <b>22</b> while turning ignition switch to RUN position (in AUTO mode). If voltage exists at <b>21</b> but not at <b>22</b> , switch is faulty.
Open circuit in wiring.	Check lead <b>19</b> for a loose or corroded connection or damage.
Faulty control module.	Replace.

## Trim DOWN/IN Switch Inoperative In Manual Trim Control

### TRIM UP/OUT SWITCH AND TRAILER SWITCH FUNCTION, AUTO MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Faulty DOWN switch in manual trim control.	Check for voltage at terminal <b>38</b> while trimming DOWN (in MANUAL mode). If no voltage is indicated, switch is faulty.
Open circuit in wiring harness.	Check for voltage at terminal <b>23</b> while trimming DOWN. If no voltage is present, check leads <b>28</b> and <b>34</b> for a loose or corroded connection or damage.
Faulty mode switch.	Check for voltage at terminal <b>22</b> while trimming DOWN. If no voltage exists, switch is faulty.

## Trim UP/OUT Switch Inoperative In Manual Trim Control

### TRIM DOWN/IN SWITCH FUNCTIONS, AUTO MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Trim 20 amp fuse "43" blown (if equipped).	Determine cause for blown fuse and correct before replacing fuse.
Open in power supply lead to trim and trailer switch.	Check voltage at terminal <b>44</b> . If no voltage is indicated, check lead <b>45</b> for a poor connection or damage.
Faulty trim UP/OUT switch (applies only to trim controls where it is necessary to actuate trim UP switch in order for trailer switch to function).	Check for voltage at terminal <b>40</b> while actuating trim UP/OUT switch. Replace switch if no voltage is indicated.

## Trailer Switch In Manual, Trim Control Inoperative

### TRIM UP/OUT SWITCH FUNCTIONS

Cause	Special Instructions
Faulty trailer switch.	Check for voltage at terminal <b>41</b> and <b>42</b> while actuating trailer switch. If voltage exists at terminal <b>42</b> , but not at terminal <b>41</b> , a faulty switch is indicated. If no voltage exists at terminal <b>42</b> , check power supply lead for an opening.
Opening in wiring.	Check lead <b>39</b> for damage or a loosened or corroded connection.

## Boat Is On Plane Well Before Drive Unit Begins To Trim Out

Cause	Special Instructions
Control module adjustment incorrect.	Adjust. (Refer to SECTION 5)
Faulty control module.	Replace control module.

## Boat Is Not On Plane Before Drive Unit Begins To Trim Out

Cause	Special Instructions
Control module adjustment incorrect.	Adjust. (Refer to SECTION 5)
Faulty control module.	Replace control module.





# Corrosion Protection

**NOTE:** Refer to “MerCathode Controller Wiring Diagram.”

## Corrosion On Underwater Parts, Without MerCathode Or Impressed Current Protection

Cause	Special Instructions
Sacrificial anode(s) consumed.	Replace anode(s) when 50% consumed.
Stainless steel propeller installed.	Add MerCathode (impressed current protection) or additional sacrificial anodes.
Sacrificial anode(s) not grounded to drive.	Remove anode(s), clean contact surface, reinstall and check continuity.
Loss of continuity between underwater parts & ground.	Provide good ground connections.
Shore power causing overload of anode(s) and/or MerCathode.	Disconnect shore power or install Quicksilver isolator.
Paint on drive heavily worn (exposing more metal).	Prime and repaint and/or install additional anode(s).
Sacrificial anode(s) painted.	Remove paint or replace anode(s).
Drive tilted so far that anode(s) are out of the water.	Leave drive down, install additional anode (below waterline) or transom mount a MerCathode.
Only power trim cylinders are corroded.	Provide good ground to drive. All parts must be grounded.
Corrosion in area of exhaust outlets. Exhaust deposits can cause corrosion.	Remove deposits with marine or auto wax.
Corrosion occurring after unit removed from saltwater.	Wash exterior and flush interior with fresh water.
Corrosion and/or salt build up between mating parts.	Exclude moisture from between mating parts with Quicksilver 2-4-C with Teflon.
Stainless Steel parts corroding: Tightly wrapped fishing line or foreign material excludes oxygen, causing corrosion. Iron particles, such as from a wire brush, cause rusting. Propeller pitting can occur if electrical continuity is lost.	Clean parts, remove foreign material, ensure continuity.

## Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection

### DRIVE CORRODING

Cause	Special Instructions
Poor connection between reference electrode (BRN) lead or anode (ORN) lead and MerCathode controller.	Clean and/or tighten connection. Repair wiring.
Faulty MerCathode reference electrode.	Disconnect reference electrode lead (BRN) from the controller "R" terminal. Connect the lead to positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect negative (-) meter lead to negative (-) battery terminal. Note meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
Faulty MerCathode controller.	With anode and reference electrode leads connected to controller, connect a jumper wire between "R" and negative(-) terminals on controller. Connect positive (+) lead of volt meter (set on 0-20 scale) to "A" terminal on controller. Connect the negative (-) meter lead to the negative (-) controller terminal. Reading should be as follows: <ul style="list-style-type: none"> <li>● Freshwater Areas = 11.5 volts minimum</li> <li>● Seawater Areas = 3.55 volts minimum</li> </ul> If the reading is low, replace the controller.
Too much cathode (such as stainless steel).	MerCathode system overpowered by large quantity of stainless steel below the waterline.
Loss of continuity between sterndrive components and ground.	Ensure continuity (check continuity wires and washers).
Sacrificial anodes consumed, painted or inoperative.	Replace anodes.
MerCathode reference electrode or anode painted.	Remove paint or replace anode or MerCathode reference electrode.

**DRIVE CORRODING - CONTINUED**

Cause	Special Instructions
No power to MerCathode controller.	Connect positive (+) lead of volt meter (set on 0-20 volt scale) to positive (+) terminal on the controller and negative (-) volt meter lead to negative (-) terminal. Meter should indicate battery voltage. Check for blown fuse (if equipped) on a standard MerCathode system. Clean the connection or repair wiring as required.
MerCathode system not functioning	Check the fuse in the hot lead.
	Check battery.
	Check for loose connections at controller and battery
	Check the grounding wire between the drive and the controller.

## Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection

### DRIVE OVER-PROTECTED

Cause	Special Instructions
Faulty MerCathode reference electrode.	Disconnect reference electrode lead (BRN) from "R" terminal on controller. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (-) meter lead to the negative (-) battery terminal. Note the meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
Faulty MerCathode controller.	Check controller output. If the hull potential indicates overprotection, remove the reference electrode lead from the controller. If the controller is off (no impressed current called for) the voltage between the negative (BLK) and the anode should be less than 1 volt. Measure amperage; with the reference electrode disconnected, the amperage between the negative on the controller and the anode terminal should be less than 1 milli-amp. Replace the controller if needed.
Stray current corrosion (electrical current leaves a metal conductor and creates a path through the water).	Disconnect electrical components one at a time and observe the multimeter reading until you eliminate the high reading. Correct the source of the stray current.
Poor connection between the MerCathode reference electrode lead (BRN) and the "R" terminal on the controller.	Clean and/or tighten the connection. Repair wiring as needed.
MerCathode system not functioning.	Check the fuse in the hot lead.
	Check the battery.
	Check for loose connections at controller and battery.
	Check the grounding wire between the sterndrive and the controller.

## Testing Procedure for Corrosion Protection

1. Unplug shore power (if equipped).
2. Measure hull potential with silver/silver chloride reference electrode and digital volt/ohm meter.

## READINGS

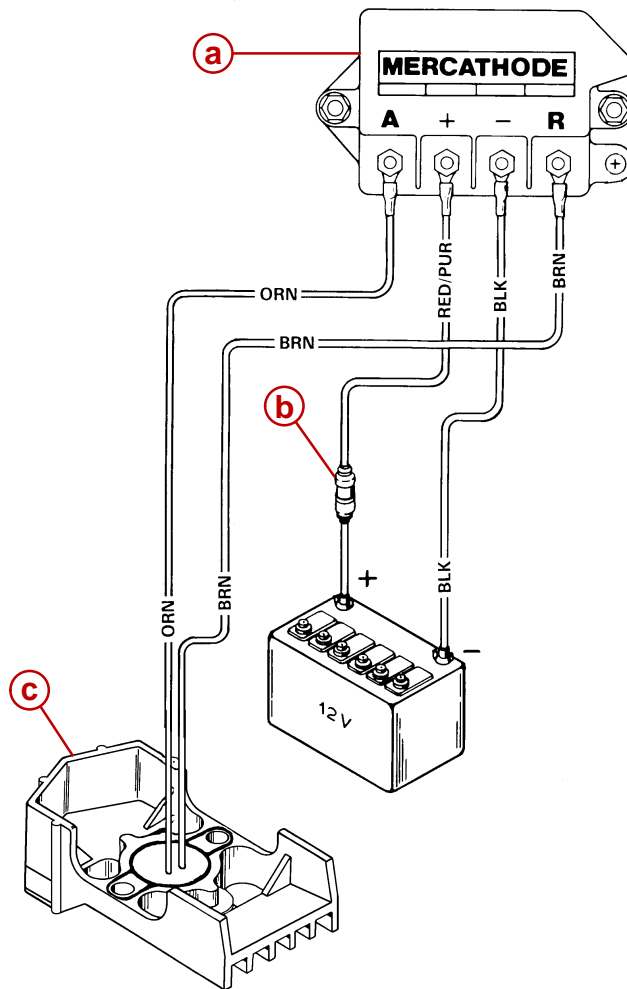
Saltwater	Potential	Diagnosis
	Below 850 millivolts	Drive is corroding. (Refer to "Drive Corroding")
	Between 850 - 1100 millivolts	Drive is protected
	Above 1100 millivolts	Drive is overprotected. (Refer to "Drive Corroding")

Freshwater	Potential	Diagnosis
	Below 750 millivolts	Drive is corroding. (Refer to "Drive Corroding")
	Between 750 - 1050 millivolts	Drive is protected
	Above 1050 millivolts	Drive is overprotected. (Refer to "Drive Corroding")

## CORROSION SYMPTOMS

- Paint blistering (usually on sharp edges)
- Loosely adhering white corrosion products on exposed aluminum surfaces (do not confuse these with tenaciously clinging calcium carbonate deposits)
- Aluminum pitting

## MerCathode Controller



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** - Controller
- b** - 20 Amp Fuse
- c** - Electrode

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# REMOVAL, INSTALLATION AND ADJUSTMENTS

## Section 2A - All Models

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**2  
A**

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# Torque Specifications

**NOTE:** Securely tighten all fasteners not listed below.

Fastener Location	lb-in.	lb-ft	Nm
Exhaust Pipe to Gimbal Housing Screws		23	31
Block Off Plate to Gimbal Housing Screws		23	31
Propeller Nut <sup>1</sup>		55	75
Drive Unit Shift Cable Locknut	Tighten Nut Until It Contacts Flat Washer, Then Loosen 1 Turn		
Steering Cable Coupler Nut		35	48
Steering System Pivot Bolts		25	34
Transom Assembly Attaching Screws and Nuts		23	31
Power Steering Hydraulic Hose Fittings		23	31
Sterndrive Unit to Bell Housing Attaching Nuts		50	68

<sup>1</sup>: Amount specified is MINIMUM.

## Lubricants / Sealants / Adhesives

Description	Part Number
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Special Lubricant 101	92-13872A1
Perfect Seal	92-34227-1
Liquid Neoprene	92-25711--3
Quicksilver Anti-Corrosion Grease	92-78376A6
Quicksilver Engine Coupler Spline Grease	92-816391A4
Special Lubricant 101	92-13872A1

## Tools

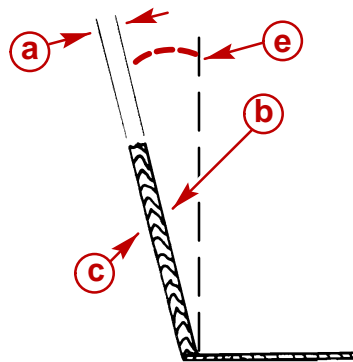
Description	Part Number
Shift Cable Adjustment Tool	91-12427
Engine Alignment Tool Assembly	91-805475A1

# Transom Thickness and Surface

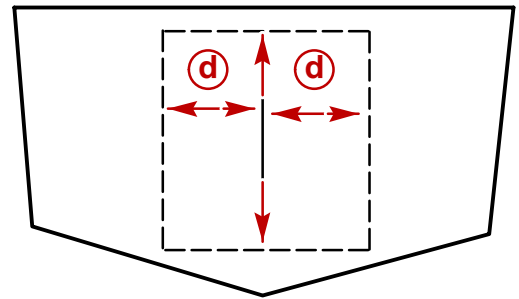
**IMPORTANT:** Transom thickness and surface plane (flatness) must be controlled where the sterndrive unit mounts.

Transom thickness and surface must conform to the following:

Transom Specifications	
Thickness	Between 2 - 2-1/4 in. (51 - 57 mm)
Parallelism	Inner and outer surfaces must be parallel within 1/8 in. (3 mm)
Flatness	Transom surfaces in area where transom assembly will be mounted (includes vertical as well as horizontal dimensions): Inner Surface – Flat within 1/8 in. (3 mm) Outer Surface – Flat within 1/16 in. (2 mm)
Angle	10 -16 Degrees

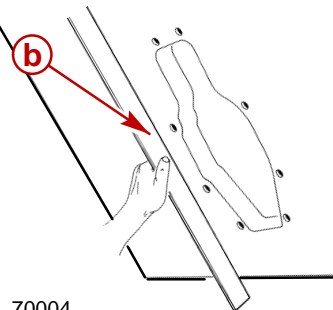
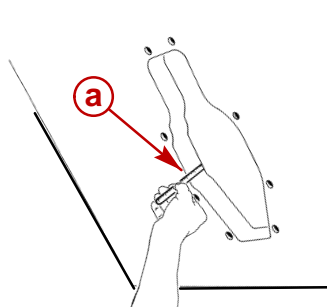


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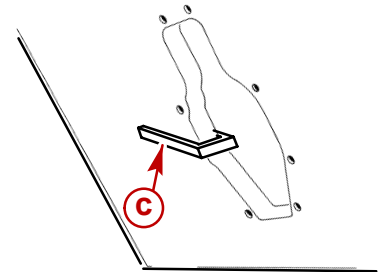


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- a** - Transom Thickness
- b** - Inner Surface
- c** - Outer Surface
- d** - Transom Plate Coverage
- e** - Transom Angle



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- a** - Measuring Thickness
- b** - Measuring Surface Flatness
- c** - Suitable Mandrel To Check For Uniform Transom Thickness.

## Special Information

### Bravo Three Notice: Trim-In Limit Insert

It has been brought to our attention that some boats (predominantly deep-V heavy boats) will roll up on their side under certain, specific, operating conditions. The roll can be to either port or starboard and may be experienced while moving straight ahead or while making a turn. The roll occurs most frequently at or near maximum speed, with the sterndrive unit trimmed at or near full IN. While the boat will not roll completely over, the roll may be sufficient to unseat the operator or passengers and thereby create an unsafe situation.

The roll is caused by stern lift. Stern lift can be created by excessive sterndrive unit trim IN. Under these extreme stern lift/bow down conditions instability can be created that may cause the boat to roll. Weight distribution to the stern can reduce stern lift and, in some circumstances, eliminate the condition. Weight distribution in the bow, port or starboard, may worsen the condition.

The trim-in limit device reduces stern lift by preventing the sterndrive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, they may not eliminate the tendency entirely. The need for the trim-in insert, and the effectiveness of them, can only be determined through boat testing and is ultimately the responsibility of the boat manufacturer.

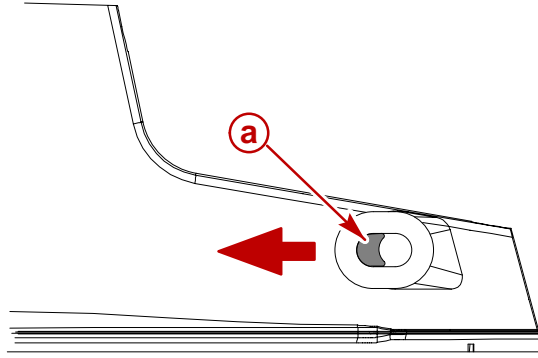
#### **WARNING**

**It is recommended that only qualified personnel adjust the Trim-In Limit Insert. Boat must be water tested after adjusting the device to ensure that the modified trim IN range does not cause the boat to exhibit an undesirable boat handling characteristic if the sterndrive unit is trimmed IN at higher speeds. Increased trim IN range may cause handling problems on some boats which could result in personal injury.**

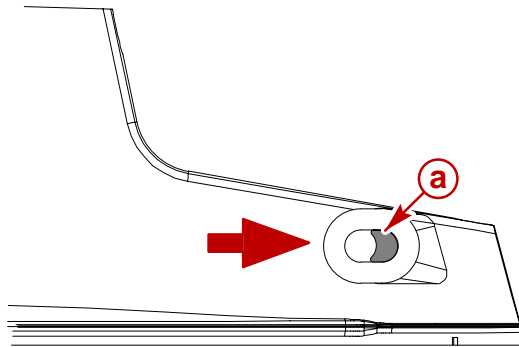
**IMPORTANT:** On Bravo One, Two and Three Models, the Trim-In Limit Insert, must be properly positioned before installing the trim cylinder anchor pin in the following steps.

**NOTE:** *When removing the sterndrive unit, make a note of the position of the insert for reference when reinstalling the sterndrive unit.*

1. Ensure that the Trim-In Limit Insert is positioned as shown for the appropriate Bravo model.



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**Bravo One and Two (Positioned Forward)**

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**Bravo Three (Positioned Aft)**

**a** - Trim-In Limit Insert

**IMPORTANT:** The position of the Trim-In Limit Insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

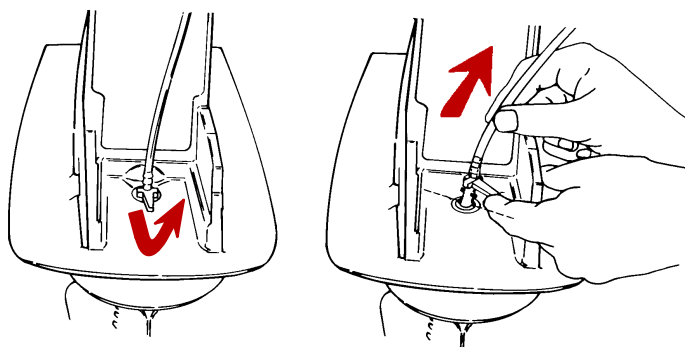
## Sterndrive Unit Removal

1. Shift remote control into neutral.
2. Place the drive unit to the full UP/OUT position.

### **⚠ CAUTION**

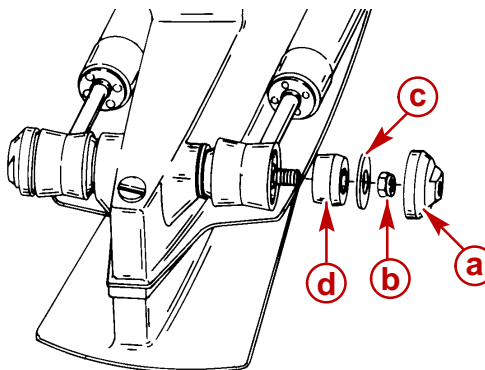
**Avoid speedometer hose fitting damage. Disconnect the speedometer hose fitting from the drive shaft housing before removing the sterndrive unit.**

3. Disconnect the speedometer hose fitting from the drive shaft housing.



22025

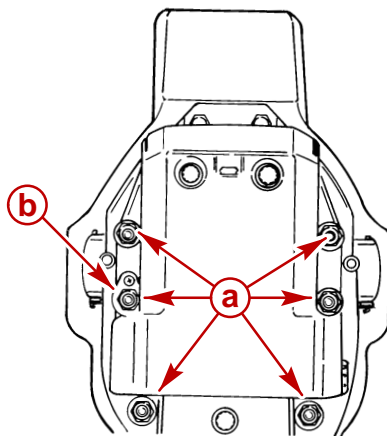
4. Place the drive unit to the full DOWN/IN position and remove the power trim cylinder from the aft end of the drive shaft housing.



22029

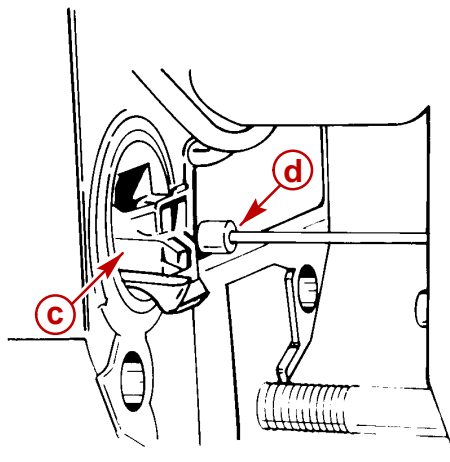
- a** - End Cap
- b** - Nut
- c** - Flat Washer
- d** - Bushing

5. Remove the locknuts holding the sterndrive onto the bell housing, then remove the sterndrive unit.



22031

- a** - Locknuts (6) And Flat Washers (5)
- b** - Ground Plate (Flat Washer Not Used Here)



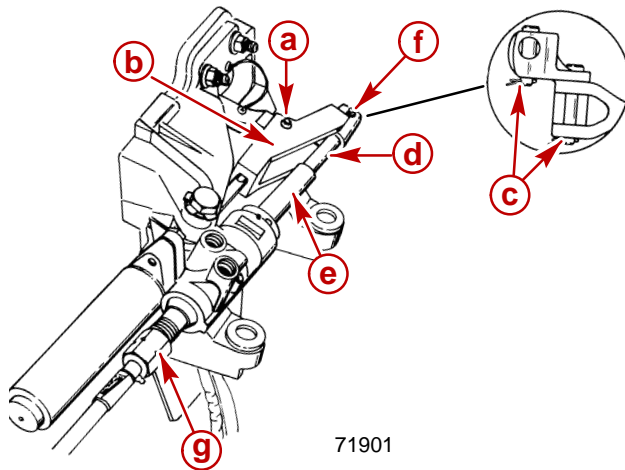
22025

- c** - Shift Linkage Jaws
- d** - Shift Cable End

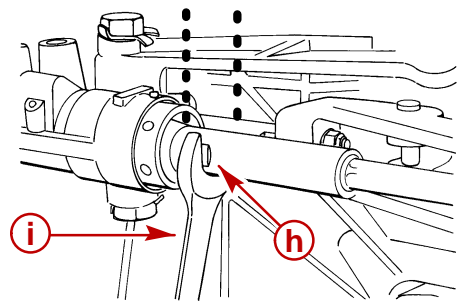
6. Ensure the shift cable linkage jaws open and release the shift cable end.

# Transom Assembly Removal

1. Remove engine (Refer to appropriate engine service manual).
2. Completely disconnect the power steering assembly.
  - a. Disconnect the rear clevis pin from the steering lever.
  - b. Disconnect forward clevis pin from steering cable end.
  - c. Holds flats on cable guide in vertical position with suitable wrench. Loosen coupler nut and remove steering cable.



71901

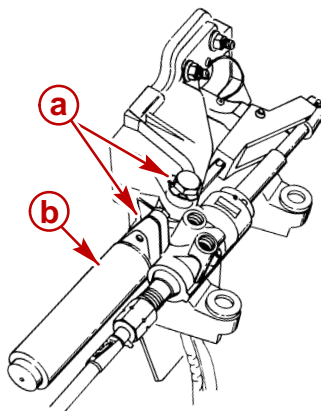


73901

## Control Valve

- |                        |                        |
|------------------------|------------------------|
| a - Rear Clevis Pin    | f - Forward Clevis Pin |
| b - Clevis             | g - Coupler Nut        |
| c - Cotter Pins        | h - Flats              |
| d - Steering Cable End | i - Suitable Wrench    |
| e - Cable Guide        |                        |

- d. Bend tab washer tabs down and away from pivot bolt heads.
- e. Remove the pivot bolts.



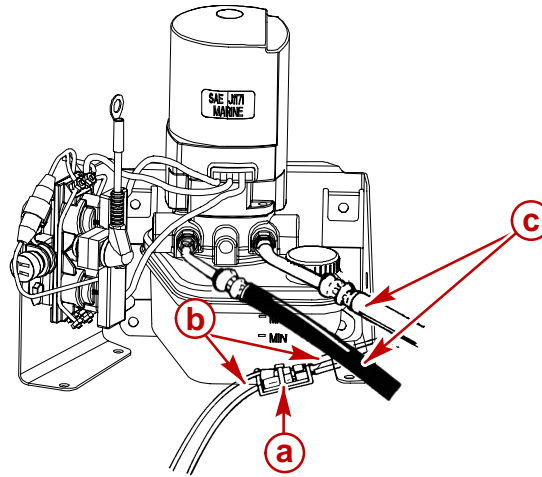
71901

- |                   |
|-------------------|
| a - Pivot Bolts   |
| b - Control Valve |

- f. Remove the power steering control valve.



3. Disconnect trim limit switch wires.
4. Remove power trim pump hydraulic hoses and disconnect trim limit switch wires. Cap hoses and plug pump fitting holes.

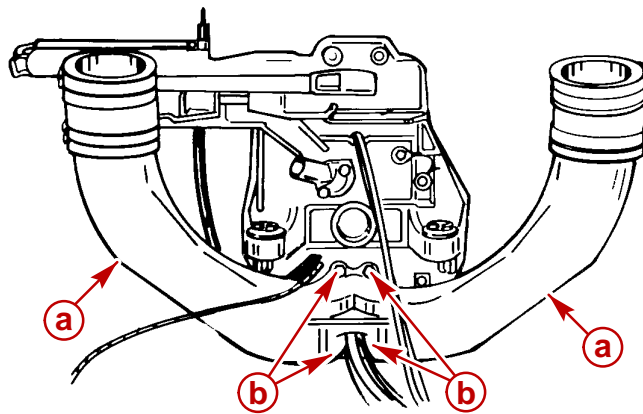


76631

- a** - Sta-Strap
- b** - Trim Limit Switch Wires
- c** - Hydraulic Hoses

5. Remove exhaust pipe.

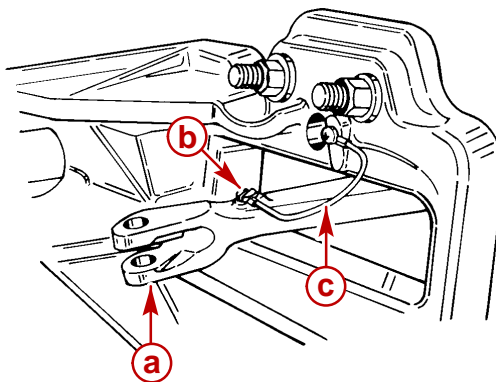
**NOTE:** For through transom exhaust, it is not necessary to remove the block-off plate unless the gasket/mating surface is leaking or the exhaust system is to be modified.



22028

- a** - Exhaust Pipe
- b** - Bolts (4)

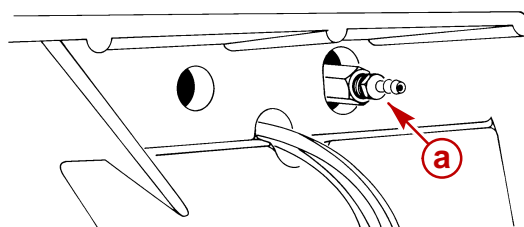
6. Remove the continuity wire from the steering lever.



22028

- a** - Steering Lever  
**b** - Screw  
**c** - Continuity Wire

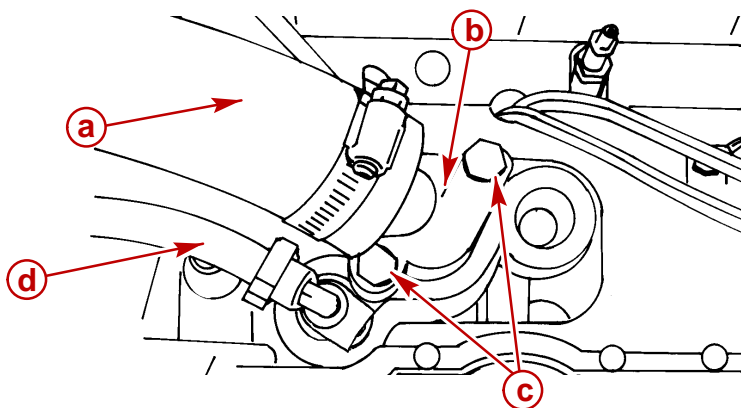
7. Disconnect the speedometer hoses.



70015

- a** - Speedometer Fitting

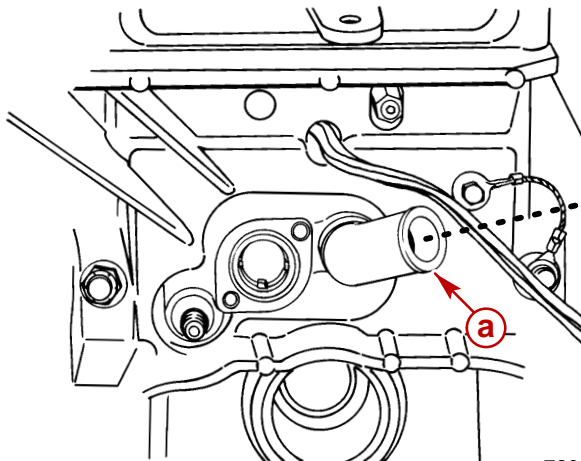
8. Remove seawater intake hose.



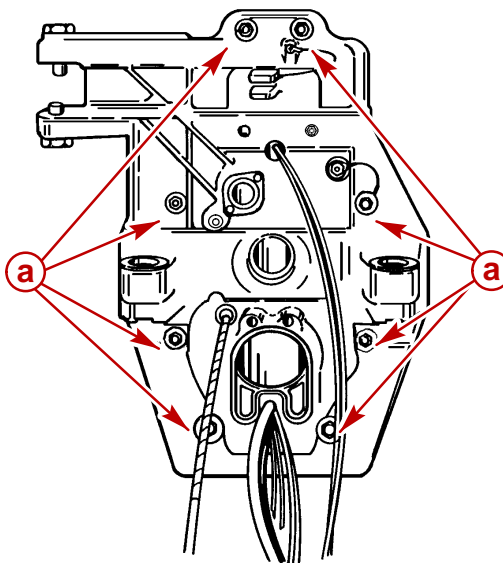
76636

- a** - Seawater Intake Hose  
**b** - Seawater Pickup Outlet  
**c** - Bolts and Star Washers  
**d** - Gear Lube Monitor Hose

9. Remove seawater pickup outlet.  
10. Remove gear lube monitor hose.

**11. On Diesel Models with Water Bypass Fitting - Remove fitting.**

72045

**a - Water Bypass Fitting****12. Remove transom locknuts and washers.**

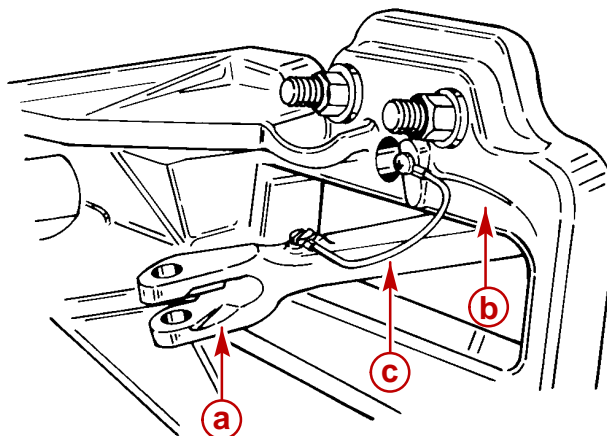
73902

**a - Locknuts and Washers (8)****13. Separate the inner transom plate from the gimbal housing assembly.**

# Transom Assembly Installation

## ⚠ CAUTION

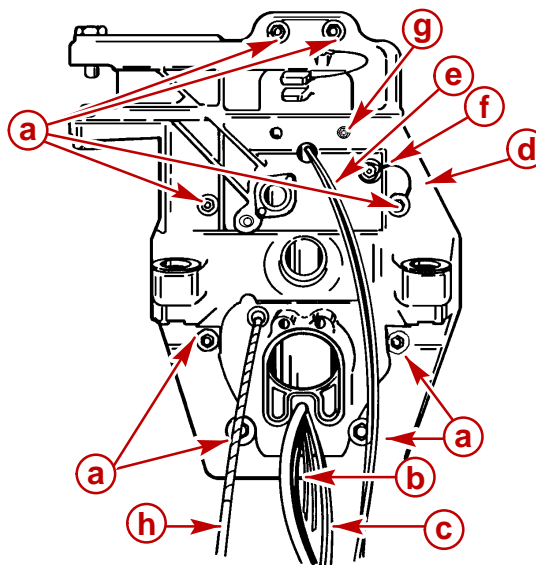
Avoid continuity wire failure. Position the steering lever ground wire as shown or the wire may fatigue and break.



22028

- a** - Steering Lever
- b** - Transom Plate
- c** - Continuity Wire

1. Install the transom assembly. Tighten locknuts evenly, starting from the center and working outward. Torque to 23 lb-ft (31 Nm).

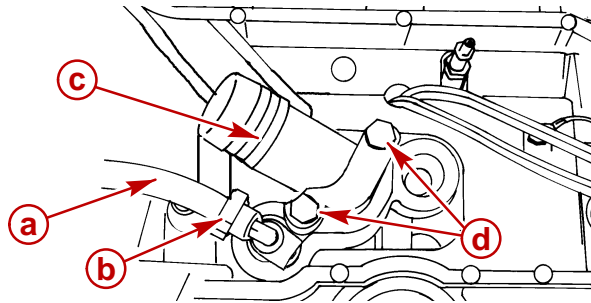


73902

- a** - Locknuts and Flat Washers
- b** - Power Trim Hoses
- c** - MerCathode Wires
- d** - Continuity Wire
- e** - Trim Limit And Trim Position Sender Wires
- f** - Grounding Bolt
- g** - Speedometer Connection
- h** - Shift Cable

**IMPORTANT:** Hose must not come in contact with steering system components or the engine coupler and drive shaft.

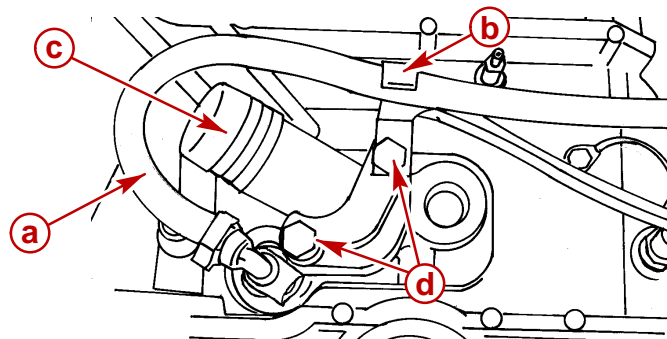
2. Connect gear lube monitor hose.
3. Install water inlet fitting with gasket. Torque bolts and star washers to 45 lb-in. (5 Nm).



76640

- a** - Hose To Gear Lube Monitor
- b** - Hose Clamp
- c** - Water Inlet Fitting
- d** - Bolts And Star Washers

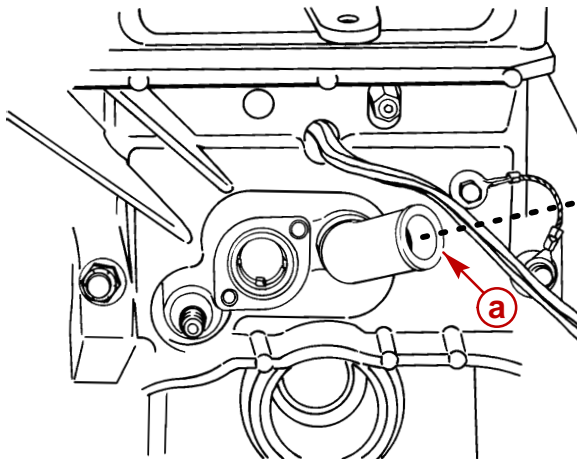
4. **On Some Models:** The gear lube hose may be routed toward the port side of the engine. Secure the hose at the top side of the water fitting using the hose clip as shown. Torque bolts and star washers to 45 lb-in. (5 Nm).



76635

- a** - Gear Lube Monitor Hose
- b** - Hose Clip
- c** - Water Hose Fitting
- d** - Bolts And Star Washers

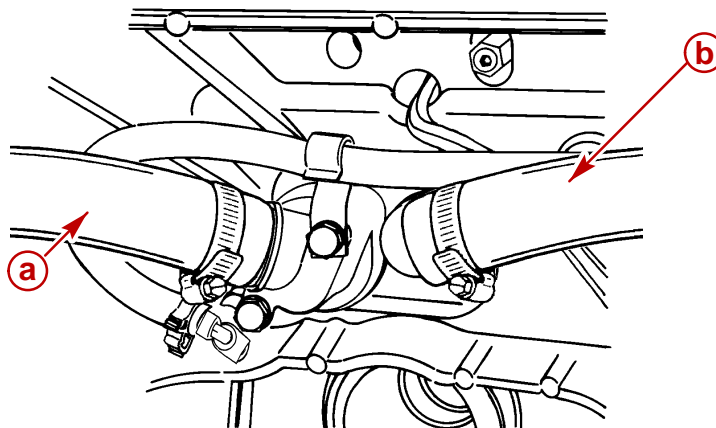
5. **On D7.3L Diesel Models with Water Bypass Fitting** - Apply Perfect Seal to threads and install fitting. Tighten securely and position as shown.



76656

**a** - Water Bypass Fitting

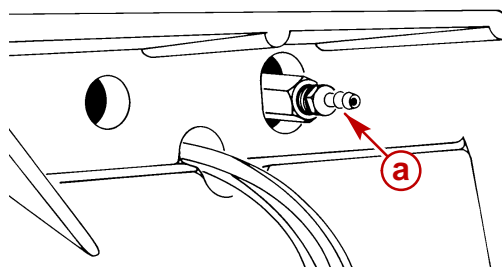
6. Connect water hoses to appropriate fittings. Tighten hose clamps securely.



76641

**a** - Seawater Hose To Engine Seawater Pump  
**b** - Seawater Pickup Hose

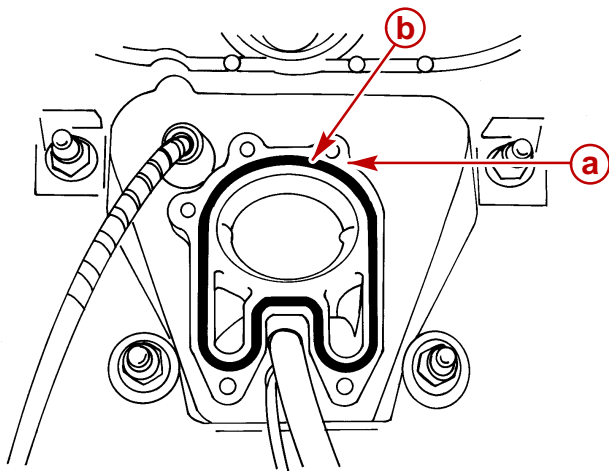
7. Connect the speedometer hose to the speedometer fitting.



70015

**a** - Speedometer Fitting

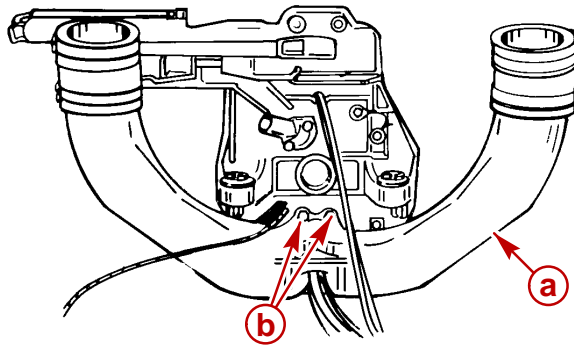
**IMPORTANT:** Exhaust pipe or block-off plate and gimbal housing mating surface, must be clean and free of nicks and scratches and O-ring must be properly seated in groove, or water may leak into boat.



- a** - Mating Surface
- b** - O-Ring

76639

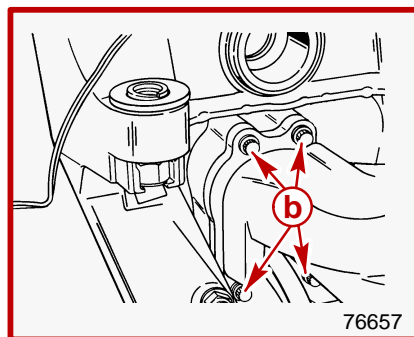
8. **Through the prop exhaust models:** Install exhaust pipe. Torque bolts to 23 lb-ft (31 Nm).



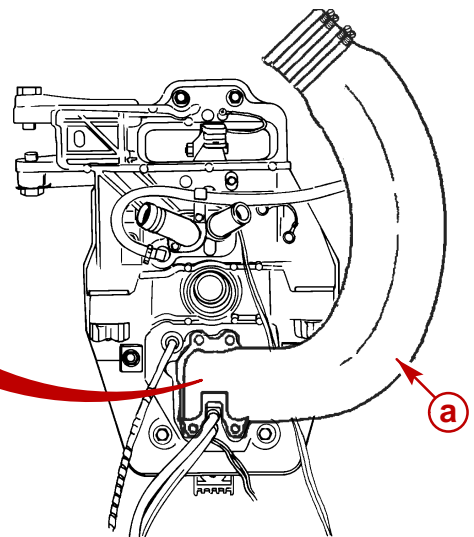
22028

### Typical V6 and V8 Gasoline Engines

- a** - Exhaust Pipe  
**b** - Bolts (4)



76657



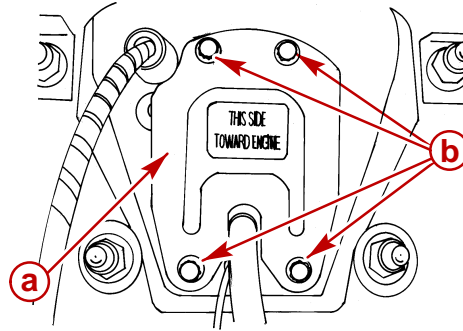
71945

### Typical Diesel Engine

- a** - Exhaust Pipe  
**b** - Bolts (4)



9. **Through the transom exhaust models:** Install exhaust block-off plate, if removed. Torque bolts to 23 lb-ft (31 Nm).



76638

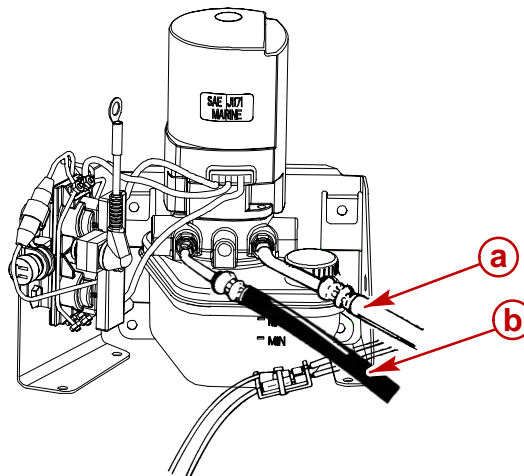
- a** - Block-Off Plate  
**b** - Bolts

**IMPORTANT:** Make hydraulic hose connections as quick as possible to prevent oil from leaking out of the system.

### ⚠ CAUTION

Installing trim pump hoses improperly can damage the hose fittings and cause leaks or loose lines. Do not cross thread or overtighten the hose fittings.

10. Connect the power trim pump hydraulic hoses. Torque both hose fittings to 125 lb-in. (14 Nm).



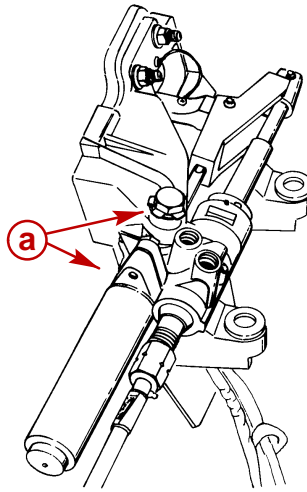
76631

- a** - DOWN Pressure Hydraulic Line (GRY)  
**b** - DOWN Pressure Hydraulic Line (BLK)

11. Install engine refer to the appropriate engine service manual.

## 12. Connect the power steering assembly to the transom.

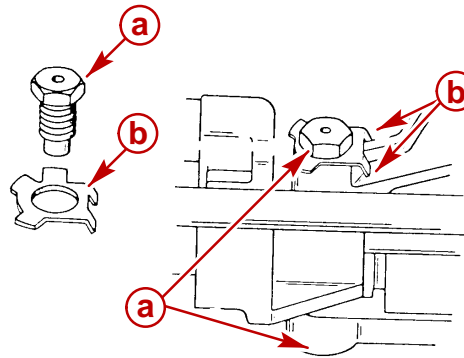
- a. Lubricate bushings with Special Lubricant 101.



71901

**a** - Bushings

- b. Slide the power steering cylinder bushings between the transom mounting brackets. Tighten the two pivot bolts by hand. At the same time, move the steering assembly slightly to ensure proper pin engagement into the pivot bushings.
- c. Ensure that the washer tangs straddle the ridges on the inner transom plate.



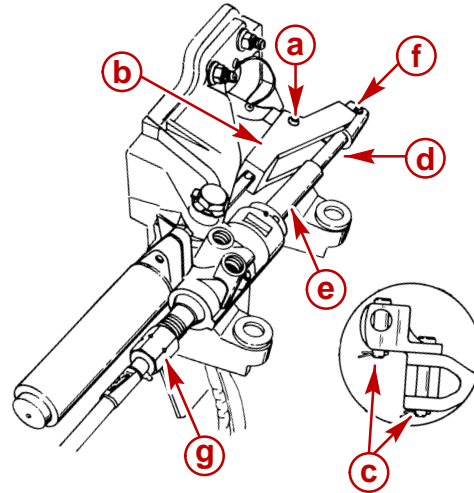
22033

**a** - Pivot Bolt

**b** - Washer Tang

- d. Torque the pivot bolts to 25 lb-ft (34 Nm). Bend the washer tabs against the corresponding flats on both pivot bolt heads.
  - e. Make sure the power steering control valve pivots freely.
13. Connect the power steering clevis to the steering lever.
- a. Lubricate the clevis pins with Special Lubricant 101.
  - b. Install the clevis pin in the clevis from the top.
  - c. Secure the pin in the clevis with a cotter pin. Spread the cotter pin ends.
14. Lubricate the steering cable end with a liberal amount of Special Lubricant 101 and install the cable through the guide.
15. Start the coupler nut on the tube. Do not tighten at this time.

16. Connect the cable end to the clevis with the forward clevis pin. Secure the pin in the clevis with a cotter pin. Spread the cotter pin ends.



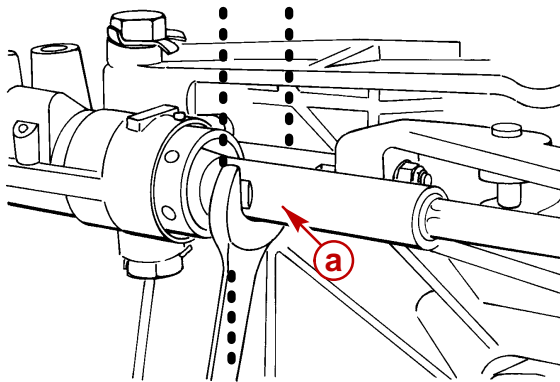
71901

- a** - Rear Clevis Pin
- b** - Clevis
- c** - Cotter Pin
- d** - Steering Cable End
- e** - Cable Guide
- f** - Forward Clevis Pin
- g** - Coupler Nut

17. Using a suitable wrench hold the flat surfaces on the cable guide tube in the vertical position.

**IMPORTANT:** Be certain the flat surfaces are still aligned vertically after torque is applied to coupler nut.

18. Torque the coupler nut to 35 lb-ft (48 Nm).

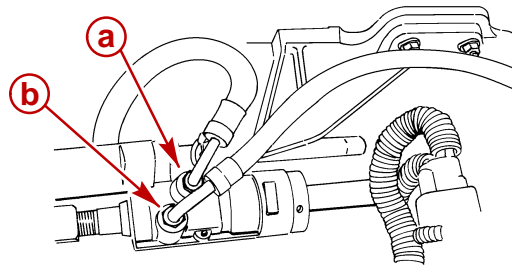


73901

- a** - Flat Surface On Guide Tube

19. Attach both hydraulic hose fittings.

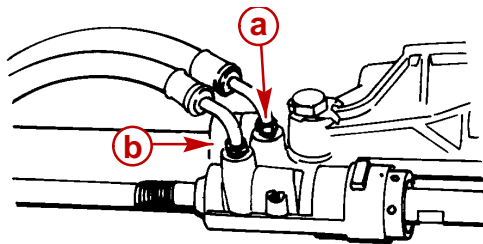
- a. Torque both fittings to 23 lb-ft (31 Nm). Route hoses as appropriate to avoid contact with the steering system components.



73860

#### Models With One Hose Routed Behind Power Steering Control Valve

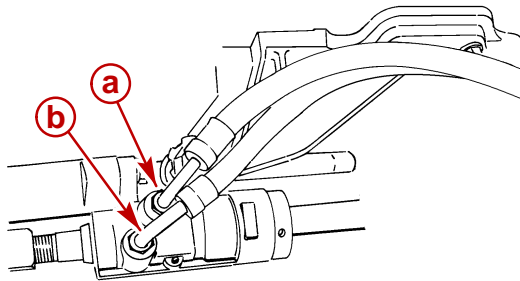
- a** - Rear Pressure Hose
- b** - Front Return Hose



74248

#### Models With Both Hoses Routed Behind Power Steering Control Valve Toward Starboard Side

- a** - Rear Pressure Hose
- b** - Front Return Hose

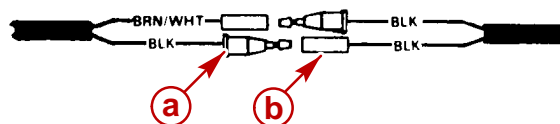


73786

#### Models With Both Hoses Routed Over Transom Plate

- a** - Rear Pressure Hose
- b** - Front Return Hose

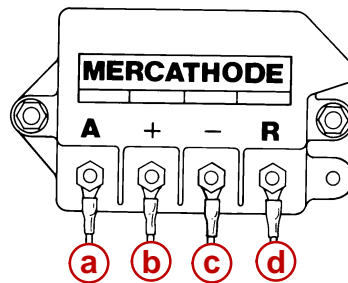
20. Connect the trim sender leads from the gimbal housing to leads from the engine harness.



24841

- a** - Bullet Connectors - From Engine Harness
- b** - Bullet Connectors - From Transom Assembly

21. Connect the MerCathode wires at the MerCathode controller.

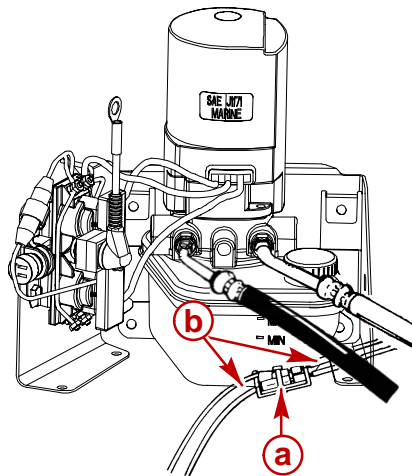


22232

- a** - ORN Lead - From Electrode on Transom Assembly
- b** - RED/PUR Lead - Connect (Other End) To Positive (+) Battery Terminal
- c** - BLK Lead - From Engine Harness
- d** - BRN Lead - From Electrode On Transom Assembly

22. Apply a thin coat of Liquid Neoprene to all electrical connections.

23. Connect the trim limit switch wires.



76631

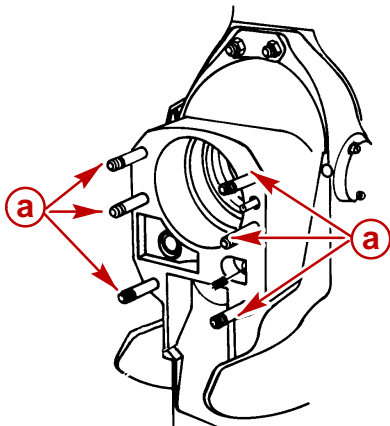
- a** - Sta-Strap
- b** - Trim Limit Switch Wires

## Sterndrive Unit Installation

1. Install and align the engine. Refer to the appropriate engine service manual.

**NOTE:** If the engine was removed and the shift cable was disconnected, reinstall and adjust the shift cable before proceeding.

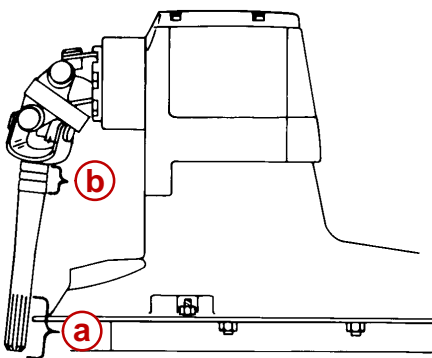
2. Place the remote control shift lever in the neutral position.
3. Lubricate the bell housing studs with Quicksilver 2-4-C Marine Lubricant with Teflon.



76674

**a** - Bell Housing Studs

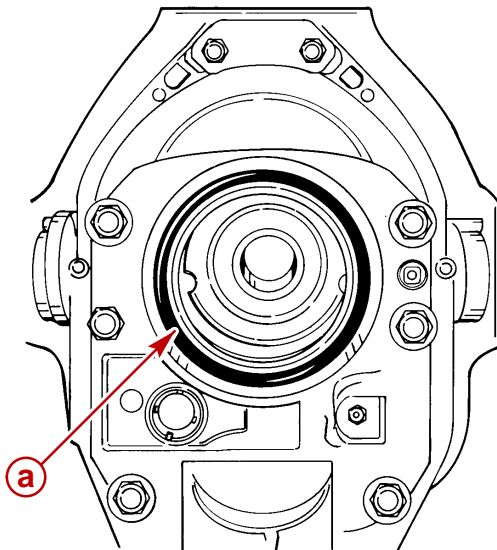
4. Lubricate the U-joint shaft splines and the O-rings with Quicksilver Engine Coupler Spline Grease.



22026

**a** - U-Joint Shaft Splines  
**b** - U-Joint Shaft O-Rings

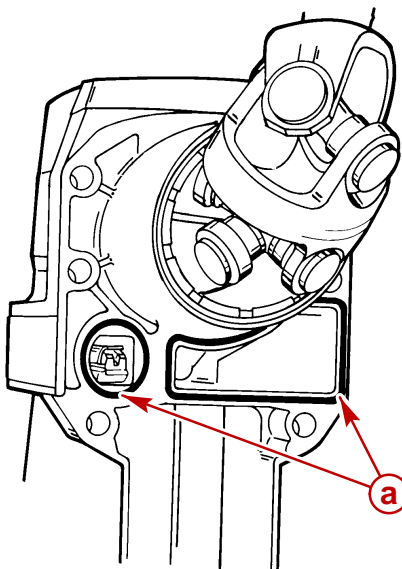
**IMPORTANT:** The edge of the U-joint bellows acts as a seal between the bell housing and the drive shaft housing. Ensure that the surface is not damaged.



24725

**a** - Drive Shaft Bellows Edge

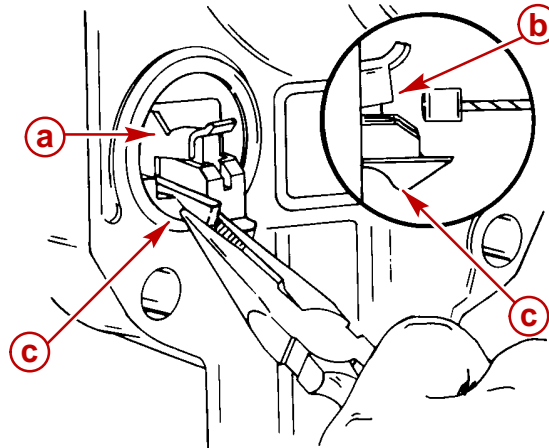
5. Inspect the U-joint bellows for cracks, nicks, and cleanliness. Replace or clean the bellows as necessary.
6. Lubricate the O-ring seals on the face of the drive shaft housing.



22031

**a** - O-Ring Seals

7. Pull out the shift linkage as far as possible. The jaws will open. Lubricate the underside of the lower lip of the shift linkage assembly with Quicksilver Special Lubricant 101.



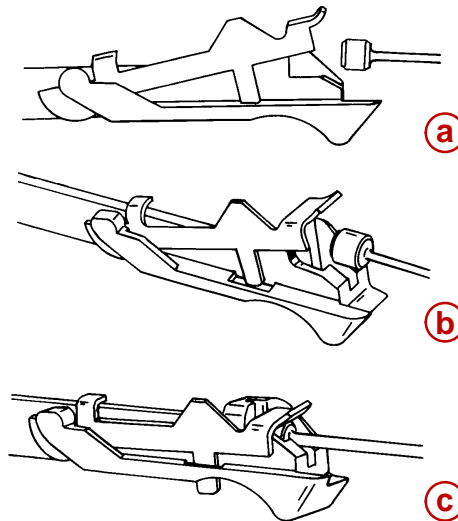
22025

- a** - Shift Linkage Assembly  
**b** - Jaws Open  
**c** - Underside of Lower Lip

8. Ensure that shift lever is in the neutral position.

**IMPORTANT:** As you are inserting the sterndrive unit into the bell housing, the entrance of the bell housing shift cable must be closely checked to ensure that the cable enters the Jaws of the shift linkage assembly in the sterndrive unit.

**NOTE:** As the shift cable enters the shift linkage assembly, it pushes the assembly back into the drive shaft housing and the jaw closes securing the cable as shown in **a**, **b** and **c** (below).

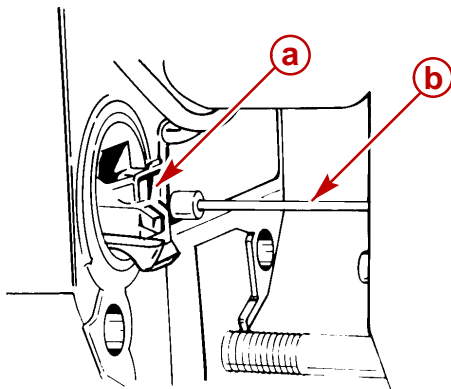


22025

**Shift Linkage Assembly and Shift Cable**



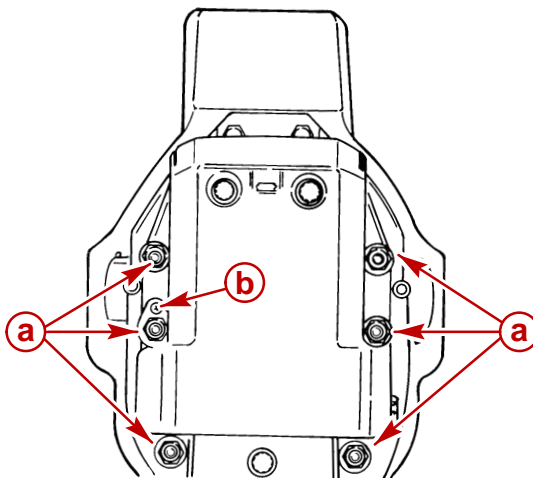
**NOTE:** If the shift cable does not line up to properly enter the shift linkage jaws, use your hand to guide the cable into place while installing the sterndrive unit.



22025

- a** - Shift Linkage Jaws  
**b** - Shift Cable

9. Install the sterndrive unit.
  - a. Position the trim cylinders so that they point straight backwards (aft).
  - b. Align the U-joint shaft with the bell housing bore. Make sure the studs on the bell housing align with the appropriate holes on the sterndrive unit.
  - c. Guide the U-joint shaft through the gimbal bearing and into the engine coupler. Make sure that the shift linkage jaws engage with the shift cable.
  - d. If necessary, rotate the propeller shaft slightly to align the U-joint shaft splines with the engine coupler splines, then slide the sterndrive unit completely into the bell housing.
  - e. Rotate the propeller shaft slightly to ensure that the sterndrive unit is still in neutral once installed.
10. Fasten the sterndrive unit to the bell housing. Start from the center and torque the nuts to 50 lb-ft (68 Nm).



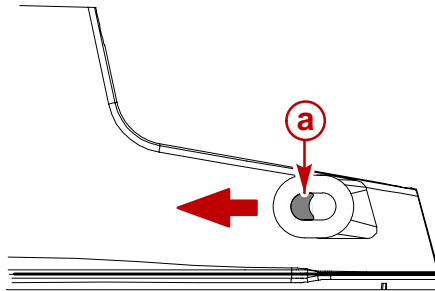
22031

- a** - Locknuts (6) and Flat Washers (5)  
**b** - Ground Plate (Flat Washer Not Used Here)

**IMPORTANT:** On Bravo One, Two and Three Models, the Trim-In Limit Insert must be properly positioned before installing the trim cylinder anchor pin in the following steps.

**NOTE:** Ensure that the Trim-In Limit Insert is reinstalled in the same position that it was in prior to removal of the sterndrive unit. If you are not sure of its original position, contact the boat manufacturer for their recommendation. Refer to "Special Information" at the front of this section before reinstalling the Trim-In Limit Insert.

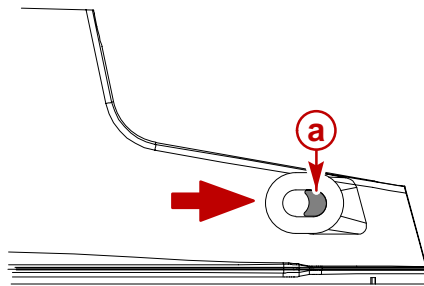
11. Ensure that the Trim-In Limit Insert is positioned as shown for the appropriate Bravo model.



75157

**Bravo One and Two (Positioned Forward)**

**a** - Trim-In Limit Insert



75158

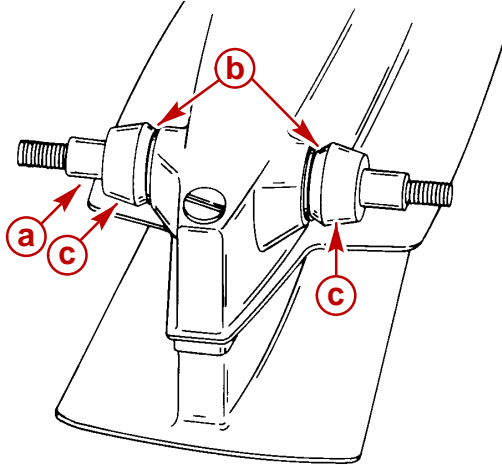
**Bravo Three (Positioned Aft)**

**a** - Trim-In Limit Insert

**IMPORTANT:** The position of the Trim-In Limit Insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

12. Insert the aft anchor pin through the hole in the drive shaft housing.

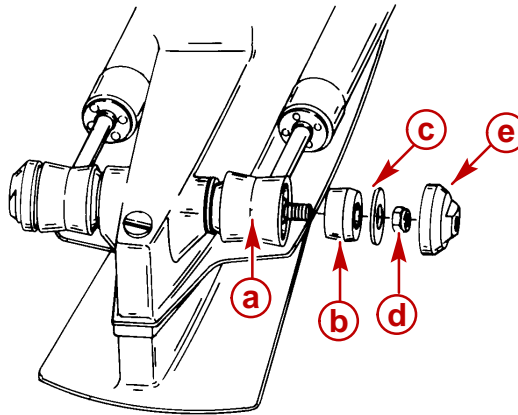
13. Place a large I.D. flat washer and bushing on each end of the anchor pin. Be sure to install the bushings with the small diameter end facing outward.



22029

- a** - Anchor Pin
- b** - Large I.D. Washers
- c** - Bushings

14. Loosen the nuts which secure the trim cylinders to the forward anchor pins. Move the cylinder pivot ends outward and place them over the aft anchor pin.
15. Place the bushings (with the smaller diameter end facing inward) and the small I.D. flat washers onto each end of the anchor pin. Install locknuts.
16. Tighten the forward and aft anchor pin locknuts until the locknuts and washers contact against anchor pin shoulder.
17. Attach the trim cylinder caps hand tight. If the caps will not catch the threads, recheck the tightness of the anchor pin nuts.

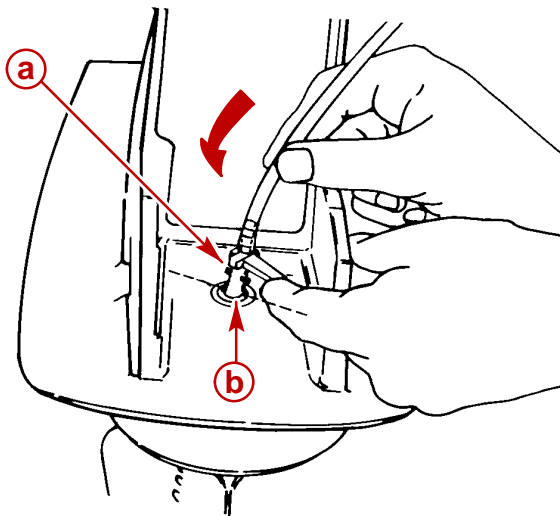


22029

- a** - Trim Cylinder Pivot Ends
- b** - Bushing
- c** - Small I.D. Flat Washer
- d** - Locknut
- e** - Trim Cylinder Cap

18. Attach the speedometer hose fitting to the sterndrive unit.

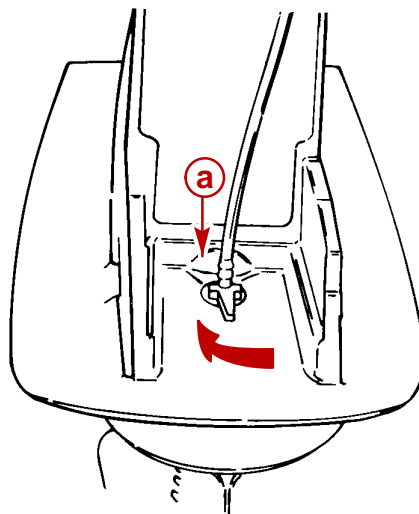
- a. Raise the sterndrive unit to gain access to the area between the gimbal housing and the sterndrive unit. Locate the opening in the forward end of the anti-ventilation plate.
- b. Insert the speedometer hose fitting into the opening.



22025

- a** - Speedometer Hose Fitting  
**b** - Opening

- c. With the fitting fully seated, turn the handle clockwise to a tightly seated position.



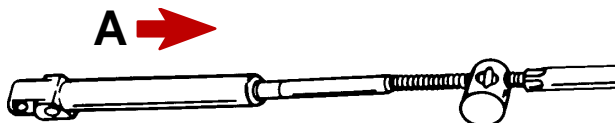
22025

- a** - Speedometer Hose Fitting Installed (Handle Pointing Forward)

## Shift Cable Installation and Adjustment

**NOTE:** Using Adjustment Tool (91-12427), shift cables can be adjusted with or without the sterndrive installed.

**IMPORTANT:** Front propeller on Bravo Three sterndrive unit is always LH rotation and rear propeller is always RH rotation. Shift cable end guide must move in direction "A", when control lever is placed in FORWARD gear position.

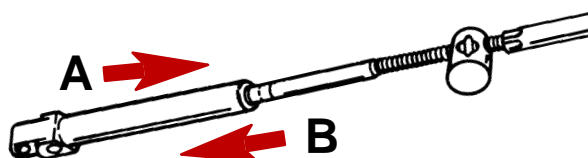


71656

### BRAVO THREE

**IMPORTANT:** For Bravo One and Two sterndrive unit propeller rotation is determined by the shift cable installation in the remote control.

- If shift cable end guide moves in direction "A," when control lever is placed in Forward, remote control is setup for RIGHT HAND (RH) propeller rotation.
- If shift cable end guide moves in direction "B," when control lever is placed in Forward, remote control is setup for LEFT HAND (LH) propeller rotation.

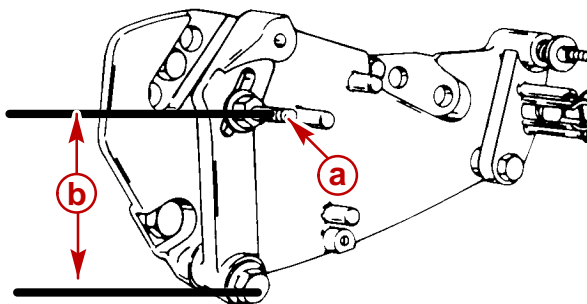


22024

### BRAVO ONE AND TWO

**IMPORTANT:** When installing shift cables, be sure that cables are routed in such a way as to avoid sharp bends and/or contact with moving parts. DO NOT fasten any items to shift cables.

1. Install shift cable into remote control. Refer to remote control manufacturer's instructions.
2. Loosen stud and move it to dimension, as shown. Retighten stud.

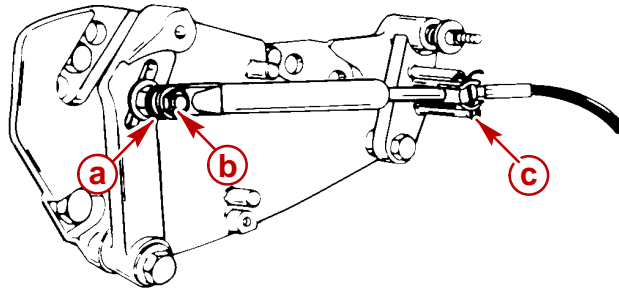


71657

**a** - Stud

**b** - 3 In. (Center of Pivot Bolt to Center of Stud)

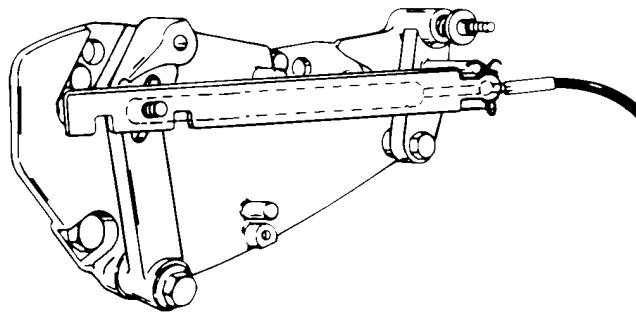
3. Install sterndrive unit shift cable.



71658

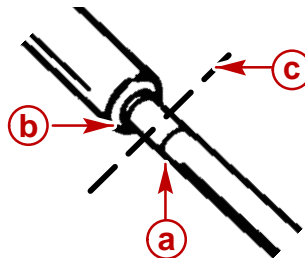
- a** - Washers (2)
- b** - Locknut-Tighten Until Contact, Then Loosen 1 Turn
- c** - Cotter Pin-Insert from Top and Spread Both Ends

4. Place adjustment tool over sterndrive unit shift cable, as shown. Hold tool in place over the barrel retainer with a piece of tape.



71659

5. Locate center of remote control and control cable play (backlash).
  - a. Shift remote control to NEUTRAL.
  - b. Push in on control cable end with enough pressure to remove play, and mark position "a" on tube.
  - c. Pull out on control cable end with enough pressure to remove play and mark position "b" on tube.
  - d. Measure distance between marks "a" and "b". Then, mark position "c" half-way between marks "a" and "b."



71656

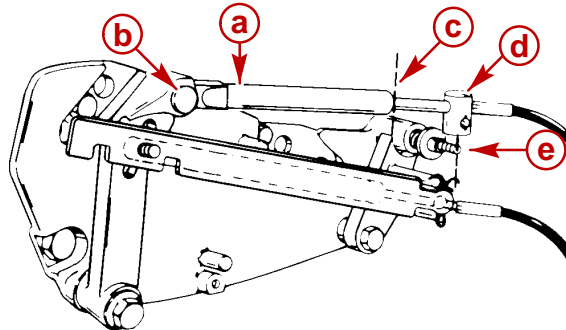
**IMPORTANT:** Be sure to keep center mark "c" aligned with control cable end guide edge when making the following adjustment.

6. Adjust control cable as follows:
  - a. Temporarily install control cable end guide into shift lever and insert anchor pin.
  - b. Adjust control cable barrel so that hole in barrel centers with vertical centerline of stud. Ensure that backlash center mark is aligned with edge of control cable end guide.

### ⚠ CAUTION

**DO NOT attempt to install or remove control cable barrel from stud, without first removing end guide anchor pin from shift lever, and removing cable. Attempting to bend control cable to install or remove barrel, will place undue stress on cable end guide and shift lever, and damage to both could occur.**

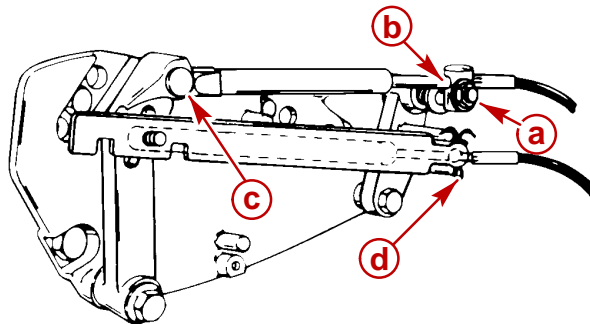
- c. Remove control cable end guide from shift lever, by removing anchor pin.



71660

- a** - Control Cable End Guide
- b** - Anchor Pin
- c** - Backlash Center
- d** - Control Cable Barrel
- e** - Stud

7. Install control cable. Tighten locknut until it bottoms out. Spread both ends of cotter pin.



71661

- a** - Locknut
- b** - Washers-Both Sides of Barrel
- c** - Anchor Pin
- d** - Cotter Pin

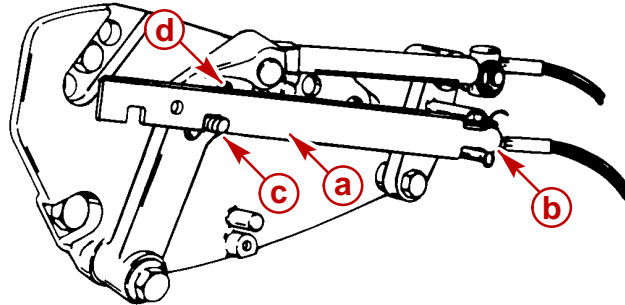
8. Remove adjustment tool.

9. Shift remote control lever into full forward position. Rear slot in tool should fit over shift lever stud.

**RH ROTATION BRAVO ONE AND TWO, AND ALL BRAVO THREE MODELS:** Rear slot in tool should fit over shift lever stud.

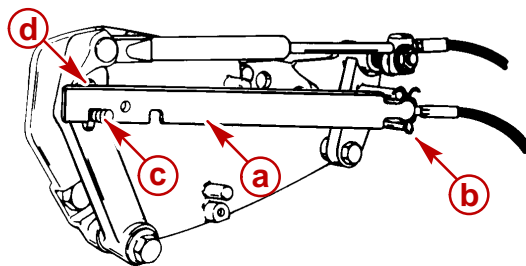
**LH ROTATION BRAVO ONE AND TWO MODELS:** Forward slot in tool should fit over shift lever stud.

If slot does not fit over stud, loosen shift lever stud and slide stud up or down, until slot in tool fits over stud. When adjustment is correct, retighten stud.



23345

**RH Rotation Bravo One And Two, And All Bravo Three Models**



23345

**LH Rotation Bravo One And Two Models**

- a** - Adjustment Tool
- b** - Barrel Retainer
- c** - Shift Lever Stud
- d** - Shift Lever Adjustment Slot

10. Remove adjustment tool.
11. Lubricate shift cable pivot points with 30W oil.

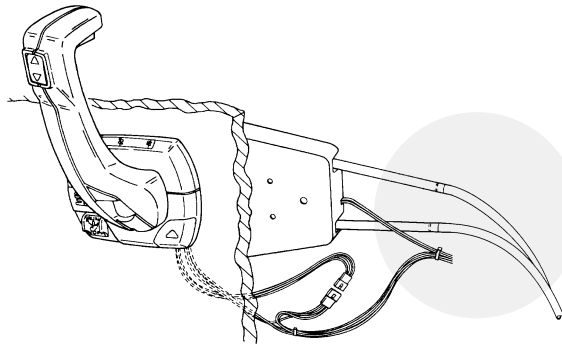


## Troubleshooting Shift Problems

**NOTE:** The following information is provided to assist an installer in troubleshooting, if hard shifting or chocking/racheting is encountered when shifting into forward gear.

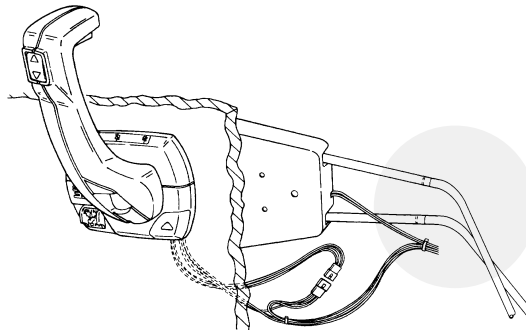
1. When installing the control box in the side panel of the boat, make sure that the cables have enough clearance to operate. This is necessary because the cables move up and down when the shift handle is moved. If the control box is mounted too far back towards any fiberglass structure, the cables will be interfered with, this will cause very hard shifting.

**NOTE:** The control box housing can be rotated in 30° increments to improve cable routing.



74688

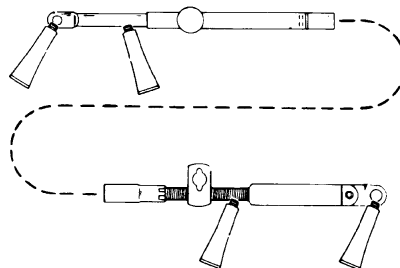
### Proper Cable Bend



74689

### Improper Cable Bend

2. Make sure that when the shift cable from the control box is lead through the side gunnel of the hull, that it does not have any extremely sharp bends in it as this will cause the stiff shifting.
3. Before installing the shift cable into the control box, extend the stainless rod eye end of the cable and grease it with 2-4-C Marine Lubricant with Teflon. Move it back and forth to allow even distribution of the grease.

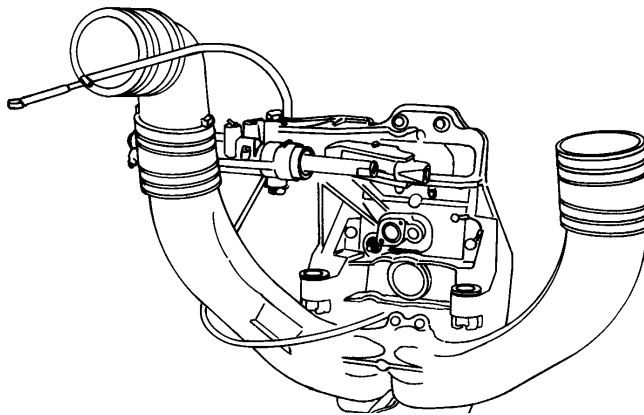


22005

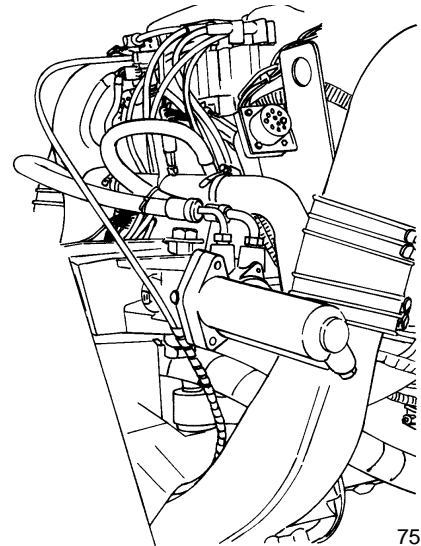
4. Do not strap or clamp the control cables to any other cables or rigid structure within **three feet** of the control box.

5. Be sure the cable is not permanently kinked.
6. Make sure there is proper clearance for cable movement when the control box is installed in the side panel. The cables must have room to move up and down when the control handle is shifted into either forward or reverse.
7. Check to make sure that the engine was not set down on the intermediate shift cable during installation, as this will crush the inner cable tubing and cause improper and / or stiff shifting.
8. DO NOT fasten the shift cable with straps or clamps to any other cable within **five feet** of the shift plate.
9. DO NOT fasten the shift cable to the transom with any type of plastic clips or fasteners within **five feet** of the shift plate.
10. DO NOT overtighten the throttle or shift cable attaching nuts at the engine end. Barrel and cable end must be free to rotate on the mounting stud.
11. Check the intermediate shift cable routing from the transom assembly to the shift plate as follows:
  - a. **V6 and V8 (except 7.4L) Models:** The cable should route above the exhaust pipe and below starboard rear engine mount then turn toward the starboard side of the boat between the exhaust pipe and the engine flywheel housing.
  - b. **7.4L MPI Models:** The cable should route under the starboard rear engine mount and turn toward the transom between the starboard rear engine mount and the exhaust pipe.
  - c. The cable should then route behind the power steering valve and loop over to the shift plate on the engine and connect to the anchor points on the shift plate.

Following this routing will prevent the engine coupler from damaging the cable.



74904

**V6 and V8 (except 7.4L) Models**

75767

**7.4L MPI Models**

# STERNDRIVE UNIT

## Section 3A - Drive Shaft Housing

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# Specifications

## Torque Specifications

Fastener Location	lb-in.	lb-ft	Nm
Shift Cam Assembly Locknuts	80		9
U-joint Bearing Retainer Nut		200	271
Shift Cam Assembly to Shifter Shaft Screw	110		13
Shift Linkage to Shifter Shaft, Screw	110		13
Top Cover Screws		20	27
Back Cover Screws		20	27
Drive Shaft Housing to Gear Housing Nuts and Screw		35	32
Anodic Plate Screw		23	32
Oil Vent Plug	40		4
Steel Bearing Adaptor		175	237

## Tools

Description	Part Number
Torque Wrench (lb-in.)	91-66274
Slide Hammer Puller	91-34569A1
U-joint Bearing Retainer Wrench	91-17256
Spanner Wrench For L-18 U-joint Bearing Retainer	91-862219
Replacement Pin Set For L-18 Spanner Wrench	91-862218
Clutch Assembly Stand	91-17301T1
Shift Handle Tool	91-17302
Bearing Removal Tool	91-17273
Bearing and Seal Driver Assembly	91-17275A1
Bearing Driver	91-813653T
Driver and Puller Assembly	91-90244A1
U-joint Press Adaptor	91-38756
Universal Puller Plate	91-37241
Steel Bearing Adaptor Socket	91-862531
Steel Bearing Adaptor Needle Bearing and Outer Race Installation Tool	91-862530

## Bearing Preloads

Description	lb-in.	Nm
U-joint Bearings (New)	8	.9
U-joint Bearings (Used)*	5	.6

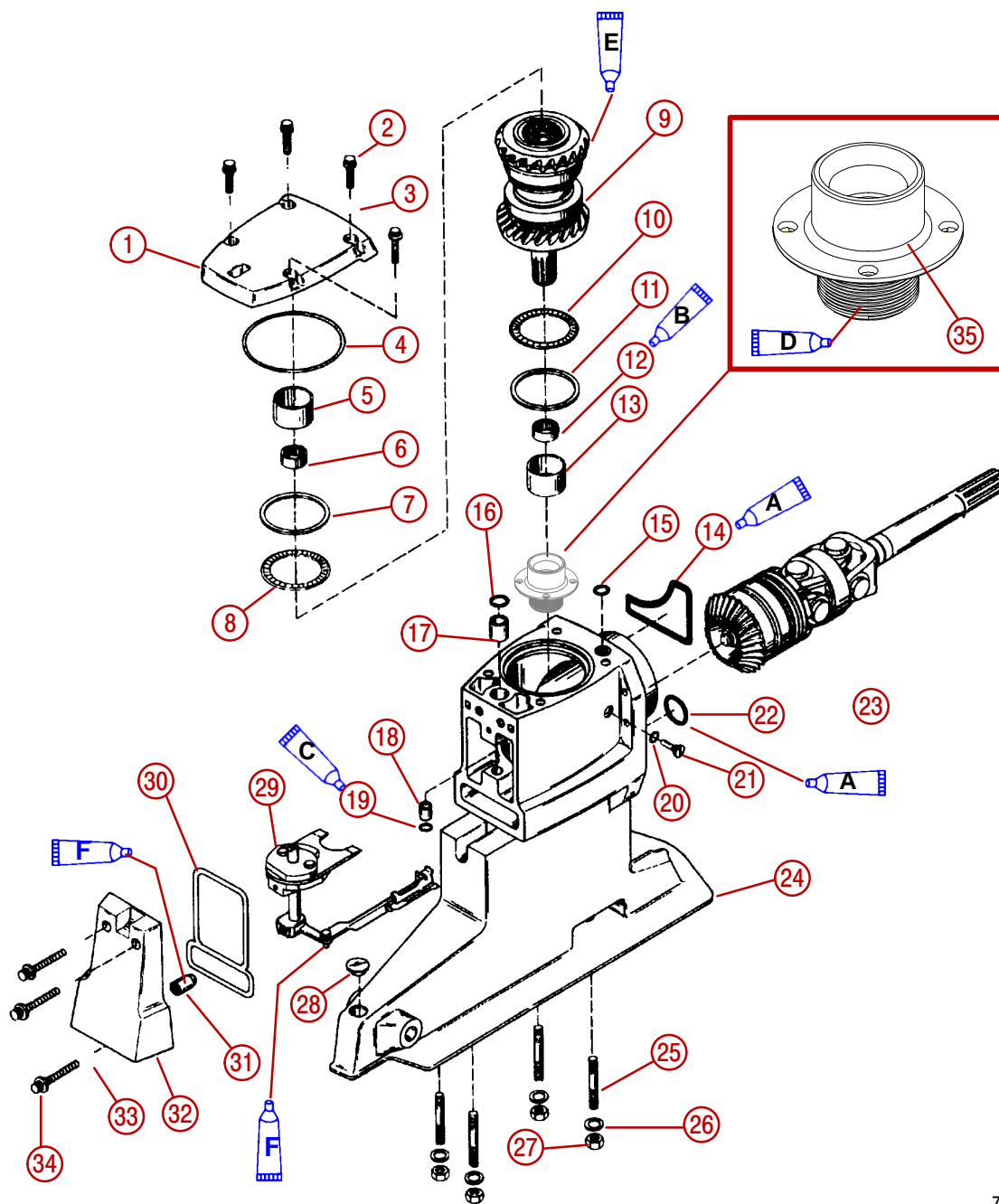
\* Bearings are used if spun once under load.

## Lubricants / Sealants / Adhesives

Description	Part Number
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A1
3M Brand Adhesive	92-86166-Q1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver High Performance Gear Lube	92-850743A1
Quicksilver U-Joint and Gimbal Bearing Grease	92-828052A2
Perfect Seal	92-34227-1
Loctite 271	91-809820
Loctite 277	Obtain Locally
Exxon Unirex EP2 Grease	Obtain Locally
Permalock 115	Obtain Locally

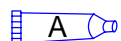
# Drive Shaft Housing Exploded View

## Complete Housing

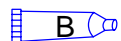


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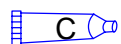
- |   |  |
|---|--|
| <b>1</b> - Top Cover                    | <b>19</b> - Shifter Shaft Seal                                       |
| <b>2</b> - Screw (4)                    | <b>20</b> - Vent Plug Seal   |
| <b>3</b> - Flat Washer (4)              | <b>21</b> - Vent Plug  |
| <b>4</b> - O-ring                       | <b>22</b> - O-ring   |
| <b>5</b> - Bearing Sleeve               | <b>23</b> - U-joint Assembly   |
| <b>6</b> - Needle Bearing               | <b>24</b> - Drive Shaft Housing                                      |
| <b>7</b> - Thrust Race (Shim)           | <b>25</b> - Stud (4)   |
| <b>8</b> - Thrust Bearing               | <b>26</b> - Flat Washer (4)  |
| <b>9</b> - Clutch Assembly              | <b>27</b> - Locknut (4)  |
| <b>10</b> - Thrust Bearing              | <b>28</b> - Plastic Plug   |
| <b>11</b> - Thrust Race (shim)          | <b>29</b> - Shifter Assembly   |
| <b>12</b> - Needle Bearing              | <b>30</b> - O-ring   |
| <b>13</b> - Bearing Sleeve              | <b>31</b> - Ball Detent Canister                                     |
| <b>14</b> - O-ring                      | <b>32</b> - Back Cover   |
| <b>15</b> - O-ring                      | <b>33</b> - Flat Washer (3)  |
| <b>16</b> - O-ring                      | <b>34</b> - Screw (3)  |
| <b>17</b> - Shifter Shaft Bushing-Upper | <b>35</b> - Steel Bearing Adapter (Bravo X, XZ, XR and Diesel Bravo) |
| <b>18</b> - Shifter Shaft Bushing-Lower |  |



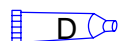
**A** - 3M Brand Adhesive



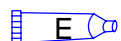
**B** - Quicksilver Needle Bearing Assembly Lubricant



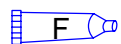
**C** - Loctite 271



**D** - Loctite 277

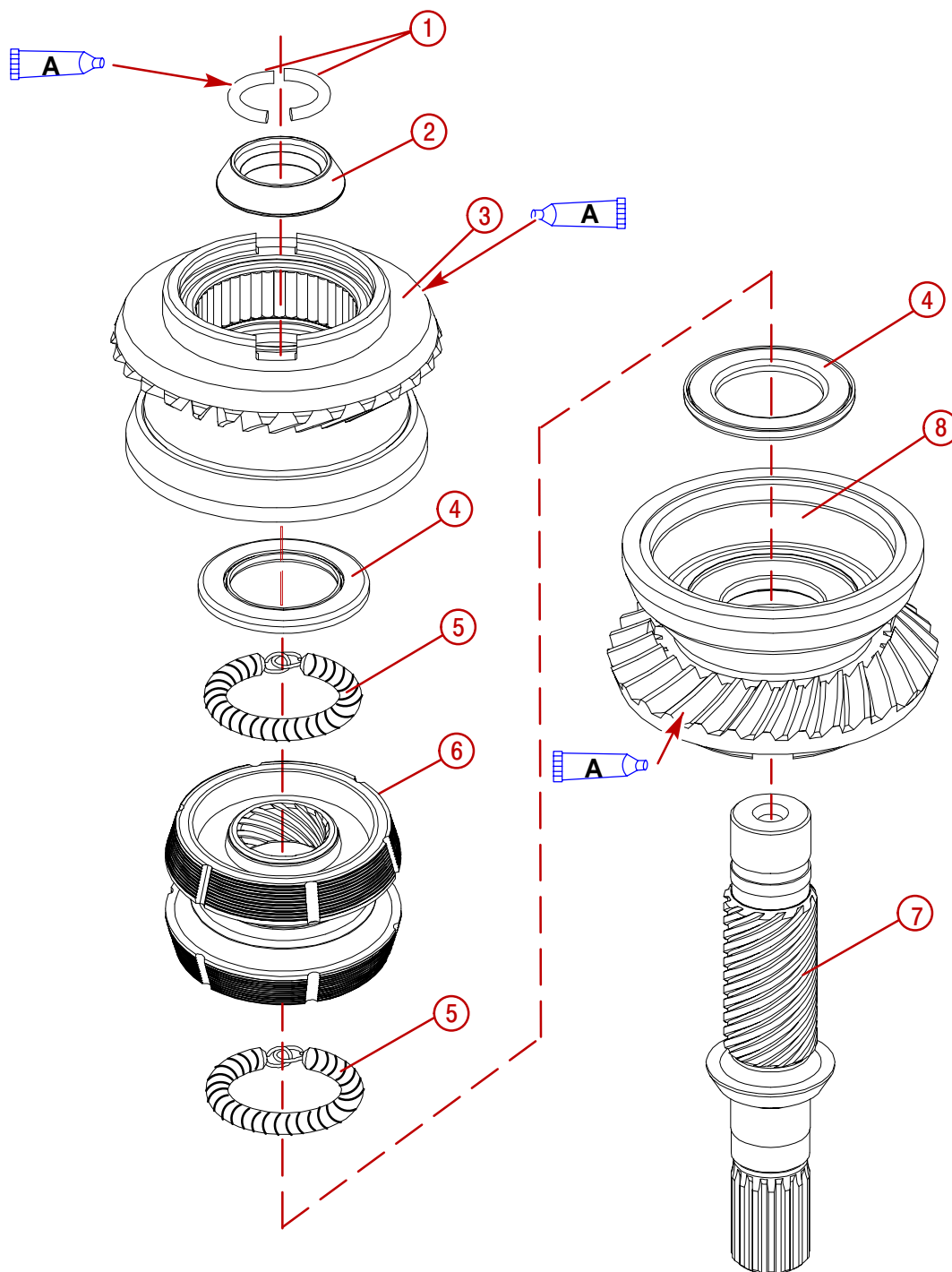


**E** - Quicksilver High Performance Gear Lube (Use On All Bearing Surfaces)



**F** - Quicksilver Special Lubricant 101

# Exploded Parts View (Clutch)



76668

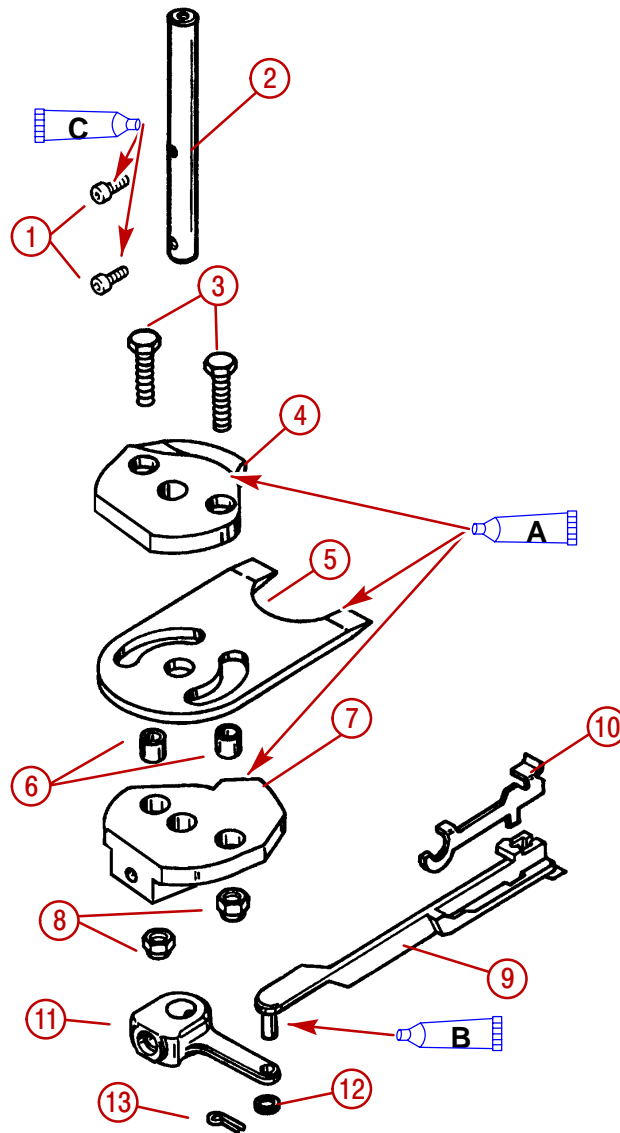
- 1 - Keepers
- 2 - Collar
- 3 - Upper Gear Assembly
- 4 - Thrust Bearings

- 5 - Garter Springs
- 6 - Clutch
- 7 - Lower Gear Assembly
- 8 - Shaft

 - Quicksilver High Performance Gear Lube



# Exploded Parts View (Shifter)



73363

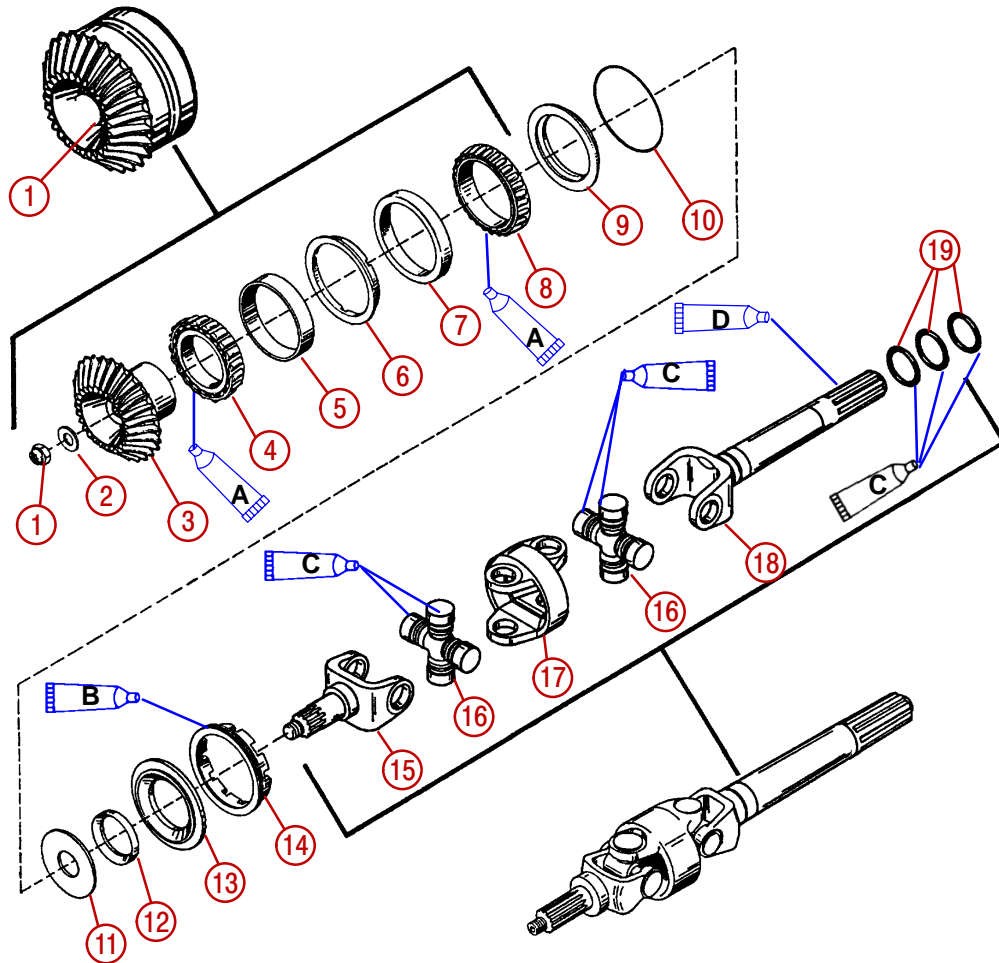
- |                            |                         |
|----------------------------|-------------------------|
| <b>1</b> - Socket Screws   | <b>8</b> - Locknuts     |
| <b>2</b> - Shifter Shaft   | <b>9</b> - Link Bar     |
| <b>3</b> - Screws          | <b>10</b> - Latch       |
| <b>4</b> - Upper Shift Cam | <b>11</b> - Shift Lever |
| <b>5</b> - Yoke            | <b>12</b> - Flat Washer |
| <b>6</b> - Spacers         | <b>13</b> - Cotter Pin  |
| <b>7</b> - Lower Shift Cam |                         |

 **A** - Quicksilver High Performance Gear Lube

 **B** - Quicksilver Special Lubricant 101

 **C** - Permalock 115

## Standard Bravo U-joint Assembly

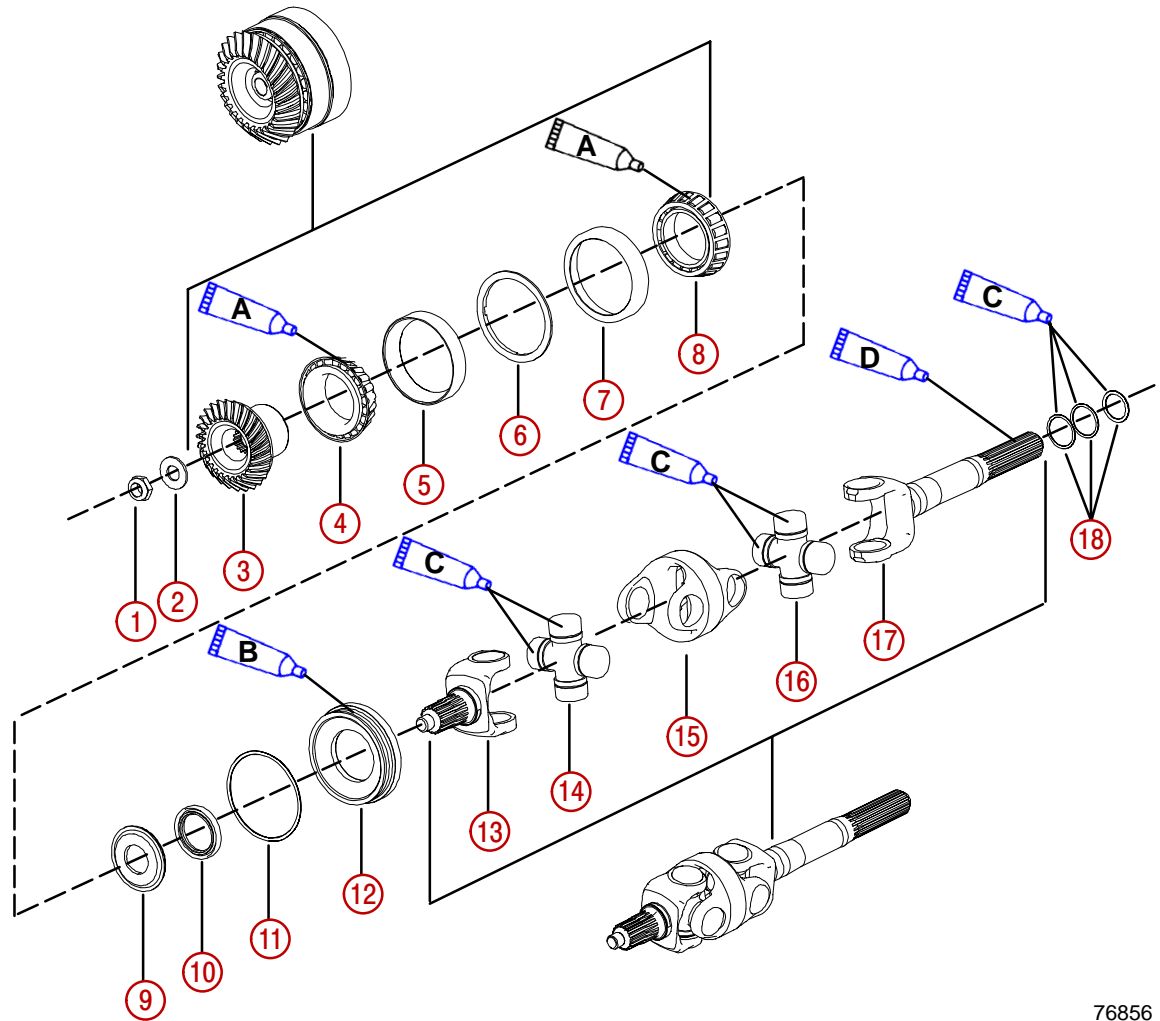


73364

- |                                    |                               |
|------------------------------------|-------------------------------|
| <b>1</b> - Locknut                 | <b>11</b> - Beveled Washer    |
| <b>2</b> - Washer                  | <b>12</b> - Oil Seal          |
| <b>3</b> - Pinion Gear             | <b>13</b> - Oil Seal Carrier  |
| <b>4</b> - Bearing (Smaller OD)    | <b>14</b> - Ring Nut          |
| <b>5</b> - Bearing (Smaller ID)    | <b>15</b> - Yoke              |
| <b>6</b> - Spacer                  | <b>16</b> - Cross and Bearing |
| <b>7</b> - Bearing Cup (Larger ID) | <b>17</b> - Socket            |
| <b>8</b> - Bearing Larger OD)      | <b>18</b> - Yoke              |
| <b>9</b> - Sealing Ring            | <b>19</b> - O-rings (3)       |
| <b>10</b> - O-Ring                 |                               |

- A** - Quicksilver High Performance Gear Lube
- B** - Quicksilver Special Lubricant 101
- C** - Quicksilver U-joint and Gimbal Bearing Grease
- D** - Engine Coupler Spline Grease

## Bravo X, XZ, XR and Diesel Bravo U-joint Assembly



76856

- |                                     |                               |
|-------------------------------------|-------------------------------|
| <b>1</b> - Locknut                  | <b>10</b> - Oil Seal          |
| <b>2</b> - Washer                   | <b>11</b> - O-Ring            |
| <b>3</b> - Pinion Gear              | <b>12</b> - Retainer Nut      |
| <b>4</b> - Bearing Cup (Smaller OD) | <b>13</b> - Yoke              |
| <b>5</b> - Bearing (Smaller ID)     | <b>14</b> - Cross and Bearing |
| <b>6</b> - Spacer                   | <b>15</b> - Socket            |
| <b>7</b> - Bearing Cup (Larger ID)  | <b>16</b> - Cross and Bearing |
| <b>8</b> - Bearing Larger OD)       | <b>17</b> - Yoke              |
| <b>9</b> - Thrust Washer            | <b>18</b> - O-rings (3)       |

**A** - Quicksilver High Performance Gear Lube

**B** - Quicksilver Special Lubricant 101

**C** - Exxon Unirex EP2 Grease

**D** - Engine Coupler Spline Grease

# Drive Shaft Housing and Gear Case Separation

## Drive Unit Gear Ratio Identification

All drive unit gear ratios are identified on each drive in two places. It is important to note the ratio of the drive unit before proceeding with any repairs. The first place to look is on the decal on the port side of the drive housing. It will have a number such as (1.50R) and then the seal number. The second place to look will be on the universal joint splined yoke. It will be identified with a letter such as (F). This method is explained in the following chart. This will be true for new or un-tampered with drive units. A drive unit could have had the gear ratio changed for high altitude, which would void out any application of the following charts. The gear ratio then would have to be determined by counting the teeth on the drive gear and the driven gear in the drive shaft housing and using the following charts for reference.

## Bravo One

### U-JOINT IDENTIFICATION

RATIO	U-JOINT SHAFT MARKING
1.65:1	C
1.50:1	F
1.36:1	H

### NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING

RATIO	DRIVE	DRIVEN
1.65:1	23	30
1.50:1	27	32
1.36:1	27	29

## Bravo Two

### U-JOINT IDENTIFICATION

RATIO	U-JOINT SHAFT MARKING
2.20:1	C
2.00:1	F
1.81:1	H
1.65:1	T

**NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING**

<b>RATIO</b>	<b>DRIVE</b>	<b>DRIVEN</b>
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	29

**Bravo Three****U-JOINT IDENTIFICATION**

<b>RATIO</b>	<b>U-JOINT SHAFT MARKING</b>
2.43:1	N
2.20:1	K
2.00:1	B
1.81:1	G
1.65:1	C
1.50:1	F
1.36:1	P

**NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING**

<b>RATIO</b>	<b>DRIVE</b>	<b>DRIVEN</b>
2.43:1	23	30
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	32
1.36:1	27	29

**Bravo XZ****U-JOINT IDENTIFICATION**

<b>RATIO</b>	<b>U-JOINT SHAFT MARKING</b>
1.50:1	Z
1.36:1	T

**NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING**

<b>RATIO</b>	<b>DRIVE</b>	<b>DRIVEN</b>
1.50:1	27	32
1.36:1	27	29

**Bravo XR****U-JOINT IDENTIFICATION**

<b>RATIO</b>	<b>U-JOINT SHAFT MARKING</b>
1.50:1	R

**NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING**

<b>RATIO</b>	<b>DRIVE</b>	<b>DRIVEN</b>
1.50:1	16	19

**Diesel Bravo One X****U-JOINT IDENTIFICATION**

<b>RATIO</b>	<b>U-JOINT SHAFT MARKING</b>
1.65:1	C
1.50:1	F
1.36:1	H

**NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING**

<b>RATIO</b>	<b>DRIVE</b>	<b>DRIVEN</b>
1.65:1	23	30
1.50:1	27	32
1.36:1	27	29

**Diesel Bravo Two X****U-JOINT IDENTIFICATION**

<b>RATIO</b>	<b>U-JOINT SHAFT MARKING</b>
2.20:1	C
2.00:1	F
1.81:1	H
1.65:1	T

**NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING**

<b>RATIO</b>	<b>DRIVE</b>	<b>DRIVEN</b>
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	29

**Diesel Bravo Three X****U-JOINT IDENTIFICATION**

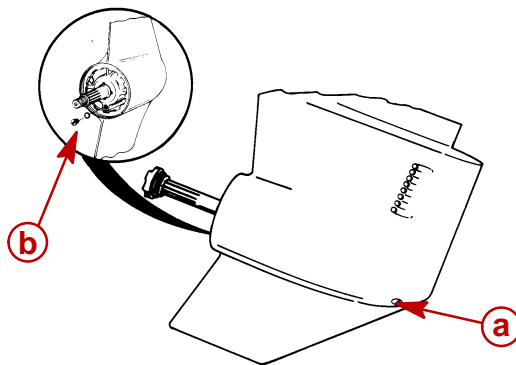
<b>RATIO</b>	<b>U-JOINT SHAFT MARKING</b>
2.43:1	N
2.20:1	K
2.00:1	B
1.81:1	G
1.65:1	C
1.50:1	F
1.36:1	P

**NUMBER OF TEETH PER GEAR - DRIVE SHAFT HOUSING**

<b>RATIO</b>	<b>DRIVE</b>	<b>DRIVEN</b>
2.43:1	23	30
2.20:1	23	30
2.00:1	27	32
1.81:1	27	29
1.65:1	27	32
1.50:1	27	32
1.36:1	27	29

## Separate Housings

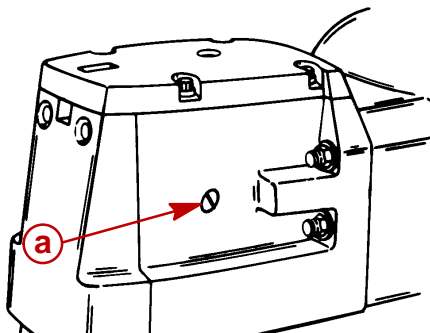
1. Remove, empty and clean gear lube monitor.
2. Drain drive unit at location “a” or “b,” as applicable, by removing fill/drain screw.



22103

- a** - Fill/Drain Screw (Bravo Two)  
**b** - Fill/Drain Screw (Bravo One)

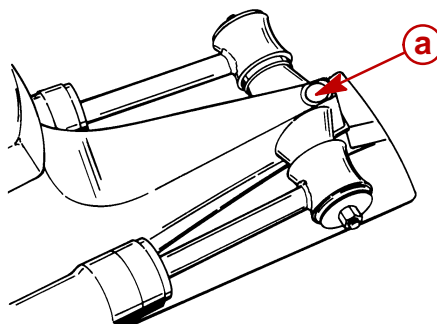
3. Remove vent plug.



50072

- a** - Vent Screw

4. **Bravo One, Bravo XZ, Bravo XR, and Diesel Bravo One X:**
  - a. Remove rubber plug.

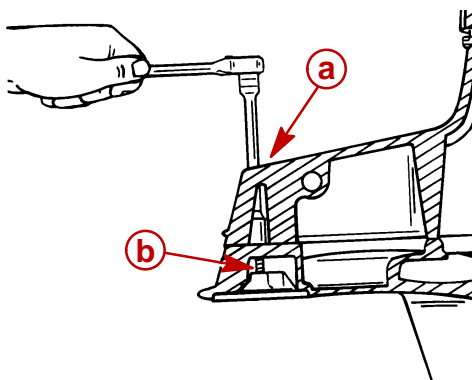


22093

- a** - Rubber Plug



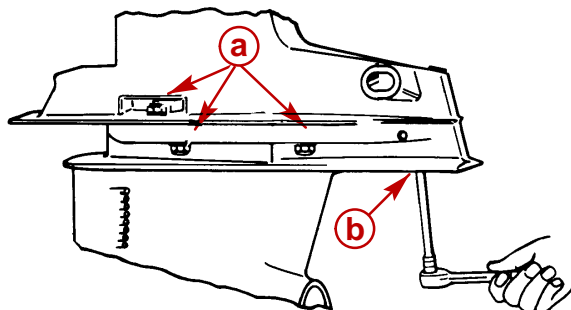
- b. Remove anodic plate.



76800

- a** - Rubber Plug  
**b** - 1/2 in. Bolt

- c. Remove gear case from drive shaft housing.

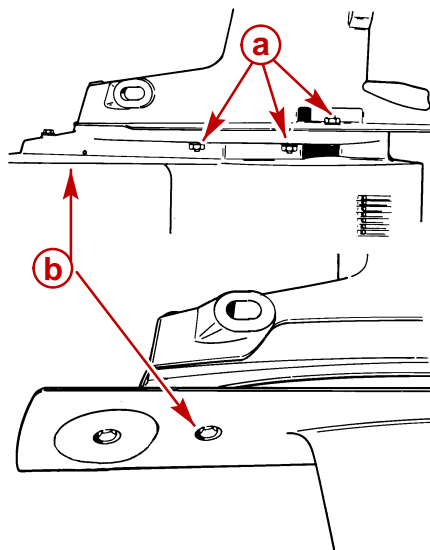


76801

- a** - 6 Nuts and Washers (3 Each Side)  
**b** - Bolt (Located In Anodic Cavity)

5. **Bravo Two and Diesel Bravo Two X:**

- a. Remove gear case from drive shaft housing.

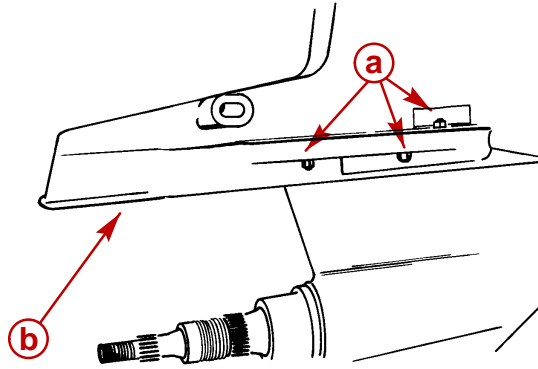


76802

- a** - 6 Nuts and Washers (3 Each Side)  
**b** - Bolt

**6. Bravo Three and Diesel Bravo Three X:**

- a. Remove gear case from drive shaft housing.

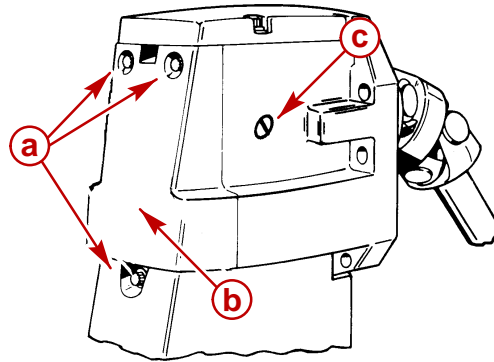


76803

- a** - Nuts and Washers (3 Each Side)  
**b** - Bolt (Located In Anodic Plate Cavity)

# Drive Shaft Housing Disassembly

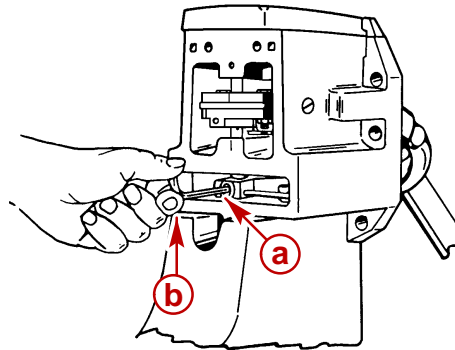
1. Shift drive unit to the neutral detent position.
2. Remove rear cover by removing screws. Do not replace vent screw until reassembly.



76805

- a** - Screws
- b** - Rear Cover
- c** - Vent Hole

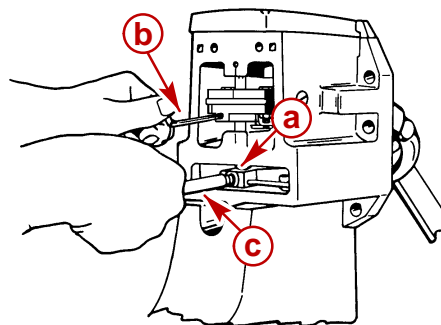
3. Remove shift linkage cap screw.



76806

- a** - Shift Linkage Cap Screw
- b** - Hex Wrench

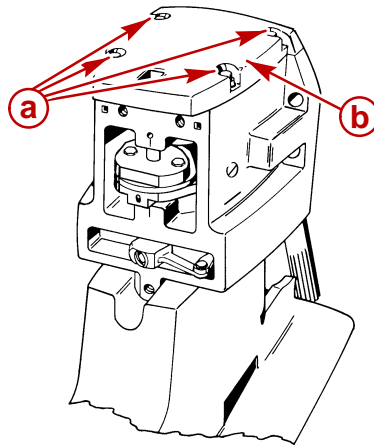
4. Install shift handle tool into shift lever and shifter shaft to aid in removing shift cam cap screw.



76807

- a** - Shift Cam Cap Screw
- b** - Hex Wrench
- c** - Shift Handle Tool (91-17302)

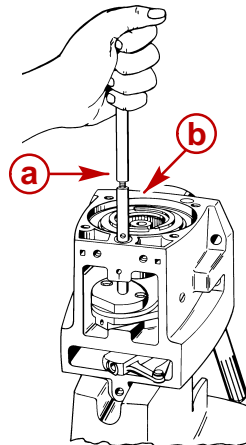
5. Remove bolts and lift top cover.



76835

- a** - Bolts (4)  
**b** - Cover

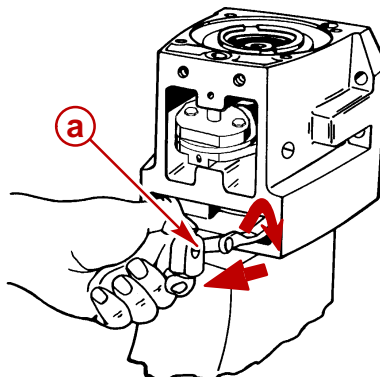
6. Install shift handle tool in shifter shaft and lift shaft straight out.



76836

- a** - Shift Handle Tool (91-17302)  
**b** - Shifter Shaft

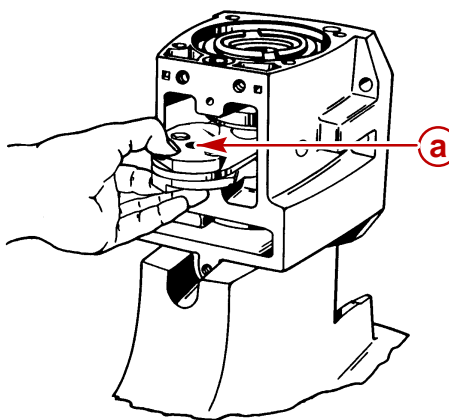
7. Remove shift linkage assembly.
  - a. Rotate link bar 1/4 turn clockwise.
  - b. Pull linkage assembly out. If linkage binds; move assembly from side to side while pulling.



76837

**a** - Shift Linkage

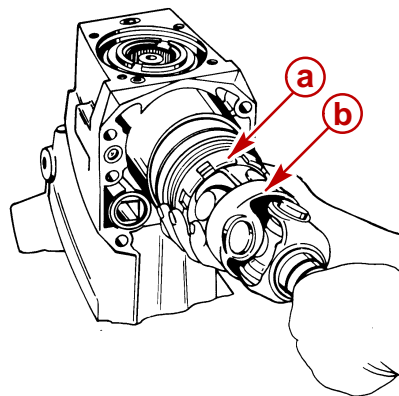
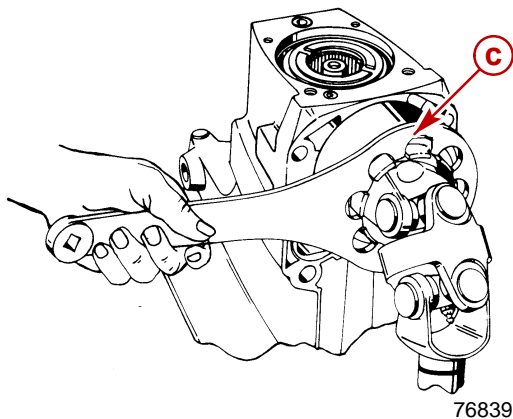
8. Remove yoke and cam assembly.



76838

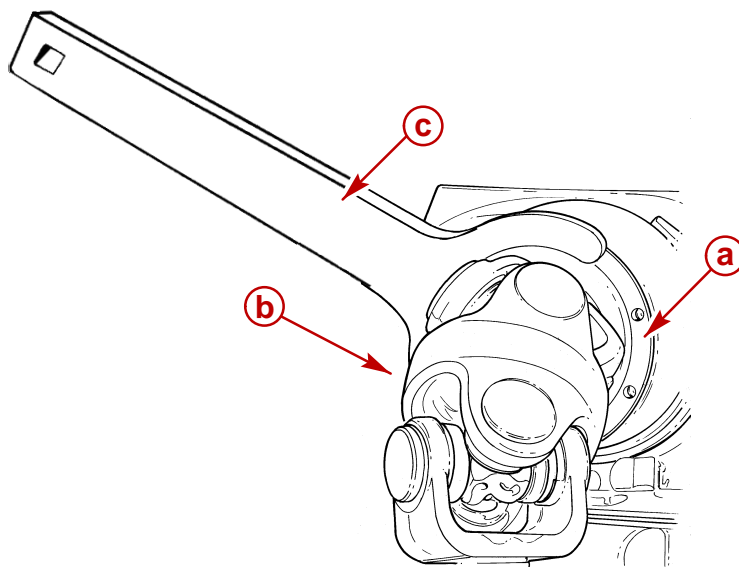
**a** - Yoke and Cam Assembly

9. Loosen retainer nut and remove pinion and U-joint assembly using U-joint retainer wrench.



### Standard Bravo

- a** - Retainer Nut
- b** - U-joint
- c** - Retainer Nut Wrench (91-17256)

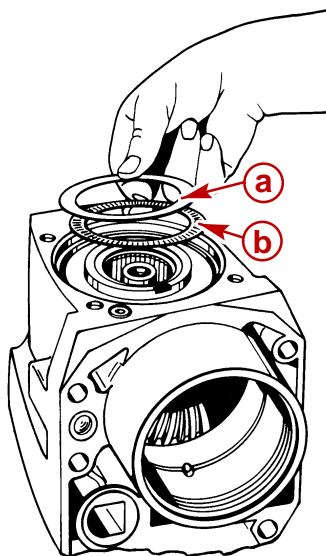


### Bravo XZ, XR & Diesel Bravo

- a** - Retainer Nut
- b** - U-joint
- c** - Retainer Nut Wrench (91-862219)

10. Remove upper thrust race (shim) and thrust bearing.

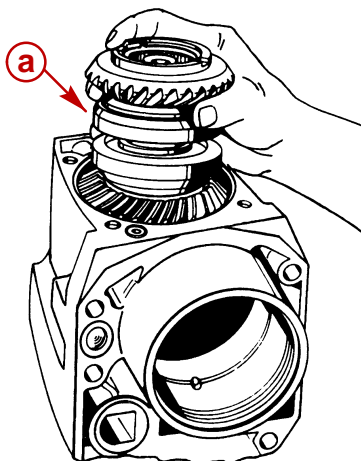
**NOTE:** In steps 10 and 12, be sure to note proper order and position of thrust races, thrust bearings and clutch assembly for later reassembly.



76841

**a** - Upper Thrust Race  
**b** - Thrust Bearing

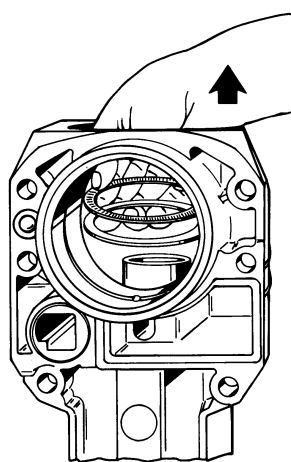
11. Remove clutch and gear assembly.



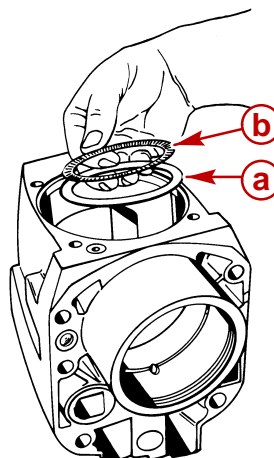
76842

**a** - Clutch and Gear Assembly

12. Remove lower thrust race (shim) and thrust bearing.



50341

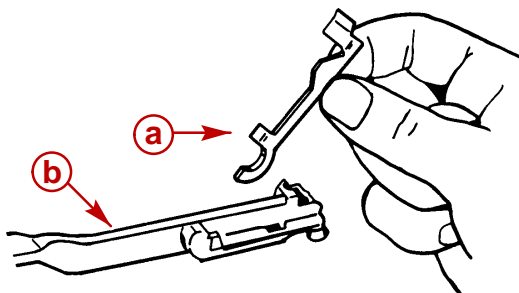


76841

- a** - Lower Thrust Race  
**b** - Thrust Bearing

## Shifter Repair

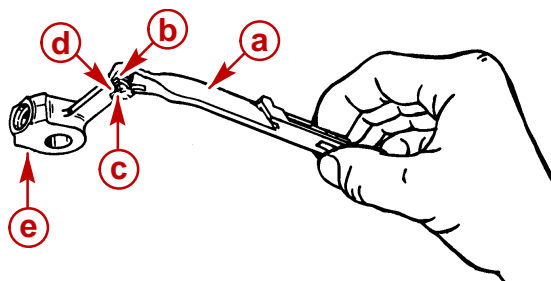
1. Remove latch from link bar.



22100

- a** - Latch  
**b** - Link Bar

2. Remove link bar from shift lever. Discard cotter pin.

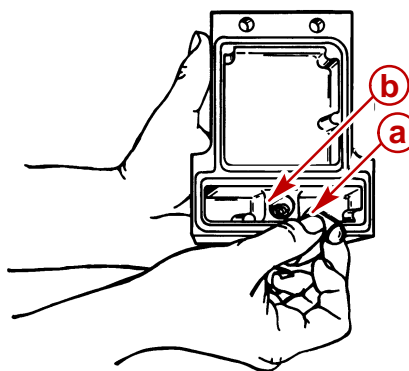


22099

- a** - Link Bar  
**b** - Cotter Pin  
**c** - Clevis Pin  
**d** - Washer  
**e** - Shift Lever



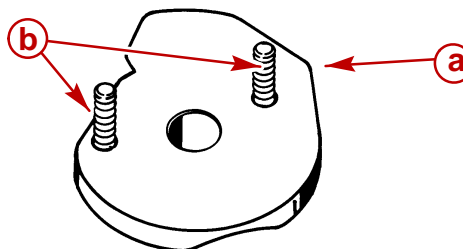
3. Remove ball detent canister and compression spring.



22100

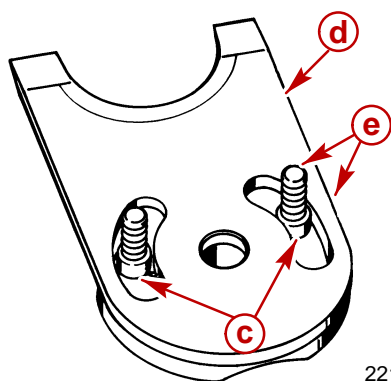
- a** - Ball Detent Canister  
**b** - Compression Spring

4. Disassemble yoke and cam assembly.

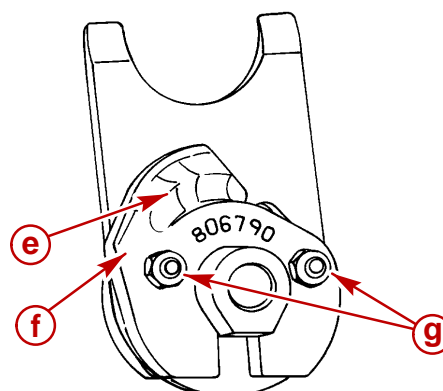


22101

- a** - Shift Cam  
**b** - Bolts



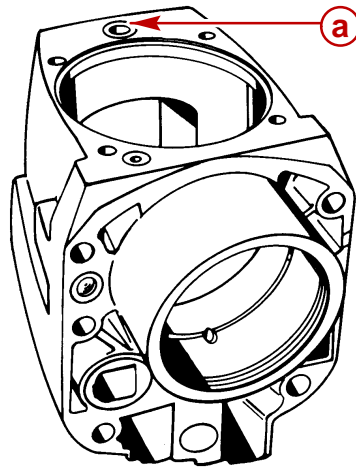
22101



75221

- c** - Spacers  
**d** - Yoke  
**e** - Contact Surface  
**f** - Shift Cam  
**g** - Locknuts

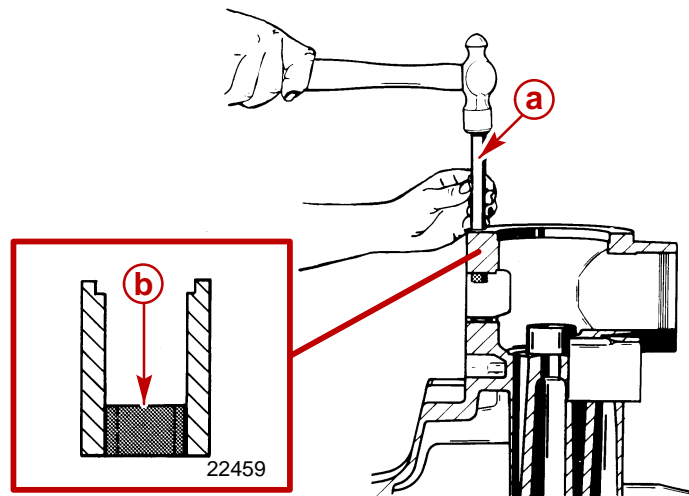
5. Remove shifter shaft upper O-ring.



