MARINER MERCURY

SERVICE MANUAL

MODELS

135 • 150 • 175 • 200

With Serial Numbers

United States . . . . . . 0G960500 and Above

Printed in U.S.A.

90-878079 JANUARY 2000

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.

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

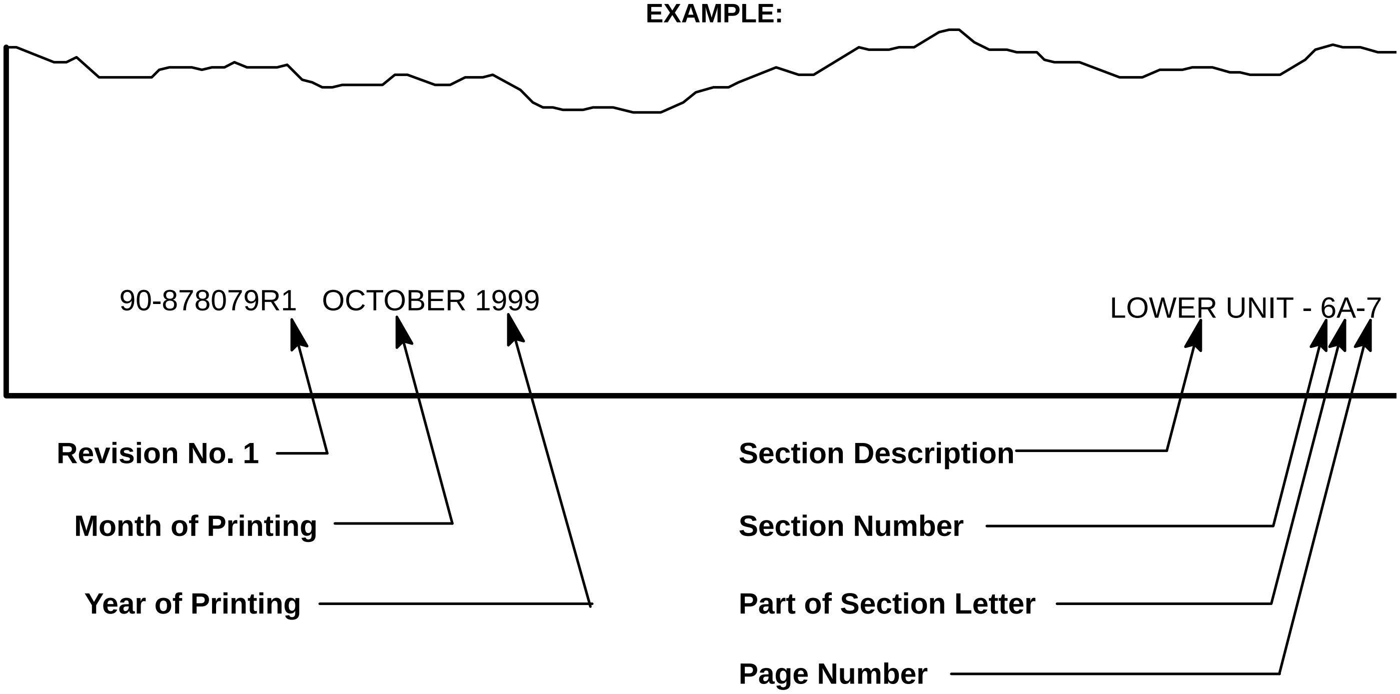
We reserve the right to make changes to this manual without prior notification.

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

Page Numbering

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

EXAMPLE:



Service Manual Outline

IMPORTANT INFORMATION

Section 1A - Specifications

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Specifications

Model 135/XR6/MAGIII/200/150XRI/175XRI/200XRI		
HORSEPOWER (KW)	**Model 135** **Model 150XRI** **Model XR6/MAGIII** **Model 175XRI** **Model 200/200XRI**	135 (100.6) 150 (111.8) 150 (111.8) 175 (130.5) 200 (149.1)
OUTBOARD WEIGHT	**Model 135** **Model XR6/MAGIII/200** **Model 150XRI/175XRI/200XRI**	413.0 lbs. (188.0 kg) 406.0 lb (184.0 kg) 416.0 lb (189.0 kg)
CYLINDER BLOCK	**Model 135** **Type** **Displacement** **Thermostat** **Model XR6/MAGIII/200** **150XRI/175XRI/200XRI** **Type** **Displacement** **Thermostat**	 V–6 Cylinder, Two Cycle, Loop Charged 121.9 cu. in. (1998cc) 143°F (61.7°C) V–6 Cylinder, Two Cycle, Loop Charged 153.0 cu. in. (2507cc) 143°F (61.7°C)
STROKE	**Length (All Models)**	2.650 in. (67.31 mm)
CYLINDER BORE	**Diameter (Std)** **– Models 135** **– Models XR6/MAGIII/200** **150XRI/175XRI/200XRI** **Taper/Out of Round/Maximum Wear** **Bore Type**	 3.125 in. (79.375 mm) 3.501 in. (88.925 mm) 0.003 in. (0.076 mm) Cast Iron
CRANKSHAFT	**Maximum Runout**	0.006 (0.152 mm)

PISTON	**Piston Type** **Models 135** **Standard** **0.015 in. (0.381 mm) Oversize** **0.030 in. (0.762 mm) Oversize** **Models XR6/MAGIII/200** **150XRI/175XRI/200XRI** **Standard** **0.015 in. (0.381 mm) Oversize**	Aluminum 3.115 in. ± 0.002 in. (79.121 mm ± 0.051 mm) 3.130 in. ± 0.002 in. (79.502 mm ± 0.051 mm) 3.145 in. ± 0.002 in. (79.883 mm ± 0.051 mm) 3.494 in. ± 0.001 in. (88.748 mm ± 0.025 mm) 3.509 in. ± 0.001 in. (89.129 mm ± 0.025 mm)
COMPRESSION	**All Models – Using a fully charged battery, throttle shutters wide open and cylinder block warm**	110 – 135 psi (753.3 – 924.5 kPa) Variance between cylinders should not exceed 15 psi (102.7 kPa)
REEDS	**Model 135** **Model XR6/MAGIII/200** **Model 150XRI/175XRI/200XRI** **Reed Type** **Reed Stand 0pen (Max.)** **Reed Stop (Max.)**	 Steel 0.020 in. (0.50 mm) Not Adjustable
MID SECTION	**Power Trim (Total Tilt Range)** **Power Trim (Tilt Range)** **Maximum Allowable Leak down in 24 hrs.** **Tilt Pin Adjustment Positions** **Steering Pivot Range** **Allowable Transom Thickness**	75° 20° 1 in. (25.4 mm) 5 60° 2-3/8 in. (6.03 cm) Maximum
FUEL SYSTEM	**Fuel** **Recommended Gasoline** **Model 135** **Model XR6/MAGIII/200** **Model 150XRI/175XRI/200XRI** **Recommended Oil** **Model 135** **Model XR6/MAGIII/200** **Model 150XRI/175XRI/200XRI** **Gasoline/Oil Ratio** **Fuel Pressure Pulse Driven Pump** **– @ Idle** **– @ WOT**	Gasoline w/Oil Injection Unleaded 87 Octane Minimum Quicksilver TC-W3 2 Cycle Outboard Oil Only 50:1 (25:1 Break-In) 1 – 3 psi (6.8 – 20.5 kPa) 12 psi (82.1 kPa) Minimum
STARTING SYSTEM	**Manual Start – All Models** **Electric Start – All Models** **Starter Draw (Under Load)** **Starter Load (No Load)** **Battery Rating**	Emergency Start Rope 175 Amperes 40 Amperes Min. 630 Marine Cranking Amps (MCA) or 490 Cold Cranking Amps (CCA)

IGNITION SYSTEM	**Type** **Spark Plug Type** **Spark Plug Gap** **Firing Order**	Capacitor Discharge NGK BPZ8HS-10 0.040 in. (1.0 mm) 1-2-3-4-5-6
CHARGING SYSTEM	**Alternator Output (Regulated)** **Voltage Regulator Draw with Ignition Key in the Off Position**	40 Amperes @ 5000 rpm 0 – 4 Milliamperes Each (0 – 8 Milliamperes total system draw)

TIMING	**Idle Speed/Pickup Timing** **– 135 Carb Models** **– XR6/MAG III** **– 200 Carb** **– 150XRI/175 XRI Models** **– 200 XRI Model**	 0° – 9° ATDC
	Maximum BTDC **– Model 135** **@ Cranking Speed** **@ WOT RPM**	 25° BTDC 19° BTDC
	– XR6/MAG III Carb/175 XRI **@ Cranking Speed** **@ WOT RPM**	 26° BTDC 20° BTDC
	– Model 150 XRI **@ Cranking Speed** **@ WOT RPM**	 22° BTDC 16° BTDC
	– Model 200 Carb **@ Cranking Speed** **@ WOT RPM**	 20° BTDC 18° BTDC
	– Model 200XRI **@ Cranking Speed** **@ WOT RPM**	 24° BTDC 18° BTDC

***NOTE:** *Timing specifications listed are for 2000 model year engines. Refer to timing decal on engine for previous model year timing specifications.*

GEAR HOUSING	**Gear Ratio** **– Models 135** **– Models XR6/MAGIII/150XRI** **– Models 200/175XRI/200XRI** **Gear Ratio – High Altitude** **– Models 135** **– Models XR6/MAGIII/175/200 150XRI/175XRI/200XRI** **Gearcase Capacity** **– 1.87:1/2.00:1/2.30:1** **Pinion Height** **– All Models** **Forward Gear Backlash** **– 1.87:1 Ratio** **– 2.00:1 Ratio** **– 2.30:1 Ratio** **Water Pressure @ rpm**	 2.00:1 (14/28 teeth) 1.87:1 (15/28 teeth) 1.87:1 (15/28 teeth) 2.30:1 (13/30 teeth) 2.00:1 (14/28 teeth) 22.5 fl oz (665.4 ml) 0.025 in. (0.64 mm) 0.018 in. – 0.027 in. (0.460 mm – 0.686 mm) 0.015 in. – 0.022 in. (0.381 mm – 0.558 mm) 0.018 in. – 0.023 in. (0.460 mm – 0.584 mm) 12 psi Minimum @ 5500 rpm
OIL INJECTION	**Recommended Oil** **Oil Tank Capacity** **Approx. Time** **– Model 135** **– Model XR6/MAGIII/175/200** **– Model 150XRI/175XRI/200XRI** **Reserve Capacity/Approx. Time** **Output @ 1000 RPM for 3 Minutes with Pump @ Full Open** **– Model 135** **– Model XR6/MAG III/200** **– Model 150XRI/175XRI/200XRI**	Quicksilver TC-W3 3 gal. (11.4 Liter) 8.7 hrs. Approx. 6.6 hrs. Approx. 6.6 hrs. Approx. .94 qt. (0.89 Liter) 30 – 35 min. 12cc @ 1000 rpm 15cc @ 1000 rpm 15cc @ 1000 rpm
FUEL INJECTION	**Idle RPM** **– All Models** **Wide Open Throttle (WOT) RPM** **– Model 150XRI/175XRI** **– Model 200XRI** **Float Adjustment (Vapor Separator) Float Level** **Injectors** **– All Models (Quantity)** **– CDM # Controls:** **– #1 Primary Circuit** **– #3 Primary Circuit** **– #5 Primary Circuit** **Line Pressure @ Injectors**	 650 ± 50 5000 – 5600 5000 – 5800 Preset @ Factory 6 #3 and #4 Injectors #5 and #6 Injectors #1 and #2 Injectors 34 psi – 36 psi (234 kPa – 248 kPa)

CARBURETOR	**Idle RPM** **– Model 135/200** **– Model XR6/MAGIII** **Wide Open Throttle (WOT) RPM** **– Model 135/200** **– Model XR6/MAGIII** **Idle Mixture Screw Adjustment (Preset - Turns Out)** **– Carburetor Model 135** **– Carburetor Models 150/200** **– All EFI Models** **Float Adjustment** **Float Level**	 650 ± 50 675 ± 50 5000 – 5500 5000 – 5500 1-1/2 ± 1/8 1-1/4 ± 1/8 Not Adjustable Float Even with Bowl Edge w/Bowl Inverted
CARBURETOR	**WMV Carburetor Jets** **– Model 135 (WMV 15)** **– Main Jet** **– Idle Air Jet** **– Vent Jet** **– Model XR6/MAGIII (WMV 16)** **– Main Jet** **– Idle Air Jet** **– Vent Jet** **– Model 200 (WMV 18)** **– Main Jet** **– Idle Air Jet** **– Vent Jet**	 .072 (all cylinders) Cyl. 2,4 – .040 Cyl. 1 – .036 Cyl. 3 - .030 Cyl. 6 - .048 Cyl. 5 - .038 .086 (all cylinders) .074 (all cylinders) Cyl. 1,2,3,4,5 – .044 Cyl. 6 – .048 .082 (all cylinders) Cyl 2,3 – .082 Cyl. 1,4 – .080 Cyl. 5 – .084 Cyl. 6 – .078 Cyl. 2 – .038 Cyl. 1 – .042 Cyl. 3,4,5,6 – .028 .086 (all cylinders)

IMPORTANT INFORMATION

Section 1B - Maintenance

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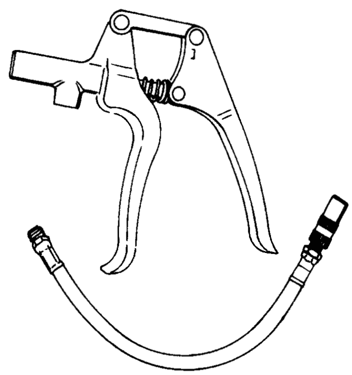
Specifications

Gear Case Lubricant Capacity

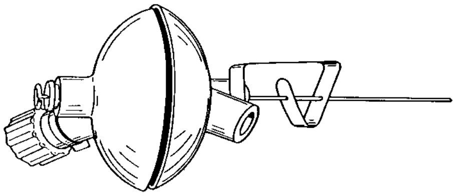
Gear Case Ratio	Capacity
1.87:1	22.5 fl. oz. (717 ml)
2.00:1	22.5 fl. oz. (717 ml)
2.30:1	22.5 fl. oz. (717 ml)

Special Tools

1. Grease Gun 91-37299A1

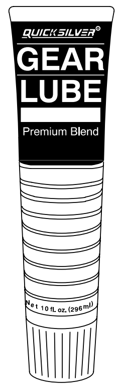


2. Flushing Attachment 44357A2

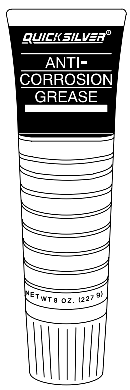


Quicksilver Lubricant/Sealant

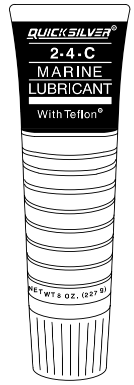
1. Gear Lubricant - Premium Blend 92-850737A1



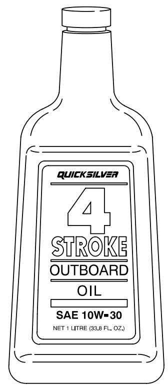
2. Anti-Corrosion Grease 92-850735A1



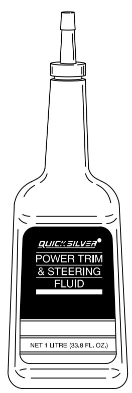
3. 2-4-C Marine Lubricant with Teflon 92-850736A1



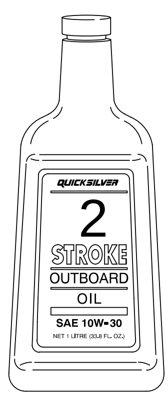
4. SAE 30W Motor Oil (Obtain Locally)



5. Quicksilver Power Trim and Steering Fluid 91-90100A12



6. 2 Stroke Outboard Oil 92-826666A24



Inspection and Maintenance Schedule

Before Each Use

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

After Each Use

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

Every 100 Hours of Use or Once Yearly, Whichever Occurs First

1. Lubricate all lubrication points. Lubricate more frequently when used in salt water.
2. Inspect and clean spark plugs.
3. Check engine fuel filter for contaminants – Carburetor models.
4. Replace water separating fuel filter – EFI models.
5. Replace compressor air intake filter.
6. Check corrosion control anodes. Check more frequently when used in salt water.
7. Drain and replace gear case lubricant.
8. Lubricate splines on the drive shaft and shift shaft.*
9. Check power trim fluid.
10. Inspect battery.
11. Check control cable adjustments.*
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.*

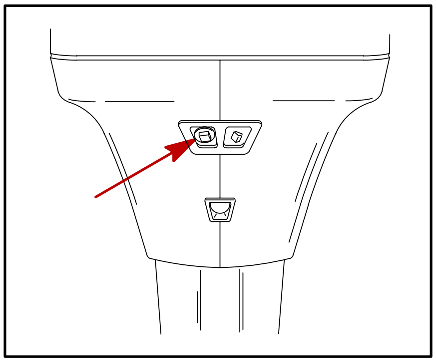
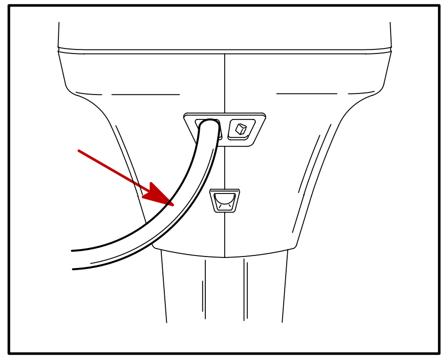
Flushing Engine

Flushing Cooling System – Using Cowl Flush Plug

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

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

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.

Flushing Cooling System – 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. (12.7 mm) I.D. or larger] between flushing attachment and water tap.

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

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

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

   b. Flush until discharge water is clear. In saltwater areas, run outboard 3 to 5 minutes.
   c. Stop engine before turning off water.

6. Stop engine, turn water off and remove flushing attachment from gear housing.

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

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.

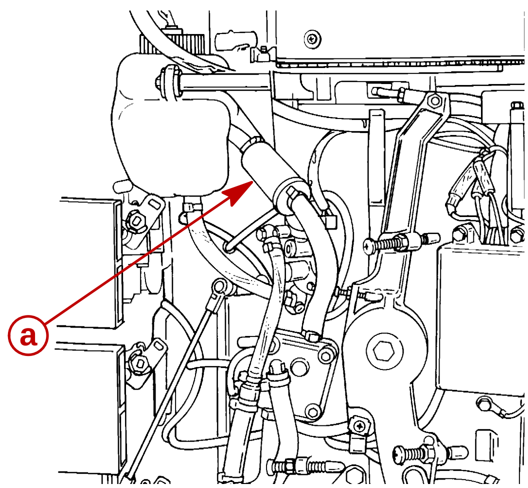
Before servicing any part of the fuel system, stop engine and disconnect the battery. Drain the fuel system completely. Use an approved container to collect and store fuel. Wipe up any spillage immediately. Material used to contain spillage must be disposed of in an approved receptacle. Any fuel system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

Fuel Line 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.

Fuel Line Filter (Models With Carburetors)

Inspect the fuel line filter. If the filter appears to be contaminated, remove and replace.



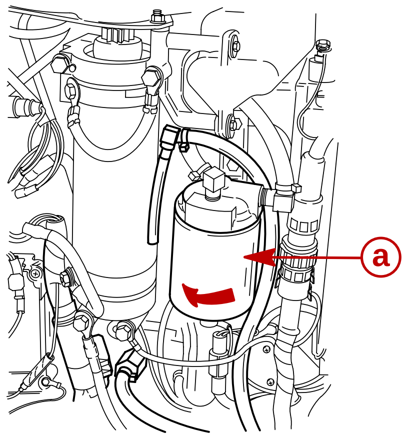
a - Fuel Line Filter

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

Water Separating Fuel Filter – EFI Models

NOTE: *The warning system will turn on when water in the fuel filter reaches the full level.*

1. 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.



a - Fuel/Water Separator Filter

Remove and replace filter as follows:

a. Turn ignition key switch to OFF position.

b. Disconnect wire at bottom of filter.

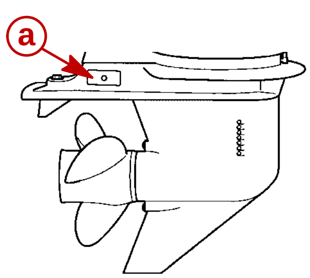
c. Remove filter by turning the filter in the direction of the arrow (clockwise). Tip the filter to drain fluid in a suitable container.

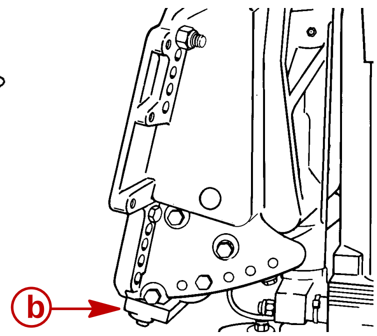
d. Lubricate the sealing ring on the filter with oil. Thread on the filter and tighten securely by hand. Reconnect the wire to the filter.

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

Corrosion Control Anode

The gear case has two corrosion control anodes (a). Another anode (b) 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.



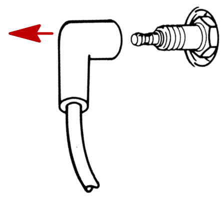


Each anode requires periodic inspection especially in salt water which will accelerate the erosion. To maintain this corrosion protection, always replace the anode before it is completely eroded. Never paint or apply a protective coating on the anode as this will reduce effectiveness of the anode.

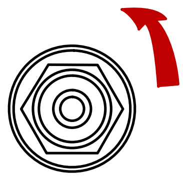
Spark Plug Inspection

Inspect spark plugs at the recommended intervals.

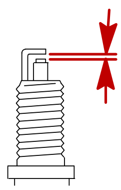
1. Remove the spark plug leads by twisting the rubber boots slightly and pull off. Inspect spark plug boots and replace if cracked.



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 Nm).

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.

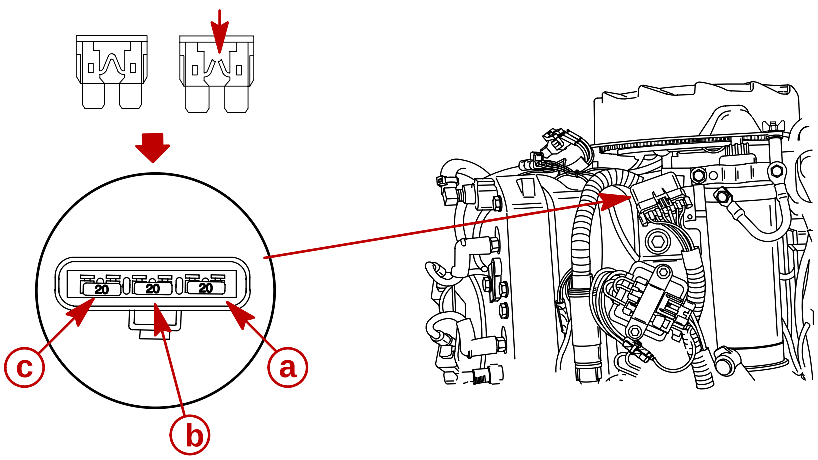
1. Turn off the engine before servicing the battery.
2. Add water as necessary to keep the battery full.
3. Make sure the battery is secure against movement.
4. Battery cable terminals should be clean, tight, and correctly installed. Positive to positive and negative to negative.
5. Make sure the battery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

Fuse Replacement

IMPORTANT: Always carry spare SFE 20 AMP fuses.

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.

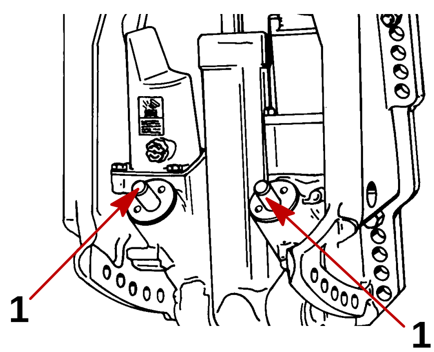
1. Open the fuse holder and look at the silver colored band inside the fuse. If band is broken, replace the fuse. Replace fuse with a new fuse with the same rating.
2. The fuses and circuits are identified as follows:
   a. Accessories and Starting Circuit – 20 AMP Fuse.
   b. Upper Voltage Regulator – 20 AMP Fuse.
   c. Lower Voltage Regulator – 20 AMP Fuse.



Lubrication Points

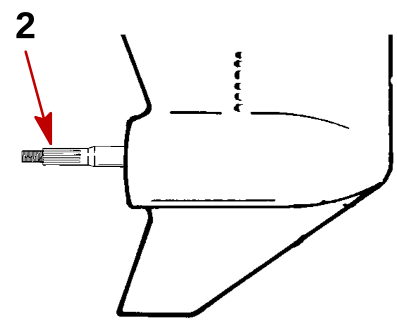
Lubricate Point 1 with Quicksilver Special Lubricant 101.

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



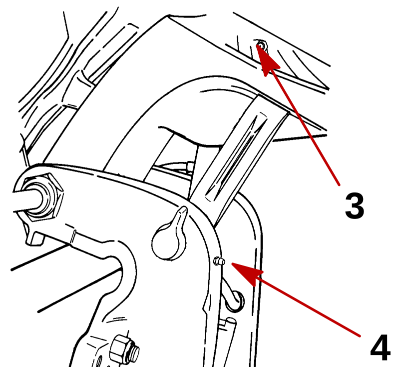
Lubricate Point 2 with Quicksilver Anti-Corrosion Grease or 2-4-C Marine Lubricant with Teflon.

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.

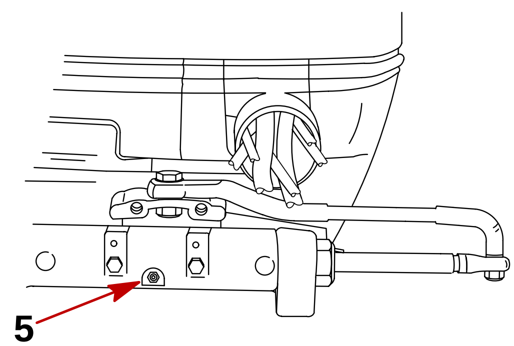


Lubricate Points 3 thru 6 with Quicksilver 2-4-C Marine Lubricant with Teflon or Special Lubricate 101.

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



5. Tilt Tube – Lubricate through fitting.



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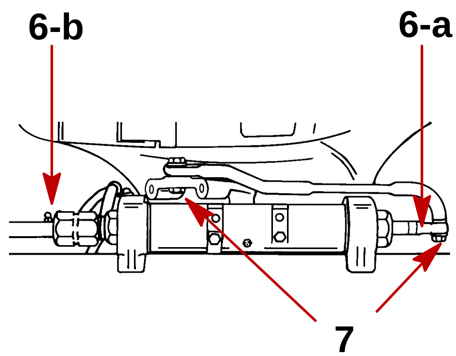
6. Steering Cable Grease Fitting (If Equipped) – Rotate steering wheel to fully retract the steering cable end (a) into the outboard tilt tube. Lubricate through fitting (b).

⚠ 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.

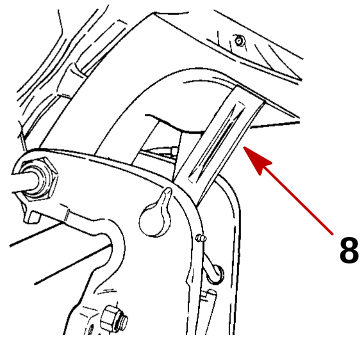
Lubricate Points 7 With Light Weight Oil.

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

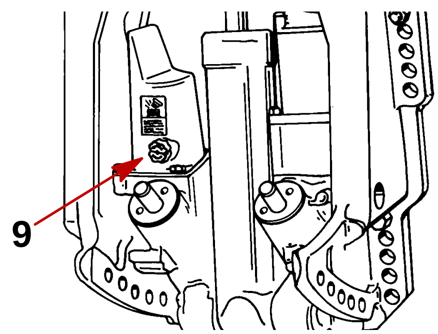


Checking Power Trim Fluid

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



9. 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.



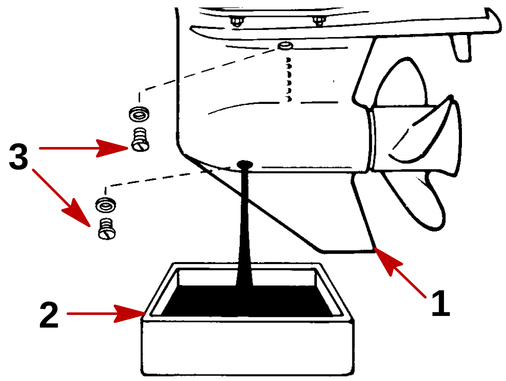
Gear Case Lubrication

When adding or changing gear case lubricant, visually check for the presence of water in the lubricant. If water is present, it may have settled to the bottom and will drain out prior to the lubricant, or it may be mixed with the lubricant, giving it a milky colored appearance. If water is noticed, have the gear case checked by your dealer.Water in the lubricant may result in premature bearing failure or, in freezing temperatures, will turn to ice and damage the gear case.

DRAINING GEAR CASE

NOTE: *Some models may have the vent and fill/drain plugs on the opposite side.*

1. Place outboard in a vertical operating position.
2. Place drain pan below outboard.
3. Remove vent plug and fill/drain plug and drain lubricant.



GEAR CASE LUBRICANT CAPACITY

Gear case lubricant capacity is approximately 22.5 fl. oz. (665 ml).

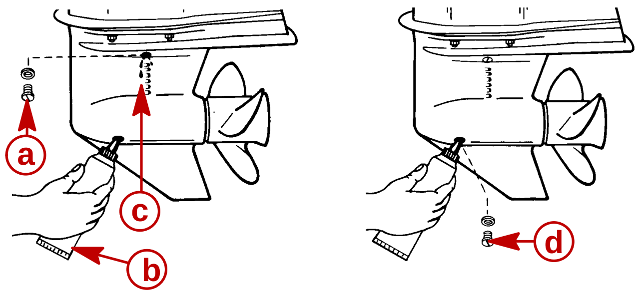
CHECKING GEAR CASE LUBRICANT LEVEL AND REFILLING GEAR CASE

NOTE: *Some models may have the vent and fill/drain plugs on the opposite side.*

1. Place outboard in a vertical operating position.
2. Remove vent plug (a).
3. Place lubricant tube (b) into the fill hole and add lubricant until it appears at the vent hole (c).

IMPORTANT: Replace sealing washers if damaged.

4. Stop adding lubricant. Install the vent plug and sealing washer (a) before removing the lubricant tube.
5. Remove lubricant tube and reinstall cleaned fill/drain plug and sealing washer (d).



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Storage Preparation

The major consideration in preparing your outboard for storage is to protect it from rust, corrosion, and damage caused by freezing of trapped water.

The following storage procedures should be followed to prepare your outboard for out of season storage or prolonged storage (two months or longer).

⚠ CAUTION
Never start or run your outboard (even momentarily) without water circulating through all the cooling water intake holes in the gear case to prevent damage to the water pump (running dry) or overheating of the engine.

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 at 2000 rpm for 10 minutes to allow treated fuel to fill the fuel system.

PROTECTING INTERNAL ENGINE COMPONENTS

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

Carburetor Models

1. Remove carburetor cover.
2. Place the outboard in water or connect flushing attachment for circulating cooling water. Start the engine and let it run in neutral to warm up.
3. With engine running at fast idle, stop the fuel flow by kinking the remote fuel line and run engine until it stops, draining the fuel system. When engine begins to stall, quickly spray Mercury Precision or Quicksilver Storage Seal into carburetors until engine stops from lack of fuel.
4. Remove the spark plugs and pour in 1 oz. (295 ml) of outboard oil around the inside of each cylinder.
5. Rotate the flywheel manually several times to distribute the oil in the cylinders. Reinstall spark plugs.

Electronic Fuel Injection (EFI) Models

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

1. Remove the spark plugs and 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.
2. Remove the water separating fuel filter and empty contents into a suitable container. Refer to Maintenance Section for removal and installation of filter. Replace fuel filter annually, or every 100 Hours of operation, or if 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. See your dealer for touch-up paint.
3. Spray Quicksilver Corrosion Guard on external metal surfaces (except corrosion control anodes).

GEAR CASE

Drain and refill the gear case lubricant (refer to maintenance procedure).

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.

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C

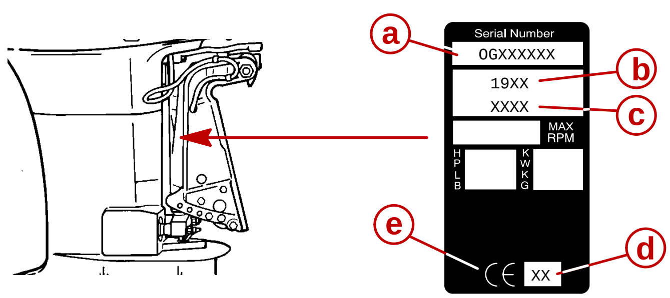
IMPORTANT INFORMATION

Section 1C - General Information

Table of Contents

Serial Number Location

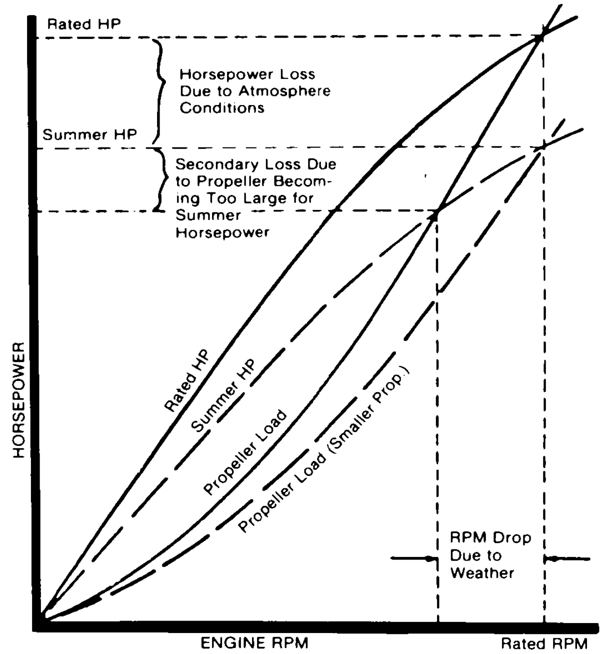
The engine serial number is located on the top of the engine block. A serial number is also located on the starboard side of the swivel bracket.



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

Conditions Affecting Performance

Weather



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

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

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

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

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

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

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

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

Boat

WEIGHT DISTRIBUTION

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

BOTTOM

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

Trim

TRIMMING OUTBOARD “OUT” (“UP”)

WARNING

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

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

TRIMMING OUTBOARD “IN” (“DOWN”) CHARACTERISTICS

WARNING

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

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

WATER ABSORPTION

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

CAVITATION

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

VENTILATION

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

Engine

DETONATION

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

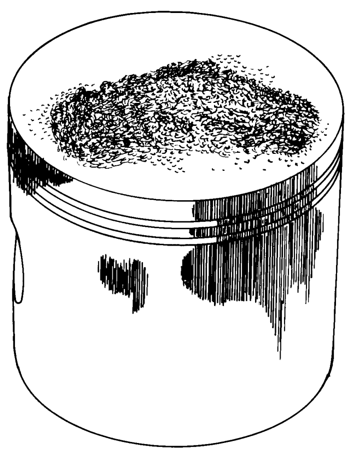
Detonation is an explosion of an unburned portion of the fuel/air charge after the spark plug has fired. Detonation creates severe shock waves in the engine, and these shock waves often find or create a weakness: The dome of a piston, cylinder head/gasket, piston rings or piston ring lands, piston pin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

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

- Over-advanced ignition timing.
- Use of low octane gasoline.
- Propeller pitch too high (engine RPM below recommended maximum range).
- Lean fuel mixture at or near wide-open-throttle.
- Spark plugs (heat range too hot – incorrect reach – cross-firing).
- Inadequate engine cooling (deteriorated cooling system).

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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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 110 to 130 psi (758.5 to 896.4 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.

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 the 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. EFI Models – Remove drain plug from vapor separator and drain fuel/water. Reinstall plug after draining.
   c. EFI Models – Remove the water separating fuel filter and empty contents.
6. Remove spark plugs and get as much water as possible out of powerhead. Most water can be eliminated by placing engine in a horizontal position (with spark plug holes down) and rotating flywheel.
7. Pour alcohol into carburetor throats (alcohol will absorbed water). Again rotate flywheel.
8. Turn engine over (place spark plug openings down) and pour engine oil into throat of carburetors while rotating flywheel to distribute oil throughout crankcase.
9. Again turn engine over and pour approximately one teaspoon of engine oil into each spark plug opening. Again rotate flywheel to distribute oil in cylinders.
10. Remove and clean carburetors and fuel pump assembly.
11. Dry all wiring and electrical components using compressed air.
12. Disassemble the engine starter motor and dry the brush contacts, armature and other corrodible parts.
13. Reinstall spark plugs, carburetors and fuel pump.
14. 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.

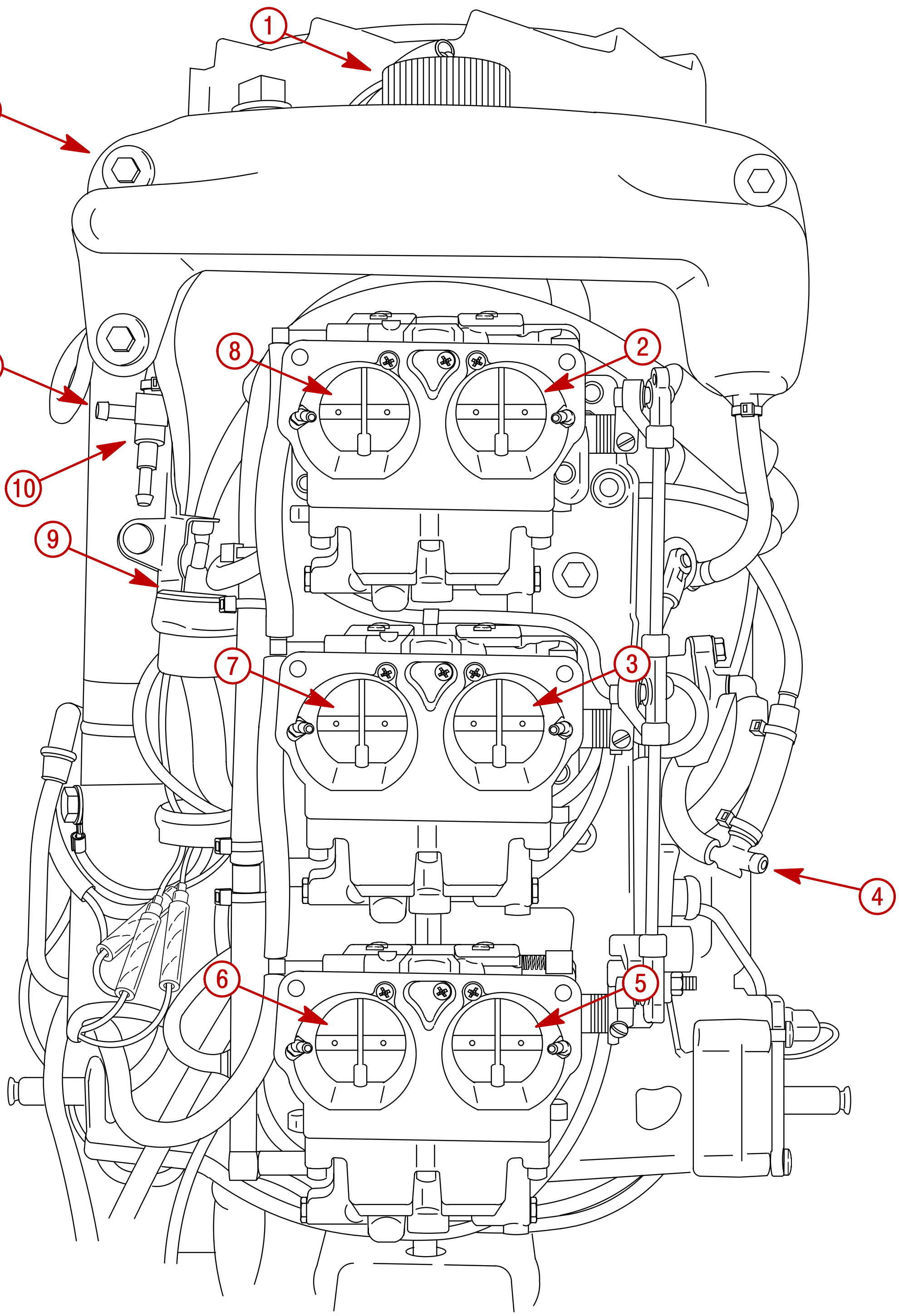
b. Drain any water from hose and reconnect.

c. If water was present in hose, check for water in the remote oil tank. Drain tank if water is present.

15. 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.

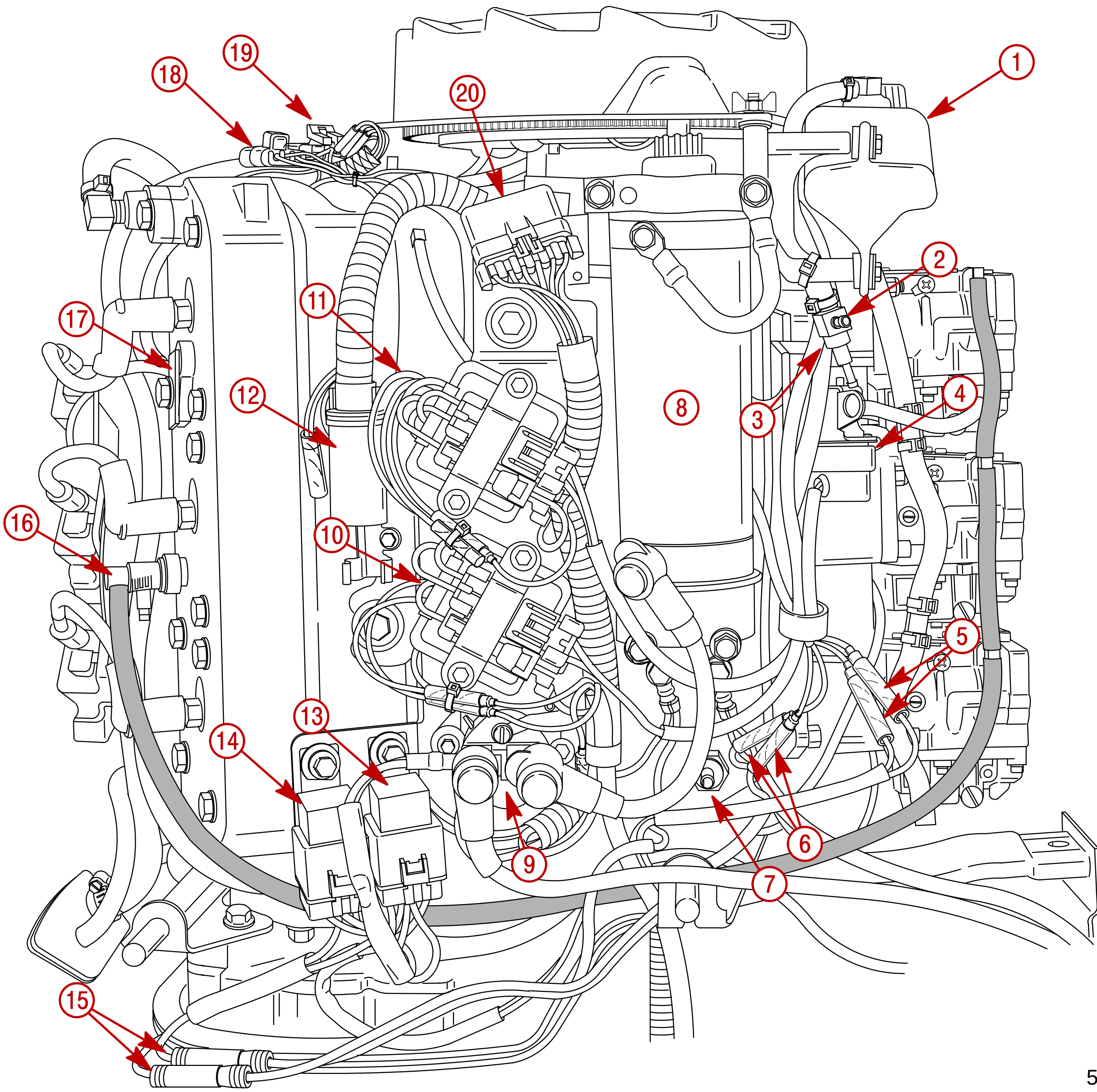
16. If engine fails to start, determine cause (fuel, electrical or mechanical). Engine should be run within 2 hours after recovery of outboard from water, or serious internal damage may occur. If unable to start engine in this period, disassemble engine and clean all parts. Apply oil as soon as possible.

Model 135/150/200 Powerhead Front View



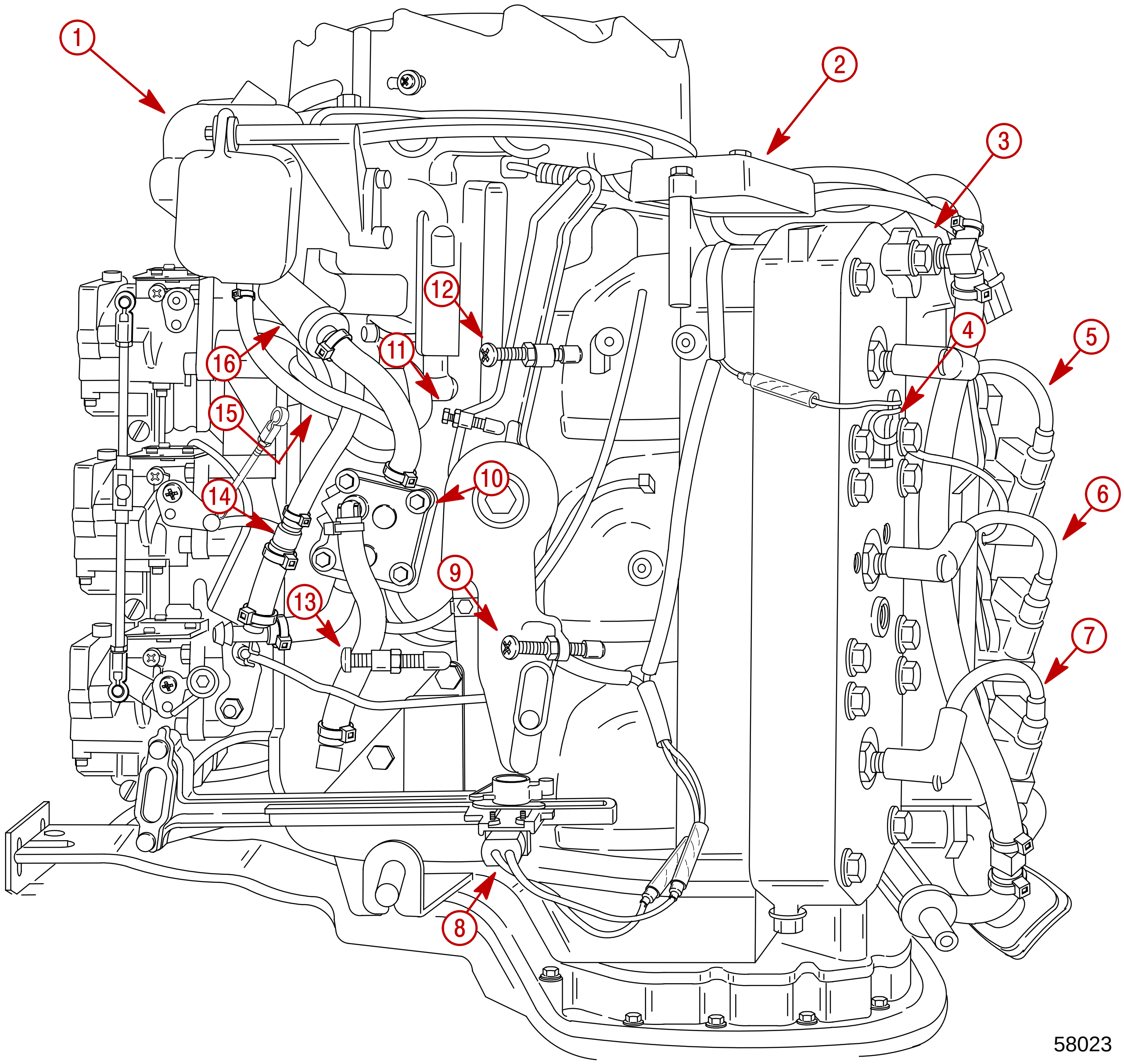
1 - Oil Fill Cap/Low Oil Sensor
2 - #1 Cylinder Carb Throat
3 - #3 Cylinder Carb Throat
4 - Remote Fuel Tank Hose Fitting
5 - #5 Cylinder Carb Throat
6 - #6 Cylinder Carb Throat
7 - #4 Cylinder Carb Throat
8 - #2 Cylinder Carb Throat
9 - Fuel Enrichment Solenoid
10 - Vent 2 psi Check Valve
11 - Remote Oil Tank Hose Fitting
12 - Oil Reservoir [0.94 qt. (0.89 Liter)]

Model 135/150/200 Powerhead Starboard View



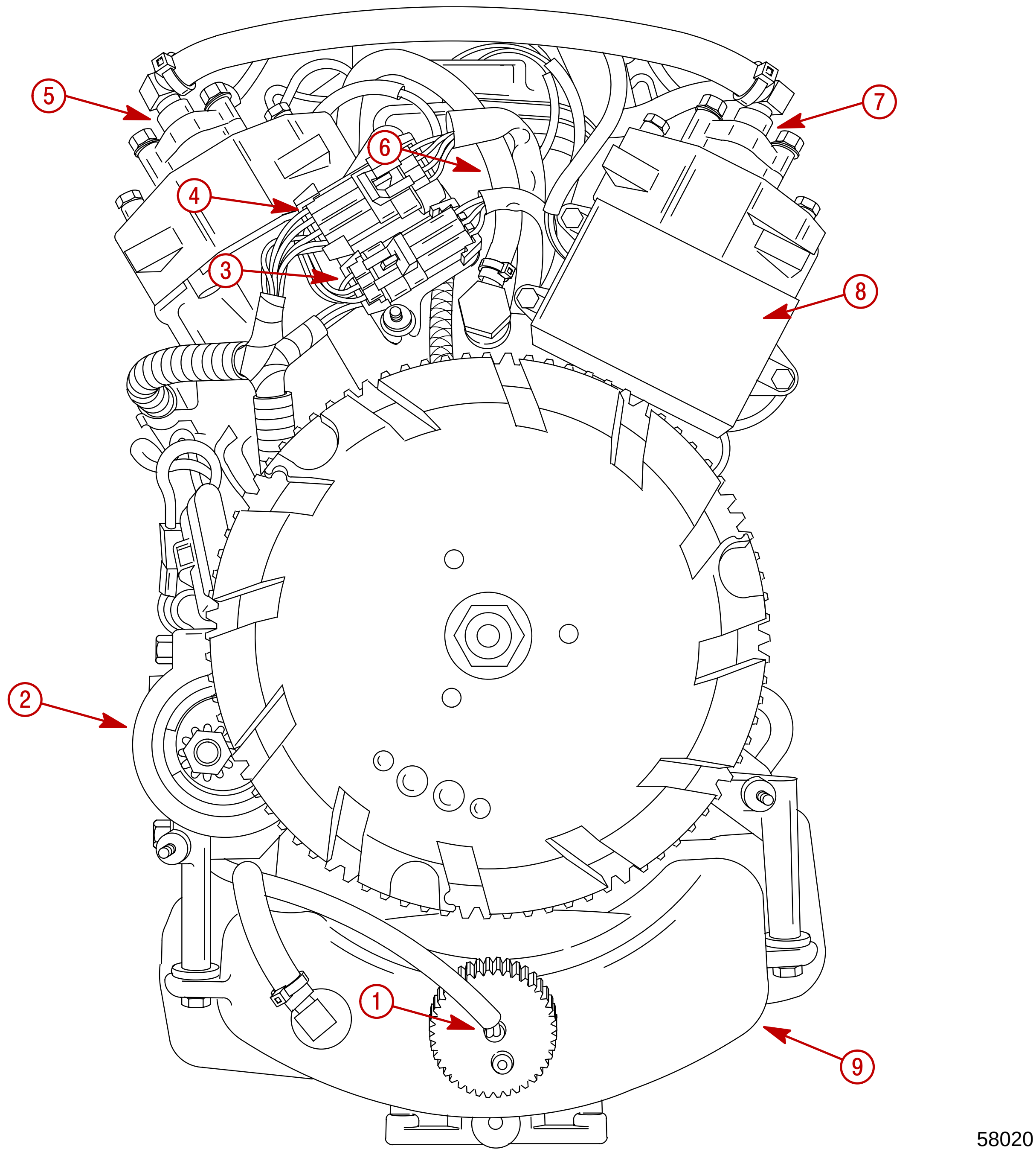
1 - Oil Reservoir
2 - Remote Oil Tank Hose Fitting
3 - Vent 2 psi Check Valve
4 - Fuel Enrichment Valve
5 - Low Oil Sensor Connectors
6 - Fuel Enrichment Valve Connectors
7 - Remote Oil Tank Pressure Check Valve
8 - Starter Motor
9 - Starter Solenoid
10 - Voltage Regulator
11 - Voltage Regulator
12 - Engine Harness Connector
13 - Trim UP Relay
14 - Trim DOWN Relay
15 - Power Trim Pump Connectors
16 - Thermal Air Valve
17 - Block Temperature Sensor
18 - Control Module Connector
19 - Trigger Connector
20 - 20 Ampere Fuses (3)

Model 135/150/200 Powerhead Port View



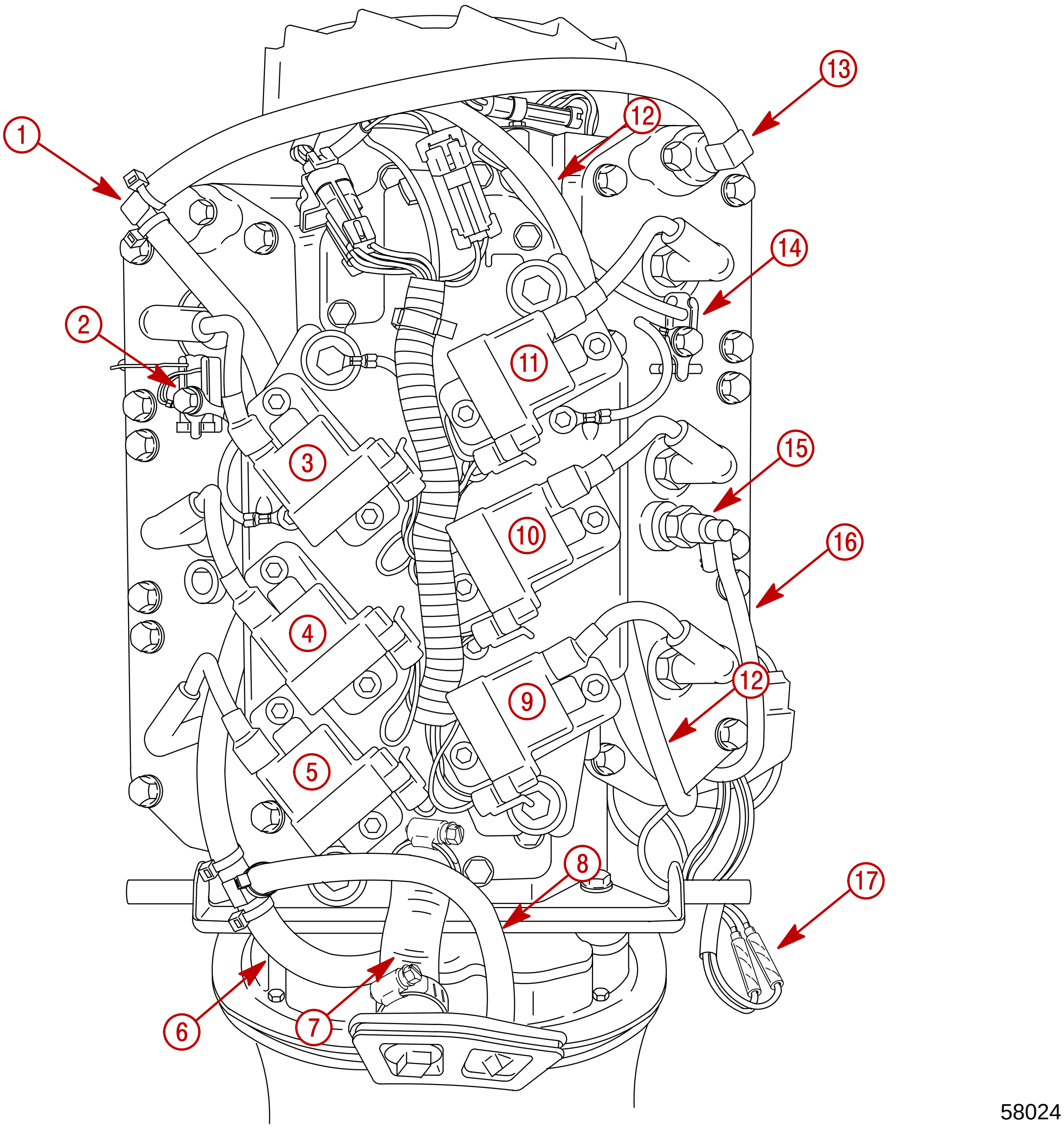
1 - Oil Reservoir
2 - Control Module
3 - Thermostat 143° F (61.7° C)
4 - Temperature Sensor
5 - #2 CDM
6 - #4 CDM
7 - #6 CDM
8 - Shift Interrupt Switch
9 - Idle Stop Screw
10 - Pulse Fuel Pump
11 - Primary Pick-up Screw
12 - Maximum Timing Screw
13 - Wide Open Throttle Stop Screw
14 - 2 psi Check Valve
15 - Oil Pump
16 - Fuel Filter

Model 135/150/200 Powerhead Top View



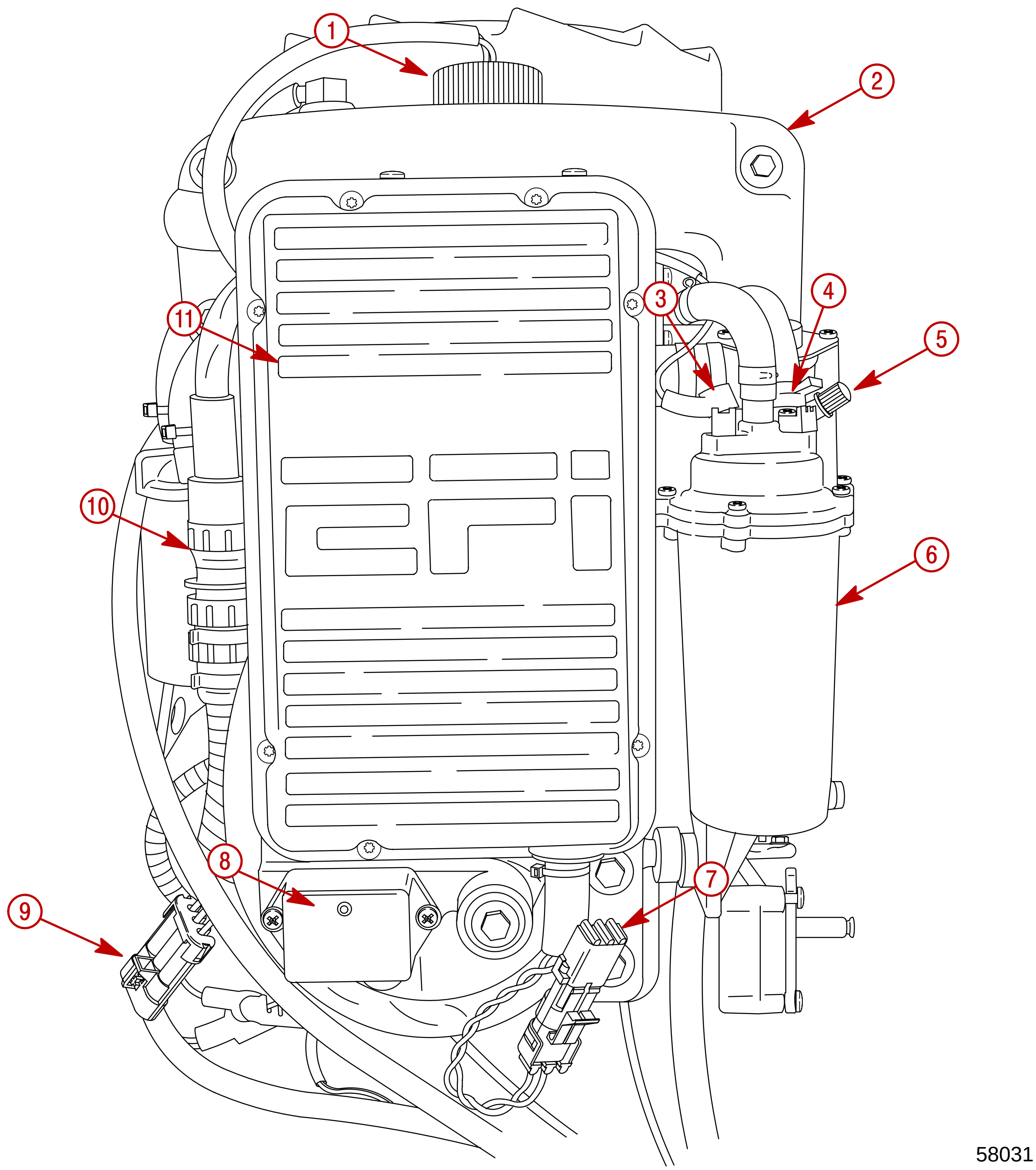
1 - Low Oil Sensor
2 - Starter Motor
3 - Trigger Harness Connector
4 - Control Module Harness Connector
5 - Starboard Thermostat (143°F (61.7°C)
6 - Water By-Pass Hose
7 - Port Thermostat (143°F (61.7°C)
8 - Control Module (RPM Limiter, Bias Control,Shift Stabilizer, Idle Stabilizer, and Low Oil Warning
9 - Oil Reservoir [0.94 qt. (0.89 Liter)]

Model 135/150/200 Powerhead Aft View



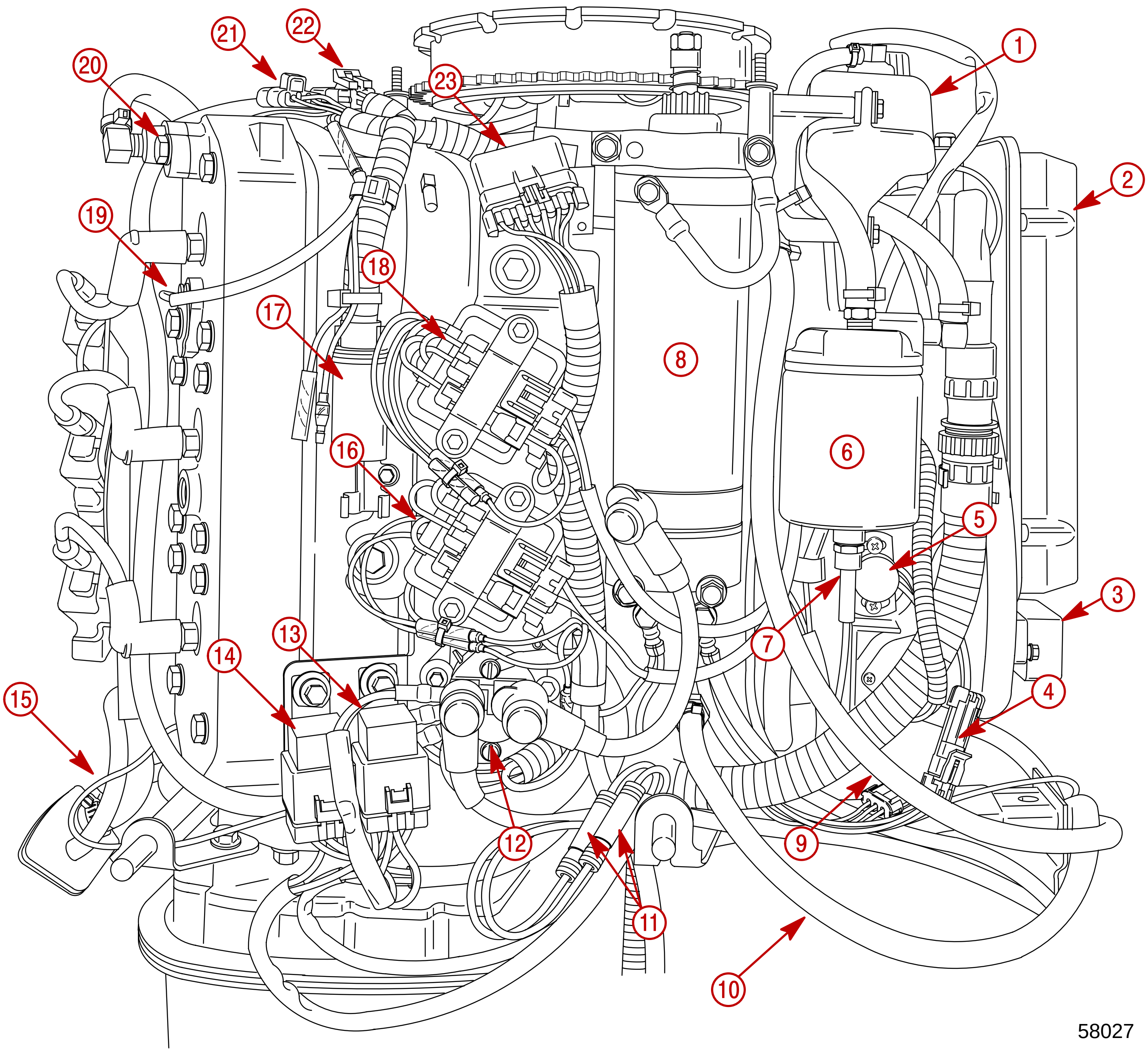
1 - Port Thermostat [143°F (61.7°C)]
2 - Temperature Sensor (Temperature Gauge)
3 - #2 CDM
4 - #4 CDM
5 - #6 CDM
6 - Thermostat Outlet Hose to Adaptor Plate
7 - Cylinder Block Flush Hose
8 - Tell–Tale Hose
9 - #5 CDM
10 - #3 CDM
11 - #1 CDM
12 - Water By-Pass Hose to Poppet Valve Cover
13 - Starboard Thermostat [143°F (61.7°C)]
14 - Temperature Sensor (Engine Overheat)
15 - Thermal Air Valve
16 - Thermal Air Hose to Carburetors
17 - Trim Motor Bullet Connectors

Model 150 XRI/175 XRI/200 XRI Powerhead Front View



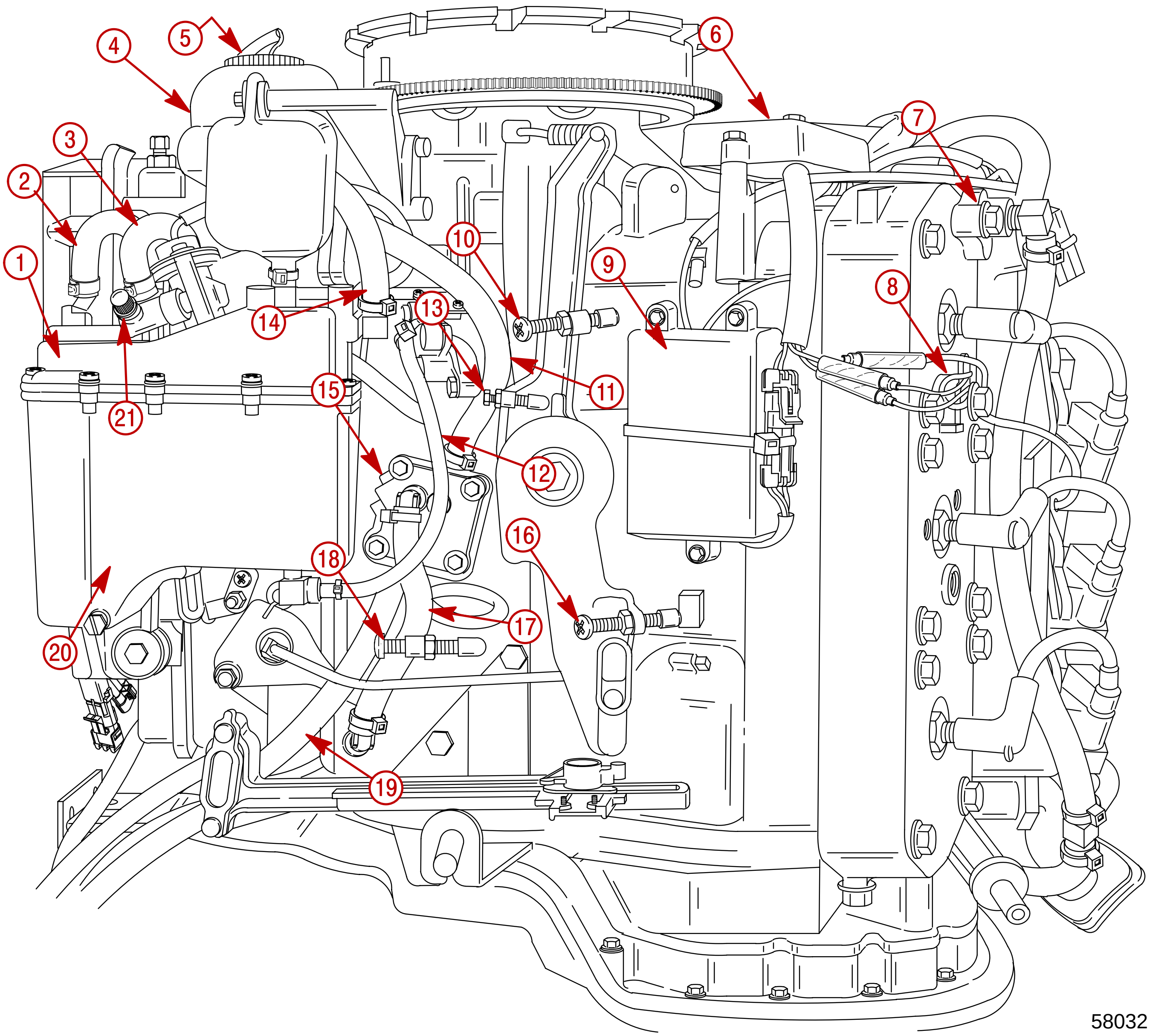
1 - Oil Fill Cap/Low Oil Sensor
2 - Oil Reservoir [0.94 qt. (0.89 Liter)]
3 - Positive (+) Terminal
4 - Negative (–) Terminal
5 - Shrader Valve
6 - Vapor Separator Tank (VST)
7 - Digital Diagnostic Terminal (DDT) Connector
8 - Water Sensor Module
9 - Throttle Position Indicator (TPI) Connector
10 - Electronic Control Module (ECM) Connector
11 - Electronic Control Module

Model 150 XRI/175 XRI/200 XRI Powerhead Starboard View



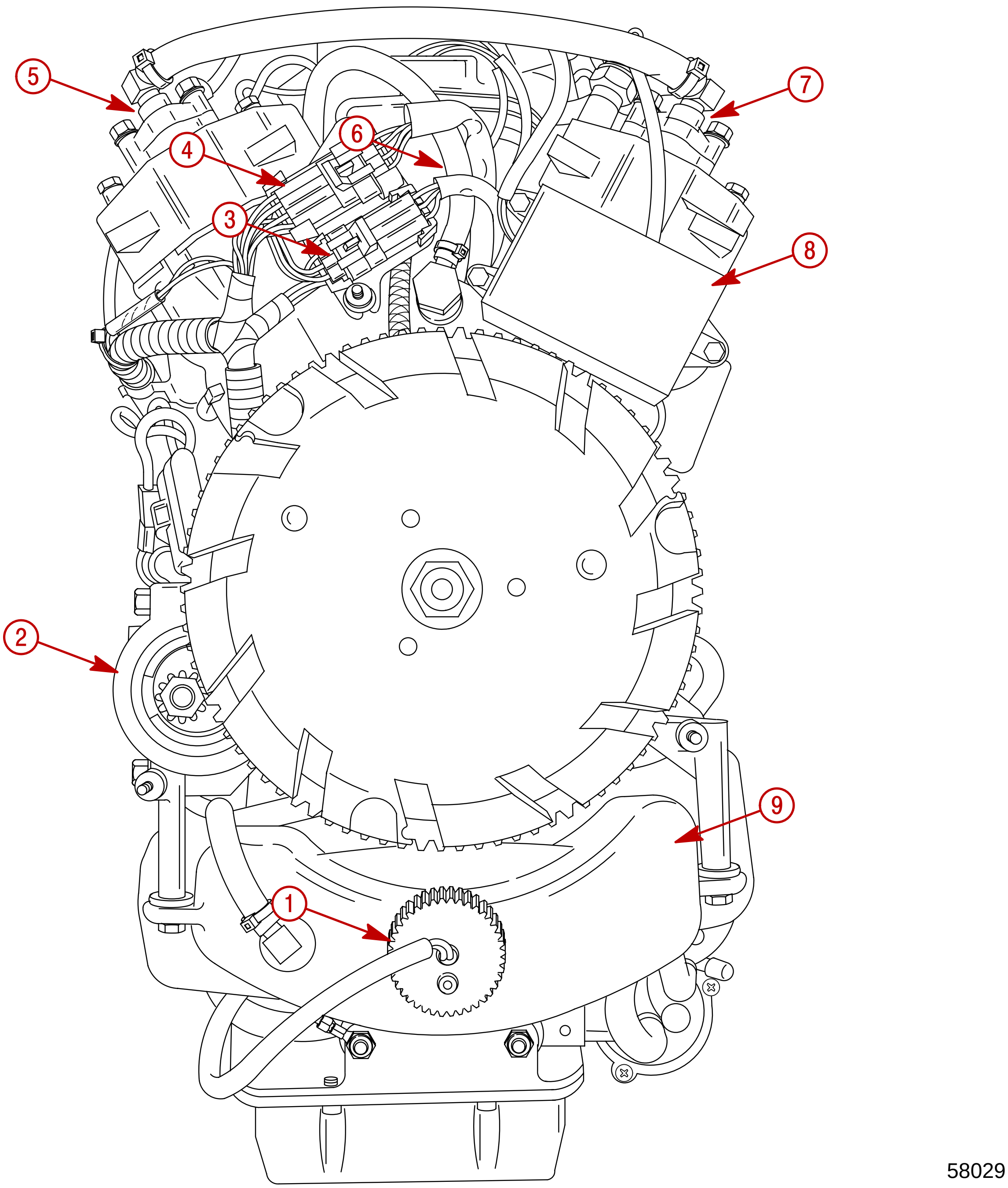
1 - Oil Reservoir [0.94 qt. (0.89 Liter)]
2 - Electronic Control Module
3 - Water Sensor Module
4 - Throttle Position Indicator (TPI) Connector
5 - Throttle Position Indicator (TPI)
6 - Fuel/Water Separator Filter
7 - Water Sensor Probe
8 - Starter Motor
9 - Oil Supply Hose to Oil Reservoir
10 - Remote Oil Tank Pressure Hose
11 - Trim Motor Bullet Connectors
12 - Starter Solenoid
13 - Trim UP Relay
14 - Trim DOWN Relay
15 - Water Pressure Gauge Hose
16 - Voltage Regulator
17 - Engine Harness Connector
18 - Voltage Regulator
19 - Temperature Sensor (Engine Overheat)
20 - Starboard Thermostat [143°F (61.7°C)]
21 - Control Module Harness Connector
22 - Trigger Harness Connector
23 - 20 Ampere Fuses (3)

Model 150 XRI/175 XRI/200 XRI Powerhead Port View



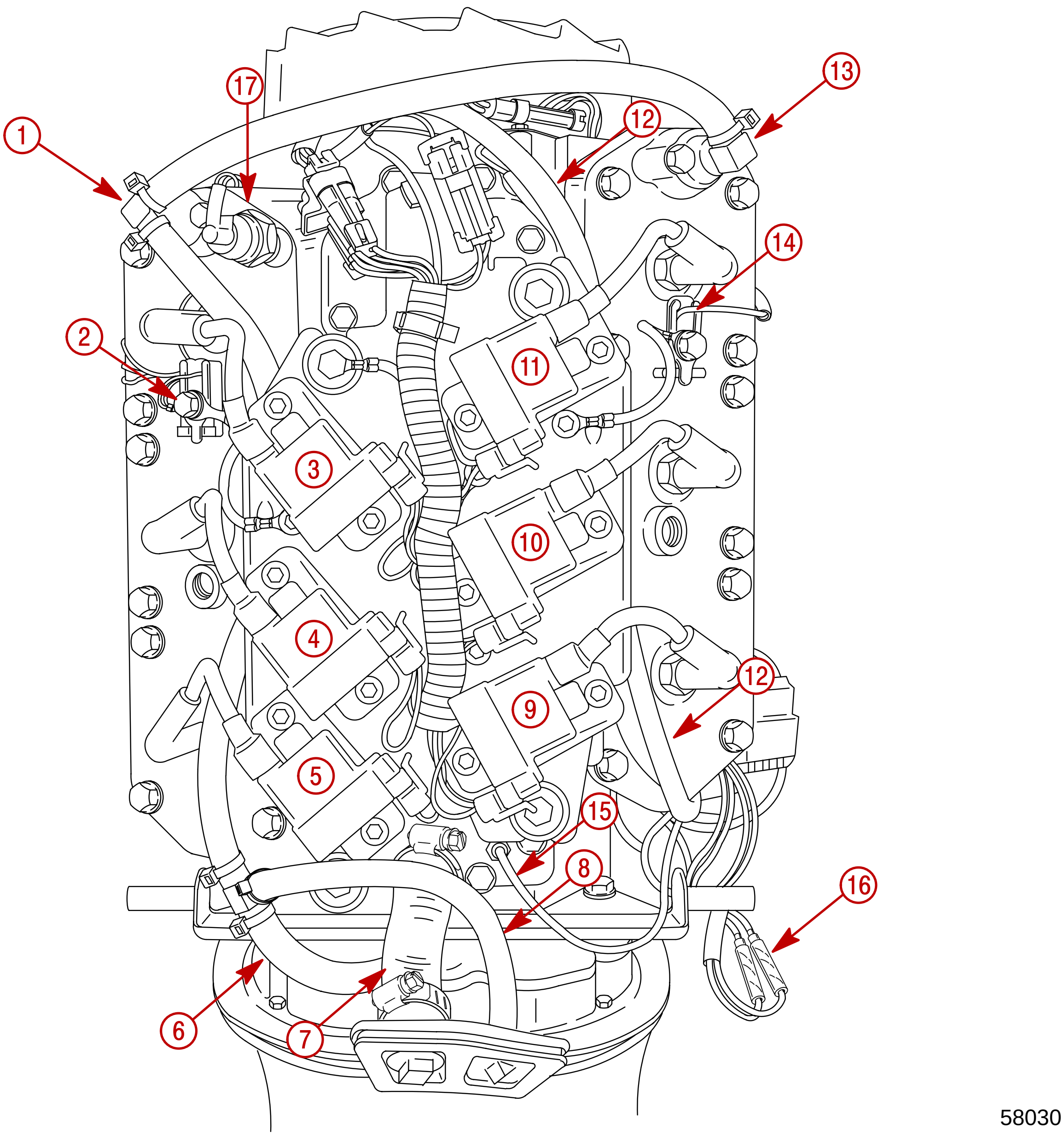
1 - Electric Fuel Pump (inside Vapor Separator)
2 - Fuel Out to Fuel Rail
3 - Fuel Return from Fuel Rail
4 - Oil Reservoir [0.94 qt. (0.89 Liter)]
5 - Low Oil Sensor
6 - Control Module (RPM Limiter, Bias Control,Shift Stabilizer, Idle Stabilizer, Injector Timing Signal and Low Oil Warning
7 - Port Thermostat [143°F (61.7°C)]
8 - Temperature Sensor (Temperature Gauge)
9 - Detonation Sensor
10 - Maximum Spark Advance Screw
11 - Fuel Outlet to Fuel /Water Separator
12 - Oil Output Hose to Vapor Separator (VST)
13 - Primary Pickup Screw
14 - Fuel Inlet from Fuel/Water Separator to VST
15 - Pulse Fuel Pump
16 - Idle Stop Screw
17 - Pulse Pump Vacuum Hose
18 - Wide Open Throttle Stop Screw
19 - Fuel Inlet Hose to Pulse Pump
20 - Vapor Separator Tank (VST)
21 - Schrader Valve

Model 150 XRI/175 XRI/200 XRI Powerhead Top View



1 - Oil Cap/Low Oil Sensor
2 - Starter Motor
3 - Trigger Harness Connector
4 - Control Module Harness Connector
5 - Starboard Thermostat (143°F (61.7°C)
6 - Water By-Pass Hose
7 - Port Thermostat (143°F (61.7°C)
8 - Control Module (RPM Limiter, Bias Control,Shift Stabilizer, Idle Stabilizer, Injector Timing Signal and Low Oil Warning
9 - Oil Reservoir [0.94 qt. (0.89 Liter)]

Model 150 XRI/175 XRI/200 XRI Powerhead Aft View



1 - Port Thermostat [143°F (61.7°C)]
2 - Temperature Sensor (Temperature Gauge)
3 - #2 CDM
4 - #4 CDM
5 - #6 CDM
6 - Thermostat Outlet Hose to Adaptor Plate
7 - Cylinder Block Flush Hose
8 - Tell–Tale Hose
9 - #5 CDM
10 - #3 CDM
11 - #1 CDM
12 - Water By-Pass Hose to Poppet Valve Cover
13 - Starboard Thermostat [143°F (61.7°C)]
14 - Temperature Sensor (Engine Overheat)
15 - Water Pressure Gauge Hose
16 - Trim Motor Bullet Connectors
17 - Detonation Sensor

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

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

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

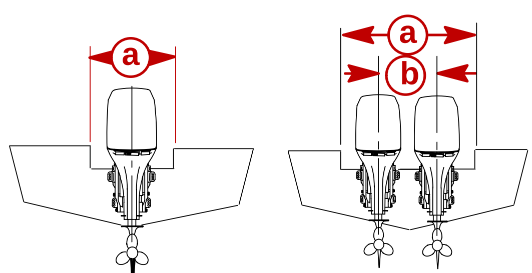
NOTE: *To remove any remaining bubbles, pierce the decal at one end of the bubble with stick pin and press out the entrapped air or wetting solution with your thumb (moving toward the puncture).*

IMPORTANT INFORMATION

Section 1D - Outboard Motor Installation

Table of Contents

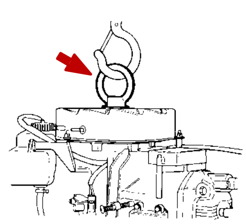
Installation Specifications



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

Lifting Outboard

Electric Start Models – Remove plastic cap from flywheel hub. Thread lifting ring into flywheel a minimum of 5 turns. Replace plastic cap after installation.



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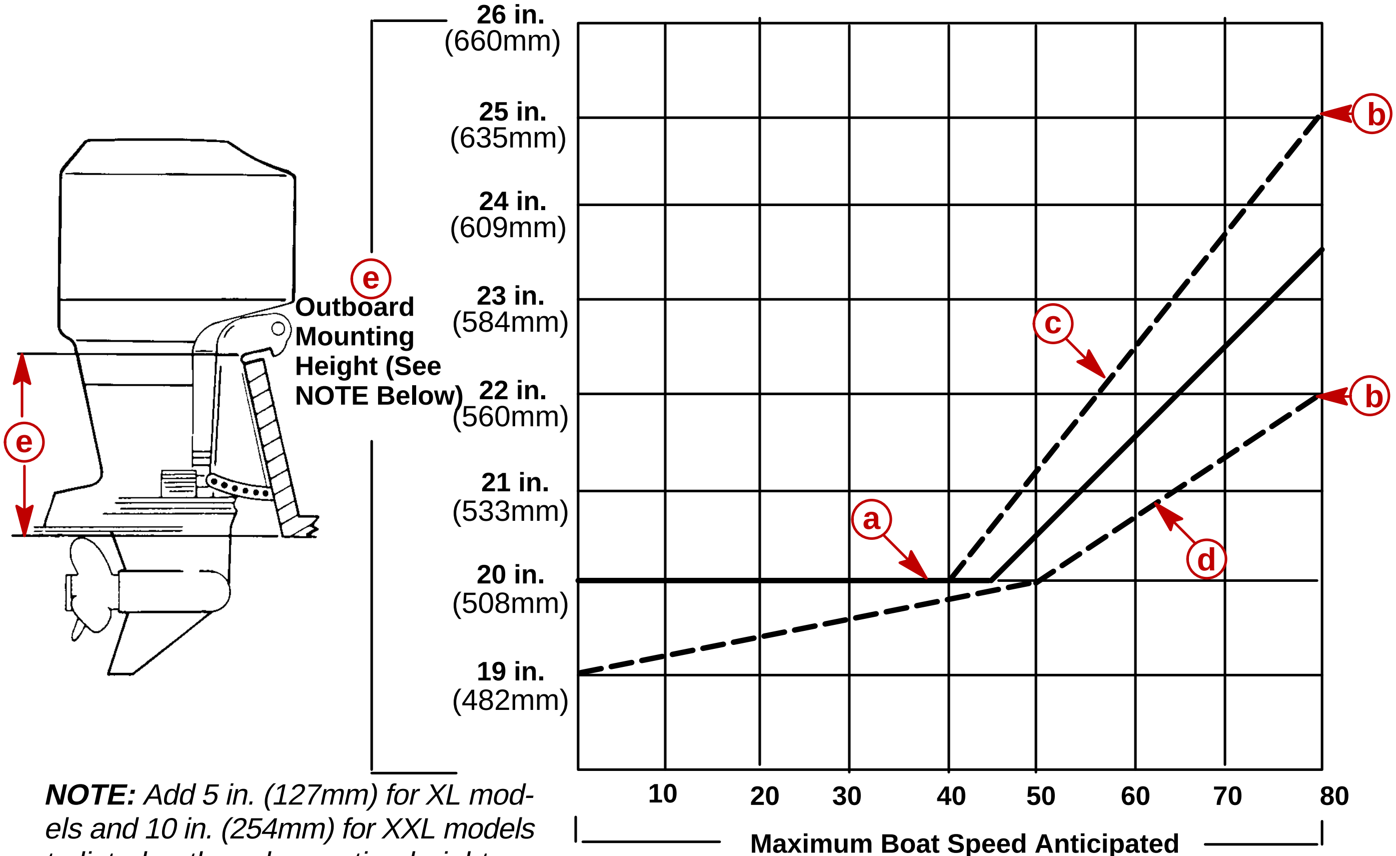
Installing Outboard to Boat Transom

Determining Recommended Outboard Mounting Height



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

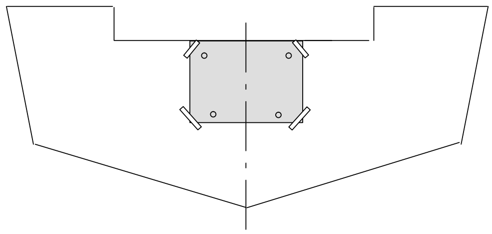
NOTICE TO INSTALLER:

1. The outboard should be mounted high enough on the transom so that the exhaust relief hole will stay at least 1 in. (25.4 mm) above the water line when the engine is running at idle speed. This will prevent exhaust restriction.
2. The mounting height (e) of the outboard must not exceed 25 in. (635 mm) for L models, 30 in. (762 mm) for XL models and 35 in. (889 mm) for XXL models. Mounting the outboard higher may cause damage to the gear case components.
   a. This solid line is recommended to determine the outboard mounting height. 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 designed for surfacing operation is usually preferred.

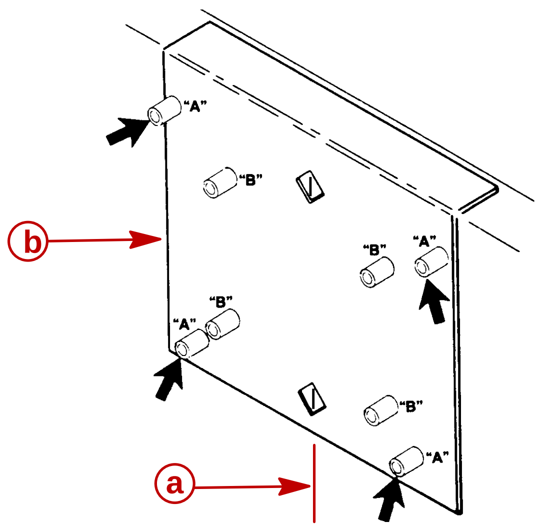
Installing Outboard

Drilling Outboard Mounting Holes

1. Attach (tape) engine mounting template (located with the installation manual) to boat transom.

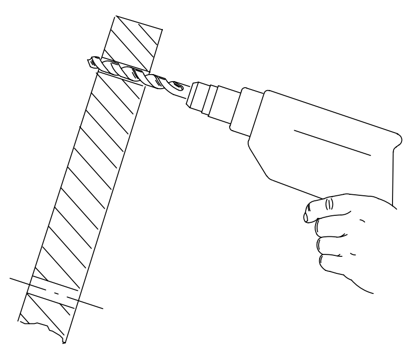


IMPORTANT: If using "Transom Drilling Fixture" (part number 91-98234A2), use drill guide holes marked "A" when drilling outboard mounting holes.



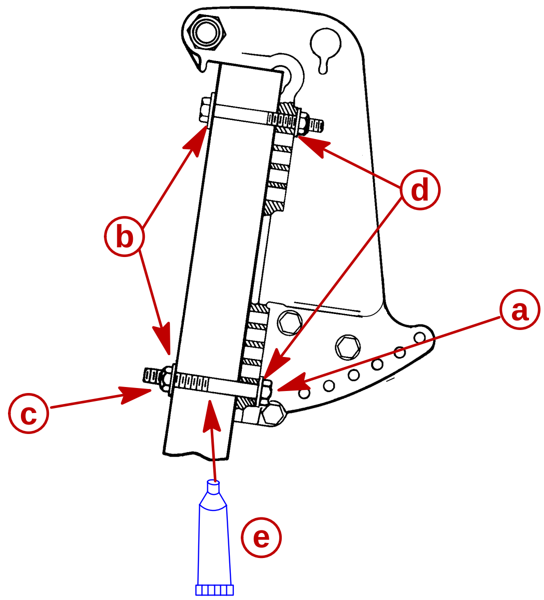
a - Centerline of Transom
b - Transom Drilling Fixture (91-98234A2)

2. Mark and drill four 17/32 in. (13.5mm) mounting holes.



Securing Outboard To Boat Transom

1. Refer to “Determining Recommended Outboard Motor Mounting Height”, preceding and Install outboard to the nearest recommended mounting height.
2. Fasten outboard with provided mounting hardware shown.

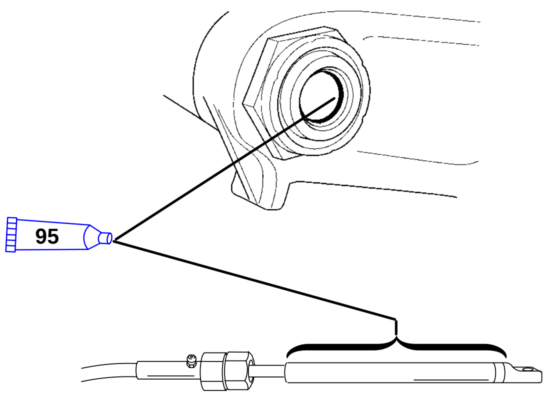


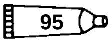
a - 1/2 in. Diameter Bolts (4)
b - Flat Washers(4)
c - Locknuts (4)
d - Flat Washers(4)
e - Marine Sealer - Apply to Shanks of Bolts, Not Threads

Steering Cable

STARBOARD SIDE ROUTED CABLE

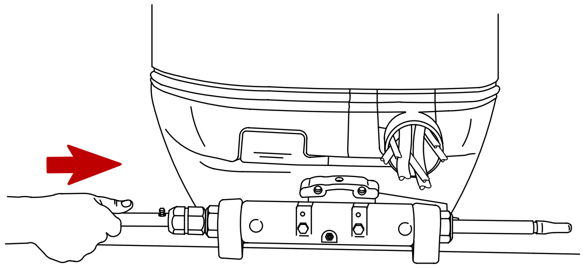
1. Lubricate O-ring seal and entire cable end.





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

2. Insert steering cable into tilt tube.



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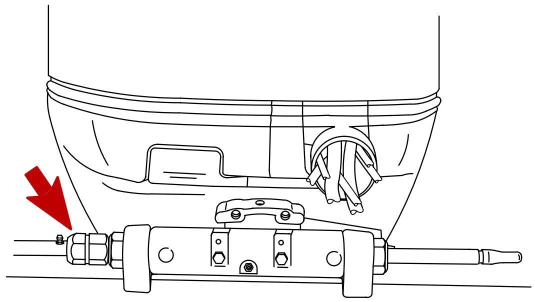
3. Torque nut to 35 lb. ft. (47.5 N·m).



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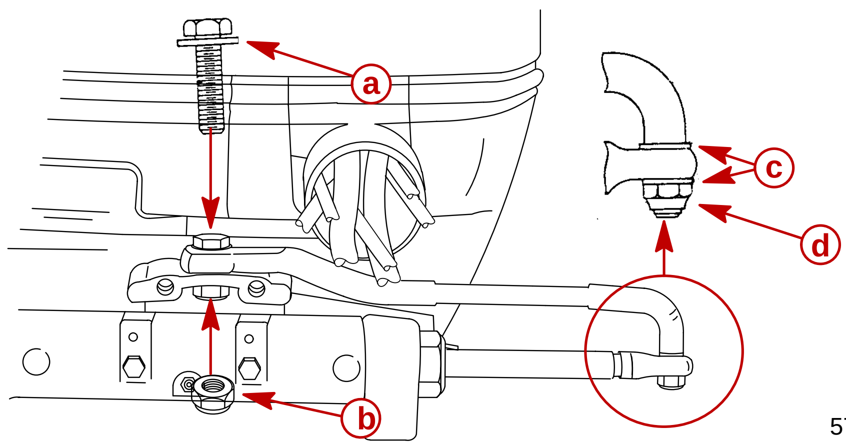
Steering Link Rod

1. Install steering link rod per illustration.



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a - Special Bolt (10-90041) Torque to 20 lb-ft (27 N·m)
b - Nylon Insert Locknut (11-34863) Torque to 20 lb-ft (27 N·m)
c - Flat Washer (2)
d - Nylon Insert Locknut (11-34863) Tighten Locknut Until it Seats, Then Back Nut Off 1/4 Turn

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

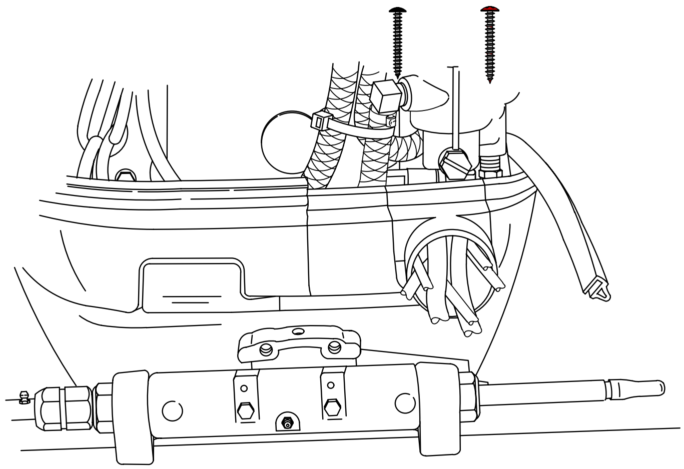
Disengagement of a steering link rod can result in the boat taking a full, sudden, sharp turn. This potentially violent action can cause occupants to be thrown overboard exposing them to serious injury or death.

Electrical, Hoses and Control Cables

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

Open the front clamp assembly.



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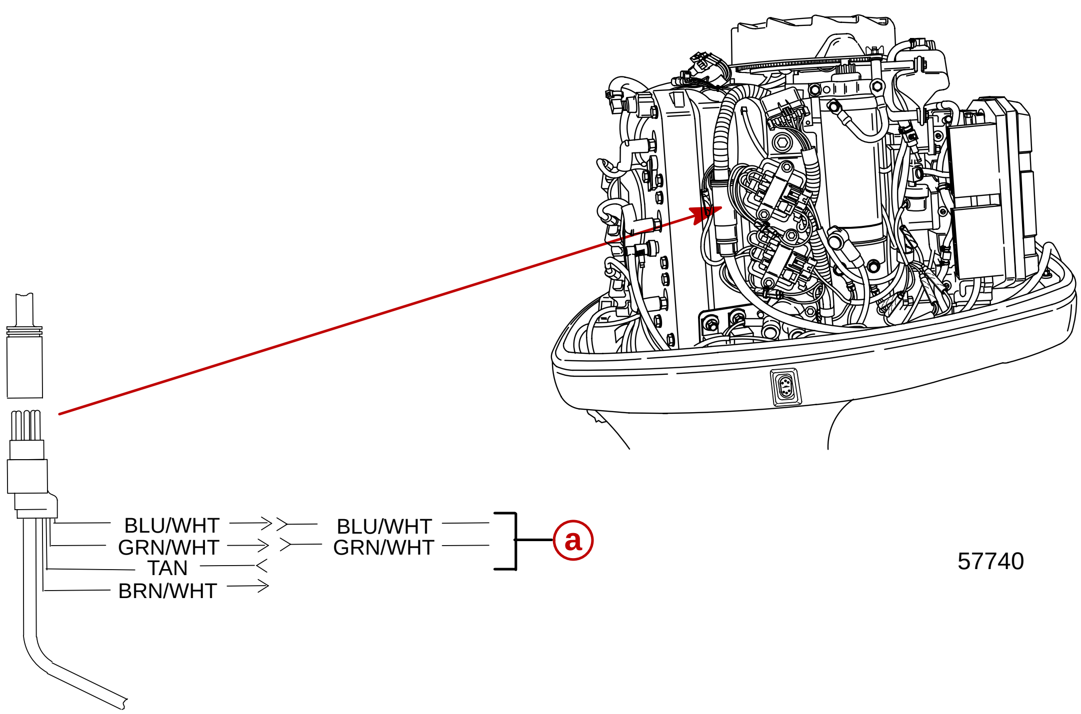
Remote Wiring Harness

1. Connect wiring. Place harness into the holder.



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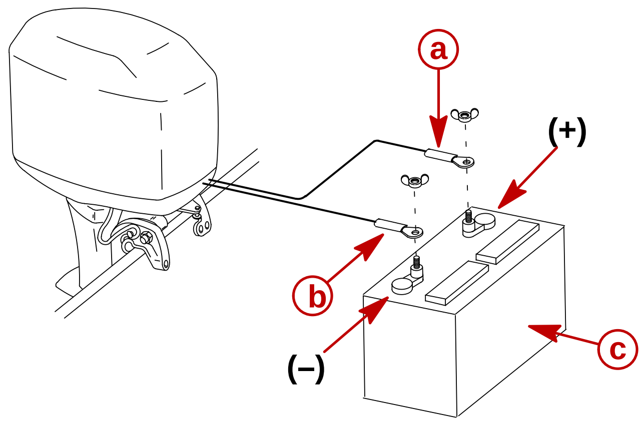
a - Power Trim Connections

Battery Cables

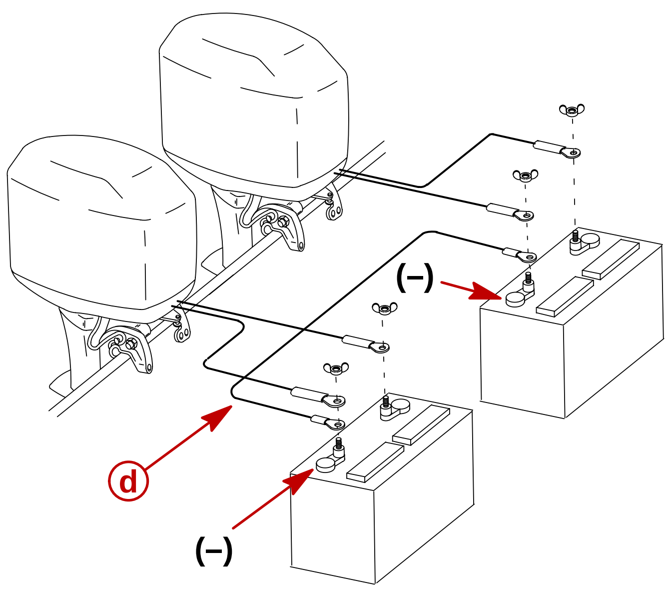
SINGLE OUTBOARD



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 - Common Ground Cable

Fuel Hose Connection

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.

Fasten remote fuel hose to fitting with hose clamp.

Oil Hose Connections

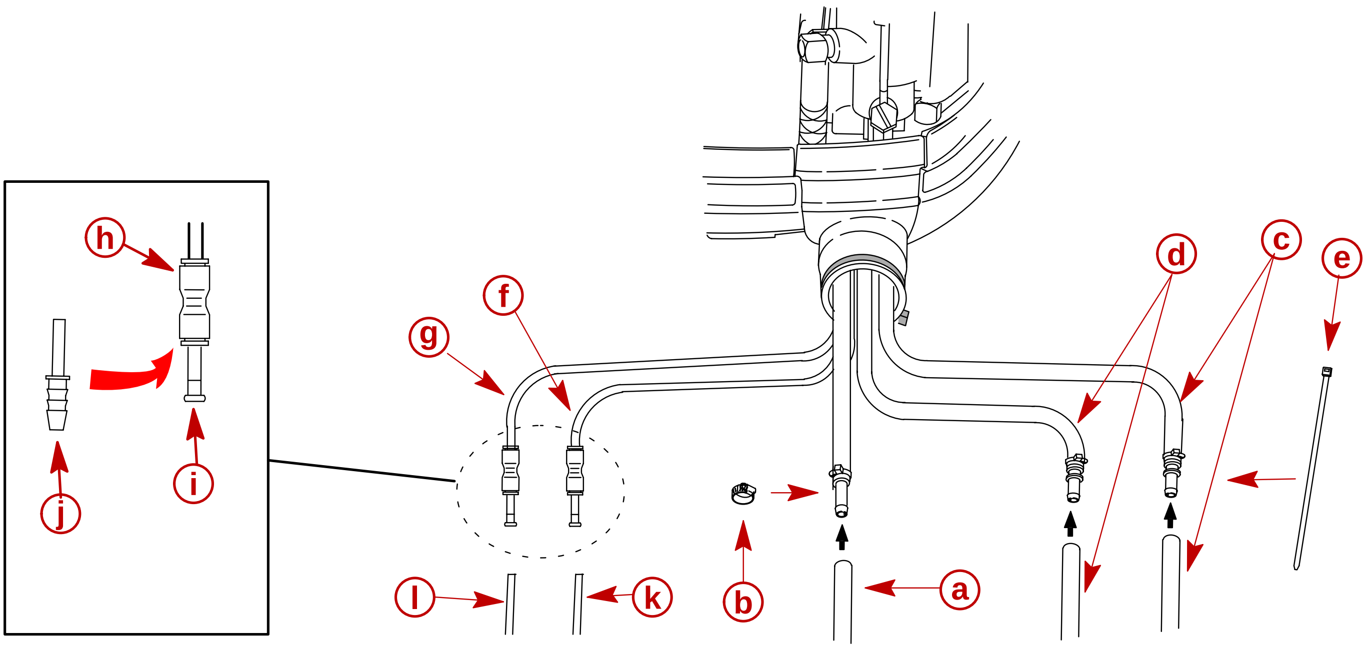
Connect the remote oil hoses to the engine hose connections as shown. Fasten hose connections with sta-straps.

Speedometer Tubing Connection

This outboard has a speedometer water pick-up located in the leading edge of the gear case. If you want to use this water pickup for the speedometer, connect the water tubing as shown.

Water Pressure Tubing Connection

If the boat is equipped with a water pressure gauge, make the water connection to this tubing as shown.



a - Remote Fuel Hose
b - Hose Clamp – Secure Remote Fuel Hose
c - Oil Hoses with Blue Stripe - Secure With Sta-Strap
d - Oil Hoses without Blue Stripe - Secure With Sta-Strap
e - Sta-Strap (2) - Secure Oil Hoses
f - Speedometer Water Pickup Tubing (Black Color)
g - Water Pressure Tubing (Gray Color)
h - Coupler – Push In on End of Coupler to Disconnect Plug or Tubing
i - Plug – Remove when Making Coupler Connection
j - Barb Hose Fitting (2) Provided with Outboard – Install this fitting into Coupler, if a Rubber Hose Connection is Required
k - Speedometer Hose – Insert the barb hose fitting (j) into Coupler and Connect Hose
l - Water Pressure Tube – Insert into coupler, pull on tube to verify that it is locked

Shift Cable

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.

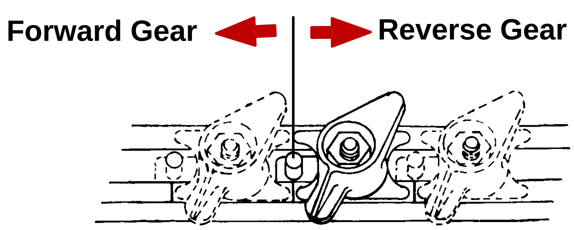
The Quicksilver Dual Engine Console Mount Control, P/N 88688A22 or 88688A52, is required to shift the counter rotation outboard. The installation instructions shipped with the control explain the procedure required to connect this control to a counter rotation outboard.

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.

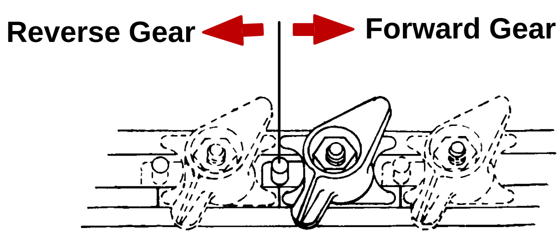
OUTBOARD SHIFTING DIRECTION

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

STANDARD ROTATION GEAR OUTBOARDS



COUNTER ROTATION OUTBOARDS



Installation

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

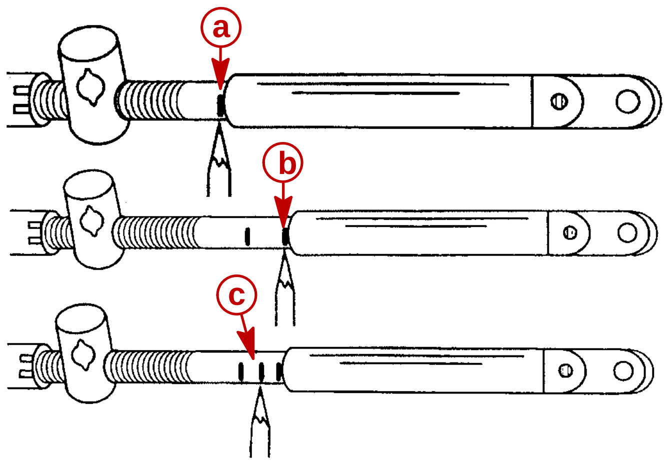
1. Locate the center point of the slack or lost motion that exists in the shift cable as follows:

   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.

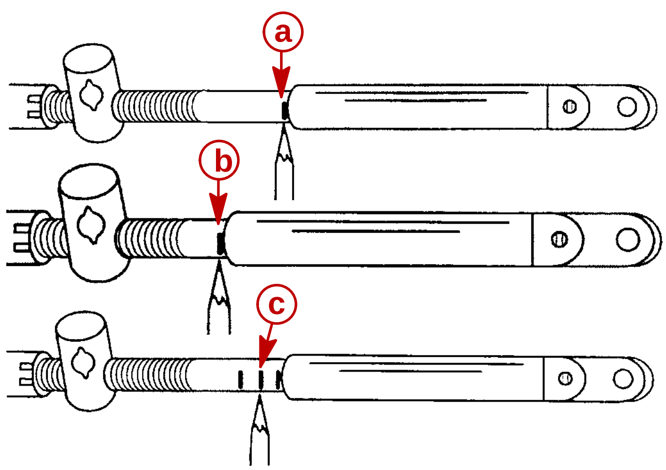
   b. Move the remote control handle from neutral into reverse and advance the handle to full speed position. Slowly return the handle back to the neutral. Place a mark (b) on the cable against the cable end guide.

   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.

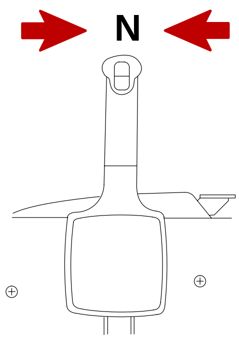
STANDARD ROTATION OUTBOARDS



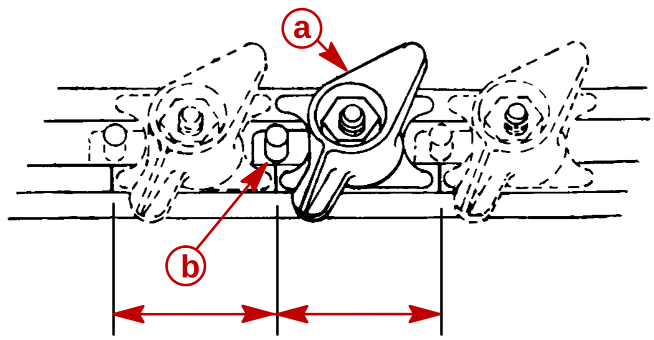
COUNTER ROTATION OUTBOARDS



2. Position remote control and outboard into neutral.

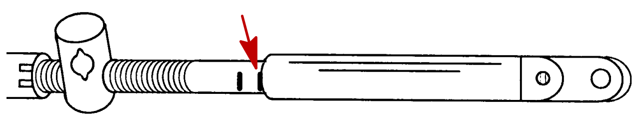


3. Slide the shift cable retainer forward until resistance is felt, then slide cable anchor toward rear until resistance is felt. Center the anchor pin between resistance points.



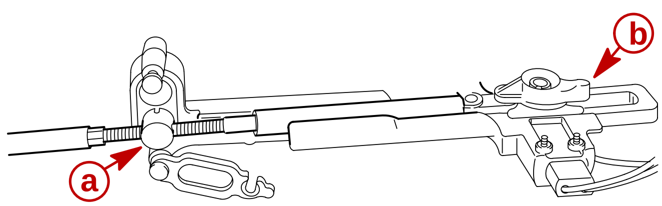
a - Shift Cable Retainer
b - Anchor Pin

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. Secure shift cable with shift cable retainer.



a - Cable Barrel
b - Shift Cable Retainer

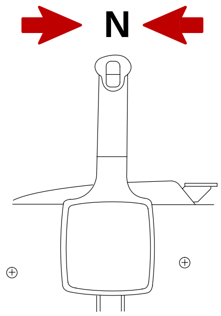
7. Check shift cable adjustments as follows:
   a. With remote control in forward, the propshaft should lock solidly in gear. If it does not, adjust cable barrel closer to cable end guide.
   b. Shift remote control into neutral. The propshaft should turn freely without drag. If not, adjust barrel away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

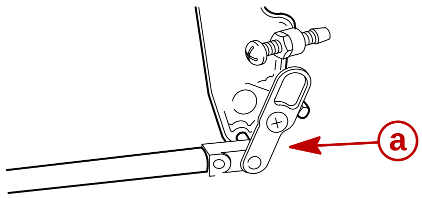
Throttle Cable

INSTALLATION

1. Position remote control into neutral.



2. Attach throttle cable to the throttle lever. Secure with washer and locknut.



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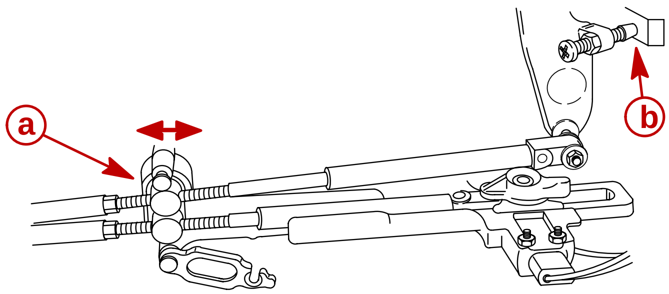
a - Latch

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



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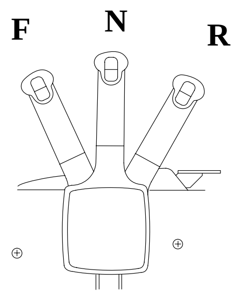
a - Cable Barrel – Adjust To Hold Idle Stop Screw Against Stop
b - Idle Stop Screw

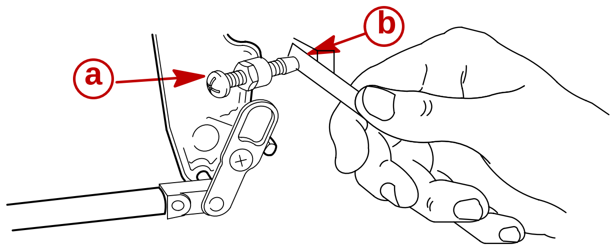
4. Check throttle cable adjustment as follows:

   a. Shift outboard into gear a few times to activate the throttle linkage. Make sure to rotate the propeller shaft while shifting into reverse.



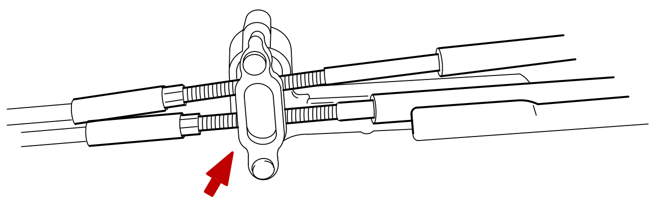
b. Return remote control to neutral. Place a thin piece of paper between idle adjustment screw and idle stop. Adjustment is correct when the paper can be removed without tearing, but has some drag on it. Readjust cable barrel if necessary.

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



a - Idle Stop Screw
b - Idle Stop

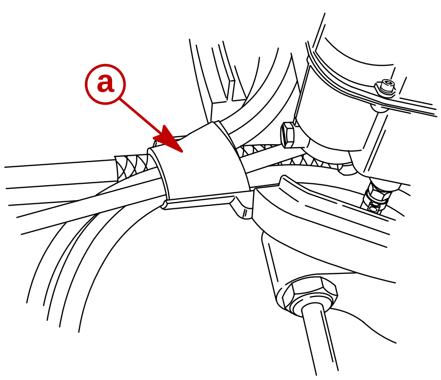
5. Lock the barrel holder in place with the cable latch.

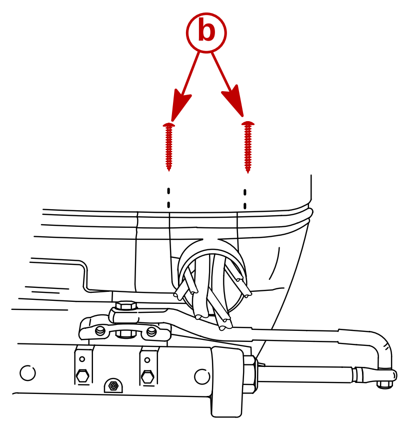


Front Clamp Reassembly

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

1. Place the neoprene wrap over the wiring, hoses, and control cables as shown.
2. Fasten clamp together with two screws.



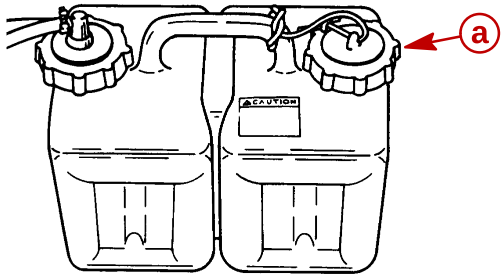


a - Neoprene Wrap
b - Screw (2)

Filling the Oil Injection System

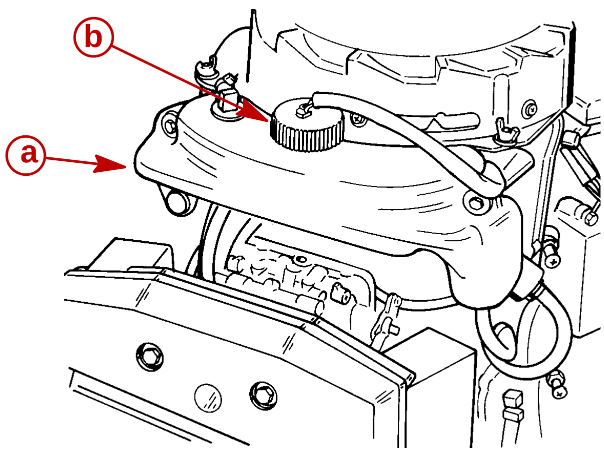
Filling

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



a - Fill Cap

2. Remove fill cap from the engine oil tank and fill the tank with oil. Reinstall the fill cap.
3. Loosen the fill cap on the engine oil tank.
4. 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 - Engine Oil Tank
b - Fill Cap

Bleeding Air from Oil Injection Pump and Oil Injection Outlet Hose

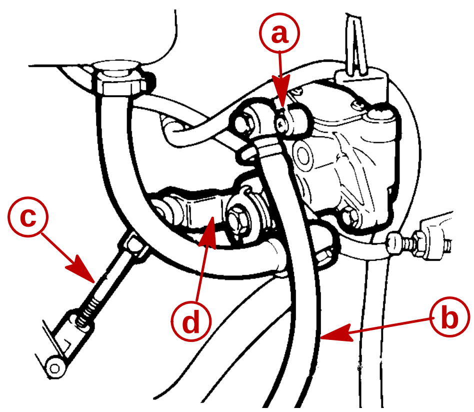
Bleeding Air from Oil Injection Pump

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

Bleeding Air from Oil Injection Outlet Hose

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

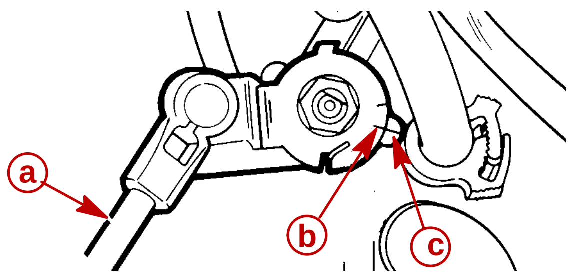
NOTE: *If air bubbles persist, they can be purged out of the hose by removing link rod and rotating the pump arm full clockwise while operating engine at 1000 to 1500 RPM: If necessary, gently pinch the fuel line between the remote fuel line connector and the oil injection pump "Tee" fitting. This will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



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

Adjusting the Oil Injection Pump

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



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

Trim In Stop Adjustment

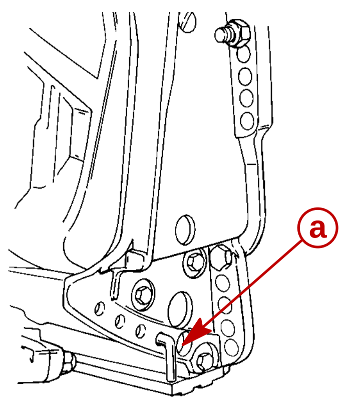
Some outboard boats, particularly some bass boats, are built with a greater than normal transom angle which will allow the outboard to be trimmed further “in” or “under”. This greater trim “under” capability is desirable to improve acceleration, reduce the angle and time spend in a bow high boat attitude 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.

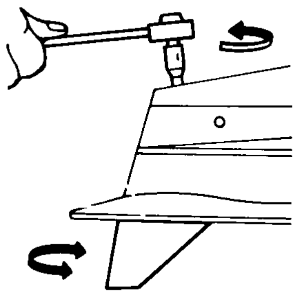
Models Without Power Steering

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 Nm) 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

Section 2A - Ignition

Table of Contents

Specifications

IGNITION SYSTEM	Type Spark Plug Type Spark Plug Gap	Capacitor Discharge NGK BPZ8HS-10 0.040 in. (1.0 mm)

CAPACITOR DISCHARGE MODULE				
Circuit Test	**Connect Negative (–) Meter Lead To:**	**Connect Positive (+) Meter Lead To:**	**Ohms Scale**	**Results:**
Stop Diode Forward Bias	Green (D) / or Green test harness lead	Black/Yellow (B) / or Black/Yellow test harness lead	R x 100 Diode Reading*	Continuity
Stop Diode Reverse Bias	Black/Yellow (B) / or Black/Yellow test harness lead	Green (D) / or Green test harness lead	R x 100 Diode Reading*	No Continuity
Return Ground Path Diode, Reverse Bias	Green (D) / or Green test harness lead	Ground Pin (A) or Black test harness lead	R x 100 Diode Reading*	No Continuity
Return Ground Path Diode, Forward Bias	Ground Pin (A) / or Black test harness lead	Green (D) / or Green test harness lead	R x 100 Diode Reading*	Continuity
CDM Trigger Input Resistance	Ground Pin (A) / or Black test harness lead	White (C) / or White test harness lead	R x 100	1000 - 1250 Ohms
Coil Secondary Impedance	Ground Pin (A) or Black test harness lead	Spark Plug Terminal (At Spark Plug Boot)	R x 100	900 - 1200 Ohms

*Diode Readings: Due to the differences in test meters, results other than specified may be obtained. In such a case, reverse meter leads and re-test. If test results then read as specified CDM is O.K. The diode measurements above will be opposite if using a Fluke equivalent multimeter.

Stator Output Test		400 DVA Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading @ Cranking to 2500 RPM**
Connect to Green Test Harness Lead	Connect to Black Test Harness Lead	160 - 320

CDM Trigger Input Test		2 DVA Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading @ Cranking**
White Test Harness Lead	Black Test Harness Lead	0.2 - 2.0

CDM Trigger Input Test		20 DVA Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading @ Idle to 2500 RPM**
White Test Harness Lead	Black Test Harness Lead	2 - 8 Volts

Bias Circuit Test (All Models Except 200 EFI)		40 DVA Scale @2500 RPM
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading**
Engine Ground	Black/White Shift Switch Wire	25 - 40 Volts

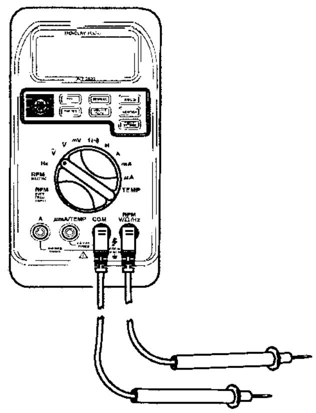
Bias Circuit Test (200 EFI)		40 DVA Scale @ 2500 RPM
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading**
Engine Ground	Disconnect 4 wire Detonation Control Module connector. Insert bent paper clip into Black/White terminal.	25 - 40 Volts

Trigger Assembly Test		
Test Leads to	**Resistance Ohms**	**Scale Reading**
Between Brown Trigger Lead and Yellow Trigger Lead	1100-1400	R x 100
Between White Trigger Lead and Red Trigger Lead	1100-1400	R x 100
Between Purple Trigger Lead and Blue Trigger Lead	1100-1400	R x 100

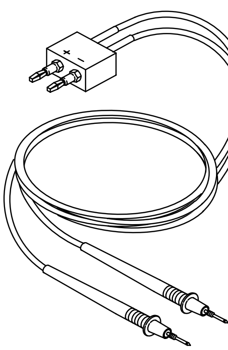
Stator Resistance Test		R x 1 Ohms Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	
Connect to White/Green stator lead	Connect to Green/White stator lead	380-430
Connect to White/Green stator lead	Connect to engine ground	No continuity
Connect to Green/White stator lead	Connect to engine ground	No continuity

Special Tools

1. DMT 2000 Digital Tachometer Multimeter 91-854009A1



2. DVA Adaptor 91-89045



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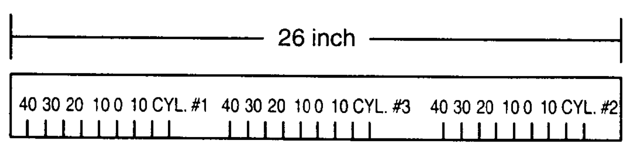
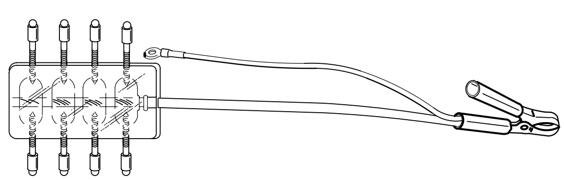
3. Cylinder Timing Decal 91-853883-1

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



4. Spark Gap Tester 91-850439



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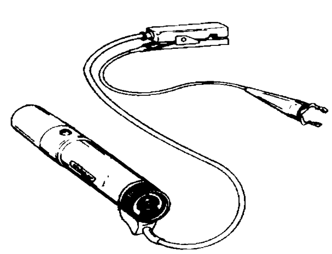
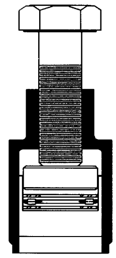
5. Timing Light 91-99379



6. Crank Shaft Protector Cap 91-24161

7. Flywheel Puller 91-849154T1



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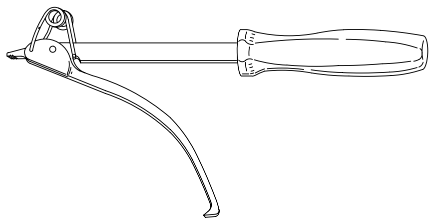
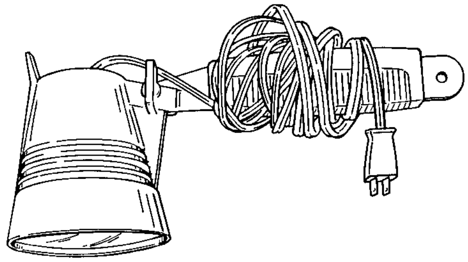
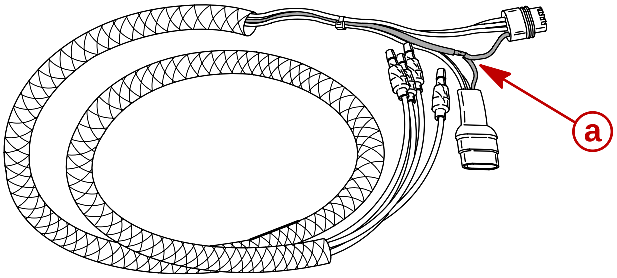
8. Flywheel Holder 91-52344



9. Heat Lamp 91-63209



10. CDM Test Harness 84-825207A2



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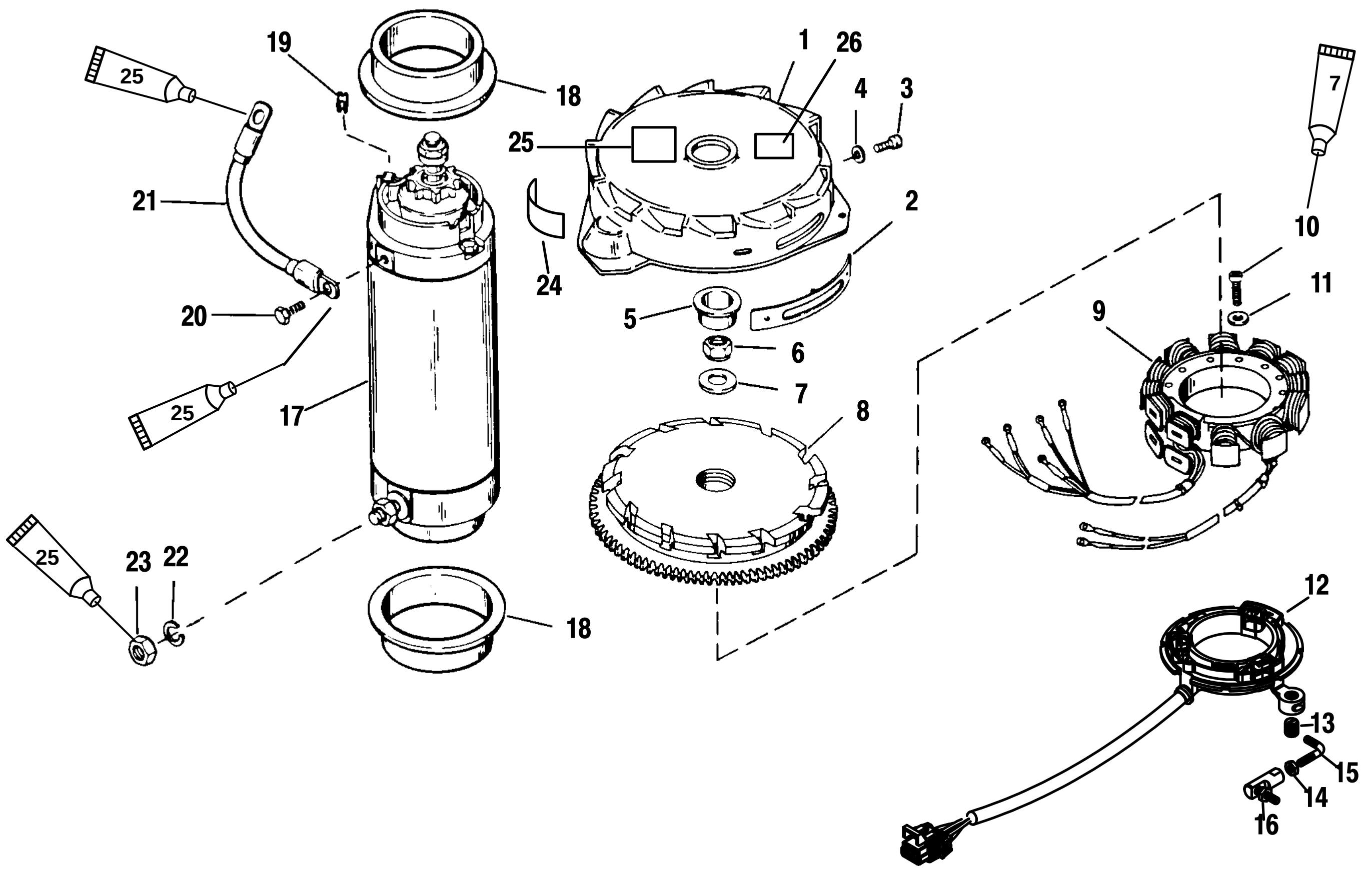
a - BLACK Ground Wires – Solder together. Prevents electrical interference while performing CDM checks with engine running.

Flywheel/Starter Motor



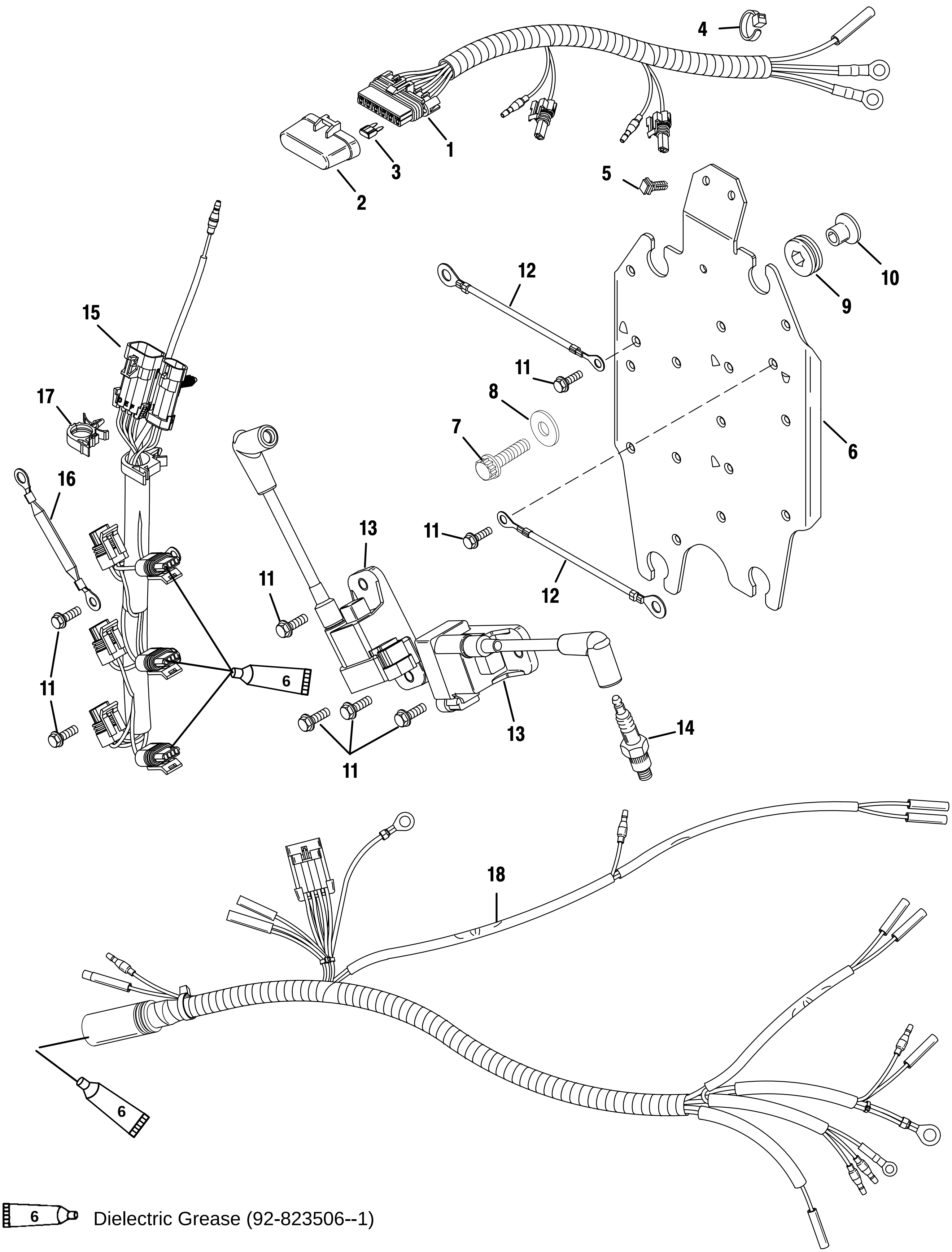
7 Loctite 271 (92-809820)

25 Liquid Neoprene (92-25711--2)

Flywheel/Starter Motor

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	FLYWHEEL COVER ASSEMBLY			
2	1	MARKER			
3	2	SCREW (3/16-32 x 3/8)			
4	2	WASHER			
5	1	PLUG			
6	1	NUT		120	163
7	1	WASHER			
8	1	FLYWHEEL			
9	1	STATOR			
10	5	SCREW (10-32 x 1-3/8)	50		5.5
11	5	WASHER			
12	1	TRIGGER PLATE ASSEMBLY			
13	1	PIVOT			
14	1	NUT			
15	1	LINK ROD			
16	1	BALL JOINT			
17	1	STARTER MOTOR **(See breakdown on Starter Motor)**			
18	2	COLLAR			
19	2	RUBBER STOP			
20	1	SCREW (1/4-20 x 5/8)	60		7
21	1	WIRE ASSEMBLY (BLACK)			
22	1	LOCKWASHER			
23	1	NUT	60		7
24	1	DECAL-In Gear Idle			
25	1	DECAL-Warning-High Voltage			
26	1	DECAL-Start in Gear			

CDM Mounting

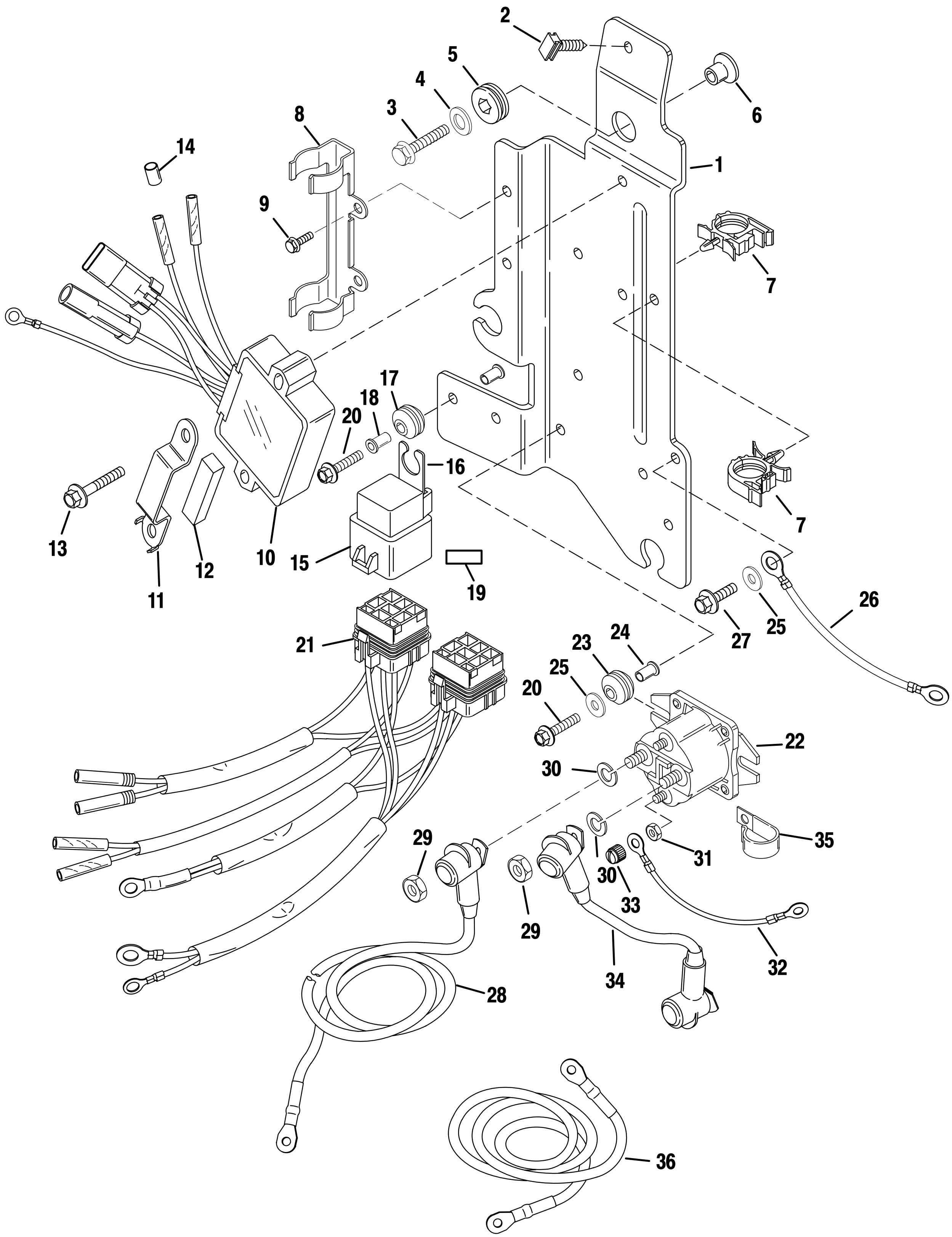


6 Dielectric Grease (92-823506--1)

CDM Mounting

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	POWER HARNESS			
2	1	COVER			
3	3	FUSE			
4	3	STA STRAP			
5	2	CLIP			
6	1	CDM MOUNTING PLATE			
7	4	SCREW (.312-18 x 1-1/4)		20	27
8	4	WASHER			
9	4	GROMMET			
10	4	BUSHING			
11	15	SCREW (M6 x 16)	70		8
12	2	CABLE			
13	6	CDM			
14	6	SPARK PLUG **(NGK#BPZ8HS10)**		20	27
15	1	CDM HARNESS			
16	1	CABLE			
17	1	CLIP			
18	1	ENGINE HARNESS			

Solenoid Mounting



Solenoid Mounting

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	SOLENOID PLATE			
2	1	CLIP			
3	3	SCREW (.312-18 x 1-1/4)		20	27
4	3	WASHER			
5	3	GROMMET			
6	3	BUSHING			
7	4	CLIP			
8	1	CLAMP			
9	2	SCREW (M5 x 12)	40		4.5
10	2	VOLTAGE REGULATOR			
11	2	BRACKET			
12	2	FOAM PAD			
13	4	SCREW (M6 x 35)	70		8
14	1	PLUG (GRAY LEAD)			
15	2	TRIM RELAY			
16	2	BRACKET			
17	2	GROMMET			
18	2	BUSHING			
19	2	DECAL			
20	4	SCREW (M6 x 25)	70		8
21	1	WIRING HARNESS			
22	1	STARTER SOLENOID			
23	2	GROMMET			
24	2	BUSHING			
25	2	WASHER			
26	1	CABLE			
27	1	SCREW (M6 x 14)	70		8
28	1	BATTERY CABLE (POSITIVE)			
29	2	NUT	60		7
30	2	LOCKWASHER			
31	2	NUT	30		3.5
32	1	CABLE			
33	2	CAP NUT	Drive Tight		
34	1	CABLE			
35	1	CLIP			
36	1	BATTERY CABLE (NEGATIVE)			

Theory of Operation

The V-6 outboard CDM ignition system is alternator-driven with distributor-less capacitor discharge. Major components of the system are the flywheel, stator assembly, trigger assembly, control module, 6 CDM assemblies and 6 spark plugs.

The stator assembly is mounted below the flywheel and has 3 capacitor charging coils. The flywheel is fitted with permanent magnets inside the outer rim. As the flywheel rotates, the permanent magnets pass the capacitor charging coils producing AC voltage. The AC voltage is conducted to the CDMs where it is rectified, regulated to 300 volts, and stored in capacitors.

The trigger assembly (also mounted under the flywheel) has 3 coils. Each coil controls the spark to 2 cylinders - one on each bank. The flywheel also has a second set of permanent magnets located around the center hub. As the flywheel rotates, the magnets pass the trigger coils producing AC voltage. The AC voltage is conducted to the control module, which shapes the signal before sending it to the electronic switch (SCR) inside the appropriate CDM. The switch discharges the capacitor voltage into the primary side of the ignition coil (inside the CDM).

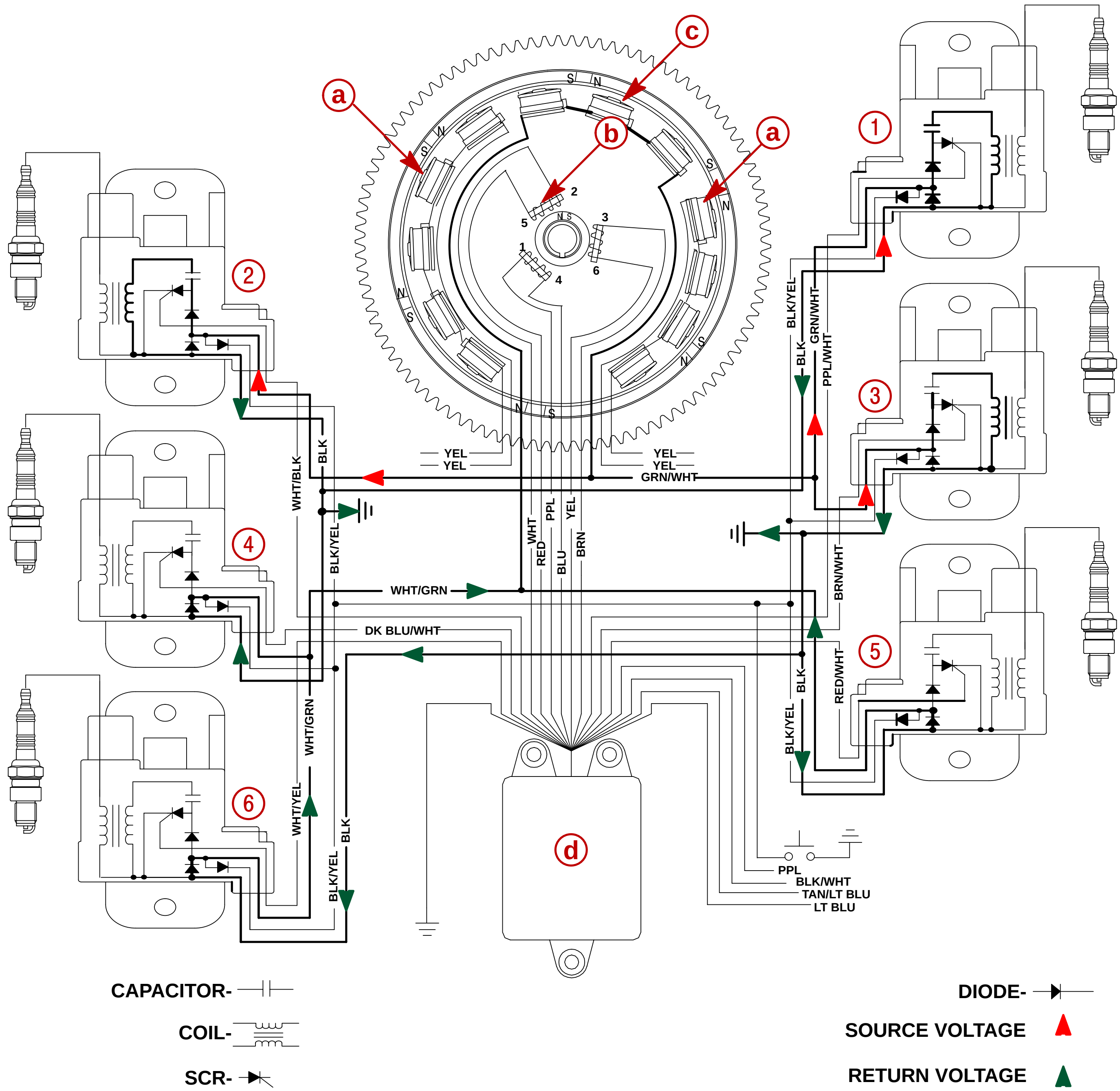
As this voltage goes to ground through the primary circuit of the coil, it induces a voltage rise in the secondary side of the ignition coil. This voltage can increase to approximately 40000 volts before bridging the spark plug gap and returning to ground.

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

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

The control module provides rev-limit (carb models), bias control, shift stabilizer, idle stabilizer, injector timing signal (EFI models), and low oil warning.

V-6 2.0/2.5L CDM Ignition



a - Battery Charging Coils
b - Trigger Coils
c - Capacitor Charging Coils
d - Control Module

Capacitor Charging #1, #2, & #3 CDMs

The STATOR assembly is mounted to the block below the flywheel and has 3 CAPACITOR CHARGING COILS connected in series. The FLYWHEEL is fitted with 6 permanent magnets inside the outer rim. The flywheel rotates the permanent magnets past the capacitor charging coils causing the coils to produce AC voltage (260-320 volts). The AC voltage is then conducted to the CAPACITOR DISCHARGE MODULES (CDM), where it is rectified (DC) and stored in a capacitor. The stator voltage return path is through the ground wire of one of the other CDMs and back through that CDM's charging coil wire to the capacitor charging coils.

NOTE: The CDM contains a zener diode (not shown for clarity). The zener diode regulates the capacitor voltage to 300 volts, preventing overcharging of the capacitor (and possible failure) if the SCR does not receive a trigger pulse.

Capacitor Charging #4, #5 & #6 CDMs

The flywheel rotates the permanent magnets past the capacitor charging coils causing the coils to produce AC voltage (260-320 volts). The opposite voltage pulse is then conducted to the CAPACITOR DISCHARGE MODULES (CDM), where it is rectified (DC) and stored in a capacitor. The stator voltage return path is through the ground wire of one of the other CDMs and back through that CDM's charging coil wire to the capacitor charging coils.

NOTE: The CDM contains a zener diode (not shown for clarity). The zener diode regulates the capacitor voltage to 300 volts, preventing overcharging of the capacitor (and possible failure) if the SCR does not receive a trigger pulse.

#1 Cylinder Trigger Circuit

The TRIGGER assembly (also mounted under the flywheel) has three coils, one for two cylinders - one on each bank. These coils are mounted adjacent to the flywheel center hub. The center hub of the flywheel contains a permanent magnet with two north-south transitions.

As the flywheel rotates, the magnet north-south transitions pass the trigger coils. This causes the trigger coils to produce a voltage pulse which is sent to the control module. The control module shapes the signal before sending it onto the capacitor discharge module (CDM). A positive voltage pulse will activate the electronic switch (SCR) inside the capacitor discharge module (CDM). The switch discharges the capacitor voltage through the coil primary windings. The return voltage pulse exits the CDM through the ground wire and returns through the control module.

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

Ignition Coil Circuit

As the capacitor voltage flows through the primary windings of the ignition coil, a voltage is induced into the ignition coil secondary windings. This secondary voltage rises to the level required to jump the spark plug gap and return to ground. This secondary voltage can, if necessary, reach approximately 40,000 volts. To complete the secondary voltage path, the released voltage enters the ground circuit of CDM module.

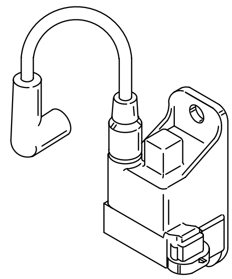
Stop Circuit

To stop the engine, the stop switch is closed allowing the capacitor charge current from the stator to drain directly to ground.

Ignition Component Description

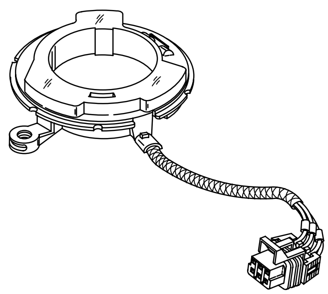
Capacitor Discharge Module (CDM)

Each module contains an ignition coil and amplifier circuitry which produces approximately 40,000 volts at the spark plugs.



Trigger Coil

Located under flywheel. Is charged by single magnet on flywheel hub. Trigger pulses are sent to CDM.



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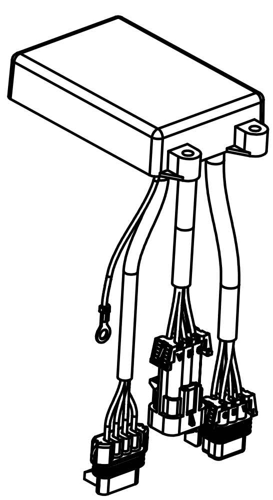
Control Module

The control module provides rev-limit (carb models), bias control, shift stabilizer, idle stabilizer, injector timing signal (EFI models), and low oil warning.

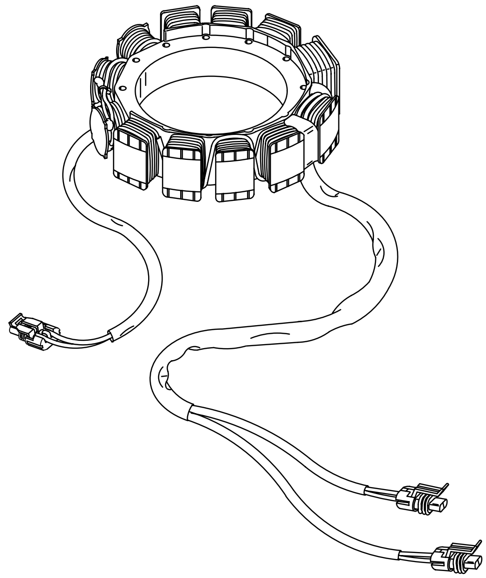
On carburetor models, the rev-limiter affects the cylinders in the following sequence 2-3-4-5-6-1. As the engine rpm exceeds the maximum specification (5900 ± 100), the control module will retard the timing on cylinder #2. The controller will retard the timing a maximum of 30 degrees and then, if necessary, stop spark on the cylinder. If the engine rpm is still above the maximum specification, the controller will begin to retard timing on the next cylinder, then stop spark, continuing in sequence until the engine rpm drops below the maximum specification.



Ignition Component Description

Stator Assembly

Located under the flywheel in the stator assembly are 12 coils; 3 ignition charge coils and 9 auxiliary power coils wound in series that provide voltage to the CDM's and battery/auxiliary circuits respectively.



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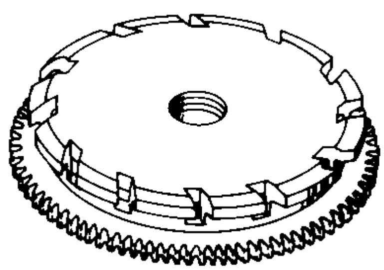
Flywheel

Contains 6 magnets (12 pole) around circumference. Flywheel has 2 magnets on inner hub for trigger. Outer magnets are for battery charge coils and ignition charge coils. These outer magnets are covered by a thin stainless steel retaining ring bonded onto the inside diameter.

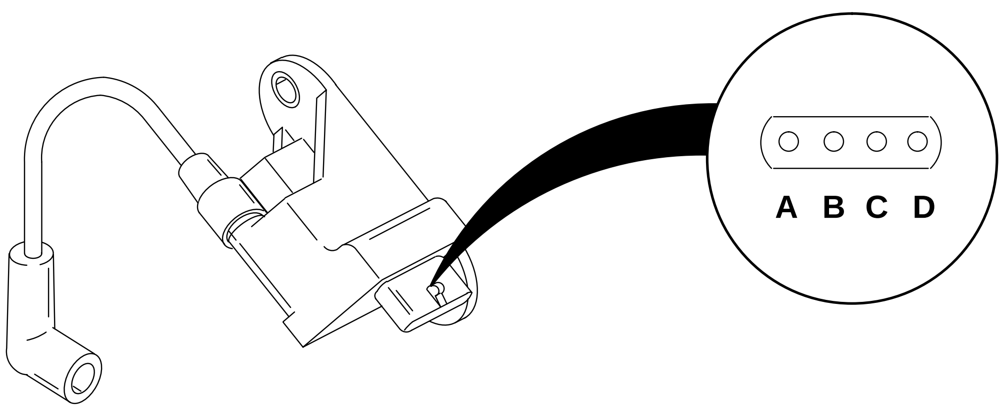


CDM (P/N 827509) Trouble Shooting Flowchart

CHART 1

Step	Action	Value	Yes	No	Tools
1	Verify High Tension Leads, Spark Plug and Spark Boots are in good condition. Inspect wires for chafing. **Visual Inspection**	–	Step 2	Replace Failed Component Step 2	High Tension lead pin P/N 84-813706A56
2	Verify 4 Pin Connector Integrity **Visual Inspection**	–	Step 3	Repair/Replace Connector Components Step 3	–
3	Verify Ground from CDM connector to block	0.2 Ohms and below	Step 4	Correct Ground Path Step 4	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045
4	Test all CDMs at Cranking with Spark Gap Tester **Spark on All CDMs?** Will spark jump a 7/16 in. (11.11 mm) gap?	7/16 in. (11.11 mm) gap	If at least one CDM has spark, continue with Chart #3	Continue with Chart #2	Spark Gap Tester P/N 91-850439

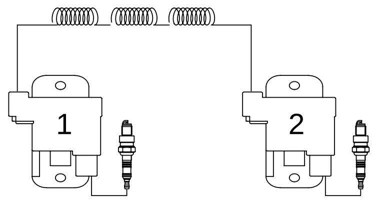
CDM (P/N 827509)



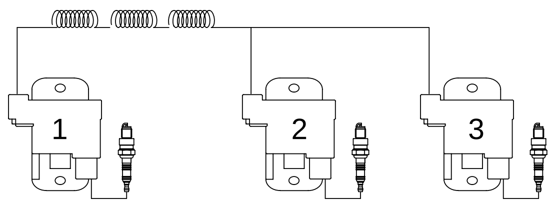
a - Ground
b - Black/Yellow
c - Trigger Connection
d - Stator Connection

CDM Stop Diode Trouble Shooting

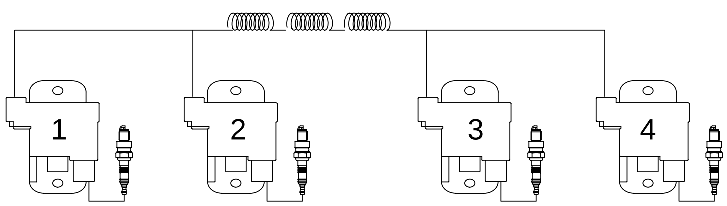
2 Cyl.:
CDM #1 gets its charging ground path through CDM #2
CDM #2 gets its charging ground path through CDM #1
A shorted Stop Diode in either CDM would prevent the opposite one from sparking.



3 Cyl.:
CDM #1 gets its charging ground path through CDM #2 or #3
CDM #2 and #3 get their charging ground path through CDM #1
A shorted Stop Diode in CDM #1 would prevent CDMs #2 and #3 from sparking.
A shorted Stop Diode in CDM #2 or #3 would prevent CDM #1 from sparking.

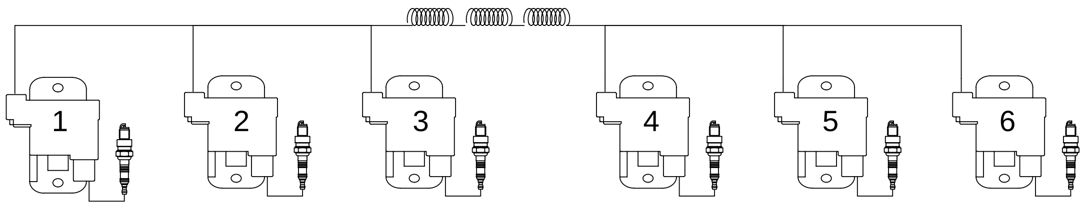


4 Cyl.:
CDM #1 and #2 get their charging ground path through CDM #3 or #4
CDM #3 and #4 get their charging ground path through CDM #1 or #2
A shorted Stop Diode in CDM #1 or #2 would prevent CDMs #3 and #4 from sparking.
A shorted Stop Diode in CDM #3 or #4 would prevent CDMs #1 and #2 from sparking.

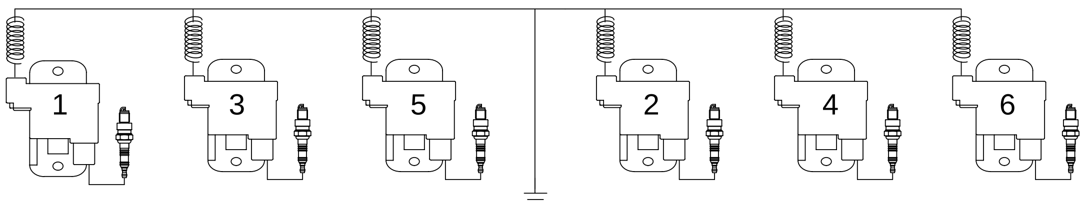


CDM Stop Diode Trouble Shooting (Con't)

2.0/2.5 Litre 6 Cyl.:
CDM #1, #2 and #3 get their charging ground path through CDM #4, #5 or #6
CDM #4, #5 and #6 get their charging ground path through CDM #1, #2 or #3
A shorted Stop Diode in CDM #1, #2 or #3 would prevent CDMs #4, #5 and #6 from sparking.
A shorted Stop Diode in CDM #4, #5 or #6 would prevent CDMs #1, #2 and #3 from sparking.



3.0 Litre 6 Cyl.:
All CDMs get their charging ground path independently through the stator's white leads.
A shorted Stop Diode in any one CDM will prevent at least 2 other CDMs from sparking.



CDM Trouble Shooting Flowchart

CHART #2 (NO SPARK ON ANY CDM)

Step	Action	Value	Yes	No	Tools
1	With the key switch ON: Verify continuity between dis-connected BLK/YEL harness wire and ground. **This Test Checks:** Lanyard Switch Key Switch Rev Limiter (external) Chafed BLK/YEL wire	NO continuity	Step 2	Repair or Replace Com-ponent Run Engine Verify Repair Step 9	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045
2	Un-plug all CDMs and verify continuity between discon-nected BLK/YEL harness wire and ground. **This Test Checks:** CDM Harness	NO continuity	Step 3	Repair or Replace Com-ponent Run Engine Verify Repair Step 9	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045
3	Connect CDM one at a time **This Test Checks:** Individual CDM Stop Circuits	Resistance will rise with each CDM con-nected, full con-tinuity indicates shorted CDM stop circuit.*	Step 4	Repair or Replace Com-ponent Run Engine Verify Repair Step 9	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045 TPI/CDM Test Har-ness 84-825207A2
4	Check Stator Open circuit voltage at cranking should be no less than 100 Volts on the DVA Resistance between GRN/WHT and WHT/GRN	660-710 Ohms 2, 3 & 4 Cyl. Models 380-430 Ohms 2.0/2.5L 990 - 1210 Ohms 3.0L	Step 5	Replace Stator Run Engine Verify Repair Step 9	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045

*Diode Readings: Due to the differences in test meters, results other than specified may be obtained. In such a case, reverse meter leads and re-test. If test results then read as specified CDM is O.K. The diode measurements above will be opposite if using a Fluke equivalent multimeter.

CHART #2 (NO SPARK ON ANY CDM) (CON'T)

Step	Action	Value	Yes	No	Tools
5	Check CDM Trigger Input/Crank Shaft Position Sensor Output: Cranking with CDM disconnected. Cranking with CDM connected.	1 Volt and above - CDM disconnected. 0.2 - 5 Volts- CDM connected.	Step 6	2, 3, & 4 Cyl Replace Trigger Run Engine Verify Repair Step 9 2.0/2.5L 6 Cyl. - Step 6 3.0L 6 Cyl. - Step 7	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045 TPI/CDM Test Harness P/N 84-825207A2
6	2.0/2.5L V-6 Models Resistance between Trigger wires. Red - White Blue - Purple Brown - Yellow	1100 - 1400 Ohms	Step 8	Replace Control Module Run Engine Verify Repair Step 9	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1
7	3.0 L V-6 Models Resistance Check Crank Position Sensor	900 - 1300 Ohms	Step 8	Replace Crank Position Sensor Run Engine Verify Repair Step 9	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045
8	Test all CDMs at Cranking with Spark Gap Tester **Spark on All CDMs?** Will spark jump a 7/16 in. (11.11 mm) gap?	7/16 in. (11.11 mm) gap	Step 9	Verify All Preceding Steps	Spark Gap Tester P/N 91-850439
9	If mis-firing is in a repeatable range: Perform DVA readings on stator and trigger at all running speeds.* 2.0/2.5L V-6 Models Preform Bias circuit tests 200 HP EFI - Disconnect Detonation Module. Check Black/White to ground All other models - Disconnect Black/White to shift switch. Check Black/White to Ground	Stator: 200 Volts and above Trigger: 2 Volts and above -25 to -40 Volts @2500 rpm	Run Engine Verify Repair END	Refer to *Note Below Replace Control Module Run Engine Verify Repair	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045 TPI/CDM Test Harness P/N 84-825207A2

* Note: Stator tests will only isolate problem down to a charging pair. Further testing is necessary to determine faulty CDM. Disconnecting one CDM of the charging pair is recommended.

CDM Trouble Shooting Flowchart

CHART #3 (AT LEAST ONE CDM HAS SPARK)

Step	Action	Value	Yes	No	Tools
1	Resistance Check ALL CDMs	Refer to chart	Step 3	Replace any CDMs that do not pass specifications even if they fire Step 2	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045
2	Test all CDMs at Cranking with Spark Gap Tester **Spark on All CDMs** Will spark jump a 7/16 in. (11.11 mm) gap?	7/16 in. (11.11 mm) gap	Run Engine Verify Repair Step 7	Step 3	Spark Gap Tester P/N 91-850439
3	Check CDM Trigger Input: Cranking with CDM disconnected Cranking with CDM connected	1 Volt and above - CDM disconnected. 0.2 - 5 Volts - CDM connected.	Step 6	2, 3, & 4 Cyl - Replace Trigger Run Engine Verify Repair Step 7 2.0/2.5L 6 Cyl. - Step 4 3.0L 6 Cyl.– Step 4	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045 TPI/CDM Test Harness 84-825207A2
4	2.0/2.5L V-6 Models Resistance between Trigger wires Red - White Blue - Purple Brown - Yellow	1100 - 1400 Ohms	Replace Control Module Step 6	Replace Trigger Step 6	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1
5	3.0 V6 Models Resistance Check Crank Position Sensor	900 - 1300 Ohms	Step 6	Replace Crank Position Sensor Run Engine Verify Repair Step 7	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045

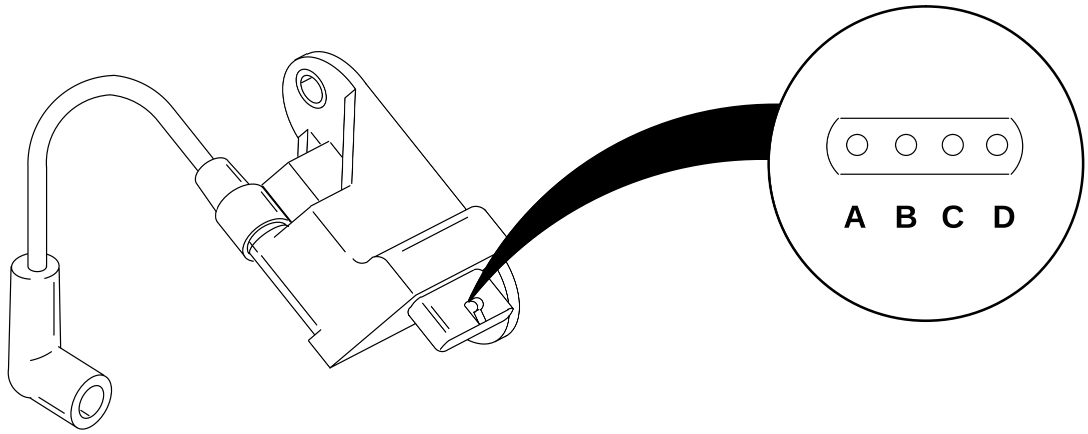
CHART #3 (AT LEAST ONE CDM HAS SPARK) (CON'T)

Step	Action	Value	Yes	No	Tools
6	Test all CDMs at Cranking with Spark Gap Tester **Spark on All CDMs?** Will spark jump a 7/16 in. (11.11 mm) gap?	7/16 in. (11.11 mm) gap	Run Engine Verify Repair Step 7	Replace any non-firing CDMs Step 7	Spark Gap Tester P/N 91-850439
7	If mis-firing is in a repeatable range: Perform DVA readings on stator and trigger at all running speeds.* 2.0/2.5L V-6 Models Preform Bias circuit tests 200 HP EFI - Disconnect Detonation Module. Check Black/White to ground All other models - Disconnect Black/White to shift switch. Check Black/White to Ground	Stator: 200 Volts and above Trigger: 2 Volts and above -25 to -40 Volts @2500 rpm	Run Engine Verify Repair END	Refer to *Note Below Replace Control Module Run Engine Verify Repair	DMT 2000 Digital Tachometer/ Multi-meter P/N 91-854009A1 & DVA Adaptor P/N 91-89045 TPI/CDM Test Harness 84-825207A2 6 Pin Connector

* Note: Stator tests will only isolate problem down to a charging pair. Further testing is necessary to determine faulty CDM. Disconnecting one CDM of the charging pair is recommended.

CAPACITOR DISCHARGE MODULE

IMPORTANT: Spark plug wires are screwed into CDM.



a - Ground
b - Black/Yellow
c - Trigger Connection
d - Stator Connection

A resistance check is required and can be performed on the CDM as follows:

NOTE: *This test can be performed using the test harness (P/N 84-825207A2). Do Not connect the test harness plug to the stator/trigger engine wire harness.*

CAPACITOR DISCHARGE MODULE				
Circuit Test	**Connect Negative (–) Meter Lead To:**	**Connect Positive (+) Meter Lead To:**	**Ohms Scale**	**Results:**
Stop Diode Forward Bias	Green (D) / or Green test harness lead	Black/Yellow (B) / or Black/Yellow test harness lead	R x 100 Diode Reading*	Continuity
Stop Diode Reverse Bias	Black/Yellow (B) / or Black/Yellow test harness lead	Green (D) / or Green test harness lead	R x 100 Diode Reading*	No Continuity
Return Ground Path Diode, Reverse Bias	Green (D) / or Green test harness lead	Ground Pin (A) or Black test harness lead	R x 100 Diode Reading*	No Continuity
Return Ground Path Diode, Forward Bias	Ground Pin (A) / or Black test harness lead	Green (D) / or Green test harness lead	R x 100 Diode Reading*	Continuity
CDM Trigger Input Resistance	Ground Pin (A) / or Black test harness lead	White (C) / or White test harness lead	R x 100	1000 - 1250 Ohms
Coil Secondary Impedance	Ground Pin (A) or Black test harness lead	Spark Plug Terminal (At Spark Plug Boot)	R x 100	900 - 1200 Ohms

*Diode Readings: Due to the differences in test meters, results other than specified may be obtained. In such a case, reverse meter leads and re-test. If test results then read as specified CDM is O.K. The diode measurements above will be opposite if using a Fluke equivalent multimeter.

Direct Voltage Adaptor (DVA)

The DVA can be used with Quicksilver DMT 854009A1, VOA Meter 91-99750A1, Quicksilver Volt/Ohm meter 91-93572, or an equivalent volt meter (capable of measuring 400 volts DC or higher) to check primary ignition voltage on Alternator Driven Ignition (ADI) systems. (Models are specified in Test Charts, following.)

CAUTION

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

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

-- 400 VDC test position (or higher) MUST BE used for all tests, except "Trigger Ohms" test.

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

WARNING

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

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

Troubleshooting Tips

1. Intermittent, weak or no spark output at any one spark plug (single cylinder) usually is a bad CDM or control module.
2. Intermittent, weak or no spark output at two spark plugs (one plug from each bank of three cylinders) usually is caused by a bad TRIGGER.
3. Intermittent, weak or no spark output at three spark plugs (1,2, & 3 or 4, 5, & 6) usually is caused by a bad CDM.
4. No spark output on any spark plug (six cylinders) usually is a bad stop circuit, stator or control module.
5. Erratic timing or an engine that will not idle down usually has a failure in the bias circuit inside the control module.

Ignition Test Procedures

Direct Voltage Adaptor (DVA) Test

CAUTION

DVA checks can be made while cranking engine with starter motor. To prevent engine from starting while being cranked, all spark plugs must be removed.

CAUTION

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

- **INSURE that the Positive (+) meter lead is connected to the DVA receptacle on the meter.**
- **DO NOT CHANGE meter selector switch position while engine is running and/or being “cranked”.**
- **DO NOT reverse battery cable connections. The battery negative cable is (–) ground.**
- **DO NOT “spark” battery terminals with battery cable connections to check polarity.**
- **DO NOT disconnect battery cables while engine is running.**

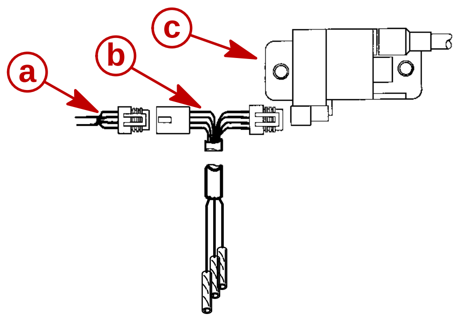
A process of elimination must be used when checking the ignition system without a voltmeter (capable of measuring 400 volts DC, or higher) and Direct Voltage Adaptor (91-89045), as the control module cannot be thoroughly checked with conventional test equipment.

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

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

***NOTE:** Each CDM is grounded through the engine wiring harness via the connector plug. It is not necessary to have the CDM mounted on the ignition plate for testing.*

1. Remove all spark plugs.
2. Insert spark gap tool (P/N 91-63998A1) into each spark plug boot and attach alligator clips to a good engine ground.
3. Disconnect remote fuel line from engine.
4. Make sure all CDMs are plugged in.
5. Test Stator and Trigger voltage to CDM:
   a. Install test harness (84-825207A2) between ignition harness and CDM.

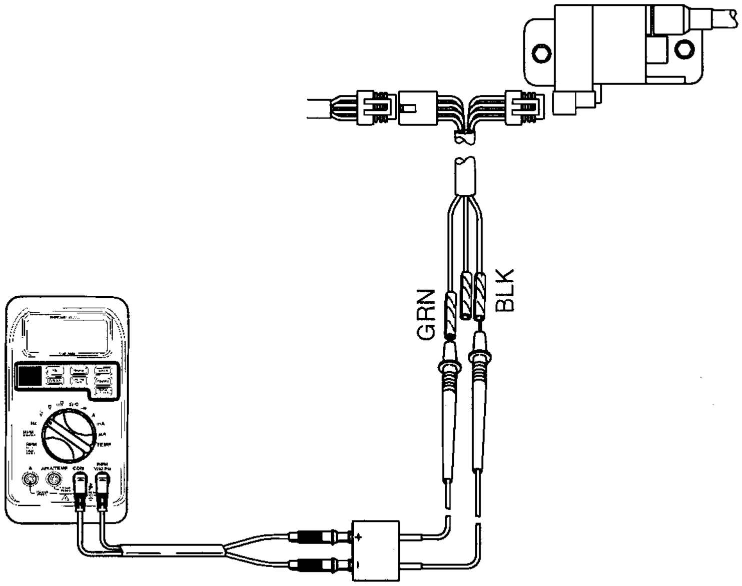


a - Stator/Trigger Harness
b - Test Harness (84-825207A2)
c - Capacitor Discharge Module

   b. Test each CDM.

Stator Output Test		400 DVA Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading**
Connect to Green Test Harness Lead	Connect to Black Test Harness Lead	160 - 320

If only one CDM stator reading is below specifications, replace that CDM. If all CDM stator voltage readings are low, go to “Testing Stator Resistance”.



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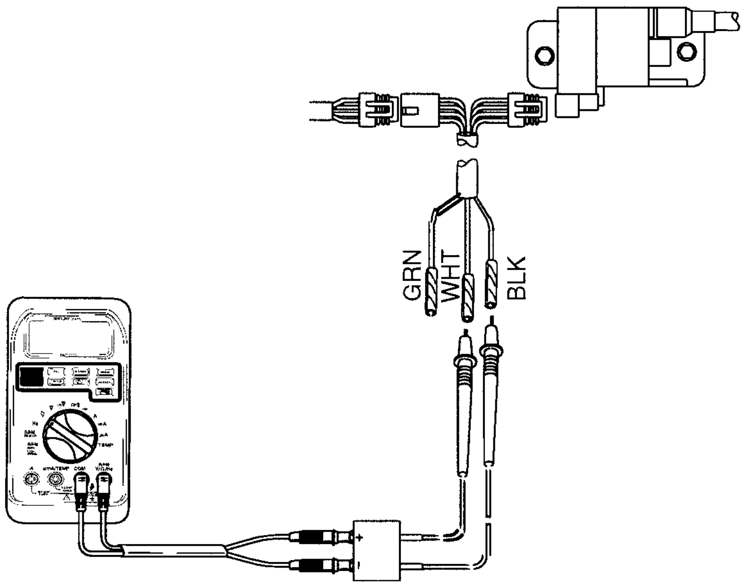
Test each CDM.

CDM Trigger Input Test		2 DVA Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading @ Cranking**
White Test Harness Lead	Black Test Harness Lead	0.2 - 2.0

If reading is below specifications, test trigger resistance. If reading is above specifications, check CDM and ground connections.



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ENGINE RUNNING AT 2500 RPM

It is not necessary to perform this test if the voltage output was tested in the previous step.

Stator Output Test		400 DVA Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading**
Connect to Green Test Harness Lead	Connect to Black Test Harness Lead	160 - 320

If stator output is low, go to “Testing Stator Resistance”.

CDM Trigger Input Test		20 DVA Scale
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading @ Idle to 2500 RPM**
White Test Harness Lead	Black Test Harness Lead	2 - 8 Volts

If reading is below specifications, go to “Testing Trigger Resistance”. If reading is above specifications, check CDM and ground connections.

2.0/2.5L V-6 Models Only - Check control module bias circuit

Bias Circuit Test (All Models Except 200 EFI)		40 DVA Scale @2500 RPM
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading**
Engine Ground	Black/White Shift Switch Wire	25 - 40 Volts

Bias Circuit Test (200 EFI)		40 DVA Scale @2500 RPM
Positive Meter Lead (+)	**Negative Meter Lead (–)**	**DVA Reading**
Engine Ground	Disconnect 4 wire Detonation Control Module connector. Insert bent paper clip into Black/White terminal.	25 - 40 Volts

If reading is below specifications, replace control module.

