

SERVICE MANUAL

MODELS
200 • 225 OPTIMAX
DIRECT FUEL INJECTION

With Serial Numbers
United States . . . 0G386496 and Above



Notice

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

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

DANGER

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

WARNING

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

CAUTION

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

Notice to Users of This Manual

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

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

We could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone

who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the products safety will be endangered by the service procedure selected.

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

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

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

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



Cleanliness and Care of Outboard Motor

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

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

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

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

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

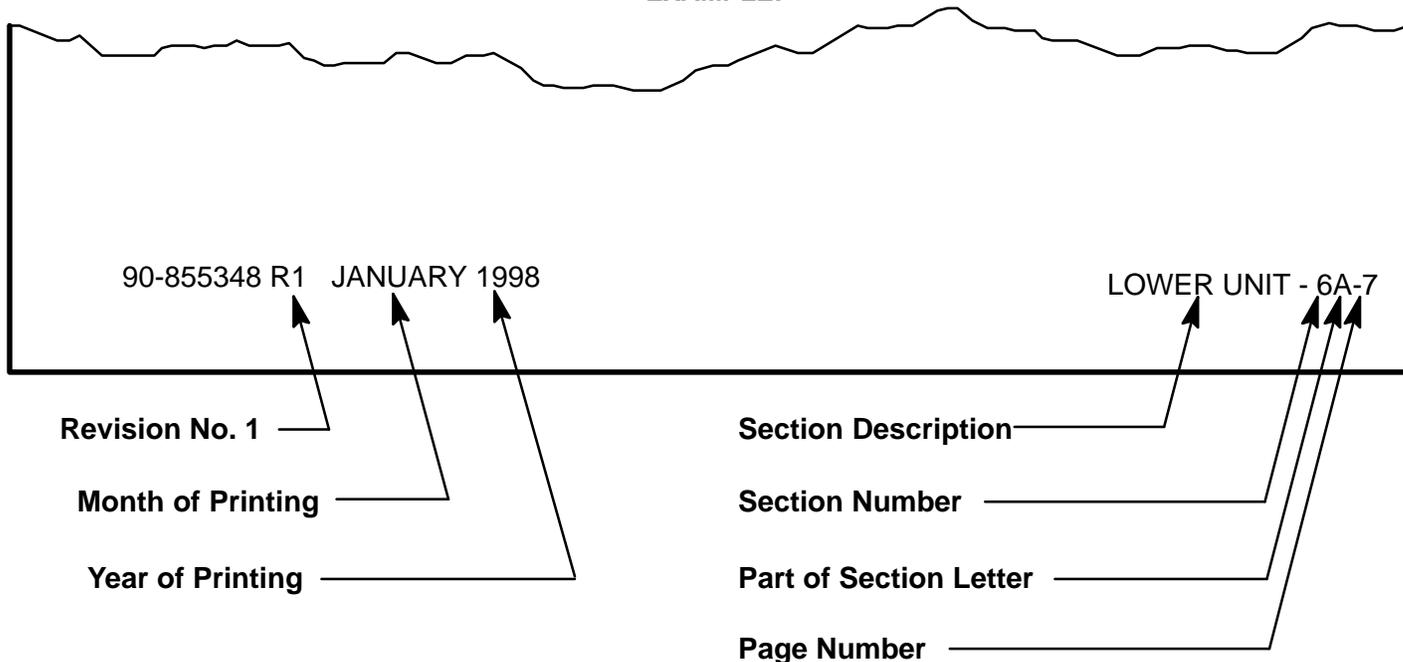
We reserve the right to make changes to this manual without prior notification.

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

Page Numbering

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

EXAMPLE:





Service Manual Outline

Section 1 - Important Information

- A - Specifications
- B - Maintenance
- C - General Information
- D - Outboard Installation

Section 2 - Electrical

- A - Ignition
- B - Charging & Starting System
- C - Timing, Synchronizing & Adjusting
- D - Wiring Diagrams

Section 3 - Fuel System

- A - Fuel Pump
- B - Direct Fuel Injection
- C - Oil Injection
- D - Emissions

Section 4 - Powerhead

- A - Cylinder Block Assembly
- B - Cooling System

Section 5 - Mid-Section

- A - Clamp/Swivel Brackets & Drive Shaft Housing
- B - Power Trim

Section 6 - Lower Unit

- A - Right Hand Rotation
- B - Left Hand Rotation

Section 7 - Attachments/Control Linkage

Important
Information

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Electrical

2

Fuel System

3

Powerhead

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Mid-Section

5

Lower Unit

6

Attachments/
Control Linkage

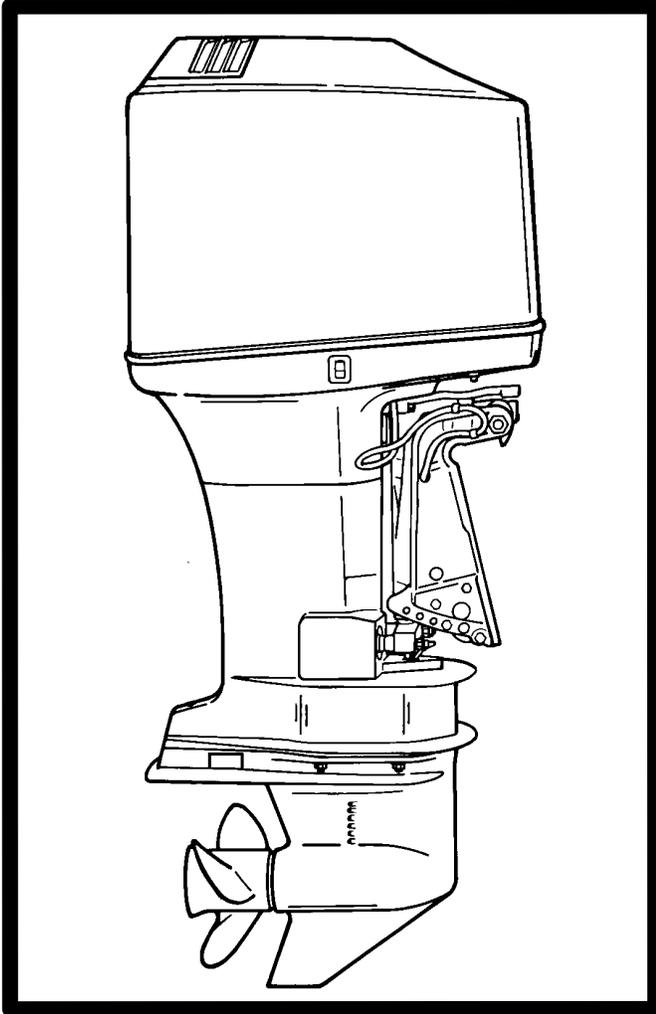
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IMPORTANT INFORMATION

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A



SPECIFICATIONS



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Master Specifications

Model 200/225 DFI		
HORSEPOWER (KW)	Model 200 Model 225	200 (149.2) 225 (167.8)
OUTBOARD WEIGHT	Model 200/225 – 20 in. (50.8cm) Shaft – 25 in. (63.5cm) Shaft	507.0 lbs. (230.0kg) 512.0 lbs. (232.0kg)
CYLINDER BLOCK	Type Displacement Thermostat	V–6 Cylinder, Two Cycle, Loop Charged 185 cu. in. (3032cc) 120°F (48.9°C)
STROKE	Length (All Models)	3.00 in. (76.2mm)
CYLINDER BORE	Diameter (Std) Taper/Out of Round/Wear Maximum Bore Type	3.6265 in. (92.1131mm) 0.003 in. (0.076mm) Cast Iron
PISTON	Piston Type Standard	Aluminum 3.6205 in. ± .0005 in. (91.9607mm ± 0.0127mm)
REEDS	Reed Stand Open (Max.)	0.020 in. (0.50mm)
MID SECTION	Power Trim (Total Tilt Range) Power Trim (Tilt Range) Steering Pivot Range Tilt Pin Adjustment Positions Allowable Transom Thickness	75° 20° 60° 5 2-3/8 in. (6.03cm)
GEAR HOUSING	Gear Ratio Standard Ratio All Models Optional High Altitude Ratio Gearcase Capacity Pinion Height Forward Gear Backlash – 1.75:1/1.87:1 Reverse Gear Backlash – Standard Rotation – Counter Rotation Water Pressure @ RPM	1.75:1 12/21 Teeth 1.87:1 15/28 Teeth 28.0 fl. oz. (828.0ml) 0.025 in. (0.635mm) 0.017 in. – 0.028 in. (0.431mm – 0.711mm) 0.028 in. – 0.052 in. (0.71mm – 1.32mm) 0.040 in. – 0.060 in. (1.0mm – 1.52mm) 8 – 10 PSI Minimum @ 5000 RPM



Master Specifications

Model 200/225 DFI

FUEL SYSTEM	Fuel Recommended Gasoline Recommended Oil Gasoline/Oil Ratio – @ Idle – @ WOT Fuel Pressure Crankcase Pump – @ Idle – @ WOT Electric High Pressure Pump – at all RPM Electric Low Pressure Pump – at all RPM	Gasoline w/Oil Injection Unleaded 87 Octane Minimum Quicksilver TC-W3 Premium Plus 2 Cycle Outboard Oil 300 – 400:1 60:1 2 PSI (13.8kPa) 8 PSI (55.2 kPa) 89 ± 2 PSI (613.7 ± 13.8kPa) Normal Amperage Draw – 6 to 9 Amps 8 – 10 PSI (55.2kPa – 68.9kPa) Normal Amperage Draw 1 to 2 Amps
STARTING SYSTEM	Electric Start – All Models Starter Draw (Under Load) Starter Draw (No Load) Minimum Brush Length Battery Rating	210 Amperes 30 Amperes 0.25 in. (65.4mm) 1000 (Minimum) Marine Cranking Amps (MCA) 750 (Minimum) Cold Cranking Amps (CCA)
IGNITION SYSTEM	Type Spark Plug Type Spark Plug Gap	Digital Inductive NGK PZFR5F-11 (1998 Heavy Duty) NGK ZFR5F-11 (1998 Light Duty) Champion RC10-ECC (1997) 0.040 in. (1.0mm)
CHARGING SYSTEM	Alternator Output (Regulated) Brush Length Voltage Output Regulator Current Draw	30 Amperes @ 750 RPM 60 Amperes @ 2000 RPM Std. Exposed Length: 0.413 in. (10.5mm) Min. Exposed Length: 0.059 in. (1.5mm) 13.5 to 15.1 Volts 0.15 m A (Ign. Switch Off) 30.0 m A (Ign. Switch On)
TIMING		Note: Timing is controlled by the ECM and is not adjustable

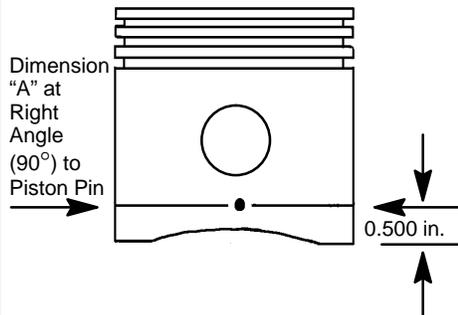


Master Specifications

Model 200/225 DFI		
DIRECT INJECTION	Injectors – Quantity – Injectors are Crank Angle Driven by ECM – #2 Cylinder – #4 Cylinder – #6 Cylinder – #1 Cylinder – #3 Cylinder – #5 Cylinder Line Pressure @ Injectors	6 WHT/RED + RED/WHT Leads WHT/YEL + YEL/WHT Leads WHT/PPL + PPL/WHT Leads WHT/BRN + BRN/WHT Leads WHT/ORG + ORG/WHT Leads WHT/DRK BLU + DRK BLU/WHT Leads 89 ± 2 PSI (613.7kPa ± 13.8kPa)
FUEL INJECTION	Idle RPM (Not Adjustable – Controlled by ECM) Wide Open Throttle (WOT) RPM Float Adjustment (Vapor Separator) Float Level Injectors – Quantity – Injectors are Crank Angle Driven by ECM – #2 Cylinder – #4 Cylinder – #6 Cylinder – #1 Cylinder – #3 Cylinder – #5 Cylinder Line Pressure @ Injectors	650 ± 25 (1997 Models) 550 ± 25 (1998 Models) 5000 – 5750 Preset @ Factory 6 RED/PNK + PNK/RED Leads YEL/PNK + PNK/YEL Leads PPL/PNK + PNK/PPL Leads BRN/PNK + PNK/BRN Leads ORG/PNK + PNK/ORG Leads DRK BLU/PNK + PNK/DRK BLU Leads 89 ± 2 PSI (613.5 ± 13.8kPa)
PISTON DIA.	<p>Dimension "A" at Right Angle (90°) to Piston Pin</p> <p>1 in. (25.4mm)</p>	3.6205 in. ± .0005 in. (91.973 mm ± .0127 mm) Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be 3.6205 in. ± .0005 for a STANDARD size piston (new) Dimension "A" will be 0.001 – 0.0015 less if coating is worn off piston (used)



Master Specifications

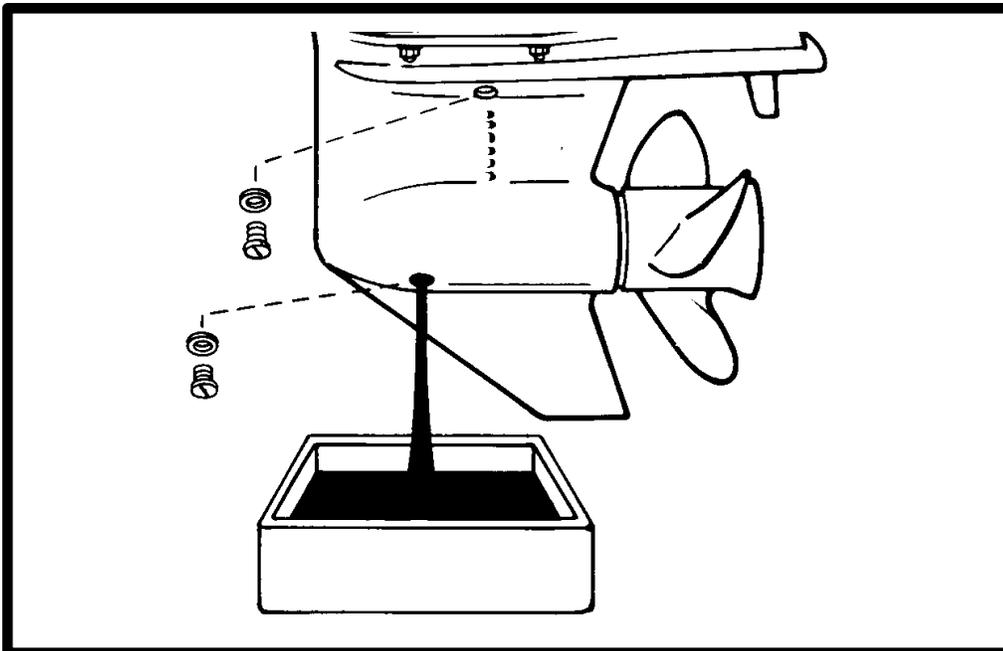
Air Compressor Specifications (Model 200/225 DFI)		
Air Compressor	Type Compressor Output	Reciprocating Piston (1 to 1 ratio with engine RPM) @ Idle – 80 psi @ W.O.T. – 110 psi
Cylinder Block	Displacement	7.07 cu. in. (116cc)
Cylinder Bore	Diameter (Standard) Taper/Out-of-Round/Wear Maximum Bore Type	2.5591 in. (65.0mm) 0.001 in. (0.025mm) Cast Iron
Stroke	Length	1.374 in. (34.9mm)
Piston	Piston Type	Aluminum
Piston Diameter		2.5578 ± .0004 in. (64.97 ± 0.010mm)
Piston Ring	End Gap Top Ring Middle Ring Bottom Ring	0.0059 - 0.0098 in. (0.15 - 0.25mm) 0.0059 - 0.0098 in. (0.15 - 0.25mm) 0.0039 - 0.014 in. (0.10 - 0.35mm)
Reeds	Reed Stand Open	0.010 in. (0.25mm)



IMPORTANT INFORMATION

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B



MAINTENANCE



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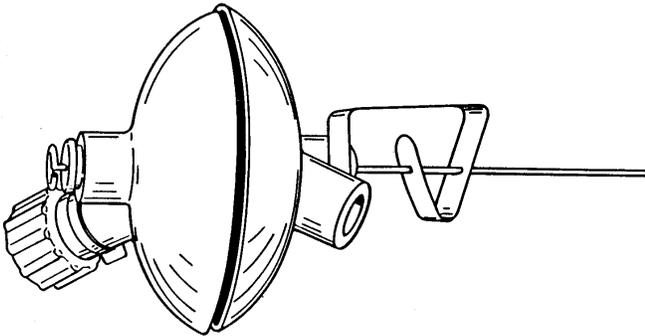
Specifications

Gear Case Lubricant Capacity

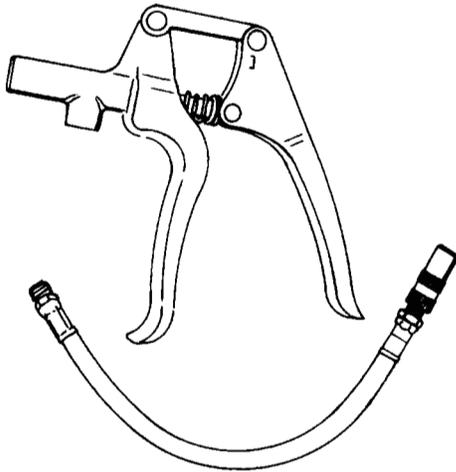
Gear Case Ratio	Capacity
1.75:1	28.0 fl. oz. (828.0ml)
1.87:1	28.0 fl. oz. (828.0ml)

Special Tools

1. Flushing Attachment 44357A2

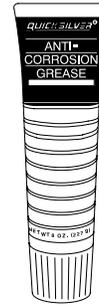


2. Grease Gun 91-37299A1

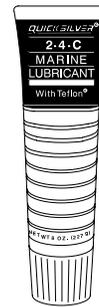


Quicksilver Lubricant/Sealant

1. Quicksilver Anti-Corrosion Grease P/N 92-78376A6



2. 2-4-C Marine Lubricant with Teflon P/N 92-825407A12



3. SAE 30W Motor Oil P/N 97959



4. Quicksilver Gear Lubricant P/N 92-19007A24





Inspection and Maintenance Schedule

Before Each Use

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

After Each Use

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

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

1. Lubricate all lubrication points. Lubricate more frequently when used in salt water.
2. Inspect and clean spark plugs.
3. Replace water separating fuel filter
4. Replace compressor air intake filter.
5. Check corrosion control anodes. Check more frequently when used in salt water.
6. Drain and replace gear case lubricant.
7. Lubricate splines on the drive shaft.*
8. Check power trim fluid.
9. Inspect battery.
10. Check control cable adjustments.*
11. Remove engine deposits with Quicksilver Power Tune Engine Cleaner.
12. Check tightness of bolts, nuts, and other fasteners.
13. Replace water pump impeller (more often if overheating occurs or reduced water pressure is noted).*

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

Before Periods of Storage

FUEL SYSTEM

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

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

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

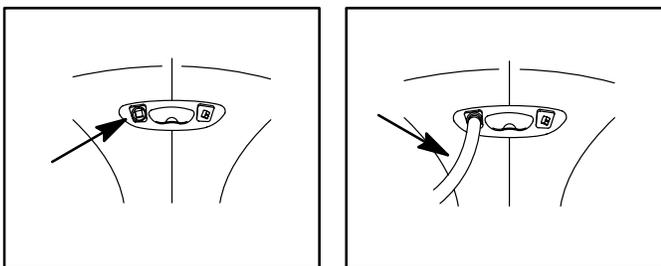


Flushing Engine

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

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

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



2. Attach a water hose to the fitting. Turn water on and flush for 3 to 5 minutes.

NOTE: Engine can be stopped or running at idle speed when flushing the cooling system. Do not flush engine using a water system that exceeds 45psi.

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

⚠ WARNING

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

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

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

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

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

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

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

Fuel System

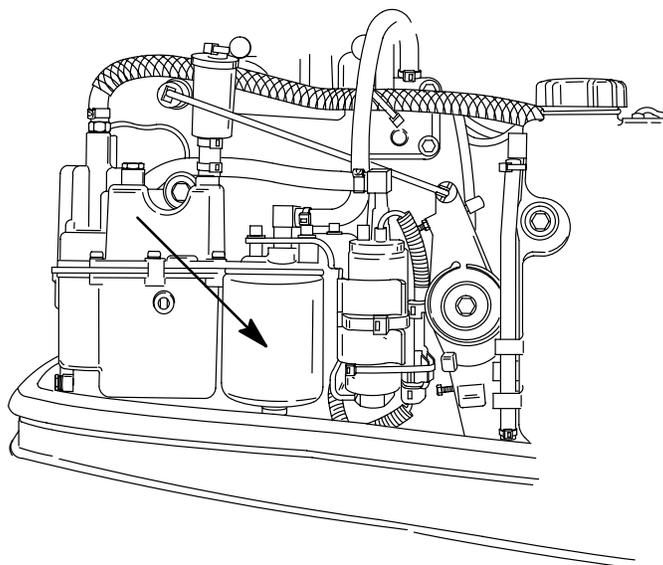
⚠ WARNING

Avoid serious injury or death from gasoline fire or explosion. Carefully follow all fuel system service instructions. Always stop the engine and DO NOT smoke or allow open flames or sparks in the area while servicing any part of the fuel system.

Before servicing any part of the fuel system, stop engine and disconnect the battery. Drain the fuel system completely. Use an approved container to collect and store fuel. Wipe up any spillage immediately. Material used to contain spillage must be disposed of in an approved receptacle. Any fuel system service must be performed in a well ventilated area. Inspect any completed service work for sign of fuel leakage.



Fuel Line Filter



Water Separating Fuel Filter

NOTE: The warning system will turn on when water in the fuel filter reaches the full level. Refer to “Warning System” in Features & Controls Section.

This filter removes moisture and also debris from the fuel. If the filter becomes filled with water, the water can be removed. If the filter becomes plugged with debris, the filter must be replaced with a new filter.

Remove and replace filter as follows:

- a. Turn ignition key switch to OFF position.
- b. Disconnect wire at bottom of filter.
- c. Remove filter by turning the filter in the direction of the arrow (clockwise). Tip the filter to drain fluid in a suitable container.
- d. Lubricate the sealing ring on the filter with oil. Thread on the filter and tighten securely by hand. Reconnect the wire to the filter.

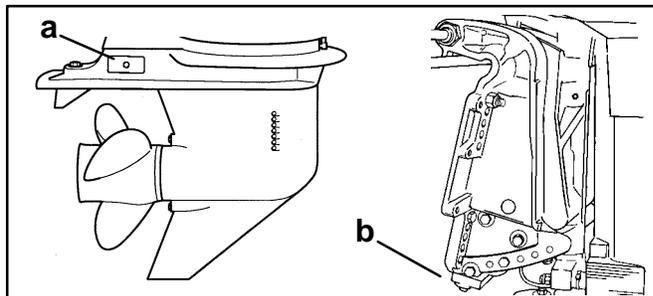
Visually inspect for fuel leakage from the filter by squeezing the primer bulb until firm, forcing fuel into the filter.

Fuel Line Inspection

Visually inspect the fuel line and primer bulb for cracks, swelling, leaks, hardness, or other signs of deterioration or damage. If any of these conditions is found, the fuel line or primer bulb must be replaced.

Corrosion Control Anode

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



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

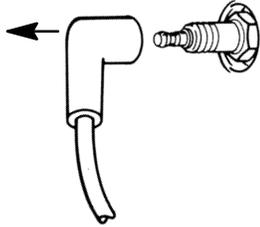
Each anode requires periodic inspection especially in salt water which will accelerate the erosion. To maintain this corrosion protection, always replace the anode before it is completely eroded. Never paint or apply a protective coating on the anode as this will reduce effectiveness of the anode.



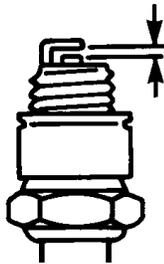
Spark Plug Inspection

Inspect spark plugs at the recommended intervals

1. Remove the spark plug leads by twisting the rubber boots slightly and pull off. Inspect spark plug boots and replace if cracked.



2. Remove the spark plugs to inspect and clean. Replace spark plug if electrode is worn or the insulator is rough, cracked, broken, blistered or fouled.
3. Set the spark plug gap. See Specification Chart in General Information Section.



4. Before reinstalling spark plugs, clean away dirt on the spark plug seats. Install plugs finger tight, and tighten 1/4 turn or torque to 20 lb. ft. (27 N·m).

Battery Inspection

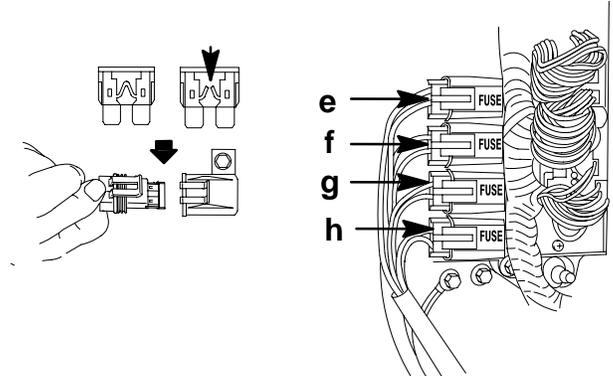
The battery should be inspected at periodic intervals to ensure proper engine starting capability.

IMPORTANT: Read the safety and maintenance instructions which accompany your battery.

1. Turn off the engine before servicing the battery.
2. Add water as necessary to keep the battery full.
3. Make sure the battery is secure against movement.
4. Battery cable terminals should be clean, tight, and correctly installed. Positive to positive and negative to negative.
5. Make sure the battery is equipped with a nonconductive shield to prevent accidental shorting of battery terminals.

Fuse Replacement

The electric starting circuit is protected from overload by an 20 AMP fuse. If the fuse is blown, the electric starter motor will not operate. Try to locate and correct the cause of the overload. If the cause is not found, the fuse may blow again. Replace the fuse with a fuse of the same rating.



The electrical wiring circuits on the outboard are protected from overload by fuses in the wiring. If a fuse is blown, try to locate and correct the cause of the overload. If the cause is not found, the fuse may blow again.

Open the fuse holder and look at the silver colored band inside the fuse. If band is broken, replace the fuse. Replace fuse with a new fuse with the same rating.

The fuses and circuits are identified as follows:

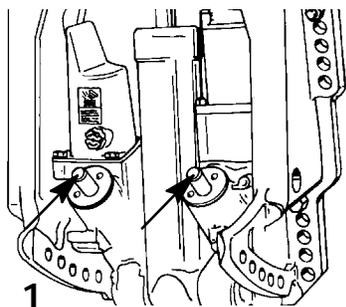
- e. Electric Fuel Pump Circuits – 20 AMP Fuse.
- f. Fuel/Air Injector Circuits – 20 AMP Fuse.
- g. Starting Circuit – 20 AMP Fuse.
- h. Ignition Coil/Oil Pump Circuit – 20 AMP Fuse.



Lubrication Points

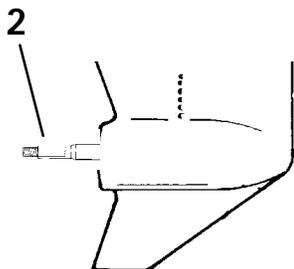
Lubricate Point 1 with Quicksilver Special Lubricant 101.

1. Trim Rod Ball Ends - Turn the ball ends to work the lubricant into the ball sockets.



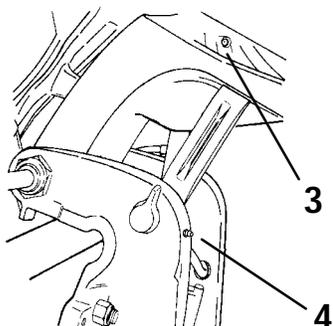
Lubricate Point 2 with Quicksilver Anti-Corrosion Grease or 2-4-C Marine Lubricant with Teflon.

2. Propeller Shaft - Refer to Propeller Replacement for removal and installation of the propeller. Coat the entire propeller shaft with lubricant to prevent the propeller hub from corroding and seizing to the shaft.

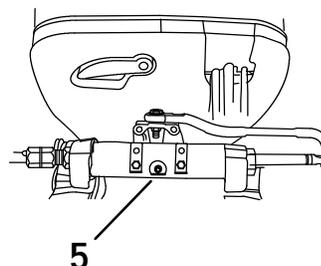


Lubricate Points 3 thru 6 with Quicksilver 2-4-C Marine Lubricant with Teflon or Special Lubricant 101.

3. Swivel Bracket - Lubricate through fitting.
4. Tilt Support Lever - Lubricate through fitting.



5. Tilt Tube - Lubricate through fitting.



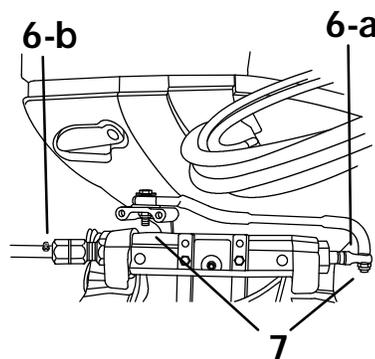
⚠ WARNING

The end of the steering cable must be fully retracted into the outboard tilt tube before adding lubricant. Adding lubricant to steering cable when fully extended could cause steering cable to become hydraulically locked. An hydraulically locked steering cable will cause loss of steering control, possibly resulting in serious injury or death.

6. Steering Cable Grease Fitting (If Equipped) - Rotate steering wheel to fully retract the steering cable end (a) into the outboard tilt tube. Lubricate through fitting (b).

Lubricate Points 7 With Light Weight Oil.

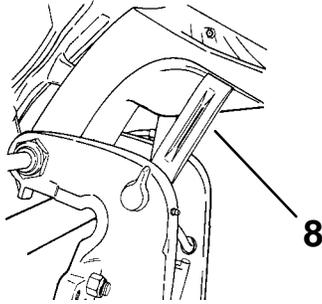
7. Steering Link Rod Pivot Points - Lubricate pivot points.



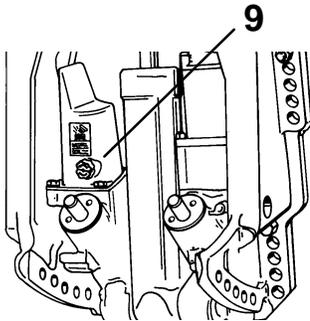


Checking Power Trim Fluid

- Tilt outboard to the full up position and engage the tilt support lock.



- Remove fill cap and check fluid level. The fluid level should be even with the bottom of the fill hole. Add Quicksilver Power Trim & Steering Fluid. If not available, use automotive (ATF) automatic transmission fluid.



Gear Case Lubrication

Gear Case Lubricant Capacity

Gear Case Ratio	Capacity
1.75:1	28.0 fl. oz. (828.0ml)
1.87:1	28.0 fl. oz. (828.0ml)

Draining Gear Case

⚠ WARNING

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

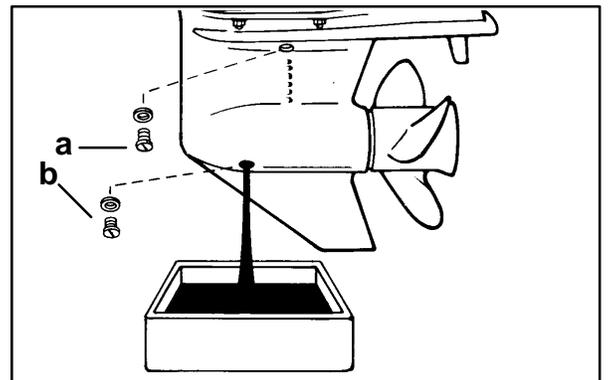
⚠ CAUTION

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

- Tilt outboard so that lubricant in gear housing will drain toward front of housing.

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

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



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



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

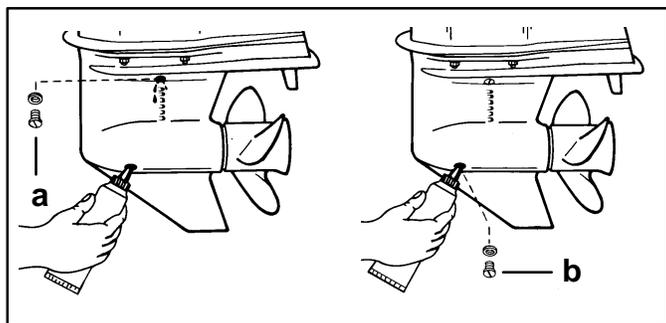
Checking Lubricant Level and Refilling Gear Case

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

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

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

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



a - Vent Screw
b - Fill Screw

Storage

FUEL SYSTEM

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

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

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

PROTECTING INTERNAL ENGINE COMPONENTS

NOTE: Before performing make sure the fuel system has been prepared for storage.

1. Remove spark plugs and add approximately one ounce (30ml) of engine oil into each spark plug hole.
2. Rotate the flywheel manually several times to distribute the oil in the cylinders. Reinstall spark plugs.
3. Remove the water separating fuel filter and empty contents in a suitable container. Replace fuel filter annually or every 100 hours of operation or if a large amount of fuel contamination is present.



PROTECTING EXTERNAL OUTBOARD COMPONENTS

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

GEAR CASE

Drain and refill the gear case lubricant.

POSITIONING OUTBOARD FOR STORAGE

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

⚠ CAUTION

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

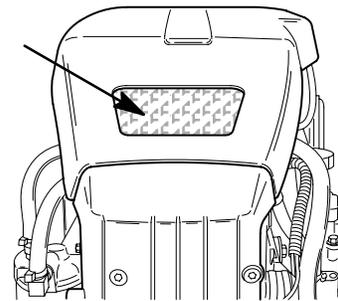
BATTERY STORAGE

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

Compressor Air Intake Filter

1997 Model Compressor Air Intake Filter

The air filter keeps dust and dirt out of the air compressor. The filter is a layered type filter that contains 4 separate filter elements. The filter is not cleanable. The pores in the filter elements clog permanently, requiring filter replacement. We recommend changing the filter every 100 hours of operation, or once a season. **Never run the engine without the air filter.**



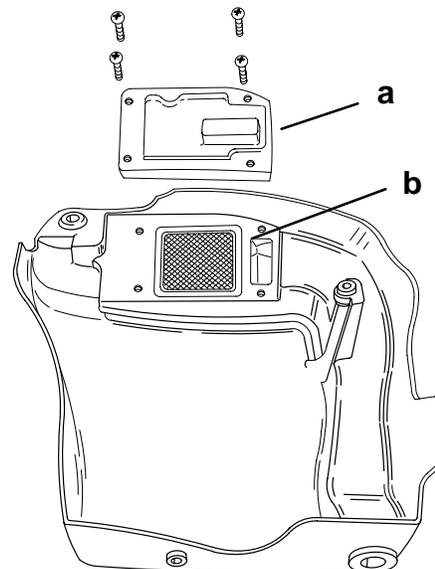
REMOVAL

Remove the filter through the top opening in the flywheel cover.

INSTALLATION

Tuck the filter into the filter pocket. White side of the filter facing out. Spread out the filter so that it fits into the channel that surrounds the pocket.

1998 Model Compressor Air Intake Filter



The filter should be changed every 100 hours of operation, or once a season. **Never run the engine without the air filter.**

Removal

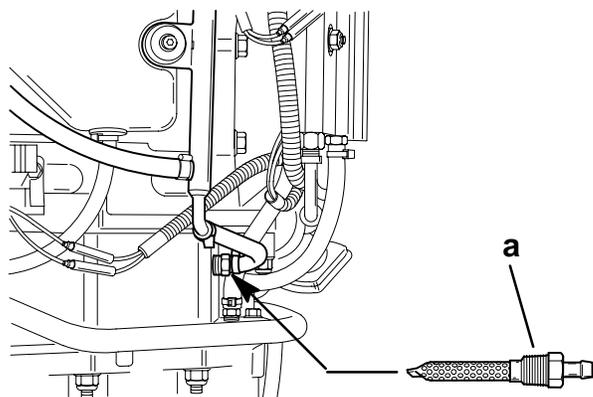
Remove flywheel cover from the engine. Remove cover (a) and the filter (b).

Installation

Install filter (b) into the cover. Fasten cover with four screws.



Cleaning the Cooling Water Strainer



The cooling water strainer (a) filters the cooling water flowing to the fuel cooler and air compressor. We recommend cleaning this strainer every 100 hours of operation, or once a season.

1. Remove the bottom cowl. Disconnect the water hose from the strainer plug.
2. Remove and clean the strainer.
3. Apply Loctite Pipe Sealant w/Teflon (92-88504) to strainer threads and reinstall strainer. Reconnect water hose and secure with sta-strap.

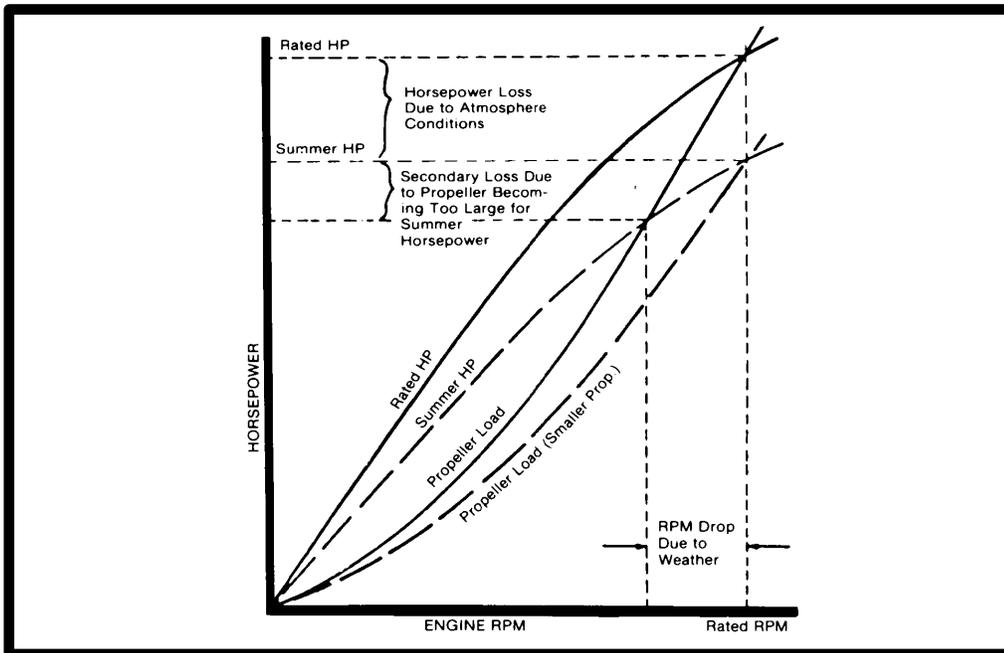
TIMING ADJUSTMENT FOR HIGH ALTITUDE OPERATION

Timing is not adjustable and is controlled automatically by the Electronic Control Unit.



IMPORTANT INFORMATION

1
C



GENERAL INFORMATION



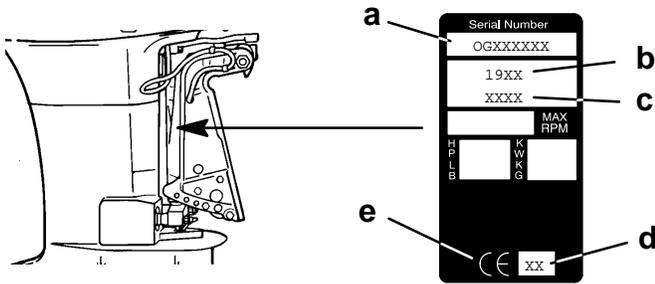
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Serial Number Location

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

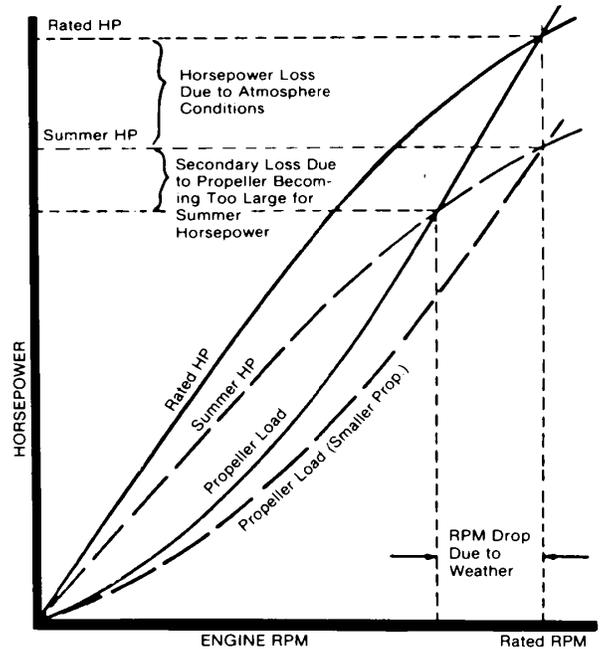


- a - Serial Number
- b - Model Year
- c - Model Designation

- d - Year Manufactured
- e - Certified Europe Insignia

Conditions Affecting Performance

Weather



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

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

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



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

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

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

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

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

Boat

WEIGHT DISTRIBUTION

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

- (1.) Improves ease of planing off.
- (2.) Generally improves rough water ride.
- (3.) If excessive, can make the boat veer back-and-forth (bow steer).

BOTTOM

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



TRIM

TRIMMING OUTBOARD “OUT” (UP)

⚠ WARNING

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

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

TRIMMING OUTBOARD “IN” (DOWN) CHARACTERISTICS

⚠ WARNING

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

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

WATER ABSORPTION

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

CAVITATION

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

VENTILATION

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



Engine Compression

Engine compression should be checked with engine block warm, throttle shutter wide open, all spark plugs removed and using a fully charged battery. Normal compression for all cylinders should be 90 to 110 psi (616.3 – 753.3 kPa). Cylinders should not vary more than 15 psi (103.4 kPa) between one another. A variance of more than 15 psi would indicate the need for a power head inspection/disassembly.

Water Pressure Check

NOTE: To perform these checks, a Water Pressure Gauge Kit, (91-79250A2) is recommended.

1. Water pressure at idle, in NEUTRAL, is 1-1/2 - 4-1/2 psi. (10.3 - 30.8 kPa).
2. Water pressure should increase, then drop to 4-6 psi. (27. - 41 kPa) prior to 2500 RPM (due to poppet valve opening at 2500 RPM).
3. At 2500 RPM, water should not exceed 12 psi (82.7 kPa).
4. Static test (boat stationary - operate in forward gear with a cut down propeller) at 5000 RPM or above is 8 - 10 psi. (54.8 - 68.5 kPa).

CAUTION

A modified propeller or low pitch propeller is required to perform the above static test. Static test requires the boat be stationary in the water secured to a dock or trailer and run in forward gear. DO NOT use a flush device for this test.

Engine

DETONATION

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

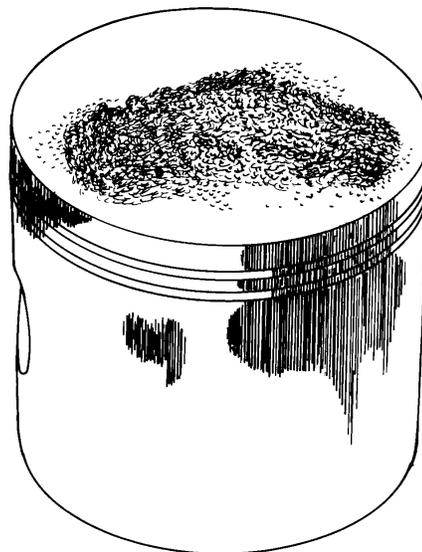
Detonation is an explosion of an unburned portion of the fuel/air charge after the spark plug has fired. Detonation creates severe shock waves in the engine, and these shock waves often find or create a weakness: The dome of a piston, cylinder head/gasket, piston rings or piston ring lands, piston pin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

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

- a. Over-advanced ignition timing.
 - (1.) Use of low octane gasoline.
 - (2.) Propeller pitch too high (engine RPM below recommended maximum range).
 - (3.) Lean fuel mixture at or near wide-open-throttle.
 - (4.) Spark plugs (heat range too hot – incorrect reach – cross-firing).
 - (5.) Inadequate engine cooling (deteriorated cooling system).
 - (6.) Combustion chamber/piston deposits (result in higher compression ratio).

Detonation usually can be prevented if:

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



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Damaged Piston Resulting from Detonation



Following Complete Submersion

Salt Water Submersion

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

Submerged While Running

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

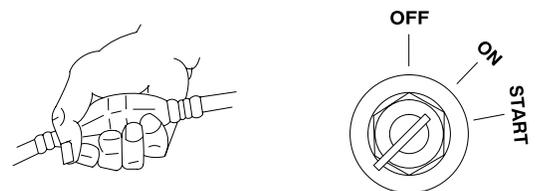
SUBMERGED ENGINE (FRESH WATER)

IMPORTANT: Engine should be run within 2 hours after recovery, or serious internal damage may occur. If unable to start engine in this period, disassemble engine and clean all parts. Apply oil as soon as possible.

NOTE: *If sand has entered the air intake on the engine, do not attempt to start the engine. Sand will cause internal engine damage. Disassembly is required to clean all internal engine components of sand.*

1. Recover engine from water as quickly as possible.
2. Remove cowling.
3. Clean the exterior of the outboard with fresh water.
4. Dry all wiring and electrical components using compressed air.
5. Drain water from fuel system as follows:
 - a. Disconnect remote fuel hose from engine.
 - b. Remove drain plug from vapor separator and drain fuel/water. Reinstall plug after draining.
 - c. Remove the fuel hose from bottom of port side fuel rail and drain fuel/water. Reinstall hose.
 - d. Remove the water separating fuel filter and empty contents.

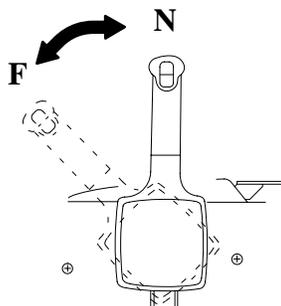
6. Drain water from air compressor system as follows:
 - a. Dry or replace the air filter for the compressor.
 - b. Remove air outlet hose for the air compressor and drain water from compressor and hose. Reinstall hose.
 - c. Remove the air hose from bottom of port side fuel rail and drain water. Reinstall hose.
7. Drain water from engine as follows:
 - a. Remove air sensor from front of the air plenum. Tilt up the outboard and drain water out of the air plenum through the air sensor mounting hole. Reinstall Sensor.
 - b. Remove spark plugs from engine.
 - c. Rotate flywheel manually to blow out any water from the cylinders.
 - d. Add approximately one ounce (30ml) of engine oil into each spark plug hole. Rotate the flywheel manually several times to distribute the oil in the cylinders. Reinstall spark plugs.
8. Drain water from the oil injection system as follows:
 - a. Remove remote oil hose (black without blue stripe) from pulse fitting on starboard side of engine.
 - b. Drain any water from hose and reconnect.
 - c. If water was present in hose, check for water in the remote oil tank. Drain tank if water is present.
9. Disassemble the engine starter motor and dry components.
10. Prime the oil injection pump as follows:
 - a. Fill the engine fuel system with fuel. Connect fuel hose and squeeze primer bulb until it feels firm.
 - b. Turn the ignition key switch to the "ON" position.



- c. Within the first 10 seconds after the key switch has been turned on, move the remote control handle from neutral into forward gear



3 to 5 times. This will automatically start the priming process.



NOTE: Audible click from the oil pump will tell you the pump is priming. It may take a few minutes for the pump to complete the priming process.

11. Attempt to start engine, using a fresh fuel source. If engine starts, it should be run for at least one hour to eliminate any water in engine.
12. If engine fails to start, determine cause (fuel, electrical or mechanical).

Propeller Replacement

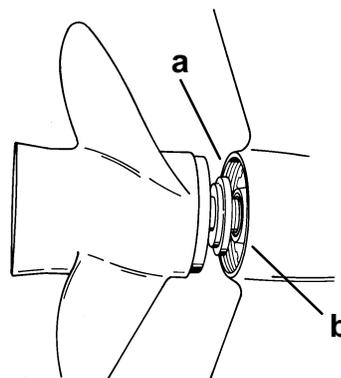
Removal

WARNING

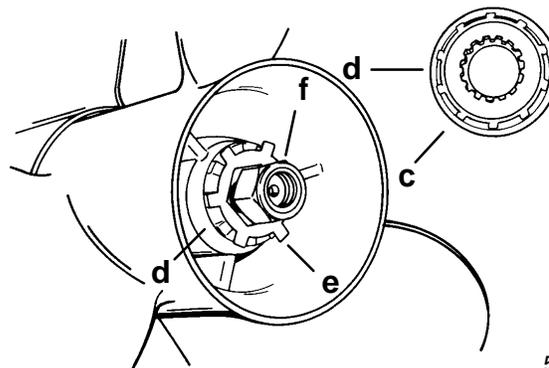
When removing or installing propeller, verify remote control is in NEUTRAL position and that key switch is "OFF." Place a block of wood between the anti-ventilation plate and propeller to prevent accidental engine starting and to protect hands from propeller blades while removing propeller nut.

1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.
2. Shift engine into neutral position.
3. Tilt engine to full up position and engage tilt lock lever.

4. Bend tabs of propeller tab washer away from thrust hub (rear), then remove propeller locknut, tab washer, thrust hub (rear), propeller and thrust hub (forward) from propeller shaft.



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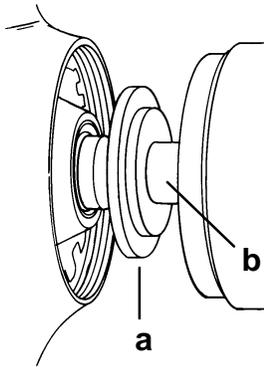
- a - Thrust Hub (Forward)
- b - Propeller Shaft
- c - Continuity Washer (If Equipped)
- d - Rear Thrust Hub
- e - Tab Washer
- f - Propeller Nut

Installation

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



3. Align splines and slide propeller onto shaft.



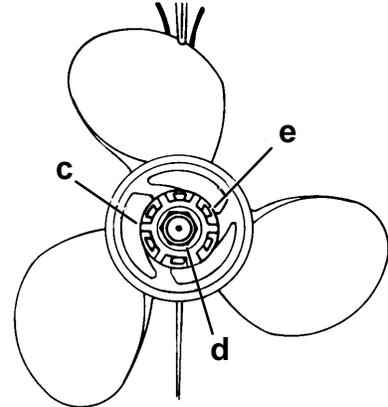
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a - Forward Thrust Hub
b - Propeller Shaft

4. Place locking tab washer on propeller shaft, then thread propeller nut on shaft.
5. Place propeller nut into recess in locking tab washer and torque propeller nut to 55 lb. ft. (74.6 N·m). Verify nut is recessed into tab washer while applying torque.
6. Bend 3 tabs from locking tab washer down into grooves of propeller hub to secure propeller nut.
7. After first use, bend three tabs straight and retorque propeller nut [55 lb. ft. (74.6 N·m)]. Bend tabs down into propeller hub grooves (check periodically for tightness.)

CAUTION

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



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



Painting Procedures

Cleaning & Painting Aluminum Propellers & Gear Housings

WARNING

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

PROPELLERS

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

GEAR HOUSINGS

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

Procedure:

1. Wash gear housing with a muriatic acid base cleaner to remove any type of marine growth, and rinse with water, if necessary.
2. Wash gear housing with soap and water, then rinse.

3. Sand blistered area with 3M 180 grit sandpaper or P180 Gold Film Disc to remove paint blisters only. Feather edge all broken paint edges.
4. Clean gear housing thoroughly with (DX-330) wax and grease remover.
5. Spot repair surfaces where bare metal is exposed with (DX-503) alodine treatment.

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

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

CAUTION

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

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

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

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



Decal Application

Decal Removal

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

Instructions for “Wet” Application

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

TOOLS REQUIRED

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

* Automotive Body Filler Squeegee

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

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

TEMPERATURE

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

SURFACE PREPARATION

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

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

DECAL APPLICATION

1. Mix $\frac{1}{2}$ ounce (16 ml) of dish washing liquid in one gallon (4 l) of cool water to use as wetting solution.

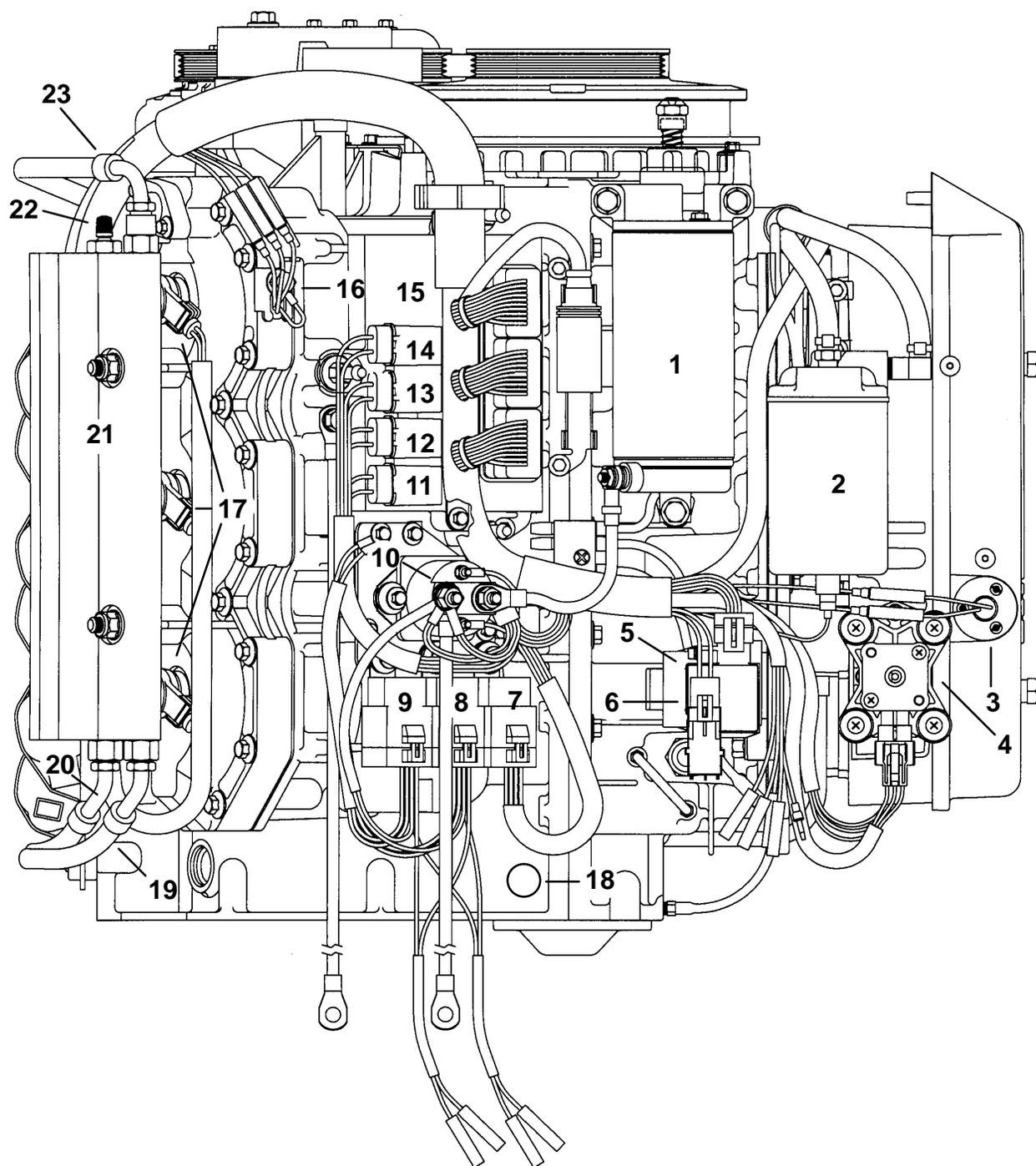
NOTE: Leave protective masking, if present, on the face of decal until final steps of decal installation. This will ensure that the vinyl decal keeps it's shape during installation.

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

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



1997 Model Powerhead Starboard View

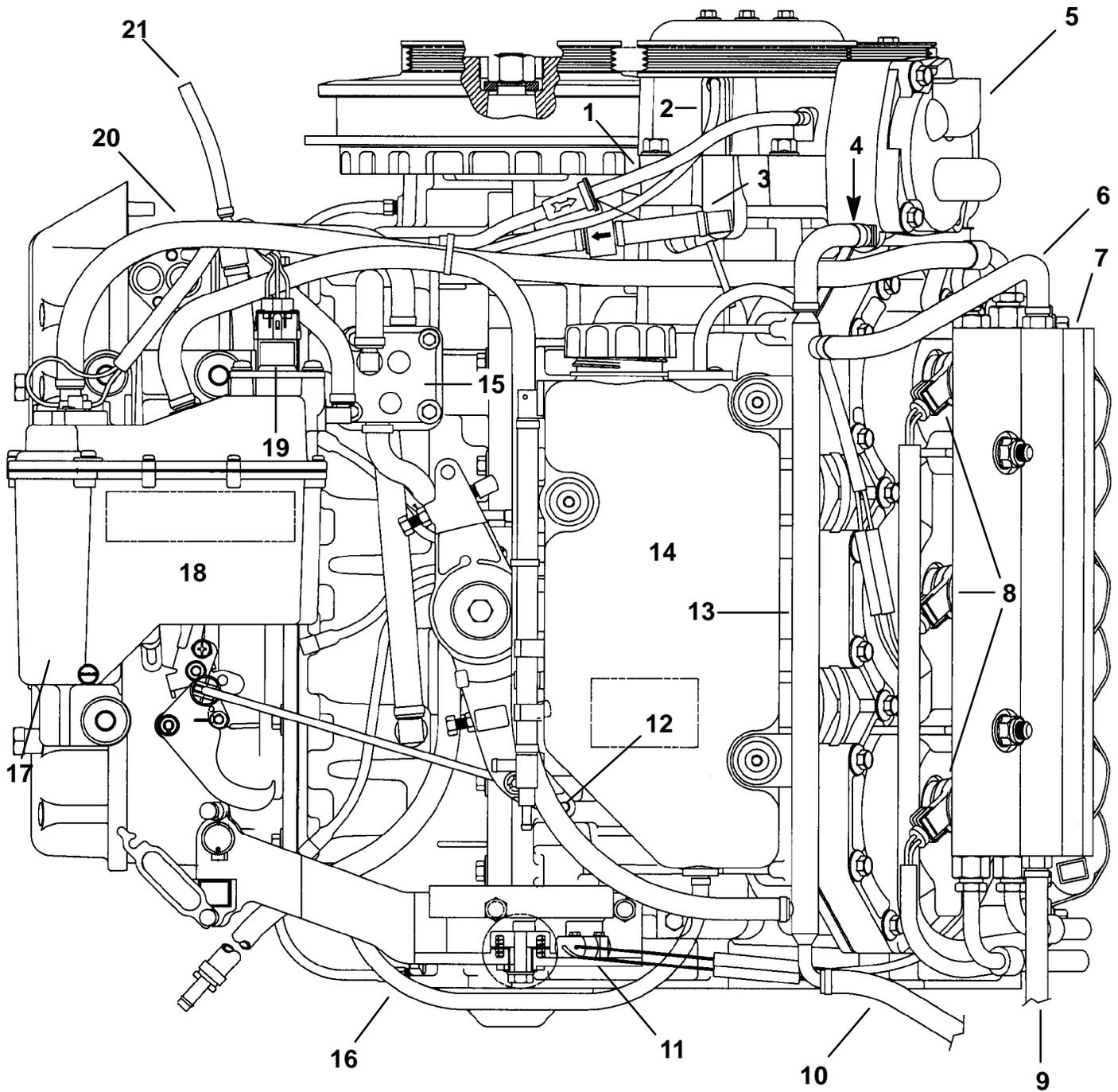


- 1 - Starter Motor
- 2 - Water Separating Fuel Filter
- 3 - Air Temperature Sensor
- 4 - Throttle Position Sensors (2) (Not Adjustable)
- 5 - Oil Pump
- 6 - Diagnostic Port
- 7 - Main Power Relay
- 8 - Trim DOWN Relay
- 9 - Trim UP Relay
- 10 - Starter Solenoid
- 11 - Oil Pump Fuse (20 Ampere)
- 12 - Harness Fuse (20 Ampere)

- 13 -ECM Fuse (20 Ampere)
- 14 -Electric Fuel Pump Fuse (20 Ampere)
- 15 -ECM
- 16 -Temperature Sensor
- 17 -Starboard Direct Injectors
- 18 -Serial Number
- 19 -Air Hose
- 20 -Fuel Hose
- 21 -Starboard Fuel Rail
- 22 -Fuel Pressure Test Valve
- 23 -Air Hose



1997 Model 200 Powerhead Port View

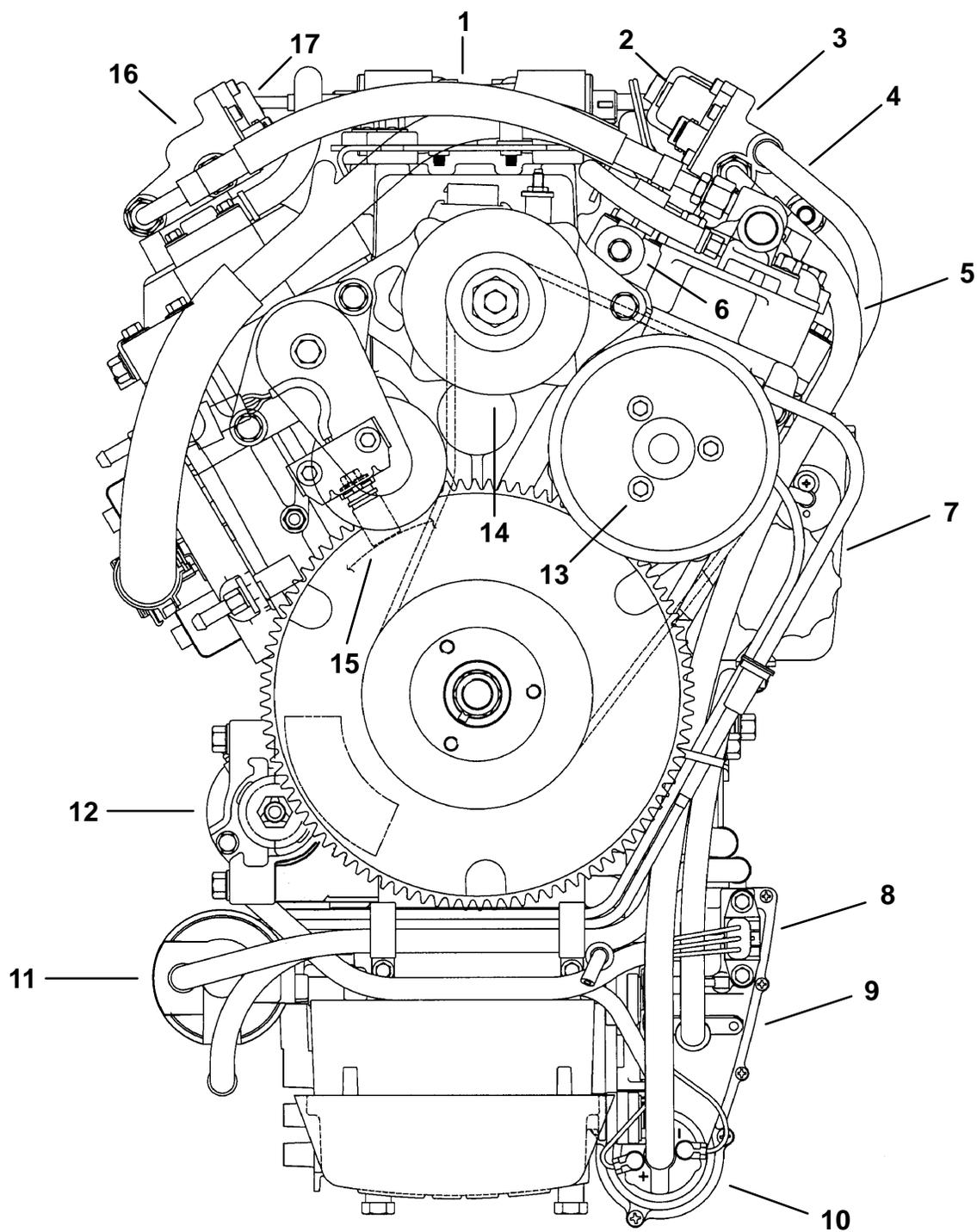


- 1 - Bleed Oil Inlet Hose to Air Compressor
- 2 - Oil Inlet Hose to Air Compressor
- 3 - Excess Oil Return to Throttle Plate Body
- 4 - Water (IN) to Air Compressor
- 5 - Air Compressor
- 6 - Fuel Return to Fuel Cooler
- 7 - Port Fuel Rail
- 8 - Direct Injectors
- 9 - Air Exit to Exhaust Adaptor Plate
- 10 - Water from Exhaust Adaptor Plate
- 11 - Shift Interrupt Switch

- 12 -Fuel Return to Vapor Separator
- 13 -Fuel Cooler
- 14 -Oil Reservoir
- 15 -Pulse Fuel Pump
- 16 -Oil Hose to Oil Pump
- 17 -Electric Fuel Pump
- 18 -Vapor Separator
- 19 -MAP Sensor
- 20 -Fuel Hose to Fuel Rail
- 21 -To Air Filter Box



1997 Model 200 Powerhead Top View

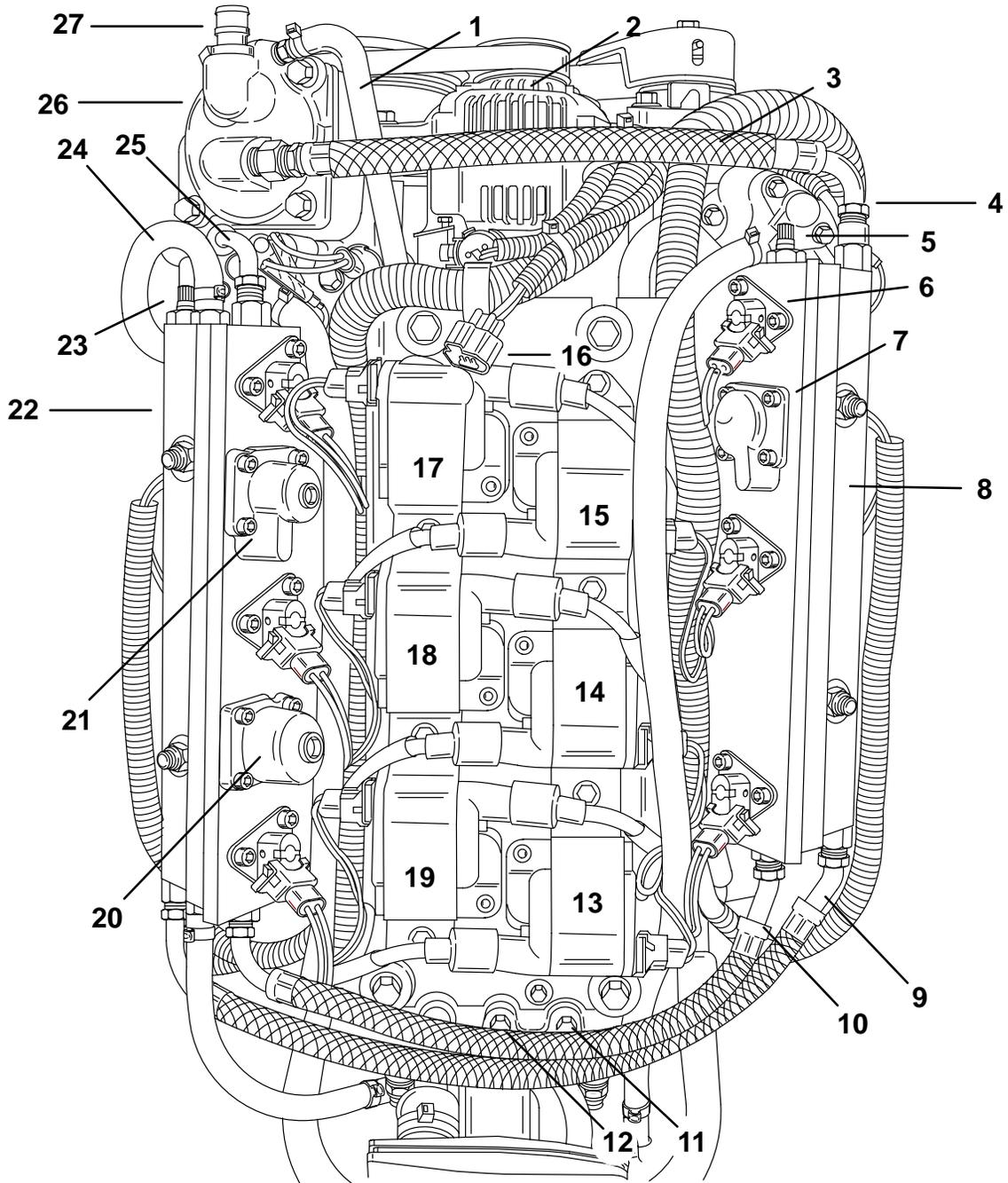


- 1 - Compressed Air (IN)
- 2 - Fuel Pressure Regulator
- 3 - Port Fuel Rail
- 4 - Fuel Return Hose to Fuel Cooler
- 5 - Fuel (IN) Hose
- 6 - Knock Sensor
- 7 - Oil Reservoir
- 8 - MAP Sensor
- 9 - Vapor Separator

- 10 - Electric Fuel Pump
- 11 - Water Separating Fuel Filter
- 12 - Starter Motor
- 13 - Air Compressor
- 14 - Alternator
- 15 - Crank Position Sensor
- 16 - Starboard Fuel Rail
- 17 - Tracker Diaphragm



1997 Model 200 Powerhead Aft View

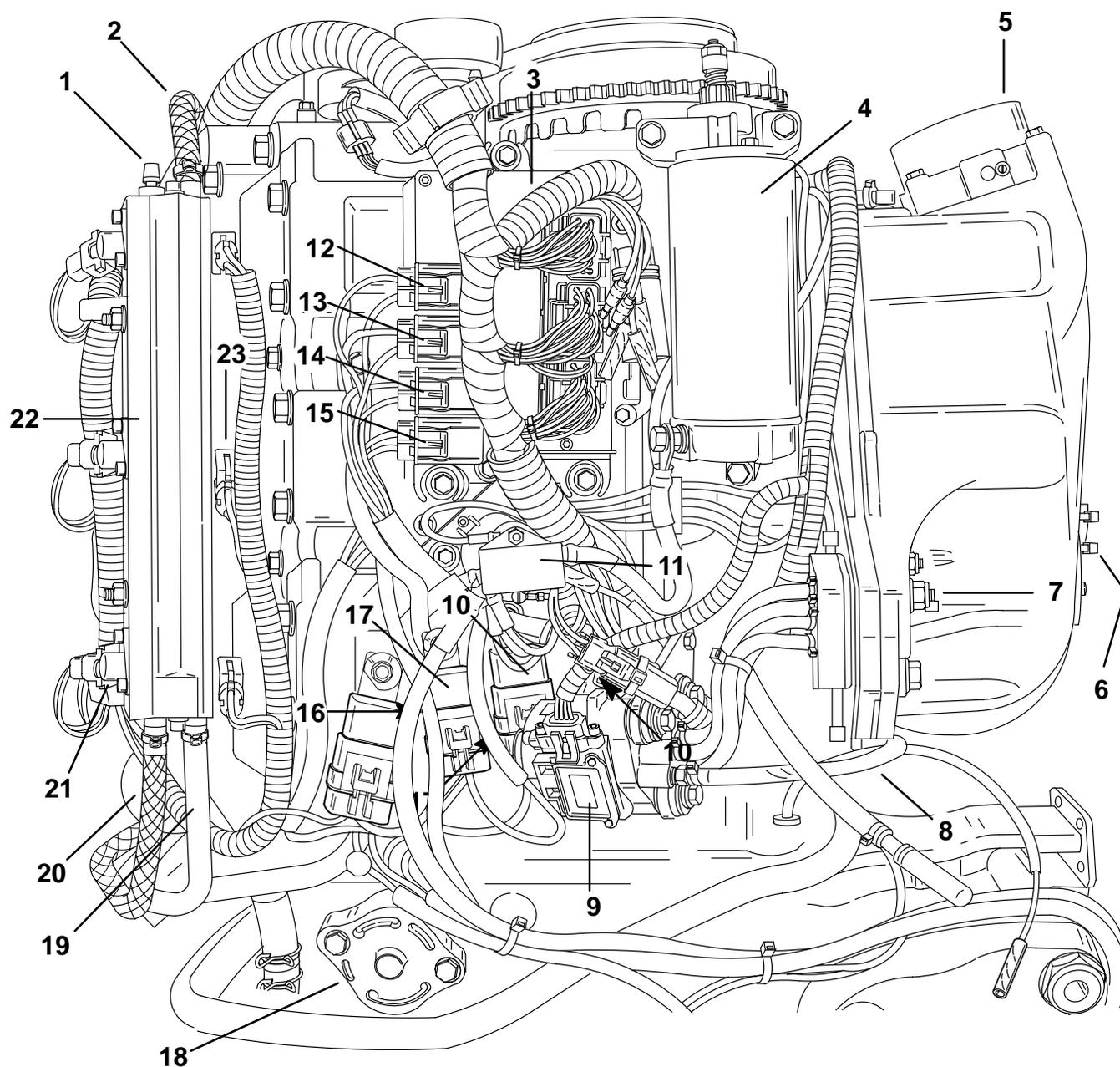


- 1 - Air Compressor Cooling Water (OUT) to Tell-Tale
- 2 - Alternator
- 3 - Compressed Air (IN)
- 4 - Air Fitting Screen
- 5 - Fuel Pressure Test Valve
- 6 - Fuel Injector
- 7 - Tracker Diaphragm
- 8 - Starboard Fuel Rail
- 9 - Air Hose
- 10 - Fuel Hose
- 11 - Not Used
- 12 - Water Pressure Plug
- 13 - #6 Ignition Coil
- 14 - #4 Ignition Coil
- 15 - #2 Ignition Coil

- 16 - Exhaust Pressure Sensor Connector
- 17 - #1 Ignition Coil
- 18 - #3 Ignition Coil
- 19 - #5 Ignition Coil
- 20 - Air Pressure Regulator
- 21 - Fuel Pressure Regulator
- 22 - Port Fuel Rail
- 23 - Air Pressure Test Valve
- 24 - Fuel Return Hose to Fuel Cooler
- 25 - Fuel (IN) Hose
- 26 - Air Compressor
- 27 - Air Inlet for Air Compressor



1998 Model 200/225 Powerhead Starboard View

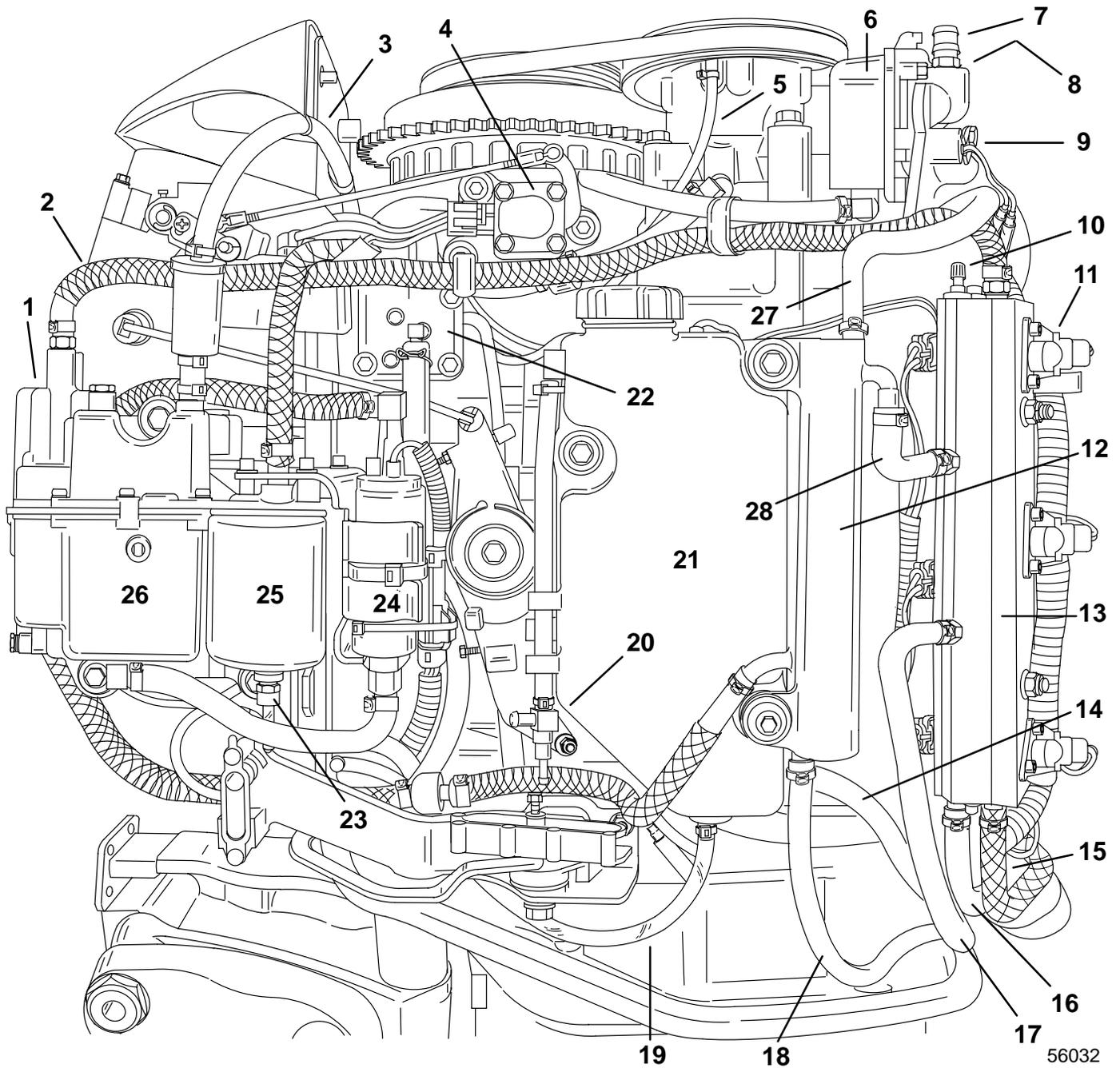


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|--|----------------------------|
| 1 - Fuel Pressure Test Valve | 18 - Poppet Valve Assembly |
| 2 - Air Hose | 19 - Air Hose |
| 3 - Electronic Control Module | 20 - Fuel Hose |
| 4 - Starter Motor | 21 - Fuel Injector |
| 5 - Throttle Plate/Air Plenum Assembly | 22 - Starboard Fuel Rail |
| 6 - Air Temperature Sensor | 23 - Direct Injector |
| 7 - Oil Hose to Air Compressor | |
| 8 - Oil Hose from Oil Tank to Oil Pump | |
| 9 - Oil Pump | |
| 10 - Main Power Relay | |
| 11 - Starter Solenoid | |
| 12 - Electric Fuel Pump Fuse (20 Ampere) | |
| 13 - ECM Fuse (20 Ampere) | |
| 14 - Harness Fuse (20 Ampere) | |
| 15 - Oil Pump Fuse (20 Ampere) | |
| 16 - Trim UP Relay | |
| 17 - Trim DOWN Relay | |



1998 Model 200/225 Powerhead Port View

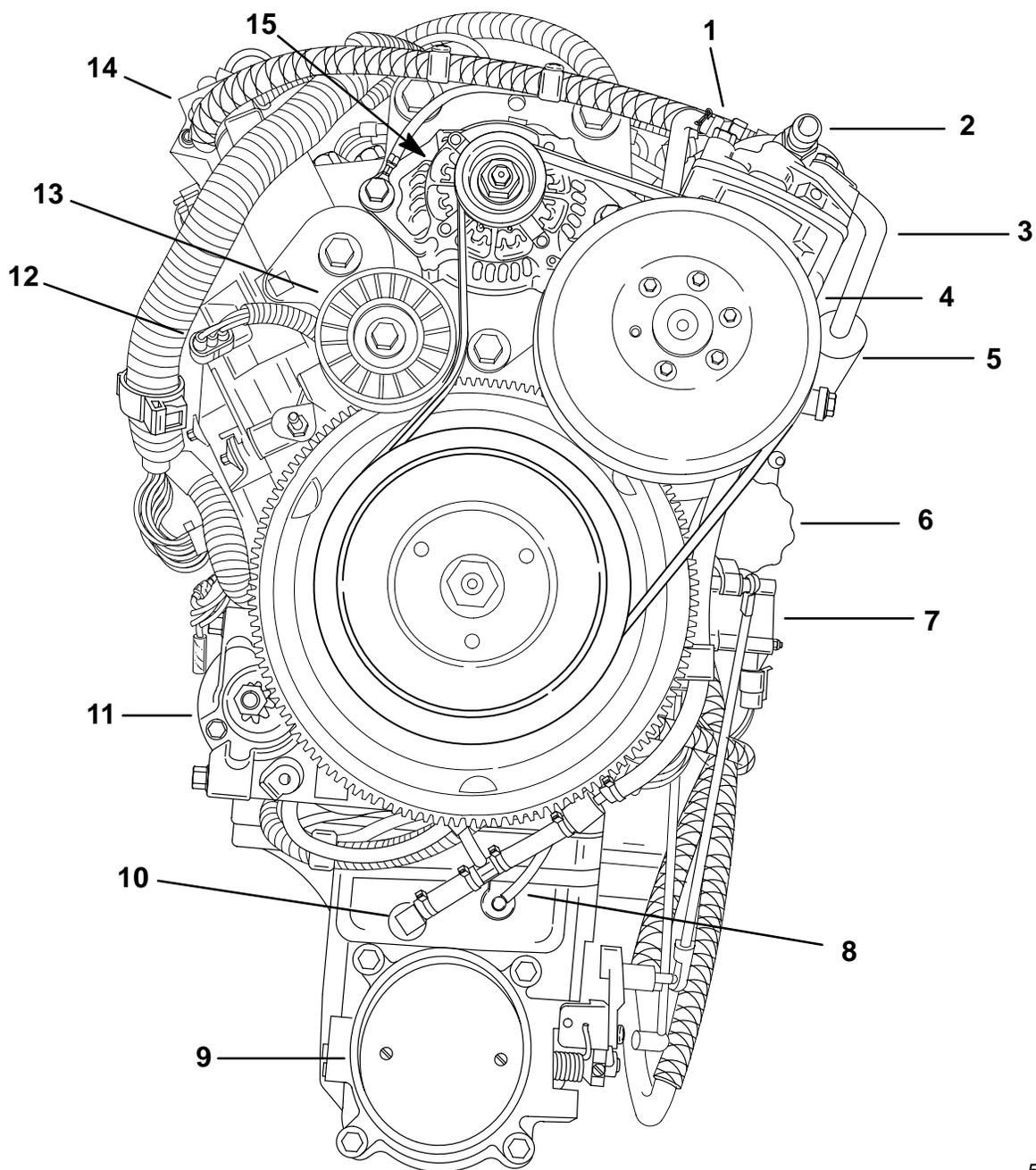


- 1 - High Pressure Fuel Pump
- 2 - Fuel Outlet Hose
- 3 - Vapor Separator Vent Hose
- 4 - Throttle Position Sensor (2 Each)
- 5 - Oil Hose to Air Compressor
- 6 - Air Compressor
- 7 - Air Inlet Hose to Air Compressor
- 8 - Tell-Tale Hose
- 9 - Temperature Sensor
- 10 - Air Pressure Valve
- 11 - Fuel Injector
- 12 - Fuel Cooler
- 13 - Port Fuel Rail
- 14 - Fuel Return Hose to Vapor Separator
- 15 - Air Hose
- 16 - Fuel Hose
- 17 - Air Exit to Exhaust Adaptor Plate

- 18 - Fuel Cooler Water Outlet Hose
- 19 - Oil Hose to Oil Pump
- 20 - 2 PSI Check Valve
- 21 - Oil Reservoir
- 22 - Plus Fuel Pump
- 23 - Water Sensor
- 24 - Low Pressure Fuel Pump
- 25 - Fuel/Water Separator Filter
- 26 - Vapor Separator
- 27 - Water Inlet Hose to Fuel Cooler
- 28 - Fuel Inlet Hose to Fuel Cooler



1998 Model 200/225 Powerhead Top View

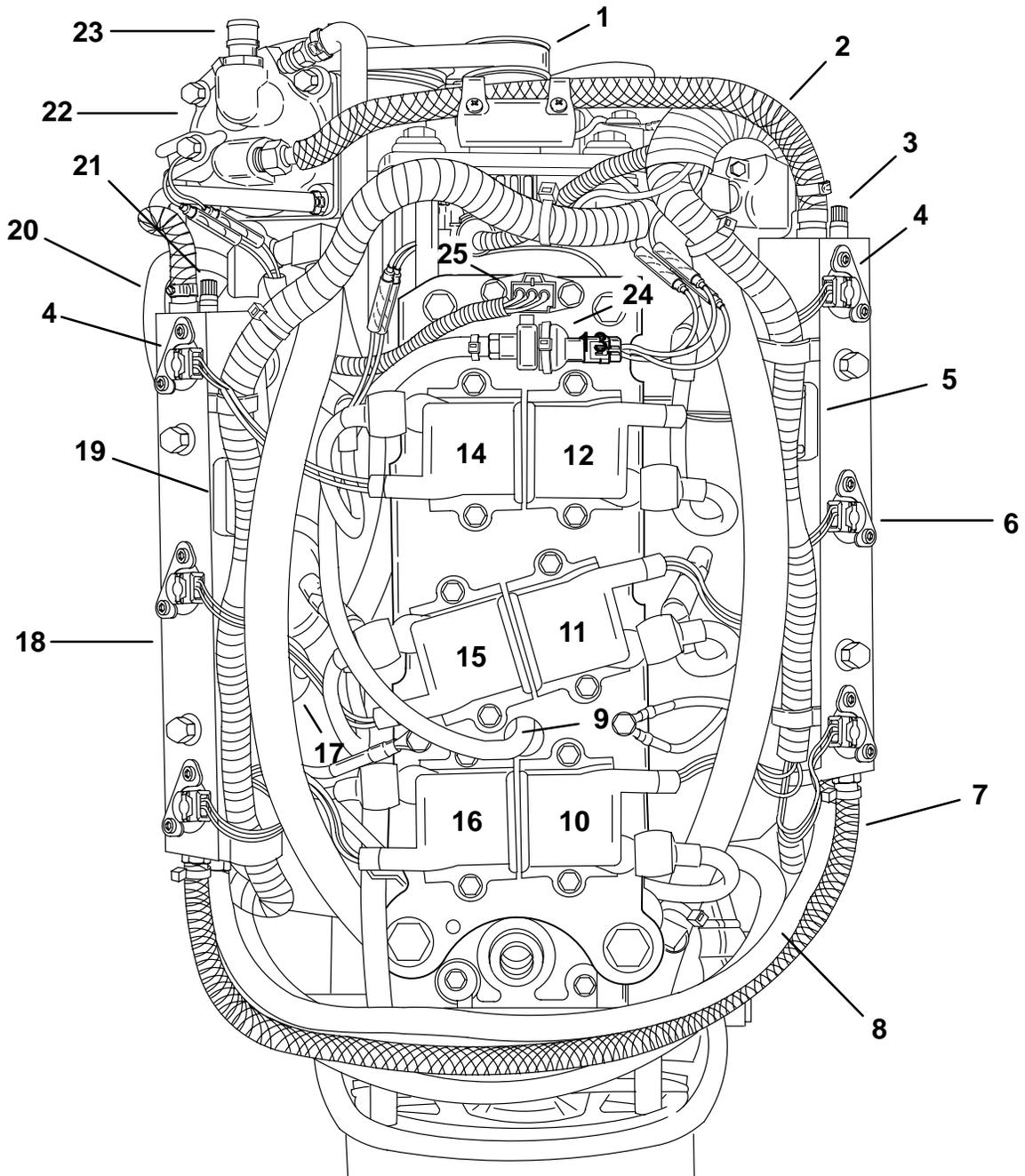


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- 1 - Water Outlet (Tell-Tale) Hose
- 2 - Air Inlet Nozzle for Air Compressor
- 3 - Water Inlet Hose to Fuel Cooler
- 4 - Air Compressor
- 5 - Fuel Cooler
- 6 - Oil Reservoir
- 7 - Throttle Position Sensors (TPS) (2 each)
- 8 - Manifold Absolute Pressure (MAP) Sensor Hose
- 9 - Throttle Plate Assembly
- 10 - Oil Return Hose from Air Compressor
- 11 - Starter Motor
- 12 - Crank Position Sensor Harness
- 13 - Belt Tensioner
- 14 - Air Hose (80 PSI) to Fuel Rail
- 15 - 60 Ampere Alternator



1998 Model 200/225 Powerhead Aft View

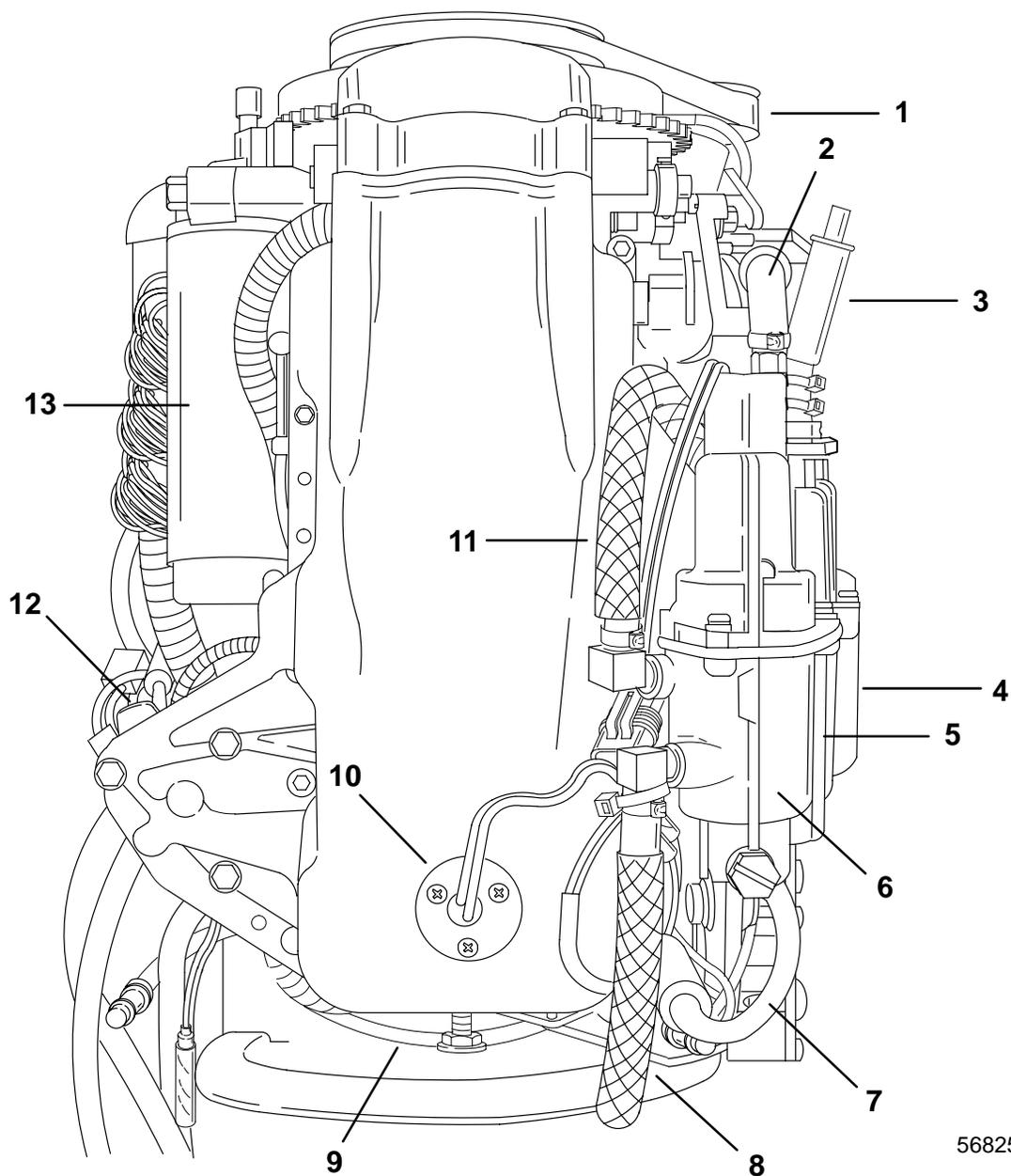


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- | | |
|--------------------------------|--|
| 1 - 60 Ampere Alternator | 18 -Port Fuel Rail |
| 2 - Compressed Air (IN) | 19 -Fuel Regulator |
| 3 - Fuel Pressure Test Valve | 20 -Fuel (IN) Hose |
| 4 - Fuel Injector | 21 -Air Pressure Test Valve |
| 5 - Tracker Valve | 22 -Air Compressor |
| 6 - Starboard Fuel Rail | 23 -Air Inlet Hose to Air Compressor |
| 7 - Air Hose | 24 - Water Pressure Sensor |
| 8 - Fuel Hose | 25 - Manifold Absolute Pressure Sensor |
| 9 - Water Pressure Sensor Hose | |
| 10 -#5 Ignition Coil | |
| 11 -#3 Ignition Coil | |
| 12 -#1 Ignition Coil | |
| 13 -MAP Sensor | |
| 14 -#2 Ignition Coil | |
| 15 -#4 Ignition Coil | |
| 16 -#6 Ignition Coil | |
| 17 -Air Regulator | |



1998 Model 200/225 Powerhead Front View



56825

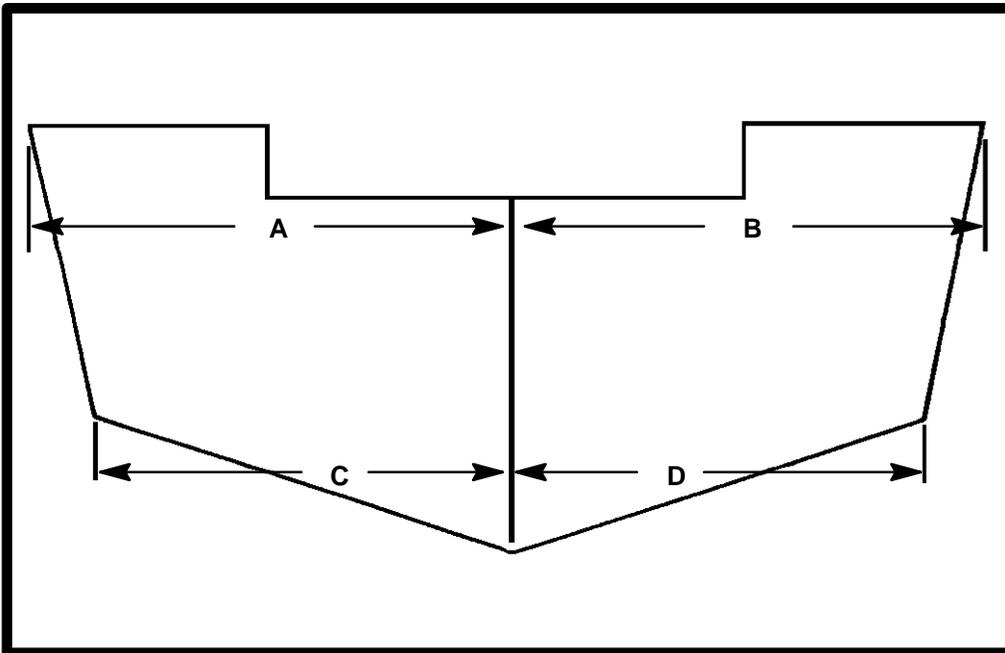
- 1 - Air Compressor
- 2 - Fuel Outlet Hose to Fuel Rails
- 3 - Vapor Separator Vent Filter
- 4 - Fuel/Water Separator
- 5 - Vapor Separator
- 6 - Internal Electric Fuel Pump
- 7 - Inlet Fuel Hose to Pulse Fuel Pump
- 8 - Inlet Fuel Hose to Low Pressure Electric Fuel Pump
- 9 - Inlet Oil Hose to Oil Pump from Oil Reservoir
- 10 - Air Temperature Sensor
- 11 - Outlet Fuel Hose from Low Pressure Electric Fuel Pump
- 12 - Electric Oil Pump
- 13 - Starter Motor



IMPORTANT INFORMATION

1

D



OUTBOARD MOTOR INSTALLATION



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Notice to Installer and Owner

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

WARNING

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

CAUTION

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

Boat Horsepower Capacity

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

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

WARNING

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

Outboard Remote Control

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

WARNING

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

Selecting Accessories For The Outboard

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

Electric Fuel Pump

If an external mounted electric fuel pump is used, the fuel pressure must not exceed 4 psi at the engine. If necessary, install a pressure regulator to regulate the pressure.

WARNING

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

Selecting Steering Cables and Remote Control Cables

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

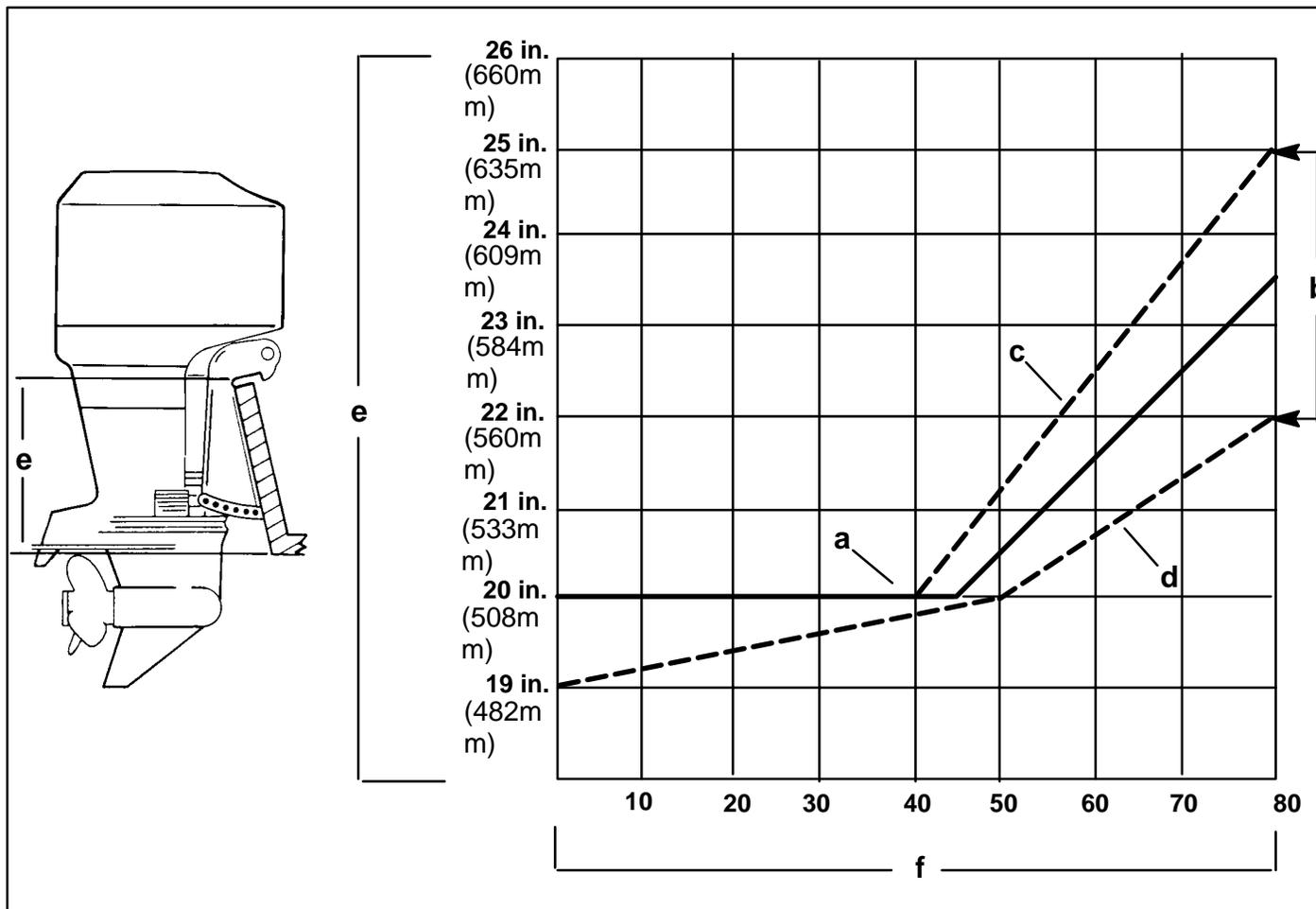
IMPORTANT: Steering cables and remote control cables must be the correct length. Sharp bends on too-short cables result in “kinks”; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables.



Determining Recommended Outboard Mounting Height

⚠ WARNING

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



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

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

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

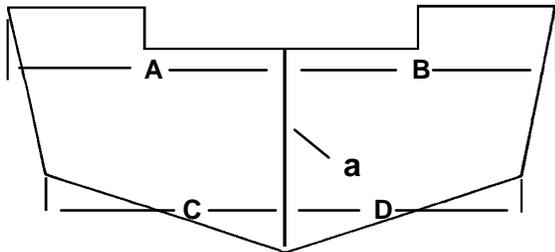
- b. These broken lines represent the extremes of known successful outboard mounting height dimensions.
- c. This line may be preferred to determine outboard mounting height dimension, if maximum speed is the only objective.

- d. This line may be preferred to determine outboard mounting height dimension for dual outboard installation.
- e. Outboard mounting height (height of outboard transom brackets from bottom of boat transom). For heights over 22 in. (560mm), a propeller, that is specifically designed for surfacing operation, such as the “Laser” and “Mirage” series, usually are preferred.
- f. Maximum boat speed anticipated.



Locating Centerline of Boat Transom

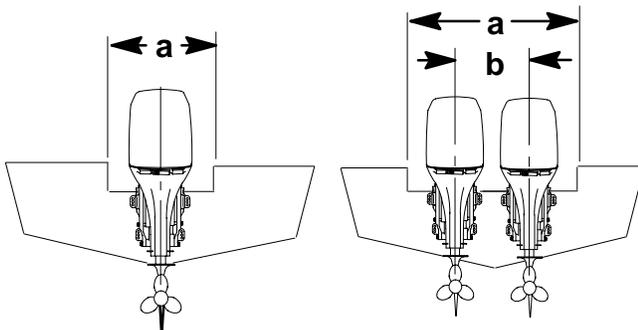
Locate (and mark with pencil) vertical centerline (a) of boat transom.



a - Centerline of Transom

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

Installation Specifications



a – Transom Opening – Minimum Single Engine – 33-3/8 in. (848 mm) Dual Engines – 59-3/4in. (1518 mm)
b – Engine Center Line For Dual Engine 26 in. (660mm) Minimum

Drilling Outboard Mounting Holes

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

⚠ WARNING

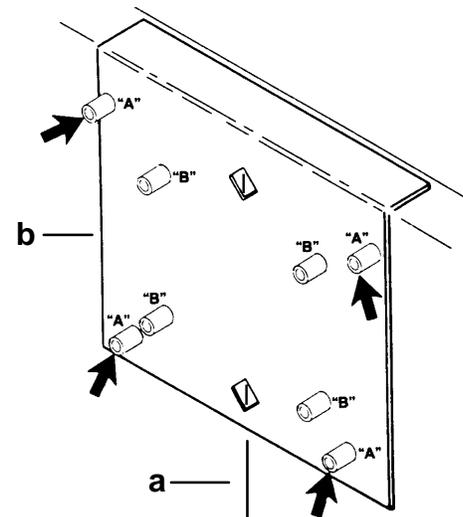
DO NOT, under any circumstances, allow upper

outboard mounting bolts to be closer than 1 in. (25.4 mm) from top of boat transom. Upper mounting bolts must never be installed thru shims.

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

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

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



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

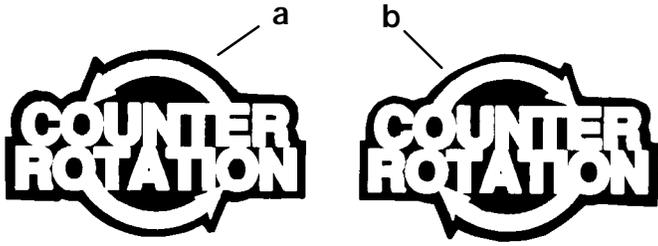
IMPORTANT: During installation of dual or multiple V-6 product, the following is recommended. A minimum of 26 inches (660mm) centerline to centerline width is recommended. This is required to alleviate cowling interference during lock to lock turns if one outboard would be in the full tilt position,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

Applying Counter Rotation Decals

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



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



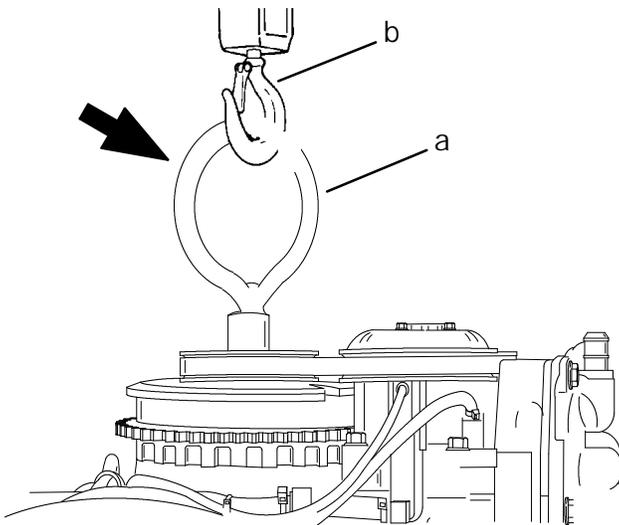
a - Counter Rotation Decal (Left-Hand Rotation Outboard)
b - Counter Rotation Decal (Right-Hand Rotation Outboard)

Lifting Outboard

⚠ WARNING

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

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



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

Installing Outboard To Boat Transom

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

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

⚠ CAUTION

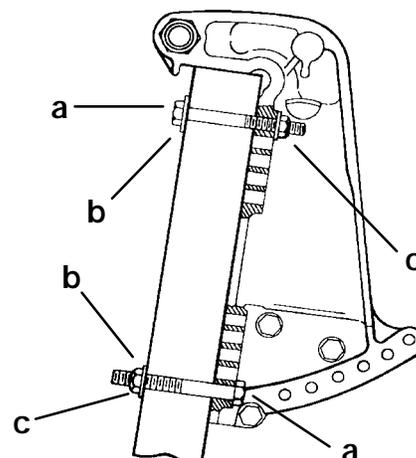
Marine sealer must be used on shanks bolts to make a water-tight installation.

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

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

⚠ WARNING

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



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



Single Steering Cable and Steering link Rod Installation

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

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

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

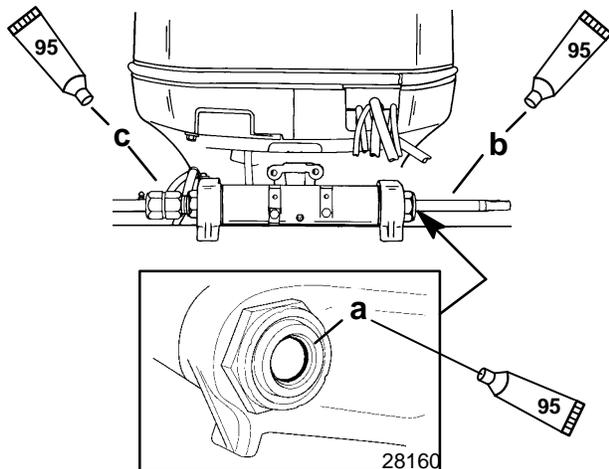
Install steering mount and steering wheel in accordance with installation instructions that accompany each.

Installing Ride Guide Cable to Outboard Tilt Tube

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

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

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



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

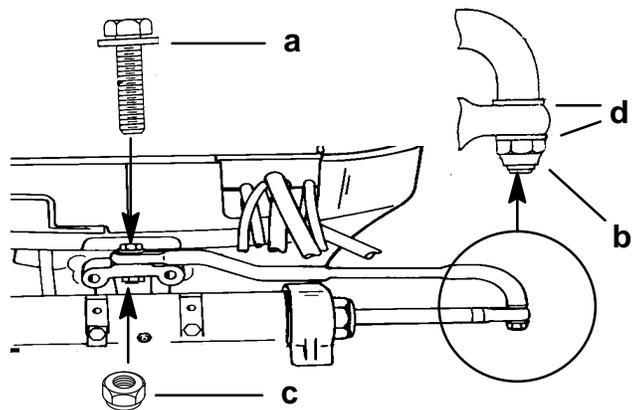
Steering Link Rod Installation

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

⚠ WARNING

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

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



⚠ WARNING

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



Remote Control Installation

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

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

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

Counter (Left Hand) Rotation Outboards

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

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

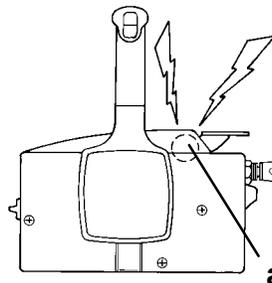
The Quicksilver Commander Series Dual Engine Console Mount Control, P/N 88688A22, is required to shift the counter rotation outboard. The installation instructions shipped with the control explain the procedure required to connect this control to a counter rotation outboard.

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

Required Side Mount Remote Control or Ignition Key Switch Assembly

Boats Equipped with Side Mount Remote Control

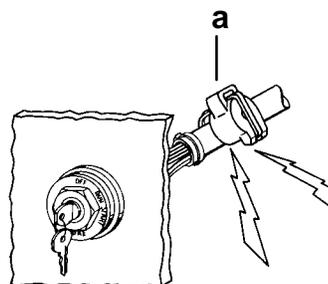
A Quicksilver Commander 2000 series Side Mount Remote Control equipped with a warning horn must be used with this outboard. This warning horn is necessary for the engine warning system.



a -Warning Horn

Boats Equipped with Panel or Console Mount Remote Control

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



a - Warning Horn



Shift and Throttle Cable Installation to the Outboard

Shift Cable Installation

Install cables into the remote control following the instructions provided with the remote control.

NOTE: Install the shift cable to the engine first. The shift cable is the first cable to move when the remote control handle is moved out of neutral.

COUNTER ROTATION OUTBOARDS

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

The Quicksilver Dual Engine Console Mount Control, P/N 88688A22 or 88688A52, is required to shift the counter rotation outboard. The installation instructions shipped with the control explain the procedure required to connect this control to a counter rotation outboard.

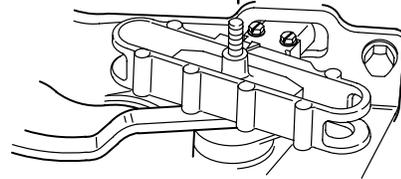
IMPORTANT: If the counter rotation outboard is rigged similar to a standard rotation outboard OR if a standard rotation outboard is rigged similar to a counter rotation outboard, the reverse gear and bearing in the gear case must function as forward gear. THE REVERSE GEAR/BEARING ARE NOT DESIGNED TO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

OUTBOARD SHIFTING DIRECTION

On counter rotation outboards, the shift linkage moves in the opposite direction compared to a standard rotation outboard.

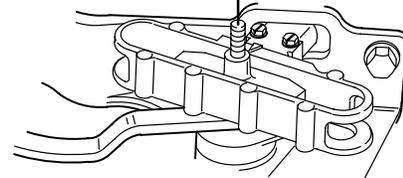
STANDARD ROTATION GEAR OUTBOARDS

Forward Gear ← → Reverse Gear



COUNTER ROTATION OUTBOARDS

Reverse Gear ← → Forward Gear



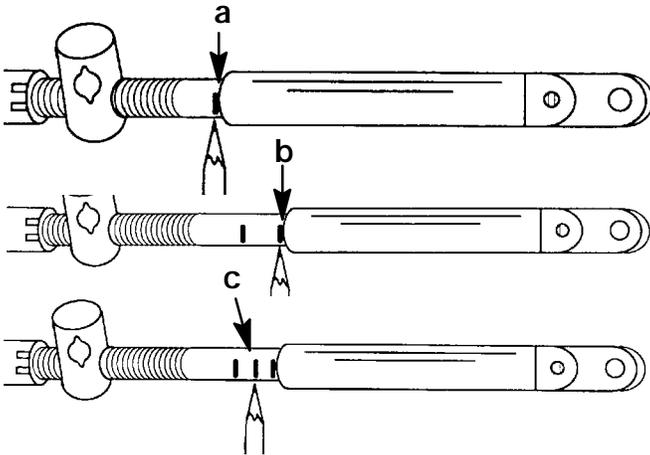


INSTALLATION

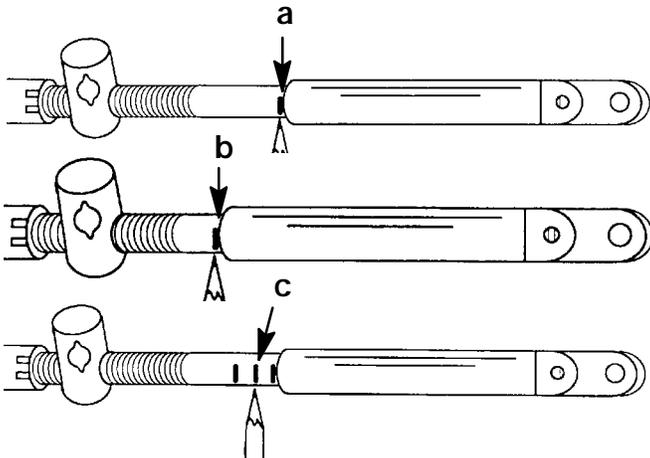
IMPORTANT: Step 1 must be followed for proper adjustment of the shift cable.

1. Locate the center point of the slack or lost motion that exists in the shift cable as follows:
 - a. Move the remote control handle from neutral into forward and advance the handle to full speed position. Slowly return the handle back to the neutral. Place a mark (a) on the cable against the cable end guide.
 - b. Move the remote control handle from neutral into reverse and advance the handle to full speed position. Slowly return the handle back to the neutral. Place a mark (b) on the cable against the cable end guide.
 - c. Make a center mark (c), midway between marks ("a" and "b"). Align the cable end guide against this center mark when installing cable to the engine.

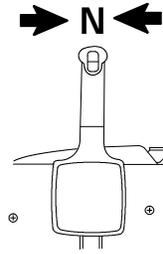
STANDARD ROTATION OUTBOARDS



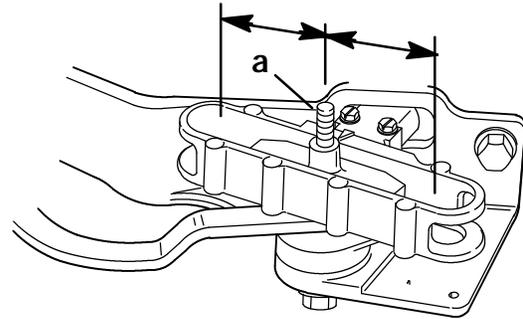
COUNTER ROTATION OUTBOARDS



2. Position remote control and outboard into neutral.

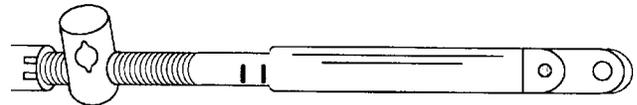


3. Slide the shift cable retainer forward until resistance is felt, then slide cable anchor toward rear until resistance is felt. Center the anchor pin between resistance points.

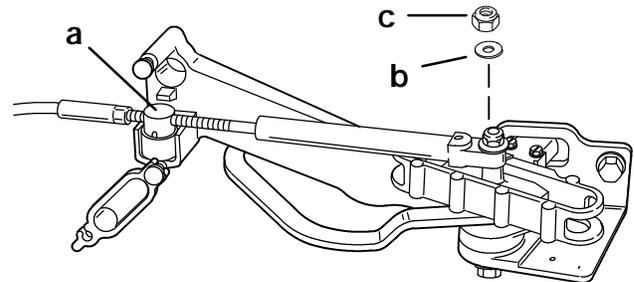


a - Anchor Pin

4. Align the shift cable end guide with the center mark as instructed in Step 1.



5. Place shift cable on anchor pin. Adjust cable barrel so it slips freely into the barrel holder.
6. Install cable to anchor pin. Tighten locknut, then back-off the locknut 1/4 turn.



a - Cable Barrel
 b - Nylon Washer
 c - Locknut - Tighten Locknut, Then Back-Off The Locknut 1/4 Turn

7. Check shift cable adjustments as follows:
 - a. With remote control in forward, the propshaft should lock solidly in gear. If it does not, adjust cable barrel closer to cable end guide.
 - b. Shift remote control into neutral. The propshaft should turn freely without drag. If not,

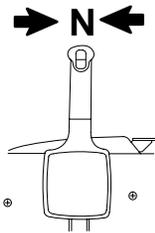


- b. Shift remote control into neutral. The propshaft should turn freely without drag. If not, adjust barrel away from cable end guide. Repeat steps a and b.
- c. Shift remote control into reverse while turning propeller. The propshaft should lock solidly in gear. If not, adjust barrel away from cable end guide. Repeat steps a thru c.
- d. Return remote control handle to neutral. The propeller should turn freely without drag. If not, adjust barrel closer to cable end guide. Repeat steps a thru d.

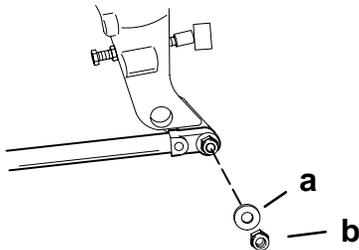
Throttle Cable

INSTALLATION

1. Position remote control into neutral.

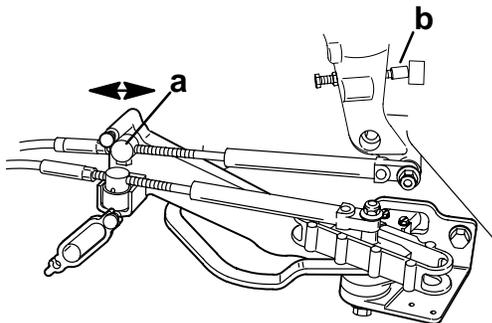


2. Attach throttle cable to the throttle lever. Secure with latch.



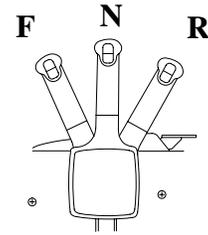
- a - Nylon Washer
b - Locknut – Tighten Locknut, Then Back-off The Locknut 1/4 Turn

3. Adjust the cable barrel so that the installed throttle cable will hold the idle stop screw against the stop.



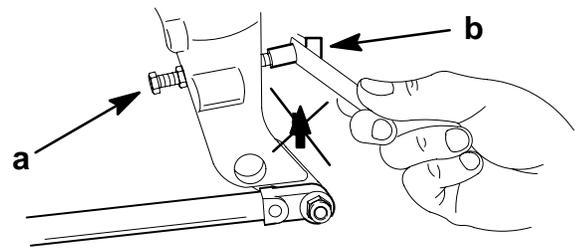
- a - Cable Barrel – Adjust To Hold Idle Adjustment Screw Against Stop
b - Idle Stop Screw

4. Check throttle cable adjustment as follows:
 - a. Shift outboard into gear a few times to activate the throttle linkage. Make sure to rotate the propeller shaft while shifting into reverse.



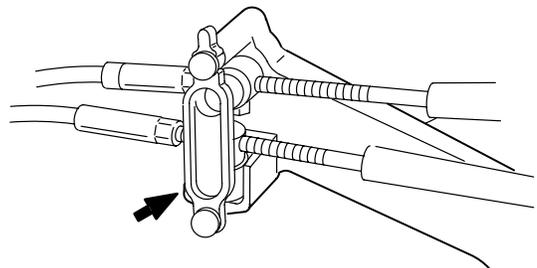
- b. Return remote control to neutral. Place a thin piece of paper between idle adjustment screw and idle stop. Adjustment is correct when the paper can be removed without tearing, but has some drag on it. Readjust cable barrel if necessary.

IMPORTANT: The idle stop screw must be touching the stop.



- a - Idle Adjustment Screw
b - Idle Stop

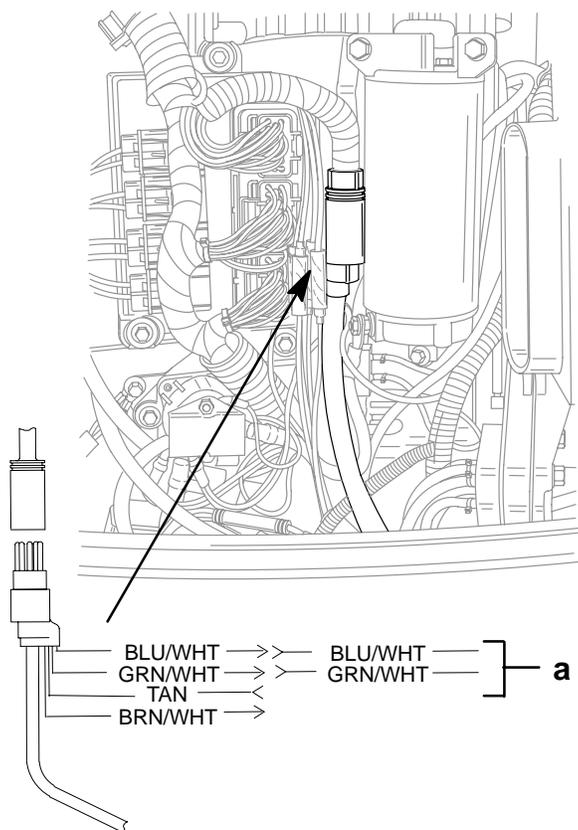
5. Lock the barrel holder in place with the cable latch.





Remote Wiring Connections

Connect wiring. Place harness into the holder.



Routing Location for Wiring and Hoses thru Clamp in Bottom Cowl

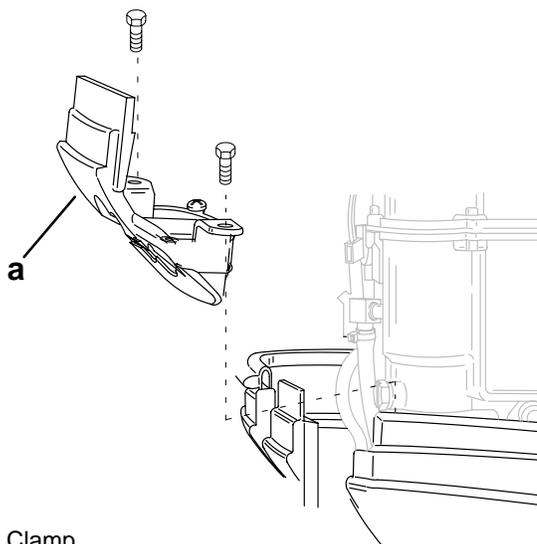
IMPORTANT: Sufficient slack must exist in engine wiring harness, battery cables, fuel hose, and oil hoses routed between clamp and engine attachment point, to relieve stress and prevent hoses from being kinked or pinched.

IMPORTANT: Warning Horn Requirement – The remote control or key switch assembly must be wired with a warning horn. This warning horn is used with the engine warning system.

Installation Note

NOTE: For ease of installation, remove the front clamp and separate the front end of the bottom cowl.

1. Remove the front clamp.



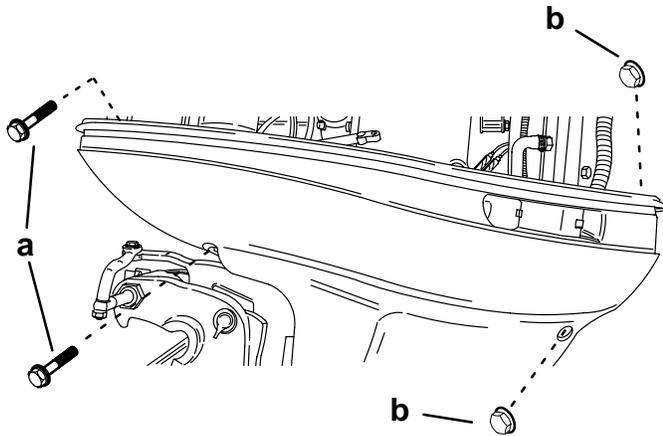
a - Front Clamp

Separate the front end of the bottom cowl as follows:

- a. Remove the 2 front screws (a).



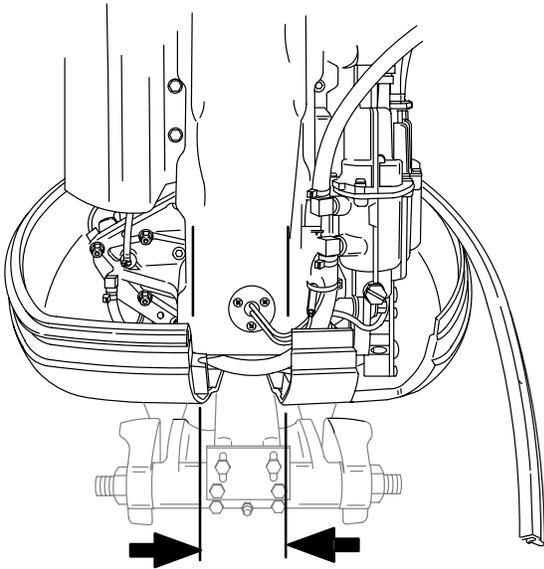
b. Loosen the rear 2 screws (b).



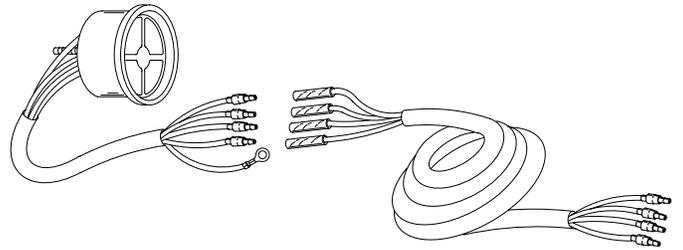
a - Remove Front Screws

b - Loosen Rear Screws - Remove Rubber Plug for Access to Lower Screw

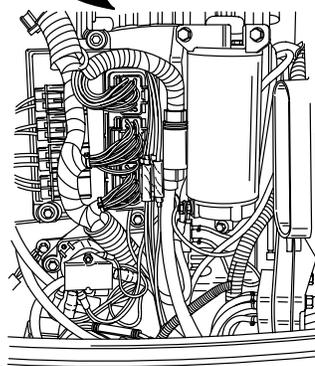
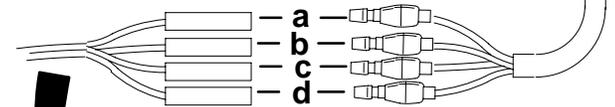
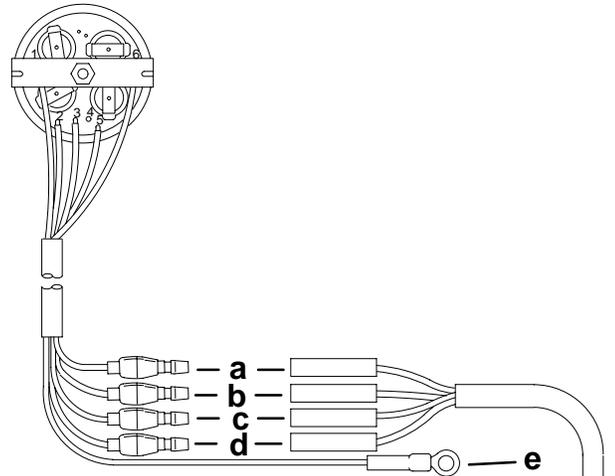
2. Separate the bottom cowl.



Warning Gauge Harness



1. Connect the harness extension to gauge and engine.



a - TAN/BLACK

b TAN/WHITE

c - PINK/LT. BLUE to PINK/LT. BLUE

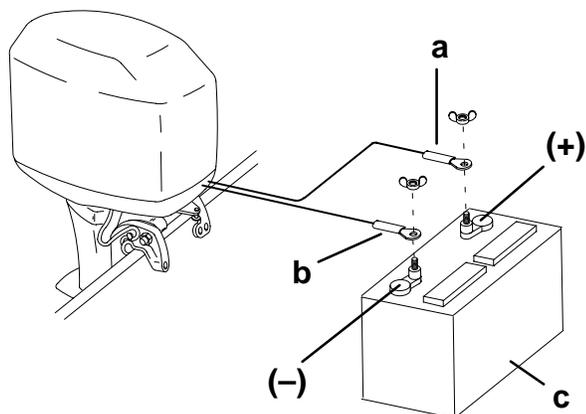
d ORANGE

e - Connect PURPLE to 12 Volt Source or Adjacent Gauge



Battery Connections

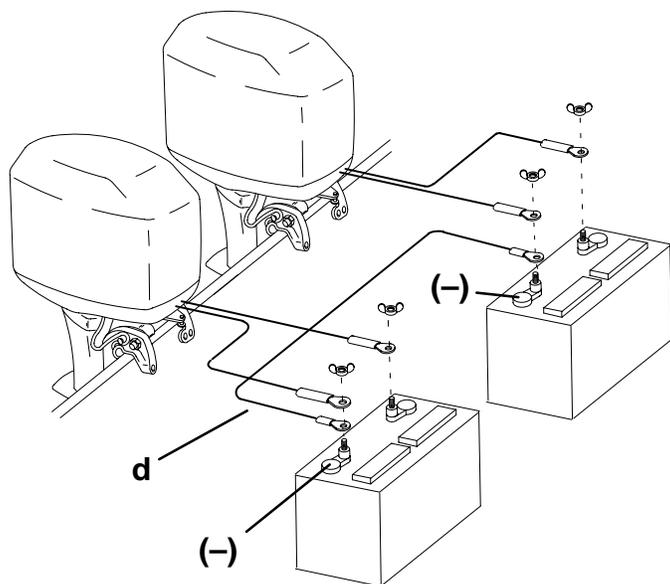
Single Outboard



- a - Red Sleeve (Positive)
- b - Black Sleeve (Negative)
- c - Starting Battery

Dual Outboard

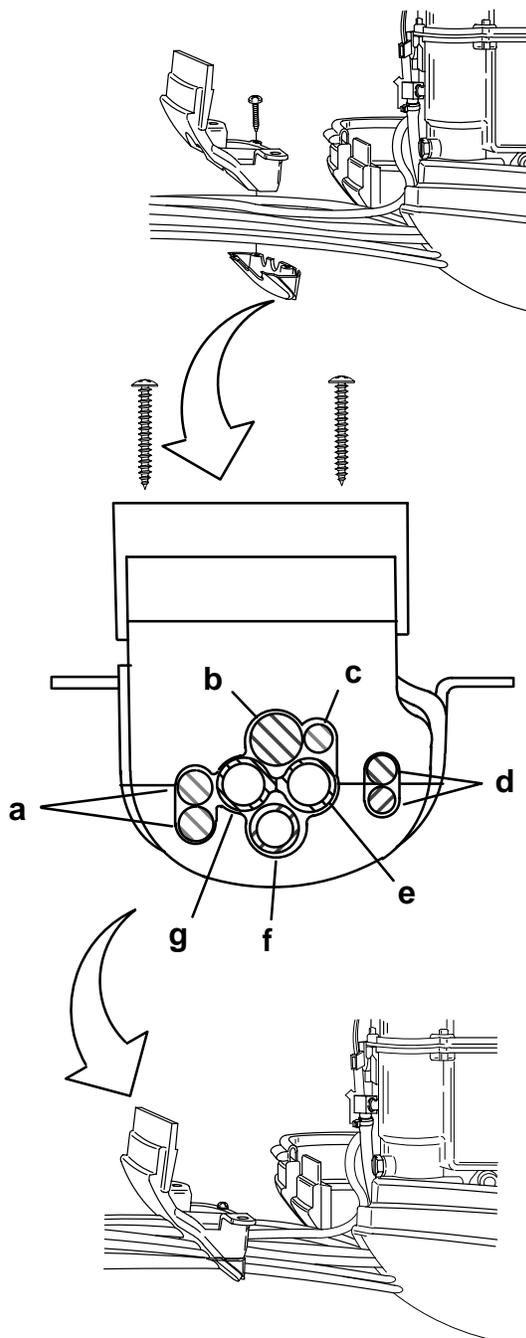
Connect a common ground cable (wire size same as engine battery cables) between negative (-) terminals on starting batteries.



- d - Ground Cable (Same Wire Size As Engine Battery Cable – .. Connect Between Negative (-) Terminals)

Front Clamp and Cowl Reassembly

1. Fasten the clamp over the wiring, hoses, and cables as shown.



- a - Battery Cables
- b - Remote Wiring Harness
- c - Warning Gauge Wiring Harness
- d - Control Cables
- e - Oil Hose with Blue Stripe
- f - Fuel Hose
- g - Oil Hose



Fuel Connections

Connecting Fuel Hose to Engine

Portable fuel tank

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

Permanent Fuel Tank

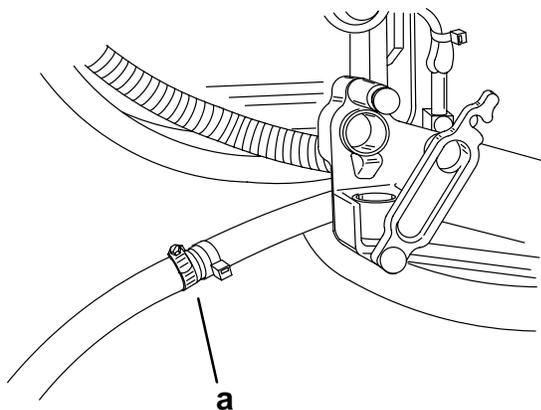
These should be installed in accordance with industry and federal safety standards which include recommendations applicable to grounding, anti-siphon protection, ventilation, etc.

Fuel Hose Size

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

Fuel Hose connection

Connect fuel hose to fitting with hose clamp.



a - Hose Clamp

Set Up Instructions for Oil Injection System

CAUTION

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

CAUTION

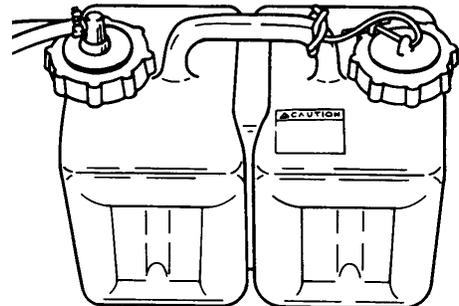
If an electric fuel pump is to be used on engines

with oil injection, the fuel pressure at the engine must not exceed 4 psi. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psi maximum.

MOUNTING OIL TANK

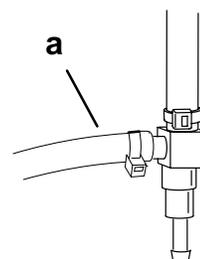
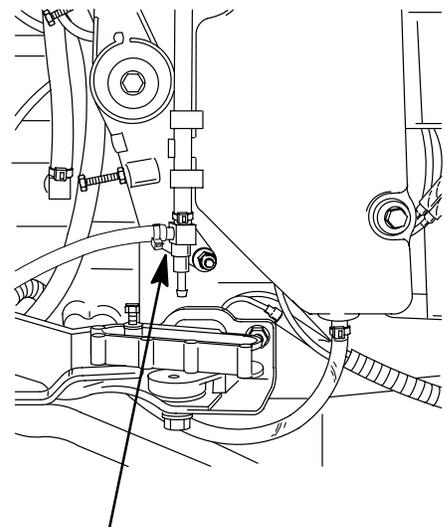
1. Mount the remote oil tank in the boat. The tank should be restrained from moving. Use the oil tank hold down kit provided.
2. Arrange the hoses so they will not get pinched, kinked, or stretched during operation.

NOTE: A Quicksilver Accessory oil hose extension kit (41729A3) is available.



CONNECTING OIL HOSE WITH BLUE STRIPE

3. Remove shipping cap from fitting and connect oil hose (a). Fasten hose with sta-strap.

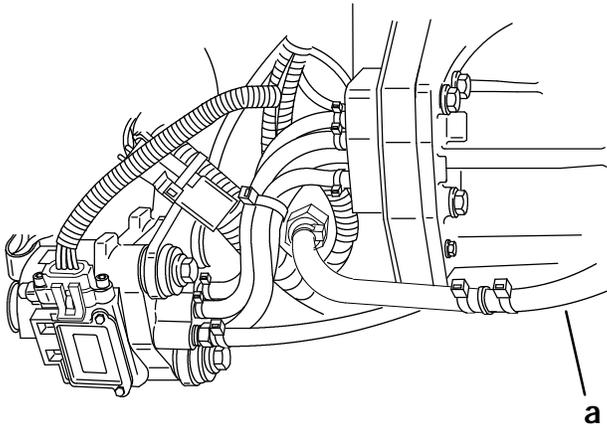


a - Oil Hose with Blue Stripe



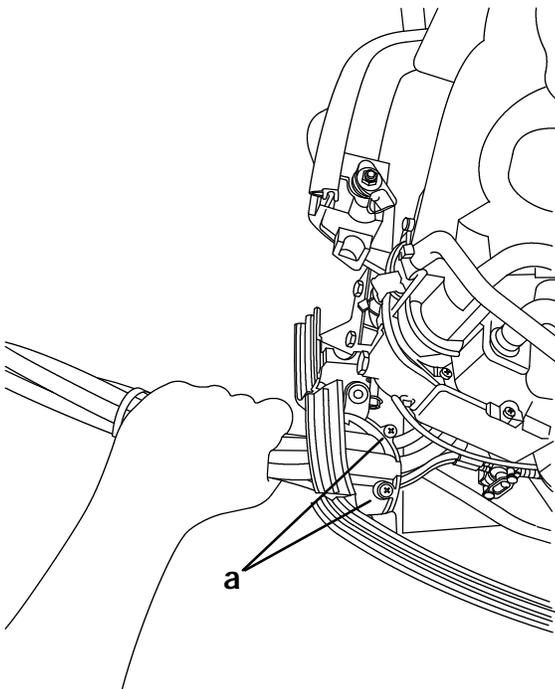
CONNECTING OIL HOSE WITHOUT BLUE STRIPE

- Remove shipping cap from fitting and connect hose (a). Fasten hose with sta-strap.



a - Oil Hose Without Blue Stripe

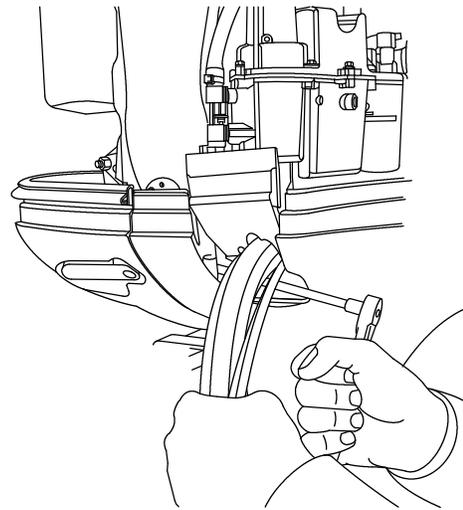
- Slide the clamp up and into the bottom cowl.
- Tighten the clamp screws at this time.



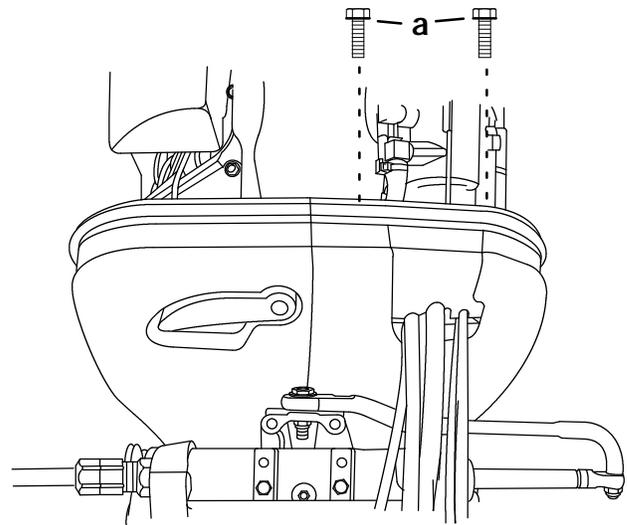
a - Clamp Screws (2)

- Fasten bottom cowl together.

NOTE: Lift up the clamp to gain access to front screw.



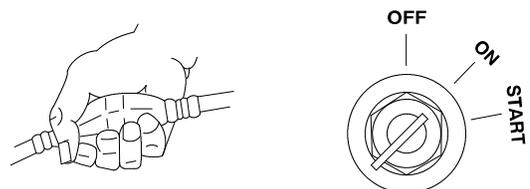
- Fasten clamp into cowl with two bolts.



a - Bolts

Filling Fuel System

NOTE: For initial start of a new engine or for an engine that ran out of fuel, or was drained of fuel, the fuel system should to be filled as follows.



- Squeeze the fuel line primer bulb until it feels firm.

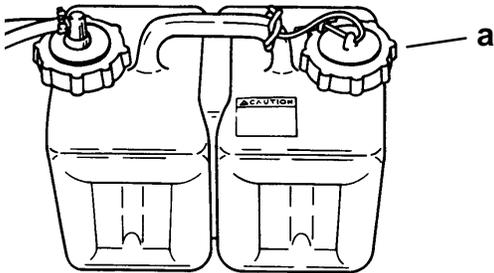


- Turn the ignition key switch to the ON position for three seconds. This operates the electric fuel pump.
- Turn the ignition key switch back to the OFF position, and squeeze the primer bulb again until it feels firm. Turn the ignition key switch to the "ON" position again for three seconds. Continue this procedure until the fuel line primer bulb stays firm.

Oil Injection System

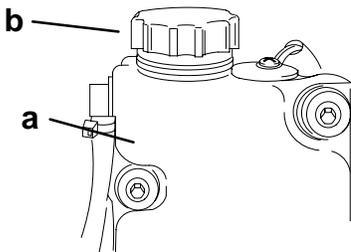
Filling

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



a - Fill Cap

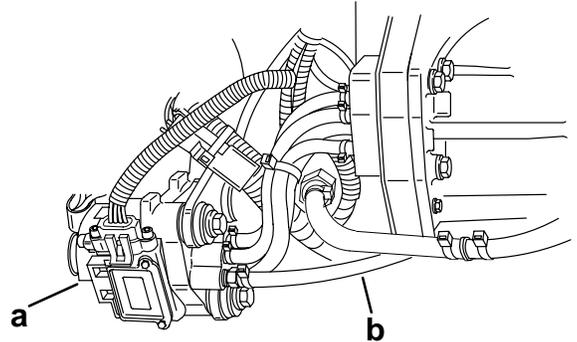
2. Remove cap and fill engine oil tank with oil. Reinstall the fill cap.



a - Engine Oil Tank
b - Fill Cap

Priming the Oil Injection Pump

Before starting engine for the first time, prime the oil injection pump. Priming will remove any air that may be in the pump, oil supply hose, or internal passages.



a - Oil Injection Pump
b - Oil Supply Hose

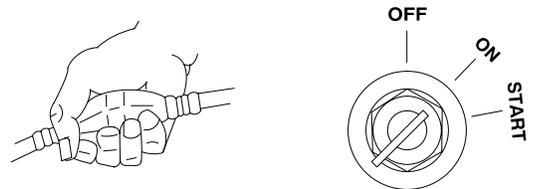
CAUTION

CAUTION

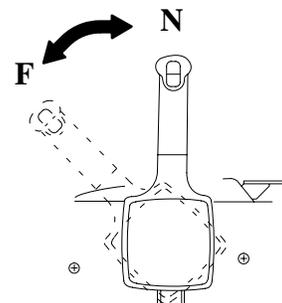
To prevent damage to the fuel pumps, fill the engine fuel system with fuel. Otherwise the fuel pumps will run without fuel during the priming process.

Prime the oil injection pump as follows:

1. Fill the engine fuel system with fuel. Connect fuel hose and squeeze primer bulb until it feels firm.
2. Turn the ignition key switch to the "ON" position.



3. Within the first 10 seconds after the key switch has been turned on, move the remote control handle from neutral into forward gear 3 to 5 times. This will automatically start the priming process.

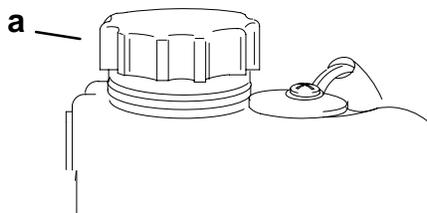


NOTE: It may take a few minutes for the pump to complete the priming process.



Purging Air From the Engine Oil Tank

1. Loosen the fill cap on the engine oil tank.
2. Start the engine. Run the engine until the all the air has been vented out of the tank and oil starts to flow out of the tank. Re-tighten fill cap.



a - Fill Cap

Trim “In” Angle Adjustment

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

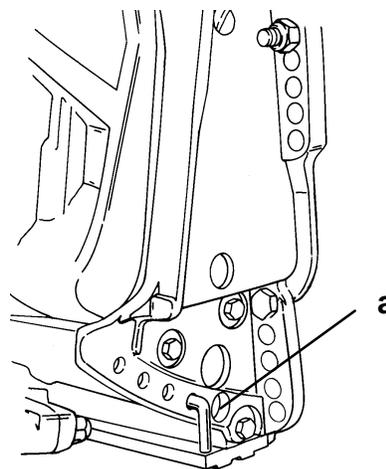
However, once on plane, the engine should be trimmed to a more intermediate position to avoid a bow-down planing condition called “plowing”. Plowing can cause “bow steering” or “over steering” and inefficiently consumes horsepower. In this condition, if attempting a turn or encountering a diagonal, moderate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

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

⚠ WARNING

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

boat when engine is trimmed extremely under or in.



a - Tilt Pin

Trim Tab Adjustment

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

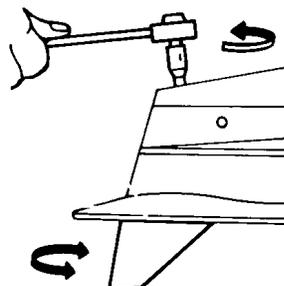
MODELS WITHOUT POWER STEERING

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

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

MODELS WITH POWER STEERING

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

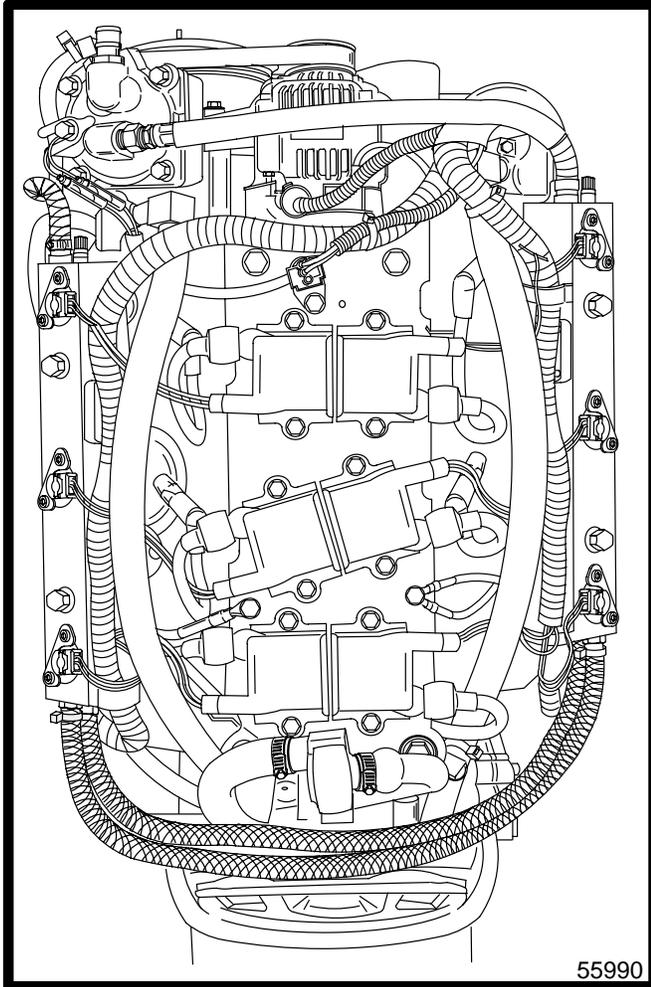




ELECTRICAL

2

A



IGNITION SYSTEM



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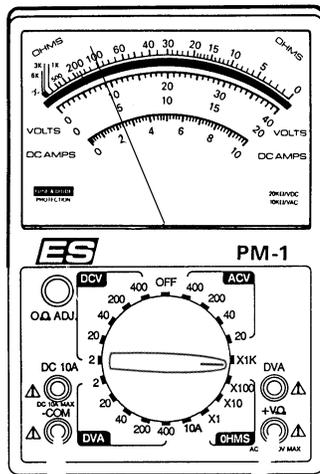


Specifications

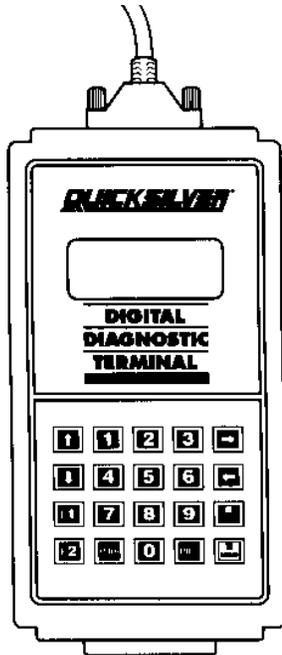
IGNITION SYSTEM	Type	Digital Inductive
	Spark Plug Type	NGK PZFR5F-11 (1998 Heavy Duty) NGK ZFR5F-11 (1998 Light Duty) Champion RC10-ECC (1997)
	Spark Plug Gap	0.040 in. (1.0mm)
CHARGING SYSTEM	Alternator Output (Regulated)	30 Amperes @ 750 RPM 60 Amperes @ 2000 RPM
	Brush Length	Std. Exposed Length: 0.413 in. (10.5mm) Min. Exposed Length: 0.059 in. (1.5mm)

Special Tools

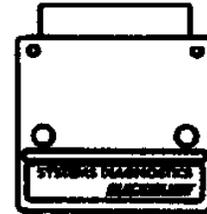
1. Volt/Ohm Meter 91-99750A1



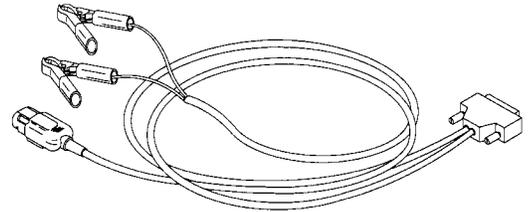
2. Digital Diagnostic Terminal 91-823686A2



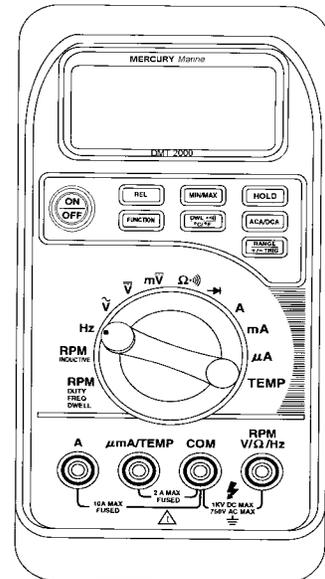
3. Cartridge 91-822608-4 or 91-822608-5



4. Adapter Harness 84-822560A5

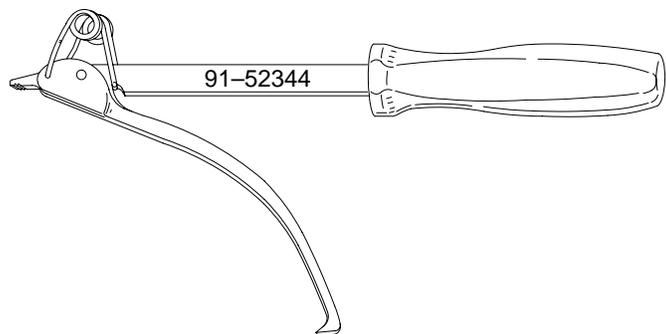


5. Service Tachometer 91-59339





Flywheel Holder 91-52344

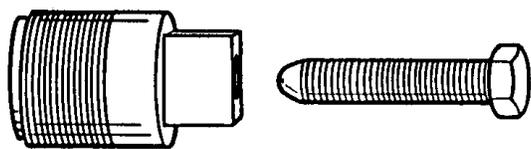


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Protector Cap 91-24161



Flywheel Puller 91-73687A1



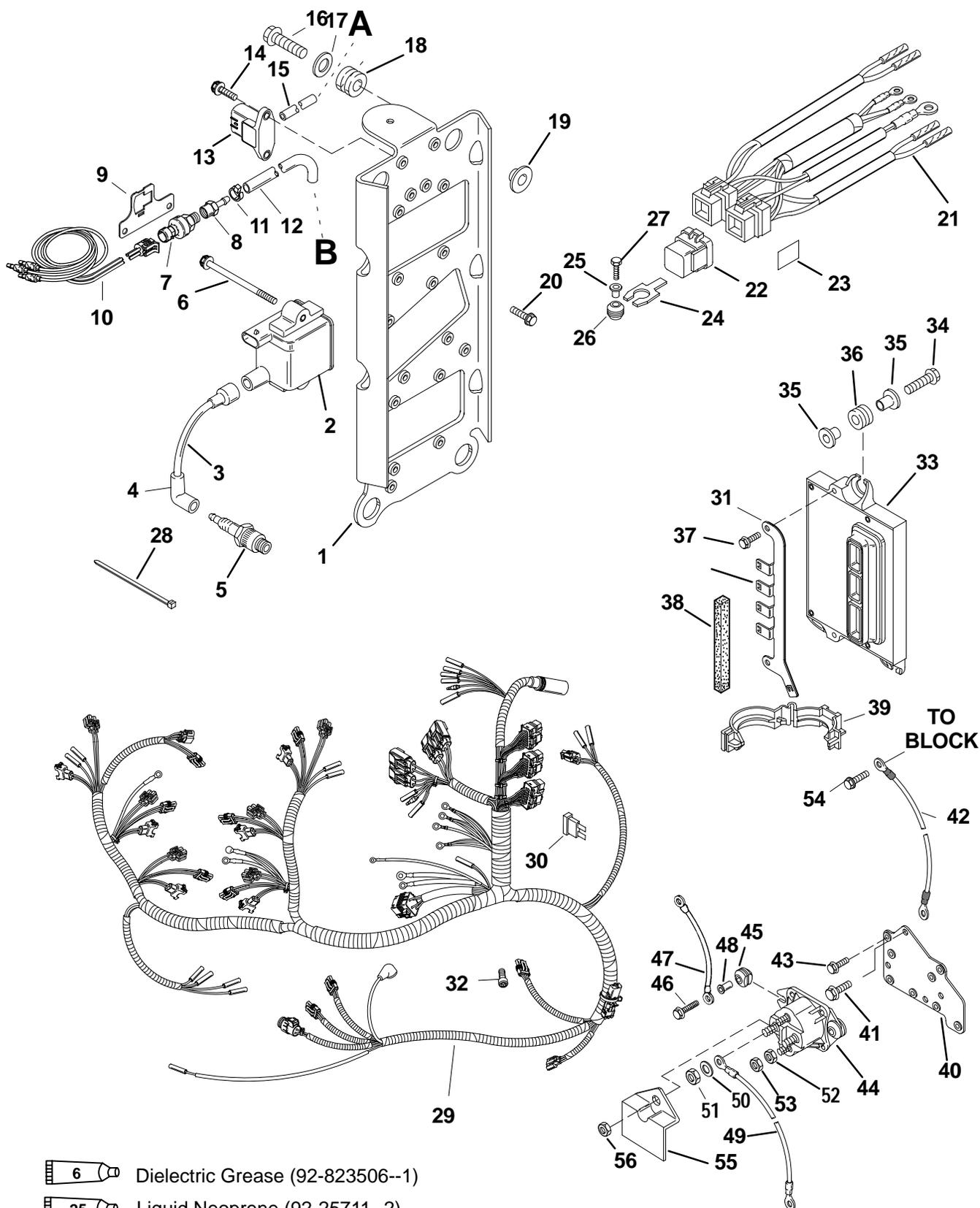


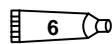
Notes:

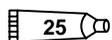




Electrical Components



 Dielectric Grease (92-823506--1)

 Liquid Neoprene (92-25711--2)

NOTE: COAT ALL EYELET WIRING TERMINALS WITH #25 GACO N700

NOTE: COAT ALL MULTI-PIN ELECTRICAL CONNECTIONS (EXCEPT POWER TRIM RELAY CONNECTORS) WITH #6 DC-4

A = TO AIR HANDLER B = TO BLOCK

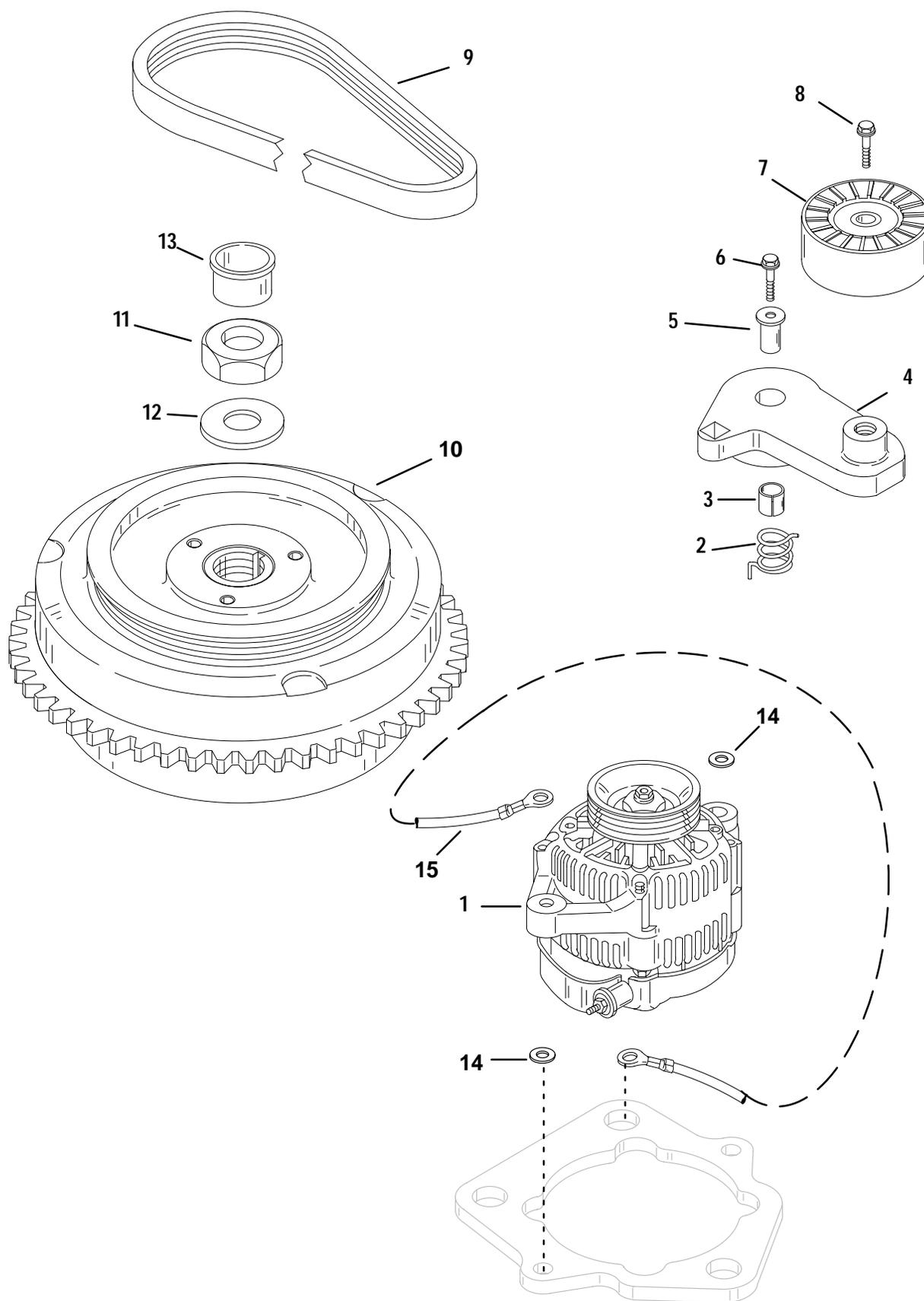


Electrical Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	ELECTRICAL MOUNTING PLATE			
2	6	IGNITION COIL			
3	1	HI-TENSION CABLE			
4	6	BOOT			
5	6	SPARK PLUG (HEAVY DUTY)		20	27.1
	OPT	SPARK PLUG (LIGHT DUTY)		20	27.1
6	12	SCREW (M6 x 30)			
7	1	SENSOR			
8	1	CONNECTOR			
9	1	RETAINER			
10	1	ADAPTOR HARNESS			
11	1	STA-STRAP			
12	1	TUBING (15 IN.)			
13	1	MAP SENSOR			
14	2	SCREW (M6 x 14)	35		3.9
15	1	TUBING (28-1/2 IN.)			
16	4	SCREW (.312-18 x 1-1/4 IN.)	235	20	26.5
17	4	WASHER			
18	4	GROMMET			
19	4	BUSHING			
20	2	SCREW-engine harness ground (M6 x 14)	35		3.9
21	1	TRIM HARNESS			
22	3	RELAY			
23	3	DECAL-Trim Relay			
24	3	BRACKET			
25	3	BUSHING			
26	3	GROMMET			
27	3	SCREW (M6 x 25)	35		3.9
28	1	STA STRAP			
29	1	ENGINE HARNESS			
30	4	FUSE			
31	1	BRACKET-Fuse Holder			
32	2	SCREW (M4 x .7)			
33	1	ECU (225)			
	1	ECU (200)			
34	3	SCREW (M6 x 25)	70		7.9
35	6	BUSHING			
36	3	GROMMET			
37	2	SCREW (M6 x 12)	100		11.3
38	1	PAD			
39	1	CLIP			
40	1	SOLENOID MOUNTING PLATE			
41	3	SCREW (M6 x 12)	150		16.9
42	1	BATTERY CABLE (NEGATIVE)			
43	2	SCREW (M6 x 14)	35		3.9
44	1	STARTER SOLENOID			
45	2	GROMMET			
46	2	SCREW (M6 x 25)	35		3.9
47	1	CABLE (BLACK)			
48	2	BUSHING			
49	1	BATTERY CABLE (POSITIVE)			
50	2	LOCKWASHER			
51	2	NUT (5/16-18)	50		5.6
52	2	NUT (10-32)	8		0.9
53	1	CAP NUT			
54	1	SCREW (M8 x 12)	190	16	21.5
55	1	INSULATOR			
56	1	NUT (10-32)(BRASS)			



Flywheel/Alternator





Flywheel/Alternator

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	ALTERNATOR			
2	1	SPRING			
3	1	BEARING			
4	1	BELT TENSIONER			
5	1	BUSHING			
6	1	SCREW (M10 x 45)	200		22.6
7	1	PULLEY			
8	1	SCREW (M10 x 35)	300		33.9
9	1	BELT			
10	1	FLYWHEEL			
11	1	NUT (.625-18)		125	169
12	1	WASHER			
13	1	PLUG			
14	2	WASHER			
15	1	CABLE			

Ignition System

Theory of Operation

When the ignition key is turned to the RUN position, battery voltage is applied to the main relay through the PURPLE wire. The main relay is then closed and D.C. current from the battery or charging system is transferred through the main relay 20 Amp fuse to the positive terminal of all 6 ignition coil primary windings. The negative terminal of the coil primary is connected to engine ground through the Electronic Control Module (ECM). When this circuit is closed, a magnetic field is allowed to be built up in the ignition coil. The Crank Position Sensor senses the location of the 24 teeth on the flywheel and supplies a trigger signal to the ECM. When the ECM receives this signal, the ECM will then open the ground circuit of the coil primary. The magnetic field in the ignition coil primary will then collapse cutting across the coil secondary winding creating a high voltage charge (50,000 volts) that is sent to the spark plug.

Electronic Control Module (ECM)

The ECM requires 8 VDC minimum to operate. If the ECM should fail, the engine will stop running.

The inputs to the ECM can be monitored and tested by the Digital Diagnostic Terminal 91-823686A2 using adaptor harness 84-822560A5.

The ECM performs the following functions:

- Calculates the precise fuel and ignition timing requirements based on engine speed, throttle position, manifold pressure and coolant temperature.
- Controls fuel injectors for each cylinder, direct injectors for each cylinder and ignition for each cylinder.
- Controls all alarm horn and warning lamp functions.
- Supplies tachometer signal to gauge.
- Controls RPM limit function.
- Monitors shift interrupt switch.

Flywheel

24 teeth under the flywheel ring gear provide engine rpm and crankshaft position information to the ECM through the crank position sensor.

Ignition Coils

Inductive type ignition coils are used on the DFI engines.

Ignition Coil Ohm Test

1997 Models

Connect meter leads between each coil terminal pin.	0.67 ± 0.1 Ω
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1998 Models

Connect meter leads between primary terminal (GRN/Striped) and ground (Black) terminal pin.	0.38 - 0.78 Ω
Connect meter leads between spark plug wire/high voltage tower and ground terminal pin.	8.1 - 8.9 k Ω

Crank Position Sensor

Senses 24 teeth located on flywheel under ring gear. Supplies the ECM with crank position information and engine speed. If sensor should fail, the engine will stop running.

Throttle Position Sensor (TPS)

Two (2) Throttle Position Sensors are used in conjunction with one another. If one sensor should fail, the dash mounted CHECK ENGINE light will light and the warning horn will sound.

On 1997 Model – RPM will not be limited.

On 1998 Model – RPM will be limited to 3000 rpm. If both TPS's should fail, on 1997 and 1998 model engines, rpm will be reduced to idle by the ECM. TPS settings are not adjustable. TPS settings can be monitored with the Digital Diagnostic Terminal through the ECM.

Charging System Alternator

Battery charging system is contained within the belt driven alternator, including the regulator. At cranking speeds, electrical power for the engine is provided by the boat battery – minimum recommended size is 750, or 1,000 MCA, cold cranking amperes. Above 650 RPM for 1997 Models (550 RPM on 1998 Models), all electrical power is provided by the alternator. Should engine rpm drop below 650 (550 RPM on 1998 Models), the alternator is not capable of providing sufficient output and the battery becomes the primary source of electrical power. Once the engine is running and rpm is 650 or higher, the engine will continue to run should the battery become shorted or disconnected.

Alternator output (when hot) to the battery @ 2000 RPM is approximately 33 - 38 amperes.



Manifold Absolute Pressure (MAP) Sensor

The map sensor is mounted between the cylinder heads. A vacuum hose connects the map sensor to the intake manifold. The ECM regulates fuel flow, in part, based on manifold absolute pressure. Drawing a vacuum on the MAP sensor hose will create a lean fuel condition.

Air Temperature Sensor

The air temperature sensor is mounted on the intake manifold. The ECM regulates fuel flow, in part, based on manifold air temperature. As air temperature increases, the ECM decreases fuel flow.

Direct Injectors

6 direct injectors (1 per cylinder) are used to inject a fuel/air mix into cylinders. Injectors are mounted between fuel rails and cylinder heads.

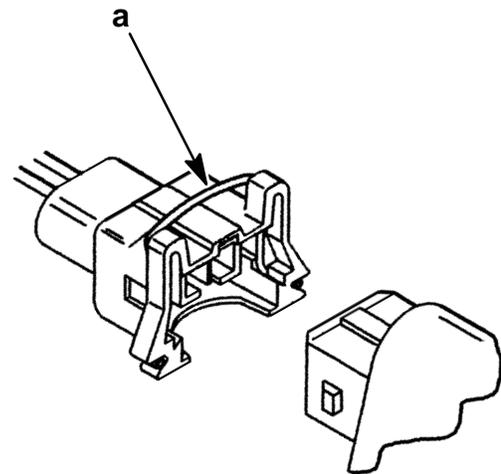
Direct Injector Ohm Test (Injector Lead Disconnected)	
Connect meter leads between each injector terminal pin.	1 - 1.6 Ω

Fuel Injectors

6 fuel injectors (1 per cylinder) are used to provide fuel from the fuel rail to the direct injectors. The fuel injectors are mounted in the fuel rail.

Fuel Injector Ohm Test (Injector Lead Disconnected)	
Connect meter leads between each injector terminal pin.	1.7 - 1.9 Ω

Disconnecting Harness Connectors from Ignition Coils and/or Injectors



54871

a - Wire Clip (push center down to remove)

1998 EPA Certified

All new outboards manufactured by Mercury Marine are certified with the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new outboard motors.

Troubleshooting

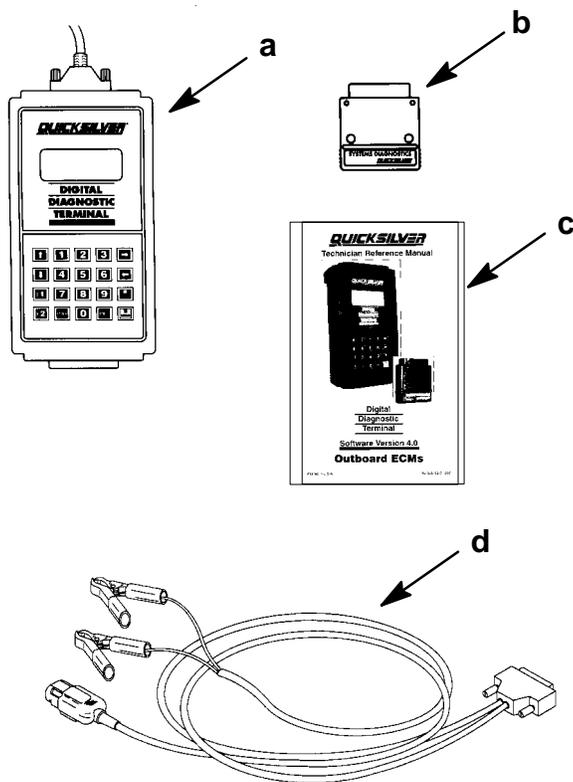
The ECM is designed such that if a sensor fails, the ECM will compensate so that the engine does not go into an over-rich condition.

Disconnecting a sensor for troubleshooting purposes may have no noticeable effect.

The Digital Diagnostic Terminal must be used to thoroughly check ECM system components.



Troubleshooting with the Digital Diagnostic Terminal



- a - Digital Diagnostic Terminal (91-823686A2)
- b - Software Cartridge (91-822608--4) (91-822608--5)
- c - DDT Reference Manual (90-825159-2)
- d - Adapter Harness (84-822560A--5)

The Quicksilver Digital Diagnostic Terminal (DDT) has been developed specifically to help technicians diagnose and repair Mercury Marine 2 and 4 cycle engines.

Attach the diagnostic cable to the ECM diagnostic connector and plug in the software cartridge. You will be able to monitor sensors and ECM data values including status switches.

The ECM program can help diagnose intermittent engine problems. It will record the state of the engine sensors and switches for a period of time and then can be played back to review the recorded information.

Refer to the Digital Diagnostic Terminal Reference Manual for complete diagnostic procedures.

Troubleshooting Without Digital Diagnostic Terminal

Troubleshooting without the DDT is limited to checking resistance on some of the sensors.

Typical failures usually do not involve the ECM. Connectors, set-up, and mechanical wear are most likely at fault.

- Verify spark plug wires are securely installed (pushed in) into the coil tower.
- The engine may not run or may not run above idle with the wrong spark plugs installed.
- Swap ignition coils to see if the problem follows the coil or stays with the particular cylinder.

NOTE: 1998 Model ECMs are capable of performing a cylinder misfire test to isolate problem cylinders. Once a suspect cylinder is located, an output load test on the ignition coil, fuel injector and direct injector may be initiated through use of the DDT.

- Any sensor or connection can be disconnected and reconnected while the engine is operating without damaging the ECM. Disconnecting the crank position sensor will stop the engine.

IMPORTANT: Any sensor that is disconnected while the engine is running will be recorded as a Fault in the ECM Fault History. Use the DDT to view and clear the fault history when troubleshooting/repair is completed.

- If all cylinders exhibit similar symptoms, the problem is with a sensor or harness input to the ECM.
- If problem is speed related or intermittent, it is probably connector or contact related. Inspect connectors for corrosion, loose wires or loose pins. Secure connector seating; use dielectric compound 92-823506-1.
- Inspect the harness for obvious damage: pinched wires, chaffing.
- Secure grounds and all connections involving ring terminals (coat with Liquid Neoprene 92-25711--2).
- Check fuel pump terminals.
- Check fuel pump pressure.
- Check air compressor pressure.



1997 DFI Troubleshooting without the DDT

1997 DFI Troubleshooting Guide		
Symptom	Cause	Action
1. Engine cranks but won't start	1.1 Weak battery or bad starter motor, battery voltage drops below 8 volts while cranking (ECM cuts out below 8 volts) (Fuel pump requires 9 volts).	Replace/charge battery. Inspect condition of starter motor. Check condition of battery terminals and cables.
	1.2 Low air pressure in rail (less than 70 psi at cranking)	Inspect air system for leaks. Inspect air filter for plugging (air pressure measured on port rail). Inspect air compressor reed valves if necessary.
	1.3 ECM not functioning	Injection System: Listen for injector "ticking" when cranking or connect spare injector to each respective harness. Ticking should start after 2 cranking revolutions. Ignition System: – Check for proper operation by using Inductive Timing Light 91-99379. – Check battery voltage (RED/YEL Lead) @ ignition coils. – Check for blown fuse (C15). – Check battery voltage to fuse from key switch (PURPLE Lead). – Check for shorted stop wire (BLK/YEL). – Check crank position sensor setting [0.015 in. – 0.040 in. (0.38mm – 1.01mm)] from flywheel or for defective crank position sensor. – Defective ECM. Power Supply: Clean and inspect remote control male and female harness connectors.
	1.4 No fuel	Check that primer bulb is firm. Key-on engine to verify that fuel pump runs for 2 seconds and then turn off. Measure fuel pressure (valve on starboard rail). Fuel pressure should be 10 ± 1 psi greater than the air pressure.
	1.5 Sheared Flywheel Key	Remove flywheel and inspect key.



1997 DFI Troubleshooting Guide (continued)

Symptom	Cause	Action
Engine cranks but will not start (continued)	1.6 Low fuel pressure 1.7 Blown fuse	Check for fuel leaks. If fuel pressure leaks down faster than air pressure, seals on fuel pump may be leaking. Check air system pressure, see 1.2 . Replace fuse. Inspect engine harness and electrical components.
2. Engine cranks, starts and stalls	2.1 Low air pressure in rail 2.2 Low fuel pressure in rail 2.3 Abnormally high friction in engine. 2.4 Air in fuel system/lines 2.5 TPS malfunction 2.6 Remote control to engine harness connection is poor. 2.7 Loose connectors or improperly attached spark leads	See 1.2 See 1.4 and 1.5 Check for scuffed piston or other sources of high friction. See 1.4 . Crank and start engine several times to purge. Check motion of throttle arm. Stop nuts should contact block at idle and WOT. Check TPS set-up. TPS reading should be in "idle" mode when remote control is in neutral. Must connect DDT with adapter harness (84-822560A5) to ECM to verify this). Clean and inspect male and female connectors. Inspect all connectors and harness leads for proper termination. Inspect spark plug wires. Inspect ground wires.
3. Engine idle is rough	3.1 Low air pressure in rail (less than 79 ± 2 psi while running). 3.2 Fouled spark plug 3.3 Flywheel key sheared	See 1.2 Replace spark plug: –If carbon bridges electrode gap or if it is completely black. –If it is not firing and is wet with fuel. <i>Note: If spark plug is grey with aluminum specs, this indicates internal mechanical damage requiring immediate attention before returning engine to service.</i> Remove flywheel and inspect key.



1997 DFI Troubleshooting Guide (continued)

Symptom	Cause	Action
4. Engine idles fast (RPM >700) or surges	4.1 TPS sensor malfunction	See 2.5
	4.2 Broken fuel pressure regulator or tracker diaphragm.	Measure fuel pressure. Remove and inspect diaphragms.
	4.3 Fuel leak	Check for fuel entering induction manifold or air compressor inlet. Fuel pump diaphragm leaking.
5. Engine runs rough below 3000 rpm	5.1 Fouled spark plug	See 3.2
	5.2 Low air pressure in rail	See 1.2
	5.3 Throttles misadjusted	Check throttle cam setup on induction manifold. Inspect linkage and roller. If throttle plate stop screws have been tampered with, contact Mercury Marine Service Department for correct adjustment procedures.
	5.4 TPS sensor malfunction	See 2.5
6. Engine runs rough above 3000 rpm	6.1 Fouled spark plug	See 3.2
	6.2 Low air pressure in rails	See 1.2
	6.3 TPS sensor malfunction	See 2.5
	6.4 Crank Position Sensor misadjusted	Gap between sensor and flywheel should be 0.015 in. – 0.040 in. (0.38mm – 1.01mm).
	6.5 Loose connectors or improperly attached spark leads	Inspect all connectors and harness leads for proper termination. Inspect spark plug wires. Inspect ground wires.
7. Engine RPM limited to approximately 3000 RPM	7.1 ECM Reset	Turn ignition off and restart engine after correcting RPM limiting fault – low oil, overheat, etc.



1998 DFI Troubleshooting without DDT

1998 DFI Troubleshooting Guide

Symptom	Cause	Action
1. Engine cranks but won't start	1.1 Weak battery or bad starter motor, battery voltage drops below 8 volts while cranking (ECM cuts out below 8 volts) (Fuel pump requires 9 volts).	Replace/charge battery. Inspect condition of starter motor. Check condition of battery terminals and cables.
	1.2 Low air pressure in rail (less than 70 psi at cranking)	Inspect air system for leaks. Inspect air filter for plugging (air pressure measured on port rail). Inspect air compressor reed valves if necessary.
	1.3 No fuel	Check that primer bulb is firm. Key-on engine to verify that fuel pump runs for 2 seconds and then turn off. Measure fuel pressure (valve on starboard rail). Fuel pressure should be 10 ± 1 psi greater than the air pressure.
	1.4 Low fuel pressure	Check for fuel leaks. If fuel pressure leaks down faster than air pressure, seals on fuel pump may be leaking. Check air system pressure, see 1.2.
	1.5 Sheared Flywheel Key	Remove flywheel and inspect key.
	1.6 Blown fuse	Replace fuse. Inspect engine harness and electrical components.
	1.7 Main Power Relay not functioning	Check lanyard switch. Listen for relay to "click" when the key switch is turned on.



1998 DFI Troubleshooting Guide (continued)

Symptom	Cause	Action
1. Engine cranks but will not start (continued)	1.8 ECM not functioning	<p>Injection System: Listen for injector “ticking” when cranking or connect spare injector to each respective harness. Ticking should start after 2 cranking revolutions.</p> <p>Ignition System: – Check for proper operation by using Inductive Timing Light 91-99379. – Check battery voltage (RED/YEL Lead) @ ignition coils. – Check for blown fuse (C15). – Check battery voltage to fuse from key switch (PURPLE Lead). – Check for shorted stop wire (BLK/YEL). – Check crank position sensor setting [0.015 in. – 0.040 in. (0.38mm – 1.01mm)] from flywheel or for defective crank position sensor. – Defective ECM.</p> <p>Power Supply: Clean and inspect remote control male and female harness connectors.</p>
2. Engine cranks, starts and stalls	2.1 Low air pressure in rail	See 1.2
	2.2 Low fuel pressure in rail	See 1.3 and 1.4
	2.3 Abnormally high friction in engine	Check for scuffed piston or other sources of high friction.
	2.4 Air in fuel system/lines	See 1.3 Crank and start engine several times to purge.
	2.5 TPS malfunction	Check motion of throttle arm. Stop nuts should contact block at idle and WOT. Check TPS set-up. Must connect DDT with adapter harness (84-822560A5) to ECM.
	2.6 Remote control to engine harness connection is poor	Clean and inspect male and female connectors.



1998 DFI Troubleshooting Guide (continued)

Symptom	Cause	Action
3. Engine idle is rough	3.1 Low air pressure in rail (less than 79 ± 2 psi while running)	See 1.2
	3.2 Fouled spark plug	Replace spark plug: –If carbon bridges electrode gap or if it is completely black. –If it is not firing and is wet with fuel. <i>Note: If spark plug is grey or completely black with aluminum specs, this indicates a scuffed piston.</i>
	3.3 Flywheel key sheared	Remove flywheel and inspect key.
4. Engine idles fast (RPM >700) or surges	4.1 Broken fuel pressure regulator or tracker diaphragm	Measure fuel pressure. Remove and inspect diaphragms (a special tool is required for assembly).
	4.2 Fuel leak	Check for fuel entering induction manifold or air compressor inlet. Fuel pump diaphragm leaking.
	4.3 Improper set-up	Check throttle cable & cam roller adjustment.
5. Engine runs rough below 3000 rpm	5.1 Fouled spark plug	See 3.2
	5.2 Low air pressure in rail	See 1.2
	5.3 Throttle misadjusted	Check throttle cam setup on induction manifold. Inspect linkage and roller. If throttle plate stop screws have been tampered with, contact Mercury Marine Service Department for correct adjustment procedures.
	5.4 TPS malfunction	See 2.5



1998 DFI Troubleshooting Guide (continued)

Symptom	Cause	Action
6. Engine runs rough above 3000 rpm	6.1 Fouled spark plug	See 3.2
	6.2 Speed Reduction	See 7
	6.3 Low air pressure in rails	See 1.2
	6.4 TPS malfunction	See 2.5
	6.5 Crank Position Sensor mis-adjusted	Gap between sensor and flywheel should be 0.015 in. – 0.040 in. (0.38mm – 1.01mm)
7. Speed Reduction (RPM reduced or limited to 3,000)	7.1 Low battery voltage ECM requires 8 volts minimum Fuel Pump requires 9 volts	Check battery and/or alternator. Check electrical connections.
	7.2 Overheat condition (engine and/or air compressor)	Check water pump impeller/cooling system.
	7.3 No oil or oil pump failure	Check oil. Check electrical connection.
	7.4 TPS failure If one (1) TPS fails rpm is reduced to 3,000. If both TPSs fail, rpm is reduced to idle	Check electrical connections.
8. Engine RPM reduced to idle only	8.1 Both TPSs failed	See 2.5
	8.2 Battery voltage below 9.5 volts	Use DDT or volt meter to check battery voltage.



Flywheel Removal and Installation

Flywheel Cover Removal and Installation

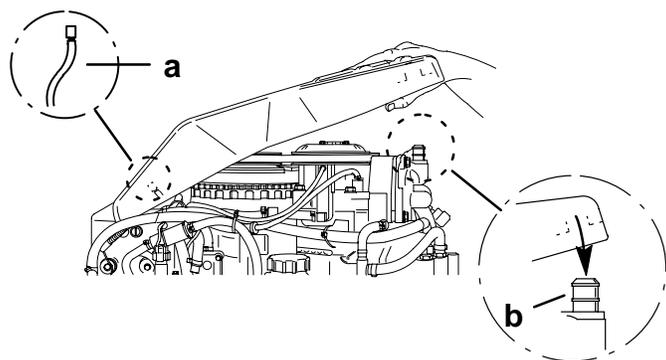
1997 MODELS:

Removal

Remove flywheel cover by lifting off. Disconnect vent hose (a).

Installation

Reconnect vent hose (a) to fitting in flywheel cover. Install the flywheel cover by inserting the two front pins into the front mounting holes, and then pushing the cover down onto the rear pin and air intake tube (b) for the air compressor.



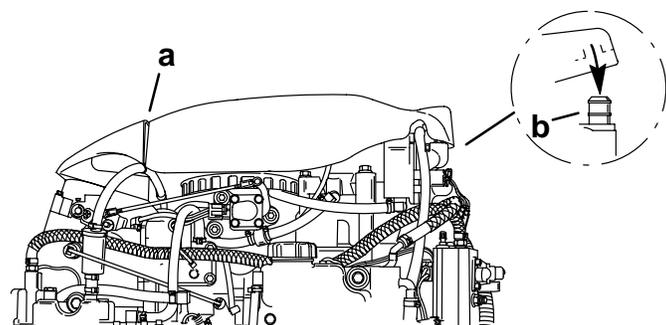
1998 MODELS:

Removal

Remove flywheel cover by lifting off.

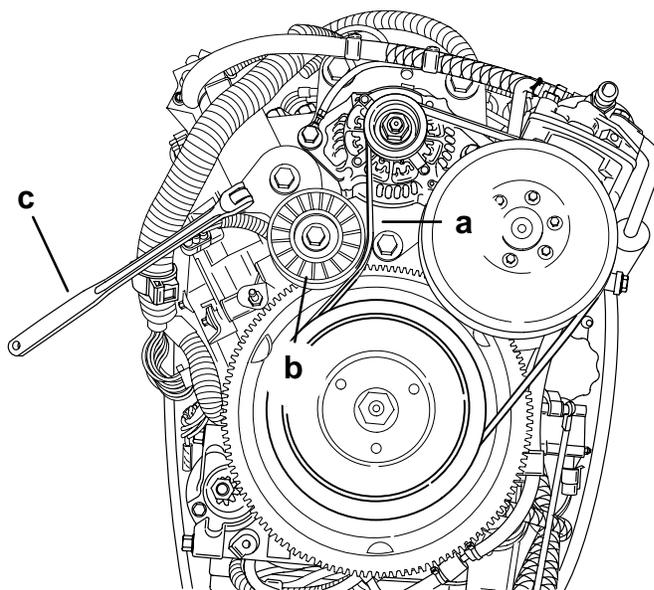
Installation

Install the flywheel cover by inserting the front pin and air tube into the rubber grommets (a), and then pushing the cover down onto the rear pin and air intake tube (b) for the air compressor.



FLYWHEEL REMOVAL

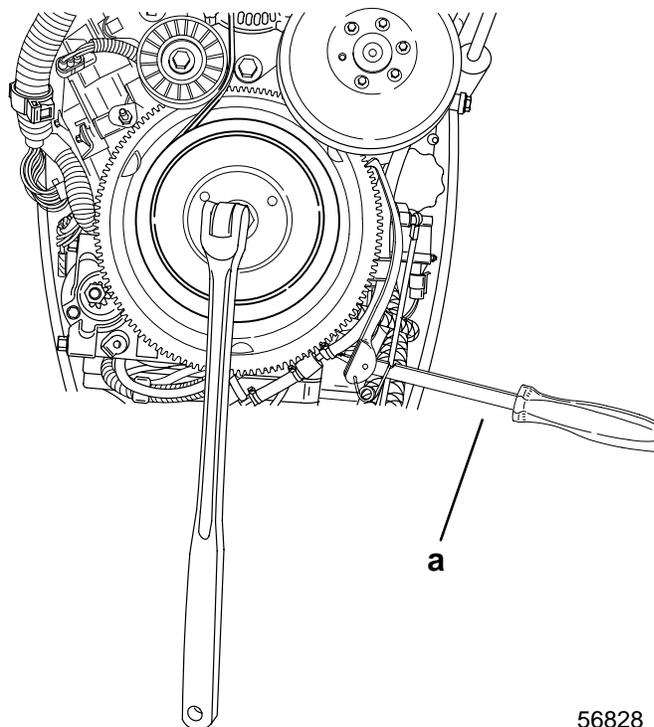
1. Remove alternator/air compressor belt from flywheel by using breaker bar to release belt tensioner.



56829

- a - Belt
- b - Tensioner
- c - Breaker Bar

2. Remove flywheel nut.

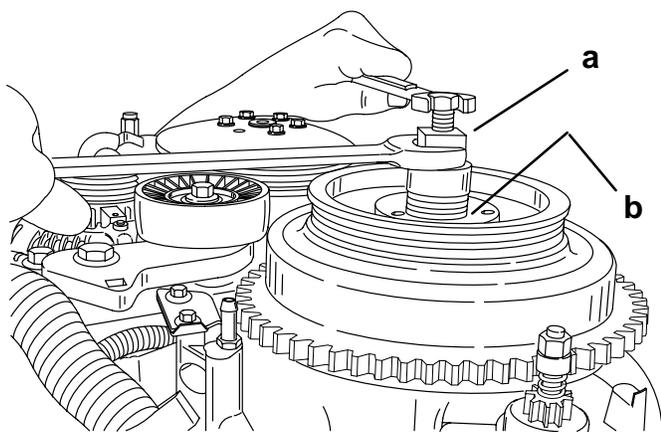


56828

- a - Flywheel Holding Tool (91-52344)



3. Remove flywheel.



56827

a - Puller (91-73687A1)

b - Protector Cap (91-24161) (HIDDEN)

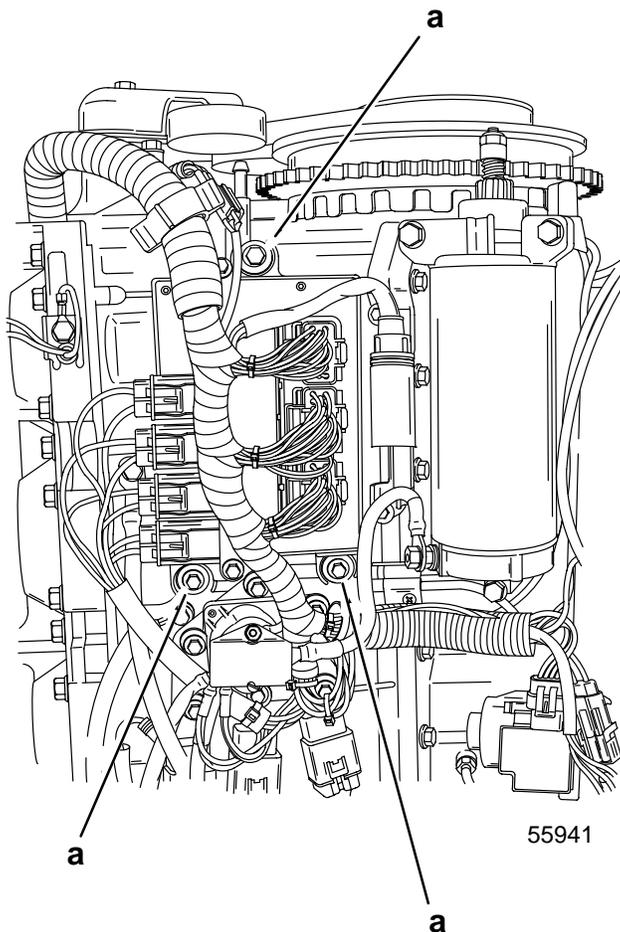
FLYWHEEL INSTALLATION

1. Reinstall flywheel with nut and washer.
2. Torque flywheel nut to 125 lb. ft. (169.5 N·m)
3. Use breaker bar to relieve belt tensioner and reinstall alternator/air compressor belt.
4. Reinstall flywheel cover.
5. Reinstall top cowling.

Electronic Control Module (ECM) Removal and Installation

Removal

1. Remove top cowling.
2. Disconnect ECM harness connectors.
3. Remove 3 bolts securing ECM.



55941

a - Bolts

Installation

1. Secure ECM to powerhead with 3 bolts. Torque bolts to 80 lb. in. (9.0 N·m).
2. Verify ECM ground lead is secured with attaching bolt.
3. Reconnect harness connectors.
4. Reinstall top cowling.

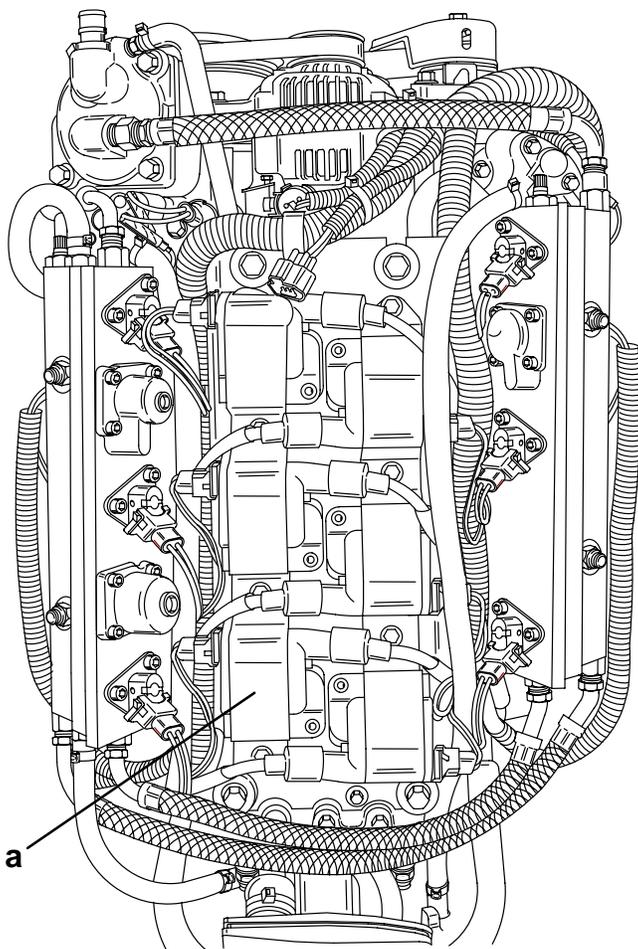


Ignition Module Removal and Installation

1997 MODEL – IGNITION MODULE (COIL)

Removal

1. Remove top cowling.
2. Disconnect module harness.
3. Remove spark plug lead from spark plug.
4. Remove module attaching bolts.



a - Ignition Modules (6)

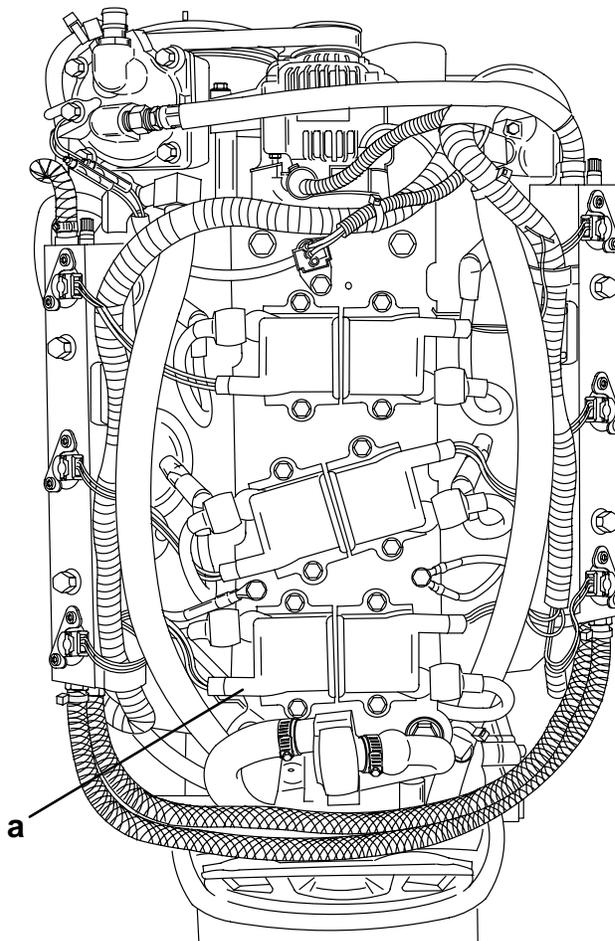
Installation

1. Secure module to ignition plate with bolt. Torque bolt to 80 lb. in. (9.0 N·m).
2. Reconnect harness.
3. Reconnect spark plug lead.
4. Reinstall top cowling.

1998 MODEL – IGNITION MODULE (COIL)

Removal

1. Remove top cowling.
2. Disconnect module harness.
3. Remove spark plug lead from spark plug.
4. Remove module attaching bolts.



55990

a - Ignition Modules (6)

Installation

CAUTION

If spark plug high tension lead boot is removed from the ignition module tower, the boot must be reglued to the coil tower using Loctite 454.

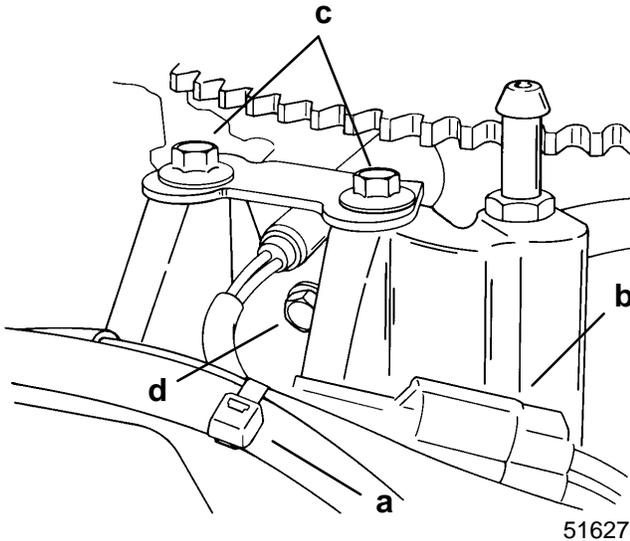
1. Secure module to ignition plate with bolts Torque bolts to 80 lb. in. (9.0 N·m).
2. Reconnect harness.
3. Reconnect spark plug lead.
4. Reinstall top cowling.



Crank Position Sensor Removal and Installation

Removal

1. Remove top cowling.
2. Remove sta-strap securing sensor harness and disconnect harness.
3. Remove two bolts securing sensor bracket.
4. Remove bolt securing sensor to bracket.



- a - Sta-strap
- b - Harness
- c - Bracket Bolts
- d - Sensor Bolt

Installation

1. Secure sensor to bracket with bolt. Torque bolt to 50 lb. in. (5.6 N·m).
2. Secure bracket to powerhead with 2 bolts.

NOTE: Position bracket/sensor assembly to allow a 0.015 – 0.040 .in (0.38mm ± 1.01mm) air gap between sensor and flywheel teeth.

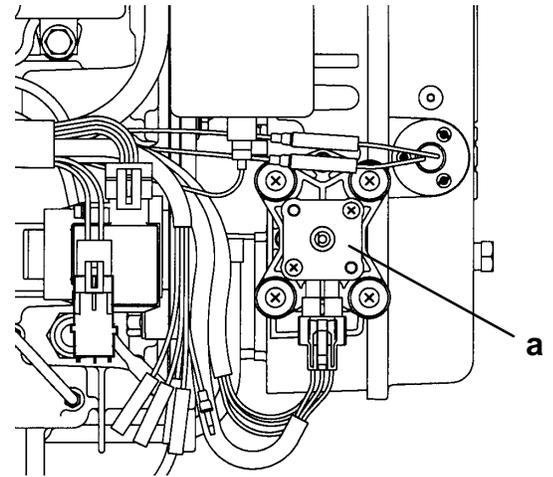
3. Torque bracket bolts to 100 lb. in. (11.3 N·m).
4. Reconnect sensor harness.
5. Secure harness with sta-strap.
6. Reinstall top cowling.

Throttle Position Sensors (TPS) Removal and Installation

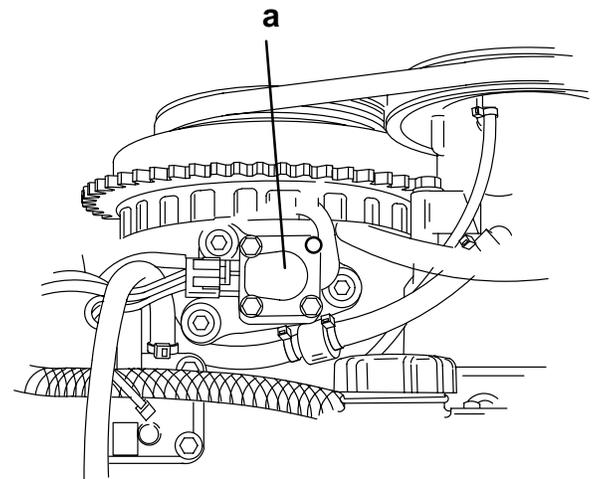
Removal

1. Remove top cowling.
2. Disconnect sensor harness.
3. Remove screws securing sensors to bracket.

1997 Models



1998 Models



a - Throttle Sensors

Installation

1. Secure sensors to bracket with screws. Torque screws to 20 lb. in. (2.3 N·m).
2. Reconnect harness.
3. Reinstall top cowling.



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Specifications

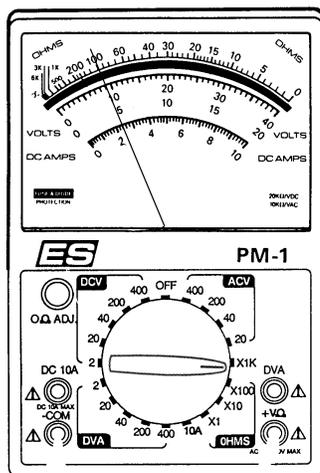
CHARGING SYSTEM	Alternator Output (Regulated) Brush Length Voltage Output Regulator Current Draw	30 Amperes @ 750 RPM 60 Amperes @ 2000 RPM Std. Exposed Length: 0.413 in. (10.5mm) Min. Exposed Length: 0.059 in. (1.5mm) 13.5 to 15.1 Volts 0.15 m A (Ign. Switch Off) 30.0 m A (Ign. Switch On)
STARTING SYSTEM	Electric Start – All Models Starter Draw (Under Load) Starter Draw (No Load) Minimum Brush Length Battery Rating	210 Amperes 30 Amperes 0.25 in. (65.4mm) 1000 (Minimum) Marine Cranking Amps (MCA) 750 (Minimum) Cold Cranking Amps (CCA)

Alternator Torque Specifications

Fastener	Torque
End Frame Bolts and Nuts	39.5 lb. in. (4.5 N·m)
Pulley Nut	50 lb. ft. (67.8 N·m)
Regulator Screws	17 lb. in. (1.9 N·m)
Rectifier Screws	17 lb. in. (1.9 N·m)
End Cover Screws	23 lb. in. (2.6 N·m)
Terminal Insulator Nut	36 lb. in. (4.1 N·m)

Special Tools

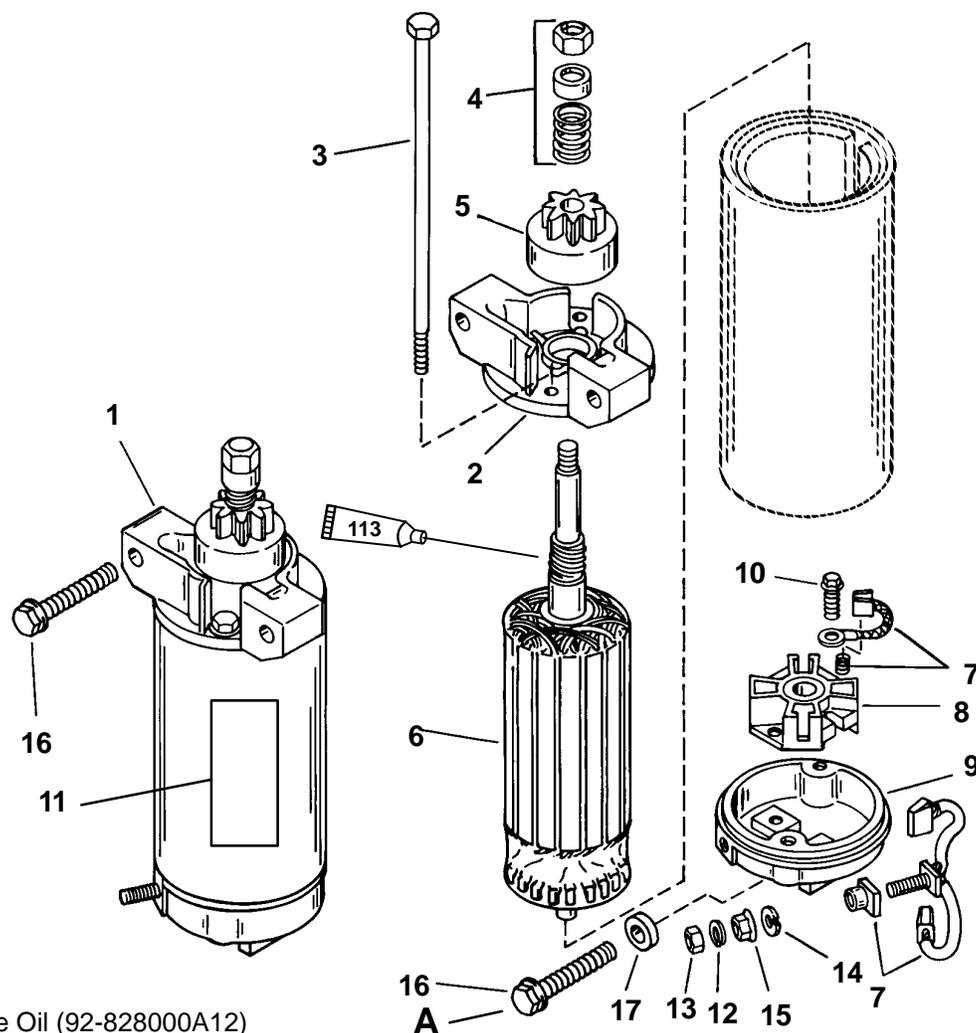
1. Volt/Ohm Meter 91-99750A1



2. Ammeter (Obtain Locally)



Starter Motor



113 4 Cycle Oil (92-828000A12)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	STARTER MOTOR			
2	1	DRIVE CAP			
3	2	THRU BOLT	70		7.9
4	1	DRIVE KIT			
5	1	PINION			
6	1	ARMATURE			
7	1	BRUSH/SPRING KIT			
8	1	BRUSH HOLDER			
9	1	COMMUTATOR CAP			
10	2	SCREW	Drive Tight		
11	1	DECAL-Warning-High voltage			
12	1	LOCKWASHER			
13	2	NUT (1/4-20)	60		6.8
14	2	LOCKWASHER			
15	1	NUT (1/4-20)	60		6.8
16	3	SCREW (M8 x 40)		23	31.2
17	1	SPACER			

A – Torque bottom starter bolt to 21.0 lb. ft. (28.5 N-m)



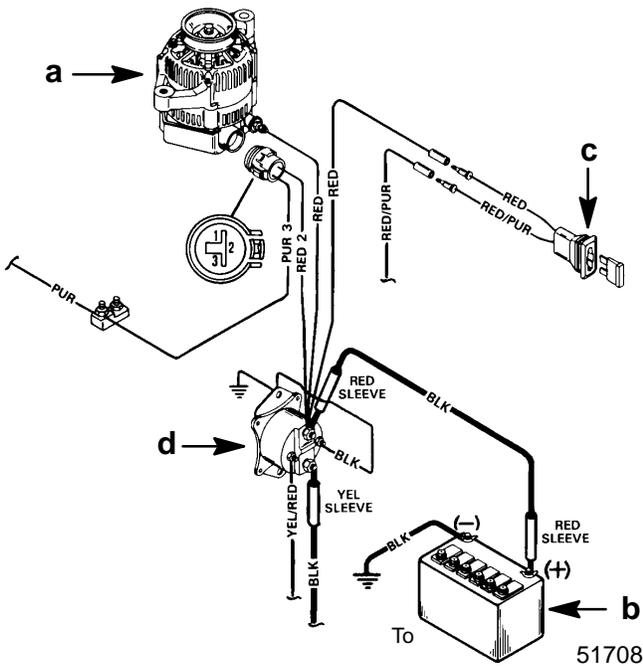
Replacement Parts

⚠ WARNING

Electrical, ignition and fuel system components on your Mercury/Mariner outboard are designed and manufactured to comply with U. S. Coast Guard Rules and Regulations to minimize risks of fire and explosions. Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

System Components

The battery charging system consists of the alternator, battery, ignition switch, starter solenoid and the wiring which connects these components.