76843

**a** - O-ring

6. Remove shifter shaft upper bushings using tool.

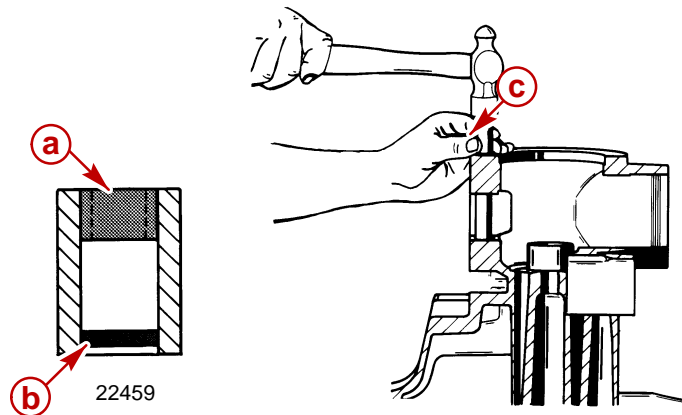


22223

**a** - Bushing Removal Tool (91-17273)

**b** - Bushing

7. Remove shifter shaft lower bushing and oil seal using tool.



- a** - Shift Shaft Lower Bushing  
**b** - Oil Seal  
**c** - Bushing Removal Tool (91-17273)

22223

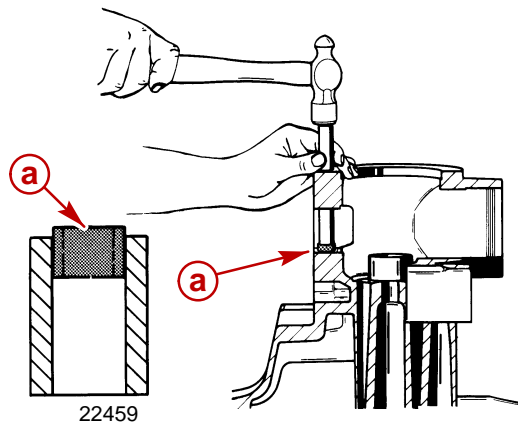
## Shifter Inspection

**NOTE:** Use exploded parts views as reference.

1. Shift link bar and shift lever for:
  - Damaged or bent parts
  - Worn jaw area
  - Excessively worn detent area on shift lever
2. Ball detent canister for:
  - Broken springs
  - Ball out of canister
3. Yoke and cam assembly for:
  - Damaged cam spacers
  - Excessively worn cam surface
4. Shifter shaft for:
  - Excessive wear in area where bushings make contact (Bushings must be replaced if replacing shifter shaft).
5. Shifter shaft bushing for:
  - Excessive wear
  - Knicks and scratches (shifter shaft must be replaced if replacing bushings)
6. Shifter shaft upper O-ring for:
  - Cuts and knicks
  - Flat spots (from being compressed)
7. Shift shaft lower oil seal for:
  - Cuts or knicks

# Shifter Reassembly

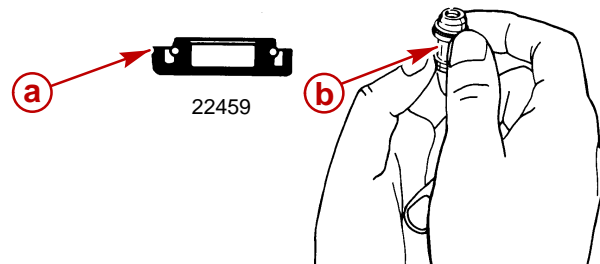
1. Install shifter shaft lower bushing and oil seal as follows:
  - a. Install lower bushing part way into bore as shown.



22223

**a** - Lower Bushing

- b. Place oil seal onto bearing and seal driver with lip of seal facing upward. Apply Loc-tite 271 to outside diameter of seal before installation.

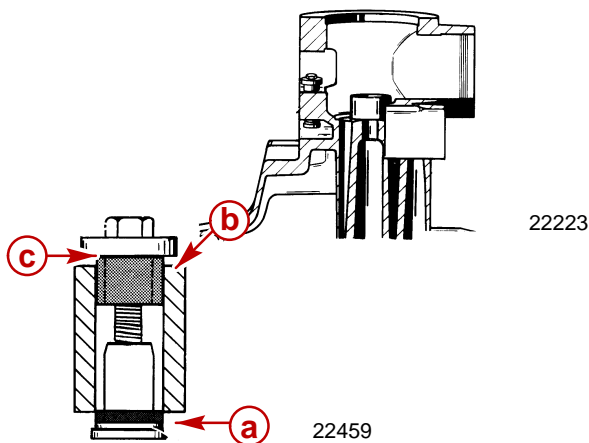


22263

**a** - Oil Seal

**b** - Seal Driver (91-17275A1)

- c. Place bearing and seal driver with oil seal into bore from bottom. Place screw pilot through bushing from top. Install screw through screw pilot and into bearing and seal driver.

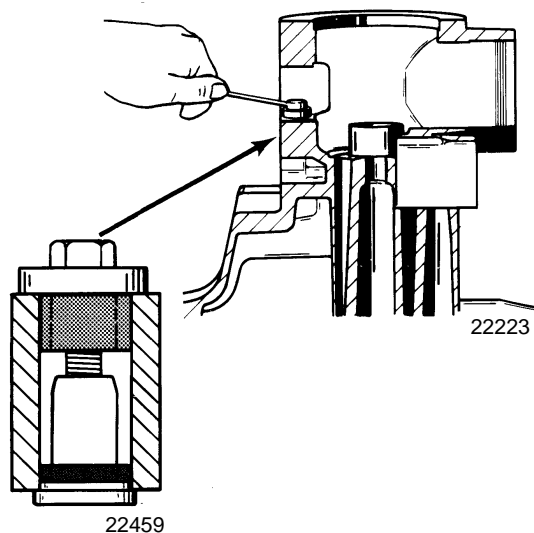


**a** - Seal Driver

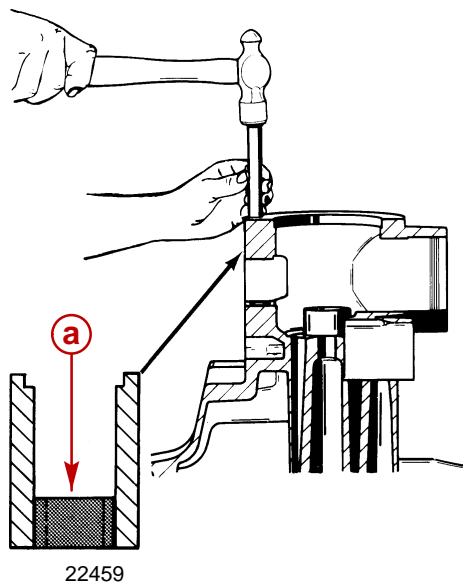
**b** - Screw Pilot

**c** - Screw

- d. Pull oil seal and bushing into place by turning screw clockwise until tool bottoms out on casting. (Top and Bottom).



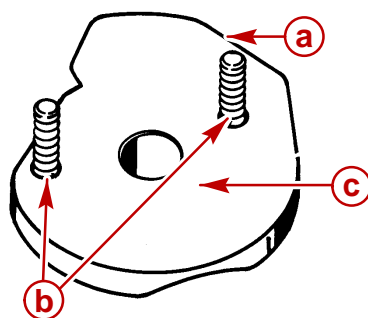
- e. Loosen screw and remove tool.
2. Install shift shaft upper bushings as follows:
- a. Install bushing into bore so that bushing is flush with bottom of bore, as shown.



**a** - Bushing

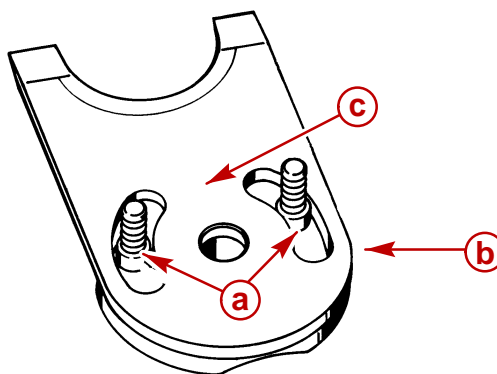
3. Assemble yoke and shift cam assembly. Coat contact surfaces with gear lube.

4. Torque locknuts to 80 lb-in. (9 Nm).



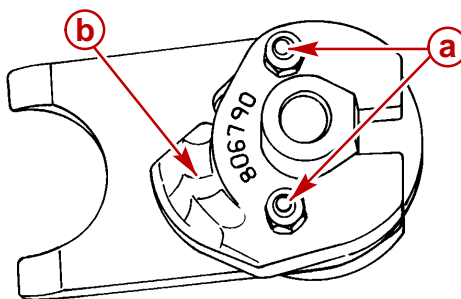
22101

- a** - Shift Cam  
**b** - Bolts  
**c** - Contact Surface



22101

- a** - Spacers  
**b** - Yoke  
**c** - Contact Surface

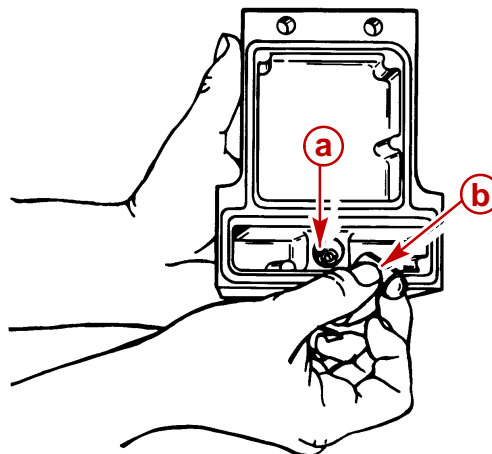


75221

### Shifter Assembly

- a** - Locknuts  
**b** - Shift Cam

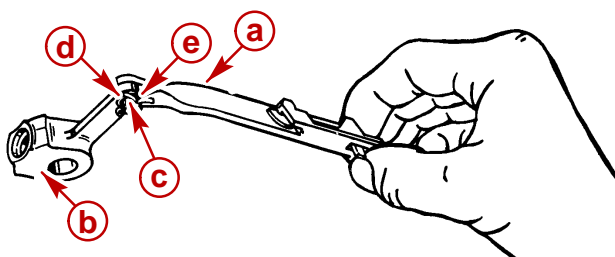
5. Apply small amount of Special Lubricant 101 to compression spring and ball detent canister and install into rear cover.



22100

- a** - Compression Spring
- b** - Detent Canister

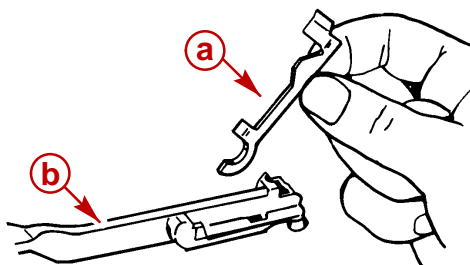
6. Install link bar to shift lever. Install cotter pin and spread ends.



22099

- a** - Link Bar
- b** - Shift Lever
- c** - Clevis Pin
- d** - Washer
- e** - Cotter Pin

7. Install latch on link bar.



22100

- a** - Latch
- b** - Link Bar

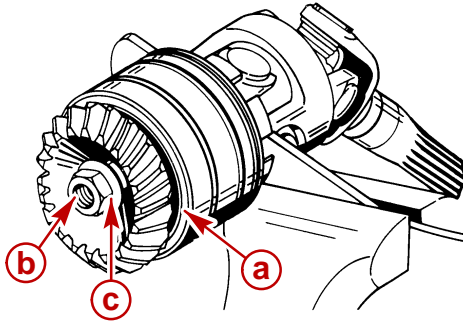
# U-Joint and Pinion Gear

## Inspection

1. Inspect pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. If any of these conditions exist, it will be necessary to replace complete drive gear and bearing assembly.
2. Rotate bearings on pinion gear by hand. Rough, uneven movement, or a loose condition indicates need for replacement. If drive gear is in good condition then it will be necessary to replace bearings only.
3. Inspect U-joints for a loose or rough movement and deteriorated seals. If any of these conditions exist, then replace cross and bearing assembly.

## Disassembly

1. Remove nut and washer from U-joint shaft and remove drive gear and bearings as an assembly. Remove remaining components.



76861

### Standard Bravo Shown

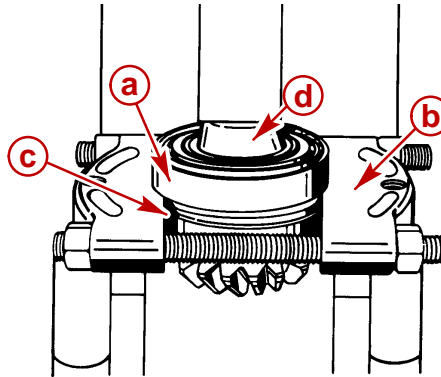
- a** - Drive Gear and Bearing Assembly
- b** - Nut
- c** - Washer

### **⚠ CAUTION**

**DO NOT** damage spacer when removing first bearing from pinion gear, spacer must be used in reassembly.



2. If you determine that U-joint bearings are in need of replacement and that gear is in good condition, remove bearings from gear using puller plate and arbor press (bearings are damaged in removal and should not be reused).

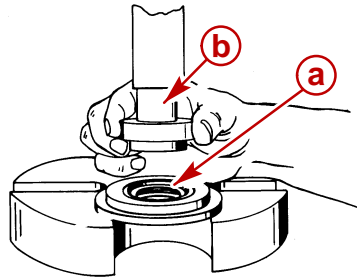


22393

- a** - Gear and Bearing Assembly
- b** - Puller Plate (91-37241)
- c** - Spacer
- d** - Suitable Mandrel

3. If seal is defective, remove U-joint seal using a punch and hammer or press out with suitable mandrel.

**NOTE:** The U-joint seal is located in the seal carrier on standard Bravo drives and in the bearing retainer nut on Bravo X, XZ, XR, and Diesel Bravo.



22102

#### Standard Bravo Shown

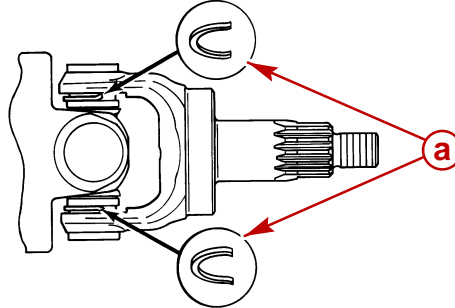
- a** - Seal
- b** - Suitable Mandrel

4. If replacing U-joint cross bearings, proceed as follows:

### ⚠ WARNING

**U-joint snap rings might accidentally be knocked off of the U-joint during installation. Wear safety glasses to avoid eye injury.**

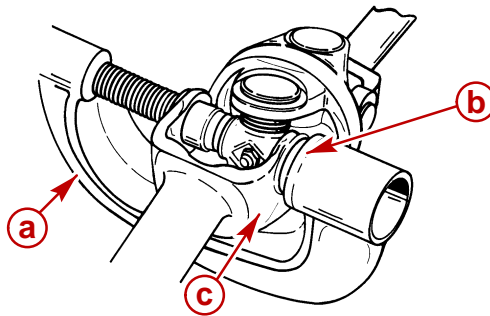
- a. Drive off universal joint bearing snap rings, using a punch and hammer.



22179

**a** - Snap Ring

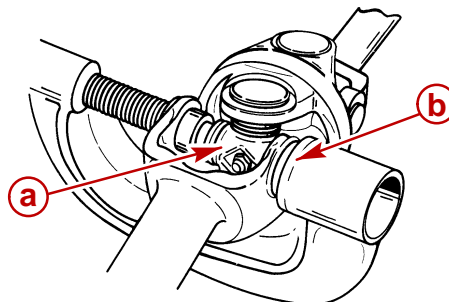
- b. **Standard Bravo:** Using adaptor and U-joint press, press one bearing in until opposite bearing is pressed out into adaptor. Remove loose bearing.



22180

**a** - Press  
**b** - Adaptor (91-38756)  
**c** - Yoke

- c. Turn U-joint assembly 180 degrees and press on bearing cross to remove second bearing. Remove second bearing. Remove each pair of bearings in this manner.

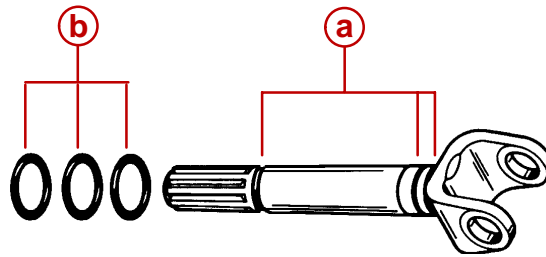


22180

**a** - Bearing Cross  
**b** - Adaptor

Art for Bravo XZ, Bravo XR, and Diesel Bravo U-joint service was not available at time of printing.

5. Remove three O-rings from coupling end of U-joint shaft.



73922

- a** - O-ring Grooves  
**b** - O-rings

## Reassembly

### ⚠ CAUTION

Use only Quicksilver U-Joint and Gimbal Bearing Grease for lubricating U-joint bearings. The use of any other lubricant will decrease the life of the bearings.

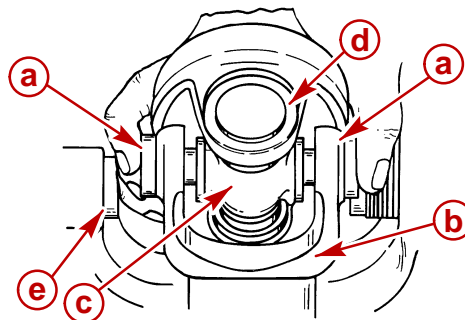
1. Reassemble U-joints as follows:

**NOTE:** When initially positioning crosses in yoke, be sure that grease fittings are facing to coupler yoke (longer yoke).

### ⚠ WARNING

U-joint snap rings might accidentally be knocked off of the u-joint during installation. Wear safety glasses to avoid eye injury.

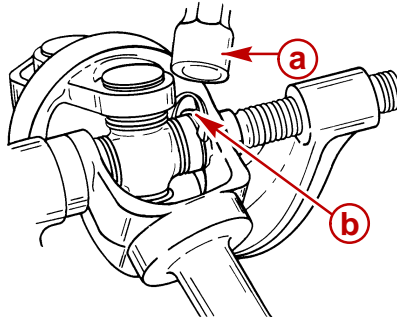
- a. **Standard Bravo U-Joint:** Place U-joint bearing cups in yoke and start them on bearing cross members. Install by using adaptor and pressing bearing through yoke and onto cross members.



22181

- a** - Bearings  
**b** - Yoke  
**c** - Cross Members  
**d** - Grease Fitting (Facing Longer Yoke)  
**e** - Adaptor (91-38756)

- b. Install bearing cup retaining snap rings.



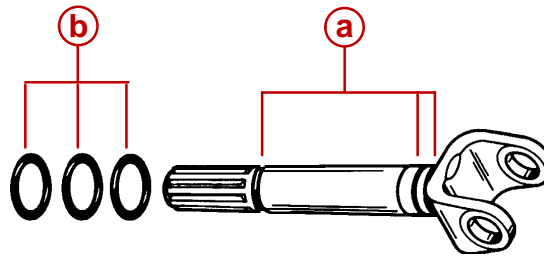
22182

- a** - Hammer  
**b** - Snap Ring

- c. Install each pair of bearings in this manner.

Art for Bravo XZ, Bravo XR, and Diesel Bravo U-joint  
service was not available at time of printing.

2. Install three new O-rings on coupling end of U-joint shaft.

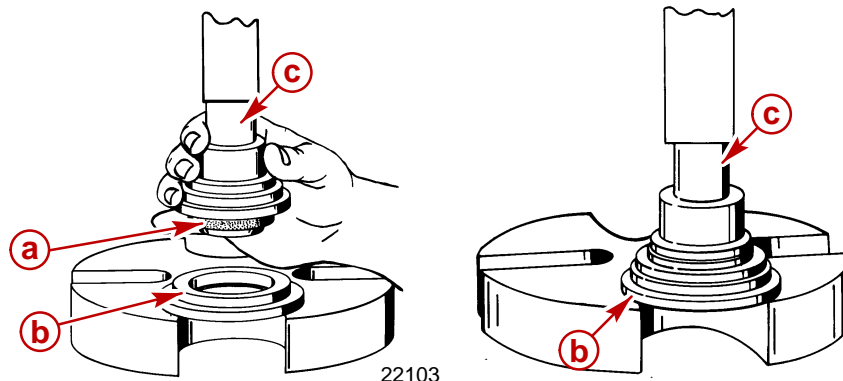


73922

- a** - O-ring Grooves  
**b** - O-rings

3. Coat outside diameter of oil seal with Loctite 271 and press oil seal in with lip of seal facing pinion gear, using bearing driver until tool bottoms out against carrier.

**NOTE:** The U-joint seal is located in the seal carrier on standard Bravo drives and in the bearing retainer nut on Bravo X, XZ, XR, and Diesel Bravo.

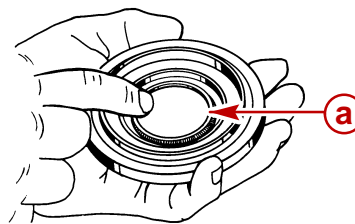


22103

#### Standard Bravo Shown

- a** - Oil Seal  
**b** - Oil Seal Carrier  
**c** - Bearing Driver (91-813653T)

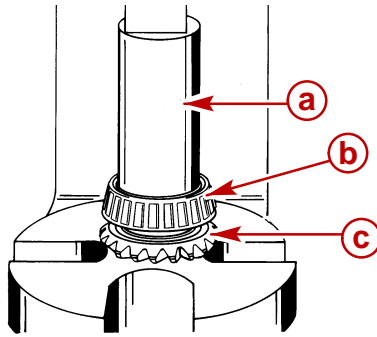
4. Lubricate lip of oil seal (a) with 2-4-C Marine Lubricant with Teflon.



22435

- a** - Oil Seal Lip

5. If tapered roller bearings were removed from pinion gear, replace as follows.
  - a. Press smaller outside diameter bearing onto pinion gear using bearing installation tool.



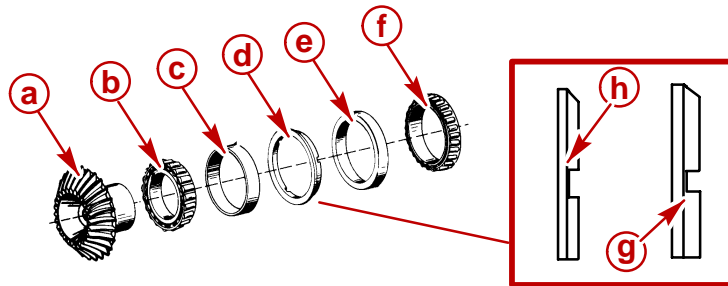
22393

- a** - Suitable Mandrel
- b** - Bearing - Smaller O.D.
- c** - Pinion Gear

### ⚠ CAUTION

**If spacer is not installed correctly in next step, severe damage to the drive unit will result during reassembly.**

- b. Place smaller outside diameter cup over bearing pressed on in step "a".
- c. Install spacer (flat face toward gear).
- d. Install larger outside diameter bearing cup.



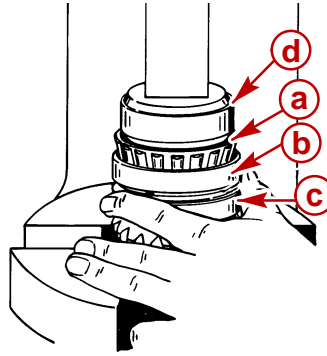
76844

- a** - Pinion Gear
- b** - Smaller Outside Diameter Bearing (First)
- c** - Smaller Outside Diameter Cup (Second)
- d** - Spacer – Wider Face Toward Gear (Third)
- e** - Larger Outside Diameter Bearing Cup (Fourth)
- f** - Larger Outside Diameter Bearing (Fifth)
- g** - Standard Bravo - Spacer .250 in. (6.35 mm) Thick
- h** - Bravo X, XZ, XR & Diesel Bravo - Spacer .210 in. (5.36 mm) Thick

**IMPORTANT: Spacer between bearing cups must free to move. Do not over press, as damage to both bearings could occur.**



- e. Press larger outside diameter bearing onto gear. Press bearing to the point where bearing rollers initially make contact with tapered bearing cup.



22393

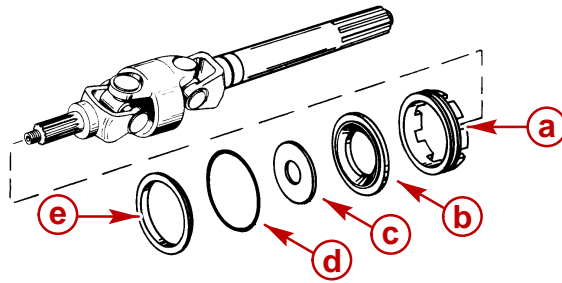
- a** - Bearing – Larger Outside Diameter.
- b** - Larger Outside Diameter Bearing Cup
- c** - Spacer – Must Move Freely
- d** - Suitable Mandrel – Must Push on Inner Bearing Race

**NOTE:** If a slight over press condition occurs (spacer does not move freely) – support large O.D. bearing cup with universal puller plate and lightly tap end of pinion gear with a soft hammer. Failure to do this can result in premature bearing failure.

**CAUTION**

U-joint and pinion gear assembly must be reassembled as shown in following steps or damage to drive unit will occur during reassembly.

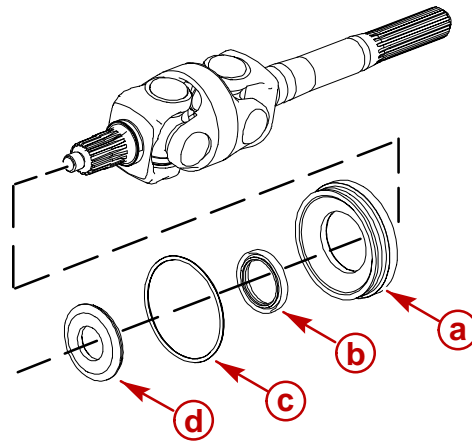
6. Install components as shown.



22249

### Standard Bravo

- a** - Retainer Nut (Threaded End Toward Pinion Gear)
- b** - Oil Seal Carrier (Lip Of Seal Facing Pinion Gear)
- c** - Large Washer (Taper Facing U-joints)
- d** - O-ring (Position Between Oil Seal Carrier And Sealing Ring)
- e** - Sealing Ring (Taper Facing U-joints)

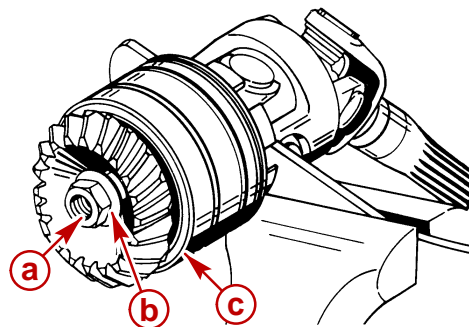


76845

### Bravo X, XZ, XR & Diesel Bravo

- a** - Retainer Nut (Threaded End Toward Pinion Gear)
- b** - Oil Seal (Lip Of Seal Facing Pinion Gear)
- c** - O-ring (Position On Retainer Nut)
- d** - Thrust Washer (Taper Facing U-joints)

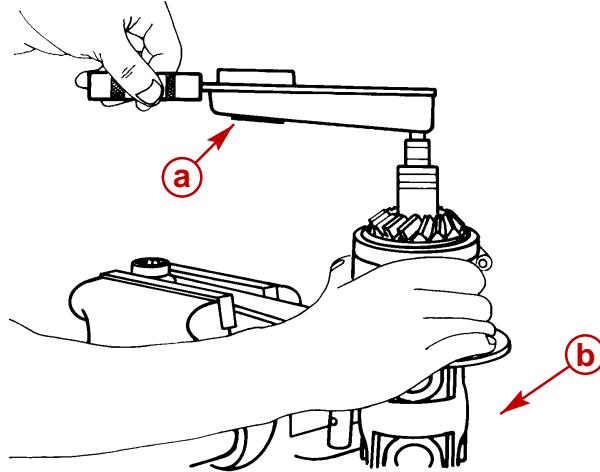
7. Secure pinion gear assembly to shaft with washer and new nut. Tighten nut to the point where washer just touches gear.



22102

- a** - Nut
- b** - Washer
- c** - Pinion Gear Assembly

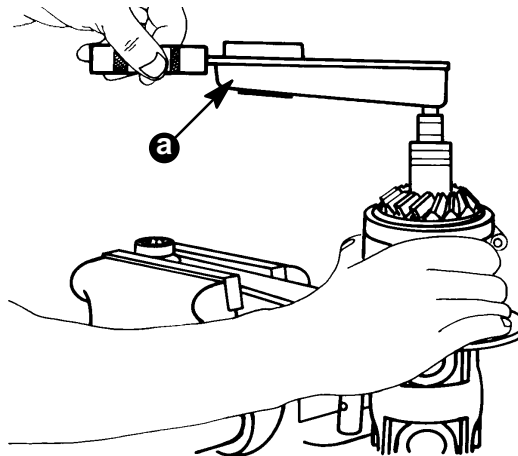
8. Set the preload on bearing package as follows:
  - a. Mount retainer wrench in vise to support U-joint assembly.
  - b. Position U-joint assembly so that shaft is pointing straight down.



70212

- a** - Torque Wrench (lb-in.)  
**b** - U-joint Shaft (Hanging Straight Down)

- c. Set preload by tightening nut 1/16 of a turn at a time. Check for proper preload by turning pinion gear, using an extension, appropriate socket, and torque wrench (lb-in. - with dial indicator), until a 6-10 lb-in. (0.7-1.1 Nm) torque is obtained. If nut becomes over-tightened (causing excessive preload), loosen nut a number of turns and lightly strike pinion end of U-joint shaft using a soft hammer. Readjust, starting at beginning of this step.



70212

**Standard Bravo Shown**

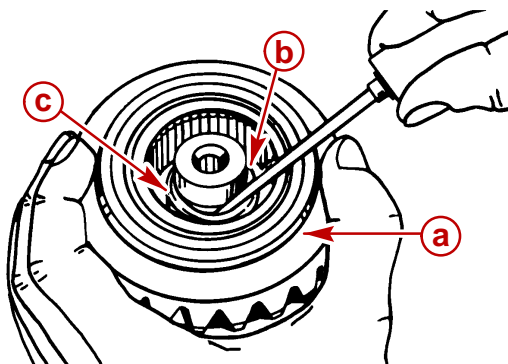
- a** - Torque Wrench (lb-in. – Dial Indicator)  
**b** - Drive Shaft Housing (U-joint Shaft Hanging Straight Down)

# Gear Disassembly, Inspection and Reassembly

- Refer to “Special Information” on page 19 if gear assembly components are being replaced.

## Disassembly

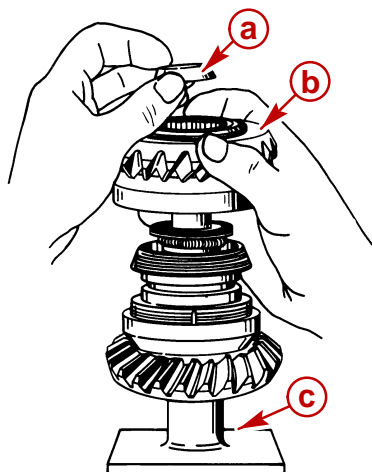
1. Remove keepers by pressing down on gear and turning clockwise to release keepers and collar.



22105

- a** - Top Gear
- b** - Thrust Collar
- c** - Keepers (2)

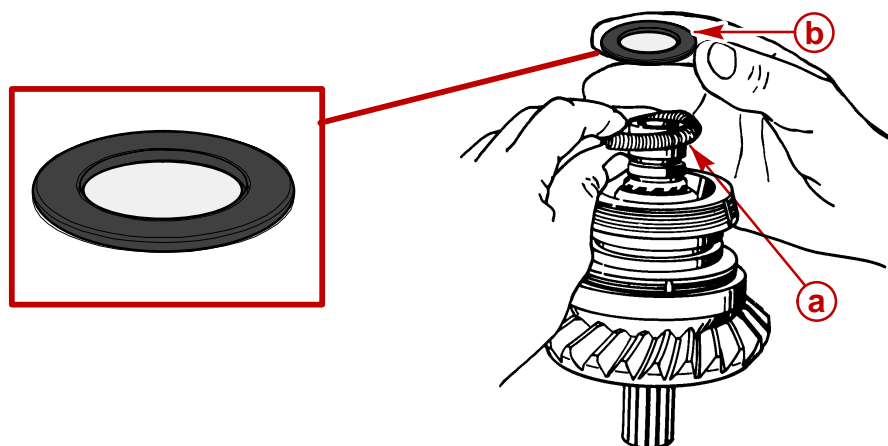
2. Remove thrust collar and gear from shaft.



76847

- a** - Thrust Collar
- b** - Top Gear
- c** - Stand (91-17301A1)

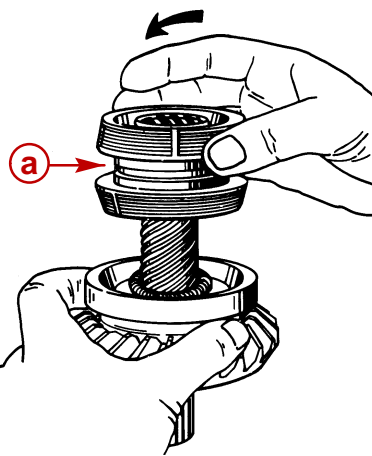
3. Remove thrust bearing and garter spring.



76862

**a** - Thrust Bearing  
**b** - Garter Spring

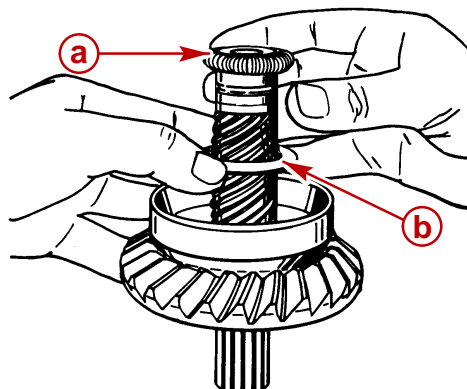
4. Twist clutch counterclockwise while pulling up to separate clutch from shaft.



22106

**a** - Clutch

5. Remove lower garter spring and thrust bearing.



76848

**a** - Garter Spring  
**b** - Thrust Bearing

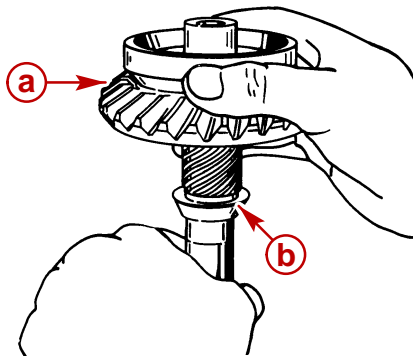
6. Remove bottom gear.

## Inspection

1. Clean all parts in nontoxic solvent; then dry with compressed air. Be careful not to spin bearings. Inspect gears for pitting, chipped or broken teeth, and excessive or uneven wear. Replace gear if any of these conditions exist.
2. Condition of bearing surfaces in drive shaft housing and top cover are an indication of the condition of the bearings in the gears. Inspect bearing surface for pitting, grooves, scoring, discoloration from overheating, uneven wear, and embedded foreign metal particles. Replace gear and bearing assembly, and also bearing sleeve, if any of these conditions exist.
3. Inspect socket of gear for particles adhering to clutch surface, and for discoloration. If particles and/or discoloration are present, attempt to clean up grooves on clutch using a bead blaster or a pick. (Do not use a wire brush or wire wheel.) If, after cleaning, grooves appear to be flattened or Nicked, clutch should then be replaced.
4. Inspect splines of clutch shaft for knicks or broken teeth. If any of these conditions exist, replace shaft.
5. Inspect bearing surfaces on clutch shaft for pitting, grooves, scoring, or discoloration. Replace shaft if any of these conditions exist.

## Reassembly

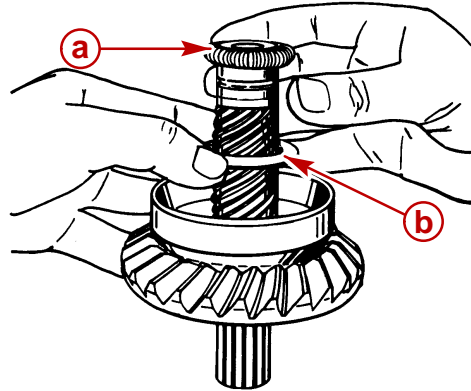
1. Apply gear oil to splines and install bottom gear on shaft and allow it to rest on thrust collar.



- a** - Bottom Gear  
**b** - Thrust Collar

22106

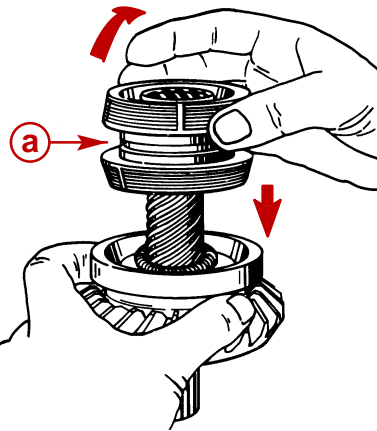
2. Install thrust bearing and garter spring with silver side of bearing toward garter spring. Lubricate parts with gear lube.



76848

- a** - Thrust Bearing (Silver Side Toward Garter Spring)
- b** - Garter Spring

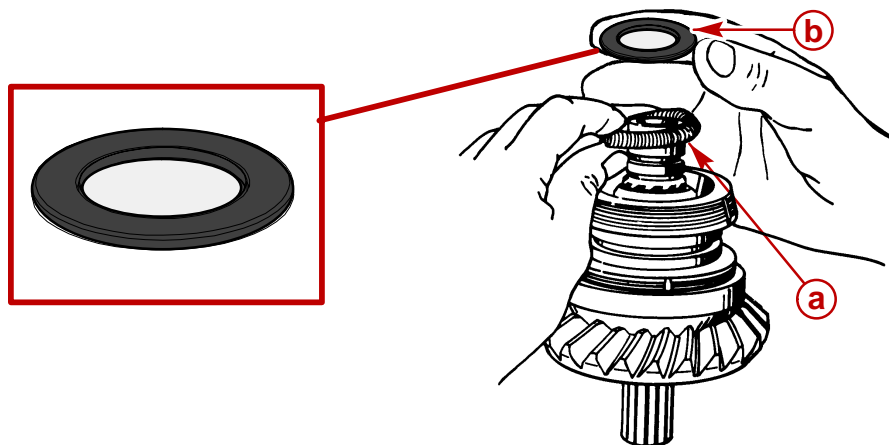
3. Lower clutch over shaft while allowing it to turn clockwise.



22106

- a** - Clutch

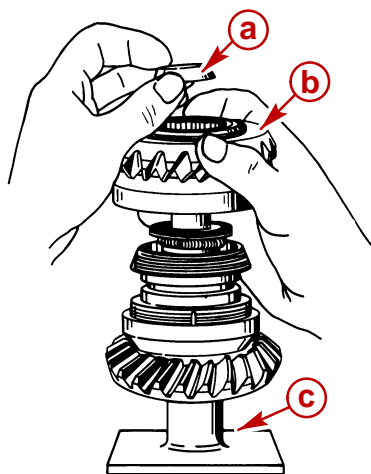
4. Install top garter spring and thrust bearing with silver side of bearing toward garter spring.



76862

- a** - Garter Spring (Silver Side Toward Garter Spring)
- b** - Thrust Bearing

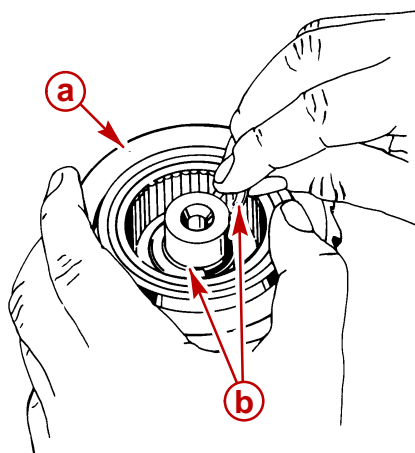
5. Place top gear and then thrust collar over shaft.



76847

- a** - Thrust Collar  
**b** - Top Gear  
**c** - Stand (91-17301A1)

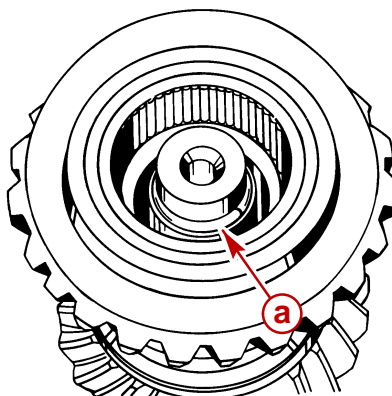
6. Press gear and thrust collar down so that groove in shaft is completely exposed. Install keepers.



22105

- a** - Top Gear  
**b** - Keepers (2)

7. Release pressure from gear. Thrust collar should come up to the point where top of keepers are level with top of thrust collar at position shown.



22105

- a** - Keepers Level With Thrust Collar



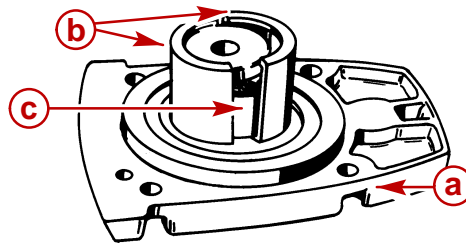
# Drive Shaft Housing and Top Cover - Bearings and Bearing Sleeves

## Inspection

1. Inspect needle bearing races in top cover and in drive shaft housing for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replace race.
2. Condition of the bearing surfaces on the clutch shaft are an indication of the condition of the bearings in the top cover and drive shaft housing. Inspect bearing surface for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, then replace bearings and shaft.

## Bearing Sleeve Removal (Top Cover)

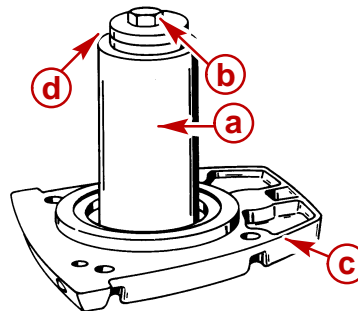
1. Place puller jaws around sleeve.



22083

- a** - Top Cover
- b** - Puller Jaws (2 Halves) – (91-90244A1)
- c** - Bearing

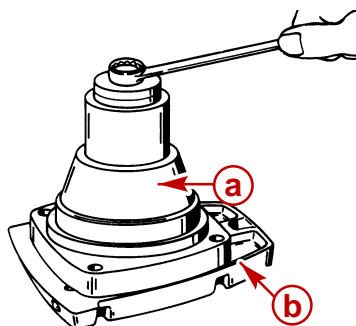
2. Position puller guide over jaws and install bolt.



22084

- a** - Puller Guide (91-90244A1)
- b** - Puller Bolt (90-90244A1)
- c** - Top Cover
- d** - Washers

3. Install driver guide as shown.



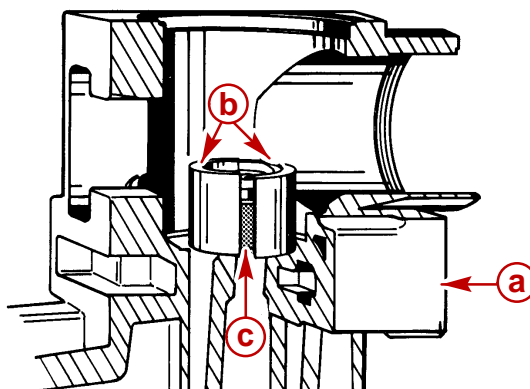
22082

- a** - Driver Guide (92-90244A1)
- b** - Top Cover

4. Remove sleeve by rotating bolt clockwise.

## Bearing Sleeve Removal (Drive Shaft Housing)

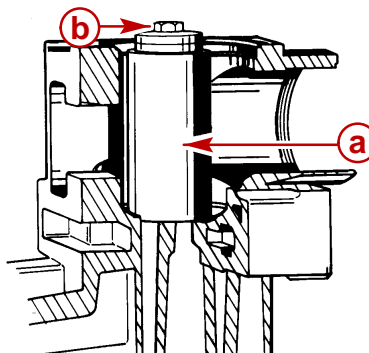
1. Place puller jaws around sleeve.



22219

- a** - Drive Shaft Housing
- b** - Pull Jaws (2 Halves) (91-90244A1)
- c** - Sleeve

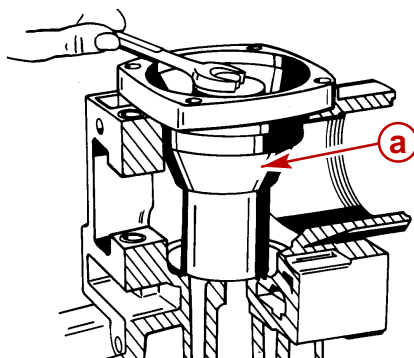
2. Position puller guide over jaws and install bolt.



22263

- a** - Puller Guide (91-90244A1)
- b** - Puller Bolt (91-90244A1)

3. Install driver guide as shown.



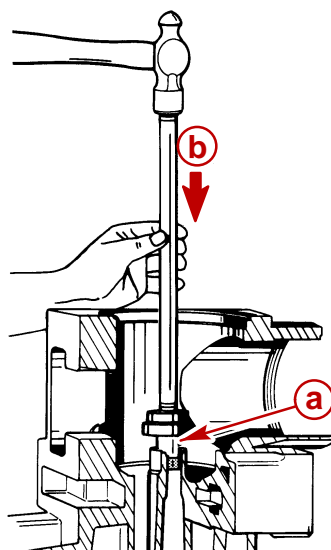
22258

**a** - Driver Guide (91-90244)

4. Remove sleeve by rotating bolt clockwise.

## Roller Bearing Removal

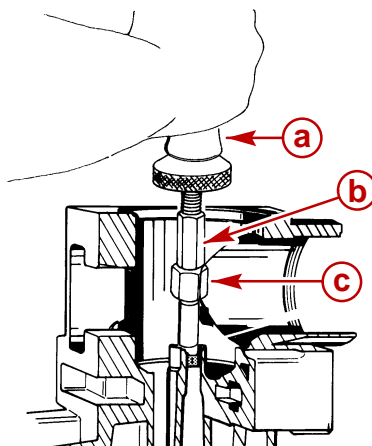
1. **Standard Bravo:** To remove roller bearing from drive shaft housing, use a suitable mandrel and drive bearing down into oil cavity.



22260

**a** - Bearing And Mandrel  
**b** - Drive In This Direction

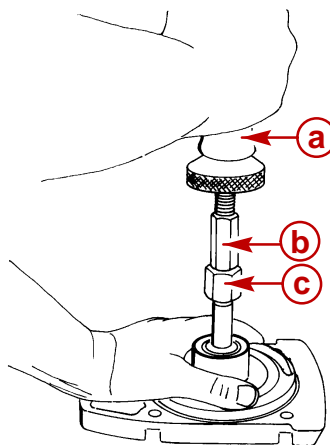
2. **Bravo X, XZ, XR & Diesel Bravo:** Remove roller bearing using a slide hammer puller, Snap-On adaptor and puller head as shown.



76863

- a** - Slide Hammer Puller (91-34569A1)
- b** - Snap-On Adaptor (CG-40-4)
- c** - Puller Head (CG-40-A10)

3. Remove top cover roller bearing using a slide hammer puller, Snap-On adaptor and puller head as shown.



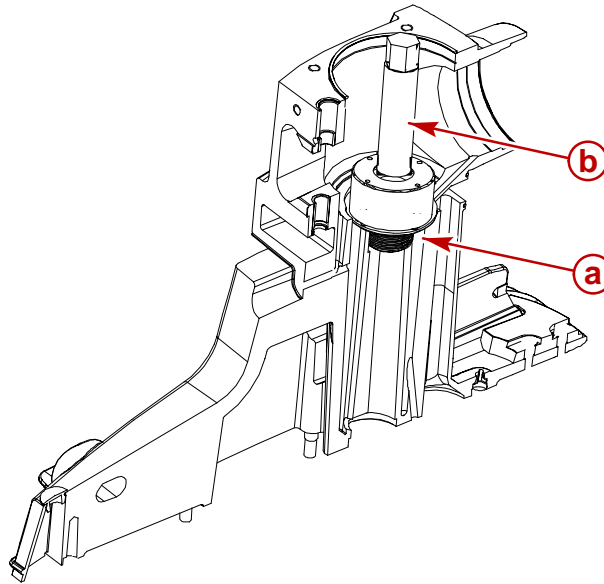
73928

- a** - Slide Hammer Puller (91-34569A1)
- b** - Snap-On Adaptor (CG-40-4)
- c** - Puller Head (CG-40-A10)

## Steel Bearing Adaptor Removal

**IMPORTANT:** It is not necessary to remove the steel bearing adaptor for normal drive-shaft housing disassembly; however, in the event of gear or bearing failure the steel bearing adaptor can be removed to aid in removal of metal chips and contamination from oil passages.

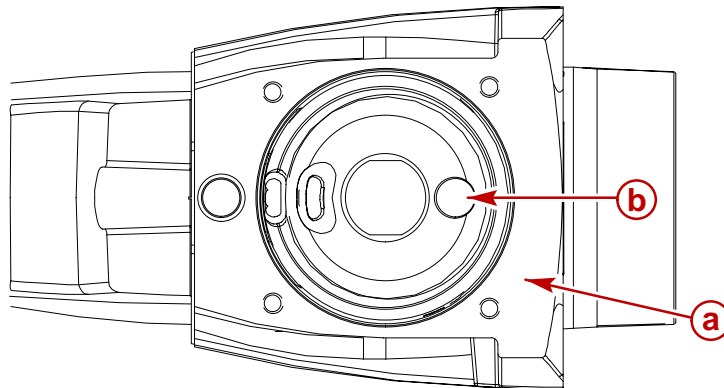
1. Remove steel bearing adaptor using bearing adaptor socket. Heat area around steel bearing adaptor with a torch lamp to ease removal.



77021

- a** - Steel Bearing Adaptor
- b** - Bearing Adaptor Socket (91-862531)

2. Remove oil passage plug.



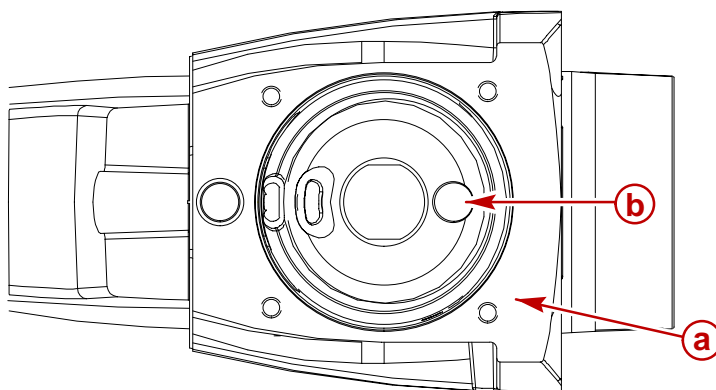
77043

- a** - Drive Shaft Housing
- b** - Oil Passage Plug

3. Clean metal chips and contamination from oil passage.

## Steel Bearing Adaptor Installation

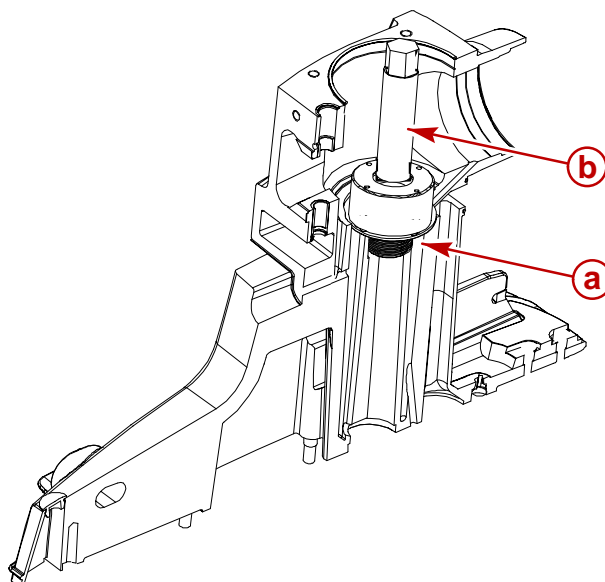
1. Install oil passage plug.



77043

- a** - Drive Shaft Housing
- b** - Oil Passage Plug

2. Clean threads of steel bearing adaptor and apply Loctite 277.
3. Install steel bearing adaptor in drive shaft housing using bearing adaptor socket. Torque to 175 lb-ft.

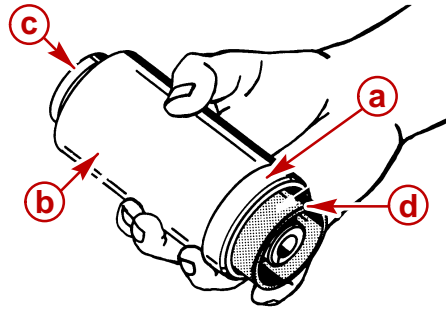


77021

- a** - Steel Bearing Adaptor
- b** - Bearing Adaptor Socket (91-862531)

## Bearing Sleeve Installation

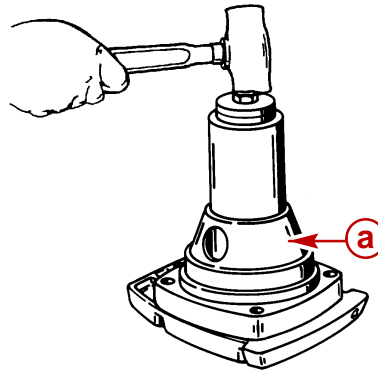
1. Install driver head onto puller guide. Secure driver head to puller guide with screw. Place bearing sleeve against edge of driver head as shown.



22084

- a** - Driver Head (91-862530)
- b** - Puller Guide (91-90774)
- c** - Screw (91-90775)
- d** - Bearing Sleeve

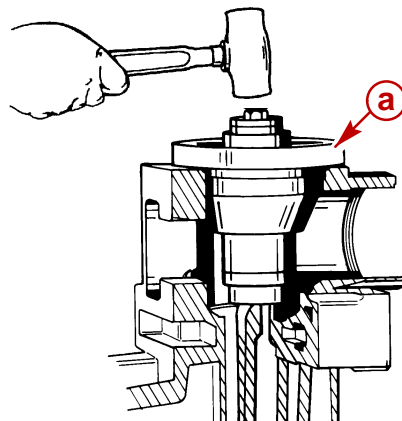
2. Place driver guide onto top cover as shown. Install puller guide assembly through driver guide assembly and install bearing sleeve by tapping into place until tool bottoms out.



22082

- a** - Driver Guide (91-90244A1)

3. Place driver guide into top of drive shaft housing, as shown. Install puller guide assembly through driver guide and install bearing sleeve by tapping into place until tool bottoms out.

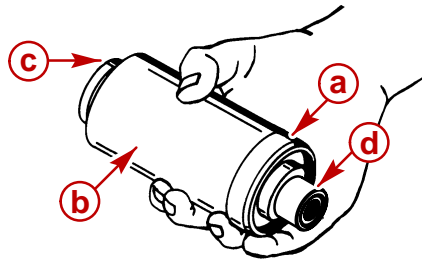


22263

- a** - Driver Guide (91-90244)

## Roller Bearing Installation

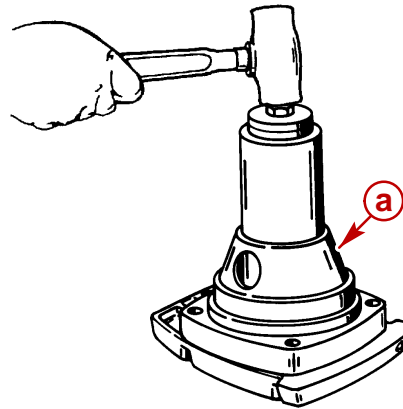
1. Install driver head onto puller guide. Secure driver head to puller guide with screw. Lubricate inside diameter of roller bearing and place roller bearing on driver head, as shown.



75967

- a** - Driver Head (91-862530)
- b** - Puller Guide (91-90774)
- c** - Screw (91-90775)
- d** - Roller Bearing

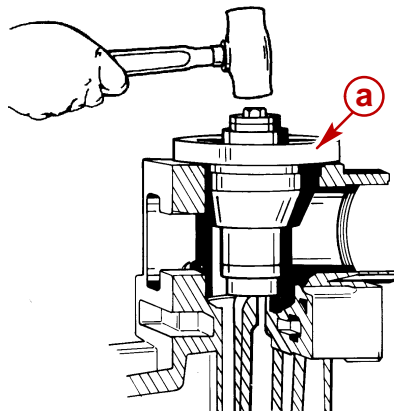
2. Place driver guide on top cover, as shown. Install puller guide assembly through driver guide and install roller bearing by tapping into place until tool bottoms out.



75968

- a** - Driver Guide (91-90244)

3. Place driver guide into top of drive shaft housing, as shown. Install puller guide assembly through driver guide and install roller bearing by tapping into place until tool bottoms out.

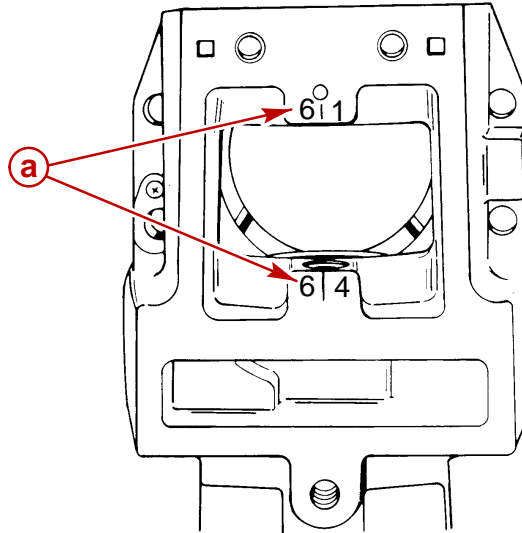


- a** - Driver Guide (91-90244)



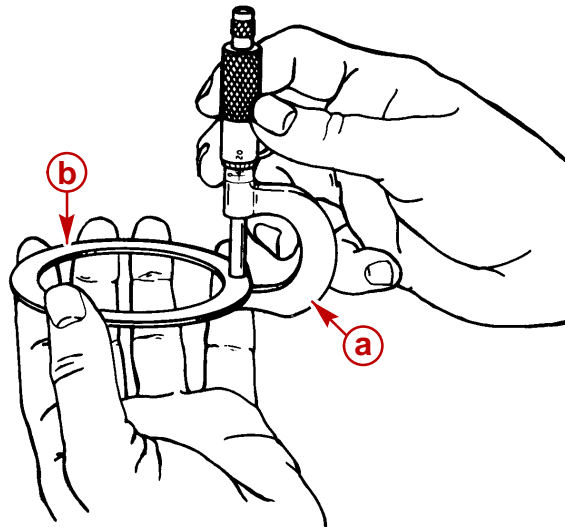
## Drive Shaft Housing Reassembly

- Two (2) numbers are stamped in the shifter cavity on the back of the drive shaft housing. The top number designates the thickness of the top thrust bearing race, and the bottom number designates the thickness of the bottom thrust bearing race. One of three numbers appears in each position (61, 64) e.g. 61 = .061 in. Use numbers that are stamped in housing as a guide for obtaining replacement parts. Measure thrust bearing races with a micrometer to be sure that their thickness correspond to the numbers stamped in the drive shaft housing.



76849

**a** - Stamped Number

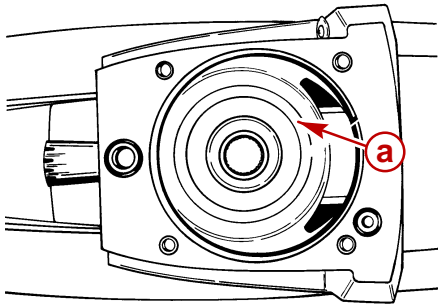


22100

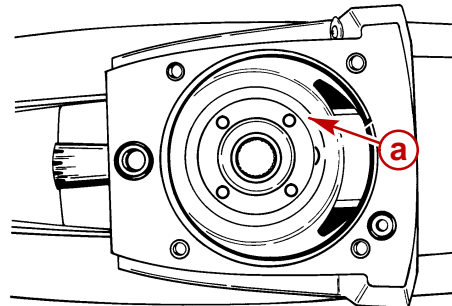
**a** - Micrometer  
**b** - Race

**NOTE:** If using original thrust bearing race, race should be installed so that the side of original contact area is in the same position as removed. Prelube all races and bearings with High-Performance Lube.

1. Position correct thrust bearing race in drive shaft housing (see "Important," preceding).



22437



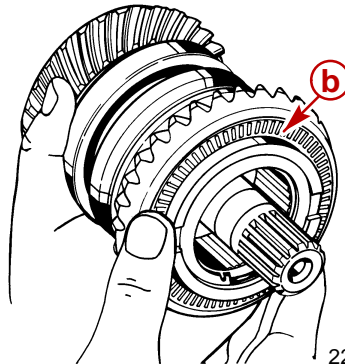
76850

### Standard Bravo

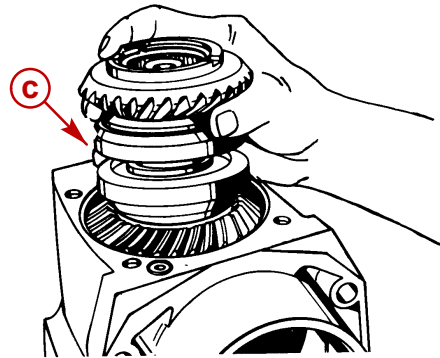
**a** - Thrust Bearing Race

### Bravo X, XZ, XR, & Diesel Bravo

2. Apply a mixture of 60% Hi Performance Gear Lube and 40% Special Lubricant 101 to bottom face of bottom gear. Stick thrust bearing to gear. Install clutch assembly.



22435

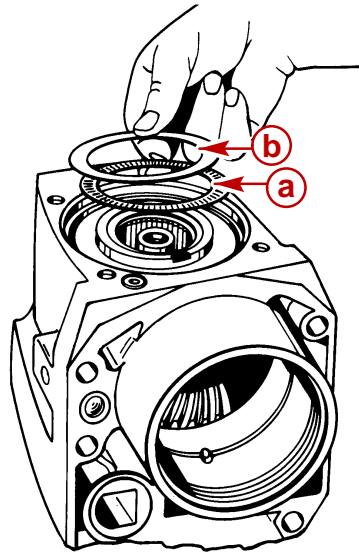


22099

**b** - Thrust Bearing

**c** - Gear Assembly

3. Apply a mixture of 60% Hi Performance Gear Lube and 40% Special Lubricant 101 to the top face top gear and the thrust bearing. Place thrust bearing on gear. Position correct thrust bearing race on top of thrust bearing.



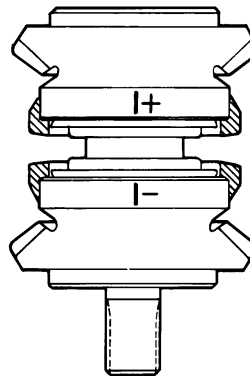
50304

- a** - Thrust Bearing  
**b** - Thrust Race

**⚠ CAUTION**

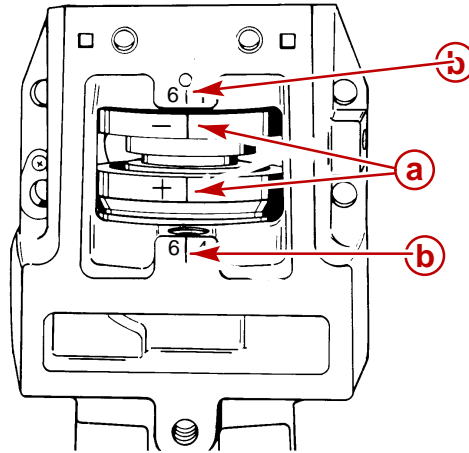
**Gear assembly must be timed as shown, following, or damage to gears and U-joint pinion gear may occur.**

- Timing marks on gears must be aligned in one of two ways. The positive (+) mark over the negative (–) or the negative (–) mark over the positive (+) mark. NEVER align two positive (+) marks or two negative (–) marks.



22107

4. Align clutch gear timing marks with index marks on drive shaft housing as close as possible.



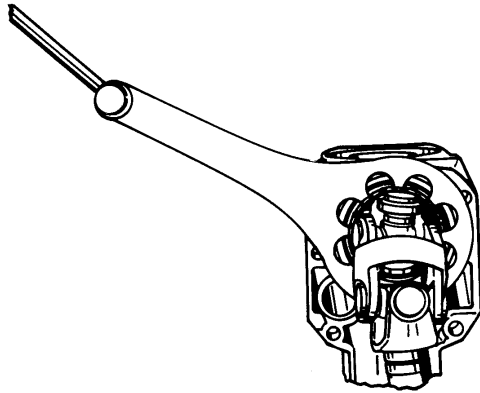
76805

- a** - Timing Marks  
**b** - Index Marks

**IMPORTANT:** Ensure that the retainer nut is not cross-threaded by turning the retainer nut counterclockwise until thread engagement is felt; then turn retainer nut clockwise.

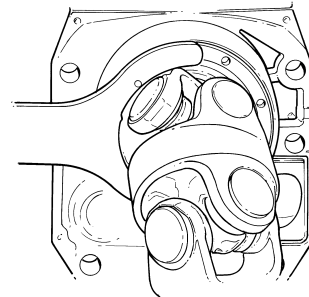
5. Install U-joint assembly into drive shaft housing. Apply Special Lubricant 101 to threads of retainer nut and install. Torque retainer nut to 200 lb-ft (271 Nm).

**NOTE:** On Bravo X, XZ, XR & Diesel Bravo, the retainer nut must be started using retainer nut spanner wrench.



22094

Standard Bravo

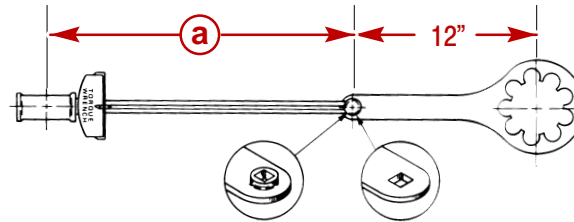


77078

Bravo X, XZ, XR, &amp; Diesel Bravo

## TORQUE CONVERSION CHART FOR U-JOINT RETAINER NUT TOOL

Torque Wrench Length in Inches (mm) <b>a</b>	Torque Wrench Reading in lb-ft (Nm) to Achieve 200 lb-ft (271 Nm)
15 (381)	111 (151)
16 (406)	114 (155)
17 (432)	117 (159)
18 (457)	120 (163)
19 (483)	123 (167)
20 (508)	125 (170)
21 (533)	127 (172)
22 (559)	129 (175)
23 (584)	131 (178)
24 (610)	133 (180)
25 (635)	135 (183)
26 (660)	136 (184)
27 (686)	138 (187)
28 (711)	140 (190)
29 (737)	141 (191)
30 (762)	143 (194)
31 (787)	144 (195)
32 (813)	145 (197)
33 (838)	147 (200)
34 (864)	148 (201)
35 (889)	149 (202)
36 (914)	150 (203)



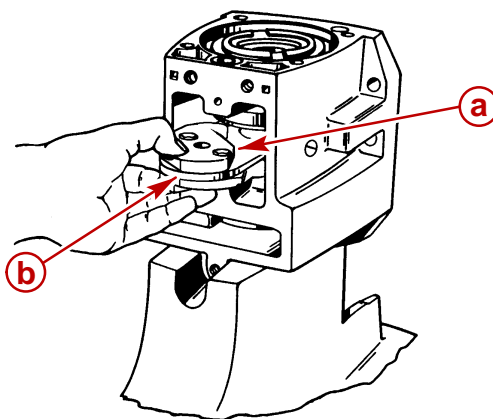
26363

**Typical Bravo Retainer Nut Tool Shown****a** - Torque Wrench Length**TORQUING BRAVO U-JOINT BEARING RETAINER NUT**

Use the following procedure to allow torquing retainer nut with a torque wrench.

- a. On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.
  - b. On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (2 bands, etc.).
6. Check that timing marks are still properly aligned (by turning U-joint, if necessary). If marks have moved; remove U-joint assembly and start over beginning with step (3).
- Refer to "Special Information" on page 23 if shift cam assembly is being replaced.

7. Install shift cam assembly into shifter cavity in drive shaft housing with the shift cam nuts facing the bottom of the drive shaft housing.

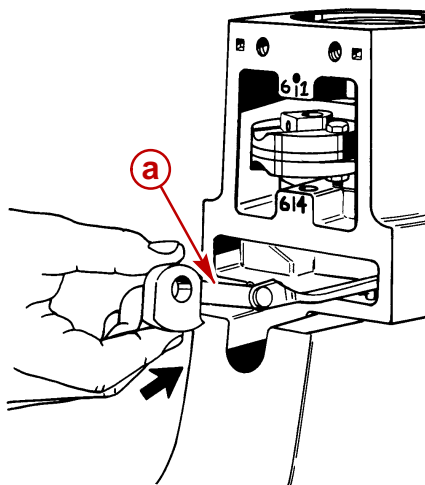


76838

**Shift Cam Assembly**

- a** - Shift Cam Assembly
- b** - Boss

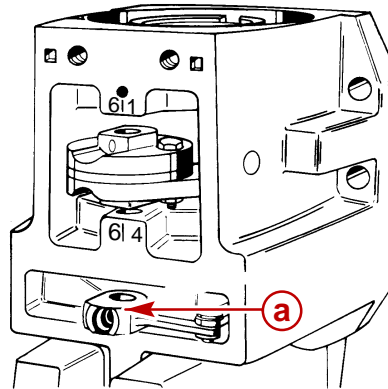
8. Install shift linkage assembly.
  - a. Push linkage assembly in. If linkage binds, move assembly gently from side to side while pushing.



76853

- a** - Linkage Assembly

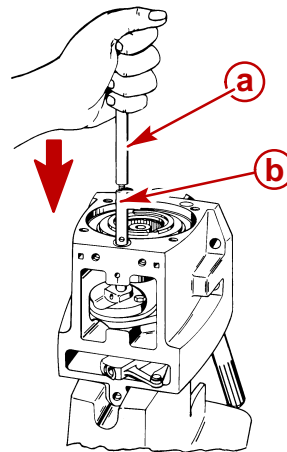
- b. Turn linkage assembly 1/4 turn counterclockwise and position as shown.



76852

**a** - Linkage Assembly

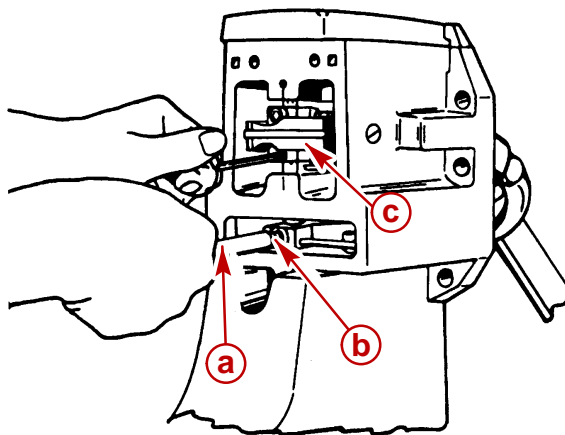
9. Install shift handle tool in shifter shaft and push shaft down. Remove tool.



50306

**a** - Shift Handle Tool (91-17302)  
**b** - Shifter Shaft

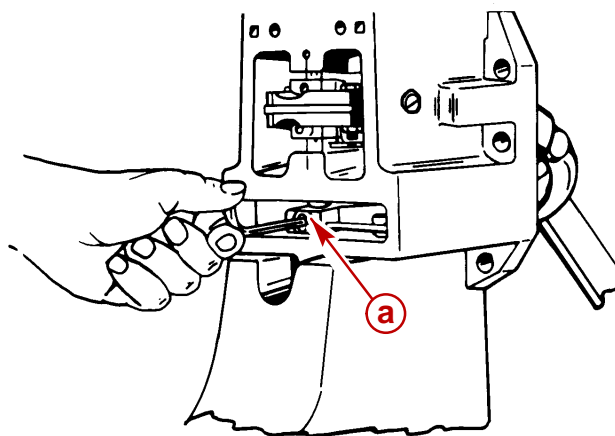
10. Install shift handle tool through shift linkage and into shifter shaft. Move shifter shaft back and forth as necessary to align lower hole in shift cam assembly with threaded hole in shifter shaft. Apply Loctite 271 to first 2 or 3 threads of screw, install shift cam cap screw and torque to 100-120 lb-in. (12-13 Nm).



76864

- a** - Shift Handle Tool
- b** - Shift Linkage
- c** - Shift Cam Assembly

11. Apply Loctite 271 to first 2-3 threads of shift linkage cap screw and install. Torque screw to 100-120 lb-in. (12-13 Nm).

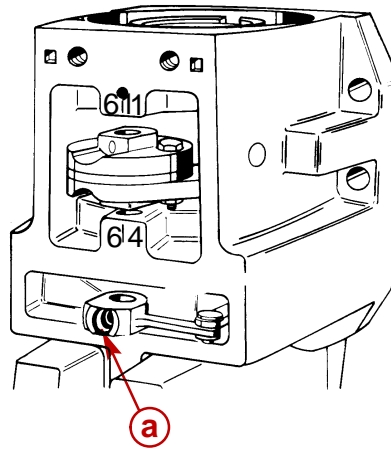


76854

- a** - Cap Screw



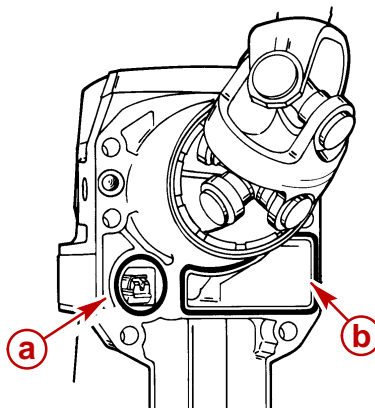
12. Move shift linkage to the neutral detent position as shown. Apply liberal amount of Special Lubricant 101 to I.D. of screw recess.



**a** - Screw Recess

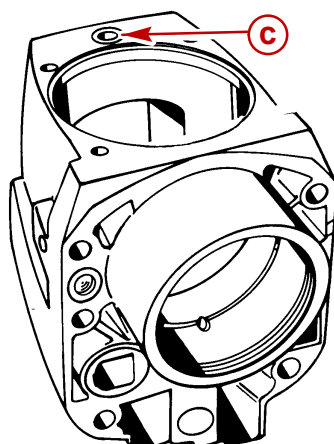
76852

13. Replace O-rings in drive shaft housing. Apply 3-M Adhesive to O-rings before installation.



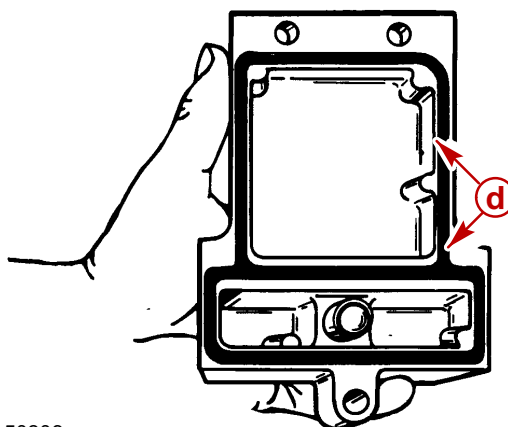
50356

- a** - Shift Linkage O-ring  
**b** - Water Passage O-ring

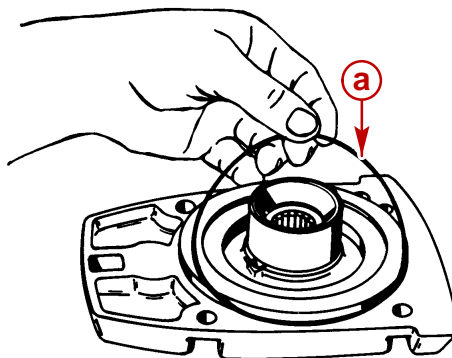


50306

- c** - Shifter Shaft O-ring  
**d** - Back Cover O-ring



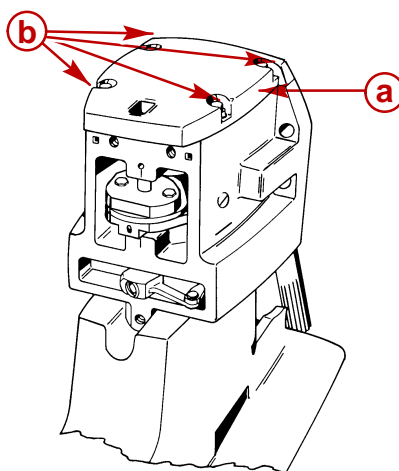
22100



22088

- a** - Top Cover O-ring

14. Install top cover. Torque screws to 20 lb-ft (27 Nm).



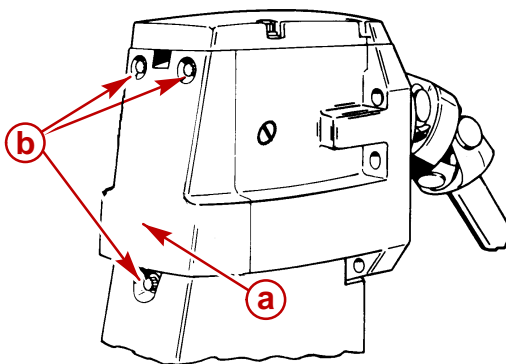
**a** - Top Cover  
**b** - Screws

50304

76835

15. Install rear cover and screws. Torque screws to 20 lb-ft (27 Nm).

**NOTE:** To avoid damage to cover, evenly tighten screws until cover is flush against drive shaft housing before torquing screws.



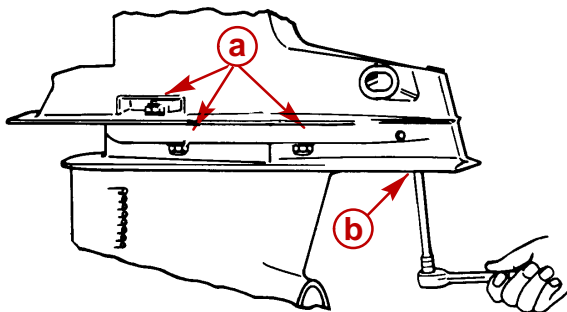
**a** - Rear Cover  
**b** - Screws (3)

76805

## Install Gear Housing To Drive Shaft Housing

### 1. Bravo One, Bravo XZ, Bravo XR, and Diesel Bravo One X:

- a. Install gear housing to drive shaft housing. Torque nuts and bolt to 35 lb-ft (47 Nm).

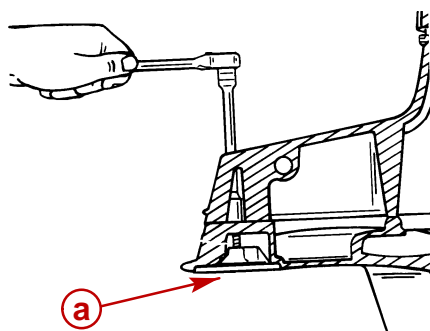


76801

**a** - Nuts and Washers (6)

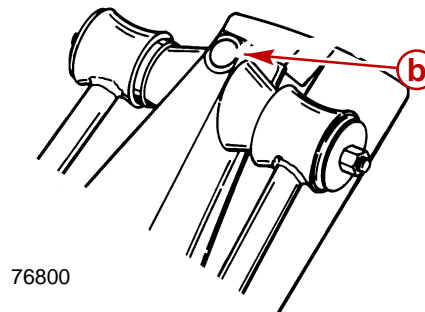
**b** - Bolt (Located in Trim Tab Cavity) (1)

- b. Install anodic plate. Torque to 20 lb-ft (27 Nm). Install rubber plug.



**a** - Anodic Plate

**b** - Rubber Plug

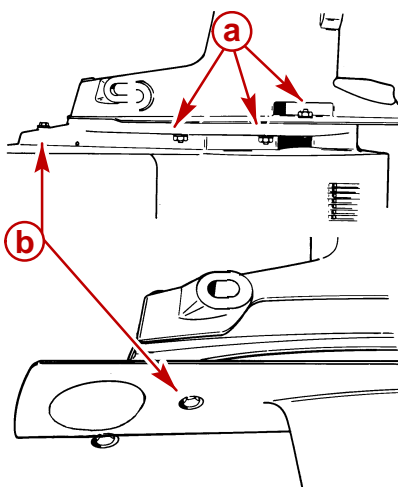


76800

22093

### 2. Bravo Two and Diesel Bravo Two X:

- a. Install gear housing to drive shaft housing. Torque nuts and bolt to 35 lb-ft (47 Nm).

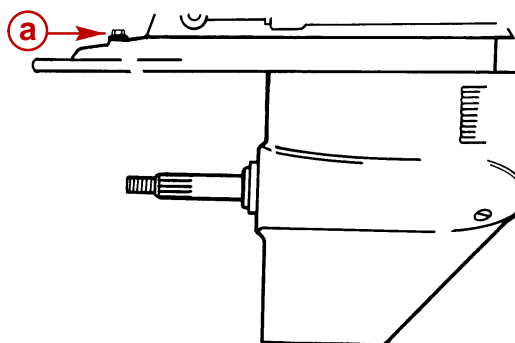


76802

**a** - Nuts and Washers (6)

**b** - Bolt (Located in Front of Trim Tab) (1)

- b. Install anodic plate. Torque bolt to 20 lb-ft (27 Nm).

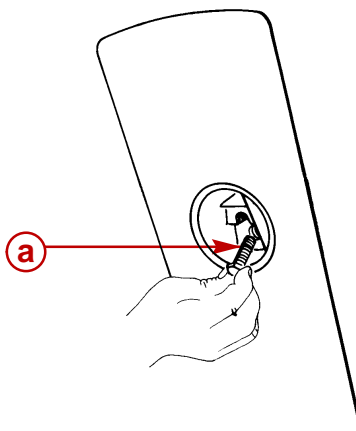


76801

**a** - 1/2 in. Bolt

3. **Bravo Three and Diesel Bravo Three X:**

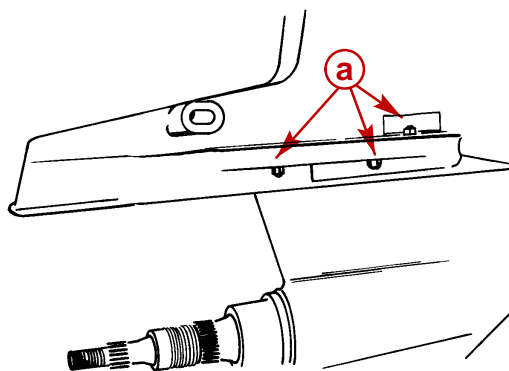
- a. Install the bolt in the anode cavity. Torque bolt to 35 lb-ft (47 Nm).



76804

**a** - Bolt

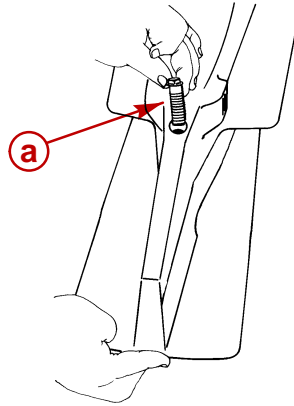
- b. Install the remaining fasteners. Torque nuts to 35 lb-ft (47 Nm).



76803

**a** - 6 Nuts And Washers

- c. Install anode. Torque bolt to 20 lb-ft (27 Nm). Install rubber plug.



76832

**a** - Bolt

4. Fill drive unit with gear lube. (Refer to Section 1B.)

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# STERNDRIIVE UNIT

## Section 3B - Bravo One Gear Housing

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# Specifications

## Torque Specifications

Fastener Location	lb-in.	lb-ft	Nm
Driveshaft Pinion Screw		45	61
Bearing Carrier Retainer Nut	Torque to Proper Preload		
Drive Shaft Housing to Gear Housing Nuts and Bolt		35	48
Anodic Plate Screw		23	32
Oil Fill/Drain Plug	40		5
Propeller Nut		55	75

## Bearing Preloads

Description	lb-in.	Nm
Drive shaft Bearings	3-5	0.3-0.55
Propeller Shaft Bearings - Checked at Propeller Shaft (New Bearings)	8-12 <sup>1</sup>	0.9-1.4 <sup>1</sup>
Propeller Shaft Bearings - Checked at Propeller Shaft (Used Bearings) <sup>2</sup>	5-8 <sup>1</sup>	0.6-0.9 <sup>1</sup>

<sup>1</sup>DOES NOT include 3-5 lb-in. (0.3-0.55 Nm) of preload on drive shaft bearings.

<sup>2</sup>A bearing is used if spun once under load.

## Gear Ratio - Teeth Per Gear (Gear Housing)

Ratio	Pinion	Driven
1.65:1	15	19
1.50:1	15	19
1.36:1	15	19

## Lubricants / Sealants / Adhesives

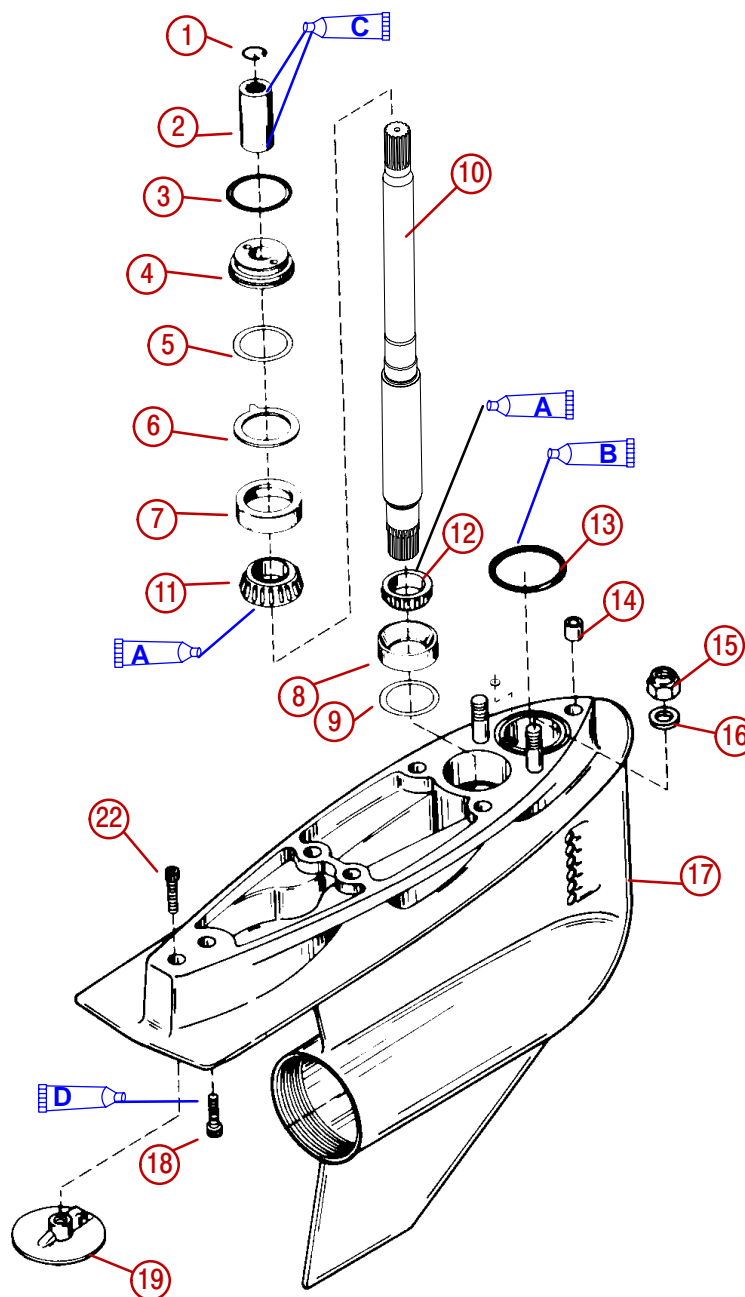
Description	Part Number
Quicksilver High-Performance Gear Lube	92-816026A2
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Perfect Seal	92-34227-1
3-M Adhesive	92-86166-Q1
Loctite 271	92-809820
Quicksilver Engine Coupler Spline Grease	92-816391A4

# Tools

Description	Part Number
Dial Indicator Set	91-58222A1
Backlash Indicator Rod	91-53459
Dial Indicator Adaptor Kit	91-83155
Slide Hammer Puller	91-34569A1
Torque Wrench (lb-in.)	91-66274
Drive Shaft Pinion Gear Shimming Tool	91-42840T
Bearing Carrier Retainer Nut Wrench	91-61069T
Bearing Carrier and Bar Puller	91-90338A1
Clamp Plate	91-43559T
Drive Shaft Adaptor Tool	91-56775T
Universal Puller Plate	91-37241
Bearing Seal Driver	91-813653
Threaded Rod	91-31229
Bearing Driver	91-89867T
Bearing Carrier Seals and Bearing Cup Driver	91-89865
Bearing Cup Driver	91-31106
Bearing Cup Driver	91-67443T
Driver Rod	91-37323
Bearing Removal Tool	91-63638T
Bearing Adaptor Installation Tool	91-18605A2
Propeller Shaft Tool Kit	91-840393 A1
Bearing Carrier Installation Tool	91-840388
Bearing Carrier Oil Seal Installer	91-840385
Bearing Carrier Retainer Nut Wrench	91-840393
Propeller Shaft and Driveshaft Adaptor	91-61077T

# Bravo One Gear Housing Exploded View


## Drive Shaft Components



76865

- |                         |   |
|-------------------------|---|
| <b>1</b> - Retainer     | <b>11</b> - Tapered Bearing (Larger Dia.)   |
| <b>2</b> - Coupler      | <b>12</b> - Tapered Bearing (Smaller Dia.)  |
| <b>3</b> - O-Ring       | <b>13</b> - Seal, Water Passage             |
| <b>4</b> - Spacer       | <b>14</b> - Seal, Speedometer Water Passage |
| <b>5</b> - Shim(s)      | <b>15</b> - Lock Nut                        |
| <b>6</b> - Tab Washer   | <b>16</b> - Flat Washer                     |
| <b>7</b> - Bearing Cup  | <b>17</b> - Gear Housing                    |
| <b>8</b> - Bearing Cup  | <b>18</b> - Screw                           |
| <b>9</b> - Shim(s)      | <b>19</b> - Anodic Plate                    |
| <b>10</b> - Drive Shaft | <b>20</b> - Screw                           |

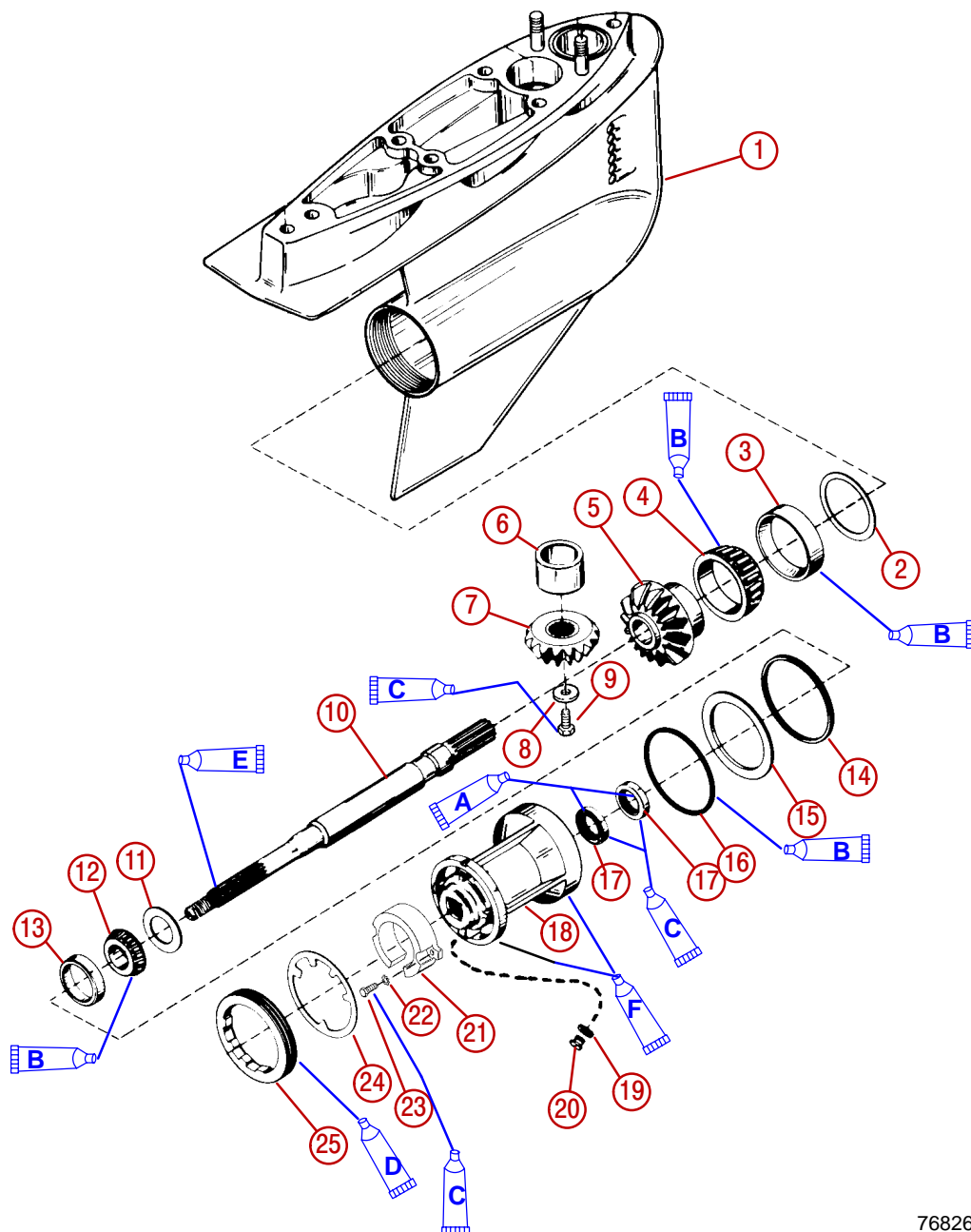
 **A** - Quicksilver High Performance Gear Lube

 **B** - 3M Adhesive

 **C** - Quicksilver 2-4-C Marine Lubricant with Teflon

 **D** - Perfect Seal

## Bravo One and Diesel Bravo One X Propeller Shaft Components



76826

- |                             |                                      |
|-----------------------------|--------------------------------------|
| <b>1</b> - Gear Housing     | <b>14</b> - Load Ring                |
| <b>2</b> - Shims            | <b>15</b> - Washer                   |
| <b>3</b> - Bearing Cup      | <b>16</b> - O-Ring                   |
| <b>4</b> - Tapered Bearing  | <b>17</b> - Seals                    |
| <b>5</b> - Driven Gear      | <b>18</b> - Bearing Carrier          |
| <b>6</b> - Needle Bearing   | <b>19</b> - Washer                   |
| <b>7</b> - Pinion Gear      | <b>20</b> - Drain Screw              |
| <b>8</b> - Washer           | <b>21</b> - Propeller Anode          |
| <b>9</b> - Screw            | <b>22</b> - Lockwasher               |
| <b>10</b> - Propeller Shaft | <b>23</b> - Screw                    |
| <b>11</b> - Washer          | <b>24</b> - Tab Washer               |
| <b>12</b> - Tapered Bearing | <b>25</b> - Bearing Carrier Retainer |
| <b>13</b> - Bearing Cup     |                                      |



**A** - Quicksilver 2-4-C Marine Lubricant with Teflon



**B** - Quicksilver High Performance Gear Lube (Use on All Bearing Surfaces)



**C** - Loctite 271



**D** - Quicksilver Special Lubricant 101

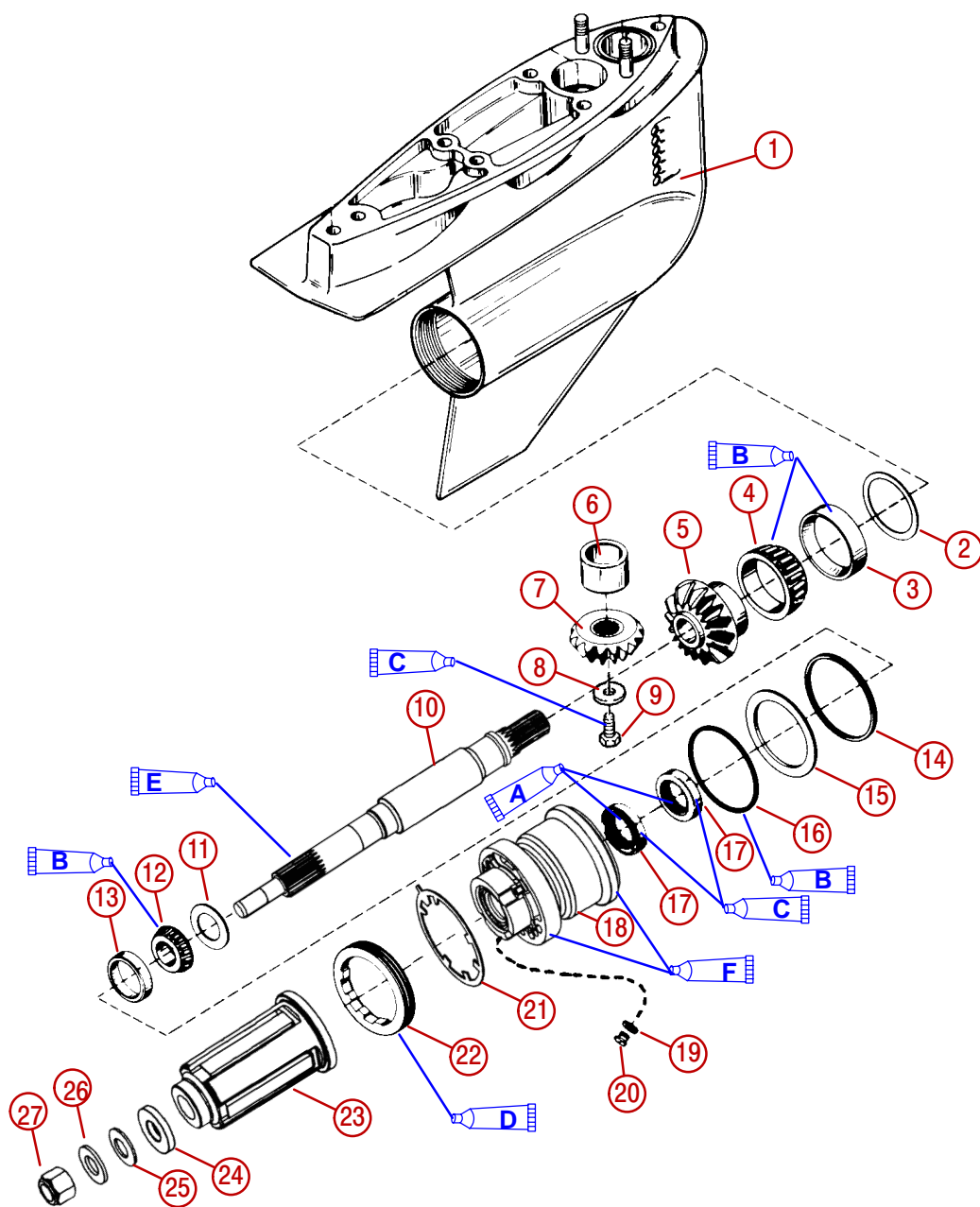


**E** - Quicksilver Engine Coupler-Spline Grease



**F** - Perfect Seal







## Bravo XZ and Bravo XR Propeller Shaft Components



77109

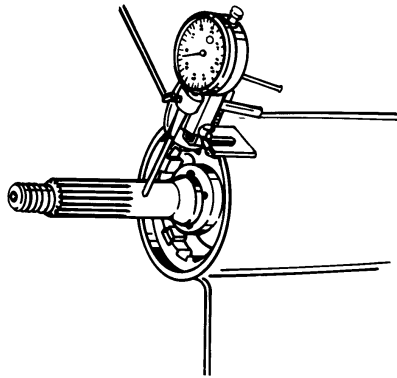


- |                             |                                      |
|-----------------------------|--------------------------------------|
| <b>1</b> - Gear Housing     | <b>15</b> - Washer                   |
| <b>2</b> - Shims            | <b>16</b> - O-Ring                   |
| <b>3</b> - Bearing Cup      | <b>17</b> - Seals                    |
| <b>4</b> - Tapered Bearing  | <b>18</b> - Bearing Carrier          |
| <b>5</b> - Driven Gear      | <b>19</b> - Washer                   |
| <b>6</b> - Needle Bearing   | <b>20</b> - Drain Screw              |
| <b>7</b> - Pinion Gear      | <b>21</b> - Tab Washer               |
| <b>8</b> - Washer           | <b>22</b> - Bearing Carrier Retainer |
| <b>9</b> - Screw            | <b>23</b> - Propeller Hub Assembly   |
| <b>10</b> - Propeller Shaft | <b>24</b> - Washer                   |
| <b>11</b> - Washer          | <b>25</b> - Belleville-Washer        |
| <b>12</b> - Tapered Bearing | <b>26</b> - Washer                   |
| <b>13</b> - Bearing Cup     | <b>27</b> - Propeller Nut            |
| <b>14</b> - Load Ring       |                                      |

-  **A** - Quicksilver 2-4-C Marine Lubricant with Teflon
-  **B** - Quicksilver High Performance Gear Lube (Use on All Bearing Surfaces)
-  **C** - Loctite 271
-  **D** - Quicksilver Special Lubricant 101
-  **E** - Quicksilver Engine Coupler-Spline Grease
-  **F** - Perfect Seal

# Pre-Disassembly Inspection

1. Check propeller shaft for side to side movement, as follows:
  - a. Position dial indicator on propeller shaft.
  - b. Push propeller shaft to one side and zero the dial indicator.
  - c. Move propeller shaft to opposite side while observing dial indicator.
  - d. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than .003 in. (0.08 mm) indicates one of the following:
    - (1.) Worn propeller shaft bearings.
    - (2.) Improper propeller shaft preload.

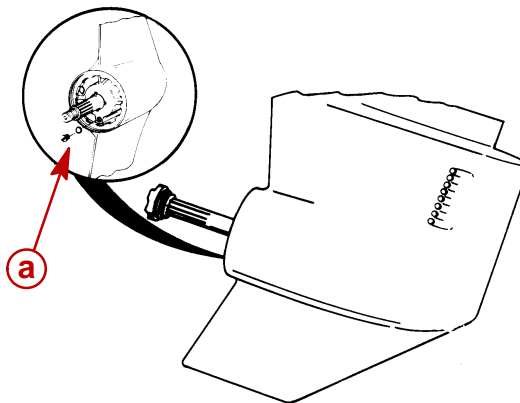


22086

2. Check for a bent propeller shaft, as follows:
  - a. Rotate propeller shaft while observing dial indicator. If deflection is more than .007 in. (.178 mm), a bent propeller shaft is indicated.

# Drive Shaft Housing and Gear Housing Separation

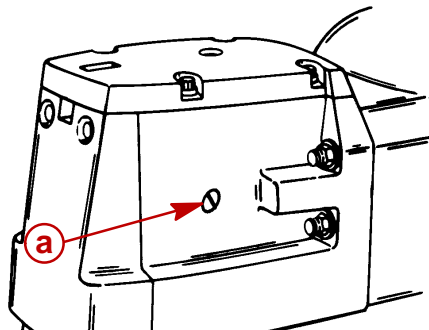
1. Remove, empty and clean gear lube monitor.
2. Drain sterndrive unit.



76827

**a** - Fill/Drain Screw

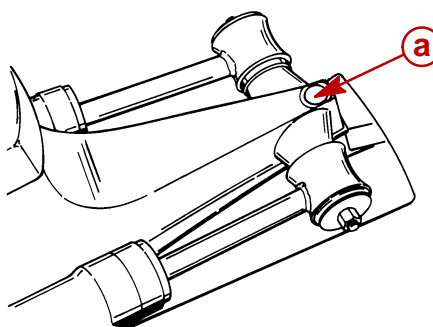
3. Remove vent plug.



76866

**a** - Vent Plug

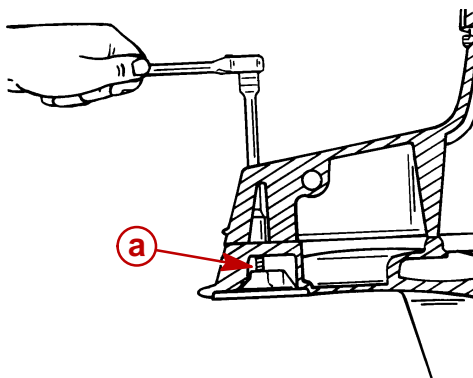
4. Remove rubber plug.



22093

**a** - Rubber Plug

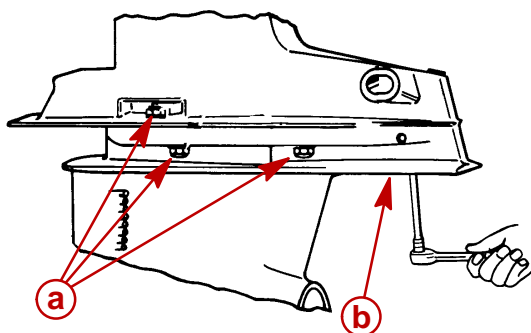
5. Remove anodic plate.



22258

**a** - 1/2 in. Bolt

6. Remove gear housing from drive shaft housing.



76879

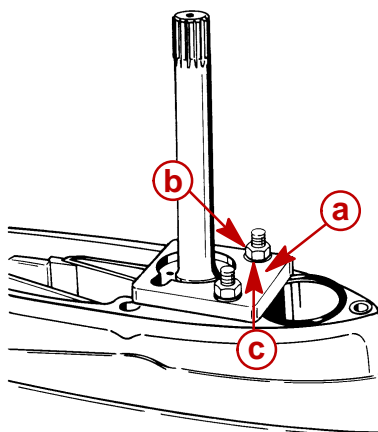
**a** - Nuts And Washers (6)

**b** - Bolt (1)

### **⚠ CAUTION**

Clamp plate (91-43559) must be installed on gear housing when gear housing is separated from drive shaft housing.

7. Install clamp plate on gear housing. Tighten securely.



22439

**a** - Clamp Plate

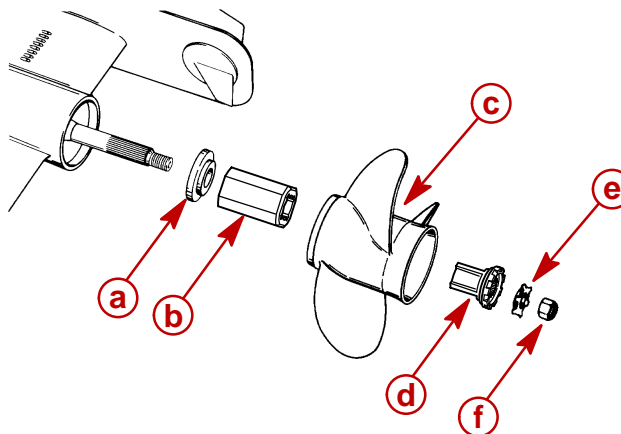
**b** - Nut

**c** - Washer (2 Per Side)

8. Finish draining gear case by turning upside down over a container.

# Gear Housing Disassembly

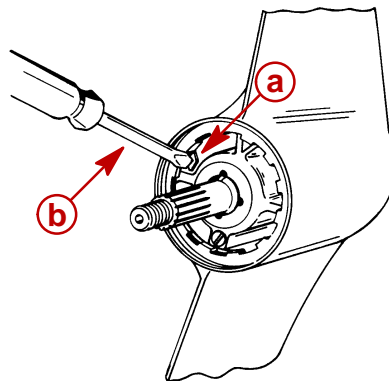
1. Remove propeller.



- a** - Forward Thrust Hub
- b** - Flo-Torque Drive Hub
- c** - Propeller
- d** - Drive Sleeve Adaptor
- e** - Tab Washer
- f** - Nut

75492

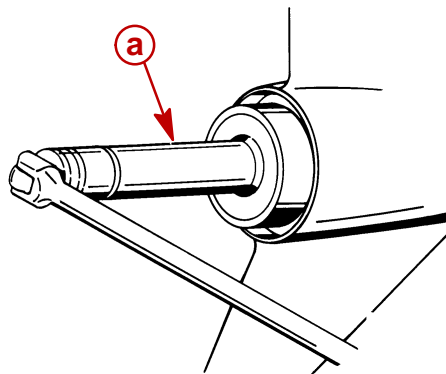
2. Bend tabs of tab washer away from bearing carrier retainer nut.



- a** - Tab
- b** - Screw Driver

50136

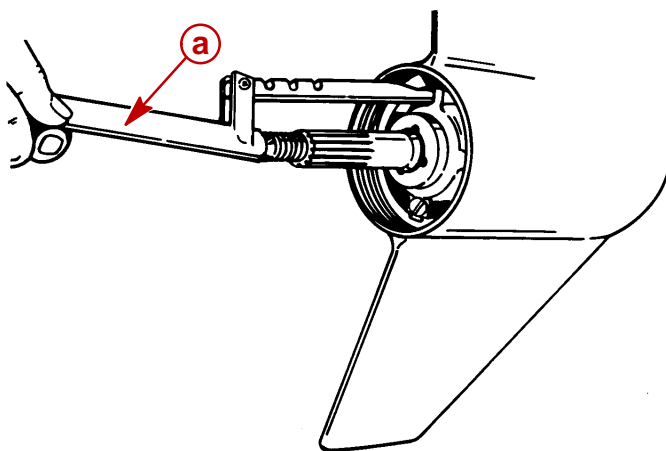
3. Remove bearing carrier retainer nut, using bearing carrier retainer wrench.



22112

**a** - Bearing Carrier Retainer Wrench (91-61069)

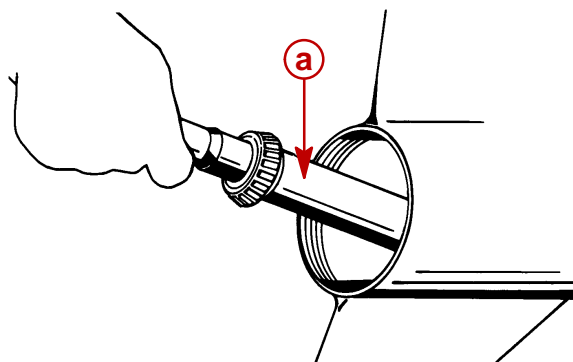
4. Remove bearing carrier using bearing carrier puller.



22104

**a** - Bearing Carrier Puller (91-90338A1)

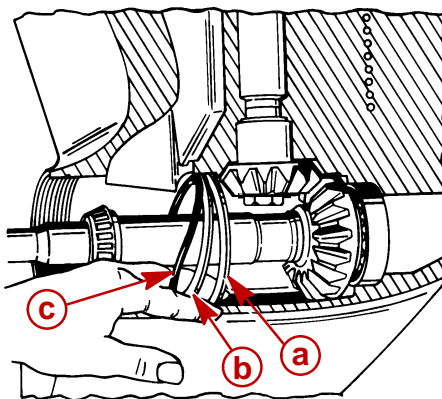
5. Remove propeller shaft.



22104

**a** - Propeller Shaft

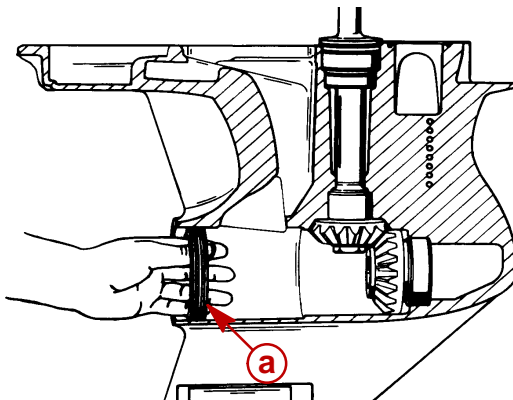
6. Remove washer, load ring and O-ring.



76829

- a** - Washer
- b** - Load Ring
- c** - O-ring

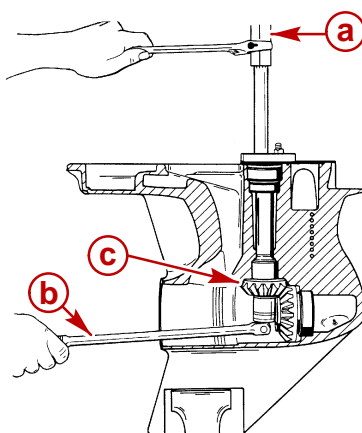
7. Temporarily reinstall bearing carrier retainer nut in gear housing to protect housing threads.



76870

- a** - Bearing Carrier Retainer Nut

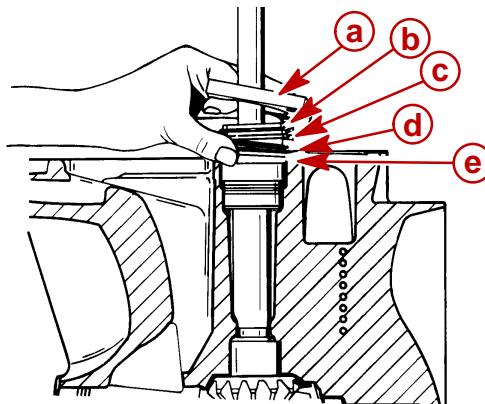
8. Remove pinion gear, screw and washer. Hold drive shaft using drive shaft adaptor tool.



72246

- a** - Drive Shaft Adaptor Tool (91-61077T)
- b** - Breaker Bar And Socket
- c** - Pinion Gear

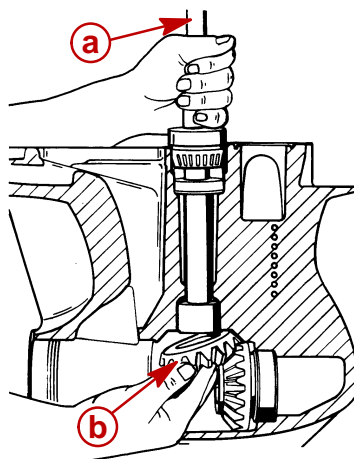
9. Remove clamp plate (installed in Step 2.), then remove O-ring, spacer, shim(s) and tab washer. Retain shims for reassembly.



22262

- a** - Clamp Plate
- b** - O-Ring
- c** - Spacer
- d** - Shim(s)
- e** - Tab Washer

10. Remove drive shaft and pinion gear.

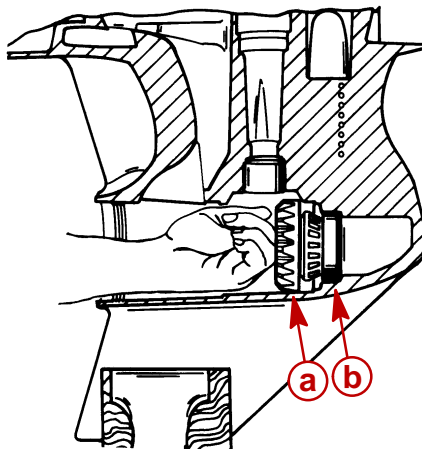


76871

- a** - Drive Shaft
- b** - Pinion Gear



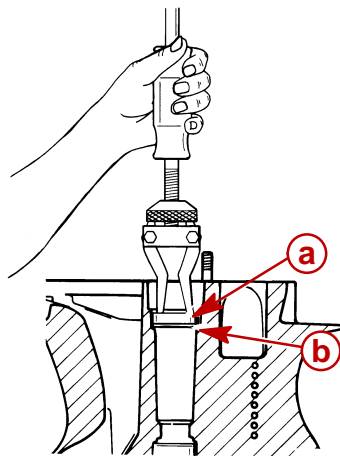
11. Remove driven gear and bearing.



22283

- a** - Driven Gear
- b** - Bearing Cup

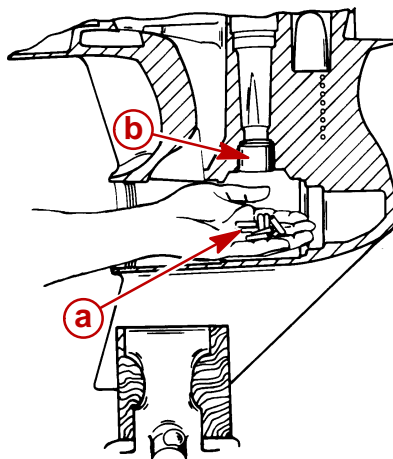
12. Remove drive shaft bearing cup and shims using slide hammer puller.



22261

- a** - Drive Shaft Bearing Cup
- b** - Shims

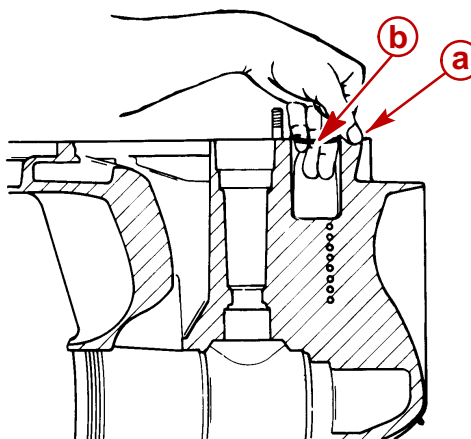
13. Unless you plan to remove the pinion bearing, remove needle bearings from drive shaft needle bearing race. (See Pinion Bearing Removal)



22083

- a** - Needle Bearings  
**b** - Drive Shaft Needle Bearing Race

14. Remove water passage O-ring and oil passage quad ring.



22222

- a** - Water Passage O-ring  
**b** - Oil Passage Quad Ring

# Drive Shaft And Pinion Bearing

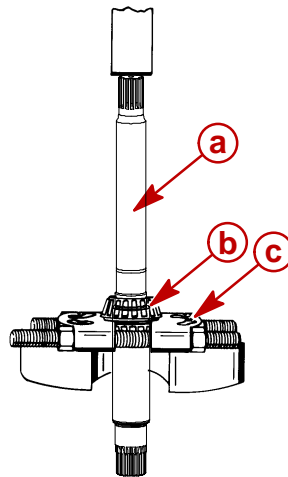
## Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replacement of drive shaft is necessary if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

## Drive Shaft Disassembly

**NOTE:** Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removing.

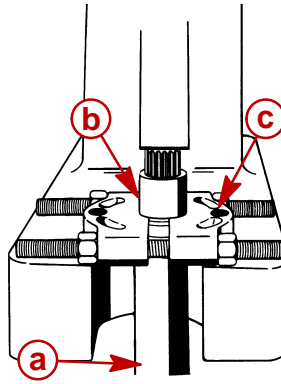
1. Press tapered roller bearing from shaft using universal puller plate to support bearing. Remove second tapered roller bearing in same manner.



- a** - Drive Shaft
- b** - Bearing
- c** - Universal Puller Plate (91-37241)

76872

2. Press drive shaft pinion bearing inner race from drive shaft, using universal puller plate.



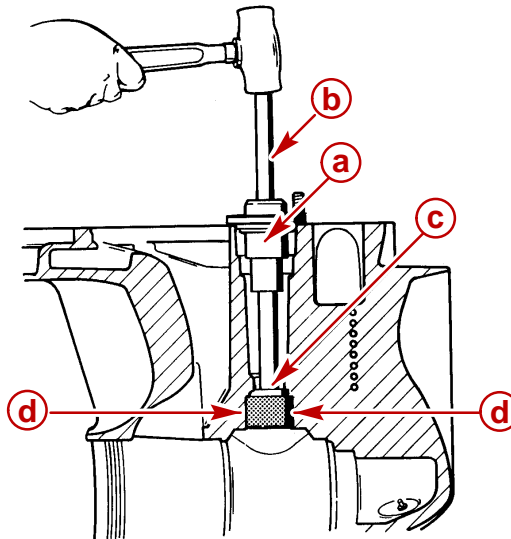
76881

- a** - Drive Shaft
- b** - Pinion Bearing Inner Race
- c** - Universal Puller Plate

## Pinion Bearing Removal

**IMPORTANT: All needle bearings MUST BE in place inside bearing casing while driving pinion bearing from gear case or bearing casing will bend or break and become difficult to remove.**

1. Heat area around bearing remover to approximately 200° F (93.3° C) to ease removal. Do not use open flame.
2. Remove pinion bearing using bearing remover, driver rod and bearing driver as a pilot.

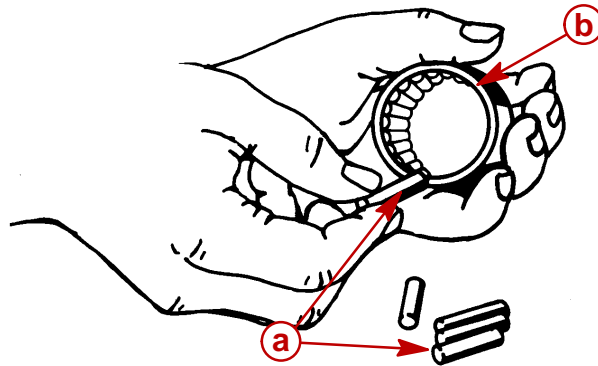


75902

- a** - Bearing Driver (91-813653) - Used As Pilot
- b** - Driver Rod (91-37323)
- c** - Bearing Remover (91-63638T)
- d** - Area Around Bearing

## Pinion Bearing Installation

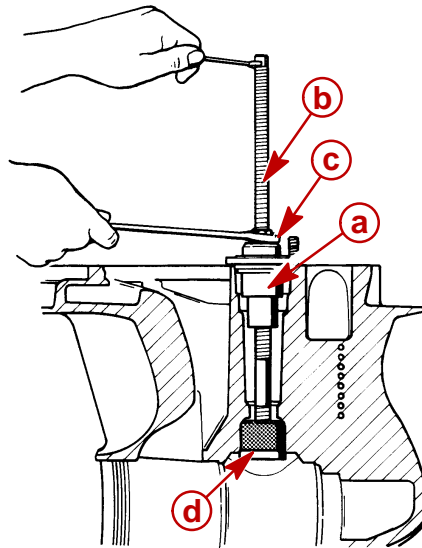
1. Install needles in casing. Use Quicksilver Needle Bearing Assembly Lubricant to help keep needles in place.
2. Position bearing assembly over bearing installation tool with number on bearing casing facing up.
3. Coat casing outside diameter with gear lube.



22219

- a** - Needle Bearings
- b** - Casing

4. Install pinion bearing using tools as shown. Use the bearing driver as a pilot.

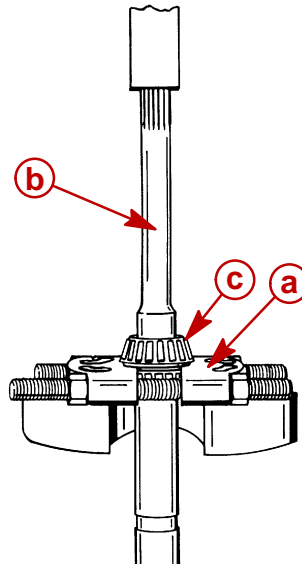


22222

- a** - Bearing Driver (91-813653) - Used As Pilot
- b** - Threaded Rod (91-31229)
- c** - Washer And Nut
- d** - Bearing Installation Tool (91-89867)

## Drive Shaft Reassembly

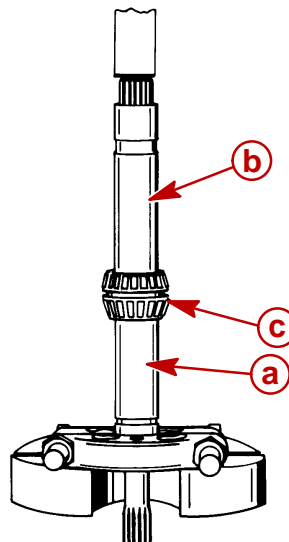
1. Lubricate inside diameter of tapered roller bearing with gear lube. Press small tapered roller bearing onto drive shaft using universal puller plate. Ensure that smaller outside diameter faces pinion end of shaft.



76873

- a** - Universal Puller Plate
- b** - Drive Shaft
- c** - Small Tapered Roller Bearing

2. Lubricate inside diameter of tapered roller bearing with gear lube. Press large tapered roller bearing onto drive shaft using a suitable mandrel. Ensure that larger outside diameter faces pinion end of shaft.



76874

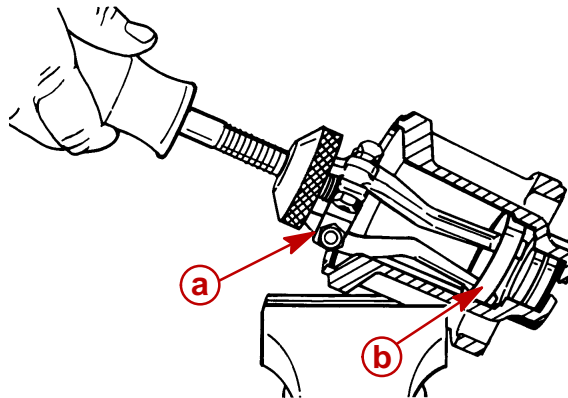
- a** - Suitable Mandrel On Inner Race Of Bearing
- b** - Drive Shaft
- c** - Large Tapered Roller Bearing

## Bearing Carrier Inspection

1. The condition of the propeller shaft tapered roller bearing cup is an indication of the condition of tapered roller bearing on propeller shaft. Replace bearing and cup if cup is pitted, grooved, scored, worn, uneven, discolored from overheating or has embedded metal particles.
2. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.

## Bearing Carrier Disassembly

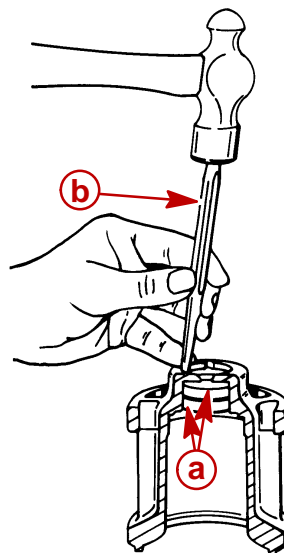
1. Remove bearing cup using slide hammer puller.



22087

- a** - Slide Hammer Puller  
**b** - Bearing Cup

2. Remove oil seals from bearing carrier using a hammer and punch.

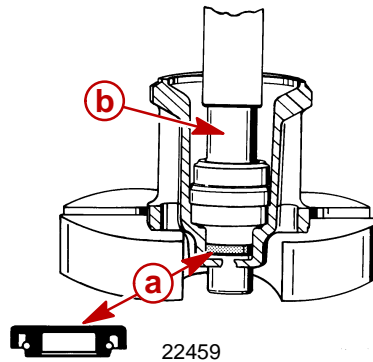


22111

- a** - Oil Seals (2)  
**b** - Punch

## Bearing Carrier Reassembly

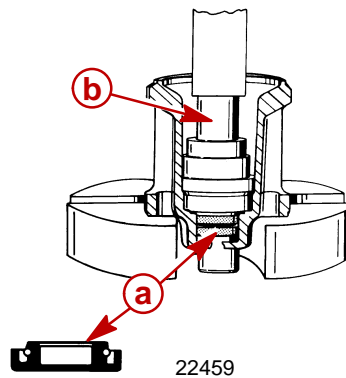
1. Coat outside diameter of oil seal with Loctite 271. Install outer oil seal with lip facing outward using cup and seal driver.



22087

- a** - Oil Seal - Lip Outward  
**b** - Cup And Seal Driver (91-89865)

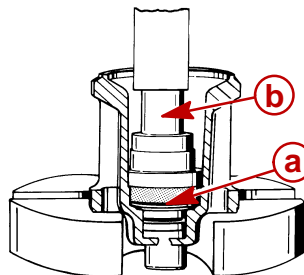
2. Coat outside diameter of oil seal with Loctite 271. Install inner oil seal with lip facing inward using cup and seal driver.



22088

- a** - Oil Seal - Lip Inward  
**b** - Cup And Seal Driver (91-89865)

3. Install bearing cup with bearing surface inward using cup and seal driver.



22088

- a** - Bearing Cup  
**b** - Cup And Seal Driver (91-89865)



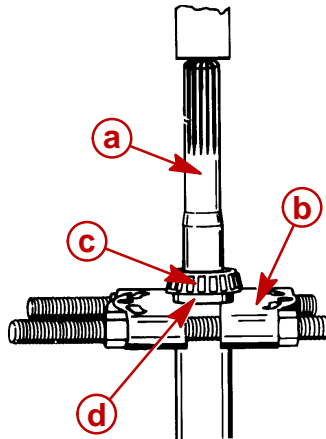
# Propeller Shaft

## Inspection

1. Check propeller shaft for bent condition.  
Use either of the following methods:
  - a. LATHE and DIAL INDICATOR METHOD:
    - (1.) Position propeller shaft centers in lathe.
    - (2.) Mount dial indicator at front edge of propeller shaft.
    - (3.) Rotate shaft and observe dial indicator. Movement of more than .007 in. (.178 mm) is reason for replacement.
  - b. V-BLOCKS and DIAL INDICATOR METHOD:
    - (1.) Position propeller shaft bearing surfaces on V-blocks.
    - (2.) Mount a dial indicator at front edge of propeller shaft.
    - (3.) Rotate shaft and observe dial indicator. Movement of more than .007 in. (.178 mm) is reason for replacement.
2. Inspect for bent or twisted splines.
3. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Oil seals will have to be replaced if any grooves are found.

## Propeller Shaft Bearing Removal

1. Press bearing from propeller shaft using universal puller plate.

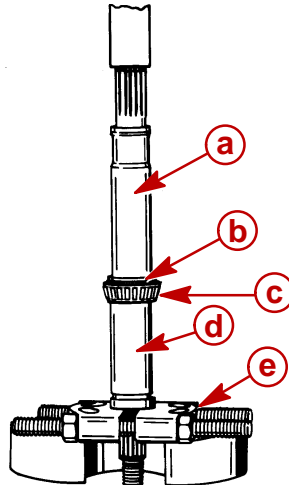


76875

- a** - Propeller Shaft
- b** - Universal Puller Plate
- c** - Tapered Roller Bearing
- d** - Washer

## Propeller Shaft Bearing Installation

1. Apply gear lube to inside diameter of new bearing. Install bearing to shaft using universal puller plate and a suitable mandrel (old bearing race) which supports bearing on inner race. Press into place.



22110

- a** - Propeller Shaft
- b** - Tapered Roller Bearing
- c** - Suitable Mandrel
- d** - Universal Puller Plate

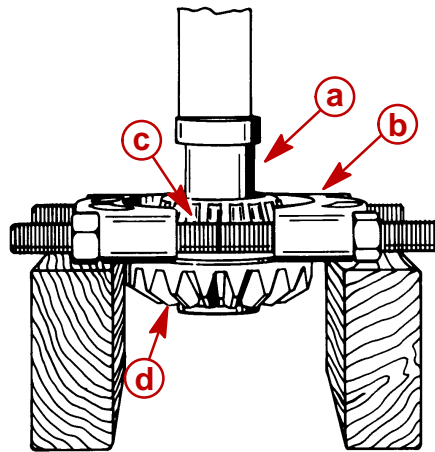
## Driven Gear Bearing

### Inspection

1. Remove bearing from driven gear. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. Replace both gears if any of these conditions exist.
2. Replace tapered roller bearing and cup if cup is pitted, grooved, scoured, worn uneven, discolored from overheating or has metal particles embedded in the cup.

## Driven Gear Bearing Removal

1. Remove bearing from driven gear using universal puller plate. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. Replace both gears if any of these conditions exist.

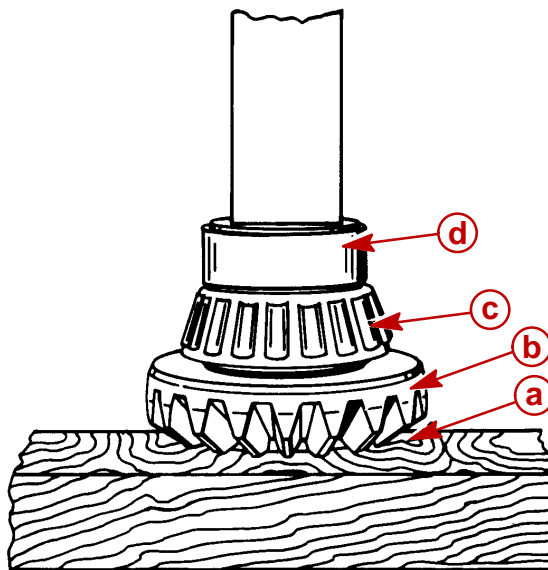


22108

- a** - Suitable Mandrel
- b** - Universal Puller Plate
- c** - Bearing
- d** - Driven Gear

## Driven Gear Bearing Installation

1. Apply a light coat of gear lube to inside diameter of new bearing. Place a suitable mandrel or old bearing race against new bearing race. Place another mandrel on face of gear and press gear and bearing together.