Resistance Tests

TRIGGER ASSEMBLY TEST

1. Disconnect all trigger leads from control module.
2. Use an ohmmeter and perform the following checks:

Test Leads to	Resistance Ohms	Scale Reading
Between BROWN Trigger Lead and YELLOW Trigger Lead	1100-1400	R x 100
Between WHITE Trigger Lead and RED Trigger Lead	1100-1400	R x 100
Between PURPLE Trigger Lead and BLUE Trigger Lead	1100-1400	R x 100

3. If meter readings are not as specified, replace trigger assembly.

STATOR

1. Disconnect stator leads.

NOTE: *Resistance varies greatly with temperature. Measurements should be taken with the stator temperature range of 65° to 85° F. The ignition bobbin resistance may rise to 1.5 times the room temperature resistance value after the engine has been running and engine block temperature has stabilized.*

Stator Resistance Test		R x 1 Ohms Scale
Positive Meter Lead (+)	Negative Meter Lead (–)	
Connect to White/Green stator lead	Connect to Green/White stator lead	380-430
Connect to White/Green stator lead	Connect to engine ground	No continuity
Connect to Green/White stator lead	Connect to engine ground	No continuity

IMPORTANT: If all CDM stator output voltage is low and stator resistance tests are within specifications, then each CDM (one at a time) must be replaced with a CDM known to be good until stator output voltage returns to proper levels. This process of elimination will reveal a defective CDM.

Bias Circuit

Bias voltage is NEGATIVE (-) voltage applied to the ignition system to raise the trigger firing threshold as engine rpm is increased, thus stabilizing ignition timing and preventing random ignition firing.

Refer to Bias Circuit Test page 2A-29 to check bias circuit on carburetor and EFI model outboards.

Shift Stabilizer Circuit

The shift stabilizer circuit (not used on all models) is designed to increase the idle to timing approximately 2 degrees when the engine is shifted into gear.

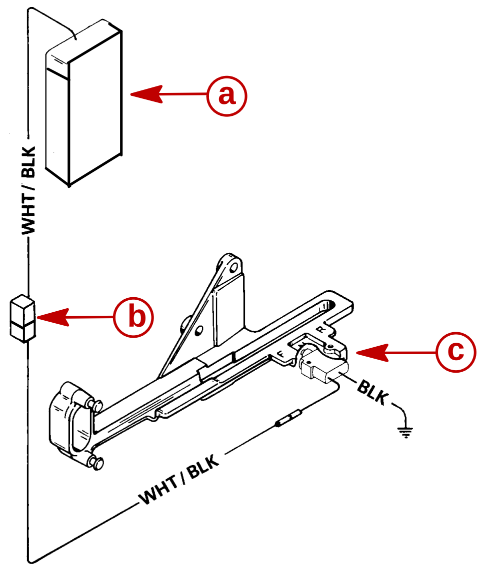
1. Check idle timing with engine out-of-gear, activate the switch, timing should increase approximately 2 degrees.
2. Shift switch may be tested with a resistance test. CONTINUITY between the BLACK wires (disconnected) with the engine in gear and NO CONTINUITY with the engine in NEUTRAL.

Idle Stabilizer

The idle stabilizer will electronically advance the ignition timing by as much as 3° if the engine idle speed falls below approximately 550 rpm. This timing advance raises the idle rpm to an acceptable level (550 rpm). When the idle stabilizer senses the idle rpm has reached the acceptable level, it returns the timing to the normal idle timing.

Note: retarding the timing with the spark arm is not an effective method of checking idle stabilizer.

1. Check idle timing with engine in-gear, slight movements of timing indicates idle stabilizer operation.



a - Control Module (Contains Idle Stabilizer and Shift Interrupt Circuitry)
b - Harness Connector
c - Shift Interrupt Switch

Rev-Limit Circuit

1. Install Flywheel Timing Tape (P/N 91-853883 3) onto flywheel.
2. With the engine under load and at maximum rpm the timing on #2 cylinder should be within specifications. As the engine rpm reaches approximately 5900 $\pm$ 100 rpm, timing on #2 cylinder will retard, as needed, to a maximum of 30 degrees and then spark to the cylinder will stop.

EFI Injector Timing Signal Test

Use DDT to monitor injector timing signals. (Press Keys1, 3, 1)

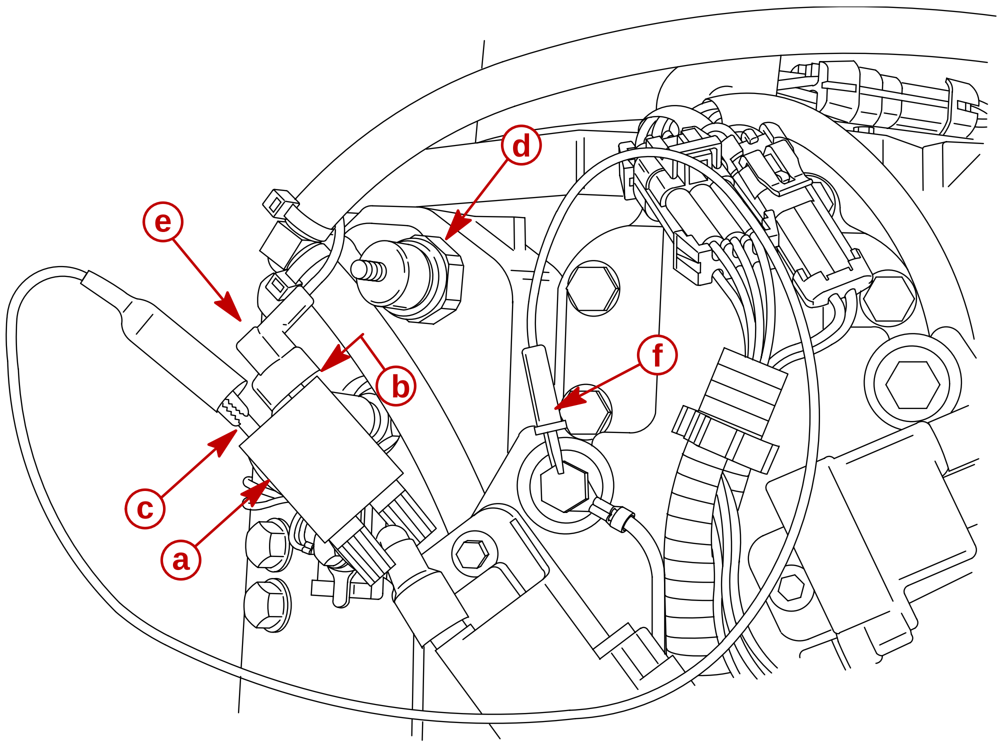
EFI Detonation Control System

The Detonation control system will only retard the timing approximately 1-2 degrees (uses same system as shift stabilizer on carburetor models).

Use DDT to monitor Knock Volts (Press Keys1, 3, 1)

Detonation Circuit Test

1. Disconnect WHITE/BLUE lead from knock sensor and connect to RED male connector of Interface Module 91-854013 (contained in DMT 2000 Multimeter Kit 91854009A1).
2. Connect jumper lead from BLACK male connector on Interface Module to engine ground.



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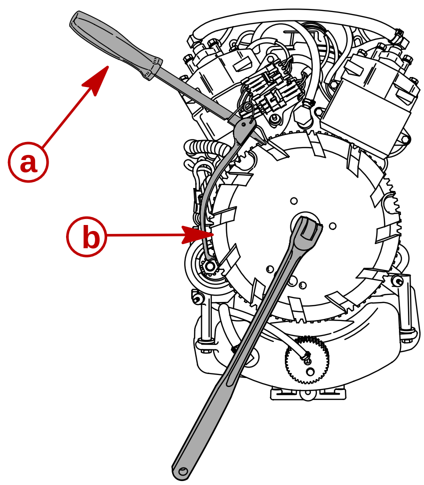
- **a** - Interface Module (91-854013)
- **b** - RED Connector
- **c** - BLACK Connector
- **d** - Knock Sensor
- **e** - Knock Sensor Lead
- **f** - BLACK Lead (to engine ground)

3. Turn key switch to RUN position (do not start engine). With Digital Diagnostic Terminal connected to engine, DDT should indicate over 6 volts for knock voltage output.
4. Start engine and run at idle. DDT indicated knock voltage output should drop below 1.0 volt. If voltage does not drop below 1.0 volt, knock circuit within detonation module is defective.

Ignition Component Removal

Flywheel Removal

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



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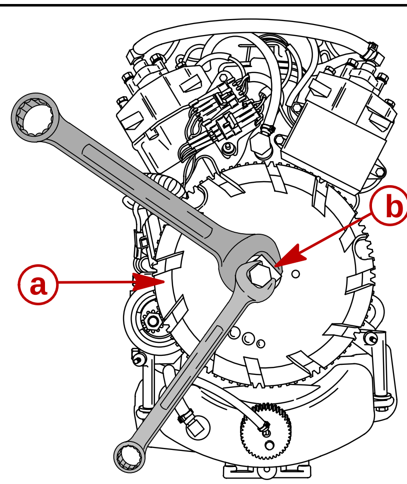
a - Flywheel Holder (91-52344)
b - Flywheel

3. Install Flywheel Puller (91-849154T1) into flywheel.

CAUTION
Do not hammer on end of puller center bolt to remove flywheel, or damage may result to crankshaft or bearings. Do not use heat to aid flywheel removal as flywheel and electrical components under flywheel may be damaged.



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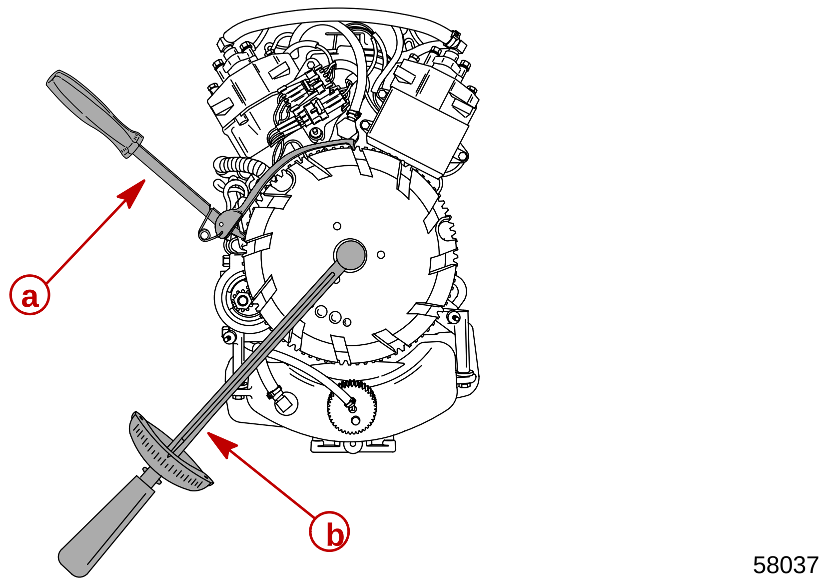
a - Flywheel
b - Flywheel Puller (91-849154T1)

Flywheel Installation

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

***NOTE:** Inspect flywheel magnets for clinging debris before installing flywheel. Failure to remove debris from magnets may result in damage to electrical components under flywheel when outboard is initially started.*

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



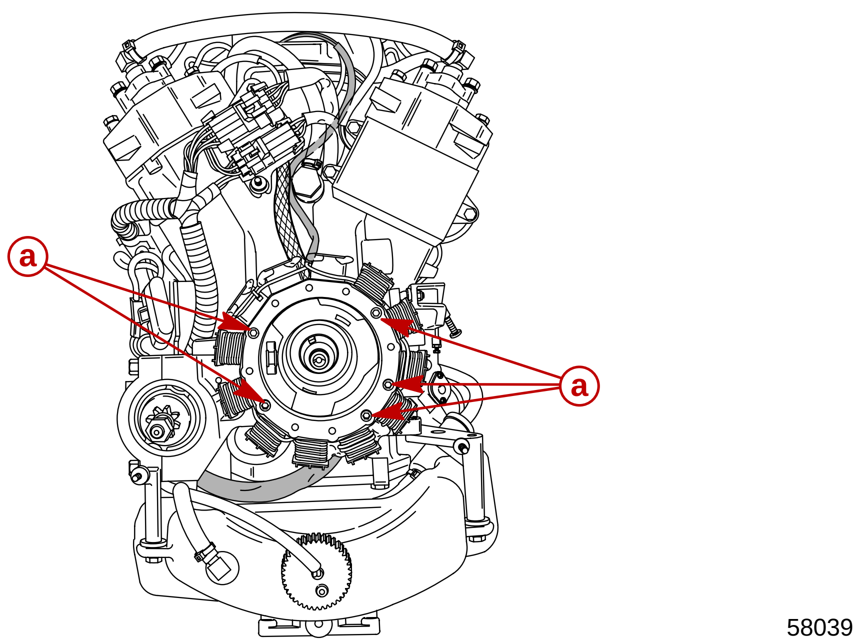
a - Flywheel Holder (91-52344)

b - Torque Nut to 120 lb. ft. (163 Nm)

2. Reinstall flywheel cover on engine.

Stator Removal

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

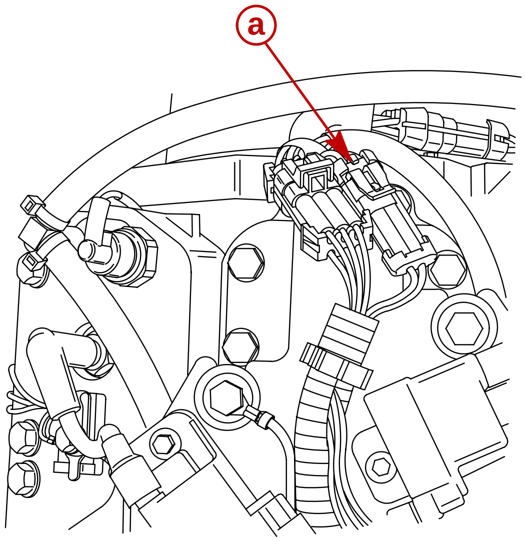


a - Stator Attaching Screws

3. Disconnect all stator harnesses from their respective connectors and remove stator.

Stator Installation

1. Clean stator attaching screw threads with Loctite 7649 Primer (92-809824) and apply Loctite 271 (92-809820). Install stator assembly in position on upper end cap and secure with attaching screws. Torque screws to 50 lb. in. (5.5 N m).
2. Route stator harnesses as shown and reconnect to appropriate connectors.



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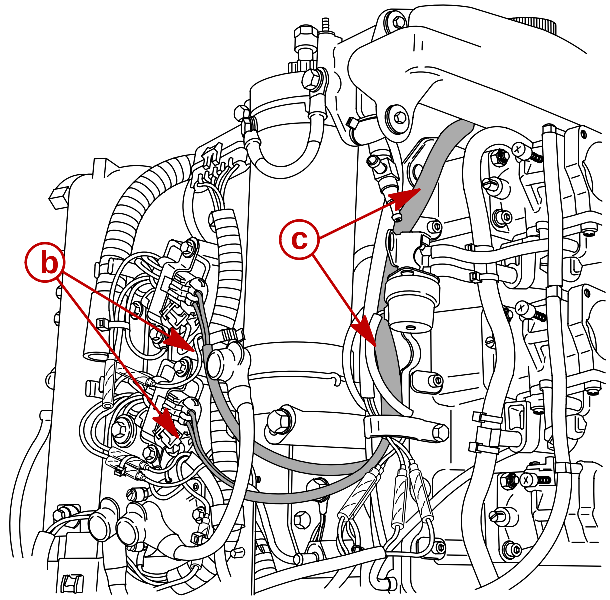

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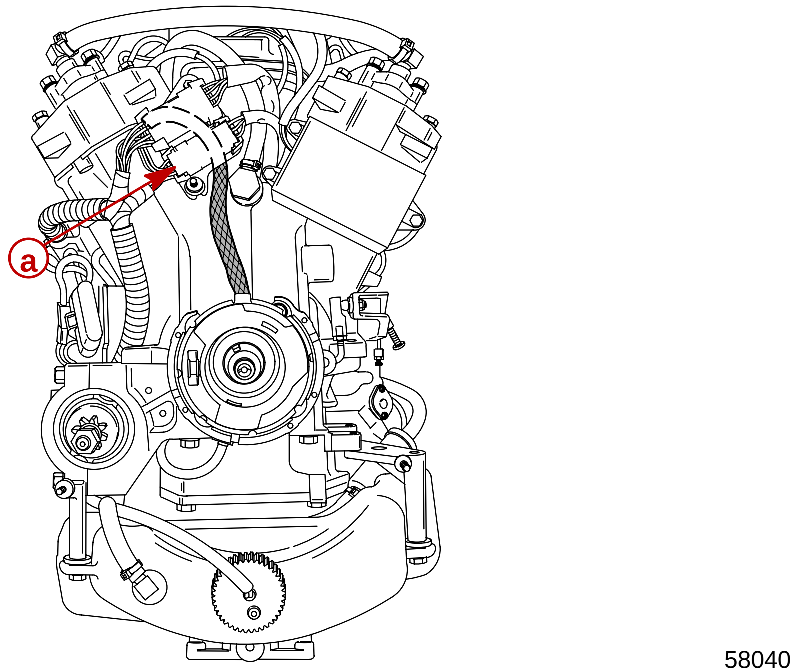
a - Stator CDM Connectors

b - Stator Voltage Regulator Connectors

c - Stator Harness Routing

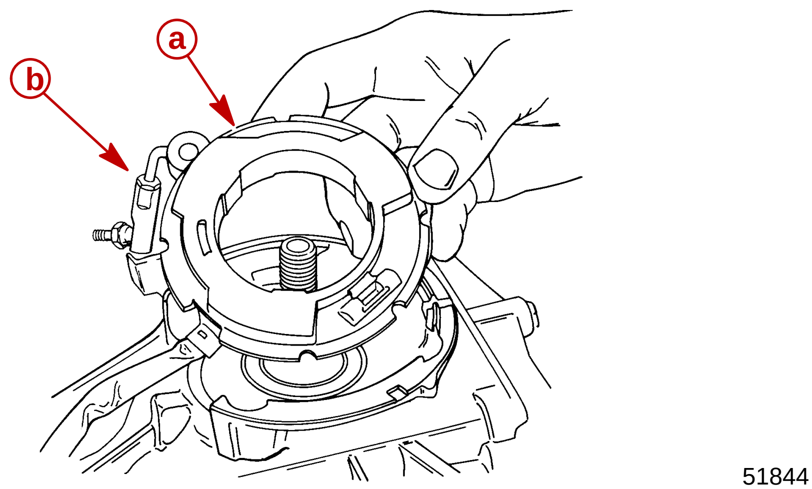
Trigger Removal

1. Remove flywheel, as outlined in **"Flywheel Removal,"** preceding.
2. Remove 5 screws which secure stator assembly to upper end cap. Lift stator off end cap and move to the side.
3. Remove locknut that secures link rod swivel into spark advance lever. Pull link rod out of lever.
4. Disconnect trigger harness from its respective connector.



a - Trigger Connector

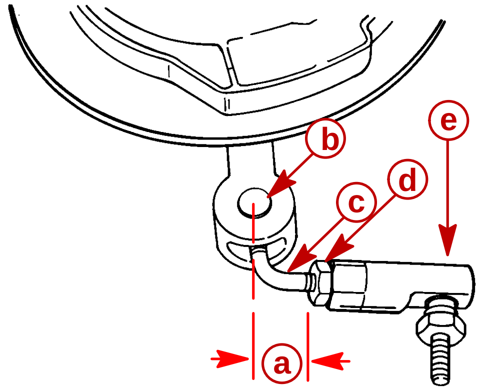
5. If trigger assembly is faulty, remove and retain link rod swivel from trigger.



a - Trigger
b - Link Rod Swivel

Trigger Installation

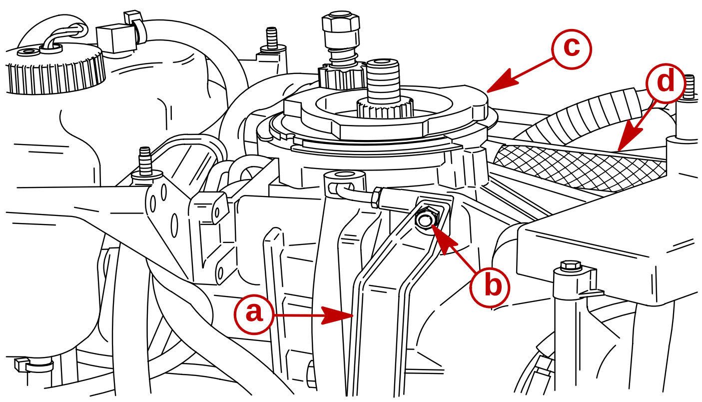
1. If link rod swivel was disassembled or removed, reassemble to trigger as shown.



51840

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

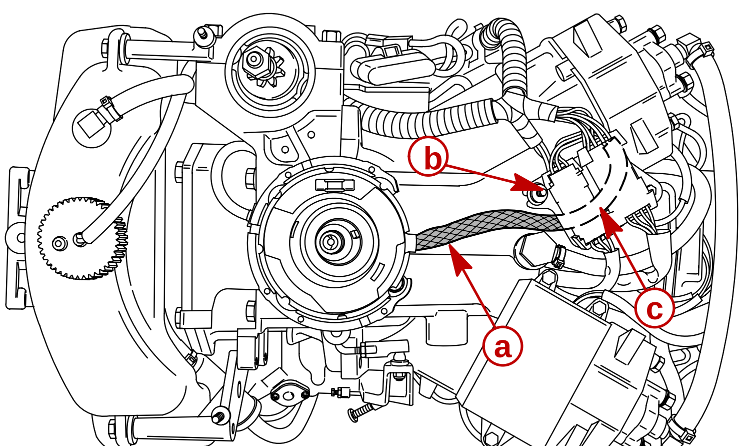
2. Place trigger assembly in upper end cap. Fasten link rod swivel to spark advance lever with locknut.



58203

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

3. Route trigger harness as shown and reconnect trigger harness connector.

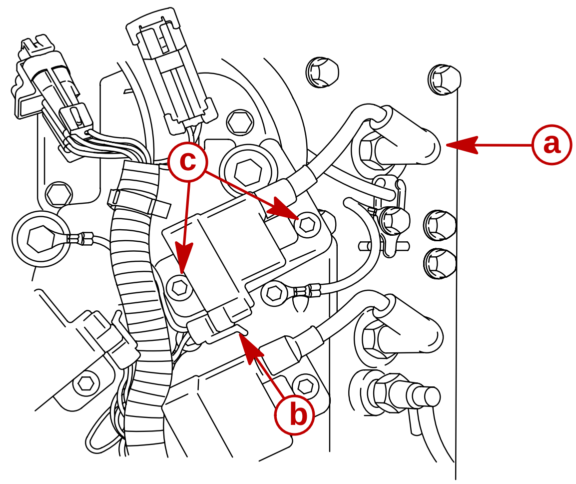


58040

a - Harness
b - Connector
c - Route Trigger Harness Under Harness Connectors

CDM Removal

1. Disconnect spark plug lead from spark plug.
2. Disconnect CDM harness connector.
3. Remove 2 bolts securing CDM and remove CDM.



58033

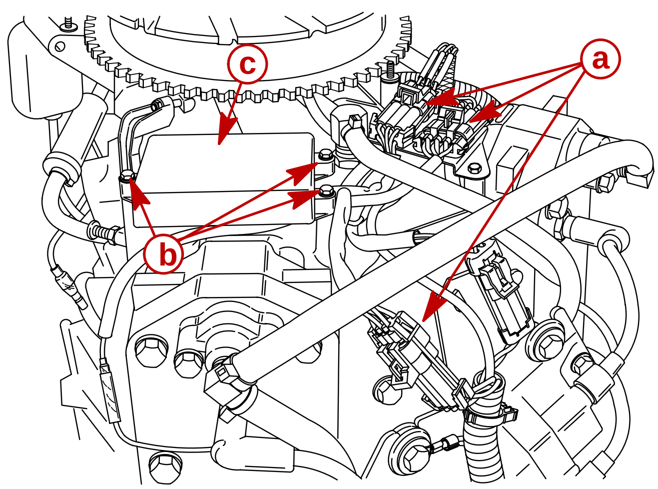
a - Spark Plug Lead
b - Harness Connector
c - Bolts

CDM Installation

1. Secure CDM with 2 bolts. Torque bolts to 70 lb. in. (8 Nm).
2. Reconnect CDM harness.
3. Reconnect spark plug lead to spark plug.

Control Module Removal

1. Disconnect 3 Control Module harness connectors.
2. Remove 3 bolts securing module and remove module.



58034

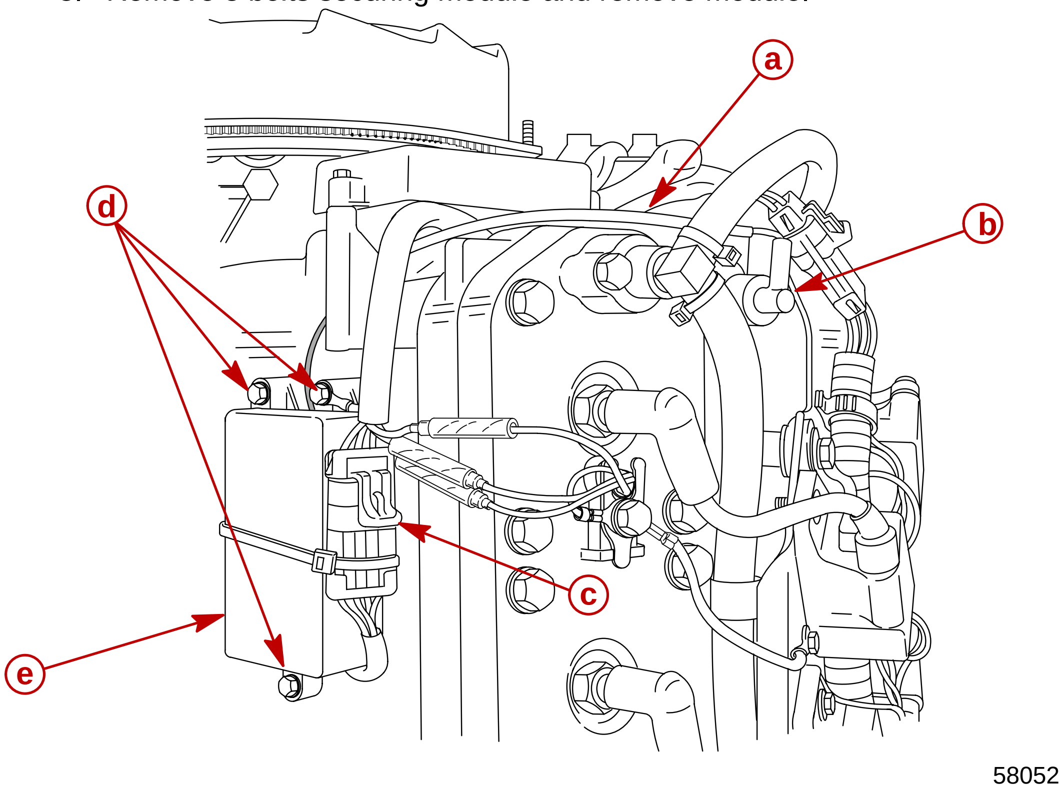
a - Harness Connectors
b - Bolts (3)
c - Control Module

Control Module Installation

1. Secure module with 3 bolts. Torque bolts to 30 lb. in. (3.5 Nm).
2. Reconnect 3 module harness connectors.

Detonation Module Removal (200 XRI only)

1. Remove detonation sensor lead from sensor.
2. Disconnect detonation module harness connector.
3. Remove 3 bolts securing module and remove module.



a - Sensor Lead
b - Sensor
c - Harness Connector
d - Bolts (3)
e - Detonation Module

Detonation Module Installation

1. Secure module with 3 bolts. Torque bolts to 30 lb. in. (3.4 Nm).
2. Reconnect 3 harness connectors.
3. Reconnect sensor lead to sensor.

ELECTRICAL

Section 2B - Charging and Starting System

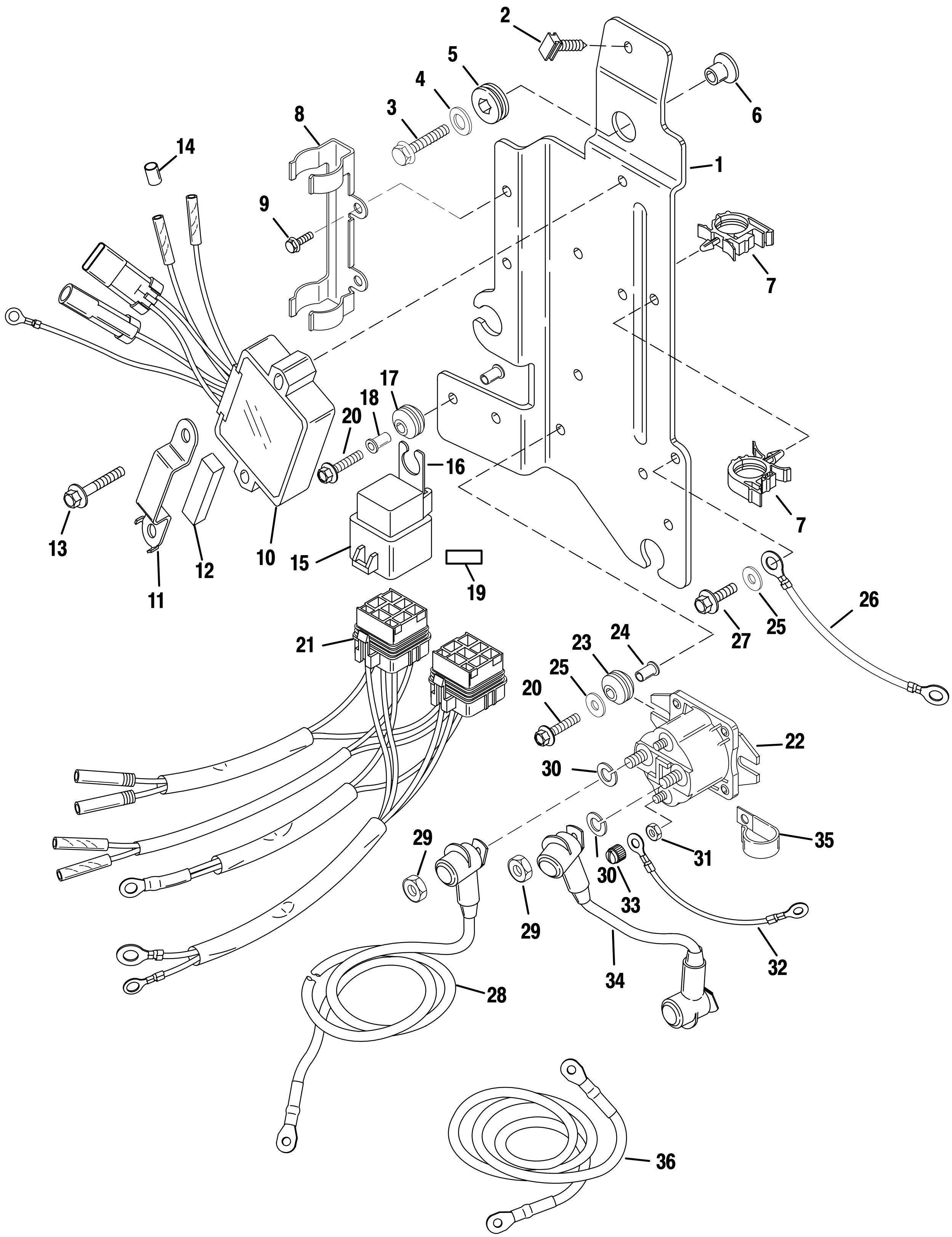
Table of Contents

Specifications

CHARGING SYSTEM	**Alternator Output (Regulated)** **Voltage Regulator Draw with Ignition Key in the Off Position***	40 Amperes @ 5000 rpm 0 – 4 Milliamperes Each (0 – 8 Milliamperes total system draw)
STARTING SYSTEM	**Manual Start – All Models** **Electric Start – All Models** **Starter Draw (Under Load)** **Starter Load (No Load)** **Battery Rating**	Emergency Start Rope 175 Amperes 40 Amperes Min. 630 Marine Cranking Amps (MCA) or 490 Cold Cranking Amps (CCA)

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

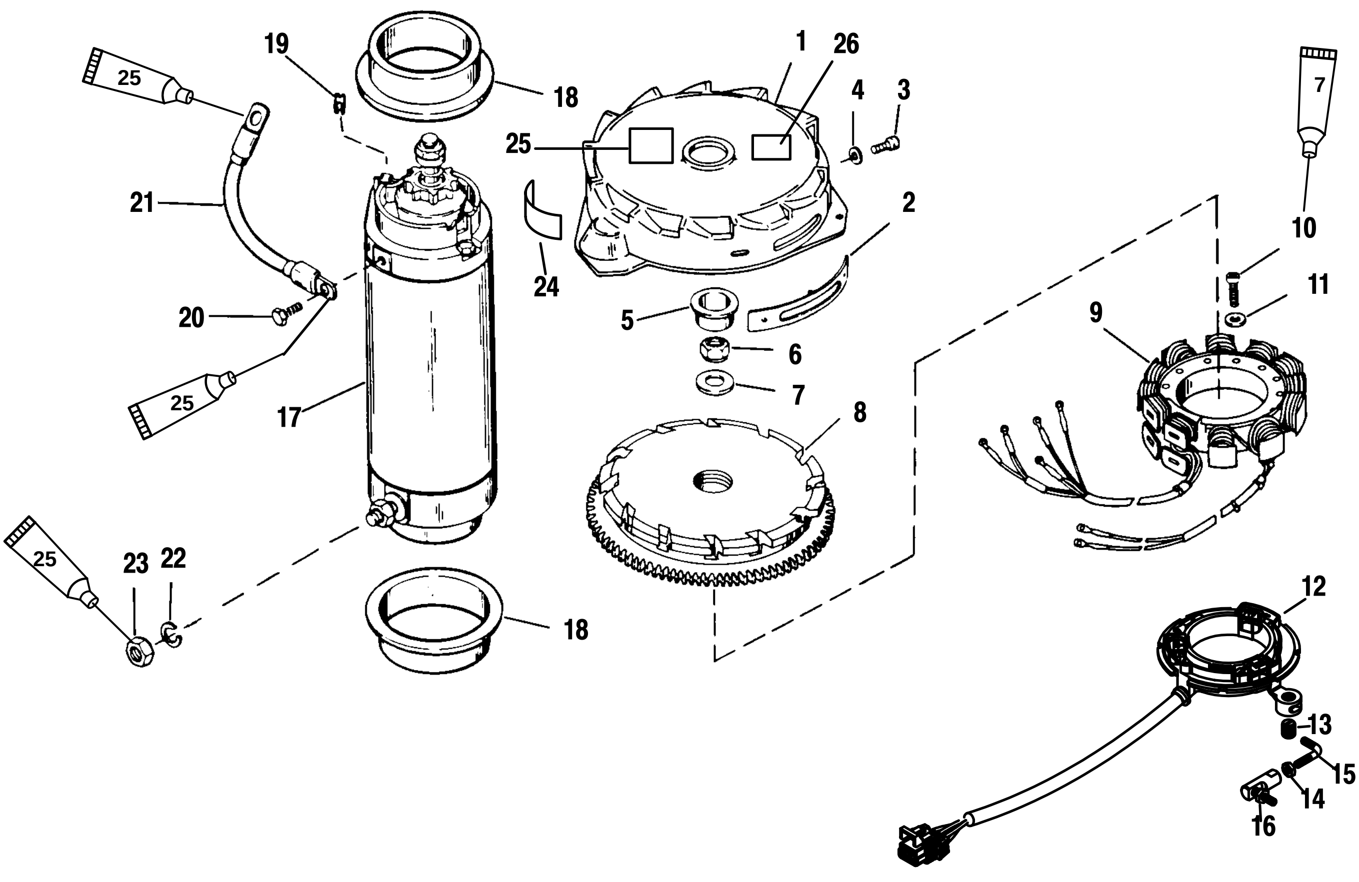
Electrical Plate



Electrical Plate

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	lb-ft	Nm.
1	1	SOLENOID PLATE			
2	1	CLIP			
3	3	SCREW (.312-18 x 1-1/4)		20	27
4	3	WASHER			
5	3	GROMMET			
6	3	BUSHING			
7	4	CLIP			
8	1	CLAMP			
9	2	SCREW (M5 x 12)	40		4.5
10	2	VOLTAGE REGULATOR			
11	2	BRACKET			
12	2	FOAM PAD			
13	4	SCREW (M6 x 35)	70		8
14	1	PLUG (GRAY LEAD)			
15	2	TRIM RELAY			
16	2	BRACKET			
17	2	GROMMET			
18	2	BUSHING			
19	2	DECAL			
20	4	SCREW (M6 x 25)	70		8
21	1	WIRING HARNESS			
22	1	STARTER SOLENOID			
23	2	GROMMET			
24	2	BUSHING			
25	2	WASHER			
26	1	CABLE			
27	1	SCREW (M6 x 14)	70		8
28	1	BATTERY CABLE (POSITIVE)			
29	2	NUT	60		7
30	2	LOCKWASHER			
31	2	NUT	30		3.5
32	1	CABLE			
33	2	CAP NUT	Drive Tight		
34	1	CABLE			
35	1	CLIP			
36	1	BATTERY CABLE (NEGATIVE)			

Flywheel/Starter Motor



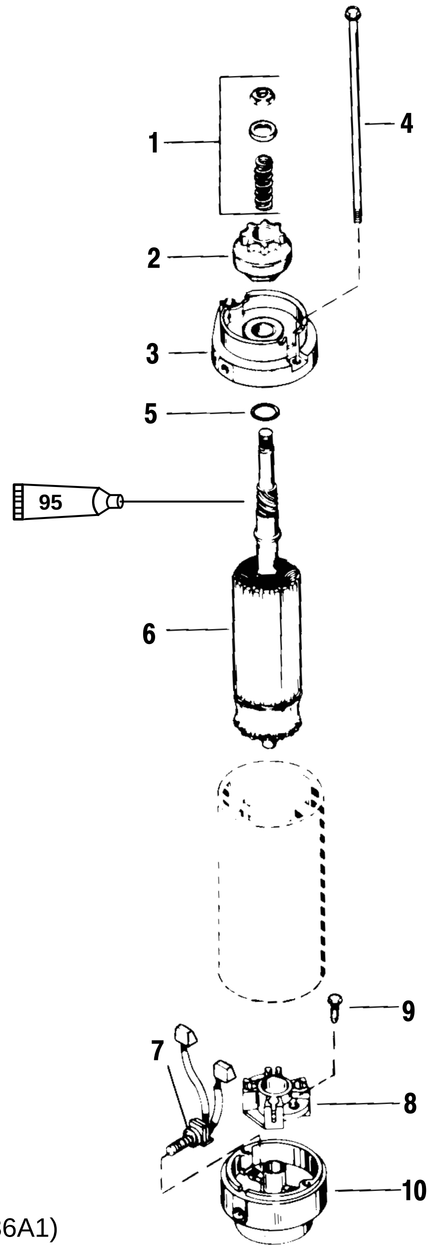
7 Loctite 271 (92-809820)

25 Liquid Neoprene (92-25711--2)

Flywheel/Starter Motor

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	FLYWHEEL COVER ASSEMBLY			
2	1	MARKER			
3	2	SCREW (3/16-32 x 3/8)			
4	2	WASHER			
5	1	PLUG			
6	1	NUT		120	163
7	1	WASHER			
8	1	FLYWHEEL			
9	1	STATOR			
10	5	SCREW (10-32 x 1-3/8)	50		5.5
11	5	WASHER			
12	1	TRIGGER PLATE ASSEMBLY			
13	1	PIVOT			
14	1	NUT			
15	1	LINK ROD			
16	1	BALL JOINT			
17	1	STARTER MOTOR **(See breakdown on Starter Motor)**			
18	2	COLLAR			
19	2	RUBBER STOP			
20	1	SCREW (1/4-20 x 5/8)	60		7.0
21	1	WIRE ASSEMBLY (BLACK)			
22	1	LOCKWASHER			
23	1	NUT	60		7.0
24	1	DECAL-In Gear Idle			
25	1	DECAL-Warning-High Voltage			
26	1	DECAL-Start in Gear			

Starter Motor

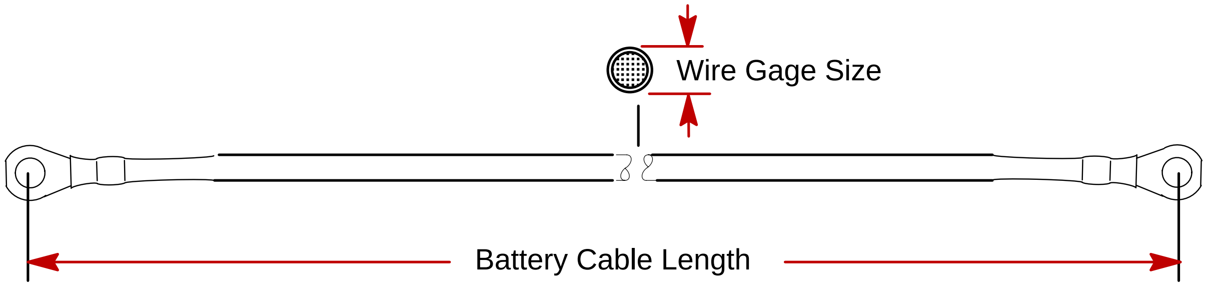


95 2-4-C w/Teflon (92-850736A1)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
–	1	STARTER MOTOR			
1	1	DRIVE KIT			
2	1	DRIVE			
3	1	DRIVE END PLATE			
4	2	THRU BOLT	70		8.0
5	1	WASHER (American Bosch #WA3122)			
6	1	ARMATURE			
7	1	BRUSH SET			
8	2	BRUSH HOLDER			
9	2	SCREW (American Bosch #02441-22-SC-30SM)			
10	1	END CAP			

Battery Cable Size

If standard (original) battery cables are replaced with longer cables, the wire gauge size must increase. See chart below for correct wire gauge size.



Battery Cable Wire Gage Size Mercury/Mariner Outboards																	
	Battery Cable Length																
	8 ft. 2.4m	9 ft. 2.7m	10ft. 3.0m	11ft. 3.4m	12ft. 3.7m	13ft. 4.0m	14ft. 4.3m	15ft. 4.6m	16ft. 4.9m	17ft. 5.2m	18ft. 5.5m	19ft. 5.8m	20ft. 6.1m	21ft. 6.4m	22ft. 6.7m	23ft. 7.0m	24ft. 7.3m
Models	Wire Gage Size No. SAE																
6-25 Hp	#8*	#8	#6	#6	#6	#6	#4	#4	#4	#4	#4	#4	#4	#4	#2	#2	#2
30-115 Hp	#6*	#4	#4	#4	#4	#4	#2	#2	#2	#2	#2	#2	#2	#2	#0	#0	#0
125-250 Hp (except DFI)			#6*	#6	#4	#4	#4	#4	#4	#4	#2	#2	#2	#2	#2	#2	#2
DFI Models					#4*	#2	#2	#2	#2	#2	#2	#2	#2	#2	#0	#0	#0

* = Standard (original) Cable Length and wire gage size.

Replacement Parts

⚠ WARNING

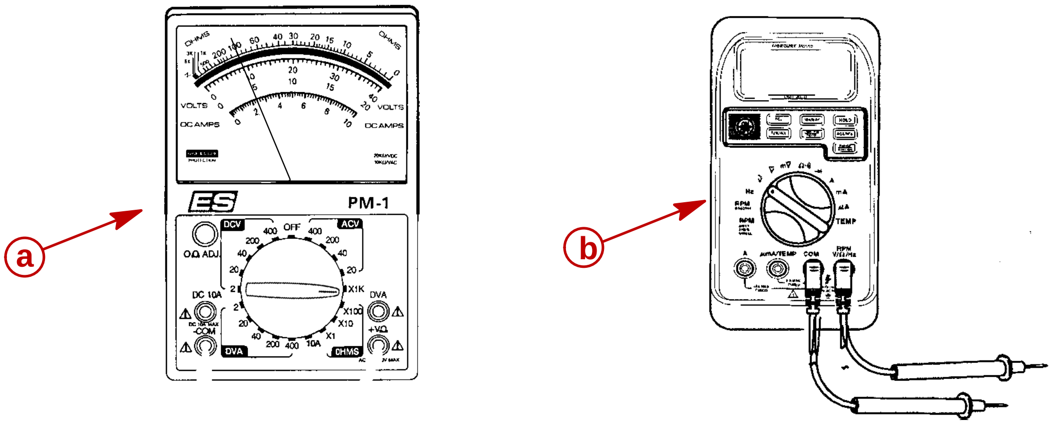
Electrical, ignition and fuel system components on your Mercury/Mariner outboard are designed and manufactured to comply with U. S. Coast Guard Rules and Regulations to minimize risks of fire and explosions. Use of replacement electrical, ignition or fuel system components, which do not comply with these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

Recommended Battery

A 12 volt marine battery with a minimum Cold Cranking amperage rating of 490 amperes or 630 (minimum) Marine Cranking amperes should be used.

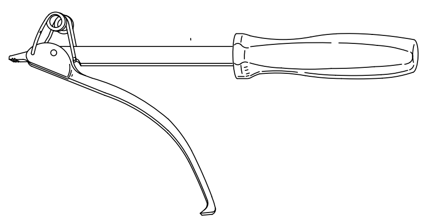
Special Tools

1. Volt/Ohm Meter 91-99750A1or DMT 2000 Digital Tachometer Multimeter 91-854009A1



a - Volt/Ohm Meter 91-99750A1
b - DMT 2000 Digital Tachometer Multimeter 91-854009A1

2. Ammeter (60 Ampere minimum) (Obtain locally)
3. Flywheel Holder 91-52344



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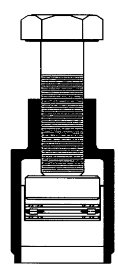
4. Protector Cap 91-24161

5. Flywheel Puller 91-849154T1



55117

Battery

Precautions

⚠ CAUTION

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

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

The following precautions should be observed to prevent an explosion.

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

Charging a Discharged Battery

WARNING

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

The following basic rule applies to any battery charging situation:

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

Winter Storage of Batteries

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

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

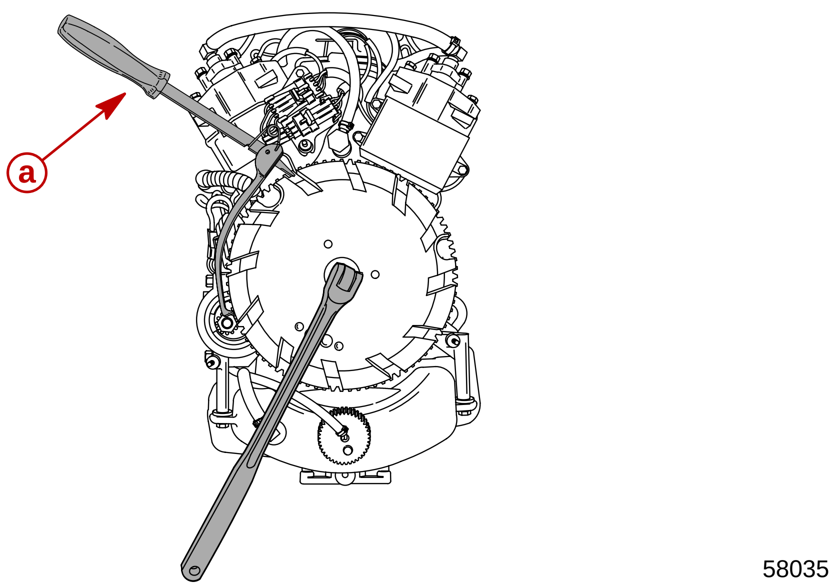
Flywheel Removal and Installation

Removal

1. Remove flywheel cover from engine.

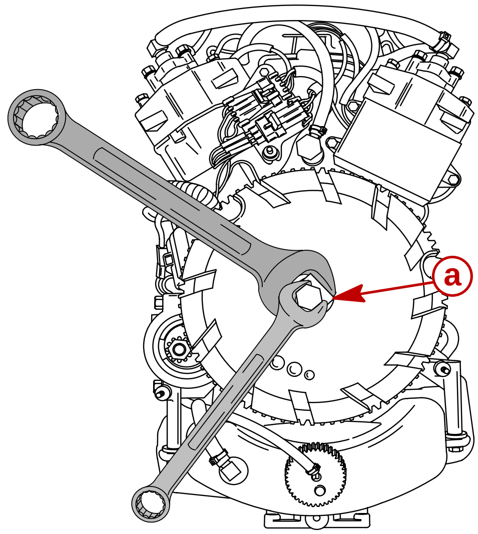
⚠ WARNING
Engine could possibly start when turning flywheel during removal and installation; therefore, disconnect (and isolate) spark plug leads from spark plugs to prevent engine from starting.

2. Disconnect spark plug leads from spark plugs.
3. While holding flywheel with Flywheel Holder (91-52344), remove flywheel nut and washer.



a - Flywheel Holder (91-52344)

4. Install Flywheel Puller (91-849154T1) into flywheel.
5. Hold flywheel tool with wrench while tightening bolt down. Tighten bolt until flywheel comes free.



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a - Flywheel Puller (91-849154T1)

***NOTE:** Neither heat or hammer should be used on flywheel to aid in removal as damage to flywheel or electrical components may result.*

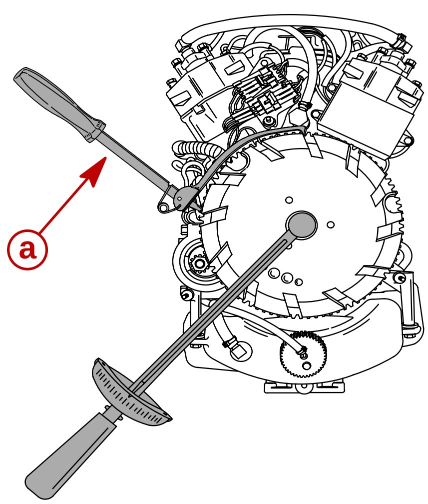
6. Remove flywheel. Inspect flywheel for cracks or damage.

Installation

IMPORTANT: Inspect flywheel magnets for clinging debris. Failure to remove debris before installing flywheel may result in damage to flywheel or electrical components under flywheel when outboard is initially started.

IMPORTANT: Do not apply any greases, oils or lubricants to flywheel/crankshaft taper surfaces. Clean flywheel/crankshaft taper with solvent and assemble dry.

1. Install flywheel.
2. Install flywheel washer and nut.
3. Hold flywheel with Flywheel Holder (91-52344). Torque nut to 120 lb. ft. (163 Nm).



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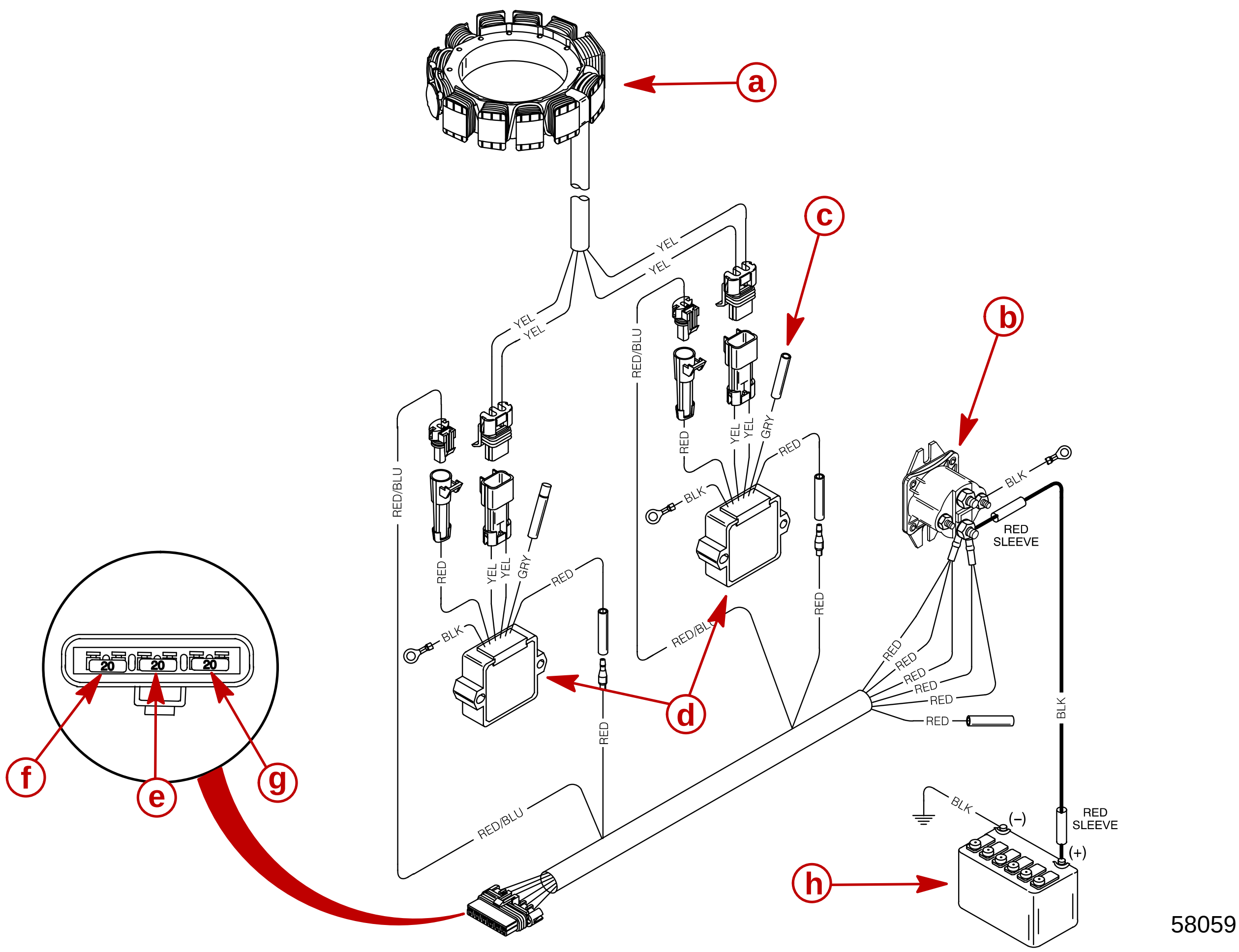
a - Flywheel Holder (91-52344)

Battery Charging System Description

Battery charging components – flywheel permanent magnets, stator, voltage regulator/rectifier and battery. Rotating flywheel magnets induce an alternating current (AC) in the stator coils. AC current is rectified to direct current (DC) by the voltage regulator. DC output from the voltage regulator is used to charge the battery. The voltage regulators sense the battery voltage as a measure of the battery's state of charge and regulate the DC current flow to the battery. The 2 voltage regulators are each protected by a 20 ampere fuse.



a - 40 Ampere Stator
b - Starter Solenoid
c - To Tachometer
d - Voltage Regulators
e - Upper Voltage Regulator – 20 Amp Fuse
f - Lower Voltage Regulator – 20 Amp Fuse
g - Accessories – 20 Amp Fuse
h - 12 Volt Battery

Precautions

1. Never disconnect voltage regulator output leads, regulator harnesses or battery cables while engine is running.
2. Always remove NEGATIVE (–) battery cable from battery before working on battery charging system.
3. When installing battery, connect the NEGATIVE (–) (GROUNDED) battery cable to NEGATIVE (–) battery terminal and the POSITIVE (+) battery cable to POSITIVE (+) battery terminal.
4. When using a charger or booster battery, connect it in parallel with existing battery (POSITIVE to POSITIVE; NEGATIVE to NEGATIVE).

Battery Charging System Troubleshooting

General Troubleshooting

A fault in the battery charging system will usually cause the battery to become UNDER-CHARGED. A defective voltage regulator or a stator winding shorted to ground may also allow the system to OVERCHARGE the battery.

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

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

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

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

If the system is still OVERCHARGING the battery, disconnect the YELLOW wire connector from the regulator(s). Check for continuity between either YELLOW wire and ground which would indicate a shorted stator winding. A short to ground in the stator bypasses the regulation circuit of the voltage regulator resulting in overcharging of the battery. If the YELLOW wires are not shorted to ground, the voltage regulator is most likely defective and should be replaced.

If the battery is undercharged, proceed with regulator, stator, and rectifier tests, following.

40 Ampere Alternator System

40 AMP STATOR TEST (ALTERNATOR COILS ONLY)

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

1. Disconnect YELLOW stator leads from voltage regulator connectors on starboard side of engine.
2. Use an ohmmeter and perform the following test:

Test Leads To-	Resistance (Ohms)	Scale Reading
Connect test leads between 2 YELLOW stator leads at each voltage regulator connector.	0.18-.45*	R x 1
RED test lead to 1 YELLOW stator lead (voltage regulator connector), and BLACK test lead to engine ground if stator is mounted or to steel frame of stator (if off engine)	No Continuity	R x 1000

NOTE: Resistance of these windings is less than one ohm. Copper wire is an excellent conductor but will have noticeable differences from cold to hot. Reasonable variation from specified reading is acceptable.

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

TROUBLESHOOTING 40 AMP ALTERNATOR SYSTEM

⚠ WARNING

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

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

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

DETERMINING CAUSE OF PROBLEM

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

PROBLEM: CONSTANT HIGH OUTPUT

⚠ CAUTION

Engine must be shut off when performing the following tests. Disconnecting the YELLOW stator lead connectors at the voltage regulators while the engine is running will result in voltage regulator failure.

1. Stator Test – Place RED ohmmeter lead in YELLOW stator lead connector. Place BLACK ohmmeter lead to ground. There should be no continuity between any YELLOW stator lead and ground. If there is continuity, stator is shorted and must be replaced.
2. Voltage Regulator SCR Test – Place RED ohmmeter lead in YELLOW voltage regulator lead connector. Place BLACK ohmmeter lead to ground. There should be no continuity. If there is continuity, SCR in voltage regulator is defective and regulator must be replaced.
3. Voltage Regulator Regulation Circuit Test* – Check voltage at battery (battery should be fully charged). After engine initially starts, voltage will rise to 15.5 – 16.5 volts and then drop below 15 volts where it should stabilize. If the voltage does not stabilize below 15 volts, voltage regulation circuit is defective. Replace voltage regulator.

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

PROBLEM: NO OUTPUT

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

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

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

REGULATION VOLTAGE CHECK

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

1. Turn on all electrical accessories and crank engine for 20 seconds with the ignition lanyard switch turned off. This will discharge battery slightly.
2. Start engine and observe battery voltage. Voltage should slowly rise to approximately 14 to 16 volts. If voltage does not rise, repeat previous tests for stator and regulator.

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

VOLTAGE REGULATOR TEST (USING ANALOG METER)

NOTE: *Verify meter is zeroed before making any measurements.*

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

Disconnect all voltage regulator wires.

Using analog meter, perform each ohms test listed below:

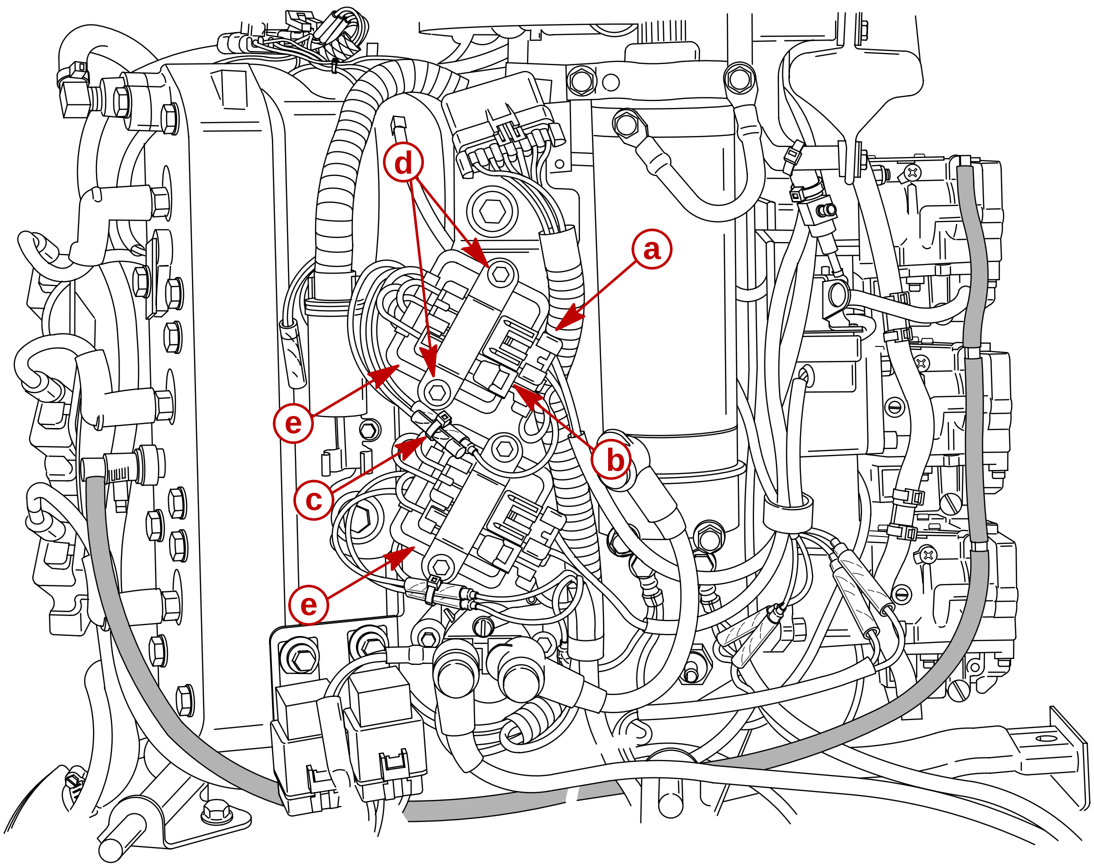
Test Leads To-	Resistance (Ohms)	Scale
Diode Check: Connect NEGATIVE (–) ohm lead to either YELLOW lead. Connect POSITIVE (+) test lead to thick RED lead.	100-400	R x 10
Diode Check: Connect NEGATIVE (–) ohm lead to thick RED lead. Connect POSITIVE (+) ohm lead to either YELLOW lead.	20000 to ∞	R x 1K
SCR Checks: Connect NEGATIVE (–) ohm lead to either YELLOW lead. Connect POSITIVE (+) ohm lead to case ground.	8000 – 15000	R x 1K
Tachometer Circuit Check: Connect NEGATIVE (–) ohm lead to case ground. Connect POSITIVE (+) ohm lead to GRAY lead.	10000 – 50000	R x 1K

VOLTAGE REGULATOR TEST (USING DIGITAL METER)

Test Leads To-	Resistance (Ohms)	Scale
Diode Check: Connect NEGATIVE (–) meter lead to RED regulator lead in connector. Connect POSITIVE (+) test lead to either YELLOW regulator lead.	0.4 – 0.8 volts	⊣▶⊢
Diode Check: Connect NEGATIVE (–) meter lead to either YELLOW regulator lead. Connect POSITIVE (+) ohm lead to RED regulator lead in connector.	∞ or OUCH or OL	⊣▶⊢
SCR Checks: Connect NEGATIVE (–) meter lead to regulator case. Connect POSITIVE (+) meter lead to either YELLOW regulator lead.	1.5 volt – ∞ or OUCH or OL	⊣▶⊢
Tachometer Circuit Check: Not measurable with digital meter		

Removal of Voltage Regulators

1. Disconnect YELLOW stator lead connector.
2. Disconnect RED output lead connector.
3. Disconnect RED sense lead bullet connector.
4. Remove 2 screws securing regulator to electrical plate.



58021

a - YELLOW Stator Connector
b - RED Output Lead Connector
c - RED Sense Lead Bullet Connector
d - Screws
e - Voltage Regulators

Installation of Voltage Regulators

1. Secure regulator to electrical plate with 2 screws. Torque screws to 70 lb. in. (8 Nm).
2. Reconnect YELLOW stator lead connector.
3. Reconnect RED output lead connector.
4. Reconnect RED sense lead bullet connector.

Incorporating a Battery Isolator with a 40 Ampere Charging System

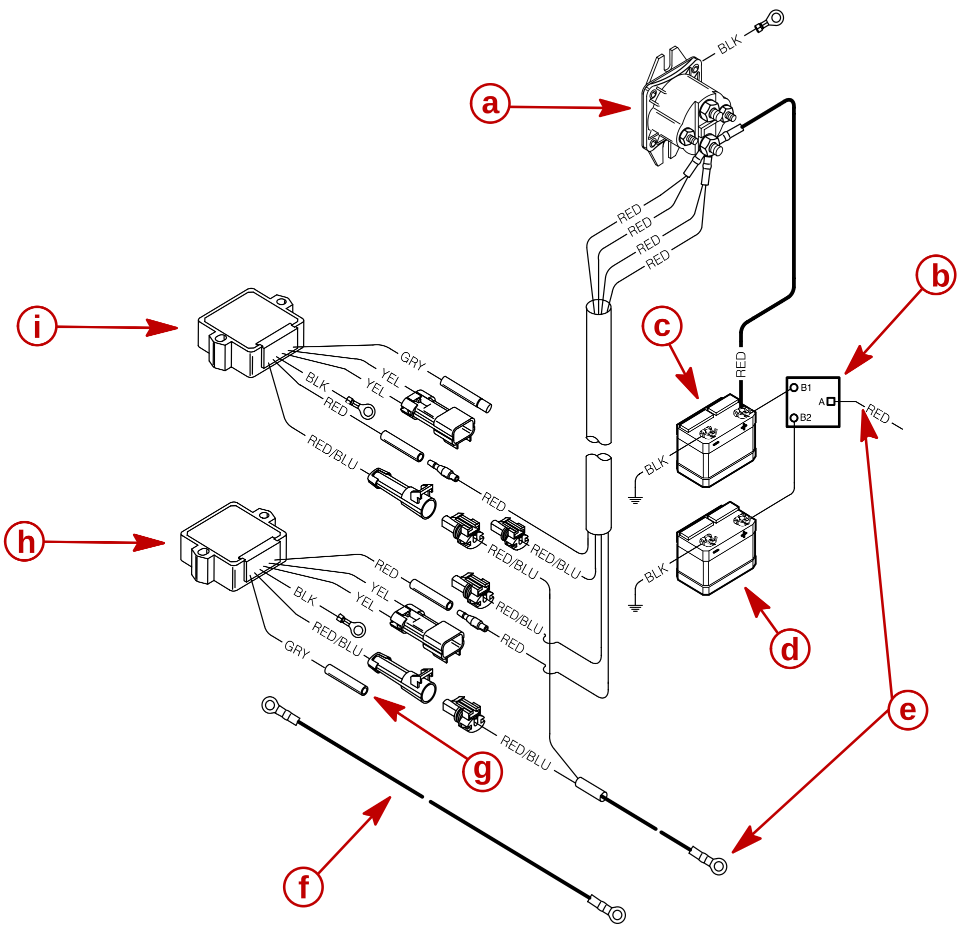
A battery isolator will allow the charging system to charge both the starting battery and an auxiliary battery at the same time while preventing accessories, connected to the auxiliary battery, from drawing power from the cranking battery.

1. Install the isolator as prescribed by the manufacturer.

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

2. Charging system can be wired to provide either 20 amps to auxiliary battery and 20 amps to cranking battery or 40 amps to isolator.

System Wired for 40 Ampere Output to Isolator



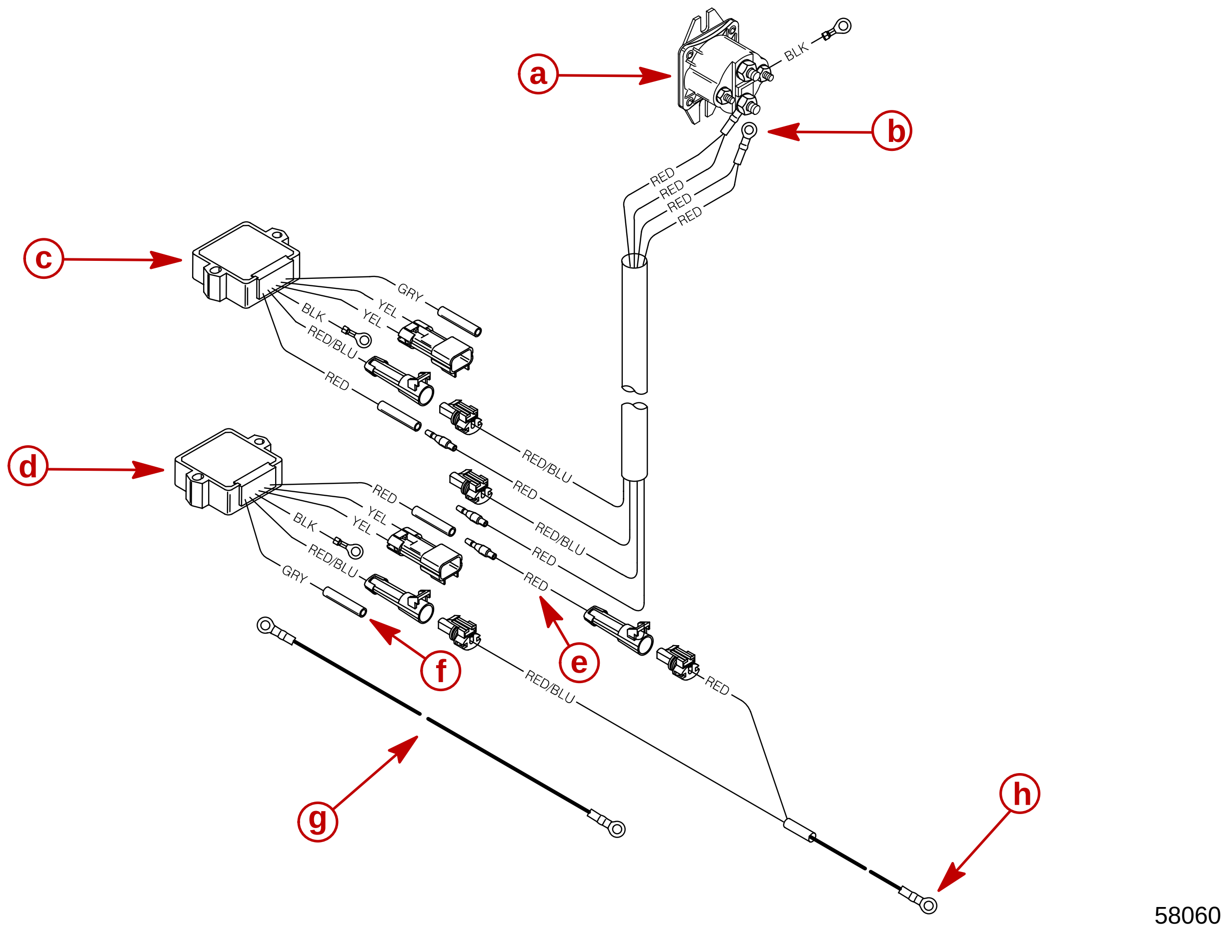
58061

- **a** - Starter Solenoid
- **b** - Battery Isolator
- **c** - Start Battery
- **d** - Auxiliary Battery
- **e** - To Battery Isolator
- **f** - BLACK Cable from Auxiliary Battery to Engine Ground
- **g** - Tachometer Lead
- **h** - Lower Regulator
- **i** - Upper Regulator

System Wired for Split Output

20 AMPERES TO AUXILIARY BATTERY

20 AMPERES TO CRANKING BATTERY



a - Starter Solenoid
b - Disconnect (and discard) RED leads to lower regulator
c - Upper Regulator
d - Lower Regulator
e - Jumper Wire (from kit)
f - Tachometer Lead
g - BLACK Cable from auxiliary battery to engine ground
h - RED Cable to auxiliary battery

Starter System

Starter System Components

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

Description

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

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

⚠CAUTION

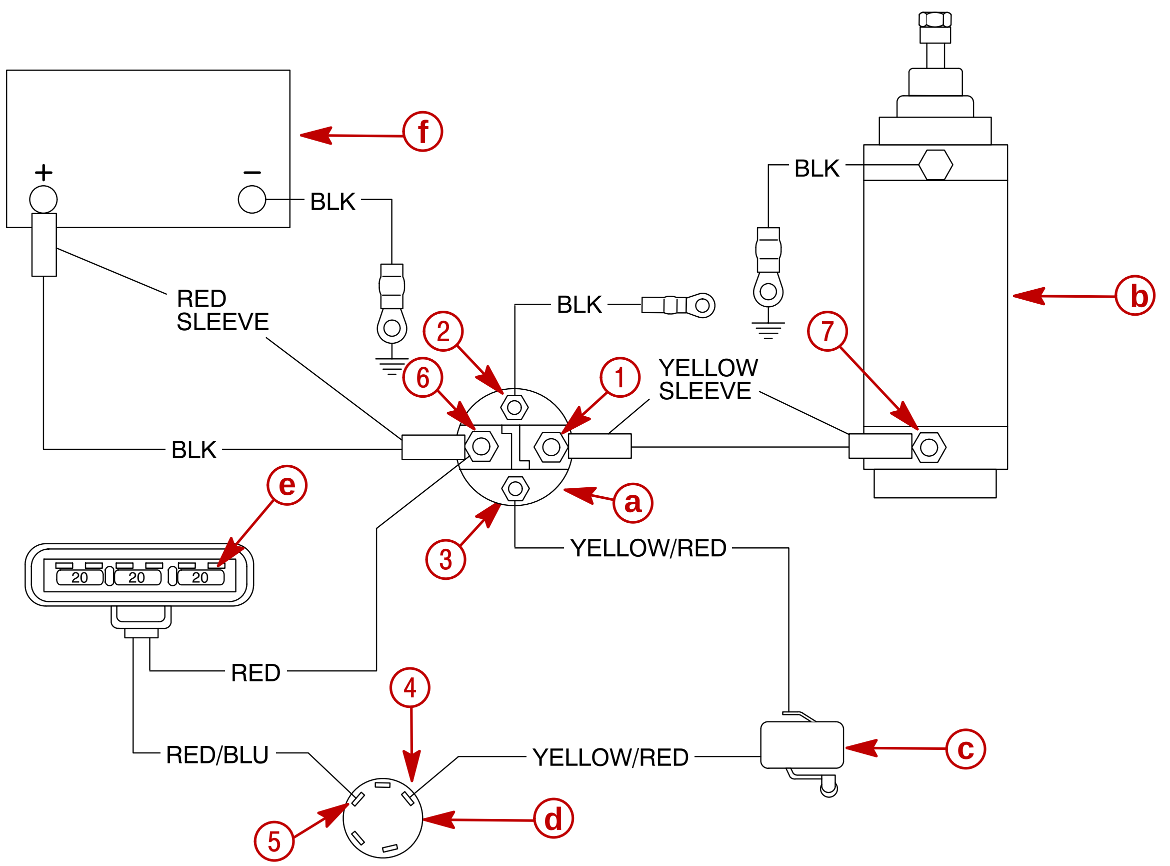
The starter motor may be damaged if operated continuously. DO NOT operate continuously for more than 30 seconds. Allow a 2 minute cooling period between starting attempts.

Troubleshooting the Starter Circuit

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

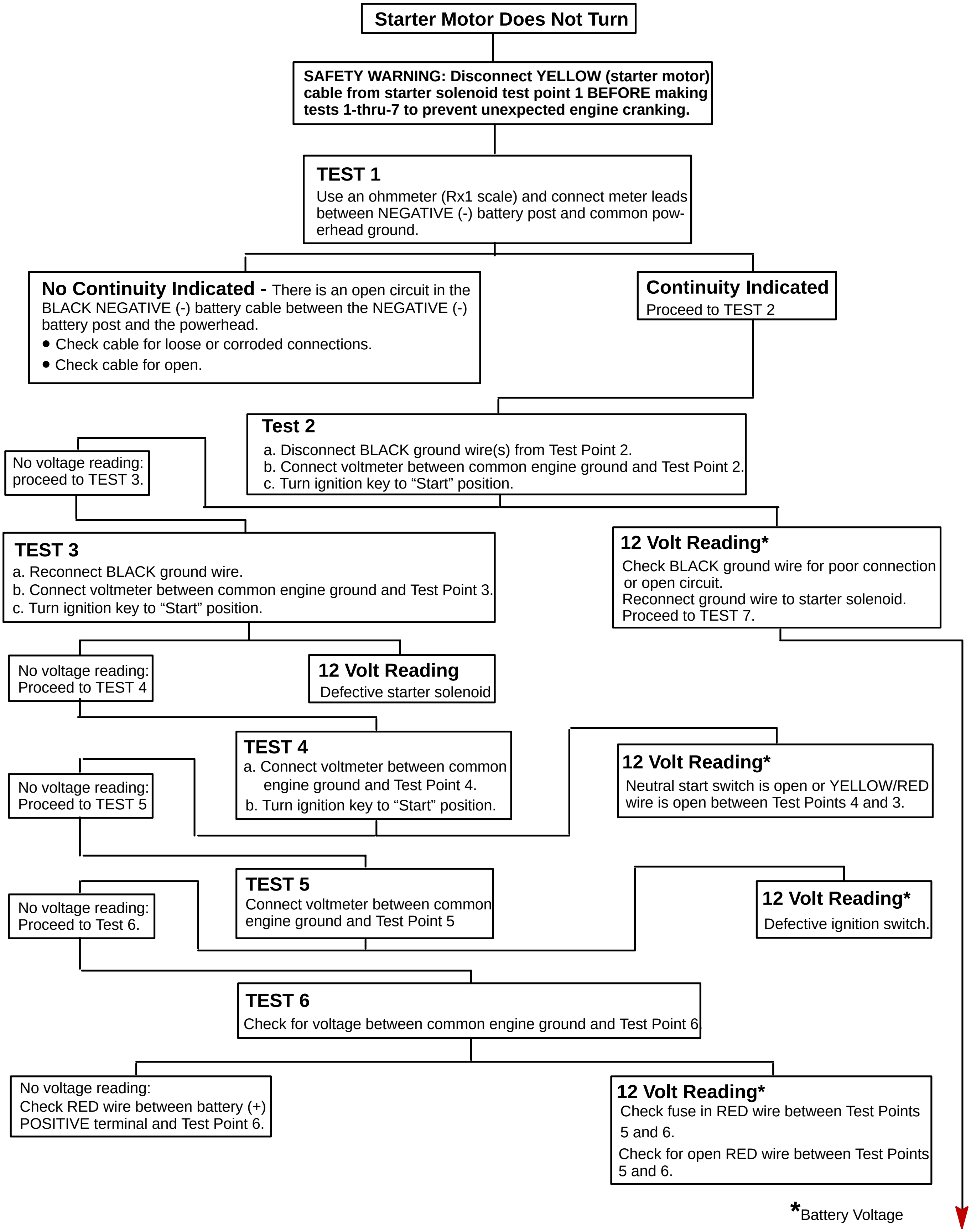
1. Battery is fully charged.
2. Control lever is in “NEUTRAL” position.
3. Check terminals for corrosion and loose connections.
4. Check cables and wiring for frayed and worn insulation.
5. Check 20 amp fuse.

***NOTE:** *Location of test points (called out in flow chart) are numbered below.*



a - Starter Solenoid
b - Starter
c - Neutral Start Switch
d - Ignition Switch
e - 20 Ampere Fuse
f - Battery

Starter Circuit Troubleshooting Flow Chart



Flow Chart (continued)

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

No voltage reading:
Defective starter solenoid

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

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

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

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

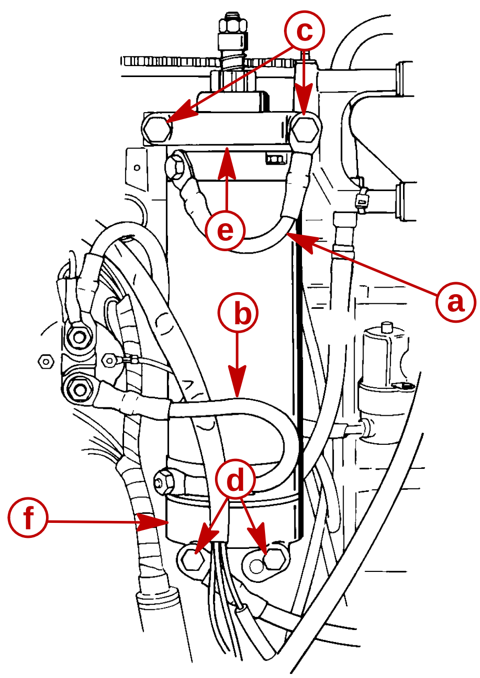
*Battery Voltage

Starter Removal

⚠ CAUTION

Disconnect battery leads from battery before removing starter.

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

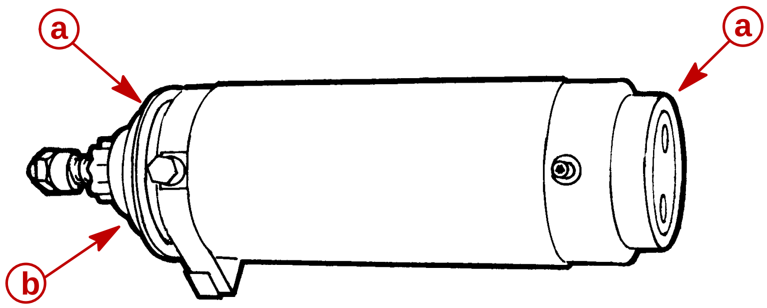


51840

a - BLACK ground cable
b - BLACK (with YELLOW sleeve) + 12 volt cable
c - Upper Mount Bolts
d - Lower Mount Bolts
e - Upper Clamp
f - Lower Clamp

Installation

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



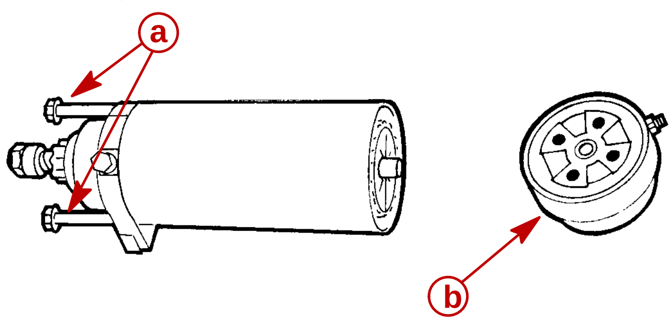
11645

a - Rubber Collar
b - Spacer (If Equipped)

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

Disassembly

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

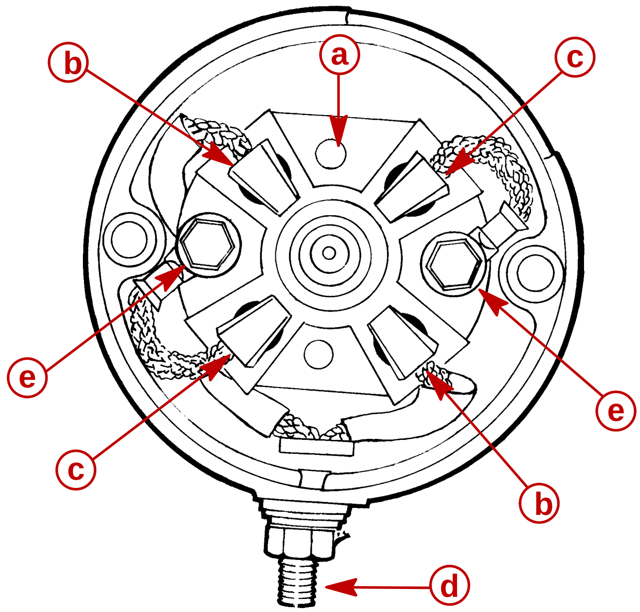


11646

a - Through Bolts
b - Commutator End Cap

3. Tap commutator end cap to loosen and remove from frame. Do not lose brush springs.

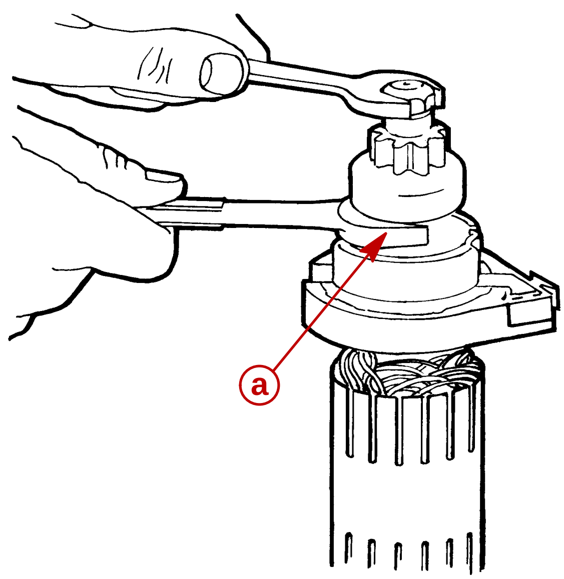
4. Brush replacement is recommended if brushes are pitted, chipped or worn to less than 0.25 in. (6.4 mm). If necessary, remove brushes as follows:
   a. Remove hex nut and washers from POSITIVE (+) terminal and remove POSITIVE brushes and terminal as an assembly.
   b. Remove 2 bolts securing NEGATIVE (-) brushes and brush holder to end cap.



11656

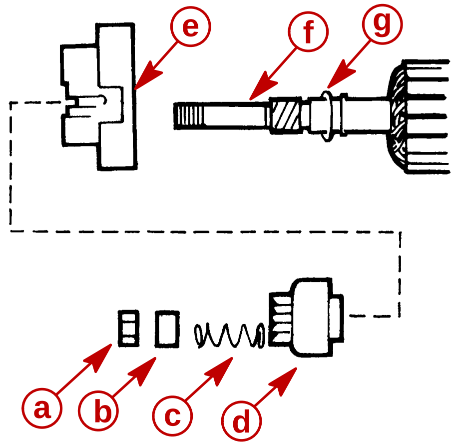
a - Brush Holder
b - Positive Brushes
c - Negative Brushes
d - Positive Terminal
e - Bolts (fasten negative brushes and holder)

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



a - Hold armature shaft with wrench on hex portion of drive assembly

7. Remove parts from shaft.



11658

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

Starter Cleaning, Inspection and Testing

CLEANING AND INSPECTION

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

⚠ CAUTION
Do not turn down the commutator excessively.

a. Resurface the commutator and undercut the insulation between the commutator bars 1/32 in. (0.8mm) to the full width of the insulation and so that the undercut is flat.

b. Clean the commutator slots after undercutting.

c. Sand the commutator lightly with No. 00 sandpaper to remove burrs, then clean the commutator.

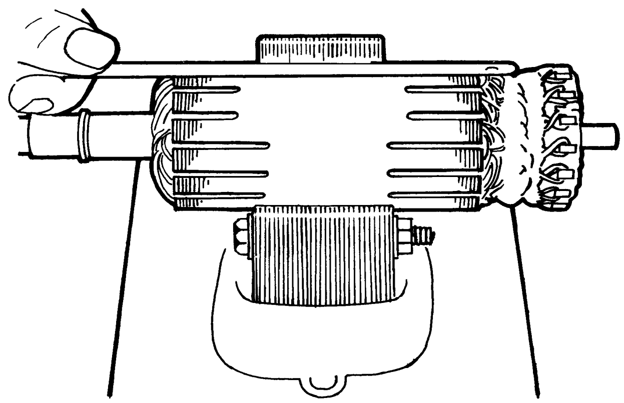
d. Recheck the armature on a growler for shorts as specified in the following procedure (“Testing”).

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

TESTING

Armature Test for Shorts

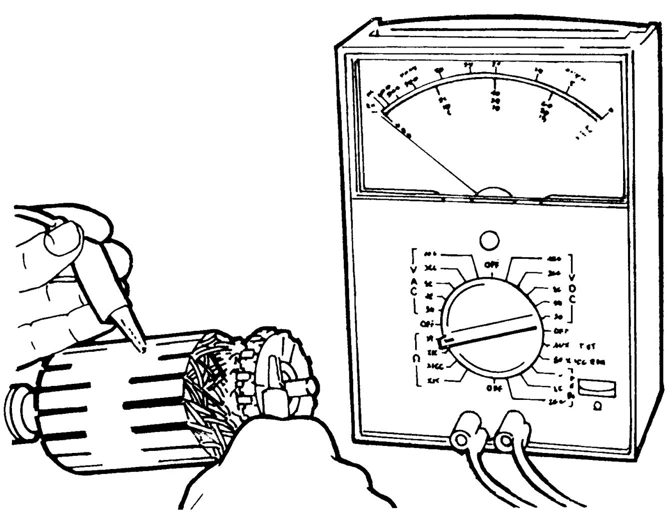
Check armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between commutator bars. If saw blade still vibrates, replace armature.



11669

Armature Test for Ground

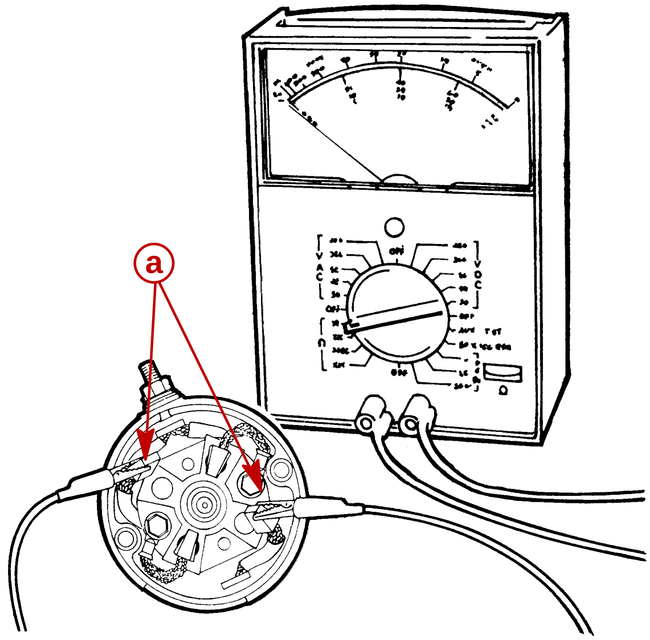
1. Set ohmmeter to (R x 1 scale). Place one lead of ohmmeter on armature core or shaft and other lead on commutator.
2. If meter indicates continuity, armature is grounded and must be replaced.



11675

Checking Positive Brushes and Terminal

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

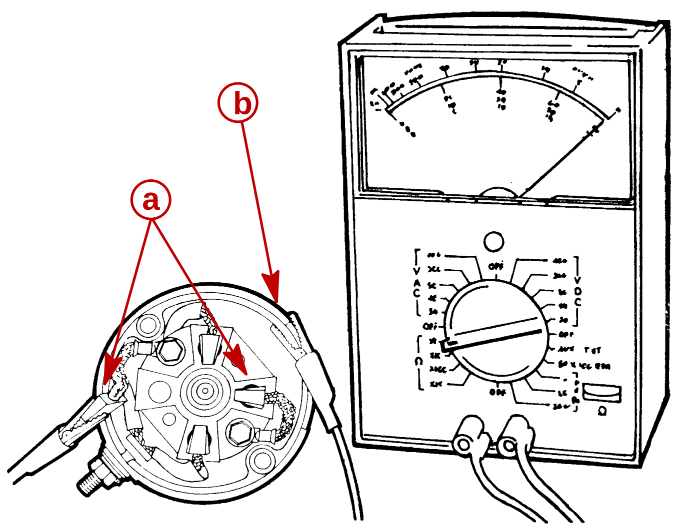


11673

a - Positive (+) Brushes

Testing Negative Brushes for Ground

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

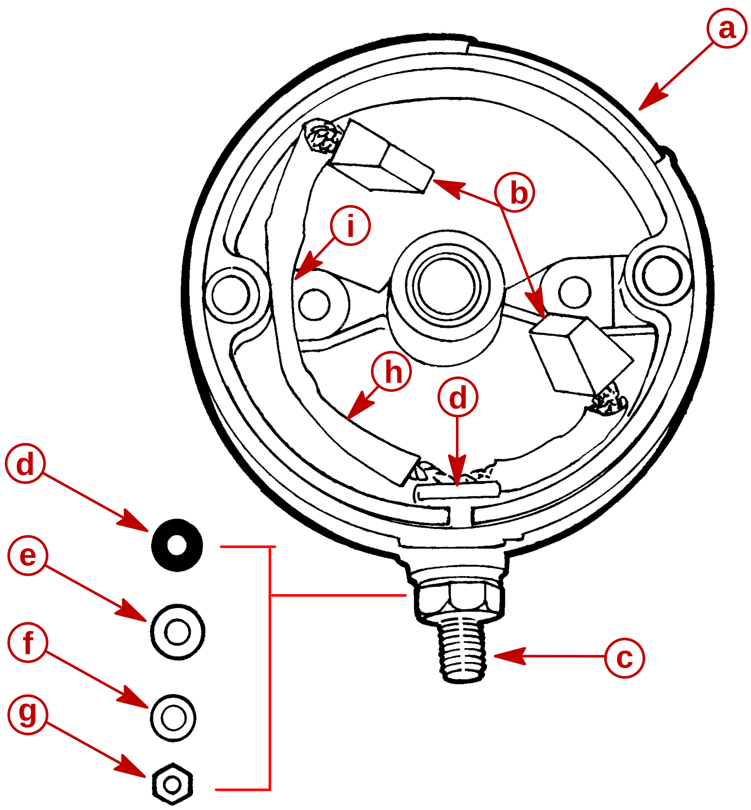


11674

a - Negative (–) Brushes
b - End Cap

Starter Reassembly

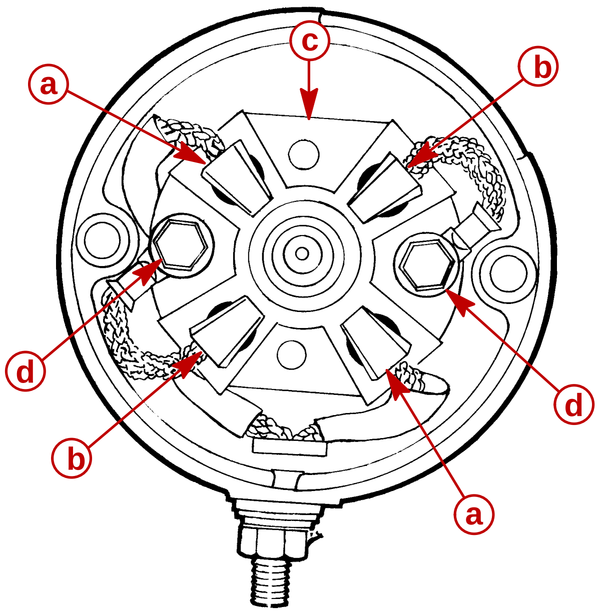
1. If brushes were removed, replace as follows:
   a. Install POSITIVE brushes (along with POSITIVE terminal) into commutator end cap.



11660

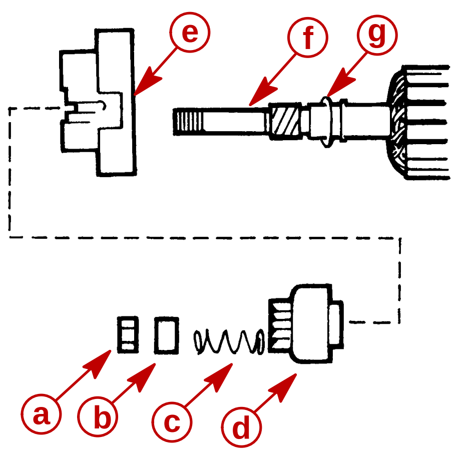
a - End Cap
b - Positive Brushes
c - Positive Terminal
d - Insulating Bushing
e - Washer
f - Split Washer
g - Hex Nut
h - Long Brush Lead
i - Push Lead into Slot

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



a - Positive (+) Brushes
b - Negative (–) Brushes
c - Brush Holder
d - Bolts (fasten negative brushes and holder)

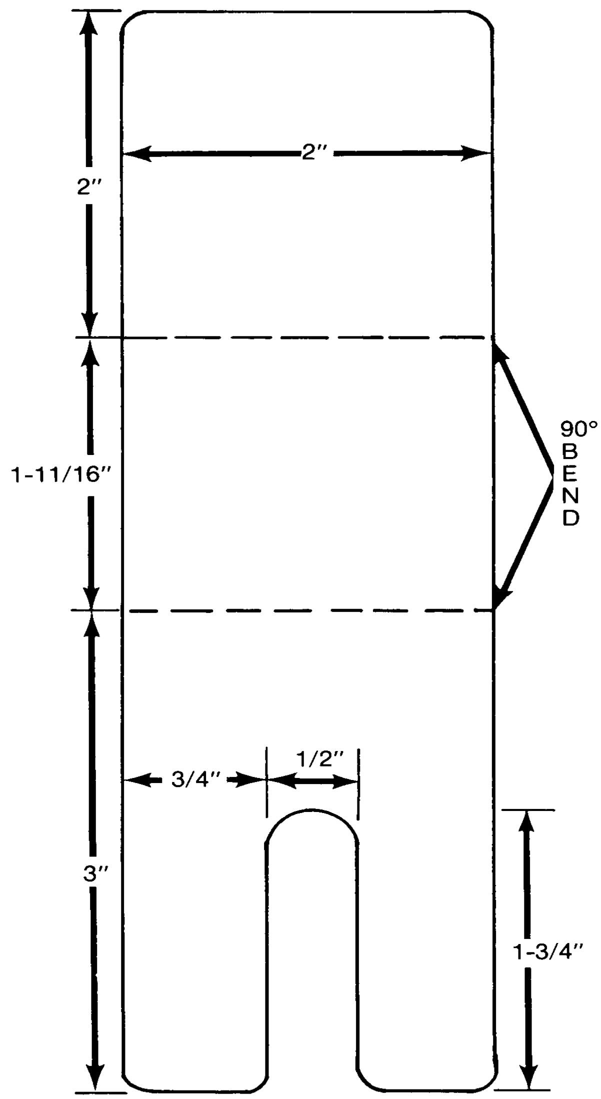
2. If removed, reinstall parts on armature shaft. Use a new locknut and tighten securely on end of shaft.

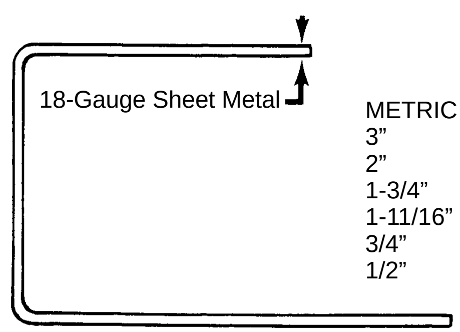


a - Locknut
b - Spacer
c - Spring
d - Drive Assembly
e - Drive End Cap
f - Armature Shaft
g - Washer

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

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



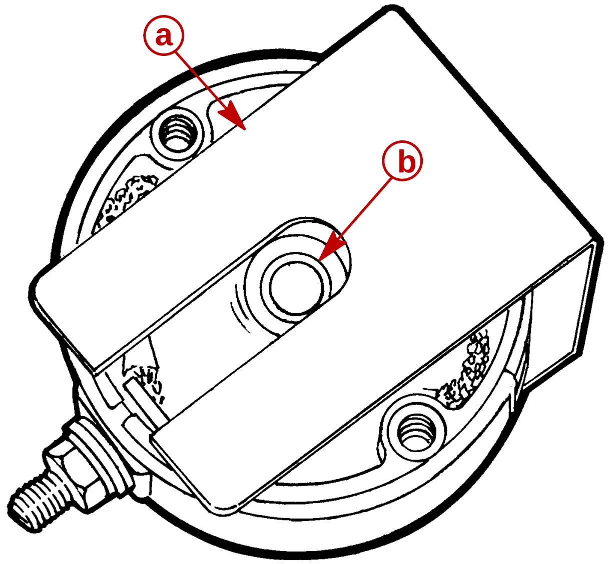


METRIC SCALE

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

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

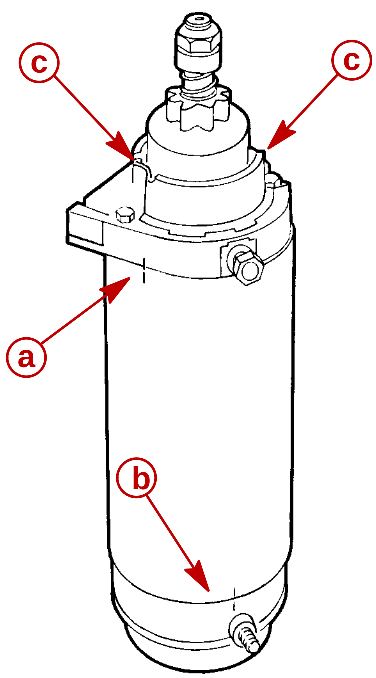
8. Place springs and brushes into brush holder and hold in place with brush retainer tool.



11661

a - Bushing Retainer Tool
b - Bushing (do not over lubricate)

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

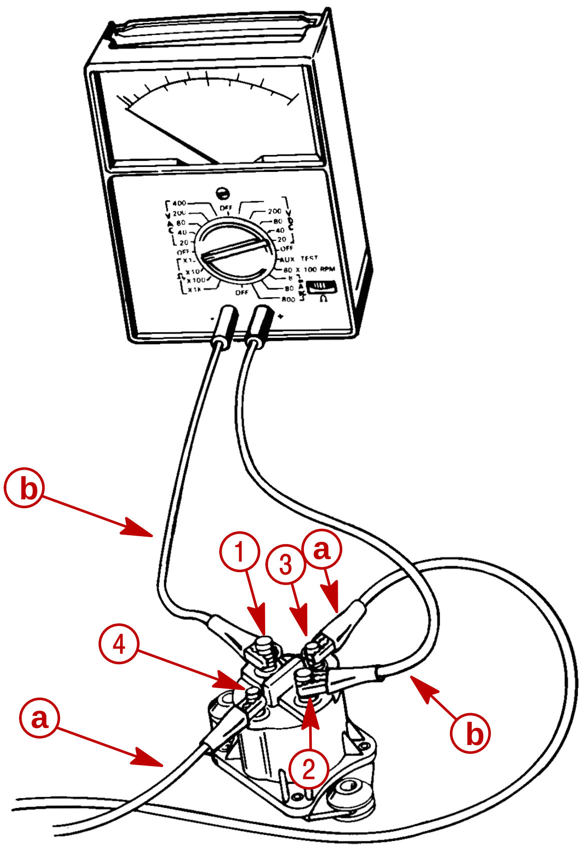


11648

a - Alignment Marks
b - Alignment Marks
c - Bolts [Torque to 70 lb. in. (8 N m)]

STARTER SOLENOID TEST

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



51809

a - 12 Volt Supply
b - VOA Leads

ELECTRICAL

Section 2C - Timing, Synchronizing & Adjusting

Table of Contents

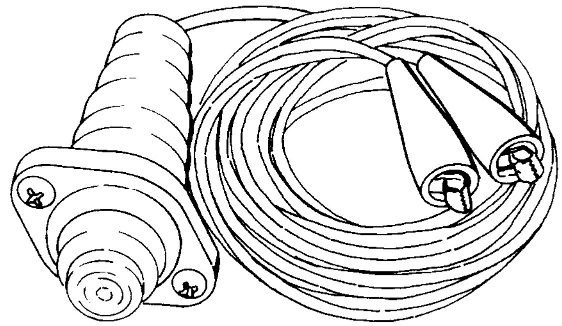
Specifications

CARBURETOR MODELS	**Idle RPM** **– Model 135/200** **– Model XR6/MAGIII** **Wide Open Throttle (WOT) RPM** **– Model 135/200** **– Model XR6/MAGIII** **Idle Mixture Screw Adjustment (Preset - Turns Out)** **– Carburetor Model 135** **– Carburetor Model 150/200** **– All EFI Models** **Float Adjustment** **Float Level**	 650 ± 50 675 ± 50 5000 – 5500 5000 – 5500 1-1/2 ± 1/8 1-1/4 ± 1/8 Not Adjustable Float Even with Bowl Edge w/Bowl Inverted
EFI MODELS	**Idle RPM** **– All Models** **Wide Open Throttle (WOT) RPM** **– Model 150XRI/175XRI** **– Model 200XRI** **Float Adjustment (Vapor Separator)** **Float Level**	 650 ± 50 5000 – 5600 5000 – 5800 Preset @ Factory
IGNITION SYSTEM	**Type** **Spark Plug Type** **Spark Plug Gap** **Firing Order**	Capacitor Discharge NGK BPZ8HS-10 0.040 in. (1.0 mm) 1-2-3-4-5-6

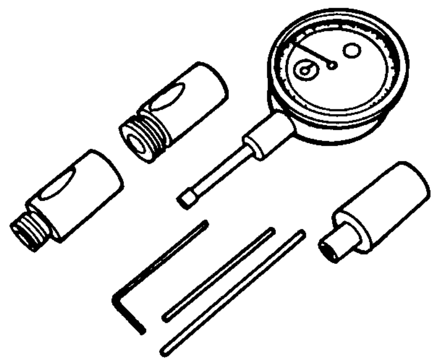
TIMING	**Idle Speed/Pickup Timing** **– 135 Carb** **– XR6/MAG III** **– 200 Carb** **– 150XRI/175 XRI Models** **– 200 XRI Model**	 0° – 9° ATDC
	Maximum BTDC **– Model 135** **@ Cranking Speed** **@ WOT RPM**	 25° BTDC 19° BTDC
	– XR6/MAG III/175 XRI **@ Cranking Speed** **@ WOT RPM**	 26° BTDC 20° BTDC
	– Model 150 XRI **@ Cranking Speed** **@ WOT RPM**	 22° BTDC 16° BTDC
	– Model 200 Carb **@ Cranking Speed** **@ WOT RPM**	 24° BTDC 18° BTDC
	– Model 200XRI **@ Cranking Speed** **@ WOT RPM**	 24° BTDC 18° BTDC

Special Tools

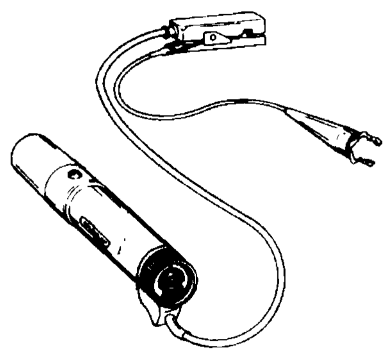
1. Remote Starter Switch 91-52024A1



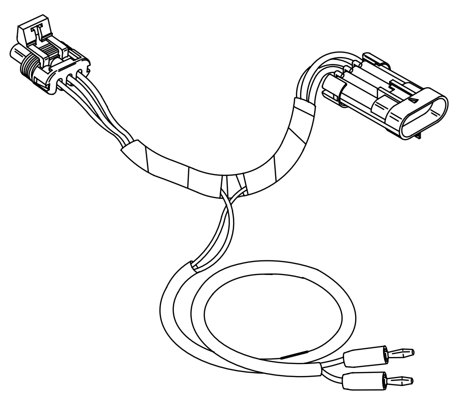
2. Dial Indicator 91-58222A1



3. Timing Light 91-99379



4. Throttle Position Sensor Test Harness (91-859199)



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Adjustments

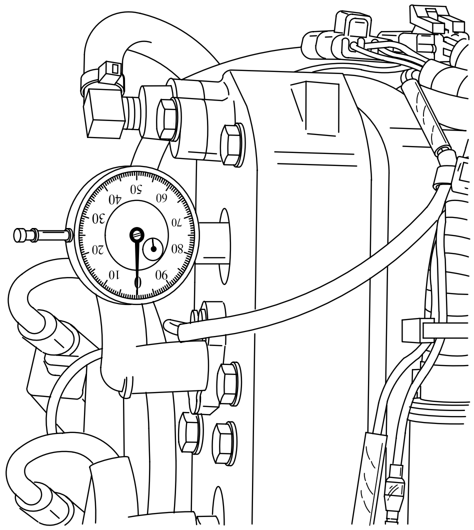
Carburetor Models

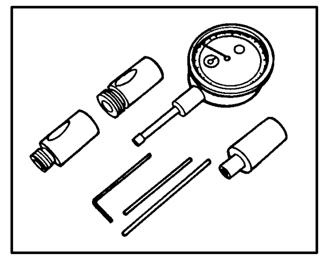
TIMING POINTER ADJUSTMENT

WARNING

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

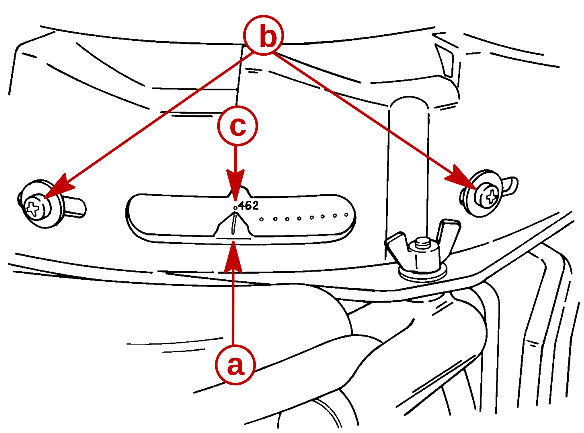
1. Remove all spark plugs and install Dial Indicator (91-58222A1) into No. 1 cylinder (top cylinder, starboard bank).





58046

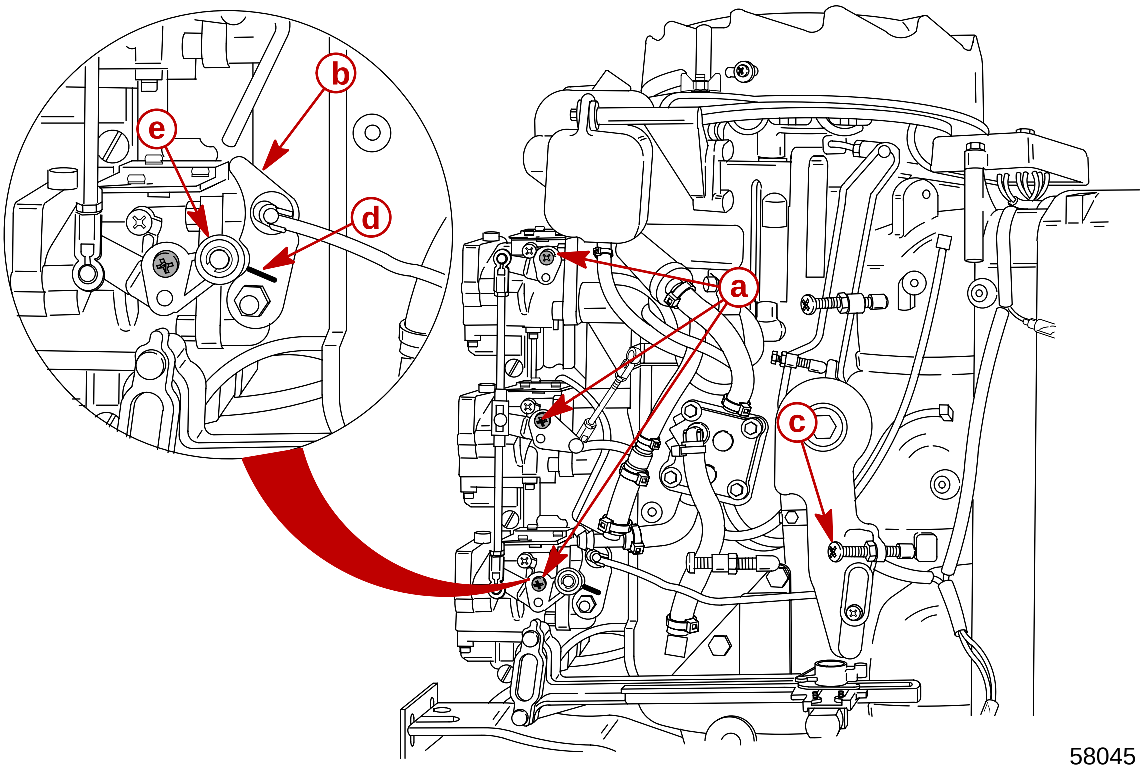
2. Turn flywheel in a clockwise direction until No. 1 piston is at top dead center (TDC). Set dial indicator at "O" (zero) and tighten indicator set screw.
3. Turn flywheel counterclockwise until dial indicator needle is approximately 1/4-turn beyond 0.462 in., then turn flywheel clockwise so that dial indicator reads 0.462 in. (11.7mm) exactly.
4. Reposition timing pointer so that timing pointer is aligned with 0.462 in. mark on timing decal. Retighten pointer attaching screws 20 lb. in. (2.3 Nm)
5. Remove dial indicator from cylinder.



a - Timing Pointer
b - Attaching Screws
c - 0.462 in. Mark

CARBURETOR SYNCHRONIZATION

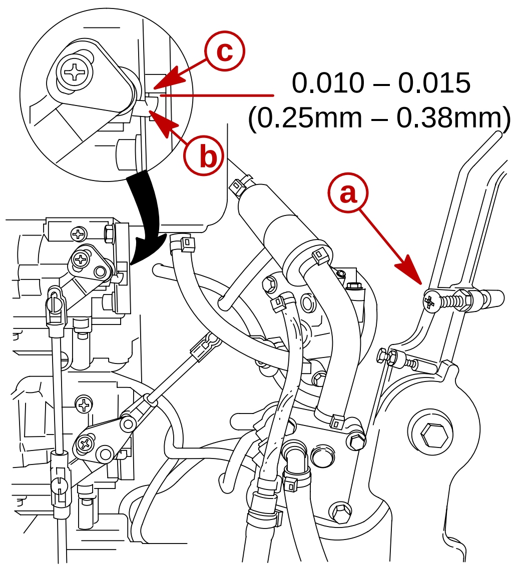
1. Loosen 3 carburetor synchronization screws (a) to allow shutter plates to close completely.
2. Position throttle lever so that idle stop screw is against idle stop and move roller arm until roller lightly touches throttle cam (b). Adjust idle stop screw (c) on throttle arm to align mark (d) on throttle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



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

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

4. Move throttle lever to wide-open-throttle (W.O.T.) position and adjust full throttle stop screw (a) to allow full throttle shutter opening at W.O.T. Verify that throttle shutters do not act as a throttle stop. Allow 0.010 in. - 0.015 in. (0.25mm - 0.38mm) clearance between throttle shaft arm(b) and stop (c) at W.O.T. Retighten jam nut on adjustment screw.

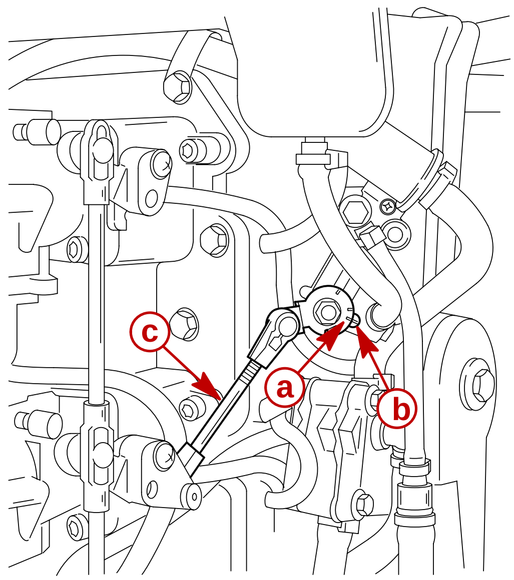


54389

a - Throttle Stop Screw
b - Throttle Shaft Arm
c - Stop

CARBURETOR/OIL PUMP SYNCHRONIZATION

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



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

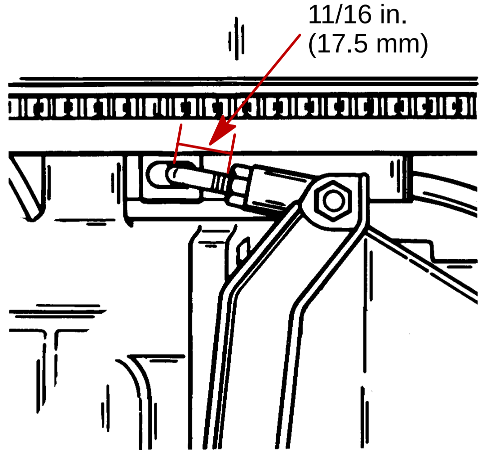
TIMING ADJUSTMENTS

⚠ CAUTION

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

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

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



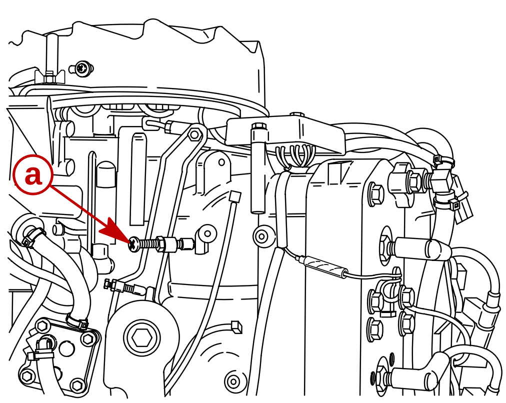
⚠ WARNING

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

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

MAXIMUM TIMING ADJUSTMENT

1. Connect timing light to No 1 spark plug lead (TOP STARBOARD BANK).
2. With engine in neutral, move throttle lever to place maximum spark advance screw against stop. Crank engine with starter motor and adjust maximum spark advance screw to align timing mark (see specifications on page 2C-2) with timing pointer. Ignition timing will retard as engine speed approaches maximum RPM.



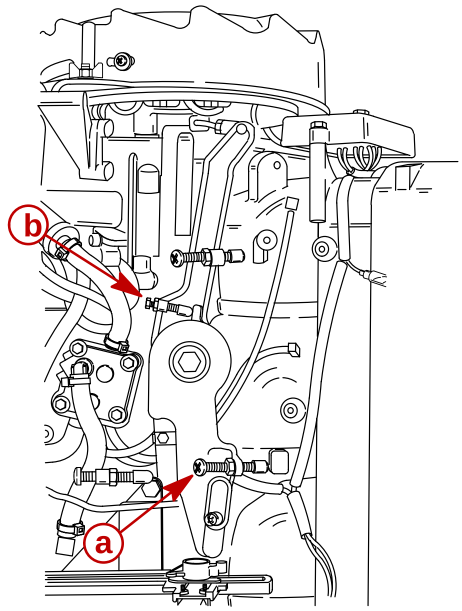
58044

a - Maximum Spark Advance Screw

PRIMARY PICKUP TIMING ADJUSTMENT

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

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



58043

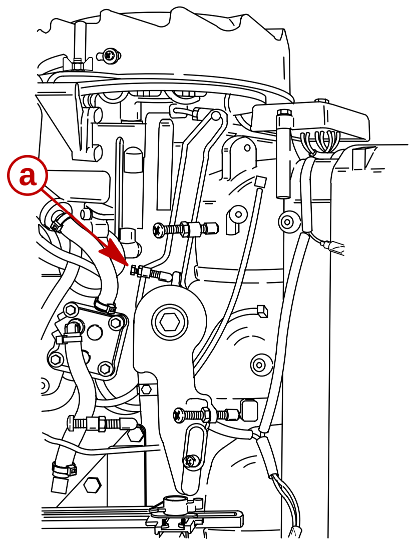
a - Idle Stop Screw
b - Primary Pickup Screw

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

2. Remove timing light from No. 1 spark plug lead.
3. Remove spark gap tools (91-63998A1) from each spark plug boot.
4. Install all spark plugs into cylinder heads. Torque spark plugs to 20 Ib. ft. (27 Nm) and attach spark plug leads to spark plugs.

IDLE SPEED ADJUSTMENT

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



a - Primary Pickup Screw

⚠ CAUTION
Engine idle RPM must NEVER EXCEED 750 RPM in gear.

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

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

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

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

Adjustments

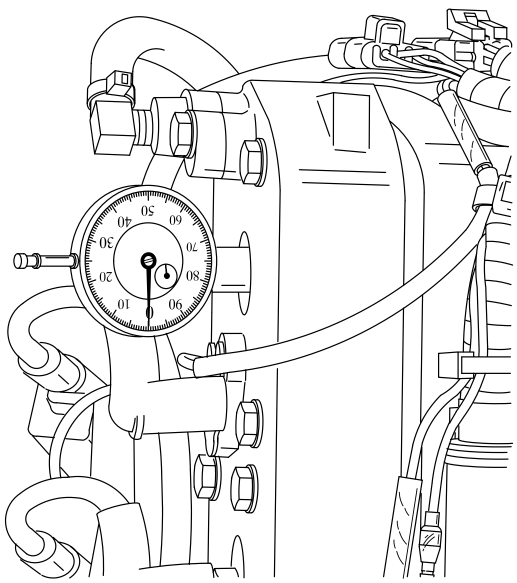
Electronic Fuel Injection Models

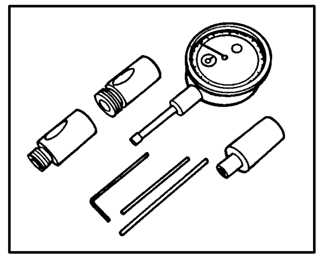
TIMING POINTER ADJUSTMENT

WARNING

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

1. Remove all spark plugs and install Dial Indicator (91-58222A1) into No. 1 cylinder (top cylinder, starboard bank)
2. Turn flywheel in a clockwise direction until No. 1 piston is at top dead center (TDC). Set dial indicator at “O” (zero) and tighten indicator set screw.
3. Turn flywheel counterclockwise until dial indicator needle is approximately 1/4 turn beyond 0.462 in., then turn flywheel clockwise so that dial indicator reads 0.462 in. (11.7mm) exactly.

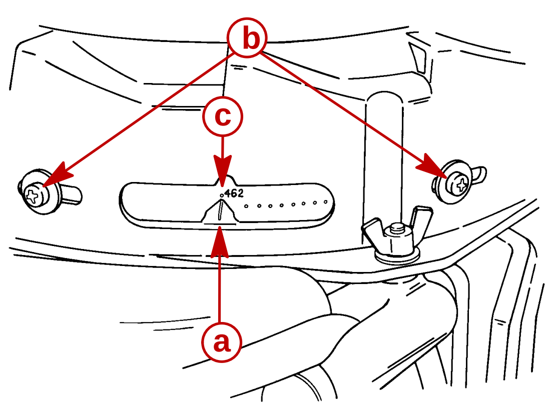




91-58222A1

58046

4. Reposition timing pointer (if necessary) so that timing pointer is aligned with 0.462 in. mark on timing decal. Retighten pointer attaching screws to 20 lb. in. (2.3 Nm).



a - Timing Pointer
b - Attaching Screws
c - 0.462 in. Mark

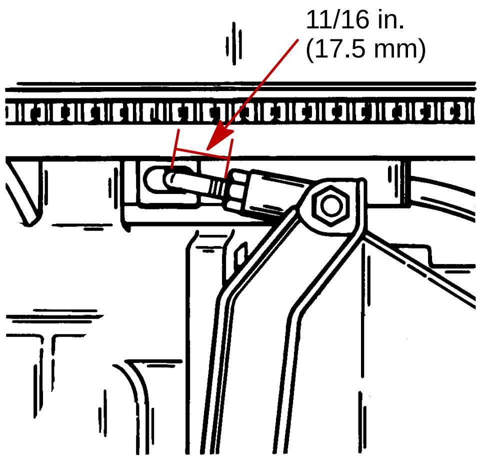
5. Remove dial indicator from cylinder.

ADJUSTMENTS

⚠ CAUTION

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

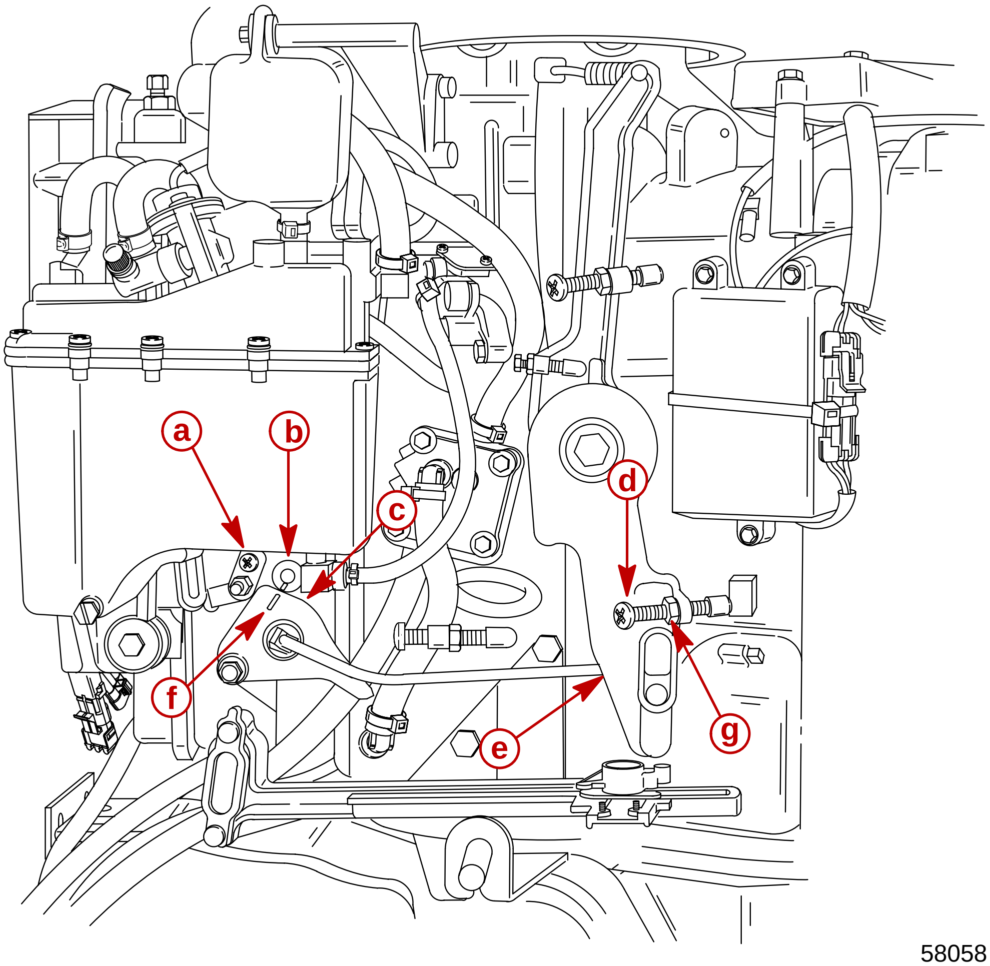
IMPORTANT: Control arm link rod must maintain a length of 11/16 in. (17.5 mm). Make any necessary adjustments to link rod before proceeding with timing adjustments.



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

THROTTLE CAM ADJUSTMENT

1. Loosen cam follower screw (a) allowing cam follower to move freely.
2. Allow roller (b) to rest on throttle cam (c). Adjust idle stop screw (d) on throttle arm (e) to align mark (f) on throttle cam (c) with center of roller (b). Tighten jam nut (g).
3. While holding throttle arm against idle stop, tighten cam follower screw (a) with roller lightly touching cam.



a - Cam Follower Screw
b - Roller
c - Throttle Cam
d - Idle Stop Screw
e - Throttle Arm
f - Mark
g - Jam Nut

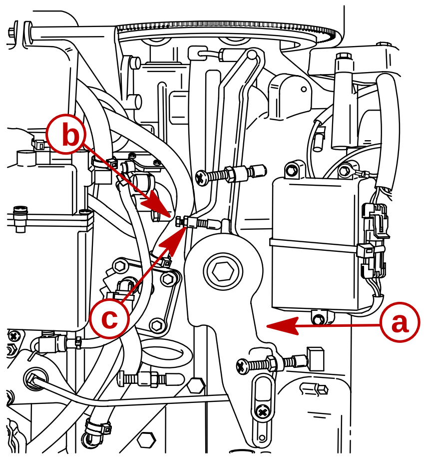
STATIC IDLE TIMING ADJUSTMENT (CRANKING ENGINE WITH STARTER)

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

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

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

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



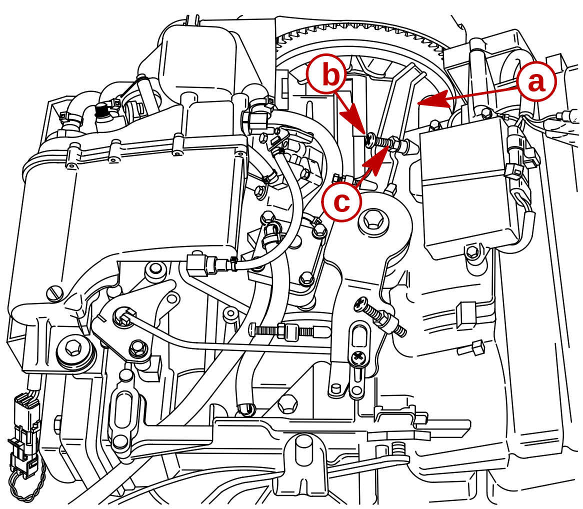
58057

a - Throttle Arm
b - Primary Pickup Screw
c - Locknut

STATIC MAXIMUM TIMING ADJUSTMENT (CRANKING ENGINE WITH STARTER)

NOTE: *ECM harness remains disconnected for maximum timing adjustment. Timing light remains hooked up to no.1 cylinder.*

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

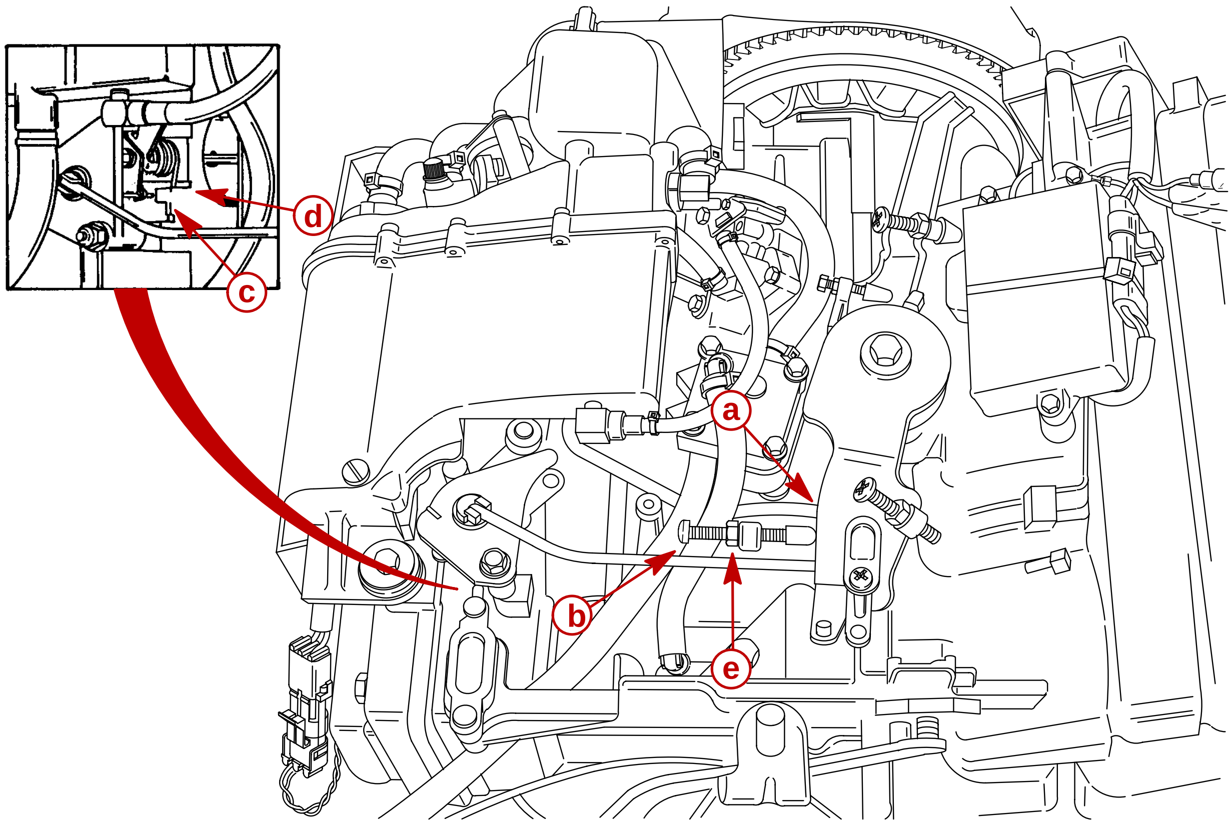


58056

a - Throttle Arm
b - Maximum Spark Advance Screw
c - Locknut

MAXIMUM THROTTLE

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



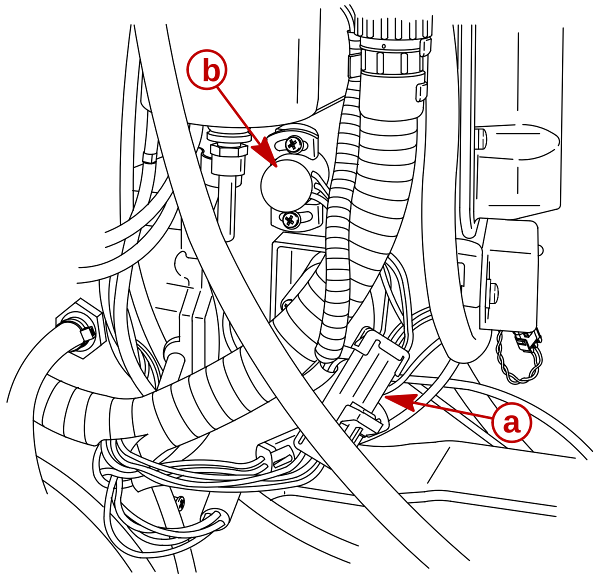
a - Throttle Arm
b - Full Throttle Stop Screw
c - Throttle Shaft Arm
d - Stop
e - Locknut

THROTTLE POSITION SENSOR (TPS) ADJUSTMENT

NOTE: *The Digital Diagnostic Terminal (DDT) can be used to determine whether the TPS is set within the recommended operating range of 0.200 – 0.300 volts. However, it is recommended that the DDT not be used to make adjustments of the TPS. Due to the circuitry characteristics of the ECM, the DDT is not able to always display accurately small TPS movements. A digital voltmeter should be used when making adjustments to the TPS.*

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

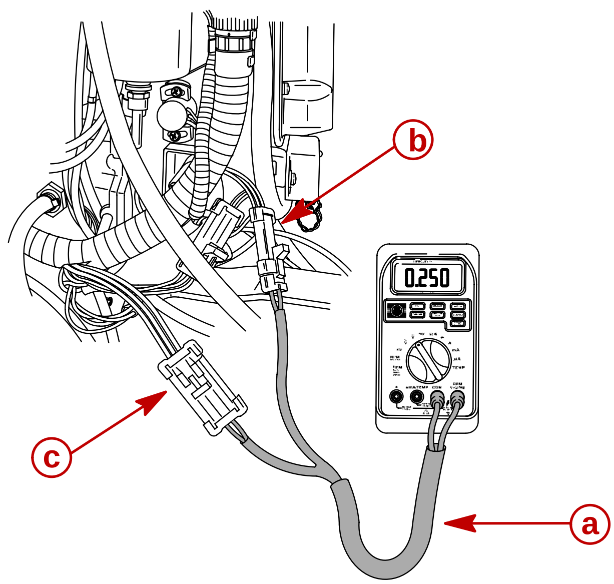
1. Disconnect TPS from EFI harness.



58055

a - TPS Connector
b - Throttle Position Sensor

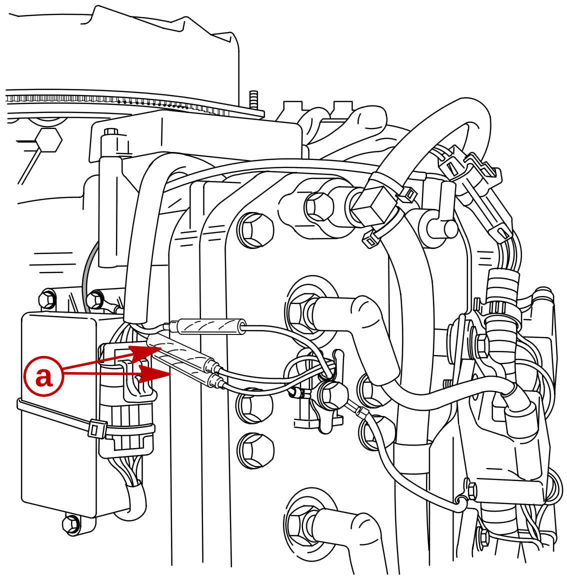
2. Connect digital volt meter using TPS Test Lead Assembly (a) (P/N 91-859199) between TPS connector (b) and EFI harness connector (c). Set voltmeter to 2 DC volts.



58054

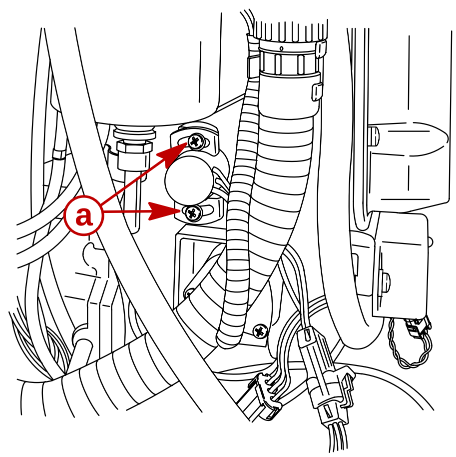
a - TPS Test Lead Assembly
b - TPS Connector
c - EFI Harness Connector

3. Disconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.



a - Temperature Sensor Leads

4. Turn key to the "ON" position.
5. Loosen screws (a) securing TPS to manifold.



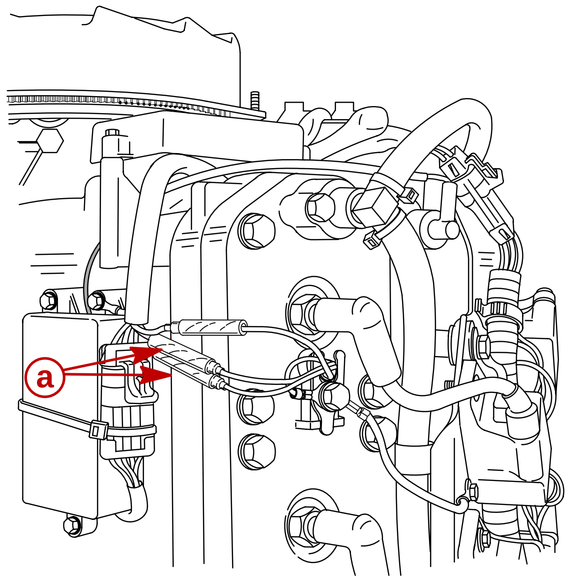
a - Screws

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

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

7. Tighten TPS screws holding correct tolerance.
8. Disconnect remote control cable from throttle lever.
9. Slowly move throttle lever to full open position while monitoring voltage reading. Voltage reading should increase and decrease smoothly.
10. Set volt meter to 20 DC volts. Maximum voltage reading at full throttle is approximately 7.46 volts.
11. Remove test lead and reconnect TPS harness to EFI harness.

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

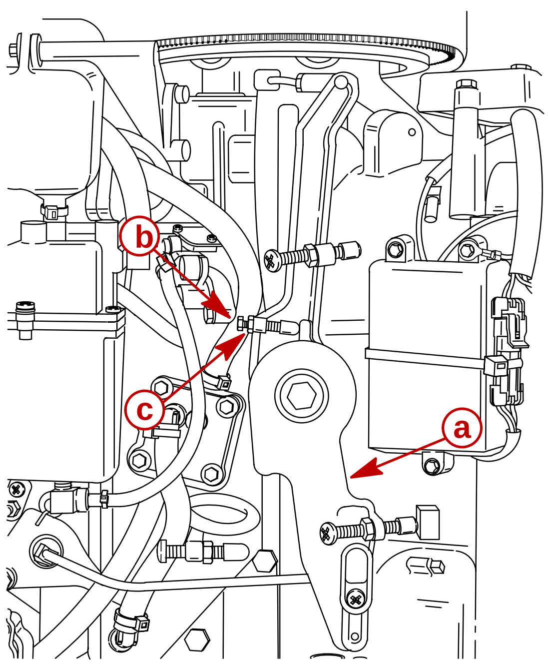


58052

a - Temperature Sensor Leads

IDLE TIMING (ENGINE RUNNING)

1. With engine in water, start engine and allow to warm up.
2. Shift engine into “FORWARD” gear.
3. Hold throttle arm (a) against idle stop (throttle cable barrel removed from barrel retainer). Adjust primary pickup screw (b) to attain appropriate setting. Tighten locknut (c).

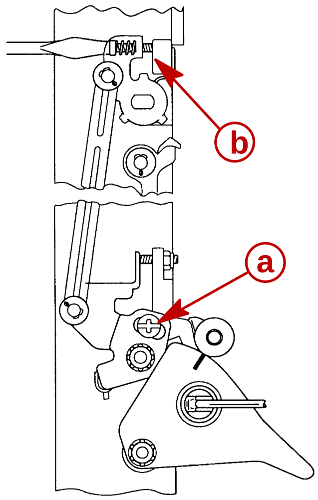


58057

a - Throttle Arm
b - Primary Pickup Screw
c - Locknut

IDLE ADJUSTMENT

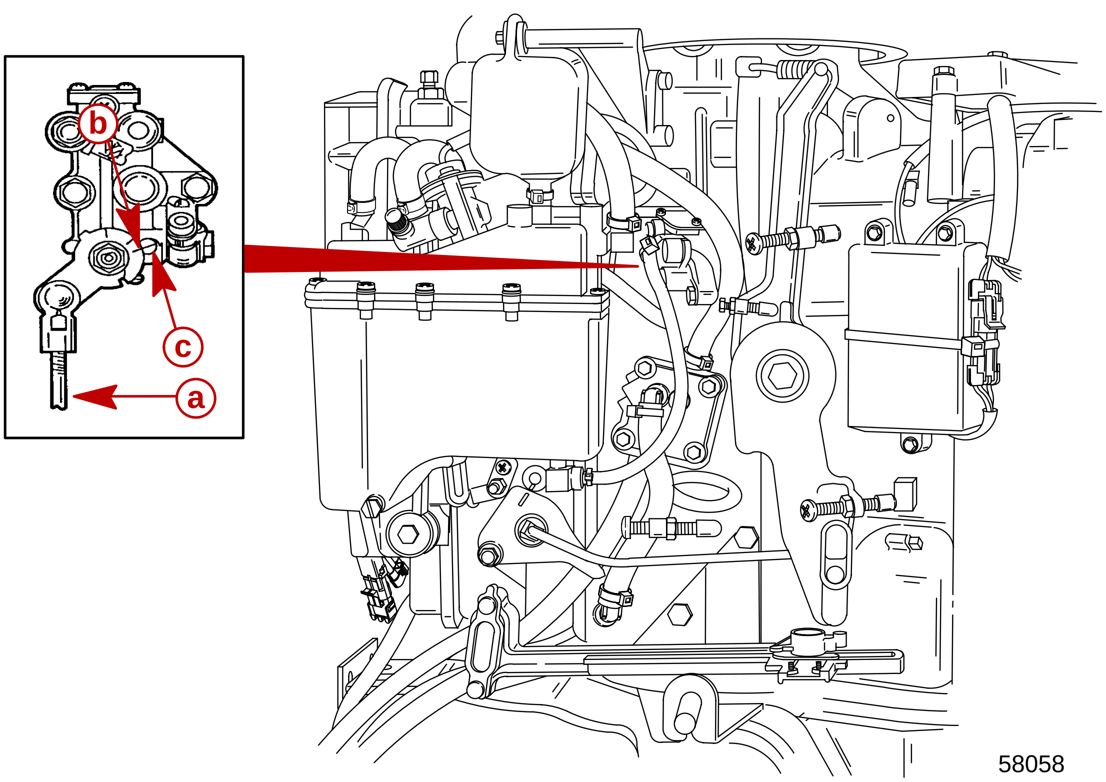
1. With outboard in water, start and allow to warm up.
2. Loosen cam follower screw (a), allowing free movement of cam. Hold throttle arm against idle stop. Adjust idle speed screw (b) by increasing or decreasing air valve opening to attain appropriate setting.



a - Cam Follower Screw
b - Idle Speed Screw

THROTTLE VALVE/OIL PUMP SYNCHRONIZATION

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

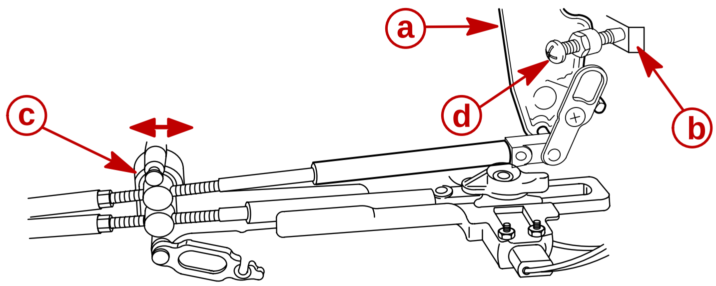


a - Link Rod
b - Stamped Mark on Lever
c - Stamped Mark on Body

THROTTLE CABLE INSTALLATION

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

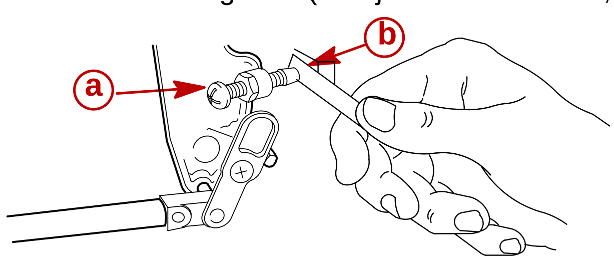
IMPORTANT: Excessive preload on throttle cable will cause difficulty when shifting from “FORWARD” to “NEUTRAL” (readjust throttle cable barrel, if necessary).



57838

- **a -** Throttle Lever
- **b -** Idle Stop
- **c -** Cable Barrel – Adjust To Hold Idle Stop Screw Against Stop
- **d -** Idle Stop Screw

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



57839

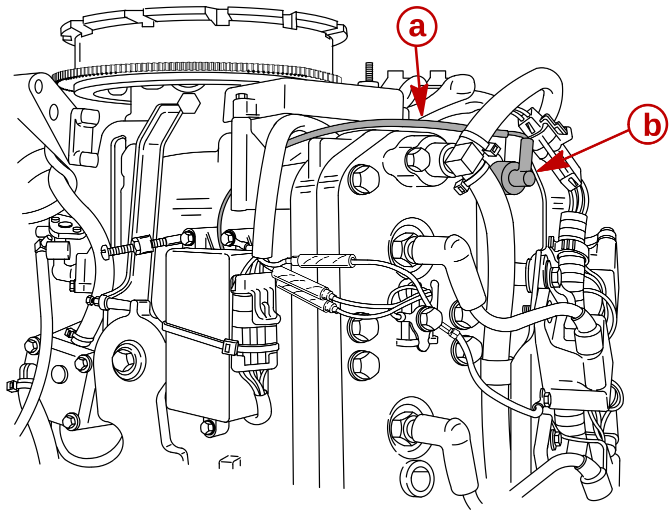
- **a -** Idle Stop Screw
- **b -** Idle Stop

DETONATION CONTROL (200 MODEL)

1. With outboard running in “FORWARD” gear, advance throttle to 3500 RPM and check that spark timing has electronically advanced timing to 24° BTDC. This indicates knock control circuit is functioning.

MAXIMUM TIMING ADJUSTMENT (ENGINE RUNNING)

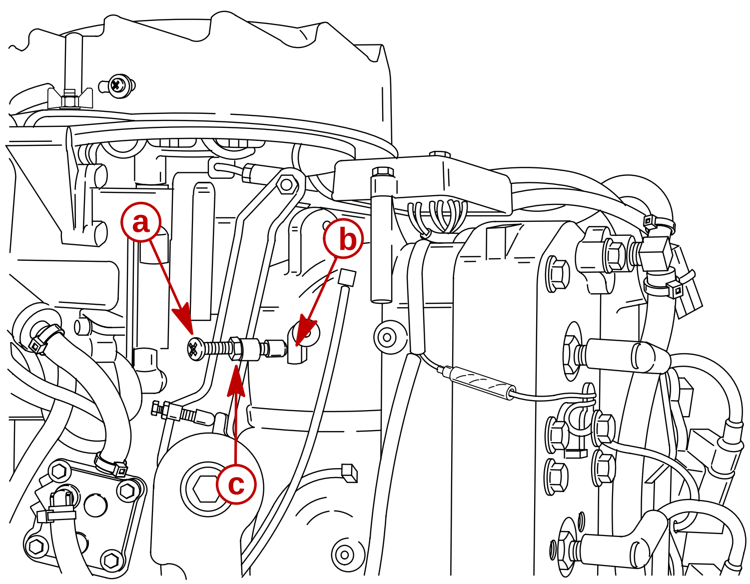
1. Disconnect WHITE/BLUE lead (a) from detonation sensor (b). (200 model)



58041

a - WHITE/BLUE Lead
b - Detonation Sensor

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



58044

a - Maximum Spark Adjustment Screw
b - Spark Stop
c - Locknut

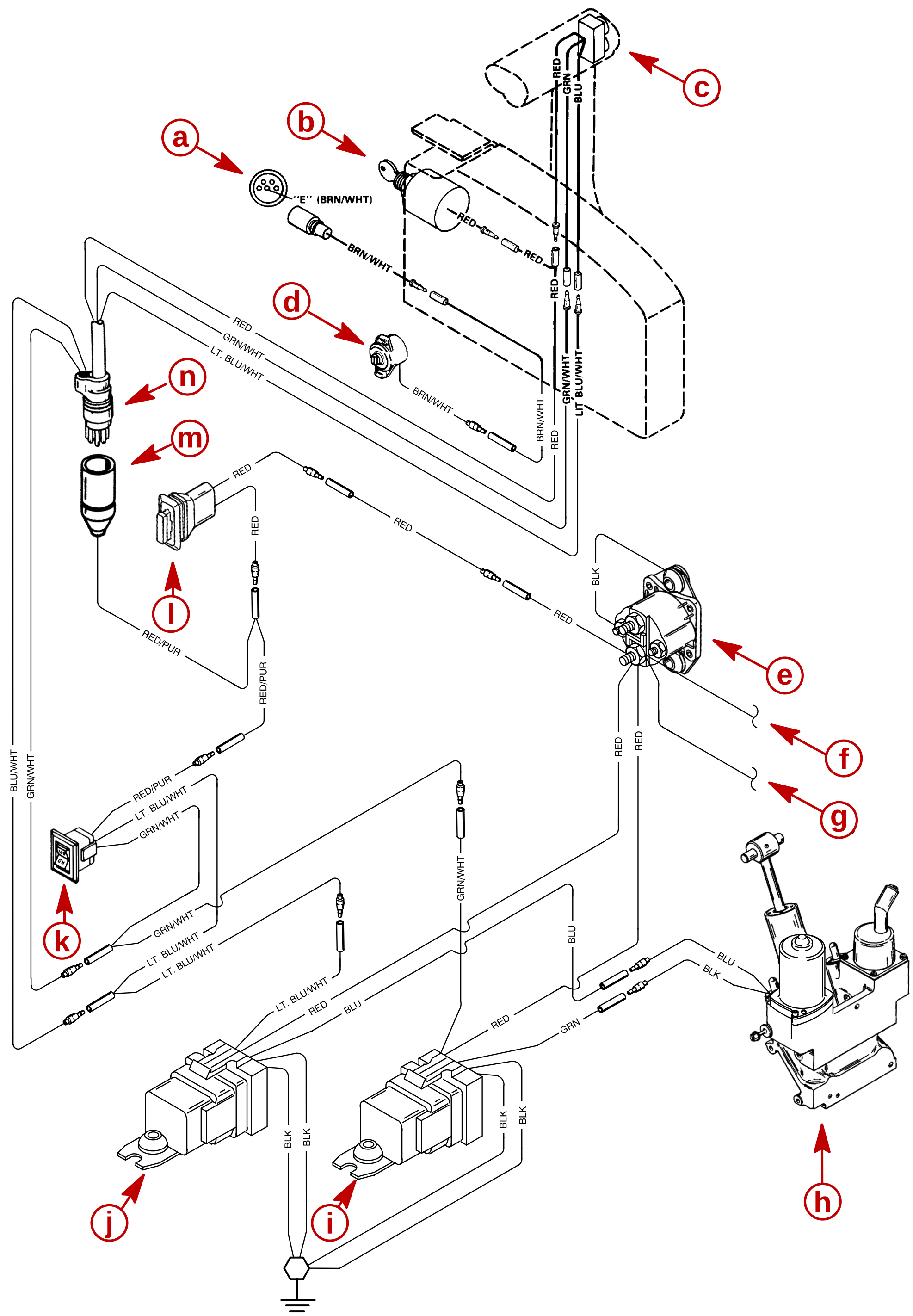
3. Reconnect WHITE/BLUE lead to detonation sensor (200 model).

ELECTRICAL

Section 2D – Wiring Diagrams

Table of Contents

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

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.)

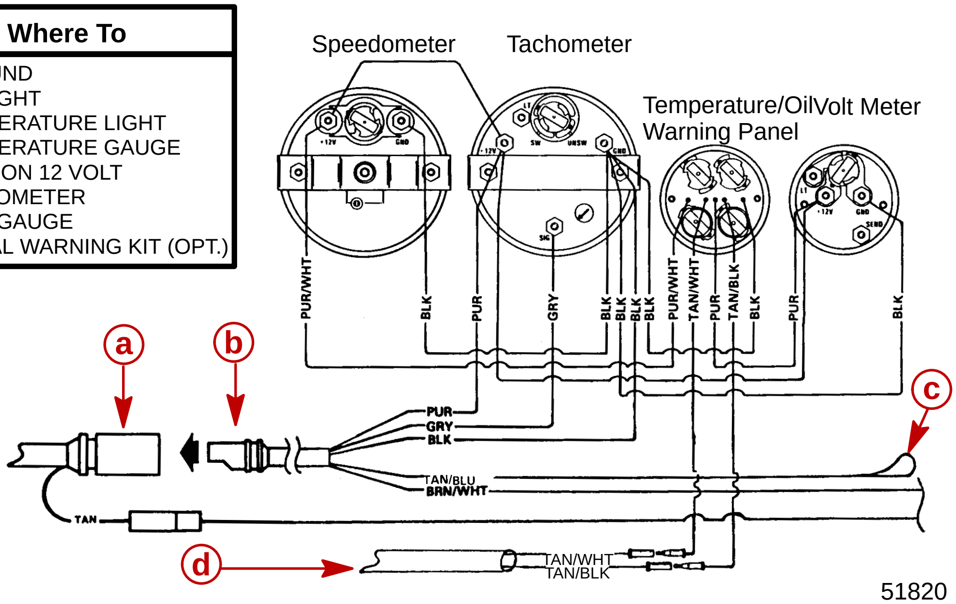


Figure 1 – Without Light Switch

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

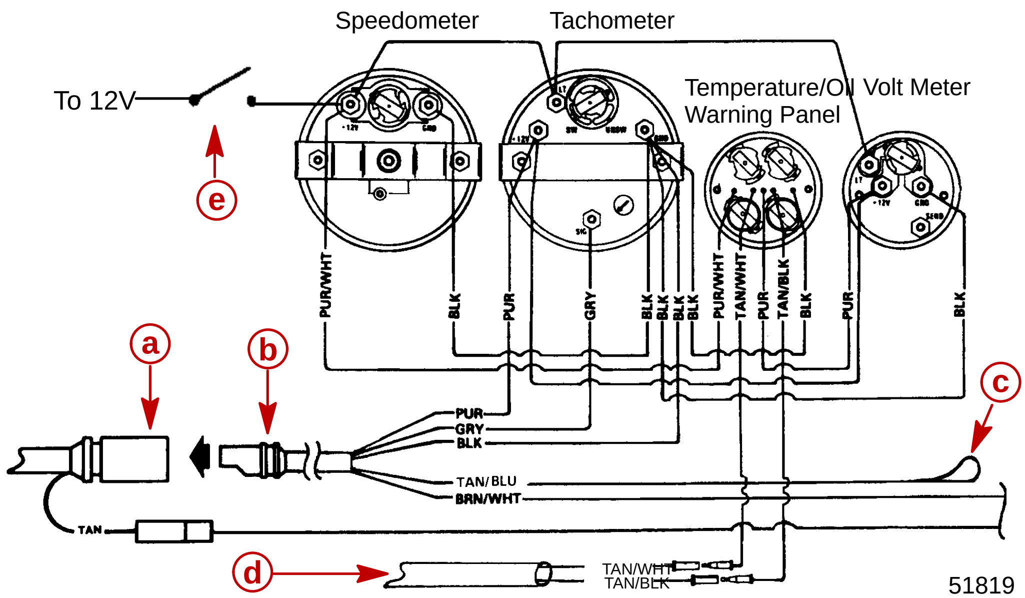
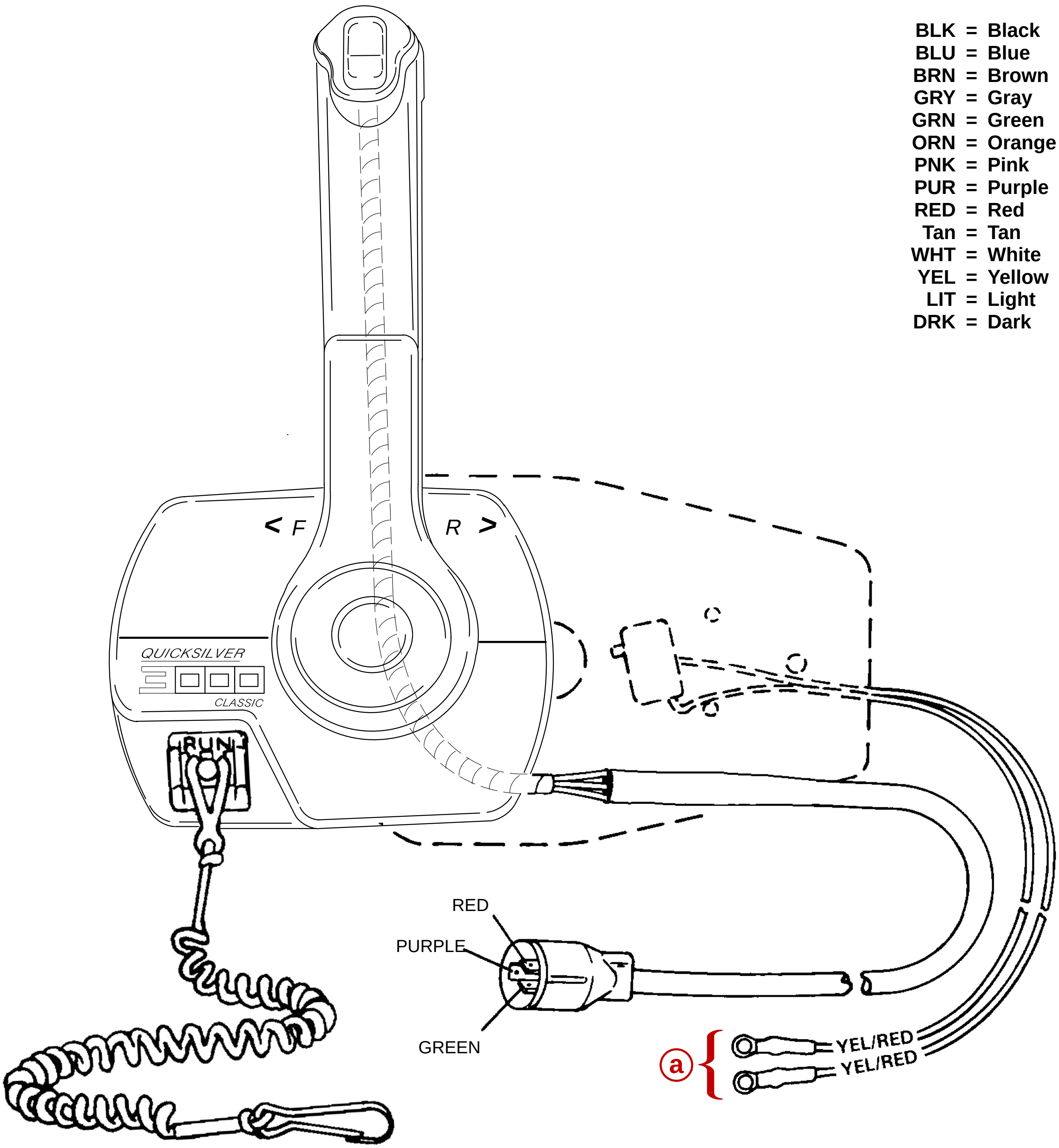


Figure 2 – With Light Switch

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

Commander 3000 Classic Panel Remote Control

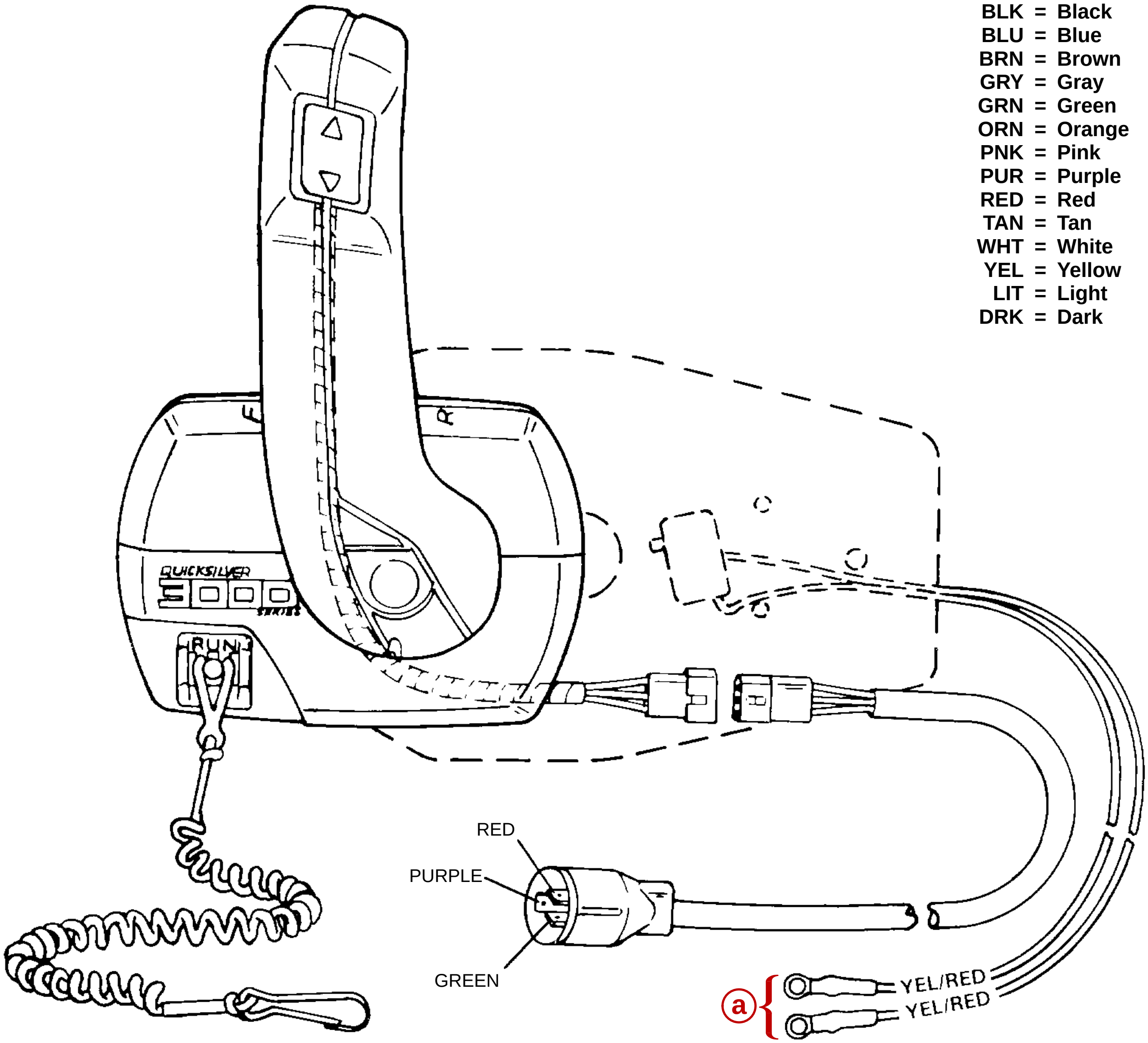
BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
Tan = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark



a - Neutral Interlock Switch

Commander 3000 Panel Remote Control

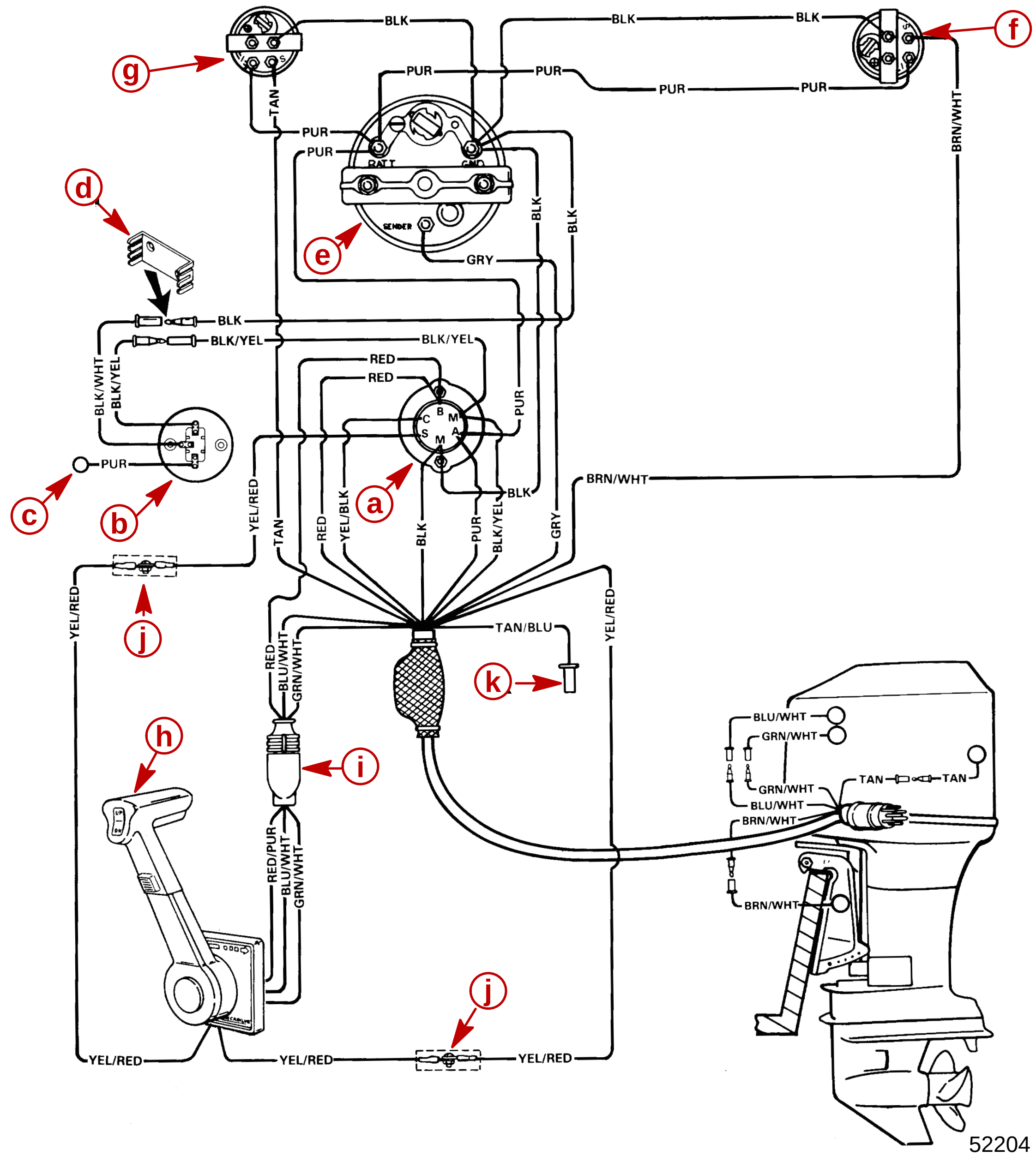
BLK	=	Black
BLU	=	Blue
BRN	=	Brown
GRY	=	Gray
GRN	=	Green
ORN	=	Orange
PNK	=	Pink
PUR	=	Purple
RED	=	Red
TAN	=	Tan
WHT	=	White
YEL	=	Yellow
LIT	=	Light
DRK	=	Dark



a - Neutral Interlock Switch

Instrument/Lanyard Stop Switch Wiring Diagram

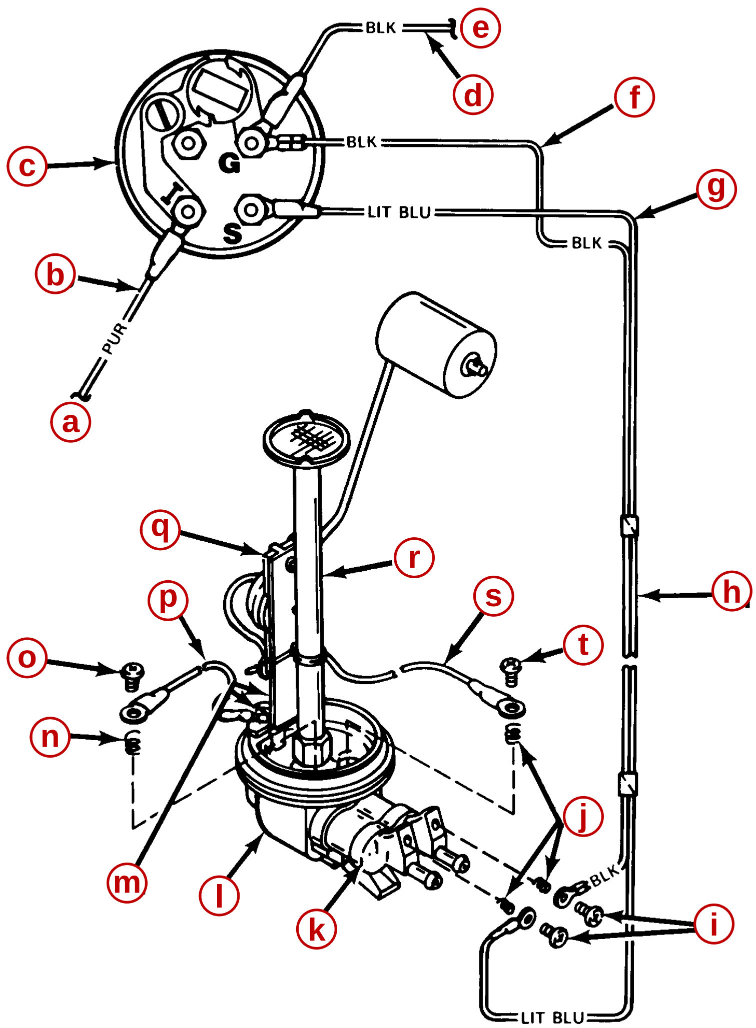
BLK=BLACK
BLU=BLUE
BRN=BROWN
GRN=GREEN
GRY=GRAY
PUR=PURPLE
RED=RED
TAN=TAN
WHT=WHITE
YEL=YELLOW



- **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.

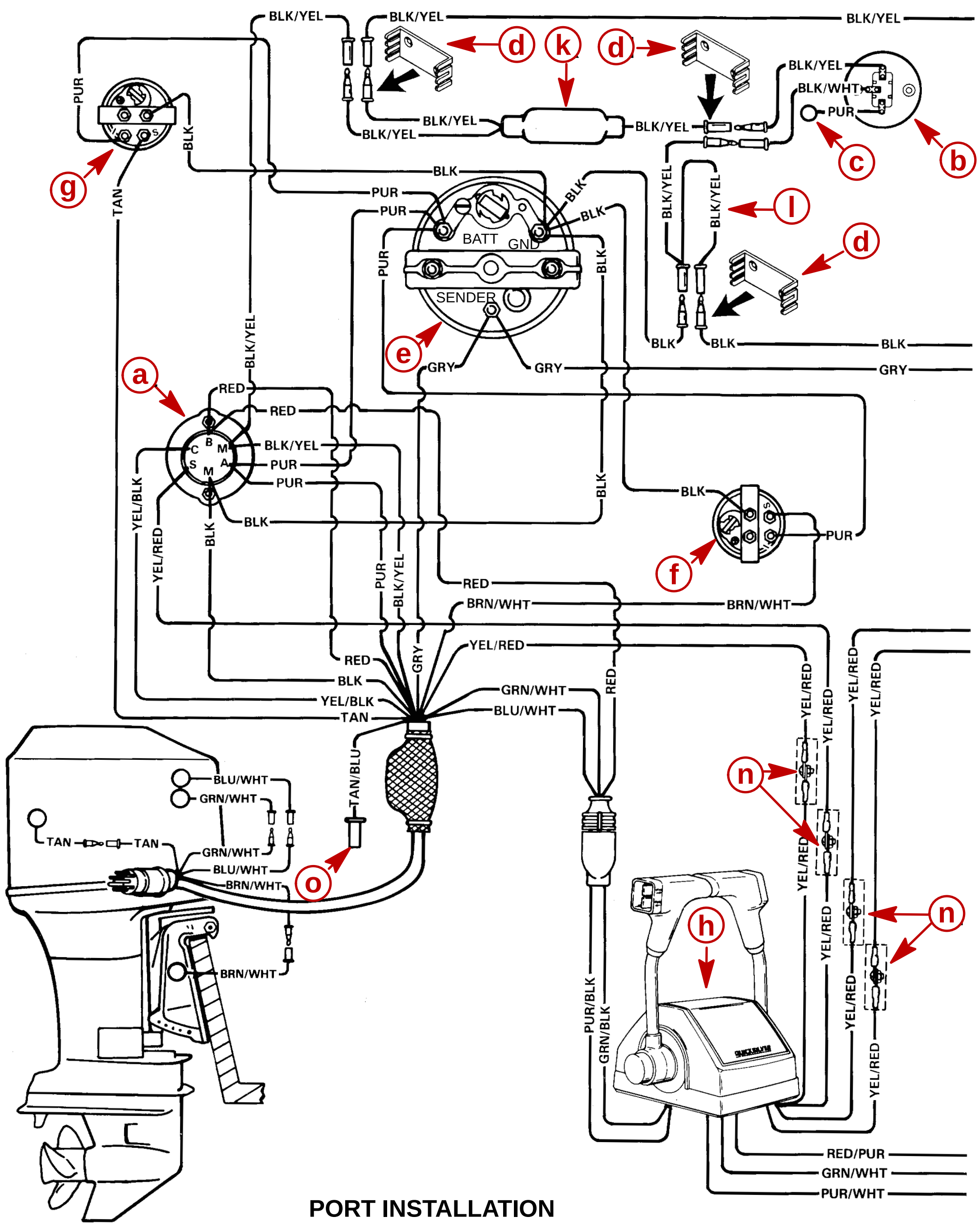
Oil Level Gauge Wiring Diagram



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

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



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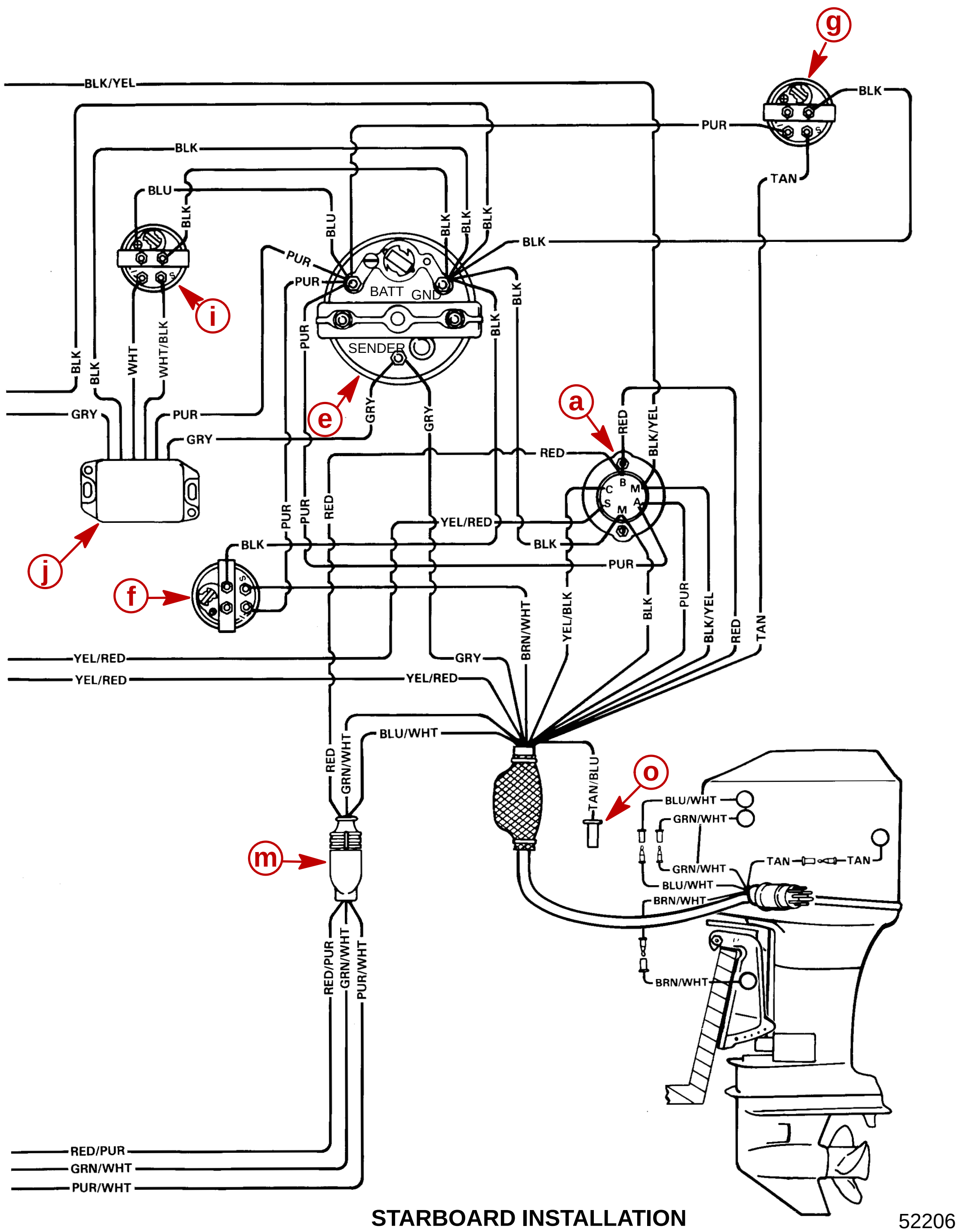
PORT INSTALLATION

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

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

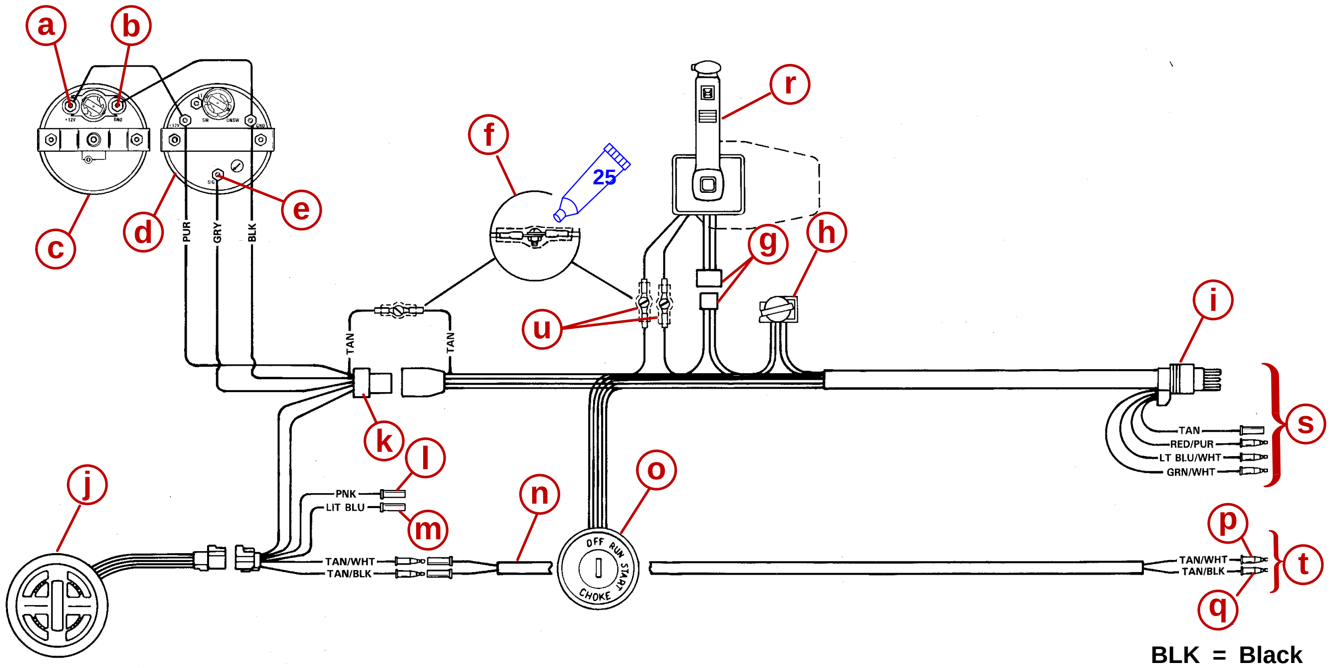


STARBOARD INSTALLATION

52206

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

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

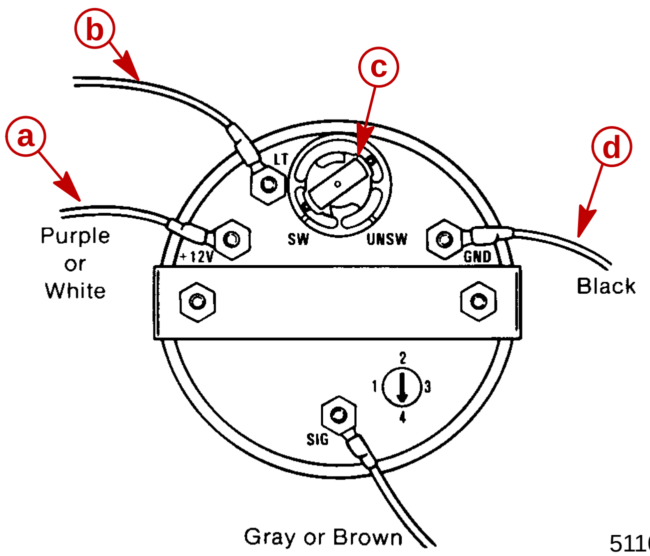
QSI Gauge Wiring Diagrams

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.