- a - Alternator
- b - Battery
- c - 20 Ampere Fuse
- d - Starter Solenoid

Precautions

The following precautions must be observed when working on the alternator system. Failure to observe these precautions may result in serious damage to the alternator system.

1. Do not attempt to polarize the alternator.
2. Do not short across or ground any of the terminals on the alternator, except as specifically instructed.

3. Never disconnect the alternator output lead, regulator harness or battery cables when the alternator is being driven by the engine.
4. Always remove NEGATIVE (-) battery cable from battery before working on alternator system.
5. When installing battery, be sure to connect the NEGATIVE (-) (GROUNDED) battery cable to NEGATIVE (-) battery terminal and the POSITIVE (+) battery cable to POSITIVE (+) battery terminal.
6. When using a charger or booster battery, connect it in parallel with existing battery (POSITIVE to POSITIVE; NEGATIVE to NEGATIVE).

Alternator Description

The alternator employs a rotor, which is supported in 2 end frames by ball bearings, and is driven at 2.5 times engine speed. The rotor contains a field winding enclosed between 2 multiple-finger pole pieces. The ends of the field winding are connected to 2 brushes which make continuous sliding contact with the slip rings. The current (flowing through the field winding) creates a magnetic field that causes the adjacent fingers of the pole pieces to become alternate north and south magnetic poles.

A 3-phase stator is mounted directly over the rotor pole pieces and between the 2 end frames. It consists of 3 windings wound 120° electrically out-of-phase on the inside of a laminated core. The windings are connected together on one end, while the other ends are connected to a full-wave rectifier bridge.

The rectifier bridge contains 8 diodes which allows current to flow from ground, through the stator and to the output terminal, but not in the opposite direction.

When current is supplied to the rotor field winding, and the rotor is turned, the movement of the magnetic fields created induces an alternating current into the stator windings. The rectifier bridge changes this alternating current to direct current which appears at the output terminal. A diode trio is connected to the stator windings to supply current to the regulator and the rotor field during operation.



Voltage output of the alternator is controlled by a transistorized voltage regulator that senses the voltage at the battery and regulates the field current to maintain alternator voltage for properly charging the battery. Current output of the alternator does not require regulation, as maximum current output is self-limited by the design of the alternator. As long as the voltage is regulated within the prescribed limits, the alternator cannot produce excessive current. A cutout relay in the voltage regulator also is not required, as the rectifier diodes prevent the battery from discharging back through the stator.

A small amount of current is supplied by the excitation circuit in the regulator to the rotor field to initially start the alternator charging. Once the alternator begins to produce output, field current is supplied solely by the diode trio.

The alternator is equipped with 2 fans which induce air flow through the alternator to remove heat created by the rectifier and stator.

Diagnosis of Alternator System on Engine

1. If problem is an undercharged battery, verify condition has not been caused by excessive accessory current draw or by accessories which have accidentally left on.
2. Check physical condition and state of charge of battery. Battery must be at least 75% (1.230 specific gravity) of fully charged to obtain valid results in the following tests. If not, charge battery before testing system.

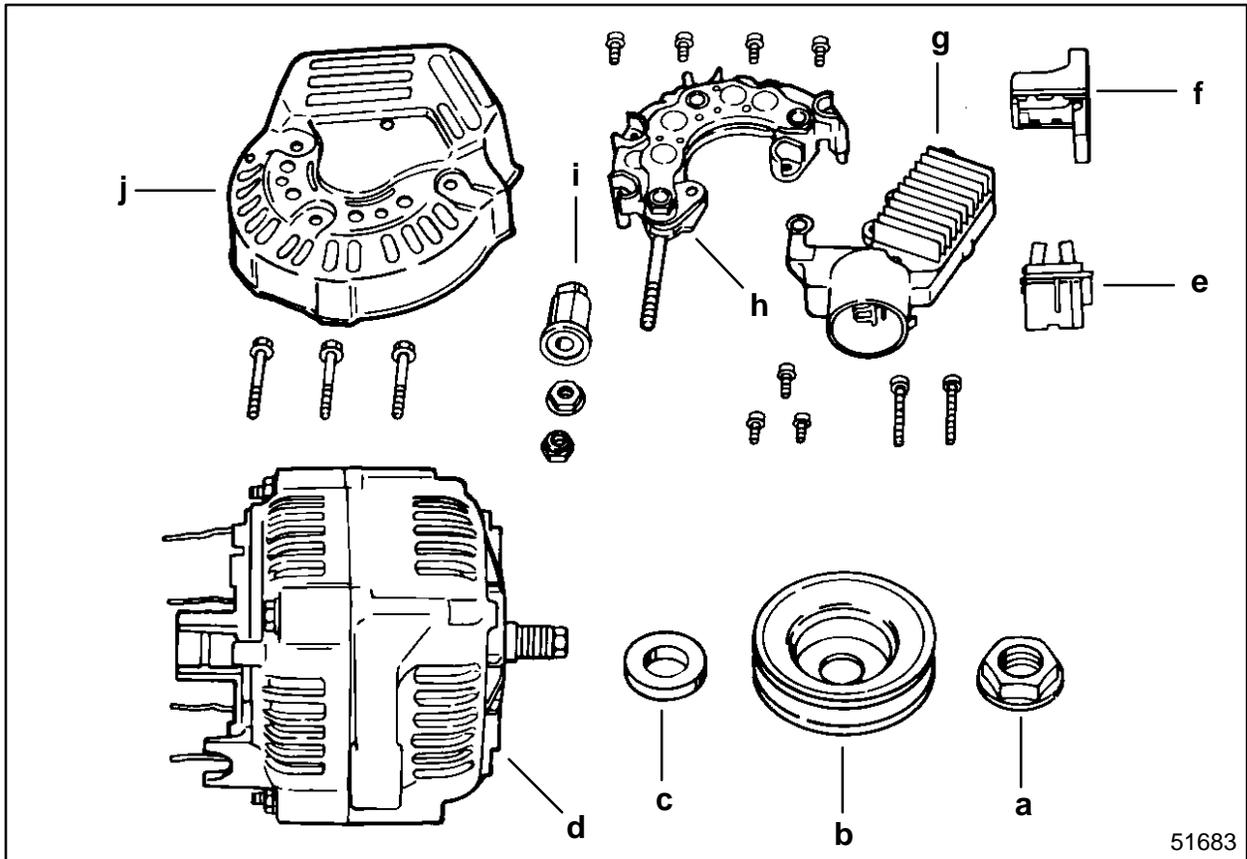


3. Inspect entire alternator system wiring for defects. Check all connections for tightness and cleanliness, particularly battery cable clamps and battery terminals.

IMPORTANT: RED output lead from alternator must be tight. A darkened RED sleeve indicates lead was loose and becoming hot.

4. Check alternator drive belt for cracks and fraying. Replace if necessary. Check belt tension. Adjust if necessary, as outlined under “**Drive Belt Replacement and Adjustment.**”

Alternator Assembly



- a - Pulley Nut
- b - Pulley
- c - Spacer
- d - Frame and Rotor Assembly
- e - Brush Holder
- f - Brush Cover
- g - Regulator
- h - Rectifier (Diode Assembly)
- i - Insulator
- j - End Cover

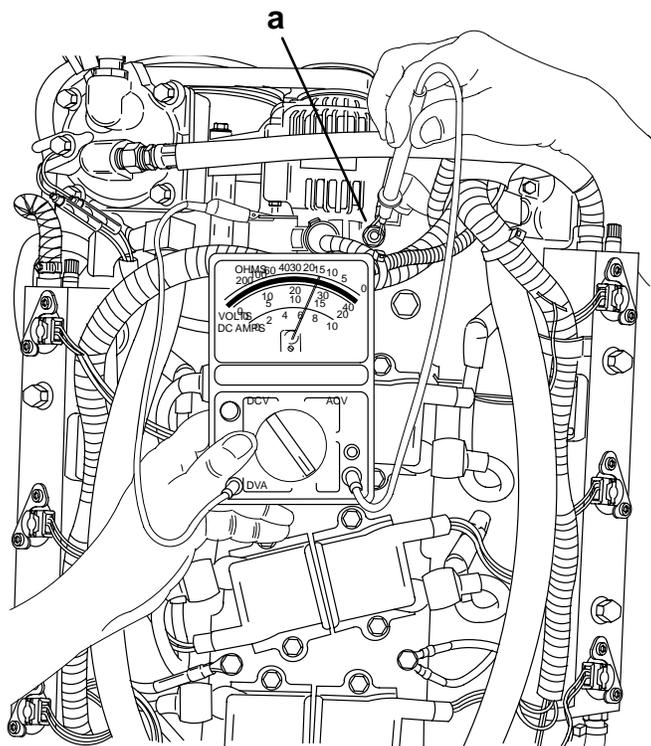


Alternator System Circuitry Test

Using a 0-20 volt DC voltmeter, perform the following tests:

OUTPUT CIRCUIT

1. Connect POSITIVE (+) voltmeter lead to alternator terminal B (output terminal). Connect NEGATIVE (-) lead to case ground on alternator.
2. Shake alternator wiring harness. Meter should indicate battery voltage and should not vary. If proper reading is not obtained, check for loose or dirty connections or damaged wiring.



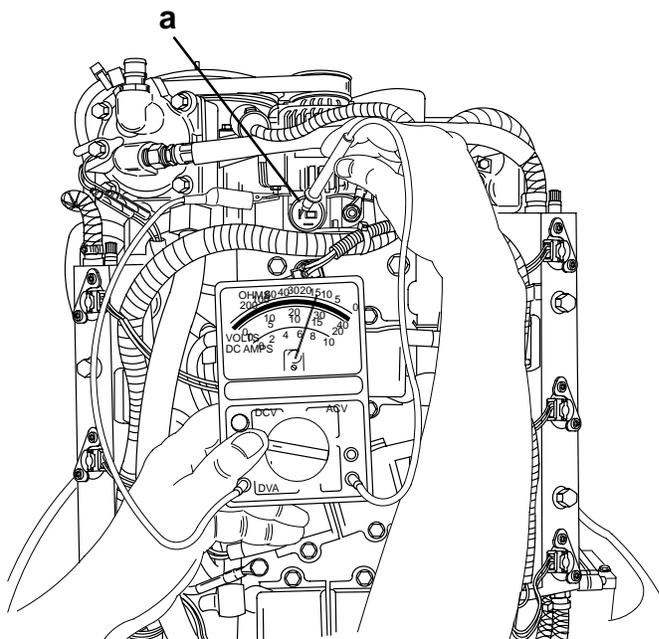
56025

a - Terminal B

SENSING CIRCUIT

1. Unplug RED and PURPLE lead connector from alternator.
2. Connect POSITIVE (+) voltmeter lead to RED lead and NEGATIVE (-) voltmeter lead to ground.

3. Voltmeter should indicate battery voltage. If correct voltage is not present, check sensing circuit (RED lead) for loose or dirty connections or damaged wiring.

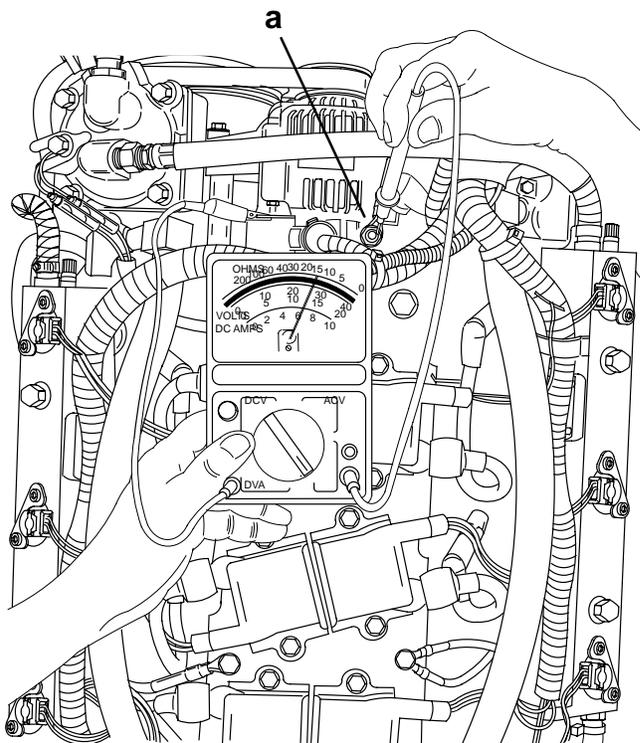


56024

a - Sense Lead (RED)

VOLTAGE OUTPUT

1. Using a 0-20 volt DC voltmeter, connect POSITIVE (+) lead of voltmeter to TERMINAL B of alternator and NEGATIVE (-) lead of voltmeter to engine ground.

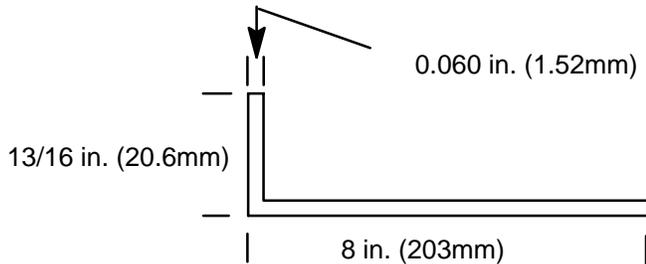


56025

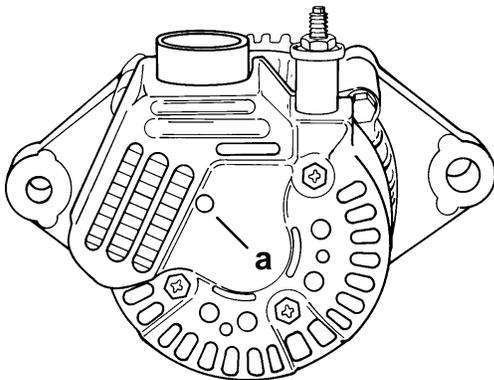
a - Terminal B



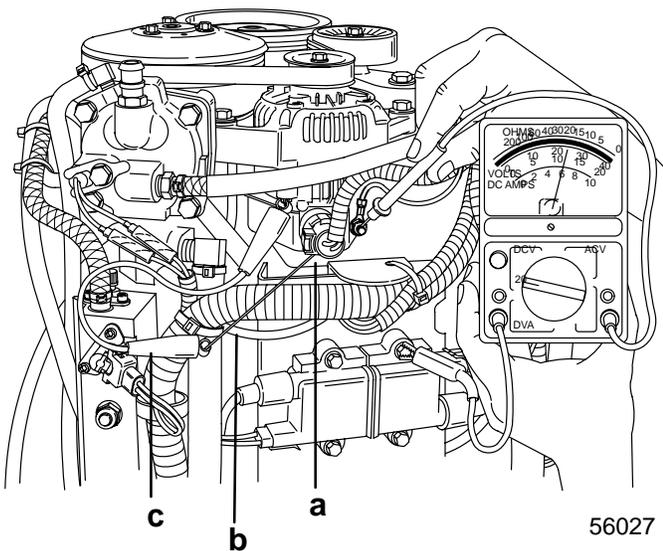
2. Start engine and allow to warm up. Increase engine RPM from idle to 2000. Normal voltage output should be 13.5 – 15.1 volts. If voltage reading is greater than normal, replace voltage regulator.
3. If voltage reading is less than normal, fabricate a tool from a piece of stiff wire to the following specifications:



4. Insert bent end of tool through end cover and ground TERMINAL F.



51683



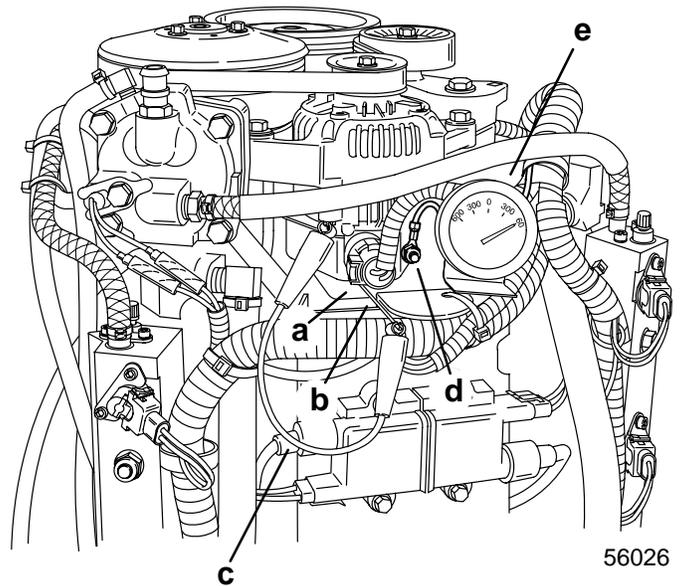
56027

- a - Terminal F
- b - Tool
- c - Jumper Wire to Engine Ground (Attach to end of Tool)

5. With TERMINAL F grounded, voltage should rise to within the normal range (13.5 – 15.1). If voltage rises, replace the regulator.
6. If the voltage DOES NOT rise to within the normal range with TERMINAL F grounded, perform “CURRENT OUTPUT” test.

CURRENT OUTPUT

1. With engine shut off, install ammeter (capable of reading 60+ amperes) in series between TERMINAL B on alternator and POSITIVE (+) terminal of battery.
2. Start engine and allow to warm up. Advance RPM to 2000.
3. Insert tool, previously fabricated for **VOLTAGE OUTPUT**, through end cover and ground TERMINAL F.



56026

- a - Terminal F
- b - Tool
- c - Jumper Wire to Engine Ground
- d - Terminal B
- e - Ammeter

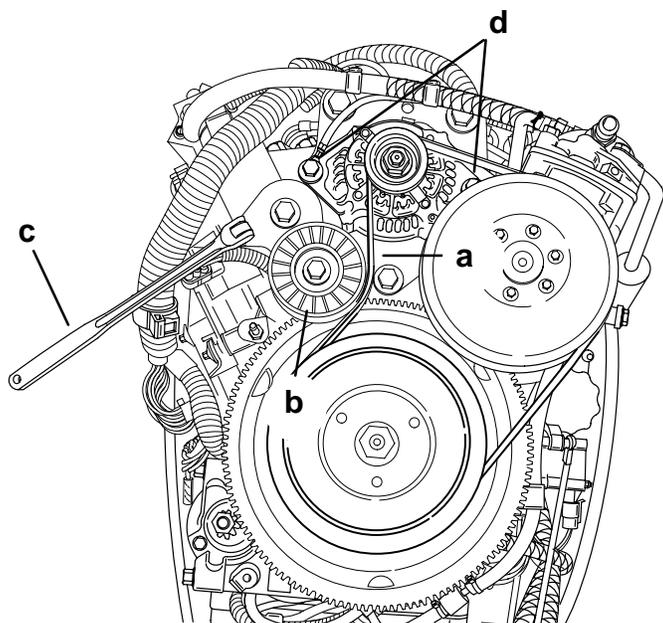
4. Normal output is 60 amperes @ 2000 RPM. If output is normal, replace regulator. If output is low, a disassembly of the alternator is necessary to inspect and test individual components.



Repair

REMOVAL

1. Remove top cowling.
2. Disconnect battery cables from battery.
3. Disconnect wiring harness from alternator.
4. Use a breaker bar to release belt tensioner and remove alternator belt.
5. Remove attaching bolts and remove alternator.

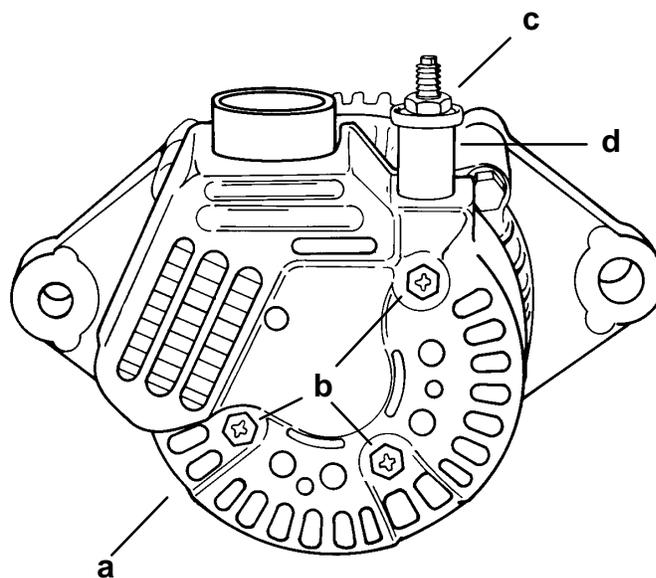


56829

- a - Belt
- b - Tensioner
- c - Breaker Bar
- d - Attaching Bolts

DISASSEMBLY AND TEST

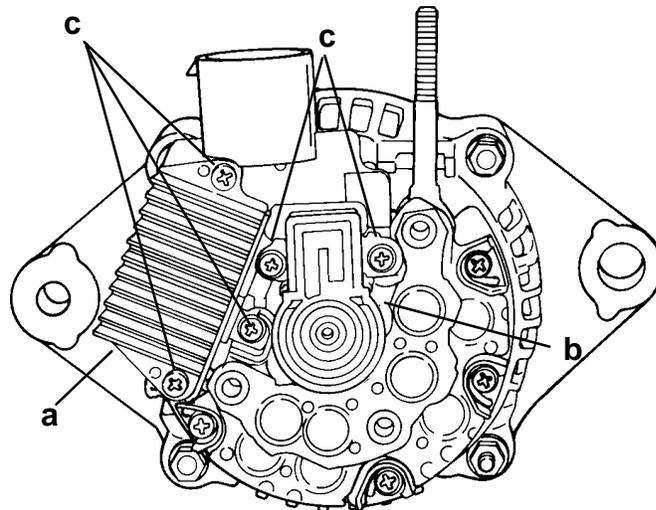
1. Remove 3 screws and nut securing end cover and remove insulator and cover.



51683

- a - Cover
- b - Screws
- c - Nut
- d - Insulator

2. Remove 5 screws securing regulator and brush assembly.



51680

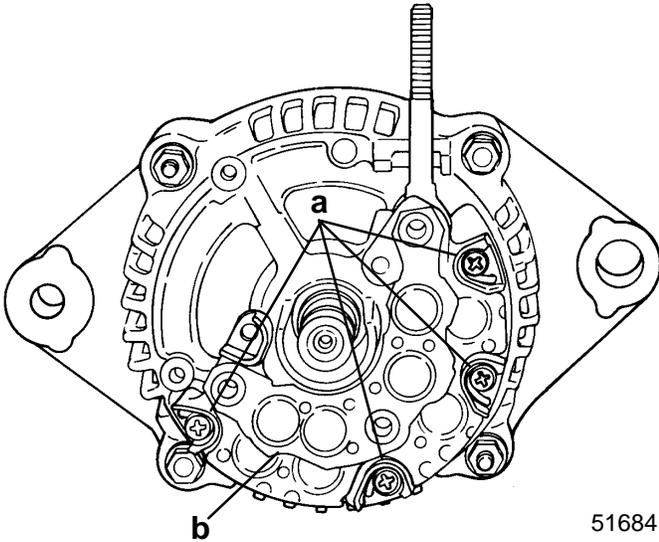
- a - Regulator
- b - Brush Assembly
- c - Screws

NOTE: Proper regulator operation can be determined by **VOLTAGE OUTPUT** and **CURRENT OUTPUT**, previous. If regulator does not meet specifications, replace regulator. Torque regulator screws to 17 lb. in. (1.9 N·m).



NOTE: Brushes are replaced as an assembly. Inspect assembly for stuck brushes or excessive brush wear. Normal exposed brush length is 0.156 in. (4.0mm). Minimum exposed brush length is 0.059 in. (1.5mm).

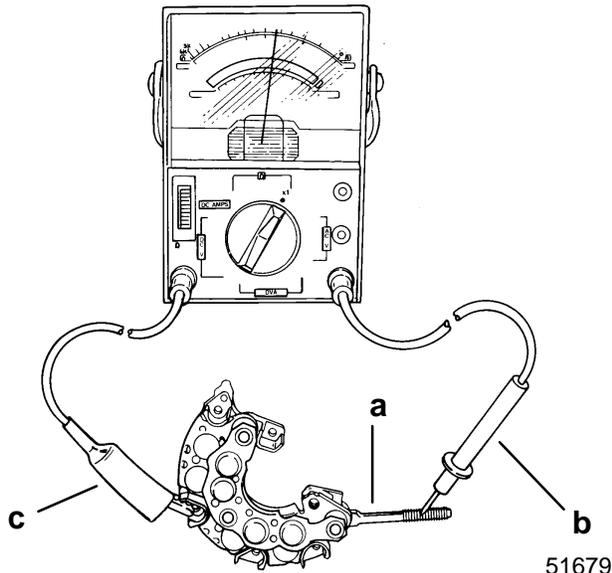
- Remove 4 screws securing rectifier (diode assembly) to alternator.



51684

- a - Screws
- b - Rectifier (Diode Assembly)

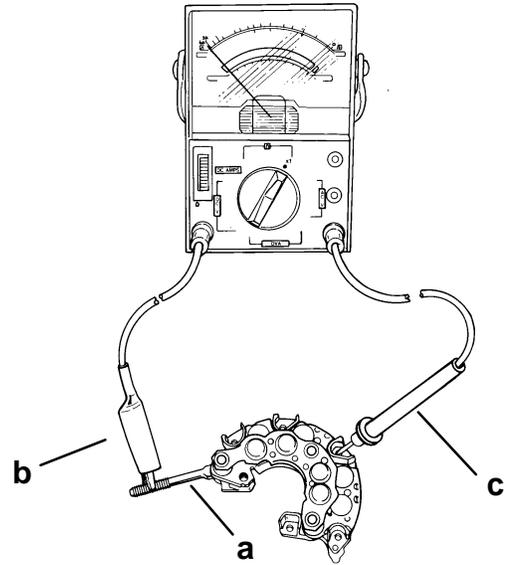
NOTE: To test rectifier assembly, touch POSITIVE (+) lead from ohmmeter to POSITIVE stud and NEGATIVE (-) lead from ohmmeter to each diode terminal. The ohmmeter should indicate continuity.



51679

- a - Positive Stud
- b - Positive Ohm Lead
- c - Negative Ohm Lead

Reverse leads – NEGATIVE lead on POSITIVE stud and POSITIVE lead on each diode assembly. NO CONTINUITY should be observed. If continuity is observed in both tests, or NO CONTINUITY is observed in both tests, the rectifier assembly is defective and must be replaced. Torque rectifier screws to 17 lb. in. (1.9 N·m).



51679

- a - Positive Stud
- b - Negative Ohm Lead
- c - Positive Ohm Lead



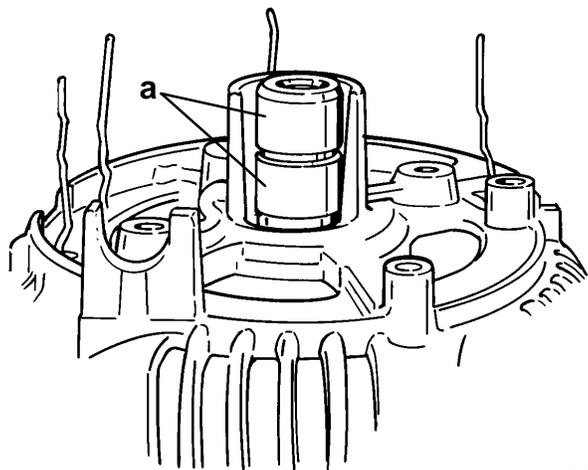
IMPORTANT: Depending on the polarity of the ohmmeter, reversed readings may be obtained – I.E. – CONTINUITY is observed when the NEGATIVE lead touches the POSITIVE stud and NO CONTINUITY is observed when the POSITIVE lead touches the POSITIVE stud.

IMPORTANT: The regulator, rectifier and brush assembly are the only components individually replaceable on this alternator. If the rotor or stator is defective, the entire rotor, stator and housing must be replaced as an assembly.

IMPORTANT: Clean anti-corrosion paint from electrical connections prior to reassembly. Coat all electrical connections with LIQUID NEOPRENE (92-25711-1).

ROTOR TEST

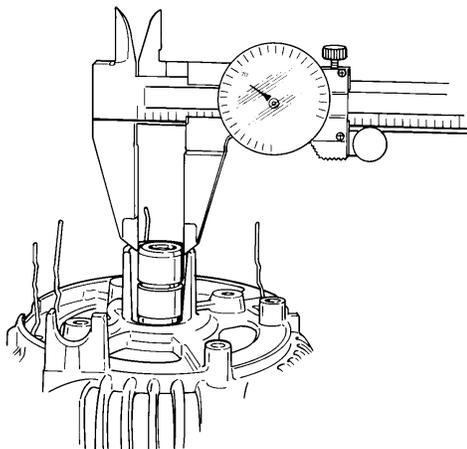
1. Inspect slip ring surface for roughness, abnormal wear and/or burning. If such conditions exist, rotor is not considered serviceable and alternator should be replaced.



51684

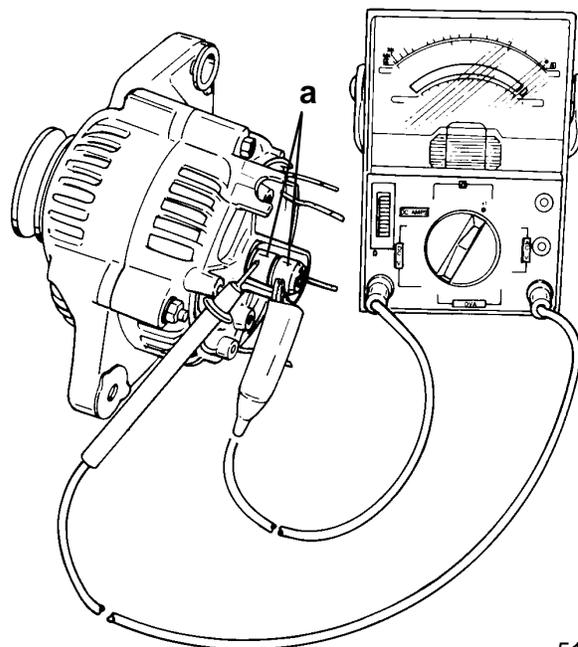
a - Slip Rings

2. Measure the outer diameter of the slip rings using vernier calipers. STANDARD DIAMETER: 0.567 in. (14.4mm); MINIMUM DIAMETER: 0.551 in. (14.0mm). If slip ring diameter is less than minimum, rotor is not considered serviceable and alternator should be replaced.



51680

3. Inspect rotor for an open circuit. Using an ohmmeter, check for continuity between slip rings. Resistance should not exceed 3 ohms. If no continuity exists, rotor is defective.

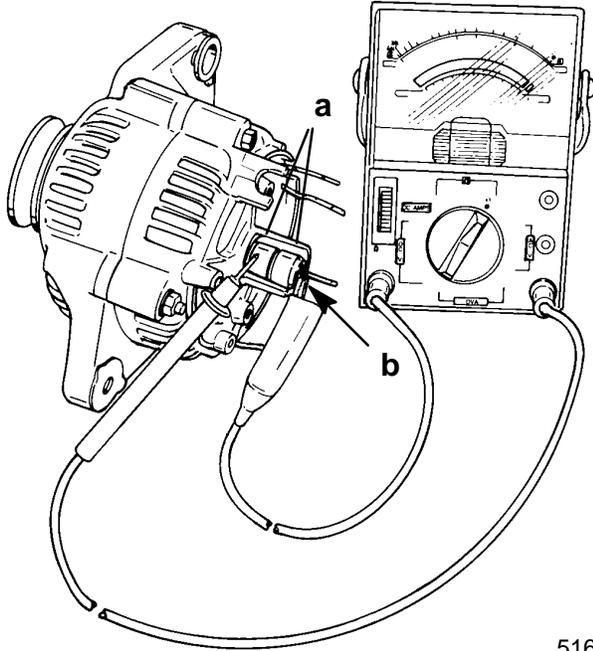


51682

a - Slip Rings



4. Check rotor for short to ground. NO CONTINUITY should exist between slip rings and rotor shaft. If CONTINUITY exists, rotor is defective.

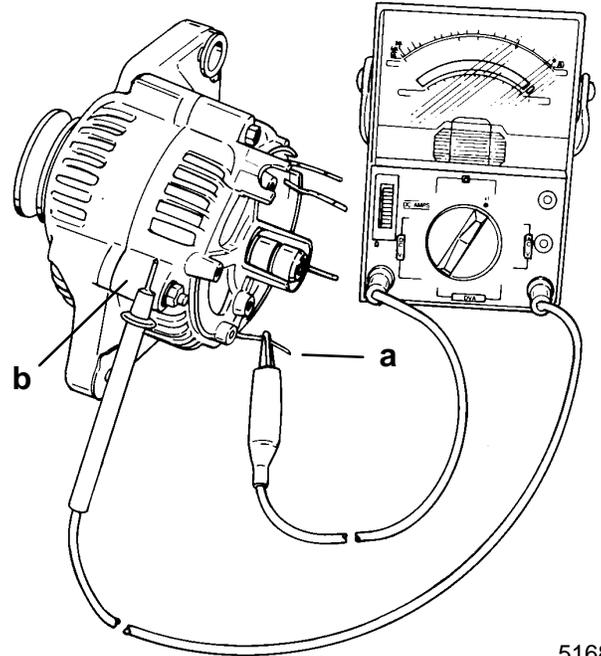


a - Slip Rings
b - Rotor Shaft

51683

STATOR TEST

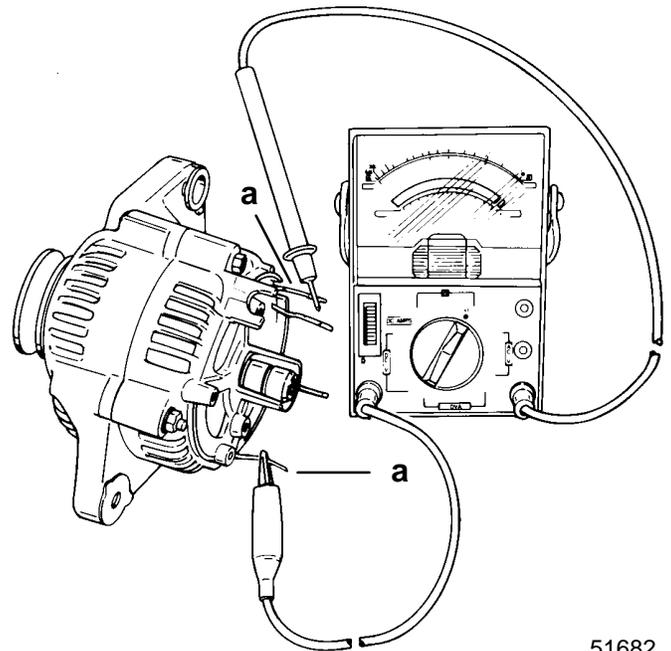
1. With rectifier removed, use an ohmmeter to check for a short circuit between each stator lead and the stator frame. If CONTINUITY exists, stator is defective.



a - Stator Leads
b - Frame

51682

2. Inspect stator for open circuit. Using an ohmmeter, check for an open circuit between each of the stator leads. If no continuity exists, stator is defective.



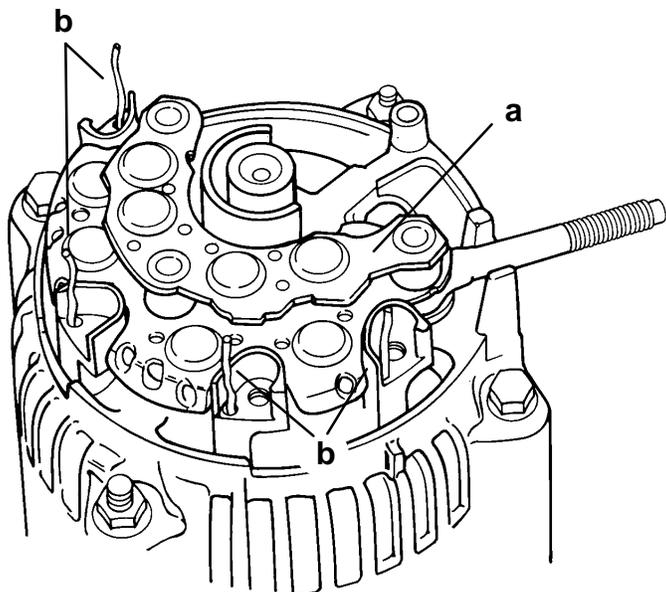
a - Stator Leads

51682



REASSEMBLY

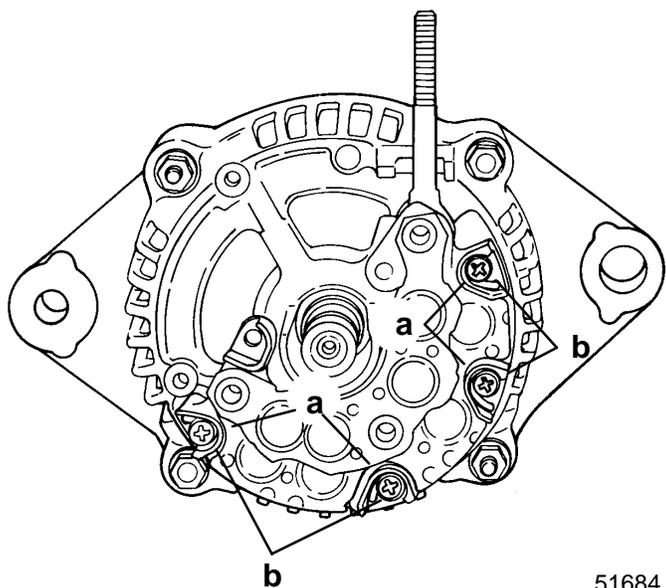
1. Position rectifier assembly over stator leads.



51683

- a - Rectifier Assembly
- b - Stator Leads

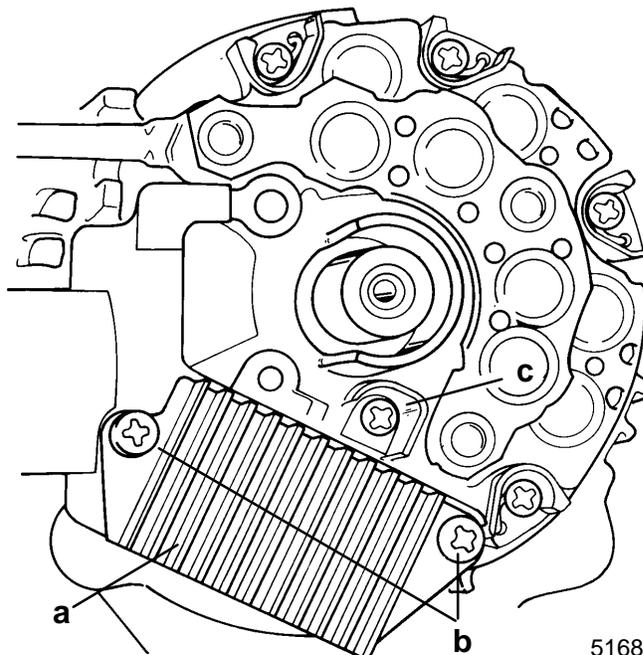
2. Form stator leads in a clockwise loop and secure leads to rectifier with 4 screws. Torque screws to 17 lb. in. (1.9 N-m).



51684

- a - Stator Leads
- b - Screws [Torque to 17 lb. in. (1.9 N-m)]

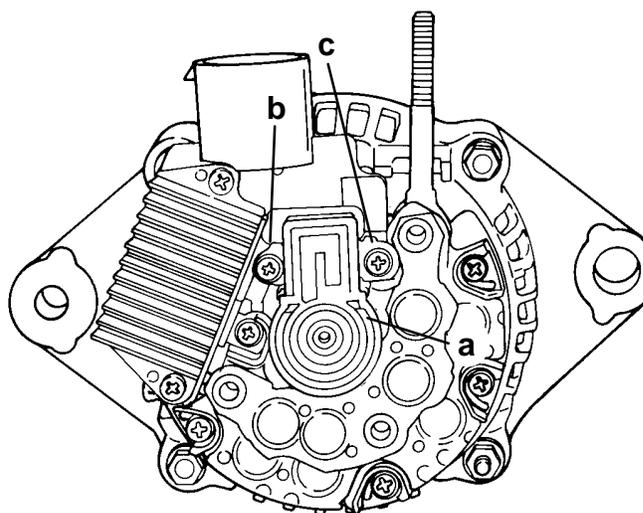
3. Secure regulator to alternator with 2 screws [1 in. (25.4mm) long]; 1 screw [0.25 in. (6.4mm) long] and lockwashers. DO NOT tighten screws at this time.



51684

- a - Regulator
- b - Screws [1 in. (25.4mm)]
- c - Screw [0.25 in. (6.4mm)]

4. Secure brush assembly with 2 screws – [0.25 in. (6.4mm) long] and [0.312 in. (8.0mm) long].

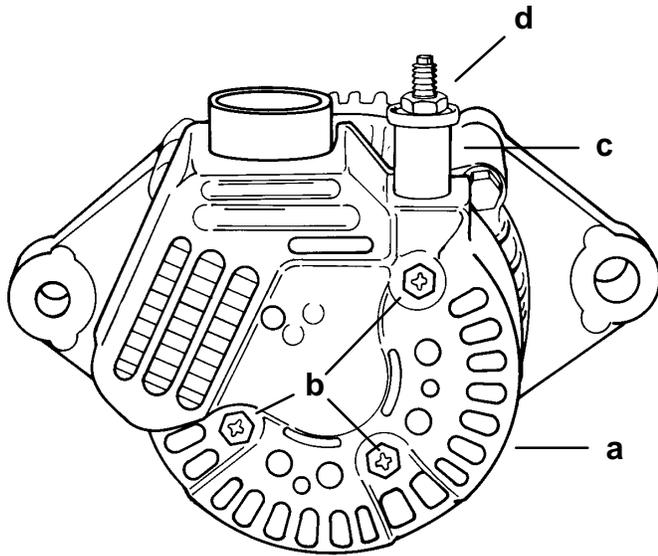


51680

- a - Brush Assembly
- b - Screw [0.25 in. (6.4mm)]
- c - Screw [0.312 in. (8.0mm)]



5. Install end cover. Secure cover with 3 screws. Torque screws to 23 lb. in. (2.6 N-m). Install terminal insulator. Torque nut to 36 lb. in. (4.1 N-m).

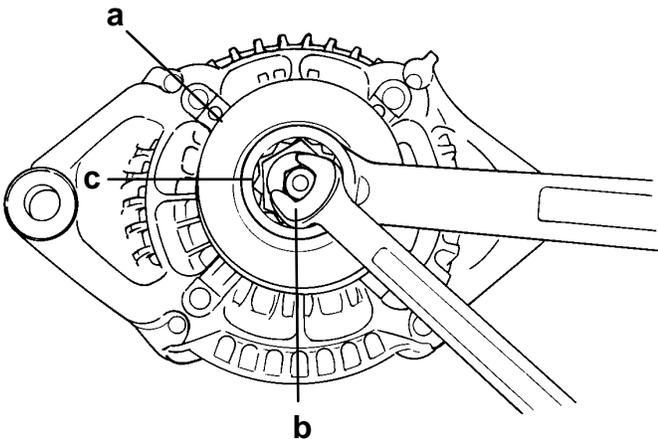


51683

- a - Cover
- b - Screw [Torque to 23 lb. in. (2.6 N-m)]
- c - Terminal Insulator
- d - Nut [Torque to 36 lb. in. (4.1 N-m)]

PULLEY

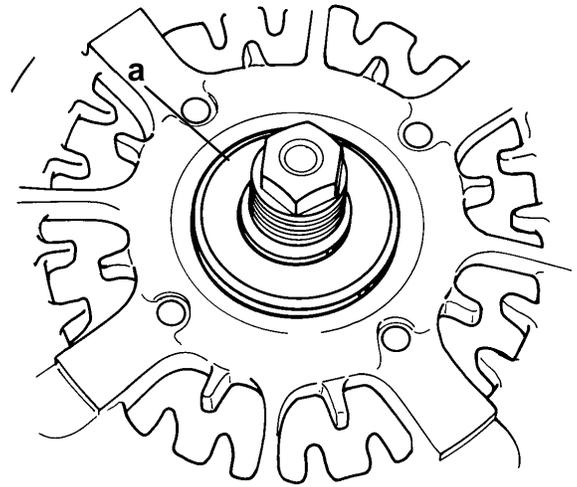
1. While holding rotor shaft, remove pulley nut.



51679

- a - Pulley
- b - Rotor Shaft
- c - Nut

2. Before reinstalling pulley, verify spacer is installed on rotor shaft.



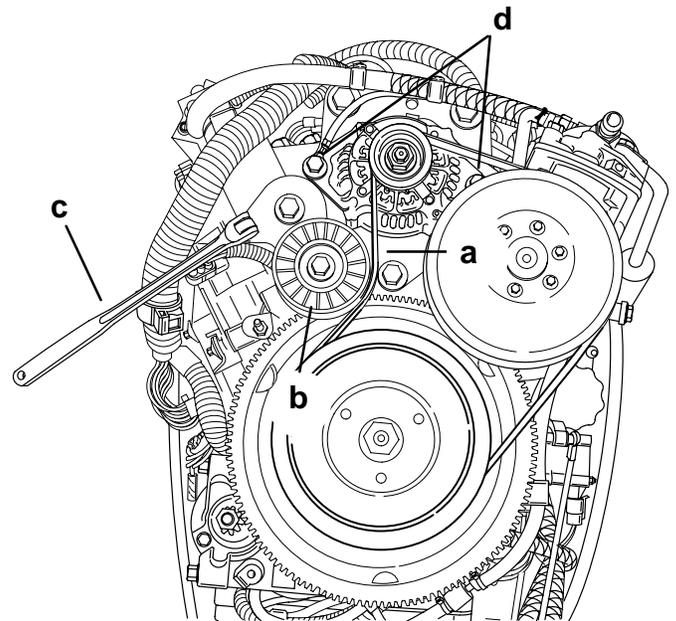
51683

- a - Spacer

3. Torque pulley nut to 50 lb. ft. (67.8 N-m).

Installation

1. Secure alternator to engine block with 2 attaching bolts. Torque bolts to 40 lb. ft. (54.2 N-m).
2. Install alternator belt in groove of flywheel, alternator and compressor pulley.
3. Reconnect electrical harness to alternator.



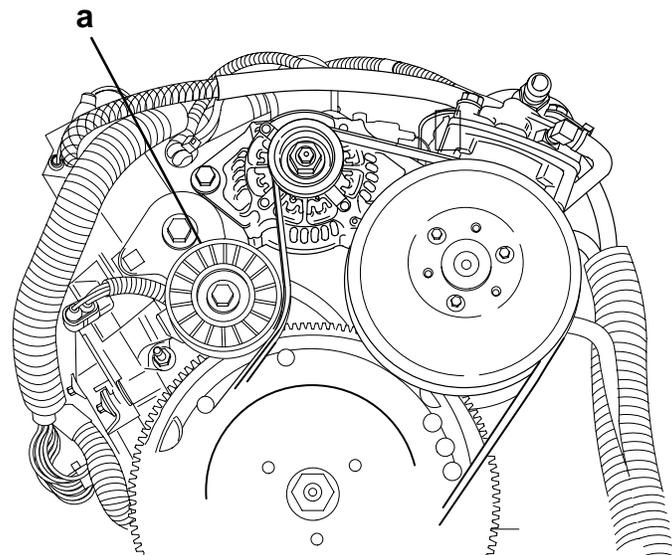
56829

- a - Belt
- b - Tensioner
- c - Breaker Bar
- d - Attaching Bolts



Alternator Belt Tension Adjustment

Correct alternator belt tension is maintained by a belt tensioner assembly.



55936

a - Belt Tensioner Assembly

Starter System

STARTER MOTOR AMPERES DRAW

STARTER MOTOR PART NO.	NO LOAD AMP. DRAW	NORMAL AMP. DRAW
50-833153-1	30 AMPS	210 AMPS

STARTER SYSTEM COMPONENTS

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

DESCRIPTION

The battery supplies electricity to activate the starter motor. When the ignition is turned to the "START" position, the starter solenoid is energized and completes the starter circuit between the battery and starter.

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

⚠ CAUTION

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

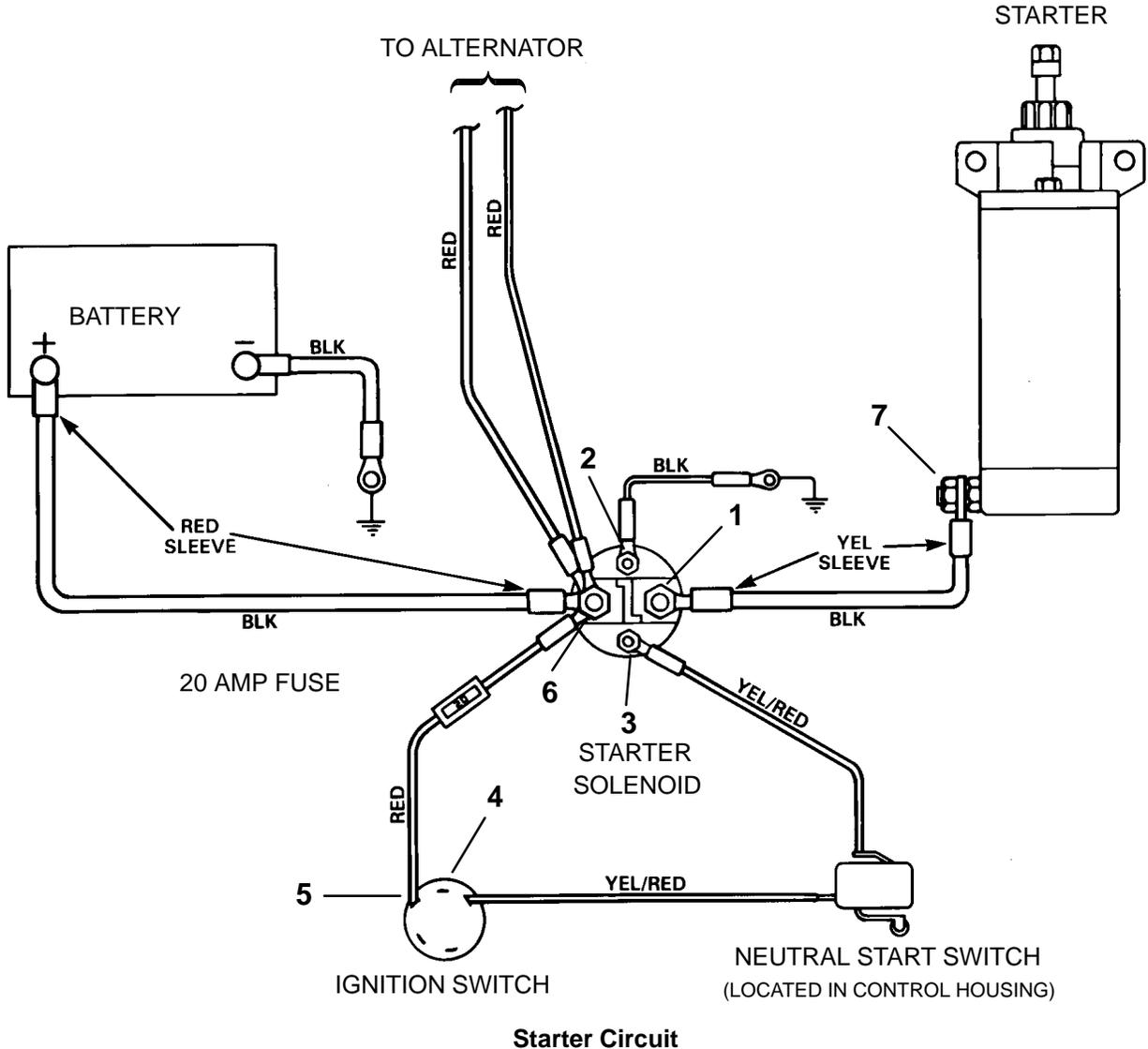


Troubleshooting the Starter Circuit

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

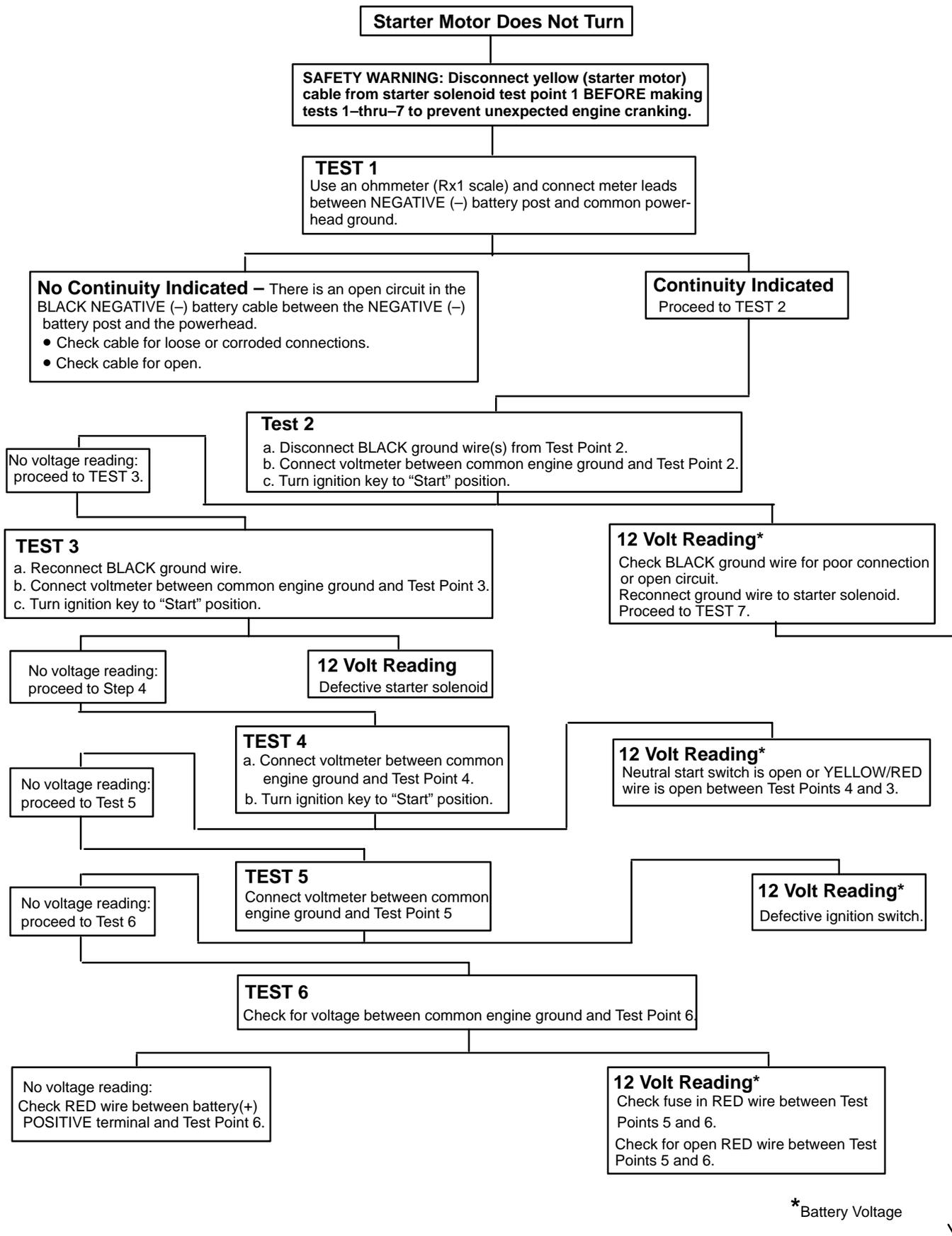
1. Confirm that battery is fully charged.
2. Check that control lever is in "NEUTRAL" position.
3. Check terminals for corrosion and loose connections.
4. Check cables and wiring for frayed and worn insulation.
5. Check 20 amp fuse.

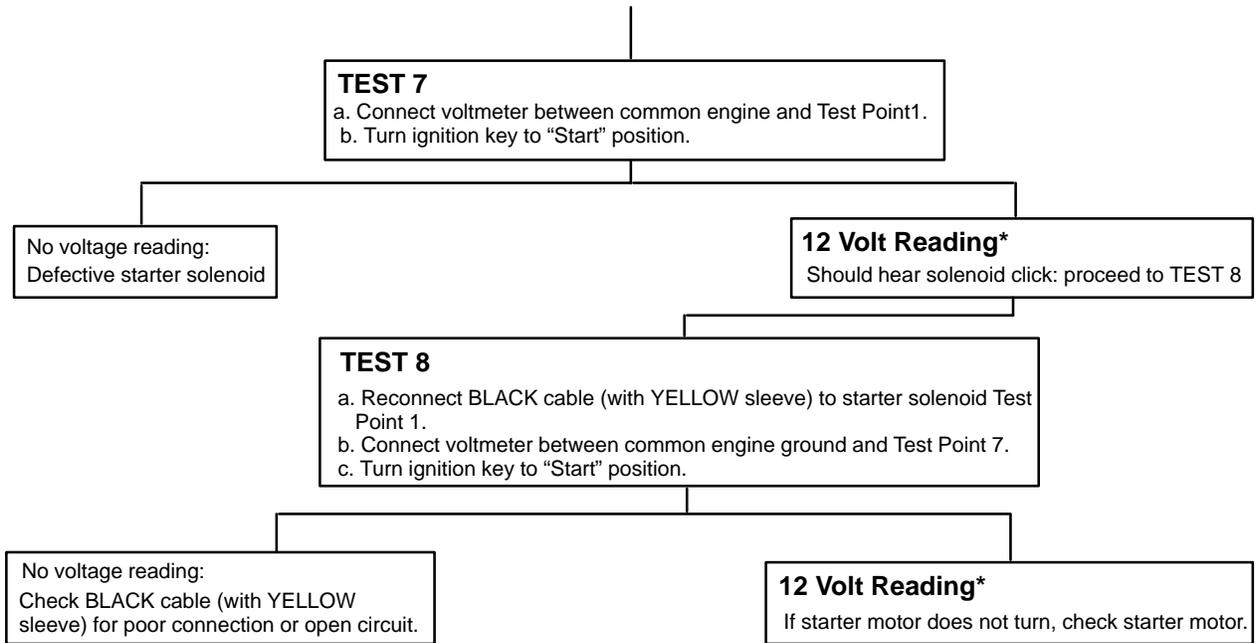
Location of "Test Points" (called out in flow chart) are numbered below.





Starter Circuit Troubleshooting Flow Chart





*Battery Voltage

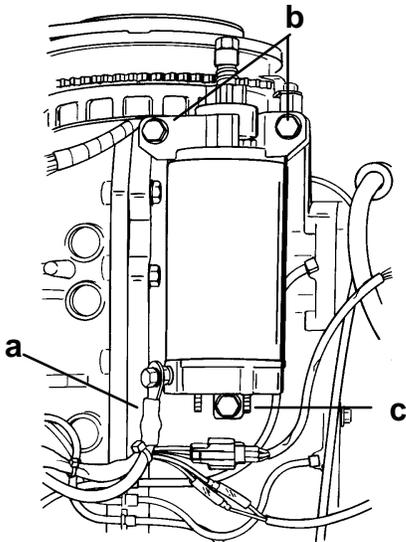
Starter Removal and Installation

REMOVAL

CAUTION

Disconnect battery leads from battery before removing starter.

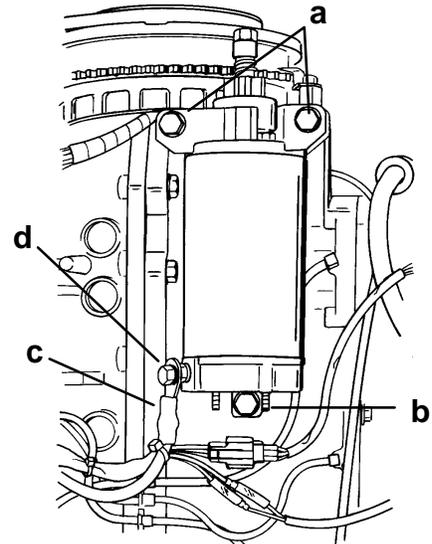
1. Disconnect BLACK cable (with YELLOW sleeve) from starter.
2. Remove 2 upper bolts and 1 lower bolt securing starter and remove starter.



- 52135
- a - BLACK (with YELLOW sleeve) POSITIVE (+) 12-Volt Cable
 - b - Upper Mounting Bolts
 - c - Lower Mounting Bolt

INSTALLATION

1. Secure starter to engine with 3 bolts. Torque top attaching bolts to 23 lb. ft. (31.2 N·m). Torque bottom attaching bolt to 21 lb. ft. (28.5 N·m).
2. Secure BLACK cable (with YELLOW sleeve) to POSITIVE (+) terminal on starter. Torque nut to 60 lb. in. (6.8 N·m).

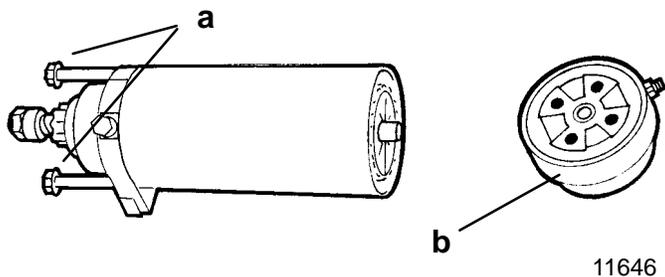


- 52135
- a - Top Bolts [Torque to 23 lb. ft. (31.2 N·m)]
 - b - Bottom Bolt [Torque to 21 lb. ft. (28.5 N·m)]
 - c - BLACK Cable (with YELLOW sleeve)
 - d - Nut [Torque to 60 lb. in. (6.8 N·m)]



DISASSEMBLY

1. Remove starter as outlined in "Starter Removal and Installation," preceding.
2. Remove 2 through bolts from starter.
3. Tap commutator end cap to loosen and remove from frame. Do not loose brush springs.

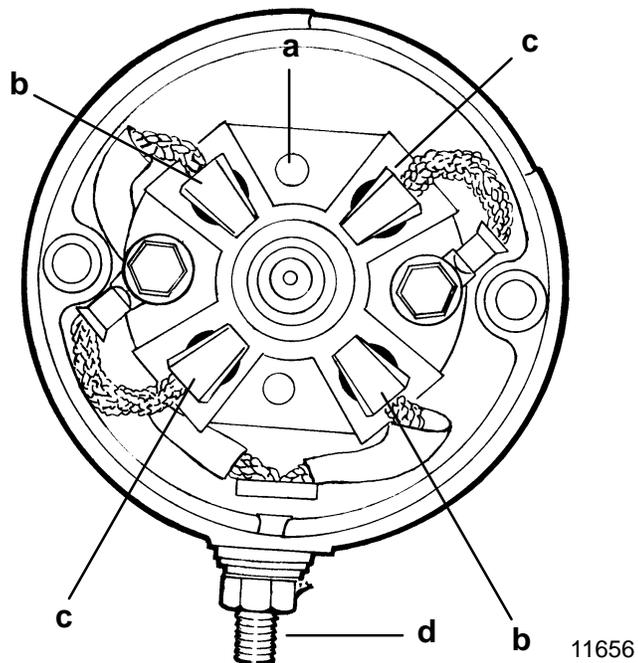


11646

- a - Through Bolts
- b - Commutator End Cap

4. Brush replacement is recommended if brushes are pitted, chipped or worn to less than 0.25 in. (6.4 mm). If necessary, remove brushes as follows:

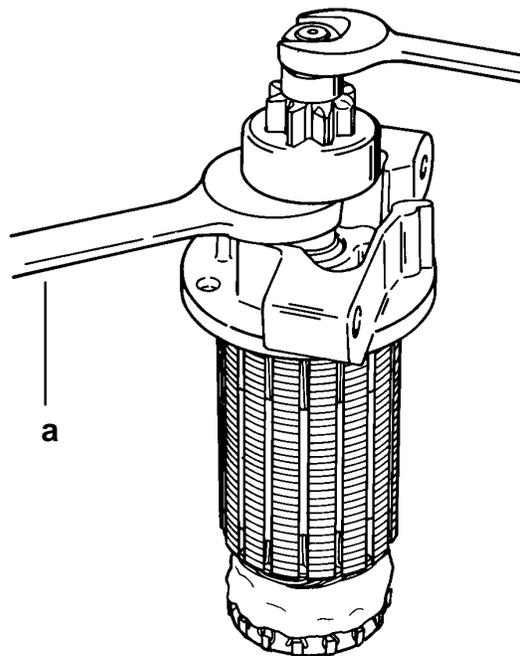
- a. Remove hex nut and washers from POSITIVE (+) terminal and remove POSITIVE brushes and terminal as an assembly.
- b. Remove 2 bolts securing NEGATIVE (-) brushes and brush holder to end cap.



11656

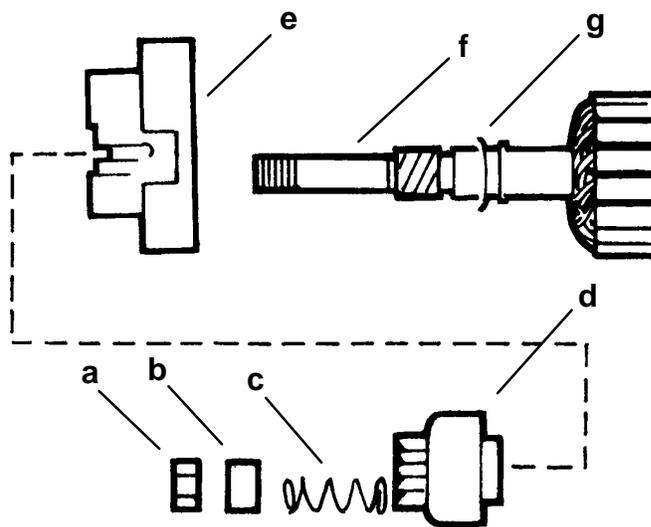
- a - Brush Holder
- b - Positive Brushes
- c - Negative Brushes
- d - Positive Terminal

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



51711

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



11658

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



Starter Cleaning, Inspection and Testing

CLEANING and INSPECTION

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

CAUTION

Do not turn down the commutator excessively.

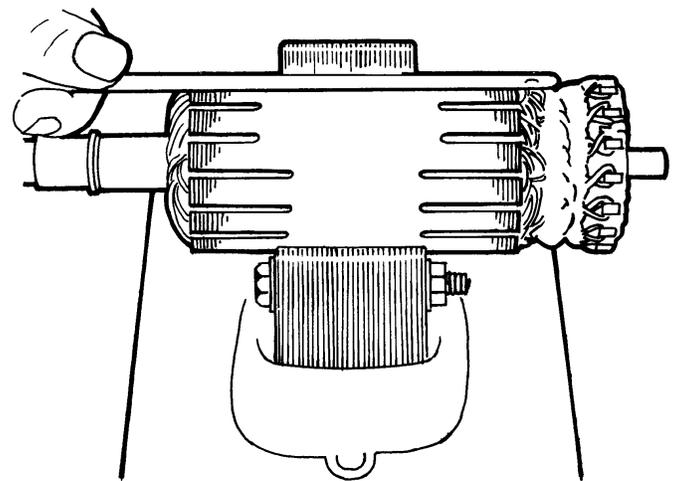
- a. Resurface the commutator and undercut the insulation between the commutator bars 1/32 in. (0.8mm) to the full width of the insulation and so that the undercut is flat.
- b. Clean the commutator slots after undercutting.
- c. Sand the commutator lightly with No. 00 sandpaper to remove burrs, then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

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

TESTING

Armature Test for Shorts

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

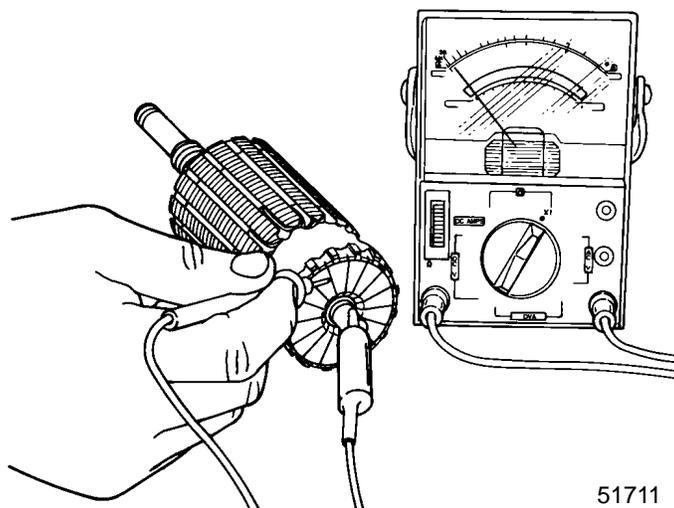


Armature Test for Ground

1. Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on armature core or shaft and other lead on commutator.



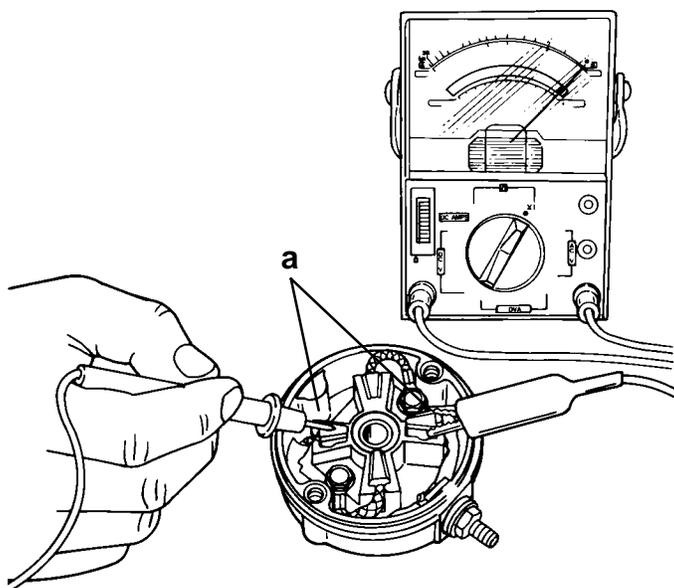
- If meter indicates continuity, armature is grounded and must be replaced.



51711

CHECKING POSITIVE BRUSHES AND TERMINAL

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

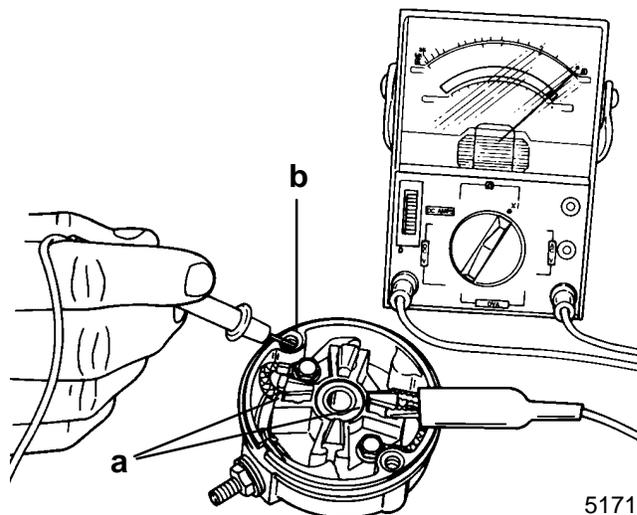


51711

a - POSITIVE (+) Brushes

Testing Negative Brushes for Ground

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



51711

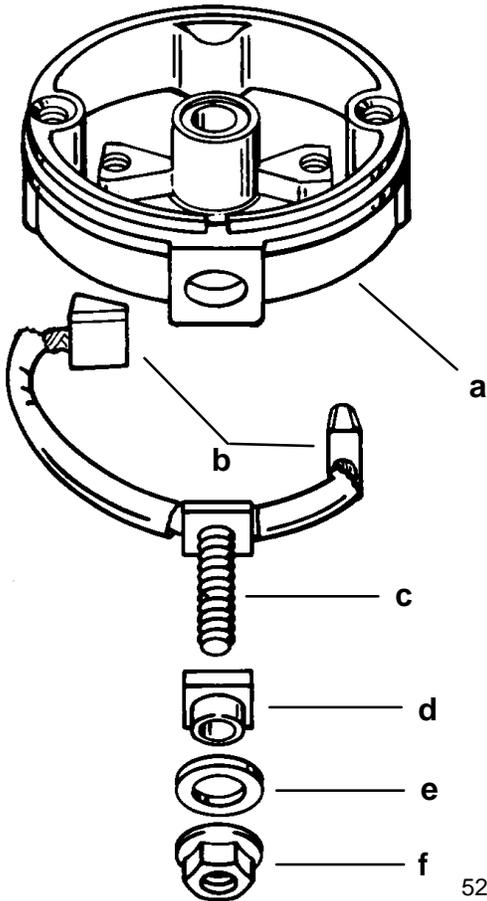
a - NEGATIVE (-) Brushes
b - End Cap



Starter Reassembly

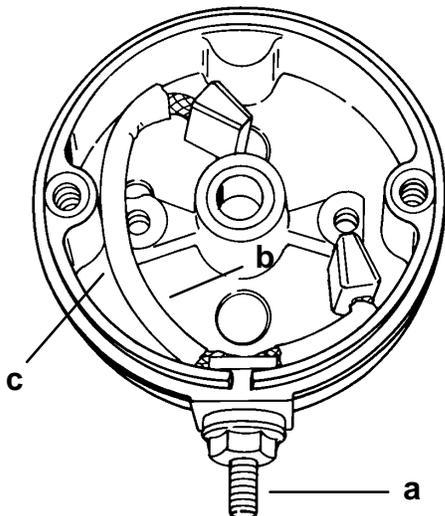
1. If brushes were removed, replace as follows:

- a. Install POSITIVE brushes (along with POSITIVE terminal) into commutator end cap.



- a - End Cap
- b - POSITIVE Brushes
- c - POSITIVE Terminal
- d - Insulating Block
- e - Insulating Washer
- f - Hex Nut

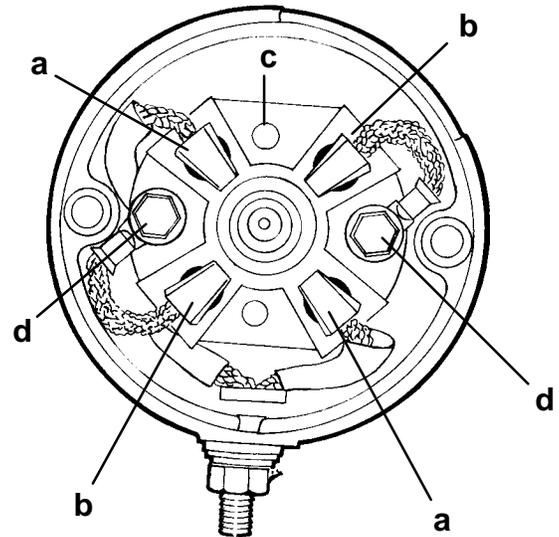
52131



- a - POSITIVE (+) Terminal
- b - Long Brush Lead
- c - Push Lead into Slot

51713

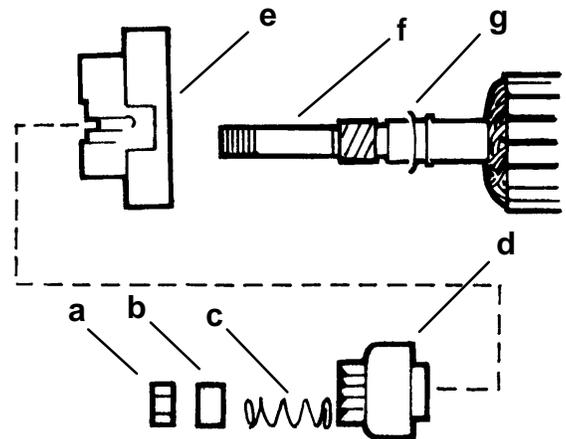
- b. Install NEGATIVE brushes (along with brush holder).



11656

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

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



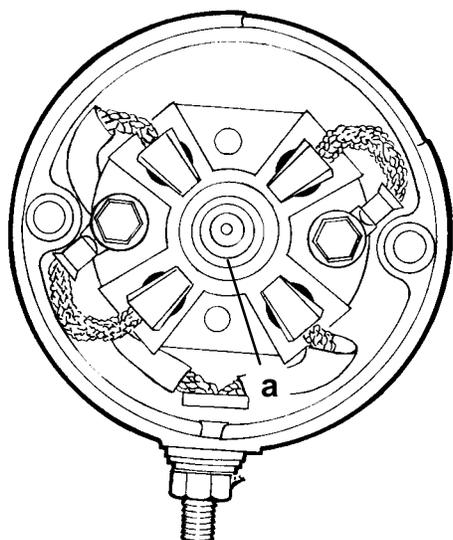
11658

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

- 3. Lubricate helix threads on armature shaft with a drop of SAE 10W oil.
- 4. Lubricate bushing in drive end plate with a drop of SAE 10W oil.
- 5. Position armature into starter frame.

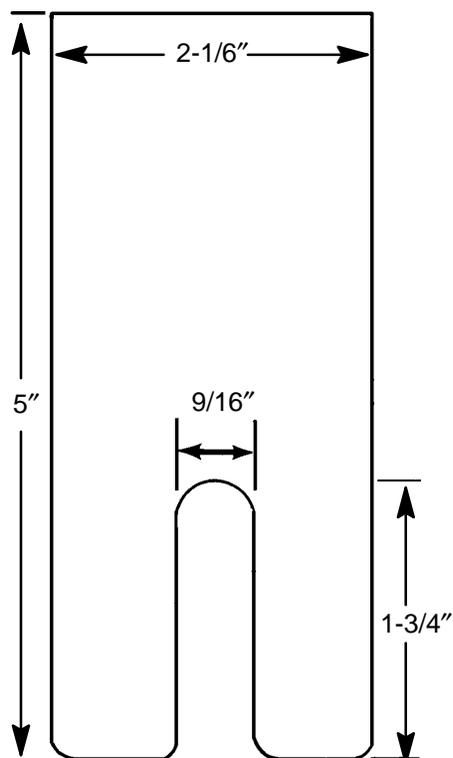


- Lubricate bushing (located in commutator end cap) with one drop of SAE 10W oil. DO NOT over-lubricate.

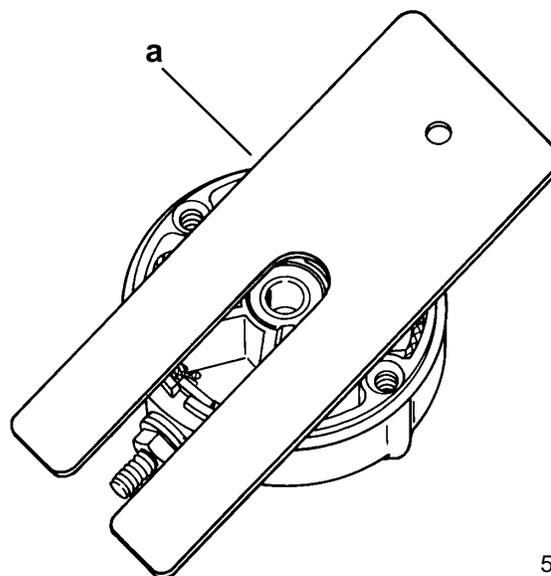


a - Bushing (DO NOT overlubricate)

- To prevent damage to brushes and springs when installing commutator end cap, it is recommended that a brush retaining tool be made as shown:



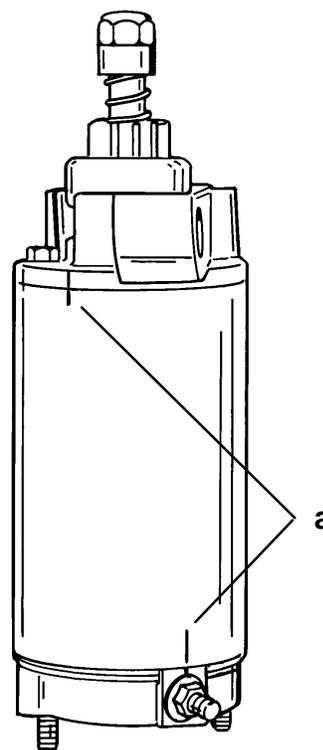
- Place springs and brushes into brush holder and hold in place with brush retainer tool.



51713

a - Brush Retainer Tool

- Install commutator end cap onto starter frame. Align marks on frame with alignment marks on end caps. Remove brush retainer tool. Install through bolts and torque to 70 lb. in. (8.0 N-m).



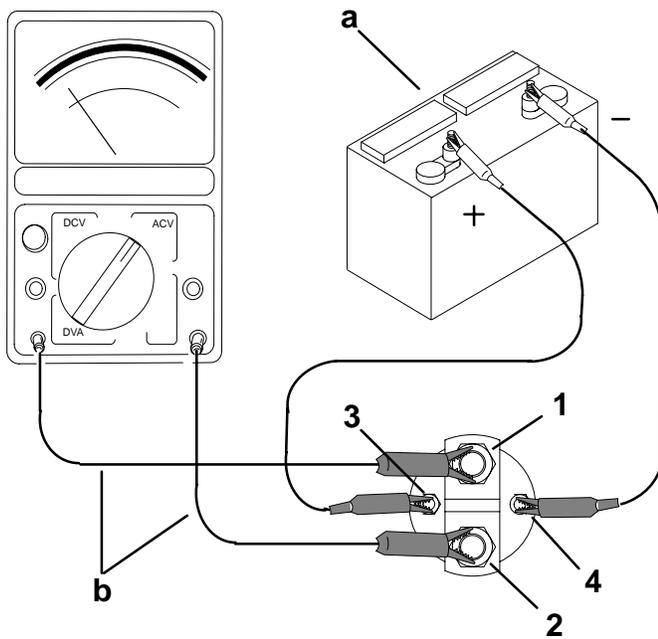
52130

a - Alignment Marks



Starter Solenoid Test

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



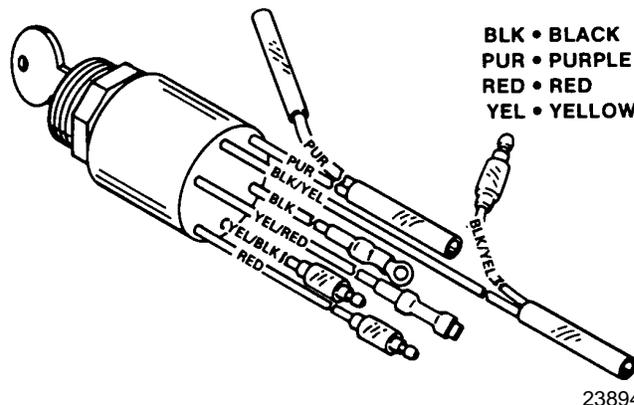
a - 12-VOLT Supply
b - VOA Leads



Commander 2000 Key Switch Test

1. Disconnect remote control wiring harness and instrument panel connector.
2. Set ohmmeter on R x 1 scale for the following tests.
3. If meter readings are other than specified in the following tests, verify that switch and not wiring is faulty. If wiring checks ok, replace switch.

IMPORTANT: Key switch must be positioned to "RUN" or "START" and key pushed in to actuate choke for this test.

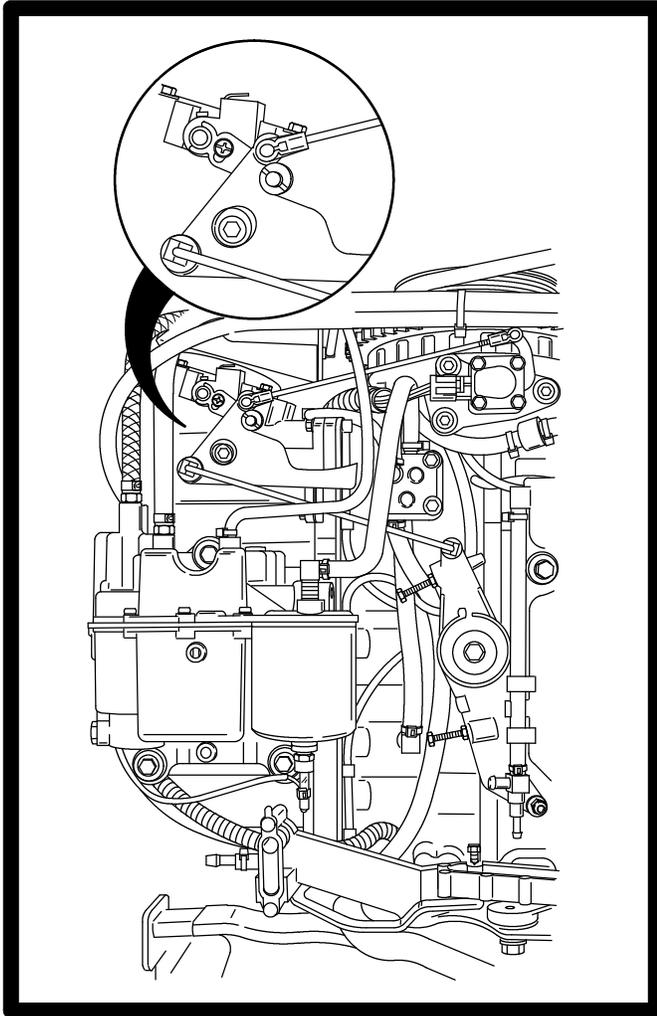


23894

KEY POSITION	CONTINUITY SHOULD BE INDICATED AT THE FOLLOWING POINTS:					
	BLK	BLK/YEL	RED	YEL/RED	PUR	YEL/BLK
OFF	○-----○					
RUN			○-----○			
START			○-----○	○-----○		
CHOCKE*			○-----○		○-----○	○-----○



ELECTRICAL



2

C

TIMING, SYNCHRONIZING AND ADJUSTING



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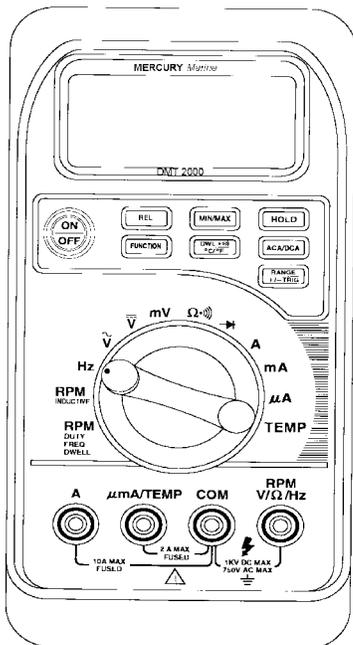
Specifications

1997 & 1998 MODELS	
FULL THROTTLE RPM RANGE	5000 - 5750
IDLE RPM (IN FORWARD GEAR) 1997 MODELS 1998 MODELS	650 550
MAXIMUM TIMING: @ WIDE OPEN	Not Adjustable Controlled by ECM
IDLE TIMING	Not Adjustable Controlled by ECM
SPARK PLUG 1997 MODEL 200 1998 MODEL 200/225	Champion RC10-ECC NGK PZFR5F-11 or Champion RC12MC4 [†]
FIRING ORDER	1-2-3-4-5-6
THROTTLE POSITION SENSOR 1 (INNER TPS) @ IDLE @ W.O.T.	4.33 ± 0.10 VDC 1.00 ± 0.25 VDC
THROTTLE POSITION SENSOR 2 (OUTTER TPS) @ IDLE @ W.O.T.	0.52 ± 0.10 VDC 4.5 ± 0.25 VDC

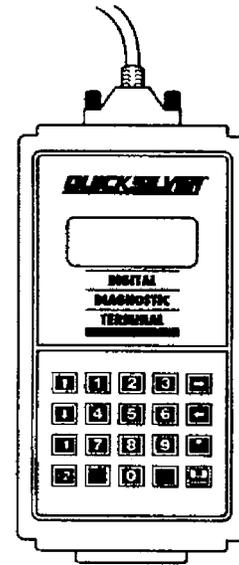
[†] Light Duty Use

Special Tools

1. Service Tachometer 91-59339



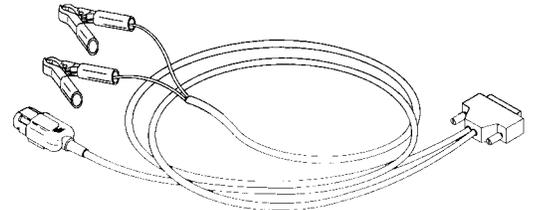
2. Digital Diagnostic Terminal 91-823686A2



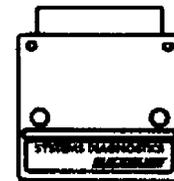
3. Cable [10 ft. (3.05m)]* 84-5003A1



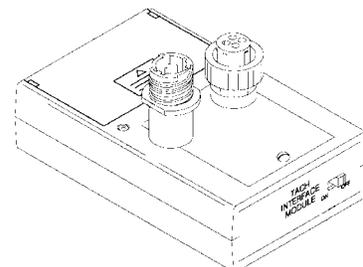
4. ECM Harness 84-822560A5



5. Cartridge 91-822608-4 or 91-822608--5



6. Tachometer Adaptor 91-825824A2



*Cable is provided with Digital Diagnostic Terminal 91-823686A2

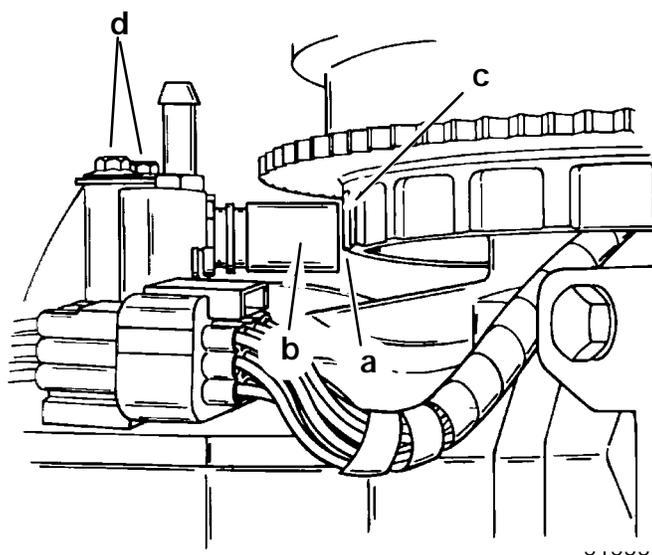


Crank Position Sensor Adjustment (All Models)

1. Remove flywheel cover.
2. Using a feeler gauge, measure the air gap between the crank position sensor and a tooth on the flywheel. It should be 0.040 in. \pm 0.020 in. [1.02 mm \pm 0.51 mm]. If not, loosen bracket screws, set gap to specification, and retighten screws to 105 lb. in. (11.9 N·m).

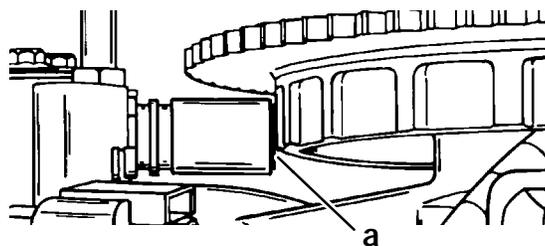
IMPORTANT: Crank Position Sensor must be perpendicular to flywheel tooth.

3. Reinstall flywheel cover.



- a - Air Gap [0.040 in. \pm 0.020 in.(1.02mm \pm 0.51mm)]
- b - Crank Position Sensor
- c - Flywheel Tooth
- d - Bracket Screws [Torque to 105 lb. in.(11.9 N·m)]

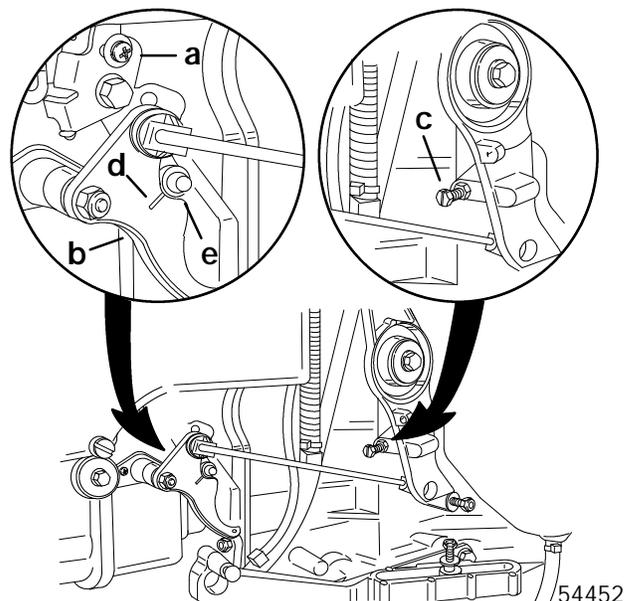
IMPORTANT: A new replacement crank position sensor will have a felt pad on the end of the sensor. Install the new sensor with the pad touching the flywheel; this will result in a gap of 0.030 (0.762mm)



- a - Felt Pad on a New Crank Position Sensor

Throttle Cam Adjustment (1997 Models)

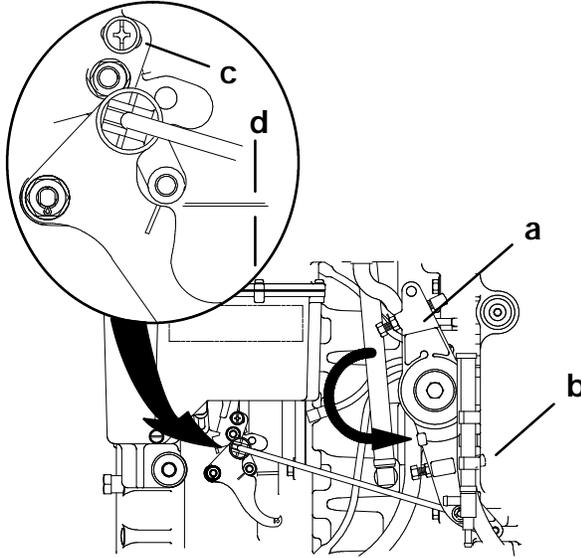
1. Loosen throttle cam roller screw so the roller moves freely. **Allow the roller to rest on the throttle cam.** Adjust the idle stop screw on the throttle arm and align mark on cam with center of roller.



- a - Throttle Cam Roller Screw
- b - Throttle Cam
- c - Idle Stop Screw
- d - Alignment Mark
- e - Roller



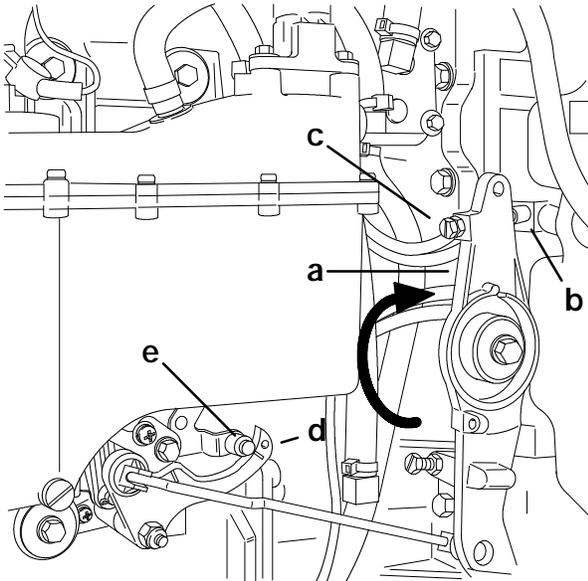
- Hold throttle arm against idle stop. Tighten throttle cam roller screw so that roller just touches throttle cam.



- a - Throttle Arm
- b - Idle Stop
- c - Throttle Cam Roller Screw
- d - 0.000 in. (0.0mm) Clearance

Maximum Throttle

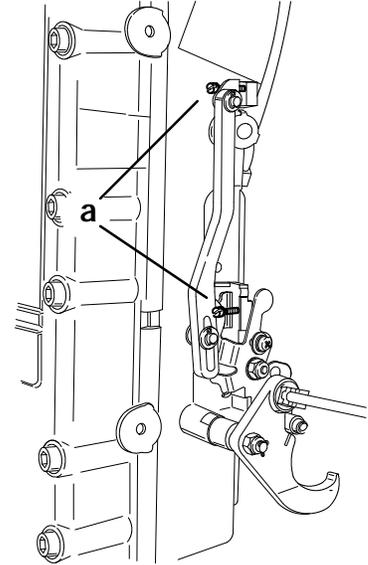
Hold throttle arm against full throttle stop. Adjust full throttle stop screw until alignment mark on cam is centered with roller.



- a - Throttle Arm
- b - Full Throttle Stop
- c - Full Throttle Stop Screw
- d - Alignment Mark on Cam
- e - Roller

Throttle Plate Stop Screws

IMPORTANT: DO NOT adjust throttle plate stop screws from factory setting. The top throttle plate clearance is set @ 0.038 in. (0.965mm) (#62 drill) and the bottom throttle plate is set @ 0.011 in. (0.279mm) (#80 drill). Contact the Mercury Marine Technical Service Department for proper adjustment procedure.

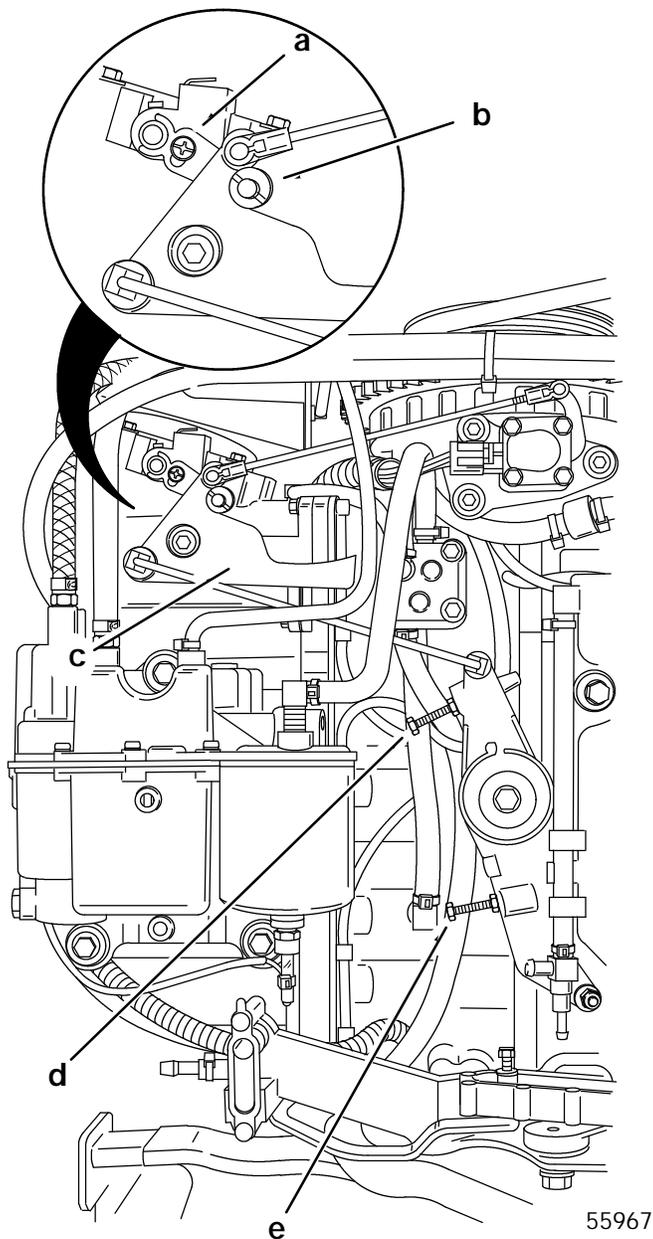


- a - Screws (DO NOT Adjust from Factory Setting)



Throttle Cam Adjustment (1998 Models)

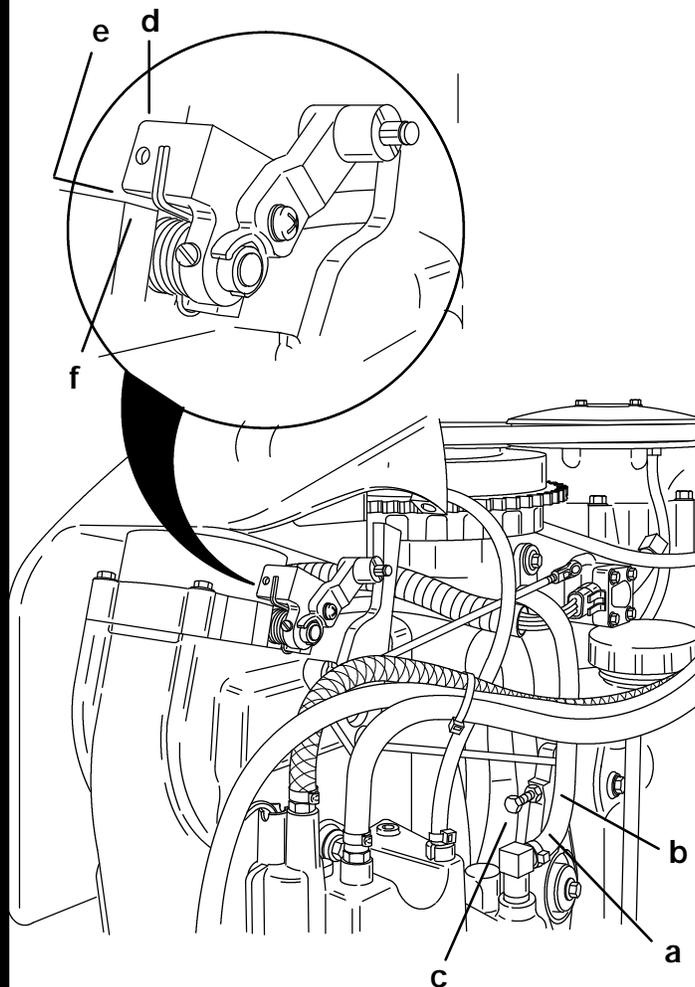
1. Loosen cam follower screw allowing cam follower to move freely.
2. Allow roller to rest on throttle cam. Adjust idle stop screw on throttle arm to align cam roller in the pocket of the throttle cam.
3. Tighten roller arm screw to provide clearance of 0.005 in. \pm 0.005 in. (0.127 mm \pm 0.127 mm) between roller and cam.



- 55967
- a - Roller Arm Screw
 - b - Roller
 - c - Throttle Cam
 - d - Wide Open Throttle Stop Screw
 - e - Idle Stop Screw

Maximum Throttle

1. Hold throttle arm against full throttle stop.
2. Adjust full throttle stop screw to allow full throttle valve opening while maintaining a 0.010 in. (0.254 mm) clearance between arm of throttle shaft and stop on attenuator box.
3. Tighten jam nut on full throttle stop screw.
4. Check for free play (roller lifts from cam) between roller and cam at full throttle to prevent linkage from binding. Readjust full throttle stop screw, if necessary.

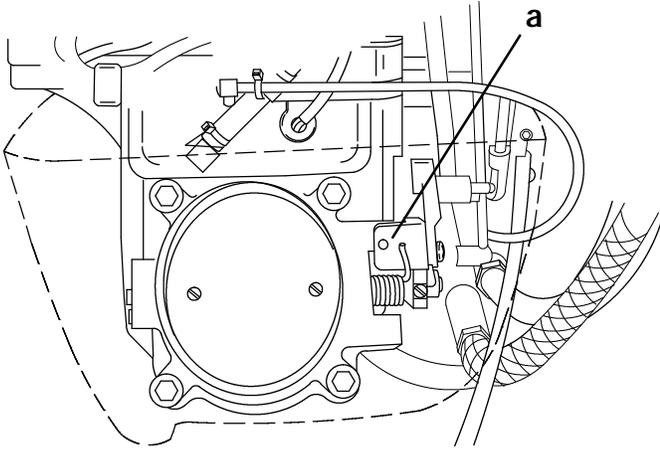


- 55982
- a - Throttle Arm
 - b - Stop
 - c - Full Throttle Stop Screw
 - d - Throttle Shaft Arm
 - e - 0.010 in. (0.254mm) Clearance
 - f - Stop on Attenuator Box



Throttle Plate Screw

IMPORTANT: DO NOT adjust throttle plate stop screw from factory setting. The throttle plate clearance is set @ 0.092 in. (02.34mm) (#42 drill). Contact the Mercury Marine Technical Service Department for proper adjustment procedure.



a - Throttle Plate Stop Screw

Throttle Position Sensor (TPS) Adjustment (All Models)

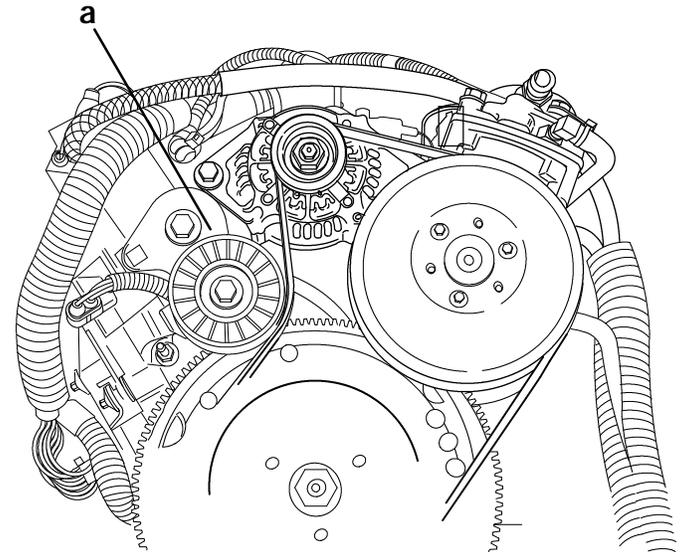
The Throttle Position Sensors are not adjustable. TPS settings can be monitored with the Digital Diagnostic Terminal through the ECM. If TPS settings are not within specifications, replace Throttle Position Sensors as required.

Idle Speed (All Models)

Engine idle speed is not adjustable. The parameters affecting idle speed can be checked and monitored by the DDT. Refer to the DDT Reference Manual for complete details.

Alternator Belt Tension Adjustment (All Models)

Correct alternator belt tension is maintained by a belt tensioner assembly.



a - Belt Tensioner Assembly

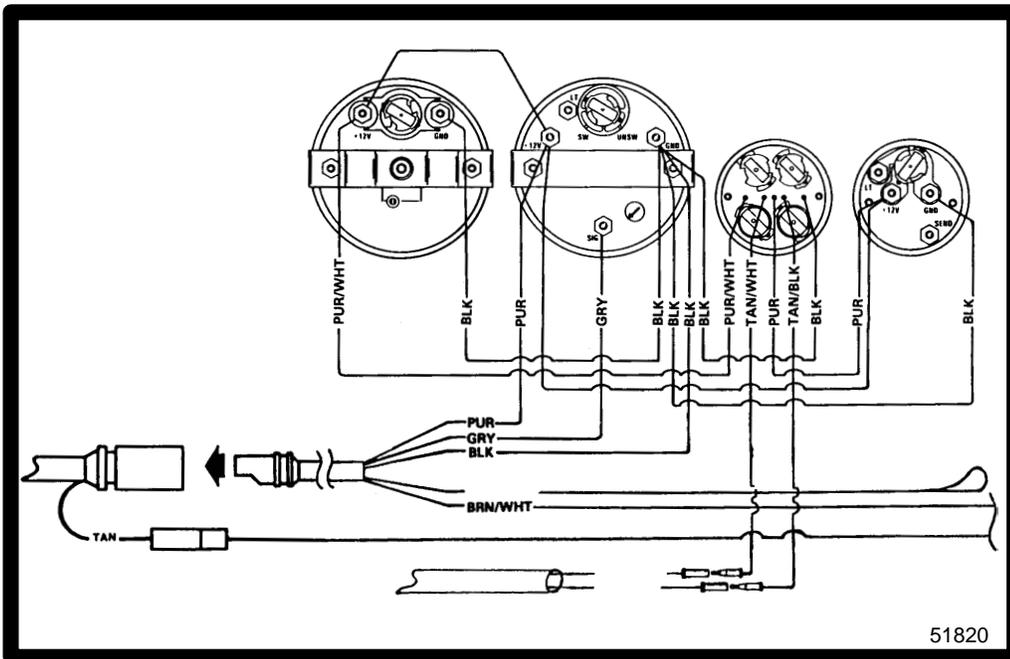
55936



ELECTRICAL

2

D



WIRING

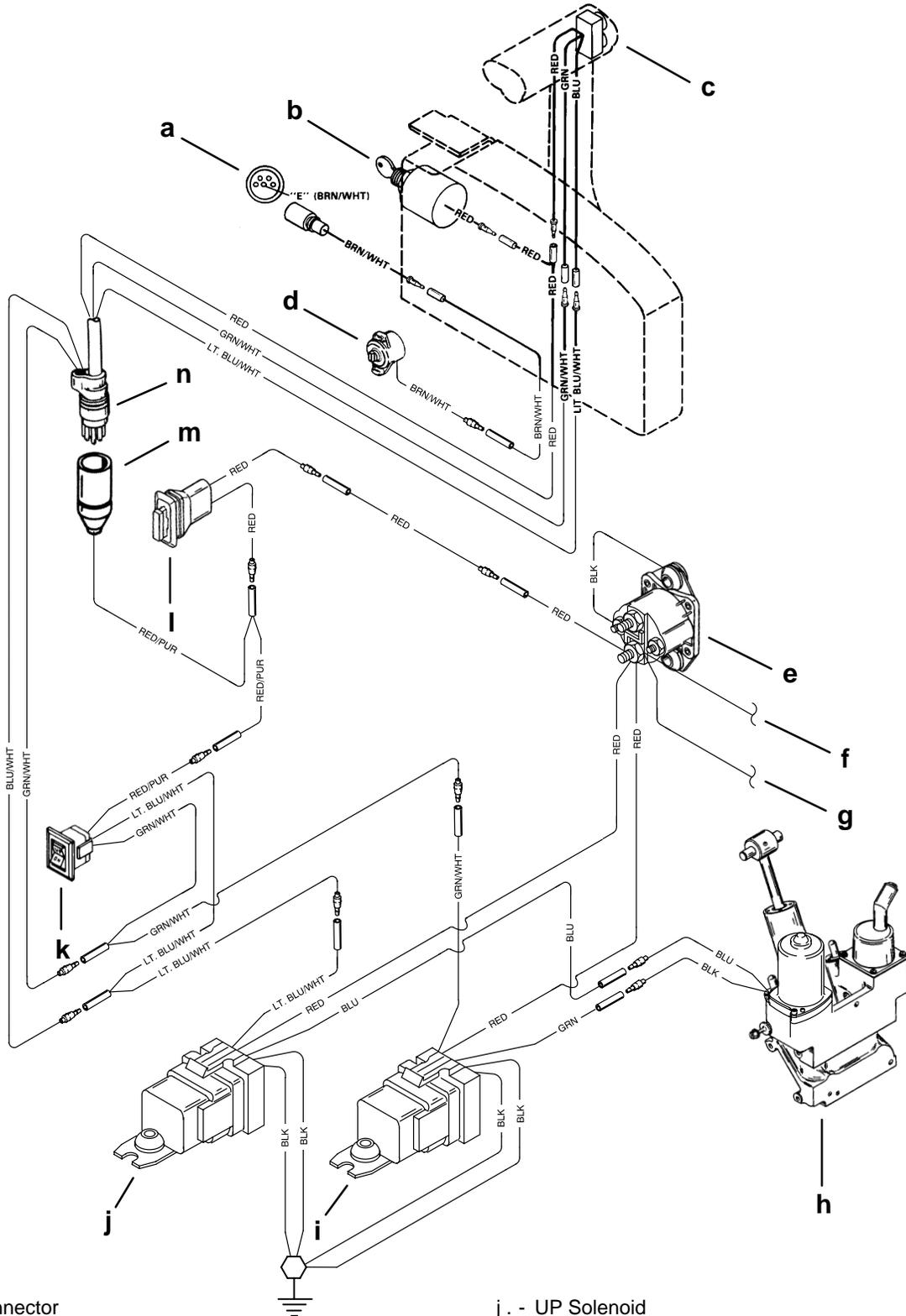


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1997 Model 200 DFI Wiring Diagram	2D-21
1998 Model 200/225 DFI Wiring Diagram	2D-22



Power Trim Wiring Diagram



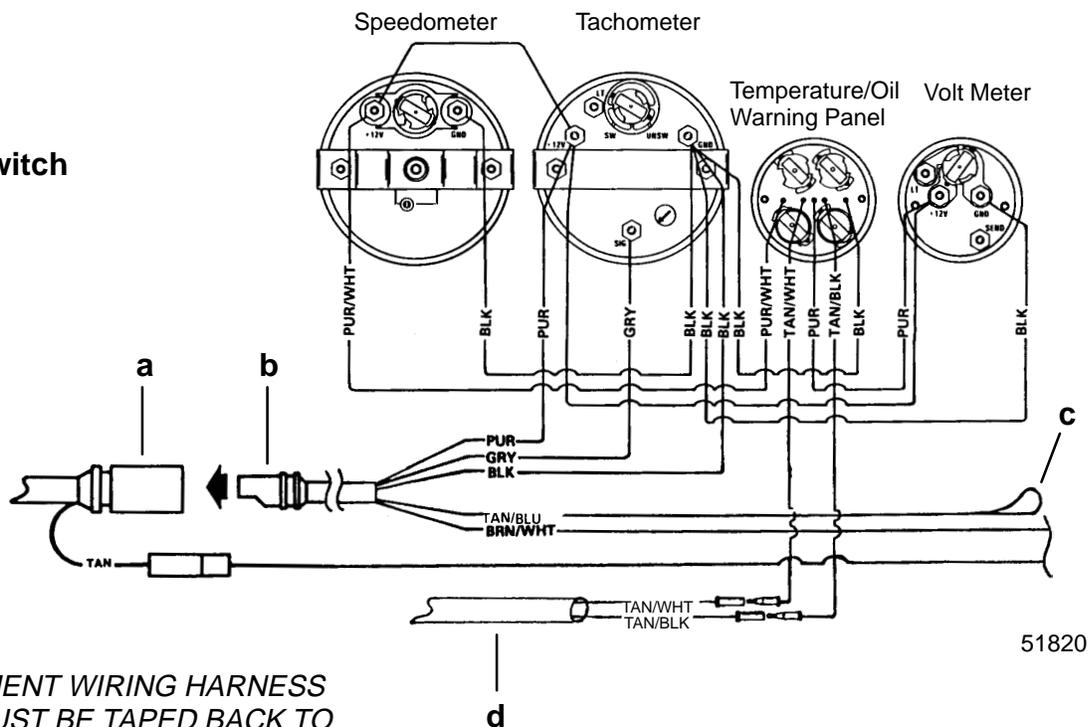
- a - Tach. Connector
- b - Key Switch Assembly
- c - Trim Switch
- d - Trim Sender
- e - Start Solenoid
- f - To Battery
- g - To Alternator
- h - Trim Pump and Motor
- i - DOWN Solenoid

- j - UP Solenoid
- k - Bottom Cowl Switch
- l - 20 Ampere Fuse
- m - Engine Harness
- n - Remote Control Harness



Instrument Wiring Connections

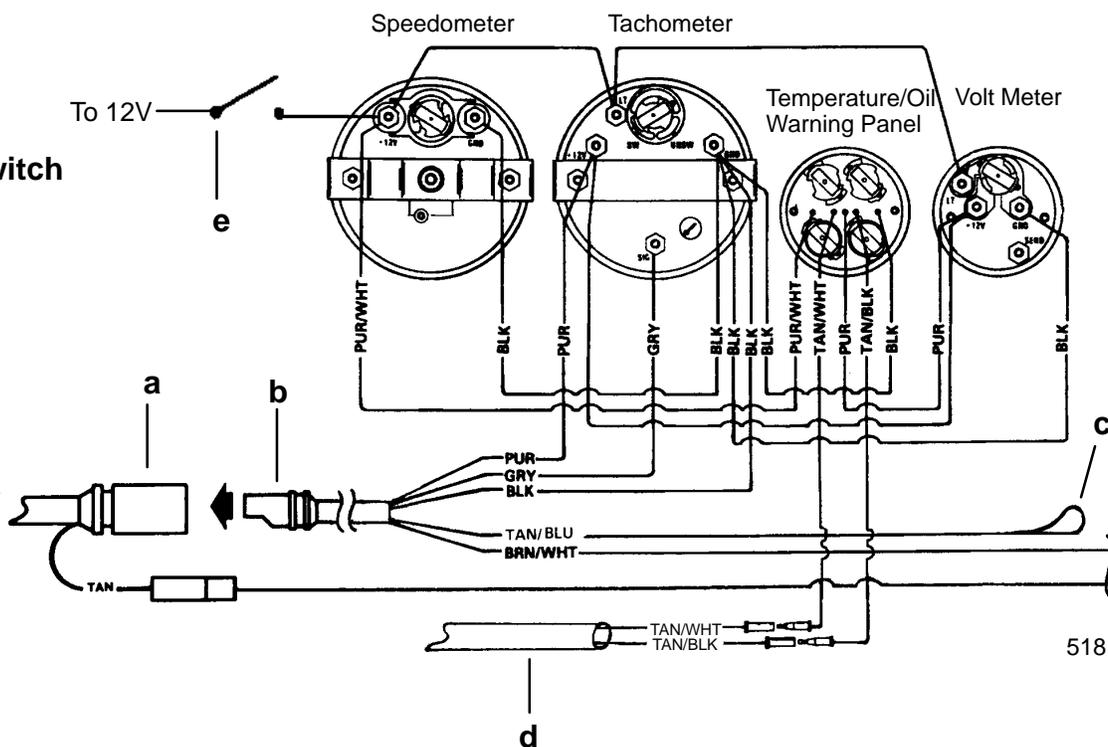
Figure 1
Without Light Switch



51820

NOTE: ANY INSTRUMENT WIRING HARNESS LEADS NOT USED MUST BE TAPED BACK TO THE HARNESS.

Figure 2
With Light Switch



51819

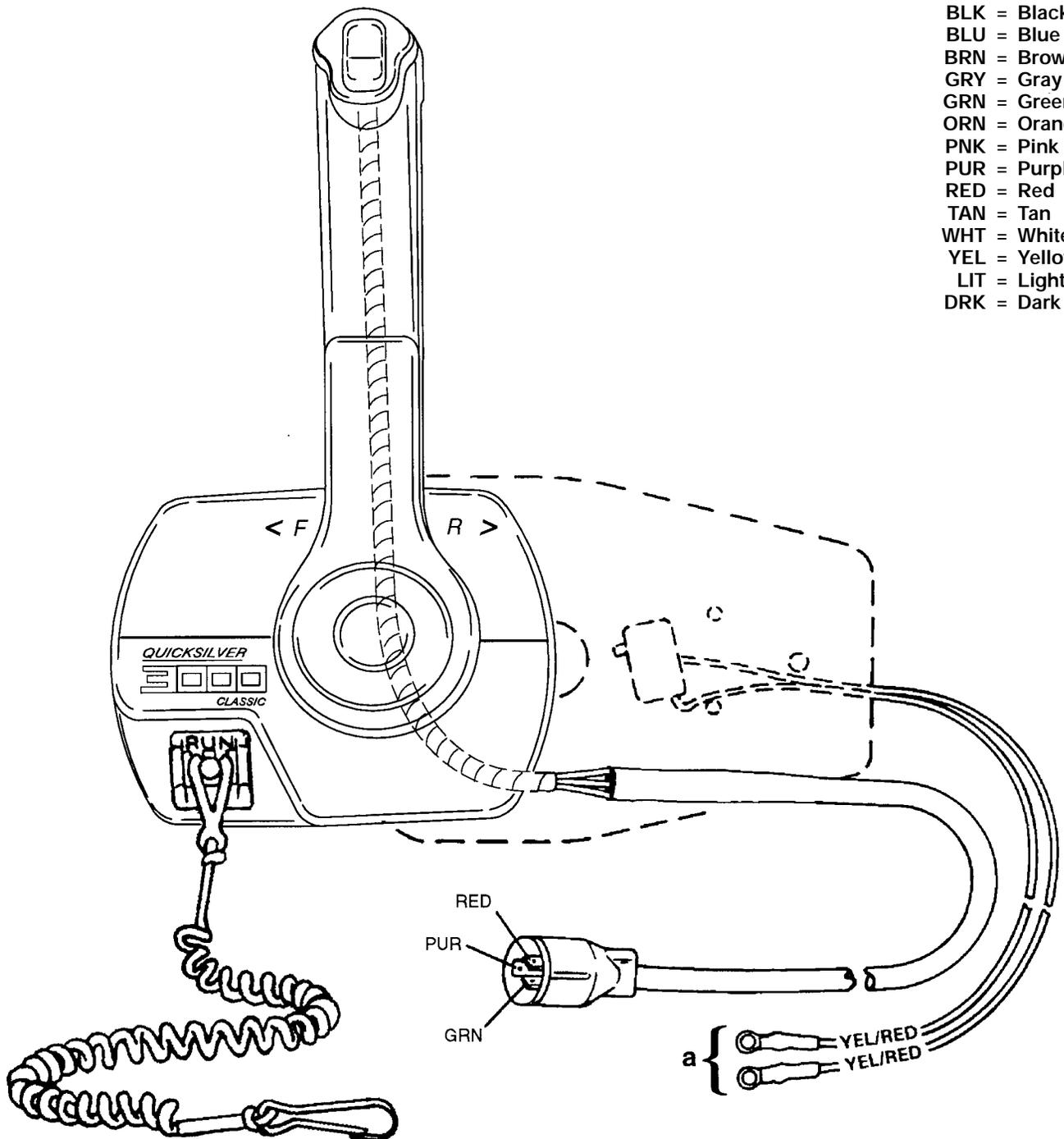
- a - Tachometer Receptacle - From Control Box or Ignition/Choke Switch
- b - Tachometer Wiring Harness
- c - Lead to Optional Visual Warning Kit (Taped Back to Harness)
- d - Cable Extension (For Two Function Warning Panel)
- e - Light Switch

Wire Color	Where To
BLK = BLACK	GROUND
TAN/WHT = TAN/WHITE	OIL LIGHT
TAN/BLK = TAN/BLACK	TEMPERATURE LIGHT
TAN = TAN	TEMPERATURE GAUGE
PUR = PURPLE	IGNITION 12 VOLT
GRY = GRAY	TACHOMETER
BRN/WHT = BROWN/WHITE	TRIM GAUGE
TAN/BLU = TAN/BLUE	VISUAL WARNING KIT (OPT.)



Commander 3000 Classic Panel Remote Control

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

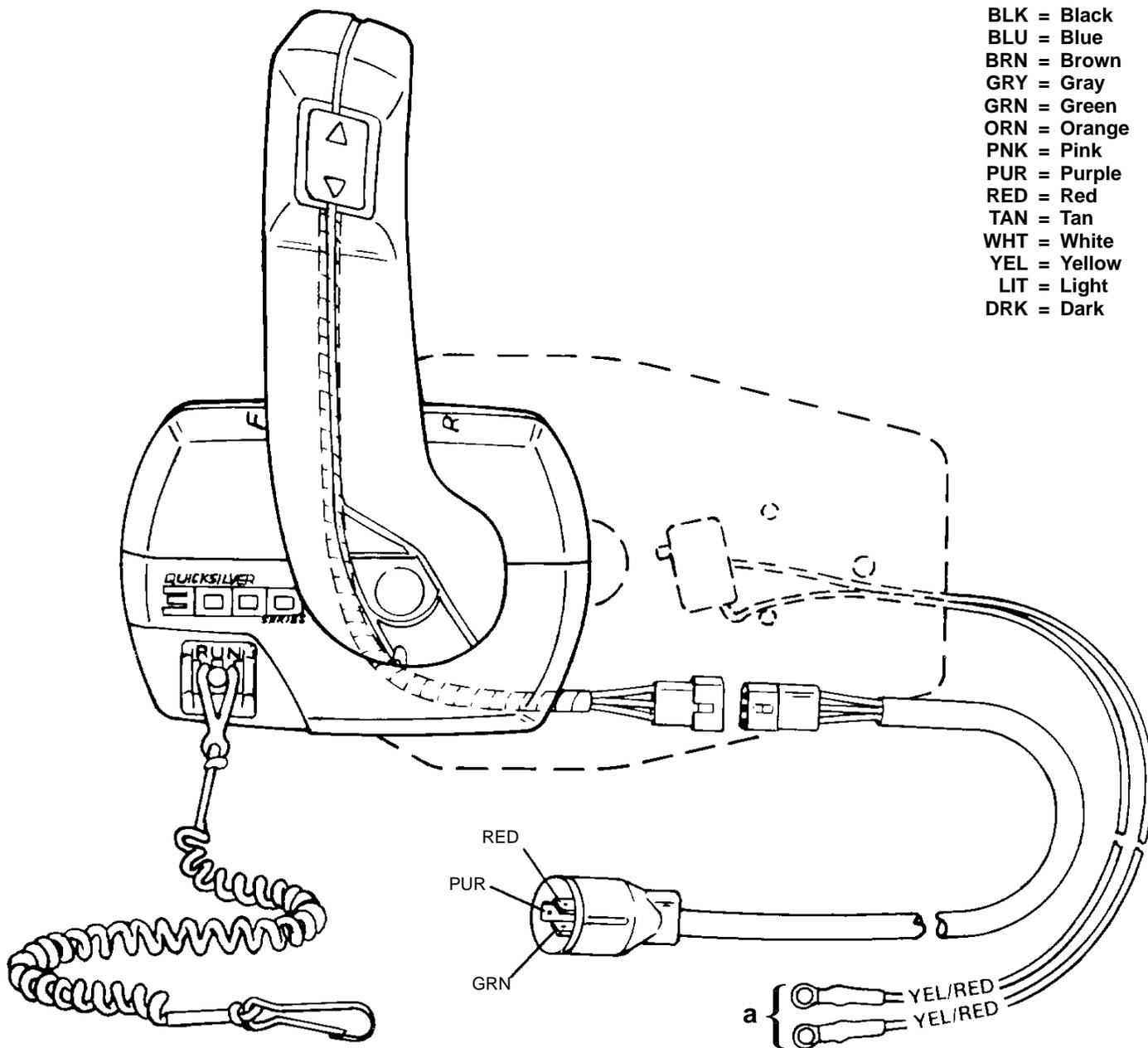


a - Neutral Interlock Switch



Commander 3000 Panel Remote Control

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



a - Neutral Interlock Switch

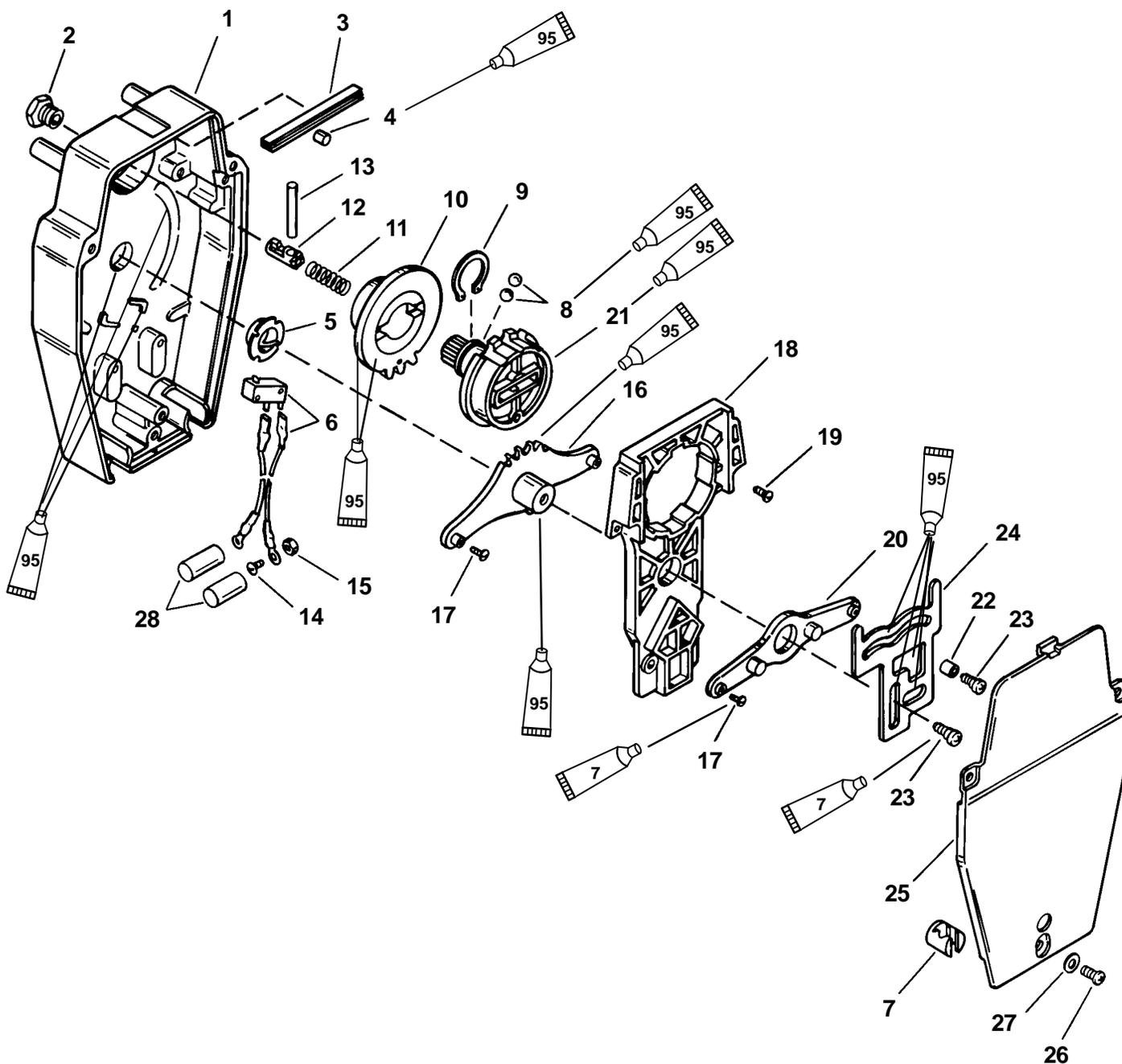


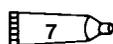
Notes:

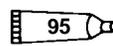




Commander 3000/3000 Classic Components



 Loctite 271 (92-809820)

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



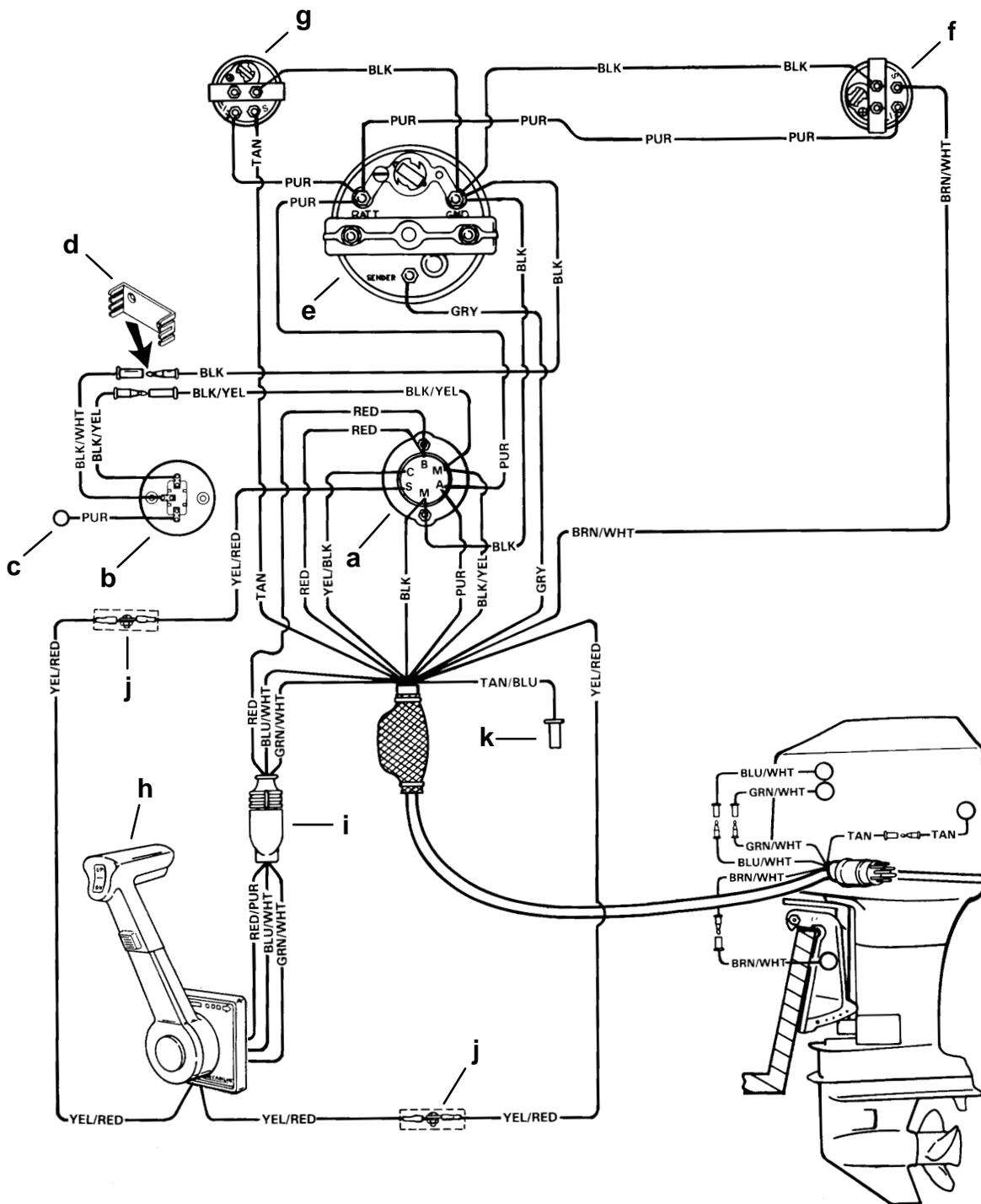
Commander 3000/3000 Classic Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	HOUSING-Control (Panel Mount)			
1	1	HOUSING-Control (Console Mount)			
2	1	BOLT-Locking (Special)	150	12.5	16.9
3	5	SPRING			
4	1	ROLLER			
5	1	BUSHING			
6	1	SWITCH ASSY-Neutral Start (2 Ring Terminals)			
6	1	SWITCH ASSY-Neutral Start (No Terminals)			
7	2	GROMMET			
8	2	BALL-Steel			
9	1	RING-Retaining			
10	1	GEAR-Shift			
11	1	SPRING			
12	1	SHAFT-Throttle Only			
13	1	PIN-Shift Gear			
14	2	SCREW (#10-32 x 1/4")			
15	2	NUT (10-32)			
16	1	ARM ASSEMBLY-Shift			
17	2	SCREW (#8-32 x 3/8")	25		2.8
18	1	SUPPORT ASSEMBLY-Shaft			
19	4	SCREW (#10-32 x 5/8")	35		4.0
20	1	ARM ASSEMBLY-Throttle			
21	1	SHAFT KIT-Handle			
22	1	ROLLER-Throttle Plate			
23	2	BOLT-Shoulder (Special)	35		4.0
24	1	PLATE			
25	1	BACK PLATE			
26	3	SCREW (#10-32 x 5/8")	10		1.1
27	1	WASHER			
28	2	INSULATOR (2")			



Instrument/Lanyard Stop Switch Wiring Diagram

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



52204

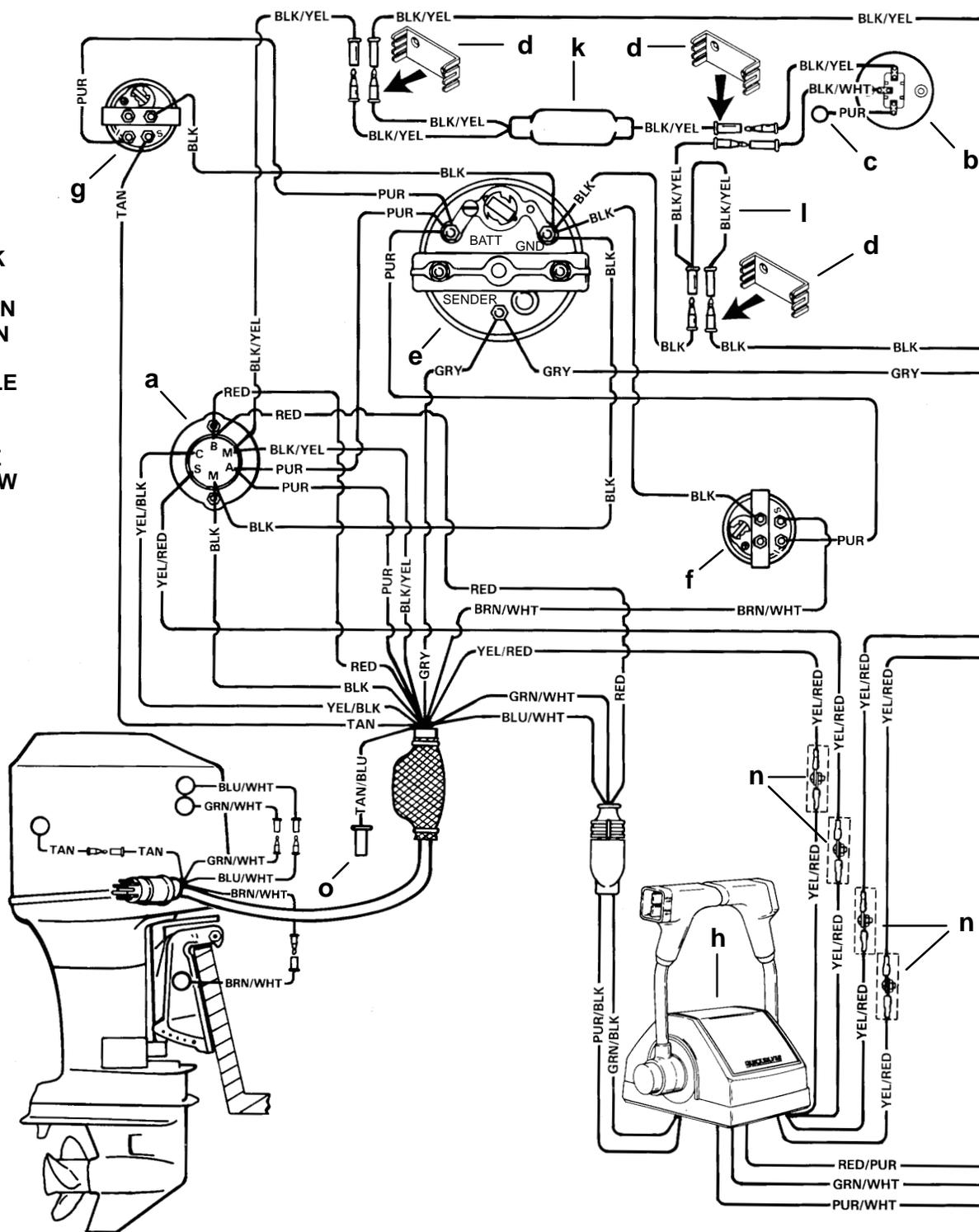
- a - Ignition/Choke Switch
- b - Lanyard Stop Switch
- c - Lead Not Used on Outboard Installations
- d - Retainer
- e - Tachometer
- f - Trim Indicator Gauge (Optional)
- g - Temperature Gauge
- h - Remote Control
- i - Power Trim Harness Connector
- j - Connect Wires Together w/Screw and Nut (2 Places);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

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



Instrument/Lanyard Stop Switch Wiring Diagram (Dual Outboard)

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



PORT INSTALLATION

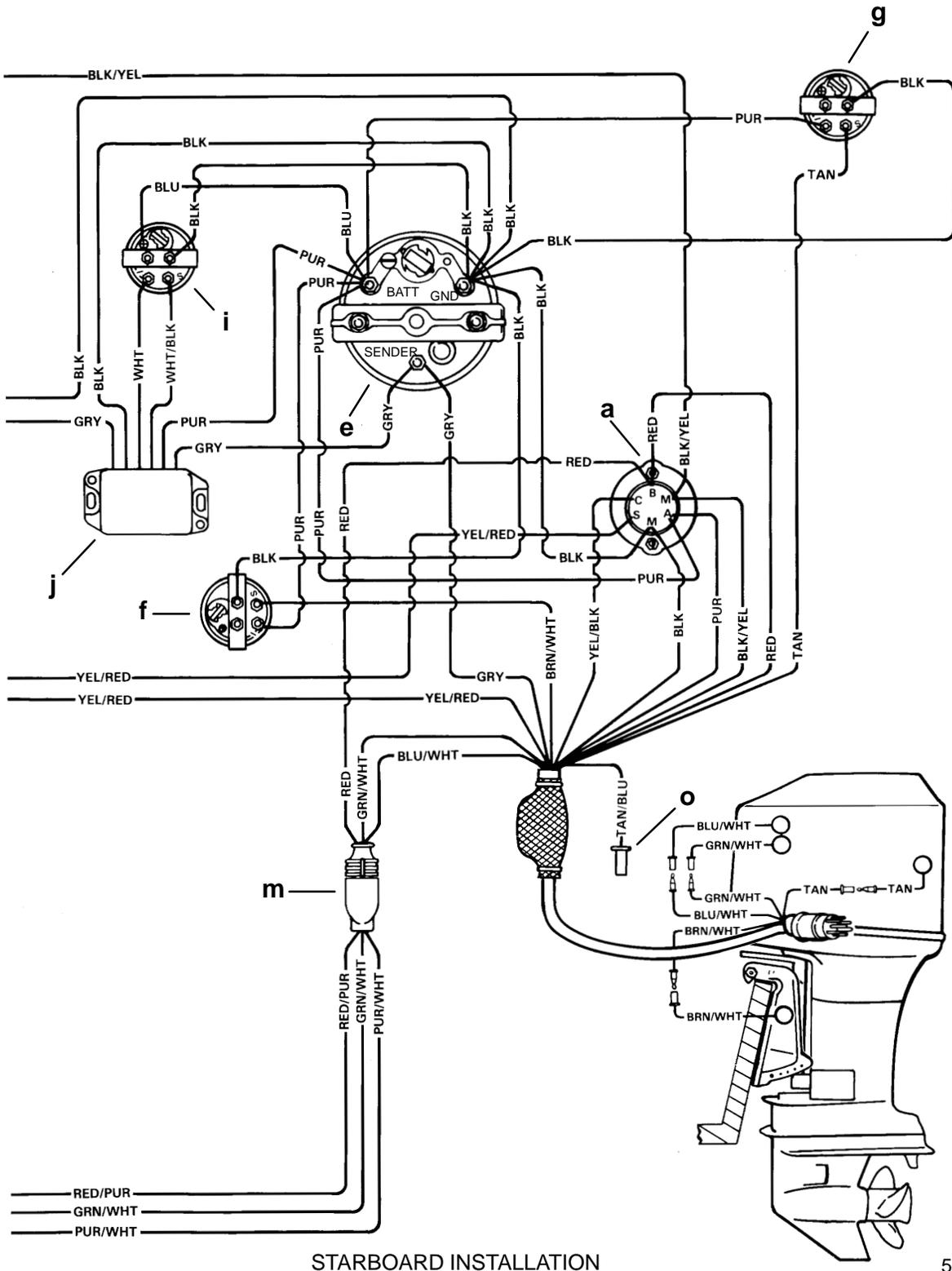
52205

- a - Ignition/Choke Switch
- b - Lanyard Stop Switch
- c - Lead not used on Outboard Installations
- d - Retainer
- e - Tachometer
- f - Trim Indicator Gauge
- g - Temperature Gauge

- h - Remote Control
- i - Synchronizer Gauge
- j - Synchronizer Module
- k - Lanyard Switch (Isolation) Diode



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



- l - Y Harness
- m - Power Trim Harness Connector
- n - Connect Wires together with Screw and Nut (4 Places);
Apply Liquid Neoprene to Connections and slide Rubber

- o - Lead to Visual Warning Kit



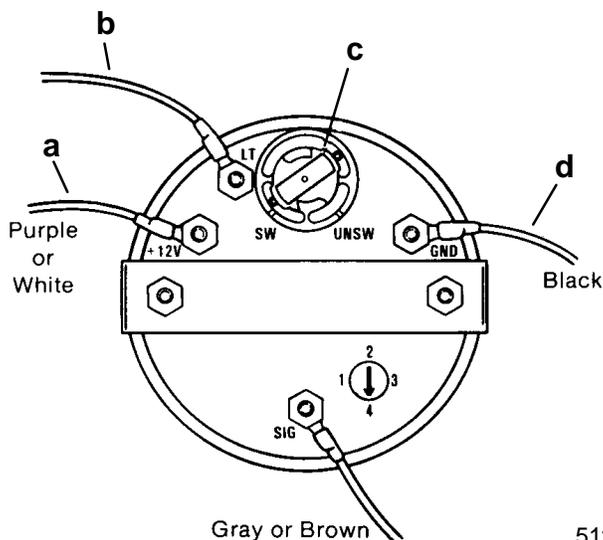
QSI Gauge Wiring Diagrams

Tachometer Wiring Diagram

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

WIRING DIAGRAM A

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

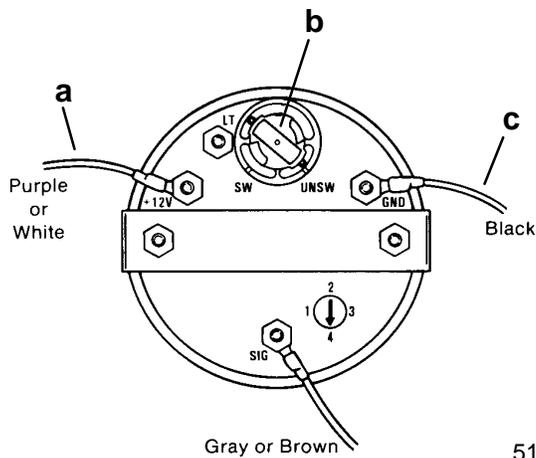


51106

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

WIRING DIAGRAM B

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



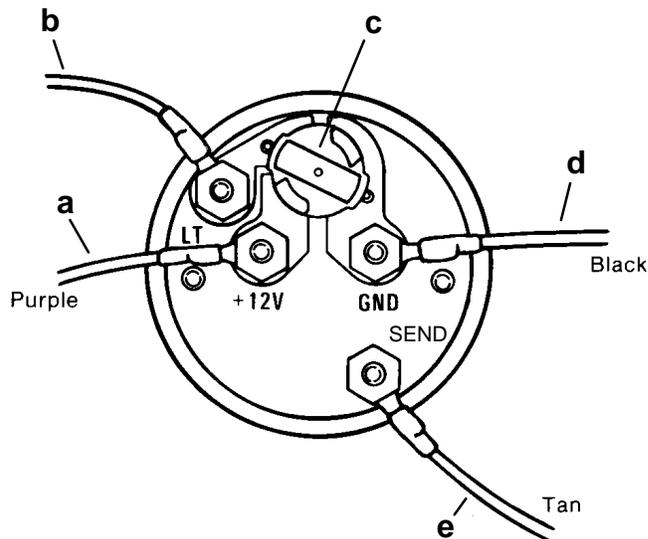
51106

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

Water Temperature Gauge

WIRING DIAGRAM A

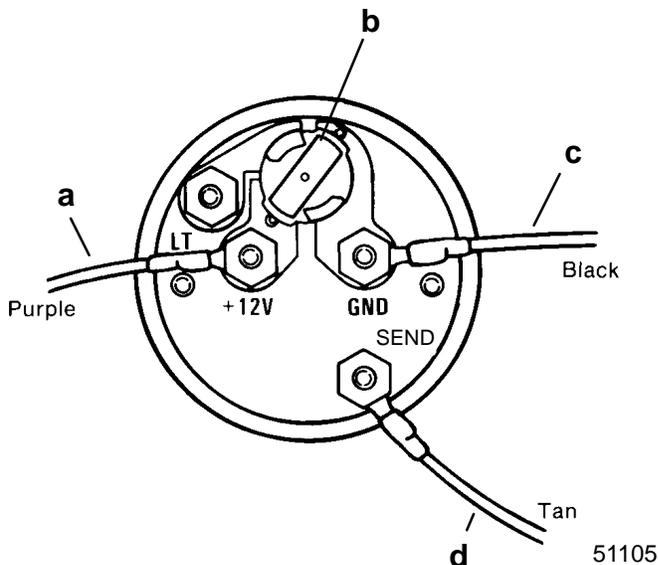
Use this wiring diagram when using a separate light switch for instrument lighting.



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

WIRING DIAGRAM B

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



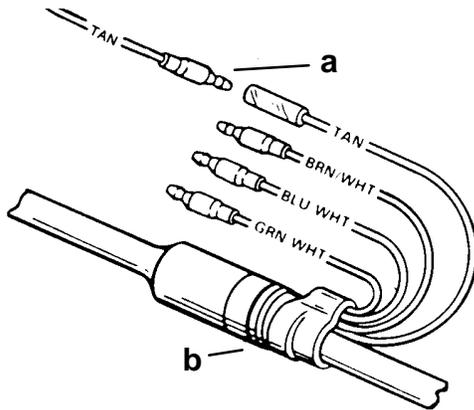
51105

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



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

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



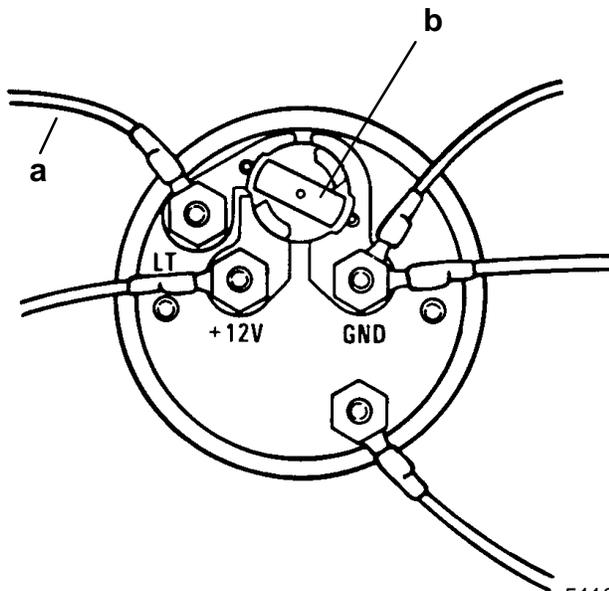
28086

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

Oil Level Gauge Wiring

LIGHT BULB POSITION A

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

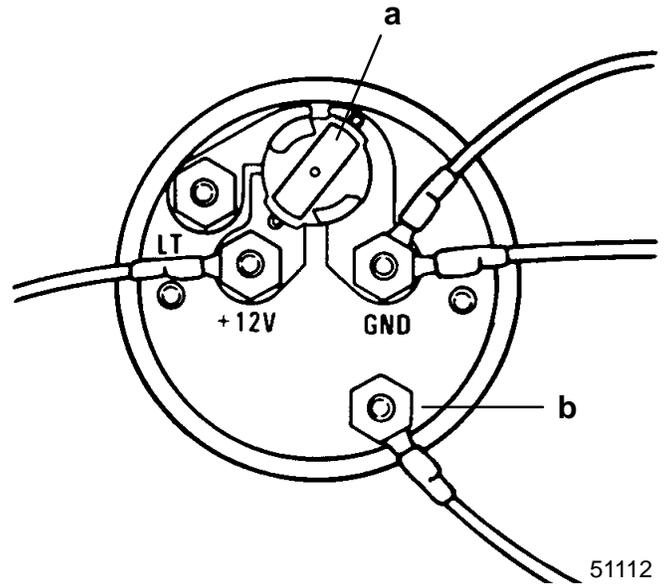


51109

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

LIGHT BULB POSITION B

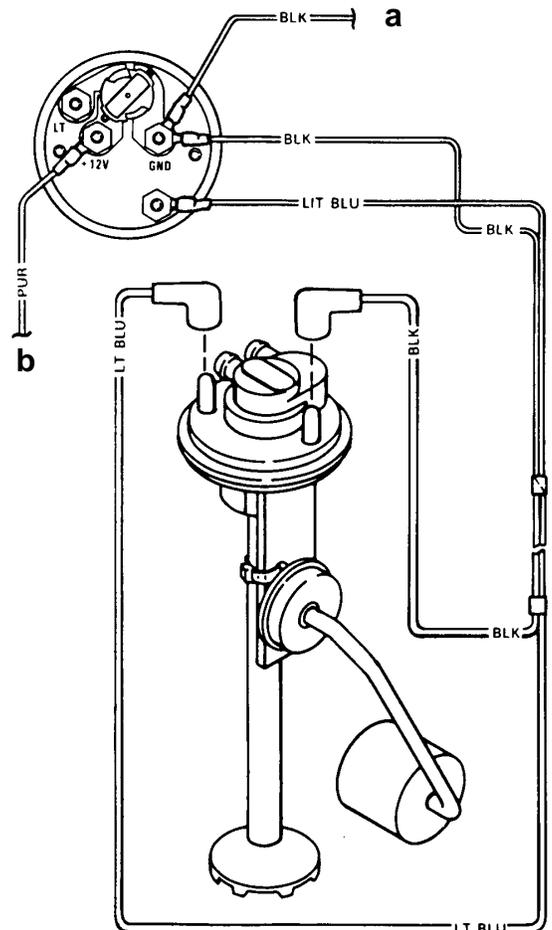
Use this position when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key switch is turned on.)



51112

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

SENDER WIRING



51108

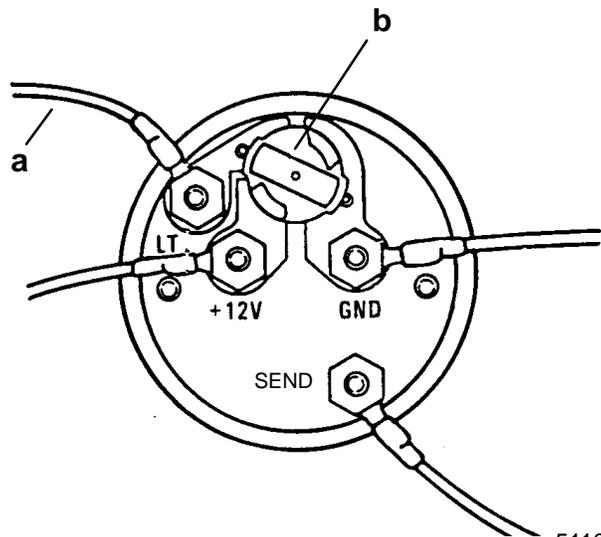
- a - Connect to +12 Volt
- b - Connect to NEGATIVE (-) Ground



Engine Synchronizer Wiring Diagram

LIGHT BULB POSITION A

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

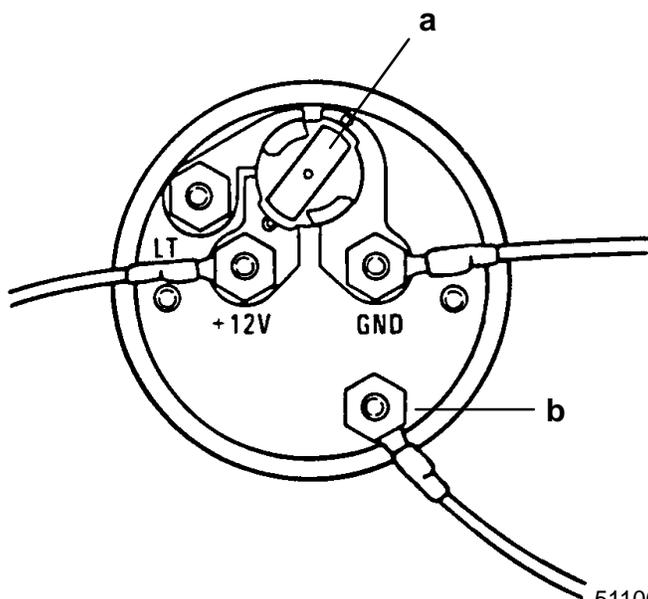


51105

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

LIGHT BULB POSITION B

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

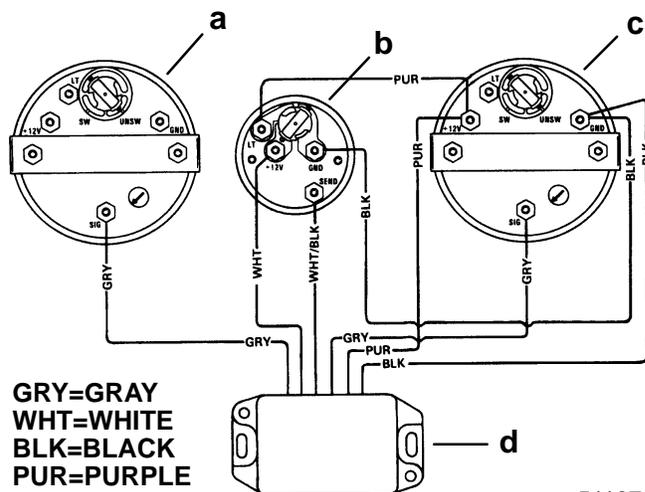


51106

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

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

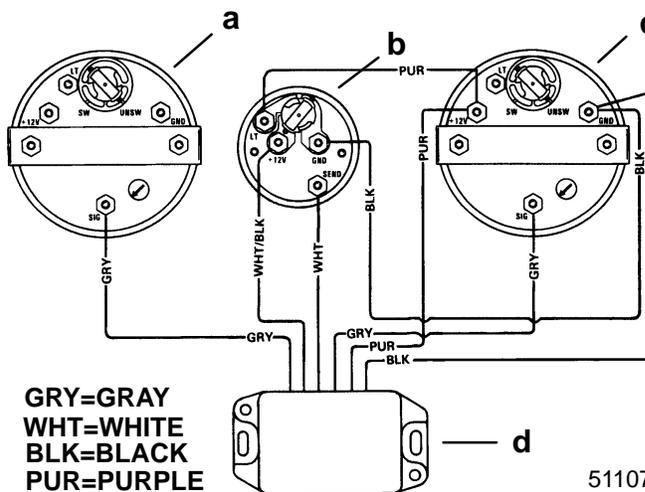
Wiring Diagram – Gauge needle to point toward slow running engine



51107

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

Wiring Diagram – Gauge needle to point toward fast running engine



51107

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

Maintenance

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



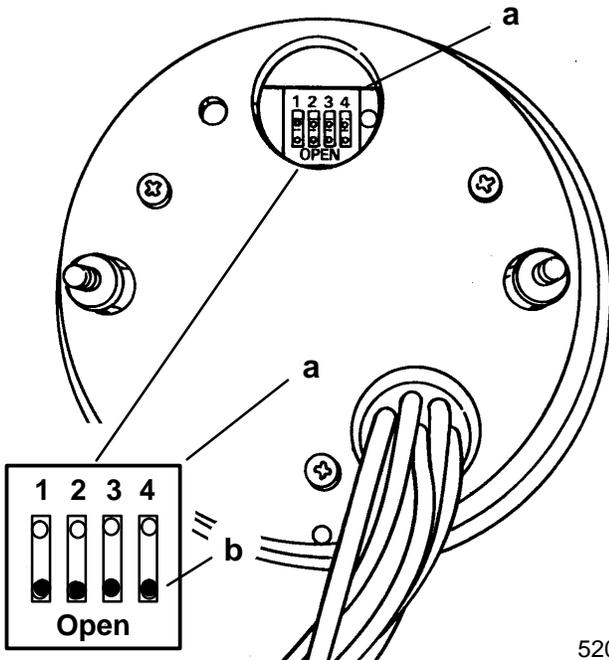
Multi-Function Gauge

Dip Switch Setting/Testing

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

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

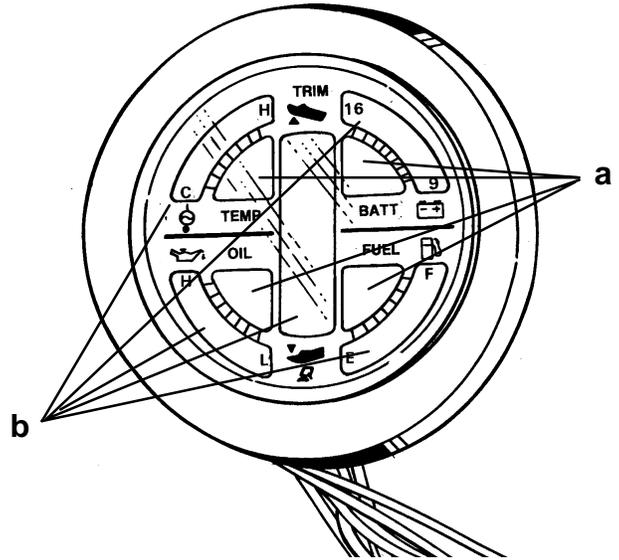
1. With the ignition switch in the "Off" position, set the multi-function gauge "Dip Switch" in (test) position as shown. (Black dot indicates switch position).



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

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

52095



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

Outboard Multi-Function Gauge Setting

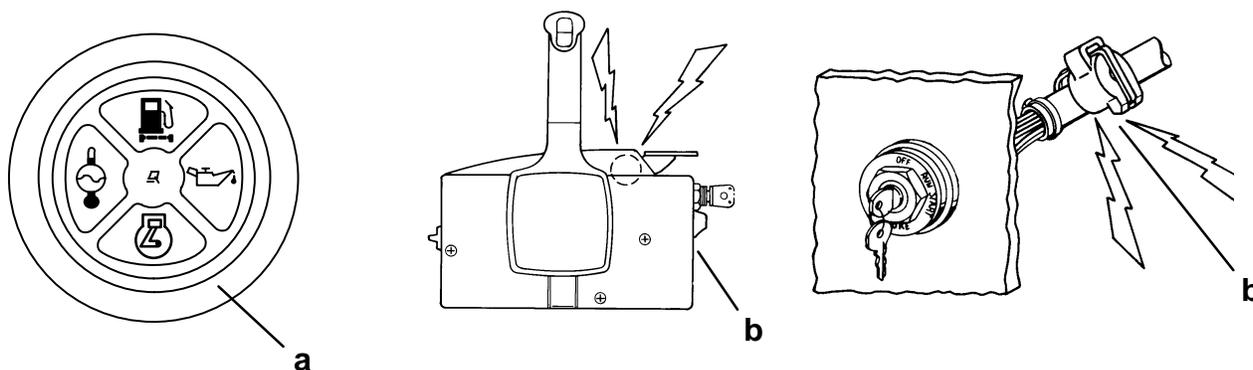
Model	Dip Switch Setting
Test Display (All)	
275 hp (3.4 Litre) Outboards (single engine)	
135-250 hp Outboards (single engine)	
"Note" On Dual Engine/Single Fuel Tank Applications: Position Dip Switch 4 "Open" *	

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



Warning System

The outboard warning system incorporates warning light gauge (a) and warning horn (b). The warning horn is located inside the remote control or is part of the ignition key switch wiring harness.



When the key switch is turned to the ON position, the warning lights and horn will turn on for a moment as a test to tell you the system is working.

Warning System Signals

NOTE: The warning system signals which includes audible and visual indicator involving the horn and lights will identify the potential problems listed in the chart.

Problem	Horn	Check Engine Light	Low Oil Light	Over Heat Light	Water In Fuel Light	Engine Speed Reduction Activated (approx. 3000 RPM)
Power Up/System Check	Single Beep	Yes	Yes	Yes	Yes	No
Low Oil	4 Beep... 2 Minutes Off		Yes			No
No Oil Flow (1997 Models Only)	Continuous Beep	Yes	Yes			Yes (Limits to 3000 RPM)
Over Heat	Continuous Beep			Yes		Yes (Limits to 3000 RPM)
Water In Fuel	4 Beep... 2 Minutes Off				Yes	
Over Speed	Continuous Beep					Yes (activated at 5800 RPM)
Coolant Sensor Failure	No	Yes				
MAP Sensor Failure	No	Yes				
Air Temperature Sensor Failure	No	Yes				
Ignition Coil Failure	No	Yes				
Injector Failure	No	Yes				
Oil Pump Electrical Failure		Yes	Yes			Yes (Limits to 3000 RPM)
Block psi	Yes	Yes		Yes		Yes (Limits to 3000 RPM)

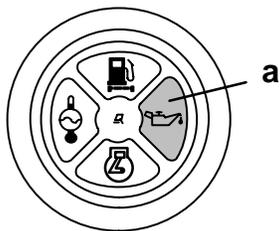


Problem	Horn	Check Engine Light	Low Oil Light	Over Heat Light	Water In Fuel Light	Engine Speed Reduction Activated
Horn Failure	N/A	Yes				No
Battery Voltage too high (16V) or too low (11V) or very low (9.5V)	No	Yes				Yes – If battery voltage is less than 10.4 V – RPM is reduced to 3000. If voltage is 9.5V or less, RPM is reduced to idle.
Over Heat Cyl. Head/Compressor	Continuous Beep			Yes		Yes
Throttle Sensor Failure	Continuous Intermittant Beeping	Yes				1997 Model – Speed does not reduce if only 1 sensor fails. 1998 Model – Speed does reduce if 1 sensor fails. On 1997 and 1998 Models – RPM is reduced to Idle speed only if both sensors fail.



Warning System Operation

LOW OIL LEVEL

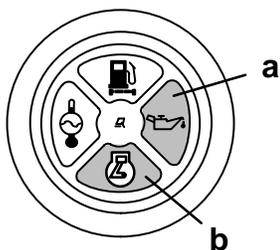


The system is activated when the oil in the engine mounted oil reservoir tank drops below 50 fl. oz. (1.5 liters) You still have an oil reserve remaining for 50 minutes of full speed operation.

NOTE: The engine mounted oil reservoir tank (located beneath the top cowl) along with the remote oil tank will have to be refilled.

The OIL light (a) will come on and the warning horn sounds a series of four short tones. If you continue to operate the outboard, the light will stay on and the horn will sound four short tones every two minutes. The engine has to be shut off to reset the warning system.

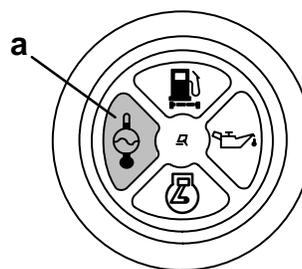
OIL PUMP NOT FUNCTIONING ELECTRICALLY



The system is activated if the oil pump stops functioning electrically. No lubricating oil is being supplied to the engine. Stop the engine as soon as possible. Continuing to operate the engine can result in severe engine damage.

The OIL light (a) and CHECK ENGINE light (b) will come on and the warning horn will begin sounding. The warning system will automatically reduce and limit the engine speed to 3000 RPM. The engine has to be shut off to reset the warning system.

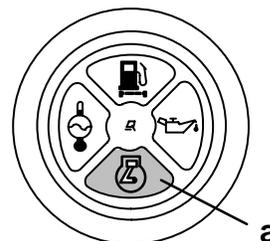
ENGINE OVERHEAT



The system is activated when the engine temperature is too hot.

The TEMP light (a) will come on and the warning horn begins sounding. The warning system will automatically limit the engine speed to 3000 RPM.

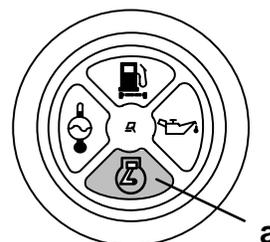
IGNITION COIL, SENSOR, INJECTOR OR WARNING HORN NOT FUNCTIONING



The system is activated if an ignition coil, sensor, injector or warning horn is not functioning correctly.

The CHECK ENGINE light (a) will turn on.

THROTTLE SENSOR NOT FUNCTIONING

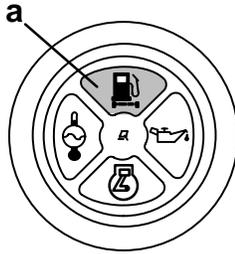


The system is activated if the throttle sensors are not functioning correctly.

The CHECK ENGINE light (a) will turn on and the warning horn will begin sounding.



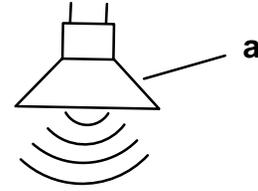
WATER SEPARATING FUEL FILTER IS FULL OF WATER



The water level detection warning is activated when water in the water separating fuel filter reaches the full level. The water can be removed from the filter.

The WATER DETECTION light (a) will come on and the warning horn will begin sounding a series of four beeps. If you continue to operate the outboard, the light will stay on and the horn will sound every two minutes.

ENGINE OVER-SPEED PROTECTION SYSTEM



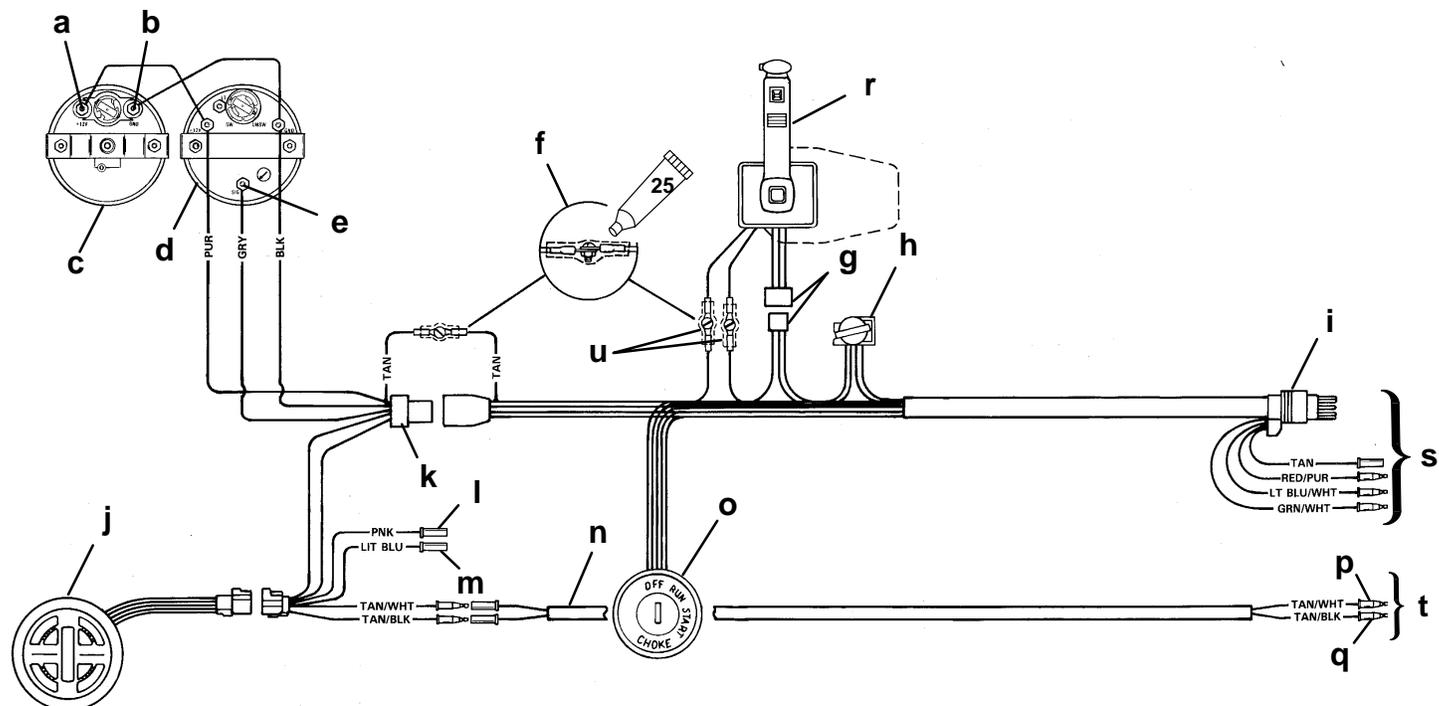
The system is activated when the engine speed exceeds the maximum allowable RPM.

Anytime the engine over-speed system is activated, the warning horn (a) begins to sound continuously. The system will automatically reduce the engine speed to within the allowable limit.

NOTE: Engine speed should never reach the maximum limit to activate the system unless the propeller is ventilating, an incorrect propeller is being used, or the propeller is faulty.



Panel Mount Remote Control Wiring Installation



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

25 Liquid Neoprene (92-25711--2)

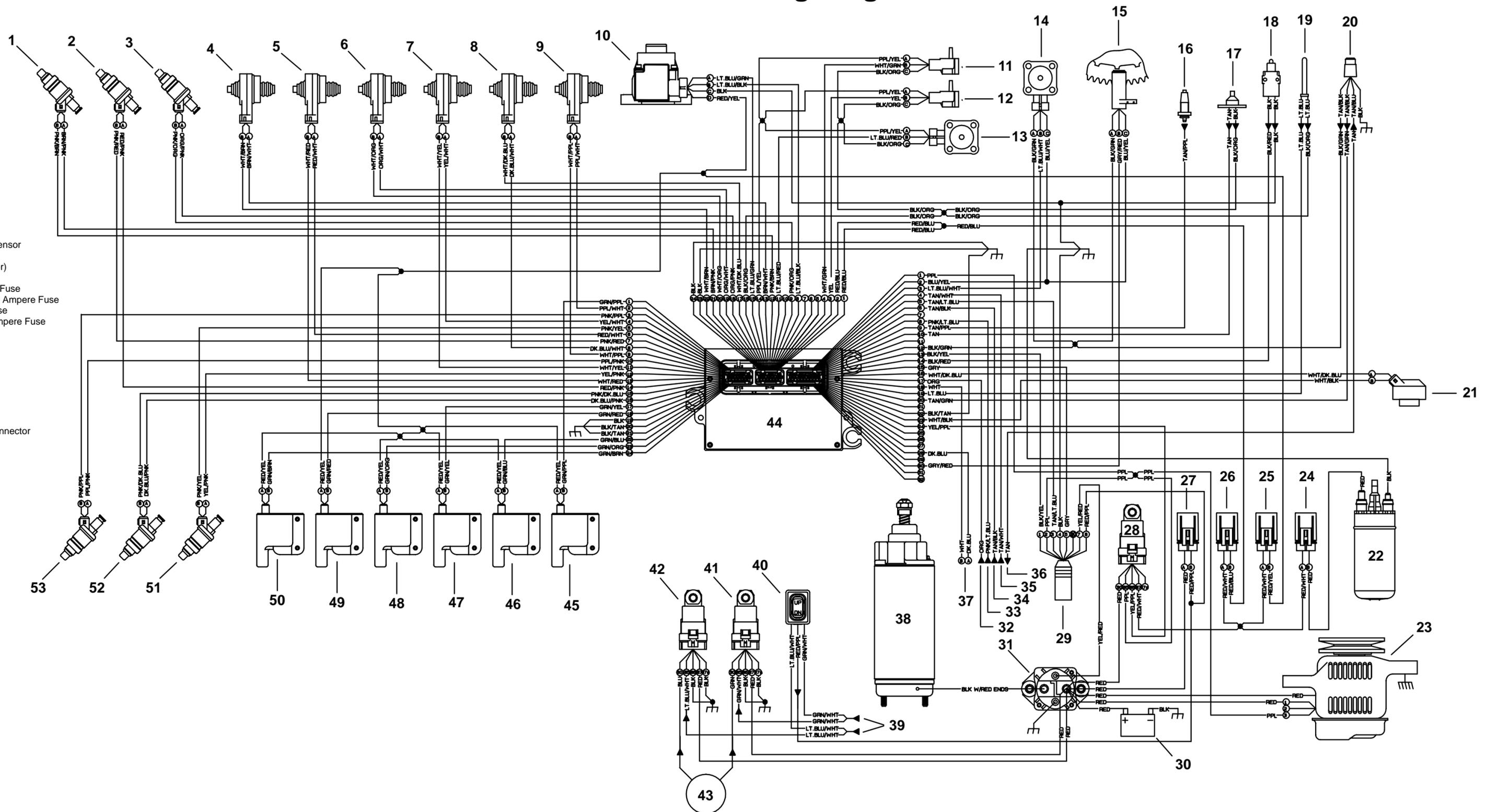
- a - (+) 12 Volt Terminal
- b - (-) Ground Terminal
- c - Speedometer
- d - Tachometer
- e - Tachometer Signal Terminal
- f - Connect Wires Together with Screw and Hex Nut (3 Places);
Apply Quicksilver Liquid Neoprene to Connections and
Slide Rubber Sleeve Over Each Connection.
- g - Power Trim Connector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



1997 Model 200 DFI Wiring Diagram

- 1 - Fuel Injector #1
- 2 - Fuel Injector #2
- 3 - Fuel Injector #3
- 4 - Direct Injector #1
- 5 - Direct Injector #2
- 6 - Direct Injector #3
- 7 - Direct Injector #4
- 8 - Direct Injector #5
- 9 - Direct Injector #6
- 10 - Oil Pump
- 11 - EAP Sensor
- 12 - MAP Sensor
- 13 - T.P.S. Sensor (Inner)
- 14 - T.P.S. Sensor (Outer)
- 15 - Crank Position Sensor
- 16 - Water Sensor
- 17 - Air Temperature Sensor
- 18 - Shift Switch
- 19 - Low-Oil Switch
- 20 - Cylinder Head Temperature Sensor
- 21 - Knock Sensor
- 22 - Fuel Pump (In Vapor Separator)
- 23 - 60 Ampere Alternator
- 24 - Fuel Pump Circuit 20 Ampere Fuse
- 25 - Ignition Coils and Oil Pump 20 Ampere Fuse
- 26 - Starting Circuit 20 Ampere Fuse
- 27 - Fuel/Air Injector Circuits 20 Ampere Fuse
- 28 - Main Power Relay
- 29 - Remote Control Connector
- 30 - 12 Volt Battery
- 31 - Starter Solenoid
- 32 - Temperature Gauge
- 33 - Low Oil Light
- 34 - Over-Heat Light
- 35 - Water In Fuel Light
- 36 - Check Engine Light
- 37 - Digital Diagnostic Terminal Connector
- 38 - Starter
- 39 - To Remote Trim Switch
- 40 - Cowl Mounted Trim Switch
- 41 - Trim-Down Relay
- 42 - Trim-Up Relay
- 43 - Trim Pump
- 44 - Electronic Control Module
- 45 - Coil #6
- 46 - Coil #5
- 47 - Coil #4
- 48 - Coil #3
- 49 - Coil #2
- 50 - Coil #1
- 51 - Fuel Injector #4
- 52 - Fuel Injector #5
- 53 - Fuel Injector #6

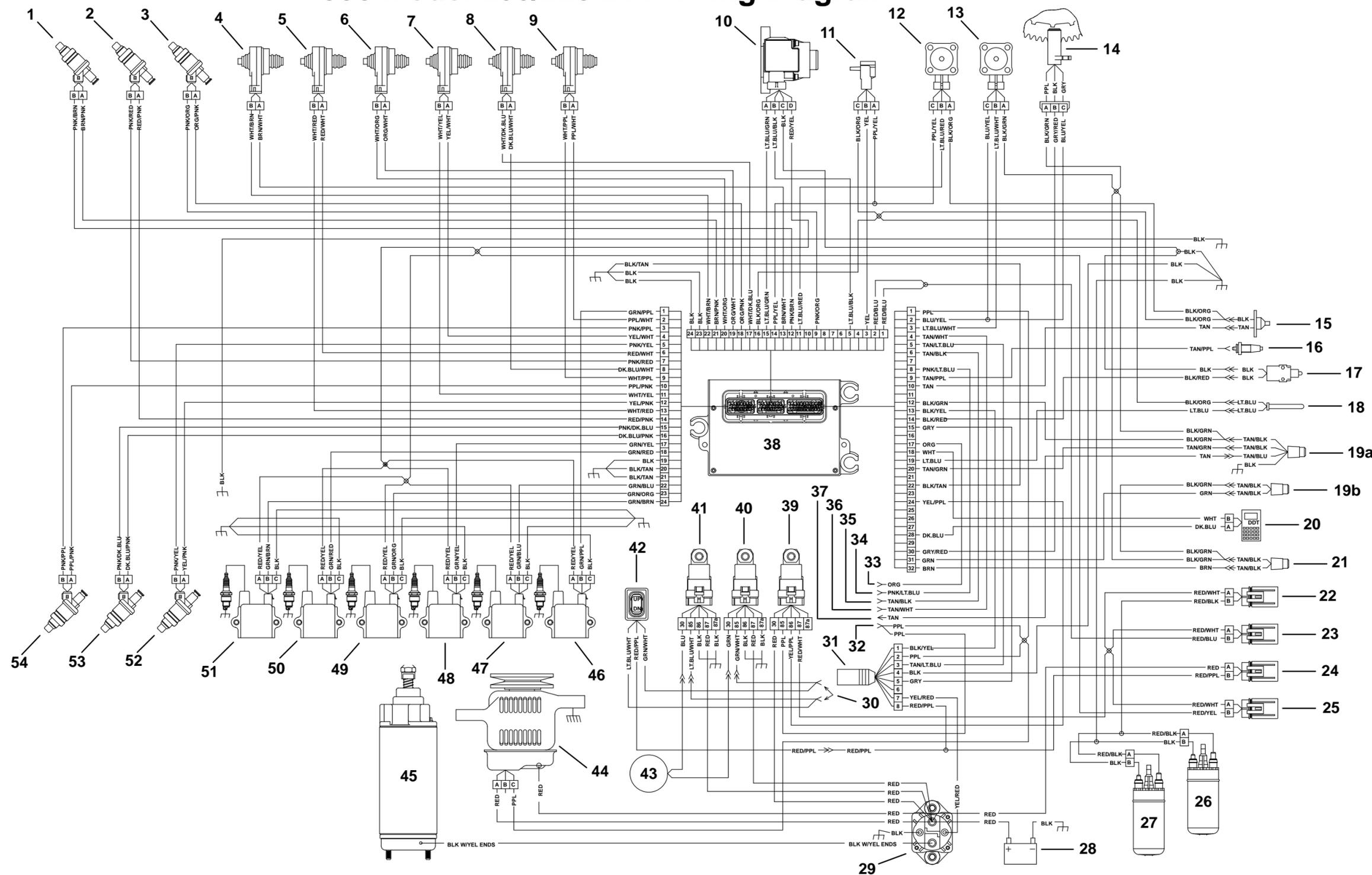
- BLK = Black
- BLU = Blue
- BRN = Brown
- GRY = Gray
- GRN = Green
- ORN = Orange
- PNK = Pink
- PUR = Purple
- RED = Red
- TAN = Tan
- WHT = White
- YEL = Yellow
- LT. = Light
- DK. = Dark





1998 Model 200/225 DFI Wiring Diagram

- 1 - Fuel Injector #1
- 2 - Fuel Injector #2
- 3 - Fuel Injector #3
- 4 - Direct Injector #1
- 5 - Direct Injector #2
- 6 - Direct Injector #3
- 7 - Direct Injector #4
- 8 - Direct Injector #5
- 9 - Direct Injector #6
- 10 - Oil Pump
- 11 - MAP Sensor
- 12 - T.P.S. #1 (Inner)
- 13 - T.P.S. #2 (Outer)
- 14 - Crank Position Sensor
- 15 - Air Temperature Sensor
- 16 - Water Sensor
- 17 - Shift Switch
- 18 - Low-Oil Switch
- 19 - a - Cylinder Head Temperature Switch (Starboard Side)
- 19 - b - Cylinder Head Temperature Switch (Port Side)
- 20 - Digital Diagnostic Terminal Connector
- 21 - Compressor Temperature Sensor
- 22 - Fuel Pump Circuit 20 Ampere Fuse
- 23 - Fuel/Air Injector Circuit 20 Ampere Fuse
- 24 - Starting Circuit 20 Ampere Fuse
- 25 - Ignition Coils and Oil Pump Circuits 20 Ampere Fuse
- 26 - Fuel Pump #2 (Outside Vapor Separator)
- 27 - Fuel Pump #1 (Inside Vapor Separator)
- 28 - 12 Volt Battery
- 29 - Starter Solenoid
- 30 - To Remote Control Trim Switch
- 31 - Remote Control
- 32 - Auxilliary
- 33 - Check Engine Light
- 34 - Water In Fuel Light
- 35 - Over-Heat Light
- 36 - Low Oil Light
- 37 - Temperature Gauge
- 38 - Electronic Control Module
- 39 - Main Power Relay
- 40 - Trim Down Relay
- 41 - Trim Up Relay
- 42 - Cowl Mounted Trim Switch
- 43 - Trim Pump
- 44 - 60 Ampere Alternator
- 45 - Starter
- 46 - Ignition Coil #6
- 47 - Ignition Coil #5
- 48 - Ignition Coil #4
- 49 - Ignition Coil #3
- 50 - Ignition Coil #2
- 51 - Ignition Coil #1
- 52 - Fuel Injector #4
- 53 - Fuel Injector #5
- 54 - Fuel Injector #6



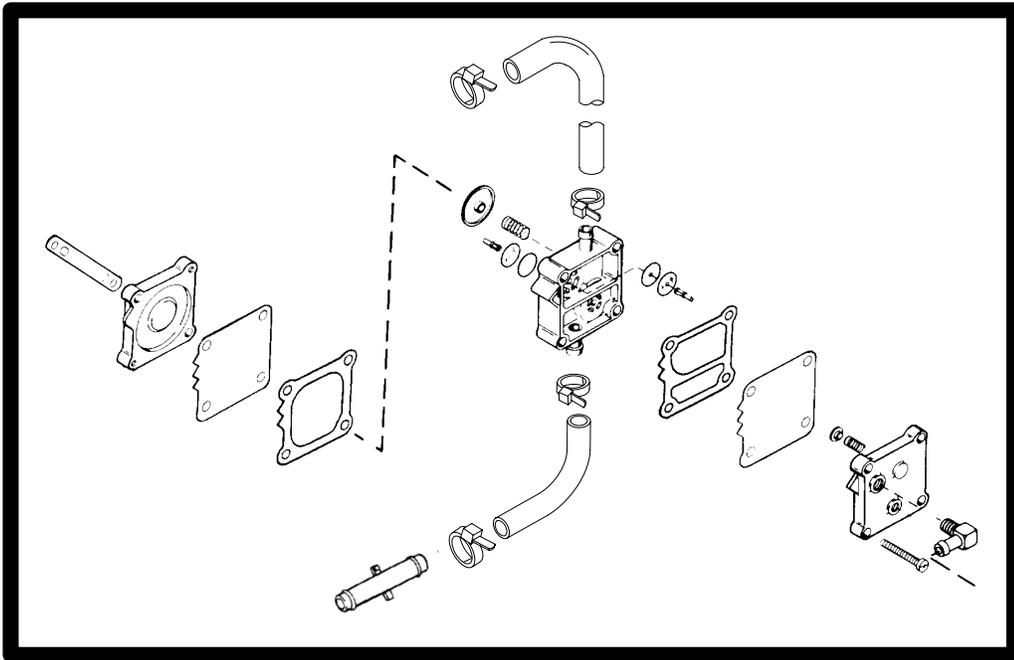
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- GRN = Green
- ORN = Orange
- PNK = Pink
- PUR = Purple
- RED = Red
- TAN = Tan
- WHT = White
- YEL = Yellow
- LT. = Light
- DK. = Dark



FUEL SYSTEM

3

A



FUEL PUMP



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Specifications

Fuel Pump Pressure @ W.O.T.

Maximum – 10 psi (68.5kPa)
Normal – 6-8 psi (41.0 – 54.8kPa)
Minimum – 4 psi (27.4kPa)

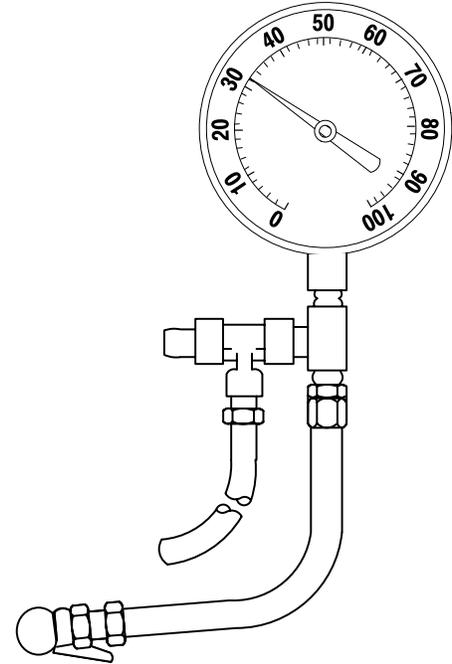
Fuel Pump Pressure @ Idle

Normal – 2-3 psi (13.7 – 20.5kPa)
Minimum – 1 psi (6.8kPa)

NOTE: Electric fuel pump pressure, if used in conjunction with engine mechanical fuel pump, must be limited to no more than 4 psi. (27.4kPa)

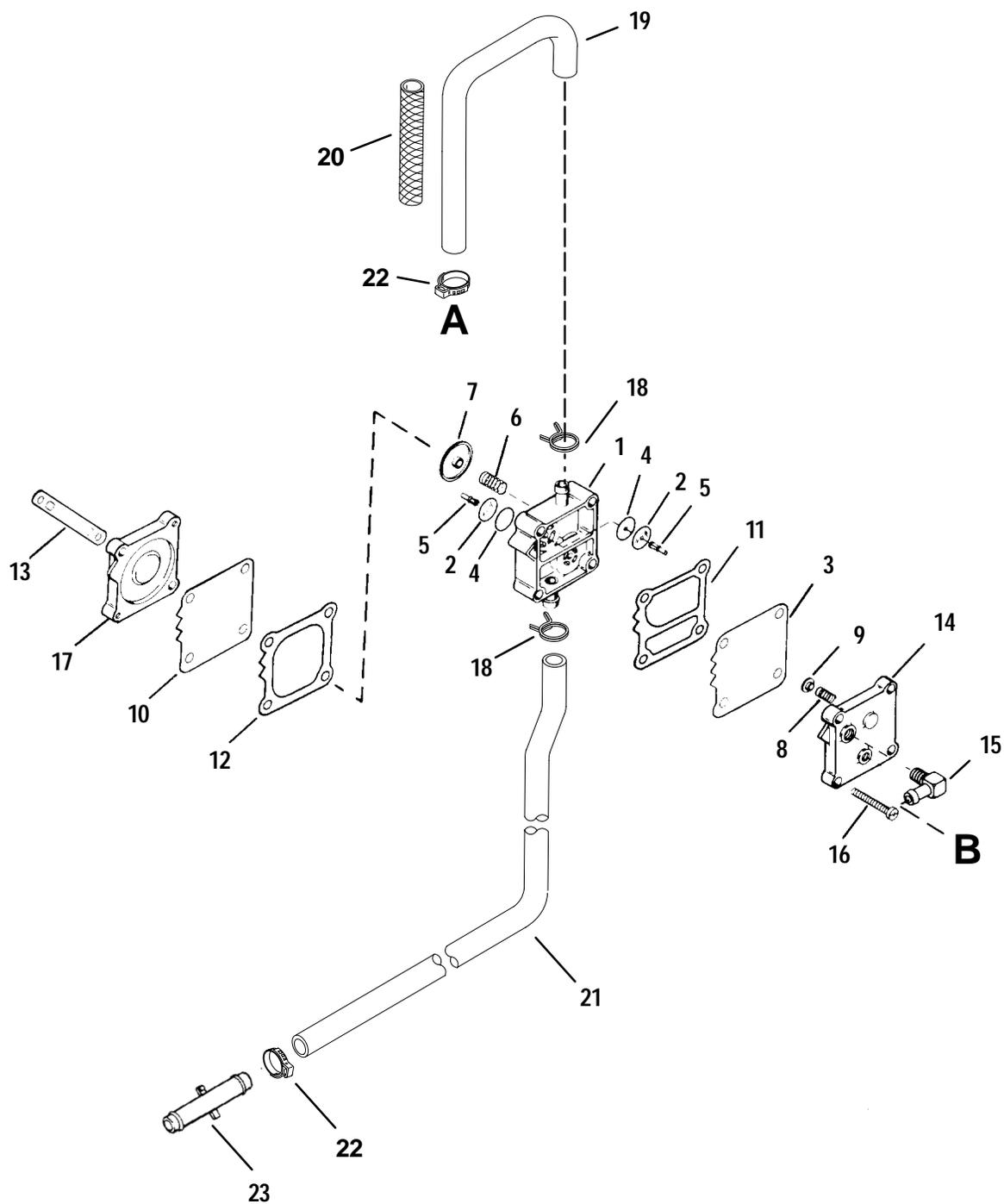
Special Tools

Fuel Pressure Gauge 91-16850





Fuel Pump



A = TO VAPOR SEPARATOR FUEL INLET FITTING B = TO CYL. BLOCK)



Fuel Pump

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
-	1	FUEL PUMP ASSEMBLY			
1	1	FUEL PUMP			
2	2	CHECK VALVE			
3	1	DIAPHRAGM KIT			
4	2	RUBBER CHECK VALVE			
5	2	RETAINER			
6	1	SPRING			
7	1	CAP			
8	1	SPRING			
9	1	CAP			
10	1	DIAPHRAGM			
11	1	GASKET-boost			
12	1	GASKET-pulse			
13	1	GASKET			
14	1	PLATE			
15	1	FITTING			
16	2	SCREW-fuel pump (M5 x 40)	55		6.2
	2	SCREW-pump to crankcase (M6 x 50)	55		6.2
17	1	BASE			
18	2	SPRING CLAMP			
19	1	HOSE			
20	1	SLEEVE-Insulating (10-1/2 IN.)			
21	1	HOSE			
22	2	CLAMP (15.3)			
23	1	CONNECTOR			



Fuel Pump Description/Operation

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

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

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

Fuel Pump Specifications

NOTE: Fuel pressure should be measured between in-line fuel filter and carburetors.

Fuel Pump Pressure at Wide Open Throttle:

Maximum: 10 PSI

Normal: 6 - 8 PSI

Minimum: 4 PSI (With Water Separating Fuel Filter)

Fuel Pump Pressure at Idle:

Normal : 2 - 3 PSI

Minimum: 1 PSI

Electric Fuel Pump Pressure, if used, must be limited to no more than 4 PSI.

Checking for Restricted Fuel Flow Caused by Anti-Siphon Valves

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

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

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

If it is found that the anti-siphon valve is the cause of the problem, either 1) remove the anti-siphon valve or 2) replace it with a solenoid-operated fuel shut off valve.



Testing Fuel Pump

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

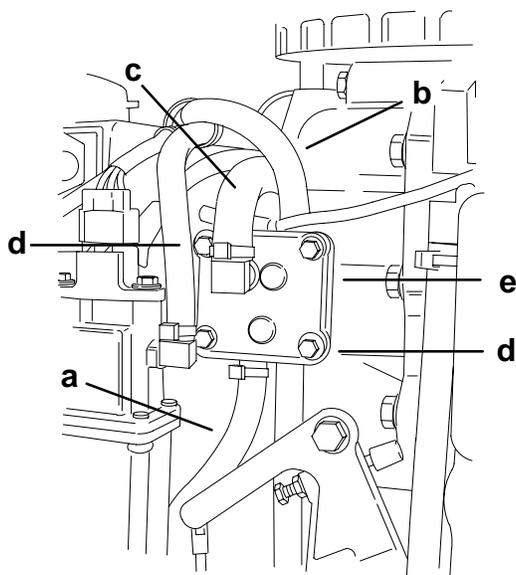
Problem: Air Bubbles in Fuel Line	
Low fuel in tank.	Fill tank with fuel.
Loose fuel line connection.	Check and tighten all connectors.
Fuel pump fitting loose.	Tighten fitting.
A hole or cut in fuel line.	Check condition of all fuel lines and replace
Fuel Pump anchor screw(s) loose.	Tighten all screws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



Fuel Pump Removal/Disassembly

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

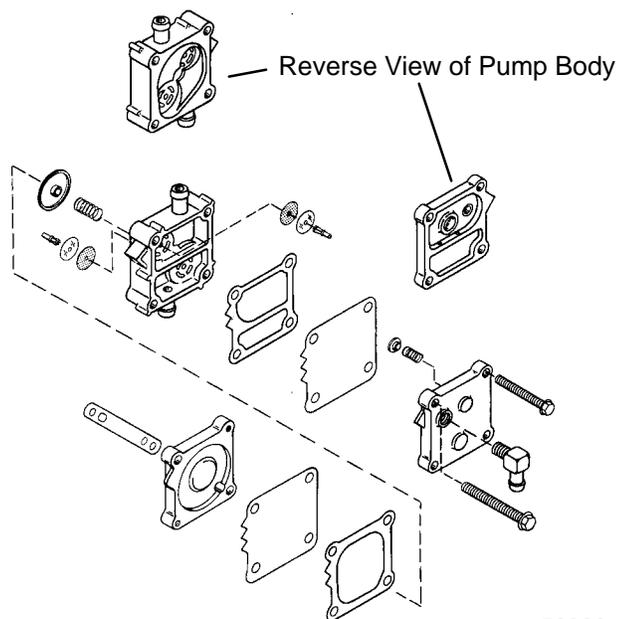
1. Disconnect fuel hoses from fuel pump.
2. Disconnect pulse hose.
3. Remove two mounting screws.
4. Remove fuel pump from engine.



53643

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

5. Disassemble fuel pump.



52362

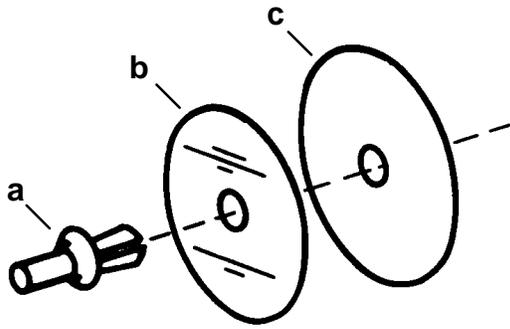
Cleaning/Inspection

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



Reassembly

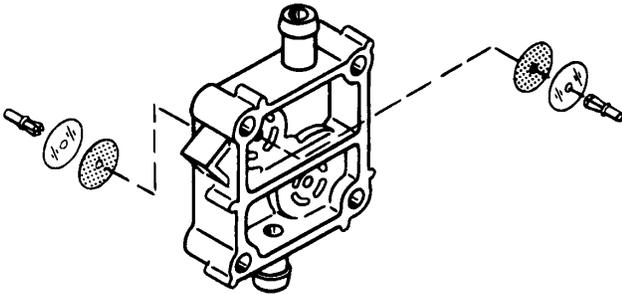
1. Insert retainer thru plastic disc and rubber check valve.



23601

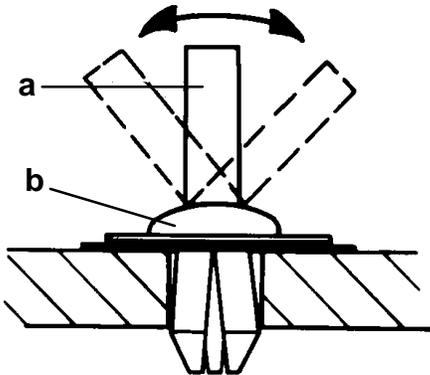
- a - Retainer
- b - Plastic Disc
- c - Rubber Check Valve

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



50161

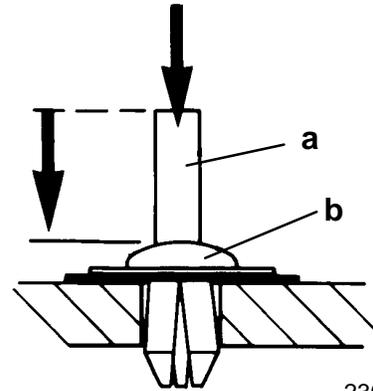
3. With retainer installed in pump body, break retainer rod from retainer by bending sideways.



23601

- a - Rod
- b - Retainer Cap

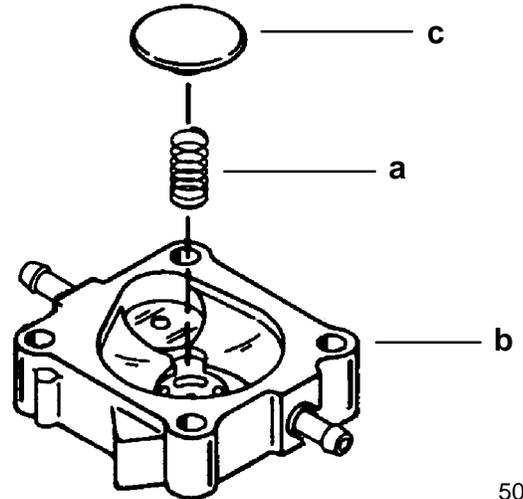
4. Reinstall rod into retainer cap and, use a small hammer or hammer and punch to tap rod down into retainer until flush with top of retainer.



23601

- a - Rod
- b - Retainer Cap

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

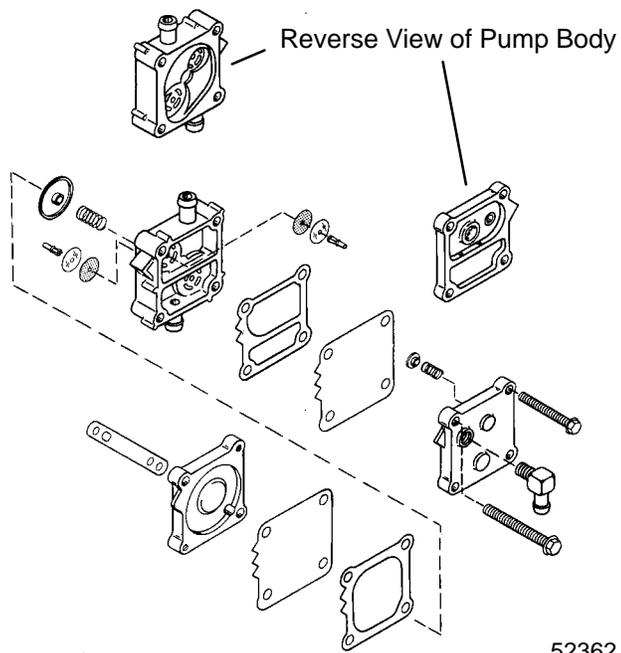


50161

- a - Boost Spring
- b - Pump Body
- c - Cap



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

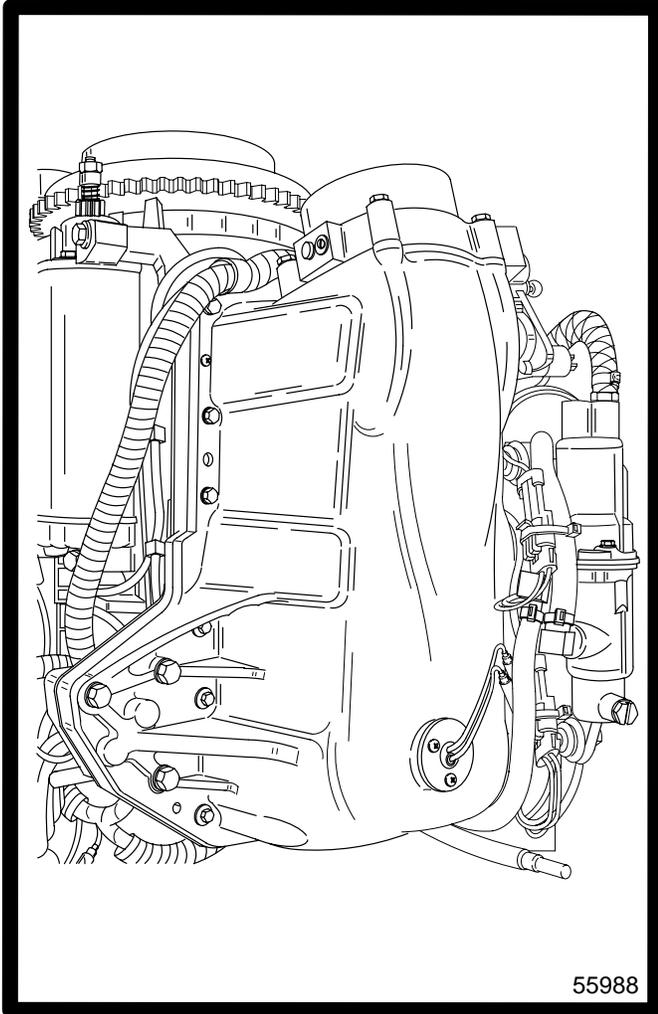


Installation

1. Install pump onto engine. Torque to 55 lb. in. (6.2 N·m).
2. Install hoses onto proper fittings and secure with sta-straps.
3. Run engine and check for leaks.



FUEL SYSTEM



3

B

DIRECT FUEL INJECTION



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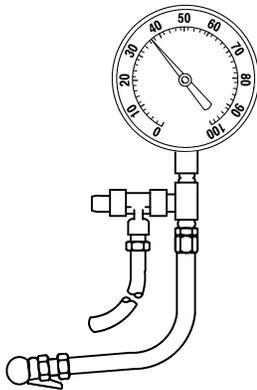
Specifications

Fuel Pressure 89 ± 2 psi (613.5 ± 13.8 kPa)
 Air Pressure 79 ± 2 psi (544.0 ± 13.8 kPa)
 Fuel/Air Differential . 10 psi (68.5 kPa)
 Electric Fuel Pump Amperage Draw . . 6-9Amps
 Fuel Injector Ohm Resistance 1.8 ± 0.1W
 Direct Injector Ohm Resistance 1.3 ± 0.3W

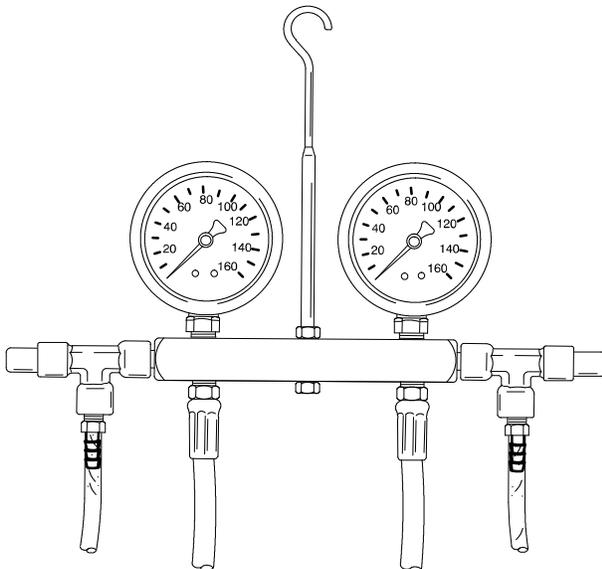
Special Tools

- 1. Single Fuel/Air Pressure Gauge 160 PSI - 91-16850A2

*Note: To convert 100 psi gauge 91-16850A1 to 160 psi gauge, order upgrade 91-16850--1.