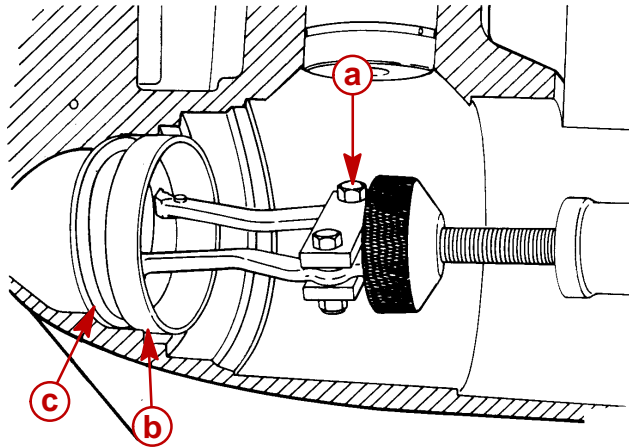


22108

- a** - Hard Wood Or Metal Block
- b** - Driven Gear
- c** - Tapered Roller Bearing
- d** - Mandrel - On Inner Bearing Race

## Driven Gear Bearing Cup Removal and Inspection

1. Remove bearing cup and shims using slide hammer puller. Replace tapered roller bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating or has metal particles embedded in the cup.

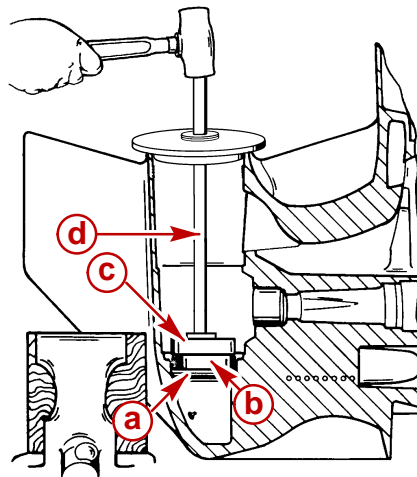


19808

- a** - Slide Hammer Puller
- b** - Bearing Cup
- c** - Shims

## Driven Gear Bearing Cup Installation

1. Install driven gear bearing cup with original thickness shim(s) using bearing driver. Ensure that cup is not canted. Coat cup outside diameter with gear lube.



75922

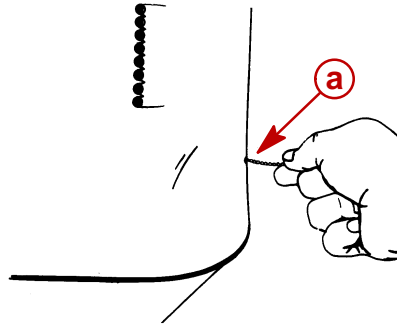
- a** - Shim(s)
- b** - Bearing Cup
- c** - Driver (91-31106)
- d** - Old Propeller Shaft Or Driver Rod

**NOTE:** If a MC-I propeller shaft is not available, use Driver Rod 91-37323 (from Bearing Removal and Installation Kit, 91-31229A7).

# Speedometer Water Passage

## Pickup Inspection and Cleaning

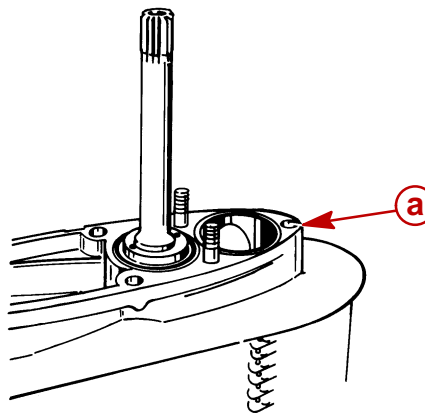
1. Inspect opening (pitot tube), on leading edge of gear housing, for obstruction. Clean opening with a short piece of wire. If obstruction can not be removed with wire, carefully reopen tube using a 5/64 in. (2 mm) diameter drill bit. Do not drill beyond a depth of 2-7/16 in. (62 mm).



22462

**a** - Pitot Tube

2. Inspect water passage seal for nicks, cuts or distortion. Replace if necessary.

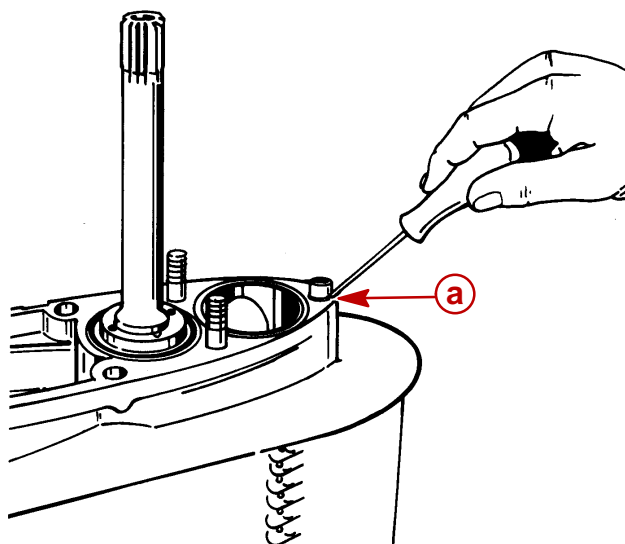


22085

**a** - Water Passage Seal

## Water Passage Seal Replacement

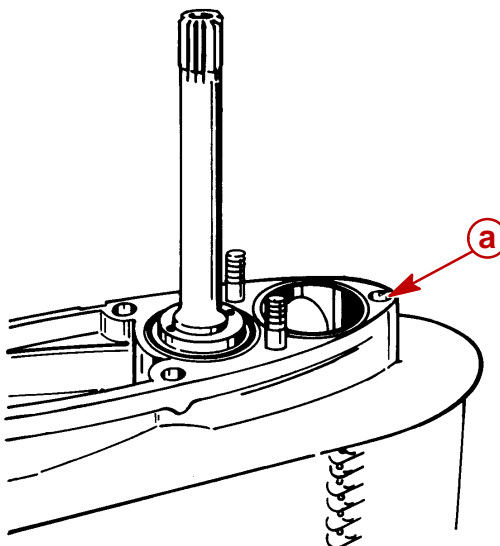
1. Pry seal out with a suitable tool.



22085

**a** - Seal

2. Lightly coat outside diameter of seal with 3-M adhesive and install in speedometer water passage bore. Ensure that top edge of seal is flush with gear housing surface.

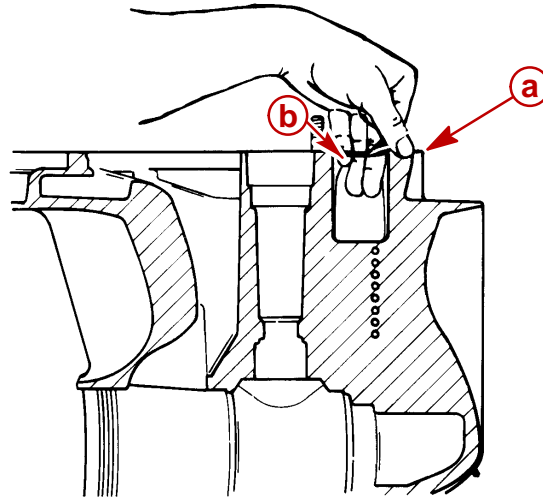


22085

**a** - Seal

## Gear Housing Reassembly And Shimming

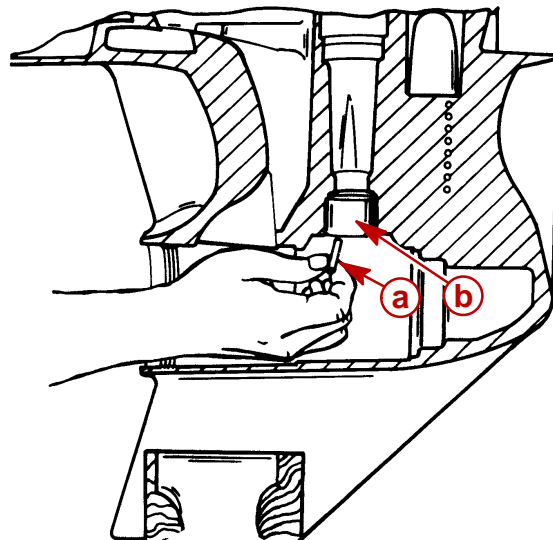
1. Lubricate all bearings with gear lube before installing. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using 3-M adhesive.



22222

- a** - O-Ring  
**b** - Oil Passage Quad Ring

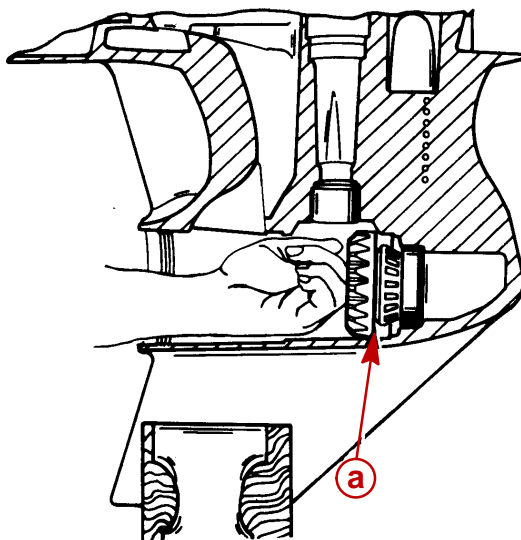
3. Install needle bearings into lower needle bearing casing. Use Quicksilver Needle Bearing Assembly Lubricant to hold needle bearings in place.



22083

- a** - Needle Bearings  
**b** - Needle Bearing Casing

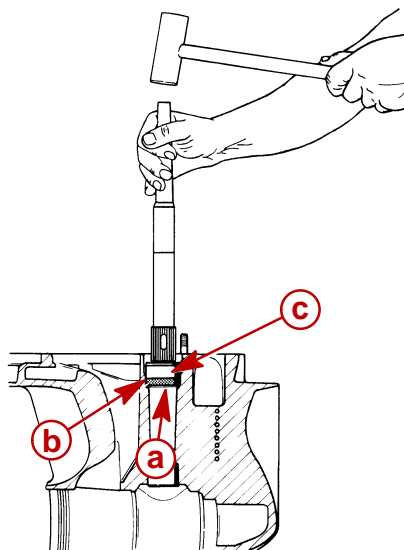
4. Install driven gear assembly.



22083

**a** - Driven Gear Assembly

5. Install original thickness shim(s) and drive shaft lower bearing cup using bearing cup driver. Use original shims or if misplaced, start with .050 in. (1.27 mm) thickness.

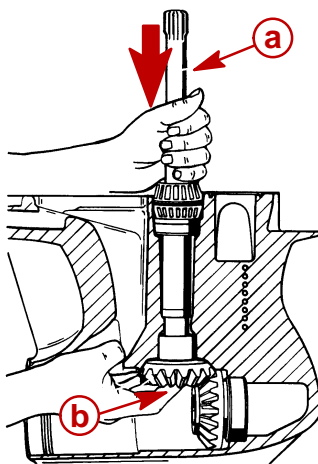


50409

**a** - Shim(s)  
**b** - Lower Bearing Cup  
**c** - Bearing Cup Driver (91-67443)



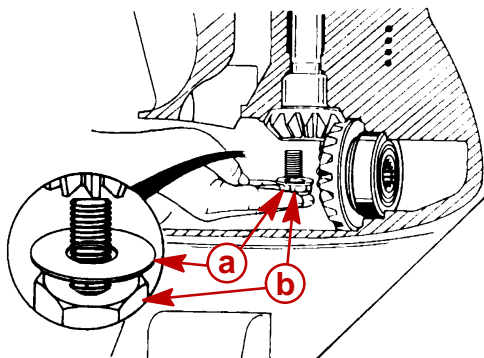
6. Install drive shaft and pinion gear.



22258

- a** - Drive Shaft  
**b** - Pinion Gear

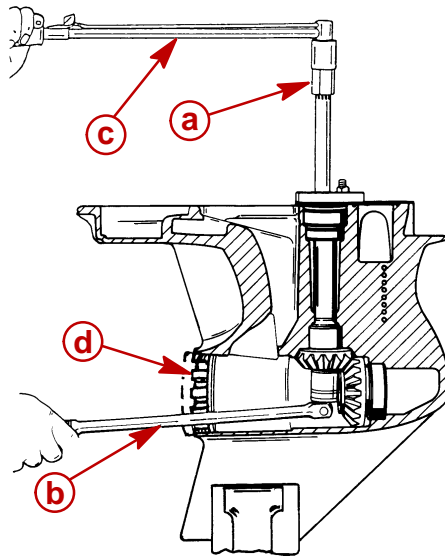
7. Install pinion washer and screw. Apply Loctite 271 to threads of screw.



76877

- a** - Washer  
**b** - Screw

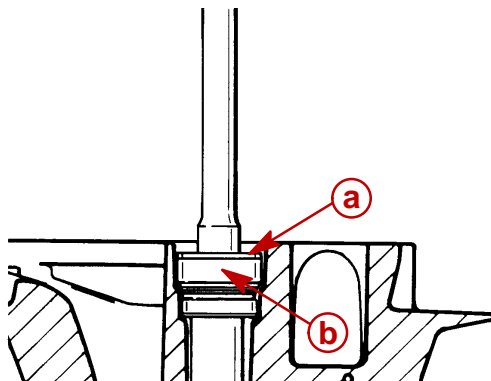
8. Temporarily install bearing carrier retaining nut to prevent damage to threads.
9. Torque pinion screw to 45 lb-ft (61 Nm).



22260

- a** - Drive Shaft Adaptor Tool (91-61077T)
- b** - Breaker Bar And Socket
- c** - Torque Wrench And Socket
- d** - Bearing Carrier Retainer

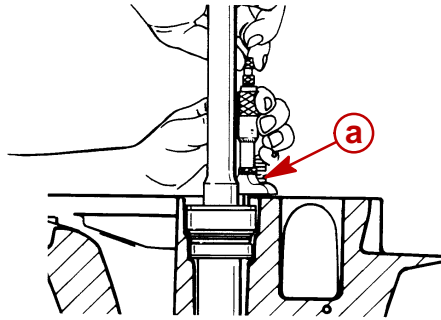
10. Remove bearing carrier retainer nut previously placed in unit for protection of threads.
11. Install upper bearing cup and tab washer.



- a** - Tab Washer
- b** - Upper Bearing Cup

12. Determine shim thickness required for drive shaft bearing preload using the following procedure or use original thickness shims.

- a. Measure distance between top of gear housing and tab washer using a 0-1 in. depth micrometer.

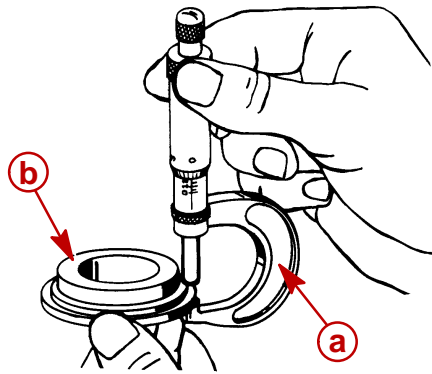


22259

**a** - Depth Micrometer

**b** - Tab Washer

- b. Measure thickness of spacer from top machined surface to bottom machined surface.



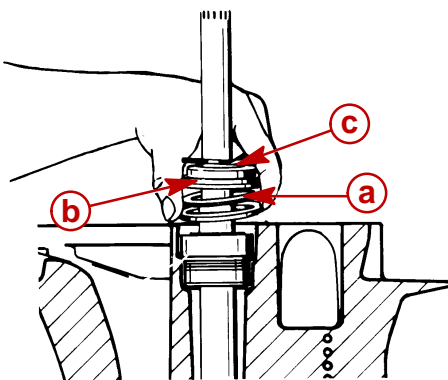
22100

**a** - Outside Micrometer

**b** - Spacer

- c. Calculate shim thickness as shown.  
Measurement from step a. -minus-  
Measurement from step b. + .001 in. =  
Shim Thickness Required.

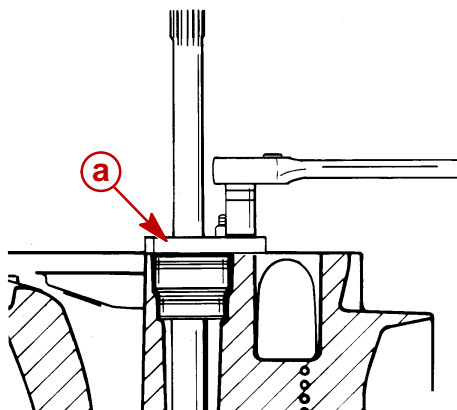
13. Install shims, spacer and O-ring.



22259

- a** - Shims
- b** - Spacer
- c** - O-ring

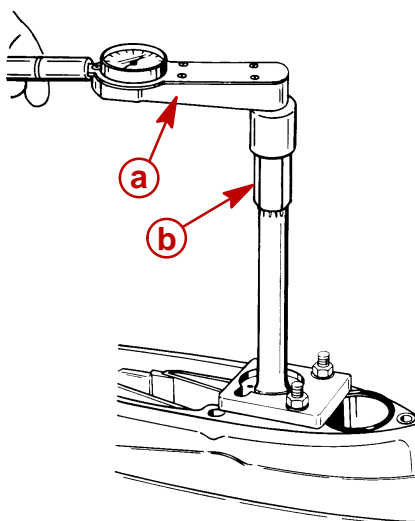
14. Install clamp plate on gear housing with nuts (2) and washers (4). Torque to 35 lb-ft (47 Nm).



22262

- a** - Clamp Plate (91-43559T)

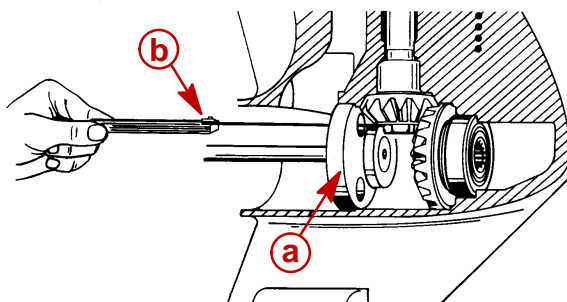
15. Using a dial-type lb-in. torque wrench, check the rolling preload by turning drive shaft with a slow steady motion (3-5 lb-in. [0.3-0.6 Nm]).



50410

- a** - Torque Wrench
- b** - Drive Shaft Adaptor

16. If preload is incorrect, adjust by adding or subtracting shims from upper tapered roller bearing cup. Reinstall clamp plate and recheck preload [3-5 lb-in. (0.3-0.6 Nm)]. Record final preload.
17. Check pinion height.
  - a. Rotate drive shaft several times to seat bearings. Insert shimming tool (91-42840) into gear housing.
  - b. Measure clearance between tool and pinion gear with feeler gauge and shimming tool. Clearance must be .025 in. (.635 mm). Take measurement at 3 locations on pinion gear (120° apart).



76878

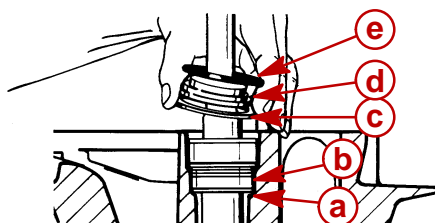
- a** - Shimming Tool  
**b** - Feeler Gauge

- c. If clearance is less than specified: Add appropriate thickness of shim(s) under lower tapered roller bearing cup.

**Any thickness added here Must be subtracted from shim thickness at upper bearing.**

If clearance is more than specified: Remove appropriate thickness of shim(s) from under lower tapered roller bearing cup.

**Any thickness subtracted here Must be added to shim thickness at upper bearing.**

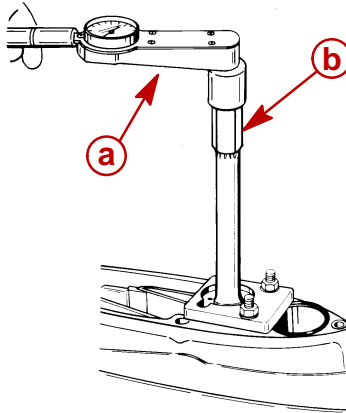


22262

- a** - Shims, Lower  
**b** - Bearing Cup, Lower  
**c** - Shims, Upper  
**d** - Spacer  
**e** - O-Ring

- d. Recheck clearance after changing shim(s) in Step b.

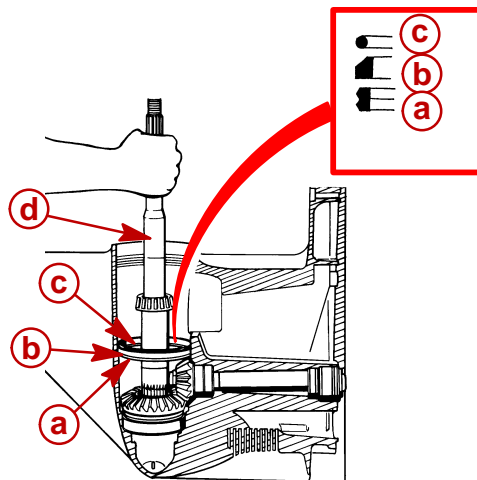
18. Using a dial-type lb-in. torque wrench, recheck the rolling preload by rotating drive shaft with a slow steady motion (3-5 lb-in. [0.3-0.6 N·m]).



50410

- a** - Torque Wrench  
**b** - Drive Shaft Adaptor

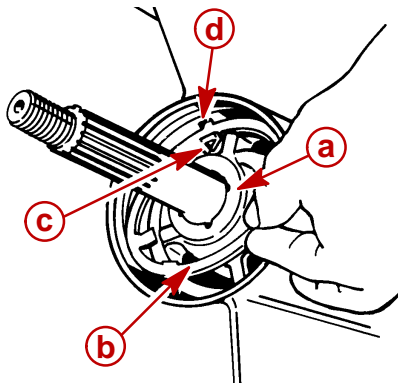
19. Install the original load ring, thrust ring, O-ring and propeller shaft into the gear housing.



76883

- a** - O-ring  
**b** - Thrust Ring  
**c** - Load Ring  
**d** - Propeller Shaft

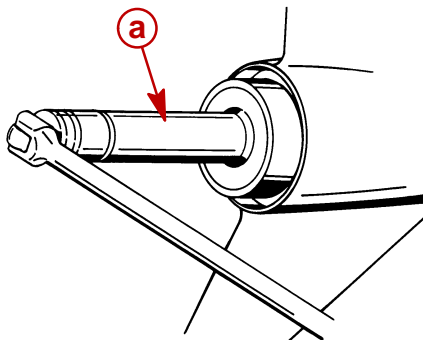
20. Install bearing carrier and tab washer. Align inner tab of tab washer with V-notch in bearing retainer.



23257

- a** - Bearing Carrier
- b** - Tab Washer
- c** - Inner Tab
- d** - Outer Tab

21. Install and tighten bearing carrier retaining nut using retainer wrench until resistance to propeller shaft rotation can be felt (to preload bearings).

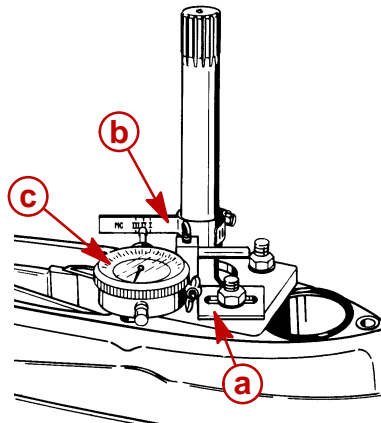


22112

- a** - Bearing Carrier Retainer Wrench (91-61069T)

## 22. Driven gear shimming:

- a. Install dial indicator adaptor kit, backlash indicator rod and dial indicator set, as shown. Ensure that dial rod is aligned with "I" on indicator rod.



22439

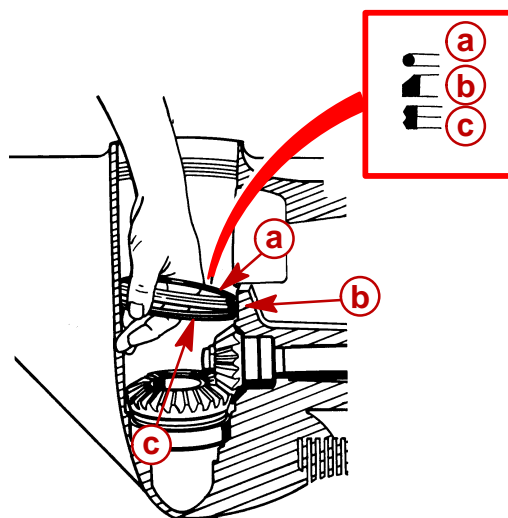
- a** - Dial Indicator Adaptor (91-83155)
- b** - Backlash Indicator Rod (91-53459)
- c** - Dial Indicator (91-58222A1)

- b. Check gear backlash by lightly rotating drive shaft back and forth. Do not allow propeller shaft to turn. Observe dial indicator. Reading should be .012-.015 in. (.28-.38 mm).
- c. If backlash is not correct, disassemble and proceed as follows:  
If backlash is MORE than specified: ADD shim(s) under driven gear bearing cup.  
If backlash is LESS than specified: REMOVE shim(s) under driven gear bearing cup.
- d. Recheck backlash reading after reassembly.

## 23. Remove bearing carrier, O-ring, thrust ring and load ring.

## 24. Reinstall load ring, thrust ring, O-ring and bearing carrier using a NEW load ring.

**IMPORTANT: Always use a new load ring for final assembly.**



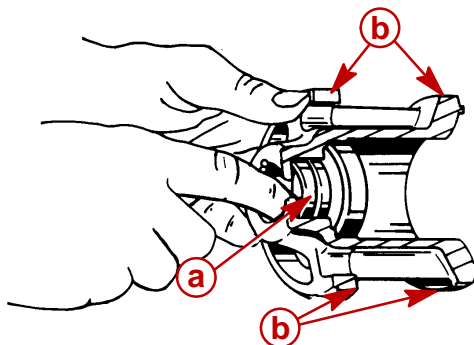
76884

- a** - O-ring
- b** - Thrust Ring
- c** - Load Ring



**IMPORTANT:** Bearing carrier and threads on retainer must be lubricated to prevent corrosion and cracking in gear housing. Use Quicksilver Special Lubricant 101 on retainer threads; coat outside diameter on carrier mating surfaces with perfect seal.

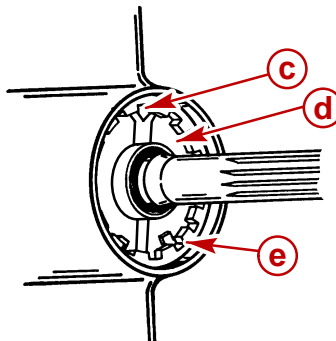
25. Lubricate bearing carrier seals and fill space between seals with Quicksilver 2-4-C Marine Lubricant with Teflon. Coat carrier mating surfaces with Perfect Seal.



22111

- a** - Space Between Seals  
**b** - Mating Surfaces

26. Install bearing carrier and tab washer in gear housing. Align inner tab of tab washer with V-notch in bearing retainer and outer tab with hole in gear housing.
27. Lubricate threads on bearing carrier retaining nut with Quicksilver Special Lubricant 101. Install and tighten bearing carrier retainer nut until resistance to propeller shaft rotation can be felt (to preload bearings).



- c** - Tab Washer – V-Notch In Recess In Carrier  
**d** - Bearing Carrier  
**e** - Bearing Carrier Retainer Nut

28. To determine overall gear case preload, add propeller shaft bearing preload (previously recorded) to drive shaft bearing preload as outlined in the example below.

**IMPORTANT: The overall preload includes both the drive shaft preload and the gear case preload.**

Preloads	
New Propeller Shaft Bearings	8-12 lb-in. (.9-1.4 Nm) <sup>2</sup>
Used Propeller Shaft Bearings <sup>1</sup>	5-8 lb-in. (.6-.9 Nm) <sup>2</sup>
Drive Shaft Bearings	3-5 lb-in. (.3-.5 Nm)

<sup>1</sup> Bearing is considered used if spun under load even once ("under load" meaning: with power applied).

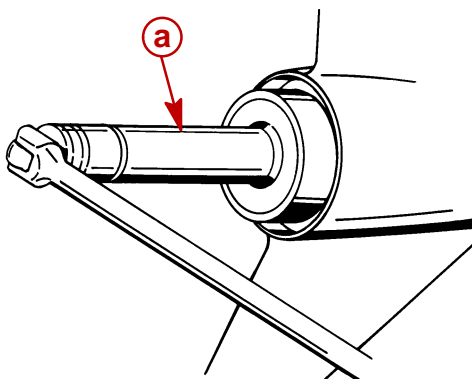
<sup>2</sup> Plus drive shaft preload of 3-5 lb-in. (.3-.6 Nm)

**Example:**

..... Drive Shaft Preload	3 lb-in. (.3 Nm)
	+
..... New Bearing Preload	<u>8 lb-in. (.9 Nm)</u>
	11 lb-in. (1.2 Nm)

29. Tighten the retainer to the proper preload using the following procedure.

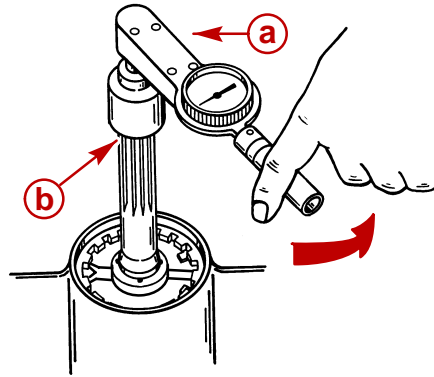
- a. Tighten retainer nut in small increments using retainer wrench.



22112

**a** - Bearing Carrier Retainer Wrench (91-61069T)

- b. Using a lb-in. torque wrench, check overall gear housing bearing preload by rotating propeller shaft in direction of normal rotation with a slow steady motion.

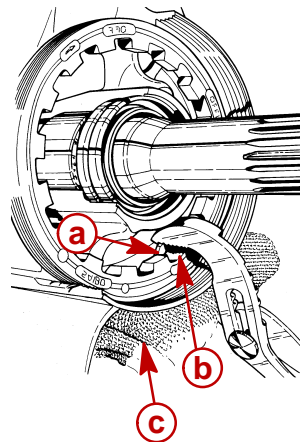


75924

- a** - Torque Wrench  
**b** - Propeller Nut (Under Socket)

- c. Continue tightening bearing carrier retainer nut and checking preload until specified bearing preload is attained.

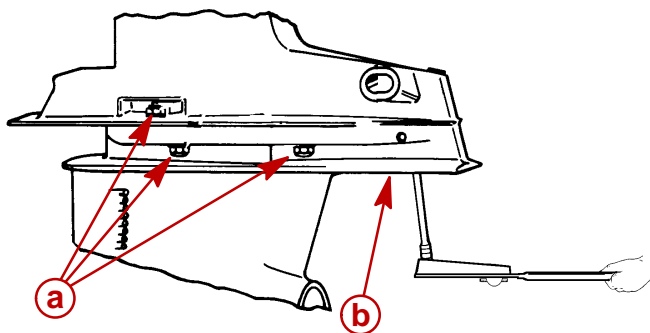
30. Bend one tab of tab washer into retaining nut as shown after propeller shaft preload has been set correctly. Bend remaining tabs down into gear housing. Cushion housing to avoid chipping or scratching paint.



19831

- a** - Tab Washer Tab  
**b** - Groove In Retainer  
**c** - Cushioning

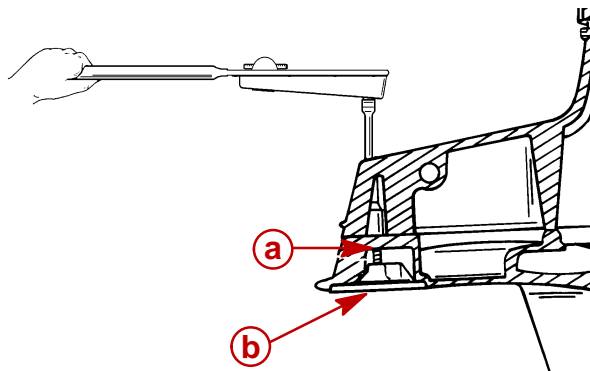
31. Install gear housing to drive shaft housing. Torque fasteners to 35 lb-ft (47 Nm).



76879

- a** - Nuts And Washers (3 Each Side)
- b** - Bolt (Located In Anodic Plate Cavity)

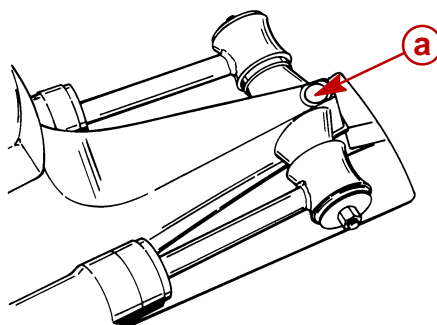
32. Install anodic plate. Torque bolt to 20 lb-ft (27 Nm).



76880

- a** - Bolt
- b** - Anodic Plate

33. Install rubber plug.



22093

- a** - Rubber Plug

34. Reinstall sterndrive unit. Refer to SECTION 2A - *Removal, Installation and Adjustments*.

35. Fill sterndrive unit with Gear Lube. Refer to SECTION 1B - *Maintenance*.

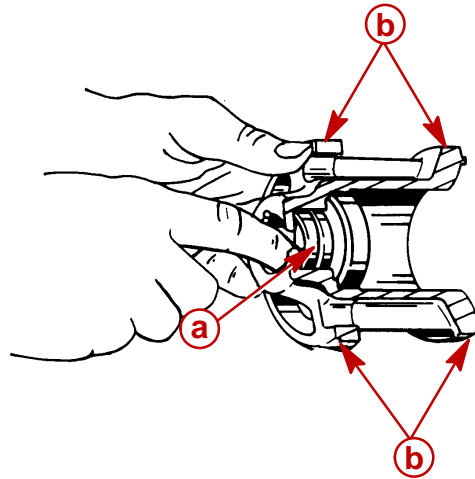
# Bravo XZ and XR Heavy Duty Propeller Shaft

## Gear Housing Disassembly/Reassembly

For disassembly and reassembly of Bravo XZ and XR gear housings refer to instructions for standard Bravo One gear housing. Procedures and specifications are identical except for installation of bearing carrier, bearing carrier retainer nut and propeller hub.

## Installing Bearing Carrier

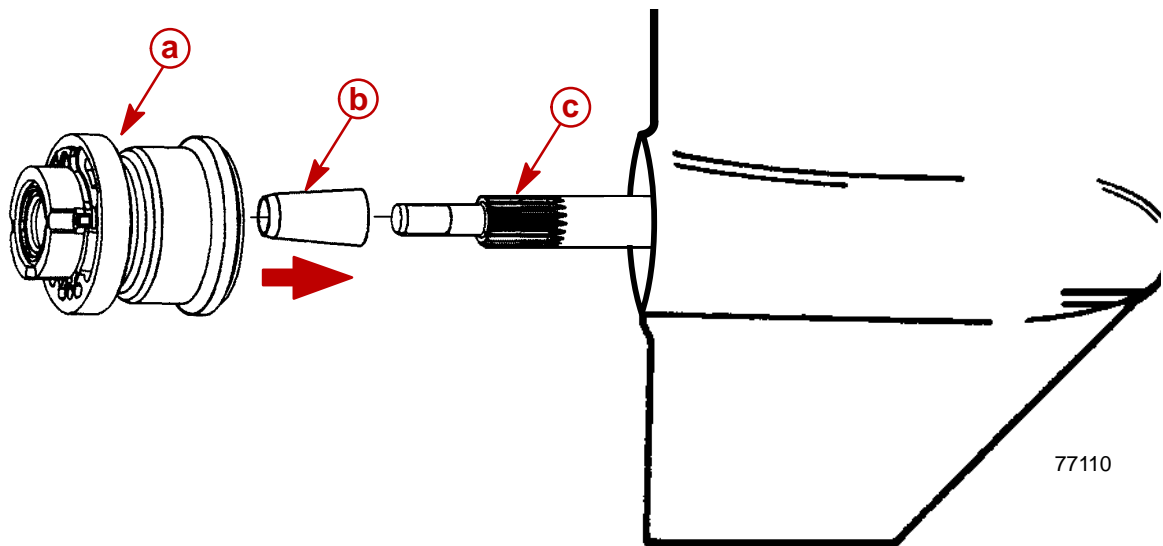
1. Lubricate bearing carrier seals. Fill space between seals with 2-4-C Marine Lubricant with Teflon and coat carrier mating surfaces with Perfect Seal. Lubricating bearing carrier and threads on retainer will help prevent corrosion and cracking in gear housing.



- a** - Space Between Seals  
**b** - Mating Surfaces

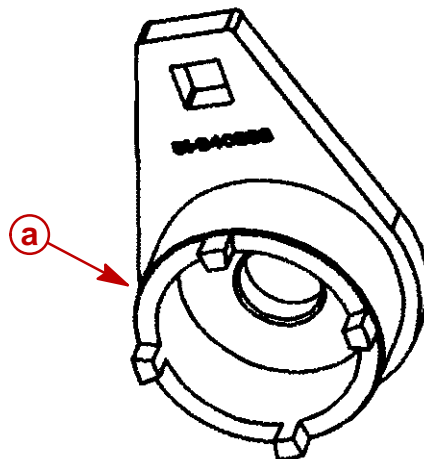
22111

2. Position bearing carrier installation tool onto prop shaft as shown below.
3. Slide bearing carrier over installer tool and insert tab washer in gear housing. Position inner tab in V-notch.



- a** - Bearing Carrier Assembly
- b** - Bearing Carrier Installation Tool (91-840388)
- c** - Heavy Duty Prop Shaft

4. Use bearing carrier retainer nut wrench to tighten bearing carrier retainer nut.

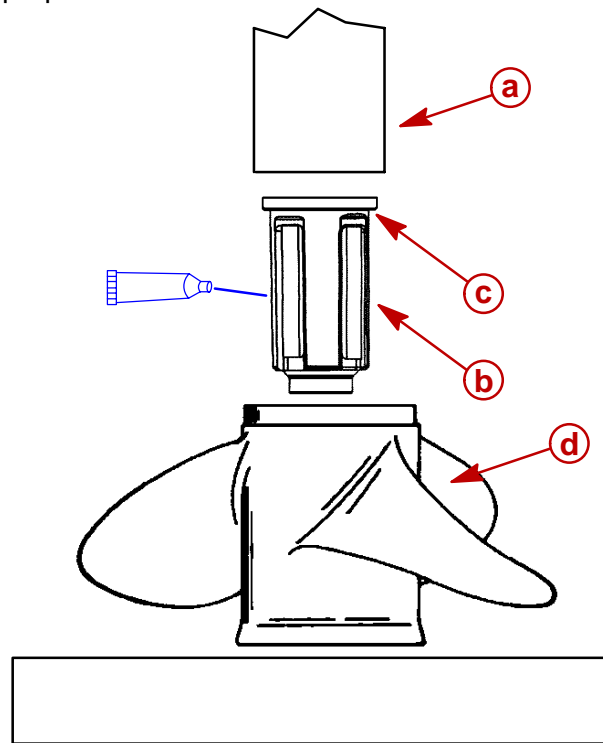


- a** - Bearing Carrier Retainer Nut Wrench (91-840393)

## Installing Propeller Hub Assembly

**NOTE:** Propeller Hub Assembly P/N 840389A1 will fit both long A45, A55 and short A46, A56 bore hub propellers.

1. Apply a small amount of Special Lubricant 101 or 2-4-C Marine Lubricant with Teflon to propeller hub assembly.
2. Use an arbor press (preferred) or suitable tool such as a rubber or plastic hammer to install propeller hub assembly.
3. Install propeller hub assembly into propeller until propeller hub shoulder is touching top edge of propeller bore.



- a** - Arbor Press
- b** - Propeller Hub Assembly
- c** - Propeller Hub Shoulder
- d** - Propeller

77111

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# STERNDRIVE UNIT

## Section 3C - Bravo Two Gear Housing

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# Specifications

## Torque Specifications

Fastener Location	lb-in.	lb-ft	Nm
Drive Shaft Pinion Nut		100	136
Drive Shaft Housing to Gear Housing Nuts and Bolt		35	48
Anodic Plate Screw		20	27
Oil Fill/Drain Plug	40		4.5
Propeller Nut		60	82

## Bearing Preloads

Description	lb-in.	Nm
Drive Shaft Bearings	3-5	0.3-0.6
Propeller Shaft Bearings - Checked at Propeller Shaft (New Bearings)	8-12 <sup>1</sup>	0.9-1.4 <sup>1</sup>
Propeller Shaft Bearings - Checked at Propeller Shaft (Used Bearings) <sup>2</sup>	5-8 <sup>1</sup>	0.6-0.9 <sup>1</sup>

<sup>1</sup> DOES NOT include 3 to 5 lb-in. (0.3-0.6 Nm) on drive shaft.

<sup>2</sup> A bearing is used if spun once under load.

## Gear Ratio - Teeth per Gear (Gear Housing)

Ratio	Drive	Driven
2.20:1	16	27
2.00:1	16	27
1.81:1	16	27
1.65:1	18	25
1.50:1	18	25

## Lubricants / Sealants / Adhesives

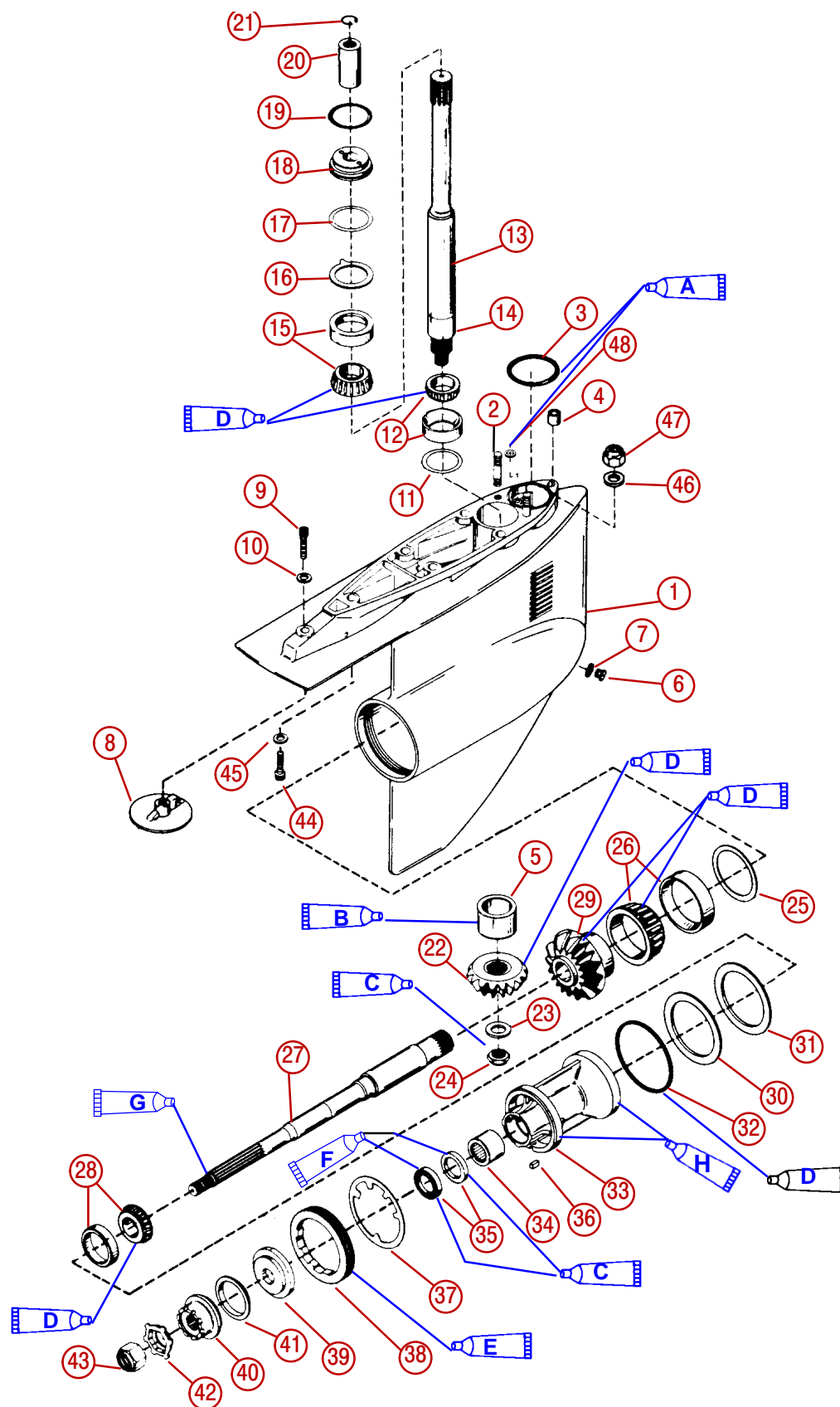
Description	Part Number
Quicksilver High-Performance Gear Lube	92-850743A1
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Perfect Seal	92-34227--1
3-M Adhesive	92-86166Q1
Loctite Type 271	92-809820
Quicksilver Engine Coupler Spline Grease	92-816391A4

# Tools

Description	Part Number
Universal Puller Plate	91-37241
Bearing / Seal Driver	91-813653
Bearing Driver	91-89867T
Threaded Rod	91-31229
Bearing Cup Driver	91-67443T
Driver Rod	91-37323
Bearing Removal Tool	91-63638T
Drive Shaft Adaptor Tool	91-56775T
Bearing Driver	91-55919
Bearing Cup Driver	91-63626
Bearing Driver	91-55918
Oil Seal Driver	91-55916
Bearing Driver	91-68891T
Seal / Bearing Driver	91-63619T
Retainer Wrench	91-17257









# Bravo Two Gear Housing Exploded View

## Drive Shaft and Propeller Shaft Components



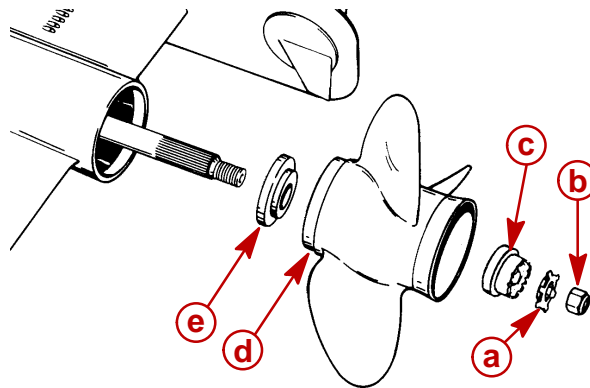
75971

- |                                    |                                      |
|------------------------------------|--------------------------------------|
| <b>1</b> - Gear Housing            | <b>25</b> - Shim Assembly            |
| <b>2</b> - Stud                    | <b>26</b> - Tapered Roller Bearing   |
| <b>3</b> - O-Ring                  | <b>27</b> - Propeller Shaft          |
| <b>4</b> - Seal                    | <b>28</b> - Tapered Roller Bearing   |
| <b>5</b> - Roller Bearing          | <b>29</b> - Drive Gear               |
| <b>6</b> - Fill/Drain Screw        | <b>30</b> - Thrust Ring              |
| <b>7</b> - O-Ring                  | <b>31</b> - Load Ring                |
| <b>8</b> - Anodic Plate            | <b>32</b> - O-Ring                   |
| <b>9</b> - Screw                   | <b>33</b> - Bearing Carrier          |
| <b>10</b> - Washer                 | <b>34</b> - Roller Bearing           |
| <b>11</b> - Shim                   | <b>35</b> - Oil Seal                 |
| <b>12</b> - Tapered Roller Bearing | <b>36</b> - Locating Key             |
| <b>13</b> - Drive Shaft            | <b>37</b> - Tab Washer               |
| <b>14</b> - Bearing Race           | <b>38</b> - Bearing Carrier Retainer |
| <b>15</b> - Tapered Roller Bearing | <b>39</b> - Thrust Hub               |
| <b>16</b> - Tab Washer             | <b>40</b> - Washer Assembly          |
| <b>17</b> - Shim Assembly          | <b>41</b> - Thrust Washer            |
| <b>18</b> - Spacer                 | <b>42</b> - Tab Washer               |
| <b>19</b> - O-Ring                 | <b>43</b> - Propeller Nut            |
| <b>20</b> - Coupling               | <b>44</b> - Screw                    |
| <b>21</b> - Retaining Ring         | <b>45</b> - Lockwasher               |
| <b>22</b> - Pinion Gear            | <b>46</b> - Washer                   |
| <b>23</b> - Washer                 | <b>47</b> - Nut                      |
| <b>24</b> - Nut                    | <b>48</b> - Quad Ring                |

-  **A** - 3M Brand Adhesive
-  **B** - Quicksilver Needle Bearing Assembly Lubricant
-  **C** - Loctite 271
-  **D** - Quicksilver High Performance Gear Lube (Use on All Bearing Surfaces)
-  **E** - Quicksilver Special Lubricant 101
-  **F** - Quicksilver 2-4-C Marine Lubricant with Teflon
-  **G** - Quicksilver Engine Coupler Spline Grease
-  **H** - Perfect Seal

# Pre-Disassembly Inspection

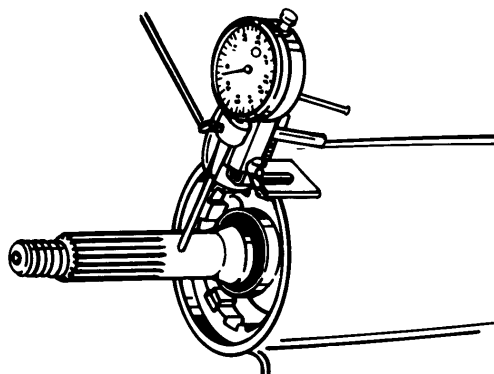
1. Bend tabs straight on tab washer. Remove nut, washer, spline washer, propeller and thrust hub.



22074

- a** - Tab Washer
- b** - Nut
- c** - Spline Washer
- d** - Propeller
- e** - Thrust Hub

2. Check propeller shaft for side to side movement, as follows:
  - a. Position dial indicator on propeller shaft.
  - b. Push propeller shaft to one side and zero the dial indicator.
  - c. Move propeller shaft to opposite side while observing dial indicator. Without rotating propeller shaft, reposition dial indicator and check up and down deflection. A shaft deflection of more than .003 in. (0.08 mm) indicates one of the following:
    - (1.) Worn propeller shaft bearings.
    - (2.) Improper propeller shaft preload.

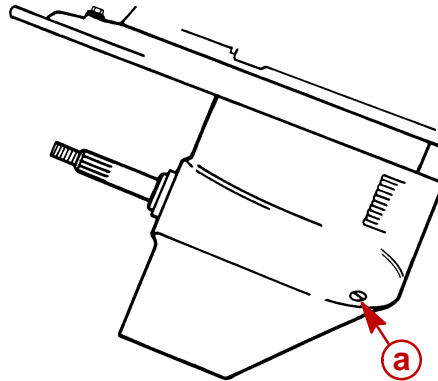


76904

3. Check for a bent propeller shaft, as follows:
  - a. Rotate propeller shaft while observing dial indicator. If deflection is more than .007 in. (.178 mm), a bent propeller shaft is indicated.

## Drive Shaft Housing and Gear Housing Separation

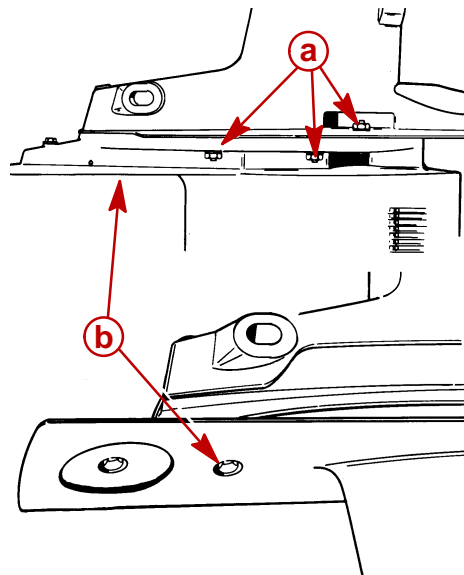
1. Remove, empty and clean gear lube monitor.
2. Tilt drive unit to a 45° angle. Remove fill/drain screw and drive shaft housing vent screw. Allow drive unit to drain completely.



76801

**a** - Fill/Drain Screw

3. Remove gear housing from drive shaft housing.



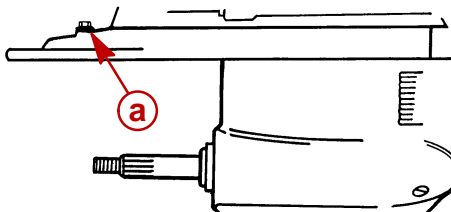
**a** - Nuts And Washers (6)

**b** - Bolt (1)

4. Finish draining gear case by turning upside down over a container.

# Gear Housing Disassembly

1. Remove bolt and anodic plate.



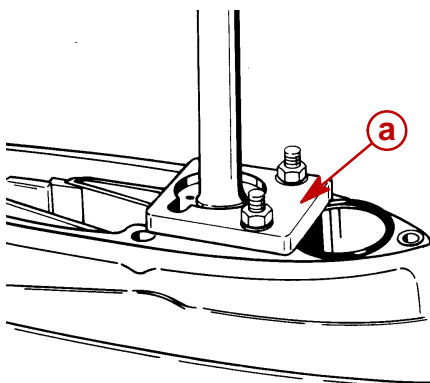
76801

**a** - Bolt

## ⚠ CAUTION

Clamp plate (91-43559) must be installed on gear housing when gear housing is separated from drive shaft housing.

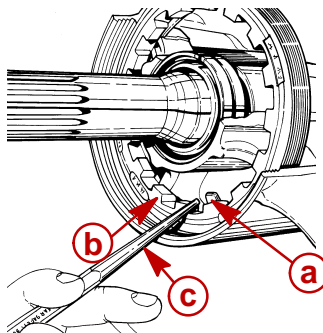
2. Install clamp plate, nuts and 4 washers on gear housing. Tighten securely.



22439

**a** - Clamp Plate (91-43559)

3. Bend tabs of tab washer away from bearing carrier retainer nut.

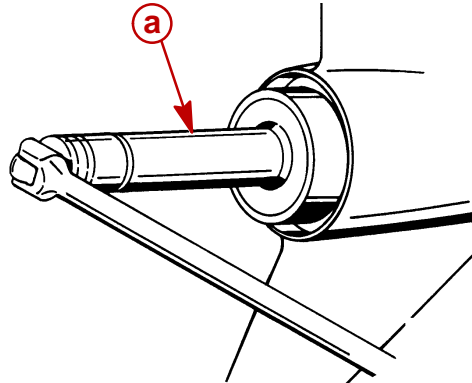


19830

**a** - Tab Washer  
**b** - Bearing Carrier Retainer Nut  
**c** - Punch



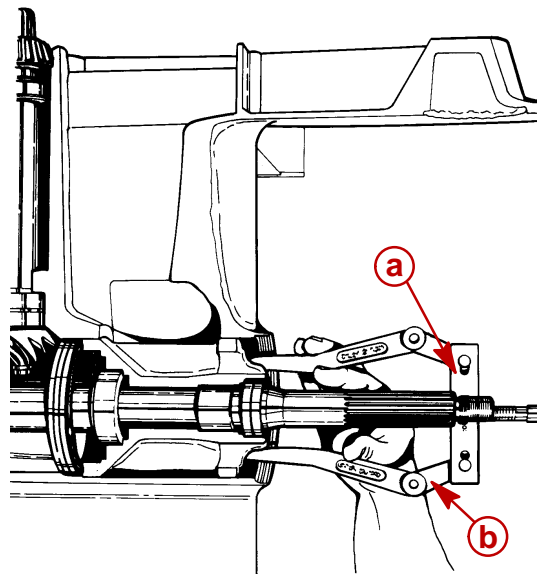
4. Remove bearing carrier retainer nut using bearing carrier retainer wrench (P/N 91-17257).



**a** - Bearing Carrier Retainer Wrench

22112

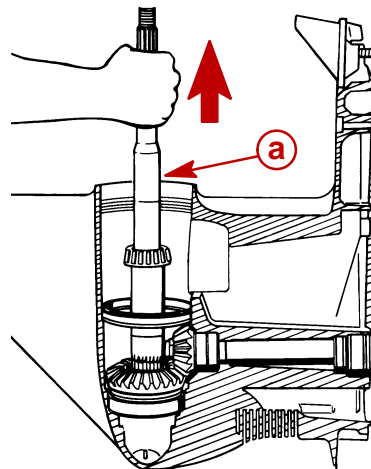
5. Remove bearing carrier using slide hammer puller.



**a** - Slide Hammer Puller, 91-34569A1  
**b** - Puller Jaws, 91-46086A1

19842

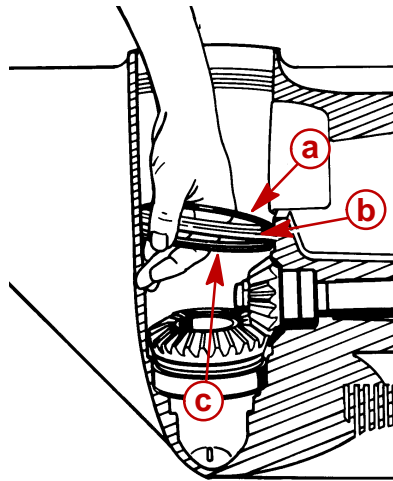
6. Remove propeller shaft assembly.



**a** - Lift Propeller Shaft From Gear Housing

24211

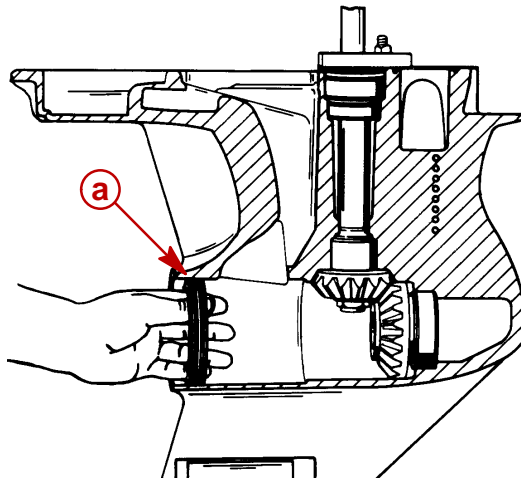
7. Remove items shown.



24211

- a** - O-Ring
- b** - Thrust Ring
- c** - Load Ring

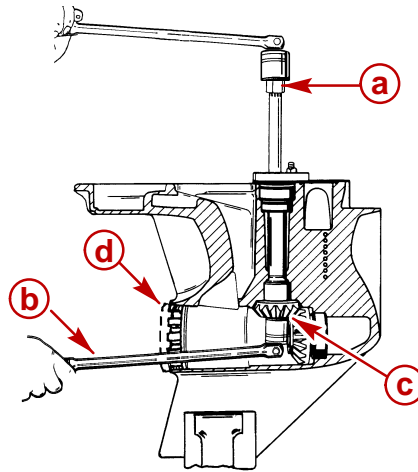
8. Temporarily reinstall retainer nut in gear housing to protect housing threads.



22217

- a** - Retainer Nut

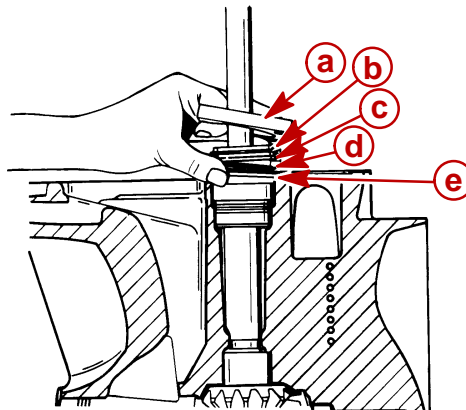
9. Remove pinion gear nut and washer. Hold drive shaft using drive shaft adaptor tool.



75921

- a** - Drive Shaft Adaptor Tool (91-61077T)
- b** - Breaker Bar And Socket
- c** - Pinion Gear
- d** - Bearing Carrier Retainer

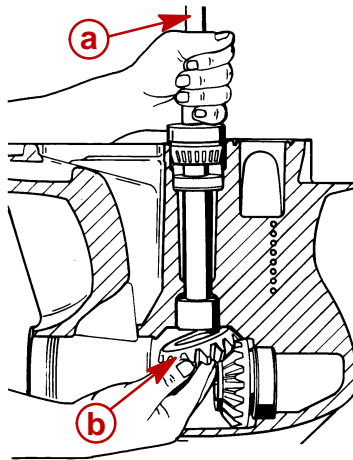
10. Remove clamp plate (installed in Step 2), then remove O-ring, spacer, shim(s) and tab washer. Retain shims for reassembly.



22262

- a** - Drive Shaft
- b** - Pinion Gear
- c** - Spacer
- d** - Shim(s)
- e** - Tab Washer

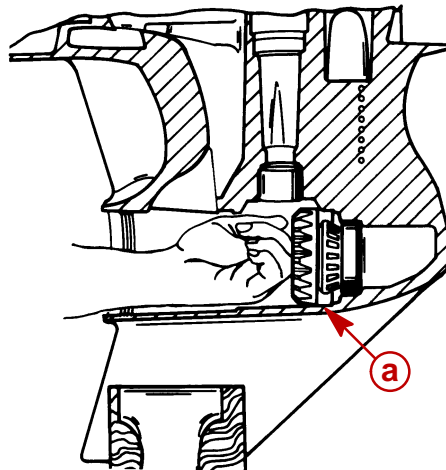
11. Remove drive shaft and pinion gear.



76871

**a** - Drive Shaft  
**b** - Pinion Gear

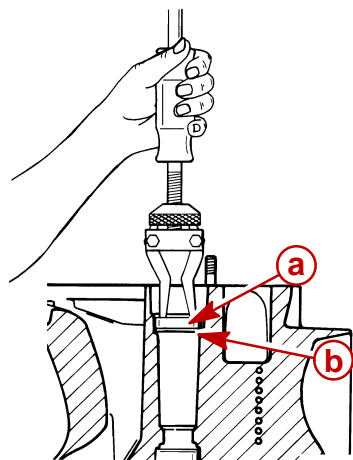
12. Remove driven gear and bearing.



22283

**a** - Driven Gear And Bearing

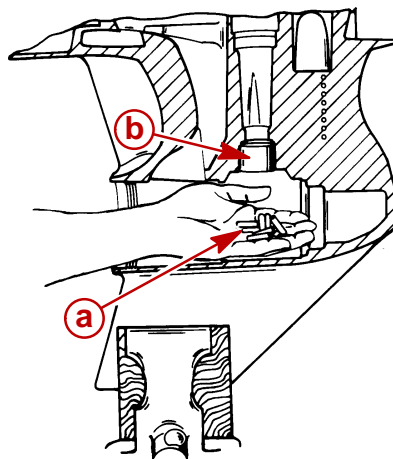
13. Remove drive shaft bearing cup and shims. Retain shims for reassembly.



22261

**a** - Drive Shaft Bearing Cup  
**b** - Shims

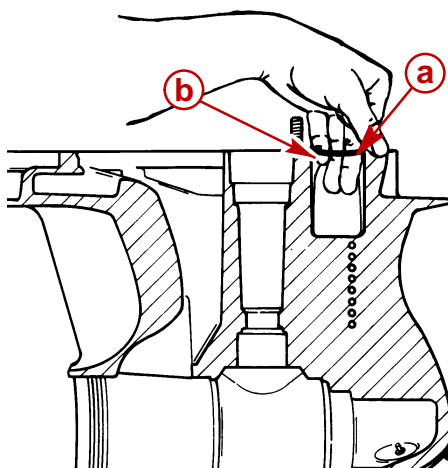
14. Unless you plan to remove the pinion bearing, remove needle bearings from drive shaft needle bearing race. (See Pinion Bearing Removal)



22083

- a** - Needle Bearings  
**b** - Drive Shaft Needle Bearing Race

15. Remove water passage O-ring and oil passage quad ring.



22222

- a** - Remote Water Passage O-Ring  
**b** - Oil Passage Quad Ring

# Drive Shaft and Pinion Bearing

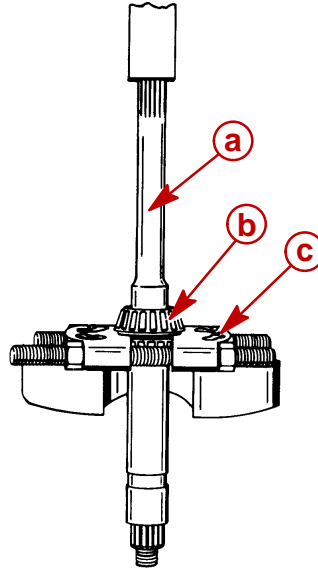
## Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replace drive shaft if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

## Drive Shaft Disassembly

**NOTE:** Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removing.

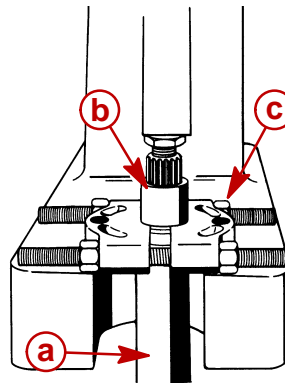
1. Press tapered roller bearing from shaft using universal puller plate to support bearing on bearing inner race. Remove second tapered roller bearing in same manner.



22109

- a** - Drive Shaft
- b** - Bearing
- c** - Universal Puller Plate (91-37241)

2. Press drive shaft pinion bearing inner race from drive shaft, using universal puller plate.



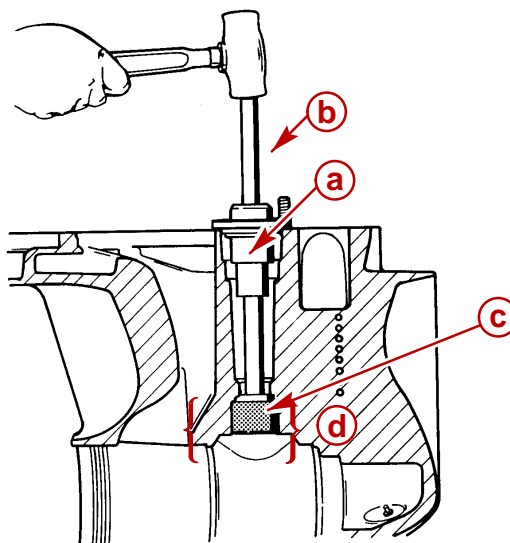
24210

- a** - Drive Shaft
- b** - Pinion Bearing Inner Race
- c** - Universal Puller Plate (P/N 91-37241)

## Pinion Bearing Removal

**IMPORTANT:** All needle bearings **MUST BE** in place inside bearing casing while driving pinion bearing from gear case or bearing casing will bend or break and become difficult to remove.

1. Heat area around bearing remover to approximately 200° F (93.3°C) to ease removal. Do not use open flame. Remove pinion bearing using bearing remover and driver rod. Use bearing driver as a pilot.



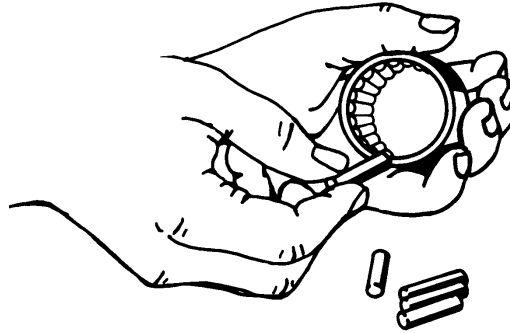
75902

- a** - Bearing Driver (91-813653)
- b** - Driver Rod (91-37323)
- c** - Bearing Remover (91-63638)
- d** - Area Around Pinion Bearing



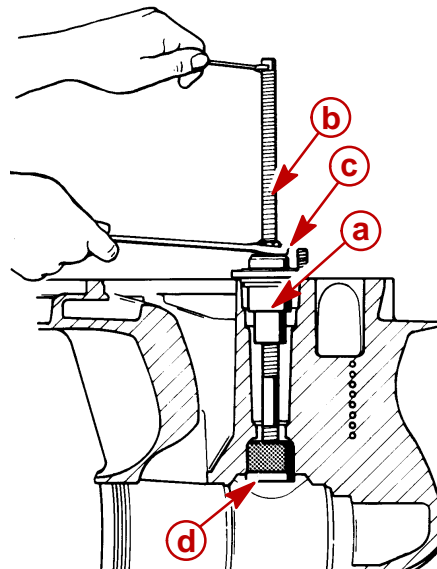
## Pinion Bearing Installation

1. Install needles in casing. Use Needle Bearing Assembly Lubricant to help keep needles in place. Position bearing assembly over bearing installation tool with number on bearing casing facing up. Coat casing outside diameter with gear lube.



22219

2. Install pinion bearing using tools as shown. Use the bearing driver as a pilot.

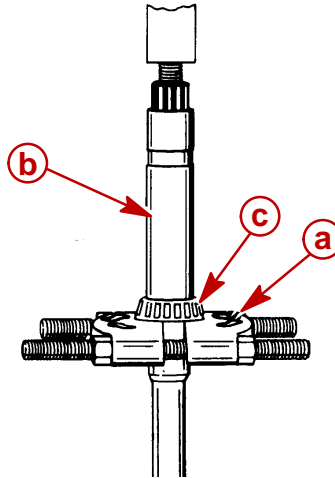


22222

- a** - Bearing Driver (91-813653)
- b** - Puller Shaft (91-31229)
- c** - Washer And Nut
- d** - Driver (91-89867T)

## Drive Shaft Reassembly

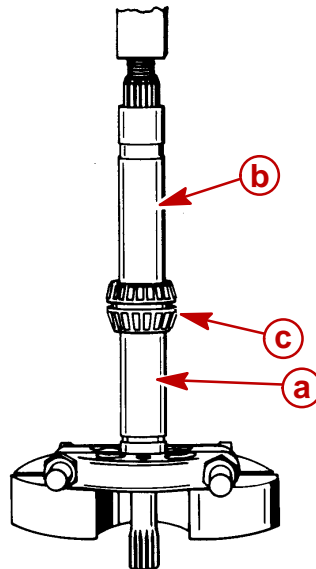
1. Lubricate inside diameter of tapered roller bearing with gear lube. Press small tapered roller bearing onto drive shaft using universal puller plate. Ensure that smaller outside diameter faces pinion end of shaft.



22109

- a** - Universal Puller Plate
- b** - Drive Shaft
- c** - Small Tapered Roller Bearing

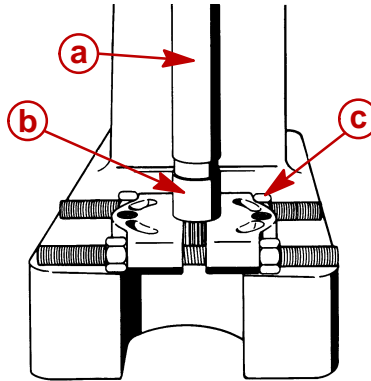
2. Lubricate inside diameter of tapered roller bearing with gear lube. Press large tapered roller bearing onto drive shaft using suitable mandrel or old bearing race. Ensure that larger outside diameter faces pinion end of shaft.



22109

- a** - Suitable Mandrel (On Inner Race Of Bearing)
- b** - Drive Shaft
- c** - Large Tapered Roller Bearing

3. Press drive shaft pinion bearing inner-race onto drive shaft until race is fully seated, using universal puller plate.



24210

- a** - Drive Shaft
- b** - Pinion Bearing Inner-Race
- c** - Universal Puller Plate (91-37241)

## Bearing Carrier

### Inspection

1. The condition of the propeller shaft tapered roller bearing cup is an indication of the condition of tapered roller bearing on propeller shaft. Replace bearing and cup if cup is pitted, grooved, scored, worn, uneven, discolored from overheating or has embedded metal particles.
2. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.

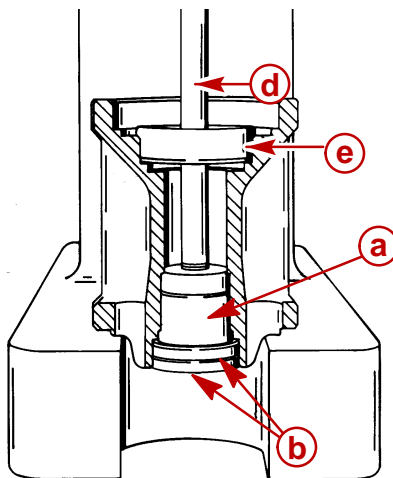
## Disassembly

1. Perform Method "a or b," following:

a. **Method A** – If Replacing Propeller Shaft Needle Bearing

(1.) Press needle bearing and oil seals from carrier.

**NOTE:** Needle bearing *MUST BE* replaced, if removed.

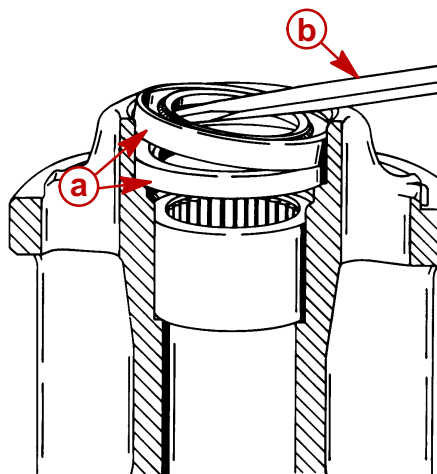


50023

- a - Needle Bearing
- b - Oil Seals (2)
- c - Driver - 91-55919
- d - Driver Rod
- e - Bearing Cup

b. **Method B** – If Propeller Shaft Needle Bearing Replacement is NOT Required

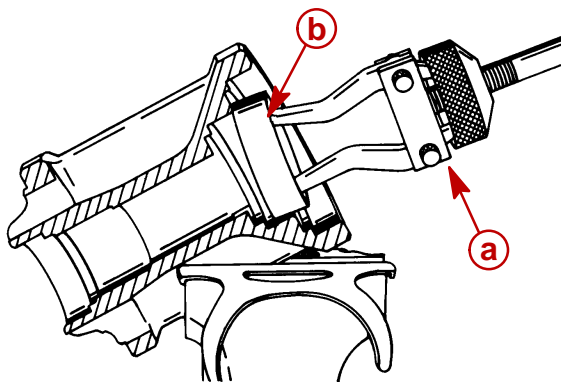
(1.) Pry oil seals from carrier.



50024

- a - Oil Seals (2)
- b - Pry Bar Or Screwdriver

2. Remove bearing cup using slide hammer puller (P/N 91-34569A1).

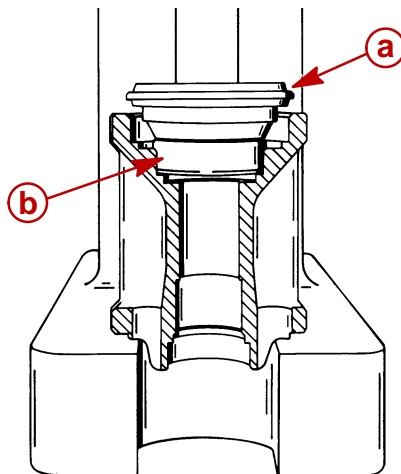


50025

- a** - Slide Hammer Puller  
**b** - Bearing Cup

## Reassembly

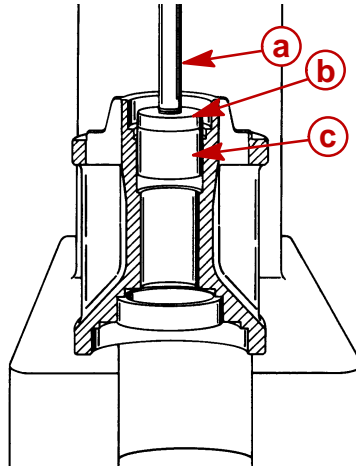
1. Install bearing cup using cup and seal driver.



50023

- a** - Cup and Seal Driver - 91-63626  
**b** - Bearing Cup

2. Install needle bearing using bearing driver and driver rod.

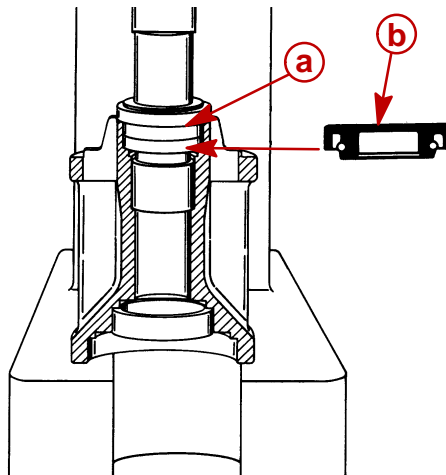


50025

- a** - Driver Rod - \*91-37323
- b** - Driver - 91-55918
- c** - Needle Bearing

\* Contained in Bearing Removal and Installation Tool Kit, 91-31229A7.

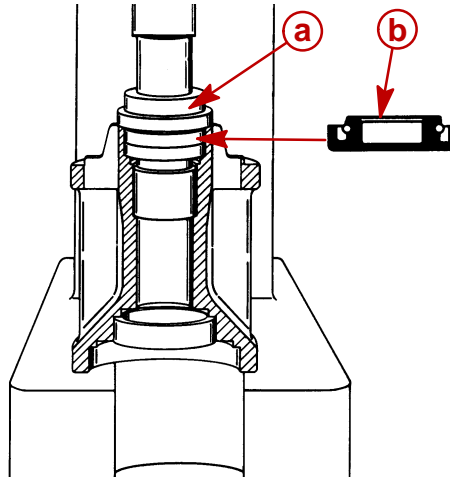
3. Coat outside diameter of oil seal with Loctite 271. Install inner oil seal with lip facing inward using cup and seal driver (P/N 91-55916).



50024

- a** - Cup And Seal Driver
- b** - Inner Oil Seal

4. Coat outside diameter of oil seal with Loctite 271. Install outer oil seal with lip facing outward using cup and seal driver (P/N 91-55916).



- a** - Cup And Seal Driver  
**b** - Outer Oil Seal

50025

5. Fill area between seals with Quicksilver 2-4-C Marine Lubricant with Teflon.

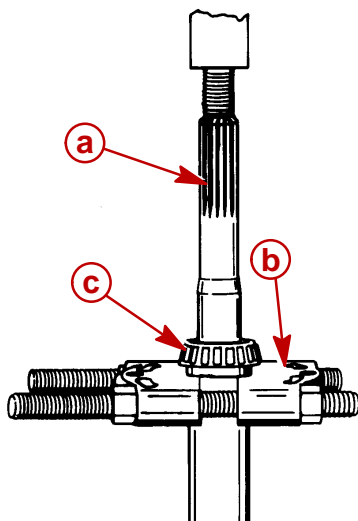
## Propeller Shaft

### Inspection

1. Check propeller shaft for bent condition. Use either method "a or b" following:
  - a. **Lathe And Dial Indicator Method:**
    - (1.) Position propeller shaft centers in lathe.
    - (2.) Mount dial indicator at front edge of propeller shaft.
    - (3.) Rotate shaft and observe dial indicator. Movement of more than .007 in. (.179 mm) is reason for replacement.
  - b. **V-blocks And Dial Indicator Method:**
    - (1.) Position propeller shaft bearing surfaces on V-blocks.
    - (2.) Mount a dial indicator at front edge of propeller shaft.
    - (3.) Rotate shaft and observe dial indicator. Movement of more than .007 in. (.179 mm) is reason for replacement.
2. Inspect for bent or twisted splines.
3. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Oil seals will have to be replaced if any grooves are found.

## Propeller Shaft Bearing Removal

1. Press bearing from shaft using universal puller plate.

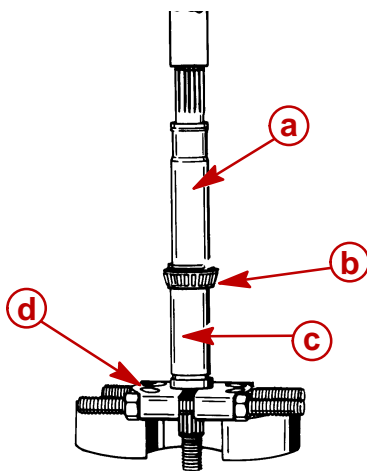


22110

- a** - Propeller Shaft
- b** - Universal Puller Plate
- c** - Tapered Roller Bearing

## Propeller Shaft Bearing Installation

1. Apply Gear Lube to inside diameter of new bearing. Install bearing to shaft using universal puller plate and a suitable mandrel (old bearing race) which supports bearing on inner race. Press into place.



22110

- a** - Propeller Shaft
- b** - Tapered Roller Bearing
- c** - Suitable Mandrel
- d** - Universal Puller Plate



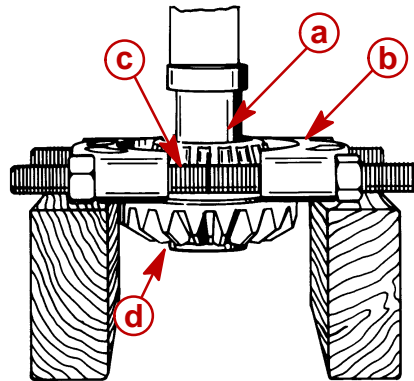
# Driven Gear Bearing

## Inspection

1. Remove bearing from driven gear. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. Replace both gears if any of these conditions exist.
2. Replace tapered roller bearing and cup if cup is pitted, grooved, scoured, worn uneven, discolored from overheating or has metal particles embedded in the cup.

## Driven Gear Bearing Removal

1. Remove bearing from driven gear using universal puller plate. Inspect both the driven gear and the pinion gear for pitting, chipped or broken teeth and excessive or uneven wear. Replace both gears if any of these conditions exist.

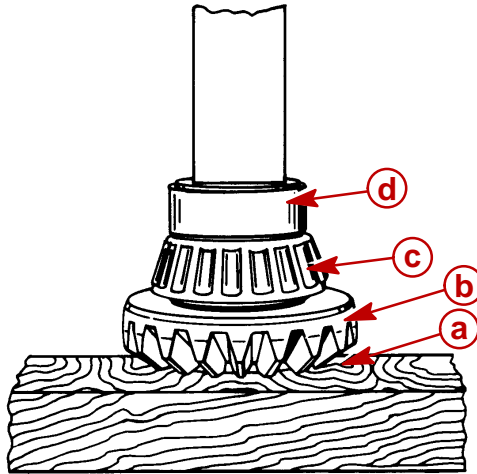


- a** - Suitable Mandrel
- b** - Universal Puller Plate
- c** - Bearing
- d** - Driven Gear

22108

## Driven Gear Bearing Installation

1. Apply Gear Lube to inside diameter of new bearing. Place a suitable mandrel (old bearing race) against new bearing race. Place another mandrel on face of gear and press gear and bearing together.

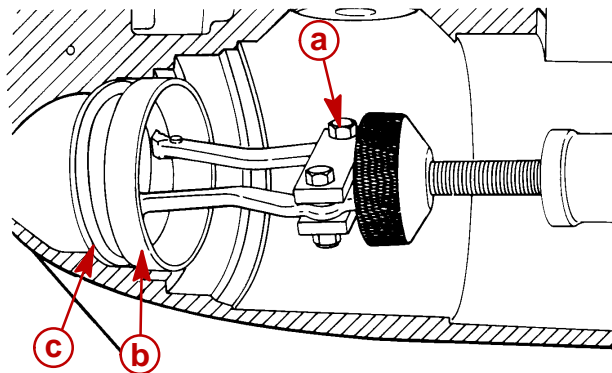


22108

- a** - Hard Wood Or Metal Block
- b** - Driven Gear
- c** - Tapered Roller Bearing
- d** - Mandrel – Contacting Inner Race

## Driven Gear Bearing Cup Removal and Inspection

1. Remove bearing cup and shims using slide hammer puller. Replace tapered roller bearing and cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating or has metal particles embedded in the cup.

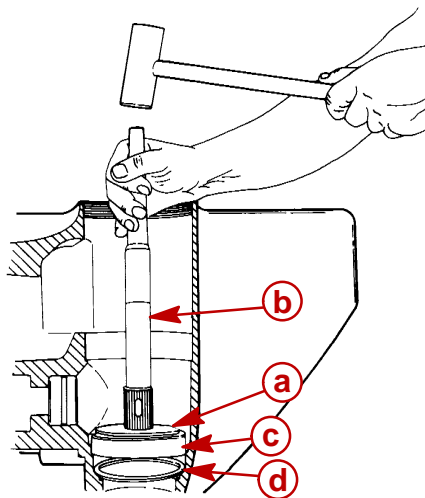


19808

- a** - Slide Hammer Puller, 91-34569A1
- b** - Bearing Cup
- c** - Shims

## Driven Gear Bearing Cup Installation

1. Install driven gear bearing cup with original thickness shim(s) using bearing driver. Ensure that cup is not canted. Coat cup outside diameter with gear lube.



19917

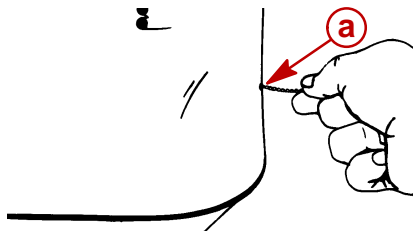
- a** - Driver - 91-63626
- b** - Old MC-I Propeller Shaft
- c** - Bearing Cup
- d** - Shim(s)

**NOTE:** If a MC-I propeller shaft is not available, use Driver Rod 91-37323 (from Bearing Removal and Installation Kit, 91-31229A7).

## Speedometer Water Passage

### Pickup Inspection and Cleaning

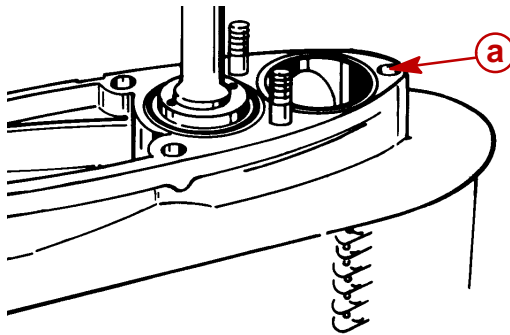
1. Inspect pitot tube on leading edge of gear housing for obstruction. Clean opening with a short piece of wire. If obstruction can not be removed with wire, carefully re-open tube using a 5/64 in. (2 mm) diameter drill bit. Do not drill beyond a depth of 2-7/16 in. (62 mm).



22462

- a** - Pitot Tube

2. Inspect water passage seal for nicks, cuts or distortion. Replace if necessary.

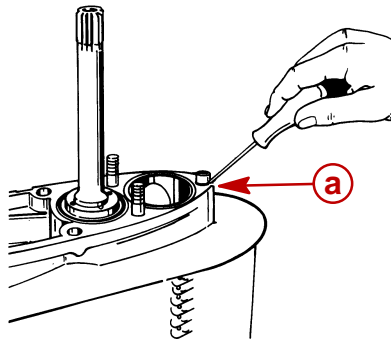


22085

**a** - Speedometer Water Passage Seal

## Water Passage Seal Replacement

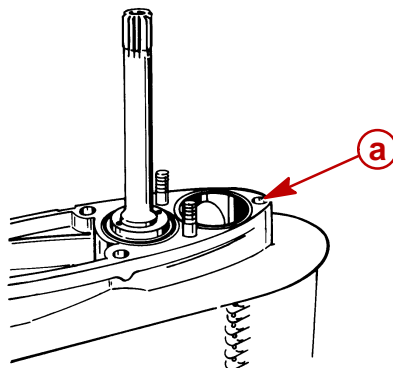
1. Pry rubber seal out with a suitable tool.



22085

**a** - Rubber Seal

2. Lightly coat outside diameter of seal with 3-M adhesive (92-86166Q1) and install in speedometer water passage bore. Ensure that top edge of seal is flush with gear housing surface.

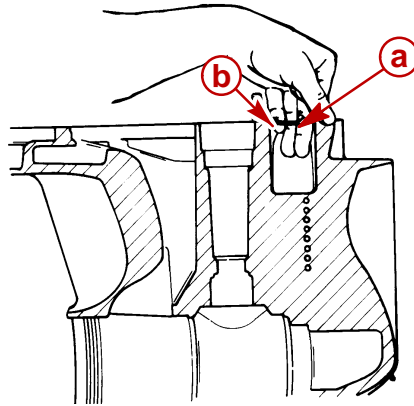


22085

**a** - Seal

## Gear Housing Reassembly and Shimming

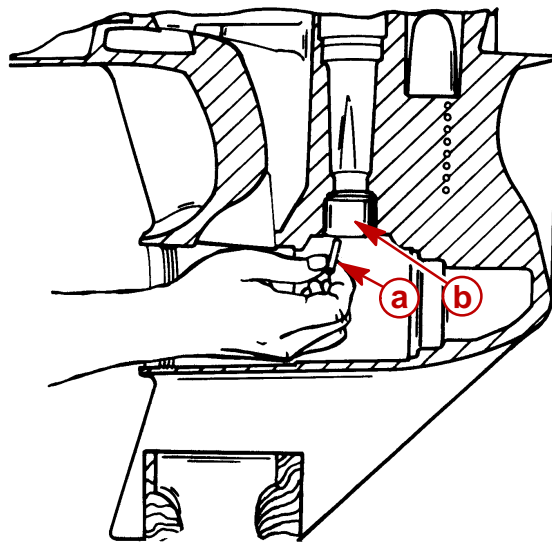
1. Lubricate all gears and bearings with gear lube before installing. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using 3-M Adhesive.



22222

- a** - Water Passage O-Ring  
**b** - Oil Passage Quad Ring

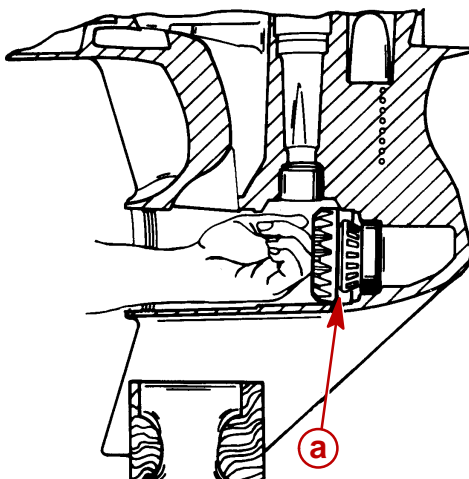
3. Install needle bearings into lower needle bearing casing. Use Quicksilver Needle Bearing Assembly Lubricant to hold needle bearings in place.



22083

- a** - Needle Bearings  
**b** - Needle Bearing Casing

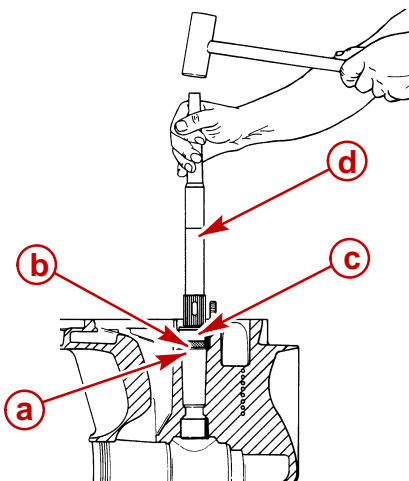
4. Install driven gear assembly.



22083

**a** - Driven Gear Assembly

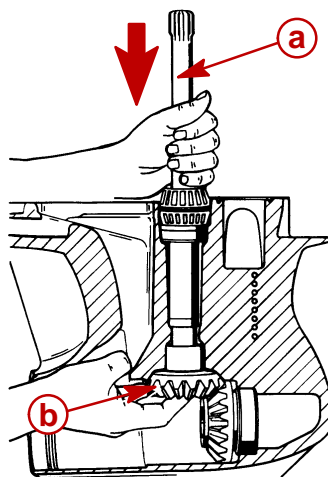
5. Install original thickness shim(s) and drive shaft lower bearing cup using cup driver and old drive shaft. Use original shims or if lost or misplaced, start with .050 in. (1.27 mm).



75903

**a** - Shims  
**b** - Lower Bearing Cup  
**c** - Cup Driver  
**d** - Old Drive Shaft

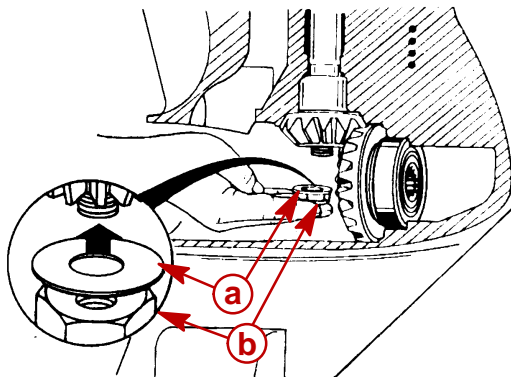
6. Install drive shaft and pinion gear.



22258

- a** - Drive Shaft  
**b** - Pinion Gear

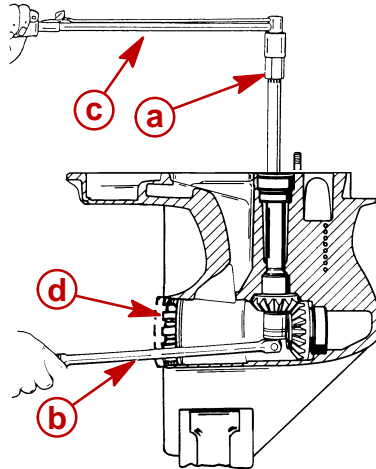
7. Install washer and new pinion nut. Apply Loctite 271 to threads of nut.



71543

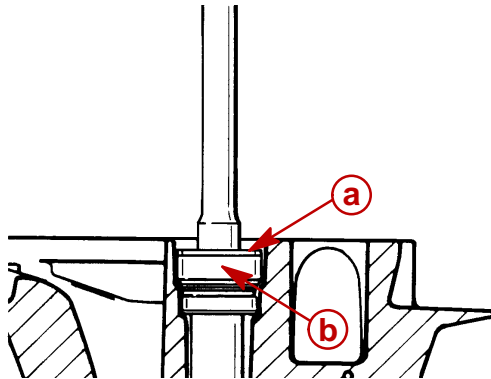
- a** - Washer  
**b** - Pinion Nut

8. Temporarily install bearing carrier retainer nut to avoid damage to threads.
9. Torque pinion nut to 100 lb-ft (136 Nm).



- a** - Drive Shaft Adaptor Tool (91-61077T)
- b** - Breaker Bar And Socket
- c** - Torque Wrench And Socket
- d** - Bearing Carrier Retainer Nut

10. Remove bearing carrier retainer nut previously placed in unit for protection of threads.
11. Install upper bearing cup and tab washer.

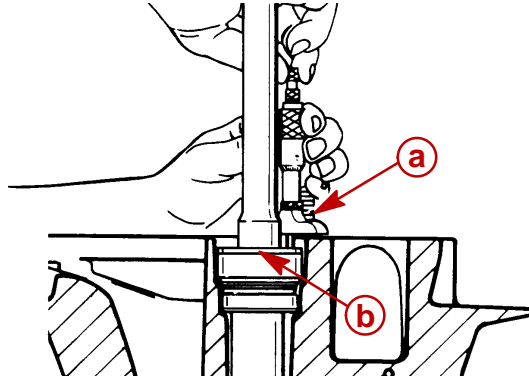


- a** - Tab Washer
- b** - Upper Bearing Cup



12. Determine shim thickness required for drive shaft bearing preload using the following procedure or use original thickness shims.

- a. Measure distance between top of gear housing and tab washer using a 0-1 in. depth micrometer.

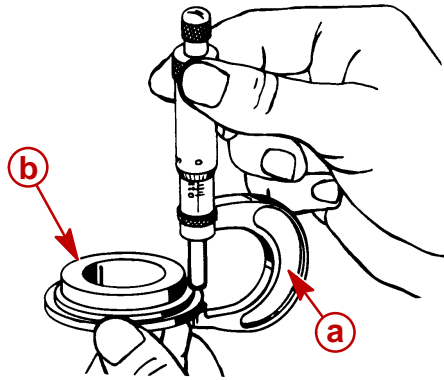


22259

**a** - Depth Micrometer

**b** - Tab Washer

- b. Measure thickness of spacer from top machined surface to bottom machined surface.



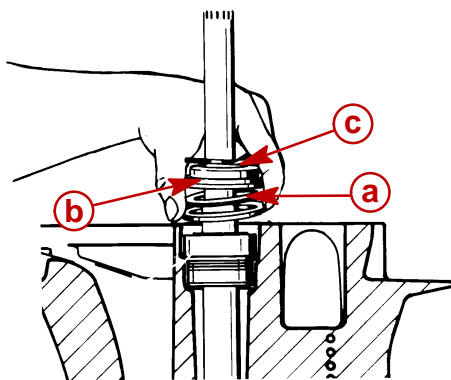
22112

**a** - Outside Micrometer

**b** - Spacer

- c. Calculate shim thickness as shown.  
Measurement from Step a. -minus-  
Measurement from Step b. + .001 in. =  
Shim Thickness Required.

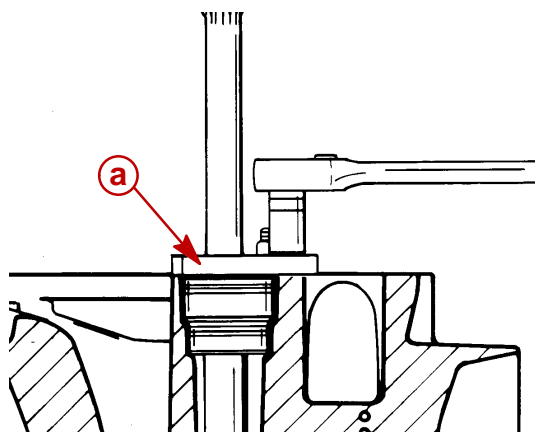
13. Install shims, spacer and O-ring.



22259

- a** - Shims
- b** - Spacer
- c** - O-Ring

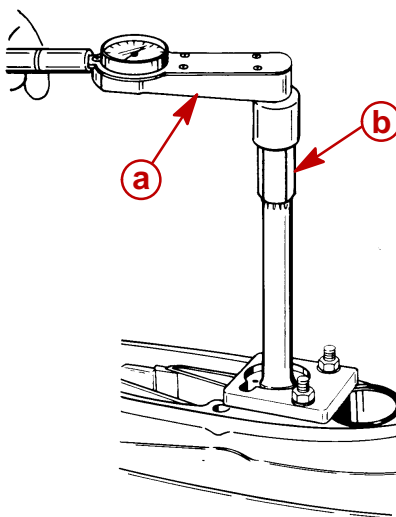
14. Install clamp plate on gear housing with nuts and 4 washers. Torque to 35 lb-ft (47 Nm).



22262

- a** - Clamp Plate (P/N 91-43559T)

15. Using a dial-type lb-in. torque wrench, check the rolling preload by turning drive shaft with a slow steady motion (3-5 lb-in. [0.3-0.6 Nm]).



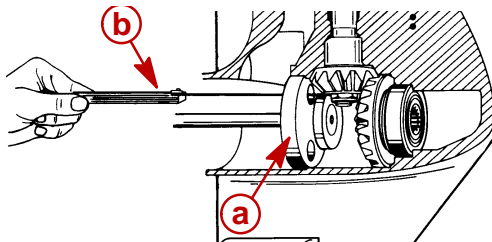
50410

- a** - Torque Wrench
- b** - Drive Shaft Adaptor

16. If preload is incorrect, adjust by adding or subtracting shims from upper tapered roller bearing cup. Reinstall clamp plate and recheck preload (3-5 lb-in. [0.3-0.6 Nm]). Record final preload.

17. **Check pinion height.**

- a. Rotate drive shaft several times to seat bearings. Insert shimming tool into gear housing.
- b. Measure clearance between tool and pinion gear using feeler gauge and shimming tool. Clearance must be .025 in. (.635 mm). Take measurement at 3 locations on pinion gear (120° apart).



50370

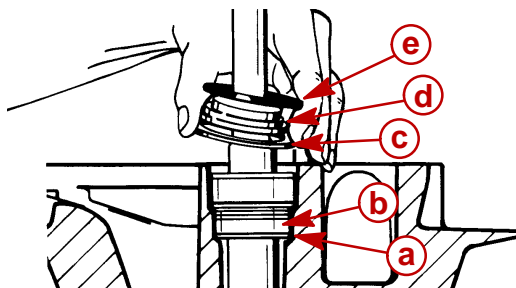
- a** - Shimming Tool (P/N 91-96512)  
**b** - Feeler Gauge

- c. If clearance is less than specified: Add appropriate thickness of shim(s) under lower tapered roller bearing cup.

**Any thickness added here must be subtracted from shim thickness at upper bearing.**

If clearance is more than specified: Remove appropriate thickness of shim(s) from under lower tapered roller bearing cup.

**Any thickness subtracted here must be added to shim thickness at upper bearing.**

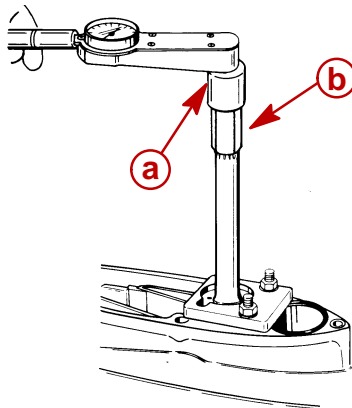


22262

- a** - Shims, Lower  
**b** - Bearing Cup, Lower  
**c** - Shims, Upper  
**d** - Spacer  
**e** - O-Ring

- d. Recheck clearance after changing shim(s), (Step b., above).

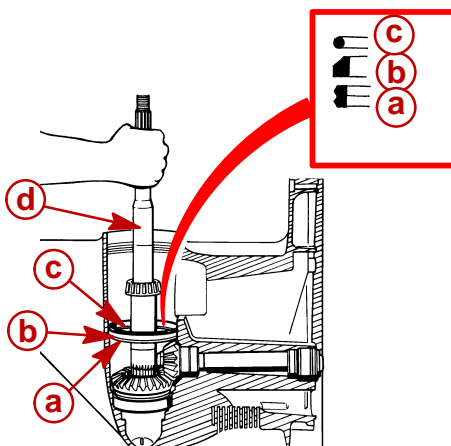
18. Using a dial-type lb-in. torque wrench, recheck the rolling preload by rotating drive shaft with a slow steady motion (3-5 lb-in. [0.3-0.6 Nm]).



50410

- a** - Torque Wrench  
**b** - Drive Shaft Adaptor

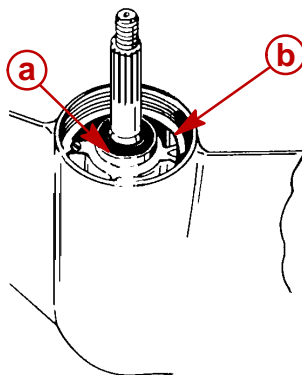
19. Install the original load ring, thrust ring and O-ring into the gear housing.



76883

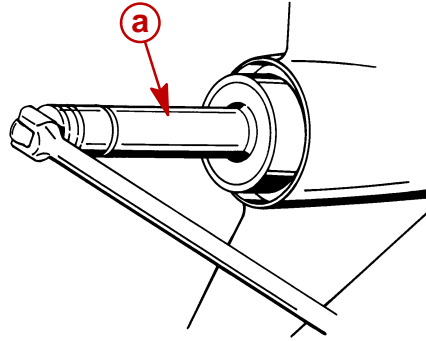
- a** - Load Ring  
**b** - Thrust Ring  
**c** - O-Ring  
**d** - Propeller Shaft

20. Install bearing carrier and tab washer. Align inner tab of tab washer with V-notch in bearing retainer and outer tab with hole in gear housing.



- a** - Bearing Carrier  
**b** - Tab Washer

21. Install and tighten bearing carrier retaining nut using retainer wrench until resistance to propeller shaft rotation can be felt (to preload bearings).

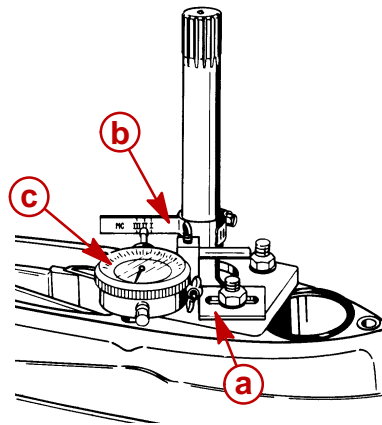


22112

**a** - Bearing Carrier Retainer Wrench (91-17257)

## 22. Driven gear shimming:

- a. Install dial indicator adaptor, backlash indicator rod and dial indicator as shown. Ensure that dial rod is aligned with "II" on indicator rod.



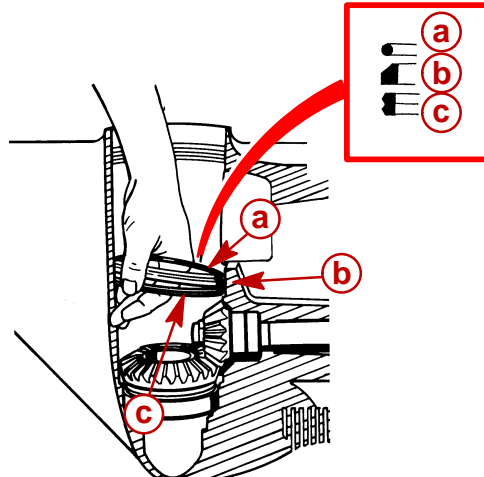
22439

- a** - Dial Indicator Adaptor (P/N 91-83155)  
**b** - Backlash Indicator Rod (P/N 91-53459)  
**c** - Dial Indicator (P/N 91-58222A1)

- b. Check gear backlash by lightly rotating drive shaft back and forth. Do not allow propeller shaft to turn. Observe dial indicator. Reading should be .009-.015 in. (.23-.38 mm).
- c. If backlash is not correct, disassemble and proceed as follows:  
 If backlash is MORE than specified: ADD shim(s) under driven gear bearing cup.  
 If backlash is LESS than specified: REMOVE shim(s) under driven gear bearing cup.
- d. Recheck backlash reading after reassembly.

23. Remove bearing carrier and items shown. Reinstall items shown using NEW load ring.

**IMPORTANT: Always use a new load ring when reassembling.**

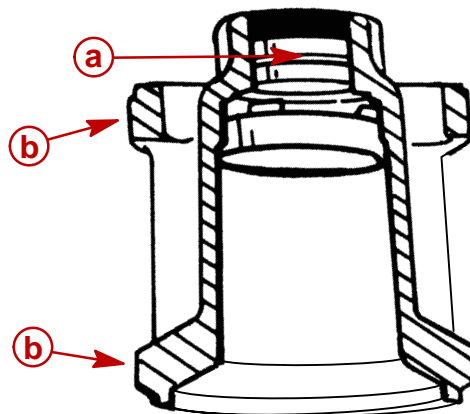


76884

- a** - O-Ring
- b** - Thrust Ring
- c** - Load Ring

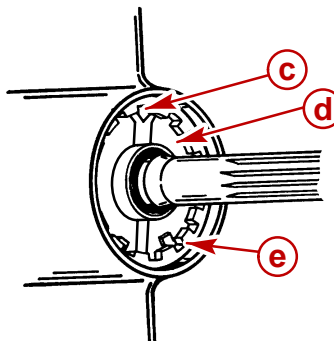
**IMPORTANT: Bearing carrier and threads on retainer must be lubricated to prevent corrosion and cracking in gear housing. Use Quicksilver Special Lubricant 101 on retainer; coat outside diameter on carrier “rounds” (b) with Perfect Seal.**

24. Lubricate bearing carrier seals and fill space between seals with Quicksilver 2-4-C marine lubricant with Teflon. Coat carrier mating surfaces with Perfect Seal.



- a** - Space Between Seals
- b** - Carrier Mating Surfaces

25. Install bearing carrier and tab washer in gear housing.
26. Lubricate threads on bearing carrier retaining nut with Quicksilver Special Lubricant 101. Install and tighten bearing carrier retainer nut until resistance to propeller shaft rotation can be felt (to preload bearings).



- c** - Tab Washer – V-Notch In Recess In Carrier
- d** - Bearing Carrier
- e** - Bearing Carrier Retainer Nut

27. To determine overall gear case preload, add drive shaft bearing preload (previously recorded) to propeller shaft bearing preload as outlined in the example below.

**IMPORTANT: The overall preload includes both the drive shaft preload and the gear case preload.**

Preloads	
<u>New</u> Propeller Shaft Bearings	8-12 lb-in. (.9-1.4 Nm) <sup>2</sup>
<u>Used</u> Propeller Shaft Bearings <sup>1</sup>	5-8 lb-in. (.6-.9 Nm) <sup>2</sup>
Drive Shaft Bearings	3-5 lb-in. (.3-.5 Nm)

<sup>1</sup> Bearing is considered used if spun under load even once ("under load" meaning: with power applied).

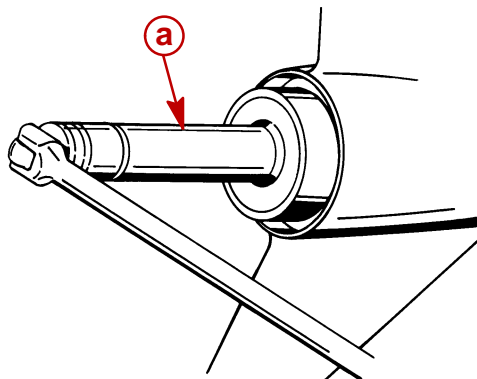
<sup>2</sup> Plus drive shaft preload of 3-5 lb-in. (.3-.6 Nm)

**Example:**

..... Drive Shaft Preload	3 lb-in. (.3 Nm)
	+
..... New Bearing Preload	<u>8 lb-in. (.9 Nm)</u>
	11 lb-in. (1.2 Nm)

28. Tighten the retainer to the proper preload using the following procedure.

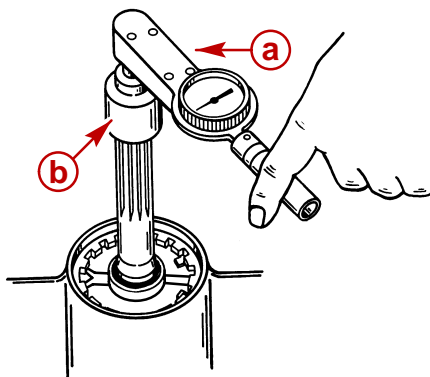
- a. Tighten retainer in small increments using retainer nut wrench.



22112

**a** - Bearing Carrier Retainer Wrench (P/N 91-17257)

- b. Using an lb-in. torque wrench , check overall gear housing bearing preload by rotating propeller shaft in direction of normal rotation with a slow steady motion.



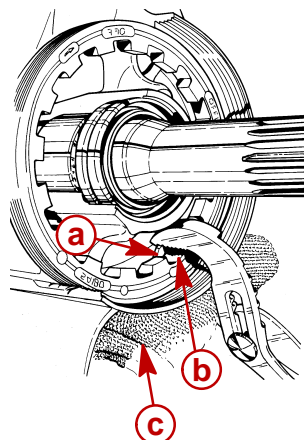
**a** - Torque Wrench (P/N 91-66274)

**b** - Propeller Nut (under socket)

- c. Continue tightening bearing carrier retainer nut and checking preload until specified bearing preload is attained.



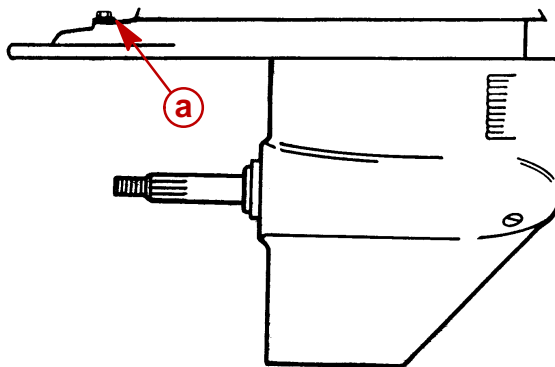
29. Bend one tab into retaining nut as shown after propeller shaft preload has been set correctly. Bend remaining tabs down into gear housing. Cushion housing to avoid chipping or scratching paint.



19831

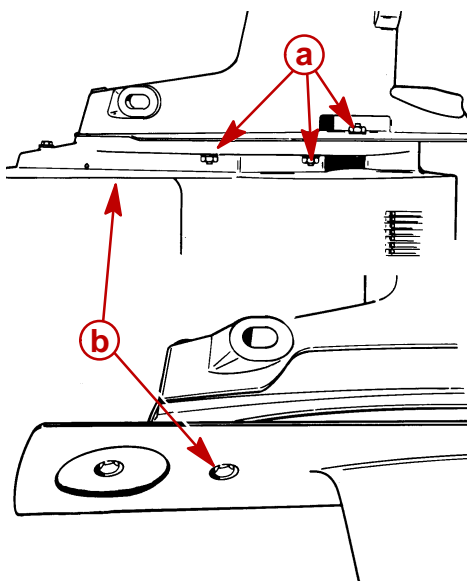
- a** - Tab Washer Tab
- b** - Groove In Retainer
- c** - Cushioning

30. Install anodic plate. Torque screw to 20 lb-ft (27 Nm).



- a** - Screw

31. Install gear housing to drive shaft housing. Torque fasteners to 35 lb-ft (47 Nm).



**a** - Nuts And Washers (3 Each Side)

**b** - Bolt (1)

32. Reinstall drive unit. Refer to SECTION 2A - *Removal, Installation and Adjustments*.

33. Fill drive unit with Gear Lube. Refer to SECTION 1B - *Maintenance*.

# STERNDRIVE UNIT

## Section 3D - Bravo Three Gear Housing

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# Specifications

## Torque Specifications

**NOTE:** Securely tighten all fasteners not listed below.

DESCRIPTION	lb-in.	lb-ft	Nm
Oil Fill/Drain Screw	40		5
Drive Shaft Pinion Gear (Bolt)		45	61
Bearing Carrier (Left-Hand Thread)		150	203
Outer Propeller Shaft Bearing Retainer Nut (Left-Hand Thread)		200	271
Drive Shaft Housing to Gear Housing Nuts and Bolt		35	47.5
Anode Plate		20	27
Front Propeller Nut		100	136
Rear Propeller Nut		60	81

## Bearing Preloads

DESCRIPTION	lb-in.	Nm
Drive Shaft Bearing	3-5	.3-.6
Overall Preload Checked at Inner Propeller Shaft (New Bearings)	8-18*	.9-2*
Overall Gear Case Preload Checked at Inner Propeller Shaft (Used Bearings)**	5-15*	.6-1.7*

\*Includes drive shaft preload

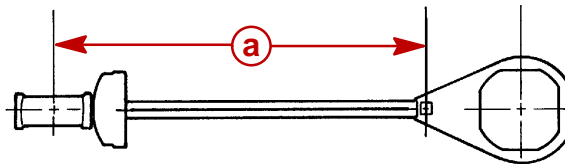
\*\* A bearing is used if spun once under load.

## Gear Ratio - Teeth per Gear (Gear Housing)

RATIO	DRIVE	DRIVEN	DRIVEN
2.43:1	13	24	24
2.20:1	16	27	27
2.00:1	16	27	27
1.81:1	16	27	27
1.65:1	18	25	25
1.50:1	15	19	19
1.36:1	15	19	19

## Torque Conversion Chart For Bearing Carrier

Torque Wrench Length in Inches (mm) <b>a</b>	Torque Wrench Reading in lb-ft (Nm) to Achieve 150 lb-ft (203 Nm)
15 (381)	122 (165)
16 (406)	123 (167)
17 (432)	124 (168)
18 (457)	126 (171)
19 (483)	127 (172)
20 (508)	128 (174)
21 (533)	129 (175)
22 (559)	129 (175)
23 (584)	130 (176)
24 (610)	131 (178)
25 (635)	132 (179)
26 (660)	132 (179)
27 (686)	133 (180)
28 (711)	133 (180)
29 (737)	134 (182)
30 (762)	134 (182)
31 (787)	135 (183)
32 (813)	135 (183)
33 (838)	136 (184)
34 (864)	136 (184)
35 (889)	136 (184)
36 (914)	137 (186)



72209

## Torque Conversion Chart For Bearing Retainer Nut

Torque Wrench Length (A) in Inches (mm) <b>a</b>	Torque Wrench Reading in lb-ft (Nm) to Achieve 200 lb-ft (271 Nm)
15 (381)	162(220)
16 (406)	164 (222)
17 (432)	166 (225)
18 (457)	167 (226)
19 (483)	169 (229)
20 (508)	170 (230)
21 (533)	171 (232)
22 (559)	173 (235)
23 (584)	174 (236)
24 (610)	175 (237)
25 (635)	175 (237)
26 (660)	176 (239)
27 (686)	177 (240)
28 (711)	178 (241)
29 (737)	178 (241)
30 (762)	179 (243)
31 (787)	180 (244)
32 (813)	180 (244)
33 (838)	181 (245)
34 (864)	181 (245)
35 (889)	182 (247)
36 (914)	182 (247)

**a** - Torque Wrench Length

## Torquing Outer Prop Shaft Bearing Retainer and Bearing Carrier

Use the following procedure to allow torquing outer prop shaft bearing retainer and bearing carrier with a torque wrench.

1. On beam-type torque wrenches, measure from square drive to fulcrum (pivot) point of handle.
2. On click-stop or dial type torque wrenches, measure from square drive to reference mark on handle (two bands, etc.).

## Lubricants/Sealants/Adhesives

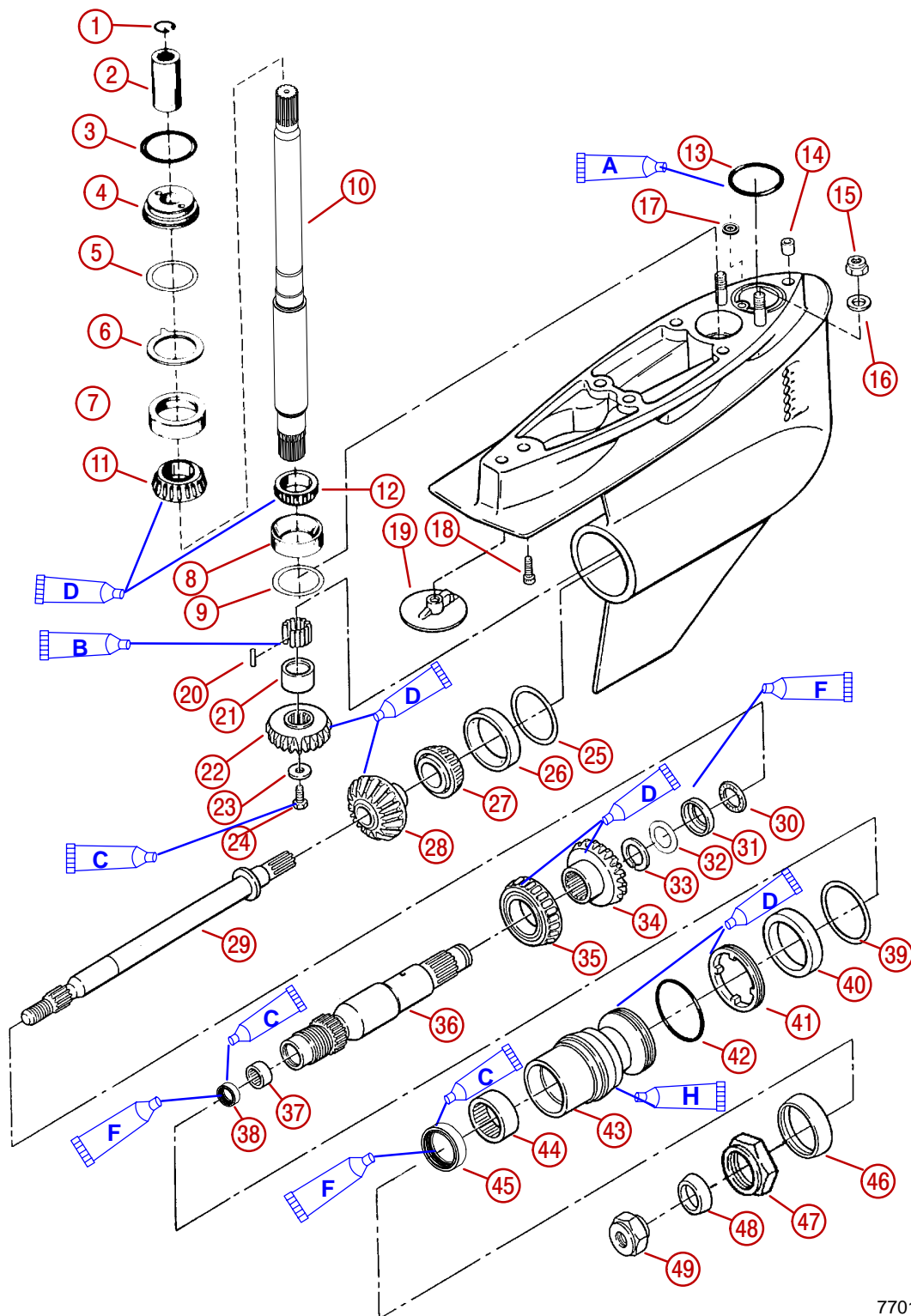
Description	Part Number
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A2
Quicksilver Special Lubricant 101	92-13872A1
3-M Adhesive	92-86166Q1
Loctite 271	92-809820
Quicksilver High Performance Gear Lube	92-19007A24
Needle Bearing Assembly Lubricant	92-825265A1
Perfect Seal	92-34227-1
Loctite 242	Obtain Locally

# Tools

Description	Part No.
Dial Indicator Set	91-58222A1
Slide Hammer Puller	91-34569A1
Torque Wrench (lb-in.)	91-66274
Clamp Plate	91-43559
Universal Puller Plate	91-37241
Threaded Rod	91-31229
Bearing Driver	91-89867
Bearing Driver	91-89868
Bearing Cup Driver	91-67443
Backlash Indicator Rod (Inner Propeller Shaft)	91-805481
Backlash Indicator Rod (Outer Propeller Shaft)	91-805482
Bearing Carrier Installation / Removal Tool	91-805374--1
Drive Shaft Pinion Bearing Driver	91-63638
Outer Propeller Shaft Bearing Installation Tool	91-805352
Outer Propeller Shaft Seal installation Tool	91-805358
Bearing Carrier Seal Installation Tool	91-805372
Front Bearing Race Driver Rod	91-805454
Propeller Nut Installation Tool	91-805457-1
Shimming Tool	91-805462
Drive Shaft Retaining Tool	91-805381
Driver Rod	91-37323
Outer Propeller Shaft Bearing Retainer Installation Tool	91-805382
Bearing Carrier Bearing Installation Tool	91-805356
Drive Shaft Adaptor Tool	91-56775
Forward Bearing Driver	91-31106
Driver Guide	91-805470
Bearing Carrier Tool	91-805374
Spline Backlash Indicator For Inner Shaft	91-806192

# Bravo Three Gear Housing Exploded View

## Drive Shaft and Propeller Shaft Components



77016



- |   |   |
|---|---|
| <b>1</b> - Retainer                               | <b>26</b> - Bearing Cup                   |
| <b>2</b> - Coupler                                | <b>27</b> - Tapered Bearing               |
| <b>3</b> - O-ring                                 | <b>28</b> - Front Gear                    |
| <b>4</b> - Spacer                                 | <b>29</b> - Inner Propeller Shaft         |
| <b>5</b> - Shim(s)                                | <b>30</b> - Thrust Bearing                |
| <b>6</b> - Tab Washer                             | <b>31</b> - Thrust Race                   |
| <b>7</b> - Bearing Cup                            | <b>32</b> - Shim (Prop Shaft End-Play)    |
| <b>8</b> - Bearing Cup                            | <b>33</b> - Snap Ring                     |
| <b>9</b> - Shim(s)                                | <b>34</b> - Rear Gear                     |
| <b>10</b> - Drive Shaft                           | <b>35</b> - Tapered Bearing               |
| <b>11</b> - Tapered Roller Bearing (Larger Dia.)  | <b>36</b> - Outer Propeller Shaft         |
| <b>12</b> - Tapered Roller Bearing (Smaller Dia.) | <b>37</b> - Bearing                       |
| <b>13</b> - O-ring                                | <b>38</b> - Inner Propeller Shaft Seal    |
| <b>14</b> - Seal                                  | <b>39</b> - Shim(s)                       |
| <b>15</b> - Locknut                               | <b>40</b> - Bearing Cup                   |
| <b>16</b> - Flat Washer                           | <b>41</b> - Bearing Retainer (Nut)        |
| <b>17</b> - Oil Passage Quad Ring                 | <b>42</b> - O-ring                        |
| <b>18</b> - Screw                                 | <b>43</b> - Bearing Carrier               |
| <b>19</b> - Anodic Plate                          | <b>44</b> - Bearing                       |
| <b>20</b> - Needle Bearings                       | <b>45</b> - Outer Propeller Shaft Seal    |
| <b>21</b> - Bearing Race                          | <b>46</b> - Front Propeller Thrust Washer |
| <b>22</b> - Pinion (Drive) Gear                   | <b>47</b> - Front Propeller Locknut       |
| <b>23</b> - Washer                                | <b>48</b> - Rear Propeller Thrust Washer  |
| <b>24</b> - Pinion Bolt                           | <b>49</b> - Rear Propeller Locknut        |
| <b>25</b> - Shim(s)                               |   |



3M Brand Adhesive



Quicksilver Needle Bearing Assembly Lubricant



Loctite 271



Quicksilver High Performance Gear Lube (Use on all bearing surfaces)



Quicksilver Special Lubricant 101



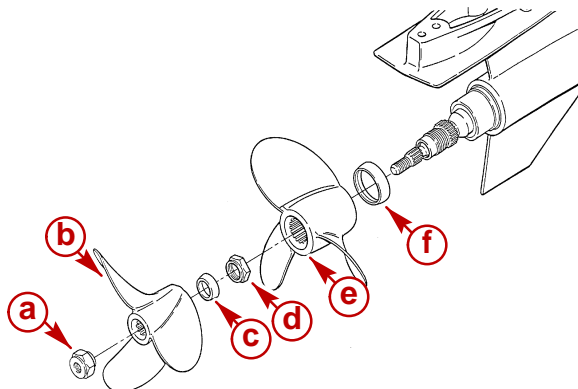
Quicksilver 2-4-C Marine Lubricant with Teflon



Perfect Seal

# Pre-Disassembly Inspection

1. Remove propellers.

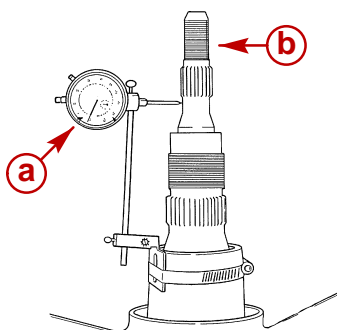


75899

- a** - Rear Propeller Nut
- b** - Rear Propeller
- c** - Rear Thrust Ring
- d** - Front Propeller Nut
- e** - Front Propeller
- f** - Front Thrust Ring

2. Check for bent propeller shafts as follows:

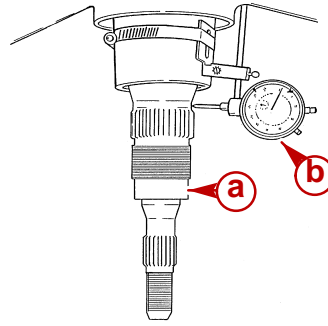
- a. Inner Shaft - Position unit with shafts positioned up. Position dial indicator on inner propeller shaft. Rotate inner propeller shaft while observing dial indicator. If deflection is more than .005 in. (0.127 mm), a bent inner propeller shaft is indicated.



75900

- a** - Dial Indicator
- b** - Inner Propeller Shaft

- b. Outer Shaft - Position unit with shafts positioned down. Position dial indicator on outer propeller shaft. Rotate outer propeller shaft while observing dial indicator. If deflection is more than .010 in. (0.254 mm), a bent outer propeller shaft is indicated.

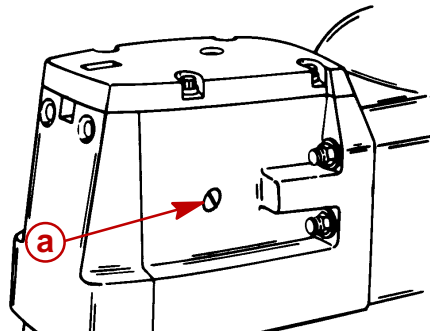


75901

- a** - Dial Indicator  
**b** - Outer Propeller Shaft

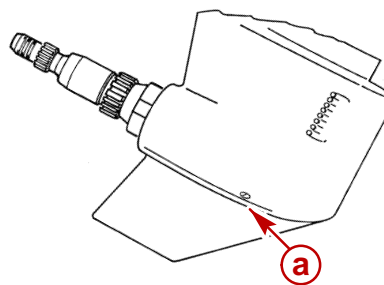
## Gear Housing Disassembly

1. Remove, empty and clean gear lube monitor.
2. Remove vent plug.



- a** - Vent Plug

3. Drain drive unit at fill/drain screw.

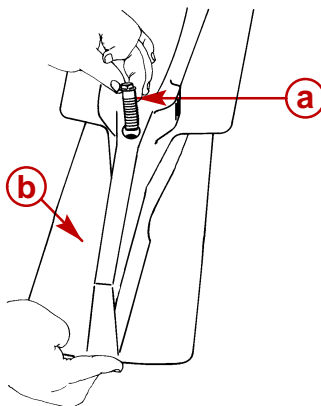


- a** - Fill/Drain Screw

72522

## 4. Remove anodic plate.

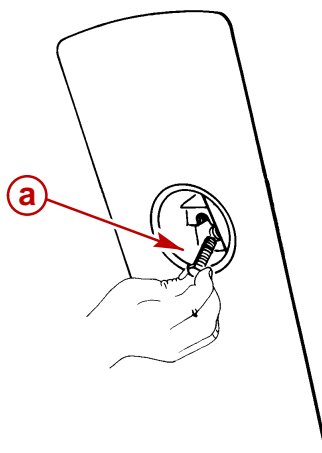
- a. Remove the rubber cap to gain access to the anode attaching bolt. Remove the bolt.



76832

**a** - Bolt

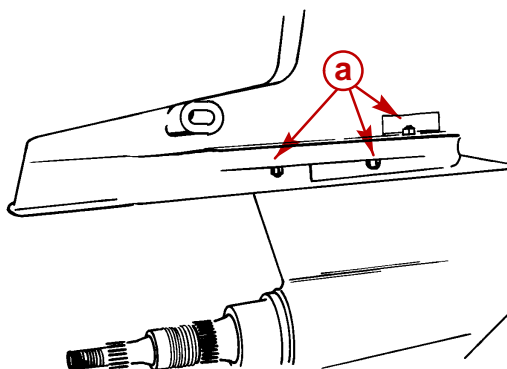
- b. Remove the bolt in the anode cavity.