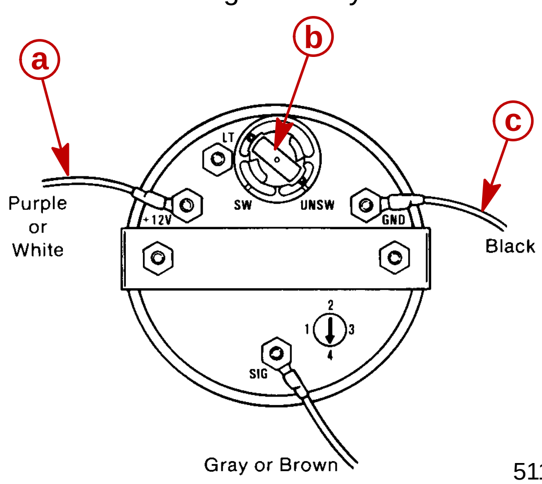


51106

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.)



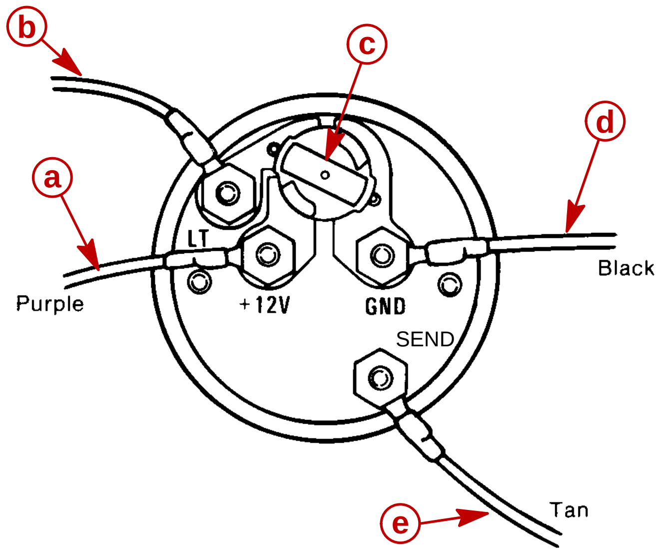
51106

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

Water Temperature Gauge

WIRING DIAGRAM A

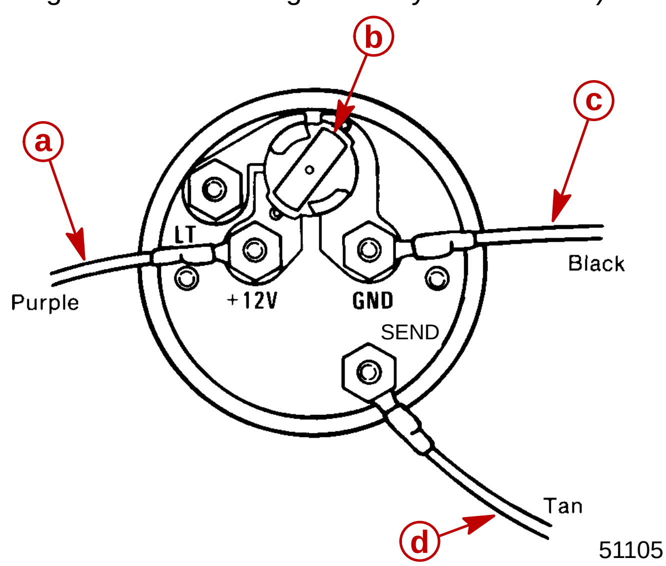
Use this wiring diagram when using a separate light switch for instrument lighting.



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

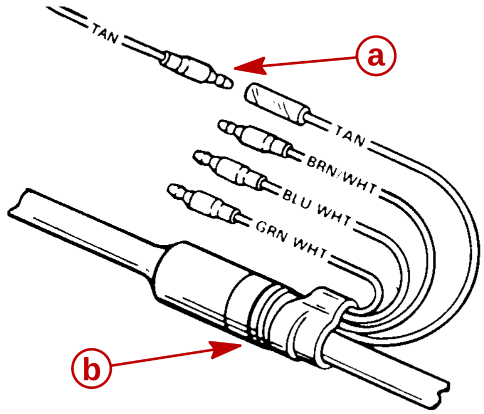
Use this wiring diagram when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key is turned on.)



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.



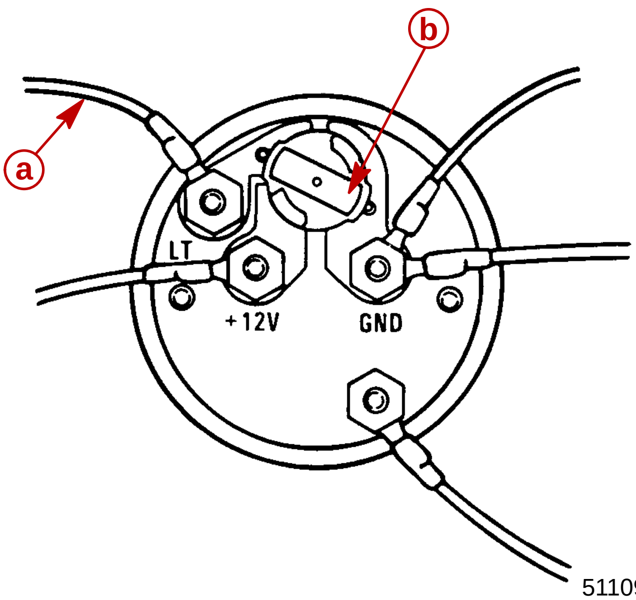
28086

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.

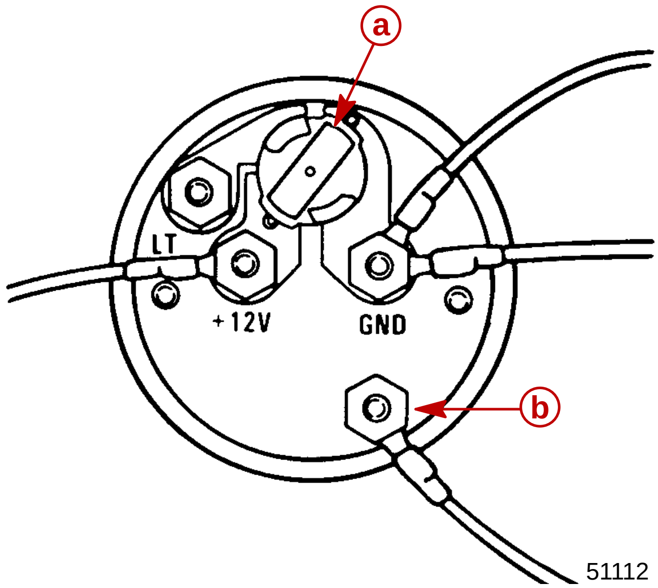


51109

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

LIGHT BULB POSITION B

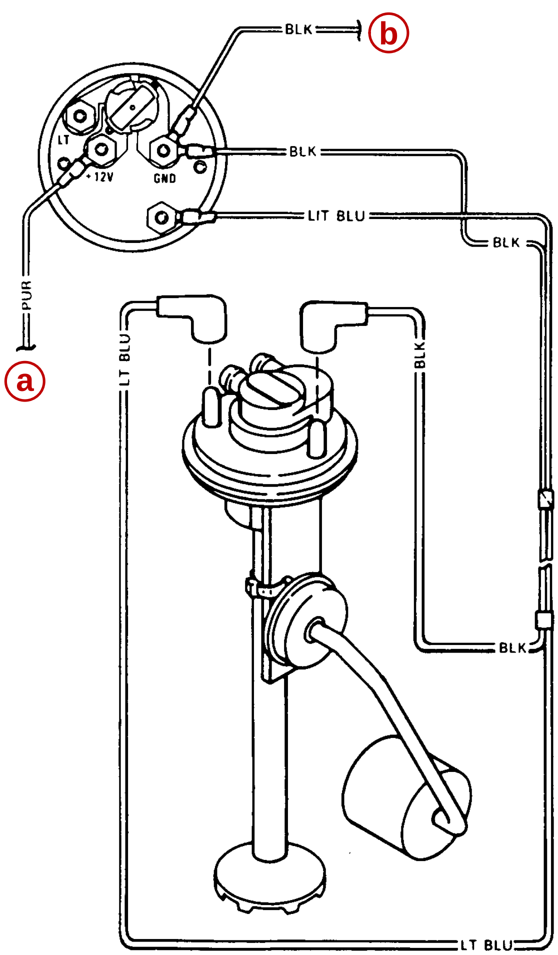
Use this position when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key switch is turned on.)



51112

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

SENDER WIRING



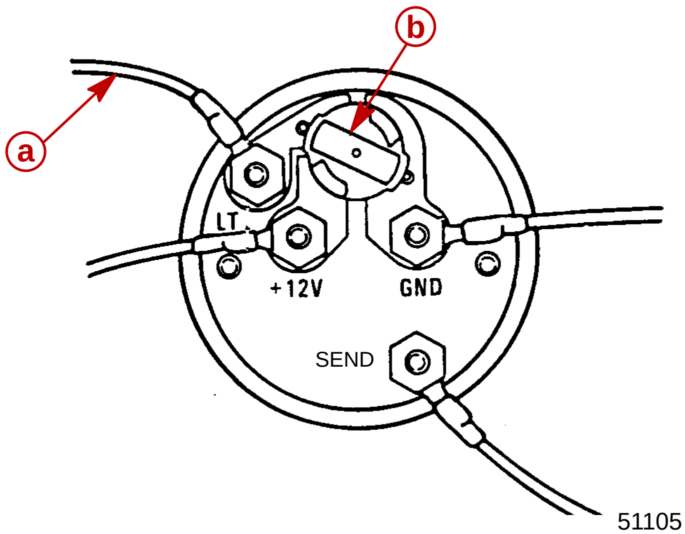
51108

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

Engine Synchronizer Wiring Diagram

LIGHT BULB POSITION A

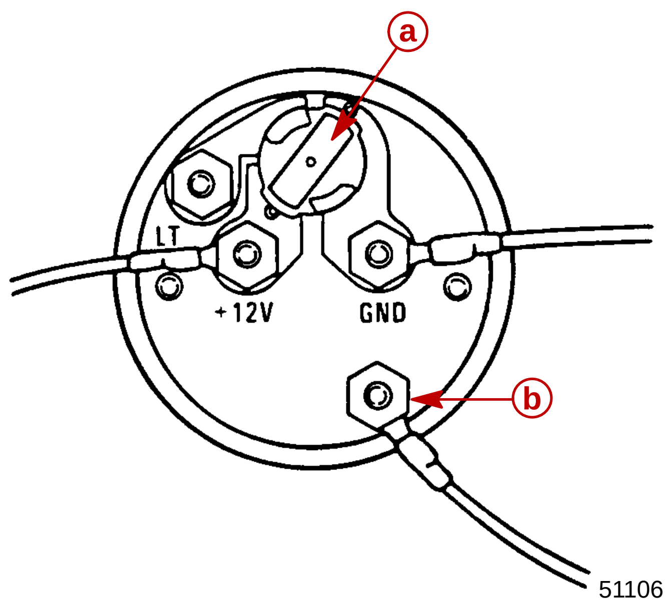
Use this position when using a separate light switch for instrument lighting.



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

LIGHT BULB POSITION B

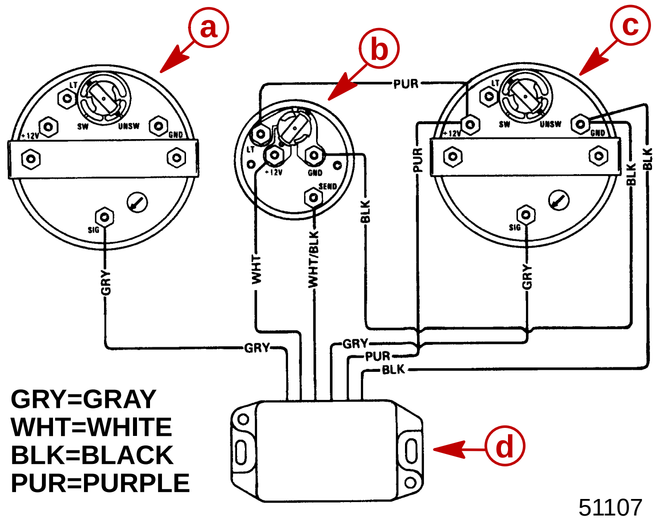
Use this position when instrument lighting is wired directly to the ignition key switch. (Instrument lights are on when ignition key switch is turned on.)



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

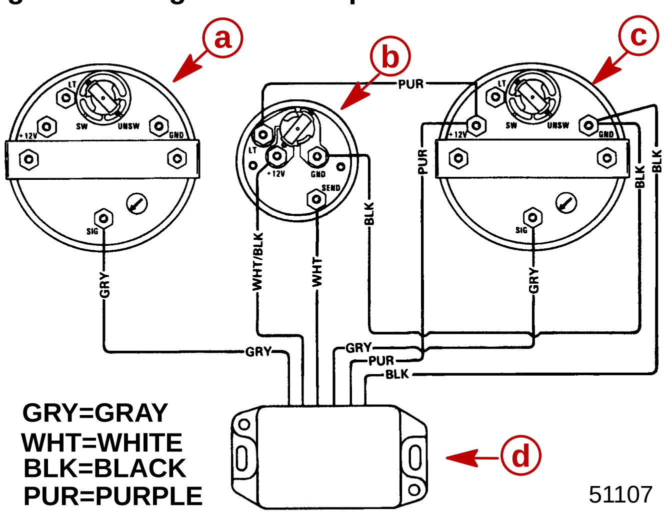
Synchronizer wiring can be accomplished two different ways as an option to the user.

Wiring Diagram – Gauge needle to point toward slow running engine



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

Wiring Diagram – Gauge needle to point toward fast running engine



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.

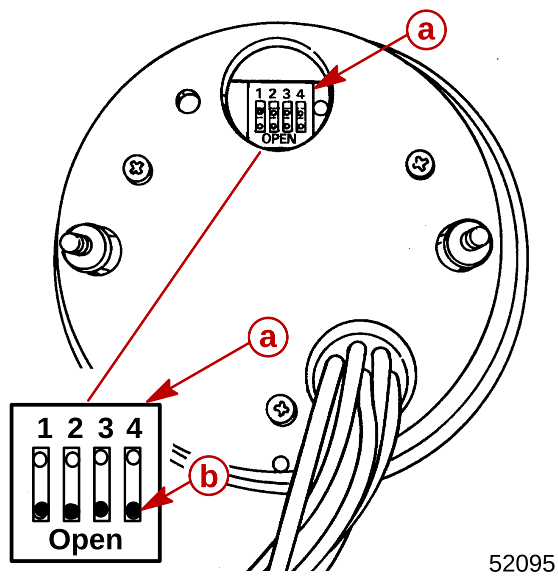
Multi-Function Gauge

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.

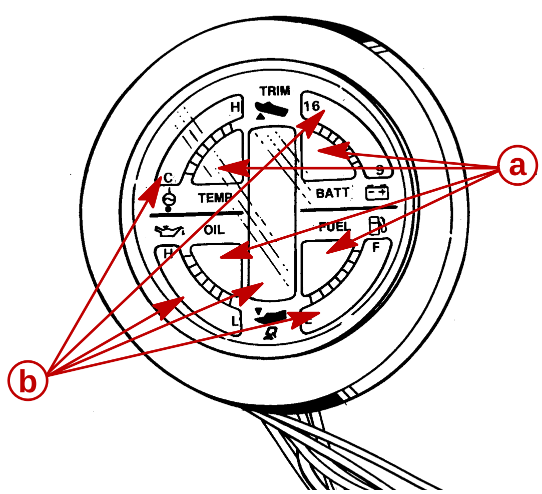
1. With the ignition switch in the "OFF" position, set the multi-function gauge dip switch in (test) position as shown. (BLACK dot indicates switch position).



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

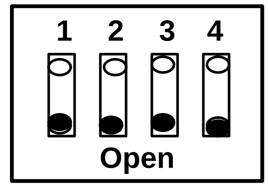
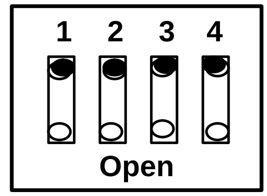
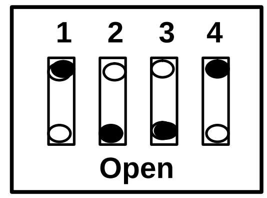
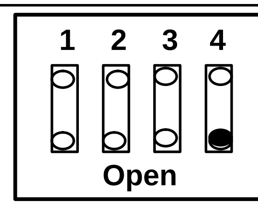
2. Turn ignition switch to the "RUN" position. The multi-function gauge now is in the display test mode. The gauge Temp, Batt, Oil, and Fuel red warning lights should be alternately flashing "ON" and "OFF"; the BLACK L.C.D. bar graphs should be cycling. (This indicates that all gauge functions are operational).

3. Turn ignition switch to the "OFF" position. Reset the gauge dip switch to the correct operating position for the outboard application.



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

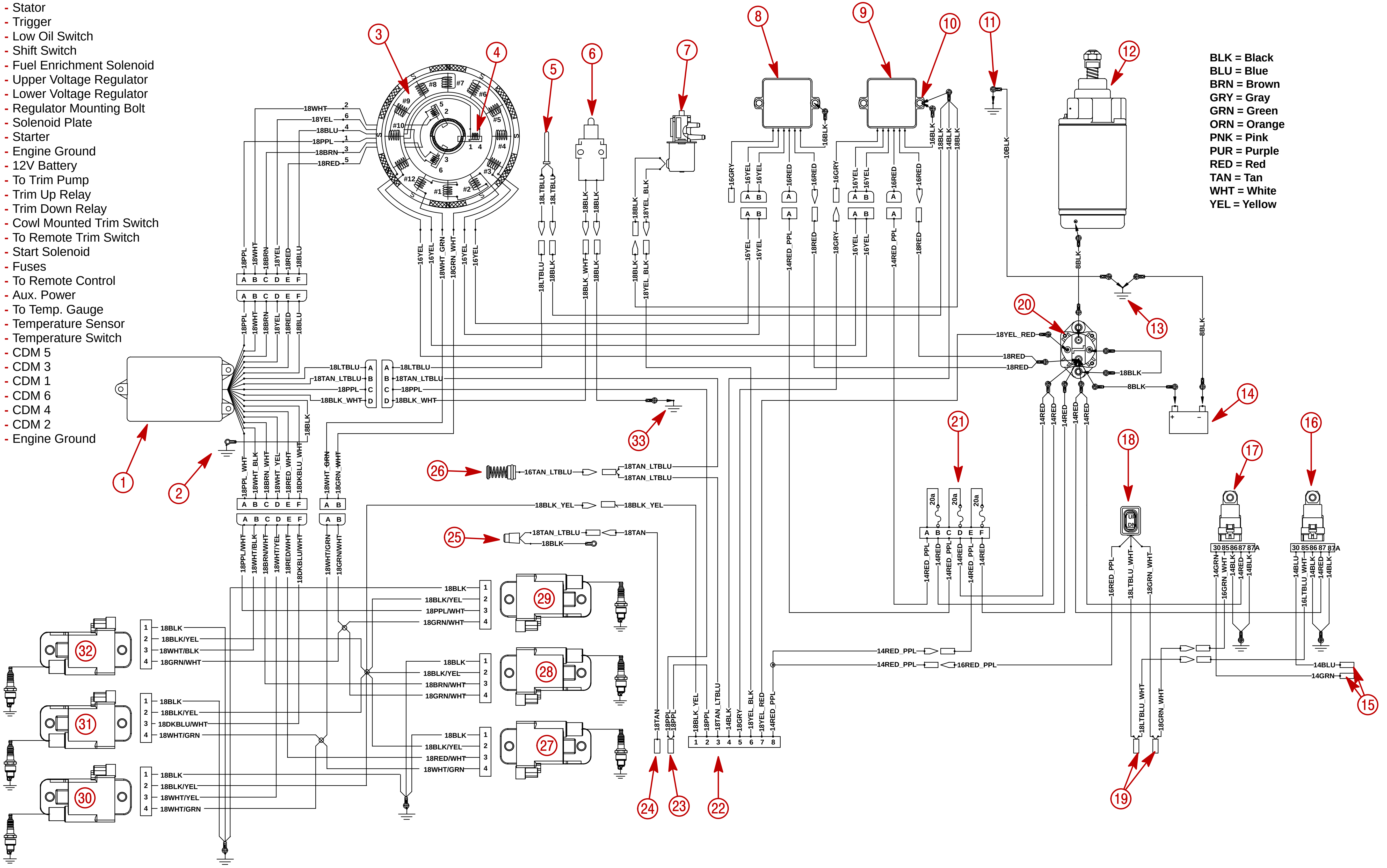
Outboard Multi-Function Gauge Setting

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.

2.5 Litre V-6 Carburetor Wiring Diagram 2000 Models

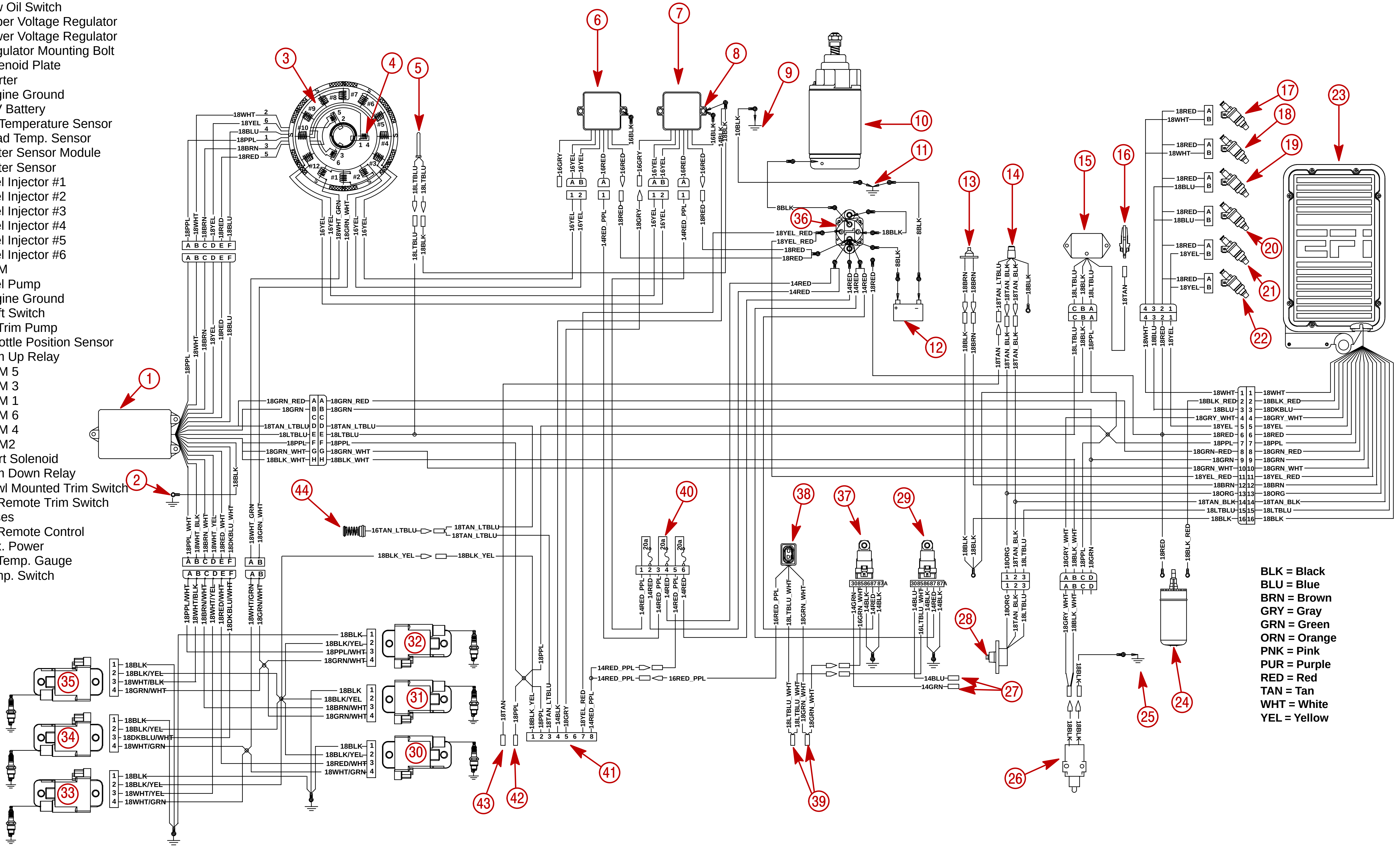
1 - Control Module
2 - Control Module Mounting Bolt
3 - Stator
4 - Trigger
5 - Low Oil Switch
6 - Shift Switch
7 - Fuel Enrichment Solenoid
8 - Upper Voltage Regulator
9 - Lower Voltage Regulator
10 - Regulator Mounting Bolt
11 - Solenoid Plate
12 - Starter
13 - Engine Ground
14 - 12V Battery
15 - To Trim Pump
16 - Trim Up Relay
17 - Trim Down Relay
18 - Cowl Mounted Trim Switch
19 - To Remote Trim Switch
20 - Start Solenoid
21 - Fuses
22 - To Remote Control
23 - Aux. Power
24 - To Temp. Gauge
25 - Temperature Sensor
26 - Temperature Switch
27 - CDM 5
28 - CDM 3
29 - CDM 1
30 - CDM 6
31 - CDM 4
32 - CDM 2
33 - Engine Ground



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

2.5 Litre V-6 150/175 EFI Wiring Diagram 2000 Models

1 - Control Module
2 - Control Module Mounting Bolt
3 - Stator
4 - Trigger
5 - Low Oil Switch
6 - Upper Voltage Regulator
7 - Lower Voltage Regulator
8 - Regulator Mounting Bolt
9 - Solenoid Plate
10 - Starter
11 - Engine Ground
12 - 12V Battery
13 - Air Temperature Sensor
14 - Head Temp. Sensor
15 - Water Sensor Module
16 - Water Sensor
17 - Fuel Injector #1
18 - Fuel Injector #2
19 - Fuel Injector #3
20 - Fuel Injector #4
21 - Fuel Injector #5
22 - Fuel Injector #6
23 - ECM
24 - Fuel Pump
25 - Engine Ground
26 - Shift Switch
27 - To Trim Pump
28 - Throttle Position Sensor
29 - Trim Up Relay
30 - CDM 5
31 - CDM 3
32 - CDM 1
33 - CDM 6
34 - CDM 4
35 - CDM2
36 - Start Solenoid
37 - Trim Down Relay
38 - Cowl Mounted Trim Switch
39 - To Remote Trim Switch
40 - Fuses
41 - To Remote Control
42 - Aux. Power
43 - To Temp. Gauge
44 - Temp. Switch



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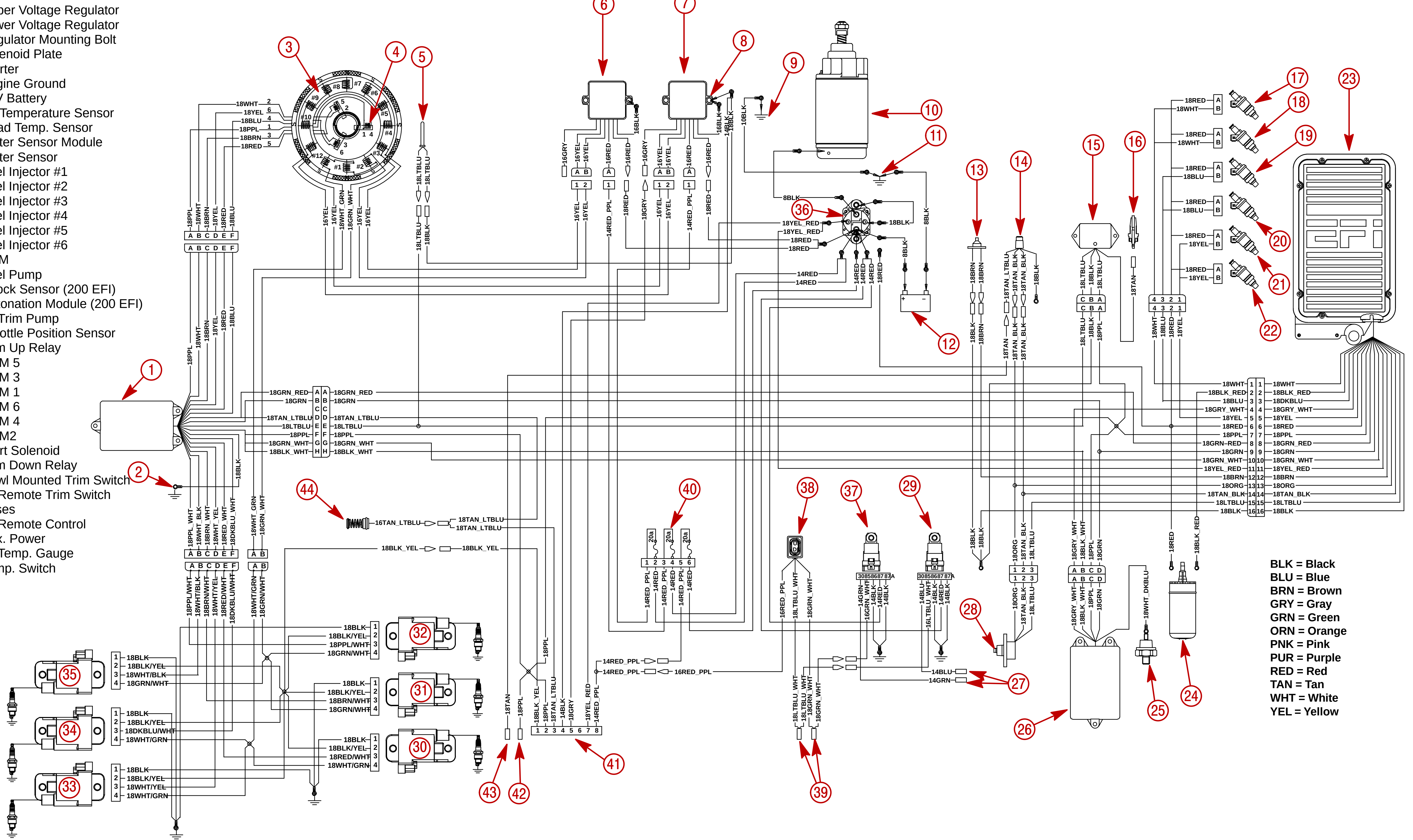
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow

2.5 Litre V-6 200 EFI Wiring Diagram 2000 Models

1 - Control Module
2 - Control Module Mounting Bolt
3 - Stator
4 - Trigger
5 - Low Oil Switch
6 - Upper Voltage Regulator
7 - Lower Voltage Regulator
8 - Regulator Mounting Bolt
9 - Solenoid Plate
10 - Starter
11 - Engine Ground
12 - 12V Battery
13 - Air Temperature Sensor
14 - Head Temp. Sensor
15 - Water Sensor Module
16 - Water Sensor
17 - Fuel Injector #1
18 - Fuel Injector #2
19 - Fuel Injector #3
20 - Fuel Injector #4
21 - Fuel Injector #5
22 - Fuel Injector #6
23 - ECM
24 - Fuel Pump
25 - Knock Sensor (200 EFI)
26 - Detonation Module (200 EFI)
27 - To Trim Pump
28 - Throttle Position Sensor
29 - Trim Up Relay
30 - CDM 5
31 - CDM 3
32 - CDM 1
33 - CDM 6
34 - CDM 4
35 - CDM2
36 - Start Solenoid
37 - Trim Down Relay
38 - Cowl Mounted Trim Switch
39 - To Remote Trim Switch
40 - Fuses
41 - To Remote Control
42 - Aux. Power
43 - To Temp. Gauge
44 - Temp. Switch



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BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
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PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow

FUEL SYSTEM

Section 3A - Fuel Pump

Table of Contents

3
A

Specifications

Fuel Pump Pressure @ W.O.T.

Maximum – 10 psi (68.5 kPa)
Normal – 8-10 psi (41.0 – 54.8 kPa)
Minimum – 3 psi (20.5 kPa)

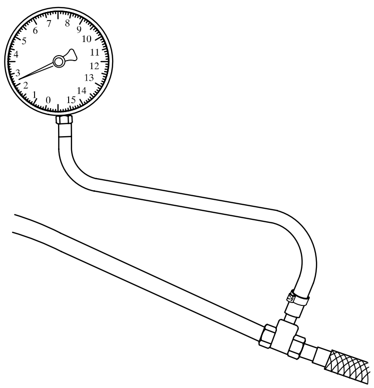
Fuel Pump Pressure @ Idle

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

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

Special Tools

1. Fuel Pressure Gauge (0–15 psi) (Obtain Locally)



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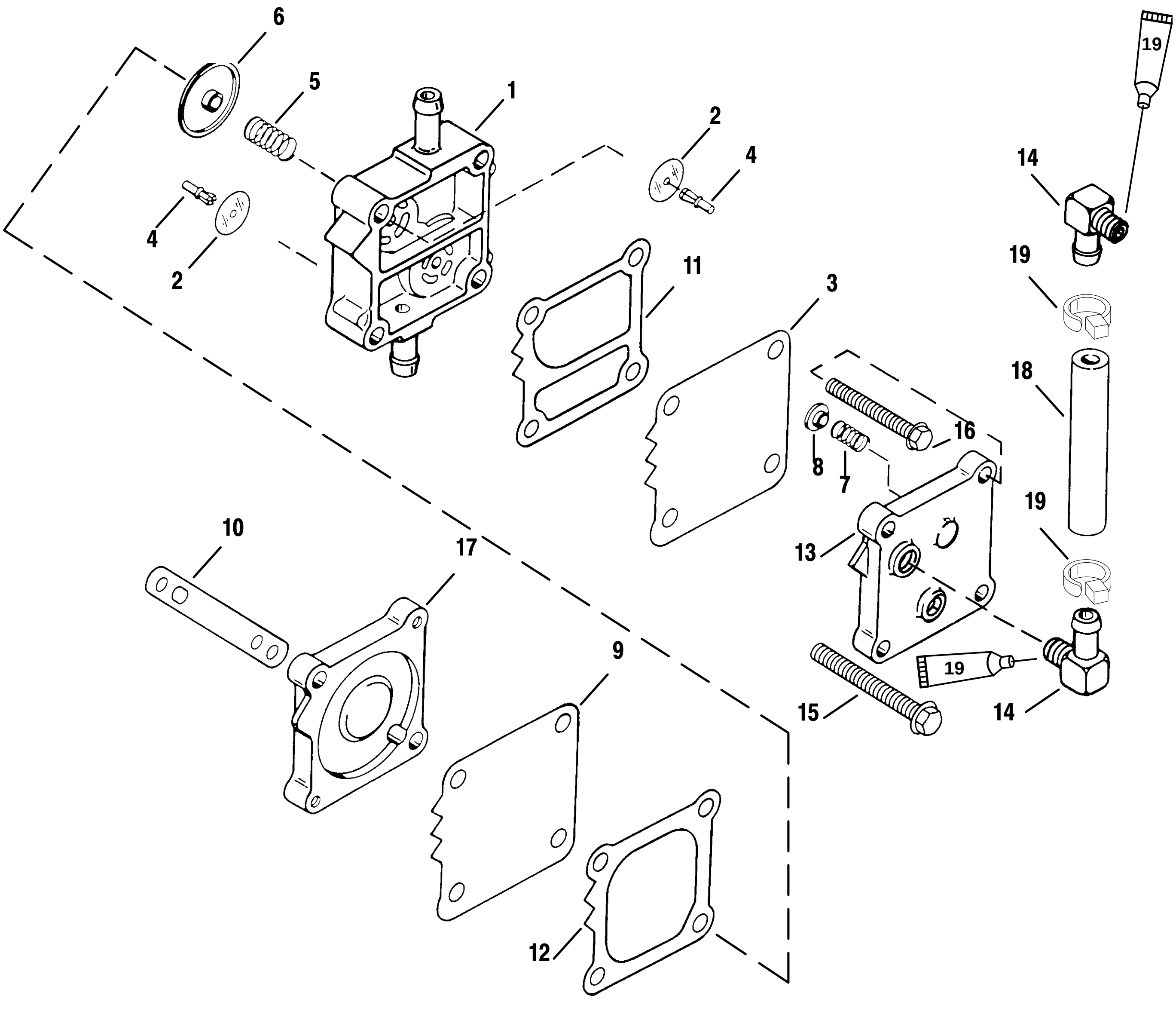
Notes:

Fuel Pump Assembly



19 Perfect Seal (92-34227-1)

Fuel Pump Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
–	1	FUEL PUMP ASSEMBLY			
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	1	DIAPHRAGM			
4	2	RETAINER			
5	1	SPRING			
6	1	CAP			
7	1	SPRING			
8	1	CAP			
9	1	DIAPHRAGM			
10	1	GASKET–base			
11	1	GASKET-Boost			
12	1	GASKET-Pulse			
13	1	PLATE–fuel pump			
14	2	ELBOW			
15	2	SCREW–pump to crankcase (M6 x 50)	55		6.0
16	2	SCREW–fuel pump (M5 x 40)	55		6.0
17	1	BASE–fuel pump			
18	1	FUEL LINE (6 IN.)			
19	2	STA STRAP			

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

Checking for Restricted Fuel Flow Caused by Anti-Siphon Valves

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

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

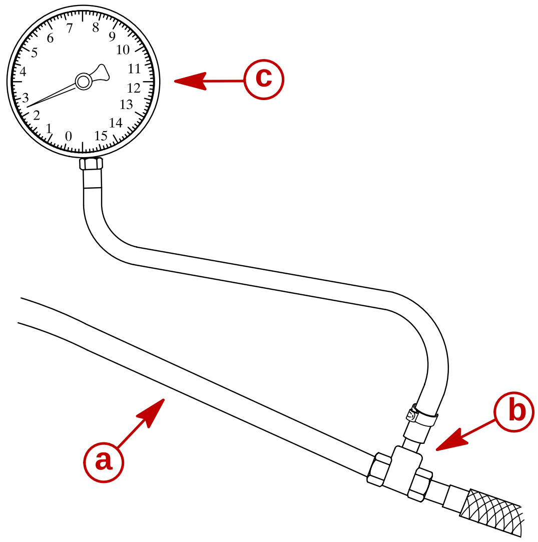
Since any type of anti-siphon device must be located between the outboard fuel inlet and fuel tank outlet, a simple method of checking [if such a device (or bad fuel) is a problem source] is to operate the outboard with a separate fuel supply which is known to be good, such as a remote fuel tank.

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

Checking Fuel Pump Lift (Vacuum)

The square fuel pump is designed to lift fuel (vertically) about 60 in. (1524 mm) if there are no other restrictions in the system using a fuel hose that is 5/16 in. (7.9 mm) minimum diameter. As restrictions are added, such as filters, fittings, valves etc., the amount of fuel pump lift decreases.

Fuel pump vacuum and air bubbles in the fuel supply can be checked with a vacuum gauge, a t-fitting and a clear piece of fuel hose. Connect the clear hose between the inlet fitting on the pulse driven fuel pump and the vacuum gauge t-fitting; keeping the t-fitting as close as possible to the pump. Connect the fuel line from the fuel tank to the remaining connection on the t-fitting.



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a - Clear Hose
b - T-fitting
c - Vacuum Gauge

Vacuum Test Troubleshooting

This test is normally performed at an idle speed. As engine rpm increases, there will be a slight increase in vacuum. The increase should not exceed specification

Normal Reading	Below 2.5 in. of vacuum (mercury)

Reading above 2.5 in. of vacuum (mercury)	Restriction within the fuel system – • Restricted anti-siphon valve • Restriction within the primer bulb • Kinked or collapsed fuel hose • Plugged water separating fuel filter (in the boat) • Restriction in fuel line thru-hull fitting • Restriction in fuel tank switching valves • Plugged fuel tank pick-up screen

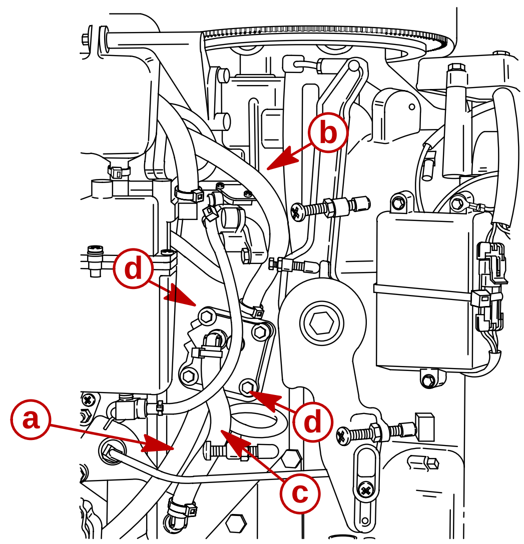
Testing Fuel Pump

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.
Fuel vaporizing	Fuel with high reed vapor pressure (winter grade fuel) may vaporize (form bubbles) when used in hot/warm weather. Use fuel with a lower reed vapor pressure (summer grade fuel)
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).
Fuel hose internal diameter too small.	Use 5/16 I.D. fuel hose.
Primer bulb check valve not opening.	Replace primer bulb.
Excessive fuel lift required.	Fuel lift exceeds 2.5 in. of vacuum (mercury)

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.



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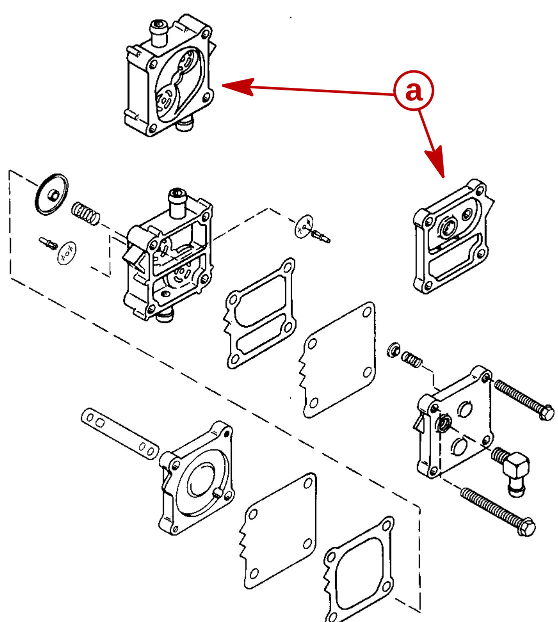
a - Fuel Inlet
b - Fuel hose from fuel pump to carburetors
c - Pulse hose
d - Mounting screws

5. Disassemble fuel pump.



52362

a - Reverse View of Pump Body

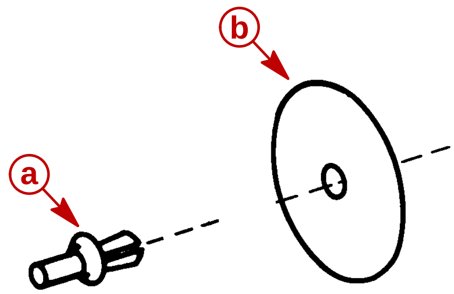
Cleaning/Inspection

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/Installation

ASSEMBLY

1. Insert retainer thru plastic check valve.



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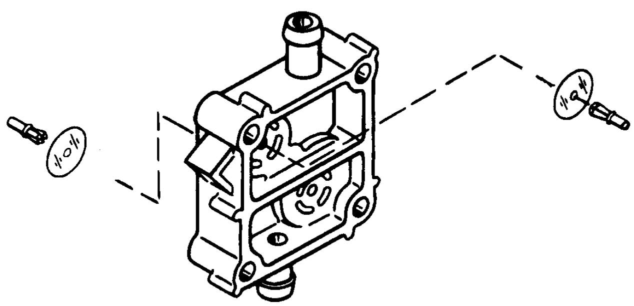
a - Retainer
b - Plastic Check Valve

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



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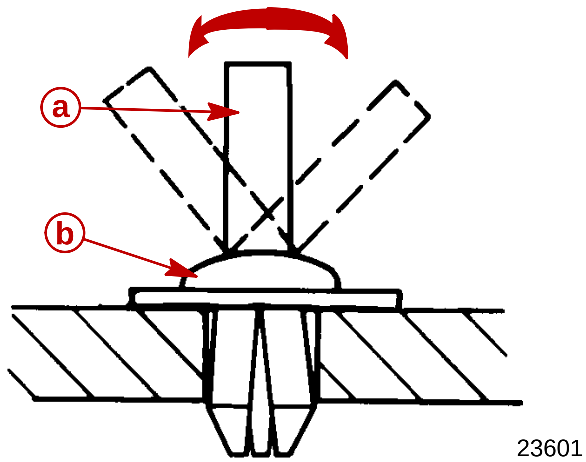
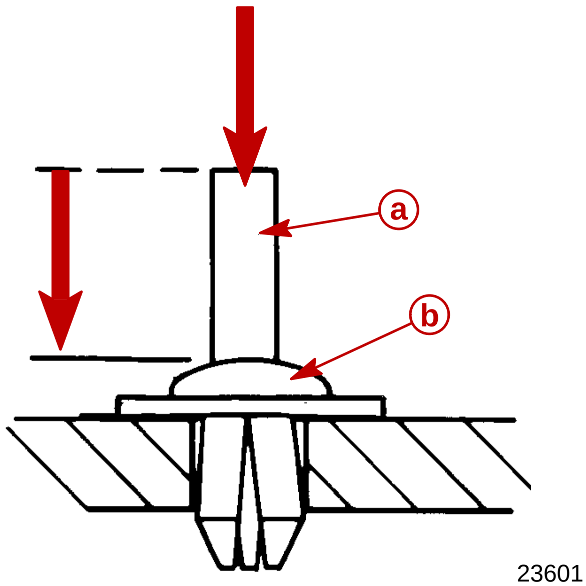
3. With retainer installed in pump body, break retainer rod from retainer by bending sideways.



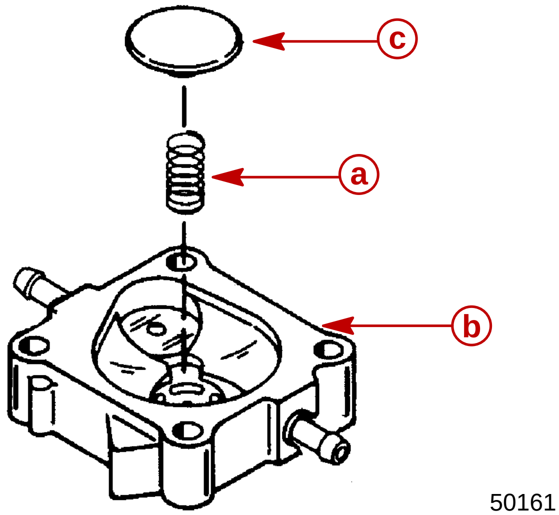
a - Rod
b - Retainer Cap

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.



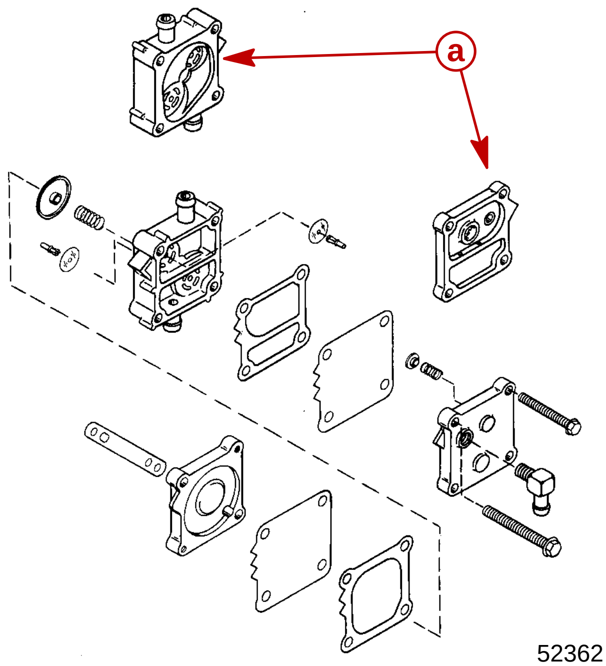
a - Rod
b - Retainer Cap

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



a - Boost Spring
b - Pump Body
c - Cap

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



a - Reverse View of Pump Body

INSTALLATION

1. Install pump onto engine. Torque to 55 lb. in. (6 N·m).
2. Install hoses onto proper fittings and secure with sta-straps.
3. Run engine and check for leaks.

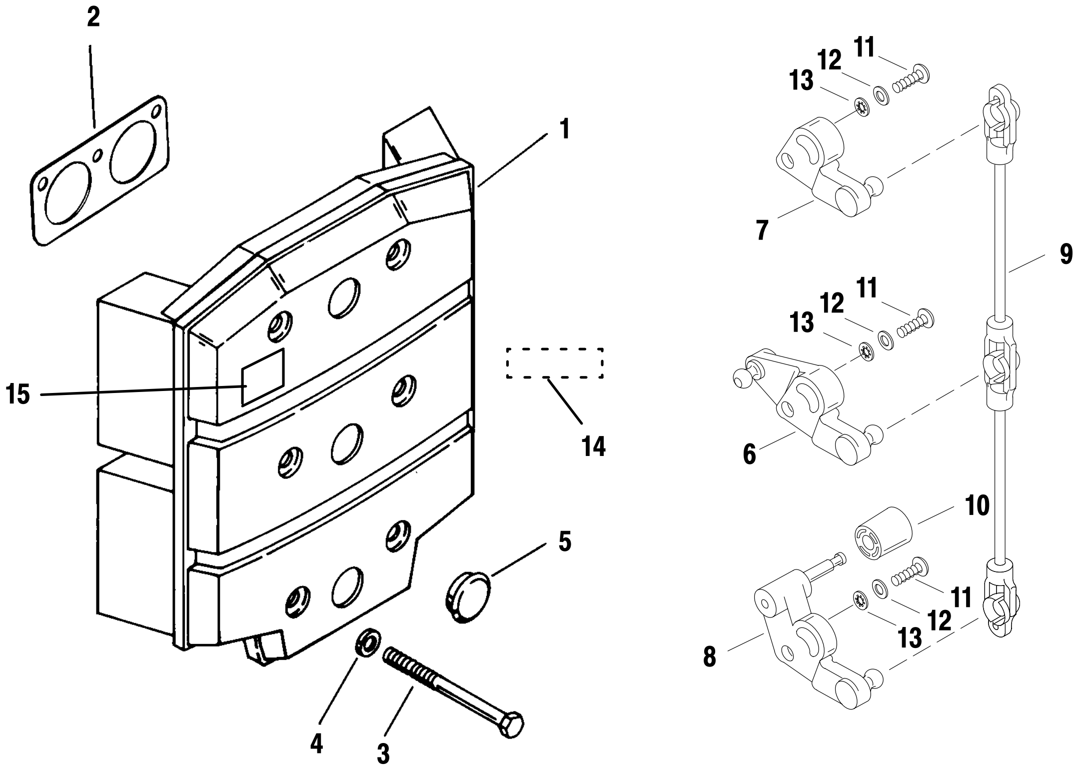
FUEL SYSTEM

Section 3B - Carburetors

3B

Table of Contents

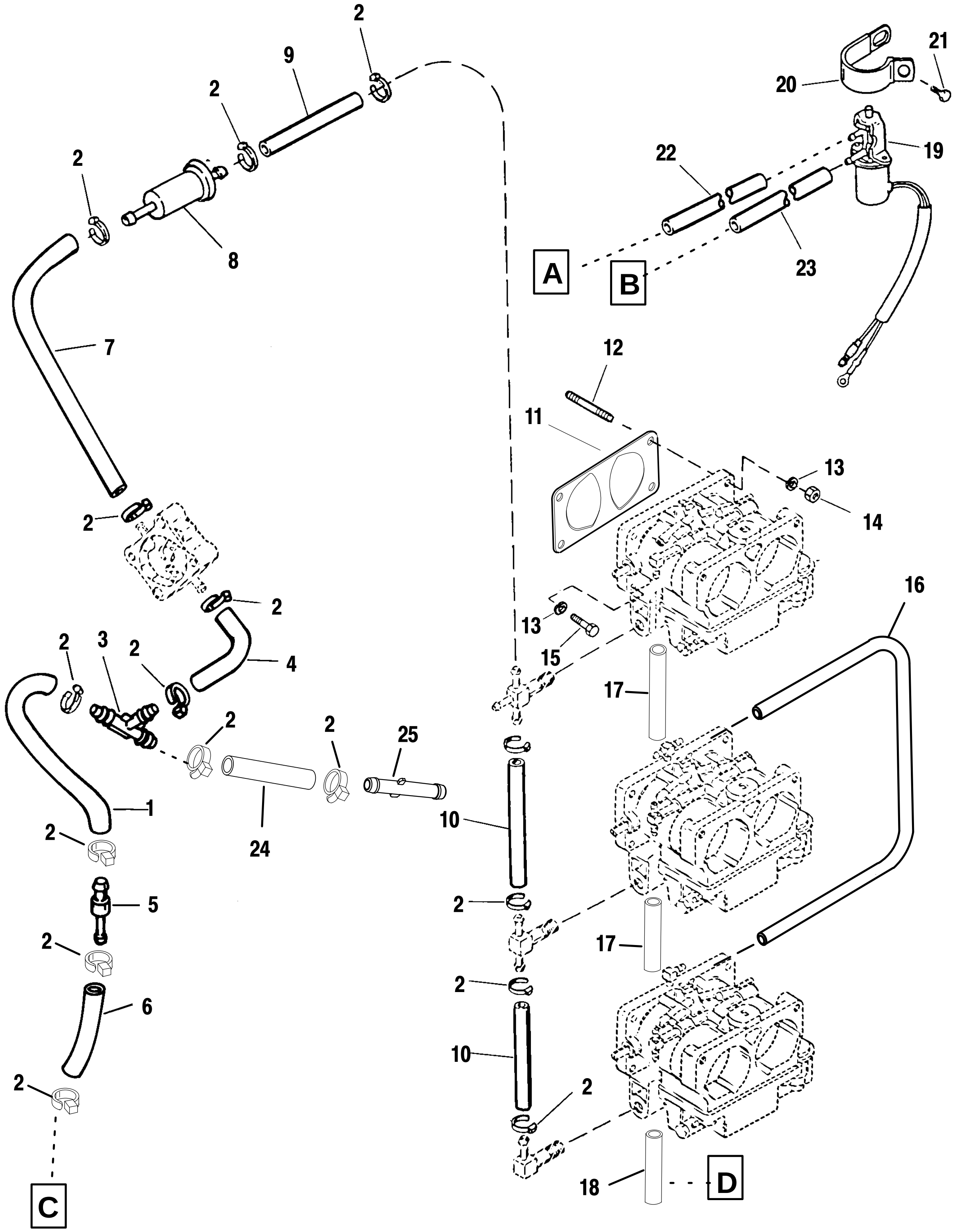
Attenuator And Carb Throttle Levers



REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	SOUND ATTENUATOR PLATE			
2	3	GASKET			
3	6	SCREW (1/4-28 x 2-1/2)	60		7.0
4	6	WASHER			
5	3	CAP PLUG			
6	1	THROTTLE LEVER KIT			
7	1	THROTTLE LEVER			
8	1	THROTTLE LEVER			
9	1	THROTTLE LINK			
10	1	ROLLER			
11	3	SCREW (10-32 x 3/4)			
12	3	WASHER			
13	3	LOCKWASHER			
14	1	DECAL-EPA INFO **(2000)(135)(SEE NOTE)**			
	1	DECAL-EPA INFO **(2000)(150/XR6/MAG. III/200) (SEE NOTE)**			
15	1	DECAL– Caution Air Box			

NOTE: THE EPA LABEL HAS IMPORTANT INFORMATION ON EPA EMISSION REGULATIONS. REPLACE ANY MISSING OR UNREADABLE EPA LABEL.

Fuel Lines

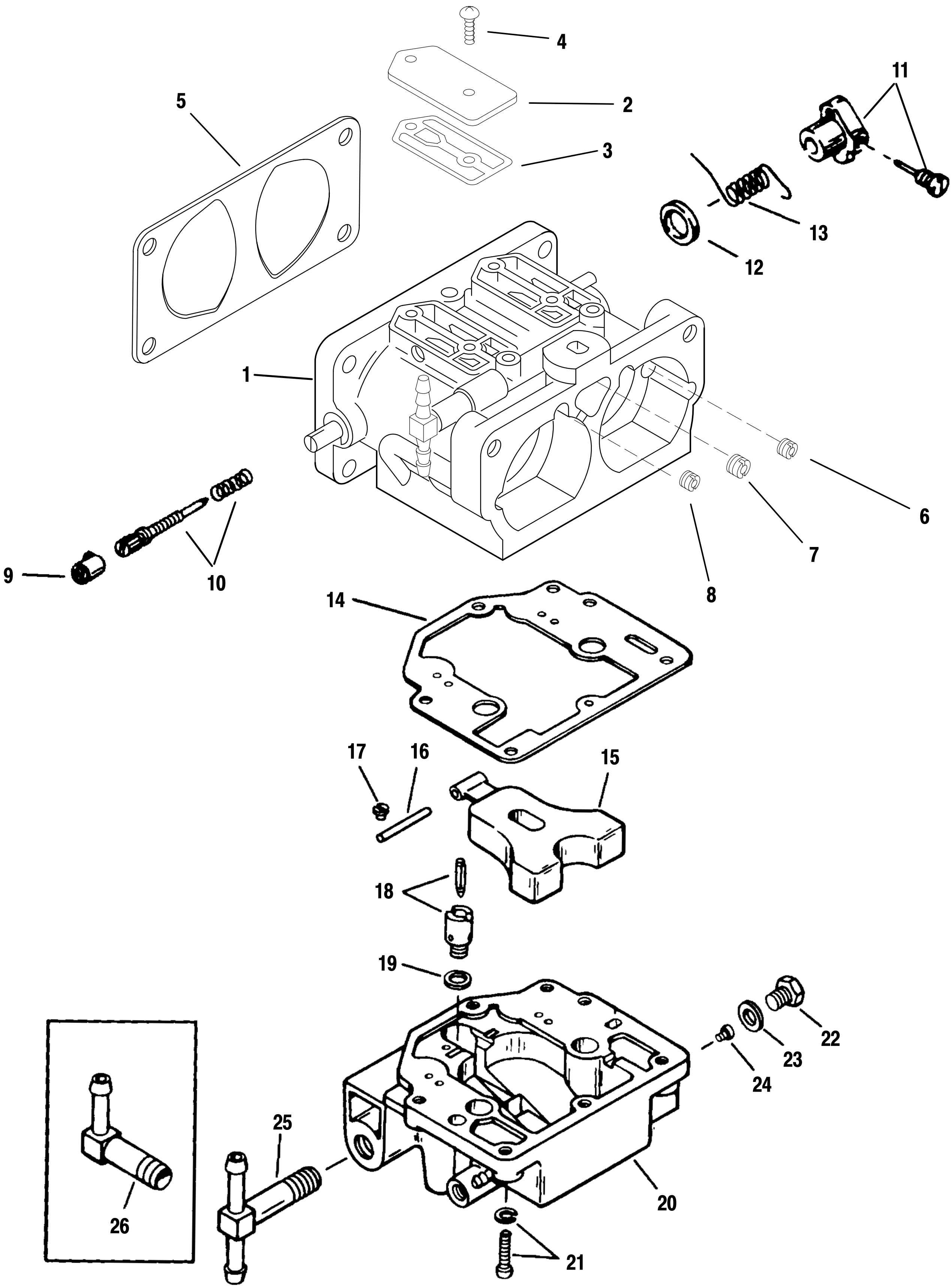


A= to top carb . . B = to middle carb . . .
C = to oil pump . D= to Cyl. Head

Fuel Lines

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	FUEL LINE (4-1/2 IN.)			
2	AR	STA-STRAP			
3	1	TEE			
4	1	HOSE			
5	1	CHECK VALVE			
6	1	FUEL LINE (2 IN.)			
7	1	HOSE			
8	1	FUEL FILTER			
9	1	HOSE (11 IN.)			
10	2	FUEL LINE (4-1/2 IN.)			
11	3	GASKET			
12	6	STUD			
13	6	LOCKWASHER			
14	6	NUT			
15	6	SCREW (1/4-20 x 7/8)			
16	1	FUEL LINE (9 IN.)			
17	2	HOSE (4-1/4 IN.)			
18	1	HOSE (26 IN.)			
19	1	ENRICHNER VALVE			
20	1	CLAMP			
21	1	SCREW (1/4-20 x 1/2)			
22	1	FUEL LINE (4-1/2 IN.)			
23	1	HOSE (3-3/4 IN.)			
24	1	TUBING (18 IN.)			
25	1	INLINE CONNECTOR			

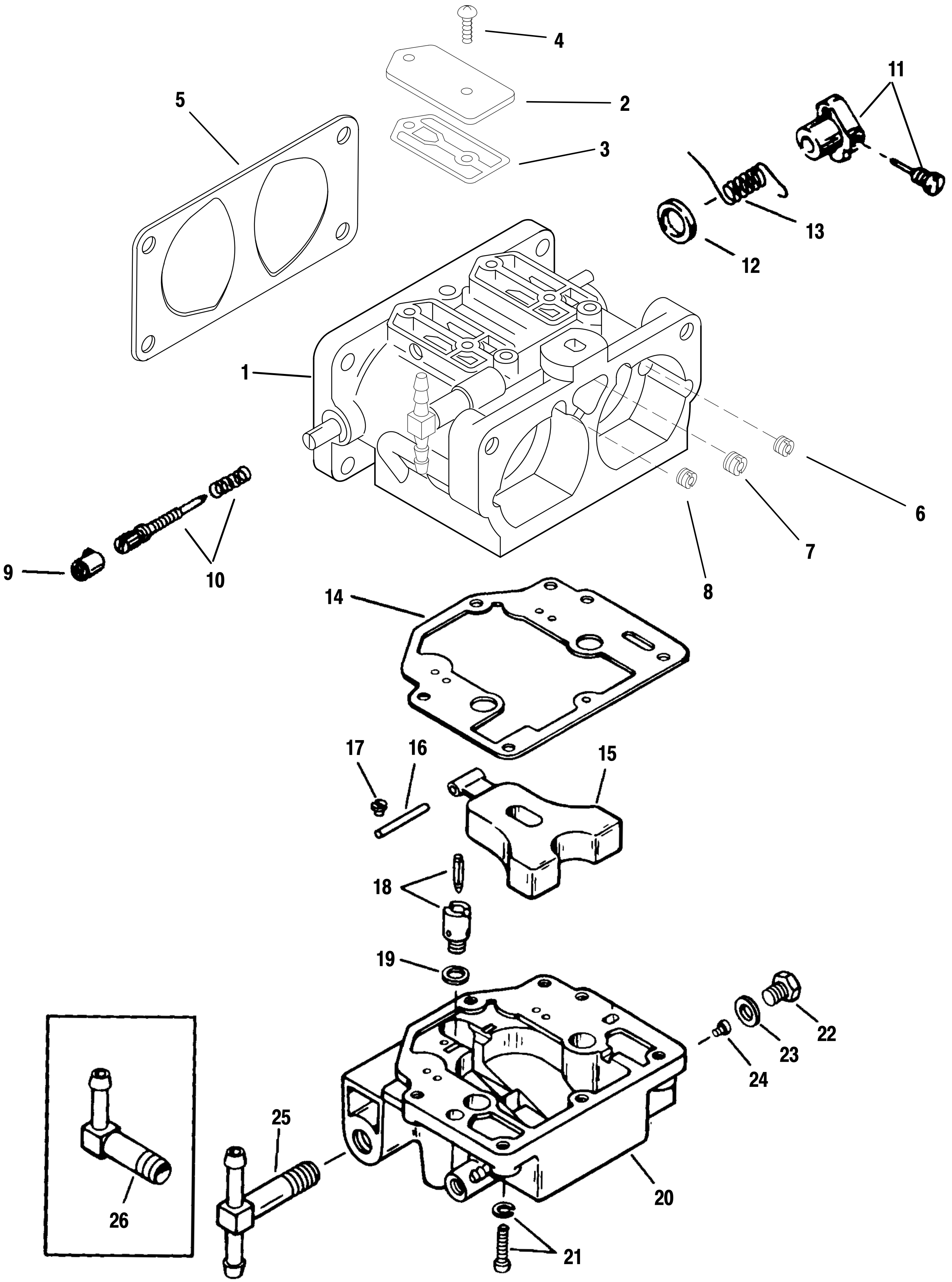
Carburetor



Carburetor

REF. NO.	QTY.	DESCRIPTION		TORQUE	
			lb-in	lb-ft	Nm.
1	1	TOP CARBURETOR **135 - WMV-15**			
	1	CENTER CARBURETOR			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR **150/XR6/MAGNUM III WMV-16**			
	1	CENTER CARBURETOR			
	1	BOTTOM CARBURETOR			
	1	TOP CARBURETOR **200 - WMV-18**			
	1	CENTER CARBURETOR			
	1	BOTTOM CARBURETOR			
2	6	COVER			
3	6	GASKET			
4	12	SCREW	18		2.0
5	3	GASKET			
6	2	JET–idle air vent **(.040-Top/Center)(135)**	14		1.5
	1	JET–idle air vent **(.048 - Bottom)(135)**	14		1.5
	2	JET–idle air vent **(.044-Top/Center)(150/XR6/Magnum III)**	14		1.5
	1	JET–idle air vent **(.048-Bottom)(150/XR6/Magnum III)**	14		1.5
	1	JET–idle air vent **(.038-Top)(200) PORT**	14		1.5
	1	JET–idle air vent **(.028-Center)(200)**	14		1.5
	1	JET–idle air vent **(.032-Bottom)(200)**	14		1.5

Carburetor



Carburetor

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
7	3	JET–bowl vent **(.086)(135/200)**			
	3	JET–bowl vent **(.082**)**(150/XR6/Magnum III)**			
8	1	JET–idle air vent **(.036-Top)(135)**			
	1	JET–idle air vent **(.030-Center)(135)**			
	1	JET–idle air vent **(.038-Bottom)(135)** **STARBOARD**			
	3	JET–idle air vent **(.044)(150/XR6/Magnum III)**			
	1	JET–idle air vent **(.038-Top)(200)**			
	2	JET–idle air vent **(.028-Center/Bottom)(200)**			
9	6	LIMITER CAP			
10	6	IDLE MIXTURE SCREW/SPRING			
11	3	LEVER KIT			
12	3	SPACER			
13	3	SPRING			
14	3	GASKET–fuel bowl			
15	3	FLOAT			
16	3	FLOAT SHAFT			
17	3	SCREW–float	10		1.0
18	3	VALVE SEAT KIT			
19	3	GASKET–valve seat			
20	1	FUEL BOWL (TOP)			
	2	FUEL BOWL (CENTER/BOTTOM)			
21	18	SCREW–fuel bowl	26		3.0
22	6	PLUG KIT	33		3.5
23	2	GASKET (Consists of 4 gaskets)			
24	6	JET–main fuel (.072)**(135)**	14		1.5
	6	JET–main fuel(.074)**(150/XR6/Magnum III)**	14		1.5
	2	JET–main fuel (.080)**(200-Top-Stbd/Center-Port)**	14		1.5
	2	JET–main fuel (.082)**(200-Top-Port)/Center-Stbd)**	14		1.5
	1	JET-main fuel (.078)**(200-Bottom-Port)**	14		1.5
	1	JET-main fuel (.084)**(200-Bottom-Stbd)**	14		1.5
25	2	TEE FITTING (TOP/CENTER)			
26	1	ELBOW (BOTTOM)			

Fuel System - Troubleshooting

General Information

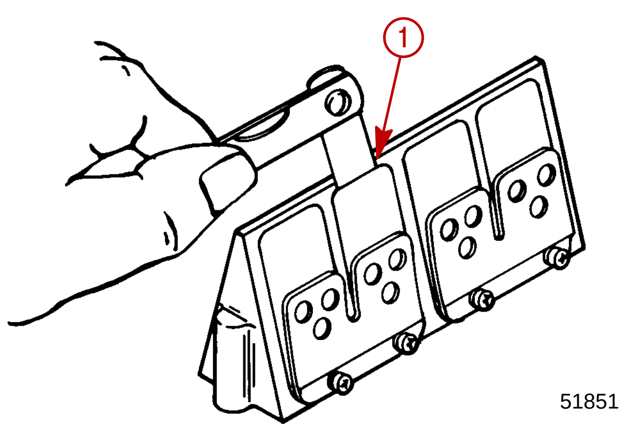
Problems, that are thought to be caused by the fuel system, may be, in reality, something completely different. Items, that are shown in the list on the left, could give the impression that there is a problem in the fuel system.

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

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

Problem: Engine Idles Rough and Stalls. Problem: Engine Hesitates Upon Acceleration. Problem: Engine Runs Uneven or Surges.	
Possible Cause	**Corrective Action**
Improperly mixed fuel. Contaminants (water, dirt, etc.) in fuel.	Check fuel in fuel tank and replace if necessary.
Fuel tank air vent closed or restricted.	Check air vent on fuel tank. Air vent must be open all-the-way and free from restrictions.
A pinched, cut or restricted fuel line. Also loose fuel line connection.	Check all fuel lines and replace as needed. Check and tighten all fuel line connections.
A dirty or restricted fuel filter.	Check and replace or clean all fuel filters.
Low fuel pump pressure.	Refer to Section 3A.
An anti-siphon valve.	Refer to Section 3A.
A needle and seat (in carburetor) that is either stuck open or closed. Open=Flooding - Closed=Starving	Refer to “Carburetor Adjustments” in this section.
Improper carburetor jets, restricted jet or idle mixture screw out of adjustment.	Refer to “Carburetor Adjustments” in this section.
Improper carburetor float level.	Refer to “Carburetor Adjustments” in this section.
Carburetor loose on reed block housing.	Tighten carburetor nuts securely.
Reed block housing loose, or gaskets are defective.	Using a pressure oil can, spray 2-cycle oil around reed block housing/crankcase housing matching surfaces and carburetor base. If engine RPM changes, tighten or replace reed block housing gaskets or carburetor base gaskets, as needed.
Improperly routed or restricted bleed hose(s).	Refer to bleed line routing in this section.

REED VALVE SPECIFICATIONS



Reed Valve Opening

1 - Max. 0.020 in. (0.59 mm)

Reed Valve Leak Test

TOOLS REQUIRED FOR TEST:

a. Fuel Pressure Gauge (0 to 15 psi)[0 – 103.4 kpa]

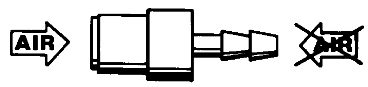
b. Hose (approx. 3 ft. x 1/8 in. ID)[274 cm x 3.2 mm ID] same diameter as bleed hoses.

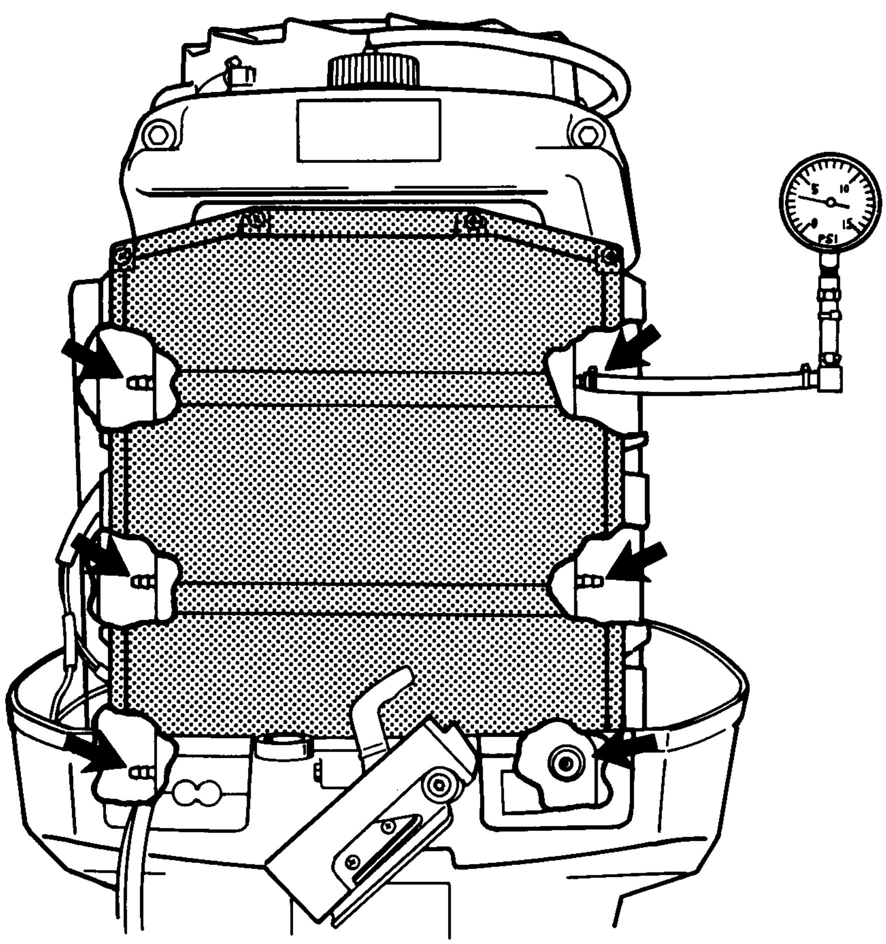
1. Remove engine cowling.
2. Place outboard in water, start and allow to warm up.

NOTE: *To gain access to cylinder #5 bleed fitting remove throttle cam from throttle linkage. Refer to "Carburetor Removal/Installation" for cam removal and installation.*

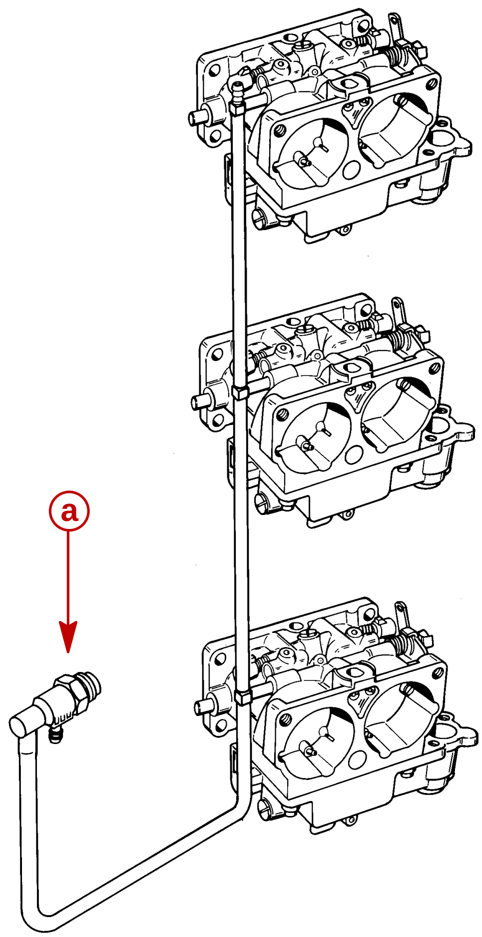
3. Remove and plug bleed hoses (one at a time) from crankcase cover and connect fuel pressure gauge as shown.
4. With engine at idle, a reading of 3 – 6 psi (20.7 – 41.4 kPa) must be attained. If reading falls below 3 psi (20.7 kPa) inspect reed valves. Refer to induction manifold disassembly in Powerhead Section 4 of service manual. Replace reed valves or check valves as required.

NOTE: *Check valve is functioning if air flows in one direction as shown.*





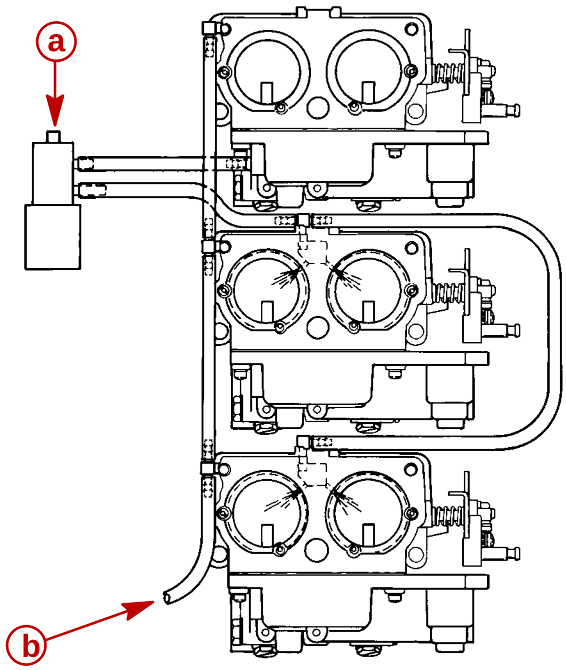
Thermal Air Valve Circuit Description



a - Thermal Air Valve

The thermal air valve circuit functions as an air restrictor for the idle circuit which is controlled by a thermal open/close valve monitoring engine temperature. The valve is located on the starboard cylinder head below no. 3 spark plug. When the engine temperature is below 100° F (38° C) the thermal air valve is closed. When a cold engine is running, the thermal air valve restricts air to the idle circuit causing the fuel mixture to be richer. When the engine warms sufficiently, the thermal valve opens allowing required fuel/air mixture for efficient operation.

Enrichener System Description



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a - Manual Primer Button
b - To Thermal Air Valve

The enrichener system provides the engine with a rich fuel charge for starting ease of a cold engine. The system consists of an electrically operated enrichener valve which is connected by hoses to the carburetors.

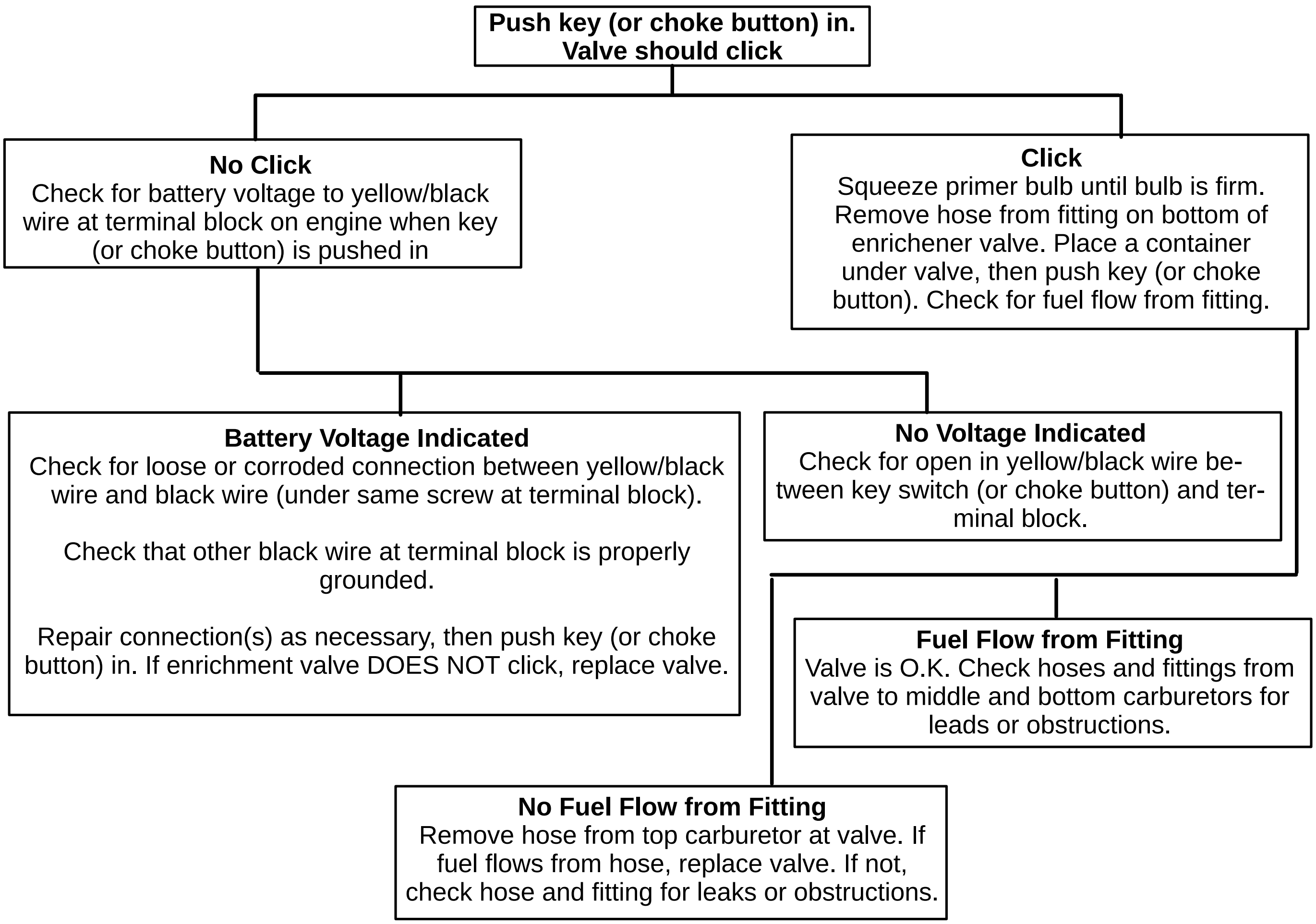
Fuel is gravity fed to the valve from the float bowl of the top carburetor via a hose. When the key (or choke button) is pushed in (and held in) current is sent to the valve causing it to open, which allows fuel to pass thru. The fuel passes thru a hose and is supplied to the engine via fittings located on top of the middle and bottom carburetors. When the key (or choke button) is released, the valve will return to the closed position. The valve can be operated manually if valve fails to operate electrically, refer to "Manual Operation of Enrichener Valve," following.

Manual Operation of Enrichener Valve

IMPORTANT: Use of enrichener if engine is warm could result in engine flooding.

Squeeze primer bulb until bulb is firm. Press button in on enrichener valve and hold approximately five seconds. Release button. Start outboard.

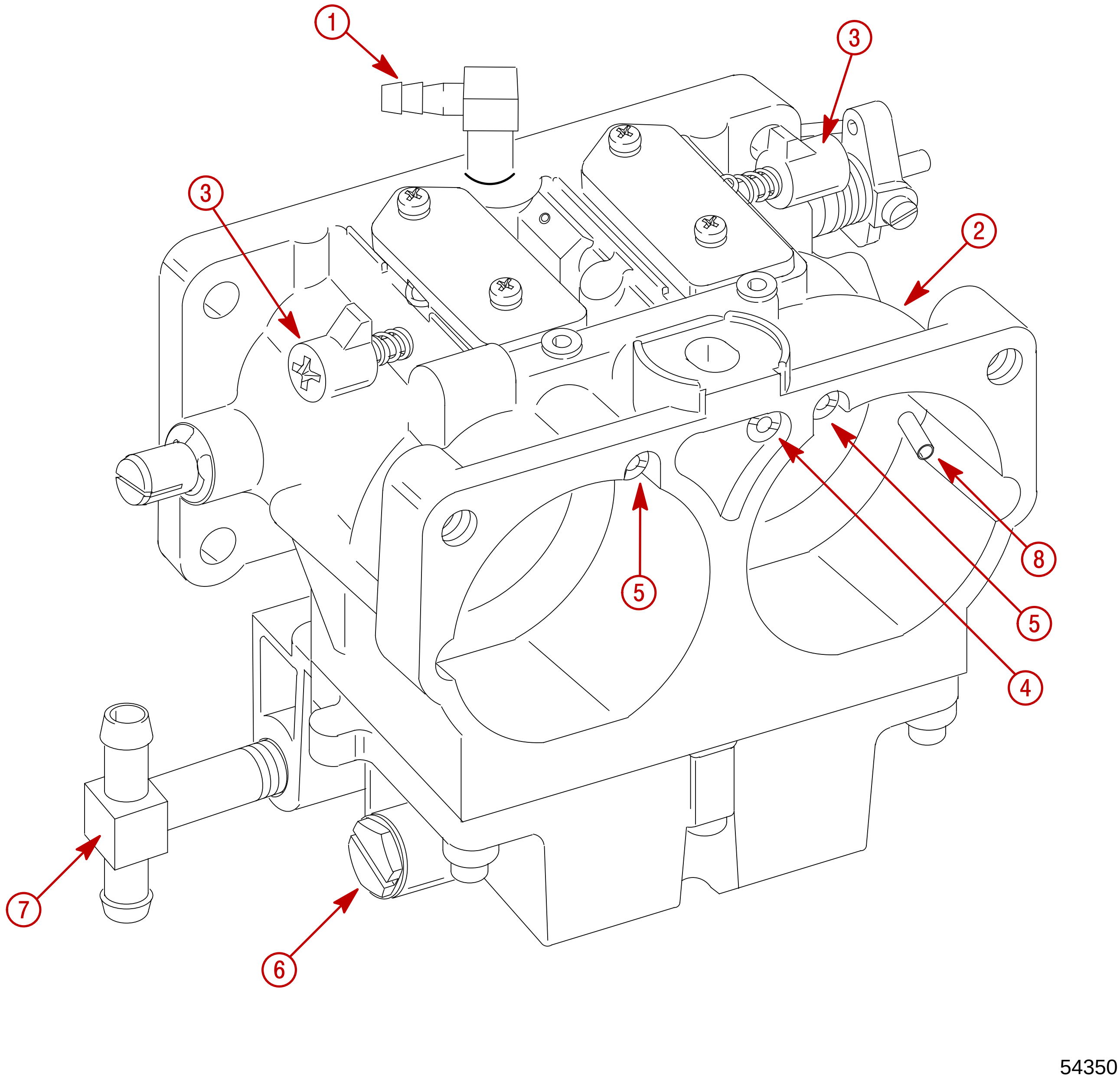
Enrichener Valve Test



ENRICHENER VALVE REPLACEMENT

1. Disconnect enrichener valve leads at terminal block.
2. Disconnect hoses from valve.
3. Remove bolt that secures valve mounting bracket to engine, then lift valve from engine.
4. Reinstall hoses to valve.
5. Apply a drop of Loctite 271 (92-809820) to threads of mounting bracket retaining bolt, then secure valve to engine with bracket and bolt.
6. Ground black (valve) lead by inserting terminal block retaining screw thru lead end and terminal block, and then securing to engine using screw.
7. Connect yellow/black lead (from engine harness) to yellow/black valve lead by inserting screw thru lead ends, and securing to terminal block using screw.

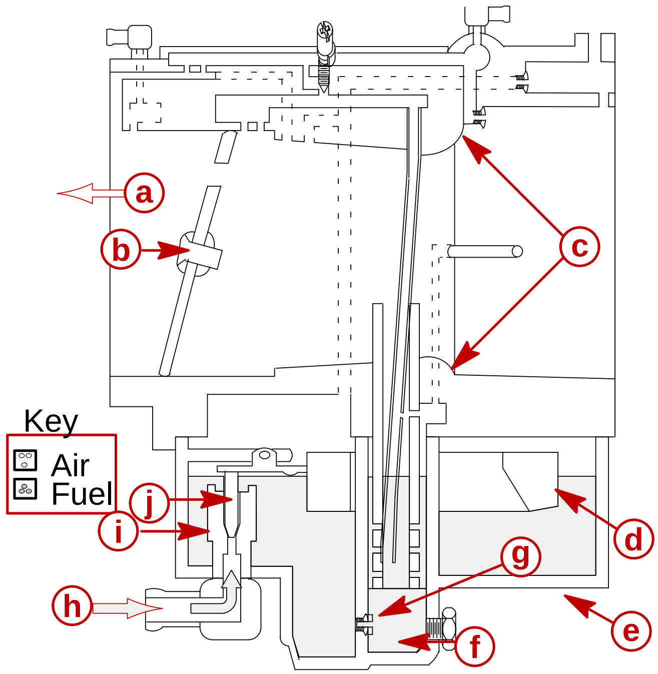
Carburetor



1 - Enrichener Hose Fitting
2 - Carburetor Number
3 - Fuel Mixture Adjustment Screw
4 - Back Draft Vent Jet
5 - Idle Air Bleed Jet
6 - High Speed Fuel Jet Access Plug (2)
7 - Fuel Line Fitting
8 - Main Nozzle Well Vent (2)

Carburetor Fuel Circuits

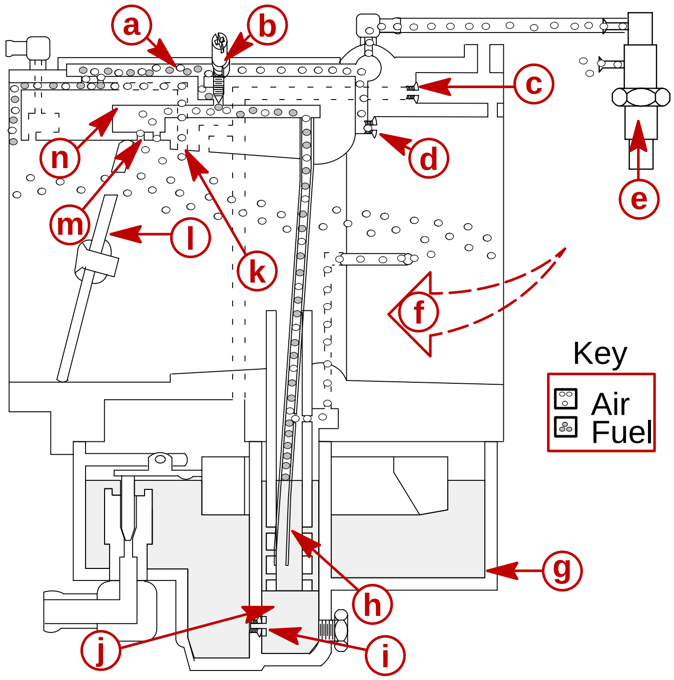
Float Bowl Circuit



- **a** - To Engine Crankcase
- **b** - Throttle Plate
- **c** - Carburetor Venturi
- **d** - Float
- **e** - Float Bowl
- **f** - Main Fuel Well
- **g** - Main Jet
- **h** - Fuel from Fuel Pump
- **i** - Inlet Seat
- **j** - Inlet Needle

Fuel from the fuel pump enters the carburetor through the fuel inlet fitting and fills the bowl until the float moves the inlet needle against the fuel inlet seat. With the inlet needle against the inlet seat, the fuel inside the float bowl is at it's maximum level. Fuel inside the bowl flows through the main fuel jet and fills the main fuel well.

Idle Circuit



a - Idle Passage
b - Idle Mixture Screw
c - Back Draft Jet
d - Idle Air Jet
e - Thermal Air Valve (open)
f - Air Flow
g - Float Bowl
h - Idle Tube
i - Main Fuel Jet
j - Main Fuel Well
k - Secondary Idle Air Bleed
l - Throttle Plate
m - Off-Idle Ports
n - Off-Idle Passage

As the engine rotates, the piston moves away from the crankcase. This movement creates a low pressure area behind the throttle plate. Atmospheric pressure pushes air through the carburetor throat (venturi), past the throttle plate (small hole in plate) and into the low pressure area inside the crankcase. Atmospheric pressure enters the float bowl chamber through the back draft jet. This pressure forces fuel toward the low pressure area behind the throttle plate. Fuel flows:

a. Through the main fuel jet into the main fuel well,

(1.) Up the idle tube,

(2.) Through the off-idle passages,

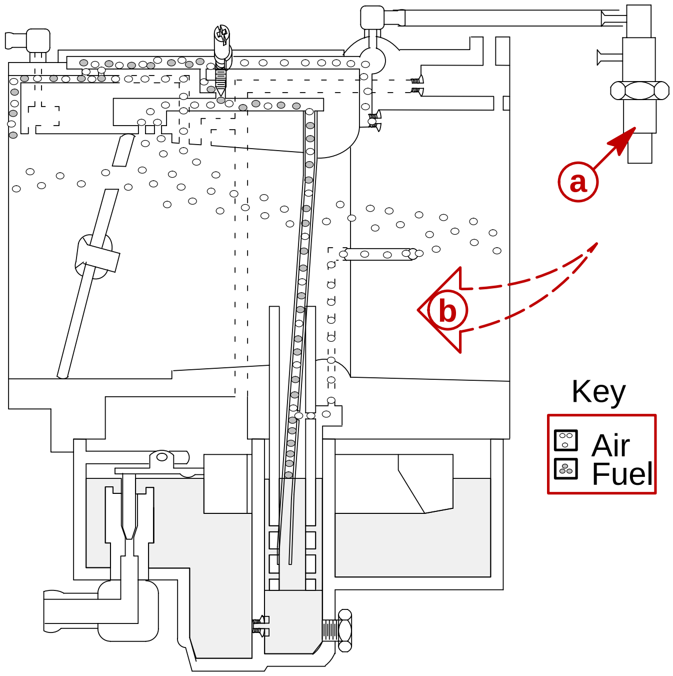
(3.) Past the idle mixture screw,

(4.) Into the idle passage

(5.) And into the carburetor throat.

Air enters the idle circuit through the idle air jet and secondary idle air bleed. This air mixes with the fuel inside the idle passage before the air/fuel mixture is discharged into the engine. Rotating the idle mixture screw will change the air/fuel mixture at idle speeds.

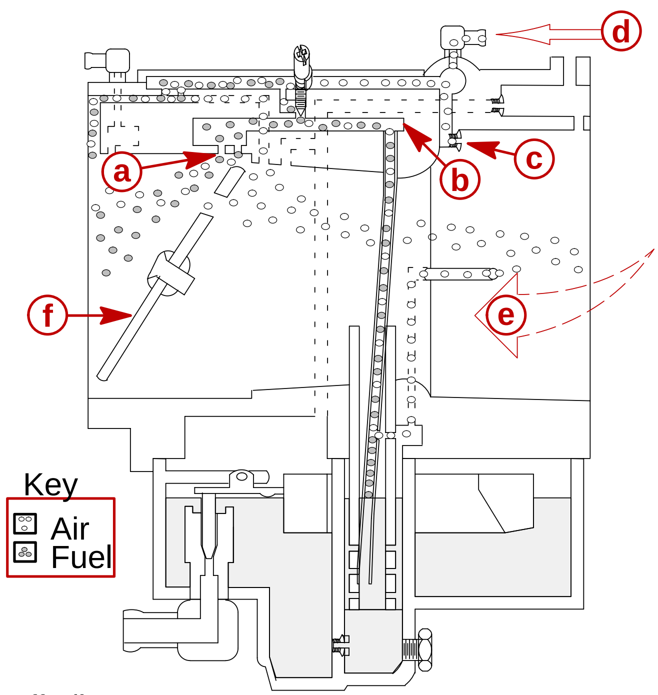
Cold Start Circuit



a - Thermal Air Valve (closed)
b - Air Flow

A cold engine will require a richer mixture. Fuel is supplied to the carburetors by the solenoid operated enrichner valve.

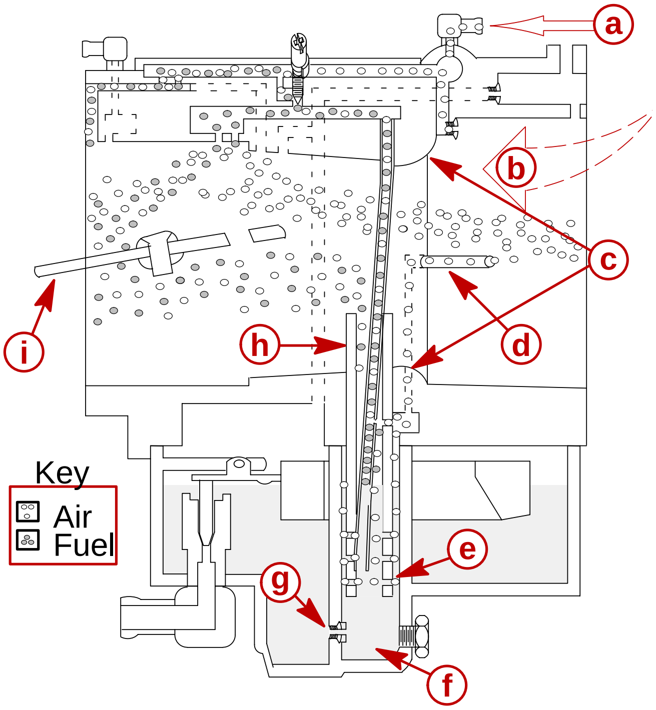
Off-Idle Circuit



a - Off-Idle Ports
b - Off-Idle Passage
c - Idle Air Jet
d - From Open Thermal Air Valve
e - Air Flow
f - Throttle Plate

As the throttle plates rotate past the off-idle ports, the ports are exposed to the low pressure area behind the throttle plate. Additional fuel flows through the off-idle passage; through the rear port; and as the throttle plate continues to rotate, through the forward port.

Main Circuit



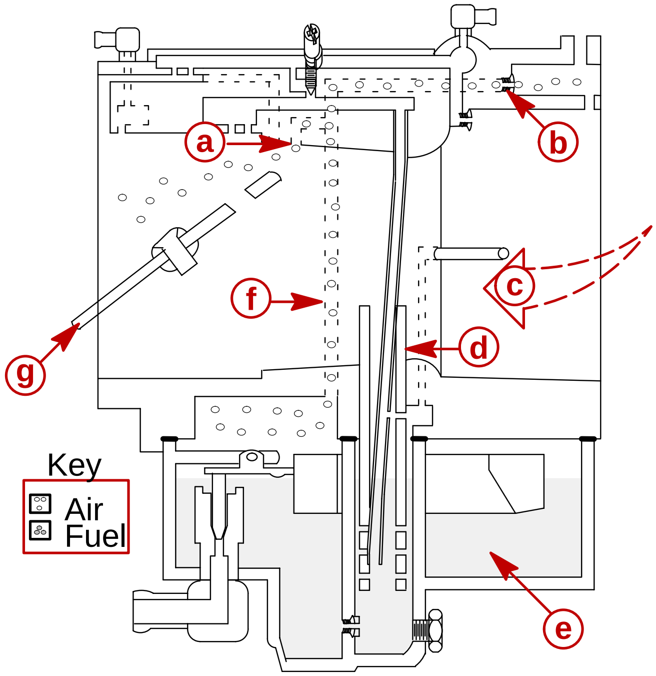
a - From Open Thermal Air Valve
b - Air Flow
c - Venturi
d - Main Discharge Air Inlet Tube
e - Cross Holes
f - Main Fuel Well
g - Main Fuel Jet
h - Main Discharge Nozzle
i - Throttle Plate

As the throttle plate rotates past the off-idle ports, the low pressure area extends to the main discharge nozzle. In addition, the increased air flow through the carburetor bore creates a low pressure area inside the venturi. These combined forces create a strong suction over the main discharge tube. Fuel flows:

1. Through the main fuel jet into the main fuel well,
2. Up the main discharge nozzle,
3. Into the venturi.

Air is mixed with the fuel to make it lighter, air enters the main fuel well through the main discharge air inlet tube. Cross holes are drilled in the main discharge tube, allowing the air to mix with the fuel inside the main well. As the throttle plate continues to open, additional fuel is drawn out of the main discharge tube, exposing additional cross holes. At full throttle, the fuel mixture is controlled by the size of the main fuel jet.

Back Draft Circuit



NOTE: *Fuel Flow Not Shown For Clarity*

- **a** - Back Draft Port
- **b** - Back Draft Jet
- **c** - Air Flow
- **d** - Main Discharge Tube
- **e** - Fuel Bowl
- **f** - Fuel Bowl Vent Passage
- **g** - Throttle Plate

At partial throttle settings, the back draft circuit leans out the mixture for increased fuel economy. The back draft circuit uses the float bowl vent circuit and bowl vent jet to lean out the air/fuel mixture. The bowl vent jet limits the amount of air entering the float bowl vent circuit. With the throttle plate positioned correctly, the low pressure area is exposed to the back draft port inside the carburetor bore. The float bowl vent circuit is connected by passages to the back draft port. The low pressure area pulls air out of the bowl vent circuit. Due to the size of the vent jet and the air loss through the back draft port, the air pressure on the fuel inside the fuel bowl is lowered to below atmospheric pressure. Lower pressure on the fuel inside the float bowl, lowers the amount of fuel being forced out of the main discharge tube.

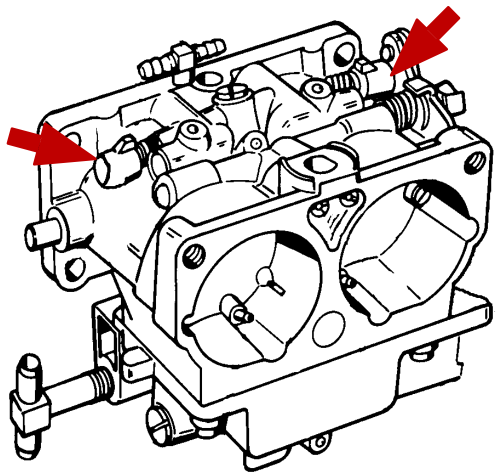
Carburetor Specifications

SYNCHRONIZING CARBURETORS

To synchronize carburetors, refer to “Timing/Synchronizing/Adjusting” section.

IDLE MIXTURE SCREW

For best running quality, the adjustable idle mixture screws are set at the factory with the limit tabs pointing straight up (approx. 1-1/2 turns out for Model 135) (1-1/4 turns out for Models 150 and 200). If adjustment is required, all idle mixture screws must be turned the same amount and the same direction. Turning the idle mixture screws (recommended 1/8 turn at a time) clockwise will lean the idle mixture. Turning the idle mixture screws counter-clockwise will richen the idle mixture.



FLOAT LEVEL ADJUSTMENT

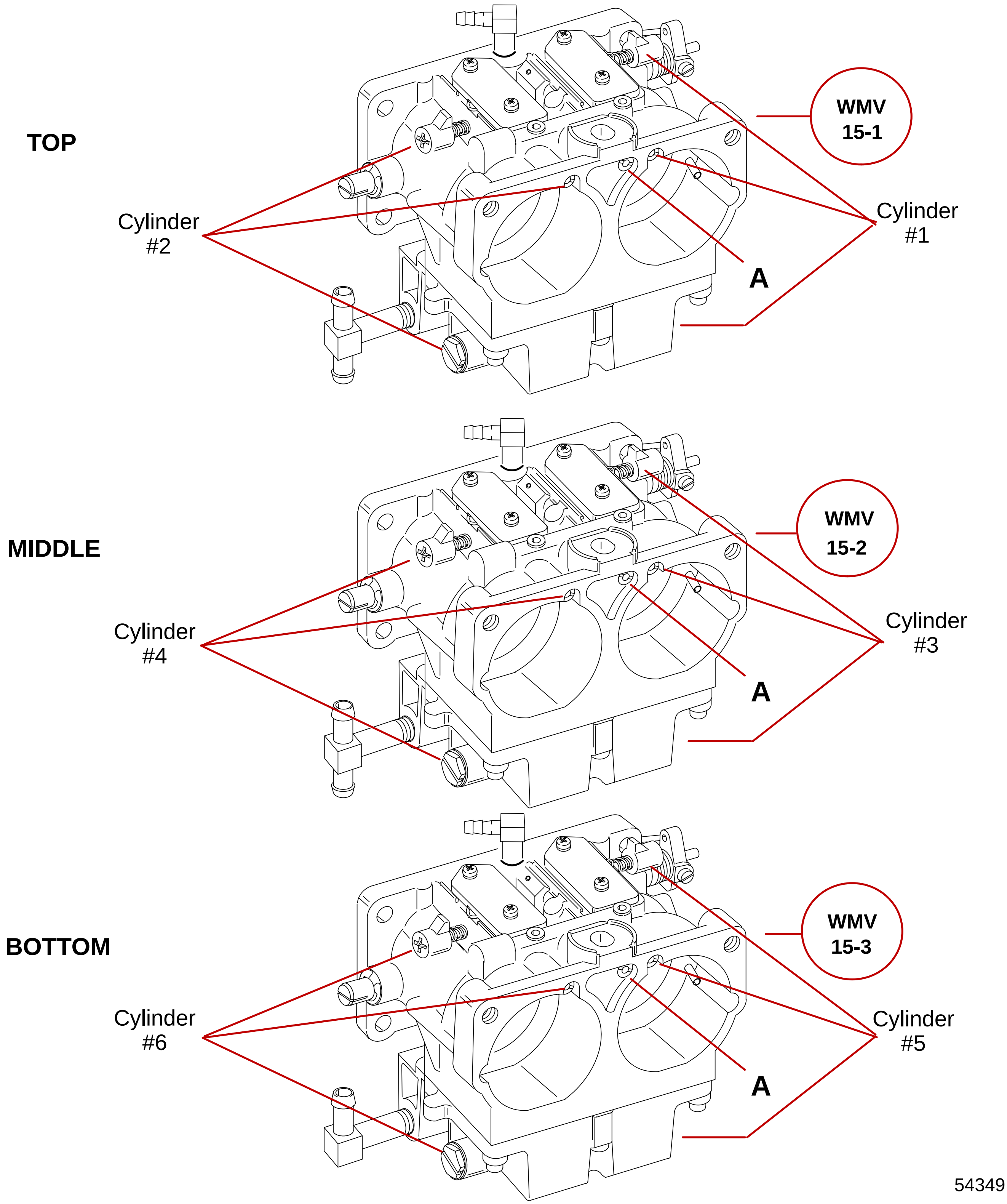
There is one float and one float bowl for 2 cylinders. To set float height, invert float bowl and adjust float tang until top of float is even with top of float bowl.

JET LOCATION FOR EACH CYLINDER

Carburetor jets and adjustment screw installed in the starboard side of the carburetor supply fuel to the port cylinder, jets and adjustment screw installed in the port side supply fuel to the starboard cylinder.

NOTE: *The idle jet and back draft jet affect both cylinders.*

Carburetor Placement and Jet Location for Each Cylinder

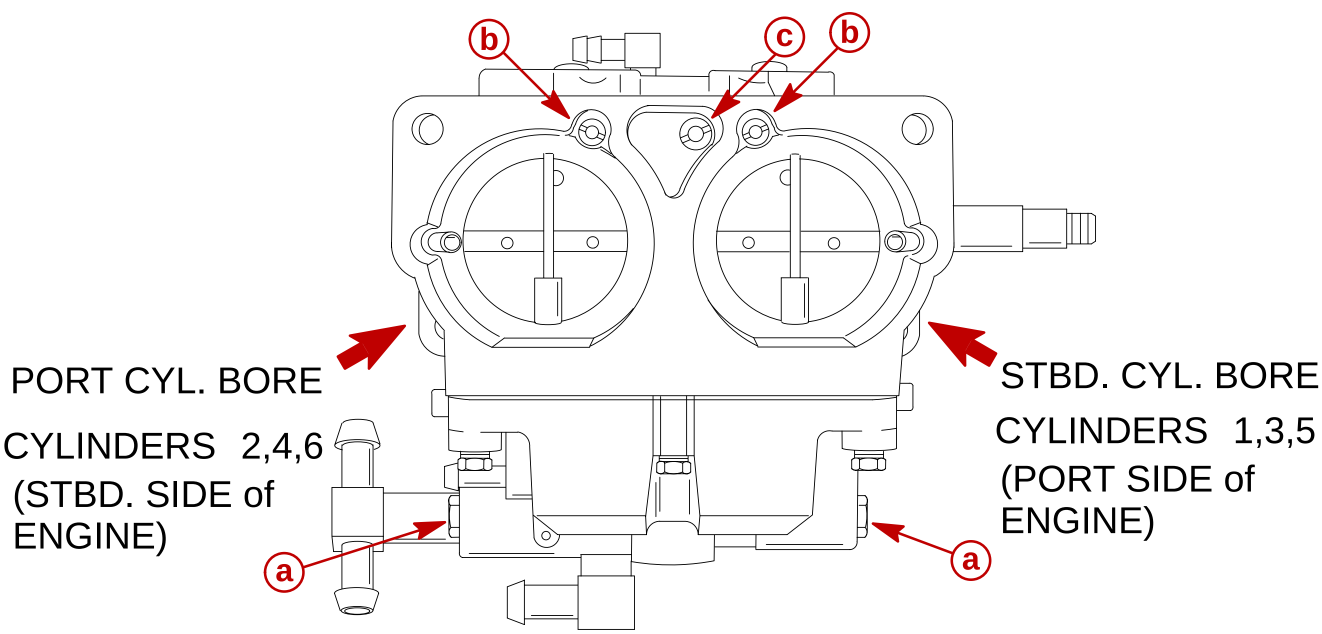


A – Backdraft Jet Affects Both Cylinders

NOTE: *Carburetor jets and adjustment screw installed in the starboard side of the carburetor supply fuel to the port cylinder, jets and adjustment screw installed in the port side supply fuel to the starboard cylinder.*

Carburetor Jet Placement

NOTE: *Jets listed are for engine operation from 0–5000 feet (0–1524m) of elevation.*				
Model 135		**Main Jet a**	**Idle Air Bleed Jet b**	**Back Draft Vent Jet c**
WMV 15-1	PORT Bore STBD Bore	.072 .072	.040 .036	.086
WMV 15-2	PORT Bore STBD Bore	.072 .072	.040 .030	.086
WMV 15-3	PORT Bore STBD Bore	.072 .072	.048 .038	.086
NOTE: *Jets listed are for engine operation from 0–5000 feet (0–1524m) of elevation.*				
Model 150		**Main Jet a**	**Idle Air Bleed Jet b**	**Back Draft Vent Jet c**
WMV 16-1	PORT Bore STBD Bore	.074 .074	.044 .044	.082
WMV 16-2	PORT Bore STBD Bore	.074 .074	.044 .044	.082
WMV 16-3	PORT Bore STBD Bore	.074 .074	.048 .044	.082
NOTE: *Jets listed are for engine operation from 0–5000 feet (0–1524m) of elevation.*				
Model 200		**Main Jet a**	**Idle Air Bleed Jet b**	**Back Draft Vent Jet c**
WMV 18-1	PORT Bore STBD Bore	.082 .080	.038 .042	.086
WMV 18-2	PORT Bore STBD Bore	.080 .082	.028 .028	.086
WMV 18-3	PORT Bore STBD Bore	.078 .084	.028 .028	.086



High Altitude Recommendations

NOTE: *Refer to "Jet Charts" for jet sizes and part numbers.*

IMPORTANT: When operating outboard above 5000 ft. (1524m), it is recommended outboard gear ratio be reduced as shown in chart below:

Model	High Altitude Gear Ratio Change
135/150 with 2:1 Ratio	2.3:1 High Altitude Gear Kit
150 Mag III/XR6 with 1.78:1 Ratio	2:1 Complete Gearcase
150 Mag III,XR6,200 with 1.87:1 Ratio	2:1 Ratio Gear Set or Complete Gearcase

Jet Part Number Chart

JET ORIFICE SIZE/PART NUMBER CHART 10-32							
Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number
.040	19266040	.058	1395-7831	.076	1399-3796	.094	1395-8423
.042	1399-5315	.060	1395-6487	.078	1395-6680	.096	1399-6249
.044	1395-7394	.062	1399-4217	.080	1395-6201	.098	1395-7355
.046	1399-5317	.064	1399-4216	.082	1399-3518		
.048	1395-6246	.066	1399-4215	.084	1399-3517		
.050	1395-6028	.068	1395-6029	.086	1395-5815		
.052	1395-6359	.070	1395-6030	.088	1395-6202		
.054	1399-5225	.072	1395-6207	.090	1395-6247		
.056	1399-5213	.074	1399-3794	.092	1395-5733		

JET ORIFICE SIZE/PART NUMBER CHART 8-32							
Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number	Jet Orifice Size (inch)	Part Number
.030	810741	.038	815633038	.046	815633046	.054	815633054
.032	1399-3252	.040	1399-7570	.048	815633048	.070	815633070
.034	1395-3251	.042	815633042	.050	815633050	.076	815633076
.036	1399-3026	.044	810742	.052	815633052		

NOTE: *Thread size for V-6 model carburetor main, idle air and back draft jets are 10-32*

NOTE: *Thread size for V-6 model carburetor progression jets are 8-32*

High Altitude Jet Chart

Factory installed main fuel jets are normally adequate for proper performance up to approximately 5000 feet (1524m) above sea level. Between 2000 feet (609.6m) and 5000 feet (1524m) the reduction of the main fuel jet(s) may result in improved performance and fuel economy. Above 5000 feet, however, it is recommended that main jet size be reduced as shown per 1000 feet (304.8m) in the following chart.

Feet **Meter**	1000 304.8	2000 609.6	3000 914.4	4000 1219.2	5000 1524	6000 1828.8	7000 2133.6	8000 2438.4	9000 2743.2	10000 3048	110003 352.8	12000 3657.6
Jet Size												
0.034	0.034	0.034	0.032	0.032	0.032	0.032	0.032	0.032	0.030	0.030	0.030	0.030
0.036	0.036	0.036	0.034	0.034	0.034	0.034	0.034	0.032	0.032	0.032	0.032	0.032
0.038	0.038	0.038	0.036	0.036	0.036	0.036	0.036	0.034	0.034	0.034	0.034	0.034
0.040	0.040	0.040	0.038	0.038	0.038	0.038	0.038	0.036	0.036	0.036	0.036	0.034
0.042	0.042	0.042	0.040	0.040	0.040	0.040	0.038	0.038	0.038	0.038	0.038	0.036
0.044	0.044	0.044	0.042	0.042	0.042	0.042	0.040	0.040	0.040	0.040	0.038	0.038
0.046	0.046	0.046	0.044	0.044	0.044	0.044	0.042	0.042	0.042	0.042	0.040	0.040
0.048	0.048	0.048	0.046	0.046	0.046	0.046	0.044	0.044	0.044	0.042	0.042	0.042
0.050	0.050	0.050	0.048	0.048	0.048	0.046	0.046	0.046	0.046	0.044	0.044	0.044
0.052	0.052	0.050	0.050	0.050	0.050	0.048	0.048	0.048	0.048	0.046	0.046	0.046
0.054	0.054	0.052	0.052	0.052	0.052	0.050	0.050	0.050	0.048	0.048	0.048	0.048
0.056	0.056	0.054	0.054	0.054	0.054	0.052	0.052	0.052	0.050	0.050	0.050	0.048
0.058	0.058	0.056	0.056	0.056	0.056	0.054	0.054	0.054	0.052	0.052	0.052	0.050
0.060	0.060	0.058	0.058	0.058	0.056	0.056	0.056	0.054	0.054	0.054	0.052	0.052
0.062	0.062	0.060	0.060	0.060	0.058	0.058	0.058	0.056	0.056	0.056	0.054	0.054
0.064	0.064	0.062	0.062	0.062	0.060	0.060	0.060	0.058	0.058	0.058	0.056	0.056
0.066	0.066	0.064	0.064	0.064	0.062	0.062	0.062	0.060	0.060	0.060	0.058	0.058
0.068	0.068	0.066	0.066	0.066	0.064	0.064	0.064	0.062	0.062	0.060	0.060	0.060
0.070	0.070	0.068	0.068	0.068	0.066	0.066	0.064	0.064	0.064	0.062	0.062	0.062
0.072	0.072	0.070	0.070	0.070	0.068	0.068	0.066	0.066	0.066	0.064	0.064	0.062
0.074	0.074	0.072	0.072	0.070	0.070	0.070	0.068	0.068	0.068	0.066	0.066	0.064
0.076	0.076	0.074	0.074	0.072	0.072	0.072	0.070	0.070	0.068	0.068	0.068	0.066
0.078	0.078	0.076	0.076	0.074	0.074	0.074	0.072	0.072	0.070	0.070	0.068	0.068
0.080	0.080	0.078	0.078	0.076	0.076	0.076	0.074	0.074	0.072	0.072	0.070	0.070
0.082	0.082	0.080	0.080	0.078	0.078	0.076	0.076	0.076	0.074	0.074	0.072	0.072
0.084	0.084	0.082	0.082	0.080	0.080	0.078	0.078	0.076	0.076	0.076	0.074	0.074
0.086	0.086	0.084	0.084	0.082	0.082	0.080	0.080	0.078	0.078	0.076	0.076	0.074
0.088	0.088	0.086	0.086	0.084	0.084	0.082	0.082	0.080	0.080	0.078	0.078	0.076
0.090	0.090	0.088	0.088	0.086	0.086	0.084	0.084	0.082	0.082	0.080	0.080	0.078
0.092	0.092	0.090	0.090	0.088	0.088	0.086	0.086	0.084	0.084	0.082	0.082	0.080
0.094	0.094	0.092	0.092	0.090	0.090	0.088	0.088	0.086	0.086	0.084	0.084	0.082
0.096	0.096	0.094	0.094	0.092	0.092	0.090	0.090	0.088	0.086	0.086	0.084	0.084
0.098	0.098	0.096	0.096	0.094	0.092	0.092	0.090	0.090	0.088	0.088	0.086	0.086

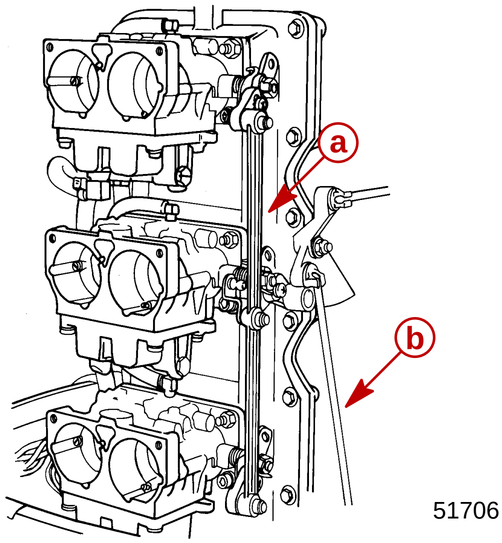
Removing Carburetor(s) from Engine

1. Remove top cowling.

IMPORTANT: Place an identifying mark on each carburetor before removal as each carburetor must be reinstalled in same location from which removed.

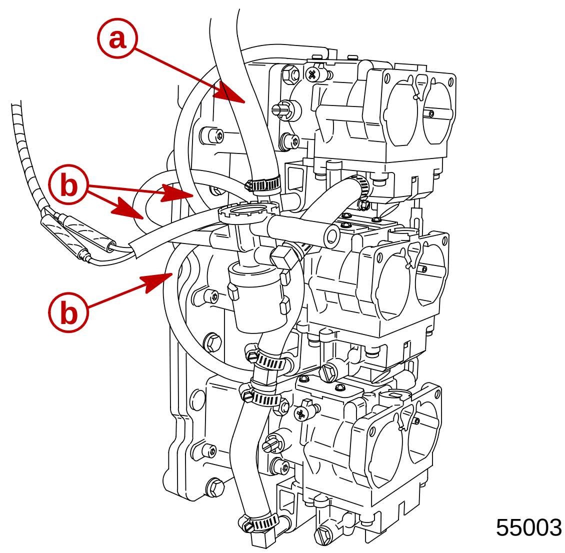
NOTE: *As each carburetor is removed from intake manifold, their respective fuel enrichment hose should be disconnected.*

2. Remove air box cover and heat shield from engine.
3. Remove throttle linkage from throttle levers as shown.
4. Remove oil pump link rod from throttle lever.



a - Throttle Linkage
b - Oil Pump Link Rod

5. Remove fuel hose and fuel enrichment valve hose from carburetors.

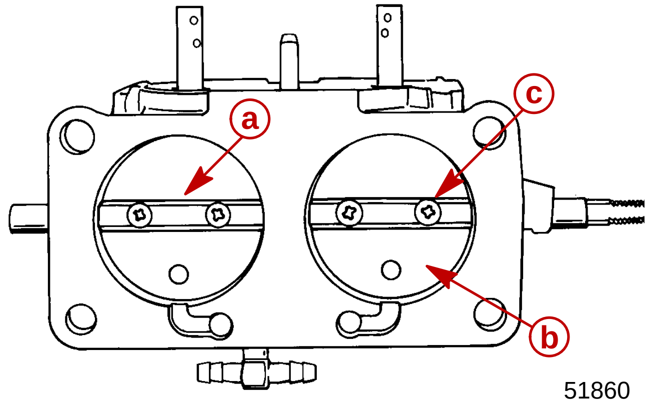


a - Fuel Hose
b - Enrichment Valve Hoses

6. Carburetors may now be removed individually. Mark location of each carburetor and reinstall in same location. Remove carburetor(s) secured by two nuts and two allen head type bolts.

Throttle Shaft Screws

NOTE: *It is recommended that the screws securing the throttle plates to the throttle shaft NOT BE REMOVED due to the difficulty in obtaining correct alignment of throttle plates during reassembly. If screws must be removed, apply Loctite 271 to screw threads before reinstalling screws.*



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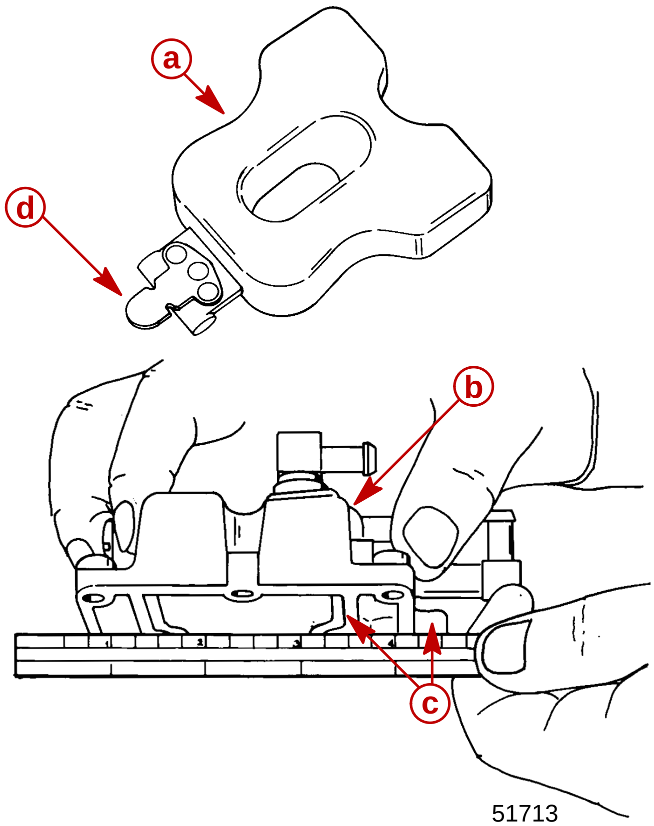
a - Throttle Shaft
b - Throttle Shutter Plate
c - Screws

Float Adjustment

NOTE: *Float height adjustment is the only adjustment made to adjust float setting.*

1. Adjust float height by turning fuel bowl upside-down, then adjust float tab until float is level with edge of fuel bowl. Adjust float tab if necessary.



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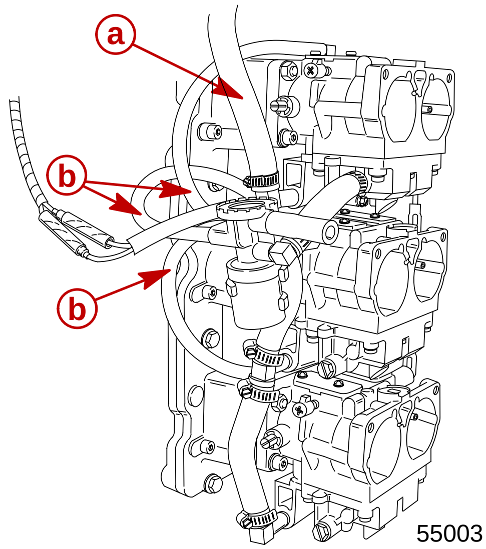
a - Float (Adjust by bending tab)
b - Fuel Bowl (Upside-Down)
c - Float Level Even with Bowl Edge
d - Float Tab

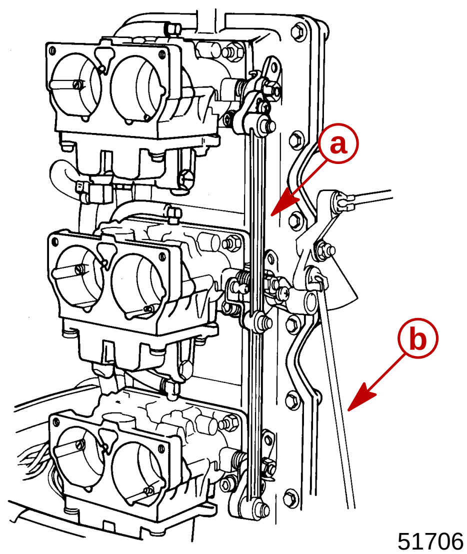
Installing Carburetor(s) to Engine

1. Place new carburetor gaskets onto carburetor mounting studs on intake manifold.
2. Install carburetors (in respective locations) onto mounting studs and secure in place with nuts and allen type bolts.
3. Connect enrichment hoses and fuel hoses. Secure hoses in place using sta-straps.



a - Fuel Hose
b - Enrichment Valve Hose

4. Attach throttle linkage and oil pump link rod to carburetors as shown.



a - Throttle Linkage
b - Oil Pump Link Rod

5. Re-synchronize carburetors following carburetor installation. Refer to "Timing/Synchronizing/Adjusting" Section 2C.

IMPORTANT: Inspect all fuel hose connections, and carburetor float bowl split lines for fuel leaks with engine running. Also inspect each carburetor throat, with outboard running at low RPM, for fuel dribbling out of vent tube which would be indicative of a float and/or needle and seat assembly not functioning properly.

IMPORTANT: Engine should not be operated above 3000 RPM with air box cover removed as engine will run too lean and internal damage could result.

FUEL SYSTEM

Section 3C - Fuel Injection

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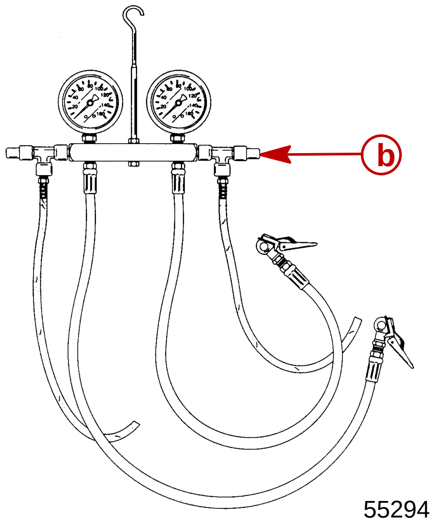
C

Specifications

Electronic Fuel Injection	
Idle RPM – All Models	1000 – 1100
Wide Open Throttle RPM	5750 – 6250
Float Adjustment (Vapor Separator) – Float Level	 Preset @ Factory
Fuel Injectors –All Models (Quantity) –Ignition Controller Uses the Trigger Signal as an Injector Timing Signal as follows: – #1 Trigger Circuit – #3 Trigger Circuit – #5 Trigger Circuit	 6 #3 and #4 Injectors #5 and #6 Injectors #1 and #2 Injectors
Line Pressure @ Injectors	34 psi – 36 psi (234kPa – 248kPa)

Special Tools

1. Fuel Pressure Gauge 91-16850A7 (a) or Fuel Pressure Gauge 91-852087A3(b).



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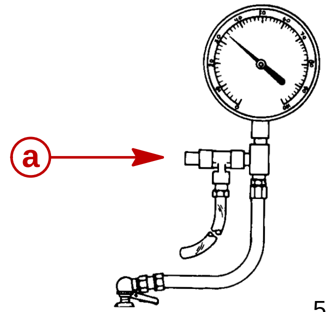

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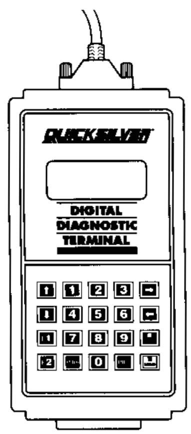
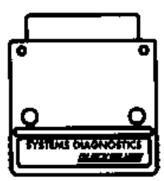
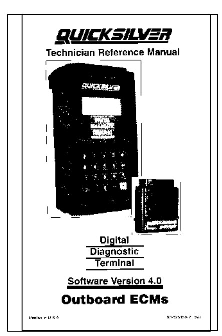
2. Digital Diagnostic Terminal (DDT) 91-823686T2



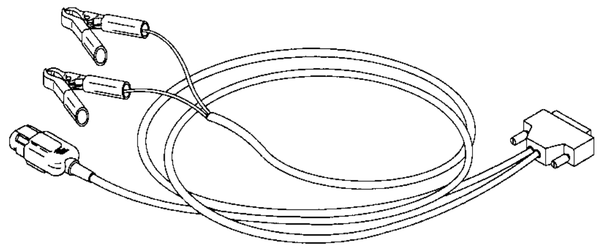
3. Software Cartridge 91-822608--5



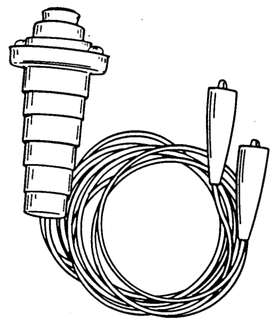
4. DDT Reference Manual 90-825159-3



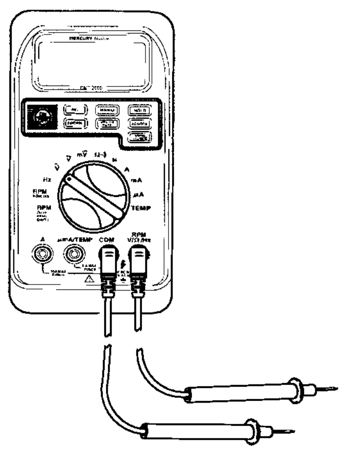
5. Adaptor Harness 84-822560A5 (use with DDT)



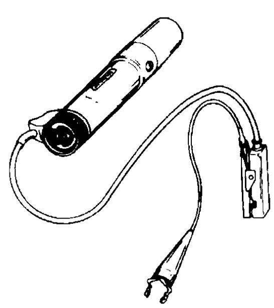
6. Remote Starter Switch 91-52024A1



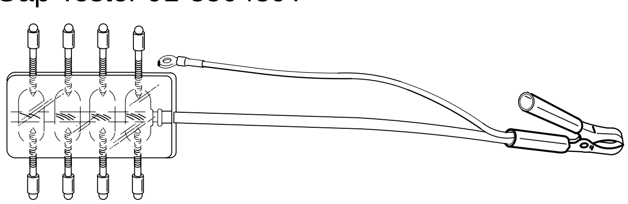
7. DMT 2000 Digital Tachometer Multi-meter P/N 91-854009A1



8. Inductive Timing Light 91-99379



9. Spark Gap Tester 91-850439T



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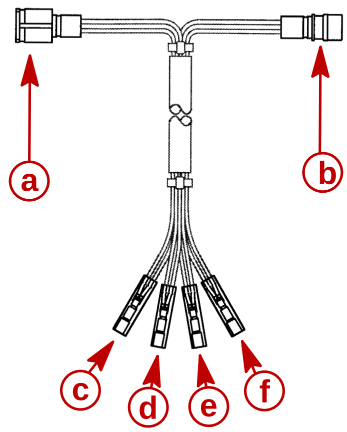
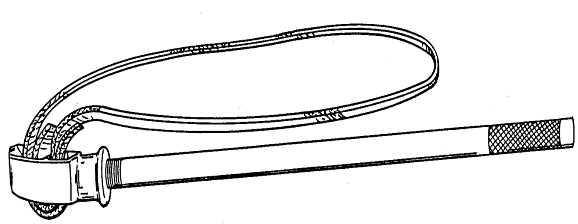
10. Injector Test Harness 91-833169A1. Can be used to verify that the ECM is supplying operating voltage to the injectors. Harness is connected between the injector harness and the engine harness. Harness is used in conjunction with DVA meter 91-99750A1. Harness will also serve as a convenient way to connect the injector harness to perform injector resistance test.

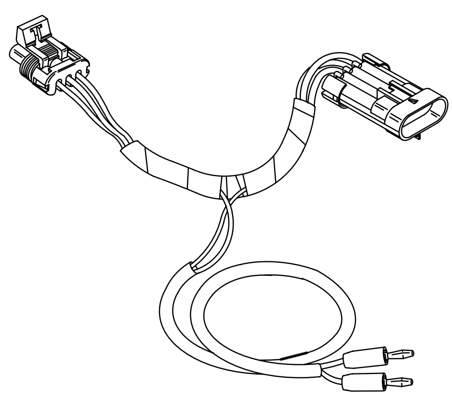


a - To Injector Manifold
b - To Engine Harness
c - RED
d - WHITE
e - BLUE
f - YELLOW

11. Strap Wrench 91-24937A1



12. Throttle Position Sensor Test Harness (91-859199)



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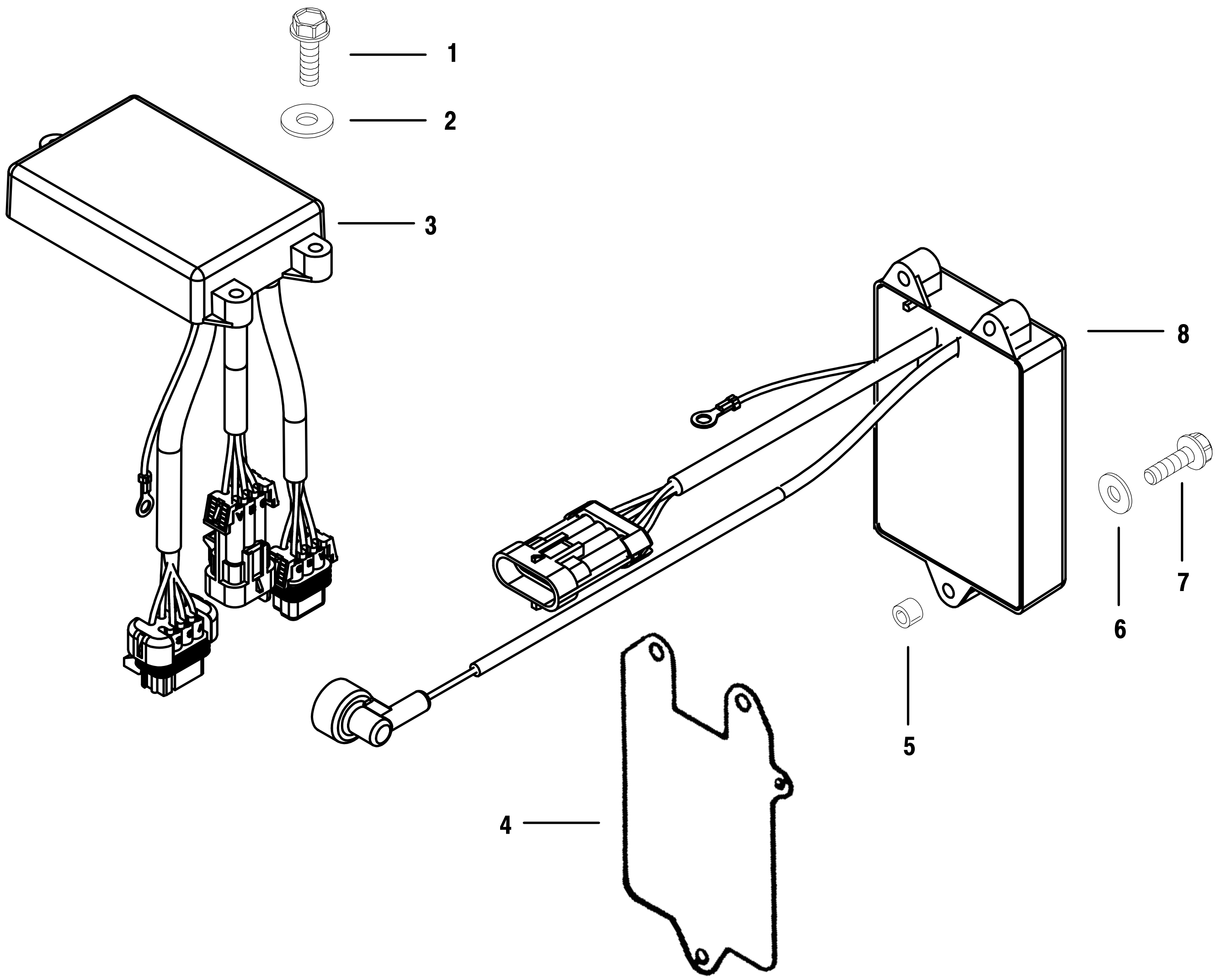
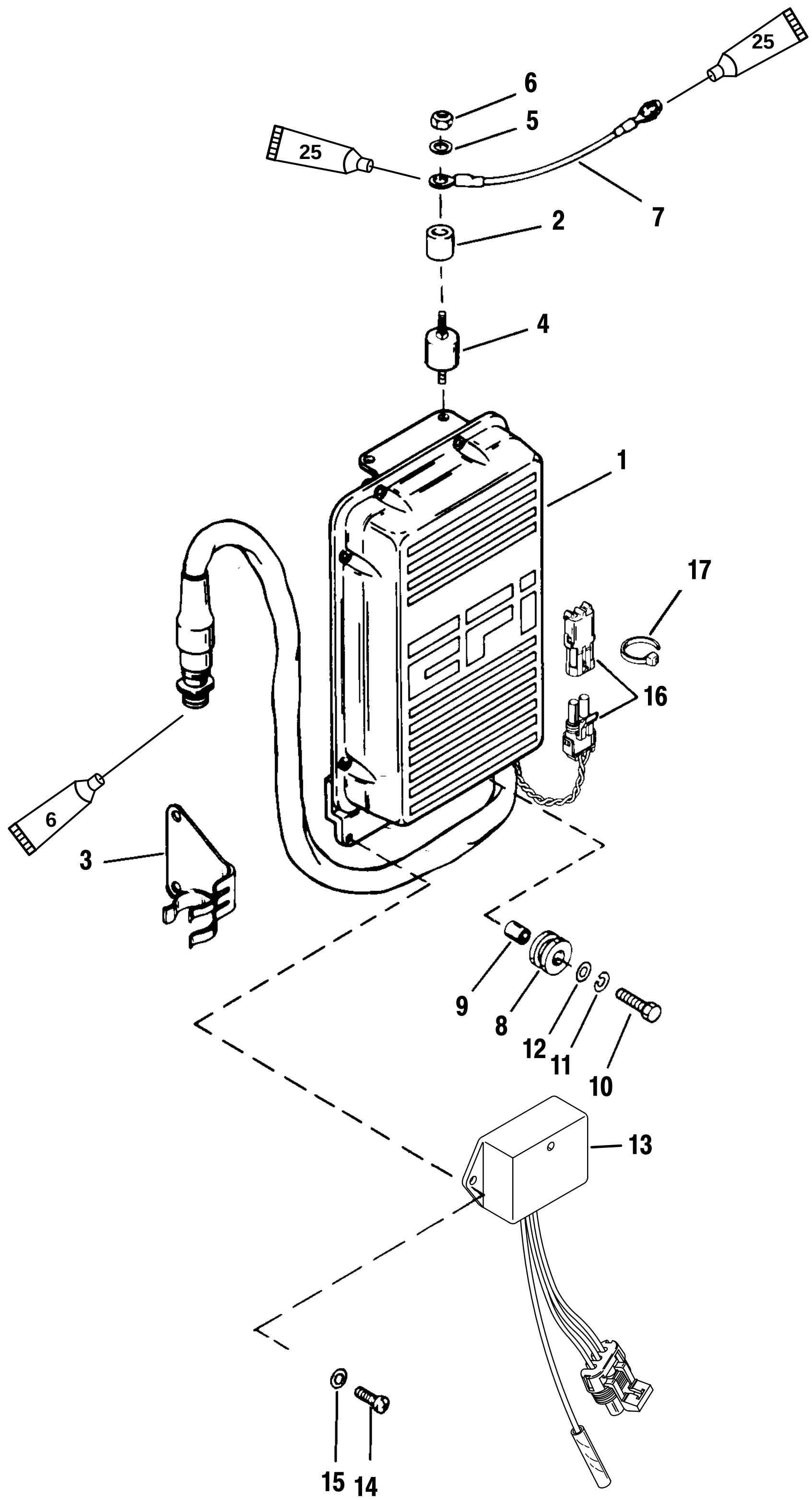
Ignition Controller and Detonation Module



Ignition Controller and Detonation Module

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	3	SCREW (10-32 X 7/8)	30		3.5
2	3	WASHER			
3	1	IGNITION CONTROLLER			
4	1	PLATE			
5	3	BUSHING			
6	3	WASHER			
7	3	SCREW (3/16-32 X 1-5/8)	30		3.5
8	1	DETONATION MODULE			

ECM Assembly



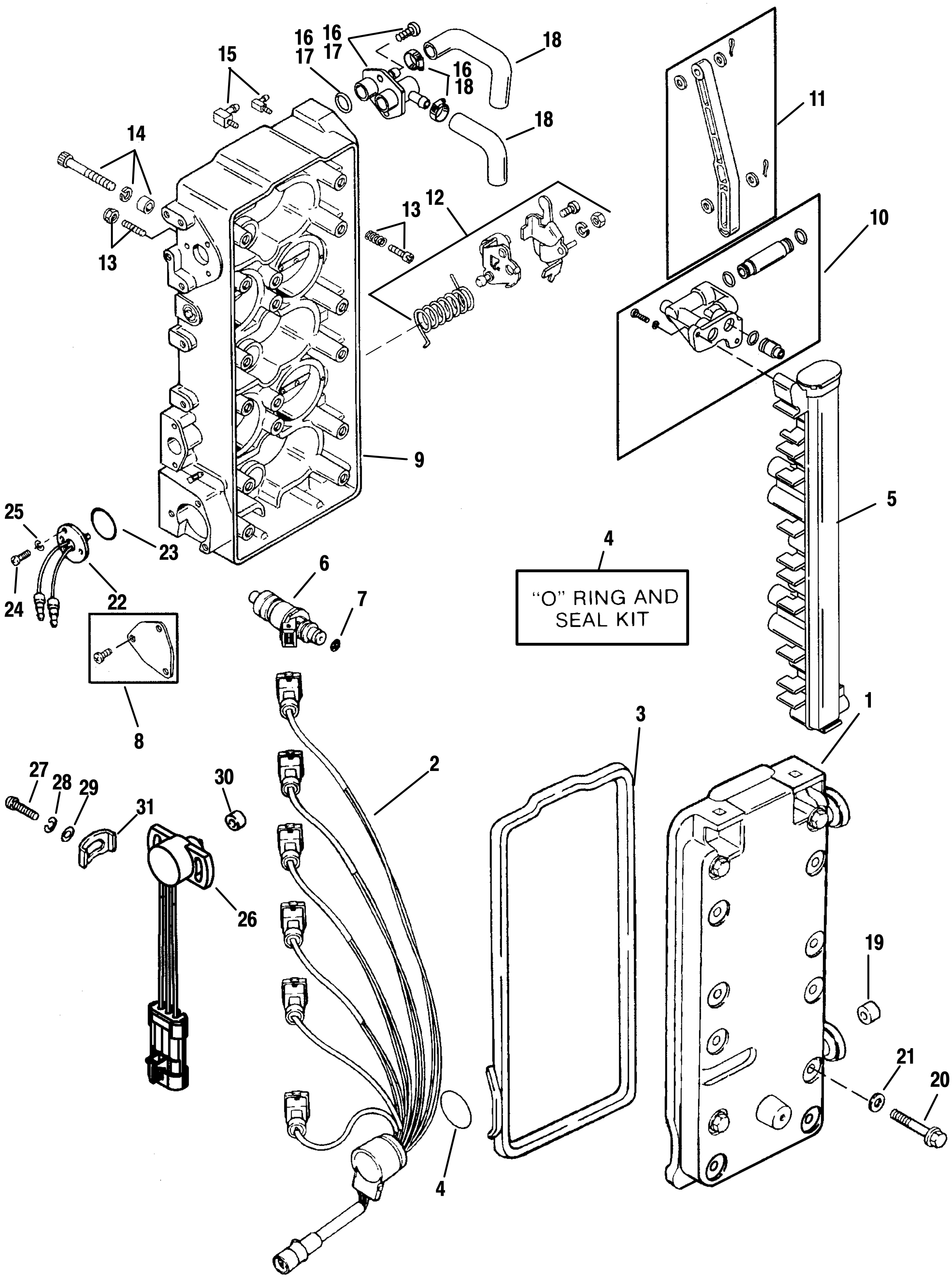
6 Dielectric Grease (92-823506--1)

25 Liquid Neoprene (92-25711--2)

ECM Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	E.C.U. ASSEMBLY **(150)**			
	1	E.C.U. ASSEMBLY **(175)**			
	1	E.C.U. ASSEMBLY **(200)**			
2	2	SPACER			
3	1	CLIP			
4	2	MOUNT–cowl mounting bracket			
5	4	WASHER			
6	4	NUT	45		5
7	1	CABLE ASSEMBLY			
8	1	GROMMET			
9	1	BUSHING			
10	1	SCREW (1/4-20 x 1)	45		5
11	1	LOCKWASHER			
12	1	WASHER			
13	1	WATER SENSOR MODULE ASSEMBLY			
14	2	SCREW (3/16-32 x 1/2)	25		3
15	2	WASHER			
16	1	CONNECTOR **(SERVICE)**			
17	AR	STA–STRAP			

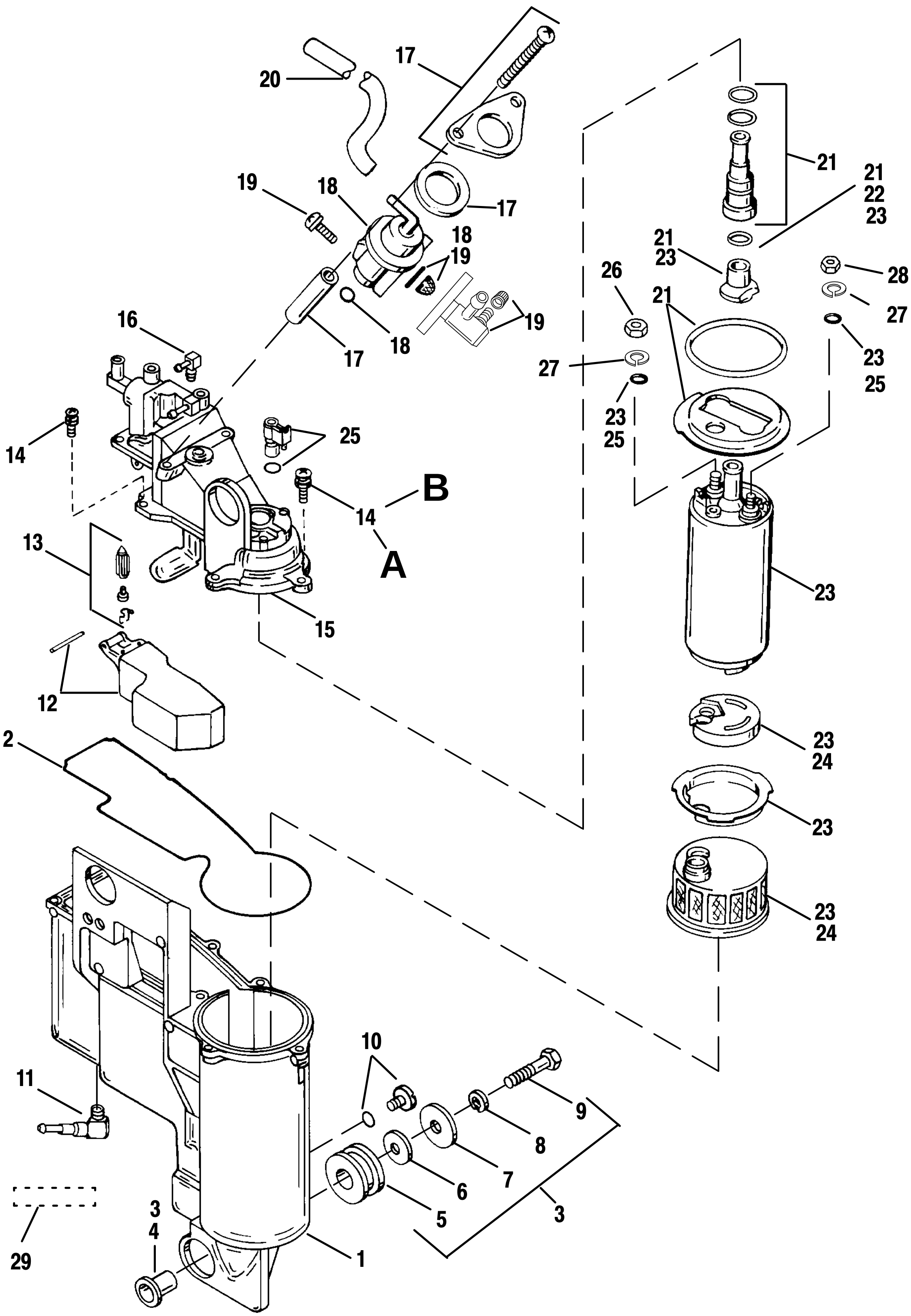
Fuel Management System



Fuel Management System

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
–	1	FUEL MANAGEMENT ASSEMBLY			
1	1	COVER			
2	1	HARNESS KIT			
3	1	SEAL			
4	1	O RING/SEAL KIT			
5	1	FUEL RAIL			
6	1	FUEL INJECTOR			
7	1	FILTER			
8	1	RETAINING KIT			
9	1	THROTTLE BODY			
10	1	JOINT KIT			
11	1	LINK			
12	1	LINK LEVER KIT			
13	1	STOP SCREW KIT			
14	1	SCREW KIT	45		5
15	1	ELBOW KIT			
16	1	SCHRADER VALVE KIT			
17	1	FMA JOINT KIT			
18	1	HOSE KIT			
19	1	ROLLER			
20	12	SCREW (1/4-20 x 4 IN.)	90		10
21	10	WASHER			
22	1	TEMPERATURE SENSOR ASSEMBLY			
23	1	O-RING			
24	3	SCREW (8-32 x 3/8)	Drive Tight		
25	3	LOCKWASHER			
26	1	INDICATOR–throttle position			
27	2	SCREW (8-32 x 5/8)	20		2
28	1	LOCKWASHER			
29	2	WASHER			
30	1	SLEEVE			
31	2	PLATE			

Fuel Management System

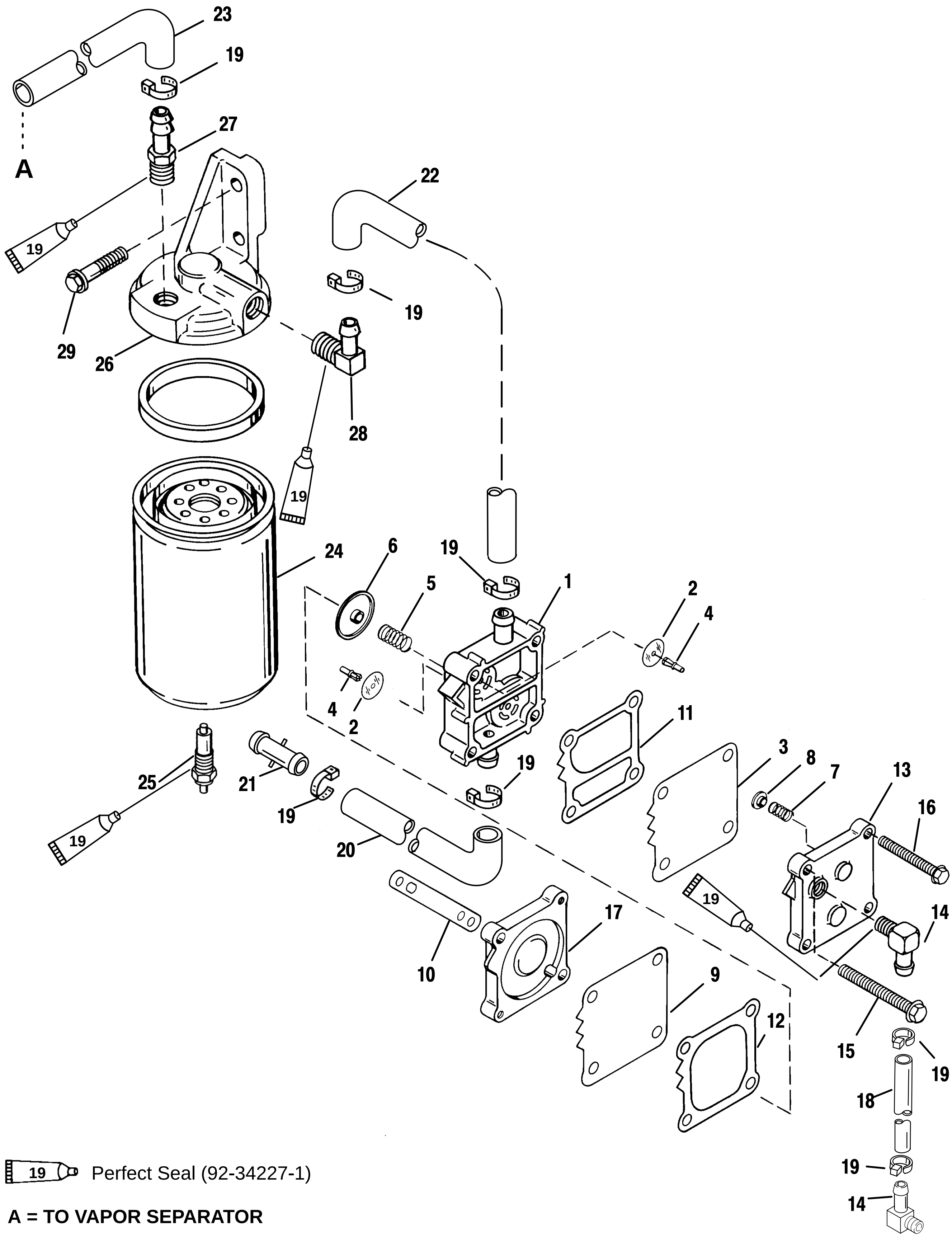


A = LARGE SCREW (5 MM) (TORQUE TO 30 LB. IN. (3.4 N.M)
B = SMALL SCREW (4 MM)(TORQUE TO 20 LB. IN. (2.3 N.M)

Fuel Management System

REF. NO.	QTY.	DESCRIPTION	TORQUE lb. in.	TORQUE lb. ft.	TORQUE N·m
–	1	FUEL MANAGEMENT ASSEMBLY			
1	1	VAPOR SEPARATOR BODY KIT			
2	1	O RING			
3	1	MOUNTING SCREW KIT			
4	1	COLLAR			
5	3	GROMMET			
6	3	WASHER			
7	3	WASHER			
8	3	LOCKWASHER			
9	3	SCREW	45		5
10	1	DRAIN SCREW KIT			
11	1	CHECK VALVE			
12	1	FLOAT KIT			
13	1	FLOAT VALVE KIT			
14	1	SCREW KIT			
15	1	COVER KIT			
16	1	ELBOW KIT			
17	1	ATTACHING KIT	30		3.5
18	1	PRESSURE REGULATOR KIT			
19	1	SCHRADER VALVE KIT	45		5
20	1	TUBING KIT			
21	1	FUEL PUMP FITTING KIT			
22	1	O RING/SEAL KIT			
23	1	FUEL PUMP KIT			
24	1	FUEL STRAINER KIT			
25	1	ELECTRICAL CONNECTION KIT			
26	1	NUT (M4 x .7)	6		0.7
27	2	LOCKWASHER			
28	1	NUT (M5 x .8)	16		1.8
29	1	DECAL-EPA INFO **(1998)**			

Fuel Pump



19 Perfect Seal (92-34227-1)

A = TO VAPOR SEPARATOR

Fuel Pump

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
–	1	FUEL PUMP ASSEMBLY			
1	1	FUEL PUMP ASSEMBLY			
2	1	CHECK VALVE			
3	1	DIAPHRAGM			
4	2	RETAINER			
5	1	SPRING			
6	1	CAP			
7	1	SPRING			
8	1	CAP			
9	1	DIAPHRAGM			
10	1	GASKET–base			
11	1	GASKET-Boost			
12	1	GASKET-Pulse			
13	1	PLATE–fuel pump			
14	2	ELBOW			
15	2	SCREW–pump to crankcase (M6 x 50)	55		6
16	2	SCREW–fuel pump (M5 x 40)	55		6
17	1	BASE–fuel pump			
18	1	FUEL LINE (6 IN.)			
19	7	STA STRAP			
20	1	FUEL LINE (10-1/2 IN.)			
21	1	CONNECTOR			
22	1	TUBING (15-1/2 IN.)			
23	1	TUBING (19 IN.)			
24	1	FUEL FILTER ASSEMBLY			
25	1	PROBE			
26	1	FUEL FILTER BASE			
27	1	CONNECTOR (STRAIGHT)			
28	1	ELBOW			
29	2	SCREW (1/4-20 x 1-1/8 IN.)			

Electronic Fuel Injection (EFI) System

Introduction

The troubleshooting information provided here consists of preliminary checks (checks to be followed before proceeding with EFI tests), diagrams (fuel flow and electrical wiring), component description (from diagrams), flow charts (low pressure fuel delivery, high pressure fuel delivery, fuel delivery vs. electrical delivery), problem diagnosis, and a series of test and check procedures that will help isolate problems associated with the fuel injection system. Each test/check (listed) can be completed without major fuel system disassembly.

Using the Test Procedures

Read the entire test before beginning to perform outlined procedures. Study the RESULTS material prior to testing. This will help in determining that each test is providing desired results.

EFI System Tests

- EFI Electrical System and ECM Check
- Fuel Gauge Connection/Pressure Test
- Vapor Separator Fuel Delivery Test
- Vapor Separator Float Test
- Water Separating Filter Flow Test
- Pulse Fuel Pump Delivery Test
- Final Filter Check
- Fuel Pressure Regulator Test
- Electric Fuel Pump Test
- Injector Electrical Test
- Injector Fuel Delivery Test
- Injector Operating Test (Manifold Cover Removed)
- Induction Manifold Leak Check (Manifold Cover Removed)
- Sensor Tests

Safety Precautions

CAUTION

Always use approved safety glasses or goggles when working on pressurized fuel systems.

DANGER

Motor fuels are extremely flammable. Do not show open sparks or flames when working near fuel systems.

WARNING

To avoid potential fire hazards, use extreme caution when connecting and disconnecting fuel line connections and test adaptors. Do not allow fuel to spill on hot engine parts or on live electrical connections.

CAUTION

Wipe up fuel spills immediately.

CAUTION

Depressurize fuel system prior to opening line connections or removing fuel system components.

DANGER

Perform the tests in this section in a well ventilated area to avoid being overcome by fuel vapors or poisonous exhaust gases.

Fuel Injection System Function

Fuel is delivered directly to the engine by way of fuel injectors. These injectors are provided with a constant supply of fuel (34 to 36 psi; 234 to 238 kPa) delivered to the fuel rail. The injectors are opened and closed electronically by the Electronic Control Module (ECM). The ECM receives input signals from various sensors in the EFI system which in turn transmits controlling outputs (open/close) to the injectors. The length of time the injectors stay open is considered pulse width. The pulse width will widen (richer) or narrow (leaner) depending on signals ECM receives from sensors, to allow efficient operation at all speeds and conditions.

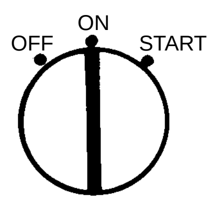
IMPORTANT: The following preliminary steps MUST BE FOLLOWED before attempting EFI problem diagnosis.

Preliminary Checks

Ignition Spark Check

Purpose: This test determines if the ignition system is delivering usable spark to the spark plugs. By performing this test, the probable cause can be isolated to either the ignition system or fuel system.

1. Disconnect all spark plug wires from spark plugs.
2. Connect spark gap tester Quicksilver (91-850439T) to a good ground on engine. Connect Spark Plug Extensions (91-877870A1) between tester and spark plug leads.
3. Connect Remote Starter Switch Quicksilver (91-52024A1).
   a. Connect RED lead from switch to large positive (+) terminal with RED banded cable attached [(+) cable from battery].
   b. Connect BLACK lead from switch to small terminal with YELLOW/RED lead attached.
4. Turn ignition key switch to the “ON” position.



5. Look at spark gap tester viewing port for presence of good quality spark.

Results: **IMPORTANT: The presence of a good spark will not necessarily indicate condition of timing. Ignition timing may be off far enough to prevent the engine from starting, but still allow a good spark to be present in the spark gap tester.**

A steady, blue spark should be present at each spark plug wire. If a good spark is present, problem may not be ignition related. If good spark is not present, problem may be ignition related. Trouble shoot ignition system or make sure engine timing is set correctly. Refer to appropriate ignition section in this service manual.

Ignition system failure (trigger, control module, wiring, etc.) can cause fuel delivery problems. Injectors are triggered in pairs by one, three, five trigger inputs.

No. 1 Triggers input No. 3 & 4 Injectors
No. 3 Triggers input No. 5 & 6 Injectors
No. 5 Triggers input No. 1 & 2 Injectors

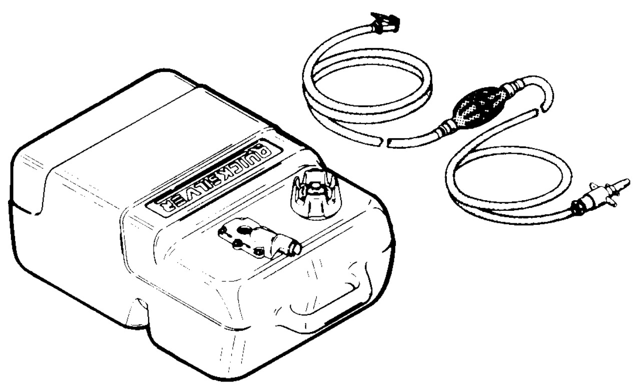
Failure in one or more of these primary circuits will cause no spark and no fuel to respective cylinders (above). Check spark and spark plugs on all cylinders before attempting EFI tests.

Electronic Fuel Injection Set Up

IMPORTANT: Follow EFI Timing/Synchronizing/Adjustment section 2C before attempting tests on EFI system.

EFI set up procedures must be followed before tests on system are performed (refer to Section 2C). Improper set up can result in poor engine performance (i.e. uncontrollable idle speeds, lean sneezing, low power during acceleration or engine will simply not run.) Failure to properly set up the EFI system can lead to misdirections in solving simple problems in the EFI system.

Fresh Quality Fuel



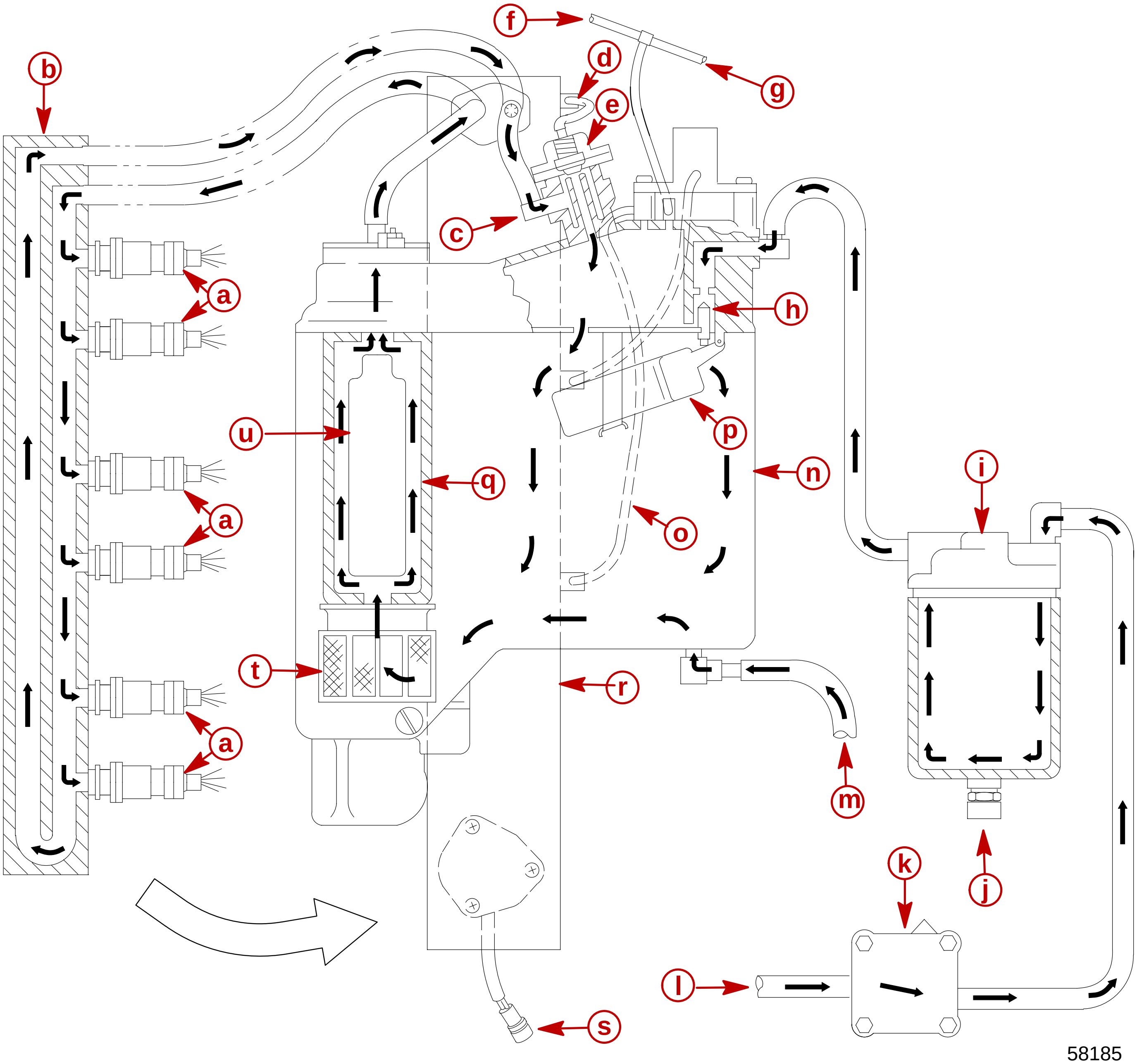
Using a remote fuel tank containing a major brand of premium unleaded gasoline, test run the outboard to eliminate any problems related to restricted fuel supply (clogged lines, malfunctioning anti-siphon valve, etc.) and/or marginal gasoline.

Low Battery Voltage

Low battery voltage can cause EFI system to deliver fuel in an inconsistent manner.

Inspect battery connections and charging system, refer to Section 2B. The EFI system requires a substantial amount of voltage to function properly. Operating engine at a low RPM for an extended period of time can cause low voltage.

Fuel Flow Diagram



- **a** - Fuel Injectors (6)
- **b** - Fuel Rail
- **c** - Fuel Rail Pressure Port
- **d** - Fuel Pressure Regulator Manifold Hose
- **e** - Fuel Pressure Regulator
- **f** - To Starboard Bleed Junction Block
- **g** - To Port Bleed Junction Block
- **h** - Needle and Seat
- **i** - Water Separator
- **j** - Water Sensor
- **k** - Pulse Fuel Pump
- **l** - From Fuel Tank
- **m** - From Oil Pump
- **n** - Vapor Separator
- **o** - Vapor Separator to Manifold Vent Hose
- **p** - Vapor Separator Float
- **q** - Electric Fuel Pump
- **r** - Manifold
- **s** - Injector Wiring Harness
- **t** - Final Filter
- **u** - Armature

Fuel Flow Component Description

Pulse Fuel Pump (k)

The pulse fuel pump operates through alternating crankcase pressure to deliver fuel through the water separating filter to the vapor separator.
Fuel pressure @ Idle – 2 – 3 psi (13.8 – 20.7 kPa) [Minimum – 1 psi (6.9 kPa)].
Fuel Pressure @ Wide-Open-Throttle – 6 – 8 psi (41.4 – 55.2) [Minimum – 4 psi (27.6 kPa)].

Water Separating Filter (i)

The water separating filter protects the fuel injectors from water and debris. The filter contains a sensor probe which monitors water level in the filter. If water is above the sensor probe, the water detection light will come on and the warning horn will begin a series of beeps.

Vapor Separator (n)

The vapor separator is a fuel reservoir which continuously blends and circulates fresh fuel, oil and unused fuel/oil from the fuel rail.

a. Fuel Inlet – Fresh fuel delivered from the water separator by the crankcase mounted pulse fuel pump. The amount of fuel allowed to enter the vapor separator is controlled by a needle/seat and float assembly mounted in the cover of the vapor separator.

b. Oil Inlet – Oil delivered by the crankshaft driven oil pump.

c. Crankcase Bleed Inlet – Recirculated (unburned) fuel/oil mixture delivered from the bleed lines through a filter into the vapor separator.

d. Fuel Pressure Regulator Inlet – Unused fuel/oil mixture being recirculated from the fuel rail back into the vapor separator.

Bleed System (f,g)

On carbureted engines, excess fuel which collects in the crankcase is channeled into the transfer ports to be burned.

On EFI engines, excess crankcase fuel is emptied into the vapor separator. It mixes with fresh incoming fuel and is pumped to the fuel rail and fed through the injectors.

Final Filter (t)

The final filter is located below the electric fuel pump in the vapor separator. The filter collects debris and prevents them from flowing through the electric pump and into the fuel rail and injectors.

Electric Fuel Pump (Inside Vapor Separator) (q)

The electric fuel pump runs continuously while providing fuel in excess of engine demands. The excess fuel is circulated through the fuel rail to the fuel pressure regulator and back to the vapor separator. Normal fuel pressure is 34 – 36 psi (234 to 248 kPa).

Fuel Injectors (a)

The fuel injectors are located inside the induction manifold on the fuel rail. The injector valve body consists of a solenoid actuated needle and seat assembly. The injector receives signals from the EFI Electronic Control Module. These signals determine how long the needle is lifted from the seat (pulse width) allowing a measured fuel flow. The pulse width will widen (richer) or narrow (leaner) depending on various signals received from sensors connected to the EFI ECM. The ECM receives signals from the primary ignition circuit of cylinders #1, #3 and #5 to fire each pair of injectors accordingly.

A four wire harness connects the fuel injectors to the ECM. The RED wire is at 12 volts and connects to all injectors. The BLUE, YELLOW and WHITE wires each go to a pair of injectors and are normally at 12 volts for a zero differential. To fire the injectors this voltage is brought down to near ground creating a potential across the injectors.

Induction Manifold (r)

The induction manifold is a common plenum chamber for accurate pressure measurement. It contains 4 throttle shutters on 2 throttle shafts. The shutter opening (idle air opening) can be adjusted during EFI set-up procedure. The manifold contains the fuel rail, injectors, throttle position sensor and air temperature sensor. A fuel rail pressure port is located on the fuel pressure regulator.

Fuel Pressure Regulator (e)

The fuel pressure regulator is located on top of the vapor separator and is continuously regulating fuel pressure produced by the electric fuel pump. The electric pump is capable of producing 90 psi (621 kPa) of fuel pressure. The pressure regulator limits fuel pressure at the injectors to 34 to 36 psi (234 to 248 kPa).

EFI Electrical Components

ELECTRONIC CONTROL MODULE (ECM)

The ECM is continually monitoring various engine conditions (engine temperature, engine detonation control, engine throttle opening) and climate conditions (induction air temperature, barometric pressure and altitude level) needed to calculate fuel delivery (pulse width length) of injectors. The pulse width is constantly adjusted (rich/lean conditions) to compensate for operating conditions, such as cranking, cold starting, climate conditions, altitude, acceleration and deceleration, allowing the outboard to operate efficiently at all engine speeds.

12 Volt Battery - The 12 volt battery provides power to the ECM even with the ignition switch in the “OFF” position.

IMPORTANT: When disassembling EFI System DISCONNECT BATTERY CABLES.