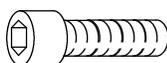


- 2. Dual Fuel/Air Pressure Gauge 160 PSI - 91-852087A1



55295

- 3. Screw (5mm x 25mm) (2 each) - 10-40073 25



- 4. Flat Washer (2 each)

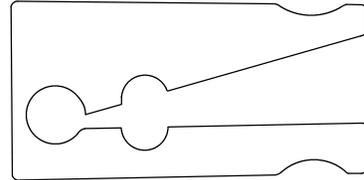


- 5. Seal/Teflon Ring Installation Tool - 91-851980



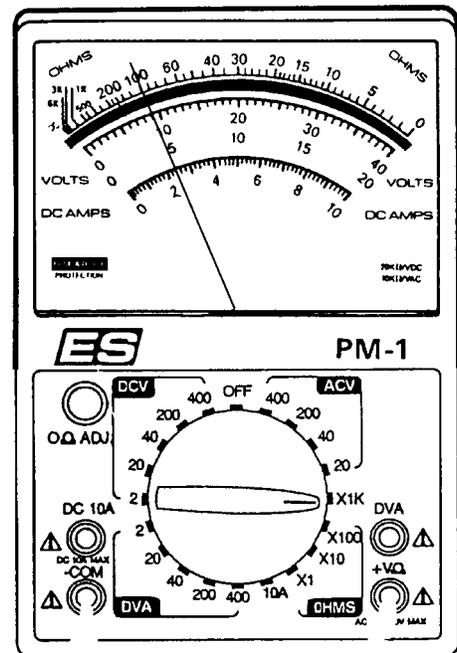
56015

- 6. Seal/Teflon Ring Sizing Tool - 91-851980-1

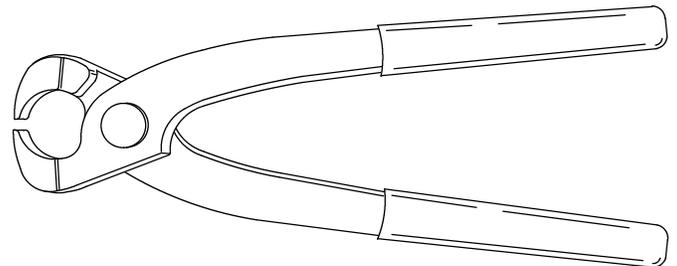


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- 7. Volt/Ohm Meter - 91-99750A1



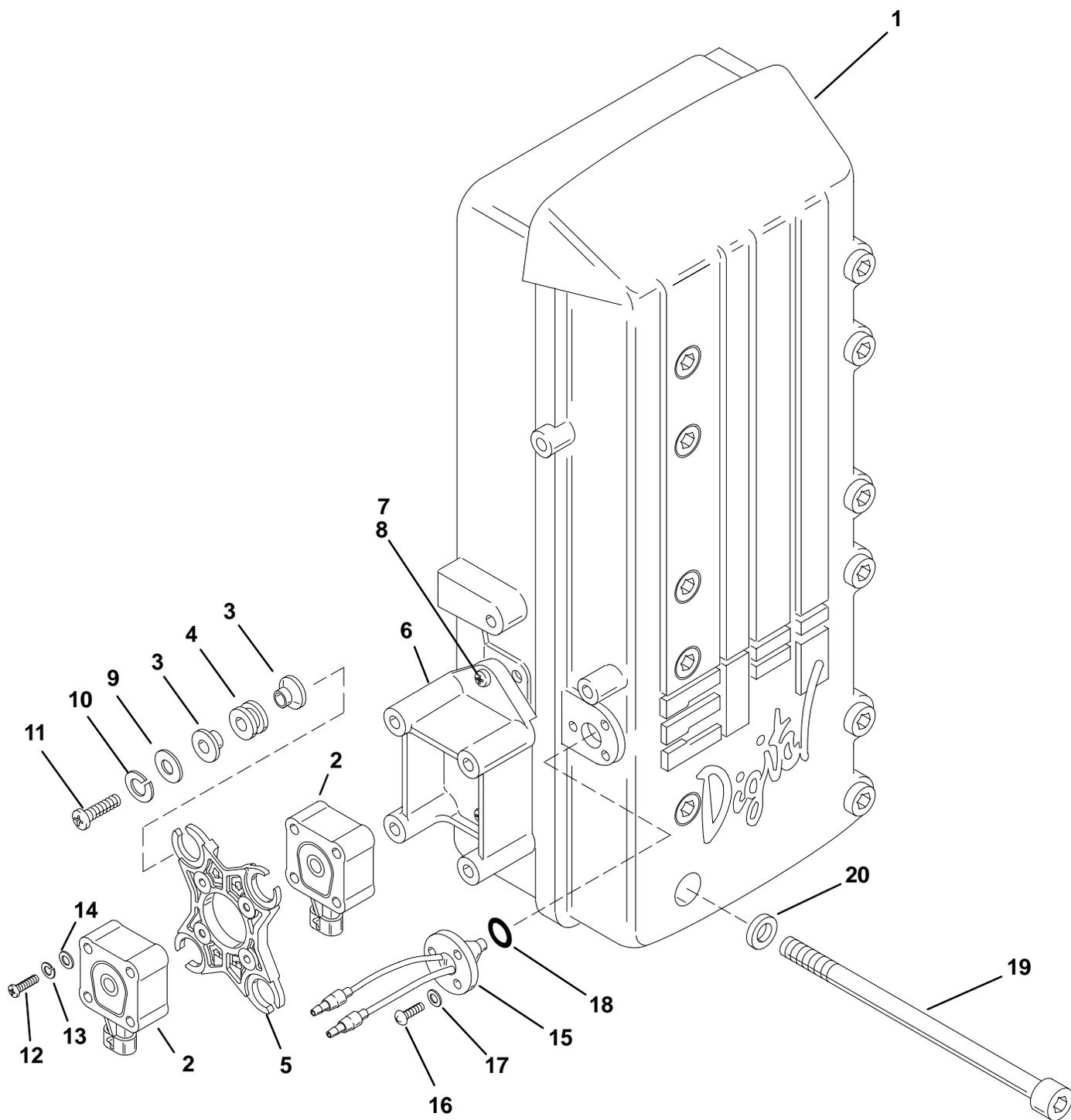
- 8. Clamp Tool - 91-



56963



1997 Model 200 DFI Fuel/Air Management System



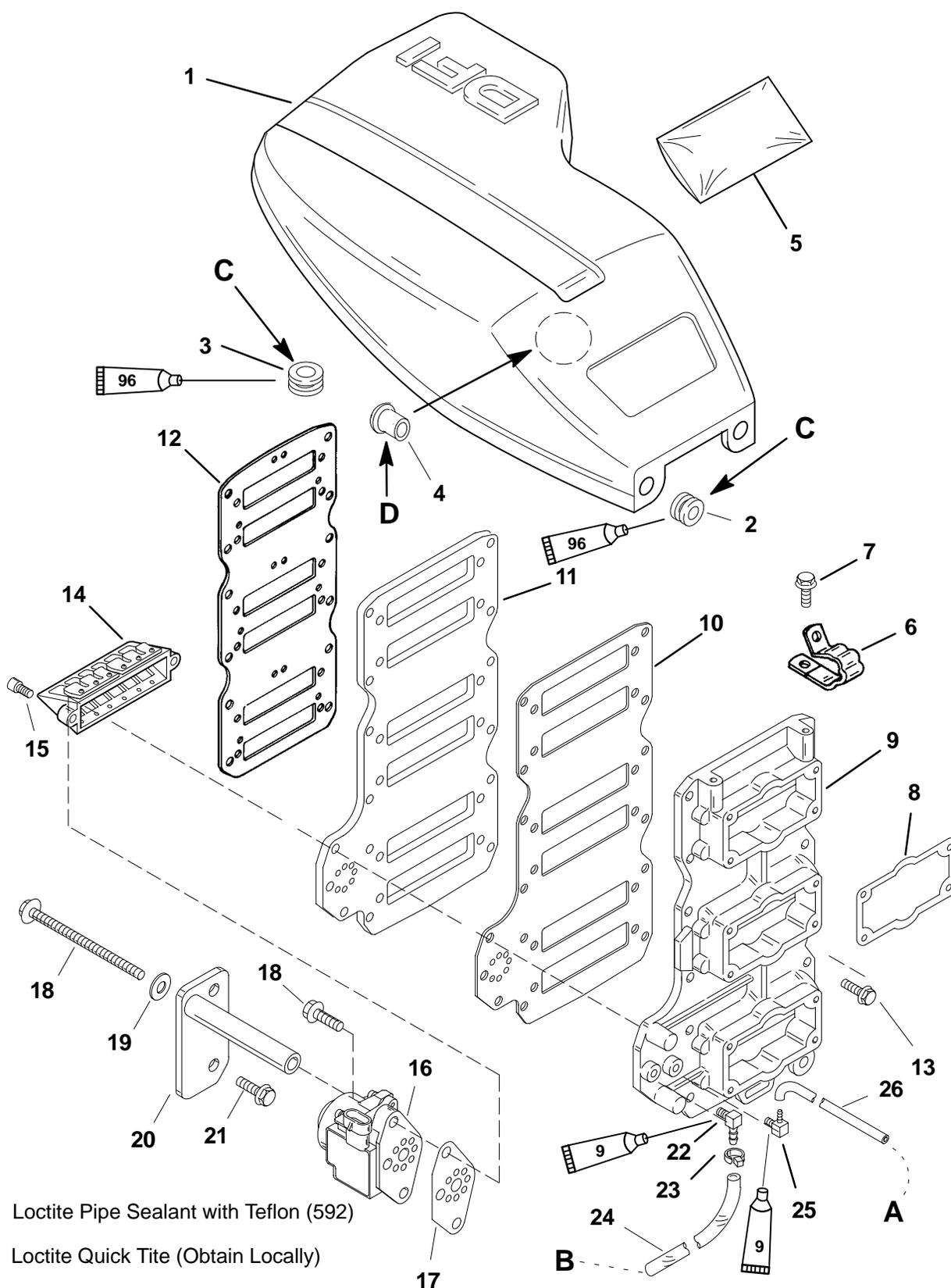


1997 Model 200 DFI Fuel/Air Management System

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	AIR MANAGEMENT			
2	2	THROTTLE POSITION INDICATOR			
3	8	BUSHING			
4	4	GROMMET			
5	1	PLATE			
6	1	HOUSING			
7	2	SCREW			
8	2	LOCKWASHER			
9	4	WASHER			
10	4	LOCKWASHER			
11	4	SCREW (M6 x 25)	45		5.1
12	4	SCREW (M5 x 30)	30		3.4
13	4	WASHER			
14	4	LOCKWASHER			
15	1	TEMPERATURE SENSOR			
16	3	SCREW (M4 x 10)		Drive Tight	
17	3	LOCKWASHER			
18	1	O RING			
19	12	SCREW		18	24.4
20	12	WASHER			



1997 Model 200 DFI Reed Block/Flywheel Cover



Loctite Pipe Sealant with Teflon (592)

Loctite Quick Tite (Obtain Locally)

A = TO COMPRESSOR

B = TO OIL TANK

C = Apply Loctite Quick Tite to O.D. of flywheel cover grommets. Apply a light coat of 2-4-C Marine Lubricant to the flywheel cover posts which pass through the grommets.

D = Air Restrictor Valve – Located inside of air filter outlet tube. This valve should be removed if outboard is operated above 5000 ft. (1524m) sea level.



1997 Model 200 DFI Reed Block/Flywheel Cover

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	FLYWHEEL COVER			
2	3	GROMMET			
3	1	GROMMET			
4	1	RESTRICTOR (8MM)			
5	1	FILTER, Air			
6	2	CLAMP			
7	2	SCREW (M6 x 12)	100		11.3
8	3	GASKET			
9	1	ADAPTOR PLATE			
10	1	GASKET			
11	1	BACKING PLATE			
12	1	GASKET			
13	12	SCREW (M6 x 25)	100		11.3
14	6	REED BLOCK (1-Piece)			
15	12	SCREW (M6 x 1 x 25)	90		10.2
16	1	OIL PUMP			
17	1	GASKET			
18	2	SCREW (M8 x 35)		17.0	23.0
	1	SCREW (M8 x 133.35)			
19	1	WASHER			
20	1	BRACKET-Oil Pump			
21	2	SCREW (M8 x 45)			
22	1	ELBOW			
23	1	STA-STRAP			
24	1	TUBING (23 IN.)			
25	1	FITTING			
26	1	TUBING (31 IN.)			
-	1	GASKET SET			
-	1	POWERHEAD			

▲ = COMPONENT OF POWERHEAD

■ = COMPONENT OF ENGINE GASKET SET

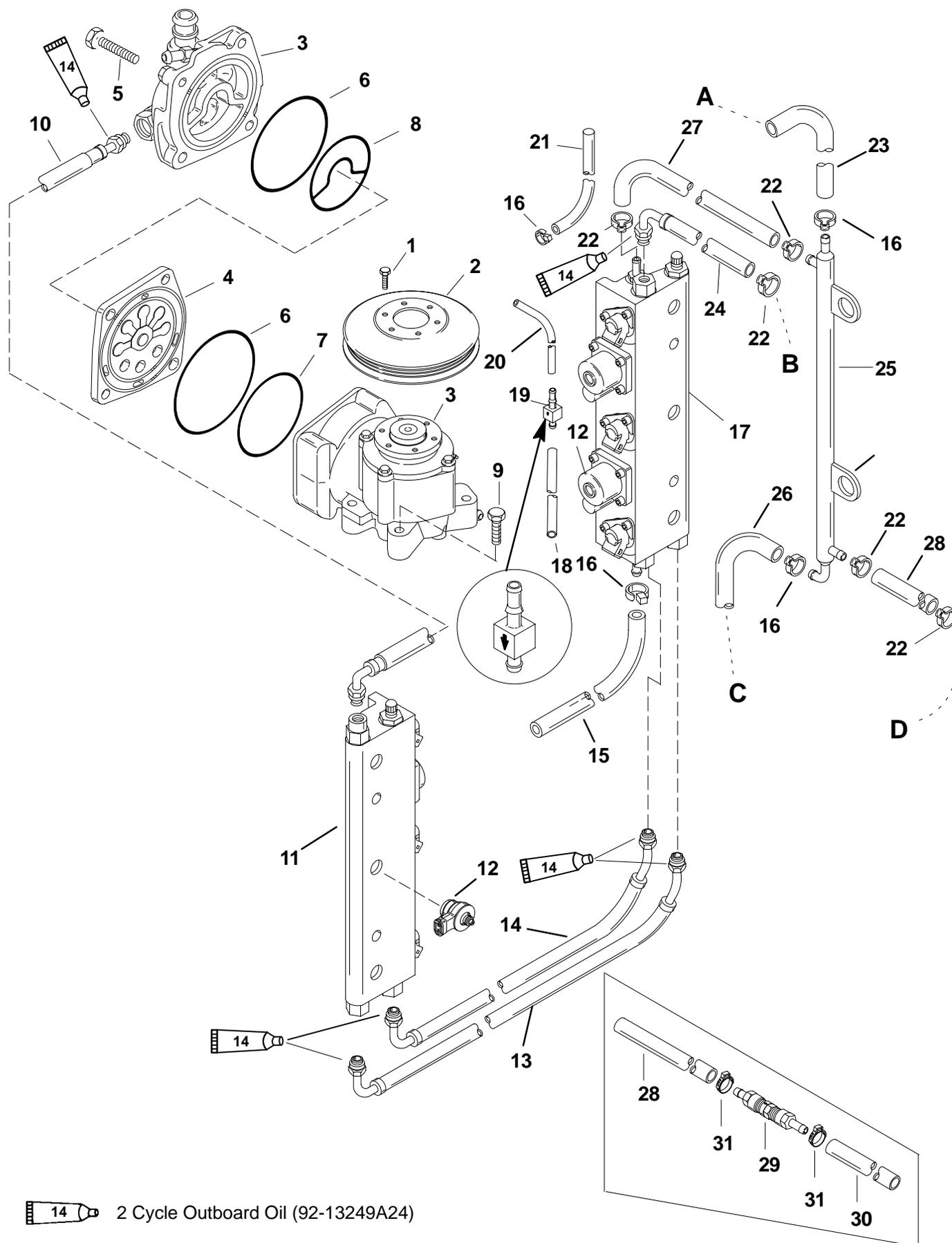


1997 Model 200 DFI Vapor Separator

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	VAPOR SEPARATOR BODY KIT			
2	1	O RING			
3	1	DRAIN SCREW KIT			Drive Tight
4	1	COVER KIT			
5	3	BOLT	45		5.1
6	3	WASHER			
7	3	WASHER			
8	3	GROMMET			
9	3	COLLAR			
10	1	TUBING (2-3/4 IN.)			
11	AR	STA-STRAP			
12	1	CHECK VALVE			
13	1	TUBING (2-1/2 IN.)			
14	1	MAP SENSOR			
15	2	SCREW (M6 x 12)	100		11.3
16	5	SCREW	30		3.4
17	4	SCREW	30		3.4
18	1	FLOAT KIT			
19	1	FLOAT VALVE KIT	10		1.1
20	1	FUEL PUMP			
21	1	COVER KIT-Fuel Pump			
22	1	PLATE			
23	1	FUEL STRAINER			
24	1	NUT (M5)	8		0.9
	1	NUT (M4)	6		0.7



1997 Model 200 DFI Fuel Rails



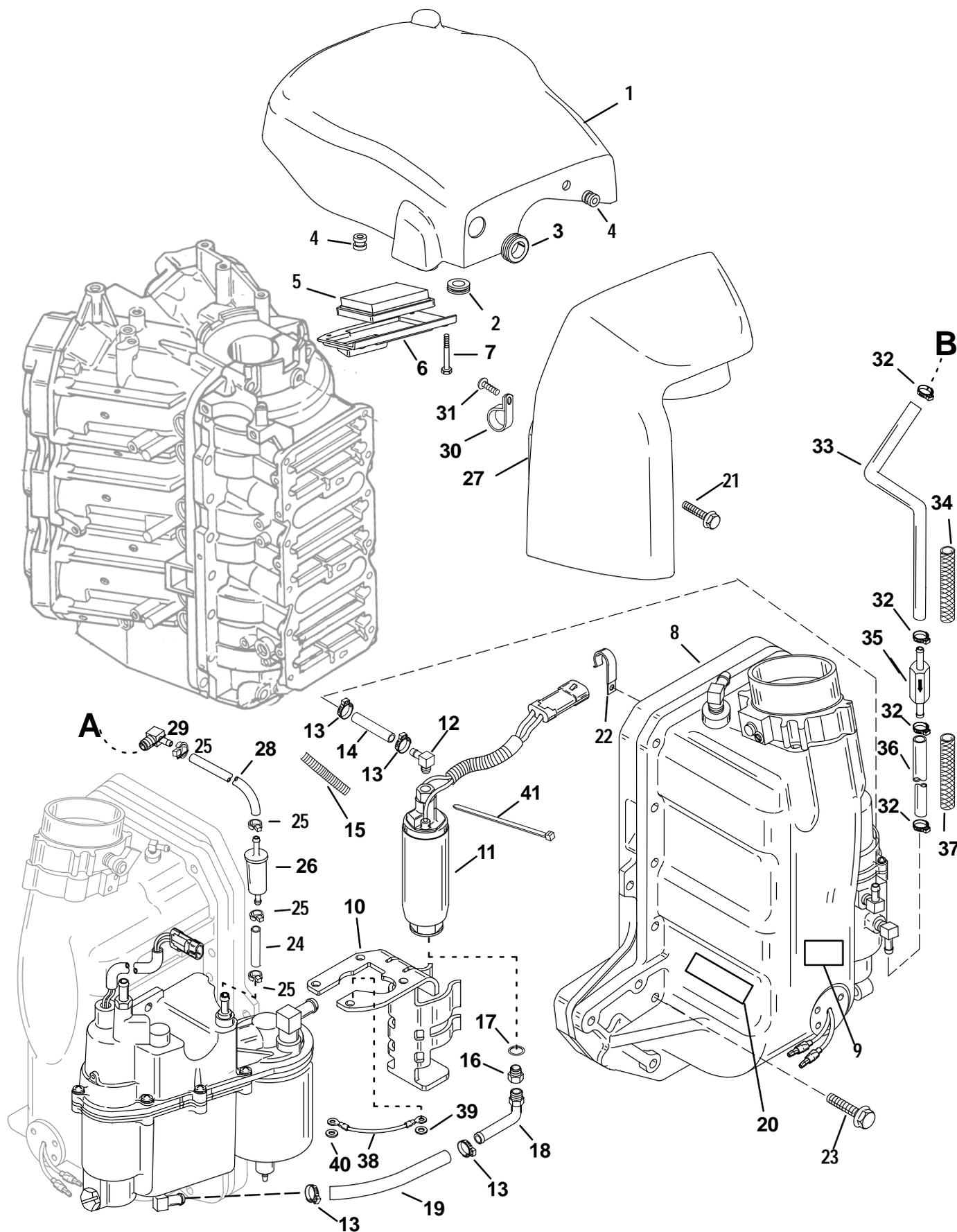


1997 Model 200 DFI Fuel Rails

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	3	SCREW	100		11.3
2	1	PULLEY			
3	1	AIR COMPRESSOR			
4	1	REED PLATE KIT			
5	4	SCREW (M8 x 35)	240	12	27.1
6	2	O RING			
7	1	O RING			
8	1	SEAL			
9	4	SCREW		19	25.8
10	1	HOSE			
11	1	FUEL RAIL (STARBOARD) (Includes tracker valve)			
12	6	INJECTOR (DIRECT)			
-	1	SEAL KIT			
13	1	HOSE			
14	1	HOSE			
15	1	TUBING (8 IN.)			
16	AR	STA-STRAP			
17	1	FUEL RAIL (PORT)(Includes regulators)			
18	1	TUBING (11 IN.)			
19	1	CHECK VALVE			
20	1	TUBING (2-1/2 IN.)			
21	1	TUBING (8 IN.)			
22	AR	CLAMP			
23	1	HOSE			
24	1	HOSE			
25	1	FUEL COOLER			
26	1	HOSE			
27	1	HOSE (MOLDED) MOLDED HOSES HAVE BEEN REPLACED			
28	1	HOSE (MOLDED) WITH CHECK VALVE DESIGN LISTED BELOW			
27	1	TUBING (8 IN.)			
28	1	TUBING (19 IN.)			
29	1	CHECK VALVE CHECK VALVE DESIGN			
30	1	TUBING (8 IN.)			
31	2	CLAMP			



1998 Model 200/225 DFI Fuel/Air Management



A = TO AIR ATTENUATOR B = TO FUEL COOLER

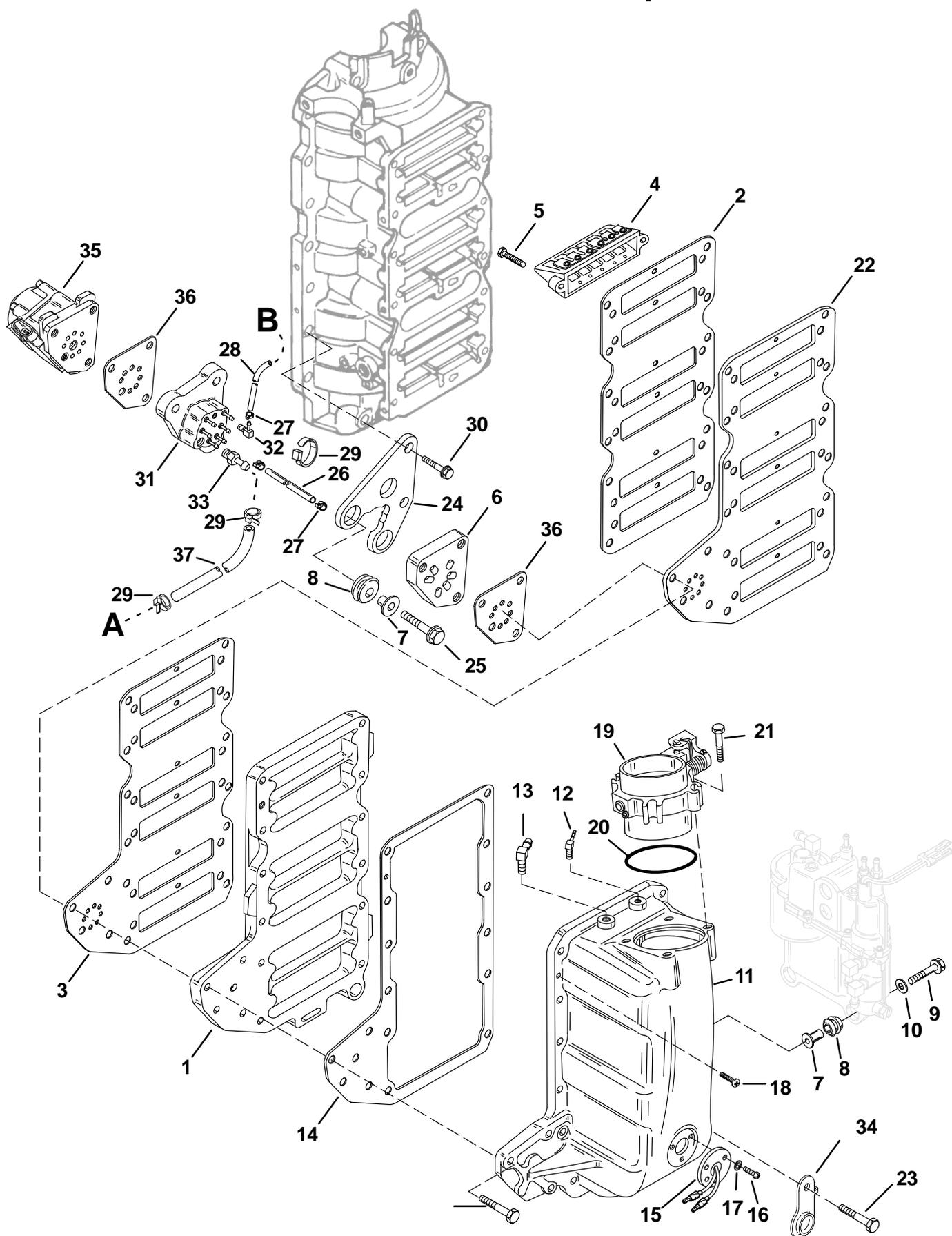


1998 Model 200/225 DFI Fuel/Air Management

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	COVER			
2	1	GROMMET			
3	1	GROMMET			
4	2	GROMMET			
5	1	AIR FILTER			
6	1	COVER			
7	4	SCREW (M5 x 13)			
8	1	AIR HANDLER ASSEMBLY			
9	1	DECAL-Caution-Start in Gear			
10	1	BRACKET			
11	1	FUEL PUMP			
12	1	ELBOW			
13	4	CLAMP			
14	1	TUBING (18 IN.)			
15	1	INSULATING SLEEVE			
16	1	FITTING ASSEMBLY			
17	1	O RING			
18	1	TUBE FITTING			
19	1	TUBING (5-1/2 IN.)			
20	1	DECAL-EPA Label Information			
21	1	SCREW (M6 x 50)	120	10	13.6
22	1	CLAMP-(STARBOARD)			
23	11	SCREW (M6 x 45)	120	10	13.6
24	1	TUBING (1-1/4 IN.)			
25	4	STA STRAP			
26	1	CANISTER-Vent			
27	1	AIR ATTENUATOR			
28	1	TUBING (15 IN.)			
29	1	FITTING-Straight			
30	1	CLIP			
31	1	SCREW (10-16 x 3/4 IN.)			
32	4	CLAMP			
33	1	HOSE			
34	1	INSULATING SLEEVE (9-1/2 IN.)			
35	1	CHECK VALVE			
36	1	TUBING (17 IN.)			
37	1	INSULATING SLEEVE (17 IN.)			
38	1	CABLE			
39	1	WASHER			
40	1	WASHER			
41	1	CABLE TIE (14 IN.)			



1998 Model 200/225 DFI Air Handler Components



A = TO OIL TANK

B = TO AIR COMPRESSOR



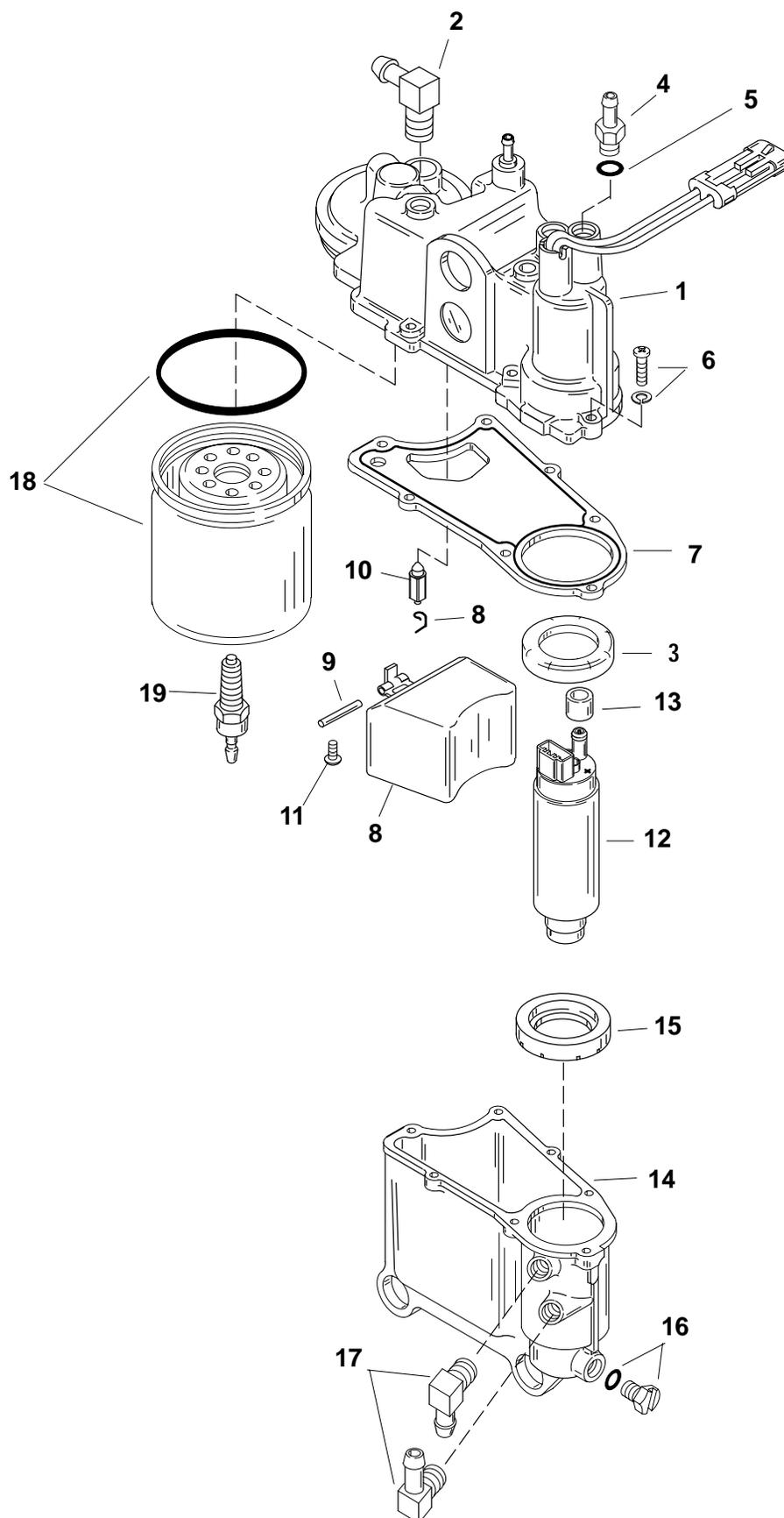
1998 Model 200/225 DFI Air Handler Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
-	1	AIR HANDLER			
1	1	ADAPTOR PLATE KIT			
2	1	GASKET			
3	1	GASKET			
4	6	REED BLOCK			
5	12	SCREW (M6 x 1)			
6	1	DISTRIBUTOR			
7	6	BUSHING			
8	6	GROMMET			
9	3	SCREW (M8 x 35)			
10	3	WASHER			
11	1	AIR PLENUM KIT			
12	1	FITTING			
13	1	ELBOW			
14	1	GASKET			
15	1	TEMPERATURE SENSOR			
16	3	SCREW			
17	3	LOCKWASHER			
18	2	SCREW (M4 x 10)			
19	1	THROTTLE BODY KIT			
20	1	O RING			
21	4	SCREW			
22	1	PLATE			
23	3	SCREW	198	17	22.4
24	1	BRACKET			
25	3	SCREW	198	17	22.4
26	6	TUBING (6 IN.)			
27	13	STA STRAP			
28	1	TUBING (36 IN.)			
29	3	STA STRAP			
30	2	SCREW (M8 x 40)		28	38.0
31	1	BRACKET			
32	1	FITTING			
33	1	FITTING			
34	1	RETAINER			
35	1	OIL PUMP			
36	2	GASKET			
37	1	TUBING (25 IN.)			
-	1	GASKET SET			

■ = COMPONENT OF ENGINE GASKET SET (27-832934A98)



1998 Model 200/225 DFI Vapor Separator



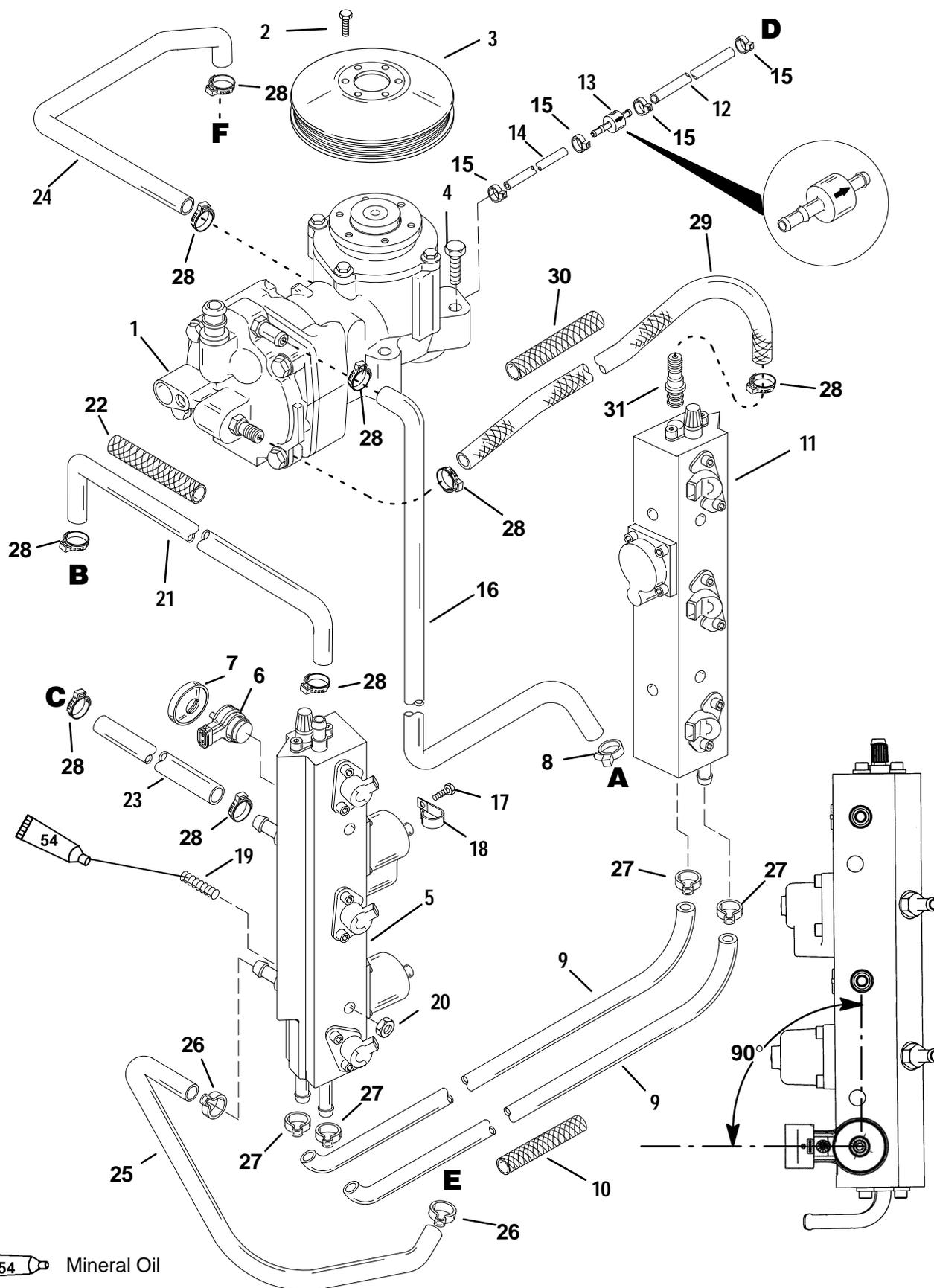


1998 Model 200/225 DFI Vapor Separator

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	COVER KIT			
2	1	ELBOW			
3	1	SEAL			
4	1	FITTING KIT-Pump Outlet			
5	1	O RING			
6	7	SCREW	30		3.4
7	1	GASKET			
8	1	FLOAT KIT			
9	1	FLOAT PIN			
10	1	NEEDLE VALVE			
11	1	SCREW	10		1.1
12	1	FUEL PUMP KIT			
13	1	SLEEVE			
14	1	BOWL KIT			
15	1	SEAL			
16	1	PLUG KIT			
17	2	ELBOW			
18	1	FUEL FILTER ASSEMBLY			
19	1	PROBE			



1998 Model 200/225 DFI Fuel Rails



A = TO TELL TALE B = TO VAPOR SEPARATOR C = TO FUEL COOLER D = TO TEE FITTING ON BLEED SYSTEM
E = TO ADAPTOR PLATE F = TO STRAINER IN TOP OF BLOCK

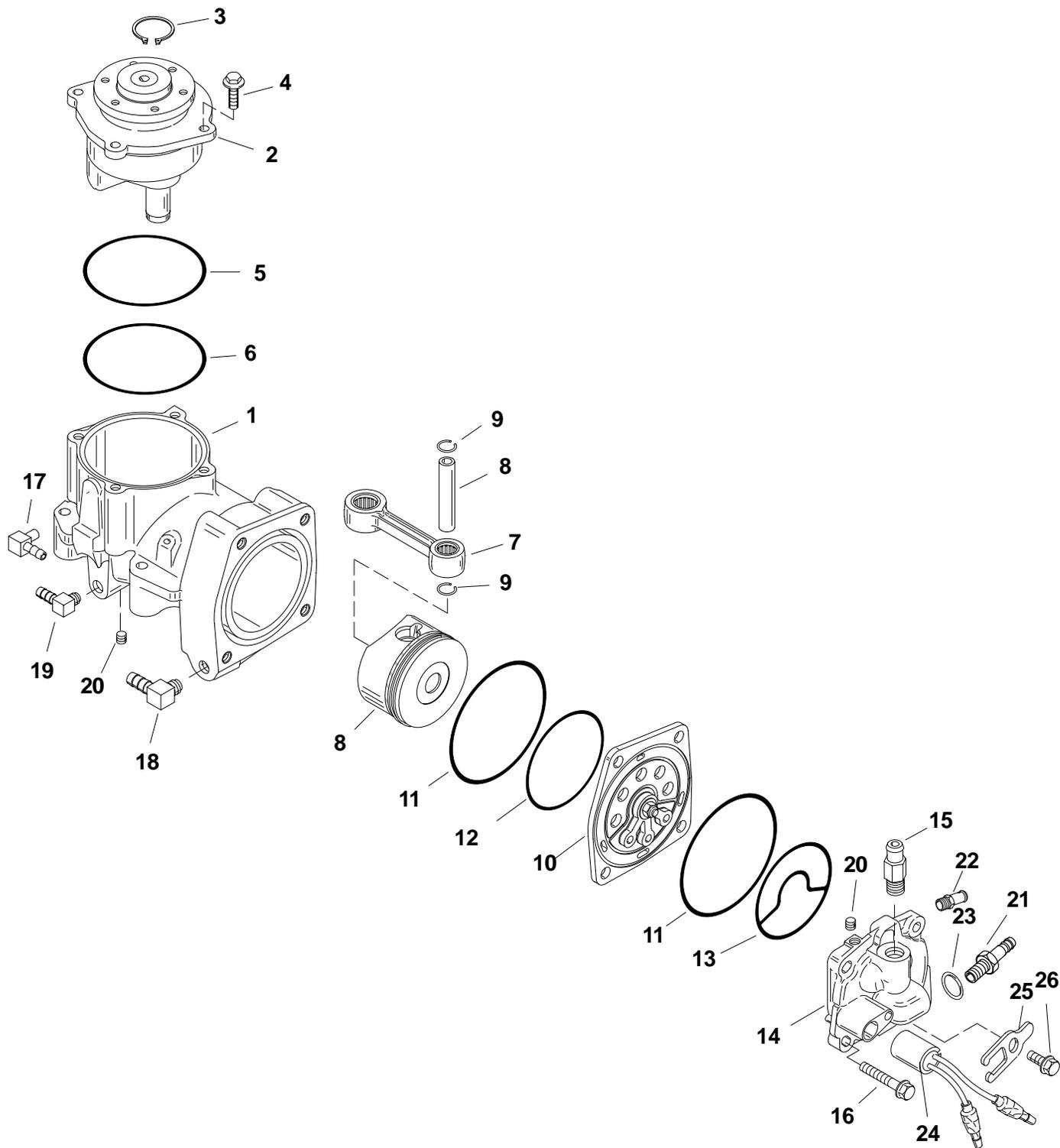


1998 Model 200/225 DFI Fuel Rails

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	AIR COMPRESSOR (See breakdown on Air Compressor Components)			
2	5	SCREW (M6 x 12)	190		21.5
3	1	PULLEY			
4	4	SCREW (M8 x 50)	240	20	27.1
5	1	FUEL RAIL (PORT)			
6	6	INJECTOR			
7	6	CUPPED WASHER			
8	1	STA-STRAP			
9	2	HOSE - Fuel/Air Balance			
10	1	INSULATING SLEEVE (27 IN.)			
11	1	FUEL RAIL (STARBOARD)			
12	1	TUBING (2-1/2 IN.)			
13	1	CHECK VALVE			
14	1	TUBING (9 IN.)			
15	4	STA-STRAP			
16	1	TUBING			
17	4	SCREW (M5 x 10)	100		11.3
18	4	CLAMP			
19	4	STUD (M10 x 91)			
20	4	NUT	399	33	45.1
21	1	HOSE - Fuel Supply			
22	1	INSULATING SLEEVE (27 IN.)			
23	1	HOSE (2 IN.) - Fuel Return			
24	1	HOSE			
25	1	TUBING - Air Dump			
26	2	CLAMP (14.0)			
27	4	CLAMP			
28	9	CLAMP (15.3)			
29	1	HOSE-Air Supply			
30	1	INSULATING SLEEVE (16 IN.)			
31	1	FITTING			



Air Compressor





Air Compressor

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	AIR COMPRESSOR			
2	1	END CAP			
3	1	SNAP RING			
4	4	SCREW (M6 x 20)	100		11.3
5	1	O RING			
6	1	O RING			
7	1	CONNECTING ROD			
8	1	PISTON ASSEMBLY			
9	2	LOCK RING			
10	1	REED PLATE ASSEMBLY			
11	2	O RING			
12	1	O RING			
13	1	SEAL			
14	1	COMPRESSOR HEAD			
15	1	FITTING-Straight			
16	4	SCREW (M8 x 35)	240	20	27.1
17	1	ELBOW			
18	1	ELBOW			
19	1	ELBOW			
20	2	PIPE PLUG			
21	1	CONNECTOR			
22	1	FITTING			
23	1	O RING			
24	1	TEMPERATURE SENSOR			
25	1	RETAINER			
26	1	SCREW (M8 x 12)	240	20	27.1



AIR INDUCTION THROUGH CRANKCASE

Combustion air enters the cowl through holes located in the top aft end of the cowl. The cowl liner directs this air to the bottom of the powerhead. This limits the exposure of salt air to the components inside the engine cowl.

Once inside the cowl the air enters the plenum through the throttle shutter(s) (17) which are located in the plenum assembly (18). The air then continues through the reed valves (15) and into the crankcase (32). The throttle shutter(s) are actuated by the throttle shaft. Mounted onto a separate shaft are two throttle position sensors (TPS) (13). These sensors tell the engine control unit (ECM) (8) the position of the throttle.

2 TPS's are installed on the DFI engine for safety redundancy. If one TPS should fail, the dash mounted CHECK ENGINE light will flash and the warning horn will sound. The 1997 Model engine will continue to perform normally; the 1998 Model engine speed will be reduced to 3000 RPM. If both TPS's should fail, engine speed will be reduced to idle. DFI engines require large amounts of air into the cylinders at idle speed. To accomplish this, the throttle shutters are partially open at low engine speeds. The dual TPS system reads the shaft movement in both directions, one reads movement up (increasing resistance), while the other reads the same movement as down (decreasing resistance). The ECM reads both and calculates the throttle shutter position.

AIR COMPRESSOR SYSTEM

Air from inside the engine cowl is drawn into the compressor (12) through the flywheel cover. This cover acts like a muffler to quiet compressor noise and contains a filter (11) to prevent the ingestion of debris into the compressor. A restrictor is located between the filter and compressor. The restrictor design lowers the compressor intake noise and should be removed at altitudes above 5000 feet. The compressor is driven by a serpentine belt (10) from a pulley mounted on the crankshaft (16), and is automatically self adjusted using a single idler pulley. This air compressor is a single cylinder unit containing a connecting rod, piston, rings, bearings, reed valves, and a crankshaft. The compressor is water cooled to lower the temperature of the air charge and is lubricated by oil from the engine oil pump assembly. As the compressor piston moves downward inside the cylinder, air is pulled through the filter, reed valves and into the

cylinder. After the compressor piston changes direction, the intake reeds close and the exhaust reeds open allowing compressed air into the hose (9) leading to the air/fuel rails (4). An orifice (6) is installed in the line between the compressor and air rail – to smooth the pulses transmitted from the compressor to the air rail.

The air/fuel rails contain two passages; one for fuel, the second is the air passage. The air passage is common between all the cylinders included in the rail. A hose connects the starboard rail air passage to the air compressor. Another hose connects the starboard air rail passage to the port air rail passage. An air pressure regulator (5) will limit the amount of pressure developed inside the air passages to approximately 10 psi below the pressure of the fuel inside the fuel passages (i.e. 80 psi air vs 90 psi fuel). Air exiting the pressure regulator is returned into the exhaust adaptor and exits thru the propeller.

FUEL

Fuel for the engine is stored in a typical fuel tank (1). A primer bulb (26) is installed into the fuel line to allow priming of the fuel system. A crankcase mounted pulse driven diaphragm fuel pump (25) draws fuel through the fuel line, primer bulb, fuel pump assembly and then pushes the fuel thru a water separating fuel filter (23). This filter removes any contaminants and water before the fuel reaches the vapor separator (22). Fuel vapors are bled into the air compressor inlet in the front of the flywheel cover preventing a vapor lock of the electric fuel pump assembly which is mounted in the vapor separator. The electric fuel pump is different than the fuel pump that is utilized on the standard EFI engine (non DFI), and is capable of developing fuel pressures in excess of 90 psi. Fuel inside the rail must remain pressurized at exactly 10 psi over the air rail pressure or the ECM (map) calibrations will be incorrect. Fuel from the vapor separator is supplied to the top of one fuel rail. A fuel line connects the bottom of the first rail to the opposite fuel rail. Fuel is stored inside the rail until an injector opens. A fuel pressure regulator (2) controls pressure in the fuel rails, and allows excess fuel to return into the vapor separator. The fuel regulator not only regulates fuel pressure but also regulates it at approximately 10 p.s.i. higher than whatever the air rail pressure is. The fuel regulator diaphragm is held closed with a spring that requires 10 p.s.i. to force the diaphragm off the diaphragm seat. The back side of the diaphragm is exposed to air rail pressure. As the air rail pressure increases, the fuel pressure needed



to open the regulator will equally increase. Example: If there is 50 p.s.i. of air pressure on the air rail side of the diaphragm, 60 p.s.i. of fuel pressure will be required to open the regulator. The return fuel line (24) to the vapor separator is water cooled. This design is used to prevent cold fuel from the fuel tank hitting the hot fuel returning from the fuel rail and flashing off the light ends (boiling over).

To equalize the pulses developed by the pumps (both air and fuel) a tracker diaphragm (3) is installed in the starboard rail. The tracker diaphragm is positioned between the fuel and air passages. The tracker diaphragm is a rubber diaphragm which expands and retracts depending upon which side of the diaphragm senses the pressure increase (pulse).

OIL

Oil in this engine is not mixed with the fuel before entering the combustion chamber. Oil is stored inside a standard remote oil reservoir (21). Crankcase pressure will force oil from the remote oil reservoir into the oil storage tank (20) on the side of the powerhead. Oil will flow from the oil storage tank into the oil pump (19). The oil pump is a solenoid design. It is activated by the ECM and includes 7 pistons with corresponding discharge ports. The oil pump is mounted directly onto the powerhead. Each cylinder is lubricated by one of the discharge ports. The oil is discharged into the crankcase in front of the reed blocks. The seventh passage connects to the hose that leads to the air compressor for lubrication. Excess oil from the compressor returns into the plenum and is ingested through the crankcase.

The ECM will change the discharge rate of the oil pump, depending upon engine demand. The ECM will also pulse the pump on initial start up to fill the oil passages eliminating the need to bleed the oil system. The ECM provides additional oil for break in, as determined by its internal clock. The oil ratio ranges from 300 - 400:1 at idle to 60:1 at WOT. A DFI engine will use less oil than a non-DFI engine.

ELECTRICAL

The electrical system consists of the ECM, crank position sensor (flywheel speed & crankshaft position) (31), throttle position sensor (TPS), MAP sensor (14), engine temperature sensor (30), ignition coils (7) and injectors (fuel & direct). The engine requires a battery to start (i.e. the ignition and injection will not

occur if the battery is dead). The system will run off of the alternator.

OPERATION

The operation of the system happens in milliseconds (ms); exact timing is critical for engine performance. As the crankshaft rotates, air is drawn into the crankcase through the throttle shutters, into the plenum, and through the reed valves. As the piston nears bottom-dead-center, air from the crankcase is forced through the transfer system into the cylinder. As the crankshaft continues to rotate the exhaust and intake ports close. With these ports closed, fuel can be injected into the cylinder. The ECM will receive a signal from the throttle position sensor (TPS), engine temperature sensor (TS) and the crank position sensor (flywheel speed and position sensor). With this information the ECM refers to the fuel calibration (maps) to determine when to activate (open and close) the injectors and fire the ignition coils. With the piston in the correct position, the ECM opens the fuel injector (27), 90 psi fuel is discharged into a machined cavity inside the air chamber of the air/fuel rail. This mixes the fuel with the air charge. Next the direct injector (28) will open, discharging the air/fuel mixture into the combustion chamber. The direct injector directs the mixture at the bowl located in top of the piston. The piston's bowl directs the air/fuel mixture into the center of the combustion chamber. This air fuel mixture is then ignited by the spark plug (29).

Compressor Notes: To aid in starting when the air rail pressure is low and before the compressor has time to build pressure, the direct injector is held open by the ECM. This allows the compression from inside the cylinders to pressurize the air rail faster (1 or 2 strokes, or 60° of crankshaft rotation).

Idle Notes: Idle quality is controlled by fuel volume and fuel timing. The throttle shutters will be open at idle speeds. The shift cut-out switch will interrupt the fuel to 3 of the cylinders to assist in shifting.

The TPS signals the ECM to change the fuel and spark without movement of the throttle shutters. The throttle cam is manufactured to allow the TPS sensor shaft to move before opening the throttle shutters.

The crankshaft position sensor is different from the standard 3.0 litre sensor. The crank position sensor is a hall effect sensor and serves two functions (flywheel speed and position).



Installation and Removal of High Pressure Fuel and Air Hoses

CAUTION

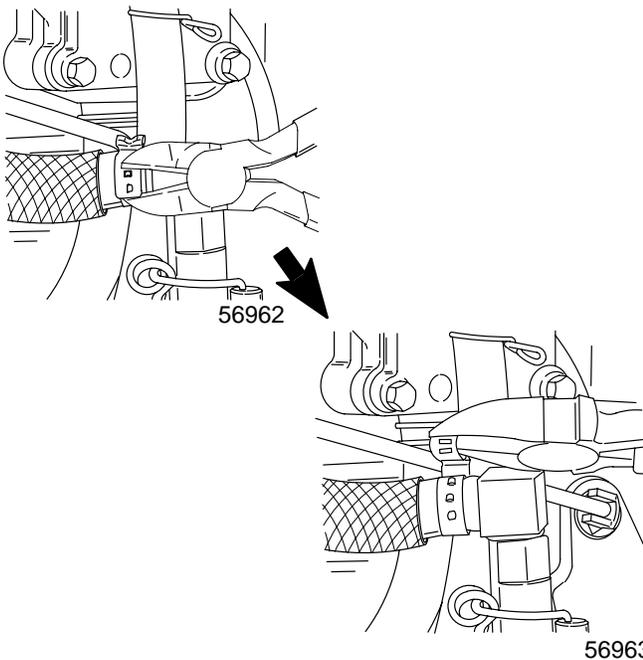
To prevent failure of high pressure fuel and air hoses, proper tools must be used when removing or reinstalling high pressure hoses. Sharp side cutter or end cutter should be used to remove hose clamps. Clamp Tool 91- must be used to install new hose clamps. Do not use screw-type clamps to secure hoses as damage to hose may result.

High Pressure Hose Removal

Use a sharp side cutter or end cutter to peel back end of clamp.

CAUTION

Do not cut through clamp. Hose damage may occur.

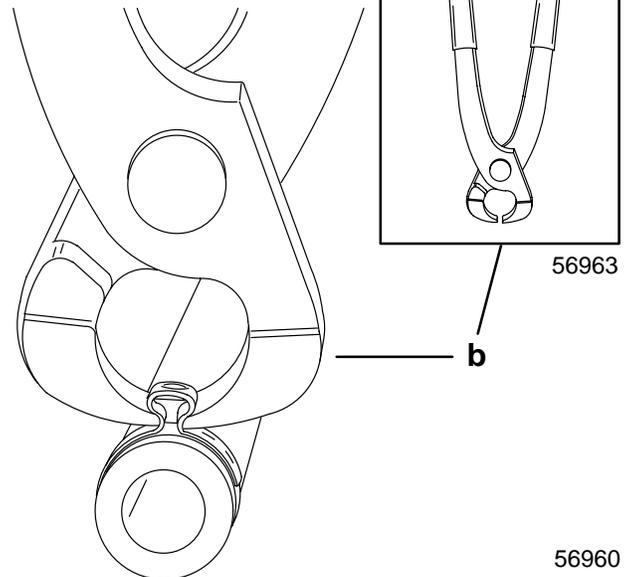
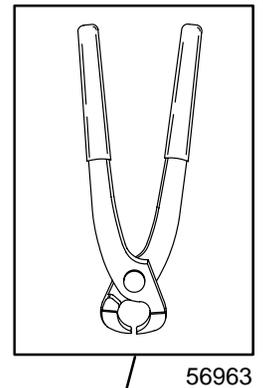
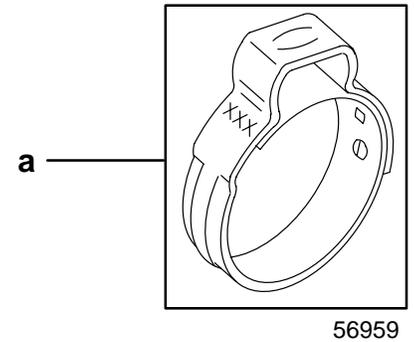


CAUTION

Do not use sharp side cutter or end cutter to crimp clamps. Damage to clamp may occur resulting in hose leakage.

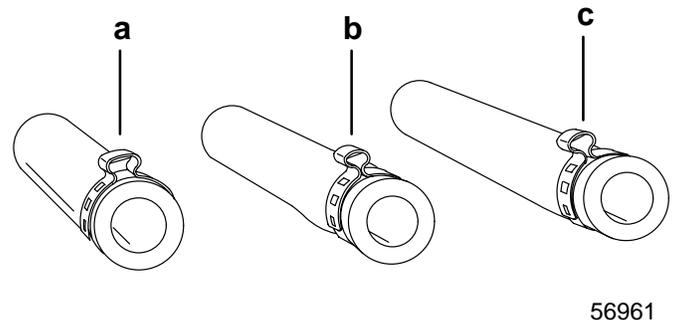
High Pressure Hose Installation

1. Use Clamp Tool 91- to install new hose clamps.



- a - Hose Clamp
- b - Clamp Tool 91-

2. Do not over crimp hose clamps. Over tight clamps may damage hose. Too loose clamps may allow fuel or air to leak pass end of hose.



- a - Too Loose
- b - Too Tight - Roll Crimp Touching
- c - Correct Tightness - Small Air Gap Between Roll Crimp

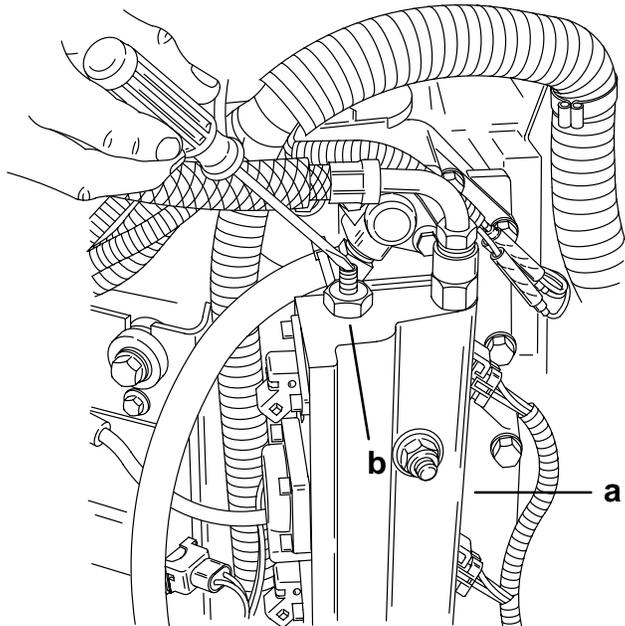


Fuel Management Assembly Removal

⚠ CAUTION

Fuel system must be bled off prior to removal of fuel system components.

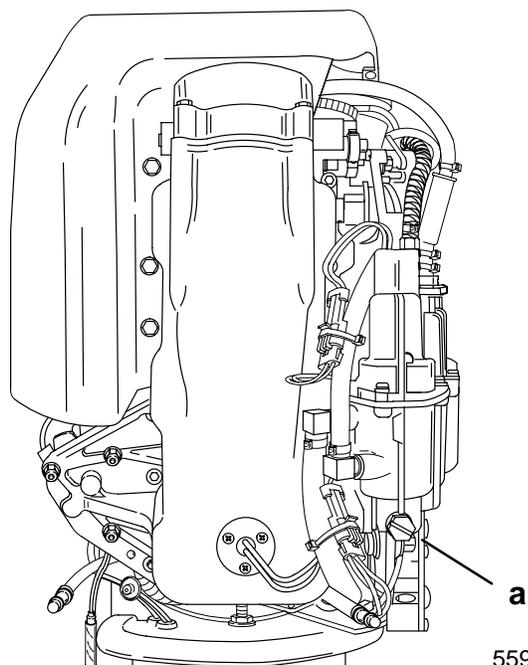
1. De-pressurize fuel system by wrapping a clean cloth around fuel pressure port valve (STARBOARD fuel rail) and depressing valve core.



55923

- a - Starboard Fuel Rail
- b - Fuel Pressure Port

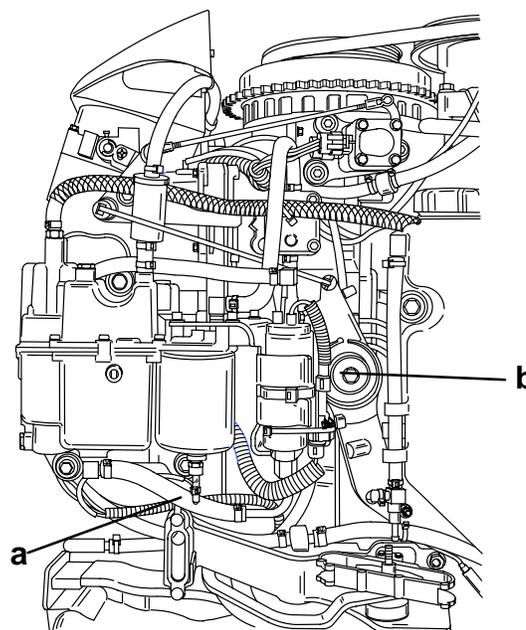
2. Place suitable container underneath vapor separator drain plug and remove plug.



55933

- a - Drain Plug

3. Disconnect water separator sensor lead.
4. Disconnect External electric fuel pump harness connector.

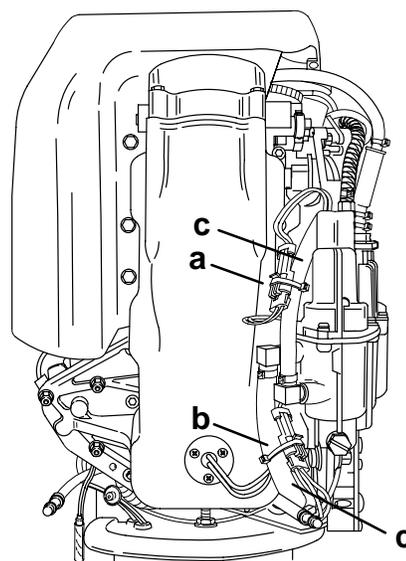


55937

- a - Sensor Lead
- b - Harness Connector

5. Disconnect internal electric fuel pump harness connector.
6. Remove sta-strap securing air temperature sensor harness to fuel hose.
7. Remove vapor separator vent hose to air plenum.

NOTE: Upper fuel hose goes to electric pump beside fuel/water separator. Lower fuel hose goes to fuel cooler.



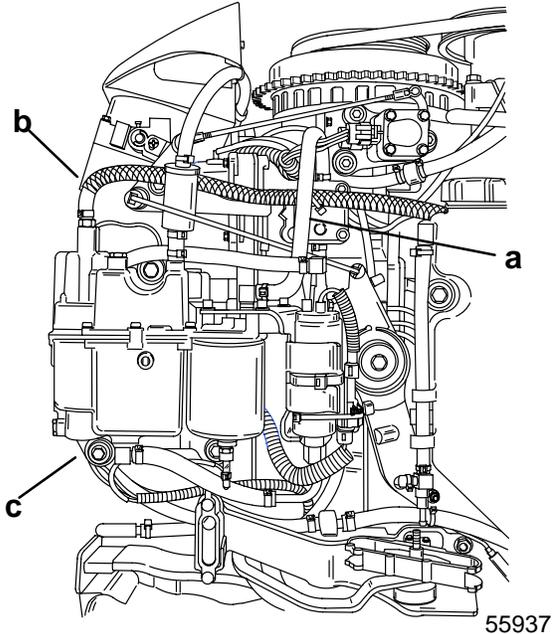
55933

- a - Harness Connector
- b - Sta-Strap
- c - Fuel Hoses



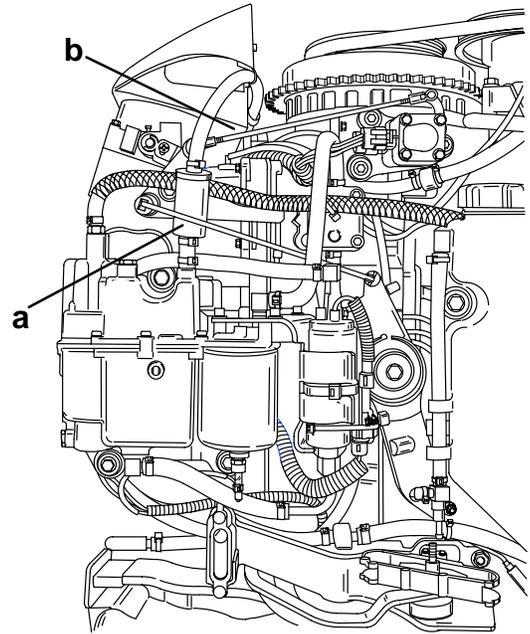
8. Remove the fuel inlet hose from the pulse fuel pump.
9. Remove the fuel outlet hose and fuel return hose from the vapor separator.
10. Remove 3 mounting bolts and remove separator.

NOTE: Front fuel hose goes to top of port fuel rail.
Rear fuel hose goes to side of port fuel rail.



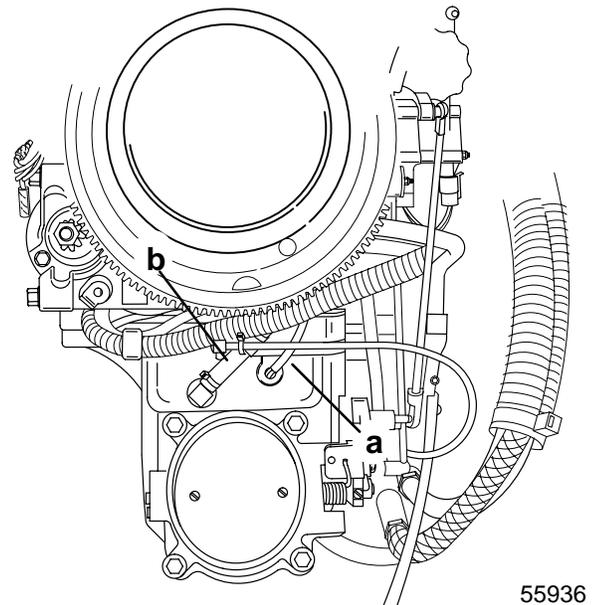
- a - Fuel Inlet Hose
- b - Fuel Outlet Hose
- c - Fuel Return Hose

11. Disconnect throttle cam link rod and the Throttle Position Sensor link rod.



- a - Throttle Link Rod
- b - Throttle Position Sensor Link Rod

12. Disconnect MAP Sensor hose and compressor oil return hose from air management assembly.

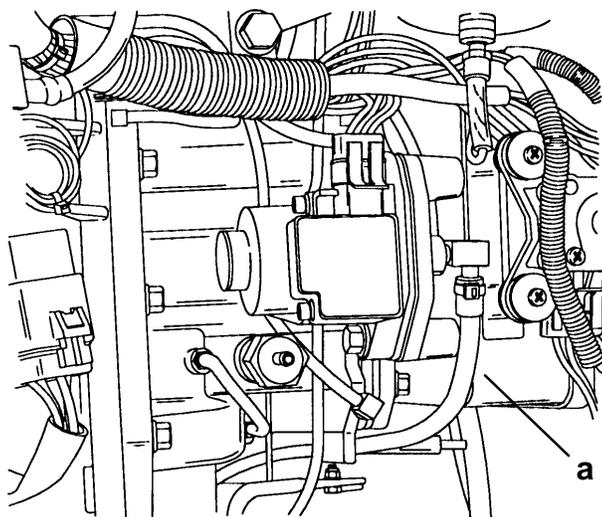


- a - MAP Sensor Hose
- b - Oil Return Hose

13. Disconnect oil hoses from oil pump adaptor plate.
14. Remove and plug oil inlet hose to oil pump.



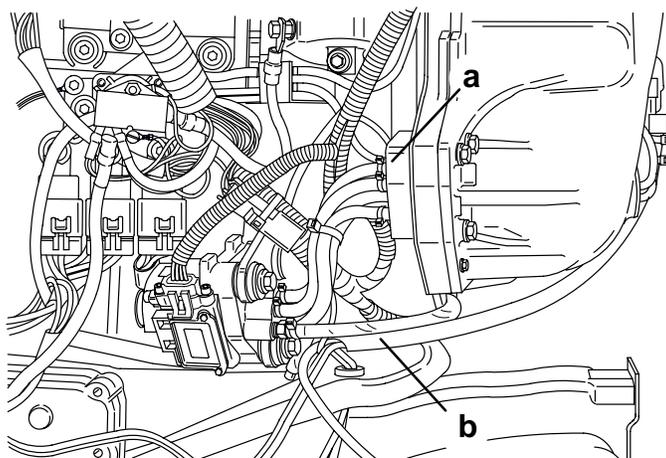
1997 Model



55194

a - Oil Inlet Hose

1998 Model

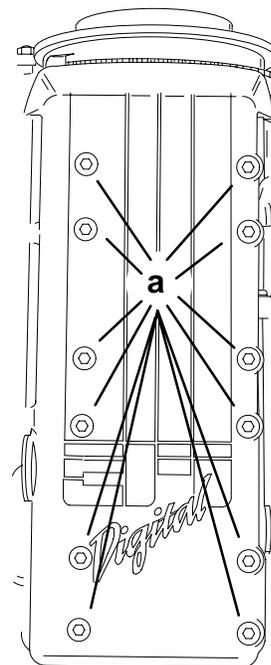


55989

a - Oil Hoses
b - Oil Inlet Hose

15. Remove 12 allen screws securing fuel management assembly to powerhead and remove assembly.

1997 Model



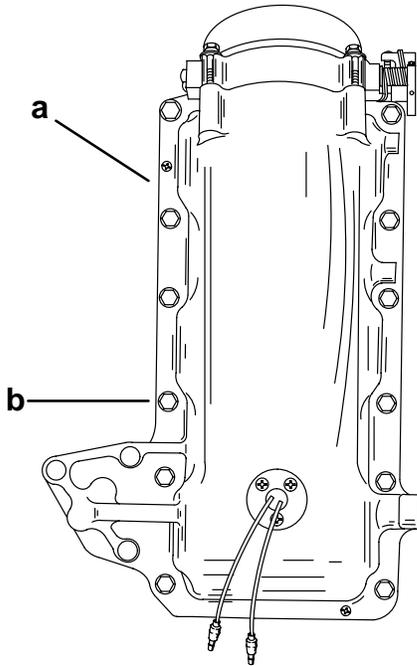
53645

a - Allen Screws



16. Remove 12 bolts securing air management assembly to crankcase and remove assembly.

1998 Model

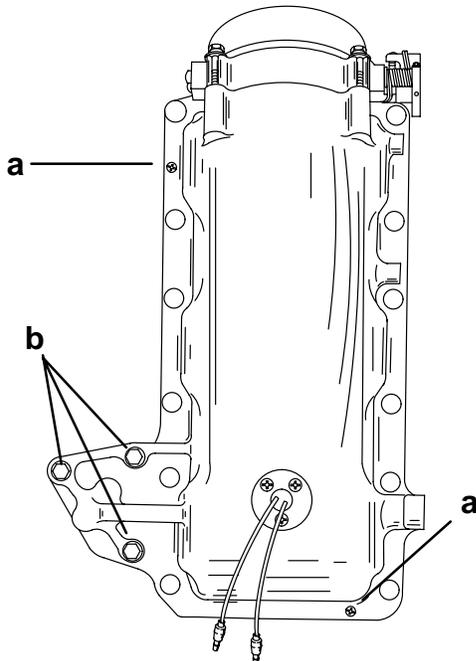


55971

- a - Air Management
- b - Bolts (12 each)

Reed Block Assembly Removal

1. Remove 2 screws securing air plenum to reed plate assembly.
2. Remove 3 bolts securing oil pump adaptor plate to air plenum assembly.



55971

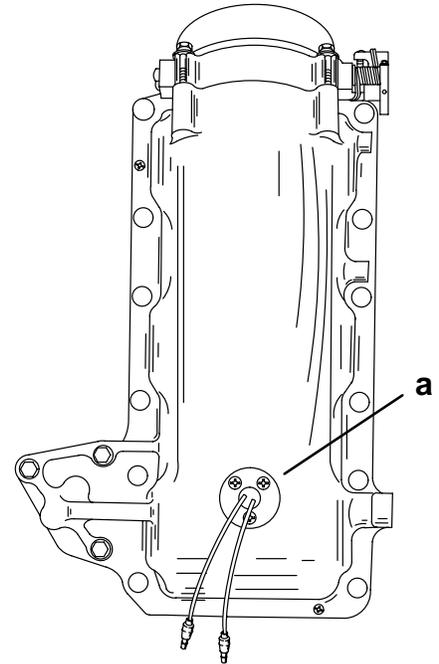
- a - Screws (2 each)
- b - Bolts (3 each)

Reed Block Assembly Installation

1. Secure oil pump adaptor plate to air plenum with 3 bolts. Torque bolts to 16 lb. ft. (21.7 N·m).
2. Secure air plenum to reed plate with 2 screws. Drive screws tight.

Air Temperature Sensor Removal

Remove 3 screws securing sensor and remove sensor.



55971

- a - Sensor

Air Temperature Sensor Installation

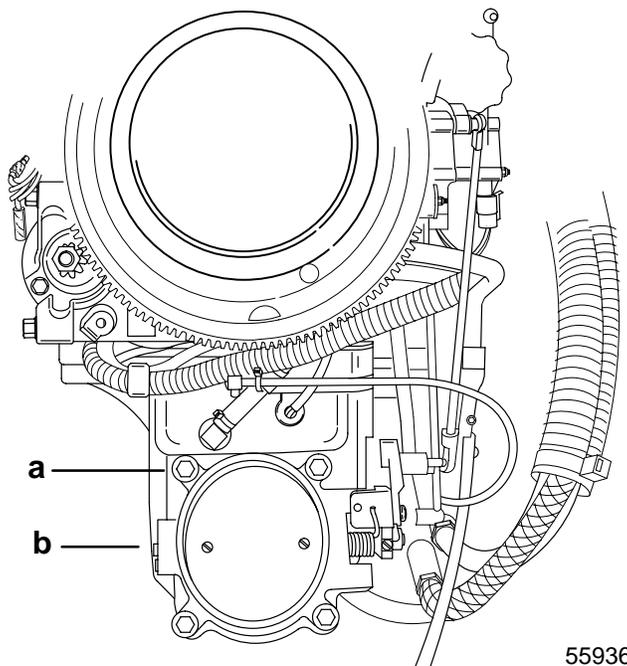
Secure sensor in air plenum with 3 screws. Drive screws tight.



Throttle Plate Assembly Removal

NOTE: The throttle plate assembly is calibrated and preset for proper running characteristics and emissions at the factory. Other than complete assembly removal from the air plenum, no further disassembly should be made.

Remove 4 bolts securing throttle plate assembly to air plenum and remove assembly.



55936

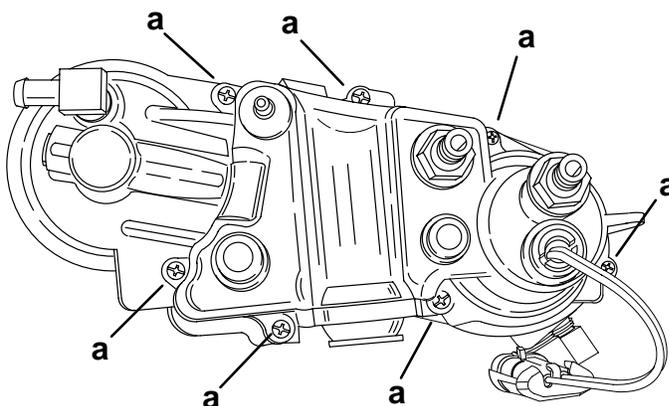
- a - Bolts
- b - Throttle Plate Assembly

Throttle Plate Assembly Installation

Secure throttle plate assembly to air plenum with 4 bolts. Torque bolts to 100 lb. in. (11.3 N·m).

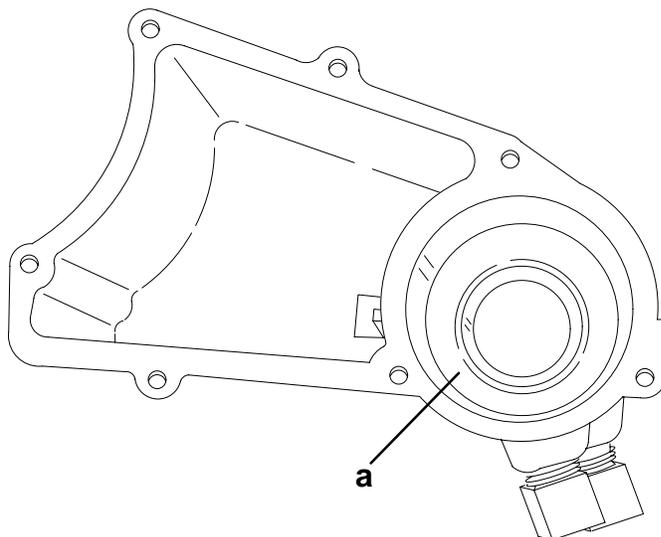
Vapor Separator Disassembly

1. Remove 7 screws securing separator cover and remove cover.



56055

- a - Screws (7 each)
2. Inspect seal in fuel pump chamber of separator tank for cuts and abrasions. Replace seal if necessary. If seal is serviceable, apply 2-4-C w/Teflon Marine Lubricant (92-825407A12) to seal lips.



56056

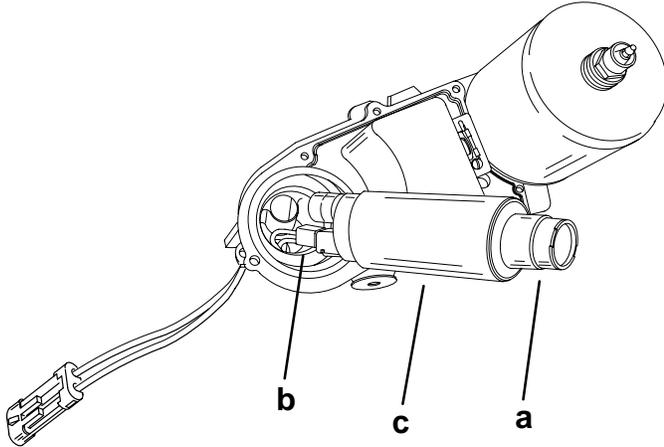
- a - Seal (Seal shoulder faces UP/OUT)



3. Fuel pump may be removed from cover by wiggling slightly while pulling outward.

IMPORTANT: On 1998 Models, DO NOT twist pump during removal as wire harness may be damaged.

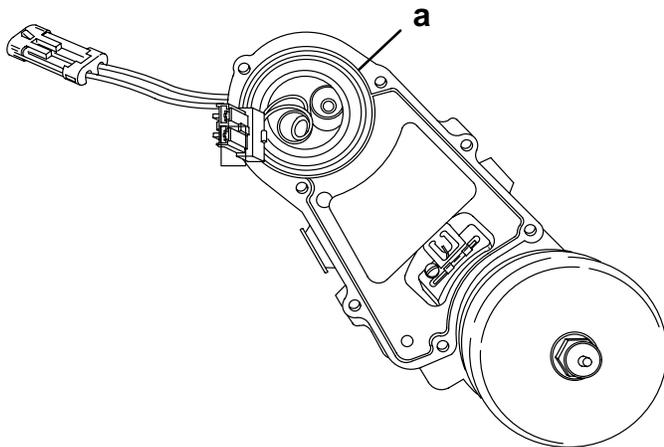
4. Disconnect harness from pump to separate pump from cover. Inspect filter screen for debris. Screen may be pried out of pump and cleaned as required.



56057

- a - Filter Screen
- b - Harness Connector
- c - Pump

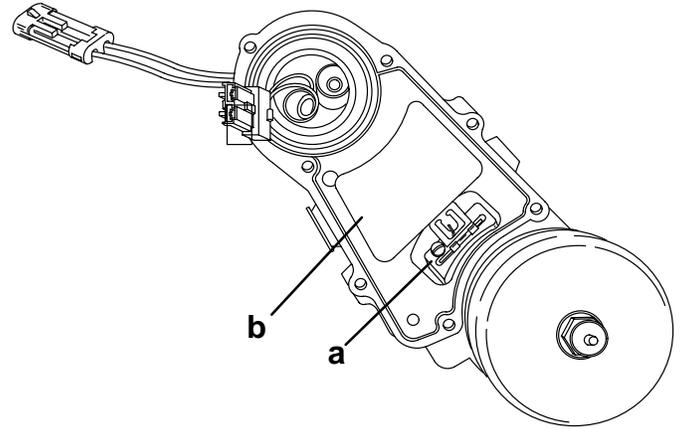
5. Inspect seal above fuel pump for cuts or abrasions. Replace seal if necessary. Apply 2-4-C w/ Teflon to seal lips.



56058

- a - Seal (Seal shoulder faces out)

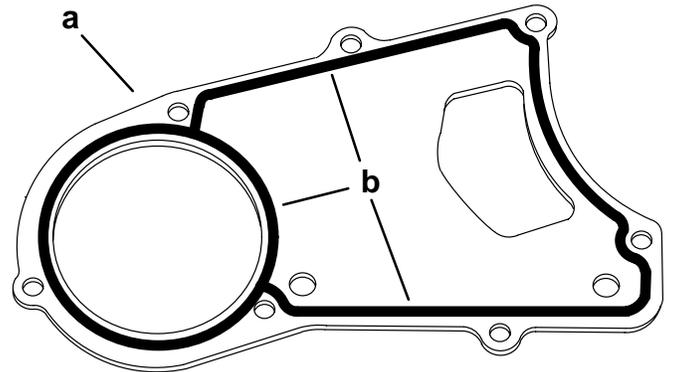
6. Loosen screw securing float assembly and remove float. Inspect float for deterioration or fuel retention. Replace float as required.



56058

- a - Screw
- b - Float

7. Remove phenolic sealing plate and inspect imbedded neoprene seal on both sides of plate for cuts or abrasions. Replace plate/seal assembly as required.



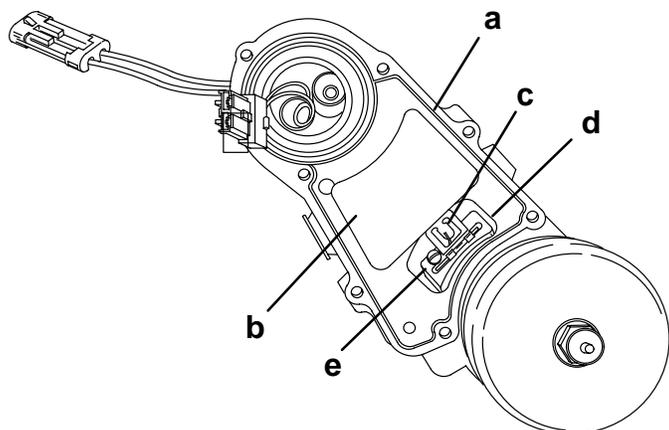
56059

- a - Plate
- b - Seal



Vapor Separator Reassembly

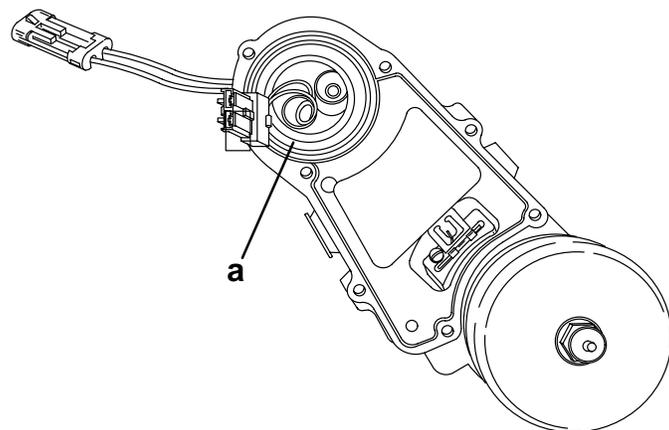
1. Reinstall phenolic sealing plate onto vapor separator cover.
2. Secure float, needle and pivot pin assembly to separator cover with screw. Torque screw to 10 lb. in. (1.1 N·m).



56058

- a - Sealing Plate
- b - Float
- c - Needle
- d - Pivot Pin
- e - Screw [Torque to 10 lb. in. (1.1 N·m)]

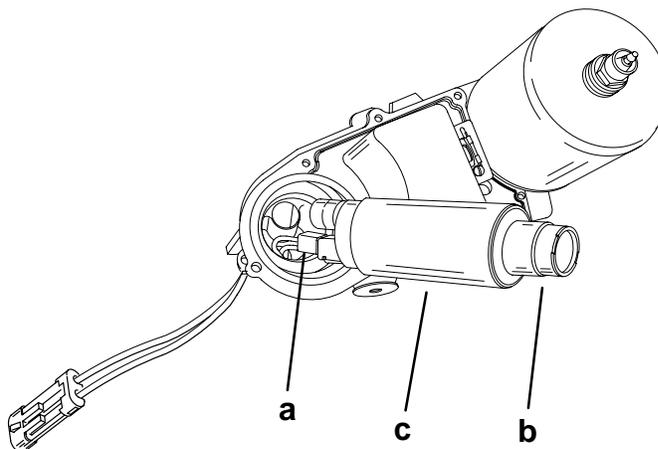
3. Apply 2-4-C w/Teflon to lips of seal in separator cover.



56058

- a - Seal (Seal shoulder faces out)

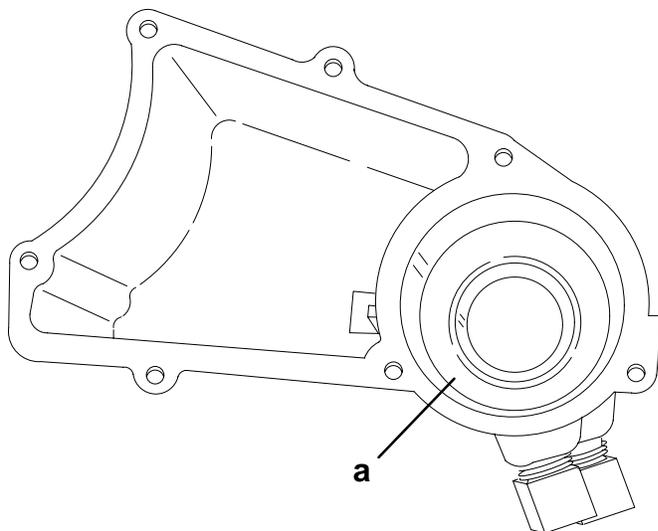
4. Connect electrical harness to fuel pump. Inspect fuel pump filter screen for debris. Remove screen and clean as required.
5. Seat fuel pump and harness into separator cover being careful not to pinch harness.



56057

- a - Harness
- b - Filter
- c - Fuel Pump

6. Apply 2-4-C w/Teflon to lips of seal in separator tank.

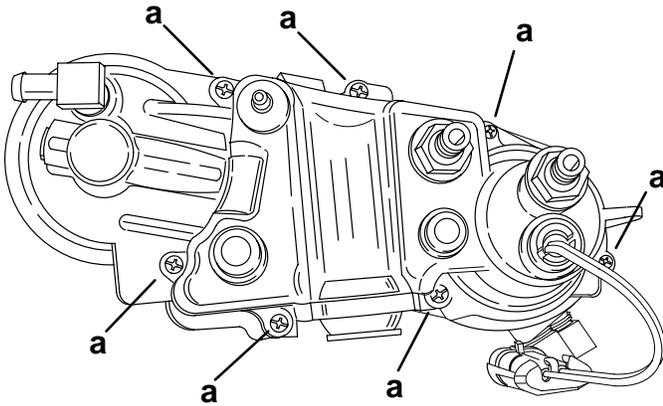


56056

- a - Seal (Seal shoulder faces up/out)



7. Install separator cover with pump onto separator tank.
8. Secure cover to tank with 7 screws. Torque screws to 30 lb. in. (3.4 N·m).

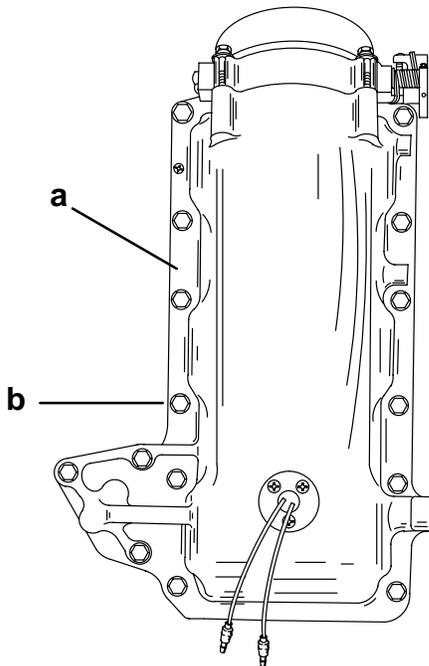


56055

a - Screws [Torque to 30 lb. in. (3.4 N·m)]

Air Plenum Installation

Secure plenum to crankcase with 12 bolts. Torque bolts to 100 lb. in. (11.3 N·m).

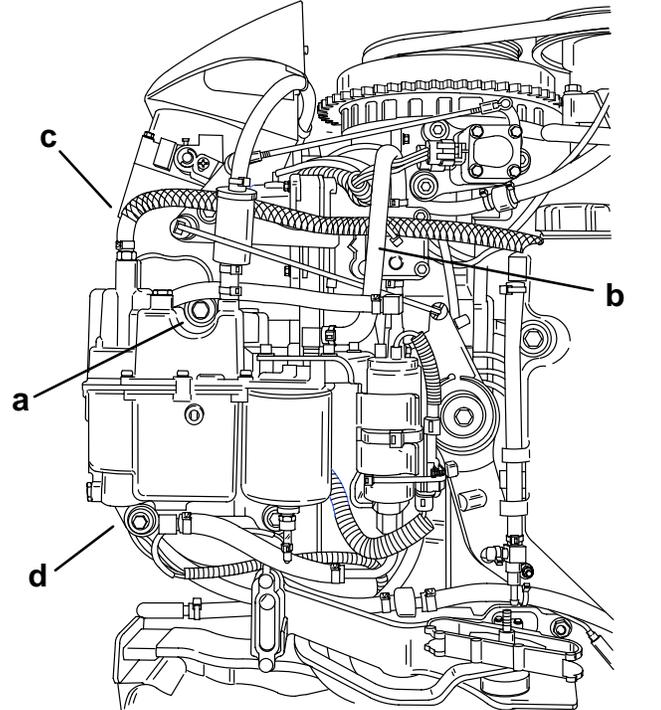


55971

a - Air Plenum
b - Bolts [Torque to 100 lb. in. (11.3 N·m)]

Vapor Separator Installation

1. Secure vapor separator to air plenum with 3 bolts. Torque bolts to 45 lb. in. (5.1 N·m).
2. Connect fuel inlet hose from pulse pump.
3. Connect fuel outlet hose and fuel return hose to vapor separator.

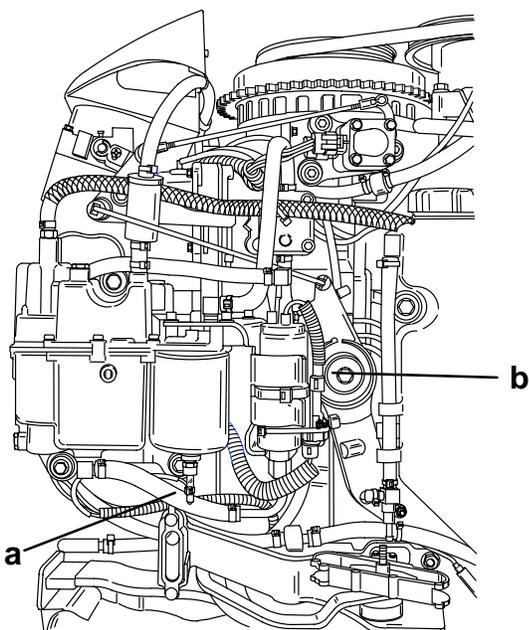


55937

a - Mounting Bolts (3) – Torque to 45 lb. in. (5.1 N·m)
b - Fuel Inlet Hose
c - Fuel Outlet Hose
d - Fuel Return Hose



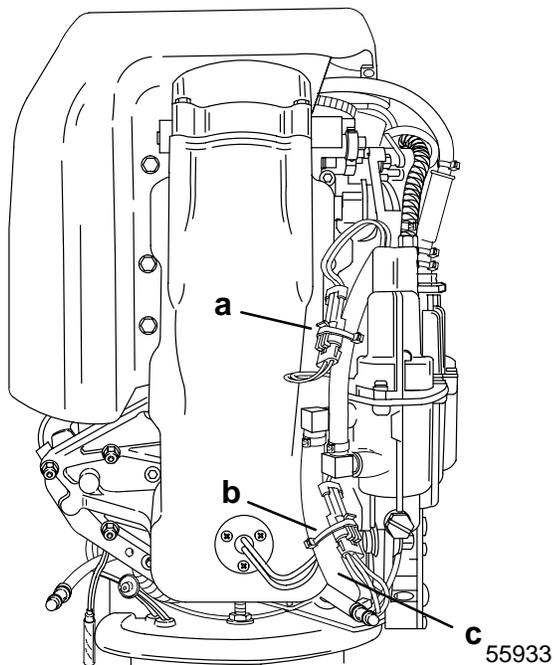
4. Connect water separator sensor lead to water separator.
5. Connect external electric fuel pump harness.



55937

- a - Sensor Lead
- b - Harness Connector

6. Connect internal electric fuel pump harness.
7. Secure air temperature sensor leads to fuel hose with sta-strap.



55933

- a - Electric Fuel Pump Harness Connector
- b - Sta-Strap
- c - Fuel Return Hose

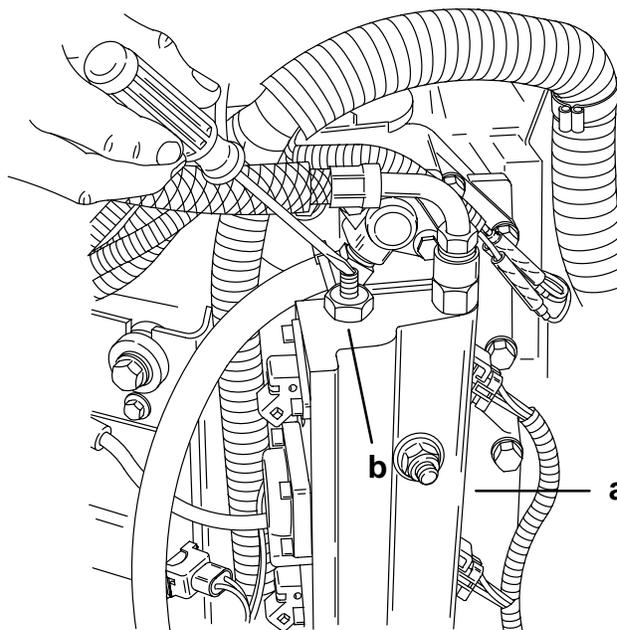
Fuel Rail Removal

⚠ CAUTION

Fuel system must be bled off prior to removal of fuel system components.

1. De-pressurize fuel system by wrapping a clean cloth around fuel pressure port valve (STARBOARD fuel rail) and depressing valve core.

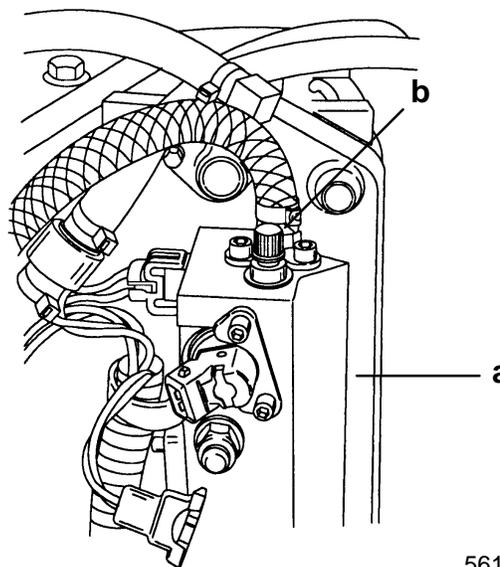
1997 Model



55923

- a - Starboard Fuel Rail
- b - Fuel Pressure Port

1998 Model

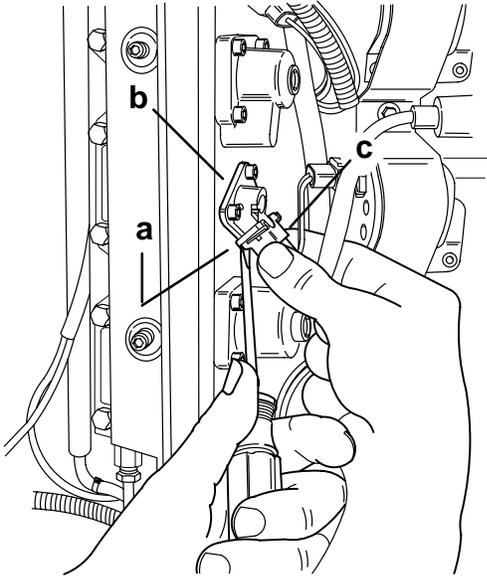


56119

- a - Starboard Fuel Rail
- b - Fuel Pressure Port



- Remove fuel injector harness from each injector by compressing spring clip with flat tip screwdriver while pulling on connector.

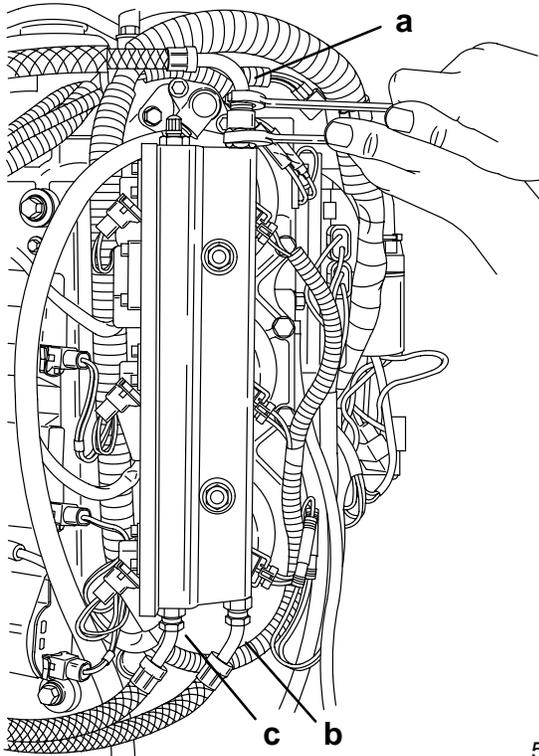


55922

- a - Spring Clip
- b - Fuel Injector
- c - Harness Connector

- Remove fuel inlet hose, fuel outlet hose and air hose from fuel rail.

1997 Model

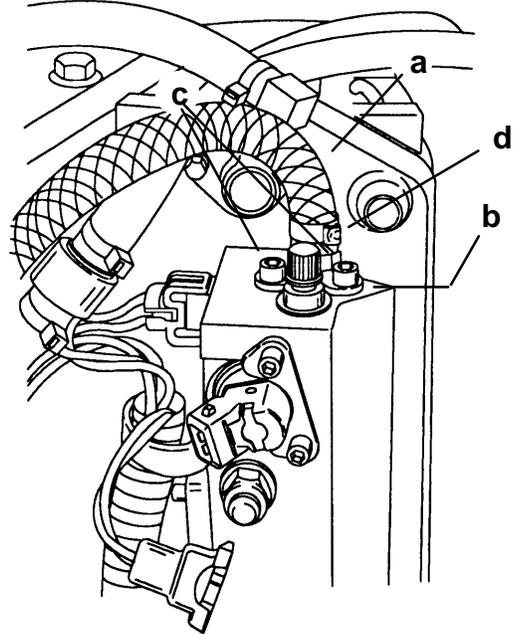


55931

- a - Air Hose
- b - Air Outlet Hose
- c - Fuel Hose

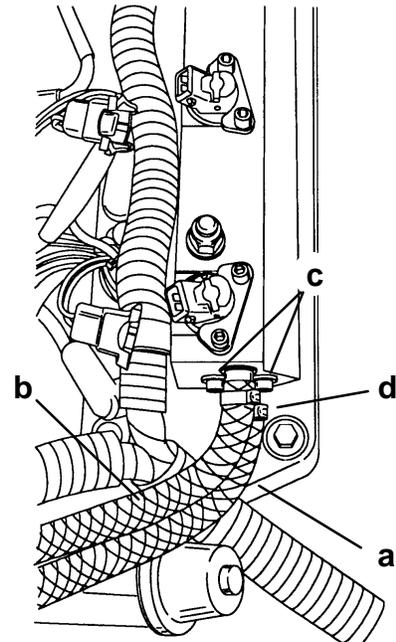
1998 Model

IMPORTANT: On 1998 Models, if air inlet or outlet hose clamps are removed, it is recommended that the respective air inlet and outlet hose be replaced to avoid the possibility of future air leaks.



- a - Air Hose
- b - Retainer
- c - Allen Screws (remove)
- d - Air Hose Clamp

1998 Model

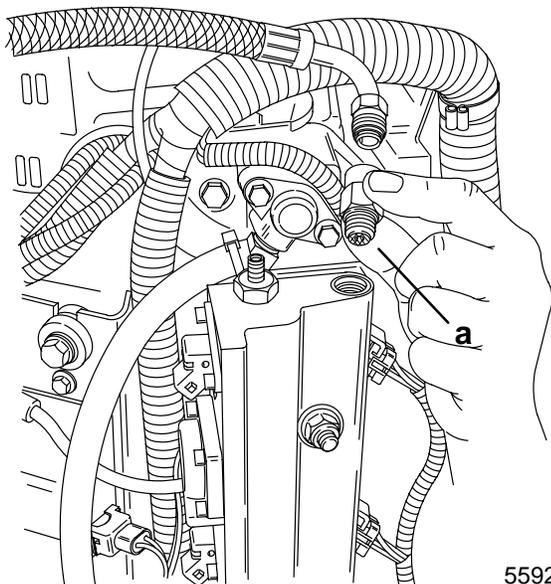


56140

- a - Air Hose
- b - Fuel Hose
- c - Allen Screws
- d - Air Hose Clamp



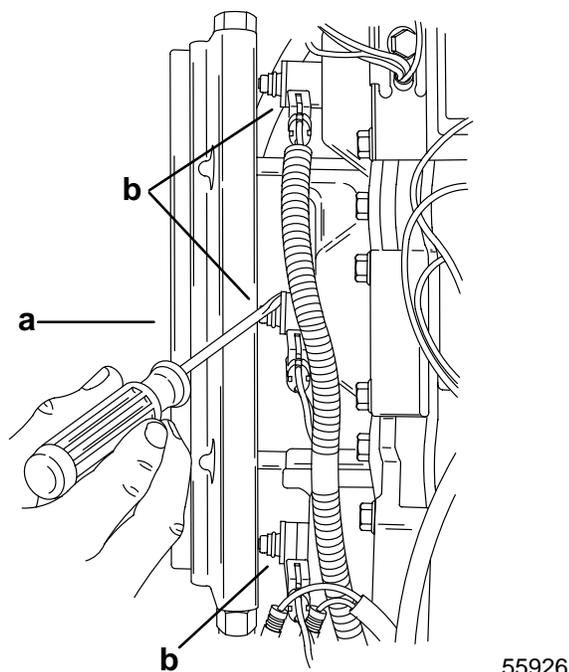
NOTE: On 1997 Models only, there is a filter in the air line adaptor on the starboard fuel rail. Inspect filter for debris and clean as required.



a - Filter

NOTE: It is recommended that direct injectors remain in the cylinder head (if they are not to be replaced) while removing the fuel rail. The direct injectors have a teflon seal which may expand if the injector is removed from the head. This expansion may cause reinstallation difficulty or require the replacement of the seal.

4. Remove 2 nuts securing fuel rail.
5. As fuel rail is removed, use a flat tip screwdriver to hold direct injectors in cylinder head.



a - Fuel Rail
b - Direct Injectors

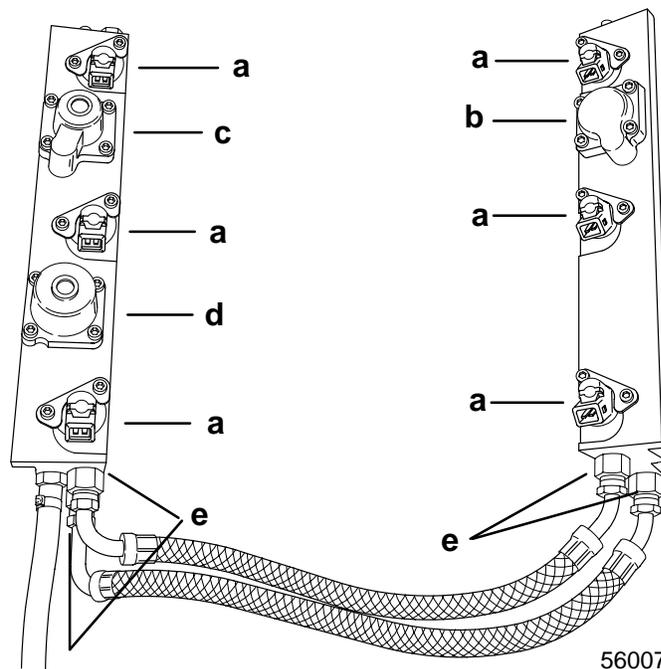
Fuel Rail Disassembly

The starboard fuel rail contains 3 fuel injectors and a tracker valve.

The port fuel rail contains 3 fuel injectors, 1 fuel fuel regulator and 1 air regulator.

NOTE: Each fuel/air inlet or outlet hose adaptor has an o-ring seal. This o-ring should be inspected for cuts or abrasions and replaced as required when fuel rail is disassembled for cleaning.

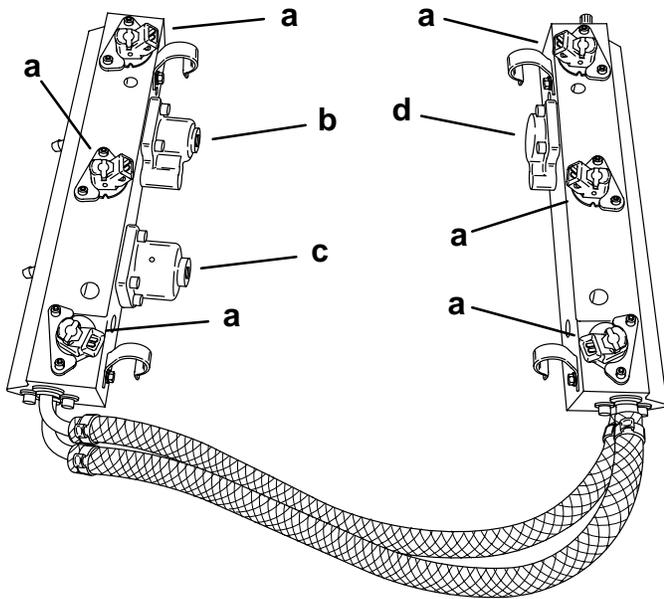
1997 Model



a - Fuel Injector
b - Tracker Valve
c - Fuel Regulator
d - Air Regulator
e - Hose Adaptor (contains o-ring seal)



1998 Model



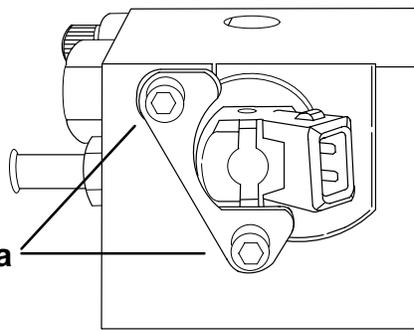
56122

- a - Fuel Injector
- b - Fuel Regulator
- c - Air Regulator
- d - Tracker Valve

FUEL INJECTOR REMOVAL

1. Remove 2 screws securing injector.

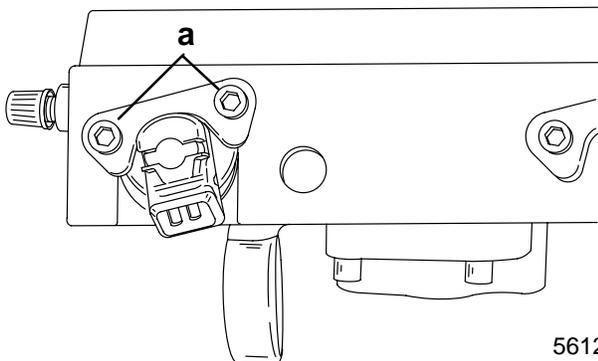
1997 Model



56006

- a - Screws

1998 Model

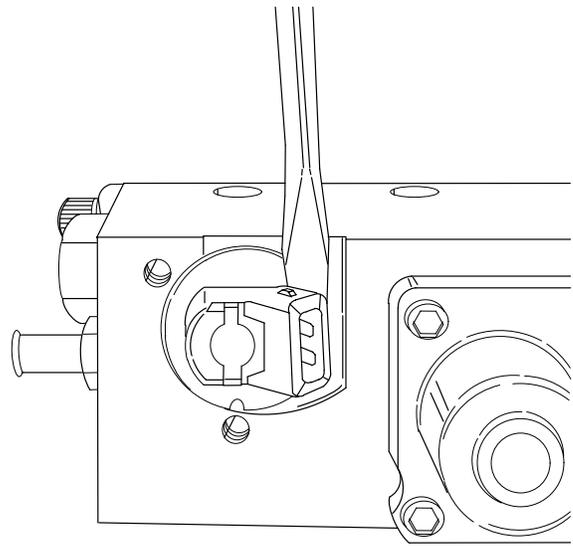


56125

- a - Screws

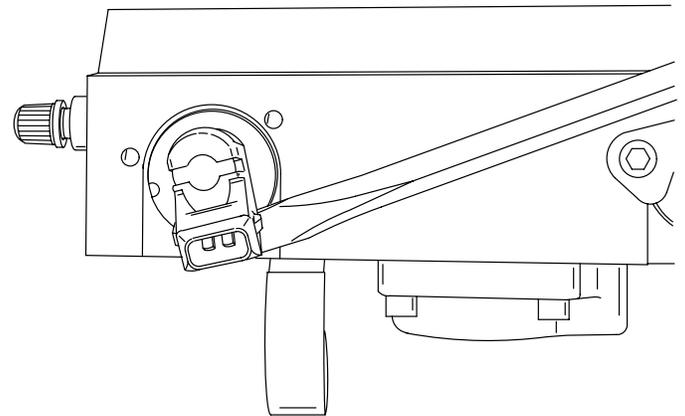
2. Gently pry up on injector to loosen o-ring adhesion and remove injector.

1997 Model



56005

1998 Model

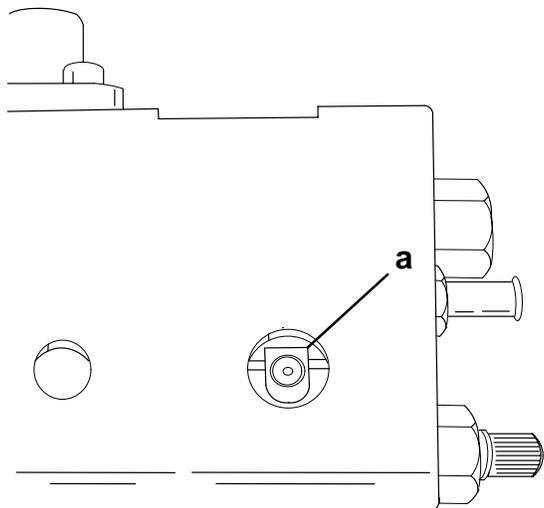


56125



3. **1997 Models Only** – Remove fuel nozzle from fuel rail.

NOTE: Move nozzle with small tip screwdriver, then tap fuel rail on hard surface to dislodge nozzle. On 1998 models, the fuel injector is positioned differently on the fuel rail and separate fuel nozzles are not required.

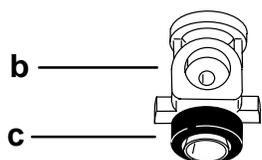
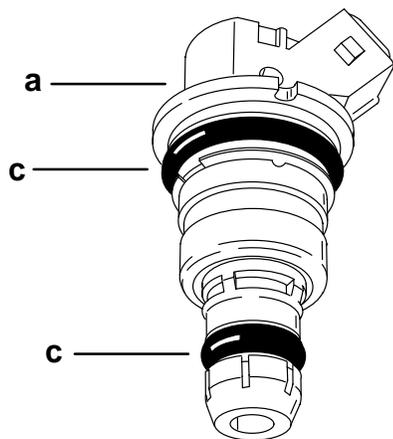


56004

a - Nozzle

4. Inspect fuel injector and fuel nozzle orifices for foreign debris; o-rings for cuts or abrasions and plastic components for heat damage. Replace components as required.

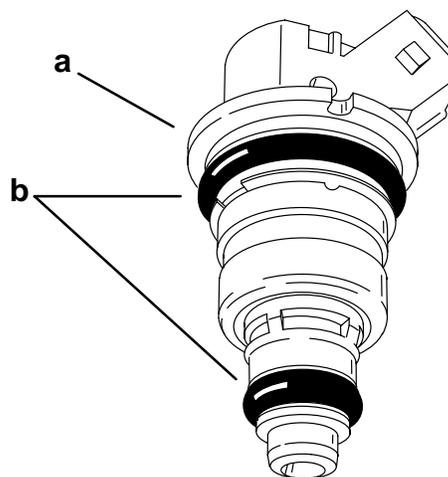
1997 Model



56016

a - Fuel Injector
b - Fuel Nozzle (1997 Model Only)
c - O-Rings

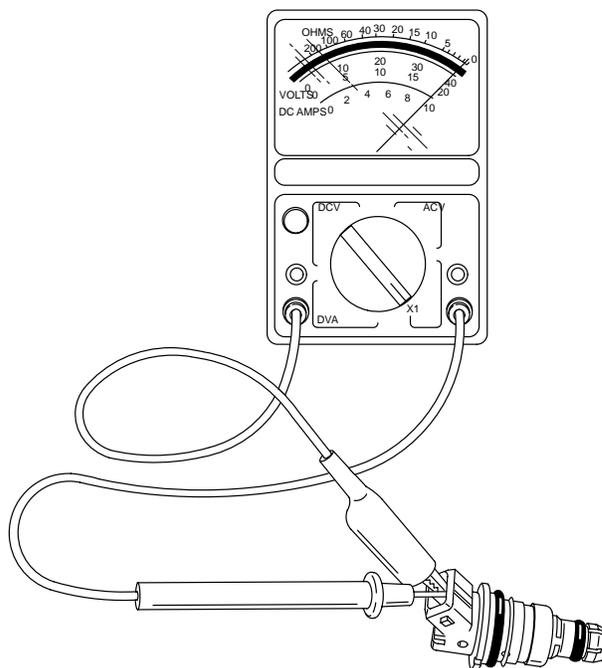
1998 Model



56124

a - Fuel Injector
b - O-Rings

5. An ohm test of the fuel injector may be made by connecting test leads to injector terminals. Ohm reading should be 1.8 ± 0.1 ohm.



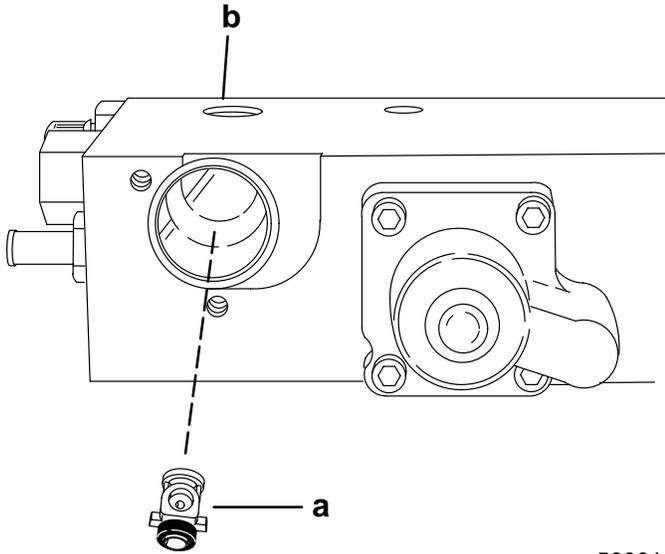
56002



FUEL INJECTOR INSTALLATION

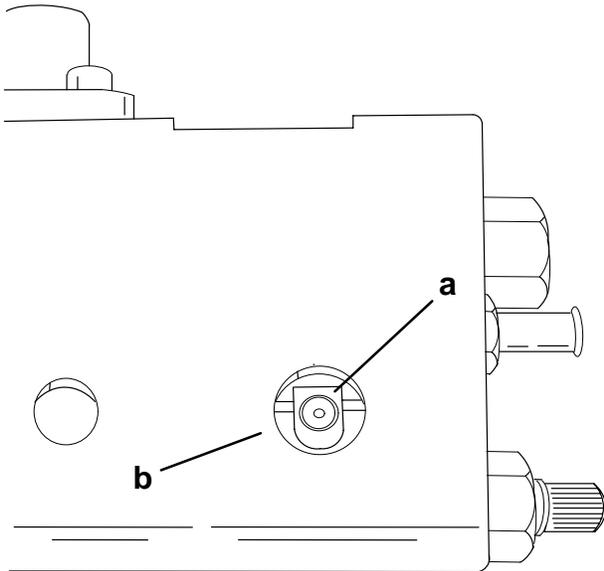
1. Insert fuel nozzle with orifice facing direct injector opening.

1997 Model



56001

- a - Fuel Nozzle (1997 Model Only)
- b - Direct Injector Opening



56004

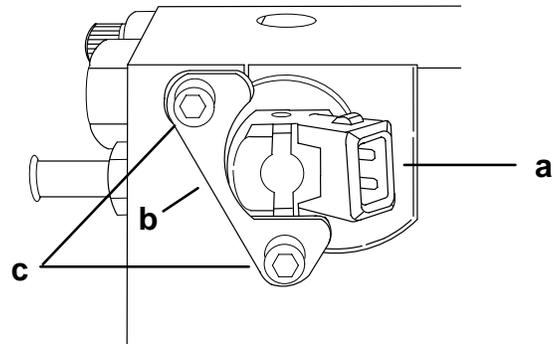
- a - Nozzle Installed (1997 Model Only)
- b - Direct Injector Opening

NOTE: Apply anti-seize grease (obtain locally) or 2-4-C w/Teflon to fuel injector attaching screw threads.

2. Insert fuel injector into fuel rail with connector pins facing towards bottom of fuel rail.

NOTE: Turn injector back-and-forth slightly to seat injector o-rings in fuel rail while securing injector with retainer and 2 screws. Torque screws to 70 lb. in. (7.9 N·m).

1997 Model

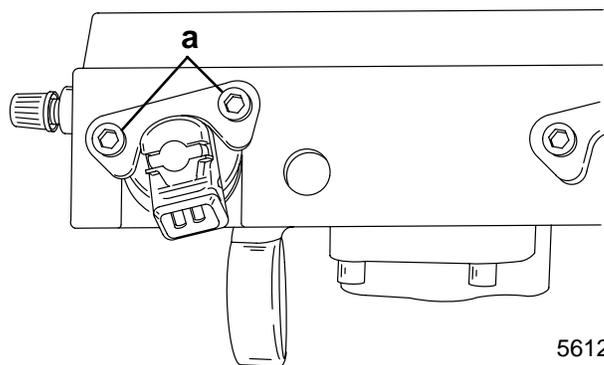


56006

- a - Injector
- b - Retainer
- c - Screws [Torque to 70 lb. in. (7.9 N·m)]



1998 Model



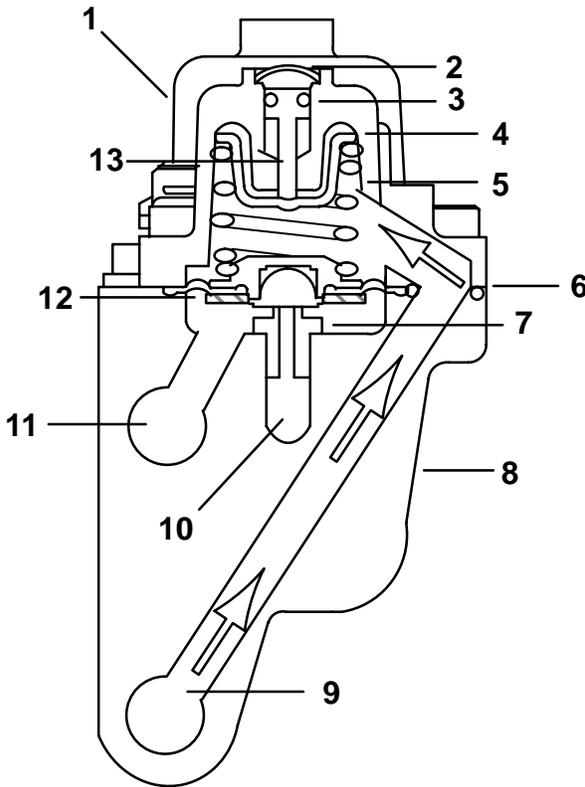
56125

a - Screws [Torque to 70 lb. in. (7.9 N·m)]

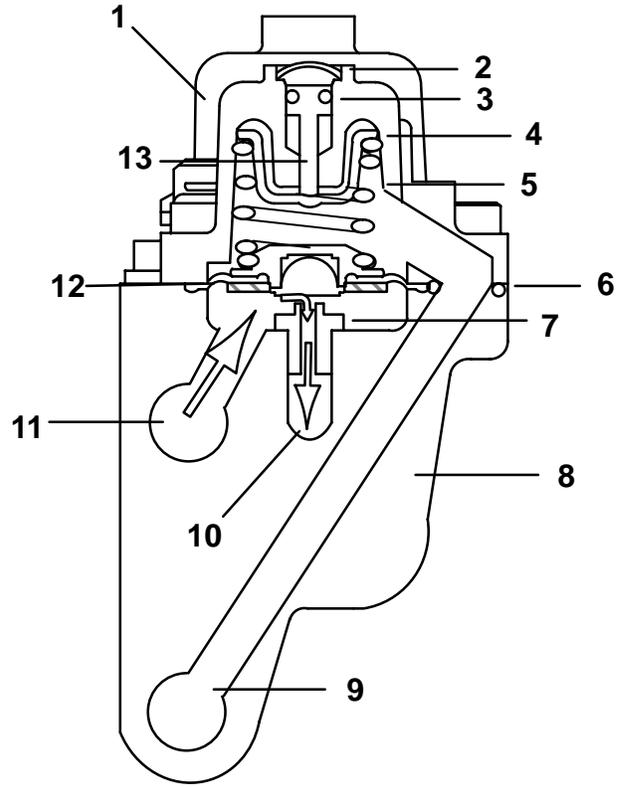


Fuel Pressure Regulator

Regulator Closed



Regulator Open



- 1 - Top Cover
- 2 - Expansion Plug
- 3 - O-ring
- 4 - Spring Retainer
- 5 - Spring
- 6 - O-ring
- 7 - Diaphragm Seat
- 8 - Air Rail
- 9 - Air Passage (from Air Compressor)
- 10- Fuel Return Passage (to Vapor Separator)
- 11- Fuel Inlet Passage (from Electric Fuel Pump)
- 12- Diaphragm Assembly
- 13- Calibration Screw (Do Not Turn)

The fuel pump is capable of delivering more fuel than the engine can consume. Excess fuel flows through the fuel pressure regulator, interconnecting passages/hoses, fuel cooler, and back to the vapor separator tank. This constant flow of fuel means that the fuel system is always supplied with cool fuel, thereby preventing the formation of fuel vapor bubbles and minimizing the chances of vapor lock.

The fuel pressure regulator is calibrated to raise the fuel pressure to 10 psi above the air pressure.

The fuel regulator is mounted on the port fuel rail, near the top. This regulator relies on both air and spring pressure to control the fuel pressure. Inside the regulator assembly is a 10 lb. spring, this spring holds the diaphragm against the diaphragm seat. The contact between the diaphragm and diaphragm seat closes the passage between the incoming fuel (from the electric fuel pump) and the fuel return passage.

When the engine is not running (no air pressure on the spring side of the diaphragm) the fuel pressure required to move the diaphragm is 10 psi.

When the engine is running, air pressure from the air compressor (80 psi) is routed through the air passages, to the spring side of the fuel pressure regulator diaphragm.

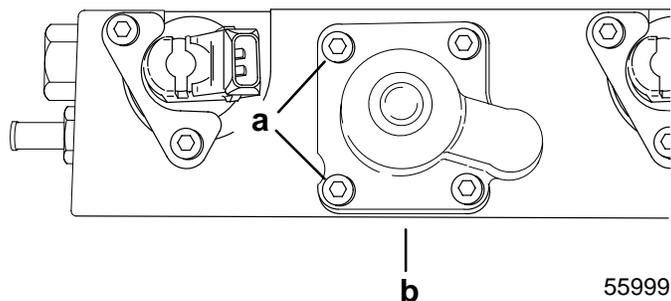
The air pressure (80 psi) and spring pressure (10 psi) combine to regulate system fuel pressure to 90 psi - or 10 psi higher than the air pressure in the DFI system fuel/air rails.



FUEL REGULATOR REMOVAL

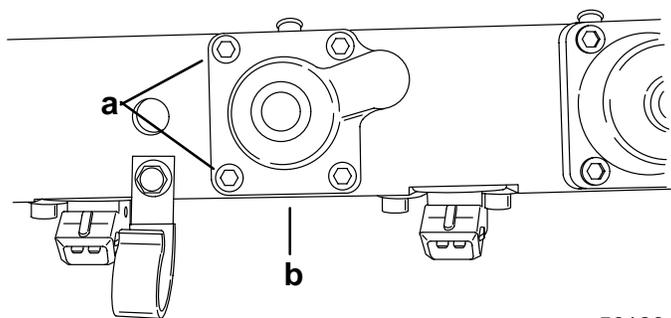
1. Remove 4 screws securing regulator and remove regulator.

1997 Model



- a - Screws
- b - Fuel Regulator

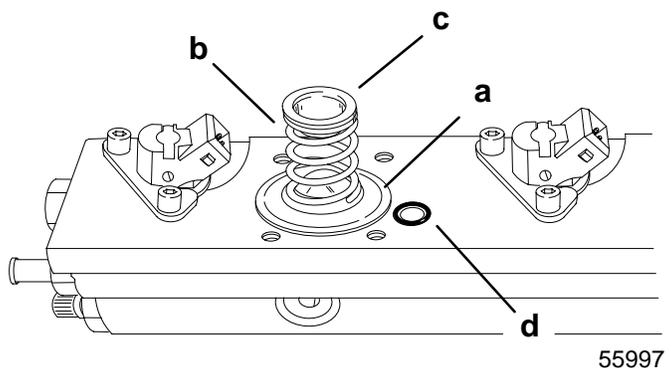
1998 Model



- a - Screws
- b - Fuel Regulator

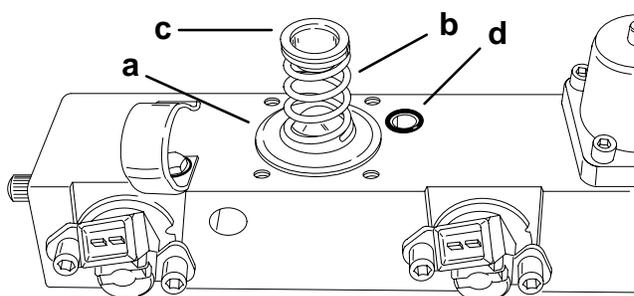
2. Inspect regulator diaphragm for cuts or tears.
3. Inspect regulator housing o-ring for cuts and abrasions. Replace components as required.

1997 Model



- a - Diaphragm
- b - Spring
- c - Cup
- d - O-Ring

1998 Model



56127

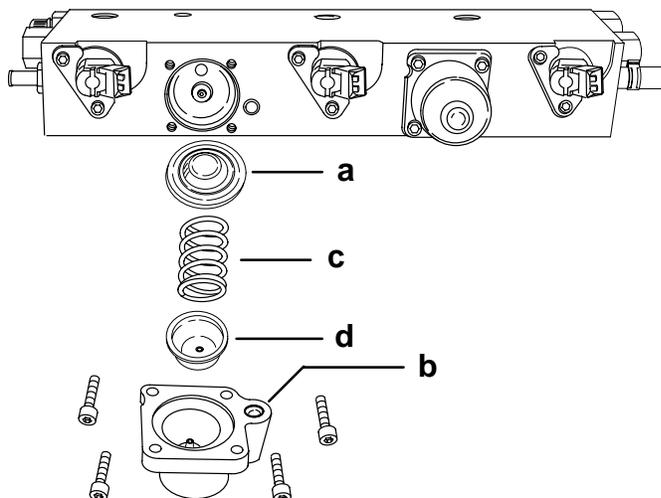
- a - Diaphragm
- b - Spring
- c - Cup
- d - O-Ring

FUEL REGULATOR INSTALLATION

NOTE: Apply a light coat of 2-4-C w/Teflon to diaphragm surface and o-ring to aid in the retention of diaphragm and o-ring on fuel rail during reassembly.

1. Position diaphragm on fuel rail.
2. Position o-ring on fuel rail.
3. Position spring and cup onto diaphragm.

1997 Model

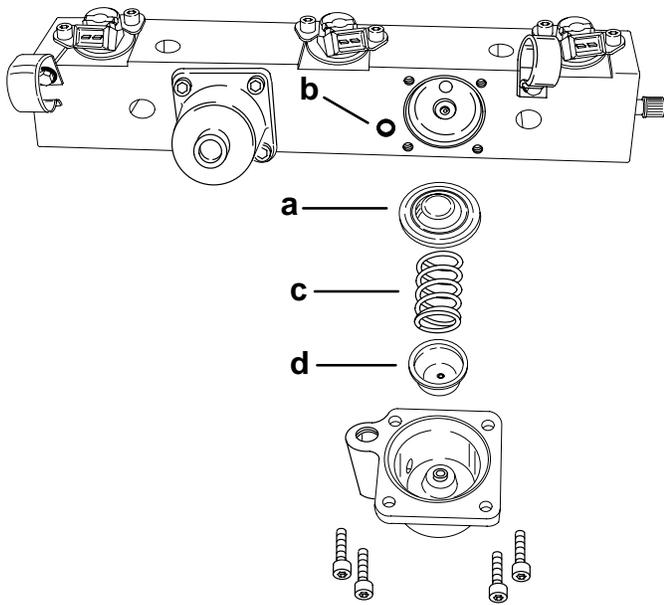


56008

- a - Diaphragm
- b - O-Ring
- c - Spring
- d - Cup



1998 Model



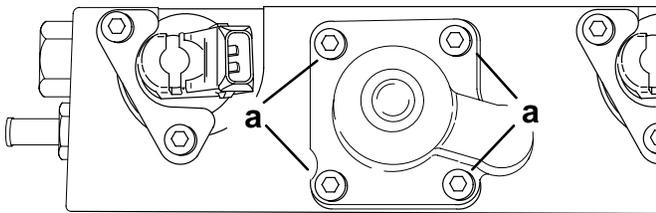
56128

- a - Diaphragm
- b - O-Ring
- c - Spring
- d - Cup

NOTE: Apply anti-seize grease (obtain locally) or 2-4-C w/Teflon to regulator attaching screw threads.

4. Place cover over spring/cup/diaphragm assembly and secure with 4 screws. Torque screws to 70 lb. in. (7.9 N·m).

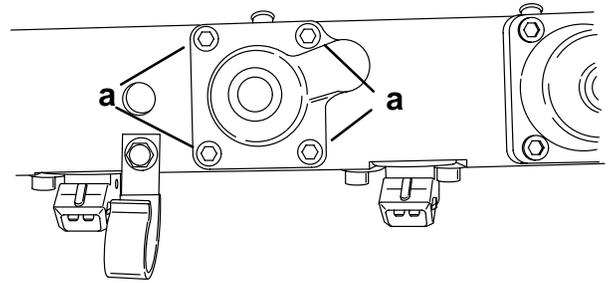
1997 Model



55999

- a - Screws [Torque to 70 lb. in. (7.9 N·m)]

1998 Model



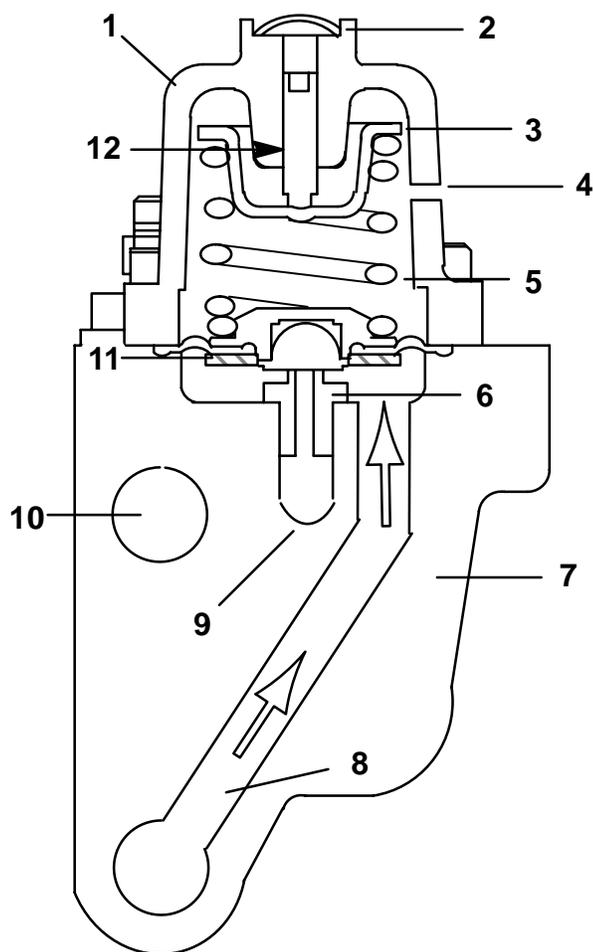
56126

- a - Screws [Torque to 70 lb. in. (7.9 N·m)]

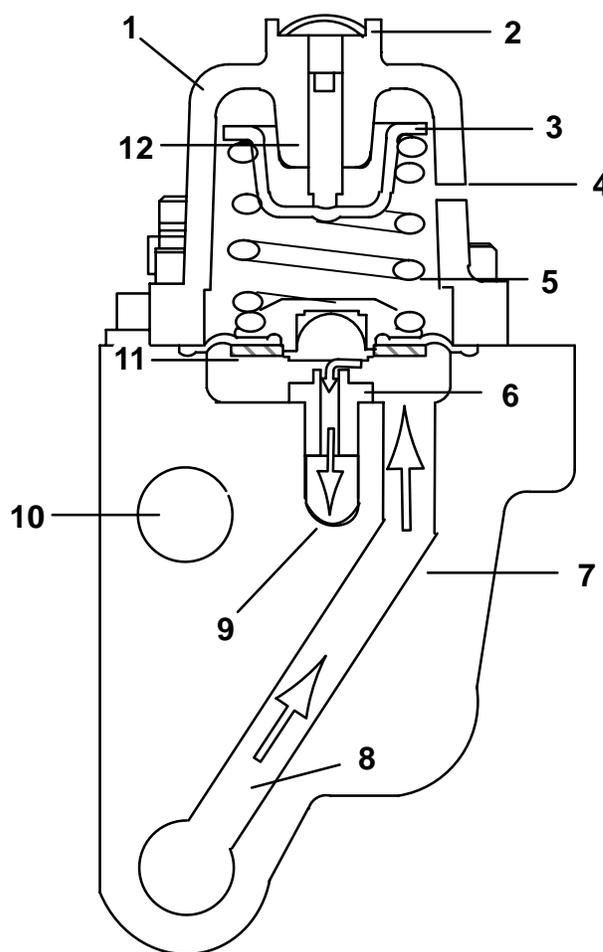


Air Pressure Regulator

Regulator Closed



Regulator Open



- 1 - Top Cover
- 2 - Expansion Plug
- 3 - Spring Retainer
- 4 - Vent
- 5 - Spring
- 6 - Diaphragm Seat
- 7 - Air Rail
- 8 - Air Passage (from Air Compressor)
- 9 - Excess Air Passage (to Exhaust Adaptor)
- 10- Fuel Inlet Passage (from Electric Fuel Pump)
- 11- Diagram Assembly
- 12- Calibration Screw (Do Not Turn)

The air pressure regulator is designed to limit the air pressure inside the rails to approximately 80 psi.

The air regulator uses a spring (pressure) to control the air pressure. This spring (80 psi) holds the diaphragm against the diaphragm seat. The contact area blocks (closes) the air inlet passage from the excess air, return passage. As the air pressure rises (below the diaphragm), it must reach a pressure equal to or greater than the spring pressure holding the diaphragm closed. Once this pressure is

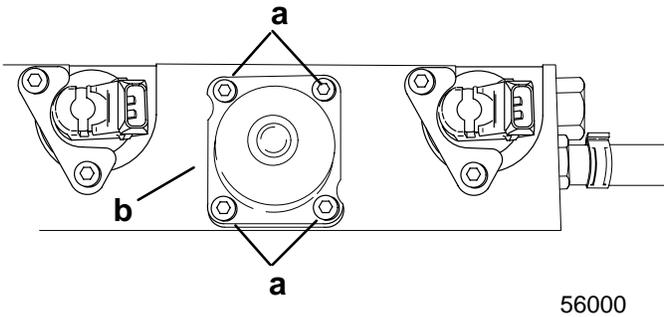
achieved, the spring compresses, allowing the diaphragm to move. The diaphragm moves away from the diaphragm seat, allowing air to exit through the diaphragm seat, into the excess air passage leading to the exhaust adaptor plate.



AIR REGULATOR REMOVAL

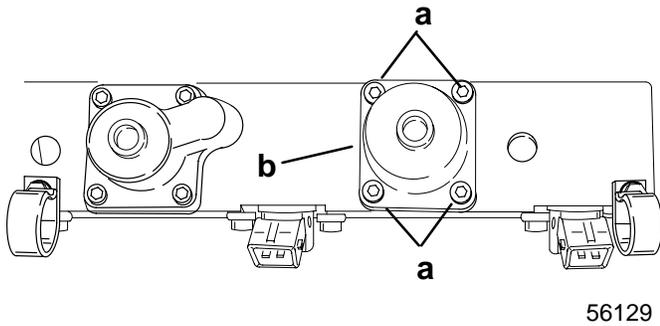
1. Remove 4 screws securing regulator and remove regulator.

1997 Model



- a - Screws
- b - Air Regulator

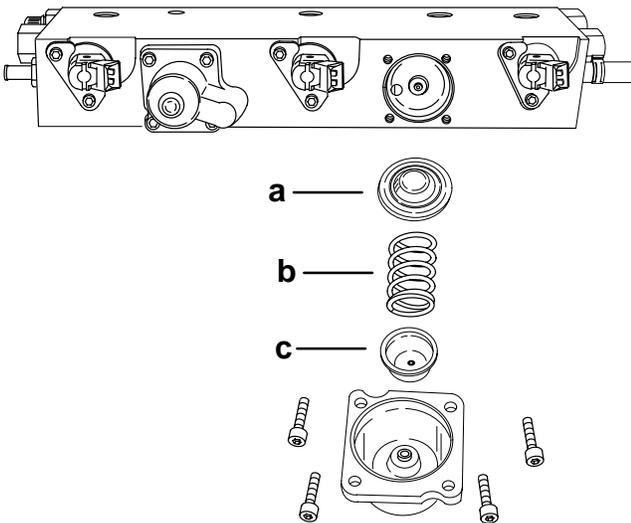
1998 Model



- a - Screws
- b - Air Regulator

2. Inspect regulator diaphragm for cuts or tears. Replace as required.

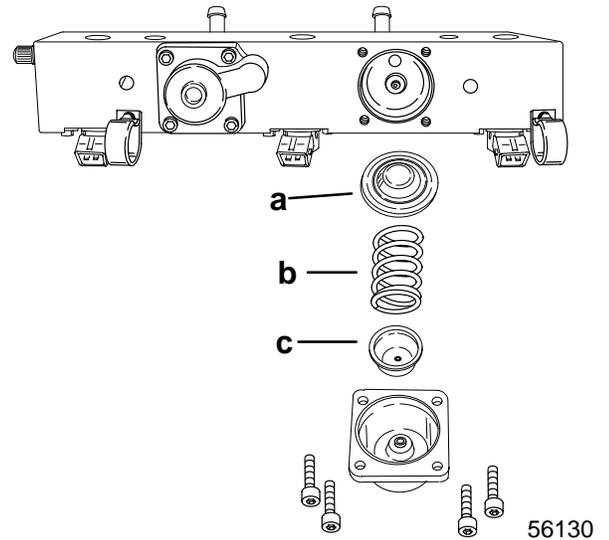
1997 Model



- a - Diaphragm
- b - Spring
- c - Cup

56009

1998 Model



- a - Diaphragm
- b - Spring
- c - Cup

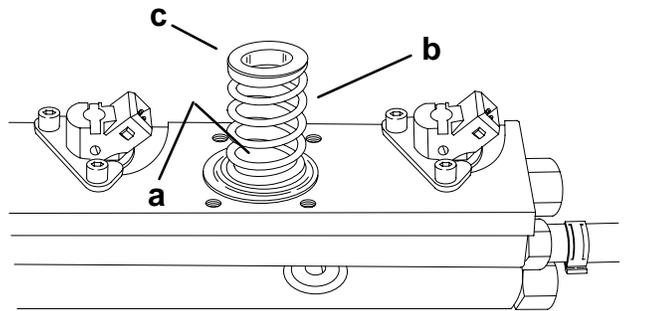
56130

AIR REGULATOR INSTALLATION

NOTE: Apply a light coat of 2-4-C w/Teflon to diaphragm surface to aid in the retention of diaphragm on fuel rail during reassembly.

1. Position diaphragm, spring and cup onto fuel rail.

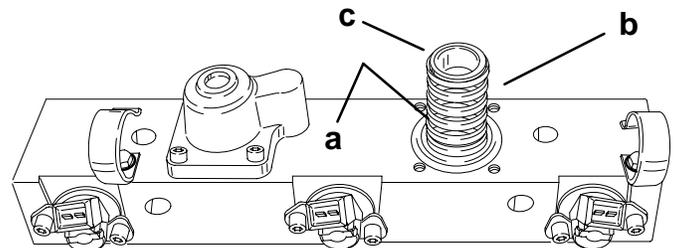
1997 Model



55998

- a - Diaphragm
- b - Spring
- c - Cup

1998 Model



56131

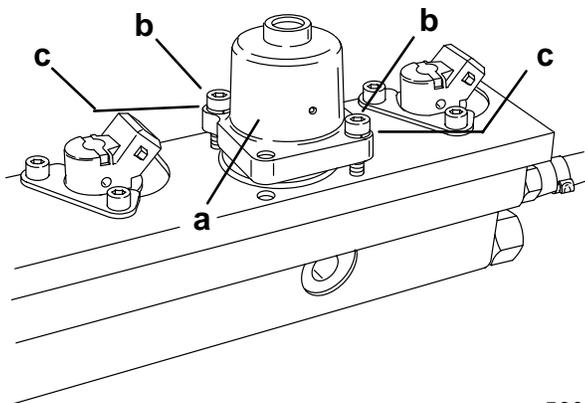
- a - Diaphragm
- b - Spring
- c - Cup



NOTE: Apply anti-seize grease (obtain locally) or 2-4-C w/Teflon to regulator attaching screw threads.

NOTE: Due to the stiffness of the regulator spring, it is recommended that 2 longer screws (5mm x 25mm long) (10-40073 25) and 2 flat washers (12-30164) be installed through cover first to begin compression. This will allow 2 shorter screws (5mm x 15mm long) to be installed. Remove 2 long screws w/flat washers and install remaining 2 short screws (5mm x 15mm). Torque screws to 70 lb. in. (7.9 N·m).

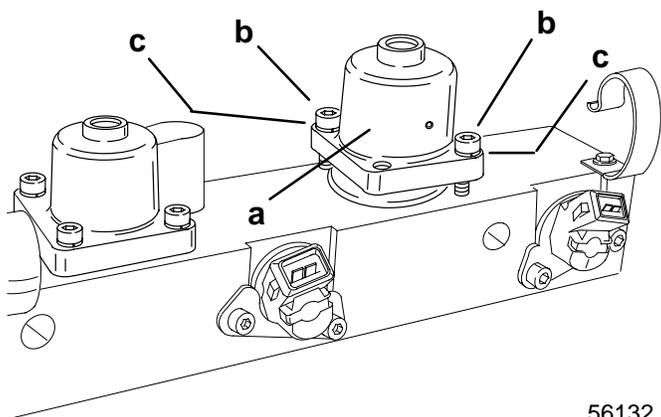
1997 Model



56010

- a - Cover
- b - Screws (5mm x 25mm) (10-40073 25)
- c - Flat Washers (12-30164)

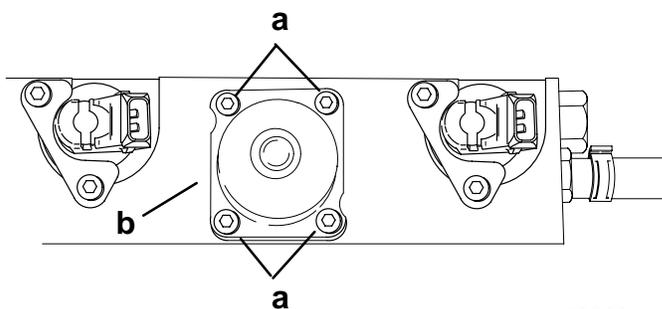
1998 Model



56132

- a - Cover
- b - Screws (5mm x 25mm) (10-40073 25)
- c - Flat Washers (12-30164)

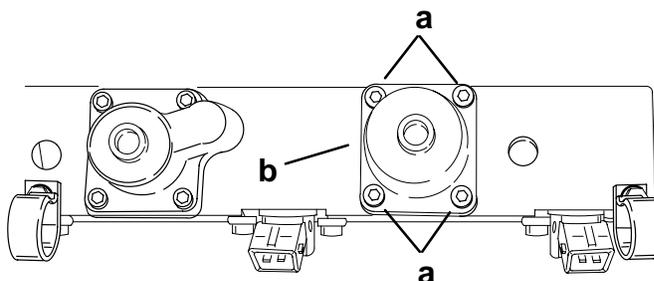
1997 Model



56000

- a - Screws
- b - Air Regulator

1998 Model



56129

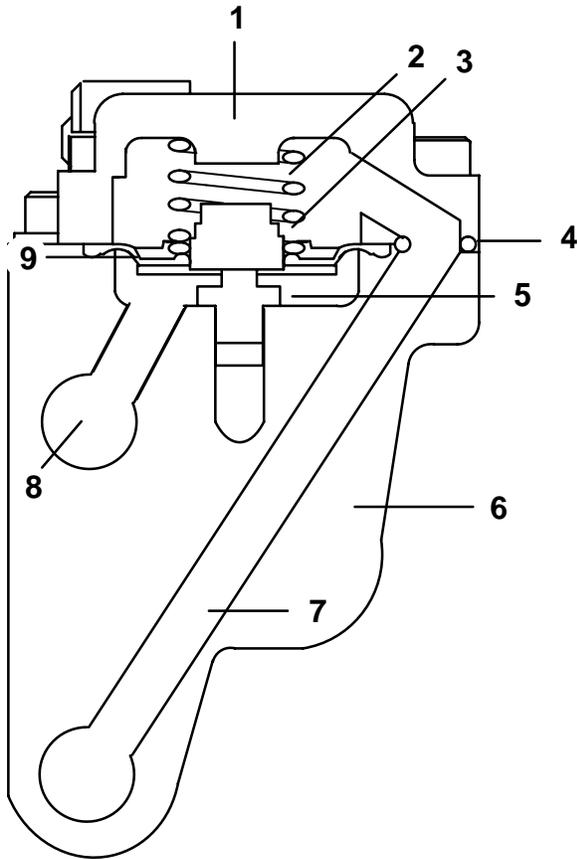
- a - Screws
- b - Air Regulator

2. Inspect regulator diaphragm for cuts or tears. Replace as required.

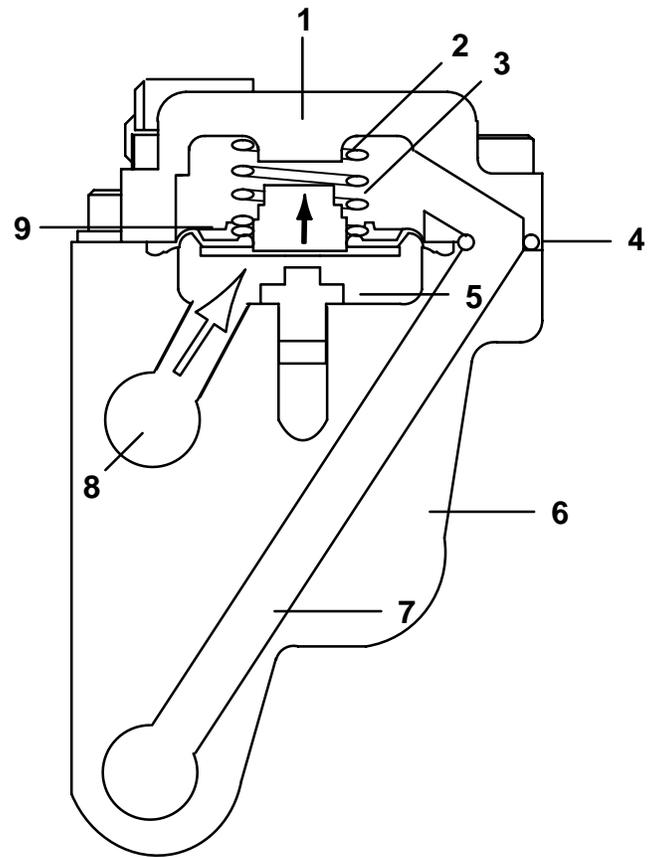


Tracker Valve

Engine Off (No Pressure)



Engine at Operating Pressures



- 1 - Top Cover
- 2 - Spring Retainer (not shown)
- 3 - Spring
- 4 - O-ring
- 5 - Diaphragm (at rest) Seat
- 6 - Air Rail
- 7 - Air Passage (from Air Compressor)
- 8 - Fuel Inlet Passage (from Electric Fuel Pump)
- 9 - Diagram Assembly

The tracker is located on the starboard fuel/air rail assembly. The DFI system must maintain a constant 10 psi pressure difference between the fuel pressure and air pressure in the rails, at all times. The tracker is designed to maintain the 10 psi differential when the air or fuel pressure suddenly raises (i.e. pulses generated by the compressor's piston or by the fuel injectors opening and closing). The tracker contains a spring on the air side of the diaphragm. This spring positions the diaphragm against the diaphragm's seat (when the engine is not running).

After the engine starts, and the fuel and air pressure reach normal operating range, the fuel pressure will compress the spring and the diaphragm will move slightly away from the seat (to a neutral position). At this point the pressure on both sides of the tracker diaphragm is equal (10 psi spring pressure + 80 psi air pressure = 90 psi fuel pressure).

Any air or fuel pressure "spikes" on one side of the diaphragm will transfer this pressure rise to the other system (air or fuel) on the other side of the diaphragm. Both systems will have a momentary increase in pressure so that the 10 psi difference between air and fuel system pressures can be maintained.

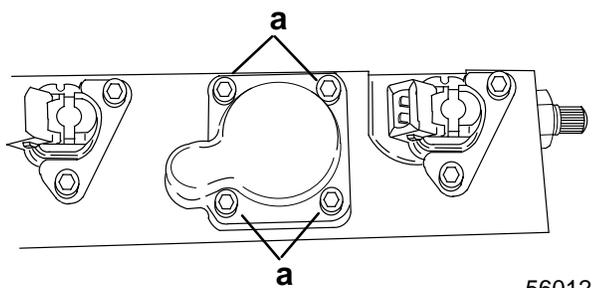
NOTE: To prevent excessive wear in the seat, the tracker is calibrated to allow the diaphragm to be slightly away from the seat during normal operation.



TRACKER VALVE REMOVAL

1. Remove 4 screws securing tracker valve and remove tracker assembly.

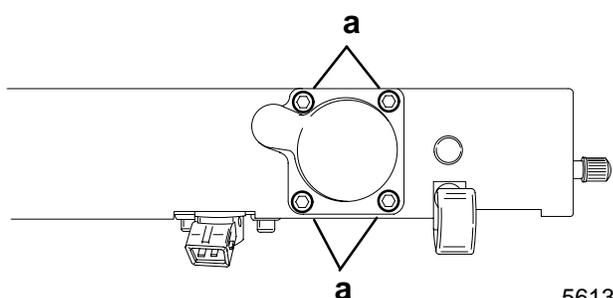
1997 Model



56012

a - Screws

1998 Model

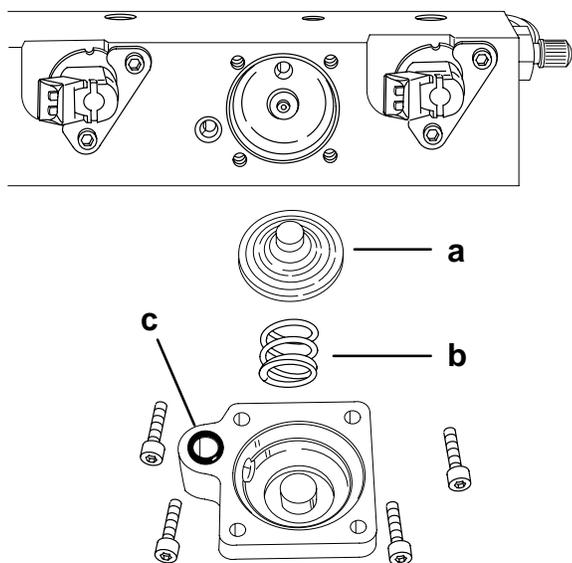


56135

a - Screws

2. Inspect tracker diaphragm for cuts or tear.
3. Inspect tracker cover o-ring for cuts and abrasions. Replace components as required.

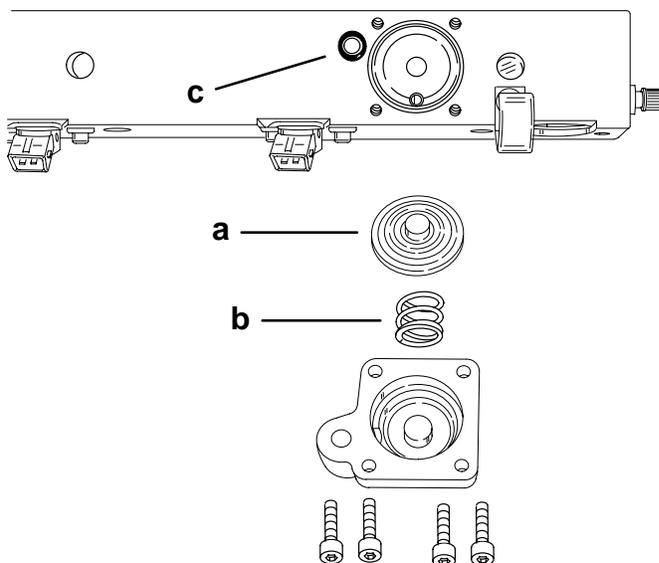
1997 Model



56013

a - Diaphragm
b - Spring
c - O-Ring

1998 Model



56136

a - Diaphragm
b - Spring
c - O-Ring

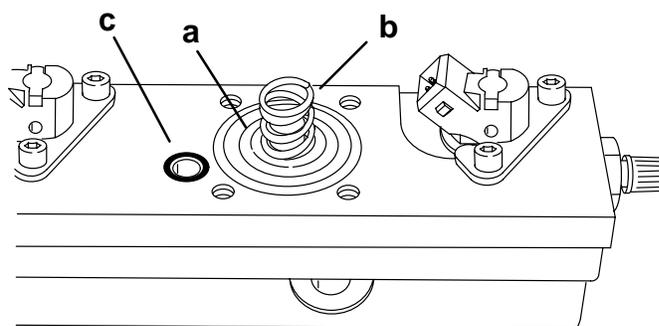
TRACKER VALVE INSTALLATION

NOTE: Apply a light coat of 2-4-C w/Teflon to tracker diaphragm and cover o-ring to aid in their retention on fuel rail while reinstalling tracker valve to fuel rail.

NOTE: Apply anti-seize grease (obtain locally) or 2-4-C w/Teflon to tracker valve attaching screw threads.

1. Position diaphragm, spring and o-ring onto fuel rail.

1997 Model

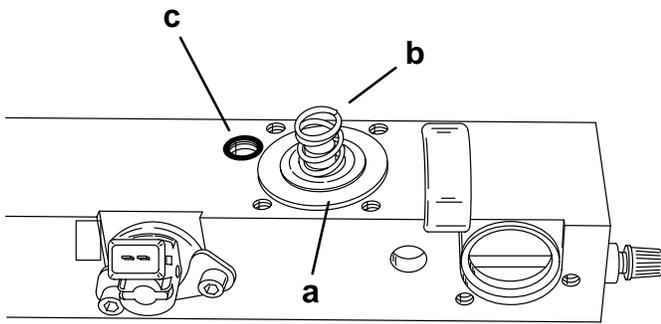


56011

a - Diaphragm
b - Spring
c - O-Ring



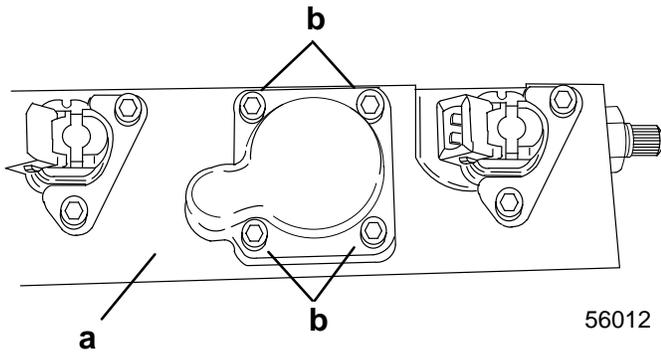
1998 Model



- a - Diaphragm
- b - Spring
- c - O-Ring

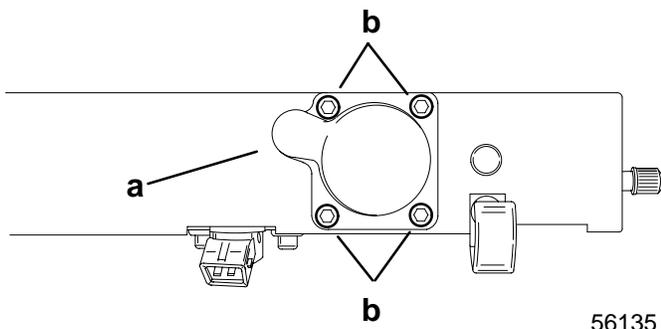
2. Place cover over diaphragm/spring/o-ring assembly and secure with 4 screws. Torque screws to 70 lb. in. (7.9 N·m).

1997 Model



- a - Cover
- b - Screws [Torque to 70 lb. in. (7.9 N·m)]

1998 Model



- a - Cover
- b - Screws [Torque to 70 lb. in. (8.0 N·m)]

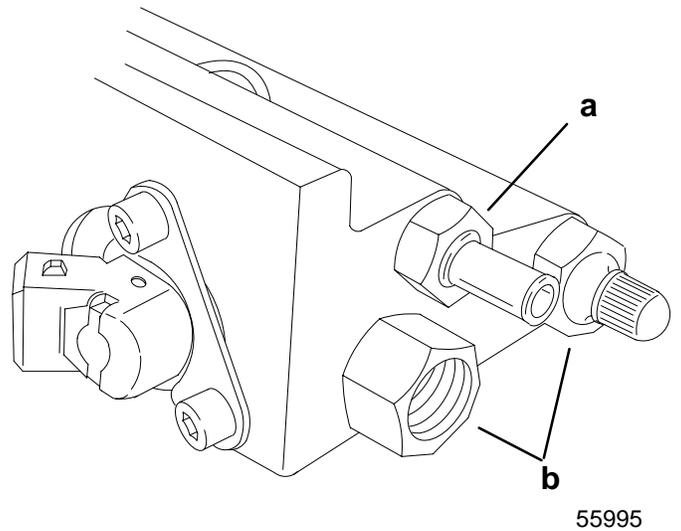
Fuel Rail Cleaning

After all fuel injectors, air regulator, tracker valve, fuel regulator, inlet hoses and outlet hoses have been removed, the fuel rails may be flushed out with a suitable parts cleaning solvent. Used compressed air to remove any remaining solvent.

Torque 1/2" (12.7mm) hose fittings on fuel rails to 28 lb. ft. (38.0 N·m).

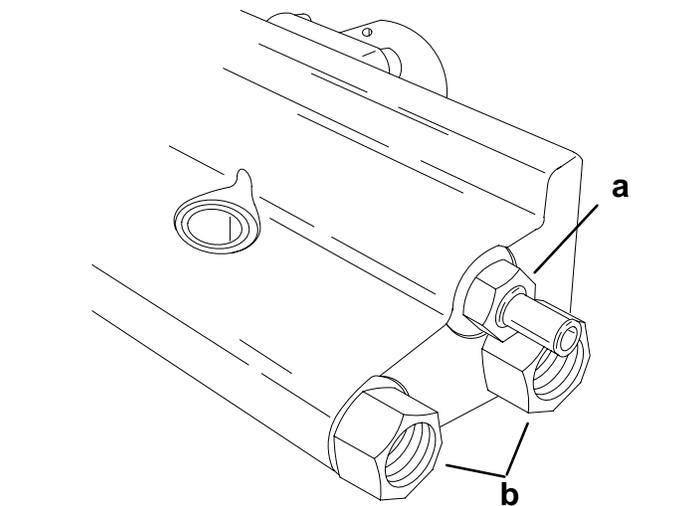
Torque 9/16" (14.3mm) hose fittings on fuel rails to 35 lb. ft. (47.5 N·m).

1997 Model Top View



- a - 1/2" (12.7mm) Fitting
- b - 9/16" (14.3mm) Fitting

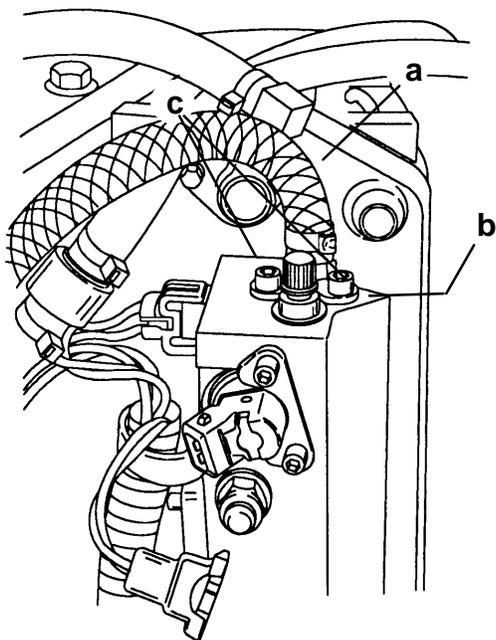
Bottom View



- a - 1/2" (12.7mm) Fitting
- b - 9/16" (14.3mm) Fitting

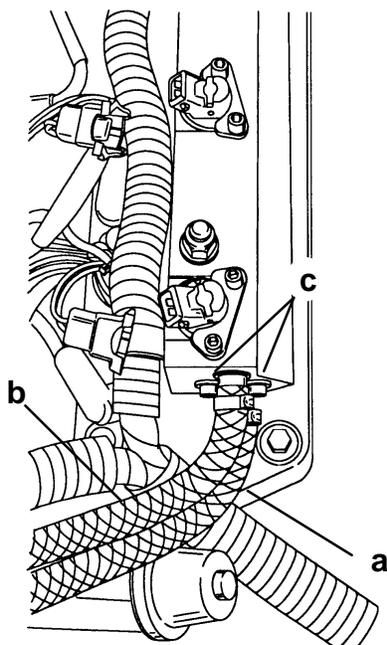


1998 Model



- a - Air Hose
- b - Retainer
- c - Allen Screws [Torque to 60 lb. in. (6.8 N·m)]

1998 Model

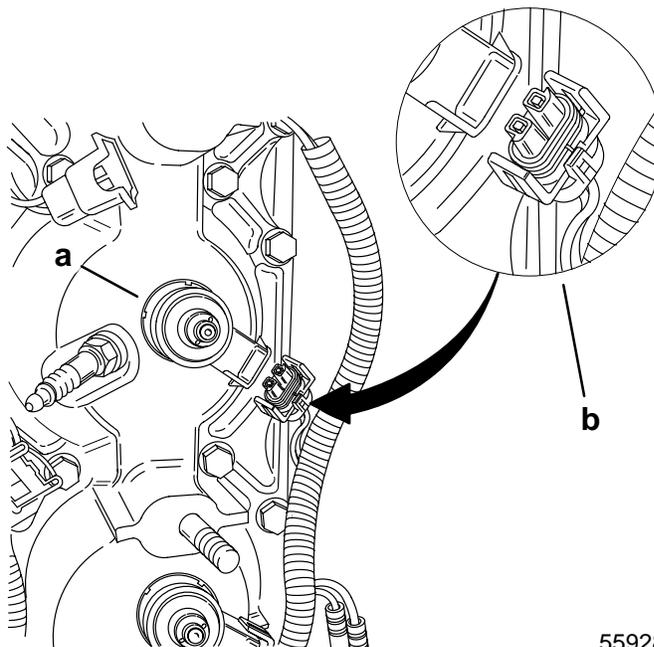


- a - Air Hose
- b - Fuel Hose
- c - Allen Screws [Torque to 60 lb. in. (6.8 N·m)]

56140

Direct Injector Removal

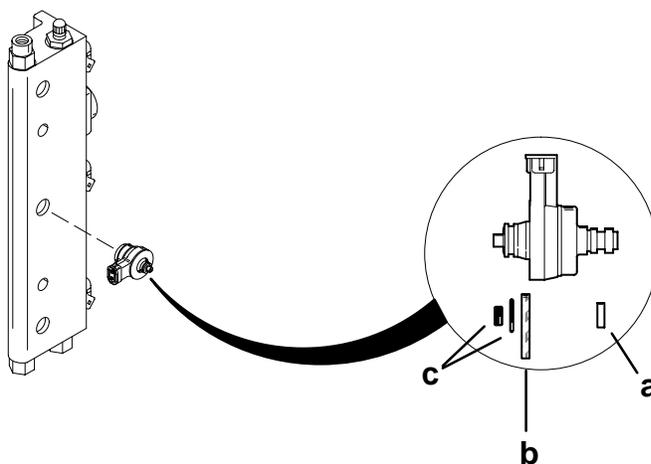
1. Remove harness connectors from direct injectors.
2. Remove direct injector from cylinder head



55928

- a - Direct Injector (3 each cylinder head)
- b - Harness Connector

3. Inspect injector teflon sealing ring (white) for signs of combustion blowby (teflon ring will be streaked brownish black). If blowby is present, replace teflon sealing ring. If blowby is not present, sealing ring may be reused.
4. Inspect o-rings and cork gasket for cuts or abraisions. Replace components as required.

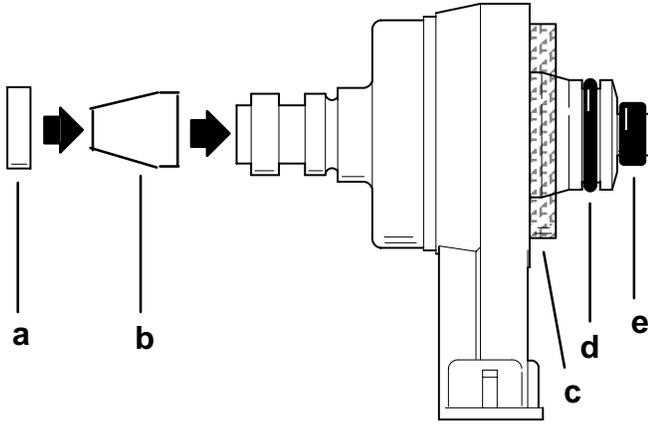


- a - Teflon Sealing Ring
- b - Cork Gasket
- c - O-Rings



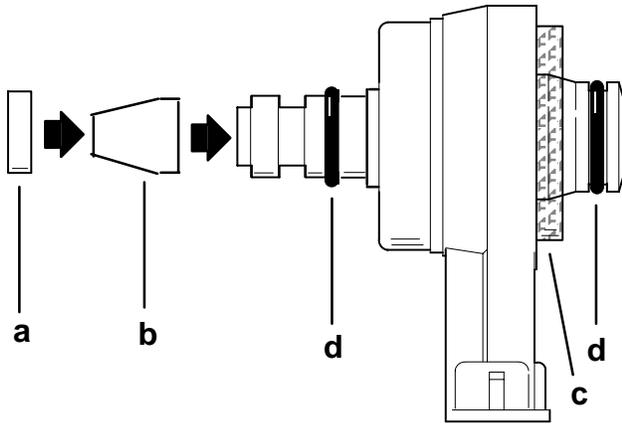
5. If teflon seal requires replacement, use teflon ring installation tool 91-851980 to slide new seal onto injector. Following installation of teflon ring, the teflon ring sizing tool (91-851980-1) can be used to compress the teflon seal to aid in the installation of the injector into the cylinder head.

1997 Model



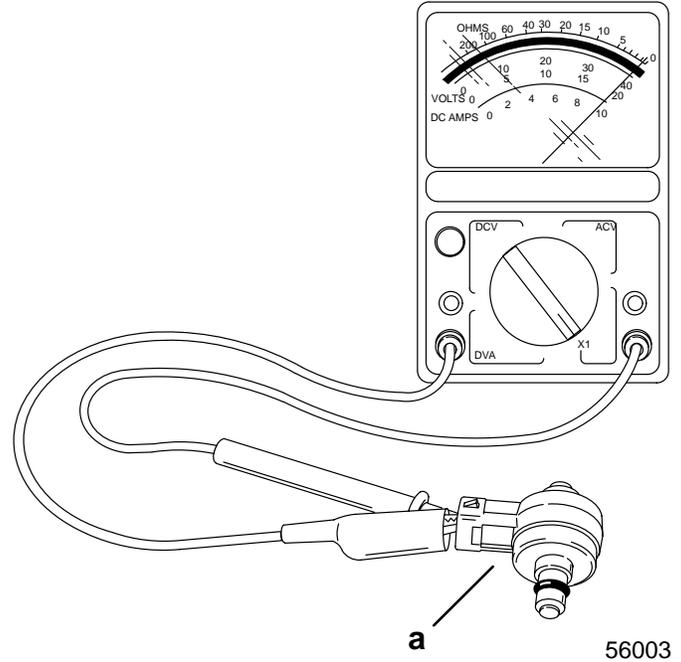
- a - Teflon Seal
- b - Seal Installation Tool (91-851980)
- c - Cork Gasket
- d - O-Ring
- e - O-Ring

1998 Model



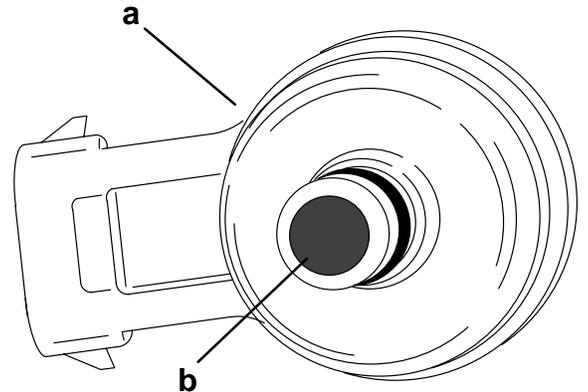
- a - Teflon Seal
- b - Seal Installation Tool (91-851980)
- c - Cork Gasket
- d - O-Ring

6. An ohm test of the direct injector may be made by connecting test leads to injector terminals. Ohm reading should be 1.3 ± 0.3 ohm.



- a - Direct Injector

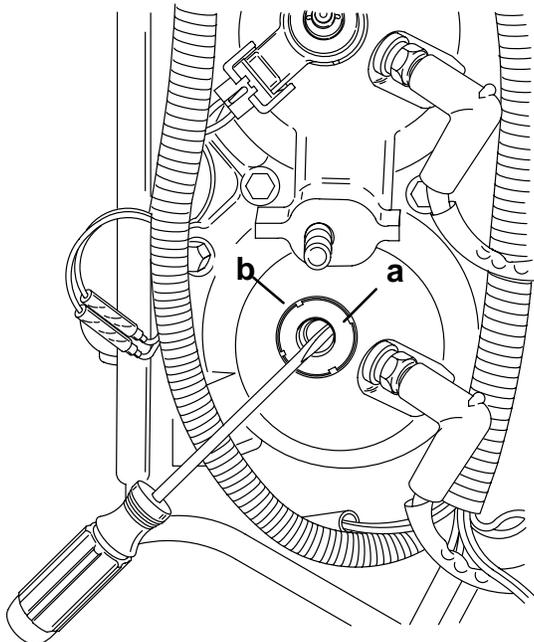
7. Carbon buildup on tip of direct injector may be removed by use of a brass wire hand brush.



- a - Direct Injector
- b - Tip



NOTE: If cylinder head is going to be replaced, remove cup washers from each direct injector port by prying out with a flat tip screwdriver. Reinstall washers with retainers into new cylinder head. Washers provide tension between direct injectors, cylinder head and fuel rails.



55927

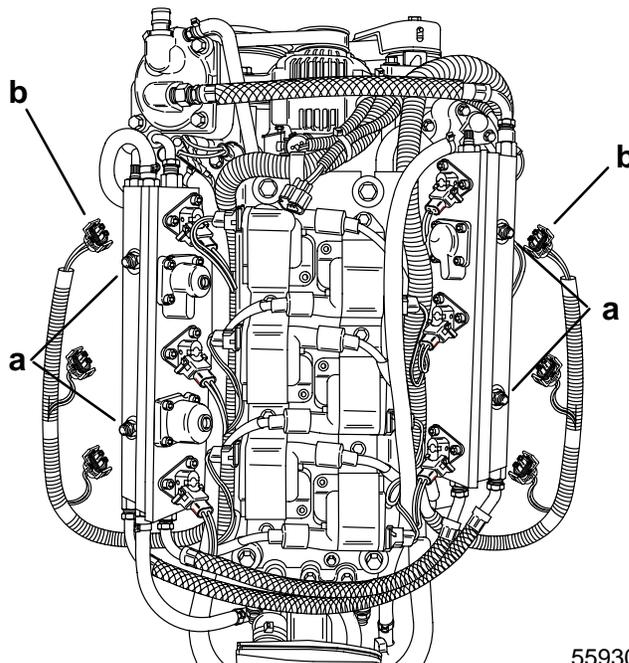
a - Cup Washer
b - Retainer

Fuel Rail and Direct Injector Installation

1. Use Teflon Ring Sizing Tool (91-851980-1) to compress new teflon sealing rings prior to installation of injector into cylinder head.
2. Carefully slide fuel rail over mounting studs and onto direct injectors.

IMPORTANT: On 1998 Models, ALL fuel and air hoses attached to the fuel rails **MUST** be secured with stainless steel hose clamps.

3. Secure each fuel rail with 2 nuts. Torque nuts to 33 lb. ft. (44.7 N·m).
4. Reinstall direct injector harness connectors.



55930

a - Nuts [Torque to 33 lb.ft. (44.7 N·m)]
b - Direct Injector Harness Connectors



Air Compressor

Air compressor is a single cylinder, water cooled and lubricated by the outboard oil pump.

Air Compressor Specifications		
Air Compressor	Type Compressor Output	Reciprocating Piston (1 to 1 ratio with engine RPM) @ Idle – 80 psi @ W.O.T. – 110 psi
Cylinder Block	Displacement	7.07 cu. in. (116cc)
Cylinder Bore	Diameter (Standard) Taper/Out-of-Round/Wear Maximum Bore Type	2.5591 in. (65.0mm) 0.001 in. (0.025mm) Cast Iron
Stroke	Length	1.374 in. (34.9mm)
Piston	Piston Type	Aluminum
Piston Diameter	<p>Dimension "A" at Right Angle (90°) to Piston Pin</p>	2.5578 ± .0004 in. (64.97 ± 0.010mm)
Piston Ring	End Gap Top Ring Middle Ring Bottom Ring	0.0059 - 0.0098 in. (0.15 - 0.25mm) 0.0059 - 0.0098 in. (0.15 - 0.25mm) 0.0039 - 0.014 in. (0.10 - 0.35mm)
Reeds	Reed Stand Open	0.010 in. (0.25mm)

COMPRESSOR REMOVAL

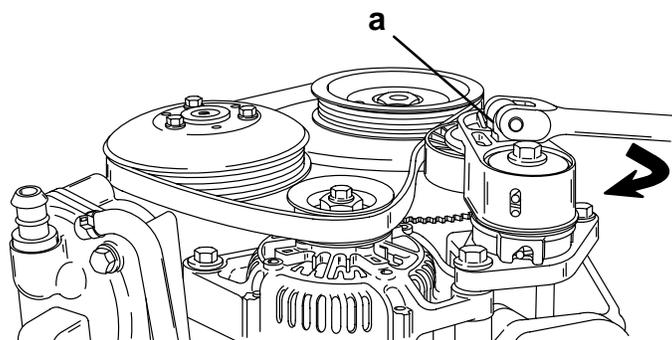
1. Disconnect battery cables from battery terminals.
2. Remove top cowling.

IMPORTANT: On 1998 Models, Prior to removing flywheel cover, remove vent hose from fitting on flywheel cover.

3. Remove flywheel cover.



- Use 1/2 inch (12.7mm) drive on belt tensioner arm to relieve belt tension. Remove belt.



55950

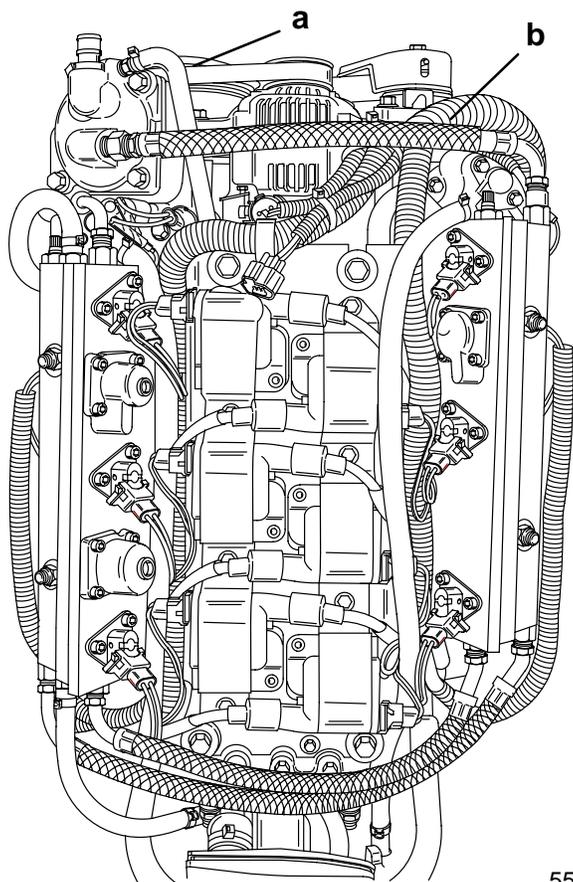
a - Belt Tensioner

CAUTION

If engine has been recently run, air pressure outlet hose fittings may be extremely hot. Allow components to cool off before beginning disassembly.

- Disconnect air pressure outlet hose
- Disconnect water outlet hose (tell-tale).

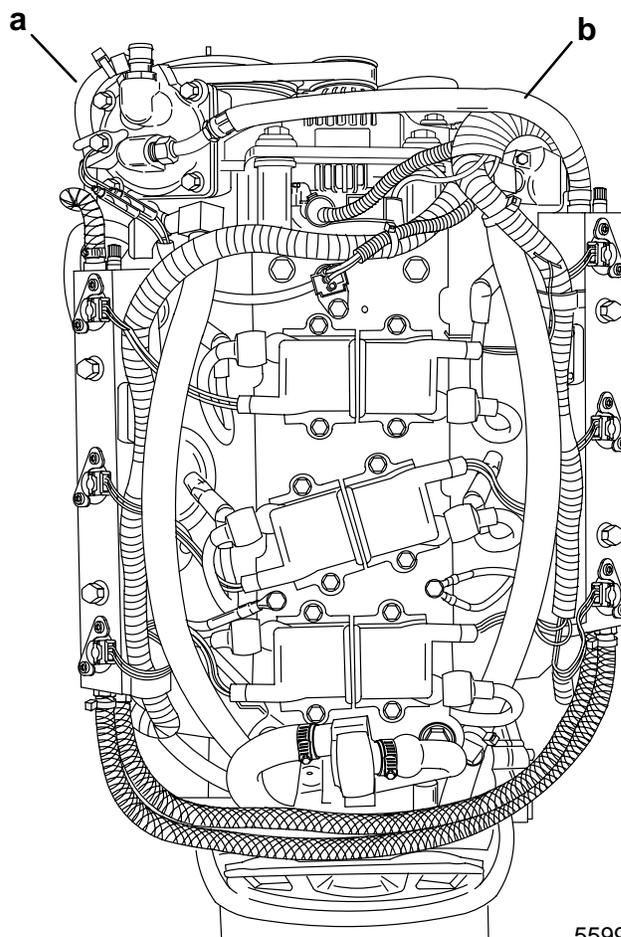
1997 Model



55925

a - Water Outlet Hose
b - Air Outlet Hose

1998 Model



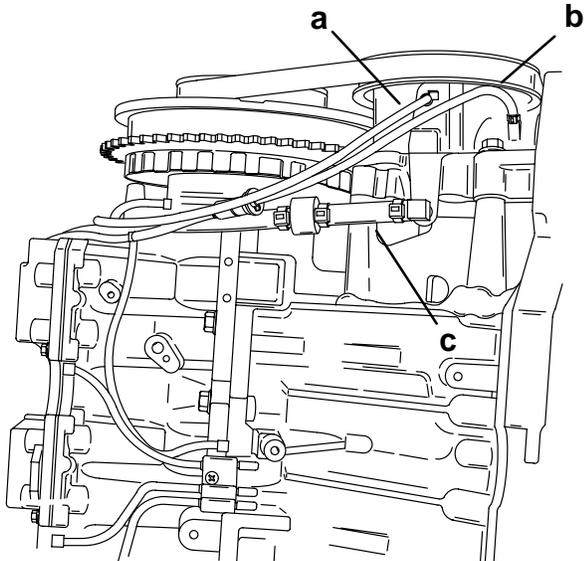
55990

a - Water Outlet Hose
b - Air Outlet Hose



NOTE: On 1998 Models, the water outlet hose (tell-tale) exits the opposite (port) side of the air compressor.

7. Disconnect oil pump inlet hose.
8. Disconnect bleed system inlet hose.
9. Disconnect excess oil return hose.



55947

- a - Oil Pump Inlet Hose
- b - Bleed System Inlet Hose
- c - Excess Oil Return Hose

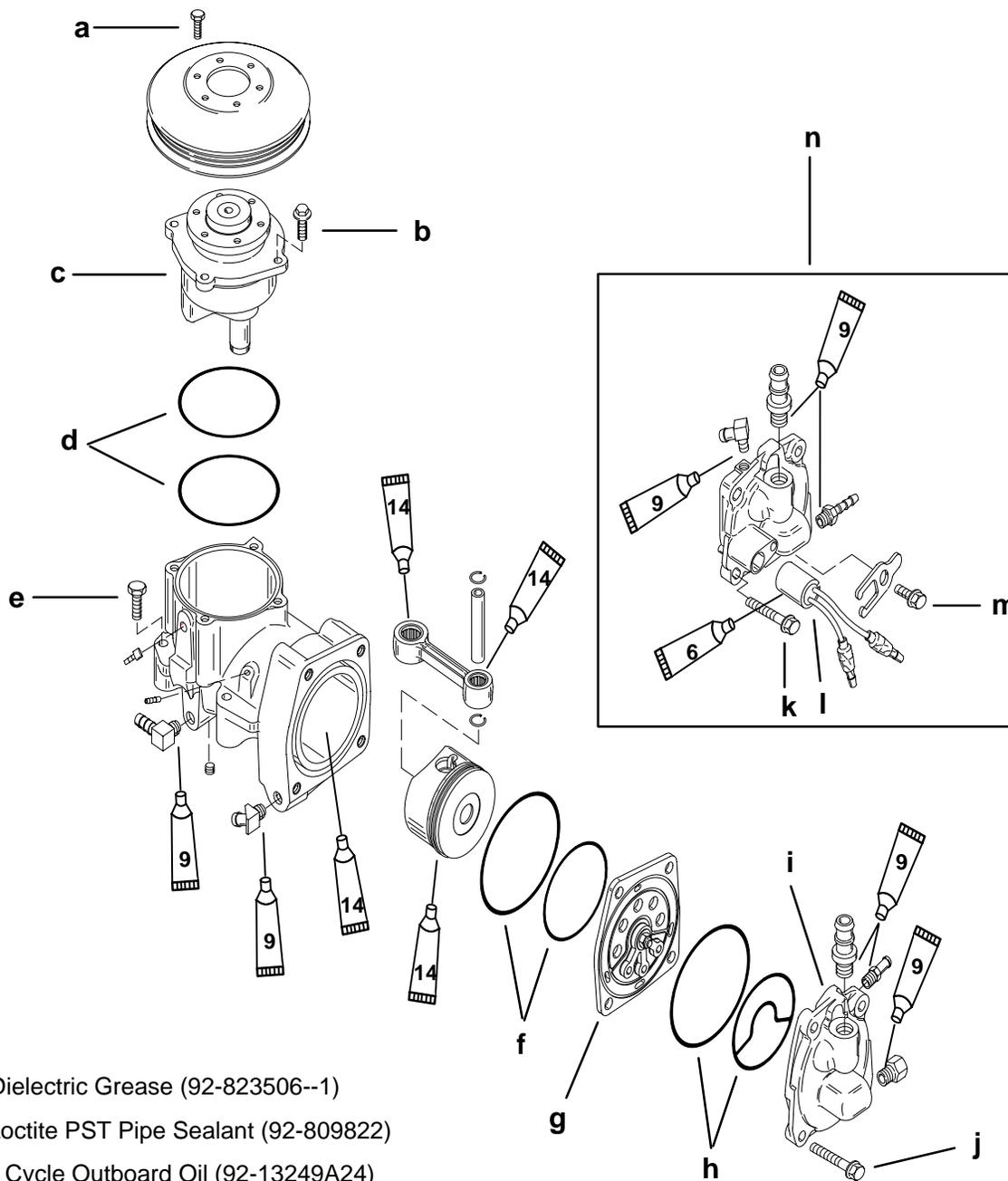
10. Remove 4 bolts securing air compressor to out-board and remove compressor.

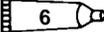
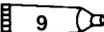
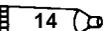


Air Compressor Disassembly/Reassembly

NOTE: If cylinder bore is scored, air compressor must be replaced as an assembly.

NOTE: The piston and rings are not sold separately. They must be replaced as an assembly. The connecting rod and bearings are not sold separately. They must be replaced as an assembly.



-  Dielectric Grease (92-823506--1)
-  Loctite PST Pipe Sealant (92-809822)
-  2 Cycle Outboard Oil (92-13249A24)

NOTE: End cap bearing and seal are not sold separately. End cap must be replaced as an assembly

NOTE: Piston Installation – use a metal hose clamp for piston ring compressor. Stagger piston ring openings.

- a - Bolt (3 each) [Torque to 100 lb. in. (11.3 N·m)]
- b - Bolt (4 each) [Torque to 100 lb. in. (11.3 N·m)]
- c - End Cap Assembly (Inspect bearing for roughness)
- d - O-Rings (Inspect for cuts or abrasions)
- e - Bolt (4 each) [Torque to 20 lb. ft. (27.1 N·m)]
- f - O-Rings (Inspect for cuts or abrasions)

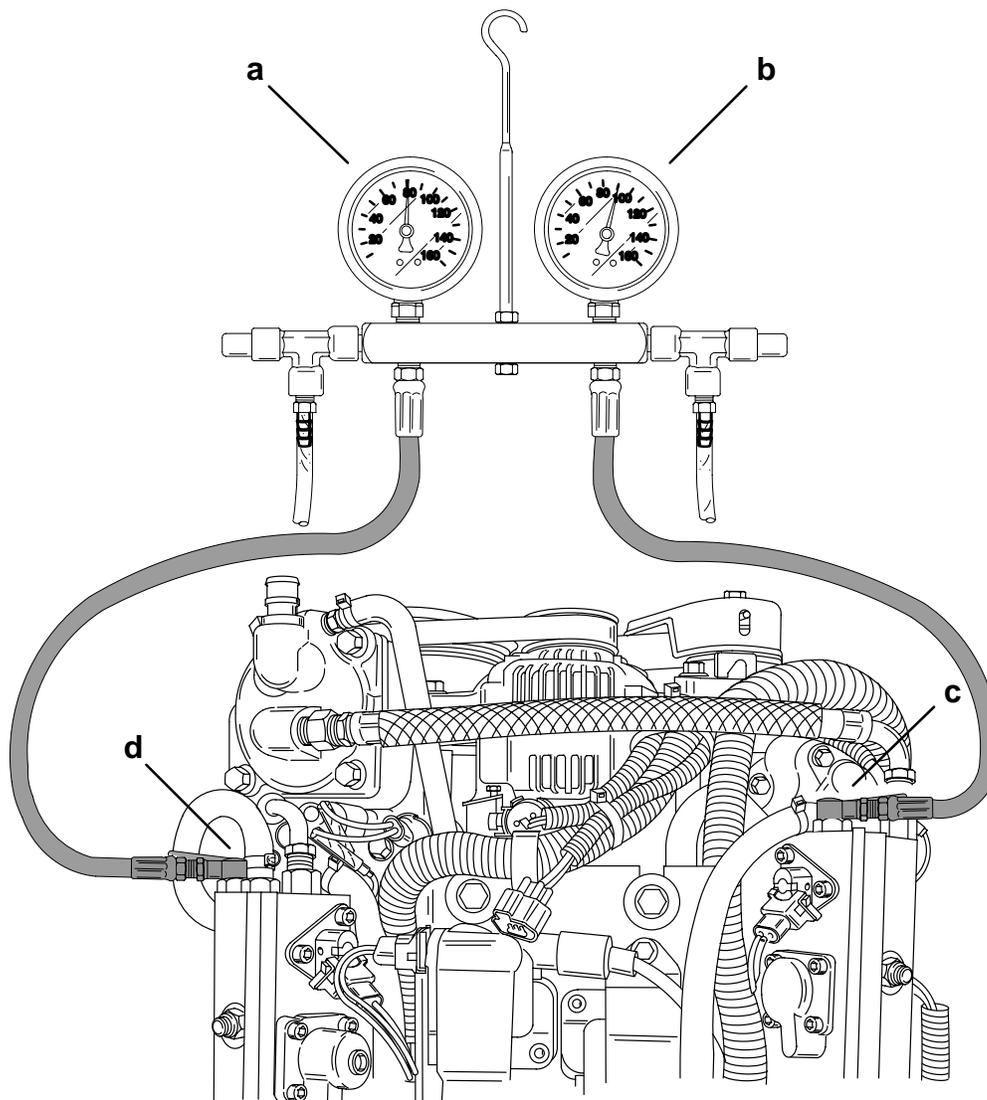
- g - Reed Plate (Inspect for broken or chipped reeds/stops)
Maximum Reed Stand-Open - 0.010 in. (0.254mm)
- h - O-Rings (Inspect for cuts or abrasions)
- i - Cylinder Head (1997 Model)
- j - Bolt [Torque to 20 lb. ft. (27.1 N·m)]
- k - Bolt [Torque to 20 lb. ft. (27.1 N·m)]
- l - Temperature Sensor
- m - Bolt [Torque to 20 lb. ft. (27.1 N·m)]
- n - Cylinder Head (1998 Model)



Air Compressor Pressure Test

Install Pressure Gauge Assembly 91-852087A1 to fuel rail pressure test valves. Starboard rail has fuel pressure test valve. Port air rail has fuel pressure test valve.

NOTE: After 15 seconds of cranking engine with starter motor, air pressure gauge should indicate 80 PSI and fuel pressure gauge should indicate 90 PSI.



55959

- a - Air Pressure Gauge (Should Indicate 80 PSI)
- b - Fuel Pressure Gauge (Should Indicate 90 PSI)
- c - Fuel Pressure Test Valve
- d - Air Pressure Test Valve



FUEL PRESSURE AND AIR PRESSURE TROUBLESHOOTING CHART

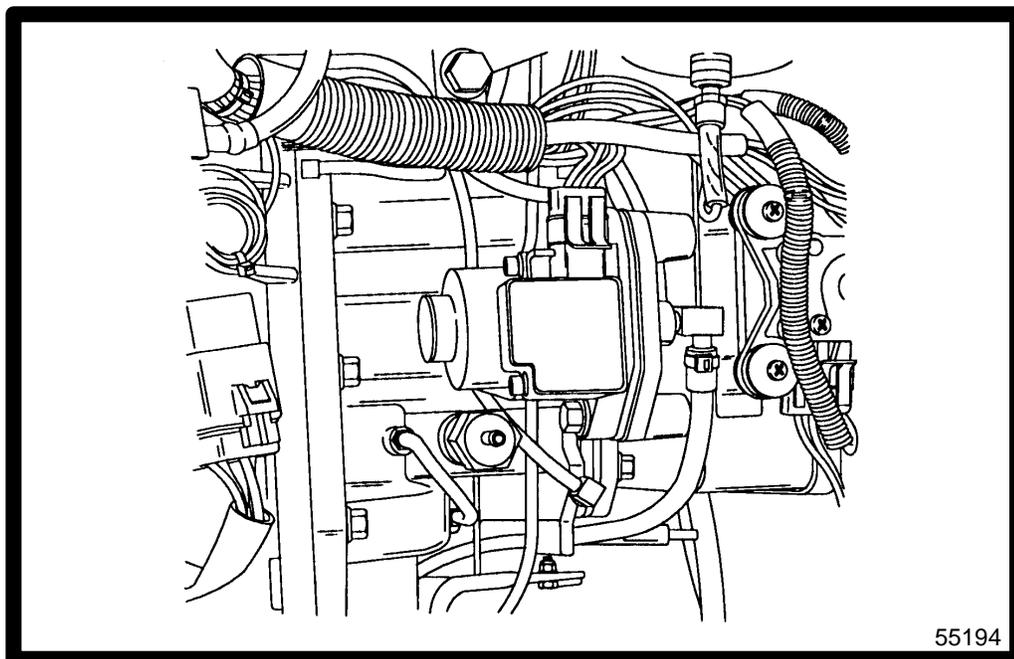
PROBLEM	CORRECTIVE ACTION
Fuel Pressure and Air Pressure are Both Low	<ol style="list-style-type: none">1. Inspect air compressor air intake (air filter in fly-wheel cover) for blockage.2. Remove air compressor cylinder head and inspect for scuffing of cylinder wall. Inspect for broken reeds and/or reed stops.3. Tracker Valve – Remove and inspect diaphragm for cuts or tears.4. Air Regulator – Remove and inspect diaphragm for cuts or tears.
Fuel Pressure Low or Fuel Pressure Drops while Running (Air Pressure Remains Normal)	<ol style="list-style-type: none">1. Each time key is turned to the RUN position, the pump should operate for 2 seconds. If it does not run, check 20 ampere fuse.2. If pump runs but has no fuel output, check vapor separator (remove drain plug) for fuel.3. If no fuel present in vapor separator, check fuel/water separator for debris. Check crankcase mounted fuel pump for output.4. Check pump amperage draw. Normal draw is 4 - 8 amperes; if draw is below 2 amperes, check fuel pump filter (base of pump) for debris. If filter is clean, replace pump. If amperage is above 8 amperes, pump is defective – replace pump.5. Fuel Regulator – Remove and inspect diaphragm for cuts or tears.



FUEL SYSTEM

3

C



OIL INJECTION SYSTEM



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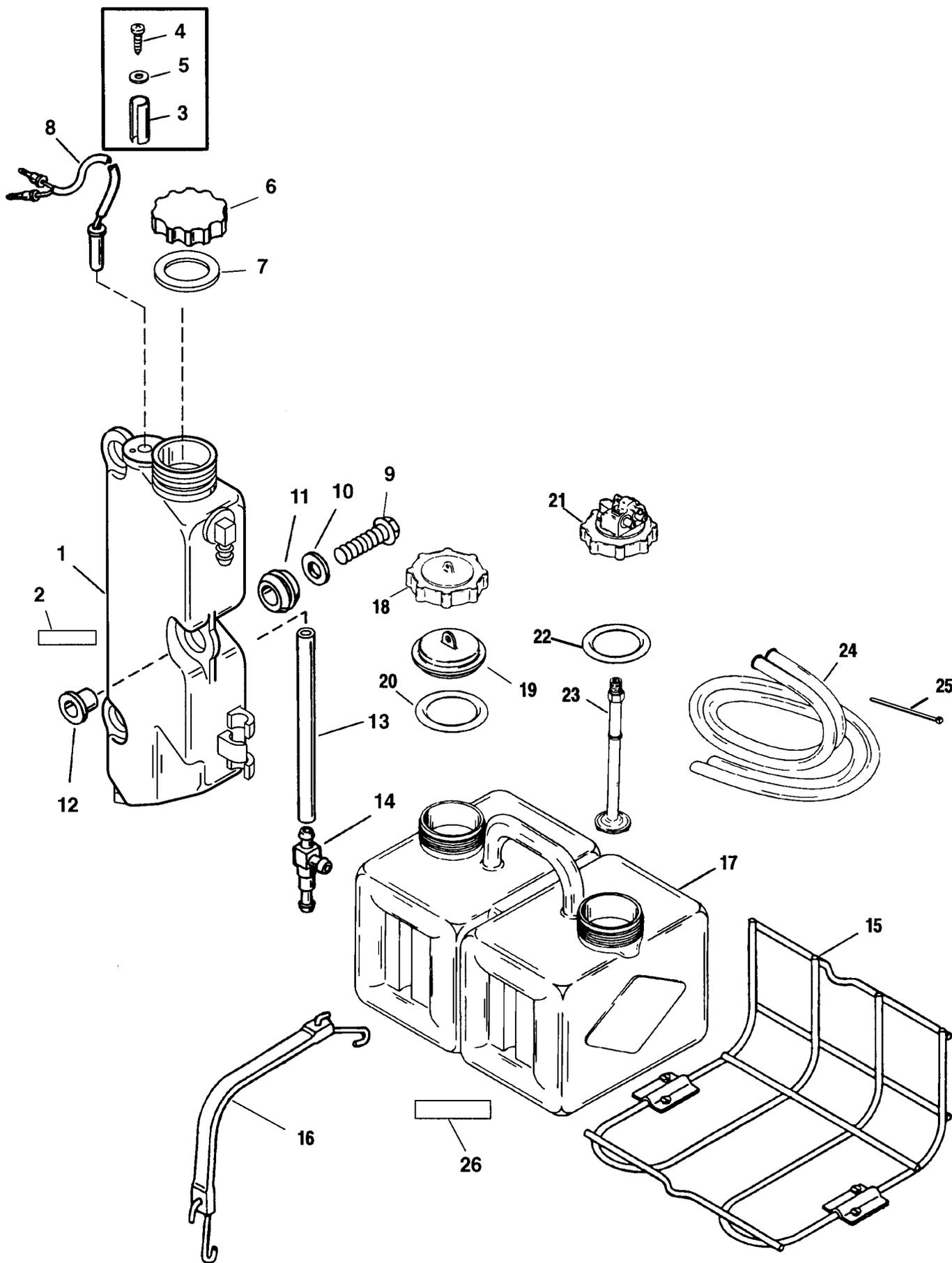


Notes:





Oil Injection Components





Oil Injection Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	OIL TANK			
2	1	DECAL-Reservoir			
3	1	SPACER			
4	1	SCREW (.164-18 x .375)	Drive Tight		
5	1	WASHER			
6	1	CAP ASSEMBLY			
7	1	GASKET			
8	1	SWITCH ASSEMBLY			
9	3	SCREW (M8 x 35)	168	14	19.0
10	3	WASHER			
11	3	GROMMET			
12	3	BUSHING			
13	1	TUBING (8 IN.)			
14	1	FITTING			
15	1	REMOTE OIL TANK HOLD-DOWN KIT			
16	1	BUNGY CORD ASSEMBLY			
17	1	OIL TANK			
18	1	CAP ASSEMBLY			
19	1	INSERT			
20	1	O RING			
21	1	ADAPTOR HOUSING			
22	1	O RING			
23	1	TUBE			
24	1	HOSE			
25	7	STA STRAP			
26	1	DECAL-Caution Remote Tank			

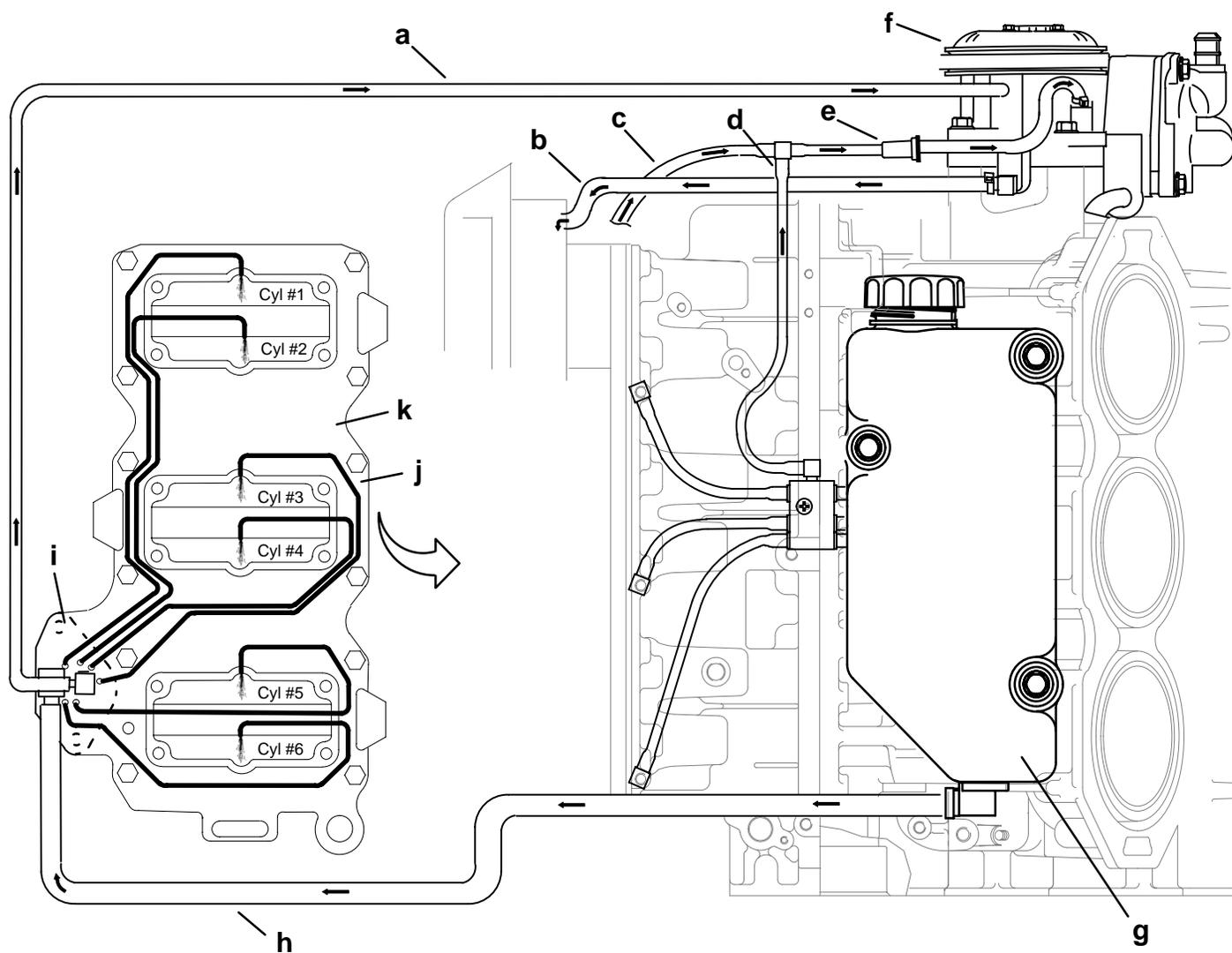


Oil Injection Operation

Oil in this engine is not mixed with the fuel before entering the combustion chamber. Oil is stored inside the remote oil tank. Crankcase pressure will force oil from the remote oil tank into the engine oil tank (g) on the side of the powerhead. Oil will flow from the engine oil tank through the oil supply hose (h) to the oil pump (i). The oil pump is a solenoid design and is activated by the ECM, it includes seven oil discharge ports. Six of the oil pump discharge ports discharge oil into the intake manifold (k) in front of the reed blocks. The oil passageways (j) are machined into the intake manifold. The last oil pump discharge port discharges oil through hose (a) to the air compressor (f) for lubrication. The port and starboard side bleed systems (c and d) also supply oil to the air compressor for lubrication. Excess oil from the compressor returns through hose (b) into the plenum and is ingested through the crankcase.

The ECM will change the discharge rate of the oil pump, depending upon engine demand. The ECM will also pulse the pump on initial start up to fill the oil passages eliminating the need to bleed the oil system. The ECM will signal the oil pump to provide additional oil (50:1) for break in, as determined by the ECM's internal clock. After break-in, the oil ratio ranges from 300 - 400:1 at idle to 60:1 at WOT.

1997 Model Oil Flow Schematic

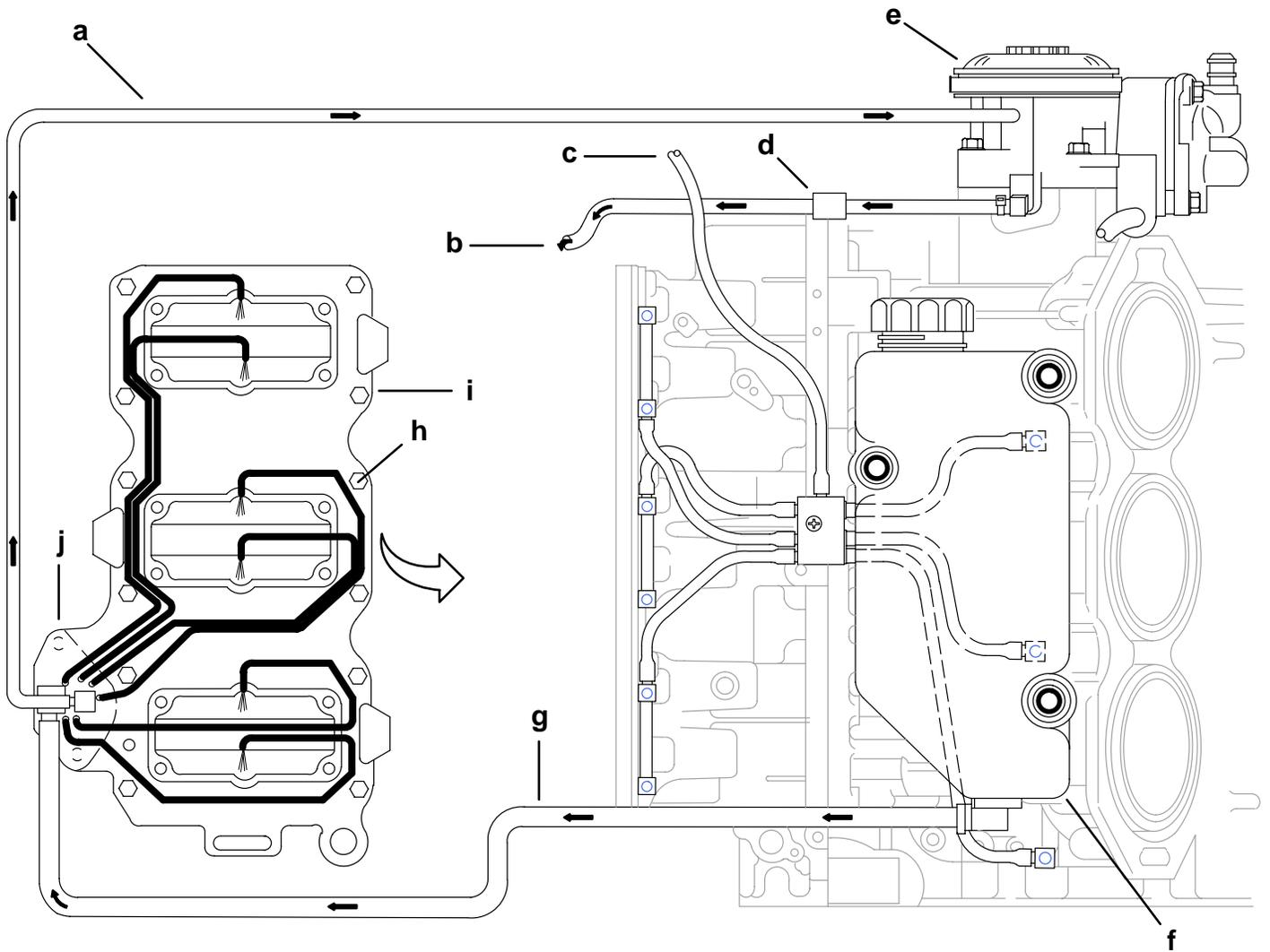


- a - Oil Hose to Air Compressor (Passageway 7)
- b - Excess Oil Return from Air Compressor
- c - Starboard Side Bleed Oil to Air Compressor
- d - PORT Side Bleed System Oil Supply Line to the Air Compressor
- e - In-Line Filter

- f - Air Compressor
- g - Oil Reservoir
- h - Oil Hose to Oil Pump
- i - Oil Pump
- j - Oil Passageway (6 each)
- k - Intake Manifold



1998 Model Oil Flow Schematic



56028

- a - Oil Hose to Air Compressor
- b - Excess Oil Return from Air Compressor to Intake Manifold
- c - PORT Side Bleed System Oil Supply Return Line to Intake Manifold
- d - Check Valve
- e - Air Compressor
- f - Oil Reservoir
- g - Oil Input Hose to Oil Pump
- h - Oil Passageway (6 each)
- i - Intake Manifold



Oil Injection

Set Up Instructions for the Oil Injection System

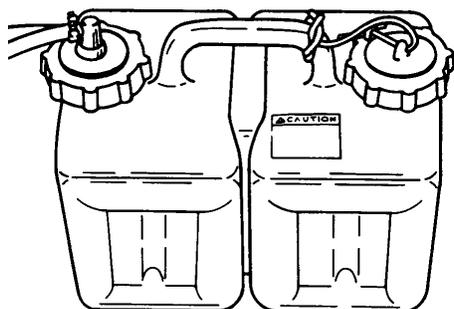
⚠ CAUTION

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

⚠ CAUTION

If an electric fuel pump is to be used, the fuel pressure at the engine must not exceed 4 psi. If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psi maximum.