76804

**a** - Bolt

- c. Remove the locknuts and flat washers.



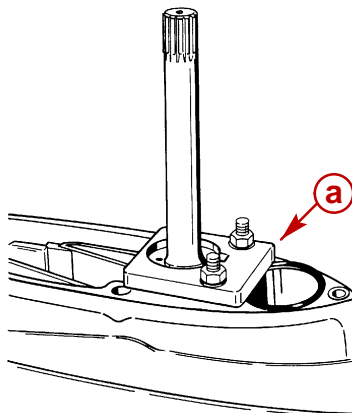
76803

**a** - Locknuts and Flatwashers (6)

**⚠ CAUTION**

Clamp plate must be installed on gear housing when gear housing is separated from drive shaft housing.

5. Install clamp plate, nuts and 4 washers on gear housing. Tighten securely.



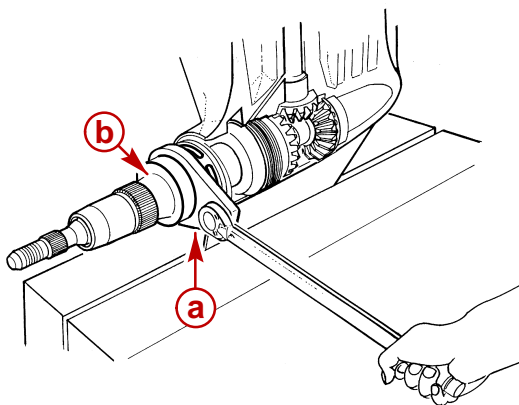
72241

**a** - Clamp Plate (91-43559T)

**⚠ CAUTION**

Bearing carrier has a LEFT-HAND THREAD. Remove by turning CLOCKWISE.

6. Remove bearing carrier, by turning clockwise, using bearing carrier tool. Use a torch-lamp to heat area where the carrier and housing meet to ease removal.



75895

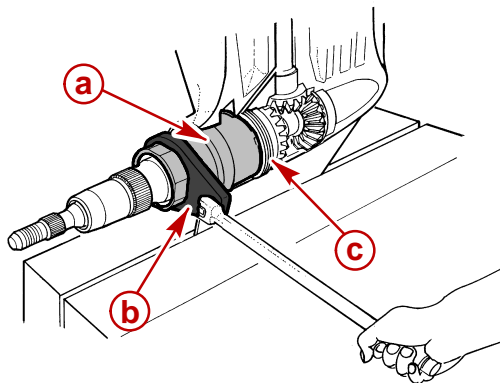
**a** - Bearing Carrier Tool (91-805374--1)

**b** - Bearing Carrier

**⚠ CAUTION**

Outer propeller shaft bearing retainer has a LEFT- HAND THREAD. Remove by turning CLOCKWISE.

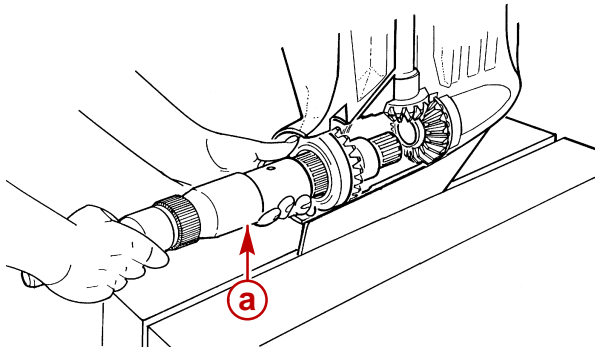
7. Remove outer propeller shaft bearing retainer, by turning clockwise, using outer propeller shaft bearing retainer tool.



75898

- a** - Bearing Retainer Tool (P/N 91-805382)
- b** - Bearing Carrier Tool (P/N 91-805374)
- c** - Bearing Retainer

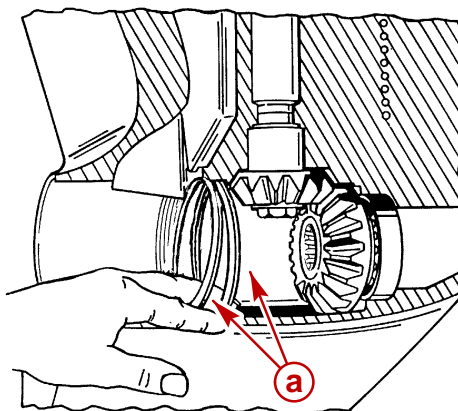
8. Remove inner and outer propeller shaft assembly from gear housing.



72244

- a** - Inner And Outer Propeller Shaft Assembly

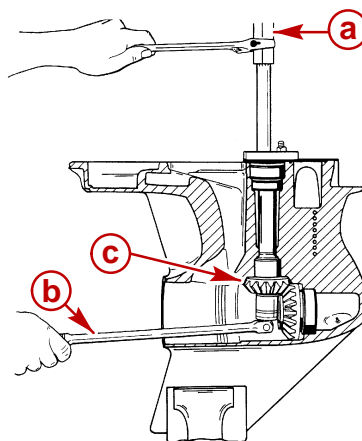
9. Remove shims from gear housing.



72245

- a** - Shims

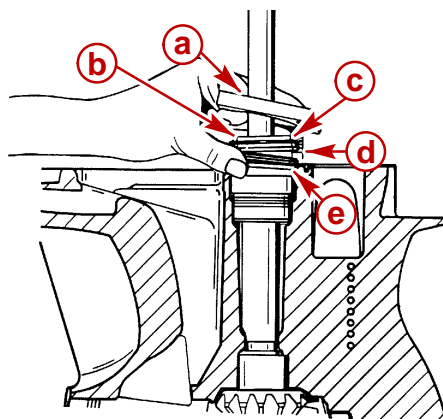
10. Remove drive shaft pinion gear retaining bolt and washer using drive shaft adaptor tool.



72246

- a** - Drive Shaft Adaptor Tool (91-61077T)
- b** - Breaker Bar and Socket
- c** - Pinion Gear

11. Remove clamp plate installed in Step 2, then remove O-ring, spacer, shim(s) and tab washer.

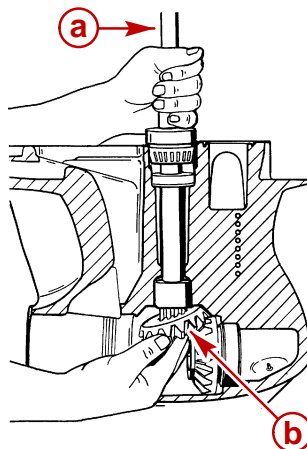


72247

- a** - Clamp Plate
- b** - O-ring
- c** - Spacer
- d** - Shim(s)
- e** - Tab Washer

12. Remove drive shaft and pinion gear.

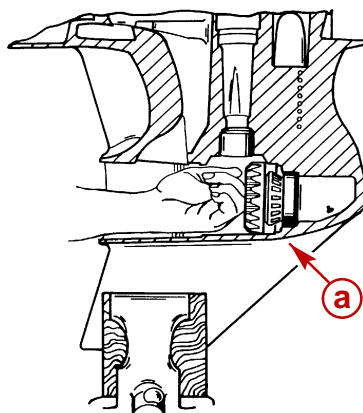
**NOTE:** Be careful not to lose rollers from drive shaft pinion bearing should they drop during drive shaft removal.



72248

- a** - Drive Shaft
- b** - Drive Shaft Pinion Gear

13. Remove front driven gear and bearing from gear housing.

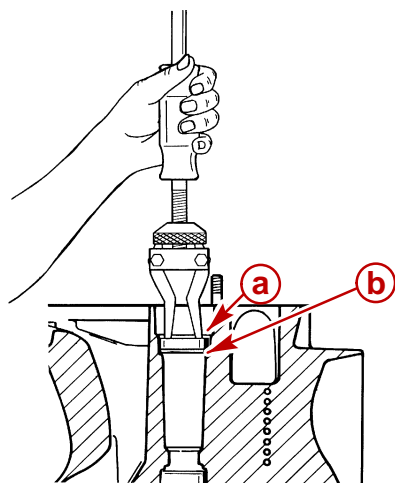


72249

- a** - Front Pinion Gear And Bearing



14. Remove drive shaft bearing cup and shim(s).

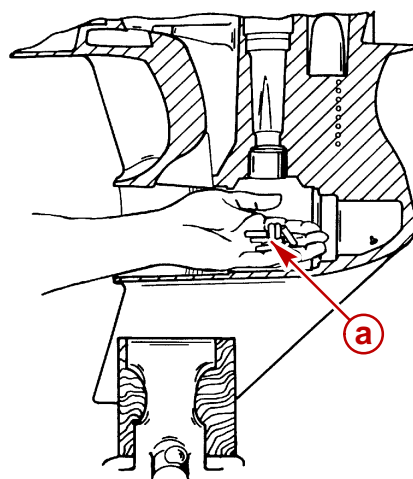


72250

**a** - Bearing Cup

**b** - Shim(s)

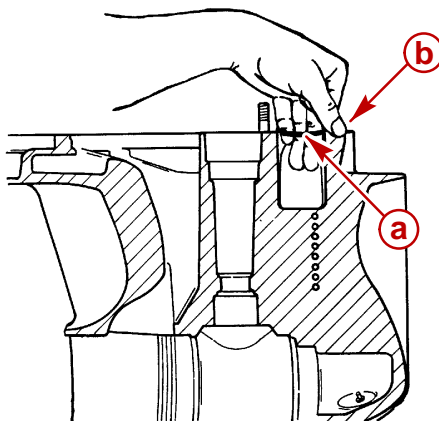
15. Unless you intend to remove the entire pinion bearing, remove needle bearings from pinion bearing race (See pinion bearing removal).



72251

**a** - Needle Bearings

16. Remove water passage O-ring and oil passage quad ring.



72252

**a** - Water Passage O-Ring

# Driveshaft And Pinion Bearing

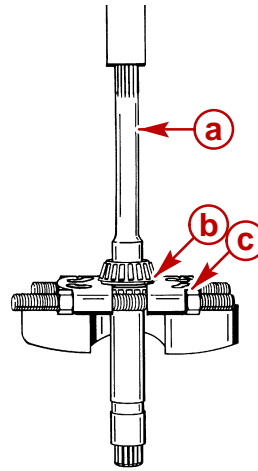
## Inspection and Cleaning

1. The condition of the drive shaft tapered bearing cups is an indication of the condition of the tapered roller bearings on the drive shaft. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
2. The condition of the bearing surface on drive shaft at needle bearing location is an indication of the condition of needle bearings. Replace needles and sleeve if pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.
3. Inspect splines for worn or twisted condition. Replace drive shaft if either condition exists.
4. Clean all parts that are to be reused with solvent. Dry parts completely using compressed air, being careful not to spin bearings.

## Drive Shaft Disassembly

**NOTE:** Bearing assembly must be replaced if removed from drive shaft. Tapered roller bearings are damaged when removed.

1. Press tapered roller bearing from shaft using universal puller plate to support bearing. Remove second tapered roller bearing in the same manner.

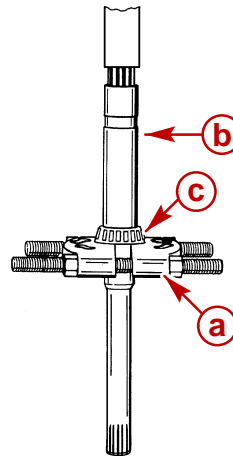


72442

- a** - Drive Shaft
- b** - Bearing
- c** - Universal Puller Plate (P/N 91-37241)

## Drive Shaft Reassembly

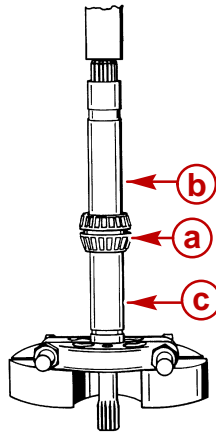
1. Lubricate inner diameter of small tapered roller bearing with Quicksilver High Performance Gear Lube. Press small tapered roller bearing onto drive shaft using universal puller plate. Ensure smaller outer diameter faces pinion end of shaft.



72444

- a** - Universal Puller Plate (P/N 91-37241)
- b** - Drive Shaft
- c** - Small Tapered Roller Bearing

2. Lubricate inner diameter of large tapered roller bearing with Quicksilver High Performance Gear Lube. Press large tapered roller bearing onto drive shaft using suitable mandrel or old bearing race on inner race. Ensure larger outer diameter faces pinion end of shaft.



72445

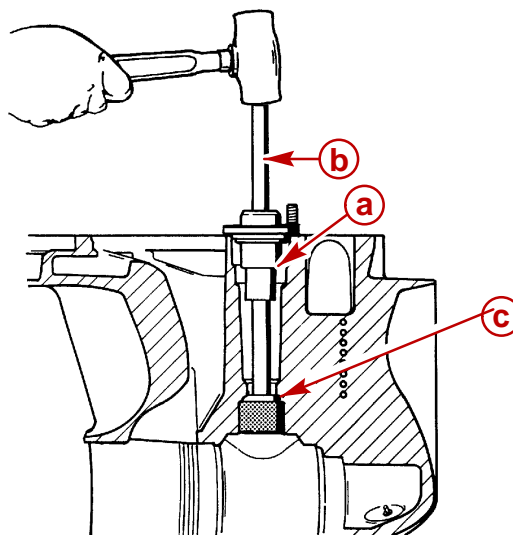
- a** - Suitable Mandrel
- b** - Drive Shaft
- c** - Large Tapered Roller Bearing

## Pinion Bearing

### Removal

**IMPORTANT: All needle bearings MUST BE in place inside bearing casing while driving pinion bearing from gear housing or bearing casing will bend or break and become difficult to remove.**

1. Remove pinion bearing using bearing remover and driver rod. Use bearing driver as a pilot. Heat bearing area of housing to approximately 200°F (93.3°C) to ease removal. Do NOT use open flame.

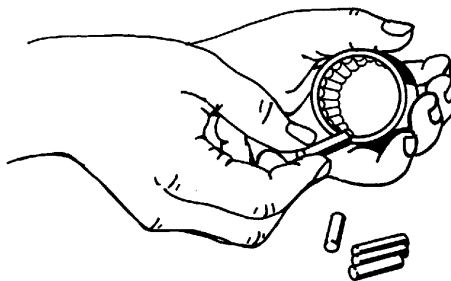


72253

- a** - Bearing Driver (P/N 91-813653) - Used as Pilot
- b** - Driver Rod (P/N 91-37323)
- c** - Bearing Remover (P/N 91-63638)

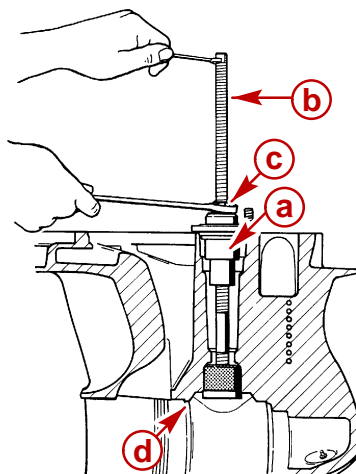
## Installation

1. Install needles in casing. Use Needle Bearing Assembly Lubricant to help keep needles in place. Position bearing assembly over bearing driver with number on bearing casing facing up. Coat casing outer diameter with Quicksilver High Performance Gear Lube.



72443

2. Install pinion bearing using tools as shown.



72254

- a** - Bearing Driver (P/N 91-813653) - Used As Pilot
- b** - Threaded Rod (P/N 91-31229)
- c** - Washer And Nut
- d** - Bearing Driver (P/N 91-89867T)

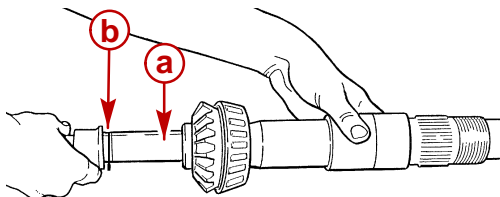
## Propeller Shaft

### Inspection

1. Inspect for bent or twisted splines.
2. Inspect surface of shaft where bearing carrier oil seal lips contact shaft. Replace shaft and oil seals if any grooves are found.
3. Inspect needle bearing race on outer propeller shaft and bearing surface of inner propeller shaft for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replace shaft.
4. Condition of the bearing surfaces on the outer propeller shaft and inner propeller shaft is an indication of the condition of the bearings in the bearing carrier and outer propeller shaft. Inspect bearing rollers for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replace bearings and shaft.
5. Inspect outer propeller shaft tapered bearing and bearing cup. Replace bearing and bearing cup if cup is pitted, grooved, scored, worn uneven, discolored from overheating, or has embedded metal particles.

## Disassembly

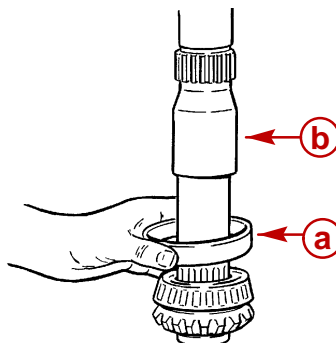
1. Remove inner propeller shaft and thrust bearing from assembly.



72255

- a** - Inner Propeller Shaft
- b** - Thrust Bearing

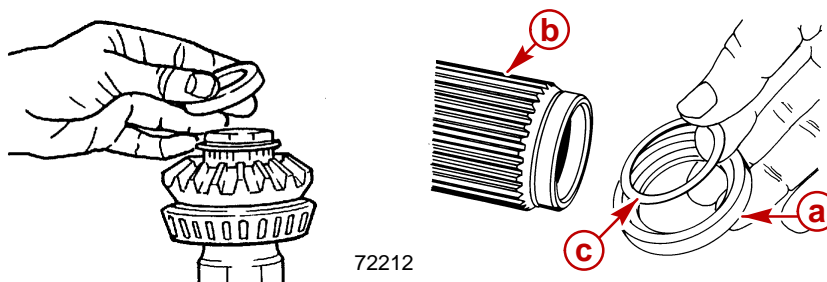
2. Remove bearing cup from outer propeller shaft.



72256

- a** - Bearing Cup
- b** - Outer Propeller Shaft

3. Remove thrust cap using a punch and hammer. Align punch with opening in snap-ring.

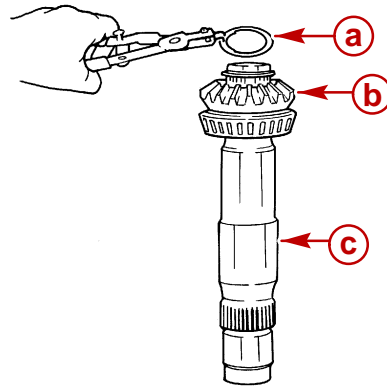


72212

71799

- a** - Thrust Cap
- b** - Outer Propeller Shaft
- c** - Shim

4. Remove snap ring, and driven gear and bearing assembly from outer propeller shaft.

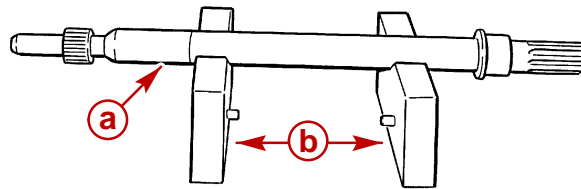


72213

- a** - Snap Ring
- b** - Driven Gear and Bearing Assembly
- c** - Outer Propeller Shaft

## Propeller Shaft Spline Lash Check

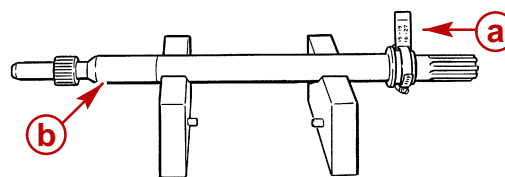
1. Check inner propeller shaft spline lash as follows:
  - a. Place inner propeller shaft on two V-blocks.



72229

- a** - Inner Propeller Shaft
- b** - V-Blocks

- b. Install indicator rod on inner propeller shaft just behind shaft spline.

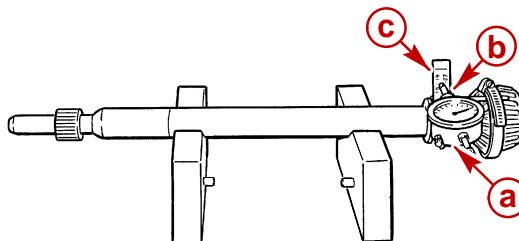


72230

- a** - Indicator Rod
- b** - Inner Propeller Shaft

- c. Slide front driven gear assembly on spline of inner propeller shaft.

- d. Mount dial indicator to gear and position so that indicator probe aligns with mark on indicator rod.



72231

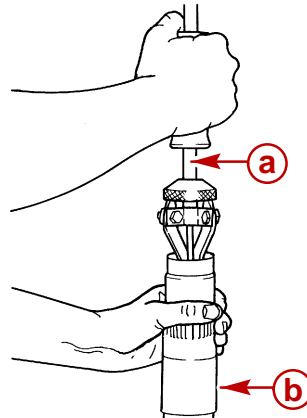
- a** - Dial Indicator  
**b** - Indicator Rod (91-806192)  
**c** - Mark Stamped on Indicator Rod

- e. Rotate gear back and forth while observing dial indicator. Record spline lash reading (for use later in this section). This reading is required to determine true backlash between pinion and driven gear.
2. Check outer propeller shaft spline lash following the same procedures as for the inner propeller shaft listed in Steps "a" through "e" above using indicator rod (91-806192).



## Outer Propeller Shaft Servicing

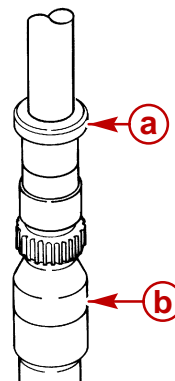
1. To remove roller bearing and oil seal from outer propeller shaft using slide hammer puller with three-jaw puller.



72216

- a** - Slide Hammer Puller (P/N 91-34569A1)  
**b** - Outer Propeller Shaft

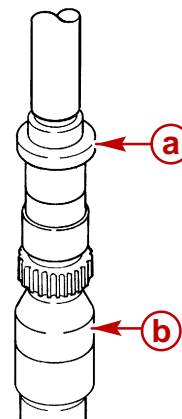
2. Install roller bearing using bearing installation tool.



72217

- a** - Bearing Installation Tool (P/N 91-805352T)  
**b** - Outer Propeller Shaft

3. Coat outer diameter of oil seal with Loctite 271. Press oil seal into outer propeller shaft using seal installation tool until tool bottoms out against shaft. Lubricate lips of oil seal and fill area between lips of seal with Quicksilver Special Lubricant 101.



72235

- a** - Seal Installation Tool (P/N 91-805358T)  
**b** - Outer Propeller Shaft

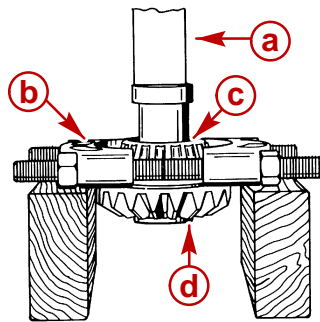
# Front Driven Gear And Bearing

## Inspection

1. Inspect driven gears for pitting, chipped or broken teeth, and excessive or uneven wear. If any of these conditions exist, replace both gear and bearing assemblies and drive shaft pinion gear.
2. Replace tapered roller bearings and cups if cups are pitted, grooved, scored, worn uneven, discolored from overheating, or have metal particles embedded in the cups.

## Bearing Removal

1. If you determine that bearings are in need of replacement and the gears are still in good condition, remove bearings from gears using puller plate and a suitable mandrel (bearings are damaged in removal and should not be reused).

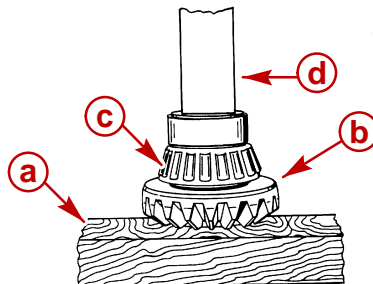


72446

- a** - Suitable Mandrel
- b** - Universal Puller Plate (P/N 91-37241)
- c** - Tapered Roller Bearing by inspection
- d** - Driven Gear

## Bearing Installation

1. Apply a light coat of Quicksilver High Performance Gear Lube to inner diameter of new bearing. Place a suitable mandrel (old bearing race) against inner bearing race. Place another mandrel on face of gear and press gear and bearing together.



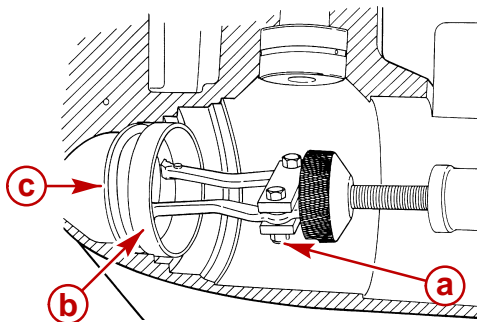
72447

- a** - Hardwood or Metal Block
- b** - Driven Gear
- c** - Tapered Roller Bearing
- d** - Mandrel - Contacting Inner Race

## Bearing Cup Removal

1. Remove bearing cup and shims using slide hammer puller. Measure shims for reassembly reference.

**NOTE:** When pulling bearing cup with puller, shims will be damaged. DO NOT reuse shims.

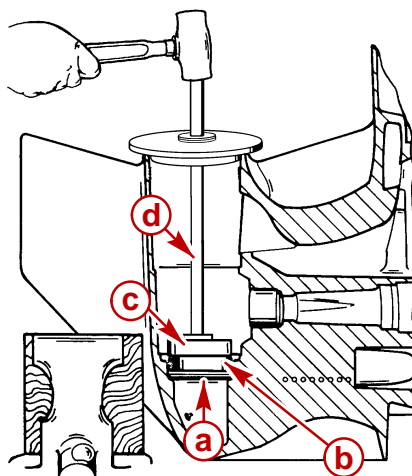


19808

- a** - Slide Hammer Puller (P/N 91-34569A1)
- b** - Bearing Cup
- c** - Shims

## Bearing Cup Installation

1. Install front driven gear bearing cup and original thickness shims using bearing cup driver and driver rod. If shims were lost or damaged where original thickness cannot be determined, install a .015 in. (0.38 mm) shim for a starting point. Ensure cup is not canted. Coat cup outer diameter with Quicksilver High Performance Gear Lube.



75958

- a** - Shim(s)
- b** - Bearing Cup
- c** - Driver (P/N 91-805454)
- d** - Old Propeller Shaft or Driver Rod

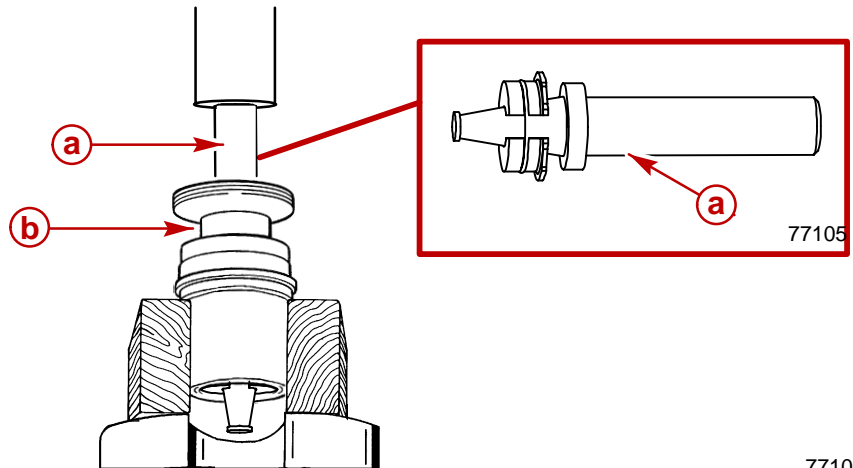
# Bearing Carrier Seal And Bearing

## Inspection

1. Check bearing carrier for signs of corrosion, especially on gear housing to bearing carrier mating surfaces. If corrosion is evident, replace bearing carrier.
2. Inspect needle bearing for pitting, grooves, discoloration or embedded particles. If any of these conditions exist, replacement is necessary.

## Removal

1. Press seal and bearing from carrier using seal removal tool.

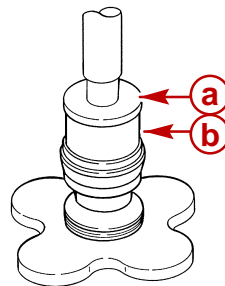


- a** - Seal Removal Tool (91-862064A1)  
**b** - Bearing Carrier

77104

## Installation

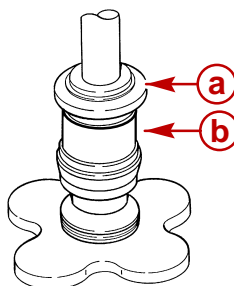
1. Apply gear lube to outer diameter of bearing and install roller bearing using bearing installation tool.



- a** - Bearing Installation Tool (P/N 91-805356)  
**b** - Bearing Carrier

75896

2. Coat outer diameter of oil seal with Loctite 271 and press oil seal into bearing carrier using seal installation tool until tool bottoms out against housing. Lubricate lips of oil seal and fill area between lips of seal with Quicksilver Special Lubricant 101.



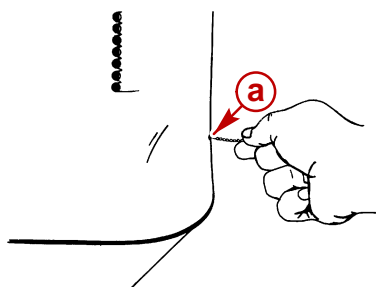
75897

- a** - Seal Installation Tool (P/N 91-805372)  
**b** - Bearing Carrier

## Speedometer Water Passage

### Inspection and Cleaning

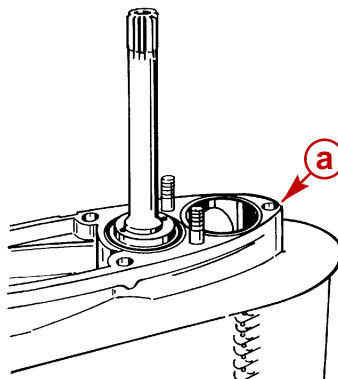
1. Inspect opening (pitot tube), on leading edge of gear housing, for obstruction. Clean opening with a short piece of wire, if necessary. If obstruction cannot be removed with wire, carefully reopen tube using a 5/64 in. (2 mm) diameter drill bit. Do not drill beyond a depth of 2-7/16 in. (62 mm).



72448

- a** - Opening (Pitot Tube)

2. Inspect water passage seal for nicks, cuts or distortion. Replace if necessary.

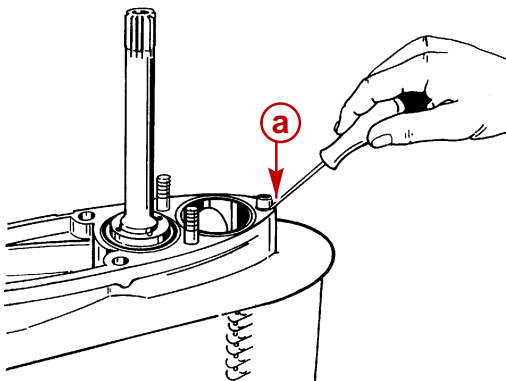


72449

- a** - Water Passage Seal

## Seal Removal

1. Pry water passage seal out with a suitable tool.

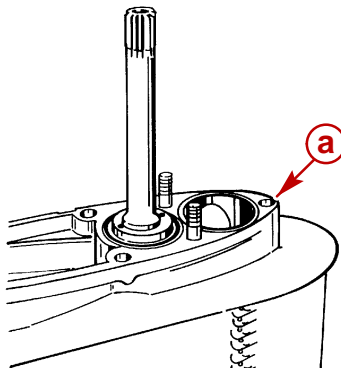


72450

**a** - Water Passage Seal

## Seal Installation

1. Lightly coat outer diameter of seal with 3-M Adhesive and install in speedometer water passage bore. Ensure top edge of seal is flush with gear housing surface.

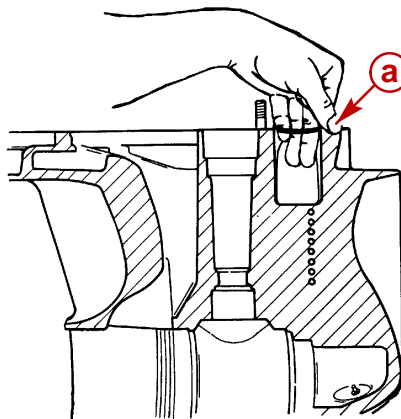


72449

**a** - Seal – Flush with Edge of Water Tube Bore

## Gear Housing Reassembly and Shimming

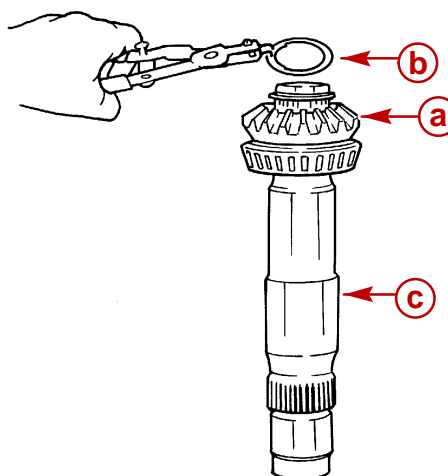
1. Lubricate all bearings with Quicksilver High Performance Gear Lube before installing. Components must be lubricated to obtain accurate bearing preload readings.
2. Install water passage O-ring and oil passage quad ring. Hold in place using 3-M Adhesive.



72252

**a** - Water Passage O-Ring

3. Install driven gear and bearing assembly to outer propeller shaft. Secure with snap ring.

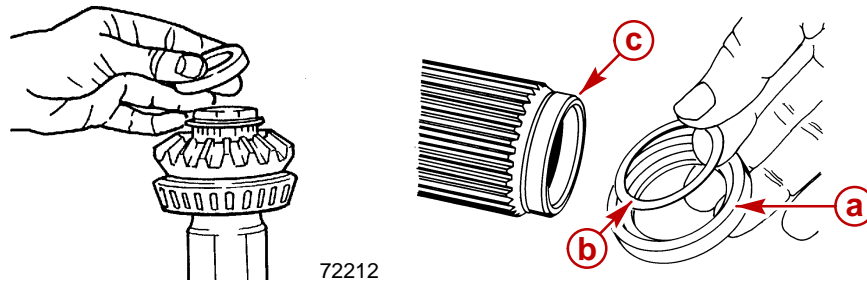


72213

- a** - Driven Gear And Bearing Assembly  
**b** - Snap Ring  
**c** - Outer Propeller Shaft

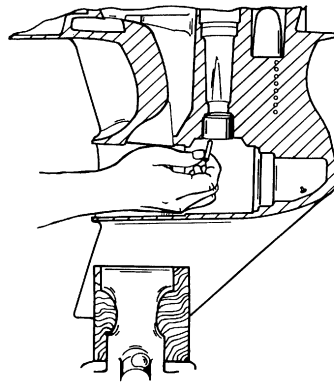
**NOTE:** The shim installed in the following step is used to regulate prop-shaft end-play. Use the existing shim as a starting point ONLY if shafts, gears, or bearings were not replaced. If any of the components were replaced, use a .020 in. shim as a starting point. This shim may need to be adjusted if the end-play is not within specifications (See "Checking Propeller Shaft End-Play" later in this section).

4. Apply a light coat of Loctite 242 to inside diameter of thrust cap. Ensure that Loctite does not contact shim mating surfaces. Install thrust cap and appropriate size shim on outer propeller shaft. Ensure that cap is straight while pressing into place.



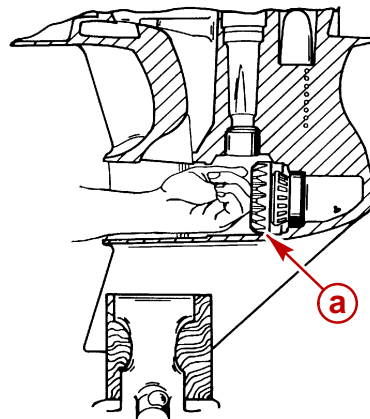
- a** - Thrust Cap
- b** - Shim
- c** - Outer Propeller Shaft

5. Ensure that all needle bearings are installed in driveshaft needle bearing case. Use needle bearing assembly lubricant to hold bearings in place.



72261

6. Install front driven gear assembly and original thickness shims into gear housing.

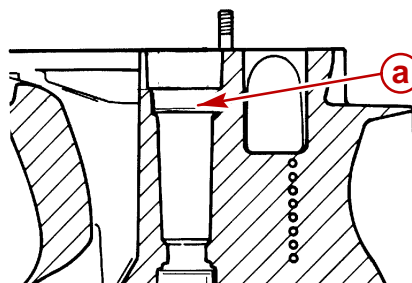


72249

- a** - Front Driven Gear Assembly And Shims



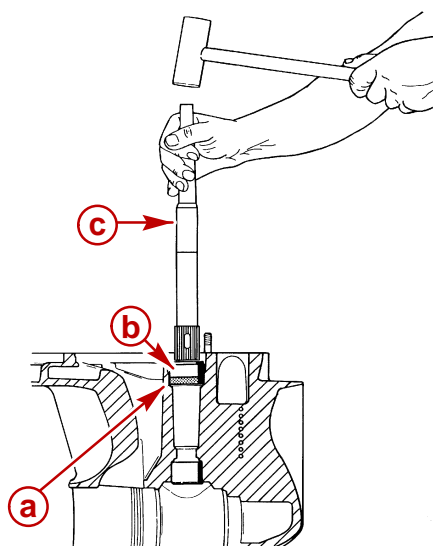
7. Install original thickness shim(s) for lower bearing cup into gear housing. If shims were lost or ruined where original thickness cannot be determined, install a .050 in. (1.27 mm) shim pack for a starting point.



72262

**a** - Shim(s)

8. Install drive shaft lower bearing cup, using cup driver.

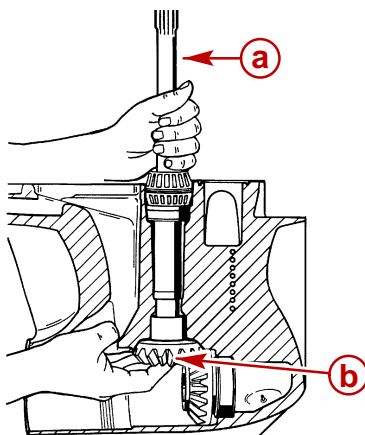


72263

**a** - Bearing Cup  
**b** - Bearing Cup Driver (P/N 91-67443T)  
**c** - Old Propeller Shaft Or Driver Rod

9. Install drive shaft and pinion gear into gear housing.

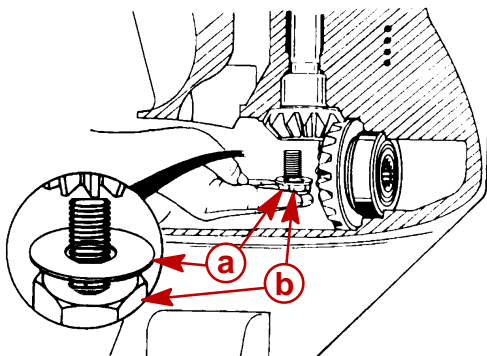
**NOTE:** Be careful not to lose rollers from drive shaft pinion bearing should they drop during drive shaft installation.



72264

- a** - Drive Shaft
- b** - Drive Shaft Pinion Gear

10. Install pinion washer and screw. Apply Loctite 271 to threads of screw. Torque pinion screw to 45 lb-ft (61 Nm).

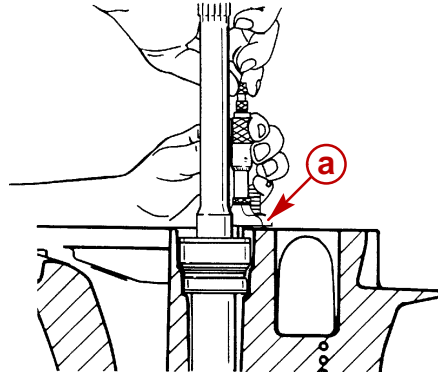


76877

- a** - Washer
- b** - Screw

## 11. Determine shim thickness required for drive shaft bearing preload.

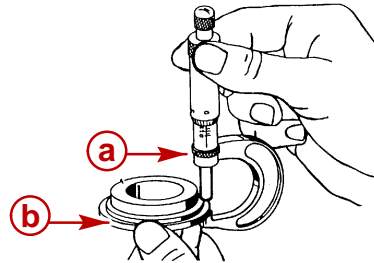
- a. Install upper bearing cup and tab washer. Measure distance between top of gear housing and tab washer using a 0-1 in. depth micrometer.



72452

**a** - 0-1 Inch Depth Micrometer

- b. Measure thickness of spacer from top machined surface to bottom machined surface using a 0-1 in. outside micrometer.



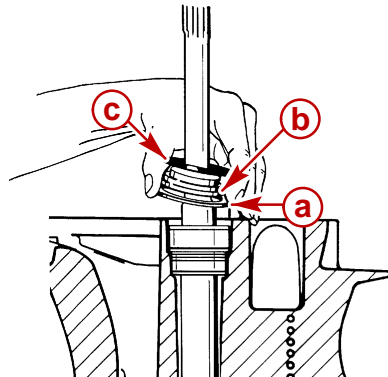
72523

**a** - 0-1 Inch Outside Micrometer

**b** - Spacer

- c. Calculate shim thickness as shown.  
 Measurement from Step "a" minus (–)  
 Measurement from Step "b" plus (+)  
 .001 In. (0.025 mm) equals (=)  
 Shim Thickness Required.

## 12. Install original thickness shims, spacer and new O-ring.



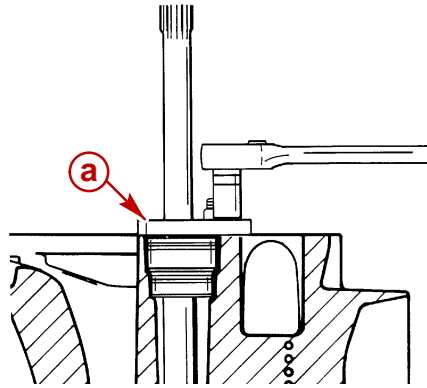
72451

**a** - Shim(s)

**b** - Spacer

**c** - O-Ring

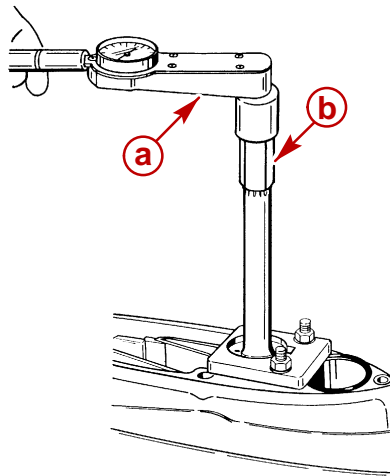
13. Reinstall clamping plate on gear housing with nuts and 4 washers. Tighten securely.



72266

**a** - Clamp Plate (P/N 91-43559T)

14. Using a dial-type lb-in. torque wrench, check the rolling preload by turning driveshaft with a slow steady motion (3-5 lb-in. [0.3-.6 Nm]). If necessary, add or subtract shims from beneath spacer to bring the preload into the specified range.



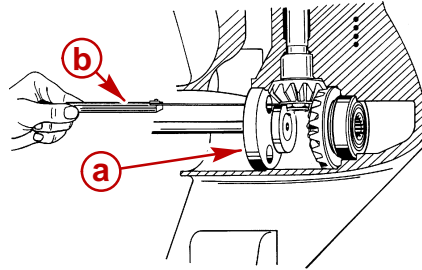
72269

**a** - Dial-Type lb-in. Torque Wrench  
**b** - Drive Shaft Adaptor (P/N 91-61077T)

15. Ensure clamp plate has been reinstalled after adjusting preload in the previous step. It must be in place for checking pinion height in the following procedure.

16. Check pinion height as follows:

- a. Insert shimming tool into gear housing.
- b. Measure clearance between tool and pinion gear with feeler gauge. Clearance must be .023-.028 in. (0.575-0.700 mm). Take measurement at three locations on pinion gear (120 degrees apart).



72268

**a** - Shimming Tool (P/N 91-805462T)

**b** - Feeler Gauge

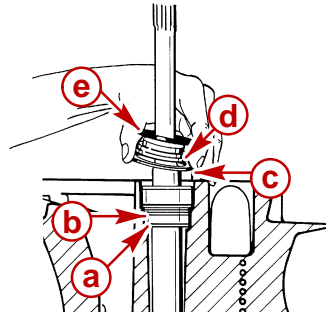
RATIO	DRIVE	DRIVEN	DRIVEN
Use Tool Position 16:27			
2.43:1	13	24	24
2.20:1	16	27	27
2.00:1	16	27	27
1.81:1	16	27	27
1.65:1	18	25	25
Use Tool Position 15:19			
1.50:1	15	19	19
1.36:1	15	19	19

If clearance is less than specified, add appropriate thickness of shims under lower tapered roller bearing cup.

**Any thickness added here must be subtracted from shim thickness at upper bearing.**

If clearance is more than specified, remove appropriate thickness of shims from under lower tapered roller bearing cup.

Any thickness subtracted here must be added to shim thickness at upper bearing.



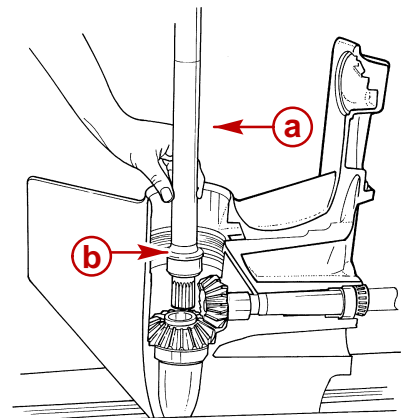
72451

- a** - Shims, Lower
- b** - Bearing Cup, Lower
- c** - Shims, Upper
- d** - Spacer
- e** - O-Ring

c. Recheck clearance after changing shim(s) (Step "b" above).

## Checking Backlash

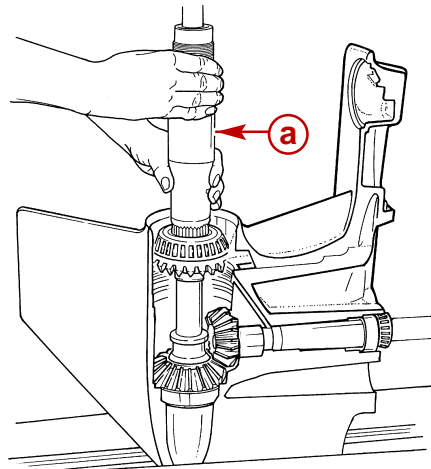
1. Install inner propeller shaft and thrust bearing into gear housing.



72270

- a** - Inner Propeller Shaft
- b** - Thrust Bearing

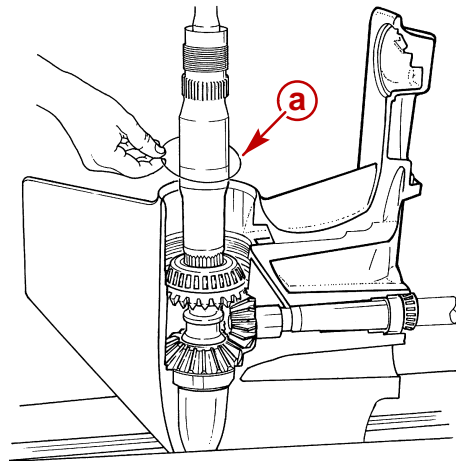
2. Fill area between outer propeller shaft seal lips with Quicksilver Special Lubricant 101 and install outer propeller shaft into gear housing.



72271

- a** - Outer Propeller Shaft

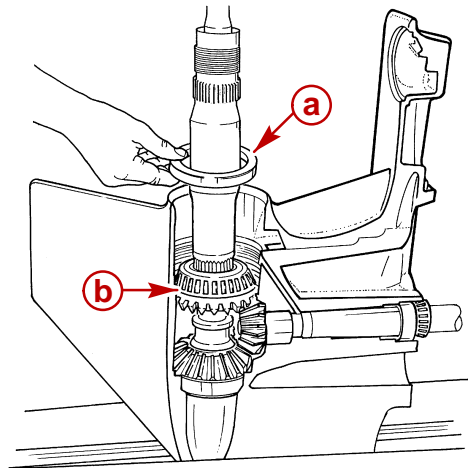
3. Install new shim pack of the same thickness as removed into gear housing. If shims were lost or ruined where original thickness cannot be determined, install a .050 in. (1.3 mm) shim pack for a starting point.



72272

**a** - Shim Pack

4. Install bearing cup into gear housing. Seat bearing cup against shim pack.



72273

**a** - Bearing Cup

**b** - Shim Pack

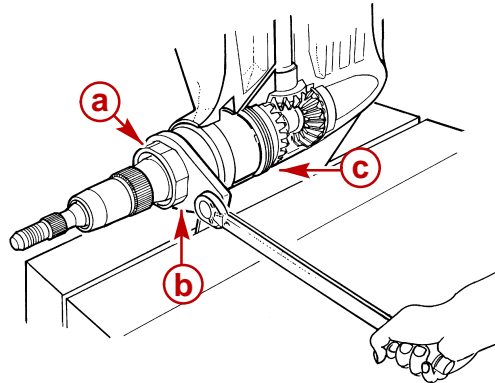
### **CAUTION**

Outer propeller shaft bearing retainer has a LEFT- HAND THREAD. Install by turning COUNTERCLOCKWISE.

**IMPORTANT:** Bearing carrier and threads on outer propeller shaft bearing retainer nut must be lubricated to prevent corrosion and cracking in gear housing.

5. Install outer propeller shaft bearing retainer nut, by turning counterclockwise, using outer propeller shaft bearing retainer installation tools. Torque to 200 lb-ft (271 Nm).

**NOTE:** To ensure proper thread engagement, start retainer nut by hand. Turn retainer nut clockwise until thread engagement is felt then turn counterclockwise.



72274

- a** - Bearing Retainer Installation Tool (P/N 91-805382T)
- b** - Bearing Carrier Tool (P/N 91-805374)
- c** - Bearing Retainer

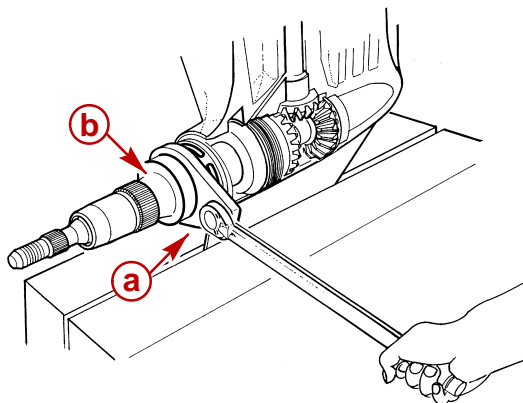
6. Apply Quicksilver Special Lubricant 101 to threads and O-ring surface area of bearing carrier and install O-ring on bearing carrier. Fill area between seals with same lubricant. Apply Quicksilver Perfect Seal to tapered surface of bearing carrier that comes in contact with housing.

### **CAUTION**

**Bearing carrier has a LEFT-HAND THREAD. Install by turning COUNTERCLOCKWISE.**

7. Install bearing carrier, by turning counterclockwise, using bearing carrier installation tool. Torque to 150 lb-ft (203 Nm).

**NOTE:** To ensure proper thread engagement, start retainer nut by hand. Turn retainer nut clockwise until thread engagement is felt then turn counterclockwise.



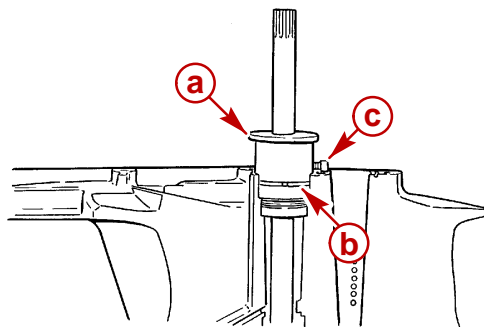
75895

- a** - Bearing Carrier Installation Tool (P/N 91-805374--1)
- b** - Bearing Carrier



## 8. Front driven gear shimming.

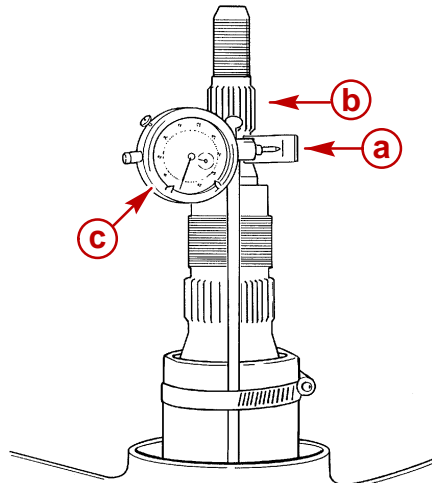
- a. Remove clamp plate, O-ring, spacer and shim(s), and place drive shaft retaining tool on tab washer as shown. Do not tighten locking bolt at this time.



72623

- a** - Drive Shaft Retaining Tool (P/N 91-805381)
- b** - Tab Washer
- c** - Locking Bolt

- b. Position gear housing so that propeller shafts are facing up in the vertical position. Rotate propeller shafts several times to seat bearings prior to making checks.
- c. Lightly press down on drive shaft retaining tool, while simultaneously turning shaft, to ensure bearings are seated in bearing cups, then tighten locking bolt to retain drive shaft.
- d. Install backlash indicator rod to inner propeller shaft as shown. Mount dial indicator to bearing carrier and position probe on mark stamped in indicator rod.



72908

- a** - Backlash Indicator Rod
- b** - Inner Propeller Shaft
- c** - Dial Indicator

- e. Check total gear/spline backlash by lightly rotating inner propeller shaft back and forth. Observe dial indicator and record reading.
- f. From the Gear/Spline Lash reading checked earlier, subtract reading obtained from Propeller Shaft Spline Lash Check. Actual gear backlash should be between .012-.016 in. (0.3-0.4 mm).

**Example:**

Total Gear/Spline Backlash  
(Reading - Step 8d Above): .030 In. (0.75 mm)

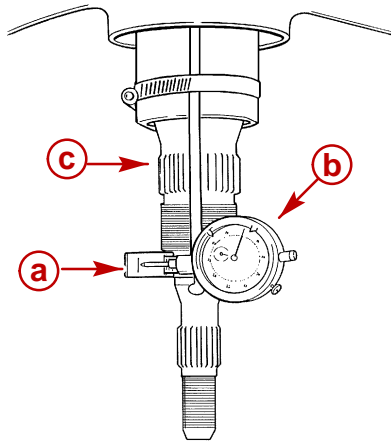
Minus

Spline Lash (From Propeller  
Shaft Spline Lash Check  
on page 3D-22): .016 In. (0.4 mm)

Equals

Actual Gear Backlash: .014 In. (0.35 mm)

- g. If backlash is not correct, disassemble and proceed as follows:
- If backlash is **more** than specified, **add** shims behind front driven gear bearing cup.
- If backlash is **less** than specified, **remove** shims behind front driven gear bearing cup.
- h. Recheck backlash reading after reassembly.
9. Rear driven gear shimming.
- a. Position gear housing so that propeller shafts are facing down in the vertical position. Loosen locking bolt on drive shaft retaining tool and rotate propeller shafts several times to seat bearings prior to making checks. Lightly press down on drive shaft retaining tool to ensure bearings are seated in bearing cups, then tighten locking bolt to retain drive shaft.
- b. Install backlash indicator rod to outer propeller shaft as shown. Mount dial indicator to bearing carrier and position probe on mark stamped in indicator rod.



75907

- a** - Backlash Indicator Rod  
**b** - Outer Propeller Shaft  
**c** - Dial Indicator

- c. Check gear/spline lash by lightly rotating outer propeller shaft back and forth. Observe dial indicator and record reading.
- d. From the Gear/Spline Lash reading checked earlier, subtract reading obtained from Propeller Shaft Spline Lash Check. Actual gear backlash should be between .012-.016 in. (0.3-0.4 mm).

**Example:**

Total Gear/Spline Backlash  
(Reading - Step 9c Above): .030 in. (0.75 mm)

Minus

Spline Lash (from Propeller  
Shaft Spline Lash Check  
from page 3D-22): .016 in. (0.4 mm)

Equals

Actual Gear Backlash: .014 in. (0.35 mm)

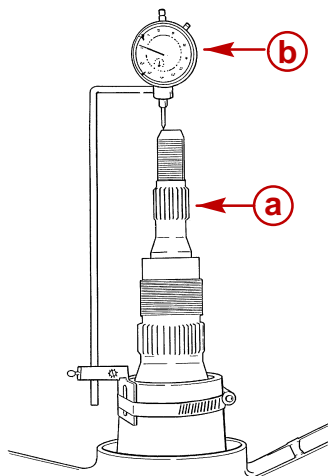
- e. If backlash is not correct, disassemble and proceed as follows:

If backlash is **more** than specified, **remove** shims in front of rear driven gear bearing cup.

If backlash is **less** than specified, **add** shims in front of rear driven gear bearing cup.

- f. Recheck backlash reading after reassembly.

10. **Check propshaft end play.** Install dial indicator on propshaft as illustrated below. Move inner shaft up and down while reading dial indicator (ensure outer shaft is also being lifted by inner shaft). End play reading should be between .001-.050 in. (0.025-1.27 mm). If reading is outside of range, the outer propeller shaft thrust race shims must be increased or decreased to bring the end-play reading within this range (Refer to 3D-25).



**a** - Inner Propeller Shaft

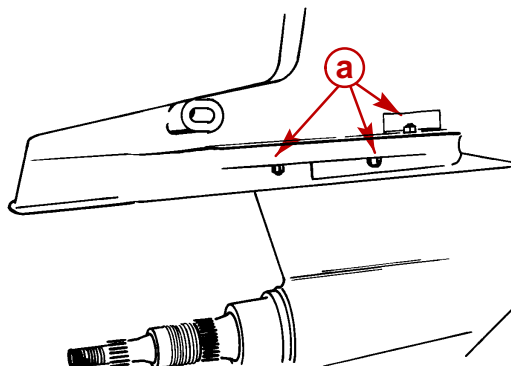
**b** - Dial Indicator

75909

11. Remove drive shaft retaining tool and reinstall shim(s), spacer and O-ring.

## Installing Gear Housing On Drive Shaft Housing

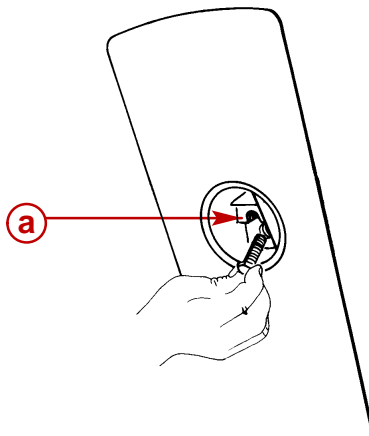
1. Install gear housing to drive shaft housing as follows:
  - a. Lower upper drive shaft housing down onto gear housing and install 6 locknuts and washers. Torque nuts to 35 lb-ft (47 Nm).



76803

**a** - Locknuts and Washers (6)

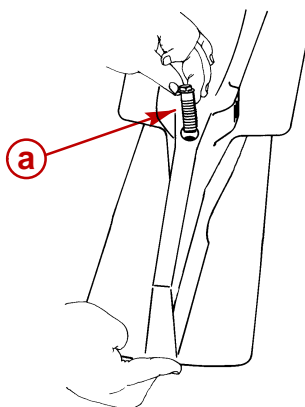
- b. Install bolt in anode cavity. Torque to 35 lb-ft (47 Nm).



76804

**a** - Bolt

- c. Install anode and torque to 20 lb-ft (27 Nm). Install rubber plug.



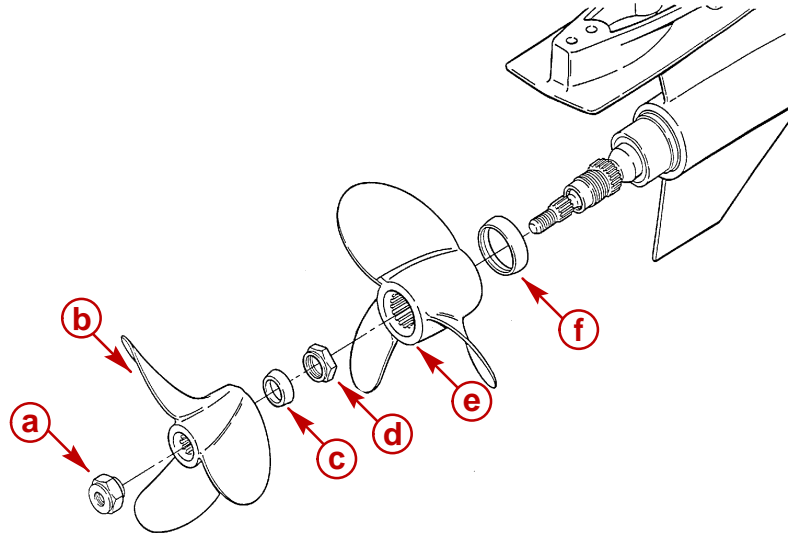
76832

**a** - Bolt

2. Reinstall drive unit. Refer to Section 2A - *Removal, Installation and Adjustments*.
3. Fill drive unit with gear lube. Refer to Section 1B - *Maintenance*.

# Propeller Installation

1. Apply a liberal coat of one of the following Quicksilver lubricants to both the inner and outer propeller shafts: Special Lubricant 101, 2-4-C Marine Lubricant with Teflon, or Anti-Corrosion Grease.



75899

- a** - Rear Propeller Nut
- b** - Rear Propeller
- c** - Rear Propeller Thrust Hub
- d** - Front Propeller Nut
- e** - Front Propeller
- f** - Front Propeller Thrust Hub

2. Slide the front thrust hub onto the outer propeller shaft with the tapered side of the hub toward the aft end of the propeller shaft.
3. Align the splines and place the forward propeller onto the outer propeller shaft.
4. Install the front propeller nut and torque to at least 100 lb-ft (136 Nm). Check propeller tightness after 20 hours of operation. DO NOT operate the boat with a loose propeller.
5. Slide the rear thrust hub onto the inner propeller shaft with the tapered side of the hub toward the aft end of the propeller shaft.
6. Align the splines and place the rear propeller onto the inner propeller shaft.
7. Install the rear propeller nut and torque to at least 60 lb-ft (81 Nm). Check propeller tightness after 20 hours of operation. DO NOT operate the boat with a loose propeller.

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# TRANSOM ASSEMBLY

## Section 4A - Service Procedures Requiring Minor Disassembly

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# Bravo Transom Assembly Specifications

## Torque Specifications

Description	lb-in.	lb-ft	Nm
Shift Cable Core Wire Anchor Screws	20		2.3
Hose Clamps	35		4
Trim Wire Retainer Screw	95		11
Hinge Pins		150	203
Through Bolt Locknut		25	34
Steering Arm Locknut		50	68
Pivot Bolt		23	30
U-bolt Nuts		53	72
Sterndrive Attaching Nut		23	30
Bell Housing Studs		50	68
Rear Engine Mount Attaching Bolts		37	50

## Lubricants / Sealants / Adhesives

Description	Part Number
3M Brand Adhesive	92-86166-1
Liquid Neoprene	92-25711-2
Resiweld Sealer	92-65150-1
Quicksilver High Performance Gear Lube	92-816026A4
Loctite 271	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver U-Joint and Gimbal Bearing Grease	92-828052A2
Super Glue	Obtain Locally
Perfect Seal	92-34227-1

## Tools

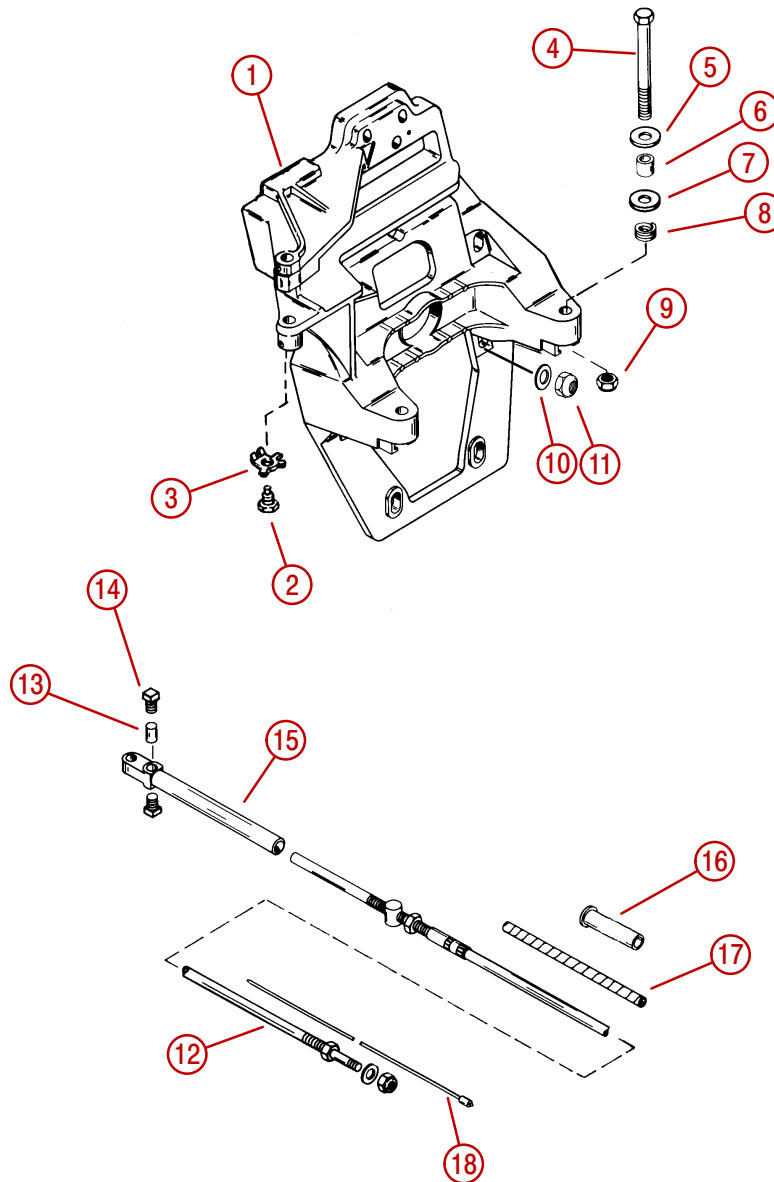
Description	Part Number
Bearing Removal and Installation Tool	91-31229A7
Bellows Expander Tool	91-45497A1
Slide Hammer Puller	91-34569A1
Tapered Insert Tool	91-43579
Core Wire Locating Tool	91-17263
Shift Cable Anchor Adjustment Tool	91-17262
Sleeve Removal Tool (U-joint Bellows)	91-862546
Sleeve Installation Tool (U-joint Bellows)	91-818162
Hinge Pin Tool	91-78310



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# Bravo Transom Assembly Exploded Views

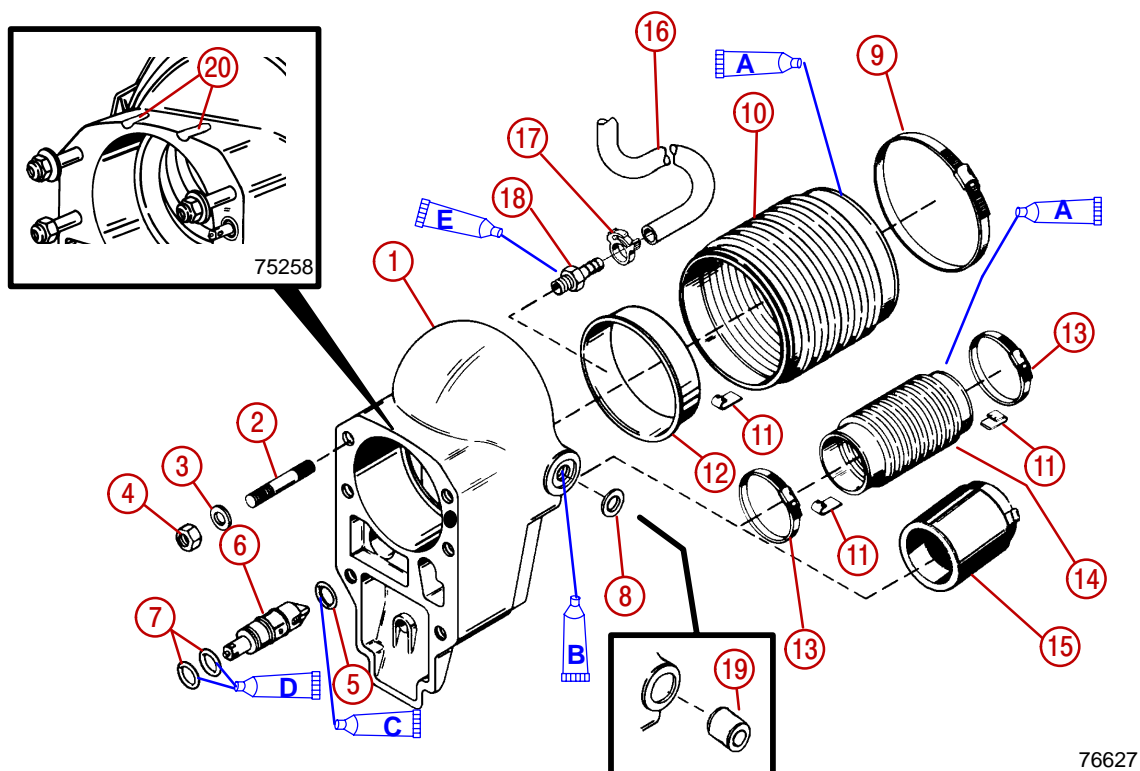
## Inner Transom Plate Components



76857






- |                                      |                                   |
|--------------------------------------|-----------------------------------|
| <b>1</b> - Transom Plate Assembly    | <b>10</b> - Washer                |
| <b>2</b> - Pivot Bolts               | <b>11</b> - Locknut               |
| <b>3</b> - Tab Washers               | <b>12</b> - Shift Cable Casing    |
| <b>4</b> - Screw Engine Mounting     | <b>13</b> - Core Wire Anchor      |
| <b>5</b> - Washer                    | <b>14</b> - Anchor Screws (2)     |
| <b>6</b> - Spacer                    | <b>15</b> - End Guide             |
| <b>7</b> - Fiber Washer              | <b>16</b> - Gimbal Housing Insert |
| <b>8</b> - Lockwasher - Double Wound | <b>17</b> - Wrapping              |
| <b>9</b> - Locknut                   | <b>18</b> - Core Wire             |

## Bell Housing Components

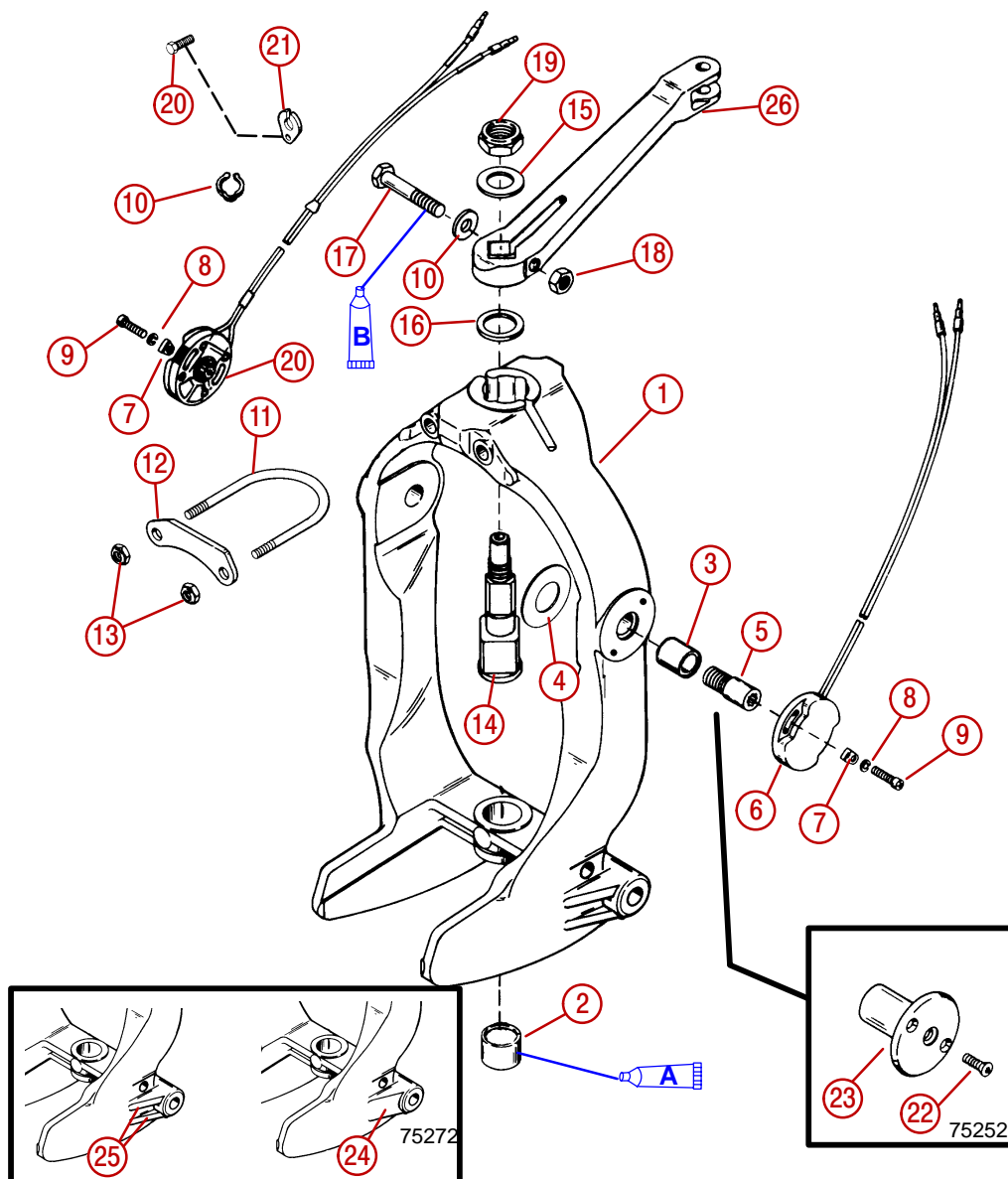


- 1 - Bell Housing
- 2 - Stud
- 3 - Washer
- 4 - Locknut
- 5 - O-ring
- 6 - Gear Lube Valve
- 7 - O-rings
- 8 - Hinge Pin Washer
- 9 - Bellows Clamp
- 10 - U-Joint Bellows

- 11 - Grounding Clip
- 12 - Sleeve
- 13 - Bellows Clamp
- 14 - Exhaust Bellows
- 15 - Exhaust Tube (Some Models)
- 16 - Lube Monitor Hose
- 17 - Hose Clamp
- 18 - Bayonet Fitting
- 19 - Bushing (High Performance Transom)
- 20 - Indentations in Bell Housing

-  - 3M Brand Adhesive
-  - Loctite 271
-  - 3M Brand Adhesive
-  - Quicksilver High Performance Gear Lube
-  - Perfect Seal

## Gimbal Ring Components



76618

- |  |   |
|--|---|
| <b>1</b> - Gimbal Ring                 | <b>16</b> - Flat Washer (Larger I.D.)   |
| <b>2</b> - Bushing                     | <b>17</b> - Clamp Screw   |
| <b>3</b> - Bushing                     | <b>18</b> - Locknut   |
| <b>4</b> - Flat Washer                 | <b>19</b> - Nut   |
| <b>5</b> - Hinge Pin                   | <b>20</b> - Screw   |
| <b>6</b> - Trim Position Sender        | <b>21</b> - Clamp Plate   |
| <b>7</b> - Clip                        | <b>22</b> - Screws (2) (High Performance Transom Only)                            |
| <b>8</b> - Lockwasher                  | <b>23</b> - Hinge Pin (High Performance Transom Only)                             |
| <b>9</b> - Screw                       | <b>24</b> - Magnum and High Performance Gimbal Ring Identification. (Filled Area) |
| <b>10</b> - Clip                       | <b>25</b> - Standard Gimbal Ring Identification. (Two Ribs)                       |
| <b>11</b> - U-Bolt                     | <b>26</b> - Steering Lever  |
| <b>12</b> - Plate                      |   |
| <b>13</b> - Locknuts                   |   |
| <b>14</b> - Swivel Shaft               |   |
| <b>15</b> - Flat Washer (Smaller I.D.) |   |

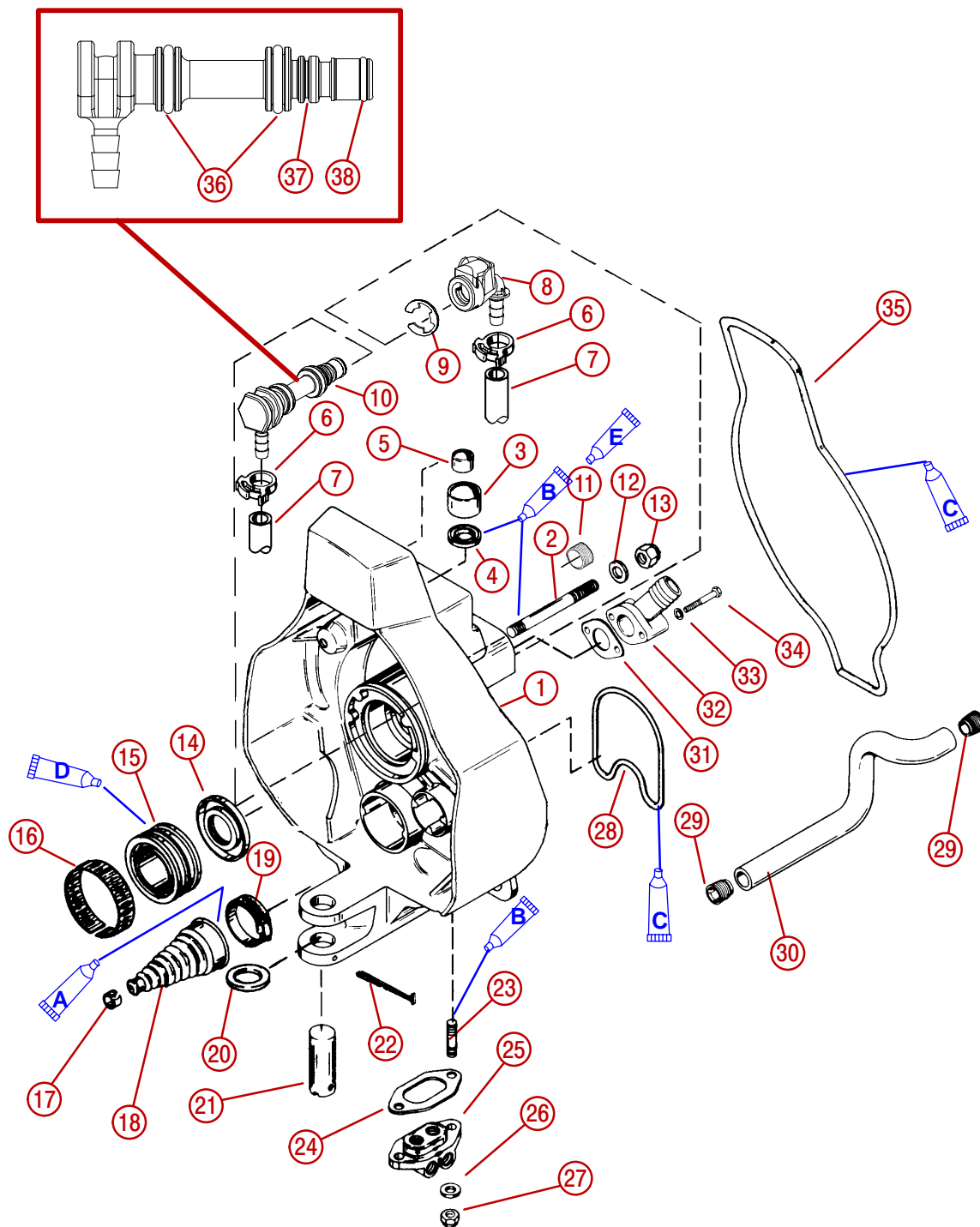


**A** - Resiweld Sealer



**B** - Quicksilver 2-4-C Marine Lubricant with Teflon

## Gimbal Housing Components



76642

- |                                       |                                  |
|---------------------------------------|----------------------------------|
| <b>1</b> - Gimbal Housing             | <b>20</b> - Washer               |
| <b>2</b> - Stud                       | <b>21</b> - Lower Swivel Pin     |
| <b>3</b> - Lower Swivel Shaft Bushing | <b>22</b> - Cotter Pin           |
| <b>4</b> - Seal                       | <b>23</b> - Stud                 |
| <b>5</b> - Upper Swivel Shaft Bushing | <b>24</b> - Gasket               |
| <b>6</b> - Clamp                      | <b>25</b> - Hydraulic Manifold   |
| <b>7</b> - Lube Monitor Hose          | <b>26</b> - Washer               |
| <b>8</b> - Quick Disconnect Fitting   | <b>27</b> - Locknut              |
| <b>9</b> - E-Clip                     | <b>28</b> - Exhaust Passage Seal |
| <b>10</b> - Gear Lube Fitting         | <b>29</b> - Water Hose Insert    |
| <b>11</b> - Water Bypass Plug         | <b>30</b> - Water Hose           |
| <b>12</b> - Flat Washer               | <b>31</b> - Water Fitting Gasket |
| <b>13</b> - Locknut                   | <b>32</b> - Water Fitting        |
| <b>14</b> - Seal                      | <b>33</b> - Lockwasher           |
| <b>15</b> - Gimbal Bearing            | <b>34</b> - Screw                |
| <b>16</b> - Tolerance Ring            | <b>35</b> - Gimbal Housing Seal  |
| <b>17</b> - Crimp Clamp               | <b>36</b> - Large O-rings        |
| <b>18</b> - Shift Cable Bellows       | <b>37</b> - Snap Ring Groove     |
| <b>19</b> - Bellows Clamp             | <b>38</b> - Small O-ring         |



- Loctite 271



- 3M Brand Adhesive



- Quicksilver U-Joint and Gimbal Bearing Grease



- Super Glue

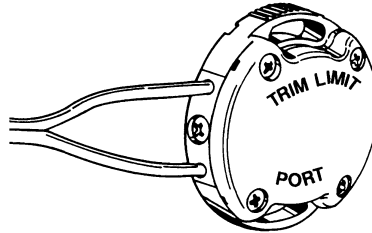


- Perfect Seal

## Special Information

### Trim Limit Switch

The trim limit switch has a sealing system for improved water resistance and durability. The trim limit switch leads are connected internally to help ensure good electrical integrity.

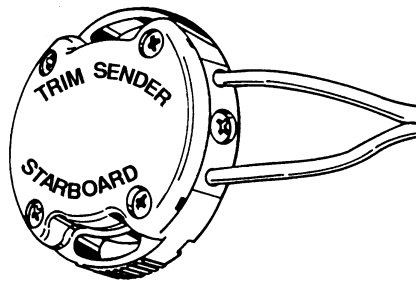


71415

Trim Limit Switch - Port

### Trim Position Sender

The trim position sender has a sealing system for improved water resistance and durability. The trim limit leads are connected internally to help ensure good electrical integrity.



71414

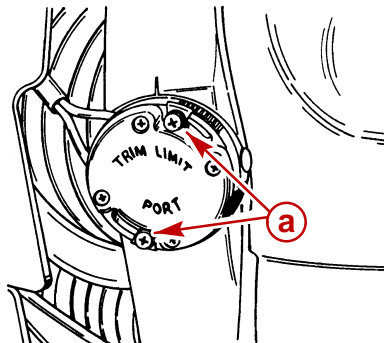
Trim Position Sender - Starboard

## Removal

### ⚠ WARNING

Disconnect both battery cables before installing new trim limit switch or trim sender.

1. Remove sterndrive unit. Refer to section 2A.
2. Remove trim limit switch.

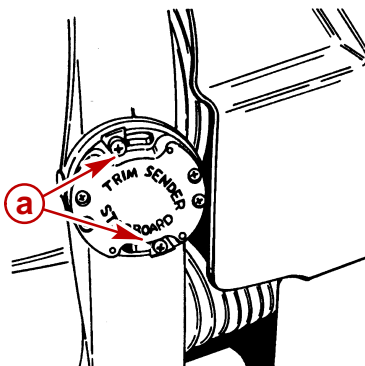


71221

**a** - Attaching Hardware



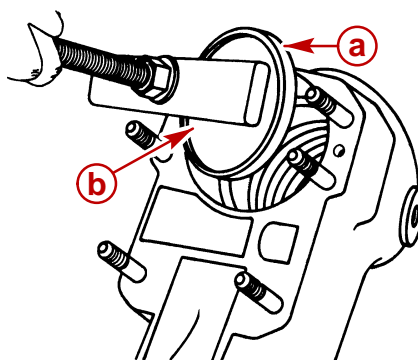
3. Remove trim position sender.



**a** - Attaching Hardware

71220

4. Remove U-joint bellows sleeve.

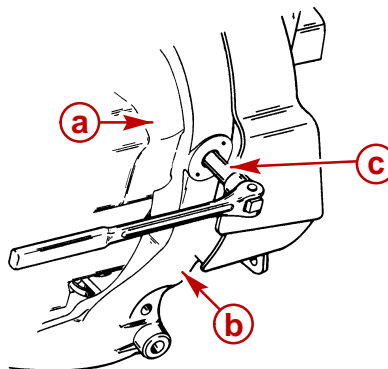


**a** - Sleeve

**b** - Removal Tool (P/N 91-862546)

71527

5. Remove both hinge pins.



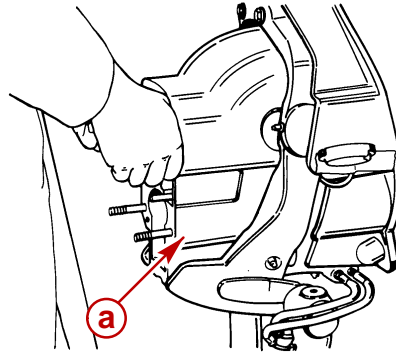
**a** - Bell Housing

**b** - Gimbal Ring

**c** - Hinge Pin Tool (P/N 91-78310)

22113

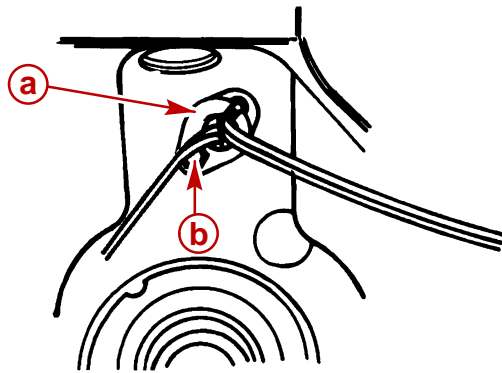
6. Pull back on bell housing and rotate it 90° to gain access to the trim wire clamp plate screw.



23363

**a** - Bell Housing

7. Remove trim wire clamp plate.



70197

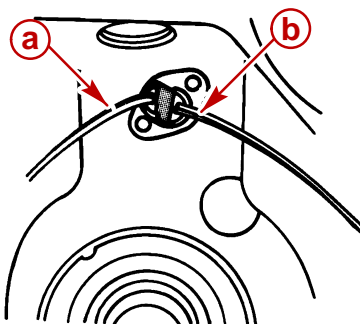
**a** - Clamp Plate  
**b** - Screw

8. Unplug trim position sender wires from engine harness.
9. Unplug trim limit switch wires from trim pump.

## Installation

**NOTE:** Old harness may be used to pilot new harnesses through hole in gimbal housing.

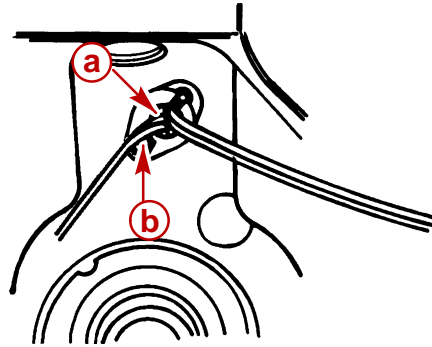
1. Route new sender wires through hole. Bring together the two grommet halves and ensure that they are seated lightly in the hole with the flat mating edges vertically aligned. Maintain light tension on the wires from inside the boat, to hold the grommets in the hole.



70198

**a** - Trim Limit Switch Wires  
**b** - Trim Position Sender Wires

2. Reinstall retainer. Torque screw to 95 lb-in. (11 Nm).

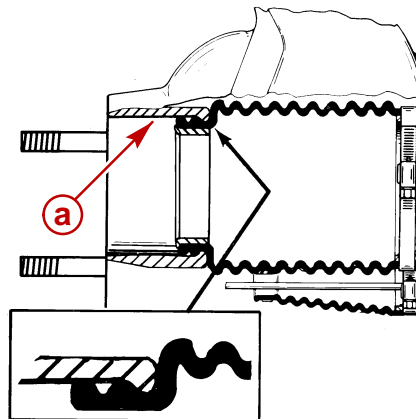


70197

- a** - Clamp  
**b** - Screw

3. Install U-joint bellows on bell housing as follows:

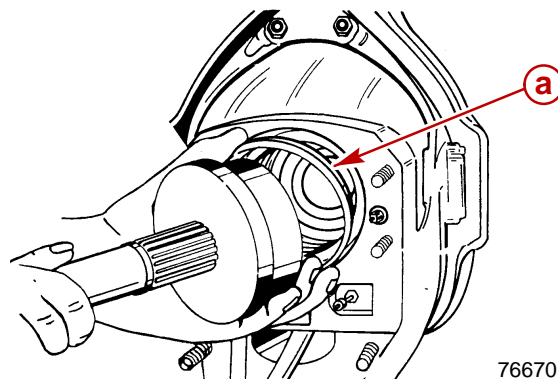
- a. Position U-joint bellows on bell housing. Ensure that the bell housing flange rests in the second groove from the end of the bellows.



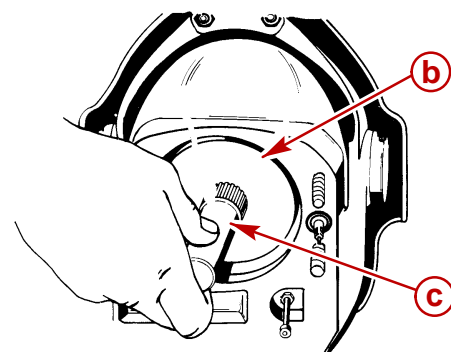
22116

- a** - Bell Housing Flange

- b. Lubricate sleeve outside diameter with soapy water or engine cleaner. Install sleeve with sleeve installation tool and a suitable driving rod.



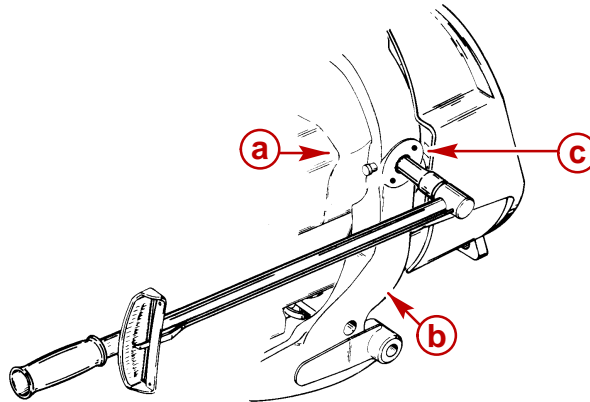
76670



76671

- a** - Sleeve  
**b** - Sleeve Installation Tool (91-818162)  
**c** - Suitable Driving Rod

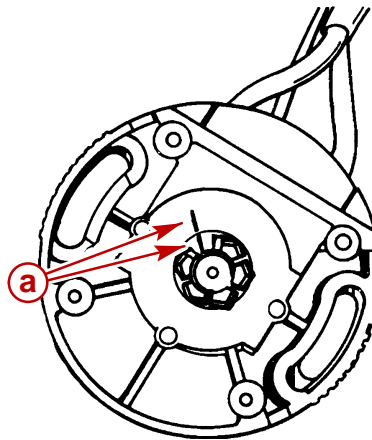
4. Apply Loctite 271 to bell housing threads and install hinge pins. Torque hinge pins to 150 lb-ft (203 Nm).



76619

- a** - Bell Housing
- b** - Gimbal Ring
- c** - Hinge Pin Tool (P/N 91-78310)

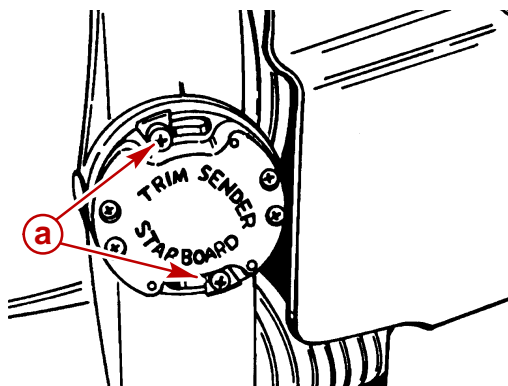
5. Install trim position sender as follows:
  - a. Place sterndrive unit in the full DOWN/IN position.
  - b. Turn center rotor of trim limit switch to align index mark with index mark on sender body.



71218

- a** - Index Marks

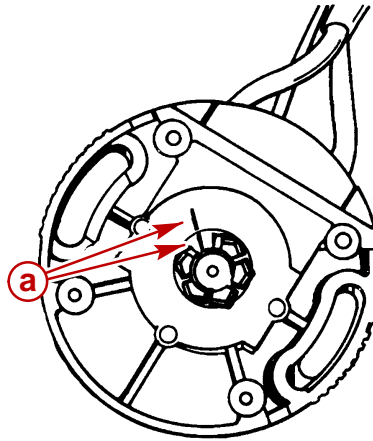
- c. Install trim position sender and secure with attaching hardware.



71220

- a** - Attaching Hardware

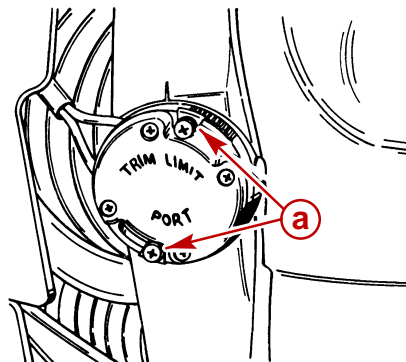
6. Reinstall trim limit switch as follows:
  - a. Place sterndrive unit in full DOWN/IN position.
  - b. Turn center rotor of trim position sender to align index mark with index mark on sender body.



71218

**a** - Index Marks

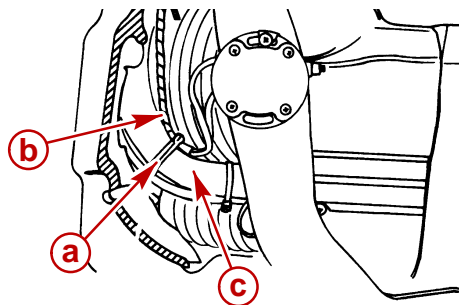
- c. Install trim limit switch and secure with attaching hardware.



71221

**a** - Attaching Hardware

7. Secure the trim limit switch harness to the water hose with the plastic clip.



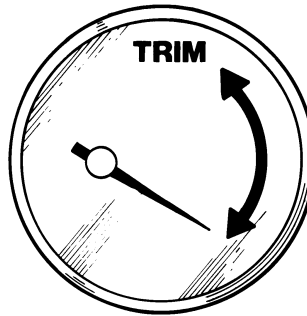
71184

**a** - Plastic Clip  
**b** - Trim Limit Switch Harness  
**c** - Water Hose

8. Reconnect trim position sender wires to engine harness and the trim limit leads to trim pump harness.
9. Reinstall battery cables.

## Trim Position Sender Adjustment

1. Turn ignition key to the RUN position. DO NOT START ENGINE. Rotate trim position sender until needle is at bottom of arc on gauge.



22175

2. Tighten trim position sender retaining screws and recheck gauge.

## Trim Limit Switch Adjustment

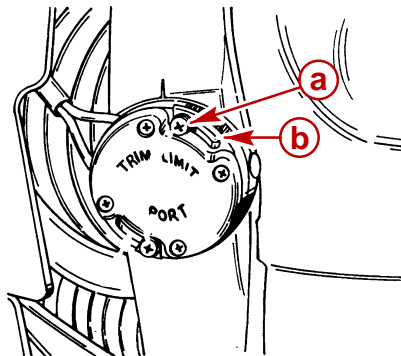
### **⚠ WARNING**

When adjusting trim limit switch, use extreme care that engine is not started and keep clear of area near propeller. Use care to prevent placing hands in an area where injury could occur because of sterndrive unit movement.

### **⚠ CAUTION**

Trim limit switch **MUST BE** adjusted exactly as outlined. If switch is adjusted incorrectly, sterndrive unit could move out beyond the gimbal ring support flanges and cause damage to sterndrive unit.

1. Adjust trim limit switch as follows:
  - a. Loosen screws and turn trim limit switch clockwise to end of slots.



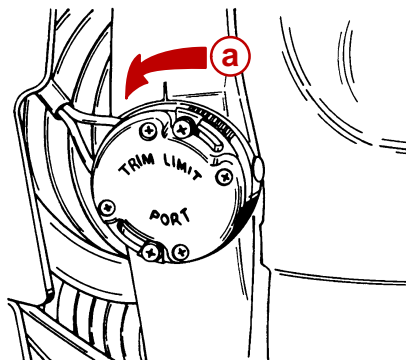
71221

**a** - Screws

**b** - Slots

- b. Ensure that sterndrive unit is in the full DOWN/IN position.
- c. Trim sterndrive unit UP/OUT. Do not use trailer switch.

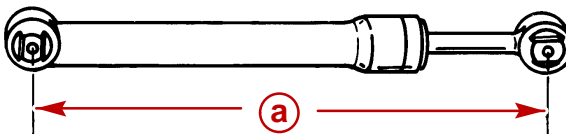
- d. Slowly turn trim limit switch counterclockwise until trim cylinders extend to correct dimension.



71221

**a** - Rotate Counterclockwise to Adjust

- e. Retighten screws when adjustment is correct.



50464

**a** - 21-3/4 in. (552mm) Maximum

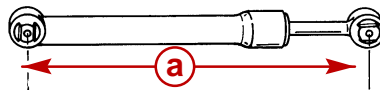
## High Performance Transom Assembly - Without Electrical Trim Sender and Trim Limit Switch

**IMPORTANT:** The electrical Trim Limit Switch and Trim Position Sender are not present on this transom assembly. Without a Trim Limit Switch, the sterndrive unit can be trimmed UP/OUT beyond the position where the sterndrive unit has side support from the gimbal ring at any throttle setting. It is highly recommended that a mechanical (cable actuated) Trim Position Indicator be installed to provide important sterndrive unit trim angle information to the operator and that the Trim Indicator be marked to clearly indicate the maximum UP/OUT position where side support is still provided. The sterndrive unit should not be trimmed to a position beyond gimbal ring side support at engine speeds above 1200 rpm.

### **WARNING**

Avoid personal injury or damage to sterndrive unit. Do not trim sterndrive unit to an UP/OUT position where the sterndrive unit receives no side support from the gimbal ring at engine speeds above 1200 rpm. Refer to a properly marked mechanical Trim Position Indicator.

1. Install WARNING DECAL (Contained in the transom assembly box) at the operator station in a place where it will be clearly visible to the operator.
2. To mark the maximum Trim UP/OUT position on the mechanical trim indicator, proceed as follows:
  - a. Trim sterndrive unit(s) to the FULL DOWN/IN position.
  - b. Ensure that the mechanical trim indicator indicates FULL DOWN/IN position. Adjust the indicator following the manufacturers recommendations.
  - c. Slowly raise the sterndrive unit(s) until the trim limit point is reached. The trim limit point can be determined by measuring the amount of trim cylinder extension. The dimension for the Bravo sterndrive units is 21-3/4 in. (552 mm), which is measured from front anchor point to rear anchor point centerlines as shown following.



50464

**a** - Trim Limit Dimension 21-3/4 in. (552 mm)

3. With the trim cylinders at this position, place a mark on the mechanical trim indicator in console.
  - a. Raise and lower sterndrive unit(s) several times to ensure that the trim limit point is properly marked.



# Gimbal Bearing

**IMPORTANT:** Gimbal bearing and carrier are a matched set and must be replaced as an assembly. Tolerance ring must be replaced any time gimbal bearing is removed.

## Inspection

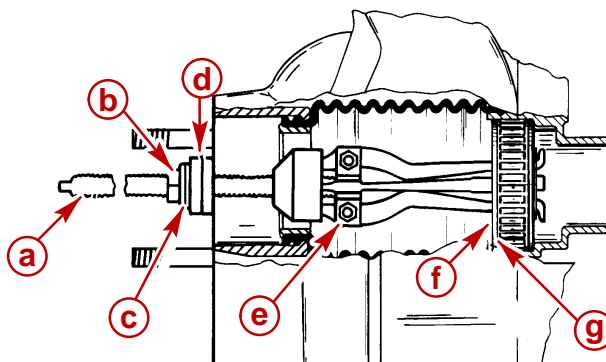
1. Remove sterndrive unit.
2. Reach through bell housing. Rotate gimbal bearing and check for rough spots. Pull and push on inner race to check for side wear. Any excessive movement or roughness is cause for replacement.

## Removal

### ⚠ CAUTION

Do not remove gimbal bearing unless replacement is necessary, as damage to bearing may result during removal.

1. Remove gimbal bearing assembly.

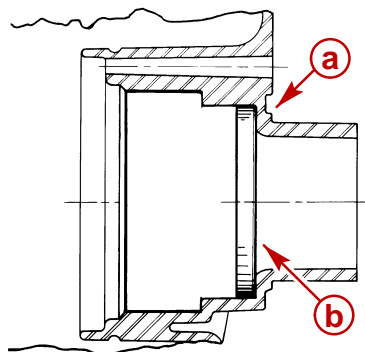


76658

- a** - \* Puller Shaft 91-31229
- b** - \* Nut 11-24156
- c** - \* Washer 12-34961
- d** - 3 Plates 91-29310
- e** - Slide Hammer Puller
- f** - Gimbal Bearing Inner Race
- g** - Gimbal Bearing Carrier

\* From Bearing Removal and Installation Tool 91-31229A7

2. Remove grease seal using a slide hammer.

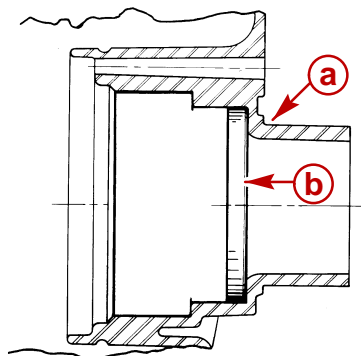


22171

- a** - Gimbal Housing
- b** - Grease Seal

## Installation

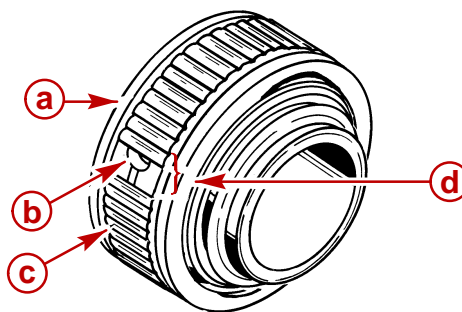
1. Install grease seal using a suitable mandrel.



22171

- a** - Gimbal Housing
- b** - Grease Seal

2. Install and position new tolerance ring.

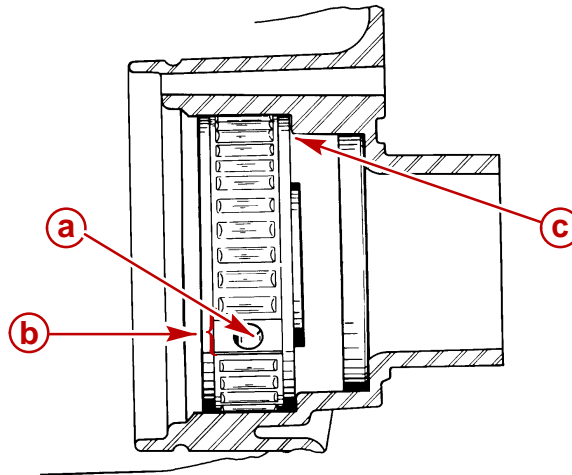


22159

- a** - Carrier
- b** - Carrier Grease Hole
- c** - Tolerance Ring
- d** - Align Opening in Tolerance Ring with Grease Hole in Carrier

**IMPORTANT:** Ensure that notched edge of bearing carrier faces inward in bore.

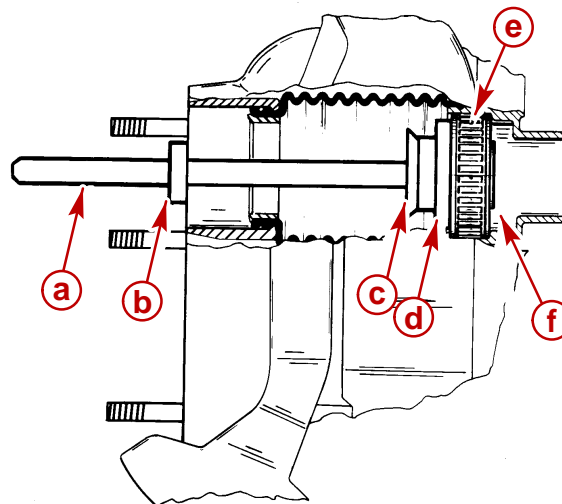
3. Align gimbal bearing carrier grease hole and tolerance ring opening with grease cavity hole in gimbal housing.



76559

- a** - Gimbal Bearing Carrier Grease Hole
- b** - Tolerance Ring Opening
- c** - Bearing Carrier Notch - Face Inward

4. Install gimbal bearing using a brass hammer and tools shown. Make sure that gimbal bearing carrier contacts gimbal housing.



22118

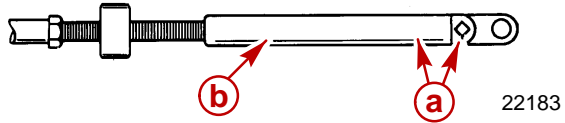
- a** - \*Drive Rod 91-37323
- b** - \*Plate 91-29310
- c** - \*Drive Head 91-32325
- d** - \*Mandrel 91-30366
- e** - Gimbal Bearing Assembly
- f** - Chamfer

\* From Bearing Removal and Installation Tool 91-31229A7

# Shift Cable

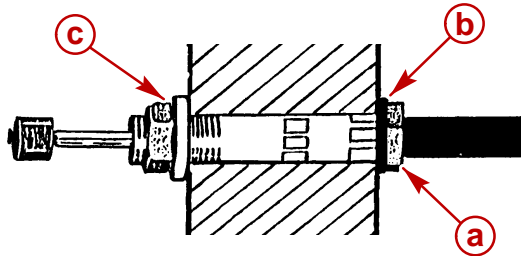
## Removal

1. Remove sterndrive unit. Refer to Section 2A.
2. Disconnect shift cable from shift plate and remove end guide.



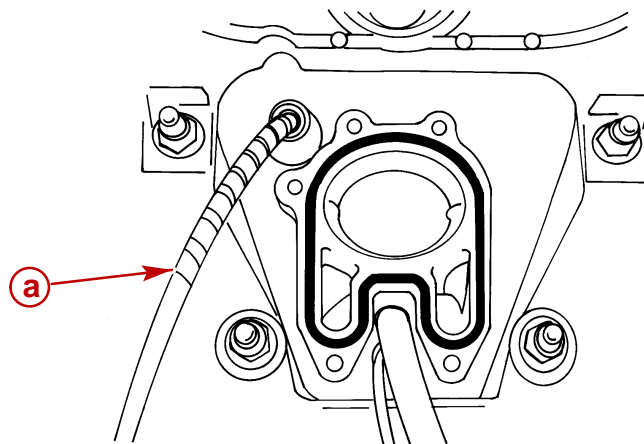
- a** - Anchor Screws (2) - Loosen
- b** - End Guide

3. Remove flanged nut.
4. Hold shift cable retaining nut with wrench.



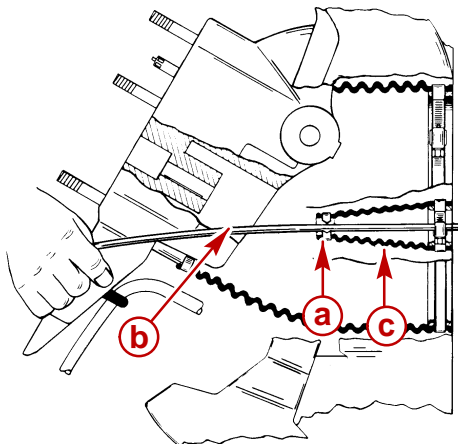
- a** - Shift Cable Retaining Nut
- b** - Seal Washer
- c** - Flanged Nut

5. Remove shift cable wrapping.



- a** - Shift Cable Wrapping

6. Loosen shift cable bellows crimp clamp.



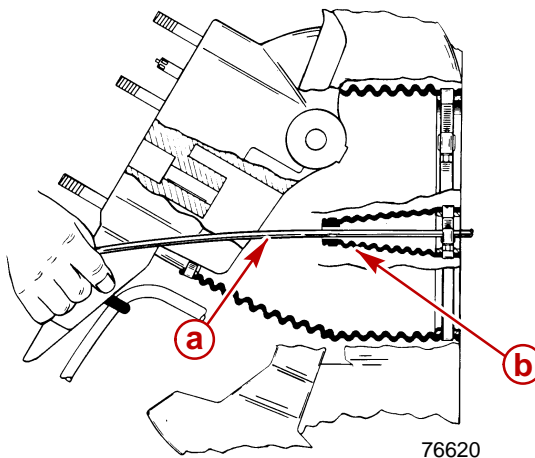
50458

- a** - Crimp Clamp
- b** - Shift Cable
- c** - Shift Cable Bellows

7. Pull shift cable through shift cable bellows.

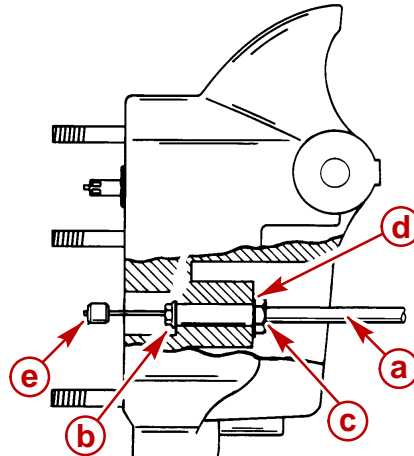
## Shift Cable Installation

1. Insert shift cable end into and through shift cable bellows.



- a** - Shift Cable End
- b** - Shift Cable Bellows

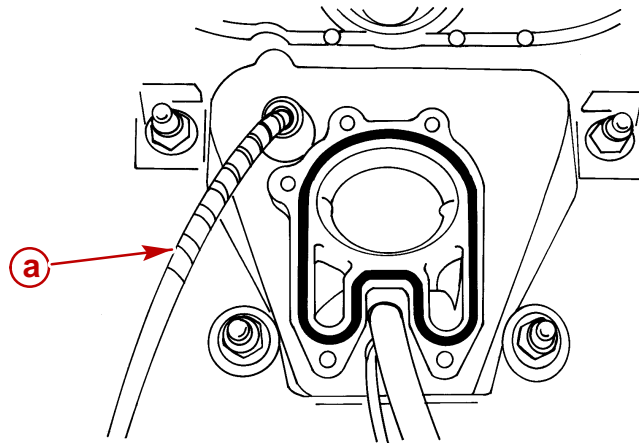
2. Apply Perfect Seal to flanged nut threads. Secure shift cable to bell housing. Hold shift cable retaining nut with wrench and torque flanged nut to 65 lb-in. (7 Nm).



50327

- a - Shift Cable
- b - Flanged Nut
- c - Shift Cable Retaining Nut
- d - Seal Washer (Hidden by Nut)
- e - Core Wire

3. Install shift cable wrapping approximately 2" from gimbal housing.



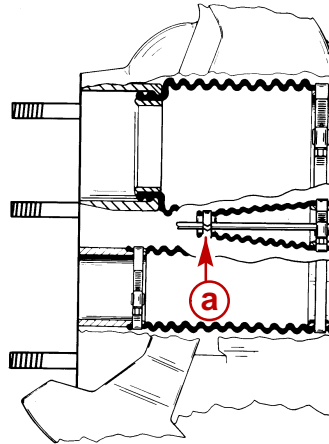
76639

- a - Shift Cable Wrapping

### **⚠ CAUTION**

Water leakage may result if clamp is not installed properly. Check that bellows end is not flattened out when crimping in the following step.

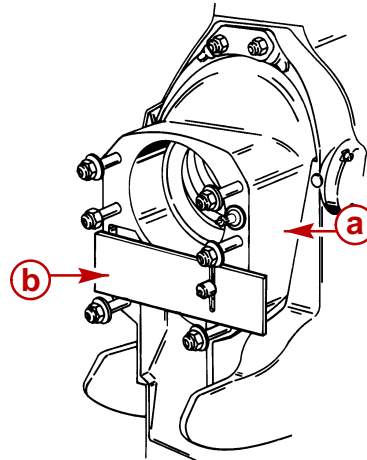
4. Install and compress shift cable bellows crimp clamp, maintaining a 1/2 in. diameter **round** O.D. Ensure that clamp is crimped evenly to maintain a good seal between bellows and shift cable. Refer to "Crimp Clamp Tool." Do NOT allow bellows to flatten.



22117

**a** - Crimp Clamp

5. Install core wire locating tool on face of bell housing.

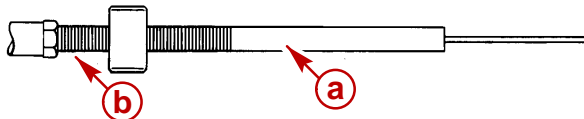


50327

**a** - Bell Housing

**b** - Core Wire Locating Tool (P/N 91-17263)

6. Install threaded tube until it bottoms.
7. Tighten finger tight.
8. Tighten jam nut securely.

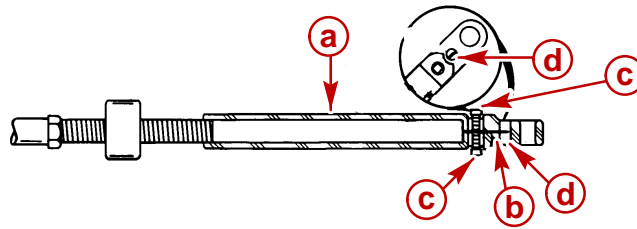


22183

**a** - Threaded Tube

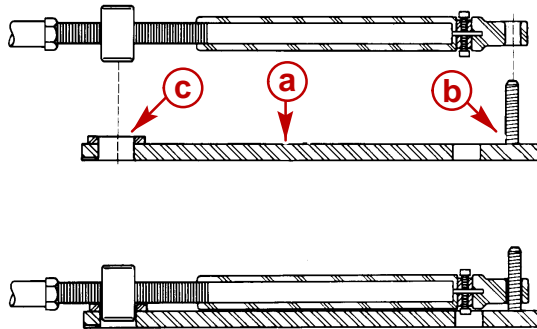
**b** - Jam Nut

9. Install cable end guide over core wire and insert core wire through cable anchor. Ensure that core wire is visible in sight port. Tighten anchor screws evenly and torque to 20 lb-in. (2.3 Nm).



- a** - Cable End Guide
- b** - Core Wire
- c** - Anchor Screws
- d** - Sight Port

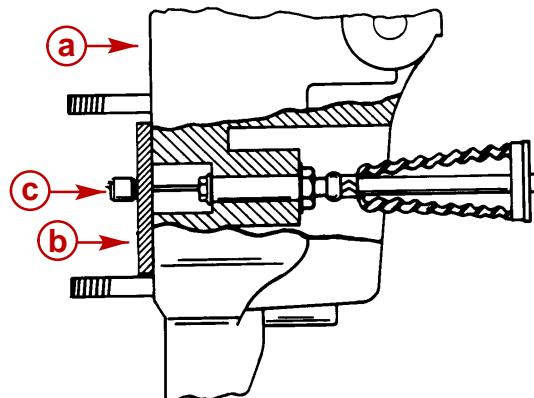
10. Place shift cable anchor adjustment tool on end of shift cable.



- a** - Shift Cable Anchor Adjustment Tool (91-17262)
- b** - Stud
- c** - Hole - Barrel Placed Here

22120

11. Ensure that bell housing end of core wire is positioned tight against core wire locating tool.



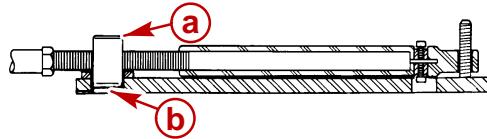
- a** - Bell Housing
- b** - Core Wire Locating Tool
- c** - Core Wire

22121

12. Adjust cable barrel to align with hole in tool.



13. Remove tools and install cable on shift plate assembly, being careful not to lose adjustment.



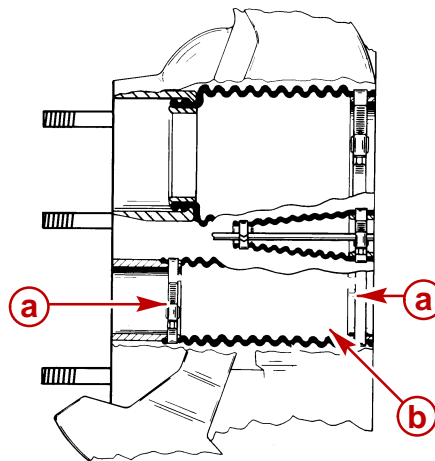
22120

- a** - Barrel  
**b** - Hole In Tool

## Exhaust Bellows (If Equipped)

### Removal

1. Remove sterndrive unit. Refer to Section 2A.
2. Loosen clamps and remove bellows.



22116

- a** - Clamps  
**b** - Bellows

### Cleaning and Inspection

1. Inspect exhaust bellows for internal charring, cracks, cuts or hardening.
2. Clean old adhesive from bellows mounting flange on gimbal housing and on bell housing with lacquer thinner.
3. Clean old adhesive from mounting surface of exhaust bellows if using old bellows.
4. Roughen exhaust bellows mating surfaces with sandpaper and wipe clean with lacquer thinner.

## Installation

**IMPORTANT:** All replacement bellows should be P/N 18654. Do not use earlier model bellows.

### **⚠ WARNING**

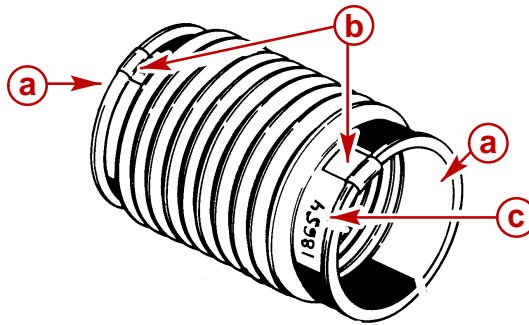
**Be sure to follow label directions when using bellows adhesive.**

1. Apply bellows adhesive to mounting surfaces on inside of bellows. Allow adhesive to dry until no longer tacky (approximately 10 minutes).

### **⚠ CAUTION**

**Bellows clamps may corrode if grounding clips are not installed.**

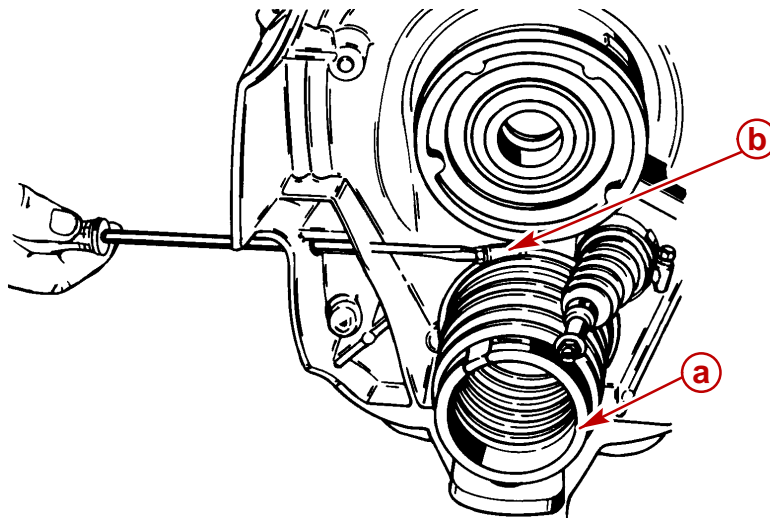
2. Position grounding clips on bellows.



22079

- a** - Apply Bellows Adhesive
- b** - Grounding Clips
- c** - Part Number -

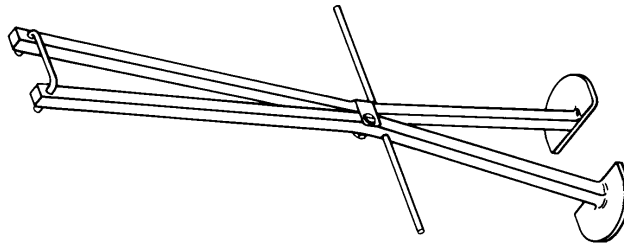
3. Install exhaust bellows on gimbal housing. Torque clamp to 35 lb-in. (4 Nm).



76660

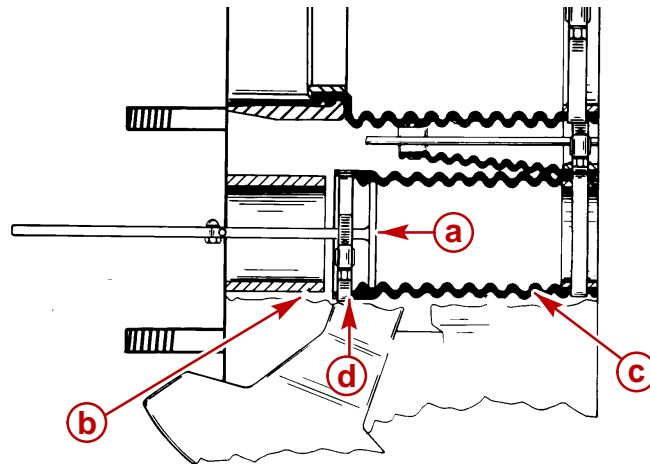
- a** - Exhaust Bellows
- b** - Hose Clamp

4. Install exhaust bellows on bell housing as follows:
  - a. Place hose clamp over bellows end.
  - b. Place expander tool into first bellows convolution.



22161

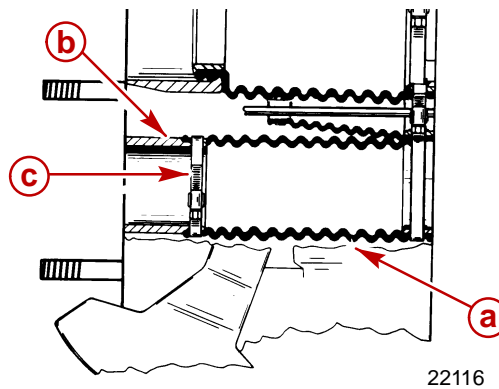
- c. Pull tool until tool touches the flange on bell housing (hose starts to slip onto flange) and then release tool.



22116

- a** - Expander Tool (91-45497A1)
- b** - Bell Housing Flange
- c** - Exhaust Bellows
- d** - Hose Clamp

- d. Reposition tool into the third bellows convolution.
  - e. Pull bellows onto bell housing flange.
  - f. Torque hose clamp to 35 lb-in. (4 Nm).



22116

- a** - Exhaust Bellows
- b** - Bell Housing Flange
- c** - Hose Clamp

# Exhaust Tube (If Equipped)

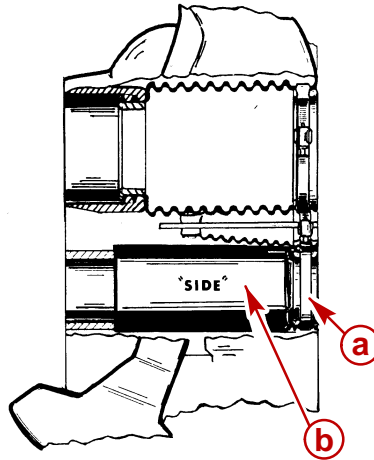
## Removal

**NOTE:** It is not necessary to remove drive unit when replacing exhaust tube.

### **⚠ CAUTION**

**Support aft end of drive unit when working between bell housing and gimbal housing.**

1. Raise drive unit to the full UP position.
2. Loosen clamp and remove exhaust tube.



22184

- a** - Clamp  
**b** - Exhaust Tube

## Cleaning and Inspection

1. Inspect exhaust tube for charring, cracks, cuts and hardening.
2. Roughen exhaust tube mating surfaces with sandpaper and wipe clean with lacquer thinner.

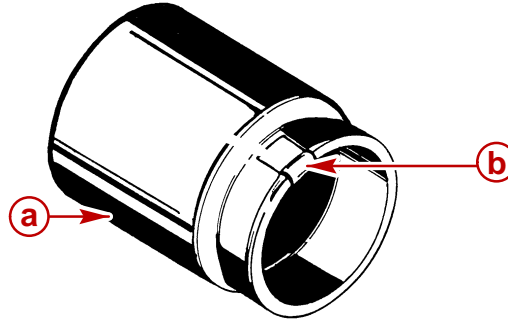
## Installation

**NOTE:** Bellows adhesive is not used when installing an exhaust tube.

### **CAUTION**

Exhaust tube clamp may corrode if grounding clip is not installed.

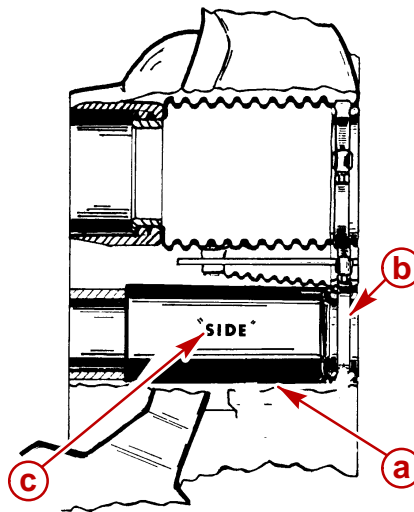
1. Position grounding clip on exhaust tube as shown.



22184

- a** - Exhaust Tube
- b** - Grounding Clip

2. Install exhaust tube on gimbal housing as follows:
  - a. Position tube so that SIDE markings on tube are facing toward the right and left sides.
  - b. Position clamp so that screw will align with screwdriver access hole in port (left) side of gimbal housing.
  - c. Tighten clamp. Torque to 35 lb-in. (4 Nm).



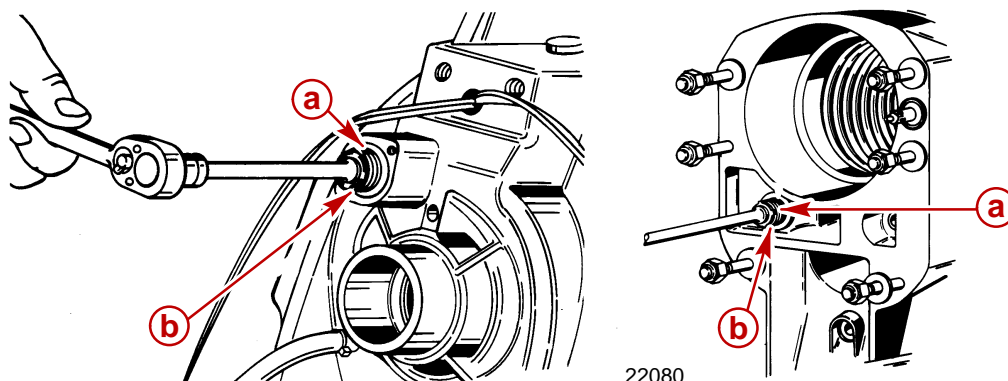
22184

- a** - Exhaust Tube
- b** - Clamp
- c** - Side Marking

# Water Hose and Water Fitting

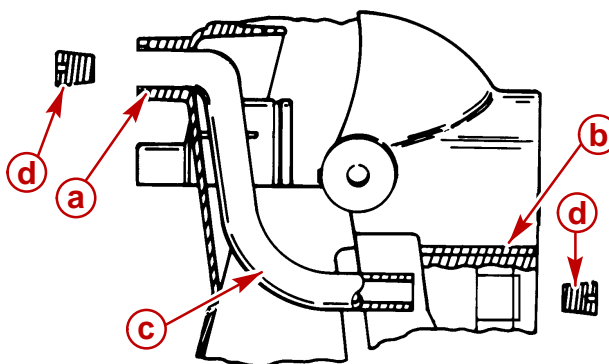
## Removal

1. Remove tapered inserts.



- a** - Tapered Inserts
- b** - Tapered Insert Tool (91-43579)

2. Remove water hose.



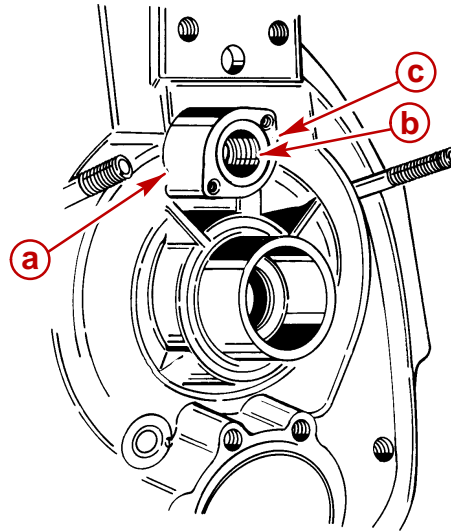
- a** - Gimbal Housing
- b** - Bell Housing
- c** - Water Hose
- d** - Tapered Inserts

## Installation

### ⚠ CAUTION

The water hose in the following step is a preformed hose and must be installed with the short end of the molded hose going into the gimbal housing. The hose must be held in place while installing the tapered inserts. Failure to hold hose in place can result in an overheat condition.

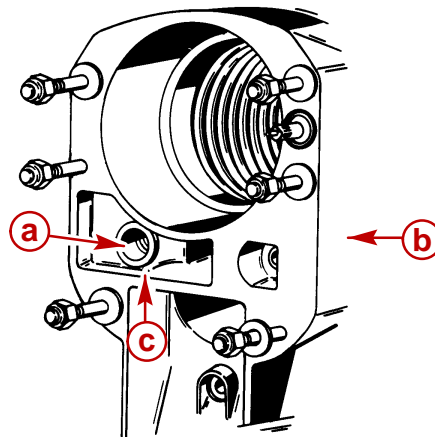
1. Position water hose as follows:
  - a. Gimbal Housing - hose edge must be flush with mounting surface.