Starter Solenoid - Provides 12 volt signal when key is in the “start” position. In the “start” position, injector pulse widths are tripled when engine head temperature is below 90° F (32.2° C) to provide adequate fuel for quick start up. When key is returned to the run position or engine head temperature is above 90° F (32.2° C), pulse widths return to normal value.

Fuel Injectors - A four wire harness connects the fuel injectors to the ECM. The red wire is at 12 volts and connects to all injectors. The blue, yellow and white wires each go to a pair of injectors and are normally at 12 volts for a zero differential. To fire the injectors this voltage is brought down to near ground creating a potential across the injectors.

Electric Fuel Pump - The ECM contains a fuel pump driver circuit that provides power to the electric fuel pump. The fuel pump does not have its negative terminal (–) "BLACK/RED wire" grounded to the pump housing. The fuel pump positive terminal (+) "RED wire" and the negative terminal (–) are at 12 volts with the ignition switch in the off position for a zero differential. When the pump is on, the negative terminal is brought down to near ground (i.e. 1.5 volts).

SENSOR INTERACTION WITH THE ECM

IMPORTANT: DO NOT run engine for extended periods of time with sensors disconnected or bypassed (shorted). Serious engine damage may result.

AIR TEMPERATURE SENSOR

The air temperature sensor transmits manifold absolute air temperature, through full RPM range, to the ECM. As air temperature increases "sensor" resistance decreases causing the ECM to decrease fuel flow (leaner mixture). Disconnecting the air temp sensor (open circuit) will increase fuel flow (richen mixture) by 10%. Bypassing air temp sensor (short in circuit) will cause fuel flow to decrease 10%.The air temperature sensor circuit can be tested using the EFI tester. The air temperature sensor can be tested following air temperature sensor test on page 3C-45.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The map sensor is a non-serviceable sensor mounted in the ECM box. The MAP sensor is used to sense changes in manifold absolute pressure and is connected to the intake manifold by the way of a vacuum hose. The MAP sensor is functioning through the full RPM range and is continually signaling induction manifold pressure readings to the ECM. The ECM in turn determines fuel flow as signals are received. Drawing a vacuum on the MAP sensor hose will create a lean fuel condition altering engine operation. If no change occurs when drawing vacuum, MAP sensor is not functioning properly.

MAP sensor can be tested with the DDT tester, page 3C-50.

ENGINE HEAD TEMPERATURE SENSOR (PORT CYLINDER HEAD)

The Engine Head Temperature Sensor provides the ECM signals related to engine temperature to determine level of fuel enrichment during engine warm up. The ECM is receiving information at all engine temperatures but stops fuel enrichment at an engine temperature of 90° F (32° C). An open circuit on the temperature sensor will increase fuel flow up to 40% but will not be affected at wide open throttle. If no change occurs when sensor is disconnected, sensor may not be functioning properly. The engine head temperature sensor can be tested following Engine Head Temperature Sensor Test on page 3C-46.

NOTE: *If sensor does not make clean contact with cylinder head a rich condition may exist.*

THROTTLE POSITION SENSOR (TPS)

The TPS transmits information to the ECM during low speed and mid range operation, related to throttle angle under various load conditions. TPS adjustment is a critical step in engine set up (Section 2C). Disconnecting the TPS will increase fuel flow 40% at idle but does not effect WOT. The TPS can be tested following the Throttle Position Sensor Test on page 3C-49.

NOTE: *The higher the voltage, the richer the fuel flow. Refer to TPS Adjustment (Section 2C).*

WATER SENSING SYSTEM

The system consists of a water separating fuel filter (starboard side powerhead), sensing probe (bottom of filter) and a water sensing module (below ECM box). The water sensing module has four wires:

PURPLE - Connects to 12 volt power supply.

LIGHT BLUE - Connects to lube alert, which sounds the warning horn when activated.

TAN - Connects to sensing probe.

BLACK - Connects to ground.

WATER SENSING SYSTEM FUNCTION

1. The filter separates the accumulated water from the fuel.
2. A voltage is always present at sensing probe. When water reaches top of probe it completes the circuit to ground.
3. The completed circuit activates the warning. The warning has a 5-10 second delay, then the module's red light illuminates and warning horn intermittently sounds.

The system can be tested by disconnecting the TAN wire from sensor probe and holding to a good engine ground connection for 10 seconds.

EFI Fuel Management (Low Pressure Fuel Route)

- Perform all preliminary checks page 3C-17.
- Install fuel pressure gauge on to manifold pressure port.
- Place ignition switch in “OFF” position 30 seconds before testing.
- Place ignition switch in “ON” position and note pressure within 30 seconds (34 to 36 psi; 234 to 248 kPa).

Pump does not run

Follow High Pressure Fuel Route Flow Chart.

No or low fuel pressure

Perform Vapor Separator Fuel Delivery Test .

Fuel pressure above 36 psi (248 kPa)

Follow High Pressure Fuel Route Flow Chart.

Results

No or little fuel flow from vapor separator. Reconnect hose.

Check in-line Filter

Perform Vapor Separator Float Test .

Results

Fuel flows freely from vapor separator. Reconnect hose.

Follow High Pressure Fuel Route Flow Chart.

Results

Fuel flows from fresh fuel inlet hose.

Inspect float system of vapor separator.

Results

Little or no flow from fresh fuel inlet hose. Reconnect hose.

Perform Water Separating Filter Flow Test.

Results

Low or no fuel flow from water separating inlet hose. Reconnect hose.

Perform Pulse Fuel Pump Delivery Test.

Results

Fuel flows freely from water separating filter inlet hose. Reconnect hose.

Replace water separating filter.

Results

Fuel flows freely from pulse pump inlet hose.

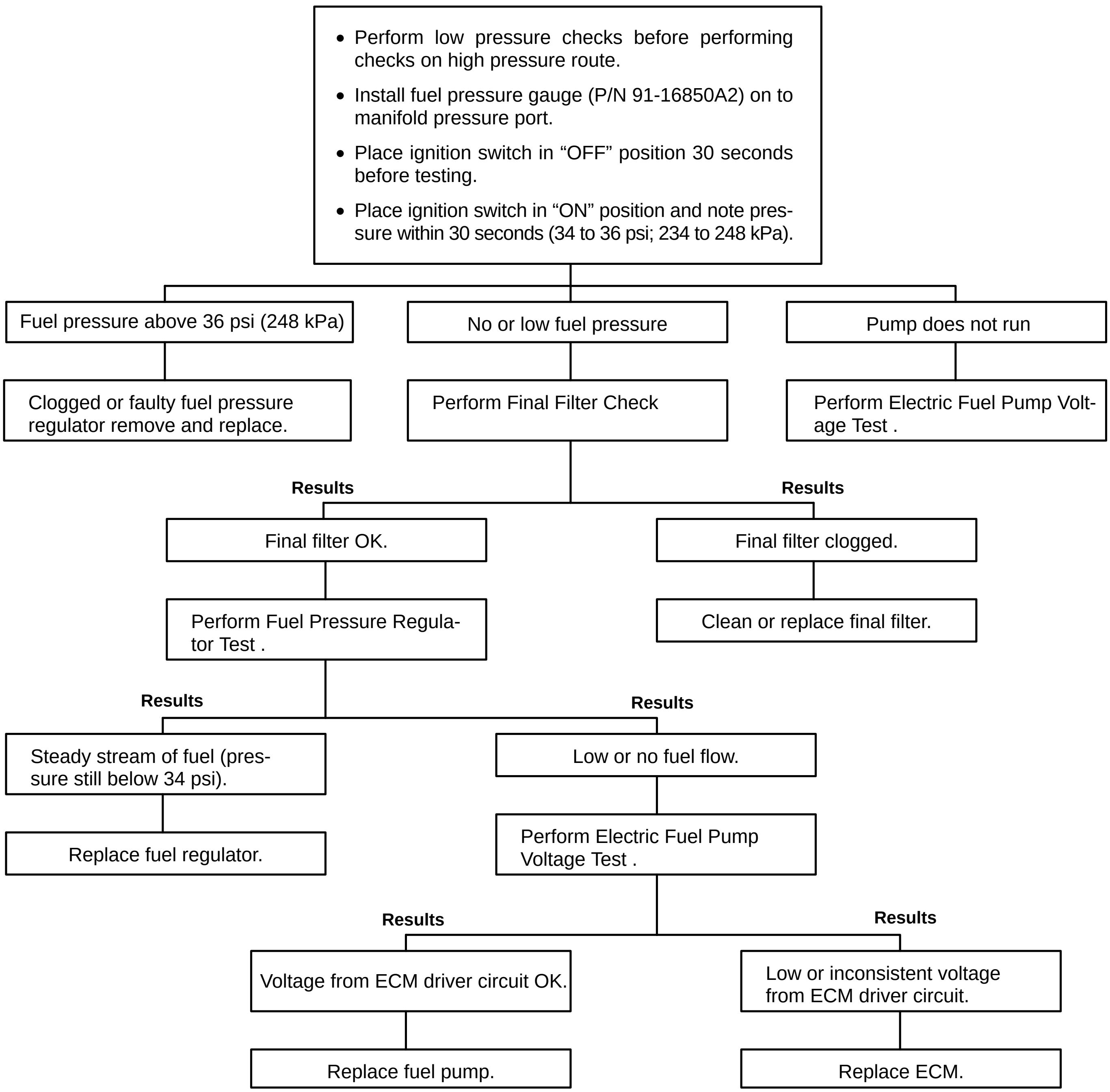
See pulse pump removal and inspection section 3A. Locate all fragments of failed pump before reassembly.

Results

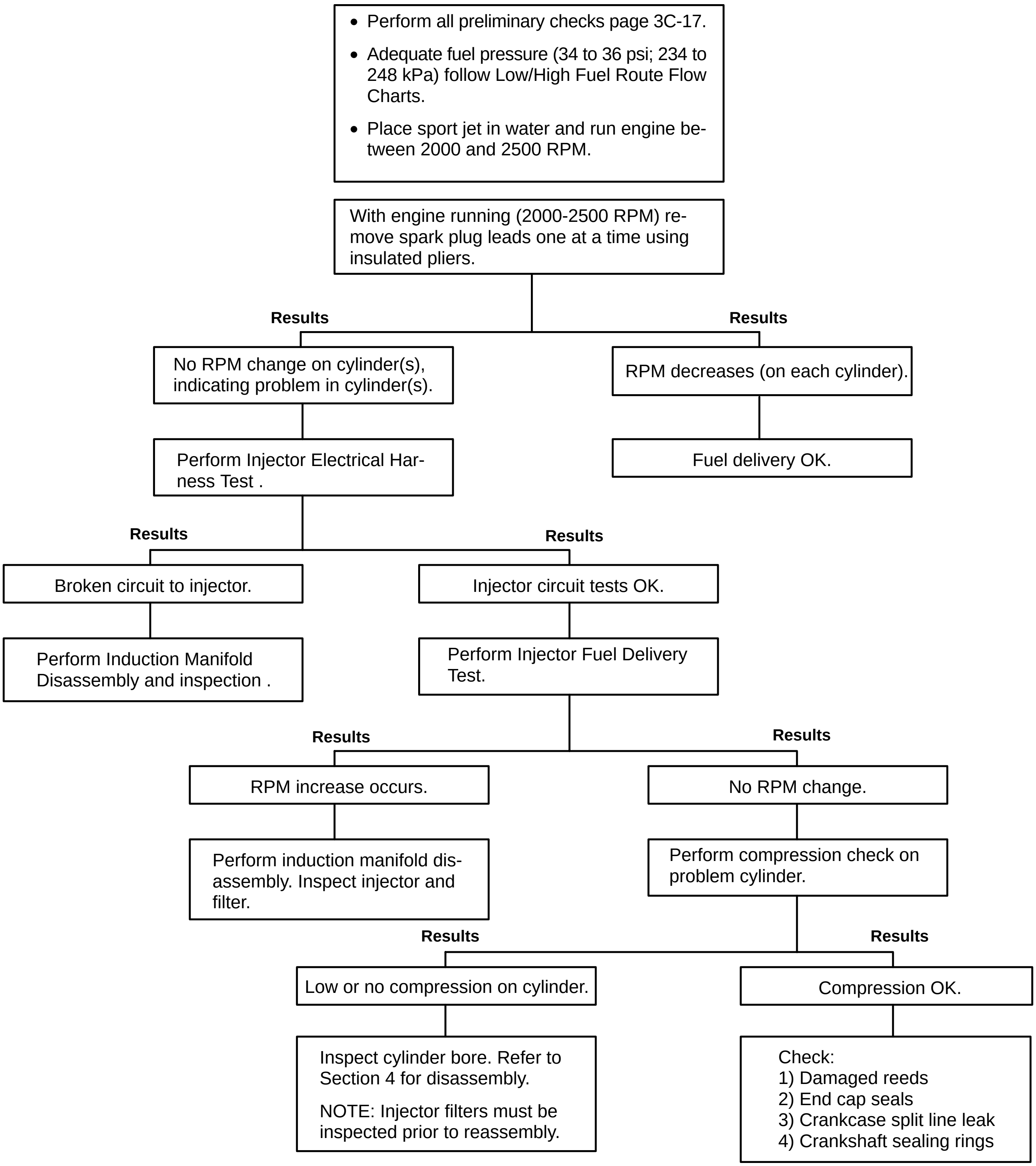
No fuel flow to pulse fuel pump.

Check for restrictions, holes or loose connections from fuel supply.

EFI Fuel Management (High Pressure Fuel Route)



Fuel Rail Electrical/Fuel Determination



EFI System Test Procedures

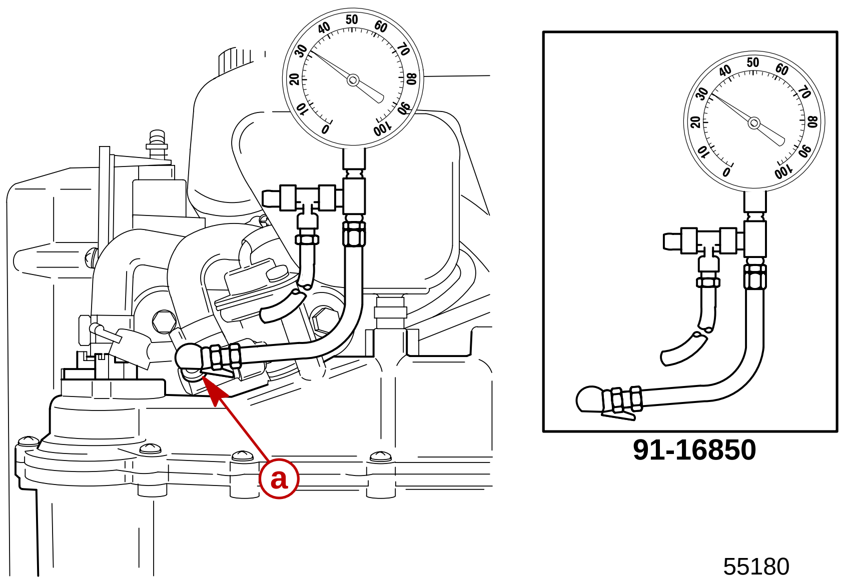
Fuel Gauge Connection/Pressure Test

IMPORTANT: When checking fuel pressure while engine is running, fuel pressure may fluctuate. Fuel pressure fluctuation (i.e. 34 to 36 psi "234 to 248 kPa") is common, as the regulated pressure is a differential between fuel rail and manifold vacuum.

Purpose: Checking fuel manifold pressure ensures that fuel under usable pressure is available to the fuel injectors. This test isolates the probable cause as either a fuel delivery or EFI electrical system failure.

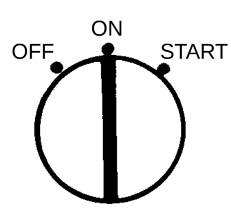
IMPORTANT: Fuel pressure should be monitored through full RPM range to determine fuel supply problems at high engine speeds.

1. Connect fuel pressure gauge to induction manifold pressure port.



a - Pressure Port

2. Turn ignition key switch to "ON" position.



3. Operate electric fuel pump for approximately 10 seconds.

NOTE: *Fuel pump will only operate for approximately 30 seconds. By turning the key switch to "OFF" and then back to "ON" the pump will operate for 30 seconds more.*

4. Take reading on fuel pressure gauge.

Results: If pressure reading is 34 to 36 psi (234 to 248 kPa), the electric fuel pump is providing fuel with enough pressure to be used by the injectors. Pump malfunction is not the cause of EFI trouble.

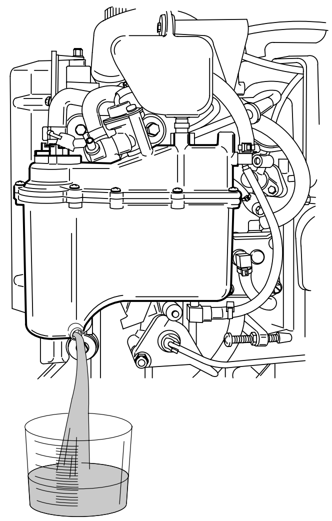
If fuel pressure is well below 34 psi (234 kPa), fuel delivery to electric fuel pump, fuel pump failure or other related problem exists. Follow low/high fuel pressure flow charts.

If fuel pressure is above 36 psi (248 kPa) go to fuel pressure regulator test.

Vapor Separator Fuel Delivery Test

Purpose: Verifying there is adequate fuel flow to the electric fuel pump (through full RPM range) will determine components in low pressure fuel system are functioning correctly.

1. Remove vapor separator drain plug and place a clean container under drain.

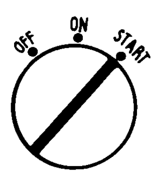


55177

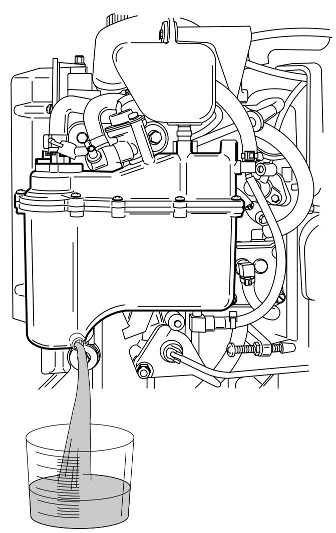
Results: If fuel flow is present, fuel is being delivered to electric fuel pump. Go to high pressure flow chart.

If fuel flow is not present, proceed to step 2.

2. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW bullet connector to engine ground.
3. Turn ignition key switch to “START” and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



55177

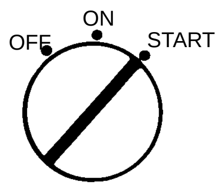
Results: If low or no fuel flow is present, inspect water separating fuel filter and perform Vapor Separator Float Test.

Vapor Separator Float Test

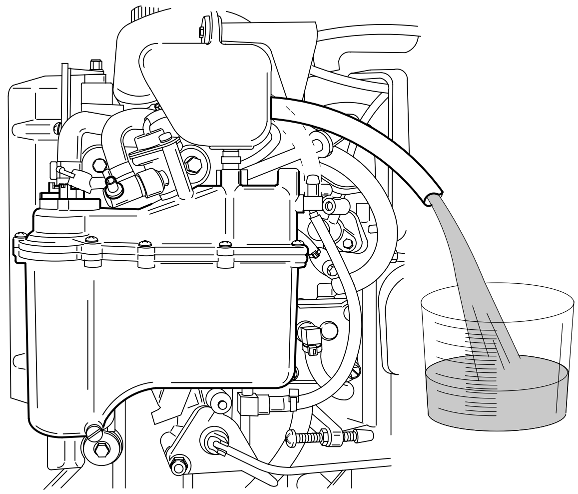
Purpose: This test will indicate if float is stuck in the up position.

NOTE: *If float is stuck down, vapor separator will over flow causing a rich condition.*

1. Remove fuel inlet hose from vapor separator and put end of hose in clean container.
2. Remove all spark plugs from engine to prevent engine from starting.
3. Turn ignition key switch to "START" position and operate starter motor for 15 to 20 seconds.



4. Look for fuel flow from hose.



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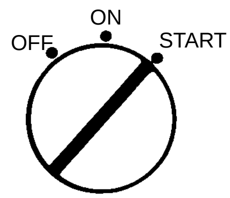
Results: If fuel flow is present at hose, remove, disassemble and inspect float assembly. See vapor separator disassembly.

If fuel flow is low or not present, perform Water Separating Filter Flow Test.

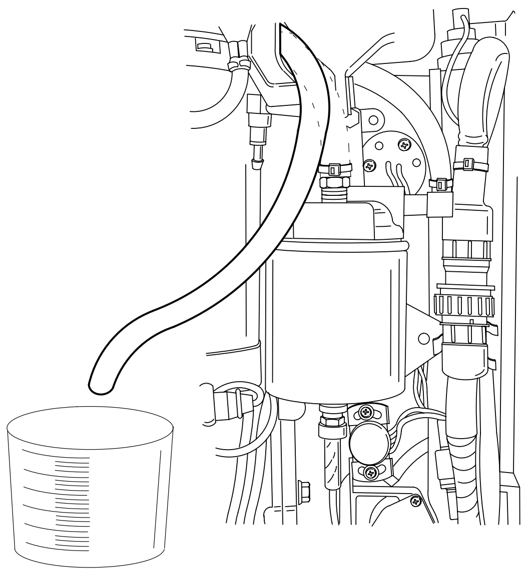
Water Separating Filter Flow Test

Purpose: This test will indicate if water separating filter is clogged.

1. Remove fuel inlet hose to water separating filter. Put end of hose in clean container.
2. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/ YELLOW bullet connector to engine ground.
3. Turn ignition key switch to "START" and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



55183

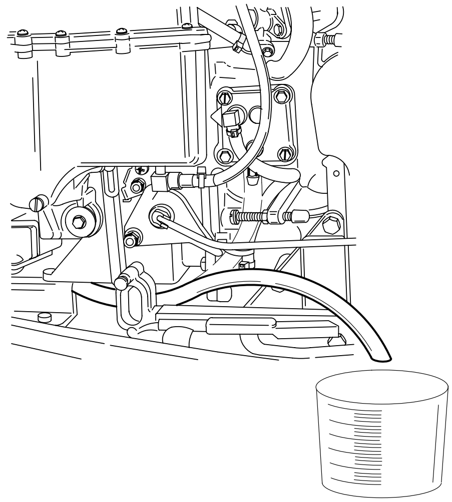
Results: Fuel flows from water separating inlet hose. Remove and replace clogged filter.

Low or no fuel flow from water separating inlet hose. Perform electric fuel pump delivery test. If test results are ok, disassemble pulse fuel pump and inspect for damaged check valves, gaskets, etc. All fragments of failed pump must be located before reassembly.

Pulse Fuel Pump Delivery Test

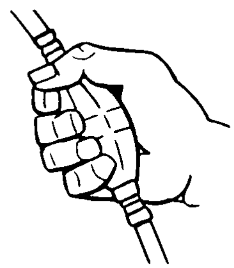
Purpose: This test will indicate pulse fuel pump is capable of supplying the low pressure fuel route with adequate fuel supply.

1. Remove inlet hose to pulse fuel pump and put end into clean container.

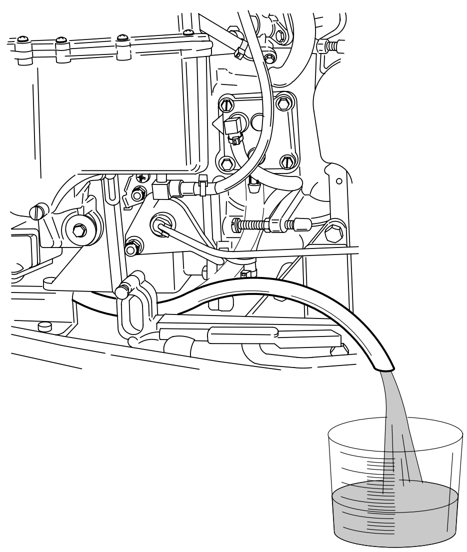


55188

2. Squeeze primer bulb several times.



3. Look for fuel flow from hose.



55187

Results: Fuel flows freely from pulse pump inlet hose. Remove, disassemble, and inspect pulse fuel pump.

IMPORTANT: All fragments of failed pump must be located before re-assembly.

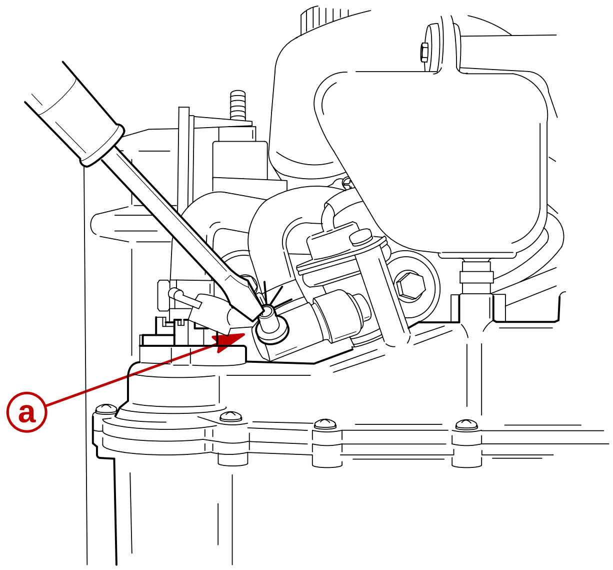
No or low fuel flow from pulse pump inlet hose. Check for restrictions, holes, or loose connections from fuel supply.

NOTE: *Inspect anti-siphon valve on tank.*

Final Filter Check and De-Pressurizing EFI System Procedures

Purpose: Checking the final filter for obstructions, damage etc. eliminates this component as a possible source of restriction in the system.

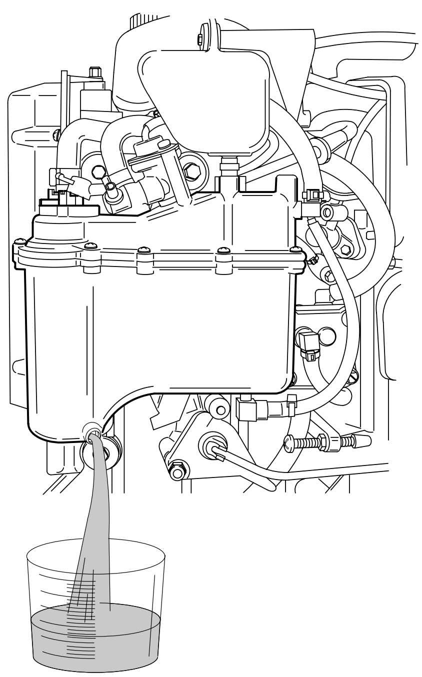
1. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

a - Pressure Port

2. Remove drain plug from vapor separator and allow fuel to drain into suitable container.



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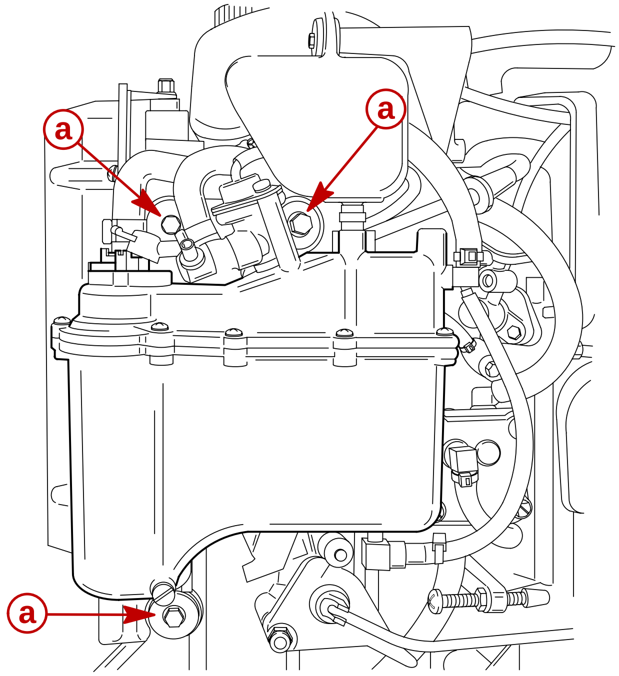
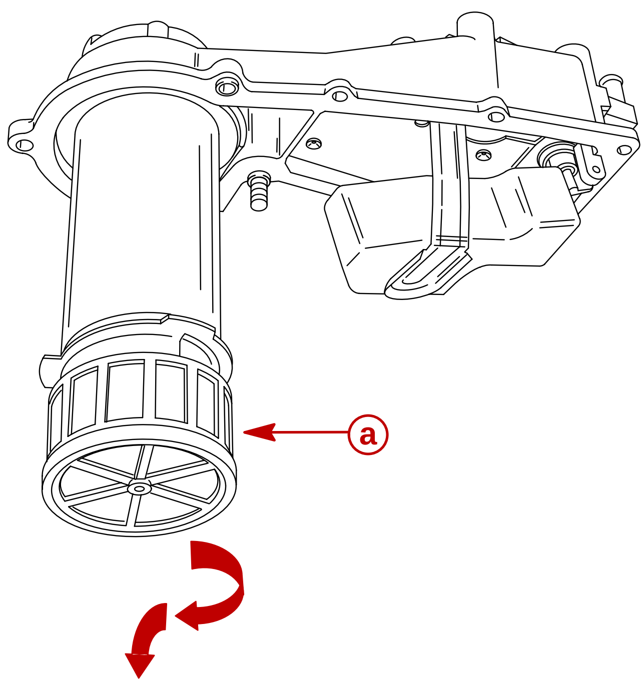
3. Remove 3 bolts securing vapor separator assembly to manifold.



a - Bolts

4. Tilt vapor separator assembly out from manifold and remove 9 screws securing cover.
5. Remove vapor separator tank from cover.
6. Rotate inlet filter counterclockwise and pull downward to remove filter from fuel pump.



a - Inlet Filter

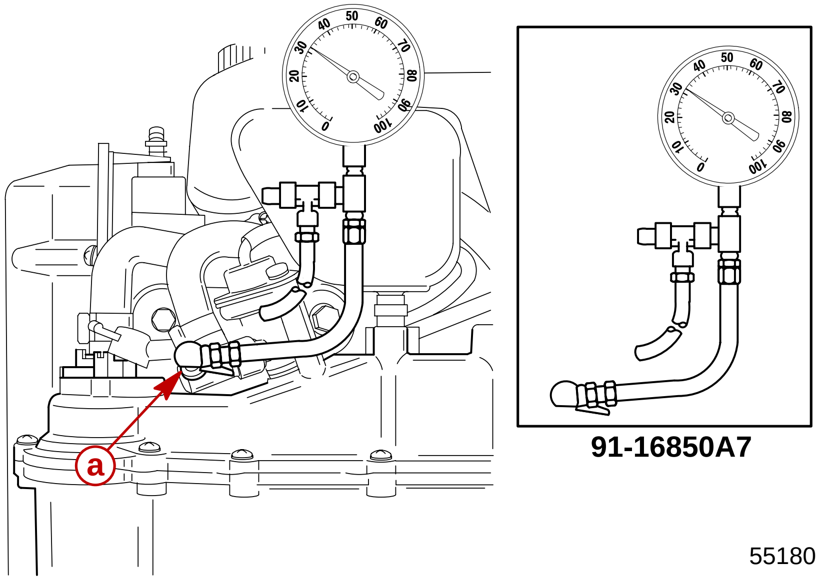
7. Inspect filter for debris or damage.

Results: If filter is clogged with debris, clean filter with solvent and compressed air or replace filter. Reassemble vapor separator to manifold and recheck fuel pressure. If pressure is still below 34 psi (234 kPa), perform fuel Pressure Regulator Test.

Pressure Regulator Test

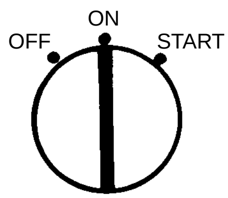
Purpose: This test will determine if a weak, plugged or open pressure regulator is causing inadequate fuel pressure in the system.

1. Connect pressure gauge to EFI test port.

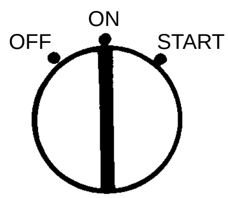


a - Test Port

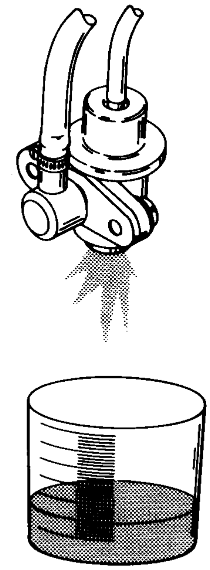
2. Turn ignition key switch to “ON” position and check fuel pressure reading on gauge. If pressure reading is below 34 psi (234 kPa) go to step 3 following.



3. Remove fuel pressure regulator, but do not disconnect any hoses from regulator.
4. Put discharge end of regulator in clean container.
5. Turn ignition key switch to “ON” position.



6. Check for fuel flow out of regulator.



Results: If steady stream of fuel exits regulator into container and pressure is below 34 psi (234 kPa), replace pressure regulator.

If low or no fuel exits regulator into container and pressure is below 34 psi (234 kPa), perform voltage checks on electric fuel pump, following.

If low or no fuel flow exits regulator into container and pressure is above 36 psi (248 kPa), replace regulator.

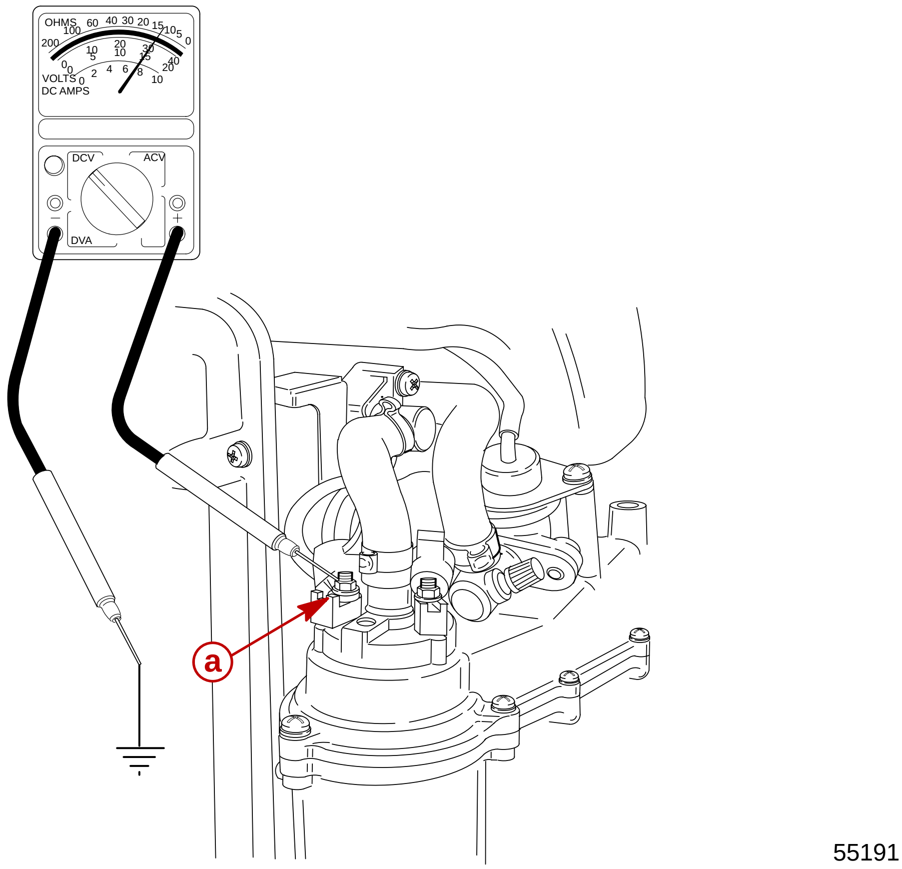
Electric Fuel Pump Voltage Test

> **⚠ CAUTION**
>
> **When checking voltage at pump, DO NOT pry boot covers off terminals with a metal object, as each terminal is at 12 volts when engine is off. Serious damage to electric fuel pump and/or ECM box can result.**

Purpose: If insufficient electrical power is available at the pump, no or low fuel pressure will be developed.

1. Set volt meter to read battery voltage and connect black test lead to ground, positive test lead to positive (+) post of fuel pump.

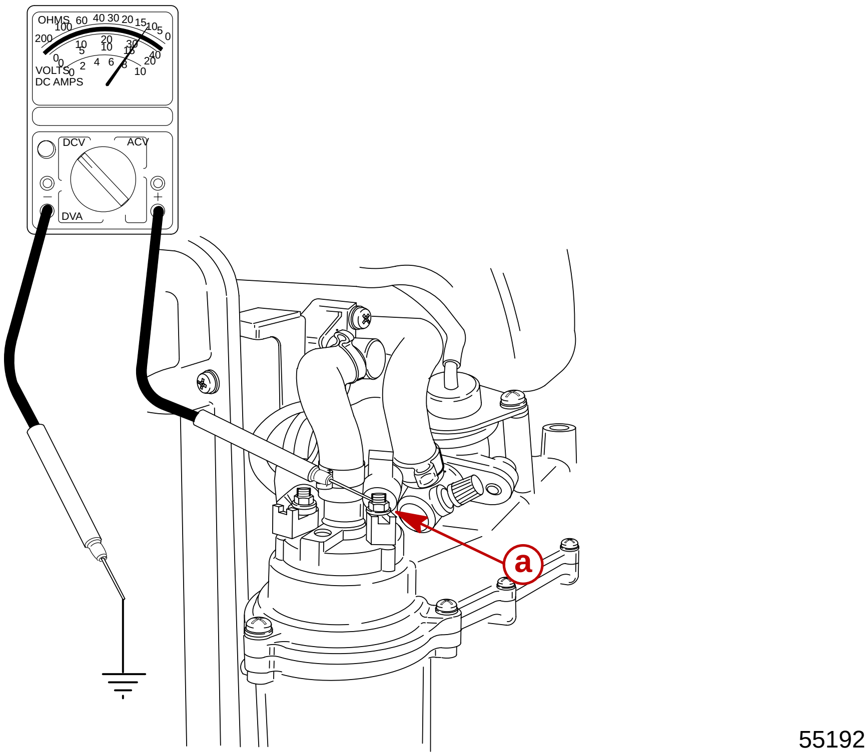
NOTE: *Positive test lead can be pierced through boot cover for testing. Refer to voltage test chart (page 3C-37) for voltage readings.*



a - Positive (+) Terminal

2. Set volt meter to read battery voltage and connect BLACK test lead to ground, POSITIVE test lead to NEGATIVE (–) post of fuel pump.

Negative Test Terminal



a - Negative (–) Terminal

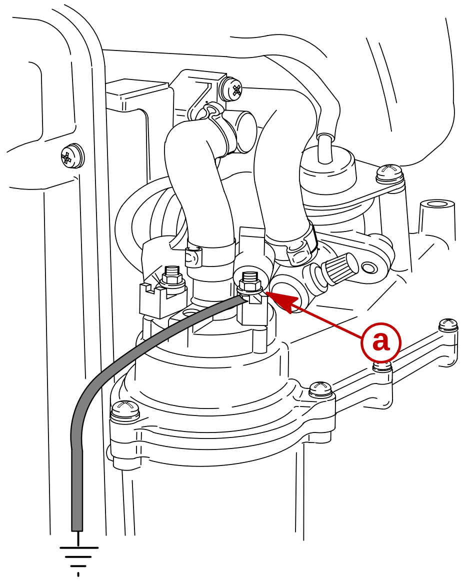
3. Perform voltage tests below.

VOLTAGE TEST CHART

Engine Mode	BLACK Meter Lead to Engine Ground; RED Meter Lead to:	Approximate Voltage Reading	If Approximate Voltage is not obtained, this indicates:
1. All models	(+) terminal of fuel pump	12 – 13.5 volts	If reading is below 12 volts, the battery is bad, discharged or has bad connection(s). If reading is higher than 13.5 volts, the battery is overcharged
2. Ignition key in “OFF” position.	(–) terminal of fuel pump.	Same reading should be obtained as reading in check No. 1 (above)	If reading is lower than in test 1, the ECM is bad or there is an open circuit in fuel pump.
3. Ignition key in “ON” position and engine NOT running.	(–) terminal of fuel pump.	1.5 volt or less (voltage should rise to 12 – 13.5 volts after approximately 30 seconds.	Bad ECM or bad fuel pump*.
4. Engine being cranked.	(–) terminal of fuel pump.	1.5 volt or less.	Bad ECM or bad fuel pump.*

*Check for proper electrical operation of electric fuel pump. (Step 4)

4. Disconnect BLACK/RED wire to negative terminal on electric fuel pump. Connect a ground jumper wire from negative pump terminal to a good engine ground.



a - Negative Terminal

Results: Pump does not operate. Replace electric fuel pump.

Pump operates. But, pressure reading does not change when performing electric fuel pump pressure test. Replace electric fuel pump.

Pump operates. Check BLACK/RED (–) lead and harness for good continuity.

NOTE: *BLACK/RED lead is connected to pin 2 of EFI harness.*

Injector Electrical Harness Test

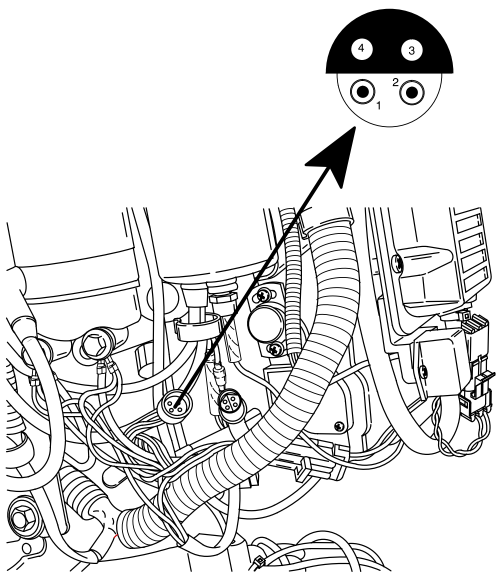
Purpose: This test will determine if electrical or fuel delivery problem exists during the fuel delivery process by checking for open circuits in injector harness.

1. With outboard in water, start and allow to warm up. Raise engine speed to 2000-2500 RPM. Remove spark plug leads one at a time and note RPM change. Determine non-working (no RPM change) cylinder. Stop engine.
2. Disconnect injector harness (4 pin connector).

IMPORTANT: Use DMT Tester (91-854009A1) and Test Harness (91-833169A1) when testing injector harness.

3. Connect digital ohmmeter (dial set at 200 scale) leads. POSITIVE lead from ohmmeter connects to POSITIVE prong "2" (RED wire) of harness connector. Connect NEGATIVE lead from ohmmeter to the remaining wires of harness connector as follows:

- **WHITE Lead** = Injectors, Cylinders 1 and 2
- **DARK BLUE Lead** = Injectors, Cylinders 3 and 4
- **YELLOW** = Injectors, Cylinders 5 and 6



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1 - YELLOW
2 - RED
3 - DARK BLUE
4 - WHITE

Results: If readings are 1.1 ± .2 both injector circuits are complete. Perform Injector Fuel Delivery Test.

If readings are 2.2 ± .2 one injector does not have a complete circuit. Perform induction manifold disassembly and inspection following.

ECM Injector Driver Test

To verify that the ECM is operating the injector pairs, connect test harness between manifold connector and engine harness. Start engine.

Use DVA meter (91-99750) or DMT (91-854009T1). Set meter to 200 scale. Connect BLACK meter lead to engine ground and RED test lead to each BLUE, WHITE or YELLOW female bullet connector

Normal voltage for a 2.5L engine will be 25 to 60 volts. Voltage will vary with RPM.

Injector Fuel Delivery Test

Purpose: This test will determine if injector is delivering fuel when signal is received.

NOTE: *It is recommended that the Digital Diagnostic Terminal 91-823686A2 be utilized following the procedure listed with its' instruction manual.*

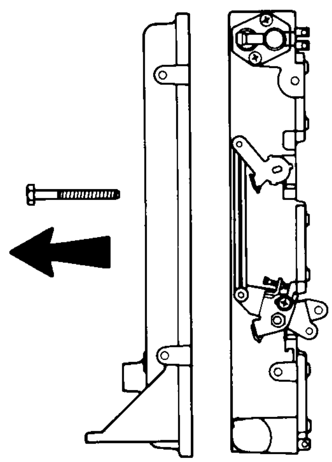
Injector Operation Test (Manifold Cover Removed)

Purpose: This test determines if the injectors are actually injecting fuel into the engine at a normal rate.

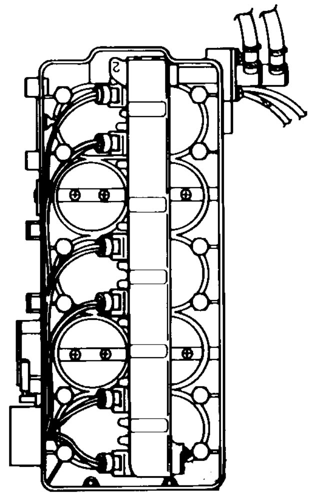
WARNING

Do not start engine with induction manifold cover removed. Disable ignition system prior to doing this test.

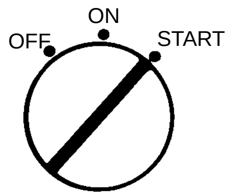
1. Remove induction manifold cover using procedures outlined under "Induction Manifold Removal."



2. Re-attach induction manifold to engine using 1/4-20 x 2-3/4″ screws.



3. Connect a jumper wire between the ECU metal case and a good engine ground.
4. Disconnect all spark plug wires from spark plugs and seal leads with electrical tape to prevent sparking.
5. Put ignition key switch in “START” position.



6. Look at injector spray pattern using an explosive proof flashlight.

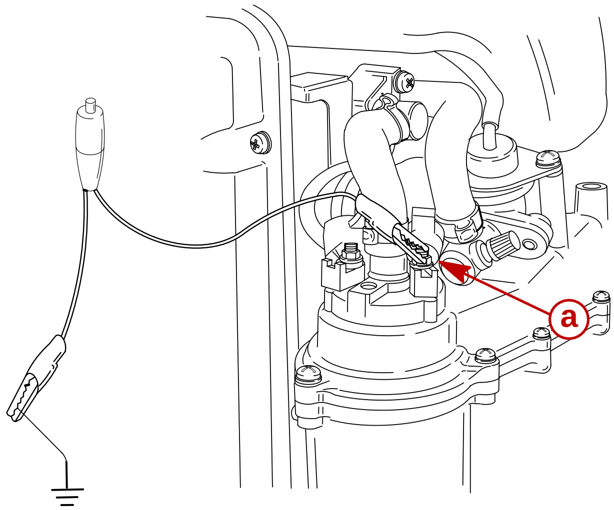
Results A: If fuel spray is not present in all injectors or spray pattern is extremely weak, check wiring harness to injector connectors, or injector filters for plugging.

If spray patterns are available in most of the injectors, but not all, perform Procedure B.

7. Connect EFI tester. Steps outlined in electrical system and ECM check.

8. Connect remote starter Quicksilver (91-52024A1) to NEGATIVE terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

WARNING
Do not operate pump for more than 20 seconds continuously.



a - Negative Terminal

9. Perform fuel injector test procedures (outlined) while depressing remote starter switch.

Results B: If fuel spray is present using EFI tester, but not present while cranking, perform switch box DVA tests Section 2A (1, 3, 5 switch box failure).

If fuel spray pattern is equal on all injectors, system is functioning normally.

Induction Manifold Leak Check (Manifold Cover Removed)

Purpose: Lack of good fuel pressure may be caused by an internal leak in the fuel induction manifold and not caused by a weak pump. This test eliminates the possibility of induction manifold leaks as a probable cause.

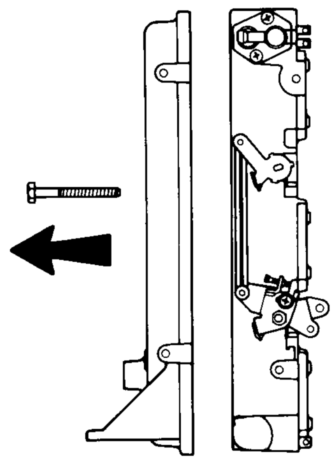
⚠ WARNING

Do not start engine with induction manifold cover removed. Disable ignition system prior to performing this test.

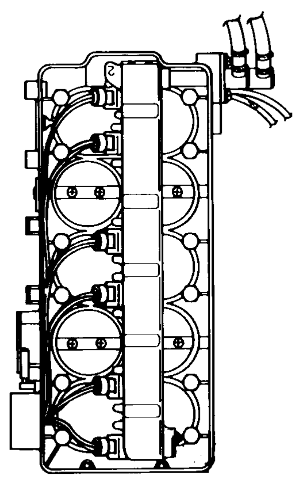
⚠ WARNING

Operation of EFI system with cover removed can allow fuel to spray components. Be extremely careful when operating the fuel system in this condition.

1. Remove induction manifold cover using procedures outlined under “Induction Manifold Removal.”



2. Reattach manifold body without cover to engine using twelve 1/4-20 x 2-3/4″ screws in place of screws normally used.



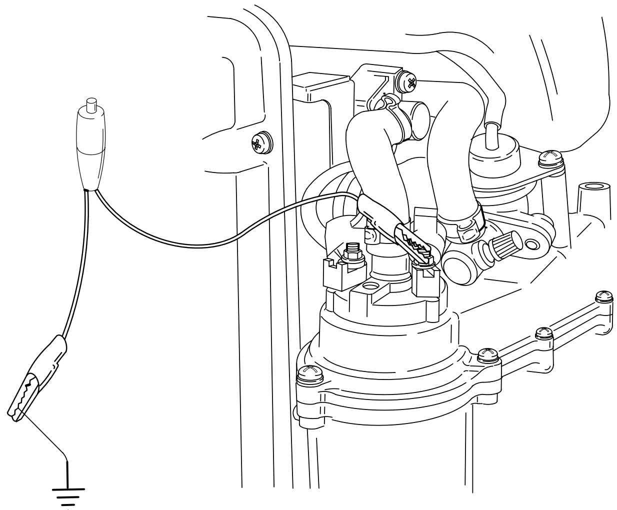
3. Connect a jumper wire between the metal case of ECM and a good engine ground.

⚠ WARNING

If a serious leak is present in the induction manifold, fuel may spray out of bad seal. Have clean up rags available to remove excess fuel from components.

4. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/ YELLOW bullet connector to engine ground.
5. Connect remote starter Quicksilver (91-52024A1) to NEGATIVE terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

⚠ WARNING
Do not operate pump for more than 20 seconds continuously.



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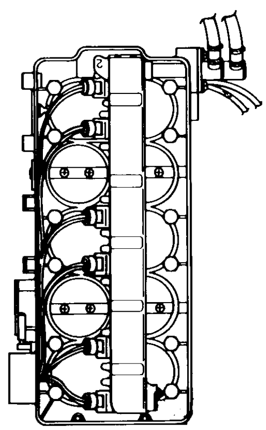
6. Look for leak points on induction manifold while depressing remote starter switch.



Results: If no leaks are present, replace cover and gasket using normal length screws.

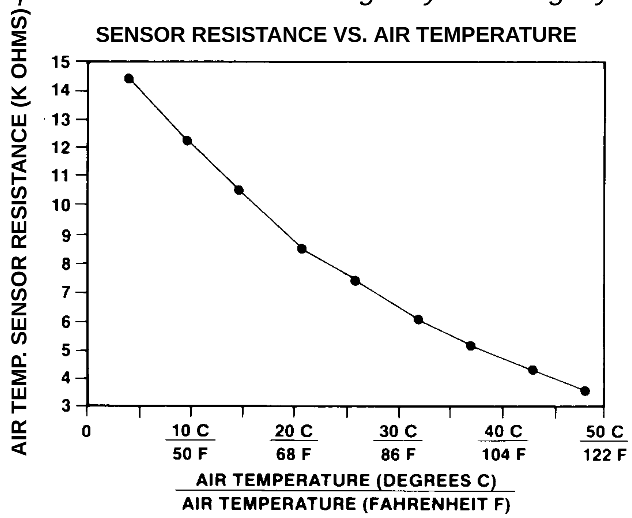
If fuel leak is present between sealing surfaces, rebuild system using new o-rings.

Air Temperature Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to air temperature sensor.

1. Disconnect and remove Air Temperature Sensor from induction manifold.
2. Connect DMT (91-854009T1) to leads of sensor.
3. Place sensor in ice water while monitoring meter reading. Use graph (below) for reference.

NOTE: *Temperature/resistance reading may differ slightly from graph curve.*



Results: Resistance does not change inversely with temperature change. Replace defective Air Temperature Sensor.

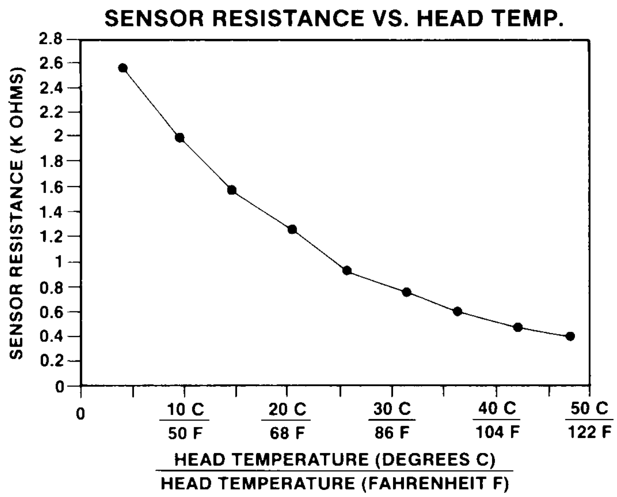
Resistance changes inversely with temperature change. Air Temperature Sensor OK.

Engine Head Temperature Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the water temperature sensor.

1. Disconnect and remove Engine Head Temperature Sensor (see page 3C-54).
2. Connect DMT (91-854009T1) to bullet leads of sensor.
3. Place sensor in ice water while monitoring meter reading. Use graph (below) for reference.

***NOTE:** Temperature/resistance reading may differ slightly from graph curve.*



Results: Resistance does not change inversely with temperature change. Replace defective Engine Head Temperature Sensor.

Resistance changes inversely with temperature change. Engine Head Temperature Sensor OK.

Detonation Control System Test (200 Models Only)

Purpose: This test eliminates possibilities of improper fuel delivery due to failure in detonation control.

1. Place outboard in water, install timing light to number one cylinder.
2. Start engine, allow to warm up. Advance throttle (between 3000-3500 RPM in gear). NOTE: Timing advancement.

Results: Timing advances from 18° to 24° BTDC system functioning properly.

Timing advance from 18° to 24° but retards while maintaining a steady throttle position. System functioning properly, detonation may be occurring. See Detonation Sensor/Module Checks (following).

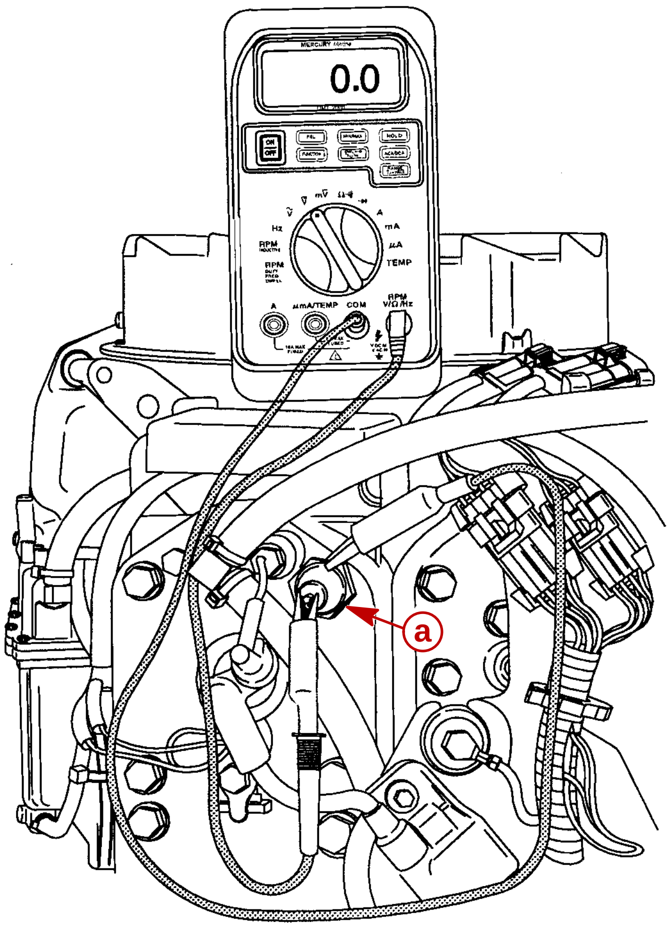
Timing advancement does not occur (18° to 24° BTDC). System functioning properly, detonation may be occurring. See Detonation Sensor/Module Checks (following).

Detonation Sensor Check

IMPORTANT: When testing detonation control system keep all test leads away from high tension leads (i.e. spark plug lead, electrical wiring etc.) to avoid false readings.

Purpose: This check will determine if sensor is correctly signaling control module.

1. Connect DMT 2000 Digital Tachometer Multi-Meter (91-854009A1) to detonation sensor as shown. RED “V-Ω” test lead to sensor terminal, BLACK “com” test lead to sensor housing (ground).



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a - Detonation Sensor

2. Turn meter dial to 200 MV volts, AC position and power switch in ON position. Place outboard in water.
3. Start and operate engine at idle speed.
4. Check meter reading. A typical reading of 0.075 to 0.120 volts AC should be present.

NOTE: *As RPM increases, volt readings will increase.*

Results: If voltage reading is not within 0.075 to 0.120 volts AC replace detonation sensor. Torque sensor to 144 lb. in. (16.0 N·m).

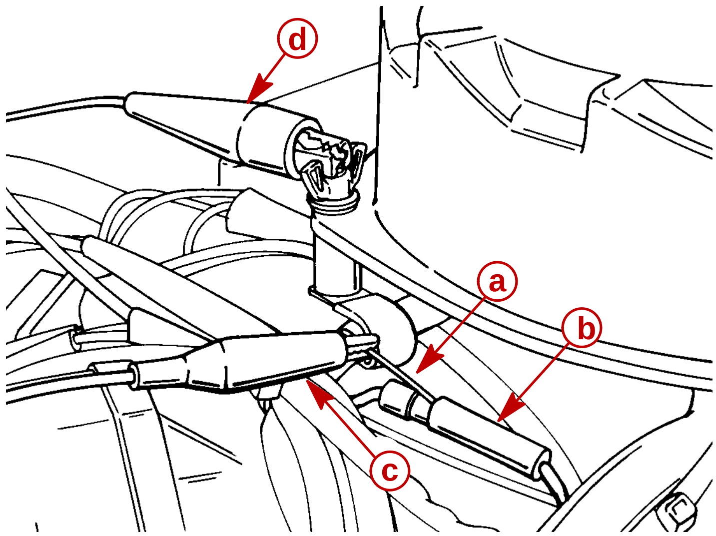
If voltage reading is within 0.075 to 0.120 volts AC perform check on detonation control module.

IMPORTANT: Handle detonation sensor with care when testing or replacing. Rough handling could cause undetectable internal damage causing false readings to be transmitted to detonation module.

Detonation Control Module Check

Purpose: This check will determine if control module is correctly signaling ECM when signals are received from sensor.

1. Insert probe (a) (i.e. paper clip) to gray/white wire connector (b). Connect digital volt meter (from EFI tester 91-11001A2 or DMT 2000 91-854009A1) positive clip (c) to probe and ground clip (d) to engine ground as shown.



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a - Probe
b - Connector
c - Positive Clip
d - Ground Clip

2. Turn meter dial to 20 volts DC position and power switch in ON position. Place outboard in water.
3. Start and operate engine at idle.
4. Check meter reading. A reading between 0.30 to 0.70 volts DC should be attained.
5. Increase engine speed (with engine in gear) between 3000-4000 RPM. Check meter reading. A typical reading should be 0.01 volts DC.

Results: If meter reading is 0.30 to 0.70 volt DC at idle and 0.01 volts DC at 3000-4000 RPM, detonation control unit is functioning properly (no detonation occurring).

If voltage reading does not fall within range (0.30 to 0.70 volts DC) at idle, control module may be bad.

If voltage reading is above 0.01 volts DC and between 1.0 to 6.6 volts DC at 3000 to 4000 RPM detonation is occurring. A constant voltage of 6.6 volts DC would indicate bad detonation control module.

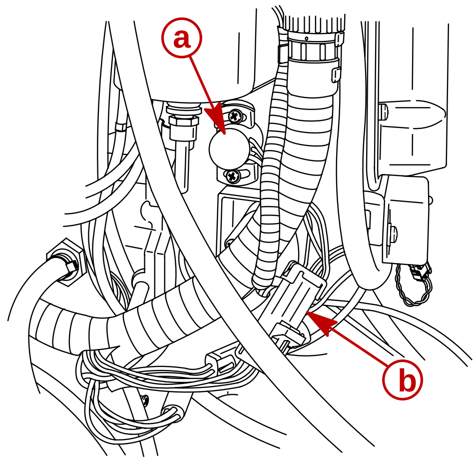
Throttle Position Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the throttle position indicator. Refer to EFI electrical system and ECM test.

***NOTE:** Engine harness MUST BE disconnected from the EFI tester 91-11001A2 (if being used) and reconnected in the normal running configuration in order to test or adjust the throttle position sensor.*

IMPORTANT: TPS can be adjusted using a digital meter (DMT). Analog (needle) type may be used although it may be difficult to read the low voltage setting accurately with most meters.

1. Disconnect TPS from EFI harness.



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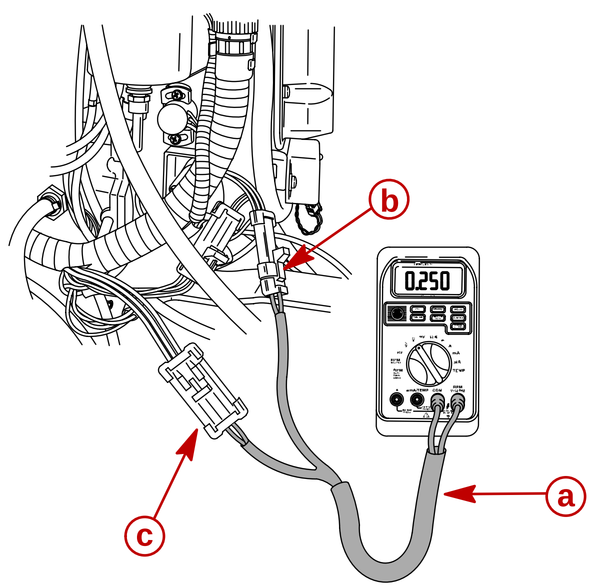
a - Throttle Position Sensor (TPS)
b - TPS Harness Connector

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



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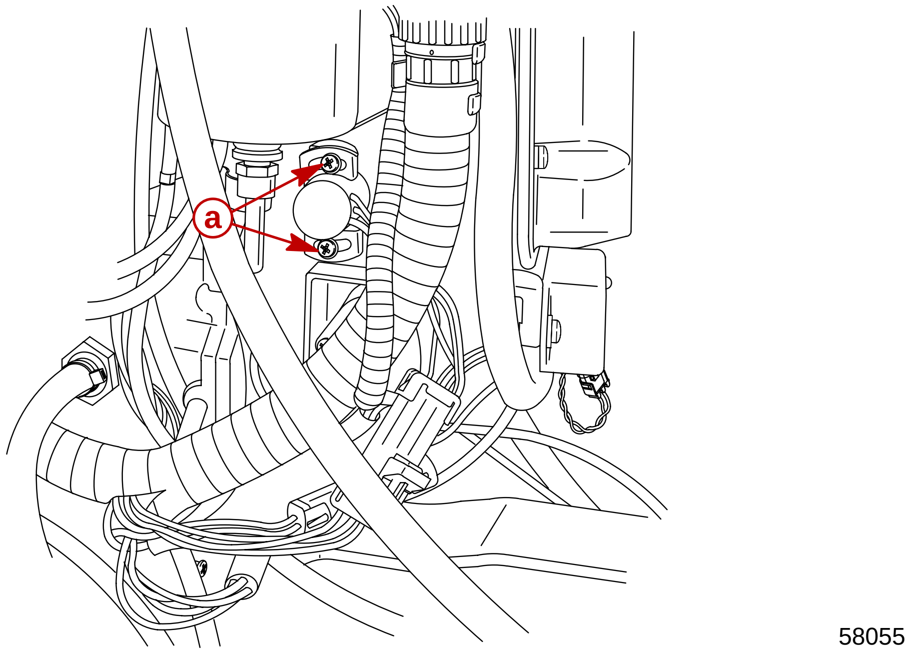
a - TPS Test Lead Assembly (91-816085)
b - TPS Connector
c - EFI Harness Connector

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

3. Disconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.
4. Turn key to the “ON” position.
5. Loosen screws (a) securing TPS to manifold.



a - Screws

6. Rotate TPS fully clockwise (holding throttle shaft in closed position). Voltmeter should read **.200 - .300**. If readout is not within specifications, adjust TPS to obtain readout of **.240 - .260.**
7. Tighten TPS screws to 20 lb. in. (2 Nm) holding correct tolerance.
8. Disconnect remote control cable from throttle lever.
9. Slowly move throttle lever to full open position while monitoring voltage reading. Voltage reading should increase and decrease smoothly
10. Set volt meter to 20 DC volts. Maximum voltage reading at full throttle is approximately 7.46 volts.
11. Remove test lead and reconnect TPS harness to EFI harness.
12. Reconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.

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

Map Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery caused by the map sensor. Refer to Electronic Fuel Injection Tester (91-11001A2) and its test manual. The Digital Diagnostic Terminal (91-823686A2) may also be used to test the MAP Sensor. It will display an LED failure light, a PASS/NO operational indication as well as a numeric display value.

Problem Diagnosis

Condition	Possible Source	Action
Engine Down On Power Or RPM	– Failed Switch Box	Refer to Section 2 Electrical and Ignition Tests.
	– Failed Stator	Refer to Section 2 Electrical and Ignition Tests.
	– Failed CDM	Refer to Section 2 Electrical and Ignition Tests.
	– Low Compression	Refer to Section 4 Power Head.
	– Broken Reed	Perform Injector Fuel Delivery Test.
	– Fuel Delivery Problem	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart.
	– Manifold Fuel Leak	Perform Induction Manifold Leak Check.
	– Vapor Separator Flooding Over, Engine Running Rich.	Check for fuel coming out of vapor separator vent hose.
	– Cylinder Head Temperature Sensor Circuit Failed.	Check cylinder head temperature sensor.
Poor Acceleration – Idles Ok, Top Speed Ok	– Improper EFI Set Up.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– Water Covering Idle Relief Exhaust Ports.	Boats with extended transoms or low engine mount can cause engine to load up on acceleration.
	– T.P.S. Failure.	Refer to page 3C-49.
	– MAP Sensor Failure	Refer to page 3C-50.
	– R.F.I. Problem*	Install BPZ8HS-10 Spark Plugs.

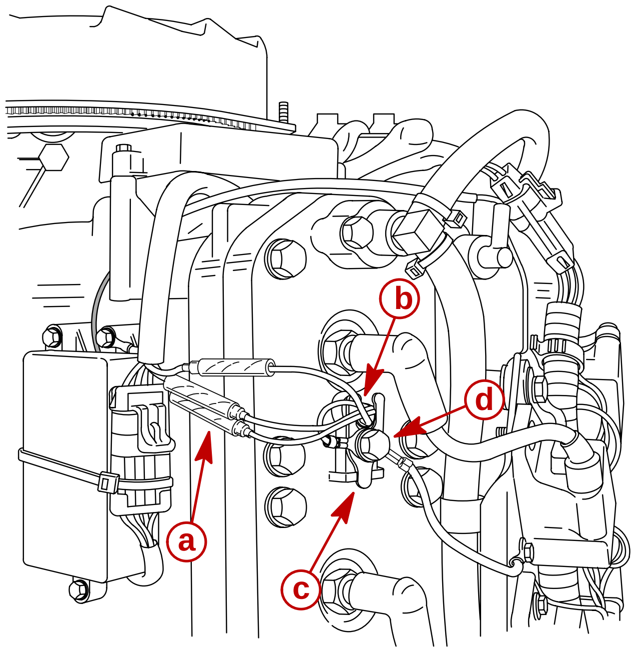
Condition	Possible Source	Action
Poor Acceleration – Idles Ok, Top Speed Ok (Continued)	– Timing Not Advancing.	Check for stuck trigger.
Engine Surges Between 4000 And 5000 RPM	– Intermittant CDM Failure. – Final Filter Clogging. – T.P.S. – Improper Adjustment. – Injector Connector Problem. – Vapor Separator Flooding Over. – Injector Filter Clogged.	Refer to Section 2A Electrical and Ignition for tests. Perform Final Filter Check. Refer to Section 2C Electrical and Ignition for T.P.S. adjustment. Perform Injector Fuel Delivery Test. Check for fuel coming out of vapor separator vent hose. Refer to Injector Fuel Delivery Test.
Engine Idles Ok But Stumbles At Off Idle Speeds	– Improper EFI Setup. – Failed CDM. – Failed Or Disconnected EFI Sensors. – Fuel Delivery Problem. – Manifold Fuel Leak. – R.F.I.* Problem. – Stator. – Induction Manifold Air Leak.	Refer to Section 2C Electrical and Ignition for proper EFI set up procedures. Refer to Section 2A Electrical and Ignition Tests. Perform EFI sensor tests. Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart. Perform Induction Manifold Leak Check. Install BPZ8HS-10 Spark Plugs. Refer to Section 2A Electrical and Ignition for tests. Check manifold cover gasket, manifold to reed block housing gasket and reed block housing to crankcase gasket.
Engine Idles Rough (May Lean Sneeze) – Acceleration Ok; Full Throttle Ok	– Improper EFI Setup. – MAP Sensor Failure.	Refer to Section 2C Electrical and Ignition for proper EFI set up procedures. Refer to page 3C-50.

Condition	Possible Source	Action
Engine Idles Rough (May Lean Sneeze) – Acceleration OK; Full Throttle Ok. (continued)	– CDM Failure. – Broken Reed.	Refer to Section 2A Electrical and Ignition Tests. Perform Injector Fuel Delivery Test.
Engine Runs but Slowly Drops RPM then Dies.	– Restrictions in Fuel System between Tank and Engine. – Clogged Final Filter. – Pulse Fuel Pump Failure. – Electric Fuel Pump Delivery Failure.	Install remote gas tank with fresh, high quality fuel. Perform Final Filter Check. Follow Low Pressure Fuel Route Flow Chart. Follow High Pressure Fuel Route Flow Chart.
Engine Stops for No Apparent Reason or Does Not Start.	– Battery Undercharged. – EFI Harness Connections. – Ignition System Failure. – Pulse Fuel Pump Failure. – Electric Fuel Pump Failure. – ECM Failure.	Check battery connections, under charged battery or worn out battery. Check EFI harness connector for improper connection. Refer to Section 2A Electrical and Ignition Tests. Follow Low Pressure Fuel Route Flow Chart. Follow High Pressure Fuel Route Flow Chart. The DDT (91-823686T2) will monitor information coming from sensors or switches to the ECM and will indicate if the sensor or switch is defective. For a more thorough analysis of the ECM, refer to EFI Tester Manual 91-11001A2.
Engine Stops for No Apparent Reason, but will Restart.	– Battery Overcharged. – Restriction in Fuel System	Check battery voltage with engine running. Should be less than 15.5 volts. Refer to Service Bulletin 96-2. Check fuel pressure on fuel rail at the RPM that failure occurs.

*R.F.I. Radio Frequency Interference. High voltage can alter signals ECM receives from sensors causing improper fuel delivery. Route all sensor wires away from high voltage leads (i.e. spark plug leads)

Engine Head Temperature Sensor Removal

1. Remove screw and retaining plate.
2. Disconnect wires and remove sensor.



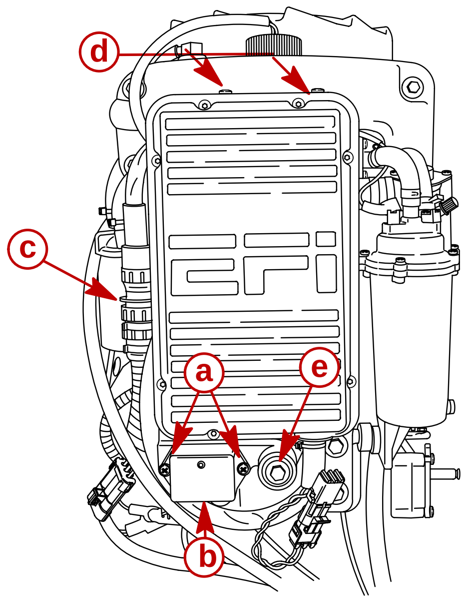
58052

a - Wires
b - Sensor
c - Retainer
d - Screw

EFI Induction Manifold Removal

IMPORTANT: Remove battery cables from battery before Induction Manifold Removal and Disassembly.

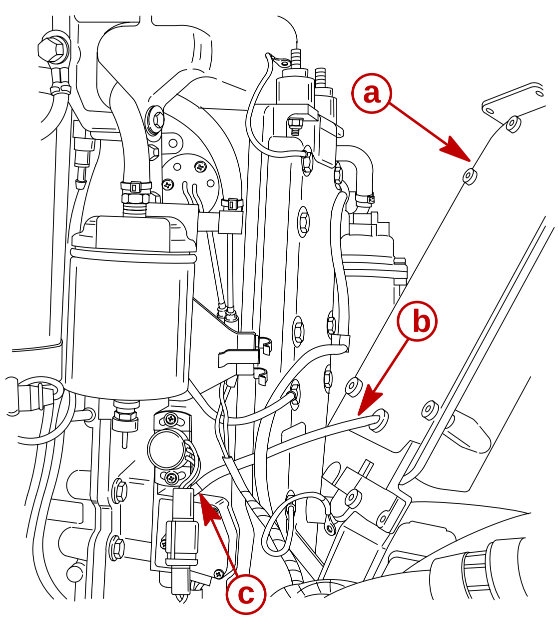
1. Disconnect ECM at harness connector.
2. Remove attaching screws.
3. Remove water sensing module.
4. Remove nuts and bolt.



58031

a - Screws
b - Water Sensing Module
c - Harness Connector
d - Nuts
e - Bolt

5. Carefully raise ECM from studs. Disconnect MAP sensor hose at manifold fitting and remove ECM.



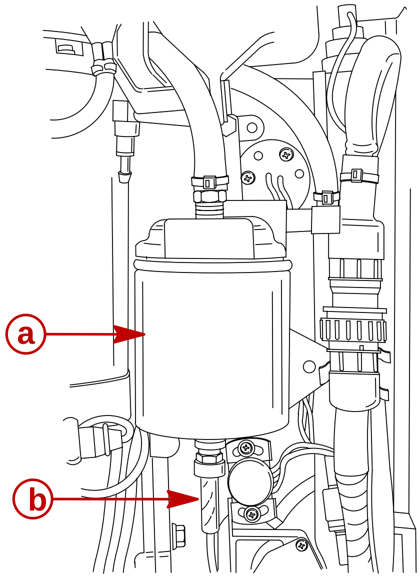
55199

a - ECM
b - MAP Sensor Hose
c - Manifold Fitting

Water Separating Filter Assembly Removal

NOTE: *To inspect or replace water separator, it is not necessary to remove inlet and outlet fuel lines or to unbolt bracket from manifold.*

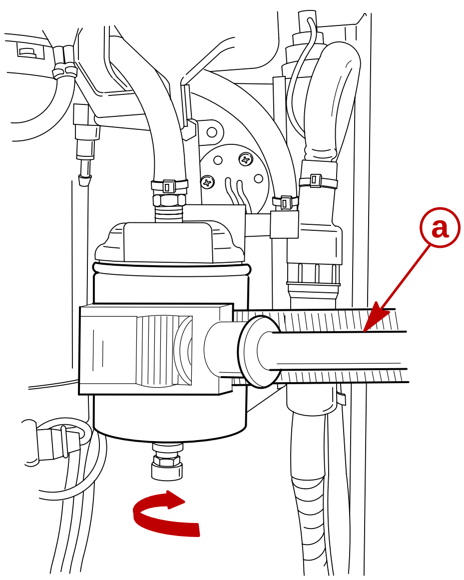
1. Remove water sensor lead from bottom of separator.



55182

a **-** Water Separator
b **-** Water Sensor Lead

2. With wipe towels available, use Strap Wrench (91-24937A1) to remove water separator.



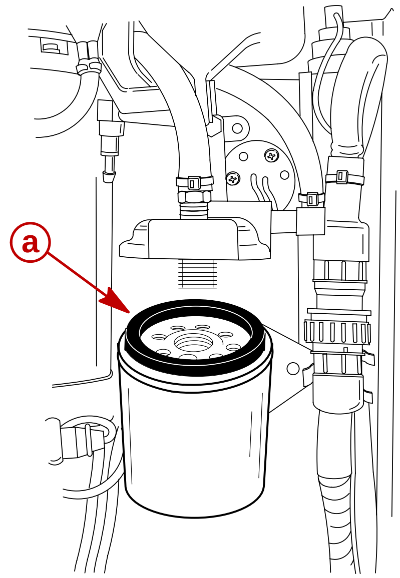
55184

a **-** Strap Wrench (91-24937A1)

Water Separating Filter Assembly Installation

IMPORTANT: Apply a light coat of outboard oil to the rectangular sealing ring on the water separator before installation.

1. After applying oil to sealing ring of water separator, install separator onto bracket.
2. HAND TIGHTEN SEPARATOR. DO NOT use strap wrench or other tool to tighten separator.
3. Reconnect water sensor lead to bottom of separator.

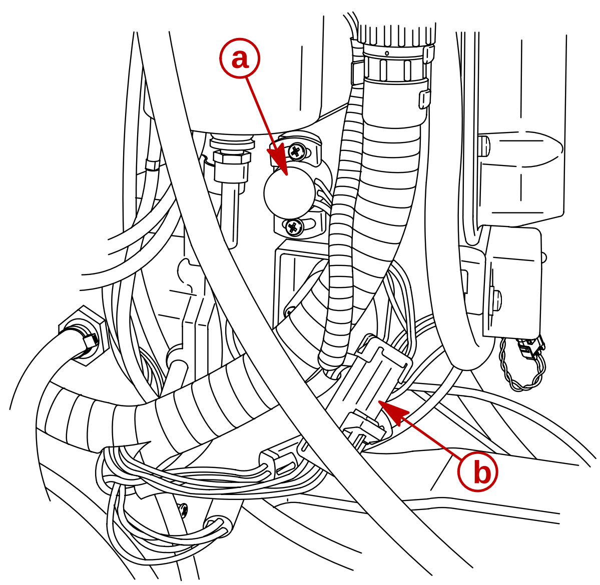


55185

a - Sealing Ring

Throttle Position Sensor and Temperature Sensor Fuel Injector Harness Disconnections

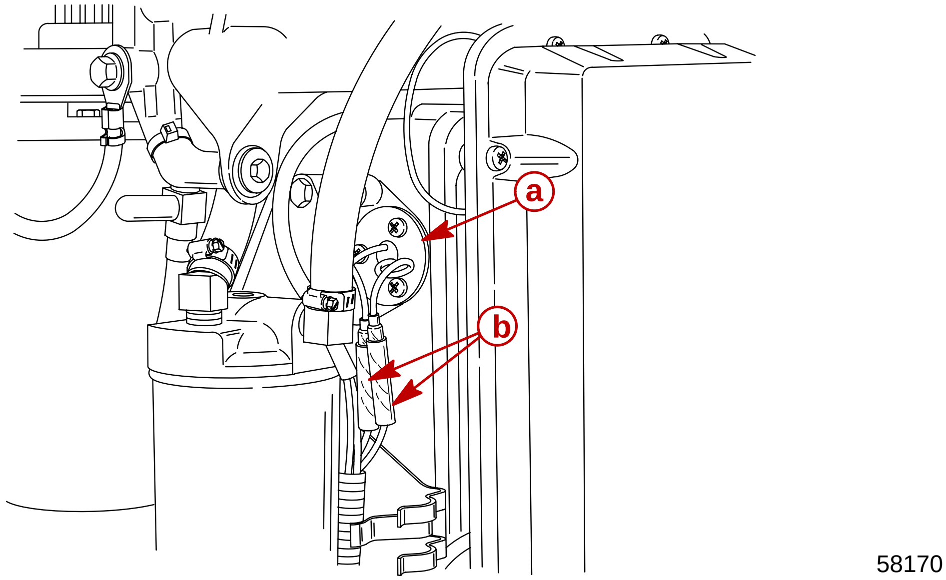
1. Disconnect throttle position sensor at 3 pin connector.



58055

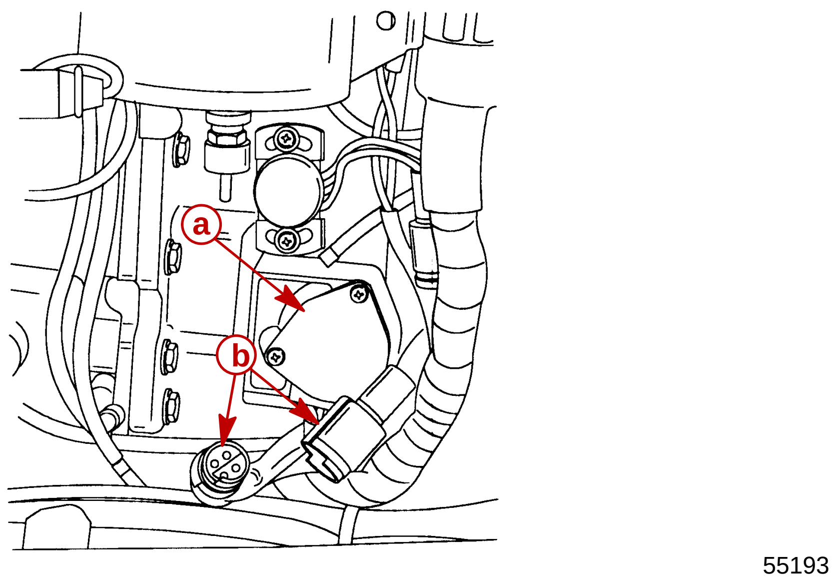
a - Throttle Position Sensor
b - 3 Pin Connector

2. Disconnect air temperature sensor at connectors.



a - Air Temperature Sensor
b - Connectors

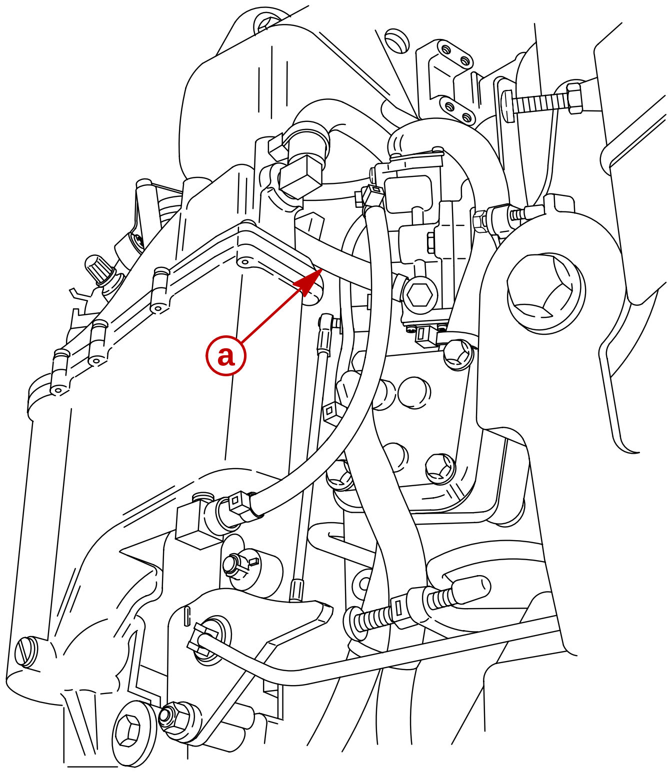
3. Disconnect fuel injector harness at 4 pin connector.



a - Fuel Injector Harness
b - 4 Pin Connector

Oil Reservoir Removal

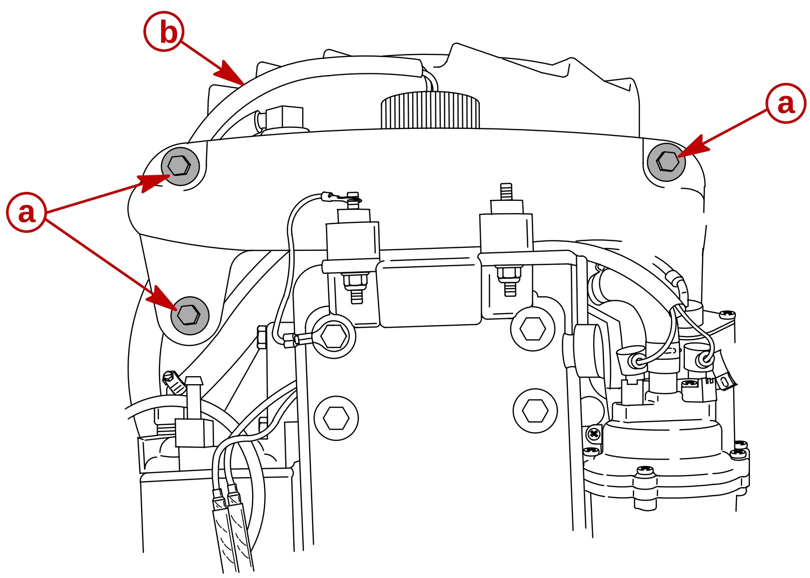
1. Disconnect low oil sensor bullet connectors (BLUE leads located below fuel/water separator)
2. Remove sta-strap securing reservoir hose to oil pump and remove hose. Plug hose to prevent leakage.



58050

a - Reservoir Hose

3. Remove 3 screws and remove reservoir.

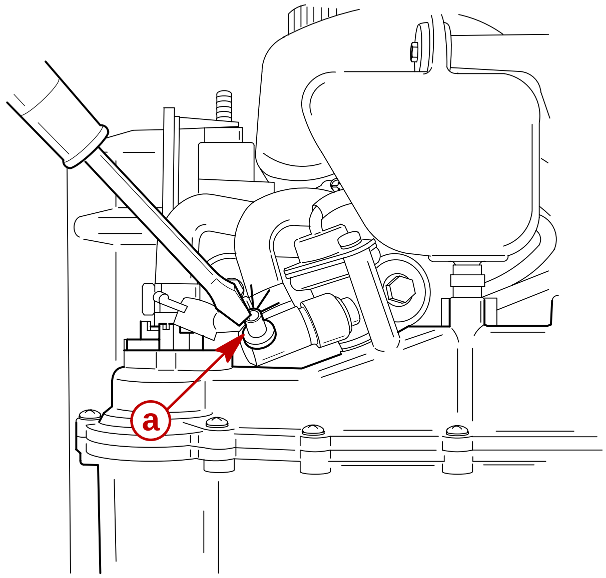


58172

a - Screws
b - Low Oil Sensor Harness (BLUE lead bullet connectors located below fuel/water separator)

Fuel Pressure Regulator Removal

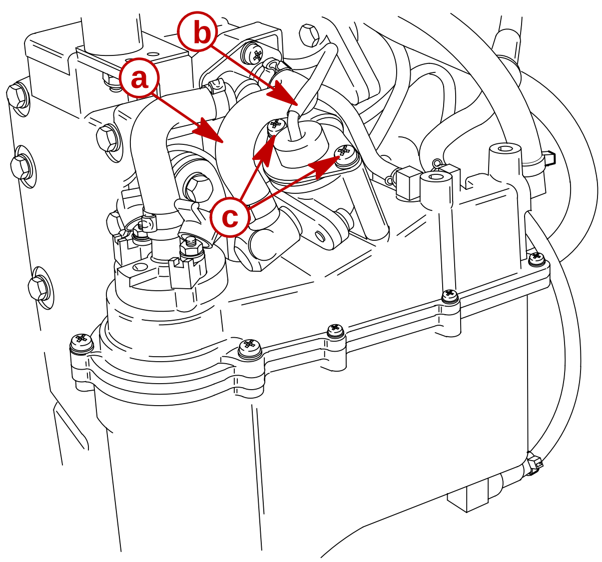
1. Disconnect boat battery from engine harness.
2. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

a - Pressure Port

3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.

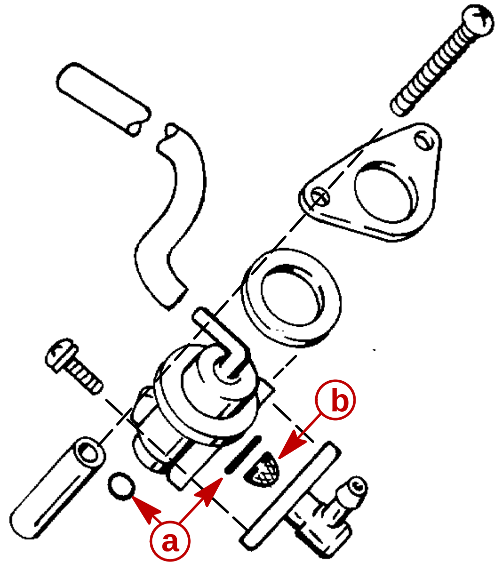


55204

a - Return Fuel Line
b - Regulator Hose
c - Screws

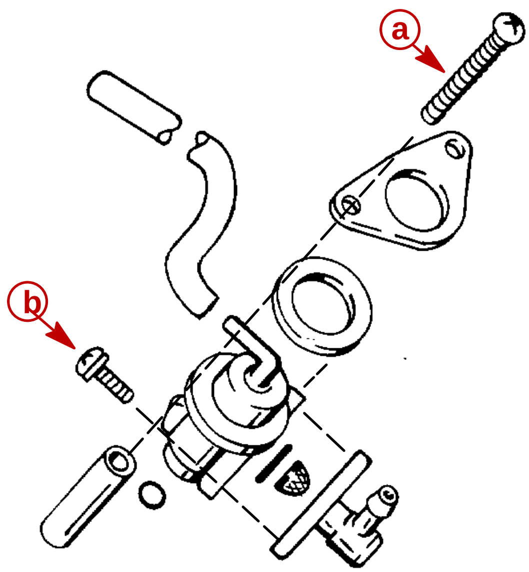
Fuel Pressure Regulator Disassembly

1. Inspect O-rings for cuts and abraisions. Replace as required.
2. Inspect fuel filter for debris. Clean with solvent as required.



a - O-Rings
b - Filter

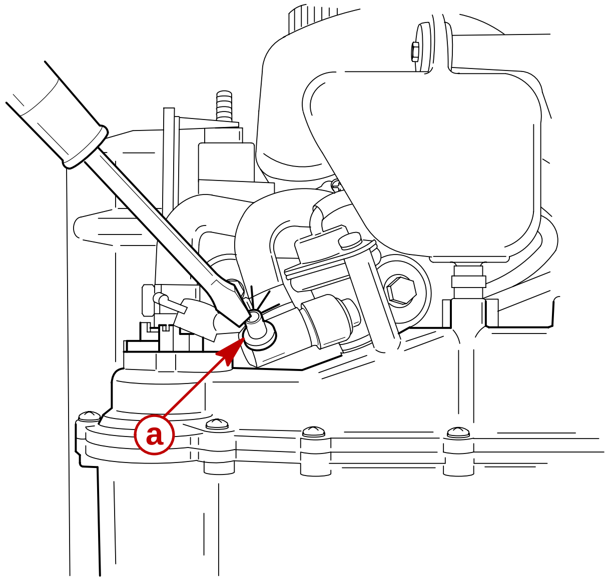
Fuel Pressure Regulator Reassembly



a - Screw (2) [Torque to 30 lb. in. (3.5 Nm)]
b - Screw (2) [Torque to 45 lb. in. (5 Nm)]

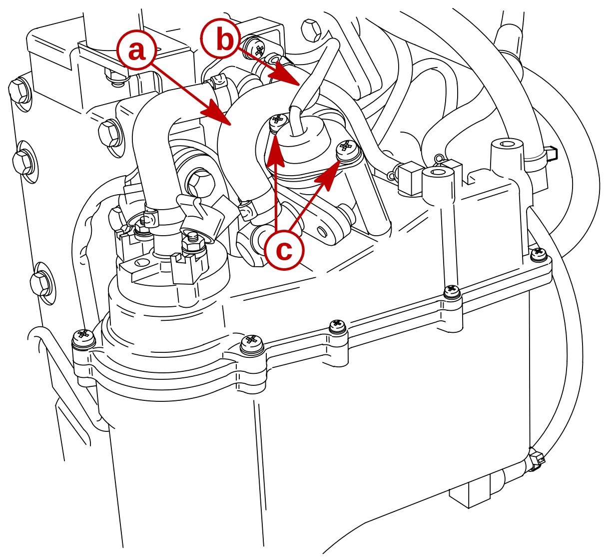
Vapor Separator Removal

1. Disconnect boat battery from engine harness.
2. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



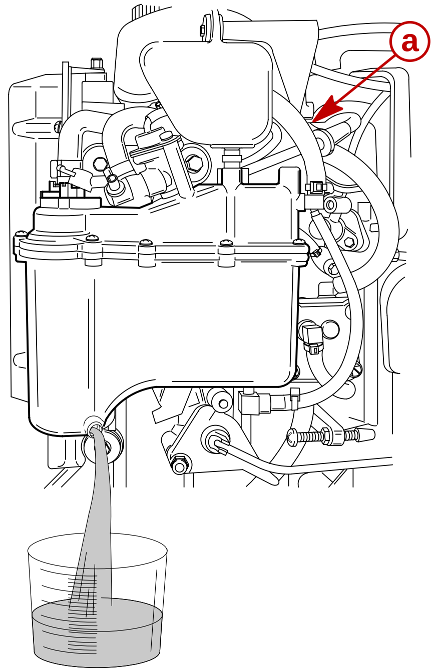
a - Pressure Port

3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.



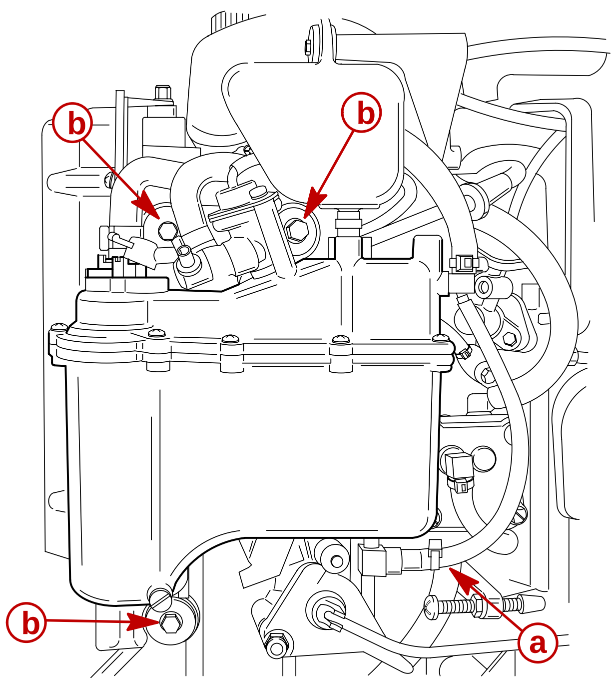
a - Return Fuel Line
b - Regulator Hose
c - Screws

6. Remove drain screw from separator and drain fuel into suitable container.
7. Remove fuel inlet hose to vapor separator.



a - Fuel Inlet Hose

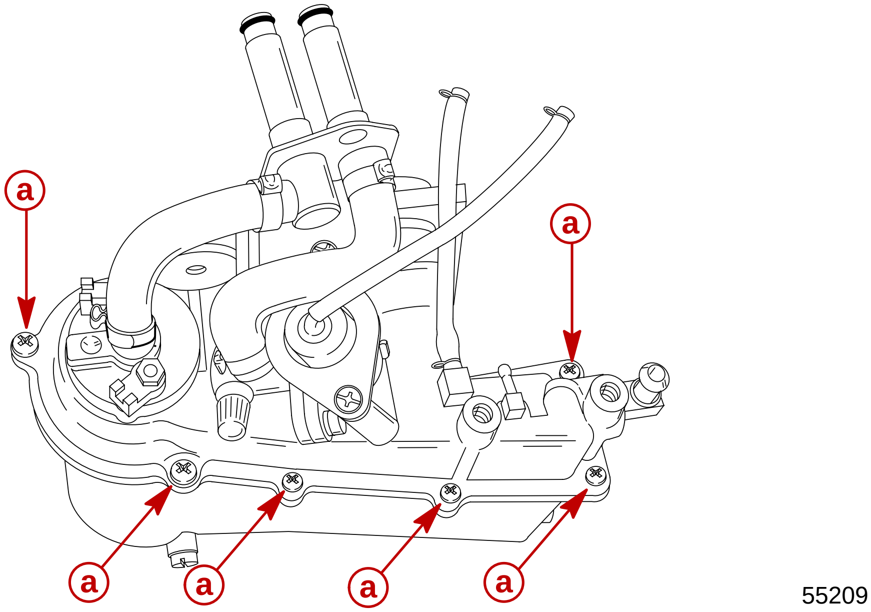
8. Disconnect and plug oil inlet hose to vapor separator.
9. Remove 3 bolts securing separator to manifold assembly.



a - Oil Inlet Hose
b - Bolts

Vapor Separator Disassembly

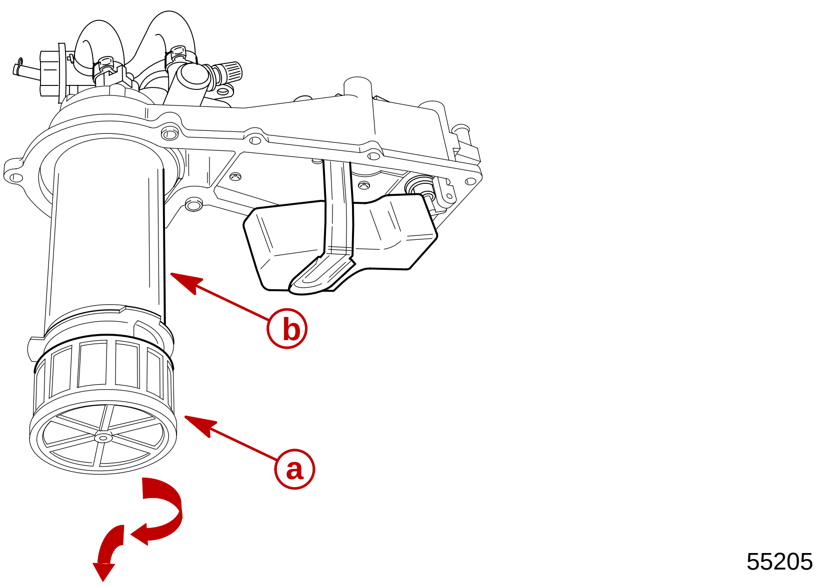
Remove 9 screws securing cover to vapor separator and remove separator tank.



a - Screws (3 screws are hidden on back side)

FINAL FILTER REMOVAL

Rotate final filter counterclockwise and pull down.

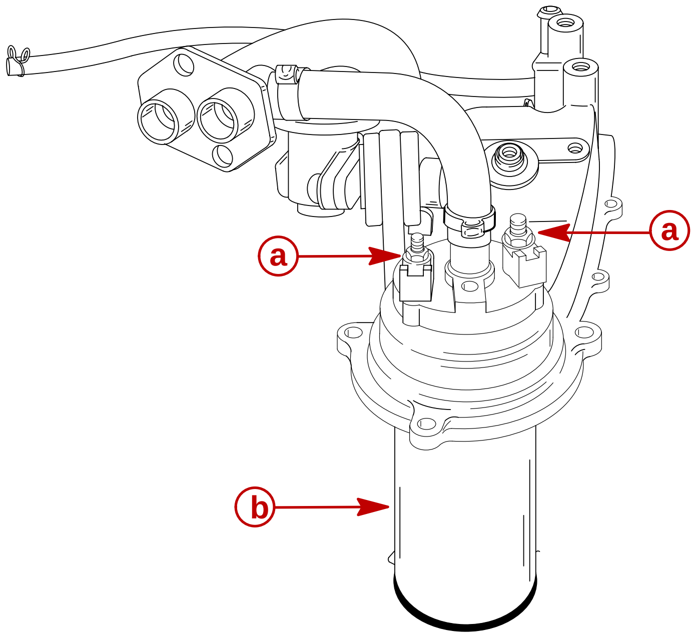


a - Final Filter
b - Electric Fuel Pump

ELECTRIC FUEL PUMP REMOVAL

NOTE: *There are no individually replaceable parts within the electric pump. If brushes or armature fails, entire pump must be replaced.*

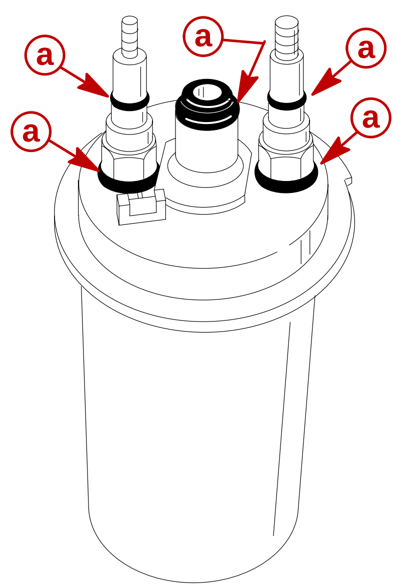
1. Remove 2 nuts on POSITIVE and NEGATIVE terminals. Remove pump from separator cover.



55206

a - Nuts
b - Pump

2. Inspect pump O-rings for cuts or abraisions. Replace O-rings as required.



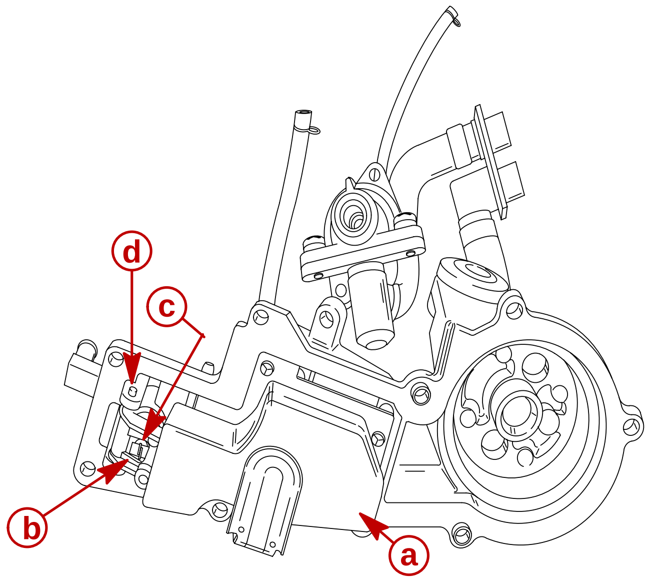
53702

a - O-rings

VAPOR SEPARATOR FLOAT REMOVAL

NOTE: *Inspect float for fuel absorbtion or deterioration. DO NOT attempt to bend float arm to adjust float height. Float height is preset at factory. Inspect float needle for grooves. Inspect needle seat for debris or corrosion. Replace float, needle and seat* as required.*

1. Remove float pivot pin.
2. Remove float and needle for inspection. Replace as required.



55207

a - Float
b - Float Arm
c - Float Needle (Hidden)
d - Pivot Pin

*Seat and separator cover must be replaced as an assembly.

ELECTRIC FUEL PUMP INSTALLATION

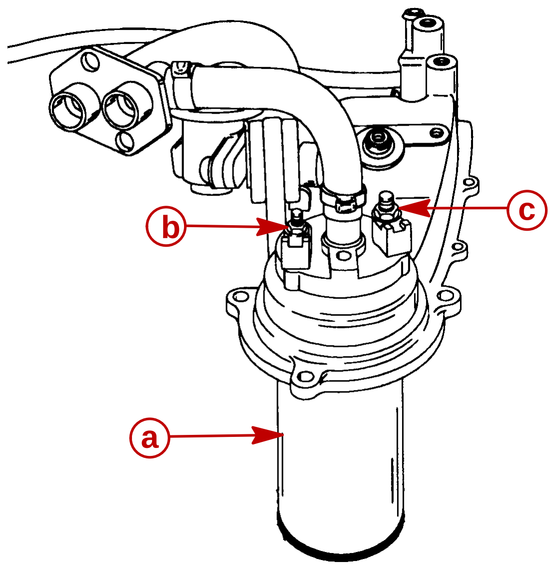
1. Slide fuel pump into separator cover.

NOTE: *Fuel pump electrical studs are different diameters. Pump will install properly into cover only one way.*

CAUTION

DO NOT over torque fuel pump POSITIVE and NEGATIVE attaching nuts as damage to fuel pump will result.

2. Secure pump to cover with 2 nuts. Torque POSITIVE nut to 6 lb. in. (0.7 Nm). Torque NEGATIVE nut to 16 lb. in. (1.8 Nm).



a - Electric Pump
b - POSITIVE (+) Stud (Small Diameter)
c - NEGATIVE (–) Stud (Large Diameter)

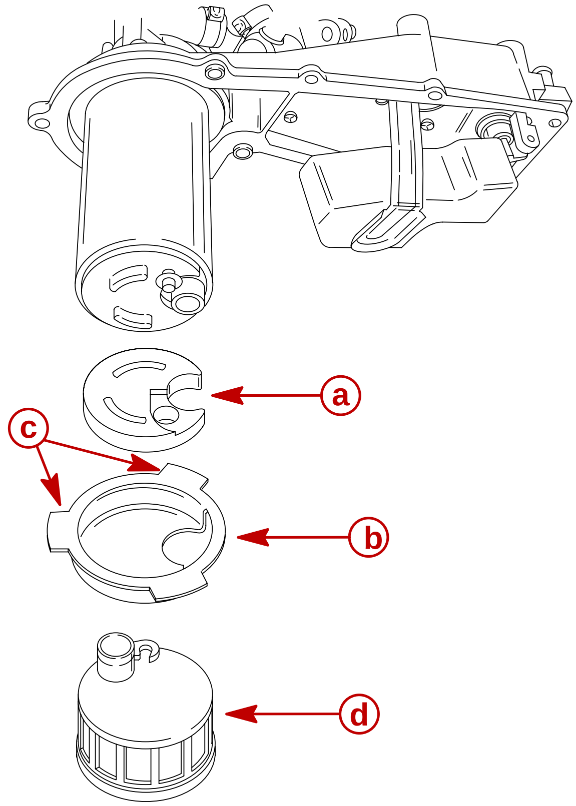
3. Install rubber pad on bottom of pump.

NOTE: *Rubber pad is molded to fit flush on bottom of pump on one side only.*

4. Install pump support ring.

NOTE: *Pump support ring fits over pad onto pump properly only one way (Tabs face up).*

5. Install final filter into pump bottom. Rotate filter clockwise to lock filter onto pump.

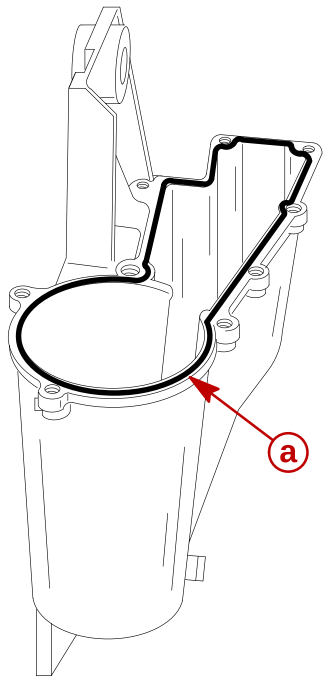


a - Rubber Pad
b - Support Ring
c - Tabs (face up)
d - Final Filter

INSTALLING SEPARATOR COVER ASSEMBLY ONTO SEPARATOR TANK

1. Inspect separator tank sealing O-ring for cuts or abraisions. Replace O-ring as required.

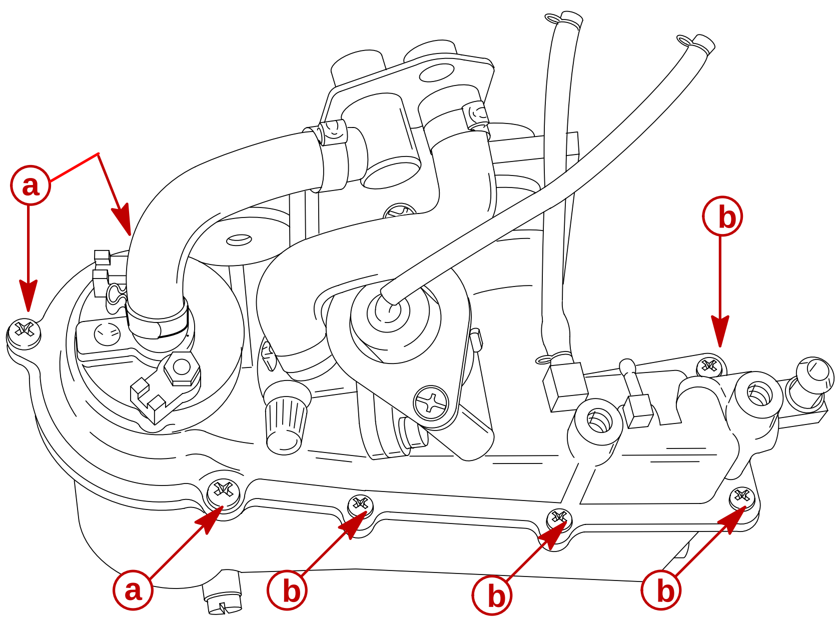
NOTE: *If O-ring swells due to fuel and air exposure and will not fit in tank O-ring groove, replace O-ring. DO NOT cut O-ring to make it fit as fuel leakage will result.*



53701

a - O-ring

2. Install cover assembly onto separator tank. Secure cover to tank with 9 screws. Torque 5mm screws to 30 lb. in. (3.5 Nm). Torque 4mm screws to 20 lb. in. (2.5 Nm).

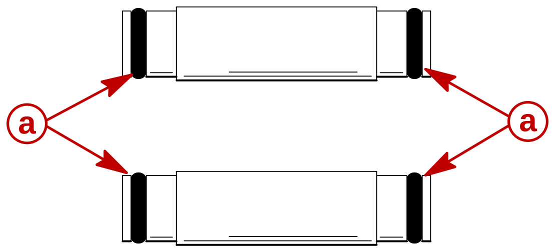


55209 58171

a - Large Screws (3) (5mm) Torque to 30 lb. in. (3.5 Nm)
b - Small Screws (6) (4mm) Torque to 20 lb. in. (2.5 Nm)

Installing Vapor Separator Assembly to Induction Manifold

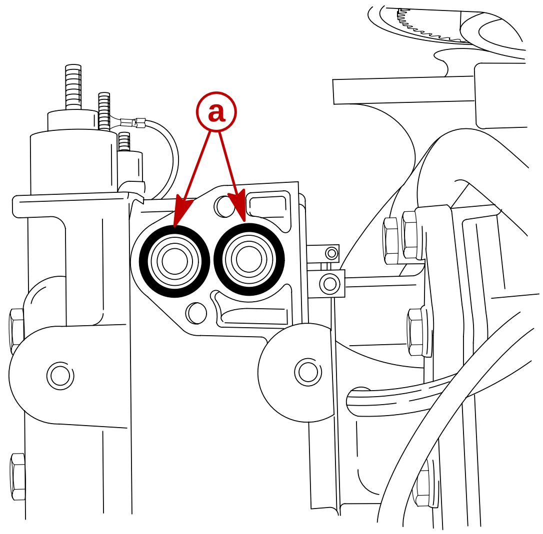
1. Inspect O-rings on ends of separator fuel tubes for cuts or abraisions. Replace O-rings as required.



55217

a - O-rings

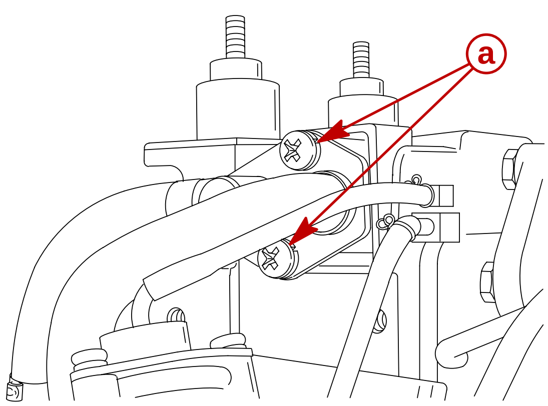
2. Install fuel tubes into manifold. Inspect adaptor plate O-rings for cuts or abraisions. Replace O-rings as required.



55215

a - O-rings

3. Secure adaptor plate to manifold with 2 screws. Torque screws to 45 lb. in. (5 Nm).



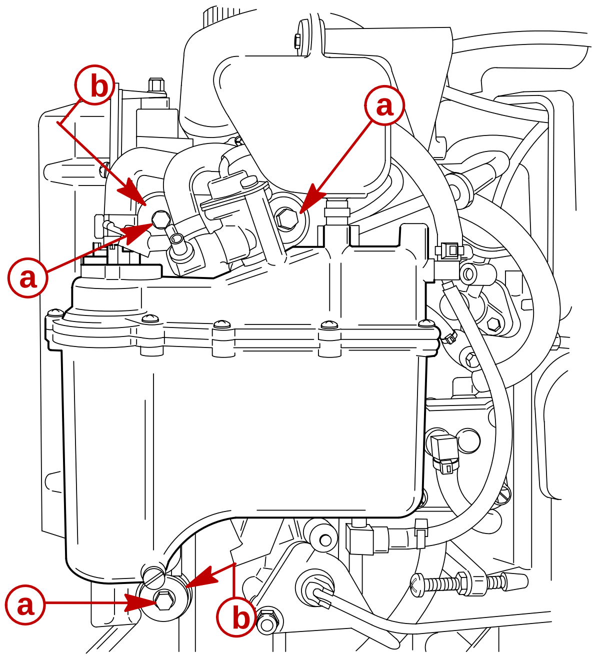
55216

a - Screws [Torque to 45 lb. in. (5 Nm)]

NOTE: *For ease of reassembly, reinstall oil reservoir on engine BEFORE installing vapor separator.*

4. Secure vapor separator to manifold with 3 screws and washers. Torque screws to 45 lb. in. (5 Nm).

NOTE: *Spacers are positioned between separator and manifold at the top front and bottom attaching screw locations.*

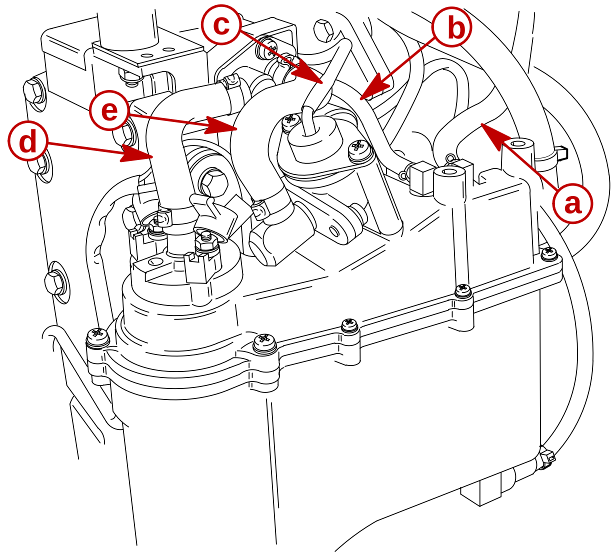


55176

a - Screws [Torque to 45 lb. in. (5 Nm)]
b - Spacers

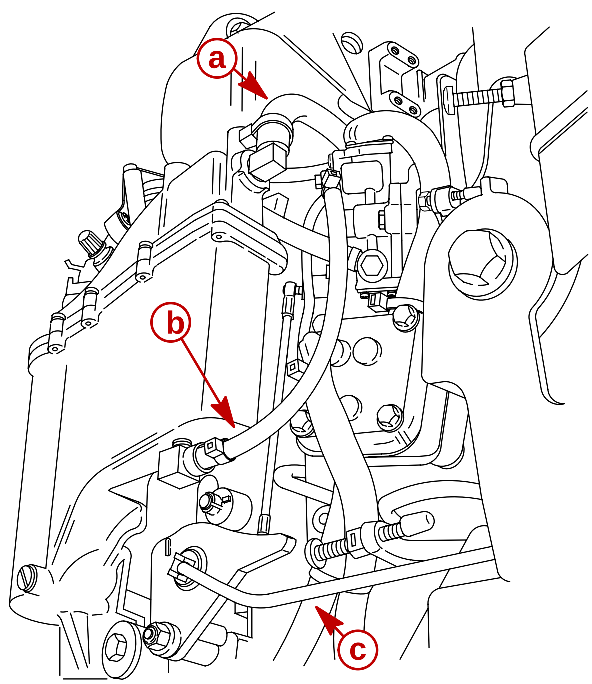
IMPORTANT: If fuel outlet hose from electric fuel pump or fuel return hose from manifold to pressure regulator was disconnected, stainless steel hose clamps MUST BE USED to secure connections. If outlet/return hoses are to be replaced, replacement tubing kit (32-827694) MUST BE INSTALLED to prevent rupturing or leakage. DO NOT use sta-straps to secure high pressure fuel lines as leakage will occur.

5. Reconnect engine bleed hose to fitting on vapor separator.
6. Reconnect vapor separator over flow hose between separator and manifold.
7. Reconnect pressure regulator hose to top fitting on regulator.



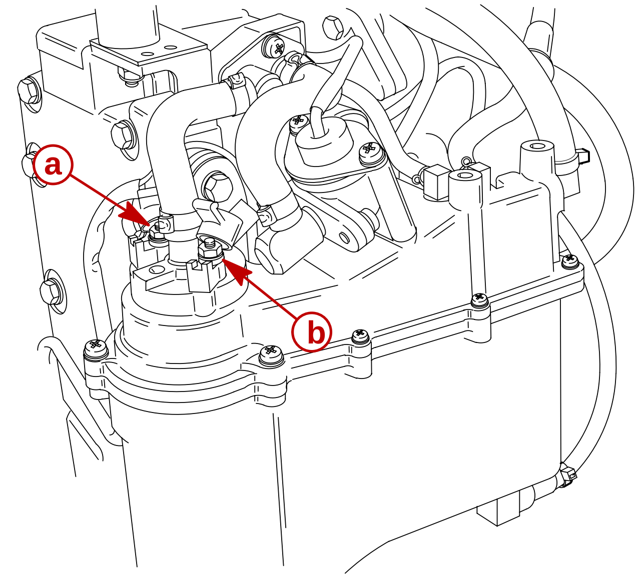
a - Over Flow Hose
b - Bleed Hose
c - Pressure Regulator Hose
d - Fuel Outlet Hose
e - Fuel Return Hose

8. Connect fuel inlet hose to vapor separator. Secure hose with sta-strap.
9. Connect oil inlet hose to vapor separator. Secure hose with sta-strap.
10. Install throttle link arm to throttle cam.



a - Fuel Inlet Hose
b - Oil Inlet Hose
c - Throttle Link Arm

11. Connect RED (POSITIVE) lead to STARBOARD terminal of electric fuel pump and BLACK/RED (NEGATIVE) lead to PORT terminal of fuel pump. Torque POSITIVE nut to 6 lb. in. (0.7 Nm) and the NEGATIVE nut to 16 lb. in. (1.8 Nm).

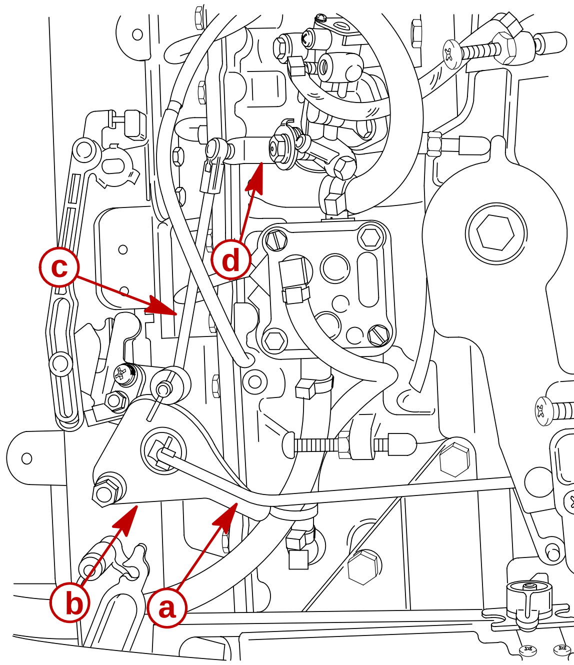


55204

a - RED (+) Terminal [Torque nut to 6 lb. in. (0.7 Nm)]
b - BLACK/RED (–) Terminal [Torque nut to 16 lb. in. (1.8 Nm)]

Manifold Removal

1. Disconnect throttle link rod from throttle cam.
2. Disconnect oil injection link rod from injector arm.

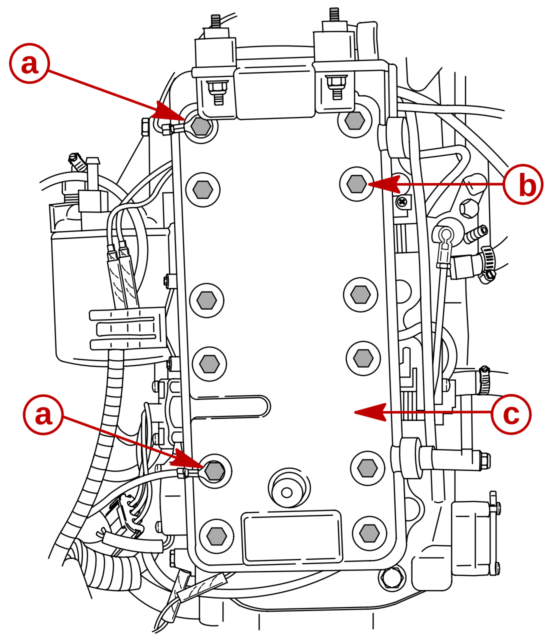


55213

a - Throttle Link Rod
b - Throttle Cam
c - Oil Injection Link Rod
d - Injector Arm

3. Identify location of 2 ground wires for reassembly purposes.
4. Remove12 screws securing manifold cover to manifold.

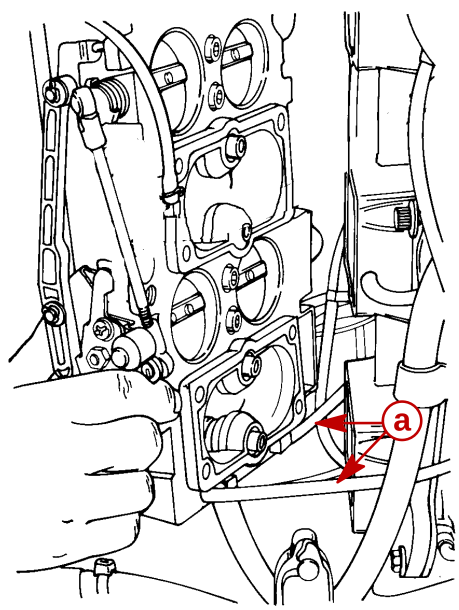
5. Remove manifold cover.



58176

a - Ground Wires
b - Screws (12)
c - Manifold Cover

6. Disconnect bleed line hoses from manifold fittings.
7. Remove manifold assembly and place on clean work surface.

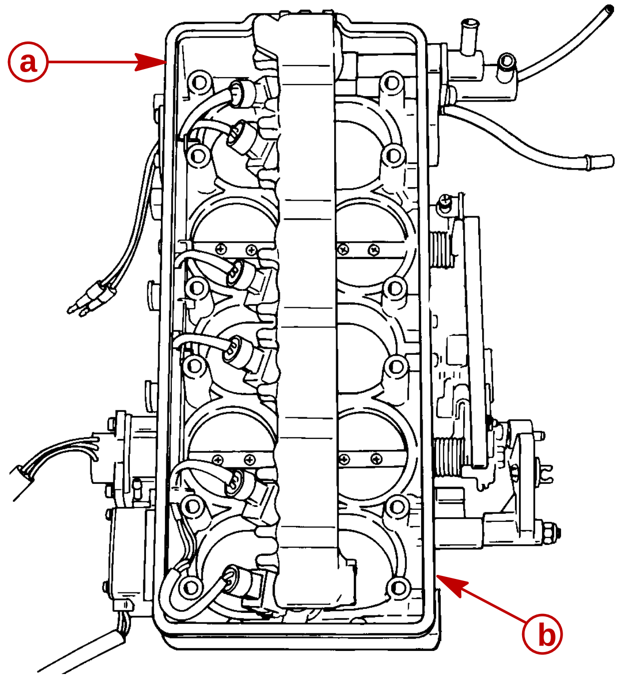


51795

a - Bleed Hoses

EFI Induction Manifold Disassembly

1. Remove manifold cover seal from manifold.

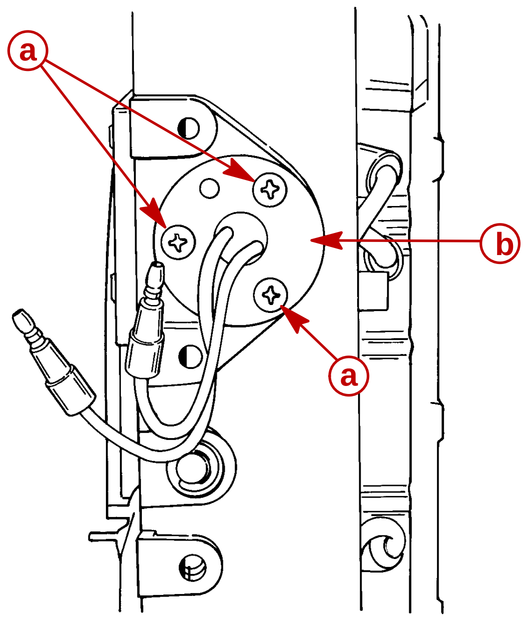


51785

a - Manifold Cover Seal
b - Manifold

Air Temperature Sensor Removal

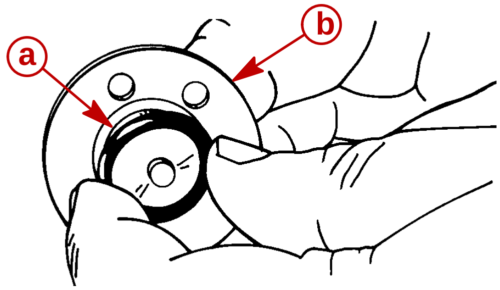
1. Remove screws and sensor.



51790

a - Screws
b - Sensor

2. Remove O-ring from sensor.



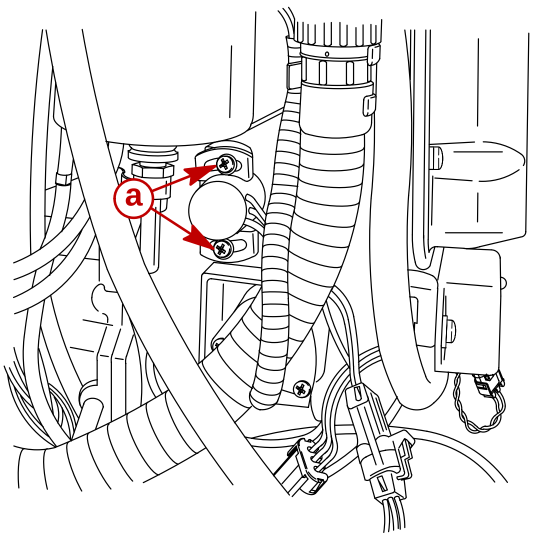
51791

a - O-ring
b - Sensor

Throttle Position Sensor Removal

IMPORTANT: Sensor position will need to be set after induction manifold assembly has been installed.

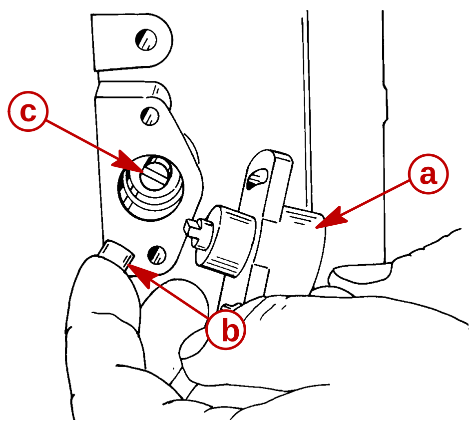
1. Remove throttle position sensor screws.



58053

a - Screws

2. Remove sensor and sleeve from throttle shaft.

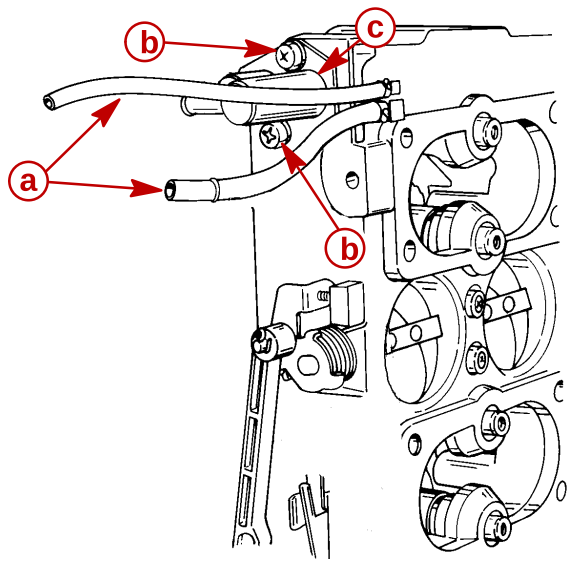


51788

a - Sensor
b - Sleeve
c - Throttle Shaft

Fuel Rail Removal

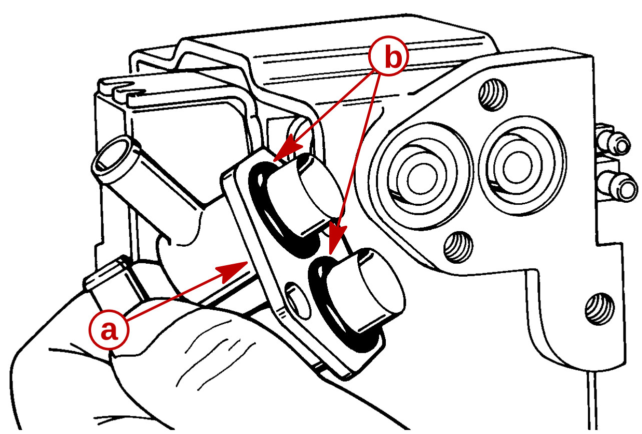
1. Remove manifold vacuum hoses.
2. Remove engine bleed hose.
3. Remove screws securing manifold fitting to manifold.



51789

a - Vacuum Hoses
b - Screws
c - Manifold Fitting

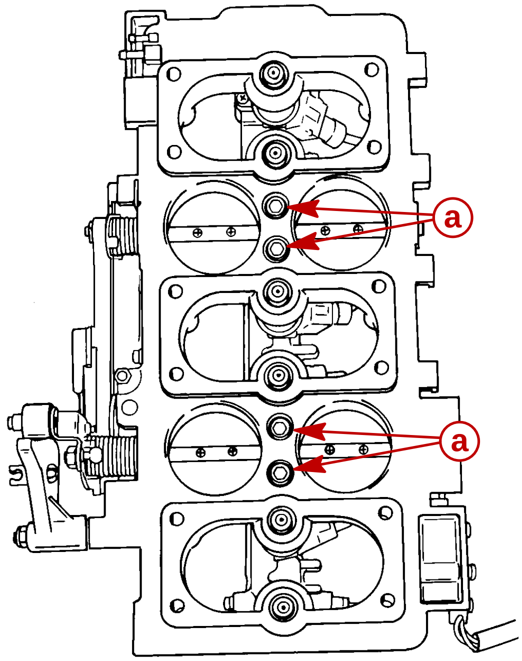
4. Remove manifold fitting and O-rings.



51791

a - Manifold Fitting
b - O-rings

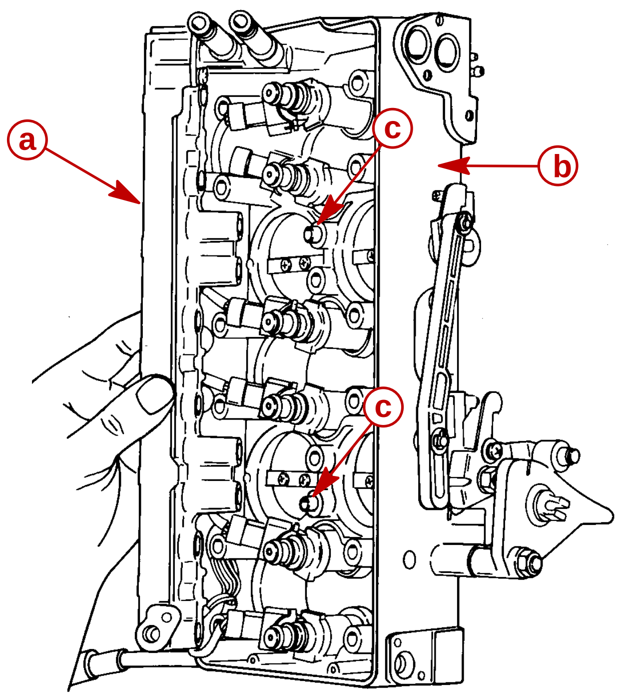
5. Remove 4 screws securing fuel rail to manifold.



51784

a - Screws (4)

6. Lift fuel rail from manifold. Note fuel rail guides.

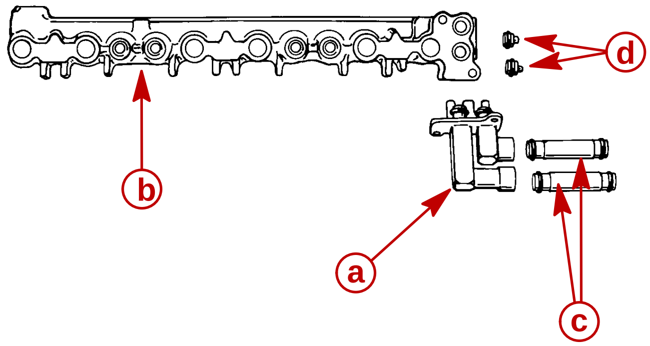


51788

a - Fuel Rail
b - Manifold
c - Guides

Fuel Rail Disassembly

1. Remove tube support from fuel rail.
2. Remove plugs from fuel rail.
3. Remove tubes from tube support.
4. Remove O-rings from plugs, tube support and tubes.

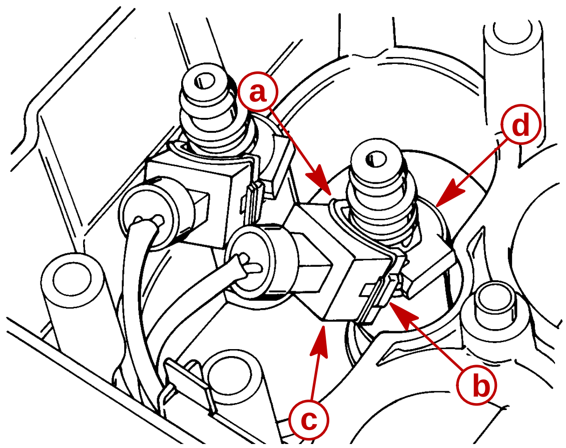


51795

a - Tube Support
b - Fuel Rail
c - Tubes
d - Plugs

Fuel Injector Removal and Disassembly

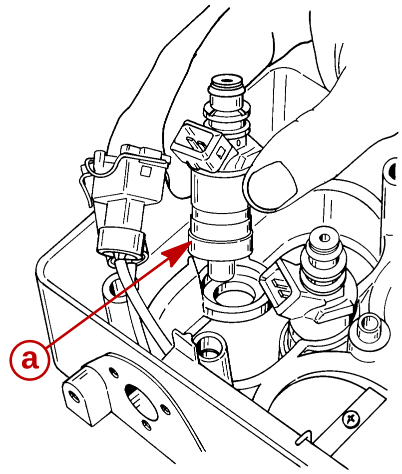
1. Lift wire clamp from slot.
2. Disconnect connector from injector.



51792

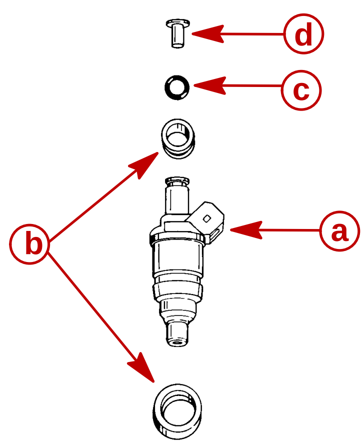
a - Clamp
b - Slot
c - Connector
d - Injector

3. Remove injector from manifold.



a - Injector

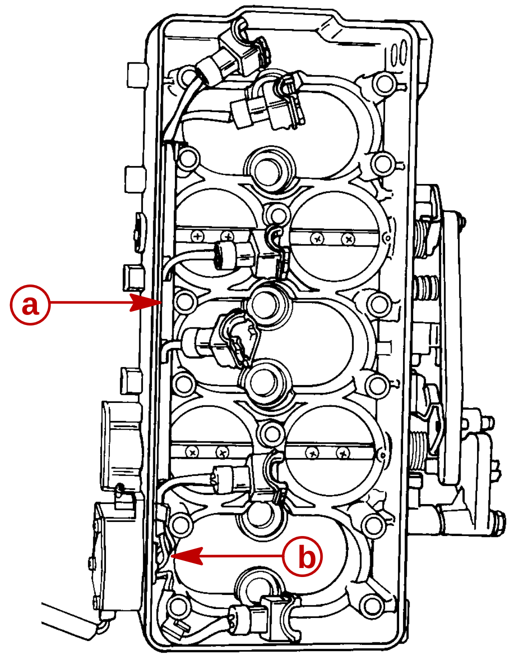
4. Place injector on clean work surface. Remove seals, O-ring and injector filter.



a - Injector
b - Seals
c - O-Ring
d - Filter

Injector Harness Removal

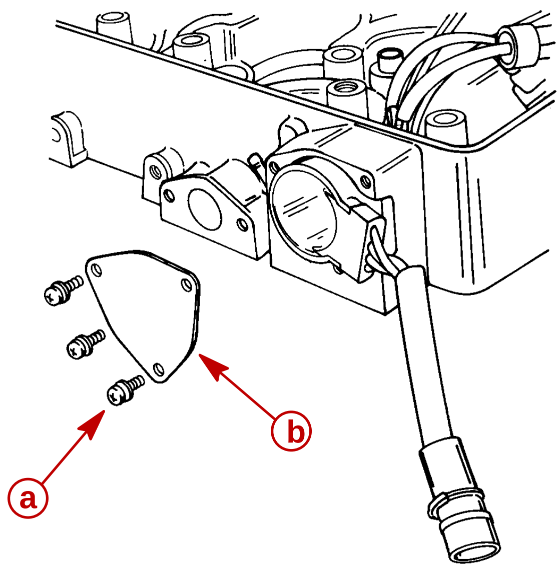
1. Remove protective casing from injector wiring harness. Note position of wires for reassembly.



51795

a - Casing
b - Harness

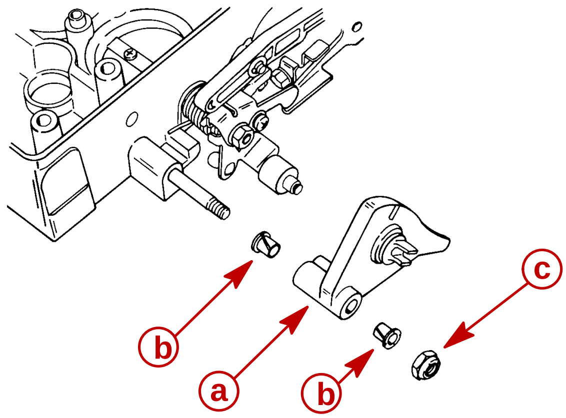
2. Remove screws and injector harness plate.



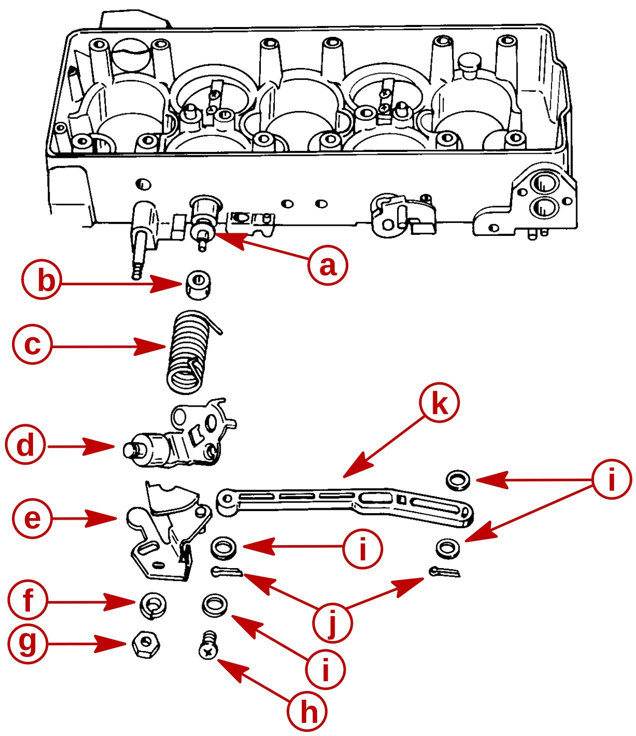
51792

a - Screws
b - Plate

Throttle Linkage Removed



a - Throttle Cam
b - Bushings
c - Nut; Tighten until snug against cam, then back off 1/4 turn



a - Fiber Washer
b - Bushing
c - Spring
d - Roller Cam Bracket
e - Bracket (Shutter Link)
f - Lock Washer
g - Nut
h - Screw
i - Flat Washer
j - Cotter Key
k - Progressive Shutter Link

EFI System Cleaning and Inspection

Cleaning

1. Clean all non-electrical metal parts using a good grade solvent.
2. Use a soft bristle brush for removing large accumulations of dirt or grease and oil.
3. Varnish type coating of induction manifold parts may be removed using carburetor cleaner.
4. Wiring harnesses can be wiped down with a slightly solvent dampened rag.
5. Clean all fuel passages in induction manifold.
6. Dry all components using clean lint free cloths that are free of abrasives such as metal shavings or dirt.
7. Compressed air may be used to dry parts if the air used is free of moisture and un-lubricated.

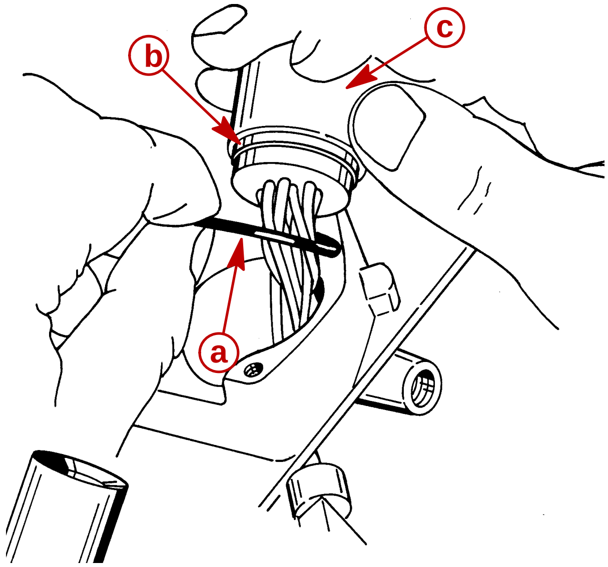
Inspection

1. Look at entire system for signs of an obvious problem such as poor condition of wire insulation, leaking fitting, cracked or loose hoses and lines.
2. Look for fuel or oil leaks wherever these fluids are used (i.e. fuel filter cap, fuel pump, vapor separator cap, etc.).
3. Check for signs of tampering or abuse such as modifications to wiring or hose routing.
4. Look at main connector between engine harness and ECM box for missing, corroded or bent contact pins and socket. Check for dislodged grommet in ECM where harness enters box.
5. Look at all sensors (throttle position, air temperature and water temperature) connectors and harnesses for bad connections or poor insulation conditions such as fraying, stripping, cracks or signs of abrasion wear.
6. Look for loose, missing or damaged mounting hardware such as stripped threads on screws.
7. Look at sensors for signs of wear or damage such as cracks, chips, etc.
8. Look at filter housing for cracks, holes or other damage. Check for secure mounting.
9. Look at vapor separator for leaks, cracks, pitting or other damage.
10. Check all rubber mounting grommets for swelling tears, cracks or other conditions that would render parts unserviceable.
11. Check vapor separator float for signs of fuel entry in the float. Look at needle for wear of point.
12. Look at injectors for signs of plugging or looseness in fit with induction manifold.
13. Look at throttle linkage for bends, kinking or binding. Check spring for kinks.
14. Inspect all rubber seals and gaskets for swelling, cracks or slices that would cause improper sealing.

Induction Manifold Assembly

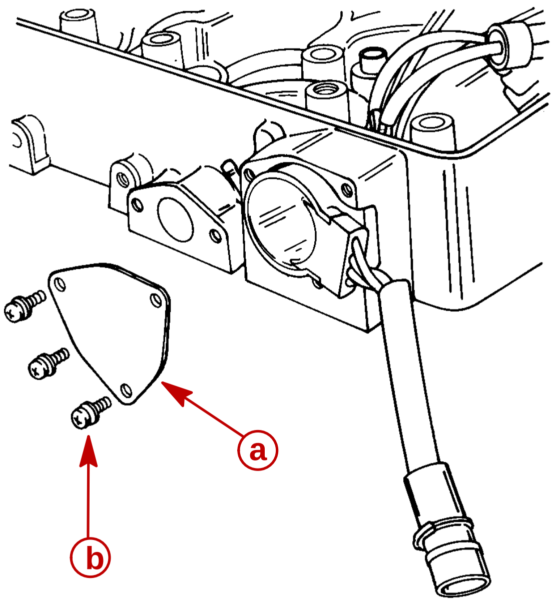
Injector Harness Installation

1. Carefully route injector harness into manifold.
2. Install O-ring into groove on injector harness insert. Install harness insert into manifold port.



a - O-Ring
b - Groove
c - Insert

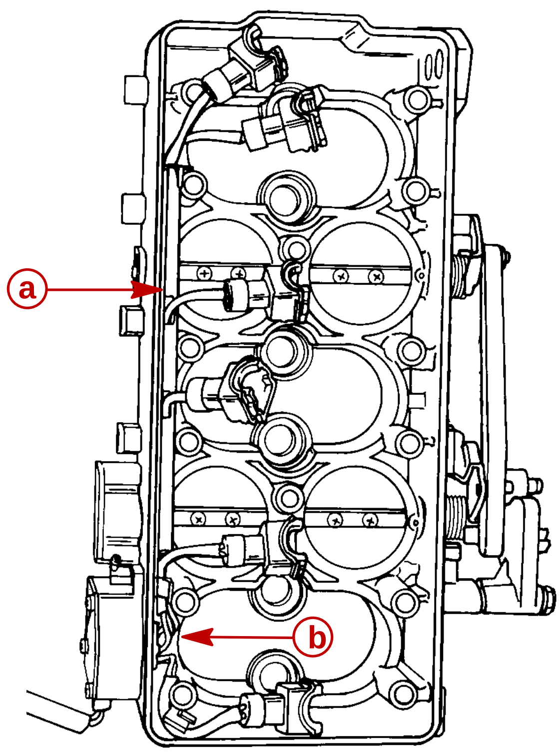
3. Install injector harness plate using screws. Tighten securely.



51792

a - Plate
b - Screws

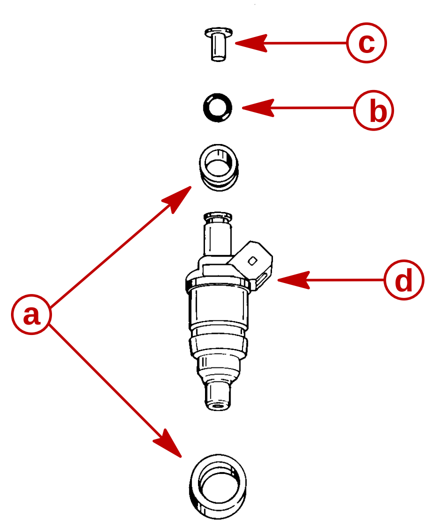
4. Install protective casing over positioned injector wiring harness and insert into manifold.



a - Casing
b - Harness

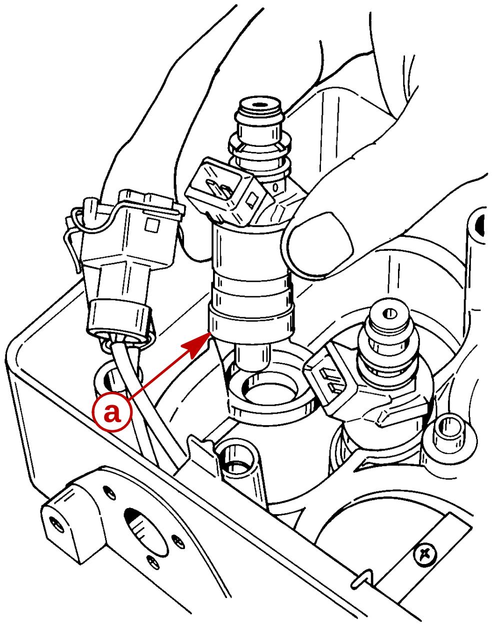
Fuel Injector Assembly and Installation

1. Install inspected seals, O-ring and injector filter to injector.



a - Seals
b - O-Ring
c - Filter
d - Injector

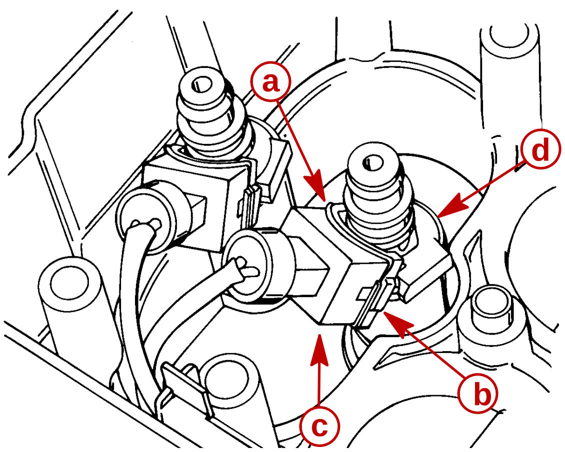
2. Install injector into manifold.



51789

a - Injector

3. Install wire clamp into slot on injector connector.
4. Connect to injector.

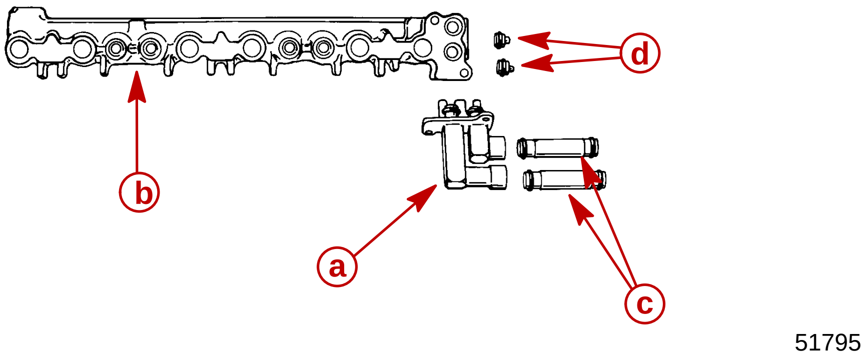


51792

a - Clamp
b - Slot
c - Connector
d - Injector

Fuel Rail Assembly

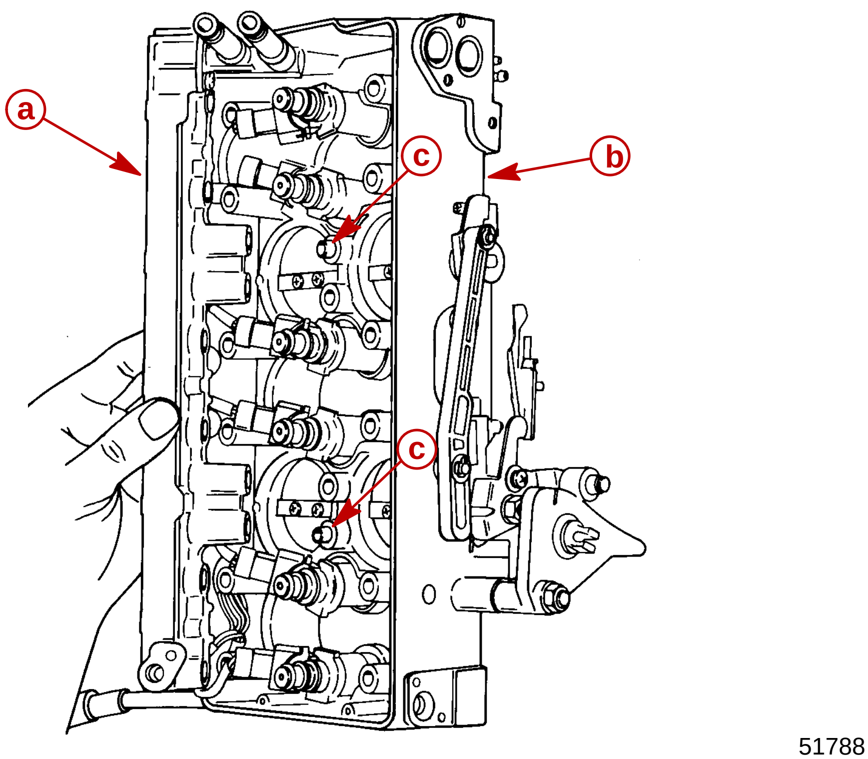
1. Install inspected O-rings to plugs. tube support and tubes.
2. Install tubes to tube support.
3. Install plugs to fuel rail.
4. Install tube support to fuel rail.



a - Tube Support
b - Fuel Rail
c - Tubes
d - Plugs

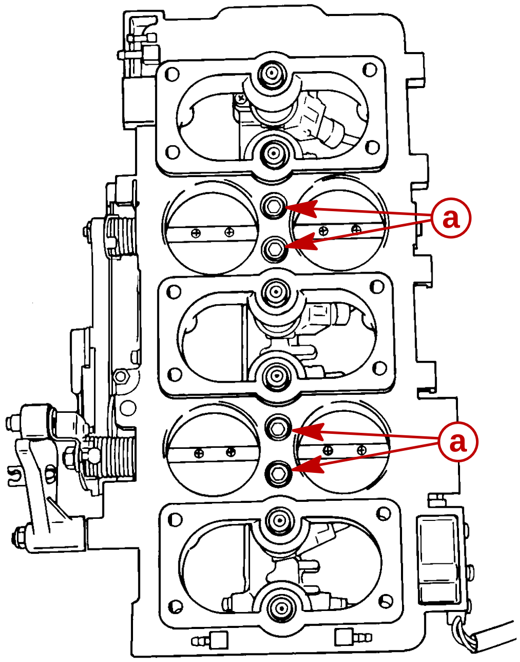
Fuel Rail Installation

1. With fuel rail guides in place, install fuel rail to manifold.



a - Fuel Rail
b - Manifold
c - Guides

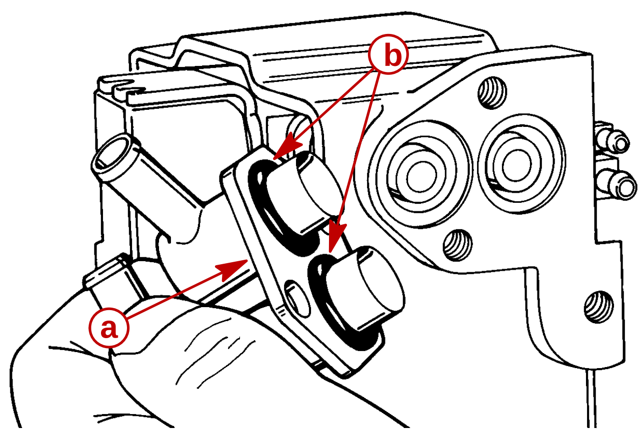
2. Install 4 screws securing fuel rail to manifold. Torque to 35 lb. in. (4 Nm).



51784

a - Screws (4)

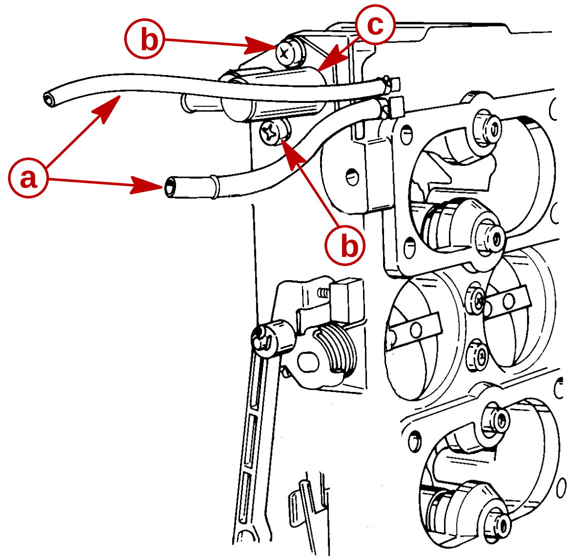
3. Install O-rings to manifold fitting. Install fitting to manifold.



51791

a - Manifold Fitting
b - O-rings

4. Install screws securing manifold fitting to manifold. Torque screws to 45 lb. in. (5 Nm).
5. Install engine bleed hose.
6. Install manifold vacuum hoses.



51789

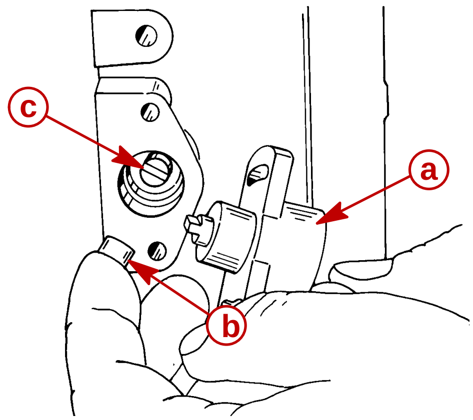
a - Vacuum Hoses
b - Screws
c - Manifold Fitting

⚠ CAUTION
Use extreme care when installing induction manifold so as to eliminate any possibility for air leaks.

Throttle Position Sensor Installation

IMPORTANT: Throttle position sensor must be adjusted following reassembly (see Section 2C - Timing, Synchronizing, Adjustment).

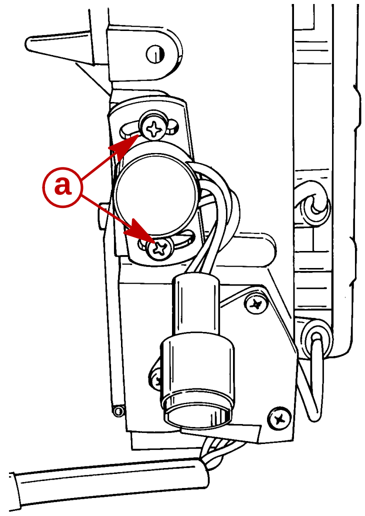
1. Install sleeve to throttle position sensor.
2. Install sensor into manifold. Sleeve must guide sensor to throttle shaft.



51788

a - Sensor
b - Sleeve
c - Throttle Shaft

3. Tighten screws after induction manifold installation and throttle position sensor adjustments are completed. Torque screws to 20 lb. in. (2 Nm).

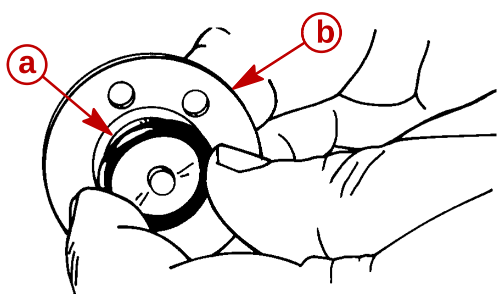


51790

a - Screws

Air Temperature Sensor Installation

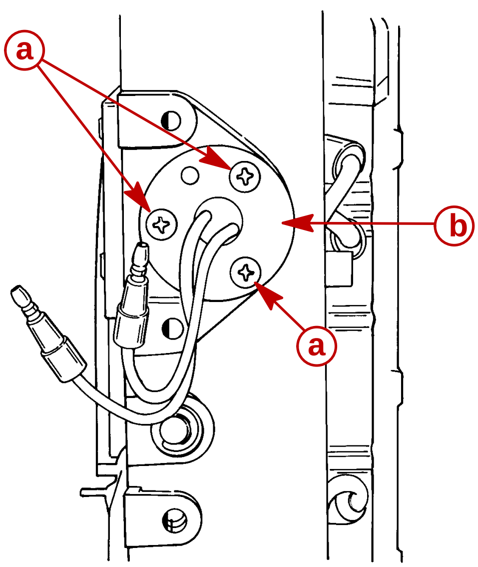
1. Install O-ring to air temperature sensor.



51791

a - O-ring
b - Sensor

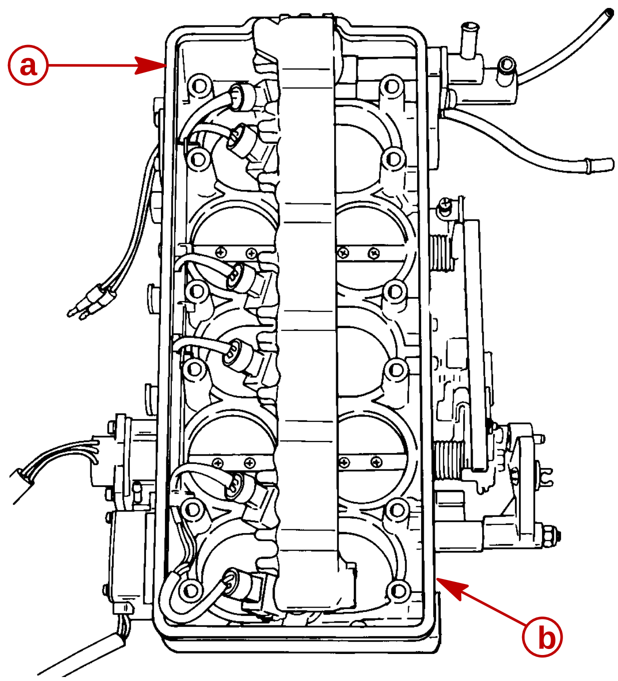
2. Install air temperature sensor and secure with screws. Tighten screws securely.



51790

a - Screws
b - Sensor

3. Carefully install manifold cover seal to manifold.

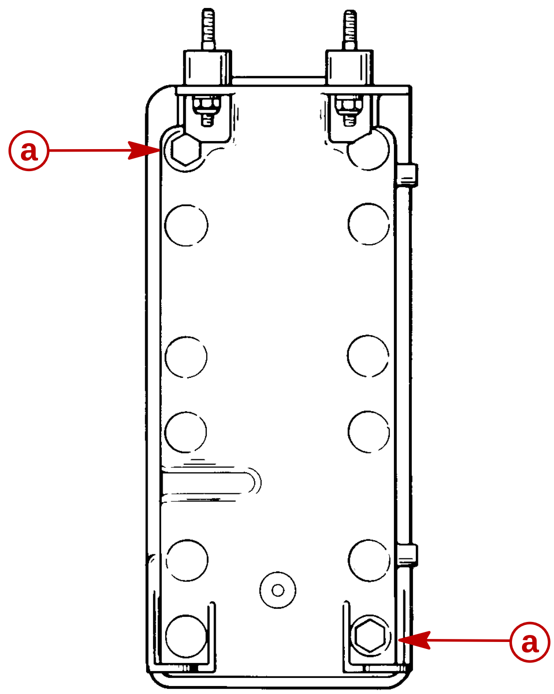


51785

a - Manifold Cover Seal
b - Manifold

4. Install manifold cover to manifold and secure with M8 x 1.25 x 38mm long bolts through holes.

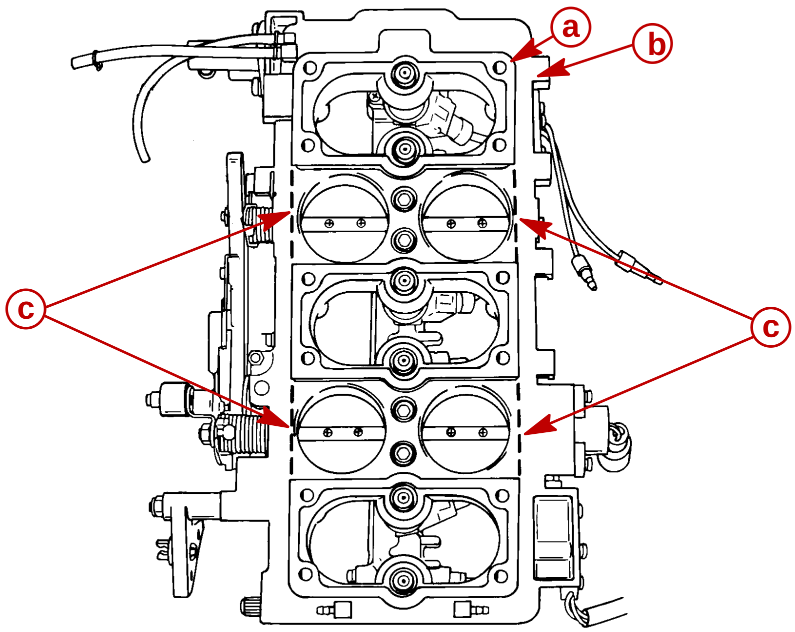
NOTE: *This will aid in induction manifold installation.*



a - Holes

EFI Induction Manifold Installation

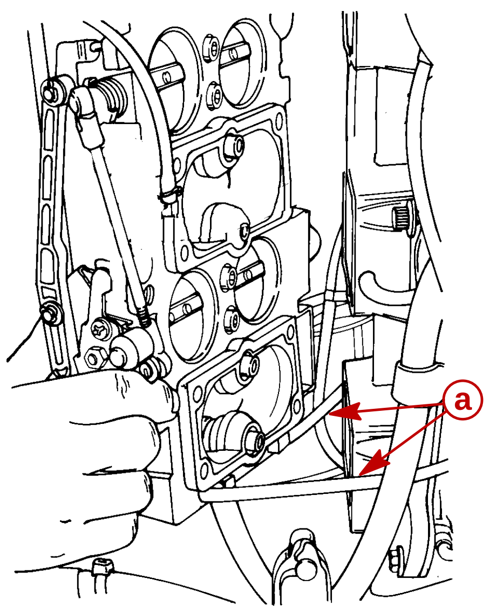
1. Install new gasket on induction manifold as shown. Removing dotted line sections after manifold installation.



51784

a - Gasket
b - Induction Manifold
c - Dotted Line Sections– Remove After Installation

2. With induction manifold held in place, connect bleed line hoses to manifold fittings.

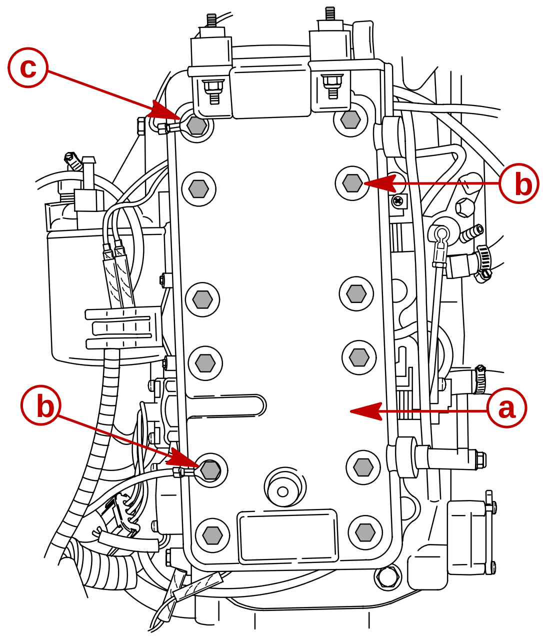


51795

a - Bleed Hoses

3. Secure induction manifold assembly to engine with screws. Torque screws to 90 lb. in. (10.0 N·m) using torque sequence shown below.

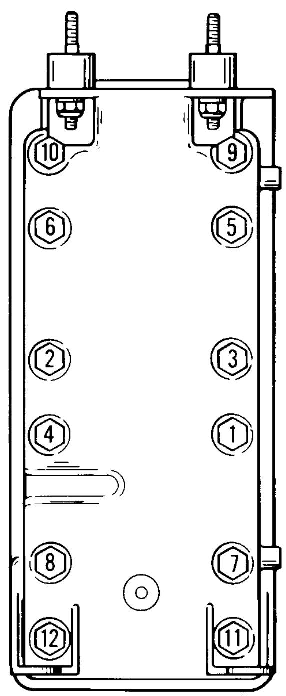
NOTE: *Remove M8 x 1.25 x 38mm long bolts used for reassembly and install remaining screws. Install ground wires to proper location.*



58176

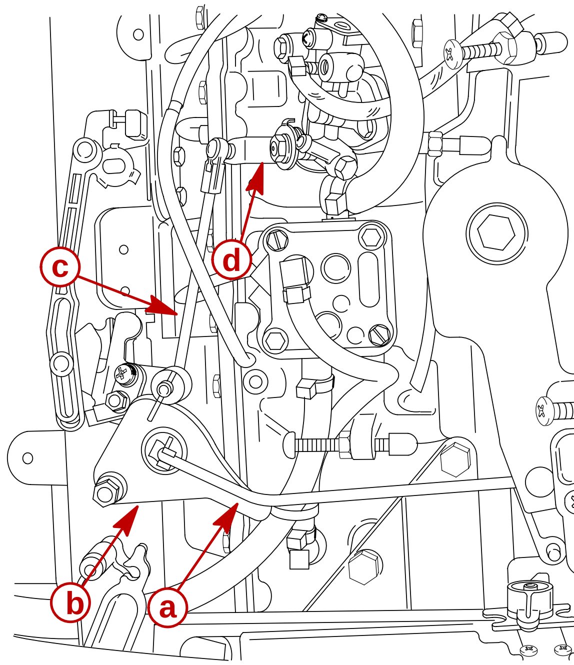
a - Manifold
b - Screws [Torque to 90 lb. in. (10 Nm)]
c - Ground Wires

Cover Screw Torque Sequence



IMPORTANT: Before connecting oil pump control rod verify pump quadrant is rotated to the clockwise of center.

4. Connect oil injection link rod to injector arm.
5. Connect throttle link rod to throttle cam.

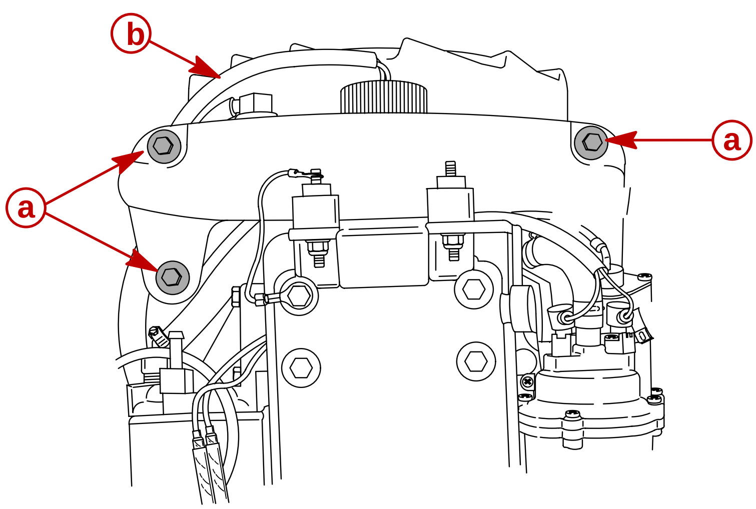


55213

a - Throttle Link Rod
b - Throttle Cam
c - Oil Injection Link Rod
d - Oil Injection Arm

Oil Reservoir Installation

1. Install oil reservoir to engine. Connect hose to oil pump fitting and secure with sta-strap.
2. Reconnect low oil sensor harness bullet connectors (BLUE leads below fuel/water separator).
3. Secure reservoir using screws. Torque screws to 25 lb. in. (3 Nm).

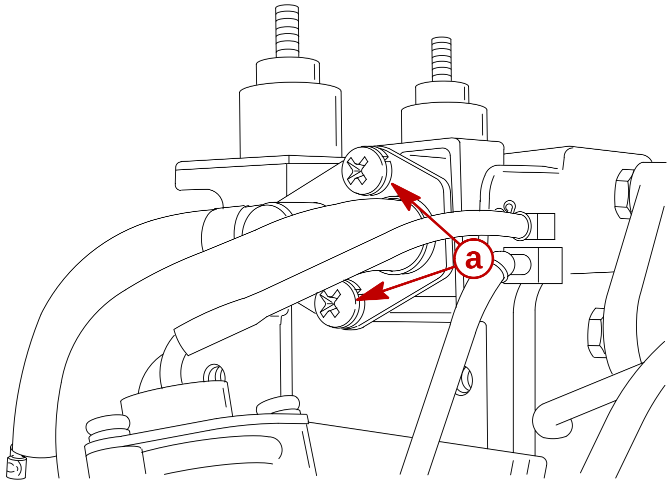


58172

a - Screws [Torque 25 lb. in. (3 Nm)]
b - Low Oil Sensor Harness (BLUE lead bullet connectors below fuel/water separator)

Vapor Separator Installation

1. Secure adaptor plate to manifold with 2 screws. Torque screws to 45 lb. in. (5 N·m).



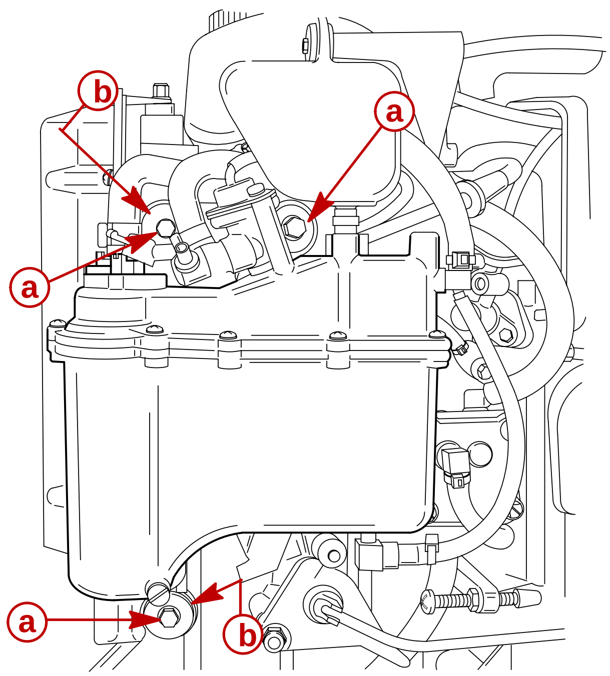
55216

a - Screws [Torque to 45 lb. in. (5 Nm)]

NOTE: *For ease of reassembly, reinstall oil reservoir on engine BEFORE installing vapor separator.*

2. Secure vapor separator to manifold with 3 screws and washers. Torque screws to 45 lb. in. (5 Nm).

NOTE: *Spacers are positioned between separator and manifold at the top front and bottom attaching screw locations.*

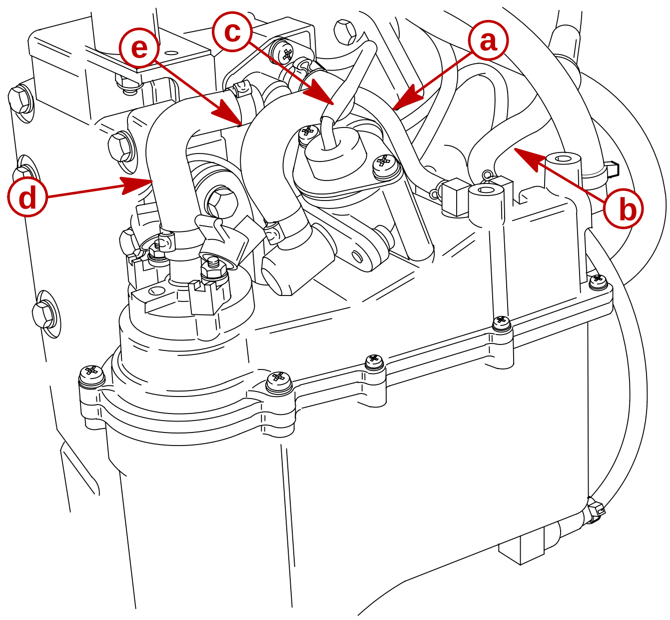


55176

a - Screws [Torque to 45 lb. in. (5 Nm)]
b - Spacers

IMPORTANT: If fuel outlet hose from electric fuel pump or fuel return hose from manifold to pressure regulator was disconnected, stainless steel hose clamps MUST BE USED to secure connections. If outlet/return hoses are to be replaced, replacement tubing kit (32-827694) MUST BE INSTALLED to prevent rupturing or leakage. DO NOT use sta-straps to secure high pressure fuel lines as leakage will occur.