INSTALLING REMOTE OIL TANK



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

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

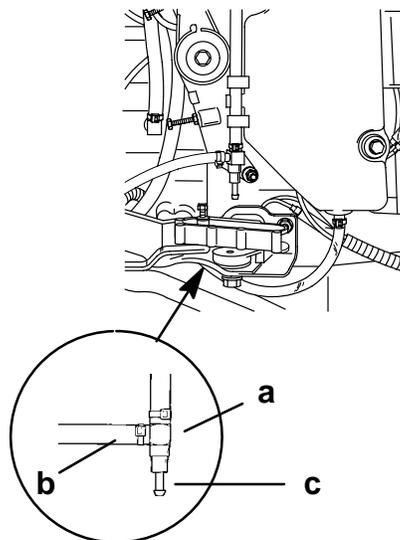
3. Oil hoses when routed thru engine well, must be able to extend to the hose fittings on engine.
4. Oil hoses must be arranged so they cannot become pinched, kinked, sharply bent or stretched during operation of the outboard.

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

Installing Oil Hoses to Engine

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

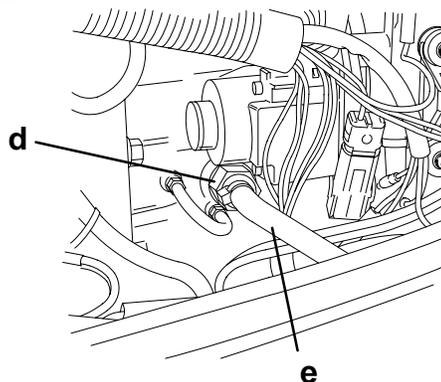
NOTE: The third fitting (c) is a vent and does not get connected.



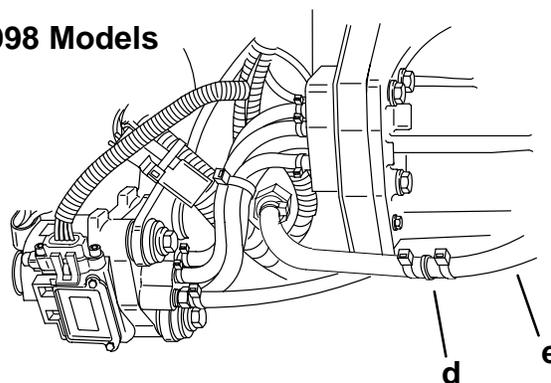
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3. Remove shipping cap from pulse fitting (d).
4. Connect the second oil hose (e) to pulse fitting as shown. Secure with sta-strap.
5. Refer to Section 7 for proper routing of oil hoses thru clamp in the bottom cowl.

1997 Models



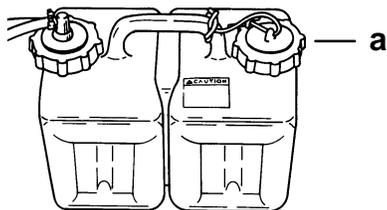
1998 Models





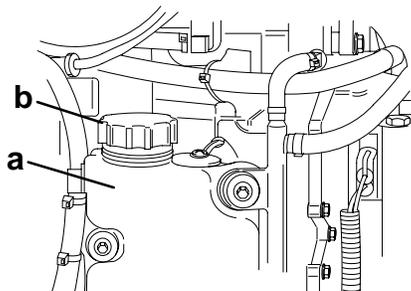
Filling the Oil Injection System

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



a - Fill Cap

2. Remove fill cap from the engine oil tank and fill the tank with oil. Reinstall the fill cap.

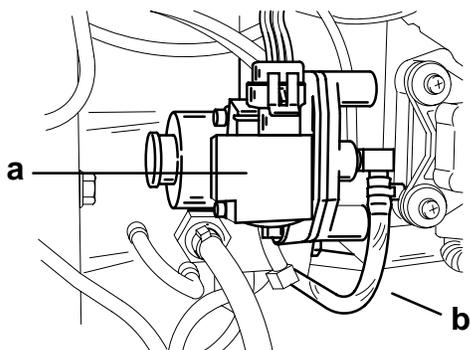


a - Engine Oil Reservoir
b - Fill Cap

Priming the Oil Injection Pump

1997 MODELS

Before starting engine for the first time, or for an engine that ran out of oil, or was drained of oil, prime the oil injection pump. Priming will remove any air that may be in the oil supply hose.



a - Oil Injection Pump
b - Oil Supply Hose

54446

54437

CAUTION

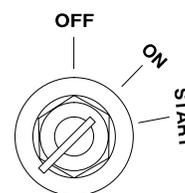
Oil supply hose between the engine oil tank and Electric oil pump must be purged of air before starting engine.

CAUTION

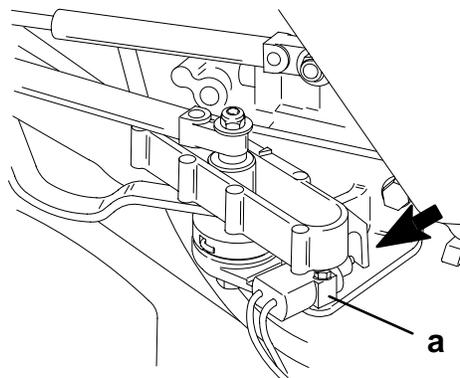
Prior to initial engine startup, remove oil hose between the oil pump and air compressor. Manually fill the hose with Quicksilver TC-W3 Premium Plus 2 Cycle Outboard.

Prime the oil injection pump as follows:

1. Shift outboard to "NEUTRAL" position.
2. Turn the ignition key switch to the "ON" position.



3. Within the first 10 seconds after the key switch has been turned on, push in the shift interrupt switch 3-5 times. This will run the pump and purge out the air.



a - Shift Interrupt Switch

54445

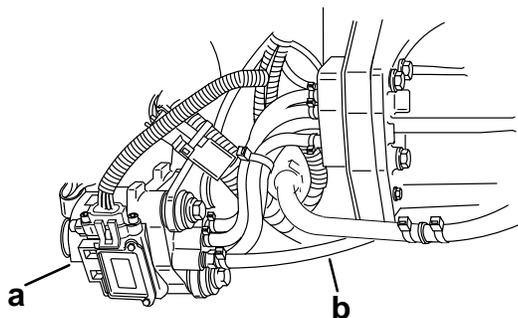
NOTE: It may take up to 1 minute to purge out the air.



Priming the Oil Injection Pump (Continued)

1998 MODELS

Before starting engine for the first time, or for an engine that ran out of oil, or was drained of oil, prime the oil injection pump. Priming will remove any air that may be in the pump, oil supply hose, or internal passages.



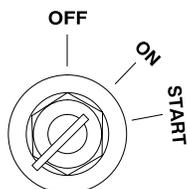
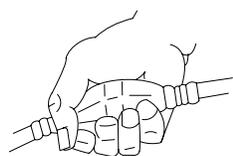
a - Oil Injection Pump
b - Oil Supply Hose

⚠ CAUTION

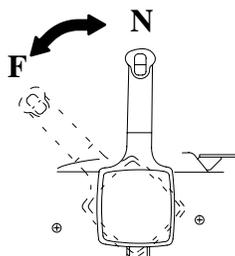
To prevent damage to the fuel pumps, fill the engine fuel system with fuel. Otherwise the fuel pumps will run without fuel during the priming process.

Prime the oil injection pump as follows:

1. Fill the engine fuel system with fuel. Connect fuel hose and squeeze primer bulb until it feels firm.
2. Turn the ignition key switch to the "ON" position.



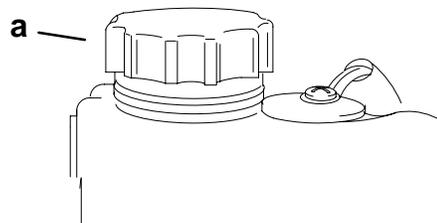
3. Within the first 10 seconds after the key switch has been turned on, move the remote control handle from neutral into forward gear 3 to 5 times. This will automatically start the priming process.



NOTE: It may take a few minutes for the pump to complete the priming process.

Purging Air From the Engine Oil Reservoir

1. Loosen the fill cap on the engine oil tank.
2. Start the engine. Run the engine until the all the air has been vented out of the tank and oil starts to flow out of the tank. Re-tighten fill cap.



a - Fill Cap

Oil Pump Activation of Break-in Sequence for Replacement Powerheads

NOTE: Do not add oil to the fuel to provide additional lubrication during break-in. The fuel delivery characteristics of Direct Fuel Injection engines are such that adding oil to the fuel will provide little or no additional lubrication to the engine. Additional oil required by the engine during break-in must be provided by the oil pump.

Priming the oil pump (filling pump and hoses) is required on new or rebuild engines and any time maintenance is performed on the oiling system.

There are three methods for priming the oil pump:

METHOD 1 – SHIFT SWITCH ACTIVATION PRIME

This method does three things:

- a. Fills the oil pump, oil supply hose feeding pump and oil hoses going to the crankcase and air compressor.
- b. Activates break-in oil ratio.
- c. Initiates a new engine break-in cycle.

Refer to priming procedure following.

NOTE: Refer to DDT reference manual for break-in time period.



METHOD 2 – (DDT) DIGITAL DIAGNOSTIC TERMINAL – RESET BREAK-IN

This method is the same as Method 1, except the run history and fault history are erased from the ECM.

Refer to procedure in the Technician Reference Manual provided with the Digital Diagnostic Software Cartridge Part. No. 91-822608-4.

METHOD 3 – (DDT) DIGITAL DIAGNOSTIC TERMINAL – OIL PUMP PRIME

This method fills the oil pump, oil supply hose feeding pump, and oil hoses going to the crankcase and air compressor.

Refer to procedure in the Technician Reference Manual provided with the Digital Diagnostic Software Cartridge Part. No. 91-822608-4.

Conditions Requiring Priming the Oil Pump	
Condition	Priming Procedure
New engine	Use Method 1 or 2
Rebuilt Powerhead	Use Method 1 or 2
New Powerhead	Use Method 1 or 2
Oil system ran out of oil	Use Method 3
Oil drained from oil supply hose feeding pump	Use Method 3
Oil pump removed	Use Method 3
Oil injection hoses drained	Use Method 3

Oil Injection Warning Systems

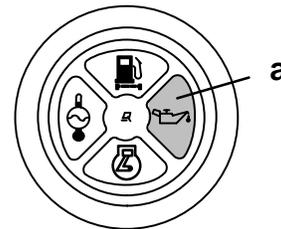
LOW OIL LEVEL (1997 AND 1998 MODELS)

The system is activated when the oil in the engine mounted oil reservoir tank drops below 50 fl. oz. (1.5 liters) You still have an oil reserve remaining for 50 minutes of full speed operation.

NOTE: The engine mounted oil reservoir tank (located beneath the top cowl) along with the remote oil tank will have to be refilled (refer to Filling the Oil Injection System).

The warning system works as follows:

The OIL light (a) will come on and the warning horn sounds a series of four short tones. If you continue to operate the outboard, the light will stay on and the horn will sound four short tones every two minutes. The engine has to be shut off to reset the warning system.



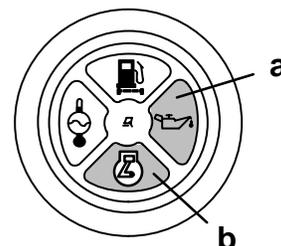
NO OIL FLOW TO THE ELECTRIC OIL PUMP (1997 MODELS ONLY)

The system is activated when the flow of oil in the electric oil pump is restricted. No lubricating oil is being supplied to the engine. Stop the engine as soon as possible. Continuing to operate the engine can result in severe engine damage.

The warning system works as follows:

The OIL light (a) and CHECK ENGINE light (b) will come on and the warning horn will begin sounding. The warning system will automatically reduce and limit the engine speed to 3000 RPM.

The engine has to be shut off to reset the warning system.

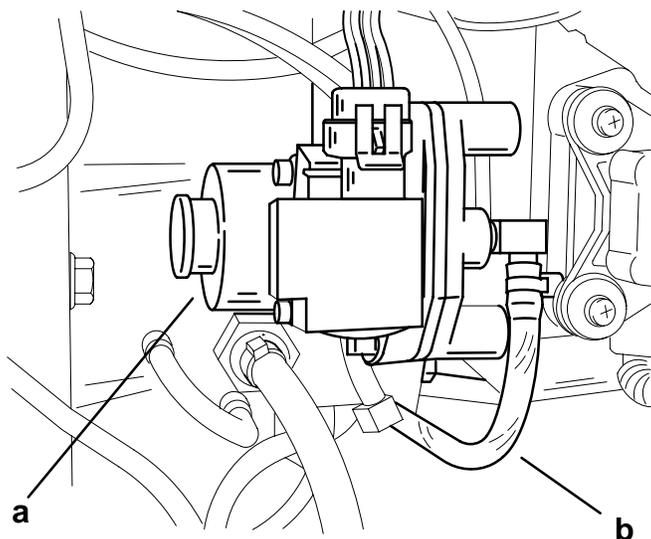




Electric Oil Pump Test (1997 Models Only)

NOTE: 1998 Model oil pumps do not activate a warning if there is an oil pump malfunction or if there are air bubbles in the oil supply hose. The oil warning system on 1998 Models will only be activated if the engine mounted oil reservoir is low on oil.

1. If the warning system is activated and indicating **no oil flow to the oil pump**, the first thing to do is visually check the oil supply hose going to the oil pump for signs of air.
2. If the oil supply hose is not full of oil, purge out the air following instructions in Filling the Oil Injection System.
3. If the oil supply hose is full of oil, this indicates a problem inside the electric oil pump. The electric oil pump is not serviceable. Replace the electric oil pump.



a - Electric Oil Pump
b - Oil Supply Hose



Oil Injection System Trouble Shooting Chart

TROUBLE SHOOTING THE OIL INJECTION SYSTEM

If a problem occurs with the oil injection system and the warning horn sounds in a pulsating manner, stop engine and check if problem is caused by (1) low oil level or (2) a faulty warning sensor.

Open the cowling on engine and check oil level in engine reservoir tank. If oil is not to the top of tank, the problem is low oil. There is a safety reserve of oil left in the reservoir after the low oil warning is sounded that allows you enough oil for 30 to 40 minutes of full throttle operation. Refer to troubleshooting chart to correct the problem.

Problem: Oil Level in Engine Oil Reservoir Tank is Low But Not Low in Remote Oil Tank.	
Possible Cause	Corrective Action
Fill cap is leaking air on the remote tank.	Make sure O-rings or gaskets are in place and caps are tight.
Remote oil hose (blue stripe) is blocked.	Check length of hose for a kink.
Remote pulse hose (second hose) is blocked or punctured.	Check length of hose for a kink or leakage.
Remote pulse hose check valve is faulty (this valve is located at the engine end of the hose).	Replace check valve.
A restricted oil outlet filter in the remote tank.	Remove filter and clean.
Air leak in upper portion of oil pickup tube.	Replace tube.
Problem: Warning Horn Does Not Sound When Ignition Key is Turned to "ON" Position.	
Possible Cause	Corrective Action
Horn malfunction or open (TAN) wire between horn and engine.	Use a jumper wire to ground TAN lead (at engine terminal block) to engine ground. Warning horn should sound. If not, check TAN wire between horn and engine for open circuit and check horn.
Electronic Control Module (ECM)	Check if all ECM leads are connected to harness leads. If so, ECM may be faulty.
Using incorrect side mount remote control or ignition/choke assembly.	Refer to page 1D-6
Open circuit on PURPLE wire going to (+) terminal of horn.	Check for battery voltage at (+) terminal of horn when ignition key is turned on.



Problem: Warning Horn Stays on When Ignition Key is Turned to "ON" Position.

Possible Cause	Corrective Action
Engine overheat sensor	If horn sounds a continuous signal, the engine overheat sensor may be faulty. Disconnect overheat sensor and turn ignition key to "ON" position. If horn still sounds the engine overheat sensor is OK.
Tan wire between warning horn and engine overheat sensor is shorted to ground.	Check wire for shorts.
Electronic Control Module (ECM)	Check connections – replace ECM.

Problem: Warning Horn sounds when Engine is Running and Oil Level in Engine Reservoir is Full.

Possible Cause	Corrective Action
Defective low oil sensor	Disconnect both low oil sensor leads from terminal connectors. connect an ohmmeter between leads. There should be NO continuity through sensor. If continuity exists, sensor is faulty.



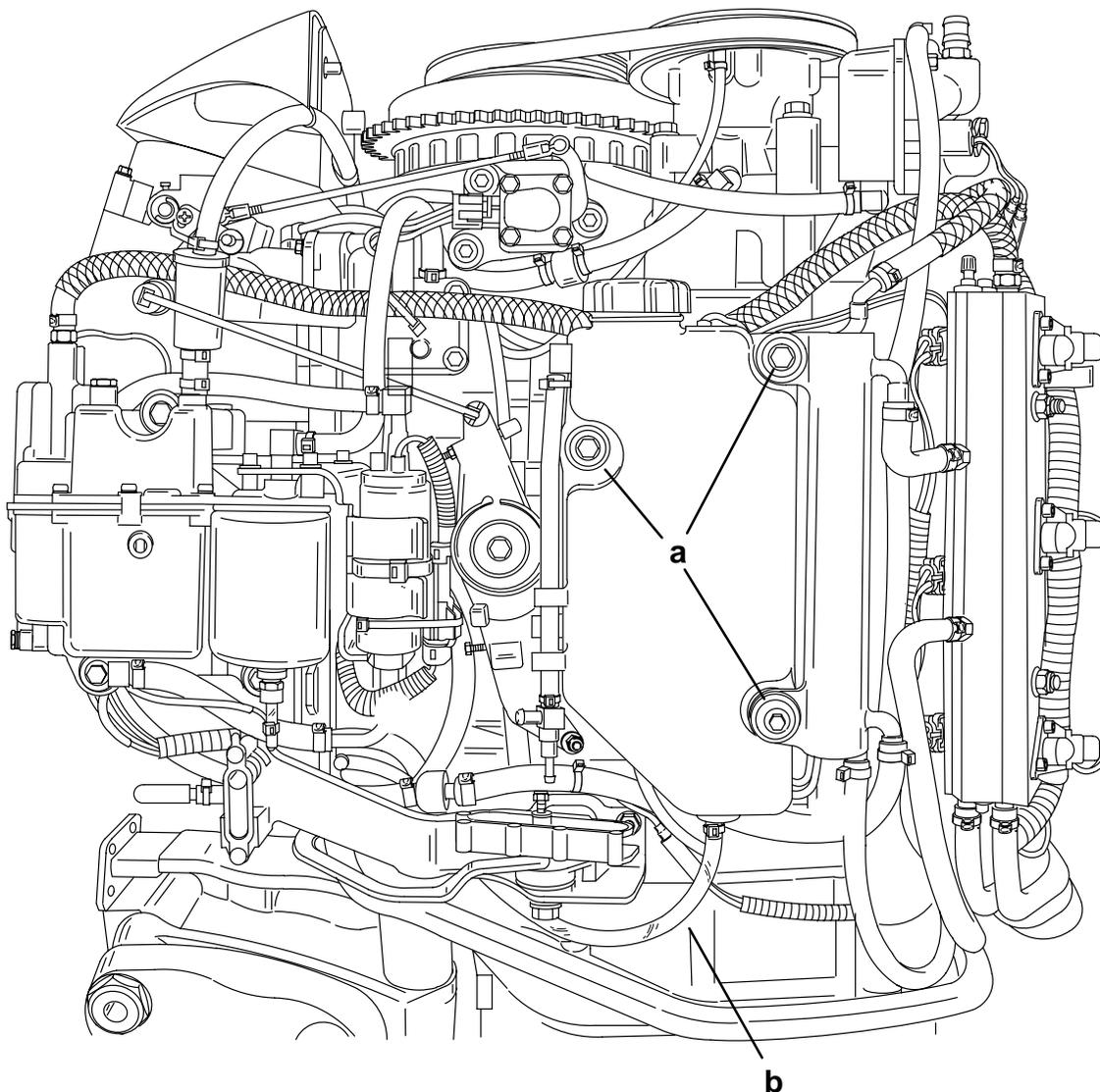
Engine Mounted Oil Reservoir

REMOVAL

NOTE: If oil reservoir contains oil, the clear oil hose going to the oil pump should be plugged upon removal to prevent oil spillage.

1. Disconnect input oil hose to oil reservoir.

2. Disconnect LIGHT BLUE leads from their respective connections.
3. Disconnect clear input hose to oil pump and plug off hose.
4. Remove three bolts securing oil reservoir to powerhead and remove reservoir.



- a - Bolts
b - Oil Pump Output Hose (Clear)

INSTALLATION

55937

1. Secure oil reservoir to powerhead with 3 bolts. Torque bolts to 14 lb. ft. (19.0 N-m).
2. Reconnect input oil hose to oil reservoir and secure with sta-strap.
3. Reconnect LIGHT BLUE leads to their respective bullet connectors.
4. Connect clear output hose from oil reservoir to oil pump. Secure hose with sta-straps.



FUEL SYSTEM

3

D

MERCURY MARINE		Emission Control Information		1998							
				PART # 37-855211 27							
This engine conforms to 1998 Model Year U.S. EPA regulations for marine SI engines.		This engine is certified to operate on regular 87 octane unleaded fuel (R+M)/2									
Refer to Owners Manual for required maintenance.		Idle Speed (in gear): 550 RPM									
Exhaust Emission Control Systems: None											
Engine Lubricants: Quicksilver Premium Plus TC-W3 2-Cycle Outboard Oil		Fuel/Oil Ratio: Not Adjustable ECM Controlled		Timing: Not Adjustable ECM Controlled							
Family: WM9XM03.0220				Spark Plug: Champion RC12MC4 Gap: .040"							
FEL: 100.00 GM/KW-HR				Valve Clearance (Cold) mm Intake: N/A Exhaust: N/A							
				3044							
				cc							
				225 HP							
				DFI							
JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC

EMISSIONS



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Exhaust Emissions Standards

Through the Environmental Protection Agency (EPA), the federal government has established exhaust emissions standards for all new marine engines sold in the U.S.

What Are Emissions?

Emissions are what comes out of the exhaust system in the exhaust gas when the engine is running. They are formed as a result of the process of combustion or incomplete combustion. To understand exhaust gas emissions, remember that both air and fuel are made of several elements. Air contains oxygen and nitrogen among other elements; gasoline contains mainly hydrogen and carbon. These four elements combine chemically during combustion. If combustion were complete, the mixture of air and gasoline would result in these emissions: water, carbon dioxide and nitrogen, which are not harmful to the environment. But combustion is not usually complete. Also, potentially harmful gases can be formed during and after combustion.

All marine engines must reduce the emission of certain pollutants, or potentially harmful gases, in the exhaust to conform with levels legislated by the EPA. Emissions standards become more stringent each year. Standards are set primarily with regard to three emissions: hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx).

Hydrocarbons – HC

Gasoline is a hydrocarbon fuel. The two elements of hydrogen and carbon are burned during combustion in combination with oxygen. But they are not totally consumed. Some pass through the combustion chamber and exit the exhaust system as unburned gases known as hydrocarbons.

Carbon Monoxide – CO

Carbon is one of the elements that make up the fuel burned in the engine along with oxygen during the combustion process. If the carbon in the gasoline could combine with enough oxygen (one carbon atom with two oxygen atoms), it would come out of the engine in the form of carbon dioxide (CO₂). CO₂

is a harmless gas. But carbon often combines with insufficient oxygen (one carbon atom with one oxygen atom). This forms carbon monoxide, CO. Carbon monoxide is the product of incomplete combustion and is a dangerous, potentially lethal gas.

Oxides of Nitrogen - NOx

NOx is a slightly different byproduct of combustion. Nitrogen is one of the elements that makes up the air going into the engine. Under extremely high temperatures it combines with oxygen to form oxides of nitrogen (NOx). This happens in the engine's combustion chambers when temperatures are too high. NOx itself is not harmful, but when exposed to sunlight it combines with unburned hydrocarbons to create the visible air pollutant known as smog. Smog is a serious problem in California as well as many other heavily populated areas of the United States.

Controlling Emissions

There are two principle methods of reducing emissions from a two-stroke-cycle marine engine. The first method is to control the air/fuel ratio that goes into the combustion chamber. The second is to control the time when this air/fuel mixture enters the combustion chamber. Timing is important, to prevent any unburned mixture from escaping out of the exhaust port.

Stoichiometric (14.7:1) Air/Fuel Ratio

In the search to control pollutants and reduce exhaust emissions, engineers have discovered that they can be reduced effectively if a gasoline engine operates at an air/fuel ratio of 14.7:1. The technical term for this ideal ratio is stoichiometric. An air/fuel ratio of 14.7:1 provides the best control of all three elements in the exhaust under almost all conditions.

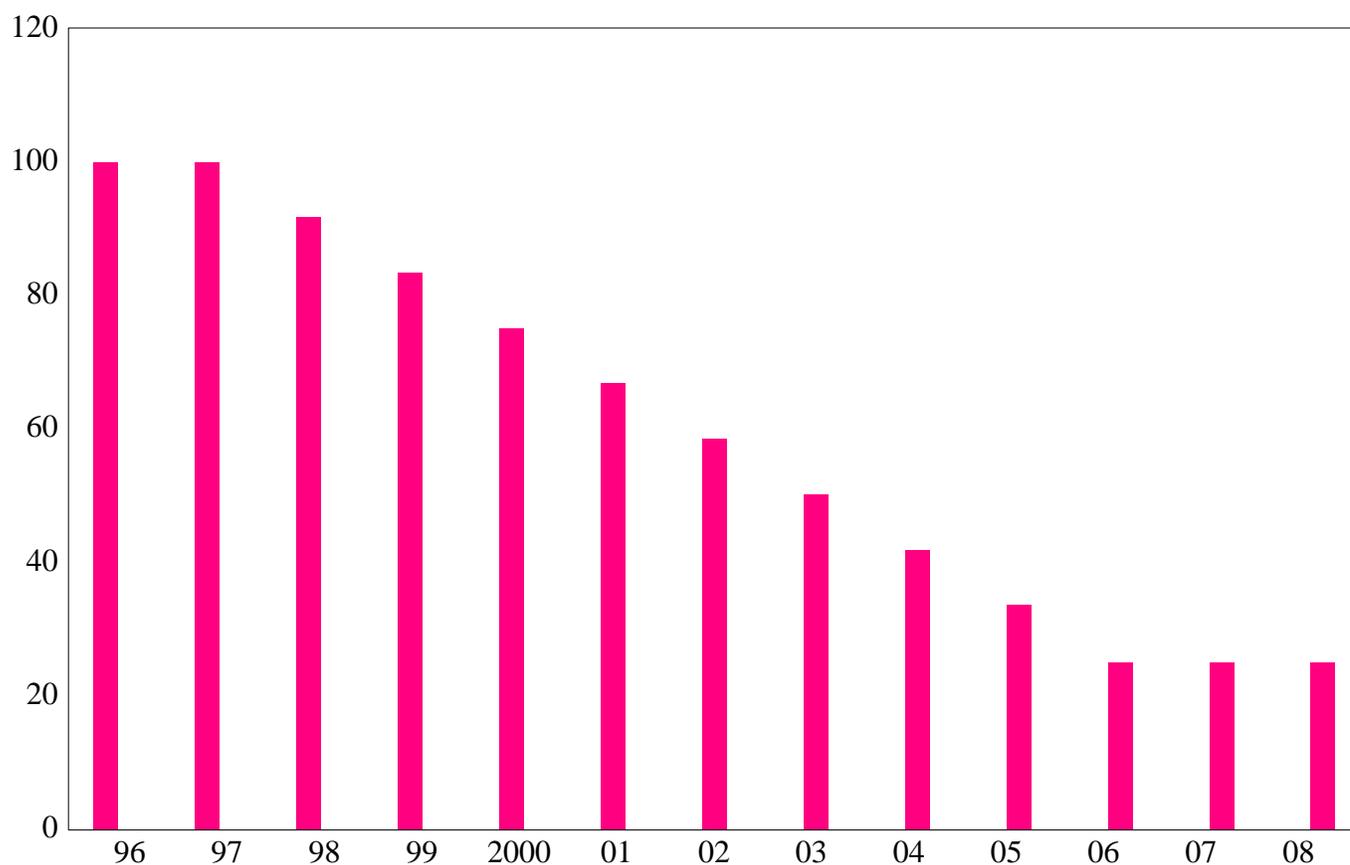
The HC and CO content of the exhaust gas is influenced significantly by the air/fuel ratio. At an air/fuel ratio leaner than 14.7:1, HC and CO levels are low, but with a ratio richer than 14.7:1 they rise rapidly. It would seem that controlling HC and CO by themselves might not be such a difficult task; the air/fuel ratio only needs to be kept leaner than 14.7:1. However, there is also NOx to consider.



As the air/fuel ratio becomes leaner, combustion temperatures increase. Higher combustion temperatures raise the NOx content of the exhaust. But, enriching the air/fuel ratio to decrease combustion temperatures and reduce NOx also increases HC and CO, as well as lowering fuel economy. So the solution to controlling NOx - as well as HC and CO - is to keep the air/fuel ratio as close to 14.7:1 as possible.

OUTBOARD HYDROCARBON EMISSIONS REDUCTIONS

8 1/3% ↓ PER YEAR OVER 9 MODEL YEARS





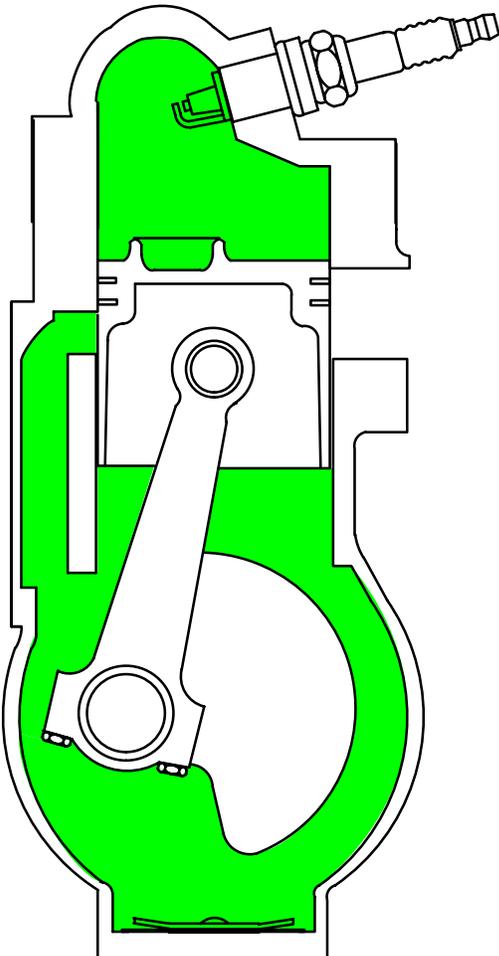
STRATIFIED VS HOMOGENIZED CHARGE

DFI engines use a stratified charge inside the combustion chamber to aid in reducing emissions. All other models use a homogenized charge. The difference between the two is:

Homogenized Charge

A homogenized charge has the fuel/air particles mixed evenly throughout the cylinder. This mixing occurs inside the carburetor venturi, reed blocks and crankcase. Additional mixing occurs as the fuel is forced through the transfer system into the cylinder.

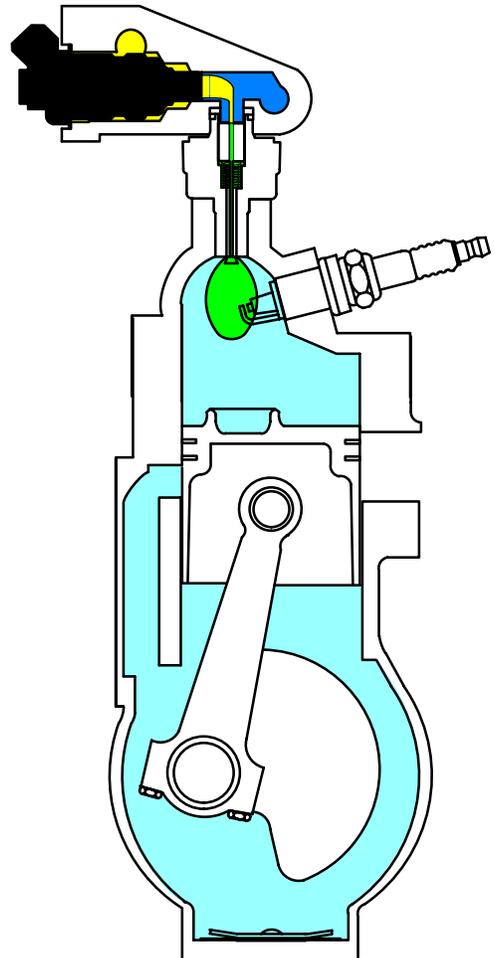
The homogenized charge is easy to ignite as the air/fuel ratio is approximately 14.7:1.



Stratified Charge

A stratified charge engine only pulls air through the transfer system. The fuel required for combustion is forced into the cylinder through an injector placed in the top of the cylinder (head). The injector sprays a fuel/air mixture in the form of a bubble into the cylinder. Surrounding this bubble is air supplied by the transfer system. As the bubble is ignited and burns, the surrounding air provides almost complete combustion before the exhaust port opens.

A stratified charge is hard to ignite, the air/fuel bubble is not evenly mixed at 14.7:1 and not easily ignited.





Emissions Information

Manufacturer's Responsibility:

Beginning with 1998 model year engines, manufacturers of all marine propulsion engines must determine the exhaust emission levels for each engine horsepower family and certify these engines with the United States Environmental Protection Agency (EPA). A certification decal/emissions control information label, showing emission levels and engine specifications directly related to emissions, **must** be placed on each engine at the time of manufacture.

Dealer Responsibility:

When performing service on all 1998 and later outboards that carry a certification, attention must be given to any adjustments that are made that affect emission levels.

Adjustments must be kept within published factory specifications.

Replacement or repair of any emission related component must be executed in a manner that maintains emission levels within the prescribed certification standards.

Dealers are **not** to modify the engine in any manner that would alter the horsepower or allow emission levels to exceed their predetermined factory specifications.

Exceptions include manufacturers prescribed changes, such as that for altitude adjustments.

Owner Responsibility:

The owner/operator is required to have engine maintenance performed to maintain emission levels within prescribed certification standards.

The owner/operator is **not** to modify the engine in any manner that would alter the horsepower or allow emissions levels to exceed their predetermined factory specifications.

Single engine exceptions may be allowed with permission from the EPA for racing and testing.

EPA Emission Regulations:

All new 1998 and later outboards manufactured by Mercury Marine are certified to the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new outboard motors. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA laws on exhaust emissions for marine products. For more detailed information on this subject, you may contact the following locations:

VIA U.S. POSTAL SERVICE:

Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
401 M St. NW
Washington, DC 20460

VIA EXPRESS or COURIER MAIL:

Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
501 3rd St. NW
Washington, DC 20001

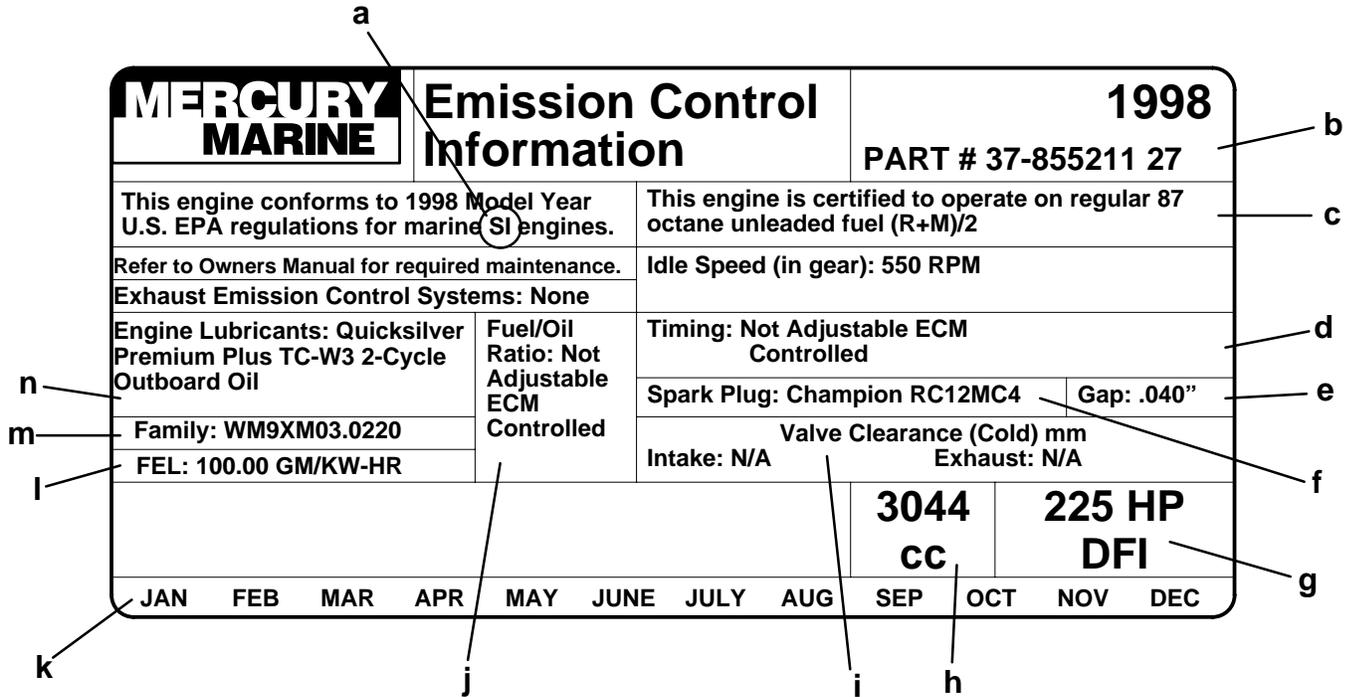
EPA INTERNET WEB SITE:

<http://www.epa.gov/omswww>

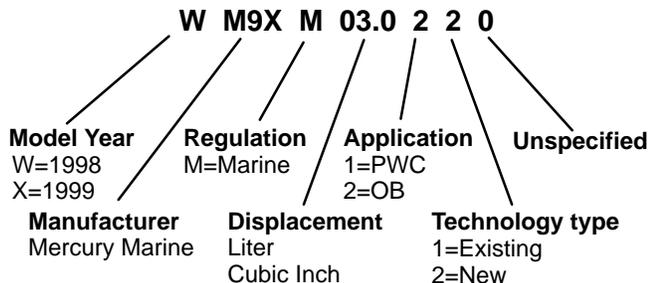


CERTIFICATION LABEL:

The certification label must be placed on each engine at the time of manufacture and must be replaced in the same location if damaged or removed. Shown below is a typical certification label and is not representative of any one model. Label shown below is not to scale; (shown at twice the normal size).



- a - Spark Ignition (SI)
- b - Model year of engine and production decal part number
- c - Type and octane of fuel used to establish emission levels
- d - Timing specifications when adjustable
- e - Spark plug gap in thousandths of an inch
- f - Recommended spark plug for best engine performance
- g - Engine Horsepower rating
- h - Cubic Centimeter
- i - Valve Clearance (Four Stroke engines only)
- j - Recommended oil/fuel ratio for best engine performance and minimal emissions
- k - Month of production (Boxing month will punched)
- l - FEL: Represents (Mercury Marine) statement of the maximum emissions output for the engine family
- m - Family example:



- n - Engine lubricants recommended by the manufacturer



Decal Location:

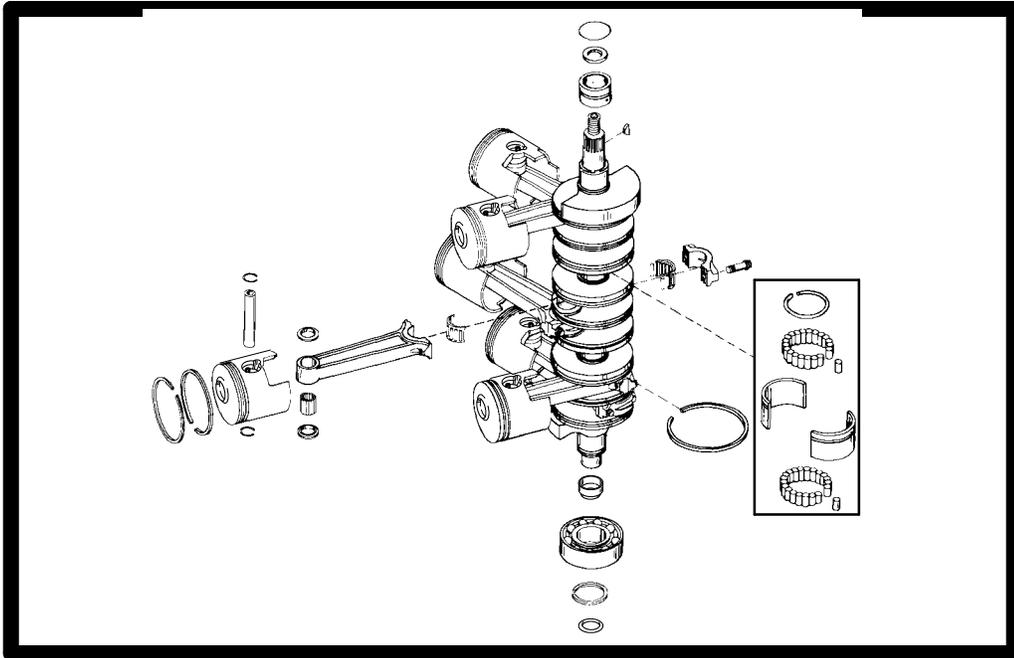
Model	Production Part No.	Service Part No.	Location on Engine
1998 Merc/Mar 3.0 L V6 DFI (200 – 225 H.P.)	37-855211 27	37-855577 27	Intake Plenum STBD Side
1999 Merc/Mar 3.0 L V6 DFI (200 – 225 H.P.)	37-856984 14		Intake Plenum STBD Side





POWERHEAD

4
A



CYLINDER BLOCK ASSEMBLY



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Reed Block Assembly	4A-27	Anchor Bracket/Throttle Linkage 1998	
Reed Block	4A-27	Model 200/225 DFI	4A-55
Connecting Rods	4A-28	Powerhead Installation on Driveshaft Housing ...	4A-56
Powerhead Reassembly and Installation	4A-29	Break-In Procedure	4A-59
General	4A-29		
Crankshaft Installation	4A-32		
Piston and Connecting Rod Reassembly	4A-33		
Piston and Piston Ring Combination	4A-35		
Piston Installation	4A-35		
Crankcase Cover Installation	4A-37		
Assembly of Reed Blocks to Intake Manifold ..	4A-38		



Specifications

Block

Type 60° V, 2 Cycle
Displacement 185.9 cu. in. (3047cc)

Reed Valve Opening

Opening (Max.) 0.020 in. (0.50mm)

Stroke

Length 3.00 in. (76.2mm)

Cylinder Bore

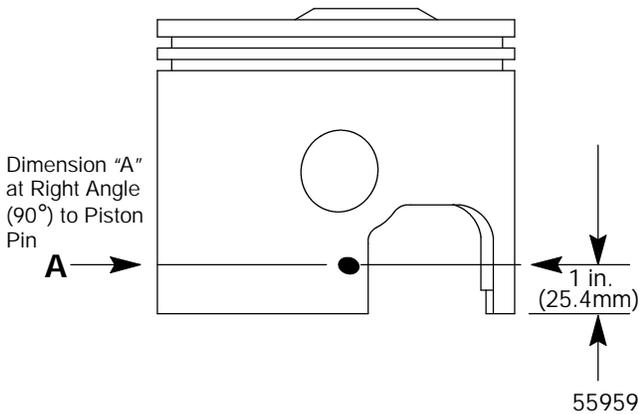
Dia. Standard 3.625 in. (92.1mm)
0.015 Oversize 3.640 in. (92.5mm)
0.030 Oversize 3.655 in. (92.8mm)

Taper/Out of Round Max. 0.003 in. (0.076mm)

Piston

Dia. Standard 3.6210 in. ±.0005 in.
(91.973 mm ±.0127 mm)
0.015 Oversize 3.636 in. ±.0005 in.
(92.354mm ±.0127 mm)
0.030 Oversize 3.651 in. ±.0005 in.
(93.1mm ±.0127 mm)

IMPORTANT: Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be 3.6210 in. ±.0005 for a STANDARD size piston.



Piston Ring

End Gap 0.010 in. to 0.018 in.
(0.254mm to 0.457mm)

Water Pressure

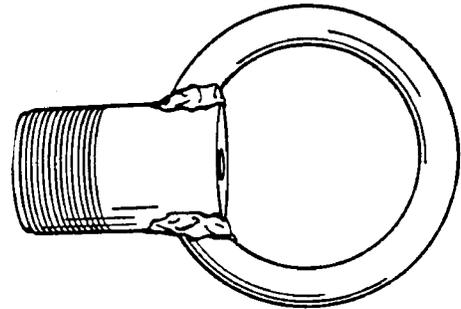
@ Idle 1-1/2 - 4-1/2 psi
@ Poppet Valve Opening .. 6-1/2 - 6-3/4 psi
@ W.O.T 8 - 10 psi

Engine Weight

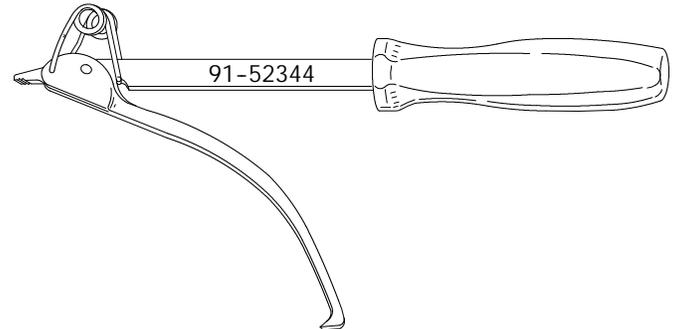
20 in. (50.8cm) Shaft ... 440 lbs. (199.8kg)
25 in. (63.5cm) Shaft ... 445 lbs. (202.0kg)
30 in. (76.2cm) Shaft ... 461 lbs. (209.3kg)

Special Tools

1. Lifting Eye 91-90455



2. Flywheel Holder 91-52344

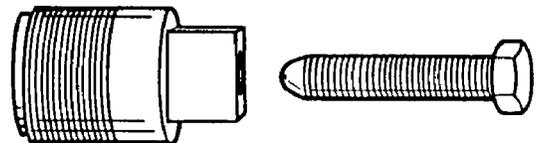


54964

3. Protector Cap 91-24161

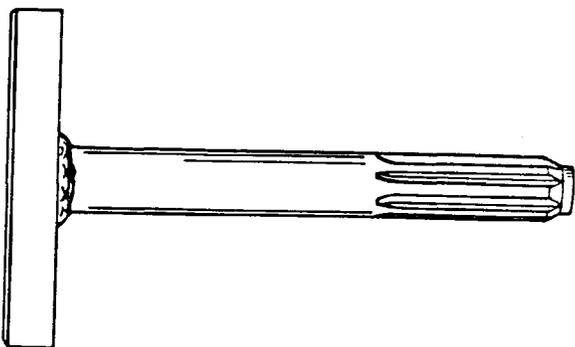


4. Flywheel Puller 91-73687A1

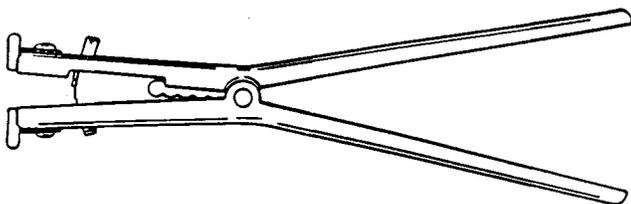




5. Powerhead Stand 91-30591A1



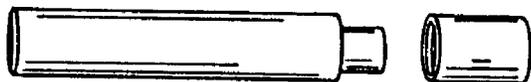
6. Piston Ring Expander 91-24697



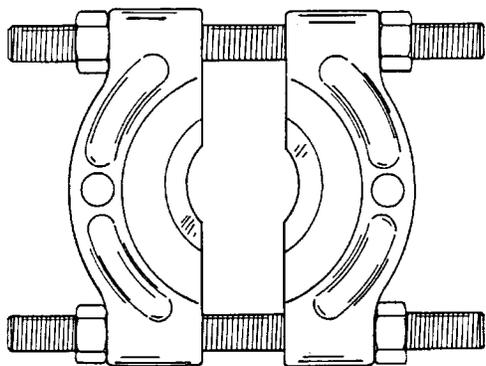
7. Lockring Removal Tool 91-52952A1



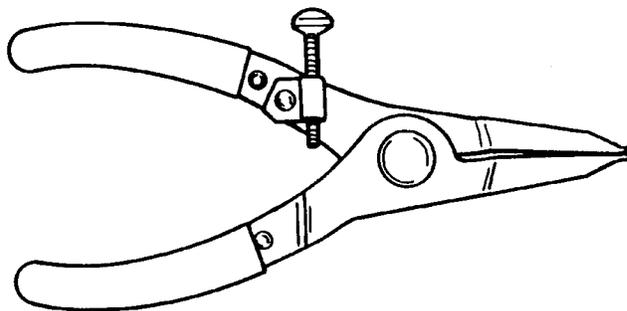
8. Piston Pin Tool 91-92973A1



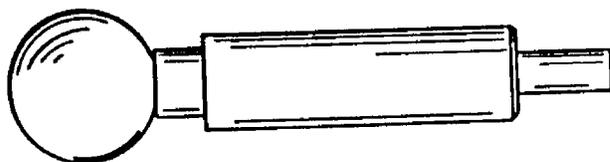
9. Universal Puller Plate 91-37241



10. Snap Ring Pliers 91-24283

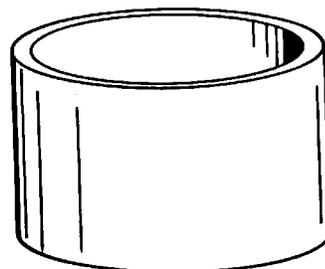


11. Lockring Installation Tool 91-91-93004A2

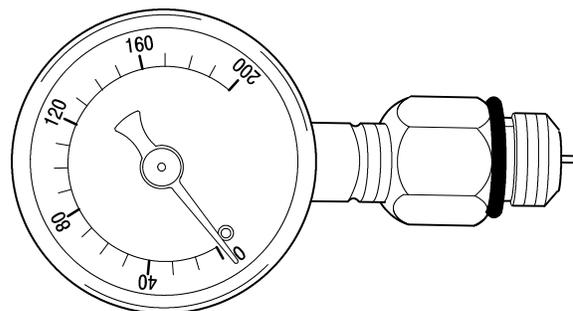


NOTE: If 3.4 Liter Piston Lock Ring Installer (91-93004A1) is available, then only Guide (91-93005-1) is required to install 3 Litre piston lock rings.

12. Piston Ring Compressor 91-823237



13. Compression Tester 91-29287



54965

Powerhead Repair Stand

A powerhead repair stand may be purchased from:

Bob Kerr's Marine Tool Co.
P.O. Box 1135
Winter Garden, FL 32787
Telephone: (305) 656-2089

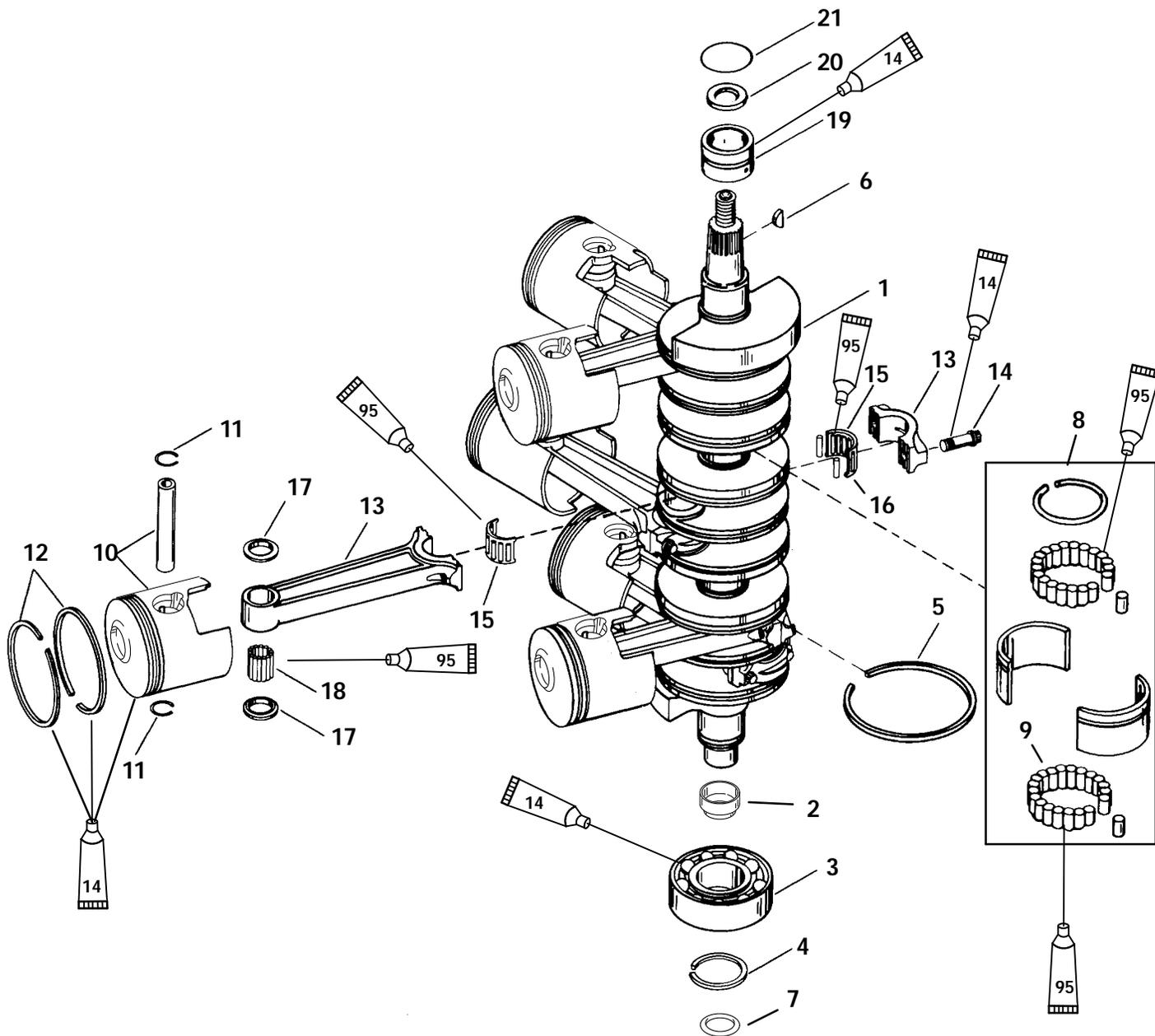


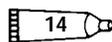
Notes:

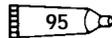




Crankshaft - Pistons - and Connecting Rods



 **14** 2 Cycle Outboard Oil (92-13249A24)

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

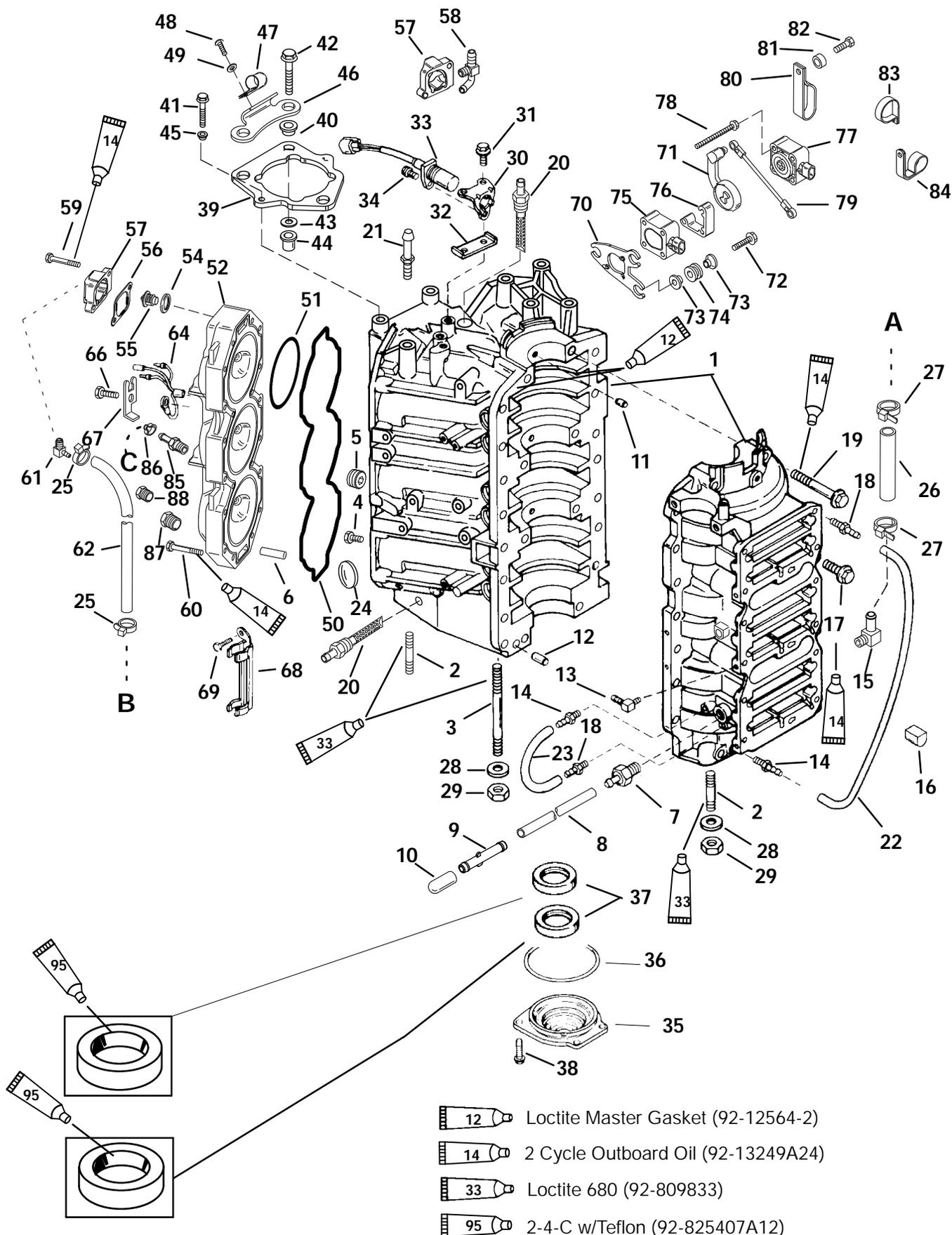


Crankshaft - Pistons - and Connecting Rods

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CRANKSHAFT			
2	1	WEAR SLEEVE			
3	1	BALL BEARING (LOWER)			
4	1	RETAINING RING			
5	7	SEAL RING			
6	1	WOODRUFF KEY			
7	1	O RING			
8	2	BEARING RACE			
9	88	NEEDLE ROLLER			
10	3	PISTON (STBD-STANDARD)			
	3	PISTON (PORT-STANDARD)			
11	12	LOCK RING			
12	12	PISTON RING (STANDARD)			
13	6	CONNECTING ROD ASSEMBLY			
14	12	SCREW (1-1/4 IN.)	Apply light oil to threads and bolt face: 1st torque - 15 lb. in. (1.7 N·m) 2nd torque - 30 lb. ft. (40.7 N·m) Turn bolt an additional 90 degrees after 2nd torque is attained.		
15	12	BEARING CAGE			
16	96	NEEDLE ROLLER BEARING			
17	12	THRUST WASHER			
18	204	ROLLER BEARING			
19	1	MAIN BEARING (UPPER)			
20	1	OIL SEAL			
21	1	O RING			



Cylinder Block and End Cap



A - TO FUEL PUMP

B = TO ADAPTOR PLATE

C = TO PRESSURE SENSOR

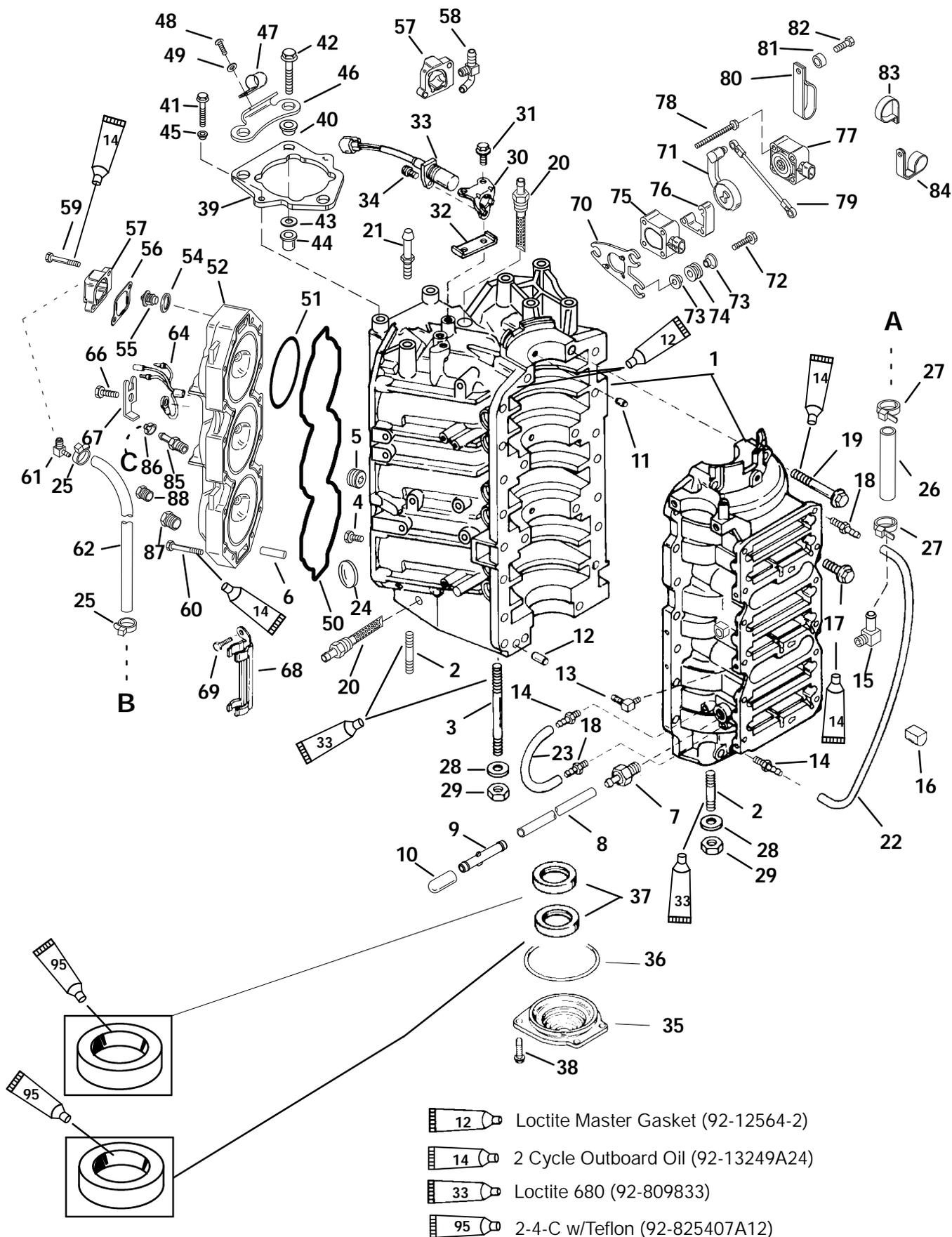


CYLINDER BLOCK AND END CAP

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	CYLINDER BLOCK (225)			
1	1	CYLINDER BLOCK (200)			
2	4	STUD (M10 x 1.5 x 64)			
3	6	STUD (M10 x 1.5 x 155)			
4	1	PIPE PLUG (1/8 IN.)			
5	1	PIPE PLUG (3/4-14)			
6	6	WATER DEFLECTOR			
7	1	CHECK VALVE			
8	1	TUBING (6 IN.)			
9	1	CONNECTOR			
10	1	PLUG			
11	3	CENTER MAIN PIN			
12	1	DOWEL PIN			
13	6	FITTING			
14	2	CHECK VALVE			
15	1	ELBOW			
16	6	STOP PLUG			
17	12	SCREW (M8 x 35)		21	28.5
18	2	CHECK VALVE			
19	8	SCREW (M10 x 1.5)			Torque to 30 lb. ft. (40.5 N·m) and rotate 90 degrees
20	2	STRAINER			
21	1	PIN	65		7.3
22	1	TUBING (22-1/2 IN.)			
23	1	TUBING (3-3/4 IN.)			
24	1	PLUG-Serial Number			
25	4	STA-STRAP			
26	1	TUBING (9-1/4 IN.)			
27	2	SPRING CLAMP			
28	10	WASHER			
29	10	NUT		50	67.8
30	1	BRACKET			
31	2	SCREW (M6 x 16)	100		11.3
32	1	GUIDE BRACKET			
33	1	CRANK POSITION SENSOR			
34	1	SCREW (M5 x 10)	50		5.6
35	1	LOWER END CAP			
36	1	O RING			
37	2	OIL SEAL			
38	4	SCREW (M6 x 20)	85		9.6
39	1	PLATE ASSEMBLY			
40	3	MOUNT			
41	3	SCREW (M10 x 45)		40	54.2
42	2	SCREW (M10 x 75)		40	54.2



CYLINDER BLOCK AND END CAP



A - TO FUEL PUMP

B = TO ADAPTOR PLATE

C = TO PRESSURE SENSOR



Cylinder Block and End Cap

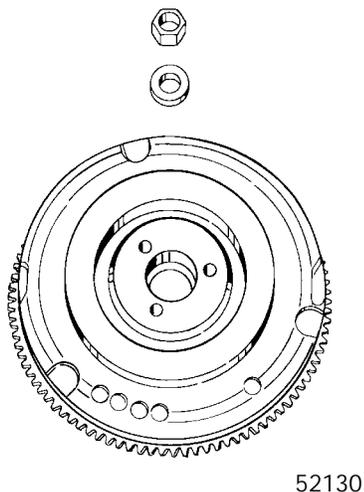
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
43	4	WASHER			
44	2	SPACER			
45	1	SPACER			
46	1	BRACKET			
47	2	CLAMP			
48	2	SCREW (M6 x 10)			
49	2	WASHER			
50	2	SEAL- cylinder head			
51	6	O RING			
52	1	CYLINDER HEAD (STARBOARD) 225			
	1	CYLINDER HEAD (PORT)			
53	1	CYLINDER HEAD (STARBOARD) 200			
	1	CYLINDER HEAD (PORT)			
54	2	SEAL-thermostat			
55	2	THERMOSTAT			
56	2	GASKET- thermostat cover			
57	2	COVER- thermostat			
58	1	FITTING (PORT)			
59	4	SCREW (M6 x 25)	100		11.3
60	40	SCREW (M8 x 50)	Refer to page 4A-11 for Cylinder Head Torque		
61	1	ELBOW (STARBOARD)			
62	1	TUBING (STBD. 21 IN.)			
63	1	TUBING (PORT 20-1/2 IN.)			
64	1	TEMPERATURE SENSOR (PORT)			
65	1	TEMPERATURE SENSOR (STARBOARD)			
66	2	SCREW (M8 x 12)	200	17	22.6
67	2	SENSOR RETAINER			
68	1	CLAMP			
69	2	SCREW (M6 x 12)	100		11.3
70	1	BRACKET			
71	1	TPI LEVER			
72	3	SCREW-Bracket to Crankcase (M6 x 25)	55		6.2
73	6	BUSHING			
74	3	GROMMET			
75	1	THROTTLE POSITION SENSOR (INSIDE)			
76	1	SPACER			
77	1	THROTTLE POSITION SENSOR (OUTSIDE)			
78	3	SCREW TPS to bracket (M5 x 65)	35		4.0
79	1	THROTTLE LINK			
80	1	CLAMP			
81	1	SPACER			
82	1	SCREW (M8 x 20)			
83	1	CLAMP			
84	1	CLAMP			
85	1	FITTING			
86	1	STA-STRAP			
87	1	PIPE PLUG			
88	1	PIPE PLUG			



Powerhead Torque Sequence and Torque Specifications

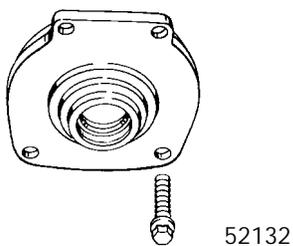
FLYWHEEL LOCKNUT
125 lb. ft. (169.5 N·m)

Important: DO NOT apply oil to flywheel/crankshaft taper.



52130

LOWER END CAP BOLTS
85 lb. in. (9.6 N·m)

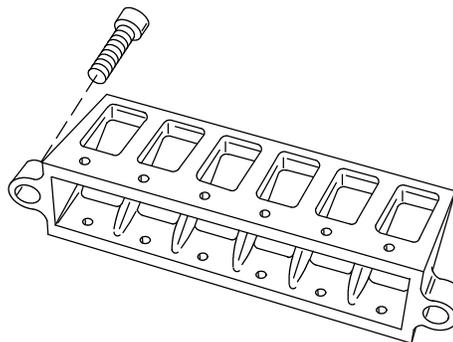


52132

SPARK PLUGS
20 lb. ft. (27.1 N·m)

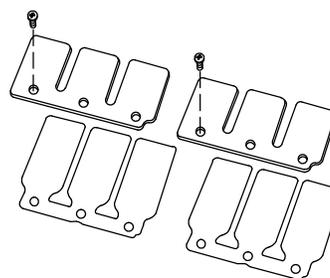


REED BLOCK MOUNTING BOLTS
90 lb. in. (10.2 N·m)



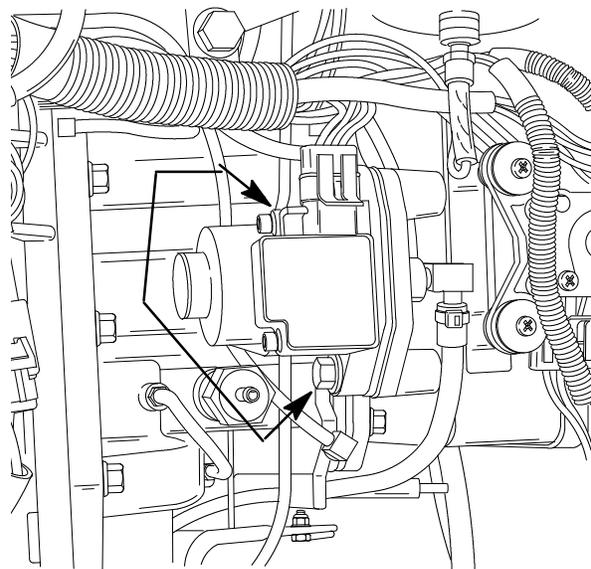
55979

REED ATTACHING SCREWS
25 lb. in. (2.8 N·m)



55980

OIL PUMP ATTACHING SCREWS
16 lb. ft. (21.7 N·m)



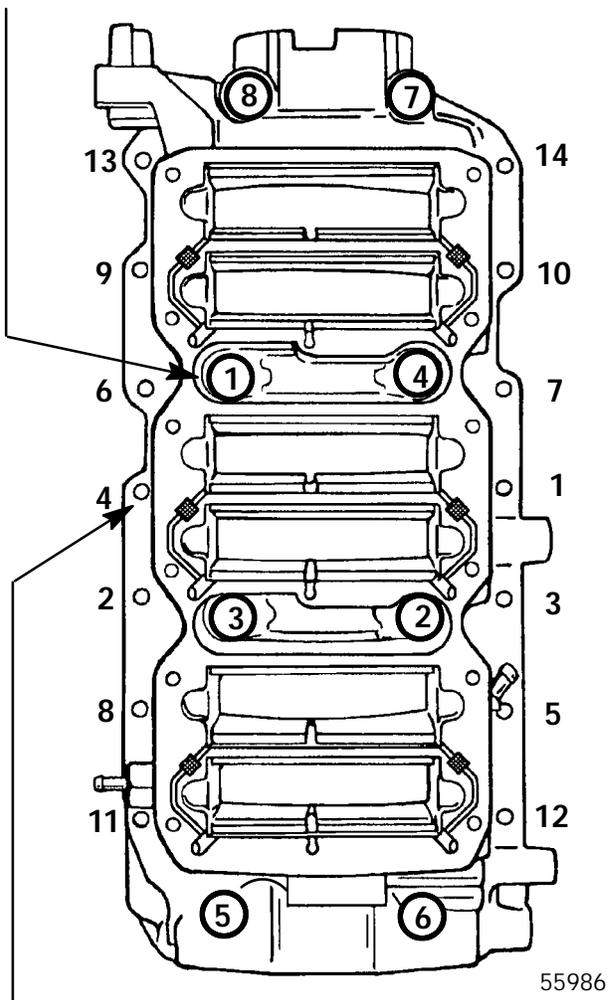
55194



Powerhead Torque Sequence and Torque Specifications

CRANKCASE COVER BOLTS (AND TORQUE SEQUENCE)

Add light oil to threads and bolt face:
8 Bolts (M10 x 1.5 x 80)
30 lb. ft. (40.6 N-m) and rotate 90°

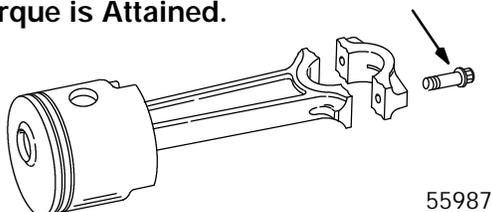


14 Bolts (M8 x 1.25 x 35)
28.0 lb. ft. (37.9 N-m)

PISTON ROD BOLTS

IMPORTANT: IT IS RECOMMENDED THAT ROD BOLTS BE DISCARDED AFTER REMOVAL AND REPLACED WITH NEW BOLTS.

Apply light oil to threads and bolt face:
1st Torque - 15 lb. in. (1.7 N-m.)
2nd Torque - 30 lb. ft. (40.7 N-m.)
Turn bolt an additional 90° after 2nd Torque is Attained.

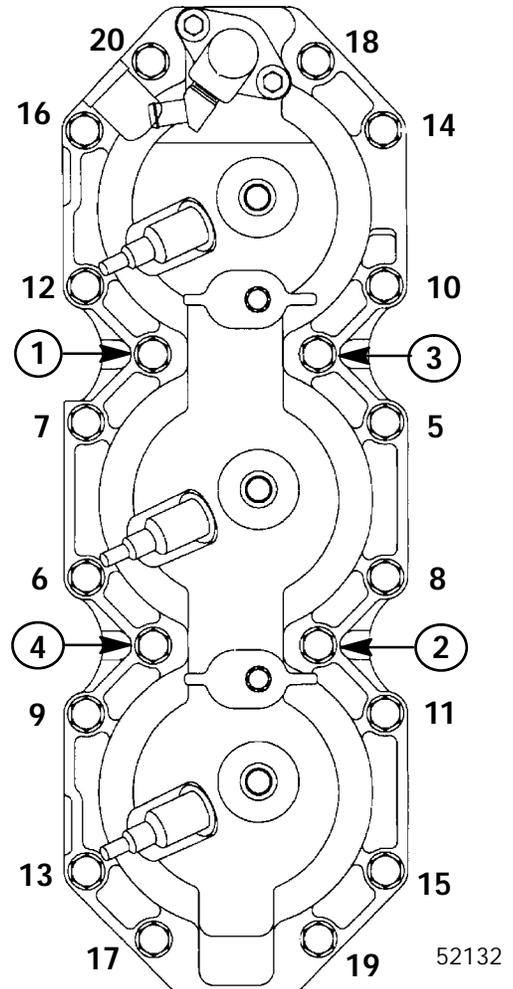


55987

CYLINDER HEAD BOLTS (AND TORQUE SEQUENCE)

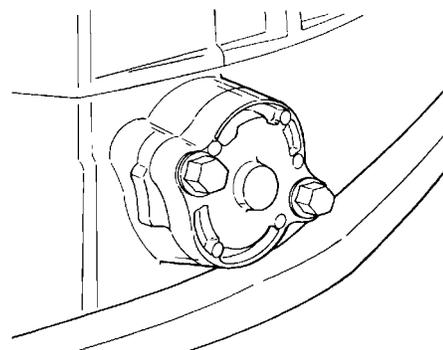
IMPORTANT

Add light oil to threads and bolt face:
Torque to 20 lb. ft. (27.1 N-m) and rotate 90°



52132

RELIEF VALVE COVER BOLTS 20.0 lb. ft. (27.1 N-m)



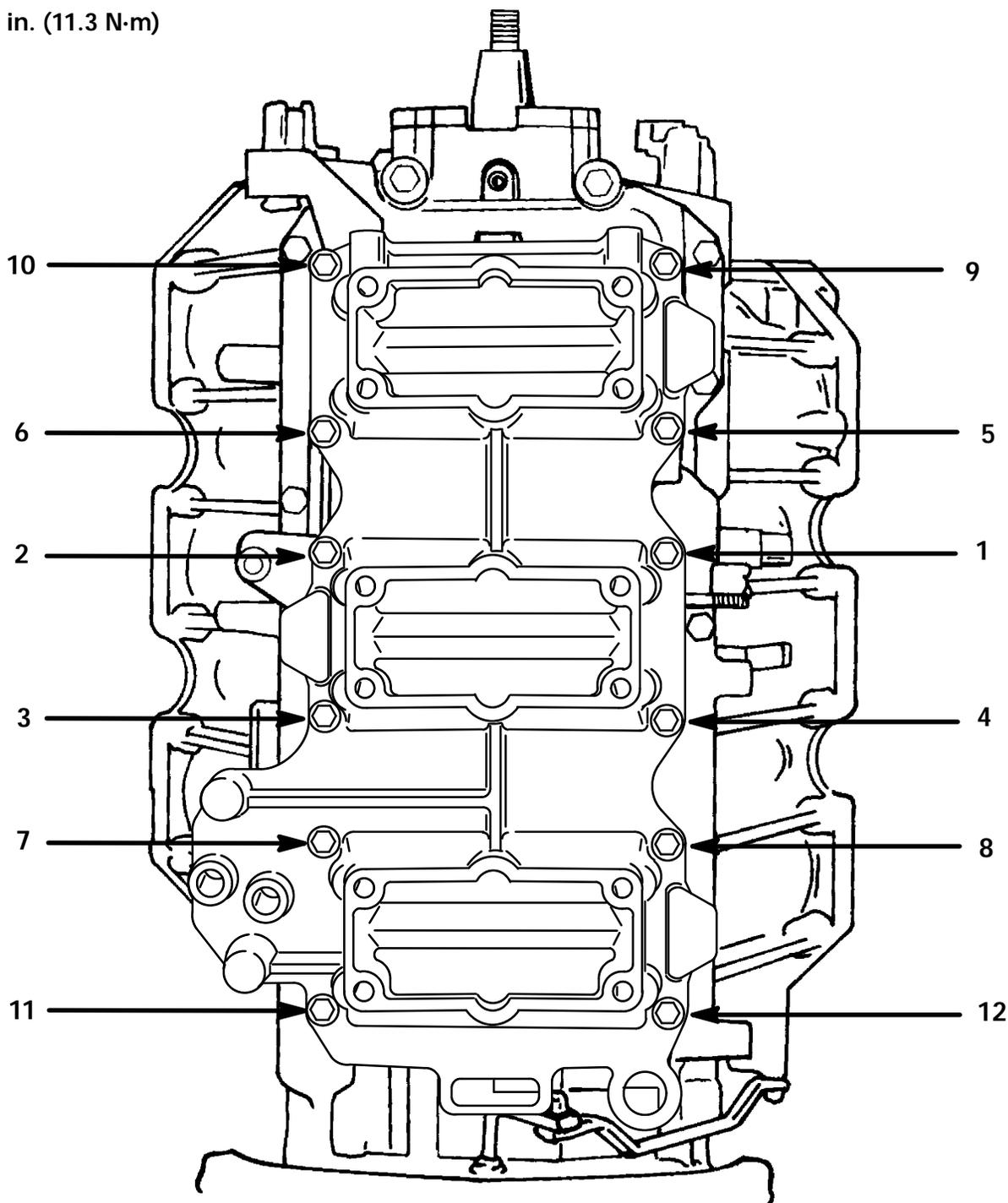
51707



Powerhead Torque Sequence (Continued)

Intake Manifold

100 lb. in. (11.3 N·m)



55975



General Information

Powerhead "Disassembly" and "Reassembly" instructions are printed in a sequence that should be followed to assure best results when removing or replacing powerhead components. If complete disassembly is not necessary, start reassembly at point disassembly was stopped. (Refer to "Table of Contents," preceding.)

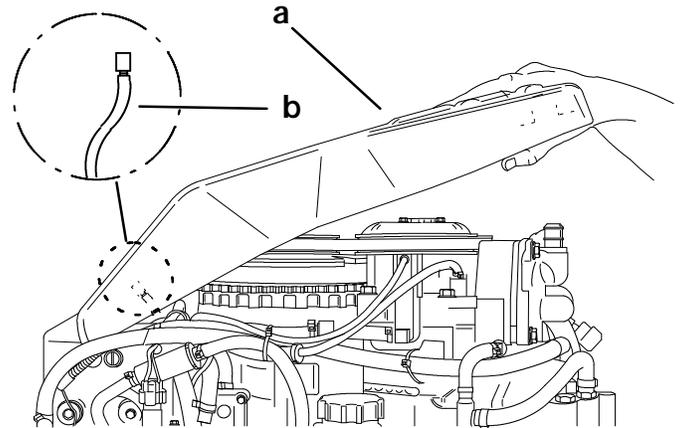
If major powerhead repairs are to be performed, remove powerhead from drive shaft housing. Removal of powerhead is not required for 1) inspection of cylinder walls and 2) minor repairs on components such as ignition system, carburetors, reed blocks, cylinder heads and checking operation of thermostats.

Powerhead Removal from Driveshaft Housing

1. Disconnect battery cables from battery terminals.
2. Remove top cowling.

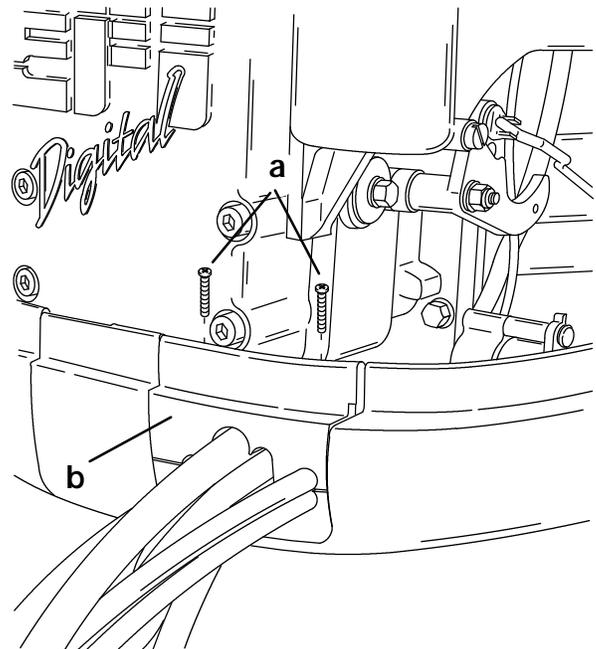
IMPORTANT: Prior to removing flywheel cover, remove vent hose from fitting on flywheel cover.

3. Remove flywheel cover.



- a - Cover
- b - Vent Hose

4. Remove two screws which secure remote control harness retainer and remove retainer.

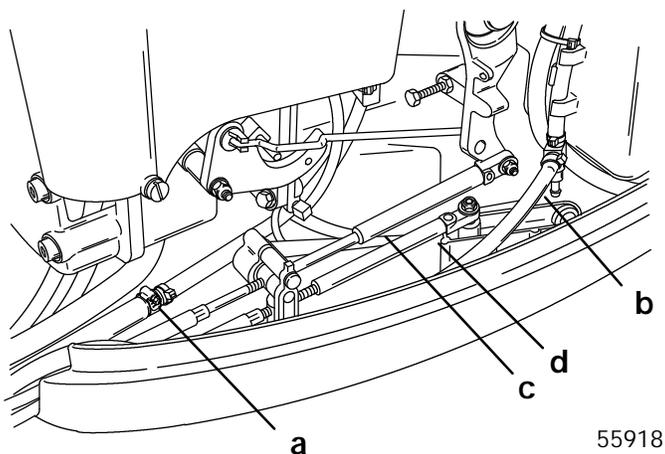


- a - Screws
- b - Retainer

55917



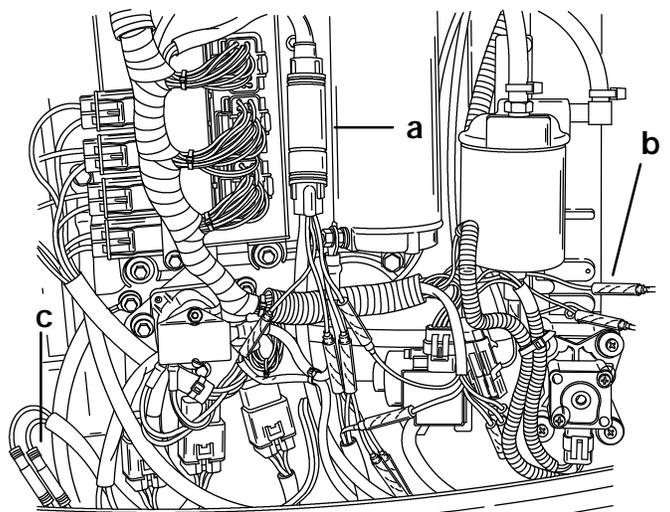
5. Disconnect fuel hose, oil inlet hose, throttle cable and shift cable.



55918

- a - Fuel Hose
- b - Oil Inlet Hose
- c - Throttle Cable
- d - Shift Cable

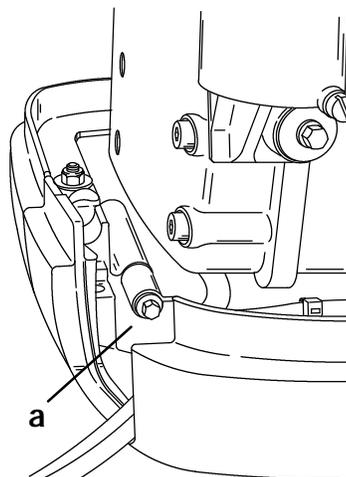
6. Disconnect remote control harness from powerhead harness.
7. Disconnect warning gauge wiring harness.
8. Disconnect trim motor harness.



55919

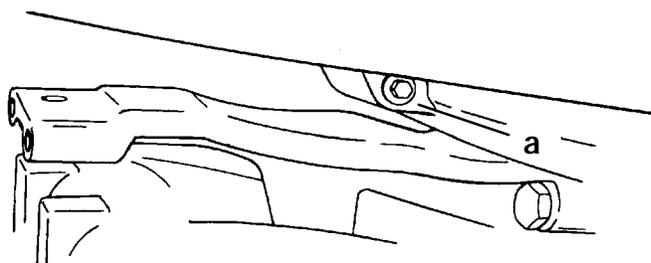
- a - Remote Control Harness
- b - Warning Gauge Harness
- c - Trim Motor Harness

9. Remove 4 bolts securing bottom cowl halves and remove bottom cowl.



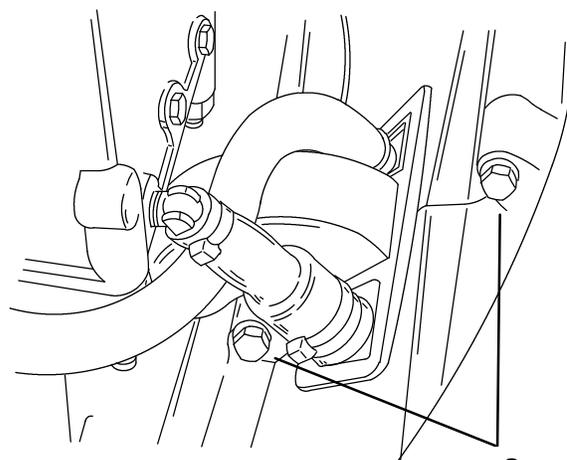
55932

- a - Bolt



52352

- a - Bolt

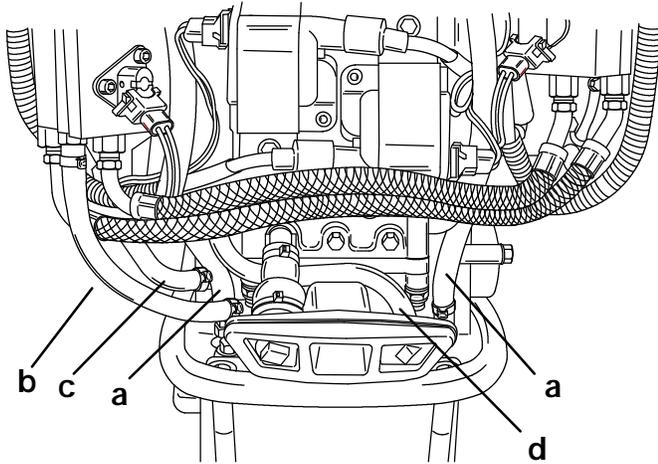


55970

- a - Bolt



10. If a suitable powerhead holding fixture is available, powerhead may be removed fully dressed. Disconnect 2 thermostat hoses, fuel rail air outlet hose, fuel cooler water hose and tell-tale hose.

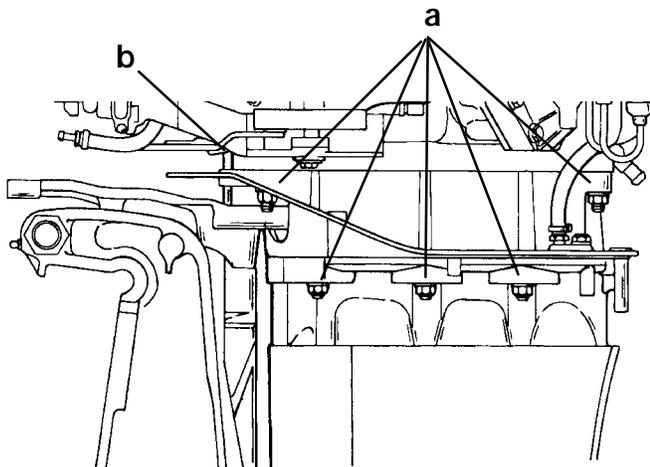


55920

- a - Thermostat Water Hoses
- b - Fuel Rail Air Outlet Hose
- c - Fuel Cooler Water Hose
- d - Tell-Tale Hose

11. Disconnect shift link from upper shift shaft.

12. Remove 10 nuts and washers (5 each side) from powerhead base.

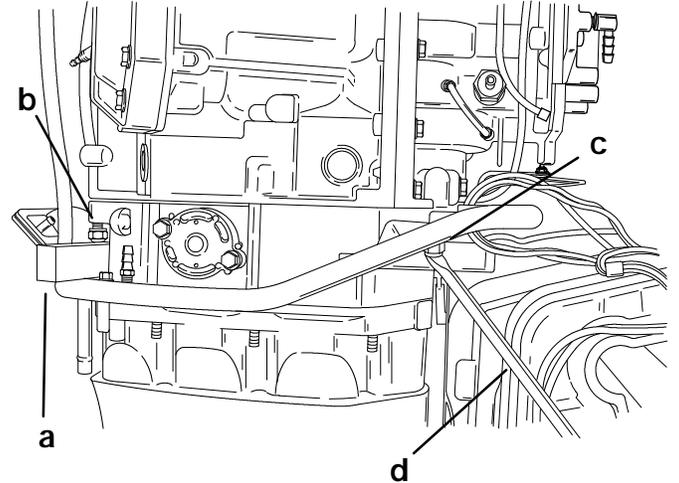


52373

- a - Nuts and Washers (5 each side)
- b - Shift Link

13. Remove plastic cap from center of flywheel and install Lifting Eye (91-90455) into flywheel at least 5 full turns. Using a hoist, lift powerhead assembly from drive shaft housing.

NOTE: If powerhead cannot be removed due to gasket adhesion, reinstall fore and aft powerhead nuts. Install a jacking block under the aft powerhead nut. Place a pry bar under the forward powerhead nut. Unscrew the aft nut against the jacking block while prying up on the forward nut to break the gasket adhesion.



55955

- a - Jacking Block
- b - Aft Nut
- c - Forward Nut
- d - Pry Bar



REMOVING ENGINE COMPONENTS

Remove the following engine components by referring to the following sections:

Section 2

Starter Motor

Alternator

Ignition Modules

Electronic Control Unit

Solenoids

Crank Position Sensor

Throttle Position Sensor

Temperature Sensor

Section 3

Air Plenum

Fuel Pump

On-Board Oil Tank

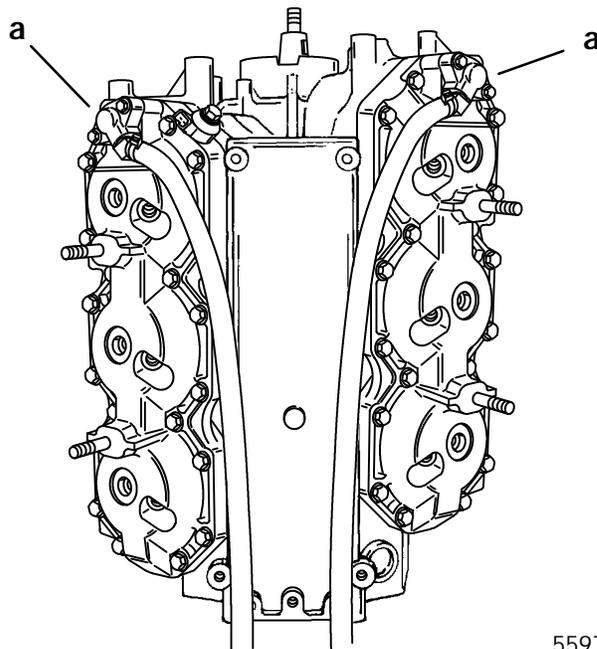
Oil Pump

Fuel Rails

Vapor Separator

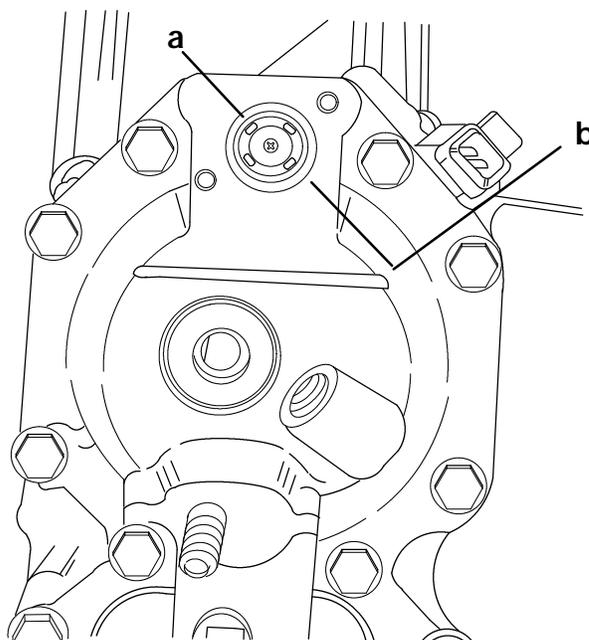
Powerhead Disassembly

1. Place powerhead in repair stand or on a bench.
2. Remove thermostat covers, thermostats and gaskets.



55973

a - Thermostat Cover

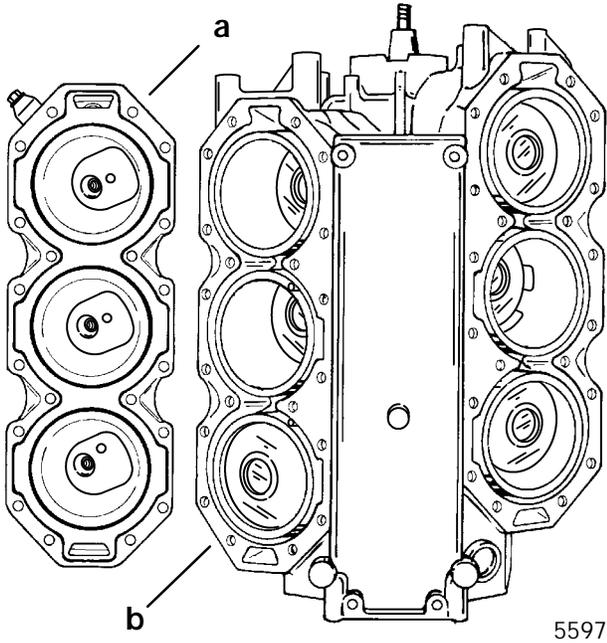


55972

a - Thermostat
b - Gasket



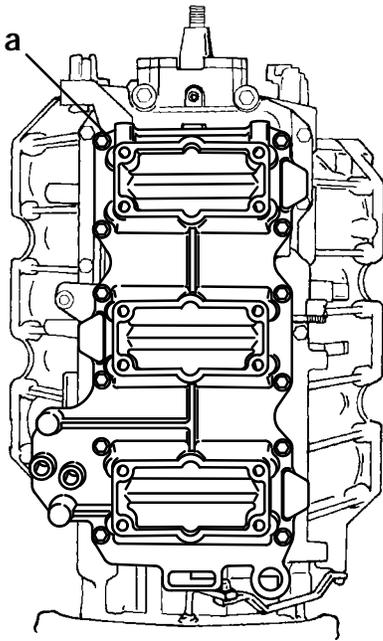
3. Remove cylinder heads from engine block.



a - Cylinder Head
b - Engine Block

55973

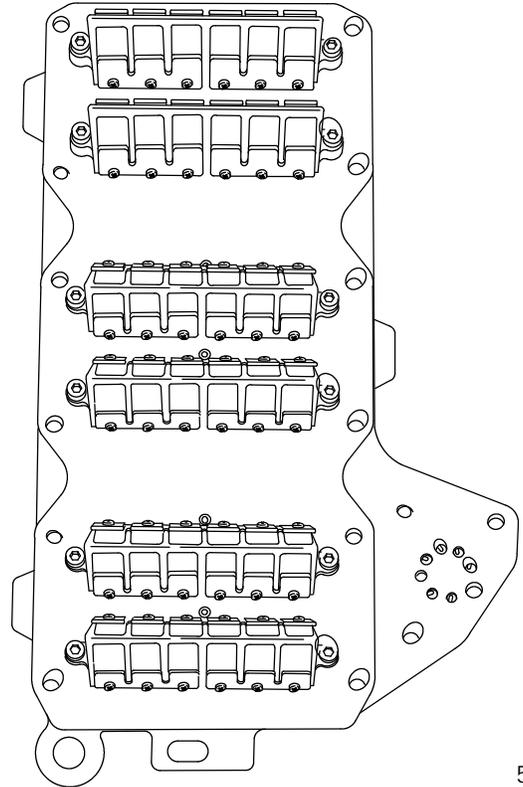
4. Remove reed block housing from cylinder block.



a - Reed Block Housing

55975

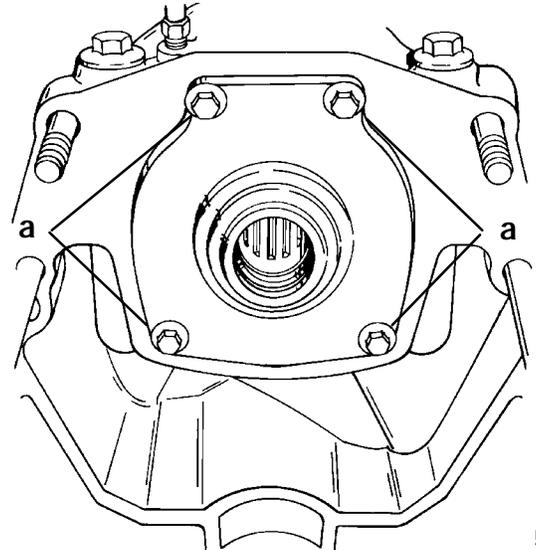
5. Inspect reeds as outlined in "Cleaning and Inspection".



55976

6. Remove bolts from end cap.

LOWER END CAP

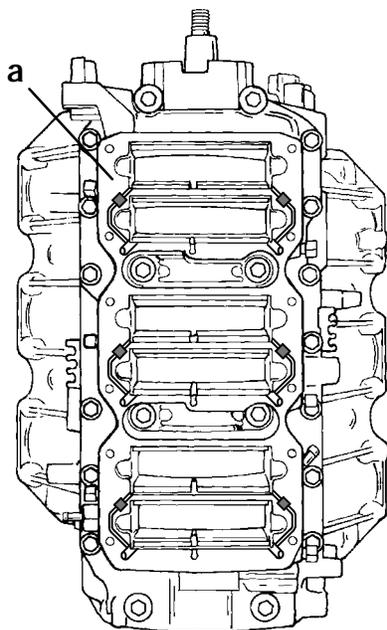


a - Crankcase Attaching End Cap Bolts

52325



7. Remove bolts which secure crankcase cover to cylinder block.

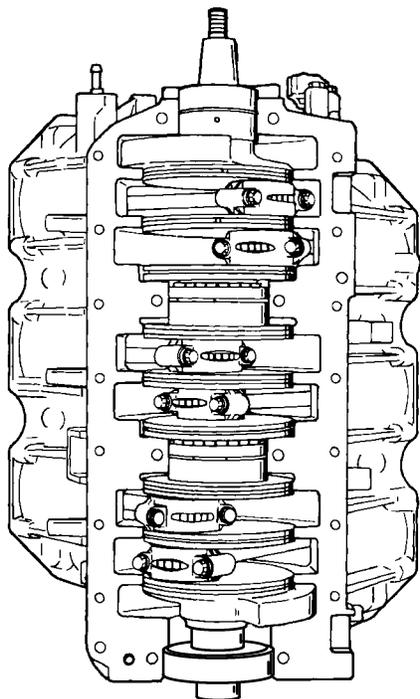


55977

a - Crankcase Cover

8. Remove crankcase end cap.

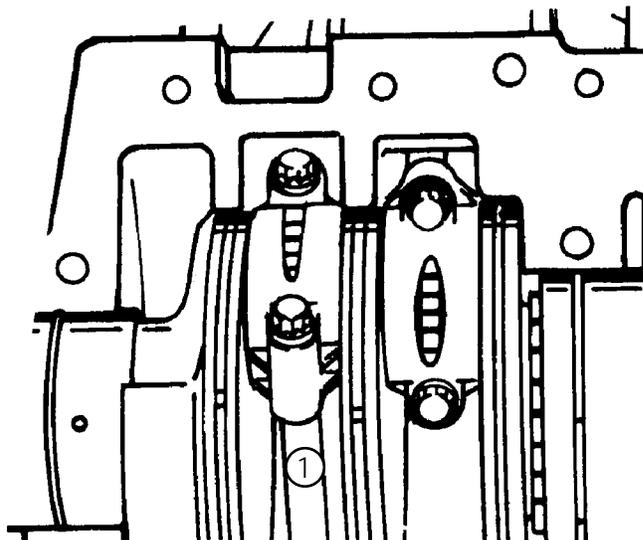
CRANKCASE COVER REMOVED



55978

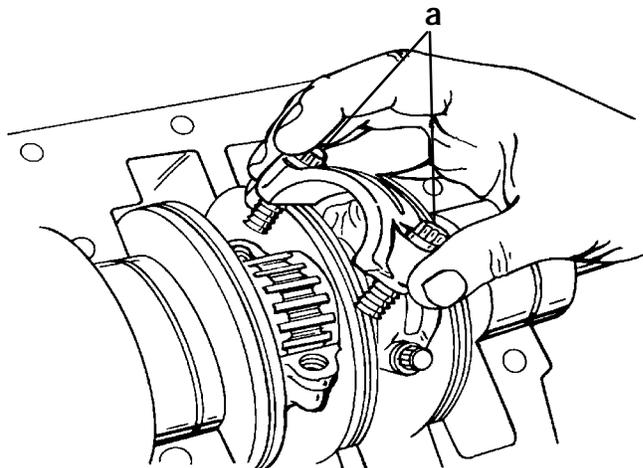
9. Use Powerhead Stand (91-812549) for rotating crankshaft to desired position for removal of connecting rods.

10. Using an awl or electric pencil, scribe the cylinder identification number on each connecting rod as shown. Reassemble connecting rods in same cylinder.



52347

11. Use a 3/8 in. 12 point socket to remove connecting rod bolts, then remove rod cap, roller bearings and bearing cage from connecting rod.



52316

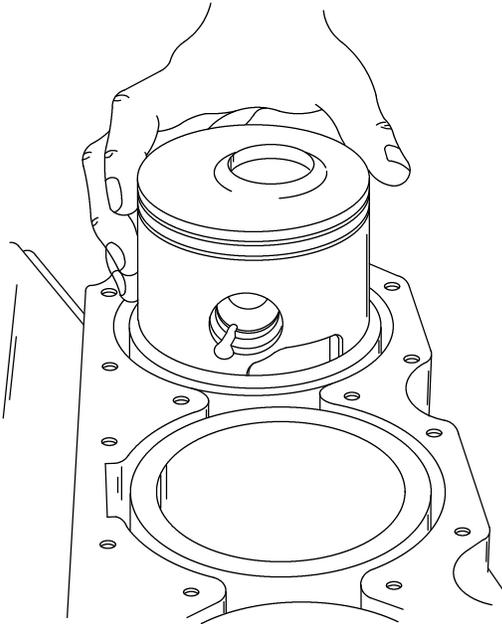
a - Connecting Rod Bolts

12. Push piston out of cylinder block.
13. After removal, reassemble each piston and connecting rod assembly.



CAUTION

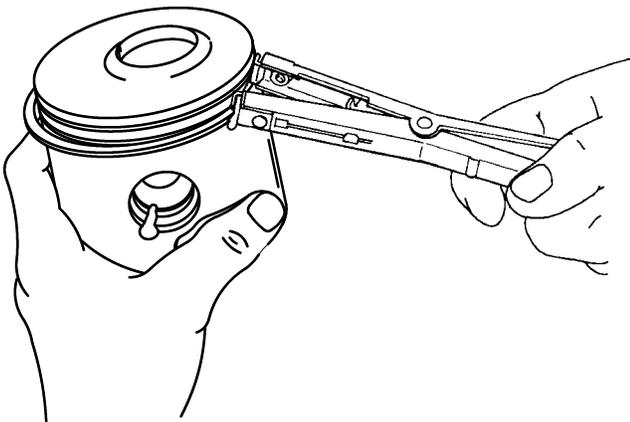
Each connecting rod and end cap are a matched machined set and must never be mismatched.



55966

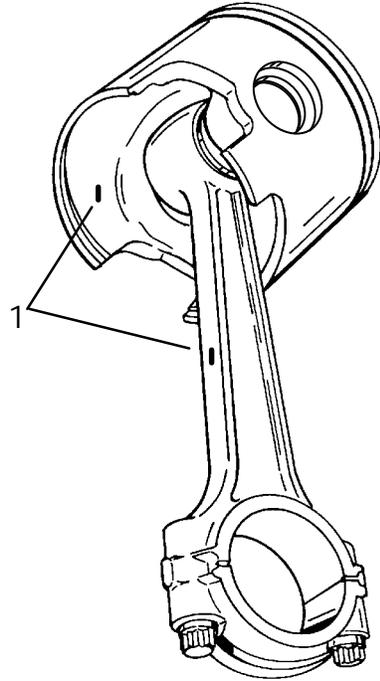
14. Inspect pistons as outlined in "Cleaning and Inspection," following.

15. Use Piston Ring Expander (91-24697) to remove piston rings. Always install new piston rings.



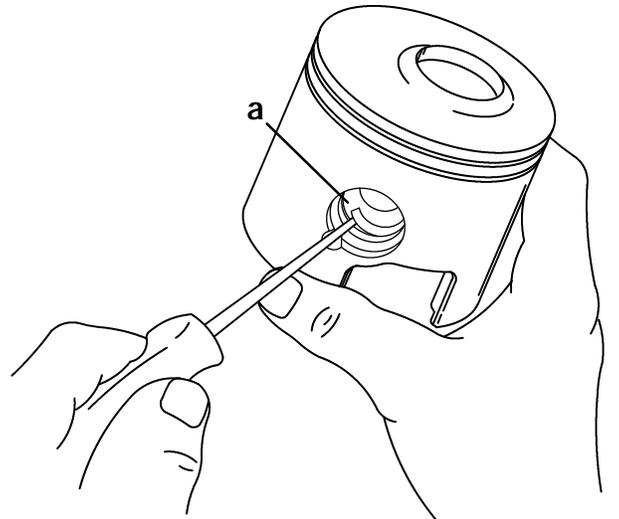
55967

16. Using an awl, scribe identification number of connecting rod on inside of piston (1). Reassemble piston on same connecting rod.



55968

17. Using tool (91-52952A1), remove piston pin lockrings from both ends of piston pin. Never re-use piston pin lockrings.



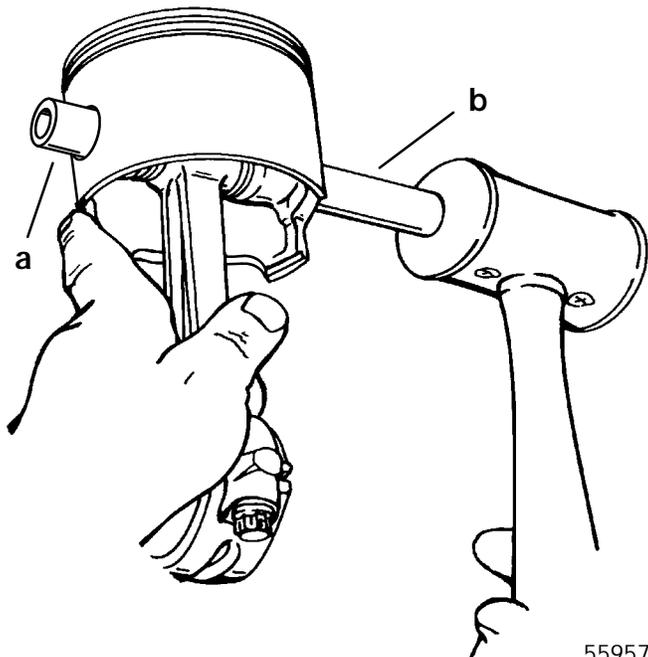
55969

a - Lockring



IMPORTANT: Warming the piston dome using a torch lamp will ease removal and installation of piston pin.

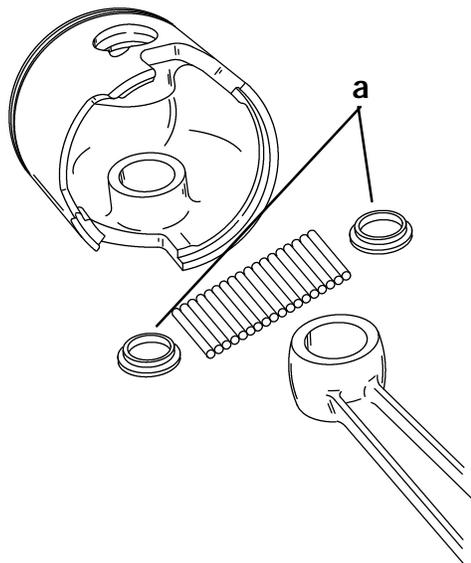
18. Support piston and tap out piston pin using service tool (91-92973A1) as shown.



a - Piston Pin
b - Piston Pin Tool (91-92973A1)

19. Remove piston pin needle bearings (34 per piston) and locating washers (2 per piston) as shown.

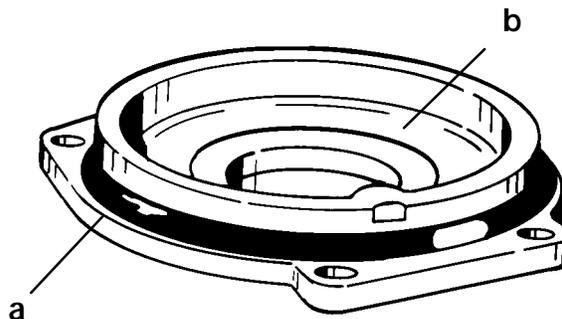
IMPORTANT: We recommend that you use new needle bearings at reassembly for lasting repair. However, if needle bearings must be re-used, keep each set of bearings identified for reassembly on same connecting rod.



a - Needle Bearing Locating Washers

20. Remove and discard O-ring seal from end cap.

21. Remove oil seals from end cap by driving seals out with a punch and hammer.

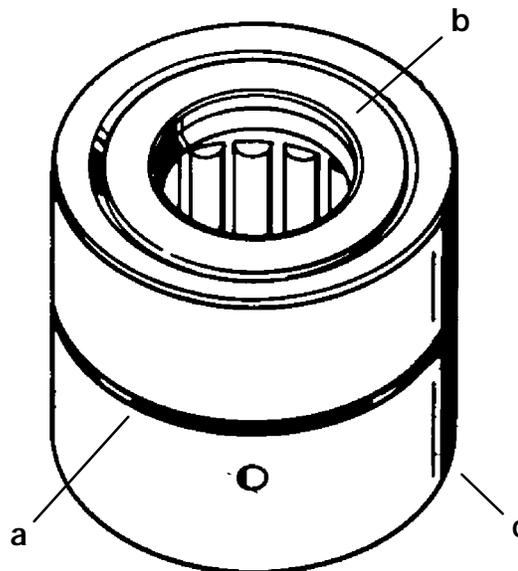


51849

a - O-ring
b - Seals (2)

22. Inspect roller bearing in upper bearing carrier as outlined in "Cleaning and Inspection".

NOTE: If roller bearing is damaged, replace bearing carrier assembly.



51473

a - O-Ring
b - Seal
c - Carrier

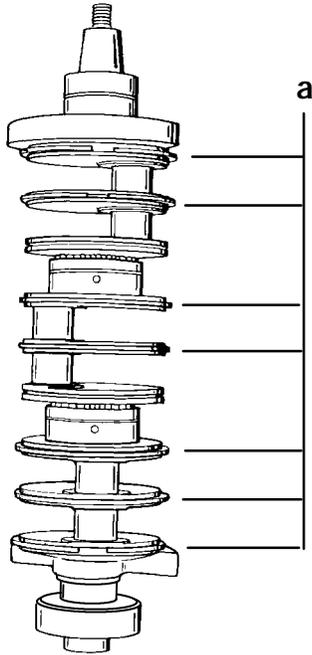


23. Remove crankshaft and place in powerhead stand as shown.

IMPORTANT: DO NOT remove crankshaft sealing rings from crankshaft, unless replacement of a sealing ring(s) is necessary. Usually, crankshaft sealing rings do not require replacement, unless broken.

CAUTION

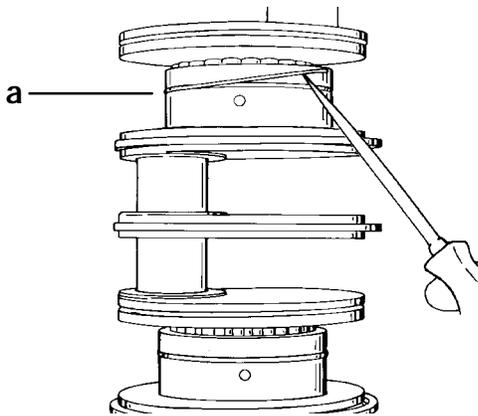
Safety glasses should be worn when removing or installing crankshaft sealing rings.



55994

a - Sealing Rings (7)

24. Remove retaining ring as shown.

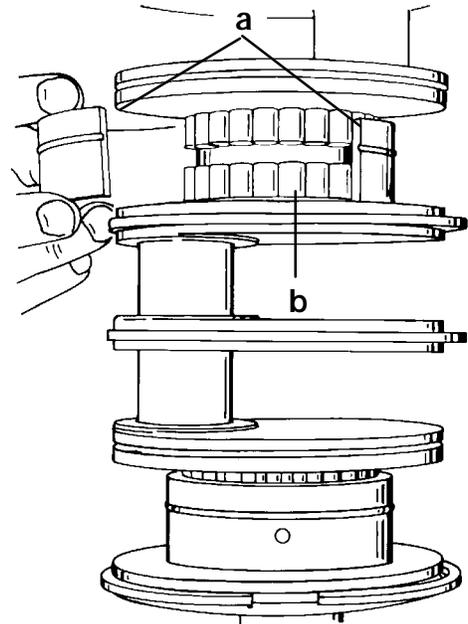


52336

a - Retaining Ring

25. Remove bearing race halves and roller bearings from crankshaft.

IMPORTANT: Keep same bearing races and roller bearings together.



52315

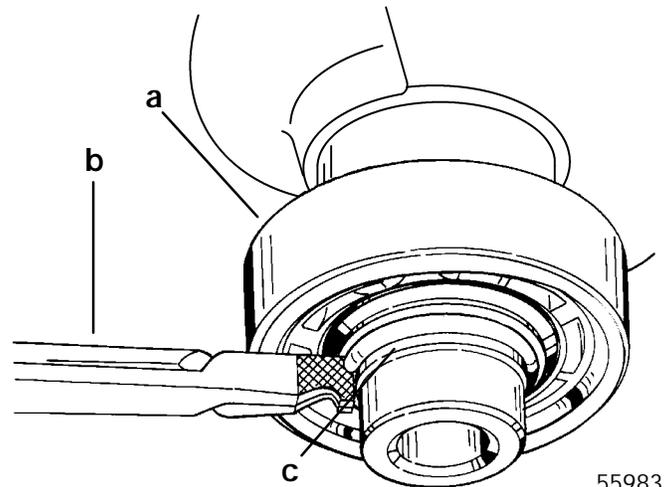
a - Bearing Race Halves
b - Roller Bearings

Inspect crankshaft ball bearing as outlined in "Cleaning and Inspection," following.

IMPORTANT: DO NOT remove crankshaft ball bearing, unless replacement is required.

26. Remove lower ball bearing from crankshaft as follows:

- a. Remove retaining ring using a pair of snap ring pliers.

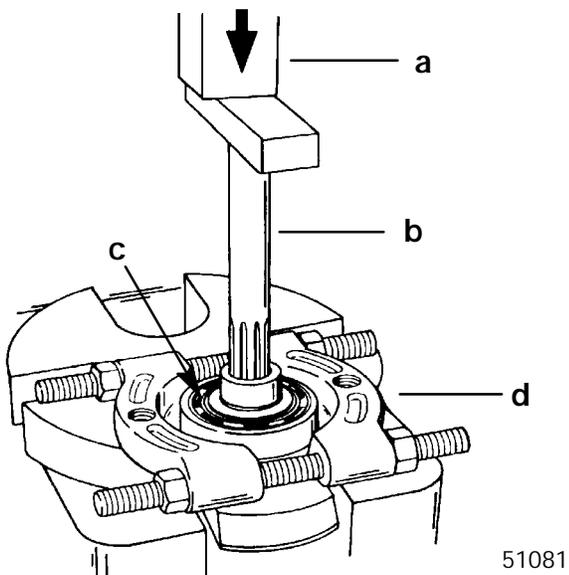


55983

a - Crankshaft Ball Bearing
b - Pliers
c - Retaining Ring



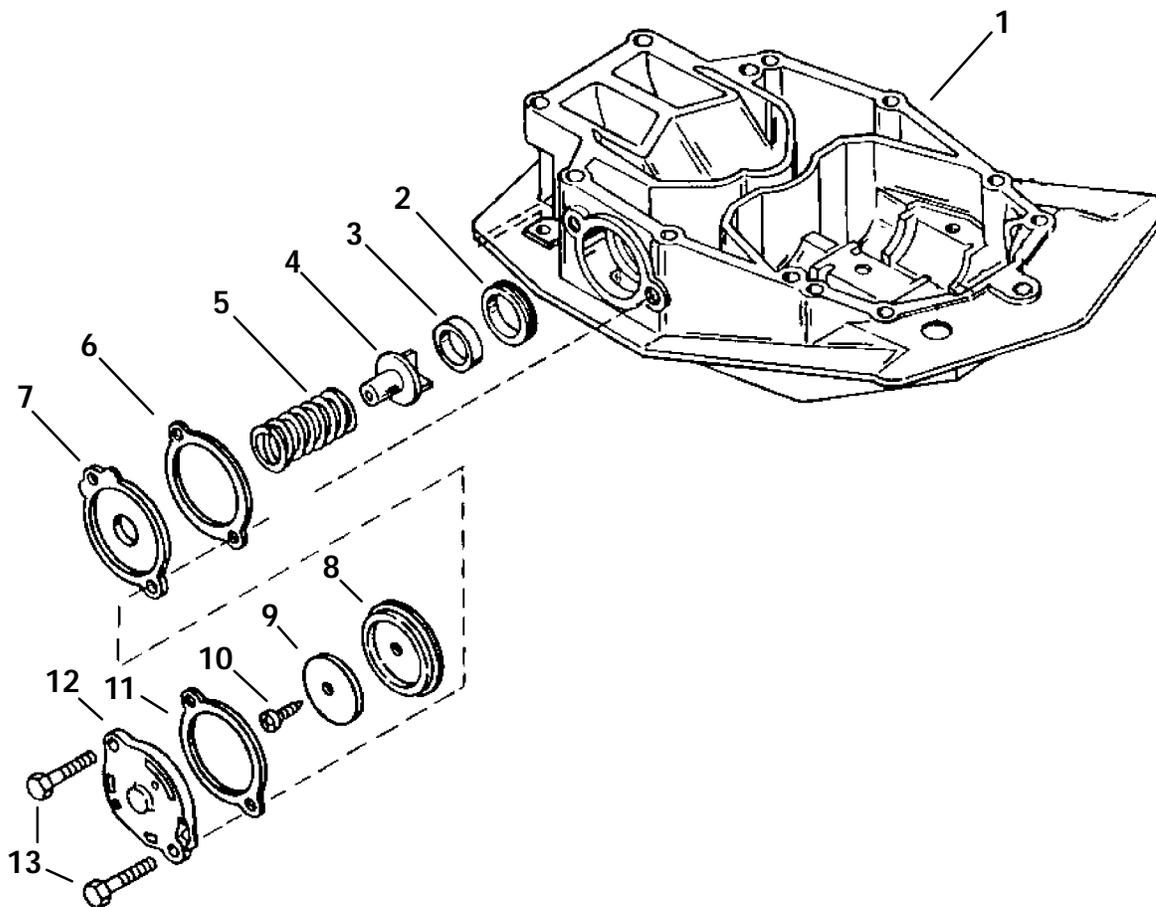
b. Press crankshaft out of lower ball bearing as shown.



51081

- a - Press
- b - Powerhead Stand (91-812549)
- c - Crankshaft Ball Bearing
- d - Universal Puller Plate (91-37241)

27. Remove and inspect water pressure relief valve components for debris or damage. Replace components as required.



- 1 - Exhaust Plate
- 2 - Carrier
- 3 - Grommet
- 4 - Poppet/Relief Valve
- 5 - Spring
- 6 - Gasket
- 7 - Inner Plate

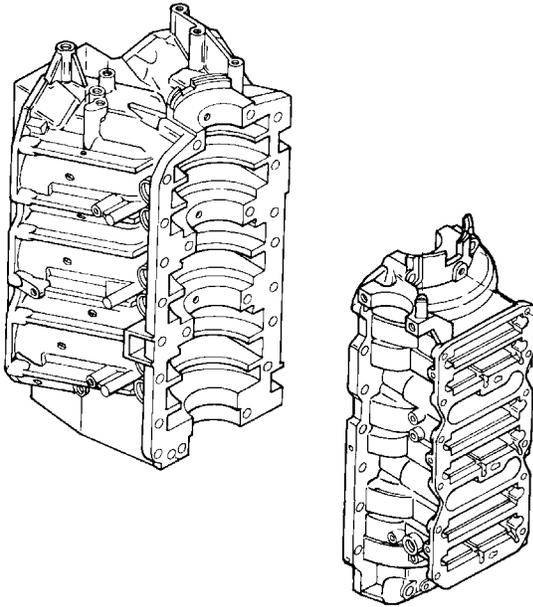
- 8 - Diaphragm
- 9 - Washer
- 10- Screw
- 11- Gasket
- 12- Outer Cover
- 13- Bolts [Torque bolts to 20 lb. ft. (27.1 N-m)]



Cleaning and Inspection

Cylinder Block and Crankcase Cover

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



⚠ CAUTION

It crankcase cover or cylinder block is to be submerged in a very strong cleaning solution, it will be necessary to remove the crankcase cover/cylinder block bleed system from crankcase cover/cylinder block to prevent damage to hoses and check valves.

1. Thoroughly clean cylinder block and crankcase cover. Be sure that all sealant and old gaskets are removed from matching surfaces. Be sure that carbon deposits are removed from exhaust ports.
2. Inspect cylinder block and crankcase cover for cracks or fractures.
3. Check gasket surfaces for nicks, deep grooves, cracks and distortion that could cause compression leakages.
4. Check all water and oil passages in cylinder block and crankcase cover to be sure that they are not obstructed and that plugs are in place and tight.

Special Service Information

Grooves in Cylinder Block Caused By Crankshaft Sealing Rings

Grooves in cylinder block caused by crankshaft sealing rings are not a problem, except if installing a new crankshaft and the new sealing rings on crankshaft do not line up with existing grooves in cylinder block. If installing a new crankshaft, refer to crankshaft installation, Powerhead Reassembly section to determine if powerhead can be used.

Cylinder Bores

1. Inspect cylinder bores for scoring, scuffing or a transfer of aluminum from piston to cylinder wall. Scoring or scuffing, if NOT TOO SEVERE, can normally be removed by honing. If a transfer of aluminum has occurred, an acidic solution such as "TIDY BOWL CLEANER" should be applied to the areas of the cylinder bore where transfer of aluminum has occurred. After the acidic solution has removed the transferred aluminum, thoroughly flush the cylinder bore(s) to remove any remaining acid. Cylinder walls may now be honed to remove any glaze and to aid in the seating of new piston rings.

HONING PROCEDURE

- a. When cylinders are to be honed, follow the hone manufacturer's recommendations for use of the hone and cleaning and lubrication during honing.
- b. For best results, a continuous flow of honing oil should be pumped into the work area. If pumping oil is not practical, use an oil can. Apply oil generously and frequently on both stones and work area.

⚠ CAUTION

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

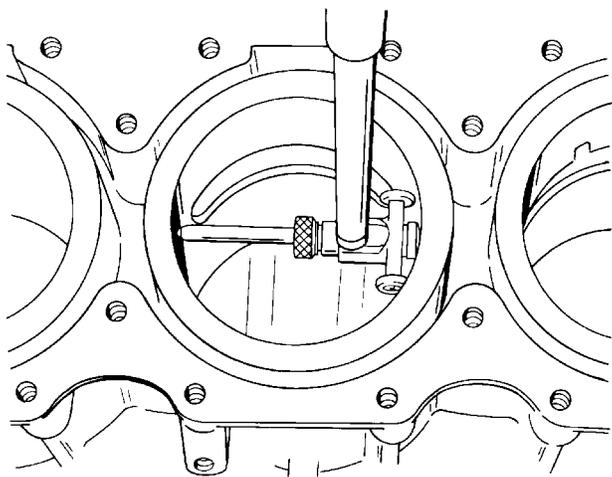
- c. Start stroking at smallest diameter. Maintain firm stone pressure against cylinder wall to assure fast stock removal and accurate results.
- d. Localize stroking in the smallest diameter until drill speed is constant throughout length of bore. Expand stones, as necessary, to compensate for stock removal and stone wear.



Stroke at a rate of 30 complete cycles per minute to produce best cross-hatch pattern. Use honing oil generously.

e. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. A good cleaning is essential. If any of the abrasive material is allowed to remain in the cylinder bore, it will cause rapid wear of new piston rings and cylinder bore in addition to bearings. After cleaning, bores should be swabbed several times with engine oil and a clean cloth, then wiped with a clean, dry cloth. Cylinders **should not** be cleaned with kerosene or gasoline. Clean remainder of cylinder block to remove excess material spread during honing operation.

2. Hone all cylinder walls **just enough** to de-glaze walls.
3. Measure cylinder bore diameter (with a snap gauge micrometer) of each cylinder, as shown below. Check for tapered, out-of-round (egg-shaped) and oversize bore.



52324

200/225 DFI Models

Model	Cylinder Block Finish Hone
200/225	3.6265 in. (92.1131mm)
0.015 in. Oversize	3.6415 in. (92.4941mm)
0.030 in. Oversize	3.6565 in. (92.8751mm)

4. If a cylinder bore is tapered, out-of-round or worn more than 0.003 in. (0.076mm) from standard "Cylinder Block Finish Hone" diameter (refer to chart, preceding), it will be necessary to re-bore that cylinder(s) to 0.015 in. (0.381mm) oversize or 0.030 in. (0.762mm) oversize and install oversize piston(s) and piston rings during reassembly.

NOTE: *The weight of an oversize piston is approximately the same as a standard size piston; therefore, it is not necessary to re-bore all cylinders in a block just because one cylinder requires re-boring.*

5. After honing and thoroughly cleaning cylinder bores, apply light oil to cylinder walls to prevent rusting.



Pistons and Piston Rings

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

1. Inspect pistons for scoring and excessive piston skirt wear.
2. Check tightness of piston ring locating pins. Locating pins must be tight.
3. Thoroughly clean pistons. Carefully remove carbon deposits from pistons, with a soft wire brush or carbon remove solution. Do not burr or round off machined edges.

Inspect piston ring grooves for wear and carbon accumulation. If necessary, scrape carbon from piston ring grooves **being careful not to scratch sides of grooves**. Refer to procedure following for cleaning piston ring grooves.

CLEANING PISTON RING GROOVES

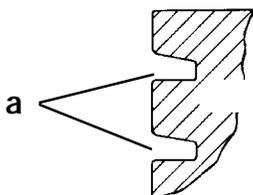
Keystone (tapered) ring grooves

CAUTION

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

1. Use a bristle brush and carbon remover solution to remove carbon from side surfaces.
2. A tool can be made for cleaning the inner diameter of the tapered ring grooves. The tool can be made from a broken tapered piston ring with the side taper removed to enable the inside edge of the ring to reach the inner diameter of the groove. Carefully scrape carbon from inner diameter of ring grooves. Care must be taken not to damage the grooves by scratching the side surfaces of the grooves.

Piston with two half keystone (half tapered) rings



a - Ring Grooves

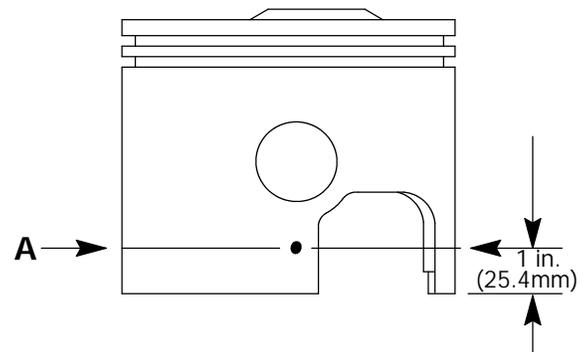
MEASURING PISTON ROUNDNESS

Piston has a barrel profile shape and is not a true diameter.

1. Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be as indicated in chart following.

Piston	Dimension "A"
Standard Piston	3.6210 in. \pm .0005 in.
.015 in. Oversize Piston	3.636 in. \pm .0005 in.
.030 in. Oversize Piston	4.383 in. \pm .0005 in.

2. Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be 3.6210 in. \pm 0.0005 in. for a STANDARD size piston.



a - Dimension "A" at Right Angle (90°) to Piston Pin

Cylinder Heads

1. Inspect internal surface of cylinder heads for possible damage (as a result of piston or foreign material striking cylinder heads).

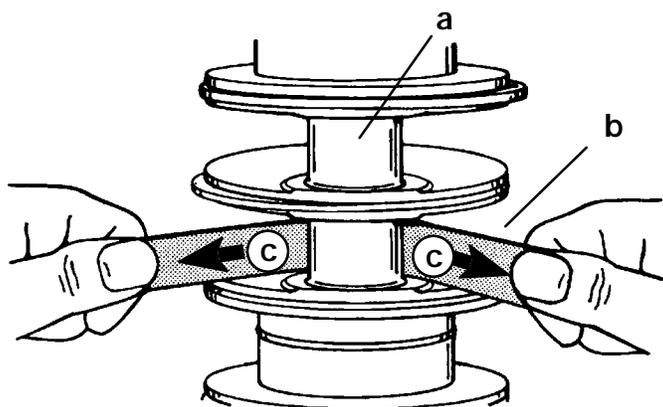
IMPORTANT: Cylinder head warpage should not exceed 0.005 in. (0.127mm) over the ENTIRE length of the cylinder head. If measured warpage, as determined on a surface block, exceeds 0.005 in. (0.127mm) or a discontinuity of up to 0.001 in. (0.025mm) exists in a 1.0 in. (25.4mm) length of the cylinder head's surface, then the cylinder head must be replaced.

2. Replace cylinder head(s) as necessary.



Crankshaft

1. Inspect crankshaft to drive shaft splines for wear. (Replace crankshaft, if necessary.)
2. Check crankshaft for straightness. Maximum runout - 0.002 in. (0.0508mm). Check runout at center main bearing surfaces with ends of crankshaft supported in v-blocks. (Replace as necessary.)
3. Inspect crankshaft oil seal surfaces. Sealing surfaces must not be grooved, pitted or scratched. (Replace as necessary.)
4. Check all crankshaft bearing surfaces for rust, water marks, chatter marks, uneven wear and/or overheating. (Refer to "Connecting Rods".)
5. If necessary, clean crankshaft surfaces with crocus cloth.



52323

- a - Crankshaft Journals
 b - Crocus Cloth
 c - Work Cloth "Back-and-Forth"

WARNING

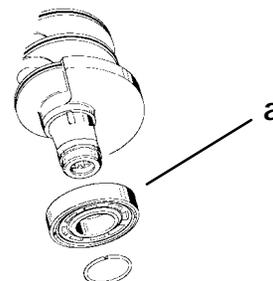
DO NOT spin-dry crankshaft ball bearing with compressed air.

6. Thoroughly clean (with solvent) and dry crankshaft and crankshaft ball bearing. Recheck surfaces of crankshaft. Replace crankshaft, if surfaces cannot be properly "cleaned up." If crankshaft will be re-used, lubricate surfaces of crankshaft with light oil to prevent rust. **DO NOT** lubricate crankshaft ball bearing at this time.

Crankshaft (and End Cap) Bearings

IMPORTANT: When overhauling powerhead assembly, it is recommended that all crankshaft bearings - upper/lower, center main, connecting rod and wrist pin bearings - be replaced to ensure optimum powerhead performance and longevity.

1. After cleaning crankshaft, grasp outer race of crankshaft ball bearing (installed on lower end of crankshaft) and attempt to work race back-and-forth. There should not be excessive play.
2. Lubricate ball bearing with light oil. Rotate outer bearing race. Bearing should have smooth action and no rust stains. If ball bearing sounds or feels "rough" or has "catches," remove and discard bearing. (Refer to "Powerhead Removal and Disassembly - Crankshaft Removal and Disassembly").



52326

- a - Lower Ball Bearing

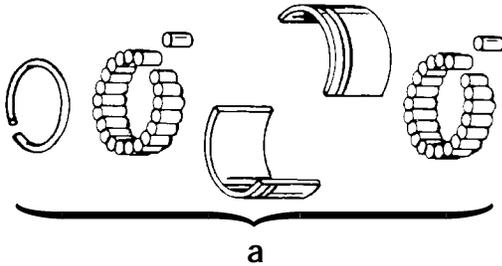
3. Thoroughly clean (with solvent) and dry crankshaft center main roller bearings. Lubricate bearings with 2-Cycle Outboard Oil.



CAUTION

DO NOT intermix halves of upper and lower crankshaft center main roller bearings. Replace bearings in pairs only.

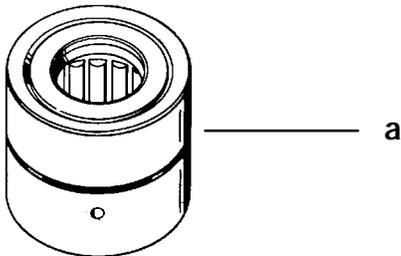
4. Thoroughly inspect center main roller bearings. Replace bearings if they are rusted, fractured, worn, galled or badly discolored.



52153

a - Center Main Roller Bearing

5. Clean (with solvent) and dry crankshaft roller bearing that is installed in upper end cap. Lubricate bearing with light oil.
6. Thoroughly inspect upper crank shaft roller bearing. If roller bearing is rusted, fractured, worn, galled or badly discolored, replace roller bearing.



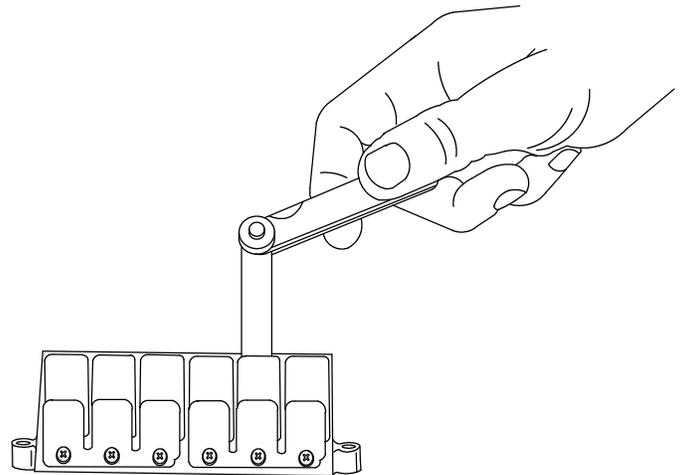
51473

a - Upper Roller Bearing

Reed Block Assembly

IMPORTANT: DO NOT remove reeds from reed blocks, unless replacement is necessary. **DO NOT** turn used reeds over for re-use. Replace reeds in sets only.

1. Thoroughly clean gasket surfaces of reed blocks and reed block housing. Check for grooves, cracks and distortion that could cause leakage. Replace parts as necessary.
2. Check for wear (indentations) on face of each reed block. Replace block(s), if reeds have made indentations.
3. Check for chipped and broken reeds.

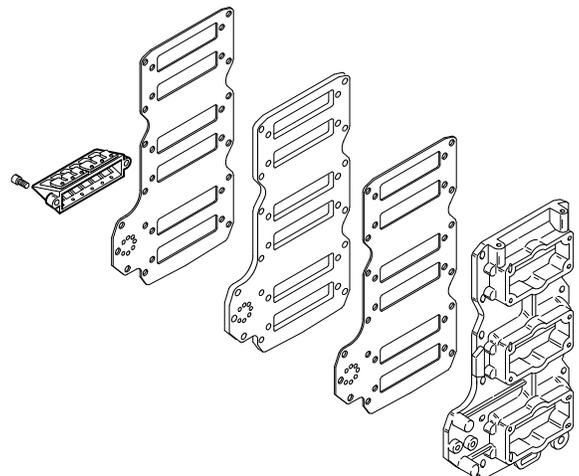


56023

Allowable reed opening is 0.020 in. (0.51mm) or less. Replace reeds if either reed is standing open more than 0.020 in. (0.51mm).

Reed Block

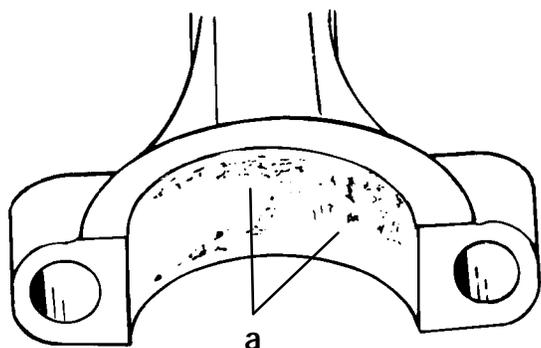
Inspect passages in reed block to be sure that they are not obstructed.





Connecting Rods

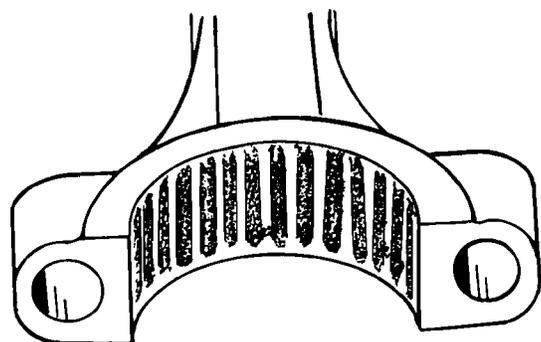
1. Check connecting rods for alignment by placing rods on a surface plate. If light can be seen under any portion of machined surfaces, if rod has a slight wobble on plate, or if a 0.002 in. (0.051mm) feeler gauge can be inserted between any machined surface and surface plate, rod is bent and must be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



51853

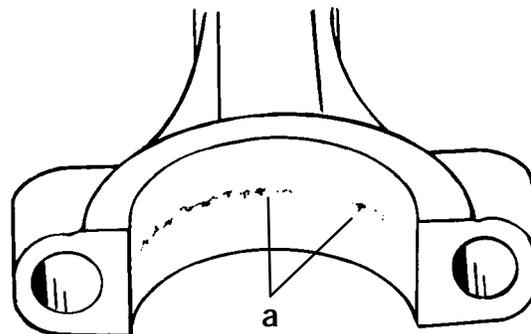
a - Pitting

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



51853

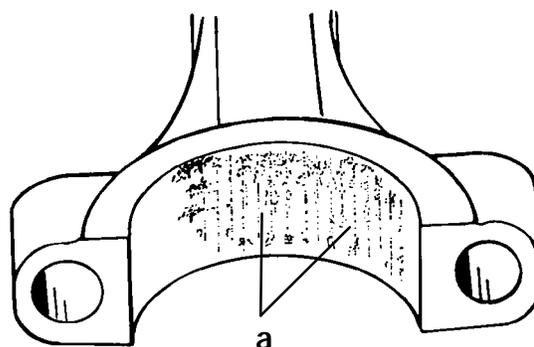
5. **Spalling:** Spalling is the loss of bearing surface, and it resembles flaking or chipping. Spalling will be most evident on the thrust portion of the connecting rod in line with the "I" beam. General bearing surface deterioration could be caused by or accelerated by improper lubrication.



51853

a - Spalling

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

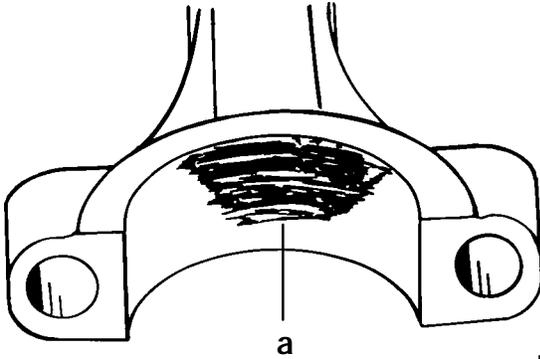


51853

a - Chatter Marks Between Arrows



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



51853

a - Uneven Wear Between Arrows

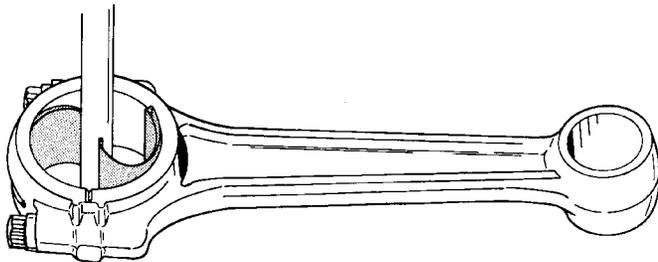
8. If necessary, clean connecting rod bearing surfaces, as follows:
- Be sure that "etched" marks on connecting rod (crankshaft end) are perfectly aligned with "etched" marks on connecting rod cap. Tighten connecting rod cap attaching bolts securely.

⚠ CAUTION

Crocus cloth MUST BE USED to clean bearing surface at crankshaft end of connecting rod. DO NOT use any other type of abrasive cloth.

- Clean CRANKSHAFT END of connecting rod by using CROCUS CLOTH** placed in a slotted 3/8 in. (9.5mm) diameter shaft, as shown. Chuck shaft in a drill press and operation press at high speed while keeping connecting rod at a 90° angle to slotted shaft.

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



52323

- Clean PISTON PIN END of connecting rod,** using same method as in Step "b", preceding,

but using 320 grit carborundum cloth instead of crocus cloth.

- Thoroughly wash connecting rods to remove abrasive grit. Recheck bearing surfaces of connecting rods. Replace any connecting rod(s) that cannot be properly "cleaned up." Lubricate bearing surfaces of connecting rods (which will be re-used) with light oil to prevent rust.

Powerhead Reassembly and Installation

General

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

During reassembly, lubricate parts with Quicksilver 2-Cycle Outboard Lubricant whenever "light oil" is specified. Quicksilver part numbers of lubricants, sealers and locking compounds and tools are listed in "Powerhead General Information," preceding.

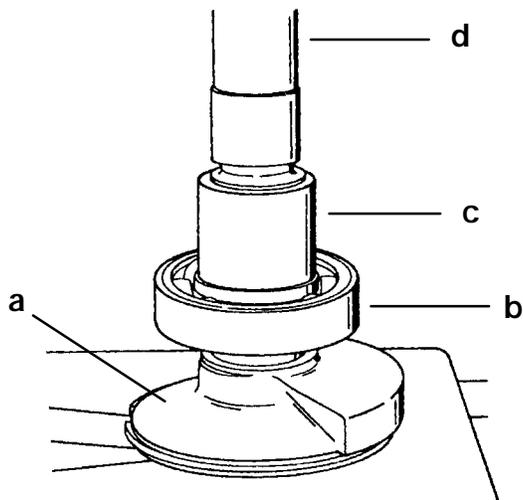
A torque wrench is **essential** for correct reassembly of powerhead. **DO NOT** attempt to reassemble powerhead without using a torque wrench. Attaching bolts for covers, housings and cylinder heads **MUST BE** torqued by tightening bolts in 3 progressive steps (following specified torque sequence) until specified torque is reached (see "Example," following).

EXAMPLE: If cylinder head attaching bolts require a torque of 20 lb. ft. (27.1 N·m), a) tighten all bolts to **5 lb. ft. (6.7 N·m)**, following specified torque sequence, b) tighten all bolts to **10 lb. ft. (13.6 N·m)**, following torque sequence, then finally c) tighten all bolts to **20 lb. ft. (27.1 N·m)**, following torque sequence.



IMPORTANT: If lower drive shaft ball bearing has been removed, it is recommended that a new bearing be installed as the removal process will damage the bearing.

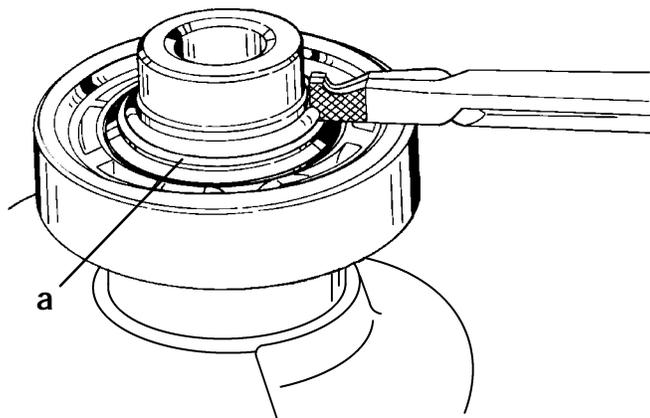
1. If removed, press new lower crankshaft ball bearing onto crankshaft as shown. Be sure bearing is pressed firmly against shoulder.



51852

- a - Crankshaft
- b - Crankshaft Ball Bearing
- c - Suitable Mandrel
- d - Press

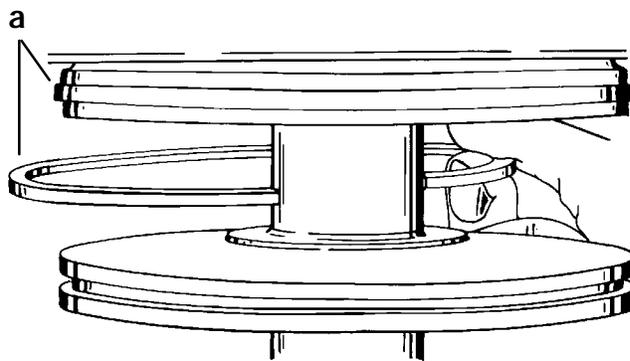
2. Reinstall retaining ring using a suitable pair of Snap Ring Pliers.



55983

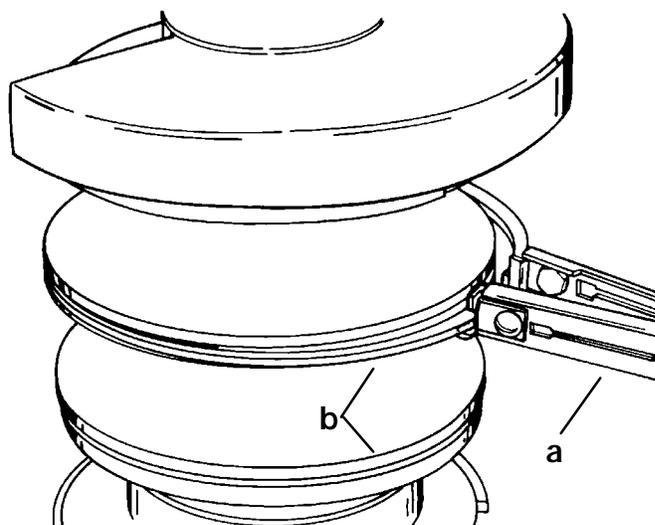
- a - Retaining Ring

3. If removed, spread new crankshaft sealing rings just enough to slide over crankshaft journal.



- a - Crankshaft Sealing Rings

4. Use Piston Ring Expander (91-24697) and install crankshaft sealing rings into groove.

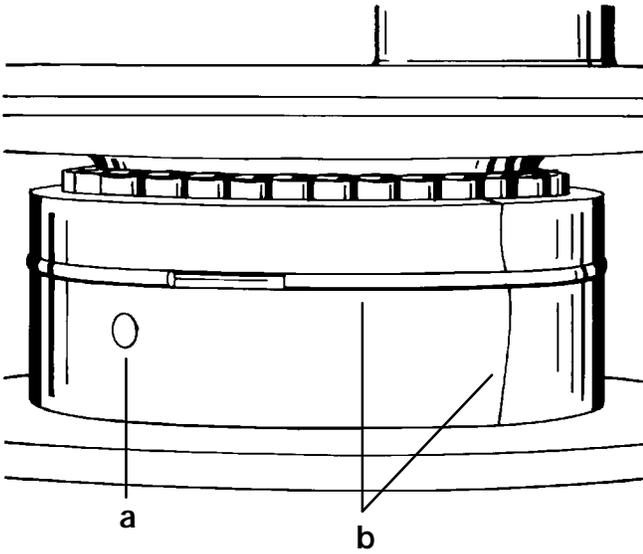


52320

- a - Piston Ring Expander (91-24697)
- b - Crankshaft Sealing Rings (7 Each)



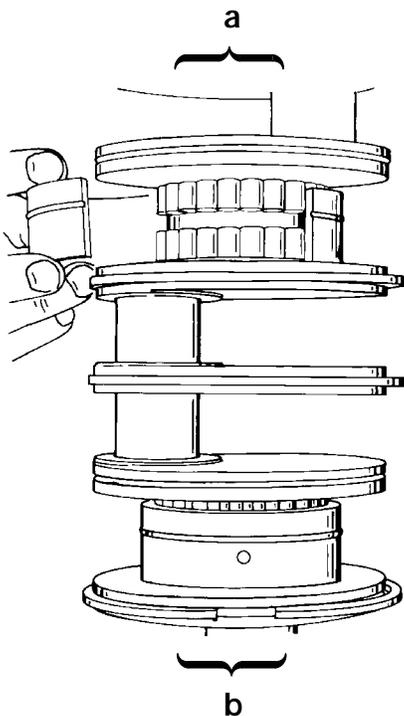
5. Lubricate center main crankshaft roller bearings and races with light oil.



52318

a - Install so Hole is Toward Drive Shaft End of Crankshaft
 b - Verify Retaining Ring Bridges the Separating Lines of the Bearing Race

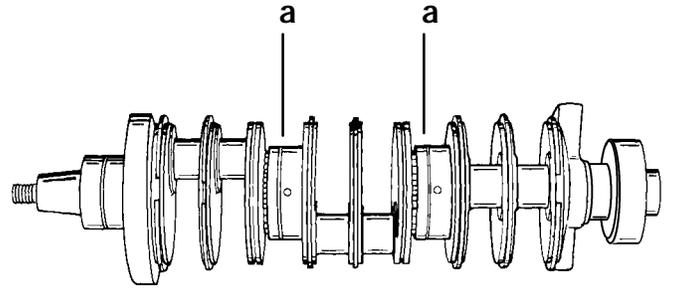
6. Place center main crankshaft roller bearings on upper and lower main bearing journals as shown.
 7. Install center main bearing races as shown.



52315

a - Flywheel End
 b - Drive Shaft End

8. Secure center main bearing races together with retaining rings. Make sure retaining ring bridges the separating lines of the bearing race.

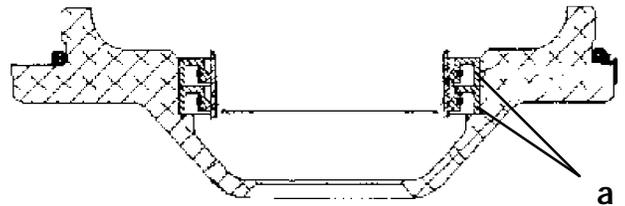


55994

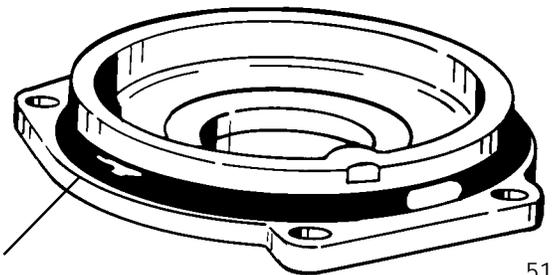
a - Center main Bearing Races

9. Install oil seals into lower end cap as follows:

- a. Apply a thin bead of Loctite Type 271 (92-32609-1) to outer diameter of lower end cap oil seals (a).
- b. Using suitable mandrel, press one oil seal (lip facing DOWN) into lower end cap until firmly seated. Remove any excess Loctite.
- c. Press second oil seal (lip facing DOWN) until firmly seated on first oil seal. Remove any excess Loctite.



- d. Lubricate oil seal lips with 2-4-C w/Teflon (92-825407A12).
- e. Apply a light coat of Perfect Seal (92-34227-1) to end cap flange.
- f. Lubricate O-ring seal with 2-4-C w/Teflon (92-825407A12) and install over lower end cap.



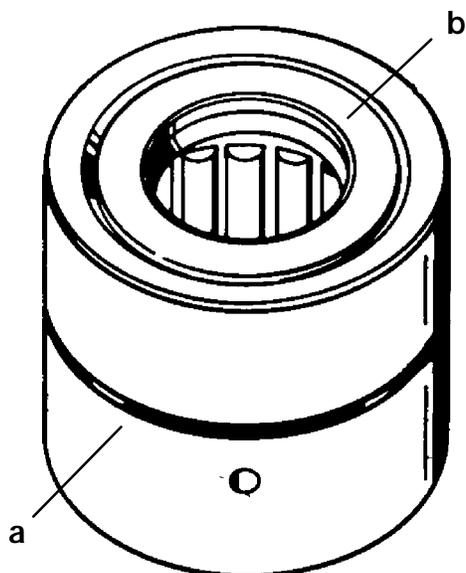
51849

a - O-ring



10. Install oil seal into upper bearing carrier assembly as follows:

- a. Apply a light film of 2-4-C w/Teflon (92-825407A12) to outer diameter of oil seal; this will ease seal installation into carrier.
- b. Lubricate oil seal lip with 2-4-C w/Teflon.
- c. Use a suitable mandrel, press oil seal into carrier (lip facing DOWN) until bottomed out on shoulder of carrier.
- d. Lubricate O-ring with 2-4-C w/Teflon and install on carrier.



51473

a - O-ring
b - Seal

Crankshaft Installation

SPECIAL INFORMATION

Installing A New Crankshaft Assembly Into Cylinder Block

Check the crankshaft sealing ring mating surfaces in the cylinder block and crankcase cover for wear grooves that were caused by the crankshaft sealing rings from the previous crankshaft. If wear grooves are present, the sealing rings on the new crankshaft will have to fit into the grooves without binding the crankshaft.

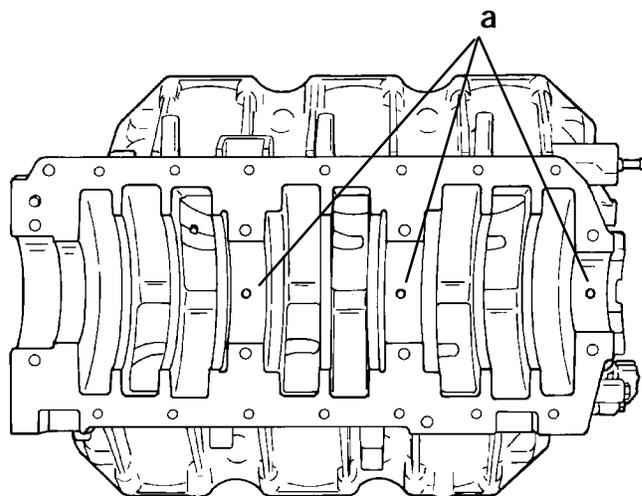
Before installing crankshaft, remove any burrs that may exist on groove edges.

Lubricate sealing rings with light oil and install new crankshaft as instructed.

Install upper and lower end caps and then inspect fit between sealing rings and grooves. Temporarily install crankcase cover and rotate crankshaft several times to check if sealing rings are binding against crankshaft. (You will feel a drag on the crankshaft.) If sealing rings are binding, recheck grooves for burrs. If this does not correct the problem, it is recommended that the cylinder block be replaced.

Install crankshaft as follows:

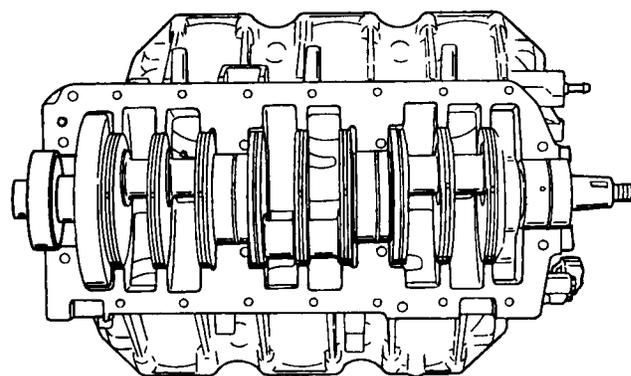
1. Lubricate crankshaft sealing rings with light oil.
2. Check cylinder block to be sure that dowel pins are in place.



55992

a - Dowel Pins

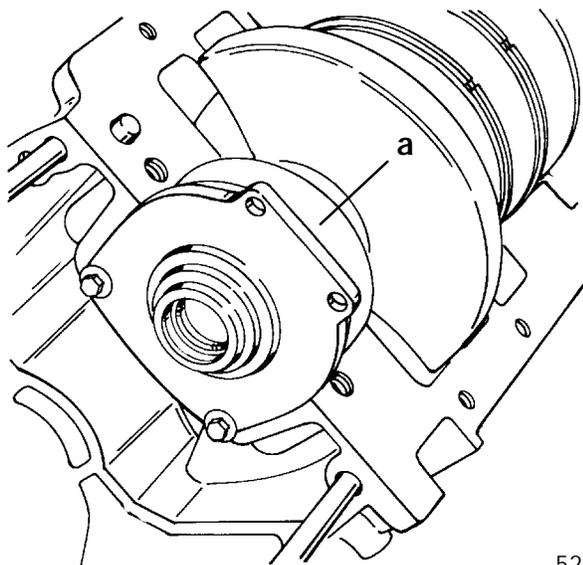
3. Position all crankshaft seal ring gaps straight up.
4. Align hole in each center main bearing race with dowel pin.
5. Gently push crankshaft down into position making sure that the dowel pins are lined up with the holes in center main bearings and crankshaft seal rings are in place.



55993



- Lubricate lower crankshaft end (oil seal area) with light oil, then install lower end cap. Secure end cap to cylinder block with attaching bolts. DO NOT tighten end cap bolts at this time.



52328

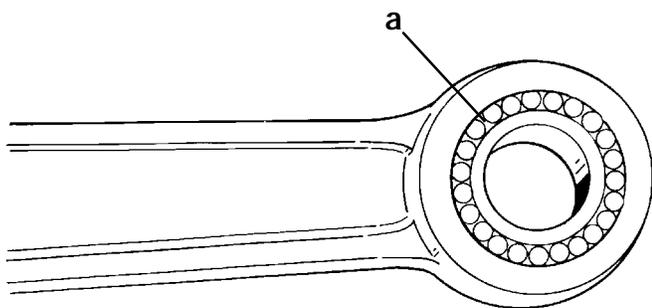
a - Lower End Cap

Piston and Connecting Rod Reassembly

- Place needle bearings on a clean piece of paper and lubricate with 2-4-C w/Teflon (92-825407A12).

NOTE: There are 34 needle bearings per piston.

- Place sleeve which is part of piston pin tool (91-92973A1) into connecting rod and install needle bearings around sleeve as shown.



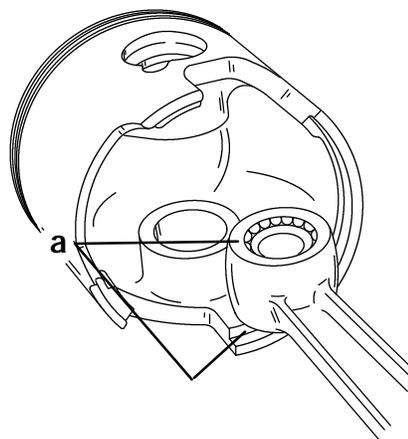
52315

a - Sleeve (Part of Tool Assy. 91-92973A1)

- Place locating washers on connecting rod.

IMPORTANT: Position connecting rod part number facing towards flywheel.

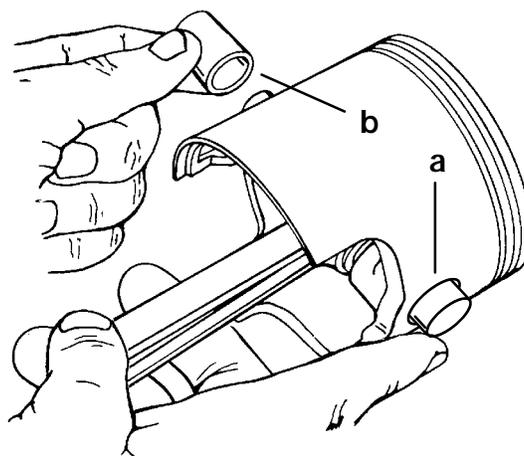
Position piston over end of rod. Verify locating washers remain in place.



55960

a - Locating Washers

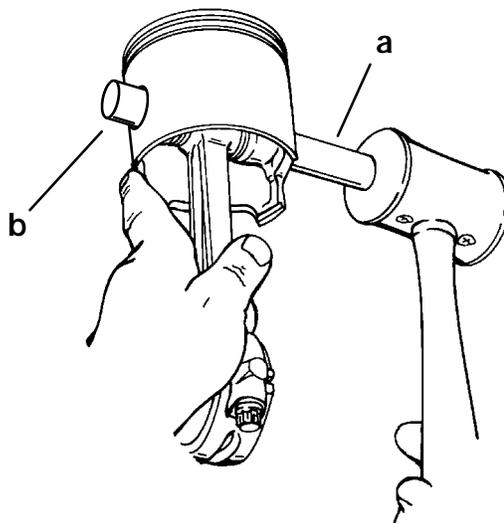
- Insert piston pin tool (91-92973A1) and push sleeve out of piston. Keep piston pin tool in piston.



55961

a - Piston Pin Tool (91-92973A1)
b - Sleeve

- Use a mallet and tap piston pin into piston and push piston pin tool out.

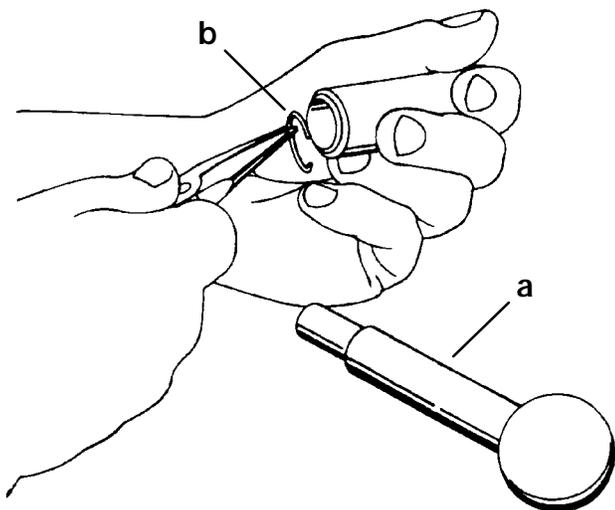


55962

a - Piston Pin
b - Piston Pin Tool

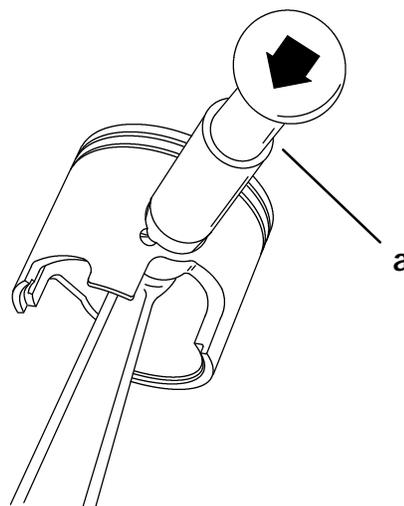


6. Install new piston pin lockrings (one each end of piston pin) with Lockring Installation Tool (91-93004A2).
7. Make sure lockrings are properly seated in piston grooves.



51086

a - Lockring Installation Tool (91-93004A2)
b - Lockring

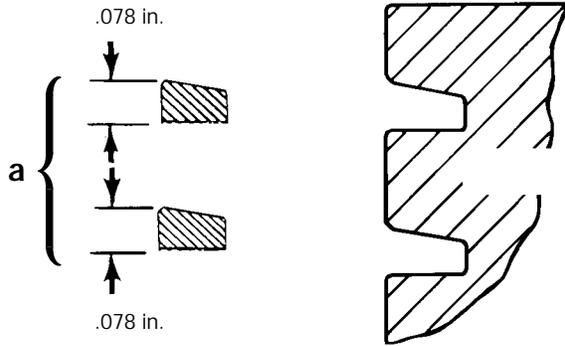


a - Lockring Installation Tool

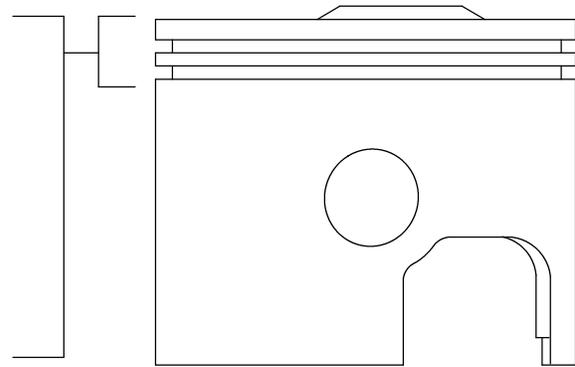
55963



Piston and Piston Ring Combination



a - Half Keystone (tapered) Piston Ring

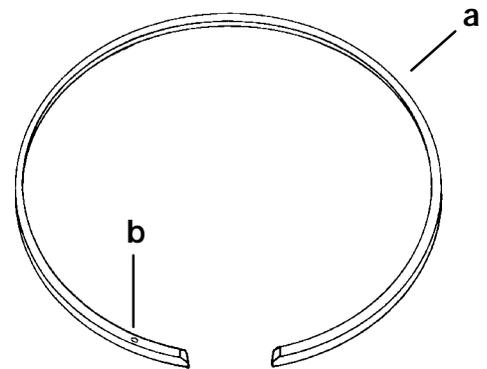


55964

IMPORTANT: Piston ring side with dot or letter must be facing up.

Piston Installation

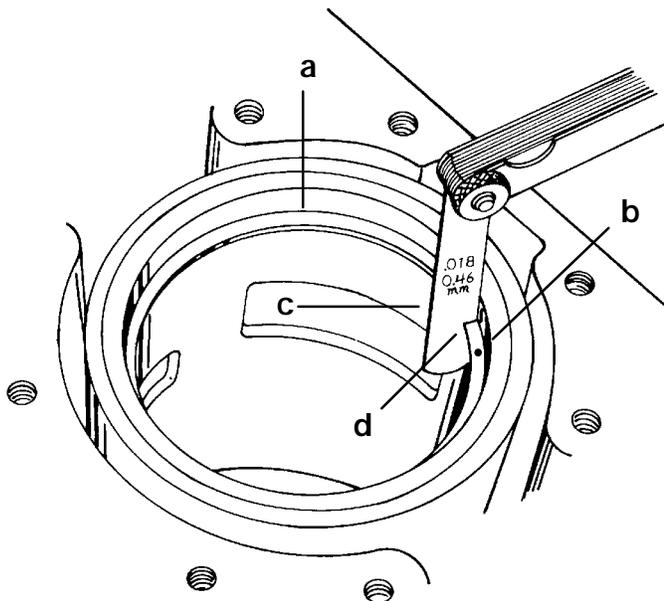
1. Before installing new piston rings, check gap between ring ends by placing each ring in its respective cylinder, then pushing ring about 1/2 in. (12.7mm) into cylinder using piston to assure proper position.
2. Check end gap of each new piston ring with a feeler gauge. End gap must be within 0.010 in. to 0.018 in. (0.254mm to 0.457mm). If end gap is greater, check other piston rings in cylinder bore, until rings (within tolerance) are found.



52317

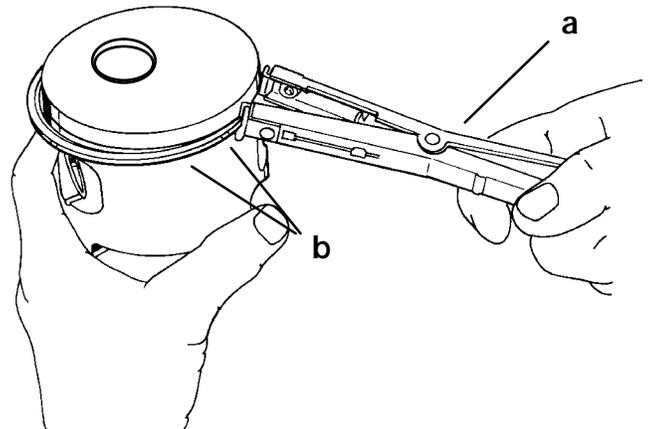
a - Piston Ring
b - Dot

3. Use Piston Ring Expander (91-24697) and install piston rings (dot side up) on each piston. Spread rings just enough to slip over piston.
4. Check piston rings to be sure that they fit freely in ring groove.
5. Lubricate piston, rings and cylinder wall with 2-Cycle Outboard Oil.



52327

a - Piston Ring
b - Dot or "T" (Faces Up)
c - Feeler Gauge
d - Ring End Gap



52319

a - Piston Ring Expander
b - Dot Side "UP" on Piston Ring



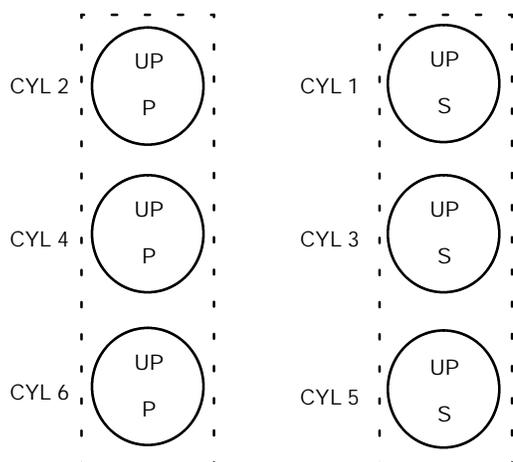
6. Rotate each piston ring so end of ring is aligned with locating pin as shown.
7. Install Piston Ring Compressor.
8. Remove screws and connecting rod cap from piston rod assembly being installed.

IMPORTANT: Piston must be correctly installed and positioned as shown.

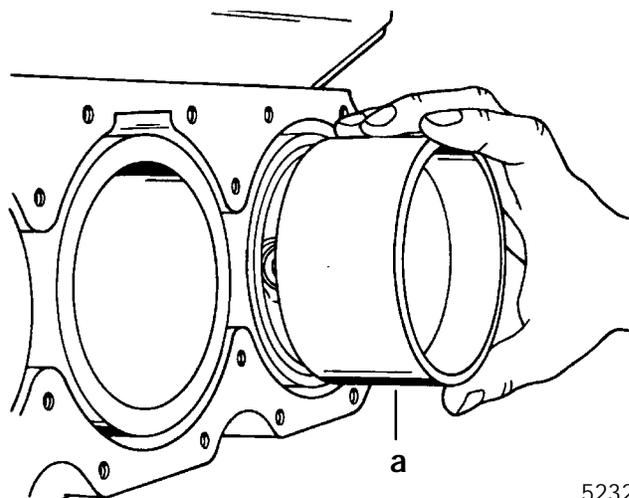
Pistons marked with the word "UP" and with the letter "P" or "S" on top of piston.

Pistons with the letter "P" must be installed in the port side of engine and the word "UP" facing toward top of engine.

Pistons with the letter "S" must be installed in the star-board side of engine and the word "UP" toward top of engine.



9. Coat cylinder bore with 2-cycle oil. Match piston assembly with cylinder it was removed from, and position piston as described below. Push piston into cylinder.



52328

a - Piston Ring Compressor (91-823237)

10. Apply 2-4-C w/Teflon to bearing surface of connecting rod and install bearing assembly, as shown.
11. Place connecting rod cap on connecting rod. Apply light oil to threads and face of connecting rod bolts. Thread connecting rod bolts finger-tight while checking for correct alignment of the rod cap as shown.

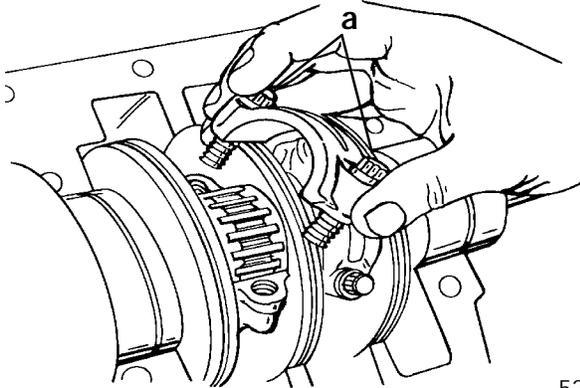
IMPORTANT: Connecting rod and connecting rod caps are matched halves. Do not torque screws before completing the following procedure.

- Run a pencil lightly over ground area.
- If pencil stops at fracture point, loosen bolts, retighten, and check again.

NOTE: If you still feel the fracture point, discard the rod.



12. Tighten connecting rod bolts (using a 3/8 in. - 12 point socket) First torque to 15 lb. in. (1.7 N·m) then 30 lb. ft. (40.7 N·m). Turn each bolt an additional 90° after 2nd torque is attained. Recheck alignment between rod cap and rod as shown.



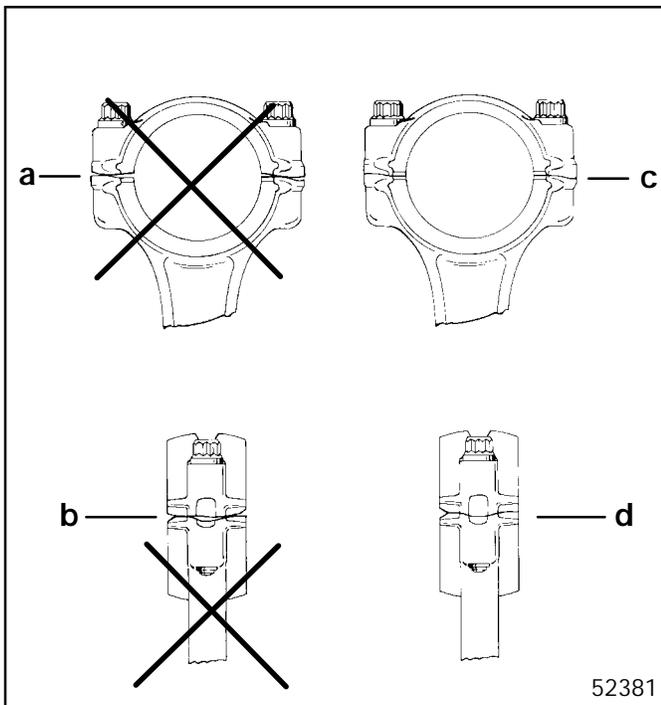
52316

a - Connecting Rod Screws

13. Rotate crankshaft several times (using powerhead stand) to assure free operation (no binds and catching).

Connecting Rod Cap Alignment

Check each connecting rod cap for correct alignment. If not aligned, a ridge can be seen or felt at the separating line as shown below. Correct any misalignment.

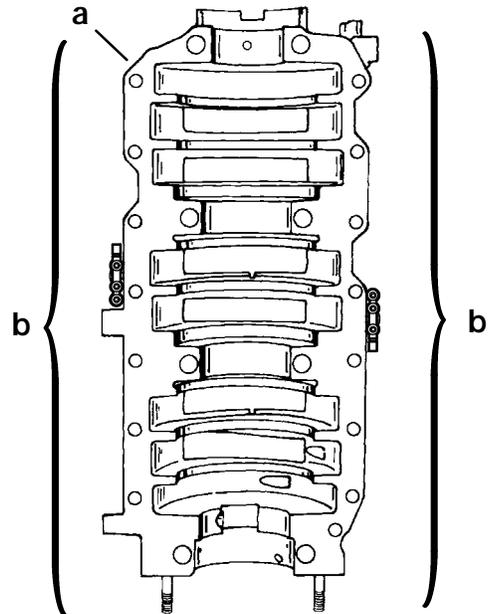


52381

a - Side View Incorrect - Cap on Backwards
 b - End View Incorrect - Cap on Backwards
 c - Side View Correct
 d - End View Correct

Crankcase Cover Installation

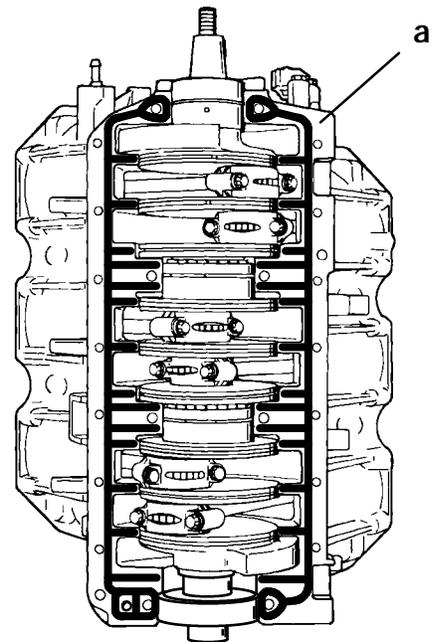
1. Thoroughly remove all oil from mating surfaces of crankcase cover and cylinder block with Loctite Primer 203 included in Master Gasket Kit (92-12564-1).



55984

a - Crankcase Cover
 b - Remove All Oil

2. Apply a thin, even coat of Loctite Master Gasket on mating surface of cylinder block.

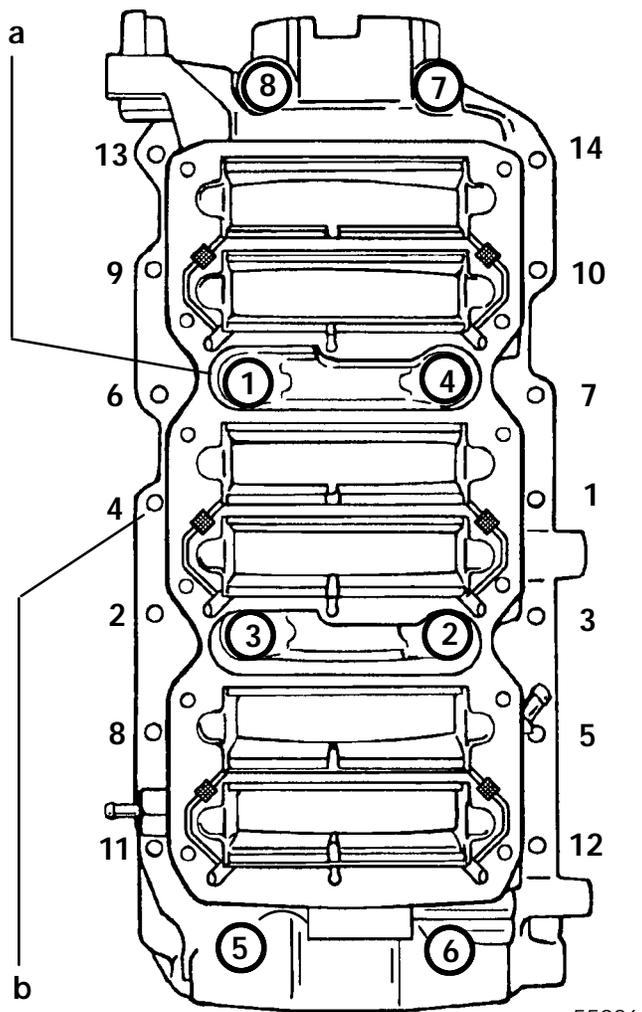


55985

a - Loctite Master Gasket (92-12564-1)

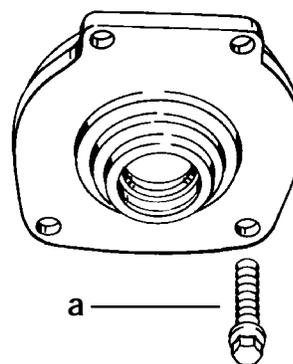


- Place crankcase cover in position on cylinder block. Turn the 8 center main bolts in a LITTLE at a time, (following torque sequence) compressing crankshaft seal rings until crankshaft cover has been drawn down to cylinder block. Tighten eight bolts (a) evenly in three progressive steps (following torque sequence).
- Install remaining crankcase cover flange bolts (following torque sequence).



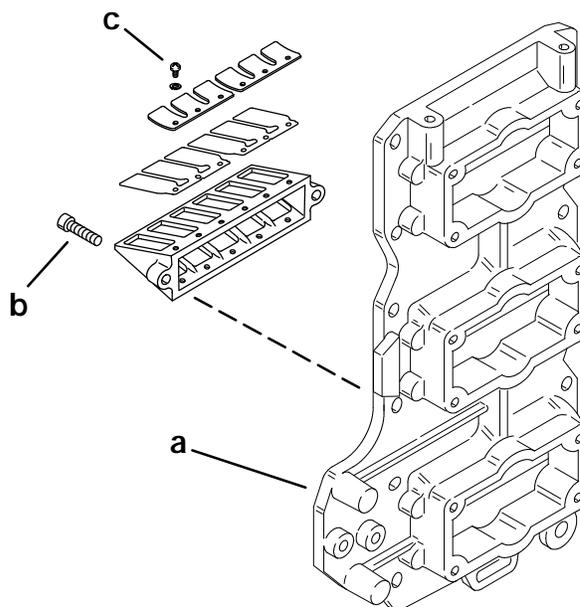
- a - Apply Light Oil to Threads and Bolt Face;
8 Bolts (M10 x 1.5 x 80);
30 lb. ft. (40.7 N·m) and Rotate 90°
- b - 14 Bolts (M8 x 1.25 x 35)
28 lb. ft. (38.0 N·m)

- Tighten end cap bolts to specified torque.



- a - Torque Bolts to 85 lb. in. (9.6 N·m)

Assembly of Reed Blocks to Intake Manifold



- a - Intake Manifold Bolts [Torque to 100 lb. in. (11.3 N·m)]
- b - Reed Block Mounting Bolts [Torque to 90 lb. in. (10.2 N·m)]
- c - Reed Attaching Screws [Torque to 25 lb. in. (2.8 N·m)]

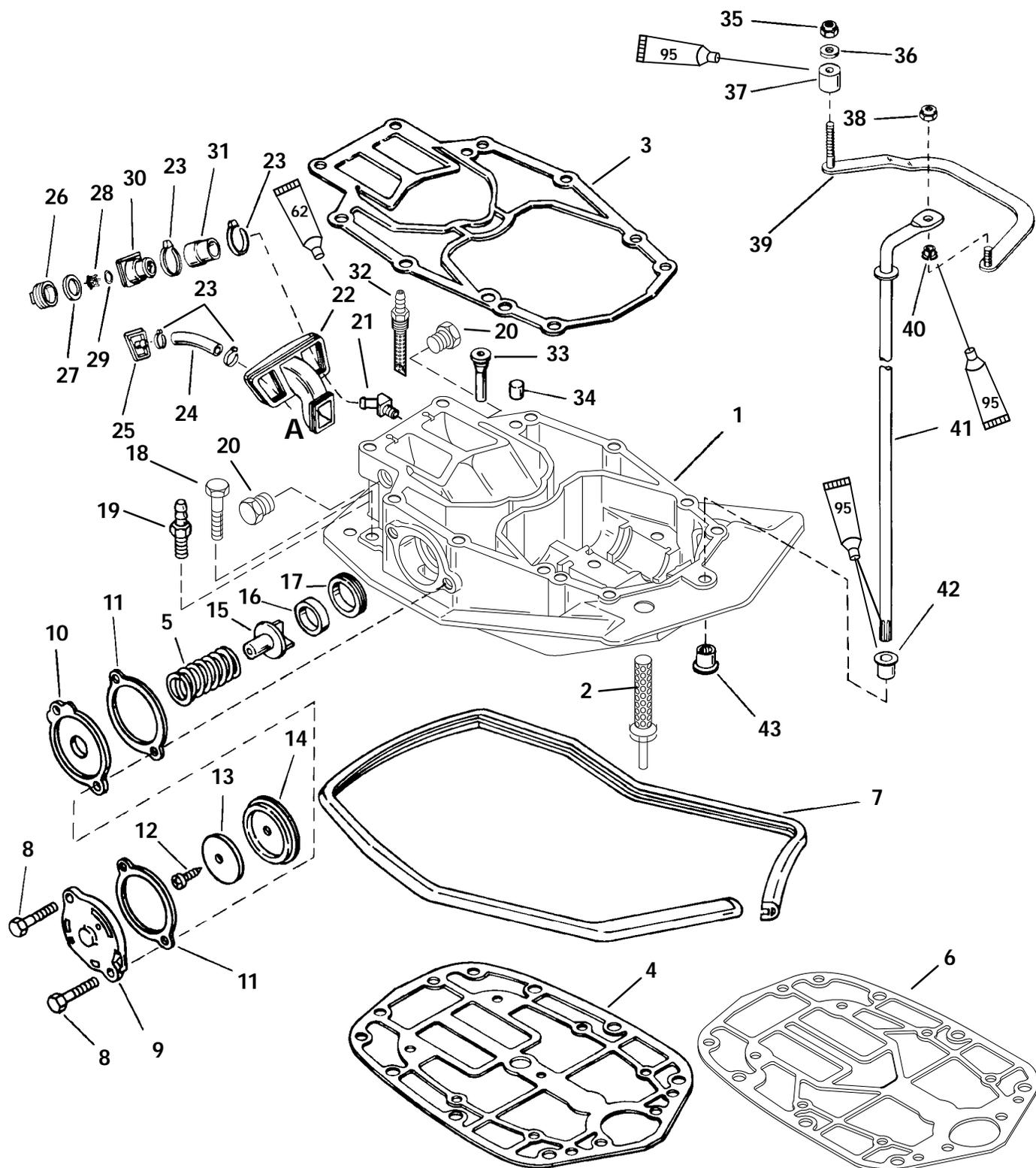


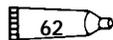
Notes:

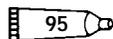




Exhaust Plate 1997 Model 200 DFI



 3M Permabond #3MO8155 (Obtain Locally)

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

A = TO AIR COMPRESSOR



Exhaust Plate 1997 Model 200 DFI

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	EXHAUST PLATE			
2	2	STRAINER S/N-0G437999 & BELOW			
3	1	GASKET			
4	1	GASKET (LOWER)			
5	1	SPRING			
	1	SPRING			
1	1	EXHAUST PLATE			
3	1	GASKET S/N-0G438000 & UP			
6	1	GASKET (LOWER)			
7	1	SEAL			
8	2	SCREW (M8 x 35)	240	20	27.1
9	1	COVER			
10	1	RELIEF VALVE PLATE ASSEMBLY			
11	2	GASKET			
12	1	SCREW			Drive Tight
13	1	WASHER			
14	1	DIAPHRAGM			
15	1	POPPET			
16	1	GROMMET			
17	1	CARRIER			
18	6	SCREW (M8 x 35)	300	25	33.9
19	3	CONNECTOR			
20	2	PIPE PLUG			
21	1	ELBOW (45°)			
22	1	IDLE EXHAUST BOOT			
23	AR	STA STRAP			
24	1	HOSE			
25	1	FITTING - tell tale			
26	1	PLUG			
27	1	WASHER			
28	1	CHECK VALVE			
29	1	O RING			
30	1	FITTING			
31	1	HOSE			
32	1	STRAINER, Fuel cooler			
33	2	DRAIN CHECK VALVE			
34	4	DOWEL PIN			
35	1	NUT			
36	1	WASHER			
37	1	ROLLER			
38	1	NUT			
39	1	SHIFT LINK			
40	1	BUSHING			
41	1	UPPER SHIFT SHAFT (LONG)			
	1	UPPER SHIFT SHAFT (X-LONG)			
42	1	BUSHING			
43	1	COUPLING			



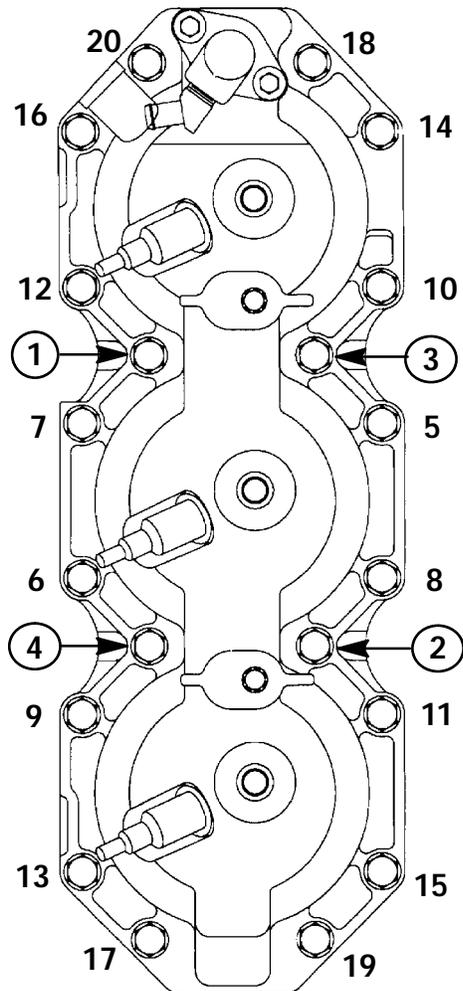
Exhaust Plate 1998 Model 200/225 DFI

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	EXHAUST PLATE			
2	1	GASKET			
3	1	GASKET (LOWER)			
4	1	SEAL			
5	1	CONNECTOR			
6	1	CHECK VALVE FITTING			
7	2	PLUG			
8	2	DRAIN CHECK VALVE			
9	4	DOWEL PIN			
10	2	FITTING			
11	1	COVER			
12	2	SCREW (M8 x 35)	240	20	27.1
13	1	CARRIER			
14	1	GROMMET			
15	1	POPPET			
16	1	SPRING			
17	1	RELIEF VALVE PLATE ASSEMBLY			
18	2	GASKET			
19	1	DIAPHRAGM			
20	1	WASHER			
21	1	SCREW (10-16 x 3/4 IN.)	Drive Tight		
22	6	SCREW (M8 x 35)	300	25	34.0
23	1	IDLE EXHAUST BOOT			
24	2	STA-STRAP			
25	1	FITTING - tell tale			
26	1	PLUG			
27	1	WASHER			
28	1	FITTING			
29	1	CHECK VALVE			
30	1	O RING			
31	1	NUT			
32	1	SLIDE			
33	1	NUT			
34	1	SHIFT LINK			
35	1	BUSHING			
36	1	UPPER SHIFT SHAFT (LONG)			
	1	UPPER SHIFT SHAFT (X-LONG)			
37	1	BUSHING			
38	1	COUPLING			
39	1	HOSE (INLET)			



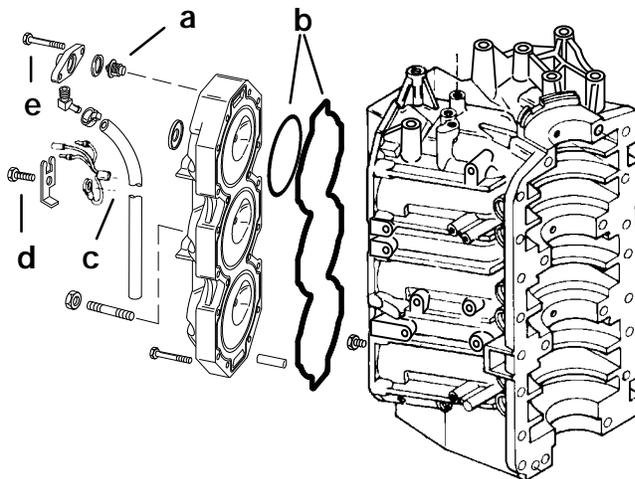
Cylinder Head Installation

1. Install each cylinder head to engine block with thermostat pocket "UP". Apply light oil to cylinder head bolt threads and bolt face. **Torque all bolts to 20 lb. ft. (27.1 N·m)** and rotate 90°.



52132

2. Install thermostat assembly into each cylinder head.
3. Install overheat temperature sensor into STARBOARD cylinder head opposite #1 spark plug.

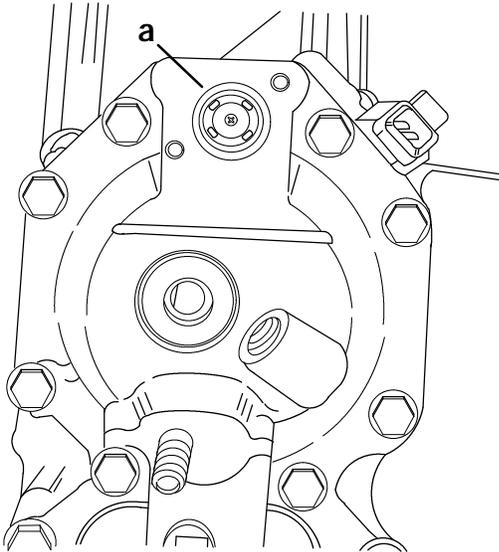


- a - Thermostat 120° F (48.9° C)
- b - O-Rings
- c - Temperature Sensor
- d - Bolt - Torque to 200 lb. in. (22.6 N·m)
- e - Bolt - Torque to 100 lb. in. (11.3 N·m)



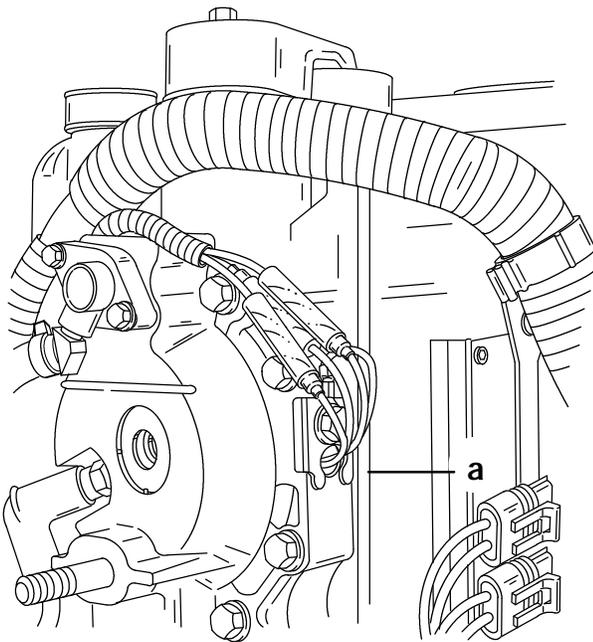
NOTE: During normal engine operating temperature, the sender electrical circuit is open and will close if temperature reaches $200^{\circ}\text{ F} \pm 8^{\circ}\text{ F}$ ($93.3^{\circ}\text{ C} \pm 13.3^{\circ}\text{ C}$) thus activating the overheat alarm.

4. Thermostat and temperature sensor installed.



55972

a - Thermostat [143° F (61.7° C)]

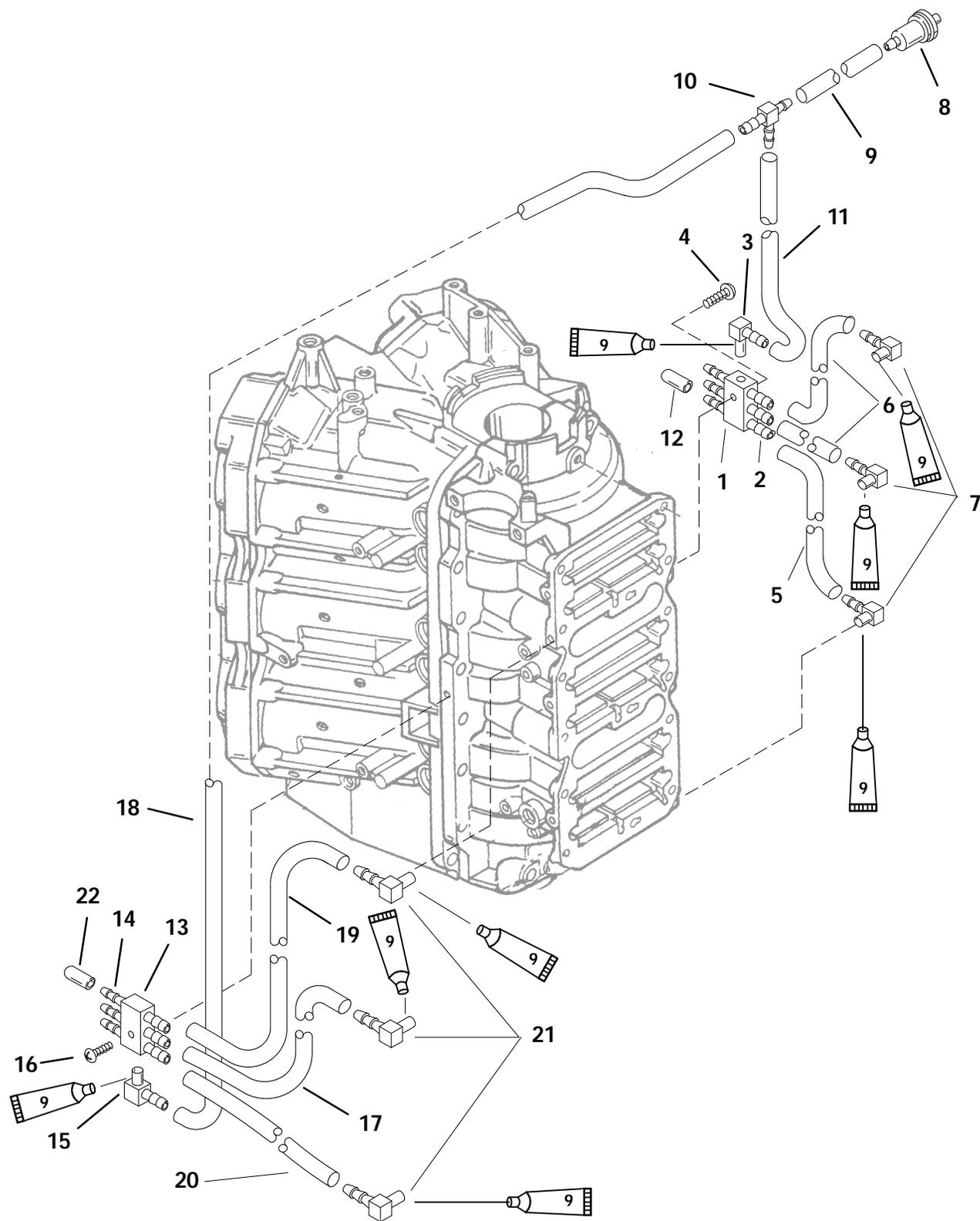


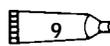
55940

a - Overheat Temperature Sensor [Torque attaching bolt to 200 lb. in. ($22.6\text{ N}\cdot\text{m}$)]



Bleed System 1997 Model 200 DFI



 Loctite PST Pipe Sealant (92-809822)

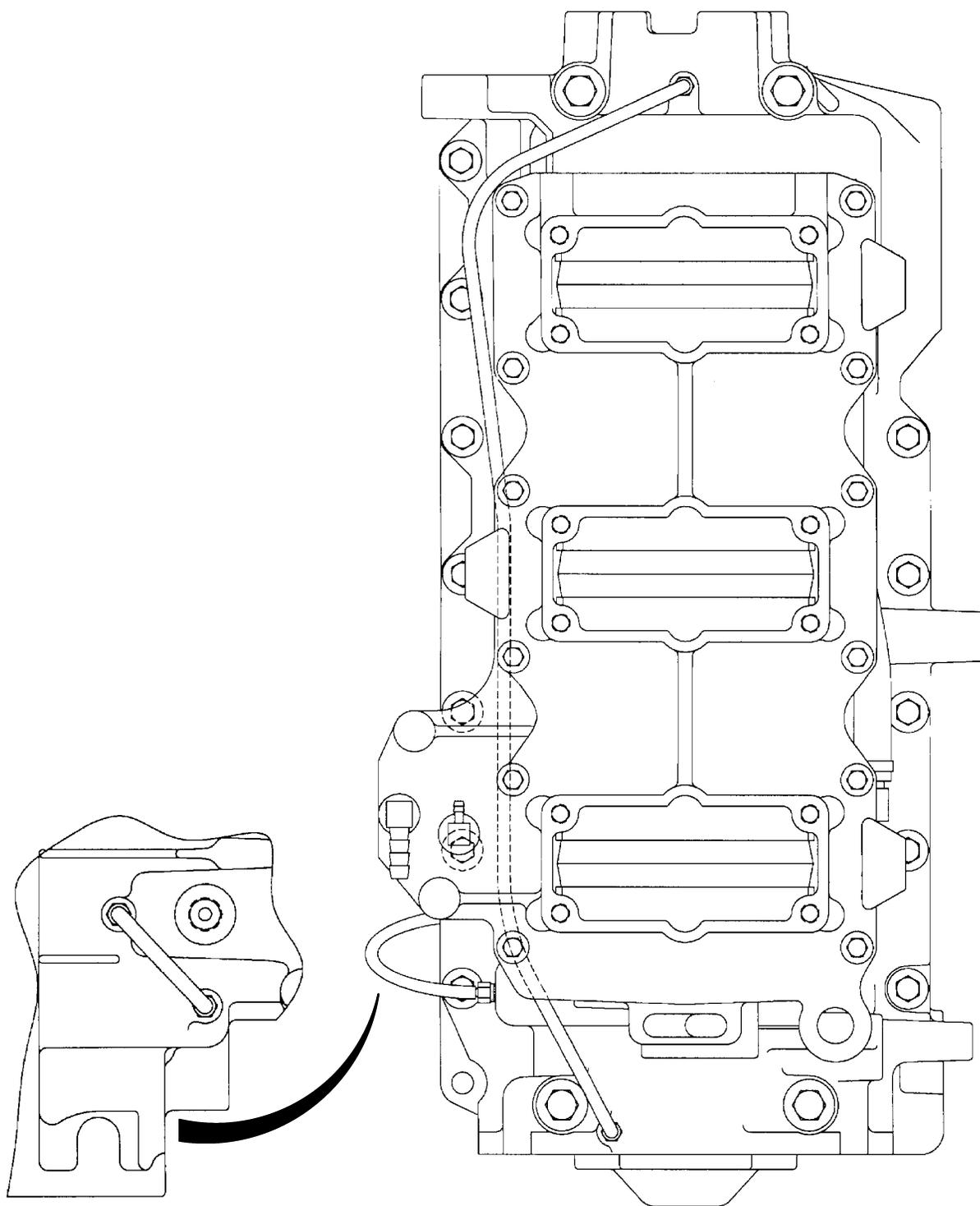


Bleed System 1997 Model 200 DFI

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	MANIFOLD-Bleed System			
2	6	CHECK VALVE			
3	1	ELBOW			
4	1	SCREW (10-16 x 3/4 IN.) PORT	Drive Tight		
5	1	TUBING (9 IN.)			
6	2	TUBING (5-1/4 IN.)			
7	3	FITTING (Shown as Ref. 10 on page 21)			
8	1	FUEL FILTER			
9	1	TUBING (2-3/4 IN.)			
10	1	FITTING-Tee			
11	1	TUBING (9-1/2 IN.)			
12	3	CAP			
13	1	MANIFOLD-Bleed System			
14	6	CHECK VALVE			
15	1	ELBOW			
16	1	SCREW (10-16 x 3/4 IN.) STARBOARD	Drive Tight		
17	1	TUBING (5-1/4 IN.)			
18	1	TUBING (20-1/2 IN.)			
19	1	TUBING (7 IN.)			
20	1	TUBING (8-1/2 IN.)			
21	3	FITTING (Shown as Ref. 10 on page 21)			
22	3	CAP			



Front Bleed View 1997 Model 200 DFI



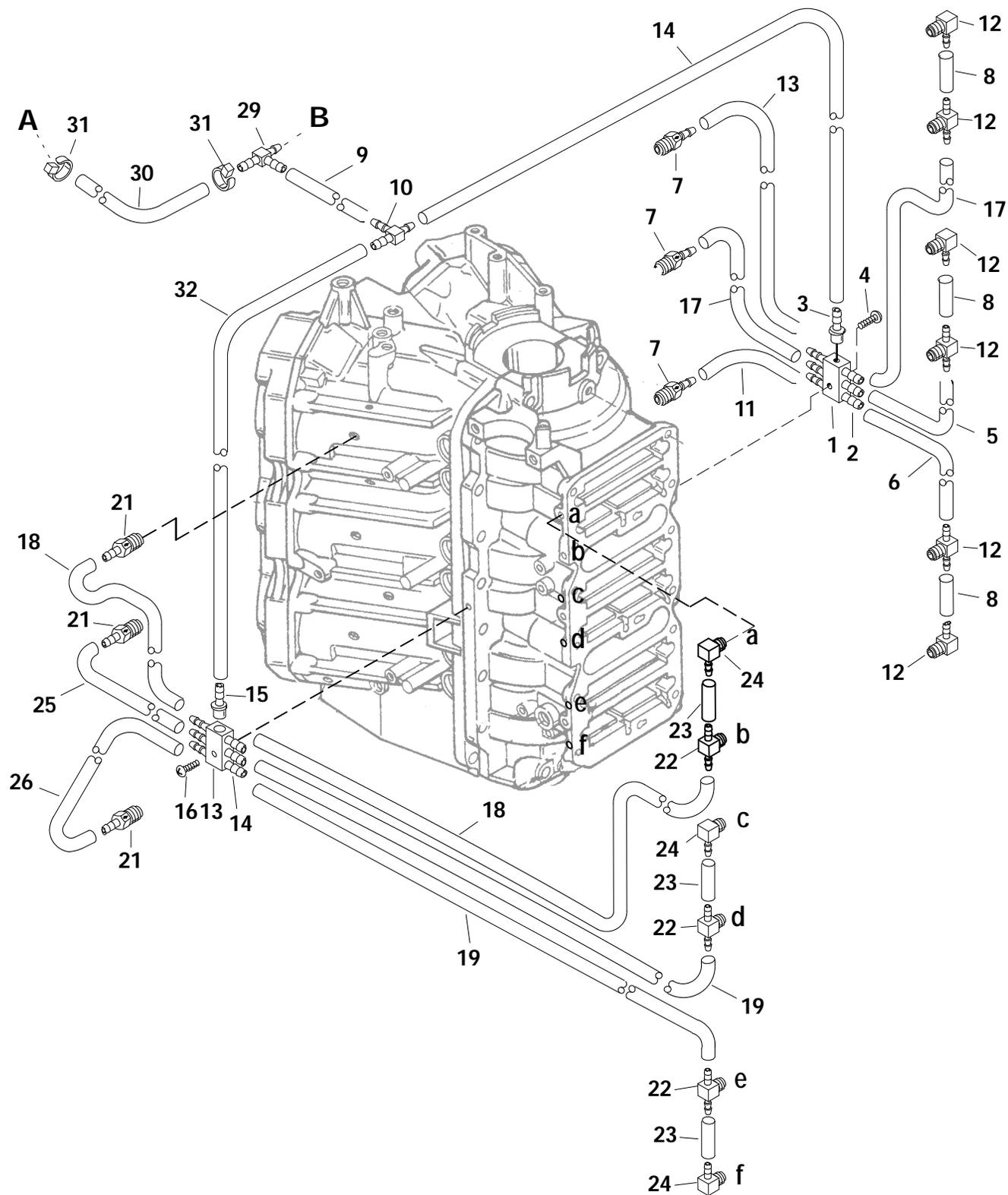


Notes:





Bleed System 1998 Model 200/225 DFI



A = TO AIR HANDLER

B = TO AIR COMPRESSOR



Bleed System 1998 Model 200/225 DFI

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	MANIFOLD-Bleed System			
2	6	CHECK VALVE			
3	1	FITTING-STRAIGHT			
4	1	SCREW (10-16 x 3/4 IN.) PORT	Drive Tight		
5	2	TUBING (5-1/2 IN.)			
6	2	TUBING (7 IN.)			
7	2	TUBING (6 IN.)			
8	3	FITTING (Shown as Ref.10 on page 16)			
9	1	TUBING (10-1/2 IN.)			
10	3	CHECK VALVE			
11	3	TUBING (1-3/4 IN.)			
12	3	CHECK VALVE			
13	1	TUBING (4-1/2 IN.)			
14	1	TUBING (10-1/4 IN.)			
15	1	MANIFOLD-Bleed System			
16	6	CHECK VALVE			
17	1	FITTING-STRAIGHT			
18	1	SCREW (10-16 x 3/4 IN.) STARBOARD	Drive Tight		
19	1	TUBING (7 IN.)			
20	1	TUBING (5-1/2 IN.)			
21	3	FITTING (Shown as Ref. 10 on page 16)			
22	3	CHECK VALVE			
23	3	TUBING (1-3/4 IN.)			
24	3	CHECK VALVE			
25	1	TUBING (4-1/2 IN.)			
26	1	TUBING (9 IN.)			
27	1	TUBING (1-1/4 IN.)			
28	1	FITTING-Tee			
29	1	TEE FITTING			
30	1	TUBING (1-1/2 IN.)			
31	2	STA STRAP			
32	1	TUBING (13 IN.)			