22080

- a** - Gimbal Housing
- b** - Water Hose
- c** - Mounting Surface

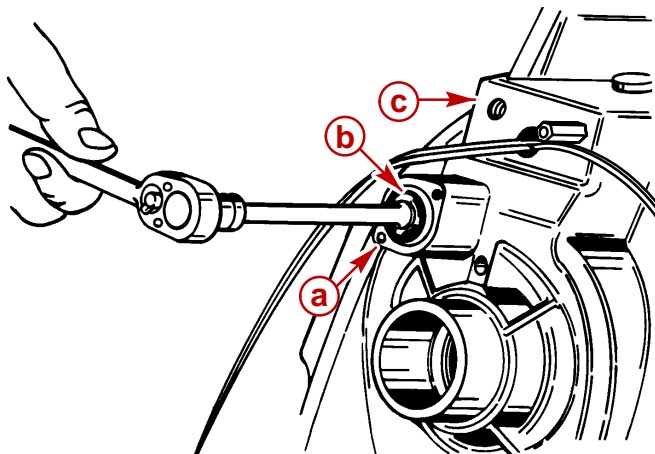
- b. Bell Housing - hose edge should protrude approximately 1/8 in. from edge of hole.



50322

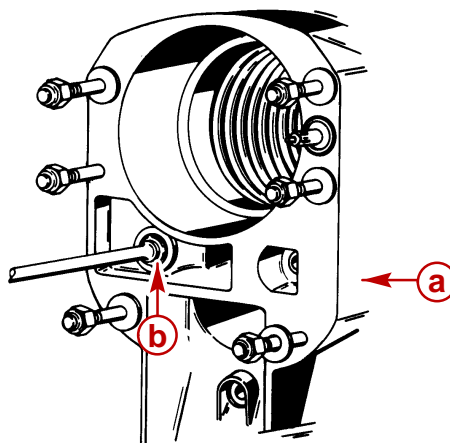
- a** - Bell Housing
- b** - Water Hose
- c** - Hole

2. Apply a small amount of 2-4-C Marine Lubricant with Teflon to threads and install tapered inserts with tapered insert tool.



75962

- a** - Tapered Insert
- b** - Tapered Insert Tool (91-43579)
- c** - Gimbal Housing

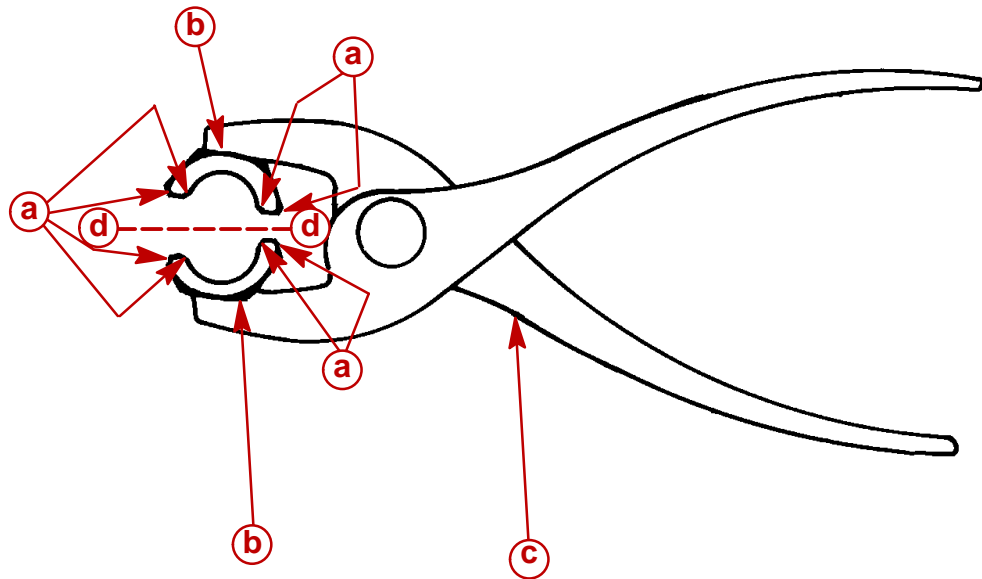


50322

- a** - Bell Housing
- b** - Tapered Insert Tool



# Crimp Clamp Tool



74148

- a** - Bevel Edges
- b** - 3/4 in. Nut
- c** - Pliers
- d** - Nut (Cut In Half)

1. Weld a 3/4 in. nut to the jaws of a pair of pliers.
2. Saw the nut in half without damaging the pliers.
3. Clamp the jaws of the pliers in a vice so that the two halves of the nut are pressed firmly together.
4. Use a 1/2 in. drill bit to drill out the threads of the nut.
5. Remove the pliers from the clamp and bevel the edges of the nut as indicated.

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# TRANSOM ASSEMBLY

## Section 4B - Service Procedures Requiring Major Disassembly

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Gimbal Housing Servicing . . . . .	4B-26	Bravo Access Plug Drilling Template . . . .	4B-55
U-joint Bellows Replacement . . . . .	4B-26	Crimp Clamp Tool . . . . .	4B-57

# Bravo Transom Assembly Specifications

## Torque Specifications

DESCRIPTION	lb-in.	lb-ft	Nm
Shift Cable Core Wire Anchor Screws	20		2.3
Hose Clamps	35		4
Trim Wire Clamp	95		11
Hinge Pins		150	203
Bell Housing Studs		50	68
Steering Arm Nut			
Rear Engine Mounting Bolt		37	50
U-Bolt Nuts		53	72
Transom Stud Locknut		25	34
Pivot Bolt		23	30
Sterndrive Attaching Nut			

## Lubricants / Sealants / Adhesives

DESCRIPTION	PART NUMBER
3M Brand Adhesive	92-86166-Q1
Liquid Neoprene	92-25711-3
Resiweld Sealer	92-65150-1
Loctite 271	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12

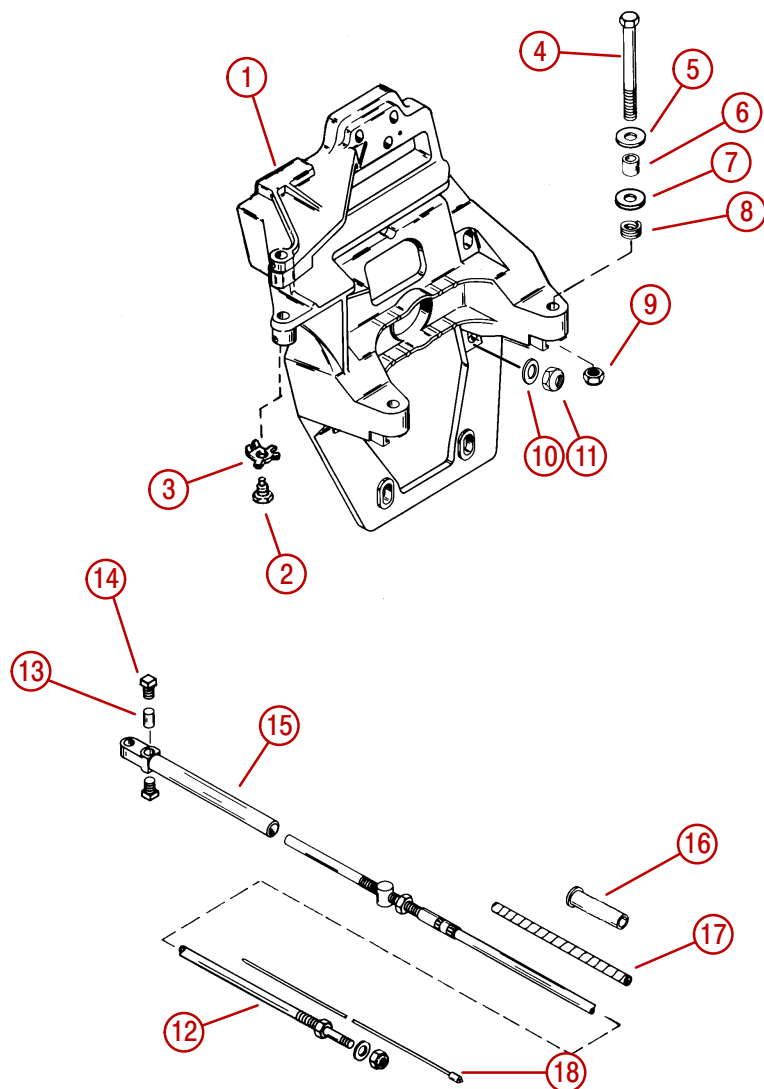
## Special Tools

DESCRIPTION	PART NUMBER
Bearing Removal and Installation Tool	91-31229A7
Bellows Expander Tool	91-45497A1
Slide Hammer Puller	91-34569A1
Tapered Insert Tool	91-43579
Core Wire Locating	91-17263
Shift Cable Anchor Adjustment Tool	91-17262
Sleeve Removal Tool (U-joint Bellows)	91-862546
Sleeve Installation Tool (U-joint Bellows)	91-818162
Hinge Pin Puller (High Performance Transom Assembly)	91-63616T

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# Bravo Transom Assembly Exploded Views

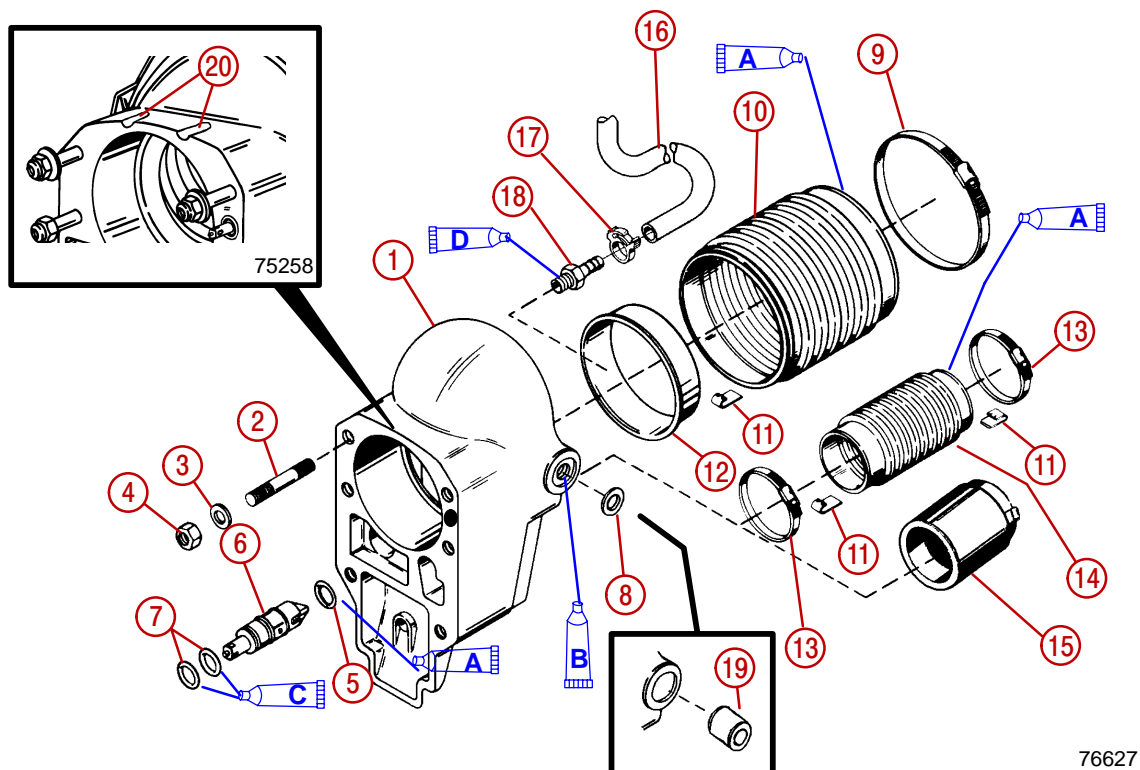
## Inner Transom Plate Components



76626





- |                                      |                                   |
|--------------------------------------|-----------------------------------|
| <b>1</b> - Transom Plate Assembly    | <b>10</b> - Washer                |
| <b>2</b> - Pivot Bolts               | <b>11</b> - Locknut               |
| <b>3</b> - Tab Washers               | <b>12</b> - Shift Cable Casing    |
| <b>4</b> - Rear Engine Mounting Bolt | <b>13</b> - Core Wire Anchor      |
| <b>5</b> - Washer                    | <b>14</b> - Anchor Screws (2)     |
| <b>6</b> - Spacer                    | <b>15</b> - End Guide             |
| <b>7</b> - Washer - Fiber            | <b>16</b> - Gimbal Housing Insert |
| <b>8</b> - Lockwasher - Double Wound | <b>17</b> - Core Wire             |
| <b>9</b> - Locknut                   |                                   |

## Bell Housing Components

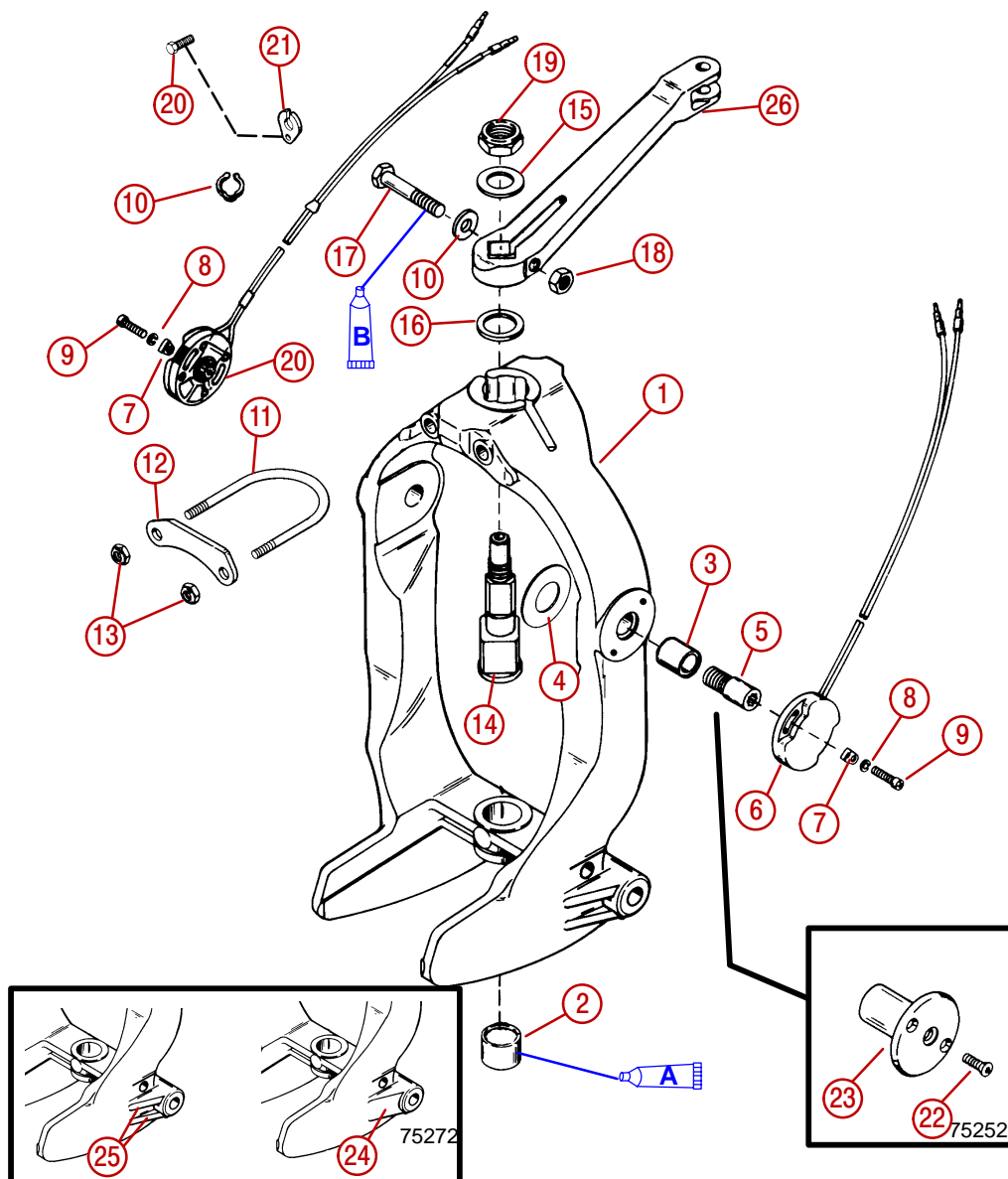


- |                             |  |
|-----------------------------|--|
| <b>1</b> - Bell Housing     | <b>12</b> - Sleeve                             |
| <b>2</b> - Stud             | <b>13</b> - Bellows Clamp                      |
| <b>3</b> - Washer           | <b>14</b> - Exhaust Bellows                    |
| <b>4</b> - Locknut          | <b>15</b> - Exhaust Tube (Some Models)         |
| <b>5</b> - O-ring           | <b>16</b> - Lube Monitor Hose                  |
| <b>6</b> - Gear Lube Valve  | <b>17</b> - Hose Clamp                         |
| <b>7</b> - O-rings          | <b>18</b> - Bayonet Fitting                    |
| <b>8</b> - Hinge Pin Washer | <b>19</b> - Bushing (High Performance Transom) |
| <b>9</b> - Bellows Clamp    | <b>20</b> - Indentations in Bell Housing       |
| <b>10</b> - U-Joint Bellows |  |
| <b>11</b> - Grounding Clip  |  |

### Lubricants/Sealants/Adhesives

-  **A** - 3M Brand Adhesive
-  **B** - Loctite 271
-  **C** - Quicksilver High Performance Gear Lube
-  **D** - Quicksilver Perfect Seal

## Gimbal Ring Components



76897



<b>1</b> - Gimbal Ring	<b>16</b> - Flat Washer (Larger I.D.)
<b>2</b> - Bushing	<b>17</b> - Clamp Screw
<b>3</b> - Bushing	<b>18</b> - Locknut
<b>4</b> - Flat Washer	<b>19</b> - Nut
<b>5</b> - Hinge Pin	<b>20</b> - Screw
<b>6</b> - Trim Position Sender	<b>21</b> - Clamp Plate
<b>7</b> - Clip	<b>22</b> - Screws (2) (High Performance Transom Only)
<b>8</b> - Lockwasher	<b>23</b> - Hinge Pin (High Performance Transom Only)
<b>9</b> - Screw	<b>24</b> - Magnum and High Performance Gimbal Ring Identification. (Filled Area)
<b>10</b> - Clip	<b>25</b> - Standard Gimbal Ring Identification. (Two Ribs)
<b>11</b> - U-Bolt	<b>26</b> - Steering Lever
<b>12</b> - Plate	
<b>13</b> - Locknuts	
<b>14</b> - Swivel Shaft	
<b>15</b> - Flat Washer (Smaller I.D.)	

### Lubricants/Sealants/Adhesives

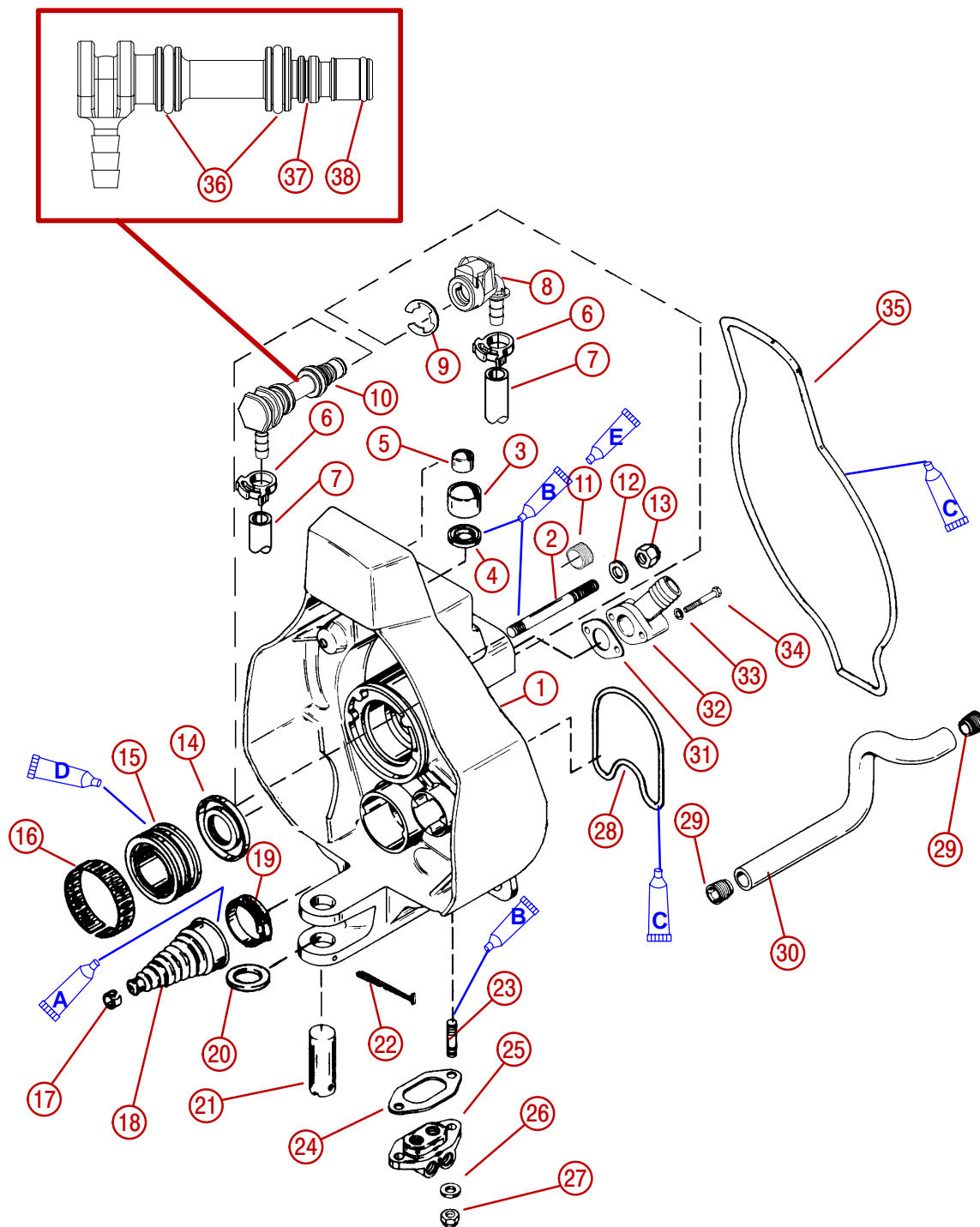


- Resiweld Sealer



- Quicksilver 2-4-C Marine Lubricant with Teflon






## Gimbal Housing Components



76642

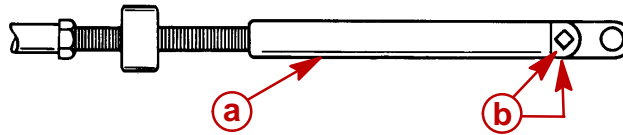
<b>1</b> - Gimbal Housing	<b>20</b> - Washer
<b>2</b> - Stud	<b>21</b> - Lower Swivel Pin
<b>3</b> - Lower Swivel Shaft Bushing	<b>22</b> - Cotter Pin
<b>4</b> - Seal	<b>23</b> - Stud
<b>5</b> - Upper Swivel Shaft Bushing	<b>24</b> - Gasket
<b>6</b> - Clamp	<b>25</b> - Hydraulic Manifold
<b>7</b> - Lube Monitor Hose	<b>26</b> - Washer
<b>8</b> - Quick Disconnect Fitting	<b>27</b> - Locknut
<b>9</b> - E-Clip	<b>28</b> - Exhaust Passage Seal
<b>10</b> - Gear Lube Fitting	<b>29</b> - Water Hose Insert
<b>11</b> - Water Bypass Plug	<b>30</b> - Water Hose
<b>12</b> - Flat Washer	<b>31</b> - Water Fitting Gasket
<b>13</b> - Locknut	<b>32</b> - Water Fitting
<b>14</b> - Seal	<b>33</b> - Lockwasher
<b>15</b> - Gimbal Bearing	<b>34</b> - Screw
<b>16</b> - Tolerance Ring	<b>35</b> - Gimbal Housing Seal
<b>17</b> - Crimp Clamp	<b>36</b> - Large O-rings
<b>18</b> - Shift Cable Bellows	<b>37</b> - Snap Ring Groove
<b>19</b> - Bellows Clamp	<b>38</b> - Small O-ring

### Lubricants, Sealants, and Adhesives

-  **A** - Loctite 271
-  **B** - 3M Brand Adhesive
-  **C** - Quicksilver U-Joint and Gimbal Bearing Grease
-  **D** - Super Glue
-  **E** - Perfect Seal

# Bell Housing Removal

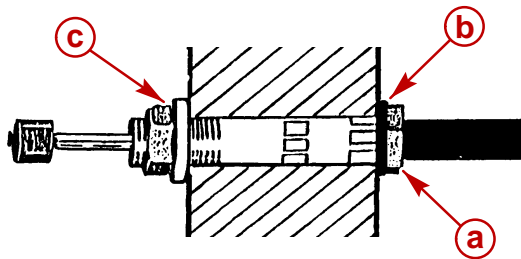
1. Remove sterndrive unit. Refer to Section 2A.
2. Remove shift cable from bell housing by loosening anchor screws and disconnecting shift cable end guide from shift bracket.
3. Remove end guide.



22183

- a** - End Guide
- b** - Anchor Screws (2)

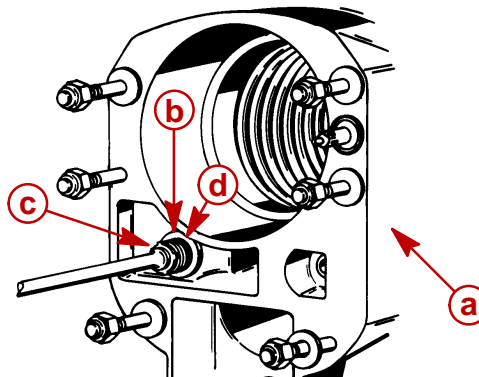
4. Remove flanged nut. Hold shift cable retaining nut with wrench.



76673

- a** - Shift Cable Retaining Nut
- b** - Seal Washer
- c** - Flanged Nut

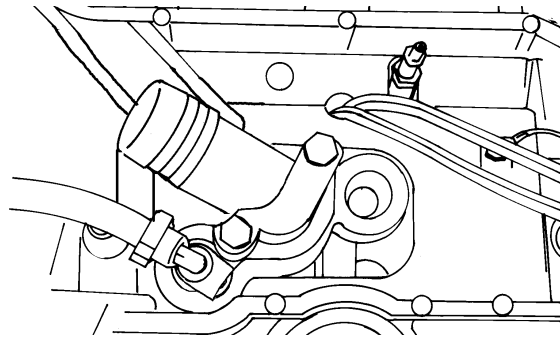
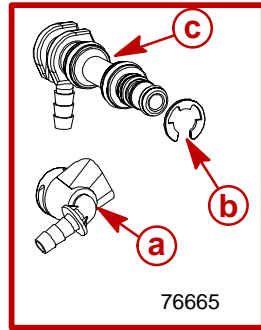
5. Turn tapered insert counterclockwise to remove from I.D. of water hose.
6. Remove water hose from bell housing.



50322

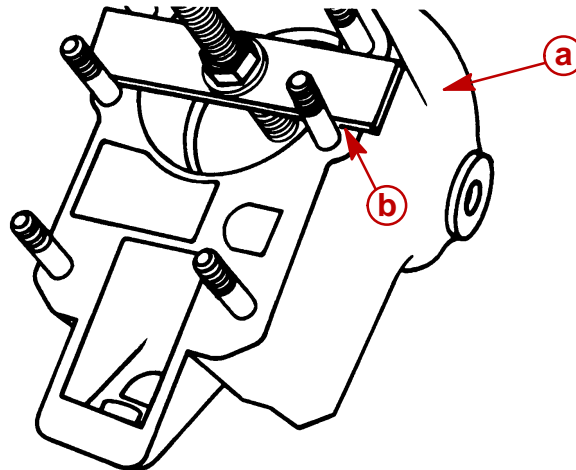
- a** - Bell Housing
- b** - Tapered Insert
- c** - Tapered Insert Tool (91-43579)
- d** - Water Hose

7. Remove gear lube monitor 90° quick disconnect fitting and through bulkhead fitting E-clip so that fitting will pull out of gimbal housing upon removal of bell housing.



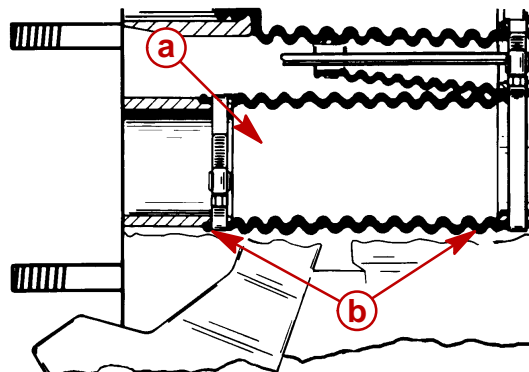
- a** - Quick Disconnect Fitting  
**b** - E-Clip  
**c** - Through Bulkhead Fitting

8. Spray engine cleaner around edge of bellows sleeve and remove with U-joint bellows sleeve removal tool.



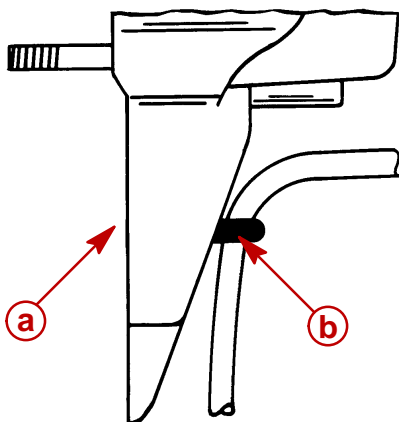
- a** - Bell Housing  
**b** - U-Bellows Sleeve Removal Tool (91-862546)

9. Loosen hose clamps.  
 10. Remove exhaust bellows from bell housing.



- a** - Exhaust Bellows  
**b** - Hose Clamps

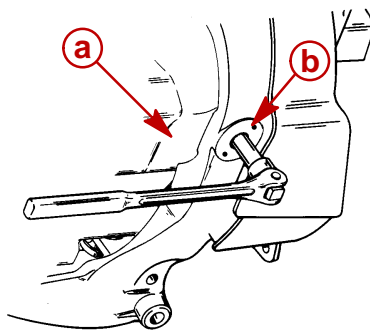
11. Remove speedometer tubing clip from bell housing.



22121

- a** - Bell Housing
- b** - Speedometer Tubing Clip

12. **On Standard Transom Assembly** - Remove hinge pins from port and starboard sides.

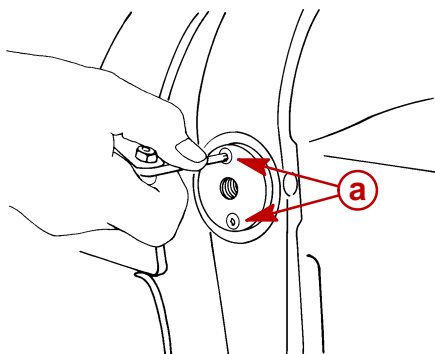


22113

- a** - Bell Housing
- b** - Hinge Pins

13. **On High Performance Transom Assembly** - Remove hinge pins using special tool (91-63616) and slide hammer as follows:

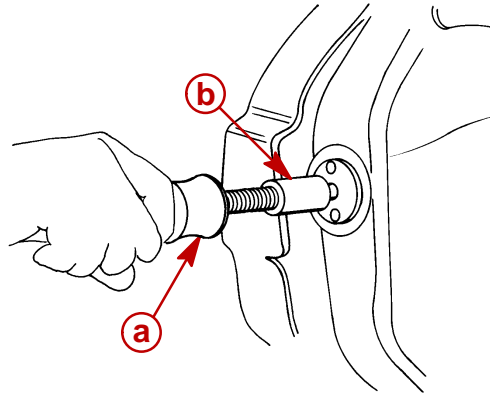
- a. Remove hinge pin screws.



71825

- a** - Hinge Pin Screws

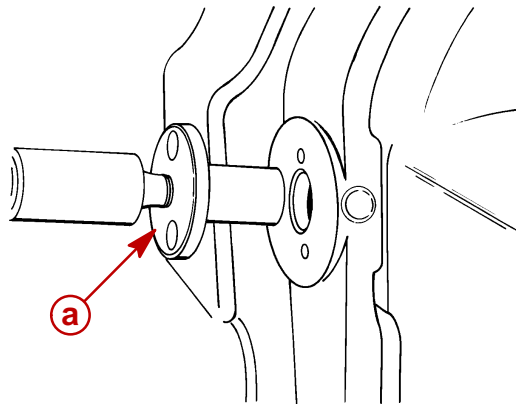
- b. Thread special tool into hinge pin.



71826

- a** - Slide Hammer  
**b** - Special Tool (91-63616)

- c. Remove hinge pins.



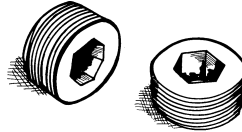
71828

- a** - Hinge Pin

## Access Plug Kit Installation

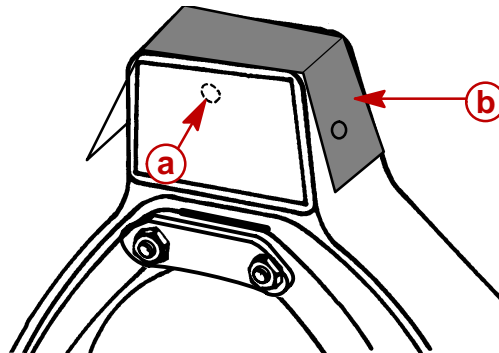
**NOTE:** If steering lever cavity is not accessible, it will be necessary to drill access holes in gimbal housing. This procedure requires the following:

Access Plug Kit 22-88847A-1  
1-1/8 in. Hole Saw (obtain locally)  
1 in. NPT Pipe Tap (obtain locally)



22756

1. Use template at the end of this section as a guide for the correct location for cutting and drilling access holes. Align template with dimple located beneath decal on the gimbal housing.



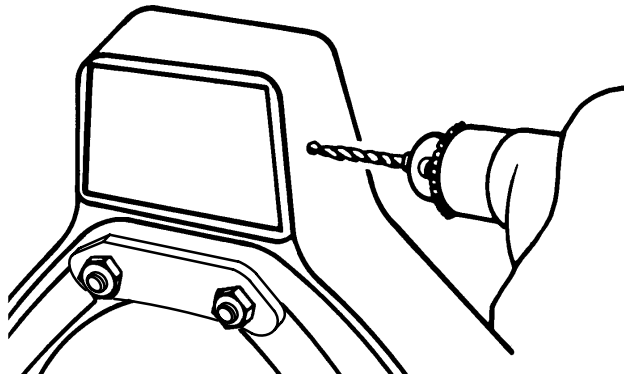
76628

**a** - Dimple (Beneath decal)  
**b** - Template

### **CAUTION**

Be sure to drill and cut hole and tap threads perpendicular to gimbal housing surfaces in the following steps.

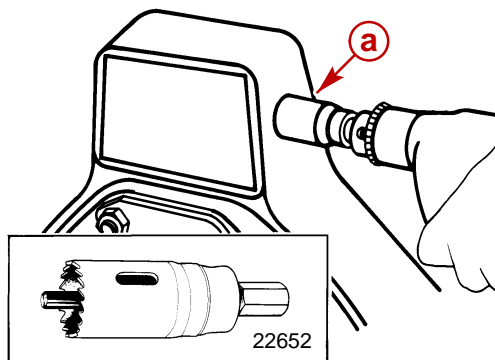
2. Drill pilot holes (port and starboard) using a 1/4 in.(6 mm) drill bit.



75915



3. Cut holes in gimbal housing (port and starboard) using 1-1/8 in. hole saw and pilot rod.



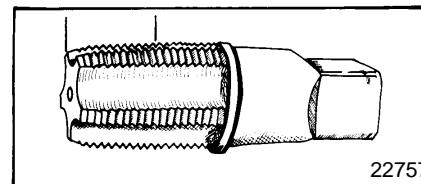
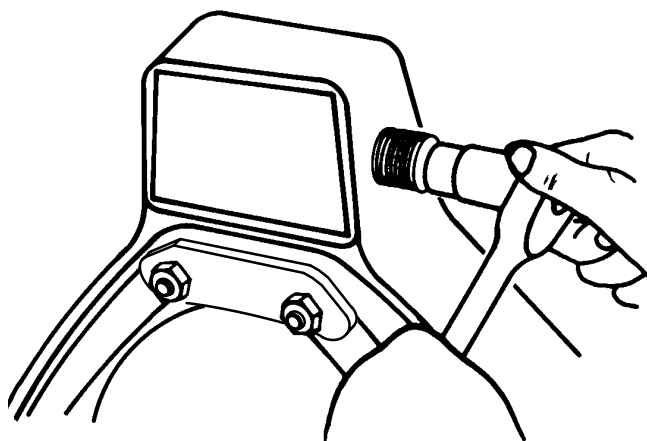
70153

**a** - Hole Saw

### **⚠ WARNING**

**Always wear safety glasses when using compressed air.**

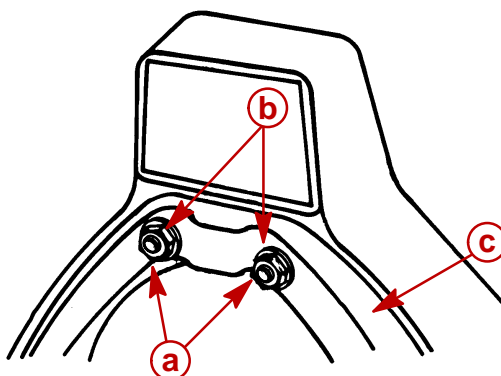
4. Remove metal chips with compressed air.
5. Mark 1 in. pipe tap with a piece of tape, 1-1/8 in. (28 mm) from end of tap.
6. Coat pipe tap with grease to aid in picking up metal chips.
7. Cut threads in access holes.
8. Stop cutting when the edge of the tape reaches the gimbal housing.



75904

## Gimbal Ring, Swivel Shaft and Steering Lever Removal

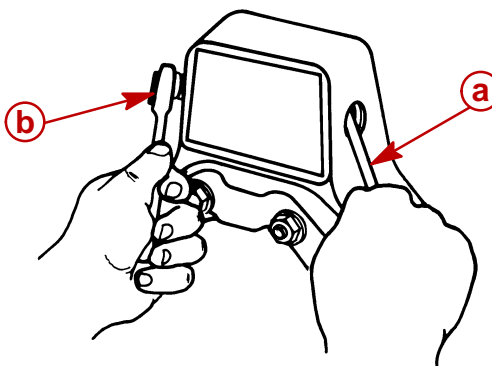
1. Loosen U-bolt nuts.



70150

- a** - U-bolt Nuts (2)
- b** - Washers (4)
- c** - Gimbal Ring

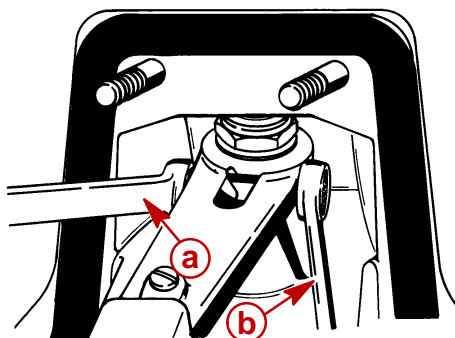
2. Loosen steering lever clamping bolt and nut.



70157

### Engine and transom assembly installed

- a** - Wrench
- b** - Socket Wrench

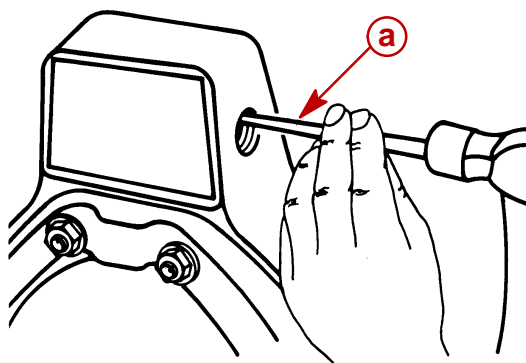


22460

### Engine and transom assembly removed

- a** - Wrench
- b** - Wrench

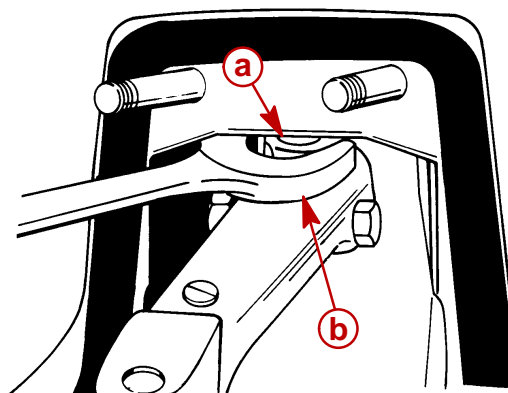
3. Remove locknut.



70156

### Engine And Transom Assembly Installed

**a** - Pin Punch



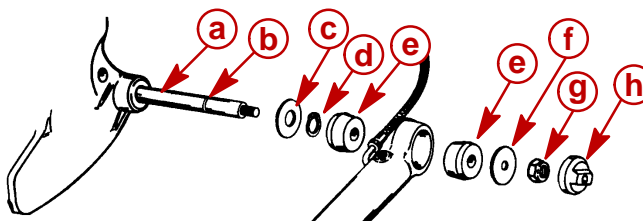
22452

### Engine And Transom Assembly Removed

**a** - Locknut

**b** - 1-1/16 in. Wrench

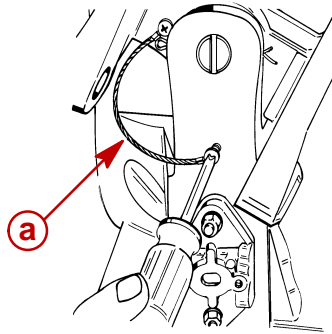
4. Disconnect trim cylinders from gimbal ring. Suspend cylinders to avoid damage to hoses.



71489

- a** - Anchor Pin (1)
- b** - Slots (2)
- c** - Flat Washer (Large I.D.) (2)
- d** - Snap Rings (2)
- e** - Bushings (4)
- f** - Flat Washer (Small I.D.) (2)
- g** - Locknut (2)
- h** - Plastic Cap (2)

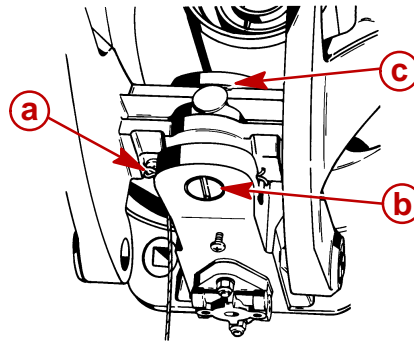
5. Disconnect continuity wire.



22261

**a** - Continuity Wire

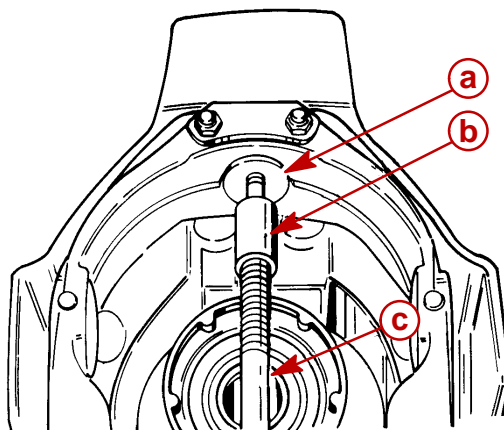
6. Remove cotter pin, lower swivel pin and washer.



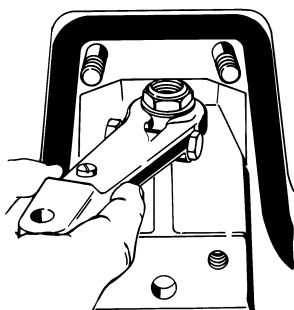
22461

**a** - Cotter Pin  
**b** - Lower Swivel Pin  
**c** - Washer

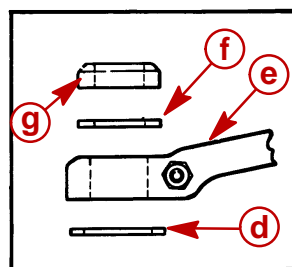
7. Remove large I.D. washer, steering lever, small I.D. washer and locknut.
8. Remove upper swivel shaft using slide hammer puller (91-34569A1) and puller head (91-63616) from gimbal ring.



76661



22463



22492

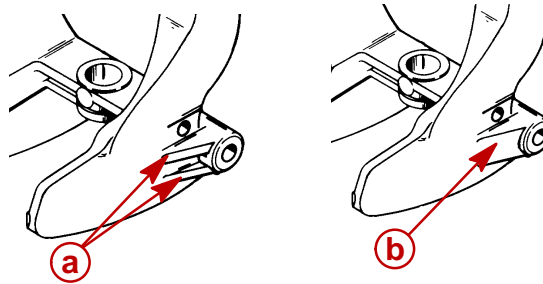
- a** - Swivel Shaft
- b** - Puller Head
- c** - Slide Hammer
- d** - Washer
- e** - Steering Lever
- f** - Small I.D. Washer
- g** - Locknut

9. Remove gimbal ring.

## Gimbal Ring Servicing

### GIMBAL RING IDENTIFICATION

The gimbal ring used on various model transom assemblies can be identified as shown in the following illustration:



75272

**a** - Standard Gimbal Ring Identification (Two Ribs)

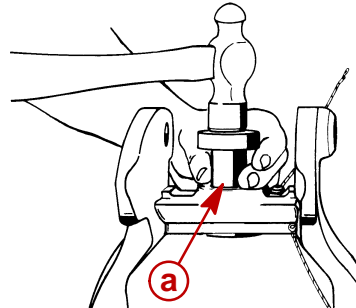
**b** - Magnum and High Performance Gimbal Ring Identification (Filled Area)

### REMOVING BUSHINGS

#### **CAUTION**

Be careful not to damage bores when removing self-lubricating bushings in the following steps.

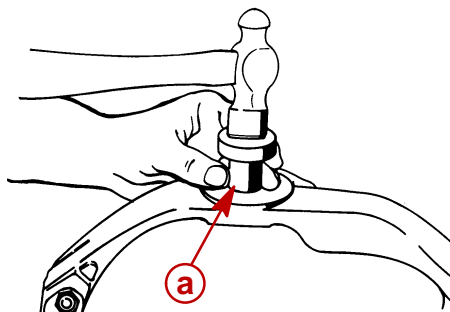
1. Tap out and remove gimbal ring lower swivel pin bushing using a suitable mandrel.



22451

**a** - Suitable Mandrel

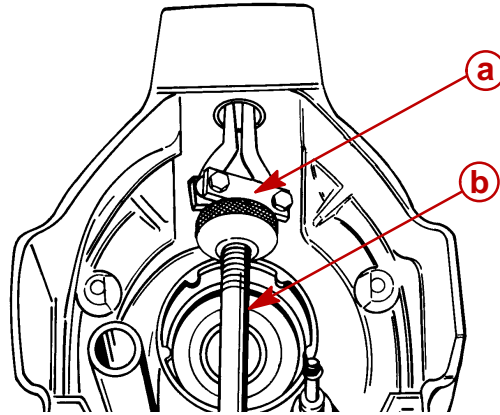
2. Remove gimbal ring hinge pin bushings (port and starboard) using a suitable mandrel.



22452

**a** - Suitable Mandrel

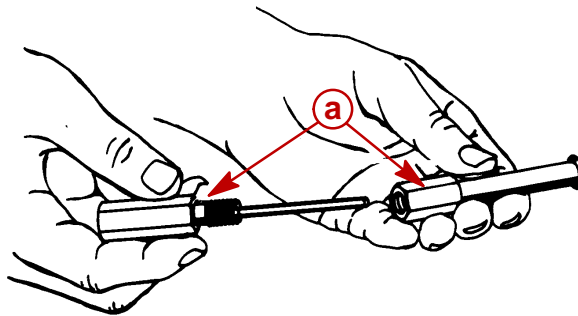
3. Remove oil seal and large bushing from gimbal housing using a two-jaw puller and slide hammer assembly.



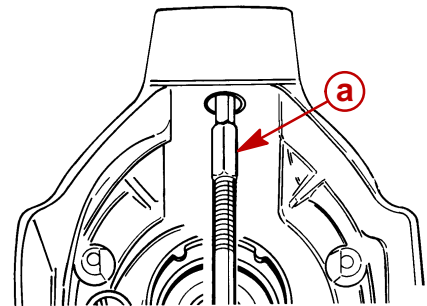
22452

- a** - Two Jaw Puller  
**b** - Slide Hammer Assembly

4. Remove small bushing from gimbal housing using a bushing removal tool.



22438

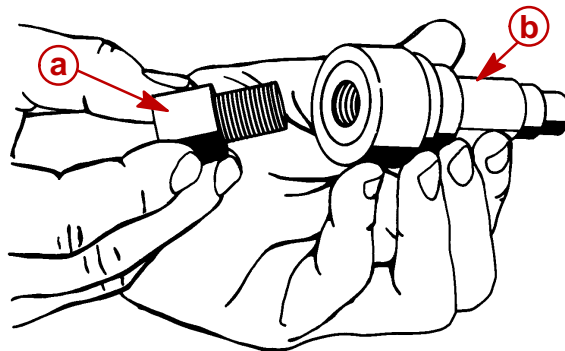


22454

- a** - Bushing Removal Tool (Snap-On Tool Company P/N CG40CB)

## INSTALL BUSHINGS

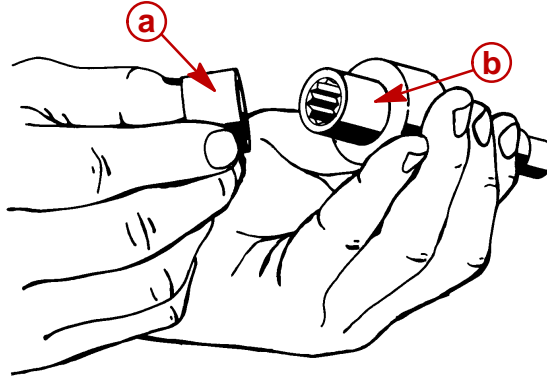
1. Install gimbal ring hinge pin bushings as follows:
  - a. Install hinge pin into bearing and seal driver.



22452

- a** - Hinge Pin  
**b** - Seal Driver (P/N 91-43578A1)

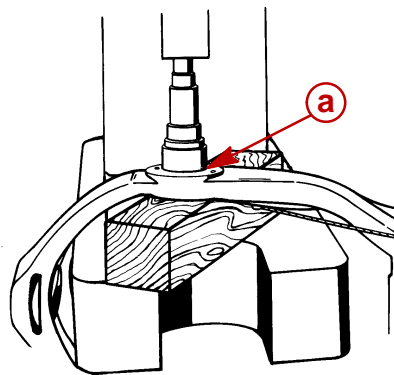
- b. Apply Resiweld Sealer to outer diameter of hinge pin bushing and position bushing on bearing and seal driver.



22440

- a** - Hinge Pin Bushing
- b** - Bearing And Seal Driver (92-65150-1)

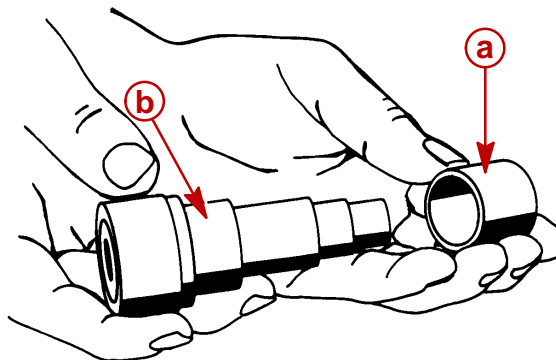
- c. Inspect bore for cleanliness and damage before installing bushing.
- d. Install bushing in each side of gimbal ring by pressing in place.



22454

- a** - Gimbal Ring

2. Install gimbal ring lower swivel pin bushing as follows:
  - a. Apply Resiweld Sealer to outer diameter of bushing and position bushing on bearing and seal driver.



22440

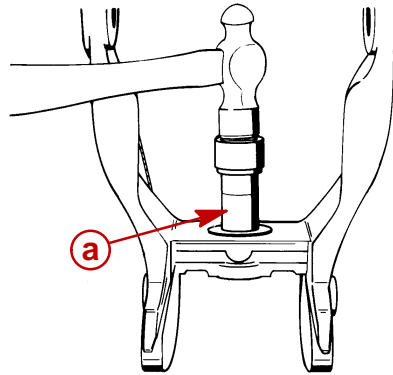
- a** - Outer Diameter Of Bushing
- b** - Bearing And Seal Driver (92-65150-1)

- b. Inspect bore for cleanliness and damage before installing bushing.



- c. Install bushing in gimbal ring by pressing or tapping in place with a hammer.

**NOTE:** Pressing is preferred. When using a hammer, install a used hinge pin in the driver to protect the threads.

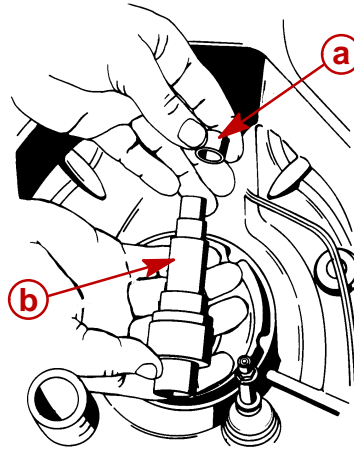


22453

**a** - Bushing

3. Install upper swivel shaft small bushing as follows:

- a. Place bushing on bearing and seal driver.

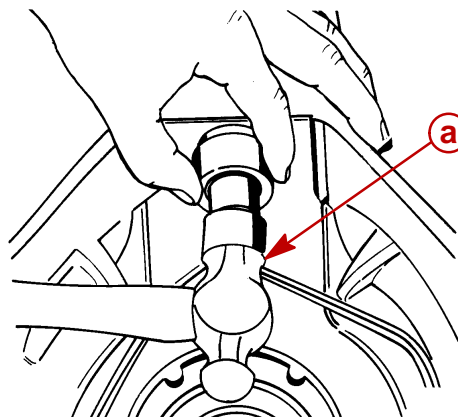


22440

**a** - Bushing

**b** - Bearing And Seal Driver

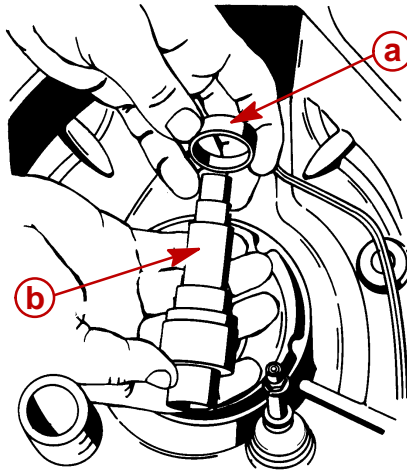
- b. Install bushing by tapping it in place with a hammer.



22450

**a** - Hammer

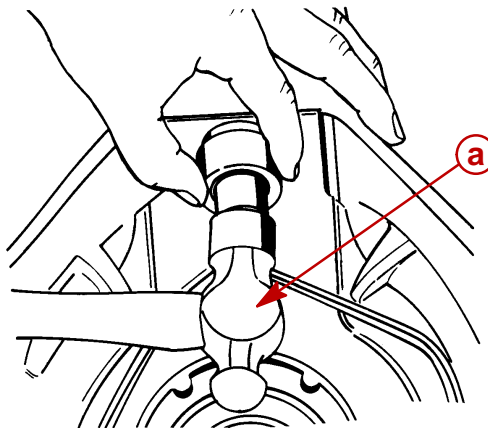
4. Install upper swivel shaft large bushing as follows:
  - a. Place bushing on bearing and seal driver.



22436

- a** - Bushing  
**b** - Bearing And Seal Driver

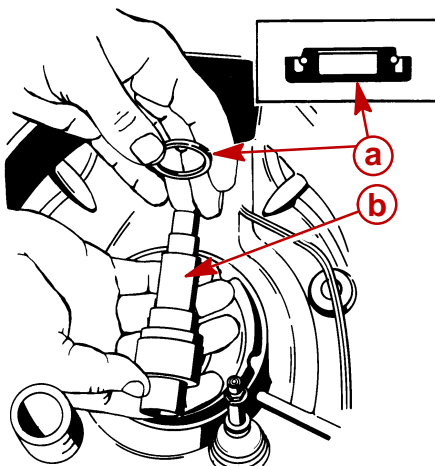
- b. Install bushing by tapping it in place with a hammer.



22450

- a** - Hammer

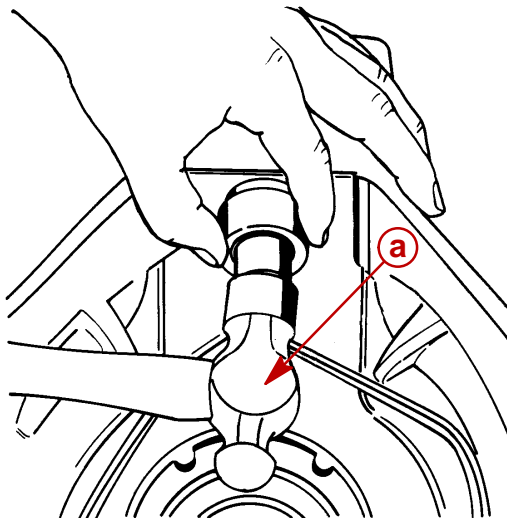
5. Install upper swivel shaft grease seal as follows:
  - a. Place seal on bearing and seal driver with lip facing the small diameter end of tool. Apply Loctite 271 to outer diameter of seal.



22440

- a** - Seal  
**b** - Bearing And Seal Driver

- b. Install grease seal by tapping it in place with a hammer.



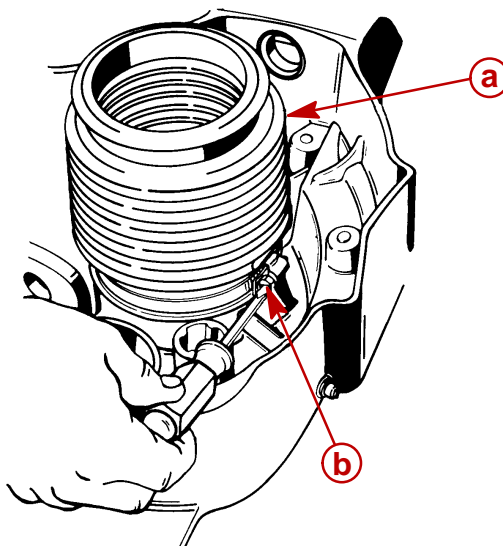
22450

- a** - Hammer

# Gimbal Housing Servicing

## U-joint Bellows Replacement

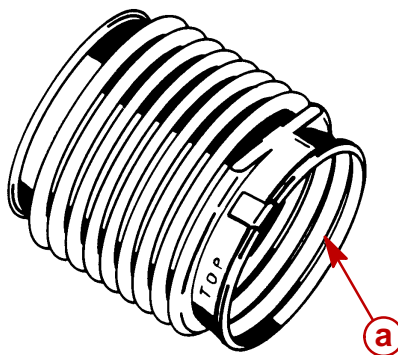
1. Remove U-joint bellows from gimbal housing.



50383

- a** - U-joint Bellows
- b** - Hose Clamp

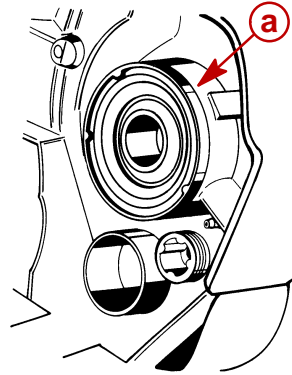
2. If reusing bellows, remove old adhesive from U-joint bellows using lacquer thinner.



50383

- a** - U-joint Bellows

3. Clean bellows mounting flange on gimbal housing with sandpaper and wipe clean with lacquer thinner.



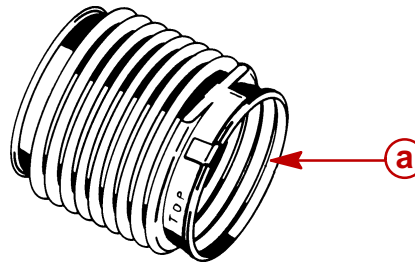
76662

**a** - Mounting Flange

### **⚠ WARNING**

**Be sure to read and follow package label direction when using bellows adhesive.**

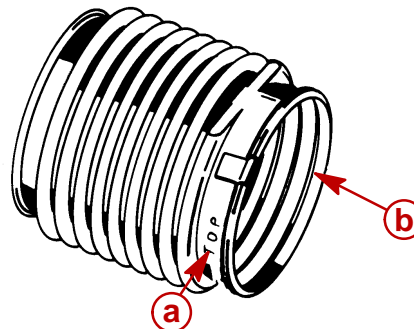
4. Apply bellows adhesive to inside diameter of bellows end that will be attached to gimbal housing. Bellows adhesive IS NOT needed on the other end that connects to the bell housing. Allow to dry until adhesive is no longer tacky (approximately 10 minutes) before installing.



50383

**a** - Inside Diameter of Bellows End

**IMPORTANT: TOP mark on U-joint bellows must be facing upward when installing bellows.**



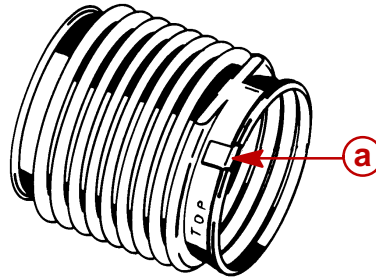
50383

**a** - TOP Mark  
**b** - Bead

**⚠ CAUTION**

**Bellows clamp may corrode if ground clip is not installed.**

5. Position ground clip on bellows.

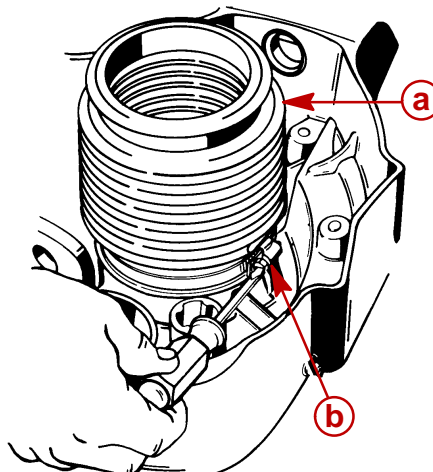


50383

**a** - Grounding Clip

6. Position U-joint bellows with TOP mark facing upwards and install U-joint bellows on gimbal housing flange and position clamp as shown. Torque to 35 lb-in. (4 Nm).

**IMPORTANT:** Ensure that the bead on the inner mating surface of bellows is positioned in the groove in gimbal housing flange.

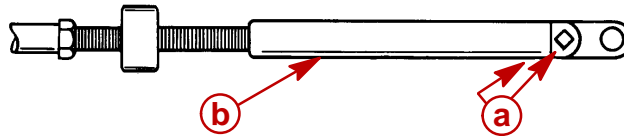


50383

**a** - U-joint Bellows  
**b** - Hose Clamp

## Shift Cable Bellows Replacement

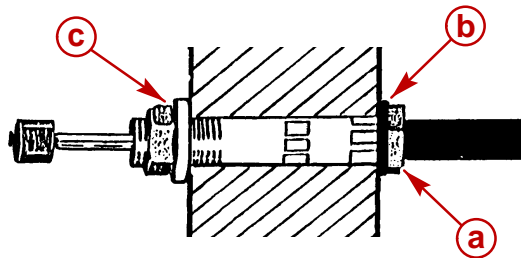
1. Remove shift cable.
  - a. Disconnect shift cable from shift plate and remove end guide.



22183

- a** - Anchor Screws (2)  
**b** - End Guide

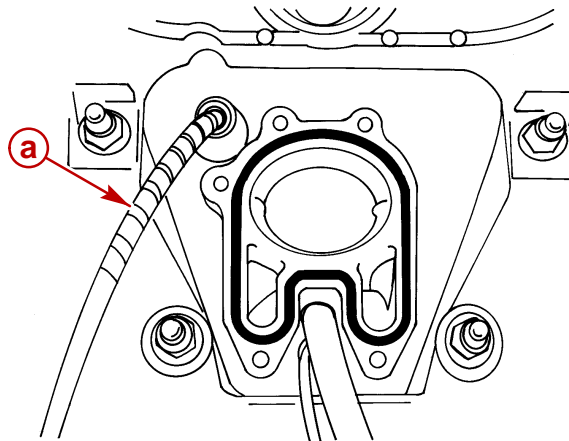
2. Remove flanged nut. Hold shift cable retaining nut with wrench.



76673

- a** - Shift Cable Retaining Nut  
**b** - Seal Washer  
**c** - Flanged Nut

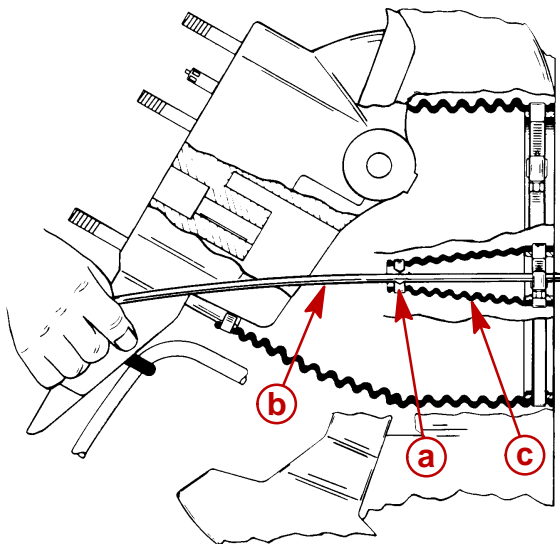
3. Remove shift cable wrapping.



76639

- a** - Shift Cable Wrapping

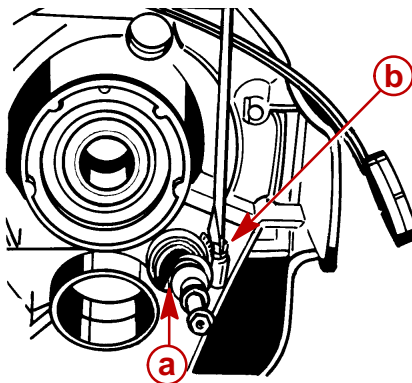
4. Loosen shift cable bellows crimp clamp and pull shift cable through shift cable bellows.



50458

- a** - Crimp Clamp  
**b** - Shift Cable  
**c** - Shift Cable Bellows

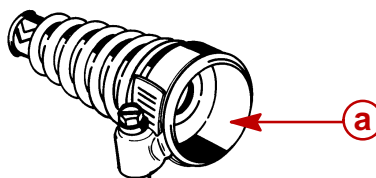
5. Remove shift cable bellows from gimbal housing.



76663

- a** - Shift Cable Bellow  
**b** - Hose Clamp

6. Remove old adhesive from shift cable bellows mounting surface using lacquer thinner.

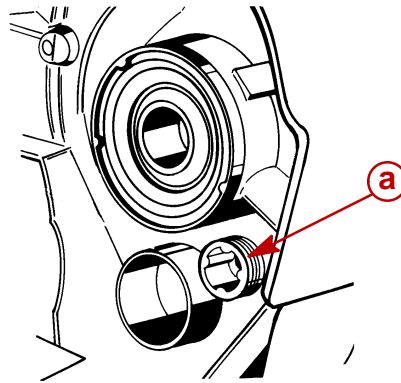


22454

- a** - Shift Cable Bellows Mounting Surface



7. Clean shift cable bellows mounting flange on gimbal housing with sandpaper and wipe clean with lacquer thinner.



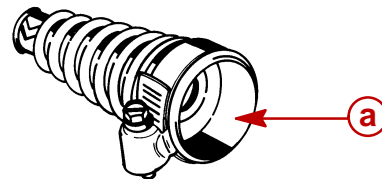
76662

**a** - Mounting Flange

### **⚠ WARNING**

**Read and follow package label directions before using bellows adhesive.**

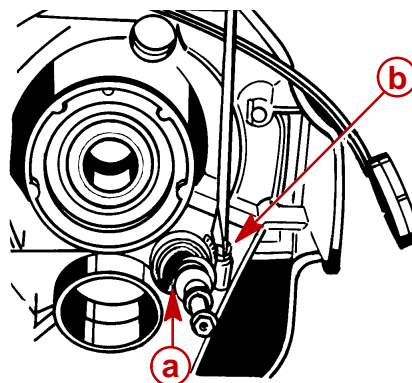
8. Apply bellows adhesive to shift cable bellows mounting surface. Allow to dry until adhesive is no longer tacky (approximately 10 minutes) before installing.



22454

**a** - Bellows Mounting Surface

9. Install shift cable bellows on gimbal housing flange. Position hose clamp as shown. Torque to 35 lb-in. (4 Nm).



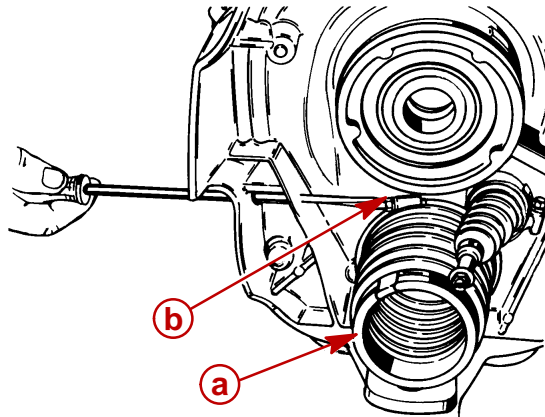
76663

**a** - Shift Cable Bellows  
**b** - Hose Clamp

## Exhaust Bellows Replacement

**NOTE:** (For Exhaust Tube Replacement, see Section 4A)

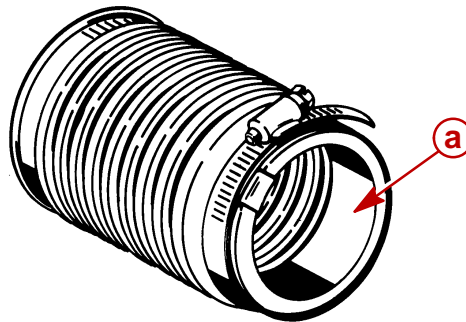
1. Remove exhaust bellows from gimbal housing.



76660

- a** - Exhaust Bellows  
**b** - Hose Clamp

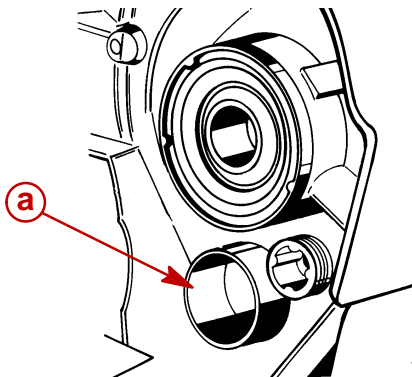
2. If old exhaust bellows will be reinstalled, remove old adhesive from exhaust bellows mounting surfaces with lacquer thinner.



22450

- a** - Mounting Surface

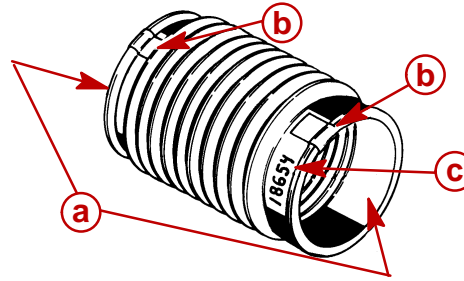
3. Clean exhaust bellows mounting flange with sandpaper and wipe clean with lacquer thinner.



76662

- a** - Mounting Flange

4. Position grounding clips on bellows. Use bellows P/N 18654, only. Do not substitute earlier model bellows.



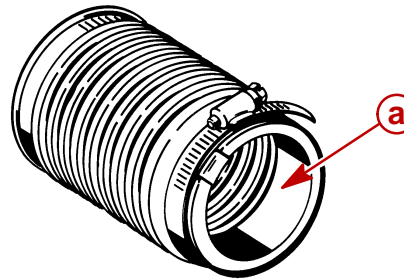
22079

- a** - Apply Bellows Adhesive
- b** - Grounding Clips
- c** - Part Number

### ⚠ WARNING

**Read and follow package label directions when using bellows adhesive.**

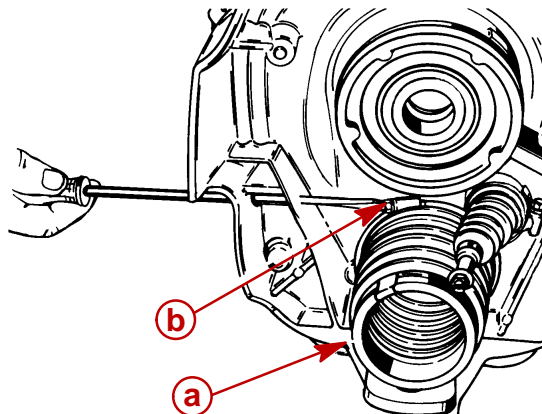
5. Apply bellows adhesive to exhaust bellows mounting surface. Allow to dry until adhesive is no longer tacky (approximately 10 minutes) before installing.



22450

- a** - Mounting Surface

6. Install exhaust bellows on gimbal housing flange.
7. Position hose clamp as shown. Torque to 35 lb-in. (4 Nm).

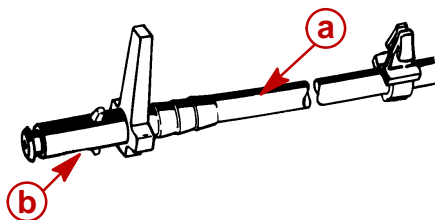


76660

- a** - Exhaust Bellows
- b** - Hose Clamp

## Speedometer Hose Replacement

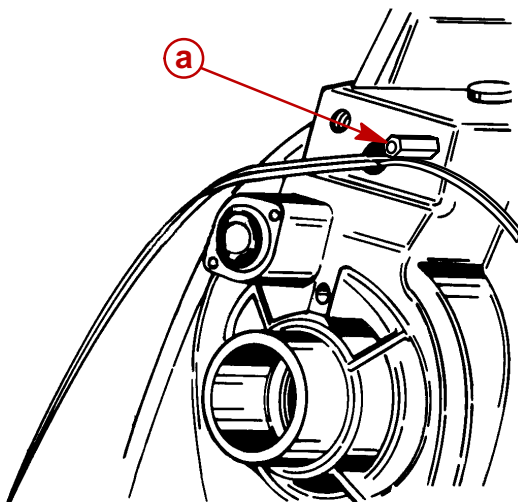
1. Remove hose from plastic adaptor fitting.



22461

- a** - Hose  
**b** - Plastic Adaptor Fitting

2. Remove hex fitting from inner transom and pull speedometer hose through transom.

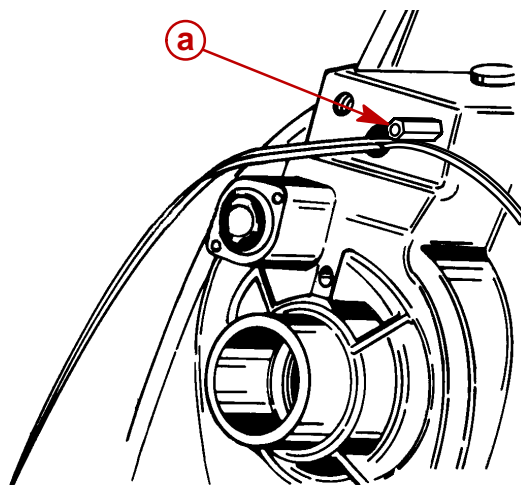


76672

- a** - Hex Fitting

3. Remove speedometer hose by removing clamp and pulling hose off.
4. Install inner new speedometer hose on barbed fitting. Secure with hose clamp.
5. Push speedometer hose through transom.

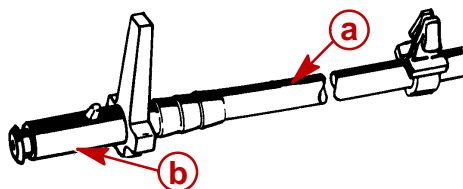
6. Install hex fitting. Torque fitting to 35 lb-in. (4 Nm).



**a** - Hex Fitting

76672

7. Install plastic adaptor fitting on speedometer hose.



**a** - Hose

**b** - Plastic Adaptor Fitting

22461

## Gear Lube Monitor System Components

### MONITOR TO THROUGH BULKHEAD FITTING HOSE

Check hose periodically for condition and replace as necessary.

1. To replace hose, remove hose clamps and remove hose.
2. Install new hose of sufficient length to allow monitor to be removed from topside or bottom side of bracket. Secure hose with hose clamps.

**NOTE:** If location does not require that the connecting hose crosses the inner transom plate to port side, the J-clip on water pickup outlet (top bolt) would neither be needed nor installed. The plastic hose clip can be used to hold hose in position, if needed, on transom and prevent it from contacting the power steering assembly or engine coupler after they are installed.

**IMPORTANT:** After installation of replacement hose, check that hose will not contact any part of the power steering assembly or engine coupler.

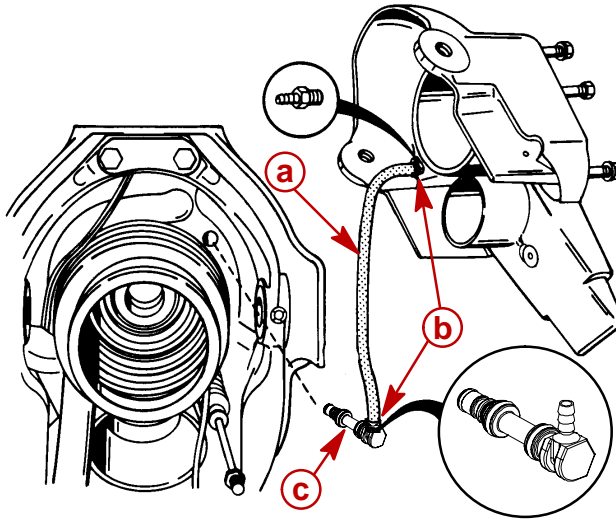
### THROUGH BULKHEAD TO BELL HOUSING GEAR LUBE MONITOR HOSE

**NOTE:** Bell housing must be removed from gimbal ring for this procedure. Refer to Section 4B.

1. Remove hose clamps.
2. Remove hose.

3. Replace hose and hose clamps.
4. Tighten hose clamps securely.

**IMPORTANT:** Hose and clamps are installed on bell housing hose barb and through bulkhead fitting, **before** through bulkhead fitting is reinstalled.



76664

- a** - Hose - 10 in. (254 mm)
- b** - Hose Clamps
- c** - Through Bulkhead Fitting

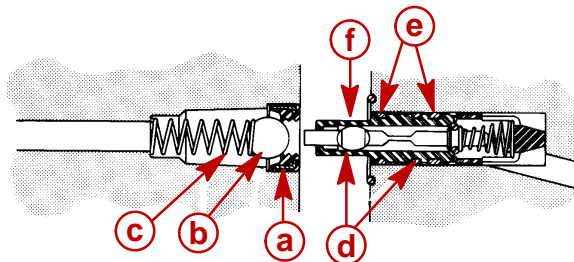
## BELL HOUSING TO DRIVE SHAFT HOUSING CHECK VALVES

Unless damaged during disassembly, or by heat, these check valves should last the life of the drive unit.

The bell housing check valve is replaced as an assembly.

### Removal

1. The bell housing check valve can be removed with pliers and discarded, or it can be removed by placing hose clamp snugly over area "f," and pulling out, with pliers on hose clamp and reinstalled if working properly.
2. The drive shaft housing check valve can be removed by retracting the seal cup with a pliers or hook and discarded. Remove the check valve and spring and discard.

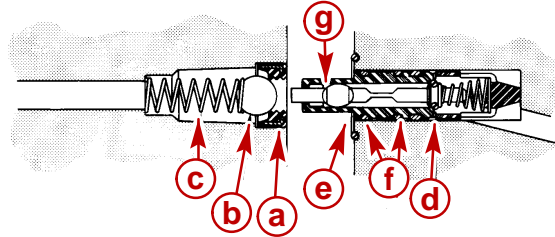


50321

- a** - Seal Cup
- b** - Check Ball
- c** - Spring
- d** - Check Valve Assembly
- e** - O-rings (2)
- f** - Area to Secure Hose Clamp for Retraction

**Reassembly**

1. **Driveshaft Housing** - insert spring, check ball and seal cup. Press or tap carefully on seal cup until outer face is flush with casting surface. Do not use sealant.
2. **Bell Housing** - coat O-rings with gear lube. Insert check valve assembly into passageway. Place 3/8 in. deep wall socket over valve end and tap into casting until shoulder surface "e" is flush with casting surface.

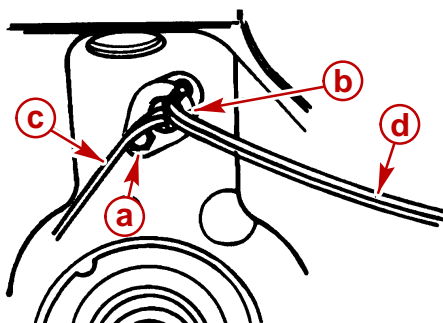


- a** - Seal Cup
- b** - Check Ball
- c** - Spring
- d** - Bell Housing Check Valve Assembly
- e** - Surface Flush with Casting
- f** - O-rings (2)
- g** - Valve End

50321

## Trim Position Sender and Trim Limit Switch Wire Replacement

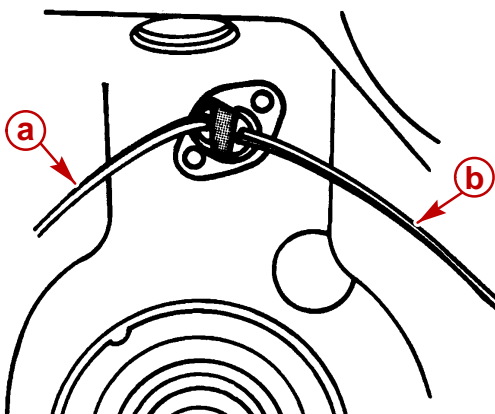
1. Remove trim limit switch wires and trim position sender wires.



70197

- a** - Screw
- b** - Trim Harness Clamp
- c** - Trim Limit Switch Wires
- d** - Trim Position Sender Wires

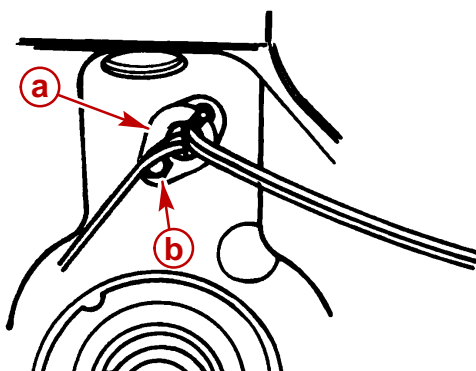
2. Install trim limit switch wires and trim position sender wires. DO NOT pinch wires.



70198

- a** - Trim Limit Switch Wires
- b** - Trim Position Sender Wires

3. Apply Perfect Seal to threads of screw and install trim harness clamp and screw.



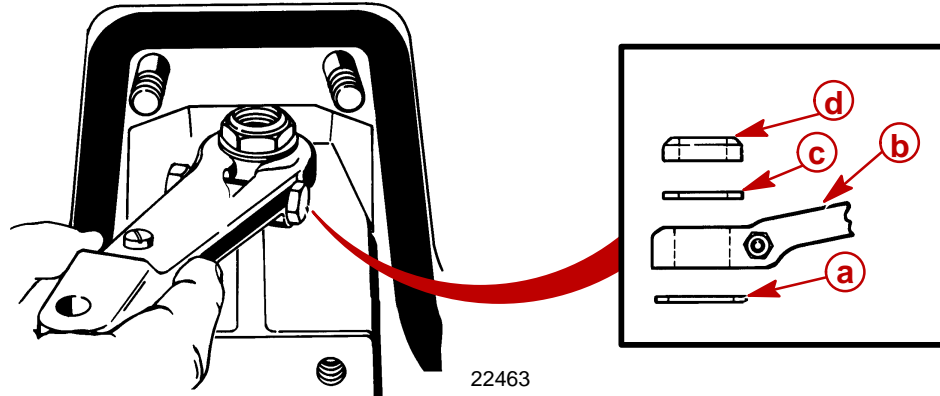
70197

- a** - Trim Harness Clamp
- b** - Screw



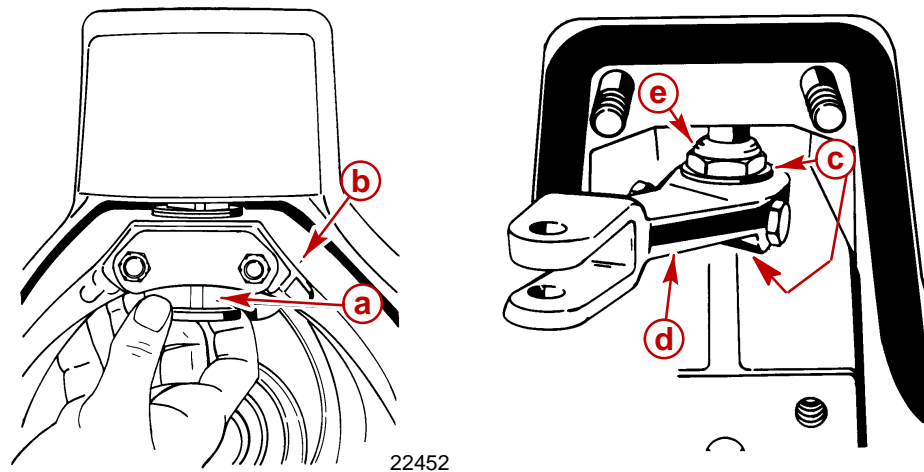
# Gimbal Ring / Swivel Shaft and Steering Lever Installation

1. Place large inner diameter washer, steering lever, small inner diameter washer and locknut into steering lever cavity in gimbal housing.



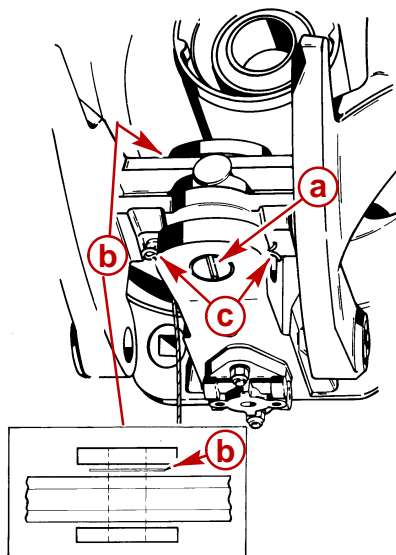
- a** - Large Inner Diameter Washer
- b** - Steering Lever
- c** - Small Inner Diameter Washer
- d** - Locknut

2. Install upper swivel shaft through gimbal ring and up into and through washers, steering lever and locknut. Start locknut on upper swivel shaft threads. DO NOT tighten at this time.



- a** - Upper Swivel Shaft
- b** - Gimbal Ring
- c** - Washers
- d** - Steering Lever
- e** - Locknut

3. Install lower swivel pin and washer. Secure with cotter pin. Spread ends.

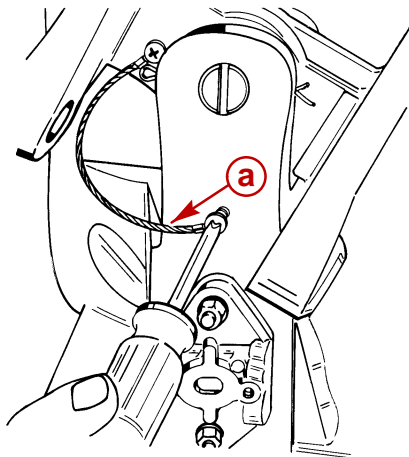


22461

22445

- a** - Swivel Pin
- b** - Washer
- c** - Cotter Pin

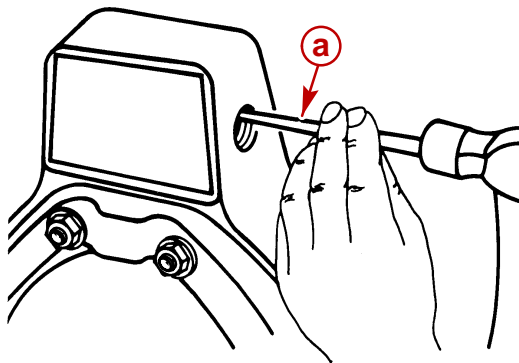
4. Clean ground wire ring terminal and screw.
5. Connect ground wire from gimbal housing to gimbal ring. Tighten securely.



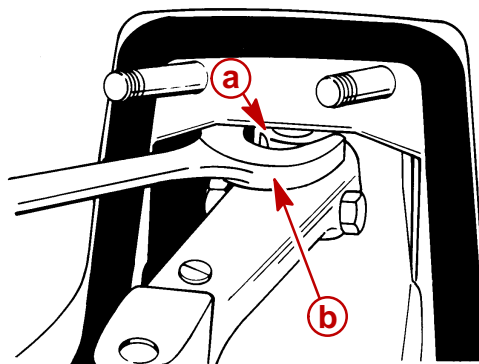
22261

- a** - Ground Wire

6. Tighten locknut until a clearance of .002 - .010 in. (0.05 - 0.25 mm) exists between lower swivel pin washer and gimbal housing mount.



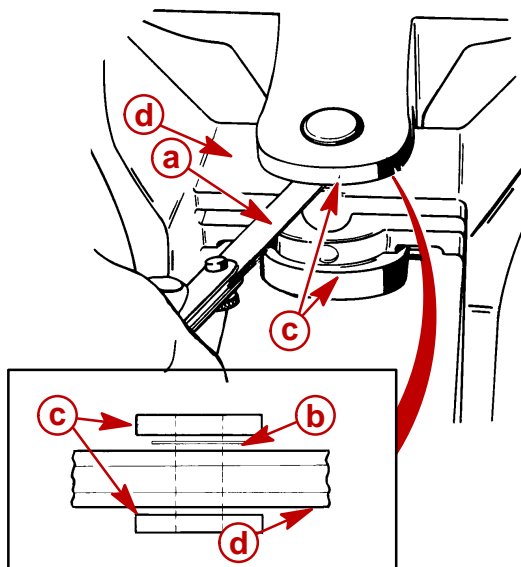
70156

**Engine And Transom Assembly Installed****a** - Pin Punch

22452

**Engine And Transom Assembly Removed****a** - Locknut**b** - 1-1/16 in. Wrench

7. Strike down on gimbal ring flanges using a plastic hammer.
8. Recheck clearance and tighten locknut as necessary.

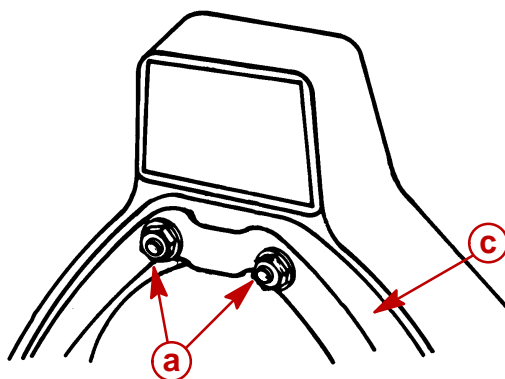


22461

22445

- a** - Feeler Gauge - .001 - .010 in. (0.05 - 0.25mm)
- b** - Washer
- c** - Gimbal Housing Mount
- d** - Gimbal Ring

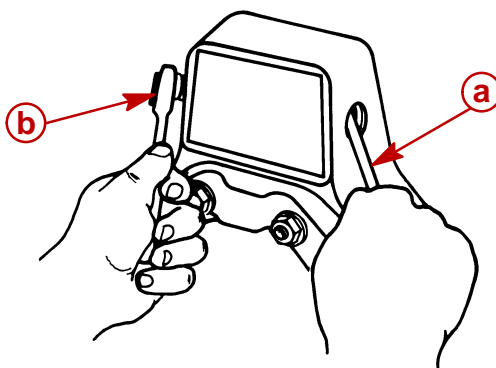
9. Torque locknuts evenly to 53 lb-ft (72 Nm).



70150

- a** - Locknuts (2) and Washers (2)
- b** - Gimbal Ring

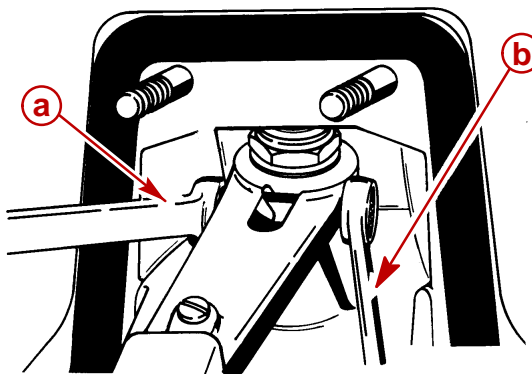
10. Tighten steering lever clamping bolt and nut. Torque 50 lb-ft (68 Nm).



70157

### Engine And Transom Assembly Installed

- a** - Wrench
- b** - Socket Wrench

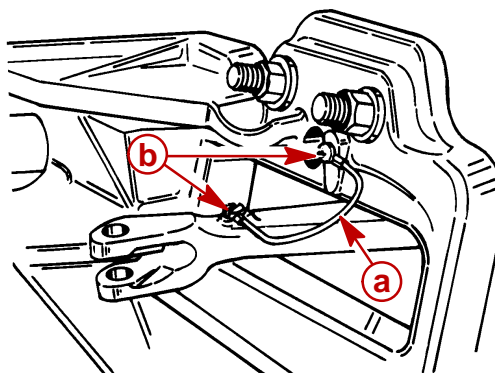


22460

### Engine And Transom Assembly Removed

- a** - Wrench
- b** - Wrench

11. Install steering lever ground wire. Wire must be positioned as shown. Tighten securely.

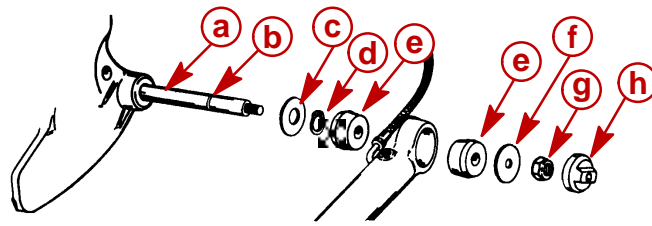


22028

- a** - Ground Wire
- b** - Screws

12. Install anchor pin and snap rings.

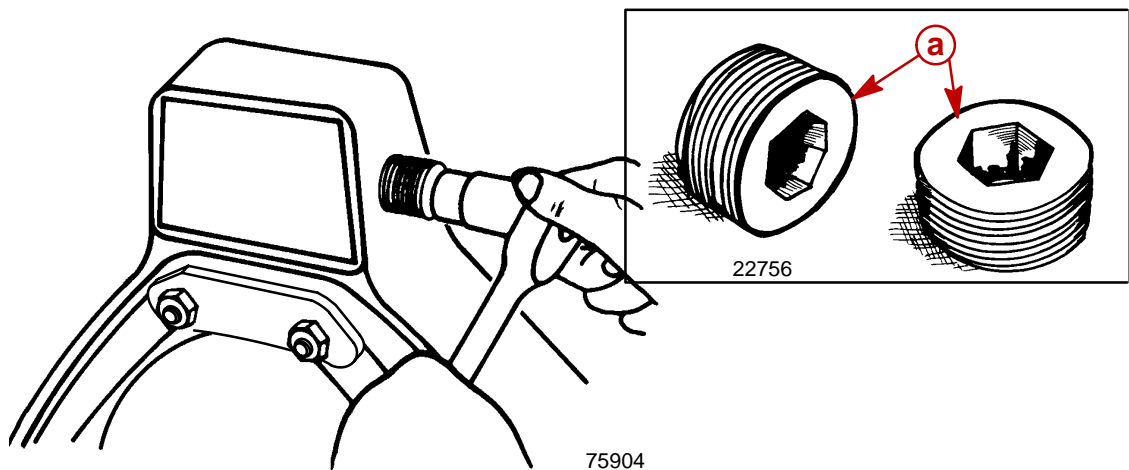
13. Install trim cylinders on gimbal ring.



71489

- a** - Anchor Pin (1)
- b** - Slots (2)
- c** - Flat Washer (Large Inner Diameter) (2)
- d** - Snap Rings (2)
- e** - Bushings (4)
- f** - Flat Washer (Small I.D.) (2)
- g** - Locknut (2)
- h** - Plastic Cap (2)

14. Coat threads of plastic plugs (if used) with Perfect Seal and thread into access hole until flush with housing. Use a 5/8 in. hex wrench or 5/8 in. hex stock to secure.



75904

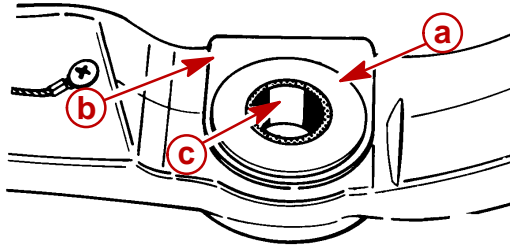
- a** - Plastic Plugs

15. Touch up any bare metal spots with primer and "Phantom Black" spray paint.

# Bell Housing Installation

## Standard Transom Assembly

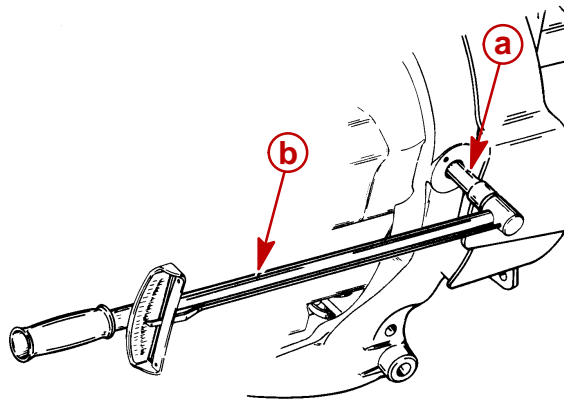
1. Install fiber washers on gimbal ring.
2. Secure with Resiweld Sealer.
3. Ensure that washer pilots on hinge pin bushing.



22454

- a** - Fiber Washers
- b** - Gimbal Ring
- c** - Hinge Pin Bushing

4. Install bell housing.
5. Clean threads and apply Loctite 271 to threads of hinge pins (port and starboard).
6. Install hinge pins and torque to 145 lb-ft (197 Nm).

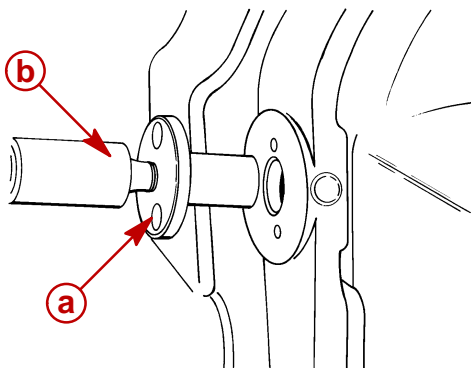


22113

- a** - Hinge Pin Tool (91-78310)
- b** - Torque Wrench

## High Performance Transom Assembly

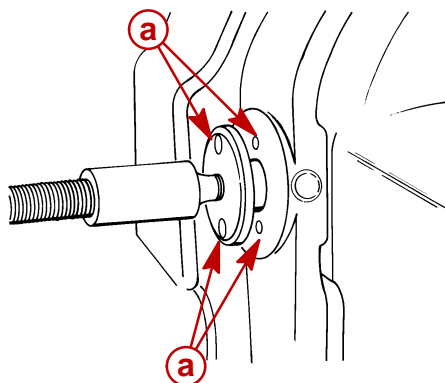
1. Thread hinge pin onto special tool. Lubricate hinge pins with Quicksilver Special Lubricant 101.



71828

- a** - Hinge Pin  
**b** - Special Tool (91-63616)

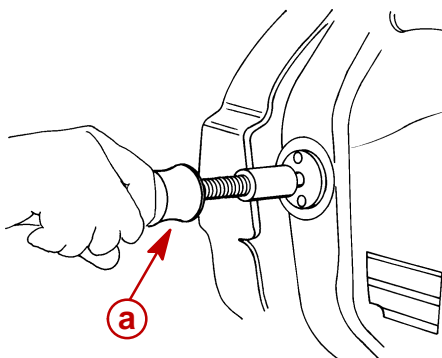
2. Slide hinge pin through gimbal ring and bell housing. Be sure to align screw holes in hinge pin with holes in gimbal ring.



71827

- a** - Screw Holes

3. Lightly tap hinge pin into place using slide hammer.

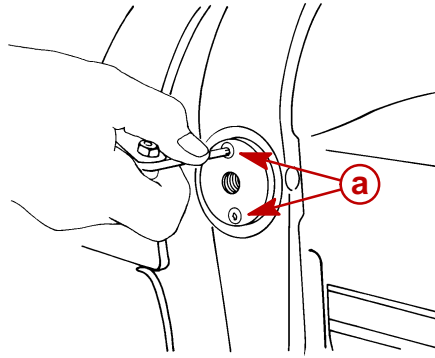


71826

- a** - Slide Hammer



4. Apply Loctite 242 to threads of screws and install. Torque screws to 25-30 lb.in. (2.8-3.3 N·m).

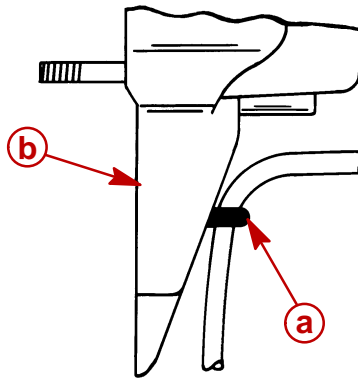


71825

**a** - Screws

## Standard And High Performance Transom Assemblies

1. Install speedometer hose clip onto bell housing.



22121

**a** - Speedometer Hose Clip  
**b** - Bell Housing

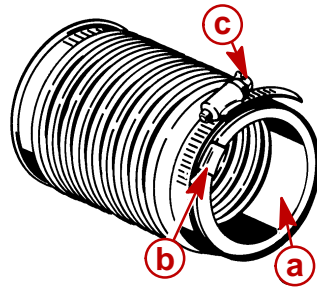
2. Clean exhaust bellows mounting flange on bell housing with sandpaper and wipe clean with lacquer thinner.

### **⚠ WARNING**

**Be sure to read and follow package label directions when using bellows adhesive.**

3. Apply bellows adhesive to mounting surface on inside of bellows. Allow to dry (approximately 10 minutes), before installing.
4. Position grounding clip on bellows.

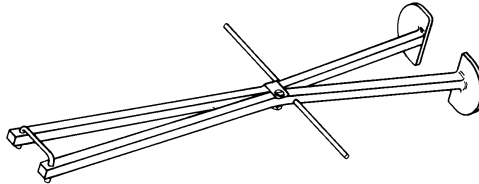
5. Place hose clamp over bellows end.



22450

- a** - Mounting Surface
- b** - Grounding Clip
- c** - Hose Clamp

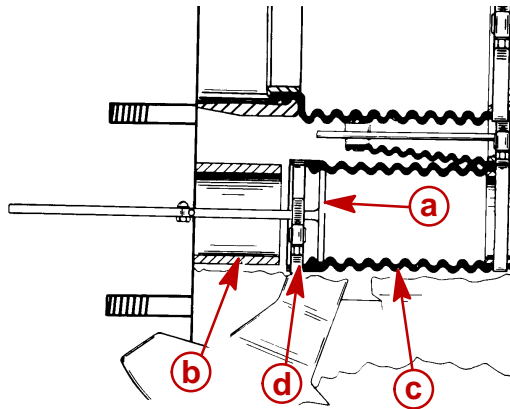
6. Place bellows expander tool into first bellows convolution.



22161

- a** - Expander Tool (91-45497A1)

7. Pull tool until tool touches the mounting flange on bell housing (bellows starts to slip onto flange) then release tool.



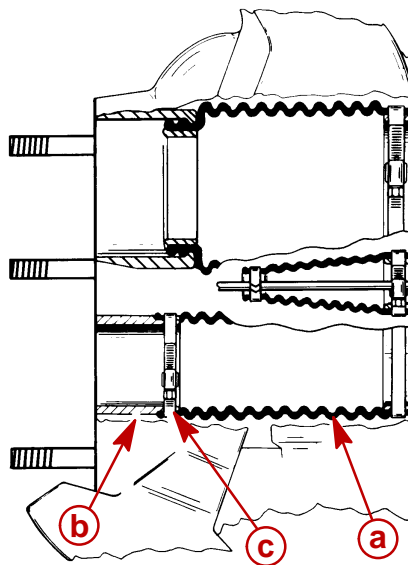
22116

- a** - Expander Tool (91-45497A1)
- b** - Bell Housing Flange
- c** - Exhaust Bellows
- d** - Hose Clamp

8. Reposition tool into the third bellows convolution.
9. Pull bellows onto bell housing flange.

10. Tighten hose clamp. Torque to 35 lb-in. (4 Nm).

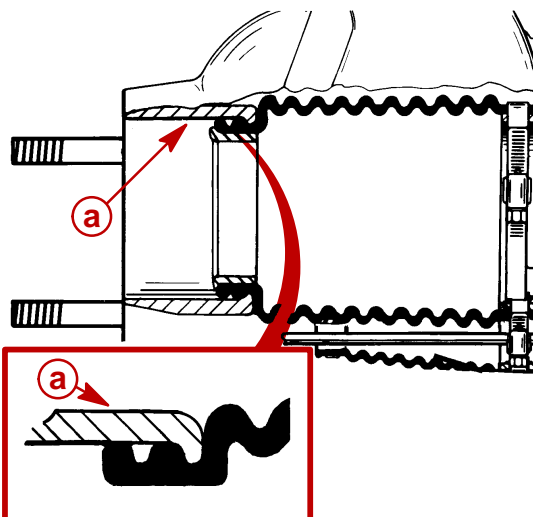
11. Remove tool.



22116

- a** - Exhaust Bellows
- b** - Bell Housing Flange
- c** - Hose Clamp - Tighten Securely

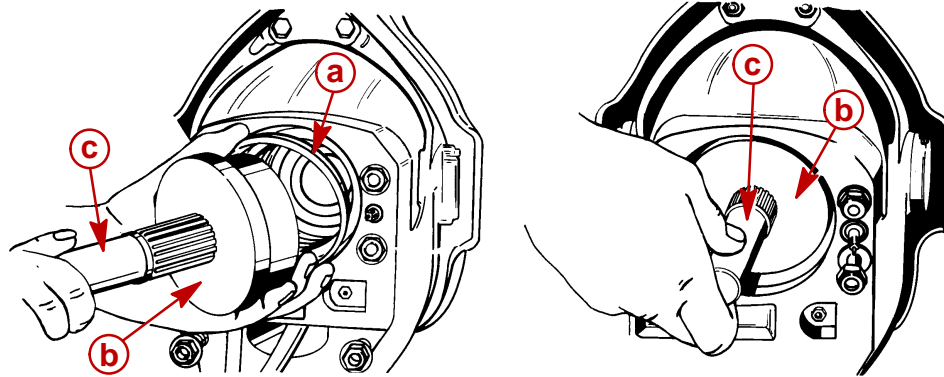
12. Position U-joint bellows on bell housing. Ensure that the bell housing flange (a) rests in the second groove from the end of bellows.



22116

- a** - Bell Housing Flange

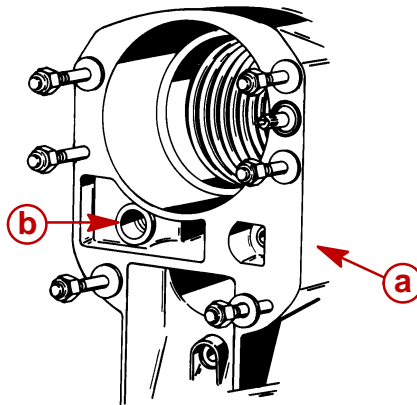
13. Lubricate sleeve outer diameter with soapy water or engine cleaner and install sleeve installation tool and a suitable driving rod.



76898

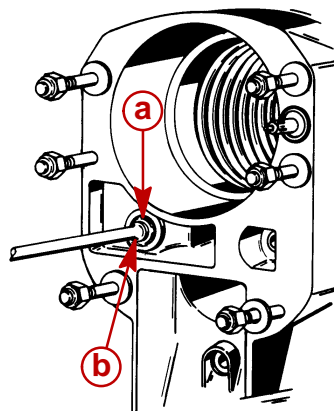
- a** - Sleeve  
**b** - Sleeve Installation Tool (91-818162)  
**c** - Suitable Driving Rod

14. Position water hose so that approximately 1/8 in. (3 mm) protrudes from edge of bell housing opening.



- a** - Bell Housing  
**b** - Water Hose

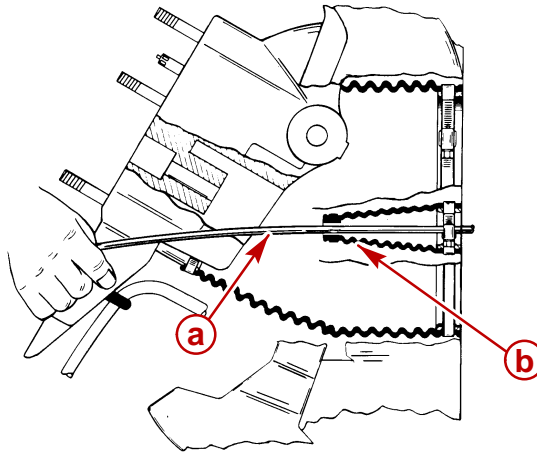
- a. Apply a small amount of 2-4-C Marine Lubricant with Teflon to hose inner diameter and install tapered inserts using the tapered insert tool.



- a** - Tapered Insert  
**b** - Tapered Insert Tool (P/N 91-43579)

# Shift Cable Installation

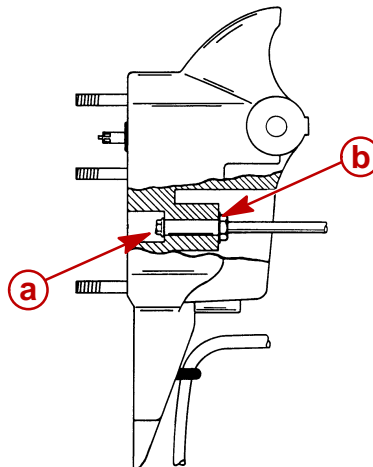
1. Insert shift cable end into and through shift cable bellows.



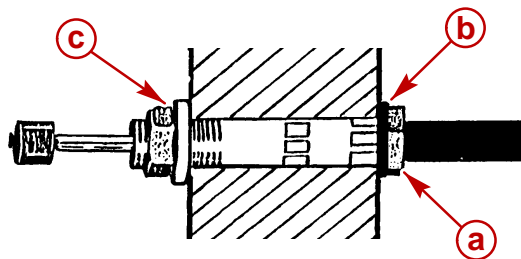
76620

- a** - Shift Cable End
- b** - Shift Bellows

2. Apply Perfect Seal to shift cable retaining nut threads. Secure shift cable to bell housing.



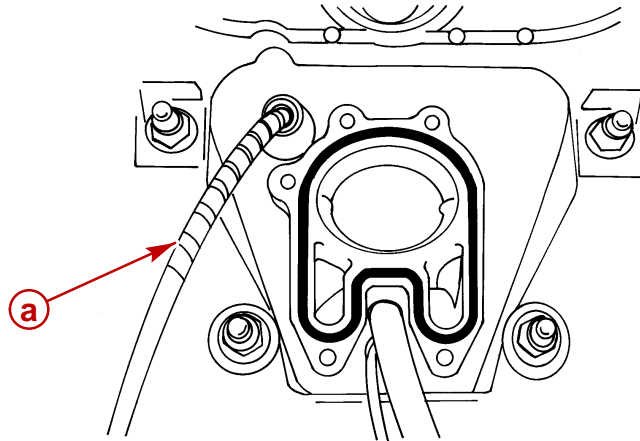
50327



76673

- a** - Shift Cable Retaining Nut
- b** - Seal Washer
- c** - Flanged Nut

3. Install shift cable wrapping approximately 2 in. from gimbal housing.



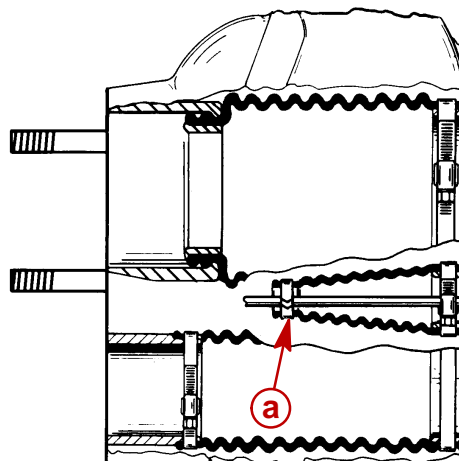
76639

**a** - Shift Cable Wrapping

### **⚠ CAUTION**

Water leakage may result if clamp is not installed properly. Check that bellows end is not flattened out when crimping in the following step.

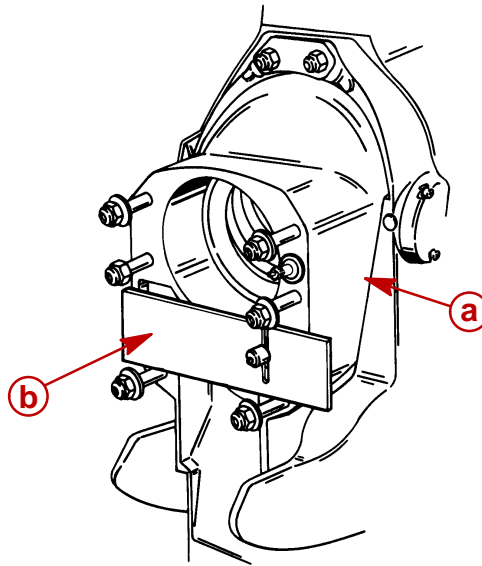
4. Install and compress shift cable bellows crimp clamp, maintaining a 1/2 in. diameter round outer diameter. Ensure that clamp is crimped evenly to maintain a good seal between bellows and shift cable. Do NOT allow bellows to flatten. (Plans for Crimp Clamp Tool are on p. 4B-57)



22117

**a** - Crimp Clamp

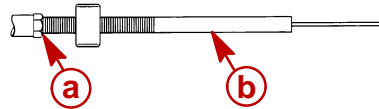
5. Install core wire locating tool on face of bell housing.



50327

- a** - Bell Housing
- b** - Core Wire Locating Tool (P/N 91-17263)

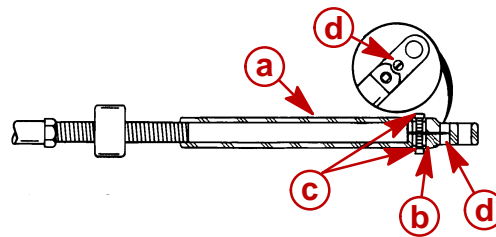
6. Install threaded tube until it contacts. Tighten finger tight.
7. Tighten jam nut securely.



22183

- a** - Threaded Tube
- b** - Jam Nut

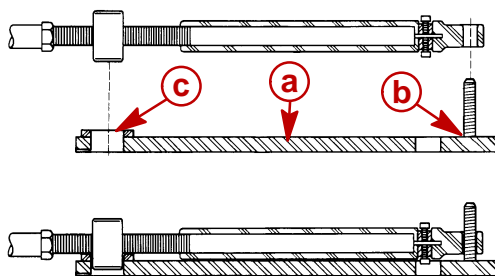
8. Install cable end guide over core wire and insert core wire through cable anchor. Tighten anchor screws evenly and torque to 20 lb-in. (2.3 Nm).



22183

- a** - Cable End Guide
- b** - Core Wire
- c** - Anchor Screws
- d** - Sight Port

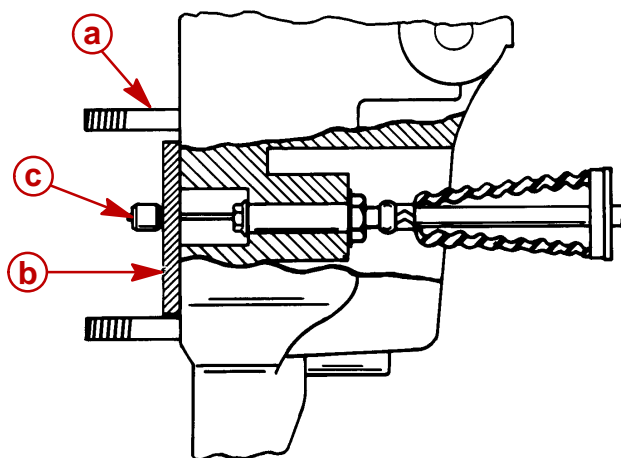
9. Place shift cable anchor adjustment tool on end of shift cable.



22120

- a** - Shift Cable Anchor Adjustment Tool (91-17262)  
**b** - Stud  
**c** - Hole - Barrel Placed Here

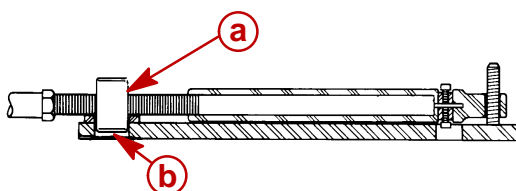
10. Ensure that bell housing end of core wire is positioned tight against core wire locating tool.



22121

- a** - Bell Housing  
**b** - Core Wire Locating Tool  
**c** - Core Wire

11. Adjust cable barrel to align with hole in tool.



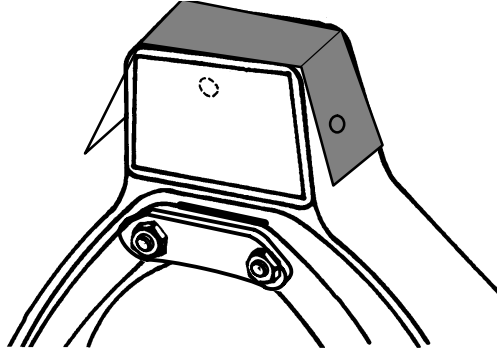
22120

- a** - Barrel  
**b** - Hole in Tool

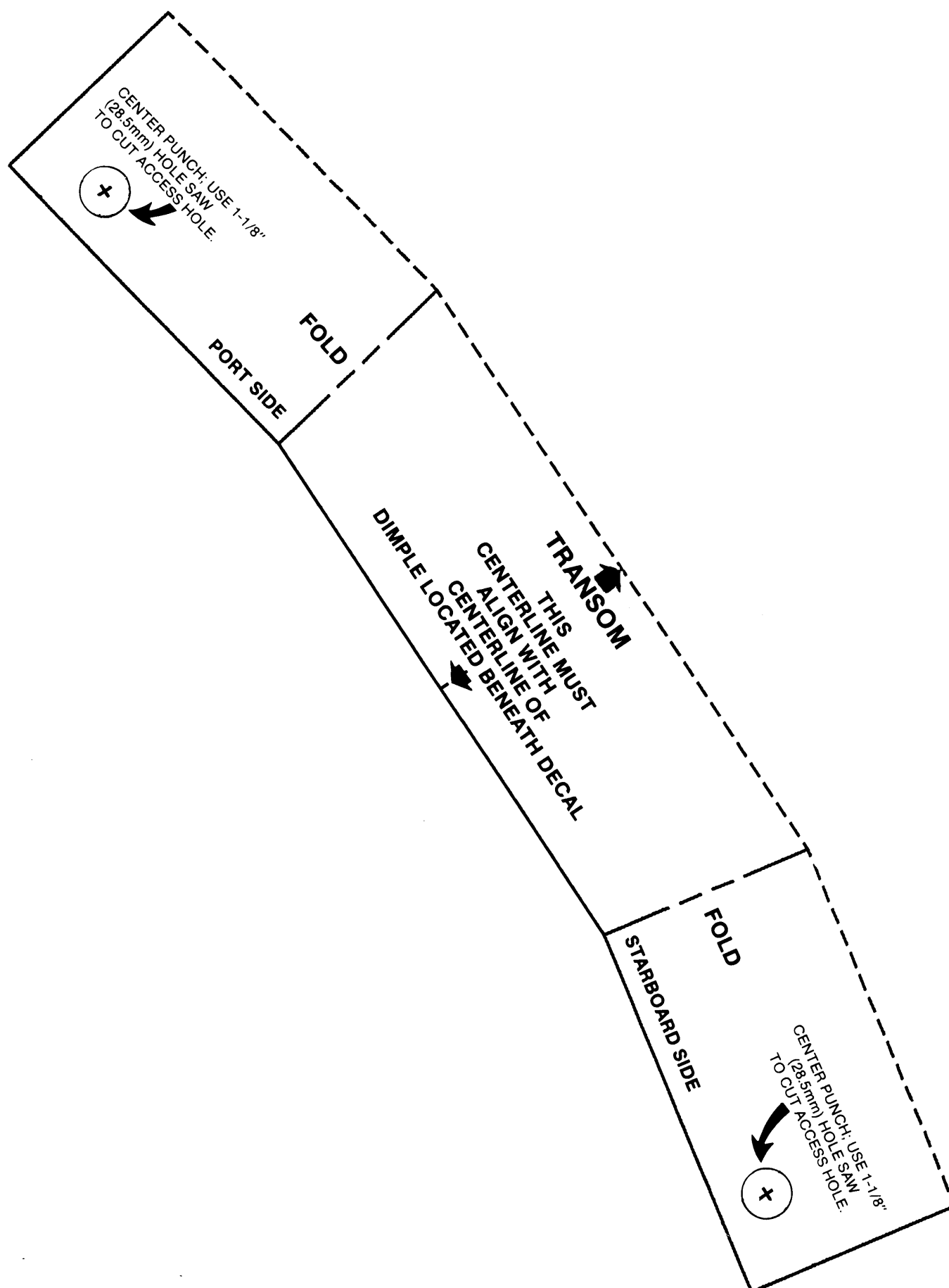


## Bravo Access Plug Drilling Template

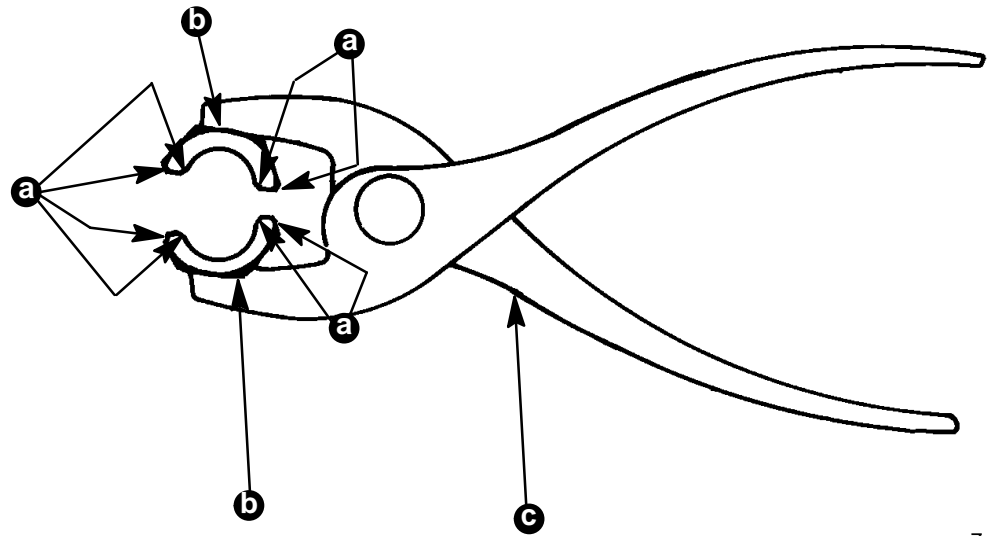
**IMPORTANT:** Carefully cut out template - use straightedge to make accurate folds. Align centerline of template with centerline of dimple or grease fitting (on older models). With template accurately aligned, securely TAPE TEMPLATE TO GIMBAL HOUSING so that it cannot move or shift.



76628



# Crimp Clamp Tool



74148

- a** - Bevel Edges
- b** - 3/4 in. Nut
- c** - Pliers

1. Weld a 3/4 in. nut to the jaws of a pair of pliers (as shown).
2. Saw the nut in half without damaging the pliers.
3. Clamp the jaws of the pliers in a vice so that the two halves of the nut are pressed firmly together.
4. Use a 1/2 in. drill bit to drill the threads out of the nut.
5. Remove the pliers from the clamp and bevel the edges of the nut as indicated.

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# POWER TRIM

## Section 5A - Oildyne Trim Pump

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# Trim Pump Specifications

## Valve Pressure Specifications

VALVE	PSI	kPa
Up Circuit	2200-2600	15173-17932
Down Circuit	400-600	2759-4138

## Electrical Specification

PUMP AMPERAGE DRAW	PSI	kPa
115 Amps at:	2200-2600	15173-17932

## Torque Specification

DESCRIPTION	lb-in.	lb-ft	Nm
Up Pressure Relief Valve	70		7.9
Down Pressure Relief Valve			
Thermal Relief Valve			
Pump-to-Adaptor Mounting Screws			
End Cap To Motor Housing	25		2.8
Motor-to-Adaptor Mounting Screws			
UP Pressure Hydraulic Hose (Black)	110		12
DOWN Pressure Hydraulic Hose (Gray)			
Hex Plug Retainers		44	60

## Special Tools

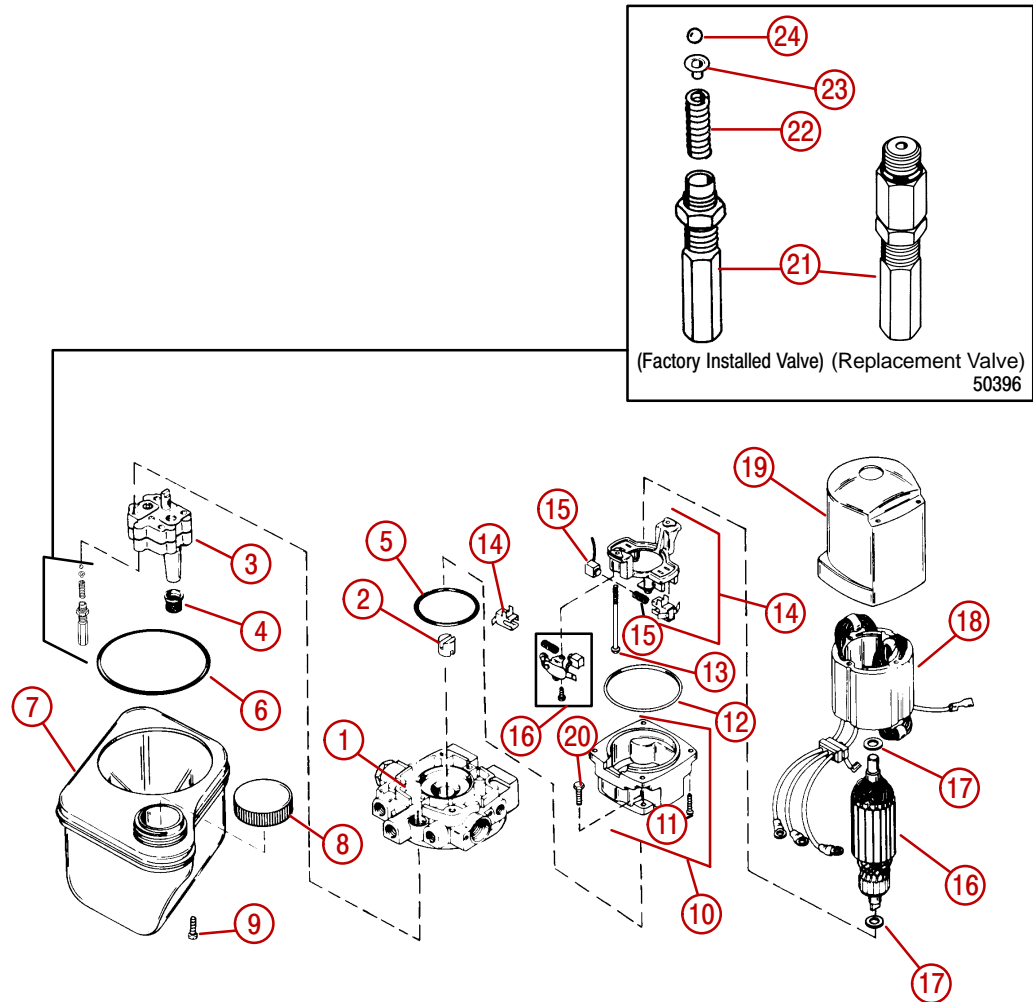
DESCRIPTION	PART NUMBER
Trim Pump Test Gauge Kit	91-52915A6
Torque Wrench (lb-in.)	91-66274

## Lubricants / Sealants / Adhesives

DESCRIPTION	PART NUMBER
Quicksilver Power Trim and Steering Fluid	92-90100A1
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Liquid Neoprene	92-25711-2

# Trim Pump Exploded View

## Oildyne Trim Pump



73519

- |                             |                         |
|-----------------------------|-------------------------|
| 1 - Adaptor                 | 13 - Screw              |
| 2 - Coupling                | 14 - Brush Holder Kit   |
| 3 - Pump                    | 15 - Brush set          |
| 4 - Filter                  | 16 - Armature           |
| 5 - O-ring-Motor End        | 17 - Thrust Washer      |
| 6 - O-ring, Reservoir End   | 18 - Field and Frame    |
| 7 - Reservoir               | 19 - Housing            |
| 8 - Cap                     | 20 - Screw              |
| 9 - Screw (Includes O-ring) | 21 - Relief Valve With: |
| 10 - End Cap w/Bearing      | 22 - Spring             |
| 11 - Screw                  | 23 - Eyelet             |
| 12 - O-ring                 | 24 - Check Ball         |

### Replacement Relief Valve Color Code:

Down Pressure: Green

Up Pressure: Blue

Thermal: Gold

# Maintaining Power Trim Pump Oil Level

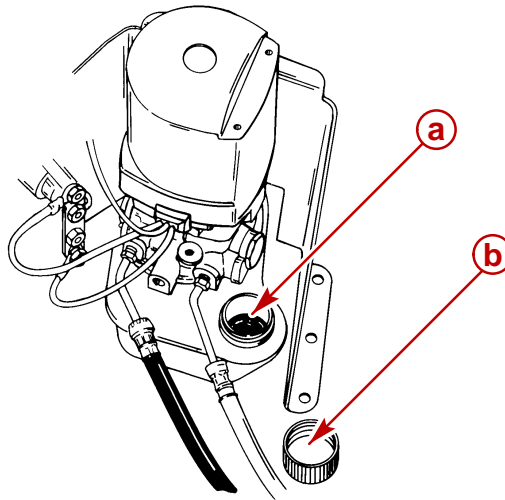
## **⚠ CAUTION**

Avoid pump damage. Vent reservoir pressure by backing out the vent screw two turns after tightening completely. Units without a vent screw have a vented fill cap. Remove the fill neck seal on models without a vent screw.