3. Connect vapor separator over flow hose between manifold and separator.
4. Connect engine bleed hose to separator.
5. Connect fuel pressure regulator hose to top fitting on manifold.

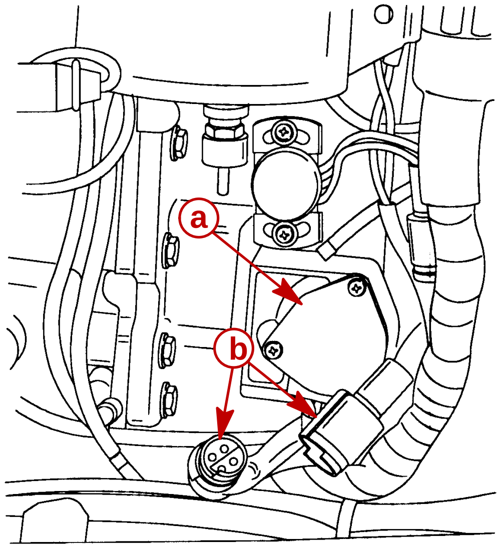


55204

a - Over Flow Hose
b - Bleed Hose
c - Pressure Regulator Hose
d - Fuel Outlet Hose
e - Fuel Return Hose

Throttle Position Sensor, Air Temperature Sensor and Fuel Injector Harness Connections

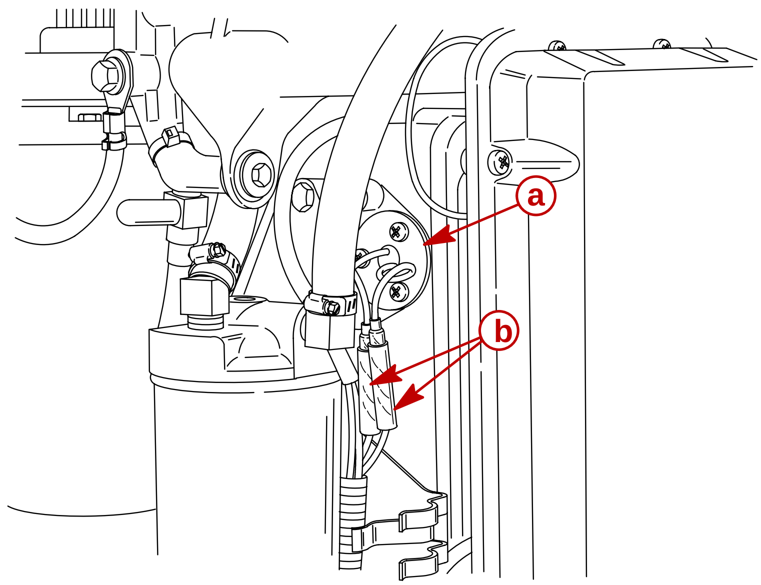
1. Connect fuel injector harness at 4 pin connector.



55193

a - Fuel Injector Harness
b - 4 Pin Connector

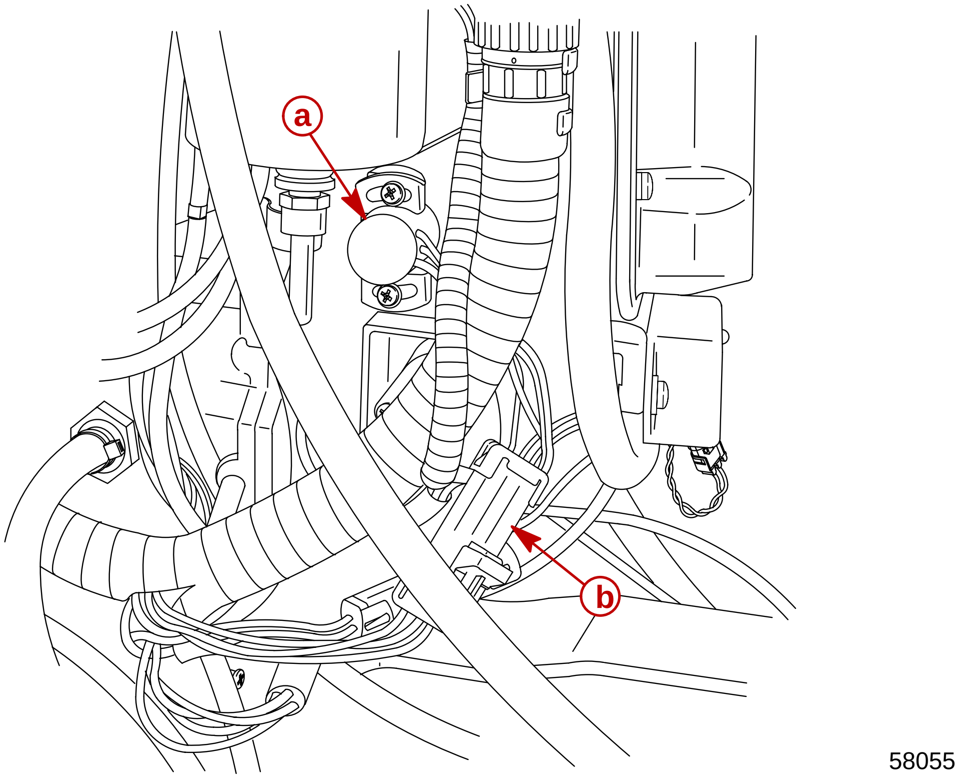
2. Connect air temperature sensor leads to bullet connectors.



58170

a - Air Temperature Sensor
b - Connectors

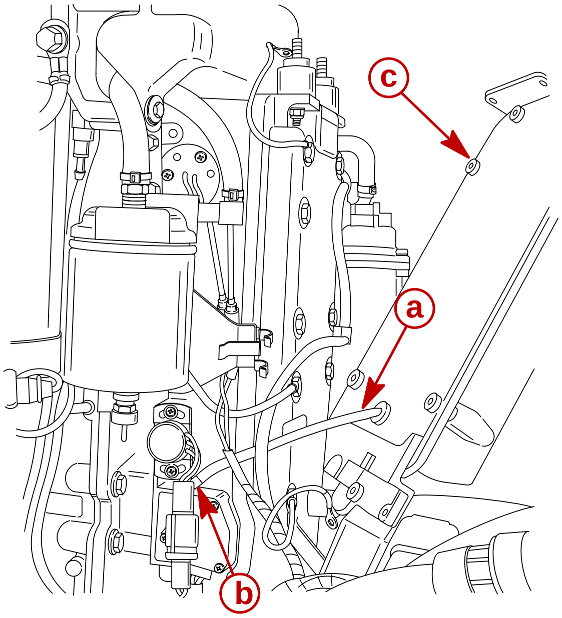
3. Connect throttle position sensor at 3 pin connector.



a - Throttle Position Sensor
b - 3 Pin Connector

ECM Installation

1. Connect MAP sensor hose from ECM to manifold fitting. Place ECM on manifold studs.

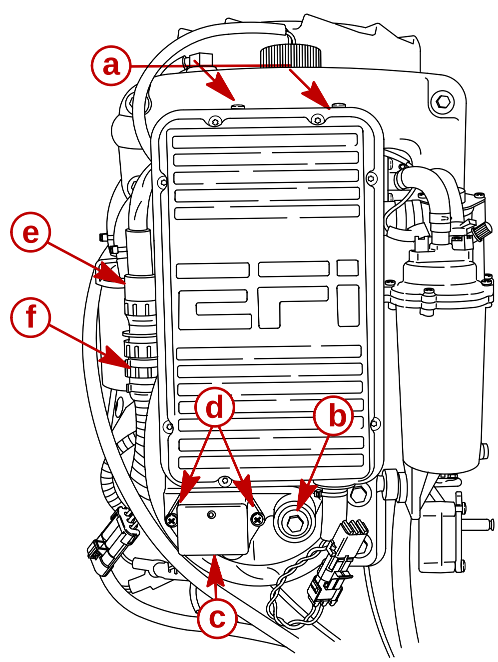


55199

a - MAP Sensor Hose
b - Fitting
c - ECM

2. Secure ECM to manifold using nuts and screw. Torque nuts and screw to 45 lb. in. (5 Nm).
3. Secure water sensing module with screws. Torque screws to 25 lb. in. (3 Nm).
4. Connect ECM harness to engine harness at connector. Install harness into harness bracket with connecting ring below or above bracket arms.

IMPORTANT: Do not force connecting ring between bracket arms.



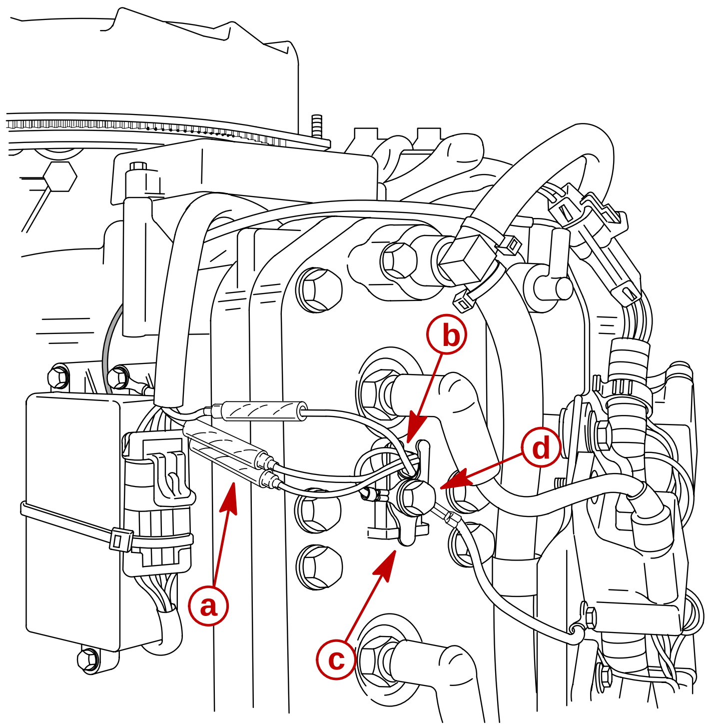
58031

a - Nuts
b - Screw
c - Water Sensing Module
d - Screws
e - ECM Harness
f - Engine Harness

Engine Head Temperature Sensor Installation

IMPORTANT: Engine Head Temperature Sensor must make clean contact with cylinder head for circuit to function properly.

1. Connect wires and install sensor.
2. Install retaining plate and screw. Torque screw to 200 lb. in. (22.5 Nm).



58052

a - Wires
b - Sensor
c - Retainer
d - Screw [Torque to 200 lb. in. (22.5 Nm)]

FUEL SYSTEM

Section 3D - Oil Injection

3 D

Table of Contents

⚠ CAUTION

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

⚠ CAUTION

Engines with oil injection must be run on a fuel mixture of 50:1 for the first 30 gallons of fuel. Refer to engine break-in procedure in the Operation and Maintenance Manual.

⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 4 psi (27 kPa). If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psi (27 kPa) maximum.

Operation of the Oil Injection System

The oil injection system delivers oil mixture on engine demand, from 100:1 at idle to 50:1 at wide open throttle.

The remote oil tank can be removed from the boat for easy refilling. The remote tank holds enough oil for over 150 gallons of fuel at wide open throttle.

The remote oil tank supplies the oil reservoir mounted on the engine. The engine oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

The oil injection pump feeds oil into the fuel just before the fuel pump on carb models and into the vapor separator on EFI models. The oil injection pump is driven by the crankshaft and is connected to the throttle linkage for metering the varied flow of oil per engine RPM.

Final Checks Before Operation of Engine

- Make sure fill cap gaskets are in place and caps are tight on engine oil reservoir and remote oil tank.
- Mix a gasoline and oil mixture of 50:1 in the remote fuel tank during the initial break-in of the engine.
- Be certain the warning horn is installed and is operational. Refer to Instrument and Warning Horn Installation.
- Each time the key switch is turned from the “OFF” to “ON” position (engine not running); the warning horn will sound momentarily. This tells you the warning system for the oil injection system is functional and the warning horn is operational. If warning horn does not sound or horn stays on when key is turned to the “ON” position, refer to oil injection system troubleshooting chart following to correct the problem.

Checking Operation of the Oil Injection System (Engine Running)

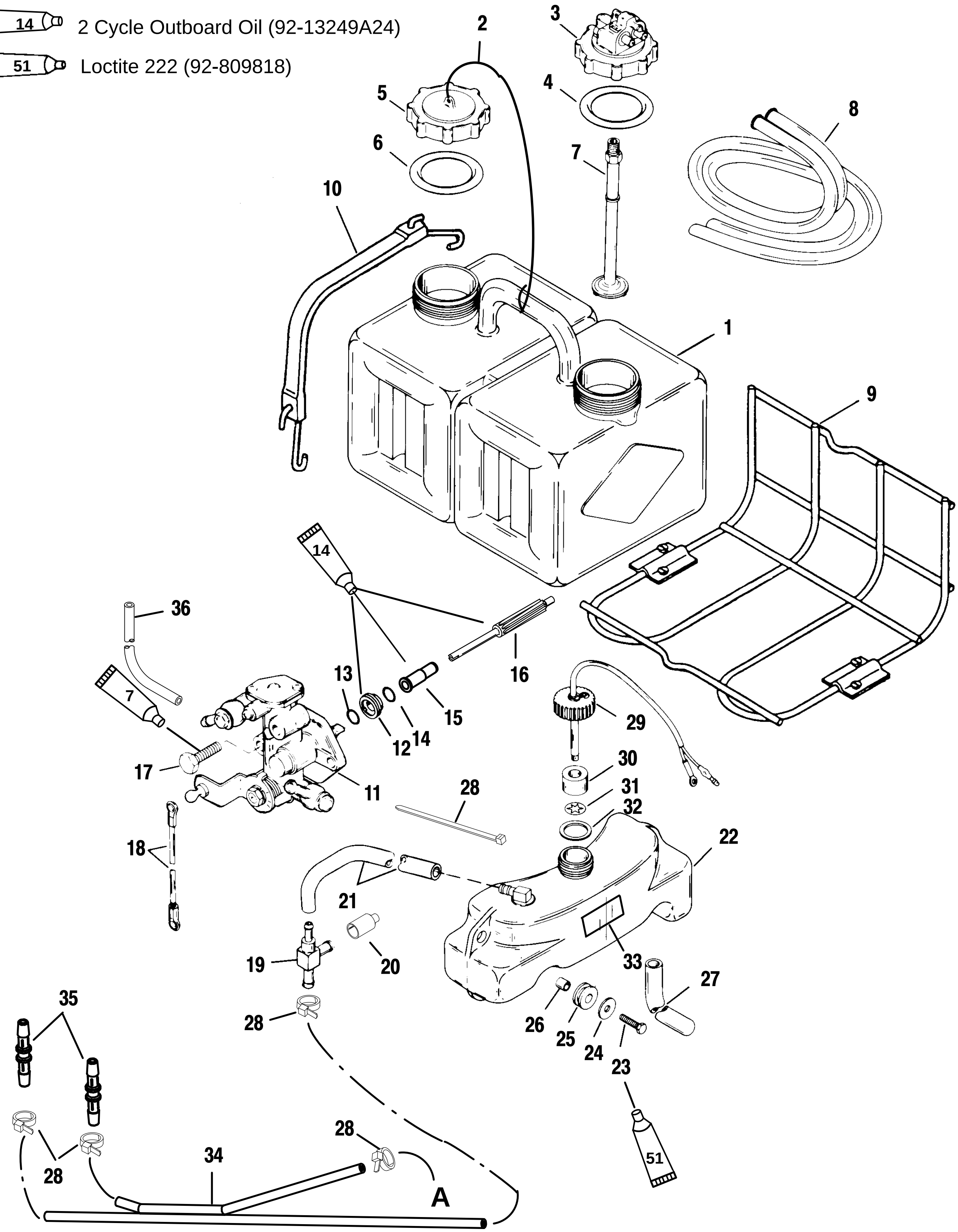
1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual. If warning horn should sound an intermittent “beep,” “beep,” “beep” during operation, this indicates low oil level in the engine mounted oil reservoir. Refer to troubleshooting following, to correct the problem.
2. After engine has been run for a short time, check that no oil is leaking out of engine oil reservoir fill cap.

Oil Injection Components

7 Loctite 271 (92-809820)

14 2 Cycle Outboard Oil (92-13249A24)

51 Loctite 222 (92-809818)



A = TO CHECK VALVE ON BLOCK

Oil Injection Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
–	1	OIL TANK			
1	1	OIL TANK			
2	1	CORD			
3	1	ADAPTOR HOUSING			
4	1	O RING			
5	1	CAP ASSEMBLY–oil tank			
6	1	O RING–cap			
7	1	TUBE–oil pick-up			
8	1	HOSE			
9	1	REMOTE OIL TANK HOLD-DOWN KIT			
10	1	BUNGY CORD ASSEMBLY			
11	1	OIL PUMP			
12	1	WORM BUSHING			
13	1	O-RING			
14	1	O RING			
15	1	BEARING ASSEMBLY–drive gear			
16	1	DRIVEN GEAR			
17	1	SCREW (10-32 x 5/8 IN.)	55		6
	1	SCREW (10-32 x 1-1/8 IN.)	55		6
18	1	LINK–throttle lever to oil pump			
19	1	FITTING–oil tubing			
20	1	PLUG			
21	1	TUBING–oil (6 IN.)			
22	1	OIL RESERVOIR			
23	3	SCREW–oil reservoir attaching (10-32 x 7/8)	25		3
24	6	WASHER–oil reservoir screw			
25	3	GROMMET–oil reservoir screw			
26	3	BUSHING–oil reservoir screw			
27	1	TUBING–oil reservoir to oil pump (4-3/4 IN.)			
28	AR	STA-STRAP			
29	1	CAP ASSEMBLY–oil reservoir			
30	1	FLOAT ASSEMBLY			
31	1	PUSHNUT			
32	1	GASKET–reservoir cap			
33	1	DECAL–Reservoir Warning			
34	1	HOSE			
35	2	FITTING			
36	1	TUBING (7 IN.)			

AR = As Required

Oil Injection Components

REMOTE OIL TANK a

Holds 3 gallons (11.5 liters) of oil.

NOTE: *Some boats may be equipped with optional 1.8 gallon (7.0 liters)oil tank.*

The tank is pressurized by air from crankcase pressure thus forcing oil up the outlet hose to the oil reservoir on engine.

OIL PICK UP TUBE b

A filter screen is located in end of tube to prevent dirt or other particles from entering the system.

OIL RESERVOIR c

The oil reservoir feeds the oil pump and contains enough oil for at least 30 minutes of full throttle running after the remote tank is empty. The warning horn will sound if the oil level in oil reservoir is low.

OIL INJECTION PUMP d

Injection pump is driven off the crankshaft.

The oil injection pump is a variable metering pump. At idle the pump will meter the oil at approximately 100 to 1 gasoline to oil ratio and at WOT, 50 to 1 ratio.

2 PSI CHECK VALVE e

If oil flow to reservoir is obstructed and injection pump continues to pump oil, the 2 PSI valve will open to allow air to enter reservoir to prevent a vacuum.

2 PSI CHECK VALVE f

This valve prevents gasoline from being forced into the oil lines.

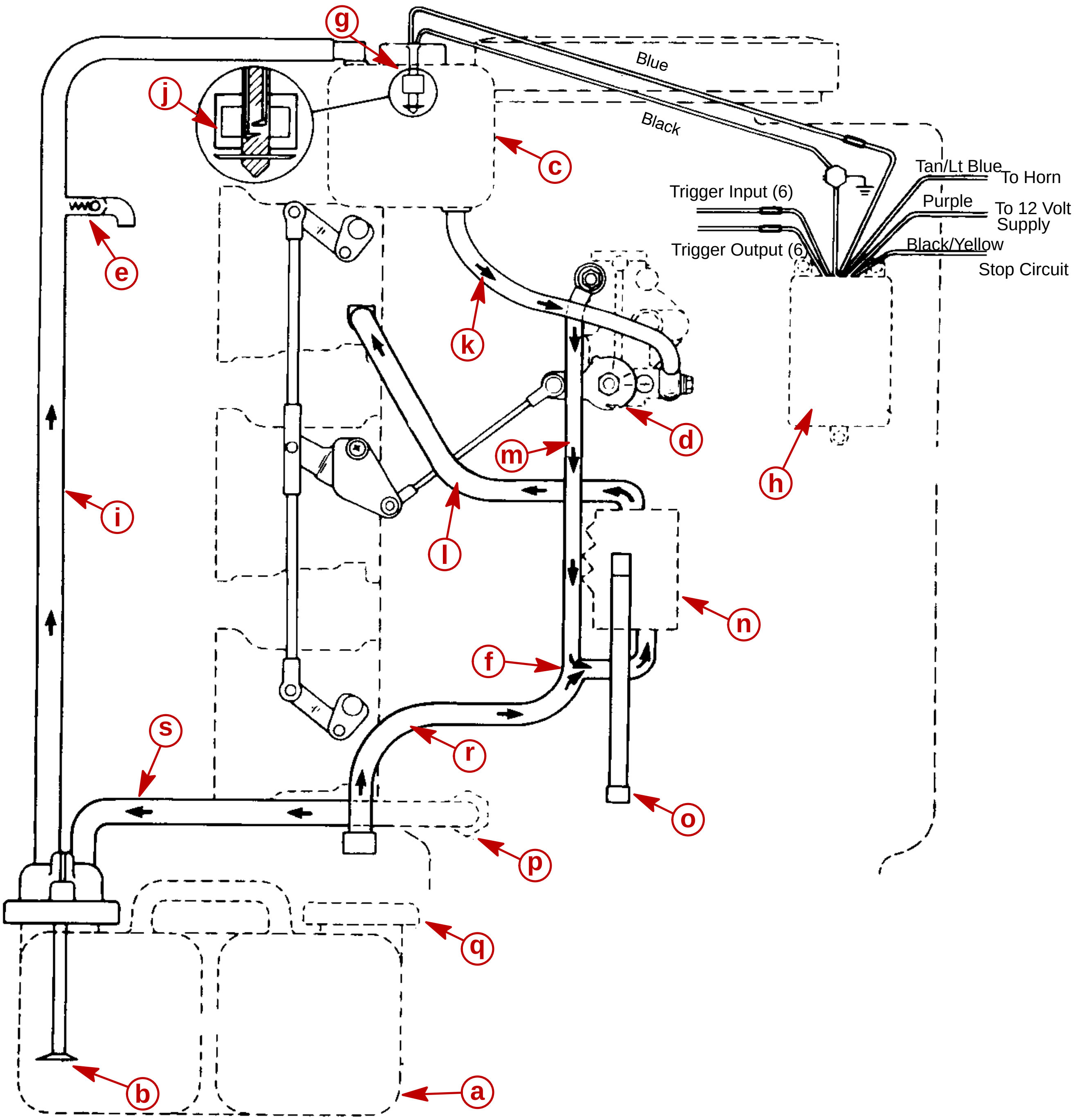
LOW OIL (FLOAT) SENSOR g

If oil level drops in oil reservoir, the sensor will signal the warning module to sound the warning horn.

CONTROL WARNING MODULE h

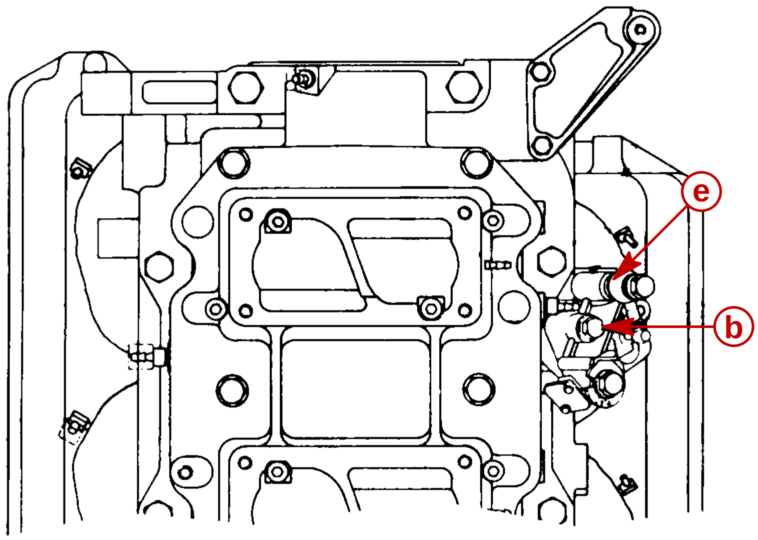
- Sounds the warning horn briefly when key switch is turned on, to indicate that the system is operational.
- If oil level drops in the engine oil reservoir, the low oil (float) sensor will signal the module to sound the warning horn.
- On 200 EFI model, retards timing and widens pulse width of fuel injectors in the event detonation is detected.

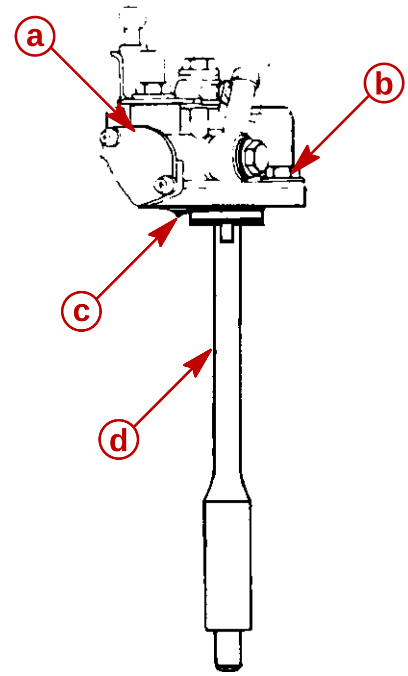
Oil Injection Flow System



- **a** - Remote Oil Tank
- **b** - Oil Pick-up Tube
- **c** - Oil Reservoir
- **d** - Oil Injection Pump
- **e** - 2 PSI Check Valve
- **f** - 2 PSI Check Valve
- **g** - Low Oil Float Sensor
- **h** - Control Module (mounted on top of cylinder block)
- **i** - Oil Line (Blue Stripe)
- **j** - Magnetic Float
- **k** - Oil Flow
- **l** - Fuel/Oil Mixture
- **m** - Oil Inlet
- **n** - Fuel Pump
- **o** - Crankcase Outlet Fuel Pump
- **p** - Crankcase Pressure with One Way Check Valve
- **q** - Filler Cap
- **r** - Fuel Inlet
- **s** - Air Pressure

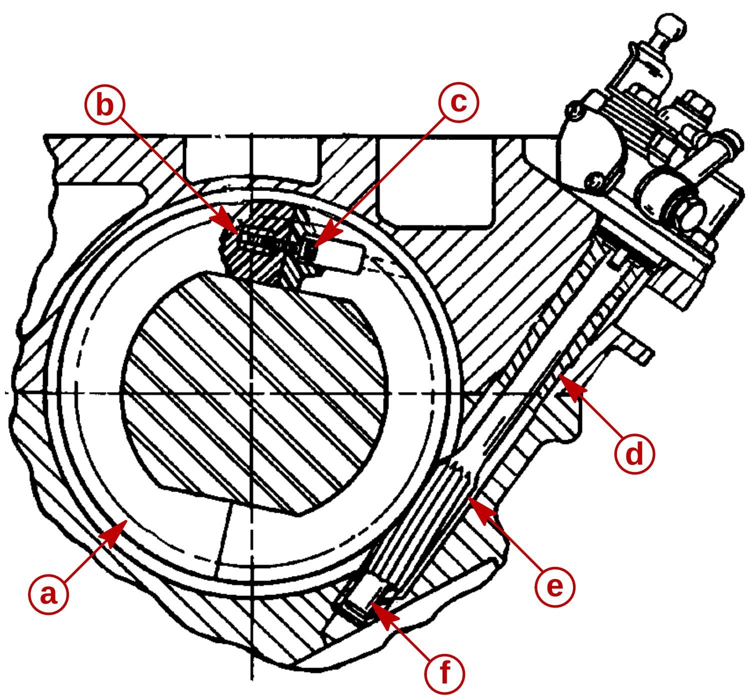
Pump Drive Assembly





a - Oil Pump
b - Retaining Bolts (2)
c - O-ring
d - Driven Gear
e - Oil Pump (Installed)

Pump Drive System



a - Drive Gear
b - Retaining Nut
c - Retaining Screw
d - Bushing
e - Driven Gear
f - Bushing

Set Up Instructions for Oil Injection System

⚠ CAUTION

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

⚠ CAUTION

Oil injected engines additionally, must be run on a 50:1 gasoline/oil mixture in the fuel tank for the first 30 gallons of fuel. Refer to engine break-in procedures in the Operation & Maintenance Manual.

⚠ CAUTION

If an electric fuel pump is to be used on engines with oil injection, the fuel pressure at the engine must not exceed 4 psi (27 kPa). If necessary, install a pressure regulator between electrical fuel pump and engine and set at 4 psi (27 kPa) maximum.

INSTALLING REMOTE OIL TANK

1. The remote oil tank should be installed in an area in the boat where there is access for refilling.

The tank should be restrained to keep it from moving around, causing possible damage.

An acceptable means of restraining the tank would be the use of eye bolts and an elastic retaining strap about the mid-section of the tank taking care that any metal hooks do not puncture the tank.

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

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

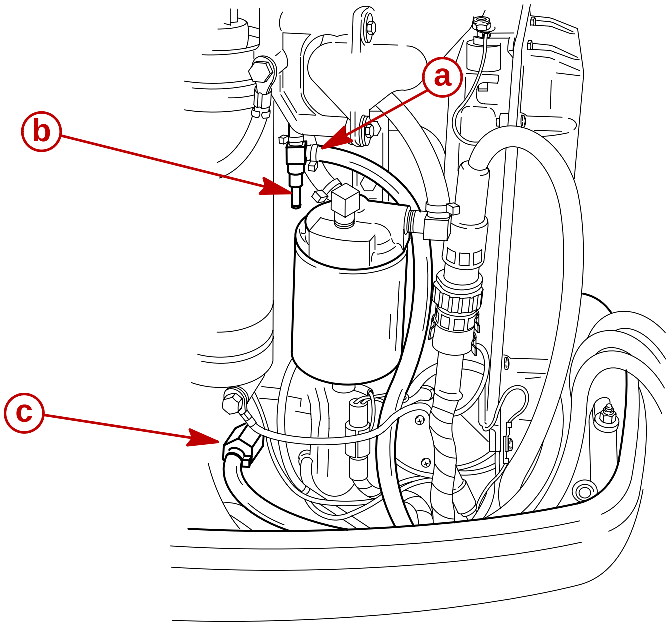
INSTALLING OIL HOSES TO ENGINE

Route remote oil tank hoses to starboard side of engine.

4. Remove (and discard) the shipping cap from hose fitting (a).
5. Connect oil hose from remote oil tank (hose with blue stripe) to fitting (a). Secure with sta-strap.

NOTE: *Fitting barb (b) is a vent and does not get connected to a hose.*

6. Remove (and discard) shipping cap from pulse fitting (c).
7. Connect the second oil hose from remote oil tank to pulse fitting. Secure with sta-strap.



a - Hose Fitting
b - Vent
c - Pulse Fitting

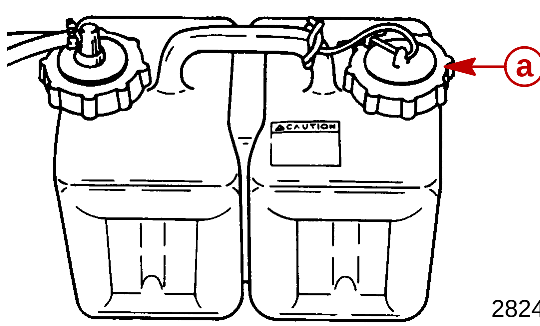
FILLING THE OIL INJECTION SYSTEM

Mercury Marine recommends the use of "Mercury Precision Premium *Plus* "or "Quicksilver Premium *Plus"* 2-Cycle Oil NMMA Certified TC-W3.

The Premium *Plus* Oil is specially formulated and tested to not only maintain a high level of performance but also increase the durability of the engine. This special blend, developed by Mercury Marine, contains more than twice the additives used in standard blends and ensures the greatest protection for your engine.

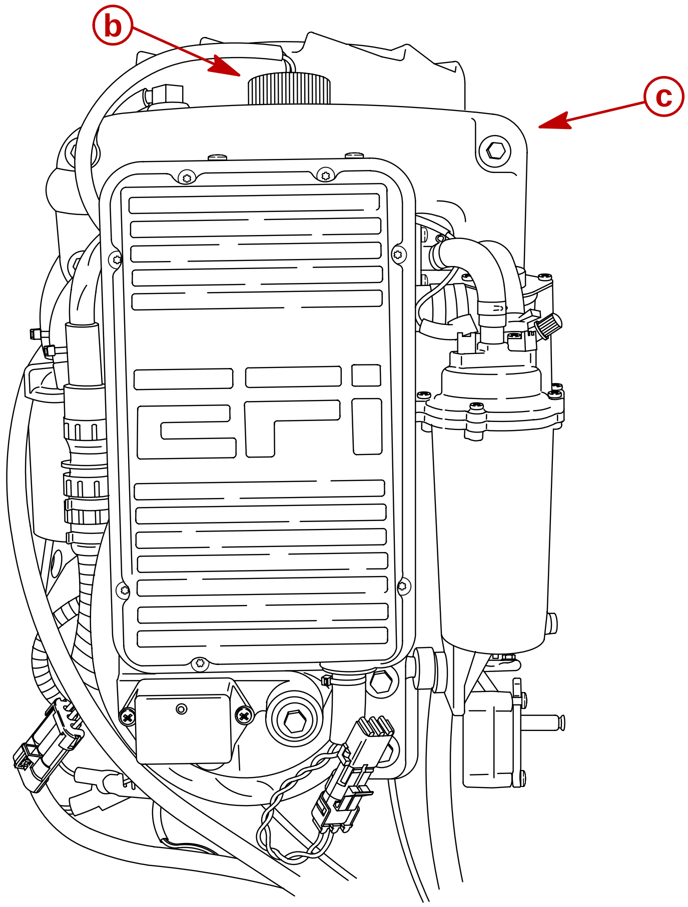
Periodically consult with your dealer to get the latest gasoline and oil recommendations. If "Mercury Precision Premium *Plus"* or "Quicksilver Premium *Plus"* Outboard Oil is not available, you may substitute another brand of 2-Cycle outboard oil that is NMMA Certified TC-W3. Nationally recognized brands are recommended. Continued use of inferior 2-Cycle outboard oil can dramatically reduce engine life. Damage from use of inferior oils that are not NMMA Certified TC-W3 will not be covered under the limited warranty.

1. Fill remote oil tank with Mercury Precision or Quicksilver Premium Plus TCW-3 2-Cycle Oil. Tighten fill cap (a).



a - Fill Cap

2. Remove fill cap (b) from the engine oil tank (c) and fill the tank with oil. Reinstall the fill cap.



b - Fill Cap
c - Engine Mounted Oil Reservoir

3. Loosen the fill cap (b) on the engine mounted oil tank. Run the engine until the all the air has been vented out of the tank and oil starts to flow out of the tank. Re-tighten fill cap.

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

Bleeding Air from Oil Injection Pump and Oil Injection Outlet Hose

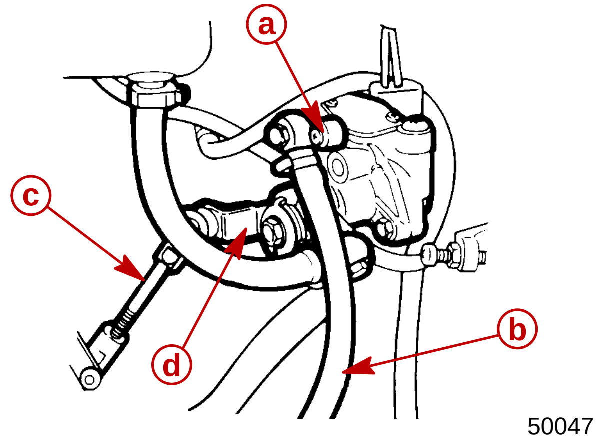
BLEEDING AIR FROM OIL INJECTION PUMP

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

BLEEDING AIR FROM OIL INJECTION PUMP OUTLET HOSE

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

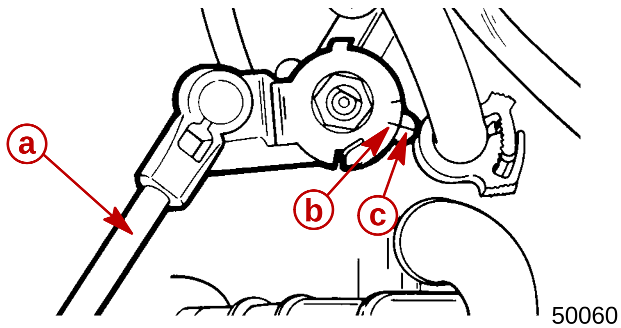
NOTE: *If air bubbles persist, they can be purged out of the hose by removing link rod and rotating the pump arm full clockwise while operating engine at 1000 to 1500 RPM: If necessary, gently pinch the fuel line between the fuel tank and the fuel pump "Tee" fitting. This* *will cause the fuel pump to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



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

Adjusting Oil Injection Pump

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



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

OPERATION OF THE OIL INJECTION SYSTEM

1. Make sure fill cap gaskets or O-rings are in place and caps are tight on engine reservoir tank and remote oil tank.
2. Make sure the fuel tank has a gasoline and oil mixture of 50:1 during the initial break-in of the engine or after extended storage.
3. Be certain the warning horn is operational.

Each time the key switch is turned from the “OFF” to “ON” position (engine not running); the warning horn will sound momentarily. This tells you the warning system for the oil injection system is functional and the warning horn is operational. If warning horn does not sound or horn stays on when key is turned to the “ON” position, refer to oil in injection system troubleshooting chart following to correct the problem.

The low oil injection warning sound is an intermittent four beeps with a 2 minute pause. The overheat warning sound is a continuous “beep” (not intermittent).

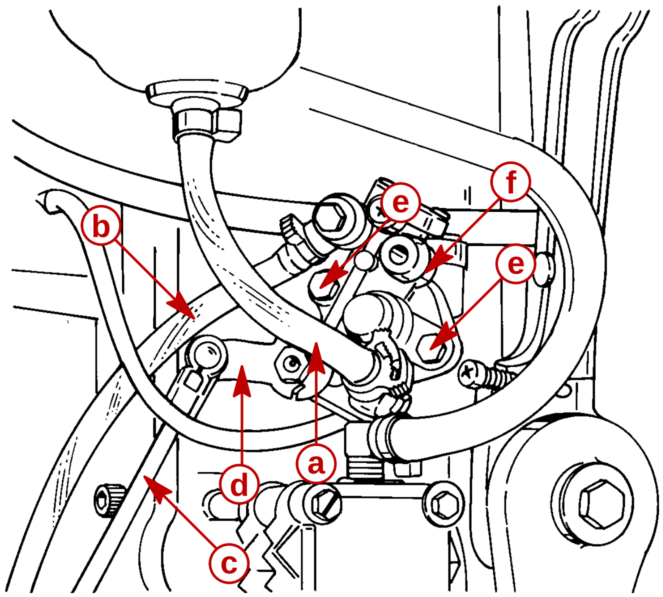
CHECK OPERATION OF THE OIL INJECTION SYSTEM (ENGINE RUNNING)

1. Operate engine following the break-in procedure outlined in the Operation and Maintenance Manual. If warning horn should sound an intermittent “beep”, “beep”, “beep” during operation, this indicates a problem occurred in the oil injection system. Check that the oil level in the engine reservoir is full.
2. After engine has been run for a short time check that no oil is leaking out of engine mounted oil reservoir fill cap.

Oil Injection Pump

Oil Pump Removal

1. Disconnect and plug inlet hose to oil pump.
2. Disconnect outlet hose on oil pump.
3. Disconnect link arm from oil pump injection arm.
4. Remove two bolts securing oil pump to powerhead and remove pump.



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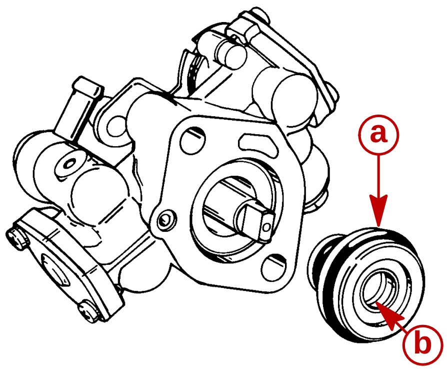
a - Inlet Hose
b - Outlet Hose
c - Link Arm
d - Injection Arm
e - Bolts
f - Oil Pump

Worm Bushing

Worm Bushing Removal

1. Grasp bushing and remove from oil pump.

NOTE: *If seal is defective, seal and bushing are replaced as an assembly.*



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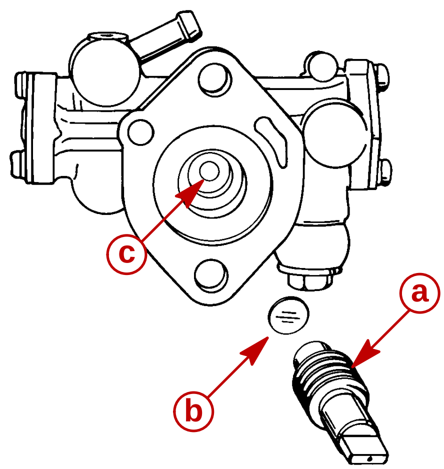
a - Bushing
b - Seal

Worm Bushing Installation

IMPORTANT: If worm shaft is removed from oil pump with worm bushing, verify thrust washer is positioned in center of worm shaft pocket before reinstalling worm shaft.



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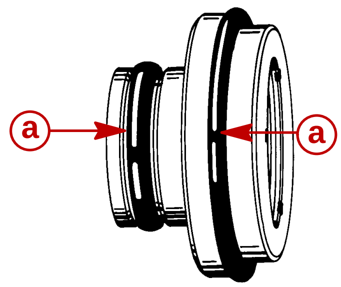
a - Worm Shaft
b - Thrust Washer
c - Pocket

1. Inspect bushing O-rings for cuts and abrasions. Replace O-rings if necessary.



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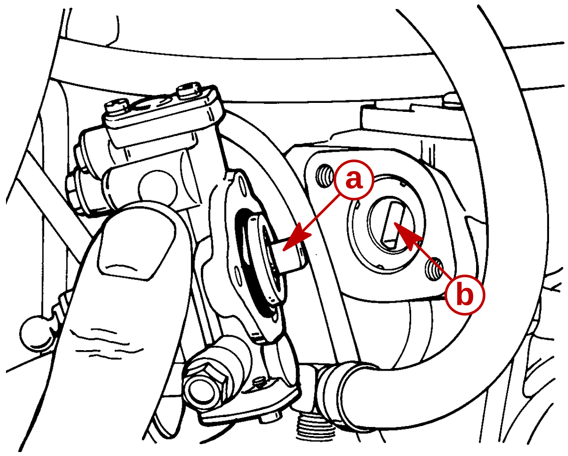
a - O-rings

2. Reinstall bushing/seal assembly.

Oil Injection Pump Installation

1. Align oil pump worm shaft with end of driven gear in powerhead.



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a - Worm Shaft
b - Driven Gear

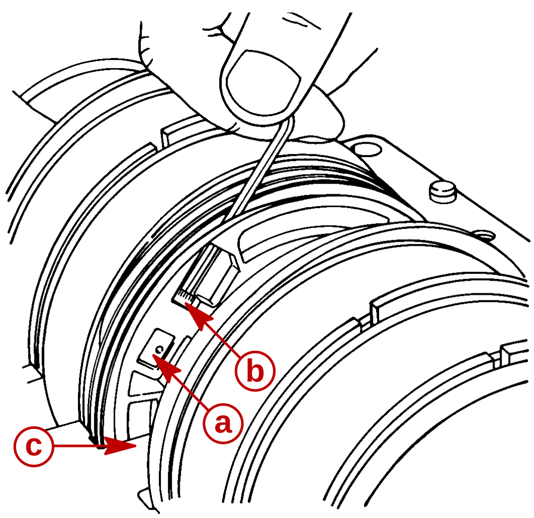
2. Apply Loctite 271 to threads of attaching bolts and secure oil pump to powerhead. Torque bolts to 55 lb. in. (6 N·m).
3. Connect inlet and outlet hoses to oil pump. Secure hoses with clamps.
4. Connect link arm to oil pump arm.
5. Prior to starting engine, refer to "**BLEEDING AIR FROM OIL INJECTION PUMP**" and "**ADJUSTING OIL INJECTION PUMP**," SECTION 1D, for proper procedures.

Installing Drive Gear (for Oil Injection Pump) onto Crankshaft

IMPORTANT: Oil pump drive gear retaining screws ARE STAKED after installation. DO NOT remove drive gear from crankshaft unless gear is damaged or shows signs of excessive wear.

REMOVAL OF DRIVE GEAR

1. Rotate crankshaft to gain access to two drive gear retaining allen screws.
2. Remove two screws and remove drive gear from crankshaft. DO NOT reuse retaining screws as screw threads may be damaged by factory staking process.



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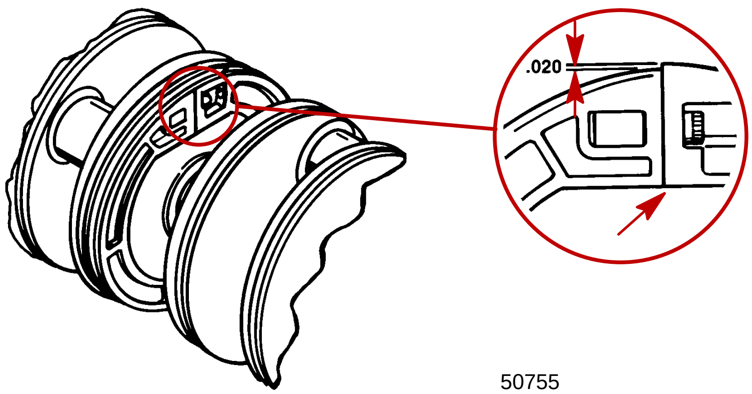
a - Retaining Nut
b - Allen Screw
c - Center Main Bearing (Hidden)

INSTALLATION OF NEW DRIVE GEAR

1. Align drive gear halves on crankshaft with retaining screw access holes towards center main bearing.
2. Clean retaining screw threads with Loctite Primer T (92-59327-1). Apply Loctite 271 (92-809820) to screw threads.
3. Secure drive gear halves together with retaining nuts and allen screws. Torque screws to 8 lb. in. (0.9 N·m)
4. Check gear halve split lines. Split should be drawn tight together (zero clearance) if gear halves are properly installed.

CAUTION

Gear tooth mismatch at split line must not exceed 0.020 in. (0.50 mm) or gear failure will result.



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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 low oil level.

1. Check oil level in engine reservoir tank. If oil level is not to the top of tank the problem is low oil level. There is a safety reserve of oil left in the reservoir after the low oil warning is sounded that allows you enough oil for 30 to 40 minutes of full throttle operation. Refer to trouble shooting chart to correct the problem.
2. If engine reservoir is full of oil, then the problem may be in the oil injection pump. DO NOT run engine on straight gas when a problem may be in the oil injection pump. Engine can be run by connecting a remote tank of 50:1 fuel and oil mixture to engine or in an emergency add (approx. a 50:1 ratio) of oil from the 3 gallon remote oil tank to the straight gas. Refer to trouble shooting chart to correct the problem.

Problem: Oil Level in Engine Oil Reservoir Tank is Low But Not Low in Remote Oil Tank.

Possible Cause	Corrective Action
Quick disconnect on remote oil tank is not fully connected	Reconnect
Remote oil hose (blue stripe) is blocked.	Check length of hose for a kink.
Remote pulse hose (second hose) is blocked or punctured.	Check length of hose for a kink.
Remote pulse hose check valve is faulty (this valve is located at the engine end of the hose).	Replace check valve.
A restricted oil outlet filter in the remote tank.	Remove filter and clean.
Leak at upper end of remote oil tank pick-up tube.	Check tube for cracks or leaks.
Oil and Pulse hoses reversed.	Check hose connections.
Low crankcase pressure.	Check pressure from pulse hose check valve (2 psi minimum).

Problem: Warning Horn Does Not Sound When Ignition Key is Turned to “ON” Position.

Possible Cause	Corrective Action
Horn malfunction or open (TAN/BLUE) wire between horn and engine.	Use a jumper wire to ground TAN/BLUE lead (at engine bullet connector starboard temperature sensor) to engine ground. Warning horn should sound. If not, check TAN/BLUE wire between horn and engine for open circuit and check horn.
Faulty Ignition Control Module	Check if all Control Module leads are connected to harness leads. If so, module may be faulty.
Using incorrect side mount remote control or ignition/choke assembly.	See info on remote control Section 1D.

Problem: Warning Horn Stays on When Ignition Key is Turned to “ON” Position.

Engine overheat sensor/Control Module	If horn sounds a continuous signal, the engine overheat sensor starboard head may be faulty. Disconnect overheat sensor and turn ignition key to “ON” position. If horn still sounds a continuous signal, the Control Module is faulty. Replace module and re-test. If signal does not sound, then engine overheat sensor is faulty. Replace and re-test.

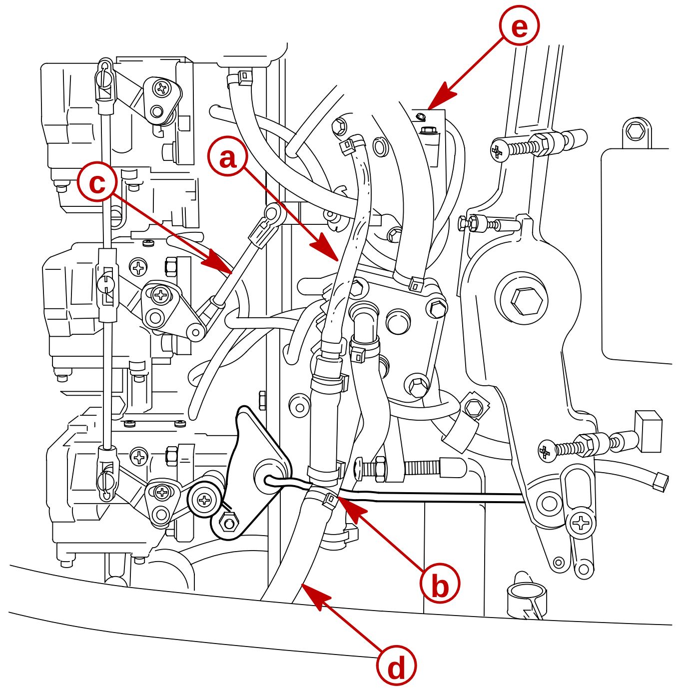
Problem: Warning Horn sounds when Engine is Running and Oil Level in Engine Reservoir is Full.

Possible Cause	Corrective Action
Defective low oil sensor (located in fill cap of engine oil reservoir).	Do not remove cap from oil reservoir. Disconnect both low oil sensor leads from terminal connectors. Connect an ohmmeter between leads. There should be no continuity through sensor. If continuity exists, sensor is faulty. Replace cap assembly.

If all of the checks are positive, the Control Module is faulty. Replace Module and re-test.

Oil Pump Volume (Flow) Test

NOTE: *The following specifications are determined with the engine running off a remote fuel supply with pre-mix fuel. The oil pump output hose (clear) must be disconnected from the input fuel line TEE fitting and directed into a graduated container. The input fuel line TEE fitting from which the oil line was removed MUST BE CAPPED OFF to prevent fuel leakage while the engine is running.*



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- **a** - Oil Pump Output Hose (Clear)
- **b** - Tee Fitting
- **c** - Link Arm
- **d** - Input Fuel Line
- **e** - Oil Pump

Two different capacity oil pumps are utilized on V-6 outboards.

Flow specifications are as follows:

135 Model:

@ 1500 RPM with oil pump link arm ATTACHED = 6.8cc ± 10% in 3 minutes.

@ 1500 RPM with oil pump link arm DISCONNECTED =17cc ± 10%in 3 minutes.

150/175/200 Models:

@ 1500 RPM with oil pump link arm ATTACHED =8.2cc ± 10% in 3 minutes.

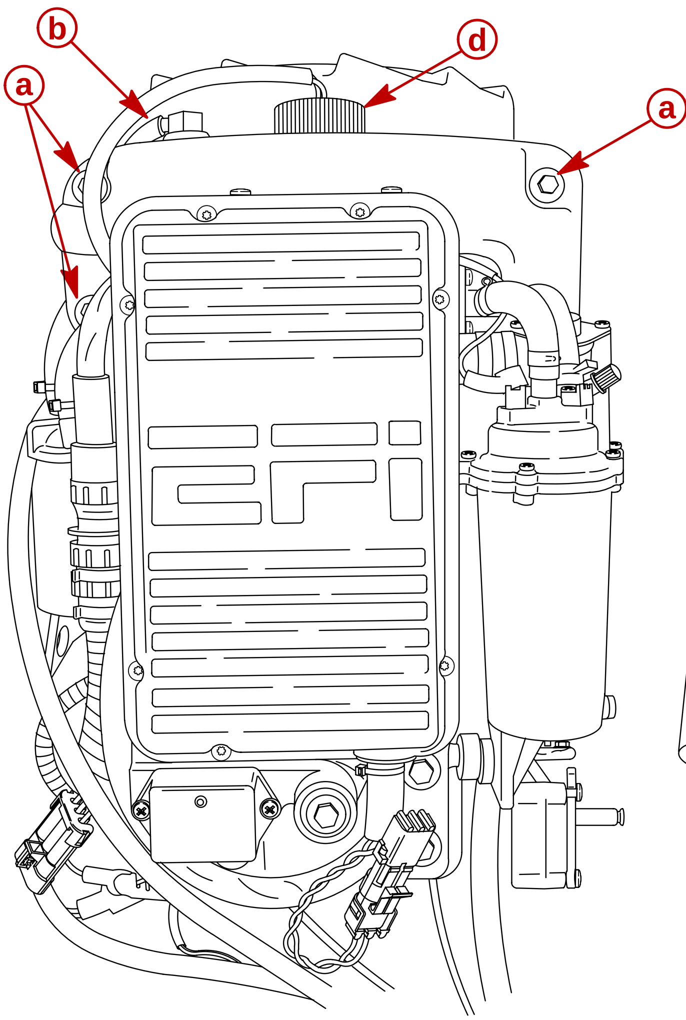
@ 1500 RPM with oil pump link arm DISCONNECTED =19.2cc ± 10% in 3 minutes.

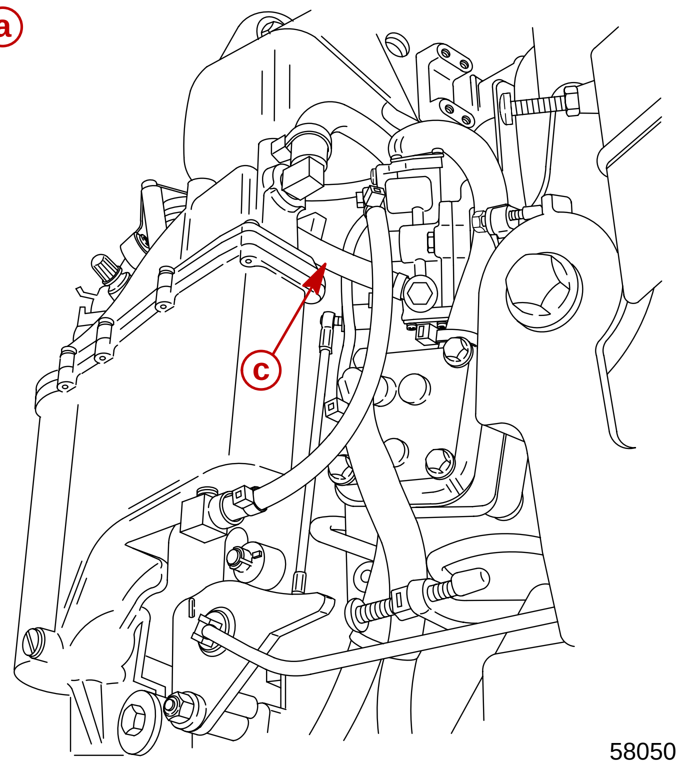
Engine Mounted Oil Reservoir

REMOVAL

NOTE: *If oil reservoir contains oil, the clear oil hose going to the oil pump should be plugged upon removal to prevent oil spillage.*

1. Disconnect input oil hose to oil reservoir.
2. Remove oil reservoir cap BLACK and LIGHT BLUE leads from their respective connections.
3. Disconnect clear input hose to oil pump and plug off hose.
4. Remove three bolts securing oil reservoir to power- head and remove reservoir.





a - Bolts
b - Input Oil Hose
c - Oil Pump Input Hose (Clear)
d - Oil Cap

INSTALLATION

1. Apply Loctite 222 (obtain locally) to threads of 3 attaching bolts and secure oil reservoir to powerhead. Torque bolts to 25 Ib. in. (2.8 N·m).
2. Install input oil hose to top of oil reservoir and secure with sta-strap.
3. Connect oil cap BLACK lead to engine ground and LIGHT BLUE lead to TKS ECM.
4. Connect clear output hose from oil reservoir to oil pump. Secure hose with sta-straps.

FUEL SYSTEM

Section 3E – Emissions

Table of Contents

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 United States.

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. However, combustion is not usually complete. Also, potentially harmful gases can be formed during and after combustion.

All marine engines must reduce the emission of certain pollutants, or potentially harmful gases, in the exhaust to conform with levels legislated by the EPA. Emissions standards become more stringent each year. Standards are set primarily with regard to three emissions: hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx).

Hydrocarbons – HC

Gasoline is a hydrocarbon fuel. The two elements of hydrogen and carbon are burned during combustion in combination with oxygen. But they are not totally consumed. Some pass through the combustion chamber and exit the exhaust system as unburned gases known as hydrocarbons.

Carbon Monoxide – CO

Carbon is one of the elements that make up the fuel burned in the engine along with oxygen during the combustion process. If the carbon in the gasoline could combine with enough oxygen (one carbon atom with two oxygen atoms), it would come out of the engine in the form of carbon dioxide (CO_2). CO_2 is a harmless gas. However, 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. However, enrichening the air/fuel ratio to decrease combustion temperatures or 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

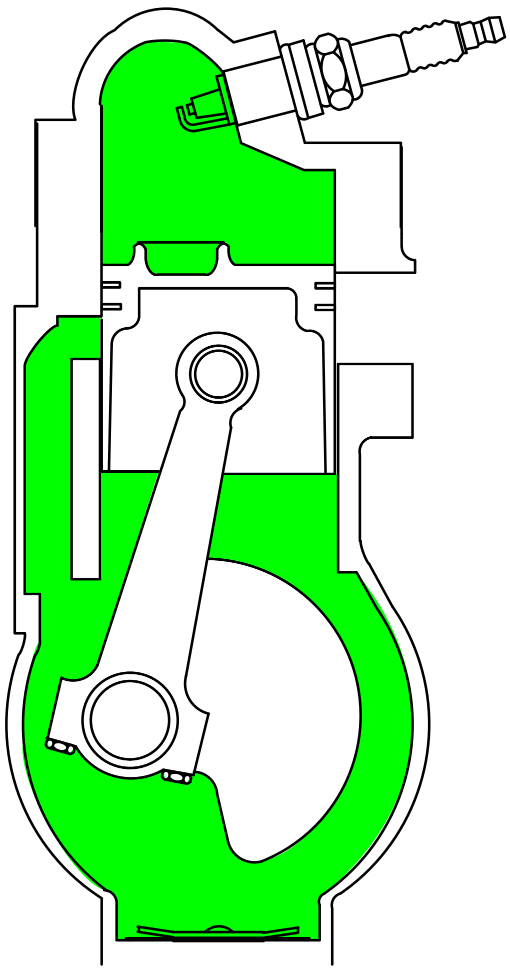
Stratified vs Homogenized Charge

At certain operating conditions, DFI engines use a stratified charge inside the combustion chamber to aid in reducing emissions. All other models exclusively 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, crankcase and/or combustion chamber. Additional mixing occurs as the fuel is forced through the transfer system into the cylinder.

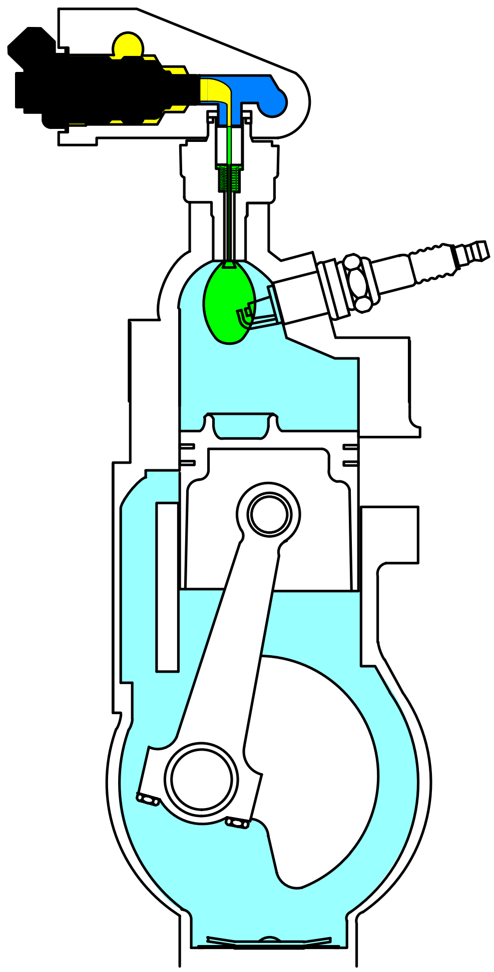
The homogenized charge has an air/fuel ratio of approximately 14.7:1 and is uniform throughout the cylinder.



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 fuel cloud into the cylinder. Surrounding this cloud is air supplied by the transfer system. As the cloud is ignited and burns, the surrounding air provides almost complete combustion before the exhaust port opens.

A stratified charge engine concentrates a rich mixture in the vicinity of the spark plug (air/fuel ratio is less than 14.7:1). Elsewhere, the mixture is very lean or is comprised of air only.



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. Also included would be factory authorized:

- Installation of performance style gear housings by Mercury Marine.
- Service replacement parts modified, changed or superceded by Mercury Marine.

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:

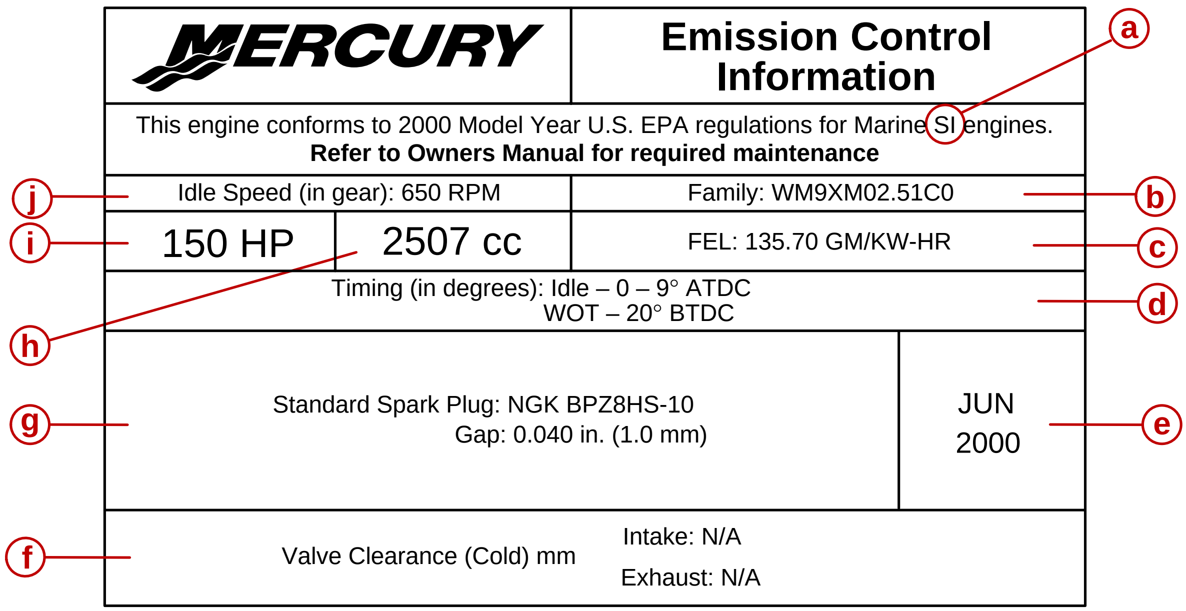
VIA U.S. POSTAL SERVICE:
Office of Mobile Sources
Engine Programs and Compliance Division
Engine Compliance Programs Group (6403J)
401 M St. NW
Washington, DC 20460

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

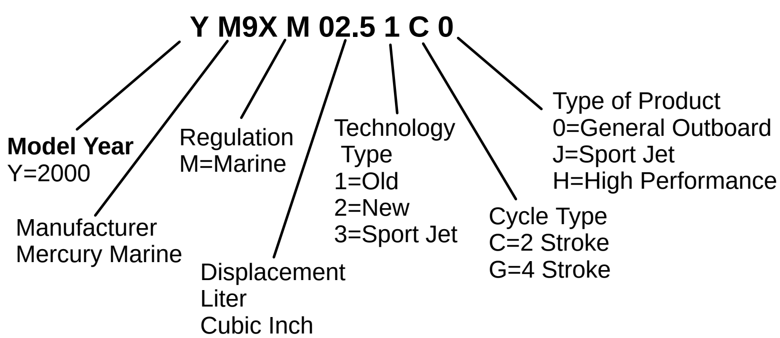
EPA INTERNET WEB SITE:
http:/www.epa.gov/omswww

Manufacturer's 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 - Family example
c - FEL: Represents (Mercury Marine) statement of the maximum emissions output for the engine family
d - Timing specifications when adjustable
e - Month and Year of Production
f - Valve Clearance (Four Stroke engines only)
g - Recommended spark plug for best engine performance
h - Cubic Centimeter
i - Engine Horsepower rating
j - Idle Speed (In Gear)



Service Replacement Certification Label

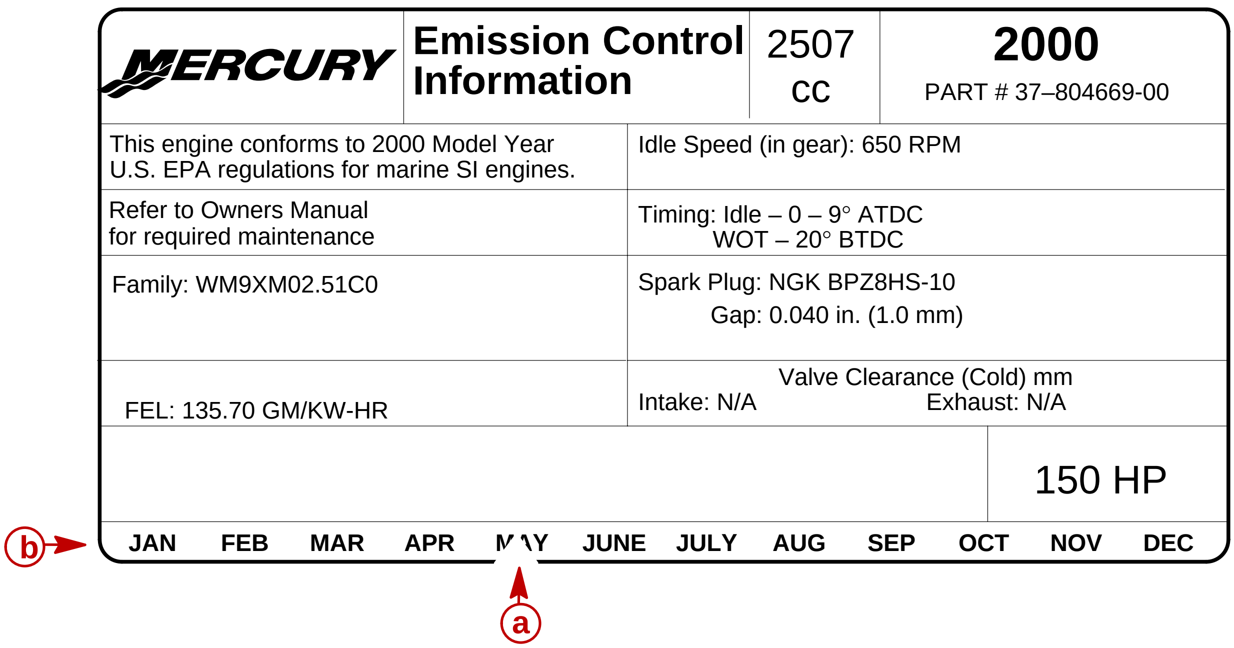
IMPORTANT: By federal law, it is required that all 1998 and newer Mercury Marine outboards have a visible and legible emission certification label. If this label is missing or damaged, contact Mercury Marine Service for replacement if appropriate.

Removal

Remove all remaining pieces of the damaged or illegible label. Do not install new label over the old label. Use a suitable solvent to remove any traces of the old label adhesive from the display location.

Date Code Identification

Cut and remove a “V” notch through the month of engine manufacture before installing the new label. The month of manufacture can be found on the old label. If the label is missing or the date code illegible, contact Mercury Marine Technical Service for assistance.



a - “V” Notch
b - Month of Manufacture

Installation

Install the label on a clean surface in the original factory location.

Decal Location:

Model	Production Part No.	Service Part No.	Location on Engine
2000 Merc/Mar 2.0 L V6 (135 H.P.)	37-859245	37-804668-00	Air Cover (Carb)
2000 Merc/Mar 2.5 L V6 (150 H.P.)	37-859245	37-804669-00	Air Cover (Carb) Vapor Separator (EFI)
2000 Merc/Mar 2.5 L V6 (175 H.P.)	37-859245	37-804669-00	Vapor Separator (EFI)
2000 Merc/Mar 2.5 L V6 (200 H.P.)	37-859245	37-804669-00	Air Cover (Carb) Vapor Separator (EFI)

POWERHEAD

Section 4A - Powerhead

Table of Contents

4
A

Powerhead Specifications (2 Liter Model 135)

Block

Type	60° V, 2 Cycle
Displacement	122 cu. in. (2.0 Litre)

Reed Valve Opening

Reed Stand Open (Max.)	0.020 in. (0.50 mm)

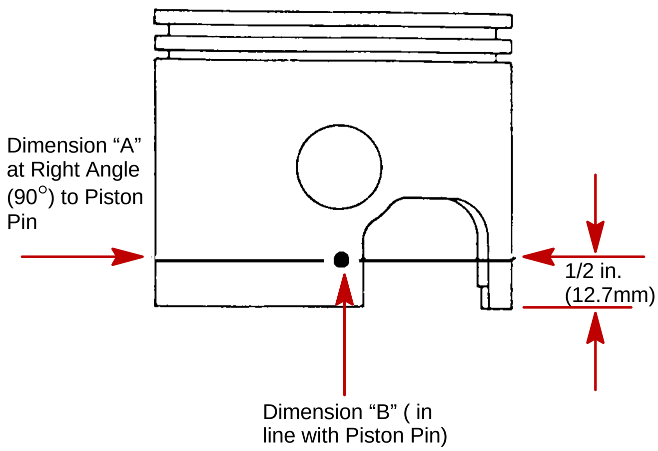
Cylinder Bore

Dia. Standard	3.125 in. (79.375 mm)
Dia. 0.015 in. Oversize	3.140 in. (79.756 mm)
Dia. 0.030 in. Oversize	3.155 in. (80.137 mm)
Taper/Out of Round Max.	0.003 in. (0.0762 mm)

Piston

Dia. Standard	3.115 in. ± .002 in. (79.121 mm ± .051 mm)
Dia. 0.015 in. Oversize	3.130 in. ± .002 in. (79.502 mm ± .051 mm)
Dia. 0.030 in. Oversize	3.145 in. ± .002 in. (79.883 mm ± .051 mm)

IMPORTANT: Using a micrometer, measure dimension "B" at location shown. Dimension "B" should be 0.008 in. or less than dimension "A".



Powerhead Specifications (2.5 Liter Model 150/175/200)

Block

Type	60° V, 2 Cycle
Displacement	153 cu. in. (2.5 Litre)

Reed Valve Opening

Reed Stand Open (Max.)	0.020 in. (0.50 mm)

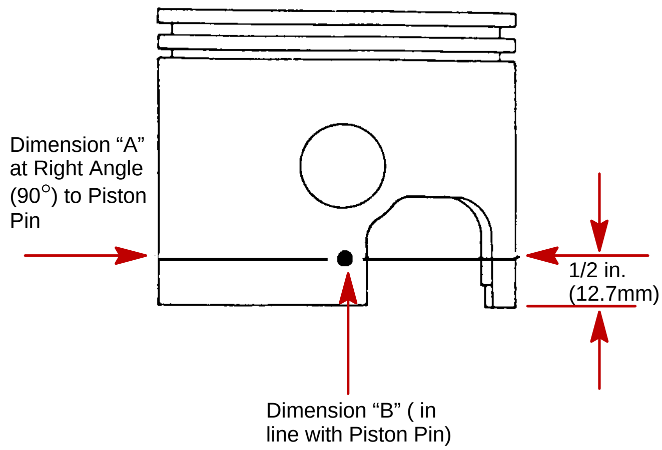
Cylinder Bore

Dia. Standard	3.501 in. (88.925 mm)
Dia. 0.015 in. Oversize	3.516 in. (89.306 mm)
Taper/Out of Round Max.	0.003 in. (0.0762 mm)

Piston

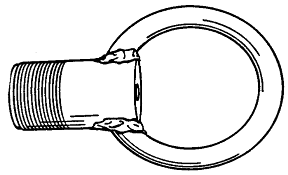
Dia. Standard	3.494 in. ± .001 in. (88.748 mm ± .025 mm)
Dia. 0.015 in. Oversize	3.509 in. ± .001 in. (89.129 mm ± .025 mm)

IMPORTANT: Using a micrometer, measure dimension “B” at location shown. Dimension “B” should be 0.008 in. or less than dimension “A”.

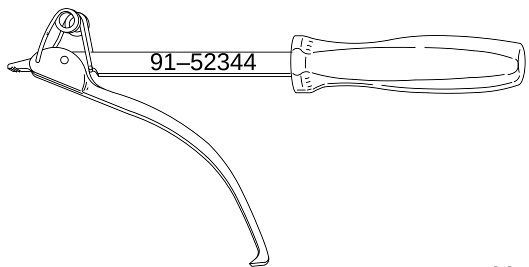


Special Tools

1. Lifting Eye 91-90455



2. Flywheel Holder 91-52344



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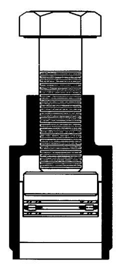
3. Protector Cap 91-24161

4. Flywheel Puller 91-849154T1



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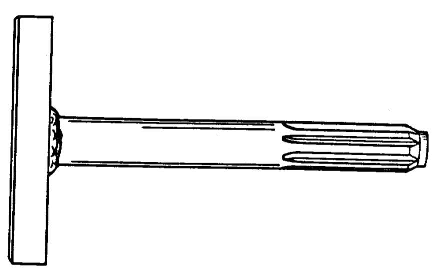
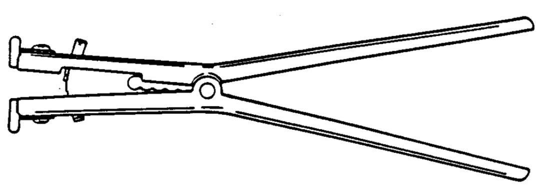
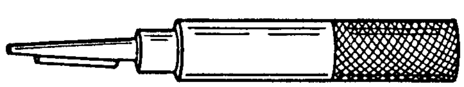
5. Powerhead Stand 812549T



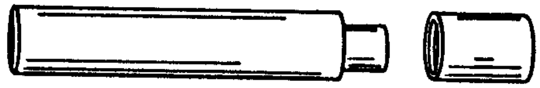
6. Piston Ring Expander 91-24697



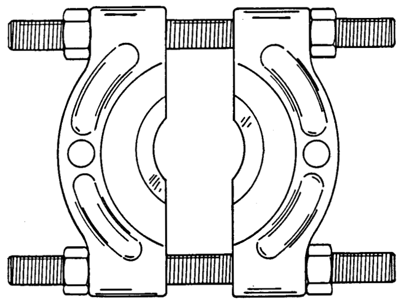
7. Lockring Removal Tool 91-52952A1



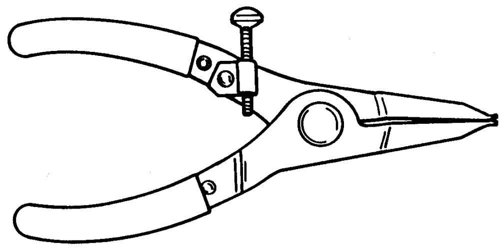
8. Piston Pin Tool 91-74607A3



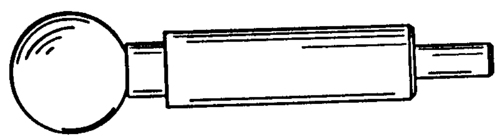
9. Universal Puller Plate 91-37241



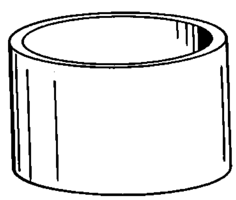
10. Snap Ring Pliers 91-24283



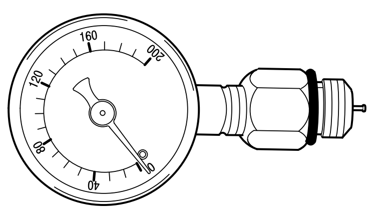
11. Lockring Installation Tool 91-91-77109A3



12. Piston Ring Compressor 91-818773 (for 2.5 Liter) and 91-65494 (for 2.0 Liter)



13. Compression Tester 91-29287



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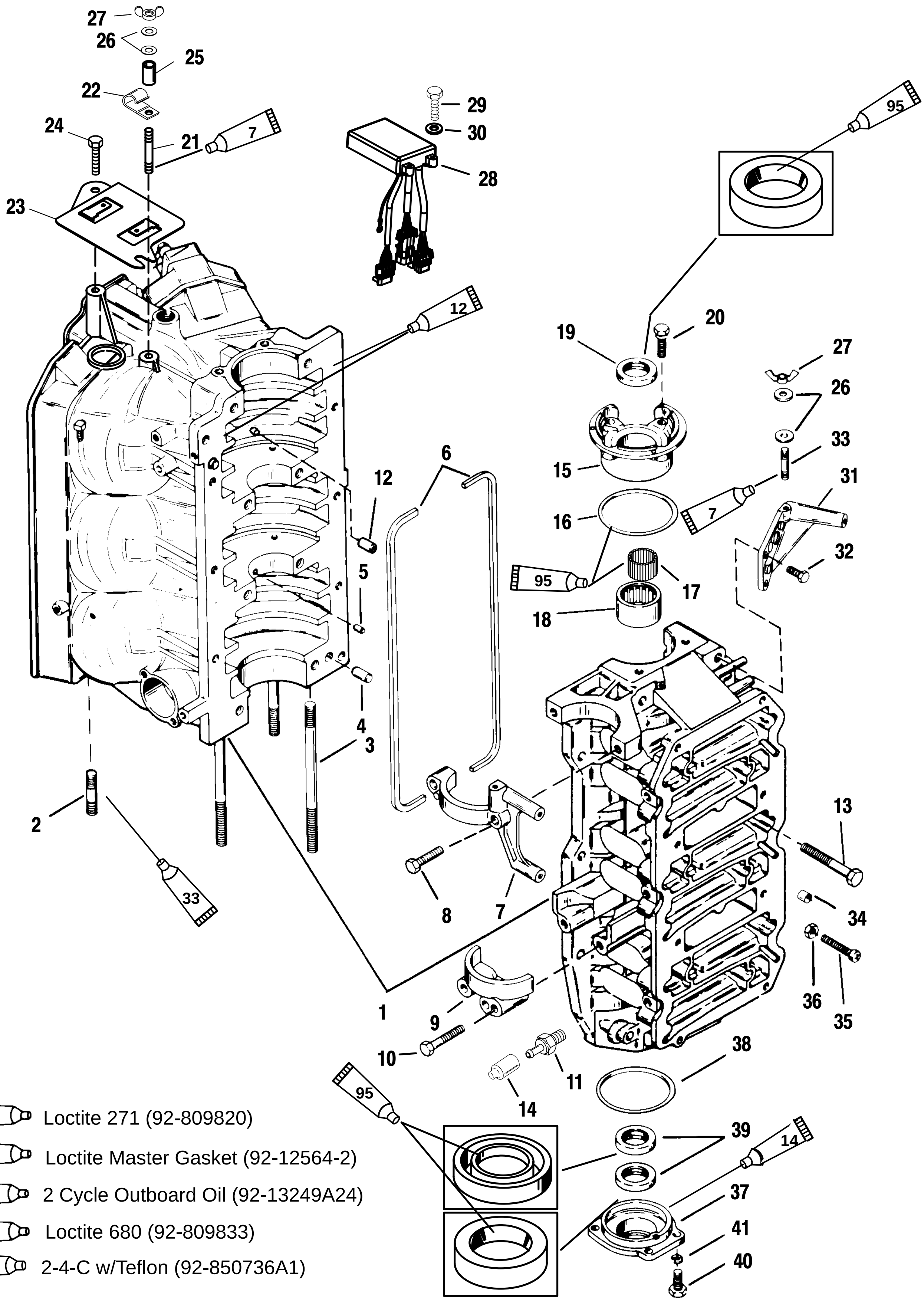
Powerhead Repair Stand

A powerhead repair stand may be purchased from:

Bob Kerr's Marine Tool Co.
P.O. Box 1135
Winter Garden, FL 32787
Telephone: (305) 656-2089

Cylinder Block Assembly



7 Loctite 271 (92-809820)

12 Loctite Master Gasket (92-12564-2)

14 2 Cycle Outboard Oil (92-13249A24)

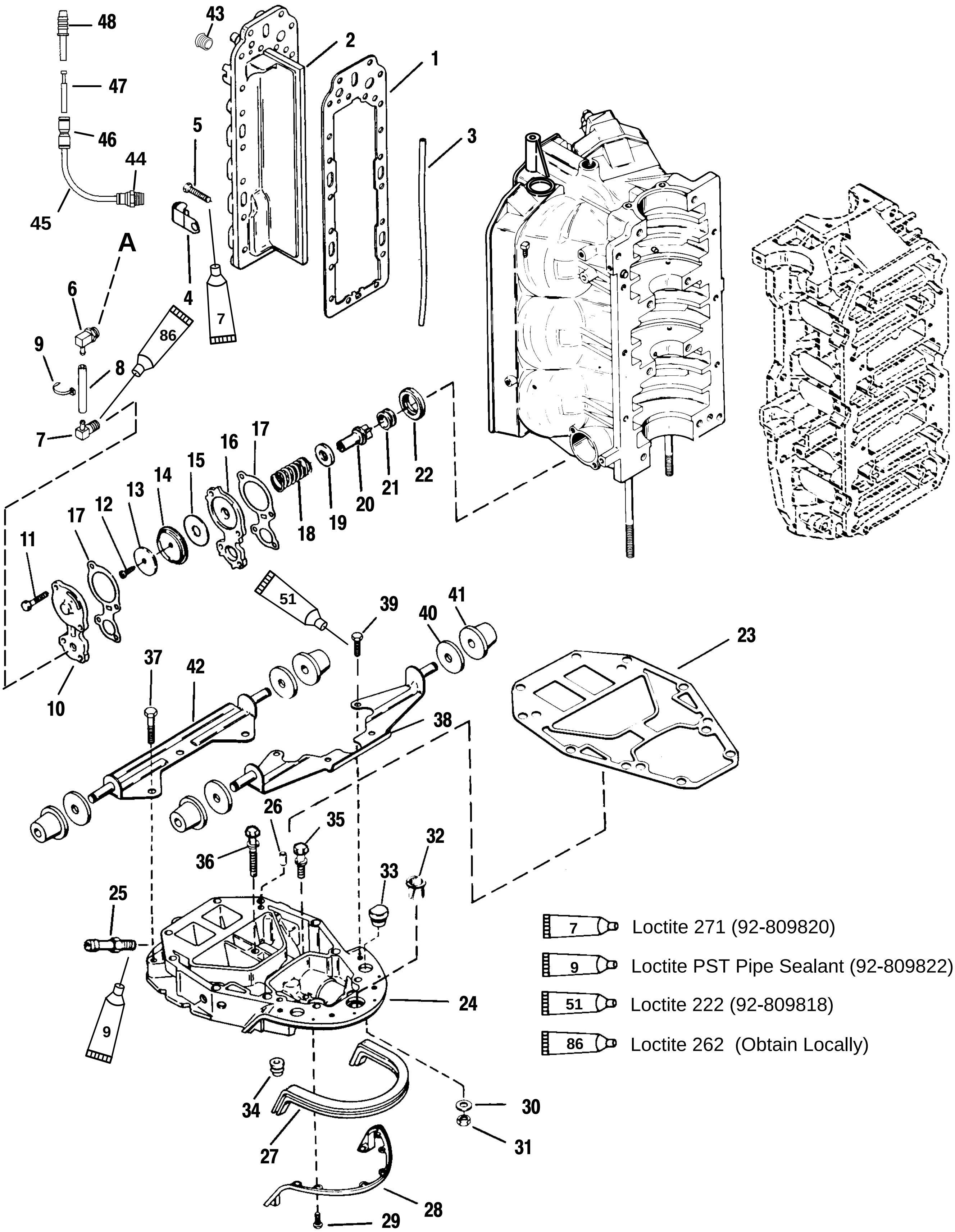
33 Loctite 680 (92-809833)

95 2-4-C w/Teflon (92-850736A1)

Cylinder Block Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	CYLINDER BLOCK **(135)**			
	1	CYLINDER BLOCK **(150/XR6/MAG. III)**			
	1	CYLINDER BLOCK **(200)**			
2	6	STUD–powerhead (1-3/4 IN.)			
3	2	STUD–powerhead (5-1/2 IN.)			
	2	STUD–powerhead (6-3/4 IN.)			
4	2	DOWEL PIN–locating			
5	2	DOWEL PIN (BEARING RACE)			
6	2	GASKET–sealing **(Use where applicable)**			
7	1	COVER–starter motor (UPPER)			
8	2	SCREW (1-1/2 IN.) (HEX FLANGE)	210	17.5	23.5
9	1	COVER (LOWER)			
10	2	SCREW (2 IN.)(HEX HEAD FLANGE)	210	17.5	23.5
11	1	FITTING			
12	1	BUSHING			
13	8	SCREW (3/8-16 x 3-1/4 IN.)		38	51.5
	6	SCREW (.312-18 x 1-1/4 IN.)		38	51.5
14	1	PLUG			
15	1	UPPER END CAP ASSEMBLY			
16	1	O-RING			
17	1	ROLLER BEARING			
18	1	RACE			
19	1	OIL SEAL			
20	4	SCREW (5/16-18 x 1 IN.)	150	12.5	17.0
21	1	STUD (1-7/8 IN.)			
22	1	J-CLIP			
23	1	BRACKET			
24	1	SCREW (10-32 x .375)			
25	1	SPACER			
26	3	WASHER			
27	3	NUT	25		3.0
28	1	CONTROL MODULE			
29	3	SCREW (10-32 x 7/8)	30		3.5
30	3	WASHER			
31	1	BRACKET			
32	2	SCREW (3/4 IN.)	80		9.0
33	2	STUD (1 IN.)			
34	1	CAP			
35	1	ADJUSTING SCREW			
36	1	JAM NUT			
37	1	LOWER END CAP			
38	1	O-RING (3-1/4 IN. I.D.)			
39	2	OIL SEAL			
40	4	SCREW (1/4-20 x 3/4 IN.)	80		9.0
41	4	LOCKWASHER			

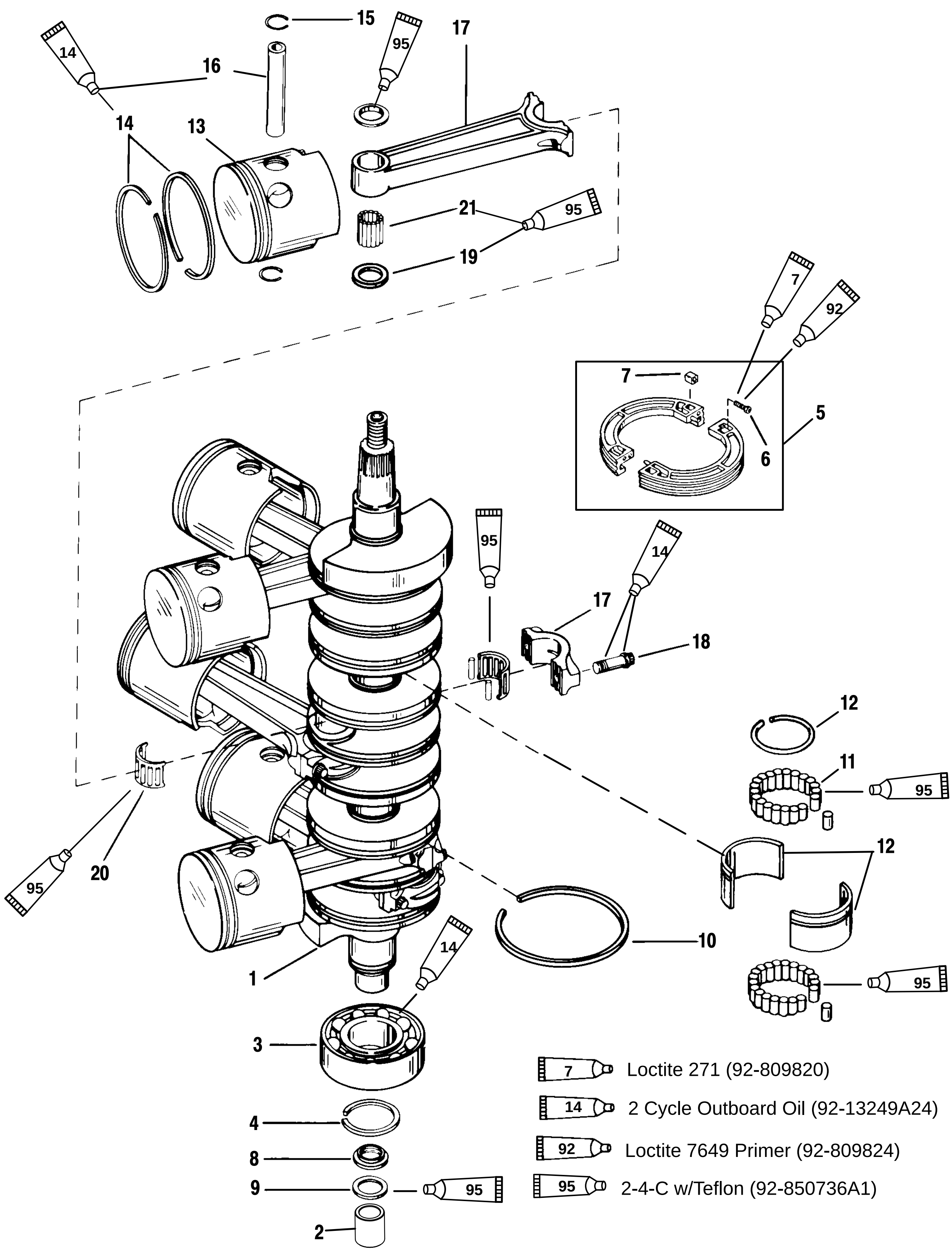
Exhaust Manifold and Exhaust Plate



Exhaust Manifold and Exhaust Plate

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	GASKET			
2	1	DIVIDER PLATE			
3	1	SEAL			
4	4	J-CLAMP			
5	17	SCREW (.312-18 x 1-1/2)	200	16.5	22.5
	2	SCREW (.312-18 x 1)	200	16.5	22.5
	1	SCREW (5/16-18 x 1-3/4)	200	16.5	22.5
6	1	FITTING			
7	1	FITTING (90 degrees)			
8	1	HOSE (26 IN.)			
9	2	STA-STRAP			
10	1	COVER–relief valve			
11	4	SCREW (.312-18 x 1-1/4 IN.)	150	12.5	17.0
12	1	SCREW (10-16 x 3/4 IN.)	25		3.0
13	1	WASHER			
14	1	DIAPHRAGM			
15	1	WATER DEFLECTOR			
16	1	PLATE			
17	2	GASKET			
18	1	SPRING			
19	1	WASHER			
20	1	POPPET			
21	1	GROMMET			
22	1	CARRIER			
23	1	GASKET			
24	1	EXHAUST PATE			
25	1	CONNECTOR (STRAIGHT)			
26	2	DOWEL PIN			
27	1	SEAL			
28	1	BRACKET			
29	8	SCREW (10-16 x 1/2 IN.)			
30	6	WASHER			
31	6	NUT	276	23	31.0
32	1	BUSHING			
33	1	GROMMET **(CLOSED)**			
	1	GROMMET **(SPLIT)**			
34	1	GROMMET			
35	1	SCREW (5/16-18 x 1-1/4 IN.)	300	25	34.0
36	1	SCREW (5/16-18 x 2-1/2 IN.)	300	25	34.0
37	3	SCREW (3/8-16 x 3-1/2 IN.)		50	68.0
38	1	FRONT BRACKET ASSEMBLY			
39	4	SCREW (5/16-18 x 1/2 IN.)			
40	4	WASHER			
41	4	GROMMET			
42	1	REAR BRACKET ASSEMBLY			
43	1	PIPE PLUG			
44	1	FITTING			
45	1	TUBING (44 IN.)			
46	1	COUPLER			
47	1	ADAPTOR FITTING			
48	1	ADAPTOR FITTING			

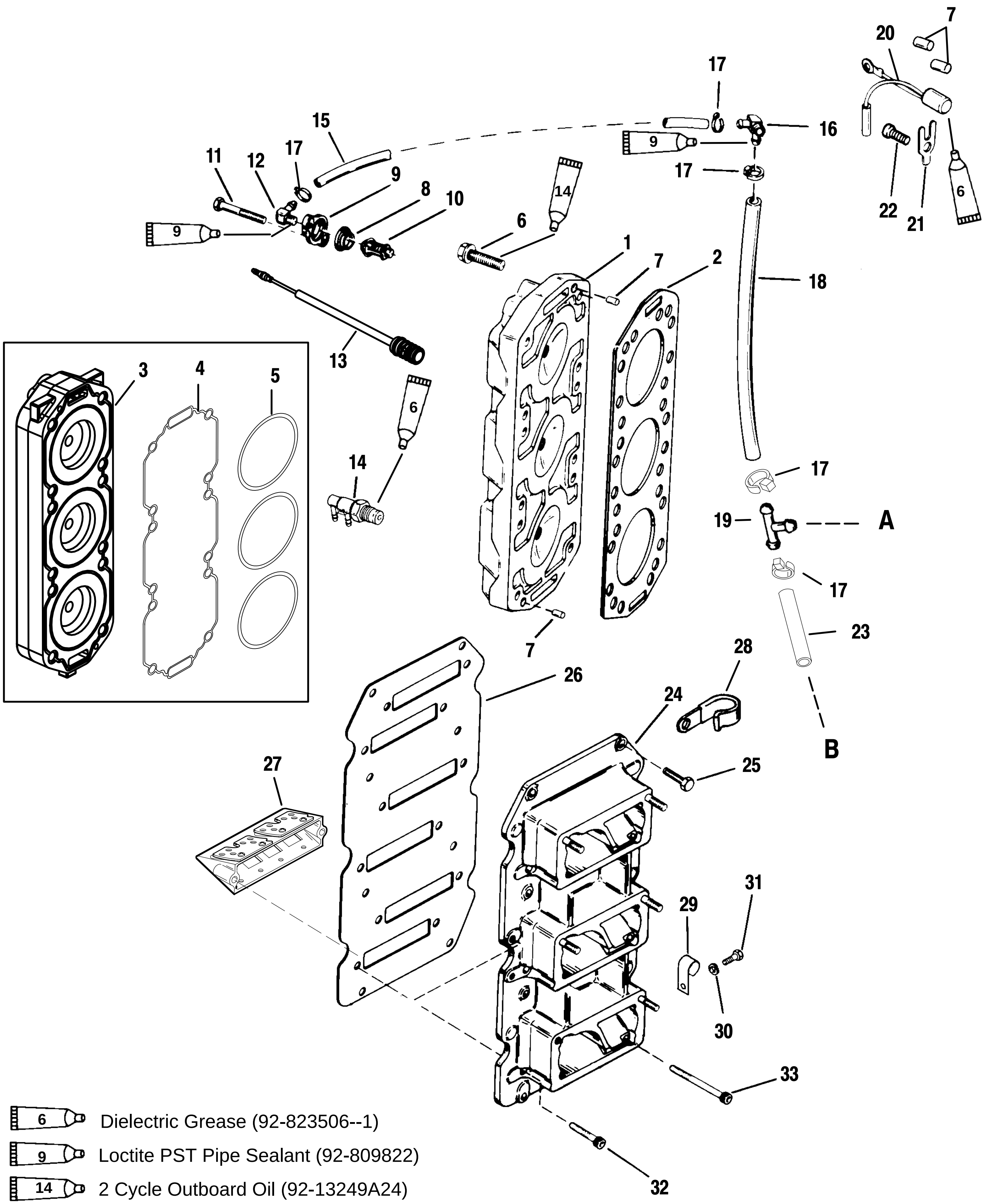
Crankshaft, Pistons and Connecting Rods



Crankshaft, Pistons and Connecting Rods

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	CRANKSHAFT ASSEMBLY			
2	1	WEAR SLEEVE			
3	1	BALL BEARING (LOWER)			
4	1	RETAINING RING			
5	1	DRIVE GEAR			
6	2	SCREW	8		1.0
7	2	NUT			
8	1	CARRIER ASSEMBLY			
9	1	SEAL			
10	7	RING–sealing - crankshaft			
11	2	ROLLER BEARING–crankshaft			
12	2	BEARING			
13	3	PISTON **(STARBOARD-STANDARD)**			
	AR	PISTON **(STARBOARD-.015 O.S.)**			
	AR	PISTON **(STARBOARD-.030 OS.)**			
	3	PISTON **(PORT-STANDARD)**			
	AR	PISTON **(PORT-.015 O.S.)** **135**			
	AR	PISTON **(PORT-.030 O.S.)**			
	3	PISTON **(STARBOARD-STANDARD)**			
	AR	PISTON **(STARBOARD-.015 O.S.)** **150/XR6**			
	3	PISTON **(PORT-STANDARD)** **Magnum III**			
	AR	PISTON **(PORT-.015 O.S.)** **200**			
14	1	PISTON RING **(STANDARD)**			
	AR	PISTON RING **(.015 O.S.)** **135**			
	AR	PISTON RING **(.030 O.S.)**			
	1	PISTON RING **(STD.)** **150/XR6/Magnum III/200**			
	2	PISTON RING **(.015 O.S.)**			
15	12	LOCK RING			
16	6	PISTON PIN			
17	6	CONNECTING ROD ASSEMBLY			
18	12	SCREW–connecting rod	1st Torque - 15 lb-in (1.5 Nm.) 2nd Torque - 20 lb-ft (27 Nm.) Turn bolt additional 90 degrees after 2nd torque		
19	12	WASHER–needle locating			
20	6	ROLLER BEARING ASSEMBLY			
21	174	NEEDLE BEARING–piston end			

Reed Block and Cylinder Head



6 Dielectric Grease (92-823506--1)

9 Loctite PST Pipe Sealant (92-809822)

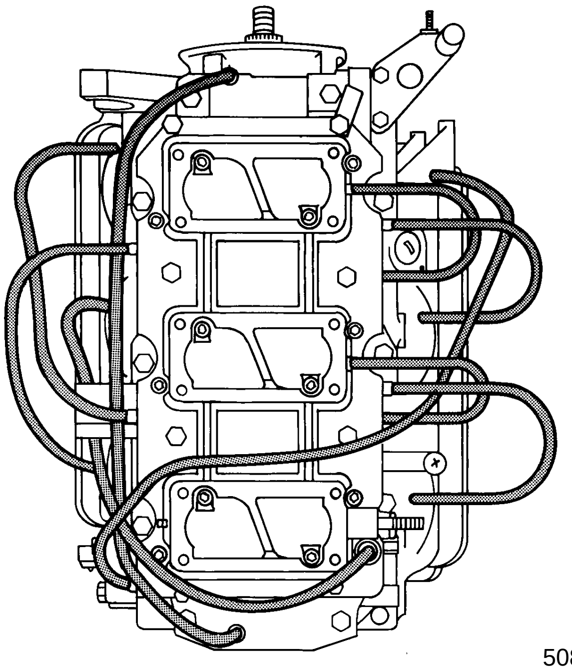
14 2 Cycle Outboard Oil (92-13249A24)

Reed Block and Cylinder Head

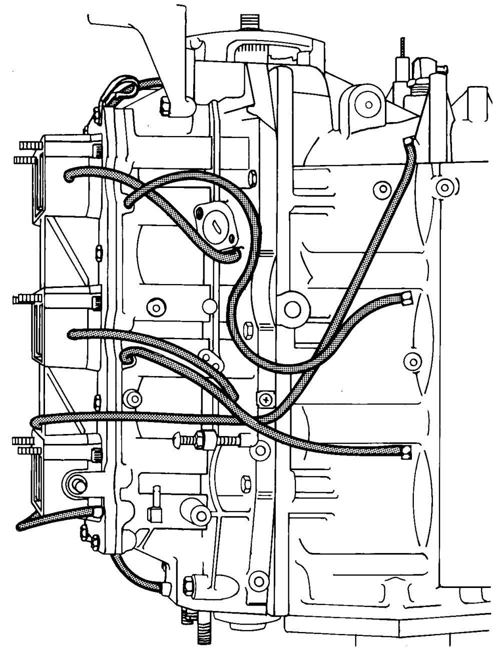
REF. NO.		DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	2	CYLINDER HEAD **135**			
2	2	GASKET			
3	2	CYLINDER HEAD **150/XR6/ Magnum III**			
	2	CYLINDER HEAD **200**			
4	2	SEAL **150/XR6/ Magnum III/200**			
5	6	SEAL			
6	24	SCREW (.375-16 x 2.30)**(135)**	**SEE NOTE #1**		
	24	BOLT **(150/XR6/ Magnum III/200)**			
7	4	DOWEL PIN			
8	2	GASKET			
9	2	COVER			
10	2	THERMOSTAT			
11	4	SCREW (M8 x 25)	200	16.5	22.5
12	1	ELBOW			
13	1	TEMPERATURE SENDER (STBD.)			
14	1	THERMAL AIR VALVE			
15	1	HOSE (12-3/4 IN.)			
16	1	FITTING			
17	10	STA-STRAP			
18	1	HOSE (13-1/2 IN.)			
19	1	T-FITTING			
20	1	TEMPERATURE SENSOR (PORT) (2-WIRE)			
21	2	RETAINER			
22	2	SCREW (M8 x 14)	200	16.5	22.5
23	1	HOSE (4-1/2 IN.)			
24	1	ADAPTOR PLATE			
25	8	SCREW (1/4-20 x .88)	105	9.0	12.0
26	1	GASKET			
27	6	REED BLOCK			
28	1	J-CLAMP			
29	1	J-CLIP			
30	1	C-WASHER			
31	1	SCREW (10-16 x 1/2)	85	7.0	9.5
32	6	SCREW (7/8 IN.)	105	9.0	12.0
33	6	SCREW (1-1/8 IN.)	80	6.5	9.0

NOTE # 1: APPLY LIGHT OIL TO THREADS - TORQUE TO 30 LB. FT. (40.5 Nm), THEN TIGHTEN ADDITIONAL 90 DEGREES.

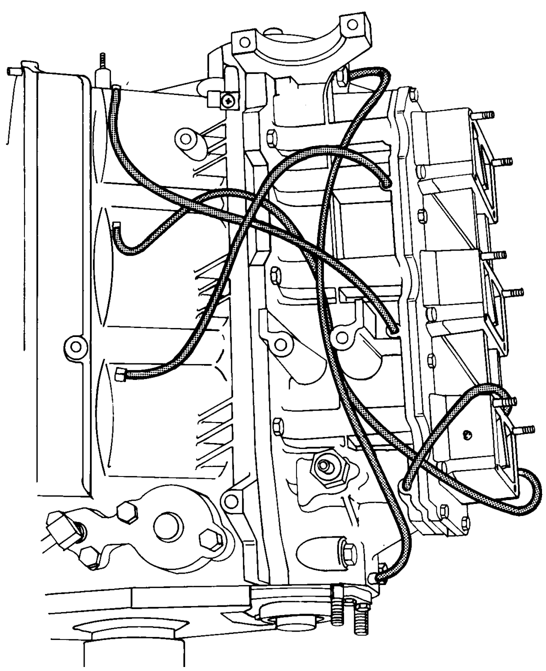
Bleed System Routing (Carburetor Models)



FRONT VIEW

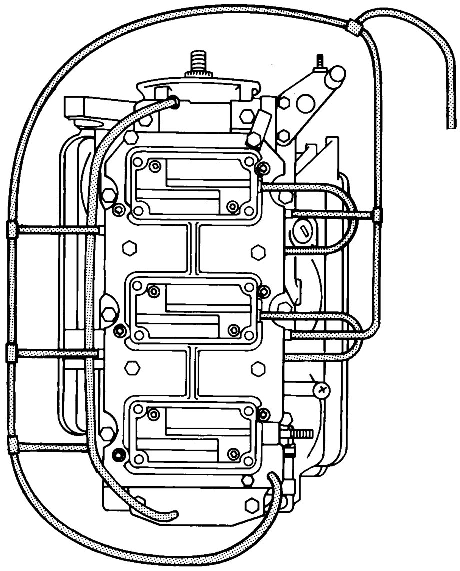


PORT VIEW



STARBOARD VIEW

Bleed System Routing (EFI Models)



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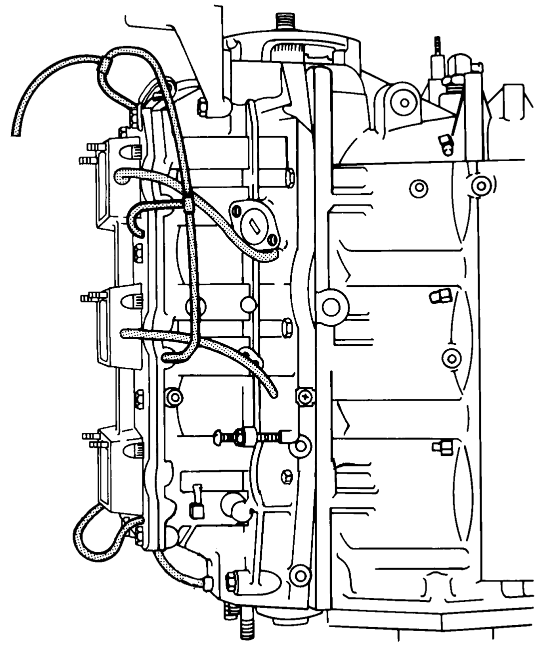
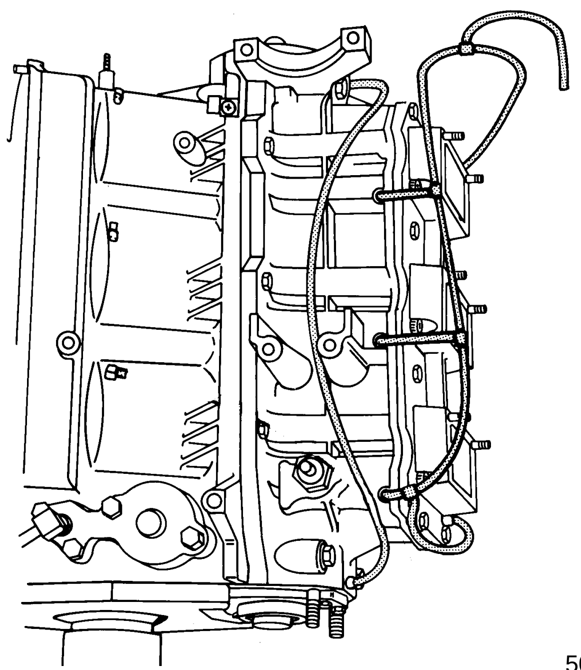
FRONT VIEW



50934

PORT VIEW

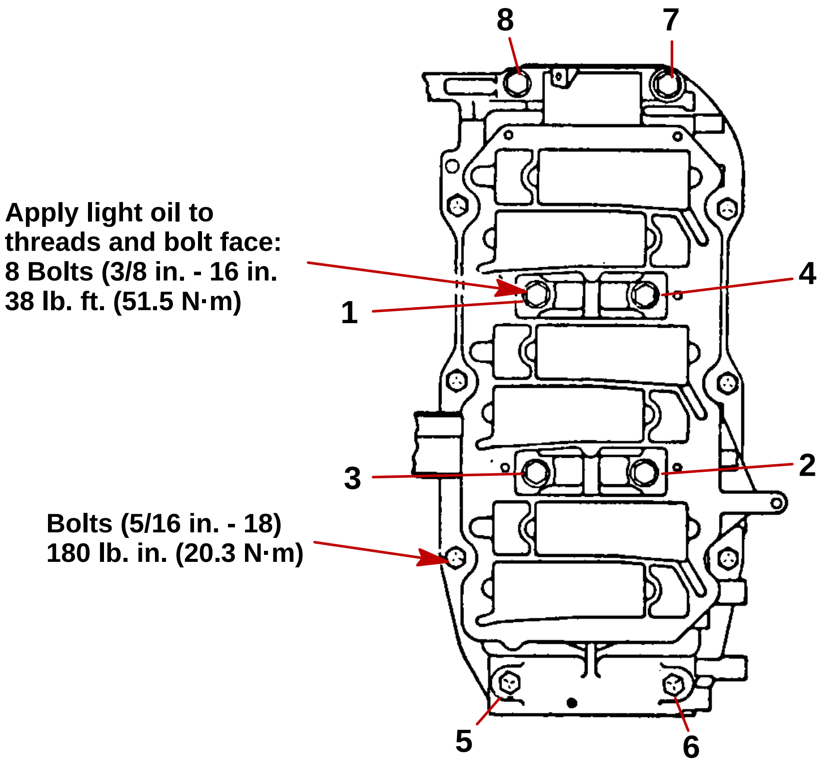


50935

STARBOARD VIEW

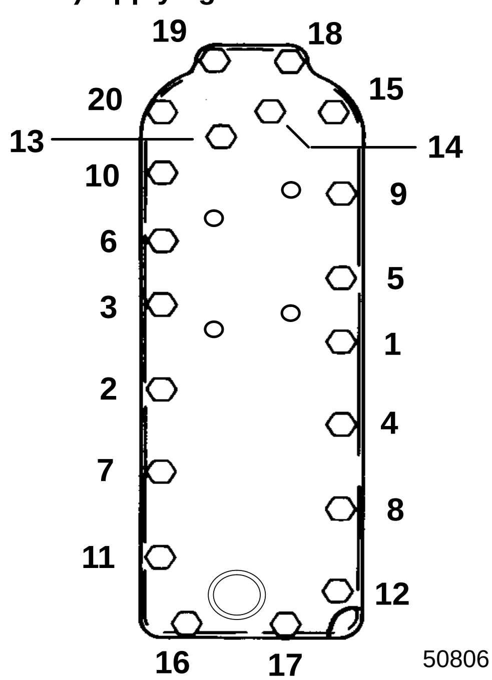
Torque Sequence

CRANKCASE COVER BOLTS



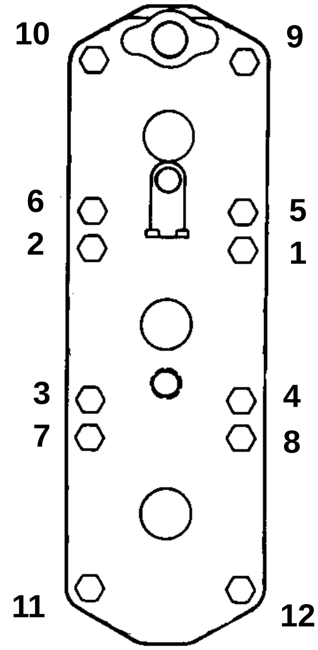
EXHAUST COVER BOLTS

180 lb. in. (20 N·m) Apply light oil to threads and bolt face



CYLINDER HEAD BOLTS

Apply light oil to threads and bolt face: 30 lb. ft. (40.7 N·m) and rotate 90°



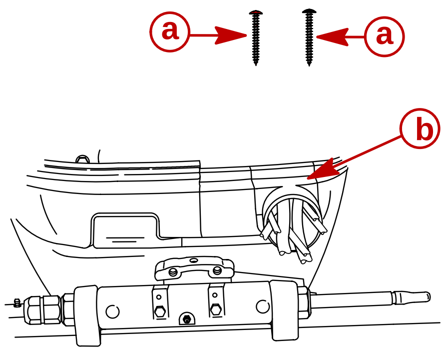
General Information

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.) Usually, complete disassembly of powerhead will be required.

If major powerhead repairs are to be performed, remove powerhead from drive shaft housing. Removal of powerhead is not required for 1) inspection of cylinder walls and pistons (refer to "Powerhead Removal and Disassembly," following, and remove cylinder heads and exhaust cover), 2) minor repairs on components, such as ignition system, carburetors, reed blocks and cylinder heads and checking operation of thermostats.

Powerhead Removal from Driveshaft Housing

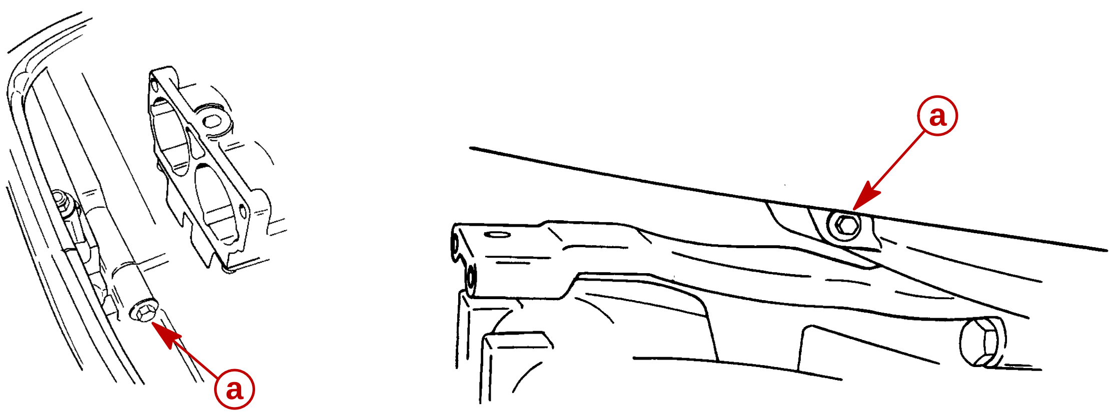
1. Disconnect battery cables from battery terminals.
2. Disconnect fuel tank hose from outboard.
3. Remove top cowling.
4. Remove two screws which secure remote control harness retainer and remove retainer.



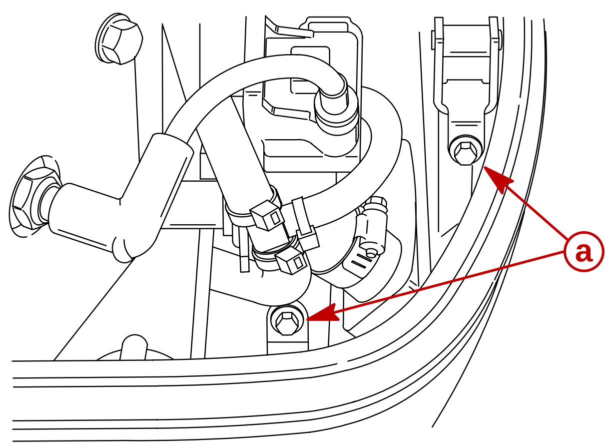
57841

a - Screws
b - Retainer

5. Remove bottom cowls.



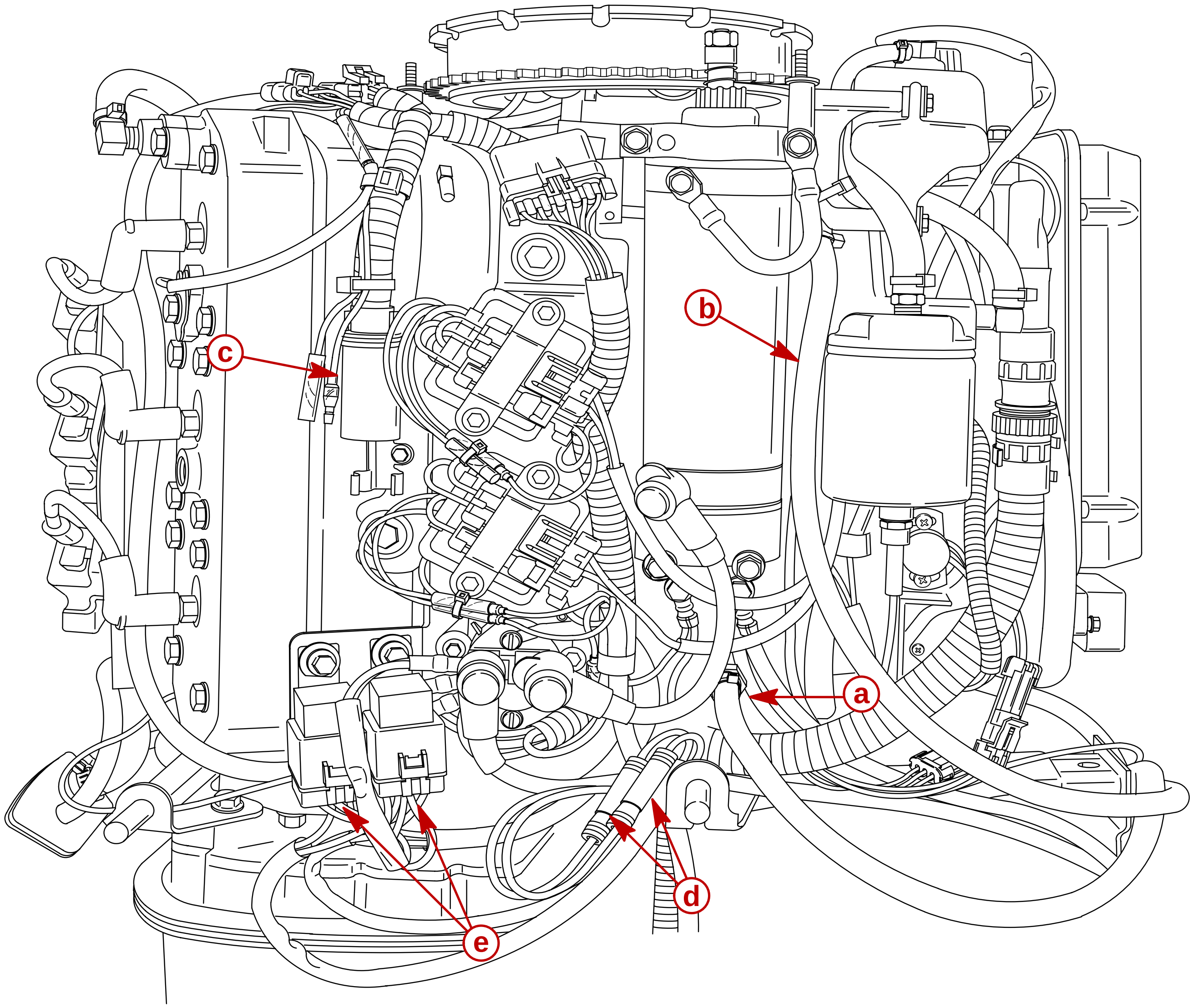
a - Bolts



58068

a - Bolts

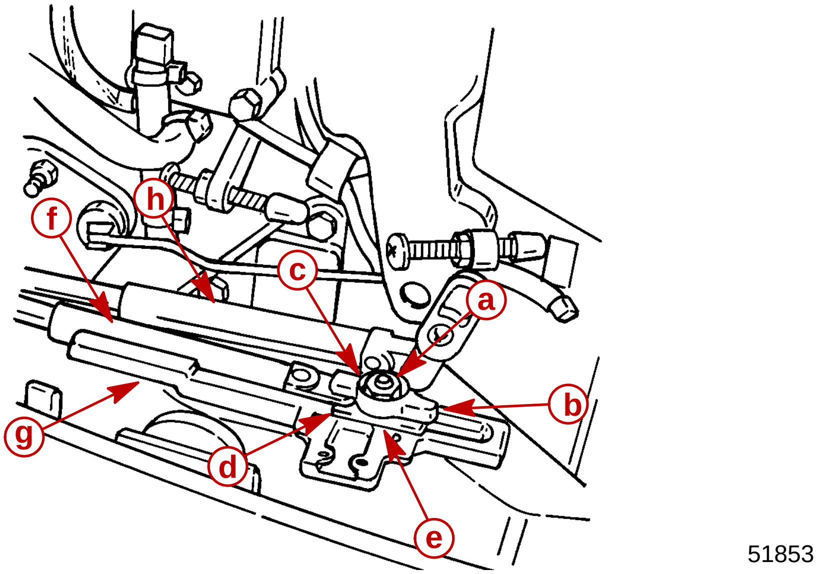
6. Disconnect remote oil tank pressure hose and supply hose to oil reservoir.
7. Disconnect remote control harness from powerhead harness connector and power trim wires.
8. Disconnect trim relay connectors.



58027

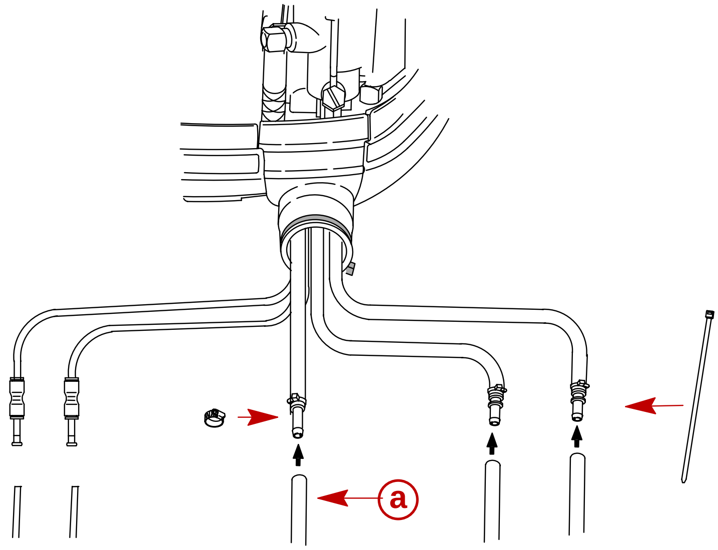
a - Remote Oil Tank Pressure Hose
b - Oil Supply Hose
c - Remote Control Harness
d - Power Trim Wires
e - Trim Relay Connectors

9. Slide outboard shift lever into neutral position.
10. Remove throttle cable.
11. Remove locknut that secures shift cable latch assembly and remove latch, flat washer, nylon wear plate, spring and shift cable from control cable anchor bracket.



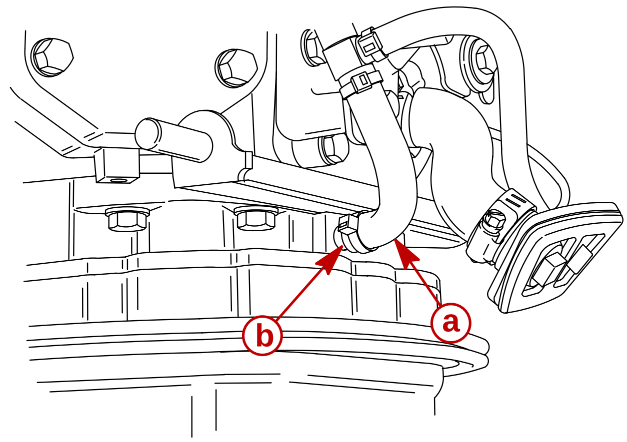
a - Lock Nut
b - Shift Cable Latch
c - Flat Washer (Hidden under nut)
d - Nylon Wear Plate
e - Spring (Hidden)
f - Shift Cable
g - Anchor Bracket
h - Throttle Cable

12. Disconnect input fuel line.



a - Input Fuel Hose

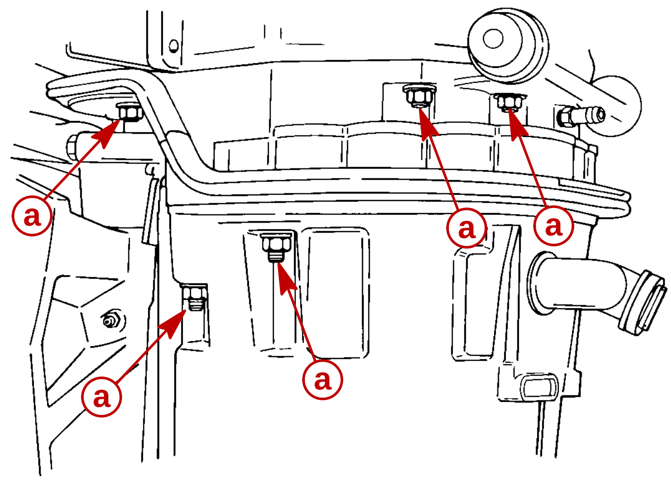
13. Remove water hose from fitting on exhaust adaptor plate.



58069

a - Water Hose
b - Fitting

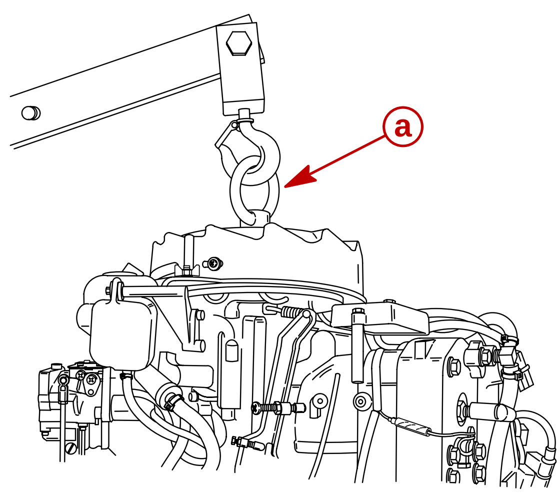
14. Remove 10 nuts and 10 washers (5 each side) from powerhead base.



51846

a - Nuts and Washers (5 each side)

15. 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 driveshaft housing.



58070

a - Lifting Eye 91-90455

Removing Engine Components

Remove the following engine components:

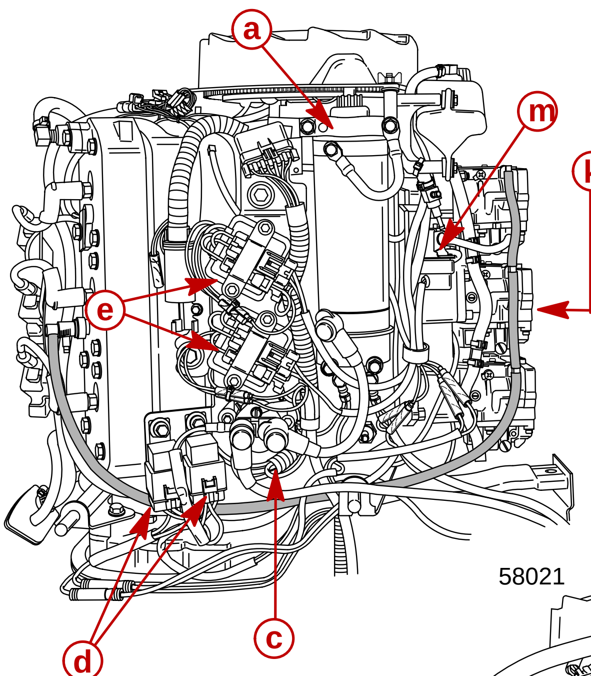
SECTION 2

- **a** - Starter Motor
- **b** - Ignition Modules*
- **c** - Starter Solenoid*
- **d** - Trim Solenoids
- **e** - Voltage Regulator*
- **f** - Control Module
- **g** - Detonation Module (200 EFI only)
- **h** - Flywheel
- **i** - Stator Assembly*
- **j** - Trigger Assembly*

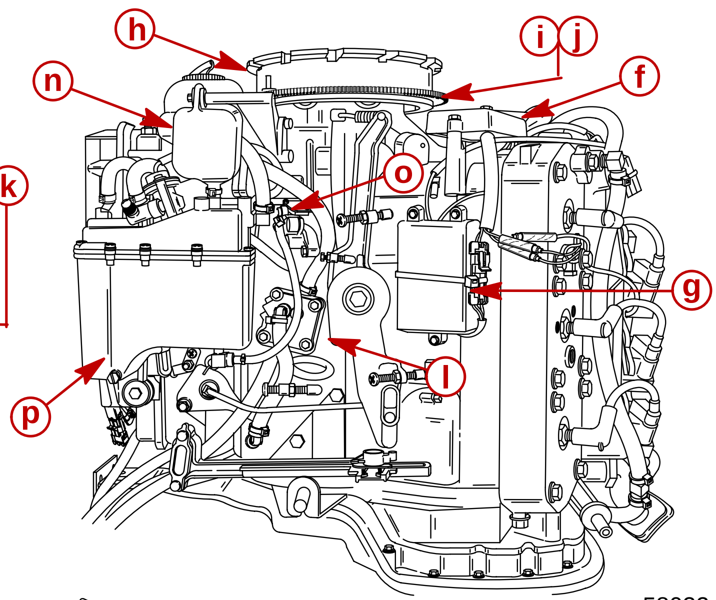
SECTION 3

- **k** - Air Silencer,Carburetors and Linkage
- **l** - Fuel Pump
- **m** - Fuel Enrichment Valve
- **n** - Oil Reservoir
- **o** - Oil Pump
- **p** - Fuel Injection

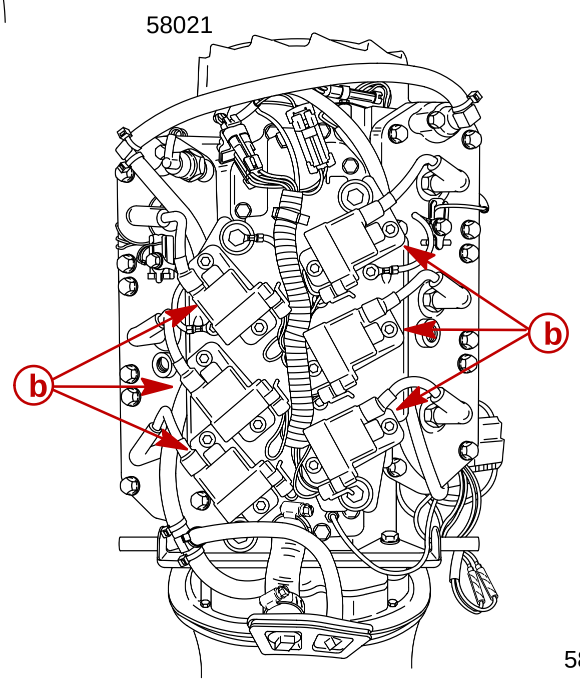
***All ignition and electrical components should remain attached to electrical plate. Plate with components can be removed as an assembly.**



58021



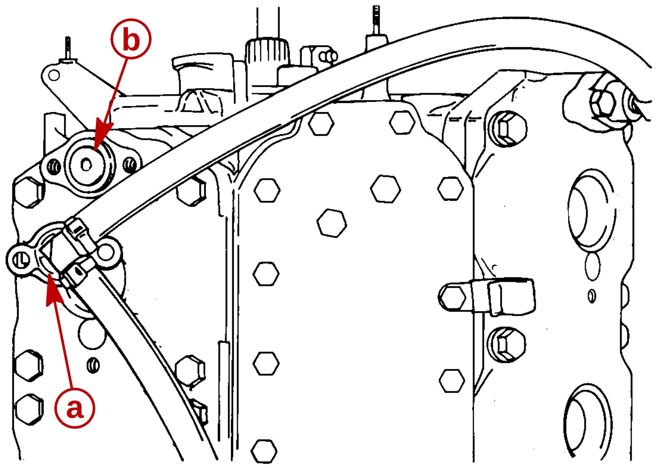
58032



58030

Powerhead Disassembly

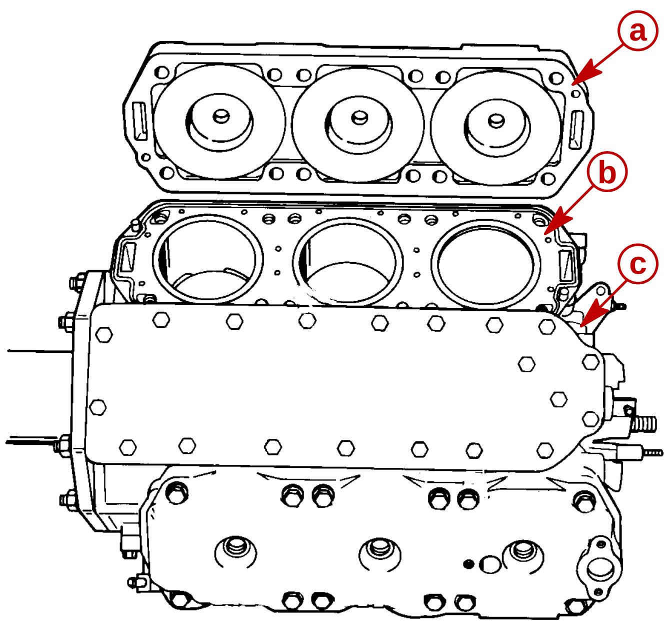
1. Place powerhead in repair stand or on a bench.
2. Remove thermostat covers and washers.



51852

a - Cover
b - Washer

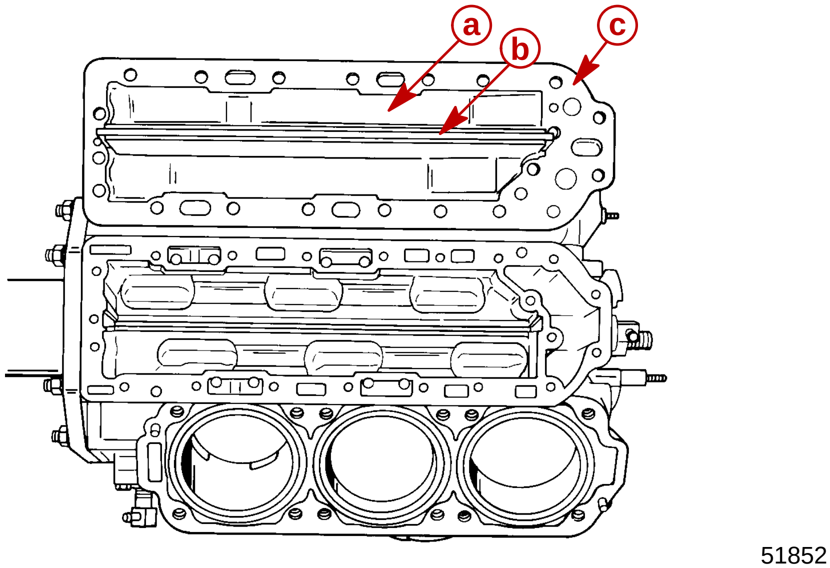
3. Remove cylinder heads from engine block.



51847

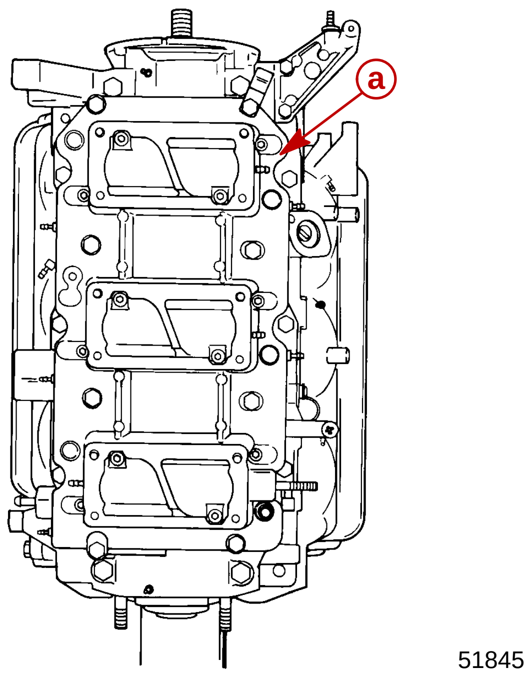
a - Cylinder Head
b - Gasket (135 Model only)
c - Engine Block

4. Remove exhaust manifold and seal.



a - Exhaust Manifold
b - Seal
c - Gasket

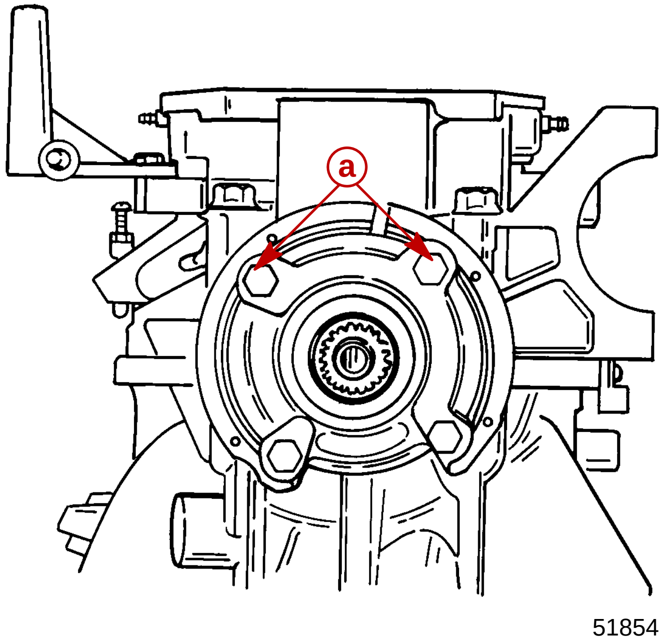
5. Remove reed block housing from cylinder block.



a - Reed Block Housing

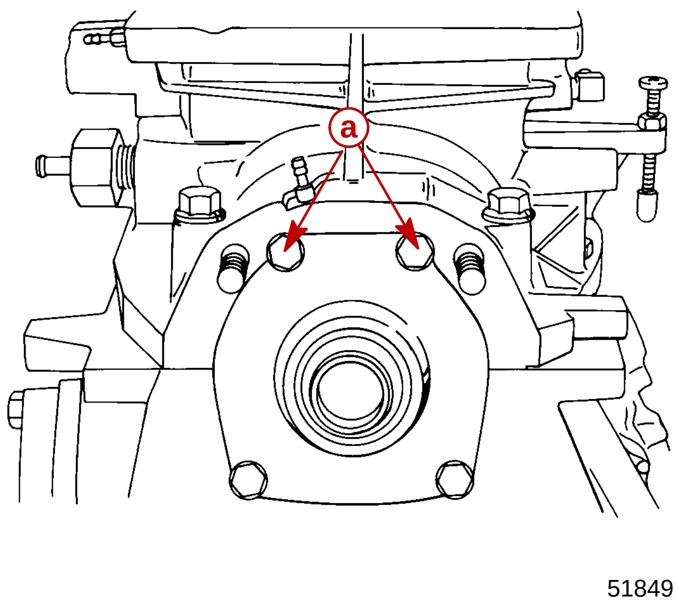
6. Inspect reeds as outlined in “Cleaning and Inspection”.
7. Remove bolts from end caps.

UPPER END CAP



a - Crankcase Attaching End Cap Bolts

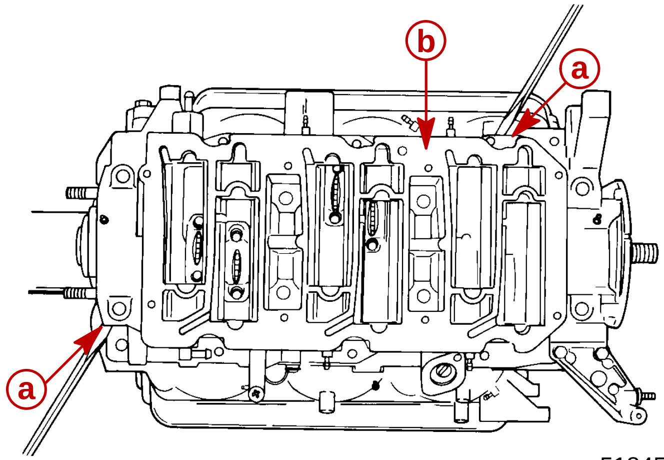
LOWER END CAP



a - Crankcase Attaching End Cap Bolts

8. Remove bolts which secure crankcase cover to cylinder block.

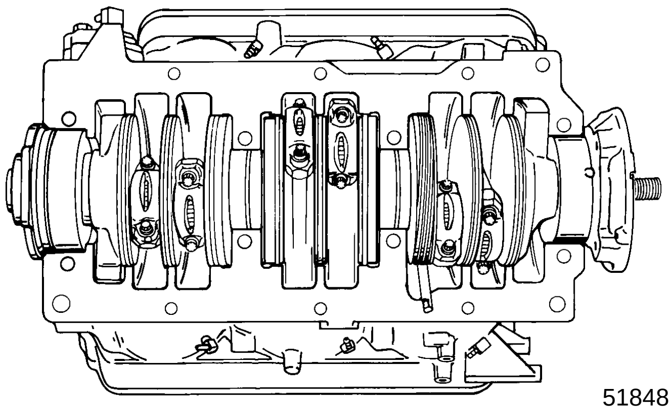
9. Pry crankcase cover off cylinder block using pry bars in locations shown.



51845

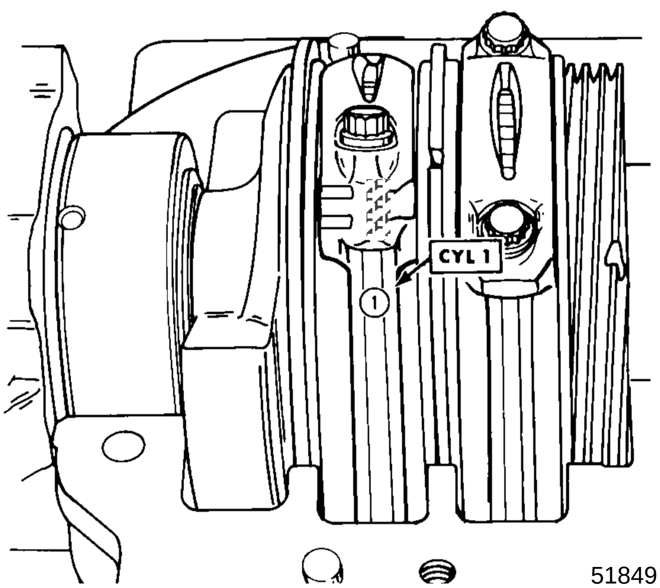
a - Pry Points
b - Crankcase Cover

CRANKCASE COVER REMOVED



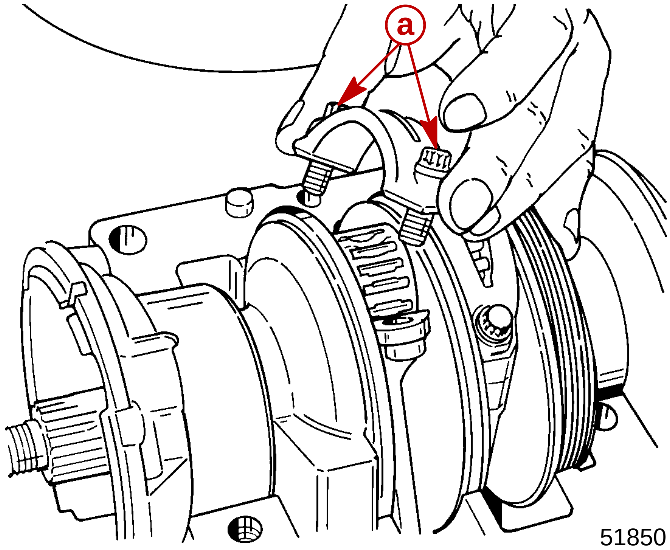
51848

10. Use Powerhead Stand (91-30591A1) for rotating crankshaft to desired position for removal of connecting rods.
11. Using an awl or electric pencil, scribe the cylinder identification number on each connecting rod as shown. Reassemble connecting rods in same cylinder.



51849

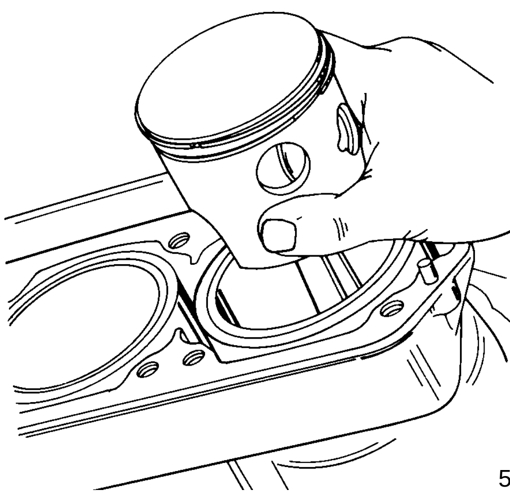
12. Use a 5/16 in. 12 point socket to remove connecting rod bolts, then remove rod cap, roller bearings and bearing cage from connecting rod.



a - Connecting Rod Bolts

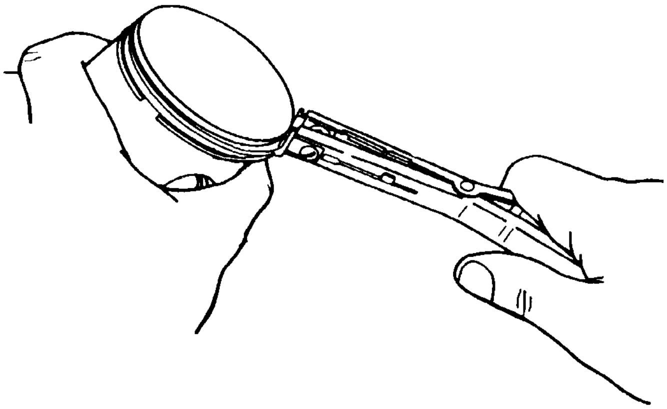
13. Push piston out of cylinder block.
14. After removal, reassemble each piston and connecting rod assembly.

⚠ CAUTION
Each connecting rod and end cap are a matched machined set and must never be mismatched.



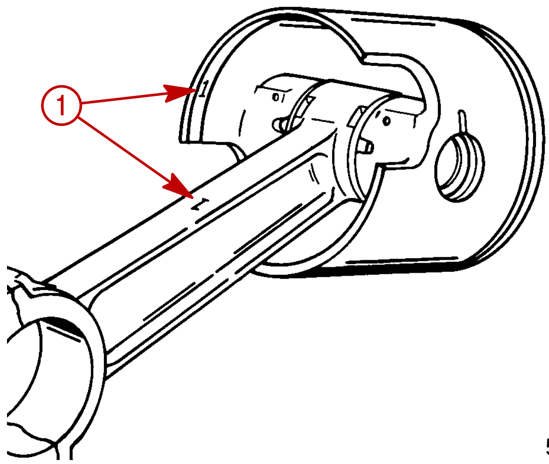
15. Inspect pistons as outlined in “Cleaning and Inspection” following.

16. Use Piston Ring Expander (91-24697) to remove piston rings. Always install new piston rings.



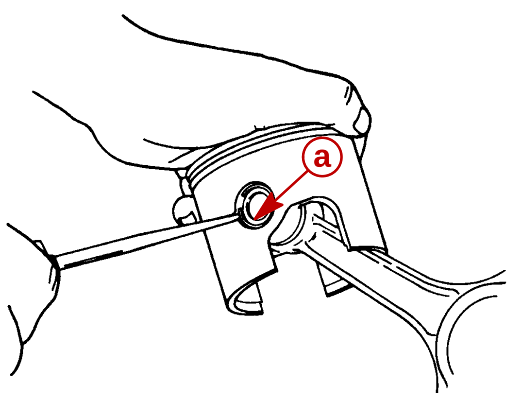
51081

17. Using an awl, scribe identification number of connecting rod on inside of piston (1). Reassemble piston on same connecting rod.



51851

18. Using tool (91-52952A1), remove piston pin lock–rings from both ends of piston pin. Never re-use piston pin lockrings.

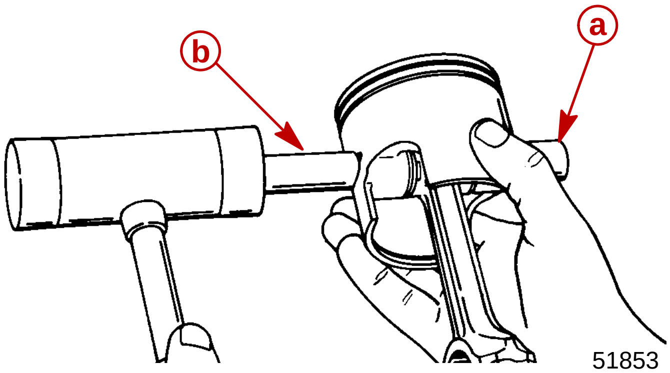


51083

a - Lockring

IMPORTANT: Warming the piston dome using a torch lamp will ease removal and installation of piston pin.

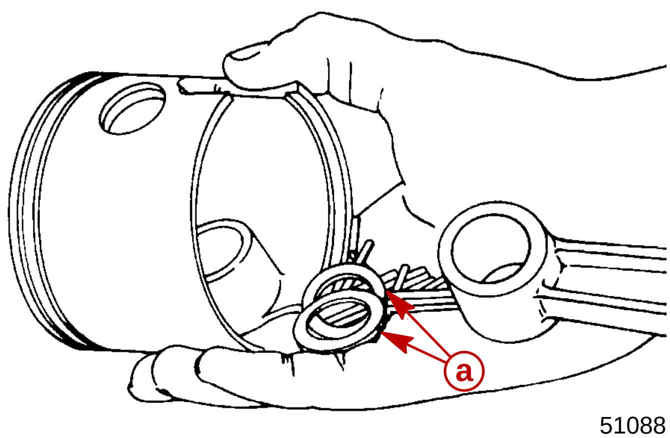
19. Support piston and tap out piston pin using service tool (91-76159A1) as shown.



a - Piston Pin
b - Piston Pin Tool (91-76159A1)

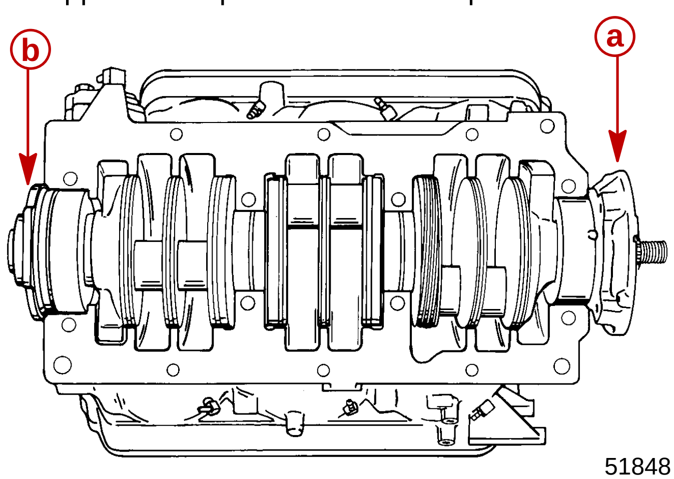
20. Remove piston pin needle bearings (29 per piston) and locating washers (2 per piston) as shown.

IMPORTANT: We recommend that you use new needle bearings at reassembly for lasting repair. However, if needle bearings must be re-used, keep each set of bearings identified for reassembly on same connecting rod.



a - Needle Bearing Locating Washers

21. Remove upper end cap and lower end cap from crankshaft.



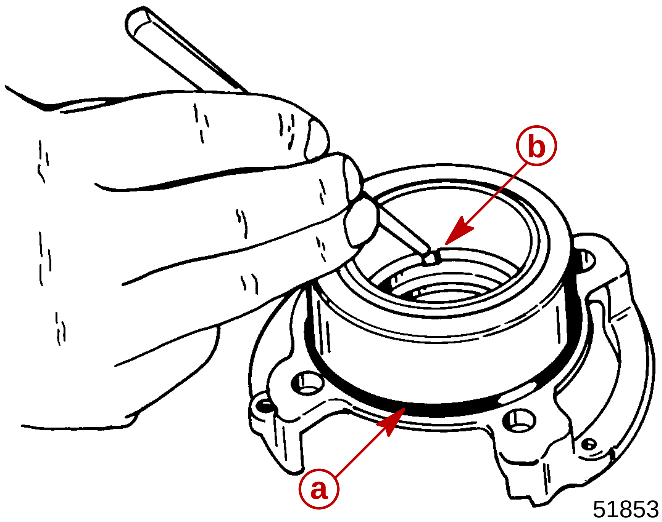
a - Upper End Cap
b - Lower End Cap

22. Remove and discard O-ring seals from each end cap.

23. Remove oil seal(s) from end of each end cap by driving seal out with a punch and hammer.

24. Inspect roller bearing in upper end cap as outlined in “Cleaning and Inspection”.

NOTE: *If roller bearing is damaged, replace upper end cap and roller bearings as an assembly.*



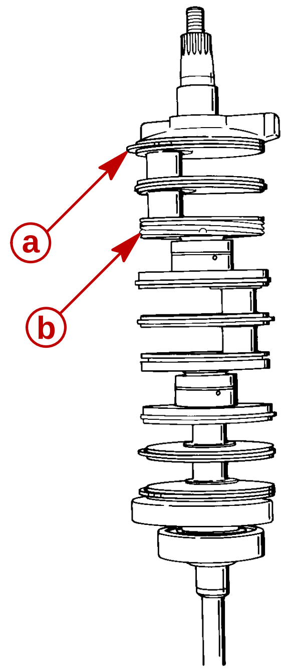
a **-** O-Ring
b **-** Seal

25. Remove crankshaft and place in powerhead stand.

IMPORTANT: DO NOT remove crankshaft sealing rings from crankshaft, unless replacement of a sealing ring(s) is necessary. Usually, crankshaft sealing rings do not require replacement, unless broken.

⚠ CAUTION
Safety glasses should be worn when removing or installing crankshaft sealing rings.

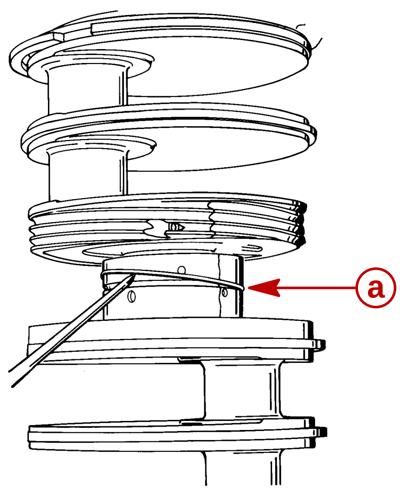
IMPORTANT: DO NOT remove oil pump drive gear on crankshaft unless gear is damaged; i.e. cracked, gear teeth chipped or fretting, or excessive looseness. Refer to Section 3D for proper oil drive gear installation procedures.



51847

a - Sealing Rings
b - Oil Pump Drive Gear

26. Remove retaining ring as shown.

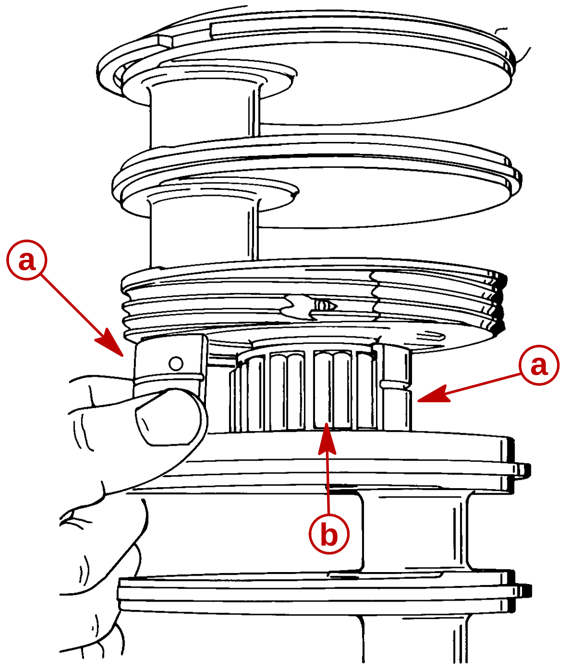


51850

a - Retaining Ring

27. Remove bearing race halves and roller bearings from crankshaft.

IMPORTANT: Keep same bearing races and roller bearings together.



51850

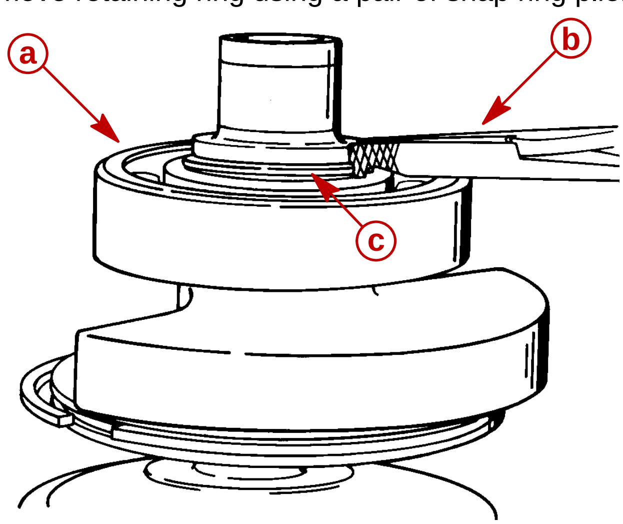
a - Bearing Race Halves
b - Roller Bearings

Inspect crankshaft ball bearing as outlined in “Cleaning and Inspection,” following.

IMPORTANT: DO NOT remove crankshaft ball bearing, unless replacement is required.

28. Remove lower ball bearing from crankshaft as follows:

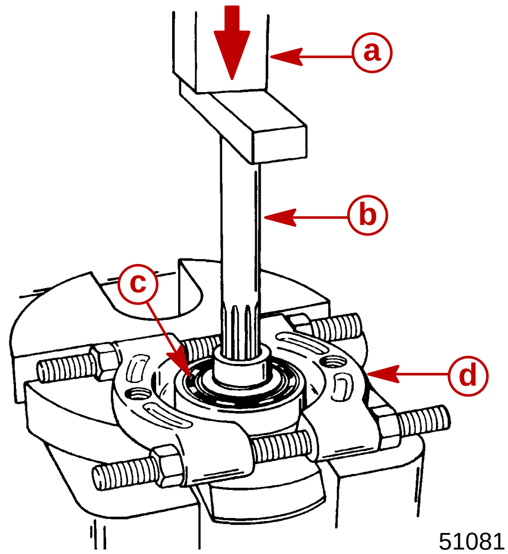
 a. Remove retaining ring using a pair of snap ring pliers.



51854

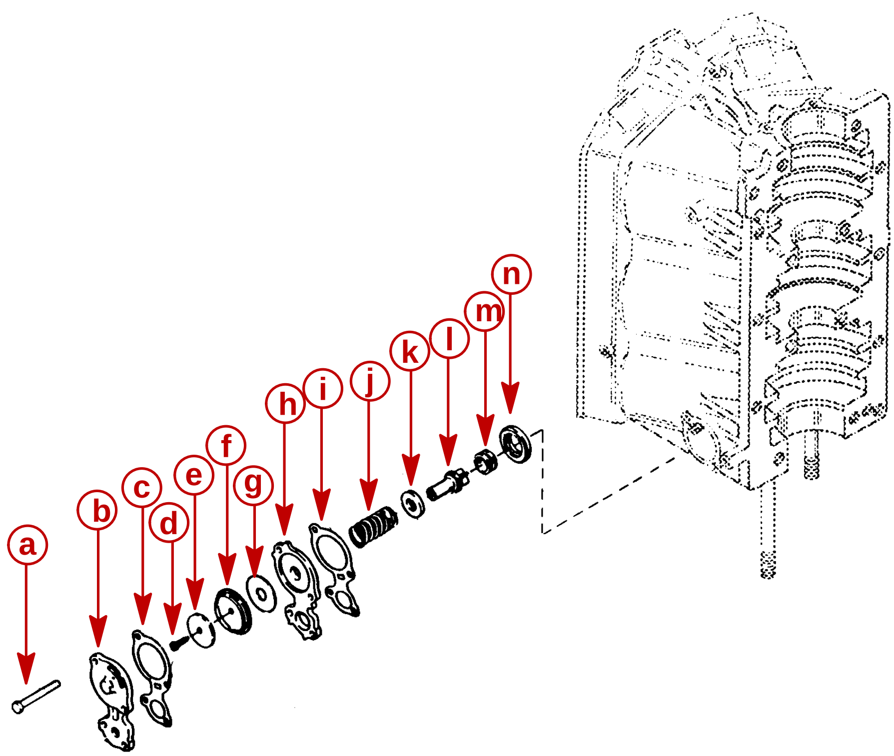
a - Crankshaft Ball Bearing
b - Pliers
c - Retaining Ring

b. Press crankshaft out of lower ball bearing as shown.



a - Press
b - Powerhead Stand (91-812549T)
c - Crankshaft Ball Bearing
d - Universal Puller Plate (91-37241)

29. If necessary, remove water pressure relief valve cover as shown.

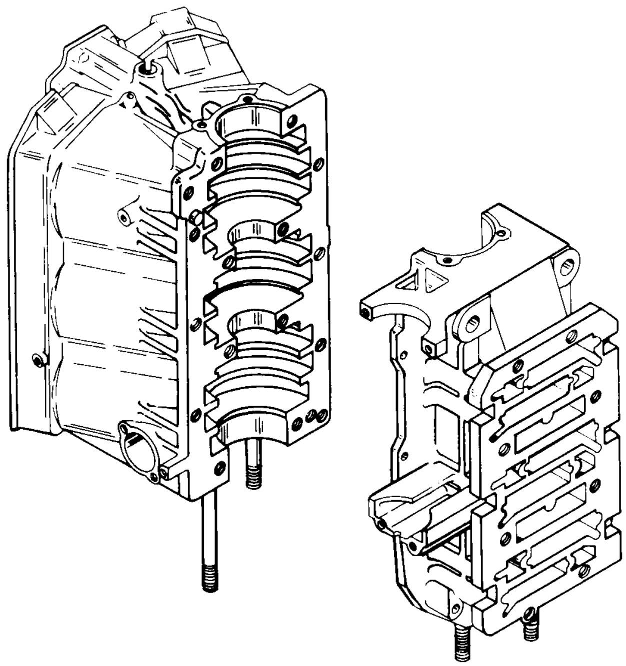


a - Bolt
b - Cover
c - Gasket
d - Screw
e - Washer
f - Diaphragm
g - Water Deflector
h - Relief Valve Plate
i - Gasket
j - Spring
k - Washer
l - Poppet Valve
m - Carrier
n - Grommet

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.

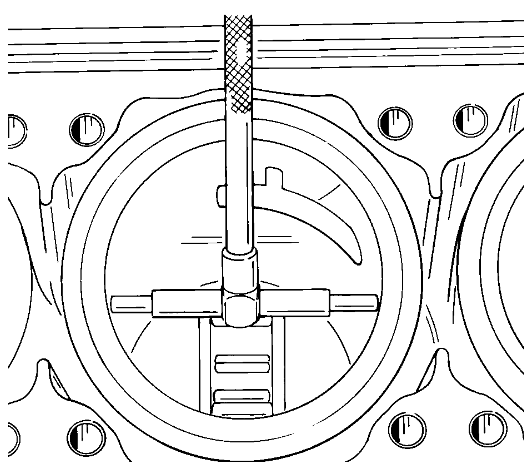
c. Start stroking at smallest diameter. Maintain firm stone pressure against cylinder wall to assure fast stock removal and accurate results.

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.



51846

Model 135 2.0 Liter	Cylinder Block Finish Hone
Standard Piston	3.125 in. (79.375 mm)
0.015 in. (0.381 mm) Oversize Piston	3.140 in. (79.756 mm)
0.030 in. (0.762 mm) Oversize Piston	3.155 in. (80.137 mm)

Models 150/175/200 2.5 liter	Cylinder Block Finish Hone
Standard Piston	3.501 in. (88.93 mm)
0.015 in. (0.381 mm) Oversize Piston	3.516 in. (89.31 mm)

4. If a cylinder bore is tapered, out-of-round or worn more than 0.003 in. (0.076 mm) 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. (0.381 mm) or 0.030 in. (0.762 mm) oversize or re-sleeve and install oversize piston(s) and piston rings during reassembly.

NOTE: *The weight of an oversize piston is approximately the same as a standard size piston; therefore, it is not necessary to re-bore all cylinders in a block just because one cylinder requires re-boring.*

5. After honing and thoroughly cleaning cylinder bores, apply light oil to cylinder walls to prevent rusting .

Pistons and Piston Rings

IMPORTANT: If engine was submerged while engine was running, piston pin and/or connecting rod may be bent. If piston pin is bent, piston must be replaced. (Piston pins are not sold separately because of matched fit into piston.) If piston pin is bent, connecting rod must be checked for straightness (refer to “Connecting Rods,” following, for checking straightness).

1. Inspect pistons for scoring and excessive piston skirt wear.
2. Check tightness of piston ring locating pins. Locating pins must be tight.
3. Thoroughly clean pistons. Carefully remove carbon deposits from pistons, with a soft wire brush or carbon removal solution. Do not burr or round off machined edges.

Inspect piston ring grooves for wear and carbon accumulation. If necessary, scrape carbon from piston ring grooves **being careful not to scratch sides of grooves**. Refer to procedure following for cleaning piston ring grooves.

CLEANING PISTON RING GROOVES

NOTE: *Cleaning instructions differ between the rectangular ring groove and keystone (tapered) ring groove. Pistons may have two keystone ring grooves or one keystone ring groove and one rectangular ring groove as shown.*

Rectangular ring grooves

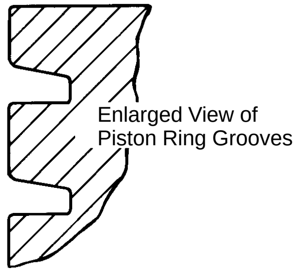
1. A broken rectangular piston ring can be used as a tool for scraping carbon from ring grooves. Carefully scrape carbon from ring grooves without scratching the side surfaces of grooves.

Keystone (tapered) ring grooves

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

1. Use a bristle brush and carbon remover solution to remove carbon from side surfaces.
2. A tool can be made for cleaning the inner diameter of the tapered ring grooves. The tool can be made from a broken tapered piston ring with the side taper removed to enable the inside edge of the ring to reach the inner diameter of the groove. Carefully scrape carbon from inner diameter of ring grooves. Care must be taken not to damage the grooves by scratching the side surfaces of the grooves.

Piston with two half keystone (half tapered) rings



MEASURING PISTON ROUNDNESS

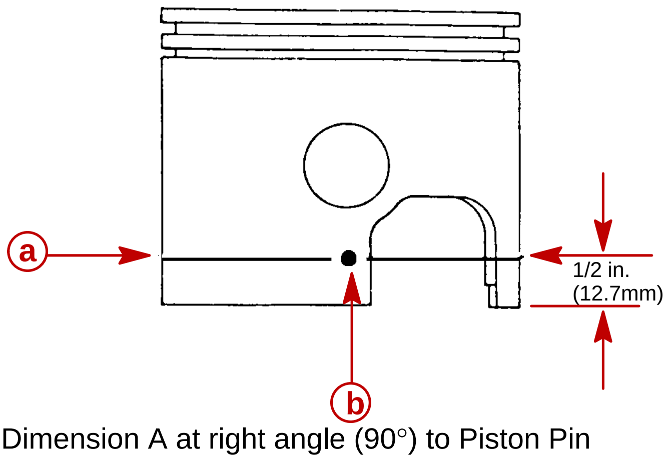
Piston has a barrel profile shape and is not a true diameter.

1. Using a micrometer, measure dimension "A" at location shown. Dimension "A" should be as indicated in chart following.

135 Piston	Dimension "A"
Standard Piston	3.115 in. ± .002 in. (79.121 mm ± .051 mm)
0.015 in. Oversize Piston	3.130 in. ± .002 in. (79.502 mm ± .051 mm)
0.030 in. Oversize Piston	3.145 in. ± .002 in. (79.883 mm ± .051 mm)

150/175/200 Piston	Dimension "A"
Standard Piston	3.494 in. ± .001 in. (88.747 mm ± .025 mm)
0.015 in. Oversize Piston	3.509 in. ± .001 in. (89.128 mm ± .025 mm)

2. Using a micrometer, measure dimension "B" at location shown. Dimension "B" should be within 0.008 in. of dimension "A."



a - Dimension A at right angle (90°) to Piston Pin
b - Dimension B (inline with Piston Pin)

Cylinder Heads and Exhaust Divider Plate

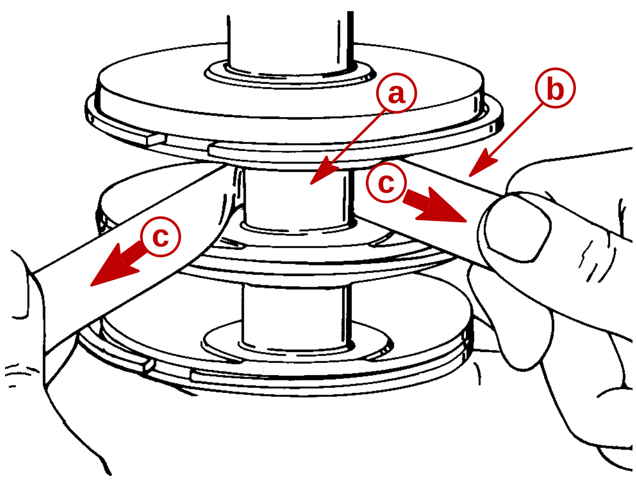
1. Inspect internal surface of cylinder heads for possible damage (as a result of piston or foreign material striking cylinder heads).

IMPORTANT: Cylinder head warpage should not exceed 0.004 in. (0.1 mm) over the ENTIRE length of the cylinder head. If measured warpage, as determined on a surface block, exceeds 0.004 in. (0.1 mm) or a discontinuity of up to 0.004 in. (0.1 mm) exists in a narrow portion of the cylinder head's surface length, then the cylinder head may be re-surfaced up to 0.010 in. (0.25 mm).

2. Replace cylinder head(s) as necessary.
3. Thoroughly clean gasket surfaces of exhaust divider plate.
4. Inspect exhaust divider plate for deep grooves, cracks or distortion that could cause leakage. Replace parts as necessary.

Crankshaft

1. Inspect crankshaft to drive shaft splines for wear. (Replace crankshaft, if necessary.)
2. Check crankshaft for straightness – maximum runout: 0.006 in. (0.152 mm) (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.



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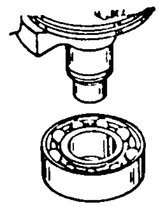
a - Crankshaft Journals
b - Crocus Cloth
c - Work Cloth "Back-and-Forth"

⚠ WARNING
DO NOT spin-dry crankshaft ball bearing with compressed air.

6. Thoroughly clean (with solvent) and dry crankshaft and crankshaft ball bearing. Re-check surfaces of crankshaft. Replace crankshaft, if surfaces cannot be properly "cleaned up." If crankshaft will be re-used, lubricate surfaces of crankshaft with light oil to prevent rust. DO NOT lubricate crankshaft ball bearing at this time.

Crankshaft (and End Cap) Bearings

1. After cleaning crankshaft, grasp outer race of crankshaft ball bearing (installed on lower end of crankshaft) and attempt to work race back-and- forth. There should not be excessive play.
2. Lubricate ball bearing with light oil. Rotate outer bearing race. Bearing should have smooth action and no rust stains. If ball bearing sounds or feels “rough” or has “catches,” remove and discard bearing. (Refer to “Powerhead Removal and Disassembly - Crankshaft Removal and Disassembly”.)

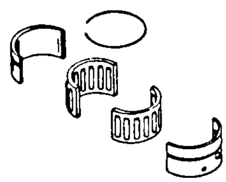


3. Thoroughly clean (with solvent) and dry crankshaft center main roller bearings. Lubricate bearings with 2-Cycle Outboard Oil.

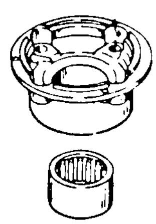
CAUTION

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.



5. Clean (with solvent) and dry crankshaft roller bearing that is installed in upper end cap. Lubricate bearing with light oil.
6. Thoroughly inspect upper end cap roller bearing. If roller bearing is rusted, fractured, worn, galled, badly discolored or loose inside of end cap replace end cap and roller bearing as an assembly.

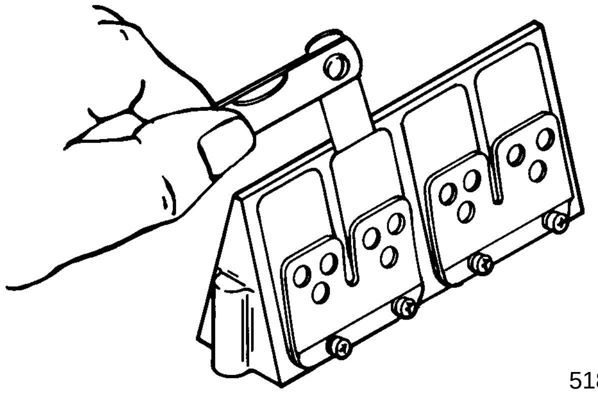


Reed Block Assembly

IMPORTANT: Reed block assembly is not serviceable. If reeds are damaged replace reed block assembly.

1. Thoroughly clean gasket surfaces of reed blocks and reed block housing. Check for deep grooves, cracks and distortion that could cause leakage. Replace parts as necessary.
2. Check for wear (indentations) on face of each reed block. Replace reed block assembly if reeds have made indentations.

3. Check for chipped and broken reeds.



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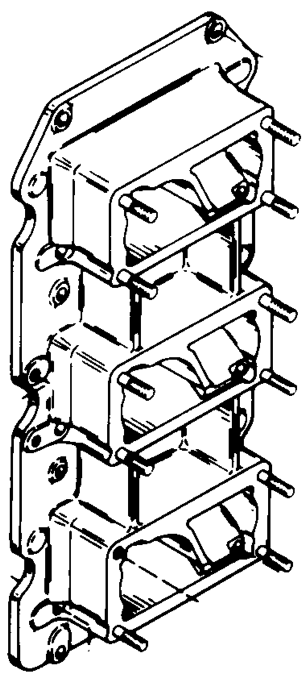
Allowable reed opening is 0.020 in. (0.51 mm) or less. Replace reed block assembly if any reed is standing open more than 0.020 in. (0.51 mm).

Reed Block Housing

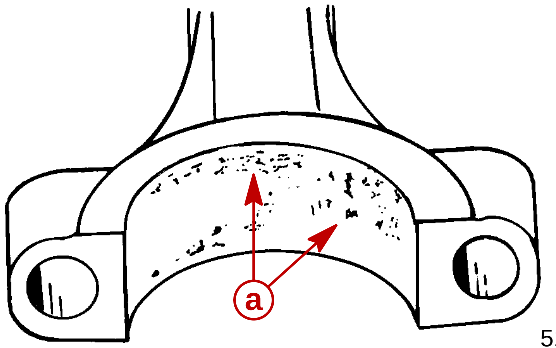
1. Check rubber bleed hoses. Replace any hose that is cracked, cut or deteriorating.
2. Check operation of bleed system check valves in reed block housing. If valves are working properly, air can be drawn thru check valves “one way” only. If air can pass thru a check valve both ways, valve is not working properly and must be replaced.
3. Check that bleed system check valves are pressed tight into reed housing.
4. Inspect passages in reed block housing to be sure that they are not obstructed.



Connecting Rods

1. Check connecting rods for alignment by placing rods on a surface plate. If light can be seen under any portion of machined surfaces, if rod has a slight wobble on plate, or if a 0.002 in. (0.051 mm) 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).