Reinstalling Engine Components

Reinstall the following components:

Section 2

- Starter Motor
- Alternator
- Ignition Modules
- Electronic Control Unit
- Solenoids
- Crank Position Sensor
- Throttle Position Sensor
- Temperature Sensor

Section 3

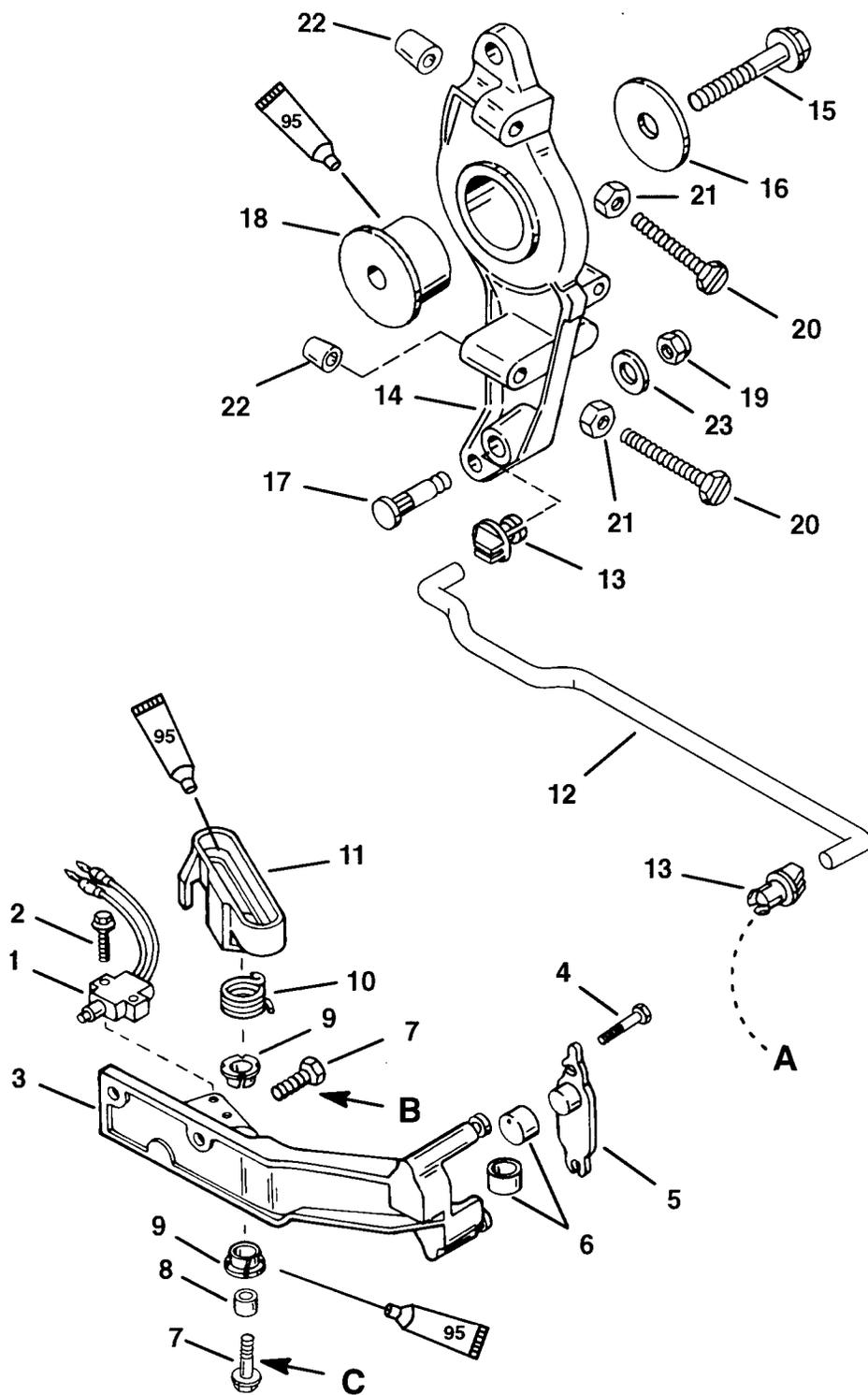
- Air Management System
- Fuel Management System
- Fuel Pump
- Fuel Rails
- Vapor Separator

Oil Injection

- On-Board Oil Tank
- Oil Pump



Anchor Bracket/Throttle Linkage Model 1997 200 DFI



A = TO FUEL MANAGEMENT BRACKET

B = 25 lb. ft. (34.0 N·m)

C = 20 lb. ft. (27.0 N·m)

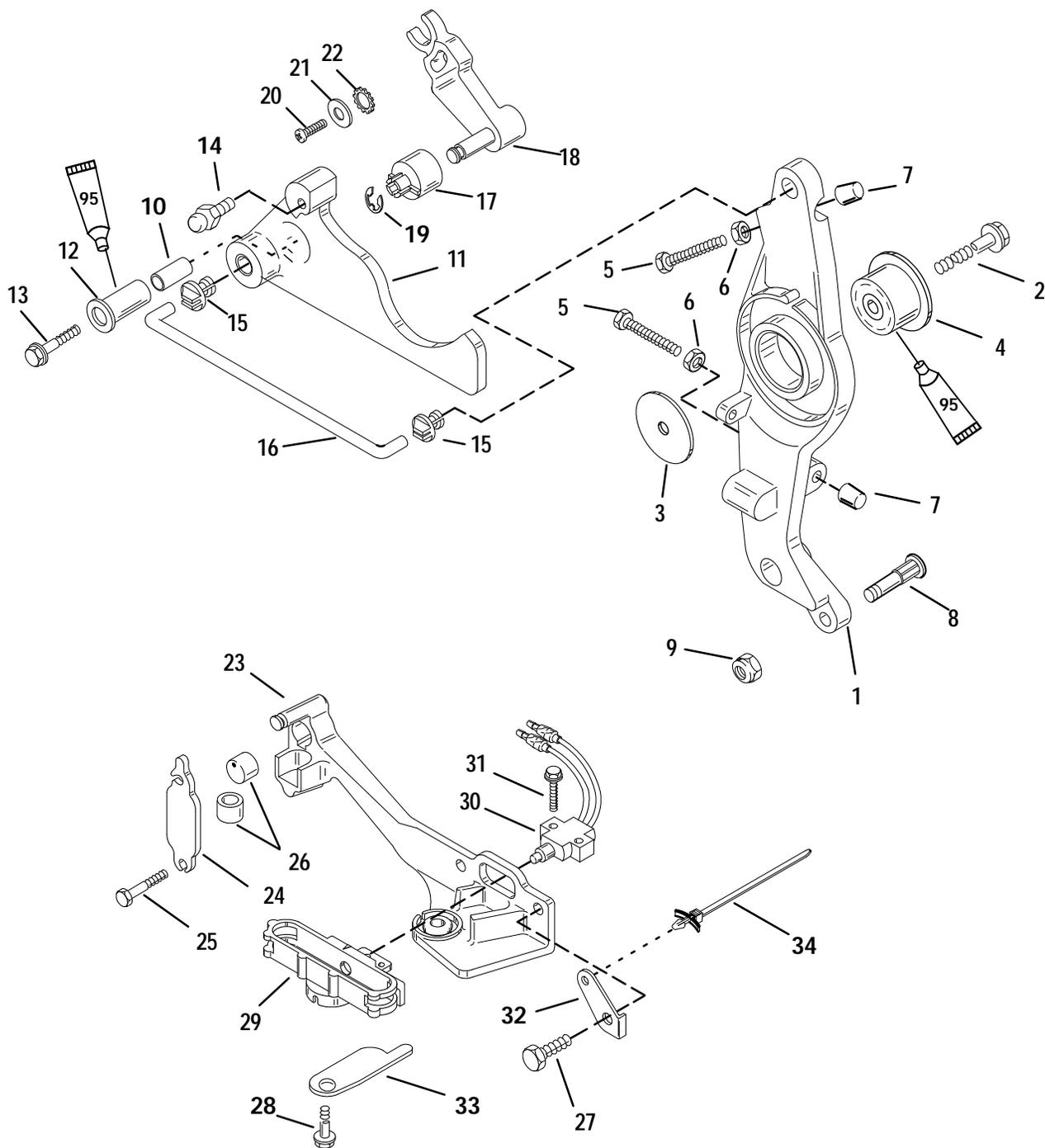


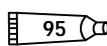
Anchor Bracket/Throttle Linkage 1997 Model 200 DFI

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	SWITCH			
2	2	SCREW (M3.5 x 20)	10		1.1
3	1	ANCHOR BRACKET			
4	2	DRIVE SCREW			
5	1	LATCH			
6	2	CUP			
7	3	SCREW (M8 x 25)			
8	1	BUSHING			
9	2	BUSHING			
10	1	SPRING			
11	1	ROLLER GUIDE			
12	1	THROTTLE LINK			
13	2	SWIVEL BUSHING			
14	1	THROTTLE LEVER			
15	1	SCREW (M8 x 35)		20	27.1
16	1	WASHER			
17	1	PIN INSERT			
18	1	BUSHING			
19	1	NUT			
20	2	SCREW (M6 x 70)			
21	2	NUT			
22	2	CAP			
23	1	WASHER			



Anchor Bracket/Throttle Linkage 1998 Model 200/225 DFI



 95 2-4-C w/Teflon (92-825407A12)



Anchor Bracket/Throttle Linkage 1998 Model 200/225 DFI

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	THROTTLE CONTROL LEVER			
2	1	SCREW (M8 x 35)	250	20.8	28.3
3	1	WASHER			
4	1	BUSHING			
5	2	SCREW (M6 x 55)			
6	2	NUT			
7	2	CAP			
8	1	PIN INSERT			
9	1	NUT	50		5.6
10	1	BEARING			
11	1	CAM			
12	1	BUSHING			
13	1	SCREW (M8 x 40)	45		5.1
14	1	THREADED BALL			
15	2	SWIVEL BUSHING			
16	1	LINK			
17	1	ROLLER			
18	1	THROTTLE ROLLER			
19	1	RETAINING RING			
20	1	SCREW (M5 x 16)	Drive Tight		
21	1	WASHER			
22	1	STAR WASHER			
23	1	ANCHOR BRACKET			
24	1	LATCH			
25	2	SCREW-Drive			
26	2	CUP			
27	3	SCREW (M8 x 25)		25	33.9
28	1	SCREW (M8 x 25)		20	27.1
29	1	ROLLER GUIDE			
30	1	SWITCH			
31	2	SCREW (M3.5 x 20)			
32	1	BRACKET			
33	1	BRACKET			
34	1	CABLE TIE			



Powerhead Installation on Driveshaft Housing

1. Install Lifting Eye (91-90455) into flywheel.

⚠ WARNING

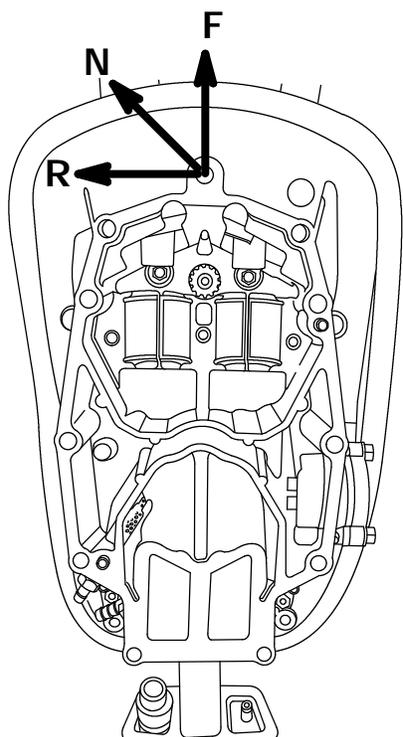
BE SURE that Lifting Eye is threaded into flywheel as far as possible **BEFORE** lifting powerhead.

2. Using a hoist, lift powerhead high enough to allow removal of powerhead from repair stand. Remove powerhead from repair stand, being careful not to damage drive shaft housing gasket surface of powerhead.

3. Place a new gasket around powerhead studs and into position on base of powerhead.

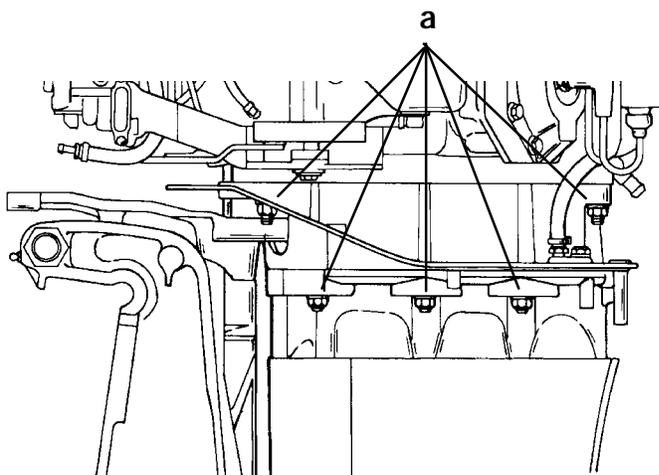
NOTE: If using powerhead base gasket with a gray bead impregnated in surface, position gasket with gray bead towards powerhead.

NOTE: Prior to installing the powerhead onto drive shaft housing, verify shift shaft is installed in gear housing and selects Forward - Neutral - Reverse as shown.



IMPORTANT: DO NOT apply lubricant to top of driveshaft as this will prevent driveshaft from fully engaging into crankshaft.

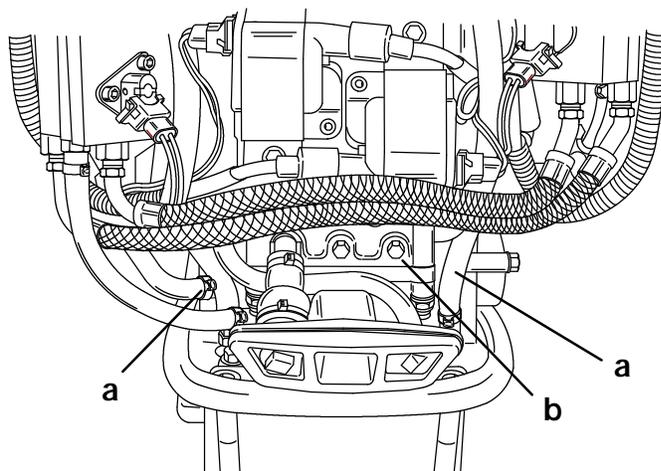
4. Apply a small amount of 2-4-C w/Teflon (92-825407A12) onto driveshaft splines.
5. Use hoist to lower powerhead onto driveshaft housing. It may be necessary to turn flywheel (aligning crankshaft splines with drive shaft splines) so that powerhead will be fully installed.
6. Install 10 flat washers and 10 locknuts which secure powerhead to exhaust extension plate/driveshaft housing. Torque locknuts in 3 progressive steps until secured.
7. Disconnect hoist from Lifting Eye and remove Lifting Eye from flywheel.
8. Reinstall plastic cap into center of flywheel cover.



52373

a - Locknuts and Flat Washers [Torque to 50 lb. ft. (68.0 N-m)]

9. Connect bypass water hoses to fittings on exhaust adaptor plate.

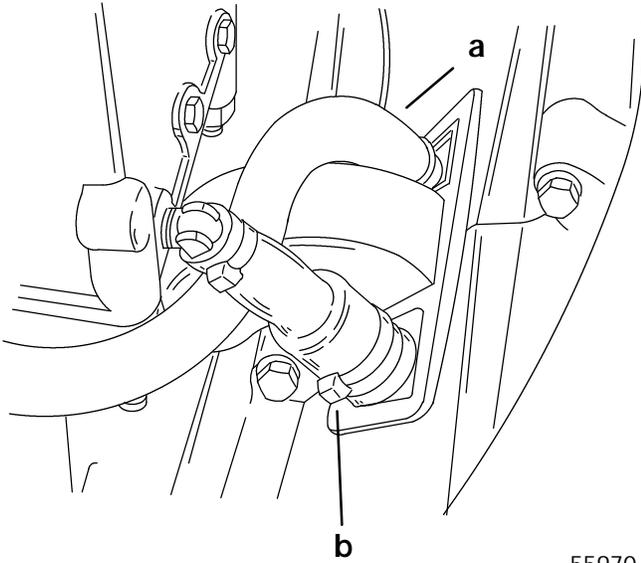


55920

a - Water Hose
b - Water Pressure Gauge Fitting (1997 Models)



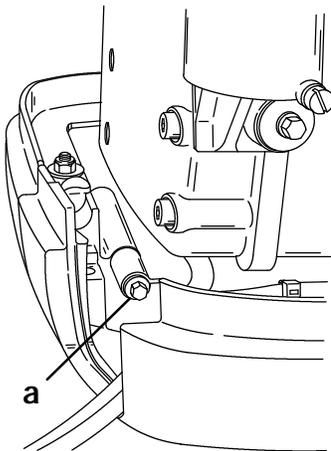
10. Connect tell-tale hose and flush hose to engine block.



a - Tell-Tale Hose
b - Flush Hose

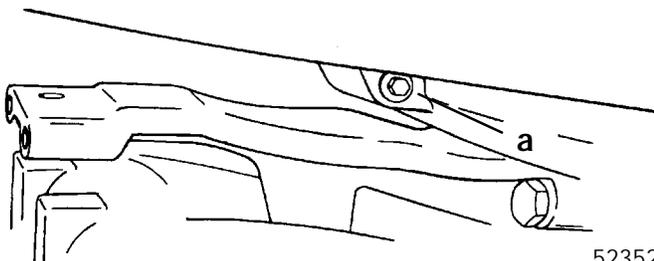
55970

11. Install four bolts which secure bottom cowl halves together.



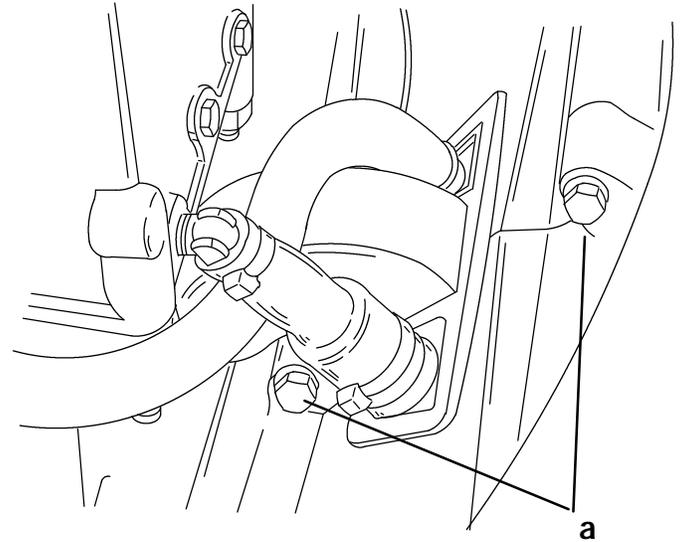
a - Bolts [Torque to 65 lb. in. (7.3 N·m)]

55932



a - Bolts [Torque to 65 lb. in. (7.3 N·m)]

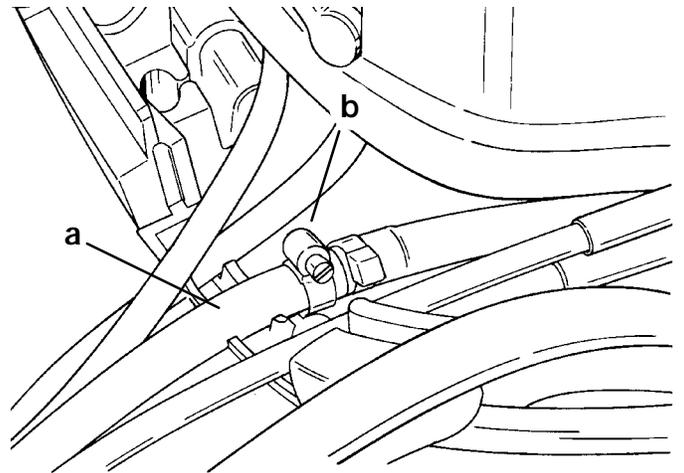
52352



a - Bolts [Torque to 65 lb. in. (7.3 N·m)]

55970

12. Re-connect input fuel line with hose clamp.

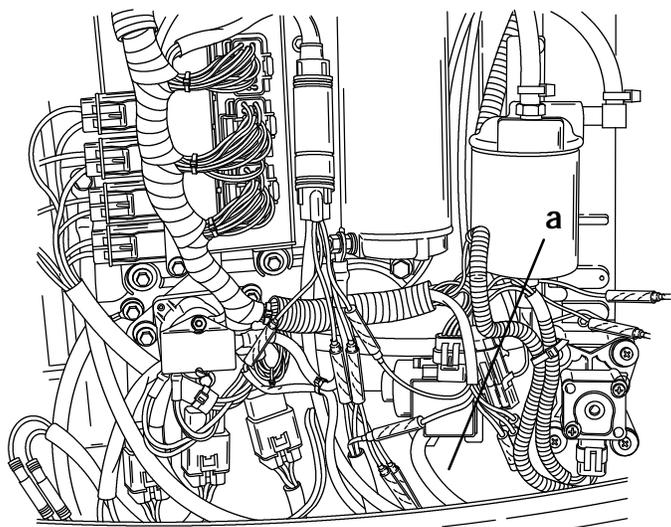


a - Fuel Line
b - Hose Clamp

52191



13. Connect remote oil tank pressure hose to to crankcase fitting.



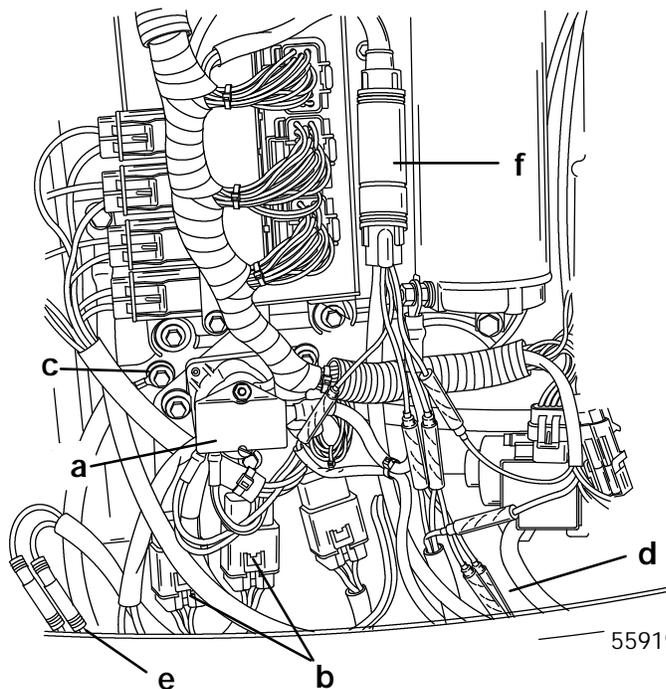
55919

a - Remote Oil Tank Pressure Hose

14. Attach relay ground harness to lower electrical plate mounting bolt. Torque bolt to 16.5 lb. ft. (22.4 N·m).

Attach relay positive leads (RED) to BATTERY SIDE of starter solenoid with nut. Torque nut to 45 lb. in. (5.1 N·m).

15. Re-connect remote control harness to power-head harness connector and wires as shown.

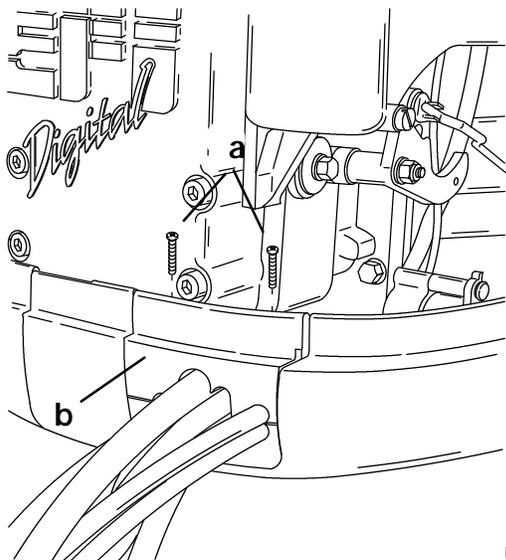


55919

- a - Nut - Attach RED Relay Leads - Torque Nut to 45 lb. in. (5.1 N·m)
- b - Relays - Secure with Retained Bolts and Nuts
- c - Bolt - Attach BLACK (ground) Relay leads - Torque Bolt to 16.5 lb. ft. (22.4 N·m).
- d - Connect BLUE/WHITE and GREEN/WHITE Trim Leads to Lower Cowl Trim Switch Harness.
- e - Connect BLUE (sleeve) and GREEN Power Trim Leads.
- f - Remote Control/Powerhead Harness



16. Install two screws which secure remote control harness retainer.



55917

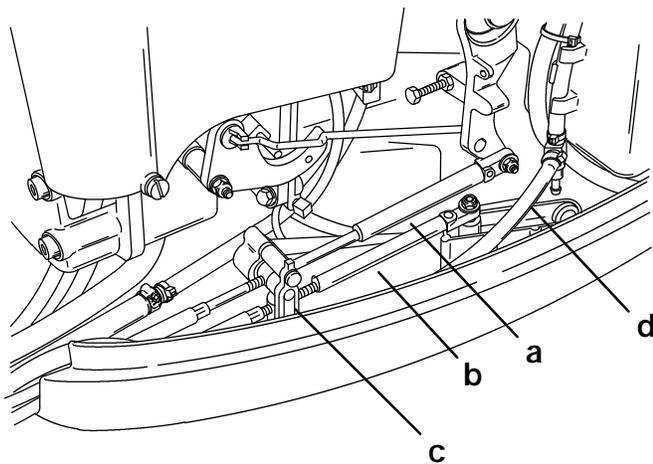
- a - Screws
- b - Retainer

17. Reinstall oil line to on board oil reservoir.

18. Slide outboard shift lever into neutral position.

19. Install throttle cable.

20. Install shift cable assembly as shown Refer to "Cable Adjustment" Section 7A.



55918

- a - Throttle Cable
- b - Shift Cable
- c - Cable Retainer
- d - Oil Hose

Refer to Section 2 of this Service Manual "Timing/Synchronizing/Adjusting" for engine set-up procedures.

Break-In Procedure

⚠ CAUTION

Severe damage to the engine can result by not complying with the Engine Break-in Procedure.

FUEL REQUIREMENTS

Do not use pre-mixed gas and oil in this engine. Use straight gasoline during engine break-in and after engine break-in. The ECM is programmed to signal the oil pump to provide additional oil (50:1 ratio) during the first 90 minutes of operation. The ECM will monitor this period through its own internal clock. At the end of this period, the ECM will signal the oil pump to go to a standard ratio of 300 - 400:1 @ idle and 60:1 @ W.O.T.

ENGINE BREAK-IN PROCEDURE (ALL MODELS)

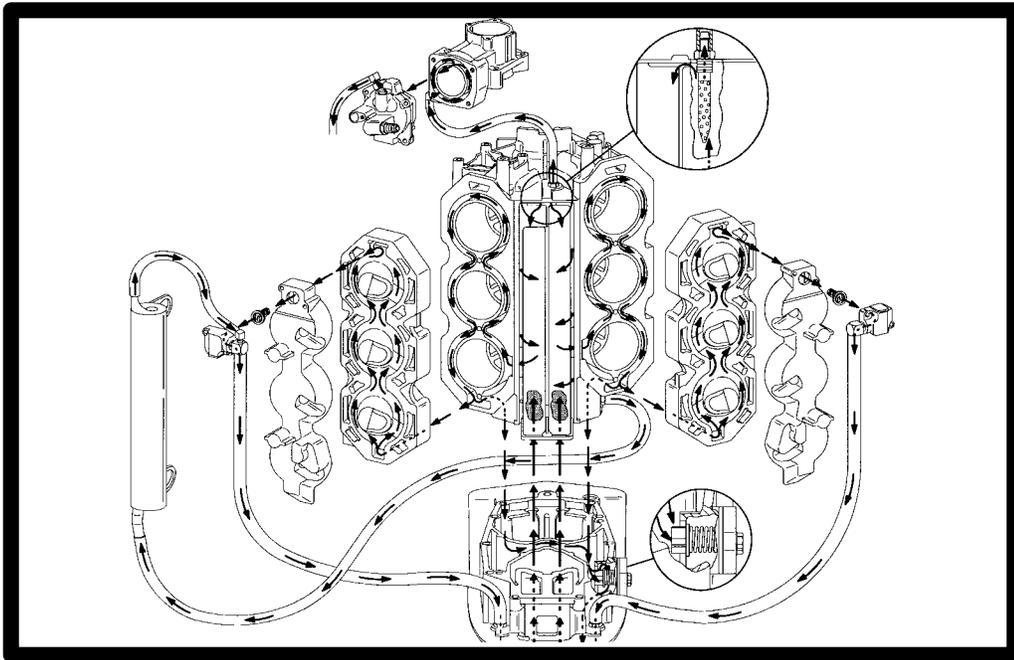
Vary the throttle setting during the first hour of operation. Avoid remaining at a constant speed for more than two minutes and avoid sustained wide open throttle.



POWERHEAD

4

B



COOLING SYSTEM



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Specifications	4B-1
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Description	4B-2
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Specifications

Water Pressure

Idle	1-1/2 – 4-1/2 psi (10.3 – 30.8kPa)
Poppet Valve Opening	6 – 7 psi (41.1 – 47.9kPa)
W.O.T.	8-10 psi (54.9 – 68.5kPa)

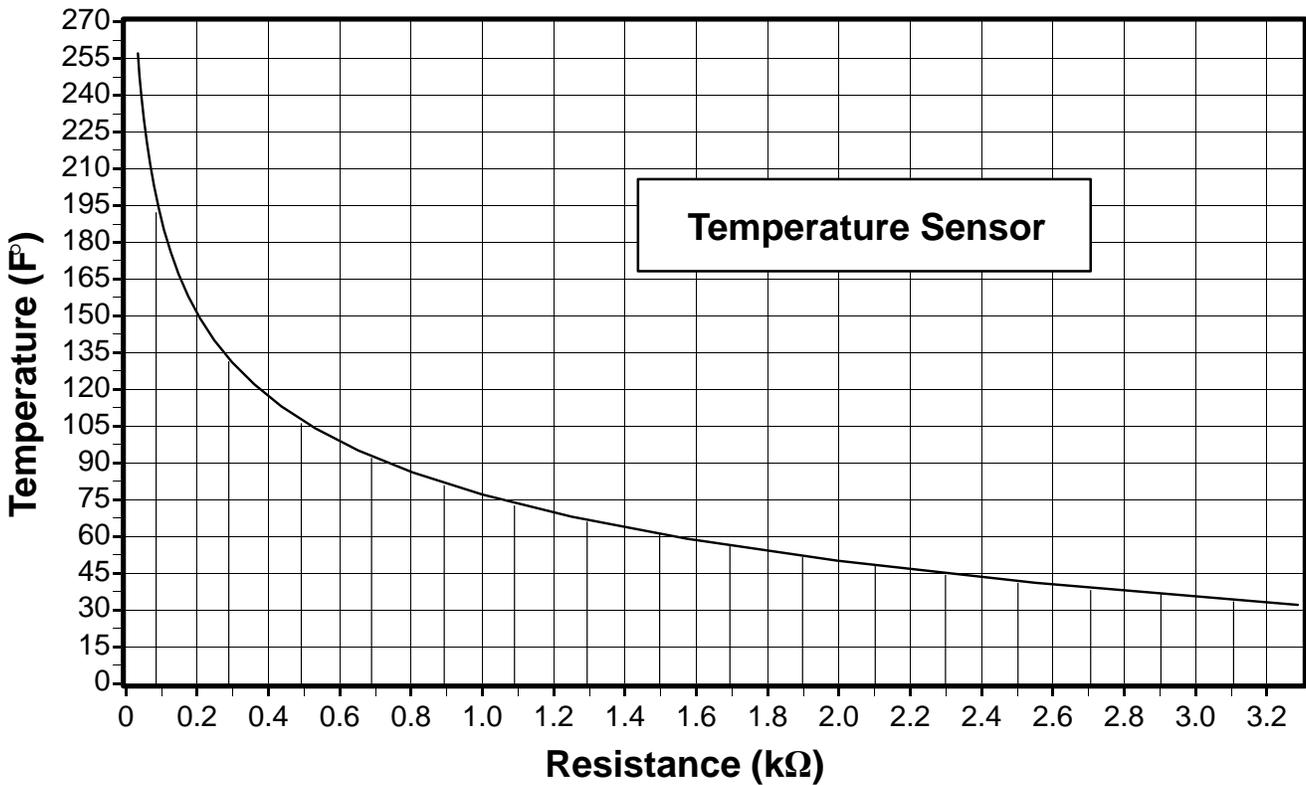
Thermostat 120°F (48.9°C)

Temperature Sensor

Three temperature sensors are used to provide cylinder head temperature information to the ECM. A sensor is mounted in each cylinder head and one in the air compressor cylinder head. The ECM uses this information to increase injector pulse width for cold starts and to retard timing in the event of an over-heat condition.

An ohms test of the temperature sensor would be as follows:

Insert digital or analog ohmmeter test leads into both TAN/BLACK sensor leads. With engine at temperature (F°) indicated, ohm readings should be as indicated ±10%.



Temperature Sensor Location	
Starboard and Port Cylinder Heads	
Horn Activation	180°F (82°C)
Speed Reduction (3000 RPM)	185°F (85°C)
Compressor	
Horn Activation	221°F (105°C)

Temperature Sensor(s)	
Between Black and each TAN/BLK wire.	No Continuity
Between each lead and ground	No Continuity

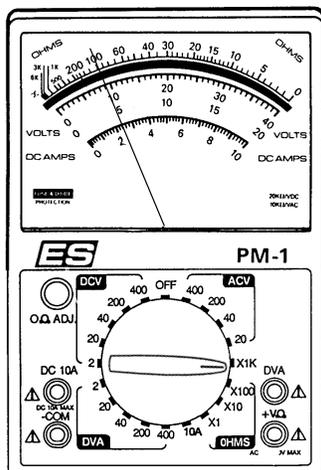
NOTE: The air compressor temperature sensor and cylinder head temperature sensors are the same part number. The ECM has been programmed to activate a warning circuit at different temperatures depending upon sensor location.

NOTE: The Digital Diagnostic Terminal (DDT) can be used to monitor temperature readings from all three temperature sensors.

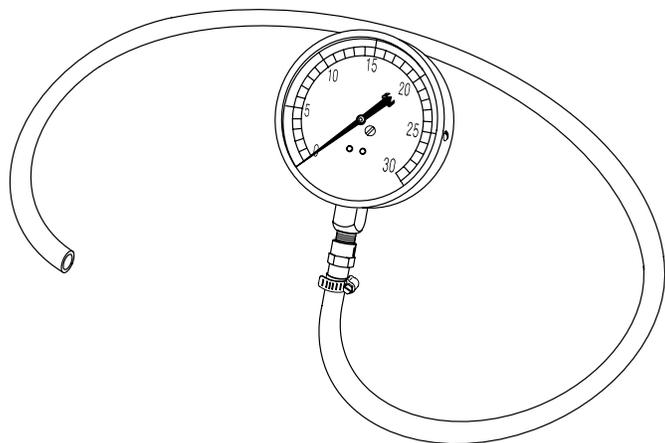


Special Tools

1. Volt/Ohm Meter 91-99750A1



2. Water Pressure Gauge 91-79250A2



56725

3.0 Liter Optimax/DFI Water Flow

Description

Cooling water enters the cooling system through the lower unit water inlets. The pump assembly forces water through the water tube and exhaust adapter plate passages filling the power head central water chamber (located behind the exhaust cavity). Water enters the exhaust cover cavity through 6 holes (3 each side) and 1 slot (top) that connects the central chamber to the exhaust cover cavity. Water also exits the top of the central chamber through a strainer screen to supply water to the air compressor.

Water exits the exhaust cover cavity through 2 slots near the lower cylinders filling the water passages around the cylinders. Water flow is directed around each cylinder sleeve by 6 water dams.

Water flow exiting the cylinder block is controlled by the thermostats (1 in each cylinder head) and the poppet valve (located in the exhaust adaptor plate). At low RPM (below 1500 RPM) the thermostats control water flow depending upon engine temperature. When the thermostats are open, water passes through the cylinder heads and exits to the drive shaft housing. At higher RPM (above 1500 RPM) the poppet valve will control the water flow.

Water that passes through the poppet valve enters water passages in the exhaust tube to help cool the exhaust tube. Water will exit the exhaust tube through 2 slots at the top of the exhaust relief holes area (helping keep the holes clear of carbon and salt buildup) and through 2 holes at lower rear of exhaust tube into the drive shaft housing.

Water dumped into the drive shaft housing builds up a wall of water around the exhaust tube. This performs 2 functions:

- Helps silence the exhaust
- Prevents air from being drawn into the pump

Water exits the engine in 3 locations:

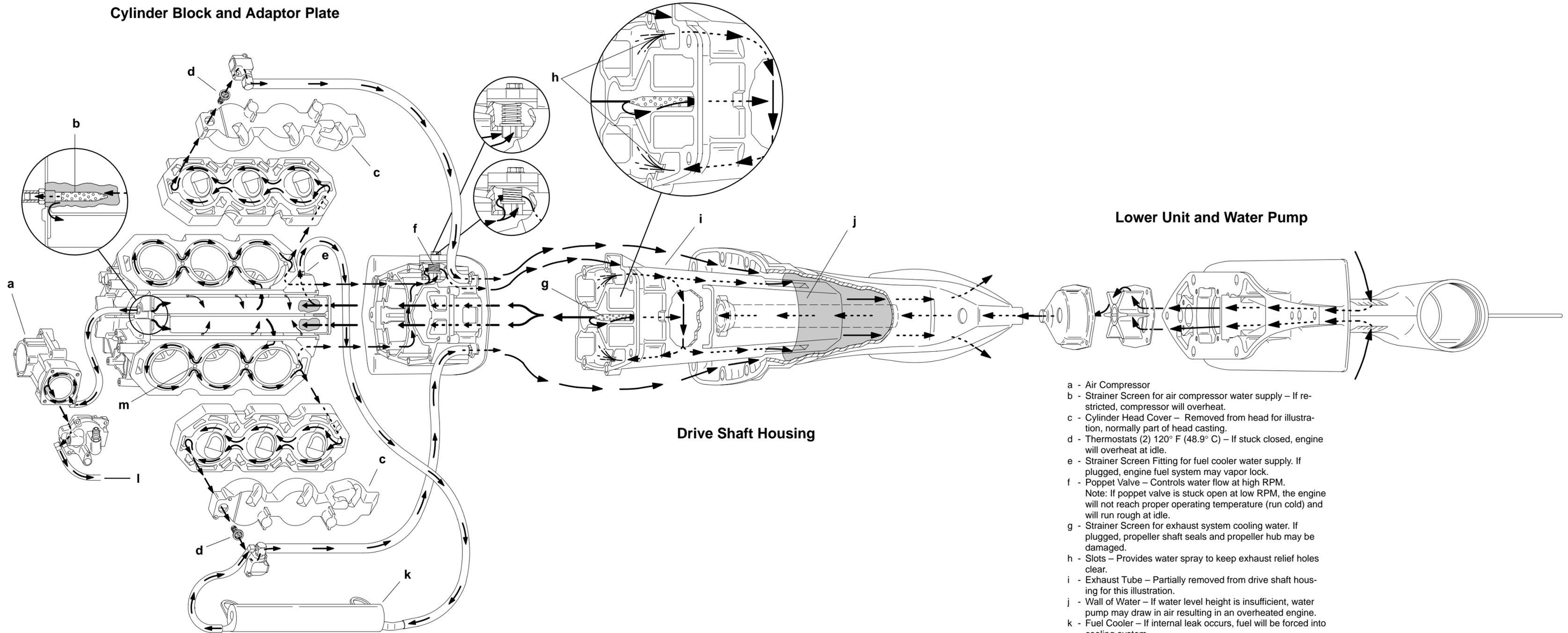
- Excess water from the wall of water exits through the bottom aft area of the drive shaft housing.
- Water that passes through the air compressor exits out the tell tail.
- Water exits through a strainer screen in the exhaust adaptor plate into the exhaust tube, mixing with the exhaust gases.

To allow complete passage filling and to prevent steam pockets, all cooling passages are interconnected. Small passages are incorporated to allow the cooling system to drain.



Water Flow Diagram

Cylinder Block and Adaptor Plate



Lower Unit and Water Pump

Drive Shaft Housing

- a - Air Compressor
- b - Strainer Screen for air compressor water supply – If restricted, compressor will overheat.
- c - Cylinder Head Cover – Removed from head for illustration, normally part of head casting.
- d - Thermostats (2) 120° F (48.9° C) – If stuck closed, engine will overheat at idle.
- e - Strainer Screen Fitting for fuel cooler water supply. If plugged, engine fuel system may vapor lock.
- f - Poppet Valve – Controls water flow at high RPM.
Note: If poppet valve is stuck open at low RPM, the engine will not reach proper operating temperature (run cold) and will run rough at idle.
- g - Strainer Screen for exhaust system cooling water. If plugged, propeller shaft seals and propeller hub may be damaged.
- h - Slots – Provides water spray to keep exhaust relief holes clear.
- i - Exhaust Tube – Partially removed from drive shaft housing for this illustration.
- j - Wall of Water – If water level height is insufficient, water pump may draw in air resulting in an overheated engine.
- k - Fuel Cooler – If internal leak occurs, fuel will be forced into cooling system.
- l - Water Outlet from Air Compressor – Connects to tell-tale outlet on bottom cowl.
- m - Rubber Water Dams (6) – If missing may result in uneven cooling of cylinders and scuffed pistons.

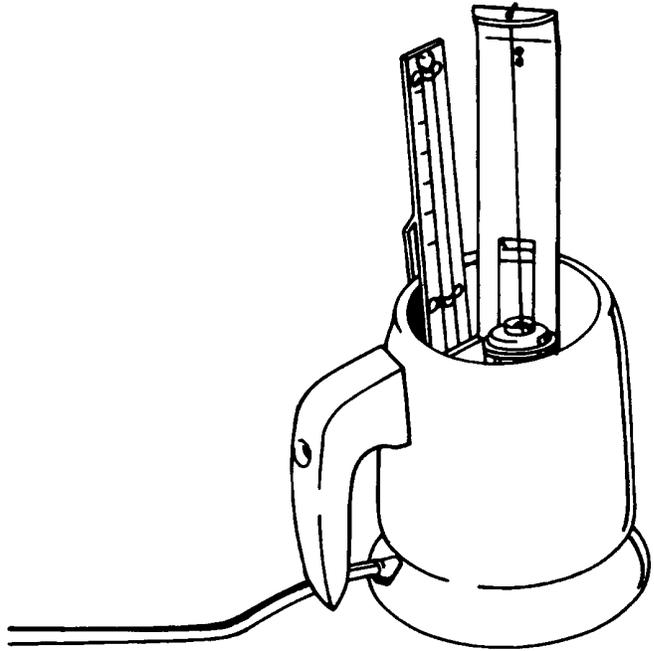


Troubleshooting

Thermostat Test

1. Inspect thermostat covers and cylinder head covers (thermostat opening) for cracks and corrosion damage that could cause leakage. Replace parts as necessary.
2. Remove and discard gasket from each thermostat.
3. Wash thermostats with clean water.
4. Using a thermostat tester, similar to the one shown, test each thermostat as follows:
 - a. Open thermostat valve, then insert a thread between valve and thermostat body. Allow valve to close against thread.
 - b. Suspend thermostat (from thread) and thermometer inside tester so that neither touches the container. Bottom of thermometer must be even with bottom of thermostat to obtain correct temperature of thermostat opening.
 - c. Fill thermostat tester with water to cover thermostat.
 - d. Plug tester into electrical outlet.
 - e. Observe temperature at which thermostat begins to open. (Thermostat will drop off thread, that was installed in Step "a", when it starts to open.) Thermostat must begin to open when temperature reaches 118°-123° F (47.8°-50.6° C).
 - f. Continue to heat water until thermostat is completely open.
 - g. Unplug thermostat tester.
 - h. Replace thermostat, if it fails to open at the specified temperature, or if it does not fully open.

NOTE: BE SURE that water in thermostat tester is allowed to cool sufficiently [below 110° F (43.3° C)] before testing the other thermostat.



51087

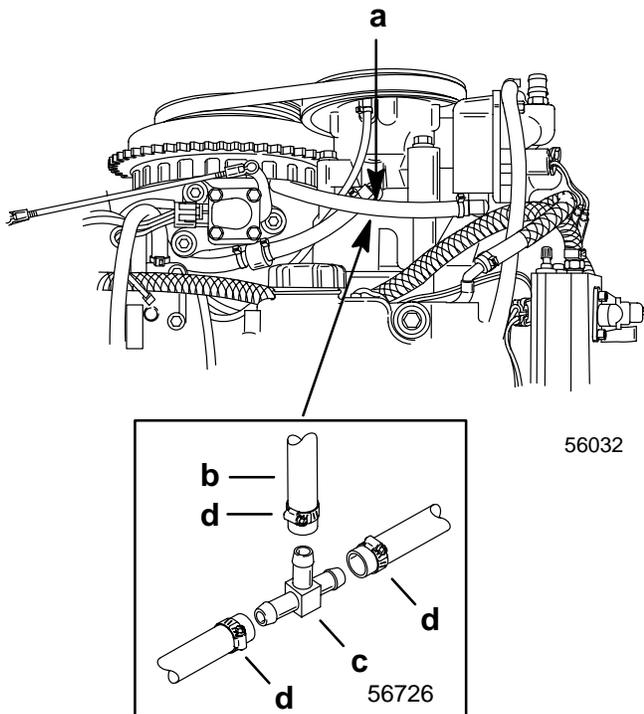
IMPORTANT: DO NOT operate engine without thermostats installed.



Water Pressure Check

Using Water Pressure Gauge 91-79250A2, cut compressor water inlet hose and install tee fitting (provided) as shown.

NOTE: This is also the same location for installing the water pressure hose for a dash mounted water pressure gauge.



56032

56726

- a - Compressor Water Inlet Hose
- b - Water Pressure Gauge Hose
- c - Tee Fitting (22-90824)
- d - Hose Clamp (54-815504104)

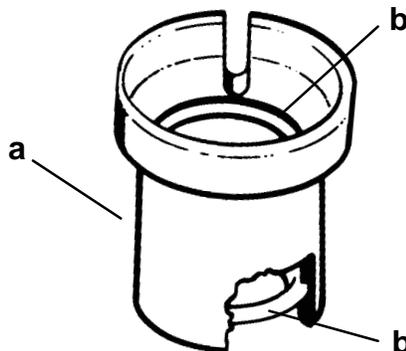
⚠ WARNING

Shut off engine and refer to troubleshooting chart if water pressure is not within specification. **DO NOT** exceed 3000 RPM in neutral.

Idle	1-1/2 – 4-1/2 psi (10.3 – 30.8kPa)
Poppet Valve Opening	6 – 7 psi (41.1 – 47.9kPa)
W.O.T.	8-10 psi (54.9 – 68.5kPa)

Water Pump Cleaning and Inspection

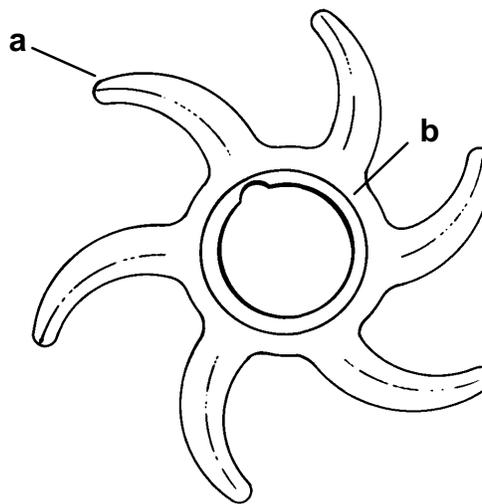
1. Inspect the water tube coupling assembly for wear or damage. If necessary replace the worn or damaged components especially the two O-rings on the inside, one at the top and one at the bottom.



70613

- a - Water Tube adapter
- b - O-rings (2)

2. Inspect the water pump impeller for wear on the end, top and bottom of the impeller blades. Replace the impeller if this condition is found.
3. Inspect for proper bonding between the hub and the impeller. Replace the impeller if improper bonding is found.



70500

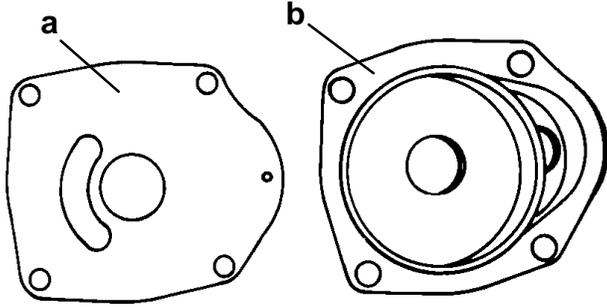
- a - Impeller
- b - Hub

4. Inspect the impeller blades to see if they are cracked, burnt, hard or deformed. Replace the impeller if the blades are in this condition.

IMPORTANT: The circular groove formed by the impeller sealing bead should be disregarded when inspecting cover and plate. The depth of the groove will not affect water pump output.



5. Replace cover if thickness of steel at the discharge slot is 0.060 in. (1.5mm) or less or if grooves (other than impeller sealing bead groove) in cover roof are more than 0.030 in. (0.76mm) deep.



70609

- a - Water Pump Face Plate
- b - Water Pump Cover

6. Inspect the water pump face plate and the water pump interior for roughness and/or grooves. Replace the appropriate components as required.

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

IMPORTANT: It is recommended that the water pump impeller be replaced whenever the gear-case is removed for maintenance. However, if it is necessary to re-use the impeller, **DO NOT** install in reverse to original rotation as premature impeller failure will occur.



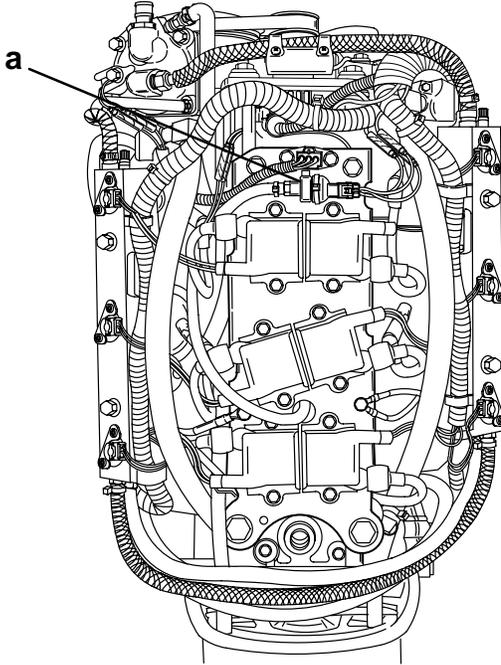
Problem Diagnosis

Condition	Recommended Range	Possible Cause
Pressure below specification @ idle	1-1/2 – 4-1/2psi (10.3 – 30.8kPa)	<ul style="list-style-type: none"> •Poppet valve spring defective (weak, broken, missing) •Defective poppet valve seal •Severe internal leak •Low output water pump •Inlet restriction •Strainer screen for air compressor water supply is restricted
Pressure above 5 psi (34.2kPa) @ idle	1-1/2 – 4-1/2psi (10.3 – 30.8kPa)	<ul style="list-style-type: none"> •Plugged poppet by-pass passage
Pressure does not drop between 1200 – 1800 RPM indicating poppet valve has opened	6 – 7psi (41.1 – 47.9kPa) between 1200 – 1800 RPM	<ul style="list-style-type: none"> •Wrong poppet valve spring •Low output water pump •Inlet restriction •Poppet valve vent hole plugged or restricted
Poppet valve flutter/water pressure drop does not start prior to 1500 RPM	6 – 7psi (41.1 – 47.9kPa) between 1200 – 1800 RPM	<ul style="list-style-type: none"> •Poppet valve spring defective (weak, broken, strong, missing) •Broken diaphragm in poppet valve •Severe internal leak •Low output water pump •Defective poppet valve seal
Poppet valve flutter/water pressure drop does not stop prior to 1800 RPM	6 – 7psi (41.1 – 47.9kPa) between 1200 – 1800 RPM	<ul style="list-style-type: none"> •Wrong poppet valve spring •Low output water pump •Inlet restriction
Pressure exceeds specification @ W.O.T.	8 – 10psi (54.9 – 68.5kPa) Note: A modified propeller or low pitch propeller is required to check water pressure @ W.O.T. if boat is stationary. Boat must be in the water and secured to a dock or trailer and run in forward gear. DO NOT perform check using a flush device.	<ul style="list-style-type: none"> •Restriction on discharge side of cooling system •Engine mounted too high on transom or trimmed too far out resulting in formation of steam pockets in cooling system •If boat is not stationary but is being run on open water, ram effect of water on coolant inlets @ high speeds may increase water pressure above specifications
Pressure is below specification @ W.O.T.	8 – 10psi (54.9 – 68.5kPa)	<ul style="list-style-type: none"> •Inlet restriction •Engine mounted too high on transom •Engine trimmed out too far •Configuration of boat bottom interfering with adequate flow of water to coolant inlets •Severe internal leak •Low output water pump



Water Pressure Switch

The 1998 200/225 DFI Models have a water pressure sensor switch. This switch is monitored by the ECM at 3000 RPM and above. Should the water pressure drop below a predetermined level for more than 2 seconds, a warning horn will be activated and a warning lamp will be illuminated. Should the low water pressure continue for more than 5 seconds, a speed reduction circuit within the ECM will be activated and maximum engine RPM will be limited to 3000 RPM.



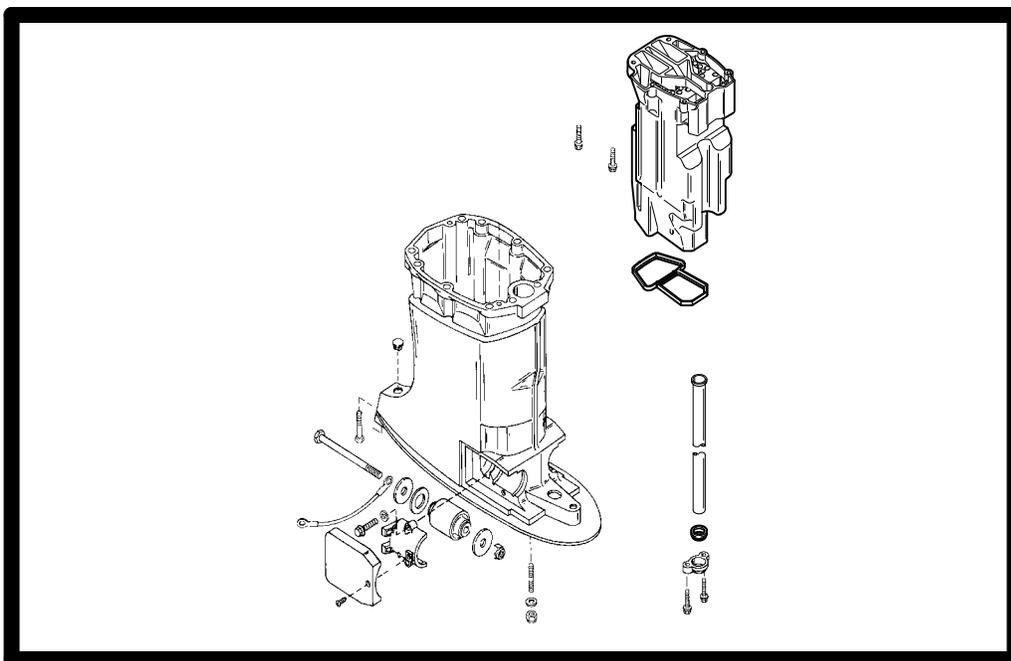
a - Water Pressure Switch

NOTE: Switch activation pressure readings can be accurately checked with the Digital Diagnostic Terminal (DDT)

Water Pressure Switch Activation	
Engine RPM	Pressure
3000	4.3psi (30kPa)
3300	4.8psi (33kPa)
3850	5.8psi (40kPa)
4400	6.2psi (43kPa)
4950	6.7psi (46kPa)
5500	7.0psi (48kPa)



MID-SECTION



**CLAMP BRACKET/SWIVEL BRACKET/
DRIVE SHAFT HOUSING**

5

A



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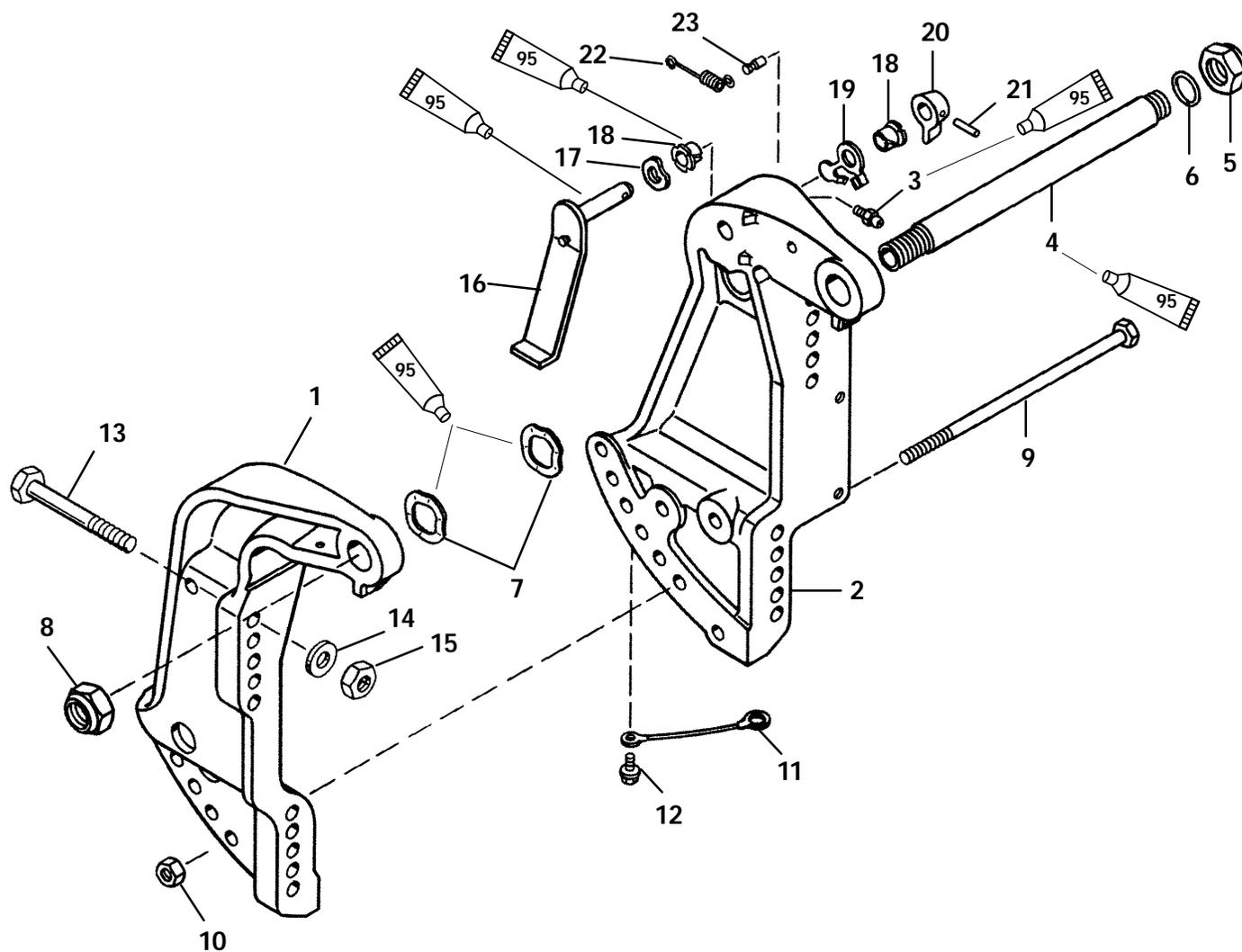


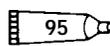
Notes:





1997 Model 200 DFI Transom Brackets



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

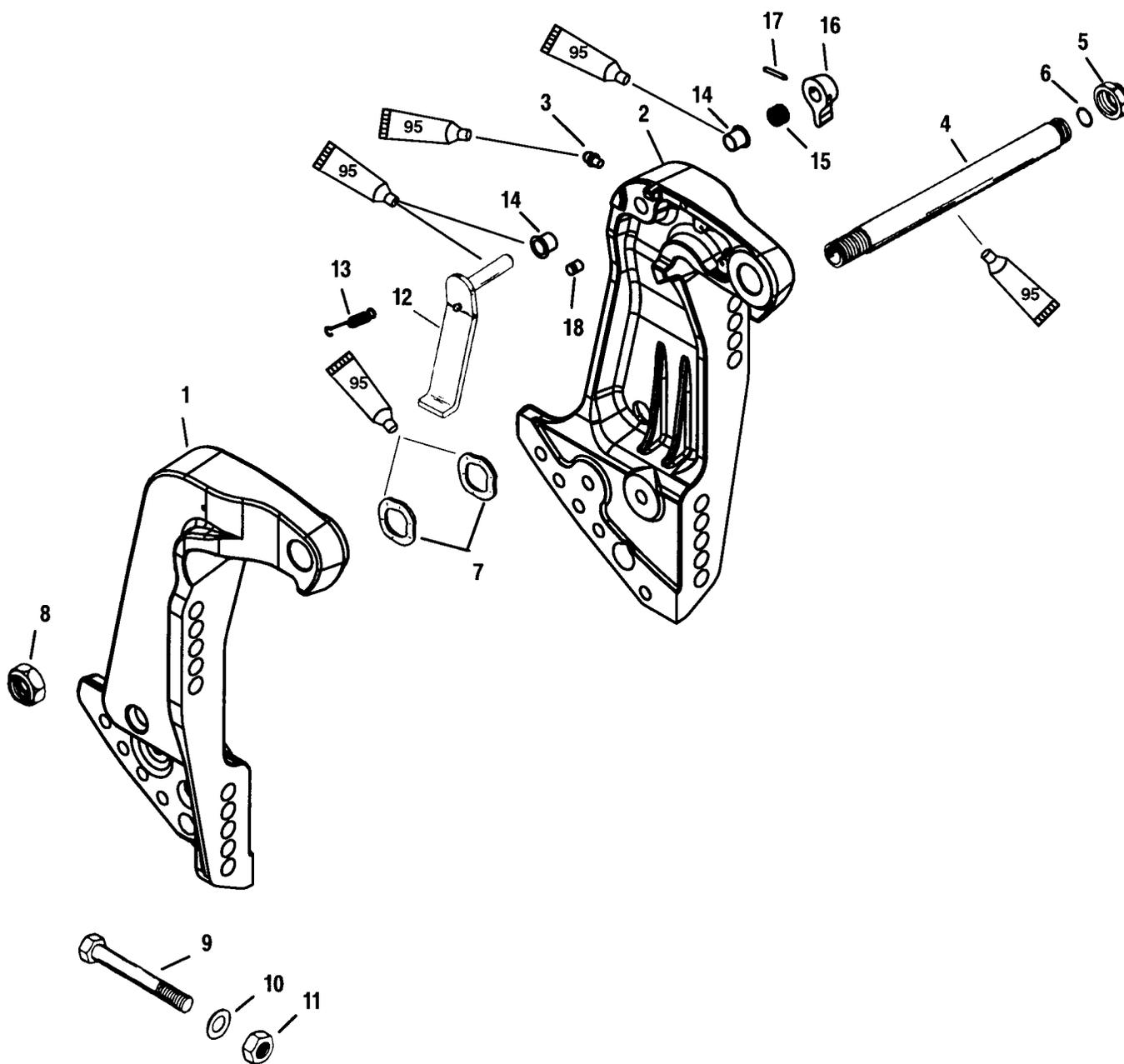


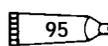
1997 Model 200 DFI Transom Brackets

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	TRANSOM BRACKET (STBD)			
2	1	TRANSOM BRACKET (PORT)			
3	1	GREASE FITTING (PORT)	85		9.6
4	1	TILT TUBE			
5	1	NUT (1 ² -14)		45	61
6	1	O RING			
7	2	WAVE WASHER			
8	1	NUT (7/8-14)		45	61
9	1	BOLT ASSEMBLY			
10	1	NUT (.375-24)	90		10.2
11	1	GROUND WIRE			
12	1	SCREW (1/4-20 x .375)	70		7.9
13	4	BOLT			
14	4	WASHER			
15	4	NUT			
16	1	TILT LOCK LEVER ASSEMBLY			
17	1	WAVE WASHER			
18	2	BUSHING			
19	1	STOP			
20	1	KNOB			
21	1	GROOVE PIN			
22	1	SPRING			
23	1	GROOVE PIN			



1998 Model 200/225 DFI Transom Brackets



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

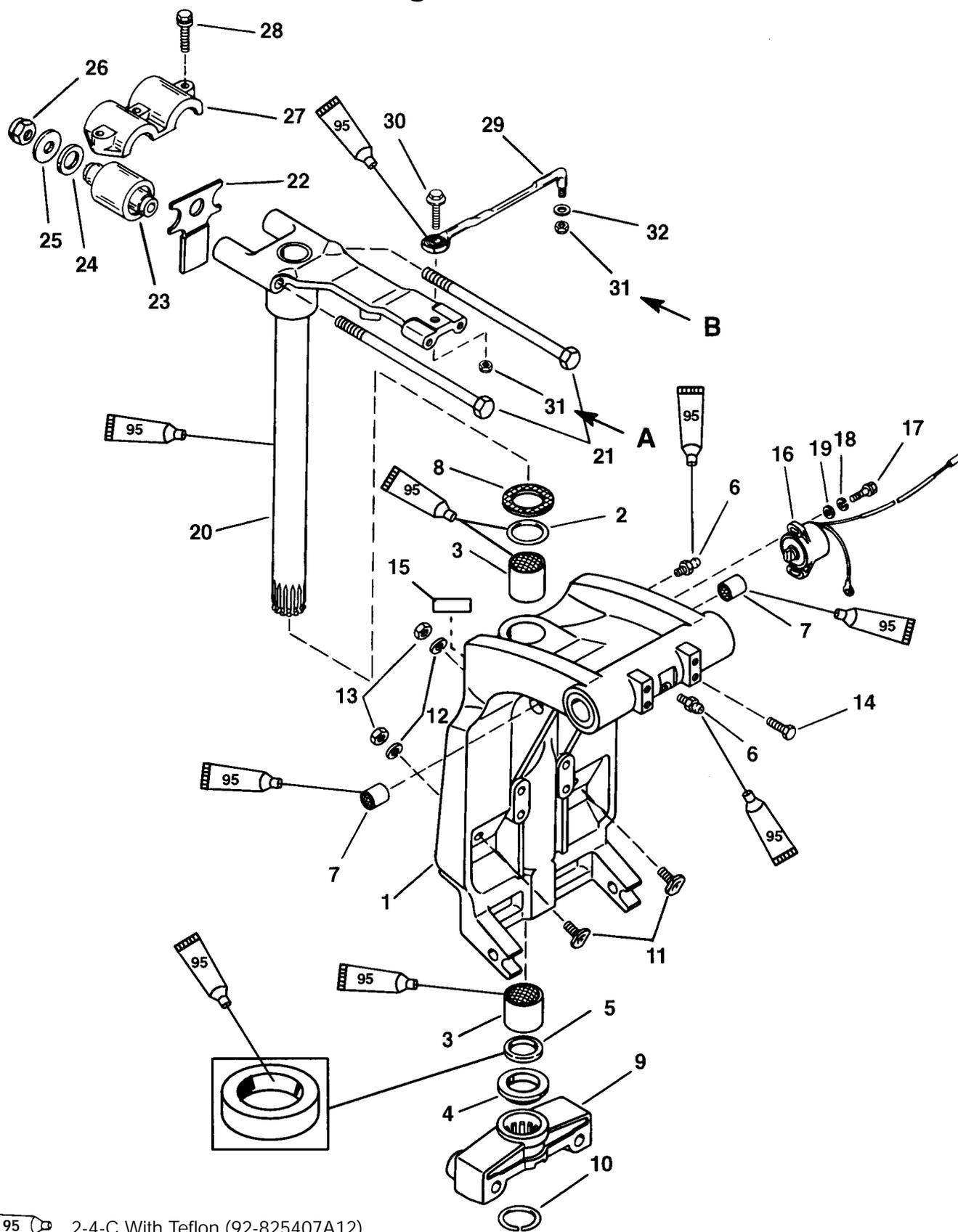


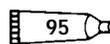
TRANSOM BRACKETS

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	TRANSOM BRACKET (STARBOARD)			
2	1	TRANSOM BRACKET (PORT)			
3	1	GREASE FITTING (PORT)	85		9.6
4	1	TILT TUBE			
5	1	NUT (1 IN.-14)		45	61
6	1	O-RING			
7	2	WAVE WASHER			
8	1	NUT (7/8-14)		45	61
9	4	BOLT			
10	4	WASHER			
11	4	NUT			
12	1	TILT LOCK LEVER ASSEMBLY			
13	1	SPRING			
14	2	BUSHING			
15	1	SPRING			
16	1	KNOB			
17	1	GROOVE PIN			
18	1	PIN			



Swivel Bracket and Steering Arm



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

A - Torque nut to 20 lb. ft. (27.1 N·m)

B - Torque nut until it seats [DO NOT exceed 120 lb. in. (13.6 N·m) of torque], then back off 1/4 turn.

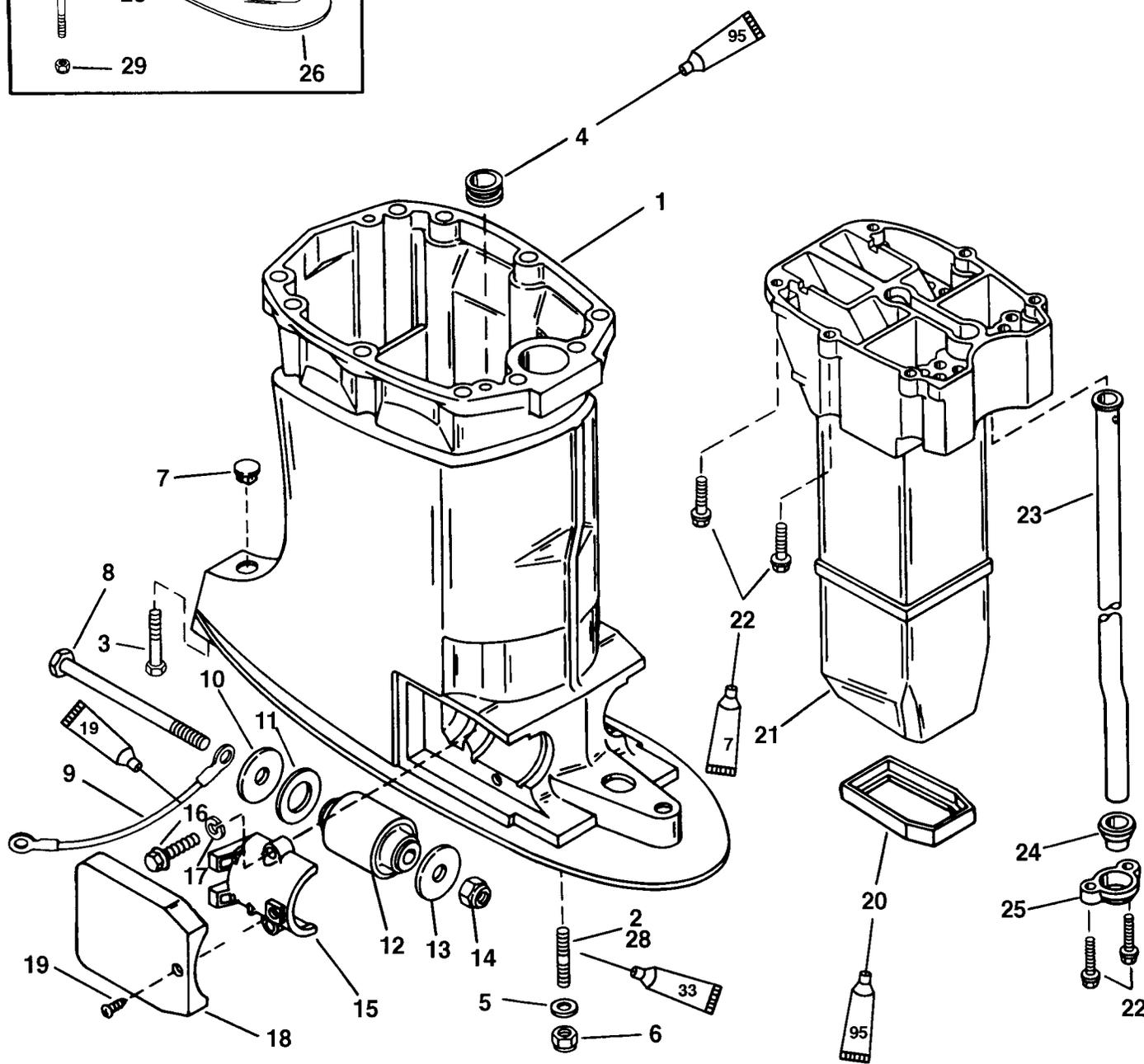
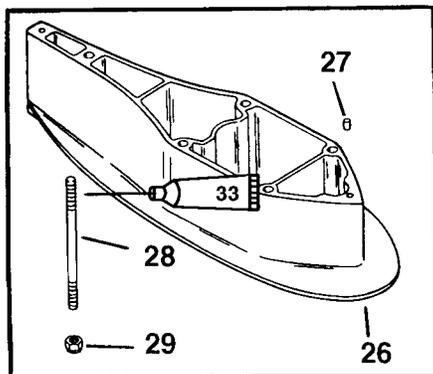


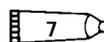
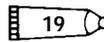
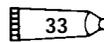
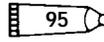
Swivel Bracket and Steering Arm

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	SWIVEL BRACKET			
2	1	O RING			
3	2	BUSHING			
4	1	SPACER			
5	1	OIL SEAL (LOWER)			
6	2	GREASE FITTING	85		9.6
7	2	BUSHING			
8	1	THRUST WASHER			
9	1	BOTTOM YOKE (LONG - CARBON STEEL)			
	1	BOTTOM YOKE (XL-STAINLESS STEEL)			
10	1	RETAINING RING			
11	2	STRIKER PLATE			
12	2	LOCKWASHER			
13	2	NUT		25	33.9
14	2	SCREW (1/4-28 x 1/2 IN.)	100		11.3
15	1	DECAL-Serial Overlamine			
16	1	TRIM SENDER			
17	2	SCREW (10-24 x 3/4 IN.)	15		1.7
18	2	LOCKWASHER			
19	2	WASHER			
20	1	SWIVEL PIN/STEERING ARM (LONG - CARBON STEEL)			
	1	SWIVEL PIN/STEERING ARM(XL-STAINLESS STEEL)			
21	2	SCREW (M12 x 1.75 x 190)			
22	1	BUMPER			
23	2	UPPER MOUNT			
24	2	WASHER			
25	2	WASHER			
26	2	NUT		50	67.8
27	1	CLAMP			
28	3	SCREW (M8 x 35)		20	27.1
29	1	STEERING LINK ASSEMBLY			
30	1	SCREW		20	27.1
31	2	NUT (.375-24)			
32	2	WASHER			



Drive Shaft Housing and Exhaust Tube (S/N-0G437999 & BELOW)



-  7 Loctite 271 (92-809820)
-  19 Perfect Seal (92-34227-1)
-  33 Loctite 680 (92-809833)
-  95 2-4-C With Teflon (92-825407A12)

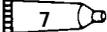
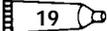
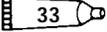
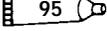


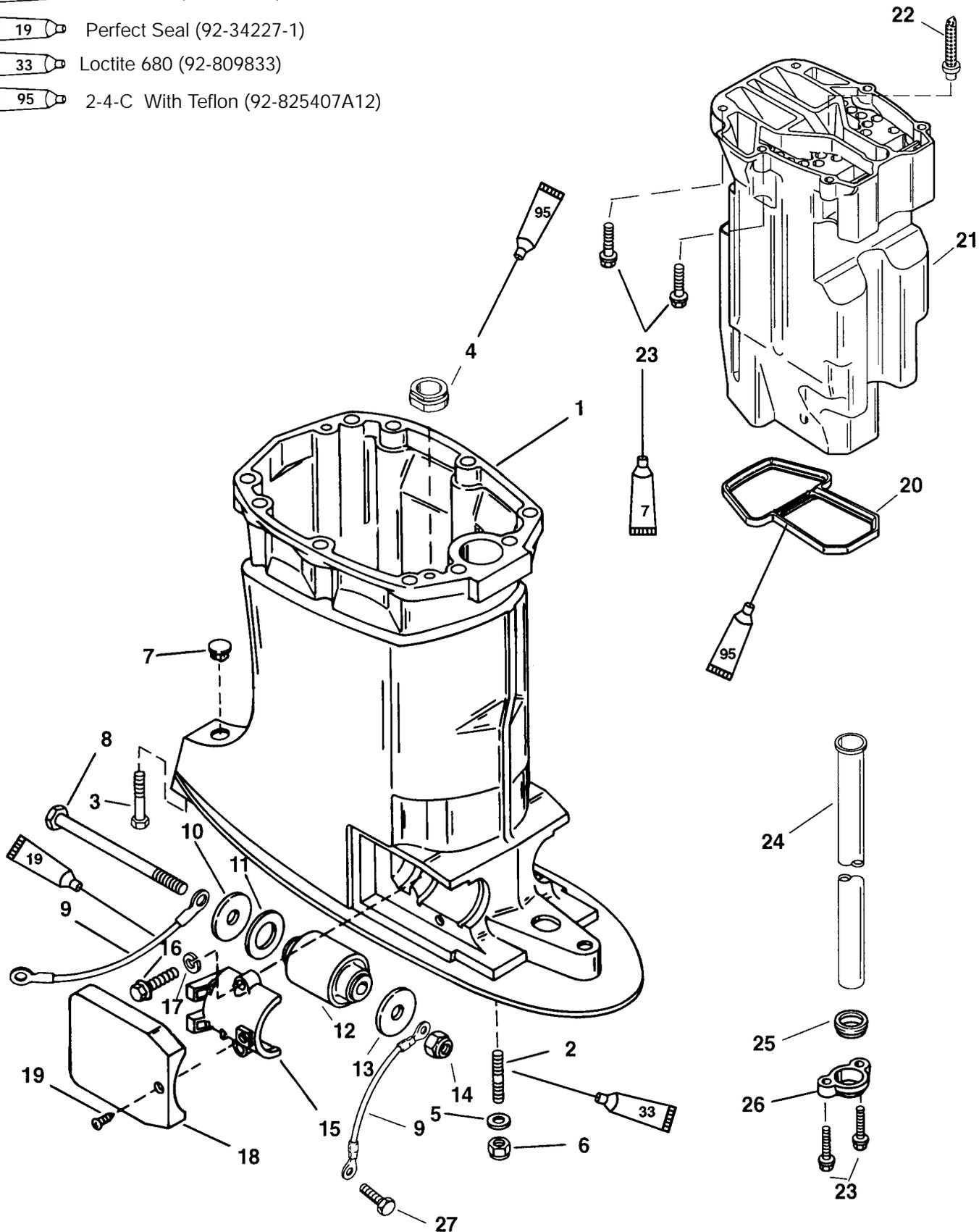
Drive Shaft Housing and Exhaust Tube (S/N-0G437999 & BELOW)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	DRIVE SHAFT HSG. (LONG)			
	1	DRIVE SHAFT HOUSING (X/XX-LONG)			
2	4	STUD (M12 x 1.75 x 50) (L/X-LONG)			
3	1	SCREW (M10 x 1.5 x 30) (L/X-LONG)		45	61.0
4	1	GROMMET			
5	4	WASHER			
6	4	NUT (M12 x 1.75)		55	74.6
7	1	PLUG			
8	2	SCREW (M14 x 2 x 178)			
9	1	GROUND WIRE			
10	2	WASHER			
11	2	WASHER			
12	2	MOUNT			
13	1	WASHER			
14	2	NUT		90	122
15	2	CLAMP			
16	4	SCREW (M8 x 35)		20	27.1
17	1	LOCKWASHER			
18	2	COVER			
19	2	SCREW (5/8 IN.)	Drive Tight		
20	1	SEAL			
21	1	EXHAUST TUBE			
22	8	SCREW (M8 x 35)		17	22.4
23	1	WATER TUBE (LONG)			
	1	WATER TUBE (X-LONG)			
	1	WATER TUBE (XX-LONG)			
24	1	SEAL			
25	1	CLAMP			
26	1	SPACER			
27	2	DOWEL PIN XX-LONG			
28	4	STUD (M12 x 1.75 x 183)			
	1	STUD (M10 x 1.5 x 173)			
29	1	NUT (M10 x 1.5)		55	74.6



Drive Shaft Housing and Exhaust Tube (S/N-0G438000 & UP)

-  7 Loctite 271 (92-809820)
-  19 Perfect Seal (92-34227-1)
-  33 Loctite 680 (92-809833)
-  95 2-4-C With Teflon (92-825407A12)





Drive Shaft Housing and Exhaust Tube (S/N-0G438000 & UP)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	DRIVE SHAFT HOUSING (LONG) BLACK			
	1	DRIVE SHAFT HOUSING (X-LONG)			
	1	DRIVE SHAFT HOUSING (LONG) GRAY			
	1	DRIVE SHAFT HOUSING (X-LONG)			
2	4	STUD (M12 x 1.75 x 50)			
3	1	SCREW (M10 x 1.5 x 30)		45	61.0
4	1	GROMMET			
5	4	WASHER			
6	4	NUT (M12 x 1.75)		55	74.6
7	1	PLUG			
8	2	SCREW (M14 x 2 x 178)			
9	2	GROUND WIRE			
10	2	WASHER			
11	2	WASHER			
12	2	MOUNT			
13	1	WASHER			
14	2	NUT		90	122
15	2	CLAMP			
16	4	SCREW (M8 x 35)		20	27.1
17	1	LOCKWASHER			
18	2	COVER (BLACK)			
	2	COVER (GRAY)			
19	2	SCREW (10-16 x 7/16 IN.)	Drive Tight		
20	1	SEAL			
21	1	EXHAUST TUBE			
22	1	STRAINER			
23	6	SCREW (M8 x 35)		17	22.4
24	1	WATER TUBE (LONG)			
	1	WATER TUBE (X-LONG)			
25	1	SEAL			
26	1	CLAMP			
27	1	SCREW (1/4-20 x .375)			

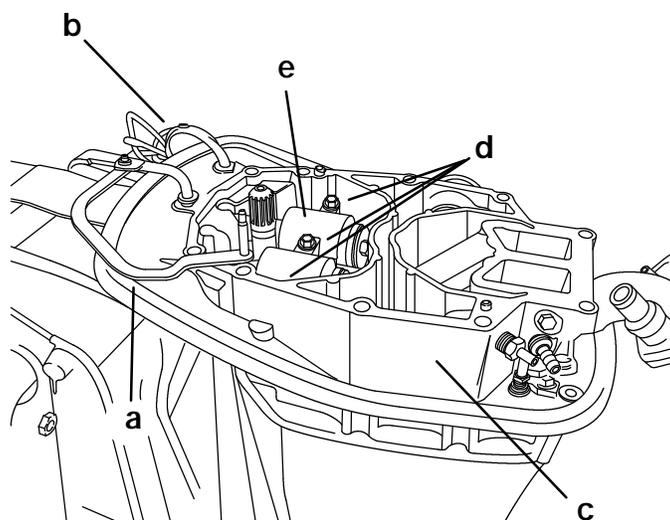


Drive Shaft Housing and Dyna-Float Suspension

Refer to "Powerhead Removal" Section to Remove Powerhead. Refer to "Lower Unit Removal" in This Section to Remove Lower Unit.

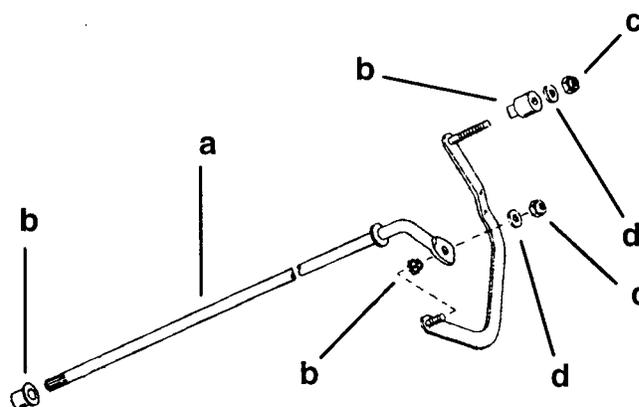
Removal and Disassembly

1. Remove shift shaft from drive shaft housing by pulling straight up on shaft.
2. Remove power trim wiring harness from exhaust adaptor plate.
3. Remove 3 bolts which secure upper mount cover to adaptor plate. Remove cover.



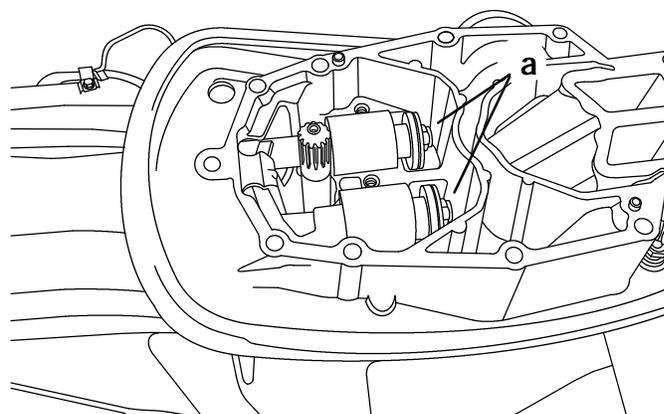
- a - Shift Shaft
- b - Wiring Harness
- c - Adaptor Plate
- d - Bolts
- e - Upper Mount Cover

SHIFT LINKAGE ASSEMBLY



- a - Shift Shaft
- b - Bushing (3)
- c - Lock Nut (2)
- d - Washer (2)

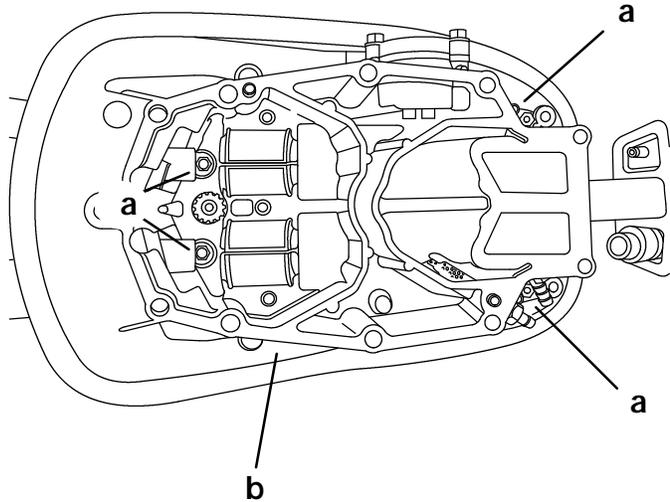
4. Remove upper mount nuts and flat washers.
5. Pull mount bolts thru mounts and remove mounts.



- a - Upper Mount Nuts

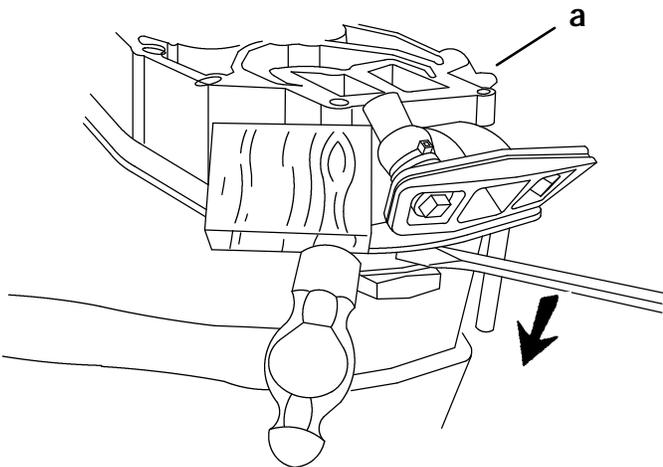


6. Remove 4 bolts securing exhaust adaptor plate to drive shaft housing.



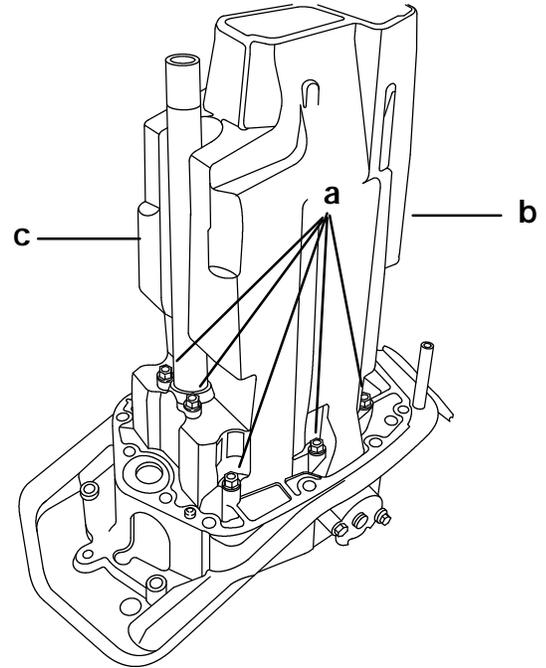
a - Bolts
b - Adaptor Plate

7. While applying upward pressure on rear of adaptor plate, use a mallet and a piece of hardwood against the adaptor plate to loosen gasket adhesion.



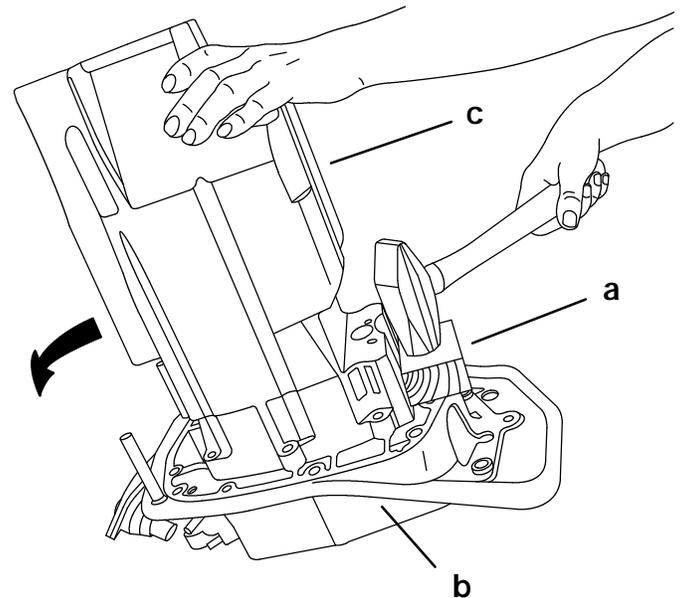
a - Adaptor Plate

8. Remove 2 bolts securing water tube to adaptor plate and remove tube. Remove 6 bolts securing exhaust tube to adaptor plate.



a - Bolts
b - Exhaust Tube
c - Water Tube

9. While tilting adaptor plate/exhaust tube assembly, use a piece of hardwood and a mallet to loosen gasket adhesion. Remove exhaust tube.

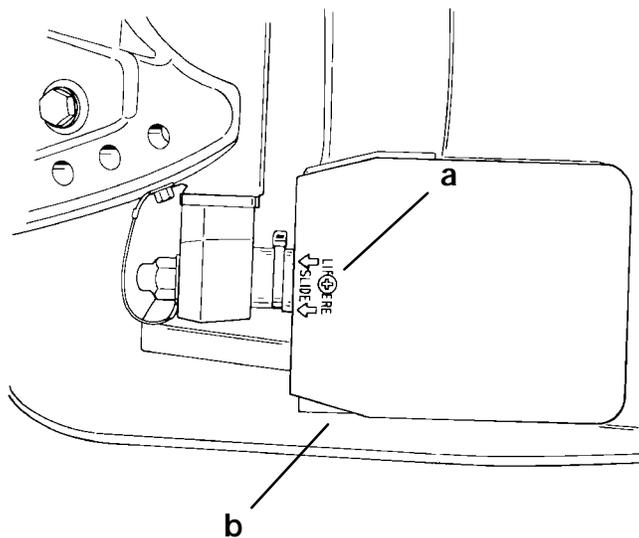


a - Hardwood
b - Adaptor Plate
c - Exhaust Tube

10. Remove all gasket and gasket material from drive shaft housing and related components.



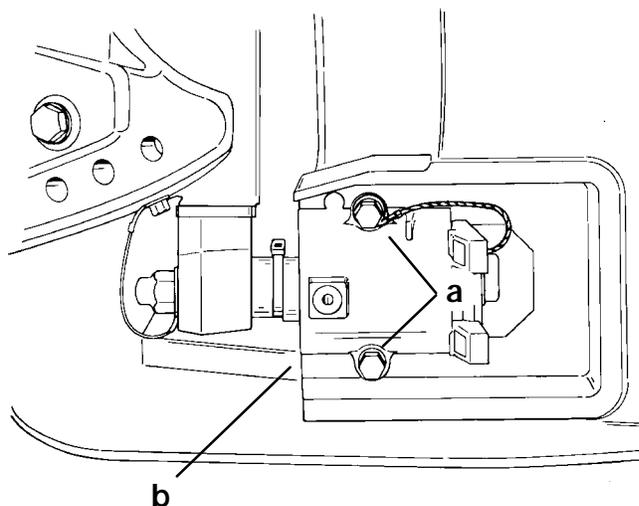
11. Remove screw which secures each lower mount cover to drive shaft housing. Remove covers.



52307

a - Screw
b - Cover

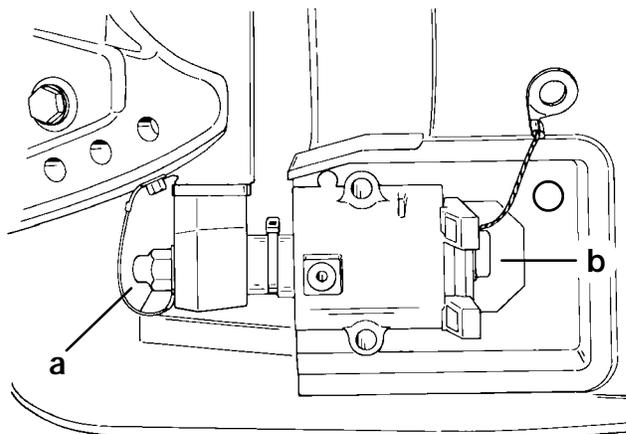
12. Remove bolts securing lower mount retainers to drive shaft housing. Remove retainers.



52308

a - Bolts
b - Lower Mount Retainer (One Each Side)

13. Remove lower mount nuts and rubber caps.



52308

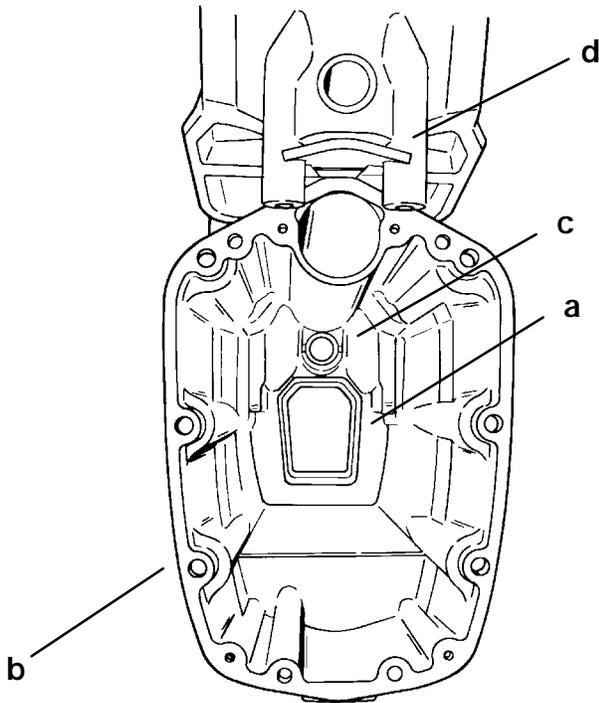
a - Lower Mount Nuts
b - Rubber Caps



14. Remove drive shaft housing from swivel bracket by pulling alternately from top to bottom on housing.
15. Remove upper and lower mounts by lifting them out of drive shaft housing.

Reassembly and Installation

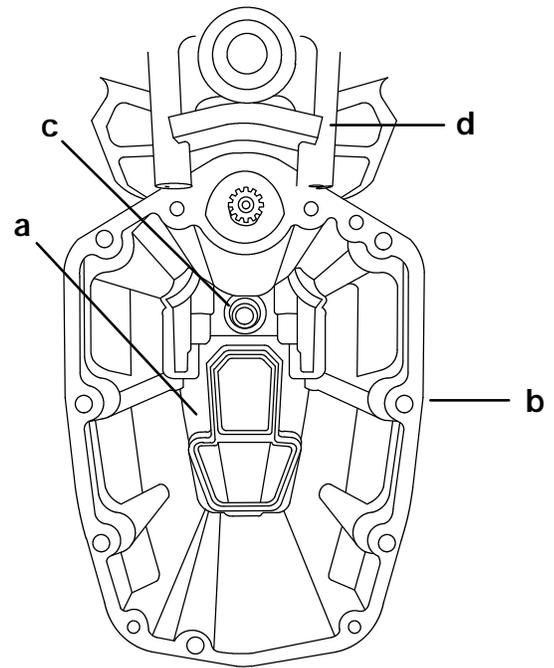
1. Apply a thin coat of 2-4-C Marine Lubricant onto inside portion of exhaust tube seal and water tube grommet.
2. Install exhaust tube seal into drive shaft housing with tapered side of seal facing up.
3. Position drive shaft housing to plate gasket on top of housing.
4. Position leather bumper on steering arm.



52307

SN OG437999 -

- a - Exhaust Tube Seal
- b - Drive Shaft Housing
- c - Water Tube Grommet
- d - Leather Bumper

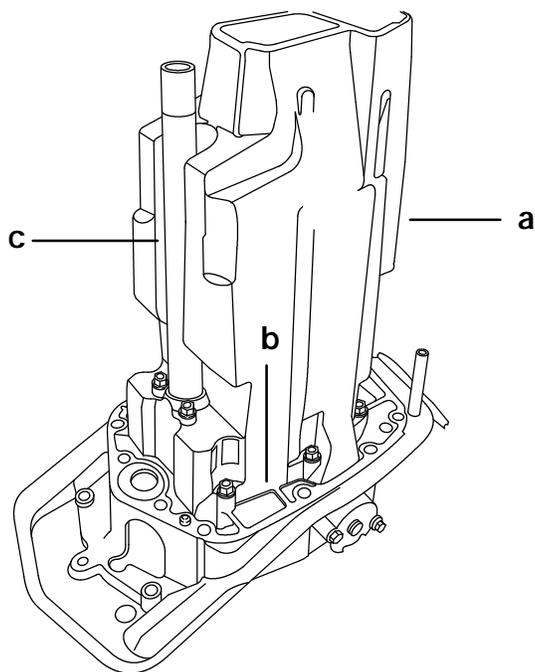


SN OG438000 -

- a - Exhaust Tube Seal
- b - Drive Shaft Housing
- c - Water Tube Grommet
- d - Leather Bumper

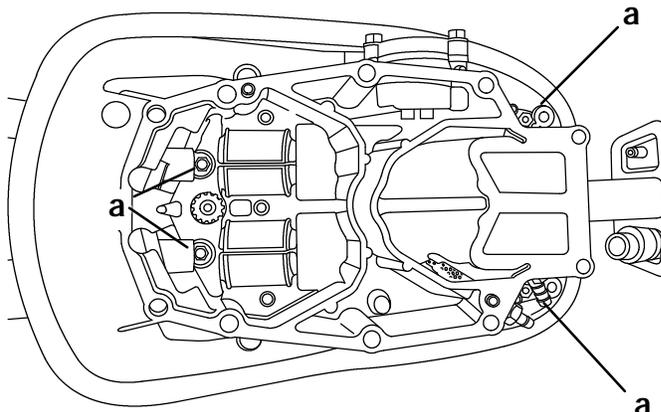


5. Position exhaust tube and gasket on adaptor plate. Secure both to plate with 6 bolts. Torque bolts to 21 lb. ft. (28.5 N·m).
6. Secure tube to adaptor plate with 2 bolts. Torque bolts to 80 lb. in. (9.0 N·m).



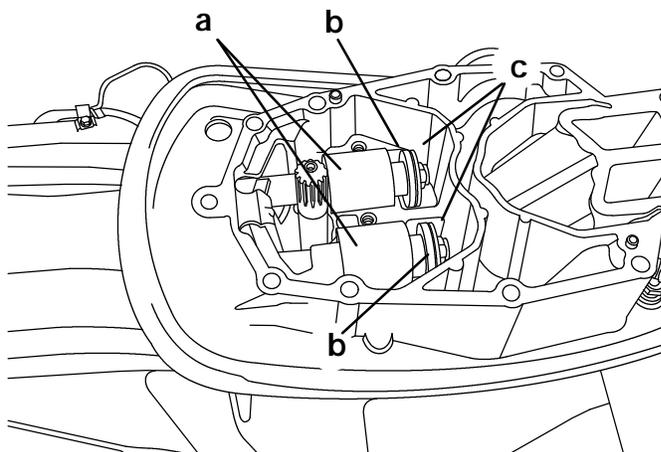
a - Exhaust Tube
b - Gasket
c - Water Tube

7. Position adaptor plate on top of housing.
8. Secure adaptor plate to drive shaft with 4 bolts. Torque bolts to 25 lb. ft. (33.9 N·m).



a - Bolts [Torque to 25 lb. ft. (33.9 N·m)]

9. Apply a thin coat of Perfect Seal onto metal portion of upper dyna-float mounts.
10. Position mounts on drive shaft housing plate.
11. Install a rubber washer onto each upper mount, followed by a metal washer.
12. Push bolts thru mounts.

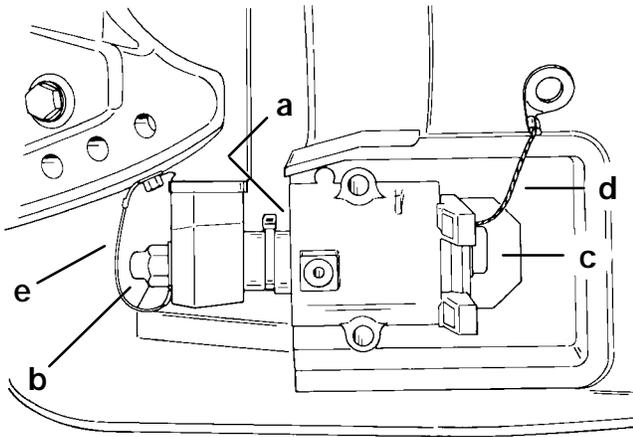


a - Dyna-Float Mounts
b - Rubber Washers
c - Metal Washer

13. Install a ground strap onto port lower mount bolt.
- NOTE:** Apply Perfect Seal along length of lower mount bolts.
14. Insert a mounting bolt thru the short end of each lower mount.



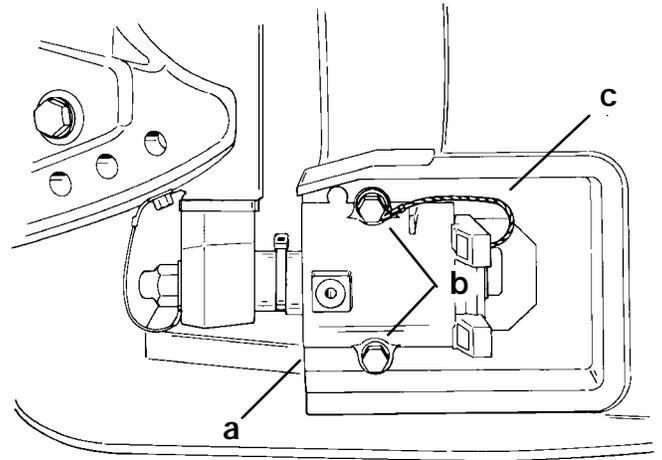
15. Position a mount on each lower side of drive shaft housing.
16. Install a flat washer over each lower mounting bolt.
17. Start upper mounting bolts in upper mounts and align lower mounting bolts with holes in swivel pin yoke. Slide drive shaft housing up against yoke and bumper.
18. Secure upper mounts to steering arm with flat washers and self-locking nuts. Torque nuts to 50 lb. ft. (68.0 N·m).
19. Install ground strap between port lower mount bolt and swivel bracket.
20. Secure lower mounts to swivel pin yoke with self-locking nuts. Torque nuts to 90 lb. ft. (122.0 N·m). Place a rubber cap over each lower mounting bolt head.



52308

- a - Lower Mount
- b - Nut [Torque to 90 lb. ft. (122.0 N·m)]
- c - Rubber Cap
- d - Ground Strap (only one side)
- e - Ground Strap (to swivel bracket)

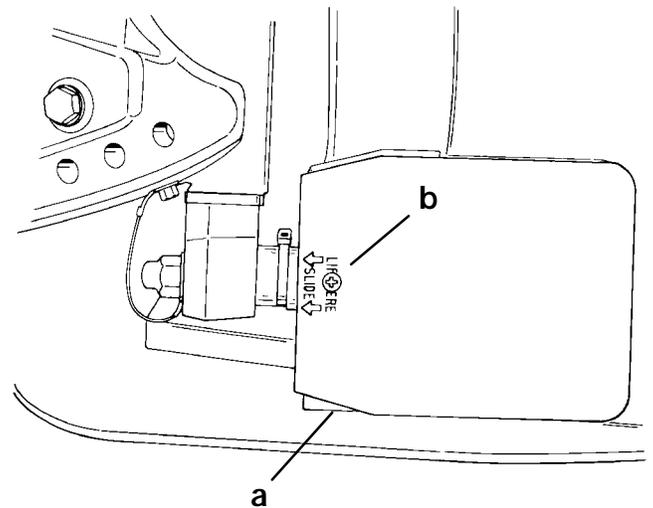
21. Install lower mount retainers and secure each retainer with 2 bolts. (Secure ground strap with the nearest retainer bolt and flat washer.) Torque bolts to 20 lb. ft. (27.1 N·m).



52308

- a - Lower Mount Retainer
- b - Bolts [Torque to 20 lb. ft. (27.1 N·m)]
- c - Ground Strap

22. Install lower mount covers and secure each cover with a screw.

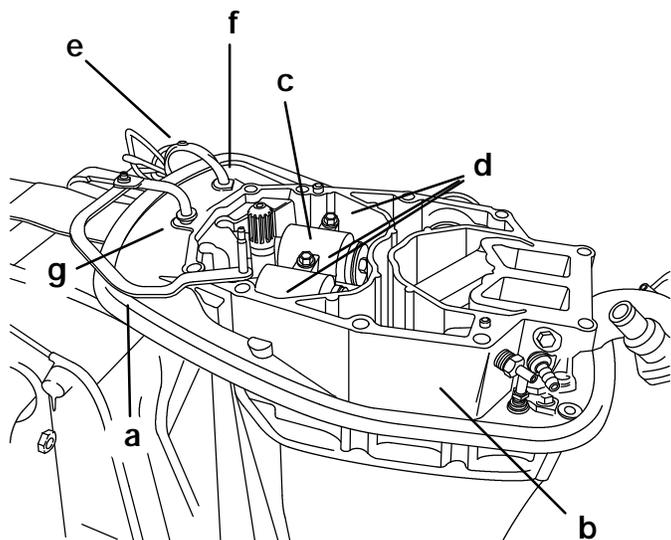


52307

- a - Cover
- b - Screw (1 for Each Cover)



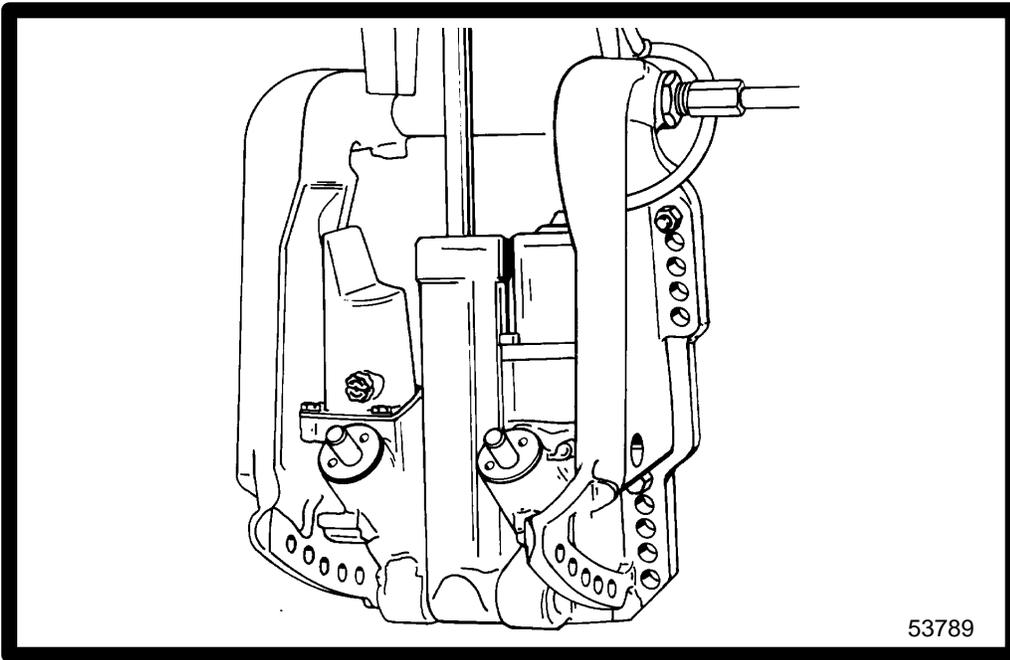
23. Install upper mount cover on adaptor plate. Secure cover with 3 bolts. Torque bolts to 20 lb. ft. (27.1 N-m).
24. Route power trim harness thru grommet in adaptor plate.
25. Reinstall shift shaft with bushing into adaptor plate. Apply 2-4-C w/Teflon to bushing.



- a - Shift Shaft Linkage
- b - Exhaust Adaptor Plate
- c - Upper Mount Cover
- d - Bolts [Torque to 20 lb. ft. (27.1 N-m)]
- e - Power Trim Harness
- f - Grommet
- g - Bushing



MID-SECTION



53789

POWER TRIM

5
B



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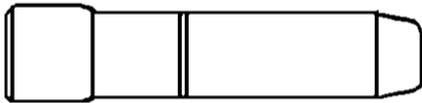


Power Trim Specifications

Test	Reading
Trim "UP"	1300 PSI (91kg/cm ²) Maximum Pressure
Trim "DOWN"	500 PSI (35kg/cm ²) Minimum Pressure

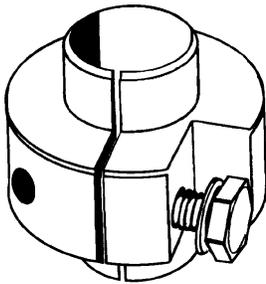
Special Tools

1. Alignment Tool 91-11230



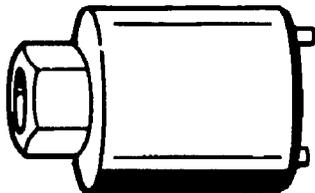
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2. Trim Rod Removal Tool 91-44486A1



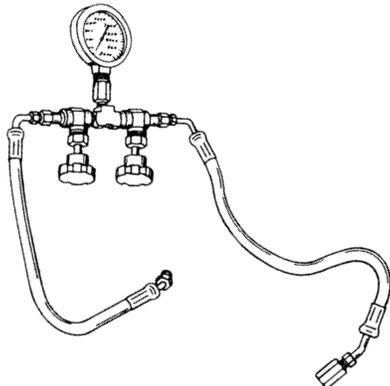
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3. Trim Rod Guide Removal Tool 91-44487A1



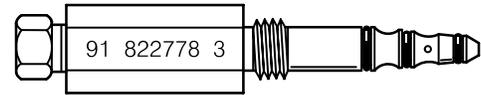
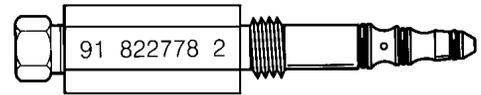
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4. Power Trim Test Gauge Kit 91-52915A6



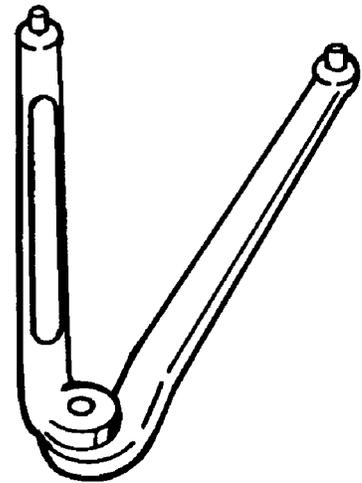
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5. Adaptor Fitting 91-82278-2 and 91-82278-3



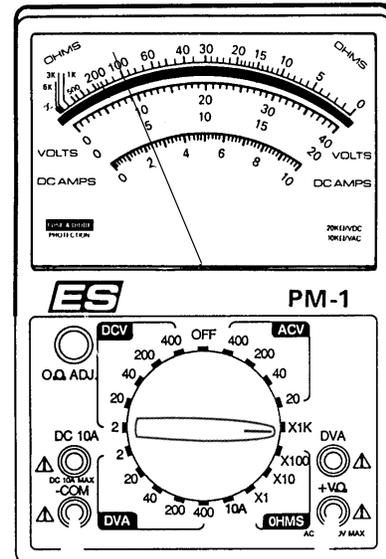
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6. Spanner Wrench 91-74951



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7. Multi-Meter DVA Tester 91-99750A1





Power Trim Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	MANIFOLD ASSEMBLY			
2	9	PIPE PLUG			
3	1	TILT CYLINDER ASSEMBLY			
4	1	PISTON ROD			
5	1	GUIDE KIT			
6	1	REPAIR KIT			
7	1	CHECK VALVE KIT			
8	2	GUIDE ASSEMBLY			
9	1	PISTON/ROD ASSEMBLY (PORT)			
9	1	PISTON/ROD ASSEMBLY (STBD.)			
10	1	TRIM FILTER ASSEMBLY			
11	1	VALVE ASSEMBLY			
12	1	E RING			
13	1	O RING KIT			
14	1	PUMP			
15	1	PLUG ASSEMBLY			
16	4	SCREW			
17	4	WASHER			
18	1	COVER			
19	1	DRIVE SHAFT S/N-0G217420 & UP			
20	1	TRIM MOTOR			
21	2	SCREW (LONG)(S/N-0G217420 & UP)			
21	2	SCREW (SHORT)			
22	1	SHAFT ASSEMBLY			
23	2	PIPE PLUG			
24	1	GROOVE PIN			
25	1	GROOVE PIN			
26	1	SHAFT			
27	1	ANODE ASSEMBLY			
28	2	SCREW (M6 x 1 x 25)	70		7.9
29	2	WASHER			
30	6	SCREW (M10 x 1.5 x 30)		40	54.2
31	6	WASHER			
32	2	CLIP(S/N-0G217420 & UP)			
33	2	SCREW (10-16 x .44)			
34	2	C WASHER			
				Drive Tight	

NOTE: Lubricate all o-rings with Power Trim and Steering Fluid.



Power Trim - General Information

Description

The Power Trim System consists of an electric motor, pressurized fluid reservoir, pump, tilt cylinder, and two trim rams.

The remote control (or trim panel) has switches that trim the outboard “Up” or “Down” and tilt the engine for “Trailing”. The outboard can be trimmed and tilted under power or when the outboard is not running.

Trimming Characteristics

NOTE: Because hull designs react differently in varying water conditions, varying the trim position will often improve the ride and boat handling. When trimming from a mid-trim position (with outboard trim tab in a straight fore and aft position), expect the following:

TRIMMING OUTBOARD “UP” (OUT):

WARNING

Excessive trim “Out” may reduce the stability of some high speed hulls. To correct instability, reduce the power gradually and trim the outboard “In” slightly before resuming high speed operation. A rapid reduction in power will result in a sudden change of steering torque and may cause additional boat instability.

Will lift boat bow, increasing top speed.

Transfers steering torque harder to port (left) on installations above 23 in. transom height.

Increases gearcase clearance over submerged objects.

Excess trim can cause “porpoising” and/or ventilation.

WARNING

Excessive outboard trim angle will result in insufficient water supply causing water pump and/or powerhead overheating damage. Insure water level is above water intake holes whenever outboard is running.

The “Up” circuit actuates the “up” relay (under outboard cowl) and closes the motor circuit. The electric motor drives the pump, forcing fluid thru passageways into the “up” side of the trim cylinders.

The trim cylinders position the outboard at the desired trim angle in the 20 degree maximum trim range. The system will not allow the outboard to be trimmed above the 20 degree trim range as long as the engine RPM is above approximately 2000 RPM.

The outboard can be trimmed above the 20 degree maximum trim angle (for shallow water operation, etc.), by keeping the engine RPM below 2000. If the RPM increases over 2000, propeller thrust (if propeller is deep enough) will result in the trim system to return the outboard to the 20 degree maximum trim position.

TRIMMING OUTBOARD “DOWN” (IN):

WARNING

Excessive speed at minimum trim “In” may result in undesirable and/or unsafe steering conditions. Test for handling characteristics after any adjustment is made to the trim angle (and tilt pin location).

Aids planing, particularly with heavy loads.

Improves ride in choppy water conditions.

Excess trim “In” can cause “bow steer” (boat veers to left or right).

Transfers steering torque to starboard (right).

Improves acceleration to planing speed.

The “Down” circuit actuates the “down” relay (under engine cowl) and closes the motor circuit. The electric motor drives the pump in the opposite direction as the “up” circuit, forcing fluid thru passageways into the “down” side of the tilt ram. The tilt ram moves the engine down to the desired position.

Trailing Outboard

The “Up” circuit first moves the trim cylinders; when the trim cylinders extend fully, the tilt ram extends to tilt the outboard to the full “Up” position for trailing.

Before the boat is trailed, the operator should check for clearance between the outboard skeg and pavement to prevent damage to skeg from striking pavement.

If the outboard must be tilted for clearance between skeg and pavement, a device such as a “Transom Saver” should be installed to prevent stress to boat transom from outboard weight while the boat/outboard are being trailed.

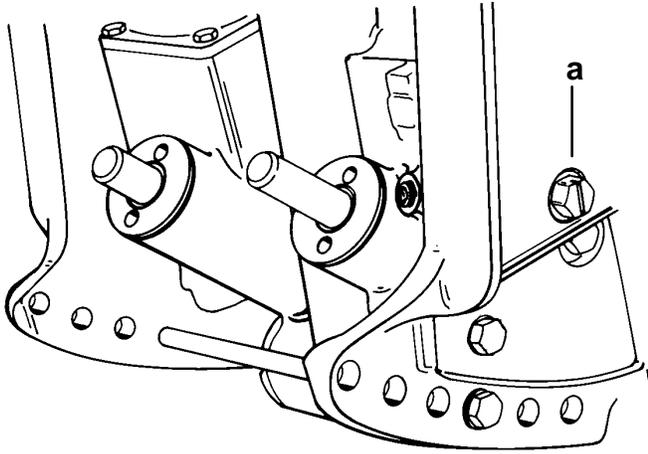


Tilting Outboard Manually

⚠ WARNING

Before opening the manual release valve knob, insure all persons are clear of outboard as outboard will drop to full “Down” when valve is opened.

The outboard can be raised or lowered manually by opening the manual release valve 3 to 4 turns counterclockwise. Close manual release valve to hold outboard at the desired tilt position.



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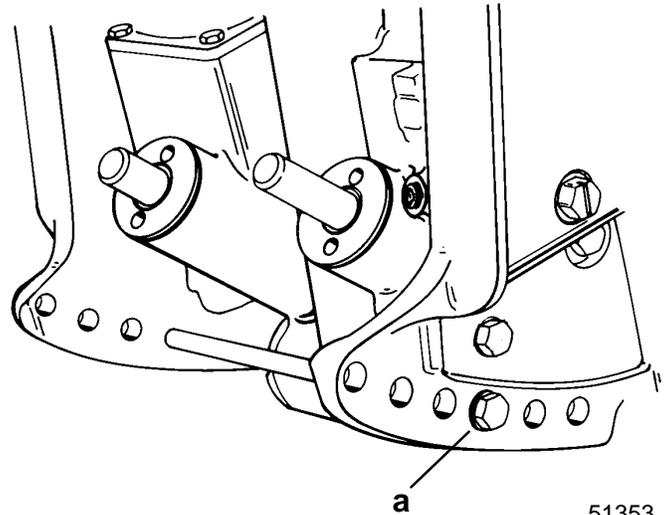
a - Manual Release Valve

Trim “In” Angle Adjustment

⚠ WARNING

Boat operation with outboard trimmed to the full “In” trim angle [not using the trim angle adjustment bolt (a)] at planing speed may result in undesirable and/or unsafe steering conditions. A water test for handling/steering conditions is required after any trim angle adjustments.

IMPORTANT: Some boat/motor combinations not using the trim angle adjustment pin (a) and trimmed to the full “In” trim angle position may not exhibit any undesirable and/or unsafe handling and/or steering characteristics at planing speed. If so, not using the trim angle adjustment bolt (a) may be advantageous to acceleration and planing. A water test is required to determine if these characteristics apply to a particular boat/motor combination.



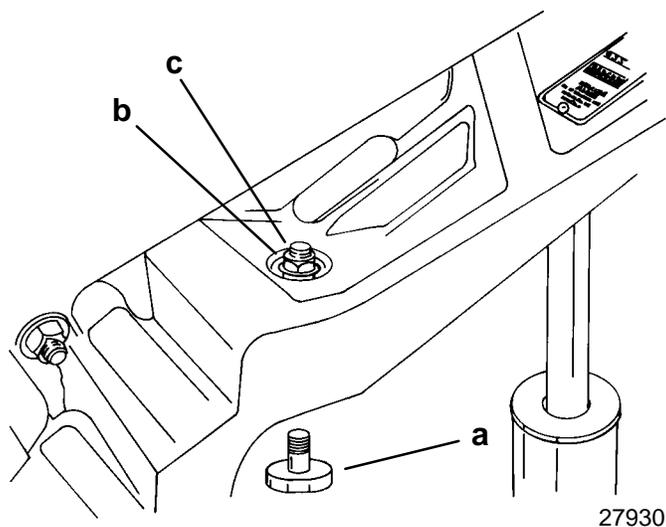
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a - Trim Angle Adjustment Bolt



Striker Plate Replacement

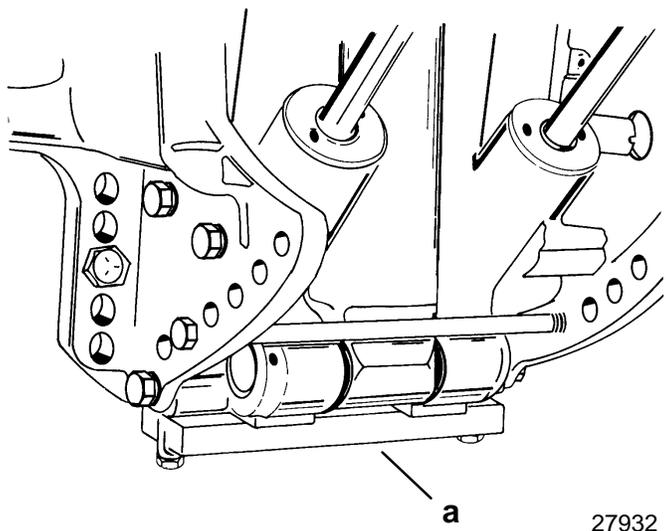
Visually inspect striker plates (a) and replace if worn excessively.



- a - Striker Plate (2)
- b - Lockwasher
- c - Locknut. Torque to 80 lb. in. (9.0 N-m)

Anode Plate

Anode plate (a) is a self-sacrificing alloy plate that is consumed gradually by corrosion while providing protection to the midsection and power trim from galvanic corrosion. Replace anode plate when it is 50% consumed.



- a - Anode Plate

IMPORTANT: Do not paint or place protective coating on anode plate, or corrosion protection function will be lost.

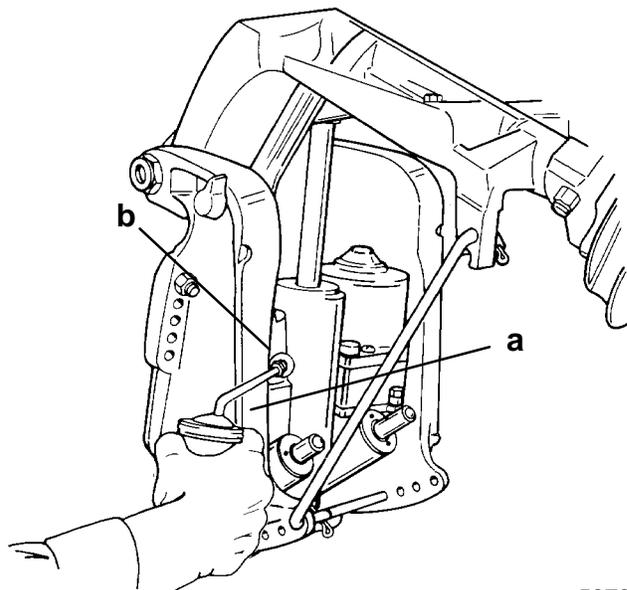
Trim Indicator Gauge

A Quicksilver Trim Indicator Gauge accessory kit is available for the power trim sender (if not previously installed).

Fill, Check, and Purge - Power Trim System

TO FILL:

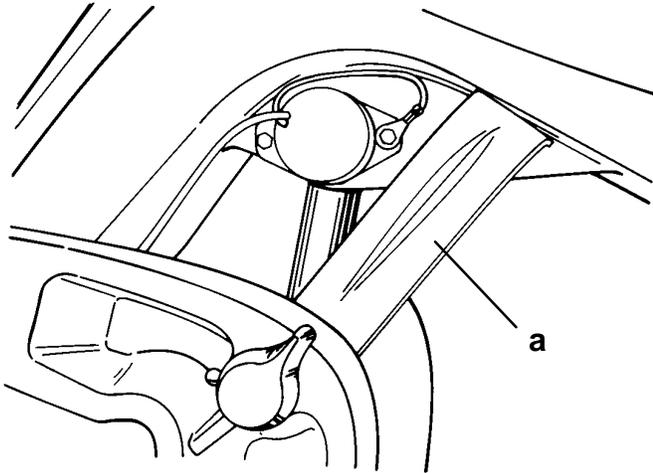
IMPORTANT: This trim system is pressurized. Remove "Fill" plug only when outboard is tilted to the full "Up" position or the trim/tilt rams are fully extended. Retighten "Fill" plug before tilting outboard down or retracting tilt/trim rams. Remove "Fill" plug and O-ring. System is full when oil level is present at fill hole. Tighten "Fill" plug securely.



- a - Fill Plug and O-ring (remove to fill system, tighten securely)
- b - Oil Can (fill system with Quicksilver Power Trim and Steering Fluid)



NOTE: Automatic Transmission Fluid (ATF) Type F, FA, Dexron II or Dexron III may be used.



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a - Tilt Lock Lever (engage to support engine in "Up" position)

TO PURGE:

IMPORTANT: Fill plug and O-ring must be tightened securely before purging system.

IMPORTANT: Run Trim System in short "jogs" until pump is primed and trim system moves. If trim motor is run without priming pump, drive-shaft failure could result.

Cycle outboard through entire trim/tilt range 4 times. Check fluid level after purging system.

Push down on outboard when trim rams are slightly extended. If rams retract more than 1/8 in. (3.2 mm), air is present in system. Cycle system again and check fluid level.

TO CHECK:

⚠ CAUTION

Tilt outboard to full "Up" position and engage tilt lock lever before checking fluid level. System is pressurized. Extend trim and tilt rams fully to de-pressurize system.

Remove fill plug and O-ring. System is full when oil level is present at filler hole. Tighten fill plug securely.

Power Trim System Troubleshooting

IMPORTANT: Acceptable trim down leakage is no more than 1 in. (2.54cm) in a 24 hour period.

IMPORTANT: Operate Power Trim System after each check to see if problem is corrected. If problem has not been corrected, proceed to next check.

1. Check that Manual Release Valve knob is tightened to full right (clockwise) position.
2. Check trim pump fluid level and fill if necessary. (Refer to "Fill, Check, and Purge - Power Trim System") preceding.
3. Check for external leaks in the system. Replace defective parts if leak is found.
4. Check for air in the system and purge if necessary. (Refer to "Fill, Check, and Purge - Power Trim System") preceding.

NOTE: When troubleshooting the hydraulic system, cleanliness, and inspection of sealing surfaces, seals, O-rings, and moving parts is important. The internal pressures required for proper operation of the Power Trim System require these parts to be in excellent condition. Replace any parts that may be suspect of failure.



Troubleshooting

IMPORTANT: Determine if Electrical or Hydraulic problem exists.

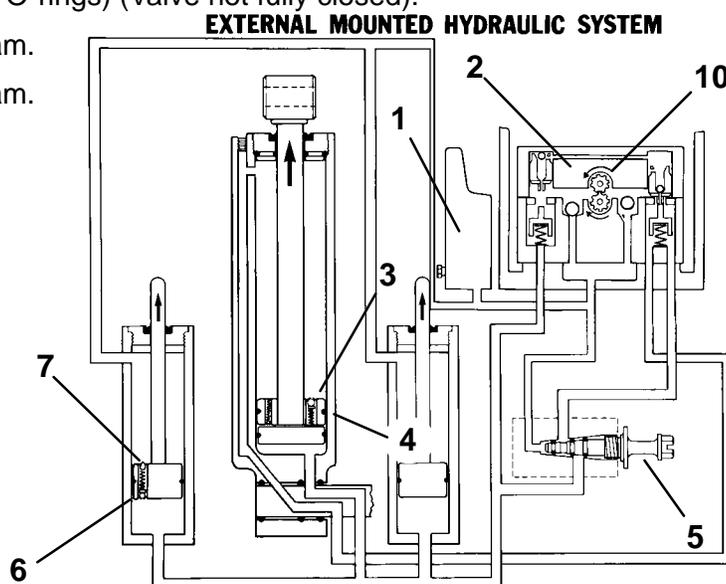
HYDRAULIC SYSTEM TROUBLESHOOTING

IMPORTANT: Make one correction at a time. Check operation of trim system before proceeding to the next check.

CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor runs; trim system does not move up or down.	1, 2, 5, 10
B. Does not trim full down. Up trim OK.	2, 3, 4
C. Does not trim full up. Down trim OK.	1, 6
D. Partial or "Jerky" down/up.	1, 3
E. "Thump" noise when shifting.	2, 3, 6, 7
F. Does not trim under load.	5, 8, 9, 10
G. Does not hold trim position under load.	2, 5, 6
H. Trail out when backing off from high speed.	3, 4
I. Leaks down and does not hold trim.	2, 5, 7
J. Trim motor working hard and trims slow up and down.	8, 9
K. Trims up very slow.	1, 2, 8, 9
L. Starts to trim up from full down position when "IN" trim button is depressed.	3, 4
M. Trim position will not hold in reverse.	3, 4

PROBLEM

1. Low oil level.
2. Pump assembly faulty.
3. Tilt ram piston ball not seated (displaced, dirt, nickel seat).
4. Tilt ram piston O-ring leaking or cut.
5. Manual release valve leaking (check condition of O-rings) (Valve not fully closed).
6. Lower check valve not seating in port side trim ram.
7. Upper check valve not seating in port side trim ram.
8. Check condition of battery.
9. Replace motor assembly.
10. Broken motor/pump drive shaft.



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ELECTRICAL SYSTEM TROUBLESHOOTING

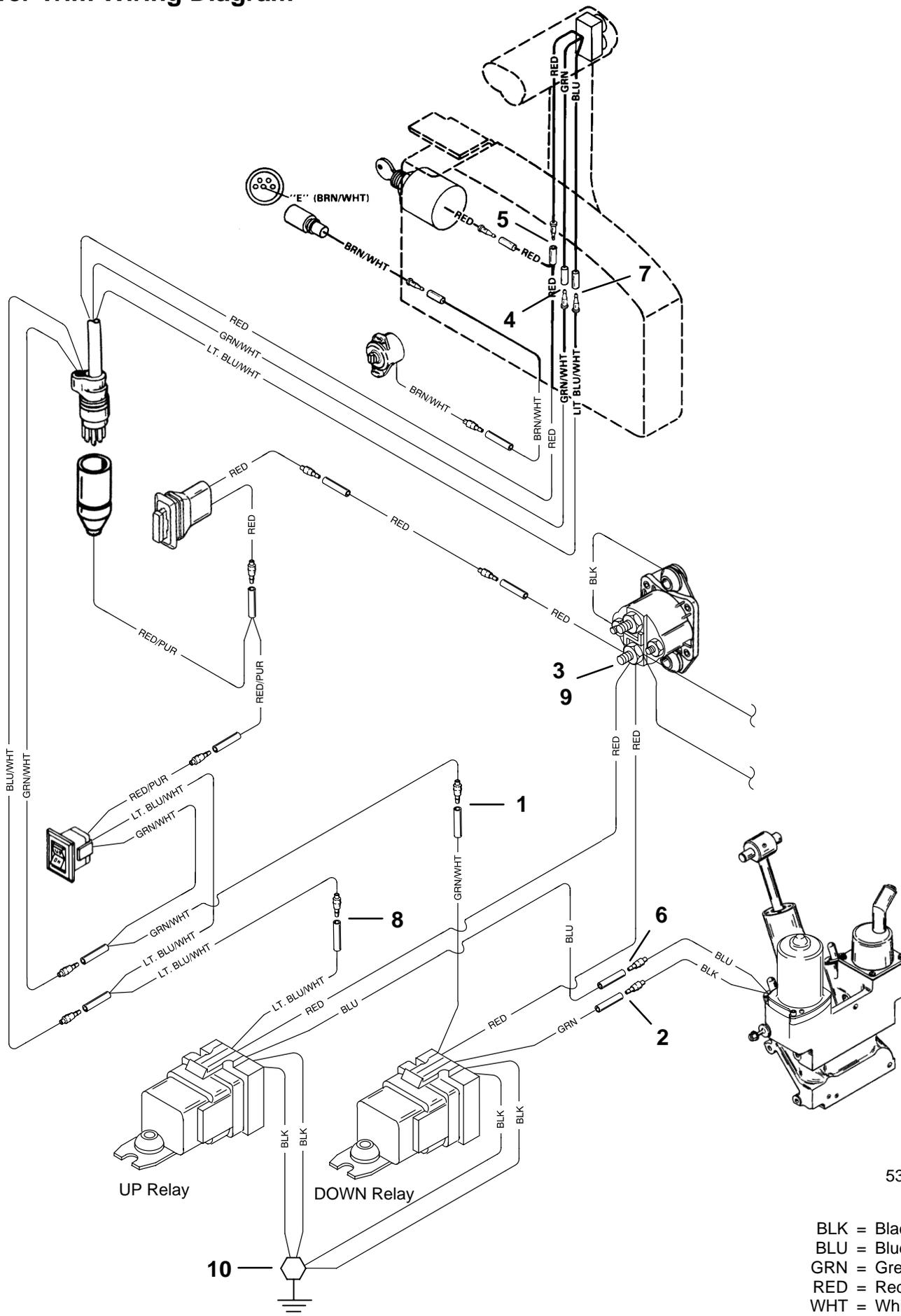
CONDITION OF TRIM SYSTEM	PROBLEM
A. Trim motor does not run when trim button is depressed.	1, 2, 4, 5, 6, 7, 8
B. Trim system trims opposite of buttons.	3
C. Cowl mounted trim buttons do not activate trim system.	2, 4, 5, 6, 7

PROBLEM

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



Power Trim Wiring Diagram



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BLK = Black
 BLU = Blue
 GRN = Green
 RED = Red
 WHT = White



Electrical System Troubleshooting

GENERAL CHECKS

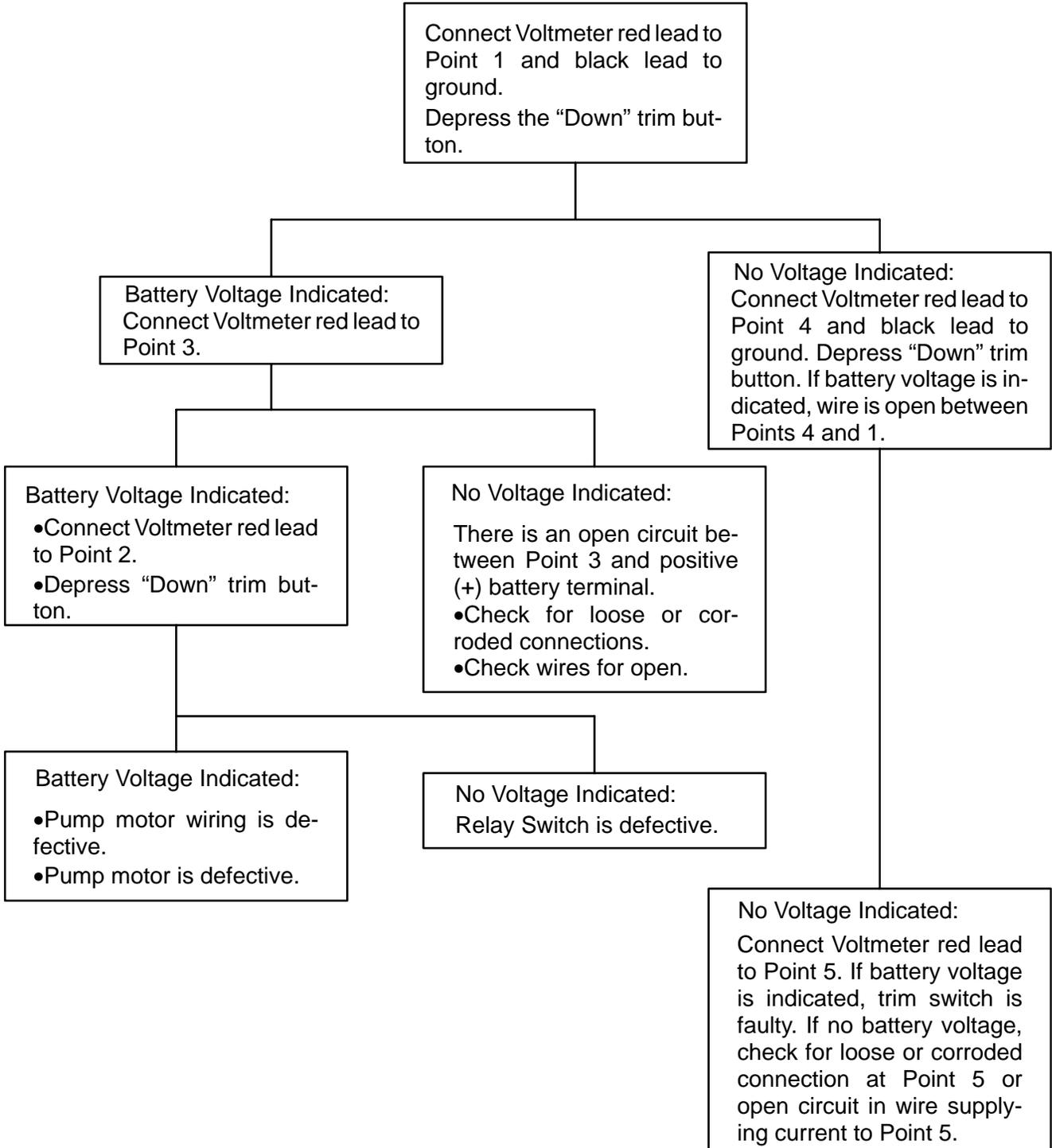
Before troubleshooting the Power Trim electrical system, check the following:

1. Check for disconnected wires.

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

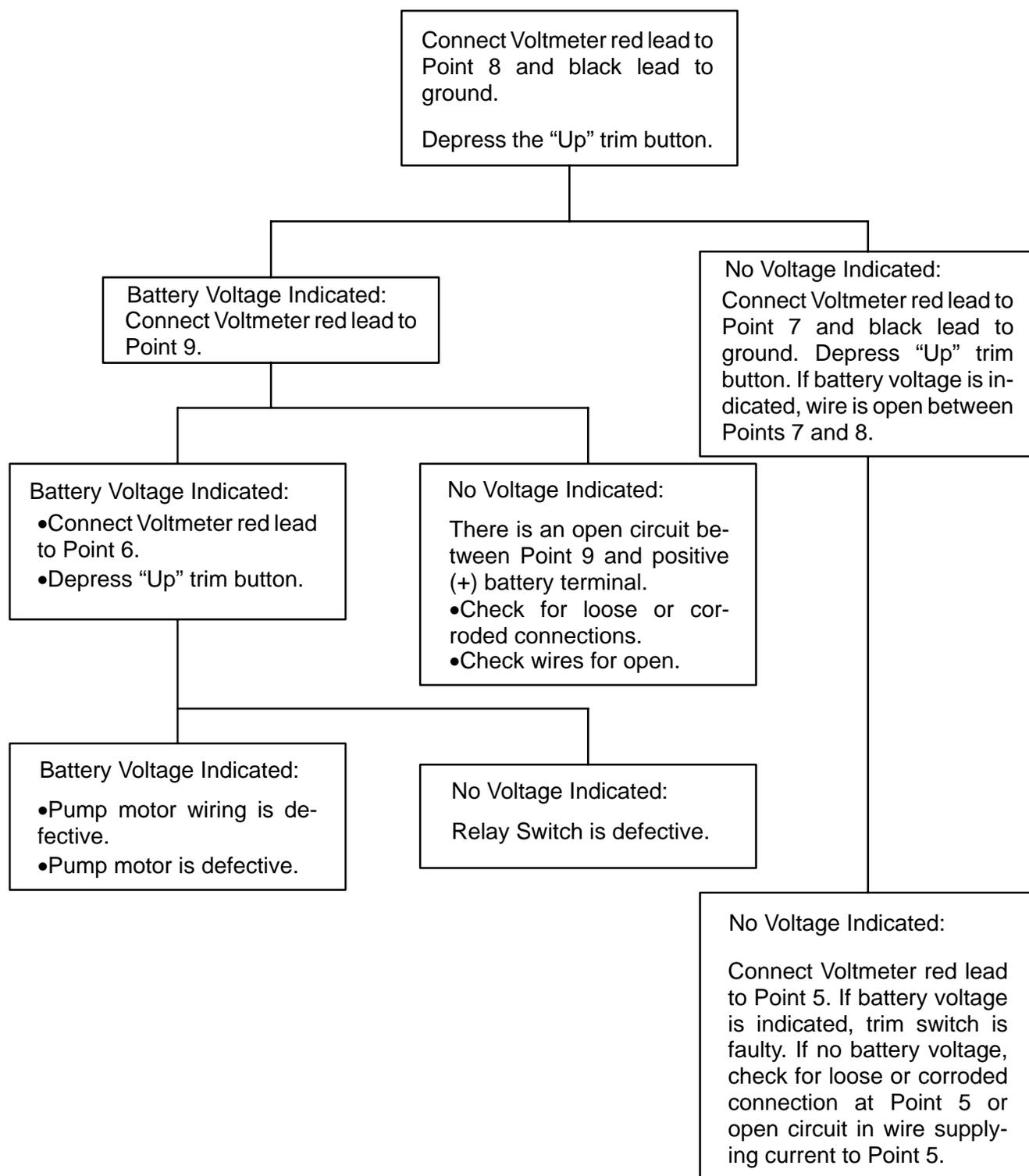
Refer to the preceding four wiring diagrams for connection points when troubleshooting the electrical systems (Connection points are specified by number.)

Troubleshooting the “Down Circuit”



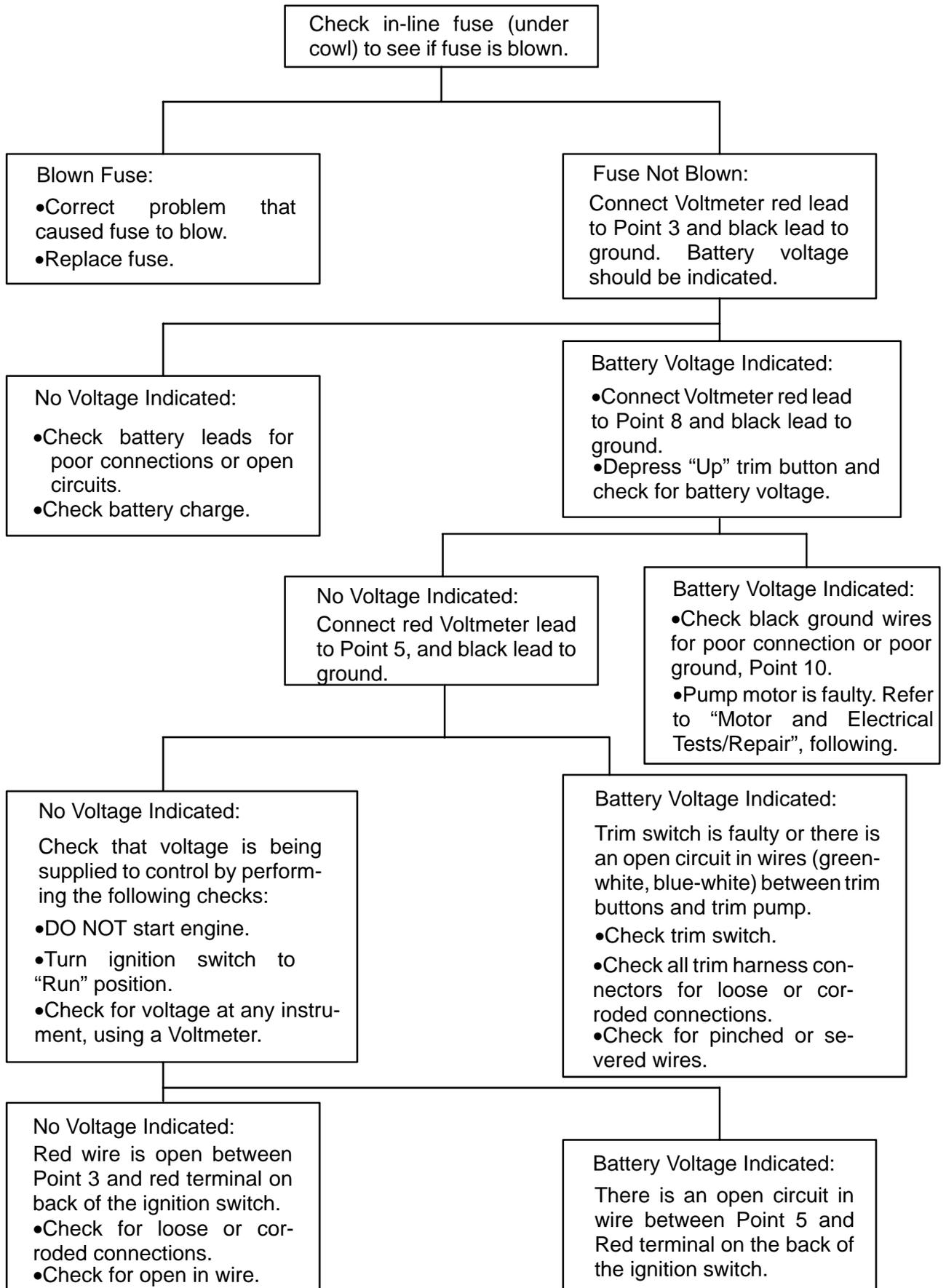


Troubleshooting the “Up” Circuit





Troubleshooting the “Down” and “Up” Circuits (All Circuits Inoperative)

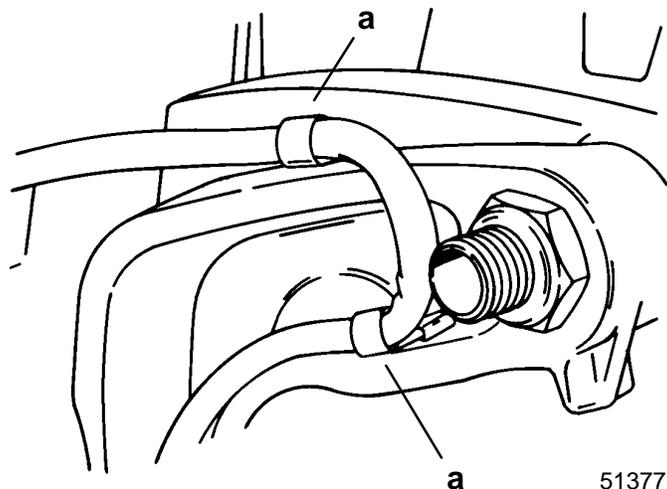




Power Trim Assembly Removal and Installation

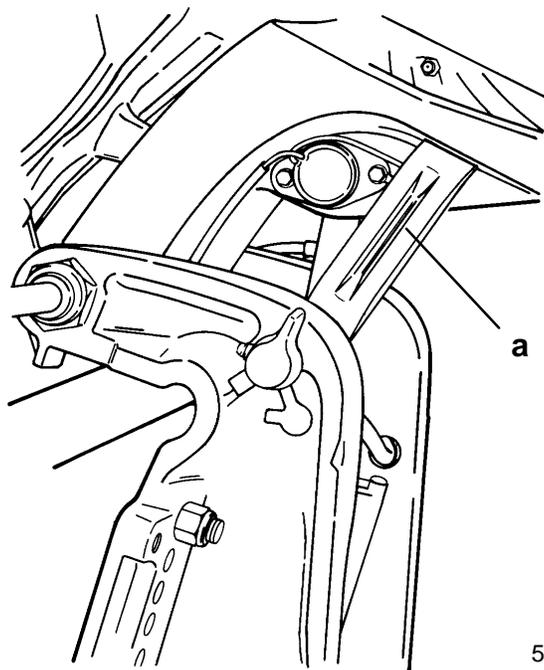
Removal

1. Remove clamps on transom bracket to free power trim wiring.



a - Clamps

2. Raise outboard to full "Up" position and engage tilt lock lever.



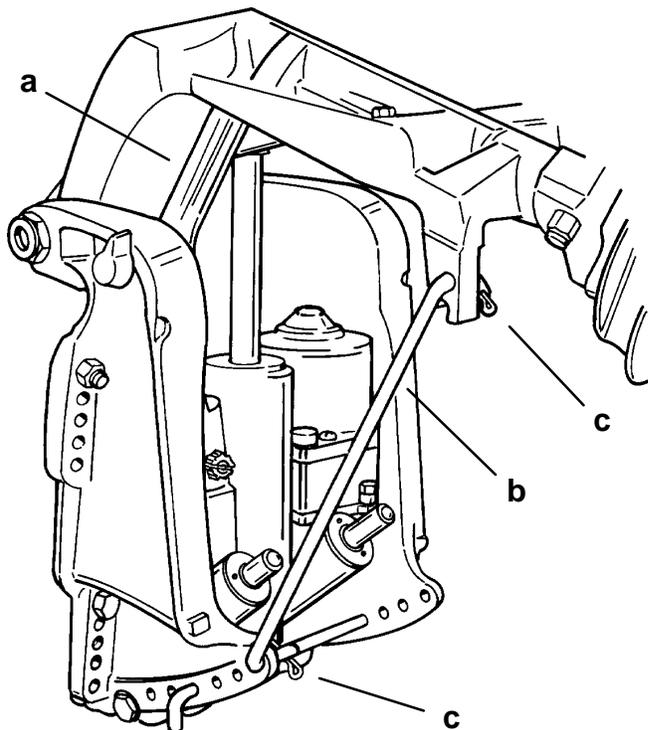
a - Tilt Lock Lever

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⚠ WARNING

Failure to support outboard as shown could result in personal injury and/or damage to outboard or boat.



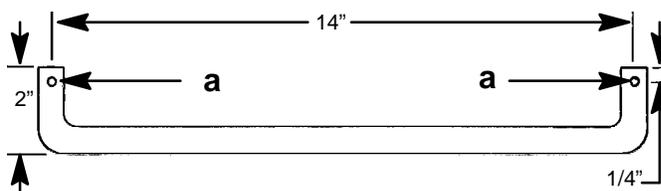
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- a - Tilt Lock Lever
- b - Support Tool
- c - Retaining Clips

IMPORTANT: Support outboard as shown above to prevent engine from tipping when power trim retaining pin is removed.

SUPPORT TOOL

3/8 in. diameter metal rod (a used shift shaft works well).



- a - Drill holes for retaining clips

METRIC CONVERSION

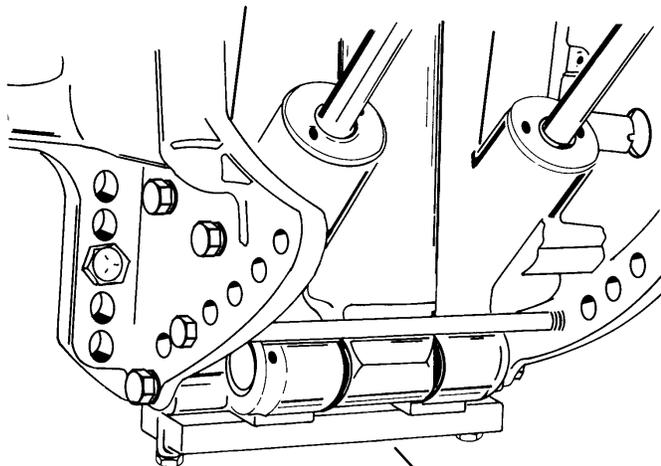
- 14 in. = 35.56 cm
- 2 in. = 50.8 mm
- 3/8 in. = 9.5 mm
- 1/4 in. = 6.35 mm



⚠ CAUTION

Disconnect battery cables at battery before removing power trim wires from solenoids.

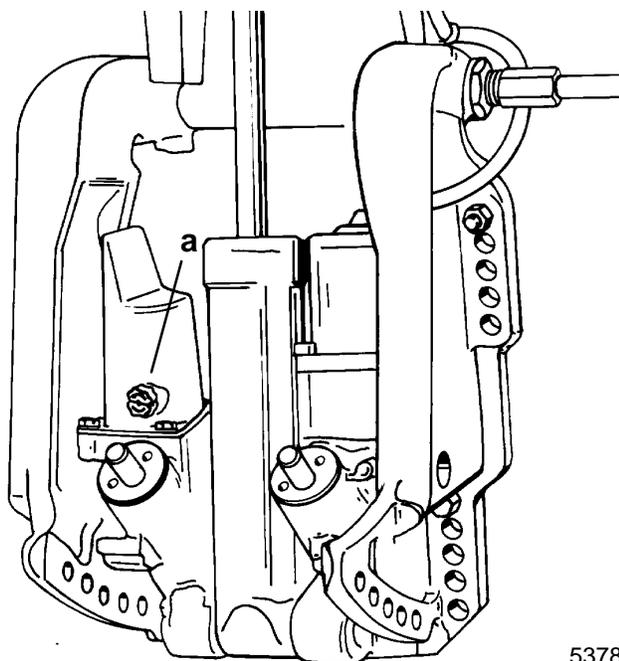
3. Disconnect power trim wires at solenoids (BLUE and BLACK).
4. Remove 2 bolts securing anode plate to bottom of trim assembly and remove anode.



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a - Anode Plate

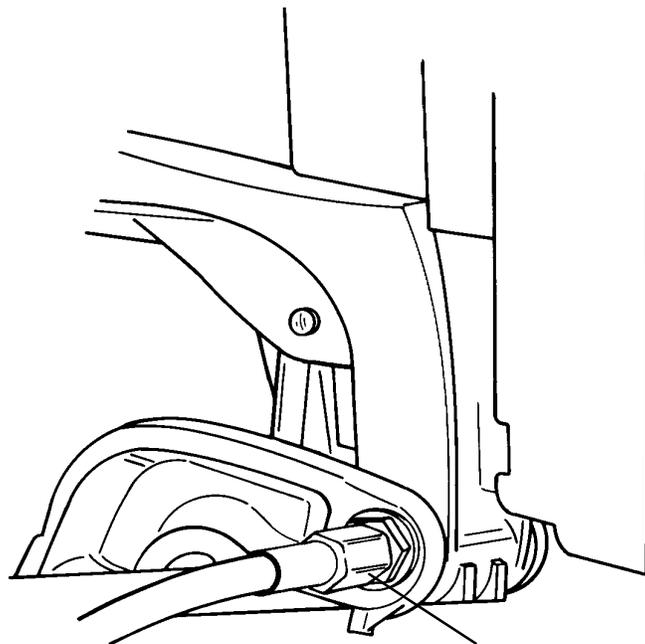
5. Open filler cap and release any remaining pressure in the system.



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a - Filler Cap

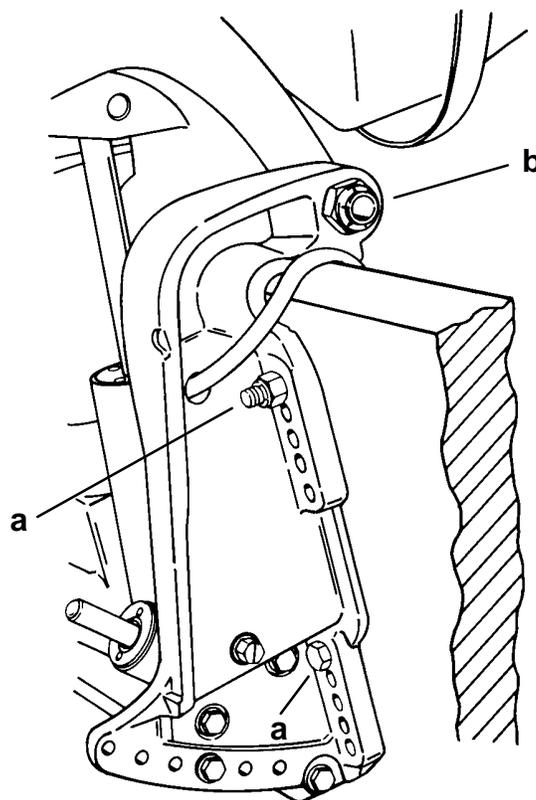
IMPORTANT: Outboards equipped with thru-the-tilt-tube steering - remove steering link arm from end of steering cable and cable retaining nut from tilt tube.



51354

a - Retaining Nut

6. Remove outboard transom mounting bolts, and loosen tilt tube nut until nut is flush with end of tilt tube thread.

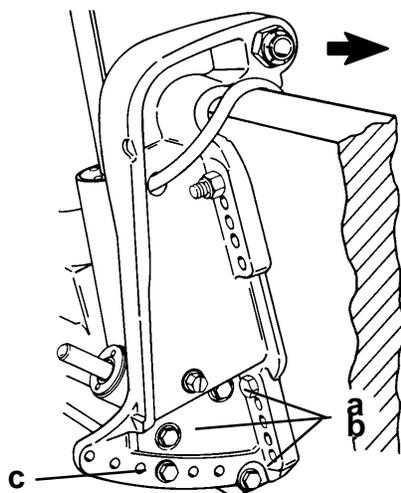


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a - Transom Mount Bolts (2)
b - Tilt Tube Nut (flush with end of thread)



- Remove 3 screws and washers and move starboard transom bracket.
- Remove trim limit bolt, if installed.

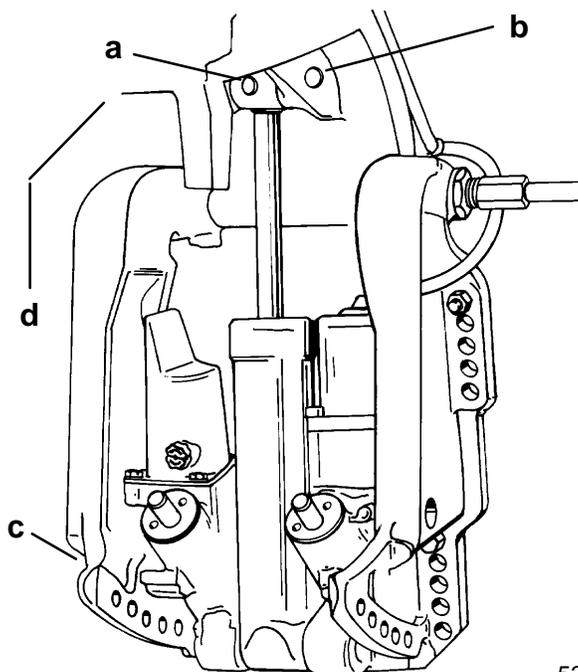


51375

- a - Screws (3)
- b - Washers (3)
- c - Trim Limit Bolt

IMPORTANT: Cross pin (a) should not be reused. Replace with new cross pin.

- Remove trim indicator sender from port side of swivel bracket.
- Drive out cross pin, push out upper swivel pin, and remove 3 screws and washers retaining trim system. Remove system from outboard.

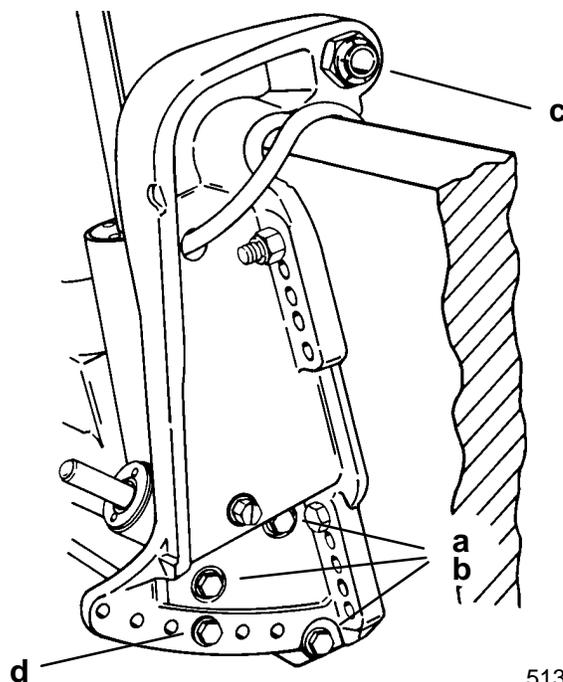


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- a - Cross Pin
- b - Upper swivel pin
- c - Port transom bracket screws and washers (3). Remove to release trim system from outboard.
- d - Trim Sender

Installation

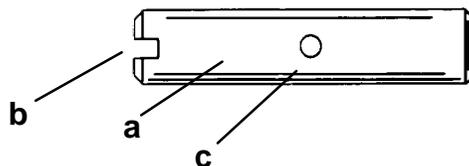
- Paint any exposed metal surfaces to prevent corrosion.
- Apply Loctite 271 to screws. Install trim system, starboard transom bracket, and tilt tube nut.
- Reinstall trim limit bolt.



51375

- a - Screw (6) Torque to 40 lb. ft. (54.0 N-m)
- b - Flatwasher (6) Install one per screw
- c - Tilt Tube Nut
- d - Trim Limit Bolt

- Use a 12 volt power source to extend tilt ram up to align upper swivel shaft hole and end of ram. Connect trim motor wires [BLUE wire to POSITIVE (+), BLACK wire to NEGATIVE (-)]. If ram extends too far, retract ram by reversing wire connections.
- Install Upper Swivel Pin with slotted end to left (port) side of engine.

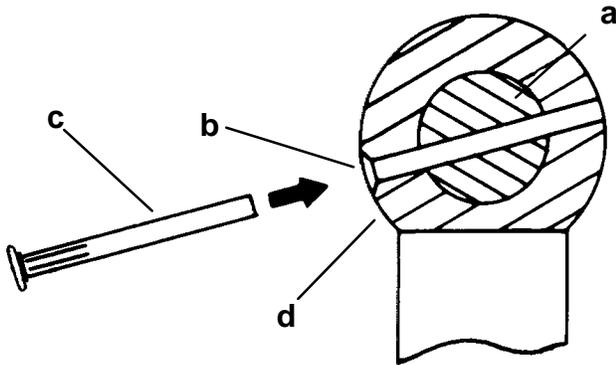


- a - Upper Swivel Pin
- b - Slotted end
- c - Cross hole (in line with slotted end)

IMPORTANT: Cross pin should not be reused. Install a new pin.



6. Position slot on end of swivel shaft in line with hole in tilt ram end. Insert a punch into tilt ram hole to align cross hole in upper swivel shaft. Tap new cross pin in until flush.



- a - Upper Swivel Shaft (Slot is in line with cross hole)
- b - Chamfered end of hole (Faces away from transom)
- c - Retaining pin
- d - Tilt ram end

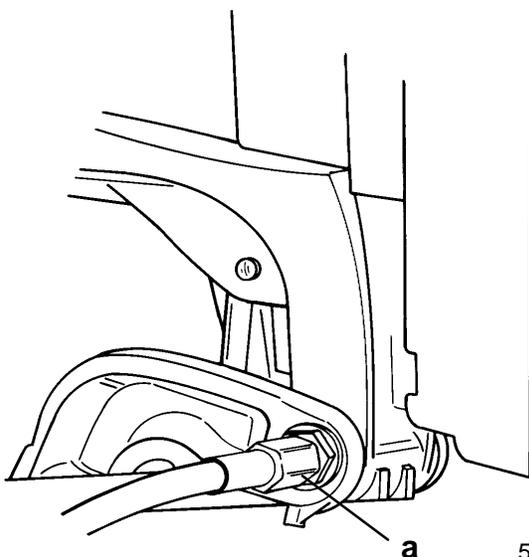
7. Connect trim motor wires to solenoids. Refer to Wiring Diagrams in this manual. Route trim wires as specified in this manual.
8. Reinstall anode plate to bottom of trim system.
9. Apply marine sealer to shanks of mount bolts and install transom mount bolts.

IMPORTANT: Do not use an impact driver to tighten transom mount bolts.

Apply marine sealer to threads of mount bolts. Secure with flat washers and locknuts. Be sure installation is watertight.

10. Tighten tilt tube nut securely.

IMPORTANT: Outboards equipped with thru-the-tilt-tube steering: Tighten steering cable retaining nut securely to tilt tube.



a - Steering Cable Retaining Nut

11. Apply Quicksilver Liquid Neoprene (91-25511--2) on all electrical connections.

⚠ WARNING

Electrical wires passing through cowl openings must be protected from chafing or being cut. Follow the recommended procedures outlined in Section 1 of this Manual. Failure to protect wires as described could result in electrical system failure and/or injury to occupants of boat.



Testing Power Trim System With Test Gauge Kit (91-52915A6)

IMPORTANT: This test will not locate problems in the trim system. The test will show if the system is correct after a repair. If minimum pressures are not obtainable, the trim system requires additional repair.

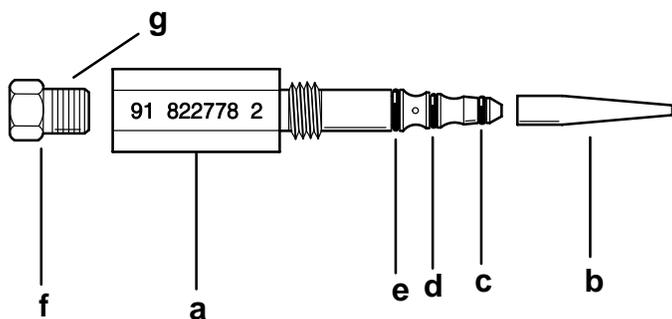
“UP” Pressure Check

IMPORTANT: Insure battery is fully charged before performing tests.

1. Tilt outboard to full “Up” position and engage tilt lock lever.
2. Slowly remove “Fill” plug to bleed pressure from reservoir.
3. Remove circlip securing manual release valve and unscrew release valve from trim assembly.

NOTE: A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.

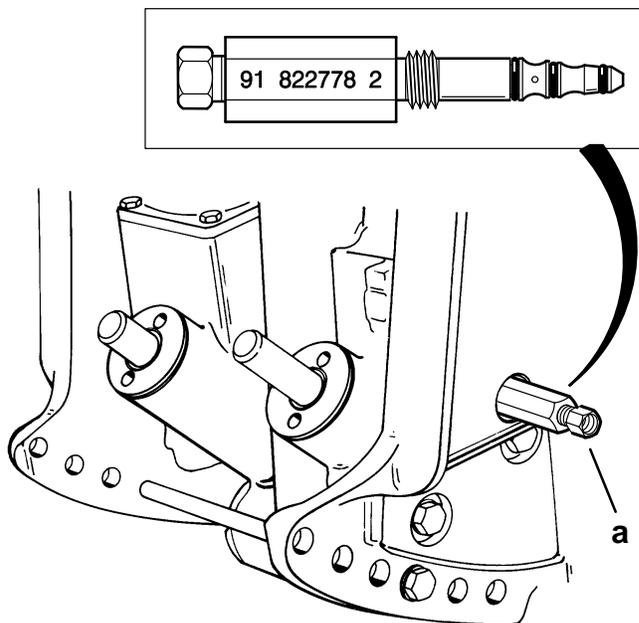
NOTE: Assemble test adaptor by using o-ring installation tool to position small o-ring onto adaptor 1st, then install medium o-ring and lastly large o-ring. Thread brass fitting into test adaptor securely using teflon tape on threads.



54457

- a - Test Adaptor (91-822778A2)
- b - O-ring Installation Tool
- c - Small O-ring (Install 1st)
- d - Medium O-ring (Install 2nd)
- e - Large O-ring (Install Last)
- f - Brass Fitting
- g - Apply Teflon Tape

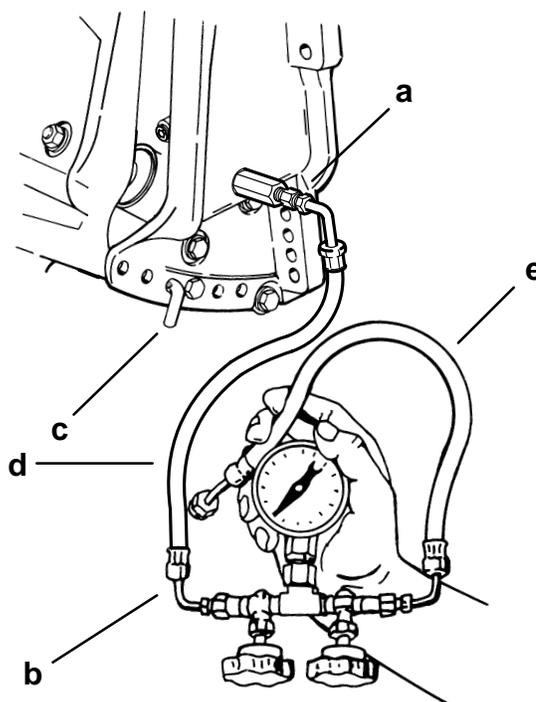
4. Install test adaptor 91-822778A2 into manual release valve hole.



54458

- a - Test Adaptor (91-822778A2)

5. Thread hose from Test Gauge Kit (91-52915A3) into brass fitting on adaptor.



54459

- a - Brass Fitting
- b - Test Gauge Assembly
- c - Tilt Pin (Position in Hole Shown)
- d - Hose
- e - Hose (Not Used)

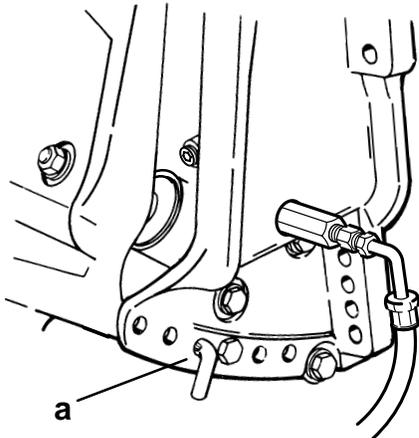
6. Reinstall fill plug.
7. Disengage tilt lock lever.



CAUTION

Failure to install spare tilt pin (or hardened bolts and nuts) in hole shown could result in transom bracket failure and possible injury.

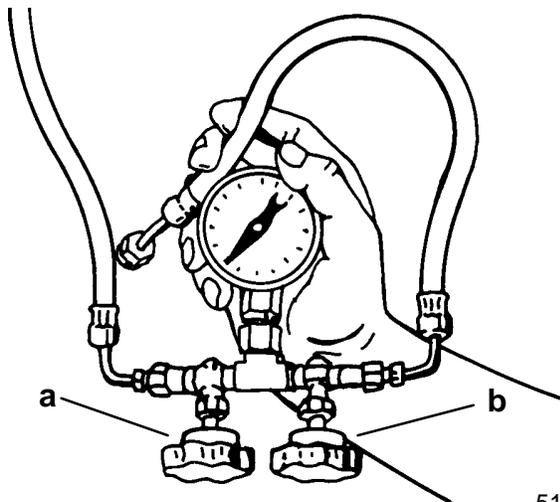
8. Move outboard "IN" until hole in swivel bracket "ear" aligns with the 3rd tilt hole in transom bracket. Lock engine in trim range by installing a 3/8 in. (9.5 mm) diameter tilt pin or two 3/8 in. (9.5 mm) hardened bolts and nuts thru the transom brackets and swivel bracket in the hole shown.



54460

a - Tilt Pin Hole (Install Spare Tilt Pin or Hardened Bolts and Nuts)

9. Open valve (a) and close valve (b).



51374

10. Run trim "UP". The minimum pressure should be 1300 P.S.I. (91 kg/cm²).
11. Run trim "DOWN" to release pressure and remove spare tilt pin or bolts and nuts.
12. Tilt outboard full "UP" and engage tilt lock lever.
13. Slowly remove "Fill" plug to bleed pressure.
14. Remove test gauge hose and adaptor.
15. Reinstall Manual Release Valve and secure valve with circlip.

16. Retighten "Fill" plug.

NOTE: If pressure is less than 1300 PSI (91 kg/cm²), troubleshoot system per instructions on page 5B-8.

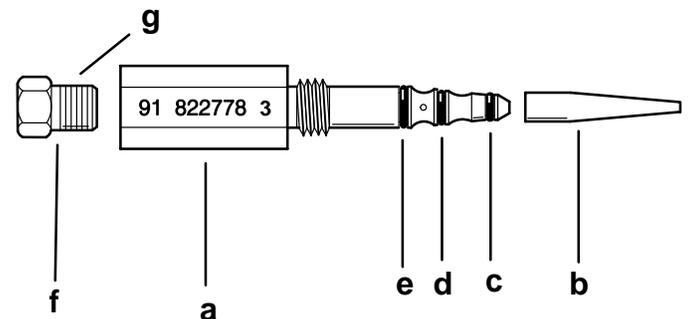
"DOWN" Pressure Check

IMPORTANT: Insure battery is fully charged before performing tests.

1. Tilt outboard to full "Up" position and engage tilt lock lever.
2. Slowly remove "Fill" plug to bleed pressure from reservoir.
3. Remove circlip securing manual release valve and unscrew release valve from trim assembly.

NOTE: A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.

NOTE: Assemble test adaptor by using o-ring installation tool to position small o-ring onto adaptor 1st, then install medium o-ring and lastly large o-ring. Thread brass fitting into test adaptor securely using teflon tape on threads.

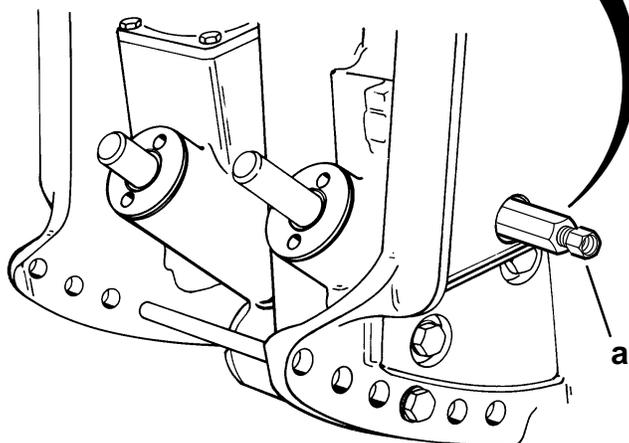
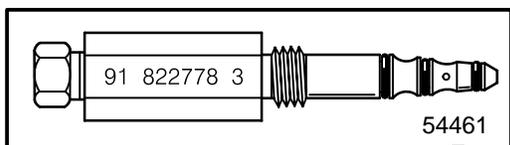


54457

- a - Test Adaptor (91-822778A3)
- b - O-ring Installation Tool
- c - Small O-ring (Install 1st)
- d - Medium O-ring (Install 2nd)
- e - Large O-ring (Install Last)
- f - Brass Fitting
- g - Apply Teflon Tape



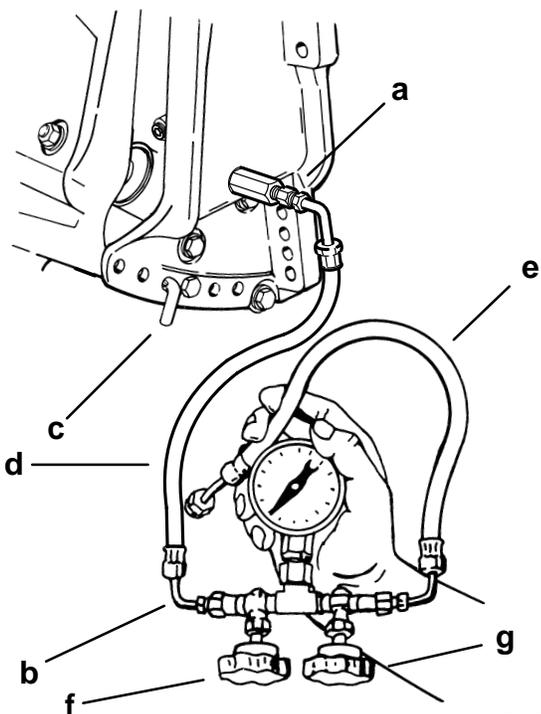
4. Install test adaptor 91-822778A3 into manual release valve hole.



54458

a - Test Adaptor (91-822778A3)

5. Thread hose from Test Gauge Kit (91-52915A3) into brass fitting on adaptor.



54459

a - Brass Fitting
 b - Test Gauge Assembly
 c - Tilt Pin (Position in Hole Shown)
 d - Hose
 e - Hose (Not Used)
 f - OPEN Valve
 g - CLOSE Valve

6. Reinstall fill plug.
7. Disengage tilt lock lever.
8. Open valve (f) and close valve (g).
9. Run trim "DOWN". Minimum pressure should be 500 P.S.I. (35 kg/cm²).
10. Tilt outboard full "UP" and engage tilt lock lever.
11. Slowly remove "Fill" plug to bleed pressure.
12. Remove test gauge hose and adaptor.
13. Reinstall manual release valve and secure valve with circlip.
14. Retighten "Fill" plug.

NOTE: If pressure is less than 500 PSI (35 kg/cm²), troubleshoot system per instructions on Page 5B-8.



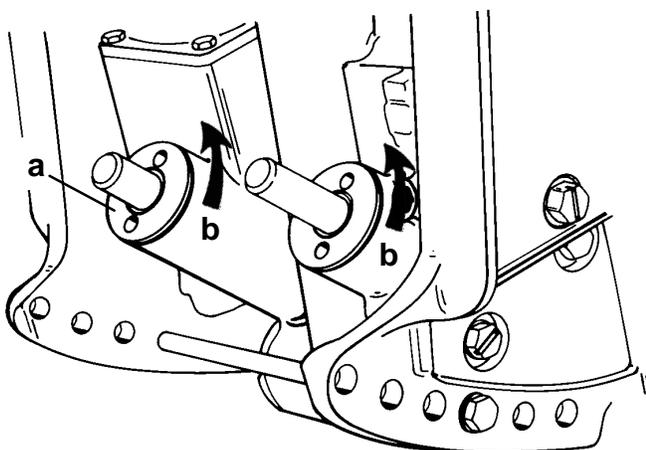
Hydraulic Repair

TRIM ROD REMOVAL AND REPAIR

NOTE: Power Trim does not have to be removed from outboard to remove trim rods.

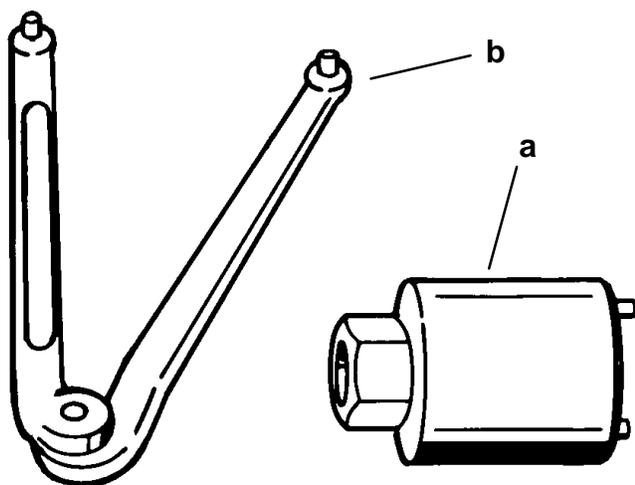
1. Tilt outboard to full "UP" position and engage tilt lock lever.
2. Slowly remove "Fill" plug to bleed reservoir pressure.
3. Turn Manual Release Valve 3 to 4 turns (counterclockwise) to bleed remaining pressure.
4. Remove trim rod cylinder caps.

NOTE: Place a clean pan under trim system to catch fluid.



51353

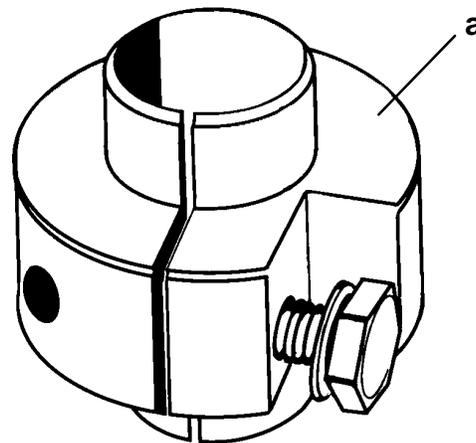
- a - Trim Rod Cylinder Cap
- b - Turn Counterclockwise To Remove



51337

- a - Removal Tool (91-44487A1)
- b - Spanner Wrench (91-74951)

5. Install trim rod removal tool and pull trim rod from cylinder.



27933

- a - Trim Rod Removal Tool (91-44486A1)

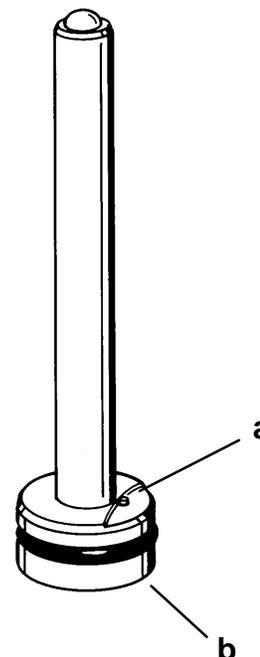
CLEANING AND INSPECTION - TRIM RODS AND CAPS

CAUTION

Do not remove check valve (a). Check valve is preset to operate at a specific pressure. Removal and installation of check valve could result in improper operating pressure and possible system damage.

NOTE: Check valve is in port side trim rod only.

1. Inspect check valve and check valve screen for debris; if debris cannot be removed, replace trim rod assembly. Clean trim rod with parts cleaner and dry with compressed air.



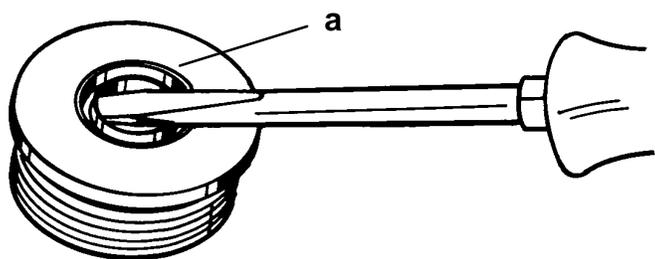
51352

- a - Check valve
- b - Check valve screen



Trim Rod End Cap Seal

1. Inspect trim cap end seal and replace if damaged or if seal does not keep trim rod clean.



51343

a - Seal (Remove as shown)

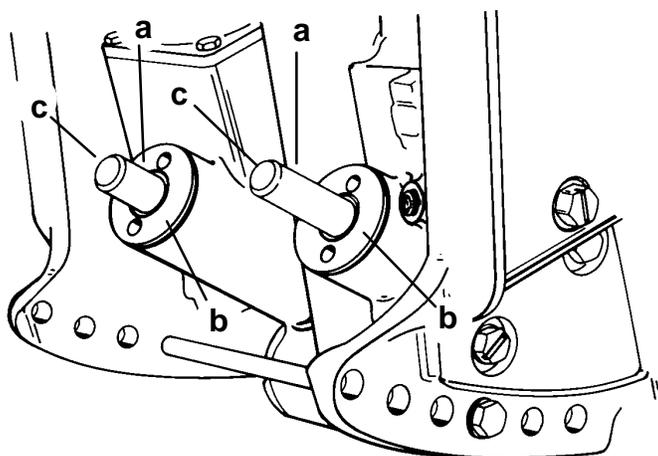
2. Install new seal with seal lip up.

TRIM ROD INSTALLATION

IMPORTANT: Components must be free of dirt and lint. Any debris in the system can cause system to malfunction.

NOTE: Install trim rod with check valve in the port (left) cylinder.

1. Apply Quicksilver Power Trim and Steering Fluid on all O-rings and seals before installation.
2. Install trim rods and caps. Use installation tool (91-44487A1) or spanner wrench (91-74951) to tighten caps securely.
3. Lubricate rod end rollers with Quicksilver Anti-Corrosion Grease or 2-4-C w/Teflon.



51353

- a - Trim rods
 b - Cylinder end caps
 c - Rod end rollers (lubricate with Quicksilver Anti-Corrosion Grease or 2-4-C w/Teflon)

Tilt Ram

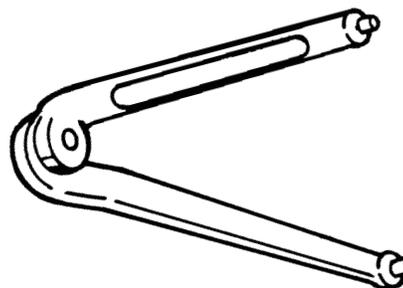
REMOVAL - TILT ROD ASSEMBLY ONLY

NOTE: Tilt Rod Assembly can be removed from cylinder without removing entire power trim system from outboard. Refer to page 5B-14 to remove upper swivel pin.

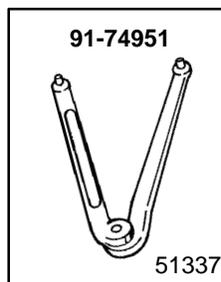
CAUTION

Insure Power Trim System Is Depressurized Prior To Tilt Rod Removal.

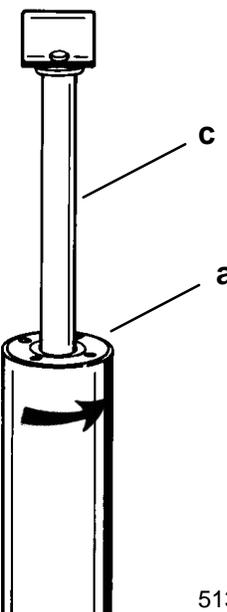
1. Use spanner wrench (91-74951) to loosen tilt ram end cap.



51337



b



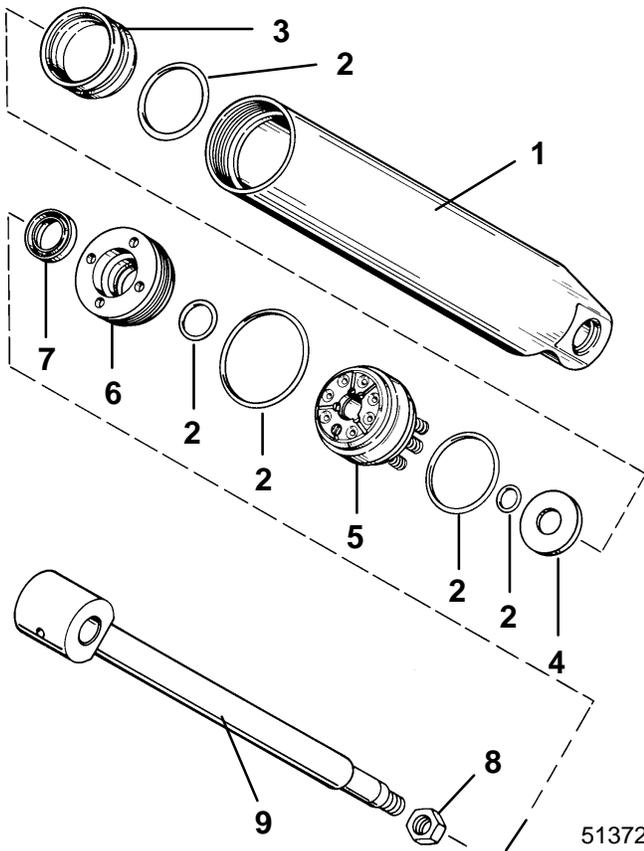
51364

- a - End cap
 b - Spanner Wrench (91-74951) (Turn counterclockwise)
 c - Tilt rod. Pull to remove.

NOTE: Place a clean pan under tilt ram to catch fluid.



TILT RAM COMPONENTS



- 1 Housing - Tilt Ram
- 2 O-ring* (5)
- 3 Memory Piston**
- 4 Washer
- 5 Piston Assembly
- 6 End Cap
- 7 Oil Seal
- 8 Nut (Design 2)
- 9 Tilt Rod (Design 2)

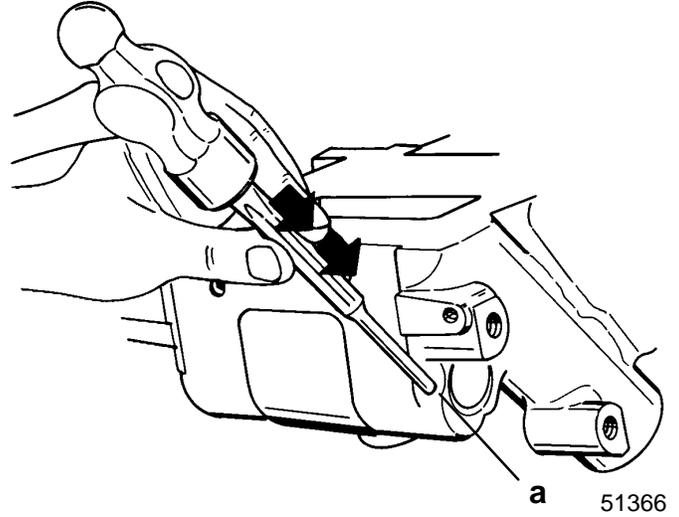
*O-ring Repair Kit Available, P.N. 811607A1 (Includes item 7, Oil Seal)

TILT RAM REMOVAL - POWER TRIM SYSTEM REMOVED FROM OUTBOARD

⚠ CAUTION

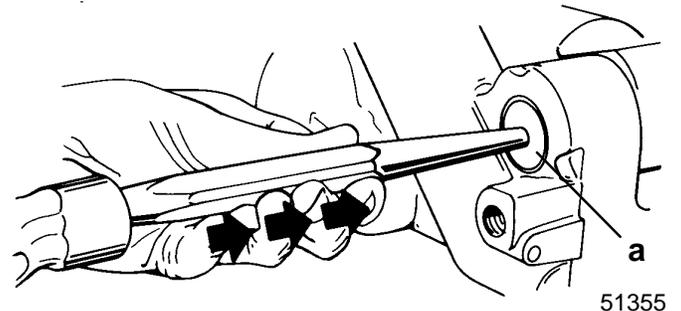
Insure trim system is depressurized prior to tilt ram removal.

1. Remove cross pin.



a - Cross Pin (Remove as shown)

2. Remove lower swivel pin.

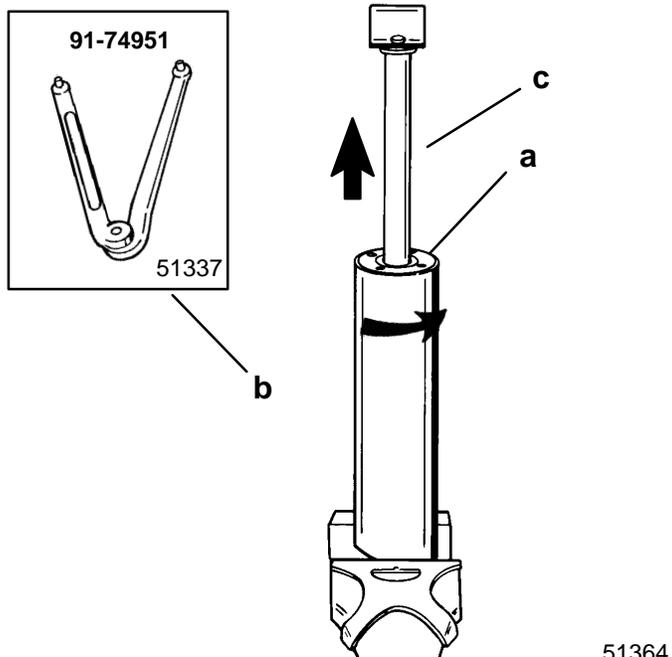


a - Lower Swivel Pin (Remove as shown)



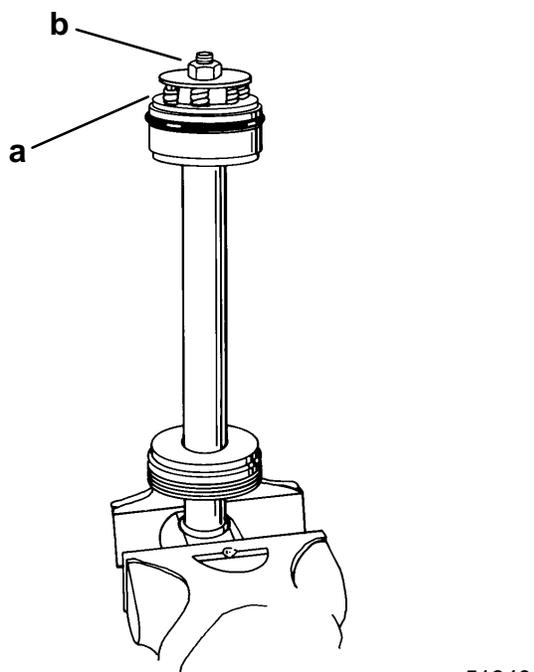
Disassembly

1. Secure tilt ram in a soft jawed vise. Remove tilt rod and cap.



- a - Cap (Turn counterclockwise to remove)
 b - Spanner wrench (91-74951)
 c - Tilt Rod - Pull to remove

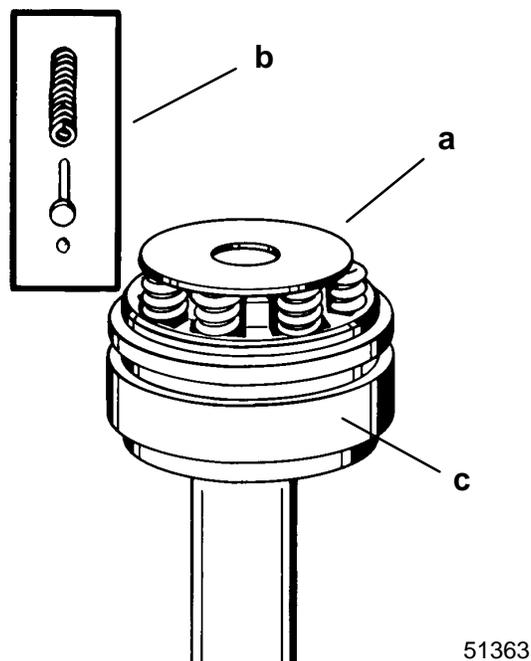
2. Clamp tilt rod in a soft jawed vise. Remove nut to disassemble rod assembly. Remove O-ring.



- a - O-Ring
 b - Nut

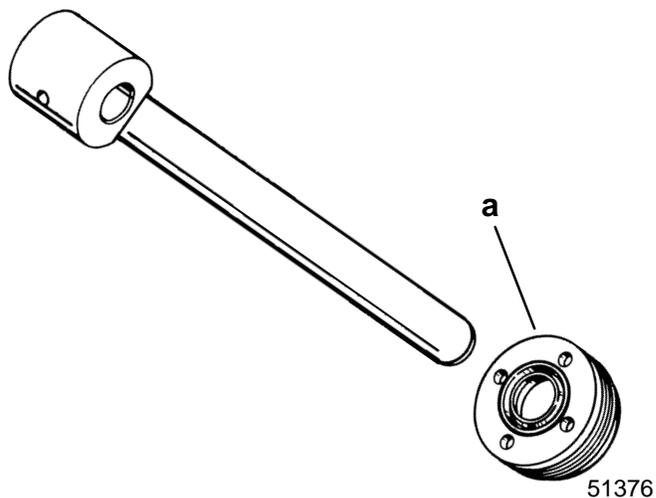
3. Remove washer, check valve assemblies, and piston.

NOTE: Check valve held in by roll pin can be cleaned but not removed.



- a - Washer
 b - Check valve assembly (7)
 c - Piston

4. Remove end cap from tilt rod.

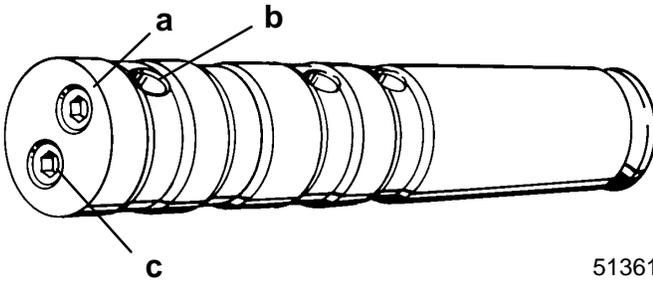


- a - End cap



5. Remove allen plug.

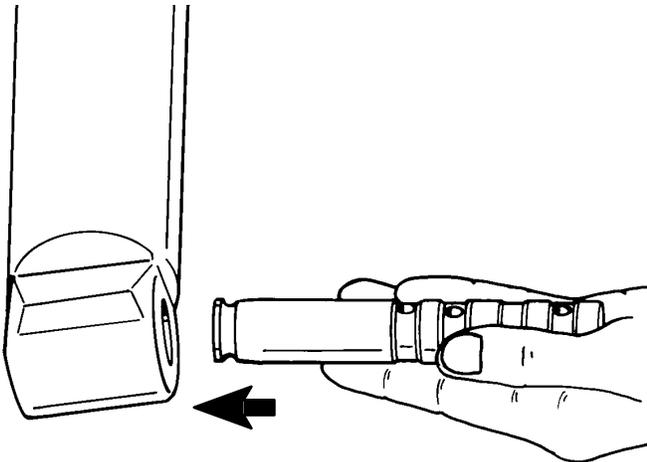
IMPORTANT: Remove plug from same side as holes in shaft.



51361

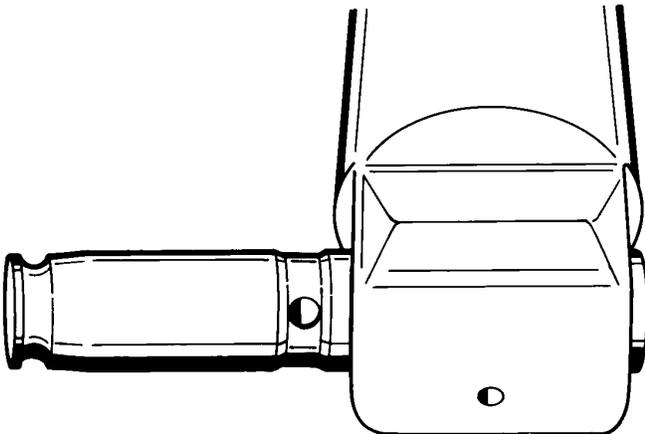
- a - Allen plug
- b - Hole in shaft
- c - Do Not Remove

6. Lubricate shaft with Quicksilver Power Trim and Steering Fluid. Insert shaft into cylinder.



51342

7. Tap shaft into cylinder until shaft is positioned as shown.

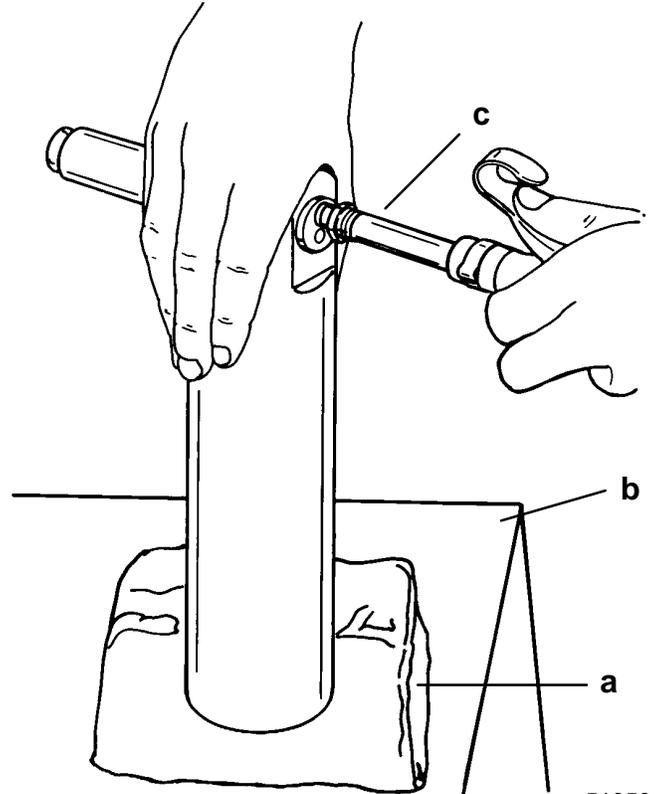


51365

⚠ WARNING

Memory Piston Cup may be expelled at a high velocity when air pressure is applied. Failure to place cylinder as shown below could result in personal injury.

8. Drain as much fluid as possible from cylinder before removing memory piston.
9. Place cylinder as shown. Hold down on cylinder and inject air into shaft opening.



51353

- a - Shop Cloth
- b - Solid surface
- c - Air nozzle

10. Remove shaft after Memory Piston Cup has been expelled. Replace allen plug removed in Step 5 and tighten securely.

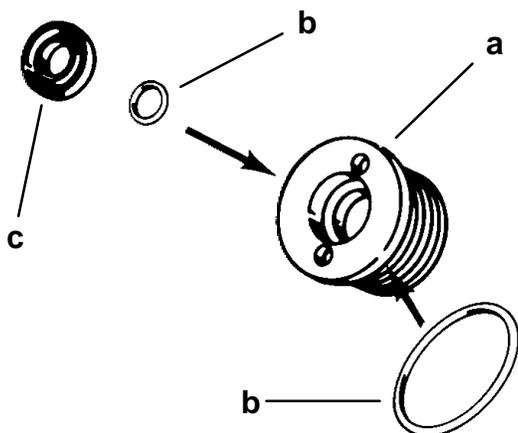
CLEANING AND INSPECTION

1. Inspect all internal parts for damage or wear. Clean and replace parts as necessary.
2. Inspect tilt rod for scratches. Replace scraper seal in rod end cap if tilt rod is scratched or worn.
3. Slight scratches or tool marks less than 0.005 in. (0.127 mm) deep in cylinder are acceptable.