**IMPORTANT:** Check the oil level with the sterndrive unit in the full down position.

**IMPORTANT:** If quicksilver Power Trim and steering fluid is not available, SAE 10W-30 or 10W-40 engine oil can be used in the system.

1. Raise and lower the sterndrive unit 6 to 10 times to purge air from the system. Check the oil level visually.
2. Maintain the oil level between the "Max" and "Min" marks on the side of the reservoir. Fill to the bottom lip on the fill neck.



22031

- a** - Bottom Lip On The Fill Neck  
**b** - Vented Cap

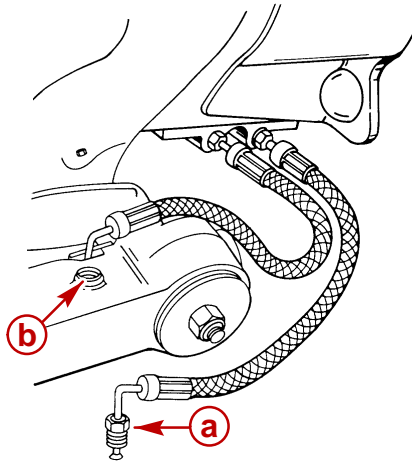


# Air Bleeding Power Trim System

1. The Power Trim System will purge itself of a small amount of air by raising and lowering the sterndrive unit several times. However, if a rebuilt trim cylinder is being installed (which has not been filled with oil), the bleeding procedure should be used to remove the air from the system.

## Bleeding OUT/UP Trim Circuit

1. Fill the pump reservoir to the proper level. The trim cylinder must be compressed.
2. Disconnect the OUT/UP hose from the front connection on the trim cylinder. If both cylinders were rebuilt, disconnect the hoses from both cylinders.
3. Direct the end of the removed trim hoses into a container.
4. Run the trim pump in the OUT/UP direction until a solid, air-free stream of fluid is expelled from the hoses. Reconnect the hoses and tighten securely.
5. Refill the trim pump to the proper level.



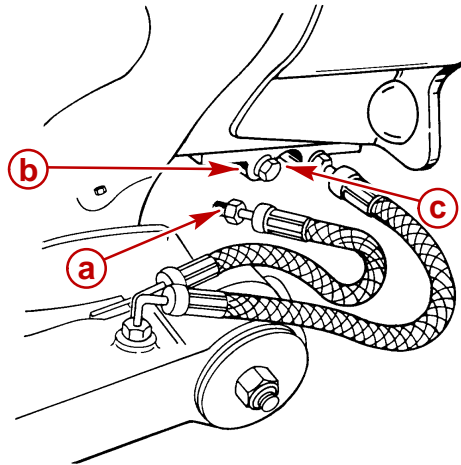
50389

- a** - OUT/UP Trim Hose  
**b** - Front Connection On Trim Cylinder

## Bleeding IN/DOWN Trim Circuit

1. Ensure that the pump reservoir is filled to the proper level.
2. Disconnect the IN/DOWN hose from the rear connection on the gimbal housing hydraulic connector. If both cylinders were rebuilt, disconnect the hoses from both sides of the hydraulic connector.
3. Plug the holes in the hydraulic connector using plug (22-38609) or suitable device.
4. Direct the end of the trim hose into a container.
5. Run the trim pump in the OUT/UP direction until the trim cylinders are fully extended.
6. Remove the plugs from the gimbal housing hydraulic connector and briefly run the trim pump in the IN/DOWN direction until a solid, air-free stream of fluid is expelled from the rear holes in the hydraulic connector. Reconnect the trim hoses and tighten securely.

7. Lower the sterndrive unit to the full IN/DOWN position and refill the trim pump to the proper level. Run the trim system IN/DOWN and OUT/UP several times and recheck the fluid level.



50389

- a** - IN/DOWN Trim Hose  
**b** - Hydraulic Connector  
**c** - Plug (22-38609)

## Testing Power Trim Pump

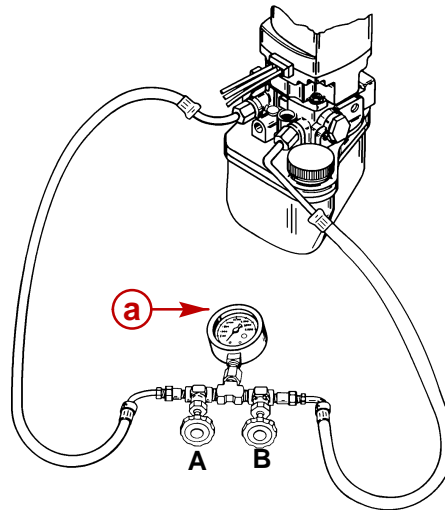
### **⚠ CAUTION**

Cross connecting trim hoses will damage the sterndrive housing. Appropriately mark trim hoses and hose connections to ensure proper reassembly.

### Test Gauge

1. Check the trim pump oil level. Fill if necessary.
2. Place the sterndrive unit in the full IN/DOWN position.

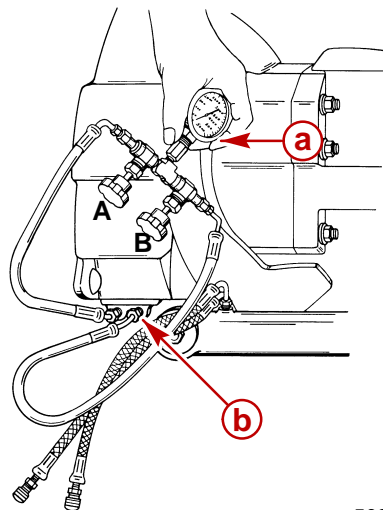
3. Connect the test gauge at the most convenient location at pump or hydraulic connector.



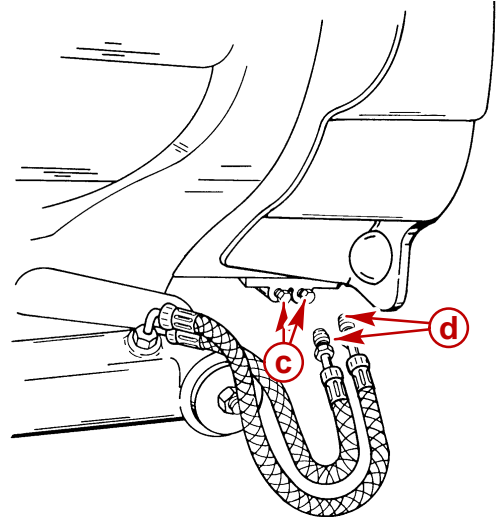
70596

### Gauge Connected to Pump

**a** - Hydraulic Test Gauge (91-52915A6)



50390



50391

### Gauge Connected to Hydraulic Connector

**a** - Hydraulic Test Gauge (91-52915A6)  
**b** - Gimbal Housing Hydraulic Connector  
**c** - Caps (Supplied with Gauge)  
**d** - Plugs (Supplied with Gauge)

4. Open valve "A" and "B" and run the pump OUT/UP and IN/DOWN several times (to purge air).

## Internal Restriction Test

1. Open valves "A" and "B".
2. Run pump OUT/UP and IN/DOWN while observing gauge.
3. Replace adapter if pressure exceeds 200 psi (1379 kPa).

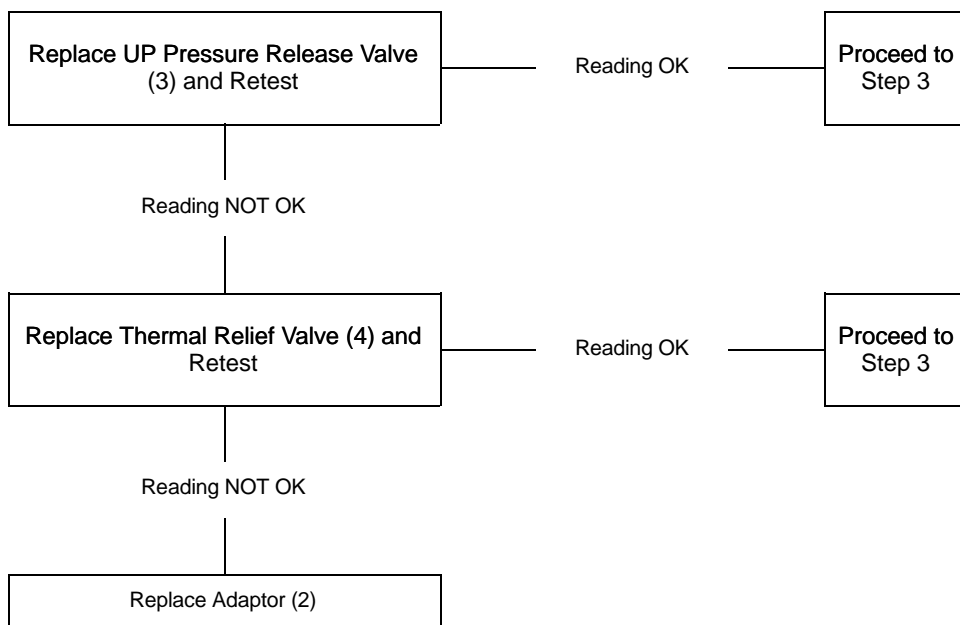
## OUT/UP Pressure Test

**NOTE:** The numbers in parentheses, e.g. (3), refer to the trim pump hydraulic system diagram on page 5A-11.

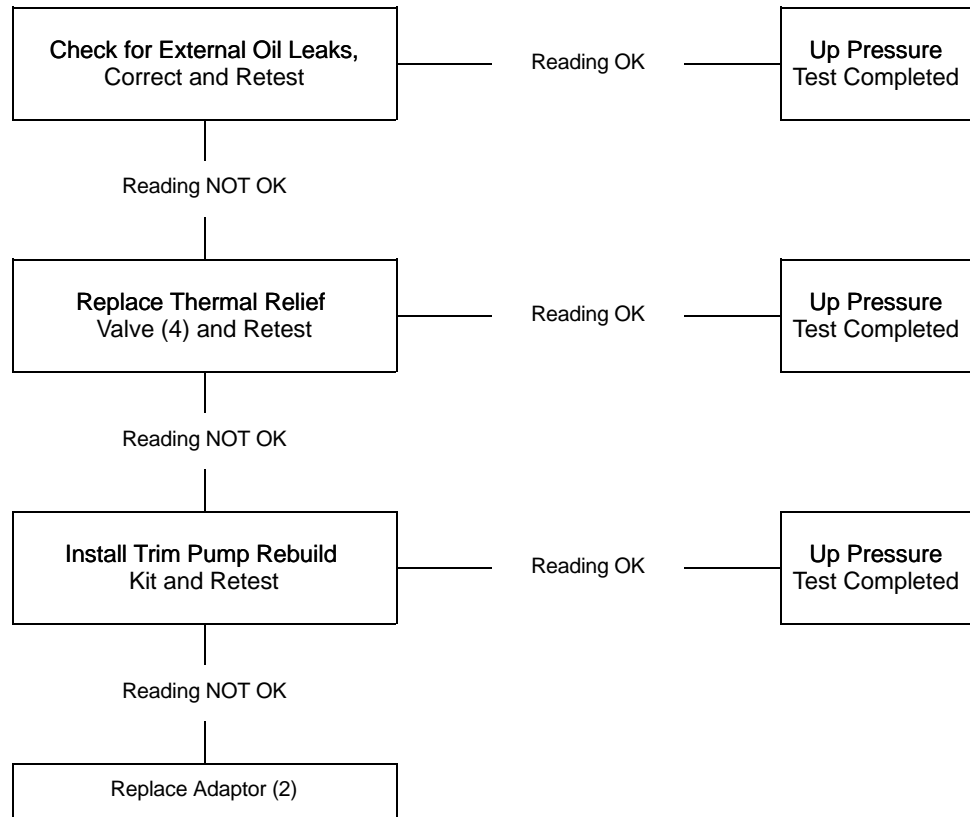
1. Leave valve “A” open and close valve “B.”
2. Run pump OUT/UP while observing the gauge. The reading should be 2200-2600 psi. (15173-17932 kPa).

**If gauge reading is within specifications,** proceed to step 3.

**If gauge reading is not within specifications,** perform the following:



3. Run the pump OUT/UP until the gauge reading reaches 2200-2600 psi (15173-17932 kPa). Stop pumping OUT/UP. The pressure should not fall below 1900 psi (13104 kPa). **If gauge reading is 1900 psi (13104 kPa) or above, UP pressure test completed.**  
**If gauge reading is below 1900 psi (13104 kPa) perform the following:**



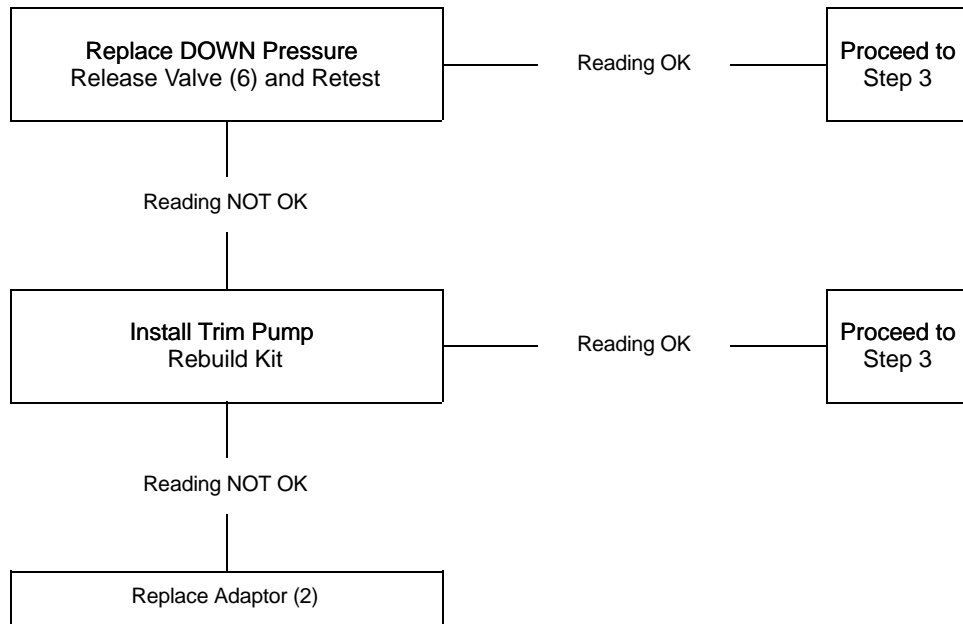
## IN/DOWN Pressure Test

**NOTE:** The numbers in parentheses, e.g. (3), refer to the trim pump hydraulic system diagram.

1. Close valve "A" and open valve "B."
2. Run the pump IN/DOWN while observing the gauge. The reading should be 400-600 psi (2759-4138 kPa).

**If gauge reading is within specifications, proceed to step 3.**

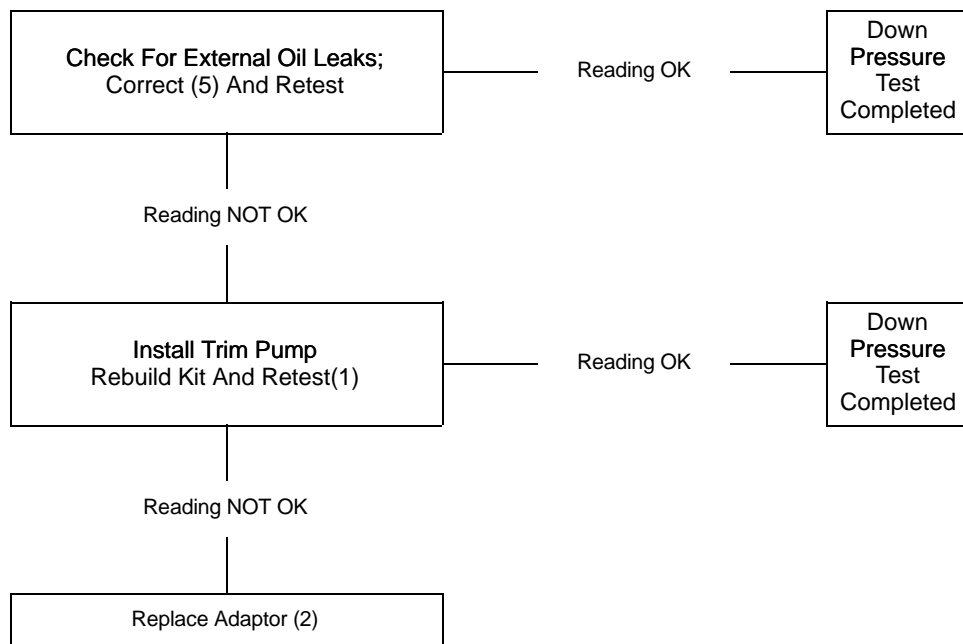
**If gauge reading is NOT within specifications, perform the following.**



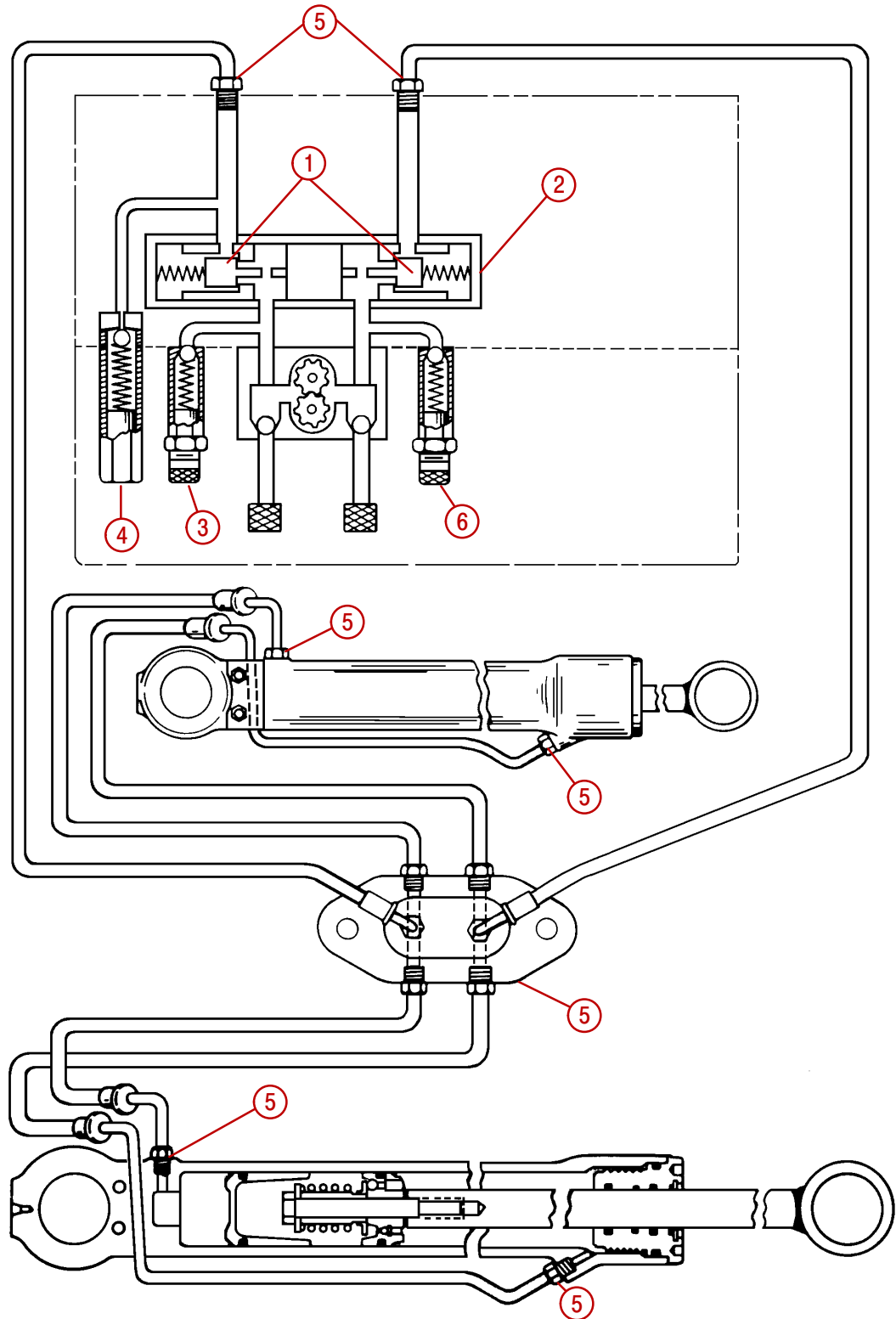
3. Run pump IN/DOWN until gauge reading reaches 400-600 psi (2759-4138 kPa). Stop pumping IN/DOWN. Pressure should not fall below 350 psi (2414 kPa).

**If gauge reading above 350 psi (2414 kPa), DOWN Pressure Test completed.**

**If gauge reading below 350 psi (2414 kPa), perform the following:**



# Trim Pump Hydraulic System



- 1 - Poppet Valves
- 2 - Pump Adaptor
- 3 - OUT/UP Pressure Relief Valve

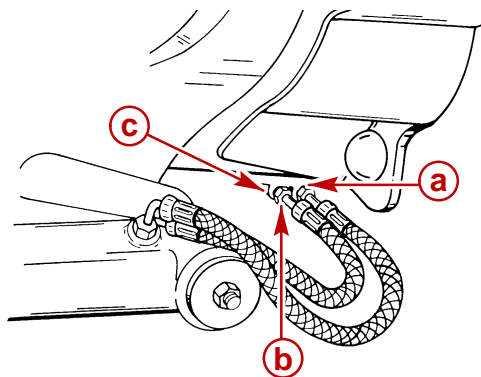
- 4 - Thermal Relief Valve
- 5 - Fitting
- 6 - IN/DOWN Pressure Relief Valve

73552

## Trim Cylinder Internal Leak Test

**IMPORTANT:** Before performing the following test, ensure that OUT/UP pressure meets specifications designated in OUT/UP pressure test.

1. Reconnect the trim cylinder hoses if disconnected.
  - a. Remove the plugs and caps.
  - b. Install the OUT/UP hose to the forward hole on the hydraulic connector. Tighten securely.
  - c. Install the IN/DOWN hose to the aft hole on the hydraulic connector. Tighten securely.

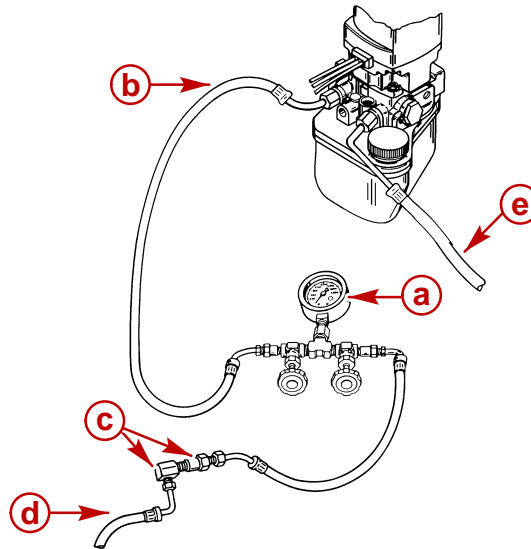


50391

- a** - OUT/UP Hose  
**b** - IN/DOWN Hose  
**c** - Hydraulic Connector



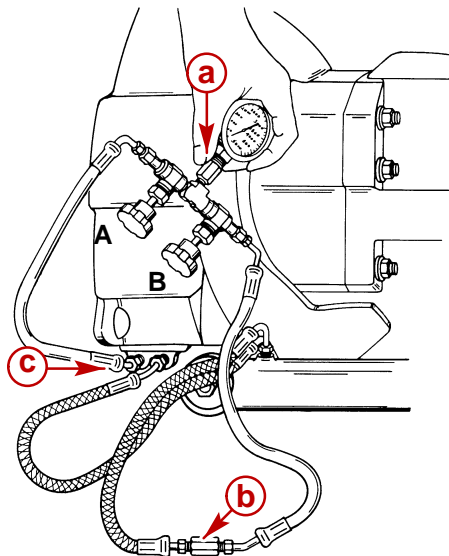
2. Connect the gauge at the most convenient location.



70598

### Gauge Connected to Pump

- a** - Hydraulic Test Gauge
- b** - Hose Connected to UP (Left Hole)
- c** - Fittings - (Supplied with Gauge)
- d** - BLACK Hose (From Gimbal Housing)
- e** - GREY Hose (From Gimbal Housing)



50390

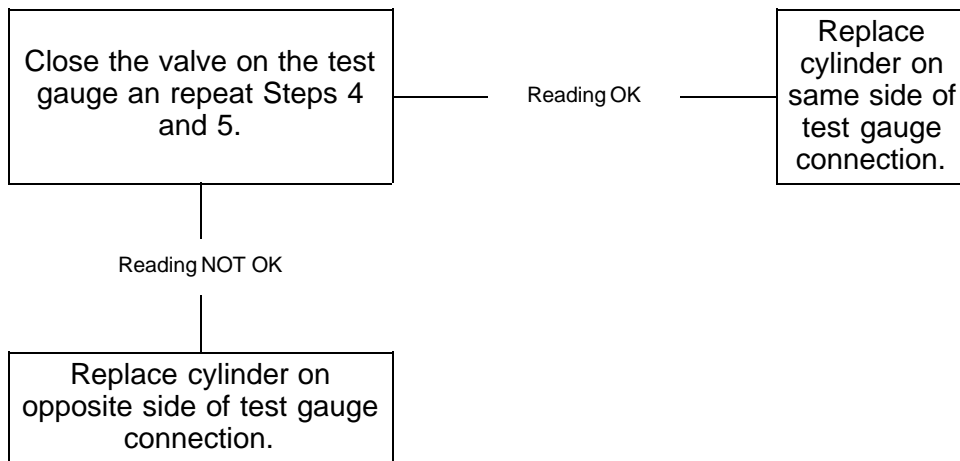
### Gauge Connected to Hydraulic Connector

- a** - Test Gauge
- b** - Coupling (Supplied with Gauge)
- c** - Front Hydraulic Connector Port

3. Open valves "A" and "B" and the run pump OUT/UP and IN/DOWN several times to purge air.
4. Run the pump OUT/UP until the trim cylinders are fully extended.
5. Observe the gauge while pumping. The pressure should be 2200-2600 psi (15173-17932 kPa).

6. Stop pumping OUT/UP. Pressure should not fall below 1900 psi (13104 kPa). Reading below 1900 psi (13105 kPa) indicates a trim cylinder leak. Use the following steps to locate the faulty cylinder.

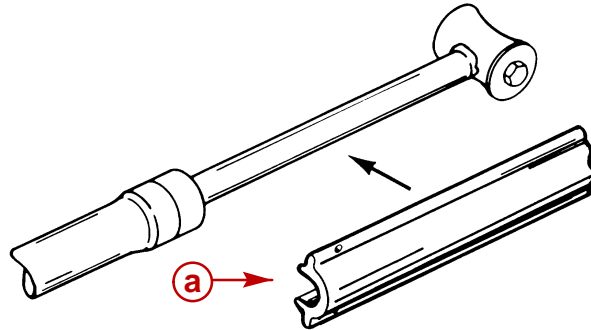
**NOTE:** If the gauge is connected at the pump, reconnect the gauge at the gimbal housing hydraulic connector. Repeat step 3, then run the pump in the OUT/UP direction until the trim cylinder is fully extended.



## Trim Cylinder Shock Piston Test

If all previous trim system test results meet specifications, but sterndrive unit will not trim IN/DOWN, the problem may be a leaky trim cylinder shock piston. Use the following test to check for this condition. No test gauge required.

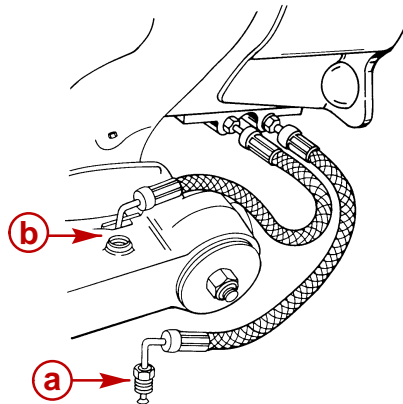
1. Run the pump in the OUT/UP direction until the trim cylinders are fully extended.
2. Use a suitable device to keep trim cylinder piston rods from retracting. The Quicksilver Trailing Kit works well for this purpose.



22562

**a** - Trailing Clip

3. Disconnect the UP trim hose from trim cylinders.



50389

**a** - UP Trim Hose  
**b** - Front Connection

4. Run the pump in the IN/DOWN direction. If oil flows from the UP port on the trim cylinder, the shock piston is leaking and must be replaced.

# Motor and Electrical Bench Tests

## Trim Pump Motor Test (In Boat)

### **⚠ WARNING**

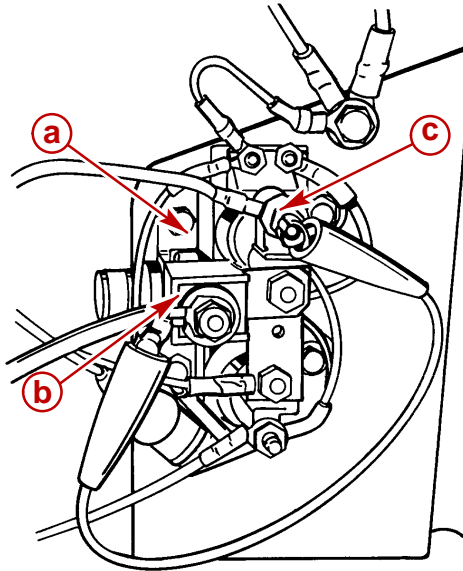
Making electrical connections may cause a spark. DO NOT perform this test near flammables or explosives.

### **⚠ WARNING**

Remain clear of the sterndrive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

## OUT/UP OPERATION

1. Connect a jumper wire between the positive (+) solenoid terminal and the blue-white motor lead terminal.
2. The motor should run.



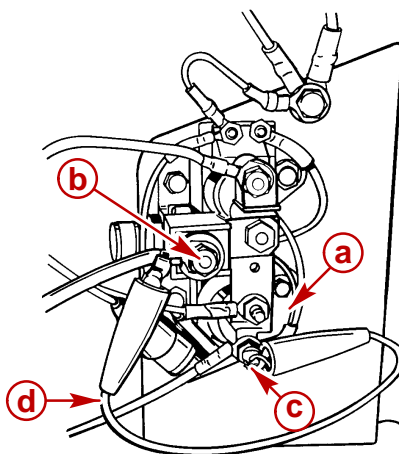
22494

## IN/DOWN POSITION

- a** - OUT/UP Solenoid
- b** - Positive Terminal (+)
- c** - Negative Supply Lead

**IN/DOWN OPERATION**

1. Connect a jumper wire between the positive (+) solenoid terminal and the green-white motor lead terminal.
2. The motor should run.



73556

- a** - IN/DOWN Solenoid
- b** - Positive Terminal (+)
- c** - GREEN-WHITE Motor Lead Terminal
- d** - Jumper Wire

3. If the motor does not run, refer to "Motor Repair."

## Trim Pump Motor Test (Out of Boat)

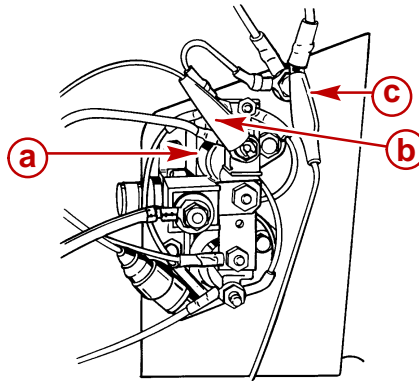
### **⚠ WARNING**

**Making electrical connections may cause a spark. DO NOT perform this test near flammables or explosives.**

1. Remove the trim pump from the boat. Refer to "Trim Pump Removal."
2. Remove the fluid from the trim pump reservoir.

### OUT/UP OPERATION

1. Connect a 12 volt Positive (+) supply lead to the blue-white motor lead terminal.
2. Connect the negative (–) supply lead to a good ground on the pump.
3. The motor should run.

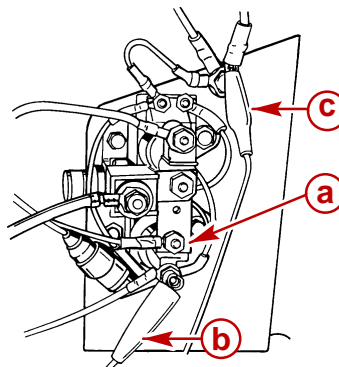


22495

- a** - OUT/UP Solenoid
- b** - 12 Volt Positive (+) Supply Lead
- c** - Negative Supply Lead

### IN/DOWN OPERATION

1. Connect a 12 volt Positive (+) supply lead to the green-white motor lead terminal.
2. Connect the negative (–) supply lead to a good ground on the pump.
3. The motor should run.



22494

- a** - IN/DOWN Solenoid
- b** - 12 Volt Positive Supply (+) Lead
- c** - GREEN/WHITE Motor Lead
- d** - Jumper Wire

4. If the motor does not run, refer to "Motor Repair."

## Solenoid Test (Pump In Boat)

### **⚠ WARNING**

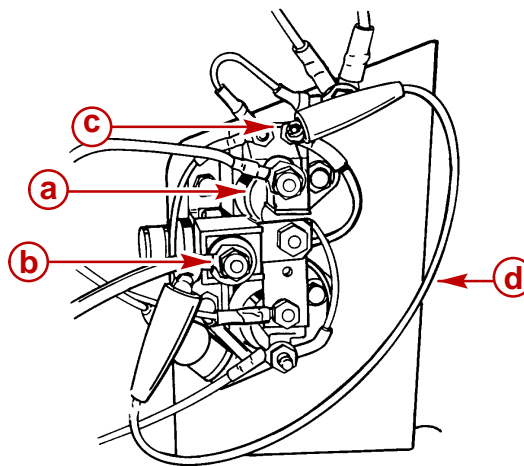
**DO NOT** perform this test near flammables or explosives as a spark may occur when making connections.

### **⚠ CAUTION**

Remain clear of the sterndrive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

### UP/OUT SOLENOID

1. Connect a jumper wire between the positive (+) solenoid terminal and the blue-white harness wire terminal.
2. The motor should run.

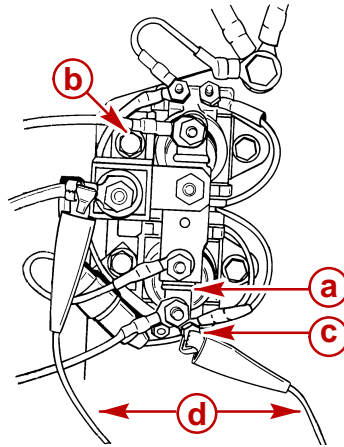


22495

- a** - OUT/UP Solenoid
- b** - Positive (+) Solenoid Terminal
- c** - BLUE/WHITE Harness Wire Terminal
- d** - Jumper Wire

**IN/DOWN SOLENOID**

1. Connect a jumper between the positive (+) solenoid terminal and the green/white harness wire terminal.
2. The motor should run.



22494

- a** - IN/DOWN Solenoid
- b** - Positive (+) Solenoid Terminal
- c** - GREEN/WHITE Harness Wire Terminal
- d** - Jumper Wire

3. If the pump motor does not run in one direction or another, replace the appropriate solenoid.

**NOTE:** See the wiring diagram on page 5A-51.

**Solenoid Test (Pump Out of Boat)****⚠ WARNING**

**DO NOT perform this test near flammables or explosives as a spark may occur when making connections.**

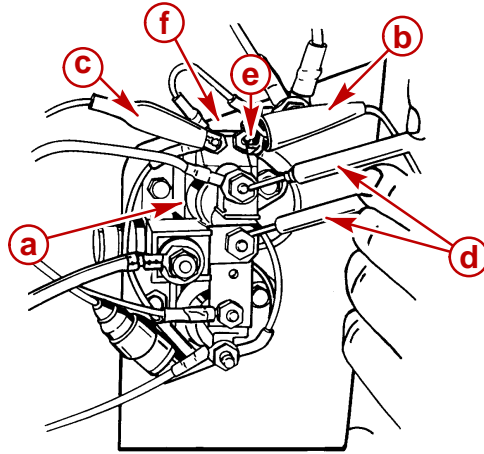
1. Remove the trim pump from the boat. Refer to "Trim Pump Removal."
2. Remove the fluid from the trim pump reservoir.

**OUT/UP SOLENOID**

1. Connect a 12 volt Positive (+) supply lead to blue-white harness terminal wire.
2. Connect the negative (–) supply lead to the solenoid ground terminal as shown.



3. Connect the ohmmeter leads to the large terminals on the solenoid.



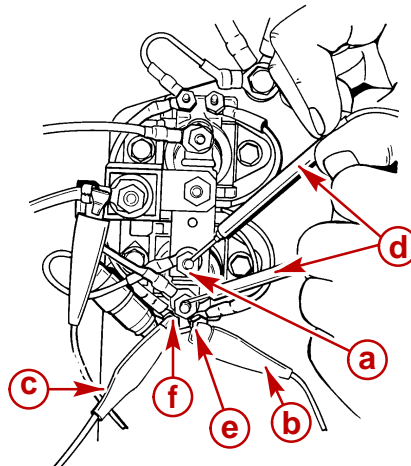
22493

- a** - OUT/UP Solenoid
- b** - 12 volt Positive (+) Supply Lead
- c** - Negative (–) Supply Lead
- d** - Ohmmeter Leads
- e** - BLUE/WHITE Harness Wire Terminal
- f** - Solenoid Ground Terminal

4. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.  
**High Ohms Reading** (No Continuity)-Replace solenoid.

#### IN/DOWN SOLENOID

1. Connect a 12 volt positive (+) supply lead to the green-white harness wire terminal.
2. Connect the negative (–) supply lead to the solenoid ground terminal.
3. Connect the ohmmeter leads to the large terminals on the solenoid.



22494

- a** - IN/DOWN Solenoid
- b** - 12 Volt Positive (+) Supply Lead
- c** - Negative (–) Supply Lead
- d** - Ohmmeter Leads
- e** - GREEN/WHITE Harness Wire Terminal
- f** - Solenoid Ground Terminal

4. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.  
**High Ohms Reading** (No Continuity)-Replace solenoid.

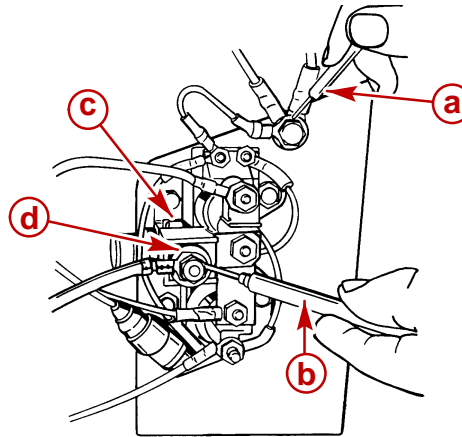
**NOTE:** See the wiring diagram on page 5A-51.

## 110 Amp Fuse Test (Pump in Boat)

### **⚠ WARNING**

**DO NOT perform this test near flammables (or explosives) as a spark may occur when making connections.**

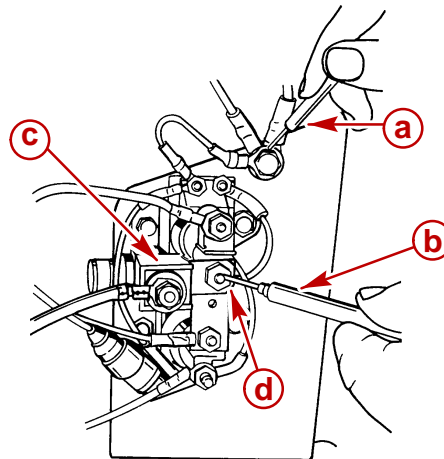
1. Check for voltage at battery power terminal using a volt meter. Voltage **MUST BE** indicated before proceeding with the next check.



22495

- a** - Volt Meter Negative (–) Lead
- b** - Volt Meter Positive (+) Lead
- c** - Fuse (RED in Color)
- d** - Battery Power Terminal

2. Check for voltage at protected terminal of 110 Amp fuse using a volt meter.



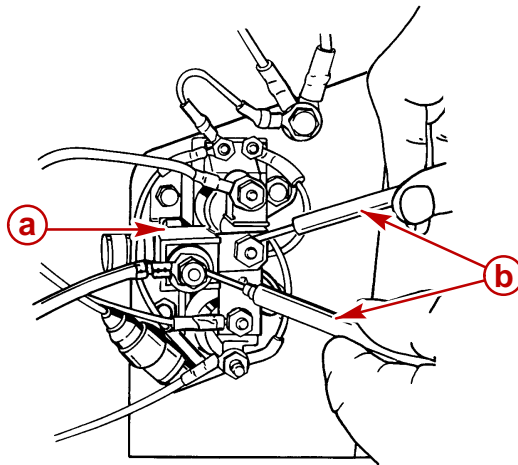
22493

- a** - Volt Meter Negative (–) Lead
- b** - Volt Meter Positive (+) Lead
- c** - Fuse (RED in Color)
- d** - Protected Terminal Of 110 Amp Fuse

3. **Voltage Indicated:** Fuse OK.  
**Voltage Not Indicated:** Replace the fuse.

## 110 Amp Fuse Test (Pump Out of Boat)

1. Connect the ohmmeter leads between the terminals on the fuse.



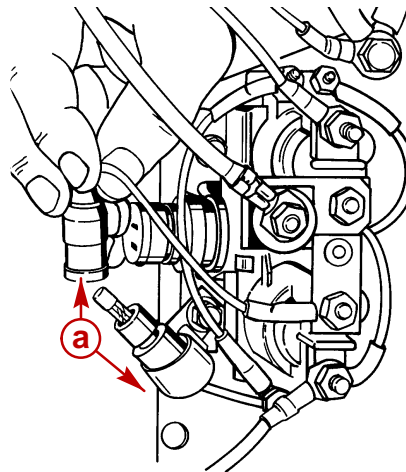
22493

**a** - 110 Amp Fuse (Red)  
**b** - Ohmmeter Leads

2. **Zero Ohms Reading** (Full Continuity)-Fuse OK.  
**High Ohms Reading** (No Continuity)-Replace fuse.

## 20 Amp Fuse Test

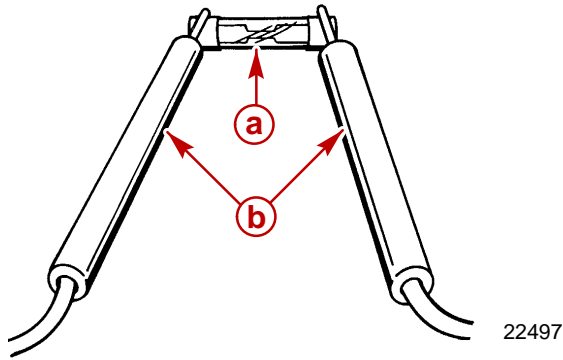
1. Remove the fuse from the fuse holder.



22496

**a** - Fuse Holder

2. Connect one ohmmeter lead to each end of the fuse.

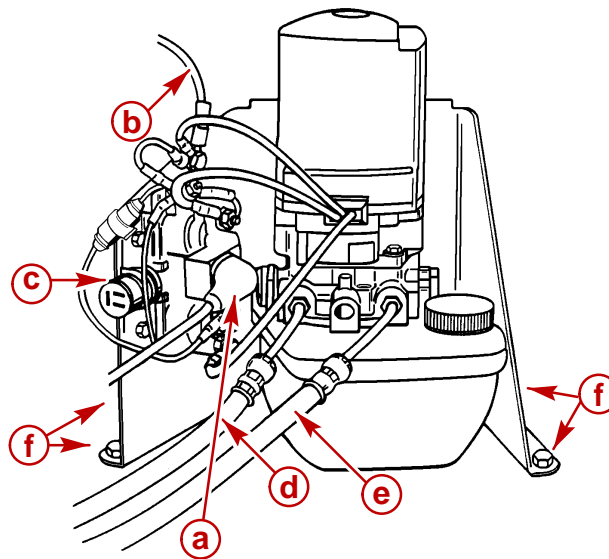


- a** - 20 Amp Fuse  
**b** - Ohmmeter Leads

3. **Zero Ohms Reading** (Full Continuity)-Fuse OK.  
**High Ohms Reading** (No Continuity)-Replace fuse.

## Trim Pump Removal

1. Disconnect the trim pump battery leads from the power source. Disconnect the negative lead first.
2. Disconnect the trim harness connector (3 pronged connector) from the trim pump.
3. Remove the hydraulic hoses from the trim pump. Cap the hose ends.
4. Remove the lag bolts and washers. Then, lift the pump and floor bracket from the boat.

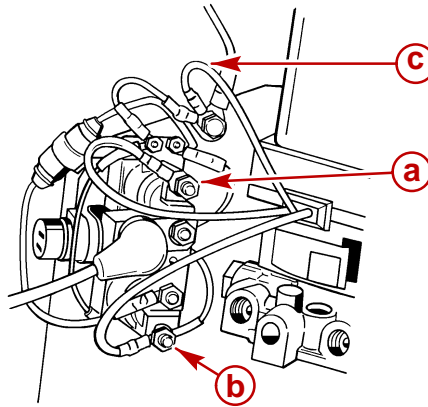


- a** - Positive Battery Lead  
**b** - Negative Battery Lead  
**c** - Harness Connector  
**d** - BLACK Hydraulic Hose (UP Hose)  
**e** - GRAY Hydraulic Hose (DOWN Hose)  
**f** - Lag Bolts and Washers

# Hydraulic Repair

## Disassembly

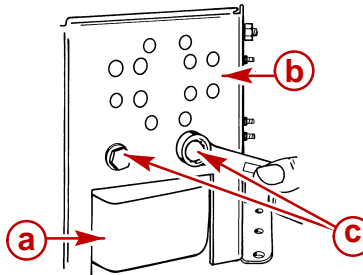
1. Disconnect the trim motor wires.



70359

- a** - BLUE/WHITE Motor Wire
- b** - GREEN/WHITE Motor Wire
- c** - BLACK Ground Wire

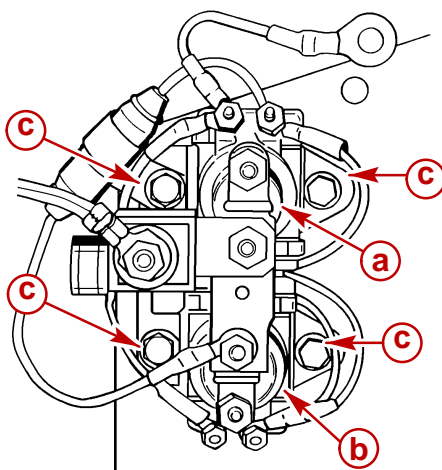
2. Remove the mounting bolts and trim pump from the floor bracket.



22548

- a** - Trim Pump
- b** - Floor Bracket
- c** - Mounting Bolts

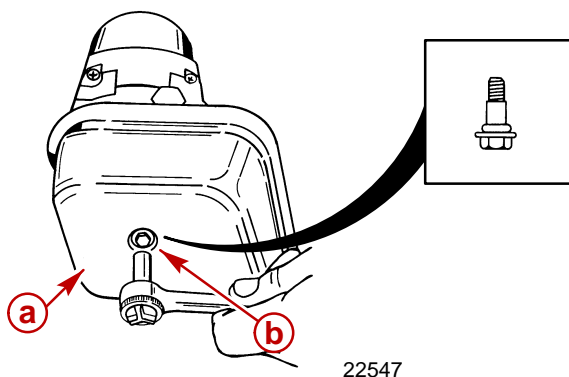
3. Remove the solenoids if replacement is necessary.



70232

- a** - UP Solenoid
- b** - DOWN Solenoid
- c** - Mounting Bolts (2 on Each Solenoid)

4. Remove the pump reservoir.



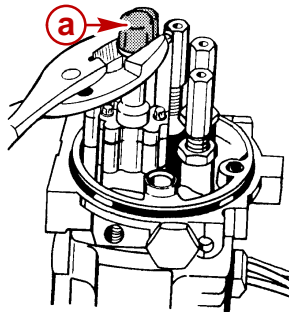
22547

76622

- a** - Pump Reservoir
- b** - Bolt and O-ring

## Filter Replacement

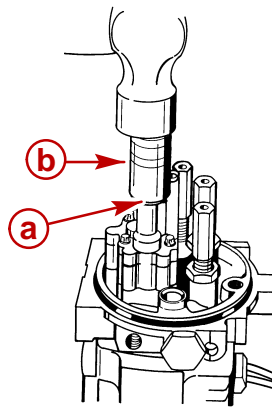
1. Remove the filters by twisting while pulling upward.



76887

**a** - Filters (2)

2. Install new filters.



76888

**a** - Filters (2)

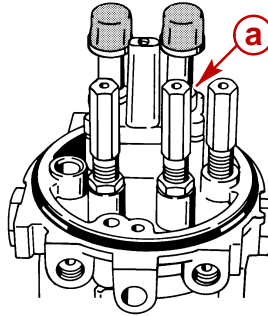
**b** - 5/8 in. Socket

## UP Pressure Relief Valve Replacement

**NOTE:** The UP pressure relief valve in the kit is color coded BLUE for easy identification.

**IMPORTANT:** A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

**IMPORTANT:** When installing a replacement pressure relief valve, do NOT loosen or attempt to remove the hex jam nut. This valve is preset at the factory for proper UP pressure relief.

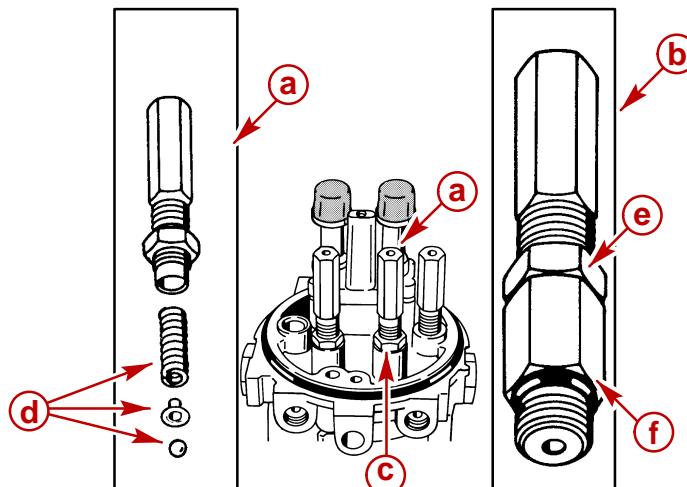


70872

**a** - Factory Installed UP Pressure Relief Valve

**NOTE:** Factory installed pressure relief valves will be a natural steel finish - they will NOT be color coded.

1. Loosen jam nut on UP pressure relief valve and remove valve.
2. Remove the pump body components and discard.
3. Ensure that the threaded hole is free of dirt.
4. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install valve.
5. Tighten at the base of the new valve. Torque to 70 lb-in. (7.9 Nm).



50396

70872

50396

- a** - Factory Installed UP Pressure Relief Valve
- b** - Replacement UP Pressure Relief Valve
- c** - Jam Nut
- d** - Pump Body Components (Spring, Eyelet And Check Ball)
- e** - Jam Nut
- f** - O-ring



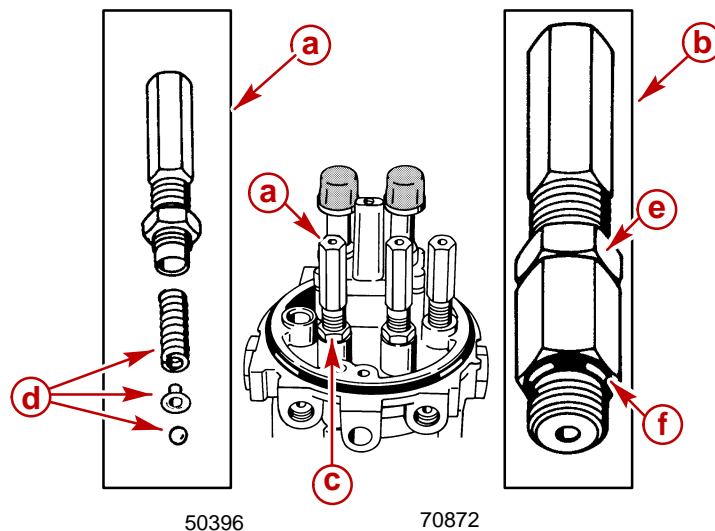
## DOWN Pressure Relief Valve Replacement

**NOTE:** The DOWN pressure relief valve in the kit is color coded GREEN for easy identification.

**IMPORTANT:** A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

**IMPORTANT:** When installing a replacement pressure relief valve, do NOT loosen or attempt to remove the hex jam nut. This valve is preset at the factory for proper DOWN pressure relief.

1. Loosen jam nut on DOWN pressure relief valve and remove valve.
2. Remove the pump body components and discard.
3. Ensure that the threaded hole is free of dirt.
4. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install valve.
5. Tighten at the base of the new valve. Torque to 70 lb-in. (7.9 Nm).



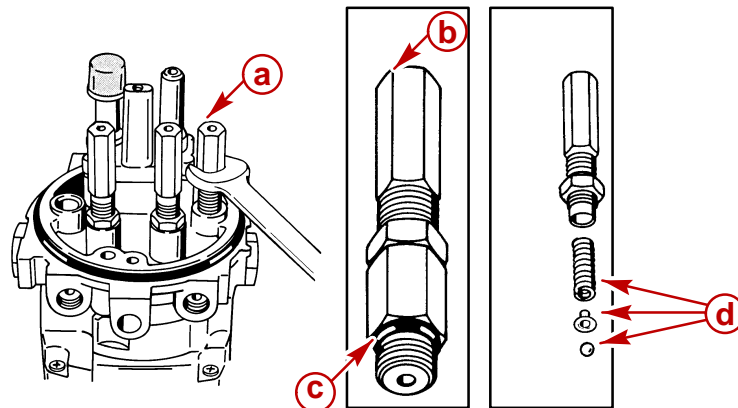
- a** - Factory Installed DOWN Pressure Relief Valve
- b** - Replacement DOWN Pressure Relief Valve (GREEN)
- c** - Jam Nut
- d** - Pump Body Components (Spring, Eyelet And Check Ball)
- e** - Jam Nut
- f** - O-ring

## Thermal Relief Valve Replacement

**NOTE:** The Thermal Relief Valve in the kit is color coded GOLD for easy identification.

**IMPORTANT:** The thermal relief valve is factory preset. do NOT loosen or attempt to separate the component parts. Do not use a wrench on the upper gold colored fitting. Use a wrench on the lower hex-fitting to tighten the relief valve.

1. Remove the thermal relief valve.
2. Remove the pump body components and discard.
3. Ensure that the threaded hole is free of dirt.
4. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install valve.
5. Tighten using the base of the new valve. Torque to 70 lb-in. (7.9 Nm).



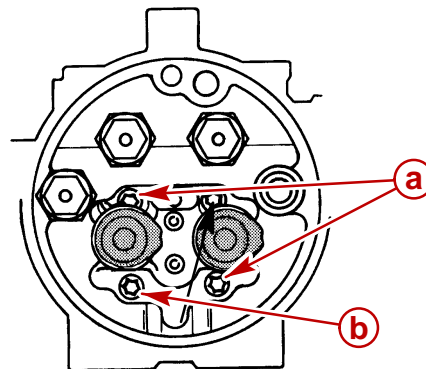
70836

- a** - Original Thermal Relief Valve
- b** - Replacement Thermal Relief Valve (Gold)
- c** - O-ring
- d** - Pump Body Components (Spring, Eyelet, Check Ball)

## Pump Replacement

**NOTE:** The pump cannot be re-built. If the pump is defective, replace it as an assembly.

1. Remove the pump attaching screws with a hex lobular socket or standard 3/16 in. (5 mm) socket and the pump. Do NOT loosen the pump assembly screws.

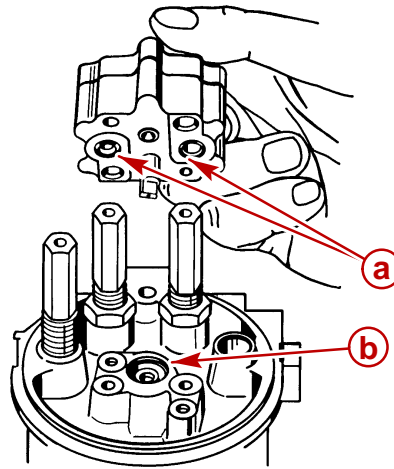


70870

- a** - Screw
- b** - Pump Assembly Screws

2. Remove the O-rings from the old pump and install them on the new pump.

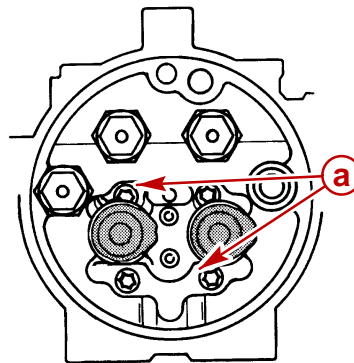
3. Lubricate the lip of the adapter seal with light weight oil.



22545

- a** - O-rings  
**b** - Adapter Seal

4. Install the pump and torque the pump screws to 70 lb-in. (7.9 Nm) using a hex lobular socket or standard 3/16 in. (5 mm) socket.

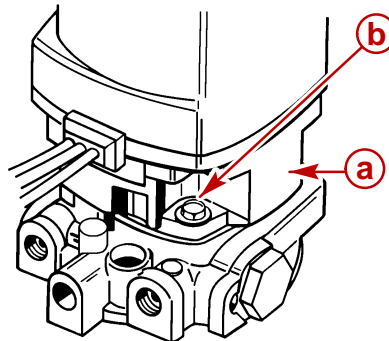


70870

- a** - Screws

## Adapter Replacement

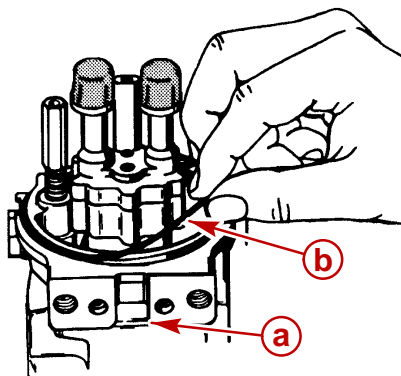
1. Remove the pump motor attaching screws and remove the pump motor.



70599

- a** - Pump Motor  
**b** - Screws (2)

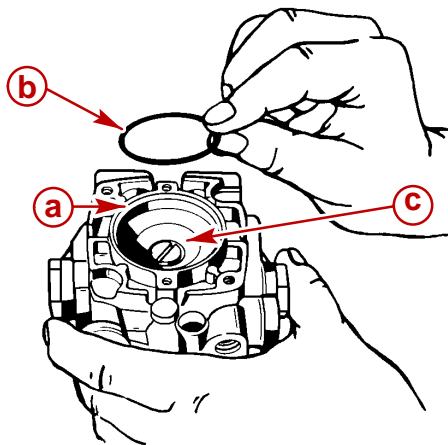
2. Remove and discard the adapter to reservoir O-ring.



70869

**a** - Adapter  
**b** - O-ring

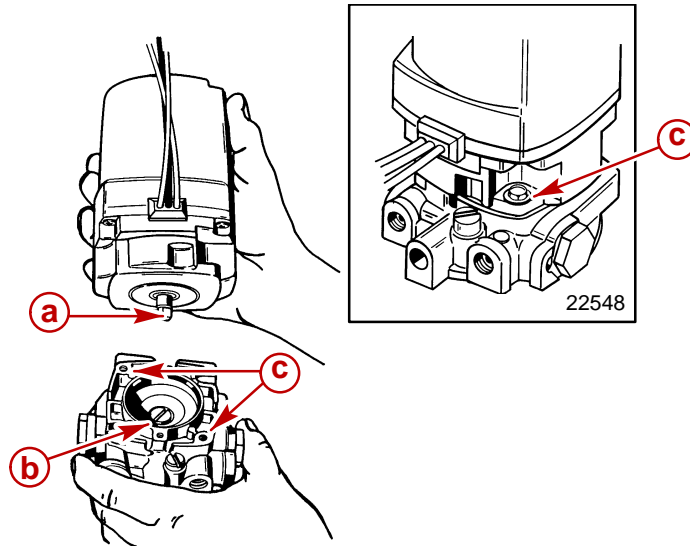
3. Remove and discard the motor to adapter O-ring.
4. Ensure that the coupling is installed with the shallow slot is toward the reservoir.
5. Lubricate the coupling with 2-4-C Marine Lubricant with Teflon.



70600

**a** - Adapter  
**b** - O-ring  
**c** - Coupling - (Shallow Slot Toward Reservoir)

6. Align the motor shaft with the coupling and install the motor onto the adapter.
7. Position the motor as shown and secure with screws. Tighten securely.



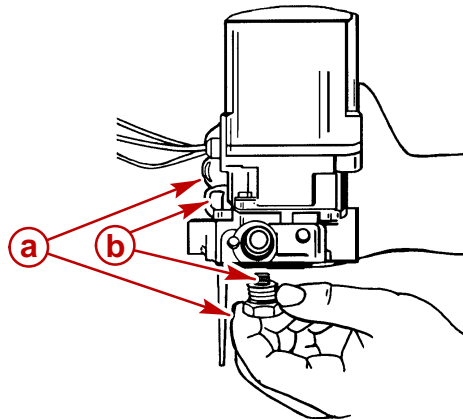
22496

- a** - Motor Shaft
- b** - Coupling
- c** - Screws (Opposite Corners)

## Adapter Repair

### INTERNAL O-RING and POPPET VALVE REPLACEMENT

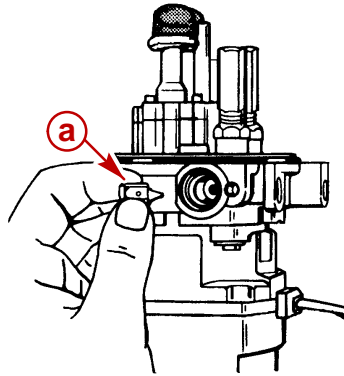
1. Remove the hex plug retainers and springs (one on each side).



70871

- a** - Hex Plug Retainers (2)
- b** - Springs (2)

2. Remove and discard the poppet valves.



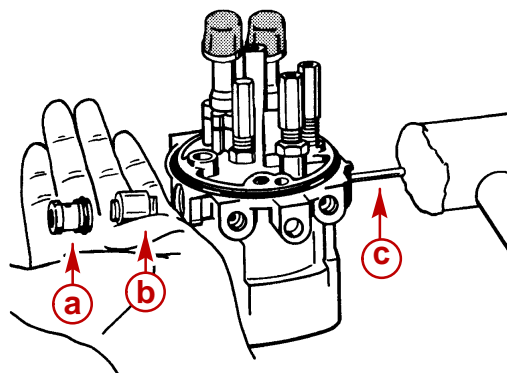
76889

**a** - Poppet Valve

### **⚠ CAUTION**

**Use care in removing check valve bodies from adapter, so as not to damage poppet valve seat surface on valve body.**

3. Remove the check valve bodies and spool using a 1/4 in. diameter metal rod and plastic hammer.

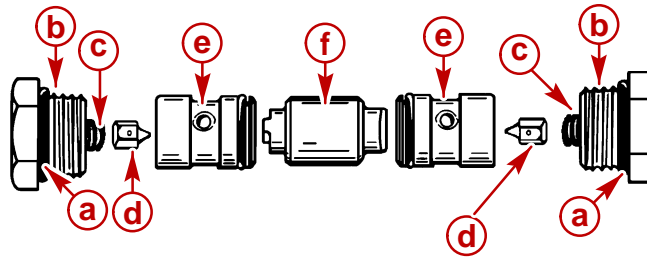


76890

**a** - Check Valve Body  
**b** - Spool  
**c** - Metal Rod

4. Remove and discard the O-rings on the hex plug retainers.
5. Discard the check valve bodies.

6. Clean the hex plug retainers and spool.



70867

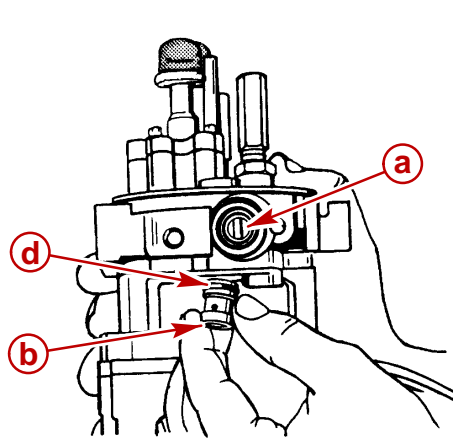
- a** - O-rings
- b** - Hex Plug Retainers
- c** - Springs
- d** - Poppet Valves
- e** - Check Valve Bodies
- f** - Spool

7. Lubricate the check valve body O-rings with Power Trim and Steering Fluid or with 10W-30 or 10W-40 motor oil.

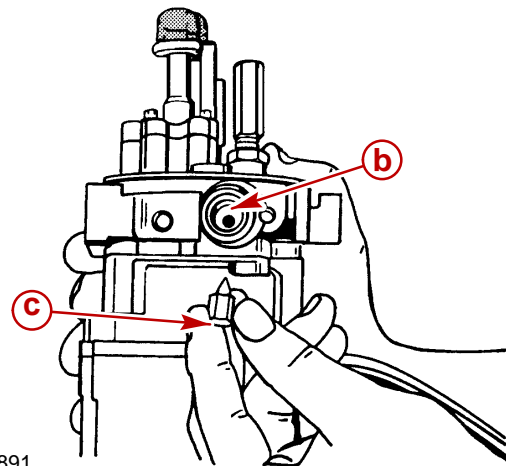
### **⚠ CAUTION**

**DO NOT force check valve bodies into adapter as damage to O-rings may result.**

8. Place the spool and check valve bodies into the adapter.  
 9. Place the poppet valves into the check valve bodies.



76891

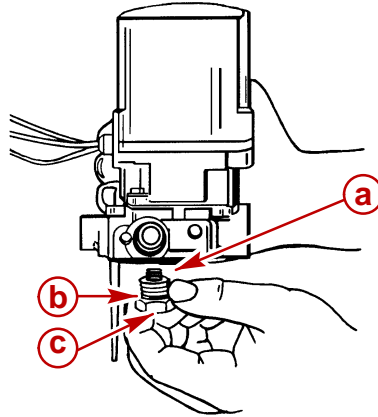


76892

- a** - Spool
- b** - Check Valve Body (2)
- c** - Poppet Valve (2)
- d** - Check Valve Body O-ring

10. Lubricate the hex plug retainer O-rings with Quicksilver Power Trim and Steering Fluid or 10W-30 or 10W-40 motor oil.  
 11. Place the springs into the hex plug retainers.

12. Thread the hex plug retainers into the adapter by hand until the retainer contacts the check valve body.

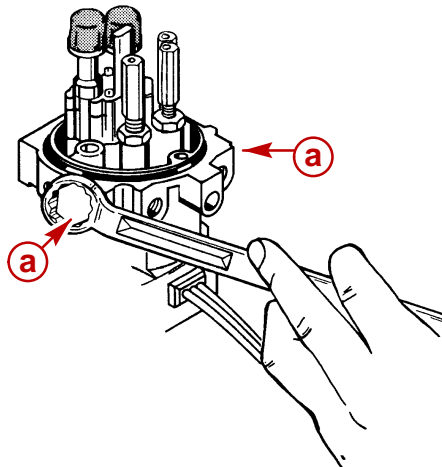


70871

- a** - Spring (2)
- b** - O-ring
- c** - Hex Plug Retainer (2)

**IMPORTANT: Hex plug retainers MUST BE turned into adapter exactly as outlined or damage to check valve body O-rings may result.**

13. Tighten the hex plug retainer securely on each side.



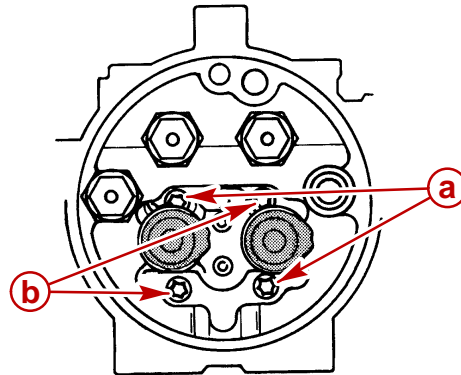
76893

- a** - Hex Plug Retainer



## Pump Shaft Oil Seal Replacement

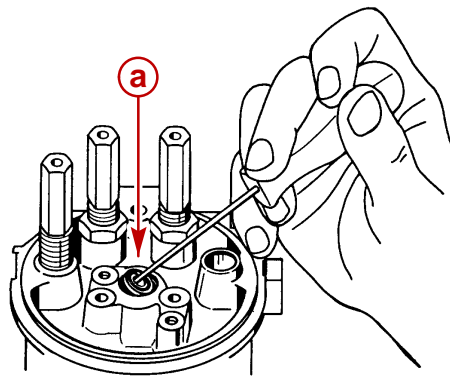
1. Remove the pump attaching screws with a hex lobular socket or standard 3/16 in. (5 mm) socket.
2. Remove pump. Do NOT loosen or remove the pump assembly screws.



70870

- a** - Screw  
**b** - Pump Assembly Screw

3. Remove the oil seal by prying out with a screwdriver.

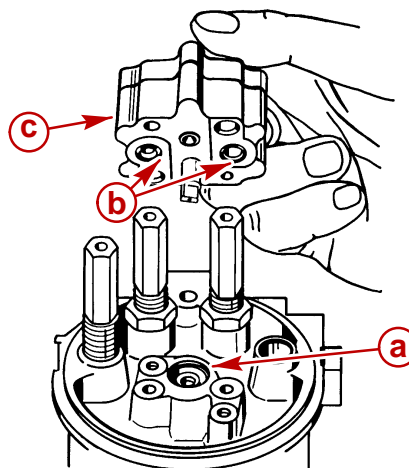


50371

- a** - Oil Seal

4. Remove and replace the O-rings on the pump base if they are worn.
5. Install a new seal with the lips toward the pump. The oil seal can be pressed in by hand.

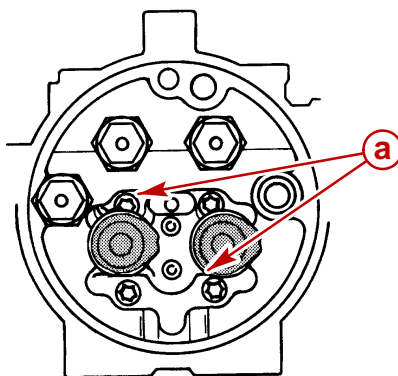
6. Lubricate the lip of the seal with light weight oil.



22545

- a** - Oil Seal  
**b** - O-rings  
**c** - Pump

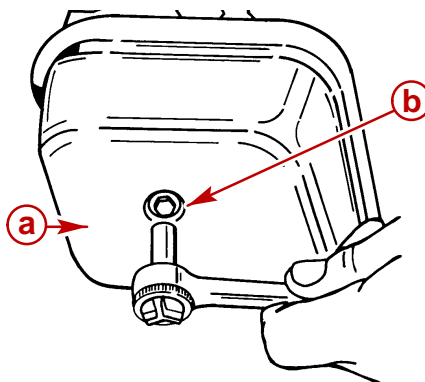
7. Install the pump. Torque the attaching screws to 75 lb-in. (8 Nm) using a hex lobular socket or standard 3/16 in. (5 mm) socket.



70870

- a** - Screws

8. Install the pump reservoir.



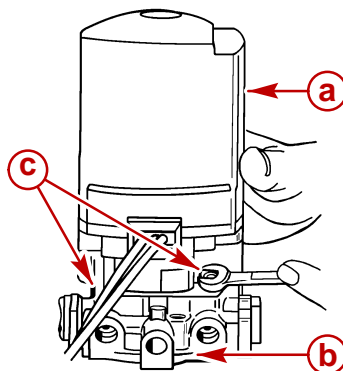
22547

- a** - Pump Reservoir  
**b** - Bolt and O-ring

# Motor Repair

## Disassembly

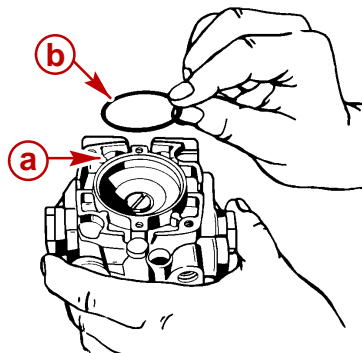
1. Remove the trim motor from the adapter.



70363

- a** - Trim Motor
- b** - Adapter
- c** - Screws

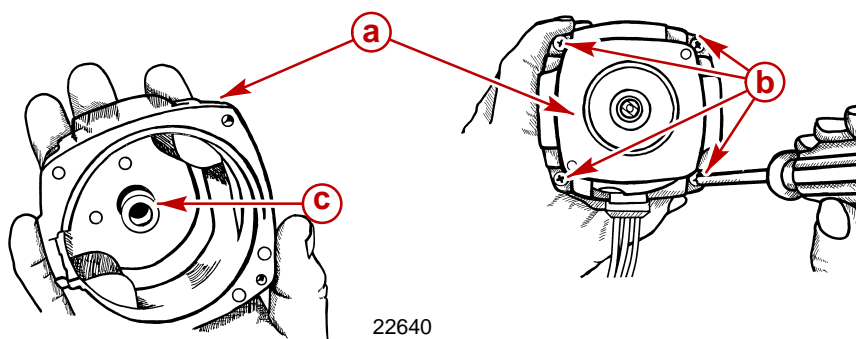
2. Remove the motor to adapter O-ring.



70600

- a** - Adapter
- b** - O-ring

3. Remove the motor end cover and washer from the armature shaft.

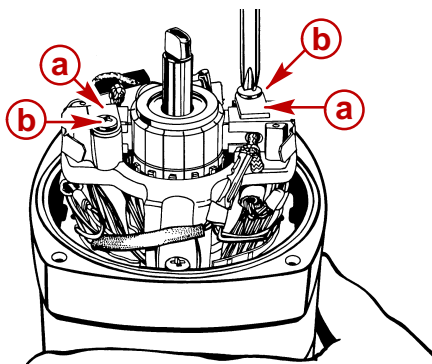


22640

22639

- a** - Cover
- b** - Screws (4)
- c** - Washer

4. Loosen the brush hold down arms.

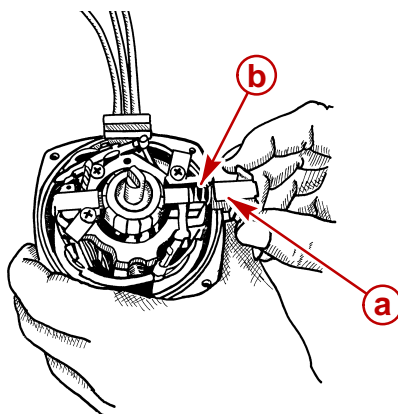


22648

- a** - Brush Hold Down Arms  
**b** - Screws

**IMPORTANT:** Use care in removing brush holders so as not to lose springs.

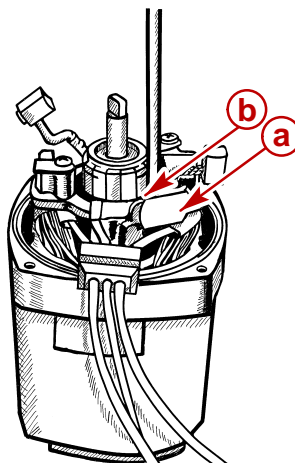
5. Remove the brush holders and springs.



22638

- a** - Brush Holder  
**b** - Spring

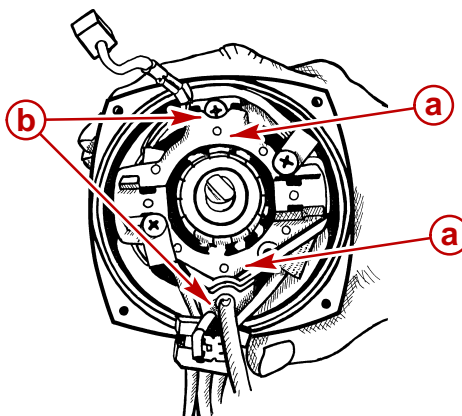
6. Remove the thermal switch and brush assembly.



22637

- a** - Thermal Switch and Brush  
**b** - Screw

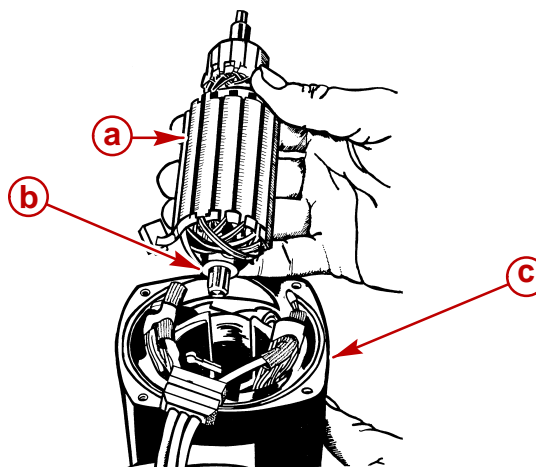
7. Remove the brush assembly mounting bracket.



22636

- a** - Brush Assembly Bracket  
**b** - Screws

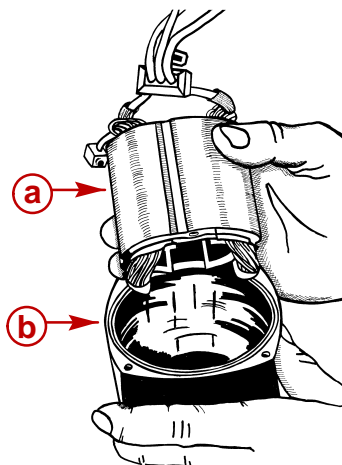
8. Remove the armature and thrust washer from the motor housing.



22499

- a** - Armature  
**b** - Thrust Washer  
**c** - Motor Housing

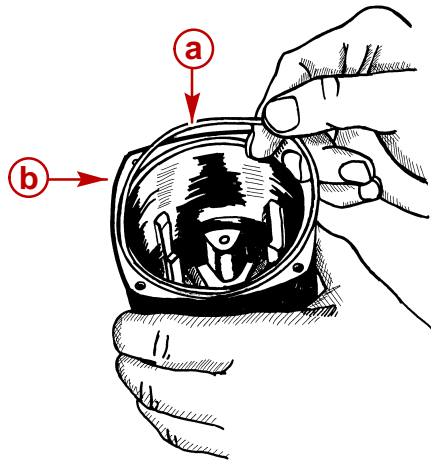
9. Remove the field assembly from the motor housing.



22501

- a** - Field Assembly  
**b** - Motor Housing

10. Remove the motor housing O-ring.



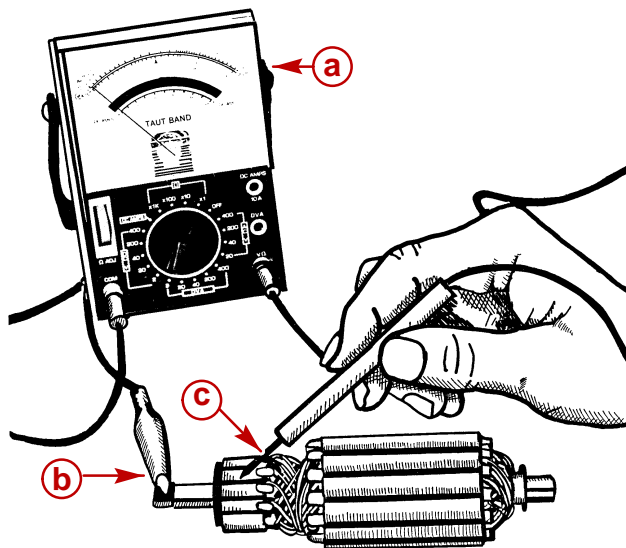
22645

- a** - O-ring  
**b** - Motor Housing

## Armature Tests

### Continuity Test

1. Set the ohmmeter on the Rx1 scale.
2. Place the alligator clip meter lead on the armature shaft.
3. Touch the meter lead probe to each commutator bar one at a time.



22646

- a** - Ohmmeter – Set on Rx1 Scale  
**b** - Meter Lead  
**c** - Meter Lead

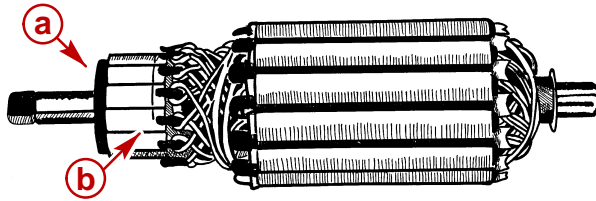
4. **Continuity Indicated** - Armature grounded (replace armature).  
**Continuity Not Indicated** - Armature not grounded.

## Test for Shorts

1. Check the armature on a growler (follow the growler manufacturers instructions). Replace the armature if it has a short.

## Cleaning Commutator

1. Clean the commutator with "00" garnet grit sandpaper. DO NOT use emery paper.
2. Check the gaps between the commutator bars for material. Remove material if present.



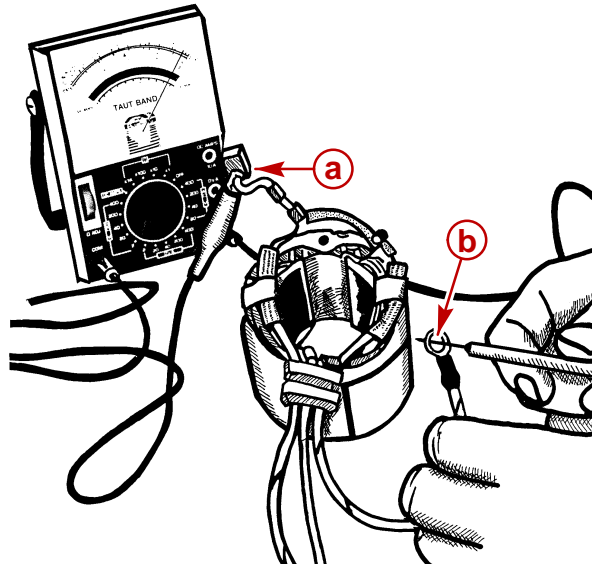
22647

- a** - Commutator  
**b** - Gap

## Field Tests

### Test for Open Circuit

1. Connect the ohmmeter between the field brush lead and the BLUE/WHITE lead.

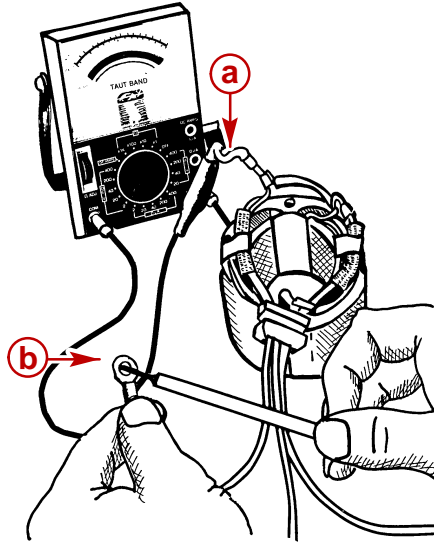


22644

- a** - Ohmmeter Lead - Connected to Brush Lead  
**b** - Ohmmeter Lead - Connected to BLUE/WHITE Lead

2. **Zero ohms indicated** (full continuity) - Field OK.  
**Zero ohms not indicated** (no continuity) - Replace field assembly.

3. Connect the ohmmeter between the field brush lead and the GREEN/WHITE lead.



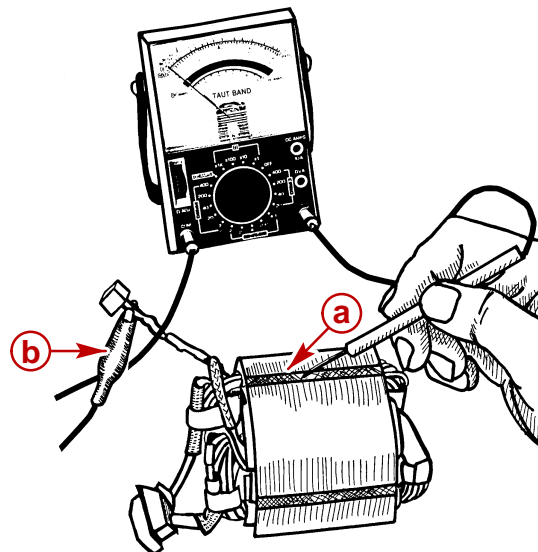
22642

- a** - Ohmmeter Lead - Connected to Brush Lead
- b** - Ohmmeter Lead - Connected to GREEN/WHITE Lead

4. **Zero ohms indicated** (full continuity) - Field OK.  
**Zero ohms not indicated** (no continuity) - Replace field assembly.

## Test for Short in Field

1. Connect the ohmmeter between the field brush lead and the field frame.



22643

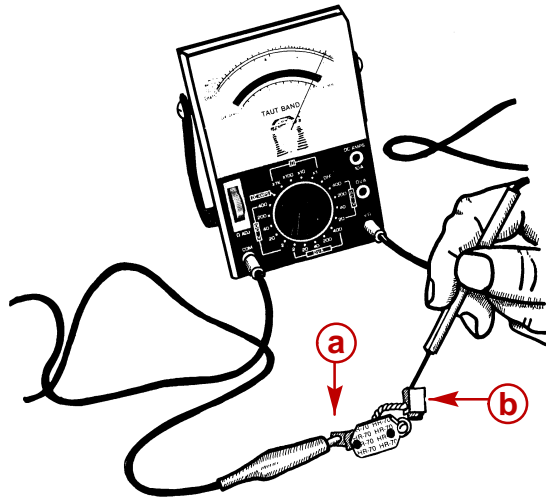
- a** - Field Frame
- b** - Field Brush Lead

2. **Zero ohms indicated** (full continuity) - Short indicated (replace field assembly).  
**Zero ohms not indicated** (no continuity) - Field OK.



## Thermal Switch Continuity Test

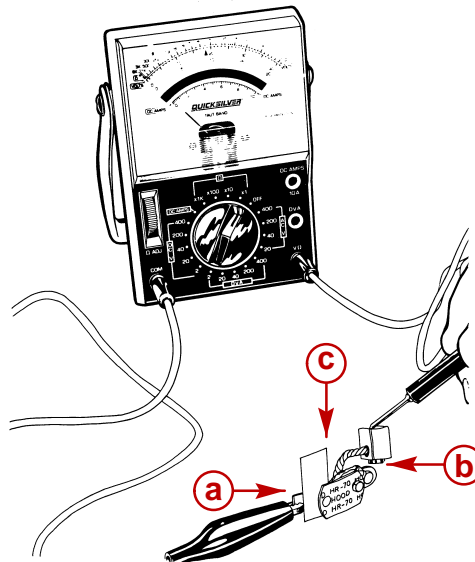
1. Connect the ohmmeter between the spade connector and the brush lead.



22631

- a** - Thermal Switch Spade Connector  
**b** - Brush Lead

2. **Zero ohms indicated** (full continuity) - Proceed to next step.  
**Zero ohms not indicated** (no continuity) - Replace thermal switch.
3. Insert an insulator (piece of paper) between the contact points on the ohmmeter (between spade connector and brush lead).



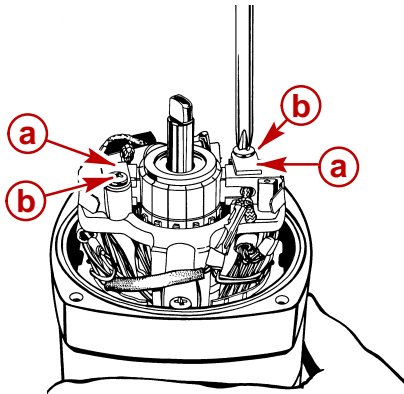
22649

- a** - Thermal Switch Spade Connector  
**b** - Brush Lead  
**c** - Insulator (Piece Of Paper)

4. **Zero ohms indicated** (full continuity) - Replace thermal switch.  
**Zero ohms not indicated** (no continuity) - Thermal switch OK.
5. Remove the insulator from between the contact points on the thermal switch. Clear all material away from the points.

## Brush Replacement

1. Loosen the brush hold down arms.

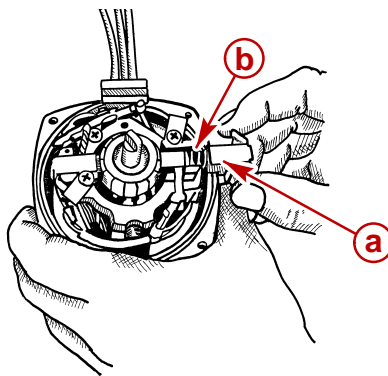


22648

- a** - Brush Hold Down Arms
- b** - Screws

**IMPORTANT: Use care in removing brush holders. Do NOT lose springs.**

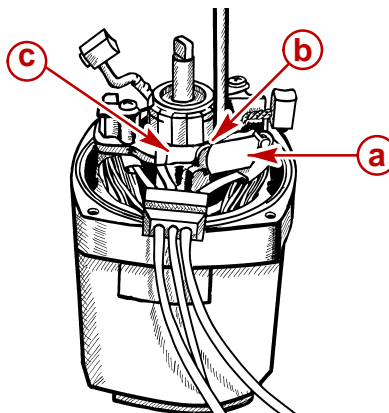
2. Remove the brush holders and springs.



22638

- a** - Brush Holder
- b** - Spring

3. Remove the thermal switch and brush assembly.

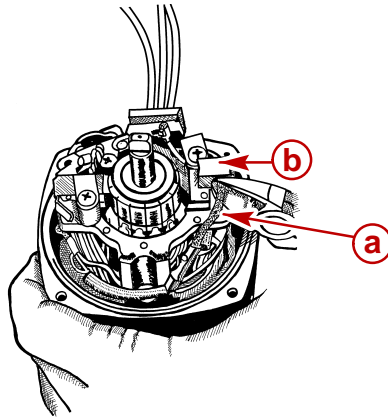


22637

- a** - Thermal Switch and Brush
- b** - Screw
- c** - Connector

**IMPORTANT:** When replacing the brush that is connected to the field wires, cut the brush wire as close to the brush as possible.

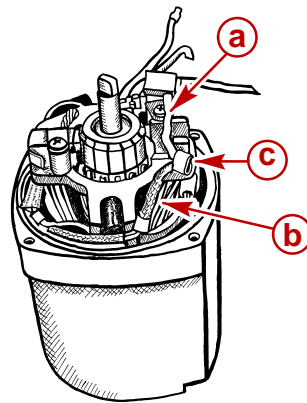
4. Cut the brush wire as close to the brush as possible and discard the brush.



22632

- a** - Brush Wire
- b** - Brush

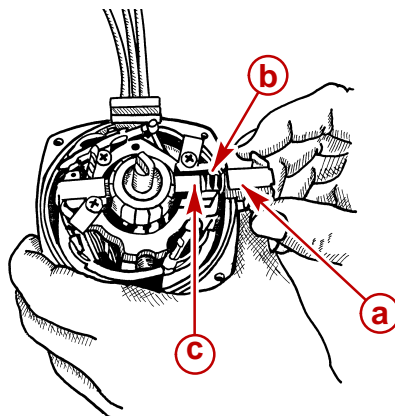
5. Connect the new brush wire to the field wire cut in the previous step. Secure by crimping both wires together as shown.



22635

- a** - Brush Wire
- b** - Field Wire (Old Brush Wire)
- c** - Crimp Connector

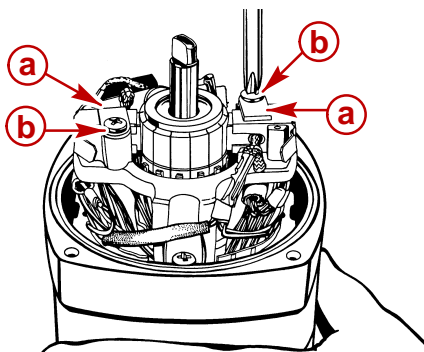
6. Reinstall the spring and brush in the brush holder.



22638

- a** - Brush Holder  
**b** - Spring  
**c** - Brush

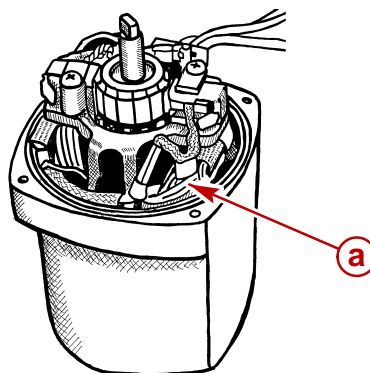
7. Position the brush hold down arms and tighten them securely. Do NOT overtighten.



22648

- a** - Brush Hold Down Arms  
**b** - Screws

8. Position the brush wire as shown before reassembly.

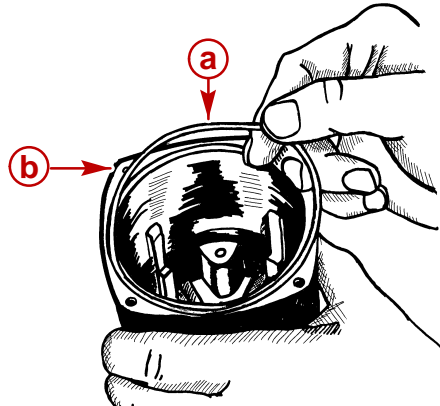


22634

- a** - Brush Wire

# Reassembly

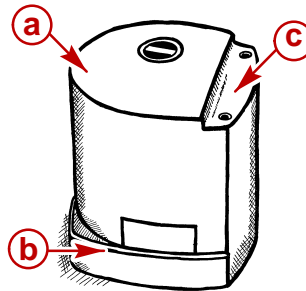
1. Install the motor housing O-ring.



22645

- a** - O-ring
- b** - Motor Housing

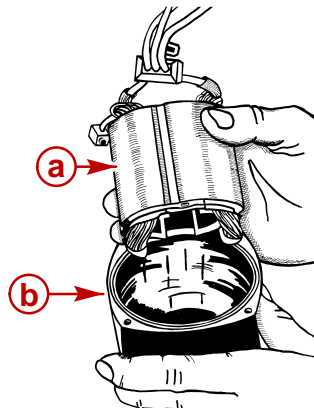
**IMPORTANT:** The field assembly wires must face the front of the motor housing. Use the notched area in the housing as a reference in determining the front.



22633

- a** - Motor Housing
- b** - Front
- c** - Notched Area

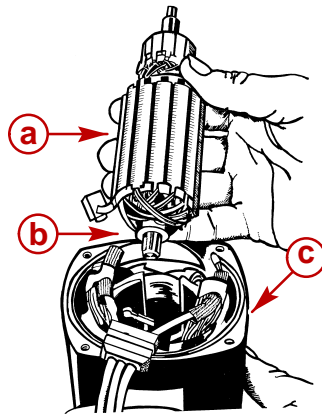
2. Install the field assembly into the motor housing.



22501

- a** - Field Assembly
- b** - Motor Housing

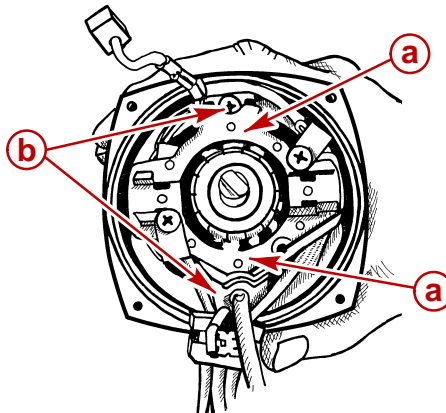
3. Install the thrust washer on the armature and install the armature into the motor housing.



22499

- a** - Armature  
**b** - Thrust Washer  
**c** - Motor Housing

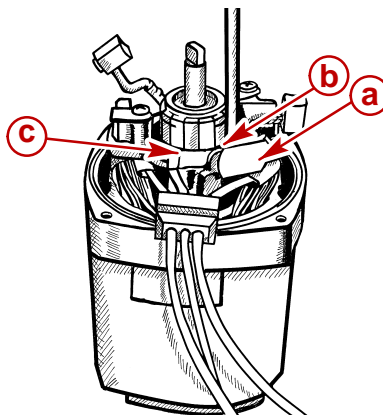
4. Install the brush assembly mounting bracket. Tighten the screws securely.



22636

- a** - Brush Assembly Mounting Bracket  
**b** - Screws

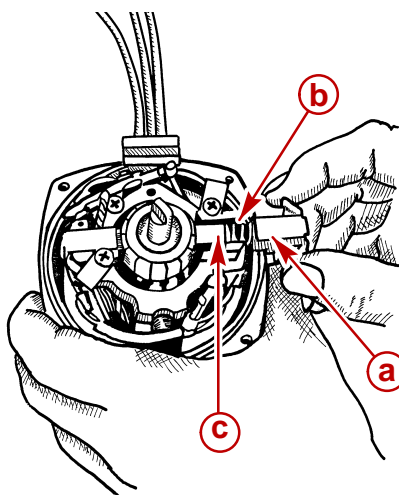
5. Install the thermal switch and connect the black wire. Do NOT overtighten the screw.



22637

- a** - Thermal Switch  
**b** - Screw  
**c** - Black Wire Connector

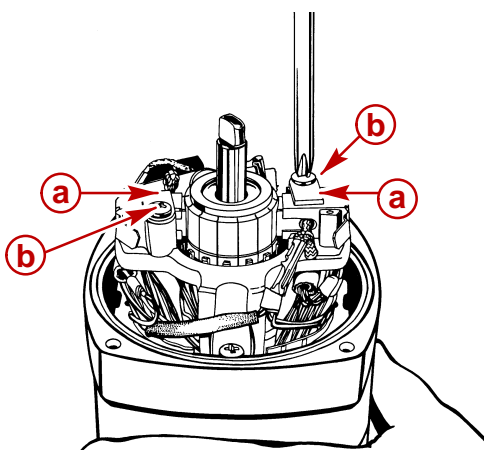
6. Install the springs and brushes in the brush holders.



22638

- a** - Brush Holders
- b** - Springs
- c** - Brushes

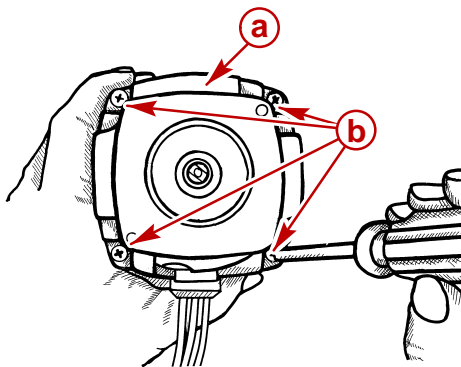
7. Position the brush holders and secure them with the brush hold down arms. Do NOT overtighten the screws.



22648

- a** - Brush Hold Down Arms
- b** - Screws

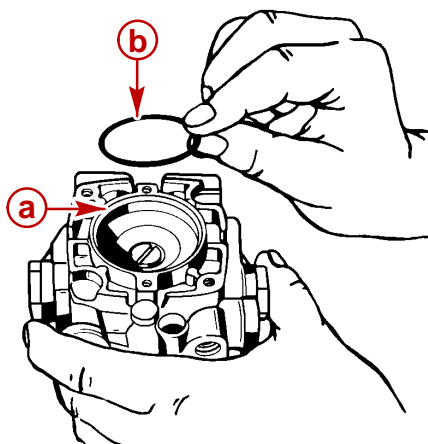
8. Install the motor end cover. Apply Loctite 271 to the screws and tighten securely. Do NOT overtighten.



22639

- a** - Motor End Cover
- b** - Screws

9. Install the motor to adapter O-ring.

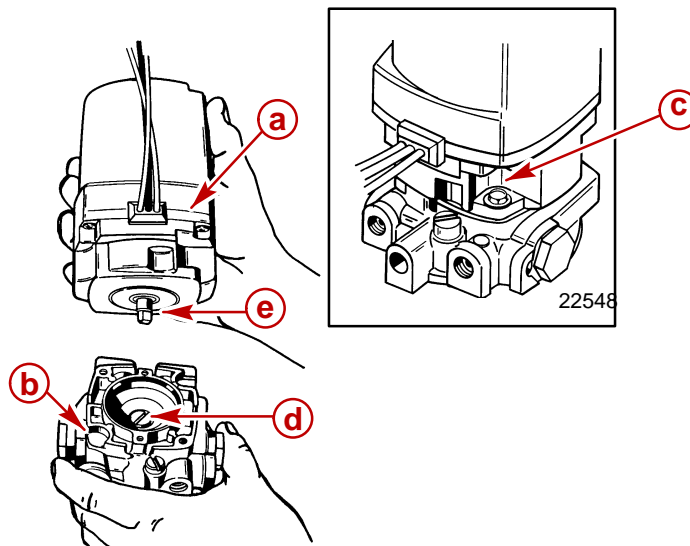


70600

- a** - Adapter
- b** - O-ring



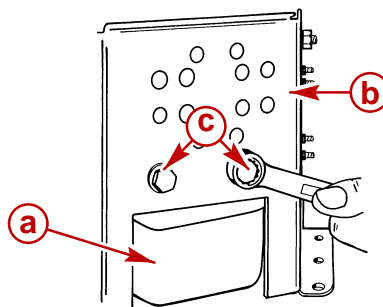
10. Align the motor shaft with the coupler and install the trim motor on the adapter. Torque the screws to 25 lb-in. (2.8 Nm).



22496

- a** - Trim Motor
- b** - Adapter
- c** - Screws (2 in Opposite Corners)
- d** - Coupler
- e** - Motor Shaft

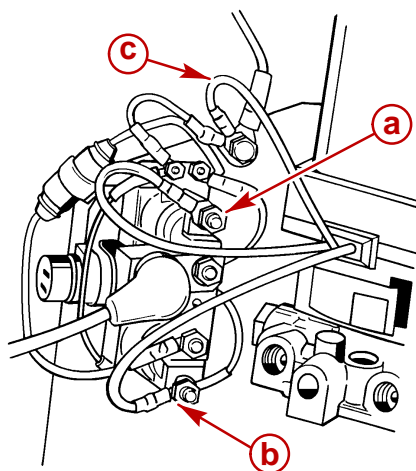
11. Install the trim pump on the dual mount bracket. Tighten securely.



22548

- a** - Trim Pump
- b** - Floor Bracket
- c** - Screws and Lock Washers

12. Connect the trim motor wires to solenoids as shown.



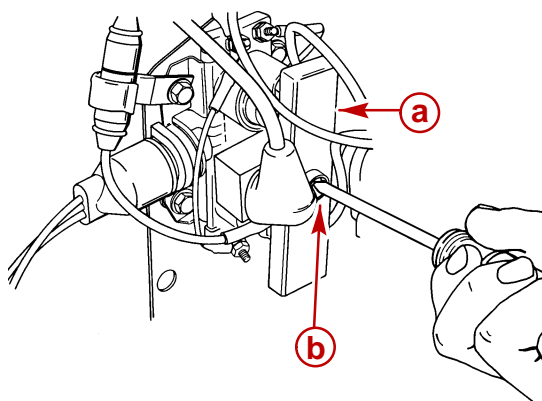
70359

- a** - Blue/White Motor Wire
- b** - Green/White Motor Wire
- c** - Black Ground Wire

**⚠ CAUTION**

Solenoid terminal cover screw is attached to 12 volt positive source. **DO NOT GROUND** the screw driver when installing cover.

13. Install the solenoid terminal cover. Tighten the screw securely.



70360

- a** - Solenoid Terminal Cover
- b** - Screw

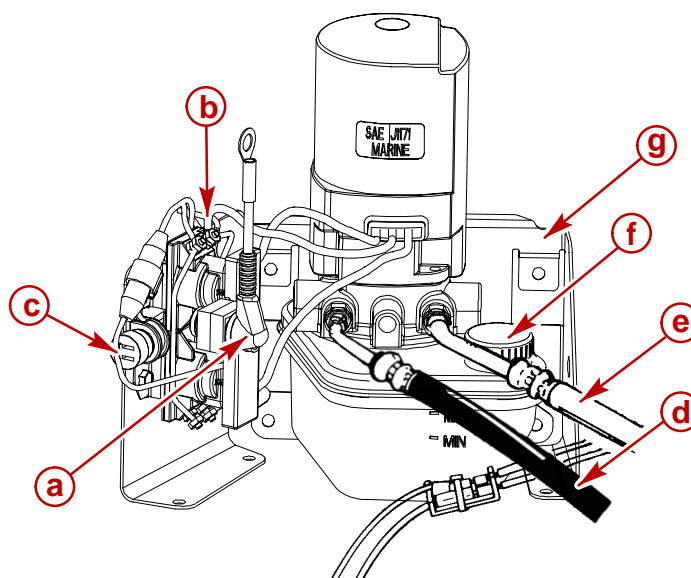
# Trim Pump Installation

1. Secure the pump and mounting bracket to the boat using lag bolts and washers.
2. Reconnect the trim hoses to the pump; black hose to the left connection, gray hose to the right connection. DO NOT cross-thread or overtighten the hose fittings. Torque the fittings to 110 lb-in. (12 Nm).
3. Reconnect the trim harness connector to the trim pump.
4. Reconnect trim pump leads to power source.

## ⚠ CAUTION

**Fill cap is vented. Be sure to remove “Caplug” (fill neck seal) from fill neck on new replacement pumps. Failure to do this can damage pump, when operated.**

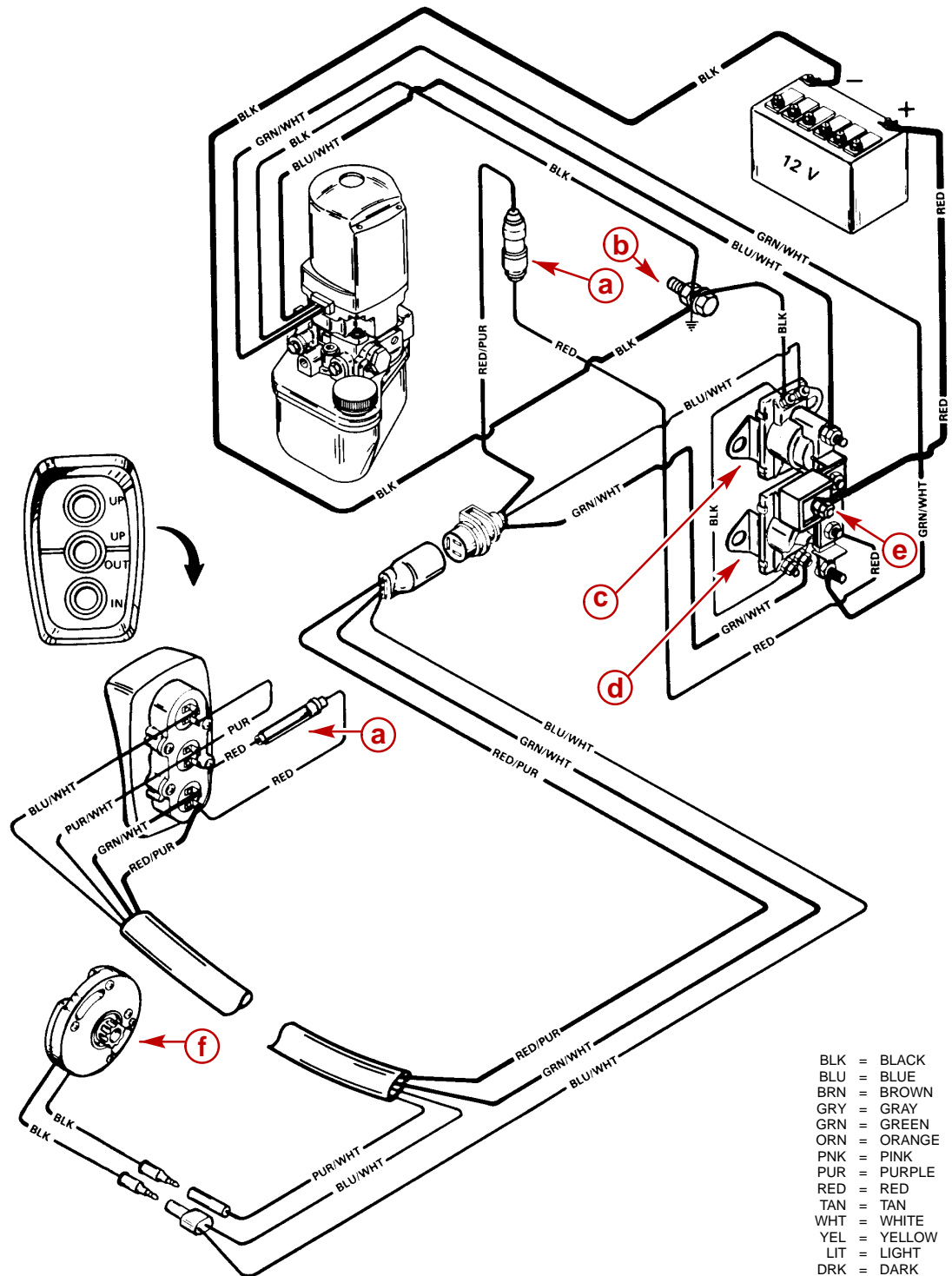
5. Check the fluid level and fill if necessary. (Refer to “Maintaining Power Trim Pump Oil Level” in this section).



- a** - Positive Battery Lead
- b** - Negative Battery Lead
- c** - Harness Connector
- d** - Black Hydraulic Hose (UP Hose)
- e** - Gray Hydraulic Hose (DOWN Hose)
- f** - Vented Fill Cap
- g** - Dual Mount Trim Pump Bracket

# Trim Pump Wiring Diagrams

## Model With Three-Button Trim/Trailer Panel

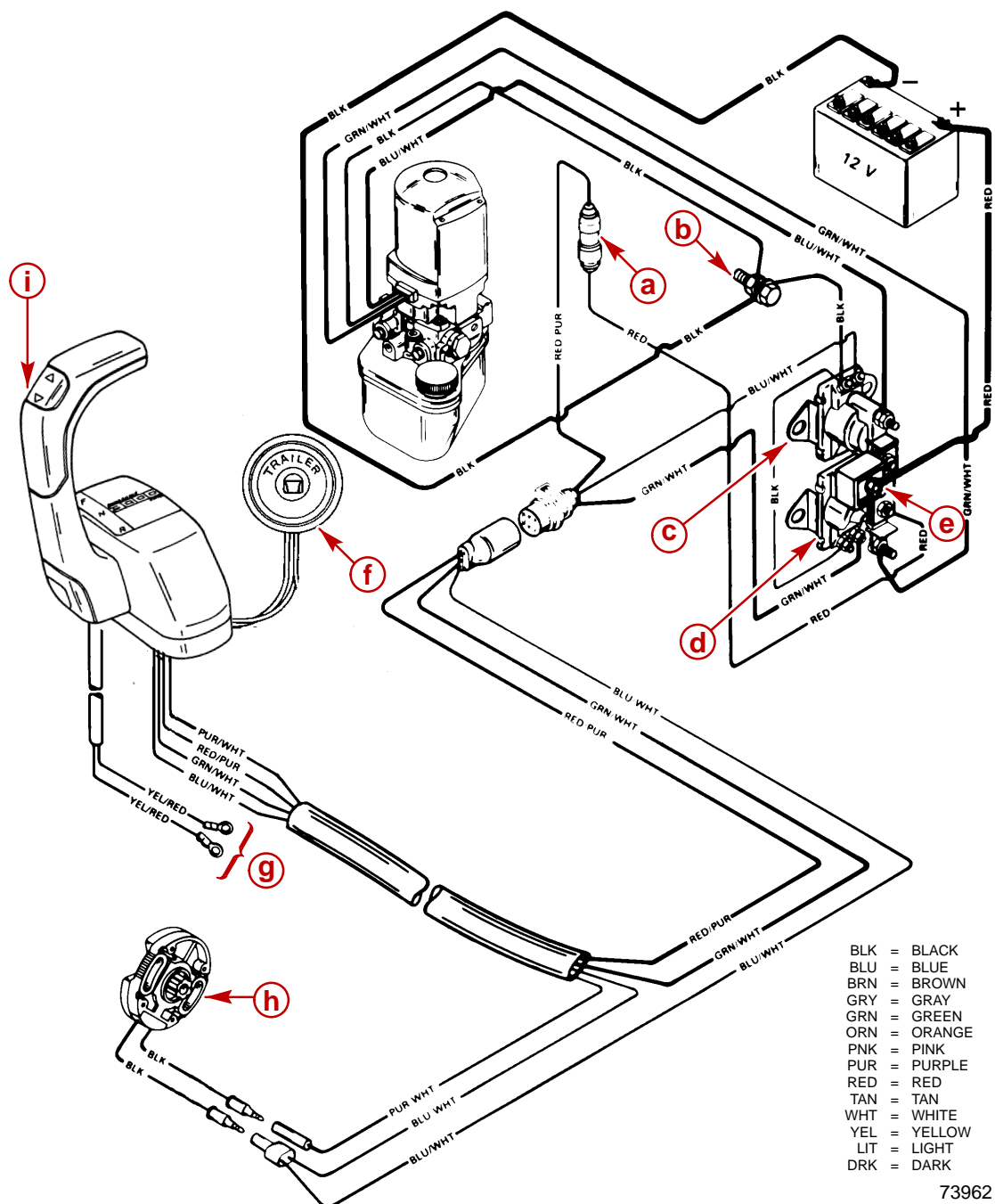


76894

- a** - 20 Amp Fuse
- b** - Ground Bolt (Floor Mount)
- c** - Up Solenoid

- d** - Down Solenoid
- e** - 110 Amp Fuse
- f** - Trim Limit Switch

# Model With Trim In Handle and Trailer Switch Separate



73962

- a** - 20 Amp Fuse
- b** - Ground Bolt (Floor Mount)
- c** - Up Solenoid
- d** - Down Solenoid
- e** - 110 Amp Fuse
- f** - Trailer Switch
- g** - Neutral Switch To Instrument Wiring Harness
- h** - Trim Limit Switch
- i** - Trim Buttons

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# POWER TRIM

## Section 5B - Trim Cylinders

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Torque Specifications .....	5B-2	Trim Cylinder Shock Piston Test .....	5B-7
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Limit Insert .....	5B-6		

# Specifications

## Torque Specifications

DESCRIPTION	lb-in.	lb-ft	Nm
Piston Rod Bolt		17	23
End Cap		45	61
Anode Screw	30		3.4

## Lubricants / Sealants / Adhesives

**NOTE:** Prior to reassembly of trim cylinder(s), lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or (if not available) 10W-30 or 10W-40 motor oil.

DESCRIPTION	PART NUMBER
Loctite 271	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Perfect Seal	92-34227--1
Quicksilver Power Trim and Steering Fluid	92-90100A12

## Special Tools

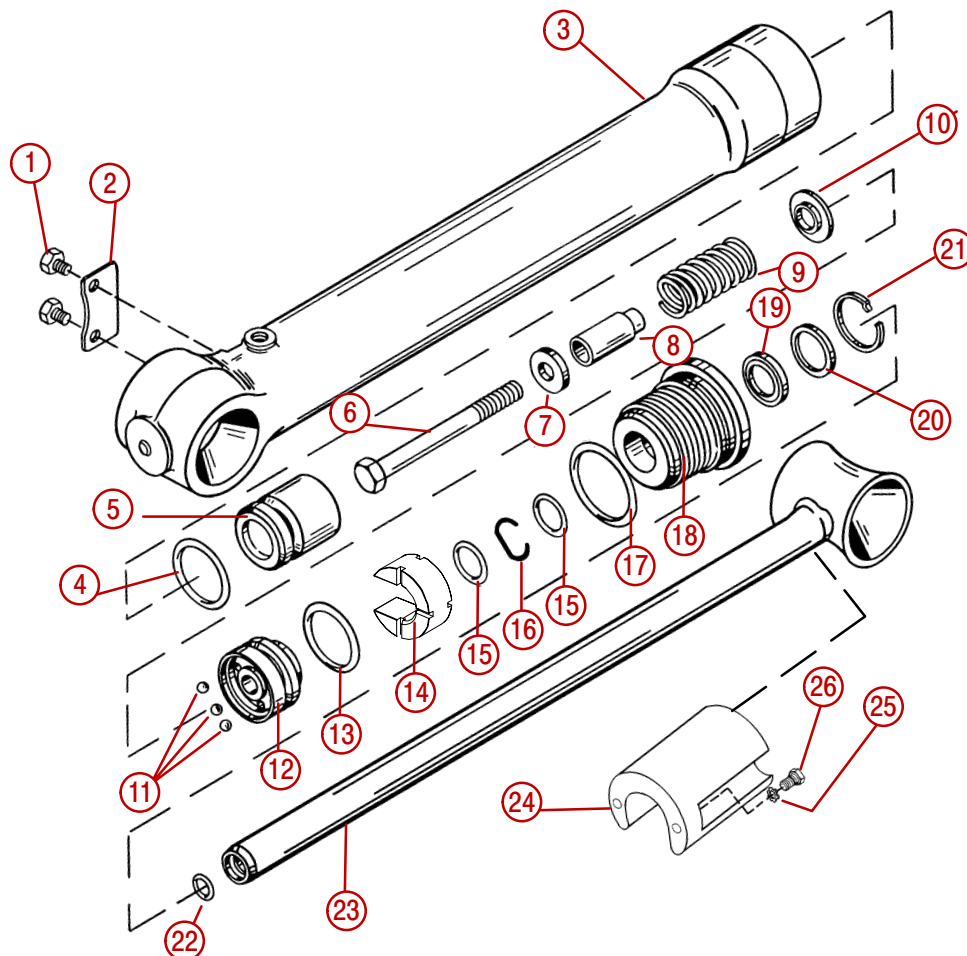
DESCRIPTION	PART NUMBER
Spanner Nut Wrench	91-821709T
Large Pin Set	91-811907
Medium Pin Set	91-811908
Small Pin Set	91-811909



# Trim Cylinder Exploded Views

## Bravo Trim Cylinders

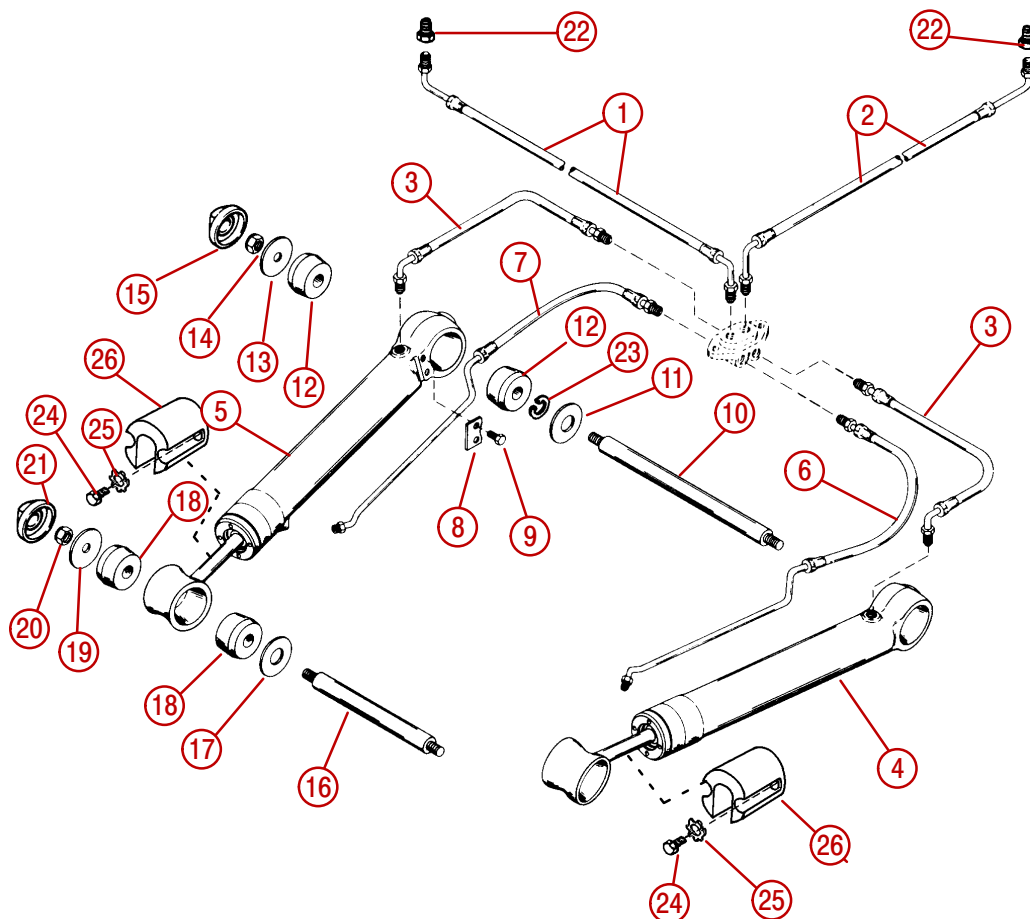
**NOTE:** Prior to reassembly of trim cylinder(s), lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or (if not available) 10W-30 or 10W-40 motor oil.



76676

- |                          |                        |
|--------------------------|------------------------|
| 1 - Screws               | 14 - Trim Limit Insert |
| 2 - Clamping Plate       | 15 - Small O-Ring      |
| 3 - Trim Cylinder        | 16 - Continuity Spring |
| 4 - O-Ring               | 17 - Large O-Ring      |
| 5 - Floating Piston      | 18 - End Cap           |
| 6 - Bolt                 | 19 - Rod Scraper       |
| 7 - Washer               | 20 - Washer            |
| 8 - Spring Guide         | 21 - Retaining Ring    |
| 9 - Spring               | 22 - Small O-Ring      |
| 10 - Spring Guide Washer | 23 - Piston Rod        |
| 11 - Check Balls         | 24 - Anode             |
| 12 - Shock Piston        | 25 - Star Washer       |
| 13 - O-Ring              | 26 - Screw             |

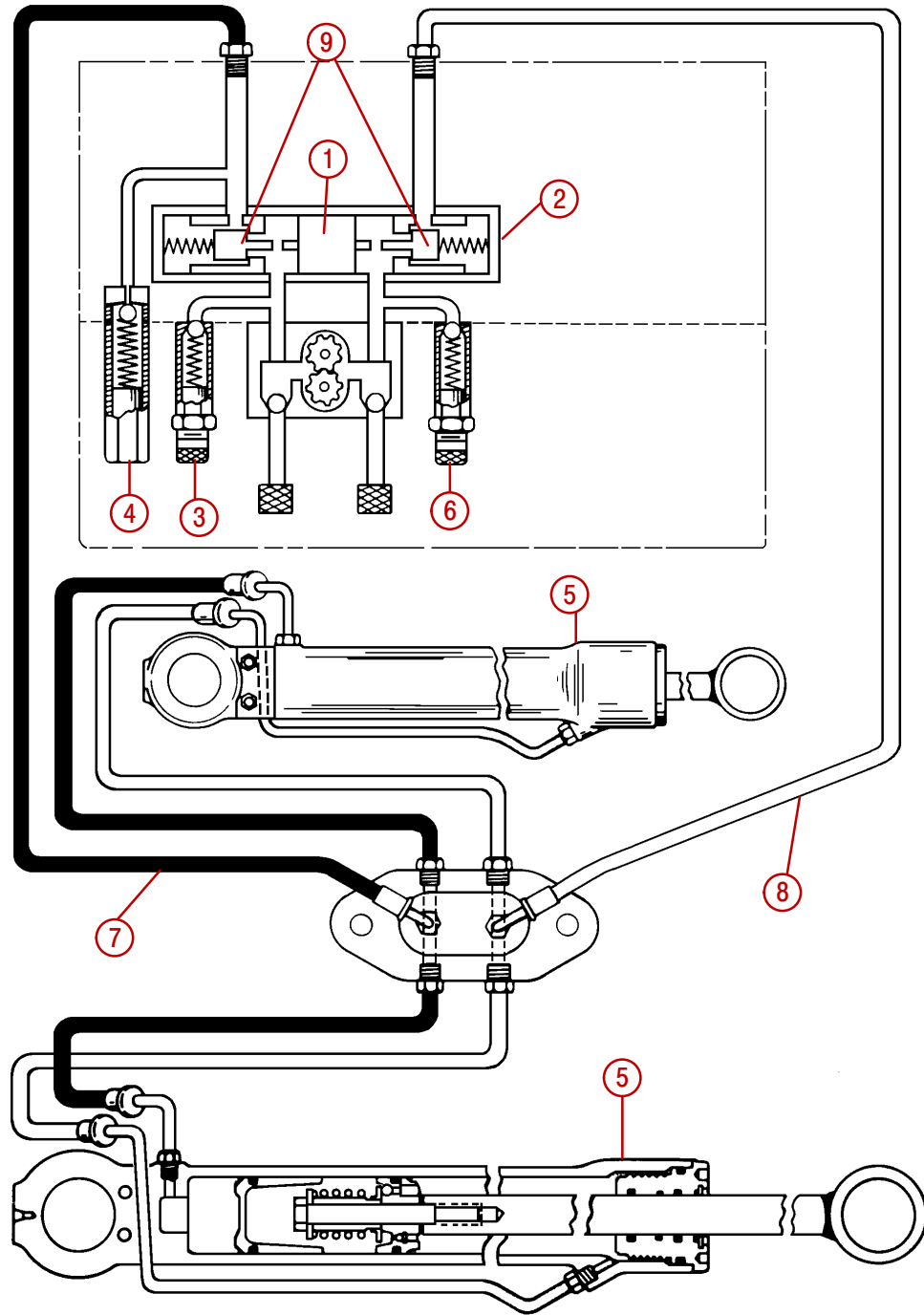
## Bravo Trim System Components



73554

- |   |                                   |
|---|-----------------------------------|
| <b>1</b> - IN/DOWN Hose to Trim Pump (Gray) | <b>14</b> - Nut                   |
| <b>2</b> - UP/OUT Hose to Trim Pump (Black) | <b>15</b> - Cap                   |
| <b>3</b> - Hose to Trim Cylinder            | <b>16</b> - Rear Pin              |
| <b>4</b> - Starboard Trim Cylinder          | <b>17</b> - Washer                |
| <b>5</b> - Port Trim Cylinder               | <b>18</b> - Bushing               |
| <b>6</b> - Starboard Trim Cylinder Hose     | <b>19</b> - Washer                |
| <b>7</b> - Port Trim Cylinder Hose          | <b>20</b> - Nut                   |
| <b>8</b> - Plate                            | <b>21</b> - Cap                   |
| <b>9</b> - Screw                            | <b>22</b> - Connector (Trim Pump) |
| <b>10</b> - Front Pin                       | <b>23</b> - Retainer              |
| <b>11</b> - Washer                          | <b>24</b> - Screw                 |
| <b>12</b> - Bushing                         | <b>25</b> - Continuity Washer     |
| <b>13</b> - Washer                          | <b>26</b> - Trim Cylinder Anode   |

# Power Trim Hydraulic Schematic



73552

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| 1 - Shuttle                      | 6 - IN/DOWN Pressure Relief Valve |
| 2 - Pump Adaptor                 | 7 - UP/OUT Hose                   |
| 3 - UP/OUT Pressure Relief Valve | 8 - IN/DOWN Hose                  |
| 4 - Thermal Relief Valve         | 9 - Poppet Valves                 |
| 5 - Trim Cylinder                |                                   |

## Special Information

### Bravo Three Notice: Trim-In Limit Insert

Some boats, predominantly deep-Vee heavy boats, will roll up on their side under certain specific operating conditions. The roll can be either to port or starboard and may be experienced while moving straight ahead or while making a turn. The roll occurs most frequently at or near maximum speed, with the drive unit trimmed at or near full IN. While the boat will not roll completely over, the roll may be sufficient to unseat the operator or passengers, and thereby create an unsafe situation.

The roll is caused by stern lift. Stern lift can be created by excessive drive unit trim IN. Under these extreme stern lift/bow down conditions, instability can be created which may cause the boat to roll. Weight distribution to the stern can reduce stern lift and, in some circumstances, eliminate the condition. Weight distribution in the bow, port or starboard, may worsen the condition.

The Trim-In Limit devices reduce stern lift by preventing the drive unit from reaching the last few degrees of full trim under. While this device should reduce the rolling tendency, they may not eliminate the tendency entirely. The need for the Trim-In Limit Insert, and the effectiveness of them, can only be determined through boat testing and is ultimately the responsibility of the boat manufacturer.

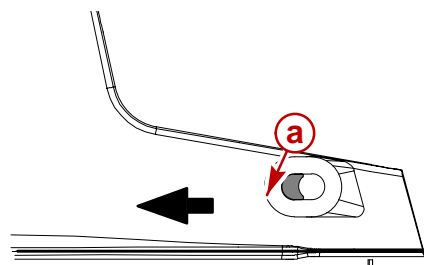
#### **⚠ WARNING**

**It is recommended that only qualified personnel adjust the Trim-In Limit Insert. Boat must be water tested after adjusting the device to ensure that the modified trim IN range does not cause the boat to exhibit an undesirable boat handling characteristic if the drive unit is trimmed IN at higher speeds. Increased trim IN range may cause handling problems on some boats which could result in personal injury.**

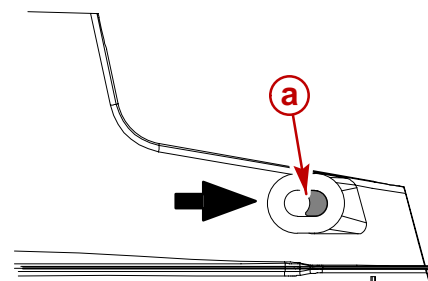
**IMPORTANT:** On Bravo One, Two and Three Models, the Trim-In Limit Insert, must be properly positioned before installing the trim cylinder anchor pin in the following steps.

**NOTE:** When removing the sterndrive unit, make a note of the position of the insert for reference when reinstalling the drive unit.

1. If equipped, ensure that the Trim-In Limit Insert is positioned as shown for the appropriate Bravo model.



75157



75158

**Bravo One and Two (Positioned Forward)    Bravo Three (Positioned Aft)**

**a** - Trim-In Limit Insert

**IMPORTANT:** The position of the Trim-In Limit Insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

## Trim Cylinder Internal Leak Test

Refer to Power Trim Pump SECTION 5A.

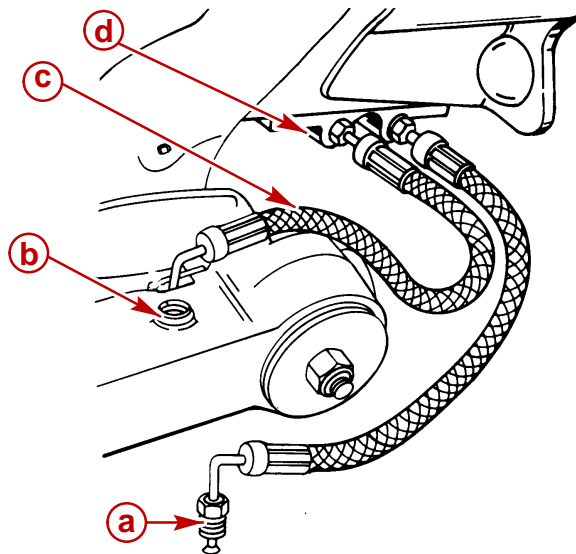
## Trim Cylinder Shock Piston Test

Refer to Power Trim Pump SECTION 5A.