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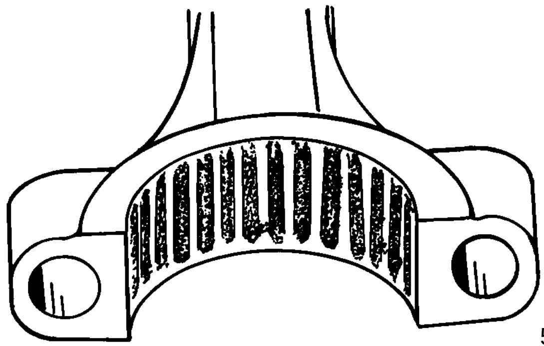
a - Pitting

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



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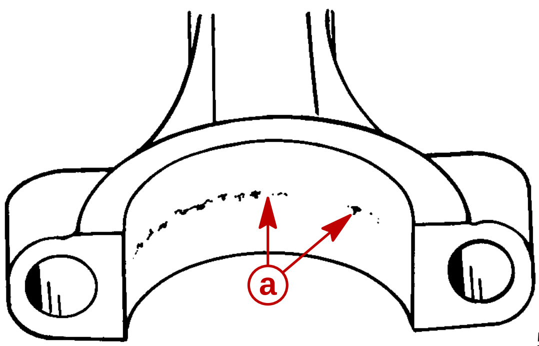
5. **Spalling:** Spalling is the loss of bearing surface, and it resembles flaking or chipping. Spalling will be most evident on the thrust portion of the connecting rod in line with the "I" beam. General bearing surface deterioration could be caused by or accelerated by improper lubrication.



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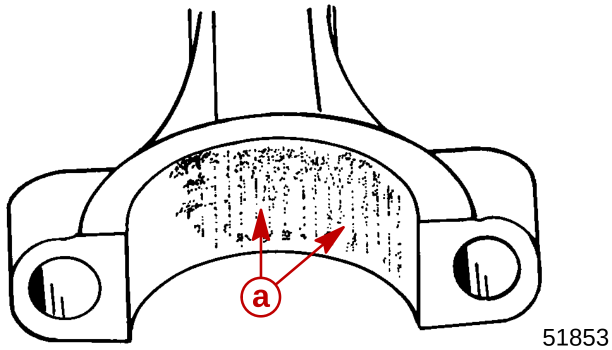
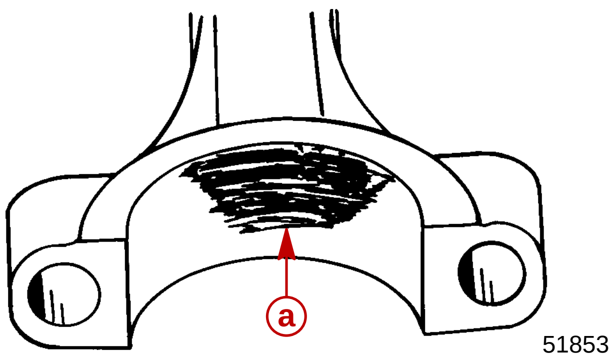
a - Spalling

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



a - Chatter Marks Between Arrows

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



a - Uneven Wear Between Arrows

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

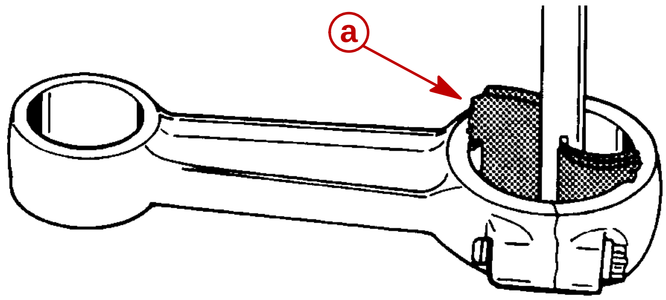
   a. Be sure that "etched" marks on connecting rod (crankshaft end) are perfectly aligned with "etched" marks on connecting rod cap. Tighten connecting rod cap attaching bolts securely.

CAUTION

Crocus cloth MUST BE USED to clean bearing surface at crankshaft end of connecting rod. DO NOT use any other type of abrasive cloth.

   b. **Clean CRANKSHAFT END of connecting rod by using CROCUS CLOTH** placed in a slotted 3/8 in. (9.5 mm) 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.



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a - Crocus Cloth

c. **Clean PISTON PIN END of connecting rod**, using same method as in Step "b", preceding, but using 320 grit carborundum cloth instead of crocus cloth.

d. Thoroughly wash connecting rods to remove abrasive grit. Recheck bearing surfaces of connecting rods. Replace any connecting rod(s) that cannot be properly "cleaned up." Lubricate bearing surfaces of connecting rods (which will be re-used) with light oil to prevent rust.

Powerhead Reassembly and Installation

General

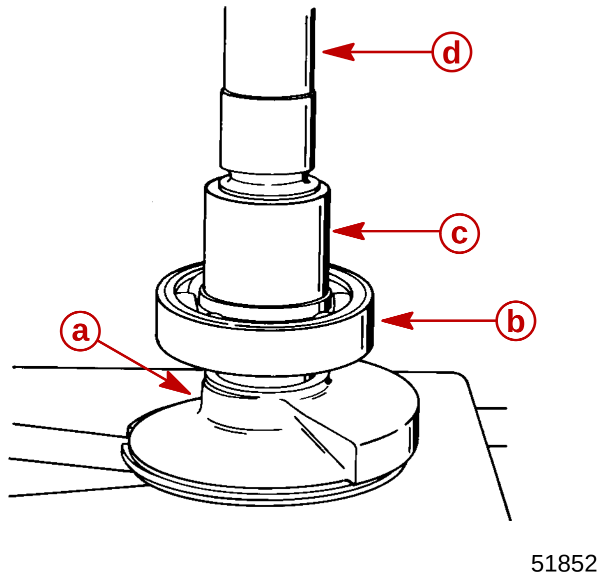
Before proceeding with powerhead reassembly, be sure that all parts to be re-used have been carefully cleaned and thoroughly inspected, as outlined in "Cleaning and Inspection," preceding. Parts, which have not been properly cleaned (or which are questionable), can severely damage an otherwise perfectly 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).

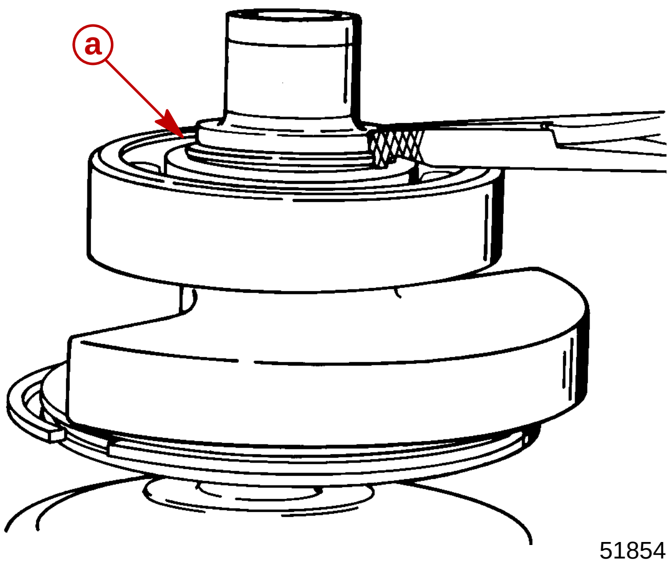
EXAMPLE: If cylinder head attaching bolts require a torque of 30 lb. ft. (40.7 N·m), a) tighten all bolts to **10 lb. ft. (13.5 N·m)**, following specified torque sequence, b) tighten all bolts to **20 lb. ft. (27 N·m)**, following torque sequence, then finally c) tighten all bolts to **30 lb. ft. (40.7 N·m)**, following torque sequence.

1. If removed, press lower crankshaft ball bearing onto crankshaft as shown. Be sure bearing is pressed firmly against counterweight.



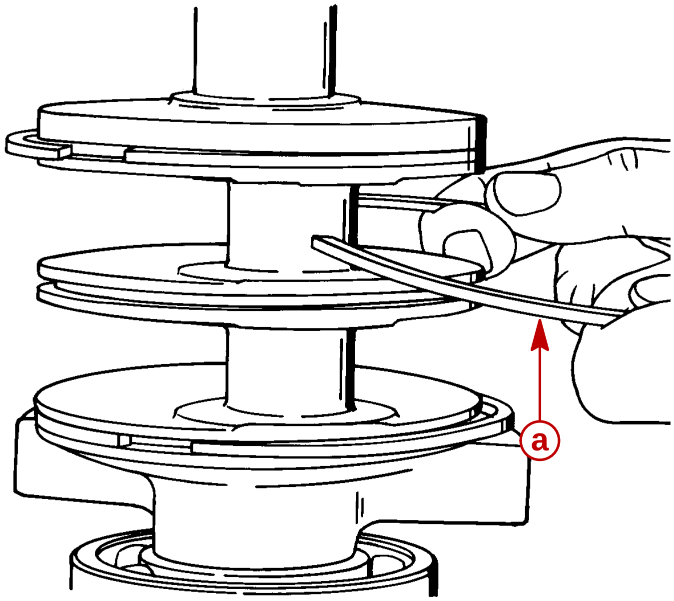
a - Crankshaft
b - Crankshaft Ball Bearing
c - Suitable Mandrel
d - Press

2. Reinstall retaining ring using a suitable pair of Snap Ring Pliers.



a - Retaining Ring

3. If removed, spread new crankshaft sealing rings just enough to slide over crankshaft journal.



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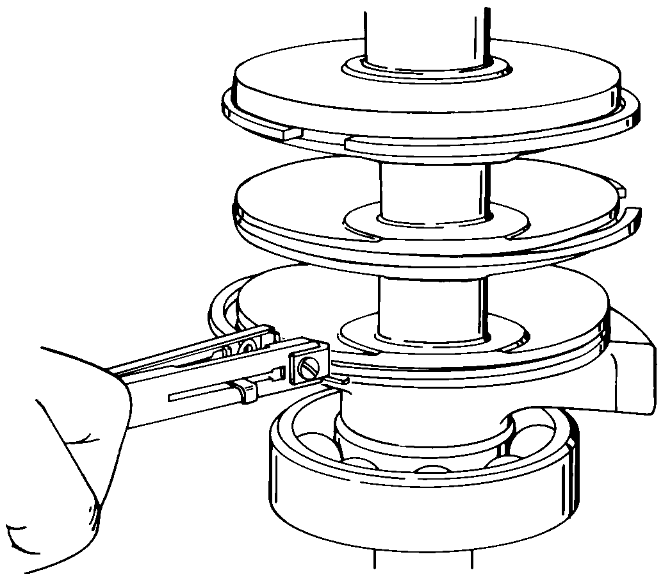
a - Crankshaft Sealing Rings

4. Use Piston Ring Expander (91-24697) and install crankshaft sealing rings into groove.



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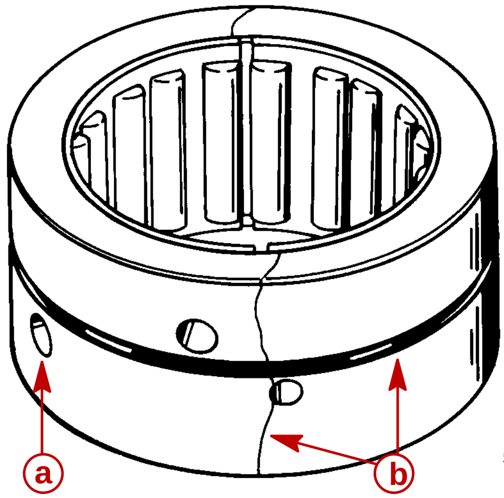
5. Lubricate center main crankshaft roller bearings and races with light oil.

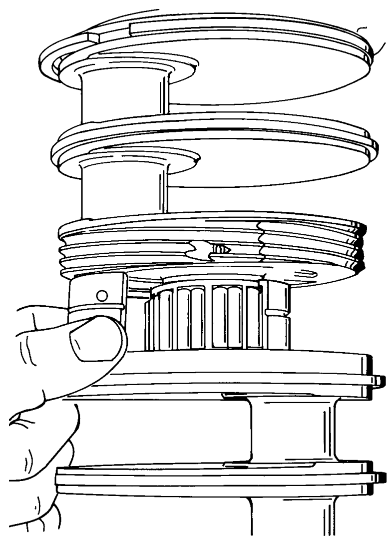


a - Install so larger of the 3 holes is toward bottom end of crankshaft
b - Verify retaining ring bridges the separating lines of the bearing race

6. Place center main crankshaft roller bearings on upper and lower main bearing journals as shown.

7. Install center main bearing races as shown.

FLYWHEEL END



BOTTOM END

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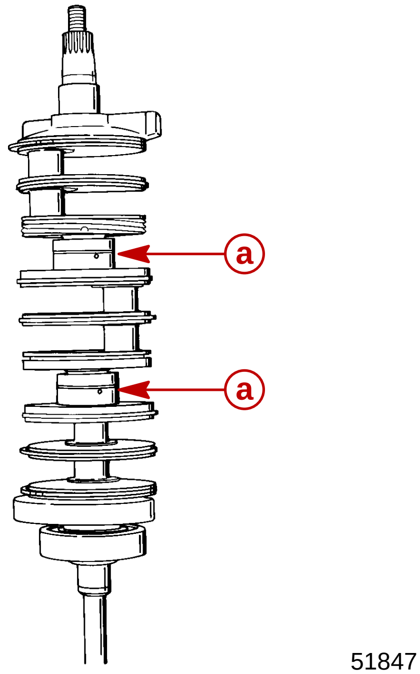
8. Secure center main bearing races together with retaining rings. Make sure retaining ring bridges the separating lines of the bearing race.



a - Center main Bearing Races

9. Install oil seals into lower end cap as follows:

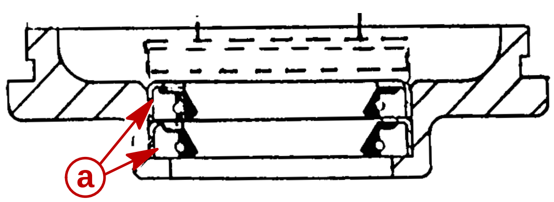
   a. Apply a thin bead of Loctite 271 (92-809820) to outer diameter on 2 lower end cap oil seals.

   b. Using driver head (91-55919) press one oil seal (lip facing down) into lower end cap until firmly seated. Remove any excess Loctite.

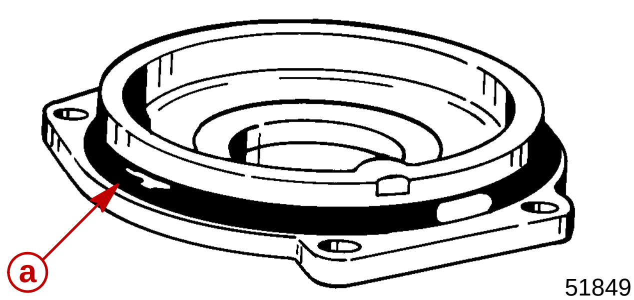
   c. Press second oil seal (lip facing down) until firmly seated on first oil seal. Remove any excess Loctite.

   d. Lubricate oil seal lips with Quicksilver 2-4-C w/Teflon Marine Lubricant (92-825407A12).

   e. Lubricate O-ring seal with Quicksilver 2-4-C w/Teflon Marine Lubricant (92-825407A12) and install over lower end cap.

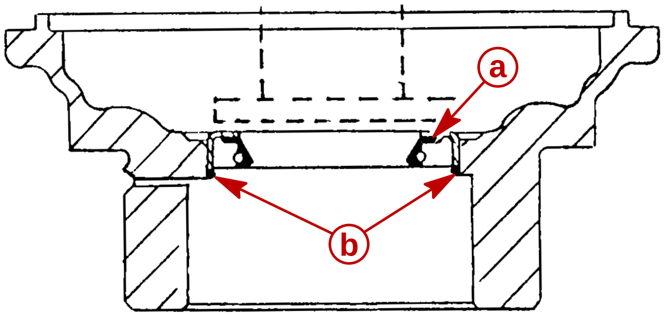


a - Oil Seal

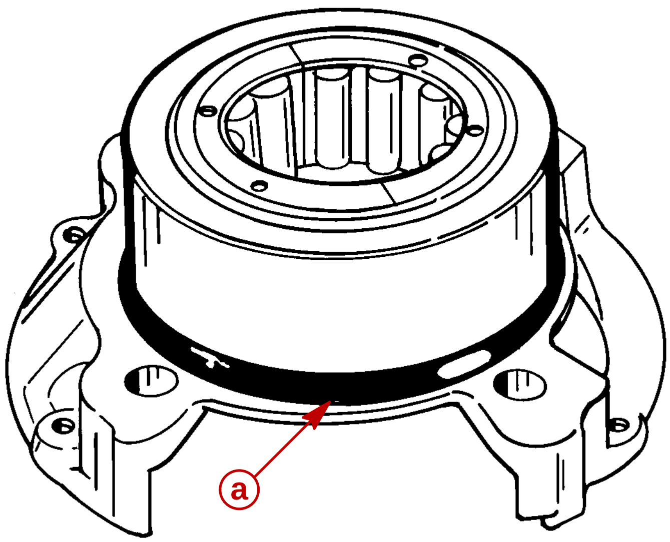


a - O-ring

10. Install oil seal into upper end cap as follows:
    a. Apply a thin bead of Loctite 271 (92-809820) to outer diameter of upper end cap oil seal.
    b. Use a suitable mandrel, press oil seal into upper end cap (lip facing down) until bottomed out on lip of end cap. Remove any excess Loctite.
    c. Lubricate oil seal lip with Quicksilver 2-4-C w/Teflon Marine Lubricant (92-825407A12).
    d. Lubricate O-ring with Quicksilver 2-4-C w/Teflon Marine Lubricant (92-825407A12) and install on end cap.



a - Oil Seal
b - Lip of End Cap



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a - O-ring

Crankshaft Installation

SPECIAL INFORMATION

Installing A New Crankshaft Assembly Into Cylinder Block

Check the crankshaft sealing ring mating surfaces in the cylinder block and crankcase cover for wear grooves that were caused by the crankshaft sealing rings from the previous crankshaft. If wear grooves are present, the sealing rings on the new crankshaft will have to fit into the grooves without binding the crankshaft.

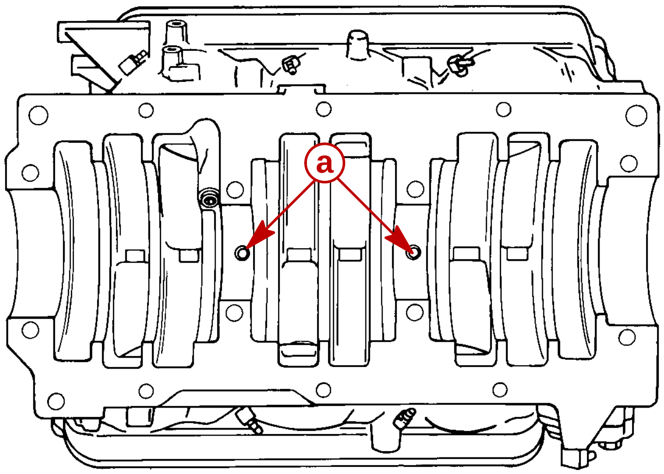
Before installing crankshaft, remove any burrs that may exist on groove edges.

Lubricate sealing rings with light oil and install new crankshaft as instructed.

Install upper and lower end caps and then inspect fit between sealing rings and grooves. Temporarily install crankcase cover and rotate crankshaft several times to check if sealing rings are binding against crankshaft. (You will feel a drag on the crankshaft.) If sealing rings are binding, recheck grooves for burrs. If this does not correct the problem, it is recommended that the cylinder block be replaced.

Install crankshaft as follows:

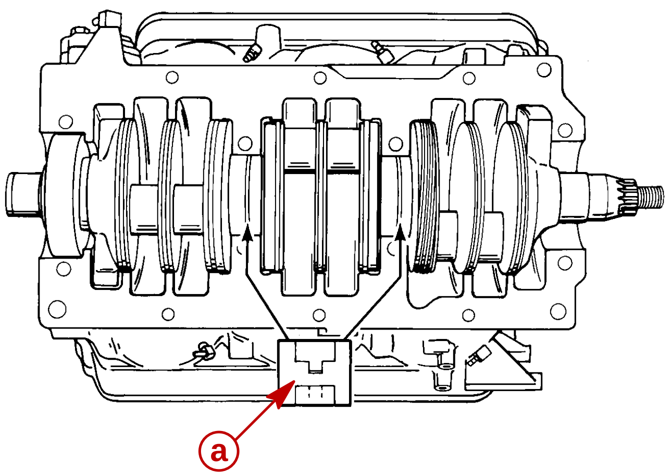
1. Lubricate crankshaft sealing rings with light oil.
2. Check cylinder block to be sure that dowel pins are in place.



51848

a - Dowel Pins

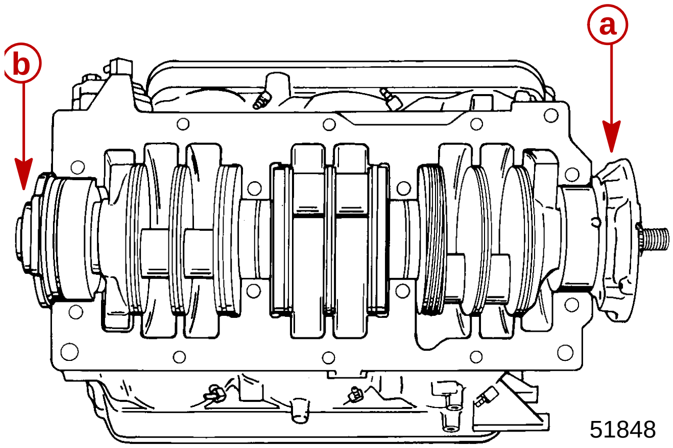
3. Position all crankshaft seal ring gaps straight up.
4. Align hole in each center main bearing race with dowel pin.
5. Gently push crankshaft down into position making sure that the dowel pins are lined up with the holes in center main bearings and crankshaft seal rings are in place.



51848

a - Dowel Pin

6. Lubricate crankshaft ends (oil seal areas) with light oil, then install upper and lower end caps (“a” and “b”). Secure end caps to cylinder block with attaching bolts. DO NOT tighten end cap bolts at this time.



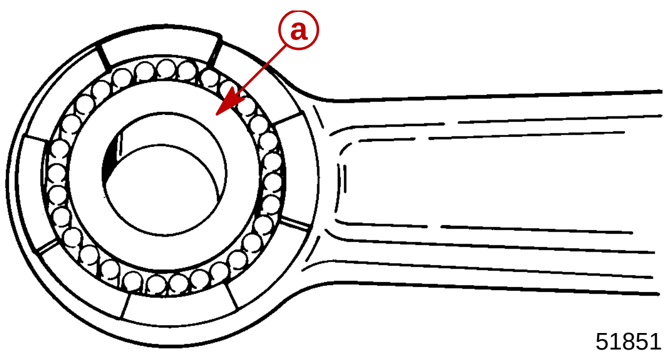
a - Upper End Cap
b - Lower End Cap

Piston and Connecting Rod Reassembly

1. Place needle bearings on a clean piece of paper and lubricate with Quicksilver 2-4-C w/Teflon Marine Lubricant (92-825407A12).

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

2. Place sleeve which is part of piston pin tool (91- 74607A3) into connecting rod and install needle bearings around sleeve as shown.

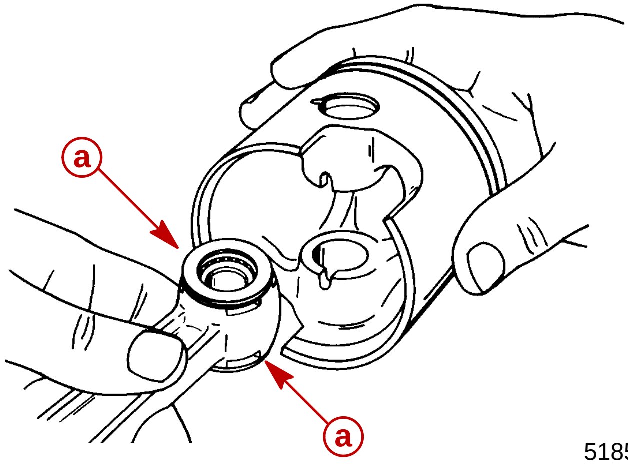


a - Sleeve (Part of Tool Assy. 91-74607A3)

3. Place locating washers on connecting rod.

IMPORTANT: Position connecting rod part number facing towards flywheel.

Carefully position piston over end of rod. Make sure locating washers remain in place.



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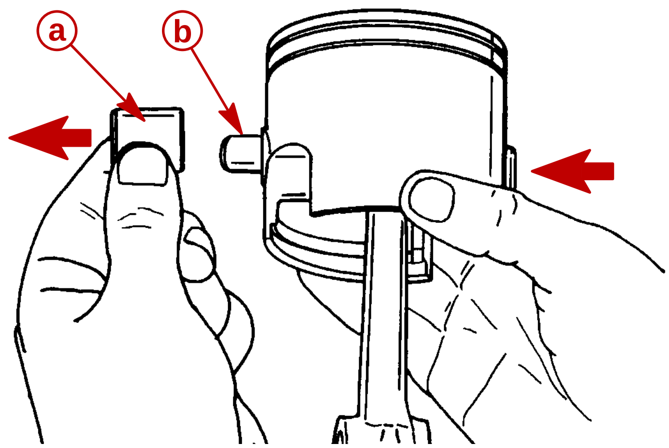
a - Locating Washers

4. Insert piston pin tool (91-74607A3) and push sleeve out of piston. Keep piston pin tool in piston.



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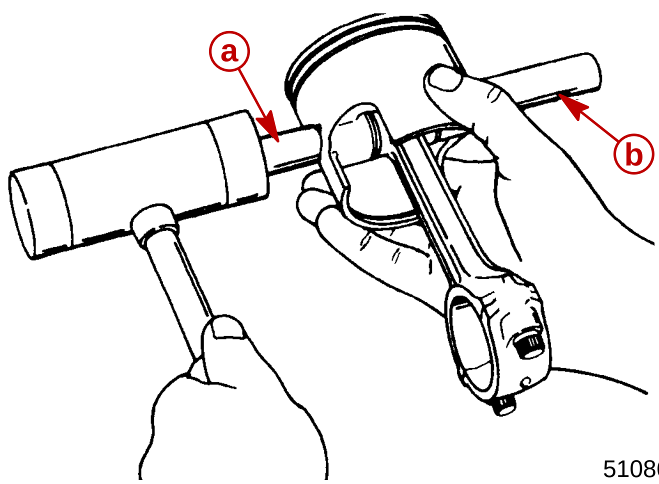
a - Piston Pin Tool (91-74607A3)
b - Sleeve

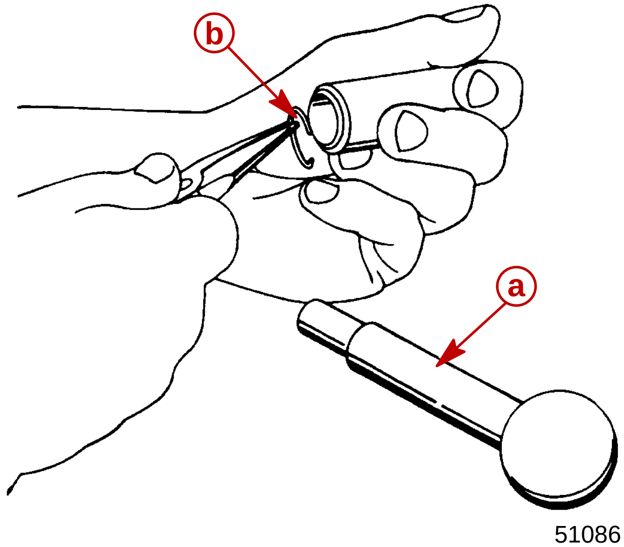
5. Use a mallet and tap piston pin into piston and push piston pin tool out.



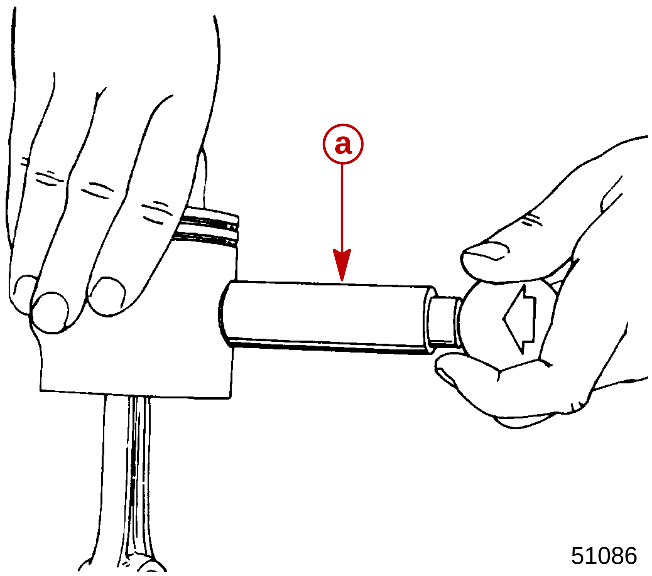
51086

a - Piston Pin
b - Piston Pin Tool

6. Install new piston pin lockrings (one each end of piston pin) with Lockring Installation Tool (91-77109A3).
7. Make sure lockrings are properly seated in piston grooves.



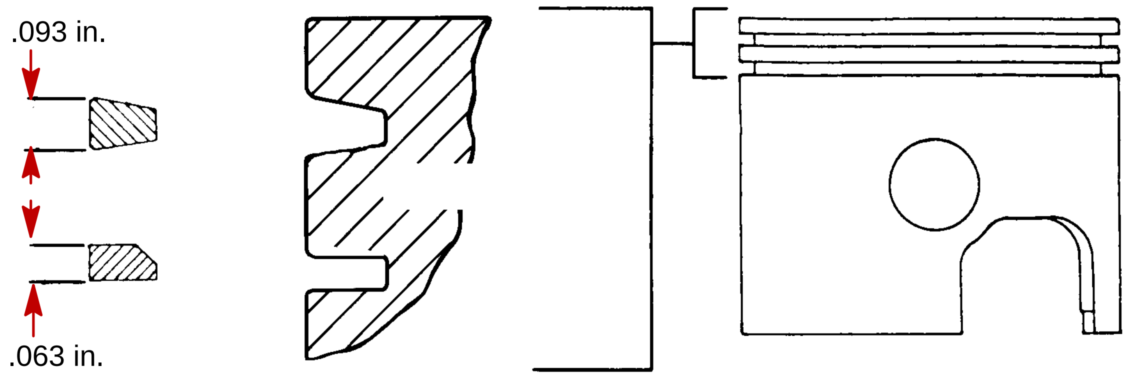
a - Lockring Installation Tool (91-77109A3)
b - Lockring



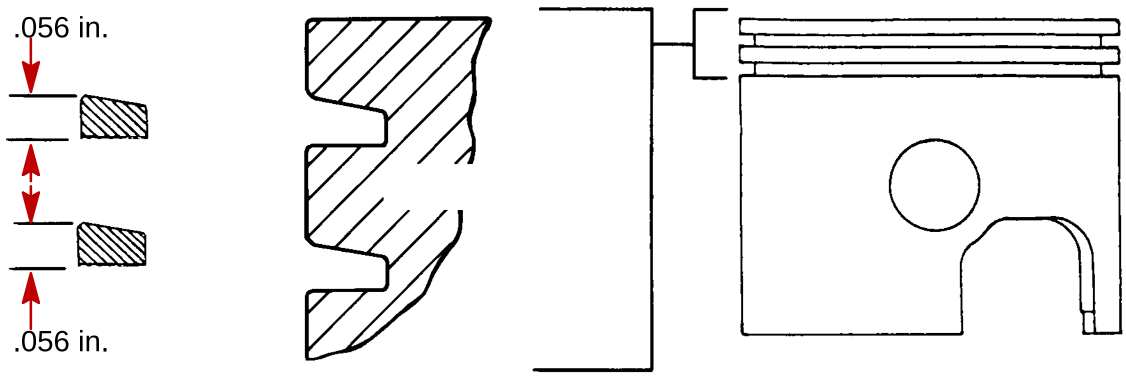
a - Lockring Installation Tool

Piston and Piston Ring Combinations

All 122 cu. in. (2.0 Liter) models have one keystone (tapered) ring on top and one rectangular ring on bottom.



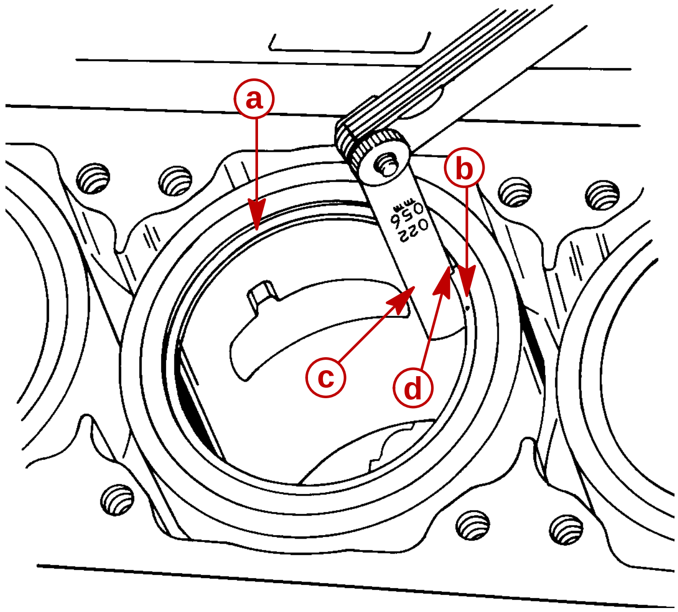
All 153 cu. in. (2.5 Liter) models have two half keystone (half tapered) rings.



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.

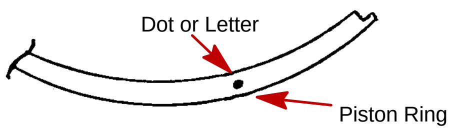
2. Check end gap of each new piston ring with a feeler gauge. End gap must be within 0.018 in. to 0.025 in. (0.45mm to 0.64mm). If end gap is greater, check other piston rings in cylinder bore, until rings (within tolerance) are found.



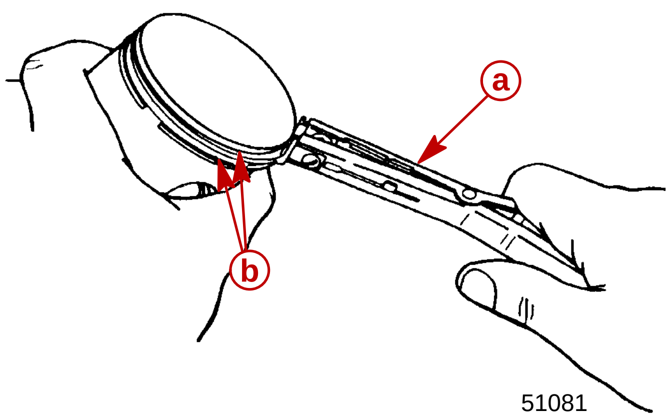
51852

a - Piston Ring
b - Dots (Faces Up)
c - Feeler Gauge
d - Ring End Gap

IMPORTANT: Piston ring side with dot or letter must be facing up.



3. Use Piston Ring Expander (91-24697) and install piston rings (dot side up) on each piston. Spread rings just enough to slip over piston.
4. Check piston rings to be sure that they fit freely in ring groove.
5. Lubricate piston, rings and cylinder wall with 2-Cycle Outboard Oil.



51081

a - Piston Ring Expander
b - Dot Side "Up" on Piston Ring

6. Rotate each piston ring so end of ring is aligned with locating pin as shown.
7. Install Piston Ring Compressor.

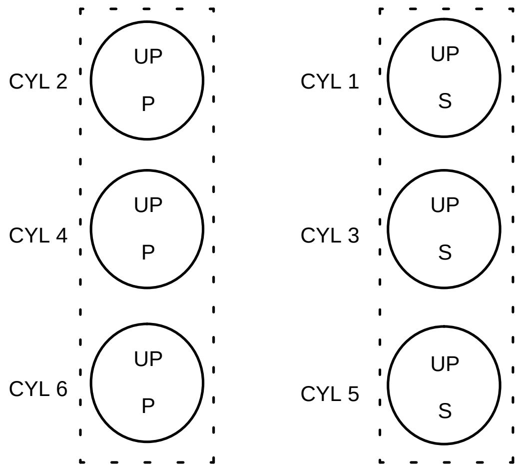
8. Remove screws and connecting rod cap from piston rod assembly being installed.

IMPORTANT: Piston must be correctly installed and positioned as shown.

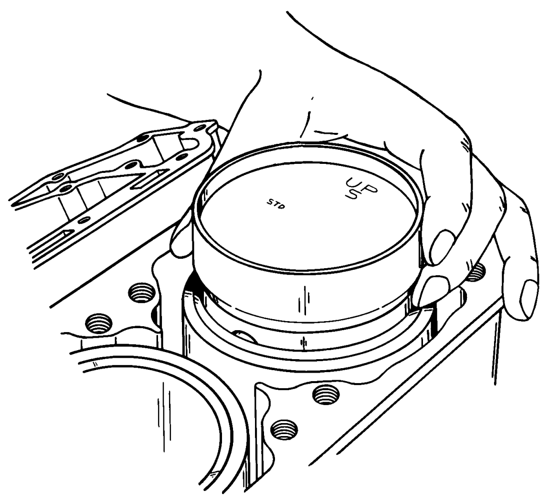
Pistons marked with the word “UP” and with the letter “P” or “S” on top of piston.

Pistons with the letter “P” must be installed in the port side of engine and the word “UP” facing toward top of engine.

Pistons with the letter “S” must be installed in the starboard side of engine and the word “UP” toward top of engine.



9. Coat cylinder bore with 2-cycle oil. Match piston assembly with cylinder it was removed from, and position piston as described below. Push piston into cylinder.



50802

10. Apply Quicksilver 2-4-C w/Teflon to bearing surface of connecting rod and install bearing assembly, as shown.

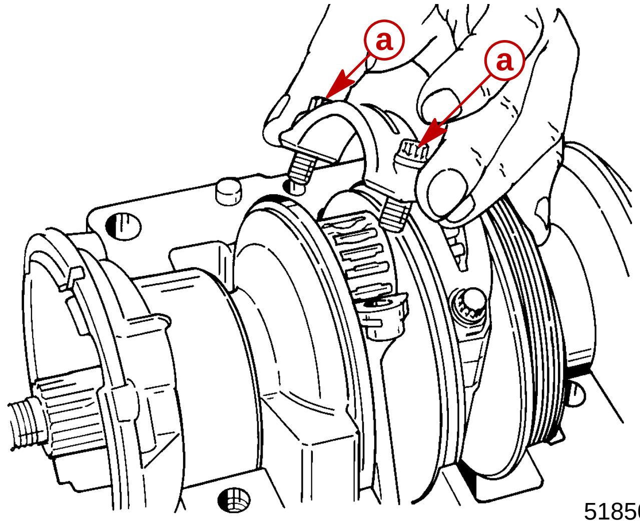
11. Place connecting rod cap on connecting rod. Apply light oil to threads and face of connecting rod bolts. Thread connecting rod bolts finger-tight while checking for correct alignment of the rod cap as shown.

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 5/16 in. - 12 point socket) First torque to 15 lb. in. (1.7 N·m) then 30 lb. ft. (40.6 N·m). Turn each bolt an additional 90° after 2nd torque is attained. Recheck alignment between rod cap and rod as shown.

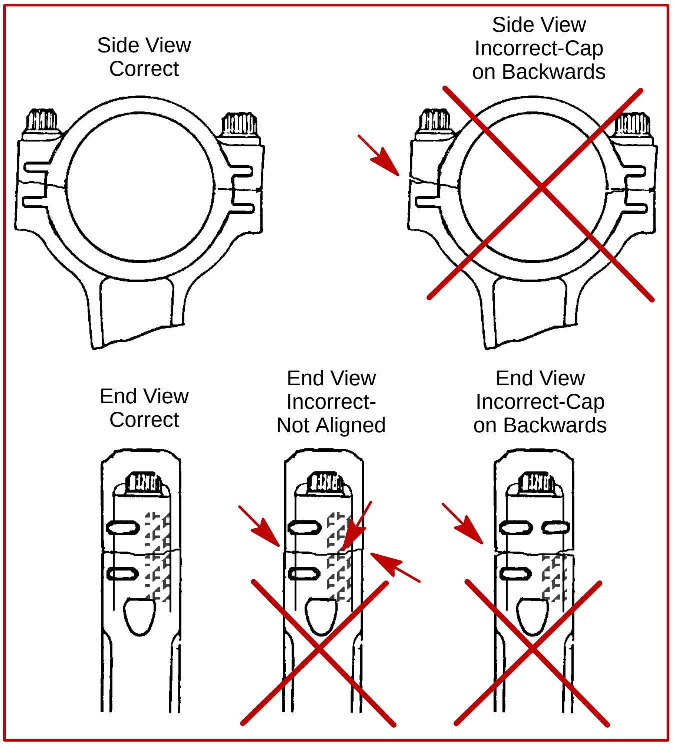


a - Connecting Rod Screws

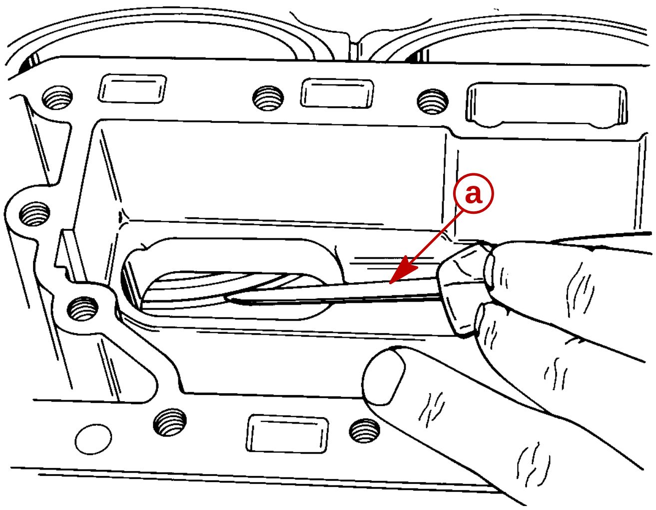
13. Rotate crankshaft several times (using powerhead stand) to assure free operation (no binds and catching).

Connecting Rod Cap Alignment

Check each connecting rod cap for correct alignment. If not aligned, a ridge can be seen or felt at the separating line as shown below. Correct any misalignment.



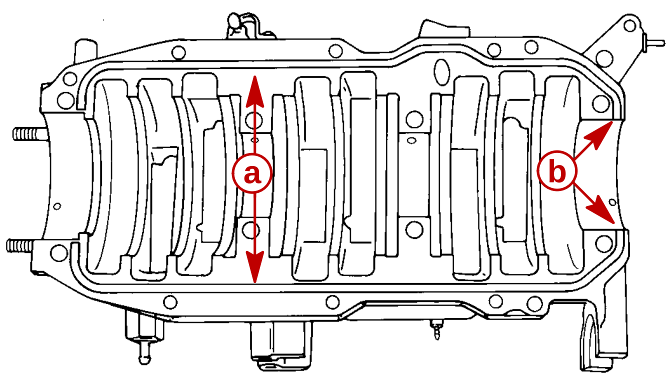
14. Verify that no piston rings were broken during installation by pressing in on each piston ring thru exhaust port using a screwdriver. If no spring tension exists (ring fails to return to position), it's likely ring is broken and must be replaced.



a - Screwdriver

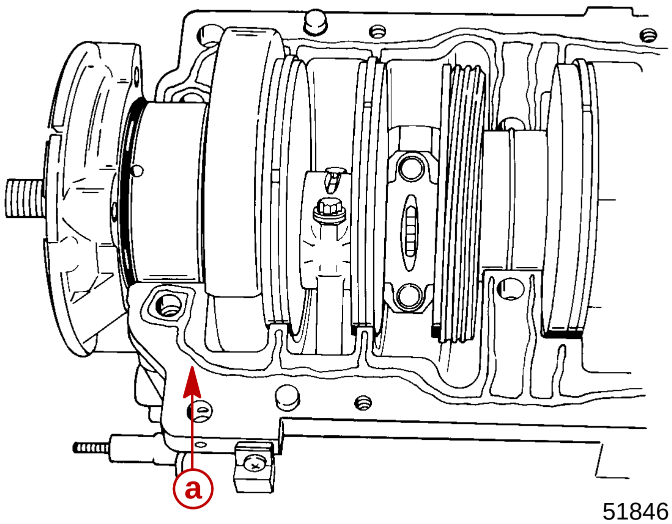
Crankcase Cover Installation

1. Thoroughly remove all oil from mating surfaces of crankcase cover and cylinder block with Loctite 7649 Primer (92-809824).
2. Install gasket strips into grooves in crankcase cover. Trim end of each gasket strip flush with edge of cover as shown.



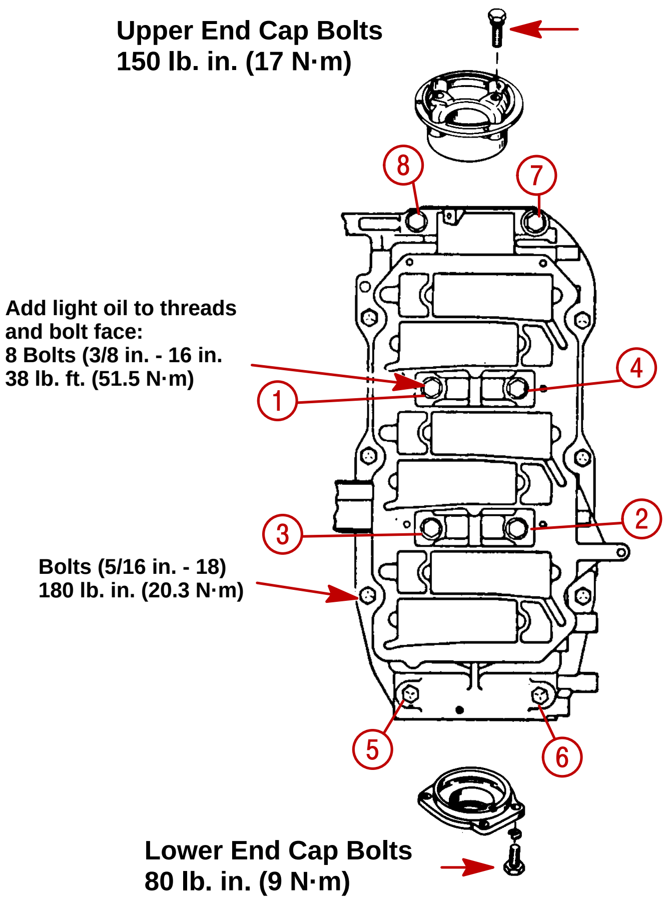
a - Gasket Strips
b - Edge of Cover

3. Apply a thin, even coat of Loctite Master Gasket #203 on mating surfaces of crankcase cover and cylinder block.

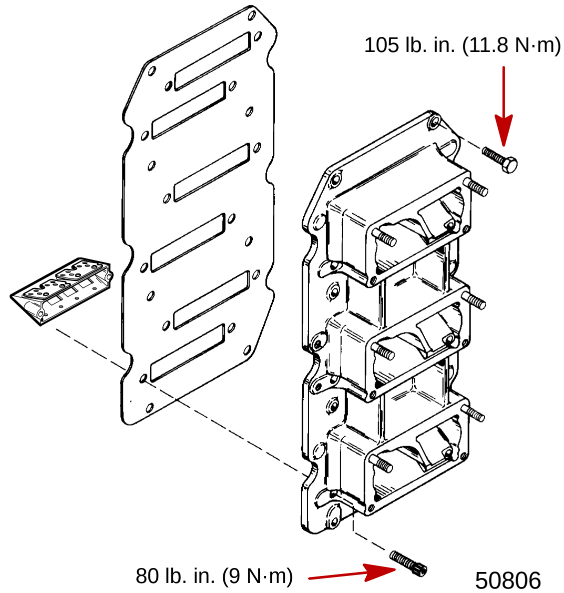


a - Loctite Master Gasket (92-12564-2)

4. Place crankcase cover in position on cylinder block. Turn the 8 center main bolts in a LITTLE at a time, (following torque sequence) compressing crankshaft seal rings until crankshaft cover has been drawn down to cylinder block. Tighten eight bolts evenly in three progressive steps (following torque sequence).
5. Install remaining crankcase cover flange bolts.
6. Tighten end cap bolts to specified torque.

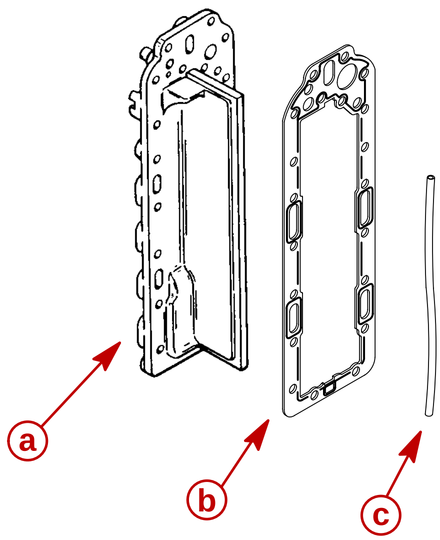


Assembly of Reed Blocks to Intake Manifold



Assembly of Exhaust Manifold to Block

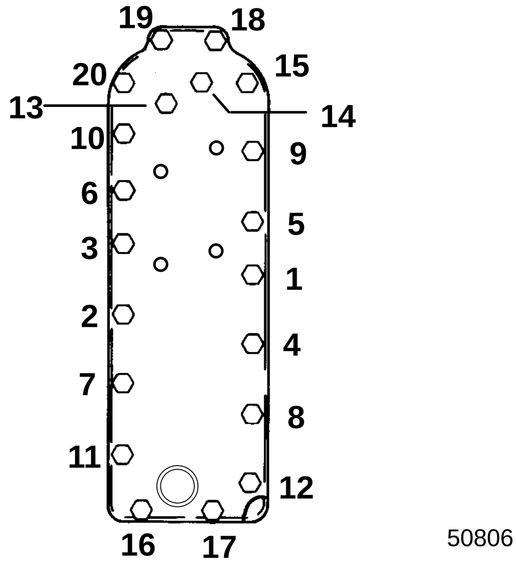
1. Place exhaust divider seal into slot in block.
2. Install exhaust manifold with gasket.
3. Install gasket and exhaust manifold cover.
4. Apply light oil to bolt threads and torque bolts to 180 lb. in. (20 N·m).



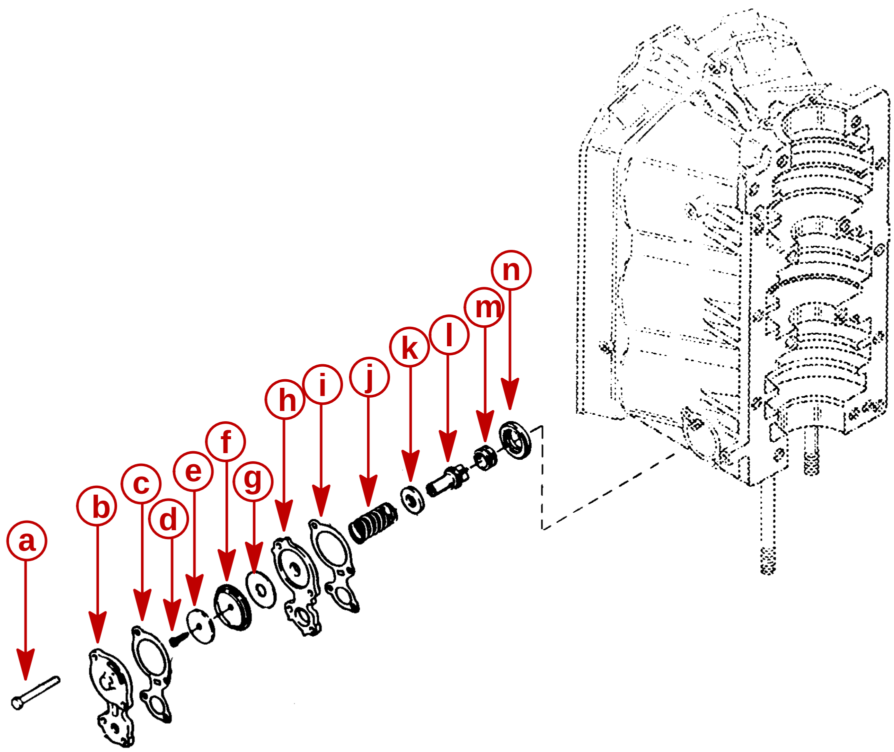
a - Divider Seal
b - Exhaust Cover
c - Gasket

5. Torque exhaust manifold cover bolts in following sequence.

Exhaust manifold cover Bolts 180 lb. in. (20 N·m)
Apply light oil to threads and bolt head



6. If removed, install water pressure relief valve cover as shown.

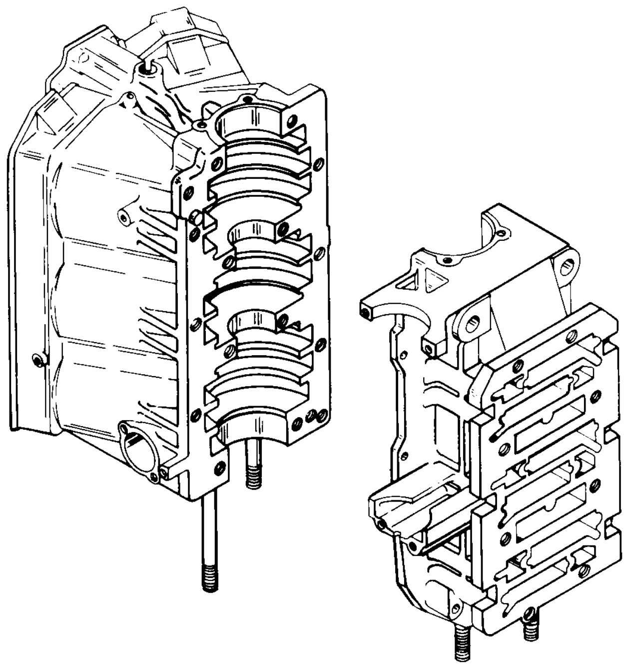


- **a** - Bolt
- **b** - Cover
- **c** - Gasket
- **d** - Screw
- **e** - Washer
- **f** - Diaphragm
- **g** - Water Deflector
- **h** - Relief Valve Plate
- **i** - Gasket
- **j** - Spring
- **k** - Washer
- **l** - Poppet Valve
- **m** - Carrier
- **n** - Grommet

Cleaning and Inspection

Cylinder Block and Crankcase Cover

IMPORTANT: Crankcase cover and cylinder block is a matched, line-bored assembly and should never be mismatched by using a different crankcase cover or cylinder block.



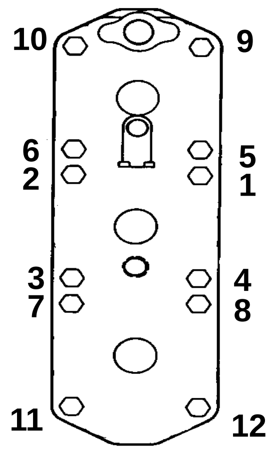
CAUTION

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.

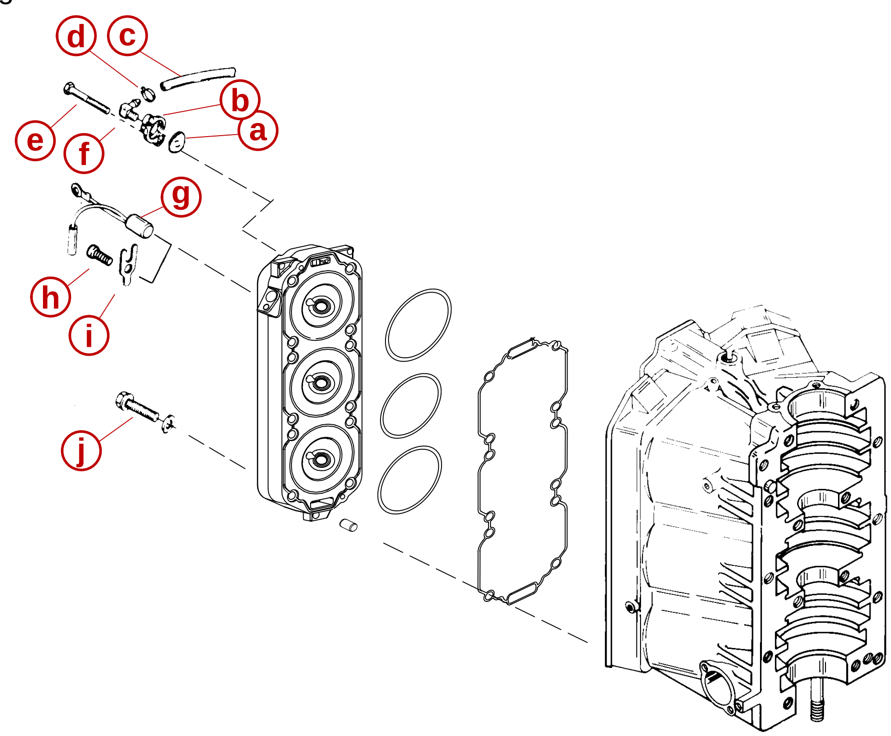
1. Thoroughly clean cylinder block and crankcase cover. Be sure that all sealant and old gaskets are removed from matching surfaces. Be sure that carbon deposits are removed from exhaust ports.
2. Inspect cylinder block and crankcase cover for cracks or fractures.
3. Check gasket surfaces for nicks, 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.

CYLINDER HEAD INSTALLATION

1. Install each cylinder head to engine block with thermostat pocket “UP”. Apply light oil to cylinder head bolt threads and torque bolts to 30 lb. ft. (40.7 N·m) and rotate 90°.



2. Install thermostat washer into each cylinder head.
3. Install overheat temperature sensor into STARBOARD cylinder head below #1 spark plug.



- **a** - Washer
- **b** - Thermostat Cover
- **c** - Hose
- **d** - Clamp
- **e** - Bolt (Torque to 200 Lb. in. - 22.6 N·m)
- **f** - 90° Elbow
- **g** - Temperature Sensor
- **h** - Bolt (Torque to 200 Lb. in. - 22.6 N m)
- **i** - Retainer
- **j** - Bolt [Apply Light Oil to Threads - Torque to 30 lb. ft. (40.7 N·m) and rotate 90°]

Reinstalling Engine Components

Install the following engine components:

SECTION 2

- **a** - Starter Motor
- **b** - Ignition Modules*
- **c** - Starter Solenoid*
- **d** - Trim Solenoids
- **e** - Voltage Regulator*
- **f** - Control Module
- **g** - Detonation Module (200 EFI only)
- **h** - Flywheel
- **i** - Stator Assembly*
- **j** - Trigger Assembly*

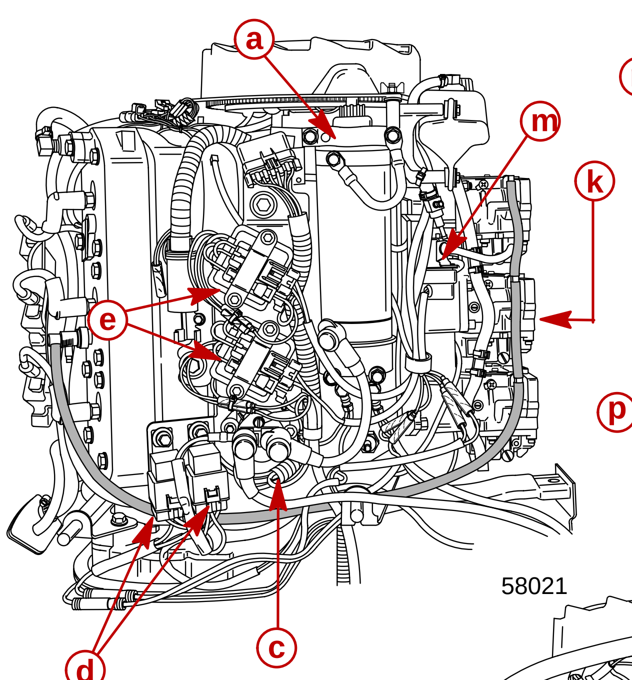
SECTION 3

- **k** - Air Silencer,Carburetors and Linkage
- **l** - Fuel Pump
- **m** - Fuel Enrichment Valve
- **n** - Oil Reservoir
- **o** - Oil Pump
- **p** - Fuel Injection

SECTION 4

- **q** - Shift Cable Latch Assy.
- **r** - Control Cable Anchor Bracket

All ignition and electrical components should remain attached to electrical plate. Plate with components can be installed as an assembly.



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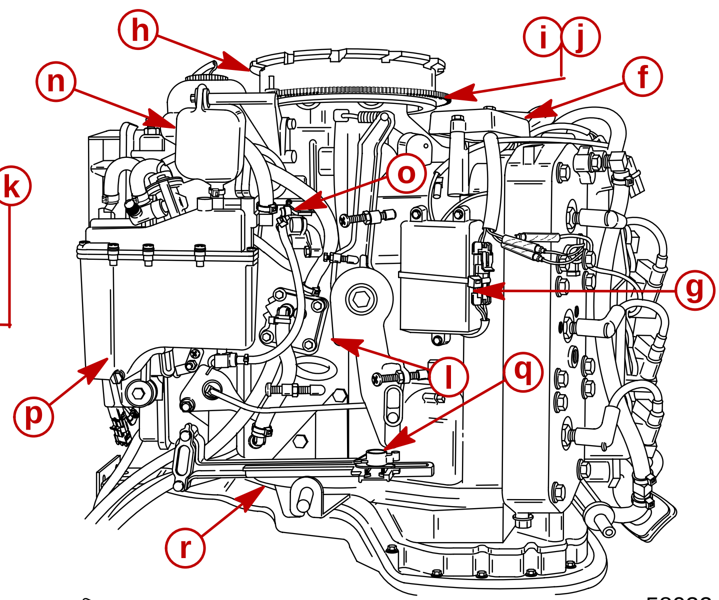

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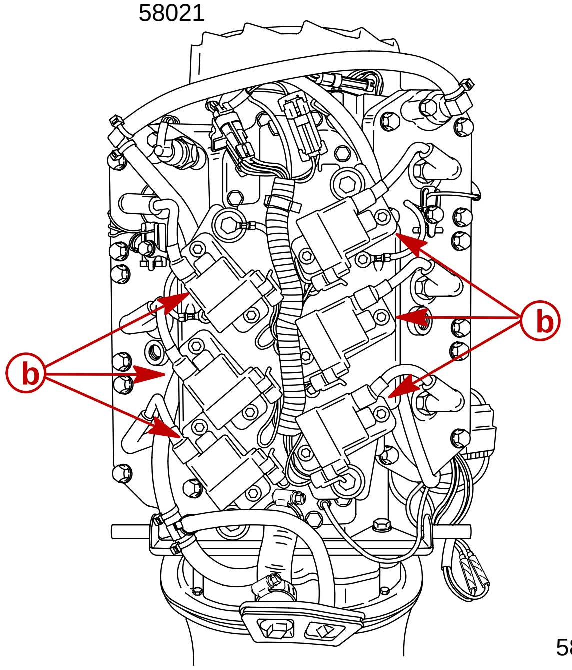

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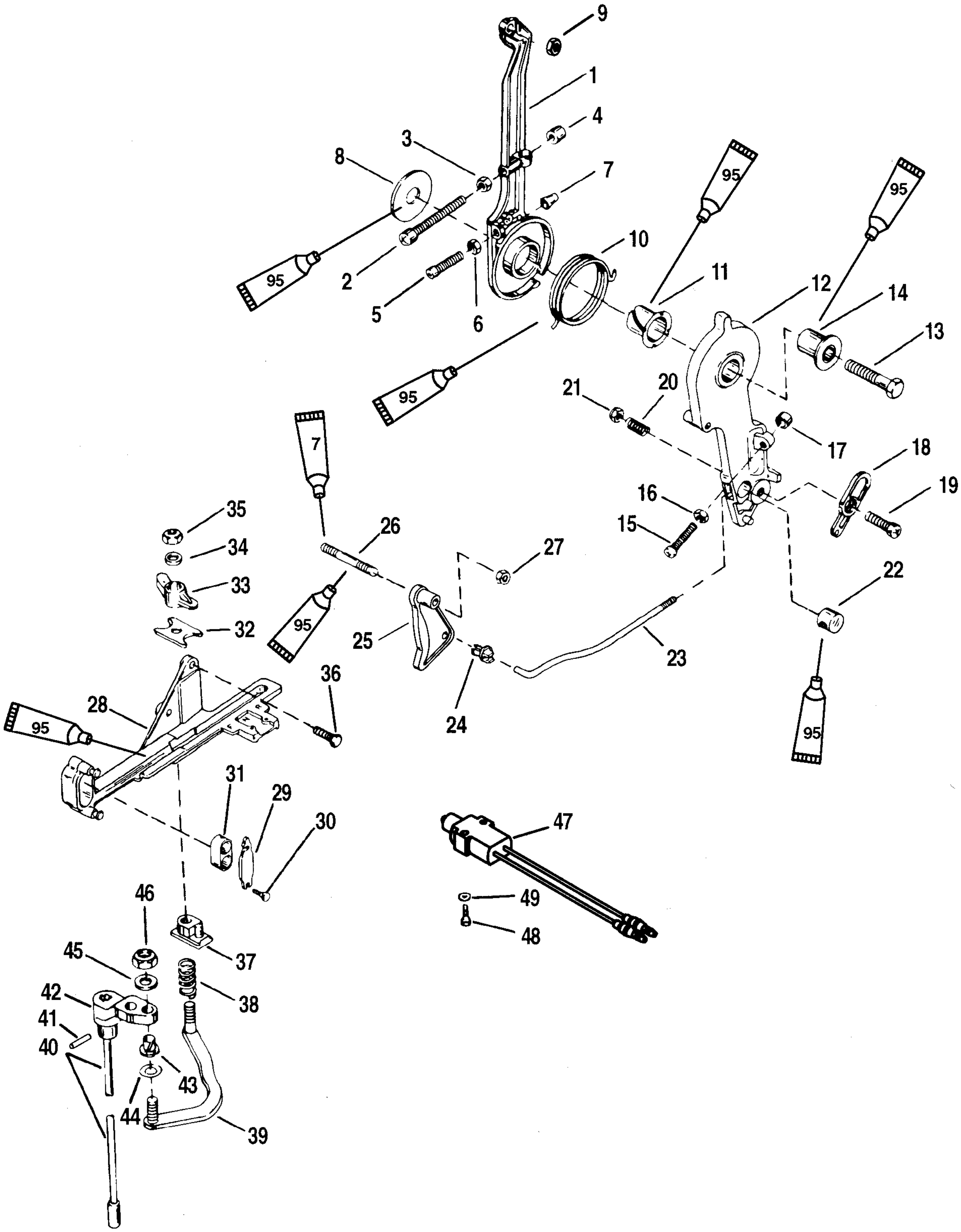
Throttle Lever and Shift Shaft



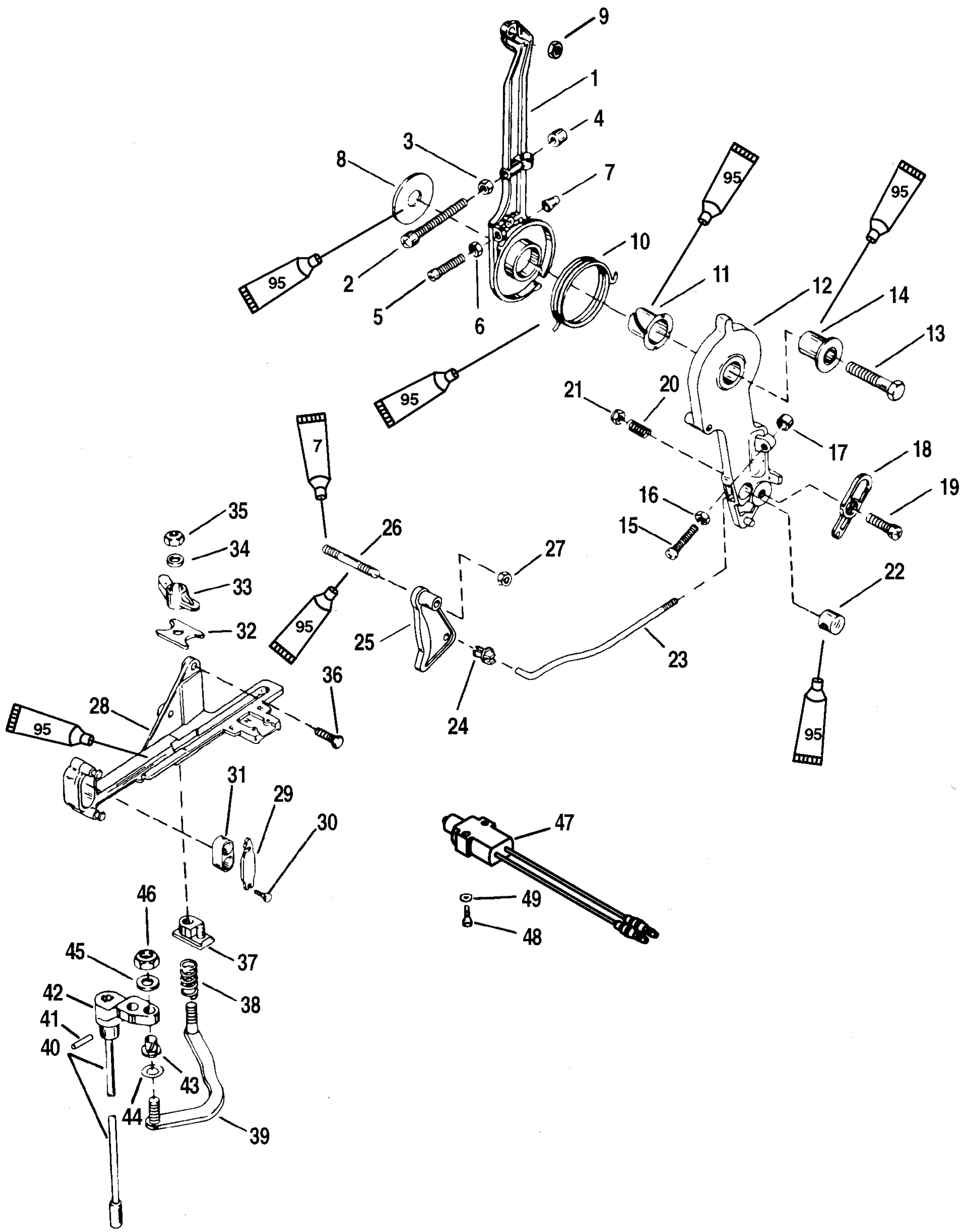
7 Loctite 271 (92-809820)

95 2-4-C w/Teflon (92-850736A1)

Throttle Lever and Shift Shaft

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	SPARK ADVANCE LEVER			
2	1	SCREW (1/4-20 x 2-1/8)			
3	1	NUT			
4	1	CAP			
5	1	SCREW (3/16-32 x 1-1/4 IN.)			
6	1	NUT			
7	1	CAP			
8	1	WASHER			
9	1	NUT	35		4.0
10	1	SPRING			
11	1	BUSHING			
12	1	THROTTLE CONTROL LEVER			
13	1	SCREW (3/8-16 x 1-3/4 IN.)			
14	1	BUSHING			
15	1	SCREW (1/4-20 x 2-1/8 IN.)			
16	1	NUT (1/4-20)			
17	1	CAP			
18	1	LATCH			
19	1	SCREW (1/4-28 x 7/8)			
20	1	SPRING			
21	1	NUT			
22	1	BARREL			
23	1	THROTTLE CONTROL ROD			
24	1	SWIVEL BUSHING			
25	1	THROTTLE CAM			
26	1	STUD (1/4 x 1-3/4)			
27	1	NUT	Tighten until snug then back off 1/4 turn		

Throttle Lever and Shift Shaft



7 Loctite 271 (92-809820)

95 2-4-C w/Teflon (92-850736A1)

Throttle Lever and Shift Shaft

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
28	1	ANCHOR BRACKET			
29	1	LATCH			
30	2	SCREW-Drive			
31	1	CAP			
32	1	WEAR PLATE			
33	1	LATCH			
34	1	WASHER			
35	1	NUT			
36	3	SCREW (5/16-18 x 7/8)	160		18.0
37	1	GUIDE BLOCK			
38	1	SPRING			
39	1	LINK ROD ASSEMBLY			
40	1	SHIFT SHAFT ASSEMBLY **(LONG)**			
	1	SHIFT SHAFT ASSEMBLY **(X-LONG)**			
41	1	ROLL PIN			
42	1	SHIFT SHAFT LEVER–UPPER			
43	1	BUSHING			
44	1	WAVE WASHER			
45	1	WASHER			
46	1	NUT			
47	1	SWITCH			
48	2	SCREW (6-32)			
49	2	WASHER			

Powerhead Installation On Driveshaft Housing

1. Install Lifting Eye (91-90455) into flywheel.

⚠ WARNING

BE SURE that Lifting Eye is threaded into flywheel a minimum of five (5) turns BEFORE lifting powerhead.

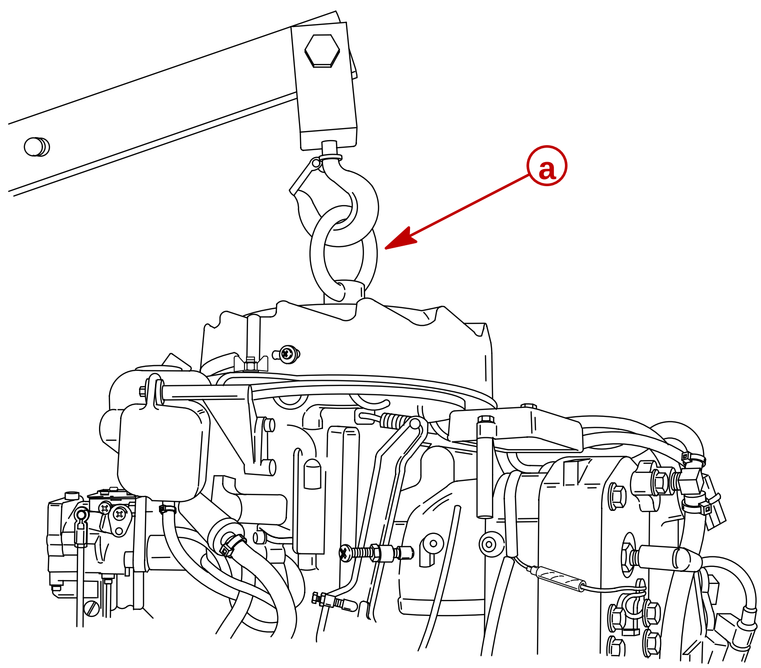
2. Using a hoist, lift powerhead high enough to allow removal of powerhead from repair stand. Remove powerhead from repair stand, being careful not to damage drive shaft housing gasket surface of powerhead.
3. Place a new gasket around powerhead studs and into position on base of powerhead.

IMPORTANT: DO NOT apply lubricant to top of driveshaft as this will prevent driveshaft from fully engaging into crankshaft.

4. Apply a small amount of 2-4-Cw/Teflon Marine Lubricant (92-90018A12) onto driveshaft splines.

NOTE: *Verify shift shaft is properly installed in gearcase/driveshaft housing before installing powerhead.*

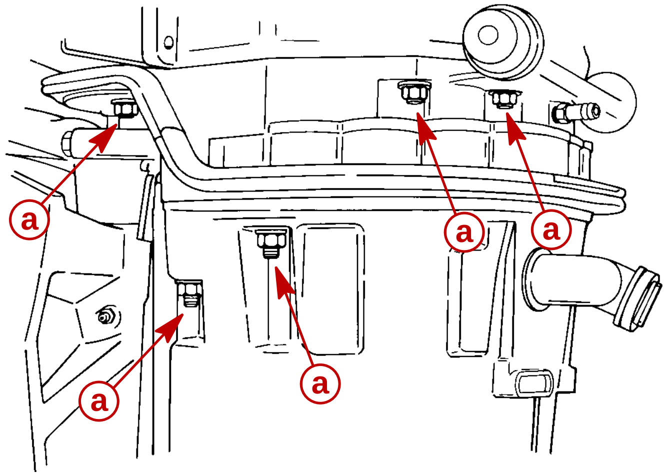
5. Use hoist to lower powerhead onto driveshaft housing. It may be necessary to turn flywheel (aligning crankshaft splines with driveshaft splines) so that powerhead will be fully installed.



58070

a - Lifting Eye (90-90455)

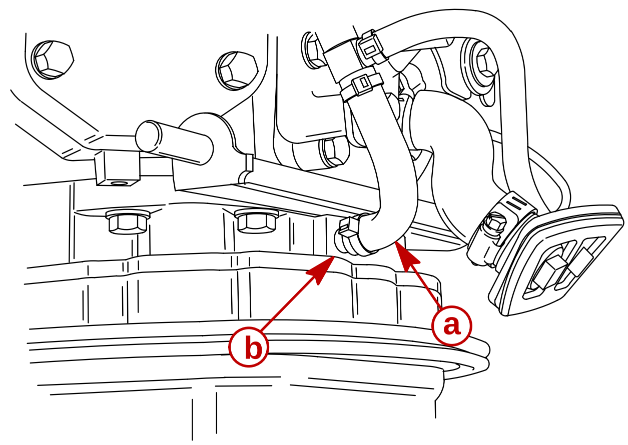
6. Install 10 flat washers,and10 locknuts which secure powerhead to exhaust extension plate/driveshaft housing. Torque locknuts in 3 progressive steps until secured.
7. Disconnect hoist from Lifting Eye and remove Lifting Eye from flywheel.
8. Reinstall plastic cap into center of flywheel cover.



51846

a - Locknuts and Washers – Torque nuts to 20 lb. ft. (27 N m)

9. Connect water hose to fitting on exhaust adaptor plate.



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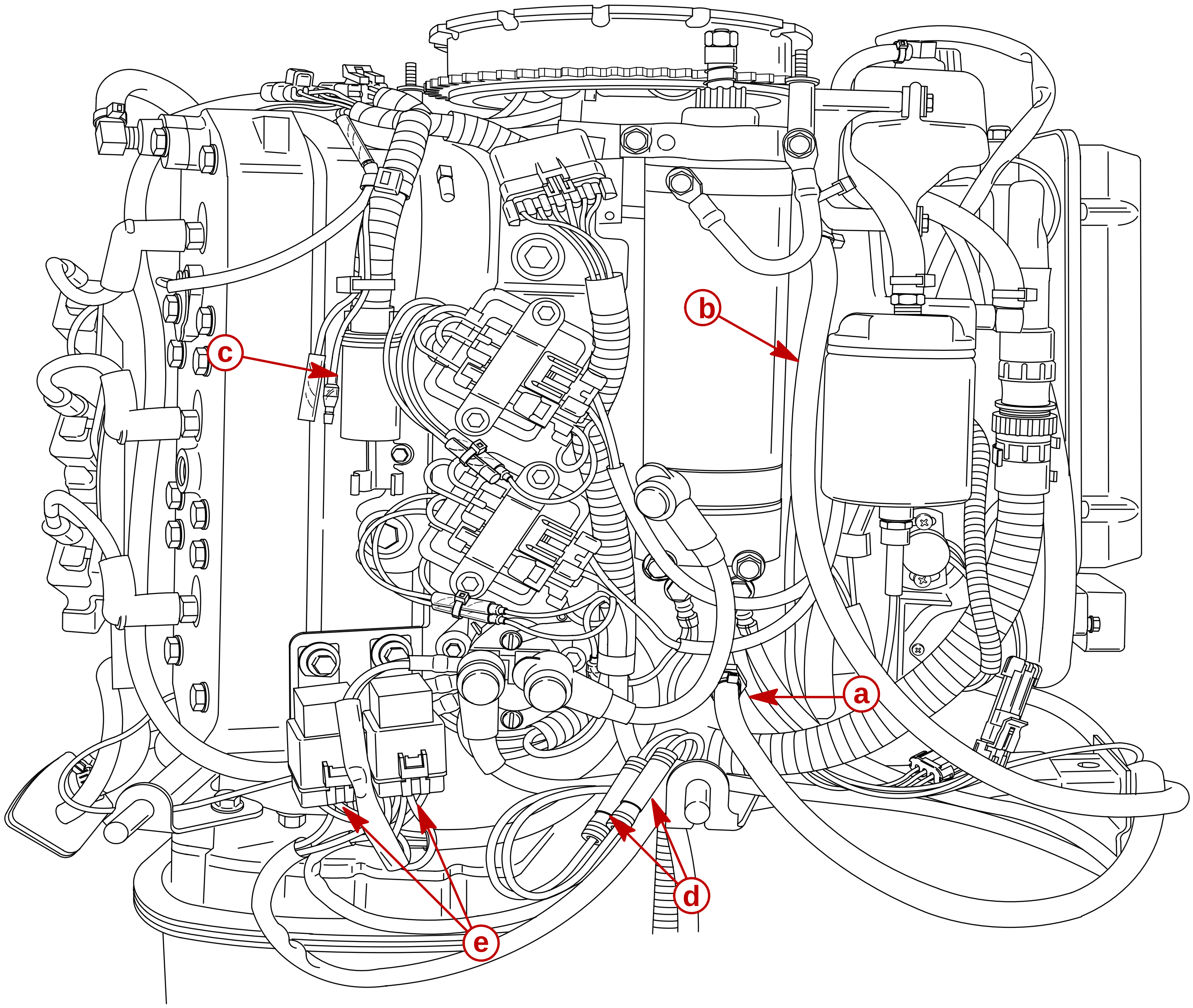
a - Water Hose
b - Fitting

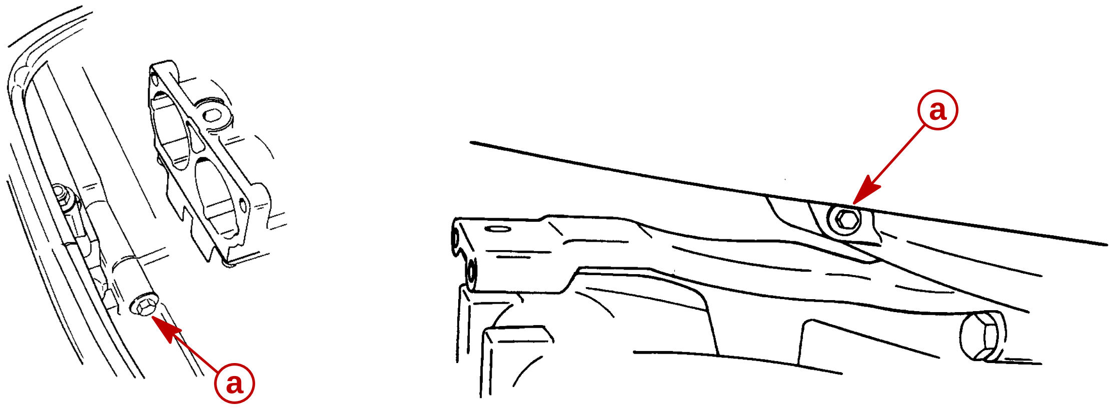
10. Reconnect remote oil tank pressure hose and supply hose to oil reservoir.
11. Reconnect remote control harness from powerhead harness connector and power trim wires.
12. Reconnect trim relay connectors.



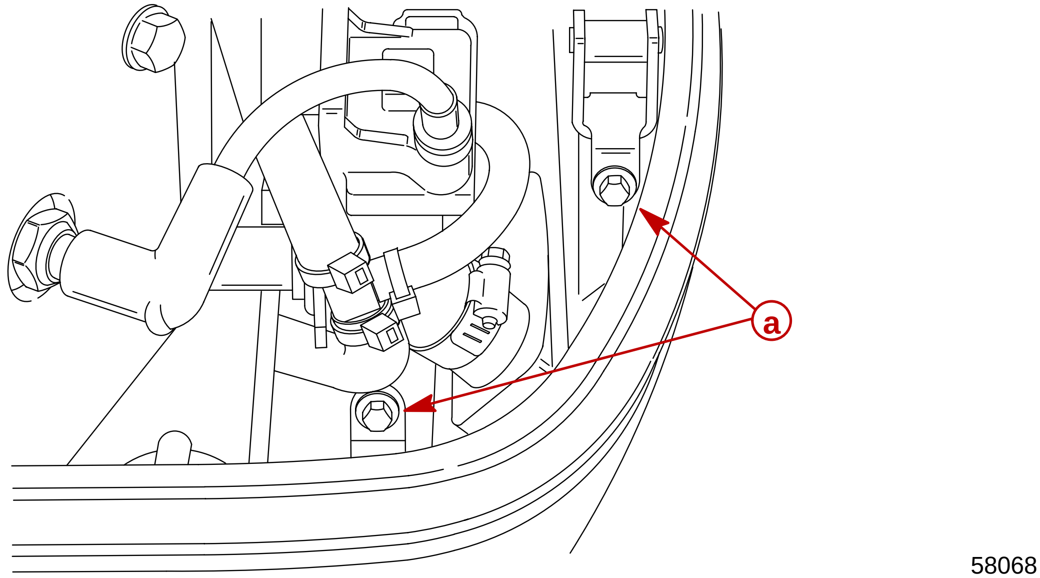
58027

a - Remote Oil Tank Pressure Hose
b - Oil Supply Hose
c - Remote Control Harness
d - Power Trim Wires
e - Trim Relay Connectors

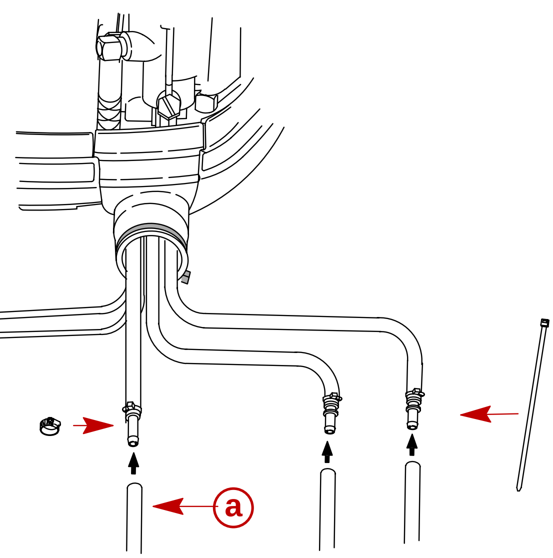
13. Install bottom cowls.



a - Bolts

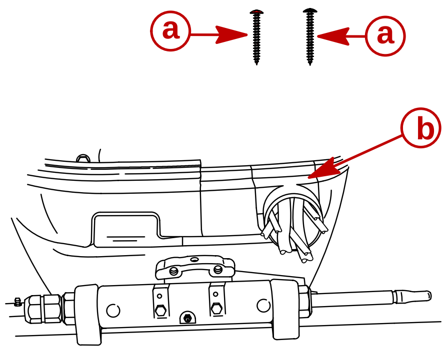


14. Reconnect input fuel line.



a - Input Fuel Hose

15. Install harness retainer and secure with 2 screws.



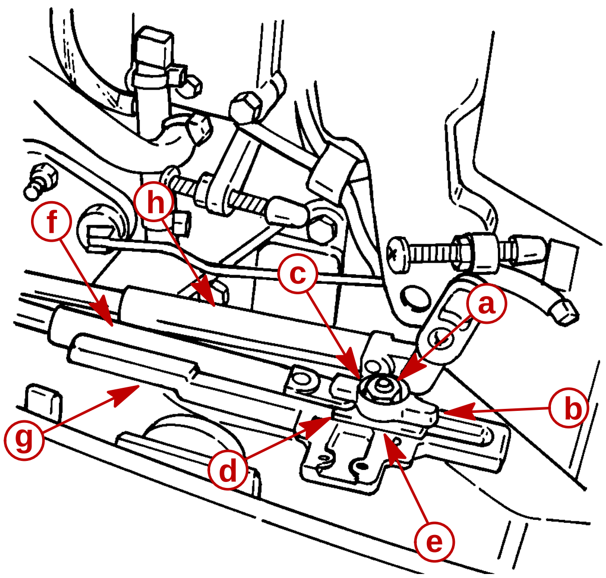
57841

a - Screws
b - Retainer

16. Slide outboard shift lever into neutral position.

17. Install throttle cable.

18. Install locknut that secures shift cable latch assembly and install latch, flat washer, nylon wear plate, spring and shift cable from control cable anchor bracket.



51853

a - Lock Nut
b - Shift Cable Latch
c - Flat Washer (Hidden under nut)
d - Nylon Wear Plate
e - Spring (hidden)
f - Shift Cable
g - Anchor Bracket
h - Throttle Cable

Refer to Section 2 of this Service Manual "Timing/ Synchronizing/Adjusting" for engine set-up procedures.

Gasoline/Oil Break-in Mixture

During Break-in, use a **50:1 (2% oil)** gasoline/oil mixture in the first tank of fuel. Follow the table below for mixing ratios. Use of this fuel mixture combined with oil from the oil injection system will supply adequate lubrication during engine break-in.

After the break-in fuel mixture is used up, it is no longer necessary to add oil with the gasoline.

NOTE: *At the end of the break-in period, visually check to see if the oil level in the oil injection tank has dropped. Oil usage indicates the oil injection system is functioning correctly.*

NOTE: **Mixing Gasoline/Oil for Break-in –** Using a funnel, pour the correct amount of oil slowly with the gasoline as tank is filled.

GASOLINE/OIL MIXING RATIO CHART

Gas/Oil Ratio	1 Gallon Gas (3.8 Liters)	3 Gallons Gas (11.5 Liters)	6 Gallons Gas (23 Liters)
50:1 (2%)	3 fl. oz. (89 ml) Oil	8 fl. oz. (237 ml) Oil	16 fl. oz. (473 ml) Oil

Break-In Procedure

CAUTION

Severe damage to the engine can result by not complying with the Engine Break-In Procedure.

Vary the throttle setting during the first hour of operation. During the first hour of operation, avoid remaining at a constant speed for more than two minutes and avoid sustained wide open throttle.

POWERHEAD

Section 4B - Cooling

Table of Contents

4
B

Specifications

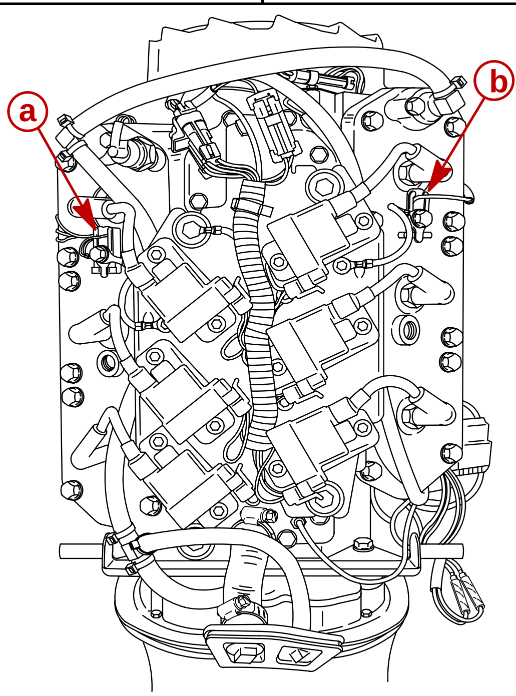
Thermostat . . . . 143°F (61.7°C)

Water Pressure

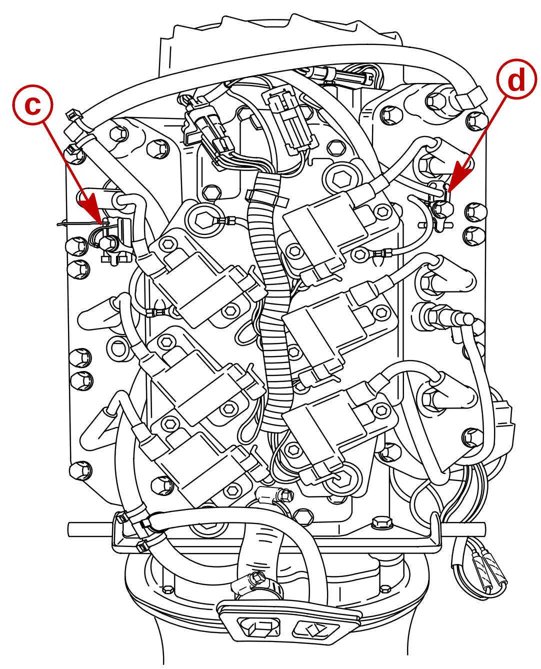
Idle	1.0 – 3.0 PSI (6.8 – 20.5 kPa)
Poppet Valve Opening	4 – 9 PSI (27.4 – 61.6 kPa)
W.O.T.	12.0 PSI (82.1 kPa) Minimum

Temperature Sensor

Temperature Sensor(s)	
Between Black and each TAN/BLK wire.	No Continuity
Between each lead and ground	No Continuity



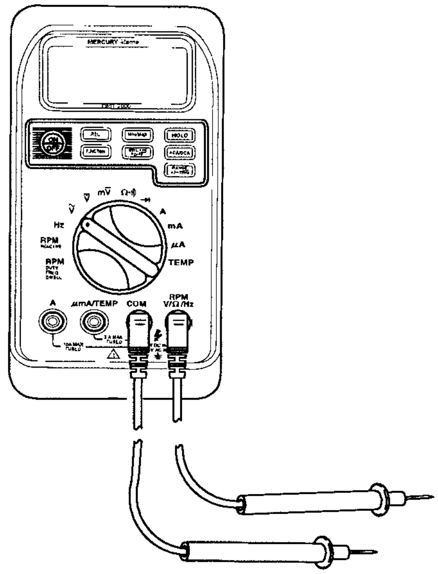
a - Temperature Sensor (EFI Models) and optional gauge sender
b - Temperature Sensor for Warning Horn (EFI Models)



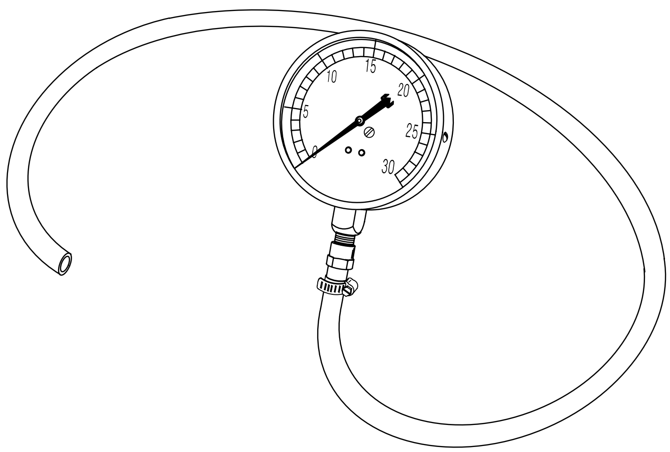
c - Temperature Sensor for optional gauge (Carb Models)
d - Temperature Sensor for Warning Horn (Carb Models)

Special Tools

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



2. Water Pressure Gauge 91-79250A2



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Temperature Sensor

EFI Models – Sensor (in port cylinder head) provides the ECM signals related to engine temperature to determine the level of fuel enrichment during engine warm up. The ECM receives information at all engine temperatures but stops fuel enrichment when engine temperature reaches 90° F (32° C). An open circuit on the temperature sensor will increase fuel flow up to 40% but will not affect fuel flow at wide open throttle. If no change occurs when sensor is disconnected, sensor may not be functioning properly.

NOTE: TAN/BLUE sensor lead (in port temperature sensor) provides signal for optional temperature gauge.

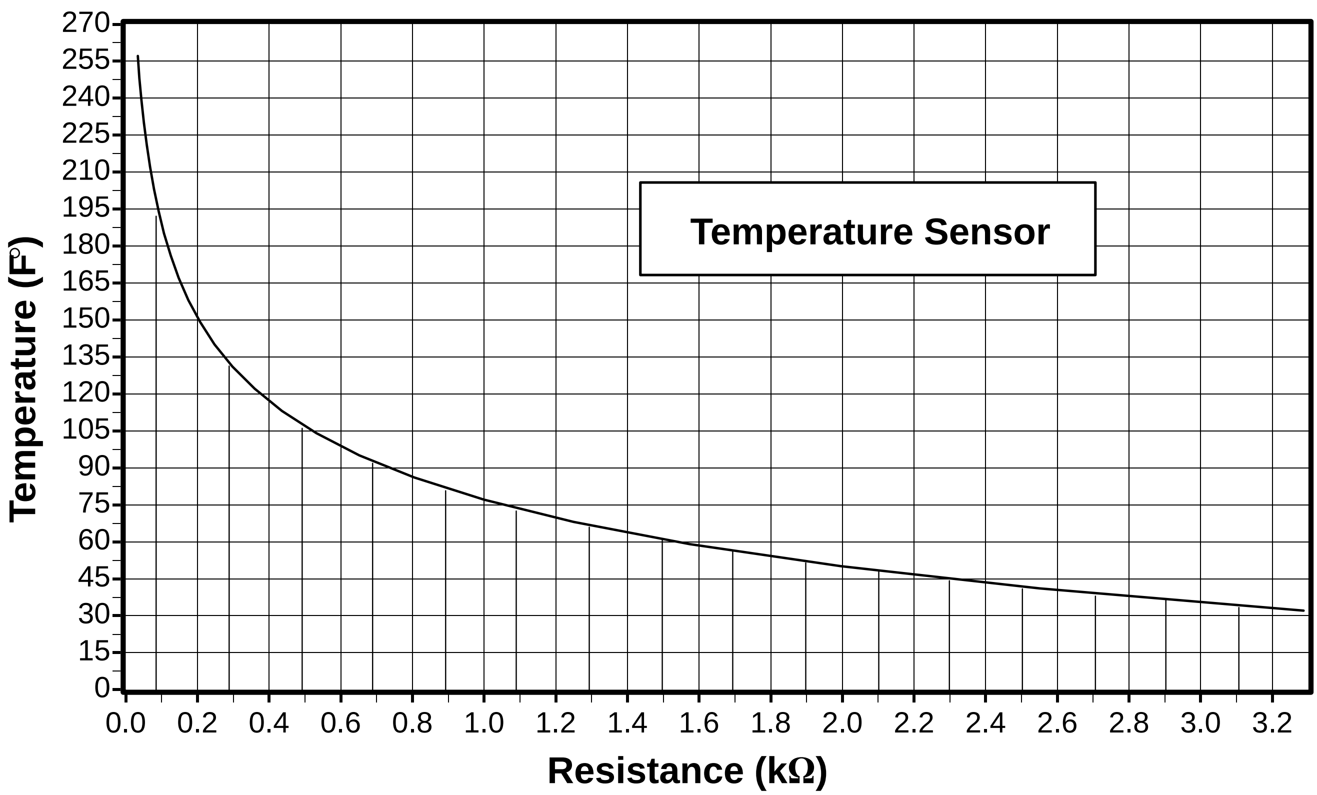
NOTE: If sensor does not make clean contact with cylinder head, a rich fuel condition may exist.

NOTE: The Digital Diagnostic Terminal (DDT) can be used to monitor temperature readings from both air and head temperature sensors.

NOTE: Temperature sensor in starboard cylinder head on EFI models activates a warning horn when engine temperature exceeds 240° F ± 8° F (115.6°C ± –13.3°C). Warning horn will deactivate when engine temperature drops below 210° F ± 15° F (98.9°C ± –9.4°C).

An ohms test of the temperature sensor (in port cylinder head) 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%.



Carburetor Models – Temperature sensor in starboard cylinder head activates a warning horn when engine temperature exceeds 240° F ± 8° F (115.6°C ± –13.3°C). Warning horn will deactivate when engine temperature drops below 210° F ± 15° F (98.9°C ± –9.4°C).

Temperature sensor in port cylinder head provides signal for optional temperature gauge.

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 2 holes near the top of the exhaust cover.

Water exits the exhaust cover cavity through 4 slots (2 each side) filling the water passages around the cylinders. Water flows around each bank of cylinders to the top of the cylinder block.

Water flow exiting the cylinder block is controlled by the thermostats (1 in each cylinder head) and the poppet valve (located at the bottom starboard side of powerhead). 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 adaptor plates. Water passes through the adaptor plates into the driveshaft housing.

Water dumped into the drive shaft housing builds up a wall of water around the exhaust tube. This performs 2 functions:

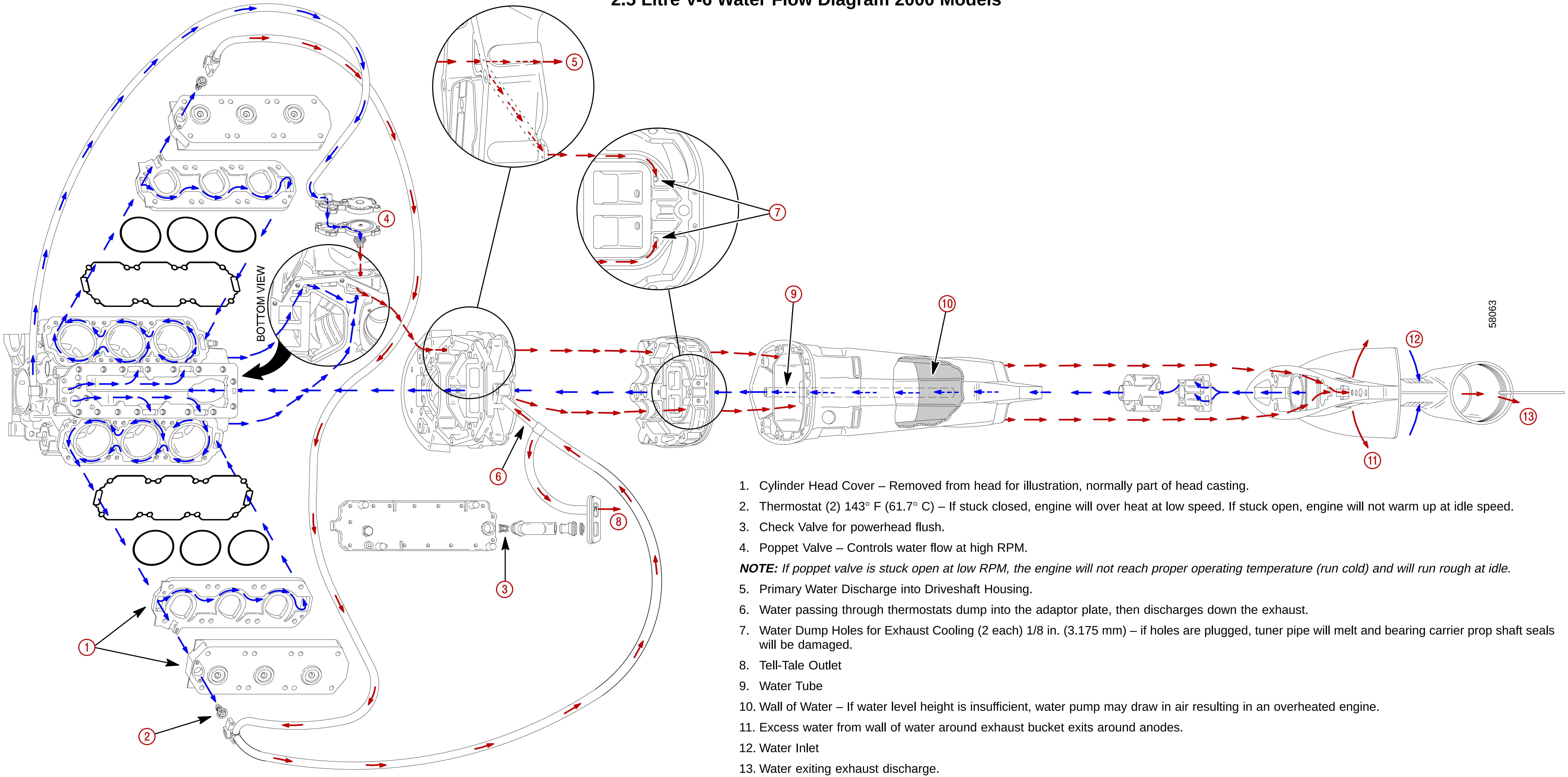
- Helps silence the exhaust
- Prevents air from being drawn into the pump

Water exits the engine in 3 locations:

- Excess water from the wall of water exits around anodes on the gear housing.
- A portion of the water that passes through the thermostats exits out the tell tail.
- Water exits through two 1/8 in. (3.175 mm) holes in the lower adaptor plate into the exhaust.

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.

2.5 Litre V-6 Water Flow Diagram 2000 Models



1. Cylinder Head Cover – Removed from head for illustration, normally part of head casting.
2. Thermostat (2) 143° F (61.7° C) – If stuck closed, engine will over heat at low speed. If stuck open, engine will not warm up at idle speed.
3. Check Valve for powerhead flush.
4. 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.*

5. Primary Water Discharge into Driveshaft Housing.
6. Water passing through thermostats dump into the adaptor plate, then discharges down the exhaust.
7. Water Dump Holes for Exhaust Cooling (2 each) 1/8 in. (3.175 mm) – if holes are plugged, tuner pipe will melt and bearing carrier prop shaft seals will be damaged.
8. Tell-Tale Outlet
9. Water Tube
10. Wall of Water – If water level height is insufficient, water pump may draw in air resulting in an overheated engine.
11. Excess water from wall of water around exhaust bucket exits around anodes.
12. Water Inlet
13. Water exiting exhaust discharge.

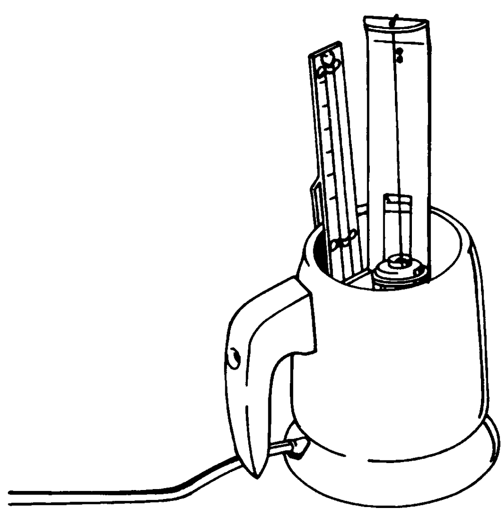
Notes:

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 140°-145° F (60°-63° C).
   f. Continue to heat water until thermostat is completely open.
   g. Unplug thermostat tester.
   h. Replace thermostat, if it fails to open at the specified temperature, or if it does not fully open.

NOTE: *BE SURE that water in thermostat tester is allowed to cool sufficiently [below 110° F (43.3° C)] before testing the other thermostat.*



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IMPORTANT: DO NOT operate engine without thermostats installed.

Water Pressure Check

Water pressure may be checked by attaching a test pressure gauge to the top of the engine block.

A water pressure line (GRAY colored) is provided that exits at the front of the lower cowl. A dash style gauge may be connected to this line to register water pressure.

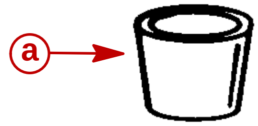
⚠ WARNING

Shut off engine and refer to troubleshooting chart if water pressure is not within specification. DO NOT exceed 3000 RPM in neutral.

Idle	1.0 – 3.0 PSI (6.8 – 20.5 kPa)
Poppet Valve Opening	4 – 9 PSI (27.4 – 61.6 kPa)
W.O.T.	12.0 PSI (82.1 kPa) Minimum

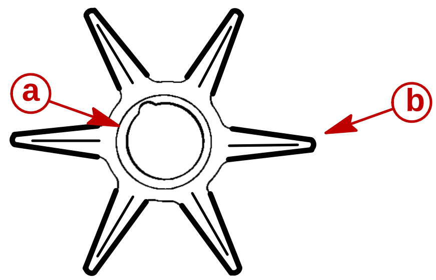
Water Pump Cleaning and Inspection

1. Inspect the water tube coupling for wear or damage. If necessary replace..



a - Water Tube Coupling

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.

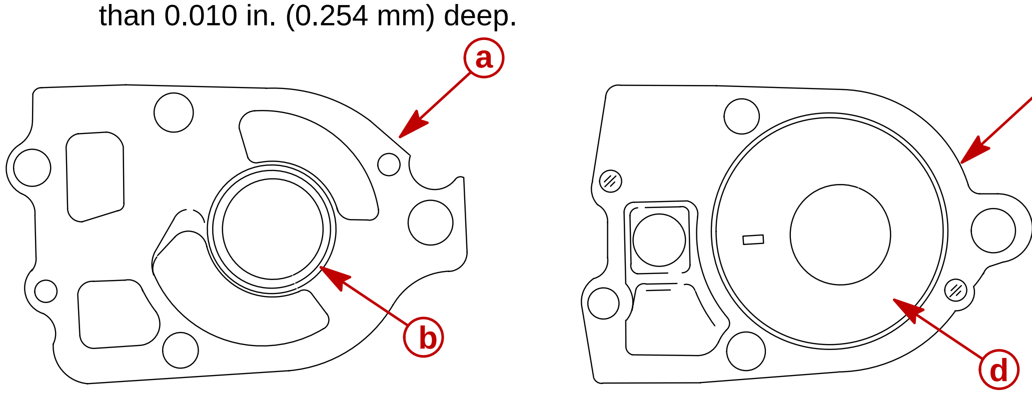


a - Hub
b - Impeller

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 plastic is melted from excessive heat (lack of water). Replace stainless insert and/or face plate if grooves (other than impeller sealing bead groove) are more than 0.010 in. (0.254 mm) deep.



a - Water Pump Face Plate
b - Sealing Groove (disregard)
c - Water Pump Cover
d - Stainless Insert [discard if grooves exceed 0.010 in. (0.254 mm)]

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 gearcase 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	1.0 – 3.0 PSI (6.8 – 20.5 kPa)	•Poppet valve spring defective (weak, broken, missing) •Defective poppet valve seal •Thermostat stuck open •Severe internal leak •Low output water pump •Inlet restriction
Pressure above 5 psi (34.2kPa) @ idle	1.0 – 3.0 PSI (6.8 – 20.5 kPa)	•Plugged poppet by-pass passage or tell-tale
Pressure does not drop between 1000 – 2500 RPM indicating poppet valve has opened	4 – 9 PSI (27.4 – 61.6 kPa) between 1000 – 2200 RPM	•Wrong poppet valve spring •Low output water pump •Inlet restriction •Poppet valve vent hole plugged or restricted •Severe internal leak •Defective poppet valve seal
Poppet valve flutter/water pressure drop does not stabilize prior to 2500 RPM	4 – 9 PSI (27.4 – 61.6 kPa) between 1000 – 2200 RPM	•Wrong poppet valve spring •Low output water pump •Inlet restriction •Broken diaphragm in poppet valve •Severe internal leak •Defective poppet valve seal
Pressure is below minimum specification @ W.O.T.	12 PSI (54.9 – 68.5kPa)	•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
Pressure higher than normal @ W.O.T., but engine still indicates overheat condition	Maximum pressure – 23 PSI (157.4 kPa)	•Outlet water passages restricted. •Steam pocket has formed at top of powerhead due to lack of cooling water

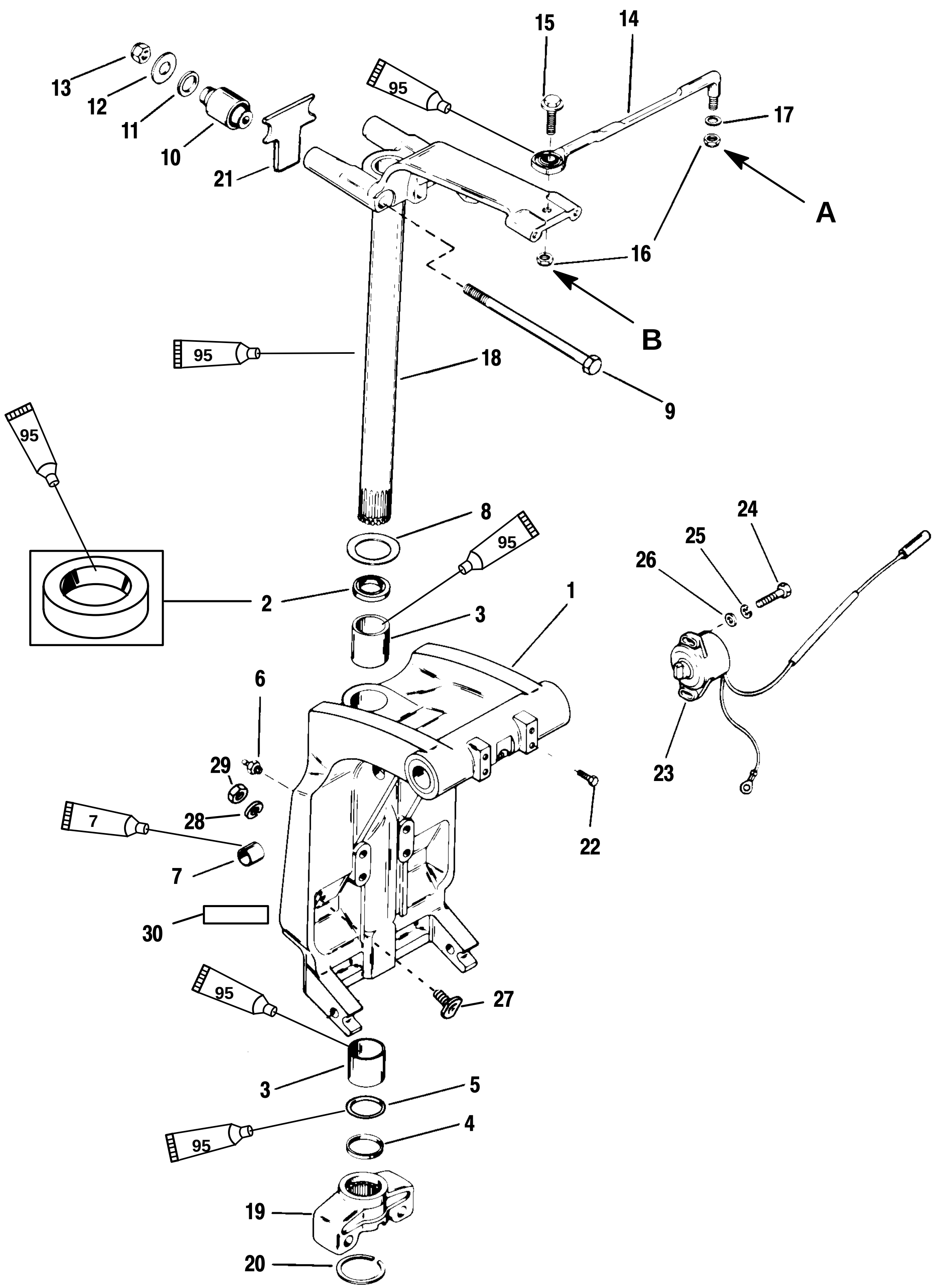
MID-SECTION

Section 5A – Clamp/Swivel Brackets & Driveshaft Housing

Table of Contents

5
A

2000Swivel Bracket and Steering Arm



7 Loctite 271 (92-809820)

95 2-4-C w/Teflon (92-825407A12)

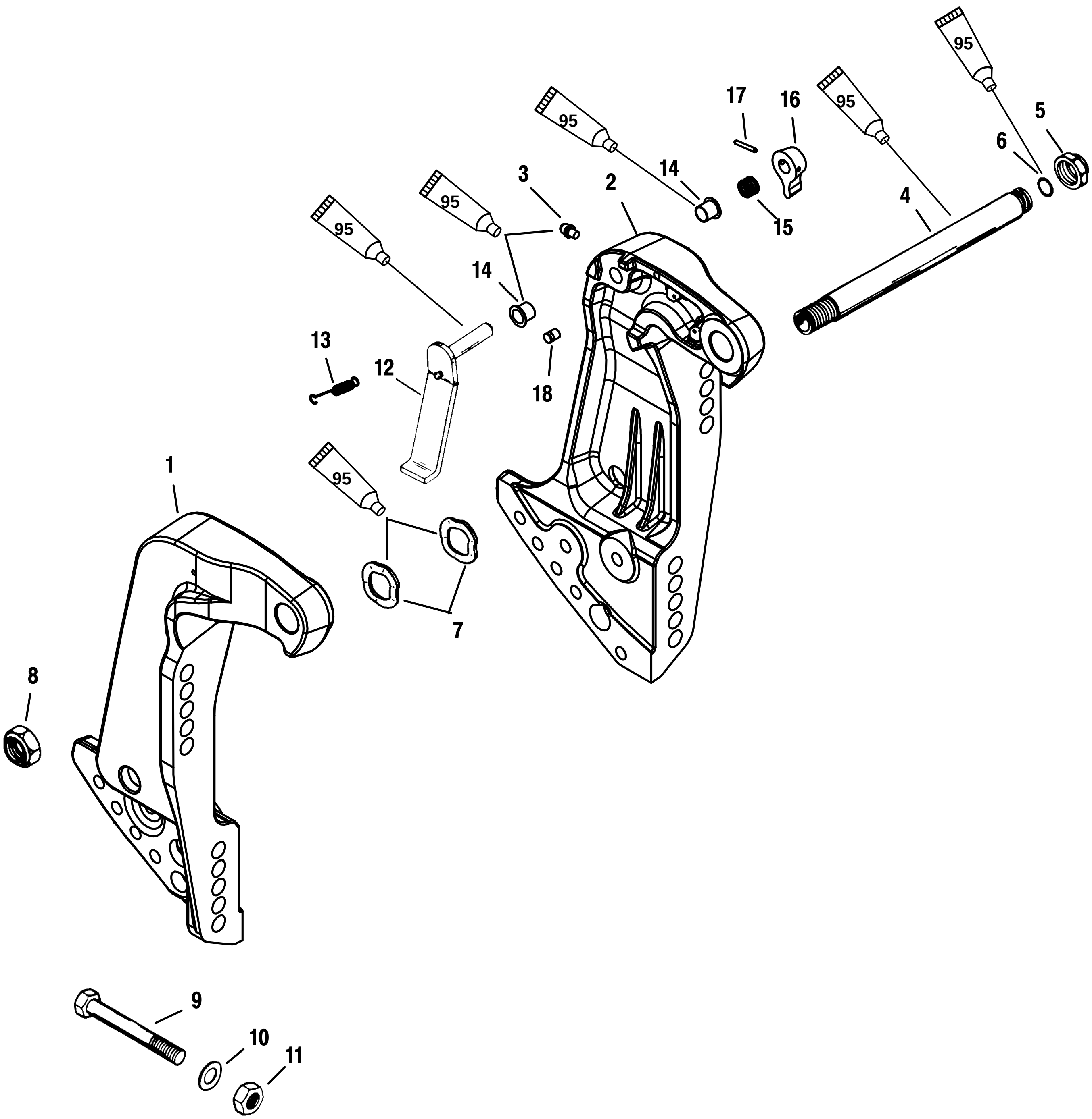
Swivel Bracket and Steering Arm

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	SWIVEL BRACKET ASSEMBLY **(BLACK)**			
2	1	OIL SEAL (LOWER)			
3	2	BUSHING			
4	1	SPACER			
5	1	O-RING			
6	2	GREASE FITTING	75		8.5
7	2	BUSHING			
8	1	THRUST WASHER			
9	2	SCREW (7/16-20 x 7-1/2 IN.)			
10	2	MOUNT			
11	2	WASHER			
12	2	WASHER			
13	2	NUT		50	68
14	1	STEERING LINK ASSEMBLY			
15	1	SCREW (3/8-24 x 1-1/4 IN.)		20	27
16	2	NUT	See Note		
17	2	WASHER			
18	1	SWIVEL PIN AND STEERING ARM **(BLACK)**			
19	1	BOTTOM YOKE **(BLACK)**			
20	1	RETAINING RING			
21	1	BUMPER			
22	2	SCREW (1/4-28 x 1/2 IN.)	100		11.5
23	1	TRIM SENDER ASSEMBLY			
24	2	SCREW	15		1.7
25	2	LOCKWASHER			
26	2	WASHER			
27	2	STRIKER PLATE			
28	2	LOCKWASHER			
29	2	NUT		23	31
30	1	DECAL-Serial Number Overlaminate			

NOTE: *A – Torque nut to 120 lb. in. (13.5 Nm) and then back off 1/4 turn.*

NOTE: *B – Torque nut to 20 lb. ft. (27 Nm)*

Transom Brackets

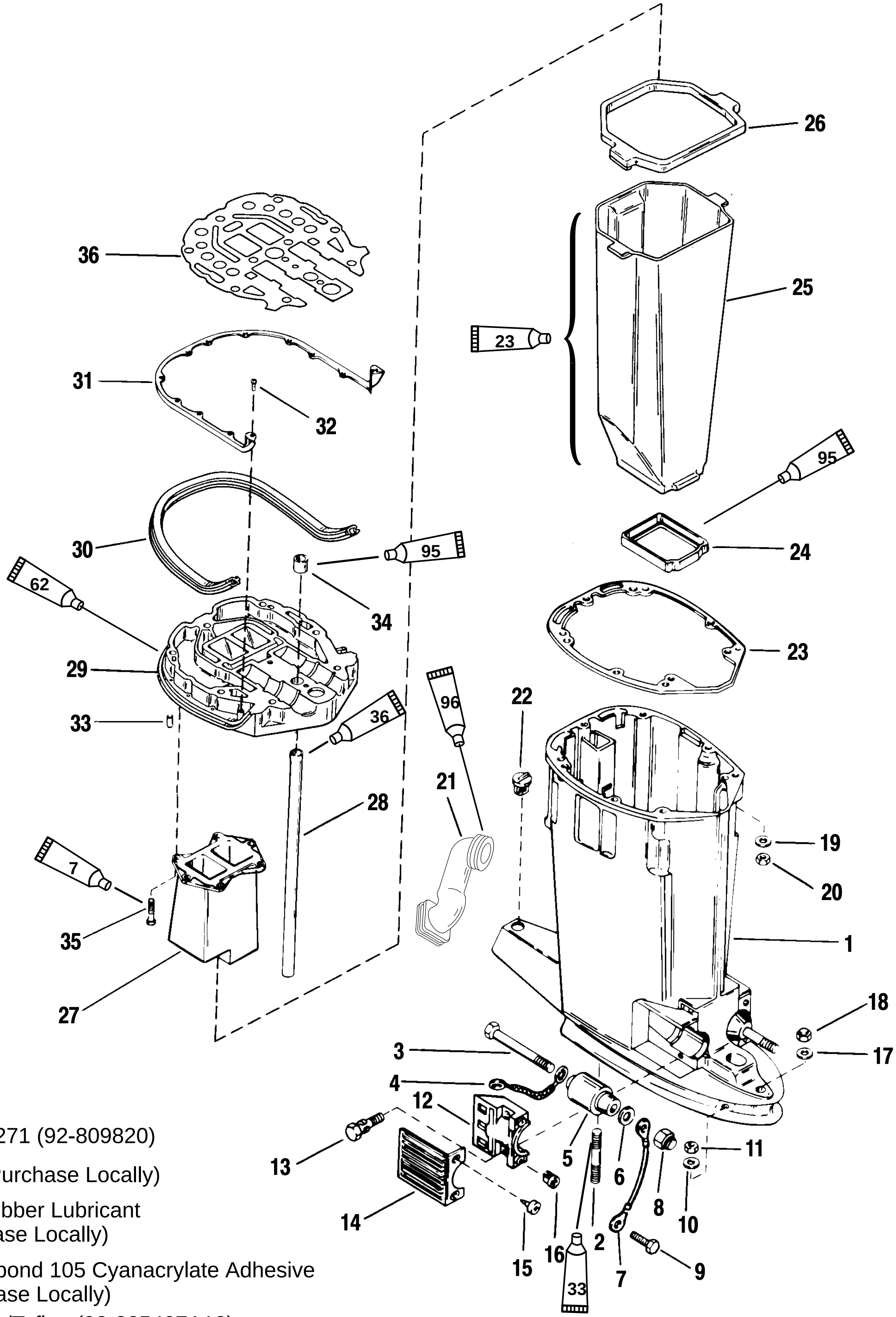


95 2-4-C w/Teflon (92-825407A12)

Transom Brackets

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	TRANSOM BRACKET **(STARBOARD)(BLACK)**			
2	1	TRANSOM BRACKET **(PORT) (BLACK)**			
3	1	GREASE FITTING **(PORT)**	80		9
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			

rive Shaft Housing and Exhaust Tube



7 Loctite 271 (92-809820)

23 Soap (Purchase Locally)

36 P80 Rubber Lubricant (Purchase Locally)

62 Permabond 105 Cyanacrylate Adhesive (Purchase Locally)

95 2-4-C w/Teflon (92-825407A12)

96 Loctite Superbonder 454 Gel (Purchase Locally)

33 Loctite “RCA/680” Retaining Compound (92-809833)

Drive Shaft Housing and Exhaust Tube

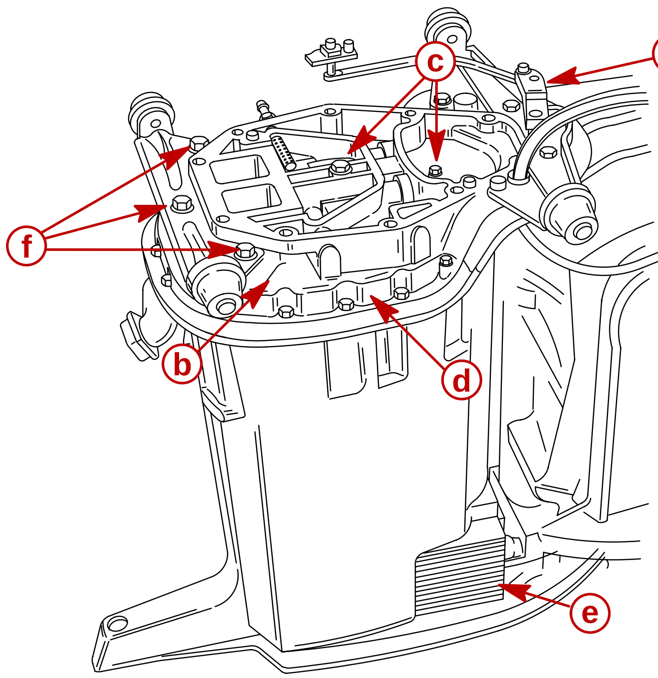
REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	1	DRIVE SHAFT HOUSING **(LONG)**			
	1	DRIVE SHAFT HOUSING **(X-LONG)**			
2	2	STUD			
3	2	SCREW (1/2-20 x 6 IN.)			
4	1	GROUND WIRE			
5	2	LOWER MOUNT			
6	2	WASHER			
7	1	GROUND WIRE			
8	2	NUT		50	68
9	1	SCREW (1/4-20 x 3/8 IN.)			
10	2	WASHER			
11	2	NUT		50	68
12	2	CLAMP			
13	4	SCREW (5/16-18 x 1-1/4 IN.)		22	30
14	2	COVER			
15	4	SCREW (12-24 x 5/8 IN.)	17		2
16	4	NUT		25	34
17	1	WASHER			
18	1	NUT		57	77
19	4	WASHER			
20	4	NUT		23	31
21	1	IDLE EXHAUST BOOT			
22	1	PLUG			
23	1	GASKET			
24	1	SEAL (LOWER)			
25	1	EXHAUST TUBE			
26	1	SEAL (UPPER)			
27	1	EXHAUST EXTENSION **(150)**			
	1	EXHAUST EXTENSION **(115, 135)**			
28	1	WATER TUBE **(LONG)**			
	1	WATER TUBE **(X-LONG)**			
29	1	PLATE ASSEMBLY			
30	1	SEAL			
31	1	BRACKET			
32	12	SCREW (10-16 x 1/2 IN.)	80		9
33	2	DOWEL PIN			
34	1	SEAL			
35	6	SCREW (1/4-20 x 3/4 IN.)	60		7
36	1	GASKET			

Drive Shaft Housing and Dyna-Float Suspension

Refer to “Powerhead Removal” section to remove powerhead. Refer to “Lower Unit Removal” in this section to remove lower unit.

Removal and Disassembly

1. Remove shift shaft from driveshaft housing by pulling straight up on shaft.
2. Remove 5 bolts which secure exhaust extension plate to drive shaft housing. After bolts are removed, lift exhaust extension plate off drive shaft housing.
3. Remove screws, which secure lower mount covers to drive shaft housing, then remove covers.



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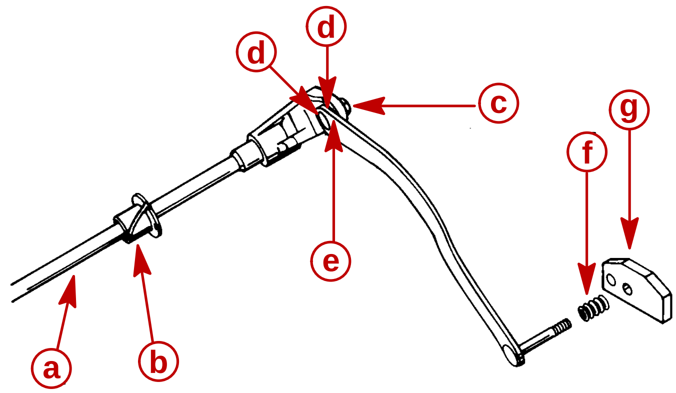
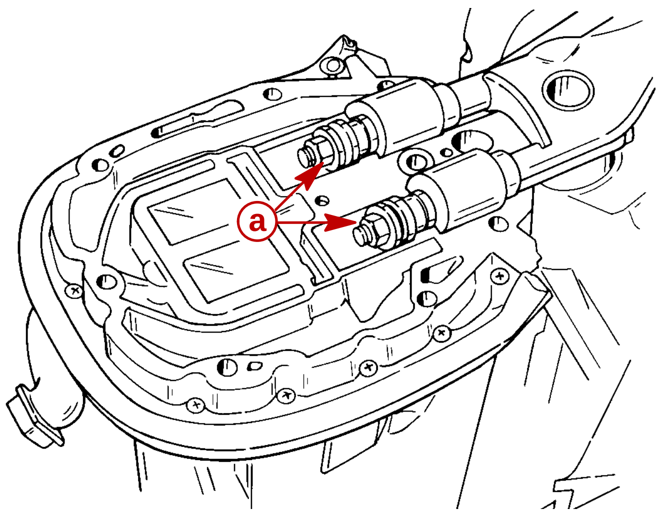
a - Shift Shaft Linkage
b - Exhaust Extension Plate
c - Exhaust Plate to Drive Shaft Housing Bolts
d - Driveshaft Housing Plate
e - Lower Mount Cover (One Each Side)
f - Mounting Bracket Bolts (3)

SHIFT LINKAGE ASSEMBLY



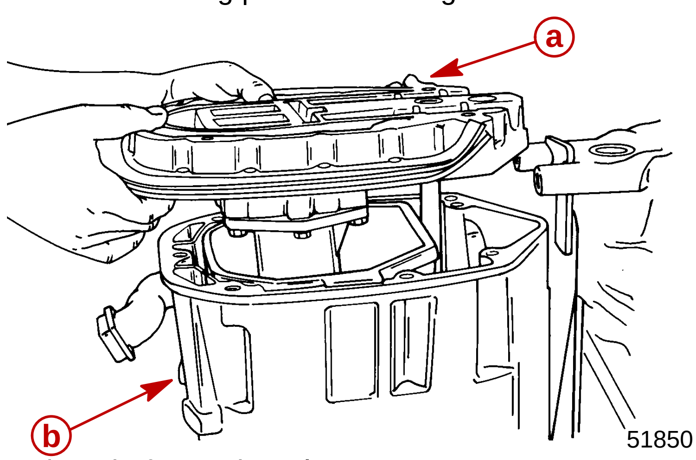
a - Shift Shaft Assembly
b - Bushing
c - Lock Nut
d - Washer (2)
e - Bushing (Hidden)
f - Spring
g - Guide Block

1. Remove upper mount nuts and flat washers.



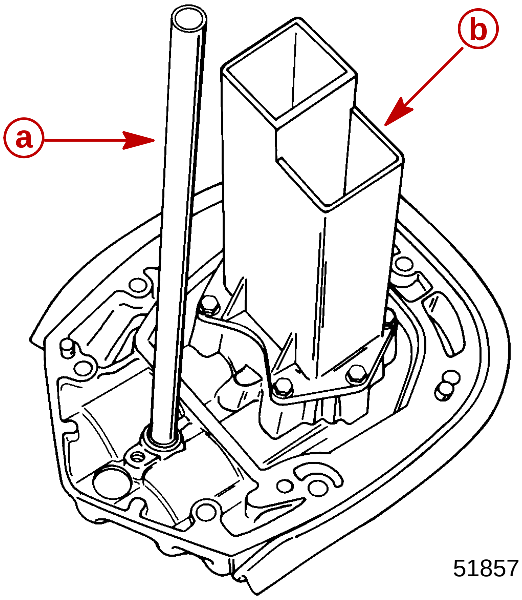
a - Upper Mount Nuts

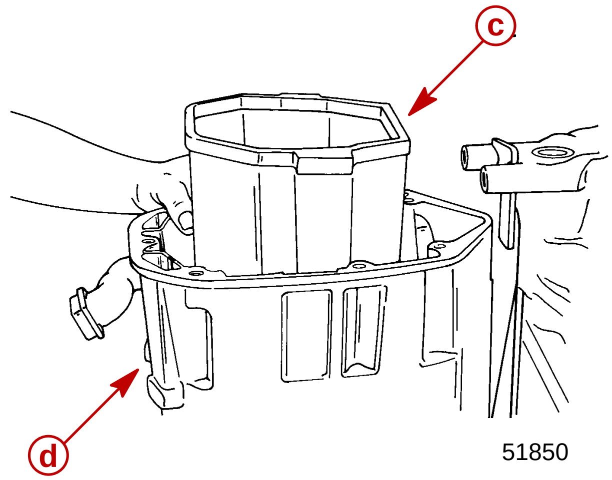
2. Lift driveshaft housing plate off housing.



a - Drive Shaft Housing Plate
b - Drive Shaft Housing

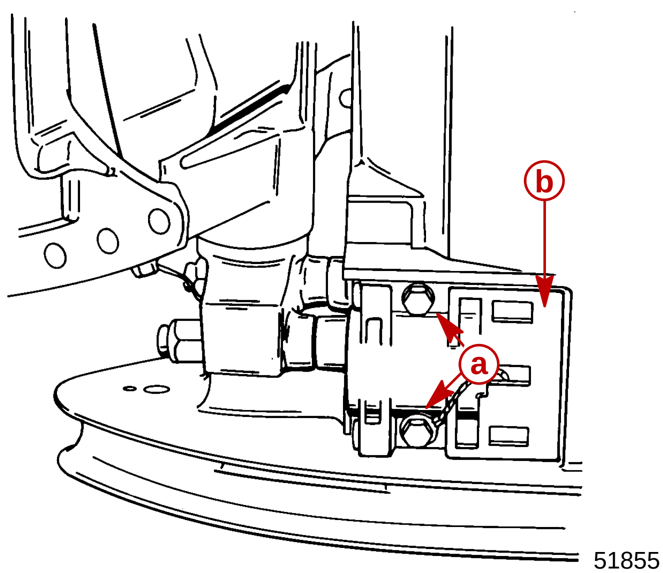
3. Remove water tube from driveshaft housing plate.
4. Exhaust diffuser is secured to housing plate with 6 bolts. Remove bolts, then remove diffuser.
5. Pull exhaust tube out of drive shaft housing.





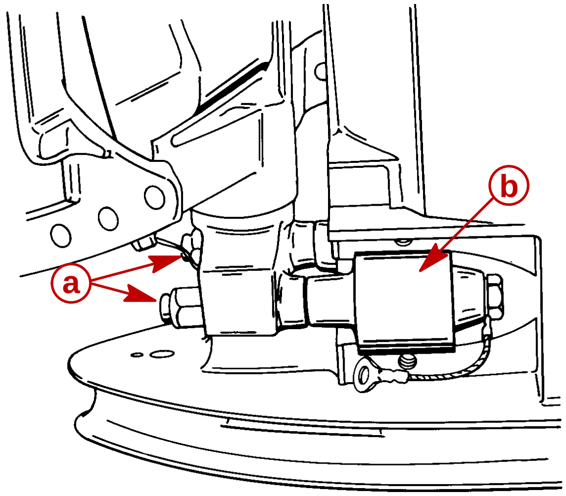
a - Water Tube
b - Exhaust Diffuser
c - Exhaust Tube
d - Drive Shaft Housing

6. Remove all gasket material from driveshaft housing and related components.
7. Remove bolts, which secure lower mount retainers to drive shaft housing, and remove retainers.
8. Remove rubber caps from lower mount bolts.



a - Bolts
b - Lower Mount Retainer (One Each Side)

9. Remove lower mount nuts.



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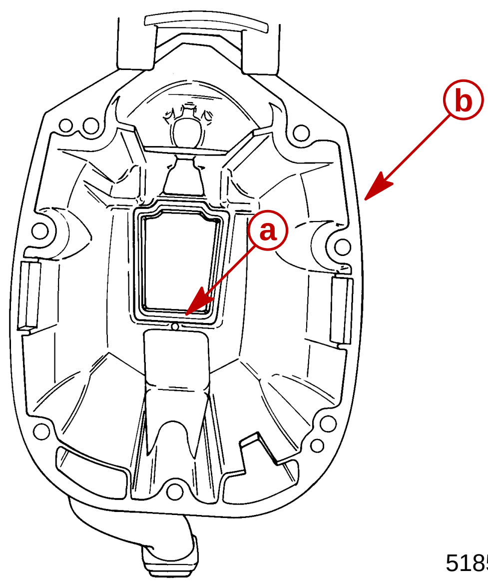
a - Lower Mount Nuts
b - Lower Mount (1 each side)

10. Remove driveshaft housing from swivel bracket by pulling alternately from top to bottom on housing.
11. Remove upper and lower mounts by lifting them out of driveshaft housing.

Reassembly and Installation

1. Apply a thin coat of 2-4-C w/Teflon Marine Lubricant onto inside portion of exhaust tube seal.
2. Install exhaust tube seal into driveshaft housing with tapered side of seal facing up.



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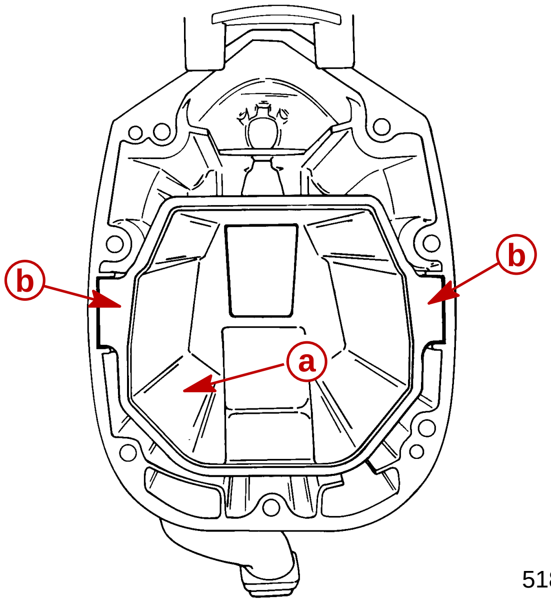
a - Exhaust Tube Seal
b - Driveshaft Housing

3. Push exhaust tube boots onto tabs on each side of exhaust tube.
4. Position exhaust tube in drive shaft housing and push down on tube until boots rest in grooves on inside of housing.
5. Position driveshaft housing to plate gasket on top of housing.
6. Install an exhaust diffuser gasket and exhaust diffuser onto plate, then secure both to plate with 6 bolts. Clean bolts with Loctite 7649 Primer and then apply Loctite 271 to bolt threads. Torque bolts to 60 lb. in. (7.0 Nm).



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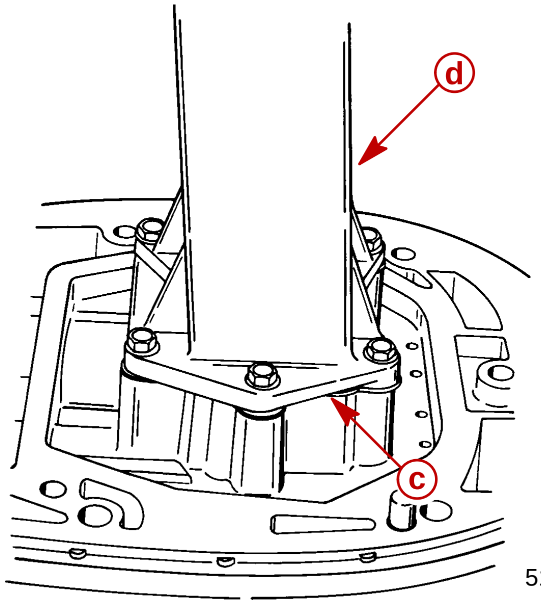

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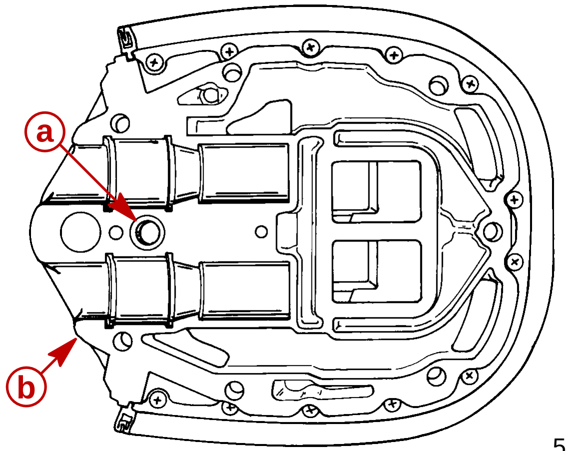
a - Exhaust Tube
b - Exhaust Tube Boots
c - Exhaust Diffuser Gasket
d - Exhaust Diffuser

7. Apply a small amount of 2-4-C w/Teflon Marine Lubricant onto water tube seal.
8. Install water tube seal into driveshaft housing plate with plastic end of seal facing up and install water tube.



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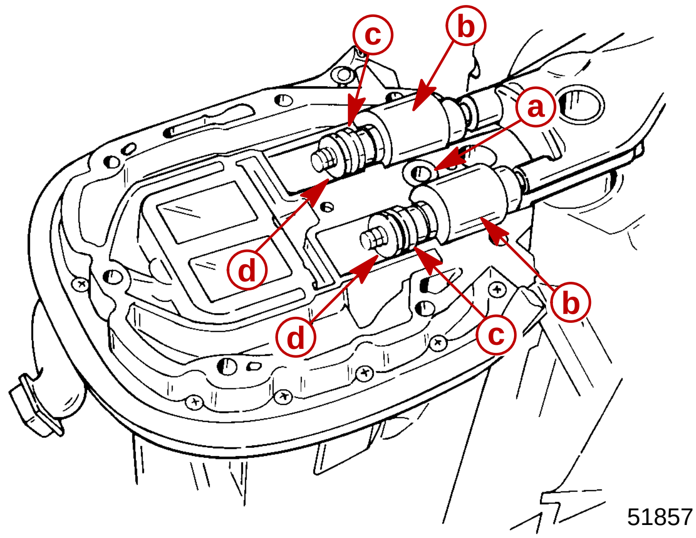
a - Water Tube Seal
b - Driveshaft Housing Plate

9. Position drive shaft housing plate on top of housing.
10. Apply a thin coat of Perfect Seal onto metal portion of upper dyna-float mounts.
11. Position mounts on drive shaft housing plate.
12. Install a rubber washer onto each upper mount, followed by a metal washer.



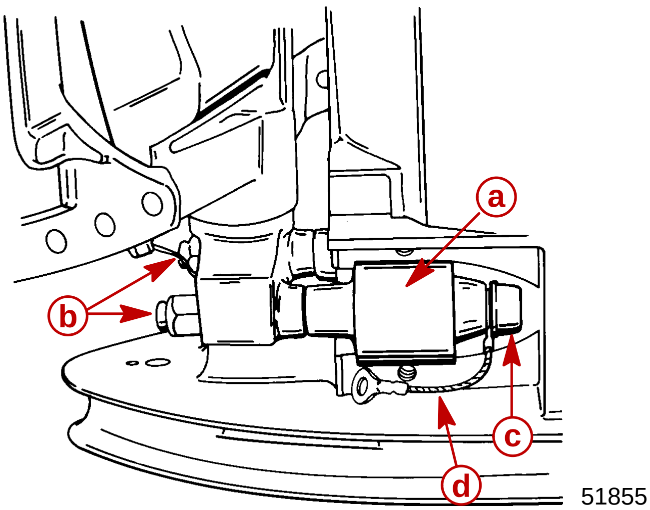
a - Water Tube Seal (Plastic End)
b - Dyna-Float Mounts
c - Rubber Washers
d - Metal Washer

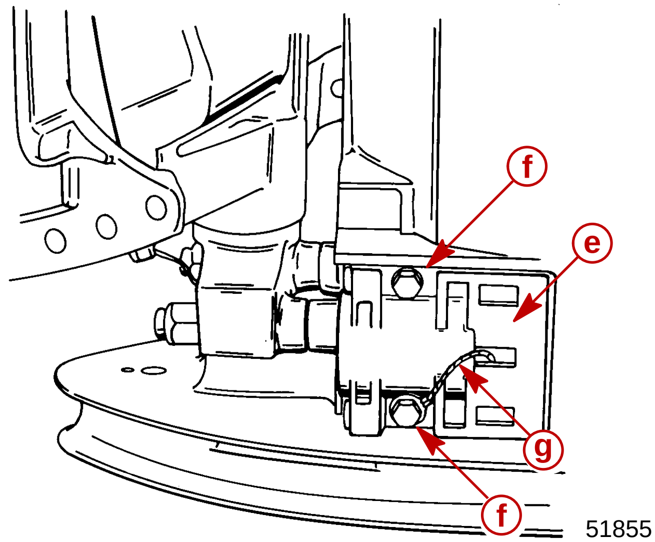
13. Install a ground strap onto one of the lower mount mounting bolts.

NOTE: *Apply Perfect Seal along length of lower mount bolts.*

14. Insert a mounting bolt thru the short end of each lower mount.
15. Position a mount on each lower side of driveshaft housing.
16. Install a flat washer over each lower mounting bolt.
17. Position a bumper on steering arm between mounting bolts.
18. Start upper mounting bolts in upper mounts and align lower mounting bolts with holes in swivel pin yoke. Slide driveshaft housing up against yoke and bumper.
19. Secure upper mounts to steering arm with flat washers and self-locking nuts. Torque nuts to 50 lb. ft. (68.0 Nm).
20. Install ground strap (if equipped) between port lower mount bolt and swivel bracket.
21. Secure lower mounts to swivel pin yoke with self- locking nuts. Torque nuts to 50 lb. ft. (68.0 Nm). Place a rubber cap over each lower mounting bolt head.

22. Install lower mount retainers and secure each retainer with 2 bolts. (Secure ground strap with the nearest retainer bolt.) Torque bolts to 160 lb. in. (18.0 Nm).

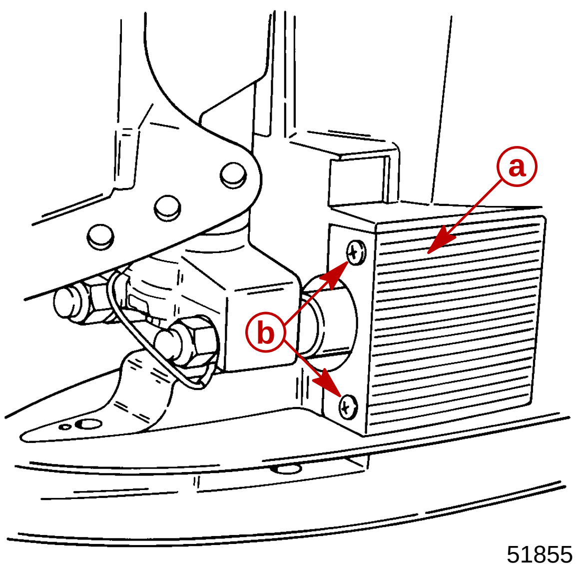


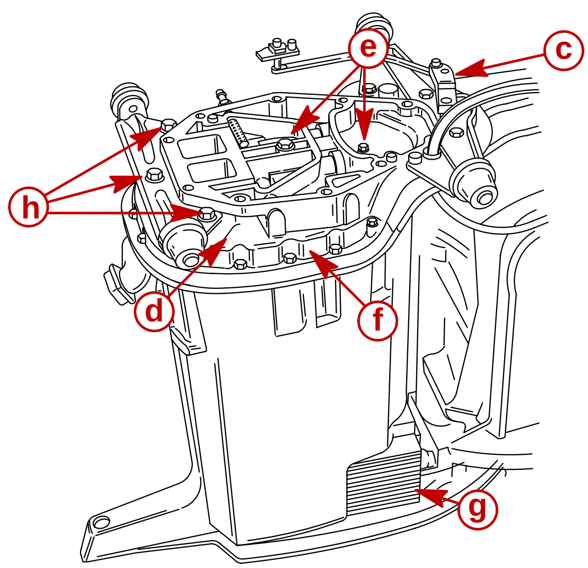


a - Lower Mount
b - Nut (2) [Torque to 50 lb. ft. (68.0 Nm)]
c - Rubber Cap
d - Ground Strap (only one side)
e - Lower Mount Retainer
f - Bolts (2) [Torque to 160 lb. in. (18.0 Nm)]
g - Ground Strap

23. Install lower mount covers and secure each cover with 2 screws.

24. Install exhaust extension plate on driveshaft housing with shift shaft assembly. Secure extension plate to drive shaft housing with 5 bolts.





a - Cover (One Each Side)
b - Screws (Two for Each Cover)
c - Shift Shaft Linkage
d - Exhaust Extension Plate
e - Exhaust Plate to Driveshaft Housing Bolts, Torque to 25 lb. ft. (34 Nm)
f - Drive Shaft Housing Plate
g - Lower Mount Cover (One Each Side)
h - Mounting Bracket Bolts, Torque to 40 lb. ft. (54 Nm)

MID-SECTION

Section 5B – Power Trim

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5
B

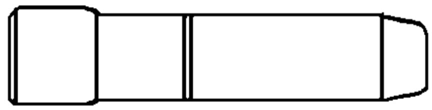
Power Trim Specifications

NOTE: *Maximum acceptable amount of leak down in 24 hours is 1 in. (25.4 mm)*

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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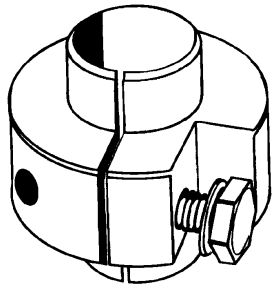
2. Trim Rod Removal Tool 91-44486A1



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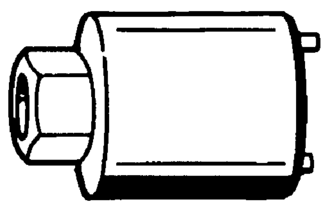
3. Trim Rod Guide Removal Tool 91-44487A1



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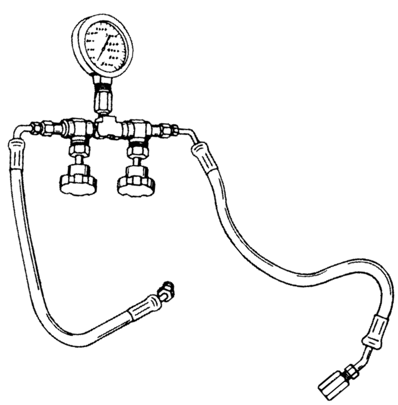
4. Power Trim Test Gauge Kit 91-52915A6



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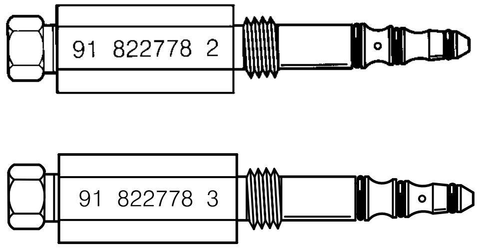
5. Adaptor Fitting 91-82278A2 and 91-82278A3



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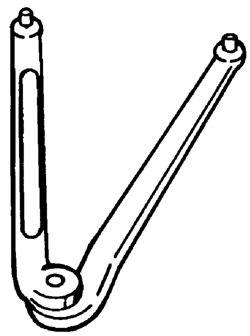
6. Spanner Wrench 91-74951



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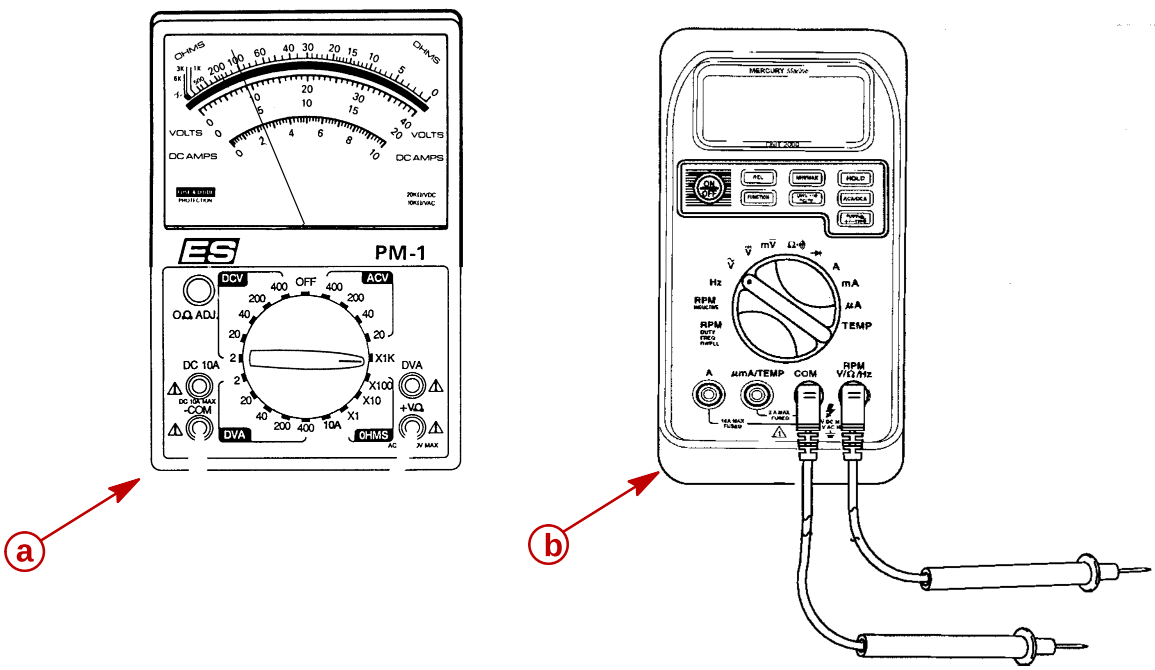
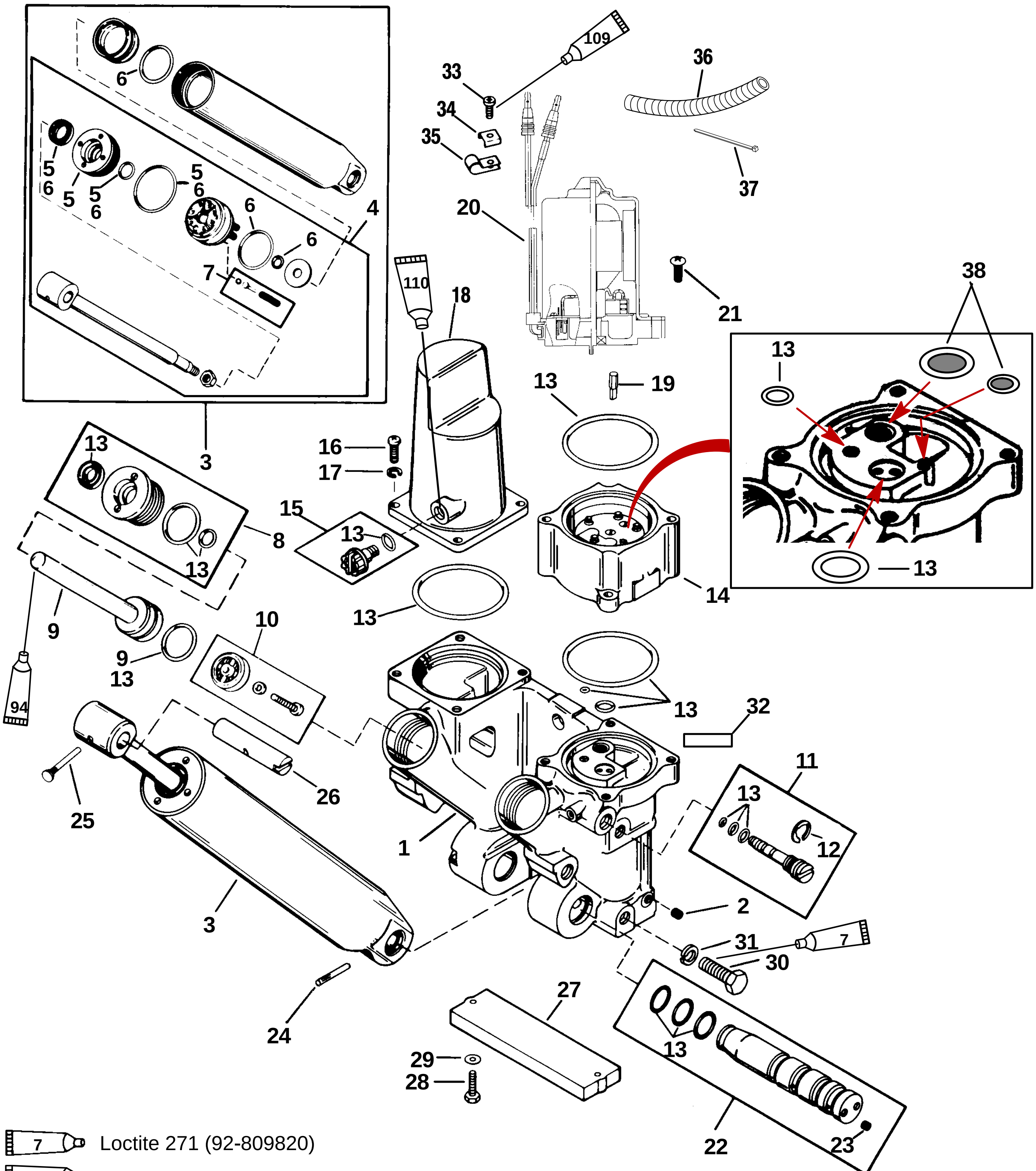
7. Multi-Meter DVA Tester 91-99750A1 or DMT 2000 Digital Tachometer Multi-meter 91-854009A1



a - Multi-Meter DVA Tester 91-99750A1
b - DMT 2000 Digital Tachometer Multi-meter 91-854009A1

Power Trim Components



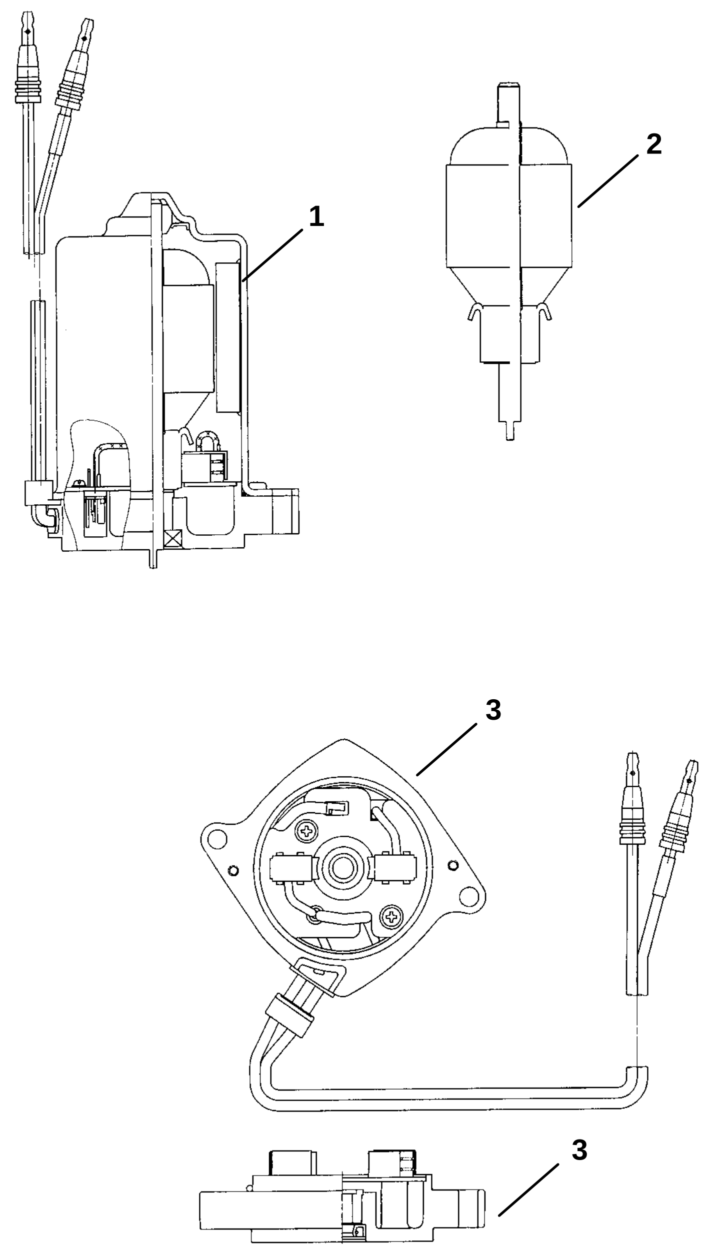
- 7 Loctite 271 (92-809820)
- 94 Anti-Corrosion Grease (92-78376A6)
- 109 GM Silicone Sealer (92-91600-1)
- 110 Power Trim & Steering Fluid (92-90100A12)

Power Trim Components

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
–	1	POWER TRIM ASSEMBLY–Complete			
1	1	MANIFOLD ASSEMBLY			
2	9	PIPE PLUG			
3	1	TILT CYLINDER ASSEMBLY			
4	1	PISTON ROD			
5	1	GUIDE KIT			
6	1	REPAIR KIT			
7	1	CHECK VALVE KIT			
8	2	GUIDE ASSEMBLY			
9	1	PISTON/ROD ASSEMBLY **(PORT)**			
	1	PISTON/ROD ASSEMBLY **(STBD.)**			
10	1	TRIM FILTER ASSEMBLY			
11	1	VALVE ASSEMBLY			
12	1	E RING			
13	1	O RING KIT			
14	1	PUMP			
15	1	PLUG ASSEMBLY			
16	4	SCREW			
17	4	WASHER			
18	1	COVER			
19	1	DRIVE SHAFT			
20	1	TRIM MOTOR (Breakdown on Power Trim Motor)			
21	2	SCREW **(LONG)**	80		9
	2	SCREW **(SHORT)**	80		9
22	1	SHAFT ASSEMBLY			
23	2	PIPE PLUG			
24	1	GROOVE PIN			
25	1	GROOVE PIN			
26	1	SHAFT			
27	1	ANODE ASSEMBLY			
28	2	SCREW (M6 x 1 x 25)	70		8
29	2	WASHER			
30	6	SCREW (M10 x 1.5 x 30)		45	61
31	6	WASHER			
32	1	DECAL-Caution power trim			
33	1	SCREW (10-16 x 3/5 IN.)			
34	1	C WASHER			
35	2	CLAMP			
36	1	TUBING			
37	1	STA-STRAP			
38	2	FILTER SCREENS			

***NOTE:** Lubricate all o-rings with Power Trim and Steering Fluid.*

Power Trim Motor



REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb.in.	lb.ft.	N·m
–	1	POWER TRIM MOTOR			
1	1	BRUSH AND SEAL KIT			
2	1	ARMATURE KIT			
3	1	END FRAME **(Complete)**			

Power Trim - General Information

Description

The Power Trim System consists of an electric motor, pressurized fluid reservoir, pump, tilt cylinder, and two trim rams.

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

Trimming Characteristics

NOTE: *Because hull designs react differently in varying water conditions, varying the trim position will often improve the ride and boat handling. When trimming from a mid-trim position (with outboard trim tab in a straight fore and aft position), expect the following:*

TRIMMING OUTBOARD “UP” (OUT):

⚠ WARNING

Excessive trim “Out” may reduce the stability of some high speed hulls. To correct instability, reduce the power gradually and trim the outboard “In” slightly before resuming high speed operation. A rapid reduction in power will result in a sudden change of steering torque and may cause additional boat instability.

Will lift boat bow, increasing top speed.

Transfers steering torque harder to port (left) on installations below 23 in. (584.2 mm) transom height.

Increases gearcase clearance over submerged objects.

Excess trim can cause “porpoising” and/or ventilation.

⚠ WARNING

Excessive outboard trim angle will result in insufficient water supply causing water pump and/or powerhead overheating damage. Insure water level is above water intake holes whenever outboard is running.

The “Up” circuit actuates the up solenoid (under outboard cowl) and closes the motor circuit. The electric motor drives the pump, forcing fluid thru passageways into the up side of the trim cylinders.

The trim cylinders position the outboard at the desired trim angle in the 20 degree maximum trim range. The system will not allow the outboard to be trimmed above the 20 degree trim range as long as the engine RPM is above approximately 2000 RPM.

The outboard can be trimmed above the 20 degree maximum trim angle (for shallow water operation, etc.), by keeping the engine RPM below 2000. If the RPM increases over 2000, propeller thrust (if propeller is deep enough) will cause the trim system to return the outboard to the 20 degree maximum trim position.

TRIMMING OUTBOARD "DOWN" (IN):

⚠ WARNING

Excessive speed at minimum trim "In" may result in undesirable and/or unsafe steering conditions. Test for handling characteristics after any adjustment is made to the trim angle (and tilt pin location).

Aids planing, particularly with heavy loads.

Improves ride in choppy water conditions.

Excess trim "In" can cause "bow steer" (boat veers to left or right).

Transfers steering torque to starboard (right).

Improves acceleration to planing speed.

The "Down" circuit actuates the down solenoid (under engine cowl) and closes the motor circuit. The electric motor drives the pump in the opposite direction as the up circuit, forcing fluid thru passageways into the "down" side of the tilt ram. The tilt ram moves the engine down to the desired position.

Trailering Outboard

The "Up" circuit first moves the trim cylinders; when the trim cylinders extend fully, the tilt ram extends to tilt the outboard to the full up position for trailering.

Before the boat is trailered, the operator should check for clearance between the outboard skeg and pavement to prevent damage to skeg from striking pavement.

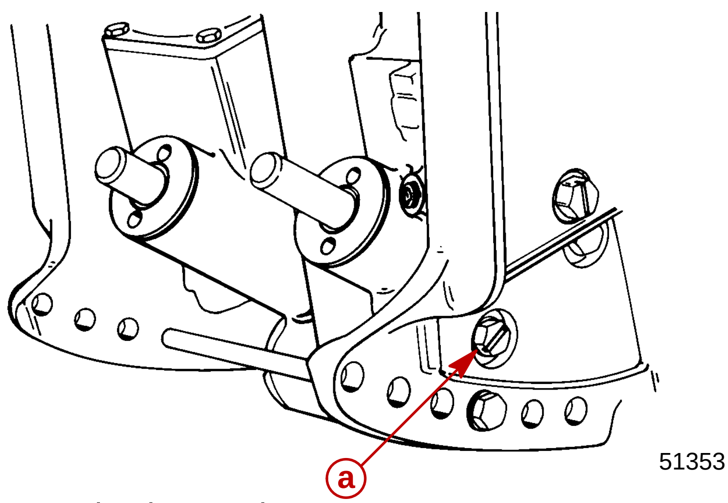
If the outboard must be tilted for clearance between skeg and pavement, a device such as a "Transom Saver" should be installed to prevent stress to boat transom from outboard weight while the boat/outboard are being trailered.

Tilting Outboard Manually

⚠ WARNING

Before opening the manual release valve knob, insure all persons are clear of outboard as outboard will drop to full "Down" when valve is opened.

The outboard can be raised or lowered manually by opening the manual release valve 3 to 4 turns counterclockwise. Close manual release valve to hold outboard at the desired tilt position.

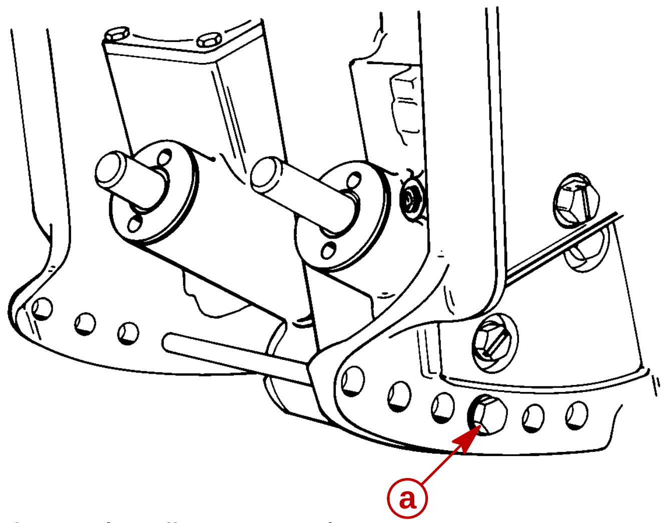


a - Manual Release Valve

Trim “In” Angle Adjustment

> **⚠ WARNING**
>
> **Boat operation with outboard trimmed to the full “In” trim angle [not using the trim angle adjustment bolt (a)] at planing speed may result in undesirable and/or unsafe steering conditions. A water test for handling/steering conditions is required after any trim angle adjustments.**

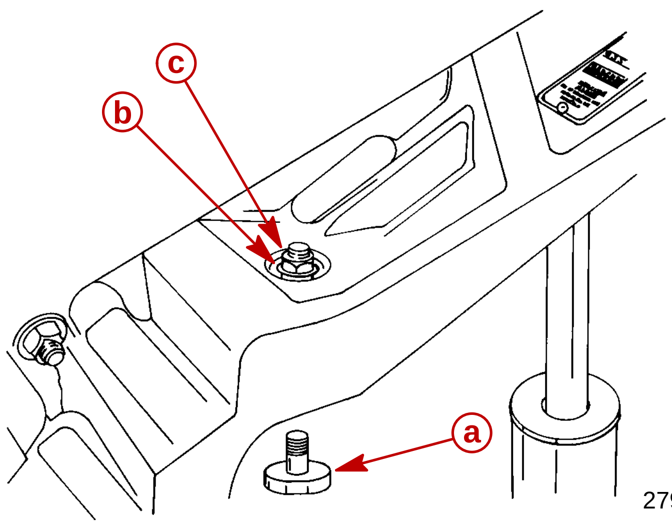
IMPORTANT: Some boat/motor combinations not using the trim angle adjustment pin (a) and trimmed to the full “In” trim angle position may not exhibit any undesirable and/or unsafe handling and/or steering characteristics at planing speed. If so, not using the trim angle adjustment bolt may be advantageous to acceleration and planing. A water test is required to determine if these characteristics apply to a particular boat/motor combination.



a - Trim Angle Adjustment Bolt

Striker Plate Replacement

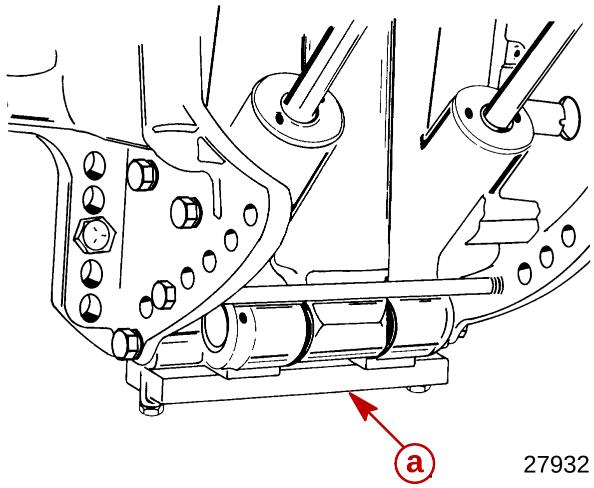
Visually inspect striker plates and replace if worn excessively.



a - Striker Plate (2)
b - Lockwasher
c - Locknut. Torque to 80 lb. in. (9 Nm)

Anode Plate

Anode plate 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).

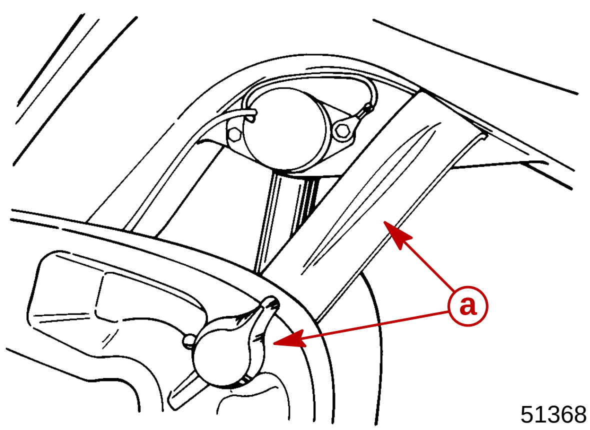
Check, Fill and Purge - Power Trim System

TO CHECK:

⚠ CAUTION
Tilt outboard to full "Up" position and engage tilt lock lever before checking fluid level. System is pressurized. Extend trim and tilt rams fully to depressurize system.

Remove fill plug and O-ring. System is full when oil level is present at filler hole. Tighten fill plug securely.

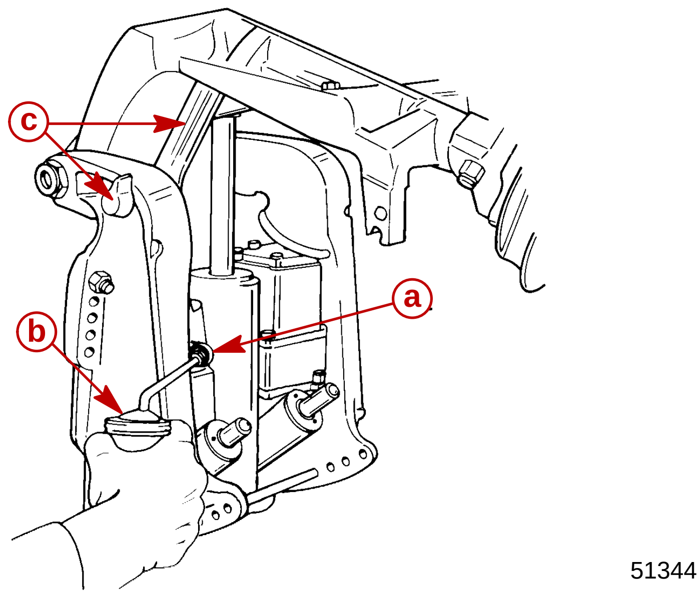
NOTE: *Automatic Transmission Fluid (ATF) Type F, FA, Dexron II or Dexron III may be used.*



a - Tilt Lock Lever

TO FILL:

IMPORTANT: This trim system is pressurized. Remove "Fill" plug only when outboard is tilted to the full "Up" position or the trim/tilt rams are fully extended. Retighten "Fill" plug before tilting outboard down or retracting tilt/trim rams. Remove "Fill" plug and O-ring. System is full when oil level is present at fill hole. Tighten "Fill" plug securely.



a - Fill Plug and O-ring (remove to fill system, tighten securely)
b - Oil Can (fill system with Quicksilver Power Trim and Steering Fluid)
c - Tilt Lock Lever (engage to support engine in "Up" position)

TO PURGE:

IMPORTANT: Fill plug and O-ring must be tightened securely before purging system.

IMPORTANT: Run Trim System in short "jogs" until pump is primed and trim system moves. If trim motor is run without priming pump, driveshaft failure could result.

Cycle outboard through entire trim/tilt range 4 times. Check fluid level after purging system.

Push down on outboard when trim rams are slightly extended. If rams retract more than 1/8 in. (3.2 mm), air is present in system. Cycle system again and check fluid level.

Troubleshooting

IMPORTANT: Determine if Electrical or Hydraulic problem exists.

IMPORTANT: Acceptable power trim leak down should not exceed 1 in. (25.4 mm) (when measured at the tilt ram) in a 24 hour period.

HYDRAULIC SYSTEM TROUBLESHOOTING

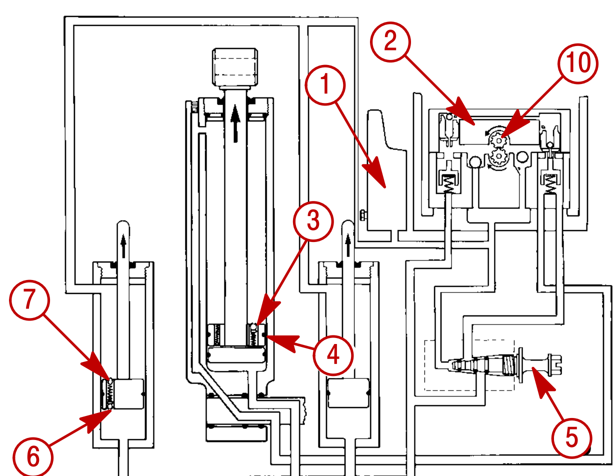
IMPORTANT: Make one correction at a time. Check operation of trim system before proceeding to the next check.

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.