Scraper Seal Replacement

1. Remove components from end cap.



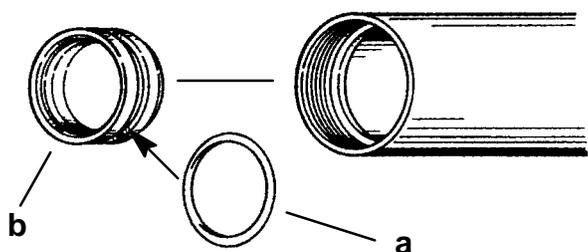
- a - Cap
- b - O-ring (2)
- c - Scraper Seal

REASSEMBLY

IMPORTANT: Components must be clean for reassembly. Any debris in the system can cause the system to malfunction.

NOTE: Refer to "Tilt Ram Components" for proper O-ring sizes.

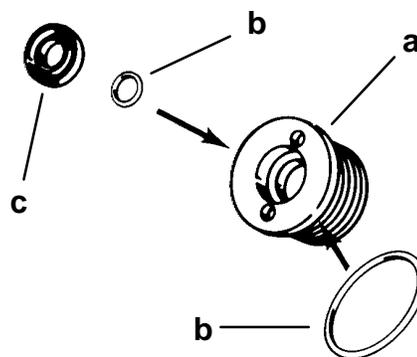
1. Apply Quicksilver Power Trim and Steering Fluid on O-rings prior to reassembly.
2. Install O-ring on Memory Piston Cup.
3. Push memory piston all the way to the bottom of the cylinder and then fill 3/4 full with oil before installing rod.



51372

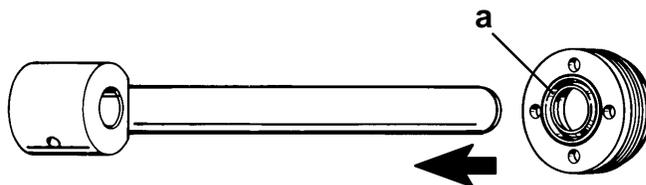
- a - O-ring
- b - Memory Piston Cup (Design 1 shown)

4. Assemble end cap.



- a - End Cap
- b - O-ring (2)
- c - Scraper Seal

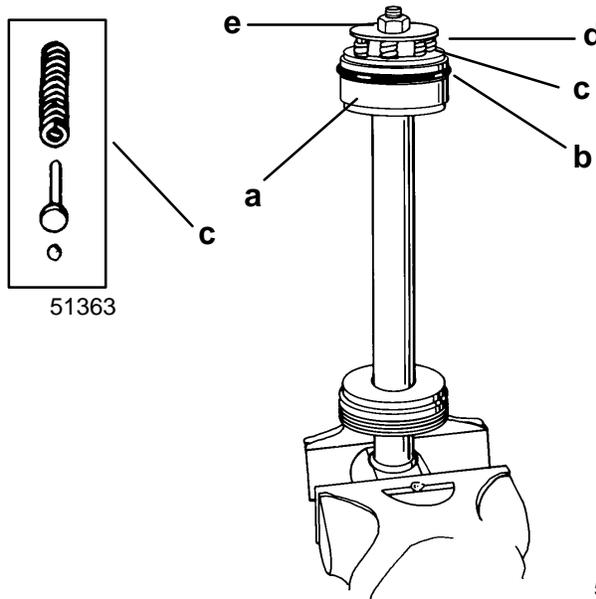
5. Lubricate seal and rod shaft with Power Trim and Steering Fluid to prevent seal damage during assembly. Reinstall end cap.



51376

- a - End Cap

6. Install components on rod. Verify check balls are properly installed in their seats.



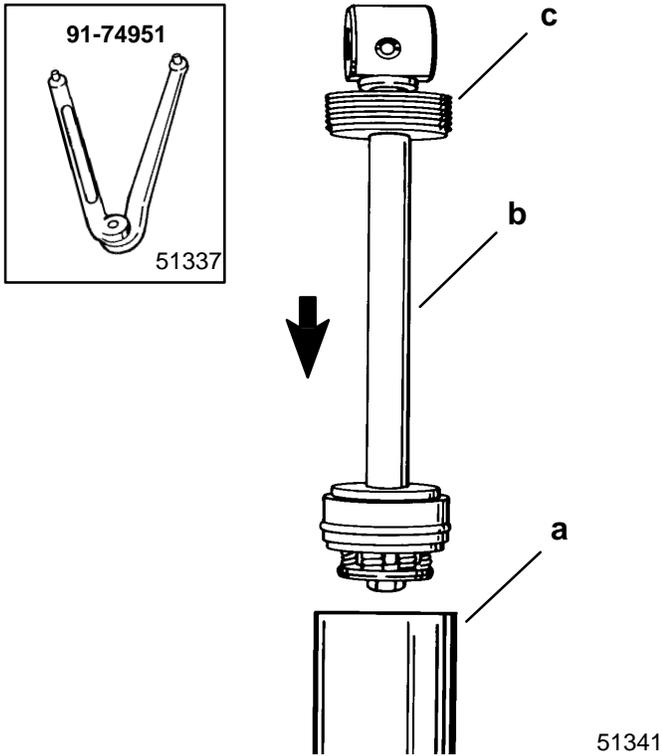
51340

- a - Piston
- b - O-ring
- c - Check Valve Assembly (7)
- d - Washer
- e - Bolt or Locknut. (Tighten securely)

NOTE: Finish filling cylinder with oil before tightening cap.



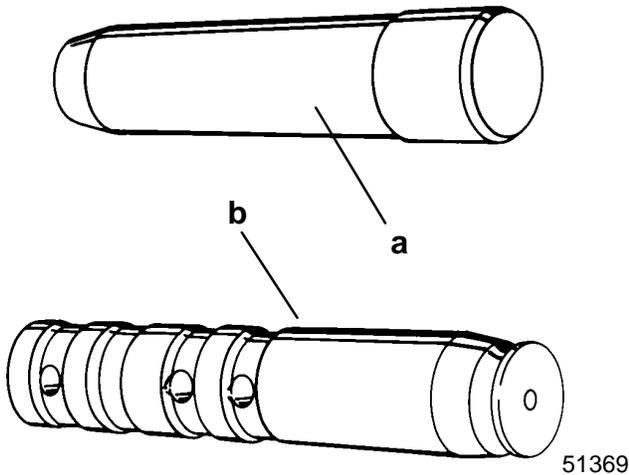
7. Lubricate the O-rings on the rod and end cap with Power Trim and Steering Fluid. Clamp cylinder in a soft jawed vise and install tilt rod assembly. Use spanner wrench and tighten end cap securely.



a - Cylinder
b - Tilt rod assembly
c - End cap (Tighten securely.) Use spanner wrench.

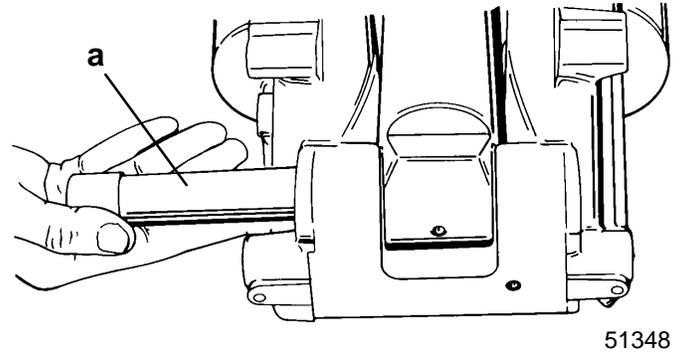
TILT RAM ASSEMBLY INSTALLATION

1. Lubricate alignment tool (91-11230) and shaft. Use Quicksilver Power Trim and Steering Fluid.



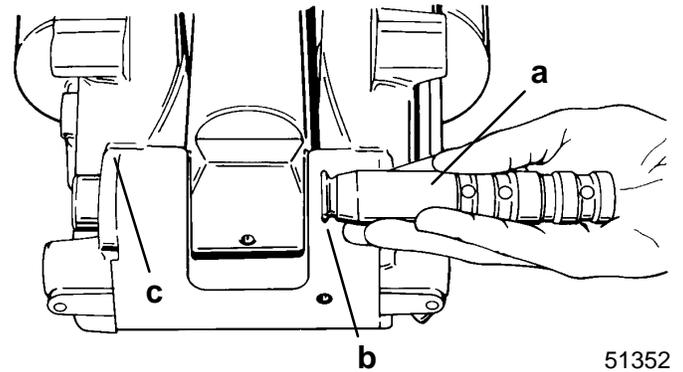
a - Alignment Tool (91-11230)
b - Shaft

2. Align tilt ram and housing using alignment tool.



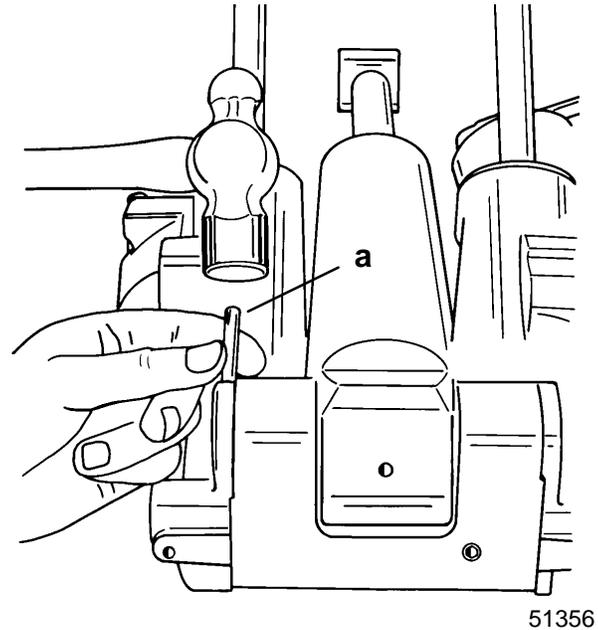
a - Alignment Tool (91-11230)

3. Install shaft.



a - Shaft
b - Groove
c - Hole [groove (b) will align with this hole.]

4. Drive pin in until flush.



a - Pin (Drive Against Knurled End)

5. Install Power Trim Assembly on outboard. Refer to "Installation" instructions on page 5B-16.



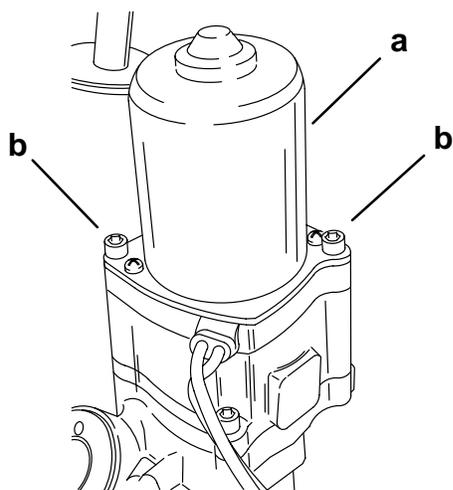
MOTOR AND PUMP REPLACEMENT

IMPORTANT: The pump is not rebuildable. If pump is defective, replace as an assembly.

NOTE: Power Trim System does not have to be removed from outboard to replace pump or motor.

1. Tilt outboard to full "UP" position. Depressurize power trim system, and loosen starboard transom bracket as outlined in "Removal and Installation" on pages 5B-14.
2. Remove 2 allen screws to remove motor from system.

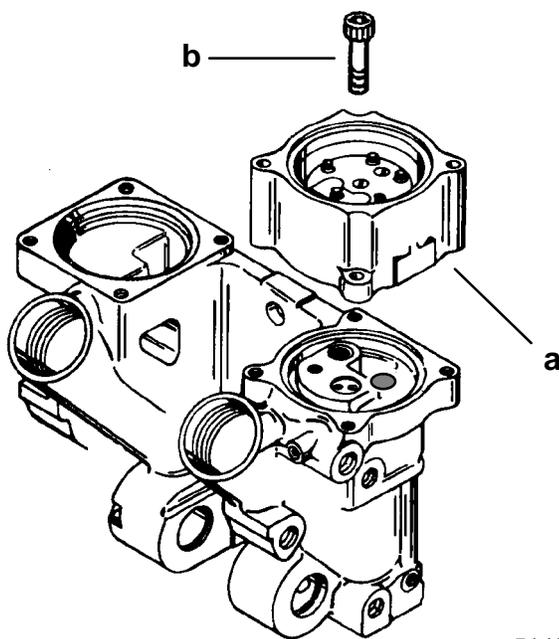
NOTE: Drive shaft is a loose part and may fall out of motor when motor is removed.



53777

- a - Motor
- b - Screw (2)

3. Remove two screws to remove pump.



51433

- a - Pump
- b - Screw (2)

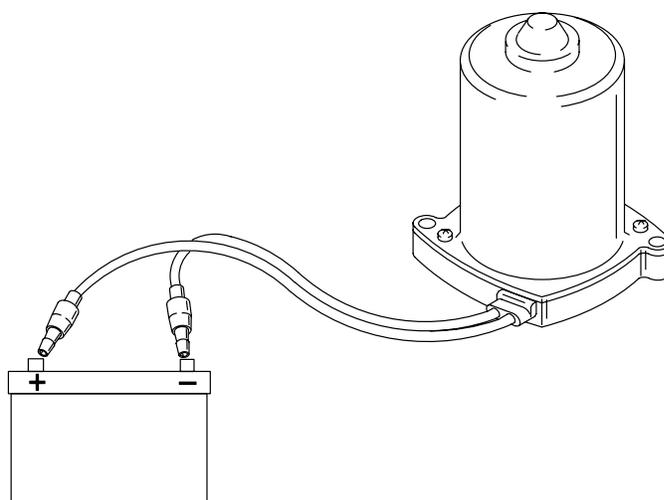
Motor and Electrical Tests/Repair

Trim Pump Motor Test

⚠ WARNING

Do not perform this test near flammable materials, as a spark may occur while making electrical connections.

1. Connect a 12 volt power supply to motor wires; one motor lead to POSITIVE (+) battery terminal and the other motor lead to the NEGATIVE (-) battery terminal. Motor should run. Reverse motor leads between battery terminals. Motor should run.



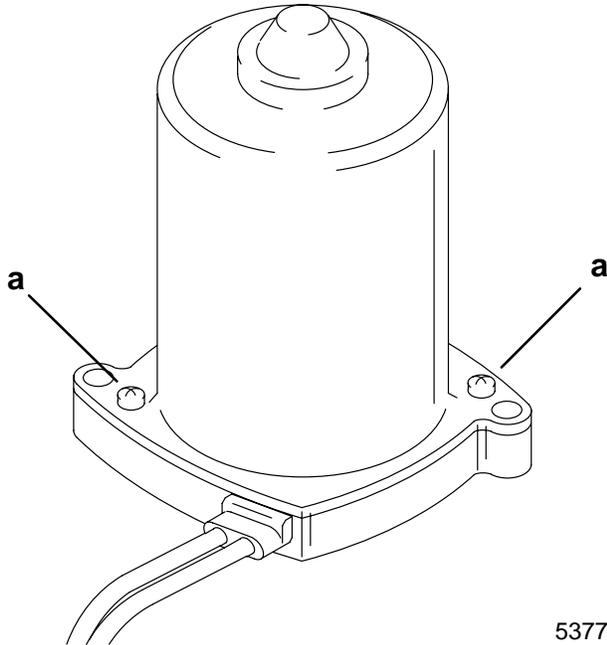
53774

2. If motor does not run, disassemble and check components.



Motor Disassembly

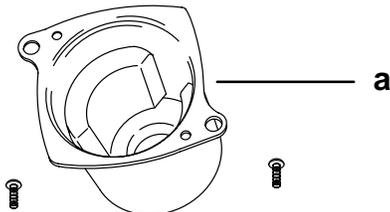
1. Remove 2 screws.



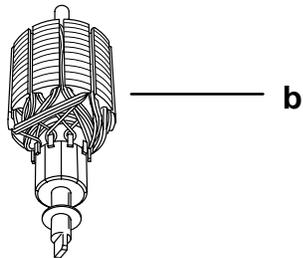
53774

a - Screw (2)

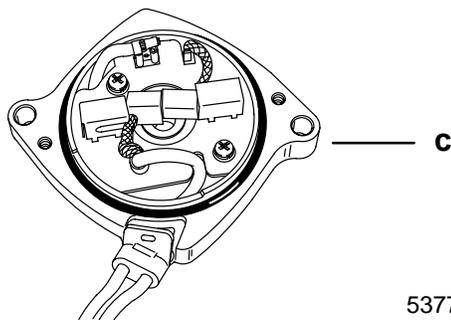
2. Remove frame and armature from end cap. Use care not to drop armature.



a



b



c

53779

a - Frame
b - Armature
c - End Cap

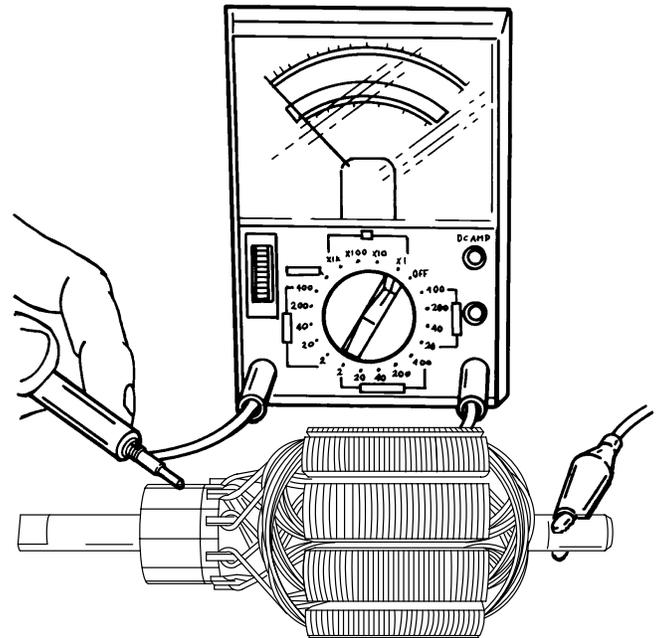
Armature Tests

TEST FOR SHORTS

Check armature on a Growler per the Growler manufacturer's instructions. Replace armature if a short is indicated.

TEST FOR GROUND

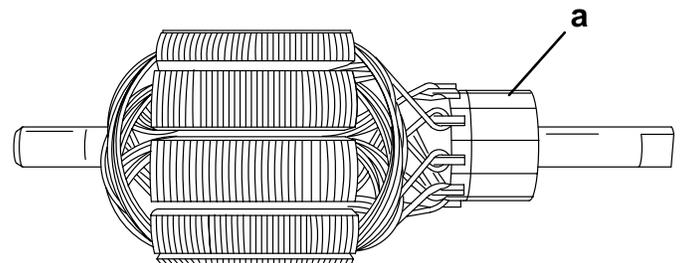
1. Use an Ohmmeter (Rx1 scale). Connect one lead on armature shaft and other lead on commutator. If continuity is indicated, armature is grounded. Replace armature.



53786

CHECKING AND CLEANING COMMUTATOR

1. If commutator is worn it may be turned on an armature conditioner or a lathe.
2. Clean commutator with "OO" sandpaper.



53775

a - Commutator



FIELD TESTS

IMPORTANT: Commutator end of armature must be installed in brushes when performing the following tests.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x _____)
BLUE and BLACK Motor Wires	0	(Rx1)
BLACK Motor Wire, and Frame (Motor Housing)	No Continuity	(Rx1)
BLUE Motor Wire and Frame	No Continuity	(Rx1)

*If specified readings are not obtained, check for:

- defective armature
- dirty or worn brushes
- dirty or worn commutator

If defective components are found, repair or replace component(s) and retest.

Motor Repair

REMOVAL

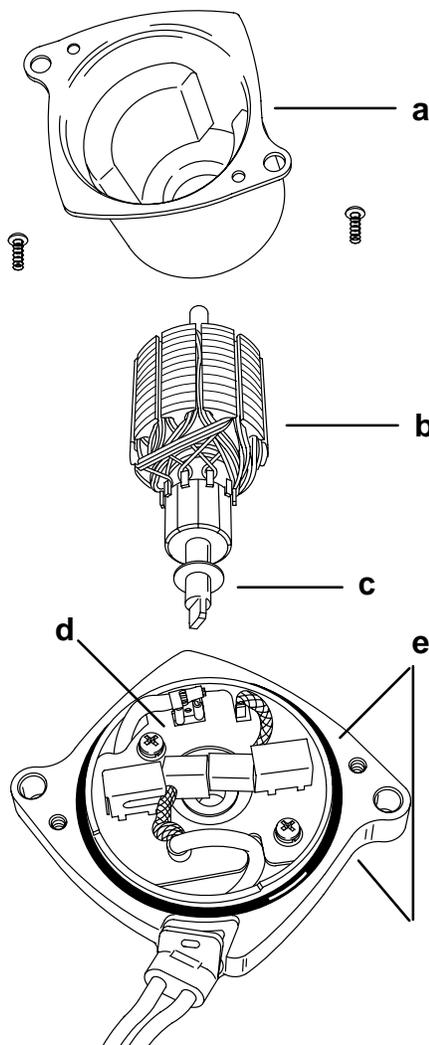
NOTE: Power Trim System does not have to be removed from outboard to repair/replace motor.

DISASSEMBLY

Refer to “**Motor Disassembly**” on page 5B-29 to disassemble motor from pump.

CLEANING AND INSPECTION

Inspect O-rings and replace if necessary. Carefully inspect power cord for cuts or tears which will allow water to enter motor. Replace cord if cut or torn. Clean, inspect, and test motor components. Refer to “**Brush Replacement**”, “**Armature Test**”, and “**Field Tests**” for inspection and test procedures.



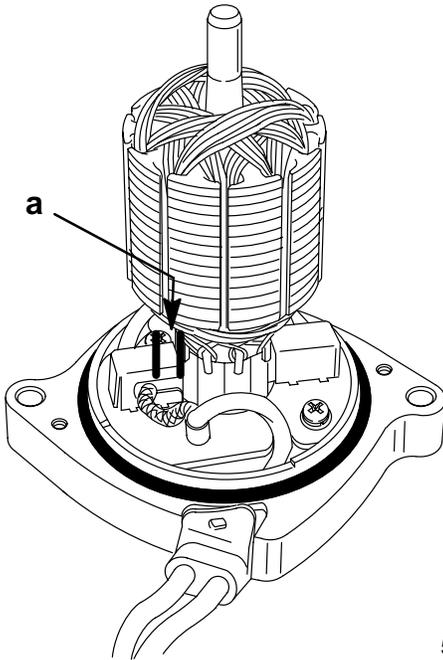
53779

- a - Frame
- b - Armature
- c - Shim
- d - Brush Card Assembly
- e - O-rings



BRUSH REPLACEMENT

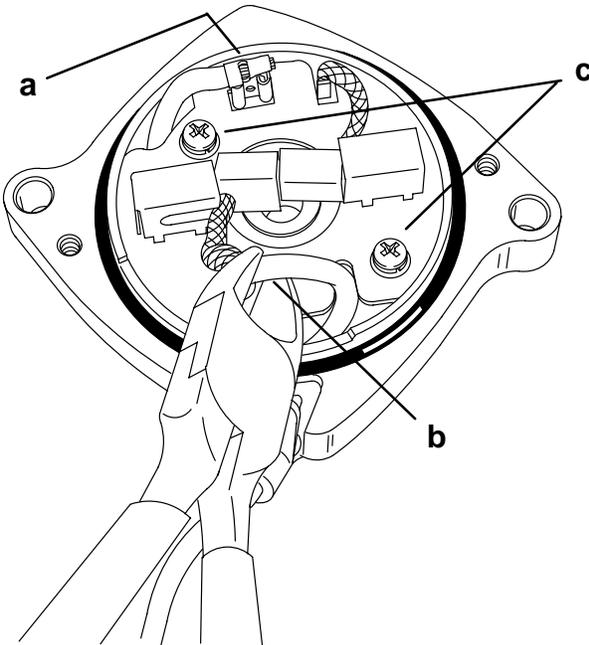
1. Brush replacement is required if brushes are pitted, chipped, or if distance (a) between the brush pigtail and end of brush holder slot is 1/16 in. or less. Check distance with armature installed.



53784

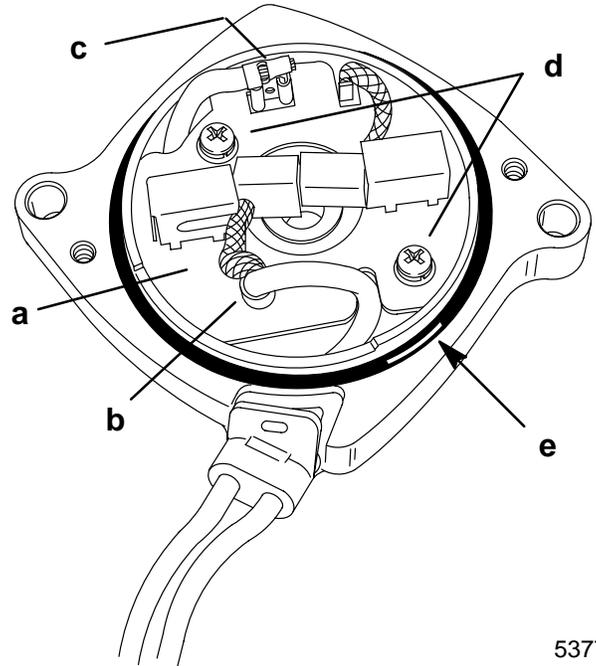
a - 1/16 in.

2. To replace brush card, disconnect spade terminal.
3. Cut crimped brush lead.
4. Remove 2 screws securing brush card to end cap.



a - Spade Terminal
 b - Crimped Brush Lead
 c - Screws

5. Install new brush card (BRUSH and SEAL KIT 828714A1).
6. Crimp metal connector onto motor lead and new brush lead.
7. Connect spade connector motor lead to brush card connector.
8. Secure brush card to end cap with 2 screws and lockwashers.
9. Inspect o-ring for cuts and abraisions. Replace o-ring as required (BRUSH and SEAL KIT 828714A1).



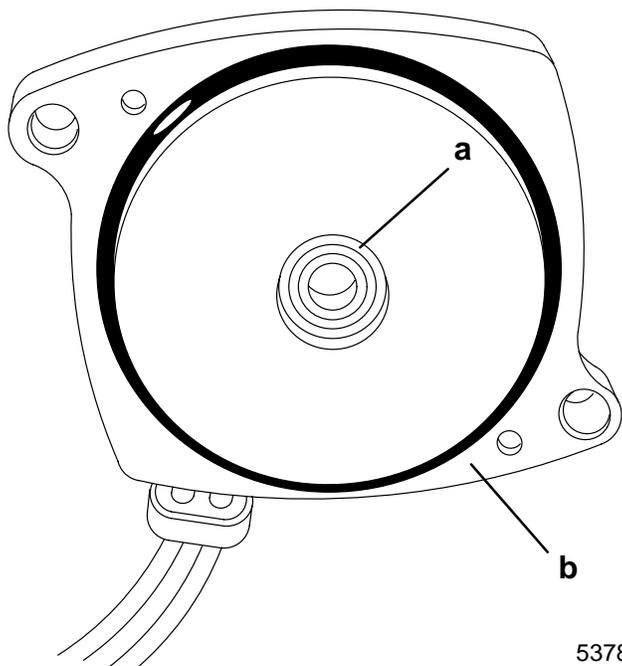
53778

a - Brush Card
 b - Metal Connector
 c - Spade Connector
 d - Screws and Lockwashers
 e - O-ring



END CAP INSPECTION

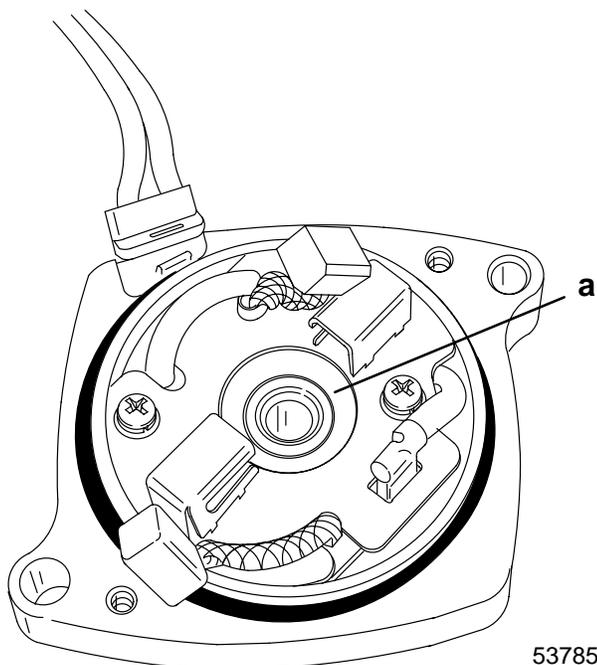
1. Inspect seal and o-ring for cuts and abrasions. If replacement is required, install BRUSH and SEAL KIT 828714A1.



53783

- a - Seal (Apply 2-4-C w/Teflon to seal lips)
- b - O-ring

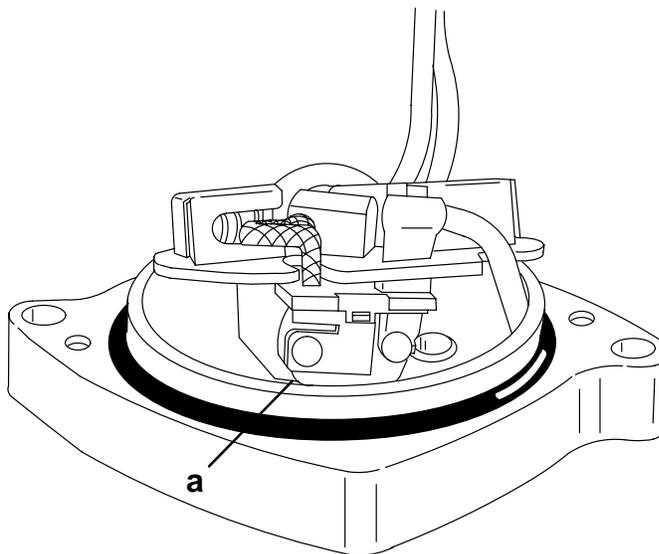
2. Inspect bushing for wear. If bushing appears to be excessively worn – grooves, scratches, etc. – install END FRAME ASSEMBLY (COMPLETE) 828715A1.



53785

- a - Bushing

3. If trim motor is overheated, a thermostwitch located under brush card will open. Normally, this switch will reset itself within 1 minute.



53781

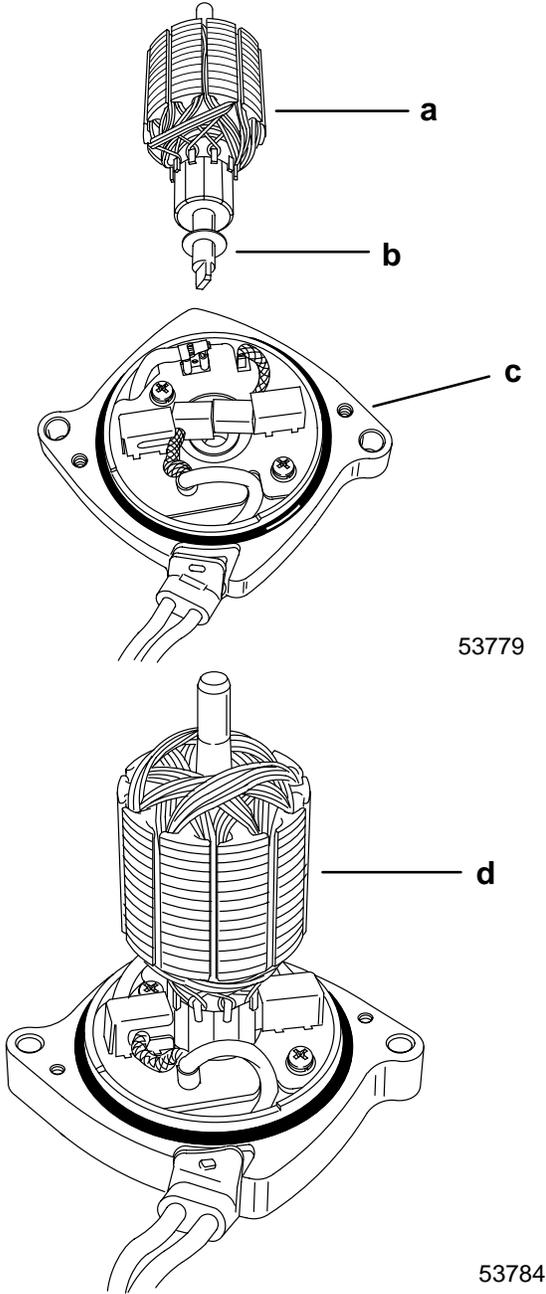
- a - Thermostwitch



Reassembly

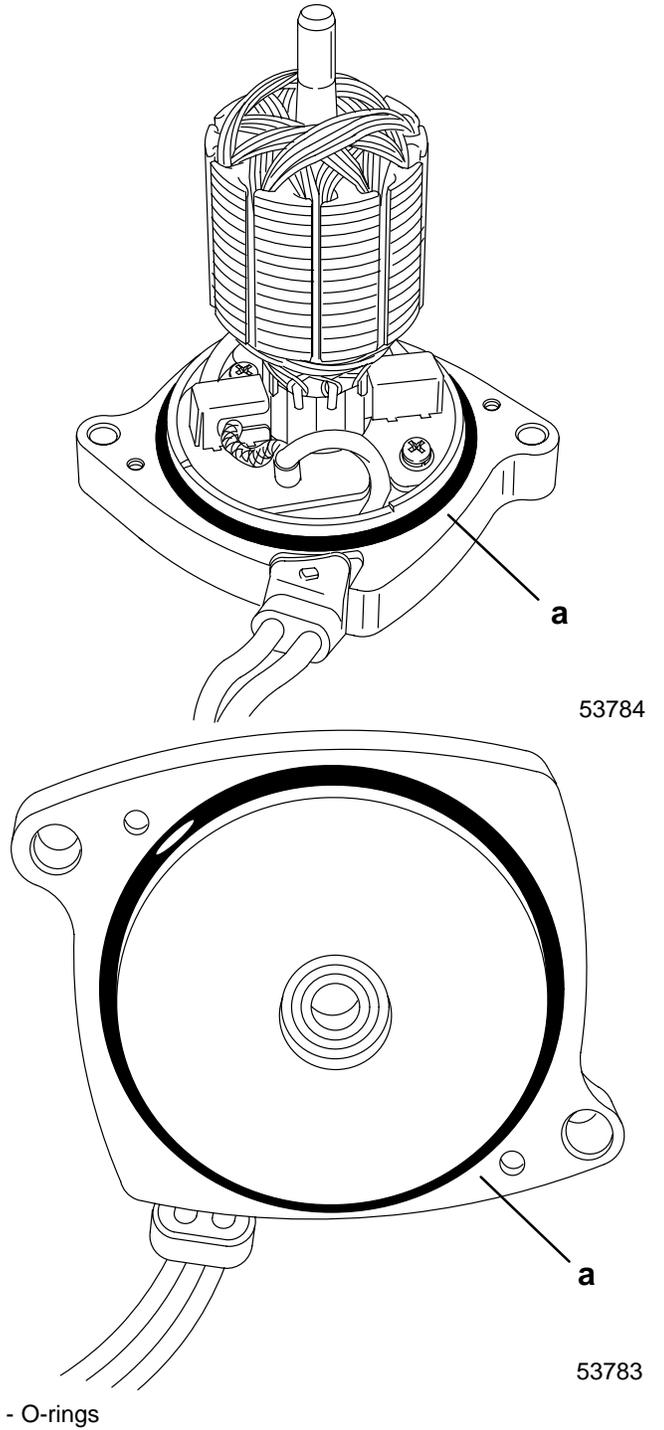
IMPORTANT: Components must be clean. Any debris in power trim system can cause system to malfunction.

1. Install armature into end cap/brush card assembly.



- a - Armature
- b - Shim
- c - End Cap Assembly
- d - Armature (Spread brushes to install armature into end cap)

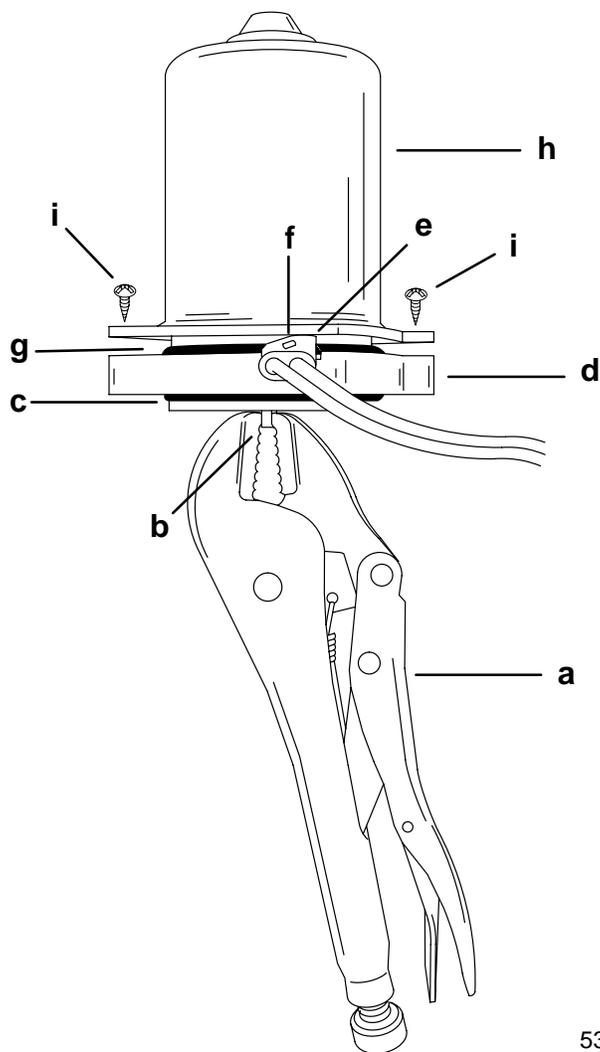
2. Install O-rings in end cap.





IMPORTANT: Attach Vise Grip® pliers to armature shaft before installing frame assembly. The Vise Grip® pliers will prevent the armature from being drawn out of the brush card assembly by the frame magnets while installing the frame assembly.

3. Install Vise Grip® pliers on armature shaft.
4. Carefully install frame assembly over armature.
5. Position harness retainer hole over tab in end cap.
6. Secure frame assembly to end cap with 2 screws.



53776

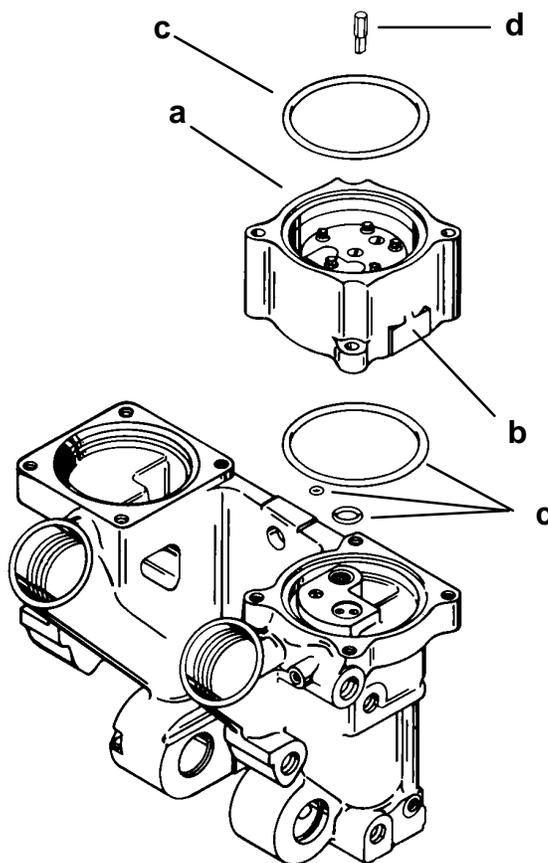
- a - Vise Grip® Pliers
- b - Armature Shaft
- c - O-ring
- d - End Cap
- e - Harness Retainer
- f - Retainer Hole
- g - O-ring
- h - Frame Assembly
- i - Screws

Reassembly - Motor and Pump

NOTE: Drive shaft is a loose part and may fall out of position.

1. Install pump onto power trim manifold. Insure O-rings are in proper locations. Secure with two (2) screws.

IMPORTANT: Install pump with location flat facing towards starboard transom bracket.



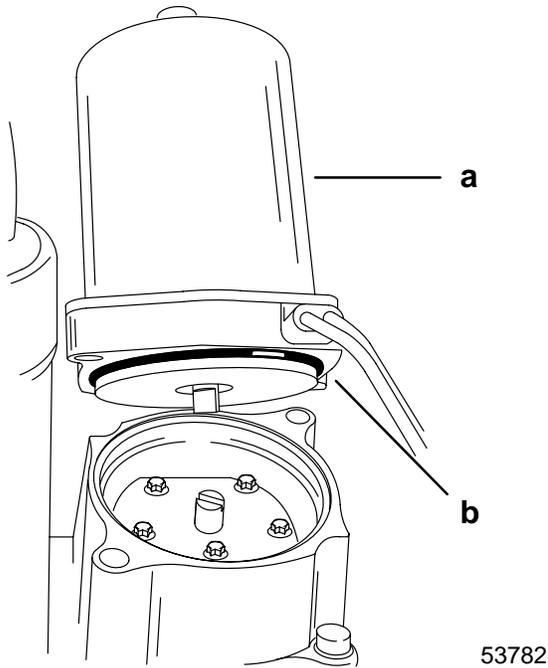
51433

- a - Pump (Flat towards starboard transom bracket)
- b - Flat - faces starboard transom bracket)
- c - O-rings (4)
- d - Drive Shaft (Install in **center** hole in pump)

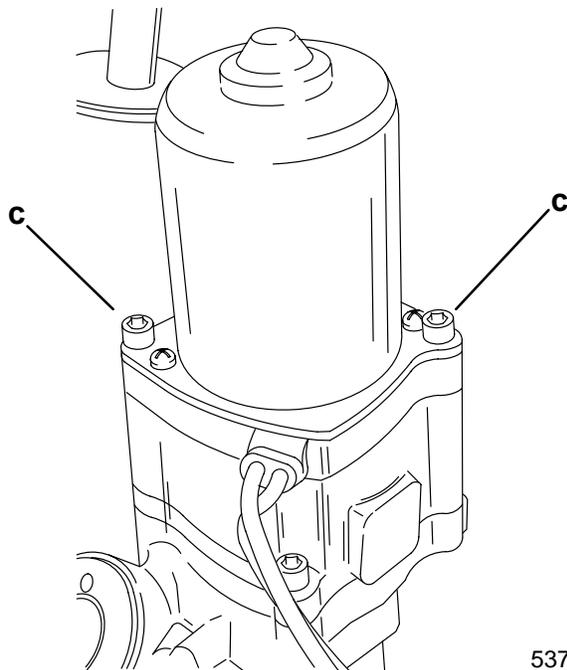


2. Fill pump with Quicksilver Power Trim and Steering Fluid prior to installing motor.
3. Install motor, secure with two (2) screws. Route wiring; refer to Wiring Diagrams in this service manual.

NOTE: Verify motor and drive shaft are aligned.



53782



53777

- a - Motor
- b - O-ring
- c - Screw (2) Tighten securely.

4. Complete reassembly of Power Trim System as outlined in “**Installation**” on page 5B-16.

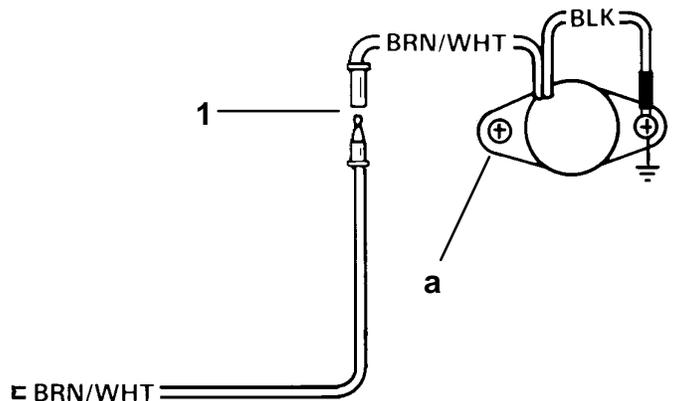
Priming Power Trim System

1. Fill system with Quicksilver Power Trim and Steering Fluid or Automatic Transmission Fluid (ATF) Type F or FA. Refer to “**Fill, Check, and Purge**” on page 5B-6.

IMPORTANT: Run Trim System in short “jogs” until pump motor primes and trim system moves. If trim motor is run without priming pump, drive shaft failure could result.

Trim Sender (Optional Accessory) Test

1. Check trim sender black lead for proper ground.
2. Trim outboard to full “DOWN” position.
3. Place ignition switch to “ON” position.
4. Connect Ohmmeter (Rx1 scale) leads between outboard ground and Point 1.
5. Depress “UP” button. Ohmmeter needle should move as the outboard is trimmed up. If needle does not move, trim sender is defective.



22908

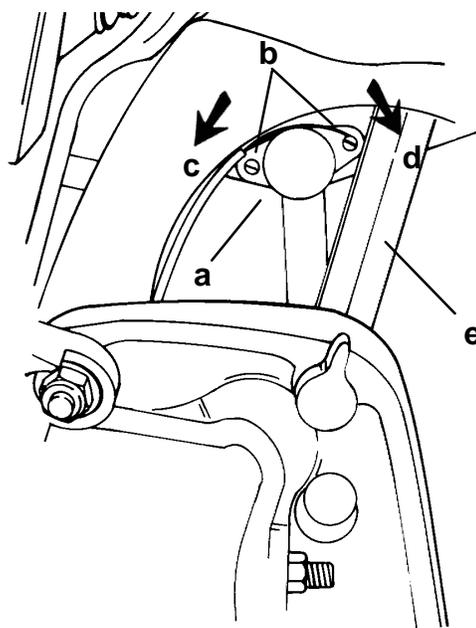
a - Trim Sender



Trim Indicator Gauge Needle Adjustment

1. Turn ignition key to "RUN" position.
2. Tilt outboard to full "IN" position. Needle of trim indicator gauge should be in full "IN" position.
3. If not, tilt outboard to full "OUT" position to gain access to trim sender and engage tilt lock lever.
4. Loosen trim sender screws and reposition trim sender.

5. Tighten trim sender screws.



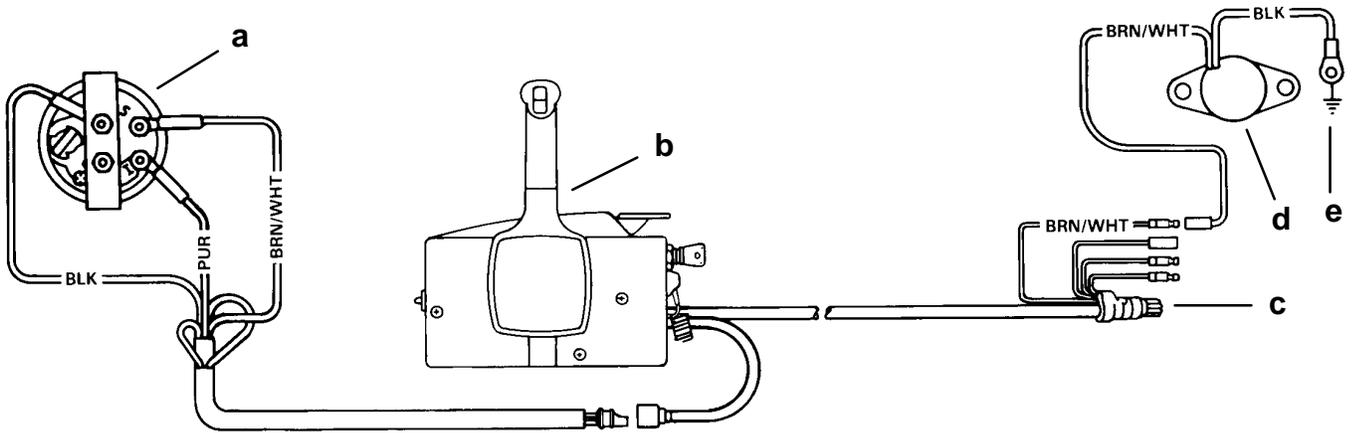
22744

- a - Trim Sender
- b - Screws, loosen to rotate sender
- c - Turn sender **counterclockwise** to raise needle reading
- d - Turn sender **clockwise** to lower needle reading
- e - Tilt lock lever



Trim Indicator Wiring Diagrams

For Boats Equipped with Quicksilver Commander Series Side Mount Remote Control

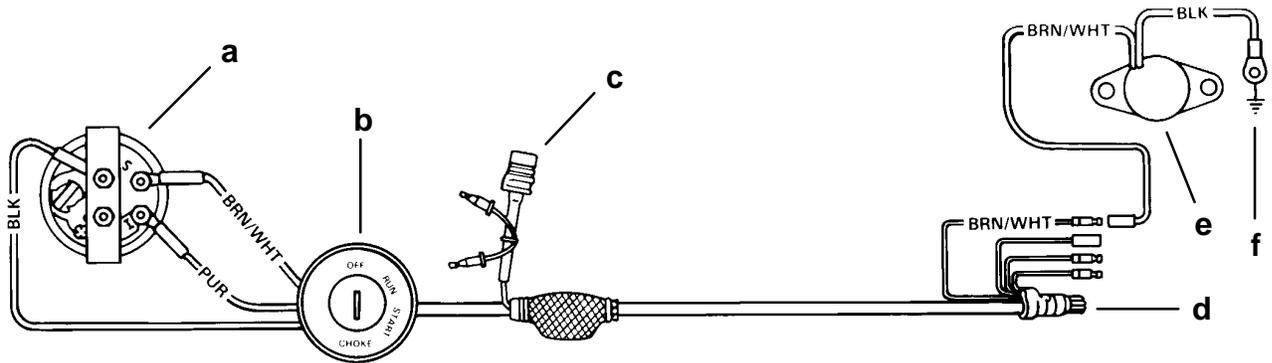


22908

- a - Trim Indicator
- b - Remote Control
- c - To Engine

- d - Trim Sender
- e - Engine Ground

For Boats Equipped with Quicksilver Ignition/Choke and Main Harness Assembly

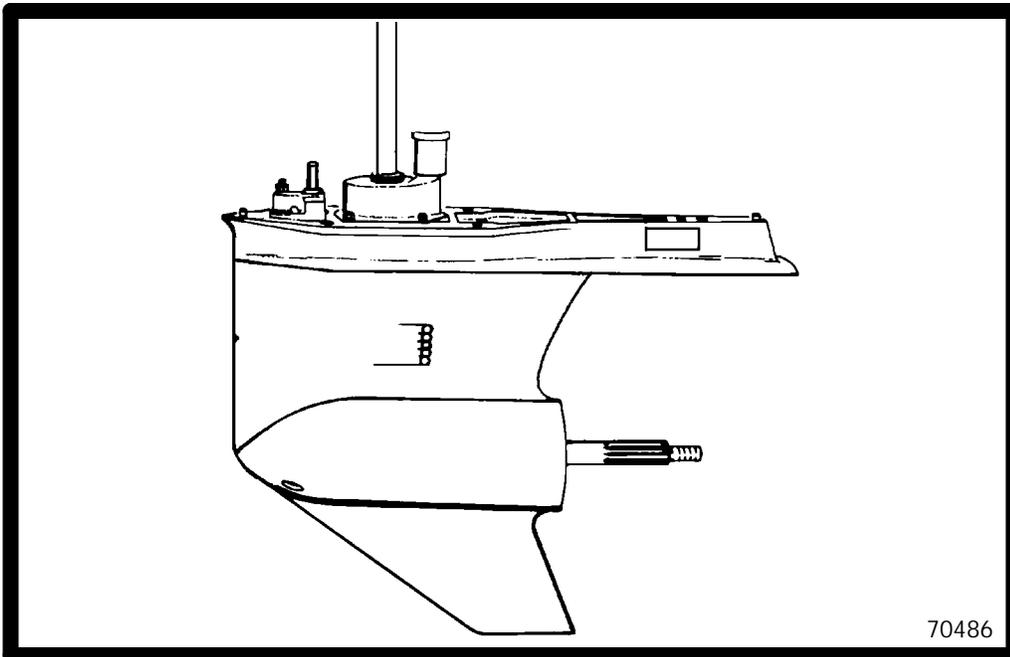


22908

- a - Trim Indicator
- b - Ignition/Choke Switch
- c - Power Trim Harness
- d - To Engine
- e - Trim Sender
- f - Engine Ground



LOWER UNIT



6
A

**GEAR HOUSING
RIGHT HAND OPERATION
(STANDARD ROTATION)
(RATCHETING AND NON-RATCHETING)**



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#1623-822442C2)	6A-6
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#1623-822442C2)	6A-8
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#1623-822442C3)	6A-10
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#1623-822442C3)	6A-12
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General Service Recommendations

There may be more than one way to “disassemble” or “reassemble” a particular part(s). It is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

Disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to “reassembly and installation” of that component in the reassembly part of this section. Use the “Table of Contents” (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, be sure that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals **SHOULD BE REPLACED** without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply Quicksilver 2-4-C w/Teflon on all O-rings. To prevent wear, apply 2-4-C w/Teflon on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply Quicksilver Perfect Seal or 2-4-C w/Teflon to external surfaces of bearing carrier and retainer nut threads prior to installation. DO NOT allow Perfect Seal to enter bearings or O-ring area.

NOTE: Before filling gear case, apply 10-15 psi (68.5 - 102.7kPa) of air pressure at the VENT hole. Pressure should not drop for 15 seconds while alternately applying a 2-3 pound force to the top of the shift shaft in the fore and aft direction.



Gear Housing Specifications (Standard Rotation)

Forward/Reverse Gear Backlash and Pinion Depth (Ratcheting and Non-Ratcheting)

Pinion Depth	
All Models	0.025 in. (0.64mm) with Tool 91-12349A2 Using Disc #2 and Flat #4
Forward Gear Backlash	
1.64:1 and 1.75:1 Gear Ratios 1.62:1 Gear Ratio Service Replacement	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-53549
Reverse Gear Backlash	
1.64:1 and 1.75:1 Gear Ratios 1.62:1 Gear Ratio Service Replacement	0.030 in. to 0.050 in. (0.76mm to 1.27mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)
Forward Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-78473
Reverse Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.030 in. to 0.050 in. (0.76mm to 1.27mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)

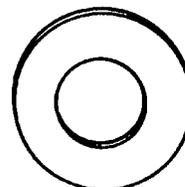
Gear Ratio	Teeth in Pinion Gear	Teeth in Forward and Reverse Gear
1.62:1	13	21
1.64:1	17	28
1.75:1	12	21
1.87:1	15	28

Water Pressure	
Idle	1-1/2 - 4-1/2 psi (10.3 - 30.8kPa)
Poppet Valve Opening	6 - 7 psi (41.1 - 47.9kPa)

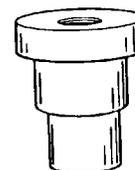
W.O.T.	8-10 psi (54.9 - 68.5kPa)
Test Propeller for Static Test	
12 Dia. x 15 Pitch	48-78116A40

Special Tools (Ratcheting and Non-Ratcheting)

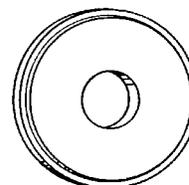
Bellville Washer 12-54048



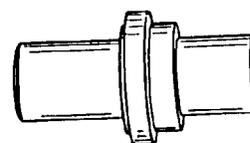
Needle Bearing Driver 91-15755



Bearing Driver Cup 91-31106



Oil Seal Driver 91-31108

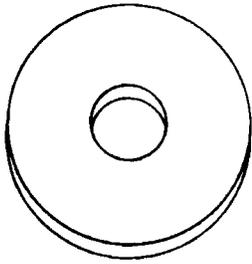


Needle Bearing Driver 91-33491

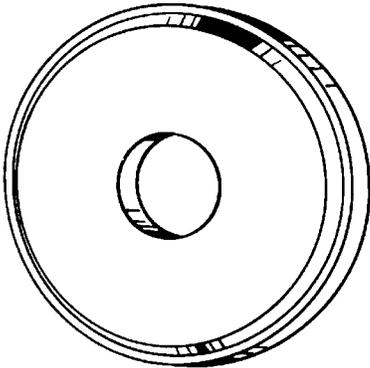




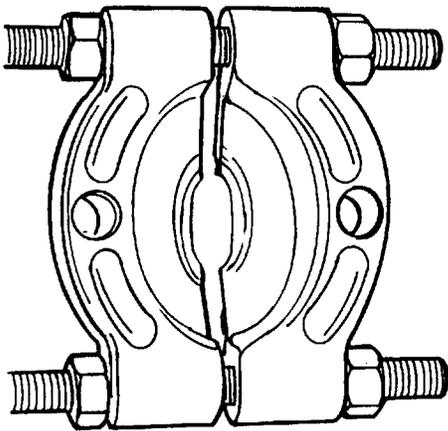
Pilot Washer 91-36571



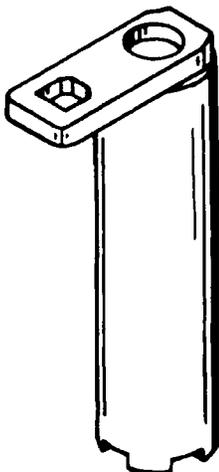
Driver Cup 91-36577



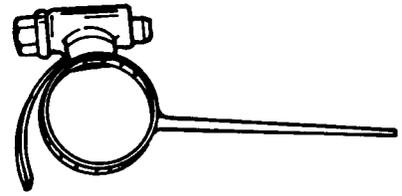
Universal Puller Plate 91-37241



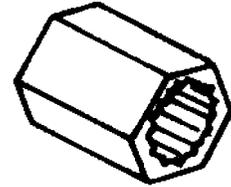
Bearing Retainer Tool 91-43506



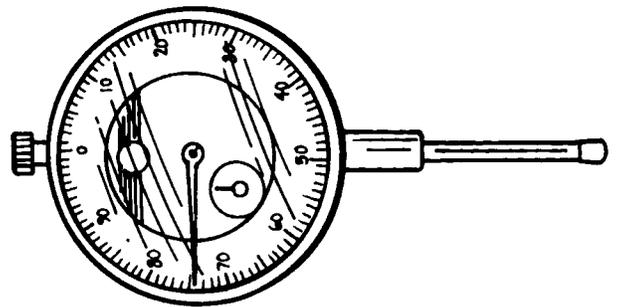
Backlash Indicator Rod 91-53459



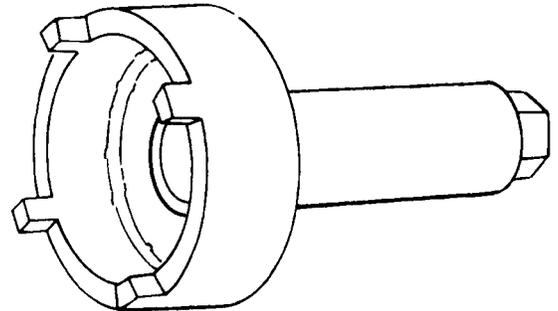
Drive Shaft Nut Wrench 91-56775



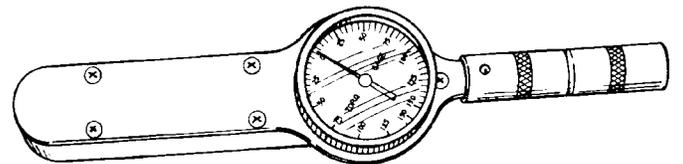
Dial Indicator 91-58222A1



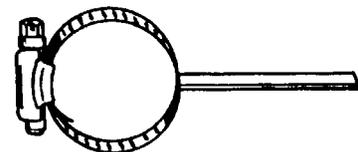
Bearing Carrier Retainer Wrench 91-61069



Torque Wrench (lb. in.) 91-66274

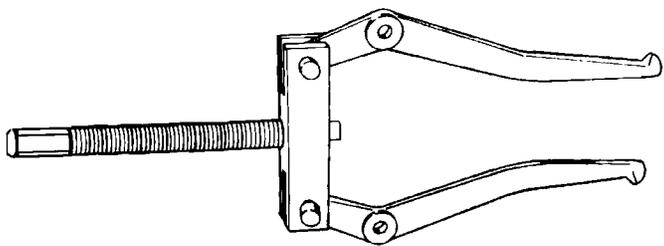


Backlash Indicator Rod 91-78473

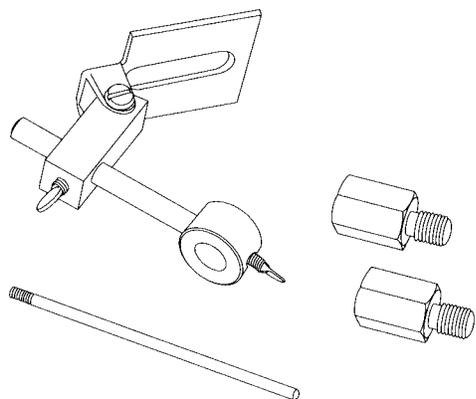




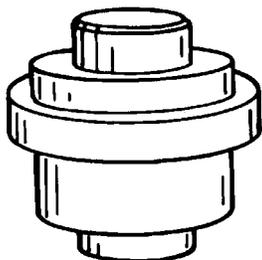
Puller Bolt 91-85716 and Puller Jaws 91-46086A1



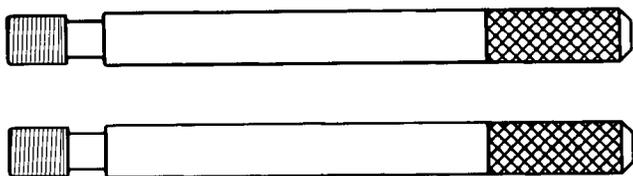
Dial Indicator Holding Tool 91-83155



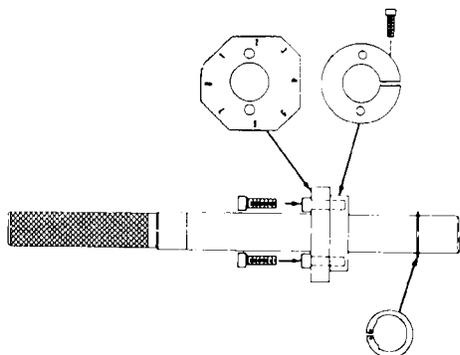
Oil Seal Driver 91-817569



Water Pump Alignment Pins 91-82157A1



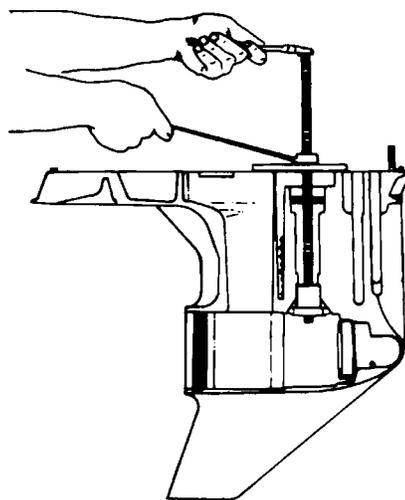
Pinion Gear Shimming Tool 91-12349A2



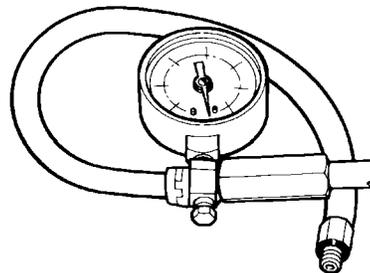
Bearing Preload Tool 91-14311A2



Bearing Removal and Installation Tool 91-31229A7
- Includes Driver Head 91-36569; Driver Head Rod 91-37323; Nut 11-24156; Pilot Washer 91-36571; Pilot Plate 91-29610; Puller/Driver Head 91-38628; Mandrel 91-30366; Plate 91-29310; Driver Head 91-32325; Puller Shaft 91-31229; Washer 91-34961.



Leakage Tester FT8950



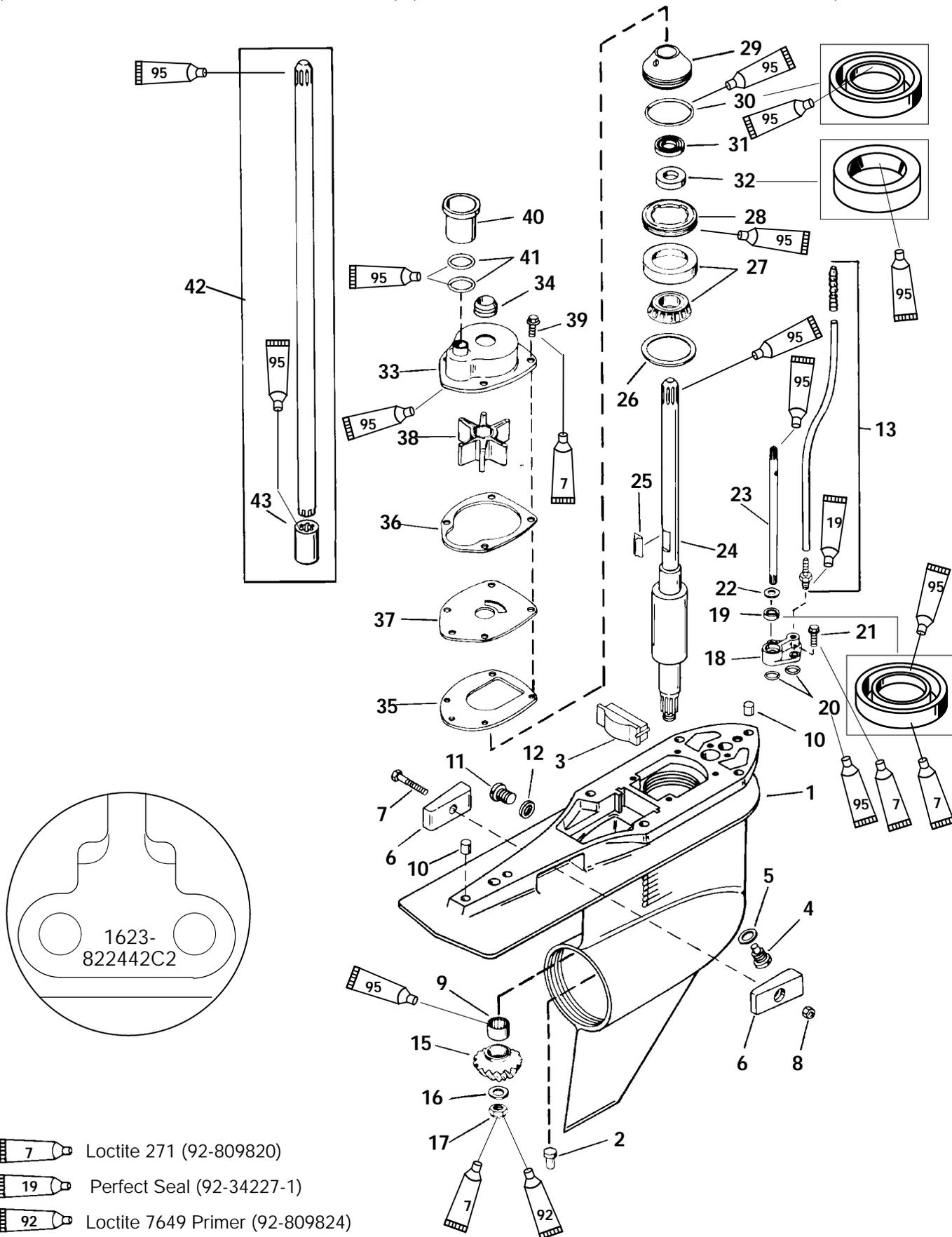


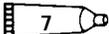
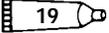
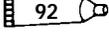
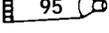
Notes:





Gear Housing (Drive Shaft) (Standard Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



-  Loctite 271 (92-809820)
-  Perfect Seal (92-34227-1)
-  Loctite 7649 Primer (92-809824)
-  2-4-C With Teflon (92-825407A12)



Gear Housing (Drive Shaft) (Standard Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW			
8	1	NUT	60		6.8
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR (LONG/X-LONG)			
14	1	CONNECTOR (XX-LONG)			
15	1	PINION GEAR (Part of 43-826181A2 - 1.75:1 or 43-828072A2 - 1.62:1)			
16	1	WASHER			
17	1	NUT		75	101
18	1	BUSHING ASSEMBLY			
19	1	OIL SEAL			
20	2	O RING			
21	2	SCREW	60		6.8
22	1	RUBBER WASHER			
23	1	SHIFT SHAFT (LOWER)			
24	1	DRIVE SHAFT (LOWER)			
25	1	KEY			
26	AR	SHIM			
27	1	TAPERED ROLLER BEARING			
28	1	RETAINER		100	135
29	1	CARRIER ASSEMBLY			
30	1	O RING			
31	1	OIL SEAL			
32	1	OIL SEAL			
33	1	WATER PUMP ASSEMBLY			
34	1	SEAL			
35	1	GASKET			
36	1	GASKET			
37	1	FACE PLATE			
38	1	IMPELLER			
39	4	SCREW	60		6.8
40	1	COUPLING ASSEMBLY			
41	2	O RING			
42	1	DRIVESHAFT KIT (LONG-20 IN.)	SEE NOTE		
	1	DRIVESHAFT KIT (X-LONG-25 IN.)	13 SPLINES		
	1	DRIVESHAFT KIT (XX-LONG-30 IN.)			
	1	DRIVESHAFT KIT (LONG-20 IN.)	SEE NOTE		
	1	DRIVESHAFT KIT (X-LONG-25 IN.)	8 SPLINES		
43	1	COUPLING			

NOTE: Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the driveshaft and ORDER REF. #'s 24 & 42.

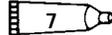
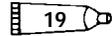
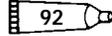
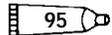


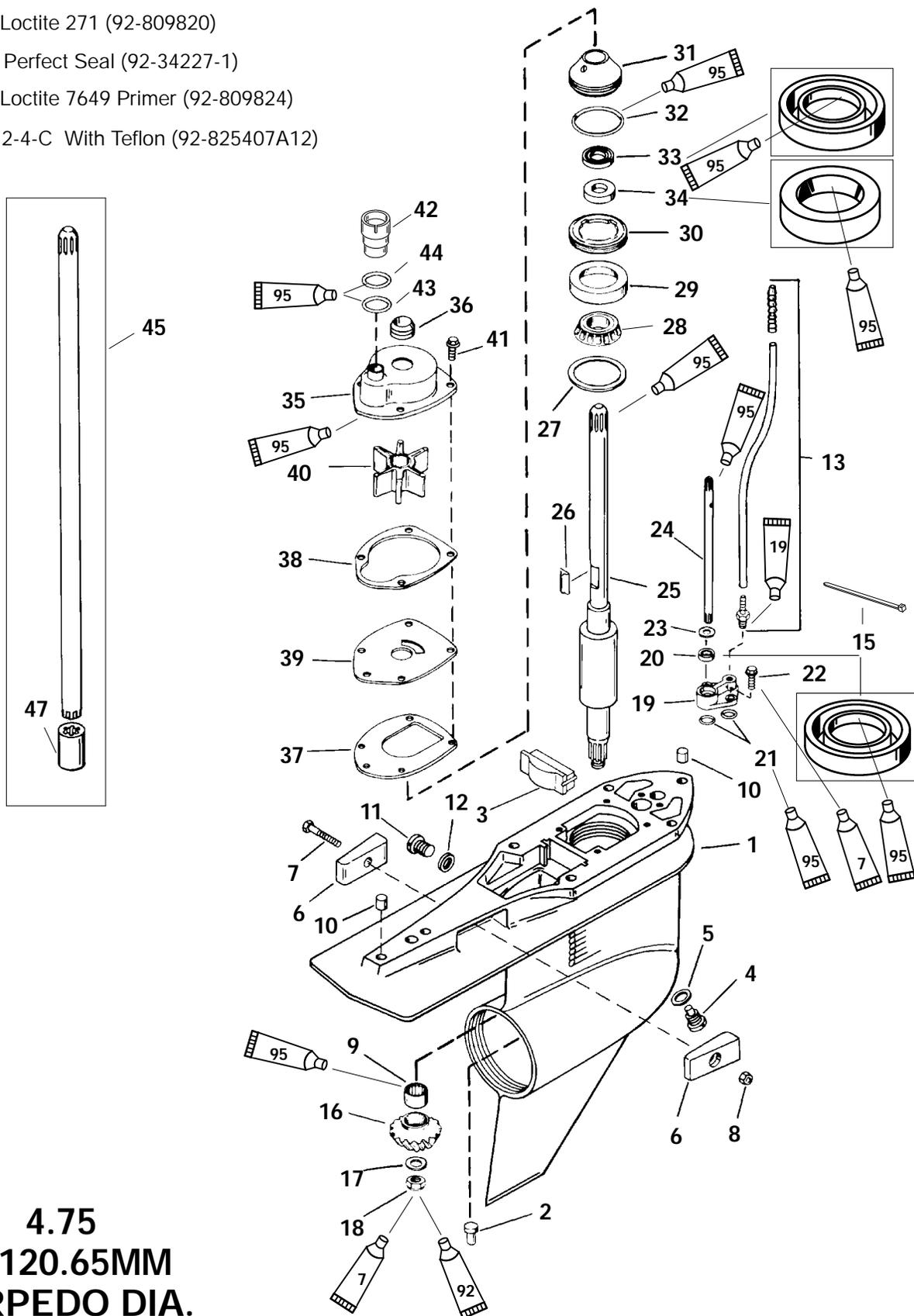
Gear Housing (Prop Shaft) (Standard Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
44	1	SHIFT CRANK			
45	1	SHIFT SPOOL KIT			
46	AR	SHIM			
47	1	TAPERED ROLLER BEARING (USE WITH 1623-822442C2 CASTING)			
	1	TAPERED ROLLER BEARING (USE WITH 1623-822442C3 CASTING)			
48	1	FORWARD GEAR SET (Includes Pinion Gear) (1.75:1 GEAR RATIO)			
	1	FORWARD GEAR (NOTE: THIS COMPLETE GEAR SET IS A 1.62:1 GEAR RATIO REPLACING A 1.64:1 GEAR RATIO)			
49	1	ROLLER BEARING			
50	1	SPRING			
51	1	SLIDING CLUTCH			
52	1	DETENT PIN			
53	1	CROSS PIN			
54	1	PROPELLER SHAFT			
55	1	REVERSE GEAR (1.75:1 GEAR RATIO)			
	1	REVERSE GEAR (1.64:1 GEAR RATIO)			
	1	REVERSE GEAR (1.62:1 GEAR RATIO)(PART OF 43-828072A2)			
56	1	THRUST SPACER			
57	1	THRUST RING			
58	1	BALL BEARING			
59	1	O RING			
60	1	BEARING CARRIER			
61	1	ROLLER BEARING			
62	1	OIL SEAL (INSIDE)			
63	1	OIL SEAL (OUTSIDE)			
64	1	TAB WASHER			
65	1	RETAINER		210	285
67	1	ANODIC PLATE			
	1	TRIM TAB (BLACK ALUMINUM)			
68	1	TRIM TAB (ANODIC) THESE REPLACEMENT PARTS ARE NOT INCLUDED WITH COMPLETE GEAR HOUSING REPLACEMENT			
	1	SCREW		40	54.2
69	1	THRUST HUB			
70	1	LOCKWASHER			
71	1	WASHER			
72	1	TAB WASHER			
73	1	PROPELLER NUT		55	74.6



Gear Housing (Drive Shaft)(Standard Rotation)(Non-Ratcheting) (S/N-0G438000 & UP)(CASTING #1623-822442C3)

-  7 Loctite 271 (92-809820)
-  19 Perfect Seal (92-34227-1)
-  92 Loctite 7649 Primer (92-809824)
-  95 2-4-C With Teflon (92-825407A12)



**4.75
IN/120.65MM
TORPEDO DIA.**



Gear Housing (Drive Shaft)(Standard Rotation)(Non-Ratcheting)(S/N-0G438000 & UP) (Casting #1623-822442C3)

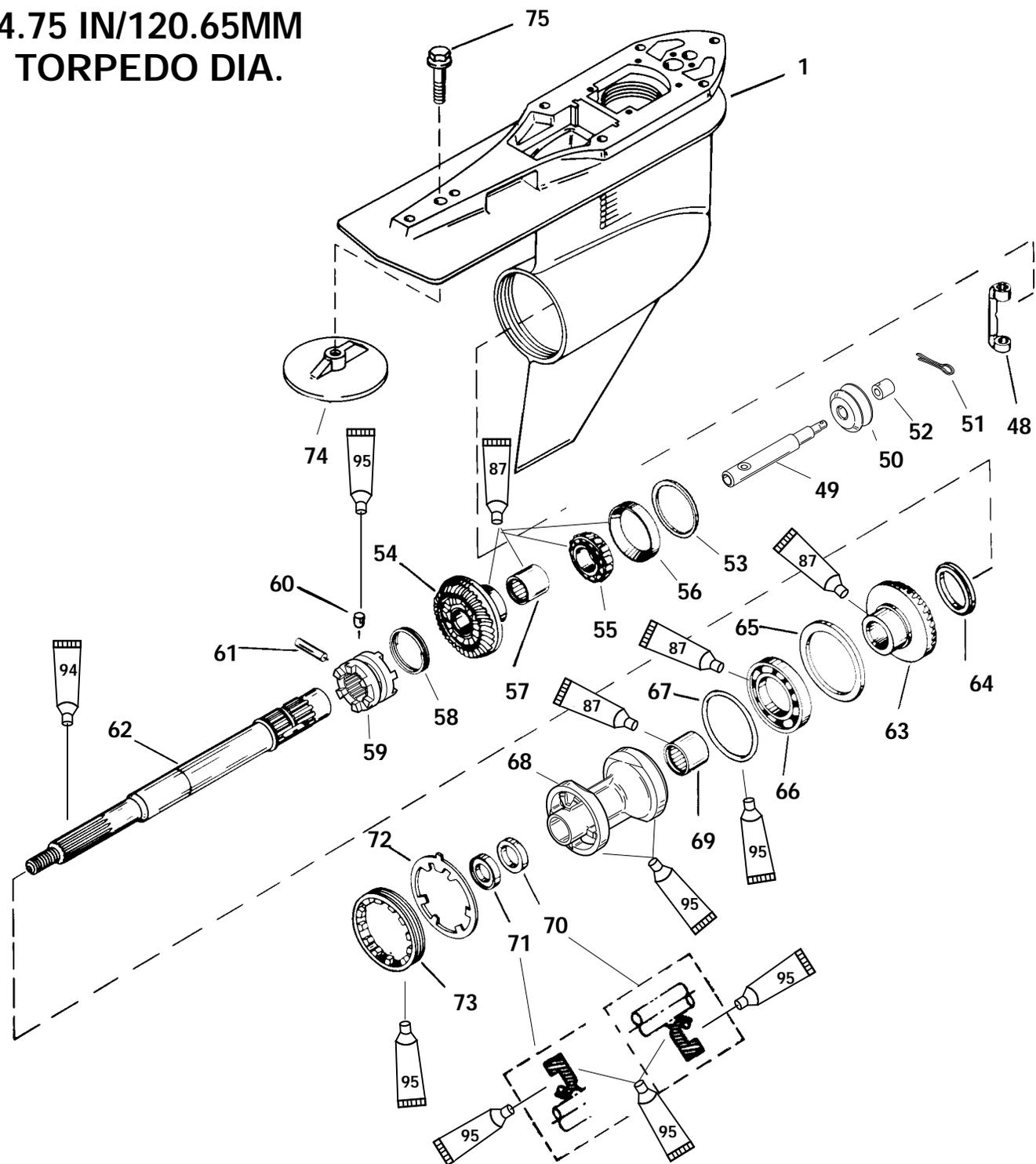
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	GEAR HOUSING (BLACK) BASIC			
1	1	GEAR HOUSING (GRAY)			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW	60		6.8
8	1	NUT			
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW ASSEMBLY	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR (L/XL)			
14	1	CONNECTOR (XXL)			
15	1	CABLE TIE			
16	1	PINION GEAR (Part of 43-828168A2)(1.75:1 - 12/21)			
17	1	WASHER			
18	1	NUT		70	94.9
19	1	BUSHING ASSEMBLY			
20	1	OIL SEAL			
21	2	O RING			
22	2	SCREW (M6 x 16)	60		6.8
23	1	RUBBER WASHER			
24	1	SHIFT SHAFT (LOWER)			
25	1	DRIVE SHAFT (LOWER)			
26	1	KEY			
27	AR	SHIM SET			
28	1	TAPERED ROLLER BEARING			
29	1	CUP			
30	1	RETAINER		100	135
31	1	CARRIER ASSEMBLY			
32	1	O RING			
33	1	OIL SEAL			
34	1	OIL SEAL			
35	1	WATER PUMP ASSEMBLY			
36	1	SEAL			
37	1	GASKET			
38	1	GASKET			
39	1	FACE PLATE			
40	1	IMPELLER			
41	4	SCREW (M6 x 16)	60		6.8
42	1	COUPLING ASSEMBLY			
43	1	O RING			
44	1	O RING			
45	1	DRIVE SHAFT KIT (LONG-20 IN.)			
46	1	DRIVE SHAFT KIT (X-LONG-25 IN.)			
	1	DRIVE SHAFT KIT (XX-LONG-30 IN.)			
47	1	COUPLING			

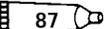
NOTE: Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the drive-shaft and ORDER REF. #'s 24 & 44.

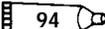


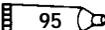
Gear Housing (Prop Shaft)(Standard Rotation)(Non-Ratcheting)(S/N-0438000 & UP) (Casting #1623-822442C3)

4.75 IN/120.65MM
TORPEDO DIA.



 Super Duty Gear Lubricant (92-13783A24)

 Anti-Corrosion Grease (92-78376A6)

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



Gear Housing (Prop Shaft)(Standard Rotation)(Non-Ratcheting)(S/N-0G438000 & UP)(Casting #1623-822442C3)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	GEAR HOUSING (BLACK) BASIC			
	1	GEAR HOUSING (GRAY)			
48	1	SHIFT CRANK			
49	1	SHAFT			
50	1	SHIFT SPOOL			
51	1	COTTER PIN			
52	1	SLEEVE			
53	AR	SHIM SET			
54	1	FORWARD GEAR (1.75:1 - 12/21)			
55	1	TAPERED ROLLER BEARING			
56	1	CUP			
57	1	ROLLER BEARING			
58	1	SPRING			
59	1	SLIDING CLUTCH			
60	1	DETENT PIN			
61	1	CROSS PIN			
62	1	PROPELLER SHAFT			
63	1	REVERSE GEAR (1.75:1 - 12/21)			
64	1	THRUST SPACER			
65	1	THRUST RING			
66	1	BALL BEARING			
67	1	O RING			
68	1	BEARING CARRIER			
69	1	ROLLER BEARING			
70	1	OIL SEAL (INSIDE)			
71	1	OIL SEAL (OUTSIDE)			
72	1	TAB WASHER			
73	1	COVER		210	285
74	1	ANODIC PLATE			
75	1	SCREW		40	54.2



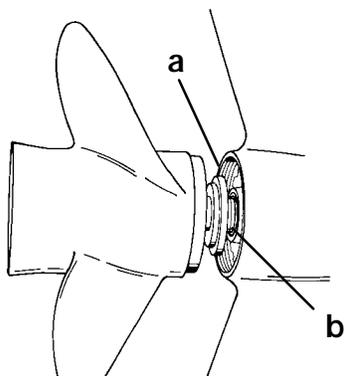
Removal, Disassembly, Cleaning and Inspection - Standard Rotation (Ratcheting and Non-Ratcheting)

REMOVAL

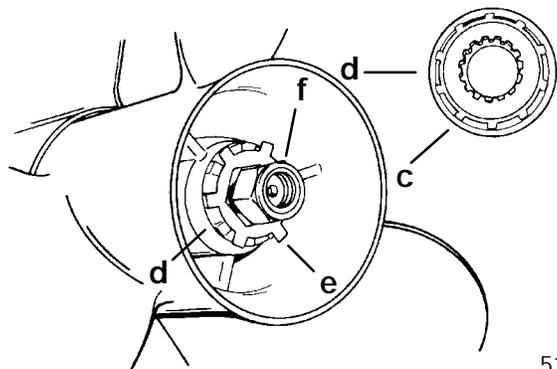
⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from drive shaft housing.

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



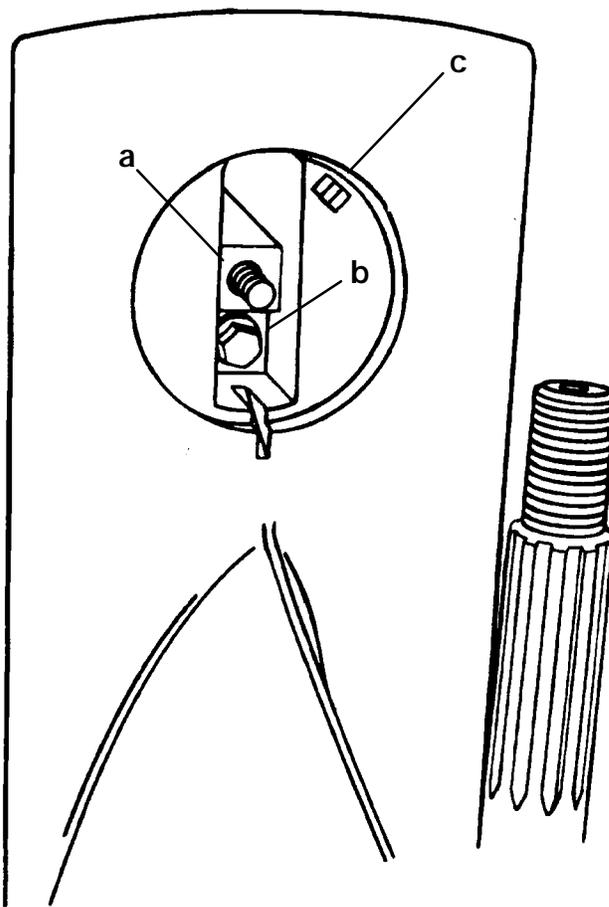
51866



51871

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

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of drive shaft housing. While holding trim tab securely, unthread bolt that secures trim tab and remove trim tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.

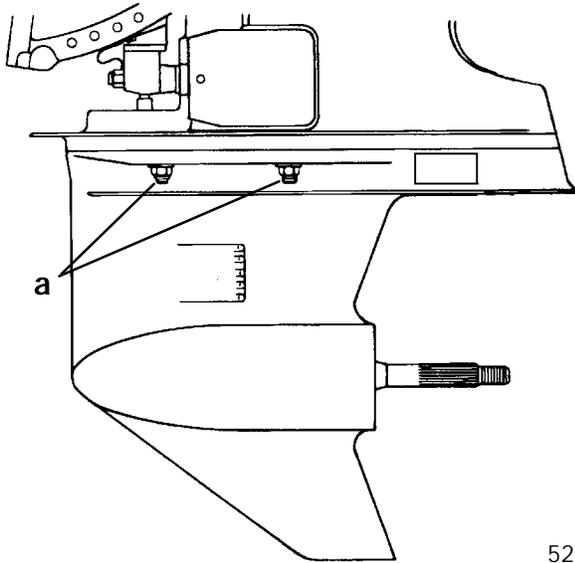


52375

- a - Bolt (Secures Trim Tab)
 - b - Bolt (Inside Trim Tab Cavity)
 - c - Ribs - Align Carefully with Trim Tab while Securing Tab
7. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or drive shaft housing could be damaged.)
 8. Pull gear housing away from drive shaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)



9. Pull gear housing from drive shaft housing.

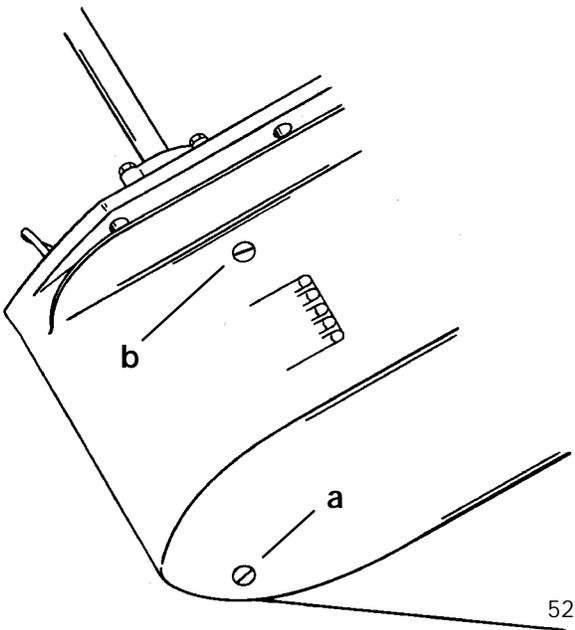


52374

a - Side Mounting Locknut (2 Each Side)

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the drive shaft in a vertical position.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing. Do not loose sealing washers on Fill and Vent screws.



52377

a - "Fill" Screw
b - "Vent" Screw

3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. Check drain pan for water separation from lubricant. Presence of water in gear lubricant indicates the need for disassembly, and inspection of oil seals, seal surfaces, O-rings and gear housing components.

NOTE: Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.

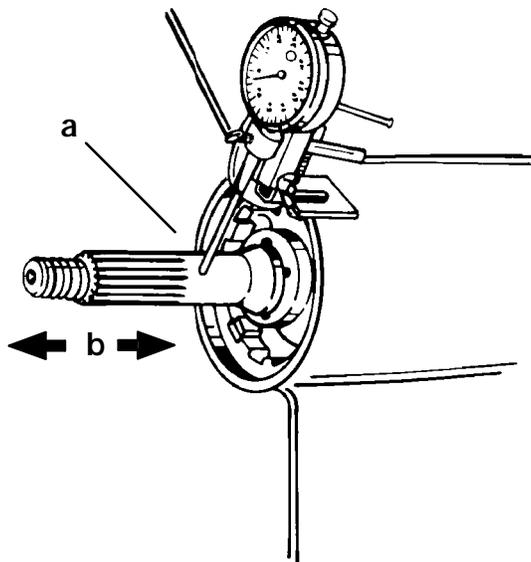


Pre-Disassembly Inspection

Propeller Shaft

INSPECTION

1. Inspect the propeller shaft for side to side movement, as follows:
 - a. Position the dial indicator on the propeller shaft.
 - b. Push the propeller shaft to one side and zero the dial indicator.
 - c. Move the propeller shaft to the opposite side while observing the dial indicator. Without rotating the propeller shaft, reposition the dial indicator and check the up and down deflection. A shaft deflection of more than 0.003 in. (0.08 mm) indicates a worn propeller shaft bearing.
2. Check for a bent propeller shaft as follows:
 - a. Rotate the propeller shaft while observing the dial indicator. If the deflection is more than 0.010 in. (0.25mm), a bent propeller shaft is indicated.
3. Measure propeller shaft end play. If it is in excess of 0.045 in. (1.14mm), disassemble gear case and check condition of the reverse shoulder of the propeller shaft, reverse gear and thrust washer. Replace components as required.



22086

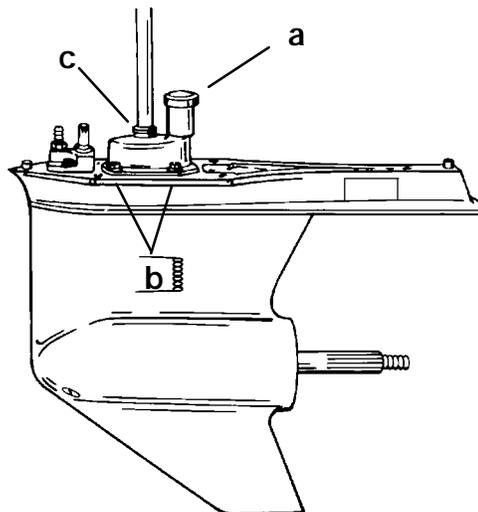
- a - Prop Shaft Runout
- b - Prop Shaft End play

Gear Housing and Component Disassembly

Water Pump Assembly

REMOVAL

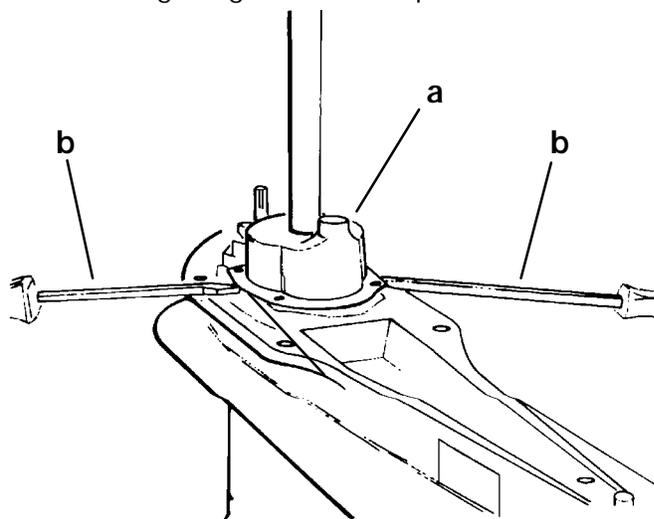
1. Remove the water seal, water tube coupling assembly, and the water pump screws.



52749

- a - Water Tube Assembly
- b - Water Pump Screws (4)
- c - Seal

2. Carefully slide the water pump straight up off of the drive shaft. It may be necessary to encourage the water pump up by gently prying up on its mounting flanges with a couple of screwdrivers.

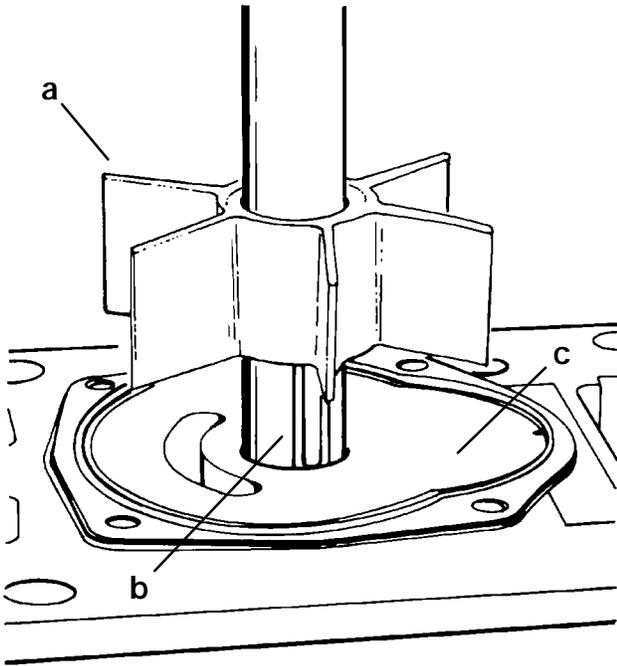


70487

- a - Water Pump Body
- b - Screw Drivers



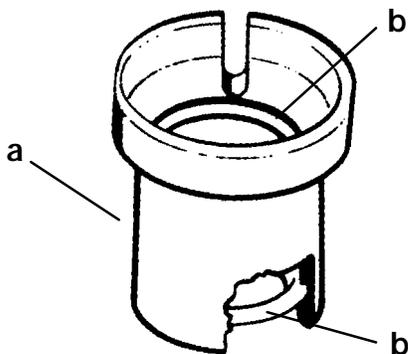
- Remove the impeller, impeller key, the face plate and gaskets, (discard the gaskets).



- a - Impeller
- b - Impeller Key
- c - Water Pump Face Plate and Gaskets
(One on each side of the face plate)

WATER PUMP ASSEMBLY - Component Inspection

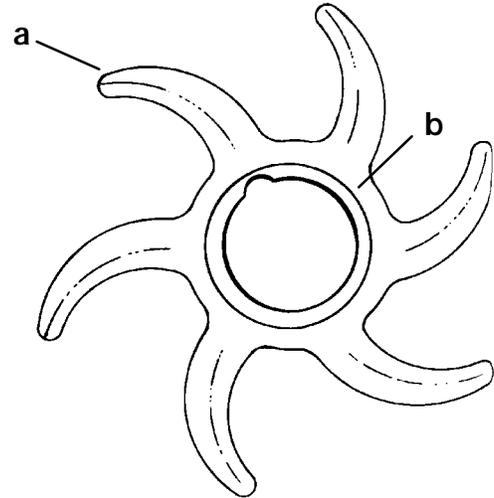
- Inspect the water tube coupling assembly for wear or damage. If necessary replace the worn or damaged components especially the two O-rings on the inside, one at the top and one at the bottom.



- a - Water Tube adapter
- b - O-rings (2)

- Inspect the water pump impeller for wear on the end, top and bottom of the impeller blades. Replace the impeller if this condition is found.

- Inspect for proper bonding between the hub and the impeller. Replace the impeller if improper bonding is found.

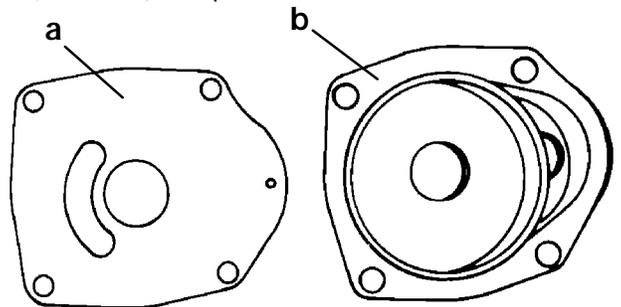


- a - Impeller
- b - Hub

- Inspect the impeller blades to see if they are cracked, burnt, hard or deformed. Replace the impeller if the blades are in this condition.

IMPORTANT: The circular groove formed by the impeller sealing bead should be disregarded when inspecting cover and plate. The depth of the groove will not affect water pump output.

- Replace cover if thickness of steel at the discharge slot is 0.060 in. (1.5mm) or less or if grooves (other than impeller sealing bead groove) in cover roof are more than 0.030 in. (0.76mm) deep.



- a - Water Pump Face Plate
- b - Water Pump Cover

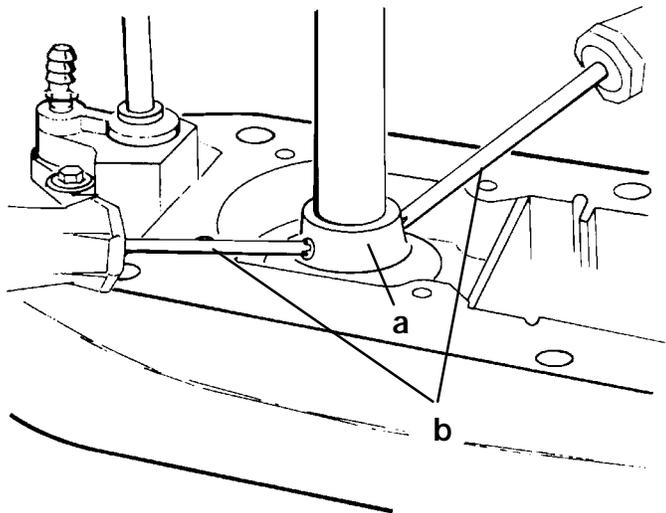
- Inspect the water pump face plate and the water pump interior for roughness and/or grooves. Replace the appropriate components if any are found.



Oil Seal Carrier Assembly

REMOVAL

1. Remove the oil seal carrier from the gear housing. It may be necessary to gently pry up on it with two screwdrivers.



70489

- a - Oil Seal Carrier
- b - Screwdrivers

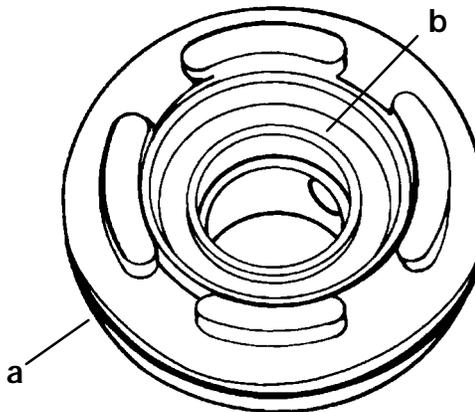
OIL SEAL CARRIER ASSEMBLY - Inspection

1. Inspect the oil seal carrier, O-ring, and seals for wear and/or damage. If necessary replace defective parts as outlined following.

OIL SEAL CARRIER ASSEMBLY - Component Disassembly

NOTE: Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.

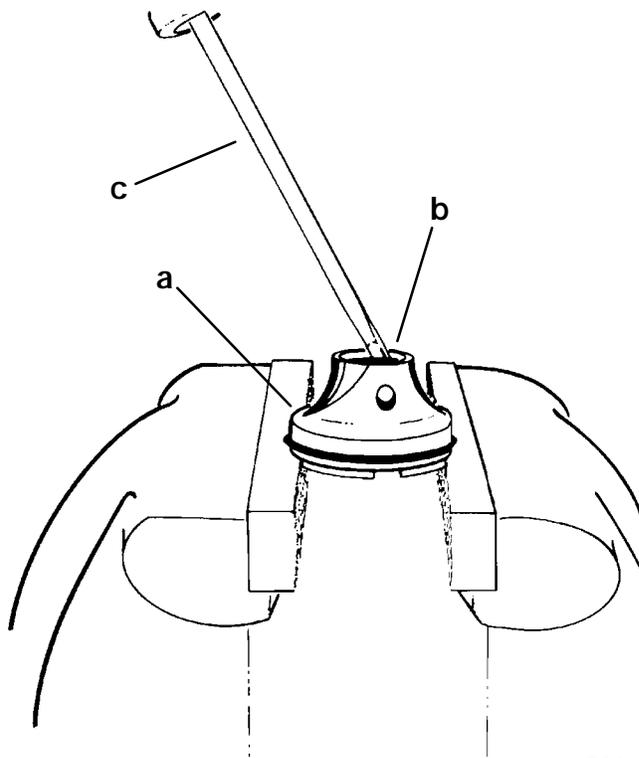
1. Remove the O-ring.



70501

- a - O-ring
- b - Oil Seals (2)

2. Remove the oil seals.



70610

- a - Oil Seal Carrier
- b - Oil Seals
- c - Screwdriver



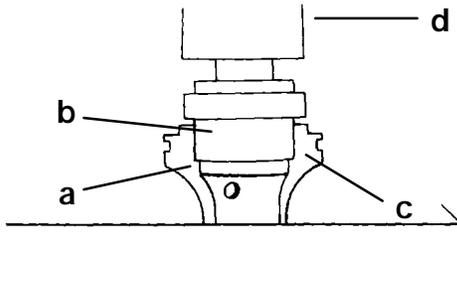
OIL SEAL CARRIER ASSEMBLY - Component Reassembly (1994/1995 MODELS)

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.



70501

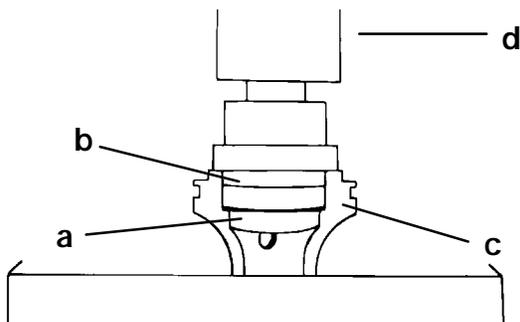
1. Assemble the small oil seal (with the lips of the oil seal facing away from the driver shoulder) onto the long end of the oil seal driver.
2. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



70611

- a - Oil Seal
- b - Oil Seal Driver (91-817569) use long end
- c - Oil Seal Carrier
- d - Press

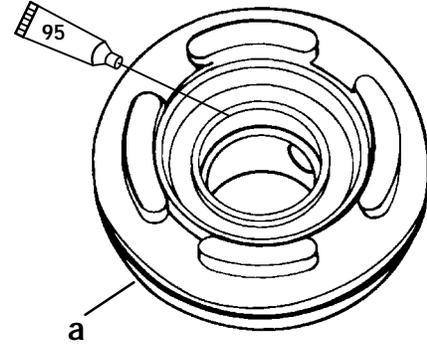
3. Assemble the large oil seal (with the lips of the oil seal facing the driver shoulder) onto the short end of the oil seal driver.
4. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



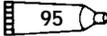
70612

- a - Oil Seal
- b - Oil Seal Driver (91-817569) use short end
- c - Oil Seal Carrier
- d - Press

5. Fill the area between the seal lips with 2-4-C w/Teflon. Apply 2-4-C w/Teflon to the O-ring.
6. Install the O-ring onto the oil seal carrier.



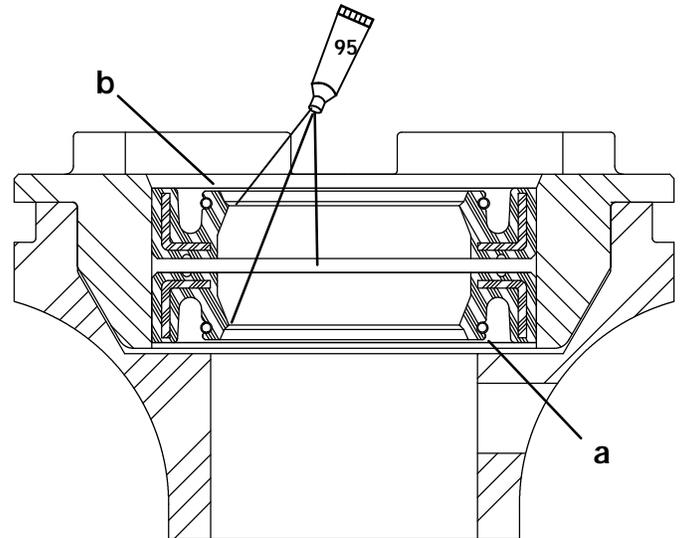
70501

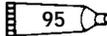
 2-4-C With Teflon (92-825407A12)

a - O-ring

OIL SEAL CARRIER ASSEMBLY - Component Reassembly (96/97/98 MODELS)

The oil seals in 1996/1997 carrier assemblies are the same diameter. The bottom (first) seal lip faces down; the top (second) seal lip faces up. Apply 2-4-C Marine Lubricant to seal lips and between seals. Press seal into carrier with suitable mandrel. Second seal should be pressed in flush with carrier surface.



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

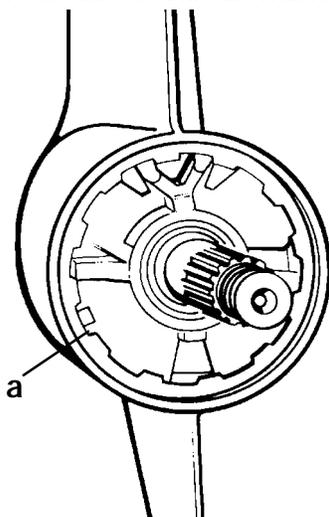
- a - Bottom Seal (Lip Faces Down)
- b - Top Seal (Lip Faces Up)



Bearing Carrier Assembly

REMOVAL

1. Straighten the tab on the tab washer.



70490

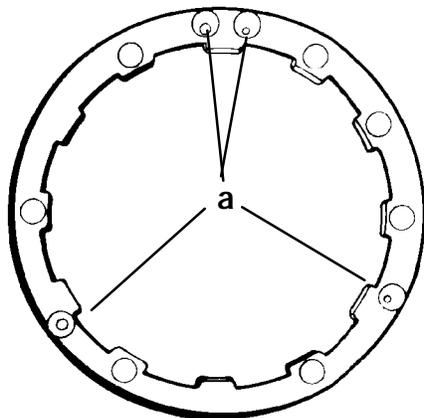
a - Tab on Tab Washer

2. Remove the bearing carrier retainer following step a or b as follows:

CAUTION

DO NOT drill into the gear housing retainer threads when using the following procedure for removing the retainer.

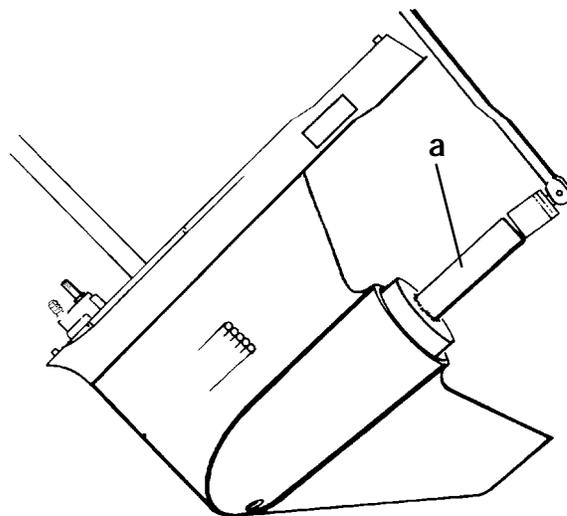
- a. If the retainer is corroded in place, drill 4 holes in the retainer and fracture the retainer with a chisel. Pry the remaining segments out.



23356

a - Drilled Holes

- b. Remove the bearing carrier retainer using the Bearing Carrier Retainer Wrench (91-61069).

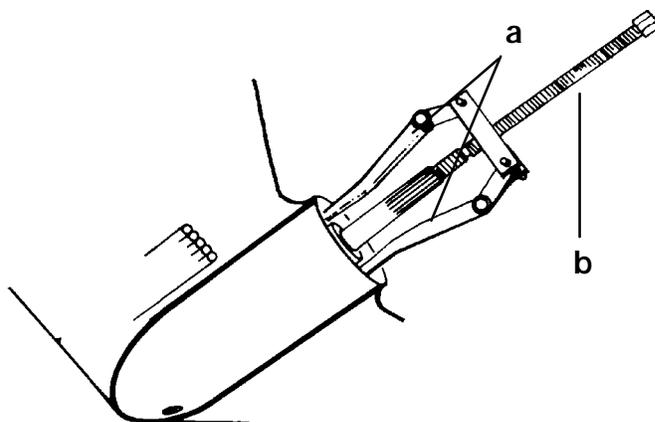


491

a - Bearing Carrier Retainer Wrench

3. Pull the bearing carrier from the gear housing by pulling on the outer ring of the bearing carrier. POSITION PULLER JAWS CLOSE TO BOSSES IN CARRIER.

NOTE: If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.



10772

a - Puller Jaws (91-46086A1)
 b - Puller Bolt (91-85716)

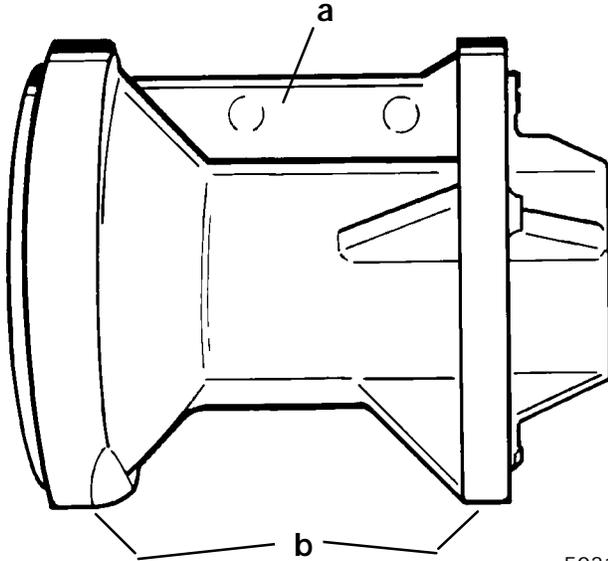


BEARING CARRIER ASSEMBLY - Inspection

1. Clean the assembly with a suitable solvent and dry the parts thoroughly using compressed air.

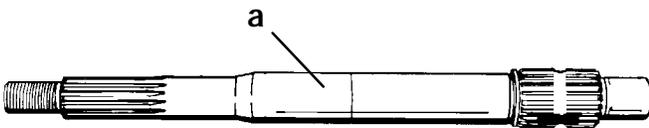
NOTE: If any of the following items are found to be defective complete the appropriate instruction(s) in "Bearing Carrier Assembly", 'Component Disassembly and Inspection' section found on page 6A-22.

2. Inspect the bearing carrier for signs of excessive corrosion especially in the area where the bearing carrier touches the gear housing. If excessive corrosion is evident replace the carrier.



- a - Bearing Carrier
- b - Mating Surfaces

3. The condition of the bearing surface on the propeller shaft in the area that the needle bearing (in the bearing carrier) rides is an indication of the condition of the needle bearing in the bearing carrier. Replace the bearing if the surface of the shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.

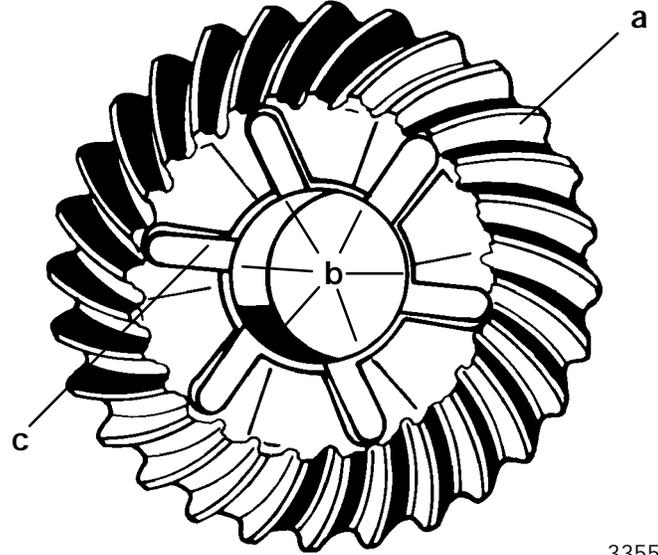


- a - Propeller Shaft Bearing Contact Area

4. Inspect the reverse gear for pitted, chipped, broken teeth, hairline fractures, and excessive or uneven wear. Replace the gear if any defects are found.

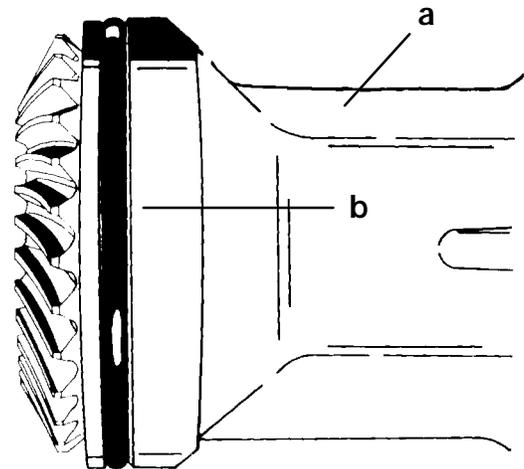
NOTE: If outboard jumps out of gear, inspect not only clutch dog teeth on reverse gear but also thrust washer surface on reverse gear for excessive wear. Replace gear if wear is evident.

5. Inspect the clutch jaws of the gear for damage. Surfaces must not be chipped or rounded off. Replace the gear if any are found.



- a - Reverse Gear Teeth
- b - Thrust Washer Surface
- c - Clutch Jaws

6. Inspect the reverse gear bearing for excessive movement or roughness by rotating gear. Replace the bearing if either of these conditions exists.
7. Inspect the bearing carrier retainer for cracks and/or broken or corroded threads. Replace carrier if any are found.
8. Remove the O-ring from the bearing carrier assembly.



- a - Bearing Carrier
- b - O-ring

- a. Inspect the O-ring for damage and/or deterioration. Replace it if necessary.



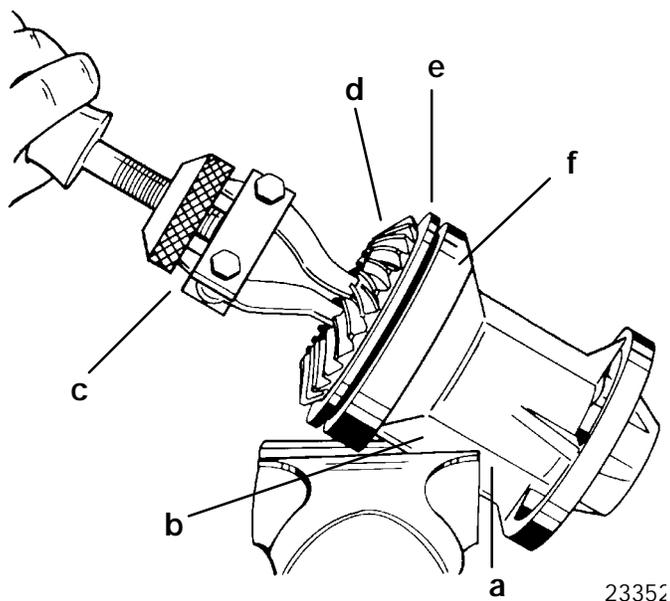
BEARING CARRIER ASSEMBLY - Component Disassembly and Inspection

NOTE: Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.

⚠ CAUTION

Clamp onto the reinforcing rib of the bearing carrier **ONLY**, or damage to the carrier may result.

1. Place the bearing carrier in a vise, clamping on the reinforcing rib.
2. Remove the reverse gear, thrust ring, and bearing as an assembly, using a slide hammer puller.



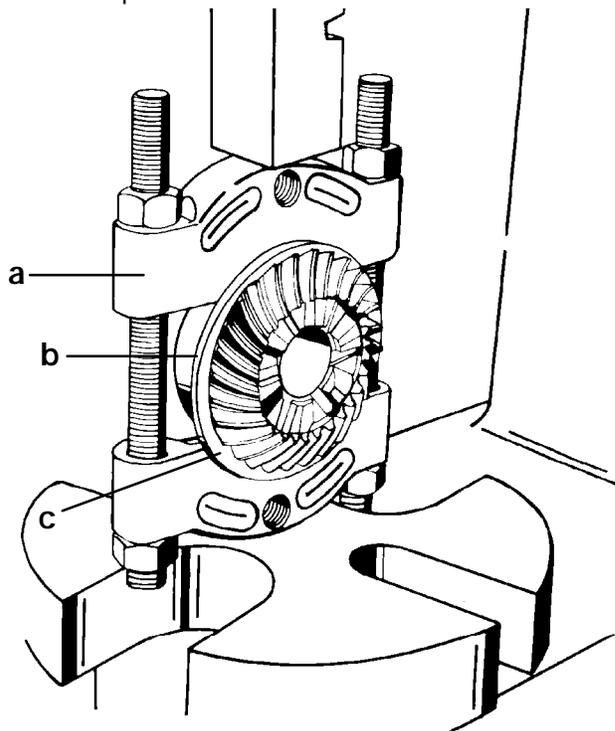
23352

- a - Bearing Carrier Reinforcing Rib
- b - Bearing Carrier
- c - Slide Hammer Puller (91-34569A1)
- d - Reverse Gear
- e - Thrust Hub
- f - Bearing (not seen) - Located in the Carrier

3. Clean all components thoroughly with a suitable solvent and inspect them for damage and/or excessive wear. Replace any parts that are found to be defective.

IMPORTANT: The bearing **MUST BE** replaced if removed from gear.

4. Place the universal puller plate between the thrust washer and bearing as shown and press on the plate until it bottoms.

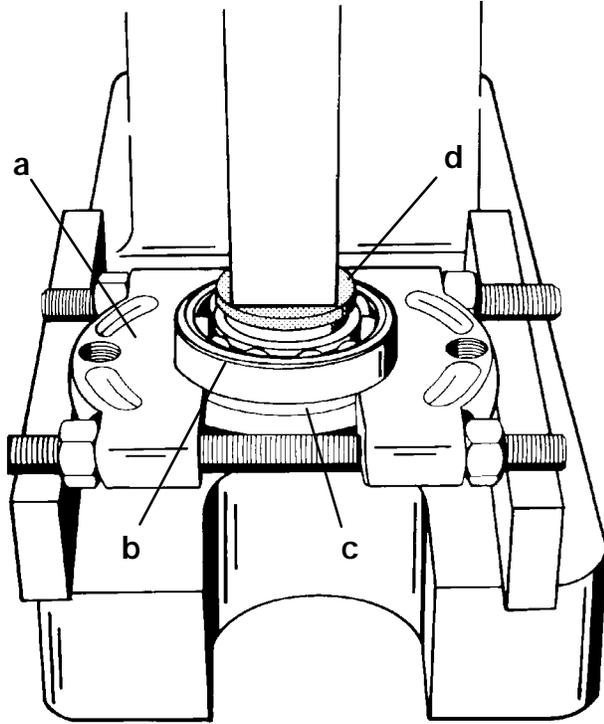


51

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



5. Using a suitable mandrel and the universal puller plate to support the bearing, press the bearing from the reverse gear as shown.



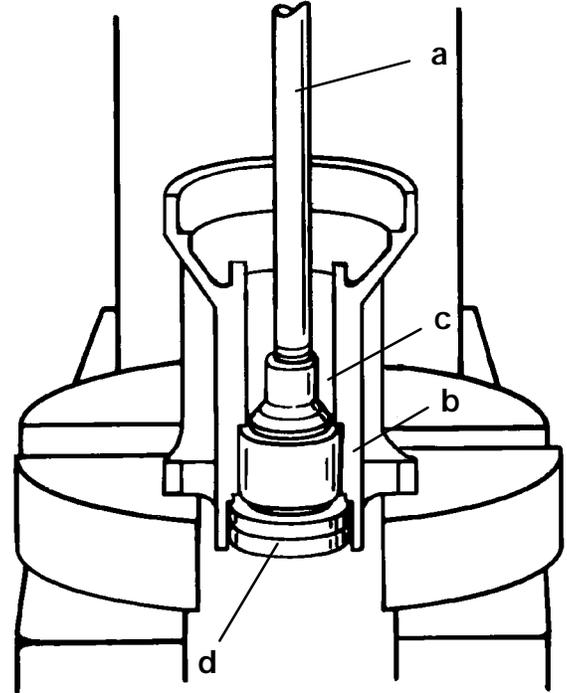
23351

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

- a. **Discard the bearing.**
- b. Inspect the gear, and thrust washer for excessive wear, cracks, or damage. Replace the appropriate components if any of these conditions are found.

NOTE: Inspection of the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing rolls, gives an indication of the condition of the needle bearing inside the bearing carrier. Replace needle bearing in the bearing carrier if the prop shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.

6. Perform the following step a. or b. as necessary.
- a. **If Replacing the Needle Bearing and Seals:** Remove the needle bearing and seals with the tools as shown.



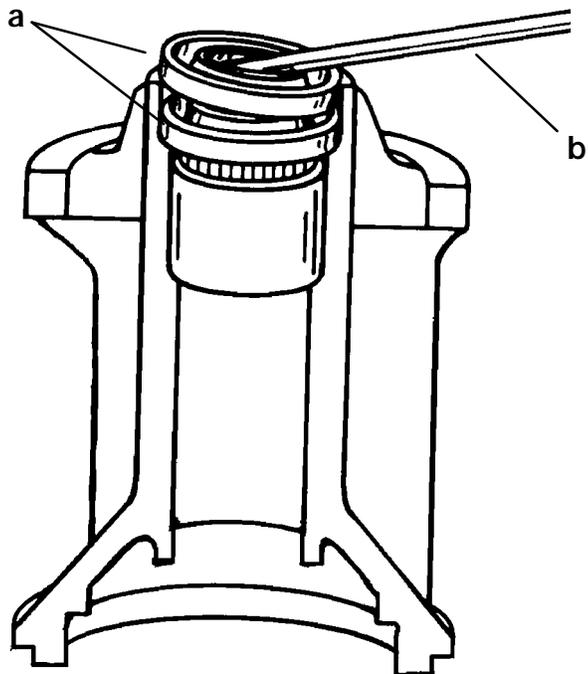
140

- a - Bearing Driver Rod (91-37323)
- b - Needle Bearing
- c - Driver Head (91-36569)
- d - Oil Seals

- (1.) **Discard the needle bearing and both seals.**



- b. **If Replacing the Seal Only:** Remove the oil seals with a suitable pry bar, being careful not to damage the bore of the bearing carrier.



23140

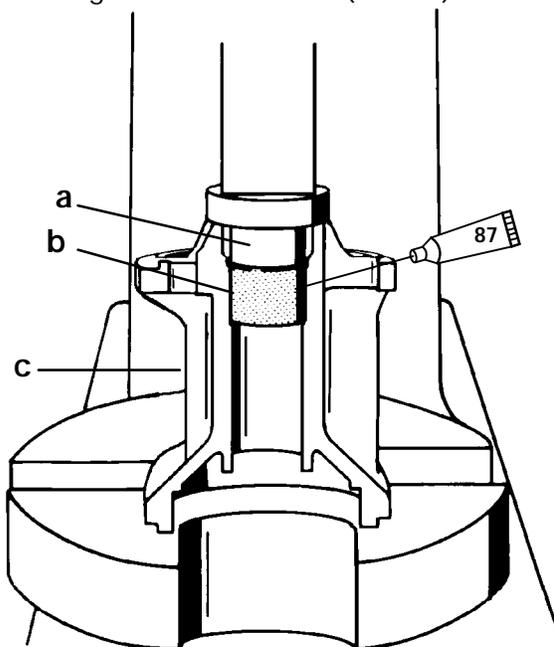
- a - Oil Seals
b - Pry Bar

(1.) **Discard both of the seals.**

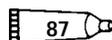
BEARING CARRIER ASSEMBLY Component reassembly

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

1. Clean all of the components with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin the bearing.
2. Lubricate the bore that the needle bearing is pressed into with Quicksilver Gear Lubricant (92-13783A24).
3. Assemble the needle bearing (with the numbered end of the bearing towards the driver shoulder), onto the driver.
4. Press the needle bearing into the bearing carrier until the driver bottoms out on the bearing carrier. Ensure that the numbered side of the needle bearing faces the seal end (aft end) of the carrier.



50315

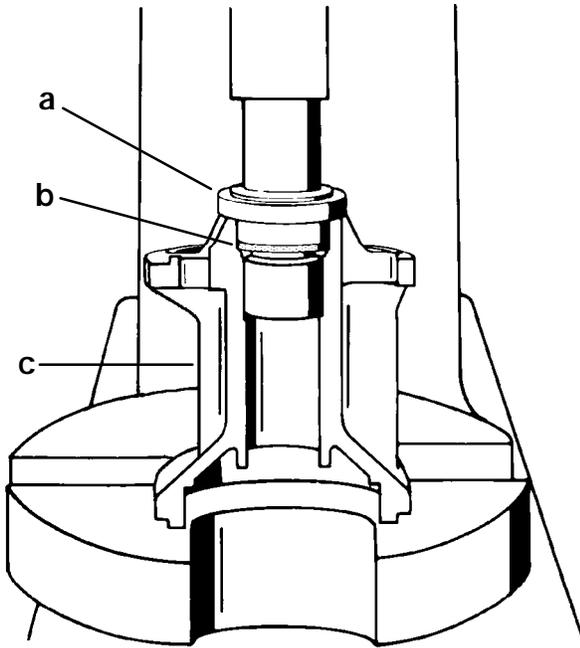
 Quicksilver Gear Lubricant (92-19007A24)

- a - Needle Bearing Driver (P/N 91-15755)
b - Needle Bearing
c - Bearing Carrier

5. **Thoroughly clean** the bore in which the first seal is to be pressed.
6. Assemble the first seal (with the lips of the seal facing away from the driver shoulder) onto the long end of the oil seal driver.



7. Press on the oil seal driver until the driver bottoms onto the aft face of the bearing carrier.

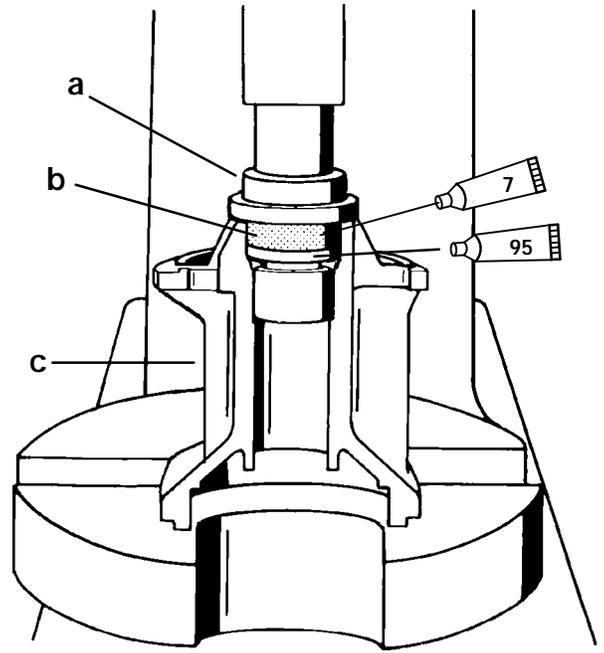


50315

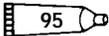
- a - Oil Seal Driver (91-31108)
- b - Oil Seal
- c - Bearing Carrier

8. Apply a thin film of Loctite 271 (92-809820) to the outer diameter of the second seal.
9. Assemble the second seal (with the lips of the seal facing the driver shoulder) onto the short end of the driver.

10. Press the oil seal with the driver until the driver bottoms out on the bearing carrier.



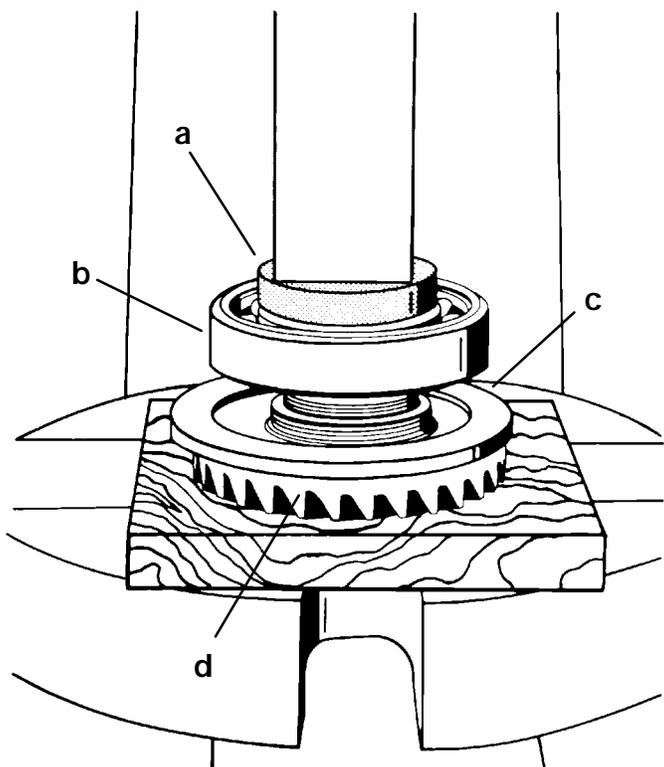
50315

-  Loctite 271 (92-809820)
-  2-4-C With Teflon (92-825407A12)

- a - Driver (short end)
 - b - Oil Seal (lips toward driver shoulder)
 - c - Bearing Carrier
11. Wipe up all of the excess Loctite. Do not allow any of the excess Loctite to spread to other parts of the assembly.
 12. Lubricate the seal lips and fill the area between the seals with 2-4-C w/Teflon (92-825407A12).



13. Install the thrust washer and **a new ball bearing** onto the reverse gear. Press on the inner race of the ball bearing using the pilot washer until the bearing bottoms out on the gear.

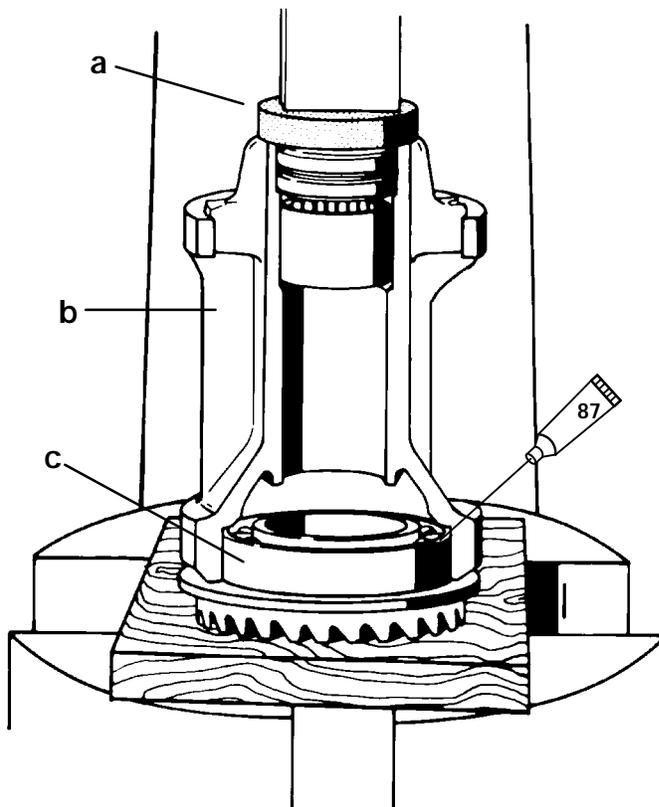


23346

- a - Pilot Washer (P/N 91-36571)
- b - Ball Bearing
- c - Thrust Hub
- d - Reverse Gear

14. Lubricate the bore that the bearing is pressed into with Quicksilver Gear Lubricant (92-13783A24).

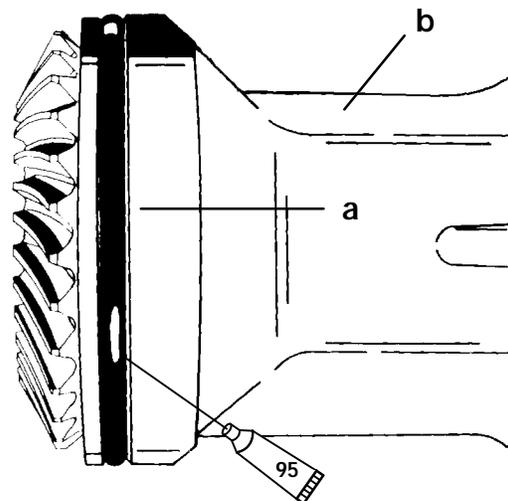
15. Press the bearing carrier onto the reverse gear and bearing until the bearing bottoms out in bearing carrier, using the pilot washer to press against the carrier.



Quicksilver Gear Lubricant (92-19007A24)

- a - Pilot Washer (91-36571)
- b - Bearing Carrier
- c - Reverse Gear and Bearing Assembly

16. Lubricate the O-ring with 2-4-C w/Teflon and install the O-ring onto the bearing carrier.



23354

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

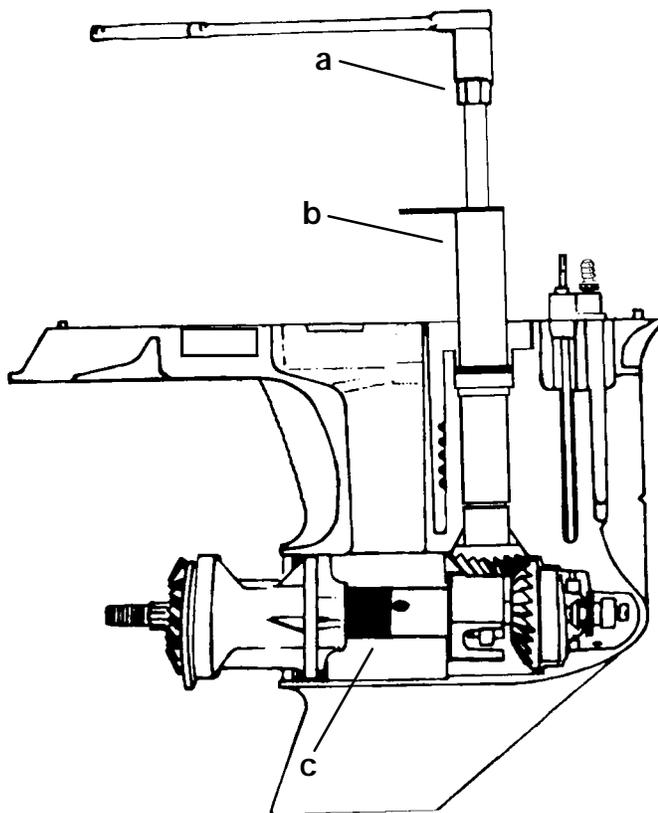
- a - O-ring
- b - Bearing Carrier



Drive Shaft Assembly

REMOVAL

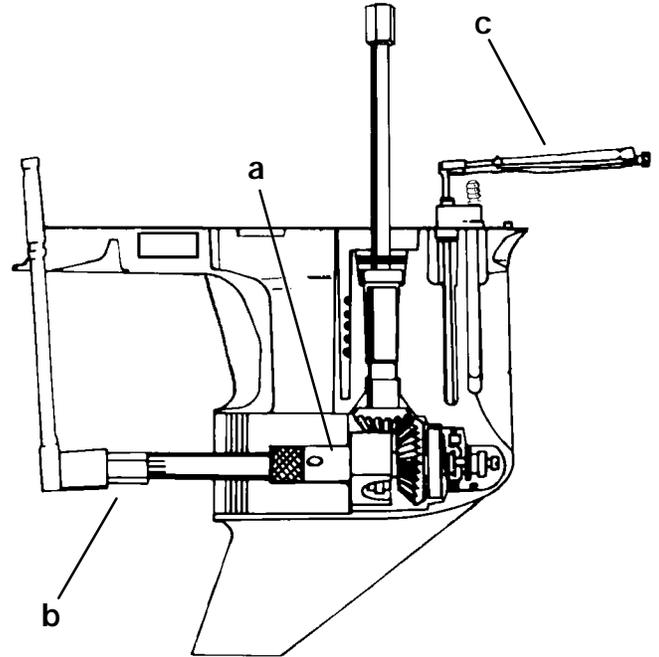
1. Remove the drive shaft pinion nut as follows:
 - a. Place the drive shaft nut wrench onto the drive shaft. Do not loosen the retainer at this time.
 - b. Insert the pinion nut adapter with the MR slot facing the pinion gear into the gear housing. It may be necessary to slightly lift and rotate the drive shaft to align the pinion gear nut into the pinion nut adapter slot.
 - c. Install the bearing carrier into the gear housing backwards to support the prop shaft and to keep the pinion nut adapter aligned.
 - d. Place the drive shaft nut wrench over the drive shaft splines and **loosen**, (but do not fully unscrew), the pinion nut by rotating the drive shaft counterclockwise.



- a - Drive Shaft Nut Wrench (91-56775)
- b - Drive Shaft Bearing Retainer Wrench (91-43506)
- c - Pinion Nut adapter (MR Slot) (91-61067A2)

- e. **If the drive shaft is broken**, place propeller shaft nut wrench onto the propeller shaft splines, hold shift shaft in forward gear and **loosen**, (but do not fully unscrew), the pinion nut by rotating prop shaft counterclockwise to turn gears, thus loosening the pinion nut.

NOTE: The propeller shaft nut wrench is included with the pinion nut adapter kit.

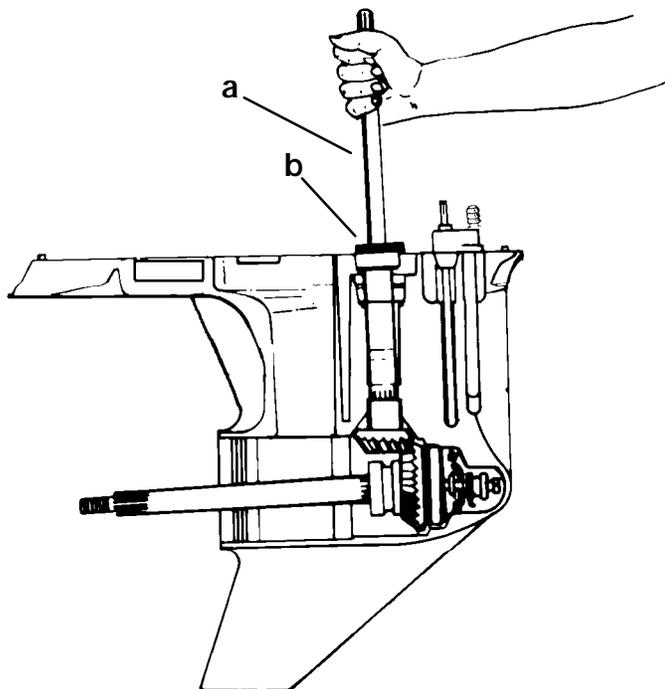


- a - Pinion Nut adapter (91-61067A2)
 - b - Propeller Shaft Nut Wrench (91-61077)
 - c - Shift Shaft (Turn Clockwise) (Protect shaft splines w/soft material)
- f. Completely unscrew the drive shaft bearing retainer.
 - g. Completely unscrew the pinion nut by rotating the drive shaft (or the propeller shaft) in a counterclockwise direction.
 - h. Remove all tools.



IMPORTANT: The pinion bearing rollers are free to fall out of the pinion bearing once the drive shaft is removed. Be careful not to loose the (18) rollers.

2. Remove the drive shaft and all components by pulling the drive shaft straight out of the gear housing as shown.



- a - Drive Shaft
- b - Drive Shaft Retainer, Bearing Cup, Bearing, and Shims

3. Move the prop shaft downward and to the PORT side of the gear case.
4. Retrieve the pinion gear, the washer and the nut from the inside of the gear housing.

DRIVE SHAFT ASSEMBLY - Inspection

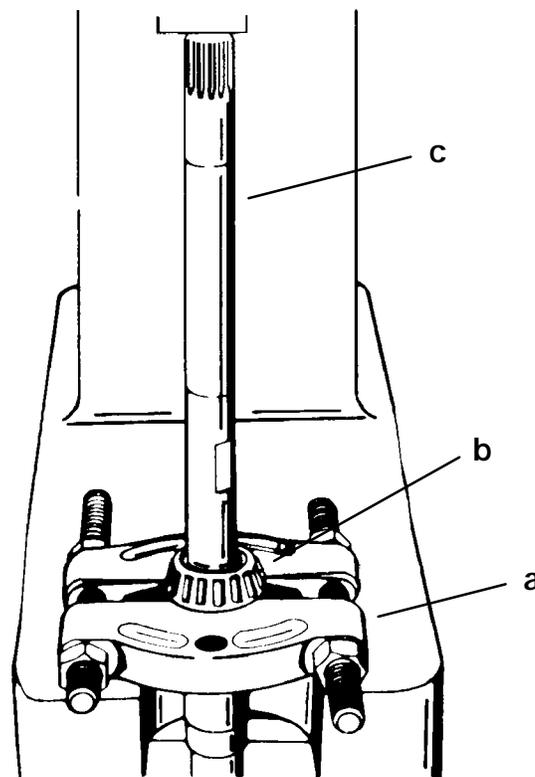
1. Clean all parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin the bearings.
2. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on the drive shaft. Replace the bearing and bearing cup if the cup is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
3. Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. Replace the drive shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.

4. Inspect the splines at both ends of the drive shaft for a worn or twisted condition. Replace the drive shaft if either condition exists.
5. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the pinion gear and the forward gear as a set** if any defects are found.

DRIVE SHAFT ASSEMBLY - Component Disassembly

NOTE: Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.

1. Press the tapered roller bearing from the drive shaft using the universal puller plate to support the **inner race** of the bearing while removing it.



70699

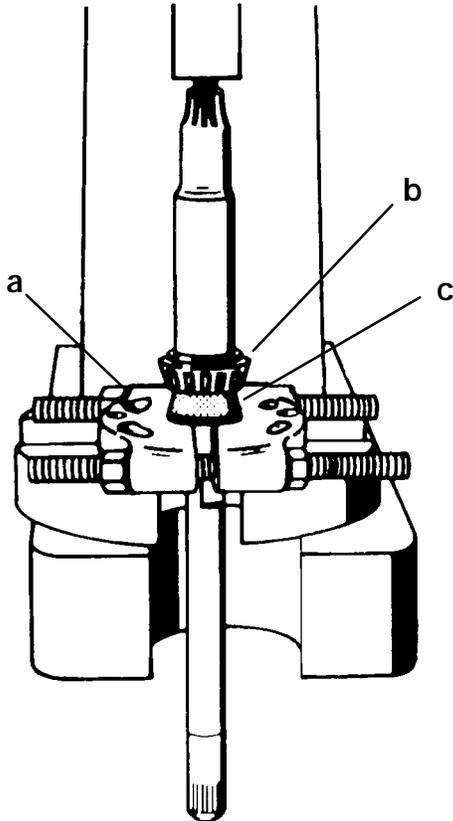
- a - Universal Puller Plate (91-37241)
- b - Tapered Roller Bearing
- c - Drive Shaft



DRIVE SHAFT ASSEMBLY - Component Reassembly

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

1. Assemble a new tapered roller bearing to the drive shaft with the large O.D. of the bearing facing the pinion gear end of the drive shaft.
2. Press the tapered roller bearing onto the drive shaft using the universal puller plate and a suitable mandrel, (an old tapered roller bearing inner race).



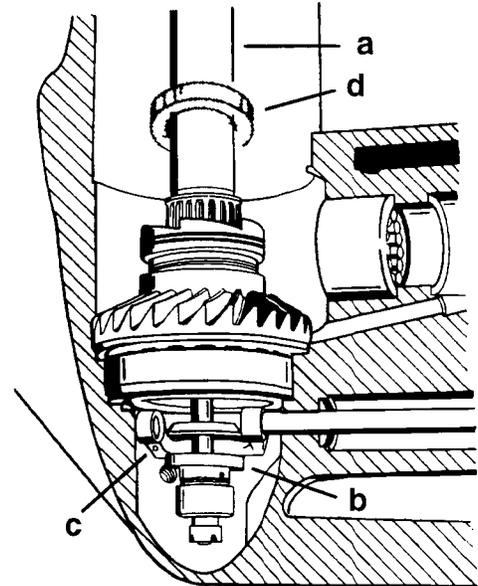
70700

- a - Universal Puller Plate (91-37241)
- b - Tapered Roller Bearing
- c - Suitable Mandrel (Inner Race of Old Bearing)

Propeller Shaft Assembly and Forward Gear Bearing Cup

REMOVAL

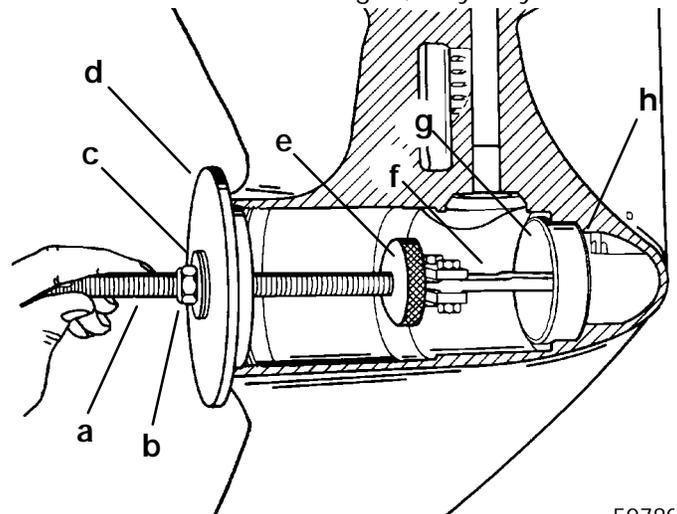
1. Tilt the propeller shaft to the port side of the gear housing and remove the shaft by pulling it straight up and out.



23348

- a - Propeller Shaft Assembly
- b - Shift Spool
- c - Shift Crank
- d - Thrust Washer (Reverse Gear)

2. Remove the forward gear bearing cup and shims. Measure and make note of the shim thickness. If the shims are not damaged, they may be reused.



5078C

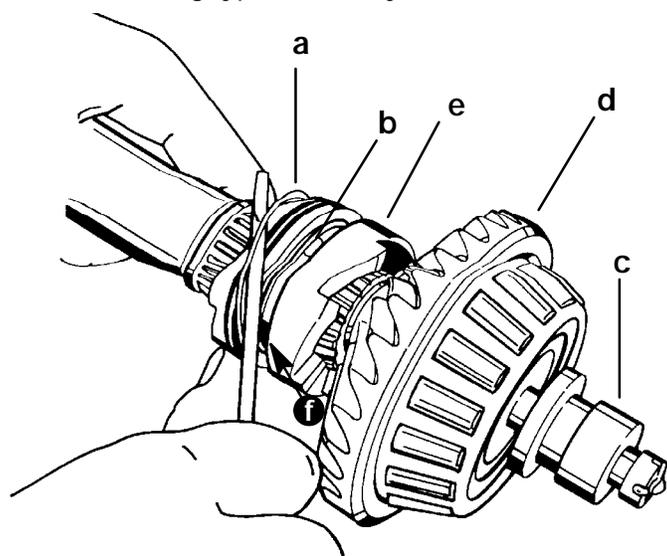
- a - Puller Shaft (91-31229)
- b - Nut (11-24156)
- c - Washer (91-34961)
- d - Guide Plate (91-816243)
- e - Puller Head (from Slide Hammer Puller Kit 91-34569A1)
- f - Jaws (from Slide Hammer Puller Kit)
- g - Bearing Cup
- h - Shims



PROPELLER SHAFT ASSEMBLY - Component Disassembly

NOTE: When accomplishing the next step, all of the parts are free to come apart. Work closely over a work bench to ensure that the parts are not dropped or damaged and to avoid personal injury.

1. Remove the spring around the clutch being careful not to over-stretch it during removal. If the spring does not coil back to its normal position once it has been removed, it must be replaced.
2. Remove detent pin.
3. Remove the cross pin that goes through the clutch.
4. Remove the remainder of the components (Ratcheting type assembly shown).

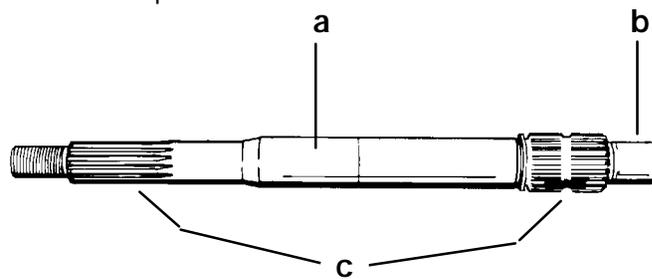


23350

- a - Spring
- b - Cross Pin
- c - Shift Spool Assembly
- d - Forward Gear Assembly
- e - Sliding Clutch
- f - Detent Pin

PROPELLER SHAFT ASSEMBLY - Component Inspection

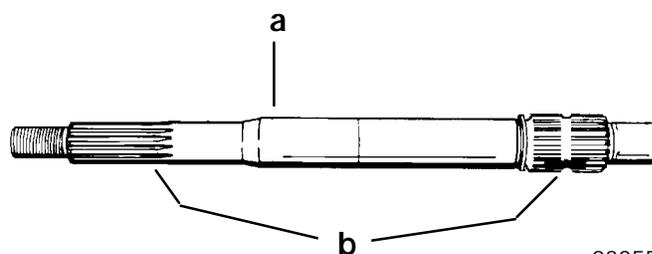
1. Clean all the parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin bearings.
2. Inspect the sliding clutch jaws for damage. Jaws must not be chipped or rounded off. Replace the clutch if they are.
3. Inspect the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing and the needles of the forward gear needle bearing roll. Replace the propeller shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.



23355

- a - Bearing Carrier Needle Bearing Contact Area
- b - Forward Gear Needle Bearing Contact Area
- c - Splines

4. Inspect the propeller shaft splines at both ends for a broken, worn, or twisted condition. Replace the propeller shaft if any of these conditions exists.
5. Inspect the surface of the propeller shaft where the bearing carrier seal lips contact the shaft. If the oil seals have made grooves, replace the propeller shaft and oil seals.

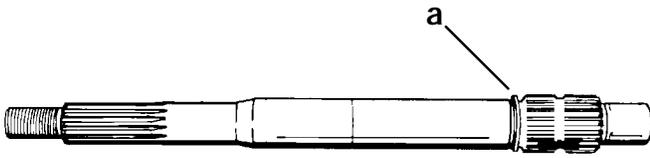


23355

- a - Bearing Carrier Seal Contact Area
- b - Splines



6. Inspect reverse gear thrust washer surface for wear or taper. If surface is worn or tapered, propeller shaft must be replaced.



23355

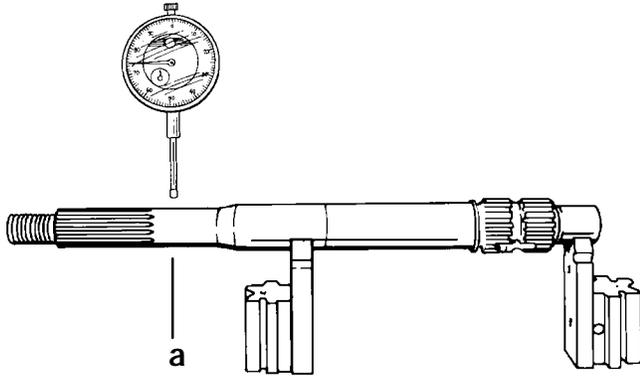
a - Thrust Washer Surface

7. Inspect the propeller shaft for a bent condition.

a. **V-Blocks and Dial Indicator**

- (1.) Position the propeller shaft bearing surfaces on V-blocks.
- (2.) Adjust the height of V-blocks to level the propeller shaft.
- (3.) Position the dial indicator tip just forward of the propeller shaft splines.

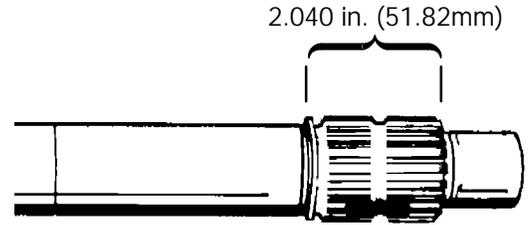
8. Rotate the propeller shaft and observe the dial indicator movement, If the indicator in the dial moves more than 0.010 in. (0.25mm), replace the propeller shaft.



52727

a - Check Movement with Dial Indicator (P/N 91-58222A1) Here.

9. Measure propeller shaft FORWARD to REVERSE shoulder length. If measurement is under 2.040 in. (51.82mm), replace propeller shaft.



23355

10. Inspect REVERSE thrust washer for wear or taper. Measure thickness of washer. If thickness is LESS than 0.240 in. (6.1mm), replace washer.

0.240 in. (6.096mm)

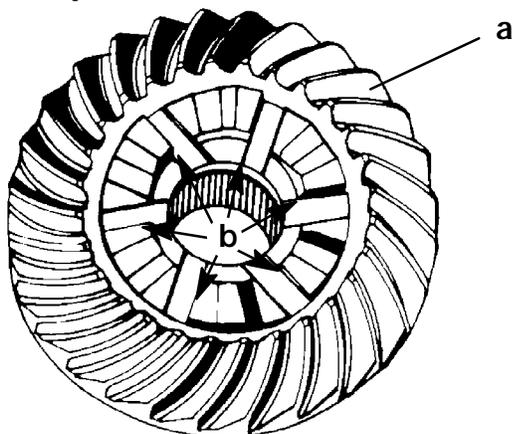




Forward Gear Assembly

COMPONENT INSPECTION

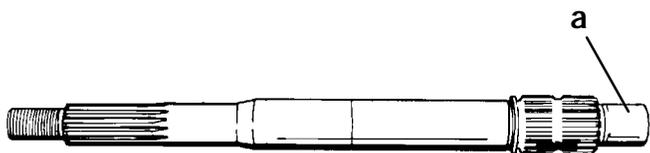
1. Clean the forward gear assembly and the forward gear bearing cup with a suitable solvent and dry with compressed air. Be careful not to spin the bearings.
2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the forward gear and the pinion gear as a set** if any defects are found.
3. Inspect the clutch jaws of the gear for damage. The surfaces must not be chipped or rounded off. **Replace both the forward and pinion gear as a set** if any of these conditions exist.



23351

- a - Forward Gear Teeth
- b - Clutch Jaws

4. Inspect the needle bearings on the inside of the forward gear and the bearing surface on the propeller shaft. If either the needle bearing or the bearing surface of the propeller shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles, replace the propeller shaft and remove and replace the needle bearing in the forward gear as outlined in the next section.



23355

- a - Forward Gear Needle Bearing Contact Area

5. Inspect the tapered roller bearings on the forward gear and the bearing surface on the forward gear bearing cup. If either the roller bearings or the bearing surface of the forward gear bearing cup is pitted, grooved, scored, worn unevenly, discol-

ored from overheating, or has embedded particles, replace the forward gear bearing cup and remove and replace the tapered roller bearings as outlined in the next section.

FORWARD GEAR ASSEMBLY - Component Disassembly

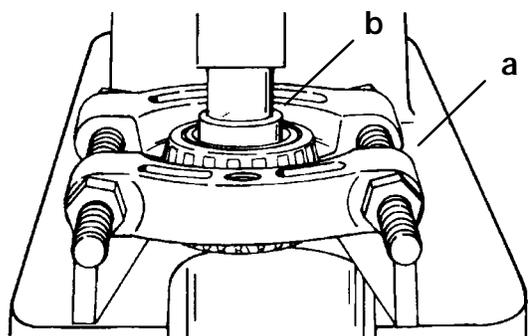
NOTE: Forward gear can only be removed from gear housing after drive shaft and pinion gear have been removed.

1. Reach into gear housing and lift out forward gear.

IMPORTANT: DO NOT remove tapered bearing or needle bearings from forward gear unless replacement of bearings is required. (Bearings cannot be reused after they have been removed.)

2. If inspection determines that replacement of forward gear tapered bearing is required, separate gear from bearing as follows:
 - a. Install Universal Puller Plate (91-37241) between forward gear and tapered bearing.
 - b. Place assembly on press and press gear out of bearing with suitable mandrel.

NOTE: Tapered bearing and race **MUST BE** replaced as a set.



51870

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

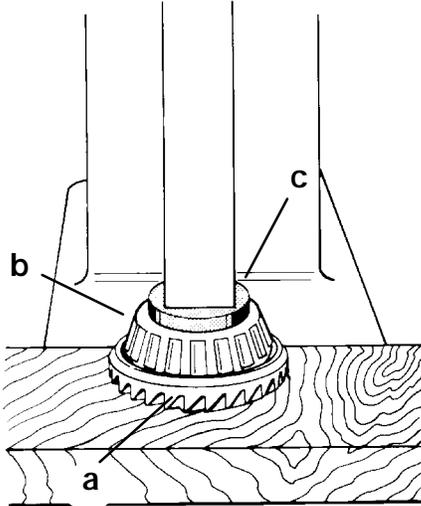
3. If inspection determines that replacement of propeller shaft needle bearings is required, remove bearing as follows:
 - a. Clamp forward gear in a soft jaw vise securely.
 - b. From toothed-side of gear, drive propeller shaft needle bearings out of gear with a punch and hammer.



FORWARD GEAR ASSEMBLY - Component Reassembly

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

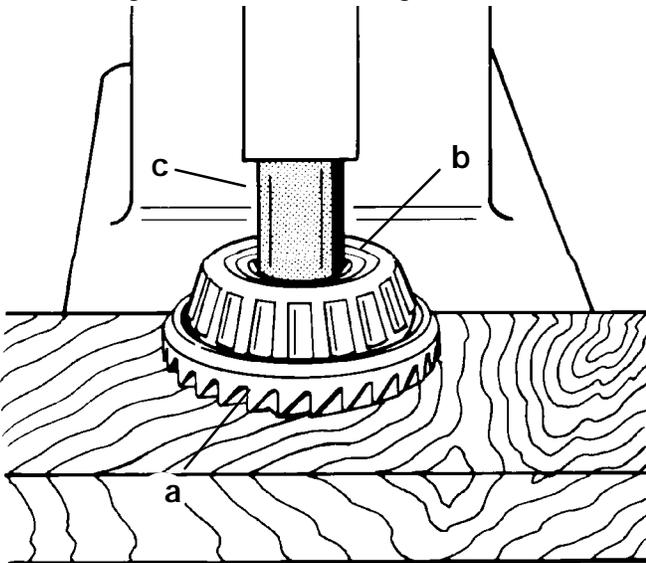
- Using a suitable mandrel, press the tapered roller bearing onto the forward gear by pressing on the inner bearing race, until the bearing bottoms out on the gear mounting shoulder.



23353

- a - Forward Gear
- b - Tapered Roller Bearing
- c - Suitable Mandrel (or Inner Race from old Bearing)

- Using the needle bearing driver, press the needle bearing, with the lettered side facing away from the gear teeth, into the forward gear until the bearing bottoms inside the gear.



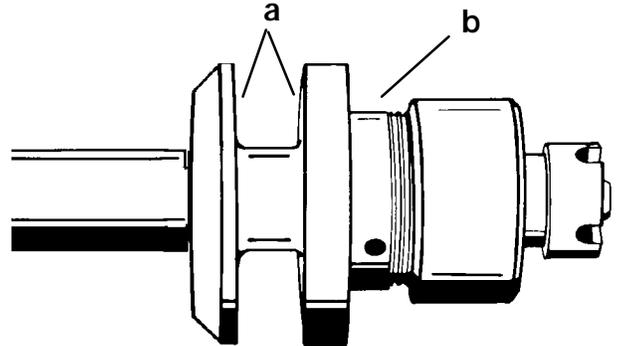
23350

- a - Forward Gear
- b - Needle Bearing (not seen)
- c - Needle Bearing Driver (91-33491)

Shift Spool Assembly

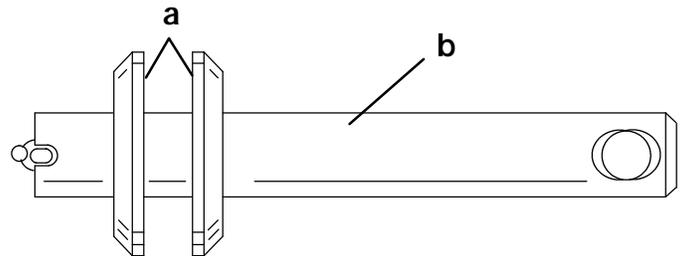
INSPECTION

- Clean the assembly with a suitable solvent and dry the parts using compressed air.
- Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn excessively, it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.
- Inspect the shift spool for wear in the area where the shift crank comes into contact.



23356

- a - Contact Area
- b - Ratcheting Shift Spool

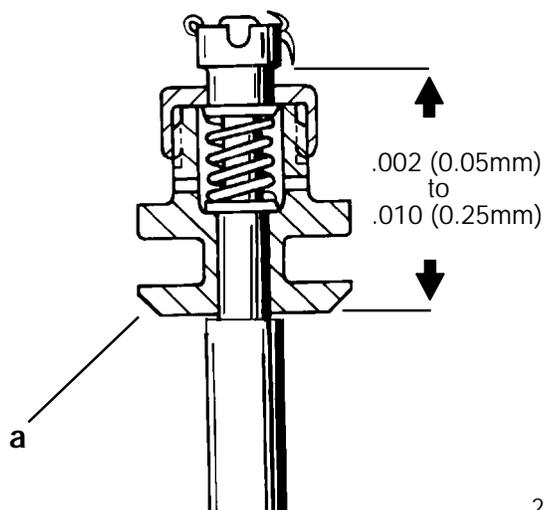


55694

- a - Contact Area
- b - Non-Ratcheting Shift Spool

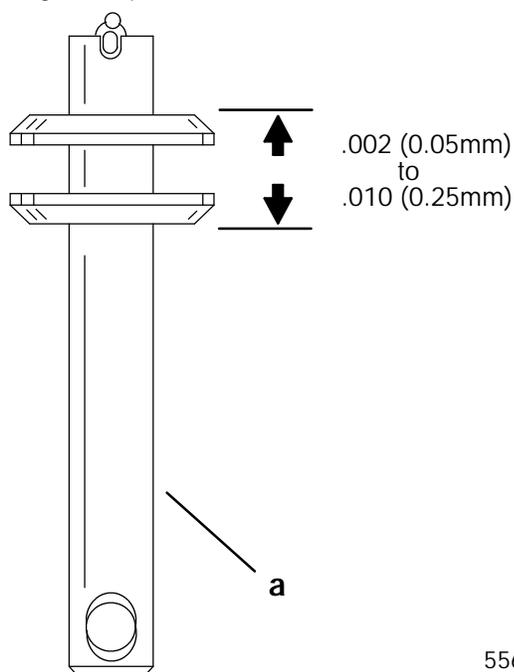


4. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift shaft against a firm surface to align the internal parts).
5. Inspect to insure that both ratcheting and non-ratcheting spools have 0.002-0.010 in. (0.05-0.25 mm) end play. This end play may be achieved by turning the castle nut (clockwise) down on either spool until it is snug and then backing off the nut (counterclockwise) to the first cotter pin slot.



23142

a - Ratcheting Shift Spool



55694

a - Non-Ratcheting Shift Spool

NOTE: Non-Ratcheting shift spools do not contain a spring under the castle nut.

NOTE: If the spool meets the above two criteria skip the disassembly and reassembly section following.

NOTE: If the spool does not meet the above criteria proceed with the disassembly and reassembly section following.

SHIFT SPOOL ASSEMBLY - Component Disassembly

NOTE: Disassembly of the shift spool is for cleaning and inspection of the internal parts due to an improperly functioning shift spool assembly or debris in the gear housing and/or shift spool assembly. Individual components for the shift spool are not available as replacement parts. If the shift spool does not function properly (see the preceding "Shift Spool Assembly - Inspection" section) and the following cleaning and adjustment procedures do not produce the desired results, it will be necessary to order a new shift spool assembly.

1. Disassemble the shift spool assembly as follows:
 - a. Remove and discard the cotter pin.
 - b. Remove the castle nut and spool.
 - c. Clamp the spool in a vice being careful not to damage the spool.
 - d. Remove the retainer by unscrewing it with a pair of pliers.
 - e. Remove the two washers and the spring.

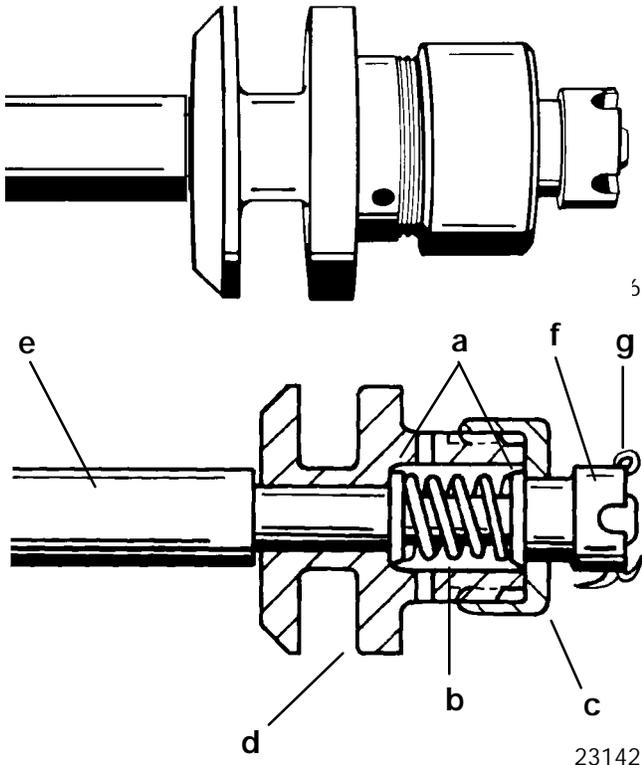
SHIFT SPOOL ASSEMBLY - Component Inspection

1. Clean all components with a suitable solvent and dry them thoroughly with compressed air.
2. Inspect each component for wear or damage. If any components are worn excessively, damaged, or broken it will be necessary to replace the complete shift spool assembly. Small nicks or burrs may be smoothed and the parts reused.



SHIFT SPOOL ASSEMBLY (RATCHETING) - Component Reassembly

1. Assemble the shift spool and shift spool shaft as follows:
 - a. Place the shift spool onto the shift spool shaft.
 - b. Assemble the first washer, then the spring, then the second washer into the shift spool.
 - c. Apply Loctite 271 (92-809820) to the first 3 threads of the spool. Thread the retainer onto the spool and tighten the retainer securely with a pair of pliers.
 - d. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
 - e. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
 - f. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.



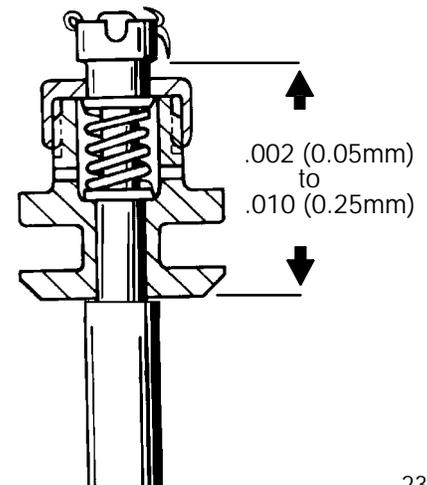
- a - Washers (2)
- b - Spring
- c - Retainer
- d - Spool
- e - Shift Shaft
- f - Castle Nut
- g - Cotter Pin

SHIFT SPOOL ASSEMBLY (RATCHETING) - Adjustment

NOTE: If the shift spool assembly has been disassembled and reassembled (as in the previous two sections) skip the following instructions, (1 through 4).

NOTE: If the shift spool assembly has not been disassembled and reassembled, do all of the following steps.

1. Remove and discard the cotter pin.
2. Screw the castle nut down until it touches the washer and a slight resistance is felt.
3. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is aligned at the hole in the shaft, back off the castle nut until the next available slot in the nut is aligned with the hole in the shaft.
4. Insert a new cotter pin and bend ends in opposite directions.
5. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).
6. Inspect to insure that the spool has 0.002 - 0.010 in. (0.05 - 0.25mm) end play, if it doesn't, adjust the castle nut once again as outlined previously.



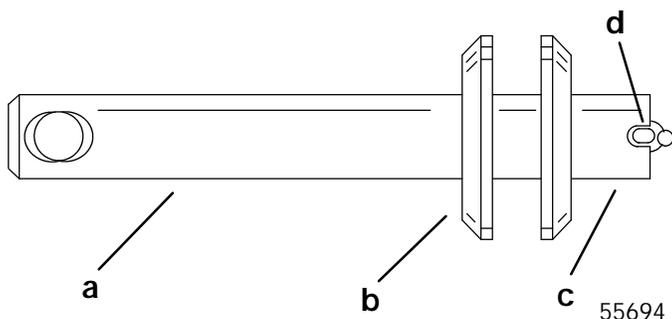
23142

7. If this adjustment did not produce the desired results it will be necessary to disassemble, clean, and reassemble the shift spool assembly. If the spool assembly has already been disassembled and cleaned it will be necessary to replace the shift spool assembly.



SHIFT SPOOL ASSEMBLY (NON-RATCHETING) - Component Reassembly and Adjustment

1. Assemble the shift spool and shift spool shaft as follows:
 - a. Place the shift spool onto the shift spool shaft.
 - b. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
 - c. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
 - d. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.
 - e. Inspect to insure that the spool has 0.002 - 0.010 in. (0.05 - 0.25mm) end play, if it doesn't, adjust the castle nut once again as outlined previously.



- a - Shift Shaft
- b - Spool
- c - Castle Nut
- d - Cotter Pin

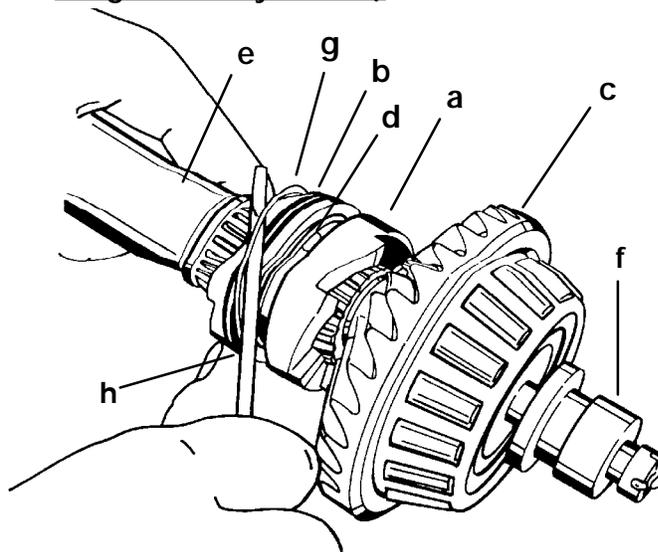
- f. If this adjustment did not produce the desired results it will be necessary to disassemble, clean, and reassemble the shift spool assembly. If the spool assembly has already been disassembled and cleaned it will be necessary to replace the shift spool assembly.

Propeller Shaft Assembly

COMPONENT REASSEMBLY

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

1. Install the sliding clutch on the propeller shaft. Align cross pin holes in the clutch with the slot in the propeller shaft. The grooved end of the clutch should be facing the propeller end of the shaft.
2. Assemble the forward gear assembly to the propeller shaft.
3. Assemble the shift spool assembly to the propeller shaft being sure to align the cross pin hole of the shift spool shaft with the clutch.
4. Assemble the cross pin through the sliding clutch, through the propeller shaft and through the shift spool shaft hole.
5. Install detent pin in 3rd hole in clutch.
6. Assemble the cross pin retaining spring over the propeller end of the propeller shaft and wind it around the clutch over the cross pin hole. Be careful not to distort the spring while assembling it. **Make sure that the spring is wound on so that it does not cross over on itself and that it lies flat against the clutch once it is assembled. If it does not lie flat against the clutch a new spring must be installed. (Ratcheting Assembly Shown)**



- a - Sliding Clutch
- b - Grooves in Clutch
- c - Forward Gear Assembly
- d - Cross Pin
- e - Propeller Shaft
- f - Spool and Actuating Shaft Assembly
- g - Cross Pin Retaining Spring
- h - Detent Pin

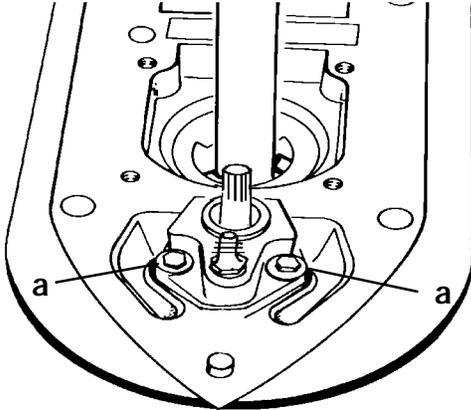


Shift Shaft Assembly

REMOVAL

NOTE: It is possible to remove and service the shift shaft assembly (but not the shift crank inside the gear case) without removing any of the internal components of the gear housing.

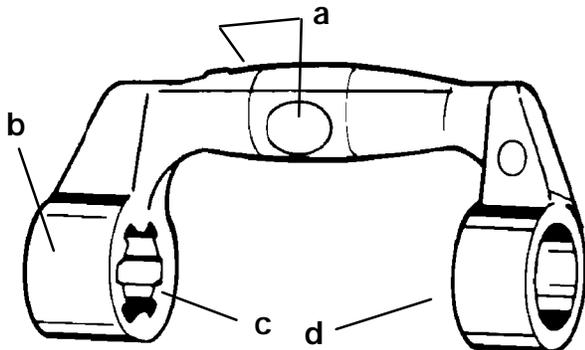
1. Remove the shift shaft bushing screws, and remove the shift shaft and bushing by pulling both straight out of gear housing.



70494

a - Shift Shaft Bushing Screws

2. Remove the shift crank from the inside of the gear housing. Clean it with a suitable solvent and dry it thoroughly. Inspect it for wear in the areas that contact the shift spool and inspect the splines and the diameter that goes over the locating pin for damage or wear.

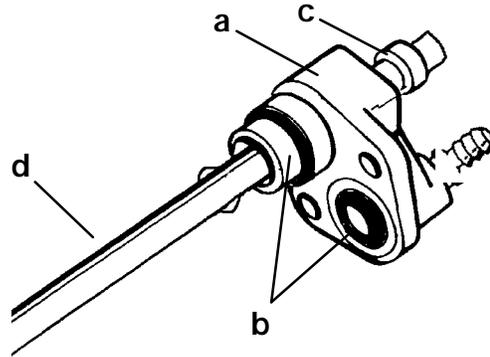


23350

a - Contact Area
 b - Shift Crank
 c - Splines
 d - Diameter for Locating Pin

SHIFT SHAFT ASSEMBLY - Component Disassembly and Inspection

1. Slide the bushing assembly off the shift shaft. Remove the coupler from the shaft.

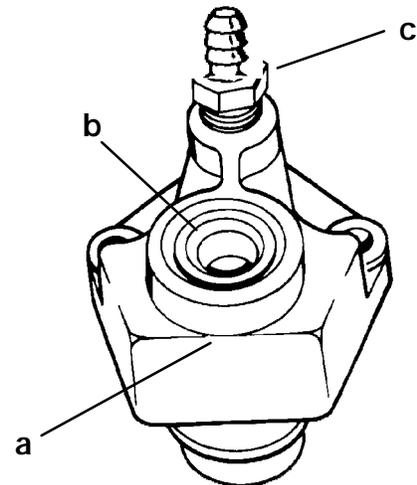


70616

a - Shift Shaft Bushing
 b - O-rings (2)
 c - Coupler
 d - Shift Shaft

2. Clean all components with a suitable solvent and dry thoroughly with compressed air.
 - a. Inspect the shift shaft bushing for cracking, damage, or excessive wear.
 - b. Inspect the oil seal inside the bushing, the sleeve, and the O-rings on the outside of the bushing for damage or excessive wear.
 - c. Inspect the speedometer connector for damage or blockage.

If any of these conditions exist, replace the appropriate components.



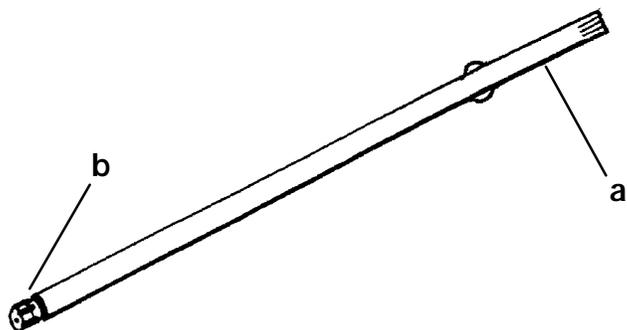
70617

a - Shift Shaft Bushing
 b - Oil Seal (Oil Seal is Replaceable)
 c - Speedometer Tube Connector



- a - Shift Shaft Bushing
- b - Oil Seal (Oil Seal is Replaceable)
- c - Speedometer Tube Connector

3. Inspect the shift shaft splines and oil seal surface for corrosion and/or excessive wear. Replace the shift shaft if either if these conditions are found.

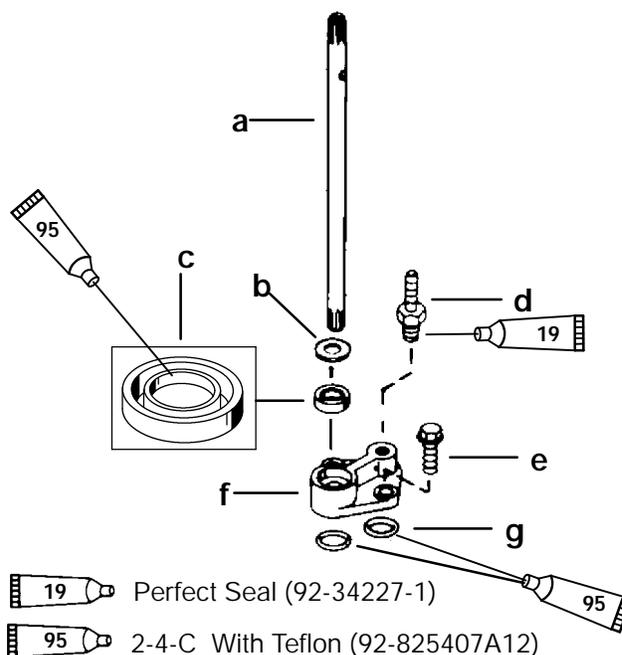


- a - Oil Seal Surface
- b - Spline

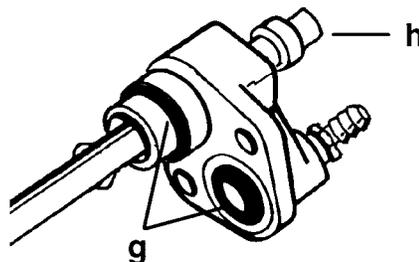
SHIFT SHAFT ASSEMBLY - Component Reassembly

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

1. Lightly lubricate the seats of the O-ring diameters on the bushing and the lip of the oil seal with 2-4-C w/Teflon (92-825407A12).
2. If the speedometer connector was removed and/or replaced, lightly coat the **threads of the connector** with Quicksilver Perfect Seal (91-34277-1). Assemble the speedometer connector to the bushing and torque the connector to 4.5 lb. in. (0.51 N·m).
3. Assemble all components as shown below.



- Perfect Seal (92-34227-1)
- 2-4-C With Teflon (92-825407A12)



70616

- a - Shift Shaft
- b - Rubber Washer
- c - Seal (Lip Faces Up)
- d - Speedometer Connector
- e - Bolt (2 ea.) [Torque to 60 lb. in. (6.8 N·m)]
- f - Bushing
- g - O-Rings (2 ea.)
- h - Coupler

NOTE: For reinstalling the shift shaft when none of the other components of the gear housing were disassembled see the "Shift Shaft Assembly", "Installation".



Pinion Bearing

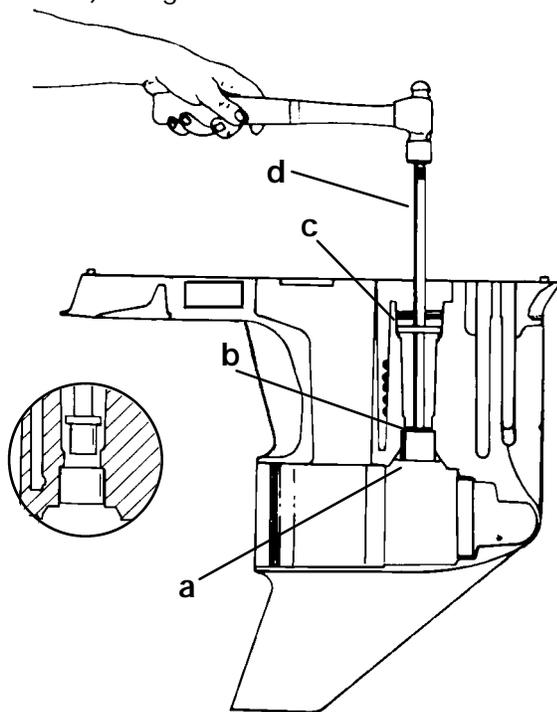
REMOVAL

NOTE: *Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. The condition of the drive shaft at this location gives an indication of the condition of the needle bearing. Replace lower pinion bearing (needles and race as a set) if the drive shaft is pitted, grooved scored, worn unevenly, discolored from overheating, or has embedded particles.*

IMPORTANT: All the needle bearings (18) MUST BE in place inside bearing race while driving the pinion bearing from the gear housing.

IMPORTANT: Do not reuse the bearing (race or rollers) once it has been removed.

1. Remove and discard the pinion bearing (race and rollers) using tools as shown.



.0614

- a - Pinion Bearing
- b - Bearing Driver (91-36569)
- c - Pilot Washer (91-36571)
- d - Driver Rod (91-37323)

Gear Housing Reassembly

Gear Housing Inspection

1. Clean the gear housing thoroughly with a suitable solvent and a hard bristle brush. Dry the gear housing thoroughly using compressed air. Insure that all sealants, locking agents and debris are removed.
2. Verify the 2 oil circulation holes in the drive shaft bore and the shift shaft hole are clear and free of debris.
3. Inspect the gear housing for excessive corrosion, impact or any other damage. Excessive damage and/or corrosion requires replacement of the gear housing.
4. Inspect the bearing carrier retainer threads in the gear housing for corrosion and/or stripped threads. Damage or corrosion to the threads requires replacement of the gear housing.
5. Inspect bearing race/cup contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores. Any one bearing bore in which the race/cup is loose will require replacement of the gear housing.
6. Inspect for blockage in water inlet holes and the speedometer hole, clean as necessary. Be careful not to enlarge the speedometer hole as this could cause erroneous speedometer readings.
7. Make sure that the locating pins are in place in the gear housing and that the corresponding holes in the drive shaft housing are not elongated. The drive shaft may break if the housings are not aligned properly due to missing locating pins or elongated holes.

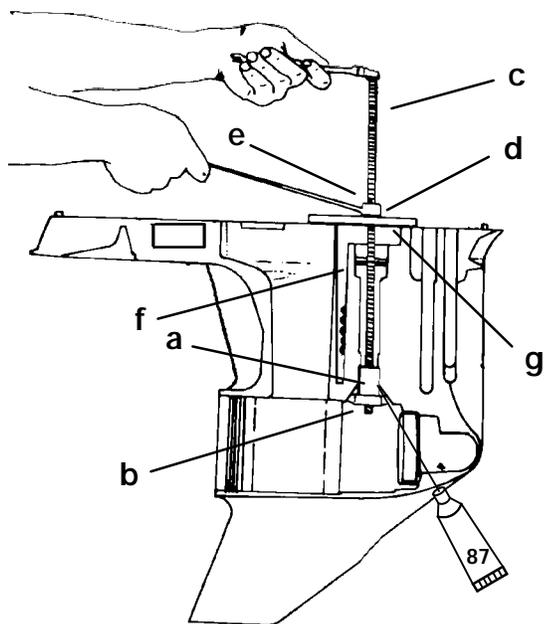


Pinion Bearing

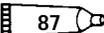
INSTALLATION

IMPORTANT: Install only a **NEW** pinion bearing. Do not reinstall a pinion bearing that has been previously removed from a gear housing.

1. Lubricate the bore into which the pinion bearing is to be installed with Quicksilver Gear Lubricant (92-19007A24).
2. Position the new pinion bearing (with the cardboard shipping sleeve in place) onto the driver head, with the lettered and numbered side of the bearing oriented upward.
3. Insert the driver with the bearing assembly, into position (by way of the propeller shaft bore) at the drive shaft bore as shown.



70615

 Quicksilver Gear Lubricant (92-19007A24)

- a - Drive Shaft Pinion Bearing (With Cardboard Shipping Sleeve)
- b - Driver Head (91-38628)
- c - Puller Shaft (91-31229)
- d - Washer (12-34961)
- e - Nut (11-24156)
- f - Pilot Washer (91-36571)
- g - Puller Plate (91-29310)

4. Install the bearing by screwing down the nut until the bearing is fully seated against the bore shoulder.

Forward Gear Bearing Cup

INSTALLATION

Forward Gear Backlash - .017 in. to .028 in. (0.43mm to 0.71mm)

NOTE: If the forward gear, forward gear bearing and cup, or gear housing were not replaced, install the same quantity of shims that were taken out when cup was removed. If the forward gear, forward gear bearing/cup, or gear housing were replaced, install 0.020 in. (0.51mm) of shims.

NOTE: If backlash has already been checked and it has determined that it needs to be adjusted, (see *Checking Forward Gear Backlash*), adding or subtracting 0.001 in. (0.03mm) shims will **change** the gear backlash by the same amount.

Example 1 (if backlash is too high)

If Forward Backlash Checks:	.040 in.	(1.02mm)
(Subtract):	.018 in.	(0.46mm)
Add This Quantity of Shims:	.022 in.	(0.56mm)
Provides Backlash of 0.018		(0.46mm)

Example 2 (if backlash is too low)

Backlash Checks:	.010 in.	(0.25mm)
Subtract this Quantity of Shims:	.008 in.	(0.30mm)
Provides Backlash of 0.018		(0.46mm)

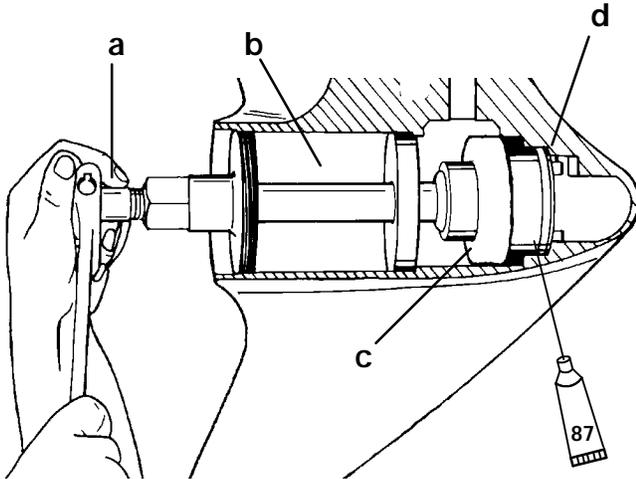
1. Lubricate the bore into which the forward gear bearing cup is to be installed with Quicksilver Gear Lubricant (92-19007A24).
2. Place the shim(s) into forward bore of gear housing.



- Press the bearing cup into the gear housing using the installation tool as follows:

NOTE: Ratcheting type gear cases use bearing cup driver 91-36577. Non-ratcheting gear cases use bearing cup driver 91-31106.

IMPORTANT: Verify that the bearing cup is position as straight as possible to avoid cocking it in the bore while pressing it in.



50791

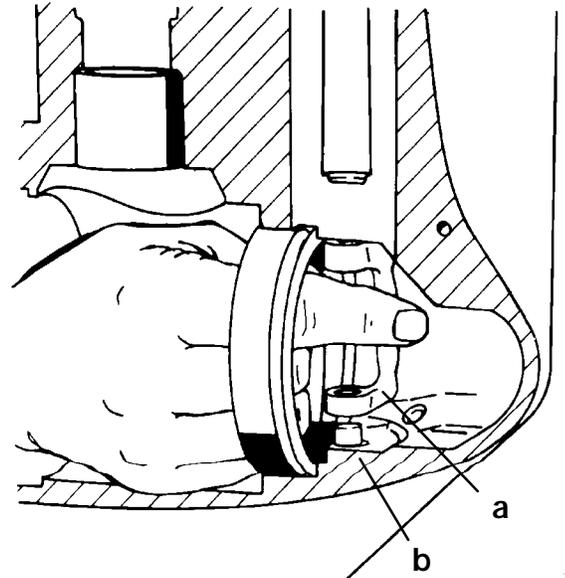
Quicksilver Gear Lubricant (92-19007A24)

- a - Hex-Head Screw
- b - Bearing Cup Installation Tool (91-18605A1)
- c - Driver Cup (91-36577) for ratcheting type gear cases.
Driver Cup (91-31106) for non-ratcheting type gear cases.
- d - Shims

Shift Shaft Assembly

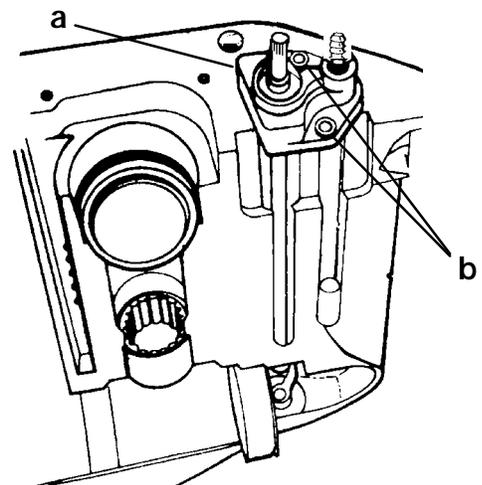
INSTALLATION

- Place the shift crank onto the locating pin in the forward section of the gear housing. Ensure that the shift crank faces towards the left (port) side of the gear housing.



- a - Shift Crank
- b - Locating Pin

- Install the shift shaft assembly into the gear housing as shown. Engage the splined end of the shift shaft with the shift crank. Verify O-rings are positioned properly and lubricated with 2-4-C w/Te-flon. Secure shift shaft bushing with 2 screws. Torque screws to 60 lb. in. (6.8 N.m).

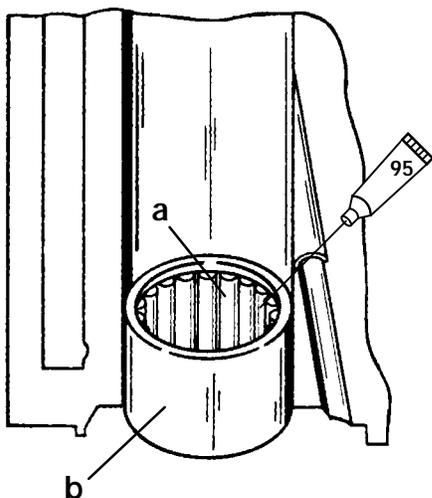


70620

- a - Shift Shaft Assembly
- b - Screws [Torque to 60 lb. in. (6.8 N-m)]



NOTE: If the pinion bearing needle bearings have fallen out, install 18 needles into needle bearing outer race. Use 2-4-C w/Teflon (92-825407A12), to help hold needles in place.



23142

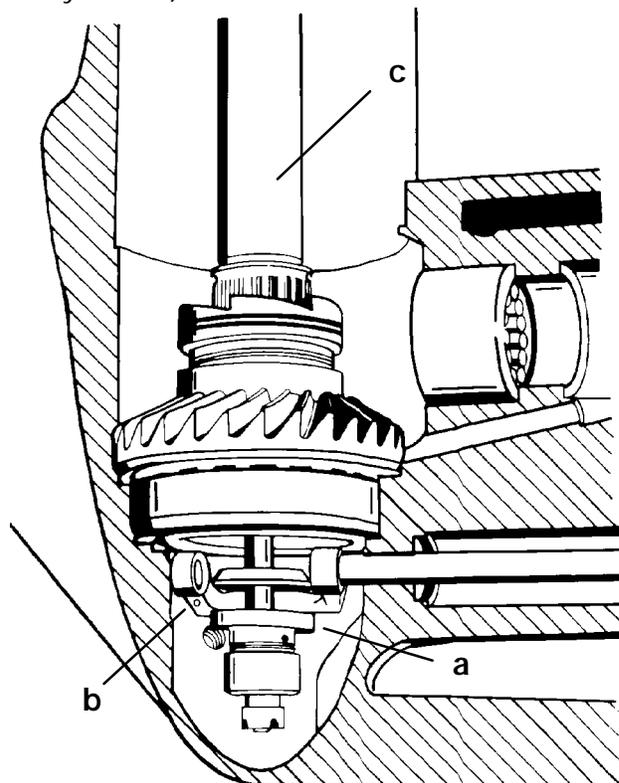
95 2-4-C With Teflon (92-825407A12)

- a - Rollers (18)
- b - Roller Bearing Outer Race

Propeller Shaft Assembly

INSTALLATION

1. To allow for the engagement of the shift spool with the shift crank, tilt the propeller end of the propeller shaft assembly to the left (port) side of gear housing and rotate the shift shaft from reverse to neutral while installing shaft (ratcheting assembly shown).



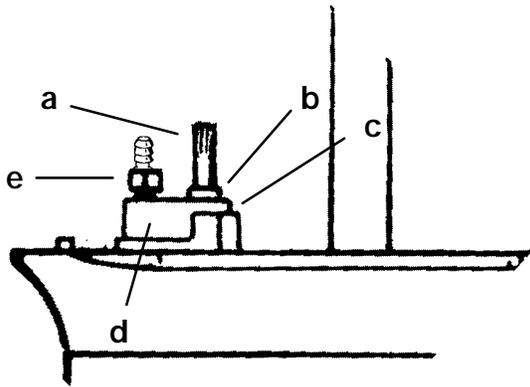
23343

- a - Shift Actuating Spool
- b - Shift Crank
- c - Propeller Shaft Assembly

2. Operate the shift shaft to ensure that it has been properly installed. The sliding clutch should move forward when the shift shaft is turned clockwise, and should move aft when the shift shaft is turned counterclockwise.



- Slide the rubber sleeve at top end of shift shaft down so that it just touches the oil seal in the bushing.



- a - Shift Shaft
- b - Rubber Sleeve
- c - Oil Seal
- d - Shift Shaft Bushing
- e - Speedometer Connector

NOTE: Secure the speedometer tube to the speedometer connector with a sta-strap.

2

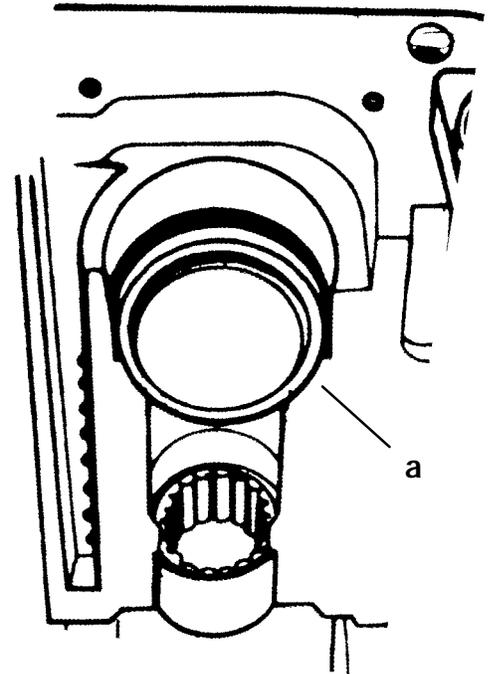
Drive Shaft and Pinion Gear

INSTALLATION

NOTE: If the original shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing and cup, or gear housing were replaced, start off by installing a 0.038 in. (0.96 mm) shim(s).

NOTE: If the original shims were retained (or measurement known) and none of the above listed parts were replaced, reinstall the same shims or same amount of shims.

- Place the shim(s) into the drive shaft housing bore.



/U620

- a - Shim(s)

NOTE: For ease of installation, glue the washer to the pinion gear, using 3M Adhesive (92-25234), or Quicksilver Bellows Adhesive (92-86166), or equivalent.

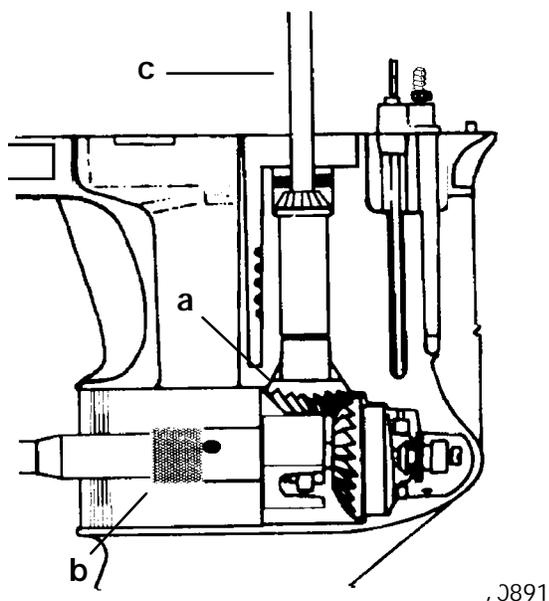
NOTE: If the backlash may have to be changed, it is recommended that Loctite 271 NOT be applied to the pinion nut UNTIL the backlash setting is finalized. DO NOT reuse the old pinion nut. Install a NEW pinion nut after backlash is finalized.

- Apply Loctite 271 (92-809820) to the threads of the pinion gear nut and place the pinion gear nut into the MR slot of the pinion nut adapter.

NOTE: Install the pinion gear nut with the flat side of the nut away from the pinion gear.

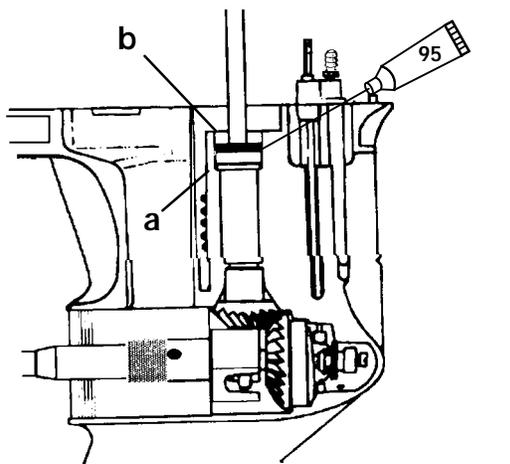


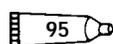
- Place the pinion gear and washer into the gear housing.
- Insert the pinion nut adaptor (with the nut) into the gear housing.
- Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.
- Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.



- a - Pinion Gear (with the washer glued to it)
- b - Pinion Nut Adaptor (91-61067A2)
- c - Drive Shaft

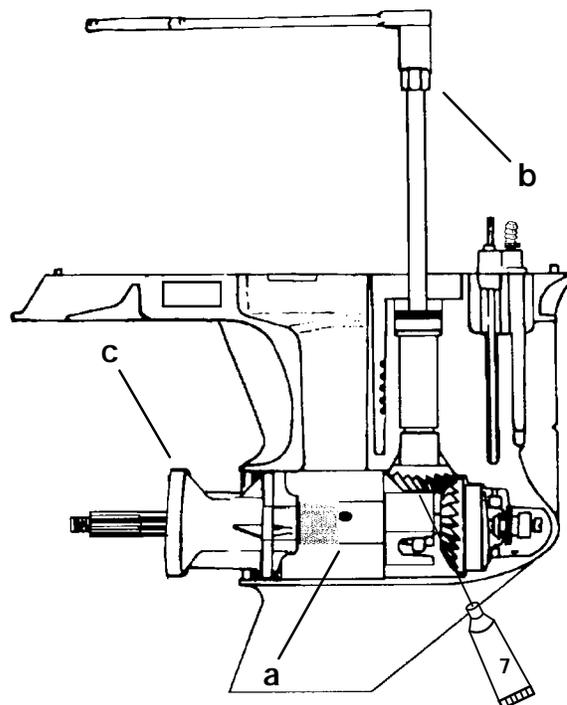
- Install the drive shaft tapered roller bearing cup. Apply 2-4-C w/Teflon to the retainer threads and install the retainer.

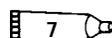


 2-4-C With Teflon (92-825407A12) 70890

- a - Tapered Roller Bearing Cup
- b - Drive Shaft Retainer

- Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adaptor in position.
- Torque the pinion nut to 75 lb. ft. (101.7 N-m) by turning the drive shaft using the drive shaft nut wrench and torque wrench.



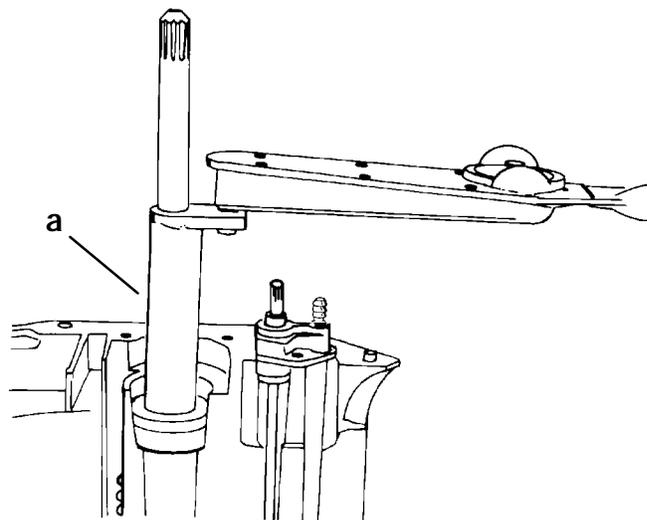
 Loctite 271 (92-809820)

70892

- a - Pinion Nut Adaptor (91-61067A2)
- b - Drive Shaft Nut Wrench (91-56775)
- c - Bearing Carrier (installed backwards)

- Remove the bearing carrier, pinion nut adaptor and drive shaft nut wrench.

- Torque the retainer to 100 lb. ft. (136.0 N-m).



- a - Drive Shaft Bearing Retainer Wrench (91-43506)

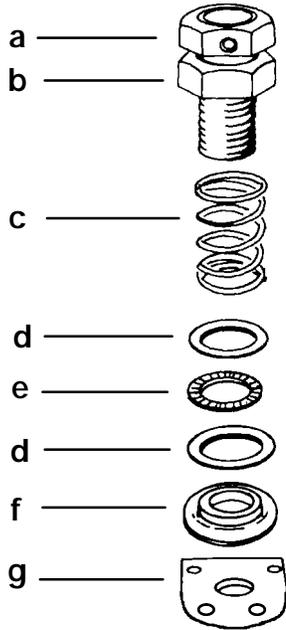


Gear Location/Backlashes Checking and Adjustment

Drive Shaft - Bearing Preload Tool

INSTALLATION

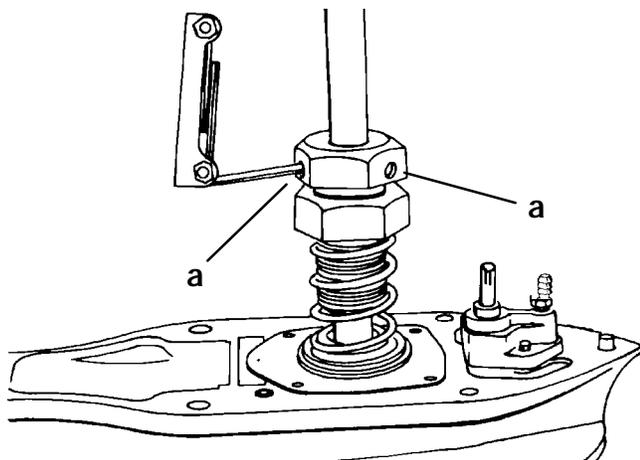
1. Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order shown.



70496

- a - Top Nut with Threaded Pipe
- b - Nut
- c - Spring
- d - Thrust Washer (2 Required) (12-18448)
- e - Thrust Bearing
- f - Thrust Washer
- g - Water Pump Face Plate (from your gear housing)

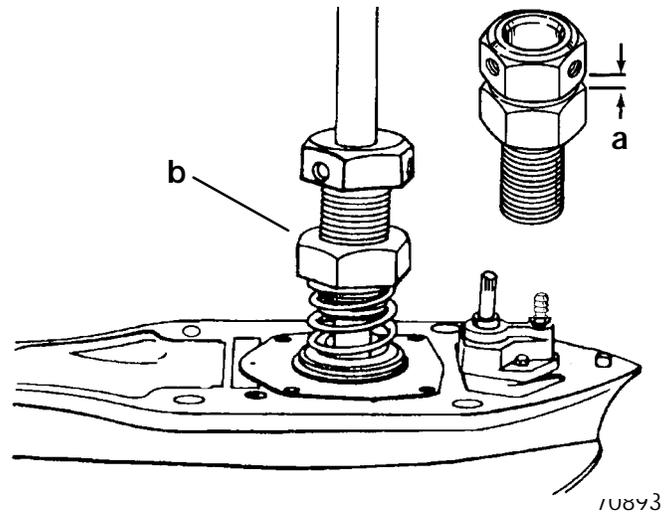
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



70716

- a - Allen Screws

3. Measure distance (a) and increase that distance by 1 in. (25.4mm) by turning bottom nut away from top nut.



- a - Distance 1 in. (25.4mm)
- b - Bottom nut [screwed down approximately 1 in. (25.4mm)]

4. Rotate the drive shaft at least three full turns in a clockwise direction.

Pinion Gear Location

CHECKING AND ADJUSTING

Pinion Depth - 0.025 in. (0.64mm)

NOTE: If the bearing preload tool has not already been set up, refer to "Drive Shaft - Bearing Preload Tool", 'Installation' section first.

NOTE: The prop shaft and forward gear can be installed when checking pinion height IF Pinion Height Tool 91-56048 is used.

1. Place the pinion gear shimming tool into the gear housing.

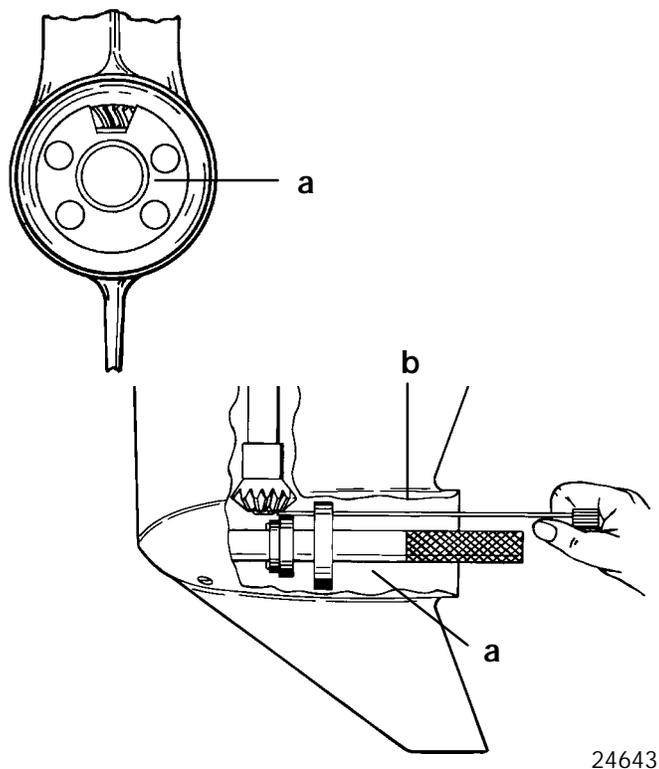
NOTE: Take the following measurements at 3 locations, rotating the drive shaft 120 degrees between each reading (always rotate the drive shaft in a clockwise direction).