## Trim Cylinder Repair

### Removal

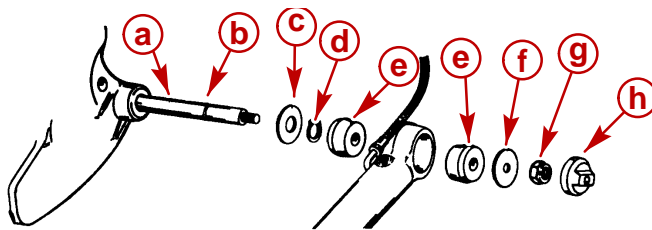
1. Disconnect OUT/UP trim hose from front hole on trim cylinder.
2. Disconnect IN/DOWN trim hose from hydraulic connector on gimbal housing. Plug holes with suitable plug or (P/N 22-38609). Cap hoses.



- a** - OUT/UP Hose
- b** - Front Hole On Trim Cylinder
- c** - IN/DOWN Hose
- d** - Hydraulic Connector

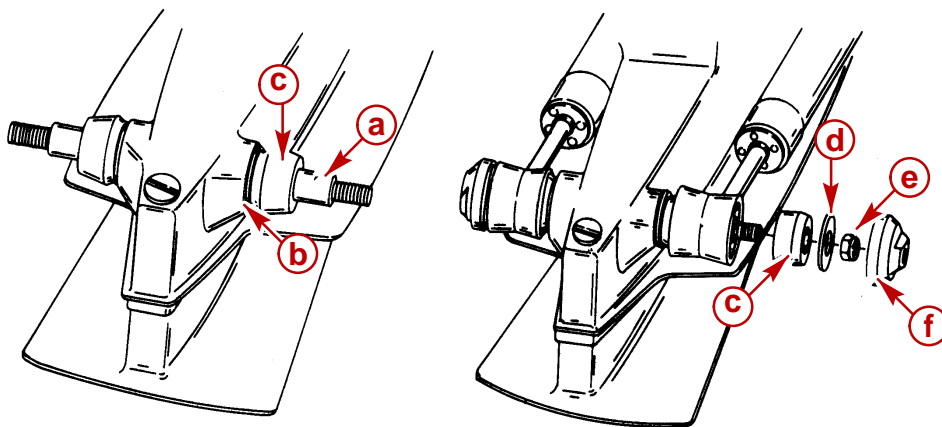
50389

3. Remove front and rear power trim cylinder mounting hardware.



71489

- a** - Anchor Pin (1)
- b** - Slots (2)
- c** - Flat Washer (Large I.D.) (2)
- d** - Snap Rings (2)
- e** - Bushings (4)
- f** - Flat Washer (Small I.D.) (2)
- g** - Locknut (2)
- h** - Plastic Cap (2)



22029

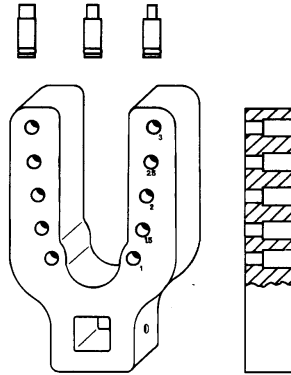
- a** - Rear Anchor Pin
- b** - Large I.D. Washers (Port and Starboard)
- c** - Bushings (2) (Port and Starboard)
- d** - Small I.D. Washers (Port and Starboard)
- e** - Locknuts (Port and Starboard)
- f** - Plastic Caps (Port and Starboard)

## Disassembly

### ⚠ CAUTION

Ensure work area is clean before disassembling power trim cylinders. Cylinder parts can be damaged by dirt entering into power trim system.

**NOTE:** Spanner Wrench Tool Part No. 91-821709.

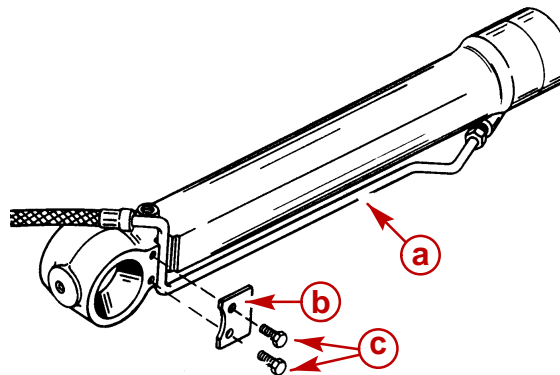


71233

### ⚠ CAUTION

**DO NOT** clamp center section of power trim cylinder during assembly or disassembly. Clamp cylinder on front mounting flange.

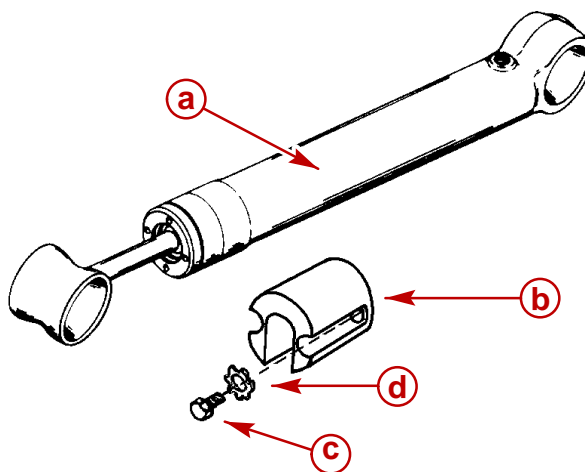
1. Remove IN/DOWN trim hose from cylinder.



22134

- a** - IN/DOWN Trim Hose
- b** - Clamping Plate
- c** - Screws

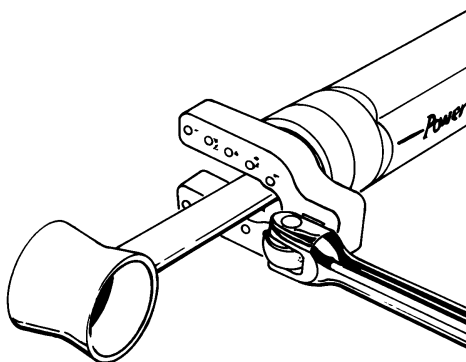
2. Remove trim cylinder anodes.



76902

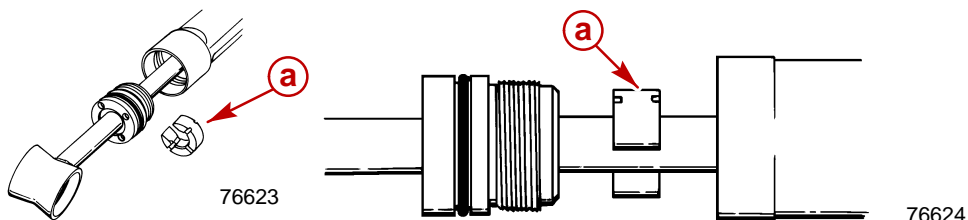
- a** - Trim Cylinder  
**b** - Trim Cylinder Anode  
**c** - Screw (2)  
**d** - Washer (2)

3. Remove trim cylinder end caps (Use special tool 91-821709).



71677

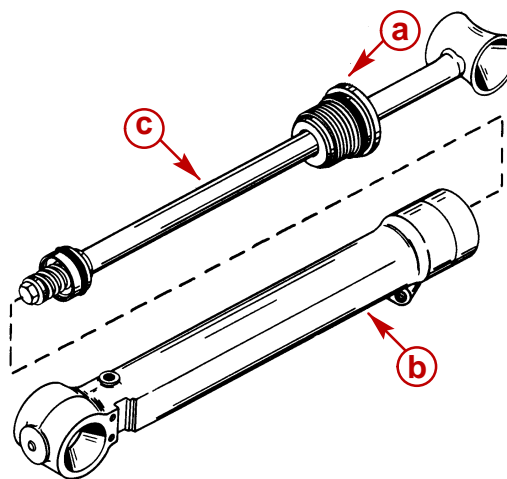
4. Remove tilt-limit insert.



- a** - Tilt Limit Insert



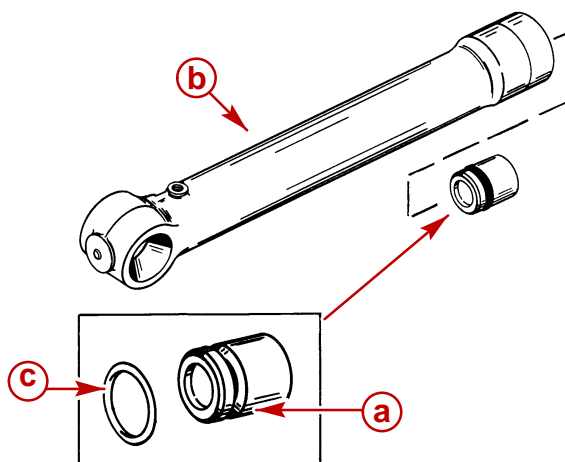
5. Remove piston rod assembly from cylinder.



22133

- a** - End Cap  
**b** - Cylinder  
**c** - Piston Rod Assembly

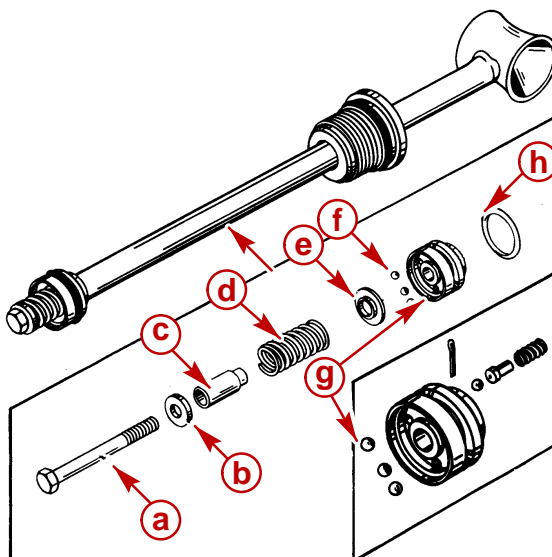
6. Remove floating piston from cylinder and remove O-ring by tapping cylinder on block of wood.



22131

- a** - Floating Piston  
**b** - Trim Cylinder  
**c** - O-ring

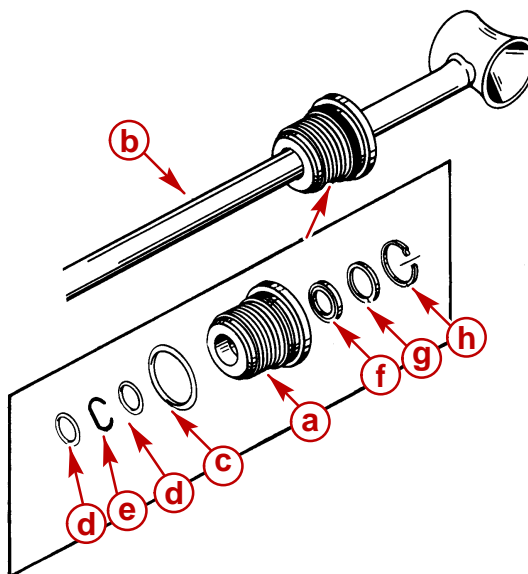
7. Disassemble shock piston assembly. Ensure that check balls are not lost.



22132

- a** - Bolt
- b** - Flat Washer
- c** - Spring Guide
- d** - Spring
- e** - Spring Guide Washer
- f** - Check Balls (3)
- g** - Shock Piston Assembly
- h** - O-ring

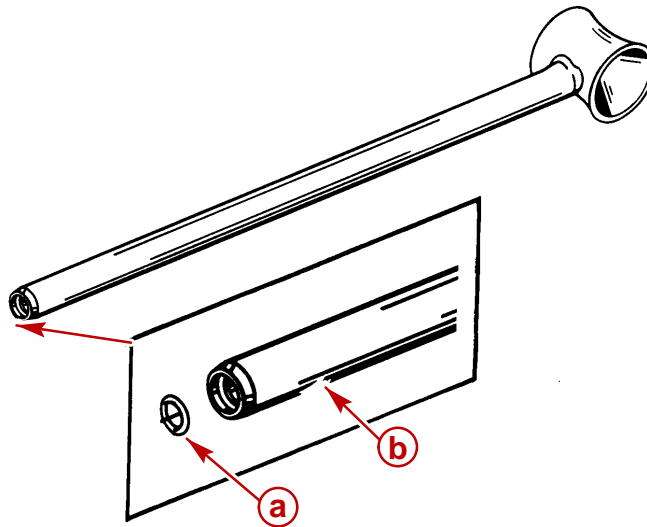
8. Remove and disassemble end cap.



22133

- a** - End Cap
- b** - Piston Rod
- c** - Large O-ring
- d** - Small O-ring (2)
- e** - Continuity Spring
- f** - Rod Scraper
- g** - Plain Washer
- h** - Retaining Ring

9. Remove small O-ring from end of piston rod.



- a** - Small O-ring  
**b** - Piston Rod

22132

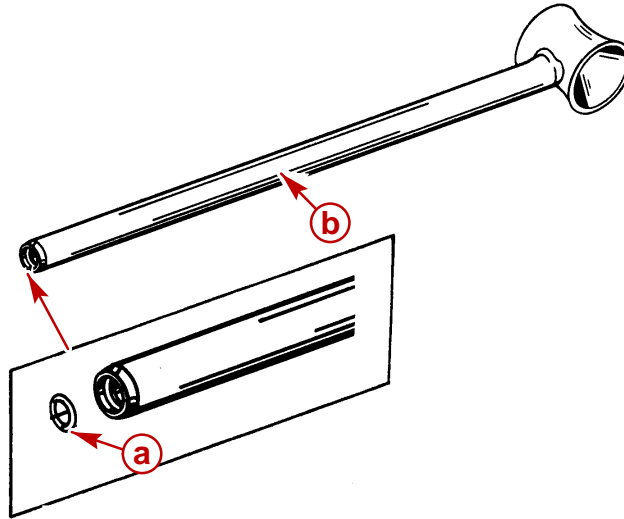
10. Clean all parts in solvent. Be sure all parts are dry before reassembly.

## Reassembly

### ⚠ CAUTION

Ensure that work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

1. Install small O-ring into end of piston rod.

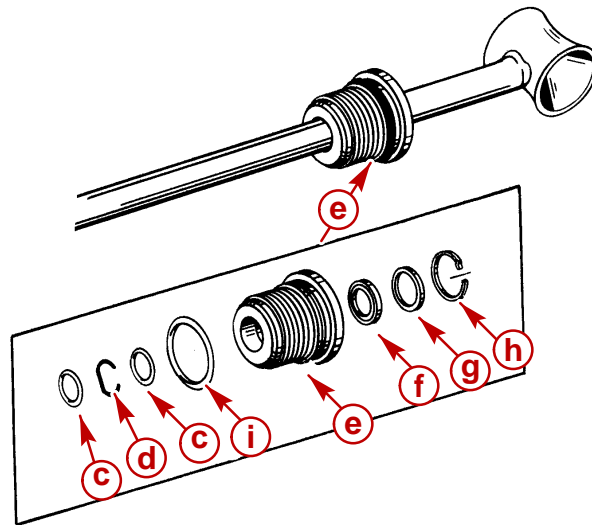


- a** - Small O-ring  
**b** - End Of Piston Rod

22132

2. Install small O-rings and continuity spring into end cap.
3. Install rod scraper, plain washer and retaining ring into end cap.
4. Install large O-ring onto outside diameter of end cap.

5. Install end cap onto piston rod.



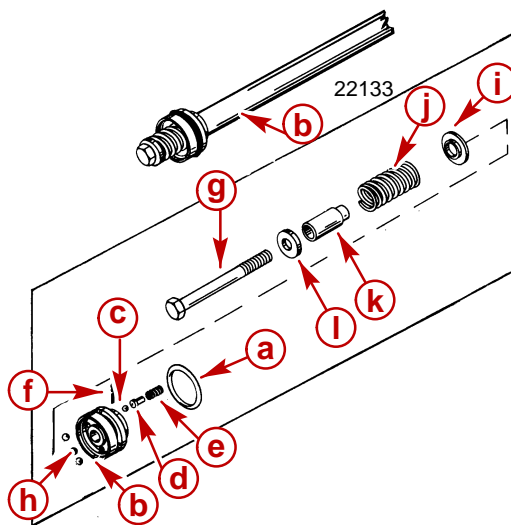
22133

22132

- c** - Small O-rings
- d** - Continuity Spring
- e** - End Cap
- f** - Rod Scraper
- g** - Plain Washer
- h** - Retaining Ring
- i** - Large O-ring

6. Install large O-ring on shock piston.
7. Install check ball, check ball eyelet, spring and spring pin into shock piston.
8. Apply Loctite 271 to threads of bolt being used in the following step.

9. Install shock piston, three check balls, spring guide washer, spring, spring guide, spring guide washer and bolt onto piston rod. Torque to 17 lb-ft (23 Nm).

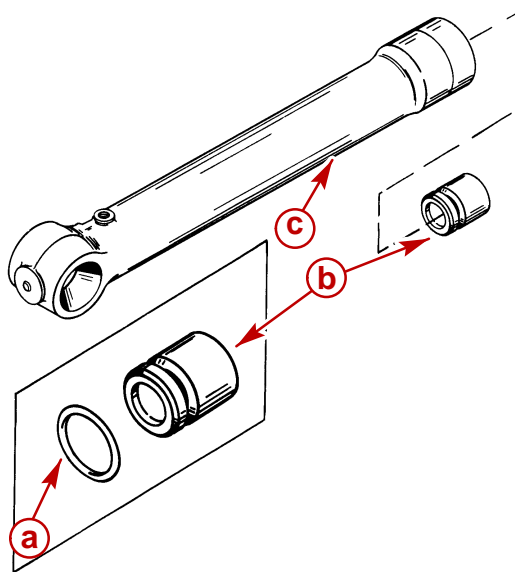


22132

- a** - Large O-ring
- b** - Shock Piston
- c** - Check Ball
- d** - check Ball Eyelet
- e** - Spring
- f** - Spring Pin
- g** - Bolt
- h** - Check Balls
- i** - Spring Guide Washer
- j** - Spring
- k** - Spring Guide
- l** - Spring Guide Washer

**NOTE:** Before installing floating piston into cylinder, lubricate all internal parts with power trim and steering fluid or SAE 10W-30 or 10W-40 motor oil.

10. Apply oil to parts. Install O-ring onto floating piston and insert floating piston into cylinder.

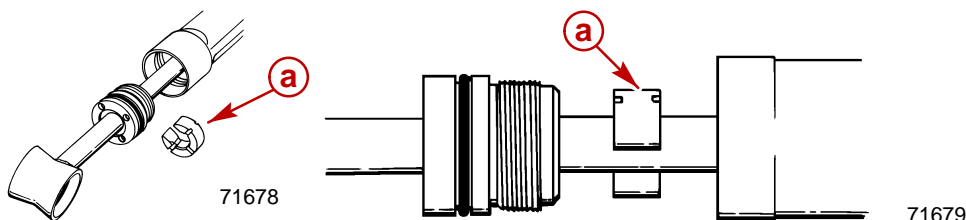


- a** - O-ring
- b** - Floating Piston
- c** - Cylinder

22132

**IMPORTANT:** Some boat configurations may require tilt-limit inserts to limit the total upward travel of the drive unit. Be sure to install the same number of inserts that were originally removed. There must be an equal number in each cylinder.

11. If required, install tilt-limit inserts.



- a** - Tilt Limit Inserts

### ⚠ CAUTION

Ensure work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

**NOTE:** Before reassembly, lubricate all internal parts with power trim and steering fluid or SAE 10W-30 or 10W-40 motor oil.

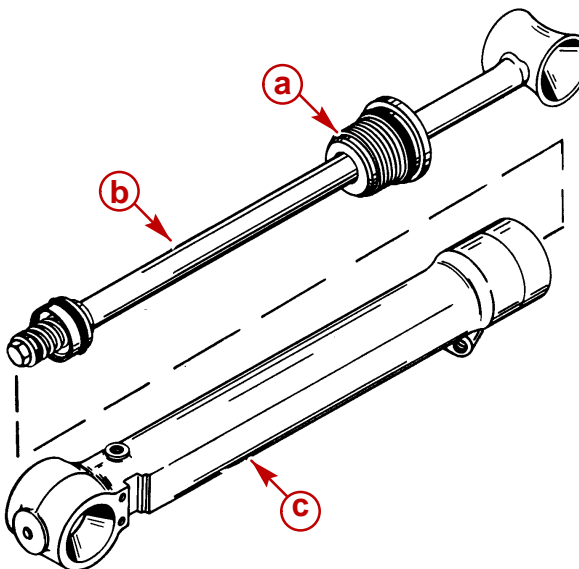
### ⚠ CAUTION

**DO NOT** clamp center section of trim cylinder during reassembly. If clamping of cylinder is necessary, clamp cylinder on front mounting flange.

### ⚠ CAUTION

Use only 2-4-C Marine Lubricant with Teflon on end cap threads. Other substances may act as an insulator and cause poor electrical continuity between cap and cylinder which could cause a corrosion problem.

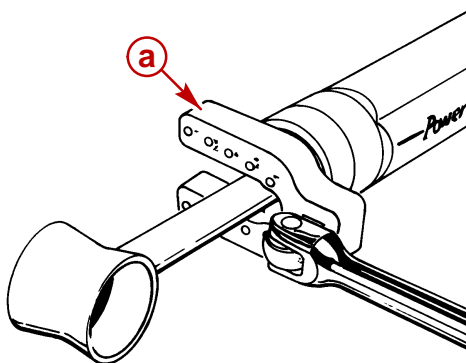
12. Apply 2-4-C Marine Lubricant with Teflon to end cap threads and install piston rod assembly into cylinder.



22133

- a** - End Cap  
**b** - Piston Rod  
**c** - Cylinder

13. Using Spanner Wrench Tool, torque end cap 45 lb-ft (61 Nm).

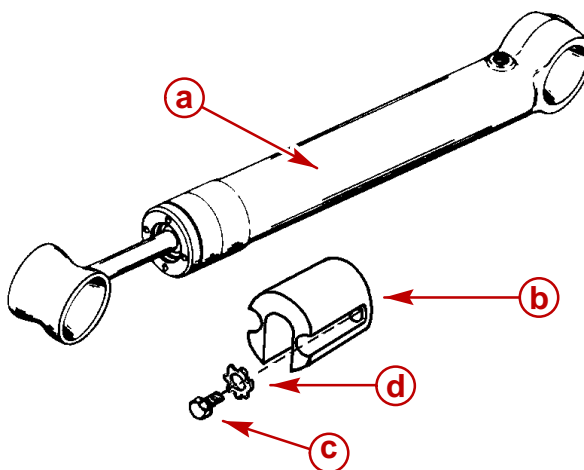


71677

- a** - Spanner Wrench (P/N 91-821709)



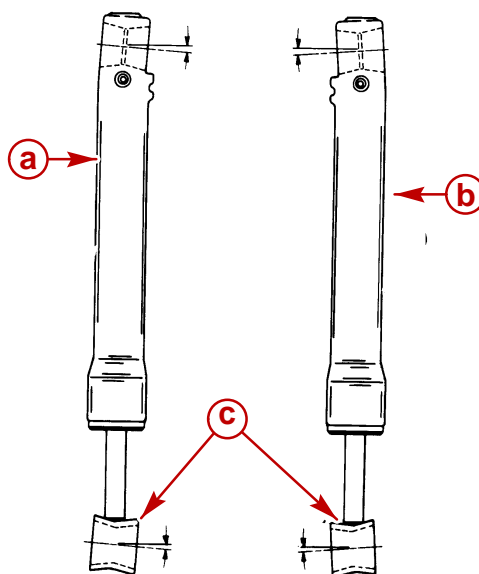
14. Install trim cylinder anodes.



76902

- a** - Trim Cylinder
- b** - Trim Cylinder Anode
- c** - Screw (2)
- d** - Washer (2)

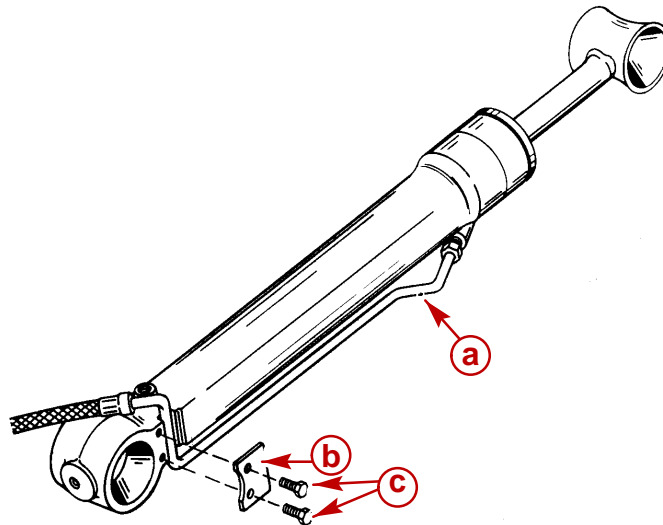
15. Position trim cylinder rear connecting ends as shown.



22135

- a** - Port Trim Cylinder
- b** - Starboard Trim Cylinder
- c** - Connecting Ends (Angled as Shown)

16. Install IN/DOWN trim hose.



22130

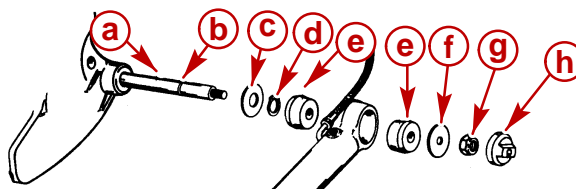
- a** - "Down" Trim Hose
- b** - Clamping Plate
- c** - Screws

17. Check painted areas of trim cylinders for scratches that expose metal and paint if necessary.

## Installation

**NOTE:** Refer to "Special Information" at the front of this section before reinstalling trim cylinders.

1. Install trim cylinder forward mounting hardware as shown.
2. Coat anchor pin threads with 2-4-C Marine Lubricant with Teflon (to prevent threads from galling).
3. Hand thread locknuts onto pin. Do NOT tighten at this time.



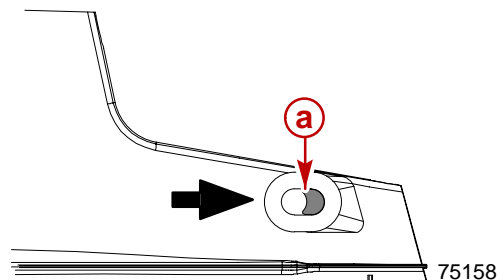
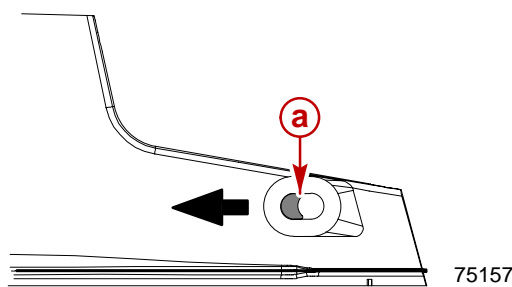
71489

- a** - Anchor Pin (1)
- b** - Slots (2)
- c** - Flat Washer (Large I.D.) (2)
- d** - Snap Rings (2)
- e** - Bushings (4)
- f** - Washers (Small I.D.) (2)
- g** - Locknut (2)
- h** - Plastic Cap (2)

**IMPORTANT:** On Bravo One, Two, and Three Models, the Trim-In Limit Insert, must be properly positioned before installing the trim cylinder anchor pin in the following steps.

**NOTE:** Ensure that the Trim-In Limit Insert is reinstalled in the same position that it was in prior to removal of the sterndrive unit. If you are not sure of its original position, contact the boat manufacturer for their recommendation. Refer to Special Information at the front of this section before reinstalling the Trim-In Limit Insert.

4. Ensure that the Trim-In Limit Insert is positioned as shown for the appropriate Bravo model.



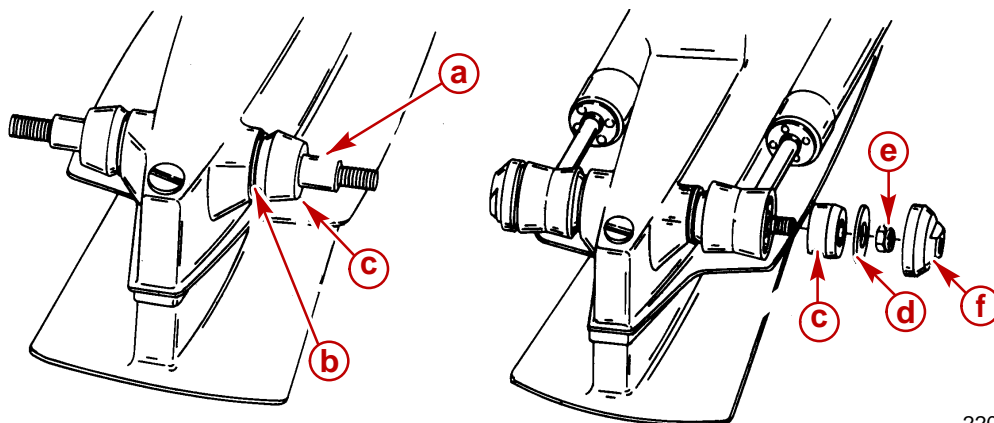
**Bravo One and Two (Positioned Forward)    Bravo Three (Positioned Aft)**

- a** - Trim-In Limit Insert

**IMPORTANT:** The position of the Trim-In Limit Insert on the Bravo Three sterndrive unit should only be changed after the boat has been properly tested. Contact the boat manufacturer if you are not sure of the original position for a particular boat application.

5. Install trim cylinder aft mounting hardware as shown.

6. Coat anchor pin threads with 2-4-C Marine Lubricant with Teflon to prevent threads from galling.
7. Hand thread locknuts onto anchor pin. Install plastic caps.



22029

- a** - Aft Anchor Pin (Shorter)
- b** - Washers (2) - Large I.D.
- c** - Bushings
- d** - Washers (2) - Small I.D.
- e** - Locknuts (2)
- f** - Plastic Caps (2)

**⚠ CAUTION**

**All 4 anchor pin locknuts must be tightened as described following or damage to sterndrive unit may result from drive unit moving too far inward.**

8. Tighten 4 anchor pin locknuts until nuts and washers bottom out against anchor pin shoulder.
9. Reconnect trim hoses after air bleeding power trim cylinders and hoses following procedures outlined in Section 5A.

# POWER TRIM

## Section 5C - Dual Power Trim System

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Trailer Switch Test .....	5C-4	Replacement .....	5C-8
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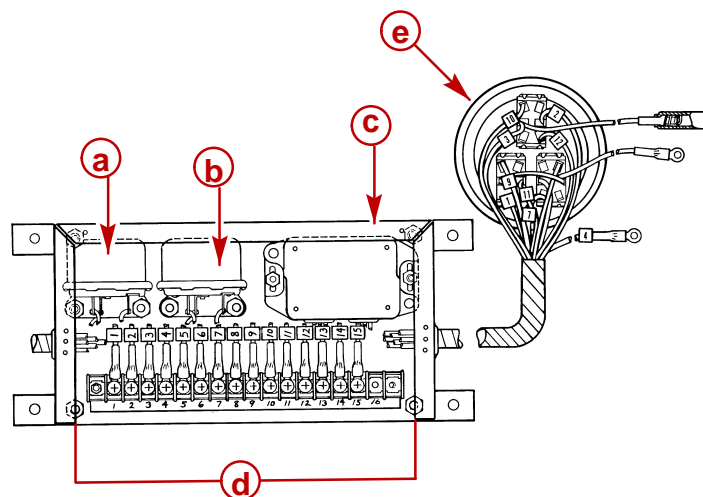
## Important Information

When testing this Dual Power Trim system, take special note of the following:

- The control box harness connectors must be disconnected and the key switch must be OFF.
- Make certain that the jumper lead used between terminals 3 and 5 is used only when specified.

The following tests are listed in order of probable component failure. It is recommended, however, that all tests be performed even if a faulty component is detected early in the sequence. This precaution will guard against repeat failure if there is more than one failed component.

## Testing Dual Power Trim System



22129

### Dual Trim Control Panel Electrical Box

- a** - Relay No. 1
- b** - Relay No. 2
- c** - Diode Module
- d** - Terminal Block
- e** - Control Panel

## Relay Test

### TESTING RELAY NO. 1

1. Test for 12 volts at terminal 2, using only terminal 4 as a ground.
  - Voltage indicated, proceed to "2."
  - No voltage indicated, replace relay.
2. Connect a jumper wire between terminals 3 and 5. Test for 12 volts at terminal 2, using only terminal 4 as a ground.
  - No voltage indicated, relay OK.
  - Voltage indicated, replace the relay.

## TESTING RELAY NO. 2

1. Test for continuity between terminals 13 and 9.
  - Continuity indicated, proceed to "2."
  - No continuity indicated, replace the relay.
2. Connect a jumper wire between terminals 3 and 5. Test for continuity between terminals 13 and 9.
  - No continuity indicated, relay OK.
  - Continuity indicated, replace relay.

## Diode Module Test

Perform the following diode tests using an ohmmeter set on the Rx1 scale. When testing diodes, take 2 readings. Note the first reading; then, reverse the meter leads and, again, note the reading.

If the diode is good, the meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading (below 60 ohms) when connected the other way.

If both readings are high or infinite, the diode is open. Replace the diode module.

### 1. Diode No. 1

- a. Connect a jumper wire between terminals 3 and 5. Test the diode between terminals 9 and 10.

### 2. Diode No. 2

- a. Connect a jumper between terminals 3 and 5. Test diode between terminals 10 and 13.

## CAUTION

**Before proceeding with further diode testing, remove fuse from red/purple harness lead so that it will not be possible to short either control box or VOA meter.**

### 3. Diode No. 3

- a. Test the diode between terminals 6 and 12.

### 4. Diode No. 4

- a. Test the diode between terminals 12 and 7.

### 5. Diode No. 5

- a. Test the diode between terminals 8 and 11.

### 6. Diode No. 6

- a. Test the diode between terminals 14 and 15.

### 7. Diode No. 7

- a. Test the diode between terminals 8 and 5.

### 8. Diode No. 8

- a. Test the diode between terminals 5 and 15.

## Trailer Switch Test

### CAUTION

**Remove fuse from RED/PURPLE harness lead before proceeding with test.**

1. Set the ohmmeter on the Rx1 scale.
2. Push down on the "Trailer" switch and check for continuity between terminals 10 and 3.
  - Continuity indicated, proceed to step 3.
  - No continuity indicated, replace the switch.
3. Push up on the trailer switch and check for continuity between terminals 2 and 12.
  - Continuity indicated, switch OK.
  - No continuity indicated, replace the switch.

## Starboard Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on STARBOARD TRIM switch and check for continuity between terminals 1 and 9.
  - Continuity indicated, proceed to step 3.
  - No continuity indicated, replace switch.
3. Push up on STARBOARD TRIM switch and check for continuity between terminals 11 and 6.
  - Continuity indicated, switch OK.
  - No continuity indicated, replace switch.

## Port Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on PORT TRIM switch and check for continuity between terminals 2 and 13.
  - Continuity indicated, proceed to step 3.
  - No continuity indicated, replace switch.
3. Push up on PORT TRIM switch and check for continuity between terminals 14 and 7.
  - Continuity indicated, switch OK.
  - No continuity indicated, replace switch.



# Dual Power Trim System Component Repair

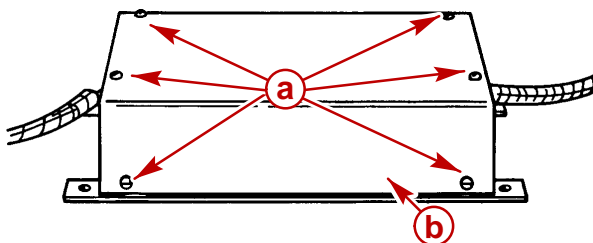
## Important Information

Use care when removing and installing components. Do not force or pull wiring during replacement. Use care to prevent wiring from stretching, pinching or chafing. Coat all terminal connections with Quicksilver Liquid Neoprene.

## Relay Replacement

### REMOVAL

1. Remove control box cover.

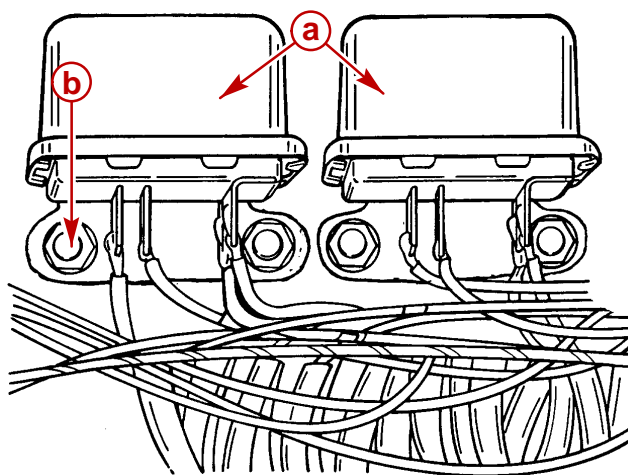


**a** - Screws

**b** - Cover

22086

2. Unsolder wires from relay to be replaced.
3. Remove relay.



**a** - Relay Assemblies (1 and 2)

**b** - Fasteners

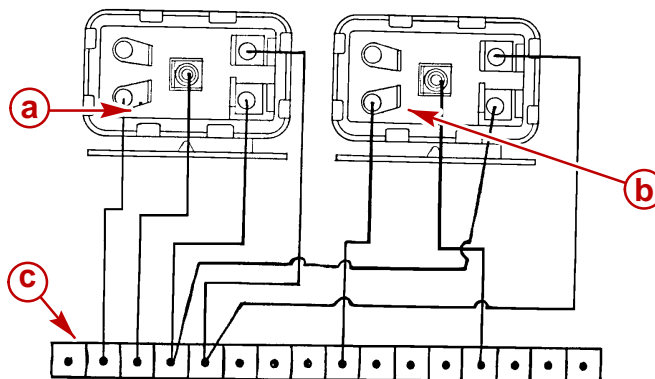
22086

**INSTALLATION**

1. Install new relay.

**IMPORTANT:** Use 63/67 (Tin/Lead) alloy solder. DO NOT use acid core solder as damage to relay can result. Coat terminal connections with Quicksilver Liquid Neoprene.

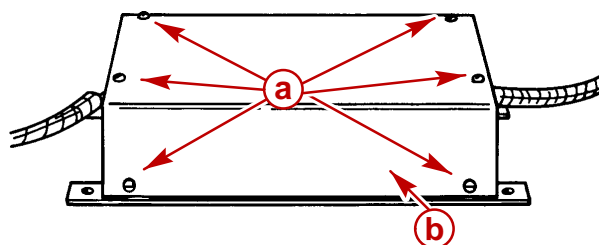
2. Resolder wires from terminal block to relay as shown.
3. Coat terminal connections with Quicksilver Liquid Neoprene.



22216

- a** - Relay No. 1
- b** - Relay No. 2
- c** - Terminal Block

4. Install control box cover.



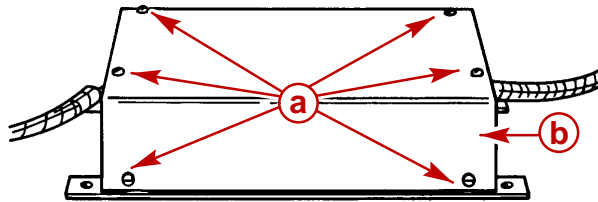
22086

- a** - Screws
- b** - Cover

# Diode Module Replacement

## Removal

1. Remove control box cover.



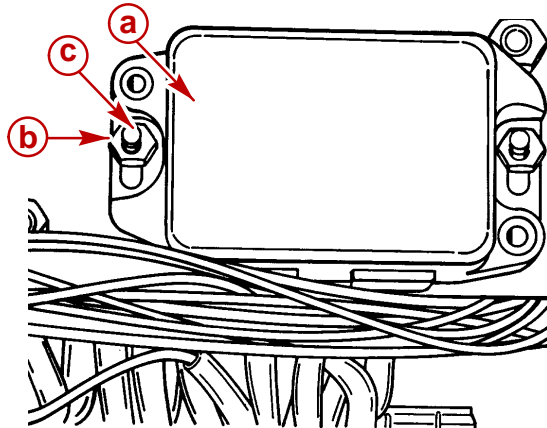
- a** - Screws  
**b** - Cover

22086

2. Disconnect leads from terminal block.

## Installation

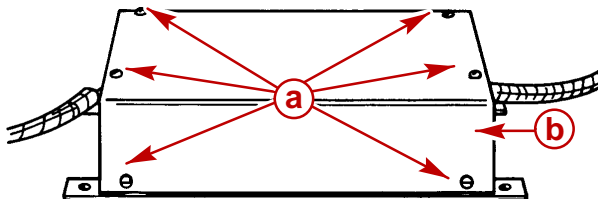
1. Replace diode module.



- a** - Diode Module  
**b** - Nut  
**c** - Bolt

22086

2. Reconnect numbered leads to respective terminals.
3. Install control box cover.



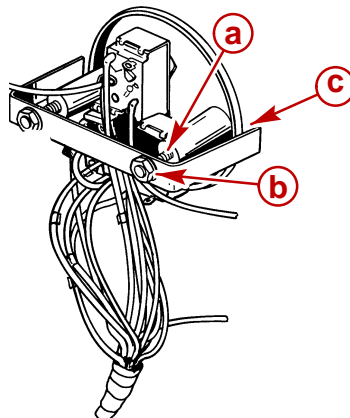
- a** - Screws  
**b** - Cover

22086

# Trim Control Panel Switch(es) Replacement

## Removal

1. Remove trim control panel from dash.
2. Cut leads (from switch to be replaced) as close to switch terminals as possible.



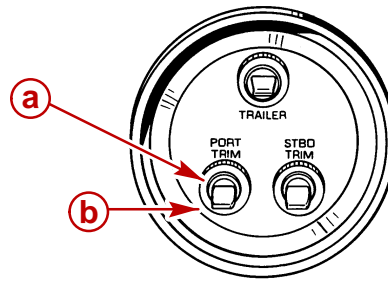
22086

- a** - No. 10-24 Studs
- b** - Flat Washers And Nuts
- c** - U-Bracket

3. Remove bezel nut.

## Installation

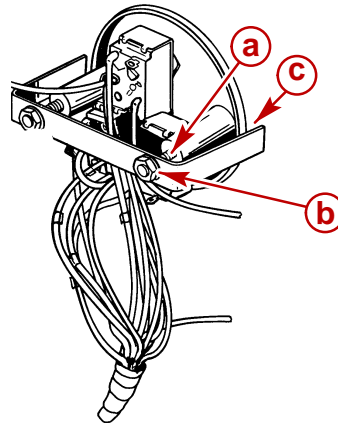
1. Replace switch.



22086

- a** - Bezel Nut
- b** - Switch

2. With new switch properly positioned in control panel, loop leads through their respective terminal eyelets. Refer to Wiring Diagram.
3. Using 60/40 (tin/lead) alloy rosin core solder, solder leads to terminals.
4. Secure trim control panel to dash.

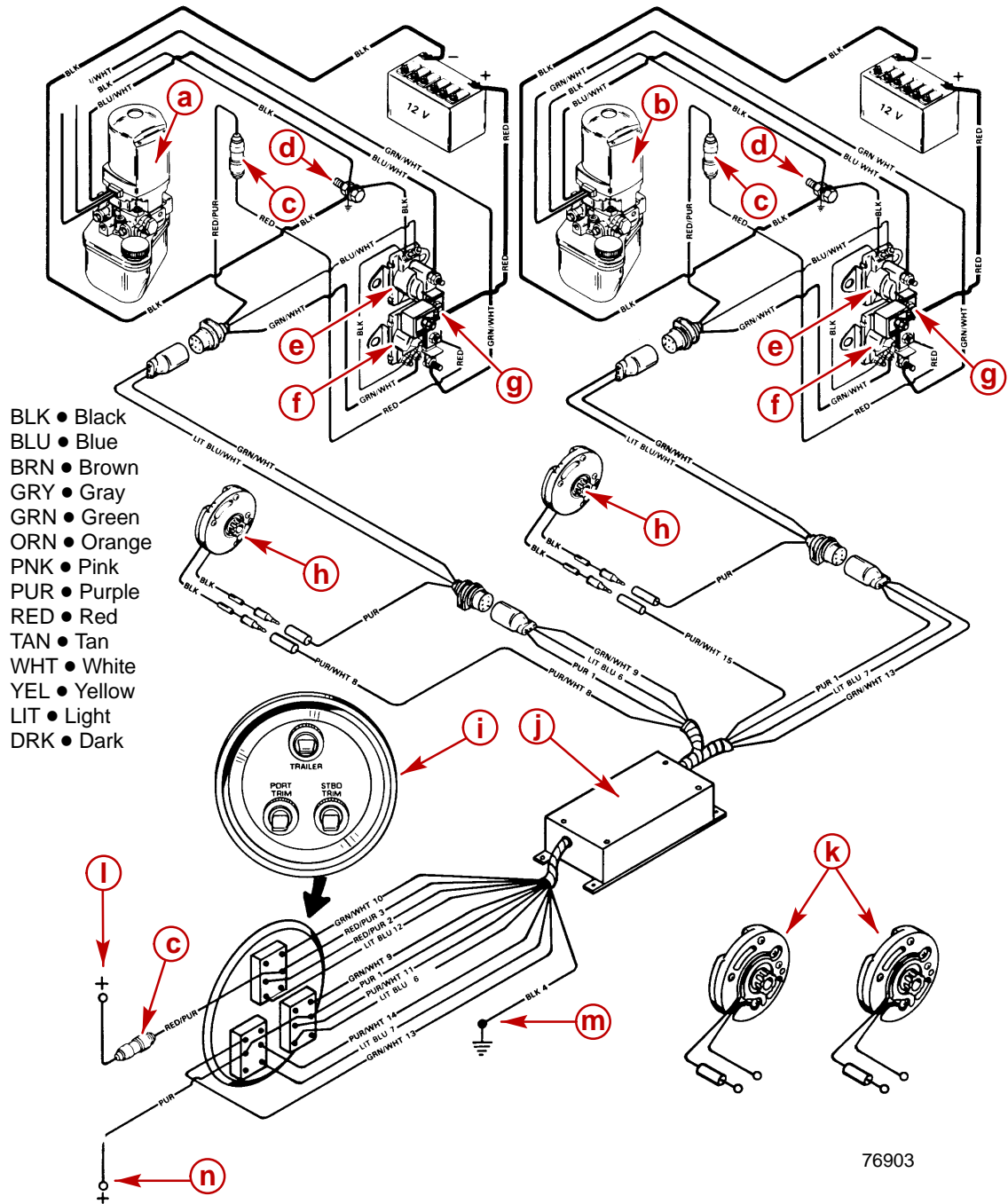


22086

- a** - No. 10-24 Studs
- b** - Flat Washers And Nuts
- c** - U-Bracket

# Wiring Diagrams

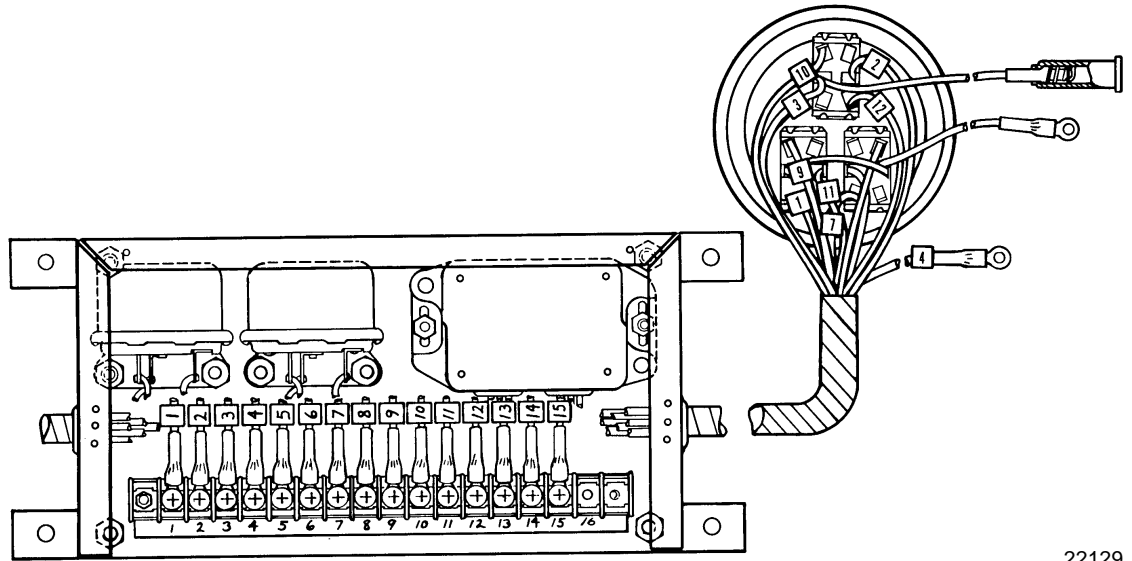
## Dual Trim Harnesses



- a-** Starboard Trim Pump
- b-** Port Trim Pump
- c-** 20 Amp Fuse
- d-** Ground Bolt (Floor Mount)
- e-** UP Solenoid
- f-** DOWN Solenoid
- g-** 110 Amp Fuse

- h-** Trim Limit Switch
- i-** Trim Switch (Various Styles)
- j-** Control Module
- k-** Trim Position Sender
- l-** 12 Volt Power From Battery
- m-** Ground Wire
- n-** 12 Volt Power From Switched Side Of Ignition Switch

## Electrical Box Wiring



22129

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# POWER TRIM

## Section 5D - Auto Trim II

### Table of Contents

Auto Trim II System .....	5D-2	Auto Trim Limit Adjustment .....	5D-6
Description .....	5D-2	Adjusting Sterndrive Unit Trim Angle ..	5D-7
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“Manual” Mode Operation .....	5D-4	Wiring Diagram .....	5D-11
Electrical System Overload Protection ...	5D-6		

# Auto Trim II System

## Description

The Auto Trim System consists of the following major components:

- Auto Trim Pump - same pump that is used on the standard power trim models.
- Control Module - a solid-state electronic device that senses engine rpm and regulates the time at which the sterndrive unit trims IN and OUT when operating in the AUTO mode. Module is protected by a 20-amp fuse.
- Mode Switch - allows the operator to select either AUTO or MANUAL trim operation from the dash.
- Manual Trim Control - will only function with mode switch in the MANUAL mode and ignition switch in the RUN position. Allows the operator to raise and lower the sterndrive unit for trailering, beaching, launching and shallow water operation. Also, allows the operator to manually adjust the sterndrive unit trim angle while underway in situations where automatic trimming is not desired (rough seas, etc.).
- Trim Limit Switch - Establishes the maximum trim OUT limit in both the MANUAL and AUTO mode. Prevents sterndrive unit from moving out of the gimbal ring support flanges, which could cause possible damage to sterndrive if it were to occur at higher engine speeds.

## Auto Trim II Operation

The Auto Trim system is designed to allow either automatic or manual trimming of the boat while underway - in addition to allowing sterndrive unit to be raised for trailering, beaching, launching or shallow water operation. A 2-position switch on dashboard allows the operator to select the mode desired.



22217

## Auto Mode Operation

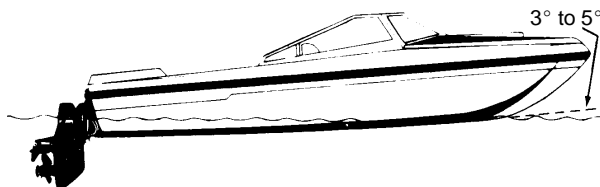
### WARNING

**Sterndrive unit will automatically lower from the raised position when the ignition switch is turned to the RUN position and mode switch is placed in the AUTO mode. BE SURE THAT NO ONE IS IN THE AREA OF THE STERNDRIVE UNIT.**

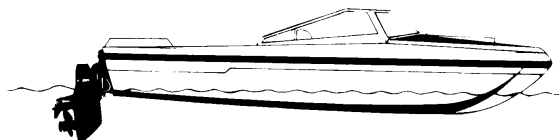
With mode switch in the AUTO mode, the sterndrive unit will move automatically to properly trim the boat while underway. This allows boat operator to keep both hands on the steering wheel and to direct operator's full attention to driving the boat.

- At engine speeds below 3100 rpm, the sterndrive unit will remain in the full IN position. This will force the bow of the boat down and help it get up on plane quickly.
- Once engine reaches 3100 rpm and after a 5-6 second delay (to ensure that boat is up on plane), the sterndrive unit will automatically trim OUT to a preset position for maximum boat speed and efficiency. Trim OUT position can be adjusted to fine tune the trim angle for each individual boat.
- Upon deceleration, the sterndrive unit will trim IN when engine reaches 2600 rpm. Most boats will still be up on plane at this point. After sterndrive reaches full IN position, the trim pump motor will continue to run for approximately 5 seconds.

**NOTE:** The AUTO mode also can be used to lower the sterndrive unit from the fully raised (trailing) position. By placing ignition switch in RUN position and mode switch in AUTO mode, the sterndrive unit will automatically lower to the full IN position. Be sure that no one is in the area of the sterndrive unit.



**Boat Running Above Planing Speed**



**Boat Running Below Planing Speed**

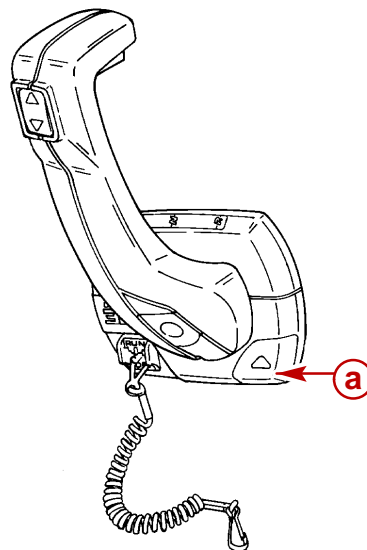
## “Manual” Mode Operation

Placing the mode switch in the MANUAL position will deactivate the AUTO system and allow the operator to adjust sterndrive unit position, using the manual trim control. Typical controls are shown following. Manual trimming may be desirable to fine tune the trim angle for a particular water condition or boat load, or in situations where greater control over the trim operation is needed.

Manual trim control also must be used to raise the sterndrive unit for trailering, beaching, launching and shallow water operation. Ignition switch must be in the RUN position for manual trim control to function.

### RAISING STERNDRIVE UNIT TO TRAILER POSITION

1. Press the trailer button until sterndrive unit reaches desired height or end of upward travel.



22174

**a** - Trailer Button

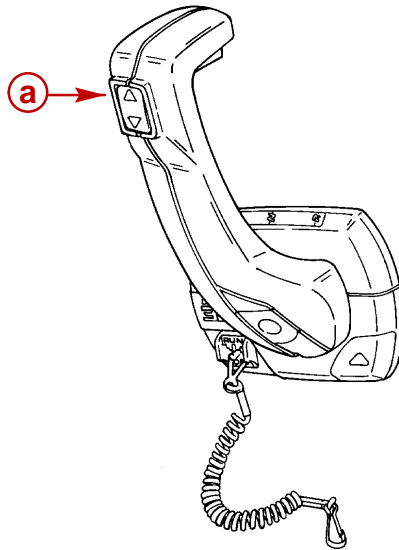
**NOTE:** Some power trim pump motors are protected from overheating by an internal circuit breaker. If trailering switch(es) are held depressed after sterndrive unit reaches end of upward travel, internal circuit breaker will open and pump will stop. If this should happen, release switch(es) and allow motor to cool for approximately 2 minutes. Once motor is cool, circuit breaker will reset automatically, and trim operation may be resumed.

### **⚠ CAUTION**

**DO NOT** run engine above idle rpm with unit raised for shallow water operation, as sterndrive unit is out beyond gimbal ring support flanges and has no side support. **USE EXTREME CAUTION WHEN OPERATING BOAT WITH STERNDRIVE UNIT RAISED.**

**TRIMMING STERNDRIVE UNIT OUT (BOW UP)**

1. Press UP/OUT Button until sterndrive unit moves to properly trim boat or trim limit switch stops outward travel.



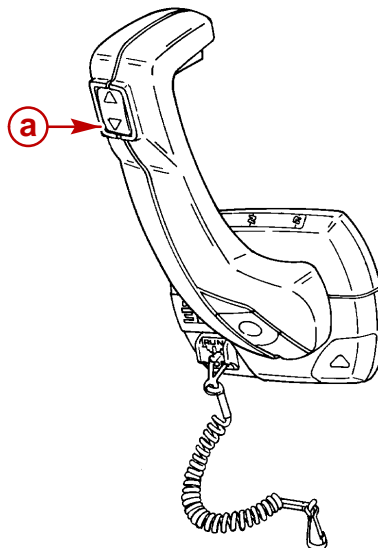
22174

**a** - UP/OUT Button**⚠ CAUTION**

**NEVER** trim the sterndrive unit OUT using the “Trailer” switch(es) while boat is underway. Severe damage to sterndrive unit may result if the unit is raised beyond the gimbal ring support flanges at engine speeds above idle RPM.

**TRIMMING STERNDRIVE UNIT IN (BOW DOWN)**

1. Press IN/DOWN Button until sterndrive unit moves to properly trim boat or until sterndrive unit reaches end of downward travel.



70023

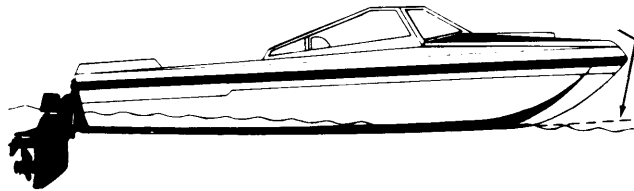
**a** - IN/DOWN Button

# Electrical System Overload Protection

The Auto Trim electrical system is protected from overload by a 110-amp fuse, and a 20-amp in-line fuse at control module positive (+) battery lead and a 20-amp in-line fuse at ignition switch (if Quicksilver ignition switch is used). If boat is equipped with 3-Button Control Panel, a 20-amp in-line fuse also is located at panel. If Auto Trim electrical system becomes inoperative, check for a blown fuse. If fuse has blown, the cause for overload **MUST BE** found and corrected **BEFORE** replacing fuse.

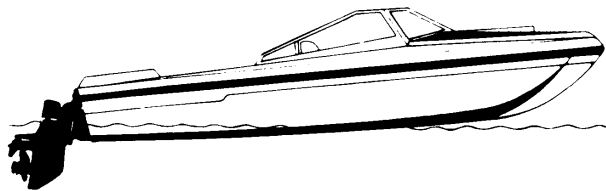
## Auto Trim Limit Adjustment

In most cases, best all-around performance is obtained with sterndrive unit adjusted so that front of hull will be slightly out of water when boat is on plane.



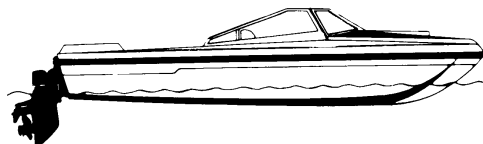
**Boat Properly Trimmed**

Adjusting the sterndrive unit **OUT** from this position will tend to raise the bow of the boat, reducing the wetted surface of the hull and, in some cases, increasing boat speed. If trimmed out excessively, bouncing, porpoising, propeller ventilation and possible difficult steering control could result.



**Bow Too High - Move Sterndrive Unit IN**

Adjusting the sterndrive unit **IN** from normal position will force the bow of the boat down, increasing the wetted surface of the hull and, in some cases, improving boat ride in rough water (at partial throttle). However, this will reduce boat speed.



**Bow Too Low - Move Sterndrive Unit OUT**

## Adjusting Sterndrive Unit Trim Angle

### ⚠ WARNING

When adjusting trim limit use extreme care that engine is not accidentally started and keep clear of area near propeller. Also, use care to prevent placing hands in an area where they could be injured by sterndrive unit movement.

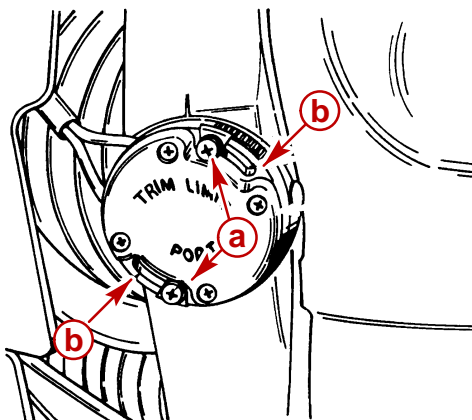
### ⚠ CAUTION

Trim limit switch **MUST BE** adjusted exactly as stated following. If switch is adjusted incorrectly, sterndrive unit may move out beyond the gimbal ring support flanges and severe damage to sterndrive unit may result.

If more trim OUT capability is desired, perform the following.

### DRY DOCK PROCEDURE

1. Place sterndrive unit in the full IN/DOWN position.
2. Loosen trim limit switch retaining screws.
3. Turn trim limit switch clockwise to end of adjusting slots.

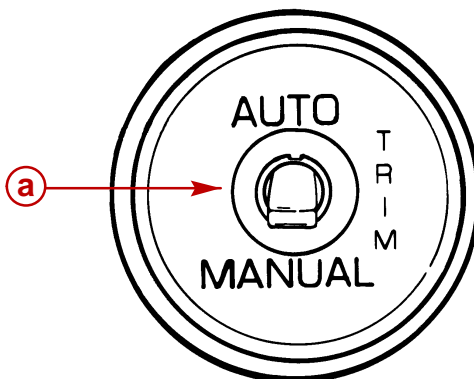


71221

#### Trim Limit Switch

- a** - Retaining Screws
- b** - Adjusting Slots

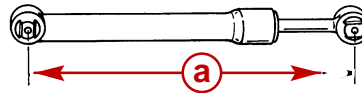
4. Place auto trim mode switch in the MANUAL mode.
5. Turn ignition key to the RUN position.



76848

#### Auto Trim Mode Switch

6. With the assistance of another person actuate manual trim control switch used to trim sterndrive unit OUT (DO NOT use "Trailer" switch) and turn trim limit switch SLOWLY counterclockwise until trim cylinders extend to dimension shown. Retighten trim limit switch retaining screws.



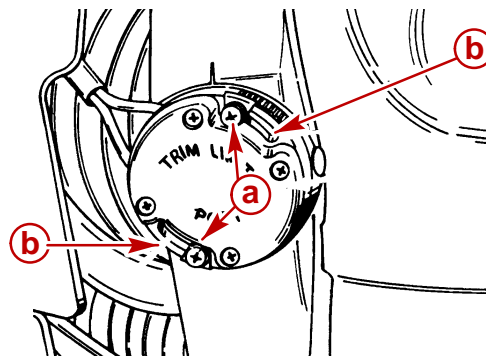
50464

**a** - Trim Limit Dimension 21-3/4 in. (552 mm)

7. Turn ignition key OFF.

## ON-WATER PROCEDURE

1. Run boat along a relatively smooth stretch of water and trim boat with manual trim control until optimum boat performance is achieved.
2. After finding trim angle that provides best performance, stop engine (without changing sterndrive unit trim angle). Accurately measure distance between trim cylinder end cap and pivot end.
3. Place sterndrive unit in the full IN position.
4. Loosen trim limit switch retaining screws.
5. Turn trim limit switch clockwise to end of adjusting slots.



71221

### Trim Limit Switch

- a** - Retaining Screws
- b** - Adjusting Slots

6. Leaving auto trim mode switch in the MANUAL mode, turn ignition key to RUN position.
7. With the assistance of another person, actuate manual trim control switch used to trim sterndrive unit OUT and turn trim limit switch SLOWLY counterclockwise until trim cylinders extend to dimension recorded in STEP 2. Tighten switch retaining screws securely.
8. Run boat with auto trim mode switch in AUTO position at several speeds, through turns under various water and load conditions, if boat does not perform to satisfaction, repeat adjusting procedure.

## **⚠ WARNING**

Difficulties in handling and operational control may result if sterndrive unit is adjusted OUT too far. If difficulties are encountered, sterndrive unit trim angle **MUST BE** moved IN the amount necessary to eliminate the problem and avoid a possible safety hazard.

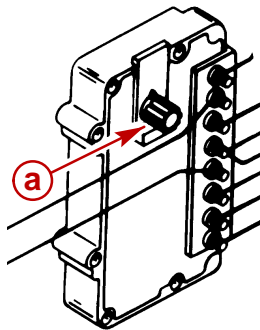


# Control Module Adjustment

1. Completely turn adjustment knob on control module COUNTERCLOCKWISE.
2. Turn knob back CLOCKWISE four clicks.
3. With auto trim mode switch in AUTO position and the sterndrive unit trimmed full IN/DOWN, accelerate boat slowly while watching trim gauge.
4. If boat is on plane well before sterndrive unit begins to trim out (this may happen with lighter, faster boats), rotate adjustment knob COUNTERCLOCKWISE one click and accelerate boat slowly.

Continue procedure until boat is on plane approximately five or six seconds before trim out occurs.

5. If boat is not on plane before sterndrive unit begins to trim out (this may happen with slower, heavier boats), rotate adjustment knob clockwise one click and accelerate boat slowly.



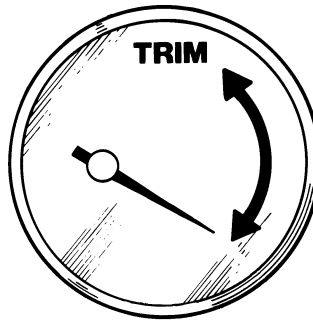
22178

## Control Module

**a** - Adjustment Knob

# Trim Position Indicator Adjustment

With ignition key in the RUN position, check Auto Trim indicator to make sure that needle points to bottom of the scale when sterndrive unit is IN/Down. If needle is not at bottom of scale, perform following steps:



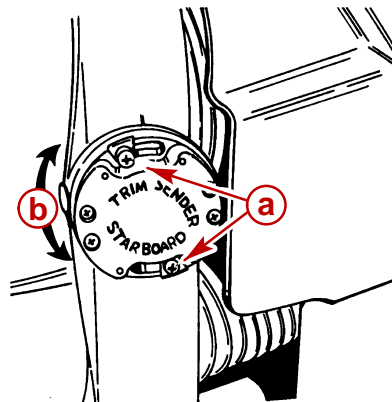
22175

Trim Position Indicator

## ⚠ WARNING

**While performing this adjustment, use extreme care that engine is not accidentally started; keep clear of the area near propeller.**

1. Turn ignition key to RUN position.
2. Loosen trim position sender retaining screws.
3. Rotate sender to position indicator needle at bottom of the scale.
4. Retighten retaining screws securely.
5. Recheck trim position indicator reading and turn ignition key to OFF position.

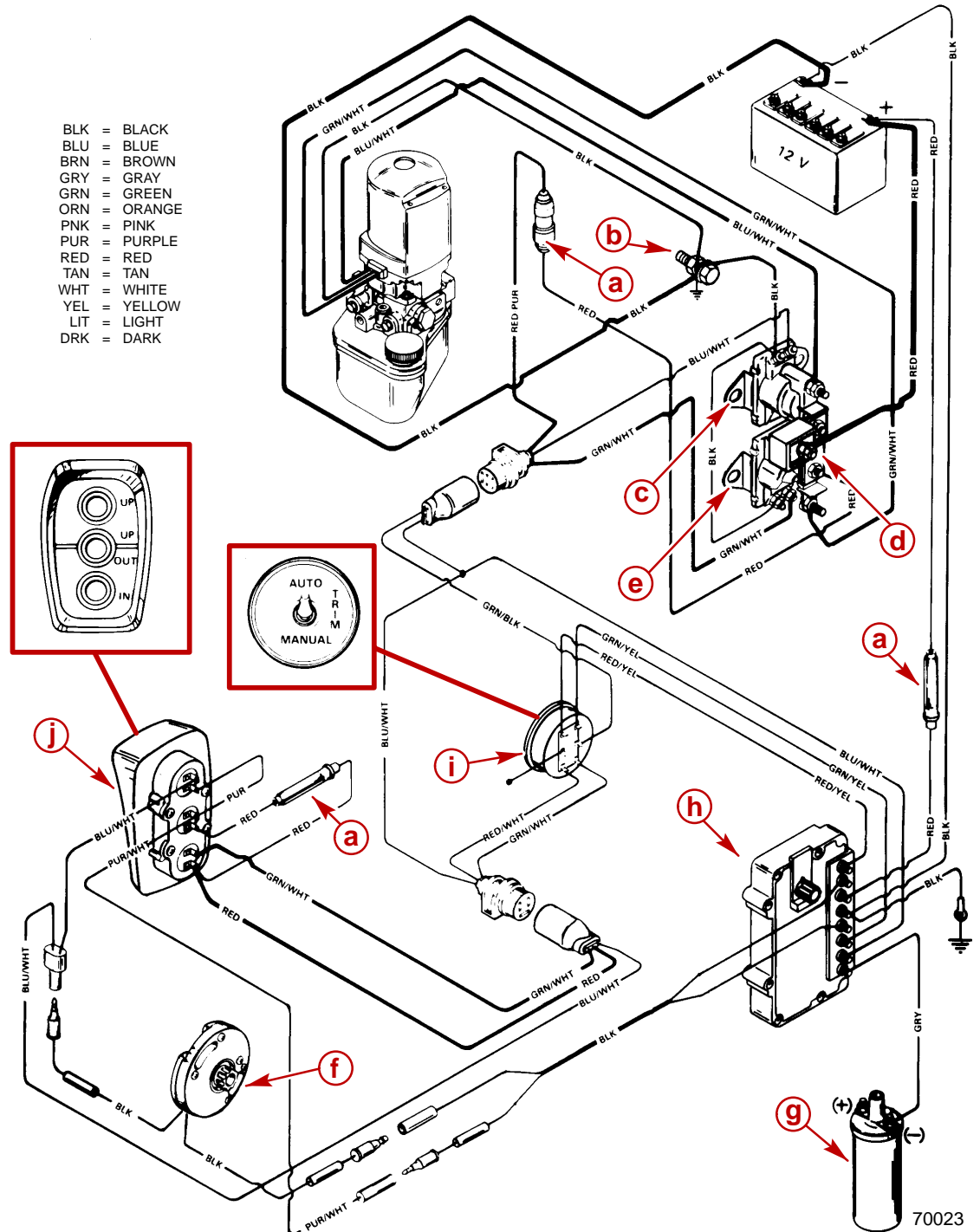


71220

Trim Sender Switch

- a** - Retaining Screws
- b** - Adjustment

# Wiring Diagram



- a** - 20 Amp Fuse
- b** - Ground Bolt (Floor Mount)
- c** - UP Solenoid
- d** - 110 Amp Fuse
- e** - DOWN Solenoid

- f** - Trim Limit Switch
- g** - Ignition Coil
- h** - Control Module
- i** - Auto/Manual Switch
- j** - Trim Switches (Various Styles)

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# STEERING SYSTEMS

## Section 6A - Power Steering

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Filling and Bleeding .....	6A-10		

# Specifications

## Torque Specifications

**NOTE:** Securely tighten all fasteners not listed below.

FASTENER LOCATION	lb-in.	lb-ft	Nm
Steering Cable Coupler Nut		35	48
Steering System Pivot Bolts		25	34
Power Steering Hydraulic Hose Fittings		23	31
Power Steering Pump Housing Studs		35	47
Pump Flow Control Valve Fitting			
Tie Bar Locknut		50	68

## Special Tools

DESCRIPTION	PART NO.
Power Steering Test Gauge	91-38053A4
Power Steering Pump Pulley Installer	91-93656A1

### KENT-MOORE SPECIAL TOOLS

Can be ordered from:

Kent-Moore Tools, Inc.  
29784 Little Mack  
Roseville, MI 48066  
Phone: (313) 774-9500

Power Steering Pump Pulley Remover	Kent-Moore Part No. J-25034
------------------------------------	-----------------------------

## Lubricants/Sealants/Adhesives

DESCRIPTION	PART NO.
2-4-C Marine Lubricant with Teflon	92-825407A12
Special Lubricant 101	92-13872A1
Loctite No. 271	92-809820
Loctite No. 277	Obtain Locally
Quicksilver Power Trim And Steering Fluid	92-802880A1

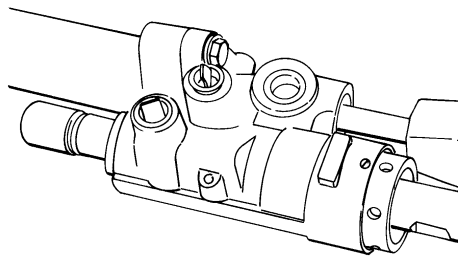
## Description

The Power Steering system utilizes an engine-driven, vane-type hydraulic pump that supplies fluid flow and pressure by means of hoses to a control valve that, in turn, controls fluid flow and pressure to-and-from a booster cylinder. Three modes make up the basic function of the Power Steering system: 1) neutral mode, 2) left turn mode, and 3) right turn mode. The control valve, which is activated by the steering cable, controls the steering system modes.

**NOTE:** The following Power Steering unit installations are viewed from inside boat, looking at transom.

## Control Valve

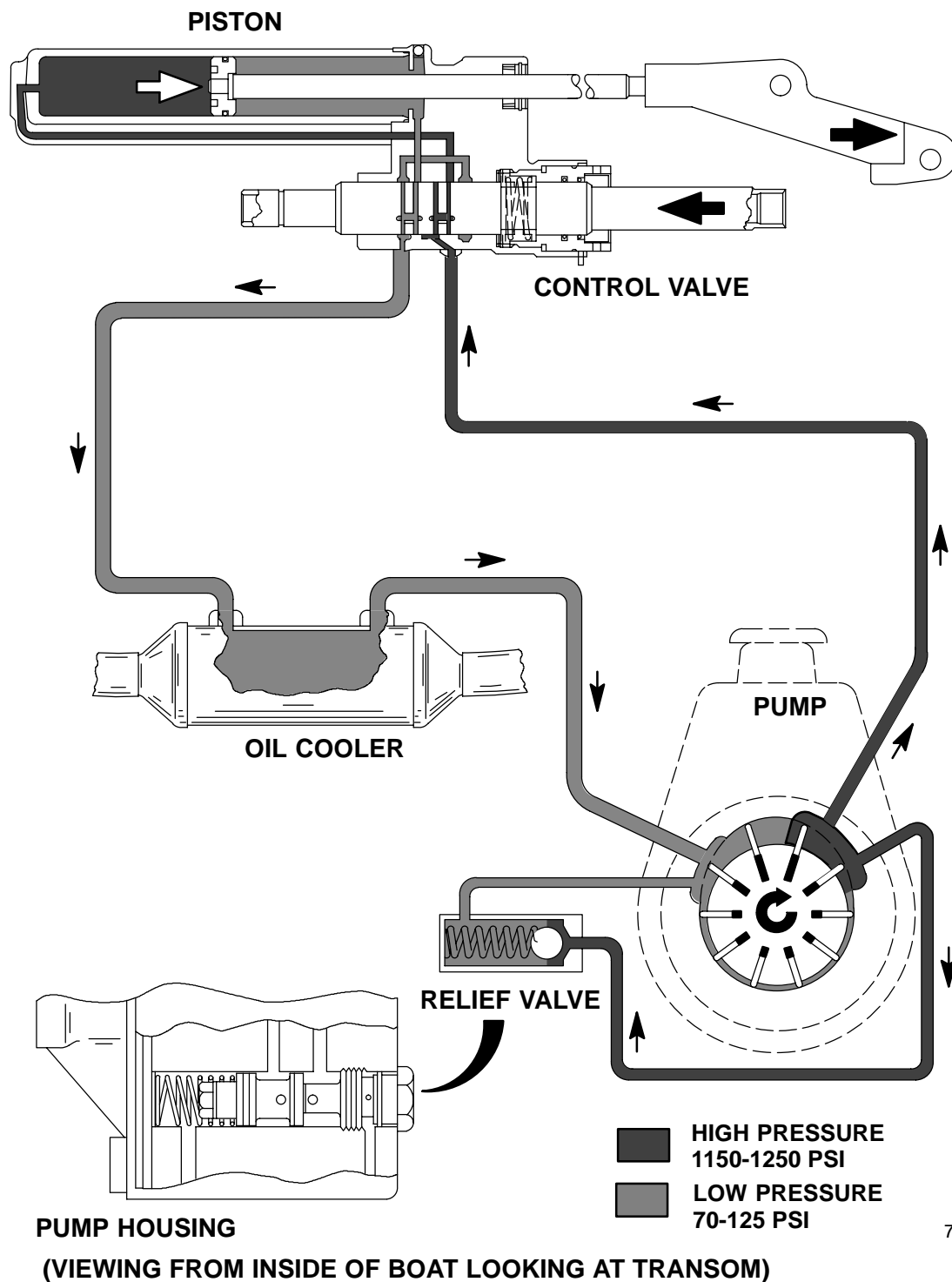
The control valve is not serviceable and must be replaced as a complete assembly.



73898

# Power Steering System

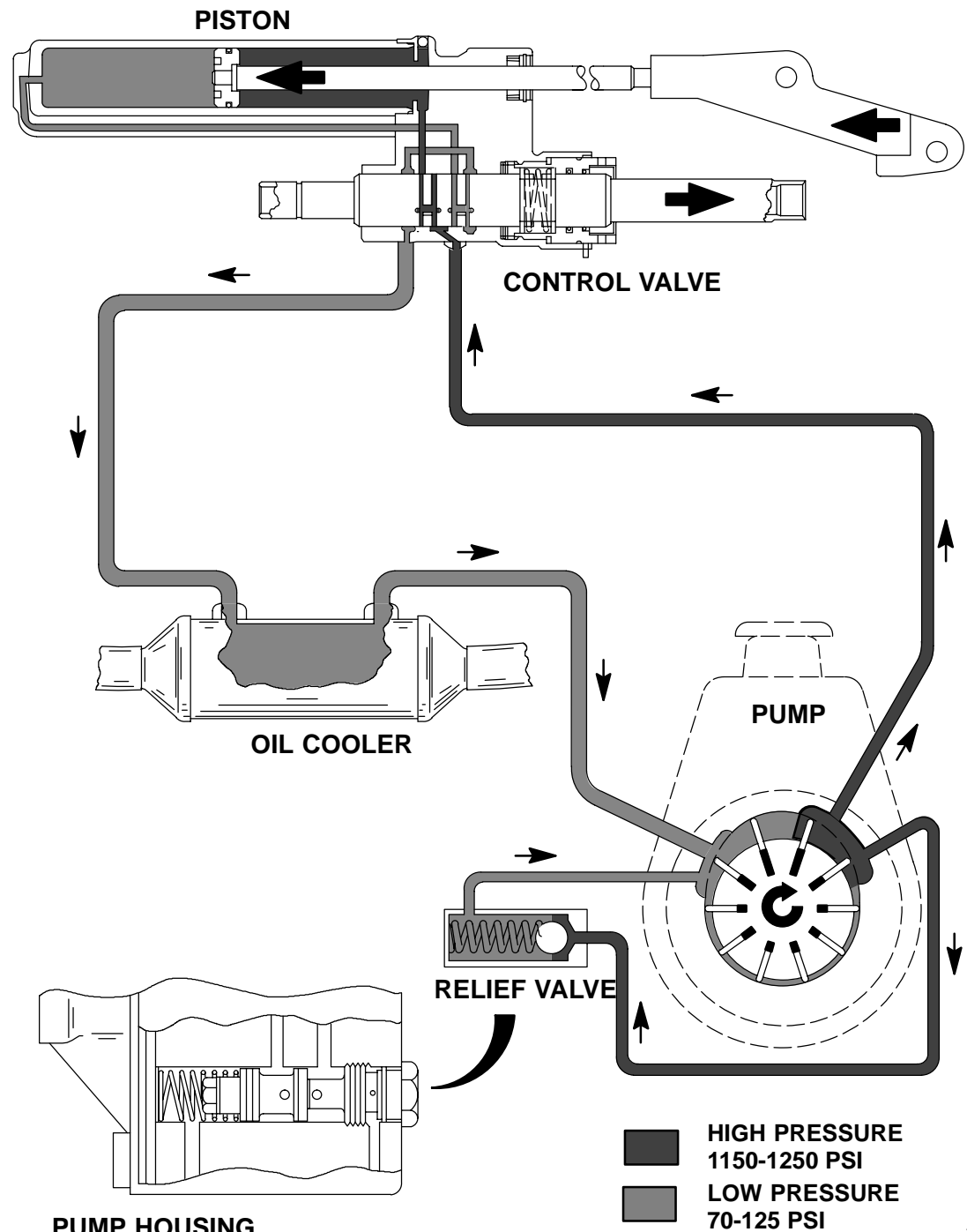
## RIGHT TURN





# Power Steering System

## LEFT TURN



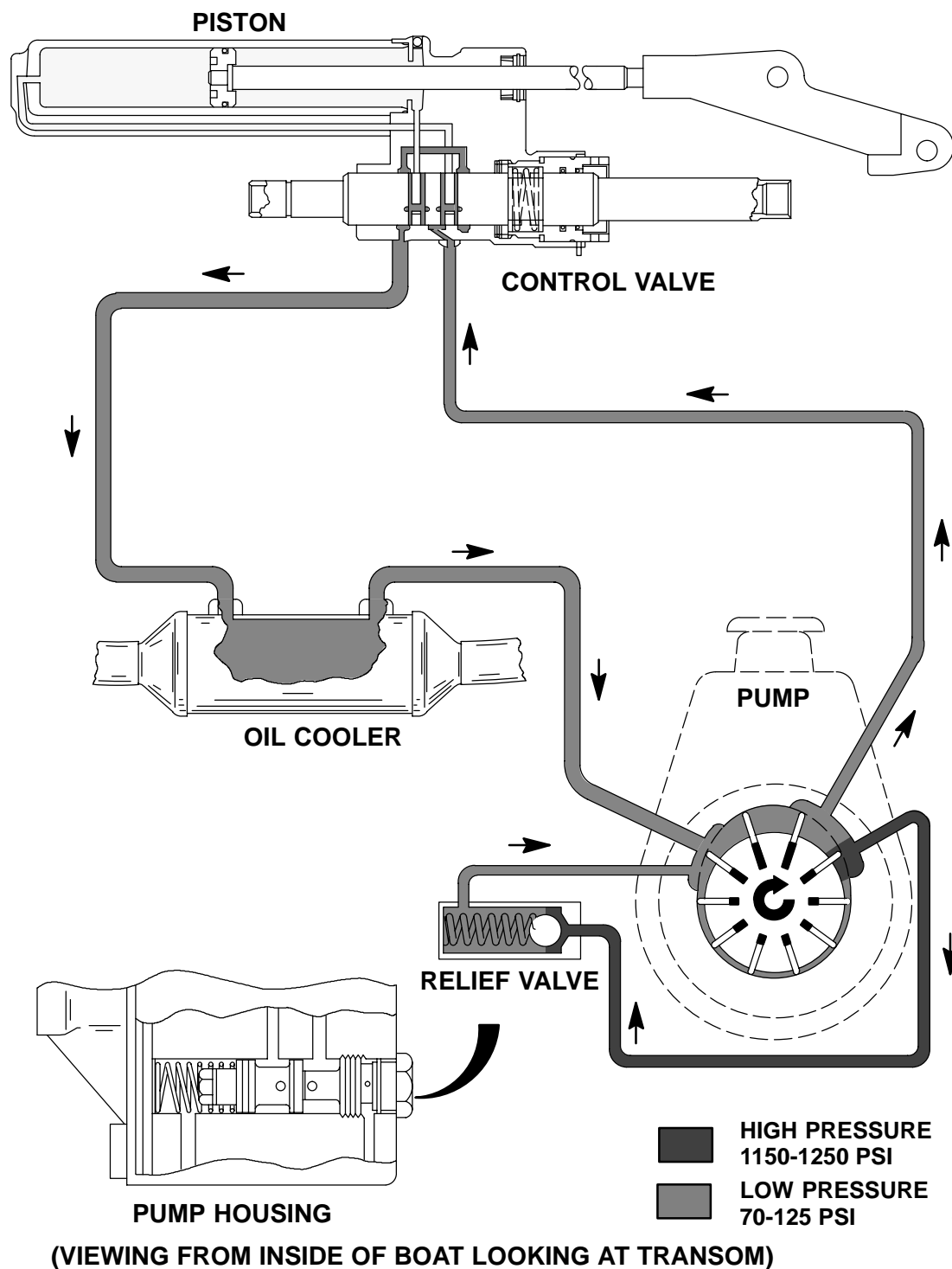
**PUMP HOUSING**

**(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)**

75239

# Power Steering System

## NEUTRAL



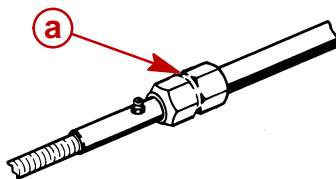
## Steering Helm and Cable

The power steering unit is shipped preset for cables with end dimensions that comply with ABYC standards as outlined in the NMMA certification handbook. The steering cable coupler nut must also have a means of locking it to the guide tube, as specified in ABYC requirements.

### **⚠ WARNING**

**Failure to use a steering cable locking device could cause loss of steering, which could cause damage to the boat and/or injury.**

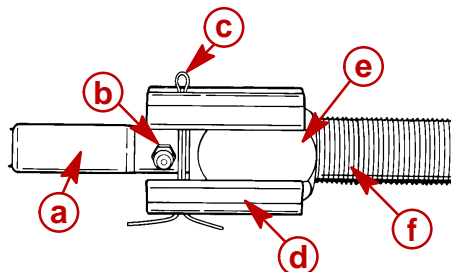
All current production Quicksilver Ride Guide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with self-locking coupler nut.)



22060

- a** - Quicksilver Ride Guide Steering Cable Self-Locking Coupler Nut (Identified by Groove)

**IMPORTANT:** If using a steering cable that does not have a self-locking coupler nut, an external locking device must be used.



### **Locking Sleeve**

- a** - Steering Cable
- b** - Grease Fitting
- c** - Cotter Pin
- d** - Locking Sleeve (If Required - Must Be Ordered Separately)
- e** - Cable Coupler Nut
- f** - Cable Guide Tube

Steering system has the steering cable guide tube set for cables with end dimensions which comply with the BIA Certification Handbook. Refer to "Steering Cable Specifications" listed previously in this section.

### **⚠ CAUTION**

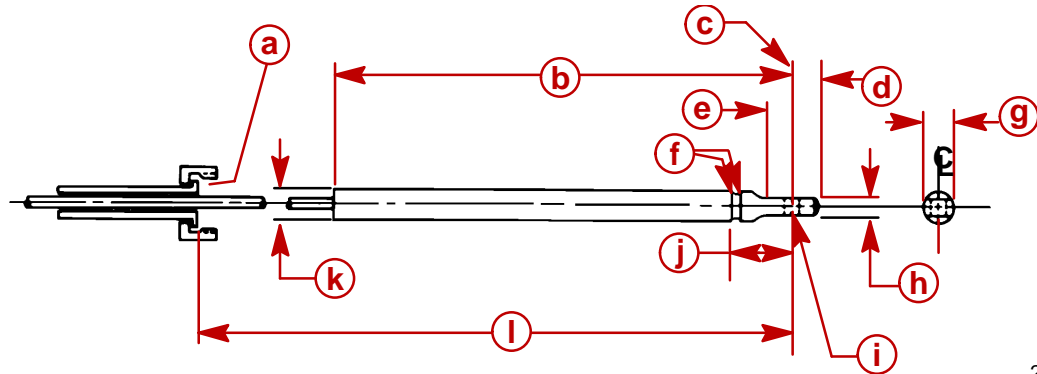
**Steering cables MUST BE THE CORRECT LENGTH**, particularly when installed in large boats. Sharp bends or too-short cables result in kinks; too-long cables require unnecessary bends and/or loops. Both place an extra stress on the cable. The proper cable is as short as possible, with the fewest bends and with radii as large as possible.

**⚠ CAUTION**

**POWER STEERING EQUIPPED UNITS ONLY** - If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result.

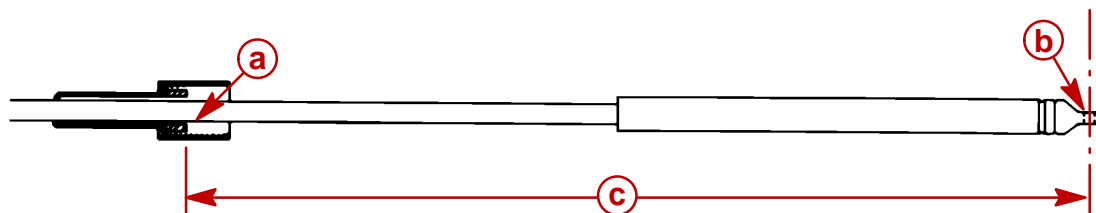
1. Steering cable must be the correct length, particularly when installed in larger boats.
2. Avoid sharp bends, kinks or loops in cable.
3. **Power Steering Models:** Fully extended steering cable end dimension must be correct.

## Steering Cable Specifications



21435

- a** - Coupler Nut - 7/8 - 14 UNF - 2B Thread
- b** - 11-3/4 in. (298 mm) Min.
- c** - Interface Point
- d** - 1/2 in. (12.7 mm) Max.
- e** - 27/64 in. (10.7 mm) Min. Flat
- f** - 7/64 in. (3.1 mm) Min. Radius
- g** - 5/8 in. (15.9 mm) Max. Diameter End Fitting
- h** - 3/8 in. (9.5 mm)
- i** - 3/8 in. (9.8 mm) Diameter Thru Hole, Chamfered Each Side
- j** - 1-3/8 in. (34.9 mm) Max.
- k** - 5/8 in. (15.9 mm) Diameter Tube
- l** - Cable Travel:
  - Mid-Travel Position - 16-7/8 in. (428.6 mm).
  - Total Travel To Be 8 in. (203.2 mm) Min., to 9 in. (228.6 mm) Max.
  - Travel Each Side of Mid-Travel Position - 4 in. (101.6 mm) Min., 4-1/2 in. (114.3 mm) Max.



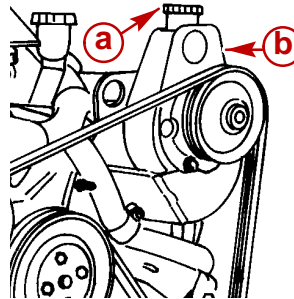
- a** - Steering Cable Mounting Flange
- b** - Center of Hole in Steering Cable End
- c** - 21-3/8 in. (543 mm) Maximum

# Filling and Air Bleeding Power Steering System

## Checking Fluid Level

### Engine Warm

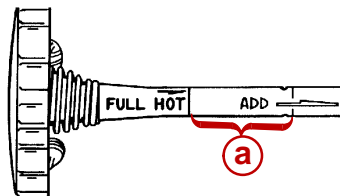
1. Stop engine. Position drive unit so that it is straight back.
2. Remove fill cap / dipstick from power steering pump and note fluid level.



74908

- a** - Fill Cap / Dipstick  
**b** - Power Steering Pump

3. Level should be between the FULL HOT mark and ADD mark on dipstick.



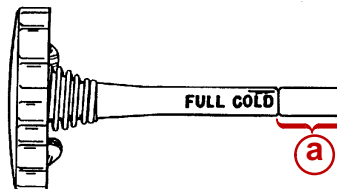
72518

- a** - Proper Fluid Level with Engine Warm

4. If level is below ADD mark, but fluid is still visible in pump reservoir, add required amount of Quicksilver Power Trim and Steering Fluid or automatic transmission fluid (ATF) Dexron III through fill cap opening, to bring level up to FULL HOT mark on dipstick. DO NOT OVERFILL.
5. If fluid is not visible in reservoir, a leak exists in the power steering system. Find cause and correct.

### Engine Cold

1. With engine stopped, position drive unit so that it is straight back.
2. Remove fill cap / dipstick from power steering pump and note fluid level.
3. Level should be between FULL COLD mark and bottom of dipstick.



72519

- a** - Proper Fluid Level with Engine Cold

4. If level is below bottom of dipstick, but fluid is still visible in pump reservoir, add required amount of Quicksilver Power Trim and Steering Fluid or automatic Dexron III transmission fluid (ATF), through fill cap opening, to bring level up to FULL COLD mark on dipstick. DO NOT OVERFILL.

If fluid is not visible in reservoir, a leak exists in the power steering system. Find cause and correct.

## Filling and Bleeding

**IMPORTANT: Power steering system must be filled exactly as explained in the following to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause power steering system to become spongy, which may result in poor boat control.**

1. With engine stopped, position drive unit so that it is straight back.
2. Remove fill cap / dipstick from power steering pump.
3. Add Quicksilver Power Trim and Steering Fluid or Dexron III automatic transmission fluid (ATF), as required, to bring level up to FULL COLD mark on dipstick.

**IMPORTANT: Use only Quicksilver Power Trim and Steering Fluid or Dexron III automatic transmission fluid (ATF), in power steering system.**

4. Turn steering wheel back and forth to end of travel in each direction several times.
5. Recheck fluid level and add fluid, if necessary.
6. Install vented fill cap. Tighten securely.

### CAUTION

**DO NOT operate engine without water being supplied to seawater pickup pump, or pump impeller may be damaged and subsequent overheating damage to engine may result.**

7. Start engine and run at fast idle (1000-1500 rpm) until engine reaches normal operating temperature. During this time, turn steering wheel back and forth to end of travel in each direction several times.
8. Position drive unit so that it is straight back and stop engine.
9. Remove fill cap from pump.
10. Allow any foam in pump reservoir to disperse.
11. Check fluid level and add fluid, as required, to bring level up to FULL HOT mark on dipstick. DO NOT OVERFILL.
12. Reinstall fill cap. Tighten securely.

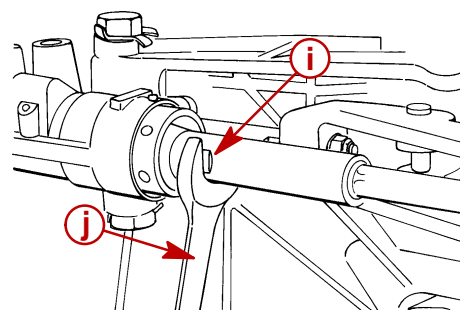
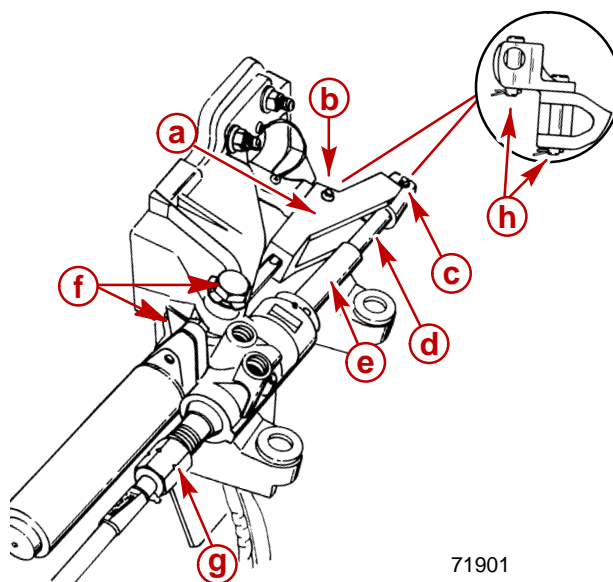
**IMPORTANT: Drive unit must be positioned straight back and power steering fluid must be hot to accurately check fluid level.**

13. If fluid is still foamy (in Step 5.), repeat Steps 7. through 12. until fluid does not foam and level remains constant.

# Power Steering Assembly

## Removal

1. Remove rear clevis pin from steering lever.
2. Remove forward clevis pin from steering cable.
3. Using suitable wrenches hold the flat surfaces on the cable guide tube in the vertical position then loosen the coupler nut and remove the steering cable.
4. Remove and plug the power steering hoses.
5. Straighten locking tabs on pivot bolt washers.
6. Remove the pivot bolts.
7. Power steering unit can now be removed from transom.



71901

73901

### Control Valve

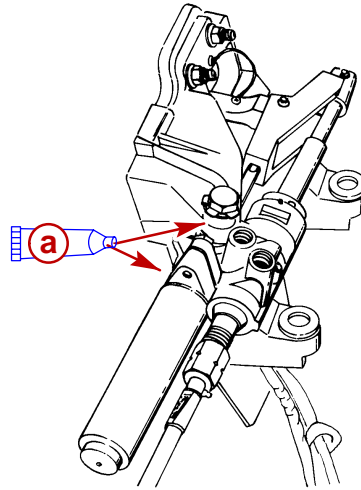
- a - Clevis
- b - Rear Clevis Pin
- c - Forward Clevis Pin
- d - Steering Cable End
- e - Cable Guide
- f - Pivot Bolt
- g - Coupler Nut
- h - Cotter Pins
- i - Flat Surface On Tube
- j - Suitable Wrench

## Installation

### **⚠ WARNING**

Steering cable outer casing **MUST BE** free to move back-and-forth for steering to function properly. **DO NOT** fasten any wires, cables or other items to steering cable, as this may prevent it from moving.

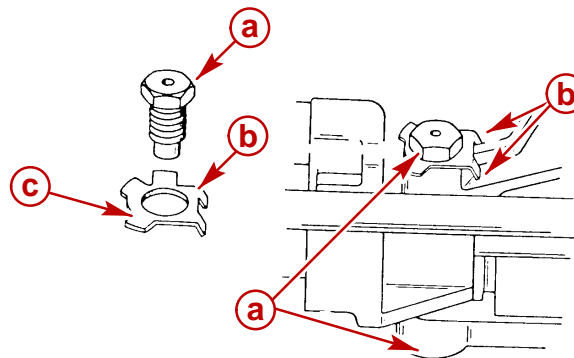
1. Lubricate bushings with Special Lubricant 101.



71901

**a** - Special Lubricant 101

2. Slide the power steering cylinder bushings between the transom mounting brackets. Tighten the two pivot bolts by hand. Move the steering assembly slightly to ensure proper pin engagement into the pivot bushings.
3. Ensure that the washer tangs straddle the ridges on the inner transom plate.



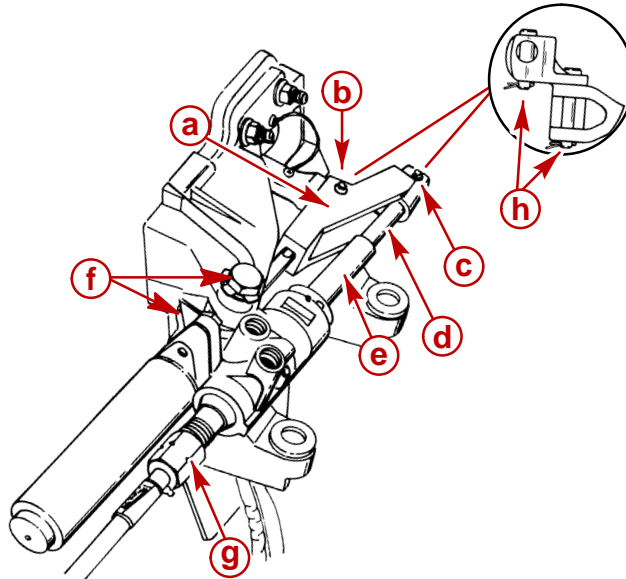
22033

**a** - Pivot Bolt  
**b** - Washer Tang  
**c** - Washer Tab

4. Torque the pivot bolts to 25 lb-ft (34 Nm).
5. Bend the washer tabs against the corresponding flats on both pivot bolt heads.
6. Ensure the power steering control valve pivots freely.



7. Connect the power steering unit to the steering lever.
  - a. Lubricate the clevis pins with Special Lubricant 101.
  - b. Install the clevis pin in the clevis from the top.
  - c. Secure the pin in the clevis with a cotter pin. Spread the cotter pin ends.
8. Lubricate the steering cable end with a liberal amount of Special Lubricant 101 and install the cable through the guide.
9. Start the coupler nut on the cable guide tube. Do not tighten at this time.
10. Connect the cable end to the clevis with the forward clevis pin. Spread the cotter pin ends.

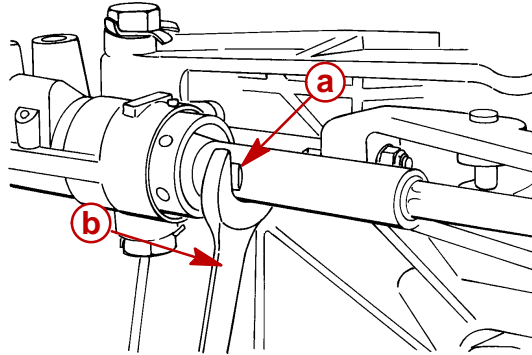


71901

**Control Valve**

- a** - Clevis
- b** - Rear Clevis Pin
- c** - Forward Clevis Pin
- d** - Steering Cable End
- e** - Cable Guide
- f** - Pivot Bolt
- g** - Coupler Nut
- h** - Cotter Pins

11. Using a suitable wrench hold the flat surfaces on the cable guide tube in the vertical position. Torque coupler nut to 35 lb-ft (47 Nm). **Be certain the flat surfaces are still aligned vertically after torque is applied to coupler nut.**



73901

- a** - Flat  
**b** - Suitable Wrench

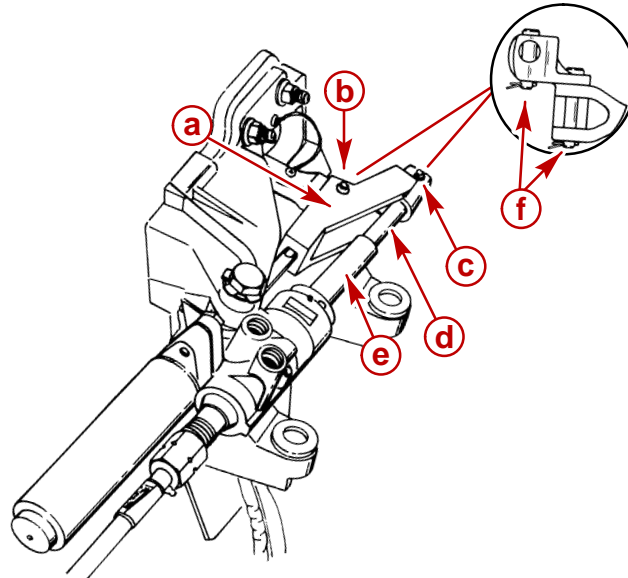
12. Install power steering hoses to power steering assembly.
- Torque both fittings to 23 lb-ft (31 Nm). Route hoses as described in section 2A to avoid contact with the steering system components.

## Power Steering System Pressure Test

### IMPORTANT INFORMATION

The following instructions are arranged so that a defective part can be detected by the process of elimination. It is suggested that the order of the instructions be followed so that the Power Steering System can be tested effectively.

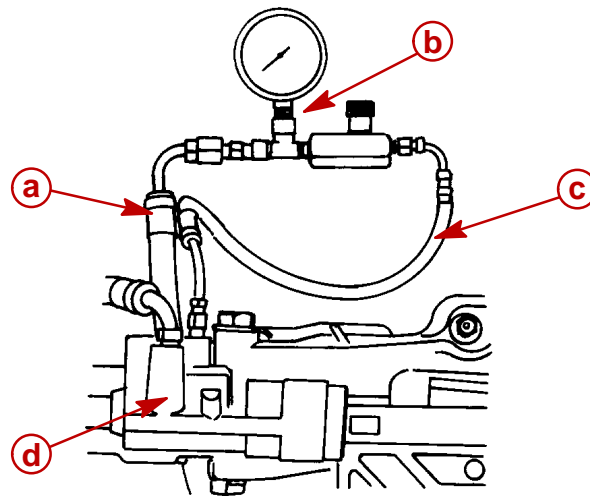
1. Remove front and rear clevis pins.
2. Retract cable into cable guide tube.



71901

- a** - Clevis
- b** - Rear Clevis Pin
- c** - Forward Clevis Pin
- d** - Steering Cable End
- e** - Cable Guide Tube
- f** - Cotter Pins

3. Assemble and install test gauge.



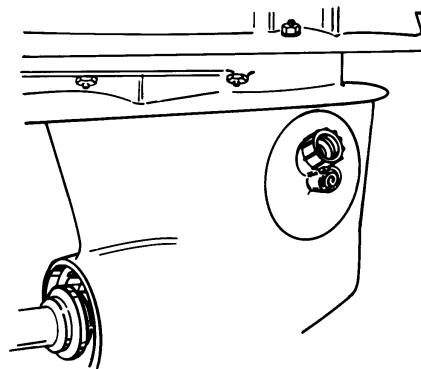
- a** - Pump Pressure Hose
- b** - Test Gauge Assembly
- c** - Gauge To Control Valve Hose
- d** - Control Valve

4. Open valve on gauge completely.

### ⚠ CAUTION

**DO NOT** operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

5. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow cooling system to fill completely. Cooling system is full when water is discharged through the propeller. **DO NOT** use full water tap pressure.



22029

### Standard Bravo Shown

6. Start engine and run at 1000-1500 RPM until engine reaches normal operating temperature.
7. With engine at idle speed, test gauge reading should be between 70 and 125 psi (483 and 862 kPa). If not, proceed as follows:

**If lower than 70 psi (483 kPa),** proceed to "Pump Pressure Test," see "Index."

**If higher than 125 psi (862 kPa),** check for hose restrictions in the system.

**⚠ CAUTION**

**DO NOT** lug pump at maximum pressure for more than 5 seconds, in next step, or damage to Power Steering pump may occur.

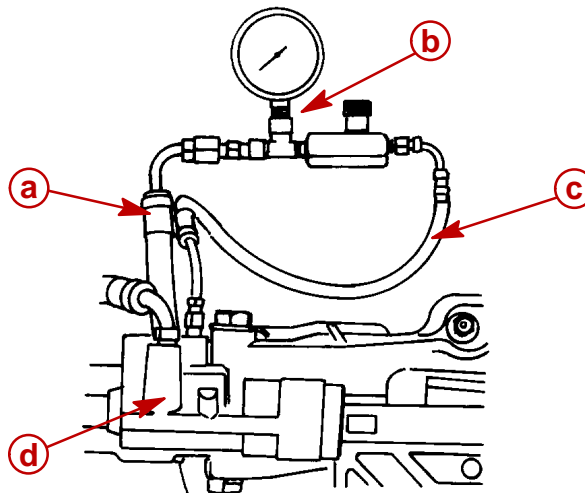
8. Push in then pull steering cable **momentarily**. Gauge reading should show an instant increase in pressure when block is pushed in both directions.
  9. Push steering cable in, until booster cylinder piston rod is fully retracted. With piston rod in this position, **momentarily** push steering cable in until maximum pressure reading is obtained.
- If pressure is above 1000 psi (6897 kPa), system pressure is good.
  - If pressure is below 1000 psi (6897 kPa), conduct "Pump Pressure Test," see "Index."

## Pump Pressure Test

**⚠ CAUTION**

In performing the following test, **DO NOT** lug pump at maximum pressure for more than 5 seconds or damage to Power Steering pump may occur.

1. Install test gauge.

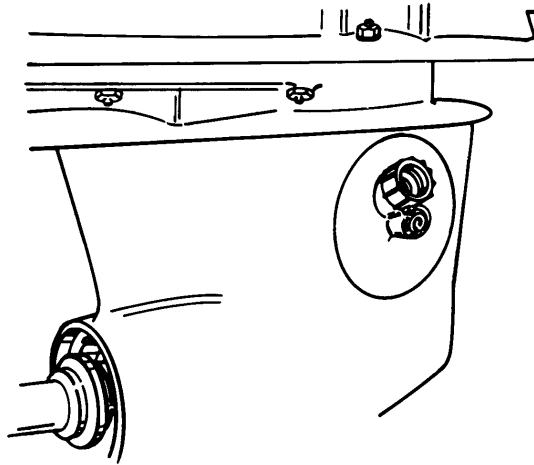


- a** - Pump Pressure Hose
- b** - Test Gauge Assembly
- c** - Gauge To Control Valve Hose
- d** - Control Valve

**⚠ CAUTION**

**DO NOT** operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

2. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

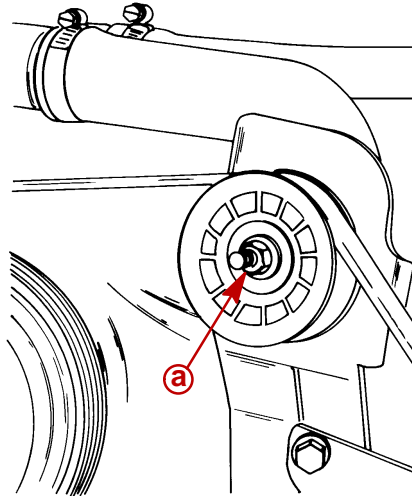
**Standard Bravo Shown**

3. Start engine and run at 1000-1500 RPM until engine reaches normal operating temperature.
4. Close test gauge valve just long enough to obtain maximum pressure reading.
5. Close and open valve 3 times. Record highest pressure reading attained each time.
  - a. **If pressure readings are between 1150 and 1250 psi (7932-8621 kPa) and are within a range of 50 psi (345 kPa),** the pump is within specifications. If the **pump** tests OK, but system pressure was low (as tested under "Power Steering System Pressure Test," see "Index"), proceed to "Booster Cylinder Test," see "Index."
  - b. **If pressure readings are between 1150-1250 psi (7932-8621 kPa), but are not within a 50 psi (345 kPa) range,** the Power Steering pump flow control valve is sticking or pump hydraulic system is dirty.
  - c. **If pressure readings are constant, but below 1000 psi (6897 kPa),** replace Power Steering pump.

# Power Steering Pump

## Removal

1. Loosen the adjusting stud and remove the serpentine belt from the power steering pulley.

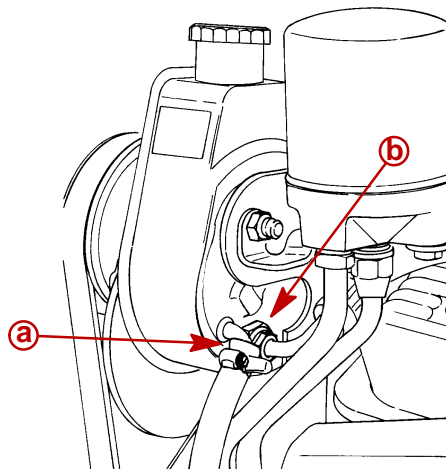


75483

**a** - Adjusting Nut

**NOTE:** Use a suitable container catch any power steering fluid when removing the power steering hoses.

2. Remove the high pressure hose and return hose from the power steering pump.

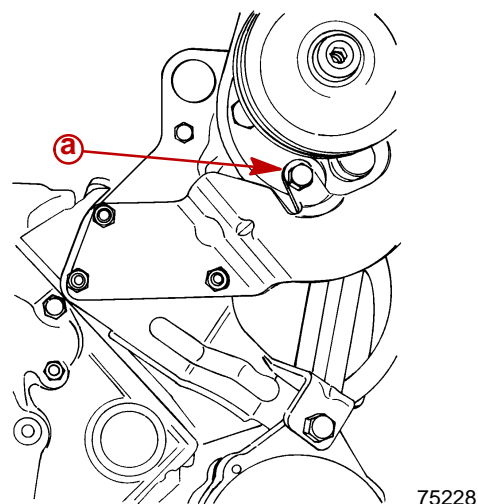
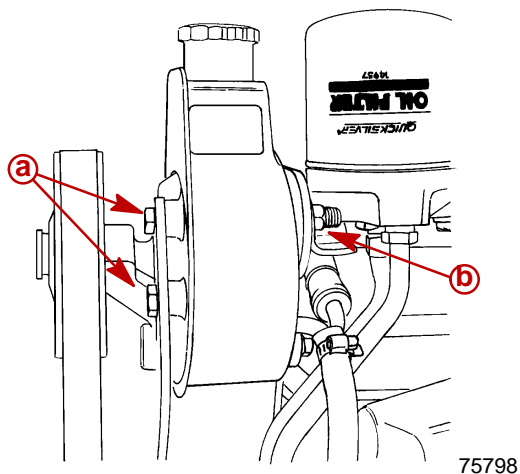


75228

### Power Steering Pump Typical Location

- a** - Return Hose  
**b** - High Pressure Hose

3. Remove mounting fasteners from pump.



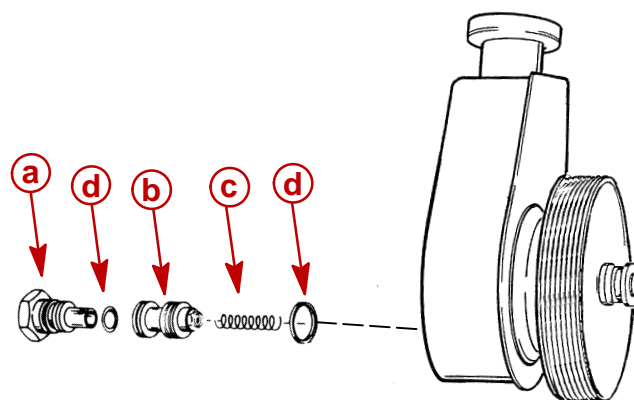
### Power Steering Pump Typical Location

- a** - Nut
- b** - Bolts

4. Remove the power steering pump from the bracket.

## Flow Control Valve Servicing

1. Drain fluid from pump.
2. Remove components shown.

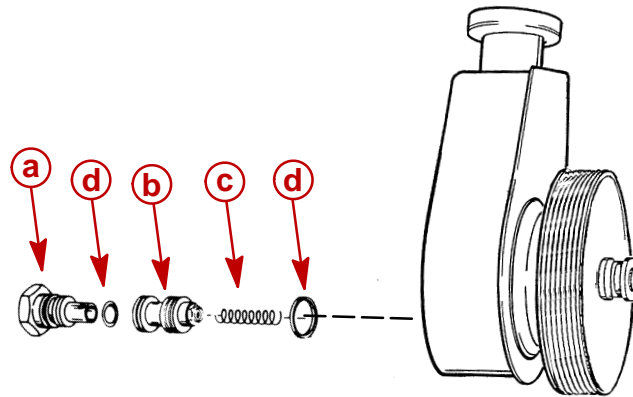


- a** - Fitting Assembly
- b** - Control Valve Assembly
- c** - Flow Control Spring
- d** - O-rings

3. Inspect control valve assembly and fitting assembly for contamination and damage.



4. Install components shown. Torque fitting to 35 lb-ft (47 Nm).

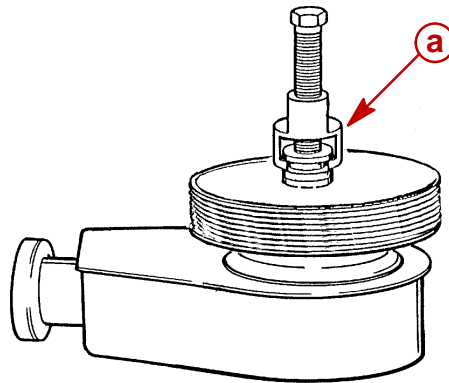


76869

- a** - Fitting Assembly
- b** - Control Valve Assembly
- c** - Flow Control Spring
- d** - New O-rings

## Pump Shaft Oil Seal Replacement

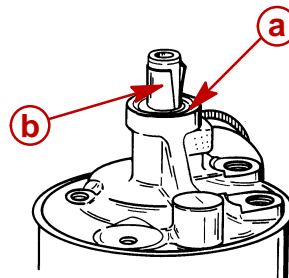
1. Remove pump pulley.



76895

- a** - Kent Moore Pulley Removal Tool (J-25034)

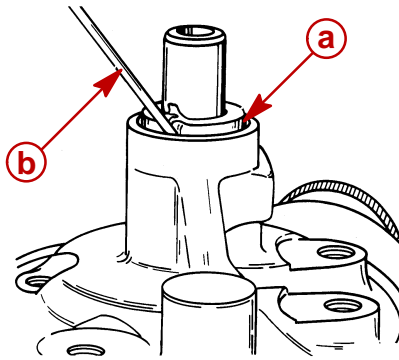
2. Push a .005 in. (0.13 mm) shim stock past oil seal until it bottoms in pump body (approximately 2-1/2 in. [64 mm] long).



76830

- a** - Oil Seal
- b** - Shim Stock

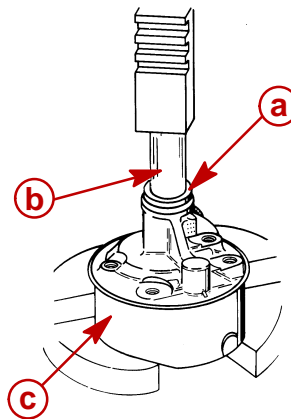
3. Remove oil seal. Remove shim stock.



22152

- a** - Seal  
**b** - Suitable Tool

4. Install new oil seal. Properly support pump reservoir so that reservoir back does not distort.

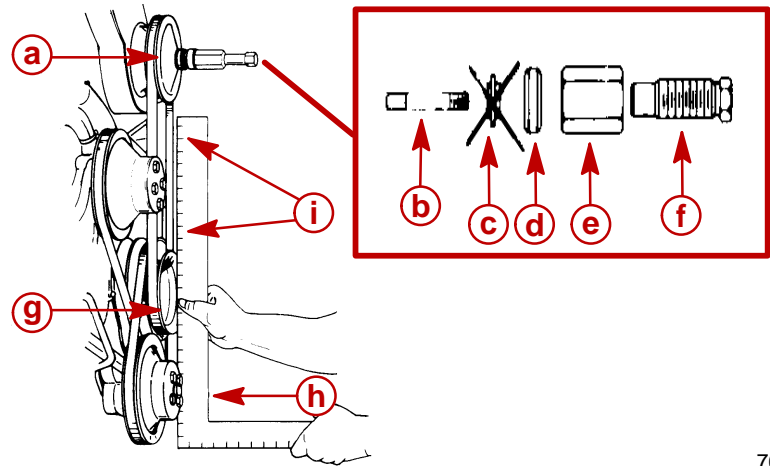


22151

- a** - New Oil Seal - Metal Side Up  
**b** - Suitable Mandrel  
**c** - Pump Reservoir

5. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
- Place pulley on pump shaft.
  - Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
  - Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
  - Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.

- e. Check pulley installation for correct alignment.

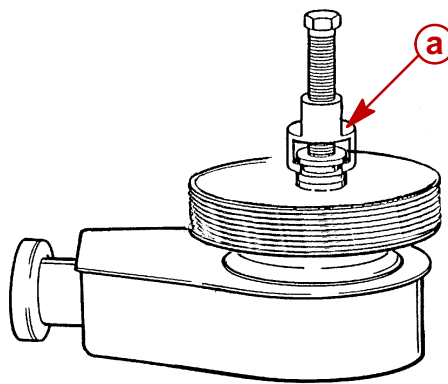


76896

- a** - Power Steering Pump Pulley
- b** - Stud
- c** - Do NOT Use Spacer
- d** - Bearing
- e** - Nut
- f** - Shaft
- g** - Crankshaft Pulley (Shown) or Water Circulating Pump Pulley
- h** - Long Straight Edge
- i** - Drive Belt Parallel

## Disassembly

1. Drain fluid from pump.
2. Remove pump pulley.

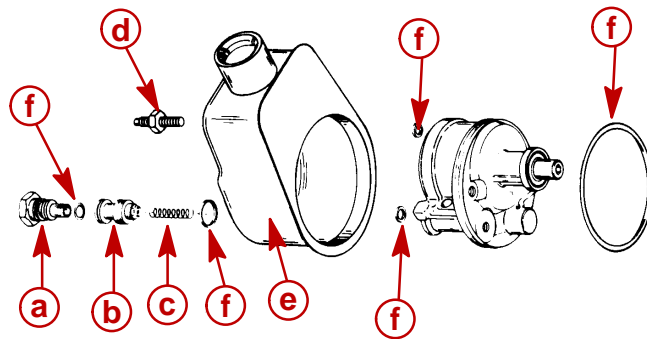


72821

- a** - Kent Moore Pulley Removal Tool (J-25034)

3. Remove reservoir, fitting assembly, control valve assembly, flow control spring, studs, and O-rings.

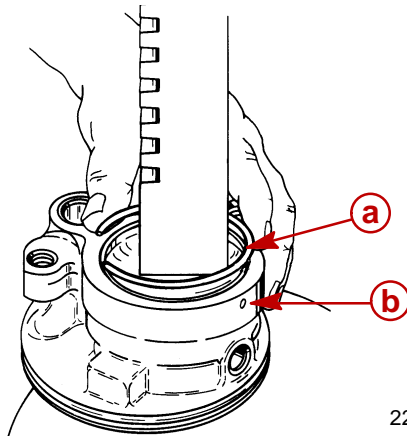
4. Discard o-rings and retain the other parts.



22155

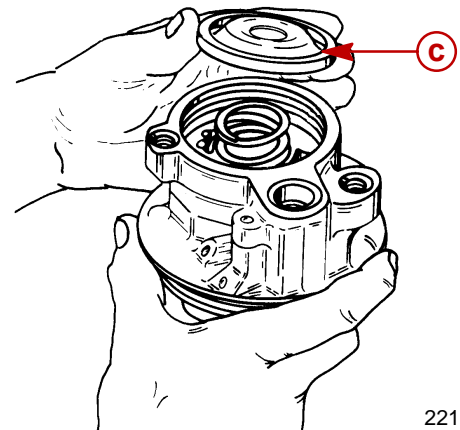
- a** - Fitting Assembly
- b** - Control Valve Assembly
- c** - Flow Control Spring
- d** - Studs
- e** - Reservoir
- f** - O-rings

5. Position retaining ring so that ring end is 1 in. (25 mm) from end of hole in housing.
6. Support housing in press and push down on end plate to remove tension on retaining ring
7. Insert awl into hole in housing to push ring from recess.
8. Use a screwdriver to remove retaining ring and end plate.



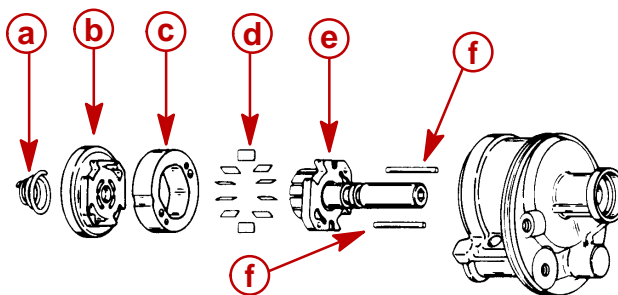
22151

- a** - Retaining Ring
- b** - Hole
- c** - End Plate



22152

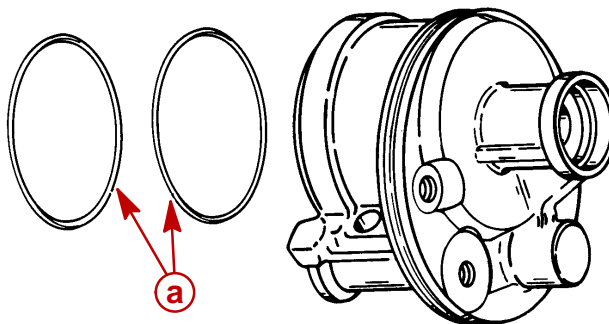
9. Remove pump components shown.



22155

- a** - Spring
- b** - Pressure Plate
- c** - Pump Ring
- d** - Pump Vanes
- e** - Pump Shaft and Rotor Assembly
- f** - Dowel Pins

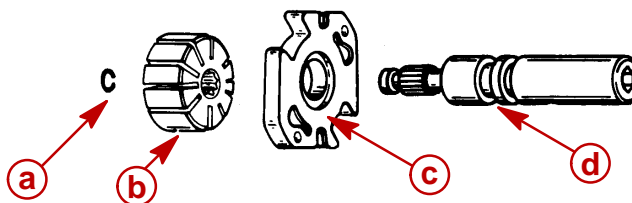
10. Remove and discard O-rings from housing.



22155

- a** - O-rings

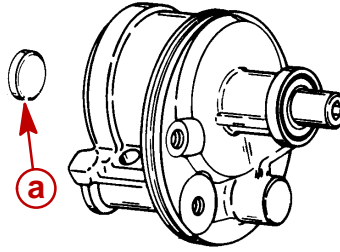
11. Remove retaining ring, rotor and thrust plate.



22155

- a** - Retaining Ring
- b** - Rotor
- c** - Thrust Plate
- d** - Pump Shaft

12. Remove magnet.



22154

**a** - Magnet

## Cleaning And Inspection

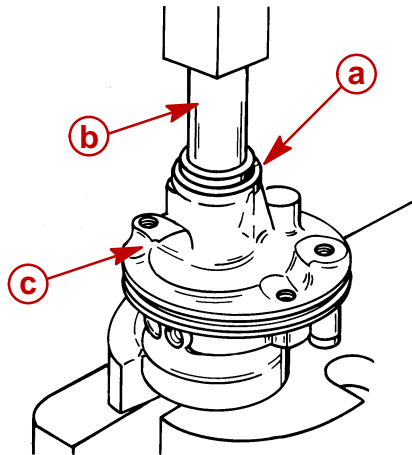
1. Clean and inspect all metal parts.

## Reassembly

**NOTE:** All references to Power Steering fluid refer to Quicksilver Power Trim and Steering Fluid, or Dexron II if Quicksilver product is not available.

**NOTE:** Obtain and install a new seal kit 5688044 from a local GM automotive dealer when reassembling pump.

1. Install new pump shaft oil seal metal side up. Support the pump reservoir so that the back does not distort.

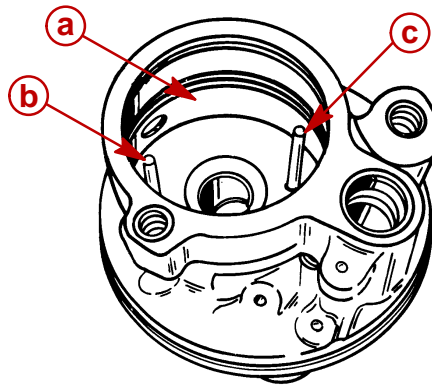


22151

**a** - New Oil Seal  
**b** - 1 in. Socket  
**c** - Pump Reservoir

2. Lubricate pressure plate O-ring with power steering fluid and place in the third groove in the housing.

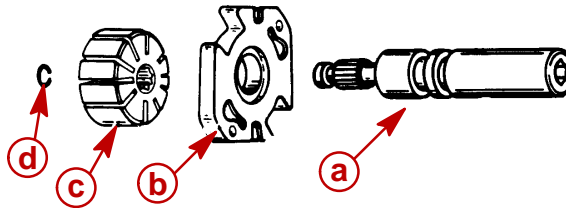
3. Install dowel pins.



22150

- a** - Pressure Plate O-ring  
**b** - Dowel Pins

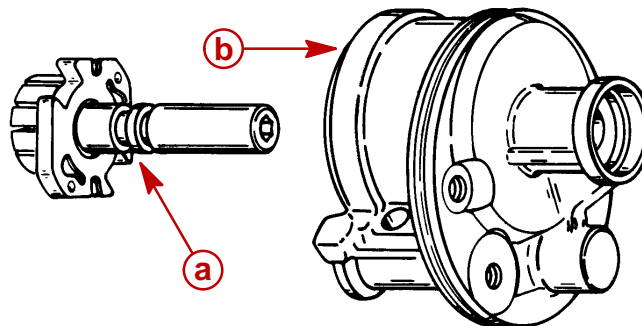
4. Assemble pump shaft and rotor assembly. Rotor should be installed with the counter-sunk side toward the thrust plate.



22155

- a** - Pump Shaft  
**b** - Thrust Plate  
**c** - Rotor  
**d** - Retaining Ring

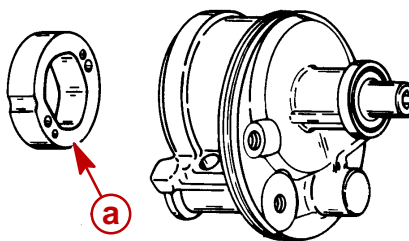
5. Install pump shaft and rotor assembly.



22154

- a** - Pump Shaft and Rotor Assembly  
**b** - Pump Housing

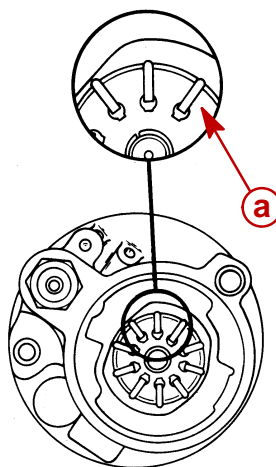
6. Install pump ring by placing the 2 smaller holes over the dowel pins.



22154

**a** - Pump Ring

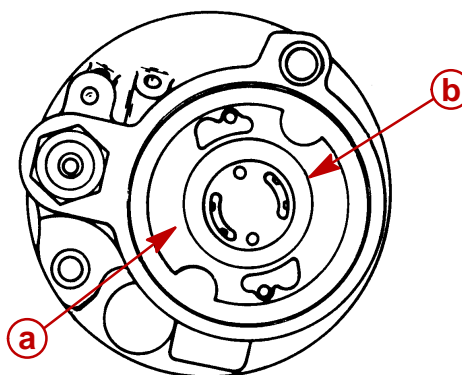
7. Install vanes in rotor slots with rounded edges toward pump ring. Vanes must slide freely.



22154

**a** - Vanes

8. Install pressure plate. Ensure spring groove faces up.

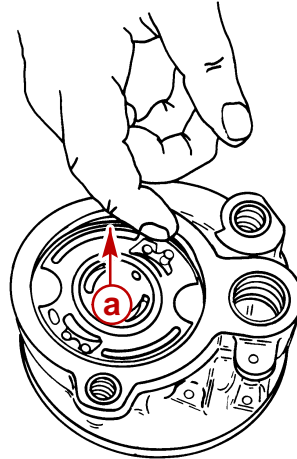


22154

**a** - Pressure Plate  
**b** - Spring Groove



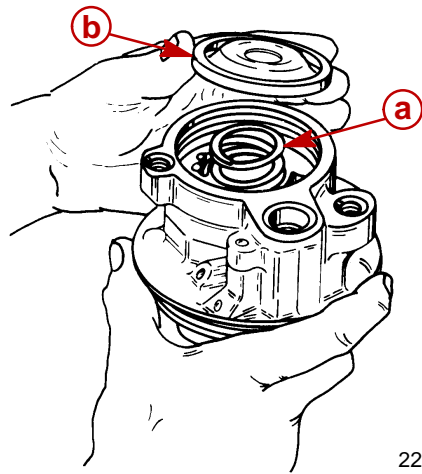
9. Lubricate end plate O-ring with power steering fluid and place in second groove in housing.