External Mounted Hydraulic System



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 relays are functioning correctly.

POWER TRIM RELAY TEST PROCEDURE

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

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

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

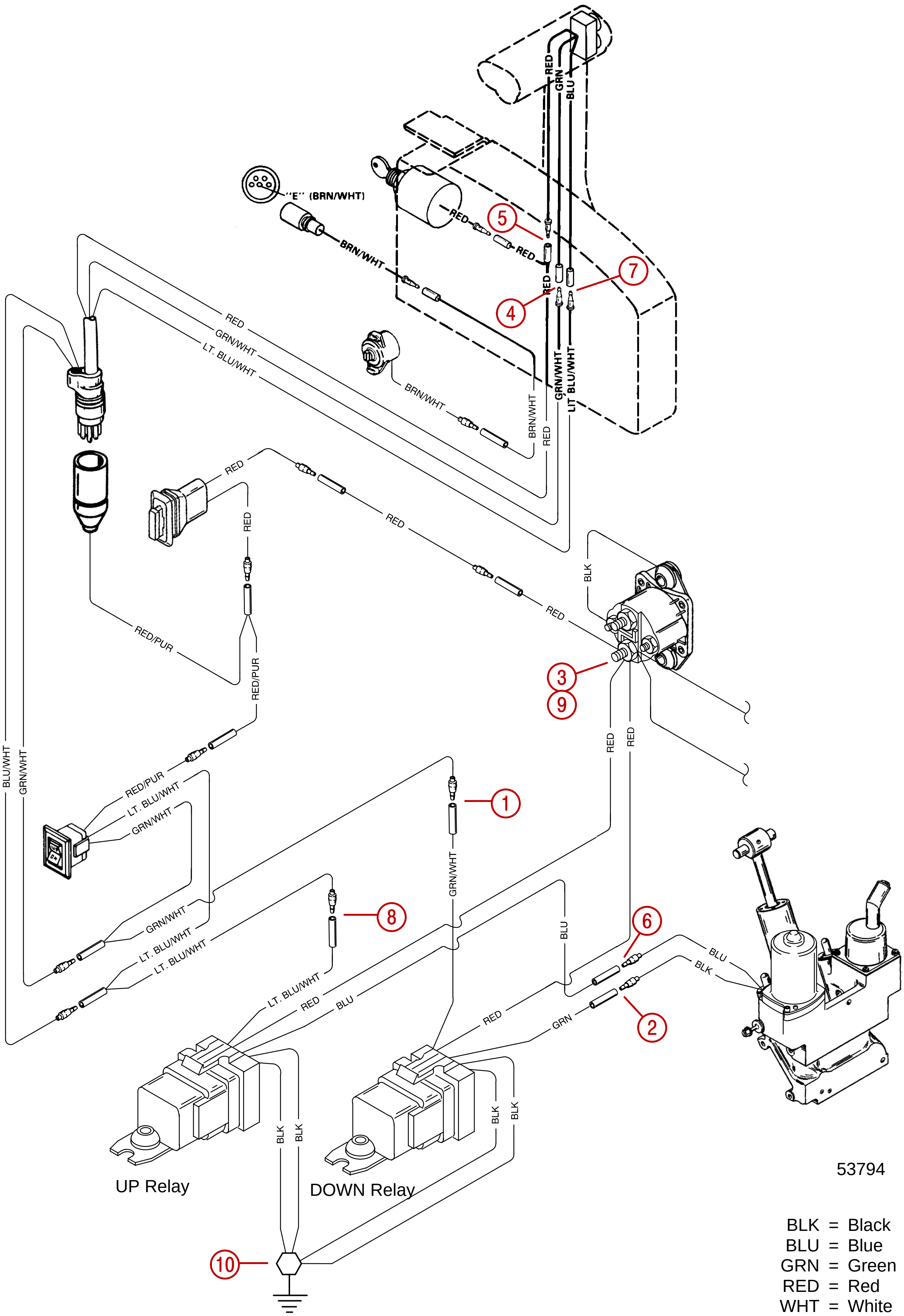
1. Disconnect the heavy gauge pump wires from the trim control relay.
2. Check for continuity between the heavy leads from the trim relays to ground.

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

Replace the relay that does not have continuity.

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

Power Trim System with Relays and 2 Wire Trim Motor



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”

Connect Voltmeter red lead to Point 1 and black lead to ground.

Depress the “Down” trim button.

Battery Voltage Indicated:
Connect Voltmeter red lead to Point 3.

Battery Voltage Indicated:
- •Connect Voltmeter red lead to Point 2.
- •Depress “Down” trim button.

Battery Voltage Indicated:
- •Test UP relay.

Refer to page 5B-13 for relay test procedure.

Relay good:
- •Pump motor wiring is defective.
- •Pump motor is defective.

No Voltage Indicated:
Relay Switch is defective.

No Voltage Indicated:

There is an open circuit between Point 3 and positive (+) battery terminal.
- •Check for loose or corroded connections.
- •Check wires for open.

No Voltage Indicated:
Connect Voltmeter red lead to Point 4 and black lead to ground. Depress “Down” trim button. If battery voltage is indicated, wire is open between Points 4 and 1.

No Voltage Indicated:

Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Up” Circuit

Connect Voltmeter red lead to Point 8 and black lead to ground.

Depress the “Up” trim button.

Battery Voltage Indicated:
Connect Voltmeter red lead to Point 9.

No Voltage Indicated:
Connect Voltmeter red lead to Point 7 and black lead to ground. Depress “Up” trim button. If battery voltage is indicated, wire is open between Points 7 and 8.

Battery Voltage Indicated:
- •Connect Voltmeter red lead to Point 6.
- •Depress “Up” trim button.

No Voltage Indicated:

There is an open circuit between Point 9 and positive (+) battery terminal.
- •Check for loose or corroded connections.
- •Check wires for open.

Battery Voltage Indicated:
- •Test DOWN relay.

Refer to page 5B-13 for relay test procedure.

No Voltage Indicated:

Relay Switch is defective.

Relay good:
- •Pump motor wiring is defective.
- •Pump motor is defective.

No Voltage Indicated:

Connect Voltmeter red lead to Point 5. If battery voltage is indicated, trim switch is faulty. If no battery voltage, check for loose or corroded connection at Point 5 or open circuit in wire supplying current to Point 5.

Troubleshooting the “Down” and “Up” Circuits (All Circuits Inoperative)

Check in-line fuse (under cowl) to see if fuse is blown.

Blown Fuse:

- Correct problem that caused fuse to blow.
- Replace fuse.

Fuse Not Blown:

Connect Voltmeter red lead to Point 3 and black lead to ground. Battery voltage should be indicated.

No Voltage Indicated:

- Check battery leads for poor connections or open circuits.
- Check battery charge.

Battery Voltage Indicated:

- Connect Voltmeter red lead to Point 8 and black lead to ground.
- Depress “Up” trim button and check for battery voltage.

No Voltage Indicated:

Connect red Voltmeter lead to Point 5, and black lead to ground.

Battery Voltage Indicated:

- Check black ground wires for poor connection or poor ground, Point 10.
- Pump motor is faulty. Refer to “Motor and Electrical Tests/ Repair”, following.

No Voltage Indicated:

Check that voltage is being supplied to control by performing the following checks:

- DO NOT start engine.
- Turn ignition switch to “Run” position.
- Check for voltage at any instrument, using a Voltmeter.

Battery Voltage Indicated:

Trim switch is faulty or there is an open circuit in wires (green-white, blue-white) between trim buttons and trim pump.

- Check trim switch.
- Check all trim harness connectors for loose or corroded connections.
- Check for pinched or severed wires.

No Voltage Indicated:

Red wire is open between Point 3 and red terminal on back of the ignition switch.

- Check for loose or corroded connections.
- Check for open in wire.

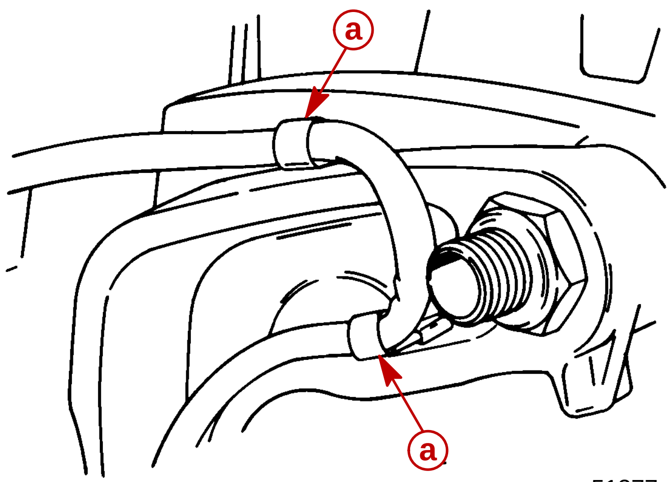
Battery Voltage Indicated:

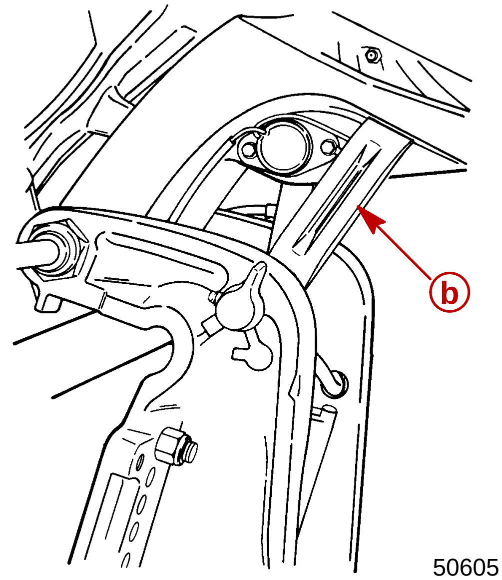
There is an open circuit in wire between Point 5 and Red terminal on the back of the ignition switch.

Power Trim Assembly Removal and Installation

Removal

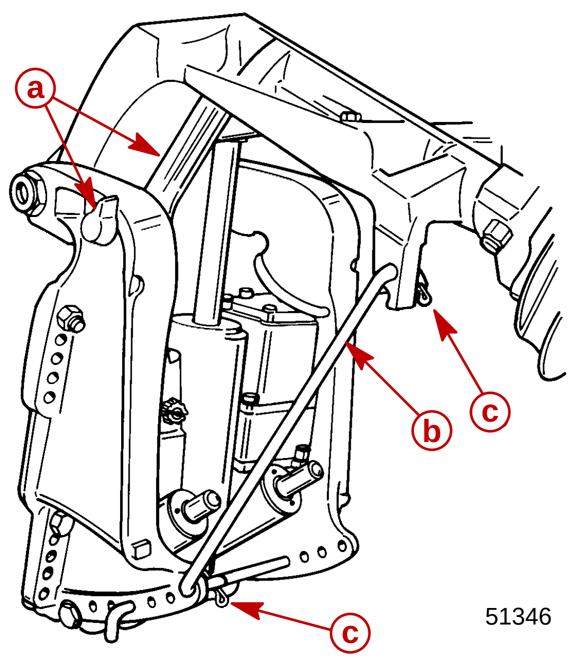
1. Remove clamps on transom bracket to free power trim wiring.
2. Raise outboard to full “Up” position and engage tilt lock lever.





a - Clamps
b - Tilt Lock Lever

⚠ WARNING
Failure to support outboard as shown could result in personal injury and/or damage to outboard or boat.

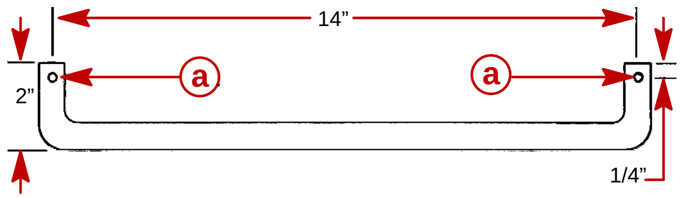


a - Tilt Lock Lever
b - Support Tool
c - Retaining Clips

IMPORTANT: Support outboard as shown above to prevent engine from tipping when power trim retaining pin is removed.

SUPPORT TOOL

3/8 in. diameter metal rod (a used shift shaft works well)



a - Drill holes for retaining clips

METRIC CONVERSION

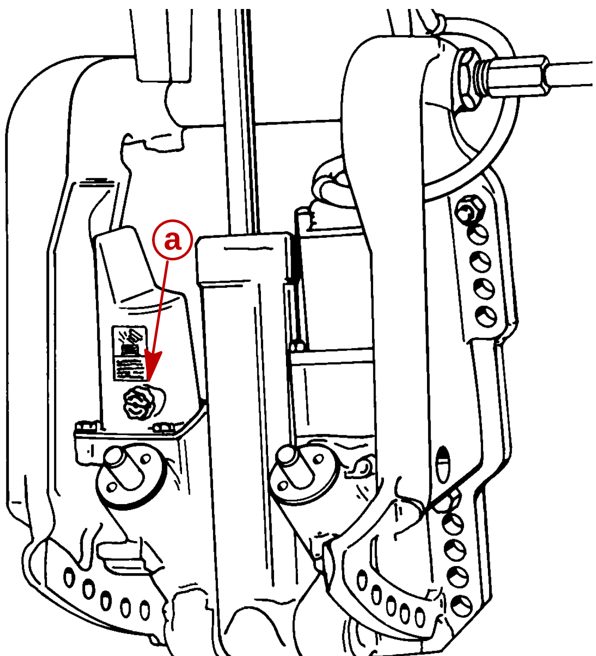
14 in. = 35.56 cm.	2 in. = 50.8 mm
3/8 in. = 9.5 mm.	1/4 in. = 6.35 mm.

> **⚠ CAUTION**
>
> **Disconnect battery cables at battery before removing power trim wires from solenoids.**

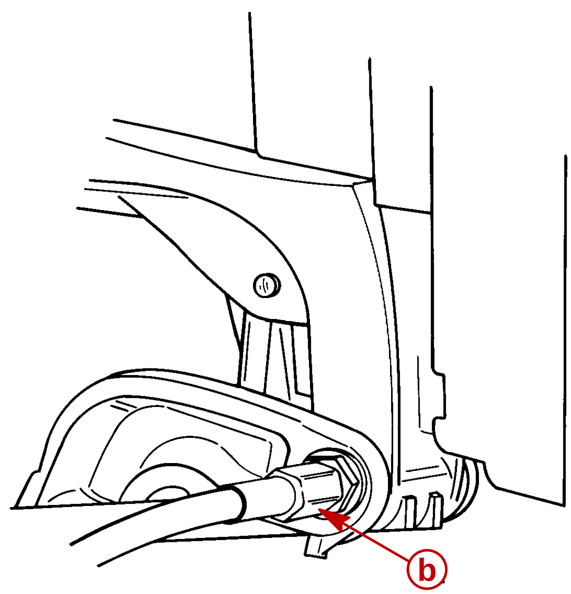
3. Disconnect power trim wires at solenoids (BLUE, GREEN, and BLACK) or if relay style, disconnect (BLUE and GREEN) bullet connector harness.

4. Open filler cap and release any remaining pressure in the system.

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.



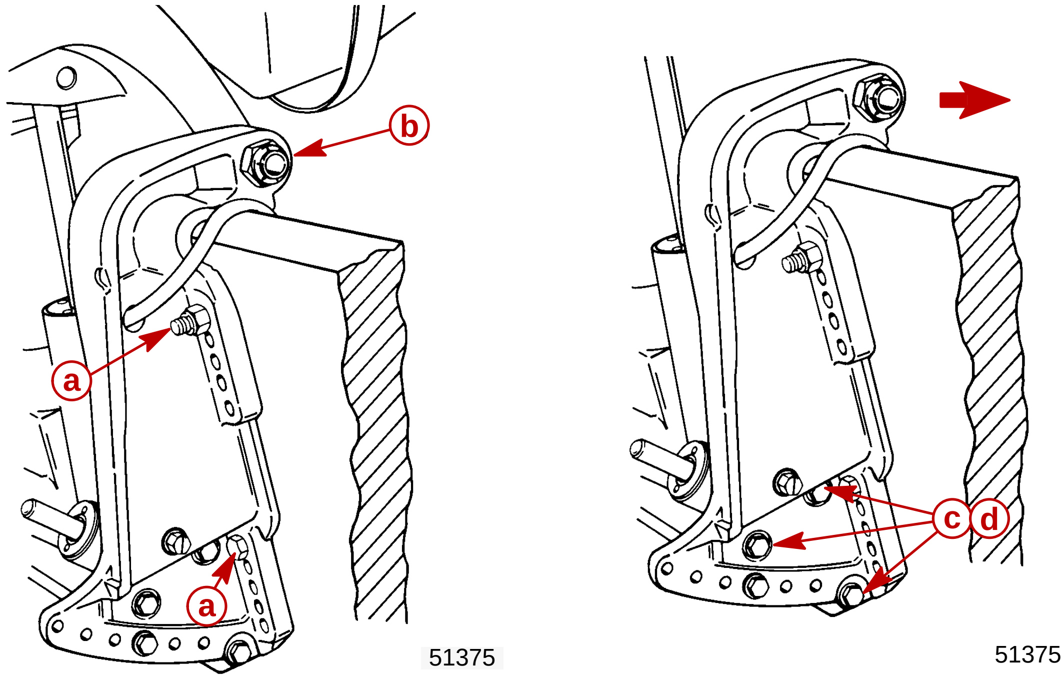
51339



51354

a - Filler Cap
b - Retaining Nut

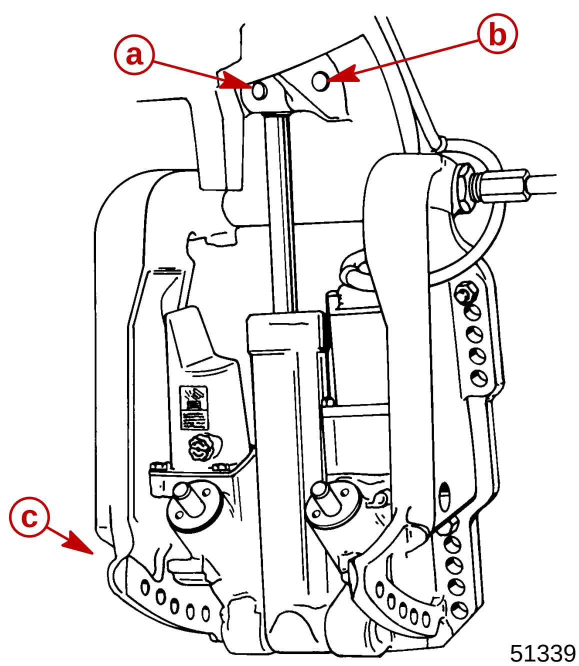
5. Remove outboard transom mounting bolts, and loosen tilt tube nut until nut is flush with end of tilt tube thread.
6. Remove 3 screws and washers and move starboard transom bracket.



a - Transom Mount Bolts (2)
b - Tilt Tube Nut (flush with end of thread)
c - Screws (3)
d - Washers (3)

IMPORTANT: Cross pin (a) should not be reused. Replace with new cross pin.

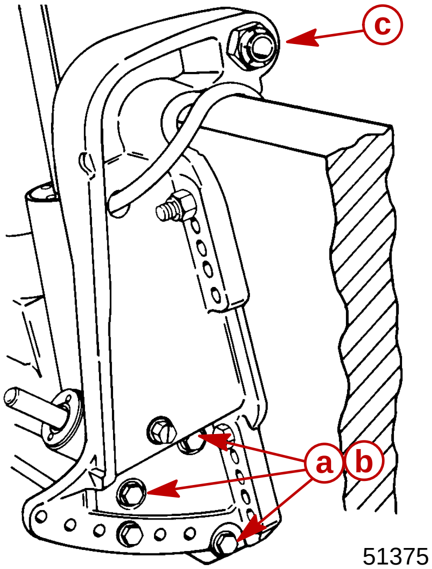
7. Drive out cross pin, push out upper swivel pin, and remove 3 screws and washers retaining trim system. Remove system from outboard.

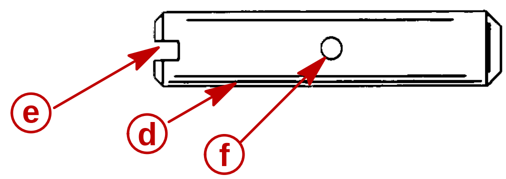


a - Cross Pin
b - Upper Swivel Pin
c - Port Transom Bracket Screws and Washers (3). Remove to Release Trim System from Outboard.

Installation

1. Paint any exposed metal surfaces to prevent corrosion.
2. Apply Loctite 271 to screws. Install trim system, starboard transom bracket, and tilt tube nut.
3. Use a 12 volt power source to extend tilt ram up to align upper swivel shaft hole and end of ram. Connect trim motor wires [BLUE wire to POSITIVE (+), BLACK wire to NEGATIVE (–)]. If ram extends too far, retract ram by connecting GREEN wire to POSITIVE (+).
4. Install Upper Swivel Pin with slotted end to left (port) side of engine.

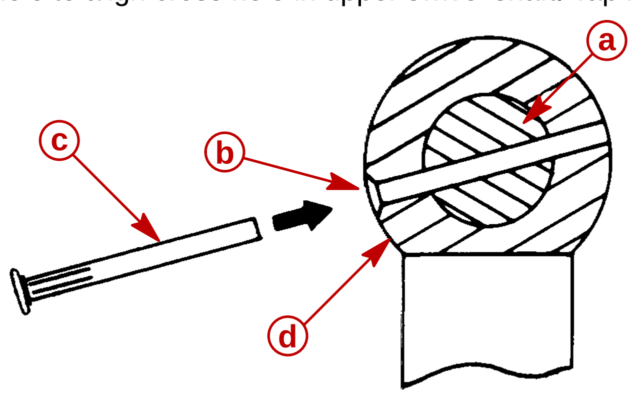




a - Screw (6) Torque to 40 lb. ft. (54.0 N·m)
b - Lockwasher (6) Install one per screw
c - Tilt Tube Nut
d - Upper Swivel Pin
e - Slotted end
f - Cross hole (in line with slotted end)

IMPORTANT: Cross pin should not be reused. Install a new pin.

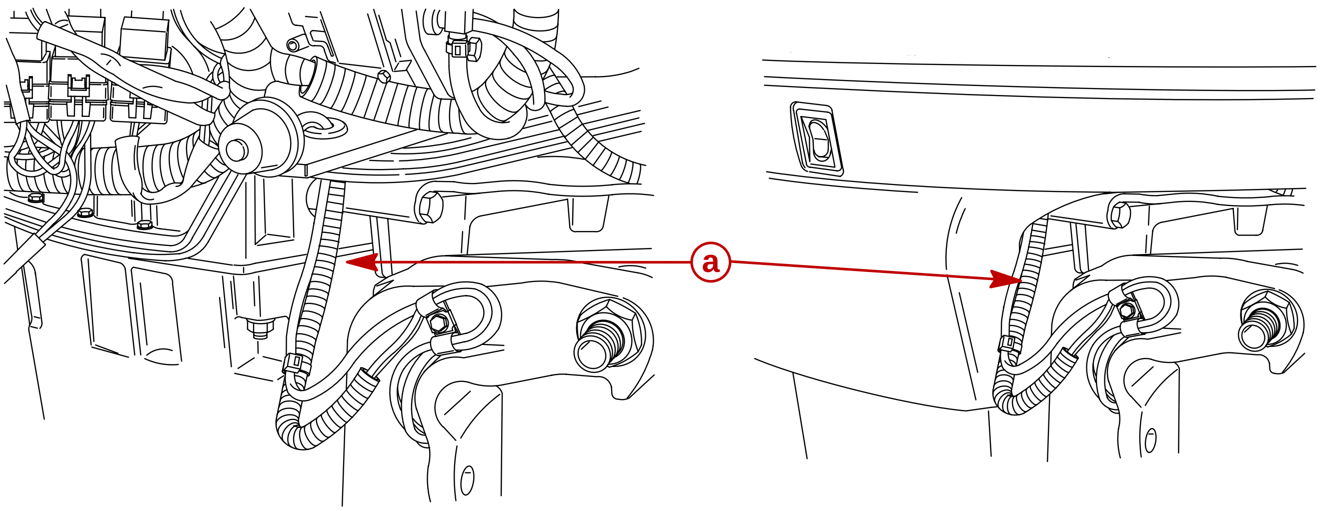
5. Position slot on end of swivel shaft in line with hole in tilt ram end. Insert a punch into tilt ram hole to align cross hole in upper swivel shaft. Tap new cross pin in until flush.



a - Upper Swivel Shaft (Slot is in line with cross hole)
b - Chamfered End of Hole (Faces away from transom)
c - Retaining Pin
d - Tilt Ram End

6. Connect trim motor wires to solenoids. Refer to Wiring Diagrams in this manual. Route trim wires as specified in this manual.

NOTE: *The 2 power leads going to the trim motor should be encapsulated with conduit tubing. If tubing has not been previously installed, order 32-828547-353 and cut to appropriate length.*



56921 56922

a - Conduit Tubing

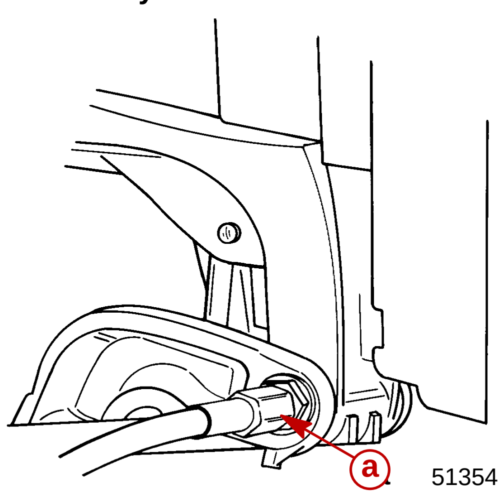
7. Apply marine sealer to shanks of mount bolts and install transom mount bolts.

IMPORTANT: Do not use an impact driver to tighten transom mount bolts.

Apply marine sealer to threads of mount bolts. Secure with flat washers and locknuts. Be sure installation is watertight.

8. Tighten tilt tube nut securely.

IMPORTANT: Outboards equipped with thru-the-tilt-tube steering: Tighten steering cable retaining nut securely to tilt tube.



51354

a - Steering Cable Retaining Nut

9. Apply Quicksilver Liquid Neoprene (91-25511--2) on all electrical connections.

⚠ WARNING

Electrical wires passing through cowl openings must be protected from chafing or being cut. Follow the recommended procedures outlined in Section 1D 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.

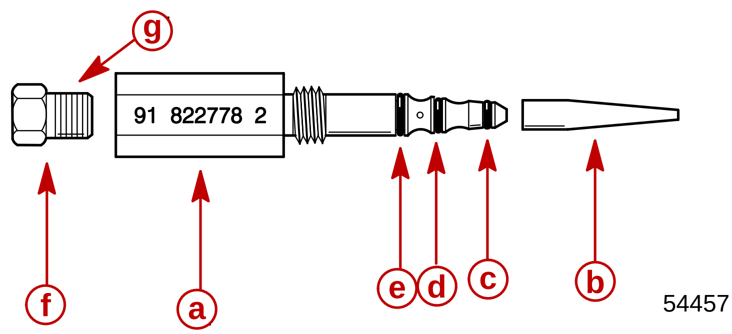
"UP" Pressure Check

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.

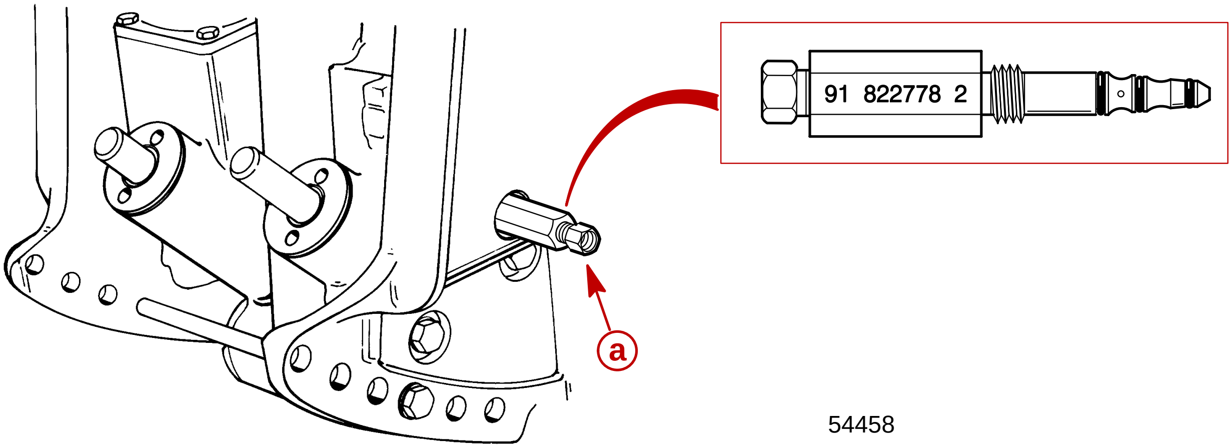
NOTE: *A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.*

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.*



a - Test Adaptor (91-822778A2)
b - O-ring Installation Tool
c - Small O-ring (Install 1st)
d - Medium O-ring (Install 2nd)
e - Large O-ring (Install Last)
f - Brass Fitting
g - Apply Teflon Tape

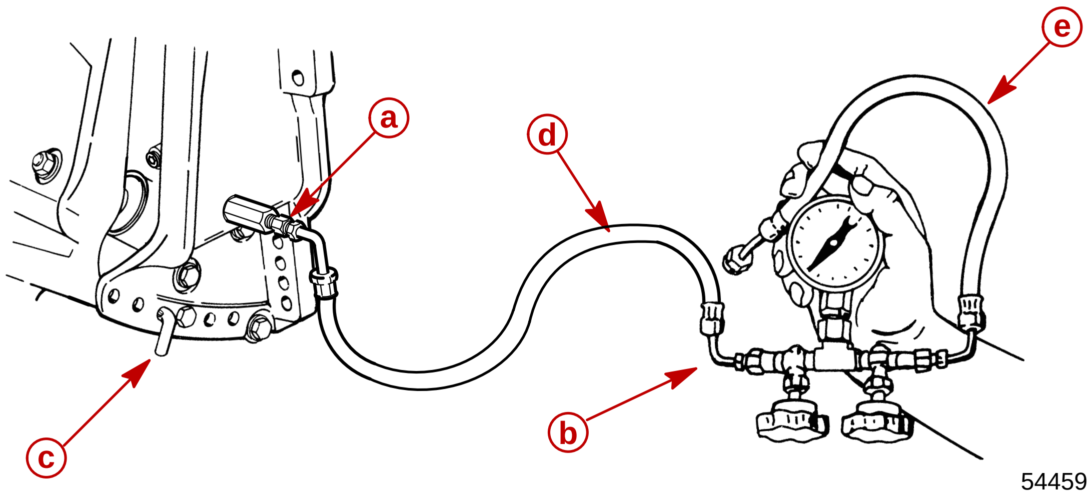
4. Install test adaptor 91-822778A2 into manual release valve hole.



54458

a - Test Adaptor (91-822778A2)

5. Thread hose from Test Gauge Kit (91-52915A6) into brass fitting on adaptor.



54459

a - Brass Fitting
b - Test Gauge Assembly
c - Tilt Pin (Position in Hole Shown)
d - Hose
e - Hose (Not Used)

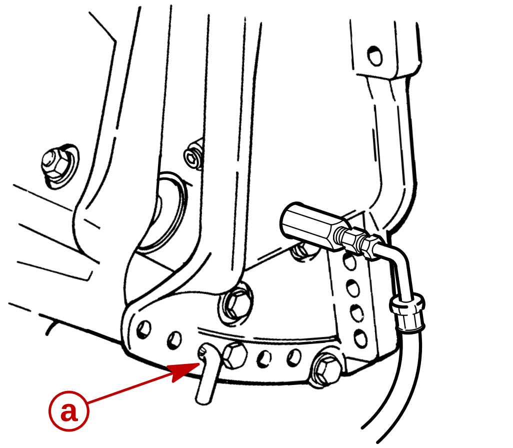
6. Reinstall fill plug.

7. Disengage tilt lock lever.

CAUTION

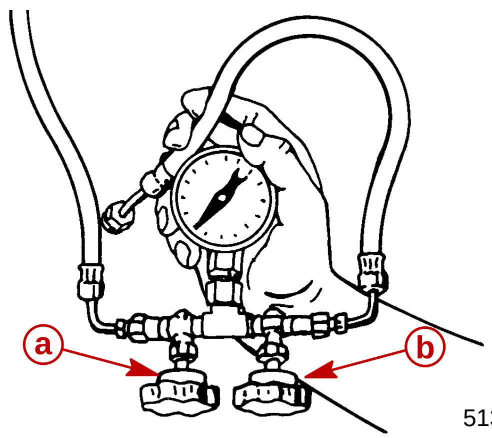
Failure to install spare tilt pin (or hardened bolts and nuts) in hole shown could result in transom bracket failure and possible injury.

8. Move outboard "IN" until hole in swivel bracket "ear" aligns with the 3rd tilt hole in transom bracket. Lock engine in trim range by installing a 3/8 in. (9.5 mm) diameter tilt pin or two 3/8 in. (9.5 mm) hardened bolts and nuts thru the transom brackets and swivel bracket in the hole shown.



a - Tilt Pin Hole (Install Spare Tilt Pin or Hardened Bolts and Nuts)

9. Open valve (a) and close valve (b).



10. Run trim "UP". The minimum pressure should be 1300 P.S.I. (91 kg/cm^2).
11. Run trim "DOWN" to release pressure and remove spare tilt pin or bolts and nuts.
12. Tilt outboard full "UP" and engage tilt lock lever.
13. Slowly remove "Fill" plug to bleed pressure.
14. Remove test gauge hose and adapter.
15. Reinstall Manual Release Valve and secure valve with circlip.
16. Retighten "Fill" plug.

NOTE: *If pressure is less than 1300 PSI (91 kg/cm^2), troubleshoot system per instructions on page 5B-16.*

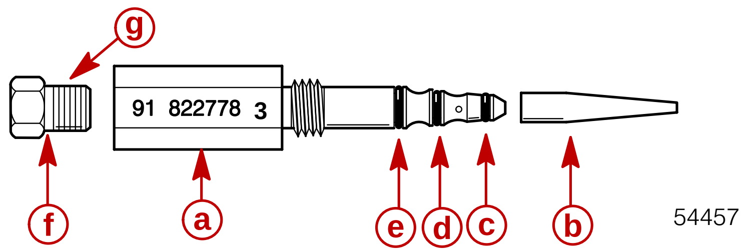
“DOWN” Pressure Check

IMPORTANT: Insure battery is fully charged before performing tests.

1. Tilt outboard to full “Up” position and engage tilt lock lever.
2. Slowly remove “Fill” plug to bleed pressure from reservoir.
3. Remove circlip securing manual release valve and unscrew release valve from trim assembly.

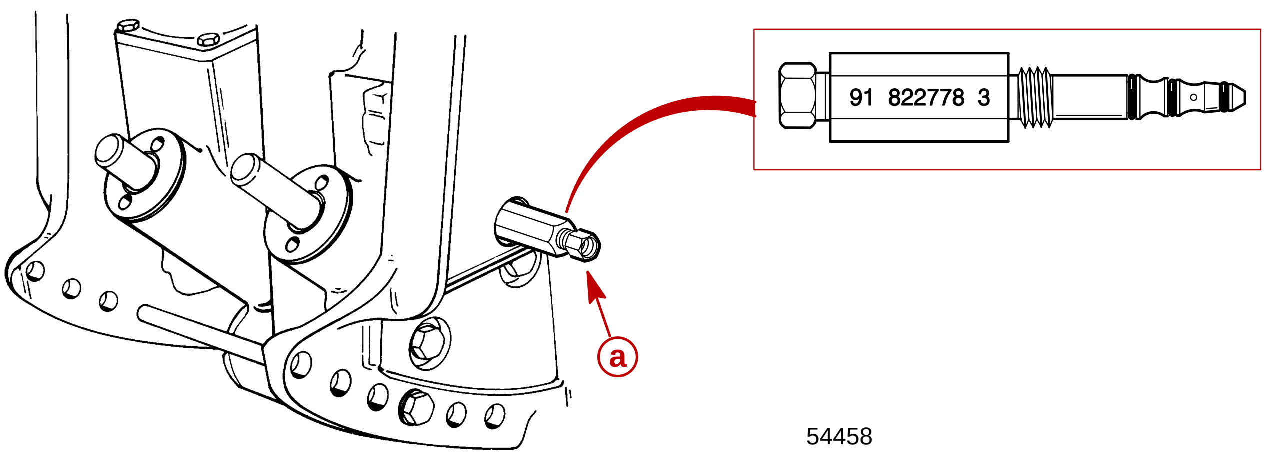
NOTE: *A small amount of trim fluid may drip from manual release valve hole. Place a suitable container under trim assembly to collect any leakage.*

NOTE: *Assemble test adaptor by using O-ring installation tool to position small O-ring onto adaptor 1st, then install medium O-ring and lastly large O-ring. Thread brass fitting into test adaptor securely using teflon tape on threads.*



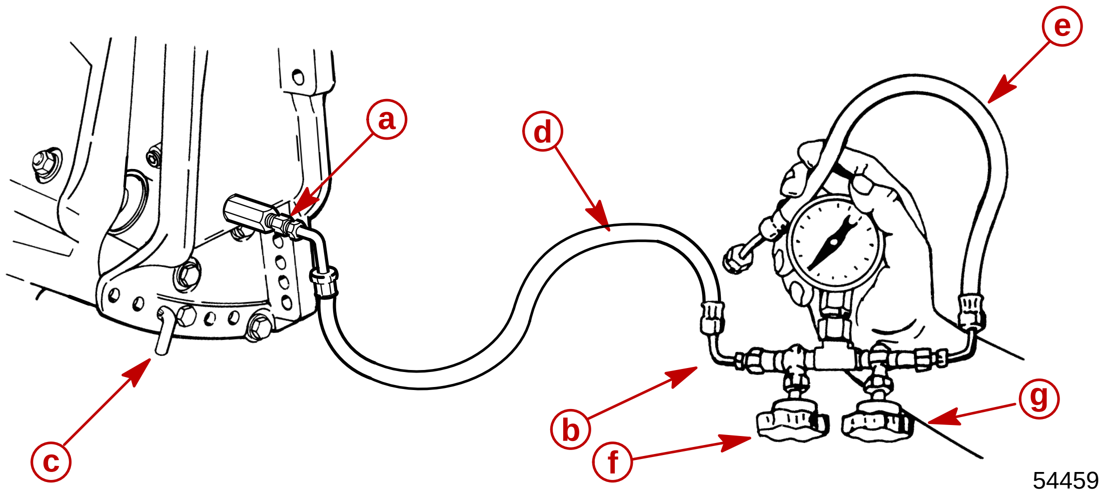
a - Test Adaptor (91-822778A3)
b - O-ring Installation Tool
c - Small O-ring (Install 1st)
d - Medium O-ring (Install 2nd)
e - Large O-ring (Install Last)
f - Brass Fitting
g - Apply Teflon Tape

4. Install test adaptor 91-822778A3 into manual release valve hole.



a - Test Adaptor (91-822778A3)

5. Thread hose from Test Gauge Kit (91-52915A6) into brass fitting on adaptor.



a - Brass Fitting
b - Test Gauge Assembly
c - Tilt Pin (Position in Hole Shown)
d - Hose
e - Hose (Not Used)
f - OPEN Valve
g - CLOSE Valve

6. Reinstall fill plug.
7. Disengage tilt lock lever.
8. Open valve (f) and close valve (g).
9. Run trim “DOWN”. Minimum pressure should be 500 P.S.I. (35 kg/cm^2).
10. Tilt outboard full “UP” and engage tilt lock lever.
11. Slowly remove “Fill” plug to bleed pressure.
12. Remove test gauge hose and adaptor.
13. Reinstall manual release valve and secure valve with circlip.
14. Retighten “Fill” plug.

NOTE: *If pressure is less than 500 PSI (35 kg/cm^2), troubleshoot system per instructions on Page 5B-15.*

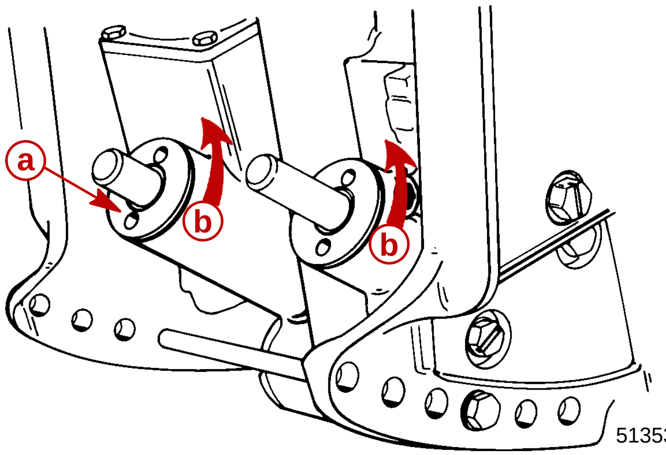
Hydraulic Repair

TRIM ROD REMOVAL AND REPAIR

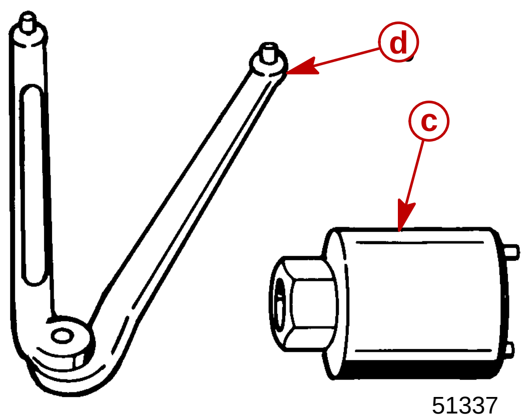
NOTE: *Power Trim does not have to be removed from outboard to remove trim rods.*

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.*



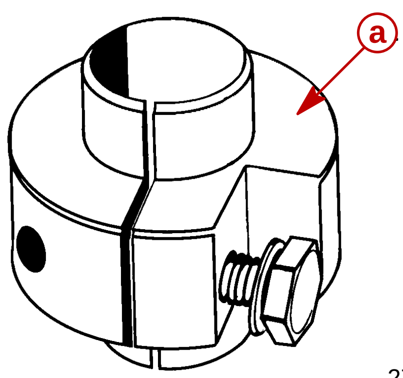
51353



51337

a - Trim Rod Cylinder Cap
b - Turn Counterclockwise to Remove
c - Removal Tool (91-44487A1)
d - 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

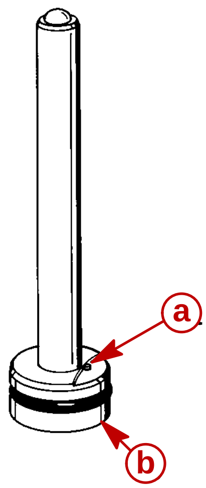
⚠ CAUTION

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.

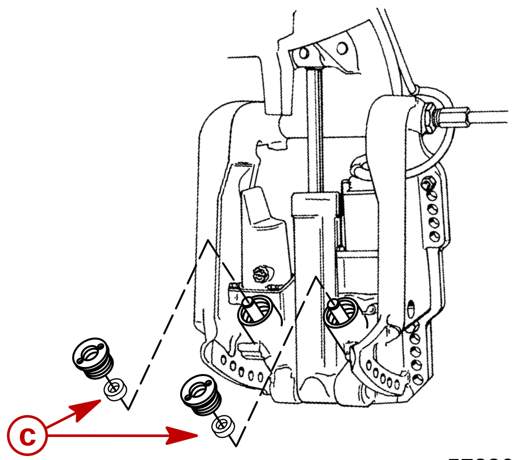
NOTE: *Check valve is in port side trim rod only.*

NOTE: *Certain models may have trim limit reducers installed on the trim rod to limit trim out angle. Each reducer limits the amount of total trim by 2°. A maximum of 5 reducers may be installed on each trim rod.*

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

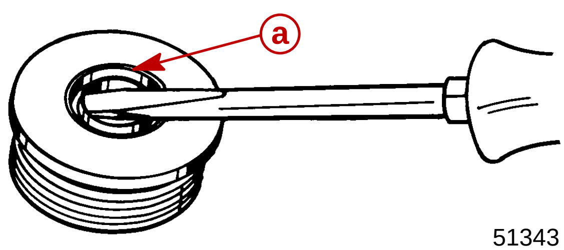


57886

a - Check Valve
b - Check Valve Screen
c - Trim Limit Reducers

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.

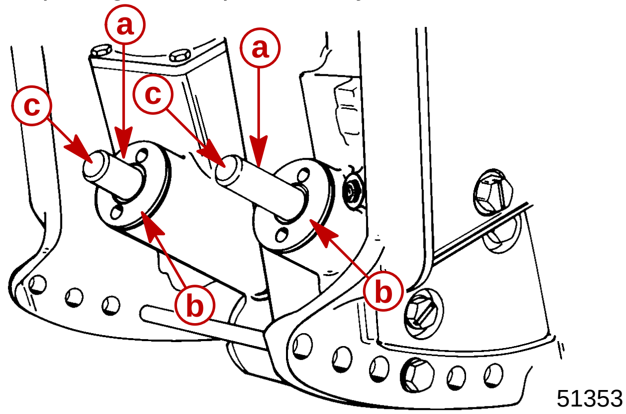
TRIM ROD INSTALLATION

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.



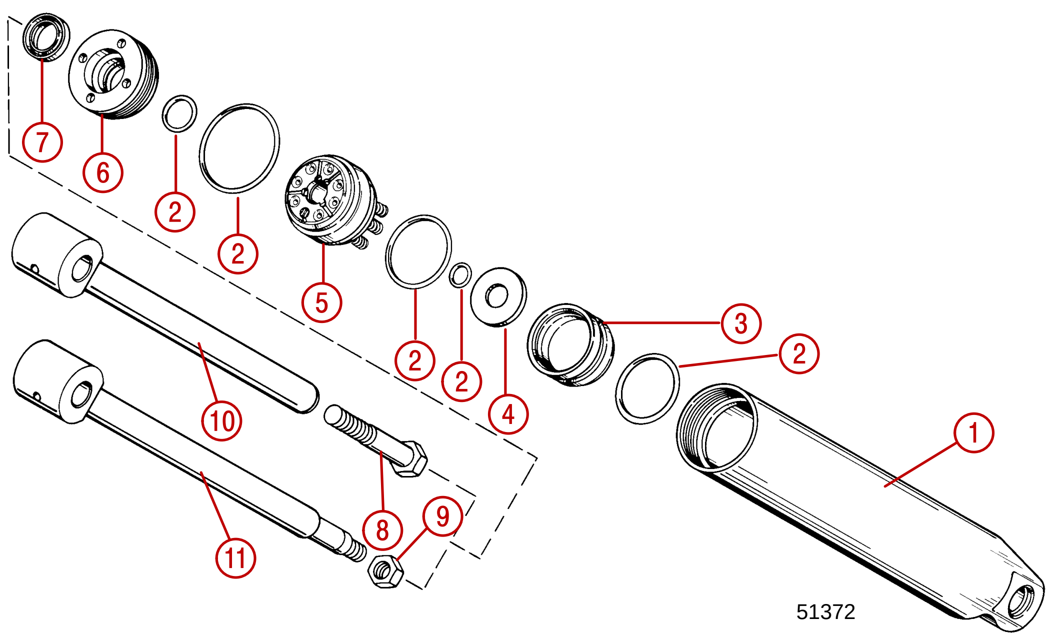
a - Trim Rods
b - Cylinder End Caps
c - Rod End Rollers (lubricate with Quicksilver Anti-Corrosion Grease or Special Lubricant 101)

Tilt Ram

REMOVAL - TILT ROD ASSEMBLY ONLY

NOTE: *Tilt Rod Assembly can be removed from cylinder without removing entire power trim system from outboard.*

TILT RAM COMPONENTS



1 - Housing - Tilt Ram
2 - O-ring* (5)
3 - Memory Piston**
4 - Washer
5 - Piston Assembly
6 - End Cap
7 - Oil Seal
8 - Bolt (Design 1)
9 - Nut (Design 2)
10 - Tilt Rod (Design 1)
11 - Tilt Rod (Design 2)

*O-ring Repair Kit Available, P.N. 811607A1 (Includes item 7, Oil Seal)

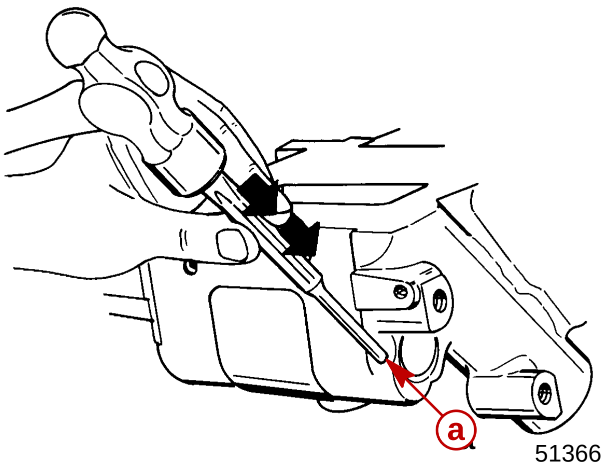
**Memory piston (3) for tilt rods (10 and 11) are different and must be used with correct tilt rod/cylinder assembly. Memory piston for Design 1 tilt rod is flat, Design 2 is dished to clear nut and thread.

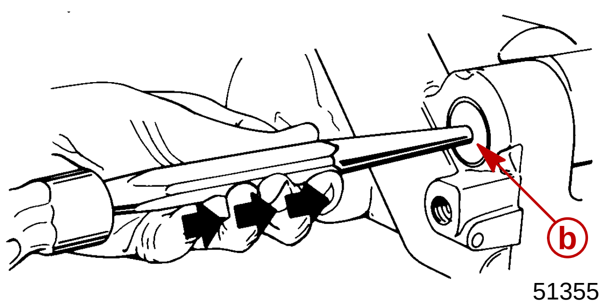
TILT RAM REMOVAL - POWER TRIM SYSTEM REMOVED FROM OUTBOARD

⚠ CAUTION

Insure trim system is depressurized prior to tilt ram removal.

1. Remove cross pin.
2. Remove lower swivel pin.

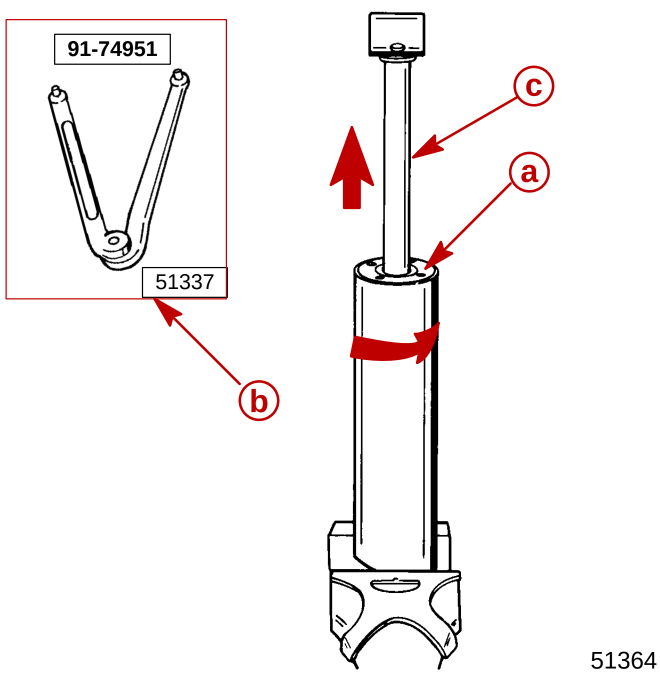




a - Cross Pin (Remove as shown)
b - Lower Swivel Pin (Remove as shown)

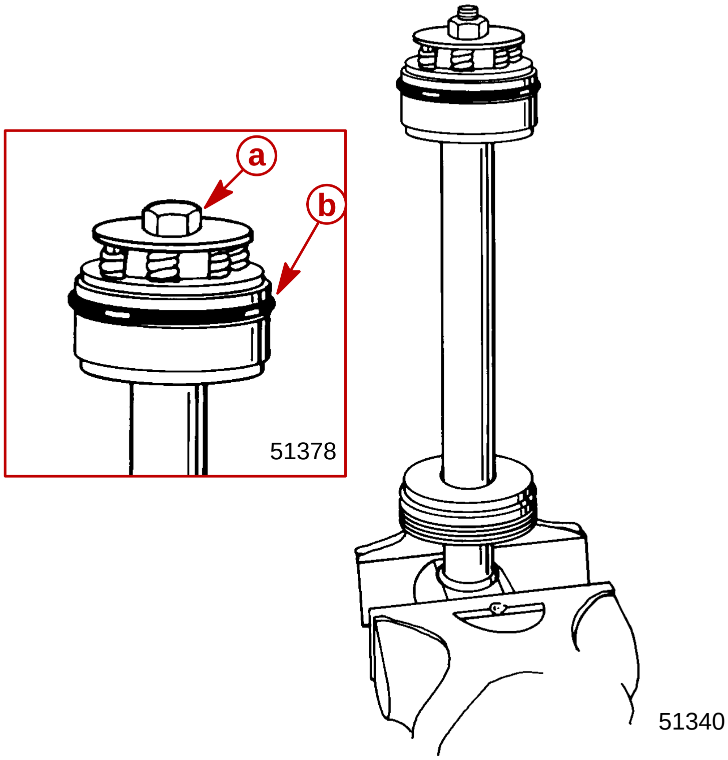
Disassembly

1. Secure tilt ram in a soft jawed vise. Remove tilt rod and cap.



a - Cap (Turn Counterclockwise to Remove)
b - Spanner Wrench (91-74951)
c - Tilt Rod - Pull to Remove

2. Clamp tilt rod in a soft jawed vise. Remove bolt or nut as applicable to disassemble rod assembly. Remove O-ring.

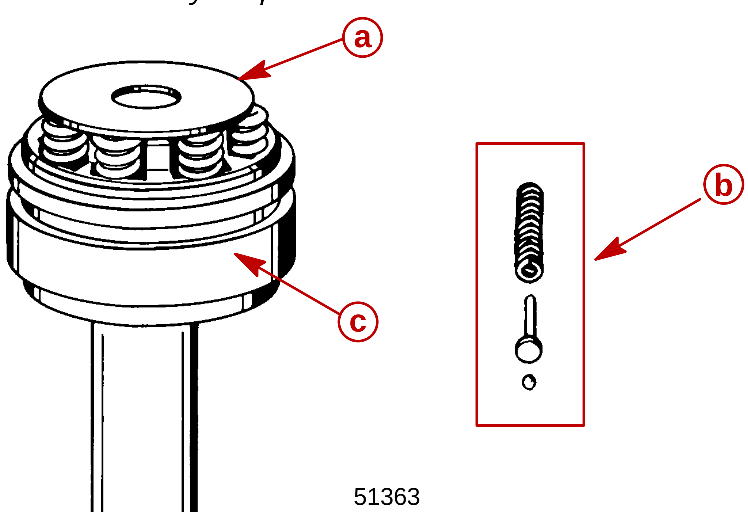


a - Bolt (Design 1) or Stud/Nut (Design 2)
b - O-Ring

IMPORTANT: Note Design 1 and 2 on page 5B-30. Design 1 tilt rod assembly replaces either tilt rod assembly. Either design will fit as a (replace) cylinder assembly complete.
Design 2 will NOT fit a cylinder originally using a Design 1 tilt rod assembly.
Memory Pistons for Design 1 and 2 differ also and must be used only on the cylinder the piston was removed from.

3. Remove washer, check valve assemblies, and piston.

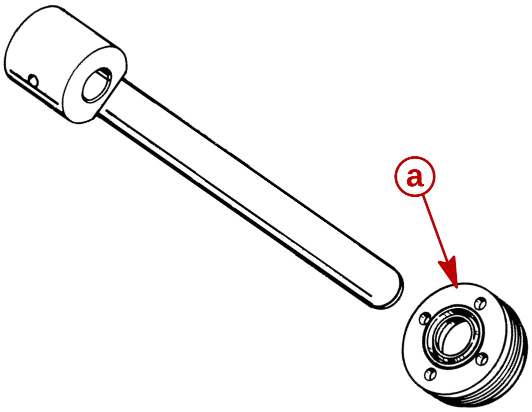
NOTE: *Check valve held in by roll pin can be cleaned but not removed.*

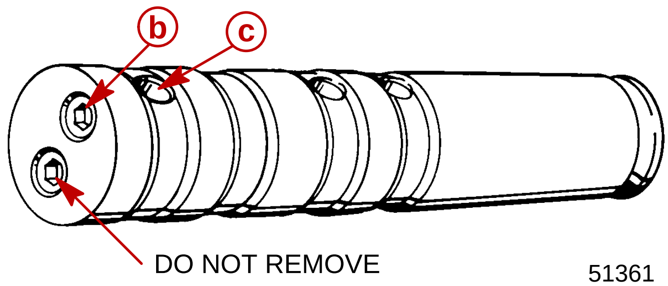


a - Washer
b - Check Valve Assembly (7)
c - Piston

4. Remove end cap from tilt rod.
5. Remove allen plug.

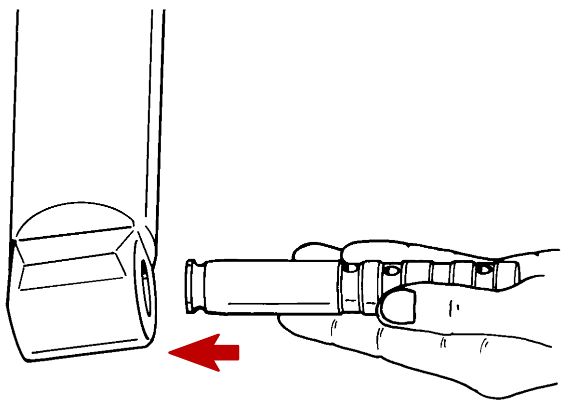
IMPORTANT: Remove plug from same side as holes in shaft.



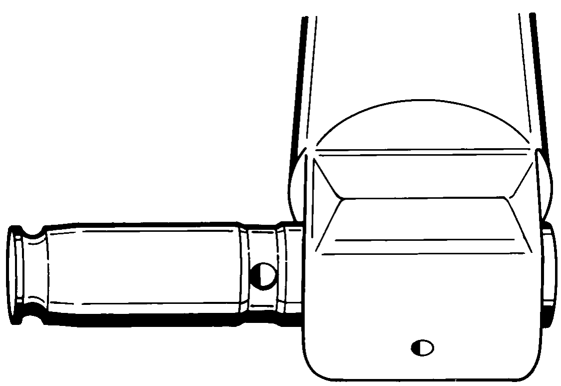


a - End Cap
b - Allen Plug
c - Hole In Shaft

6. Lubricate shaft with Quicksilver Power Trim and Steering Fluid. Insert shaft into cylinder.



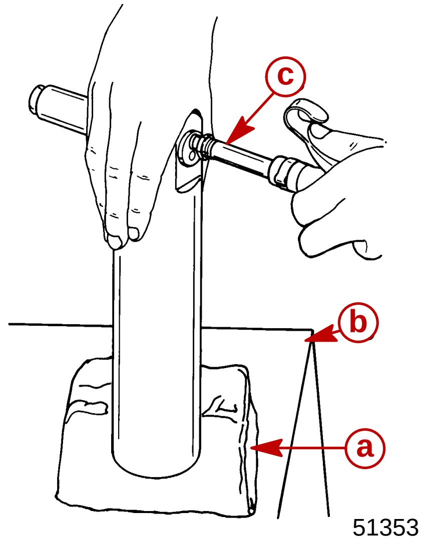
7. Tap shaft into cylinder until shaft is positioned as shown.



⚠ WARNING

Memory Piston Cup may be expelled at a high velocity when air pressure is applied. Failure to place cylinder as shown below could result in personal injury.

8. Place cylinder as shown. Hold down on cylinder and inject air into shaft opening.



a - Shop Cloth
b - Solid Surface
c - Air Nozzle

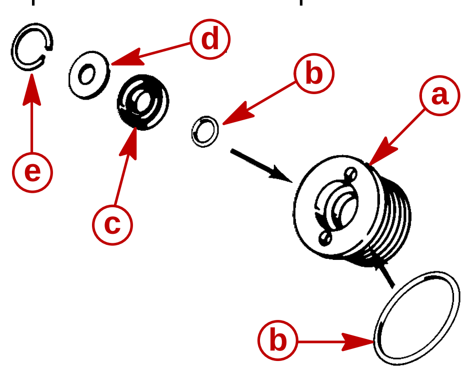
9. Remove shaft after Memory Piston Cup has been expelled. Replace allen plug removed in Step 5 and tighten securely.

CLEANING AND INSPECTION

1. Inspect all internal parts for damage or wear. Clean and replace parts as necessary.
2. Inspect tilt rod for scratches. Replace scraper seal in rod end cap if tilt rod is scratched or worn.
3. Slight scratches or tool marks less than 0.005 in. (0.1 mm) deep in cylinder are acceptable.

Scraper Seal Replacement

1. Remove components from end cap.



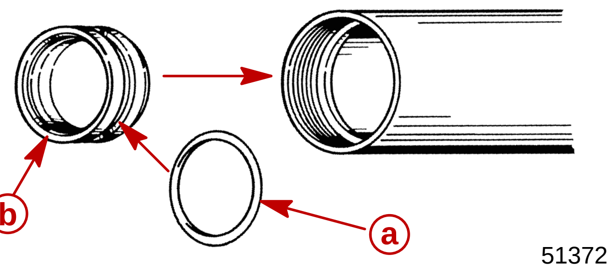
a - Cap
b - O-ring (2)
c - Scraper Seal
d - Washer
e - Retaining Ring

REASSEMBLY

IMPORTANT: Components must be clean for reassembly. Any debris in the system can cause the system to malfunction.

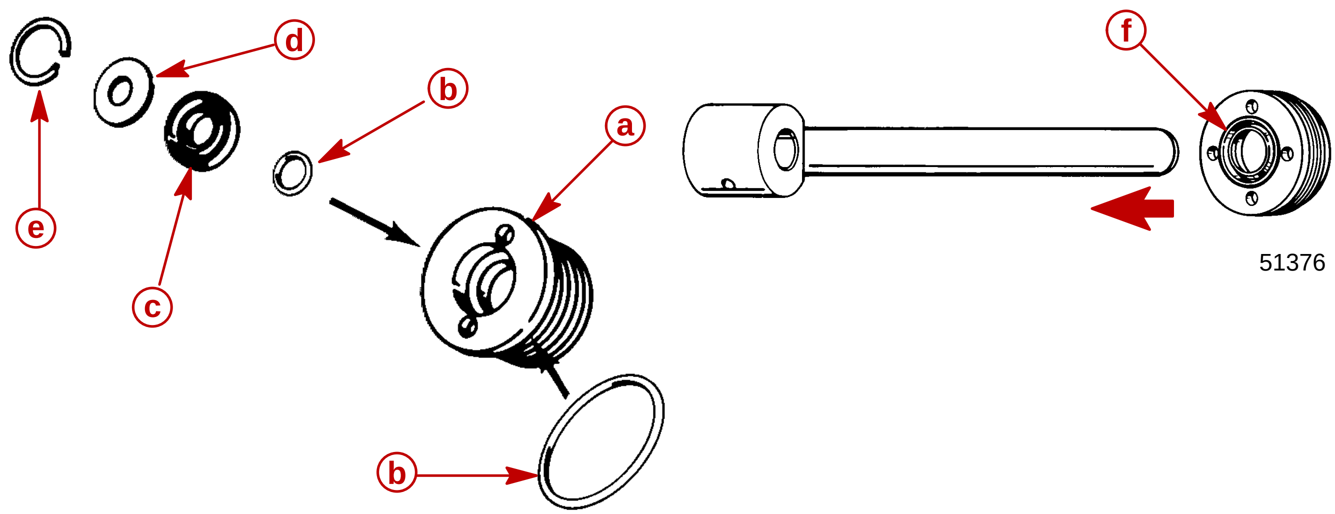
NOTE: *Refer to "Tilt Ram Components" for proper O-ring sizes.*

1. Apply Quicksilver Power Trim and Steering Fluid on O-rings prior to reassembly.
2. Install O-ring on Memory Piston Cup and install in cylinder.



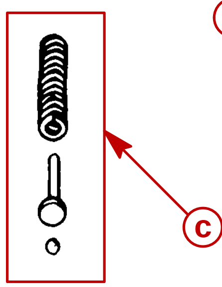
a - O-ring
b - Memory Piston Cup (Design 1 shown)

3. Assemble end cap.
4. Install end cap.

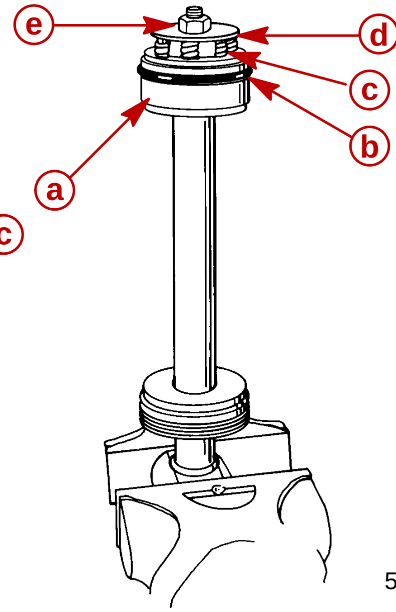


a - End Cap
b - O-ring (2)
c - Scraper seal
d - Washer
e - Retaining Ring
f - End Cap

5. Install components on rod.



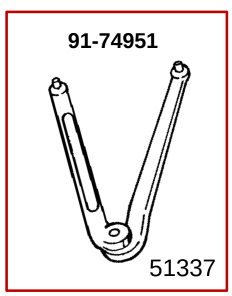
51363

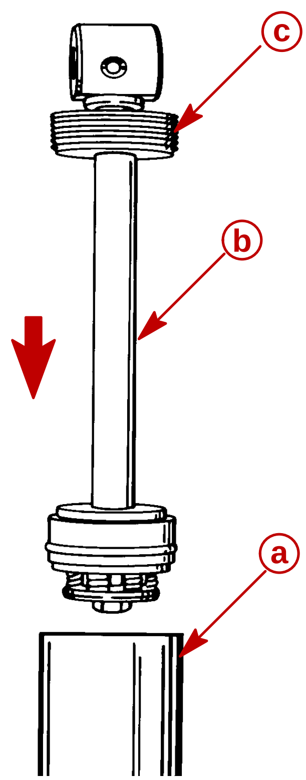


51340

a - Piston
b - O-ring
c - Check Valve Assembly (7)
d - Washer
e - Bolt or Locknut. (Tighten securely)

6. Clamp cylinder in a soft jawed vise and install tilt rod assembly. Use spanner wrench and tighten end cap securely.



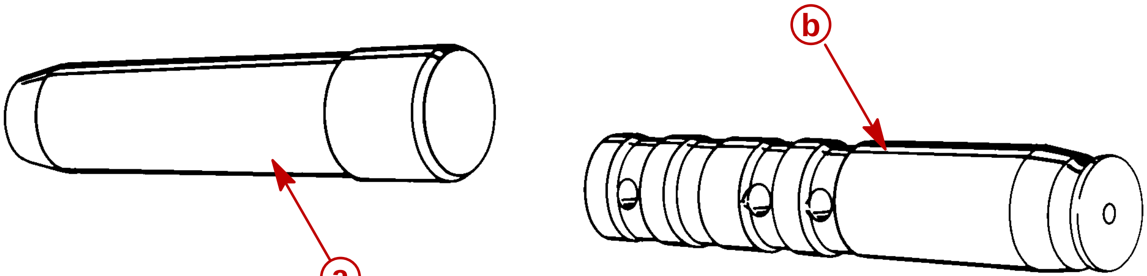


51341

a - Cylinder
b - Tilt Rod Assembly
c - End Cap (Tighten Securely.) Use Spanner Wrench.

TILT RAM ASSEMBLY INSTALLATION

1. Lubricate alignment tool (91-11230) and shaft. Use Quicksilver Power Trim and Steering Fluid.

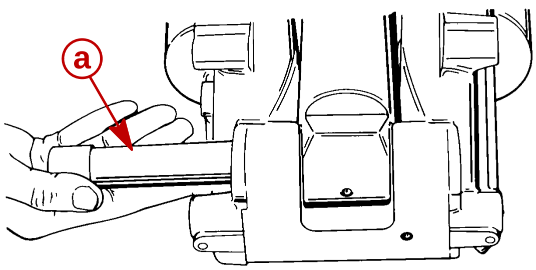


51369

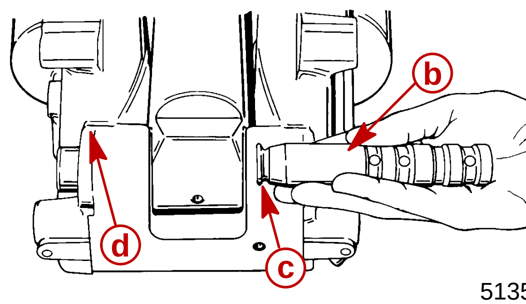
a - Alignment Tool (91-11230)
b - Shaft

2. Align tilt ram and housing using alignment tool.

3. Install shaft.



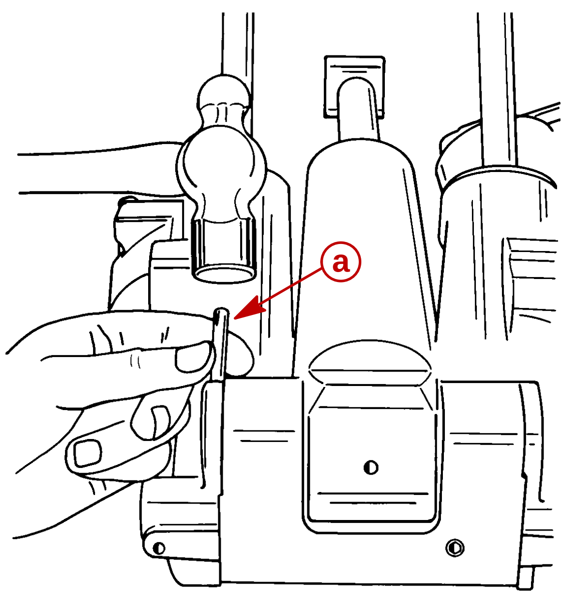
51348



51352

a - Alignment Tool (91-11230)
b - Shaft
c - Groove
d - Hole [Groove (c) will Align with this Hole]

4. Drive pin in until flush.



51356

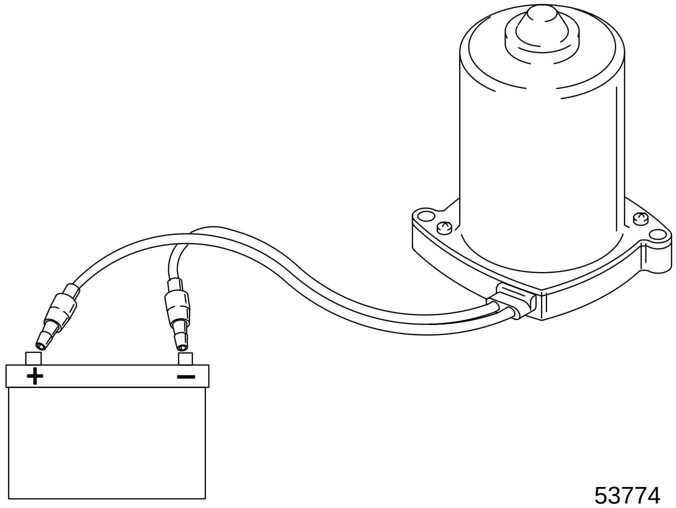
a - Pin (Drive Against Knurled End)

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.

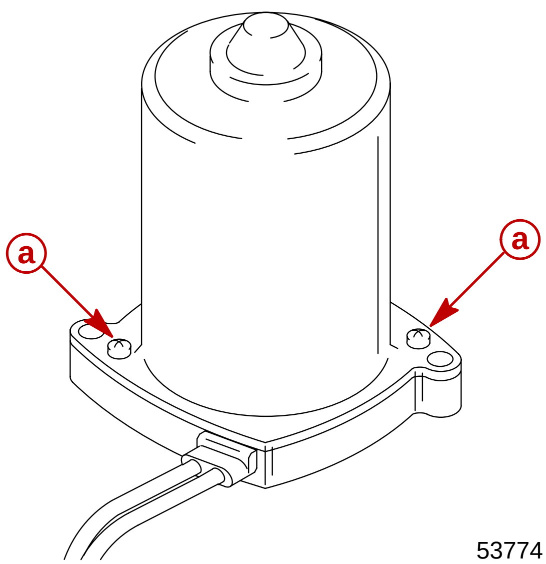


53774

2. If motor does not run, disassemble and check components.

Motor Disassembly

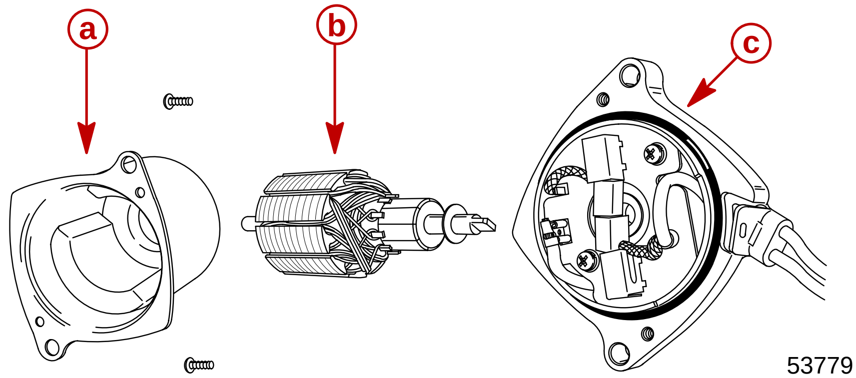
1. Remove 2 screws.



53774

a - Screw (2)

2. Remove frame and armature from end cap. Use care not to drop armature.



a - Frame
b - Armature
c - End Cap

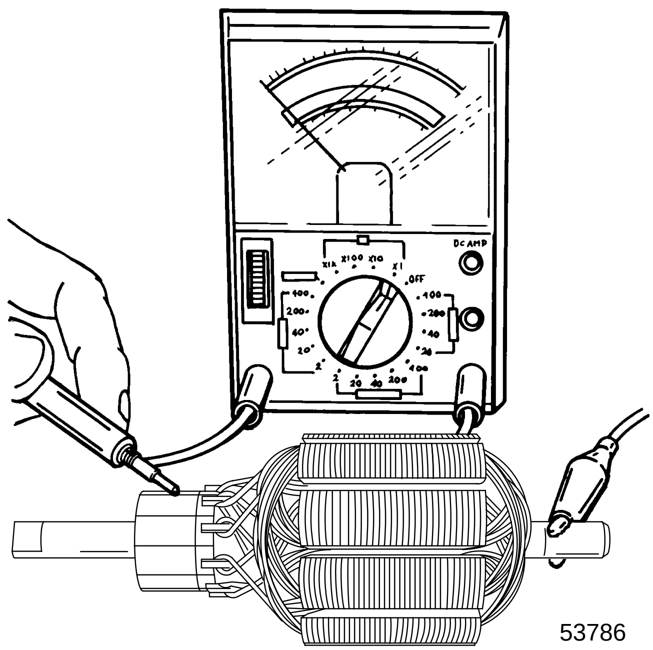
Armature Tests

TEST FOR SHORTS

Check armature on a Growler per the Growler manufacturer's instructions. Replace armature if a short is indicated.

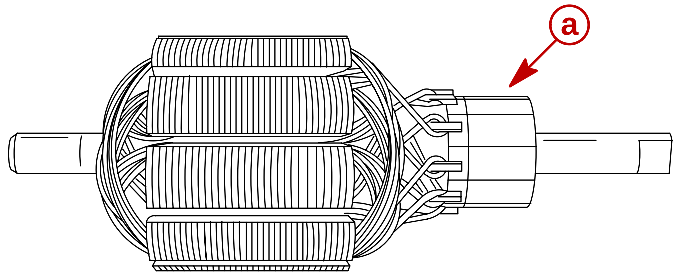
TEST FOR GROUND

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.



CHECKING AND CLEANING COMMUTATOR

1. If commutator is worn it may be turned on an armature conditioner or a lathe.
2. Clean commutator with “OO” sandpaper.



a - Commutator

FIELD TESTS

IMPORTANT: Commutator end of armature must be installed in brushes when performing the following tests.

Ohmmeter Leads Between	Resistance (Ohms)	Scale Reading* (x__________)
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

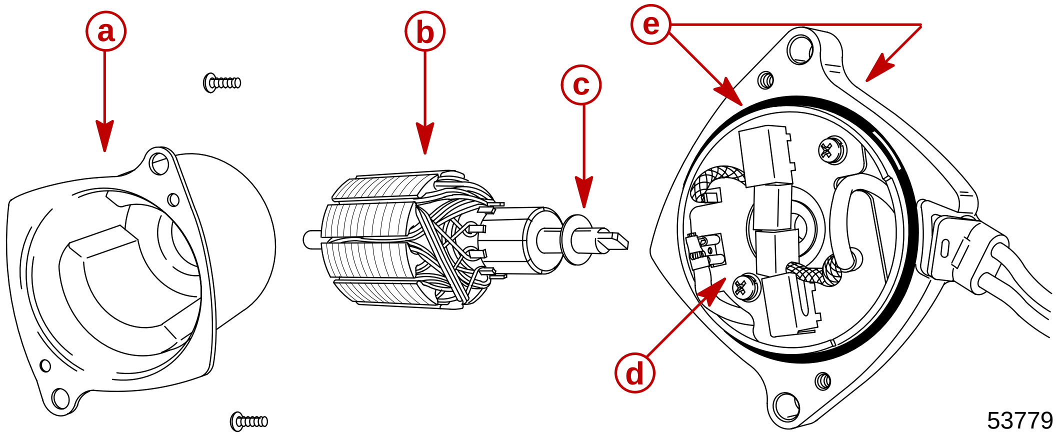
NOTE: *Power Trim System does not have to be removed from outboard to repair/replace motor.*

DISASSEMBLY

Refer to **“Motor Disassembly”** on page 5B-38 to disassemble motor from pump.

CLEANING AND INSPECTION

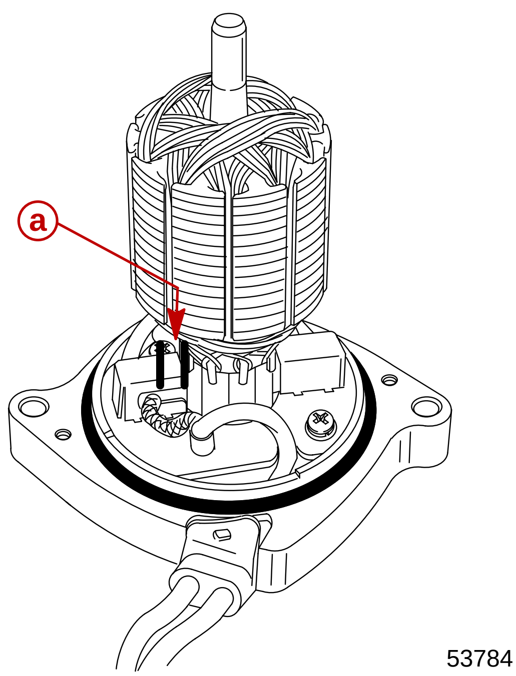
Inspect O-rings and replace if necessary. Carefully inspect power cord for cuts or tears which will allow water to enter motor. Replace cord if cut or torn. Clean, inspect, and test motor components. Refer to **"Brush Replacement"**, **"Armature Test"**, and **"Field Tests"** for inspection and test procedures.



a - Frame
b - Armature
c - Shim
d - Brush Card Assembly
e - O-rings

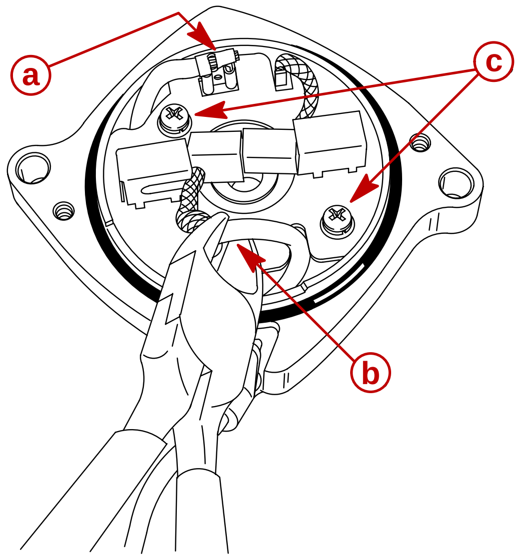
BRUSH REPLACEMENT

1. Brush replacement is required if brushes are pitted, chipped, or if distance (a) between the brush pigtail and end of brush holder slot is 1/16 in. (1.6 mm) or less. Check distance with armature installed.



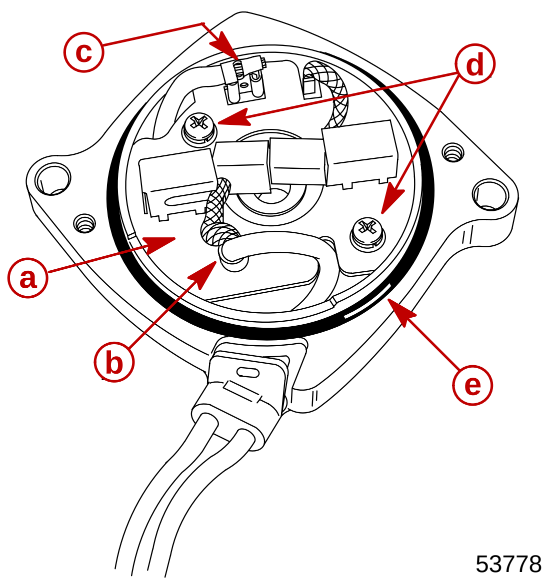
a - 1/16 in. (1.6 mm)

2. To replace brush card, disconnect spade terminal.
3. Cut crimped brush lead.
4. Remove 2 screws securing brush card to end cap.



a - Spade Terminal
b - Crimped Brush Lead
c - Screws

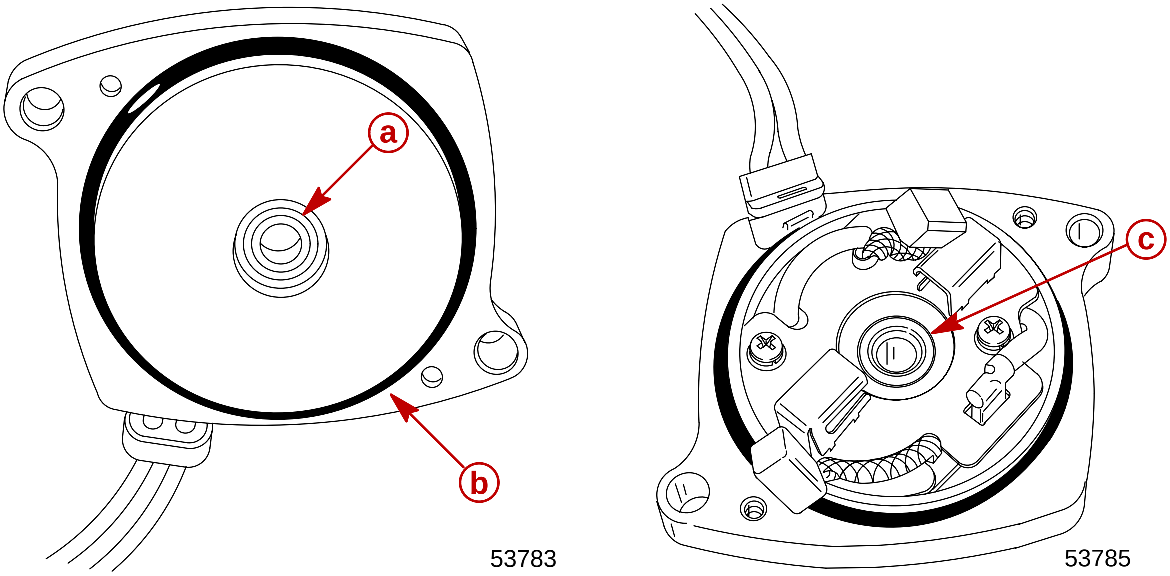
5. Install new brush card (BRUSH and SEAL KIT 828714A1).
6. Crimp metal connector onto motor lead and new brush lead.
7. Connect spade connector motor lead to brush card connector.
8. Secure brush card to end cap with 2 screws and lockwashers.
9. Inspect O-ring for cuts and abraisions. Replace O-ring as required (BRUSH and SEAL KIT 828714A1).



a - Brush Card
b - Metal Connector
c - Spade Connector
d - Screws and Lockwashers
e - O-ring

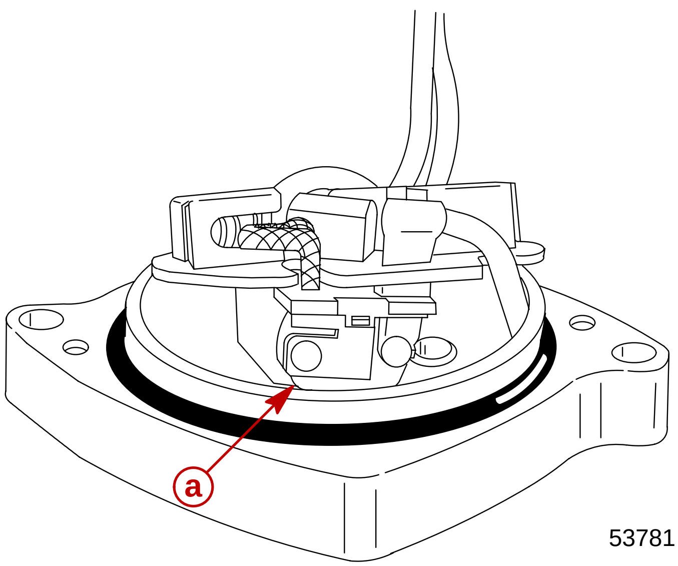
END CAP INSPECTION

1. Inspect seal and O-ring for cuts and abraisions. If replacement is required, install BRUSH and SEAL KIT 828714A1.
2. Inspect bushing for wear. If bushing appears to be excessively worn – grooves, scratches, etc. – install END FRAME ASSEMBLY (COMPLETE) 828715A1.



a - Seal (Apply 2-4-C w/Teflon to seal lips)
b - O-ring
c - Bushing

3. If trim motor is overheated, a thermoswitch located under brush card will open. Normally, this switch will reset itself within 1 minute.

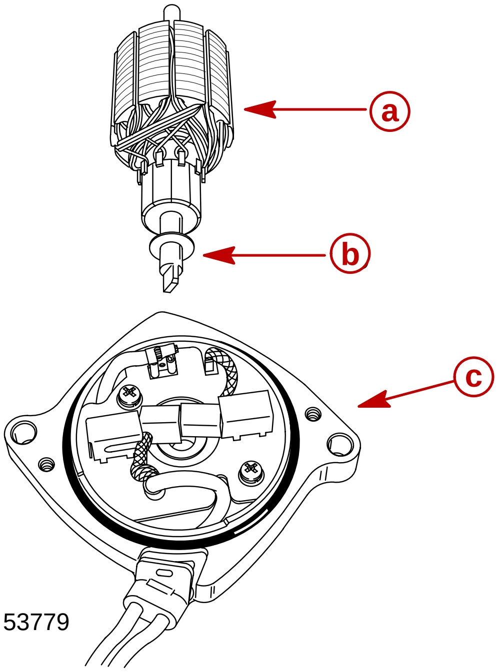


a - Thermoswitch

Reassembly

IMPORTANT: Components must be clean. Any debris in power trim system can cause system to malfunction.

1. Install armature into end cap/brush card assembly.



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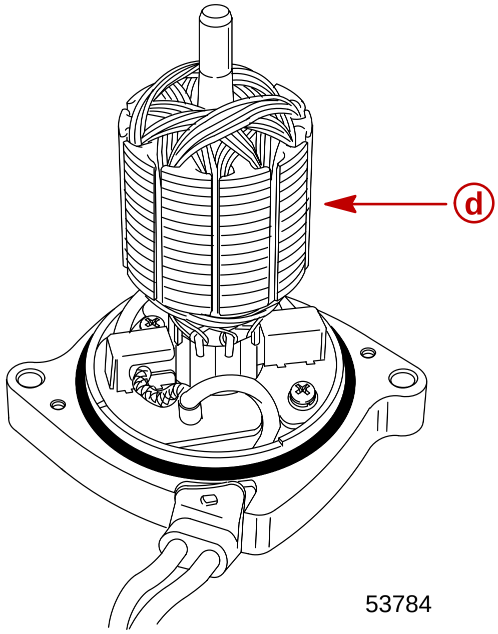
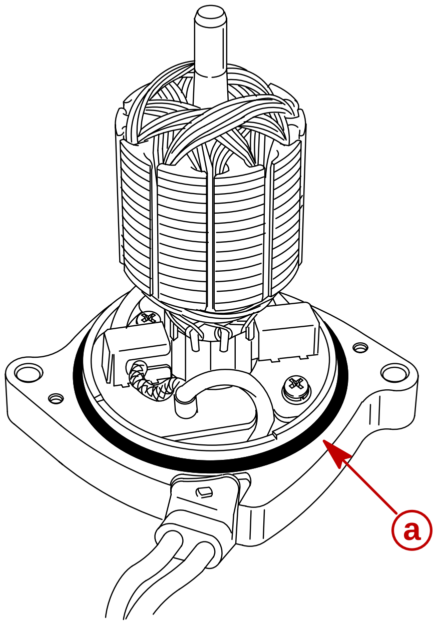


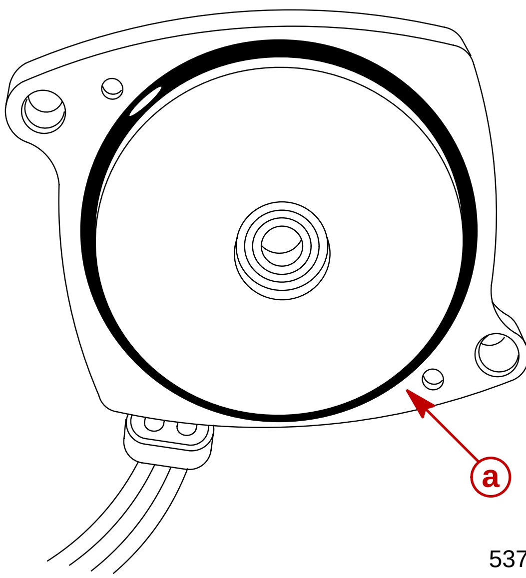
53784

a - Armature
b - Shim
c - End Cap Assembly
d - Armature (Spread brushes to install armature into end cap)

2. Install O-rings in end cap.



53784

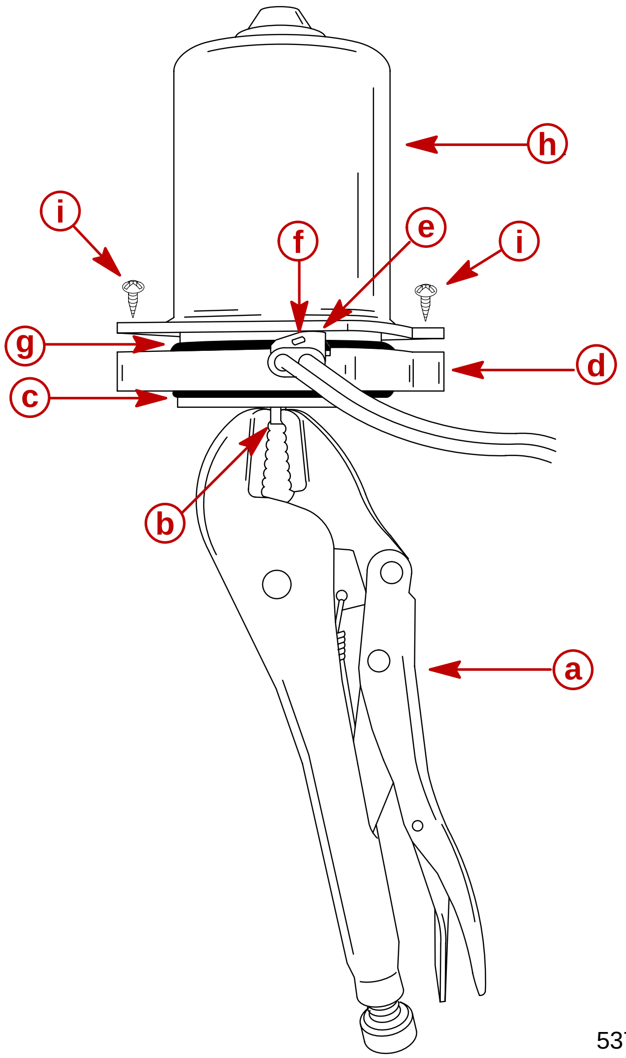


53783

a - O-rings

IMPORTANT: Attach Vise Grip® pliers to armature shaft before installing frame assembly. The Vise Grip® pliers will prevent the armature from being drawn out of the brush card assembly by the frame magnets while installing the frame assembly.

3. Install Vise Grip® pliers on armature shaft.
4. Carefully install frame assembly over armature.
5. Position harness retainer hole over tab in end cap.
6. Secure frame assembly to end cap with 2 screws.



53776

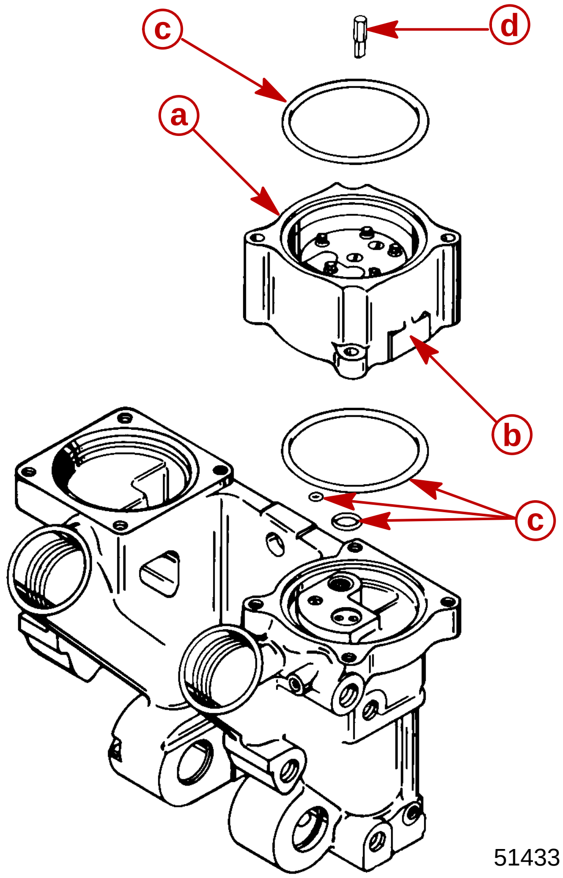
a - Vise Grip® Pliers
b - Armature Shaft
c - O-ring
d - End Cap
e - Harness Retainer
f - Retainer Hole
g - O-ring
h - Frame Assembly
i - Screws

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. Torque screws to 80 lb. in. (9 N·m).

IMPORTANT: Install pump with location flat facing towards starboard transom bracket.



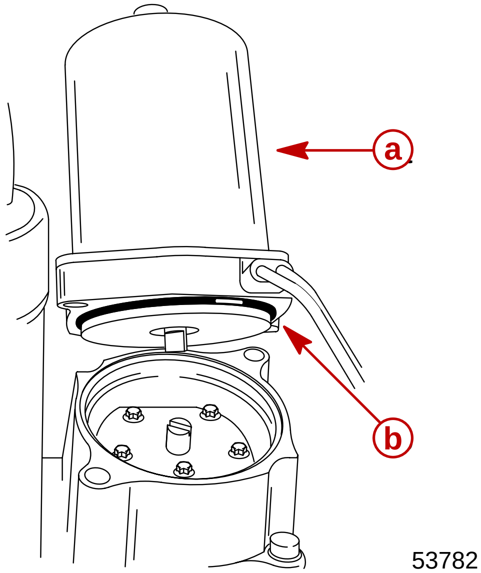
51433

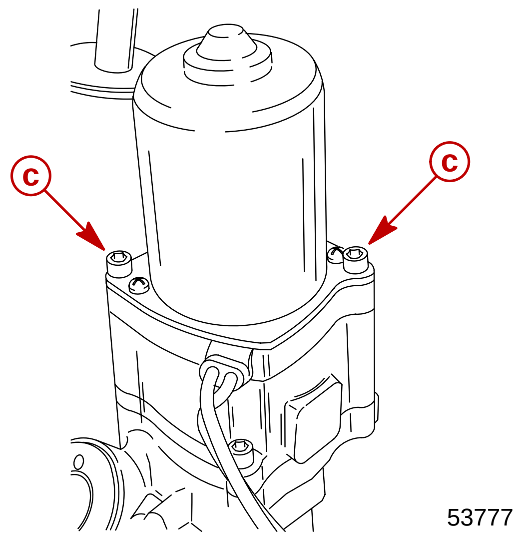
a - Pump (Flat Towards Starboard Transom Bracket)
b - Flat - Faces Starboard Transom Bracket)
c - O-rings (4)
d - Drive Shaft (Install in **Center** Hole in Pump)

2. Fill pump with Quicksilver Power Trim and Steering Fluid prior to installing motor.

3. Install motor, secure with two (2) screws. Route wiring; refer to Wiring Diagrams in this service manual.

NOTE: *Verify motor and drive shaft are aligned.*





a - Motor
b - O-ring
c - Screw (2) Tighten securely.

4. Complete reassembly of Power Trim System as outlined in **"Installation"** on page 5B-21.

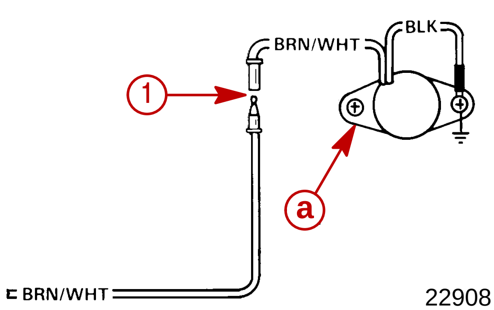
Priming Power Trim System

1. Fill system with Quicksilver Power Trim and Steering Fluid or Automatic Transmission Fluid (ATF) Type F,FA, Dexron II or Dexron III. Refer to **"Fill, Check, and Purge"** on page 5B-10.

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 Test

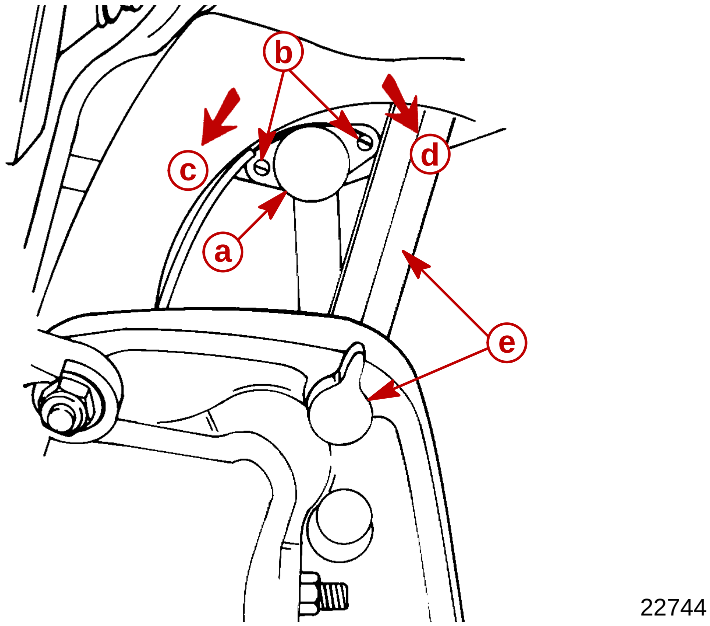
1. Check trim sender BLACK lead for proper ground.
2. Trim outboard to full "DOWN" position.
3. Place ignition switch to "ON" position.
4. Disconnect BRN/WHT trim sender wire from trim sender harness.
5. Connect Ohmmeter (Rx1 scale) leads between outboard ground and Point 1 (trim sender end).
6. Depress "UP" button. Ohmmeter needle should move as the outboard is trimmed up. If needle does not move, trim sender is defective.



a - Trim sender

Trim Indicator Gauge Needle Adjustment

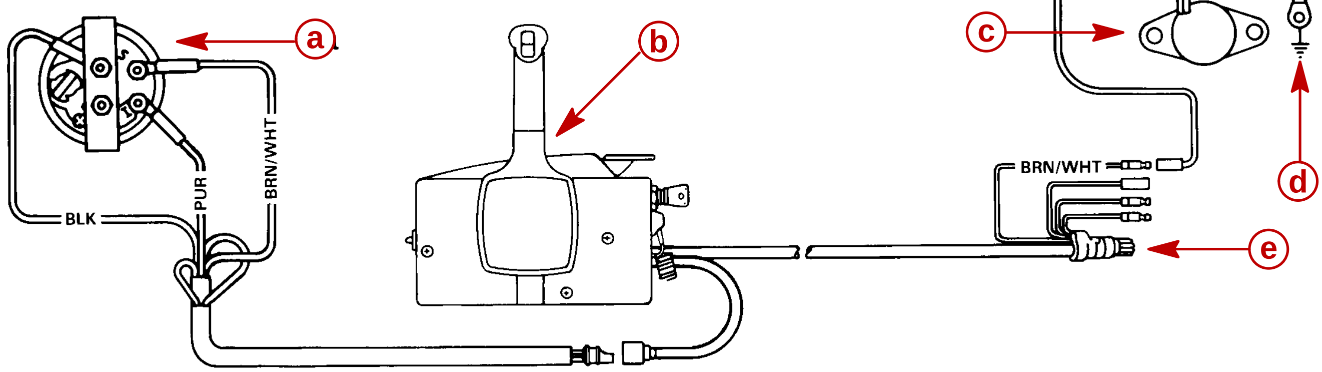
1. Turn ignition key to “RUN” position.
2. Tilt outboard to full “IN” position. Needle of trim indicator gauge should be in full “IN” position.
3. If not, tilt outboard to full “OUT” position to gain access to trim sender and engage tilt lock lever.
4. Loosen trim sender screws and reposition trim sender.
5. Tighten trim sender screws.



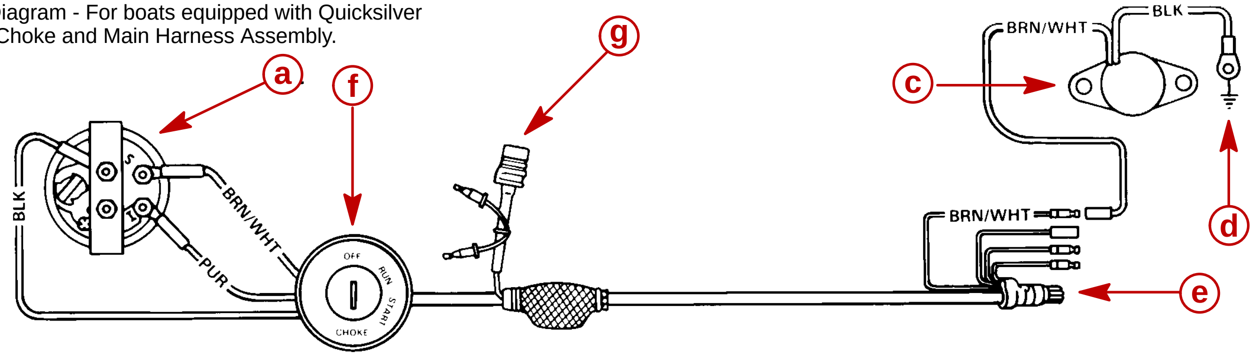
a - Trim Sender
b - Screws, Loosen to Rotate Sender
c - Turn Sender **Counterclockwise** to raise needle reading
d - Turn Sender **Clockwise** to Lower Needle Reading
e - Tilt lock lever

Trim Indicator Wiring Diagrams

Wiring Diagram - For boats equipped with Quicksilver Commander Series side mount remote control.



Wiring Diagram - For boats equipped with Quicksilver Ignition/Choke and Main Harness Assembly.



22908

a - Trim Indicator
b - Remote Control
c - Trim Sender
d - Engine Ground
e - To Engine
f - Ignition Switch
g - Power Trim Harness

LOWER UNIT

Section 6A – Right Hand Non-Ratcheting

Table of Contents

6
A

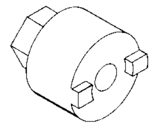
Gear Housing Specifications (Standard Rotation)

Ratio	Pinion Depth	Forward Gear Backlash	Reverse Gear Backlash
1.87:1	0.025 in. (0.635 mm) With Tool 91-12349A2 using Disc #2 and Flat #7	0.018 in. to 0.027 in. (0.460 mm to 0.686 mm) Pointer on line mark #1	0.030 in. to 0.050 in. (0.762 mm to 1.27 mm)
2.00:1	0.025 in. (0.635 mm)With Tool 91-12349A2 using Disc #2 and Flat #7	0.015 in. to 0.022 in. (0.38 mm to 0.56 mm) Pointer on line mark #2	0.030 in. to 0.050 in. (0.762 mm to 1.27 mm)
2.30:1	0.025 in. (0.635 mm)With Tool 91-12349A2 using Disc #2 and Flat #7	0.018 in. to 0.023 in. (0.46 mm to 0.58 mm) Pointer on line mark #4	0.030 in. to 0.050 in. (0.762 mm to 1.27 mm)
Gearcase Lubricant Capacity			
All Ratios		22.5 fl. oz. (665.4 ml)	

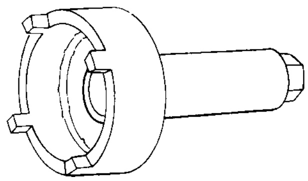
Gear Ratio	Teeth on Pinion Gear	Teeth on Forward and Reverse Gear
1.87:1	15	28
2.00:1	12	24
2.30:1	13	30

Special Tools

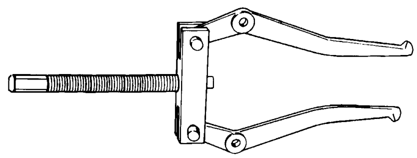
1. Shift Shaft Bushing Tool 91-31107



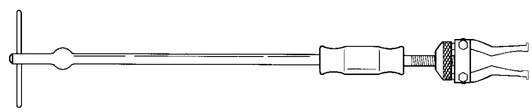
2. Gear Housing Cover Nut Tool 91-61069



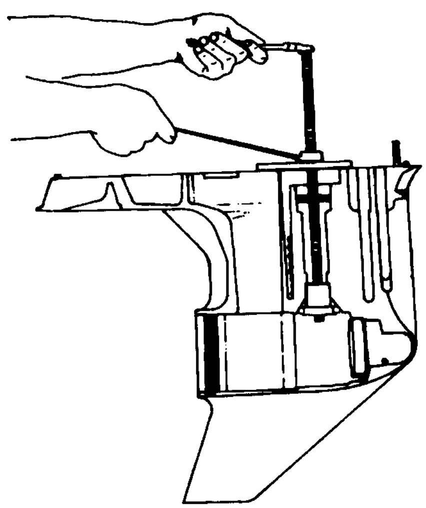
3. Bearing Carrier Removal Tool 91-46086A1 and Puller Bolt 91-85716



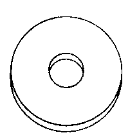
4. Slide Hammer Puller 91-34569A1



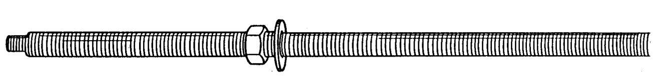
5. Bearing Removal and Installation Kit 91-31229A5. This kit contains the following tools: Pilot 91-36571; Puller Rod 91-31229; Nut 11-24156; Puller Plate 91-29310; Mandrel 91-38628; and Driver Rod 91-37323.



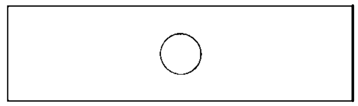
6. Pilot 91-36571



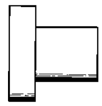
7. Puller Rod 91-31229 and Nut 91-24156



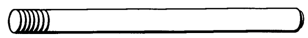
8. Puller Plate 91-29310



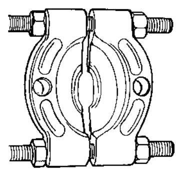
9. Mandrel 91-38628



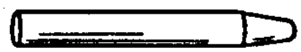
10. Driver Rod 91-37323



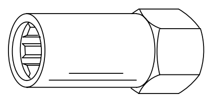
11. Universal Puller Plate 91-37241



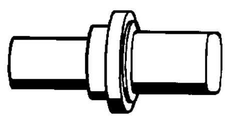
12. Cross Pin Tool 91-86642



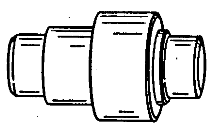
13. Driveshaft Holding Tool 91-34377A1or 91-90094



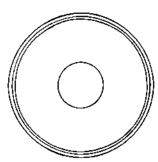
14. Oil Seal Driver 91-31108



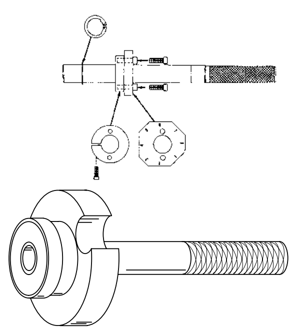
15. Forward Gear Bearing Tool 91-86943



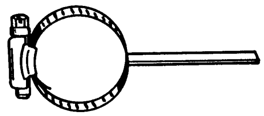
16. Bearing Driver Cup 91-31106



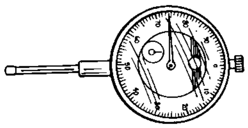
17. Pinion Locating Gear Tool 91-12349A2 or 91-74776



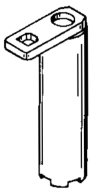
18. Backlash Indicator Rod 91-78473



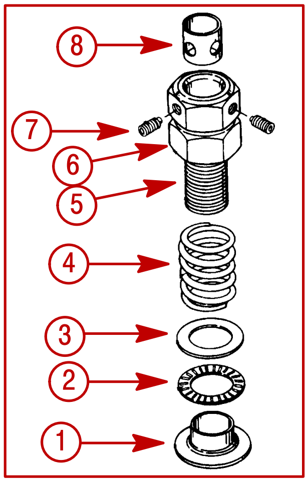
19. Dial Indicator 91-58222A1



20. Bearing Retainer Tool 91-43506

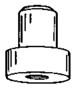


21. Bearing Preload Tool 91-14311A1



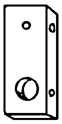
1 - Adaptor (N.S.S.)
2 - Bearing (N.S.S.)
3 - Washer (N.S.S.)
4 - Spring (24-14111)
5 - Bolt (10-12580)
6 - Nut (11-13953)
7 - Set Screw (10-12575)
8 - Sleeve (23-13946)

22. Mandrel 91-92788



23. Mandrel 91-15755

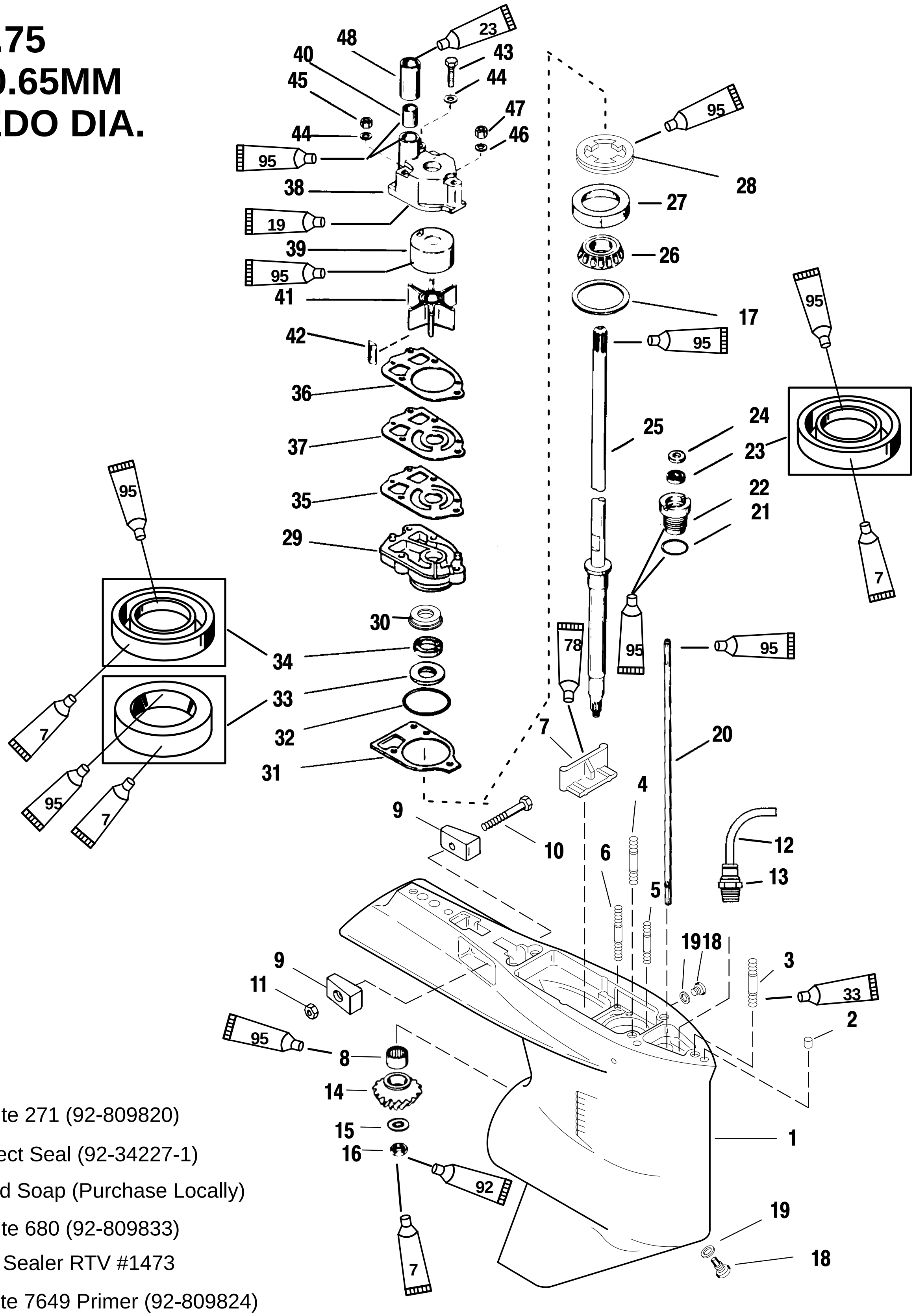
24. Dial Indicator Holder 91-89897



Notes:

Gear Housing (Drive Shaft)(Standard Rotation)

4.75 IN/120.65MM TORPEDO DIA.



7 Loctite 271 (92-809820)

19 Perfect Seal (92-34227-1)

23 Liquid Soap (Purchase Locally)

33 Loctite 680 (92-809833)

78 G.E. Sealer RTV #1473

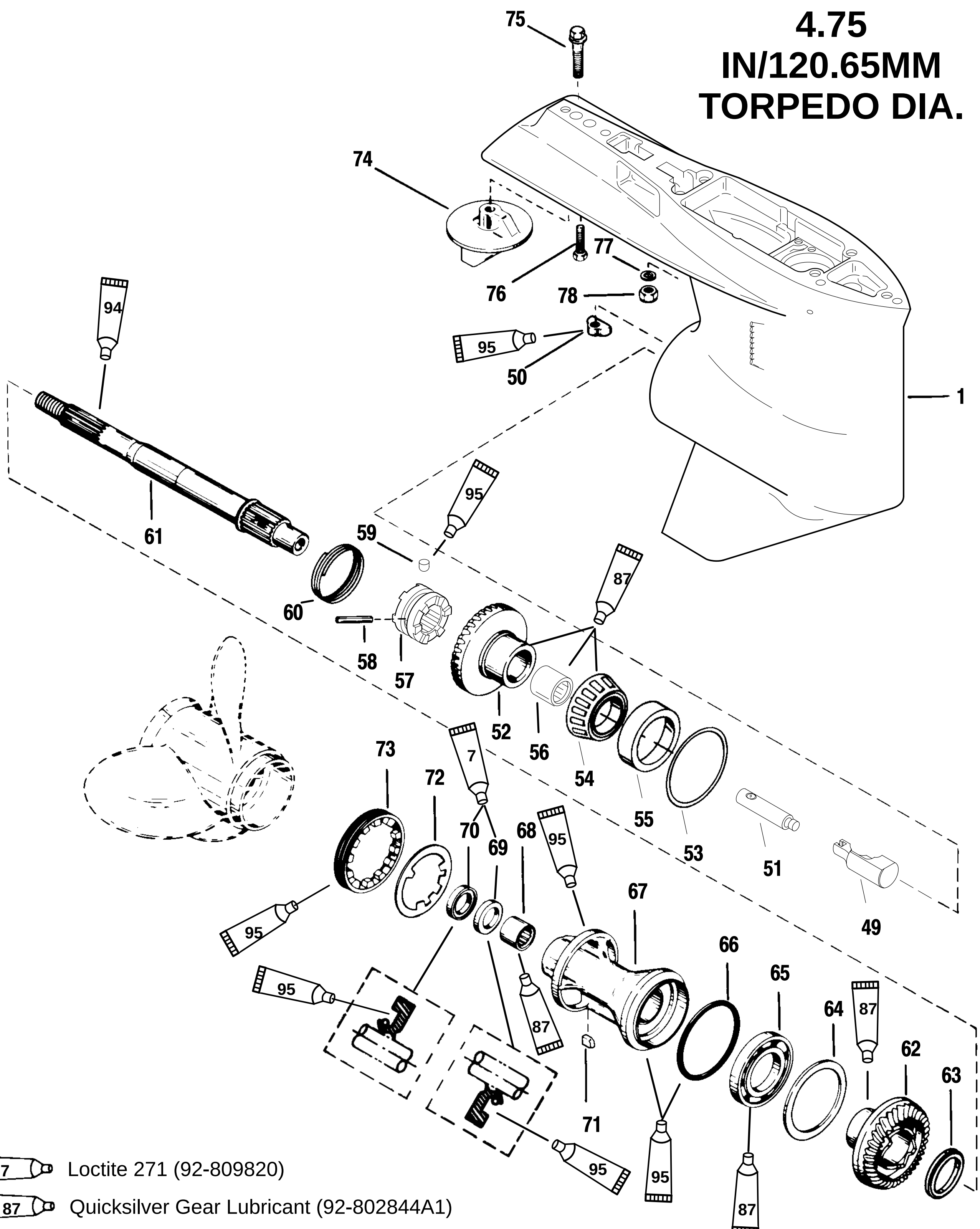
92 Loctite 7649 Primer (92-809824)

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

Gear Housing (Drive Shaft)(Standard Rotation)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	1	GEAR HOUSING **(BLACK)(BASIC)**			
2	2	DOWEL PIN			
3	1	STUD (3-1/8 IN.) **(LONG)**			
	1	STUD (3-11/16 IN.) **(X-LONG)**			
4	2	STUD (2-1/16 IN.)			
5	1	STUD (3-3/8 IN.)			
6	2	STUD (3-1/8 IN.)			
7	1	FILLER BLOCK			
8	1	ROLLER BEARING			
9	2	ANODE			
10	1	SCREW (M6 x 40)			
11	1	NUT	60		7
12	1	HOSE **(10 IN. - LONG)**			
	1	HOSE **(12 IN. - X-LONG)**			
13	1	FITTING			
14	1	PINION GEAR **(1.87:1- 15 TEETH)(150)**			
	1	PINION GEAR **(2:1 - 14 TEETH)(115/135)**			
15	1	WASHER			
16	1	NUT		75	101
17	AR	SHIM (006 thru 048)			
18	2	SCREW–drain	60		7
19	2	WASHER			
20	1	SHIFT SHAFT			
21	1	O-RING			
22	1	BUSHING ASSEMBLY		50	68
23	1	OIL SEAL			
24	1	WASHER–rubber			
25	1	DRIVE SHAFT **(LONG)**			
	1	DRIVE SHAFT **(X-LONG)**			
26	1	ROLLER BEARING			
27	1	CUP			
28	1	RETAINER		100	135
29	1	WATER PUMP BASE			
30	1	RETAINER			
31	1	GASKET			
32	1	O-RING			
33	1	OIL SEAL			
34	1	OIL SEAL			
35	1	GASKET–lower			
36	1	GASKET–upper			
37	1	FACE PLATE			
38	1	WATER PUMP BODY ASSEMBLY			
39	1	INSERT			
40	1	SEAL–rubber			
41	1	IMPELLER			
42	1	KEY			
43	1	SCREW (#14-8 x 2-1/4 IN.)	35		4
44	2	WASHER			
45	2	NUT	50		5.5
46	1	WASHER			
47	1	NUT	50		5.5
48	1	SLEEVE			

Gear Housing (Prop Shaft)(Standard Rotation)



7 Loctite 271 (92-809820)

87 Quicksilver Gear Lubricant (92-802844A1)

94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft)(Standard Rotation)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm
1	1	GEAR HOUSING**(BASIC)**			
49	1	CAM FOLLOWER			
50	1	SHIFT CAM			
51	1	ROD			
52	1	FORWARD GEAR **(1.87:1 – 15/28)(150)**			
	1	FORWARD GEAR **(2:1 – 14/28)(115/135)**			
53	AR	SHIM (.006 thru 050)			
54	1	TAPERED ROLLER BEARING			
55	1	CUP			
56	1	NEEDLE BEARING			
57	1	CLUTCH			
58	1	CROSS PIN			
59	1	DETENT PIN			
60	1	SPRING			
61	1	PROPELLER SHAFT			
62	1	REVERSE GEAR **(1.87:1 – 15/28)(150)**			
	1	REVERSE GEAR **(2:1 – 14/28)(115/135)**			
63	1	THRUST SPACER			
64	1	THRUST RING			
65	1	BALL BEARING			
66	1	O-RING			
67	1	BEARING CARRIER ASSEMBLY			
68	1	ROLLER BEARING			
69	1	OIL SEAL **(INSIDE)**			
70	1	OIL SEAL **(OUTSIDE)**			
71	1	KEY			
72	1	TAB WASHER			
73	1	COVER		210	285
74	1	TRIM TAB			
	1	ANODIC PLATE **(TRACKER/150 LONG)**			
75	1	SCREW (1-3/4 IN.)		25	34
76	1	SCREW (3/8-16 x 1 IN.)		30	41
77	2	WASHER			
78	2	NUT		50	68

General Service Recommendations

There may be more than one way to “disassemble” or “reassemble” a particular part(s), therefore, it is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

In many cases, disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure order in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to “reassembly and installation” of that component in the reassembly part of this section. Use the “Table of Contents” (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, be sure that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear.

When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from overheating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced, if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly, as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply Quicksilver 2-4-C w/Teflon Marine Lubricant on all O-rings. To prevent wear, apply Quicksilver 2-4-C w/Teflon Marine Lubricant on I.D. of oil seals.

To prevent corrosion damage after reassembly, apply Quicksilver 2-4-C w/Teflon Marine Lubricant to external surfaces of bearing carrier and cover nut threads prior to installation.

Removal, Disassembly, Cleaning and Inspection – Standard Rotation

Removal

WARNING

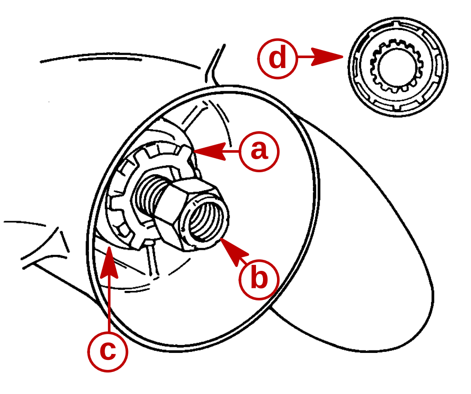
Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from driveshaft housing.

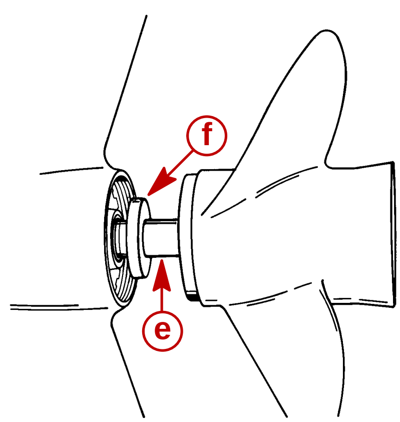
1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.

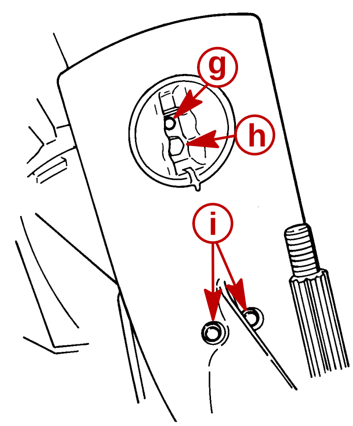
CAUTION

Gear housing MUST BE in NEUTRAL position and shift shaft MUST BE removed from gear housing BEFORE propeller shaft can be removed from gear housing.

2. Shift engine into NEUTRAL position.
3. Tilt engine to full up position and engage tilt lock lever.
4. Bend tabs of propeller tab washer away from thrust hub (rear), then remove propeller locknut, tab washer, thrust hub (rear), propeller and thrust hub (forward) from propeller shaft.
5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of driveshaft housing. Remove bolt that secures trim tab and remove tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.
7. Remove 2 locknuts from bottom middle of anti-cavitation plate.

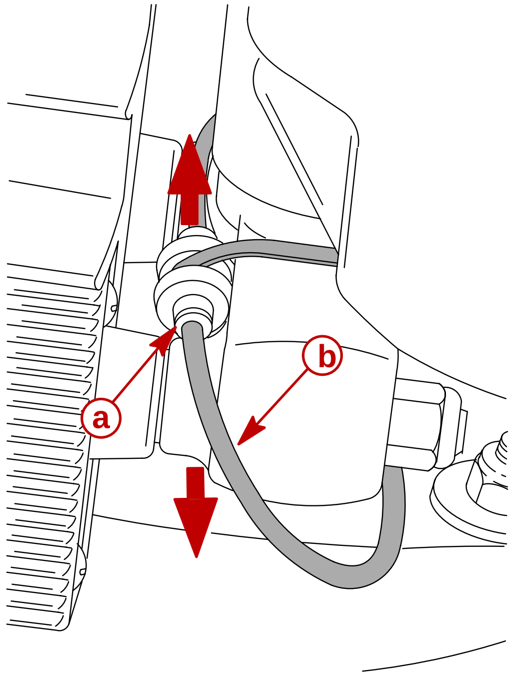






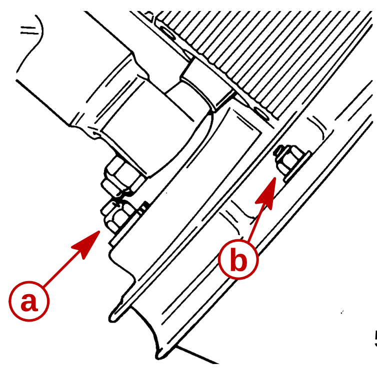
a - Tab Washer
b - Propeller Nut
c - Rear Thrust Hub
d - Continuity Washer (if equipped)
e - Propeller Shaft
f - Thrust Hub (forward)
g - Bolt (secures trim tab)
h - Bolt (inside trim tab cavity)
i - Locknuts and Washers

8. While pressing in on speedometer hose junction, pull out on hose to disconnect.



a - Press in on Junction
b - Pull out on Hose

9. Remove locknut from the front gear housing mounting stud.
10. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or driveshaft housing could be damaged.)



a - Front Mounting Locknut
b - Side Mounting Locknut (One Each Side)

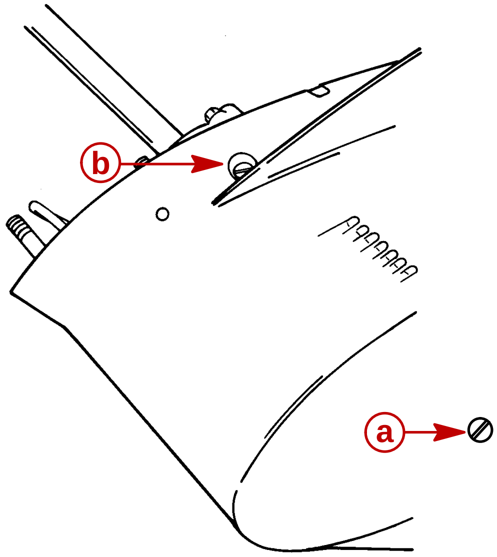
11. Pull gear housing away from driveshaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)
12. Pull gear housing from driveshaft housing.

Draining and Inspecting Gear Housing Lubricant

1. Place gear housing in a suitable holding fixture or vise with the driveshaft in a vertical position.

NOTE: *Drain and Fill screws may be located on the starboard side of gearcase on later models.*

2. Position a clean drain pan under gear housing and remove “Fill” and “Vent” screws from gear housing.



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a - “Fill” Screw
b - “Vent” Screw

3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. Check drain pan for water separation from lubricant. Presence of water in gear lubricant indicates the need for disassembly, and inspection of oil seals, seal surfaces, O-rings and gear housing components.

NOTE: *Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.*

Water Pump

CLEANING AND INSPECTION

1. Clean all water pump parts with solvent and dry with compressed air.
2. Inspect water pump cover and base for cracks and distortion (from overheating).
3. Inspect face plate and water pump insert for grooves and/or rough surfaces.

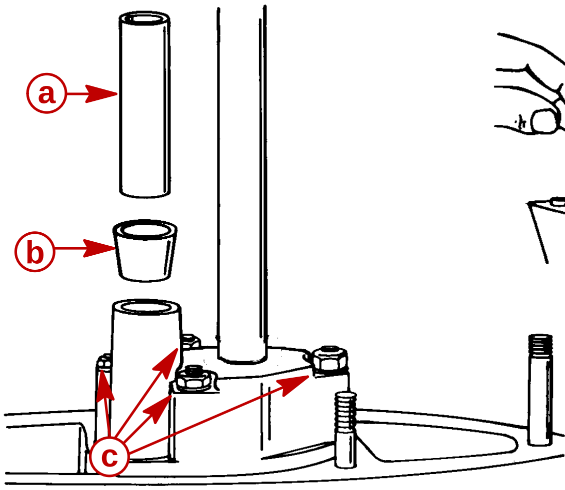
IMPORTANT: When completing gear housing repairs, that require removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to re-use impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur.

4. Inspect impeller side seal surfaces and ends of impeller blades for cracks, tears and wear. Replace impeller if any of these conditions are found.
5. Inspect impeller bonding to impeller hub.
6. Inspect impeller for glazed or melted appearance (caused by operation without sufficient water supply). Replace impeller if any of these conditions exist.

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

REMOVAL AND DISASSEMBLY

1. Slide rubber centrifugal slinger up and off driveshaft.
2. Remove water tube guide and seal from water pump cover. (Retain guide for reassembly and discard seal.)
3. Remove (and retain) 3 nuts, one bolt and all washers which secure water pump cover to gear housing.
4. Using 2 pry bars, lift water pump cover up and off driveshaft.



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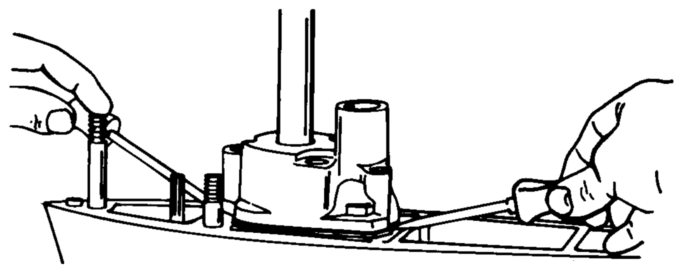

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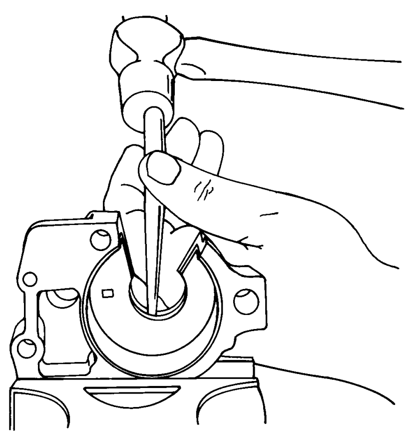
a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolt and Washers To Be Removed

5. Inspect water pump cover and insert, as outlined in **"Cleaning and Inspection,"** previous.
6. If inspection of water pump insert determines that replacement is required, follow Step "a" or "b" (immediately following) to remove insert from water pump cover.

NOTE: *Try Step "a" first. If insert cannot be removed with Step "a," use Step "b".*

a. Drive water pump insert out of water pump cover with a punch and hammer.



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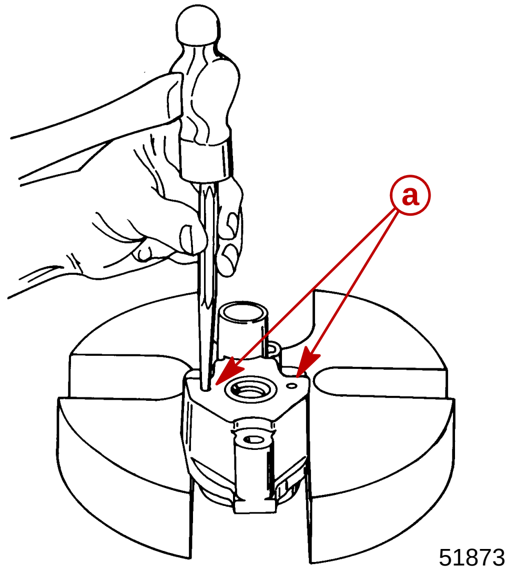
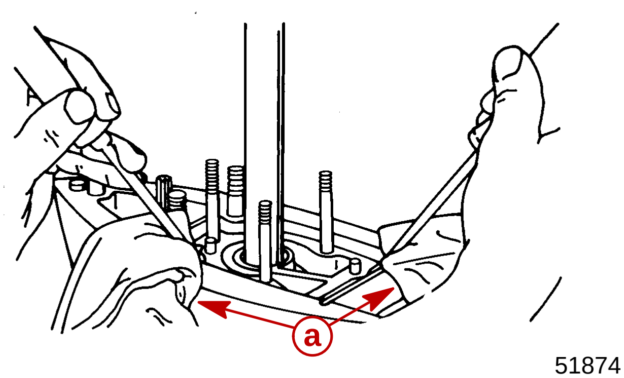
b. Drill two 3/16 in. (4.8mm) diameter holes thru the top of water pump cover (but not thru insert). Drive insert out of cover with a punch and hammer.



a - Drill Two Holes at These Locations

7. Remove impeller from driveshaft. (It may be necessary to use a punch and hammer to drive impeller upward on driveshaft. In extreme cases, it may be necessary to split hub of impeller with a hammer and chisel.)
8. Once impeller is removed, remove impeller drive key from driveshaft.
9. Remove water pump face plate and both gaskets (one above and below face plate) from water pump base.
10. Using 2 pry bars, positioned and padded as shown, lift water pump base up and off driveshaft.



a - Pads

11. Remove (and discard) O-ring from O-ring groove on water pump base.
12. Using a screwdriver, pry oil seals out of water pump base from gear housing side of base.

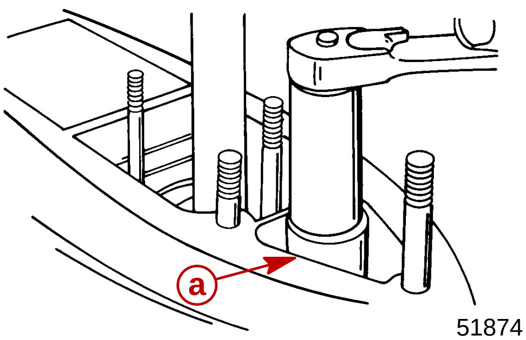
Bearing Carrier and Propeller Shaft Removal

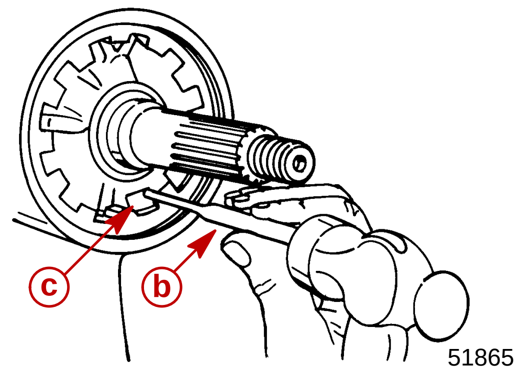
> **⚠ CAUTION**
>
> **Gear housing MUST BE in NEUTRAL position, and shift shaft MUST BE removed from gear housing before propeller shaft can be removed from gear housing.**

1. Place gear housing in a suitable holding fixture with propeller shaft in a horizontal position.
2. Use Shift Shaft Bushing Tool (91-31107) to unthread shift shaft bushing. (DO NOT remove bushing from shift shaft at this time.)

IMPORTANT: Prior to removal of shift shaft from gear housing, recheck that gear housing is in NEUTRAL position.

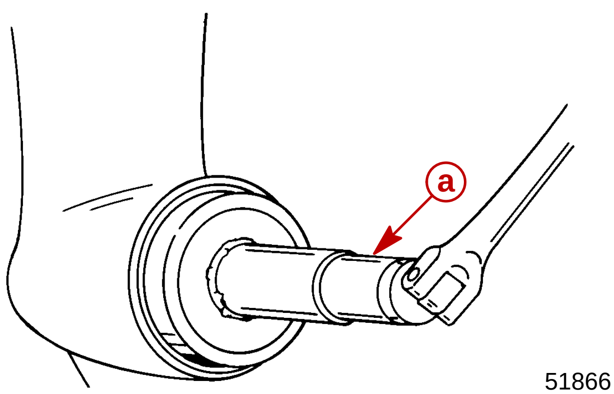
3. Bend cover nut lock tab out of cover nut recess.





a - Shift Shaft Bushing Tool (91-31107)
b - Punch
c - Tab of Tab Washer

4. Remove gear housing cover nut with Cover Nut Tool (91-61069).



a - Cover Nut Tool (91-61069)

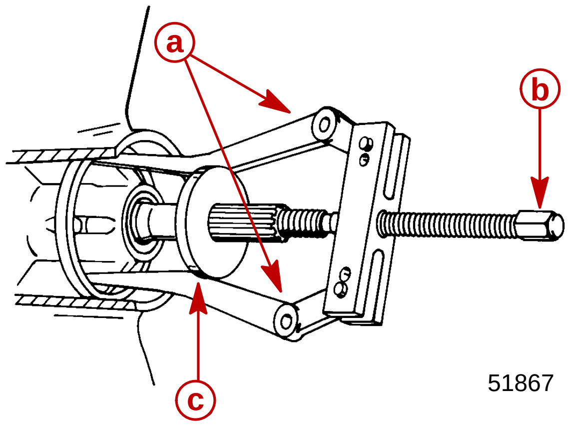
5. After cover nut has been removed, remove lock tab washer from gear housing.

> **⚠ CAUTION**
>
> **Once bearing carrier is removed from gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.**

6. Use long Puller Jaws (91-46086A1) and Puller Bolt (91-85716) to remove bearing carrier. (Use propeller thrust hub to maintain outward pressure on puller jaws.)

NOTE: *When bearing carrier is removed from gear housing, the bearing carrier alignment key will come out with it.*

7. With gear housing in NEUTRAL, pull shift shaft out of gear housing. If necessary, use a pliers to pull shift shaft out of gear housing. If pliers are used to pull shift shaft out, wrap a strip of soft metal (aluminum) around splines before clamping pliers. DO NOT turn shaft (clockwise OR counterclockwise) while pulling shaft out. (For further information on shift shaft, see “Shift Shaft Cleaning/Inspection and Disassembly.”)



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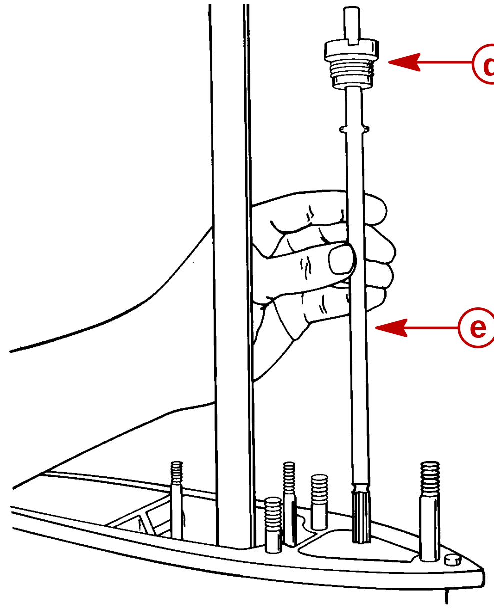

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a - Long Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)
c - Thrust Hub
d - Shift Shaft Bushing
e - Shift Shaft

CAUTION

Propeller shaft, cam follower and shift cam, in most cases, will come out of gear housing by simply pulling outward on propeller shaft. DO NOT FORCE shaft sideways or ATTEMPT TO PULL with a slide hammer or any mechanical puller.

8. Remove propeller shaft, cam follower and shift cam by pulling shaft straight out of gear housing. (DO NOT JERK propeller shaft.) If propeller shaft will not come out, proceed with Step “a” or “b”, following:

   a. Push propeller shaft back into place against the forward gear. Visually inspect location of shift cam by looking down shift shaft hole (illuminated with a flashlight). If splined hole in shift cam is visible, reinstall shift shaft and rotate shift shaft to neutral position. Remove shift shaft, then remove propeller shaft as instructed in Step 8, immediately preceding.

   b. Push propeller shaft back into place against forward gear. Slide bearing carrier back into gear housing (to support propeller shaft). Place gear housing on its left side (viewed from rear) and strike upper leading end of gear housing with a rubber mallet. This will dislodge the shift cam from cam follower into a clearance pocket in left side of gear housing. Remove bearing carrier and pull propeller shaft out of gear housing.

***NOTE:** If Step 8-b was used to remove propeller shaft, the shift cam can be retrieved after removal of forward gear.*

Shift Shaft

CLEANING AND INSPECTION

1. Clean shift shaft and bushing with solvent and dry with compressed air.
2. Check shift shaft splines on both ends for wear and/or corrosion damage.
3. Inspect shift shaft for groove(s) at shift shaft bushing seal surface.
4. Inspect shift shaft bushing for corrosion damage.
5. Inspect shift shaft bushing oil seal for wear and/or cuts.

***NOTE:** Oil seal in shift shaft bushing should be replaced as a normal repair procedure.*

DISASSEMBLY

1. Remove (and discard) shift shaft bushing oil seal by prying it out or driving it out with a punch and hammer.

CLEANING/INSPECTION - BEARING CARRIER

IMPORTANT: It is recommended that all seals and O-rings be replaced (as a normal repair procedure) to assure effective repair.

1. Clean bearing carrier with solvent and dry with compressed air.

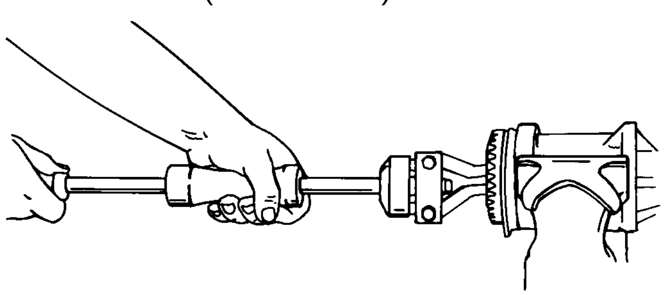
CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

2. Bearing carrier propeller shaft needle bearing condition is determined by propeller shaft bearing surface condition. (See “Propeller Shaft Inspection.”)
3. Inspect reverse gear to pinion gear wear pattern (should be even and smooth). If not, replace reverse gear and pinion gear.
4. Check clutch jaws on reverse gear for damage. Replace reverse gear, if damage is found on clutch jaws.
5. Apply light oil to reverse gear bearing. Rotate reverse gear bearing while checking bearing for rough spots and/or catches. Push in and pull out on reverse gear to check for bearing side wear. Replace bearing if any of the listed conditions exist.

DISASSEMBLY - BEARING CARRIER

1. Remove and discard O-ring from between bearing carrier and thrust washer.
2. If inspection of reverse gear or reverse gear bearing determines that replacement of gear or bearing is required, remove gear and bearing as follows:
   a. Position bearing carrier in a soft jaw vise.
   b. Use Slide Hammer (91-34569A1) and remove reverse gear.



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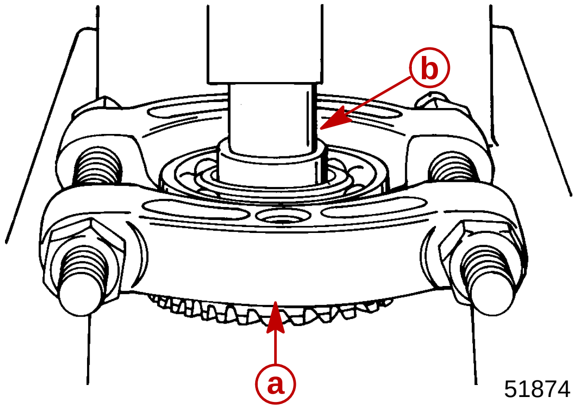
c. If reverse gear bearing remains attached to reverse gear, install Universal Puller Plate (91-37241) and position puller plate, gear and bearing on a press with gear side down. Use a suitable mandrel and press gear out of bearing.



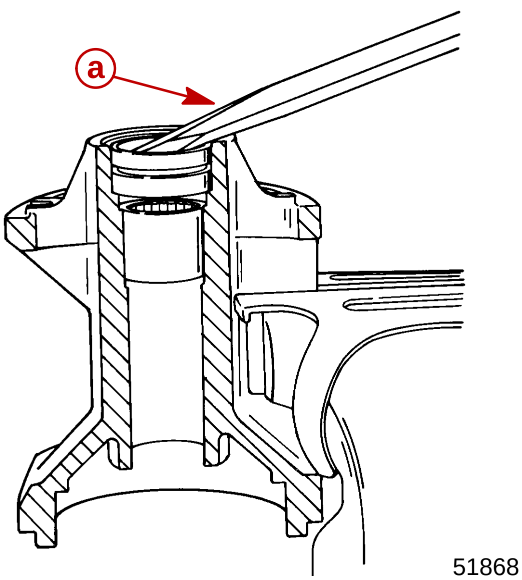
a - Universal Puller Plate
b - Mandrel

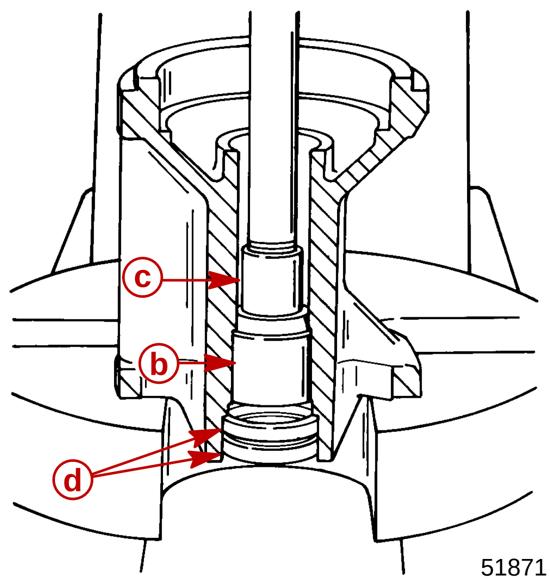
d. If reverse gear bearing has remained in bearing carrier, use slide hammer to remove bearing in the same methods as was used to remove reverse gear (Step "b").

3. Propeller shaft oil seals can be removed by (a) using a pry bar, or (b) pressing seals out when propeller shaft needle bearing is pressed out of bearing carrier.

4. If inspection of propeller shaft needle bearing determines that replacement of bearing is required, use Universal Bearing Removal and Installation Tool (91-31229A1) to press bearing and seals out of bearing carrier.

NOTE: *Reverse gear must be removed from bearing carrier before propeller shaft needle bearing can be removed.*





a - Pry Bar
b - Propeller Shaft Needle Bearing
c - Mandrel
d - Oil Seals

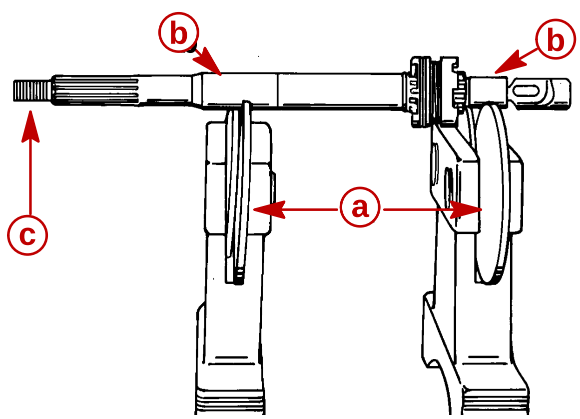
Propeller Shaft

INSPECTION

1. Clean propeller shaft assembly with solvent and dry with compressed air.
2. Inspect bearing carrier oil seal surfaces for grooves. Run fingernail across seal surface to check for groove. Replace shaft if groove is found.
3. Visually check bearing surfaces of propeller shaft for pitting, grooves, scoring, uneven wear or discoloration (bluish color) from overheating. Replace shaft and corresponding needle bearing if any of the above conditions are found. (Bearing carrier needle bearing contacts propeller shaft just in front of oil seal surface. Forward gear bearing contacts propeller shaft in front of sliding clutch splines.)
4. Inspect propeller shaft splines for wear and/or corrosion damage.
5. Check propeller shaft for straightness. Use either method, following:

BALANCE WHEELS

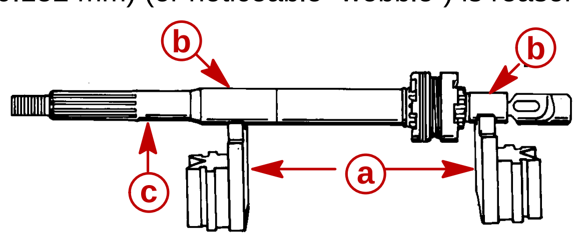
Place propeller shaft on balance wheels. Rotate propeller shaft and observe propeller end of shaft for “wobble.” Replace shaft if any “wobble” is observed.



51872

a - Balance Wheels
b - Bearing Surfaces
c - Watch for Wobble

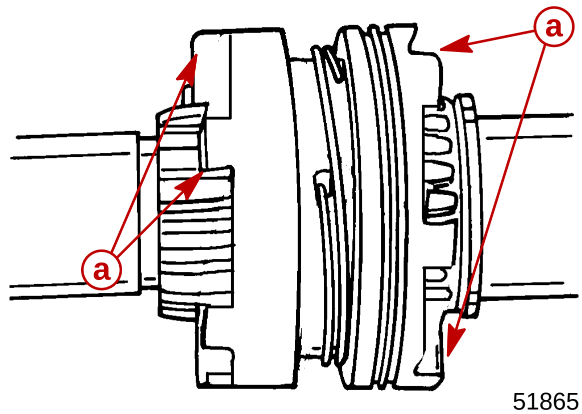
Position propeller shaft roller bearing surfaces on “vee” blocks. Mount a dial indicator at front edge of propeller splines. Rotate propeller shaft. Dial indicator movement of more than 0.006 in. (0.152 mm) (or noticeable “wobble”) is reason for replacement.



51872

a - “Vee” Blocks
b - Bearing Surfaces
c - Measure with Dial Indicator at this Point

6. Inspect sliding clutch. Check reverse gear and forward gear clutch jaws. Rounded jaws indicate one or more of the following:
   a. Improper shift cable adjustment.
   b. Improper shift habits of operator(s) (shift from NEUTRAL to REVERSE gear too slowly).
   c. Engine idle speed too high (while shifting).



a - Clutch Jaws

7. Check condition of cam follower. If it shows wear (pitting, scoring or rough surface), replace cam follower and shift cam.

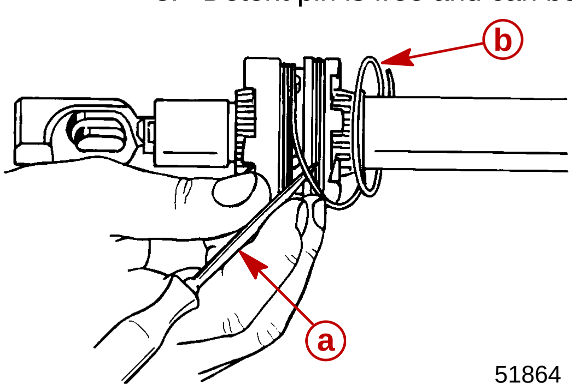
DISASSEMBLY

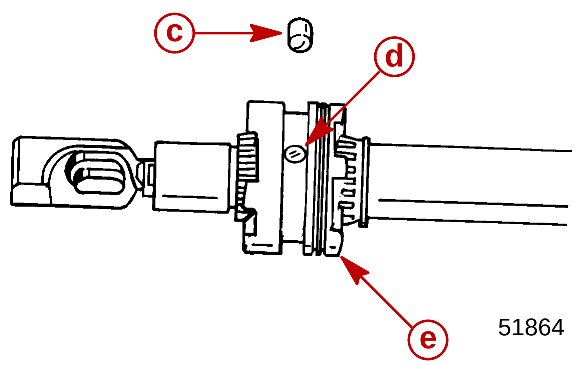
1. Remove shift cam from cam follower.
2. Insert a thin blade screwdriver or awl under first coil of cross pin retainer spring and rotate propeller shaft to unwind spring from sliding clutch. DO NOT over-stretch spring.

⚠CAUTION

Detent pin is free and can fall out of sliding clutch. Care MUST BE taken not to lose pin.

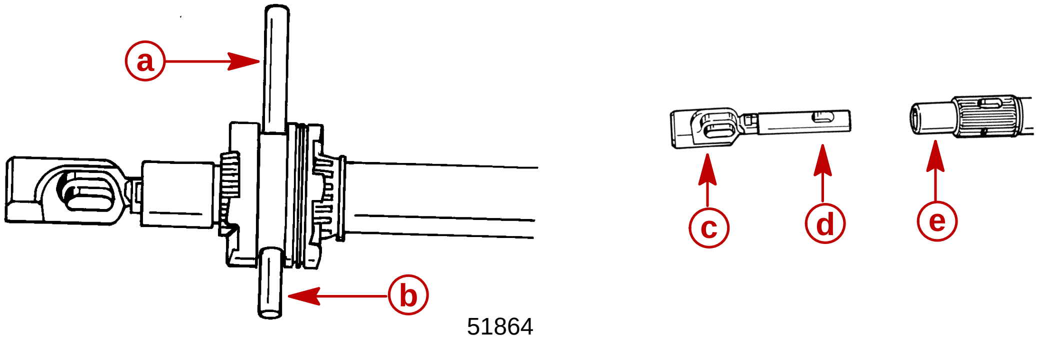
3. Detent pin is free and can be removed from sliding clutch at this time.





a - Awl
b - Cross Pin Retainer Spring
c - Detent Pin
d - Cross Pin
e - Sliding Clutch

4. Push cross pin out of sliding clutch and propeller shaft with Cross Pin Tool (91-86642).
5. Pull sliding clutch off propeller shaft.
6. Pull cam follower and clutch actuator rod out of propeller shaft. DO NOT force cam follower up-or-down or side-to-side when pulling from propeller shaft.



51864

51864

a - Cross Pin Tool (91-86642)
b - Cross Pin
c - Cam Follower
d - Clutch Actuator Rod
e - Propeller Shaft

7. Once cam follower and clutch actuator rod are removed from propeller shaft, lift rod out of cam follower.

Clutch Actuator Rod

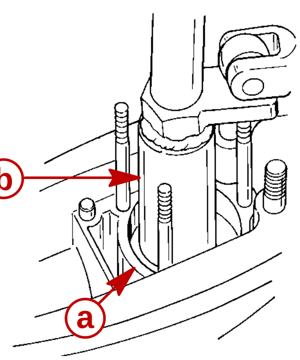
CLEANING AND INSPECTION

1. Clean clutch actuator rod in solvent and dry with compressed air.
2. Inspect actuator components for wear or damage. Replace components as required.

Pinion Gear and Driveshaft

REMOVAL

1. Remove bearing retainer using Bearing Retainer Tool (91-43506).



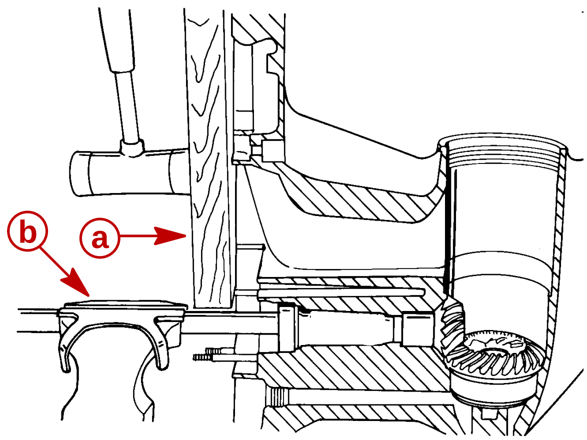
51865

a - Bearing Retainer
b - Bearing Retainer Tool (91-43506)

2. Place Driveshaft Holding Tool (91-34377A1) over driveshaft splines.
3. Use a socket and flex handle to hold pinion nut. (Pad area of gear housing where flex handle will make contact to prevent damage to gear housing.)
4. Use a socket and flex handle on Driveshaft Holding Tool to loosen pinion nut. Remove pinion nut and Driveshaft Holding Tool.

5. Remove gear housing from vise and re-position it as shown. Be sure to use soft jaw vise covers and clamp as close as possible to water pump studs.
6. Place a block of wood on gear housing mating surface. Use a mallet and carefully tap gear housing away from driveshaft.

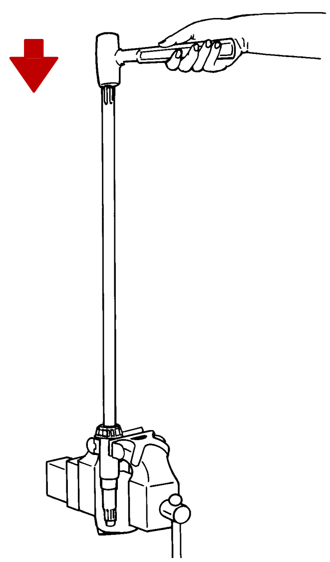
CAUTION
DO NOT strike gear housing hard with the mallet or allow gear housing to fall.



51870

a - Wooden Block
b - Soft Jaw Vise Covers

7. Reach into gear housing and remove pinion gear and forward gear assembly.
8. After driveshaft is removed from gear case, remove and retain shim(s) that were located under upper tapered driveshaft bearing.
9. If inspection determines that replacement of driveshaft tapered bearing is required, remove bearing from driveshaft as follows:
   a. Position driveshaft in a vise; DO NOT tighten vise jaws against shaft.
   b. Strike shaft with a lead hammer; take care not to drop shaft.

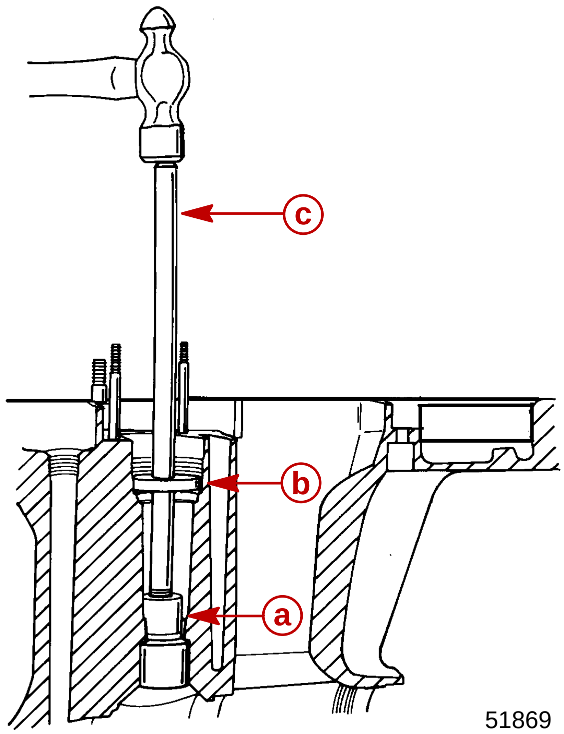


51866

10. Remove 18 loose needles from outer race of driveshaft needle bearing.
11. If inspection of driveshaft needle bearing surface determines that replacement of needle bearing is required, the 18 loose needle bearings previously removed must be reinstalled in bearing race to provide surface for mandrel to drive against.

NOTE: *FORWARD gear must be removed first BEFORE removing driveshaft needle bearing.*

IMPORTANT: Discard driveshaft needle bearing after removal. (Bearing cannot be reused.)



a - Mandrel (91-37263)
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)
*From Bearing Removal and Installation Kit (91-31229A5)

CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air. DO NOT allow driveshaft bearing to spin while drying.
2. Inspect pinion gear for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace pinion gear, if any of the above conditions are found.
3. Inspect driveshaft needle bearing surface (area just above pinion gear splines) for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace driveshaft and driveshaft needle bearing, if any of the preceding conditions are found.
4. Inspect driveshaft to crankshaft splines for wear. Replace driveshaft if wear is excessive.
5. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing and race as a set, if any of the preceding conditions are found.
6. Inspect driveshaft for groove(s) where water pump base oil seals contact shaft. Replace driveshaft if groove(s) are found.

Forward Gear

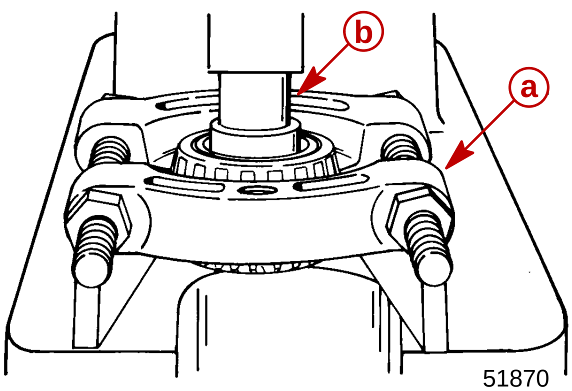
REMOVAL AND DISASSEMBLY

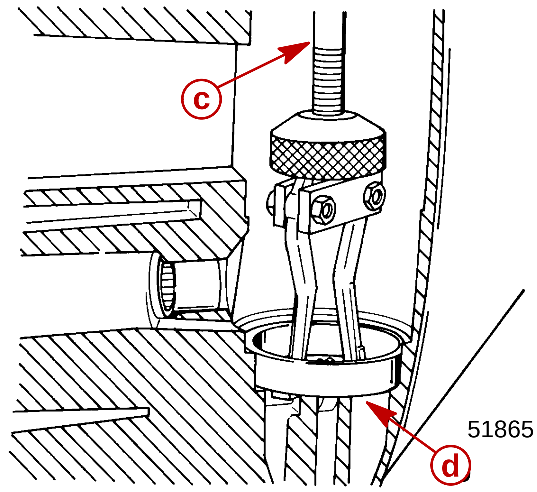
NOTE: *Forward gear can only be removed from gear housing after driveshaft and pinion gear have been removed.*

1. Reach into gear housing and lift out forward gear.

IMPORTANT: DO NOT remove tapered bearing or needle bearings from forward gear, unless replacement of bearings is required. (Bearings cannot be reused after they have been removed.)

2. If inspection determines that replacement of forward gear tapered bearing is required, remove bearing from gear and bearing race from gear housing (tapered bearing and race MUST BE replaced as a set), as follows:
   a. Install Universal Puller Plate (91-37241) between forward gear and tapered bearing.
   b. Place forward gear, bearing and puller plate on a press and press gear out of bearing with a suitable mandrel.
   c. Use Slide Hammer (91-34569A1) to remove forward gear tapered bearing race.





a - Universal Puller Plate
b - Mandrel
c - Slide Hammer
d - Tapered Bearing Race

   d. After forward gear tapered bearing race is removed from gear housing, lift out and retain shims which were behind bearing race.

3. If inspection determines that replacement of propeller shaft needle bearings in forward gear is required, remove bearing from gear as follows:
   a. Clamp forward gear in a soft jaw vise securely.
   b. From toothed-side of gear, drive propeller shaft needle bearings out of gear with a punch and hammer.

CLEANING AND INSPECTION

⚠ CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean forward gear and bearings with solvent and dry with compressed air.
2. Inspect gear teeth for pitting, grooves, scoring, uneven wear and for discoloration (from overheating). Replace gear if any of these conditions are found.
3. Check clutch jaws on forward gear for damage. Replace forward gear if damage is found.
4. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration (from overheating). Replace tapered bearing (on forward gear) and race if any of these conditions are found. (Always replace tapered bearing and race as a set.)
5. To determine condition of propeller shaft needle bearings (in forward gear), inspect propeller shaft forward gear needle bearing surface as outlined in "Propeller Shaft Inspection."

Gear Housing

CLEANING AND INSPECTION

1. Clean gear housing with solvent and dry with compressed air.
2. Check gear housing carefully for impact damage.
3. Check for loose fitting bearing cups and needle bearings.
4. Inspect bearing carrier cover nut retainer threads in gear housing for corrosion damage and/or stripped threads.

Reassembly and Installation Standard Rotation

Driveshaft Needle Bearing

REASSEMBLY/INSTALLATION

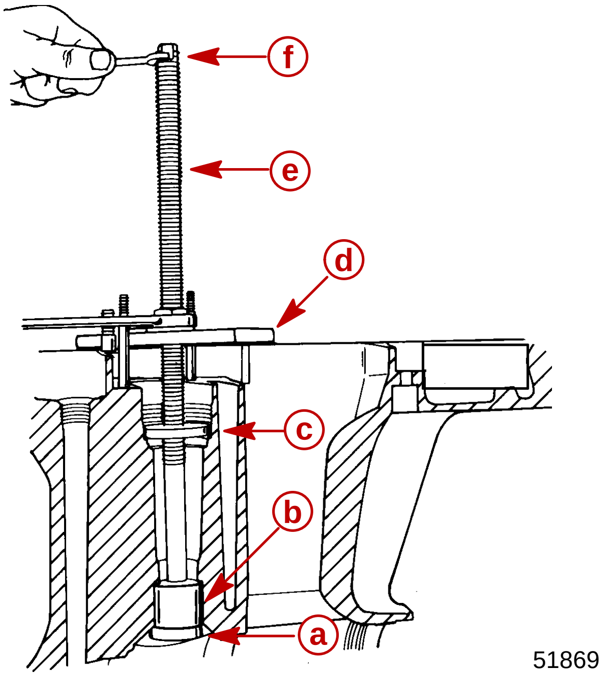
⚠ CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing MUST be replaced. Loose fitting needle bearing will move out of position and cause repeated failures.

1. Apply a thin coat of Quicksilver 2-4-Cw/Teflon Lubricant to driveshaft needle bearing bore in gear housing.
2. By way of propeller shaft cavity, place needle bearing in driveshaft bore with numbered side of bearing facing up driveshaft bore.

3. Install and seat needle bearing with the following tools: Puller Rod* (91-31229), Nut* (11-24156), Pilot* (91-36571), Plate* (91-29310) and Mandrel (91-92788). Pull bearing up into bore until it bottoms on gear housing shoulder. (DO NOT use excessive force.)

*From Bearing Removal and Installation Kit (91-31229A5)



a - Mandrel
b - Bearing
c - Pilot
d - Plate
e - Puller Rod
f - Hold

Bearing Carrier

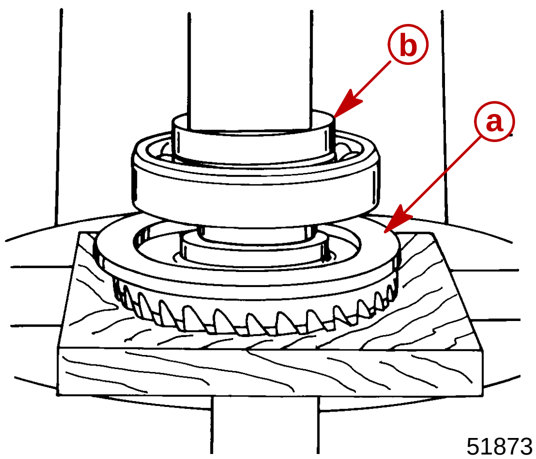
REASSEMBLY

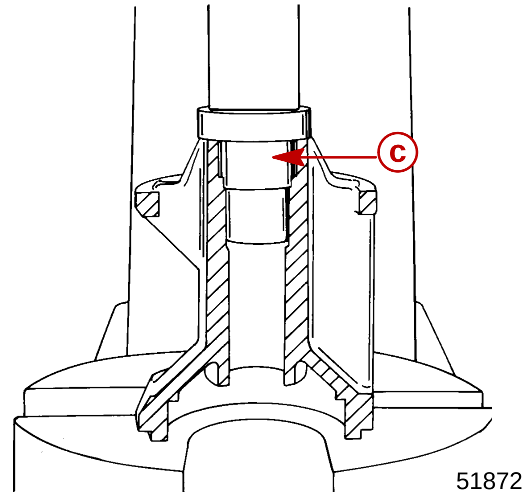
1. Place reverse gear on a press with gear teeth facing down.

IMPORTANT: The reverse gear thrust washer has a tapered outside diameter so that one side is larger than the other. The larger outside diameter of washer must be toward reverse gear.

2. Place thrust washer over gear with the larger outside diameter down toward gear.
3. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto inside diameter of reverse gear ball bearing.
4. Position ball bearing over gear (with numbered side of bearing up).

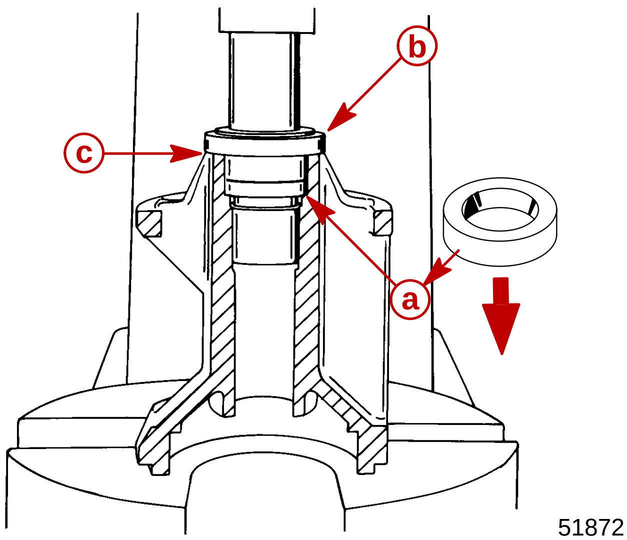
5. Press ball bearing onto gear with a suitable mandrel until firmly seated. (Be sure to press only on inner race of bearing and that bearing is firm against gear.)
6. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto outside diameter of propeller shaft needle bearing.
7. Place propeller shaft needle bearing into aft end of bearing carrier with numbered side toward aft end.
8. Use Mandrel 91-15755 and press needle bearing into bearing carrier.





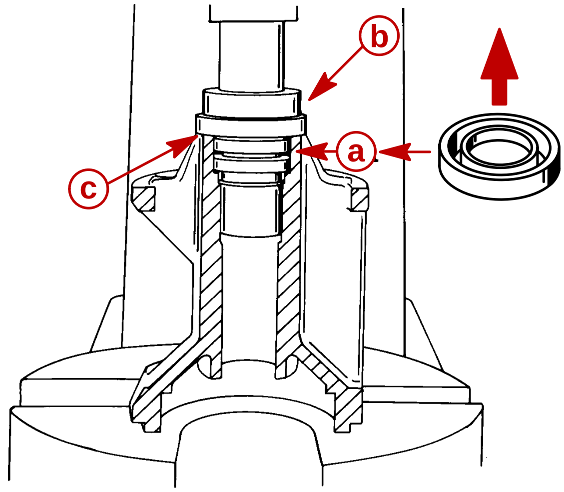
a - Thrust Washer
b - Mandrel
c - Mandrel (91-15755)

9. Apply Loctite 271 to outer diameter of propeller shaft oil seals.
10. Place one seal on longer shoulder side of Oil Seal Driver (91-31108) with lip of seal away from shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.



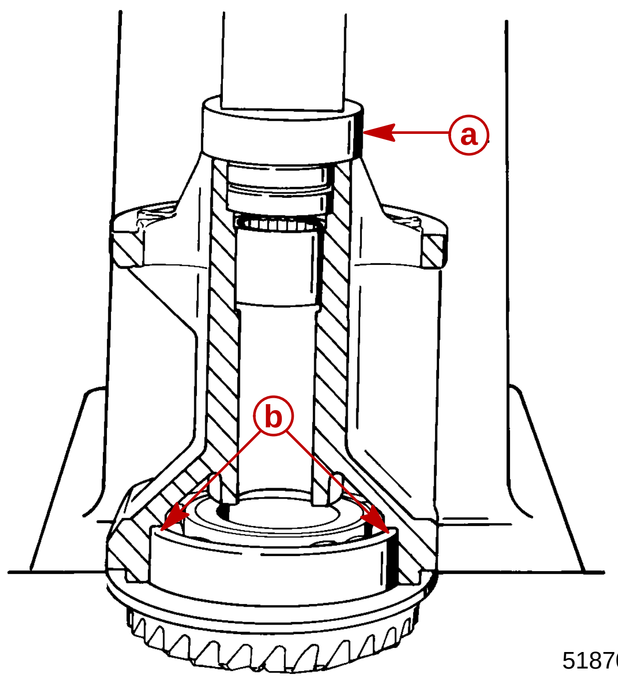
a - Oil Seal (Lip of Seal Down)
b - Oil Seal Driver
c - Seated

11. Place second seal on short shoulder side of seal driver with lip of seal toward shoulder. Press seal into bearing carrier until seal driver bottoms against bearing carrier.



a - Oil Seal (Lip of Seal Up)
b - Oil Seal Driver
c - Seated

12. Wipe off excess Loctite.
13. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto the outside diameter of reverse gear ball bearing.
14. Place bearing carrier over reverse gear and bearing assembly. Press bearing carrier onto bearing.



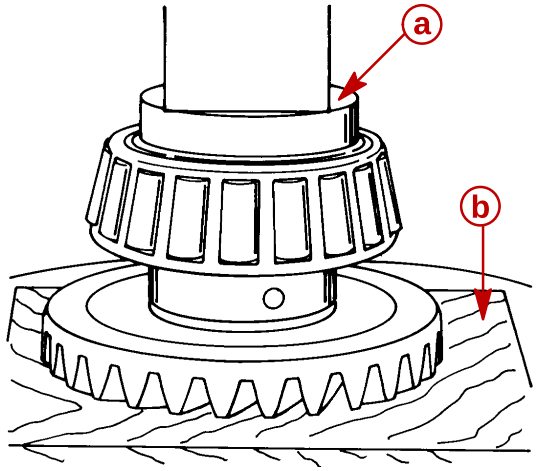
a - Mandrel
b - Seated

15. Place O-ring over bearing carrier and position it between bearing carrier and thrust washer.
16. Lubricate oil seals and O-ring with Quicksilver 2-4-C w/Teflon Marine Lubricant.

Forward Gear

REASSEMBLY

1. Place forward gear on a press with gear teeth down.
2. Apply a light coat of Quicksilver Super Duty Gear Lubricant onto the inside diameter of forward gear tapered bearing.
3. Position forward gear tapered bearing over gear.
4. Press bearing onto gear until firmly seated. (Be sure to press only on inner race of bearing and that bearing is firm against the gear.)



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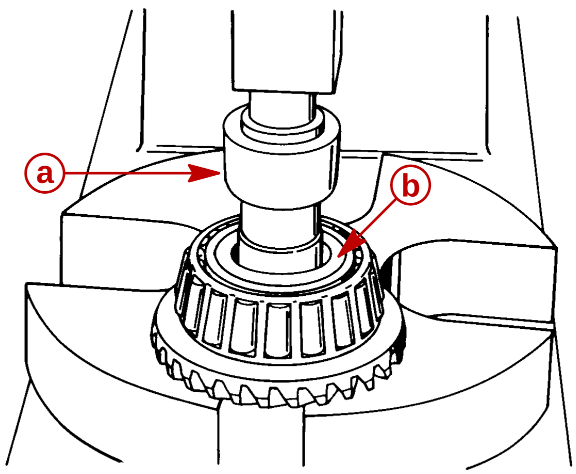
a - Mandrel
b - Wooden Block

5. Apply a light coat of Quicksilver Super Duty Gear Lubricant to bore in center of forward gear.
6. Place one forward gear needle bearing on longer shoulder side of Forward Gear Bearing Tool (91-86943) with numbered side of bearing toward shoulder. Press bearing into forward gear until bearing tool bottoms against gear.