2. Insert the thickest feeler gauge that fits snugly between one tooth of the pinion gear and high point of the shimming tool.
3. Rotate the drive shaft 120 degrees in a clockwise direction and take another reading.
4. Repeat this process until 3 readings have been taken.
5. Add the three readings together and divide the sum by 3 to get the average pinion gear height. Make note of this average measurement.



The average pinion gear height should be 0.025 in. (0.64mm).

- If the average pinion gear height is not correct, remove the bearing preload tool, the drive shaft retainer and the drive shaft tapered roller bearing cup. (The cup can be removed by wiggling the drive shaft back and forth or by turning gear housing and shaking it.) Add or subtract shims beneath the cup to obtain the proper average pinion gear height. Reinstall the cup and retainer. Retorque retainer to 100 lb. ft. (135.6 N·m). Reinstall the bearing preload tool and rotate the drive shaft at least 3 full turns in a clockwise direction. Recheck the pinion gear height as in step 5 above. Repeat this process until the average pinion gear height is within specification.



24643

- a - Pinion Gear Shimming Tool (91-12349A2) Using Disc #2 and Flat #4
- b - 0.025 in. (0.64mm) Feeler Gauge

NOTE: Install a NEW pinion nut with Loctite 271 AFTER all clearances are correct.

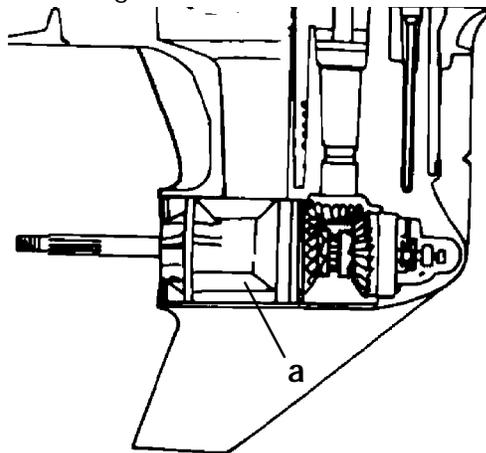
- When the correct pinion gear height is achieved, remove pinion nut and apply Loctite 271 to nut threads IF FORWARD GEAR and PROP SHAFT ARE INSTALLED. Reinstall pinion nut and torque to 75 lb. ft. (101.7 N·m).

Bearing Carrier Assembly

INSTALLATION - (FOR CHECKING BACKLASHES)

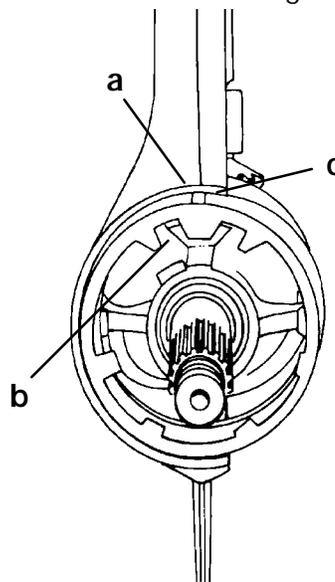
NOTE: If backlashes have already been checked and they are to specification proceed with "Bearing Carrier Assembly", 'Final Installation' section found on page 6A-50.

- Place the bearing carrier assembly into the gear housing. It may be necessary to turn the drive shaft to align the teeth of the pinion and the reverse gears.



70712

- a - Bearing Carrier Assembly
- Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.

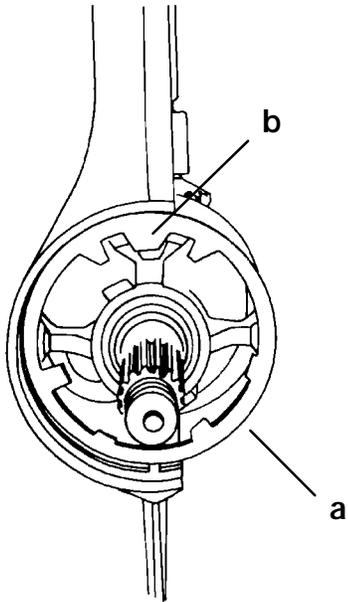


70713

- a - Gear Housing Tab Washer Alignment Hole (not seen)
- b - "V" Shaped Notch in Bearing Carrier
- c - Alignment Tab of Tab Washer



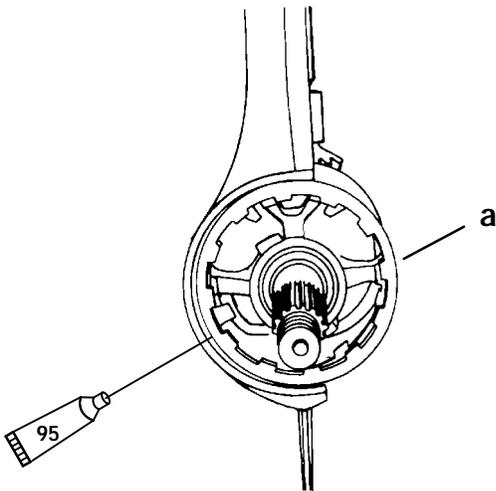
3. Verify that the "V" shaped tab aligns with the "V" notch in bearing carrier.



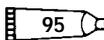
70714

- a - Tab Washer
- b - "V" Tab

4. Lubricate the bearing carrier retainer threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



70715

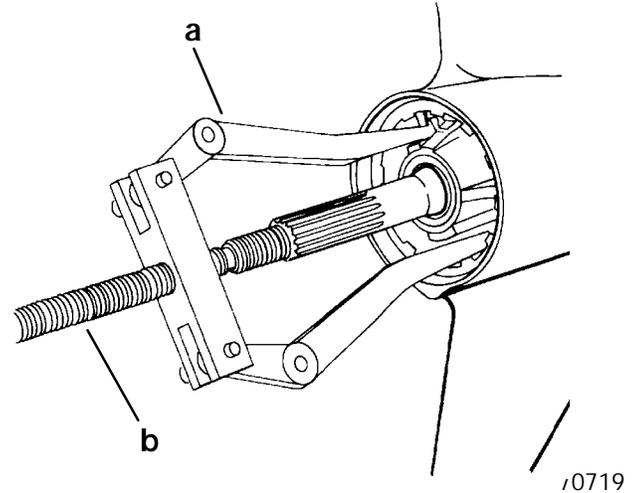
 95 2-4-C With Teflon (92-825407A12)

- a - Bearing Carrier Retainer

Forward Gear Backlash

CHECKING

1. Apply forward pressure to propeller shaft as follows:
 - a. Attach puller jaws and puller bolt onto bearing carrier bosses and propeller shaft.



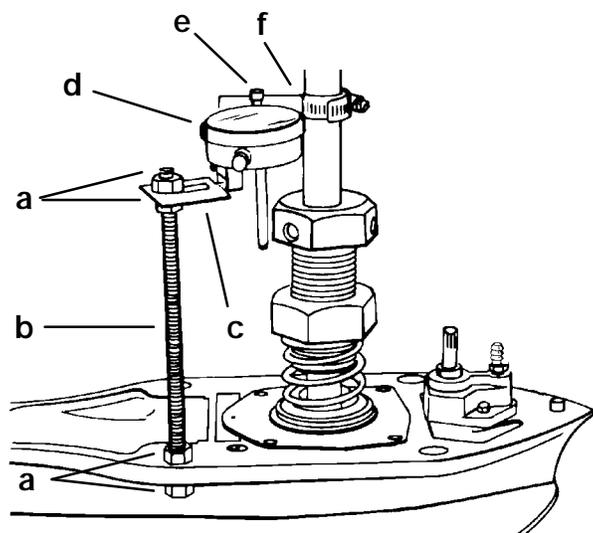
- a - Puller Jaws (91-46086A1)
- b - Puller Bolt (91-85716)

- b. Torque the puller bolt to 45 lb. in. (5.1 N·m). Rotate drive shaft three full turns clockwise and retorque the bolt to 45 lb. in. (5.1 N·m).

NOTE: If the bearing preload tool has not already been set up, see "Drive Shaft - Bearing Preload Tool", 'Installation' section found on page 6A-45 first.



2. Install a dial indicator and align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to "0" on the dial indicator scale.



70717

- a - Nuts (4) (Obtain Locally)
 - b - Threaded Rod [3/8 in. (9.5mm) obtain locally]
 - c - Dial Indicator Holding Tool (91-83155)
 - d - Dial Indicator (91-58222A1)
 - e - Indicator Pointer
 - f - Backlash Indicator Rod (91-53459) (for 1.64:1 or 1.75:1)
Backlash Indicator Rod (91-78473) (for 1.87:1 ratio)
3. Take the backlash readings by lightly turning the drive shaft back and forth, (no movement should be noticed at the propeller shaft).
 - a. Observe the dial indicator and record the reading.
 - b. Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.
 - c. Repeat step 2 above and take and record another reading. Repeat step 3 until a total of 4 backlash readings have been taken.
 4. Add the four readings together and divide the sum by four. This is your average backlash, which should be 0.017 in. - 0.028 in. (0.431mm - 0.711mm) (for 1.64:1; 1.75:1 and 1.87 ratios).

5. If backlash is LESS than the specified minimum, REMOVE shim(s) from in front of forward gear bearing race to obtain correct backlash. When re-installing pinion nut, apply Loctite 271 to threads of nut.
6. If backlash is MORE than the specified MAXIMUM, add shim(s) in front of forward gear bearing race to obtain correct backlash. When re-installing pinion nut, apply Loctite 271 to threads of nut.

NOTE: By adding or subtracting 0.001 in. (0.03mm) shim, the backlash will change approximately 0.001 in. (0.03mm).

Reverse Gear Backlash

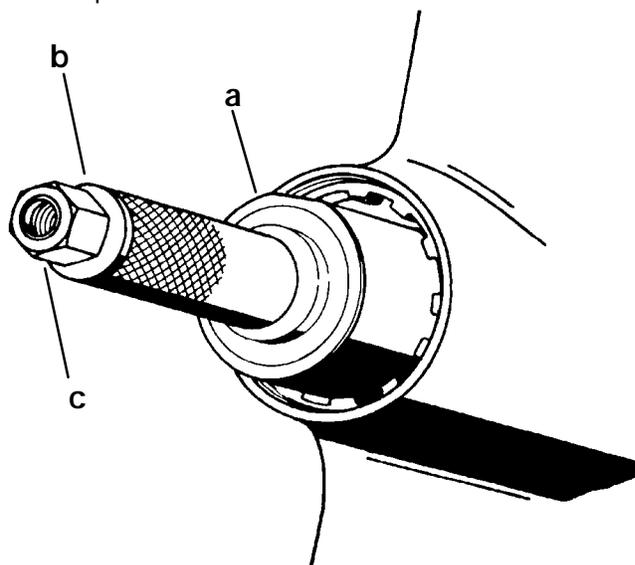
CHECKING

Reverse Gear Backlash - 0.030 in. to 0.050 in. (0.76mm to 1.27mm)

Although reverse gear backlash is not adjustable, it may be checked as follows:

NOTE: Torque cover nut to 210 lb. ft. (284.7 N·m).

1. Apply backward pressure on the propeller shaft as follows:
 - a. Install the pinion nut adaptor, washer and propeller nut as shown.

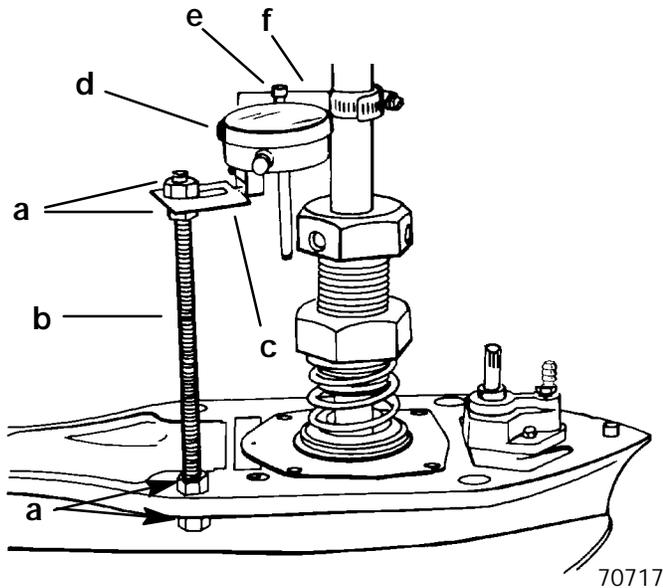


55

- a - Pinion Nut Adaptor (91-61067A2)
- b - Washer (12-54048)
- c - Prop Nut



- b. Torque the propeller nut to 45 lb. in. (5.1 N·m). Rotate the drive shaft 3 full turns in a clockwise direction and retorque the propeller nut to 45 lb. in. (5.1 N·m).
2. Install a dial indicator and align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to "0" on the dial indicator scale.



- a - Nuts (4) (obtain locally)
- b - Threaded Rod [3/8 in. (9.5 mm) obtain locally]
- c - Dial Indicator Holding Tool (91-83155)
- d - Dial Indicator (91-58222A1)
- e - Indicator Pointer
- f - Backlash Indicator Rod (91-53459) (for 1.64:1 or 1.75:1)
- g - Backlash Indicator Rod (91-78473) (for 1.87:1 ratio)

3. Take the backlash readings by lightly turning the drive shaft back and forth, so as to feel the backlash between the gears, (no movement should be noticed at the propeller shaft).
 - a. Observe the dial indicator and record the reading.
 - b. Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.
 - c. Repeat step 2 above and take and record another reading. Repeat step 3 until a total of 4 backlash readings have been taken.
4. Add the four readings together and divide the sum by four. This is your average backlash and it should be 0.030 in. - 0.050 in. (0.76mm - 1.27mm) (for 1.64:1; 1.75:1 and 1.87:1 ratios).

If backlash is not as indicated, gear case is not properly assembled or parts are excessively worn and must be replaced before returning gear case to service.

5. Loosen the backlash indicator tool and remove the propeller nut, washer and pinion nut adaptor. Remove the dial indicator and all its mounting components. **Do not remove the bearing preload tool. The following instructions give specific instructions for its removal.**

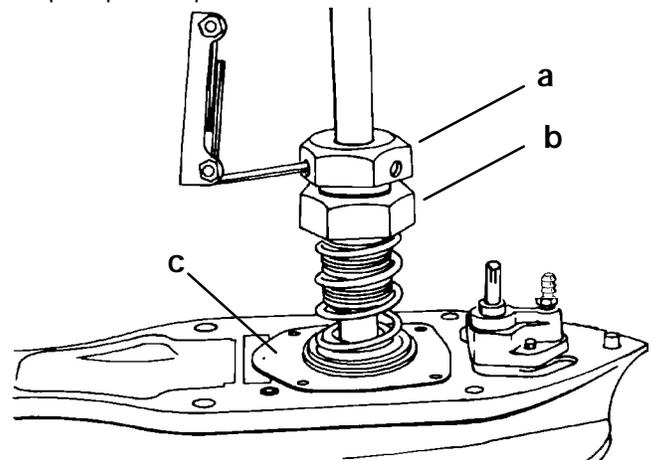
Drive Shaft - Bearing Preload Tool

REMOVAL

⚠ CAUTION

Before loosening the top nut allen screws of the bearing preload tool, screw the bottom nut up as close as possible to the top nut.

1. Remove the dial indicator and its supporting tooling.
2. Screw the bottom nut of the bearing preload tool until it is as close as possible to top nut.
3. Loosen the allen screws in the top nut.
4. Remove all components including the water pump face plate.



70716

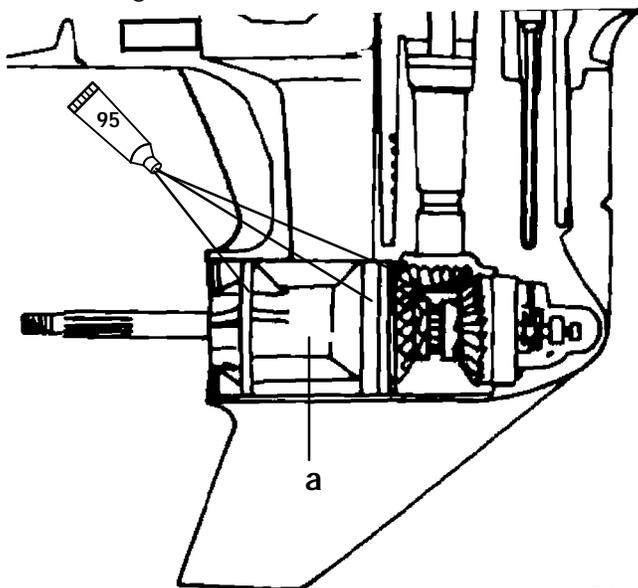
- a - Top Nut (with allen screws)
- b - Bottom Nut
- c - Water Pump Face Plate



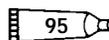
Bearing Carrier Assembly

Final Installation

1. Remove the Bearing Carrier and lubricate the following as specified:
 - a. Lubricate the carrier O-ring with 2-4-C w/Teflon (92-825407A12).
 - b. Lubricate both the forward and aft outer diameters of the bearing carrier and gear case area where carrier will seat with 2-4-C w/Teflon.
 - c. Fill the space between the carrier oil seals with 2-4-C w/Teflon.
2. Place the bearing carrier assembly into the gear housing. It may be necessary to turn the drive shaft to align the teeth of the pinion and the reverse gears.

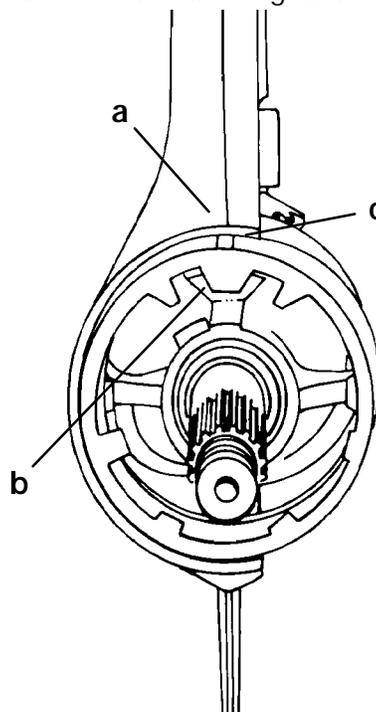


70712

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

a - Bearing Carrier Assembly

3. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.

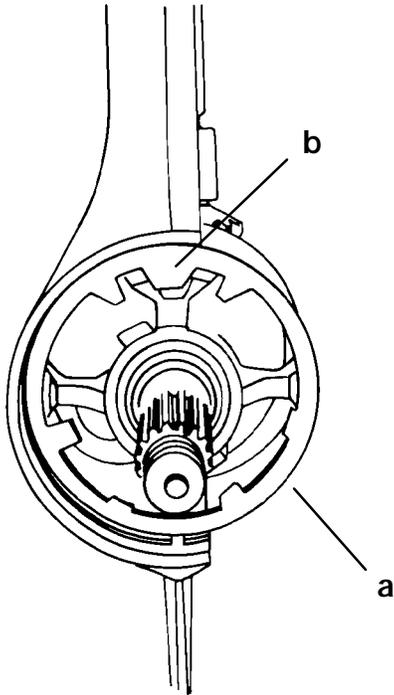


70713

- a - Gear Case Alignment Hole
b - "V" Shaped Notch in Bearing Carrier
c - Alignment Tab of Tab Washer



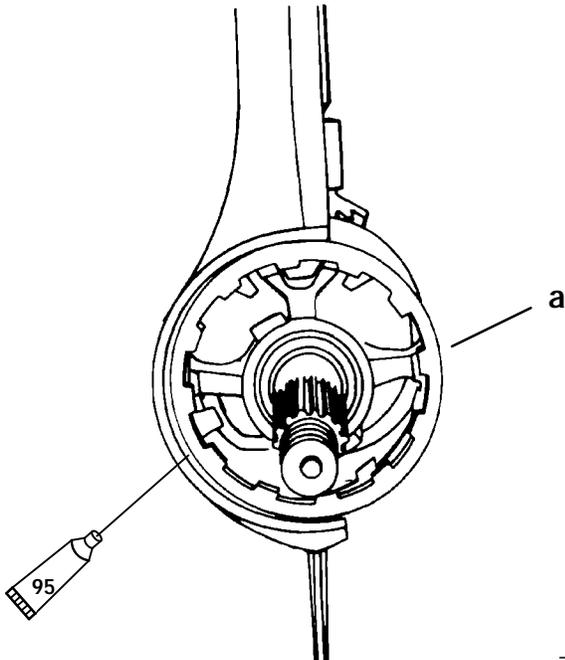
- Verify the "V" shaped tab aligns with the "V" notch in bearing carrier.



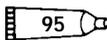
70714

- a - Tab Washer
- b - "V" Tab

- Fill the bearing carrier retainer nut threads and corresponding gear housing threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



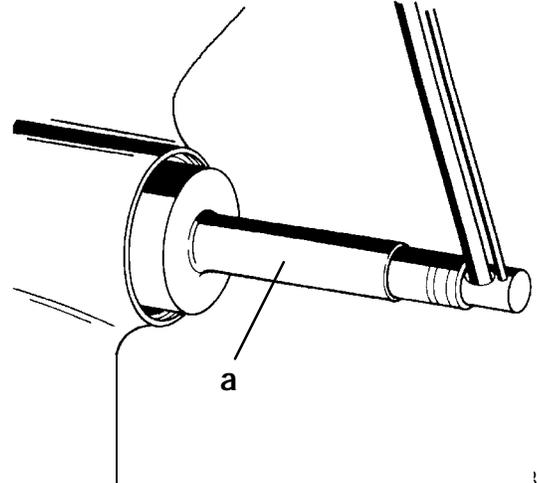
70715

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

- a - Bearing Carrier Retainer

IMPORTANT: Before torquing bearing carrier retainer, gear case must be bolted to drive shaft housing or securely fastened in a gear case holding fixture to avoid possible damage to gear housing.

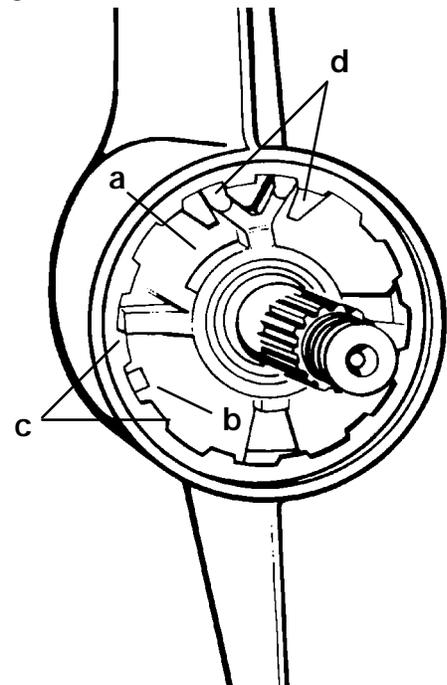
- Torque the bearing carrier retainer to 210 lb. ft. (284.7 N·m). If one tab does not align up in space between two of the notches, continue to tighten retainer until alignment is achieved. **DO NOT** loosen retainer to achieve alignment.



70716

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

- Bend one tab aft (outward) into a space between two of the notches of the retainer. Bend all the remaining tabs forward (inward).



70717

- a - Bearing Carrier
- b - Tab
- c - Retainer Notches
- d - Alignment Tabs (Bend Inward)

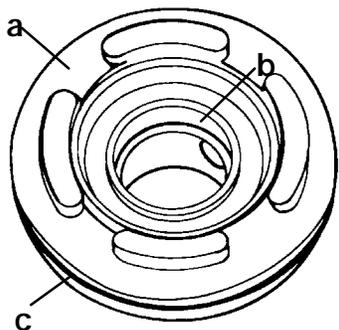


Oil Seal Carrier Assembly

Installation

NOTE: Apply hand pressure only to install the oil seal carrier into position. Do not hammer it into position.

1. Lubricate the oil seal carrier oil seal lips, space between seals and O-ring with 2-4-C w/Teflon and install the oil seal carrier over the drive shaft and into the gear case.



70501

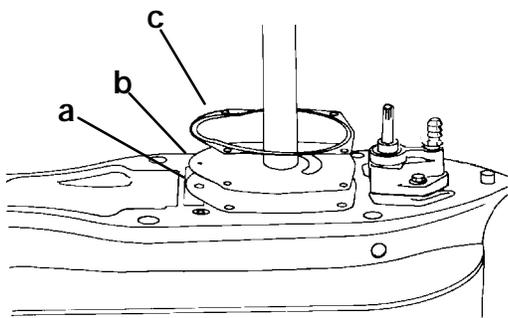
- a - Oil Seal Carrier
- b - Oil Seal Lips
- c - O-ring

Water Pump Assembly

Installation

NOTE: The gaskets/face plate hole pattern is not symmetrical. If the holes of the gaskets/face plate do not align with the screw holes of the gear case and/or each other, one or more of the parts is upside down. Determine which part(s) is (are) upside down and turn the appropriate part(s) over.

1. Install the small hole gasket then the face plate followed by the large hole gasket onto the gear case.



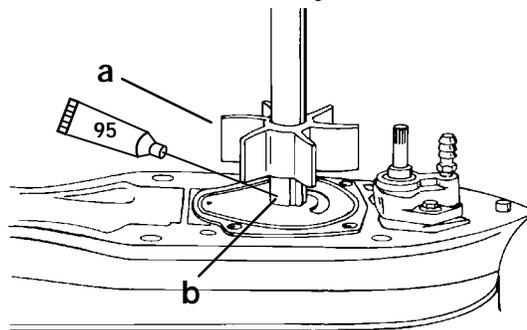
70720

- a - Small Hole gasket
- b - Face Plate
- c - Large Hole Gasket

2. Place a small amount of 2-4-C w/Teflon on the flat surface of the impeller key and install the key onto the drive shaft keyway.

IMPORTANT: When using an impeller whose blades have taken a set, face the curl of the blades in a counterclockwise direction. **DO NOT** install the impeller with its blades oriented in a reversed direction from original rotation, or premature impeller failure will occur.

3. Assemble the water pump impeller onto the drive shaft and down over the key.



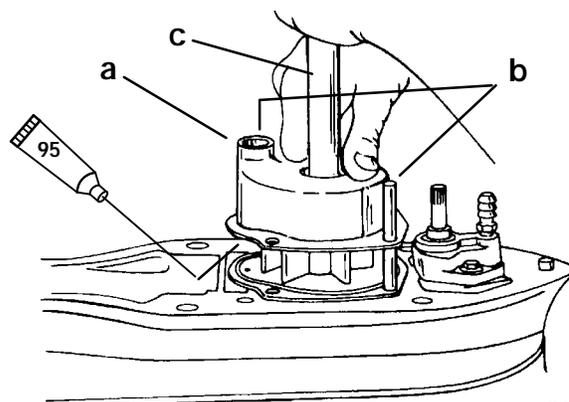
52725

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

- a - Water Pump Impeller
- b - Water Pump Impeller Key

4. Install the 2 water pump locating pins through the gaskets and face plate.

5. Apply a light coat of 2-4-C w/Teflon to the inside of the pump cover. Position the water pump body over the drive shaft and water pump locating pins. Rotate the drive shaft in a clockwise direction, while pushing down on the water pump body to ease the water pump over the impeller blades.



52751

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

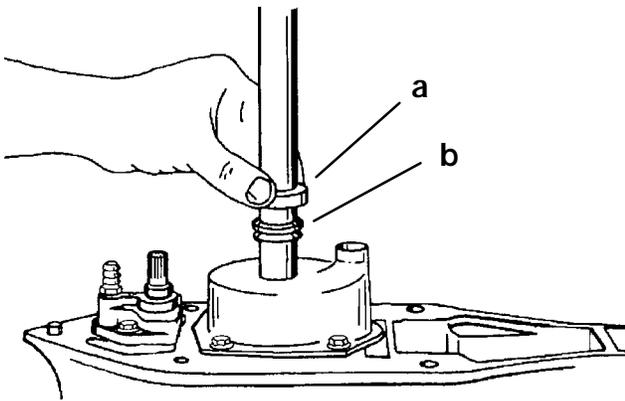
- a - Water Pump Body
- b - Water Pump Alignment Pins (91-821571A1)
- c - Drive Shaft (turn clockwise while installing water pump body)



- Hand start two (2) fasteners into the water pump assembly and remove the water pump locating pins. Install the remaining 2 fasteners. Run all fasteners down and torque to 60 lb. in. (6.8 N·m).
- Lightly lubricate the O-rings in the water tube coupling with 2-4-C w/Teflon (92-825407A12).
- Install the water tube coupling assembly to the water pump ensuring that the O-rings are not damaged during assembly.

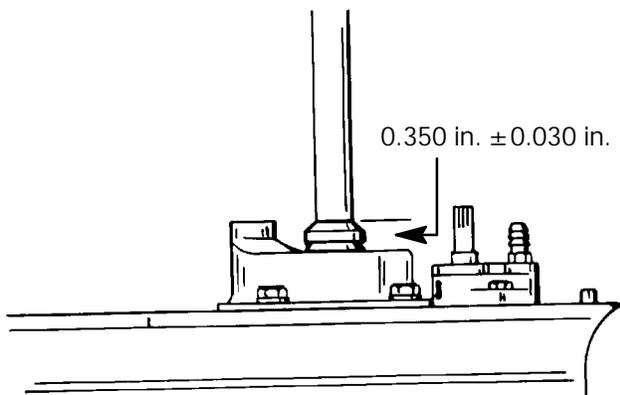
IMPORTANT: If seal installed above pump housing is not at the proper height, air will be drawn into the pump resulting in overheating of the engine.

- Using tool (a) provided in seal kit (26-816575A2) or water pump kit (817275A3), press seal (b) down over drive shaft (DO NOT GREASE DRIVE SHAFT) until tool seats against pump housing.



52724

If tool is not available, lightly press seal against housing until a height of 0.350 in. \pm 0.030 in. (8.9mm \pm 0.76mm) is obtained.



52726

NOTE: Secure speedometer tube to speedometer connector with a strap.

Gear Lubricant Filling Instructions

- Inspect "Fill" and "Vent" sealing washers for cuts or abrasions. Replace O-rings if necessary.
- Clean any metal debris from magnet on "Fill" plug.

IMPORTANT: Never add lubricant to gear housing without first removing "Vent" screw, or gear housing cannot be filled because of trapped air. Fill gear housing ONLY when housing is in a vertical position.

- Slowly fill housing thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.
- Install "Vent" screw into "Vent" hole.

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

- Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Drive Shaft Housing

⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing into drive shaft housing.

- Tilt engine to full up position and engage the tilt lock lever.
- Apply a light coat of 2-4-C w/Teflon onto drive shaft splines.

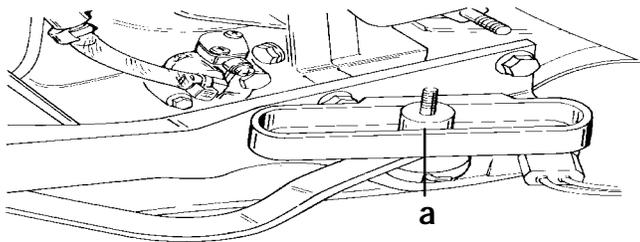
⚠ CAUTION

DO NOT allow lubricant on top of drive shaft. Excess lubricant, that is trapped in clearance space, will not allow drive shaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of drive shaft) will load the drive shaft/crankshaft and damage either or both the powerhead and gear housing. Top of drive shaft is to be wiped free of lubricant.

- Apply a light coat of 2-4-C w/Teflon onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)



4. Insert a NEW trim tab bolt (with patch) into hole in rear of gear housing to drive shaft housing machined surface.
5. Shift gear housing into NEUTRAL and place guide block anchor pin into NEUTRAL position.



52189

a - Guide Block Anchor Pin

6. Position gear housing so that the drive shaft is protruding into drive shaft housing.
7. Feed speedometer tube through opening in drive shaft housing.

NOTE: If, while performing Step 8, the drive shaft splines will not align with crankshaft splines, have helper rotate flywheel slightly to align drive shaft splines with crankshaft.

8. Move gear housing up toward drive shaft housing while aligning shift shaft splines and water tube.
9. Place flat washers onto studs (located on either side of drive shaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gear case up into place with attaching nuts.

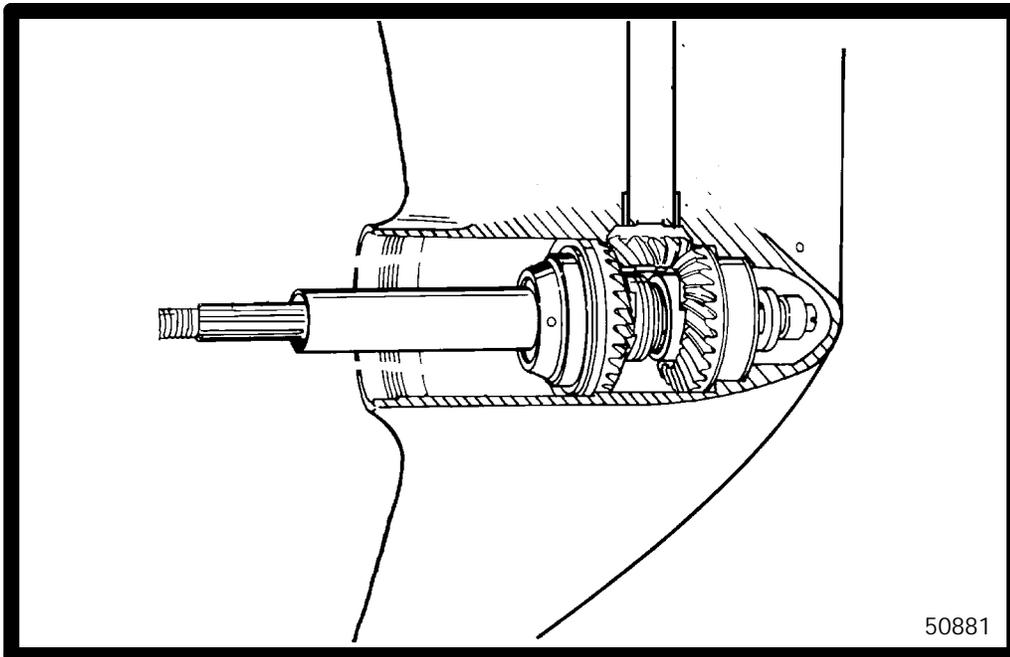
12. Evenly tighten 2 nuts which were started in Step 9. Torque to 55 lb. ft. (74.6 N·m).
13. After 2 nuts (located on either side of drive shaft housing) are tightened, check shift operation as follows:
 - a. Place guide block anchor pin into forward gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
 - b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
 - c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

14. Install remaining washers and nuts onto drive shaft studs. Torque to 55 lb. ft. (74.6 N·m).
15. Torque bolt (started in Step 10) to 45 lb. ft. (61.0 N·m).
16. Position trim tab in gear housing aligning grooves of trim tab with ribs in trim tab pocket. Adjust to position in which it had previously been installed, and while holding trim tab, torque bolt to 40 lb. ft. (54.2 N·m)
17. Install plastic cap into trim tab bolt opening at rear edge of drive shaft housing.



LOWER UNIT



6
B

**GEAR HOUSING
LEFT HAND OPERATION
(COUNTER ROTATION)
(RATCHETING AND NON-RATCHETING)**



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General Service Recommendations

There may be more than one way to “disassemble” or “reassemble” a particular part(s). It is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

Disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to “reassembly and installation” of that component in the reassembly part of this section. Use the “Table of Contents” (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, be sure that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply Quicksilver 2-4-C w/Teflon (92-825407A12) on all O-rings. To prevent wear, apply 2-4-C w/Teflon on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply Quicksilver Perfect Seal or 2-4-C w/Teflon to external surfaces of bearing carrier and retainer nut threads prior to installation. DO NOT allow Perfect Seal to enter bearings or O-ring area.

NOTE: Before filling gear case, apply 10-15 psi (68.5 - 102.7kPa) of air pressure at the VENT hole. Pressure should not drop for 15 seconds while alternately applying a 2-3 pound force to the top of the shift shaft in the fore and aft direction.



Gear Housing Specifications (Counter Rotation)

Backlash and Pinion Depth (Ratcheting and Non-Ratcheting)

Pinion Depth	
All Models	0.025 in. (0.64mm) with Tool 91-12349A2 Using Disc 2 and Flat 4
Forward Gear Backlash	
1.64:1 and 1.75:1 Gear Ratios 1.62:1 Gear Ratio Service Replacement	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-53549
Reverse Gear Backlash	
1.64:1 and 1.75:1 Gear Ratios 1.62:1 Gear Ratio Service Replacement	0.040 in. to 0.060 in. (1.01mm to 1.52mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)
Forward Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.017 in. to 0.028 in. (0.431mm to 0.711mm) Pointer on line mark #1 with Backlash Indicator Rod 91-78473
Reverse Gear Backlash	
1.87:1 Gear Ratio (High Altitude)	0.040 in. to 0.060 in. (1.01mm to 1.52mm)
Lubricant Capacity	28 fl. oz. (0.828 liter)

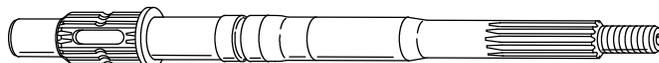
Gear Ratio	Teeth in Pinion Gear	Teeth in Forward and Reverse Gear
1.62:1	13	21
1.64:1	17	28
1.75:1	12	21
1.87:1	15	28

Water Pressure	
Idle	1-1/2 - 4-1/2 psi (10.3 - 30.8kPa)
Poppet Valve Opening	6 - 7 psi (41.1 - 47.9kPa)

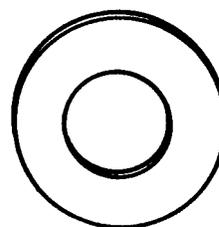
W.O.T.	8-10 psi 54.9 - 68.5kPa)
Test Propeller for Static Test	
12 Dia. x 15 Pitch	48-78116A40

Special Tools

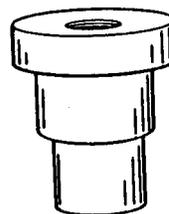
Propeller Shaft 44-93003 and Load Washer 12-37429



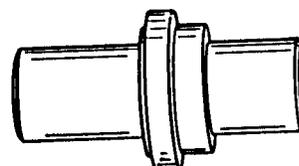
Bellville Washer 12-54048



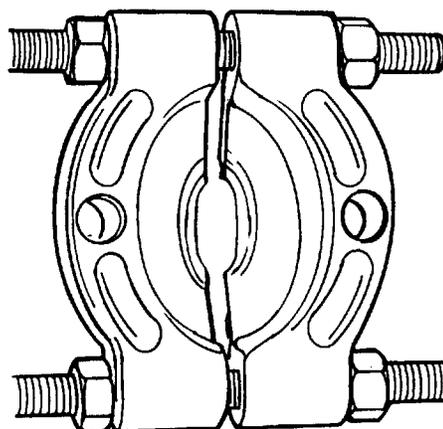
Needle Bearing Driver 91-15755



Oil Seal Driver 91-31108

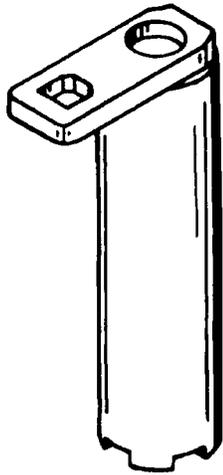


Universal Puller Plate 91-37241

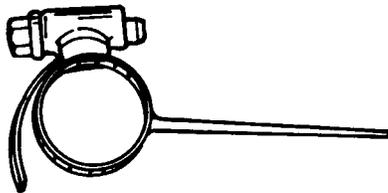




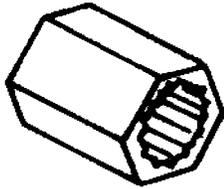
Bearing Retainer Tool 91-43506



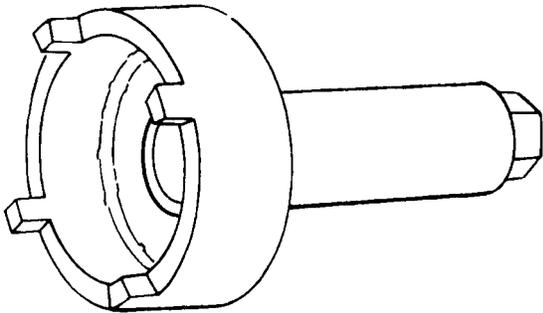
Backlash Indicator Rod 91-53459



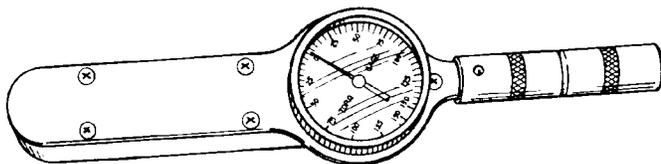
Drive Shaft Nut Wrench 91-56775



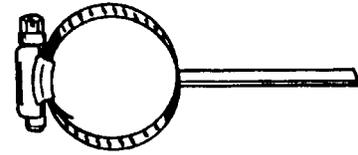
Bearing Carrier Retainer Wrench 91-61069



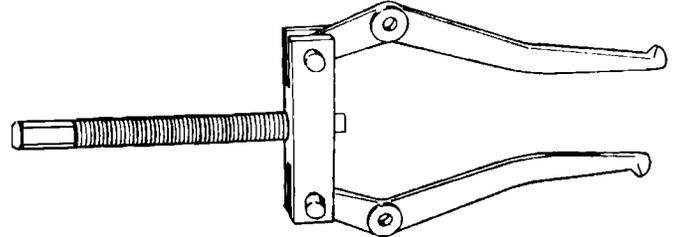
Torque Wrench (lb. in.) 91-66274



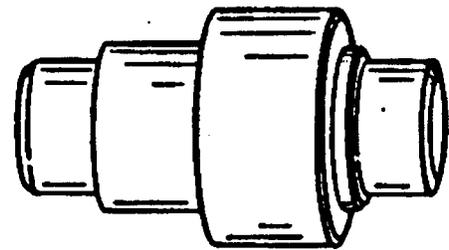
Backlash Indicator Rod 91-78473



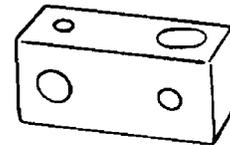
Puller Bolt 91-85716 and Puller Jaws 91-46086A1



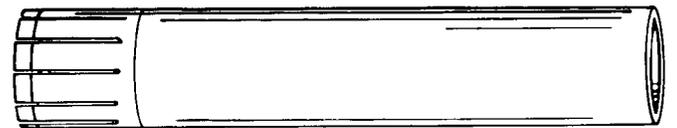
Forward Gear Bearing Tool 91-86943



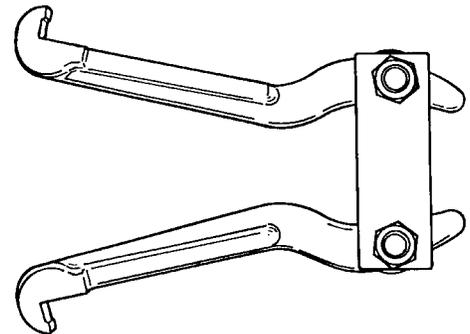
Dial Indicator Holding Tool 91-89897



Forward Gear Installation Tool 91-815850

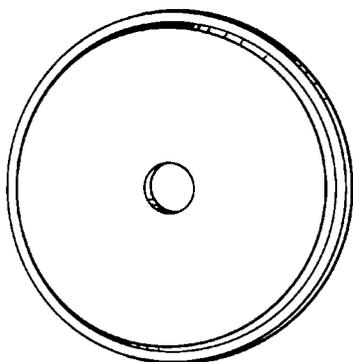


Puller Jaws 91-816242

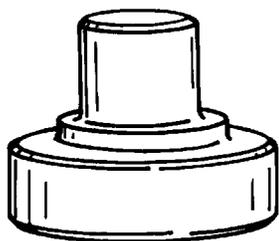




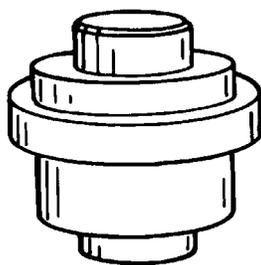
Guide Plate 91-816243



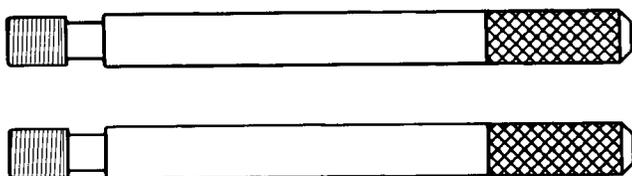
Bearing Driver 91-816244



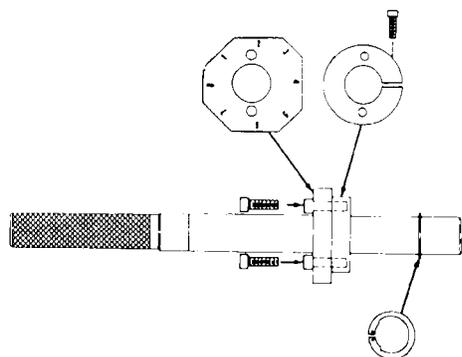
Oil Seal Driver 91-817569



Water Pump Alignment Pins 91-82157A1



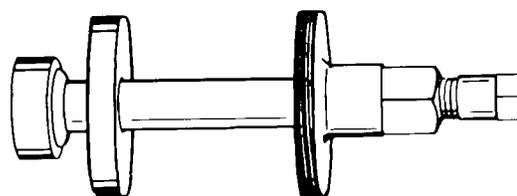
Pinion Gear Shimming Tool 91-12349A2



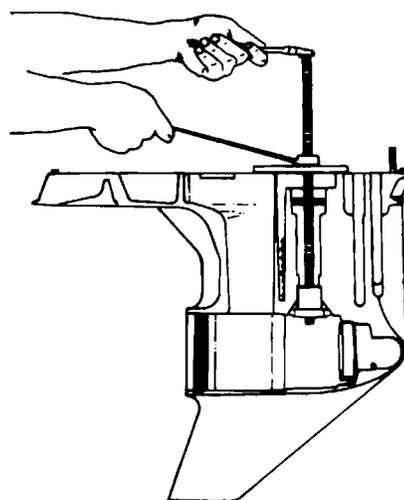
Bearing Preload Tool 91-14311A2



Bearing Adaptor Installation Tool 91-18605A2



Bearing Removal and Installation Tool 91-31229A7 - Includes Driver Head 91-36569; Driver Head Rod 91-37323; Nut 11-24156; Pilot Washer 91-36571; Pilot Plate 91-29610; Puller/Driver Head 91-38628; Mandrel 91-30366; Plate 91-29310; Driver Head 91-32325; Puller Shaft 91-31229; Washer 91-34961.

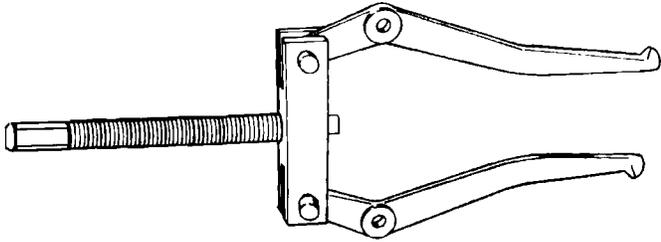




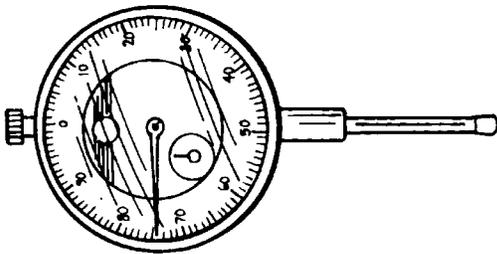
Slide Hammer Puller 91-34569A1



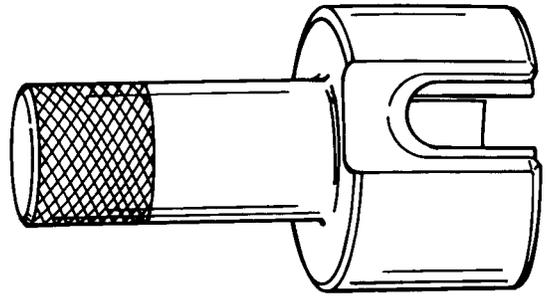
Puller Bolt 91-85716 and Puller Jaws 91-46086A1



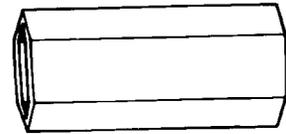
Dial Indicator 91-58222A1



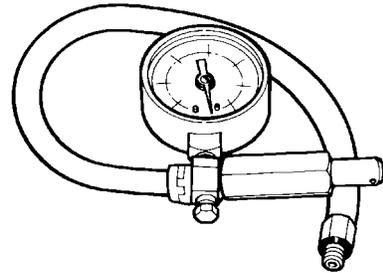
Pinion Nut Adaptor 91-61067A3



Drive Shaft Adaptor 91-61077

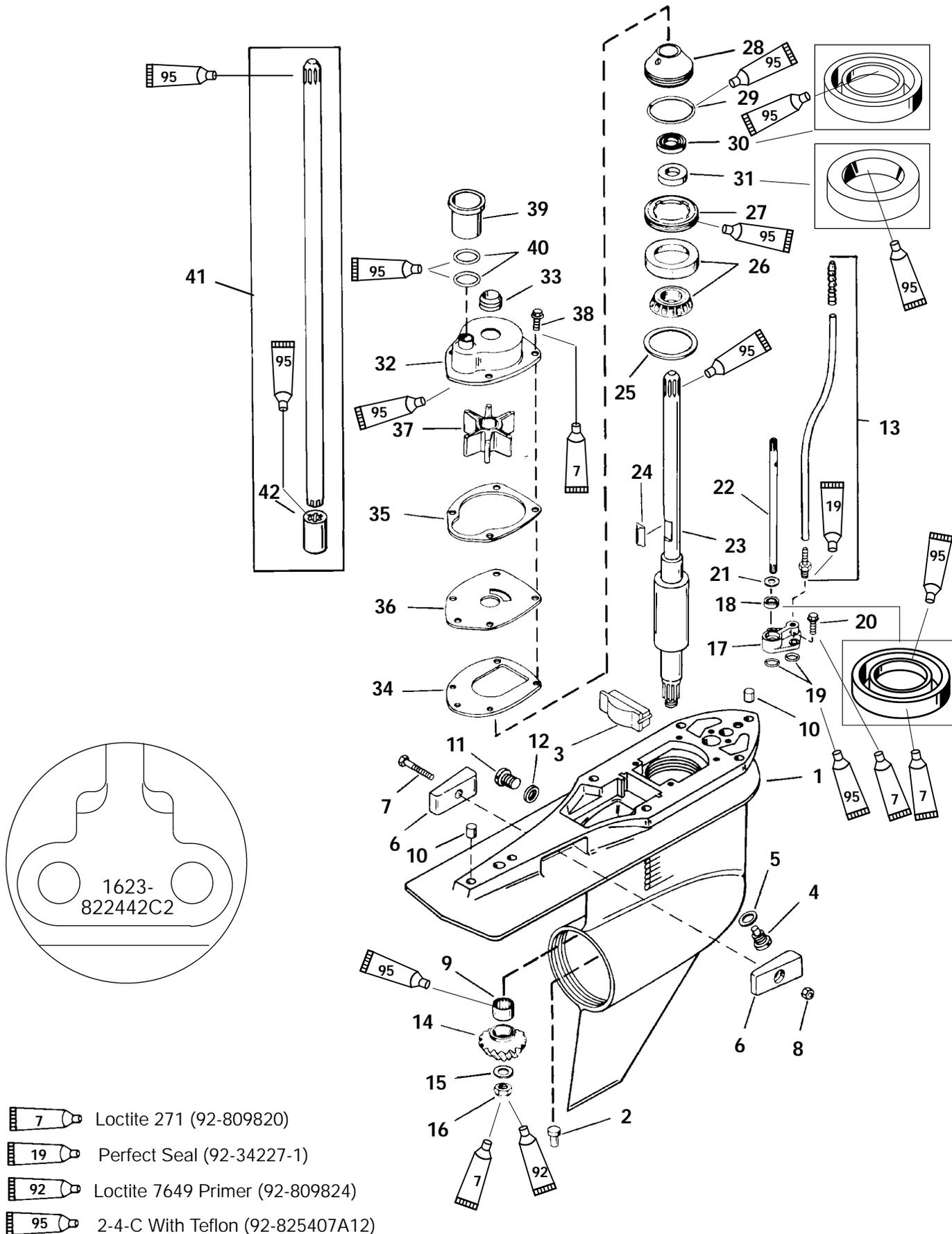


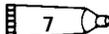
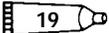
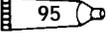
Leakage Tester FT8950





Gear Housing (Drive Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



-  7 Loctite 271 (92-809820)
-  19 Perfect Seal (92-34227-1)
-  92 Loctite 7649 Primer (92-809824)
-  95 2-4-C With Teflon (92-825407A12)



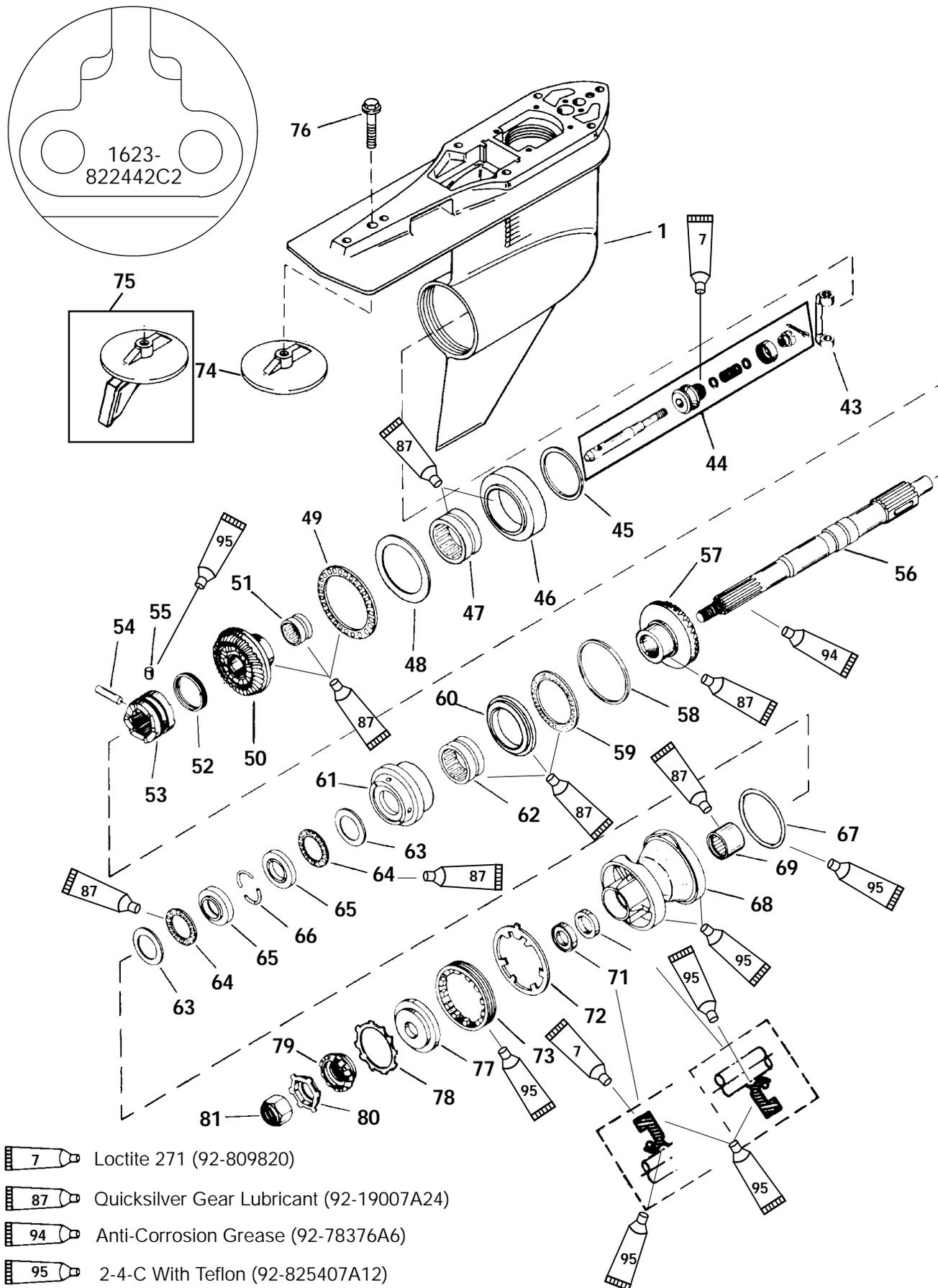
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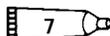
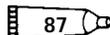
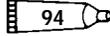
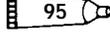
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW	60		6.8
8	1	NUT			
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR (X-LONG)			
	1	CONNECTOR (XX-LONG)			
14	1	PINION GEAR (Part of 43-826287A1 or 43-812975A5 or 43-828289A3)			
15	1	WASHER			
16	1	NUT		75	101
17	1	BUSHING ASSEMBLY			
18	1	OIL SEAL			
19	2	O RING			
20	2	SCREW	60		6.8
21	1	RUBBER WASHER			
22	1	SHIFT SHAFT (LOWER)			
23	1	DRIVE SHAFT (LOWER)			
24	1	KEY			
25	AR	SHIM			
26	1	TAPERED ROLLER BEARING			
27	1	RETAINER		100	135
28	1	CARRIER ASSEMBLY			
29	1	O RING			
30	1	OIL SEAL			
31	1	OIL SEAL			
32	1	WATER PUMP ASSEMBLY			
33	1	SEAL			
34	1	GASKET			
35	1	GASKET			
36	1	FACE PLATE			
37	1	IMPELLER			
38	4	SCREW	60		6.8
39	1	COUPLING ASSEMBLY			
40	2	O RING			
41	1	DRIVESHAFT KIT (LONG-20 IN.)			SEE NOTE
	1	DRIVESHAFT KIT (X-LONG-25 IN.)			13 SPLINES
	1	DRIVESHAFT KIT (X-LONG-30 IN.)			
	1	DRIVESHAFT KIT (LONG-20 IN.)			SEE NOTE
	1	DRIVESHAFT KIT (X-LONG-25 IN.)			8 SPLINES
42	1	COUPLING			

NOTE: Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the driveshaft and ORDER REF. #'s 23 & 41.



Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



-  Loctite 271 (92-809820)
-  Quicksilver Gear Lubricant (92-19007A24)
-  Anti-Corrosion Grease (92-78376A6)
-  2-4-C With Teflon (92-825407A12)

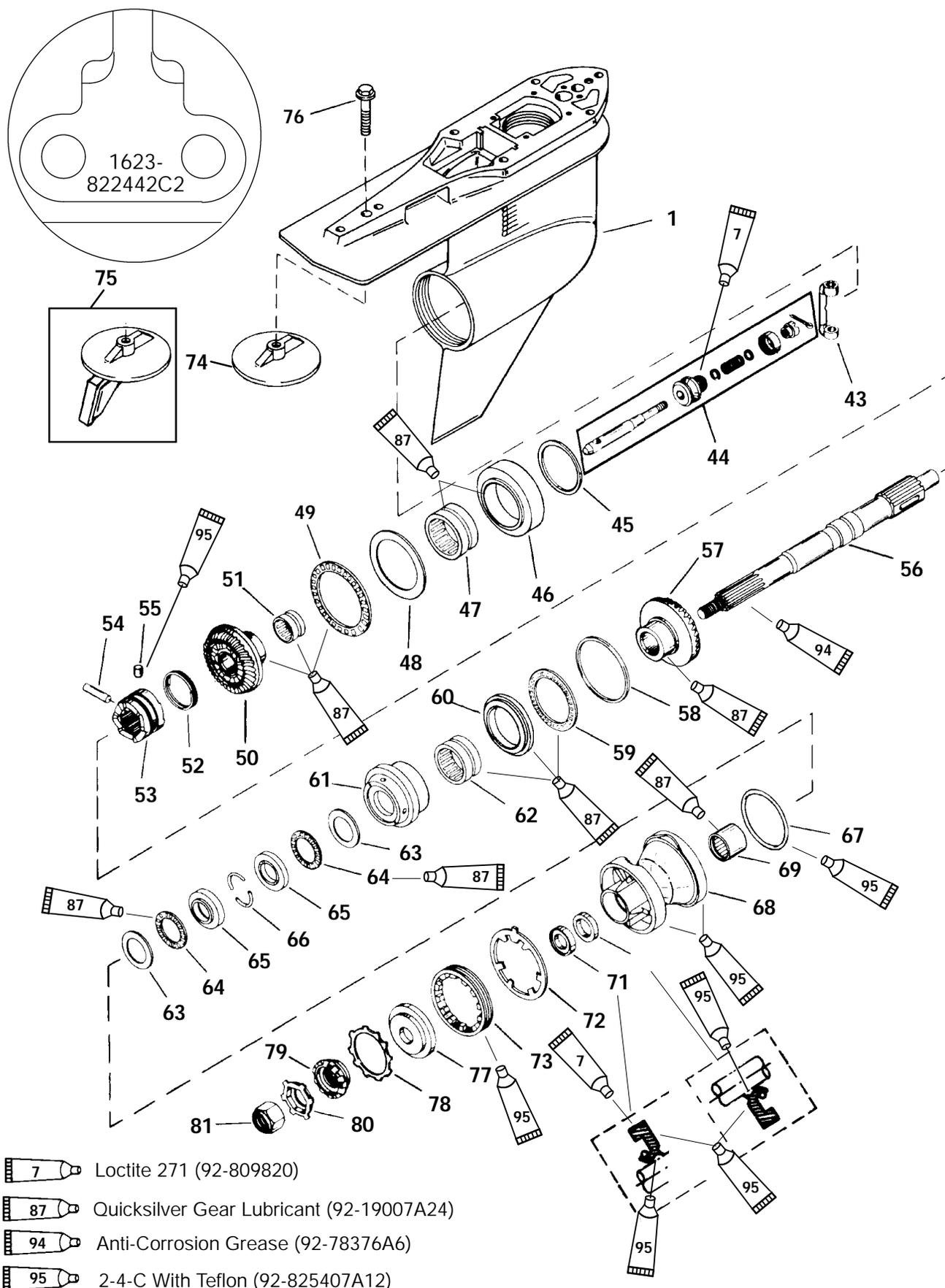


Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
43	1	SHIFT CRANK			
44	1	SHIFT SPOOL KIT			
45	AR	SHIM			
46	1	BEARING ADAPTOR ASSEMBLY (1623-822442C2 CASTING)			
47	1	ROLLER BEARING			
48	1	THRUST WASHER			
49	1	THRUST BEARING			
50	1	REVERSE GEAR (1.75:1 GEAR RATIO)			
	1	REVERSE GEAR (1.64:1 GEAR RATIO)			
	1	REVERSE GEAR (1.62:1 GEAR RATIO)			
51	1	ROLLER BEARING			
52	1	SPRING			
53	1	SLIDING CLUTCH			
54	1	CROSS PIN			
55	1	DETENT PIN			
56	1	PROPELLER SHAFT			
57	1	FORWARD GEAR (Includes Pinion)(1.75:1 GEAR RATIO)			
	1	FORWARD GEAR (Includes Pinion)(NOTE: THIS COMPLETE GEAR SET IS A 1.62:1 GEAR RATIO REPLACING A 1.64:1 GEAR RATIO)			
58	AR	SPACER SHIM .206 IN.			
	AR	SPACER SHIM .208 IN.			
	AR	SPACER SHIM .210 IN.			
	AR	SPACER SHIM .212 IN.			
	AR	SPACER SHIM .214 IN.			
	AR	SPACER SHIM .216 IN.			
	AR	SPACER SHIM .218 IN.			
	AR	SPACER SHIM .220 IN.			
	AR	SPACER SHIM .222 IN.			
	AR	SPACER SHIM .224 IN.			
	AR	SPACER SHIM .226 IN.			
	AR	SPACER SHIM .228 IN.			
AR	SPACER SHIM .230 IN.				



Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)



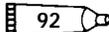
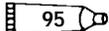


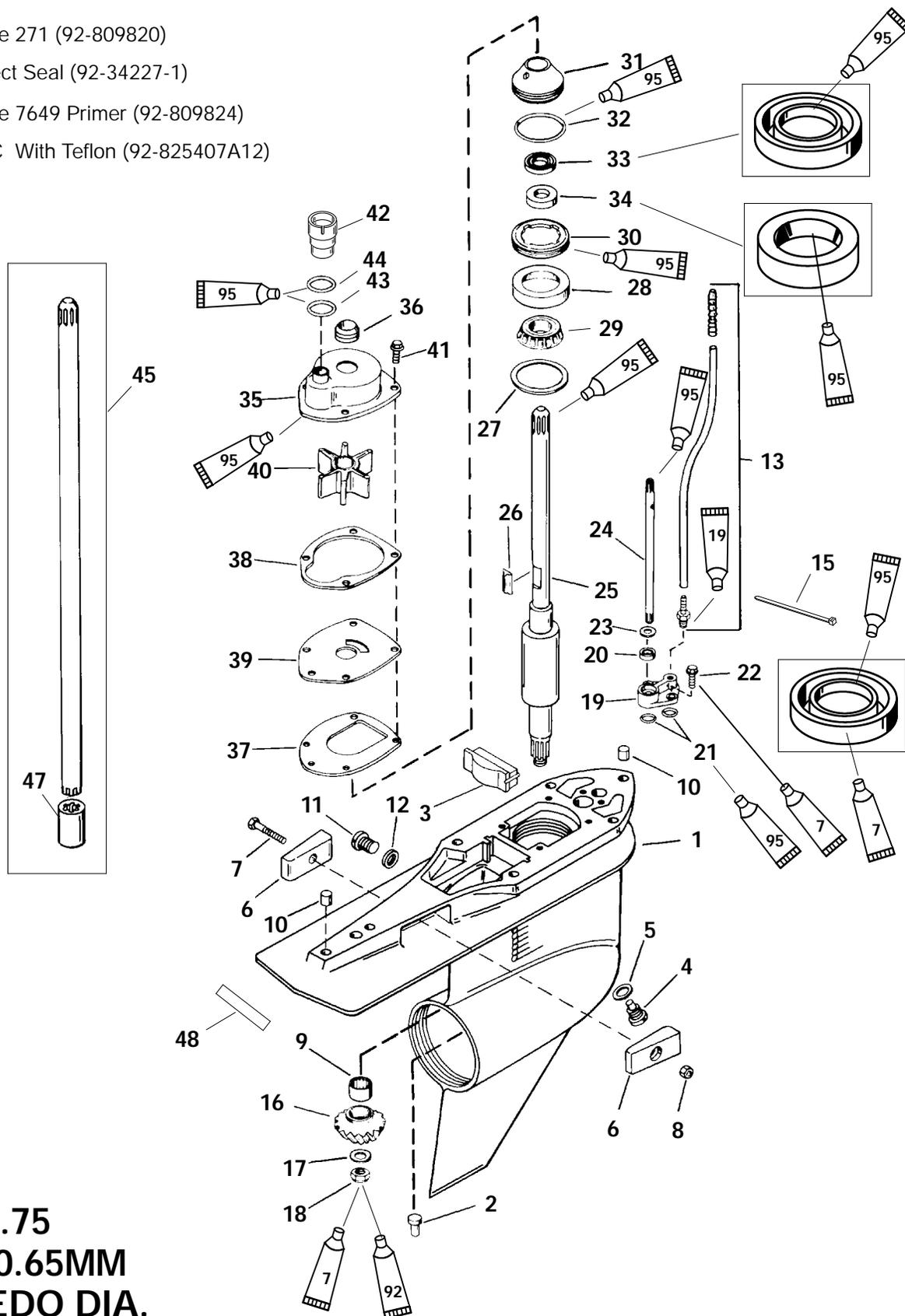
Gear Housing (Prop Shaft) (Counter Rotation)(Ratcheting) (S/N-0G437999 & BELOW)(CASTING #1623-822442C2)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	GEAR HOUSING			
59	1	ROLLER BEARING			
60	1	THRUST RING			
61	1	BEARING ADAPTOR ASSEMBLY			
62	1	ROLLER BEARING			
63	2	THRUST WASHER			
64	2	THRUST BEARING			
65	2	THRUST RACE			
66	2	KEEPER			
67	1	O RING			
68	1	BEARING CARRIER ASSEMBLY			
69	1	ROLLER BEARING			
70	1	OIL SEAL (INSIDE)			
71	1	OIL SEAL (OUTSIDE)			
72	1	TAB WASHER			
73	1	RETAINER	210		285
74	1	ANODIC PLATE			
75	1	TRIM TAB (ANODIC)			
	1	TRIM TAB (BLACK ALUMINUM)			
76	1	SCREW THESE REPLACEMENT		40	54.2
77	1	THRUST HUB PARTS ARE NOT			
78	1	LOCKWASHER INCLUDED WITH			
79	1	WASHER COMPLETE GEAR			
80	1	TAB WASHER REPLACEMENT			
81	1	PROPELLER NUT		55	74.6



Gear Housing (Drive Shaft) (Counter Rotation) (Non-Ratcheting) (S/N-0G438000 & UP) (CASTING #1623-822442C3)

-  7 Loctite 271 (92-809820)
-  19 Perfect Seal (92-34227-1)
-  92 Loctite 7649 Primer (92-809824)
-  95 2-4-C With Teflon (92-825407A12)



**4.75
IN/120.65MM
TORPEDO DIA.**



Gear Housing (Drive Shaft) (Counter Rotation) (Non-Ratcheting) (S/N-0G438000 & UP) (CASTING #1623-822442C3)

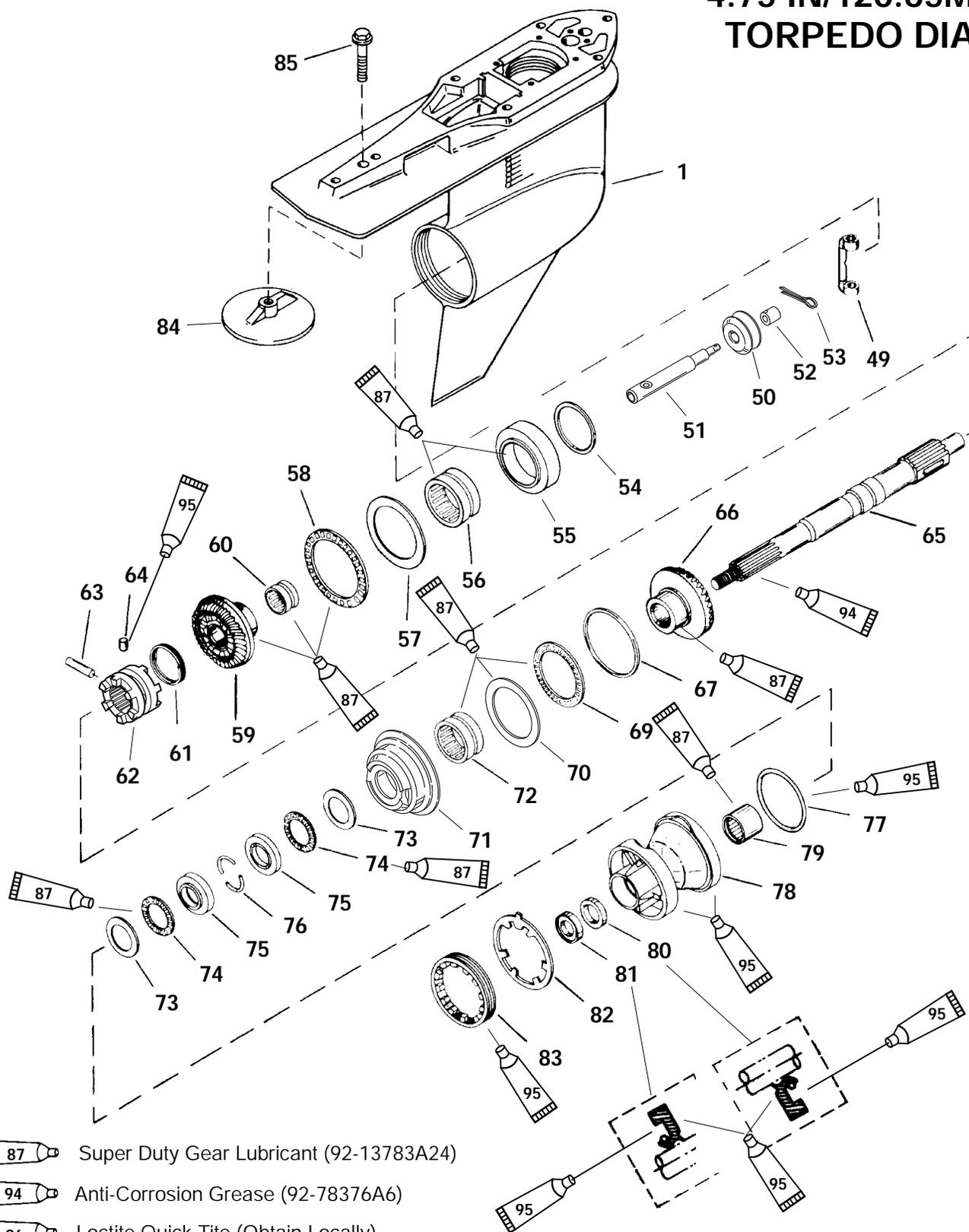
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	GEAR HOUSING (BLACK) BASIC			
1	1	GEAR HOUSING (GRAY)			
2	1	PIN			
3	1	FILLER BLOCK			
4	1	MAGNETIC SCREW	60		6.8
5	1	SEALING WASHER			
6	2	ANODE			
7	1	SCREW	60		6.8
8	1	NUT			
9	1	ROLLER BEARING			
10	2	DOWEL PIN			
11	1	SCREW ASSEMBLY	60		6.8
12	1	SEALING WASHER			
13	1	CONNECTOR (XL)			
14	1	CONNECTOR (XXL)			
15	1	CABLE TIE			
16	1	PINION GEAR (Part of 43-828695A1) (1.75:1 - 12/21)			
17	1	WASHER			
18	1	NUT		75	101
19	1	BUSHING ASSEMBLY			
20	1	OIL SEAL			
21	2	O RING			
22	2	SCREW (M6 x 16)	60		6.8
23	1	RUBBER WASHER			
24	1	SHIFT SHAFT (LOWER)			
25	1	DRIVE SHAFT (LOWER)			
26	1	KEY			
27	AR	SHIM SET			
28	1	TAPERED ROLLER BEARING			
29	1	CUP			
30	1	RETAINER		100	135
31	1	CARRIER ASSEMBLY			
32	1	O RING			
33	1	OIL SEAL			
34	1	OIL SEAL			
35	1	WATER PUMP ASSEMBLY			
36	1	SEAL			
37	1	GASKET			
38	1	GASKET			
39	1	FACE PLATE			
40	1	IMPELLER			
41	4	SCREW (M6 x 16)	60		6.8
42	1	COUPLING ASSEMBLY			
43	1	O RING			
44	1	O RING			
45	1	DRIVESHAFT KIT (X-LONG-25 IN.) SEE NOTE			
46	1	DRIVESHAFT KIT (XX-LONG-30 IN.)			
47	1	COUPLING			
48	1	DECAL-Counter Rotation			

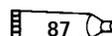
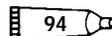
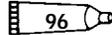
NOTE: Service replacement of the one (1) piece driveshaft is not being offered. Determine the length of the drive-shaft and ORDER REF. #'s 24 & 44.



Gear Housing (Prop Shaft) (Counter Rotation) (Non-Ratcheting) (S/N-0G438000 & UP) (CASTING #1623-822442C3)

4.75 IN/120.65MM
TORPEDO DIA.



-  Super Duty Gear Lubricant (92-13783A24)
-  Anti-Corrosion Grease (92-78376A6)
-  Loctite Quick Tite (Obtain Locally)



Gear Housing (Prop Shaft)(Counter Rotation)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N-m
1	1	GEAR HOUSING (BLACK) BASIC			
1	1	GEAR HOUSING (GRAY)			
49	1	SHIFT CRANK			
50	1	SHIFT SPOOL			
51	1	SPOOL			
52	1	SLEEVE			
53	1	COTTER PIN		55	74.6
54	AR	SHIM SET			
55	1	BEARING ADAPTOR ASSEMBLY			
56	1	ROLLER BEARING			
57	1	THRUST WASHER			
58	1	THRUST BEARING			
59	1	REVERSE GEAR (1.75:1 - 12/21)			
60	1	ROLLER BEARING			
61	1	SPRING			
62	1	SLIDING CLUTCH			
63	1	CROSS PIN			
64	1	DETENT PIN			
65	1	PROPELLER SHAFT			
66	1	FORWARD GEAR (1.75:1 - 12/21)			
67	AR	SPACER SHIM .206 IN.			
68	AR	SPACER SHIM .208 IN.			
	AR	SPACER SHIM .210 IN.			
	AR	SPACER SHIM .212 IN.			
	AR	SPACER SHIM .214 IN.			
	AR	SPACER SHIM .216 IN.			
	AR	SPACER SHIM .218 IN.			
	AR	SPACER SHIM .220 IN.			
	AR	SPACER SHIM .222 IN.			
	AR	SPACER SHIM .224 IN.			
	AR	SPACER SHIM .226 IN.			
69	1	ROLLER BEARING			
70	1	THRUST RING			
71	1	BEARING ADAPTOR ASSEMBLY			
72	1	ROLLER BEARING			
73	2	THRUST WASHER			
74	2	THRUST BEARING			
75	2	THRUST RACE			
76	2	KEEPER			
77	1	O RING			
78	1	BEARING CARRIER ASSEMBLY			
79	1	ROLLER BEARING			
80	1	OIL SEAL (INSIDE)			
81	1	OIL SEAL (OUTSIDE)			
82	1	TAB WASHER			
83	1	COVER		210	285
84	1	ANODIC PLATE			
85	1	SCREW		40	54.2



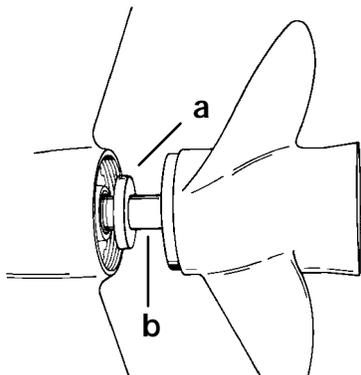
Removal, Disassembly, Cleaning and Inspection - Counter Rotation (Ratcheting and Non-Ratcheting)

REMOVAL

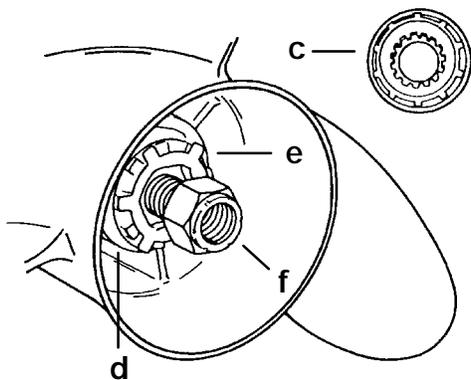
⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from drive shaft housing.

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



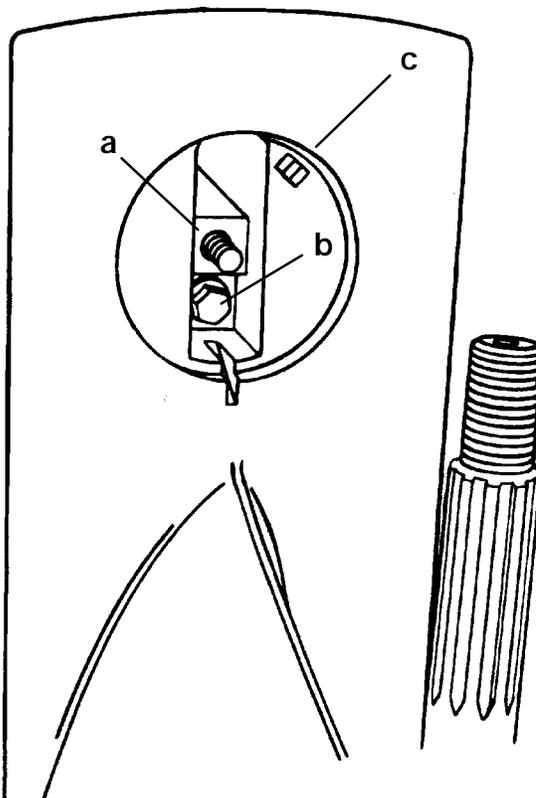
51912



51916

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

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of drive shaft housing, then unthread bolt that secures trim tab and remove trim tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.

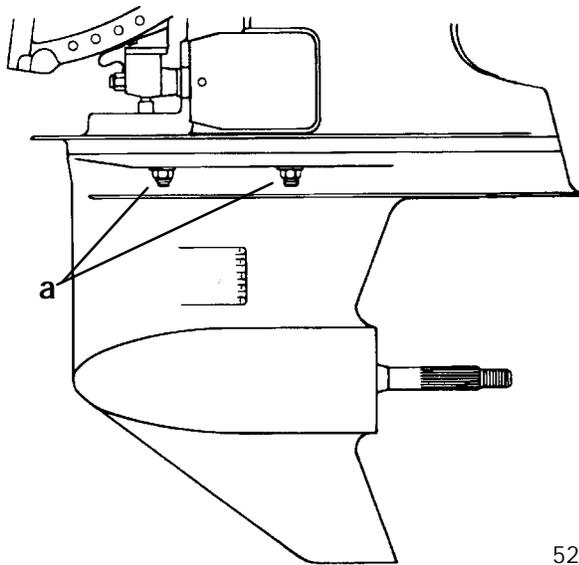


52375

- a - Bolt (Secures Trim Tab)
 - b - Bolt (Inside Trim Tab Cavity)
 - c - Ribs - Align Carefully with Trim Tab while Securing Tab
7. Disconnect speedometer tube, if connected.
 8. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or drive shaft housing could be damaged.)
 9. Pull gear housing away from drive shaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)



10. Pull gear housing from drive shaft housing.

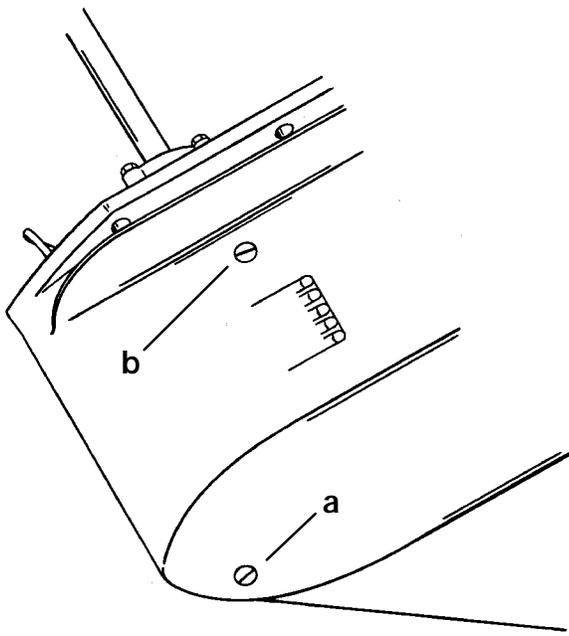


52374

- a - Front Mounting Locknut
- b - Side Mounting Locknut (One Each Side)

DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the drive shaft in a vertical position.
2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing. Do not loose sealing washers on FILL and VENT screws.



52377

- a - "Fill" Screw
- b - "Vent" Screw

3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. Check drain pan for water separation from lubricant. Presence of water in gear lubricant indicates the need for disassembly, and inspection of oil seals, seal surfaces, O-rings and gear housing components.

NOTE: Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.

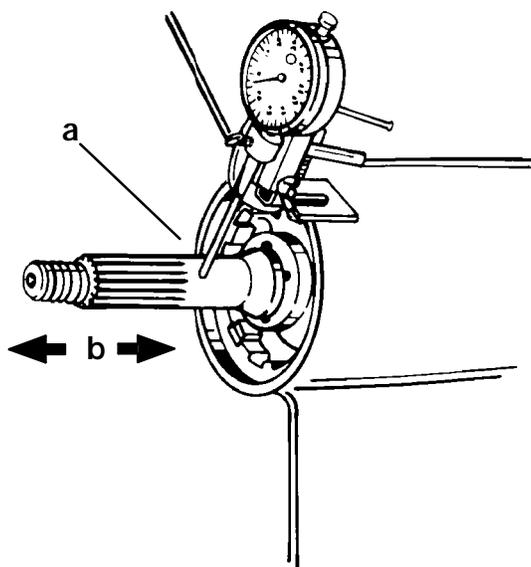


Pre-Disassembly Inspection

Propeller Shaft

INSPECTION

1. Inspect the propeller shaft for side to side movement, as follows:
 - a. Position the dial indicator on the propeller shaft.
 - b. Push the propeller shaft to one side and zero the dial indicator.
 - c. Move the propeller shaft to the opposite side while observing the dial indicator. Without rotating the propeller shaft, reposition the dial indicator and check the up and down deflection. A shaft deflection of more than 0.003 in. (0.08 mm) indicates a worn propeller shaft bearing.
2. Check for a bent propeller shaft as follows:
 - a. Rotate the propeller shaft while observing the dial indicator. If the deflection is more than 0.009 in. (0.23 mm), a bent propeller shaft is indicated.
3. Measure propeller shaft endplay. If it is in excess of 0.093 in. (2.36mm), disassemble gear case and check condition of the reverse shoulder of the propeller shaft, reverse gear and thrust washer. Replace components as required.



22086

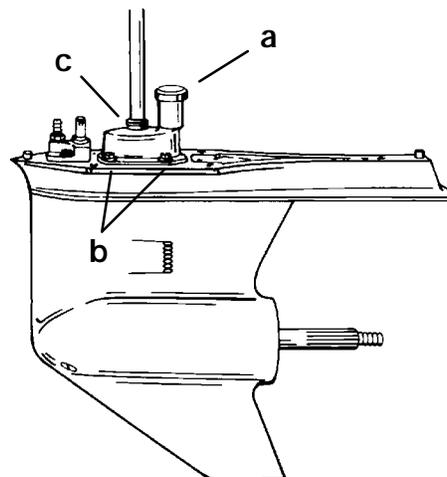
- a - Prop Shaft Runout
- b - Prop Shaft Endplay

Gear Housing and Component Disassembly

Water Pump Assembly

REMOVAL

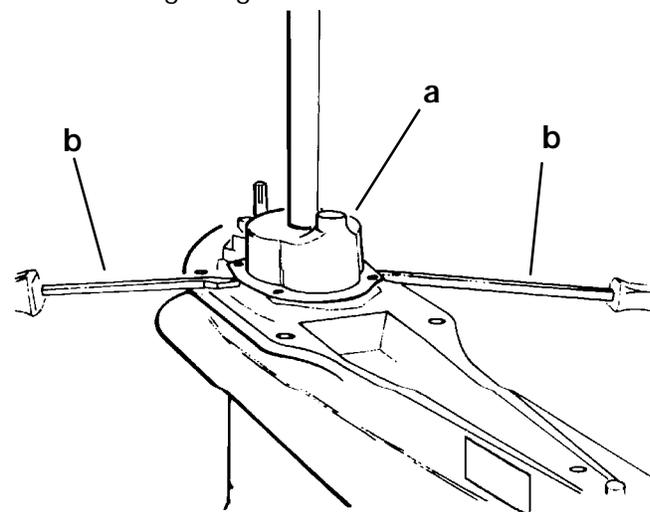
1. Remove the water seal, water tube coupling assembly, and the water pump screws.



52749

- a - Water Tube Assembly
- b - Water Pump Screws (4)
- c - Seal

2. Carefully slide the water pump straight up off of the drive shaft. It may be necessary to encourage the water pump up by gently prying up on its mounting flanges with screwdrivers.

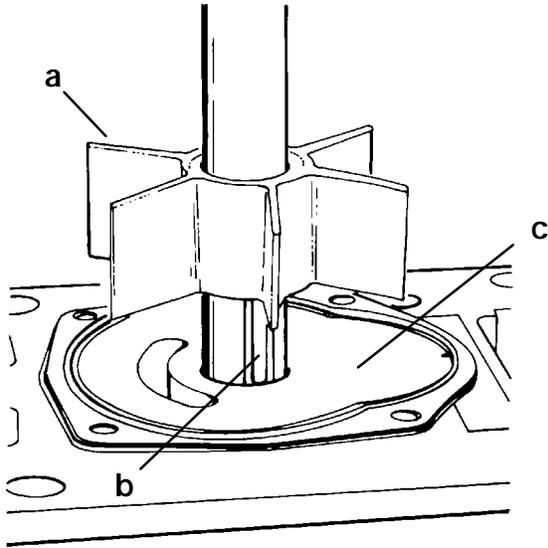


70487

- a - Water Pump Body
- b - Screw Drivers



3. Remove the impeller, impeller key, the face plate and gaskets, (discard the gaskets).

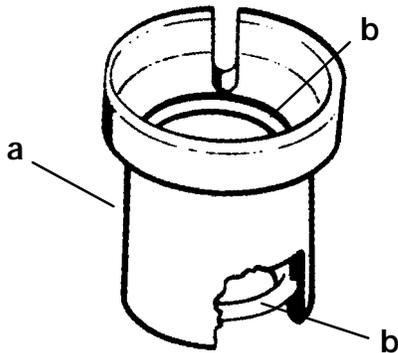


70605

- a - Impeller
- b - Impeller Key
- c - Water Pump Face Plate and Gaskets
(One on each side of the face plate)

WATER PUMP ASSEMBLY - COMPONENT INSPECTION

1. Inspect the water tube coupling assembly for wear or damage. If necessary, replace the worn or damaged components especially the two O-rings on the inside, one at the top and one at the bottom.

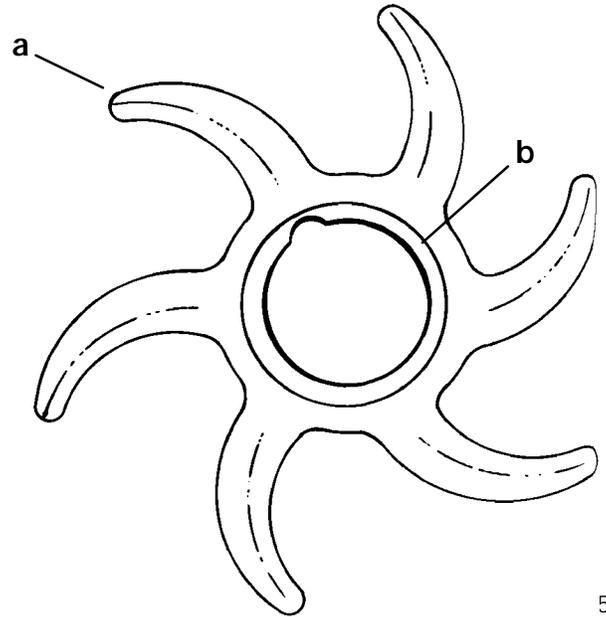


70613

- a - Water Tube adapter
- b - O-rings (2)

2. Inspect the water pump impeller for wear on the end, top and bottom of the impeller blades. Replace the impeller if this condition is found.

3. Inspect for proper bonding between the hub and the impeller. Replace the impeller if improper bonding is found.



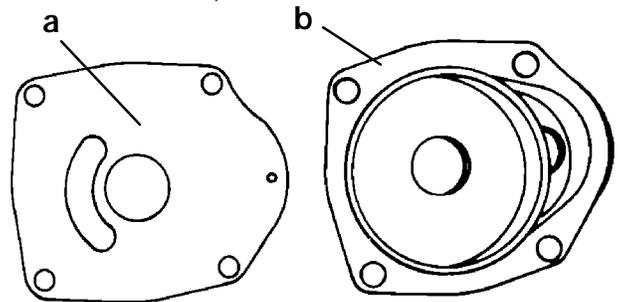
500

- a - Impeller
- b - Hub

4. Inspect the impeller blades to see if they are cracked, burnt, hard or deformed. Replace the impeller if the blades are in this condition.

IMPORTANT: The circular groove formed by the impeller sealing bead should be disregarded when inspecting cover and plate. The depth of the groove will not affect water pump output.

5. Replace cover if thickness of steel at the discharge slot is 0.060 in. (1.5mm) or less or if grooves (other than impeller sealing bead groove) in cover roof are more than 0.030 in. (0.76mm) deep.



70609

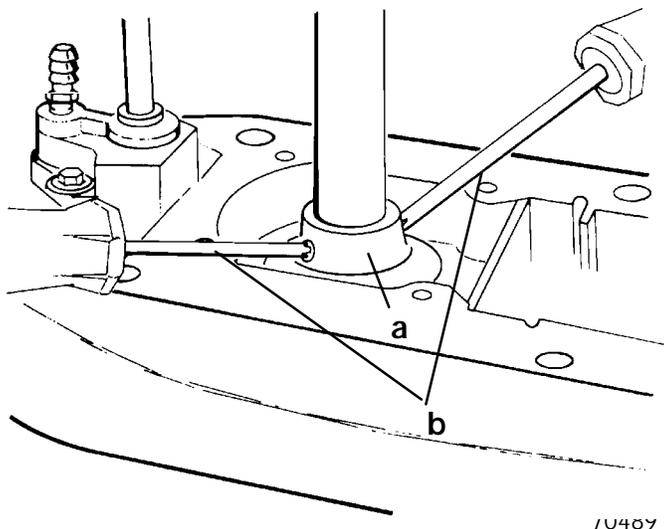
- a - Water Pump Face Plate
- b - Water Pump Cover



Oil Seal Carrier Assembly

REMOVAL

1. Remove the oil seal carrier from the gear housing. It may be necessary to gently pry up on it with two screw drivers.



- a - Oil Seal Carrier
- b - Screwdrivers

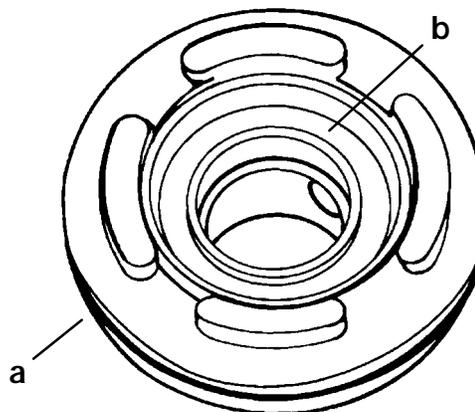
OIL SEAL CARRIER ASSEMBLY - INSPECTION

1. Inspect the oil seal carrier, O-ring, and seals for wear and/or damage. If necessary, replace defective parts as outlined following.

OIL SEAL CARRIER ASSEMBLY - COMPONENT DISASSEMBLY

NOTE: Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.

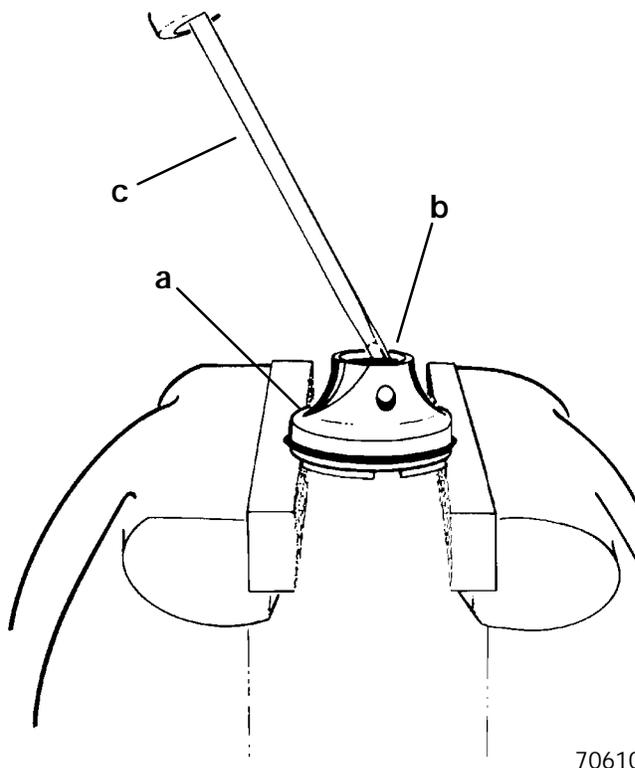
1. Remove the O-ring.



70501

- a - O-ring
- b - Oil Seals (2)

2. Remove the oil seals.



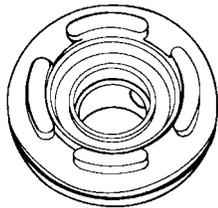
70610

- a - Oil Seal Carrier
- b - Oil Seals
- c - Screwdriver



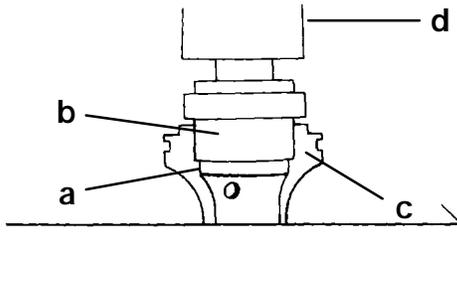
OIL SEAL CARRIER ASSEMBLY - COMPONENT REASSEMBLY (1994/1995 MODELS)

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.



70501

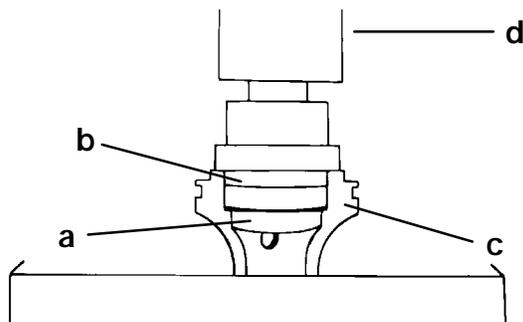
1. Assemble the small oil seal (with the lips of the oil seal facing away from the driver shoulder) onto the long end of the oil seal driver.
2. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



70611

- a - Oil Seal
- b - Oil Seal Driver (91-817569) use long end
- c - Oil Seal Carrier
- d - Press

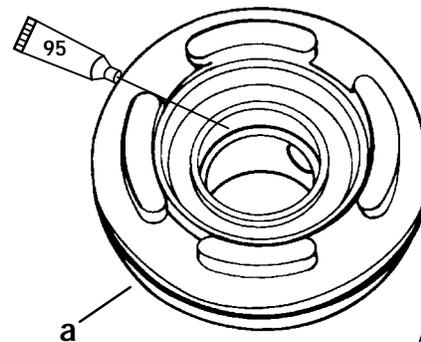
3. Assemble the large oil seal (with the lips of the oil seal facing the driver shoulder) onto the short end of the oil seal driver.
4. Press on the oil seal driver until the driver bottoms against the carrier. Do not press so hard as to damage the oil seal carrier while driving the oil seal.



70612

- a - Oil Seal
- b - Oil Seal Driver (91-817569) use short end
- c - Oil Seal Carrier
- d - Press

5. Fill the area between the seal lips with 2-4-C w/Teflon. Apply 2-4-C w/Teflon to the O-ring.
6. Install the O-ring onto the oil seal carrier.



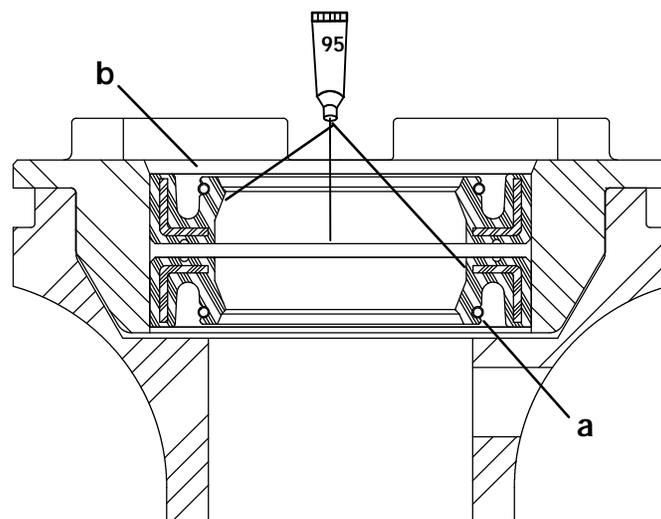
70501



a - O-ring

OIL SEAL CARRIER ASSEMBLY - COMPONENT REASSEMBLY (1996/1997 MODELS)

The oil seals in 1996/1997 carrier assemblies are the same diameter. The bottom (first) seal lip faces down; the top (second) seal lip faces up. Apply 2-4-C w/Teflon Marine Lubricant to seal lips and between seals. Press seal into carrier with suitable mandrel. Second seal should be pressed in flush with carrier surface.



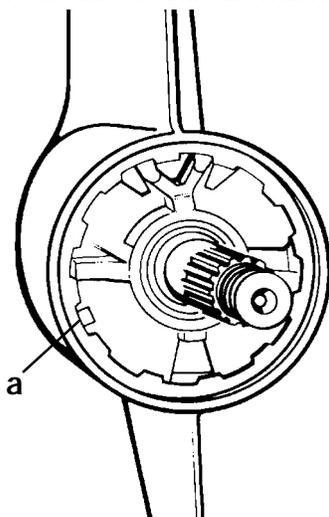
- a - Bottom Seal (Lip Faces Down)
- b - Top Seal (Lip Faces Up)



Bearing Carrier Assembly

REMOVAL

1. Straighten the tab on the tab washer.



70490

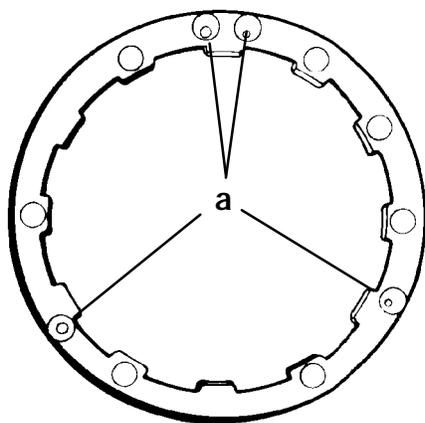
a - Tab on Tab Washer

2. Remove the bearing carrier retainer following step a or b as follows:

⚠ CAUTION

DO NOT drill into the gear housing retainer threads when using the following procedure for removing the retainer.

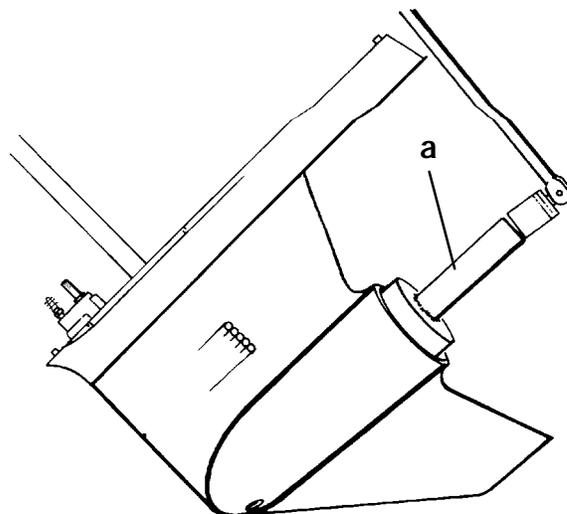
- a. If the retainer is corroded in place, drill 4 holes in the retainer and fracture the retainer with a chisel. Pry the remaining segments out.



23356

a - Drilled Holes

- b. Remove the bearing carrier retainer using the Bearing Carrier Retainer Wrench (91-61069).

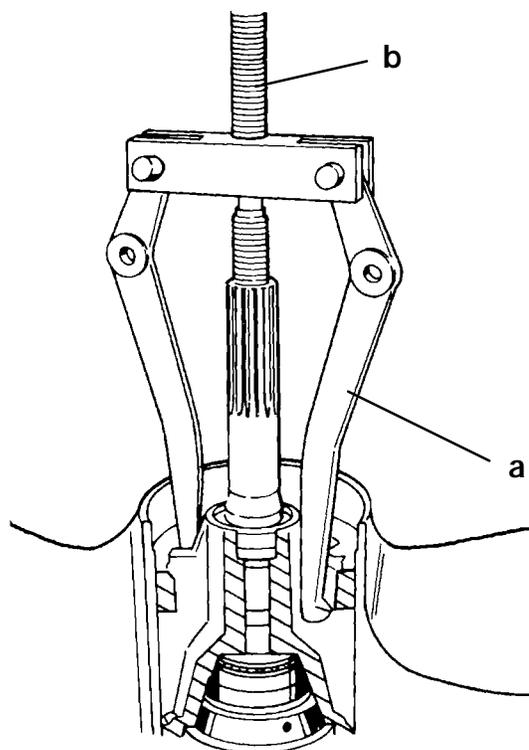


.0491

a - Bearing Carrier Retainer Wrench

3. Pull the bearing carrier from the gear housing by pulling on the outer ring of the bearing carrier. POSITION PULLER JAWS CLOSE TO BOSSES IN CARRIER.

NOTE: If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.



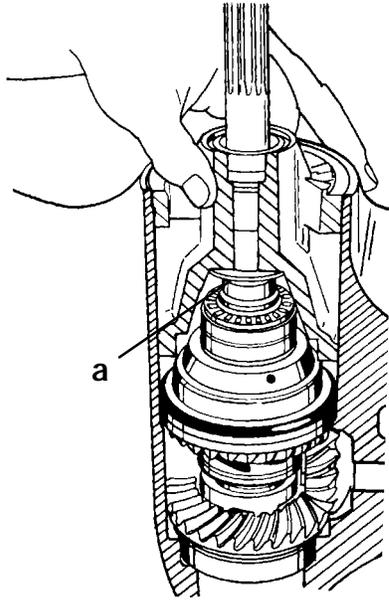
.0786

a - Puller Jaws (91-46086A1)

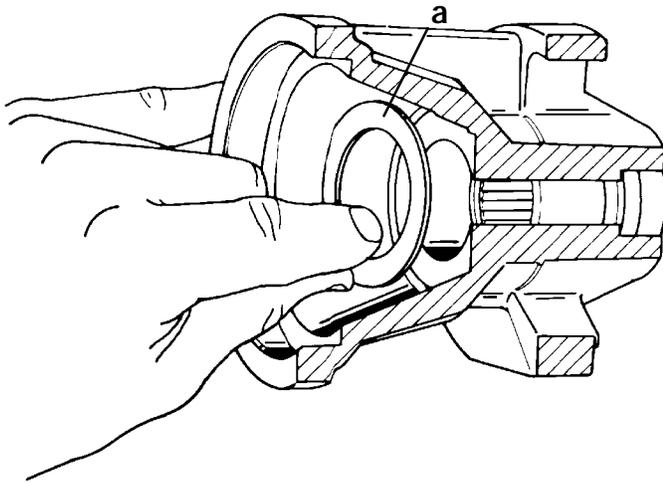
b - Puller Bolt (91-85716)



4. Lift the bearing carrier out of the gear housing. Locate and retain the thrust washer that may be stuck to the inside surface of the bearing carrier.



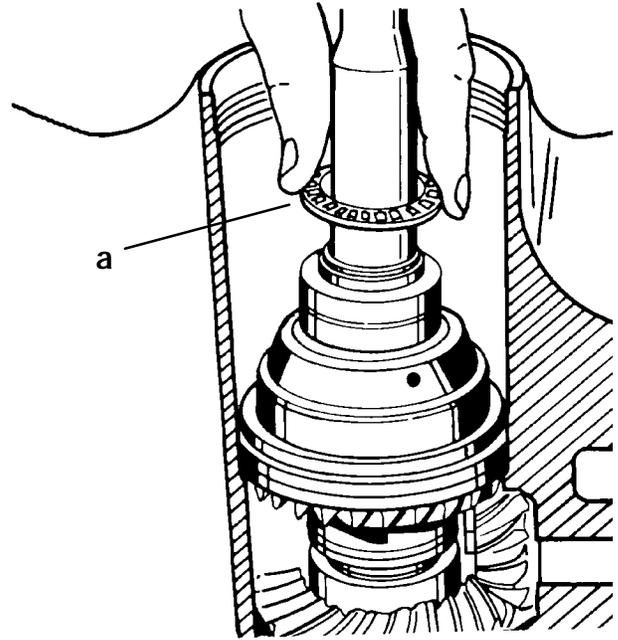
50826



50779

a - Thrust Washer

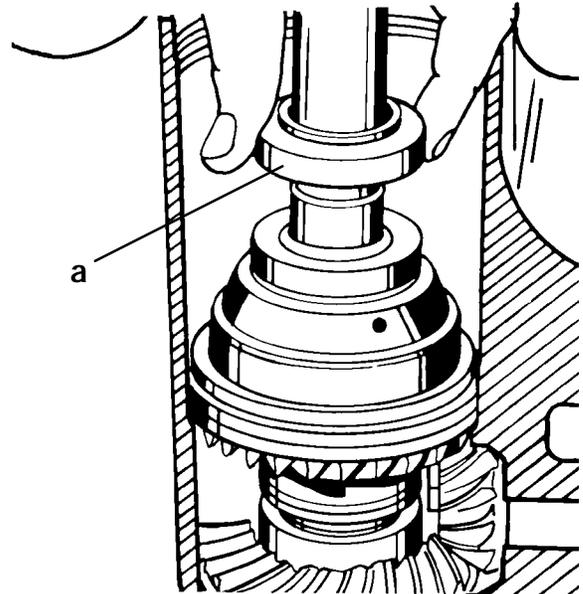
5. Remove the aft thrust bearing.



50786

a - Thrust Bearing

6. Remove the aft thrust collar.

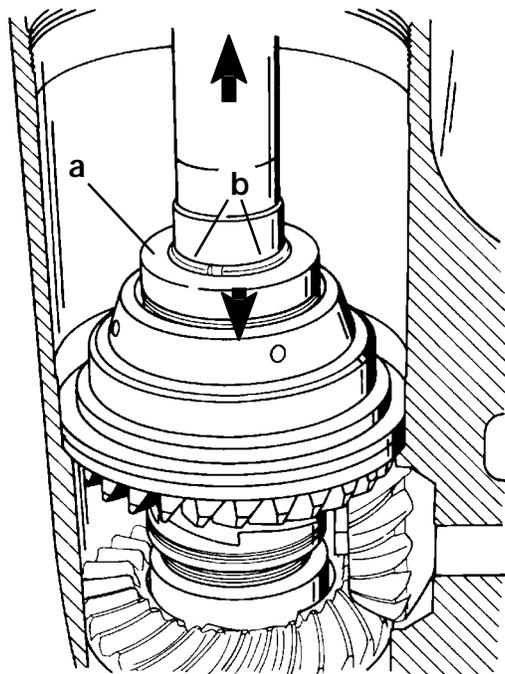


50787

a - Thrust Collar

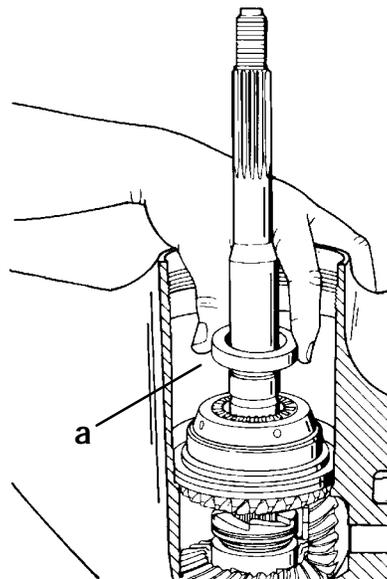


7. Lift up on the propeller shaft and push down on the forward thrust collar to remove the two keepers.



50778

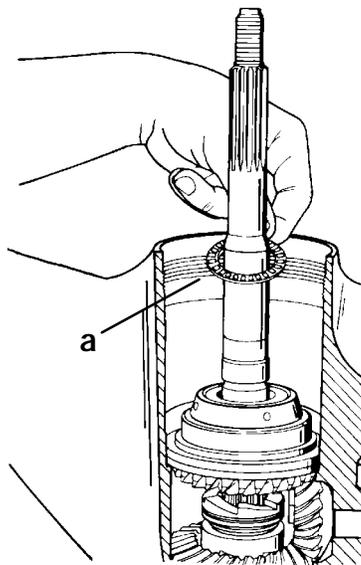
8. Remove the forward thrust collar.



50784

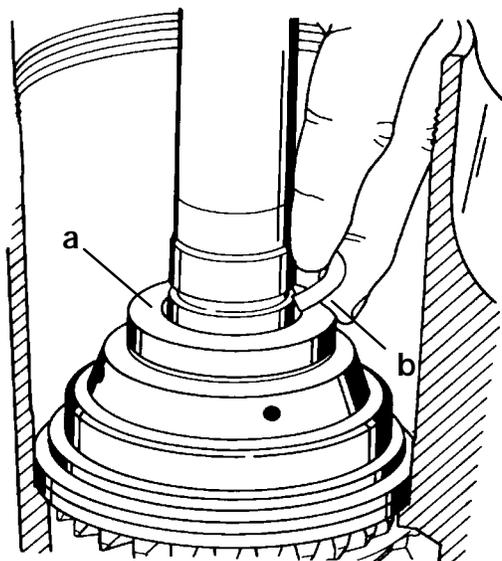
a - Thrust Collar

9. Remove the forward thrust bearing.



50783

a - Thrust Bearing

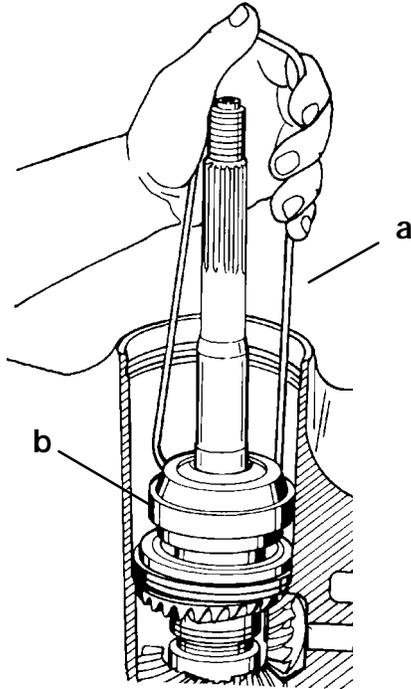


50826

a - Thrust Collar
b - Keepers (2)



10. Form a tool using a 1/8 in. (3 mm) wire as shown in the following figure and remove the forward gear bearing adaptor.



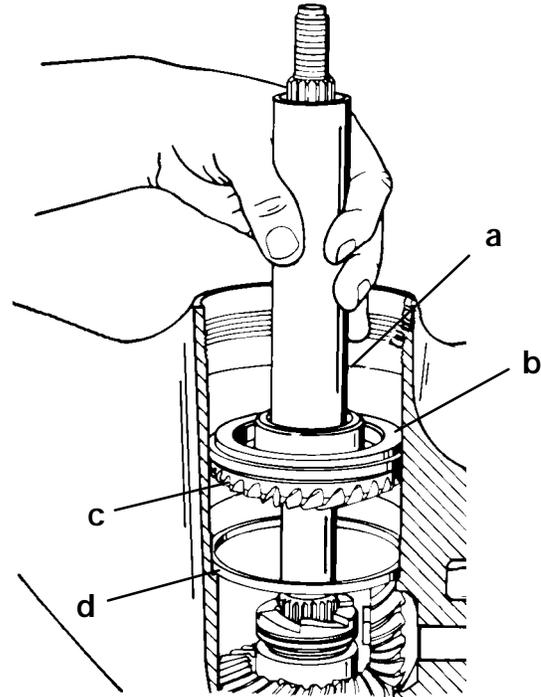
50786

- a - Wire Tool
b - Forward Gear Bearing Adaptor

11. Shift gear case into forward gear.

NOTE: The thrust race has a tight fit in the gear housing bore. Use the Forward Gear Installation Tool (91-815850) to remove the thrust race and the forward gear together. If this attempt fails, form a small hook on the end of a stiff piece of wire and while applying heat to the outside of gear case, pull the thrust race up and out of the gear housing.

12. Remove the O-ring from inside the gear housing.
13. Remove the forward gear, thrust race, and the thrust bearing (between the gear and the race).
14. Remove the forward gear shim.



50783

- a - Forward Gear Installation Tool (91-815850)
b - Thrust Race
c - Forward Gear
d - Shim

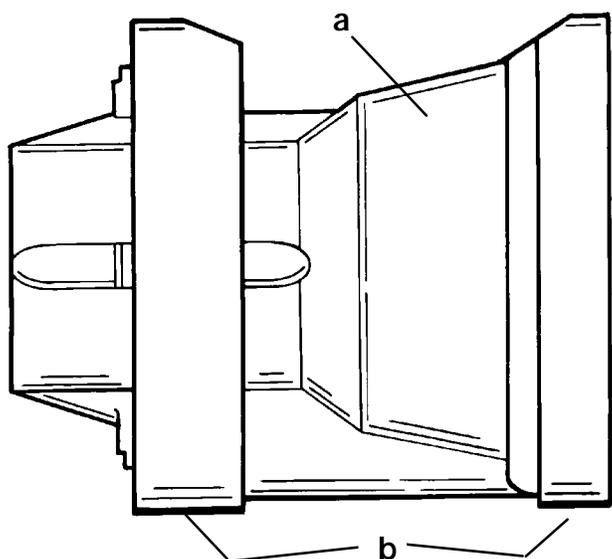
BEARING CARRIER ASSEMBLY - INSPECTION

1. Clean the assembly and all components with a suitable solvent and dry the parts thoroughly using compressed air.

NOTE: If any of the following items are found to be defective complete the appropriate instruction(s) in "Bearing Carrier Assembly", 'Component Disassembly and Inspection' section.



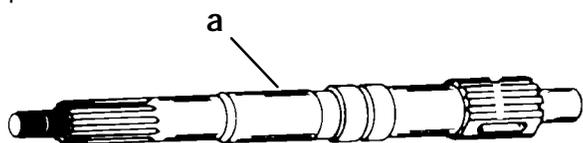
2. Inspect the bearing carrier for signs of excessive corrosion especially in the area where the bearing carrier touches the gear housing. If excessive corrosion is evident replace the carrier.



50818

- a - Bearing Carrier
- b - Mating Surfaces

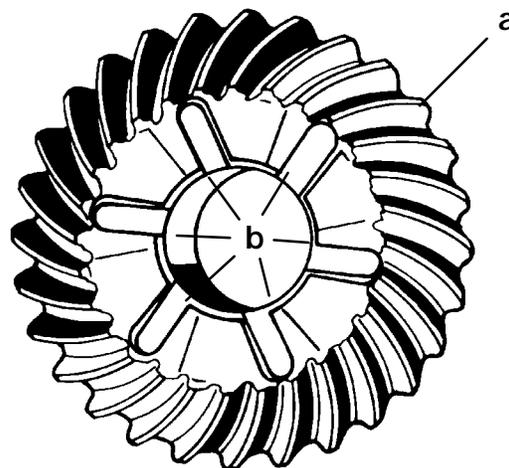
3. The condition of the bearing surface on the propeller shaft in the area that the needle bearing (in the bearing carrier) rides is an indication of the condition of the needle bearing in the bearing carrier. Replace the bearing if the surface of the shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.



50698

- a - Propeller Shaft Bearing Contact Area

4. Inspect the forward gear for pitted, chipped, broken teeth, hairline fractures, and excessive or uneven wear. Replace the forward gear and the pinion gear if any defects are found.
5. Inspect the outer hub of the forward gear for excessive wear or damage. Replace the forward and the pinion gear if either of these conditions exist.
6. Inspect the clutch jaws of the gear for damage. Surfaces must not be chipped or rounded off. Replace the forward and the pinion gear if any are found.



23355

- a - Reverse Gear Teeth
- b - Clutch Jaws

7. Inspect the thrust bearings, collars and forward gear bearing adaptor for excessive wear in the areas where the thrust bearings come into contact with them. Replace the appropriate components if they are found to be defective.
8. Inspect the bearing carrier retainer for cracks and/or broken or corroded threads. Replace it if any are found.



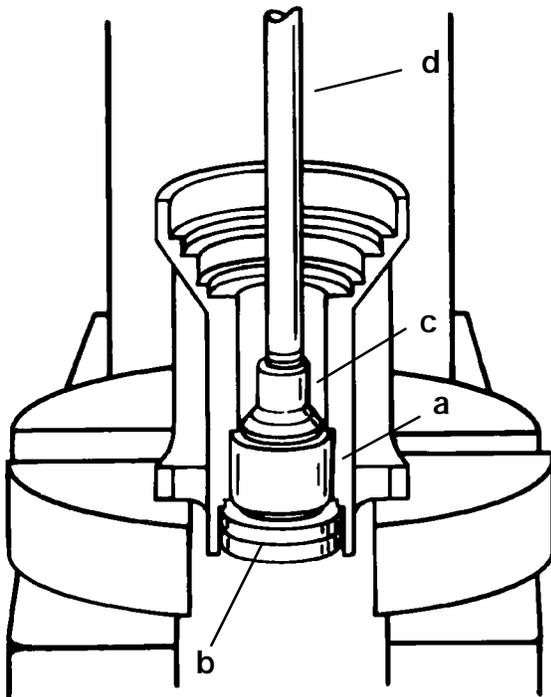
9. Inspect the large O-ring for damage and/or deterioration. Replace it if either condition is found.

BEARING CARRIER ASSEMBLY - COMPONENT DISASSEMBLY AND INSPECTION

NOTE: Complete the instructions in this section only if the assembly components have been found to be defective.

NOTE: Inspection of the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing rolls, gives an indication of the condition of the needle bearing inside the bearing carrier. Replace needle bearing in the bearing carrier if the prop shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.

1. Perform the following step a. or b. as necessary.
 - a. **If Replacing the Needle Bearing and Seals:** Remove the needle bearing and seals with the tools as shown.

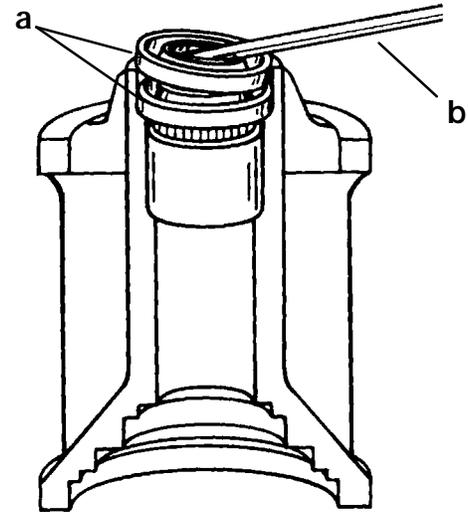


140

- a - Needle Bearing
- b - Oil Seals
- c - Driver Head (91-36569)
- d - Bearing Driver Rod (91-37323)

(1.) **Discard the needle bearing and both seals.**

- b. **If Replacing the Seal Only:** Remove the oil seals with a suitable pry bar, being careful not to damage the bore of the bearing carrier.



23140

- a - Oil Seals
- b - Pry Bar

(1.) **Discard both of the seals.**

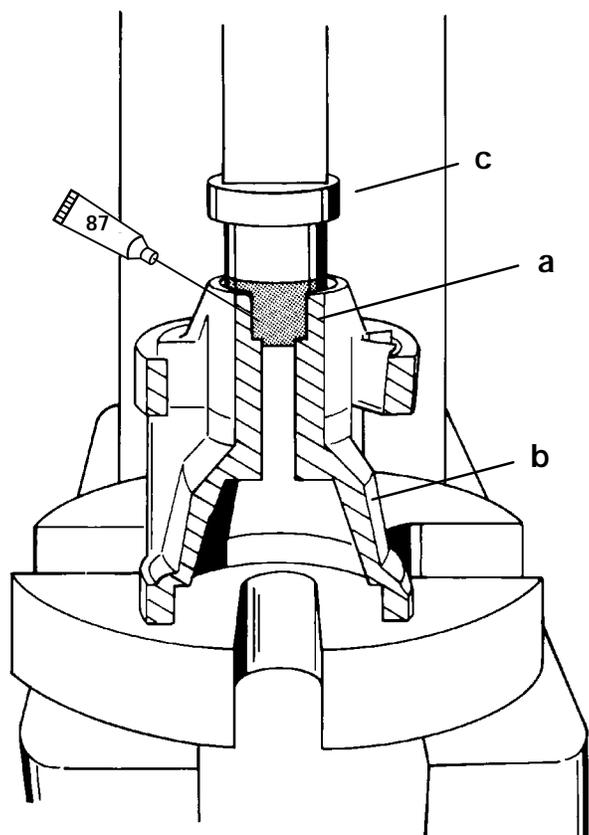
BEARING CARRIER ASSEMBLY - COMPONENT REASSEMBLY

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

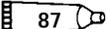
1. Clean all of the components with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin the bearing.
2. Lubricate the bore that the needle bearing is pressed into with Quicksilver Gear Lubricant (92-13783A24).
3. Assemble the needle bearing (with the numbered end of the bearing towards the driver shoulder), onto the driver.



4. Press the needle bearing into the bearing carrier until the driver bottoms out on the bearing carrier. Ensure that the numbered side of the needle bearing faces the seal end (aft end) of the carrier.



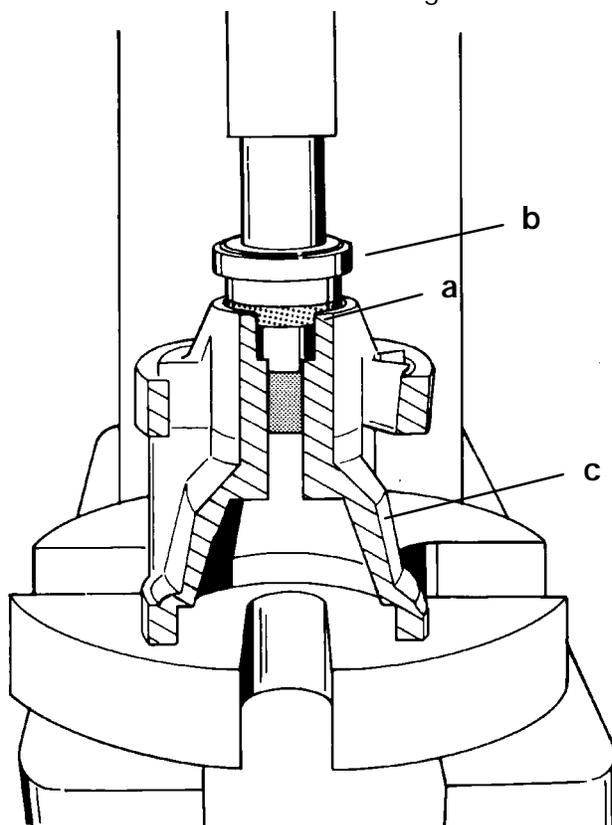
50788

 Quicksilver Gear Lubricant (92-19007A24)

- a - Needle Bearing
- b - Bearing Carrier
- c - Needle Bearing Driver (91-15755)

5. **Thoroughly clean** the bore to which the first seal is to be pressed.
6. Assemble the first seal (with the lips of the seal facing away from the driver shoulder) onto the long end of the oil seal driver.

7. Press on the oil seal driver until the driver bottoms out on the aft face of the bearing carrier.



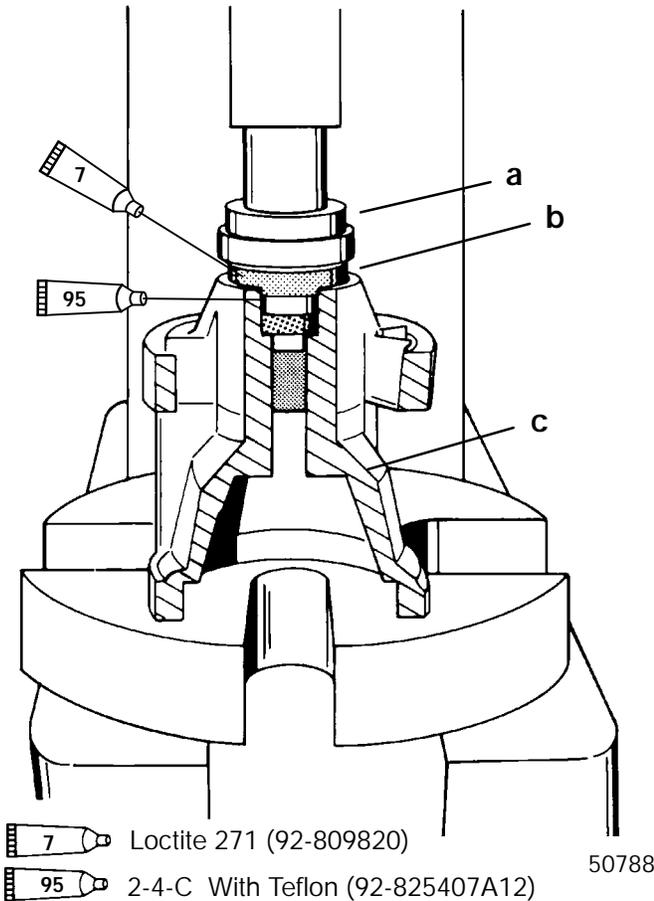
50788

- a - Oil Seal
- b - Oil Seal Driver (91-31108) (long end)
- c - Bearing Carrier

8. Apply a thin film of Loctite 271 (92-809820) to the outer diameter of the second seal.
9. Assemble the second seal (with the lips seal facing the driver shoulder) onto the short end of the driver.



10. Press the oil seal with the driver until the driver bottoms out on the bearing carrier.



- a - Driver (short end)
- b - Oil Seal (lips toward driver shoulder)
- c - Bearing Carrier

11. Wipe up all of the excess Loctite. Do not allow any of the excess Loctite to spread to other parts of the assembly.

12. Lubricate the seal lips and fill the area between the seals with 2-4-C w/Teflon (92-825407A12).

Forward Gear Bearing Adaptor Assembly

INSPECTION

1. Thoroughly clean the forward gear bearing adaptor with a suitable solvent and dry it using compressed air.

NOTE: The condition of the bearing surfaces on the forward gear in the areas that the bearings of the bearing adaptor and the thrust bearing rides, is an indication of the condition of the respective bearings. Replace the bearing(s) if the surface of the gear and/or the thrust washer is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.

2. Assemble the forward gear to the bearing adaptor. Inspect them for excessive movement or roughness by rotating the gear in the adaptor. Replace the bearing in the adaptor if either of these conditions exist.

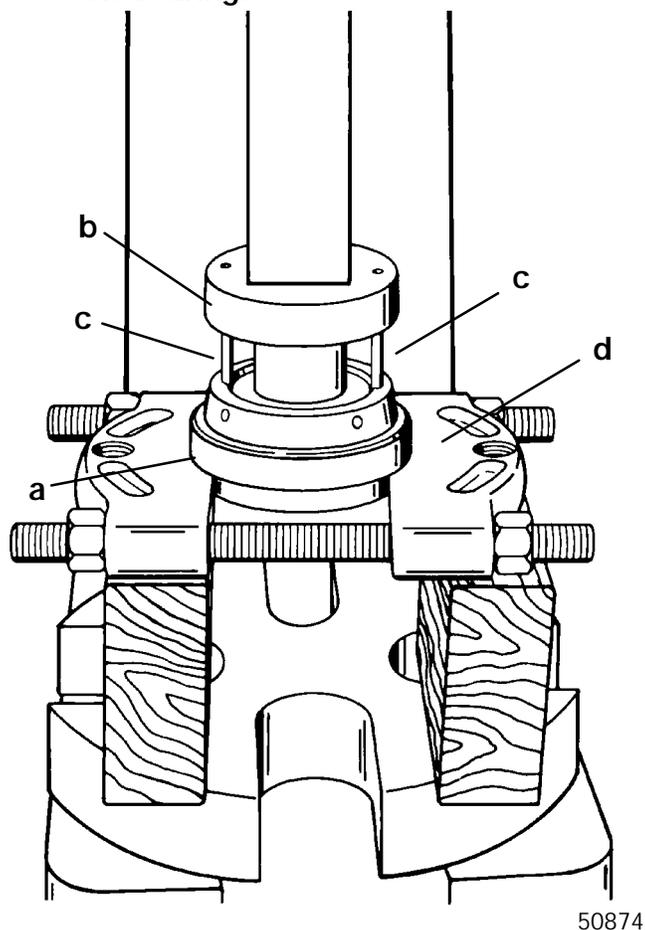
3. Inspect the adaptor for other signs of excessive wear or damage. Replace the adaptor if any are found.



FORWARD GEAR BEARING ADAPTOR ASSEMBLY - COMPONENT DISASSEMBLY AND REASSEMBLY

NOTE: Complete the instructions in this section only if the needle bearing in the bearing adaptor is defective and the adaptor is to be reused.

1. Disassemble the adaptor as follows:
 - a. Remove the bearing from the adaptor using the bearing removal tool. Align the pins of the tool with the holes of the adaptor and apply pressure to the center of the tool so that the pressure is equal on both of the pins. **Discard the bearing.**



50874

- a - Forward Gear Bearing Adaptor
- b - Bearing Removal Tool (91-816245)
- c - Pins
- d - Universal Puller Plate

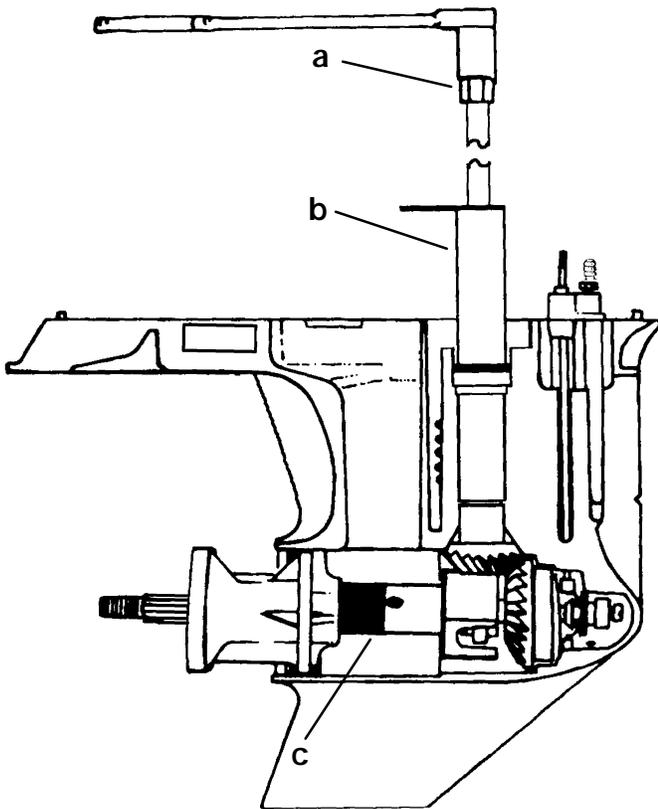
2. Assemble the adaptor as follows:
 - a. Lubricate the bore that the needle bearing is pressed into with 2-4-C w/Teflon (92-825407A12).
 - b. Assemble the needle bearing to the adaptor with the numbered end of the bearing facing the driver shoulder.
 - c. Press the needle bearing into the bearing adaptor using a suitable mandrel until the bearing bottoms in the adaptor.



Drive Shaft Assembly

REMOVAL

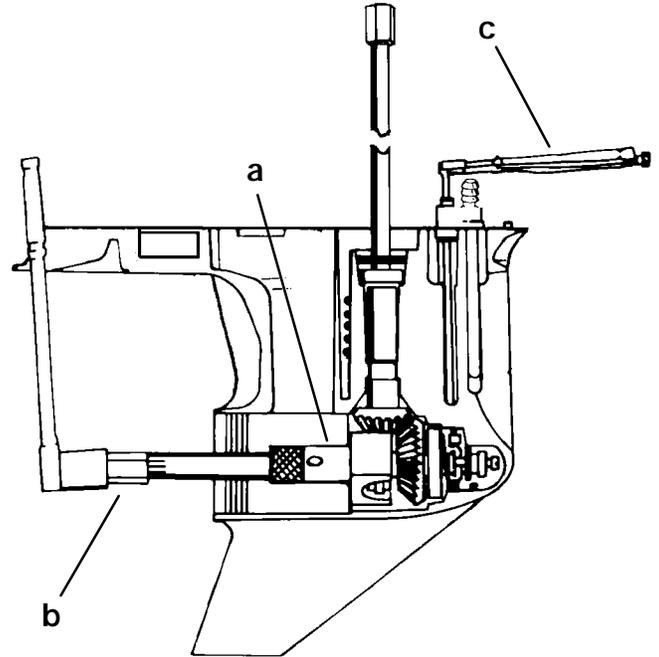
1. Remove the drive shaft pinion nut as follows:
 - a. Place the drive shaft bearing retainer wrench onto the drive shaft. Do not loosen the retainer at this time.
 - b. Insert the pinion nut adapter, with the MR slot facing the pinion gear, into the gear housing. It may be necessary to slightly lift and rotate the drive shaft to align the pinion gear nut into the pinion nut adapter slot.
 - c. Install the bearing carrier into the gear housing backwards to support the prop shaft and to keep the pinion nut adapter aligned.
 - d. Place the drive shaft nut wrench over the drive shaft splines and **loosen**, (but do not fully unscrew), the pinion nut by rotating the drive shaft counterclockwise.



- a - Drive Shaft Nut Wrench (91-56775)
b - Drive Shaft Bearing Retainer Wrench (91-43506)
c - Pinion Nut adapter (91-61067A3) (MR Slot)

- e. **If the drive shaft is broken**, place propeller shaft nut wrench onto the propeller shaft splines, hold shift shaft in forward gear and **loosen**, (but do not fully unscrew), the pinion nut by rotating prop shaft counterclockwise to turn gears, thus loosening the pinion nut.

NOTE: The propeller shaft nut wrench is included with the pinion nut adapter kit.



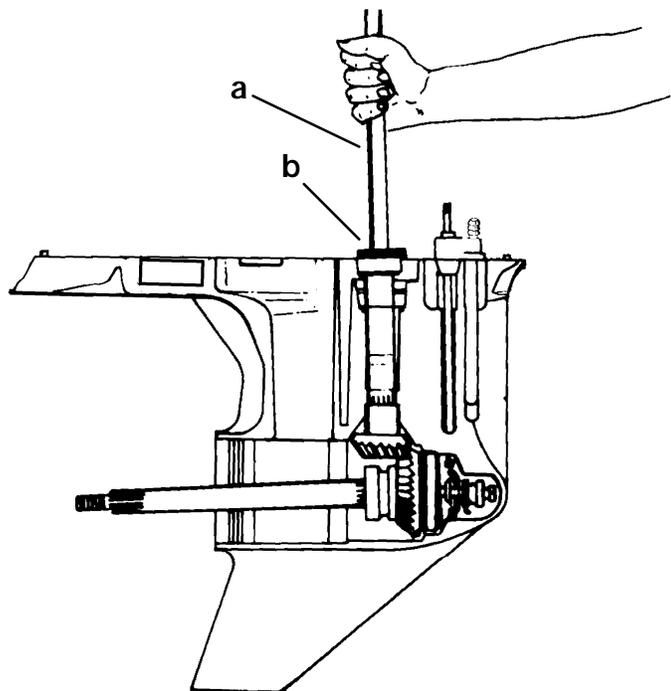
- a - Pinion Nut adapter (91-61067A3)
b - Propeller Shaft Nut Wrench (91-61077)
c - Shift Shaft (Turn Clockwise)(Protect Splines w/Soft Material)

2. Completely unscrew the drive shaft bearing retainer.
3. Completely unscrew the pinion nut by rotating the drive shaft (or the propeller shaft) in a counterclockwise direction.
4. Remove the bearing carrier and all tools.



IMPORTANT: The pinion bearing rollers are free to fall out of the pinion bearing once the drive shaft is removed. Be careful not to lose the (18) rollers.

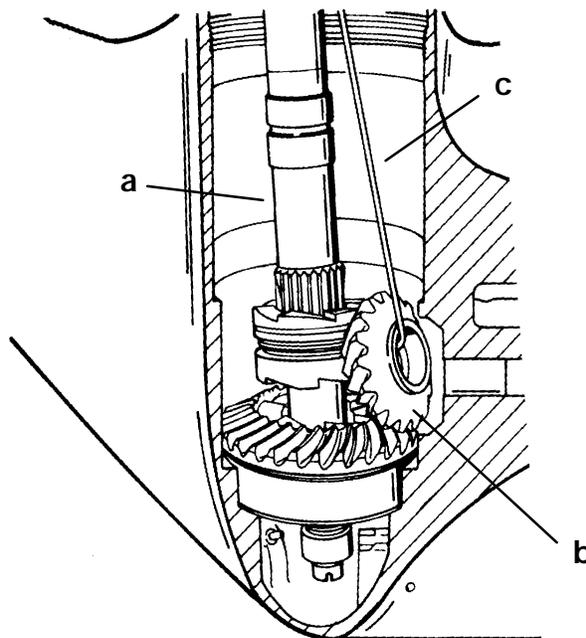
5. Remove the drive shaft and all components by pulling the drive shaft straight out of the gear housing as shown.



- a - Drive Shaft
- b - Drive Shaft Retainer, Bearing Cup, Bearing, and Shims

6. With propeller shaft facing straight up, rotate shift lever into forward. Pull propeller shaft up and over towards port side of gear case.

7. Form a small hook on a stiff piece of wire and attempt to hook onto the top side of the gear and pull it out. It may be necessary to slightly move the propeller shaft from side-to-side to dislodge the pinion gear.



50884

- a - Propeller Shaft
- b - Pinion Gear
- c - Wire Tool



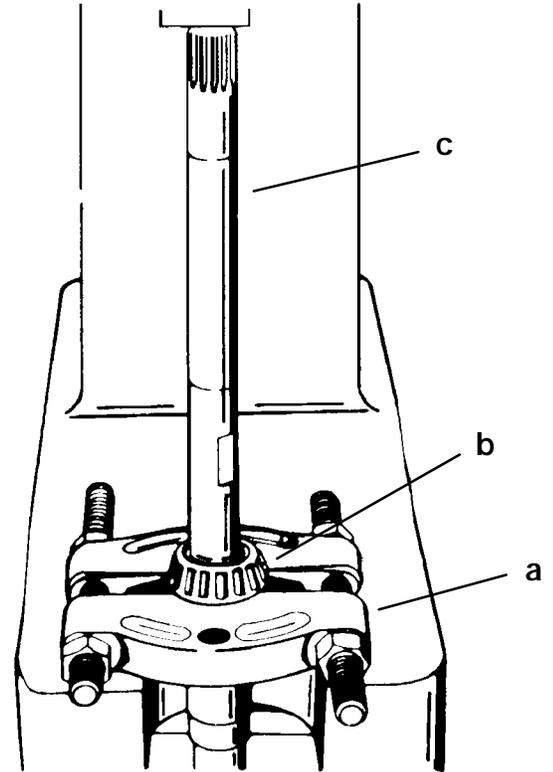
DRIVE SHAFT ASSEMBLY - INSPECTION

1. Clean all parts with a suitable solvent and dry the parts using compressed air. DO NOT spin the bearings.
2. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on the drive shaft. Replace the bearing and bearing cup if the cup is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
3. Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. Replace the drive shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
4. Inspect the splines at both ends of the drive shaft for a worn or twisted condition. Replace the drive shaft if either condition exists.
5. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the pinion gear and the forward gear** if any defects are found.

DRIVE SHAFT ASSEMBLY - COMPONENT DISASSEMBLY

NOTE: Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.

1. Press the tapered roller bearing from the drive shaft using the universal puller plate to support the **inner race** of the bearing while removing it.



70699

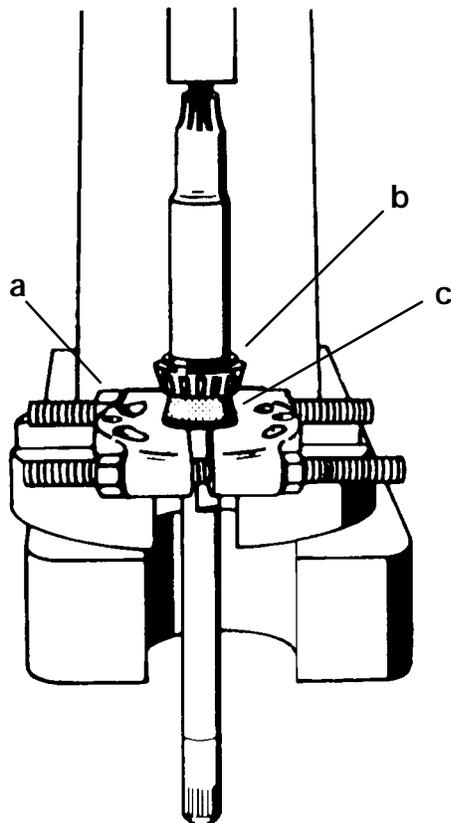
- a - Universal Puller Plate (91-37241)
- b - Tapered Roller Bearing
- c - Drive Shaft



DRIVE SHAFT ASSEMBLY - COMPONENT REASSEMBLY

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

1. Assemble a new tapered roller bearing to the drive shaft with the large O.D. of the bearing facing the pinion gear end of the drive shaft.
2. Press the tapered roller bearing onto the drive shaft using the universal puller plate and a suitable mandrel, (an old tapered roller bearing inner race).



70700

- a - Universal Puller Plate (91-37241)
- b - Tapered Roller Bearing
- c - Suitable Mandrel (Inner Race of Old Bearing)

Propeller Shaft Assembly

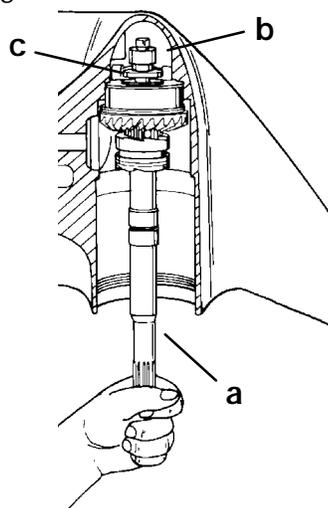
REMOVAL

CAUTION

Hold onto the propeller shaft assembly in the following step to avoid personal injury and/or dropping components when turning the gear housing over.

1. While holding onto the propeller shaft, turn the gear housing over so that the bore opening is facing down.
2. While moving the propeller shaft to the left (port) side of the gear housing, to allow the shift spool to disengage from the shift crank, lower the propeller shaft out of the gear housing.

NOTE: The rollers of the reverse gear bearing adaptor may become dislodged while removing the propeller shaft assembly. If this occurs, inspect the bearing cage to see if it has been damaged. If it has not been damaged simply snap the rollers back into position. If it has been damaged it will be necessary to remove and replace the bearing as outlined in the "Reverse Gear Bearing Adaptor Assembly", 'Component Disassembly and Reassembly' section found on page 6B-45.

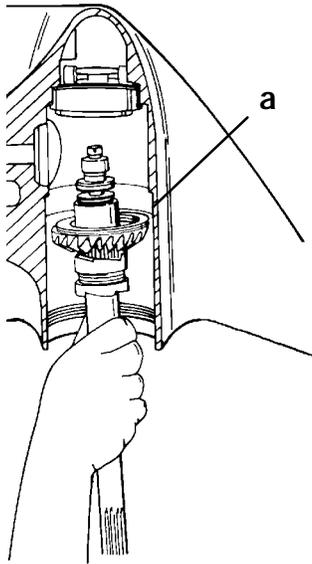


50887

- a - Propeller Shaft Assembly
- b - Shift Spool
- c - Shift Crank



3. Locate and retain the thrust race and thrust bearing which could be on top of the reverse gear (if not, they may be stuck to the reverse gear bearing adaptor).



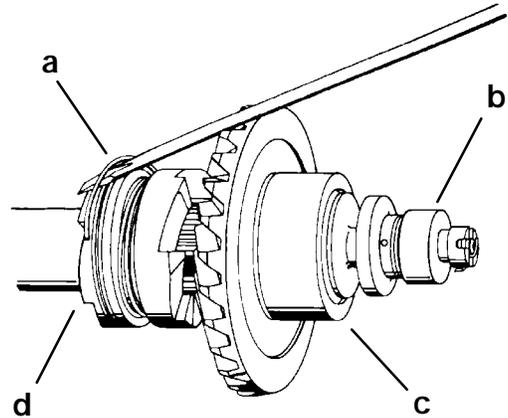
50887

a - Thrust Bearing and Race

PROPELLER SHAFT ASSEMBLY - COMPONENT DISASSEMBLY

IMPORTANT: When accomplishing the next step, all of the parts are free to come apart. Work closely over a work bench to ensure that the parts are not dropped or damaged, and to avoid personal injury.

1. Remove the spring around the clutch being careful not to overstretch it during removal. If the spring does not coil back to its normal position once it has been removed, it must be replaced (ratcheting assembly shown).



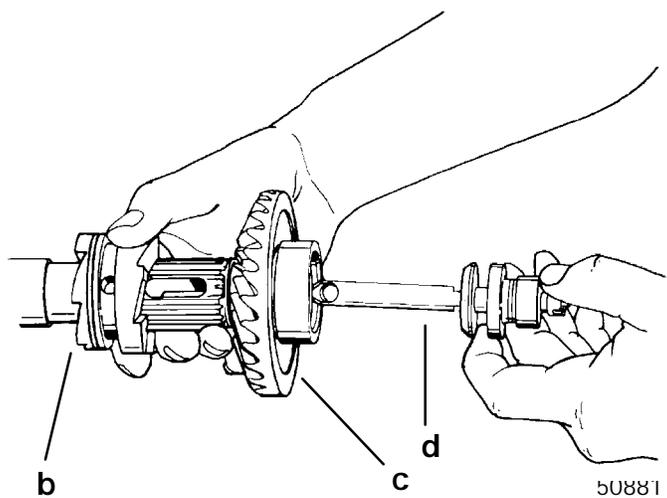
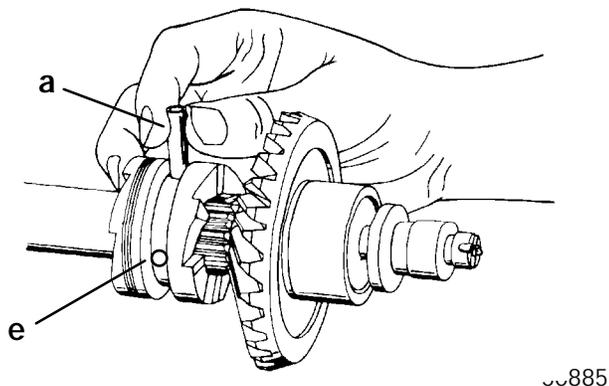
50885

- a - Spring
- b - Shift Spool Assembly
- c - Reverse Gear Assembly
- d - Sliding Clutch

2. Remove detent pin.



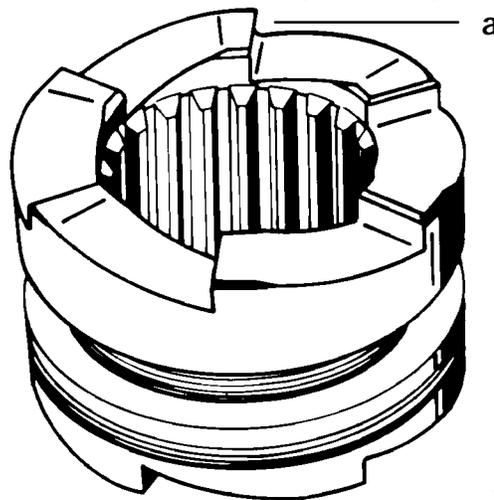
3. Remove the cross pin that goes through the clutch dog. Remove the reverse gear and slide the clutch off of the propeller shaft.



- a - Cross Pin
- b - Clutch
- c - Reverse Gear Assembly
- d - Spool
- e - Detent Pin

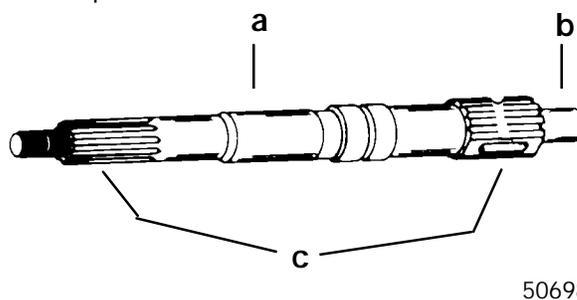
PROPELLER SHAFT ASSEMBLY - COMPONENT INSPECTION

1. Clean all the parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin bearings.
2. Inspect the sliding clutch jaws for damage. Jaws must not be chipped or rounded off. Replace the clutch if they are (ratcheting assembly shown).



a - Jaws

3. Inspect the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing and the needles of the forward gear needle bearing roll. Replace the propeller shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.

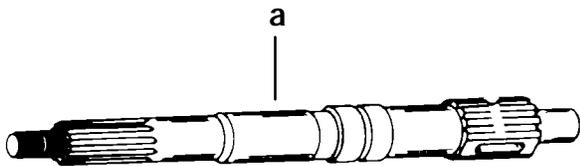


- a - Bearing Carrier Needle Bearing Contact Area
- b - Reverse Gear Needle Bearing Contact Area
- c - Splines

4. Inspect the propeller shaft splines at both ends for a broken, worn, or twisted condition. Replace the propeller shaft if any of these conditions exist.



5. Inspect the surface of the propeller shaft where the bearing carrier seal lips contact the shaft. If the oil seals have made grooves, replace propeller shaft and seals.



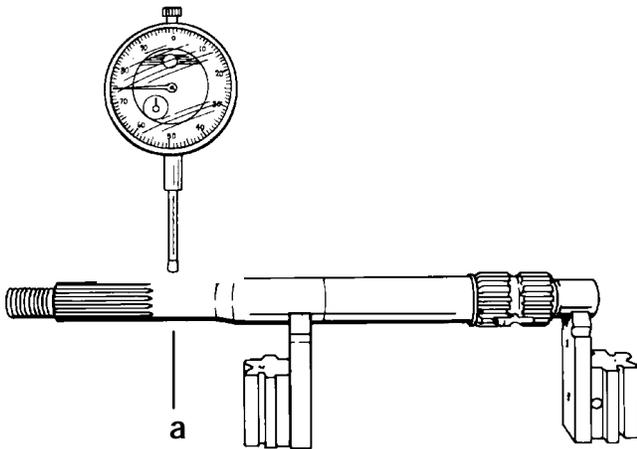
50698

a - Bearing Carrier Seal Contact Area

6. Inspect the propeller shaft for a bent condition.

a. **V-Blocks and Dial Indicator**

- (1.) Position the propeller shaft bearing surfaces on V-blocks.
- (2.) Adjust the height of V-blocks to level the propeller shaft.
- (3.) Position the dial indicator tip just forward of the propeller shaft splines.



52727

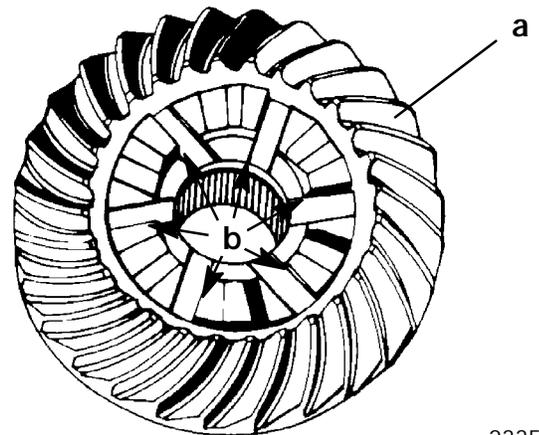
a - Check Movement with Dial Indicator (91-58222A1) Here

7. Rotate the propeller shaft and observe the dial indicator movement. If the indicator in the dial moves more than 0.009 in. (0.23mm), replace the propeller shaft.

Reverse Gear Assembly

COMPONENT INSPECTION

1. Clean the reverse gear assembly with a suitable solvent and dry thoroughly with compressed air. Be careful not to spin the bearings.
2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures, and excessive or uneven wear. **Replace the reverse gear** if any defects are found.
3. Inspect the clutch jaws of the gear for damage. The surfaces must not be chipped or rounded off. **Replace the reverse gear** if any of these conditions exist.



23351

a - Reverse Gear Teeth

b - Clutch Jaws

NOTE: The needle bearing in the reverse gear should not be removed unless damage has been found. Inspect to ensure that all of the needles are present and in position. The needles may have become dislodged while removing the gear from the propeller shaft (and/or while removing the propeller shaft assembly from the gear housing). They may be snapped back into place as long as no damage has occurred to the bearing cage.

4. Inspect the needle bearings on the inside of the reverse gear and the bearing surface on the propeller shaft. If either the needle bearings, or the bearing surface of the propeller shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles, replace the propeller shaft and remove and replace the needle bearing in the reverse gear as outlined in the next section.



18

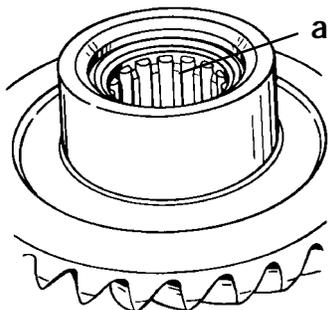
a - Forward Gear Needle Bearing Contact Area



REVERSE GEAR ASSEMBLY - COMPONENT DISASSEMBLY

NOTE: Complete the instructions in this section only if the needle bearing in the gear has been found to be defective and the reverse gear is to be reused. Bearings that have become dislodged may be snapped back into position. If this is the only problem that exists it is not necessary to replace the needle bearing.

1. Press the reverse gear needle bearing out using suitable mandrel.



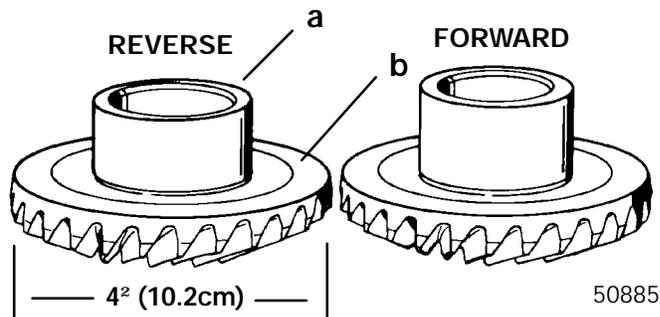
50778

a - Reverse Gear Needle Bearing

REVERSE GEAR ASSEMBLY - COMPONENT REASSEMBLY

NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

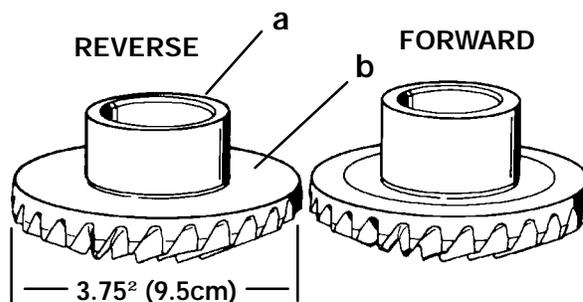
IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



50885

1994/1995/1996 Models

- a - Shorter Hub
- b - Groove

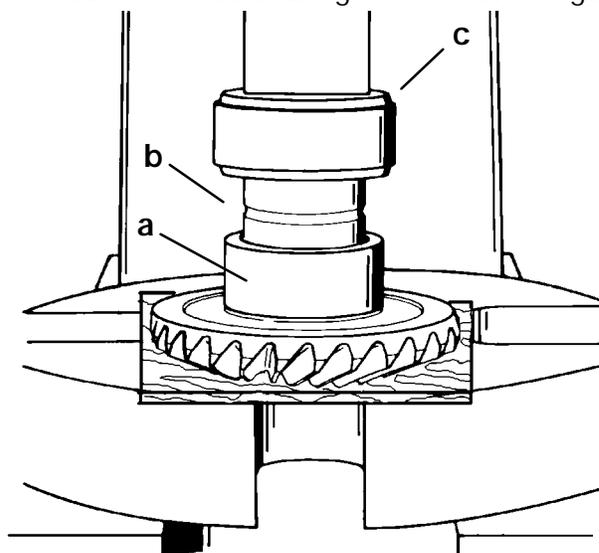


50885

1997/1998 Models

- a - Reverse Gear is Smaller in Diameter for 97/98 Models
- b - No Groove in Reverse Gear for 97/98 Models

1. Press the needle bearing into the reverse gear.



50789

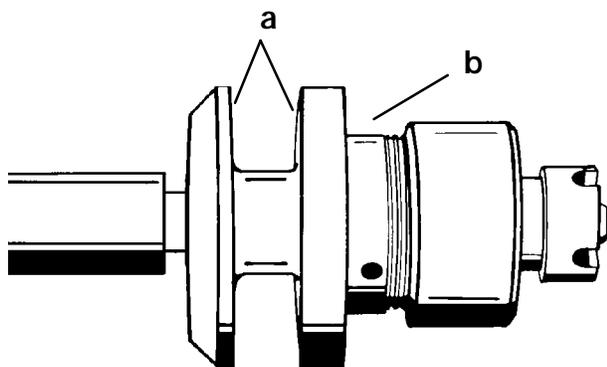
- a - Reverse Gear
- b - Needle Bearing
- c - Bearing Driver (91-816244)(Ratcheting gear cases)
Bearing Driver (91-86943) (Non-Ratcheting gear cases)



Shift Spool Assembly

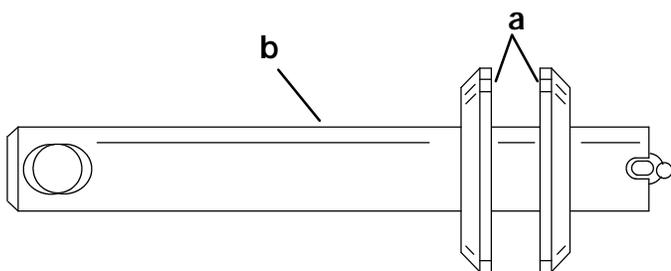
INSPECTION

1. Clean the assembly with a suitable solvent and dry the parts using compressed air.
2. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn beyond repair it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.
3. Inspect the shift spool for wear in the area where the shift crank comes into contact.



23356

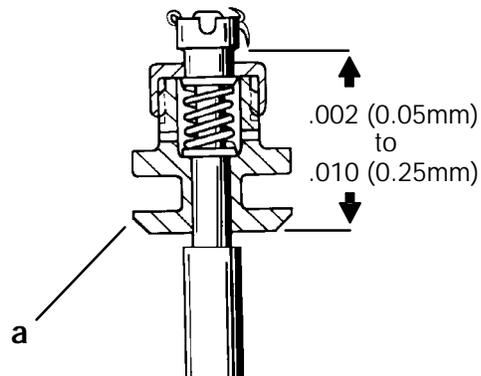
- a - Contact Area
- b - Ratcheting Shift Spool



55694

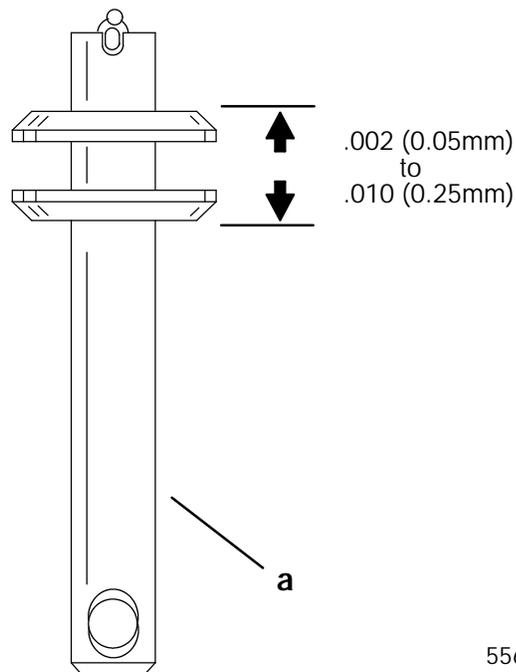
- a - Contact Area
- b - Non-Ratcheting Shift Spool

4. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).
5. Inspect to insure that the spool has no more than 0.002-0.010 (0.05-0.25 mm) end play.



23142

a - Ratcheting Spool



55694

a - Non-Ratcheting Spool



SHIFT SPOOL ASSEMBLY (RATCHETING) - COMPONENT DISASSEMBLY

NOTE: Disassembly of the shift spool is for cleaning and inspection of the internal parts of the assembly due to an improperly functioning shift spool assembly or debris in the gear housing and/or shift spool assembly. Individual components for the shift spool are not available as replacement parts. If the shift spool does not function properly (see the preceding "Shift Spool Assembly - Inspection" section) and the following cleaning and adjustment procedures do not produce the desired results, it will be necessary to order a new shift spool assembly.

1. Disassemble the shift spool assembly as follows:
 - a. Remove and discard the cotter pin.
 - b. Remove the castle nut and the spool.
 - c. Clamp the spool in a vice being careful not damage the spool.
 - d. Remove the retainer by unscrewing it with a pair of pliers.
 - e. Remove the two washers and the spring.

SHIFT SPOOL ASSEMBLY (NON-RATCHETING) - COMPONENT DISASSEMBLY

NOTE: Disassembly of the shift spool is for cleaning and inspection of the internal parts of the assembly due to an improperly functioning shift spool assembly or debris in the gear housing and/or shift spool assembly. Individual components for the shift spool are not available as replacement parts. If the shift spool does not function properly (see the preceding "Shift Spool Assembly - Inspection" section) and the following cleaning and adjustment procedures do not produce the desired results, it will be necessary to order a new shift spool assembly.

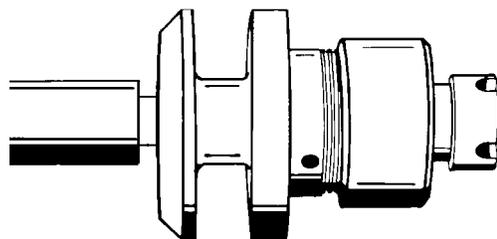
1. Disassemble the shift spool assembly as follows:
 - a. Remove and discard the cotter pin.
 - b. Remove the castle nut and the spool.

SHIFT SPOOL ASSEMBLY - COMPONENT INSPECTION

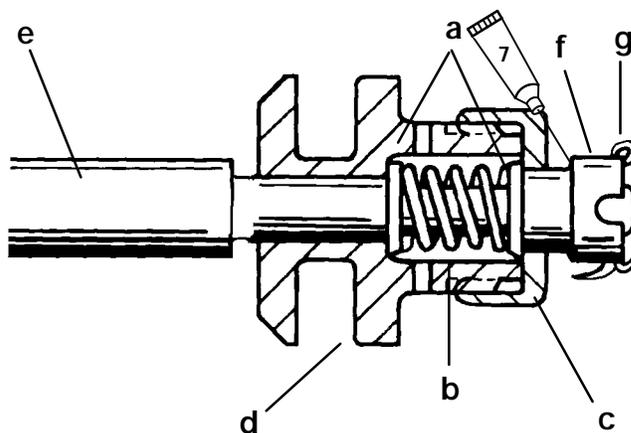
1. Clean all components with a suitable solvent and dry them with compressed air.
2. Inspect each component for wear or damage. If any components are worn beyond repair, damaged, or broken it will be necessary to replace the complete shift spool assembly. Small nicks or burrs may be smoothed and the parts reused.

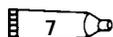
SHIFT SPOOL ASSEMBLY (RATCHETING) - COMPONENT REASSEMBLY

1. Assemble the shift spool and shift spool shaft as follows:
 - a. Place the shift spool onto the shift spool shaft.
 - b. Assemble the first washer, then the spring, then the second washer into the shift spool.
 - c. Apply Loctite 271 (92-809820) to the first three threads of the spool. Thread the retainer onto the spool and tighten the retainer securely with a pair of pliers.
 - d. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
 - e. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
 - f. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.



23356



 Loctite 271 (92-809820)

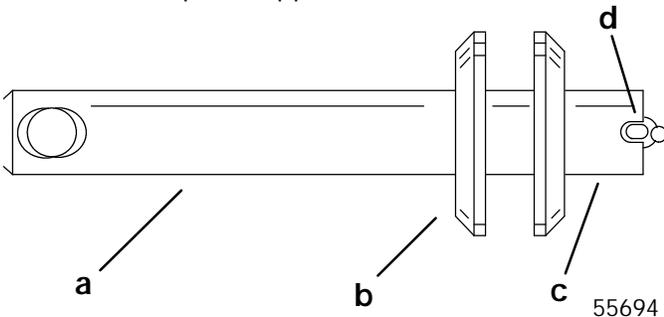
23142

- a - Washers (2)
- b - Spring
- c - Retainer
- d - Spool
- e - Shift Shaft
- f - Castle Nut
- g - Cotter Pin



SHIFT SPOOL ASSEMBLY (NON-RATCHETING) - COMPONENT REASSEMBLY

1. Assemble the shift spool and shift spool shaft as follows:
 - a. Place the shift spool onto the shift spool shaft.
 - b. Assemble the castle nut and screw it down until it touches the washer and a slight resistance is felt.
 - c. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is already aligned at the hole in the shaft, back the castle nut off until the next available slot in the nut is aligned with the hole in the shaft.
 - d. Insert a new cotter pin and bend ends of the cotter pin in opposite directions.



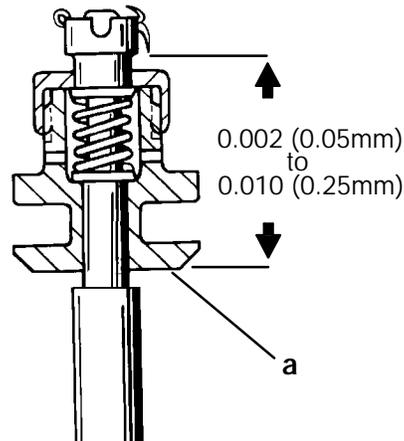
- a - Shift Spool Shaft
- b - Shift Spool
- c - Castle Nut
- e - Cotter Pin

SHIFT SPOOL ASSEMBLY - ADJUSTMENT

NOTE: If the shift spool assembly has been disassembled and reassembled (as in the previous two sections) skip the following instructions, (1 through 4).

NOTE: If the shift spool assembly has not been disassembled and reassembled, do all of the following steps.

1. Remove and discard the cotter pin.
2. Screw the castle nut down until it touches the washer and a slight resistance is felt.
3. Loosen the castle nut until the cotter pin slot of the castle nut is aligned with the hole in the shaft. If, when the castle nut is screwed down, the cotter pin slot is not aligned at the hole in the shaft, back off the castle nut until the next available slot in the nut is aligned with the hole in the shaft.
4. Insert a new cotter pin and bend ends in opposite directions.
5. Inspect to insure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).
6. Inspect to insure that the spool has no more than 0.002-0.010 (0.05-0.25 mm) end play, if it does adjust the castle nut once again as outlined previously.



- a - Ratcheting Type Spool

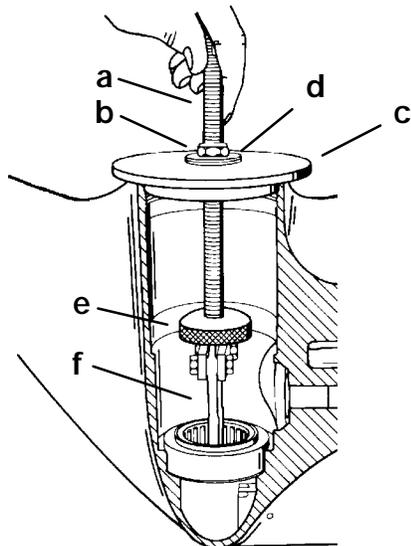
7. If this adjustment did not produce the desired results it will be necessary to disassemble, clean, and reassemble the shift spool assembly. If the spool assembly has already been disassembled and cleaned it will be necessary to replace the shift spool assembly.



Reverse Gear Bearing Adaptor Assembly

REMOVAL

1. Remove the reverse gear bearing adaptor using the tools as shown in the next figure. Remove, measure and make note of the shim thickness. If the shims are not damaged, they may be reused.



50780

- a - Bolt (91-31229)
- b - Nut (11-24156)
- c - Guide Plate (91-816243)
- d - Washer (91-34961)
- e - Puller Head (from Slide Hammer Puller Kit 90-34569A1)
- f - Jaws (91-816242)

REVERSE GEAR BEARING ADAPTOR ASSEMBLY - INSPECTION

1. Thoroughly clean the reverse gear bearing adaptor with a suitable solvent and dry it using compressed air.

NOTE: *The condition of the bearing surfaces on the reverse gear in the areas that the bearings of the bearing adaptor and the thrust bearing rides, is an indication of the condition of the respective bearings. Replace the bearing(s) if the surface of the gear and/or the thrust washer is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.*

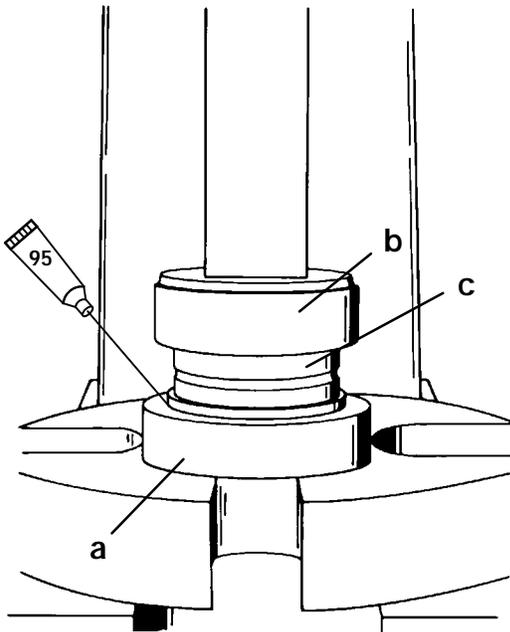
2. Assemble the reverse gear, the thrust bearing, and the thrust race, to the bearing adaptor. Inspect them for excessive movement or roughness by rotating the gear in the adaptor. Replace the bearing in the adaptor and/or the thrust bearing if either of these conditions exist.
3. Inspect the adaptor for other signs of excessive wear or damage. Replace the adaptor if any are found.

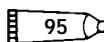


REVERSE GEAR BEARING ADAPTOR ASSEMBLY - COMPONENT DISASSEMBLY AND REASSEMBLY

NOTE: Complete the instructions in this section only if the needle bearing in the bearing adaptor is defective and the adaptor is to be reused.

1. Disassemble the adaptor as follows:
 - a. Remove the bearing from the adaptor using a suitable mandrel.
 - b. **Discard the bearing.**
2. Assemble the adaptor as follows:
 - a. Lubricate the bore that the needle bearing is to be pressed into with 2-4-C w/Teflon (92-825407A12).
 - b. Position the needle bearing on the adaptor with the numbered end of the bearing facing the driver shoulder.
 - c. Press the needle bearing into the bearing adaptor using a suitable mandrel until the bearing is flush with the face of the adaptor.



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

50790

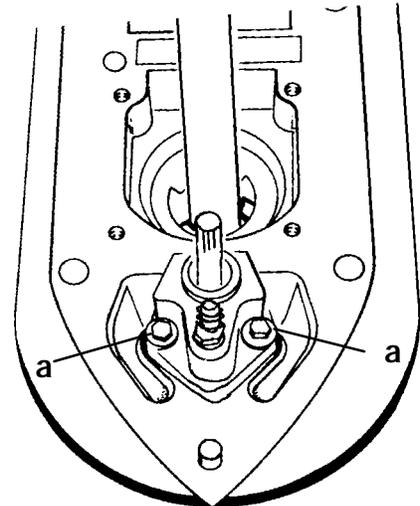
- a - Reverse Gear Bearing Adaptor
- b - Suitable Mandrel
- c - Bearing

Shift Shaft Assembly

REMOVAL

NOTE: It is possible to remove and service the shift shaft assembly (but not the shift crank inside the gear case) without removing any of the internal components of the gear housing.

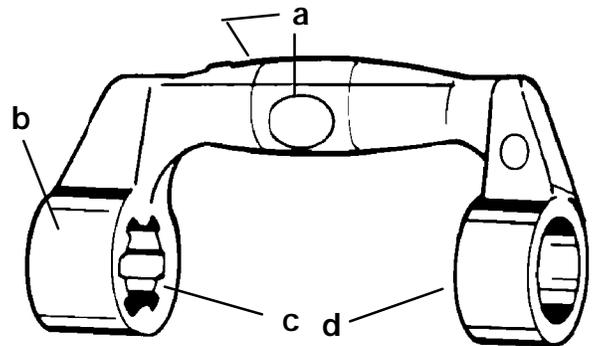
1. Remove the shift shaft bushing screws, and remove the shift shaft and bushing by pulling them straight out of gear housing.



70494

- a - Shift Shaft Bushing Screws

2. Remove the shift crank from the inside of the gear housing. Clean it with a suitable solvent and dry it thoroughly. Inspect it for wear in the areas that contact the shift spool and inspect the splines and the diameter that goes over the locating pin for damage or excessive wear.



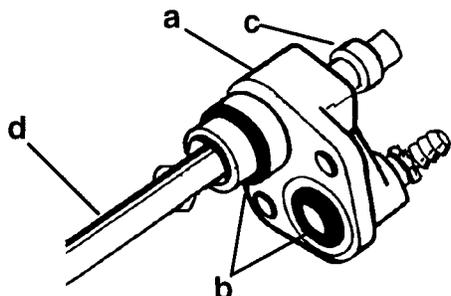
23350

- a - Contact Area
- b - Shift Crank
- c - Splines
- d - Diameter for Locating Pin



SHIFT SHAFT ASSEMBLY - COMPONENT DISASSEMBLY AND INSPECTION

- Slide the bushing assembly off of the straight end of the shift shaft. Remove the coupler from the shaft.

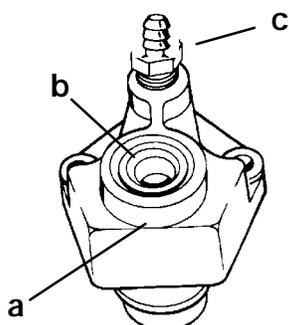


70616

- a - Shift Shaft Bushing
- b - O-rings (2)
- c - Coupler
- d - Shift Shaft

- Clean all components with a suitable solvent and dry thoroughly with compressed air.
 - Inspect the shift shaft bushing for cracking, damage, or excessive wear.
 - Inspect the seal inside the bushing, the sleeve, and the O-rings on the outside of the bushing for damage or excessive wear.
 - Inspect the speedometer connector for damage or blockage.

If any of these conditions exist, replace the appropriate components. The oil seal is a replaceable component.



70617

- a - Shift Shaft Bushing
- b - Seal (Lips Face Up)
- c - Speedometer Tube Connector

- Inspect the shift shaft splines and seal surface for corrosion and/or excessive wear. Replace the shift shaft if either if these conditions are found.

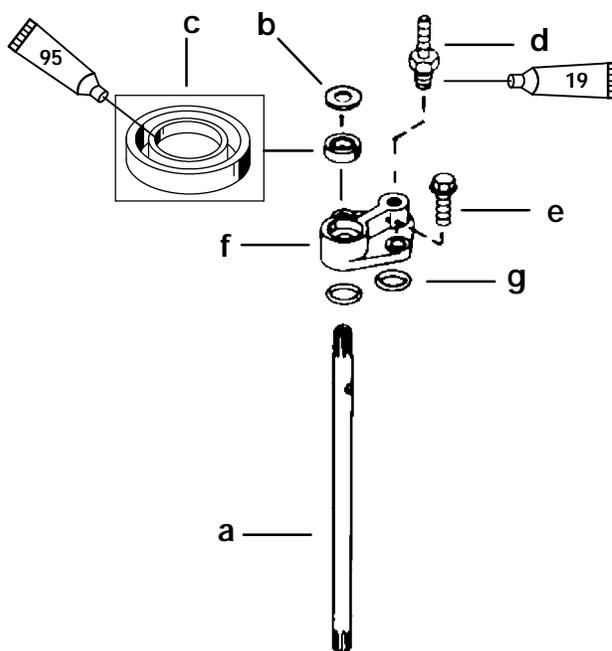


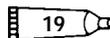
- a - Seal Surface
- b - Spline

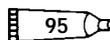
SHIFT SHAFT ASSEMBLY - COMPONENT REASSEMBLY

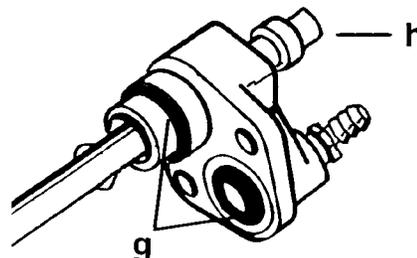
NOTE: Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.

- Lightly lubricate the seats of the O-ring diameters on the bushing and the lip of the oil seal with Quicksilver 2-4-C w/Teflon (92-825407A12).
- If the speedometer connector was removed and/or replaced, lightly coat the **threads of the connector** with Quicksilver Perfect Seal (91-34277-1). Assemble the speedometer connector to the bushing and torque the connector to 4.5 lb. in. (0.5 N·m).
- Assemble all components as shown below.



 Perfect Seal (92-34227-1)

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



70616

- a - Shift Shaft
- b - Rubber Washer
- c - Seal (Lip Faces Up)
- d - Speedometer Connector
- e - Bolt (2 ea.) [Torque to 60 lb. in. (6.8 N·m)]
- f - Bushing
- g - O-Rings (2 ea.)
- h - Coupler



Pinion Bearing

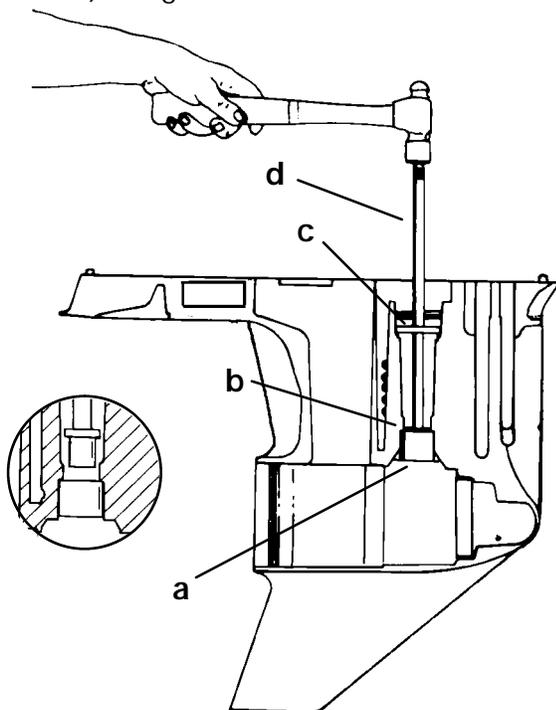
REMOVAL

NOTE: Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. The condition of the drive shaft at this location give an indication of the condition of the needle bearing. Replace lower pinion bearing (needles and race as a set) if the drive shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.

IMPORTANT: All the needle bearings (18) **MUST BE** in place inside bearing race while driving the pinion bearing from the gear housing.

IMPORTANT: Do not reuse the bearing (race or rollers) once it has been removed.

1. Remove and discard the pinion bearing (race and rollers) using tools as shown.



,0614

- a - Pinion Bearing
- b - Bearing Driver (91-36569)
- c - Pilot Washer (91-36571)
- d - Driver Rod (91-37323)

Gear Housing Reassembly

Gear Housing Inspection

1. Clean the gear housing thoroughly with a suitable solvent and a hard bristle brush. Dry the gear housing using compressed air. Insure that all sealants, locking agents and debris are removed.
2. Verify the 2 oil circulation holes in the drive shaft bore and shift shaft hole are clear and free of debris.
3. Inspect the gear housing for excessive corrosion, impact or any other damage. Excessive damage and/or corrosion requires replacement of the gear housing.
4. Inspect the bearing carrier retainer threads in the gear housing for corrosion and/or stripped threads. Excessive damage to the the threads requires replacement of the gear housing.
5. Inspect bearing race/cup contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores. Any one bearing bore in which the race/cup is loose will require replacement of the gear housing.
6. Inspect for blockage in water inlet holes and the speedometer hole, clean as necessary. Be careful not to enlarge the speedometer hole as this could cause erroneous speedometer readings.
7. Verify that the locating pins are in place in the gear housing and that the corresponding holes in the drive shaft housing are not elongated. The drive shaft may break if the housings are not aligned properly due to missing locating pins or elongated holes.

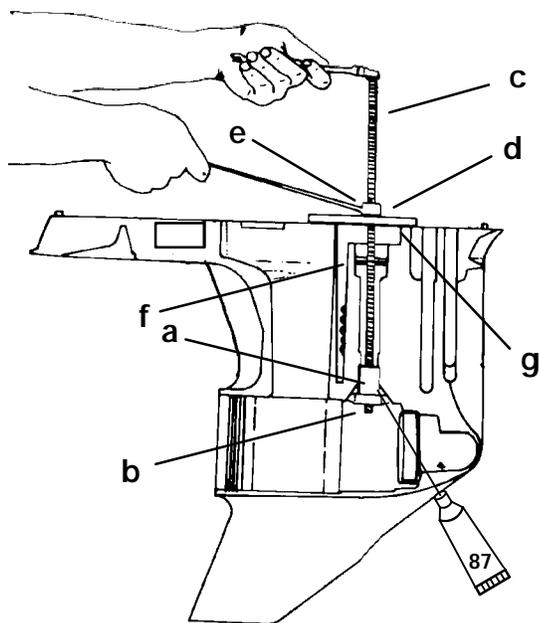


Pinion Bearing

INSTALLATION

IMPORTANT: Install only a **NEW** pinion bearing (race and rollers). Do not reinstall a pinion bearing that has been previously removed from a gear housing.

1. Lubricate the bore into which the pinion bearing is to be installed with Quicksilver Gear Lubricant (92-19007A24).
2. Position the new pinion bearing (with the cardboard shipping sleeve in place) onto the driver head, with the lettered and numbered side of the bearing oriented upward.
3. Insert the driver with the bearing assembly, into position (by way of the propeller shaft bore) at the drive shaft bore as shown.



70615

Quicksilver Gear Lubricant (92-19007A24)

- a - Drive Shaft Pinion Bearing (w/cardboard sleeve)
- b - Driver Head (91-38628)
- c - Puller Shaft (91-31229)
- d - Washer (12-34961)
- e - Nut (11-24156)
- f - Pilot Washer (91-36571)
- g - Puller Plate (91-29310)

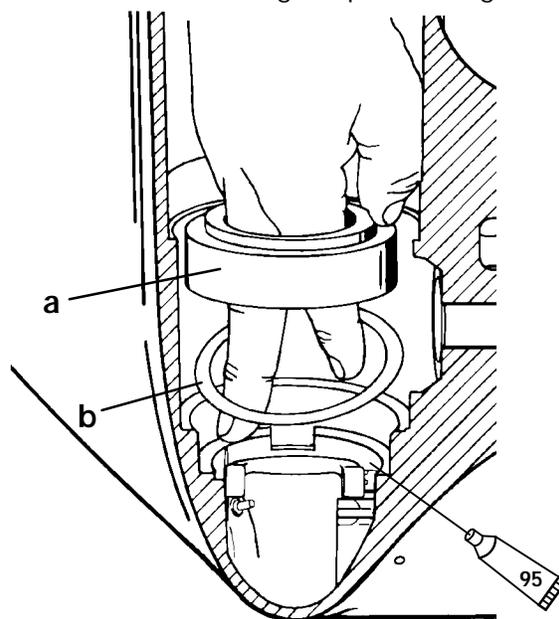
4. Install the bearing by screwing down the nut until the bearing is fully seated against the bore shoulder.

Reverse Gear Bearing Adaptor Assembly

INSTALLATION

NOTE: If the reverse gear, reverse gear adaptor, large thrust bearing, or bearing race in the gear housing were not replaced, install the same shim(s) (or the same thickness of shim(s) that were taken out when adaptor was removed. If the reverse gear, reverse gear adaptor, large thrust bearing, bearing race, or gear housing were replaced, install 0.008 in. (0.51 mm) of shims.

1. Lubricate the bore into which the reverse gear bearing adaptor is to be installed with 2-4-C w/Teflon (92-825407A12).
2. Place the shim(s) into reverse bore of gear housing.
3. Position the bearing adaptor in the gear housing.



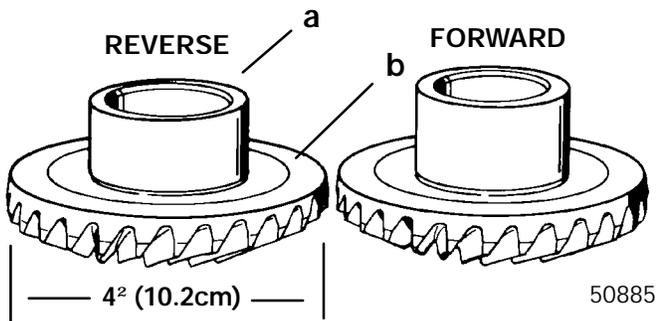
50781

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

- a - Bearing Adaptor
- b - Shims

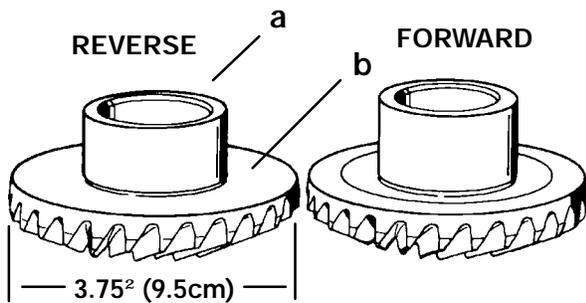


IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



1994/1995/1996 Models

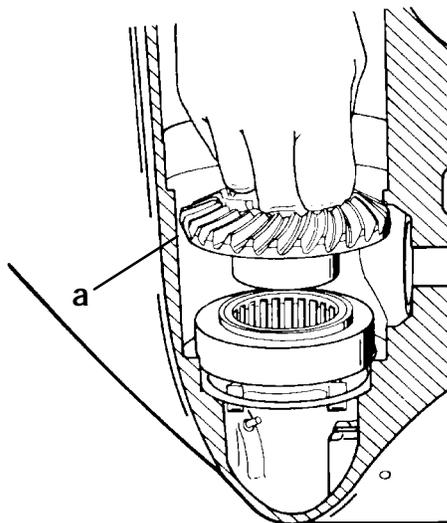
- a - Shorter Hub
- b - Groove



1997/1998 Models

- a - Reverse Gear is Smaller in Diameter for 97/98 Models
- b - No Groove in Reverse Gear for 97/98 Models

4. Position the reverse gear (without the thrust race or thrust bearing) into the gear housing and into the adaptor.



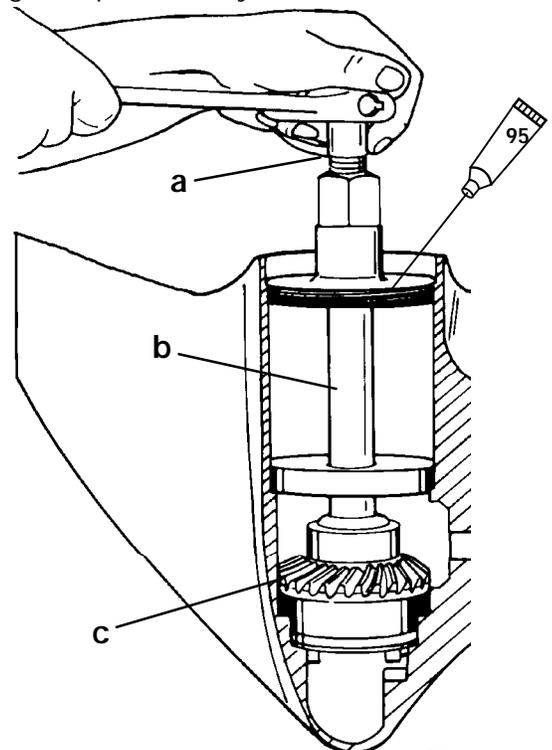
50781

- a - Reverse Gear

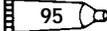
5. Press the bearing adaptor into the gear housing using the installation tool as follows:

IMPORTANT: Be sure that the bearing adaptor is positioned as straight as possible to avoid cocking it in the bore while pressing it in.

- a. Lubricate the threads of the installation tool with 2-4-C w/Teflon (92-825407A12).
- b. Turn the hex-head screw of the installation tool until the bearing adaptor bottoms out on the gear housing shoulder. DO NOT continue to turn the tool once the screw resistance goes up noticeably.



50791

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

- a - Hex-Head Screw
- b - Bearing Adaptor Installation Tool (91-18605A1)
- c - Reverse Gear

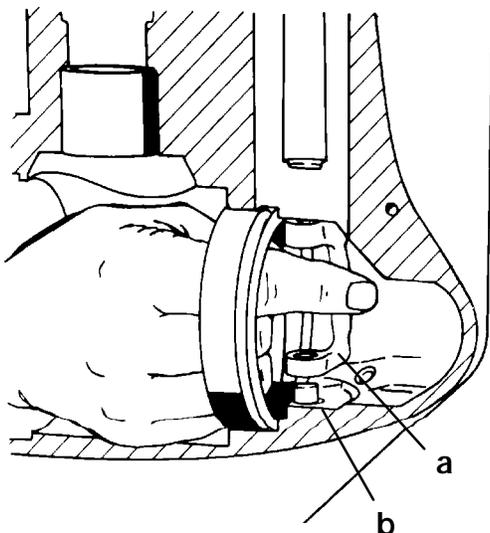
c. Remove the installation tool **and the reverse gear.**



Shift Shaft Assembly

INSTALLATION

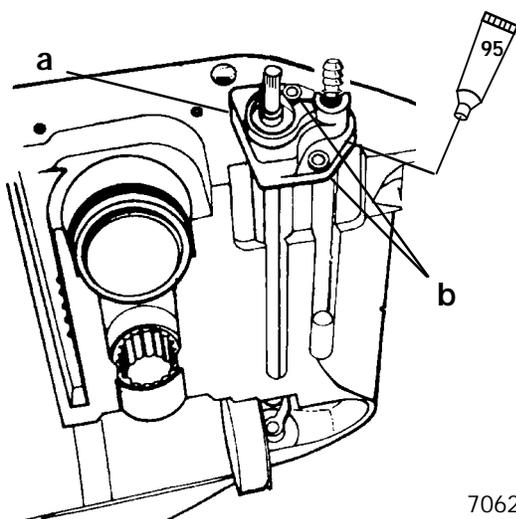
1. Place the shift crank onto the locating pin in the forward section of the gear housing. Ensure that the shift crank faces towards the left (port) side of the gear housing.



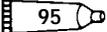
50314

- a - Shift Crank
- b - Locating Pin

2. Install the shift shaft assembly into the gear housing. Engage the splined end of the shift shaft with the shift crank. Verify O-rings are positioned properly and lubricated with 2-4-C w/Teflon. Secure shift shaft bushing with 2 screws. Torque screws to 60 lb. in. (6.8 N·m).

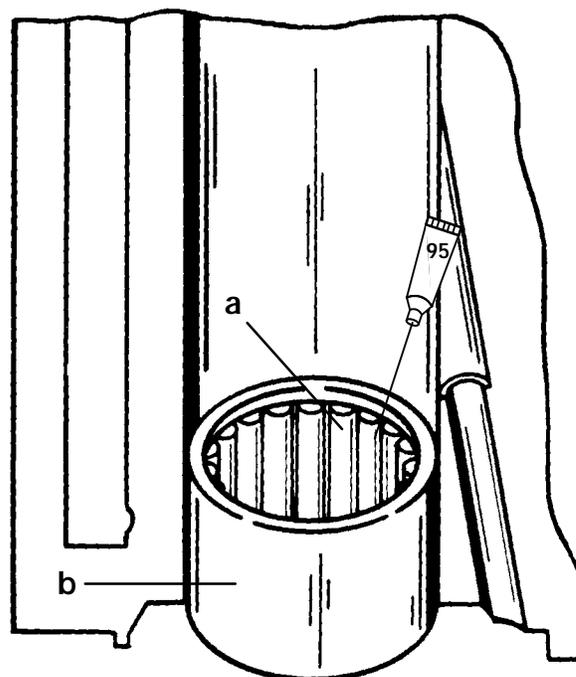


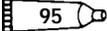
70620

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

- a - Shift Shaft Assembly
- b - Screws [Torque to 60 lb. in. (6.8 N·m)]

NOTE: If the pinion bearing needle bearings have fallen out, install 18 needles into needle bearing outer race. Use 2-4-C w/Teflon, to help hold needles in place.



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

- a - Rollers (18)
- b - Roller Bearing Outer Race

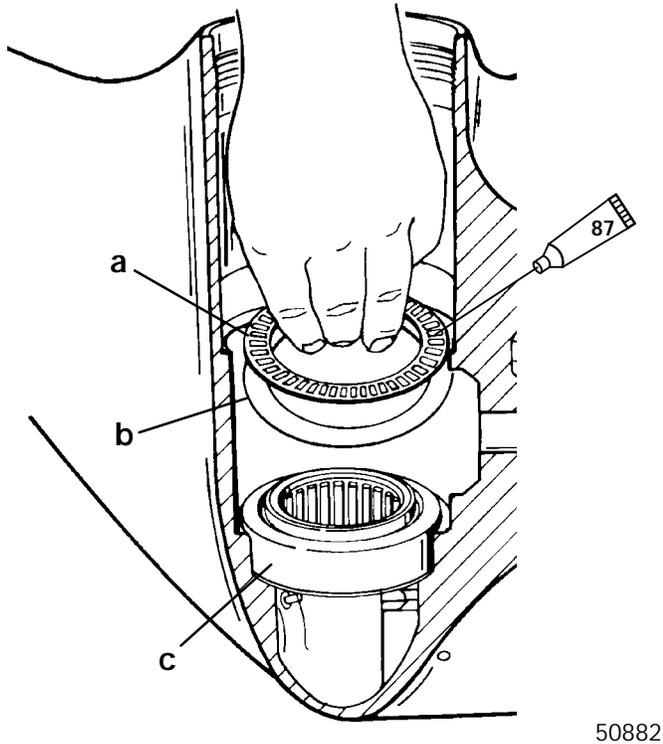


Gear Location/Backlashes Checking and Adjustment

Reverse Gear

INSTALLATION (FOR CHECKING BACKLASH ONLY)

1. Lubricate the large reverse gear thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and position first the thrust race, then the bearing into the gear housing and onto the reverse gear bearing adaptor.

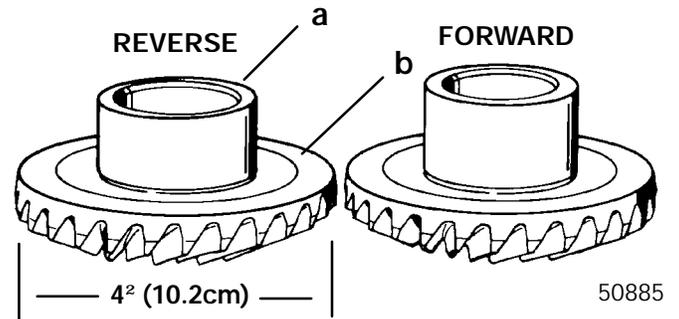


50882

87 Quicksilver Gear Lubricant (92-19007A24)

- a - Thrust Bearing
- b - Thrust Race
- c - Reverse Gear Bearing Adaptor

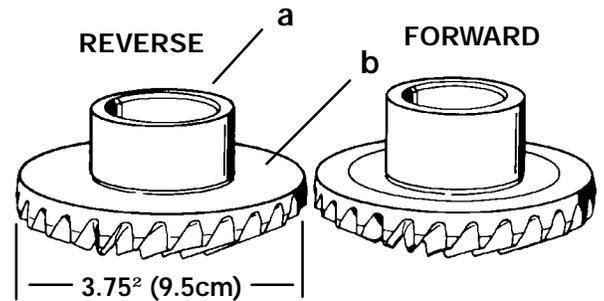
IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



50885

1994/1995/1996 Models

- a - Shorter Hub
- b - Groove

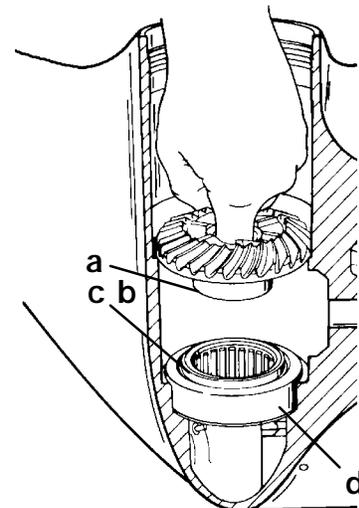


50885

1997/1998 Models

- a - Reverse Gear is Smaller in Diameter for 97/98 Models
- b - No Groove in Reverse Gear for 97/98 Models

2. Install the reverse gear into the gear housing and into the reverse gear bearing adaptor.



50884

- a - Reverse Gear
- b - Thrust Bearing
- c - Thrust Race (under Bearing)
- d - Reverse Gear Bearing Adaptor



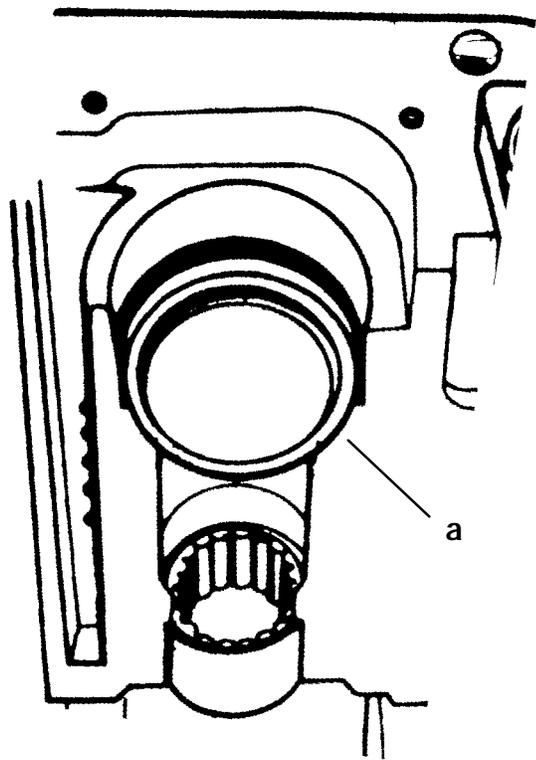
Drive Shaft and Pinion Gear

INSTALLATION (FOR CHECKING GEAR LOCATION AND BACKLASHES ONLY)

NOTE: If the original shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing and cup, or gear housing were replaced, start off by installing a 0.038 in. (0.96 mm) shim(s).

NOTE: If the original shims were retained (or measurement known) and none of the above listed parts were replaced, reinstall the original shims (or an amount of shims equal to the original shims).

1. Place the shim(s) into the drive shaft housing bore at the location shown.



20

a - Shim(s)

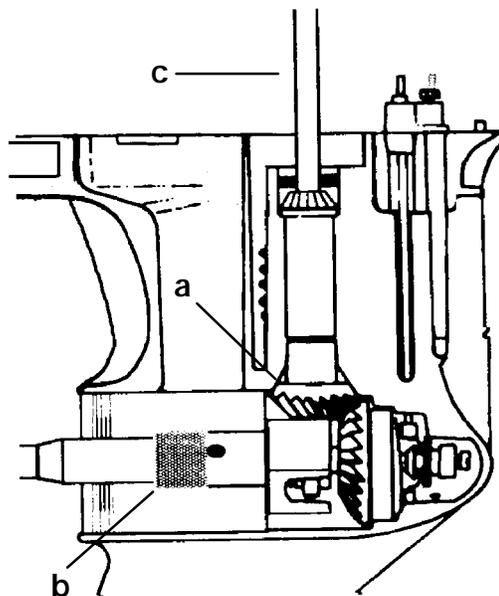
NOTE: For ease of installation, glue the washer to the pinion gear, using 3M Adhesive (92-25234), or Quicksilver Bellows Adhesive (92-86166), or equivalent.

2. Apply Loctite 271 (92-809820) to the threads of the pinion nut and position the pinion gear nut in the MR slot of the pinion nut adapter.

NOTE: Install the pinion gear nut with the flat side of the nut away from the pinion gear.

3. Place the pinion gear (with the washer glued to it) into the gear housing.

4. Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.
5. Temporarily install the propeller shaft (without the sliding clutch installed) into reverse gear.
6. Insert the pinion nut adaptor (with the nut) into the gear housing. It may be necessary to raise the drive shaft slightly to clear the tool.
7. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.

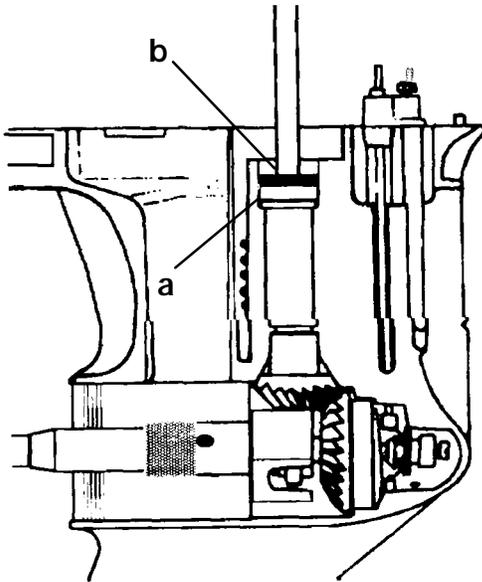


70891

- a - Pinion Gear (with the washer glued to it)
b - Pinion Nut Adaptor (91-61067A3)
c - Drive Shaft



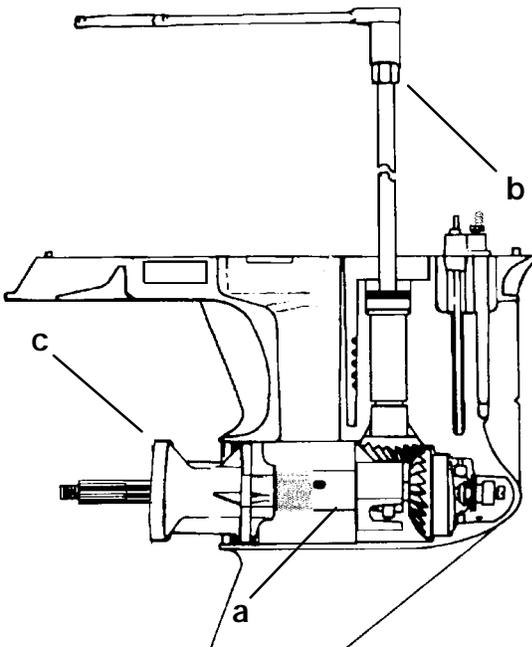
8. Install the drive shaft tapered roller bearing cup followed by the retainer.



70890

- a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

9. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adaptor in position.
10. Torque the pinion nut by turning the drive shaft using the drive shaft nut wrench and torque wrench with the appropriate socket to 75 lb. ft. (101.7 N·m).