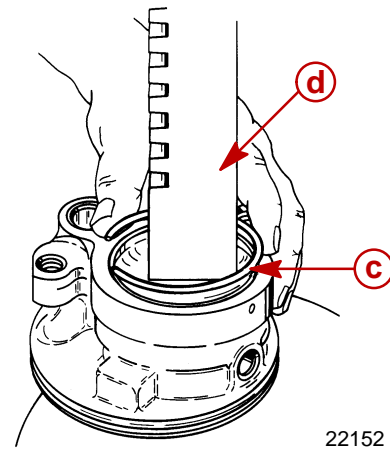
22150

**a** - End Plate O-ring

10. Install pressure plate spring, end plate and retaining ring. Use care not to damage end plate and O-ring.



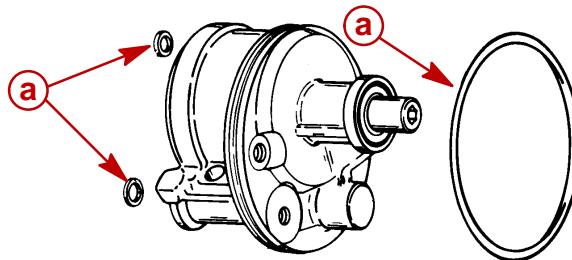
22151



22152

**a** - Pressure Plate Spring  
**b** - End Plate  
**c** - Retaining Ring  
**d** - Arbor Press

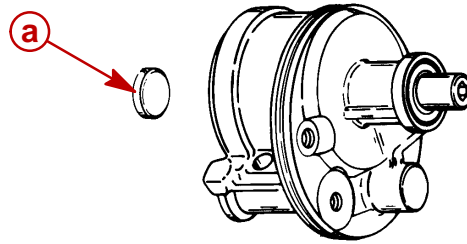
11. Lubricate reservoir O-rings with power steering fluid and install in groove in pump housing.



22153

**a** - Reservoir O-rings

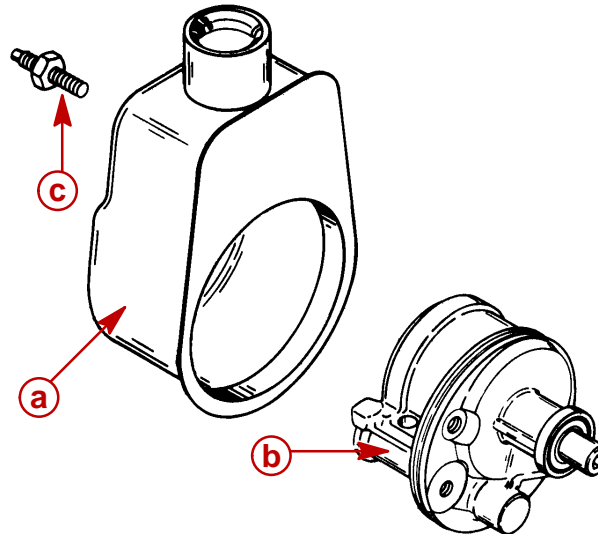
12. Place magnet on housing.



22153

**a** - Magnet

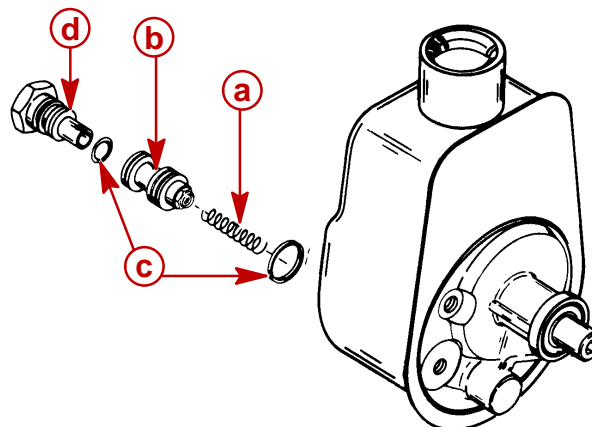
13. Secure reservoir to pump housing. Torque studs to 35 lb-ft (47 Nm).



22153

**a** - Reservoir  
**b** - Pump Housing  
**c** - Studs

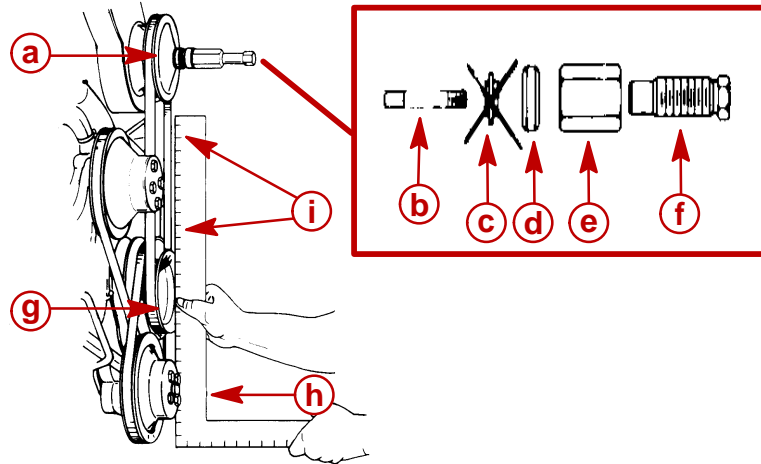
14. Install components shown. Torque fitting assembly to 35 lb-ft (47 Nm).



22153

**a** - Flow Control Spring  
**b** - Control Valve Assembly  
**c** - O-ring For Fitting Assembly  
**d** - Fitting Assembly

15. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
- Place pulley on pump shaft.
  - Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
  - Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
  - Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.
  - Check pulley installation for correct alignment. Do NOT use spacer.



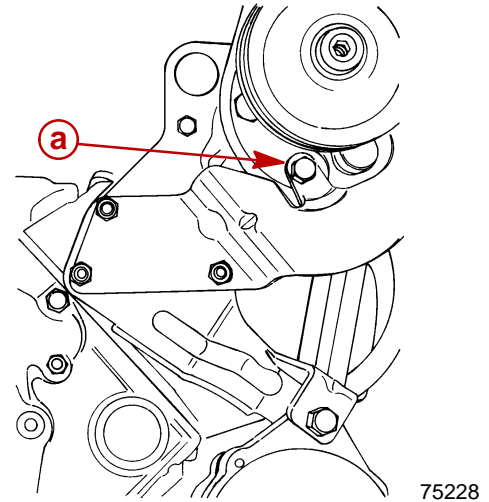
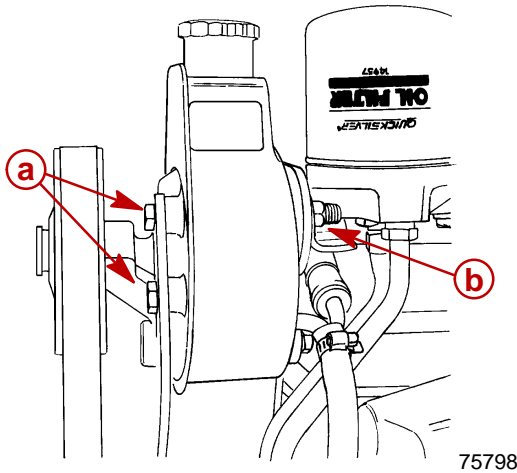
76896

- a** - Power Steering Pump Pulley  
**b** - Stud  
**c** - Spacer  
**d** - Bearing  
**e** - Nut  
**f** - Shaft  
**g** - Crankshaft Pulley (Shown) or Water Circulating Pump Pulley  
**h** - Long Straight Edge  
**i** - Drive Belt Parallel

## Installation

**IMPORTANT: Be careful to not cross-thread or overtighten hose fittings.**

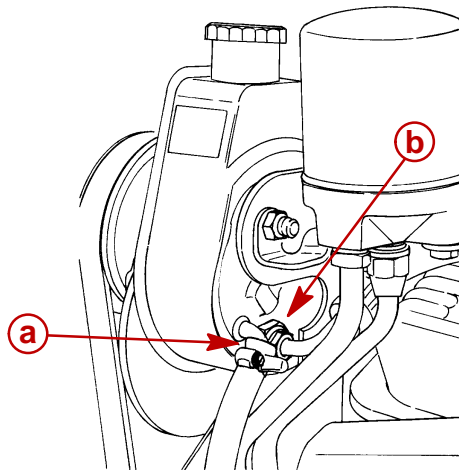
1. Place the power steering pump on the bracket and install the screws and nut. Torque to 30 lb-ft (41 Nm).



### Power Steering Pump Typical Location

- a** - Nut
- b** - Bolts

2. Be certain a new high pressure hose O-ring is present. Install threaded fitting in back of pump assembly. Tighten fitting securely. Connect low pressure hose on back of pump. Tighten hose clamp securely.



### Power Steering Pump Typical Location

- a** - Return Hose
- b** - High Pressure Hose

3. Install mounting hardware and fasteners to retain pump to bracket. (Refer to "Exploded View" for specific details on your engine.)
4. Install drive belt and adjust tension. Refer to "Pump Drive Belt Adjustment" as previously outlined.
5. Fill and air bleed system. Refer to SECTION 1B - "Maintenance."

## Multiple Sterndrive Steering Tie Bar Arrangements

With multiple sterndrives you must select one of several possible steering systems.

### CAUTION

**Failure to observe the recommended Tie Bar Arrangements as presented in this section could result in serious damage to the steering and/or trim system components. This damage could adversely affect control of the boat.**

#### INTERNAL POWER STEERING WITH INTERNAL TIE BAR ONLY

At the lower end of the performance spectrum, boats not capable of speeds in excess of 60 MPH, the basic internal tie bar is recommended. It connects the slave sterndrive to the stern-drive that is directly connected to the factory power steering output. This internal tie bar is available in a variety of lengths from the sterndrive manufacturer.

#### INTERNAL POWER STEERING WITH INTERNAL AND EXTERNAL TIE BAR

As a boat moves into the moderate performance range of 60-70 MPH or for a reduction in steering backlash, an external tie bar should be added. External tie bars are usually designed to attach at the aft power trim cylinder bosses. This location is an excellent choice because of its proximity to the propeller. HOWEVER, because of the potential overstress that can occur if one drive is trimmed much differently than the other, a dual trim control kit (Part Number 90362A3) should be installed to limit this potential tilt differential to about 20°.

**IMPORTANT: Mercury Marine does not recommend the use of an external tie bar ONLY with no internal tie bar when using the internal power steering system. This can cause excessive loads on the steering components on the drive connected to the internal power steering system. These increased loads can damage the steering components, resulting in increased play in the steering of the boat.**

#### EXTERNAL POWER STEERING

When boat speeds move past 70 MPH or if additional steering backlash reduction is desired, external power steering is recommended. This normally will include an external tie bar mounted at the same general location as the power steering cylinders, which are generally attached at the top of the sterndrive's drive shaft housing. With this steering system, no internal tie bar should be used. These steering cylinders can be attached either inboard (between) or outboard of the sterndrives.

#### EXTERNAL POWER STEERING WITH LOW EXTERNAL TIE BAR

For the fastest boats, over 80 MPH, or for the ultimate in steering backlash reduction, use external power steering, BUT (where mechanically possible) with the external tie bar mounted at the trim cylinder boss location (as previously described in "Internal Power Steering with Internal and External Tie Bar" statements). Again, this system does NOT use an internal tie bar.

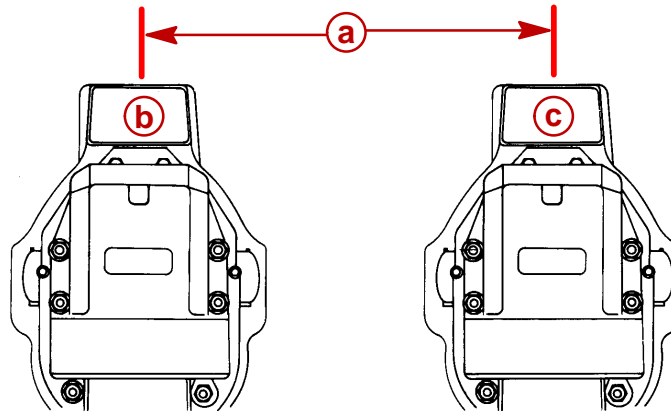
## Determining Tie Bar Length

### **⚠ WARNING**

**ON DUAL INSTALLATION USING STARBOARD TIE BAR KIT.** The steering cable **MUST** have a minimum radius of 8 in. (203 mm) at the transom end. A radius less than 8 in. (203 mm) may kink the steering cable which, in turn, may affect steering operation. If the minimum 8 in. (203 mm) requirement cannot be met due to boat construction, etc., steering cable must then be routed to port transom and a port transom and a port tie bar kit 96708A4, A5 or A6 **MUST BE** used in place of the starboard tie bar kit.

**NOTE:** If sterndrive units are to be “toed-in” or “toed-out,” measure from centerlines of steering levers (with sterndrive units positioned as desired), instead of centerlines of power packages. In most cases, the best boat handling and performance characteristics will be obtained with the sterndrive units positioned parallel.

1. Determine tie bar length.
  - a. Measure centerline distance (Dimple in Gimbal Housing is located beneath the decal in the top center).
  - b. Apply measurement to appropriate chart to determine tie bar length.



70133

- a** - Distance Between Centerlines
- b** - Port Transom Assembly Centerline
- c** - Starboard Transom Assembly Centerline

## Selection

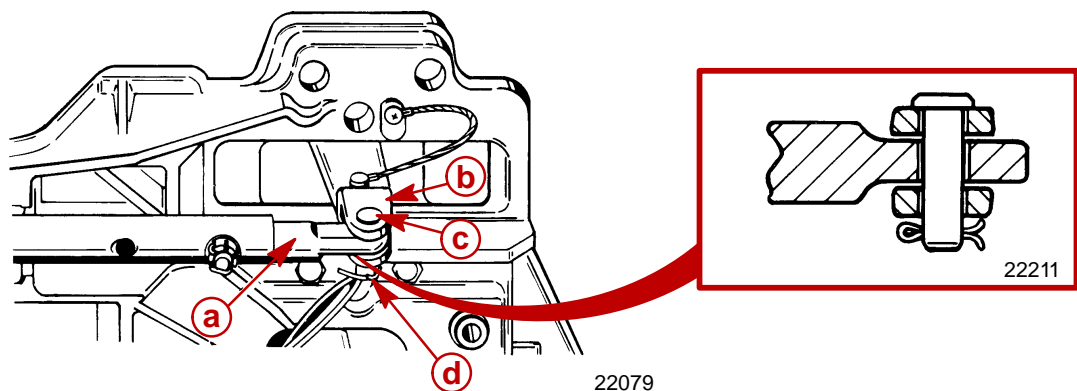
TIE BAR CHART For Dual Installations with Steering Cable Attached to Starboard Power Package	
* 16" to 30"	92020A1
* 30" to 46"	92020A2
46" to 62"	92020A3
* If centerline distance is the same as maximum figure, use next larger size tie bar.	

TIE BAR CHART For Dual Installations with Steering Cable Attached to Port Power Package	
* 28" to 37-1/2"	96708A4
* 37-1/2" to 55"	96708A5
55" to 72"	96708A6
* If centerline distance is the same as maximum figure, use next larger size tie bar.	

## Installation

### DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO STARBOARD POWER PACKAGE

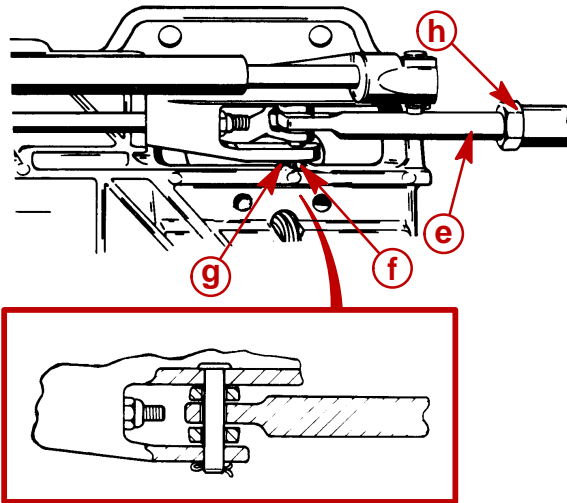
1. Attach fixed bar end to steering lever, using clevis pin and cotter pin. Spread cotter pin ends.



- a** - Fixed End
- b** - Steering Lever
- c** - Clevis Pin
- d** - Cotter Pin

2. Position sterndrive units as desired and turn adjustable end out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis.
3. Turn adjustable end out 3 to 4 turns from this position.
4. Apply Loctite 277 to exposed tie bar threads; then turn tie bar back in (3 to 4 turns) to previously aligned position.

5. Attach tie bar end using clevis pin (f), and cotter pin (g).
6. Spread cotter pin ends.
7. Apply Loctite 277 to exposed tie bar threads.
8. Tighten locknut against tie bar to 50 lb-ft (68 Nm).



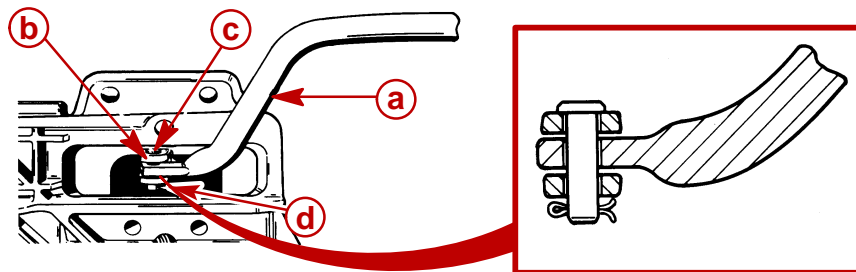
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22211

- e** - Adjustable End  
**f** - Clevis Pin  
**g** - Cotter Pin  
**h** - Locknut

## DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO PORT POWER PACKAGE

1. Attach fixed bar end to steering lever, using clevis pin and cotter pin. Spread cotter pin ends.



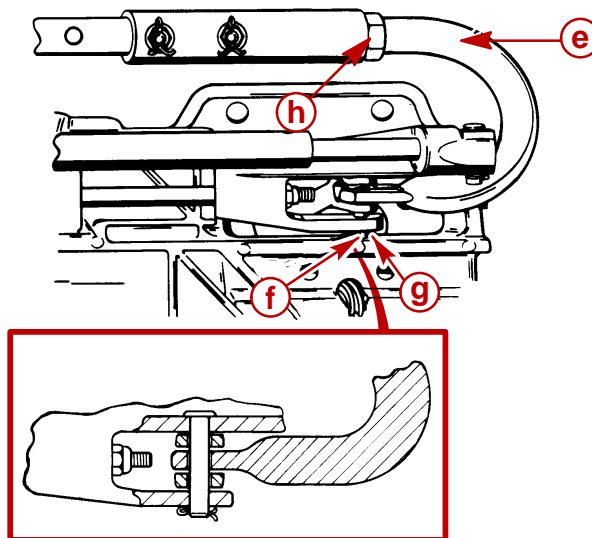
22211

- a** - Fixed Bar End  
**b** - Steering Lever  
**c** - Clevis Pin  
**d** - Cotter Pin

2. Position sterndrive units as desired and turn adjustable end out (if necessary) to align hole in bar end with holes in steering lever and piston rod end clevis.
3. Turn adjustable end out 3 to 4 turns from this position.
4. Apply Loctite 271 to exposed tie bar threads.
5. Turn tie bar back in (3 to 4 turns) to previously aligned position.
6. Attach tie bar end using clevis pin and cotter pin.



7. Spread cotter pin ends.
8. Apply Loctite 271 or equivalent to exposed tie bar threads.
9. Tighten locknut (against tie bar) to 50 lb-ft (68 Nm).



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22211

- e** - Adjustable End
- f** - Clevis Pin
- g** - Cotter Pin
- h** - Locknut

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# STEERING SYSTEMS

## Section 6B - Compact Hydraulic Steering

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Removal .....	6B-3	Hydraulic Fluid Level .....	6B-11
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Twin Station and/or Twin Cylinder .....	6B-6	System Check .....	6B-11

## Important Information About Thru-Transom Exhaust

This Hydraulic Steering system is not designed for use with Through-Transom exhaust systems. Do not use this Hydraulic Steering System with a Through-Transom Exhaust System.

## Torque Specifications

DESCRIPTION	lb-in.	lb-ft	Nm
Steering Hydraulic Hose Fittings	130		15
Steering System (Pivot Bolts)		25	34
Steering Wheel Shaft Nut <sup>1</sup>	150		17
Helm Nuts	110		12

<sup>1</sup>: Amount specified is MINIMUM. Do not exceed 200 lb-in. (22 Nm).

## Lubricants / Sealants / Adhesives

Description		Part Number
Quicksilver 2-4-C Marine Lubricant with Teflon		92-825407A1
Loctite 567 PST Pipe Sealant		92-809822
Approved Hydraulic Steering Fluids	Quicksilver Hydraulic Fluid,	64-826485A1
	Texaco® H015	92-862014A1
	SeaStar® Hydraulic Fluid HA5430	Obtain Locally
	Chevron® Aviation Fluid A	
	Mobil® Aero HFA	
	Shell® Aero 4	
Fluid meeting MIL Specification H5606C		

### WARNING

Avoid serious bodily injury or death due to loss of steering control. Any non-approved fluid used in this system may cause irreparable damage, loss of steering, and cancellation of warranty. Never use brake fluid in this hydraulic steering system. Use only approved hydraulic fluids.

# Removal

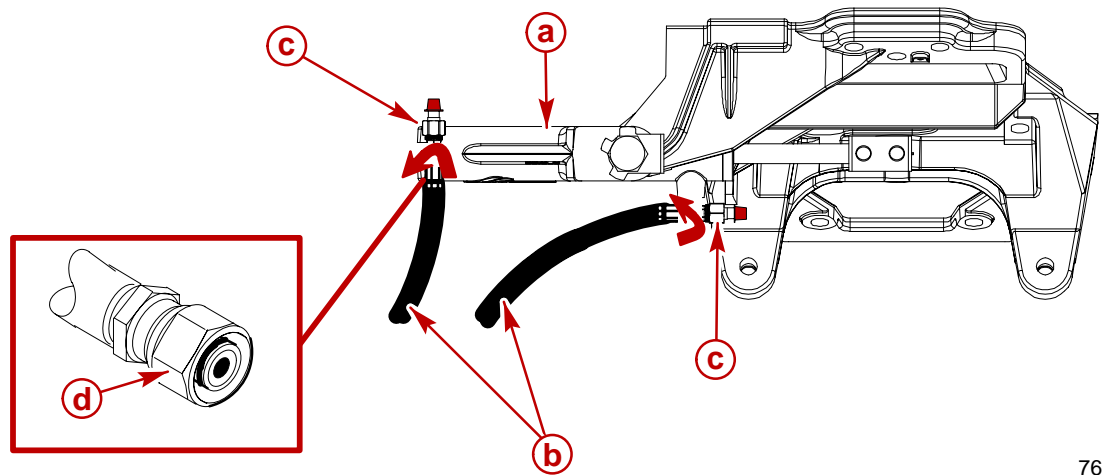
## ⚠ CAUTION

Avoid product malfunction and diminished steering control. Dirt and contamination introduced into the hydraulic system can result in damage to internal parts of steering system. Do not allow dirt or contamination to enter the helm, lines or cylinder of this steering system.

## ⚠ WARNING

Avoid serious bodily injury or death due to loss of steering control. Extreme heat will lower burst pressure or melt hydraulic hoses. In either case, instant loss of steering may occur. Do not allow hydraulic hoses to contact hot engine.

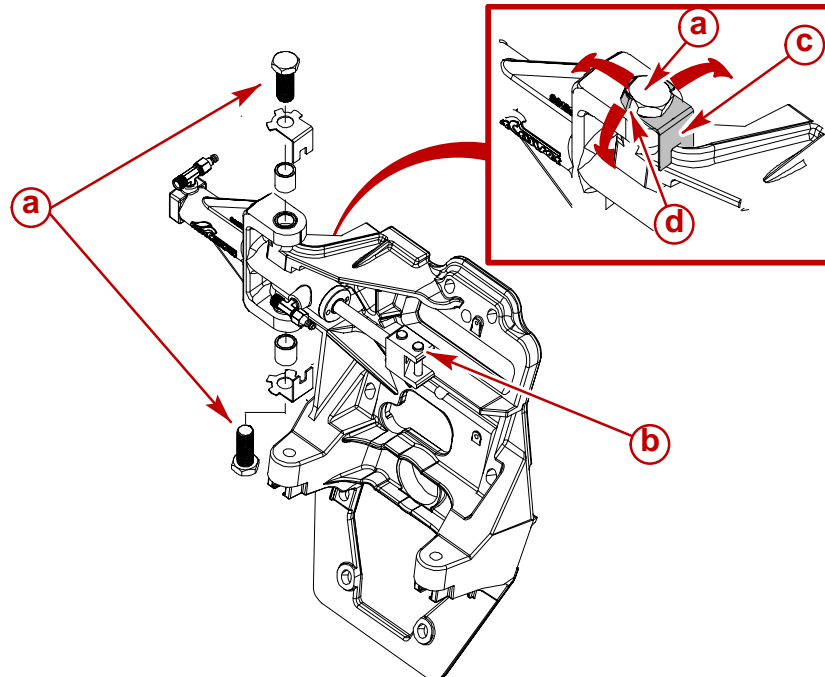
1. Loosen hose fittings and remove hoses from steering cylinder T-Fittings.
2. Plug hose ends to prevent fluid loss.



76085

- a - Steering Cylinder
- b - Hoses
- c - T-Fittings
- d - Hose Fittings

3. Remove cotter pin from port clevis pin and remove clevis pin.
4. Bend pivot bolt tab washer tabs away from bolts.
5. Remove pivot bolts.



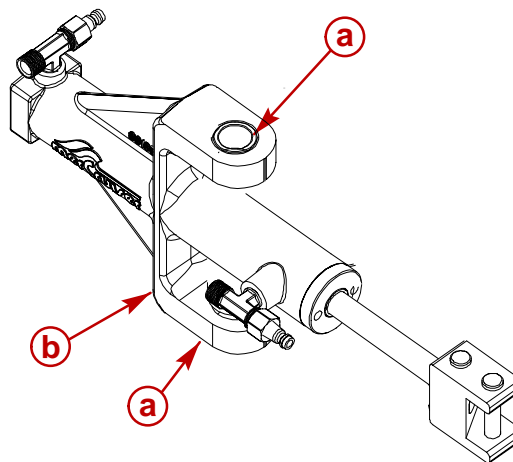
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- a** - Pivot Bolts
- b** - Port Clevis Pin
- c** - Tab Washer
- d** - Tab

6. Remove steering cylinder from transom.

## Installing The Steering Cylinder

1. Ensure that bushings are clean. Lubricate bushings with Special Lubricant 101.



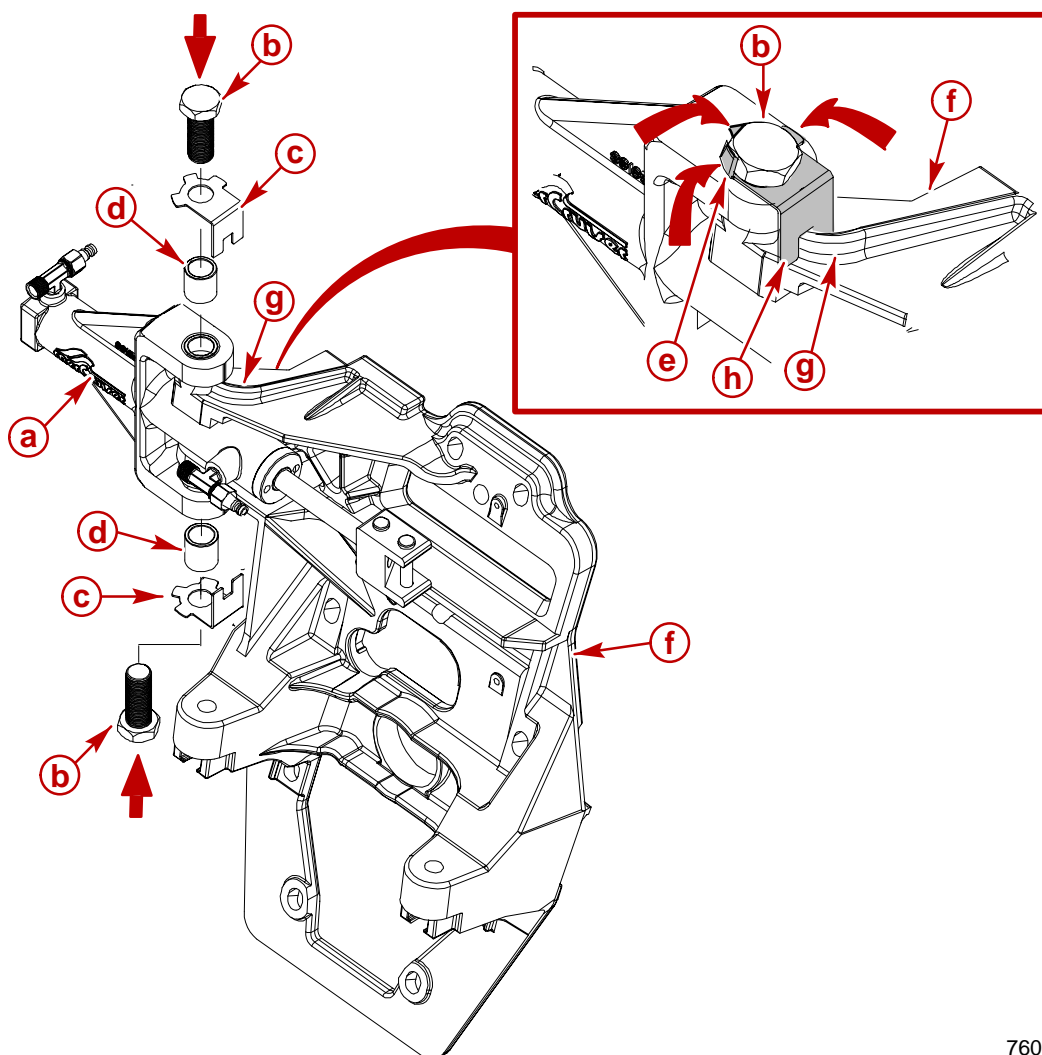
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- a** - Bushings
- b** - Steering Cylinder Assembly

## 2. Install steering cylinder assembly as follows:

- a. Position steering cylinder assembly so that upper and lower pivot bolts (with tab washers and spacers) can be threaded by hand into transom plate.
- b. Ensure that tab washer tangs straddle the ridge on transom plate.
- c. Ensure steering cylinder assembly pivots freely.
- d. Torque pivot bolts to 25 lb-ft (34 Nm). Bend washer tabs against corresponding flats on bolt heads.

**NOTE:** It may be necessary to tighten pivot bolts further to align flats on bolt with tabs on tab washer.

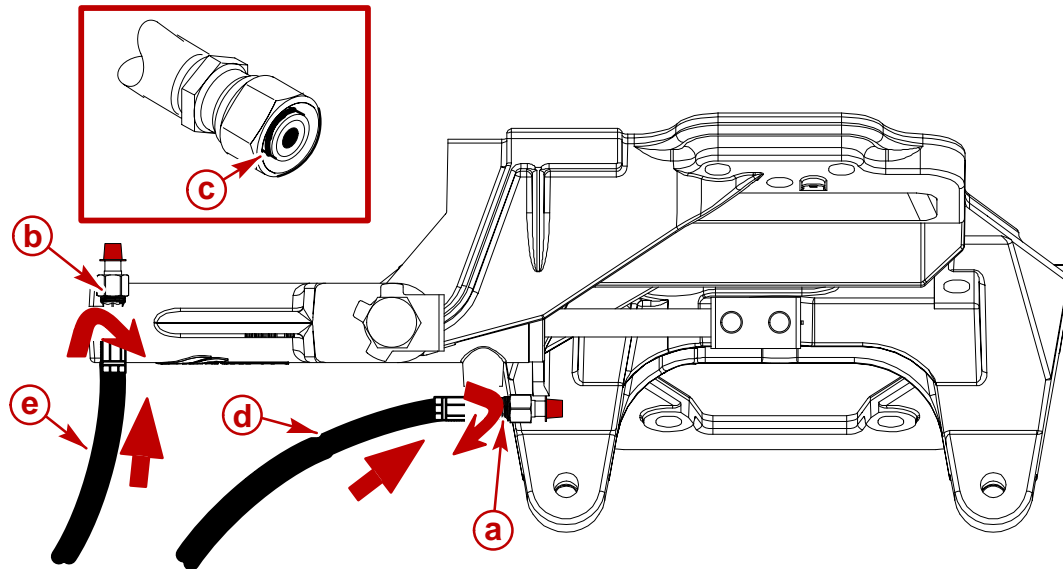


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- a** - Steering Cylinder Assembly
- b** - Pivot Bolt
- c** - Tab Washer
- d** - Spacer
- e** - Tab
- f** - Transom Plate
- g** - Ridge on Transom Plate
- h** - Tab Washer Tangs (Straddle Ridge)

**IMPORTANT:** Do not connect clevis to steering lever at this time. Bleed and purge the system before connecting clevis to steering lever.

3. Connect hoses to steering cylinder as follows:
  - a. Apply a small amount of clean hydraulic fluid to the hydraulic hose end O-ring area.
  - b. Push port and starboard hoses completely into fittings.
  - c. Hand tighten hose fittings.
  - d. Torque hose fittings to 130 lb-in. (15 Nm).



76085

- a - Port T-Fitting
- b - Starboard T-Fitting
- c - Hose O-Ring
- d - Port Hose From Helm ("P")
- e - Starboard Hose From Helm ("S")

## Filling And Purging The System

**NOTE:** Due to system design, one technician may not be able to completely purge all the air from the system after installation. This will result in spongy and unresponsive steering. Two technicians are required for successful filling and purging of any system.

### Twin Station and/or Twin Cylinder

#### **⚠ WARNING**

Avoid serious injury or death resulting from a loss of steering control. Improper venting or plugging of hydraulic helm pump reservoir can cause loss of fluid or introduction of air into hydraulic system resulting in insufficient hydraulic pump pressure for proper steering control. If more than one steering station is being installed, the vent-fill plug on all but the uppermost helm must be replaced with a non-vent plug which is included in a dual station fitting kit.

For Twin Station and/or Twin Cylinder filling and purging (bleed) instructions, follow instructions provided by SeaStar®. How to fill and purge a Single Station with Single Cylinder System is outlined in the following.



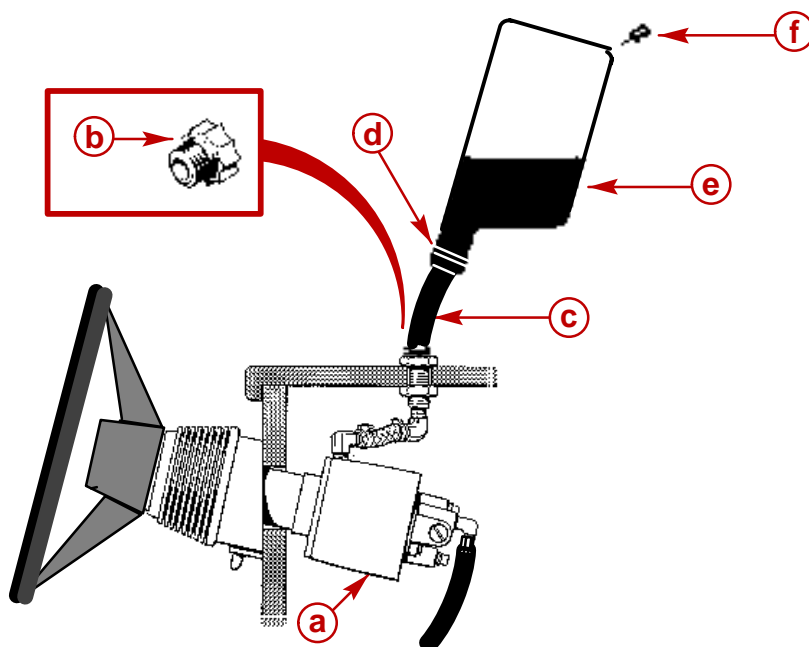
## Single Station With Single Cylinder

### FILLING

**IMPORTANT:** Hydraulic fluid must be visible in the filler tube during the entire filling procedure. **DO NOT** allow the bottle of fluid used for filling to empty causing the filler tube to empty. This may introduce air into the system and cause additional filling and purging to be needed.

Approximately two bottles (2 quarts) of approved hydraulic fluid are required for this single station and single cylinder system. The length of hydraulic hoses required will cause the amount to vary.

1. Remove vent/fill plug from helm.
2. Using a Filler Kit (ordered separately) screw the filler tube into vent/fill plug hole. Hand tighten.
3. Screw bottle of hydraulic fluid into the filler tube bottle cap end. Turn bottle upside-down and poke a hole in bottom of bottle.
4. Ensure hydraulic fluid is always visible in filler tube and fill helm pump. Install next bottle while fluid is still visible in filler tube but first bottle is empty.
5. The helm is full when air bubbles no longer appear in filler tube. Stop filling.



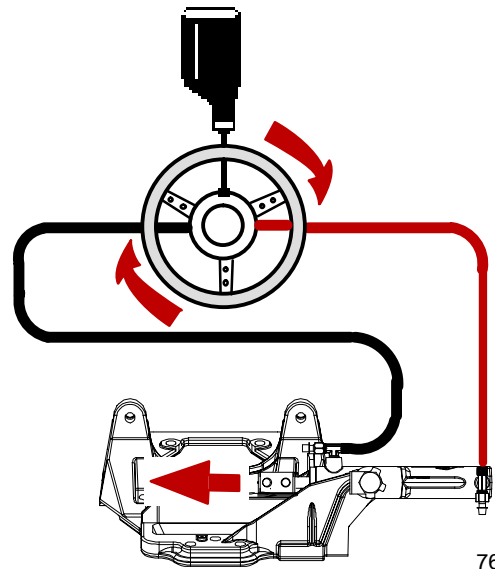
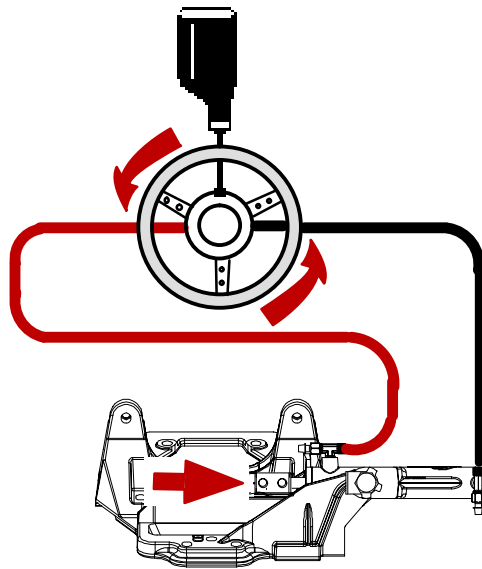
- a** - Helm
- b** - Vent/Fill Plug
- c** - Filler Tube
- d** - Bottle Cap End
- e** - Hydraulic Fluid Bottle
- f** - Pin (To Pierce Bottle)

**IMPORTANT:** Do not proceed to the next step until helm is full of hydraulic fluid. Ensure no air is visible in filler tube.

6. Leave bottle of fluid connected to helm for use in the following steps - "Purging."

## Purging

Turning the steering wheel in direction shown moves the cylinder rod as indicated by arrow.

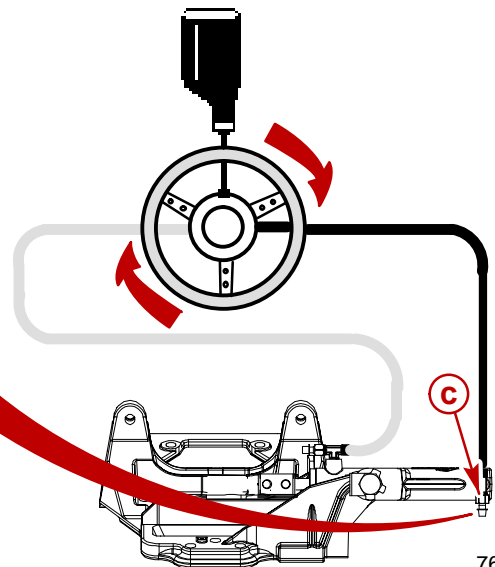
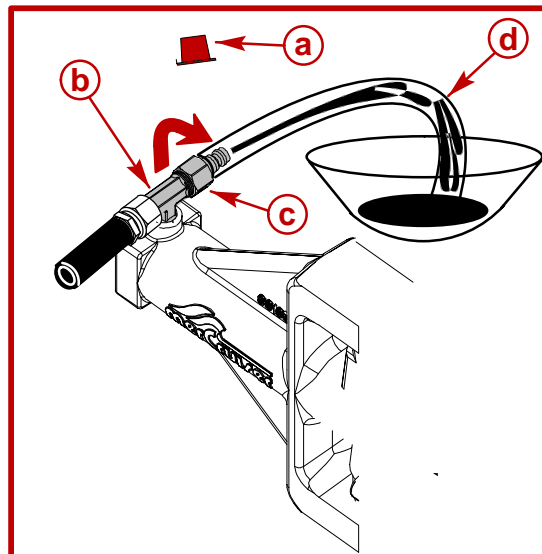


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1. Remove caps from bleeder valves on T-Fittings at cylinder assembly.

**NOTE:** Place temporary hoses (obtain locally - clear hose is recommended) on bleeder outlets and position these hoses in a container to avoid spillage and air return to bleeder.

2. Turn the steering wheel slowly **CLOCKWISE** while your assistant opens the **STARBOARD** bleeder valve.
3. Continue to turn steering wheel clockwise until a stream of air free hydraulic fluid is visible out of bleeder.
4. While continuing to slowly turn the steering wheel, close the **STARBOARD** bleeder.

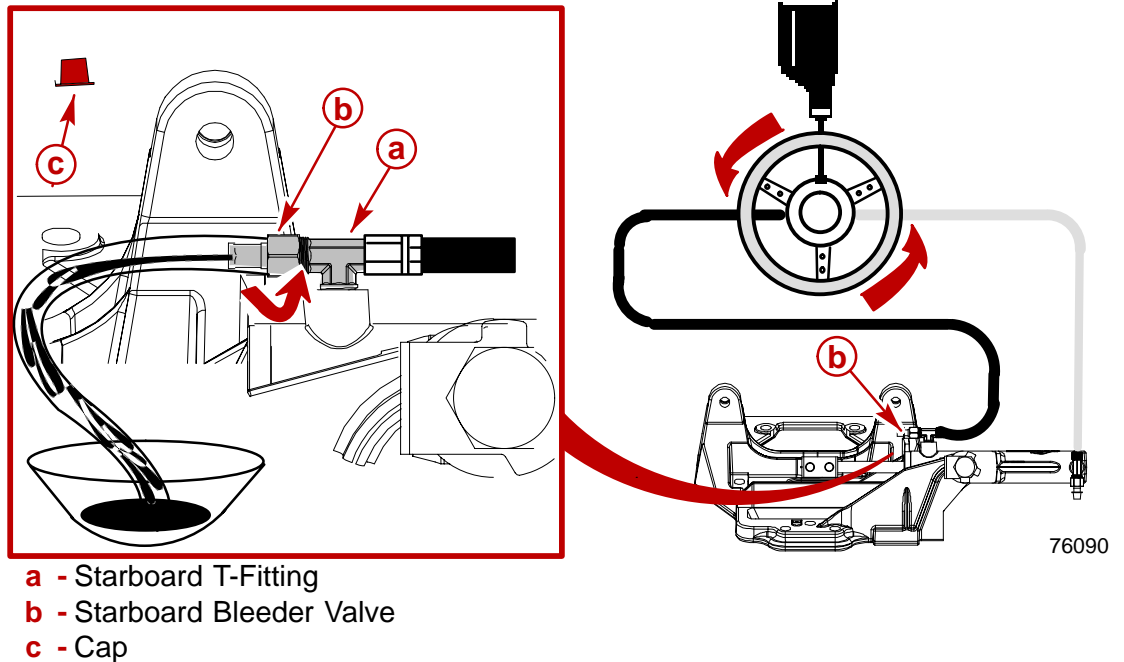


76090

- a - Cap
- b - Starboard T-Fitting
- c - Starboard Bleeder Valve
- d - Temporary Hose

5. Turn steering wheel clockwise until cylinder rod is fully extended. Ensure steering lever does not interfere with cylinder clevis.

6. Turn the steering wheel slowly COUNTERCLOCKWISE while your assistant opens the PORT bleeder valve on the steering cylinder.
7. Continue to turn steering wheel until a stream of air free fluid is visible out of bleeder.
8. Continuing to slowly turn the steering wheel while closing the PORT bleeder.

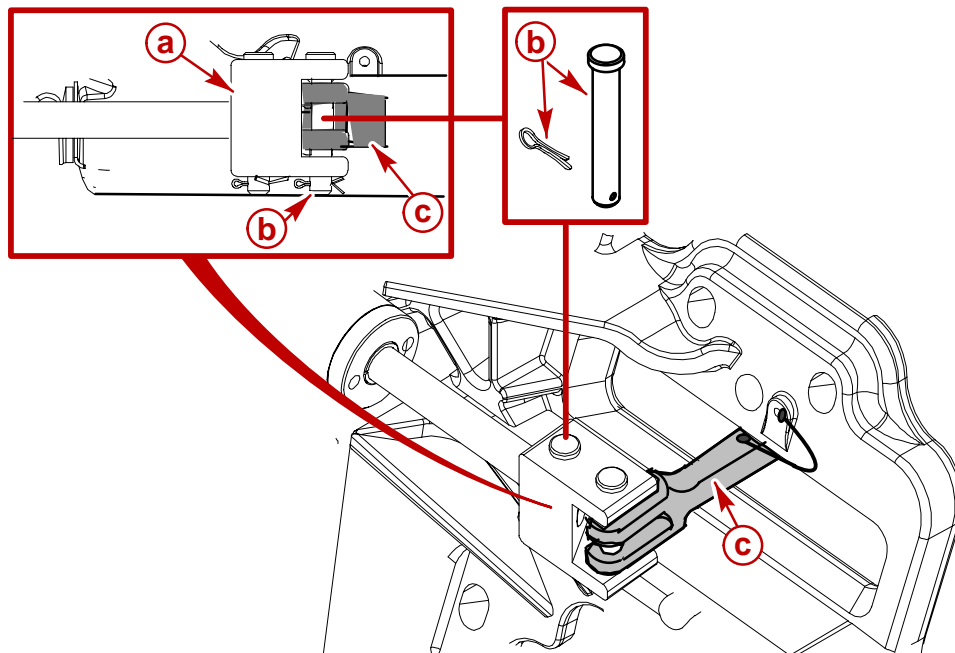


9. Turn the steering wheel COUNTERCLOCKWISE until the cylinder rod is fully retracted. Steering wheel will come to a stop.
10. Open STARBOARD bleeder.
11. Hold cylinder rod to prevent extension. Continue to turn steering wheel counterclockwise until a stream of air free fluid is visible out of bleeder.
12. Close the bleeder while continuing to turn steering wheel.
13. Filling and purging is complete. Refer to "Hydraulic Fluid Level" to set fluid level and to check the system after connecting the clevis as outlined following.

## Connecting The Clevis

1. Lubricate clevis pin and clevis with Special Lubricant 101.
2. Connect clevis to steering lever. Be sure to spread both ends of cotter pin.

**IMPORTANT:** Ensure that the clevis is positioned as shown below. The angled notch in the clevis must face the rear.



76087

- a** - Clevis
- b** - Clevis Pin and Cotter Pin
- c** - Steering Lever

# Hydraulic Fluid Level

## Setting Fluid Level

### WARNING

Avoid serious bodily injury or death due to loss of steering control. This system operates with an unbalanced steering cylinder volume. Proper fluid level in the helm can only be set or checked with the cylinder rod fully retracted. Do not set or check hydraulic fluid level in helm with cylinder rod extended.

System must be filled and purged as outlined previously before setting fluid level.

1. Ensure cylinder rod is fully retracted.
2. With filler tube screwed into helm filler plug hole, fill tube approximately 1/2 full of air free fluid.
3. Open Starboard bleeder valve and slowly turn steering wheel CLOCKWISE until fluid level in filler tube is at the top of the plastic filler fitting. Continue turning steering wheel CLOCKWISE 1/4 turn more and stop. Close bleeder.
4. Remove filler tube. Fluid level should be at bottom of filler hole. Install vent/fill plug.

## Maintaining Fluid Level

To maintain proper fluid level, observe the following:

- Do not allow fluid level to drop more than 1/4 in. (6 mm) below bottom of filler hole.
- Check fluid level periodically.

## System Check

The system must be checked for proper connections, possible leaks and complete purging of air after filling, purging and setting the fluid level.

**IMPORTANT:** In the following, turn the wheel with enough force to exceed the pressure relief valve in the helm. This should not harm the helm or the system.

1. Turn steering wheel (any wheel on multi-steering station) very hard to port to pressurize system.
2. While pressure is maintained, check all port fittings and hose connections. Ensure there are no leaks. If leaks are present, correct before using.
3. Turn steering wheel (any wheel on multi-steering station) very hard to starboard to pressurize system.
4. While pressure is maintained, check all starboard fittings and hose connections. Ensure there are no leaks. If leaks are present, correct before using.

**NOTE:** Observing a significant drop in the fluid level at the helm while performing the system check may mean you are compressing air and further filling and purging would be required.

5. If no leaks are present, the system is ready for service.

### WARNING

Avoid serious bodily injury or death due to loss of steering control. Hydraulic pump in helm requires hydraulic fluid to create the necessary pressure for steering the boat. Do not operate boat with a steering system fluid leak which could cause insufficient hydraulic pump pressure and loss of steering control.

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# CORROSION PROTECTION

## Section 7A - All Models

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# Specifications

## Special Tools

DESCRIPTION	PART NUMBER
MerCathode Reference Electrode Test	76675T1
Quicksilver VOA Meter*	91-93572

\*If you do not already have this meter, use a digital multi-meter. Do NOT use a standard analog meter as inaccurate readings will result.

**IMPORTANT: Quicksilver Volt/OhmMeter 91-93572 and Multi-Meter DVA/Tester 91-99750 are no longer recommended for testing corrosion protection.**

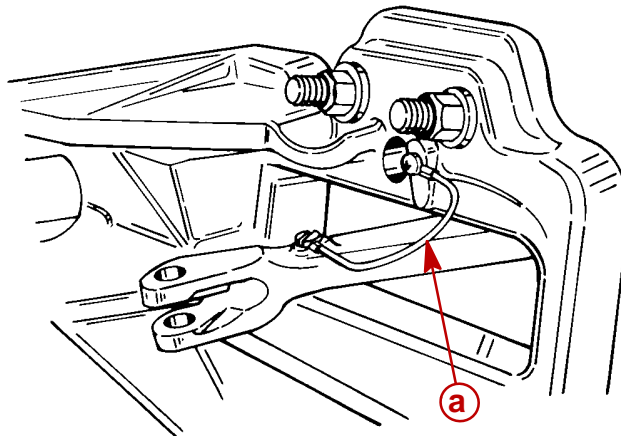
## Lubricants / Sealants / Adhesives

DESCRIPTION	PART NUMBER
Quicksilver Liquid Neoprene	92-25711-3

## Continuity Circuit

Transom assembly and sterndrive unit are equipped with ground circuit wires to ensure good electrical continuity between engine, transom assembly and sterndrive components. Good continuity is essential for the Anode and MerCathode System to function most effectively.

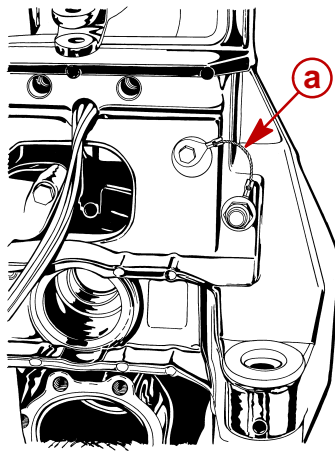
Inspect the following ground circuit components at intervals (Section 1B) for loose connections, broken or fraying wires.



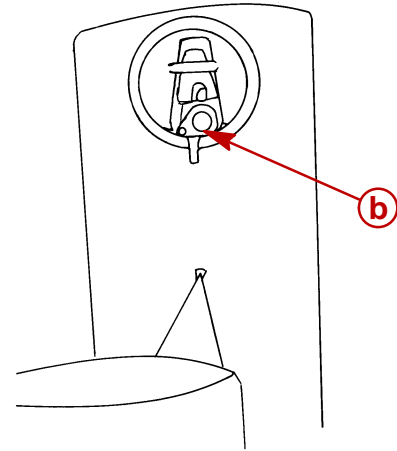
**a** - Steering Lever Ground Wire

22028





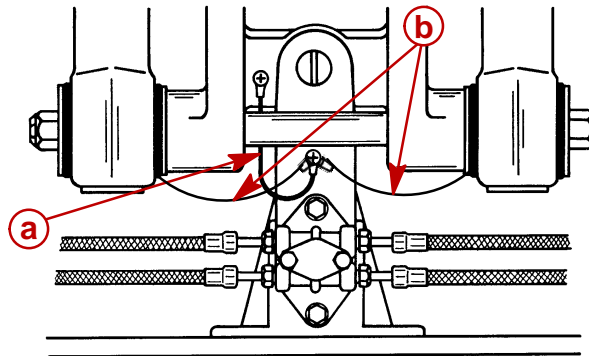
22650



77079

**a** - Inner Transom Plate To Gimbal Housing Ground Wire

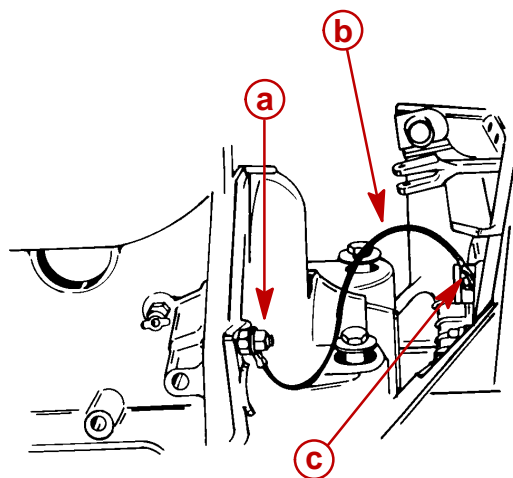
**b** - Driveshaft Housing To Gear Housing Ground Plate (Inside Anode Cavity)



77100

**a** - Gimbal Housing To Gimbal Ring Ground Wire

**b** - Gimbal Ring To Trim Cylinder Ground Wires



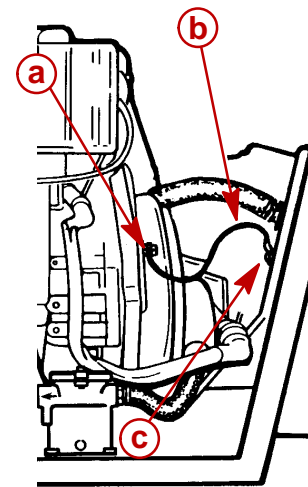
22028

### Gasoline Models

**a** - Flywheel Housing Grounding Stud

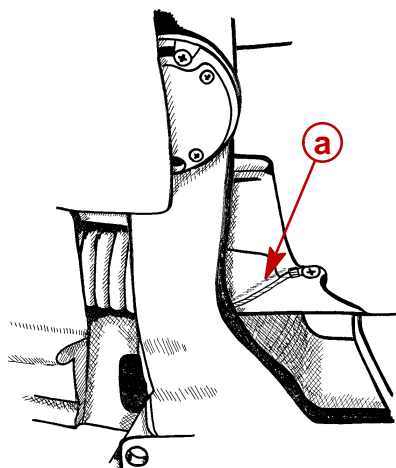
**b** - Ground Wire

**c** - Inner Transom Plate Grounding Screw

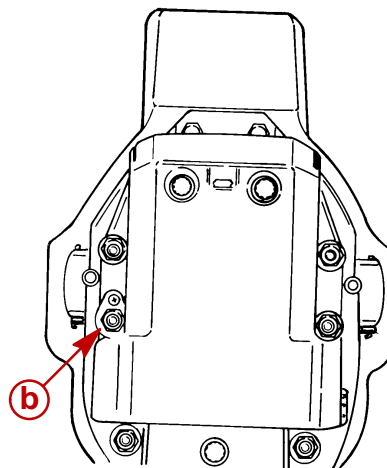


50242

### Diesel Models

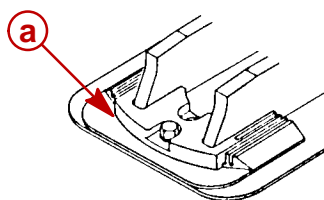


22755

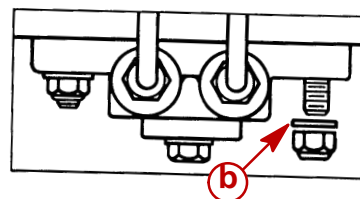


22031

- a** - Gimbal Ring To Bell Housing Ground Wire  
**b** - Sterndrive Unit To Bell Housing Ground Plate

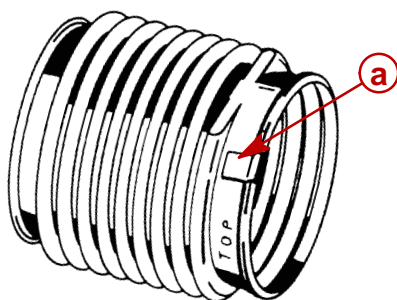


70575

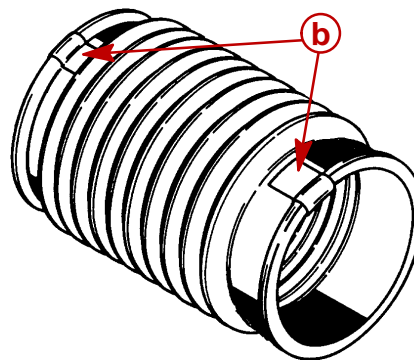


22230

- a** - Driveshaft Housing To Gear Housing Anodic Plate  
**b** - Hydraulic Connector Block To Gimbal Housing Ground Washer



50383



22079

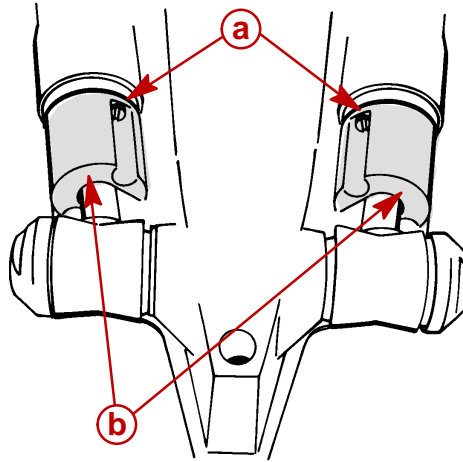
- a** - U-joint Bellows Ground Clip  
**b** - Exhaust Bellows Ground Clips

# Trim Cylinder Anodes

## ⚠ CAUTION

**DO NOT** paint new trim cylinder anodes, as this will render them ineffective as a galvanic corrosion inhibitor.

1. Remove screws that secure anodes to trim cylinders. Remove anodes.

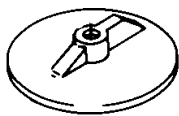


71966

- a** - Screws  
**b** - Trim Cylinder Anodes

2. Scrape mounting surface on cylinder end cap down to bare metal.
3. Install new anodes and tighten securely.

# Anodic Plate



75251

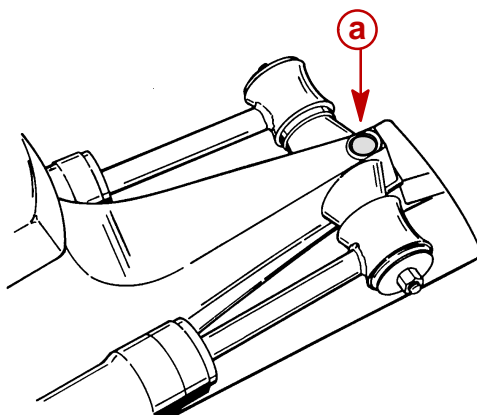
**a** - Anodic Plate

## ⚠ CAUTION

**DO NOT** paint new anodic plate, as this will render it ineffective as a galvanic corrosion inhibitor.

## Bravo One Sterndrive Units

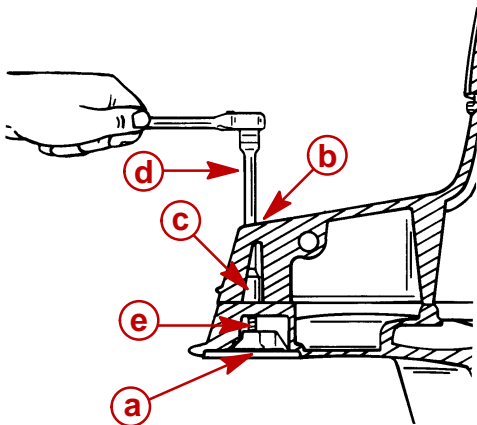
1. Remove plug from driveshaft housing to gain access to attaching screw.



22093

**a** - Rubber Plug

2. Use a 1/2 in. standard socket and extension to loosen screw and remove anodic plate.



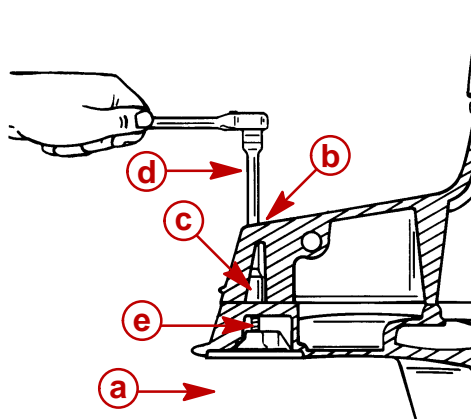
76800

**a** - Anodic Plate  
**b** - Rubber Plug (Removed)  
**c** - 1/2 in. Socket  
**d** - Extension  
**e** - Screw

**⚠ CAUTION**

To be effective, new anodic plate **MUST** make good electrical contact with gear housing.

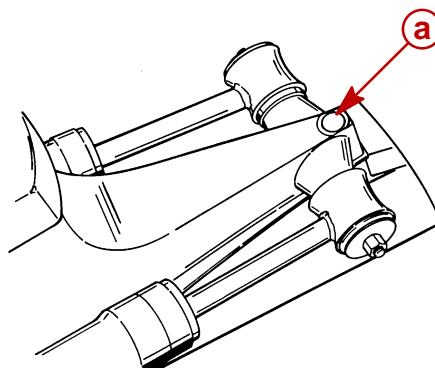
3. Scrape anodic plate mounting surface on gear housing down to bare metal.
4. Install anodic plate. Torque screw to 30 lb-ft (41 Nm).



76800

- a** - Anodic Plate
- b** - Rubber Plug (Removed)
- c** - 1/2 in. Socket
- d** - Extension
- e** - Screw

5. Reinstall plug in driveshaft housing.

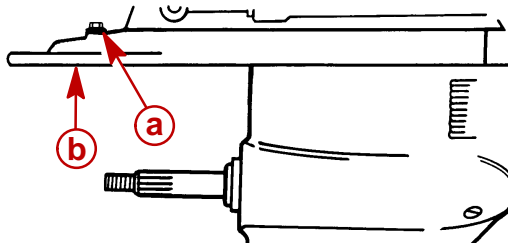


22093

- a** - Rubber Plug

## Bravo Two Sterndrive Units

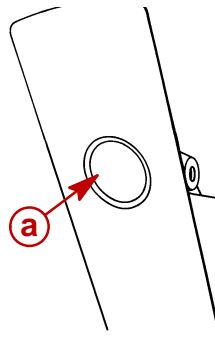
1. Use a 1/2 in. standard socket to loosen screw and remove anodic plate.
2. Scrape anodic plate mounting surface down to bare metal to ensure continuity.
3. Install anodic plate. Torque screw to 30 lb-ft (41 Nm).



50323

- a** - Screw  
**b** - Anodic plate

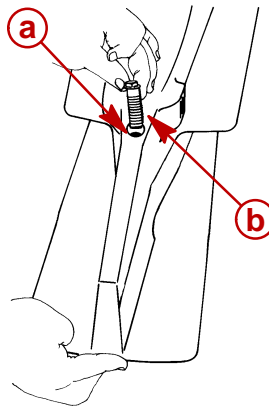
## Bravo Three Sterndrive Units



76831

- a** - Anodic Plate

1. Remove plastic cap to gain access to the anode attaching bolt.



76832

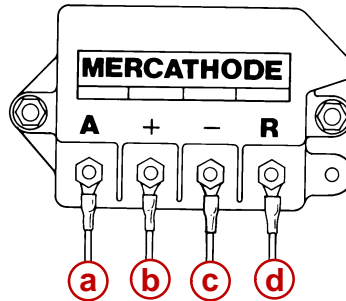
- a** - Plastic Cap (Removed)  
**b** - Bolt

2. Scrape the mounting surface on gear housing down to bare metal to ensure continuity.
3. Install new anode. Torque to 23 lb-ft (32 Nm).
4. Reinstall plastic cap.

# Integral MerCathode System

## Removing Electrode Assembly

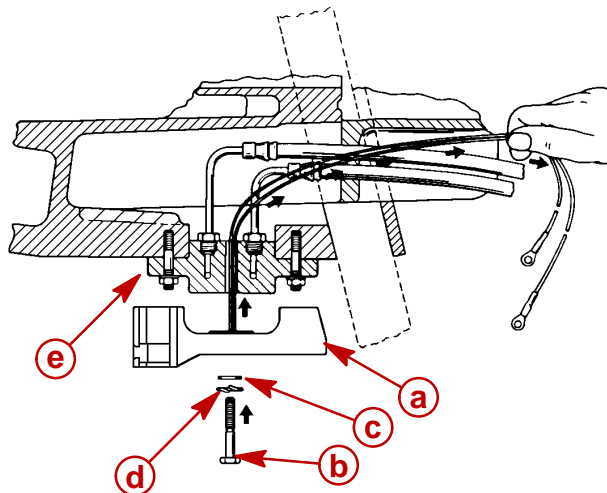
1. Disconnect electrode assembly wires from MerCathode Controller.



22232

- a** - ORANGE Lead - From Electrode On Transom Assembly
- b** - RED/PURPLE Lead - Connect To Positive (+) Battery Terminal
- c** - BLACK Lead - From Engine Harness
- d** - BROWN Lead - From Electrode On Transom Assembly

2. Remove two screws, flat washers and lock washers.
3. Remove electrode assembly.



70771

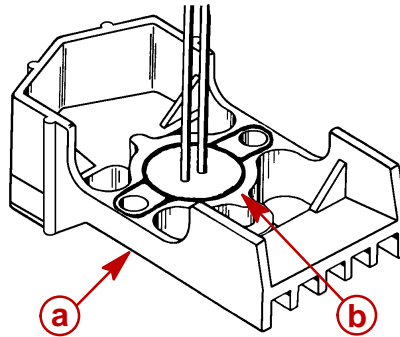
- a** - Electrode Assembly
- b** - Screw (2)
- c** - Flat Washer (2)
- d** - Lock Washer (2)
- e** - Hydraulic Connector Block

# Installing Electrode Assembly

## ⚠ CAUTION

O-ring **MUST BE** properly seated in groove of electrode assembly or water leakage into boat will result.

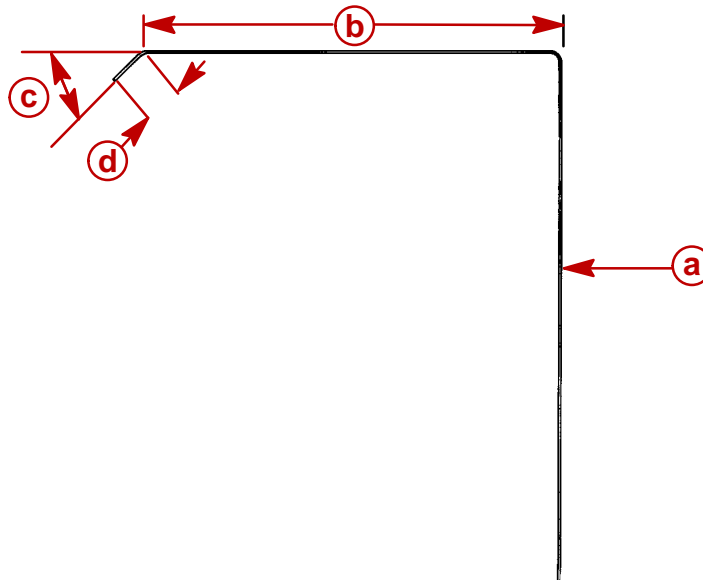
1. Electrodes have a factory installed rubber grommet and Do NOT require an O-ring.



71862

- a** - Electrode
- b** - Rubber Grommet

2. Form a 2 ft. (610 mm) long piece of .032 in. (6.8 mm) diameter wire to the dimensions shown.



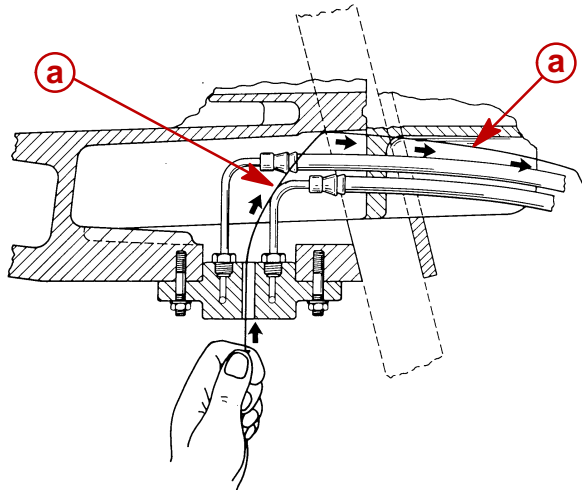
74106

- a** - 2 Ft. (610 Mm) Of Approximately .032 In. (0.8 Mm) Dia. Wire
- b** - 5 in. (123 mm)
- c** - 45° Angle
- d** - 1/2 in. (13 mm)

3. Insert 45° angle end of wire through center hole in hydraulic connector block.



4. Guide wire through hole until wire protrudes through cavity on the bottom of exhaust pipe.



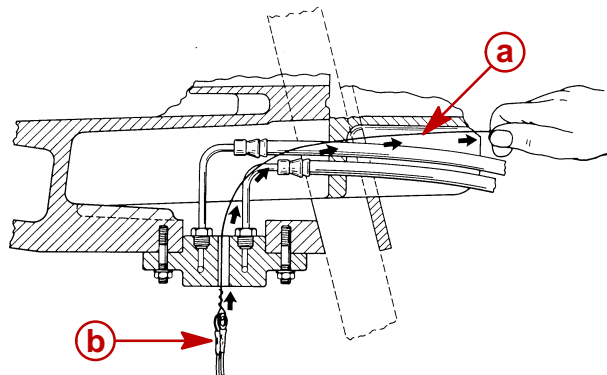
22235

**a** - Wire

5. Secure ring terminals to tracer wire.
6. Guide leads through center hole in connector block.

**IMPORTANT: Orange lead is approximately 6 in. (150 mm) longer than the brown lead.**

7. Pull leads ALL the way into the boat.



22234

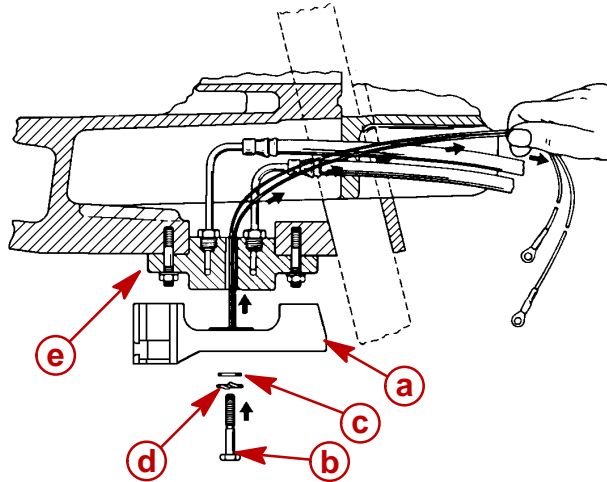
**a** - Wire

**b** - Leads

**⚠ CAUTION**

**DO NOT paint sacrificial anodes or MerCathode System electrode assembly, as this will render them ineffective as galvanic corrosion inhibitors.**

8. Position and secure electrode assembly to gimbal housing using two 1-3/8 in. (35 mm) long screws, flat washers and lockwashers. Torque to 25 lb-in. (2.8 Nm). Do NOT overtighten.



70771

- a** - Electrode Assembly
- b** - Screw (2)
- c** - Flat Washer (2)
- d** - Lock Washer (2)
- e** - Hydraulic Connector Block

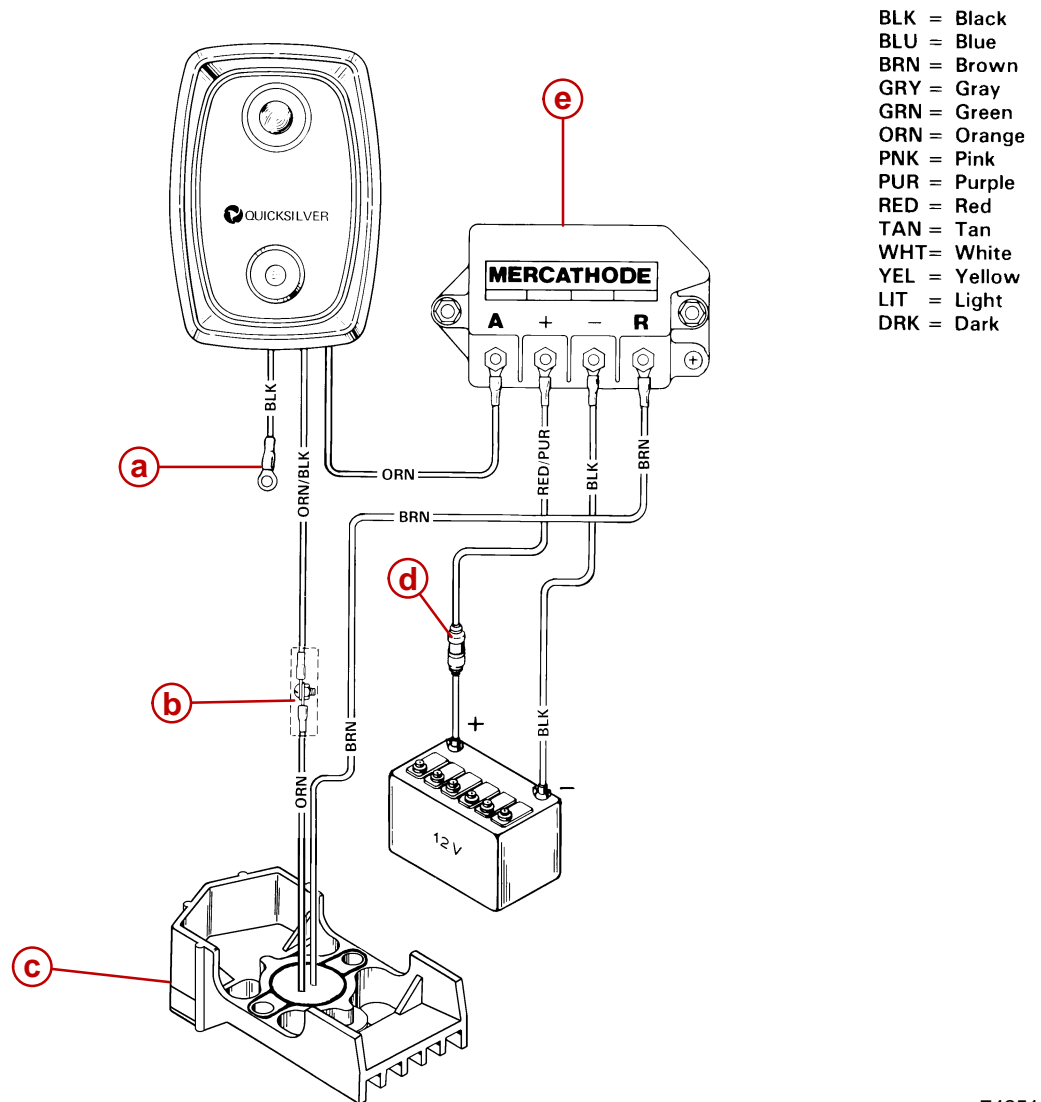
## Connect Electrical Leads to Controller Assembly

**NOTE:** If black (ground) wire is not available at terminal block or from wire harness, install a separate lead between controller negative (–) terminal and negative (–) battery cable attaching point on engine.

1. Securely connect electrical leads to controller assembly. (See Wiring Diagrams, following.)
2. Apply a thin coat of Quicksilver Liquid Neoprene (92-25711) to ALL electrical connections.

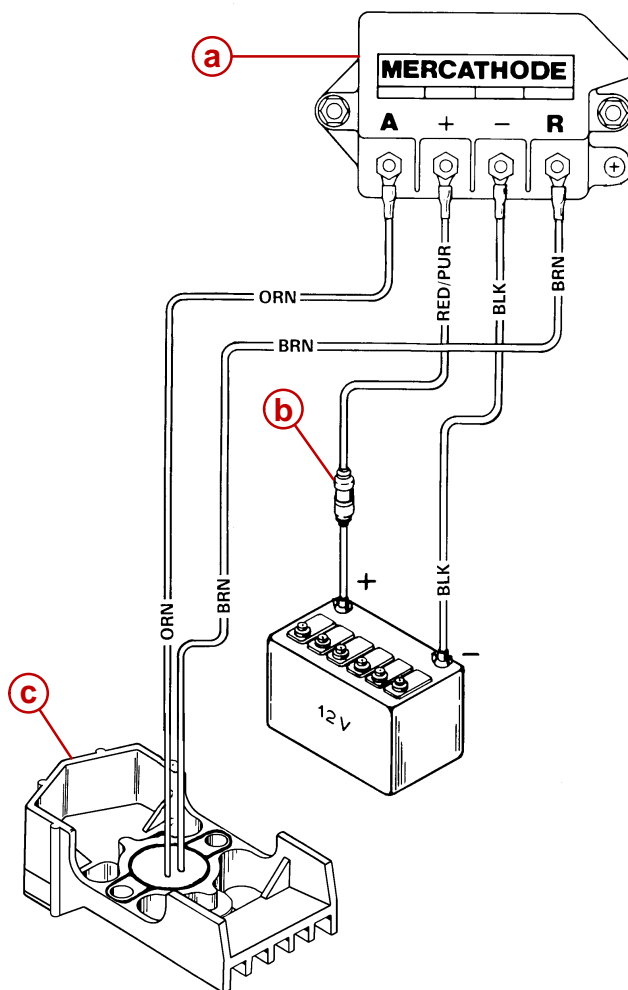
# Wiring Diagrams

## MerCathode Monitor



74251

# MerCathode Controller



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** - Controller  
**b** - 20 Amp Fuse  
**c** - Electrode

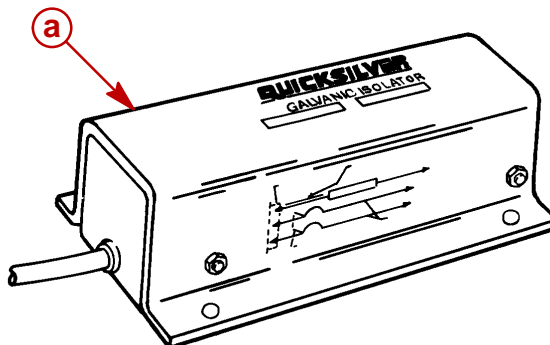
73596

## Quicksilver Isolator

Boats that are connected to AC shore power require additional protection to prevent destructive low voltage galvanic currents from passing through the shore power ground wire. A Quicksilver Isolator can be installed to block the passage of these currents, while still providing a path to ground for dangerous fault (shock) currents.

### ⚠ CAUTION

If A.C. shore power is not isolated from boat ground, the MerCathode System and sacrificial anodes may be unable to handle the increased galvanic corrosion potential.



76833

**a** - Quicksilver Isolator (18478A2)

## Corrosion Protection Testing and Troubleshooting

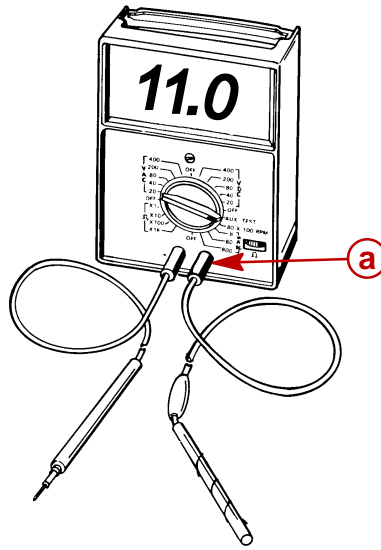
**NOTE:** The following corrosion protection test supersedes all previously issued tests. This test can be used on applications with or without a MerCathode System.

If the unit is equipped with a MerCathode System, this test should be performed annually where the boat is moored to ensure that the system is functioning properly.

Test requires the use of MerCathode Reference Electrode Test 76675A1 and Quicksilver VOA meter 91-62562A1. This meter is no longer available from Mercury Marine. If you do not already have this meter, a digital multi-meter must be used. A STANDARD ANALOG METER CANNOT BE USED, AS AN INACCURATE READING WILL RESULT.

**IMPORTANT:** Quicksilver Volt/Ohm Meter 91-93572 and Multi-Meter DVA/Tester 91-99750 are no longer recommended for testing corrosion protection.

The MerCathode Reference Electrode Tester 76675A1 is equipped with a special jack containing a resistor to provide the proper scale reading when used with a digital multimeter. **Do NOT remove this plug or use analog meters.** Resistor jack can be left in place when using digital meters.



76834

### Digital Multimeter and MerCathode Reference Tester 76675A1

**a** - Special Resistor Jack

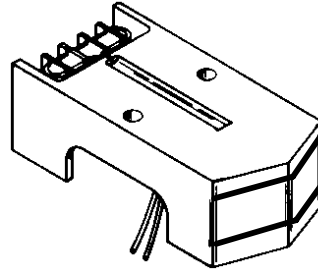
**NOTE:** Set-up test equipment as shown on page 7A-21.

**IMPORTANT:** Be sure to observe the following when performing test:

- If equipped with MerCathode System, ensure battery is fully charged (12.6 Volts or above).
  - Boats recently placed in service usually will produce a reading higher than normal because the sterndrive unit is protected by a good finish and new sacrificial anodes. To obtain an accurate diagnosis, the test should be performed after the boat has been in service at least one or two weeks. This will give the paint a chance to soak and minor abrasions and scratches will have appeared resulting in a more accurate reading.
  - Boats should be moored, without being operated, for at least 8 hours before performing tests. This is necessary to allow the MerCathode System and/or sacrificial anodes to polarize the surrounding water. Be careful not to rock the boat excessively while boarding to perform a test as this will alter the test reading.
1. Plug negative meter lead into negative (–) receptacle of meter. Connect other end of lead to negative (–) battery terminal or other convenient engine ground.
  2. Plug Reference Electrode Tester lead into positive (+) receptacle of meter.
  3. Set meter on scale required to read 0-2000 millivolts (0-2 volts).

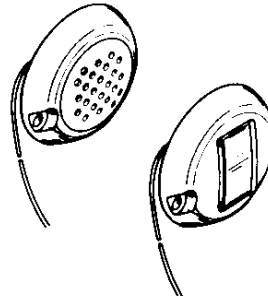
4. Immerse Electrode Tester in the water within 6 in. (150 mm) of aft end of sterndrive unit.

**IMPORTANT:** There will be different voltage readings depending on the type of Mer-Cathode System you are testing.



76868

**Electrode Mounted on Bottom of Transom Assembly**



71895

**Electrodes Mounted on Boat Transom**

5. The following readings indicate that the sterndrive unit is adequately protected:

a. **MODELS WITH ELECTRODES MOUNTED ON BOAT TRANSOM**

**Fresh Water Areas -**

7.5 - 10.5 millivolts with Quicksilver  
VOA Meter  
750 - 1050 Millivolts with Digital Meter

**Salt, Polluted or Mineral Laden Water Areas:**

8.8 - 10.5 millivolts with Quicksilver  
VOA Meter  
880 - 1050 Millivolts with Digital Meter

b. **MODELS WITH ELECTRODE MOUNTED ON BOTTOM OF TRANSOM ASSEMBLY**

**Fresh Water Areas -**

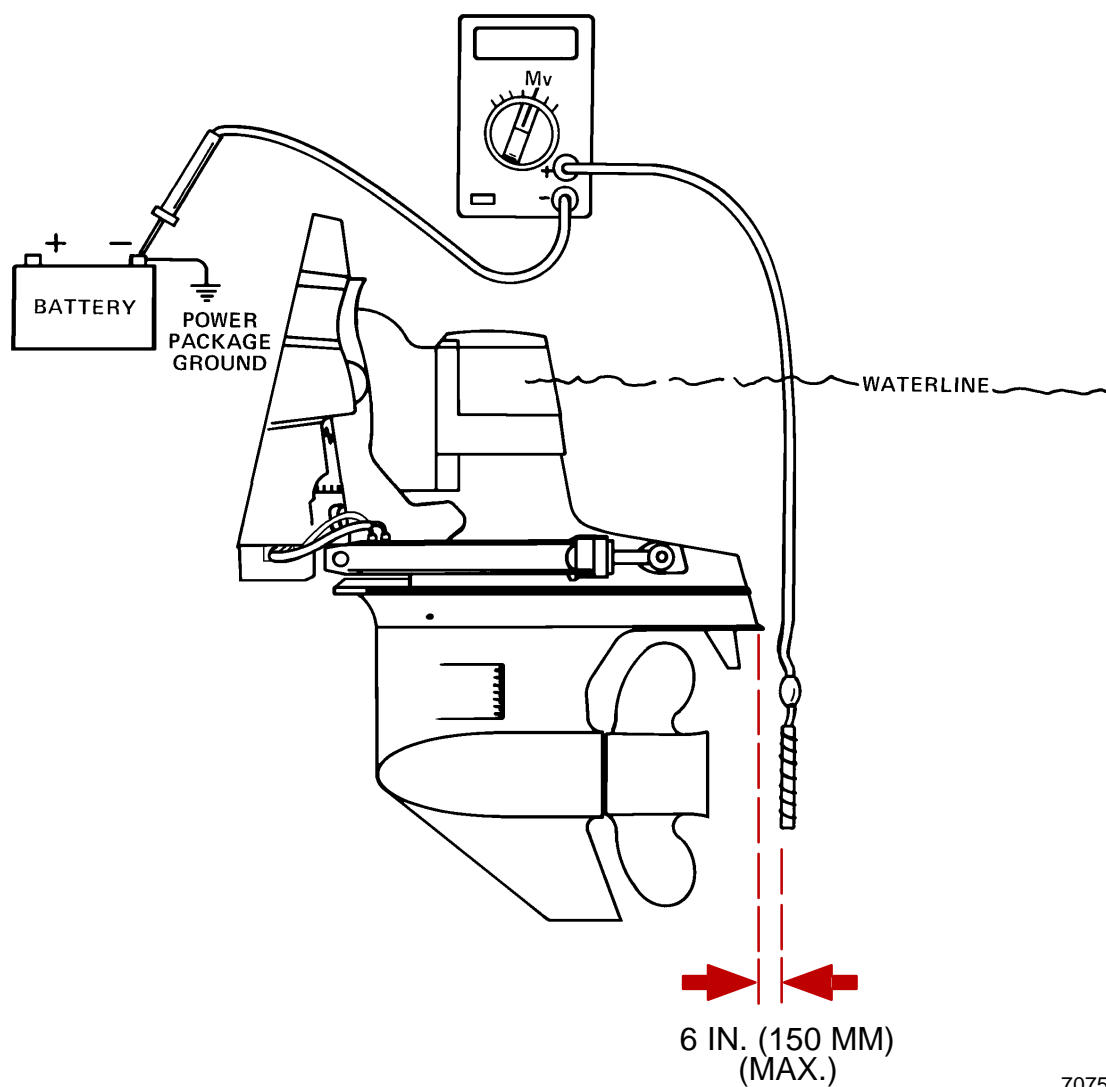
6.2 - 11.8 Millivolts with Quicksilver  
VOA Meter  
620 - 1180 Millivolts with Digital Meter

**Salt, Polluted or Mineral Laden Water Areas:**

7.5 - 11.8 Millivolts with Quicksilver  
VOA Meter  
750 - 1180 Millivolts with Digital Meter

6. If the reading is not within specified limits, or if reading is within specifications but there is evidence of corrosion on sterndrive, refer to the following troubleshooting charts to aid in diagnosis.

## Test Equipment Set-Up



70755



## Low Readings

Cause	Special Instructions
Loss of continuity between sterndrive unit components and negative (-) battery terminal.	Ensure that continuity devices are not missing or damaged and that connections are clean and tight.
Shore power green safety grounding lead not isolated from the power package ground on boats equipped with shore power.	Disconnect shore power and verify if reading increases. If so, install a Quicksilver Isolator P/N 18478A2 or an isolation transformer.
Underwater metal parts on the sterndrive unit and/or boat are unpainted or the paint is in poor condition. The boat has more exposed metal than the anodes and/or MerCathode system can protect.	Prime and paint underwater metal parts. This will reduce the load on the anodes and/or MerCathode system.
Anodes painted.	Remove paint or replace anodes.
The anodes are improperly grounded or inactive.	Clean anode mounting surface or replace anodes if they have oxidized.
Anodes consumed (no longer protect).	Replace anodes if eroded 50% or more.
Sterndrive unit and/or boat bottom painted with anti-fouling paint containing copper or tin.	Avoid any electrical interconnection between the MerCruiser product, anodic blocks, or MerCathode system and the paint by allowing a minimum of 1-1/2 in. (40 mm) of UNPAINTED area around these items on the transom of the boat.
MerCathode reference electrode or anode painted.	Remove paint.
Anodic heads used instead of plastic caps.	Reinstall the plastic caps.
No power to MerCathode controller.	Connect the positive (+) volt meter lead (set on 0-20 volt scale) to the positive (+) controller terminal and the negative (-) volt meter lead to the negative (-) terminal. The meter should indicate battery voltage. Check for a blown fuse (if equipped) on the starboard MerCathode system. Clean the connection or repair wiring as required.
Poor connection between reference electrode lead (brown) or anode lead (orange) and MerCathode controller.	Clean and/or tighten the connection. Repair the wiring.

## Low Readings (continued)

Cause	Special Instructions
Faulty MerCathode reference electrode.	Disconnect the reference electrode lead(brown) from the controller "R" terminal. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (-) meter lead to the negative (-) battery terminal. Note the meter reading; then repeat the test using a MerCathode Reference Electrode Tester 76675A1. You should obtain the same reading in both cases. If not, replace the reference electrode.
Faulty MerCathode Controller.	<p>With anode and reference electrode leads connected to the controller, connect the jumper wire between "R" and negative (-) terminals on the controller. Connect the positive (+) lead of the volt meter (set on 0-20 scale) to terminal "A" on the controller. Connect the negative (-) meter lead to the negative (-) controller terminal. Reading should be as follows:</p> <p>● <b>Freshwater Areas -</b>  <u>Electrodes Mounted on boat transom:</u> 7.5 - 10.5 Millivolts  <u>Electrode mounted on bottom transom assembly:</u> 6.2 - 11.8 Millivolts</p> <p>● <b>Saltwater Areas -</b>  <u>Electrodes mounted on boat transom:</u> 8.8 - 10.5 Millivolts  <u>Electrode mounted on bottom of transom assembly:</u> 7.5 - 11.8 Millivolts</p> <p>If the reading is low, replace the controller.</p>
Additional corrosion protection required. Boats equipped with a sizable amount of underwater metal (stainless steel prop, after planes, etc.), or that are moored in an area with warm or rapid flowing water may require additional protection.	Install additional anodes or MerCathode system 88334A2. If the unit is already equipped with a MerCathode system, a second system may be required.

## High Reading

Cause	Special Instructions
Stray current corrosion. If an electrical current flowing along a metal conductor leaves the metal for a water path, it will cause ionization of the metal, and an area of rapid corrosion.	Observe the reading while disconnecting the electrical components one at a time until you eliminate the high reading. Correct the course of stray current.
Poor connection between MerCathode reference electrode lead (brown) and "R" terminal on controller.	Clean and /or tighten connection. Repair wiring as required.
Faulty MerCathode reference electrode.	Disconnect the reference electrode lead (brown) from "R" terminal on the controller. Connect the lead to the positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect the negative (-) meter lead to the negative (-) battery terminal. Note the meter reading; then, repeat the test using MerCathode Reference Electrode Tester 76675A1. Both tools should produce the same reading. If not, replace the reference electrode.
Faulty MerCathode controller.	Replace the controller.

## Normal Reading But Corrosion is Evident

### CORROSION ON THE ENTIRE STERNDRIIVE UNIT

Cause	Special Instructions
The sterndrive unit is raised so that the sacrificial anodic trim tab is out of the water.	Leave the sterndrive unit in the IN/DOWN position when the boat is moored to ensure the trim tab is in the water, providing protection.

### CORROSION PROBLEM DEVELOPED AFTER REFINISHING THE DRIVE UNIT

Cause	Special Instructions
A steel wire brush was used to clean the aluminum casting. Steel particles became en-trapped and set up a small galvanic cell.	Use only a nylon or bristle brush.

### PAINT BLISTERING ON DRIVE UNIT

Cause	Special Instructions
Battery charger, using 110 volt shore power improperly connected to the battery.	Ensure the charger is connected correctly.

**TRIM CYLINDER CORRODING**

<b>Cause</b>	<b>Special Instructions</b>
Continuity lost between trim cylinder and drive unit.	Install proper continuity devices.

**ONLY ONE OR TWO COMPONENTS CORRODING**

<b>Cause</b>	<b>Special Instructions</b>
Continuity lost between drive unit and components.	If not already done, install Continuity Circuit Kit 99940A1.

**CORROSION IN THE EXHAUST OUTLET AREA**

<b>Cause</b>	<b>Special Instructions</b>
Exhaust gas deposits accumulating on the drive exterior can result in paint blistering and corrosion.	Remove deposits with marine or automotive wax.

**CORROSION OCCURS AFTER THE UNIT IS REMOVED FROM THE WATER**

<b>Cause</b>	<b>Special Instructions</b>
Salt crystals remaining on the surface of the drive components combine with high humidity to cause electrolyte formation, resulting in corrosion.	Wash drive exterior and flush drive interior with fresh water.

**CORROSION BETWEEN SURFACES**

<b>Cause</b>	<b>Special Instructions</b>
Salt buildup between surfaces.	Protect mating parts with Quicksilver Special Lubricant 101 (92-13872A1), Quicksilver 2-4-C Marine Lubricant (92-825407A2) or Perfect Seal (92-34227-1).

**ALUMINUM CORRODING IN LUBRICATED AREAS**

<b>Cause</b>	<b>Special Instructions</b>
Graphite in the lubricant.	Never use lubricants containing graphite because they accelerate corrosion. Use specially formulated Quicksilver marine lubricants.

**STAINLESS STEEL COMPONENTS CORRODING**

<b>Cause</b>	<b>Special Instructions</b>
Foreign matter (fishing line, marine growth, etc.) covering the steel and starving it of oxygen. This causes a breakdown of the protective oxide film and subsequent corrosion (known as oxygen starvation corrosion). Burying stainless steel in sand or silt can also cause this problem.	Remove foreign matter and prevent surfaces from being covered by sand or silt.

**STAINLESS STEEL PROPELLER CORRODING**

<b>Cause</b>	<b>Special Instructions</b>
Continuity lost between propeller and propeller shaft.	Clean the mating surfaces on the propeller, propeller shaft and attaching parts. If applicable, install a continuity washer.

**PAINT BLISTERING - THE METAL UNDER THE BLISTERED PAINT IS NOT PITTED**

<b>Cause</b>	<b>Special Instructions</b>
The surface was not properly prepared before paint was applied.	Sand the surface down to bare metal, prime and repaint with Quicksilver Spray Paint.

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# ACCESSORIES

## Section 8A - All Models

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Specifications

Torque Specifications

Description	lb-in.	lb-ft	Nm
Dust Cover	34		4
Inlet Flange	132		15
Valve Guide Bracket Through Bolts	72		8
End Plate to Valve Guide Bracket	132		15
End Plate to Cylinder	240		27

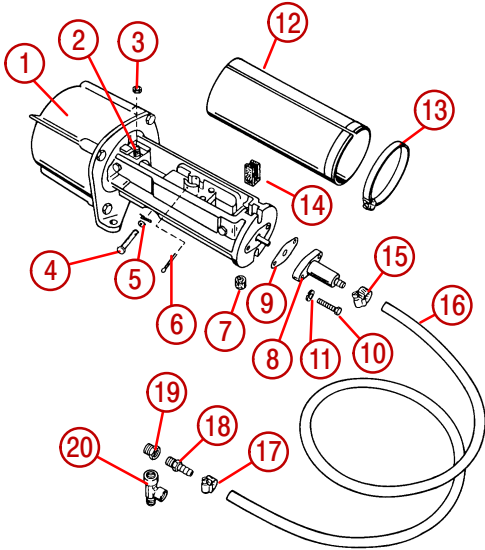
Lubricants / Sealants / Adhesives

DESCRIPTION	PART NUMBER
2-4-C Marine Lubricant with Teflon	92-825407A1

Power Shift (P/N 38638A4)

Description

The power shift cylinder is a vacuum actuated cylinder that assists the mechanical shifting. It utilizes the vacuum produced in the intake manifold. The vacuum is routed by hose to the shift cylinder.



50419

- 1 - Power Shift Assembly

2 - Output Cable Stud

3 - Output Cable Stud Nut

4 - Clevis Pin

5 - Input Cable Washer and Cotter Pin

6 - Cotter Pin

7 - Felt Power Shift Cylinder Plug

8 - Flange

9 - Inlet Flange Gasket

10 - Screw
- 11 - Lockwasher

12 - Dust Shield

13 - Clamp

14 - Spacer

15 - Vacuum Hose Clamp

16 - Vacuum Hose

17 - Vacuum Hose to Engine Fitting Clamp

18 - Vacuum Hose Fitting

19 - Vacuum Hose Fitting Reducer Bushing

20 - T-fitting (used only with vacuum gauge)



## General Information

**Control Cables** - Use quicksilver control cables for the input cable, output cable and throttle cable.

### ATTACHING OUTPUT SHIFT CABLE TO STERNDRIVE UNIT

Refer to the Sterndrive Unit Installation Manual or Installation Section of this manual and follow the procedure outlined for attaching and adjusting the shift cable.

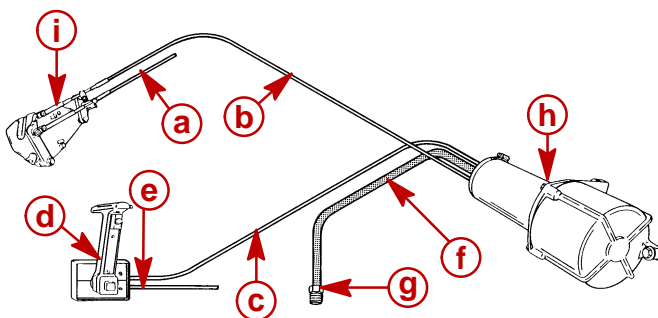
#### IMPORTANT:

- Do not install the propeller before attaching and adjusting the shift cable.
- Do not attach the throttle cable to the carburetor before attaching and adjusting the shift cable.
- The engine must be running and the power shift operating when the cable adjustment procedure requires moving the remote control handle to the full forward or full reverse positions. After the handle has been moved, the engine may be stopped.
- Failure to comply with the above instructions will result in improper unit shift cable adjustment and possible damage to the sterndrive shift mechanism.

### CABLE REPLACEMENT

**IMPORTANT:** To ensure proper operation of the remote control and power shift, comply with the following:

- Control cables must be correct length.
- Control cables should follow the shortest route from the remote control to the power shift, and from the power shift to the shift plate.
- Keep the bends to a minimum number and allow a bend with minimum of a 12 in. (305 mm) radius.
- DO NOT EXCEED 6 ft. (1.8 m) in length of output cable.



50151

- a** - Shift Cable (To Sterndrive Unit)
- b** - Output Cable (To Shift Plate)
- c** - Input Cable
- d** - Remote Control
- e** - Throttle Cable
- f** - Vacuum Hose To Engine
- g** - Vacuum Hose Connection At Engine
- h** - Power Shift Cylinder
- i** - Shift Plate

## DETERMINING INPUT CABLE LENGTH

1. Measure the distance from the remote control where the cables leave the housing, to the power shift cylinder where the vacuum hose attaches; make the cable bends of a 12 in. (305 mm) radius or larger.
2. Select the input cable length. Use the next full foot longer cable than the measurement taken.

**EXAMPLE:** Measured distance = 16 ft. 3 in. (4.96 m). Use a 17 ft. (5.18 m) cable.

## DETERMINING OUTPUT CABLE LENGTH

1. Measure distance from power shift cylinder where the vacuum hose attaches to the shift plate, following the path that the cable will travel. Keep bends to a minimum with a 12 in. (305 mm) or larger radius.
2. Select the output cable length. Use the next full foot longer cable than the measurement.

**EXAMPLE:** Measured distance = 16 ft. 3 in. (4.96 m). Use a 17 ft. (5.18 m) cable.

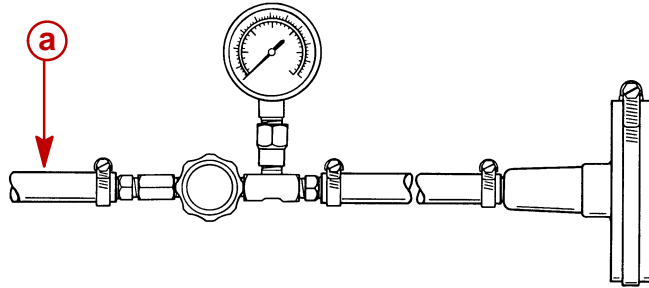
**IMPORTANT:** For the power shift unit to work properly, there must be a bend in the output cable. Mount the power shift cylinder at 90°-180° to the shift plate. DO NOT mount the cylinder in line with the shift plate.

## IF RELOCATING THE POWER SHIFT CYLINDER

1. Select a location above the height of the intake manifold to mount the power shift cylinder in the boat.
  - The location must not allow sharp bends in the cable.
  - Bends must form not less than a 12 in. (305 mm) radius.
  - The location must place the power shift cylinder within a distance (measured along the cable path) of not less than 3 ft. (9.14 m) nor more than 6 ft. (1.8 mm) from the shift plate.
2. Position drilling template (90-36274) and drill holes. Temporarily mount the power shift cylinder in the selected location, reusing the lag screws or bolts. Fill and seal the mounting holes in the former location.

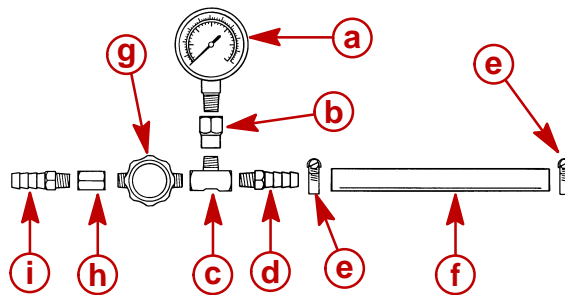
## Checking Vacuum Drop-Off

1. Connect a leak proof shut-off valve and pressure gauge between the Power Shift cylinder input flange and the vacuum connection at the engine manifold. Position the valve toward the manifold side and the gauge toward the power shift cylinder.



50446

**a** - Engine Manifold To Power Shift Cylinder Vacuum Hose

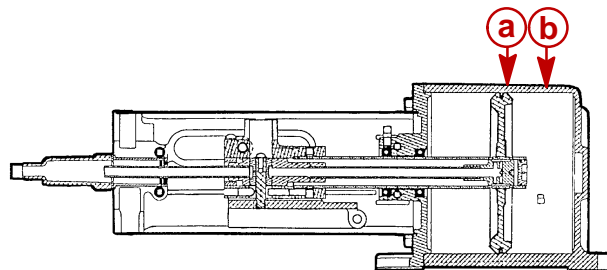


50445

### Locally Obtained Components

- a** - Vacuum Gauge
- b** - Coupling
- c** - T-fitting
- d** - Hose Barb Coupling
- e** - Hose Clamp
- f** - Short Vacuum Hose
- g** - Leak Proof Shut-off Valve
- h** - Coupling
- i** - Hose Barb

2. With the engine running at idle, turn off the valve in the vacuum line. If the vacuum drops to "0" (zero) in less than 5 seconds in either test, install a gasket rebuild kit.
  - a. TEST1: With the cylinder piston in NEUTRAL.
  - b. TEST 2: With the cylinder piston in REVERSE.



50422

- a** - Neutral
- b** - Reverse

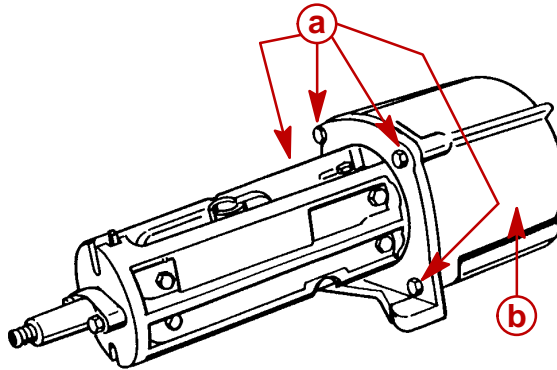
# Power Shift Cylinder Repair

## Removal

1. Loosen the clamps (2) and remove the dust cover from the valve guide brackets.
2. Remove the inlet hose clamp at the inlet flange and remove the inlet hose.
3. Remove the lag screws or bolts that anchor the cylinder to the boat.
4. Remove the cylinder from the mounting surface.

## Disassembly

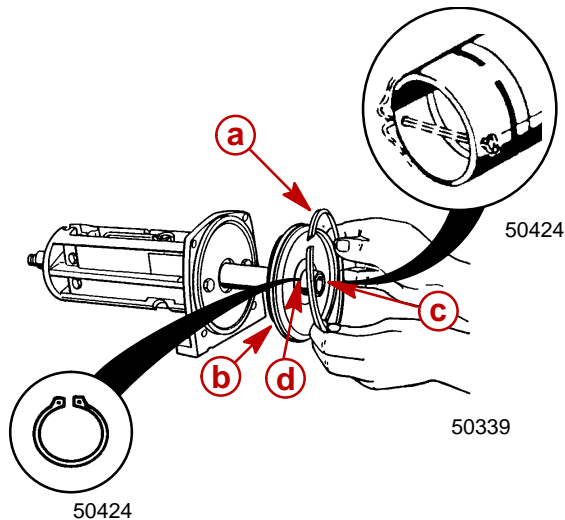
1. Remove the 4 bolts and lockwashers on the end plate. Then, remove the cylinder.



50339

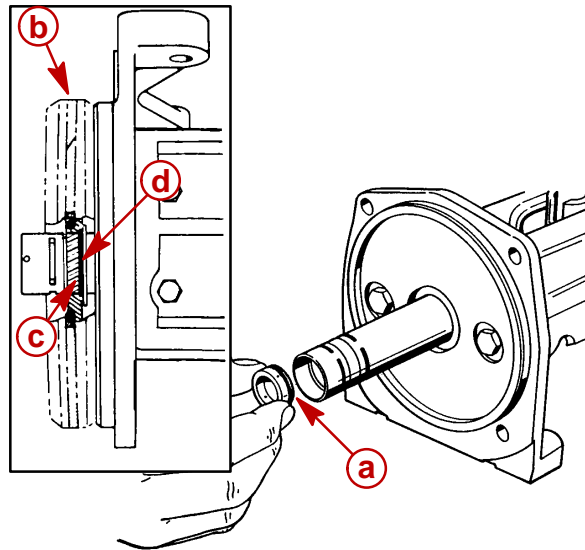
- a** - 4 Bolts and Lockwashers  
**b** - Cylinder

2. Remove the piston seal and O-ring from the piston. The O-ring is located under the piston seal in the same groove.
3. Remove the cotter pin securing the shaft end plug.
4. Remove the snap ring that secures the piston to the shaft.



- a** - Piston Seal  
**b** - O-ring  
**c** - Cotter Pin  
**d** - Snap Ring

5. Remove the piston by removing the O-ring from the shaft (behind the piston, next to the 2nd snap ring) and then removing the snap ring.
6. Remove the shaft end plug.

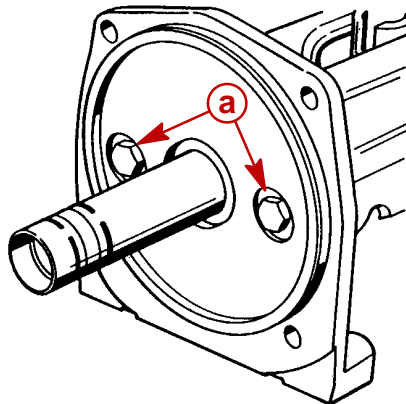


50423

- a** - Shaft End Plug
- b** - Piston
- c** - O-ring (Behind Piston)
- d** - Snap Ring

50339

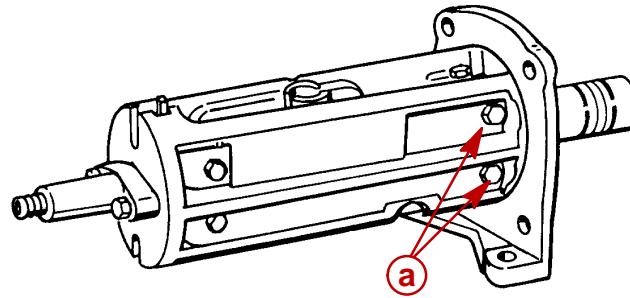
7. Remove the 2 bolts and copper sealing washers indicated below.



50339

- a** - 2 Bolts and Copper Washers

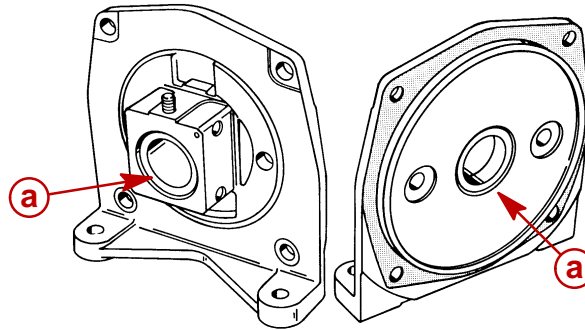
8. Remove the 2 thru-bolts which secure the end plate to the valve guide bracket.



50453

**a** - 2 Thru-bolts

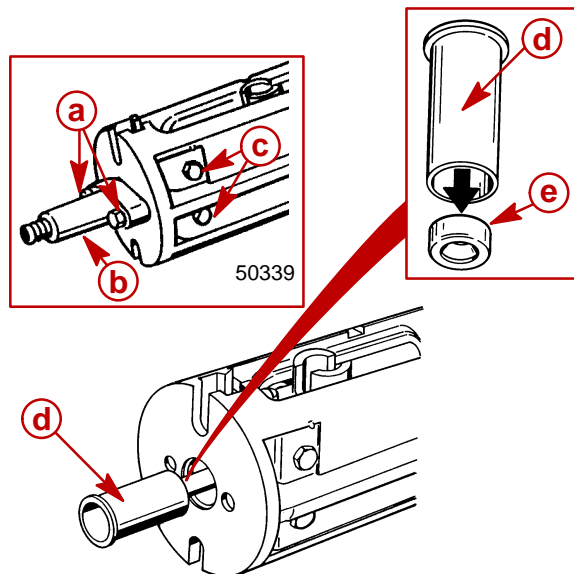
9. Slip the end plate from the valve guide bracket, and off of the shaft. It may be necessary to tap off the plate with a rawhide mallet.
10. Drive the old seals out of the end plate.



50425

**a** - Old Seals

11. Remove the bolts, inlet flange, and gasket. Loosen the thru-bolts and tap out the seal tube. Press or drive the old seal out of the tube.



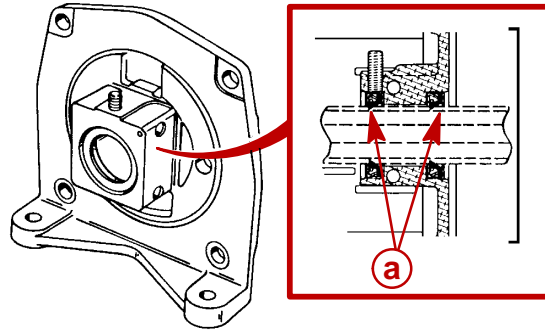
50413

50339

**a** - Bolts  
**b** - Inlet Flange  
**c** - Thru-bolts  
**d** - Seal Tube  
**e** - Old Seal

## Reassembly

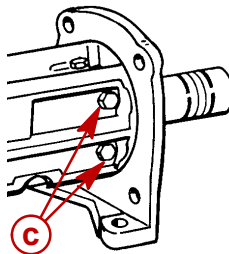
1. Press the new oil seals into the end plate/housing until the seals bottom out. The seal lips face in the direction shown.



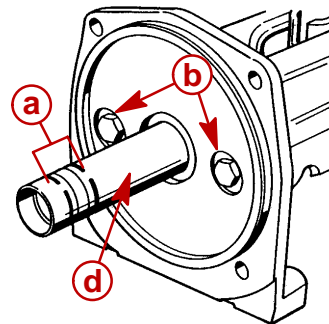
50452

**a** - New Oil Seals

2. Wrap the diameter of the shaft (area "a,") with masking tape to protect the seal lips.
3. Generously lubricate the shaft with 2-4-C Marine Lubricant with Teflon.
4. Lubricate the seal lips with 2-4-C Marine Lubricant with Teflon, then slide the end plate housing onto the shaft. You may need to tap the housing into the valve guide bracket, to seat it fully.
5. Remove the masking tape from the shaft end.
  - a. Install thru-bolts, flat washers and nuts. Tighten the bolts by hand.
  - b. Torque the end plate bolts and copper sealing washers to 132 lb-in. (15 Nm).
  - c. Torque the thru-bolts to 72 lb-in. (8 Nm).



50453

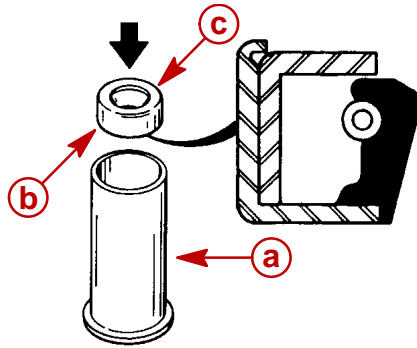


50339

**a** - Put Masking Tape Over Shaft Diameter (Area "a")  
**b** - End Plate Bolts  
**c** - Thru-bolts  
**d** - Drive Shaft

6. Press a new seal, lip facing out, into the seal tube, so that the seal is flush with the end of the tube.

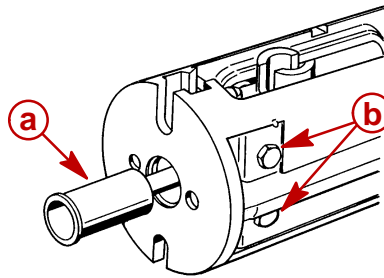
7. Lubricate the I.D. of the seal with 2-4-C Marine Lubricant with Teflon.



50452

- a** - Seal Tube  
**b** - New Seal  
**c** - Lip

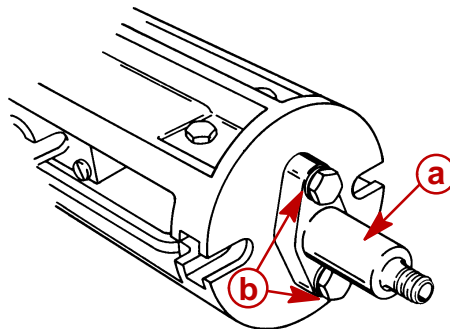
8. Place masking tape over the shaft end to protect the seal.
9. Lubricate the shaft with 2-4-C Marine Lubricant with Teflon.
10. Slide the seal tube (with the seal installed) onto the shaft and slide the seal tube into the valve guide bracket.
11. While holding the seal tube firmly in the seated position in the valve guide bracket, tighten the thru-bolts. Torque the thru-bolts to 72 lb-in. (8 Nm).
12. Remove the masking tape from the shaft end.



50339

- a** - Seal Tube  
**b** - Thru-bolts

13. Install the inlet flange (a) along with a new gasket.
14. Secure the flange and gasket with two bolts and lockwashers. Torque the bolts to 132 lb-in. (15 Nm).

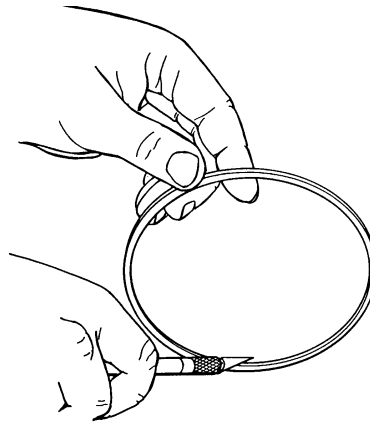


50421

- a** - Inlet Flange  
**b** - Two Bolts and Lockwashers



15. If the piston seal is not pre-cut, make a diagonal cut/separation as shown.



50339

16. Install the O-ring in the O.D. groove in the piston.

17. Install the piston seal over the O-ring.

18. Install the snap ring on the shaft.

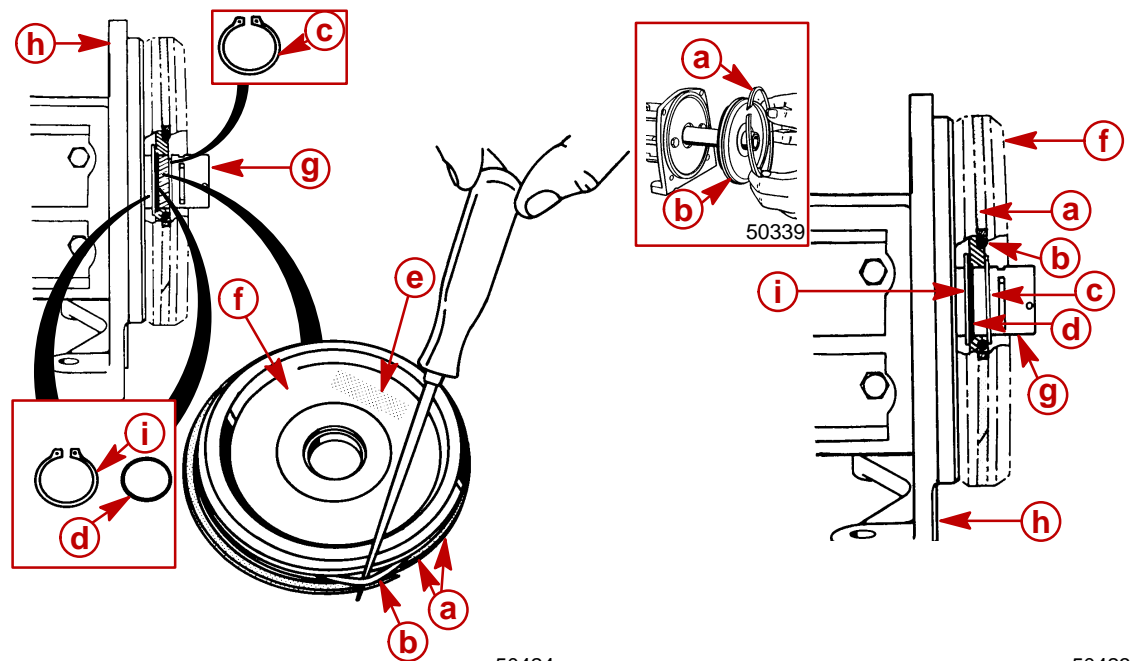
19. Make sure the snap ring is fully seated in its groove.

20. Install the O-ring onto the shaft.

21. Slide the O-ring down to the snap ring.

22. Slide the piston onto the shaft. Secure the piston with a snap ring.

23. Ensure the snap ring is fully seated in its groove.

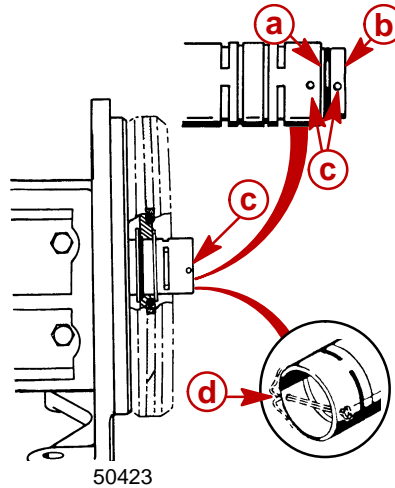


50424

50423

- a** - Piston Seal
- b** - O-ring (Under Piston Seal)
- c** - Snap Ring (Outer)
- d** - O-ring (On Shaft)
- e** - Casting Number (This Side In, Toward The End Plate)
- f** - Piston
- g** - Shaft
- h** - End Plate/Housing
- i** - Snap Ring (Inner)

24. Install a new O-ring onto the shaft end plug.
25. Lightly lubricate the O-ring with 2-4-C Marine Lubricant with Teflon and insert the plug into the shaft end. Be careful not to damage the O-ring. A damaged O-ring will cause a vacuum leak.
26. Align the cotter pin holes and secure the end plug to the shaft with a cotter pin. Spread both ends of the cotter pin.

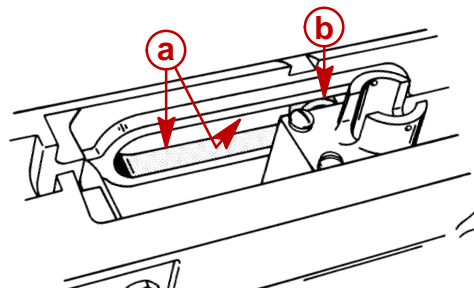


50422

50424

- a** - O-ring
- b** - Shaft End Cap
- c** - Cotter Hole(s)
- d** - Cotter Pin Ends

27. Liberally apply 2-4-C Marine Lubricant with Teflon to each side of the slide rails and wheel.

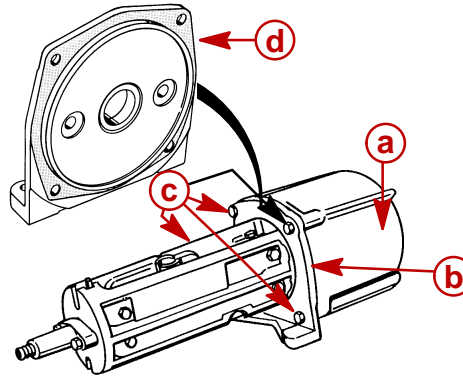


50426

- a** - Slide Rails
- b** - Wheel

28. Install a paper gasket onto the end plate. Hold the gasket in place with 2-4-C Marine Lubricant with Teflon.

29. Attach the cylinder to the end plate with 4 bolts and lock washers. Torque the bolts to 204-276 lb-in. (23-31 Nm).



50425

50339

- a** - Cylinder
- b** - End Plate
- c** - 4 Bolts and Lockwashers
- d** - Paper Gasket

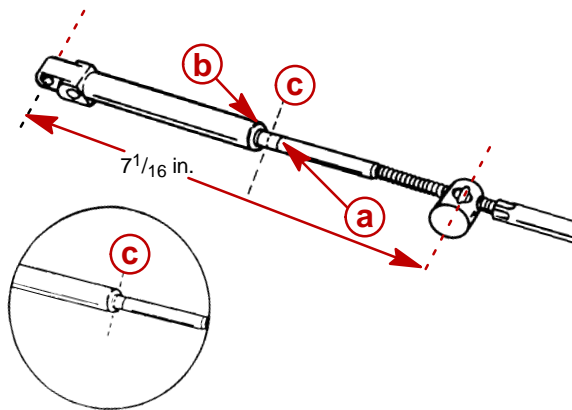
# Shift Cable Replacement and Adjustment

## Installation Preparation

If installing a new shift cable(s), complete the hookup to the remote control and route the shift cable(s) before starting the following procedures.

## Shift Cable Barrel Adjustment

1. Shift the remote control into NEUTRAL.
2. Push in on the input shift cable end guide with enough pressure to remove free-play and mark position "a" on the tube.
3. Pull out on the input shift cable end guide with enough pressure to remove free-play and mark position "b."
4. Measure the distance between marks "a" and "b," then mark position "c" halfway between them. Position "c" marks the center of free-play.
5. Position the cable end guide at the center of free-play.
6. Adjust the barrel so that the distance between the centerline of the cable end guide mounting hole, and the centerline of the cable barrel hole is  $7\frac{1}{16}$  in. (179 mm) apart (with the end guide in position "c").

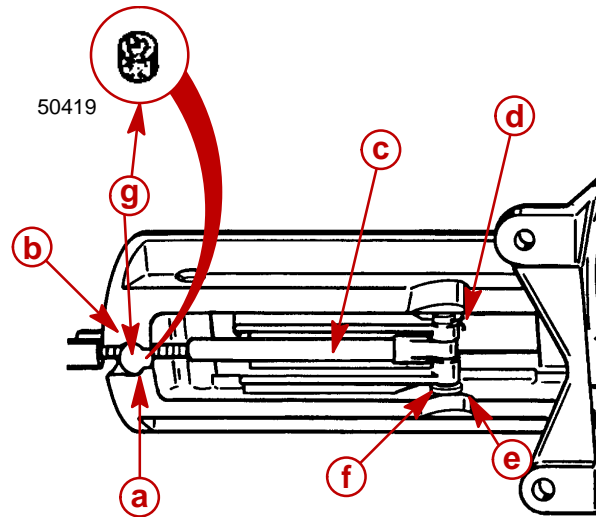


22024

- a** - Position "a"
- b** - Position "b"
- c** - Position "c"

## Installing Input Cable

1. Install the input cable as shown. Take care not to change the position of the barrel.
2. Place a round felt plug in the valve guide bracket hole on top of the cable barrel.

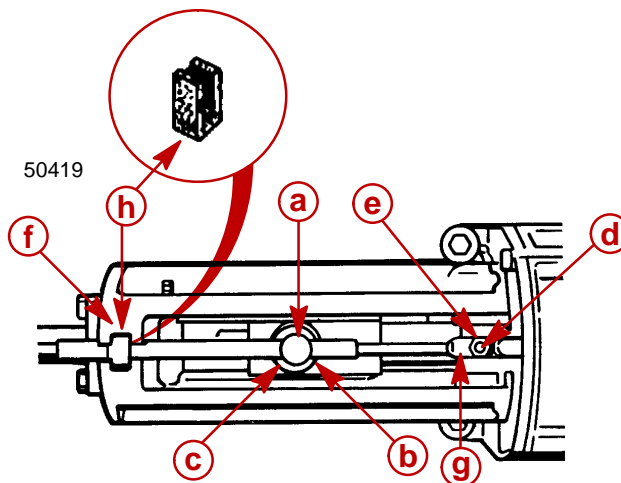


- a** - Input Cable Barrel
- b** - Valve Guide Bracket
- c** - Cable End Guide
- d** - Cotter Pin
- e** - Clevis Pin
- f** - Input Cable Bracket
- g** - Round Felt Plug

50176

## Installing Output Cable

1. Install output cable as shown.
2. Place a rectangular felt spacer in the recess of the valve guide bracket.

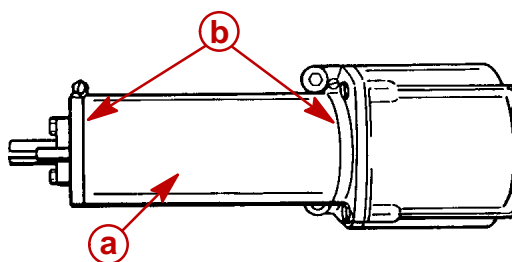


50176

- a** - Output Cable Barrel
- b** - Cotter Pin
- c** - Yoke
- d** - Threaded Stud
- e** - Nut
- f** - Valve Guide Bracket
- g** - Output Cable End
- h** - Rectangular Felt Spacer

## Attach Dust Cover

1. Place the dust cover in to position. The slot in the cover should be on bottom when the power shift cylinder is mounted to the boat.
2. Place clamps around each end of the cover. Tighten securely.



50151

- a** - Dust Cover
- b** - Clamps

**NOTE:** For shift cable adjustment, refer to Section 2A of this manual.

## Mounting Power Shift Cylinder

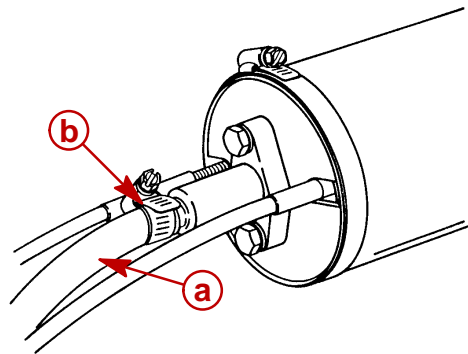
1. Securely fasten the power shift cylinder to the boat with lag screws or bolts.
2. Fasten the input cable to the boat. Do not fasten the cable within 18 in. (457 mm) of the power shift cylinder.

**IMPORTANT:** Do not secure the output cable to the boat or any other cable or hose. The outer conduit of the cable must be free to move back and forth when the unit is shifted.

## Connecting Vacuum Hose to Engine

**IMPORTANT:** Keep the vacuum hose in as straight an incline, from the cylinder to the engine hose fitting, as possible. Avoid a sag (low spot) in the hose.

1. Connect the vacuum hose to power shift cylinder, as shown.
2. Securely tighten the hose clamp.

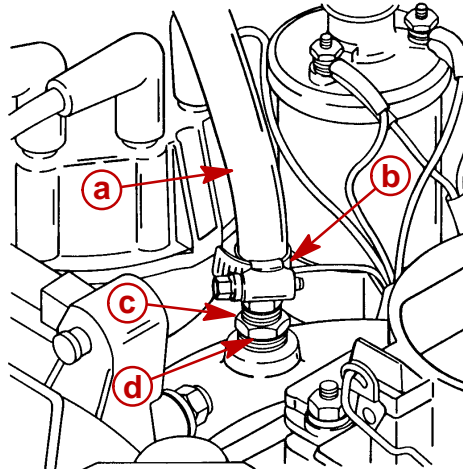


50152

**a** - Vacuum Hose  
**b** - Hose Clamp

3. If replacing the vacuum hose, cut the hose to the length required.

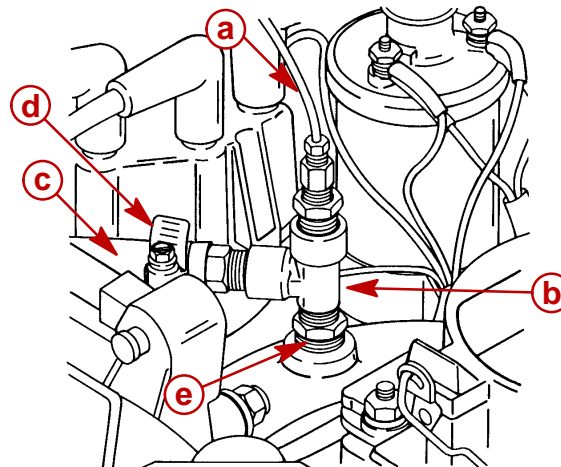
4. Place the hose clamp over the end of the hose and slide the hose over the fitting. Tighten the hose clamp securely.



50152

### Engine WITHOUT Vacuum Gauge Installed

- a** - Vacuum Hose
- b** - Hose Clamp
- c** - Hose Connector Fitting
- d** - Reducer Fitting



50152

### Engine WITH Vacuum Gauge Installed

- a** - Vacuum Gauge Line (To Instrument Panel)
- b** - T-fitting
- c** - Vacuum Hose (From Power Shift Cylinder)
- d** - Hose Clamp
- e** - Reducer Fitting