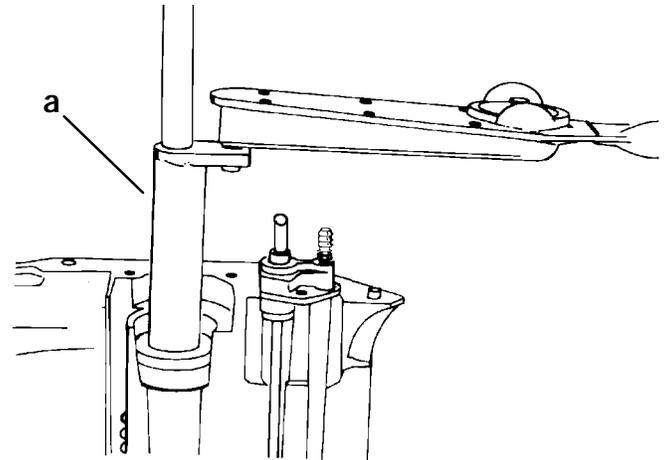


70892

- a - Pinion Nut Adaptor (91-61067A2)
b - Drive Shaft Nut Wrench (91-56775)
c - Bearing Carrier (installed backwards)

11. Remove bearing carrier, pinion nut adaptor and drive shaft nut wrench.

12. Torque retainer to 100 lb. ft. (135.6 N·m).



70711

- a - Drive Shaft Bearing Retainer Wrench (91-43506)

13. Remove retainer wrench.

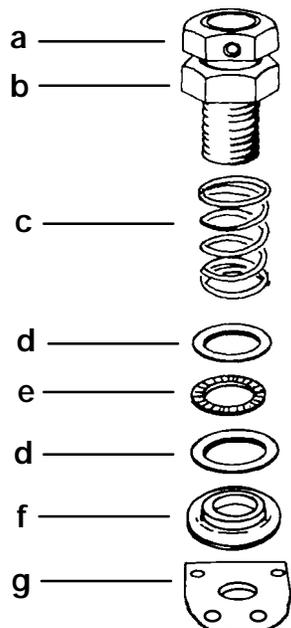


Drive Shaft - Bearing Preload Tool

INSTALLATION

NOTE: Ensure that the top nut and the bottom nut of the bearing preload tool are screwed as close together as possible prior to proceeding with the following step.

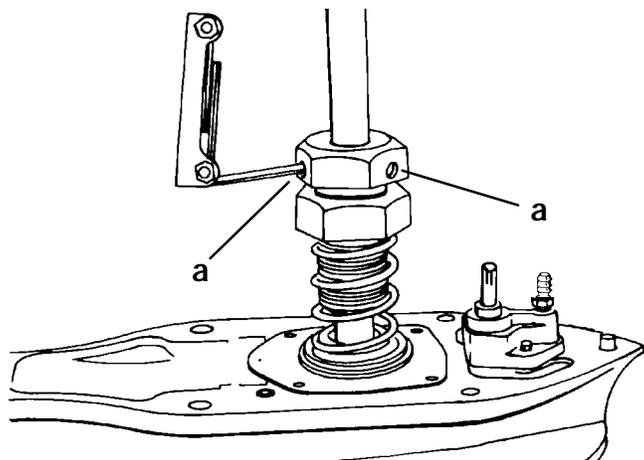
1. Install the components from the Bearing Preload Tool Kit (91-14311A1), over the drive shaft in the order shown.



70496

- a - Top Nut with Threaded Pipe
- b - Nut
- c - Spring
- d - Thrust Washer (2 Required) (12-18448)
- e - Thrust Bearing
- f - Thrust Washer
- g - Water Pump Face Plate (from your gear housing)

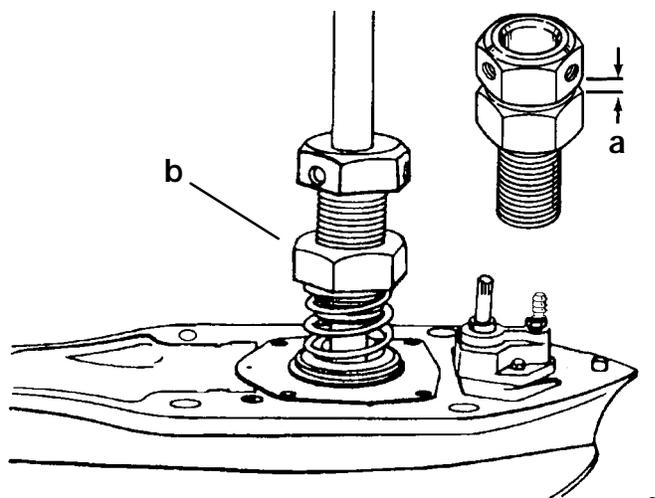
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



70716

- a - Allen Screws

3. Measure distance (a) and increase that distance by 1 in. (25.4mm) by turning bottom nut away from top nut.



10893

- a - Measure distance and increase by 1 in. (25.4mm)
- b - Bottom Nut [screwed down by approximately 1 in. (25.4mm)]

4. Rotate the drive shaft at least three full turns in a clockwise direction.



Pinion Gear Location

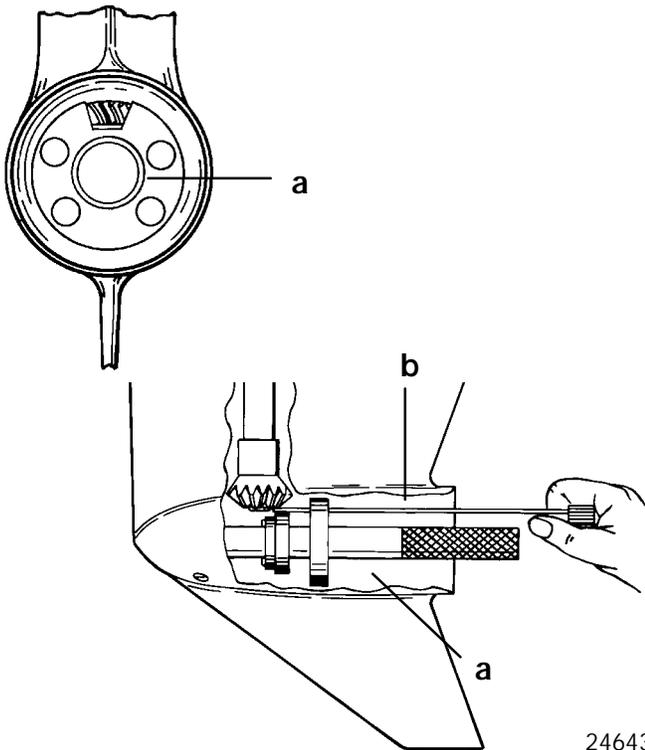
CHECKING

Pinion Gear Location Specification: .025 in. (0.64 mm)

1. Place the pinion gear shimming tool into the gear housing.

NOTE: Take the following measurements at 3 locations, rotating the drive shaft 120 degrees between each reading (always rotate the drive shaft in a clockwise direction).

2. Insert the thickest feeler gauge that fits snugly between one tooth of the pinion gear and high point of the shimming tool.



24643

a - Pinion Gear Shimming Tool 91-12349A2 Using Disc #2 and Flat #4

b - 0.025 in. (0.64mm) Feeler Gauge

3. Rotate the drive shaft 120 degrees in a clockwise direction and take another reading.
4. Repeat this process until 3 readings have been taken.
5. Add the three readings together and divide the sum by 3 to get the average pinion gear height.
6. **A.** If the (average) pinion gear location does not meet the specification of 0.025 in. (0.64 mm) continue with the instructions on the following section.

B. If the (average) pinion gear location meets specification, skip the following section and go on to the "Reverse Gear Backlash", 'Checking' section.



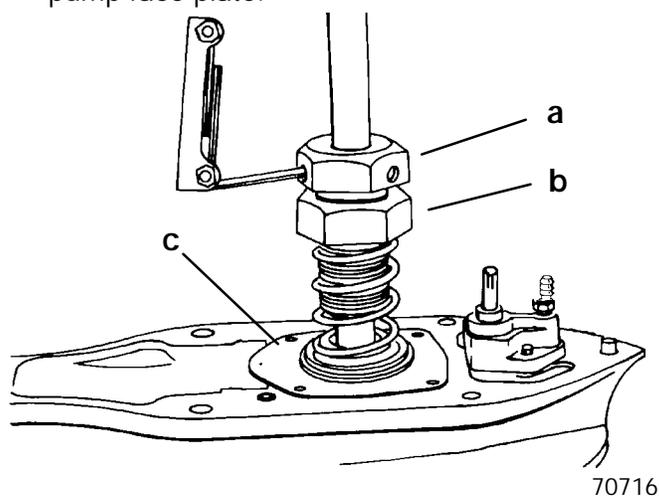
Drive Shaft - Bearing Preload Tool

REMOVAL

⚠ CAUTION

Before loosening the top nut allen screws of the bearing preload tool, screw the bottom nut up as close as possible to the top nut.

1. Screw the bottom nut of the bearing preload tool until it is as close as possible to top nut.
2. Loosen the allen screws in the top nut.
3. Remove all components including the water pump face plate.



- a - Top Nut (with allen screws)
- b - Bottom Nut
- c - Water Pump Face Plate

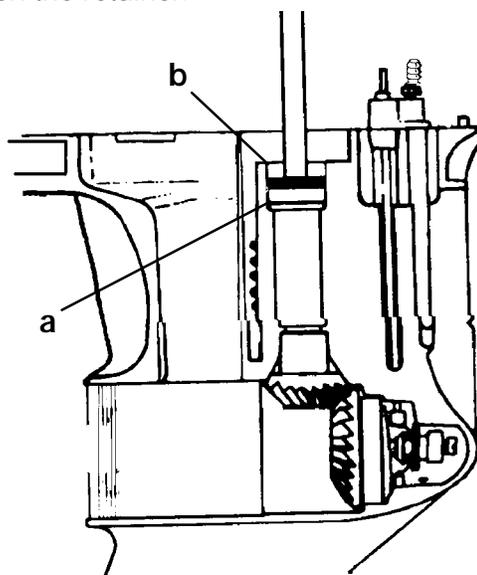
Pinion Gear Location

ADJUSTING

NOTE: Adding 0.001 in. (0.03mm) shims will increase the gear location by 0.001 in. (0.03mm). Subtracting 0.001 in. (0.03mm) will decrease the gear location by 0.001 in. (0.03mm).

1. Remove the drive shaft retainer and the drive shaft tapered roller bearing cup. (The cup can be removed by wiggling the drive shaft back and forth or by turning gear housing over and shaking it.) Add or subtract shims beneath the cup to obtain the proper average pinion gear height.

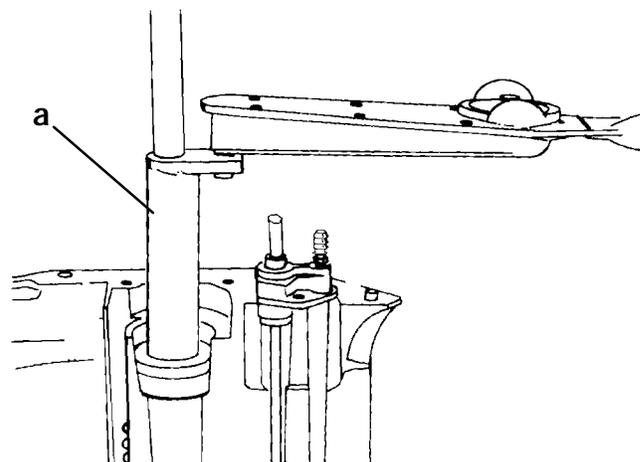
2. Install the drive shaft tapered roller bearing cup, then the retainer.



70890

- a - Tapered Roller Bearing Cup
- b - Drive Shaft Retainer

3. Torque the retainer to 100 lb. ft. (135.6 N·m).



- a - Drive Shaft Bearing Retainer Wrench (91-43506)

4. Reinstall the drive shaft bearing preload tool as outlined in the "Drive Shaft - Bearing Preload Tool", 'Installation' section.
5. Recheck the pinion gear height as outlined in the "Pinion Gear Location", 'Checking' section.



Reverse Gear Backlash

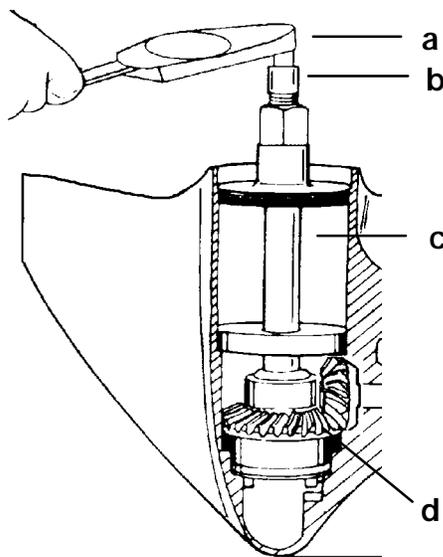
CHECKING

Reverse Gear Backlash Specification: 0.040-0.060 in. (1.01mm-1.5 mm).

NOTE: If the bearing preload tool has not already been set up see "Drive Shaft - Bearing Preload Tool", 'Installation' section first.

NOTE: The reverse gear bearing adaptor installation tool is used to apply a light preload to the reverse gear in the following steps.

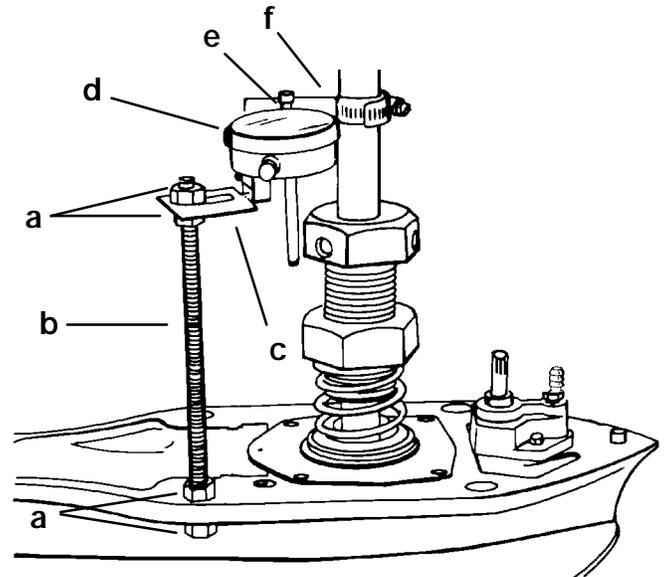
1. Install the reverse gear bearing adaptor installation tool into the gear housing to hold the reverse gear against the thrust bearing as follows:
 - a. Assemble the reverse gear bearing adaptor installation tool into the gear housing and tighten it by hand until a slight resistance is felt.
 - b. Torque the adaptor's driver bolt to 45 lb. in. (5.1 N·m).



70973

- a - Torque Wrench (91-66274)
- b - Driver Bolt
- c - Bearing Adaptor Installation Tool (91-18605A1)
- d - Reverse Gear

2. Install a dial indicator as shown in the following figure.



70717

- a - Nuts (4) (obtain locally)
- b - Threaded Rod [3/8 in. (9.5 mm) obtain locally]
- c - Dial Indicator Holding Tool (91-89897)
- d - Dial Indicator (91-58222A1)
- e - Indicator Pointer
- f - Backlash Indicator Rod (91-53459) (for 1.64:1 or 1.75:1)
- g - Backlash Indicator Rod (91-78473) (for 1.87:1)

3. Align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to the "0" mark on the dial indicator scale.
4. Take the backlash readings by lightly turning the drive shaft back and forth, so as to feel the backlash between the gears.
 - a. Observe the dial indicator and record the reading.
 - b. Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.
 - c. Repeat step 3 an 4 above until a total of 4 backlash readings have been taken.
5. Add the four readings together and divide the sum by four. This is your average backlash and it should be 0.040 in. - 0.060 in. (1.0mm - 1.5mm) (for 1.64:1, 1.75:1 and 1.87:1 ratios).



NOTE: If backlash needs to be adjusted, (see *Checking Reverse Gear Backlash*), adding 0.001 in. (0.03 mm) shims will **reduce** the gear backlash by approximately 0.001 in. (0.03mm). Subtracting 0.001 in. (0.03mm) shims will **increase** backlash by approximately the same amount.

Example 1 (if backlash is too high)

Backlash checks:	.070 in.	(1.79 mm)
(subtract) middle of specification:	.050 in.	(1.27 mm)
You get:	.020 in.	(0.50 mm)

add this quantity of shims

Example 2 (if backlash is too low)

middle of specification:	.050 in.	(1.27 mm)
Backlash checks:	.020 in.	(0.50 mm)
(subtract) You get:	.030 in.	(0.76 mm)

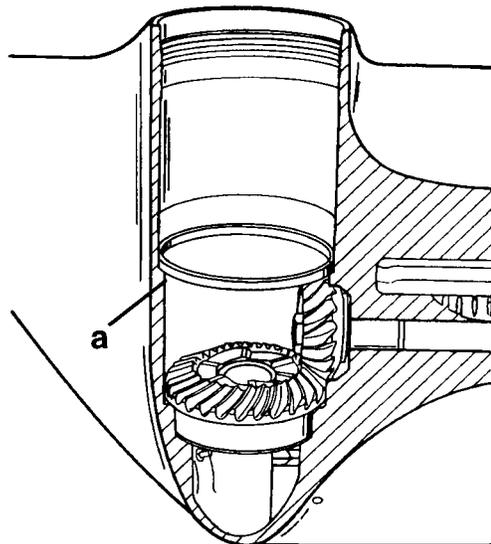
subtract this quantity of shims

Forward Gear/Bearing Carrier Assembly

CHECKING FORWARD GEAR BACKLASH - (RATCHETING)

NOTE: If backlashes have already been checked and they are to specification, proceed with "Bearing Carrier Assembly", 'Final Installation' section.

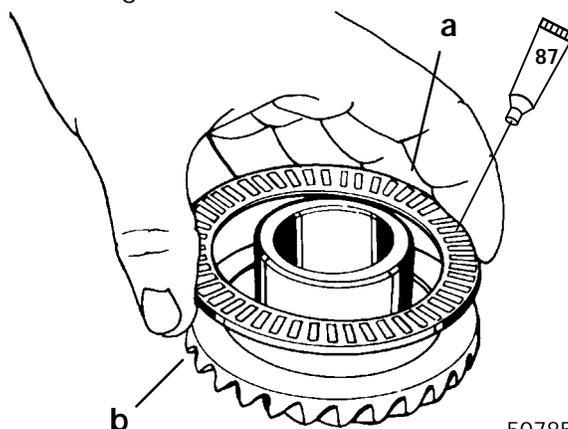
1. Install the appropriate spacer shim into the gear housing.



55428

a - Shim

2. Temporarily install the propeller shaft (without sliding clutch installed) into the reverse gear. Position the shift crank so propeller shaft will rest on the crank.
3. Lubricate the thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and place it onto the forward gear.



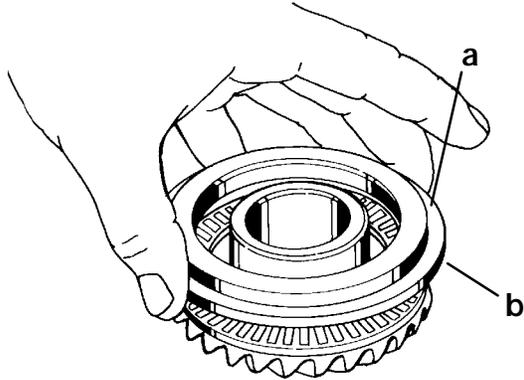
50785

87 Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Bearing
b - Forward Gear



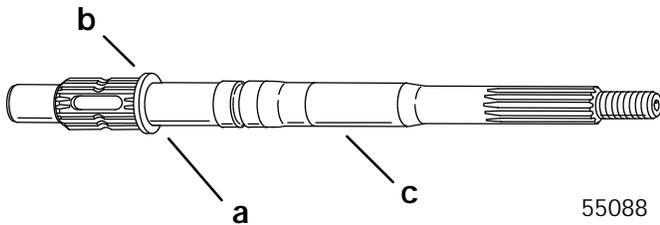
- Place the thrust race on top of the thrust bearing with the **wide flat side against** the thrust bearing.



50785

- a - Thrust Race
- b - Wide Flat Side

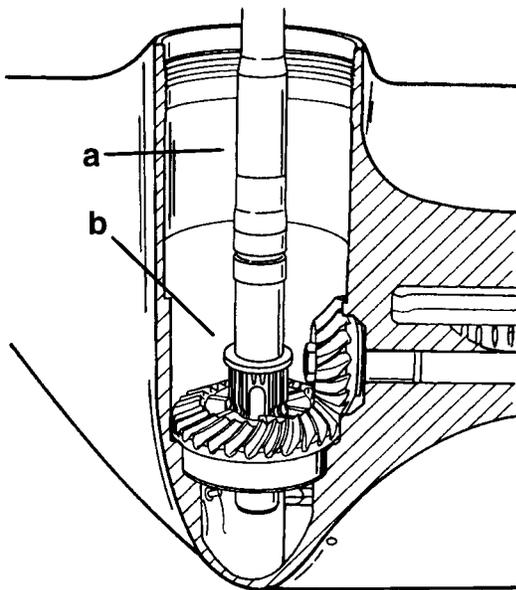
- Install a load washer (12-37429) over a 44-93003 propeller shaft so that it seats against the REAR shoulder of the clutch spline teeth.



55088

- a - Load Washer (12-37429)
- b - Shoulder
- c - Propeller Shaft (44-93003)

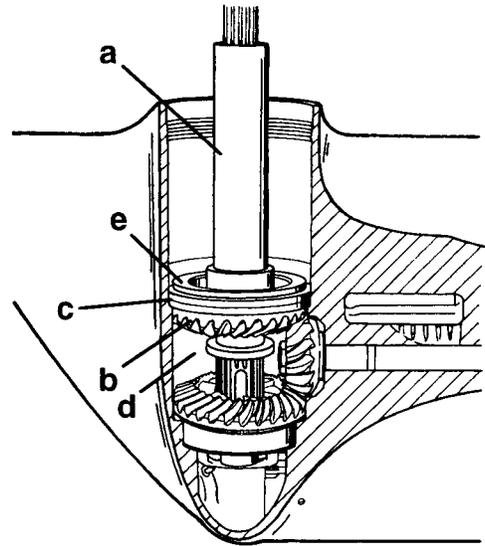
- Install propeller shaft with load washer into gear housing.



55623

- a - Propeller Shaft (44-93003)
- b - Load Washer (12-37429)

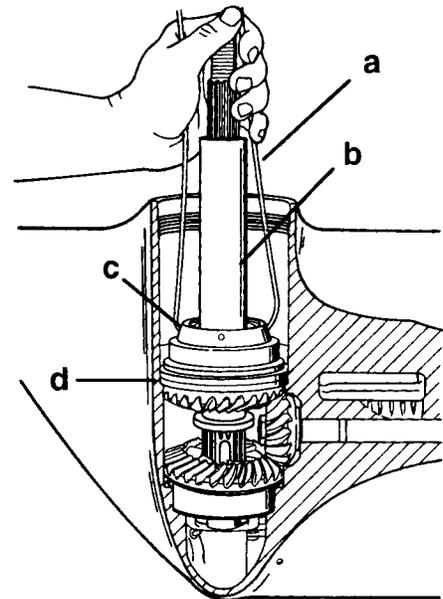
- Assemble the forward gear installation tool to the forward gear, then place it down over the propeller shaft. Ensure that the thrust race seats evenly onto the shim. Tap the thrust race down lightly with a soft tool, do not damage the thrust race surface.



55624

- a - Forward Gear Installation Tool (91-815850)
- b - Forward Gear
- c - Spacer Shim
- d - Load Washer (12-37429)
- e - Thrust Race

- Install the forward gear bearing adaptor using a hook tool (which was fashioned when the adaptor was removed) as shown. Ensure that the adaptor seats evenly against the thrust race.

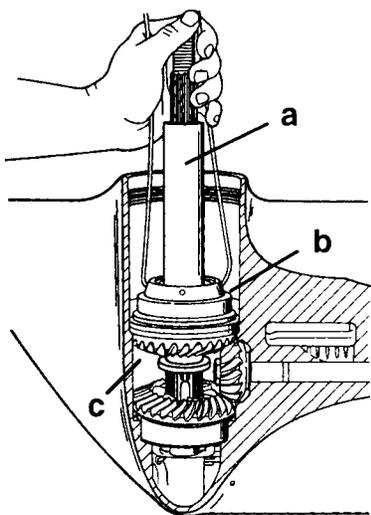


55430

- a - Hook Tool
- b - Forward Gear Installation Tool (91-815850)
- c - Forward Gear Bearing Adaptor
- d - Thrust Race



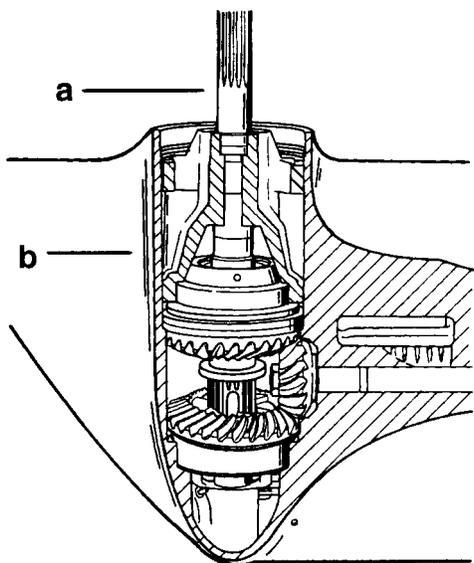
9. Remove the hook tool and while holding down on the forward gear remove the forward gear installation tool.



55430

- a - Forward Gear Installation Tool (91-815850)
 b - Forward Gear Bearing Adaptor
 c - Forward Gear

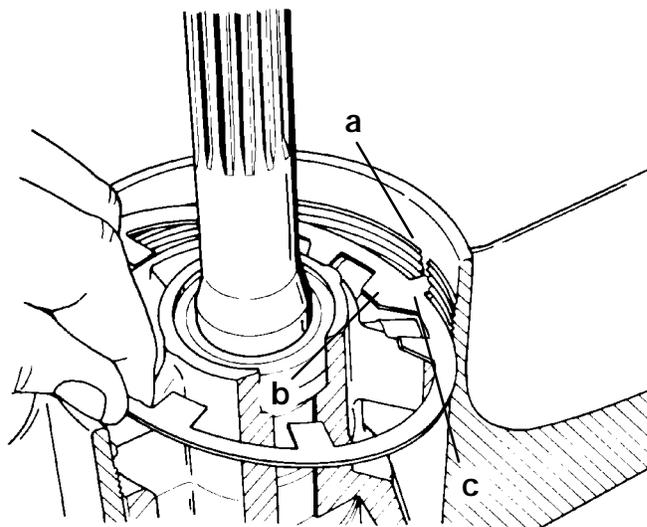
10. Install the bearing carrier over the propeller shaft pushing bearing carrier down until it is fully seated.



55429

- a - Propeller Shaft
 b - Bearing Carrier

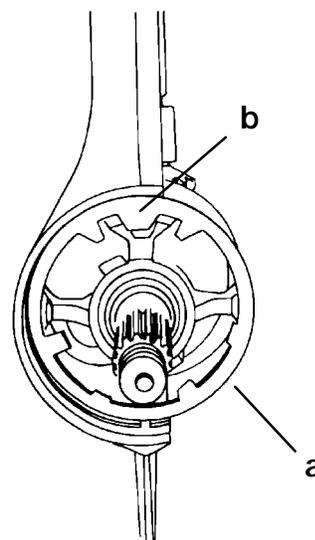
11. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing. Install the tab washer with the external tab inserted into the hole in the gear housing.



50779

- a - Gear Housing Tab Washer Alignment Hole (not seen)
 b - "V" Shaped Notch in Bearing Carrier
 c - Alignment Tab of Tab Washer

12. Insure that the "V" shaped tab aligns with the "V" notch in bearing carrier.

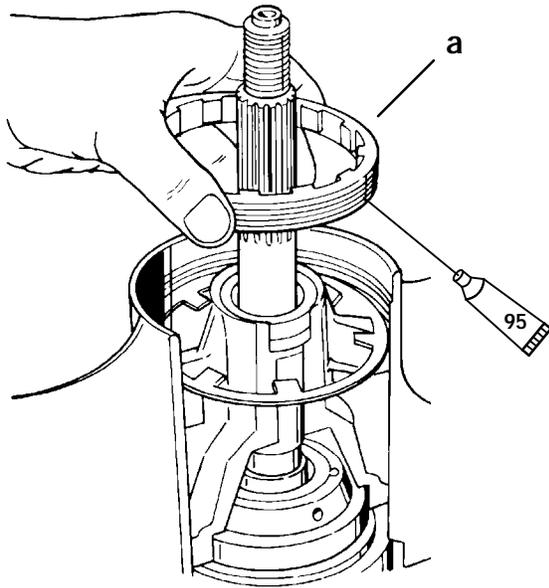


70714

- a - Tab Washer
 b - "V" Tab



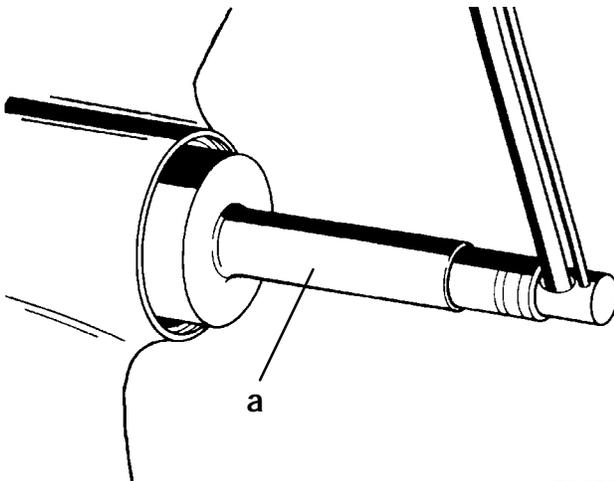
13. Lubricate the bearing carrier retainer threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



2-4-C With Teflon (92-825407A12) 50881

a - Bearing Carrier Retainer

14. Torque the bearing carrier retainer to 210 lb. ft. (284.7 N-m) to seat forward gear assembly in gear case.

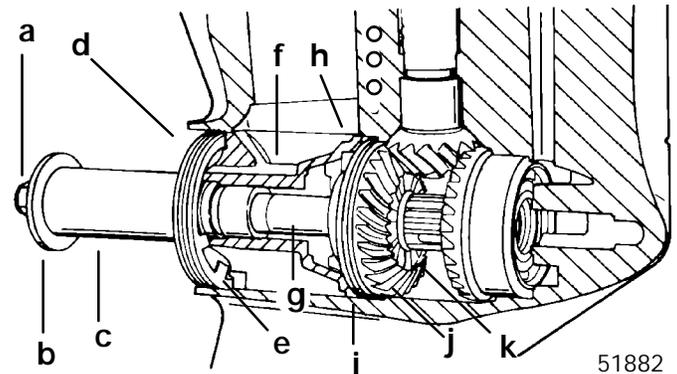


23355

a - Bearing Carrier Retainer Wrench (91-61069)

NOTE: Drill a 3/8" (22.2mm) diameter hole through the side (PROPELLER NUT END) of a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe. A screwdriver may be inserted thru pipe into propeller shaft splines to prevent PVC pipe from turning while tightening retaining nut.

15. Install a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe (obtain locally) over propeller shaft and secure it against the bearing carrier with a flat washer and nut.



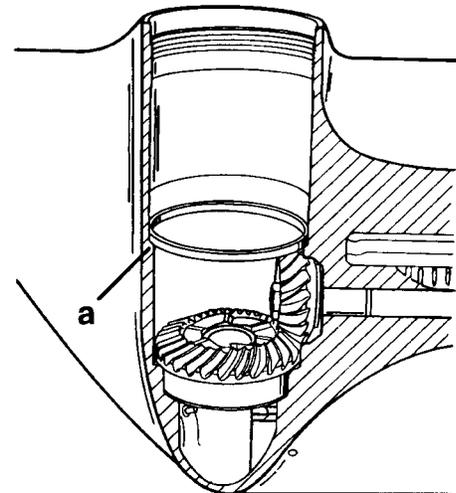
51882

- a - Prop Nut
- b - Flat Washer
- c - PVC Pipe [5" x 2" (127mm x 50.8mm)]
- d - Retainer
- e - Tab Washer
- f - Bearing Carrier
- g - Prop Shaft
- h - Bearing Adaptor
- i - Shim
- j - Forward Gear
- k - Load Washer

16. Tighten nut to 45 lb. in. (5.1 N-m). This will seat the forward gear against the forward thrust bearing and tends to hold the propeller shaft from moving when measuring backlash.

CHECKING FORWARD GEAR BACKLASH - NON-RATCHETING

1. Install the appropriate spacer shim into the gear housing.

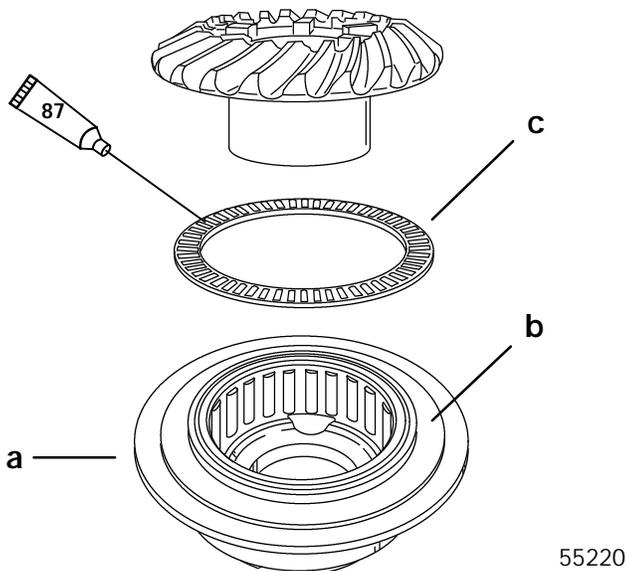


55428

a - Shim



2. Apply Quicksilver Gear Lubricant to thrust bearing and install thrust bearing and thrust race onto forward gear bearing adaptor.

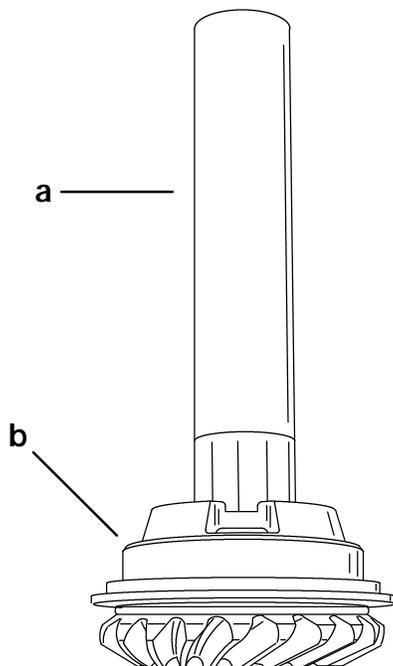


55220

Quicksilver Gear Lubricant (92-19007A24)

- a - Bearing Adaptor
- b - Thrust Washer
- c - Thrust Bearing

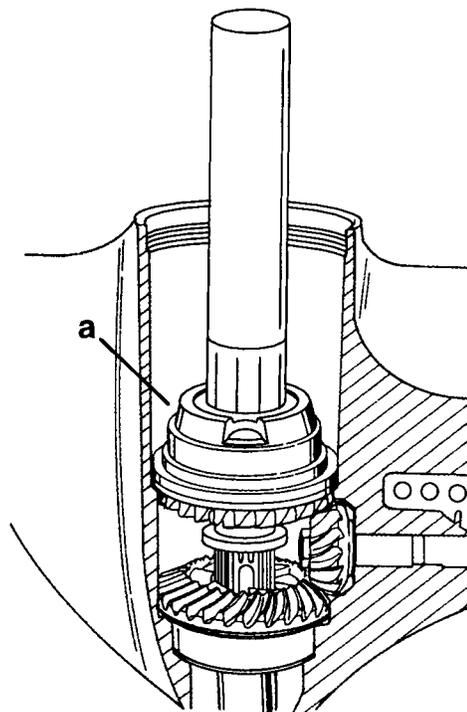
3. Insert Forward Gear Installation Tool (91-815850) into forward gear/bearing adaptor assembly.



55221

- a - Forward Gear Installation Tool (91-815850)
- b - Forward Gear/Bearing Adaptor Assembly

4. Install tool with adaptor assembly over propeller shaft and into gear housing. Applying downward pressure to bearing adaptor, remove installation tool from assembly.

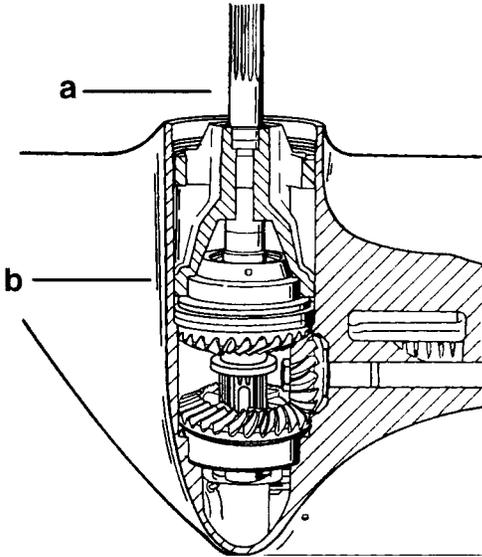


55431

- a - Forward Gear Bearing Adaptor



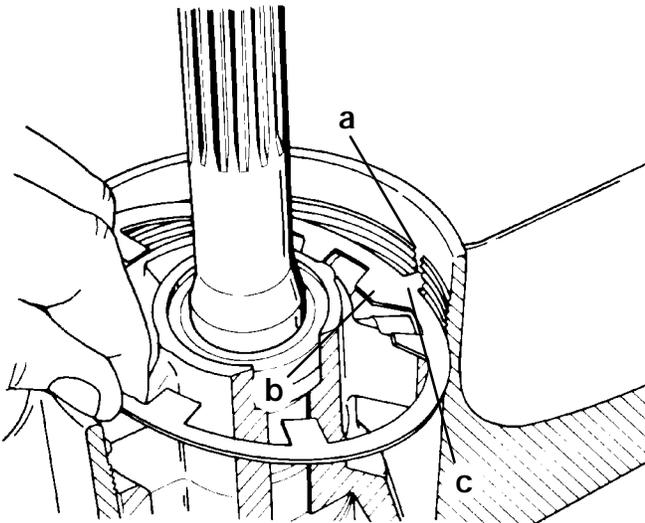
5. Install the bearing carrier over the propeller shaft pushing bearing carrier down until it is fully seated.



55429

- a - Propeller Shaft
- b - Bearing Carrier

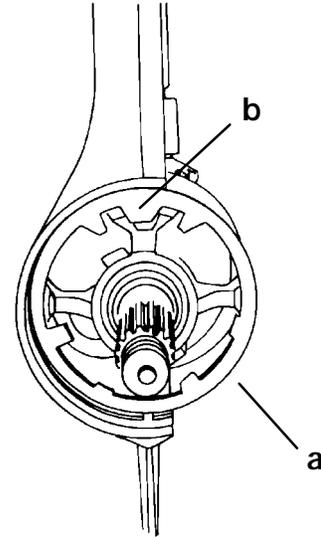
6. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing. Install the tab washer with the external tab inserted into the hole in the gear housing.



50779

- a - Gear Housing Tab Washer Alignment Hole (not seen)
- b - "V" Shaped Notch in Bearing Carrier
- c - Alignment Tab of Tab Washer

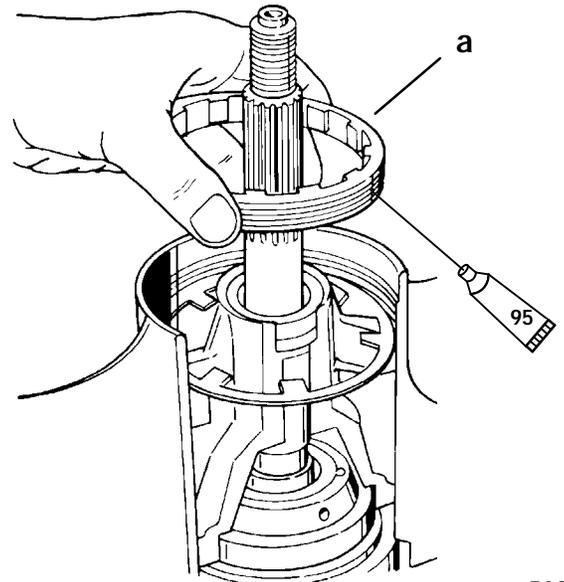
7. Insure that the "V" shaped tab aligns with the "V" notch in bearing carrier.



70714

- a - Tab Washer
- b - "V" Tab

8. Lubricate the bearing carrier retainer threads with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



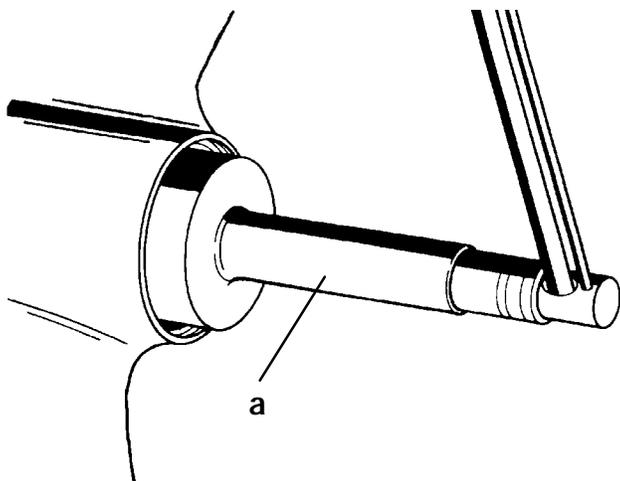
50881

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

- a - Bearing Carrier Retainer



- Torque the bearing carrier retainer to 210 lb. ft. (284.7 N·m) to seat forward gear assembly in gear case.

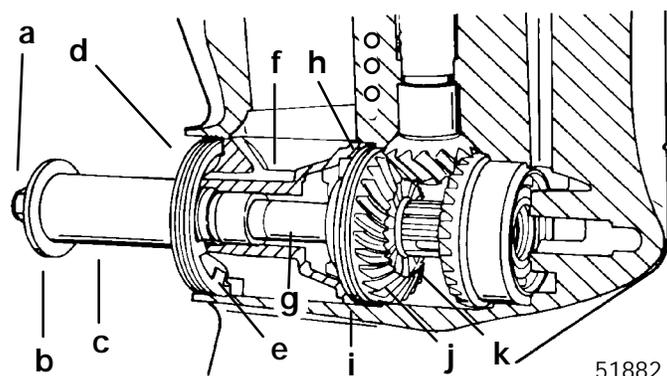


23355

a - Bearing Carrier Retainer Wrench (91-61069)

NOTE: Drill a 3/8" (22.2mm) diameter hole through the side (PROPELLER NUT END) of a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe. A screwdriver may be inserted thru pipe into propeller shaft splines to prevent PVC pipe from turning while tightening retaining nut.

- Install a 5" x 2" (127mm x 50.8mm) long piece of PVC pipe (obtain locally) over propeller shaft and secure it against the bearing carrier with a flat washer and nut.



51882

a - Prop Nut
 b - Flat Washer
 c - PVC Pipe [5" x 2" (127mm x 50.8mm)]
 d - Retainer
 e - Tab Washer
 f - Bearing Carrier
 g - Prop Shaft
 h - Bearing Adaptor
 i - Shim
 j - Forward Gear
 k - Load Washer

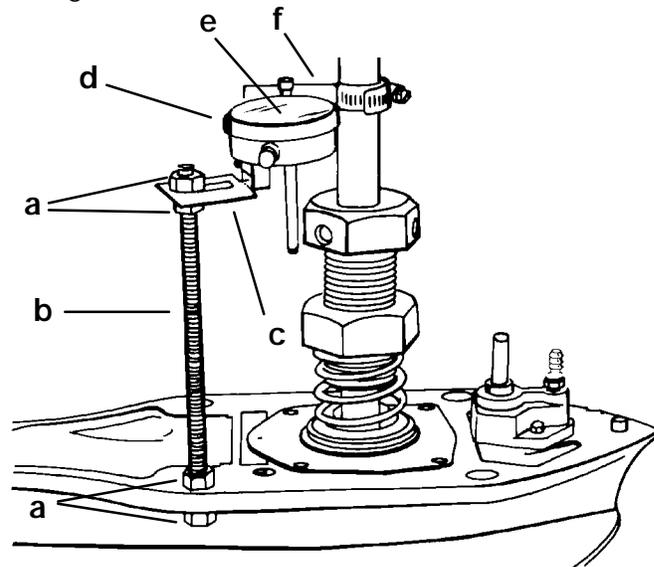
- Tighten nut to 45 lb. in. (5.1 N·m). This will seat the forward gear against the forward thrust bearing and tends to hold the propeller shaft from moving when measuring backlash.

Forward Gear Backlash

CHECKING

NOTE: If the bearing preload tool has not already been set up, see "Drive Shaft - Bearing Preload Tool", 'Installation' section first.

- Install a dial indicator as shown in the following figure.



a - Nuts (4) (obtain locally)
 b - Threaded Rod [3/8 in. (9.5 mm) obtain locally]
 c - Dial Indicator Holding Tool (91-89897)
 d - Dial Indicator (91-58222A1)
 e - Indicator Pointer
 f - Backlash Indicator Rod (91-53459) (for 1.64:1 and 1.75:1 ratios) Backlash Indicator Rod (91-78473 (for 1.87:1 ratio)

- Align the dial indicator pointer so that it is perpendicular to and touching the "1" mark on the dial indicator tool. Tighten the indicator tool onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to "0" on the dial indicator scale.
- Take the backlash readings by lightly turning the drive shaft back and forth.
 - Observe the dial indicator and record the reading.
 - Loosen the indicator tool and rotate the drive shaft 90 degrees in a clockwise direction.
 - Repeat step 4 above and take and record another reading. Repeat step 4 until a total of 4 backlash readings have been taken.
- Add the four readings together and divide the sum by 4. This is your average backlash, which should be 0.017 in. - 0.028 in. (0.431mm - 0.711mm) (for 1.64:1; 1.75:1 and 1.87:1 ratios).



5. If backlash is MORE than the specified MAXIMUM, REMOVE shim(s) from in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 to threads of nut.

6. If backlash is LESS than the specified MINIMUM, add shim(s) in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 to threads of nut.

NOTE: By adding or subtracting 0.001 in. (0.03mm) shim, the backlash will change approximately 0.001 in. (0.03mm).

7. Remove the propeller nut, washer, and the pinion nut adaptor.

a. **If the Backlash is to Specification**, skip the next step (8b), and go on to step 9 following.

b. **If the Backlash is not to Specification**, complete the following instructions to install a different size spacer shim under the forward gear thrust race.

(1.) Remove the bearing carrier retainer, tab washer, and the bearing carrier.

(2.) Using the hook tool, remove the forward gear bearing adaptor.

(3.) Insert the forward gear installation tool into the forward gear and remove the forward gear, thrust bearing and thrust race.

(4.) Remove the spacer shim.

(5.) Complete the instruction found in section "Forward Gear/Bearing Carrier Assembly", 'Installation - (For Checking Forward Gear Backlash)' section found on page 6B-58.

(6.) Recheck backlash as outlined in the "Forward Gear Backlash", 'Checking' section.

8. Remove the following items as outlined following:

a. Remove the bearing carrier retainer, tab washer, and the bearing carrier.

b. Using the hook tool remove the forward gear bearing adaptor.

c. Insert the forward gear installation tool into the forward gear and remove the forward gear, thrust bearing and thrust race.

d. Remove the propeller shaft.

e. Remove the spacer shim.

f. "Drive Shaft - Bearing Preload Tool", 'Removal' section.

g. "Drive Shaft Assembly", 'Removal' section.

h. Remove the reverse gear.

9. Reinstall the following items as outlined in the following sections:

a. "Drive Shaft and Pinion Gear", 'Installation (For Checking Gear Location and Backlashes Only)' section.

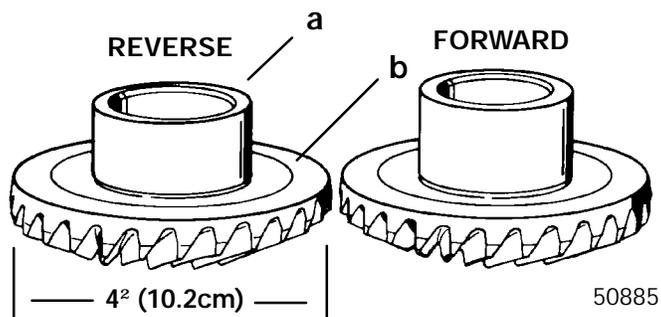
b. "Drive Shaft - Bearing Preload Tool", 'Installation' section.



Propeller Shaft Assembly

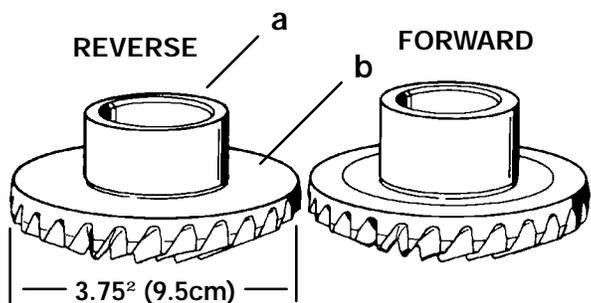
Component Reassembly

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



1994/1995/1996 Models

- a - Shorter Hub
- b - Groove

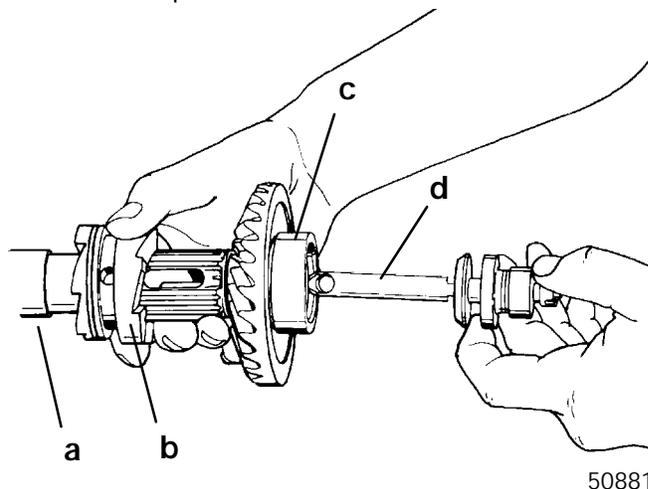


1997/1998 Models

- a - Reverse Gear is Smaller in Diameter for 97/98 Models
- b - No Groove in Reverse Gear for 97/98 Models

1. Assemble the sliding clutch on the propeller shaft, being sure to align cross pin holes in the clutch with the slot in the propeller shaft. Make sure that the sliding clutch is placed on the propeller shaft with the grooved end of the clutch facing the propeller end of the shaft.
2. Assemble the reverse gear onto the propeller shaft.

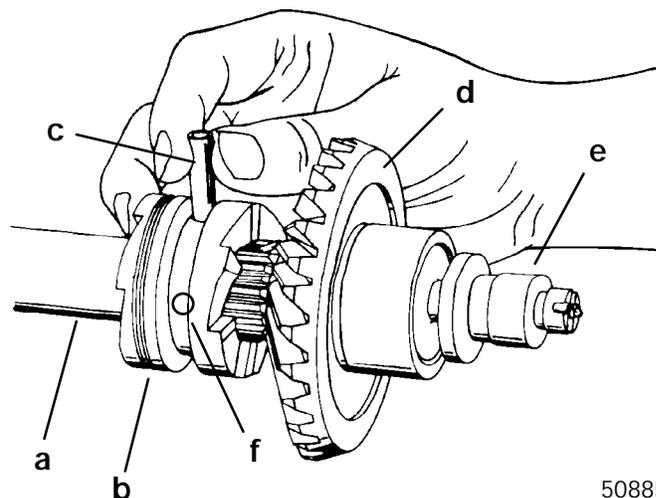
3. Assemble the shift spool assembly to the propeller shaft being sure to align the cross pin hole of the shift spool shaft with the clutch slot.



50881

- a - Propeller Shaft
- b - Sliding Clutch
- c - Reverse Gear
- d - Shift Spool Assembly

4. Assemble the cross pin through the sliding clutch, through the propeller shaft and through the shift spool shaft hole.
5. Install detent pin in third hole in clutch.

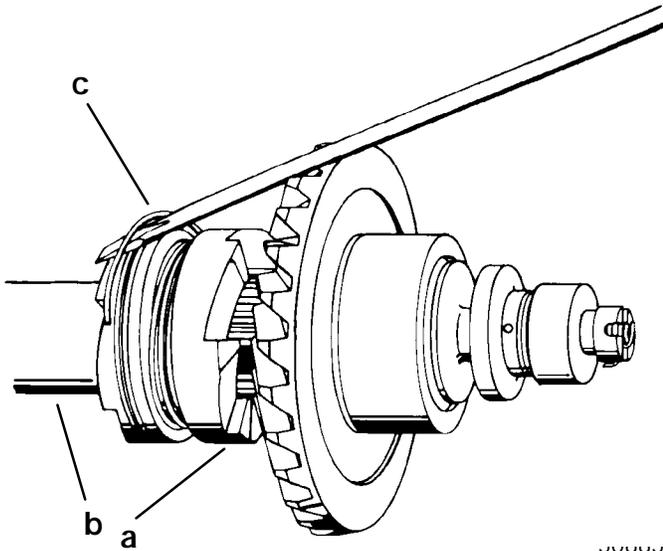


50885

- a - Propeller Shaft
- b - Sliding Clutch
- c - Cross Pin
- d - Reverse Gear
- e - Shift Spool Assembly
- f - Detent Pin



- Assemble the cross pin retaining spring over the propeller shaft and wind it around the clutch over the cross pin hole. **Make sure that the spring is wound on so that it does not cross over on itself and that it lies flat against the clutch once it is assembled. If it does not lie flat against the clutch a new spring must be installed.**

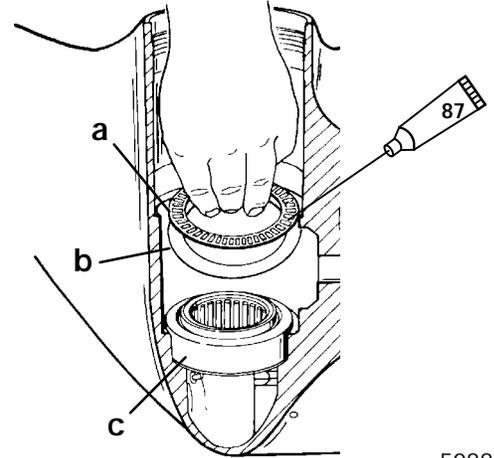


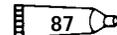
- a - Sliding Clutch
- b - Propeller Shaft
- c - Cross Pin Retaining Spring

Propeller Shaft Assembly

Installation

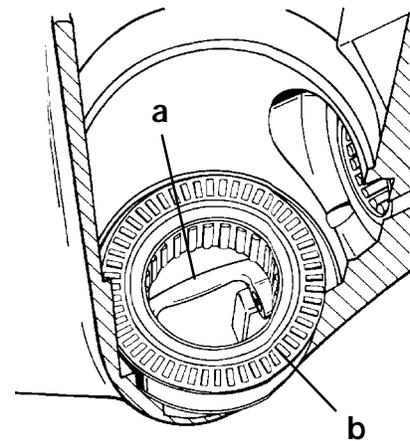
- Lubricate the large thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and position first the thrust race then the bearing into the gear housing onto the reverse gear bearing adaptor.



 Quicksilver Gear Lubricant (92-19007A24)

- a - Thrust Bearing
- b - Thrust Race
- c - Reverse Gear Bearing Adaptor

- Rotate the shift crank toward the aft end of the gear housing until it touches against the bearing adaptor and hold it in this position.

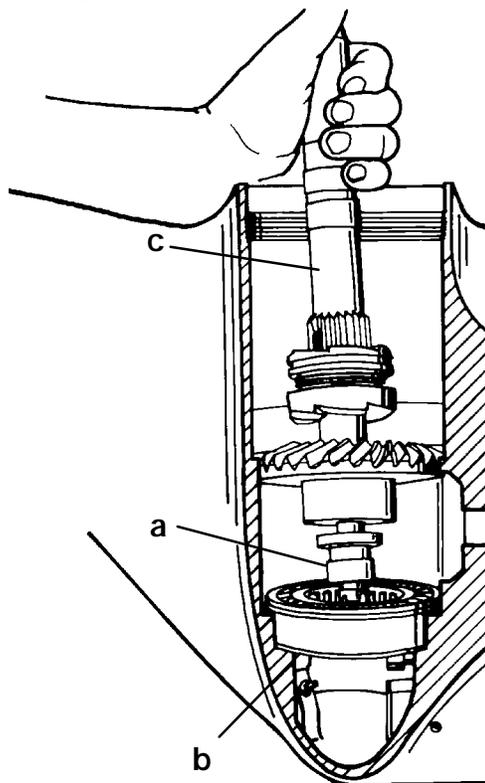


- a - Shift Crank
- b - Bearing Adaptor

IMPORTANT: Be careful when inserting the propeller shaft assembly into the gear housing as the needle bearings in the reverse gear bearing adaptor can become dislodged. If it is suspected that a needle has become dislodged, remove the propeller shaft assembly and inspect the needle bearing cages for damage. If the cages have not been damaged and a needle bearing is mispositioned, it can be snapped back into place.



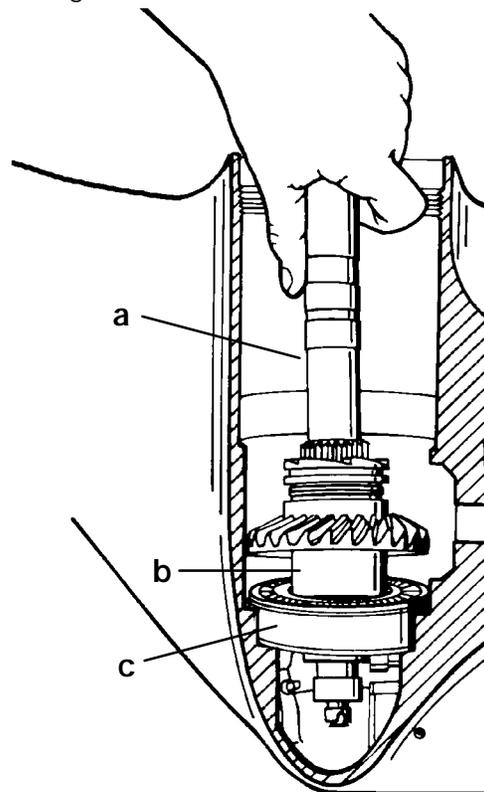
- To allow for the engagement of the shift spool with the shift crank, tilt the propeller end of the propeller shaft assembly to the left (port) side of gear housing and begin to lower it into the gear housing.



50888

- a - Shift Actuating Spool
- b - Shift Crank
- c - Propeller Shaft Assembly

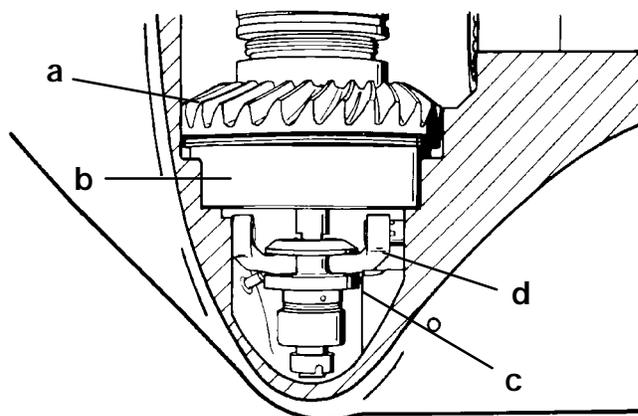
- With the propeller shaft assembly tilted to the port side of the gear housing, continue to lower the assembly until the reverse gear hub comes into contact with the reverse gear bearing adaptor and the propeller shaft is fully inserted into the reverse gear.



50888

- a - Propeller Shaft
- b - Reverse Gear Hub
- c - Bearing Adaptor

- Slowly move the propeller shaft to the center of the housing and lower the reverse gear into the bearing adaptor. The shift spool should engage with the shift crank as the propeller shaft centers itself.

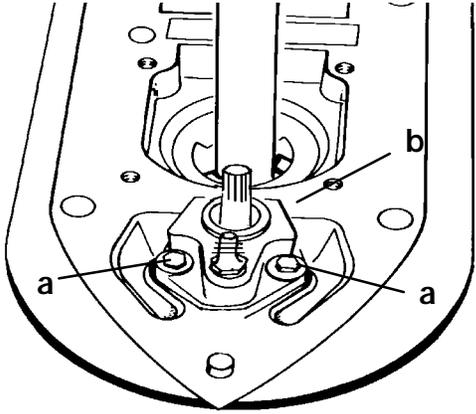


50885

- a - Reverse Gear
- b - Bearing Adaptor
- c - Shift Spool
- d - Shift Crank



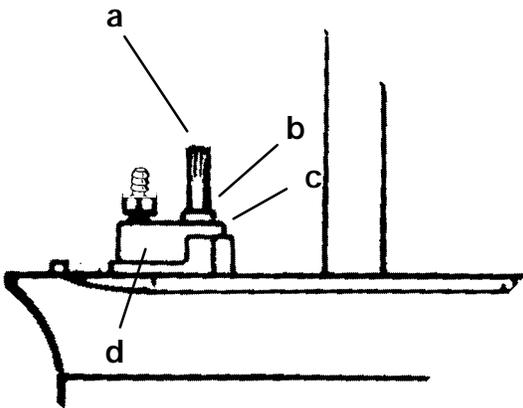
- Operate the shift shaft to ensure that it has been properly installed. The sliding clutch should move forward when the shift shaft is turned clockwise, and should move aft when the shift shaft is turned counterclockwise.
- Make sure that the O-rings are present and positioned correctly. Install the screws that secure the shift shaft bushing and torque them to 60 lb. in. (6.8 N·m).



70494

- a - Screws (2)
- b - Shift Shaft Bushing

- Slide the rubber sleeve at top end of shift shaft down so that it just touches the oil seal in the bushing.



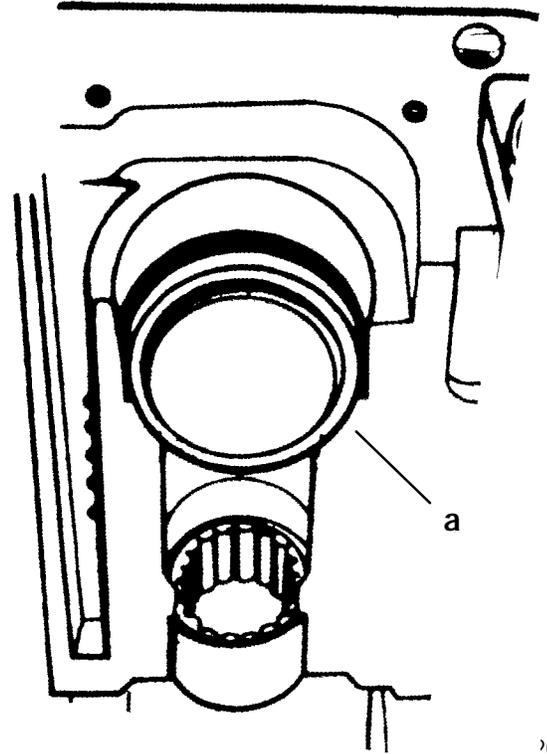
2

- a - Shift Shaft
- b - Rubber Sleeve
- c - Oil Seal
- d - Shift Shaft Bushing

Drive Shaft and Pinion Gear

Final Installation (Ratcheting and Non-Ratcheting)

- Place the shim(s) into the drive shaft housing bore at the location shown.



20

- a - Shim(s)

NOTE: For ease of installation, glue the washer to the pinion gear, using 3M Adhesive (92-25234), or Quicksilver Bellows Adhesive (92-86166), or equivalent.

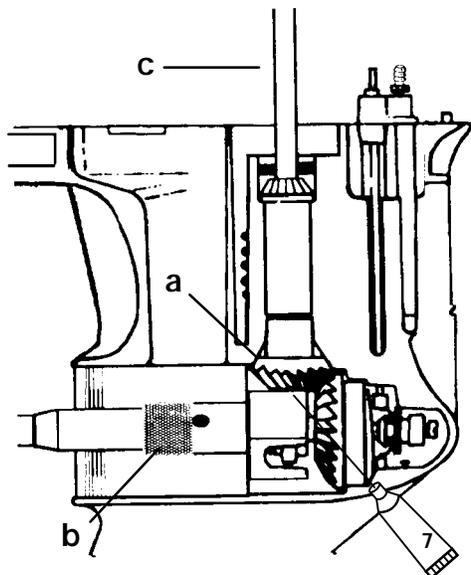
- Apply Loctite Type 271 (92-809820) to the threads of the **NEW** pinion gear **NUT** and assemble the pinion gear nut into the MR slot of the pinion nut adaptor.

NOTE: Install the pinion gear nut with the flat side of the nut away from the pinion gear.

- Place the pinion gear (with the washer glued to it) into the gear housing.
- Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.



5. Insert the pinion nut adaptor (with the nut assembled to it) into the gear housing. It may be necessary to raise the drive shaft slightly to clear the tool.
6. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.

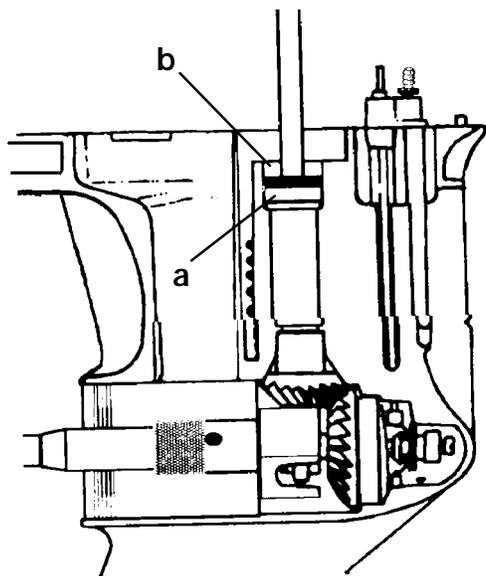


70891



- a - Pinion Gear (with the washer glued to it)
- b - Pinion Nut Adaptor (91-61067A3)
- c - Drive Shaft

7. Install the drive shaft tapered roller bearing cup then the retainer.

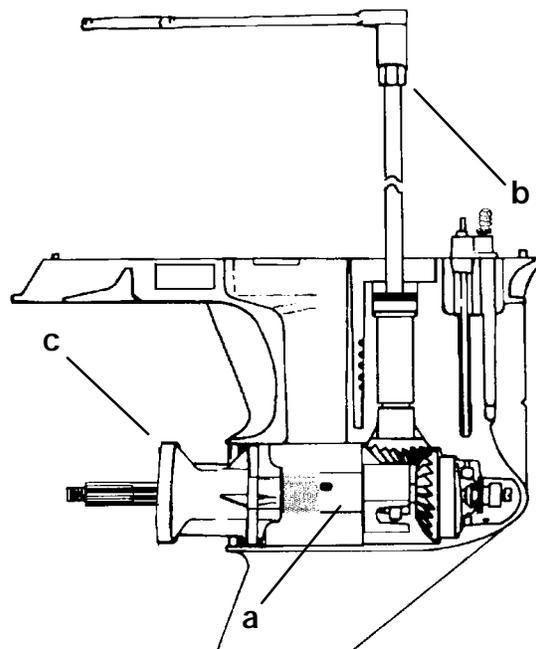


70890

- a - Tapered Roller Bearing Cup
- b - Drive Shaft Retainer

8. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adaptor in position.

9. Torque the pinion nut by turning the drive shaft using the drive shaft nut wrench and torque wrench with the appropriate socket to 75 lb. ft. (101.7 N·m).

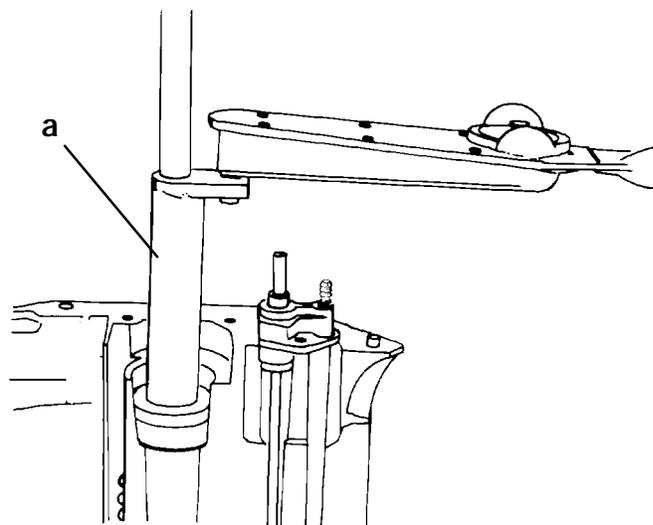


70892

- a - Pinion Nut Adaptor (91-61067A2)
- b - Drive Shaft Nut Wrench (91-56775)
- c - Bearing Carrier (installed backwards)

10. Remove the bearing carrier, pinion nut adaptor and drive shaft nut wrench.

11. Torque the retainer to 100 lb. ft. (135.6 N·m).



- a - Drive Shaft Bearing Retainer Wrench (91-43506)

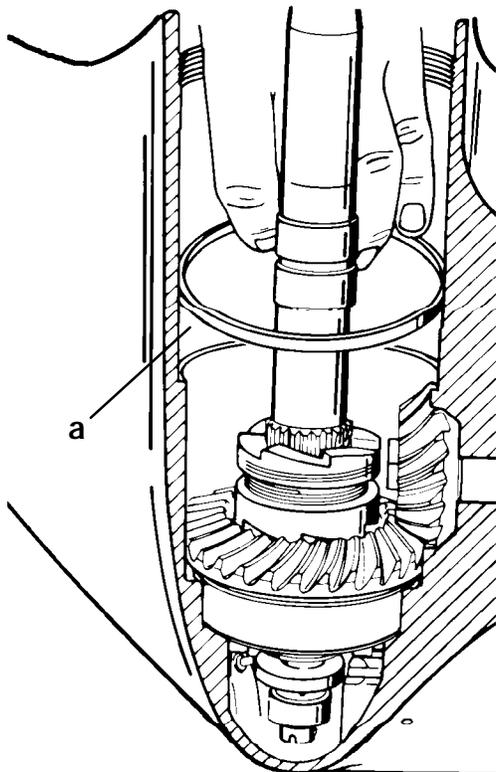
12. Remove the retainer wrench.



Bearing Carrier Assembly

Final Installation (Ratcheting)

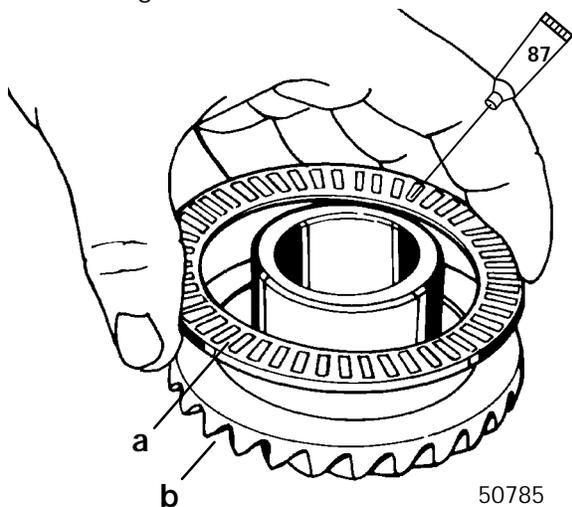
1. Install the appropriate spacer shim into the gear housing.



50782

a - Shim

2. Lubricate the thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and place it onto the forward gear.

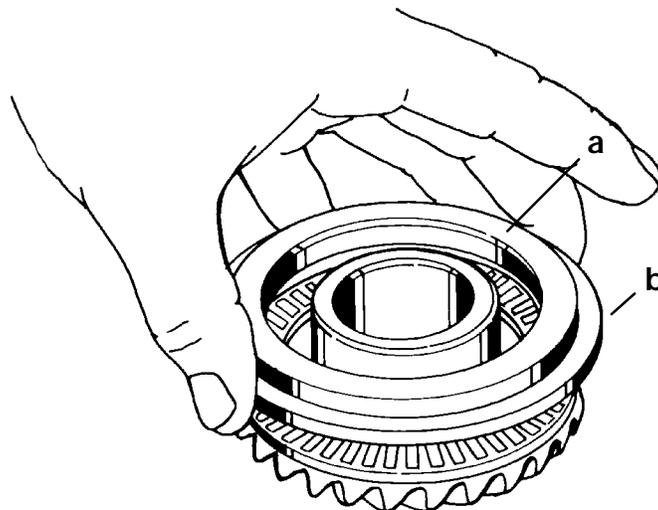


50785

Quicksilver Gear Lubricant (92-19007A24)

a - Thrust Bearing
b - Forward Gear

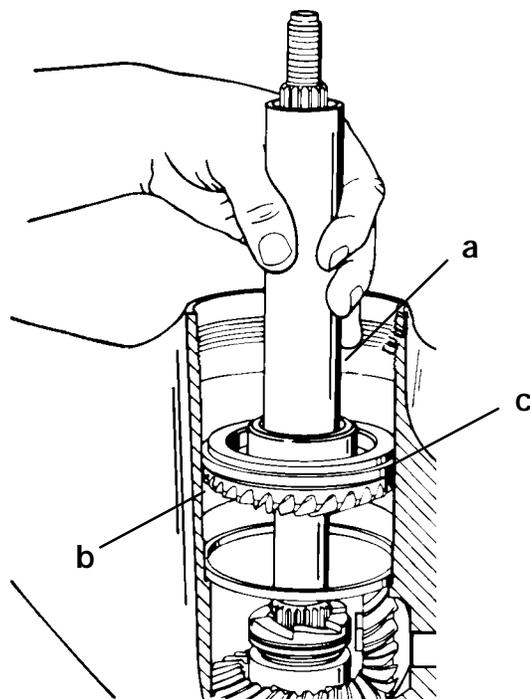
3. Place the thrust hub on top of the thrust bearing with the **wide flat side** against the thrust bearing.



50785

a - Thrust Hub
b - Wide Flat Side

4. Use the Forward Gear Installation Tool (91-815850) to install the forward gear down over the propeller shaft. Ensure that the thrust hub seats evenly onto the shim. Tap the race down lightly using a soft punch. Do not damage the thrust race surface.

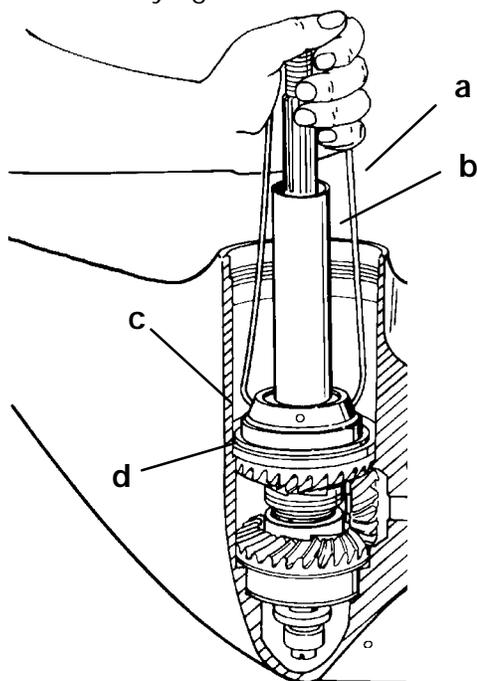


50783

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear
c - Spacer Shim



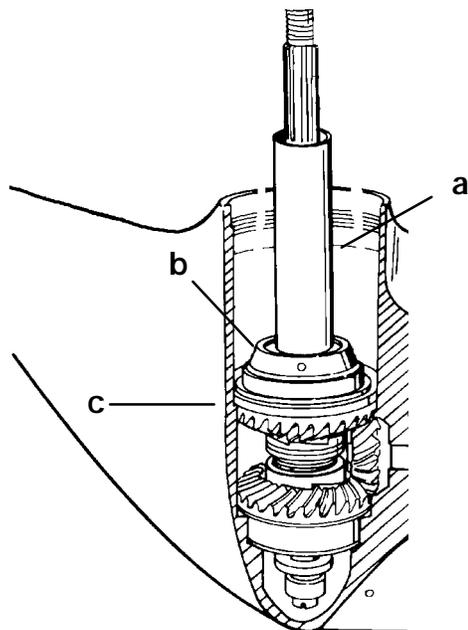
5. Install the forward gear bearing adaptor using a hook tool (which was fashioned when the adaptor was removed) as shown. Ensure that the adaptor seats evenly against the thrust race.



50881

- a - Hook Tool
- b - Forward Gear Installation Tool (91-815850)
- c - Forward Gear Bearing Adaptor
- d - Thrust Race

6. Remove the hook tool and while holding down on the forward gear, remove the forward gear installation tool.

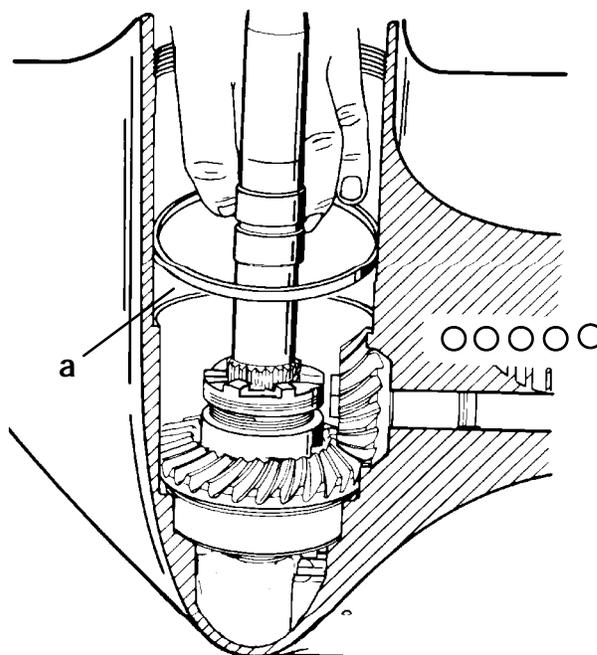


50881

- a - Forward Gear Installation Tool (91-815850)
- b - Forward Gear Bearing Adaptor
- c - Forward Gear

Final Installation (Non-Ratcheting)

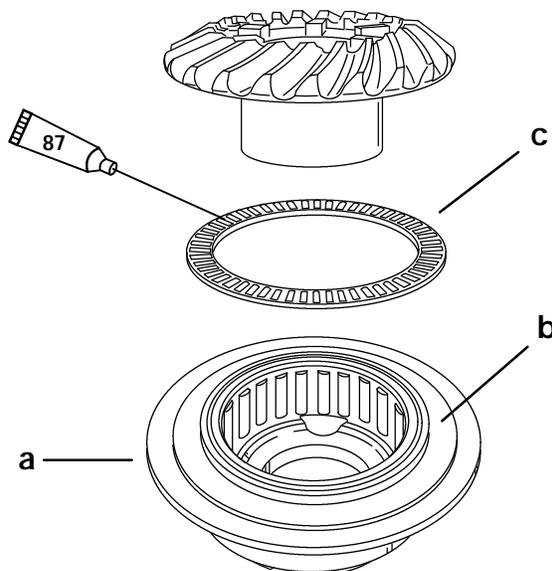
1. Install appropriate spacer shim into the gear housing.



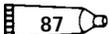
50782

- a - Shim

2. Apply Quicksilver Gear Lubricant to thrust bearing and install thrust bearing and thrust race onto forward gear bearing adaptor.



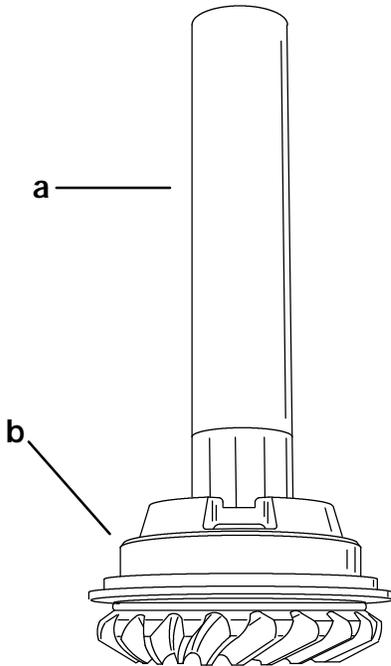
55220

 Quicksilver Gear Lubricant (92-19007A24)

- a - Bearing Adaptor
- b - Thrust Washer
- c - Thrust Bearing



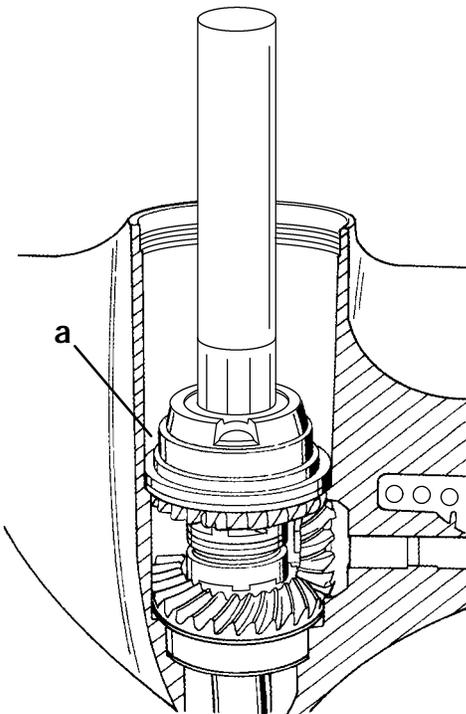
3. Insert Forward Gear Installation Tool (91-815850) into forward gear/bearing adaptor assembly.



55221

- a - Forward Gear Installation Tool (91-815850)
- b - Forward Gear/Bearing Adaptor Assembly

4. Install tool with adaptor assembly over propeller shaft and into gear housing. Applying downward pressure to bearing adaptor, remove installation tool from assembly.

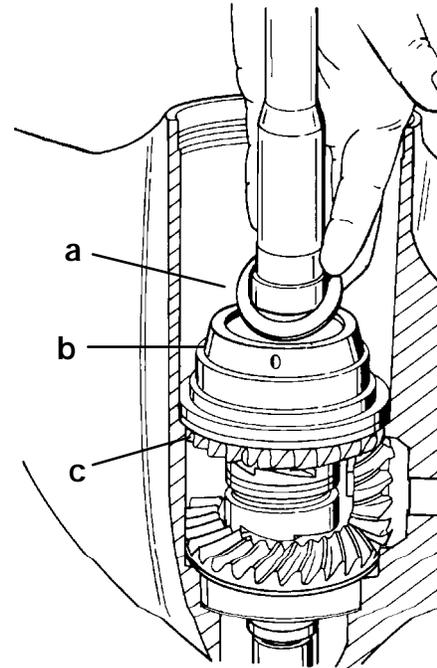


55202

- a - Forward Gear Bearing Adaptor

Final Installation (Ratcheting and Non-Ratcheting)

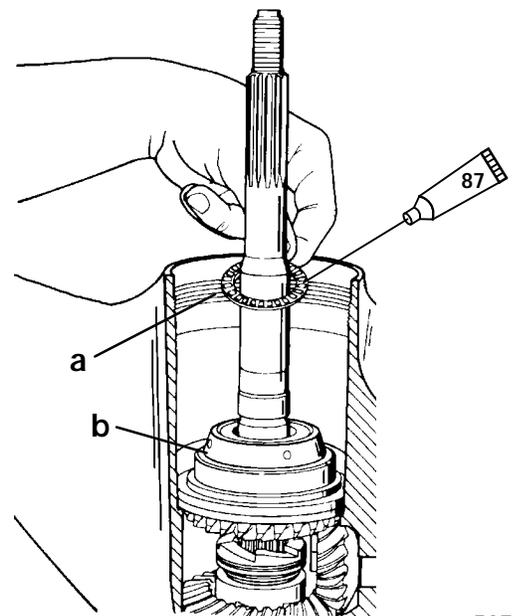
1. Ensure that the top of the bearing adaptor is clean and install the small thrust race on top of the bearing adaptor.



50880

- a - Thrust Race
- b - Forward Gear Bearing Adaptor
- c - Forward Gear

2. Lubricate the small thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and install it on top of the thrust race.



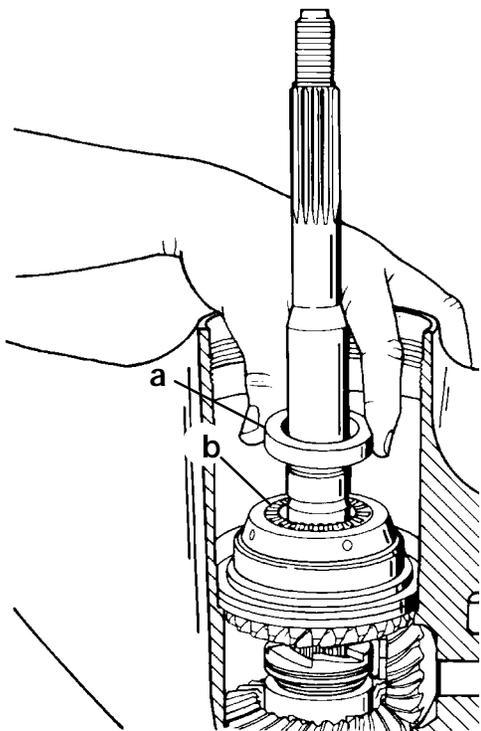
50783

87 Quicksilver Gear Lubricant (92-19007A24)

- a - Small Thrust Bearing
- b - Forward Gear Bearing Adaptor



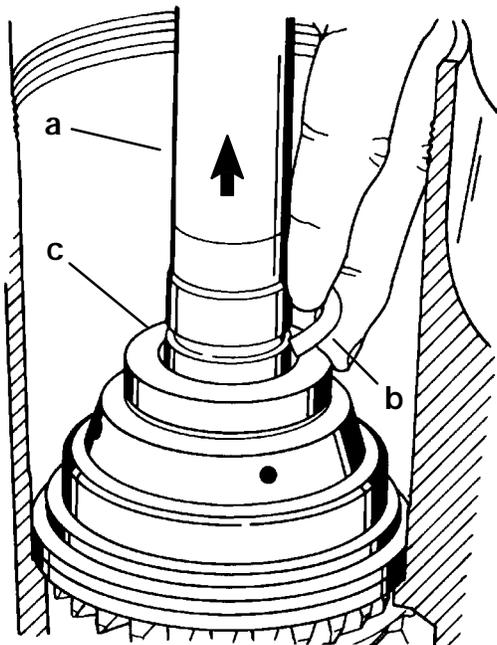
3. Assemble the thrust collar with its STEPPED SIDE DOWN toward the small thrust bearing.



50784

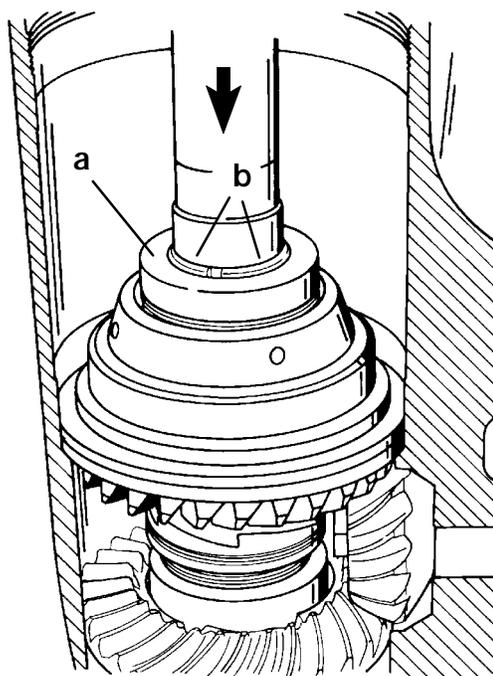
- a - Thrust Collar
- b - Small Thrust Bearing

4. Pull up slightly on the propeller shaft to gain access to the groove on the shaft for the keepers. Assemble the two keepers into the groove and lower the propeller shaft.



_0826

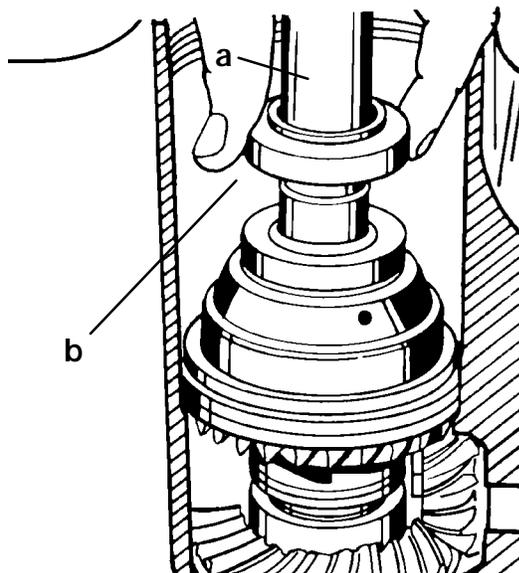
- a - Propeller Shaft (slightly lifted)
- b - Keepers (2)
- c - Thrust Collar



50778

- a - Thrust Collar
- b - Keepers

5. Install the second thrust collar with its STEPPED SIDE UP.

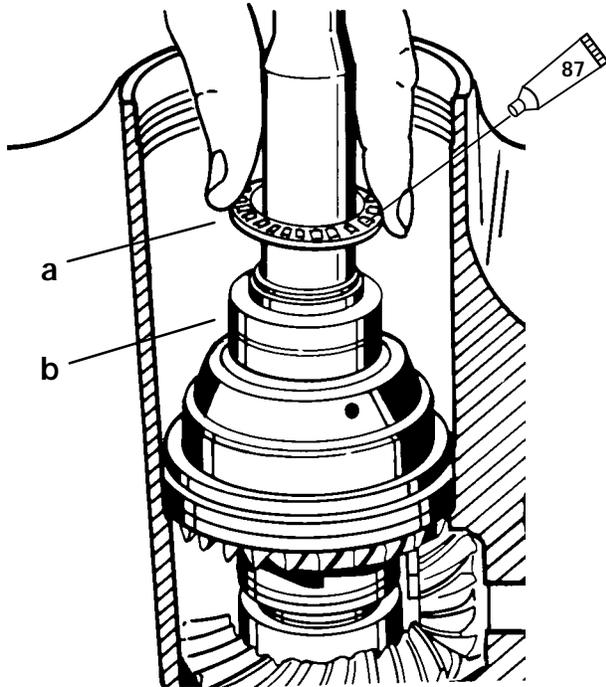


50787

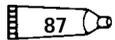
- a - Propeller Shaft
- b - Thrust Collar



6. Lubricate the second thrust bearing with Quicksilver Gear Lubricant (92-13783A24) and install it to the top of the thrust collar.

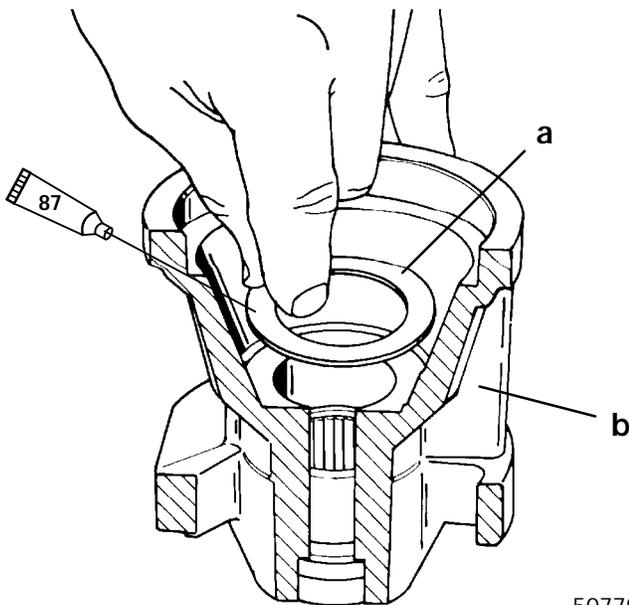


50786

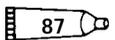
 Quicksilver Gear Lubricant (92-19007A24)

- a - Thrust Bearing
b - Thrust Collar

7. Lubricate the second small thrust bearing race with Quicksilver Gear Lubricant (92-13783A24). Assemble it to the surface inside of the bearing carrier as shown.

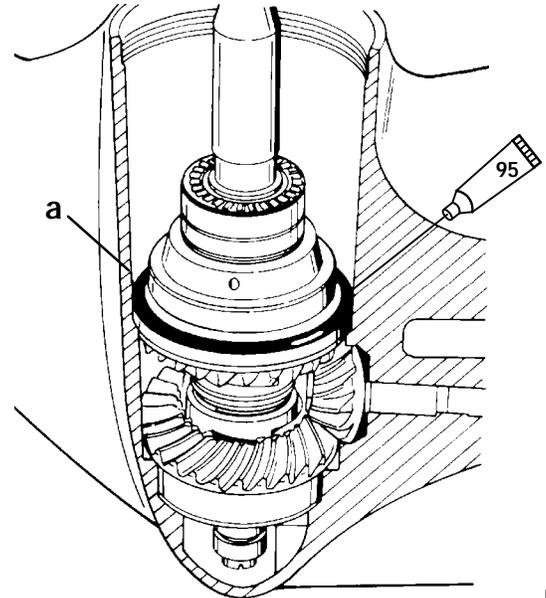


50779

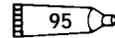
 Quicksilver Gear Lubricant (92-19007A24)

- a - Thrust Race
b - Bearing Carrier

8. Lubricate the large O-ring with 2-4-C w/Teflon (92-825407A12) and assemble into the gear housing as shown following.



50886

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

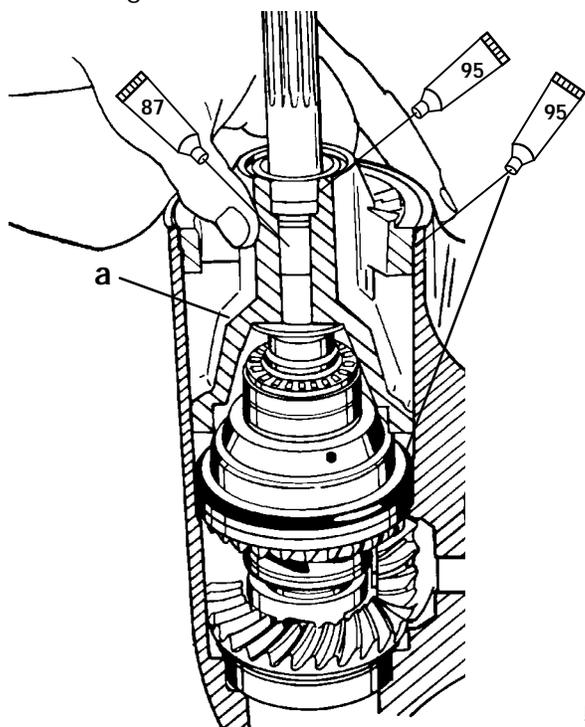
- a - O-ring

9. Prepare the bearing carrier for installation as follows:

- Lubricate the outer diameter of the bearing carrier with 2-4-C w/Teflon (92-825407A12).
- Fill the space between the carrier oil seals with 2-4-C w/Teflon.
- Lubricate the needle bearing with Quicksilver Gear Lubricant (92-13783A24).



10. Install the bearing carrier assembly into the gear housing.



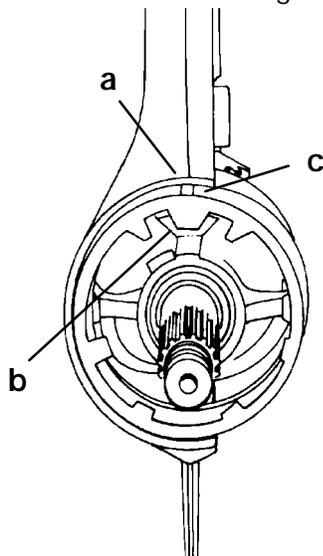
50826

87 Quicksilver Gear Lubricant (92-19007A24)

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

a - Bearing Carrier Assembly

11. Align the bearing carrier "V" shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.



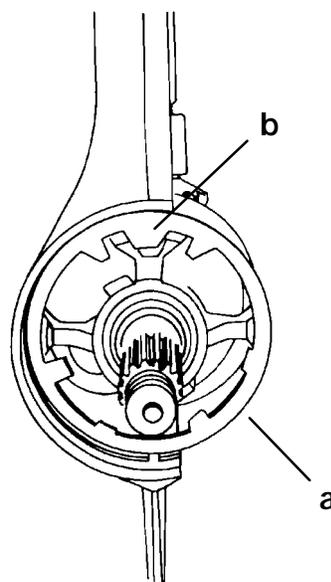
70713

a - Gear Case Alignment Hole

b - "V" Shaped Notch in Bearing Carrier

c - Alignment Tab of Tab Washer

12. Insure that the "V" shaped tab aligns with the "V" notch in bearing carrier.

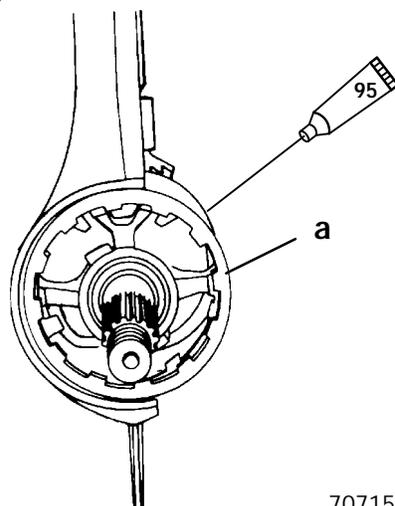


70714

a - Tab Washer

b - "V" Tab

13. Fill the bearing carrier retainer nut threads and corresponding gear housing threads (360°) with 2-4-C w/Teflon (92-825407A12). Start the retainer into the gear housing threads and screw it down fully by hand.



70715

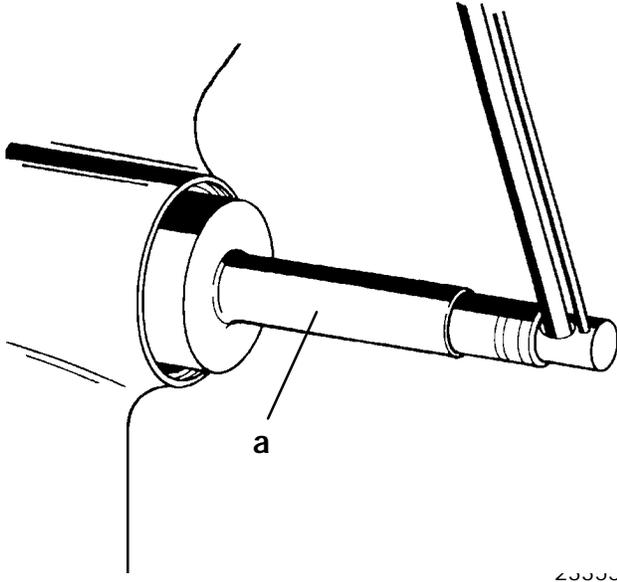
95 2-4-C With Teflon (92-825407A12)

a - Bearing Carrier Retainer

IMPORTANT: Before torquing bearing carrier retainer, gear case must be bolted to drive shaft housing or securely fastened in a gear case holding fixture to avoid possible damage to gear housing

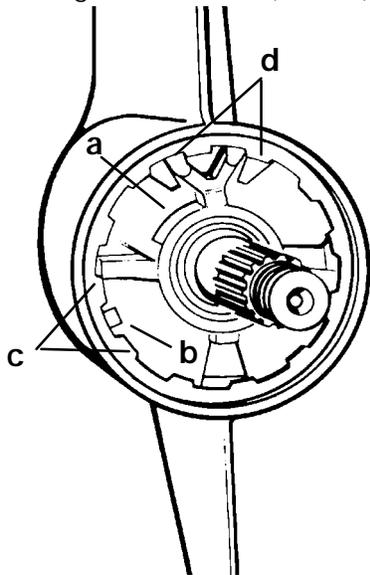


14. Torque the bearing carrier retainer to 210 lb. ft. (284.7 N·m). If one tab does not align up in space between two of the notches, continue to tighten retainer until alignment is achieved. DO NOT loosen retainer to achieve alignment.



a - Bearing Carrier Retainer Wrench (91-61069)

15. Bend one tab aft (outward) into a space between two of the notches of the retainer. Bend all the remaining tabs forward (inward).



a - Bearing Carrier
b - Tab
c - Retainer Notches
d - Alignment Tabs (Bend Inward)

23333

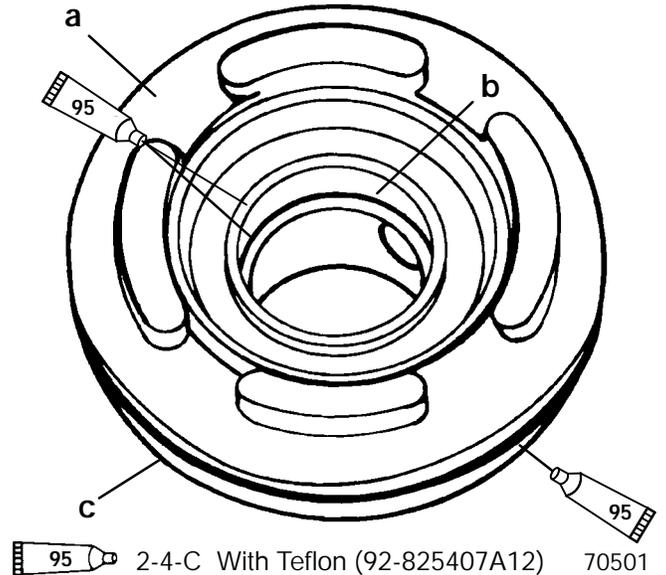
70490

Oil Seal Carrier Assembly

Installation

NOTE: Apply hand pressure only to install the oil seal carrier into position. Do not hammer it into position.

1. Lubricate the oil seal carrier oil seal lips, between oil seals and O-ring with 2-4-C w/Teflon (92-825407A12) and install the oil seal carrier over the drive shaft and into the gear case.



a - Oil Seal Carrier
b - Oil Seal Lips
c - O-ring

Water Pump Assembly

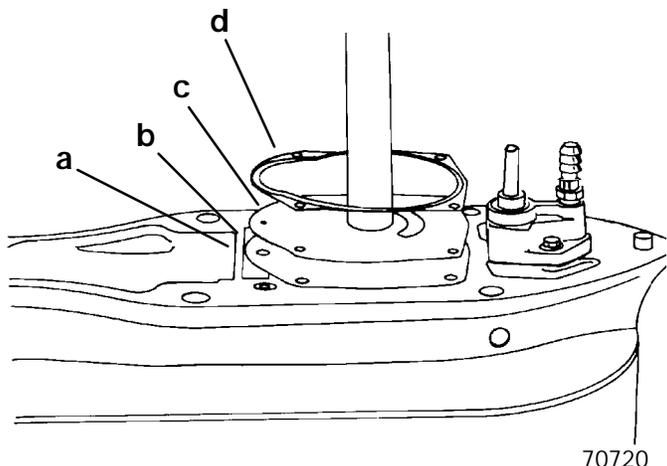
Installation

NOTE: The gaskets/face plate hole pattern is not symmetrical. If the holes of the gaskets/face plate do not align with the screw holes of the gear case and/or each other, one or more of the parts is upside down. Determine which part(s) is (are) upside down and turn the appropriate part(s) over.

1. Reinstall filler block in housing, if removed.



2. Install the small hole gasket then the face plate followed by the large hole gasket onto the gear case.

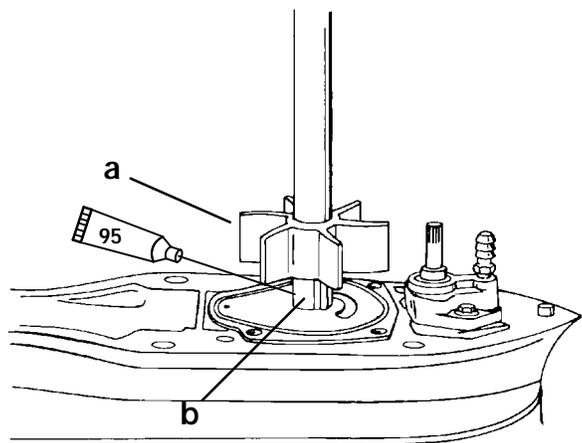


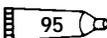
- a - Filler Block
- b - Small Hole Gasket
- c - Face Plate
- d - Large Hole Gasket

3. Place a small amount of 2-4-C w/Teflon (92-825407A12) on the flat surface of the impeller key and install the key onto the drive shaft keyway.

IMPORTANT: When using an impeller whose blades have taken a set, face the curl of the blades in a counterclockwise direction. DO NOT install the impeller with its blades oriented in a reversed direction from original rotation, or premature impeller failure will occur.

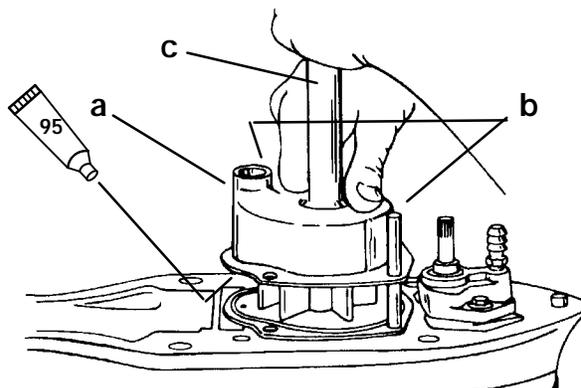
4. Assemble the water pump impeller onto the drive shaft and down over the key.

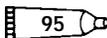


 2-4-C With Teflon (92-825407A12)

- a - Water Pump Impeller
- b - Water Pump Impeller Key

5. Install the 2 water pump locating pins through the gaskets and face plate.
6. Apply a light coat of 2-4-C w/Teflon (92-825407A12) to the inside of the pump cover. Position the water pump body over the drive shaft and water pump locating pins. Rotate the drive shaft in a clockwise direction, while pushing down on the water pump body to ease the water pump over the impeller blades.



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

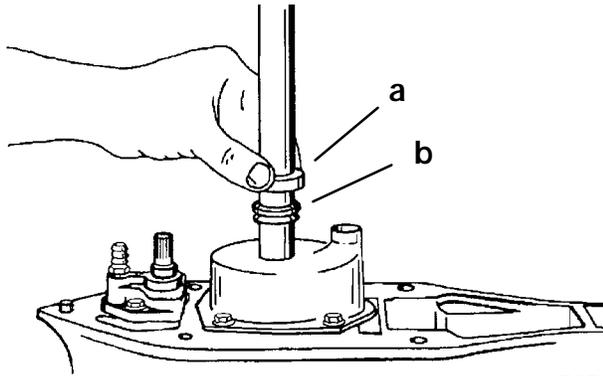
- a - Water Pump Body
- b - Water Pump Alignment Pins (91-821571A1)
- c - Drive Shaft (turn clockwise while installing water pump body)

7. Hand start two (2) fasteners into the water pump assembly and remove the water pump locating pins. Install the remaining 2 fasteners. Run all fasteners down and torque to 60 lb. in. (6.8 N·m).
8. Lightly lubricate the O-rings in the water tube coupling with 2-4-C w/Teflon (92-825407A12).
9. Install the water tube coupling assembly to the water pump ensuring that the O-rings are not damaged during assembly.

IMPORTANT: If seal installed above pump housing is not at the proper height, air will be drawn into the pump resulting in overheating of the engine.



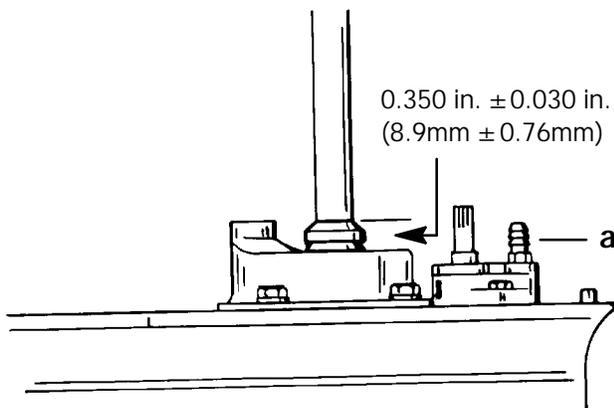
- Using tool provided in seal kit (26-816575A2) or water pump kit (817275A3), press seal down over drive shaft (DO NOT GREASE DRIVE SHAFT) until tool seats against pump housing.



52724

- a - Tool
b - Seal

- If tool is not available, lightly press seal against housing until a height of 0.350 in. \pm 0.030 in. (8.9mm \pm 0.76mm) is obtained.



52726

- a - Speedometer Connector

NOTE: Secure speedometer tube to speedometer connector with sta-strap.

Gear Lubricant Filling Instructions

- Inspect "Fill" and "Vent" sealing washers for cuts or abrasions. Replace washers if necessary.
- Clean any metal debris from magnet on "Fill" plug.

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

- Slowly fill housing thru "Fill" hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of "Vent" hole and no air bubbles are visible.

- Install "Vent" screw into "Vent" hole.

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

- Remove grease tube (or hose) from "Fill" hole and quickly install "Fill" screw into "Fill" hole.

Installing Gear Housing to Drive Shaft Housing

⚠ WARNING

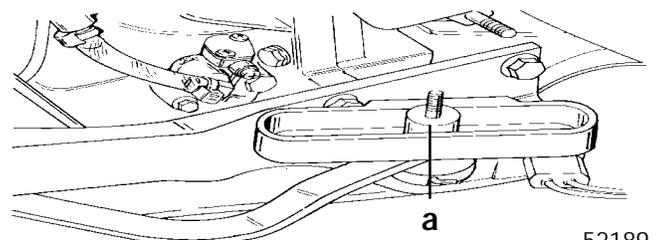
Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing into drive shaft housing.

- Tilt engine to full up position and engage the tilt lock lever.
- Apply a light coat of 2-4-C w/Teflon onto drive shaft splines.

⚠ CAUTION

DO NOT allow lubricant on top of drive shaft. Excess lubricant, that is trapped in clearance space, will not allow drive shaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of drive shaft) will load the drive shaft/crankshaft and damage either or both the powerhead and gear housing. Top of drive shaft is to be wiped free of lubricant.

- Apply a light coat of 2-4-C w/Teflon onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
- Insert a NEW trim tab bolt (with patch) into hole in rear of gear housing to drive shaft housing machined surface.
- Shift gear housing into NEUTRAL and place guide block anchor pin into NEUTRAL position.



52189

- a - Guide Block Anchor Pin



6. Position gear housing so that the drive shaft is protruding into drive shaft housing.
7. Feed speedometer tube through opening in drive shaft housing.

NOTE: *If, while performing Step 8, the drive shaft splines will not align with crankshaft splines, lower the gear case enough to reach in and turn the drive shaft by hand slightly to align drive shaft splines with crankshaft.*

8. Move gear housing up toward drive shaft housing while aligning shift shaft splines and water tube with water tube guide (in water pump cover).
9. Place flat washers onto studs (located on either side of drive shaft housing). Start a nut on these studs and tighten finger-tight.
10. Start bolt at rear of gear housing inside trim tab recess. DO NOT tighten bolt at this time.
11. Recheck shift shaft spline engagement and correct if necessary.

IMPORTANT: Do not force gear case up into place with attaching nuts.

12. Evenly tighten 2 nuts which were started in Step 9. Torque to 55 lb. ft. (74.6 N·m).
13. After 2 nuts (located on either side of drive shaft housing) are tightened, check shift operation as follows:
 - a. Place guide block anchor pin into FORWARD gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.
 - b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
 - c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

14. Install remaining washers and nuts onto drive shaft studs. Torque to 55 lb. ft. (74.6 N·m).
15. Torque bolt (started in Step 10) to 45 lb. ft. (61.0 N·m).
16. Position trim tab in gear housing aligning grooves of trim tab with ribs in trim tab pocket. Adjust to position in which it had previously been installed, and while holding trim tab, torque bolt to 40 lb. ft. (54.2 N·m).
17. Install plastic cap into trim tab bolt opening at rear edge of drive shaft housing.



ATTACHMENTS/CONTROL LINKAGE

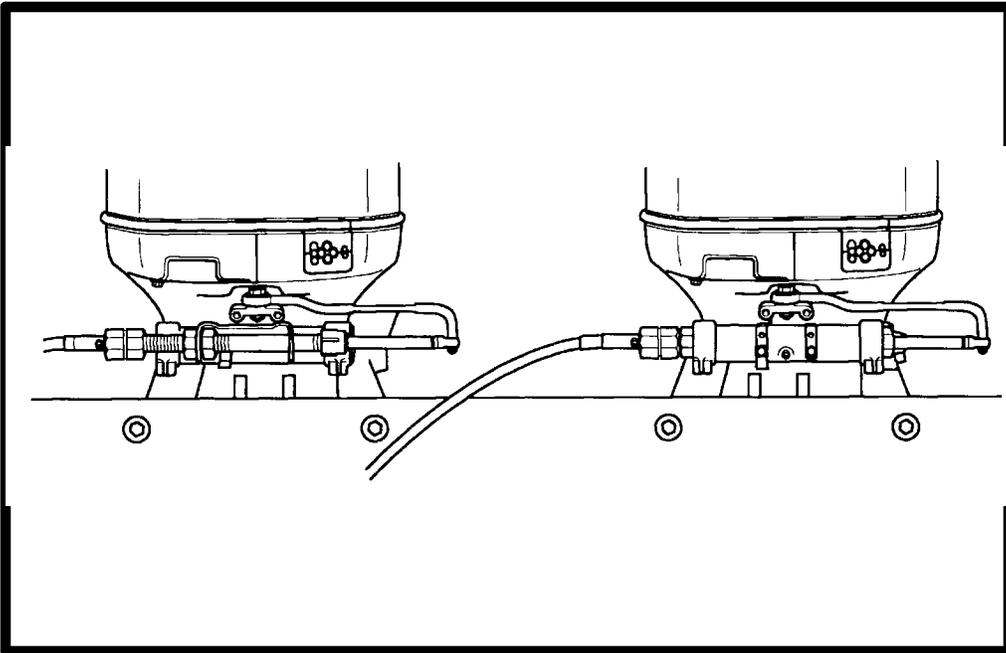




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Ride Guide Steering Cable/ Attaching Kit Installation (92876A1)

Single Cable -

Refer to “**Quicksilver Accessories Guide**” to determine correct length of steering cable and remote control cables.

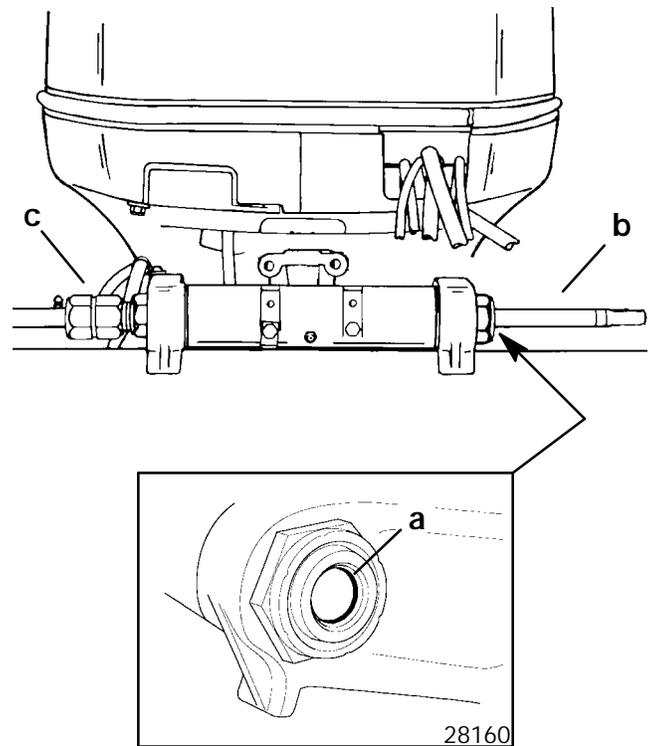
IMPORTANT: Steering cable and remote control cables must be the correct length, sharp bends on too-short cables result in “kinks”; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and will reduce the performance of the steering system.

INSTALLING RIDE GUIDE CABLE TO OUTBOARD TILT TUBE

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

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

1. Lubricate seal (a) inside of outboard tilt tube and entire cable end (b) with Quicksilver 2-4-C w/Teflon.
2. Insert steering cable end thru outboard tilt tube and secure steering cable to tilt tube with steering cable attaching nut (c), as shown. Torque nut to 35 lb. ft. (47.5 N·m).





STEERING LINK ROD INSTALLATION

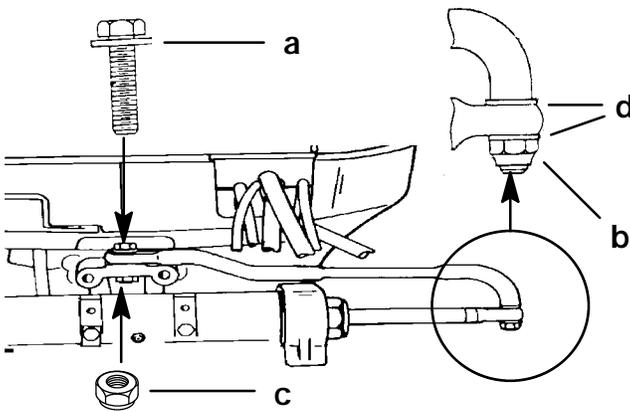
IMPORTANT: The steering link rod that connects the steering cable to the engine must be fastened using special washer head bolt ("a" - Part Number 10-14000) and self locking nuts ("b" & "c" - Part Number 11-34863). These locknuts must never be replaced with common nuts (non locking) as they will work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

⚠ WARNING

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

- Assemble steering link rod to steering cable with two flat washers (d) and nylon insert locknut ("b" - Part Number 11-34863). Tighten locknut (b) until it seats, then back nut off 1/4 turn.
- Production Outboards** - Assemble steering link rod to engine with special washer head bolt ("a" - Part Number 10-14000) and nylon insert locknut ("c" - Part Number 11-34863). First torque bolt (a) to 20 lb. ft. (27.1 N·m), then torque locknut (c) to 20 lb. ft. (27.1 N·m).

High Performance Outboards - An access hole is provided through the bottom cowl to ease installation of the link rod connecting bolt. Remove the **BACK** plug for installation and reinstall after installation.



⚠ WARNING

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

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "Severe Service."

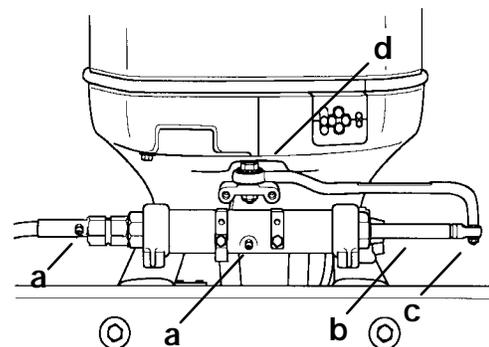
- Carefully check steering system components for wear. Replace worn parts.
- Check steering system fasteners to be sure that they are torqued to correct specifications.

NOTE: Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.

⚠ WARNING

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

- With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable end (b) with 2-4-C w/Teflon.
- Lubricate pivot point (c) of steering link rod and ball joint (d) of link rod with SAE 30 Weight Oil.
- Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon. Ride Guide Steering Cable / Attaching Kit Installation (92876A3).



28169



Ride Guide Steering Cable/ Attaching Kit Installation (92876A3)

Dual Cable - Single Outboard

⚠ WARNING

Quicksilver Super Ride-Guide Steering (dual cables) **MUST BE USED** with this attaching kit. Failure to adhere to this requirement could result in steering system failure.

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

IMPORTANT: Steering cables and remote control cables **MUST BE THE CORRECT LENGTH**, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and will reduce the performance of the steering system.

⚠ CAUTION

With this kit installed, the upper (outboard) mounting bolts **MUST BE** installed so that hex head end of bolts is on the inside of boat transom, as illustrated. Failure to install upper mounting bolts, as shown in illustration, could result in interference between steering cable nut and ends of mounting bolts when outboard is tilted up.

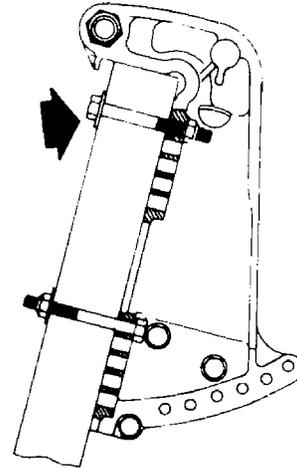
⚠ CAUTION

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

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

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

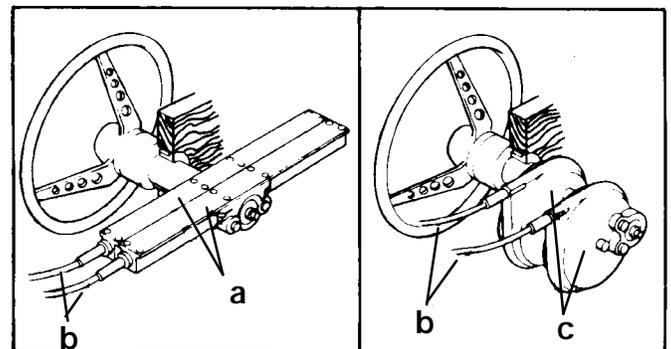
Install upper bolts so that hex head end of bolts is on the inside of boat transom.



Super Ride-Guide Steering Kit Installation

IMPORTANT: Both gear racks or rotary steering heads **must be installed** so that both steering cables will be routed together on the same side of the boat and will push-and-pull together.

1. Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.
2. Make sure that both gear racks or rotary steering heads are installed so that both steering cables are routed together down starboard side of boat and will push-and-pull together.



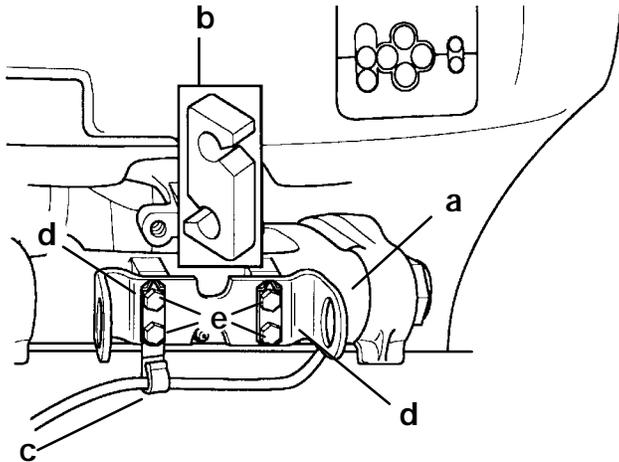
- a - Gear Rack
- b - Steering Cables
- c - Rotary Steering Heads



Steering Cable Mounting Tube Installation

IMPORTANT: Spacers (b) must be installed between outboard swivel bracket and mounting bracket for steering cable mounting tube to provide proper spacing between steering cables.

Secure mounting bracket for steering cable mounting tube on to swivel bracket of outboard.



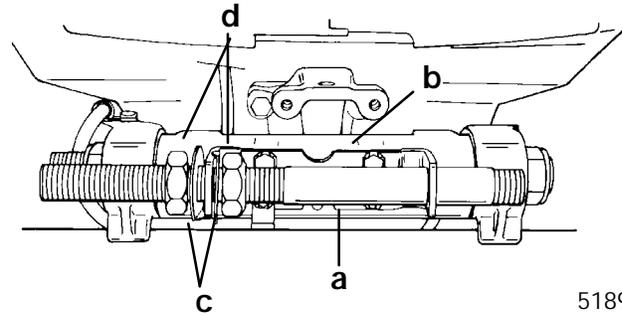
- a - Mounting Bracket for Steering Cable Mounting Tube 28163
- b - Spacer (2)
- c - Locking Retainer (2)
- d - Bolts (4) - 7/8 in. (22mm) Long - Torque to 100 lb. in. (11.3 N·m), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs, **MUST BE bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube to outboard swivel bracket to prevent bolts from turning out.**

Install steering cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Verify longer threaded end of tube is toward starboard side of boat.

Temporarily adjust tube so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



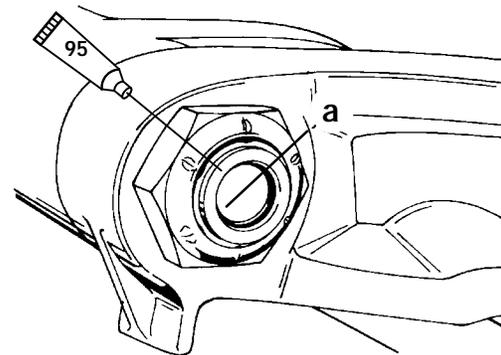
51891

- a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
- b - Mounting Bracket
- c - Locking Tab Washers (2)
- d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

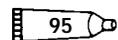
Installing Steering Cables

IMPORTANT: Lubricate inside of outboard tilt tube, inside of steering cable mounting tube and rubber O-ring seal (located in outboard tilt tube) with Quicksilver 2-4-C w/Teflon before installing steering cables.

Lubricate inside of outboard tilt tube and inside of steering cable mounting tube with Quicksilver 2-4-C w/Teflon. Verify rubber O-ring seal (a) (located in outboard tilt tube) is lubricated.



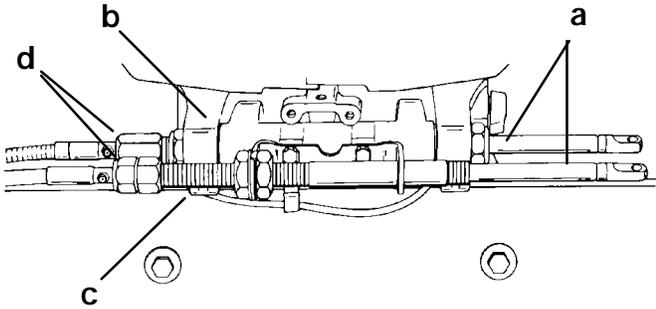
51890

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



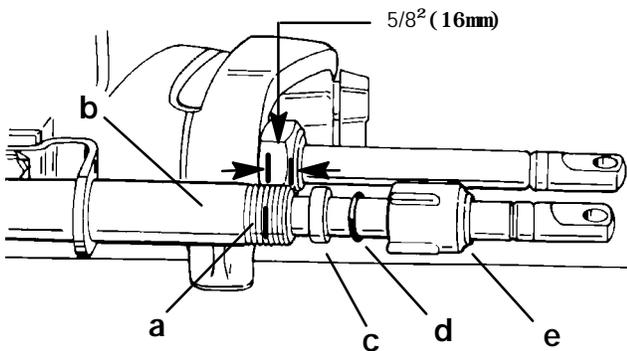
Insert steering cable ends (a) thru outboard tilt tube (b) and cable mounting tube (c). Thread steering cable attaching nuts (d) on to tubes hand tight.

NOTE: Torque steering cable attaching nuts only after final steering adjustments have been made.



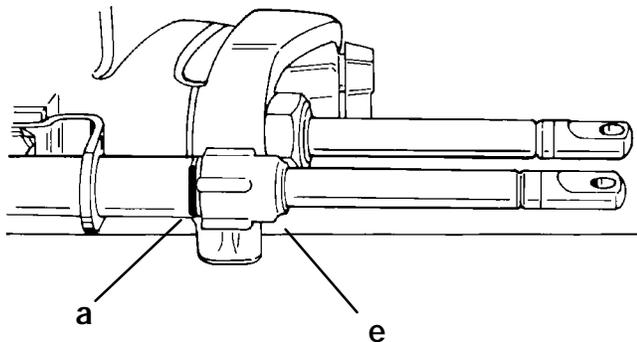
51891

Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



51890

Thread cap (e) onto steering cable mounting tube, up to mark (a).



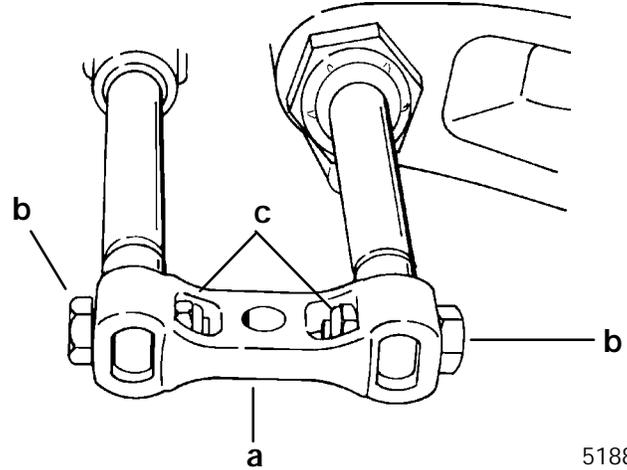
51890

Coupler Installation

⚠ WARNING

Locknuts must be used with bolts to secure steering cables to coupler. Failure to adhere to this requirement could result in steering system failure.

Slide coupler (a) onto steering cable ends and secure each steering cable to coupler with bolt (b) and locknut (c) as shown. Tighten to a torque of 20 lb. ft. (27.1 N·m).



51888

Installing Link Rod

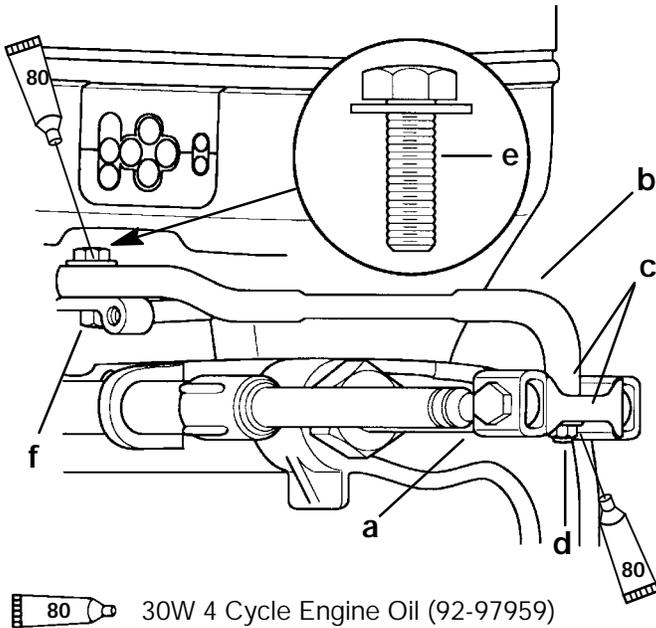
⚠ WARNING

Steering link rod **MUST BE** secured between outboard steering arm and steering coupler, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts **MUST BE** tightened as specified.

Lubricate hole in steering coupler, with Quicksilver 2-4-C w/Teflon. Assemble steering link rod to steering coupler, using 2 flat washers (one each side of coupler) and nylon insert locknut. Tighten locknut until it seats [DO NOT exceed 120 lb. in. (13.6 N·m) of torque], then back nut off 1/4 turn.



Lubricate ball joint in steering link rod with SAE 30W Motor Oil. Secure link rod to outboard steering arm, using special washer head bolt (10-14000) provided and nylon insert locknut as shown. Torque special bolt to 20 lb. ft. (27.1 N·m), then torque locknut to 20 lb. ft. (27.1 N·m).

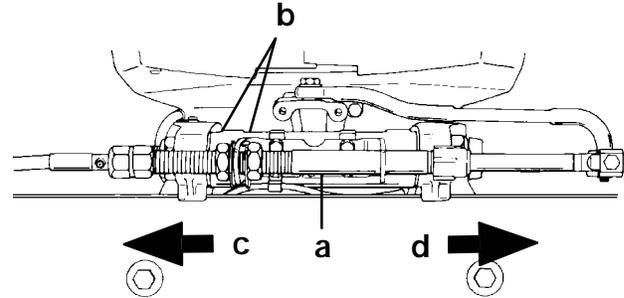


- a - Steering Coupler
- b - Steering Link Rod
- c - Flat Washer (2)
- d - Nylon Insert Locknut - Torque until it seats [DO NOT exceed 120 lb. in. (14.0 N·m) of torque], then back nut off 1/4 turn
- e - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27.1 N·m)
- f - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)

STEERING SYSTEM TENSION ADJUSTMENT

IMPORTANT: After this dual steering cable attachment kit is installed, there must be proper tension in forward mounted steering cable for this attachment kit to operate properly. Not enough tension will cause slack (or play) in steering system. Too much tension will cause steering cables to bind. Perform the following steps to adjust for correct tension.

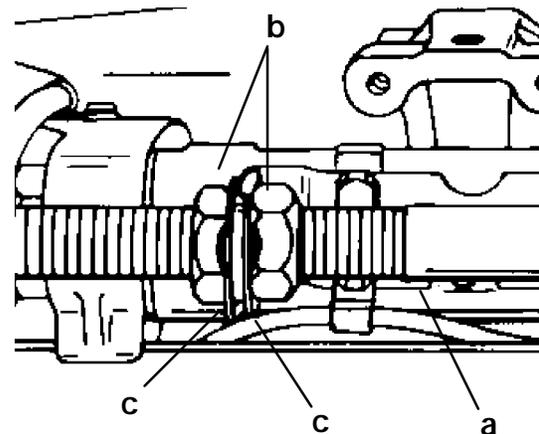
Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play.) If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



51887

- a - Steering Cable Mounting Tube
- b - Adjustment Nuts
- c - Adjust Tube in This Direction to Remove Slack from Steering System
- d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.4 N·m) and bend a tab lock washer against flat on each adjustment nut.

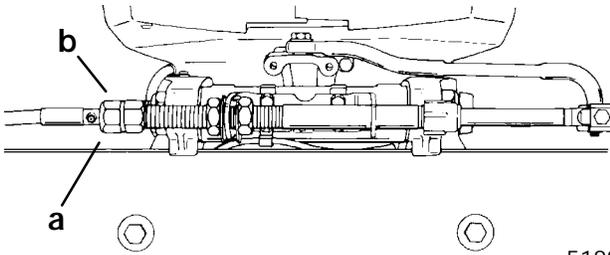


51887

- a - Steering Cable Mounting Tube
- b - Adjustment Nuts; Torque to 35 lb. ft. (47.4 N·m)
- c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)



Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).

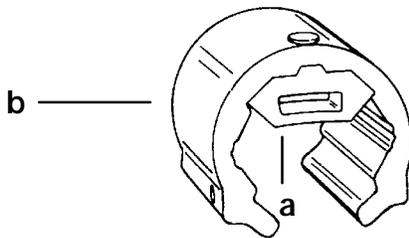


51889

- a - Cable Attaching Nut
- b - "V" Groove

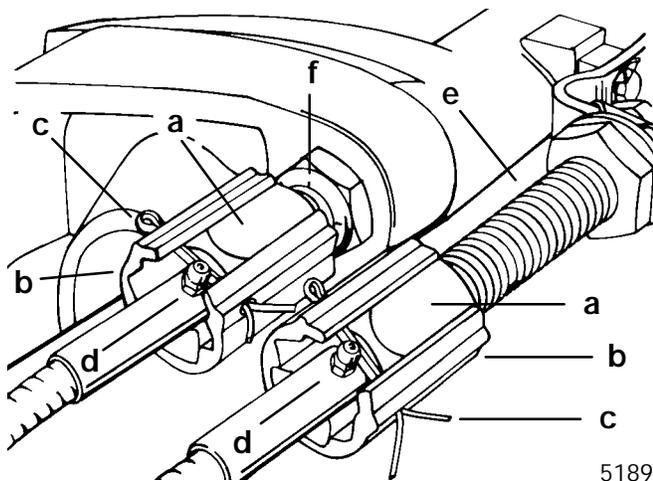
NOTE: Cable attaching nuts with a "V" groove around the outer circumference of the nut are self locking and do not require locking sleeves.

Install rubber bumpers (a) on inside of each locking sleeve (b).



51889

Install locking sleeves over steering cable attaching nuts and secure with cotter pins. Spread ends of cotter pins. Be sure to install cotter pin so that it is located in between attaching nut and grease fitting.



51890

- a - Steering Cable Attaching Nut [Torque to 35 lb. ft. (47.5 N·m)]
- b - Locking Sleeve (If Equipped)
- c - Cotter Pin
- d - Grease Fitting
- e - Steering Cable Mounting Tube
- f - Outboard Tilt Tube

⚠ WARNING

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

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

- Normal Service** - Every 50 hrs. of operation or 60 days (whichever comes first)
- *Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "Severe Service."

1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

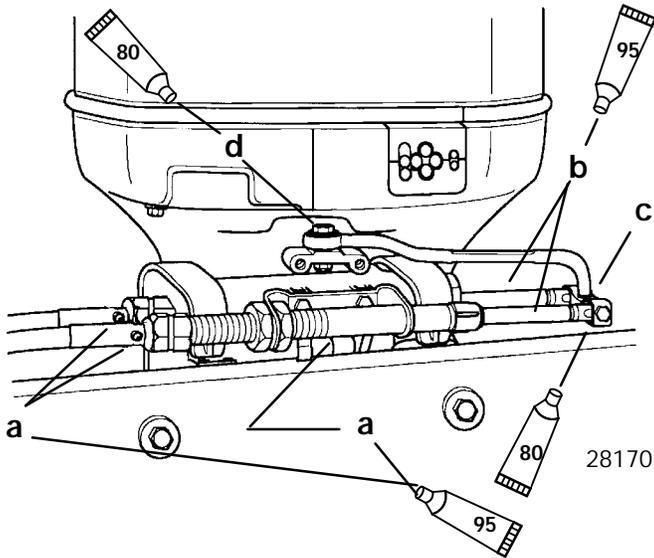
NOTE: Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.

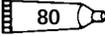
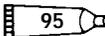
⚠ WARNING

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



3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A2).
4. Lubricate ball joint (d) of link rod/steering coupler and pivot point (c) of steering link rod with SAE 30W Motor Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



-  30W 4 Cycle Engine Oil (92-97959)
-  2-4-C With Teflon (92-825407A12)

Ride Guide Steering Cable/ Attaching Kit Installation (92876A6)

Dual Cable - Dual Outboard

WARNING

Quicksilver Super Ride-Guide Steering (dual cables) **MUST BE USED** with this attaching kit. Failure to adhere to this requirement could result in steering system failure.

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

IMPORTANT: Steering cable and remote control cables **MUST BE THE CORRECT LENGTH**, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables.

Installation Requirements

IMPORTANT: The distance from each outboard's centerline to the side of transom opening **MUST BE** a minimum of 16 in. (40.6cm).

This kit contains all necessary parts to connect both outboards to Ride-Guide Steering Cables for 23-1/2 in. thru 27-1/2 in. (59.7cm thru 69.9cm) outboard centerline spacing. If outboard centerline distance is other than specified, refer to end of this instruction manual for optional extension couplers.

DETERMINE ROUTING OF STEERING CABLES

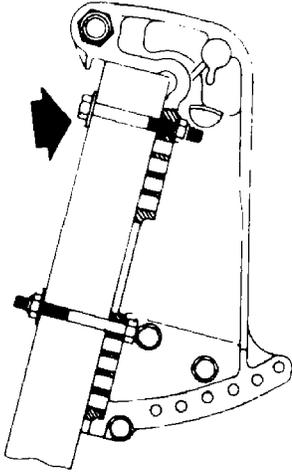
Use "1" or "2", following, to route steering cables:

1. **Parallel cable routing:** Cables routed together down starboard side of boat. Refer to "Parallel Routed Steering Cables and Attaching Kit Installation," immediately following.
2. **Opposite side cable routing:** One cable routed down starboard side of boat and one cable routed down port side of boat. Refer to "Opposite Side Routed Steering Cables and Attaching Kit Installation," located on page 7-16 of this section.



⚠ CAUTION

With this kit installed, the upper (outboard) mounting bolts **MUST BE** installed so that hex head end of bolts is on the inside of boat transom, as illustrated. Failure to install upper mounting bolts, as shown in illustration, could result in interference between outer steering cable locking sleeve and ends of mounting bolts when outboard is tilted up.



Install upper bolts so that hex head end of bolts is on the inside of boat transom.

Parallel Routed Steering Cables and Attaching Kit Installation

(Both Steering Cables Routed Together Down Starboard Side of Boat)

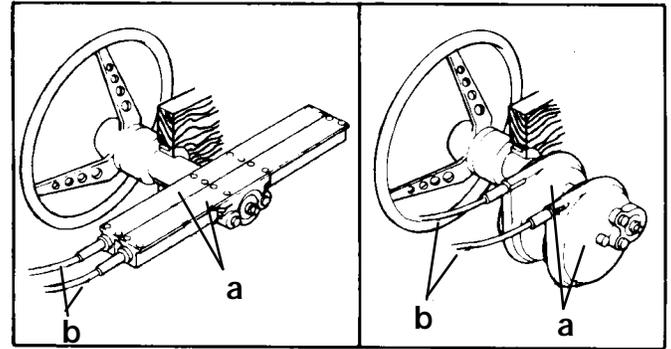
SUPER RIDE-GUIDE STEERING KIT INSTALLATION

IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

Both gear racks or rotary steering heads must be installed so that both steering cables will be routed together on the same side of the boat and will push- and-pull together.

1. Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.

2. Make sure that both gear racks or rotary steering heads are installed so that both steering cables are routed together and will push-and-pull together.

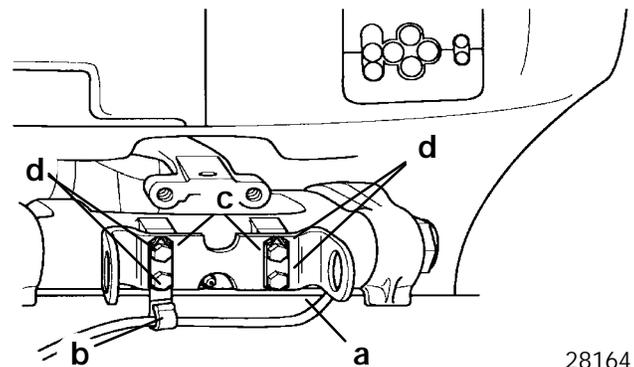


- a - Straight Rack (Left); Rotary Steering (Right)
b - Steering Cables (Install so that Both Cables Will Push and Pull Together)

STEERING CABLE INSTALLATION STARBOARD OUTBOARD

IMPORTANT: Mounting bracket for steering cable mounting tube **MUST BE** secured to outboard swivel bracket, using 5/8 in. (16mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



- 28164
a - Mounting Bracket for Steering Cable Mounting Tube
b - "J" Clip - Supplied with Outboard
c - Locking Retainers (2)
d - Bolts (4) - 5/8 in. (16mm) Long - Torque to 100 lb. in. (11.3 N·m), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

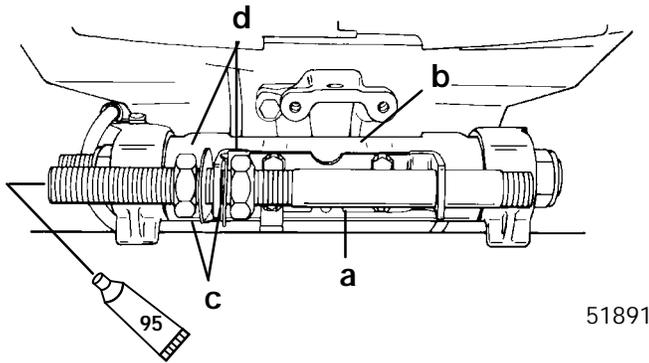
⚠ WARNING

Locking retainer corner tabs, **MUST BE** bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube to outboard swivel bracket, to prevent bolts from turning out.



Install steering cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Be sure longer threaded end of tube is toward starboard side of boat.

Temporarily adjust tube, so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



51891

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

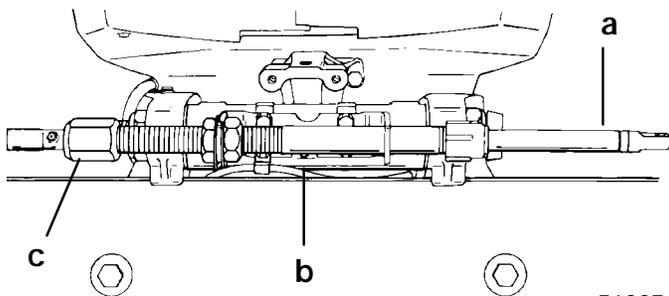
- a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
- b - Mounting Bracket
- c - Locking Tab Washers (2)
- d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

IMPORTANT: Lubricate inside of steering cable mounting tube with 2-4-C w/Teflon before installing steering cable.

Lubricate inside of steering cable mounting tube (starboard outboard) with 2-4-C w/Teflon.

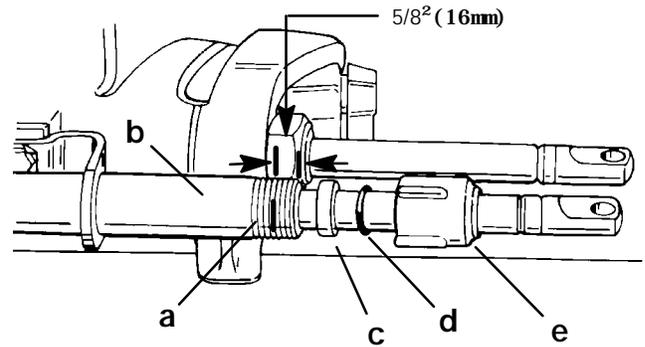
Insert steering cable end (a) thru cable mounting tube (b) and thread steering cable attaching nut (c) onto tube hand tight.

NOTE: Torque steering cable attaching nut only after final steering adjustments have been made.



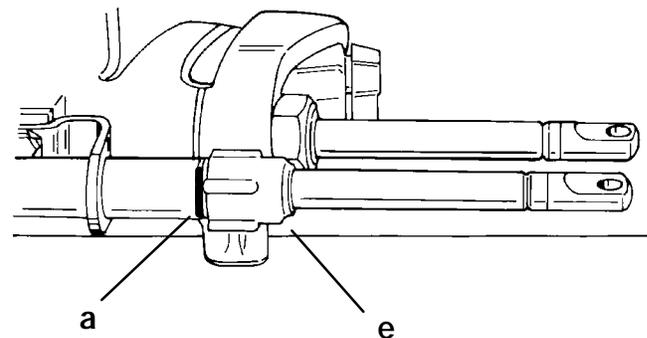
51887

Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



51890

Thread cap (e) onto steering cable mounting tube, up to mark (a).



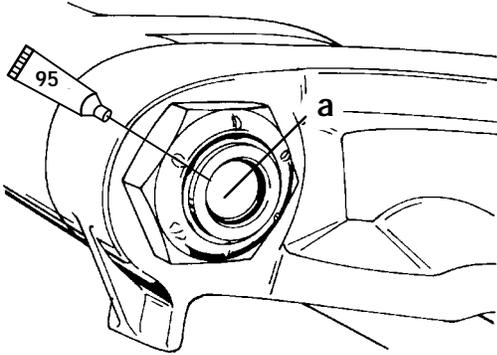
51890



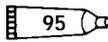
STEERING CABLE INSTALLATION - PORT OUTBOARD

IMPORTANT: Lubricate inside of port outboard's tilt tube and rubber O-ring seal located inside tilt tube with 2-4-C w/Teflon, before installing steering cable.

Lubricate inside of port outboard's tilt tube and rubber O-ring seal (a) with 2-4-C w/Teflon.

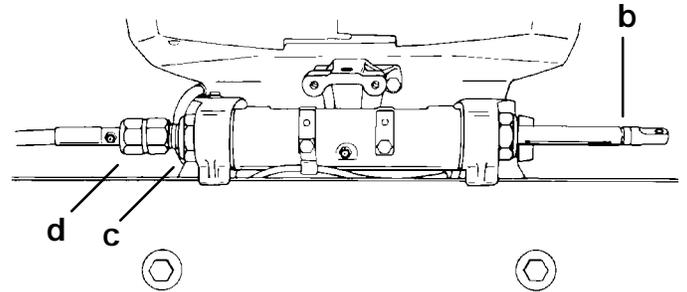


51890

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

Insert steering cable end (b) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

NOTE: Torque steering cable attaching nuts only after final steering adjustments have been made.



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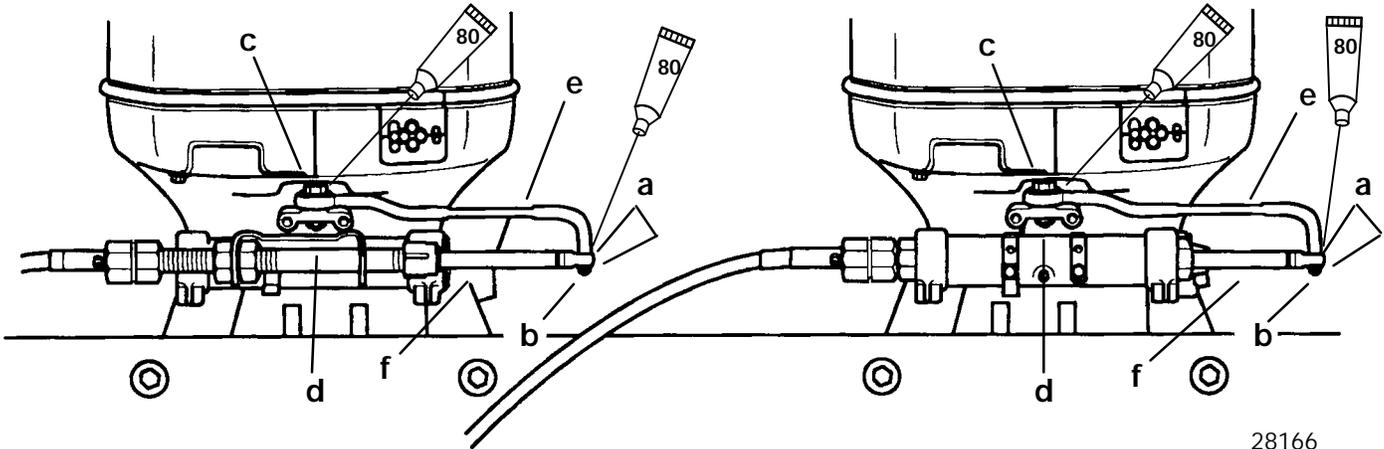
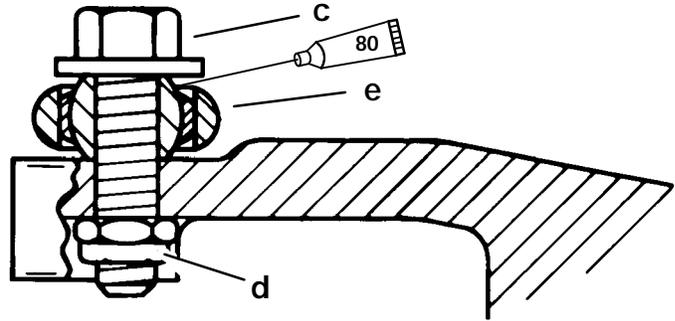


STEERING LINK ROD INSTALLATION

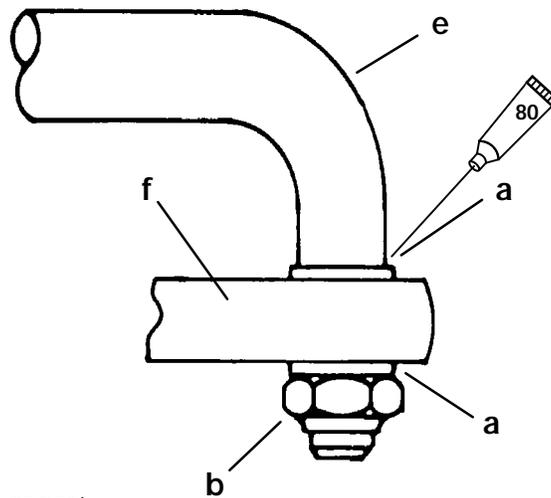
⚠ WARNING

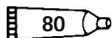
Steering link rods **MUST BE** secured between outboard steering arm and steering cable end, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown.

Both special washer head bolt and nylon insert locknuts **MUST BE** tightened as specified.



28166



 30W 4 Cycle Engine Oil (92-97959)

- a - Flat Washer (2 Each Link Rod)
- b - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.6 N·m) of Torque], Then Back Off 1/4 Turn
- c - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27.1 N·m)
- d - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
- e - Steering Link Rod
- f - Steering Cable End

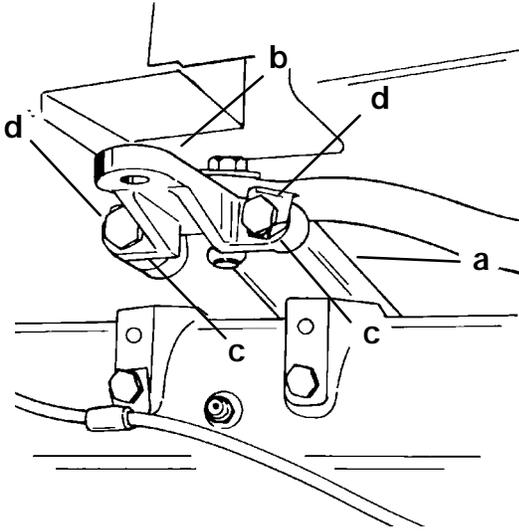
Lubricate holes in ends of steering cables with SAE 30W Motor Oil. Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 lb. in. (13.6 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joints in steering link rods with SAE 30W Motor Oil. Secure link rods to outboard steering arms, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown. Torque special bolts to 20 lb. ft. (27.1 N·m) then torque locknuts to 20 lb. ft. (27.1 N·m).



STEERING ARM EXTENSION BRACKET INSTALLATION

Secure a steering arm extension bracket to each outboard's steering arm.



51889

- a - Steering Arm (Port Outboard Shown)
- b - Extension Bracket
- c - Locking Retainer (2 Each Bracket)
- d - Bolts (2 Each Bracket) 1-1/4 in. (31.8mm) Long - Torque to 280 lb. in. (31.6 N·m), Then Bend Corner Tabs of Locking Retainers Up Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs **MUST BE bent up and against flats on each bolt that secures extension bracket to outboard steering arm to prevent bolts from turning out.**

STEERING COUPLER ASSEMBLY AND INSTALLATION

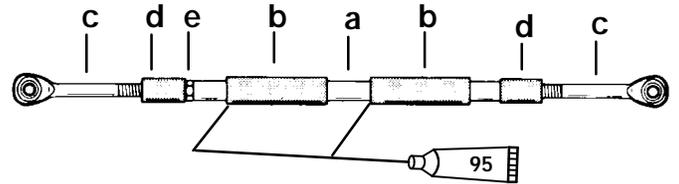
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions **MUST BE** equal to distance between propeller shaft centerlines.)

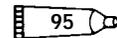
Lubricate inside of rubber sleeves with 2-4-C w/Teflon and slide sleeves on steering coupler.

Work rubber bushings onto threaded ends of steering eyes.

Thread jam nut on starboard steering eye.

Thread steering eyes equally into coupler, so that distance between hole centers of steering eye ball joints is equal to distance between threaded hole centers of steering arm extensions. Exposed threads of steering eyes **MUST BE** of equal length and threads **MUST NOT** extend out from coupler more than 2-3/4 in. (69.9mm).



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

50061

- a - Coupler
- b - Rubber Sleeve
- c - Steering Eye
- d - Rubber Bushing
- e - Jam Nut

⚠ WARNING

Both steering eyes must be threaded into coupler 3/4 in. (19mm) minimum. Thread length of steering eye is 3-1/2 in. (88.9mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (69.9mm). Failure to adhere to this requirement could result in steering system failure.



Lubricate ball joint in steering eyes, with SAE 30W Motor Oil.

Assemble steering coupler between outboard steering arm extension brackets, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown.

IMPORTANT: With assembled steering coupler installed and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts **MUST BE** equal to distance between propeller shaft center lines, for proper steering. It adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

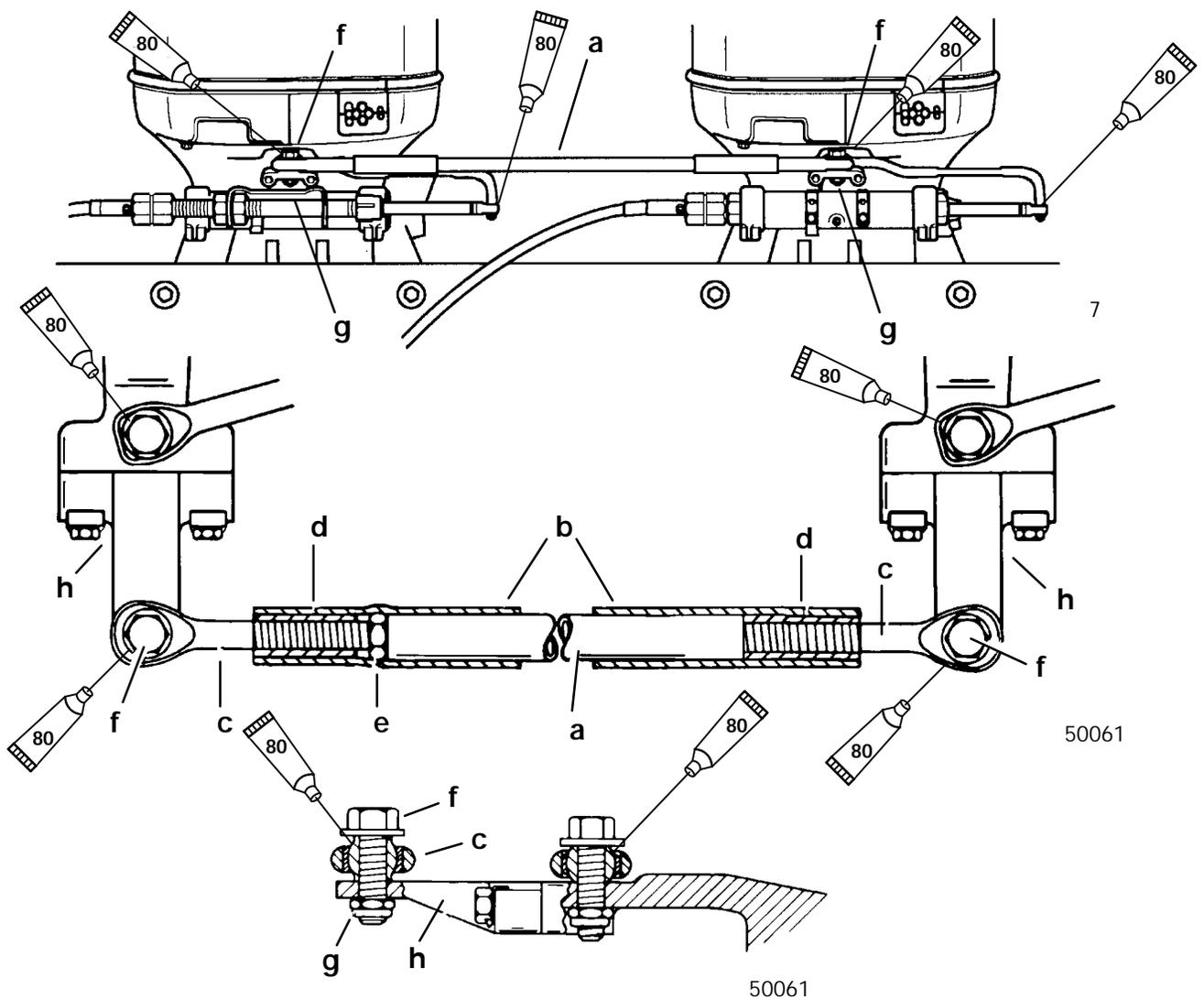
Torque special washer head bolts to 20 lb. ft. (27.1 N·m), then torque locknuts to 20 lb. ft. (27.1 N·m).

⚠ WARNING

Both steering eyes MUST BE threaded into coupler 3/4 in. (19mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque "jam" nut to 20 lb. ft. (27.1 N·m).

Tighten "jam" nut against coupler. Torque "jam" nut to 20 lb. ft. (27.1 N·m).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.



80 30W 4 Cycle Engine Oil (92-97959)

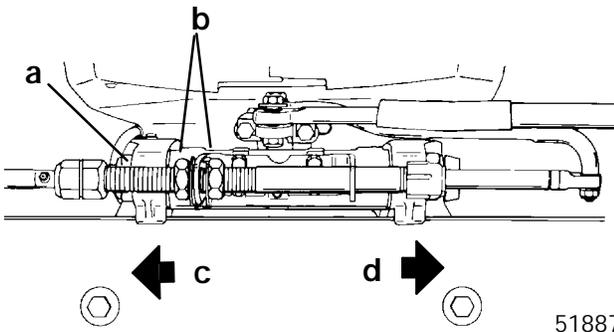
- a - Coupler
- b - Rubber Sleeve
- c - Steering Eye
- d - Rubber Bushing
- e - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27.1 N·m)
- f - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.1 N·m)
- g - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
- h - Steering Arm Extension Bracket



STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

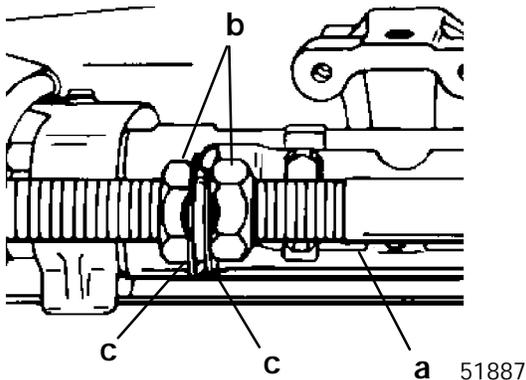
IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there **MUST BE** proper tension in the steering system. **NOT ENOUGH** tension will cause slack (play) in steering system. **TOO MUCH** tension will cause steering cables to bind. Perform the following steps to correctly adjust tension.

Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play). If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



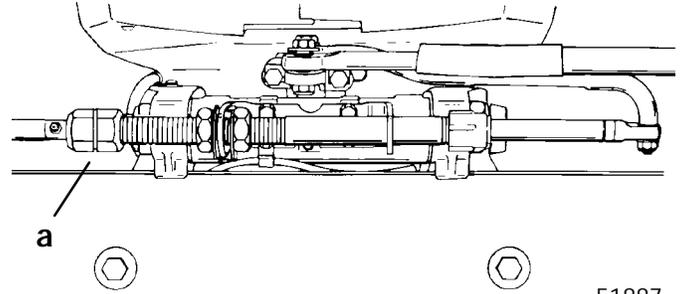
- a - Steering Cable Mounting Tube
- b - Adjustment Nuts
- c - Adjust Tube in This Direction to Remove Slack from Steering System
- d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.5 N·m) and bend a tab lock washer against a flat on each nut.



- a - Steering Cable Mounting Tube
- b - Adjustment Nuts Torque to 35 lb. ft. (47.5 N·m)
- c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).



- a - Cable Attaching Nut

WARNING

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

Adjust trim tabs of both outboards, as outlined in "Trim Tab Adjustment", following.



Opposite Side Routed Steering Cables and Attaching Kit Installation

(One Cable Routed down Starboard Side of Boat and One Cable Routed down Port Side of Boat)

SUPER RIDE-GUIDE STEERING KIT INSTALLATION

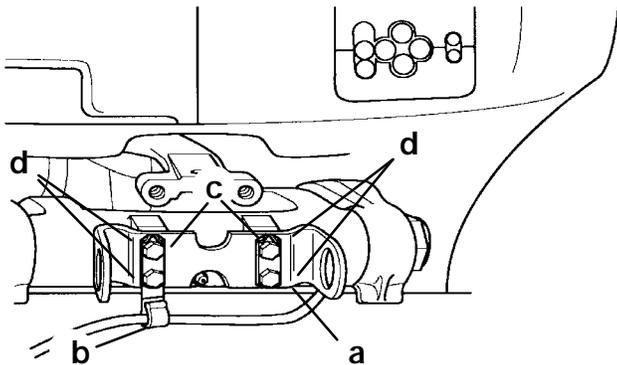
IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.

STEERING CABLE INSTALLATION - STARBOARD OUTBOARD

IMPORTANT: Mounting bracket for steering cable mounting tube **MUST BE** secured to outboard swivel bracket, using 5/8 in. (16mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



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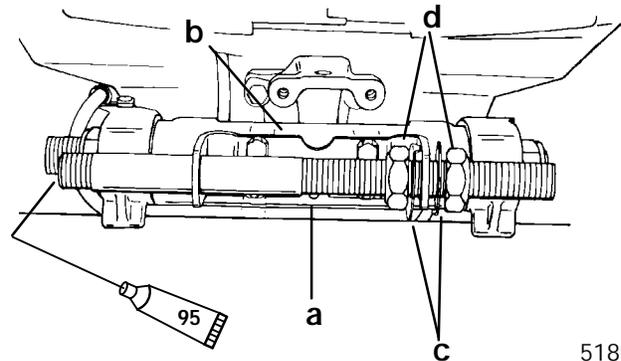
- a - Mounting Bracket for Steering Cable Mounting Tube
- b - "J" Clip - Supplied with Outboard
- c - Locking Retainers (2)
- d - Bolts (4) - 5/8 in. (16mm) Long - Torque to 100 lb. in. (11.3 N·m), Then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs **MUST BE** bent up and against flats on each bolt that secures mounting bracket for steering cable mounting tube, to prevent bolts from turning out.

Install Steering Cable mounting tube into mounting bracket with 2 adjusting nuts and 2 locking tab washers. Verify longer threaded end of tube is toward center of boat transom.

Temporarily adjust tube, so that longer threaded end of tube extends out the same distance as the outboard tilt tube. Do not tighten adjustment nuts at this time.



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

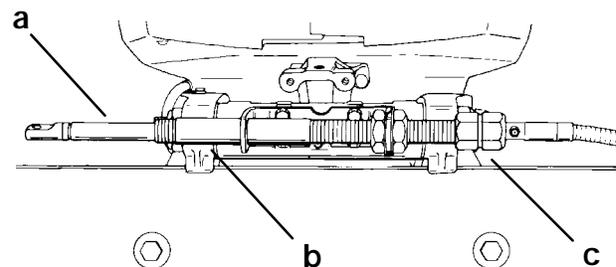
- a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Center of Boat Transom)
- b - Mounting Bracket
- c - Locking Tab Washers (2)
- d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

IMPORTANT: Lubricate inside of steering mounting tube with 2-4-C w/Teflon (92-825407A12) before installing steering cable.

Lubricate inside of steering cable mounting tube (starboard outboard) with 2-4-C w/Teflon.

Insert steering cable end (a) (steering cable routed down port side of boat) thru cable mounting tube (b) and thread steering cable attaching nut (c) onto tube hand tight.

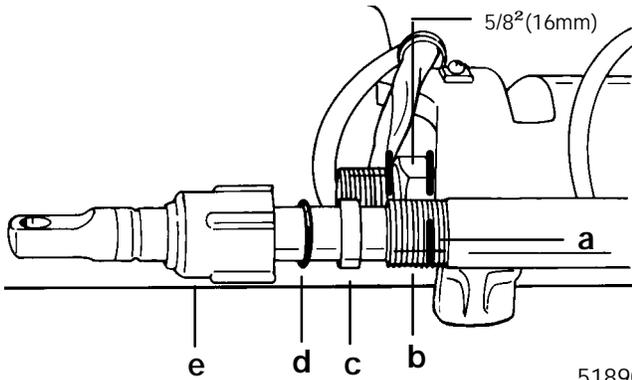
NOTE: Torque steering cable attaching nut only after final steering adjustments have been made.



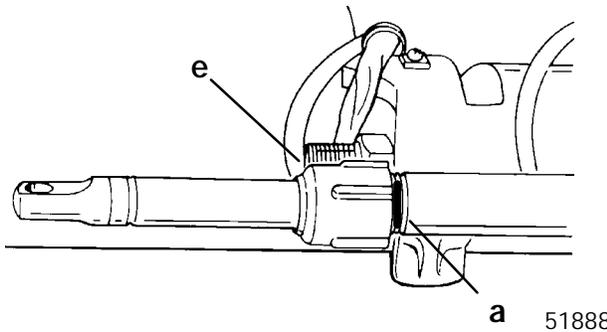
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Place a mark (a) on steering cable mounting tube (b) 5/8 in (16mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



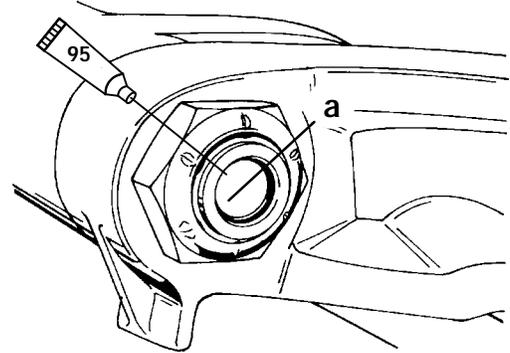
51890
Thread cap (e) onto steering cable mounting tube, up to mark (a).



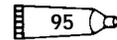
STEERING CABLE INSTALLATION - PORT OUTBOARD

IMPORTANT: Lubricate inside of port outboard's tilt tube and rubber O-ring seal located inside tilt tube with 2-4-C w/Teflon, before installing steering cable.

Lubricate inside of port outboard's tilt tube and rubber O-ring seal (a) with 2-4-C w/Teflon.

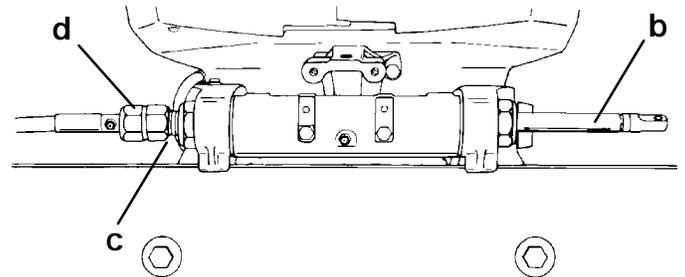


51890

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

Insert steering cable end (b) (steering cable routed down starboard side of boat) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

NOTE: Torque steering cable attaching nut only after final steering adjustments have been made.



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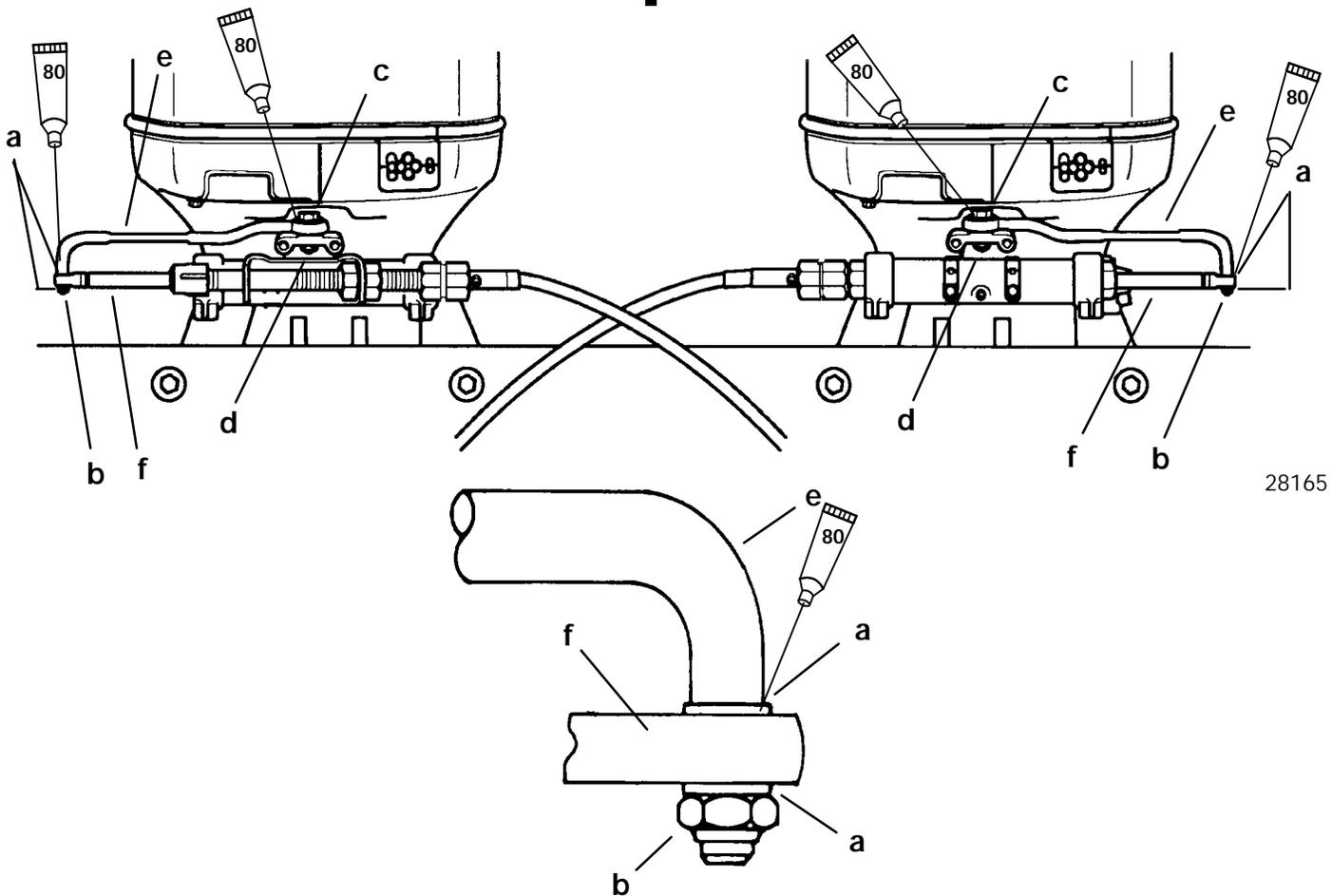
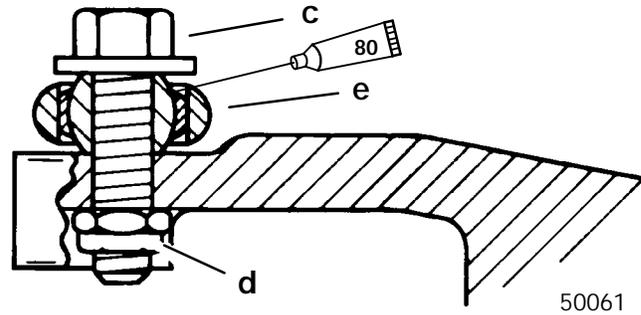
STEERING LINK ROD INSTALLATION

⚠ WARNING

Steering link rods **MUST BE** secured between outboard steering arm and steering cable end, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts **MUST BE** tightened as specified.

Lubricate holes in ends of steering cables with SAE 30W Motor Oil. Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 lb. in. (13.6 N·m) of torque], then back nut off 1/4 turn.

Lubricate ball joints in steering link rods with SAE 30W Motor Oil. Secure link rods to outboard steering arms, using special washer head bolts (10-14000) provided and nylon insert locknuts as shown. Torque special bolts to 20 lb. ft. (27.1 N·m) then torque locknuts to 20 lb. ft. (27.1 N·m).

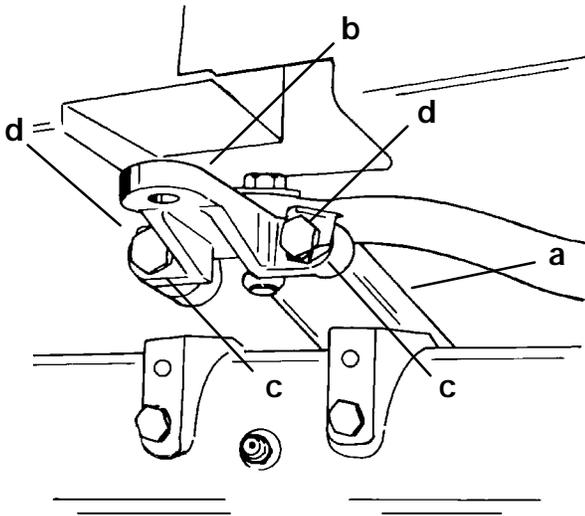


- a - Flat Washer (2 Each Link Rod)
- b - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.6 N·m) of Torque], Then Back Off 1/4 Turn
- c - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.1 N·m)
- d - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
- e - Steering Link Rod
- f - Steering Cable End



STEERING ARM EXTENSION BRACKET INSTALLATION

Secure a steering arm extension bracket to each outboard's steering arm.



51889

- a - Steering Arm (Port Outboard Shown)
- b - Extension Bracket
- c - Locking Retainer (2 Each Bracket)
- d - Bolts (2 Each Bracket) 1-1/4 in. (31.8mm) Long - Torque to 280 lb. in. (31.6 N-m), Then Bend Corner Tabs of Locking Retainers Up Against Flats on Each Bolt

⚠ WARNING

Locking retainer corner tabs, **MUST BE bent up and against flats on each bolt that secures extension bracket to outboard steering arm, to prevent bolts from turning out.**

STEERING COUPLER ASSEMBLY AND INSTALLATION

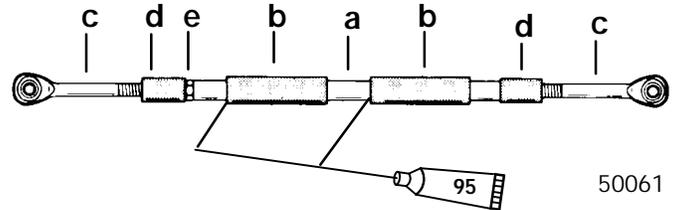
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions **MUST BE** equal to distance between propeller shaft centerlines.)

Lubricate inside of rubber sleeves with 2-4-C w/Teflon and slide sleeves on steering coupler.

Work rubber bushings onto threaded ends of steering eyes.

Thread jam nut on starboard steering eye.

Thread steering eyes equally into coupler, so that distance between hole centers of steering eye ball joints is equal to distance between threaded hole centers of steering arm extensions. Exposed threads of steering eyes **MUST BE** of equal length and threads **MUST NOT** extend out from coupler more than 2-3/4 in. (69.9mm).



50061

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

- a - Coupler
- b - Rubber Sleeve
- c - Steering Eye
- d - Rubber Bushing
- e - Jam Nut

⚠ WARNING

Both steering eyes must be threaded into coupler 3/4 in. (19mm) minimum. Thread length of steering eye is 3-1/2 in. (88.9mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (69.9mm). Failure to adhere to this requirement could result in steering system failure.



Lubricate ball joint in steering eyes with SAE 30W Motor Oil.

Assemble steering coupler between outboard steering arm extension brackets, using special washer head bolts (10-14000) provided and nylon insert locknuts, as shown.

IMPORTANT: With assembled steering coupler installed and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts **MUST BE** equal to distance between propeller shaft center lines, for proper steering. If adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

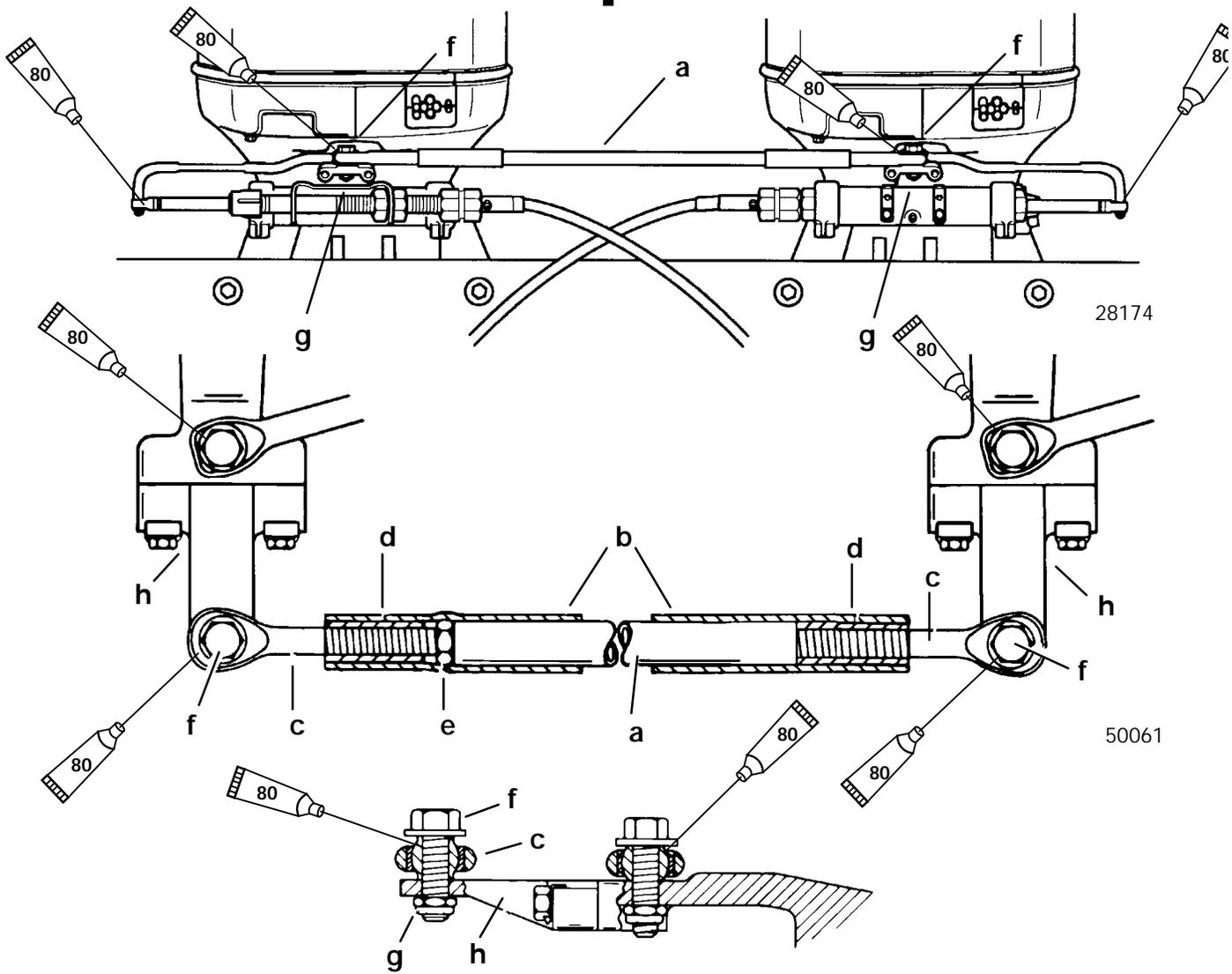
Torque special washer head bolts to 20 lb. ft. (27.1 N·m), then torque locknuts to 20 lb. ft. (27.1 N·m).

⚠ WARNING

Both steering eyes MUST BE threaded into coupler 3/4 in. (19mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque "jam" nut to 20 lb. ft. (27.1 N·m).

Tighten "jam" nut against coupler. Torque "jam" nut to 20 lb. ft. (27.1 N·m).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.



30W 4 Cycle Engine Oil (92-97959)

- a - Coupler
- b - Rubber Sleeve
- c - Steering Eye
- d - Rubber Bushing
- e - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27.1 N·m)

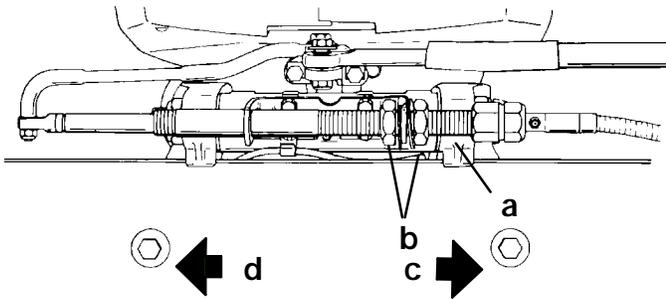
- f - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27.1 N·m)
- g - Nylon Insert Locknut - Torque to 20 lb. ft. (27.1 N·m)
- h - Steering Arm Extension Bracket



STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

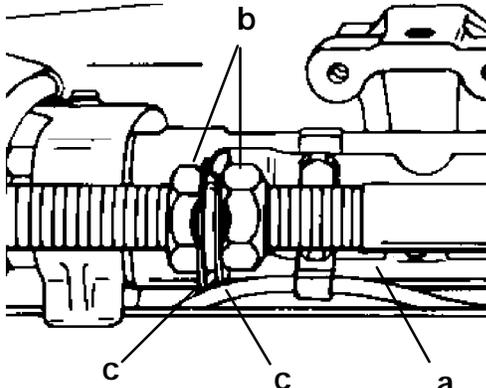
IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there **MUST BE** proper tension in the steering system. **NOT ENOUGH** tension will cause slack (play) in steering system. **TOO MUCH** tension will cause steering cables to bind. Perform the following steps to correctly adjust tension.

Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system.) Tighten adjustment nuts against mounting bracket and check system for slack (play.) If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



- 51887
- a - Steering Cable Mounting Tube
 - b - Adjustment Nuts
 - c - Adjust Tube in This Direction to Remove Slack from Steering System
 - d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket to a torque of 35 lb. ft. (47.5 N·m) and bend a tab lock washer against a flat on each nut.

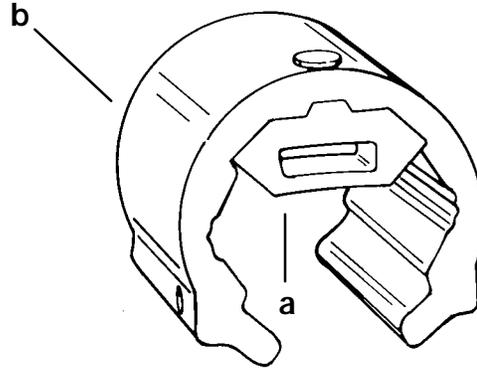


- 51887
- a - Steering Cable Mounting Tube
 - b - Adjustment Nuts; Torque to 35 lb. ft. (47.5 N·m)
 - c - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 N·m).

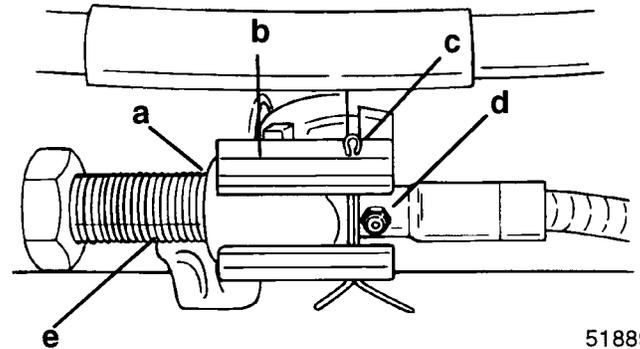
NOTE: Cable attaching nuts with a "V" groove around outer circumference are self locking and do not require locking sleeves.

Install rubber bumpers (a) on inside of each locking sleeve (b).

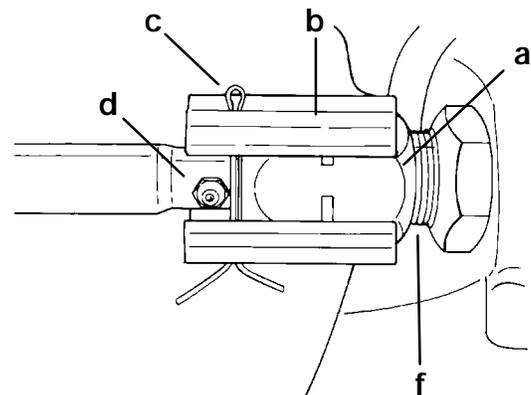


51889

Install locking sleeves over steering cable attaching nuts and secure with cotter pins. Spread ends of cotter pins. Be sure to install cotter pin so that it is located in between attaching nut and grease fitting.



51889



51888

- a - Steering Cable Attaching Nut [Torque to 35 lb. ft. (47.5 N·m)]
- b - Locking Sleeve (If Equipped)
- c - Cotter Pin
- d - Grease Fitting
- e - Steering Cable Mounting Tube (Starboard Outboard)
- f - Outboard Tilt Tube (Port Outboard)



⚠ WARNING

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

Adjust trim tabs of both outboards, as outlined in "Trim Tab Adjustment," following.

Trim Tab Adjustment

DUAL OUTBOARD - COUNTER ROTATION INSTALLATION

1. Shift outboard into neutral and make sure ignition key is at "OFF" position.
2. Remove plastic cap from rear of drive shaft housing and loosen bolt and trim tab.
3. Position trim tabs of both outboards straight to rear of outboard, so that tabs are aligned with gear housing center line.
4. Tighten both trim tab bolts securely and replace plastic caps. No further adjustment will be required.

DUAL OUTBOARD - NON COUNTER ROTATION INSTALLATION

1. Check trim tab position as follows:

IMPORTANT: Initial trim tab setting for both outboards should be straight to rear of outboard, so that tabs are aligned with gear housing center line. Refer to "If necessary, adjust trim tab as follows," following.

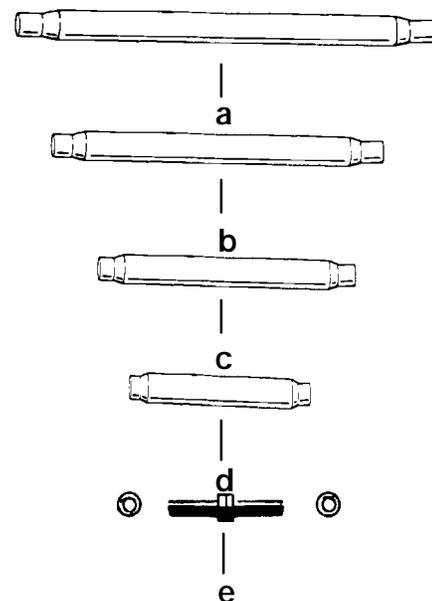
- a. Operate boat at normal cruise throttle setting and adjust trim to optimum setting.
 - b. If boat pulls to the right (starboard), trailing edge of trim tab must be moved to the right (when viewing outboard from behind). If boat pulls to the left (port), trailing edge of trim tab must be moved to the left.
2. If necessary, adjust trim tab as follows:
 - a. Shift outboard into NEUTRAL and make sure ignition key is at "OFF" position.
 - b. Remove plastic cap from rear of drive shaft housing and loosen bolt and trim tab.

IMPORTANT: Trim tabs MUST BE set in the same position on both outboards.

- c. If boat pulls to the right, adjust trailing edges of both trim tabs to the right. If boat pulls to the left, adjust trailing edges of both trim tabs to the left.
- d. Tighten both trim tab bolts securely and replace plastic caps.
- e. Operate boat per "**Check trim tab position as follows,**" preceding, to check trim tab setting. Readjust trim tabs, if necessary.

Ride Guide Steering Attachment Extension Couplers

Outboard Center Line Distance	Required Coupler(s) Between Steering Eyes
22-1/2 in. thru 24-1/2 in. (57.2cm thru 62.2cm)	12 in. (30.5cm) Coupler
23-1/2 in. thru 27-1/2 in. (59.7cm thru 69.9cm)	15 in. (38.1cm) Coupler (Supplied with this kit)
26-1/2 in. thru 30-1/2 in. (67.3cm thru 75.5cm)	18 in. (45.7cm) Coupler
30 in. thru 34 in. (76.3cm thru 86.4cm)	9 in. (22.9cm) Coupler and 12 in. (30.5cm) Coupler (Connected together with coupler link rod)
33 in. thru 37 in.	12 in. (30.5cm) Coupler and 12 in. (30.5cm) Coupler (Connected together with coupler link rod)

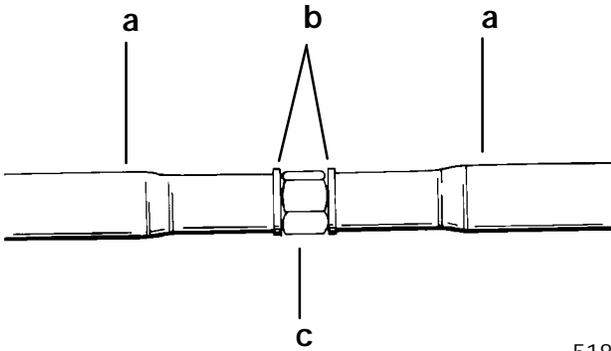


- a - 18 in. (45.7cm) Coupler (97932-3)
- b - 15 in. (38.1cm) Coupler (97932-2)
- c - 12 in. (30.5cm) Coupler (97932-1)
- d - 9 in. (22.9cm) Coupler (97932-4)
- e - Coupler Link Rod (98181A1)



⚠ WARNING

When 2 couplers are connected together with coupler link rod, a lock washer must be used on each side of coupler link rod, and link rod must be torqued to 20 lb. ft. (27.1 N·m) into end of each coupler.



51890

- a - Couplers Connected Together
- b - Lock washers
- c - Coupler Link Rod [Torque to 20 lb. ft. (27.1 N·m) into End of Each Coupler]

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "**Severe Service.**"

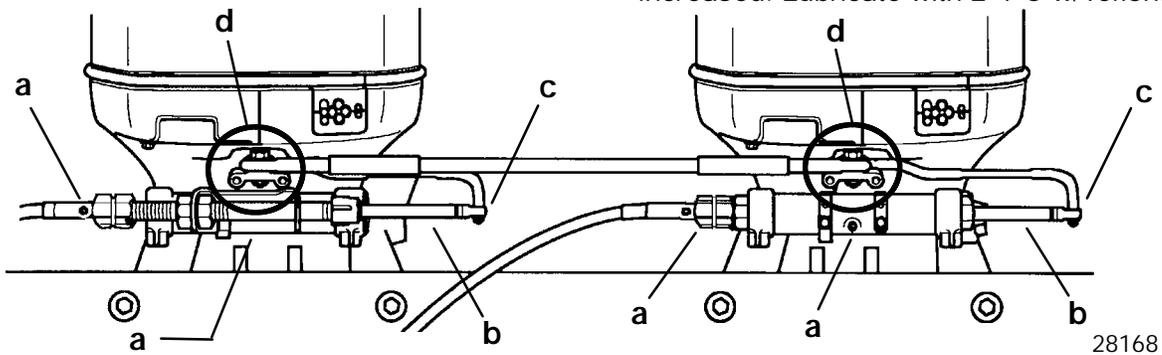
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

NOTE: Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.

⚠ WARNING

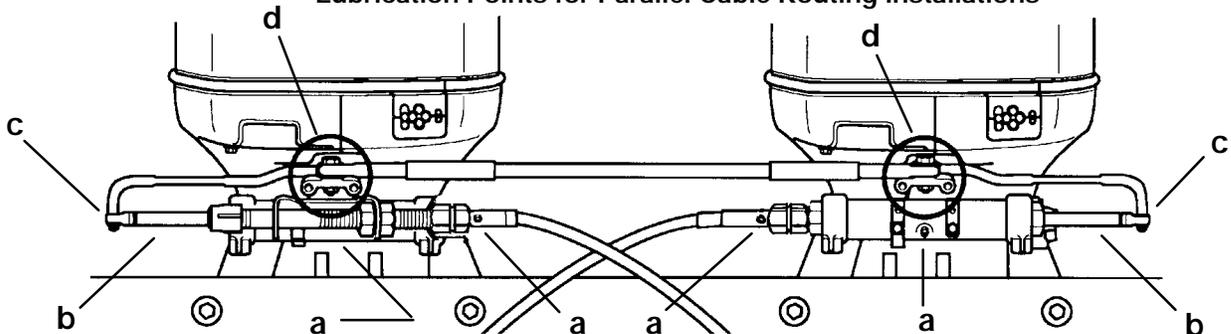
Core of each steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable ends (b) with 2-4-C w/Teflon.
4. Lubricate pivot points (c) of steering link rods and ball joints (d) of link rods/steering coupler with SAE 30W Motor Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



Lubrication Points for Parallel Cable Routing Installations

28168



Lubrication Points for Opposite Side Cable Routing Installations

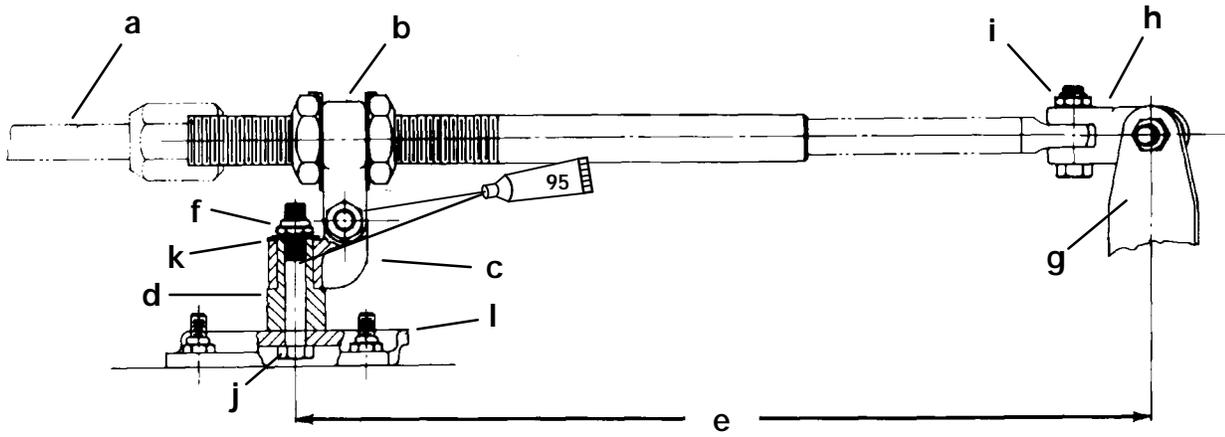
28175



Transom Mounted Ride Guide Attaching Kit Installation (73770A1)

Attaching Kit Installation

1. Lubricate both holes in pivot block (Figure 1) with Quicksilver 2-4-C w/Teflon.
2. Place pivot block on pivot spacer and secure to transom bracket with 3/8 in. x 2-1/2 in. (9.5mm x 63.5mm) bolt, flat washer and locknut, as shown in Figure 1. Torque locknut to 20 lb. ft. (27.1 N·m).



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

Figure 1

- a - Ride-Guide Cable
- b - Ride-Guide Yoke
- c - Pivot Block
- d - Pivot Spacer
- e - 15 in. (381mm) (Centerline of Attaching Kit Pivot to Centerline of Outboard)
- f - Pivot Attaching Locknut [Torque to 20 lb. ft. (27.1 N·m)]
- g - Outboard Steering Arm
- h - "Clevis Kit"
- i - Ride-Guide Cable Attaching Locknut [Torque to 10 lb. ft. (13.6 N·m)]
- j - Bolt [3/8 in. x 2-1/2 in. (9.5mm x 63.5mm)]
- k - Flat Washer
- l - Transom Bracket

3. Place Ride-Guide yoke on pivot block and secure with 7/16 in. x 1-3/4 in. (11.1mm x 44.5mm) bolt and locknut, as shown in Figures 1 and 2. Torque locknut to 10 lb. ft. (13.6 N·m), **then back off 1/4-turn.**

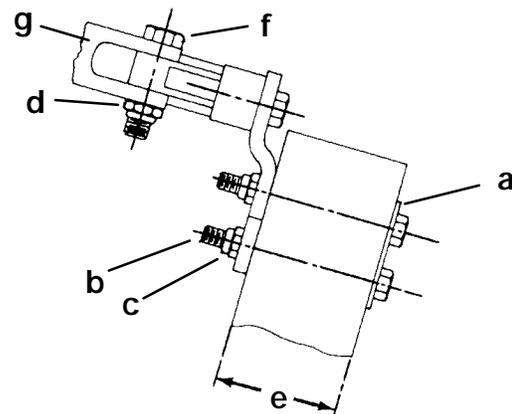


Figure 2

- a - Transom Backing Plate
- b - Bolt [5/16 in. x 3-1/4 in. (7.9mm x 82.5mm)]
- c - Locknut [Torque to 10 lb. ft. (13.6 N·m)]
- d - Ride-Guide Yoke Attaching Locknut [Torque to 10 lb. ft. (13.6 N·m)] **Then Back Off 1/4-Turn**
- e - 2-3/8 in. (60.3mm) Maximum Transom Thickness
- f - Bolt [7/16 in. x 1-3/4 in. (11.1mm x 44.5mm)]
- g - Ride-Guide Yoke



4. Install one cable tube jam nut onto steering cable tube. Place tab washer over Ride-Guide yoke, then insert cable tube thru tab washer and yoke. Install second cable tube jam nut onto cable tube but do not tighten at this time. (Figure 3)
5. Position transom attaching kit on transom as
 - a. Determine centerline of outboard, then measure 15 in. (38.1cm) over from this

centerline and draw a vertical line on transom. (Figure 1)

- b. Position attaching kit on transom so that **transom bracket is centered on the 15 in. (38.1mm)** (Figure 1) at a height where the **center of Ride-Guide yoke is even with, or not more than 1/2 in. (12.7mm) above top edge of transom.** (Figure 3)

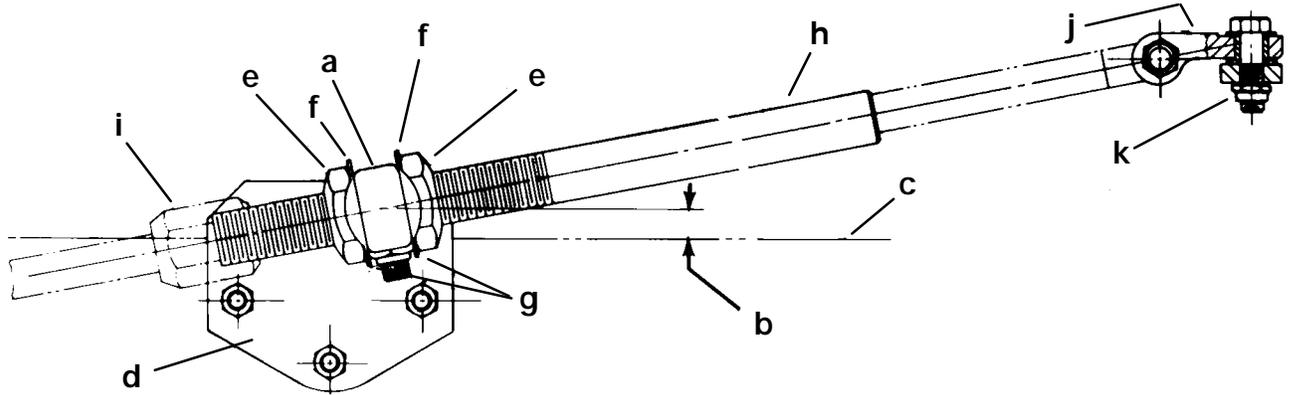


Figure 3

- a - Ride-Guide Yoke
- b - 0 in. to 1/2 in. (0mm to 12.8mm) (Center of Ride-Guide Yoke to Top of Transom)
- c - Top of Transom
- d - Transom Bracket
- e - Cable Tube Jam Nuts [Torque to 35 lb. ft. (47.5 N·m)]
- f - Tab Washer
- g - After Jam Nuts Are Torqued to Specification, Bend Locking Tabs against Nuts
- h - Cable Guide Tube
- i - Ride-Guide Cable Attaching Nut [Torque to 35 lb. ft. (47.5 N·m)]
- j - "Clevis Kit"
- k - Clevis Attaching Locknut [Torque to 20 lb. ft. (27.1 N·m)]

NOTE: When drilling thru transom, be sure that holes are drilled perpendicular to transom.

6. With attaching kit positioned as outlined preceding, use 3 holes in transom bracket as a guide and drill three 11/32 in. (8.7mm) holes thru transom.
7. Use a marine-type sealer on three 5/16 in. x 3-1/4in. (7.9mm x 82.6mm) bolts. Secure attaching kit to transom, using transom backing plate, 3 bolts (with sealer) and 3 locknuts, installed as shown in Figure 2. Torque lock nuts to 10 lb. ft. (13.5 N·m).

STEERING CABLE INSTALLATION

1. Lubricate steering cable end with Quicksilver 2-4-C w/Teflon (92-825407A12).

2. Install steering cable thru steering cable tube and secure to cable tube with cable attaching nut. (Figure 3) Do not tighten cable attaching nut at this time.
3. Attach Ride-Guide cable to outboard steering arm, using the proper "Clevis Kit." Installation instructions for clevis are with "Clevis Kit."
4. Adjust 2 large jam nuts on cable tube of attaching kit, so that **steering wheel** is in normal straight-driving position with outboard in straight-running position. Torque each jam nut to 35 lb. ft. (47.5 N·m), then bend a side of tab washer against flat of each jam nut. (Figure 3)
5. Torque Ride-Guide cable attaching nut (which secures cable to guide tube) to 35 lb. ft. (47.5 N·m). (Figure 3) Install locking sleeve over cable attaching nut and secure with cotter pin. Spread ends of cotter pin.

⚠ WARNING

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



Maintenance Instructions

Lubrication and maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "**Severe Service.**"

⚠ CAUTION

Core of steering cable must be fully retracted into cable housing when lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

1. Lubricate outboard end of Ride-Guide steering cable (thru grease fitting next to cable attaching nut) with Quicksilver 2-4-C w/Teflon.

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

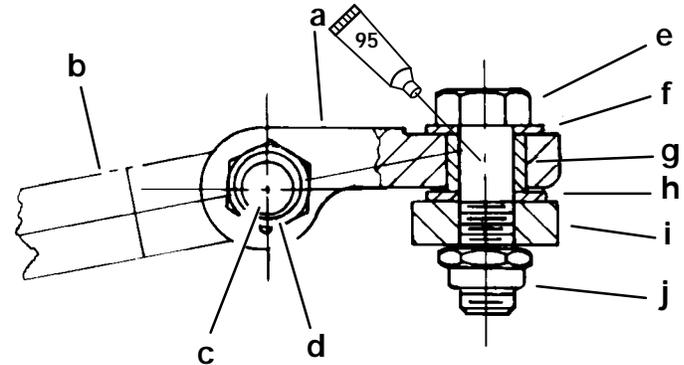
2. Lubricate all steering system pivot points (and exposed portion of steering cable core) with Quicksilver 2-4-C w/Teflon. Lubricate at intervals specified preceding.
3. Carefully check steering system components for wear (at intervals specified, preceding). Replace worn parts.
4. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications. (Figures 1, 2 and 3)

Clevis Attaching Kit Installation (A-70599A2)

NOTE: This kit is used to attach Ride-Guide cable to outboard steering arm ONLY when "**Transom Mounted Ride-Guide Attaching Kit**" is being used. If Ride-Guide cable is installed thru outboard tilt tube, then "**Steering Link Rod**" must be used.

Installation Instructions

1. Install clevis to steering cable as shown.
2. Lubricate 3/8 in. x 1-3/8 in. (9.5mm x 34.9mm) bolt (area without threads) with 2-4-C w/Teflon, then secure clevis to steering cable with this bolt and a locknut. Torque locknut (item "d") to 10 lb. ft. (13.6 N·m).



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

- a - Clevis
 - b - Steering Cable
 - c - Bolt [3/8 in. x 1-3/8 in. (9.5mm x 34.9mm)]
 - d - Clevis to Steering Cable Locknut [Torque to 10 lb. ft. (13.6 N·m)]
 - e - Bolt [3/8 in. x 1-1/4 in. (9.5mm x 31.8mm)] [Torque to 20 lb. ft. (27.1 N·m)]
 - f - Thin Washer [1/16 in. (1.6mm) Thick]
 - g - Spacer
 - h - Thick Washer [1/8 in. (3.2mm) Thick]
 - i - Engine Steering Arm
 - j - Clevis to Engine Locknut [Torque to 20 lb. ft. (27.1 N·m)]
3. Lubricate spacer (supplied with this kit) with 2-4-C w/Teflon.
 4. Attach clevis to top of outboard steering arm with a 3/8 in. x 1-1/4 in. (9.5mm x 31.8mm) bolt, thin washer, spacer, thick washer (thick washer must be installed between clevis and steering arm) and locknut, as shown. Torque bolt (item "e") to 20 lb. ft. (27.1 N·m), then torque locknut (item "j") to 20 lb. ft. (27.1 N·m).



Maintenance Instructions

Lubrication and maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service** - Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "**Severe Service.**"

1. Carefully check steering system components (at intervals specified, preceding) for wear. Replace worn parts.
2. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications.
3. Lubricate clevis pivot points with a drop of light oil. Lubricate at intervals specified, preceding.