51873

a - Forward Gear Bearing Tool (91-86943)
b - Numbered Side of Needle Bearing

7. Place second needle bearing on short shoulder side of bearing tool with numbered side of bearing toward shoulder. Press bearing into forward gear until bearing tool bottoms against gear.

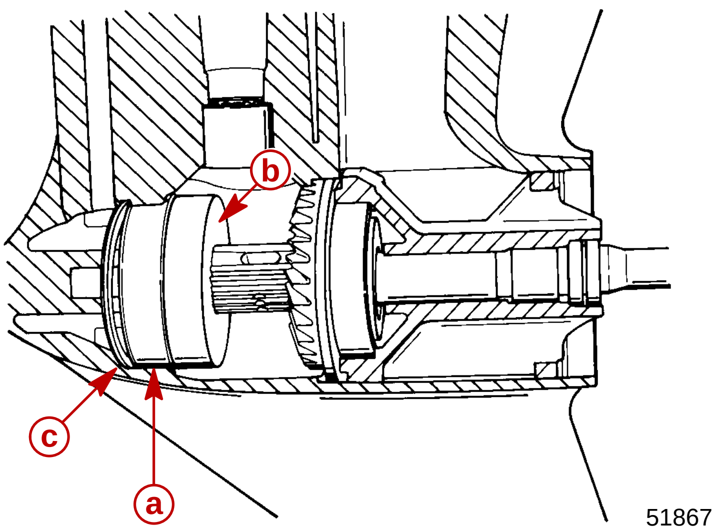
Forward Gear Bearing Race

INSTALLATION

1. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or a new gear housing is being used, start with approximately 0.010 in. (0.254 mm).
2. Apply a light coat of Quicksilver Super Duty Gear Lubricant to forward gear bearing race bore in gear housing.
3. Position tapered bearing race squarely over bearing bore in front portion of gear housing.
4. Place Bearing Driver Cup (91-87120) over tapered bearing race.

NOTE: *A used propeller shaft is recommended for use in Step 5. If it is necessary, however, to use the propeller shaft that will be installed in gear housing, the propeller shaft must be disassembled. (Refer to “Propeller Shaft Disassembly,” preceding.)*

5. Place propeller shaft into hole in center of bearing driver cup.
6. Install bearing carrier assembly over propeller shaft and lower it into gear housing. Bearing carrier acts as a pilot to assure proper bearing race alignment.
7. Thread a nut onto propeller shaft to protect propeller shaft threads.
8. Use a mallet to drive propeller shaft against bearing driver cup until tapered bearing race is seated against shim(s).



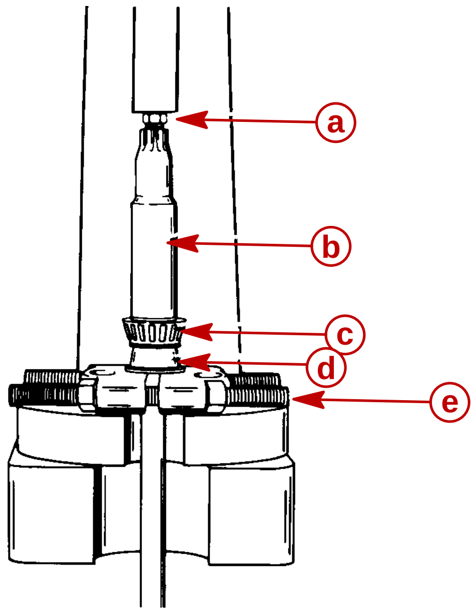
a - Tapered Bearing Race
b - Bearing Driver Cup (91-31106)
c - Shim(s)

9. Remove nut from propeller shaft, then remove bearing carrier and propeller shaft from gear housing. Lift bearing driver cup out of gear housing.
10. Apply a light coat of oil on tapered bearing race, then place forward gear assembly into forward bearing race.

Driveshaft and Pinion Gear

REASSEMBLY/INSTALLATION

1. Apply a light coat of Quicksilver Super Duty Gear Lubricant on I.D. of driveshaft tapered bearing.
2. Thread a used pinion nut onto end of driveshaft. Leave approximately 1/16 in. (1.6 mm) of nut threads exposed. Driveshaft threads MUST NOT extend beyond nut or thread damage could result while pressing.
3. Place bearing over driveshaft.
4. Using an old driveshaft bearing inner race or other suitable mandrel (which applies pressing force on center bearing race only), press bearing onto shaft until seated.



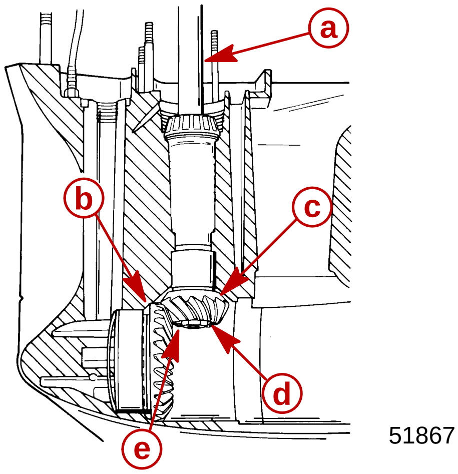
a - Used Pinion Nut
b - Driveshaft
c - Tapered Bearing
d - Old Bearing Inner Race
e - Universal Puller Plate

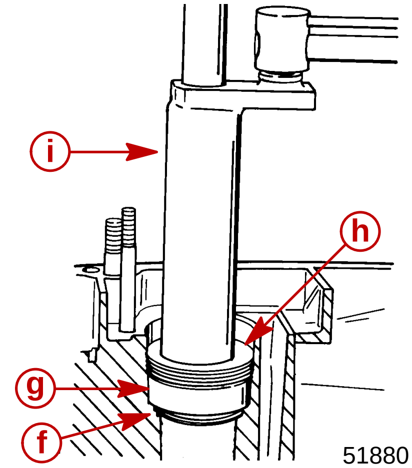
5. Position pinion gear in gear housing below driveshaft bore with teeth of pinion gear meshed with teeth of reverse gear.
6. Insert driveshaft into driveshaft bore while holding pinion gear. Rotate driveshaft to align and engage driveshaft splines with pinion gear splines. Continue to insert driveshaft into gear housing until driveshaft tapered bearing is against bearing race.

NOTE: *It is recommended that after final pinion depth is obtained, a new pinion nut be installed. Clean pinion nut threads with Loctite 7649 Primer (92-809824) before applying Loctite 271.*

7. Place a small amount of Loctite 271 onto threads of pinion gear nut and install flat washer and nut on driveshaft with flat side of nut away from pinion gear. Hand tighten pinion nut.
8. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or are not reusable (damaged), start with approximately 0.010 in. (0.254 mm).

9. Install bearing race and bearing retainer.

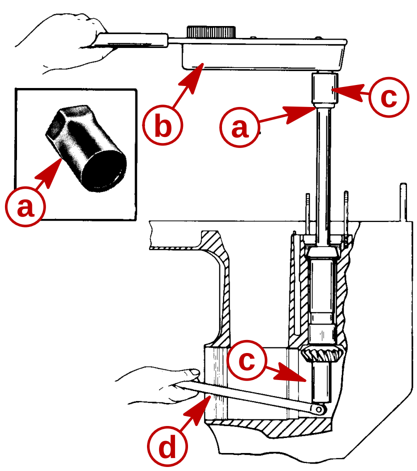




a - Driveshaft (rotate to engage splines with pinion gear)
b - Forward Gear Assembly
c - Pinion Gear
d - Washer (located above pinion nut)
e - Pinion Nut [apply Loctite 271 on threads and install with flat side away from pinion gear.]
f - Shim(s)
g - Bearing Race
h - Bearing Retainer (Word "OFF" must be visible) Torque to 100 lb. ft. (135.5 Nm)
i - Bearing Retainer Tool (91-43506)

10. Use a socket and flex handle to hold pinion nut (pad area where flex handle will contact gear housing while torquing nut).

11. Place Driveshaft Holding Tool (91-34377A1) or (91-90094) over crankshaft end of driveshaft. Torque pinion nut to 75 lb. ft. (101.5 Nm).



a - Driveshaft Holding Tool (91-34377A1)
b - Torque Wrench; Torque Nut to 75 lb. ft. (101.5 Nm)
c - Socket
d - Breaker Bar

IMPORTANT: Wipe any excess Loctite from pinion nut and pinion gear.

Pinion Gear Depth/Forward Gear Backlash/Reverse Gear Backlash

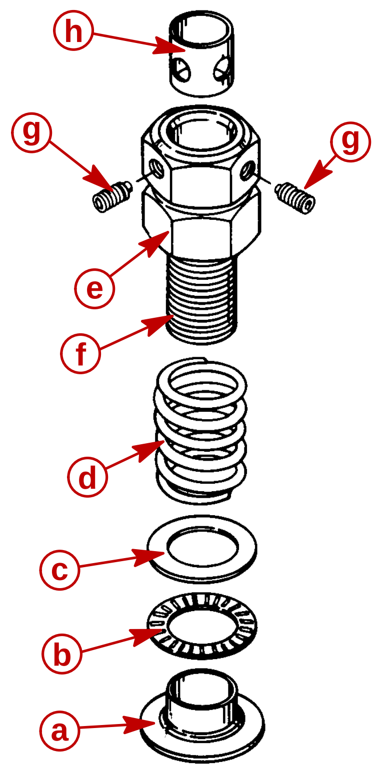
DETERMINING PINION GEAR DEPTH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Forward gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

1. Clean the gear housing bearing carrier shoulder.
2. Install Bearing Preload Tool (91-14311A1) over driveshaft in sequence shown.

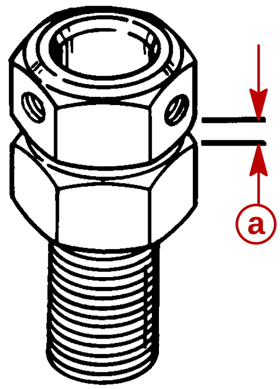
NOTE: *Bearing Preload Tool (91-44307A1) may also be used. Follow instructions provided with tool for proper installation.*

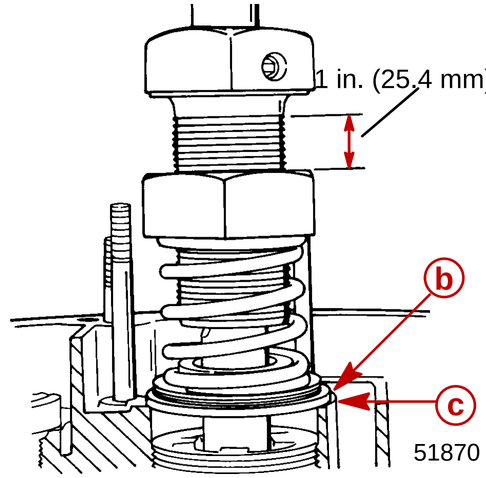


a - Adaptor
b - Bearing
c - Washer
d - Spring
e - Nut; thread nut all the way onto bolt
f - Bolt
g - Set Screw
h - Sleeve; Holes in sleeve must align with set screw

3. Align adaptor on driveshaft bearing pocket ledge.
4. With tool installed over driveshaft, tighten both set screws securely, making certain to align sleeve holes to allow set screws to pass thru.

5. Measure distance (a) and increase that distance by 1 in. (25.4 mm) by turning bottom nut away from top nut.



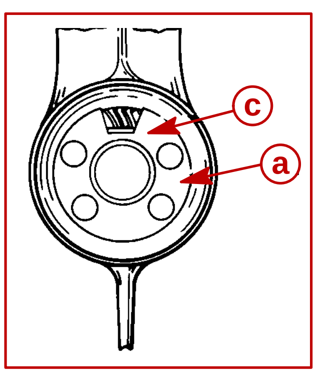


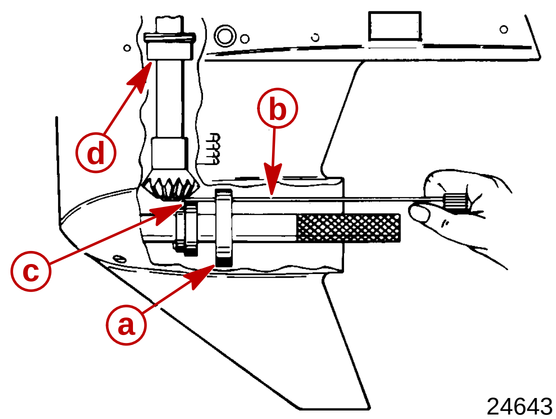
a - Distance
b - Adaptor
c - Ledge

6. Turn driveshaft clockwise 2 or more turns to seat driveshaft bearings.
7. Insert Pinion Gear Locating Tool* (91-74776) into gear housing until it bottoms out on bearing carrier shoulder.

*Pinion Gear Locating Tool (91-12349A2) can be used. Use flat #7 and disc #2. Follow instructions supplied with tool.

8. Determine pinion gear depth by inserting a feeler gauge thru access slot in pinion gear shimming tool.
9. Clearance between shimming tool and pinion gear should be 0.025 in. (0.64 mm).
10. If clearance is correct, leave Bearing Preload Tool on driveshaft for “Determining Forward Gear Backlash,” following.
11. If clearance is not correct, add (or subtract) shims at location shown to raise (or lower) pinion gear. When reinstalling pinion nut, apply Loctite 271 on threads of nut and retorque pinion nut.





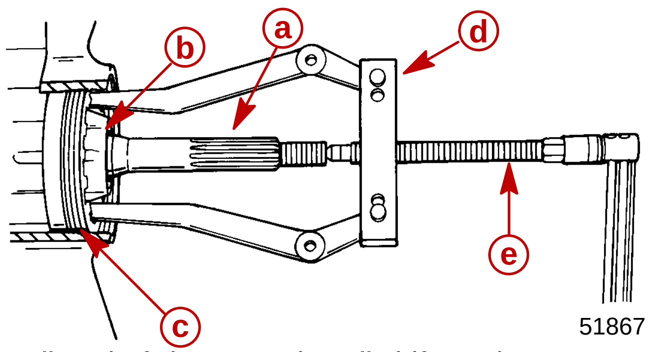
a - Pinion Gear Tool (91-74776 or 91-12349A2)
b - Feeler Gauge
c - Obtain 0.025 in. (0.64 mm) Clearance between Shimming Tool and Pinion Gear
d - Add or Subtract Shim(s) Here

NOTE: *Bearing Preload Tool (91-14311A1) should remain installed on driveshaft after setting pinion gear depth as it is required to properly check forward gear and reverse gear backlash.*

DETERMINING FORWARD GEAR BACKLASH

IMPORTANT: Bearing carrier must be assembled to provide a pilot for propeller shaft.

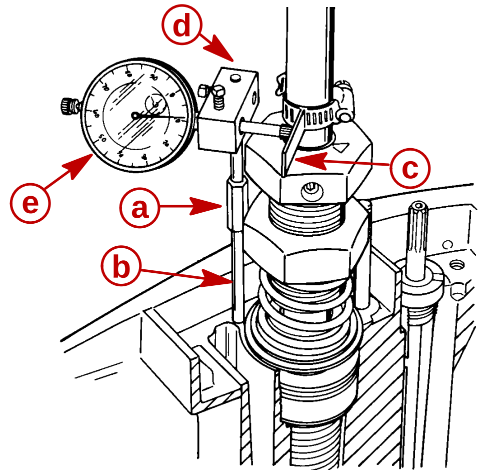
1. Insert propeller shaft into position in gear housing. (DO NOT place shift cam on propeller shaft.)
2. Place bearing carrier into gear housing and thread cover nut tightly against bearing carrier. (It is not necessary to torque cover nut against bearing carrier.)
3. Attach Bearing Carrier Removal Tool (91-46086A1) and Puller Bolt (91-85716) onto gear housing.
4. Torque puller bolt against propeller shaft to 45 lb. in. (5 Nm). Turn driveshaft 10 revolutions with the load applied to propeller shaft. This will seat forward gear bearing.



a - Propeller Shaft (DO NOT install shift cam)
b - Bearing Carrier (assembled)
c - Cover Nut (Tighten; DO NOT torque)
d - Bearing Carrier Removal Tool (91-46086A1)
e - Puller Bolt (91-85716); Torque to 45 lb. in. (5 Nm)

5. Fasten dial indicator to gear housing and Backlash Indicator Tool (91-78473) to driveshaft.
6. Recheck torque on puller bolt [45 lb. in. (5 Nm)].

7. Position dial indicator pointer on line marked “1” on Backlash Indicator Tool, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked “2” on Backlash Indicator Tool, if gear ratio is 2:1 (14 teeth on pinion gear) or on line marked “4” if gear ratio is 2.3:1 (13 teeth on pinion gear).



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a - Thread Stud Adaptor (from 91-14311A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)

8. Lightly turn driveshaft back-and-forth (no movement should be noticed at propeller shaft).
9. Dial indicator registers amount of backlash which must be 0.018 in. to 0.027 in. (0.46 mm to 0.69 mm) for the 1.87:1 gear ratio, 0.015 in. to 0.022 in. (0.38 mm to 0.56 mm) for the 2:1 gear ratio and 0.018 in. to 0.023 in. (0.46 mm to 0.58 mm) for the 2.3:1 gear ratio.
10. If backlash is LESS than the specified minimum, REMOVE shim(s) from in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.
11. If backlash is MORE than the specified MAXIMUM, add shim(s) in front of forward gear bearing race to obtain correct backlash. When reinstalling pinion nut, apply Loctite 271 on threads of nut.

NOTE: *By adding or subtracting 0.001 in. (0.025 mm) shim, the backlash will change approximately 0.001 in. (0.025 mm).*

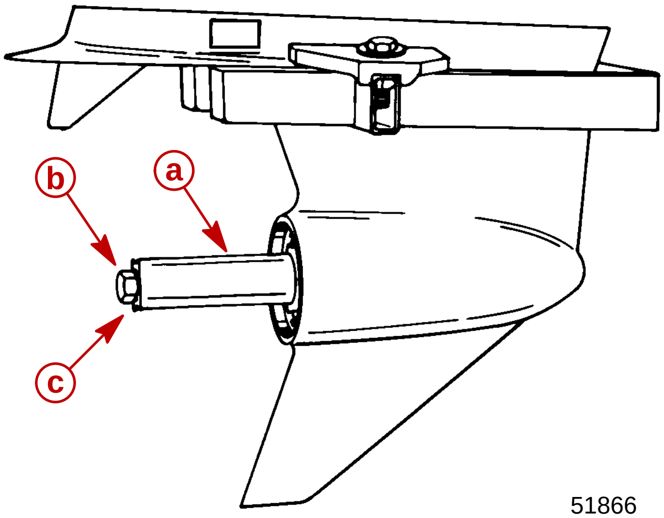
REVERSE GEAR

Determining Reverse Gear Backlash

Although reverse gear backlash is not adjustable, it may be checked as follows:

1. Propeller shaft and bearing carrier must be completely assembled and installed in gearcase.
2. Install shift shaft in gearcase.
3. Shift gearcase into reverse.
4. Slide 5-1/2 in. x 1.5 in. I.D. (139.7 mm x 38.0 mm) piece of PVC pipe over propeller shaft and position pipe against bearing carrier.

5. Secure pipe against carrier with propeller nut and tab washer.



a - Pipe [5-1/2 in. x 1.5 in. (139.7 mm x 38.0 mm)]
b - Propeller Nut
c - Tab Washer

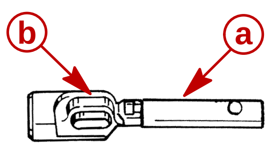
6. Torque propeller nut to 45 lb. in. (5 Nm).
7. Gently rock driveshaft. Dial indicator should show backlash of 0.030 in. – 0.050 in. (0.762 mm – 1.27 mm).

If backlash is not as indicated, gear case is not properly assembled or parts are excessively worn and must be replaced before returning gear case to service.

Clutch Actuator Rod

REASSEMBLY

1. Place a small amount of Quicksilver 2-4-C w/Teflon Lubricant on actuator rod and install cam follower.



a - Actuator Rod
b - Cam Follower

Shift Shaft Bushing

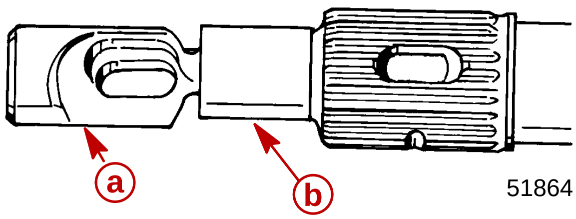
REASSEMBLY

1. Position shift shaft bushing on a press with threaded side down.
2. Apply Loctite 271 to outside diameter of oil seal.
3. Press oil seal into shift shaft bushing with lip of seal up.
4. Wipe any excess Loctite from oil seal and bushing.
5. Place rubber washer against oil seal.
6. Install O-ring over threads and up against shoulder of bushing.
7. Lubricate O-ring and oil seal with Quicksilver 2-4-C w/Teflon Marine Lubricant.

Propeller Shaft

REASSEMBLY/INSTALLATION

1. Insert clutch actuator rod assembly into end of propeller shaft. Align cross pin slot in actuator rod with cross pin slot in propeller shaft.
2. On PRODUCTION MODEL GEAR CASES, position sliding clutch onto propeller shaft with GROOVED RINGS (ON SLIDING CLUTCH) TOWARD PROPELLER END OF PROPELLER SHAFT. Cross pin hole and detent holes (in sliding clutch) must line up with cross pin slot and detent notches on propeller shaft.



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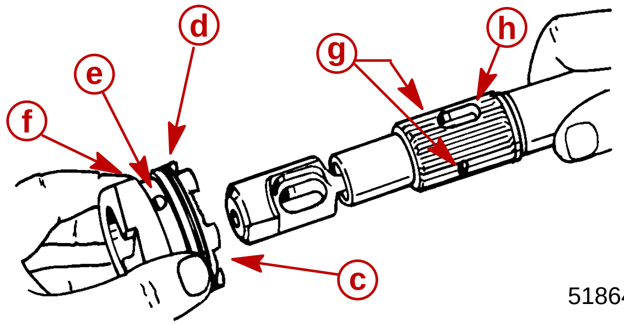

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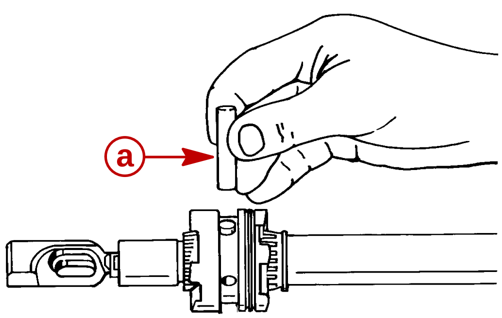
a - Cam Follower
b - Propeller Shaft
c - Sliding Clutch
d - Grooved Rings
e - Cross Pin Hole
f - Detent Hole (Behind Finger and Thumb)
g - Detent Notch (One on Each Side)
h - Cross Pin Slot

3. Insert cross pin thru sliding clutch, propeller shaft and actuator rod, forcing cross pin tool out.
4. Apply a small amount of 2-4-C w/Teflon Marine Lubricant on detent pin. Position a detent pin in detent pin hole of sliding clutch with rounded end of pin toward propeller shaft.



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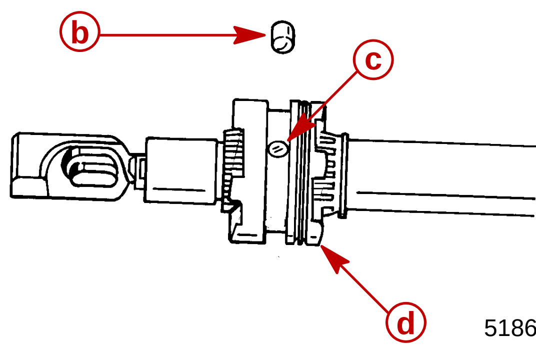

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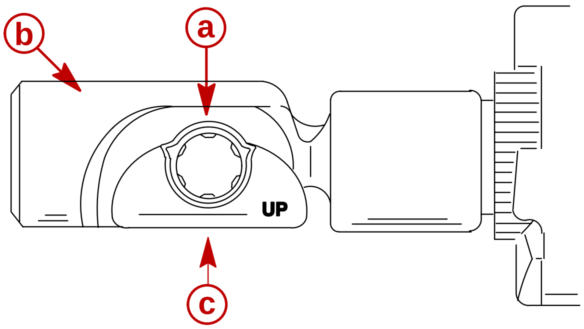
a - Cross Pin
b - Detent Pin
c - Cross Pin
d - Sliding Clutch

5. Install cross pin retaining spring onto sliding clutch as follows:

IMPORTANT: DO NOT over-stretch retaining spring when installing onto sliding clutch.

6. Spirally wrap spring into groove on sliding clutch.
7. Place gear housing in a soft jaw vise with the driveshaft in a vertical position.
8. Coat cam pocket of cam follower with 2-4-C w/Teflon Marine Lubricant.
9. Place shift cam into cam pocket of cam follower with numbered side of cam facing up.
10. With shift cam positioned as shown, insert propeller shaft thru forward gear until shaft bottoms out.



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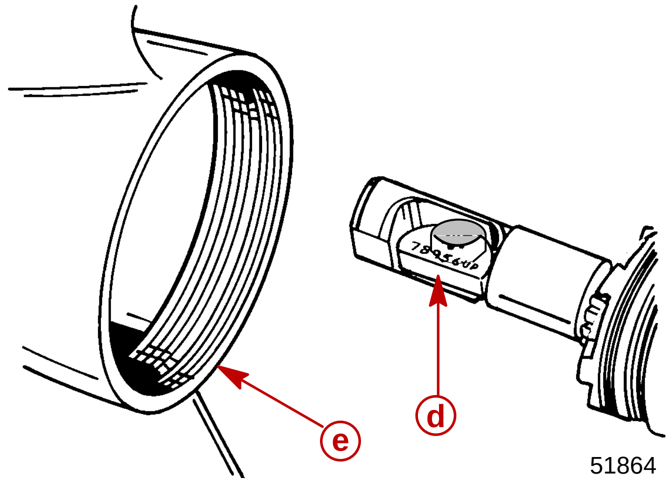


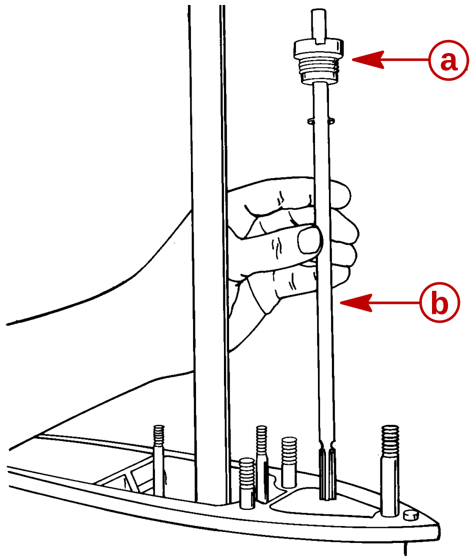
51864

a - Cam Pocket
b - Cam Follower
c - Shift Cam
d - Shift Cam (Position as Shown)
e - Gear Housing

CAUTION

Until bearing carrier is installed into gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

11. Insert shift shaft down shift shaft hole (of gear housing) and thru shift cam and cam follower. (It may be necessary to rotate shift shaft back-and-forth slightly for it to enter shift cam.)
12. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to threads of shift shaft bushing. (Thread bushing into position, but do not tighten down at this time)



51867

a - Shift Shaft Bushing
b - Shift Shaft

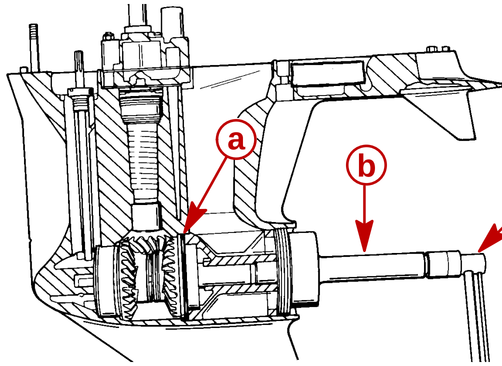
13. Lubricate O-ring on bearing carrier with Quicksilver 2-4-C w/Teflon Marine Lubricant.
14. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to outside diameter of bearing carrier (where carrier contacts gear housing).

NOTE: *When performing Step 15, rotate driveshaft clockwise (viewed from top) to mesh pinion gear with reverse gear.*

15. Position bearing carrier over propeller shaft and slide it into gear housing. (Be sure to align bearing carrier keyway with gear housing keyway.)
16. Push bearing carrier in as far as possible by hand, then install bearing carrier key.
17. Place tab washer against bearing carrier.
18. Apply Quicksilver 2-4-C w/Teflon Marine Lubricant to threads of cover nut and install cover nut in gear housing (verify that the word “OFF” and arrow are visible).

NOTE: *Before torquing bearing carrier cover nut, gear case should either be mounted in a stand specifically designed for holding gear cases or bolted to a driveshaft housing to avoid possible damage to the gear case.*

19. Start cover nut a few turns by hand, then using Cover Nut Tool (91-61069) and torque wrench, torque cover nut to 210 lb. ft. (285 Nm).



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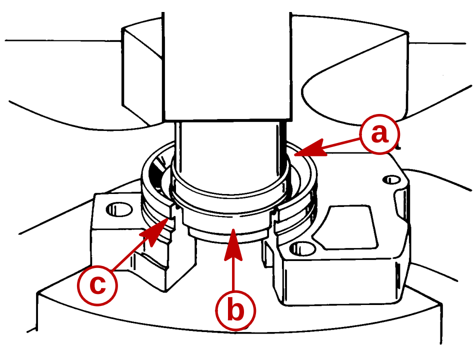
a - O-ring
b - Cover Nut Tool
c - Torque Wrench

20. Bend one lock tab of tab washer into cover nut (only one will align).
21. Bend remaining tabs of tab washer toward front of gear housing.
22. Use Shift Shaft Bushing Tool (91-31107) and torque shift shaft bushing to 30 lb. ft. (41 Nm).

Water Pump

REASSEMBLY/INSTALLATION

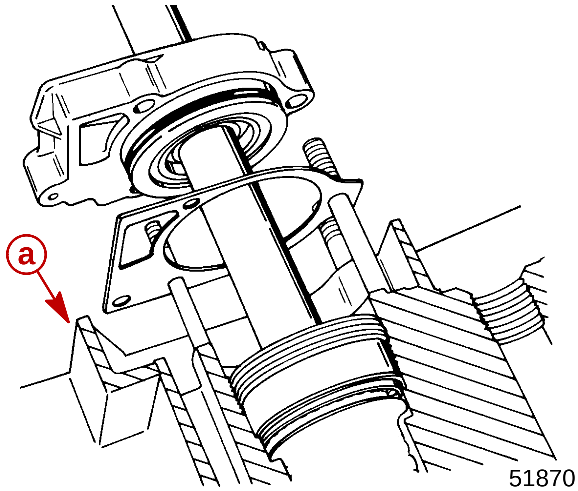
1. Install oil seals into water pump base, as follows:
   a. Place water pump base on a press.
   b. Just before installing each seal apply Loctite 271 on outside diameter of oil seal.
   c. With a suitable mandrel, press the smaller diameter oil seal into pump base with lip of oil seal toward impeller side of base.
   d. With a suitable mandrel, press the larger diameter oil seal into pump base with lip of oil seal toward gear housing side of base.
   e. Wipe any excess Loctite from oil seals and water pump base.
2. Install O-ring into O-ring groove of water pump base. Lubricate O-ring and oil seals with 2-4-C w/Teflon Marine Lubricant (92-90018A12).

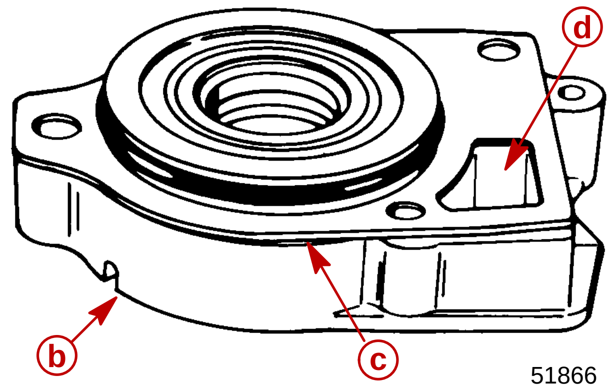


51869

a - Mandrel
b - Oil Seal (Smaller OD)
c - O-ring Groove

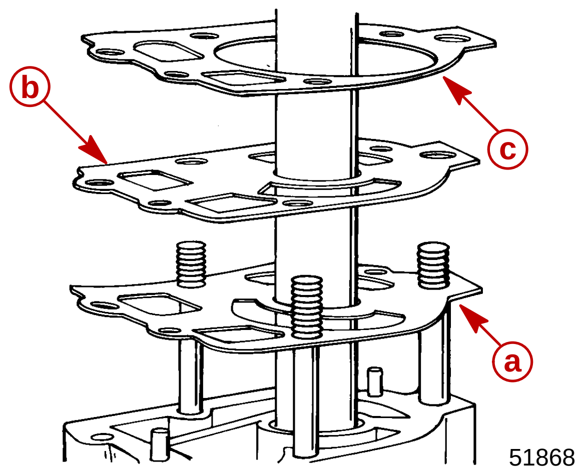
3. Install divider block if removed. Use RTV Sealer to seal seams between divider block and gear housing.
4. Install a new water pump base gasket and install water pump base.





a - Divider Block
b - Water Pump Base
c - Gasket
d - Hole (MUST be positioned as shown)

5. Install the following in order: Pump base to face plate gasket, face plate gasket and face plate to pump cover gasket. Gaskets and face plate are indexed by dowel pin location and must be installed correctly.



a - Gasket (Water Pump Base to Face Plate)
b - Face Plate
c - Gasket (Face Plate to Water Pump Cover)

6. Place impeller drive key on flat of driveshaft. Hold key on driveshaft with a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant.

IMPORTANT: When completing gear housing repair, that requires removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to reuse the impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur. Original rotation is clockwise.

⚠ CAUTION
A visual inspection of impeller drive key MUST BE made to determine that drive key is on flat of driveshaft after impeller is installed. If key has moved off flat of driveshaft, repeat Steps 6 and 7.

7. Slide impeller down driveshaft to impeller drive key. Align drive key with keyway in the center hub of impeller, and slide impeller over drive key.
8. If removed, install new water pump insert into pump cover as follows:
   a. Apply Perfect Seal to water pump insert area of pump cover.
   b. Install water pump insert into pump cover. Verify that tab on insert enters recess in pump cover.
   c. Wipe any excess Perfect Seal from insert and cover.

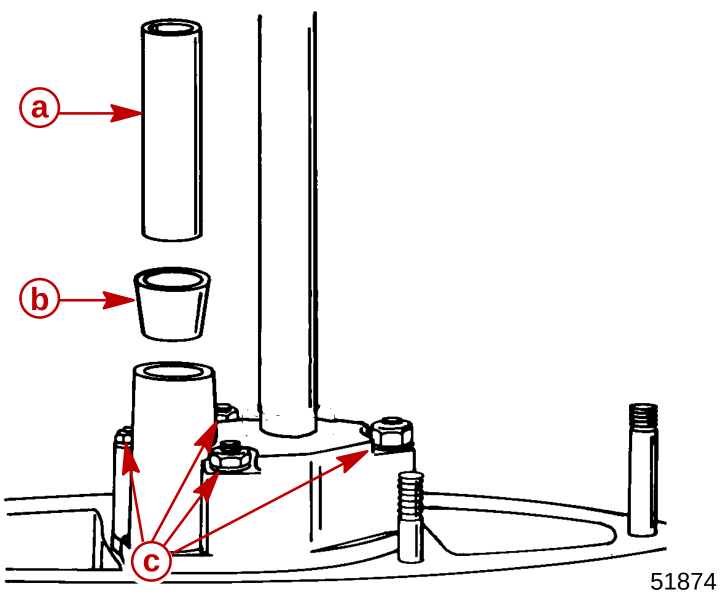
NOTE: *If 2 holes were drilled in top of water pump cover to aid in removal of insert, fill holes with RTV Sealer or equivalent. Allow to cure, 24 hours prior to operating engine.*

9. Install water tube seal into pump cover, being sure that plastic side of seal goes into cover first.
10. Reinstall water tube guide into water pump cover.
11. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant inside of water pump insert.
12. Position assembled water pump cover over driveshaft and lower over water pump studs. Rotate driveshaft in a clockwise direction (viewed from top), while pushing down on pump cover to ease impeller entry into cover.
13. Install water pump cover retainer washers, nuts and bolt.

CAUTION

DO NOT over-torque nuts and bolt, as this could cause cover to crack during operation.

14. Torque water pump nuts to 50 lb. in. (5.5 Nm), and water pump bolt to 35 lb. in. (4 Nm).
15. Install centrifugal slinger over driveshaft and down against pump cover.



a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolts and Washers

Gear Lubricant Filling Instructions

1. Remove any gasket material from “Fill” and “Vent” screws and gear housing.
2. Install new gaskets on Fill and Vent screws.

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

3. Slowly fill housing thru Fill hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of “Vent” hole and no air bubbles are visible.
4. Install Vent screw into Vent hole.

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

5. Remove grease tube (or hose) from Fill hole and quickly install Fill screw into Fill hole.

Installing Gear Housing to Driveshaft Housing

WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing onto driveshaft housing.

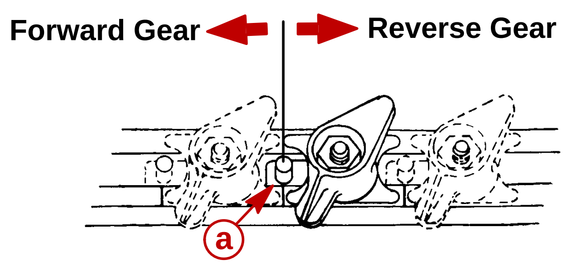
1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto driveshaft splines.

CAUTION

DO NOT allow lubricant on top of driveshaft. Excess lubricant, that is trapped in clearance space, will not allow driveshaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of driveshaft) will load the driveshaft/crankshaft and damage either or both the powerhead and gear housing. Top of driveshaft is to be wiped free of lubricant.

3. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Apply a thin bead of G.E. Silicone Sealer (92-91600-1) against the top of divider block.
5. Insert trim tab bolt into hole in rear of gear housing to driveshaft housing machined surface.
6. Shift gear housing into forward gear and place guide block anchor pin into forward gear position.

Right Hand Rotation Outboard



a - Guide Block Anchor Pin

7. Position gear housing so that the driveshaft is protruding into driveshaft housing.

NOTE: *If, while performing Step 8, the driveshaft splines will not align with crankshaft splines, place a propeller onto propeller shaft and turn it counterclockwise as the gear housing is being pushed toward driveshaft housing.*

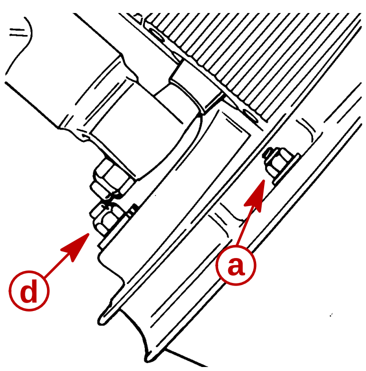
8. Move gear housing up toward driveshaft housing while aligning shift shaft splines and water tube with water tube guide (in water pump cover).
9. Place flat washers onto studs (located on either side of driveshaft housing). Start a nut (a) on these studs and tighten finger-tight.
10. Start bolt (b) 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 (a) which were started in Step 9. Torque to listing in **“Torque Specifications,”** preceding.
13. After 2 nuts (located on either side of driveshaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position while turning prop shaft. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

14. Install washers and nuts (c) onto studs (located on bottom center of anti-cavitation plate). Torque to listing in **“Torque Specifications,”** preceding.



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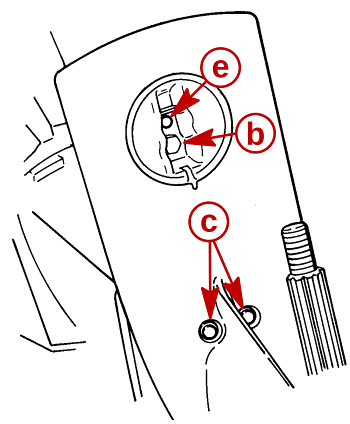

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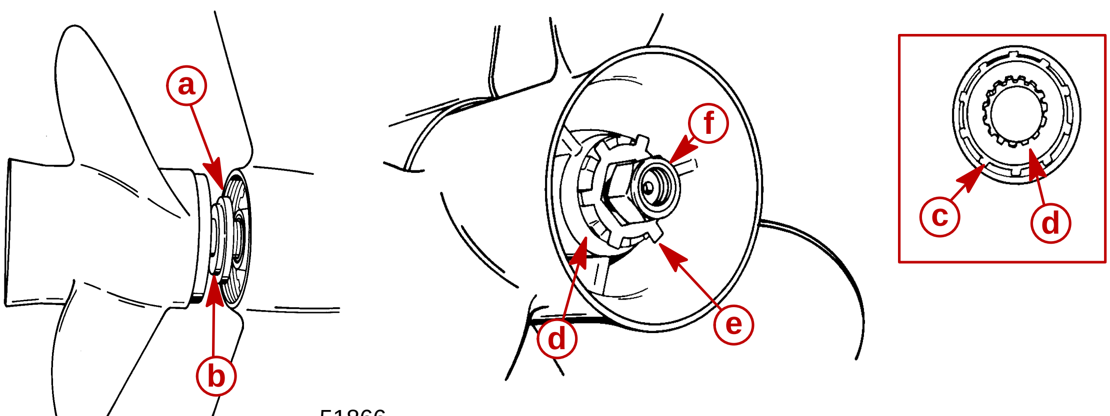
15. Install special flat washer and nut (d) on stud at leading edge of driveshaft housing. Torque to listing in **“Torque Specifications,”** preceding.
16. Torque bolt (started in Step 10) to listing in **“Torque Specifications,”** preceding.
17. Install trim tab, adjust to position in which it had previously been installed, and tighten bolt (e) securely.
18. Install plastic cap into trim tab bolt opening at rear edge of driveshaft housing.

Propeller Installation

⚠ WARNING

When installing or removing propeller, because of the engine’s ease in starting, be sure that the remote control is in neutral position and that the key switch is “OFF.” Place a block of wood between the anti-cavitation plate and propeller to prevent accidental starting and to protect hands from propeller blades while removing or installing nut.

1. To aid in future removal of the propeller, liberally coat the propeller shaft splines with one of the following Quicksilver products:
   -- Anti-Corrosion Grease (92-78376A6)
   -- Special Lubricant 101 (92-13872A1)
   -- 2-4-C Marine Lubricant (92-90018A12)
   -- Perfect Seal (92-34227--1)
2. Place forward thrust hub over propeller shaft with shoulder side toward propeller.
3. Place propeller on propeller shaft and slide it up against thrust hub.
4. Place continuity washer (if equipped) onto shoulder of rear thrust hub.
5. Place rear thrust hub, tab washer and propeller nut on propeller shaft.
6. Thread propeller nut onto propeller shaft until nut is recessed into tab washer.
7. After propeller nut is recessed into tab washer, tighten nut securely [minimum of 55 lb. ft. (74.5 Nm) torque].
8. Bend 3 of the tabs of tab washer down in grooves of rear thrust hub to secure propeller nut. (If tab washer tabs do not align with slots, continue to tighten propeller nut to obtain alignment. DO NOT loosen nut to align tabs.)



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

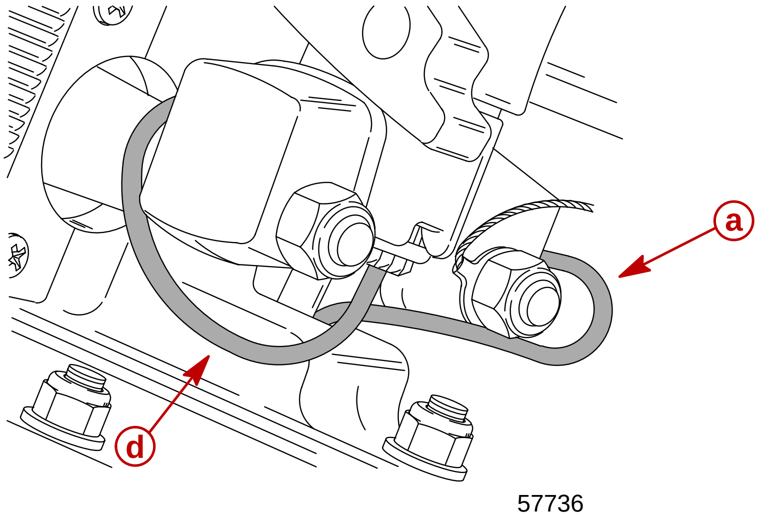
⚠ CAUTION

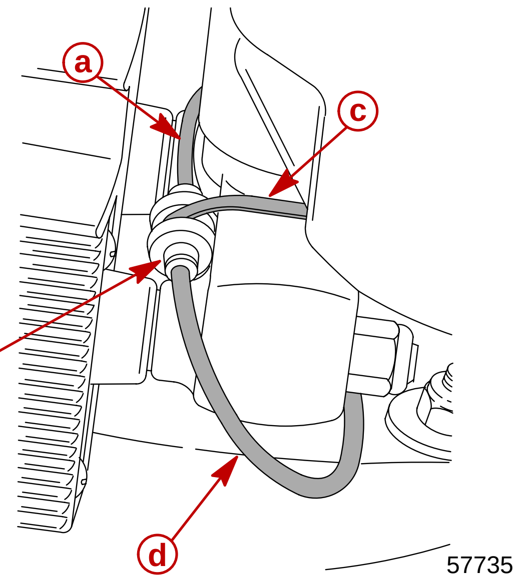
DO NOT misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; however, propeller should not move forward-and-aft on propeller shaft.

9. After first use, retighten propeller nut and again secure with tab washer (Steps 7 and 8, preceding). Propeller should be checked periodically for tightness, particularly if a stainless steel propeller is used.

Speedometer Tube Installation

1. Route speedometer tube from gearcase around lower yoke and push into junction. Junction should be secured to yoke with sta-strap.
2. Route speedometer tube from swivel tube around lower yoke and push into junction. After insertion of speedometer tubes into junction, pull on each tube to verify that they are locked into junction. If tube pulls out, reinsert into junction.





a - Speedometer Tube from Gearcase
b - Junction
c - Sta-strap
d - Speedometer Tube from Swivel Tube

LOWER UNIT

Section 6B – Left Hand Non-Ratcheting

Table of Contents

6
B

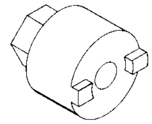
Gear Housing Specifications (Counter Rotation)

Ratio	Pinion Depth	Forward Gear Backlash	Reverse Gear Backlash
1.87:1	0.025 in. (0.635 mm) With Tool 91-12349A2 using Disc #2 and Flat #7	0.018 in. to 0.027 in. (0.460 mm to 0.686 mm) Pointer on line mark #1	0.030 in. to 0.050 in. (0.762 mm to 1.27 mm)
2.0:1	0.025 in. (0.635 mm)With Tool 91-12349A2 using Disc #2 and Flat #7	0.015 in. to 0.022 in. (0.38 mm to 0.56 mm) Pointer on line mark #2	0.030 in. to 0.050 in. (0.762 mm to 1.27 mm)
Gearcase Lubricant Capacity			
All Ratios	22.5 fl. oz. (665.4 ml)		

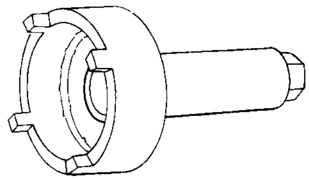
Gear Ratio	Teeth on Pinion Gear	Teeth on Forward and Reverse Gear
1.87:1	15	28
2.00:1	12	24

Special Tools

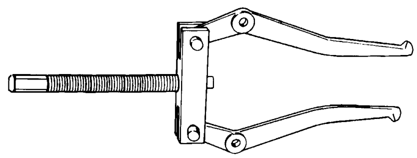
1. Shift Shaft Bushing Tool 91-31107T



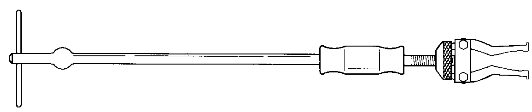
2. Gear Housing Cover Nut Tool 91-61069



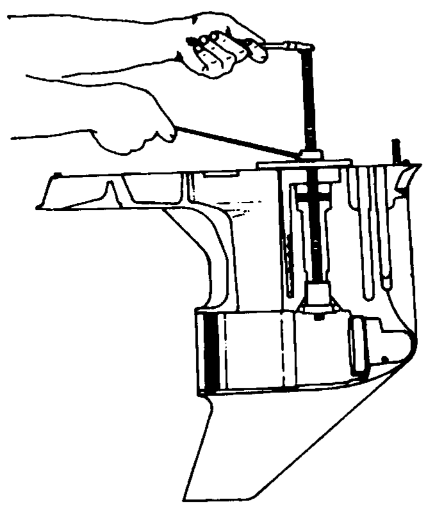
3. Bearing Carrier Removal Tool 91-46086A1 and Puller Bolt 91-85716



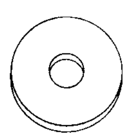
4. Slide Hammer Puller 91-34569A1



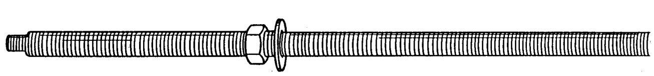
5. Bearing Removal and Installation Kit 91-31229A5. This kit contains the following tools: Pilot 91-36571; Puller Rod 91-31229; Nut 11-24156; Puller Plate 91-29310; Mandrel 91-38628; and Driver Rod 91-37323.



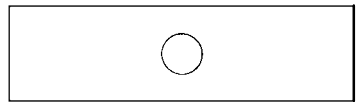
6. Pilot 91-36571



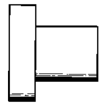
7. Puller Rod 91-31229 and Nut 91-24156



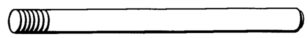
8. Puller Plate 91-29310



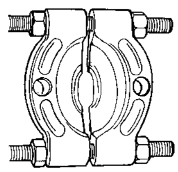
9. Mandrel 91-38628



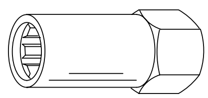
10. Driver Rod 91-37323



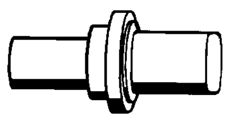
11. Universal Puller Plate 91-37241



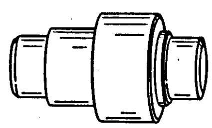
12. Driveshaft Holding Tool 91-34377A1 or91-90094



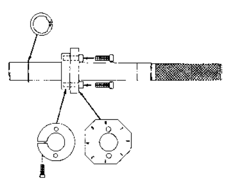
13. Oil Seal Driver 91-31108

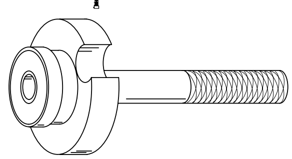


14. Forward Gear Bearing Tool 91-86943

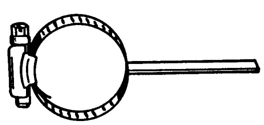


15. Pinion Locating Gear Tool 91-12349A2 or 91-74776

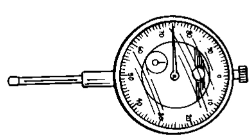




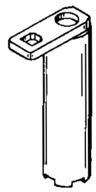
16. Backlash Indicator Rod 91-78473



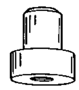
17. Dial Indicator 91-58222A1



18. Bearing Retainer Tool 91-43506

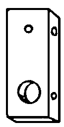


19. Mandrel 91-92788

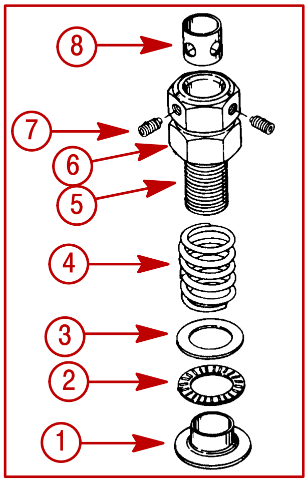


20. Mandrel 91-15755

21. Dial Indicator Holder 91-89897

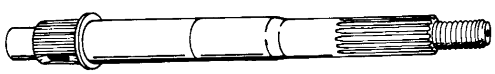


22. Bearing Preload Tool 91-14311A1



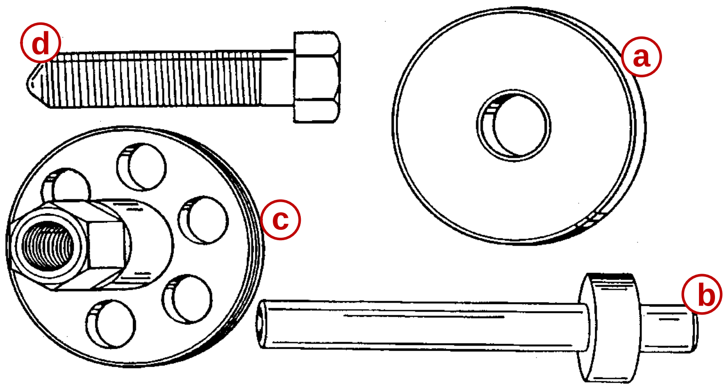
1 - Adaptor (N.S.S.)
2 - Bearing (N.S.S.)
3 - Washer (N.S.S.)
4 - Spring (24-14111)
5 - Bolt (10-12580)
6 - Nut (11-13953)
7 - Set Screw (10-12575)
8 - Sleeve (23-13946)

23. Propeller Shaft 44-93003 and Load Washer (i) 12-37429



24. Forward Gear Installation Tool 91-815850

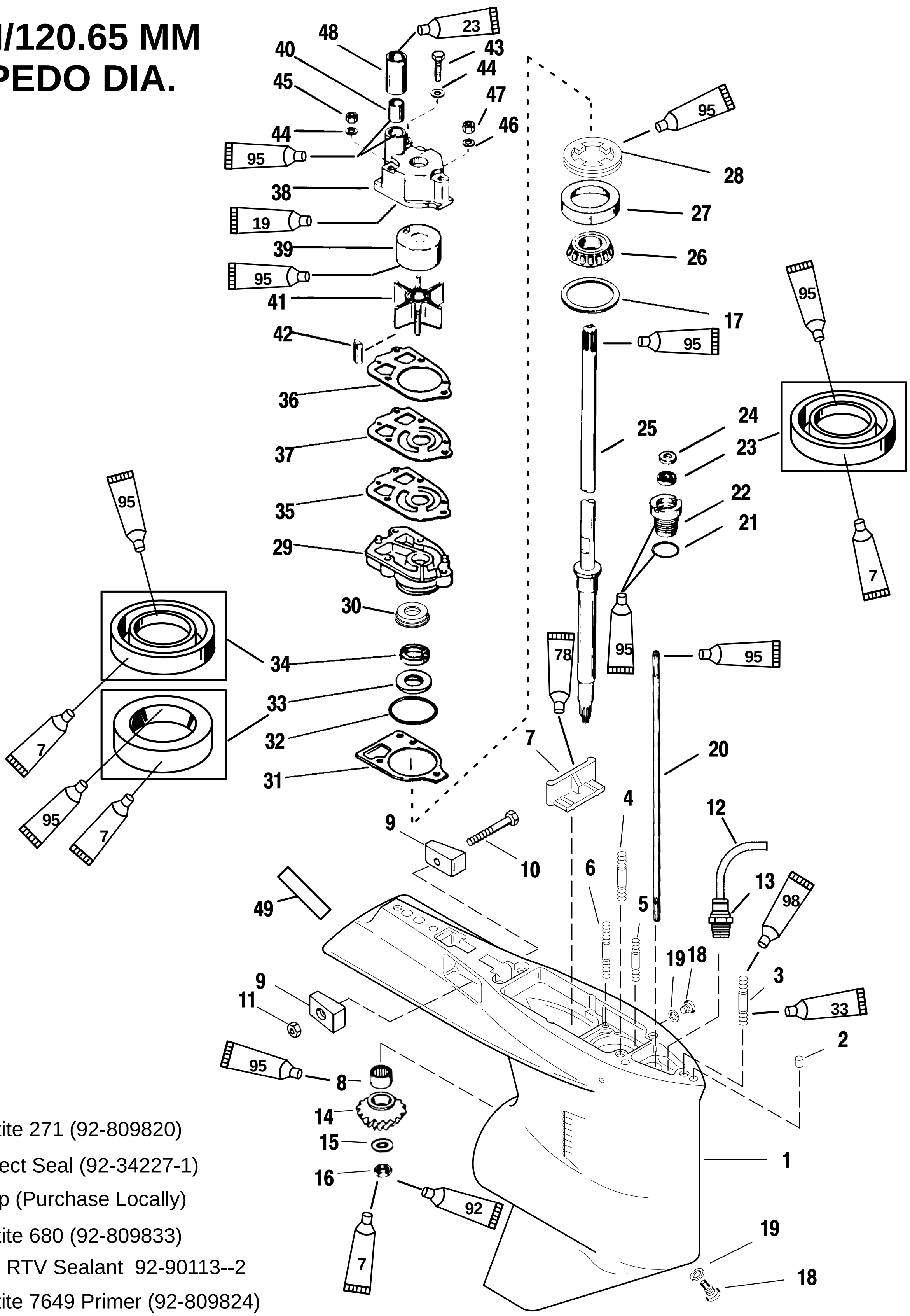
25. Reverse Gear Installation Kit 91-18605A1 includes Pilot 91-18603; Retainer 91-18604; Shaft 91-18605 and Screw 10-18602



a - Pilot 91-18603
b - Shaft 91-18605
c - Retainer 91-18604
d - Screw 10-18602

Gear Housing (Drive Shaft)(Counter Rotation)

4.75 IN/120.65 MM TORPEDO DIA.

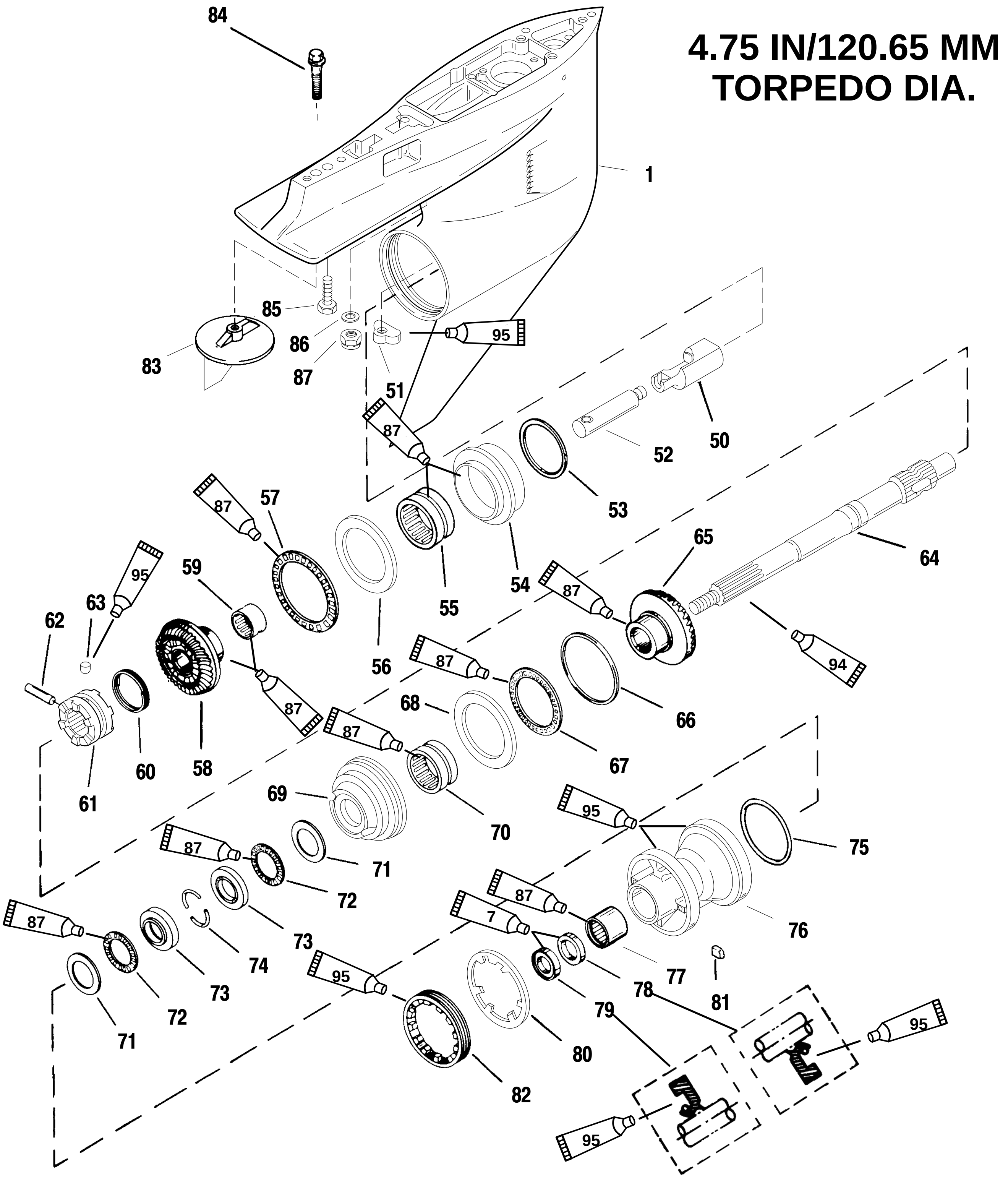


- 7 Loctite 271 (92-809820)
- 19 Perfect Seal (92-34227-1)
- 23 Soap (Purchase Locally)
- 33 Loctite 680 (92-809833)
- 78 G. E. RTV Sealant 92-90113--2
- 92 Loctite 7649 Primer (92-809824)
- 95 2-4-C With Teflon (92-825407A12)

Gear Housing (Drive Shaft)(Counter Rotation)

REF. NO.	QTY.	DESCRIPTION	TORQUE		
1	1	GEAR HOUSING **(BASIC)**			
2	2	DOWEL PIN			
3	1	STUD (3-11/16 IN.)			
4	2	STUD (2-1/16 IN.)			
5	1	STUD (3-3/8 IN.)			
6	2	STUD (3-1/8 IN.)			
7	1	FILLER BLOCK			
8	1	ROLLER BEARING			
9	2	ANODE			
10	1	SCREW			
11	1	NUT	60		7
12	1	HOSE (12 IN.)			
13	1	FITTING	50		5.5
14	1	PINION GEAR **(1.87:1 - 15 TEETH- 150)**			
	1	PINION GEAR **(2:1 - 14 TEETH - 135)**			
15	1	WASHER			
16	1	NUT		75	101
17	AR	SHIM (006 thru 048)			
18	2	SCREW–drain	60		7
19	2	WASHER			
20	1	SHIFT SHAFT			
21	1	O-RING			
22	1	BUSHING ASSEMBLY		50	68
23	1	OIL SEAL			
24	1	WASHER–rubber			
25	1	DRIVE SHAFT			
26	1	ROLLER BEARING			
27	1	CUP			
28	1	RETAINER		100	135
29	1	WATER PUMP BASE			
30	1	RETAINER			
31	1	GASKET			
32	1	O-RING			
33	1	OIL SEAL			
34	1	OIL SEAL			
35	1	GASKET–lower			
36	1	GASKET–upper			
37	1	FACE PLATE			
38	1	WATER PUMP BODY ASSEMBLY			
39	1	INSERT			
40	1	SEAL–rubber			
41	1	IMPELLER			
42	1	KEY			
43	1	SCREW (#14-8 x 2-1/4 IN.)	35		4
44	2	WASHER			
45	2	NUT	50		5.5
46	1	WASHER			
47	1	NUT	50		5.5
48	1	SLEEVE			
49	1	DECAL-Counter Rotation			

Gear Housing (Prop Shaft)(Counter Rotation)

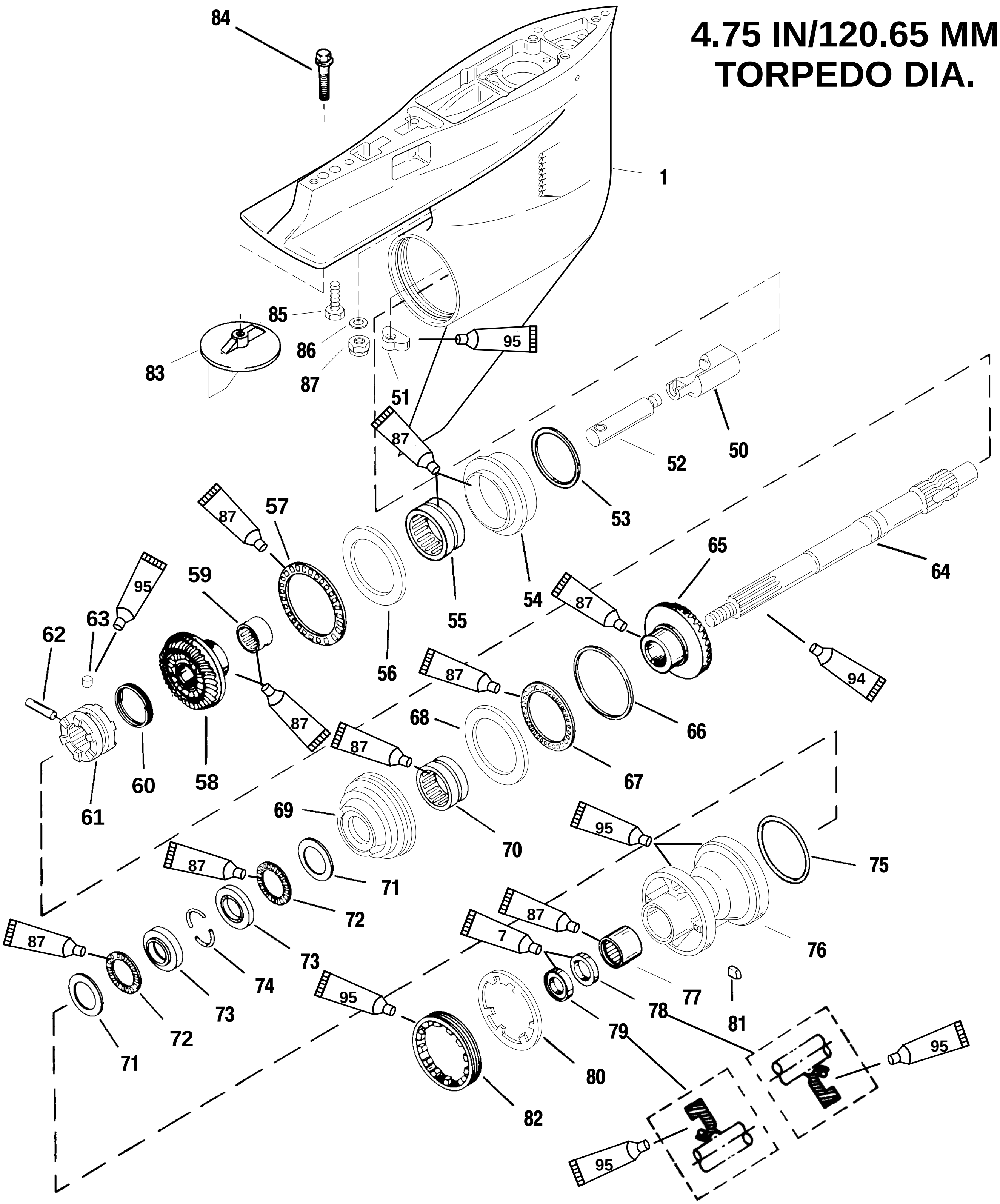


7 Loctite 271 (92-809820)	94 Anti-Corrosion Grease (92-78376A6)
87 Quicksilver Gear Lubricant (92-802844A1)	95 2-4-C With Teflon (92-825407A12)

Gear Housing (Prop Shaft)(Counter Rotation)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	GEAR HOUSING **(BLACK)(BASIC)**			
50	1	CAM FOLLOWER			
51	1	SHIFT CAM			
52	1	ROD			
53	AR	SHIM SET			
54	1	BEARING ADAPTOR ASSEMBLY			
55	1	ROLLER BEARING			
56	1	THRUST WASHER			
57	1	THRUST BEARING			
58	1	REVERSE GEAR **(1.87:1 – 15/28)(150)**			
	1	REVERSE GEAR **(2:1 – 14/28)-(135)**			
59	1	ROLLER BEARING			
60	1	SPRING			
61	1	SLIDING CLUTCH			
62	1	CROSS PIN			
63	1	DETENT PIN			
64	1	PROPELLER SHAFT			
65	1	FORWARD GEAR **(1.87:1 – 15/28)(150)**			
	1	FORWARD GEAR **(2:1 – 14/28)-(135)**			
66	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)



7 Loctite 271 (92-809820)

87 Quicksilver Gear Lubricant (92-802844A1)

94 Anti-Corrosion Grease (92-78376A6)

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

Gear Housing (Prop Shaft)(Counter Rotation)

REF. NO.	QTY.	DESCRIPTION	TORQUE lb-in	TORQUE lb-ft	TORQUE Nm.
1	1	GEAR HOUSING **(BLACK)(BASIC)**			
67	1	ROLLER BEARING			
68	1	THRUST WASHER			
69	1	BEARING ADAPTOR ASSEMBLY			
70	1	ROLLER BEARING			
71	2	THRUST WASHER			
72	2	THRUST BEARING			
73	2	THRUST RACE			
74	2	KEEPER			
75	1	O RING			
76	1	BEARING CARRIER ASSEMBLY			
77	1	ROLLER BEARING			
78	1	OIL SEAL (INSIDE)			
79	1	OIL SEAL (OUTSIDE)			
80	1	TAB WASHER			
81	1	KEY			
82	1	COVER		210	285
83	1	TRIM TAB			
84	1	SCREW (1-3/4 IN.)		25	34
85	1	SCREW (3/8-16 x 1)		30	41
86	2	WASHER			
87	2	NUT		50	68

General Service Recommendations

There may be more than one way to “disassemble” or “reassemble” a particular part(s), therefore, it is recommended that the entire procedure be read prior to repair.

IMPORTANT: Read the following before attempting any repairs.

In many cases, disassembly of a sub-assembly may not be necessary until cleaning and inspection reveals that disassembly is required for replacement of one or more components.

Service procedure order in this section is a normal disassembly-reassembly sequence. It is suggested that the sequence be followed without deviation to assure proper repairs. When performing partial repairs, follow the instructions to the point where the desired component can be replaced, then proceed to “reassembly and installation” of that component in the reassembly part of this section. Use the “Index” (on back of section divider) to find correct page number.

Threaded parts are right hand (RH), unless otherwise indicated.

When holding, pressing or driving is required, use soft metal vise jaw protectors or wood for protection of parts. Use a suitable mandrel (one that will contact only the bearing race) when pressing or driving bearings.

Whenever compressed air is used to dry a part, verify that no water is present in air line.

BEARINGS

Upon disassembly of gear housing, all bearings must be cleaned and inspected. Clean bearings with solvent and dry with compressed air. Air should be directed at the bearing so that it passes thru the bearing. DO NOT spin bearing with compressed air, as this may cause bearing to score from lack of lubrication. After cleaning, lubricate bearings with Quicksilver Gear Lubricant. DO NOT lubricate tapered bearing cups until after inspection.

Inspect all bearings for roughness, catches and bearing race side wear. Work inner bearing race in-and-out, while holding outer race, to check for side wear. When inspecting tapered bearings, determine condition of rollers and inner bearing race by inspecting bearing cup for pitting, scoring, grooves, uneven wear, imbedded particles and/or discoloration from over-heating. Always replace tapered bearing and race as a set.

Roller bearing condition is determined by inspecting the bearing surface of the shaft that the roller bearing supports. Check shaft surface for pitting, scoring, grooving, imbedded particles, uneven wear and/or discoloration from overheating. The shaft and bearing must be replaced, if the conditions described are found.

SHIMS

Keep a record of all shim amounts and location during disassembly to aid in reassembly. Be sure to follow shimming instructions during reassembly, as gears must be installed to correct depth and have the correct amount of backlash to avoid noisy operation and premature gear failure.

SEALS

As a normal procedure, all O-rings and oil seals SHOULD BE REPLACED without regard to appearance. To prevent leakage around oil seals, apply Loctite 271 to outer diameter of all metal case oil seals. When using Loctite on seals or threads, surfaces must be clean and dry. To ease installation, apply 2-4-C w/Teflon Marine Lubricant on all O-rings. To prevent wear, apply 2-4-C w/Teflon Marine Lubricant on I.D. of oil seals. To prevent corrosion damage after reassembly, apply Quicksilver 2-4-C w/Teflon to external surfaces of bearing carrier and cover nut threads prior to installation.

Removal, Disassembly, Cleaning and Inspection of Counter Rotation (Left Hand) Gear Housing

REMOVAL

⚠ WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before removing gear housing from driveshaft housing.

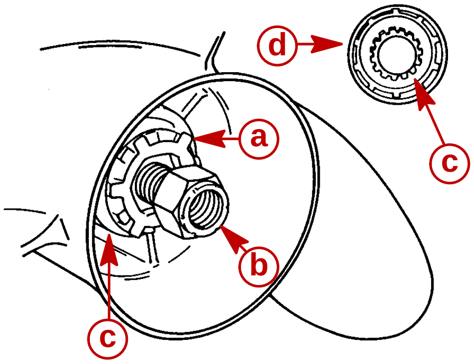
1. Disconnect high tension leads from spark plugs and remove spark plugs from engine.

⚠ CAUTION

Gear housing MUST BE in NEUTRAL position and shift shaft MUST BE removed from gear housing BEFORE propeller shaft can be removed from gear housing.

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

5. Mark gear housing and trim tab so that trim tab can be reinstalled in the same position. Remove plastic cap at rear edge of driveshaft housing. Remove bolt that secures trim tab and remove tab from gear housing.
6. Once trim tab is removed, remove bolt from inside of trim tab cavity.
7. Remove 2 locknuts from bottom middle of anti-cavitation plate.



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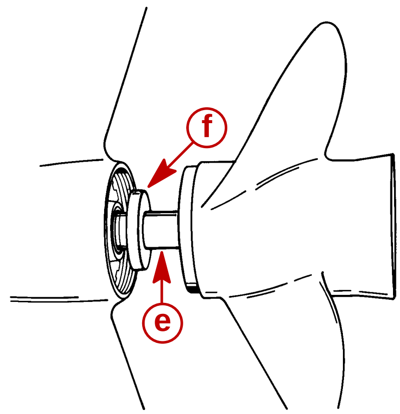

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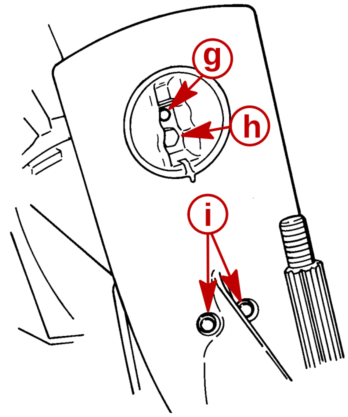
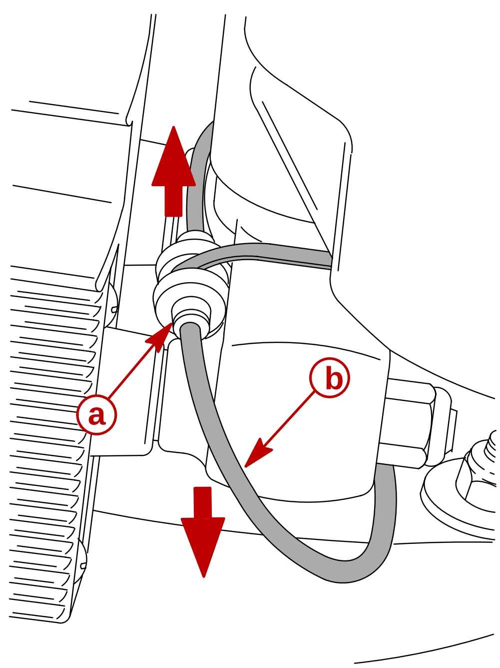


51866

a - Tab Washer
b - Propeller Nut
c - Rear Thrust Hub
d - Continuity Washer (if equipped)
e - Propeller Shaft
f - Thrust Hub (forward)
g - Bolt (secures trim tab)
h - Bolt (inside trim tab cavity)
i - Locknuts and Washers

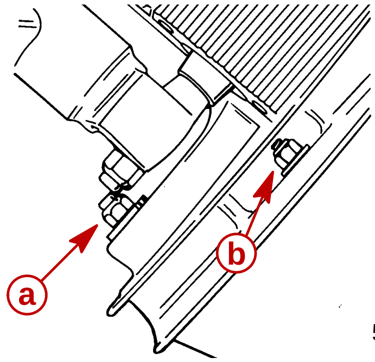
8. While pressing in on speedometer hose junction, pull out on hose to disconnect.



57735

a - Press in on Junction
b - Pull out on Hose

9. Remove locknut from the front gear housing mounting stud.
10. Loosen the side mounting locknuts. (DO NOT attempt to remove one nut before opposite side is loosened sufficiently, or driveshaft housing could be damaged.)



51873

a - Front Mounting Locknut
b - Side Mounting Locknut (One Each Side)

11. Pull gear housing away from driveshaft housing as far as the loosened nuts (in Step 9) will allow, then remove loosened nuts. (DO NOT allow gear housing to fall, as it now is free.)
12. Pull gear housing from driveshaft housing.

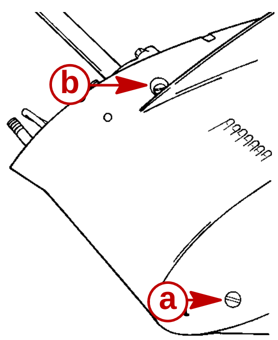
DRAINING AND INSPECTING GEAR HOUSING LUBRICANT

1. Place gear housing in a suitable holding fixture or vise with the driveshaft in a vertical position, as shown.

NOTE: *Drain and Fill screws may be located on the starboard side of gearcase on later models.*

2. Position a clean drain pan under gear housing and remove "Fill" and "Vent" screws from gear housing.
3. Inspect gear lubricant for metal particles. Presence of a small amount of fine metal particles (resembling powder) indicates normal wear. Presence of larger particles (or a large quantity of fine particles) indicates need for gear housing disassembly, and component inspection.
4. Note the color of gear lubricant. White or cream color indicates presence of water in lubricant. Check drain pan for water separation from lubricant. Presence of water in gear lubricant indicates the need for disassembly, and inspection of oil seals, seal surfaces, O-rings and gear housing components.

IMPORTANT: Gear lubricant drained from a recently run gear case will be a light chocolate brown in color due to agitation/aeration. Oil which is stabilized will be a clear yellow brown in color.



51871

a - Fill Screw
b - Vent Screw

Water Pump

CLEANING AND INSPECTION

1. Clean all water pump parts with solvent and dry with compressed air.
2. Inspect water pump cover and base for cracks and distortion (from overheating).
3. Inspect face plate and water pump insert for grooves and/or rough surfaces.

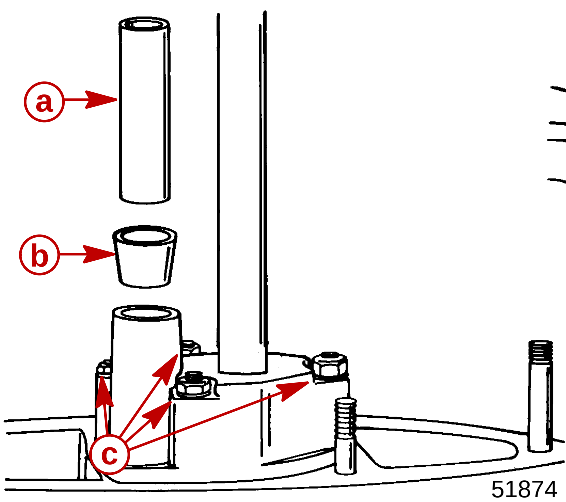
IMPORTANT: When completing gear housing repairs, that require removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary, however, to re-use impeller, DO NOT install in reverse to original rotation, or premature impeller failure will occur.

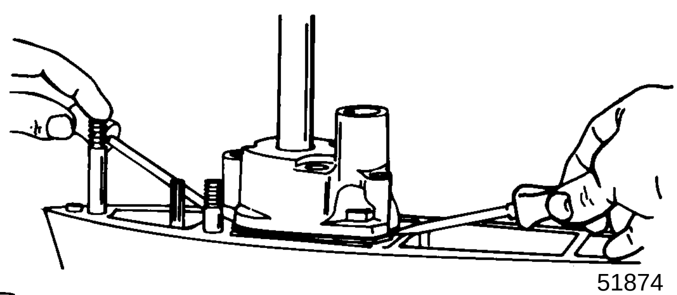
4. Inspect impeller side seal surfaces and ends of impeller blades for cracks, tears and wear. Replace impeller if any of these conditions are found.
5. Inspect impeller bonding to impeller hub.
6. Inspect impeller for glazed or melted appearance (caused by operation without sufficient water supply). Replace impeller if any of these conditions exist.

IMPORTANT: It is recommended that all seals and gaskets be replaced (as a normal repair procedure) to assure effective repair.

REMOVAL AND DISASSEMBLY

1. Slide rubber centrifugal slinger up and off driveshaft.
2. Remove water tube guide and seal from water pump cover. (Retain guide for reassembly and discard seal.)
3. Remove (and retain) 3 nuts, one bolt and all washers which secure water pump cover to gear housing.
4. Using 2 pry bars, lift water pump cover up and off driveshaft.





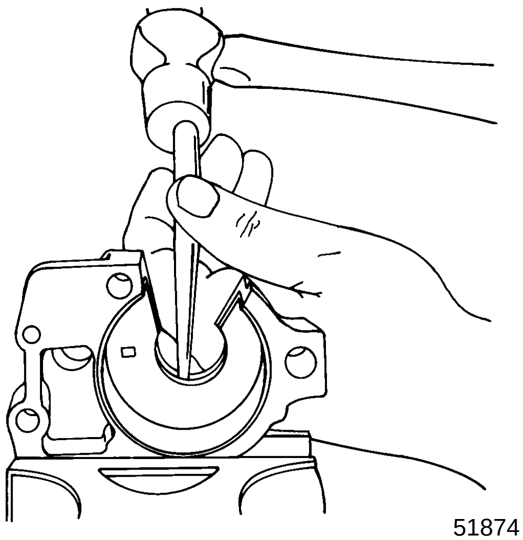
a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolt and Washers to be Removed

5. Inspect water pump cover and insert, as outlined in “Cleaning and Inspection,” previous.
6. If inspection of water pump insert determines that replacement is required, follow Step “a” or “b” (immediately following) to remove insert from water pump cover.

NOTE: *Try Step "a" first. If insert cannot be removed with Step "a," use Step "b."*

a. Drive water pump insert out of water pump cover with a punch and hammer.

b. Drill two 3/16 in. (4.8 mm) diameter holes thru the top of water pump cover (but not thru insert). Drive insert out of cover with a punch and hammer.



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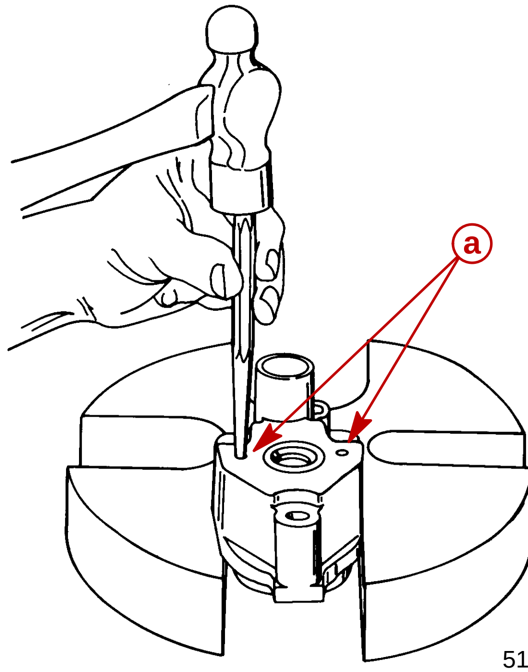

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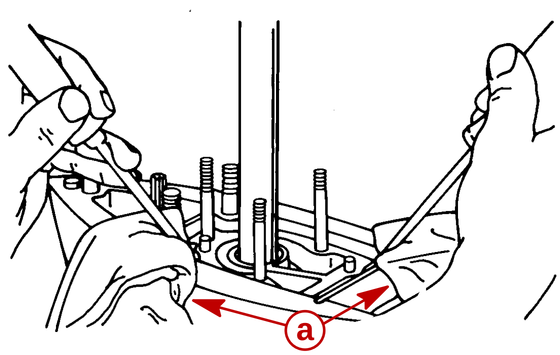
a - Drill Two Holes at These Locations

7. Remove impeller from driveshaft. (It may be necessary to use a punch and hammer to drive impeller upward on driveshaft. In extreme cases, it may be necessary to split hub of impeller with a hammer and chisel.)
8. Once impeller is removed, remove impeller drive key from driveshaft.
9. Remove water pump face plate and both gaskets (one above and below face plate) from water pump base.
10. Using 2 pry bars, positioned and padded as shown, lift water pump base up and off driveshaft.



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a - Pads

11. Remove (and discard) O-ring from O-ring groove on water pump base.
12. Using a screwdriver, pry oil seals out of water pump base from gear housing side of base.

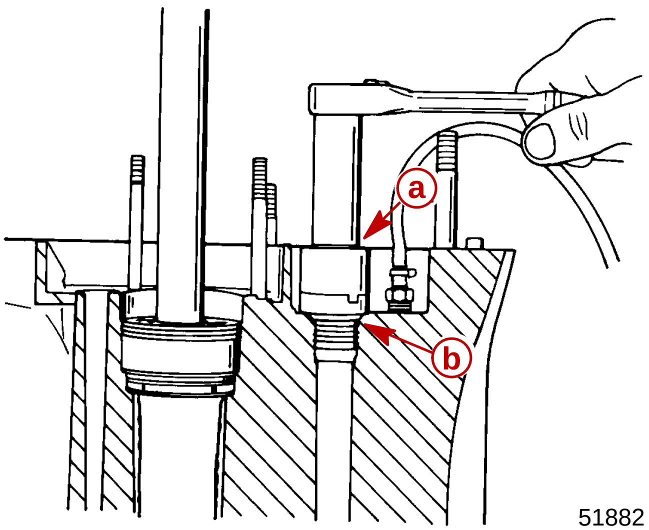
Bearing Carrier and Propeller Shaft

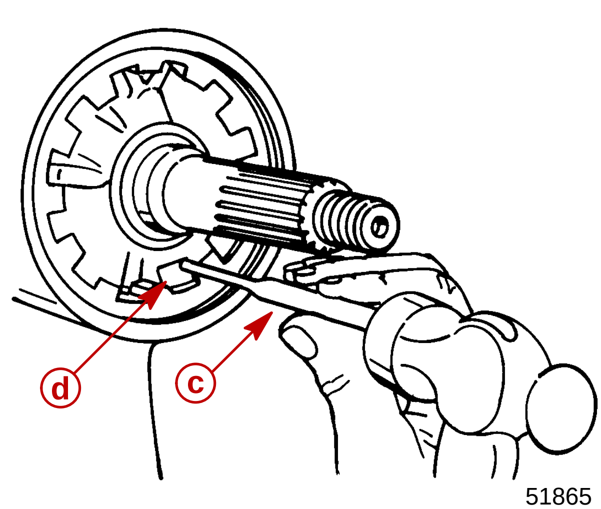
REMOVAL

CAUTION

Gear housing MUST BE in neutral position, and shift shaft MUST BE removed from gear housing before propeller shaft can be removed from gear housing.

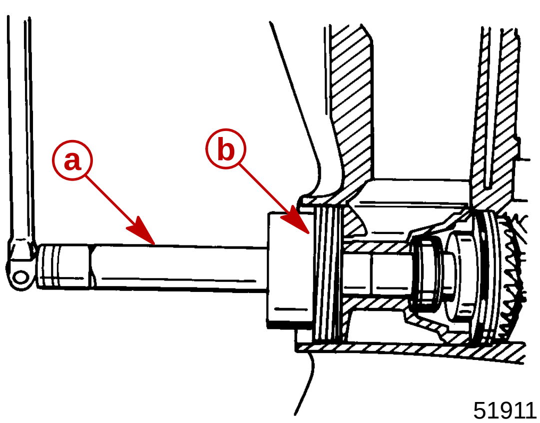
1. Place gear housing in a suitable holding fixture or vise with propeller shaft in a horizontal position.
2. Use Shift Shaft Bushing Tool (91-31107) to un-thread shift shaft bushing. (DO NOT remove bushing from shift shaft at this time.)
3. Bend retainer nut lock tab out of retainer nut recess.

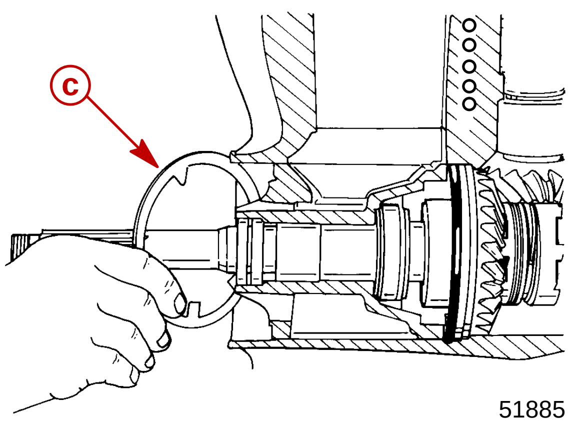




a - Shift Shaft Bushing Tool (91-31107)
b - Shift Shaft Bushing
c - Punch
d - Tab of Tab Washer

4. Remove gear housing retainer nut with Retainer Nut Tool (91-61069).
5. After retainer nut has been removed, remove lock tab washer from gear housing.





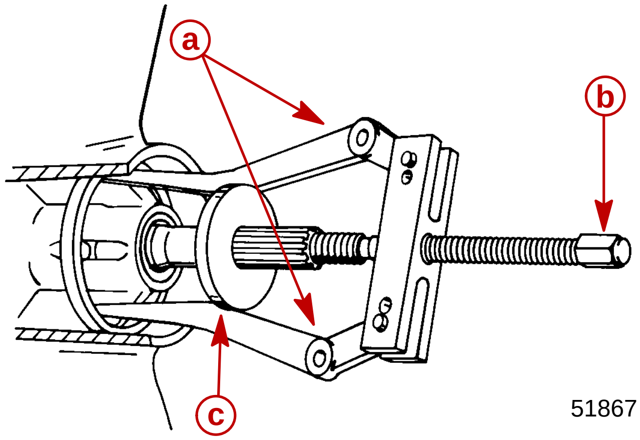
a - Retainer Nut Tool (91-61069)
b - Retainer Nut
c - Tab Washer

⚠ CAUTION

Once bearing carrier is removed from gear housing, extreme care MUST BE taken not to apply any side force on propeller shaft. Side force on propeller shaft may break the neck of the clutch actuator rod.

6. Use long Puller Jaws (91-46086A1) and Puller Bolt (91-85716) to remove bearing carrier. (Use propeller thrust hub to maintain outward pressure on puller jaws.)

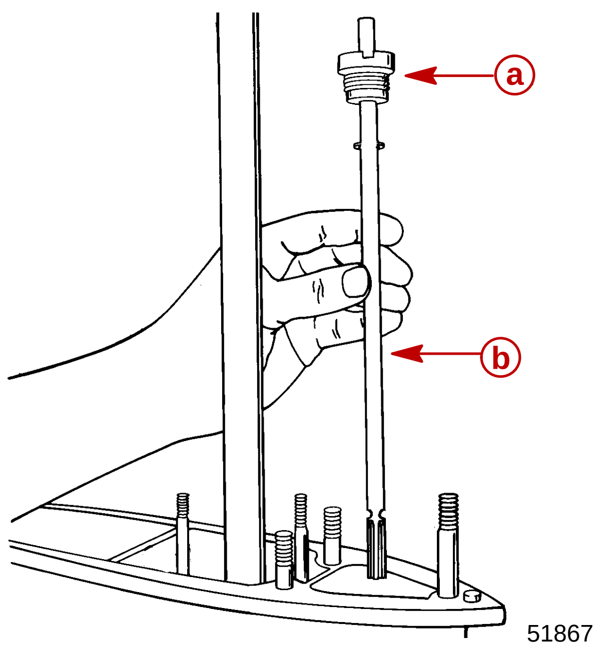
NOTE: *When bearing carrier is removed from gear housing, the bearing carrier alignment key will come out with it.*



a - Long Puller Jaws (91-46086A1)
b - Puller Bolt (91-85716)
c - Thrust Hub

IMPORTANT: Prior to removal of shift shaft from gear housing, recheck that gear housing is in neutral position.

7. With gear housing in neutral, pull shift shaft out of gear housing. If necessary, use a pliers to pull shift shaft out of gear housing. If pliers are used to pull shift shaft out, wrap a strip of soft metal (aluminum) around splines before clamping pliers. DO NOT turn shaft (clockwise OR counterclockwise) while pulling shaft out. (For further information on shift shaft, see “Shift Shaft Cleaning/Inspection and Disassembly.”)



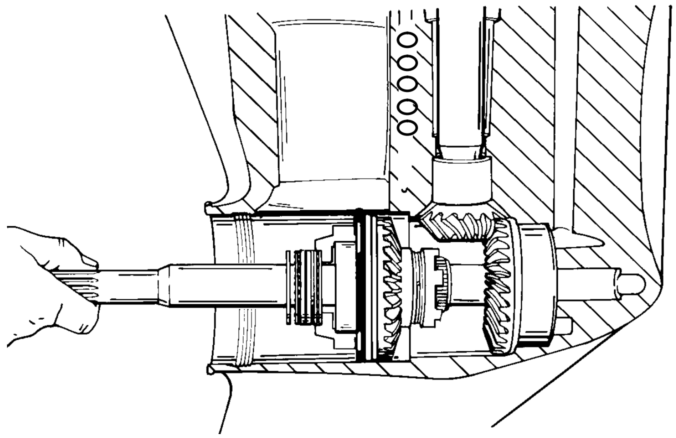
a - Shift Shaft Bushing
b - Shift Shaft

CAUTION

Propeller shaft, cam follower and shift cam, in most cases, will come out of gear housing by simply pulling outward on propeller shaft. DO NOT FORCE shaft sideways or ATTEMPT TO PULL with a slide hammer or any mechanical puller.

8. Remove propeller shaft, cam follower and shift cam by pulling shaft straight out of gear housing. (DO NOT JERK propeller shaft.)

NOTE: *Sliding clutch, forward gear assembly, bearing adaptor, thrust washer and thrust bearings will be removed from gearcase with propeller shaft.*



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9. If propeller shaft will not come out, proceed with Step "a" or "b," following:
   a. Push propeller shaft back into place against the reverse gear. Visually inspect location of shift cam by looking down shift shaft hole (illuminated with a flashlight). If splined hole in shift cam is visible, reinstall shift shaft and rotate shift shaft to neutral position. Remove shift shaft, then remove propeller shaft as instructed in Step 8, immediately preceding.
   b. Push propeller shaft back into place against reverse gear. Slide bearing carrier back into gear housing (to support propeller shaft). Place gear housing on its left side (viewed from rear) and strike upper leading end of gear housing with a rubber mallet. This will dislodge the shift cam from cam follower into a clearance pocket in left side of gear housing. Remove bearing carrier and pull propeller shaft out of gear housing.

NOTE: *If Step 9-b was used to remove propeller shaft, the shift cam can be retrieved after removal of reverse gear.*

Shift Shaft

CLEANING AND INSPECTION

1. Clean shift shaft and bushing with solvent and dry with compressed air.
2. Check shift shaft splines on both ends for wear and/or corrosion damage.
3. Inspect shift shaft for groove(s) at shift shaft bushing seal surface.
4. Inspect shift shaft bushing for corrosion damage.
5. Inspect shift shaft bushing oil seal for wear and/or cuts.

DISASSEMBLY

1. Remove (and discard) shift shaft bushing oil seal by prying it out or driving it out with a punch and hammer.

CLEANING/INSPECTION - BEARING CARRIER

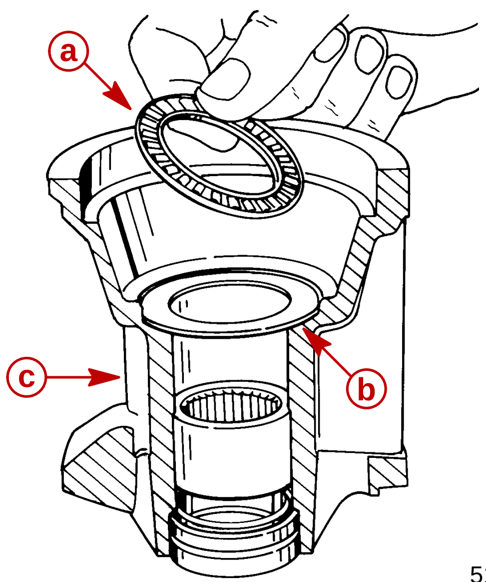
IMPORTANT: It is recommended that all seals and O-rings be replaced (as a normal repair procedure) to assure effective repair.

⚠ CAUTION
DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean bearing carrier with solvent and dry with compressed air.
2. Bearing carrier propeller shaft needle bearing condition is determined by propeller shaft bearing surface condition. (See **"Propeller Shaft Inspection."**)

DISASSEMBLY- BEARING CARRIER

1. Remove thrust bearing and thrust washer from bearing carrier.
2. If thrust bearing, thrust washer or thrust bearing surface on propeller shaft shows signs of rust, pitting or blueing from lack of lubricant, component(s) should be discarded.
3. Remove bearing carrier oil seals.



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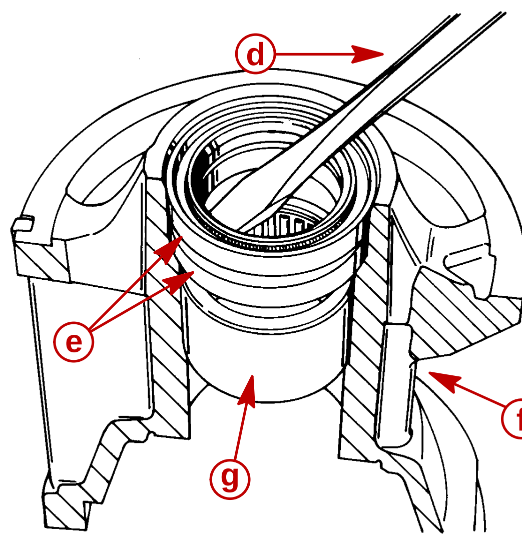

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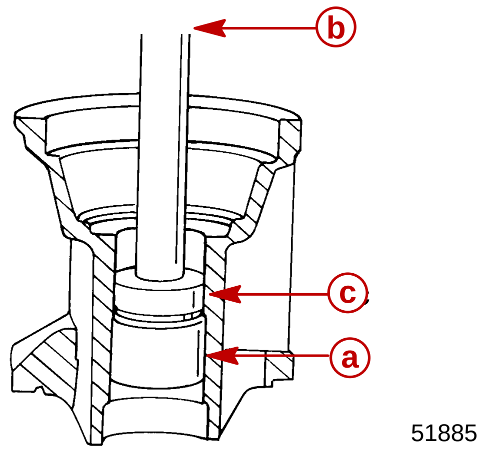
a - Thrust Bearing
b - Thrust Washer
c - Bearing Carrier
d - Pry Bar
e - Oil Seals
f - Bearing Carrier
g - Bearing Carrier Needle Bearing

NOTE: *Do not remove bearing carrier needle bearing unless replacement is needed.*

4. Use bearing removal and replacement tool (91-31229A5) or equivalent to press bearings out of bearing carrier.



a - Needle Bearing
b - Push Rod
c - Mandrel

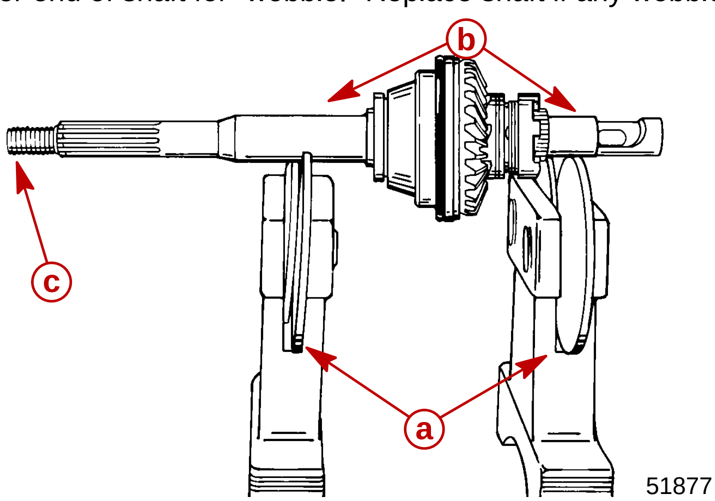
Propeller Shaft

INSPECTION

1. Clean propeller shaft assembly with solvent and dry with compressed air.
2. Inspect bearing carrier oil seal surfaces for grooves. Run fingernail across seal surface to check for groove. Replace shaft if groove is found.
3. Visually check bearing surfaces of propeller shaft for pitting, grooves, scoring, uneven wear or discoloration (bluish color) from overheating. Replace shaft and corresponding needle bearing if any of the above conditions are found. (Bearing carrier needle bearing contacts propeller shaft just in front of oil seal surface. Reverse gear bearing contacts propeller shaft in front of sliding clutch splines.)
4. Inspect propeller shaft splines for wear and/or corrosion damage.
5. Check propeller shaft for straightness. Use either method, following:

Balance Wheels

Place propeller shaft on balance wheels, as shown. Rotate propeller shaft and observe propeller end of shaft for “wobble.” Replace shaft if any wobble is observed.



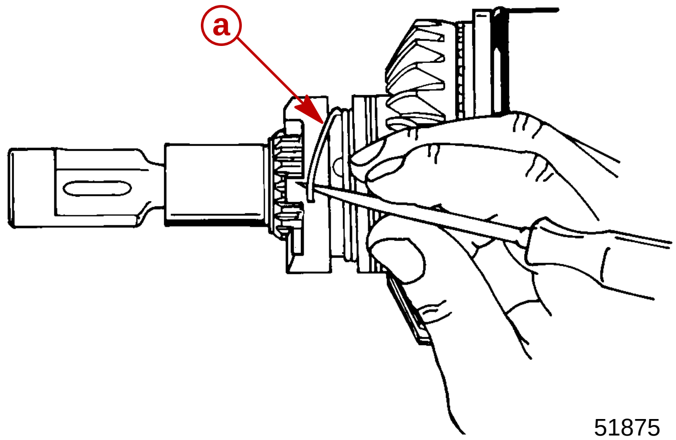
a - Balance Wheels
b - Bearing Surfaces
c - Watch for Wobble

“Vee” Blocks and Dial Indicator

Position propeller shaft roller bearing surfaces on vee blocks. Mount a dial indicator at front edge of propeller splines. Rotate propeller shaft. Dial indicator movement of more than 0.006 in. (0.152 mm) (or noticeable wobble) is reason for replacement.

DISASSEMBLY

1. Remove shift cam from cam follower.
2. Insert a thin blade screwdriver or awl under first coil of cross pin retainer spring and rotate propeller shaft to unwind spring from sliding clutch. DO NOT overstretch spring.



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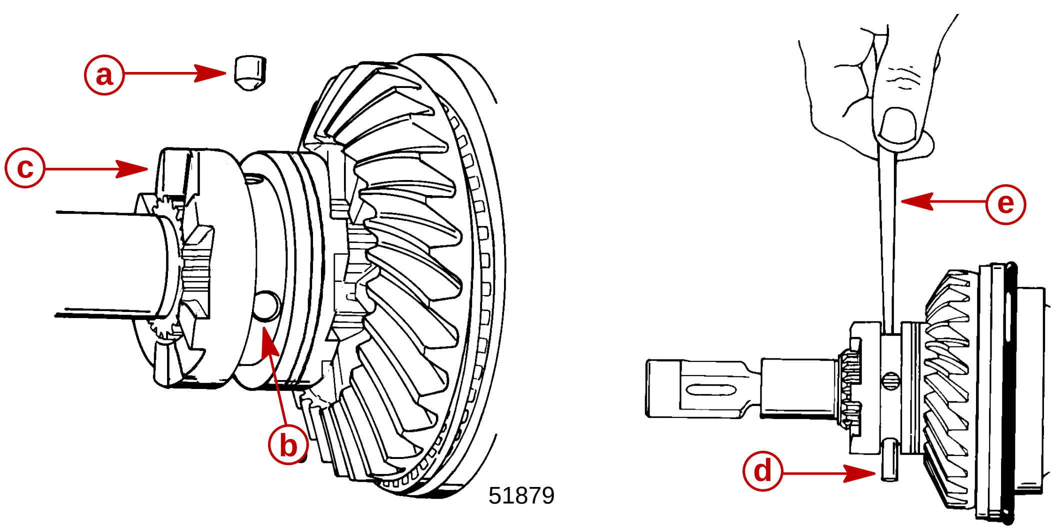
a - Cross Pin Retainer Spring

> **⚠ CAUTION**
>
> **Detent pin is free and can fall out of sliding clutch. Care MUST BE taken not to lose pin.**

3. Detent pin is free and can be removed from sliding clutch at this time.
4. Push cross pin out of sliding clutch and propeller shaft with a punch.



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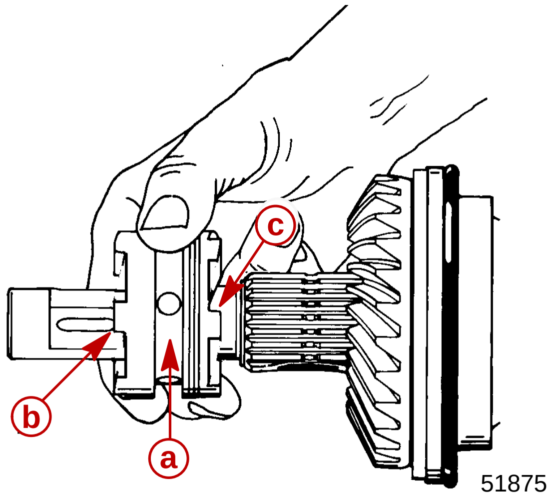
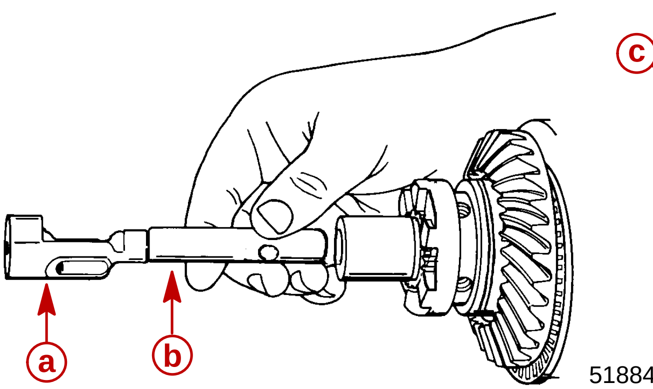
a - Detent Pin
b - Cross Pin
c - Sliding Clutch
d - Cross Pin
e - Punch

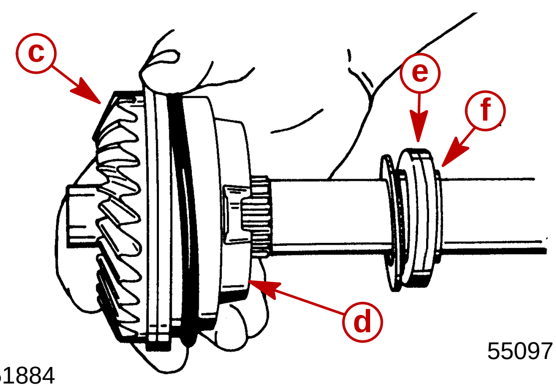
5. Pull sliding clutch off propeller shaft.
6. Inspect sliding clutch. Check reverse gear clutch "jaws" and forward gear clutch "jaws." Rounded "jaws" indicate one or more of the following:
   a. Improper shift cable adjustment.
   b. Improper shift habits of operator(s) (shift from neutral to reverse gear or forward gear too slowly).
   c. Engine idle speed too high (while shifting).



a - Sliding Clutch
b - Reverse Gear Clutch Jaws
c - Forward Gear Clutch Jaws

7. Pull cam follower and clutch actuator rod out of propeller shaft. DO NOT force cam follower up-or-down or side-to-side when pulling from propeller shaft.
8. Once cam follower and clutch actuator rod are removed from propeller shaft, lift rod out of cam follower.
9. Check condition of cam follower. If it shows wear (pitting, scoring or rough surface), replace cam follower and shift cam.
10. Remove forward gear and bearing adaptor assembly.
11. Remove 2 thrust races and 2 keepers from prop shaft.





a - Cam Follower
b - Clutch Actuator Rod
c - Forward Gear
d - Bearing Adaptor Assembly
e - Thrust Races (2)
f - Keepers (hidden) (2)

Clutch Actuator Rod

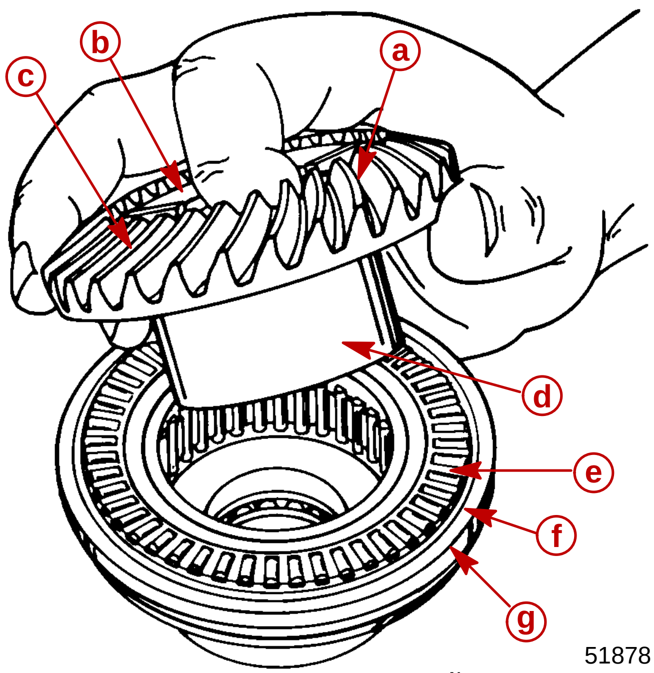
CLEANING AND INSPECTION

1. Clean clutch actuator rod in solvent and dry with compressed air.
2. Inspect actuator components for wear or damage. Replace components as required.

Forward Gear and Bearing Adapter

DISASSEMBLY/CLEANING/INSPECTION

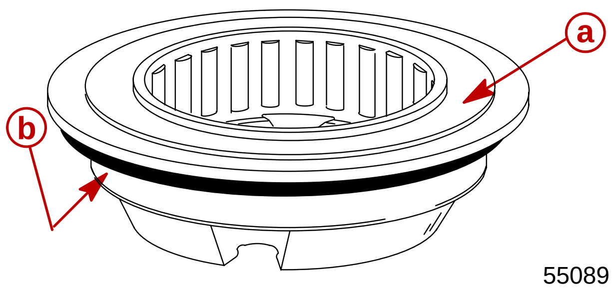
1. Remove forward gear from bearing adapter.
2. Inspect forward gear clutch teeth for signs of wear. If clutch teeth are worn, sliding clutch should be replaced also.
3. Inspect forward gear teeth for full tooth contact, chips, pits and signs of rust. If forward gear teeth are damaged, pinion gear must be inspected and replaced if necessary.
4. Inspect forward gear hub for signs of pitting, rust, scoring or discoloration (blueing) due to lack of lubricant.
5. Remove thrust bearing and spacer shim. Inspect thrust bearing for pits, rust, or discoloration (blueing) due to lack of lubricant.



a - Forward Gear
b - Forward Gear Clutch Teeth
c - Forward Gear Teeth
d - Forward Gear Hub
e - Thrust Bearing
f - Thrust Washer
g - Spacer Shim

6. Remove thrust washer and O-ring. The thrust washer acts as a bearing surface for the thrust bearing and it should be inspected for pits, rust, scoring or discoloration due to lack of lubricant. O-ring should be inspected for cuts or abrasions and replaced if necessary.

7. Remove thrust bearing and thrust washer from bearing adaptor. Thrust roller bearing should be inspected for pitting, rust or signs of discoloration (blueing) due to lack of lubricant. If thrust roller bearing must be replaced, the bearing surfaces on the thrust washer and propeller shaft where the thrust roller bearing rides should also be inspected for signs of wear.



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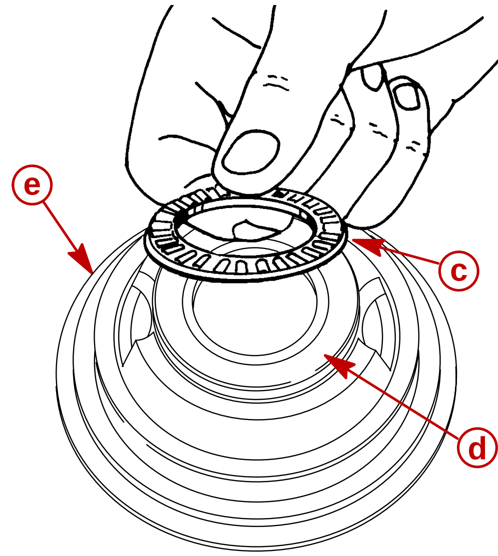

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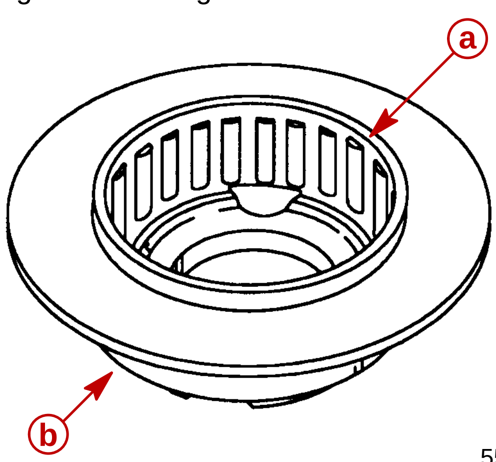
a -Thrust Washer
b -O-Ring (hidden)
c -Thrust Bearing
d -Thrust Washer
e -Bearing Adaptor

8. The forward gear bearing should be carefully inspected for smoothness of movement, pits, rust, or signs of discoloration (blueing) due to lack of lubricant. If the bearing must be replaced, it is recommended that a hammer and cape chisel be used to break the bearing loose from the bearing adapter. Be careful not to damage bearing adapter when removing roller bearing.



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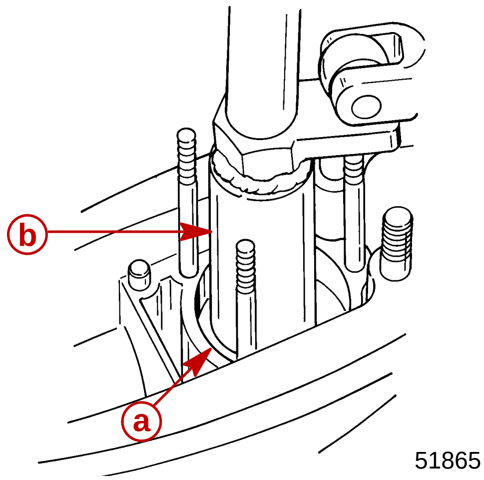
a -Forward Gear Bearing
b -Bearing Adaptor

Pinion Gear and Driveshaft

REMOVAL

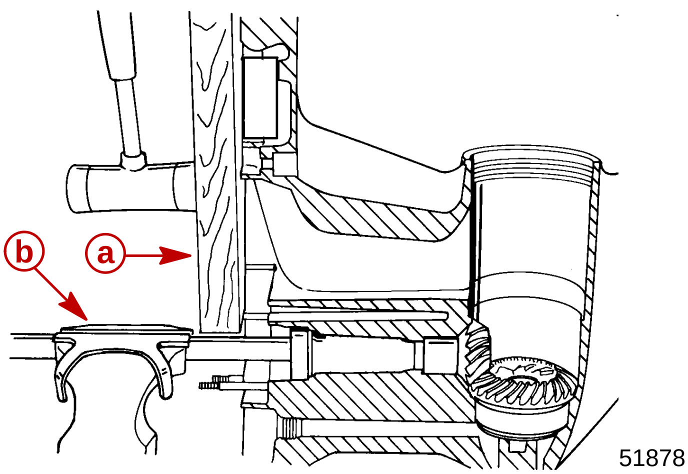
1. Remove bearing retainer using Bearing Retainer Tool (91-43506).



a - Bearing Retainer
b - Bearing Retainer Tool (91-43506)

2. Place Driveshaft Holding Tool (91-34377A1) over driveshaft splines.
3. Use a socket and flex handle to hold pinion nut. (Pad area of gear housing, where flex handle will make contact, to prevent damage to gear housing.)
4. Use a socket and flex handle on Driveshaft Holding Tool to loosen pinion nut. Remove pinion nut and Driveshaft Holding Tool.
5. Remove gear housing from vise and re-position it as shown. Be sure to use soft jaw vise covers and clamp as close as possible to water pump studs.
6. Place a block of wood on gear housing mating surface. Use a mallet and carefully tap gear housing away from driveshaft.

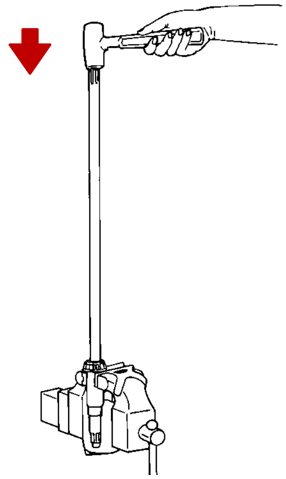
CAUTION
DO NOT strike gear housing hard with the mallet or allow gear housing to fall.



a - Wooden Block
b - Soft Jaw Vise Covers

7. Reach into gear housing and remove pinion gear.

8. After driveshaft is removed from gear case, remove and retain shim(s) that were located under upper tapered driveshaft bearing.
9. If inspection determines that replacement of driveshaft tapered bearing is required, remove bearing from driveshaft as follows:
   a. Position driveshaft in a vise; DO NOT tighten vise jaws against shaft.
   b. Strike shaft with a lead hammer; take care not to drop shaft.



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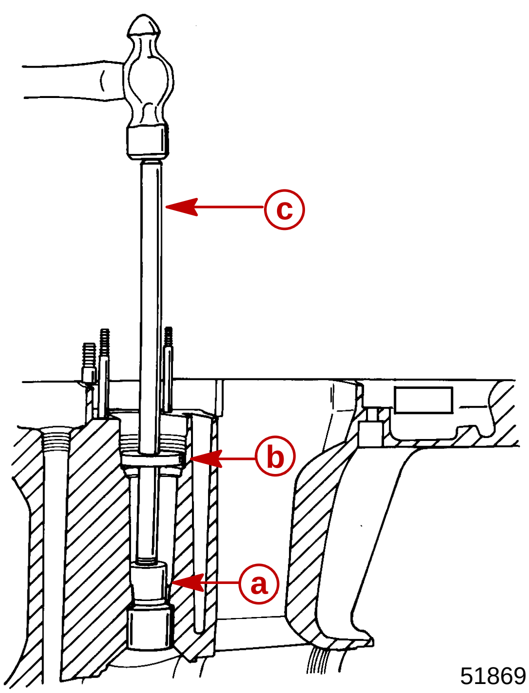
10. Remove 18 loose needles from outer race of driveshaft needle bearing.
11. If inspection of driveshaft needle bearing surface determines that replacement of needle bearing is required, the 18 loose needle bearings previously removed must be reinstalled in bearing race to provide surface for mandrel to drive against.

NOTE: *Reverse gear must be removed first before removing driveshaft needle bearing.*

IMPORTANT: Discard driveshaft needle bearing after removal. (Bearing cannot be reused.)



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a - Mandrel (91-37263)
b - Pilot* (91-36571)
c - Driver Rod* (91-37323)

*From Bearing Removal and Installation Kit (91-31229A5)

CLEANING AND INSPECTION

1. Clean driveshaft, tapered bearing and race, and pinion gear with solvent. Dry with compressed air. DO NOT allow driveshaft bearing to spin while drying.
2. Inspect pinion gear for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace pinion gear, if any of the above conditions are found.
3. Inspect driveshaft needle bearing surface (area just above pinion gear splines) for pitting, grooves, scoring, uneven wear and/or discoloration from overheating. Replace driveshaft and driveshaft needle bearing, if any of the preceding conditions are found.
4. Inspect driveshaft to crankshaft splines for wear. Replace driveshaft if wear is excessive.
5. Inspect tapered bearing race for pitting, grooves, scoring, uneven wear and discoloration from overheating. Replace tapered bearing and race as a set, if any of the preceding conditions are found.
6. Inspect driveshaft for groove(s) where water pump base oil seals contact shaft. Replace driveshaft if groove(s) are found.

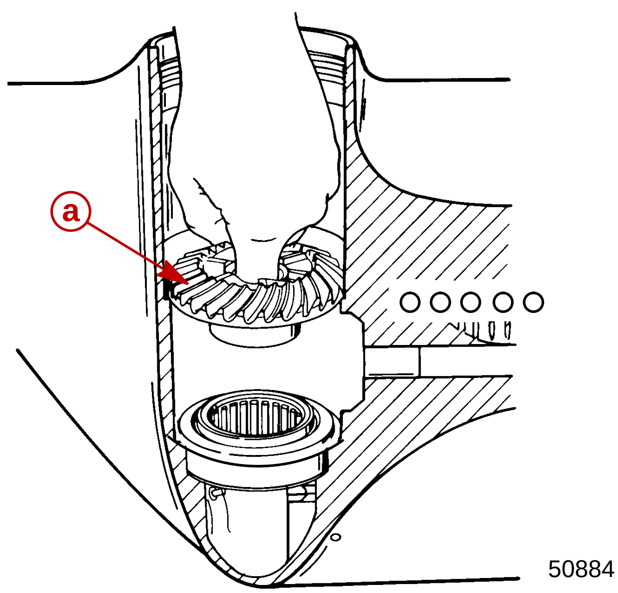
Reverse Gear

REMOVAL AND DISASSEMBLY

NOTE: *Reverse gear can be removed from gear housing only after driveshaft and pinion gear have been removed.*

NOTE: *Cautiously applying heat to both sides of gearcase where reverse gear assembly is located will aid in removal of bearing cup adapter.*

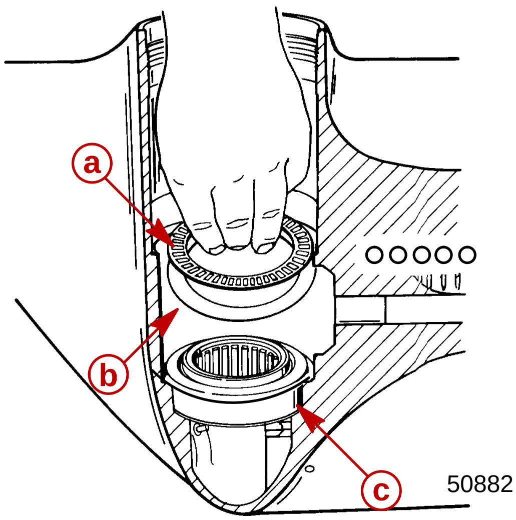
1. Remove reverse gear by hand.

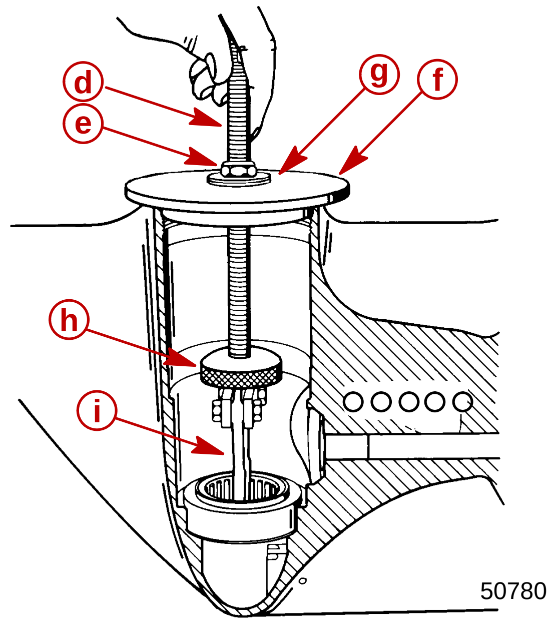


a - Reverse Gear

IMPORTANT: DO NOT remove needle bearing from reverse gear unless replacement of bearing is required. Bearing cannot be reused after it has been removed.

2. Remove thrust bearing and thrust washer from reverse gear bearing cup.
3. Remove reverse gear bearing adaptor. Remove, measure and make note of the shim thickness and **discard (DO NOT reuse shims if they are damaged during removal) the shims.**





a - Thrust Bearing
b - Thrust Washer
c - Reverse Gear Bearing Adaptor
d - Bolt (91-31229)
e - Nut (91-11-24156)
f - Guide Plate (91-816243)
g - Washer (91-34961)
h - Puller Head (from Slide Hammer Puller Kit 91-34569A1)
i - Jaws (91-816242)

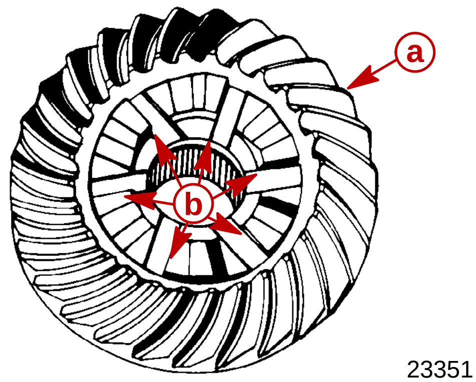
CLEANING AND INSPECTION

CAUTION

DO NOT spin bearings dry with compressed air, as this could cause bearing to score.

1. Clean reverse gear and bearing with solvent and dry with compressed air. DO NOT spin the bearing.
2. Inspect gear teeth for pitting, grooves, scoring, uneven wear and for discoloration (from overheating). Replace gear if any of these conditions are found.

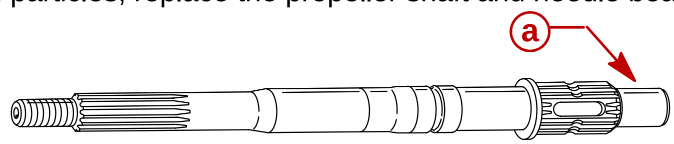
3. Check clutch jaws on reverse gear for damage. Replace reverse gear if damage is found.



a - Reverse Gear Teeth
b - Clutch Jaws

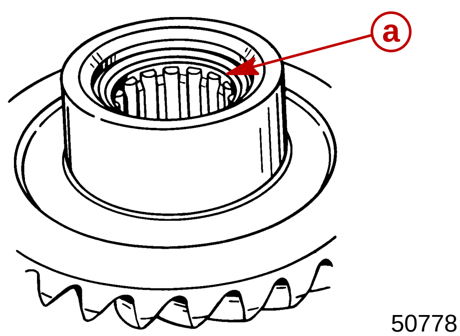
NOTE: *The needle bearings in the reverse gear should not be removed unless damage has been found. Inspect to ensure that all of the needles are present and in position. Needles that have been dislodged may be snapped back into place as long as no damage has occurred to the bearing cage.*

4. Inspect the needle bearings on the inside of the reverse gear and the bearing surface on the propeller shaft. If either the needle bearings or the bearing surface of the propeller shaft is pitted grooved, worn unevenly, discolored from overheating or has embedded particles, replace the propeller shaft and needle bearing in the reverse gear.



a - Reverse Gear Needle Bearing Contact Area

5. If reverse gear needle bearing is found to be damaged, place reverse gear in a press and use mandrel 91-63569 to press bearing out of gear.



a - Bearing

Gear Housing

CLEANING AND INSPECTION

1. Clean gear housing with solvent and dry with compressed air.
2. Check gear housing carefully for impact damage.
3. Check for loose fitting bearing adaptors and needle bearings.

NOTE: *If bearing adaptors have spun in gear case, gear housing must be replaced.*

4. Inspect bearing carrier cover nut retainer threads in gear housing for corrosion damage and/or stripped threads.

Reassembly and Installation of Counter Rotation Gear Housing

Driveshaft Needle Bearing

REASSEMBLY/INSTALLATION

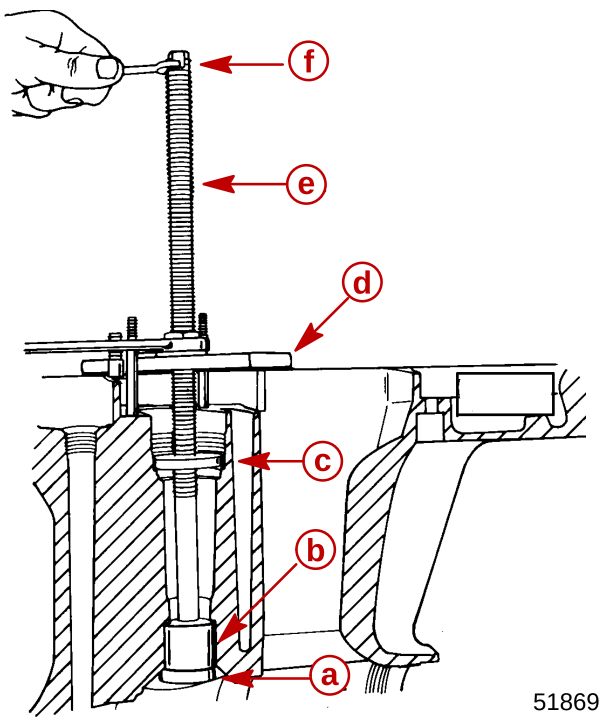
CAUTION

If driveshaft needle bearing failure has occurred, and original bearing race has turned in the gear housing, gear housing must be replaced. Loose fitting needle bearing will move out of position and cause repeated failures.

NOTE: *Driveshaft needle bearing must be installed prior to installation of reverse gear.*

1. Apply a thin coat of Quicksilver 2-4-C w/Teflon Lubricant to driveshaft needle bearing bore in gear housing.
2. By way of propeller shaft cavity, place needle bearing in driveshaft bore with numbered side of bearing facing up driveshaft bore.
3. Install and seat needle bearing with the following tools: Puller Rod* (91-31229), Nut* (91-24156), Pilot* (91-36571), Plate* (91-29310), and Mandrel* (91-92788). Pull bearing up into bore until it bottoms on gear housing shoulder. (DO NOT use excessive force.)

*From Bearing Removal and Installation Kit (91-31229A5)

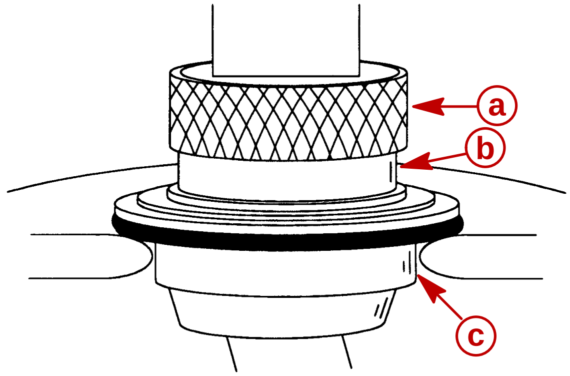


a - Mandrel
b - Bearing
c - Pilot
d - Plate
e - Puller Rod
f - Hold

Bearing Carrier, Forward Gear and Bearing Adaptor

REASSEMBLY

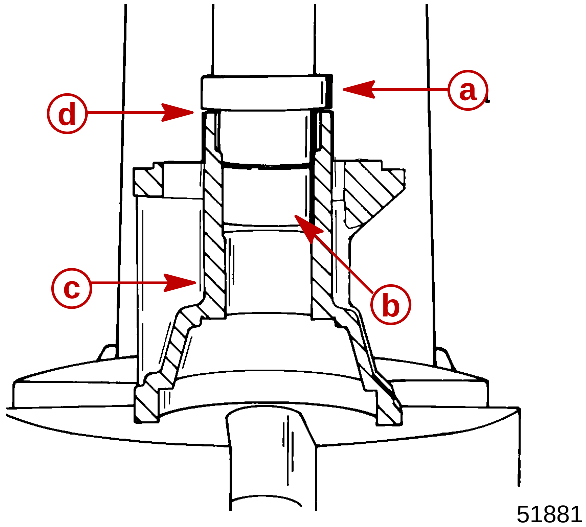
1. Using suitable mandrel, press forward gear bearing into bearing adaptor until bearing is flush with lip of adaptor.



a - Suitable Mandrel
b - Forward Gear Bearing
c - Bearing Adaptor

PROPELLER SHAFT NEEDLE ROLLER BEARING AND OIL SEAL INSTALLATION

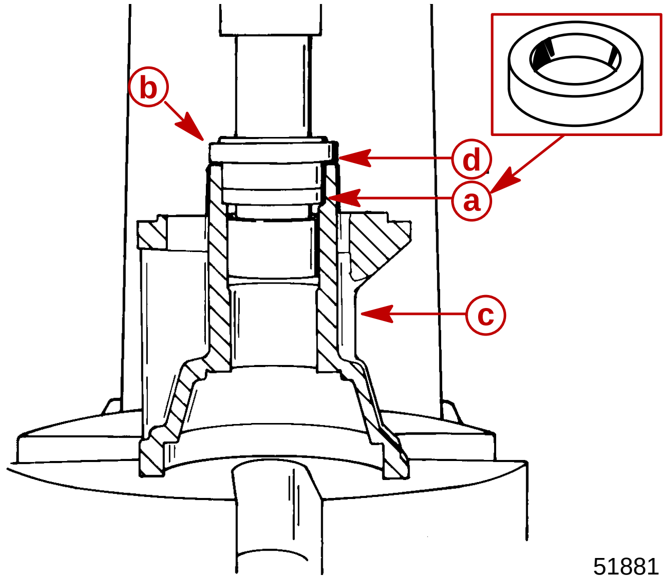
1. Using mandrel 91-15755, press bearing carrier needle bearing (number side up) into bearing carrier until mandrel shoulder contacts bearing carrier.



a - Mandrel (91-15755)
b - Bearing Carrier Needle Bearing
c - Bearing Carrier
d - Shoulder

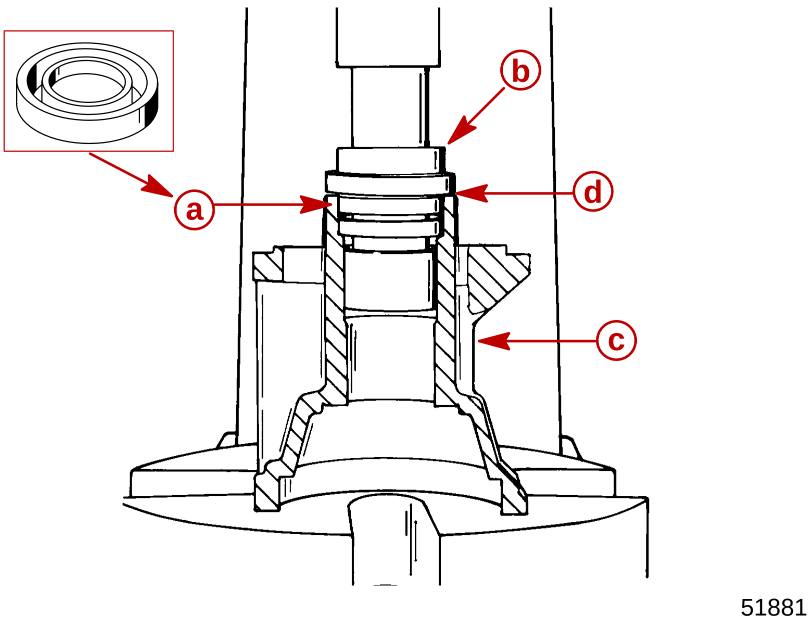
2. Apply Loctite 271 (92-809820) to outside diameter of oil seals.

3. With seal lip facing towards bearing, press inner seal (a) using long end of mandrel (b) (91-31108) into bearing carrier (c) until mandrel shoulder (d) bottoms out on bearing carrier.



a - Inner Seal
b - Mandrel (91-31108)
c - Bearing Carrier
d - Mandrel Shoulder

4. With seal lip facing towards mandrel, press outer seal (a) using short end of mandrel (b) (91-31108) into bearing carrier (c) until mandrel shoulder (d) bottoms out on bearing carrier.



a - Outer Seal
b - Mandrel (91-31108)
c - Bearing Carrier
d - Mandrel Shoulder

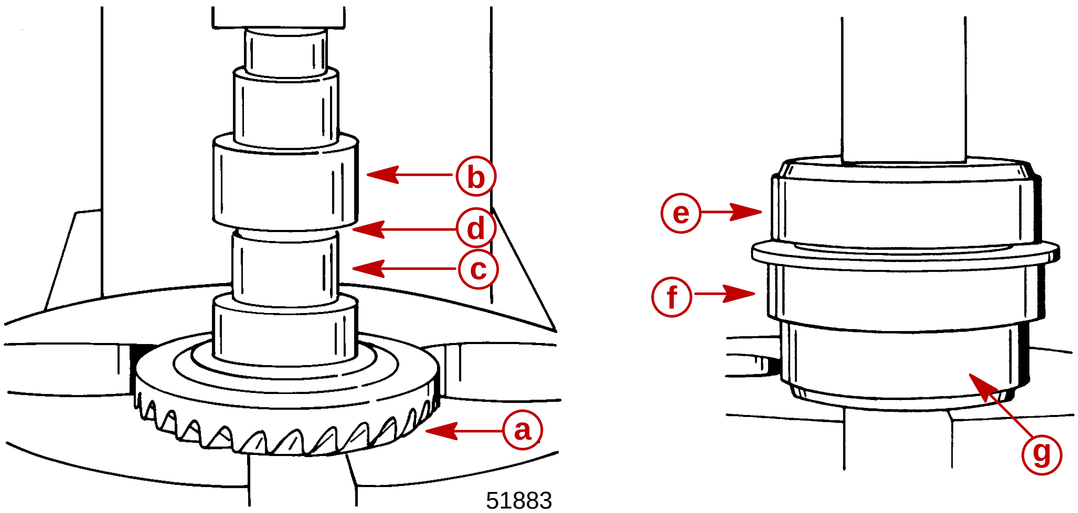
5. Lubricate both seal lips with 2-4-C w/Teflon Marine Lubricant (92-90018A12).

REVERSE GEAR AND BEARING CUP ADAPTOR REASSEMBLY

1. With reverse gear teeth facing down, use mandrel (91-86943) to press propeller shaft needle bearing (NUMBERS/LETTERS UP) into reverse gear until short shoulder on mandrel bottoms on reverse gear.

NOTE: *If gear housing has been replaced or inspection determines that reverse gear bearing adapter must be replaced, assemble and install as follows:*

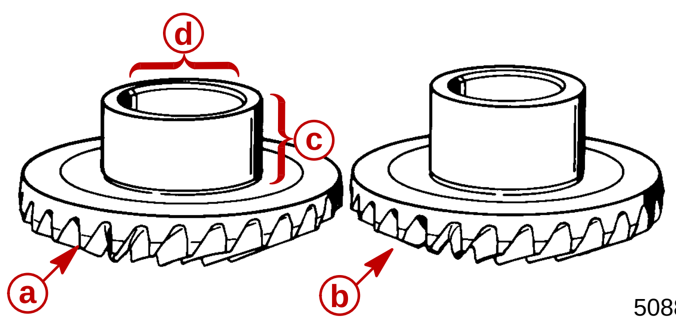
2. Place reverse gear roller bearing (NUMBER/LETTERS UP) in press. Using suitable mandrel, press bearing cup adapter onto reverse gear bearing.



51883

a - Reverse Gear Teeth
b - Mandrel (91-86943)
c - Propeller Shaft Needle Bearing
d - Shoulder
e - Mandrel
f - Bearing Cup Adapter
g - Reverse Gear Roller Bearing

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a smaller inner diameter needle bearing bore.



50885

a - Reverse Gear
b - Forward Gear
c - Shorter Length Hub
d - Smaller Diameter Bearing Bore

Reverse Gear Bearing Adaptor Assembly

INSTALLATION

NOTE: *If the reverse gear, reverse gear adaptor, large thrust bearing, or bearing race in the gear housing were not replaced, install the same shim(s) (or the same thickness of shim(s)) that were taken out when adaptor was removed. If the reverse gear, reverse gear adaptor, large thrust bearing, bearing race, or gear housing were replaced, install 0.008 in. (0.51 mm) of shims.*

NOTE: *If backlash has already been checked and it has determined that it needs to be adjusted, (see Checking Reverse Gear Backlash), adding 0.001 in. (0.025 mm) shims will* ***reduce*** *the gear backlash by approximately 0.001 in. (0.025 mm). Subtracting 0.001 in. (0.025 mm) shims will* ***increase*** *backlash by approximately the same amount.*

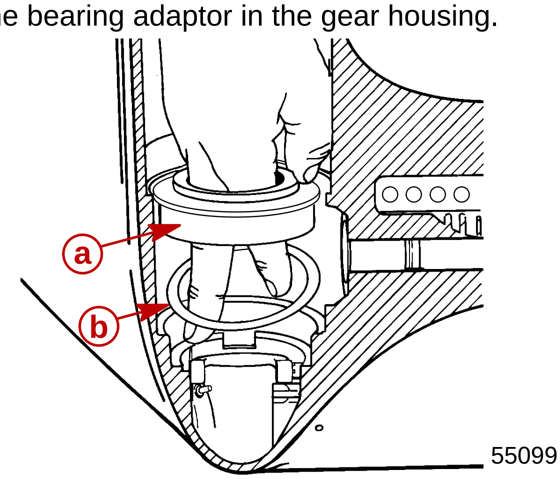
Example 1 (if backlash is too high)

Backlash checks:	0.045 in.	(1.14 mm)
(subtract) middle of specification:	0.025 in.	(0.64 mm)
You get:	0.020 in.	(0.51 mm)
add this quantity of shims:		

Example 2 (if backlash is too low)

middle of specification:	0.025 in.	(0.64 mm)
Backlash checks:	0.009 in.	(0.23 mm)
(subtract) You get:	0.016 in.	(0.41 mm)
subtract this quantity of shims:		

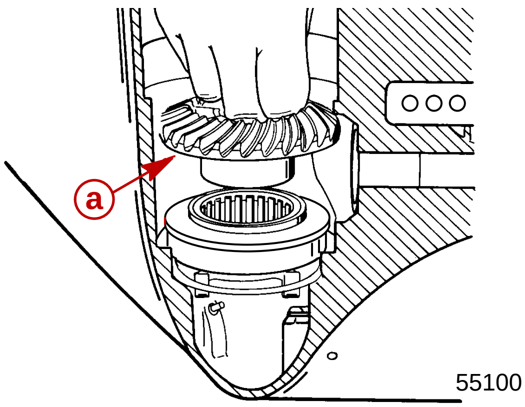
1. Lubricate the bore into which the reverse gear bearing adaptor is to be installed with Quicksilver Super Duty Gear Lubricant.
2. Place the shim(s) into reverse bore of gear housing.
3. Position the bearing adaptor in the gear housing.

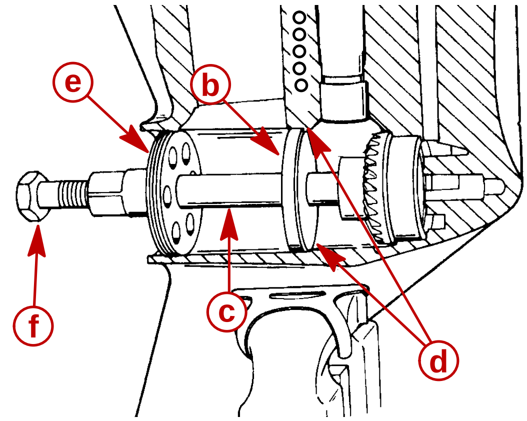


a - Bearing Adaptor
b - Shims

4. Position the reverse gear (without the thrust race or thrust bearing) into the gear housing and into the adaptor.

5. Install PILOT RING (91-18603) over DRIVER TOOL (91-18605) and seat pilot ring in gearcase against inner ledge. Thread RETAINER (91-18604) into bearing carrier threads. Install SCREW (10-18602) into retainer and gently tighten screw against driver tool while holding retainer securely. Continue to apply pressure against driver rod until reverse gear/bearing cup adaptor JUST SEATS in gearcase. DO NOT OVER-SEAT the adaptor as the reverse gear bearing will be damaged. As bearing adaptor begins to seat, the effort required to turn screw will increase considerably.

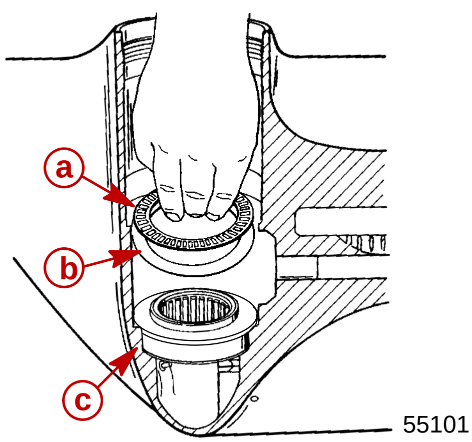


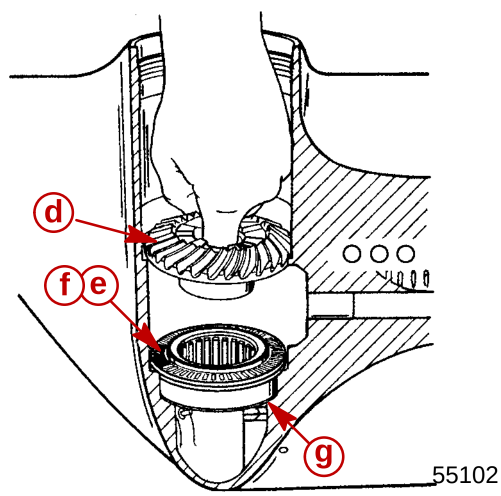


a - Reverse Gear
b - Pilot Ring (91-18603)
c - Driver Tool (91-18605)
d - Inner Ledge
e - Retainer (91-18604)
f - Screw (10-18602)

6. After reverse bearing adaptor is seated, remove screw, retainer, driver tool, pilot ring and reverse gear. Apply Quicksilver Super Duty Gear Lubricant to thrust bearing and install thrust race and bearing onto bearing adaptor.

7. Reinstall reverse gear into bearing adaptor.



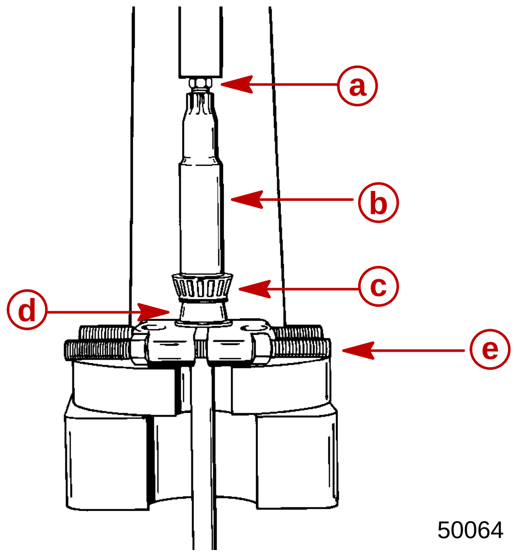


a - Thrust Bearing
b - Thrust Washer
c - Bearing Adaptor
d - Reverse Gear
e - Thrust Bearing
f - Thrust Washer (under thrust bearing)
g - Bearing Adaptor

Driveshaft and Pinion Gear

REASSEMBLY/INSTALLATION

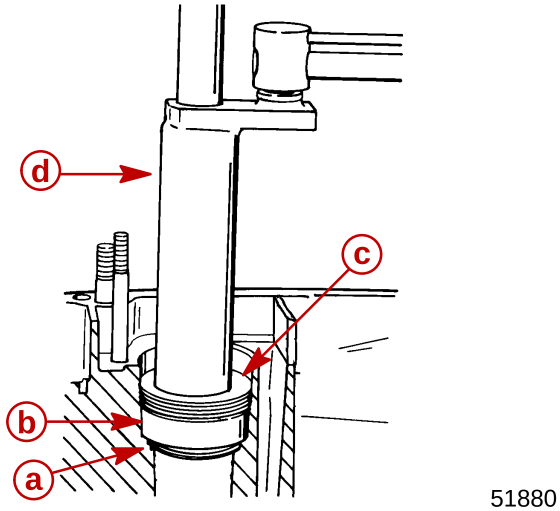
1. Apply a light coat of Quicksilver Super Duty Gear Lubricant on I.D. of driveshaft tapered bearing.
2. Thread a used pinion nut onto end of driveshaft. Leave approximately 1/16 in. (1.6 mm) of nut threads exposed. Driveshaft threads MUST NOT extend beyond nut or thread damage could result while pressing.
3. Place bearing over driveshaft.
4. Using an old driveshaft bearing inner race or other suitable mandrel (which applies pressing force on center bearing race only), press bearing onto shaft until seated.



a -Used Pinion Nut
b -Driveshaft
c -Tapered Bearing
d -Old Bearing Inner Race
e -Universal Puller Plate

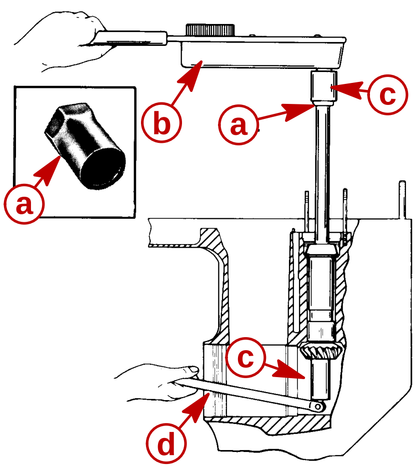
5. Position pinion gear in gear housing below driveshaft bore with teeth of pinion gear meshed with teeth of reverse gear.
6. Insert driveshaft into driveshaft bore while holding pinion gear. Rotate driveshaft to align and engage driveshaft splines with pinion gear splines. Continue to insert driveshaft into gear housing until driveshaft tapered bearing is against bearing race.
7. Apply Loctite 271 to threads of pinion gear nut and install flat washer and nut on driveshaft with flat side of nut away from pinion gear.
8. Place shim(s) (retained from disassembly) into gear housing. If shim(s) were lost or are not reusable (damaged), start with approximately 0.010 in. (0.254 mm).

9. Install bearing race and bearing retainer.



a - Shim(s)
b - Bearing Race
c - Bearing Retainer (Word "OFF" must be visible); Torque to 100 lb. ft. (135.5 Nm)
d - Bearing Retainer Tool (91-43506)

10. Use a socket and breaker bar to hold pinion nut (pad area where flex handle will contact gear housing while torquing nut).
11. Place Driveshaft Holding Tool (91-34377A1) over crankshaft end of driveshaft. Torque pinion nut to 75 lb. ft. (101.5 Nm).



a - Driveshaft Holding Tool (91-34377A1)
b - Torque Wrench; Torque Nut to 75 lb. ft. (101.5 Nm)
c - Socket
d - Breaker Bar

IMPORTANT: Wipe any excess Loctite from pinion nut and pinion gear.

Pinion Gear Depth

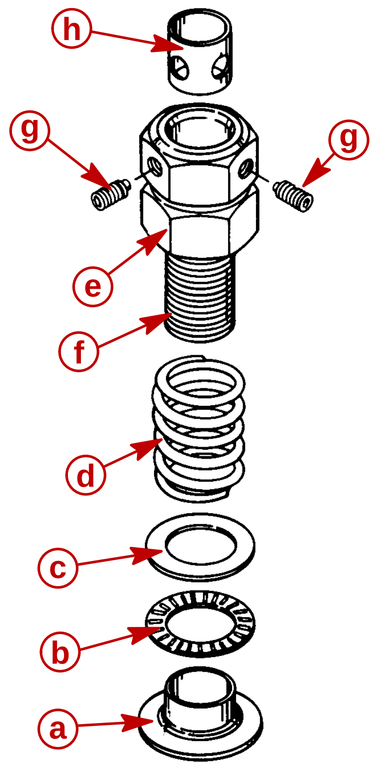
DETERMINING PINION GEAR DEPTH

NOTE: *Read entire procedure before attempting any change in shim thickness.*

IMPORTANT: Reverse gear assembly must be installed in gear housing when checking pinion gear depth or an inaccurate measurement will be obtained.

1. Clean gear housing bearing carrier shoulder.
2. Install Bearing Preload Tool (91-14311A1) over driveshaft in sequence shown.

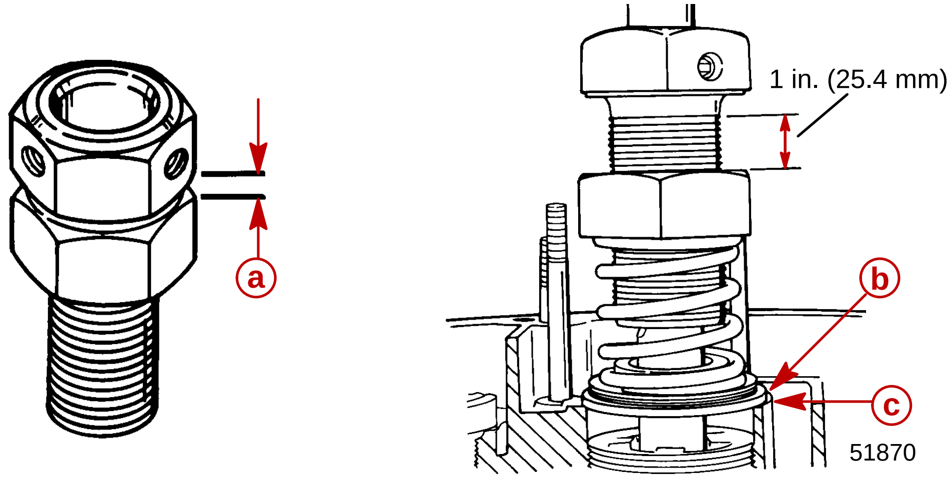
NOTE: *Bearing Preload Tool (91-44307A1) may also be used. Follow instructions provided with tool for proper installation.*



a - Adaptor
b - Bearing
c - Washer
d - Spring
e - Nut; thread nut all the way onto bolt
f - Bolt
g - Set Screw
h - Sleeve; holes in sleeve must align with set screws

3. Align adaptor on driveshaft bearing pocket ledge.
4. With tool installed over driveshaft, tighten both set screws securely, making certain to align sleeve holes to allow set screws to pass thru.

5. Measure distance (a) and increase that distance by 1 in. (25.4 mm) by turning bottom nut away from top nut.

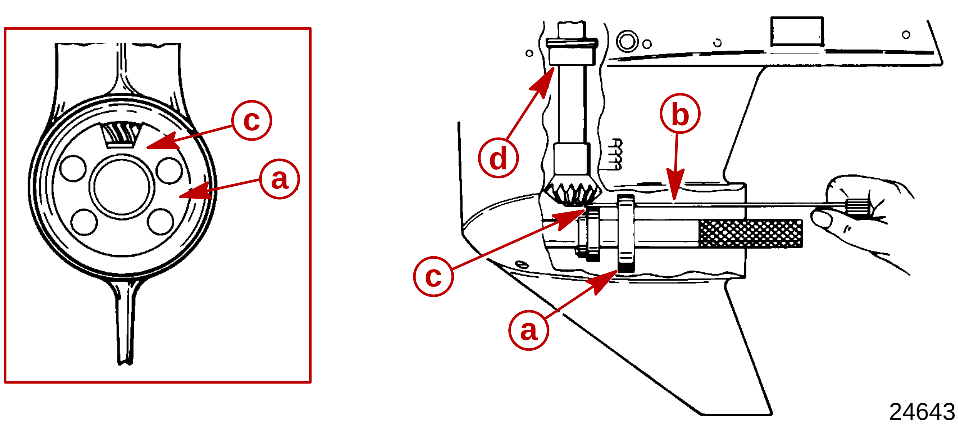


a - Distance
b - Adaptor
c - Ledge

6. Turn driveshaft clockwise 2 or more turns to seat driveshaft bearings.
7. Insert Pinion Gear Locating Tool* (91-74776) into gear housing until it bottoms out on bearing carrier Shoulder.

*Pinion Gear Locating Tool (91-12349A2) can be used. Use flat #7 and disc #2. Follow instructions supplied with tool.

8. Determine pinion gear depth by inserting a feeler gauge thru access slot in pinion gear shimming tool.
9. Clearance between shimming tool and pinion gear should be 0.025 in. (0.64 mm).
10. If clearance is correct, leave Bearing Preload Tool on driveshaft for **"Determining Forward Gear Backlash,"** following.
11. If clearance is not correct, add (or subtract) shims at location shown to raise (or lower) pinion gear.
    When reinstalling pinion nut, apply Loctite 271 on threads of nut and retorque pinion nut.



a - Pinion Gear Shimming Tool (91-74776 or 91-12349A2)
b - Feeler Gauge
c - Obtain 0.025 in. (0.64 mm) Clearance between Shimming Tool and Pinion Gear
d - Add or Subtract Shim(s) Here

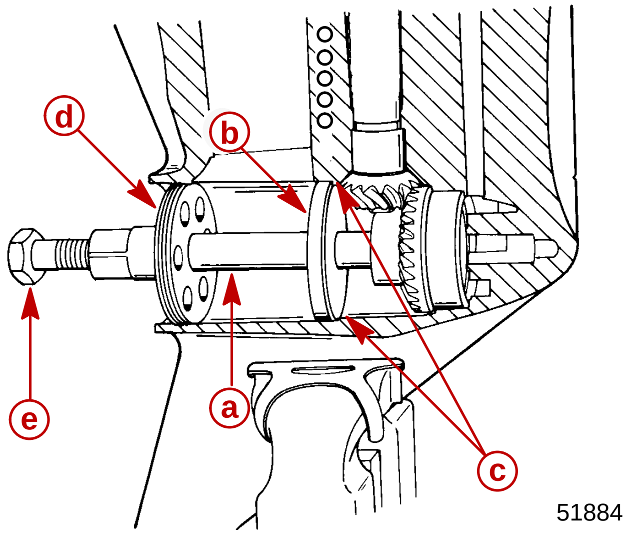
NOTE: *Bearing Preload Tool (91-14311A1) should remain installed on driveshaft after setting pinion gear depth as it is required to properly check forward gear and reverse gear backlash.*

Reverse Gear

DETERMINING REVERSE GEAR BACKLASH

NOTE: *Reverse gear backlash is adjustable using shims; it can be checked as follows:*

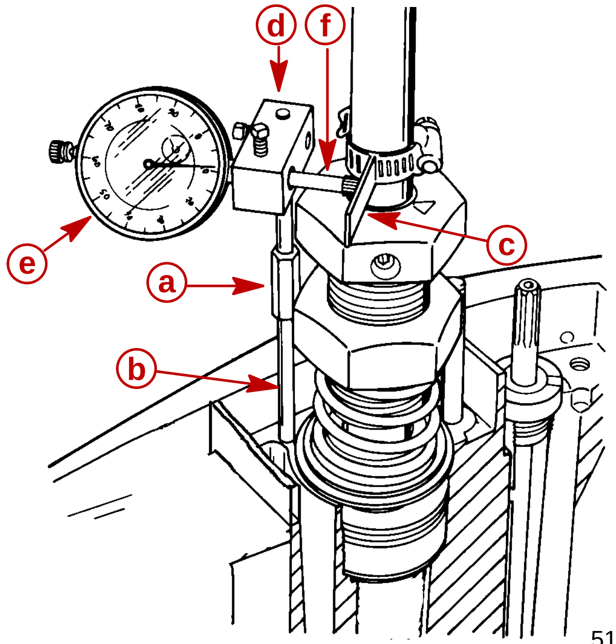
1. Install Driver Tool (91-18605) into reverse gear assembly.
2. Slide Pilot Ring (91-18603) over driver tool and seat pilot ring against inner ledge in gear case.
3. Thread Retainer (91-18604) into gear case cover nut threads.
4. Torque Screw (91-18602) to 45 lb. in. (5 Nm) against driver tool.



a -Driver Tool (91-18605)
b -Pilot Ring (91-18603)
c -Inner Ledge
d -Retainer (91-18604)
e -Screw (91-18602) [Torque to 45 lb. in. (5 Nm)]

5. Thread stud adapter [from Bearing Preload Tool (91-14311A1)] all the way onto stud.
6. Install: Backlash Indicator Tool (91-78473)
   Dial Indicator Holder (91-89897)
   Dial Indicator (91-58222A1)
7. Position dial indicator pointer on line marked “1” on Backlash Indicator Tool, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked “2” on Backlash Indicator Tool, if gear ratio is 2:1 (14 teeth on pinion gear).
8. Lightly turn driveshaft back-and-forth (no movement should occur at propeller shaft).

9. Dial Indicator registers amount of backlash, which should be 0.030 in. to 0.050 in. (0.76 mm to 1.27 mm).



a - Stud Adaptor (from 91-14311A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)
f - Dial Indicator Pointer

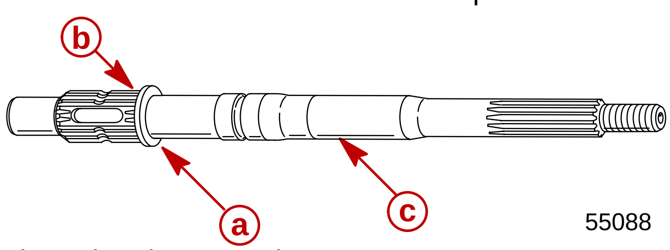
NOTE: *If reverse gear backlash is not within specifications, then gear case is not properly assembled or component(s) within gear case are excessively worn and must be replaced before returning gear case to service.*

10. Remove Driver Tool, Pilot Ring, Retainer and Screw from gear case.

Forward Gear

DETERMINING FORWARD GEAR BACKLASH

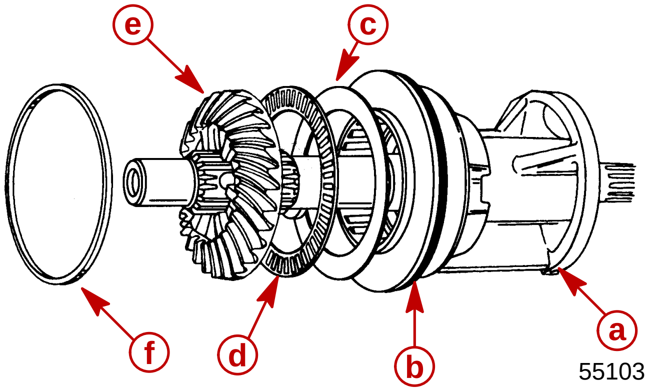
1. Install a load washer (12-37429) over a 44-93003 propeller shaft so that it seats against the REAR shoulder of the clutch spline teeth.

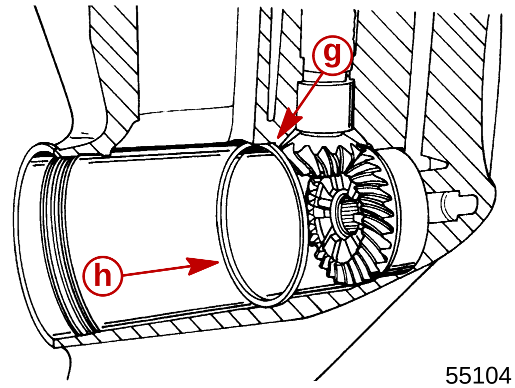


a - Load Washer (12-37429)
b - Shoulder
c - Propeller Shaft (44-93003)

2. Assemble BEARING CARRIER, BEARING ADAPTOR, THRUST WASHER, THRUST BEARING, and FORWARD GEAR onto propeller shaft.

3. Position shim against shoulder in gear case.





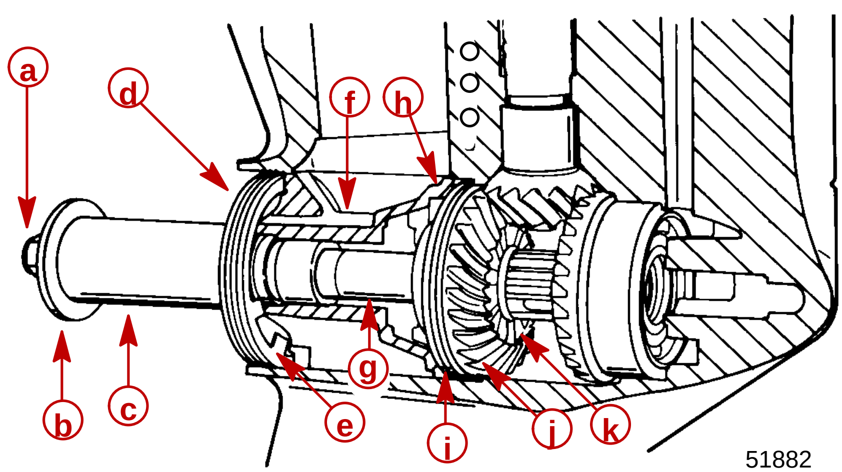
a - Bearing Carrier
b - Bearing Adaptor
c - Thrust Washer
d - Thrust Bearing
e - Forward Gear
f - Shim (PLACE IN GEARCASE FIRST)
g - Shoulder
h - Shim

4. Insert entire propeller assembly into gear case.

5. Install tab washer and cover nut. Torque cover nut to 100 lb. ft. (135.5 N m) to seat forward gear assembly in gear case.

NOTE: *Drill a 3/8 in. (22.2 mm) diameter hole through the side (PROPELLER NUT END) of a 5-1/2 in. x 1-1/2 in. (139.7 mm x 38.1 mm) long piece of PVC pipe. A screwdriver may be inserted thru pipe into propeller shaft splines to prevent PVC pipe from turning while tightening retaining nut.*

6. Install a 5-1/2 in. x 1-1/2 in. (139.7 mm x 38.1 mm) long piece of PVC pipe (obtain locally) over propeller shaft and secure it against the bearing carrier with a flat washer and nut.

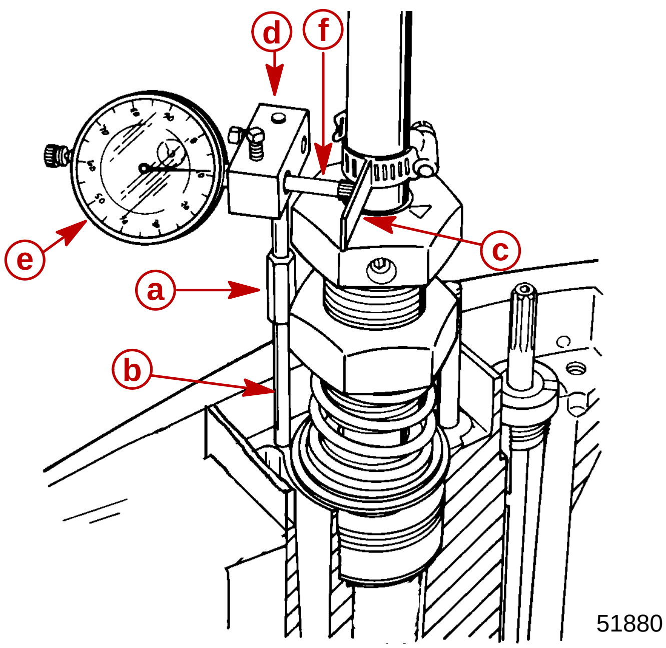


a - Prop Nut
b - Flat Washer
c - PVC Pipe [5 in. x 2 in. (127 mm x 50.8 mm)]
d - Cover Nut
e - Tab Washer
f - Bearing Carrier
g - Prop Shaft
h - Bearing Adaptor
i - Shim
j - Forward Gear
k - Load Washer

7. Tighten nut to 45 lb. in. (5 Nm). This will seat the forward gear against the forward thrust bearing and tends to hold the propeller shaft from moving when measuring backlash.

NOTE: *Bearing Preload Tool (91-44307A1) should still be installed from having previously been used to determine pinion gear depth and reverse gear backlash. If it is not still installed on gear case, refer to* ***"DETERMINING PINION GEAR DEPTH,"*** *previously, for proper installation procedure.*

8. With the proper preload applied to the propeller shaft and the driveshaft, rotate the driveshaft clockwise 5 to 10 complete revolutions. This will seat the forward gear and upper driveshaft bearings and thus provide the most accurate backlash readings.
9. If not previously installed:
   a. Thread stud adaptor [from bearing preload tool (91-44307A1) all the way onto stud.
   b. Install: Backlash Indicator Tool (91-78473)
      Dial Indicator Holder (91-89897)
      Dial Indicator (91-58222A1)
10. Position dial indicator pointer on line marked "1" on BACKLASH INDICATOR TOOL, if gear ratio is 1.87:1 (15 teeth on pinion gear), or on line marked "2" on BACKLASH INDICATOR TOOL, if gear ratio is 2:1 (14 teeth on pinion gear).



a - Stud Adaptor (from 91-44307A1)
b - Stud
c - Backlash Indicator Tool (91-78473)
d - Dial Indicator Holder (91-89897)
e - Dial Indicator (91-58222A1)
f - Dial Indicator Pointer

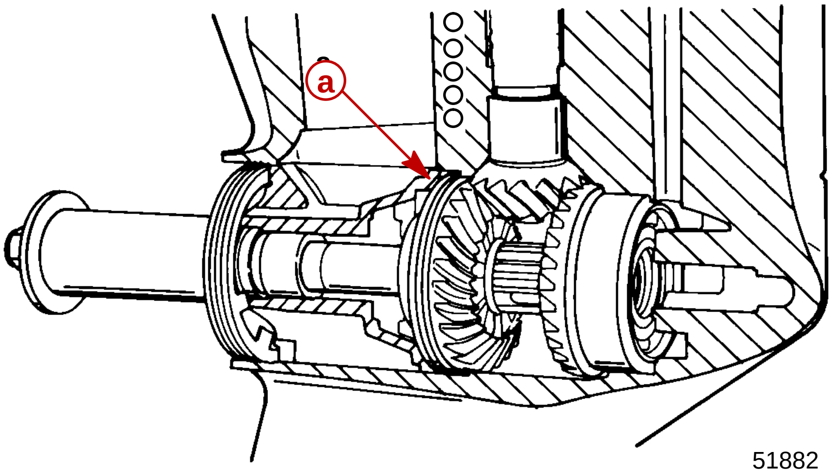
11. Gently rock driveshaft back and forth to determine forward gear backlash.

175 and 200 HP models with 1.87:1 Ratio = 0.018 in. to 0.027 in. (0.46 mm - 0.69 mm) backlash.

135 and 150 HP models with 2.00:1 Ratio = 0.015 in. to 0.022 in. (0.38 mm - 0.56 mm) backlash.

12. If backlash is less than the specifications, then a larger shim should be installed. Conversely, if the backlash indicated is greater than specifications, then a smaller shim should be installed.

NOTE: *By adding or subtracting 0.002 in. (0.051 mm) shim, the backlash will change approximately 0.002 in. (0.051 mm).*



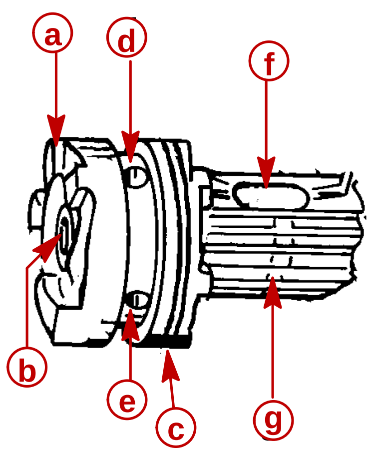
a - Shim

13. If forward gear backlash is within specifications, then Bearing Preload Tool, Dial Indicator, Backlash Indicator Tool/Dial Indicator Holder, PVC pipe, forward gear assembly, bearing adaptor, bearing carrier and test propeller shaft can all be removed from the gear case.

Propeller Shaft/Forward Gear Bearing Adapter/Bearing Carrier

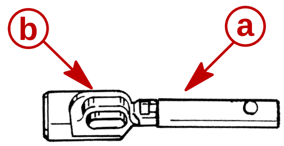
REASSEMBLY

1. Position sliding clutch onto propeller shaft. “GROOVED RINGS” are for manufacturing purposes only and may be positioned towards either gear. Cross pin hole and detent hole in sliding clutch must line up with cross pin slot and detent notch in propeller shaft.



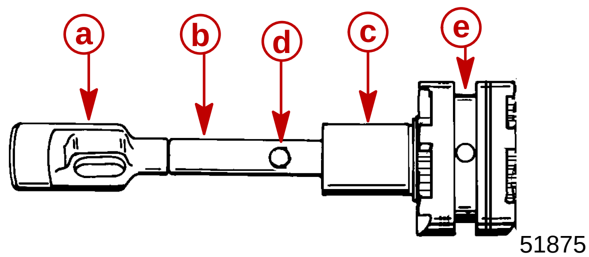
a - Sliding Clutch
b - Propeller Shaft
c - Grooved Rings
d - Cross Pin Hole
e - Detent Hole
f - Cross Pin Slot
g - Detent Notches

2. Place a small amount of Quicksilver 2-4-C w/Teflon Lubricant on actuator rod and install cam follower.



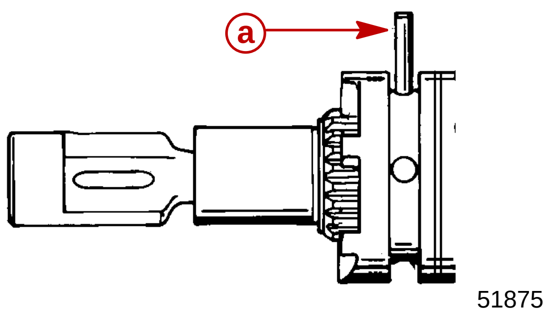
a - Actuator Rod
b - Cam Follower

3. Slide clutch actuator assembly into propeller shaft. Align cross pin slot in actuator rod with cross pin slot in clutch/propeller shaft.



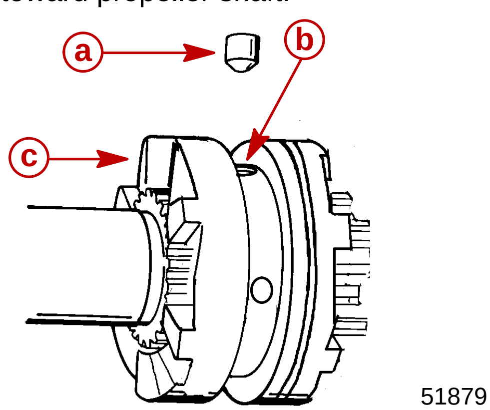
a - Cam Follower
b - Clutch Actuator Rod
c - Propeller Shaft
d - Cross Pin Slot
e - Clutch/Propeller Shaft

4. Insert cross pin through sliding clutch, propeller shaft and actuator rod forcing cross pin tool out.



a - Cross Pin

5. Apply a small amount of 2-4-C w/Teflon Marine Lubricant (92-90018A12) to the rounded end of detent pin. Position detent pin in detent pin hole of sliding clutch with rounded end of pin toward propeller shaft.



a - Detent Pin
b - Detent Pin Hole
c - Sliding Clutch

6. Install cross pin retaining spring onto sliding clutch as follows:

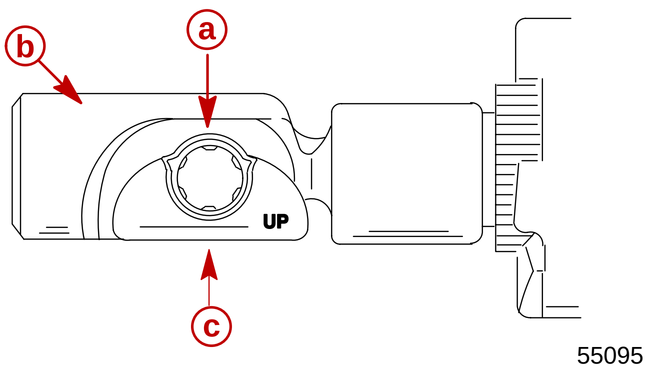
IMPORTANT: DO NOT over-stretch retaining spring when installing onto sliding clutch.

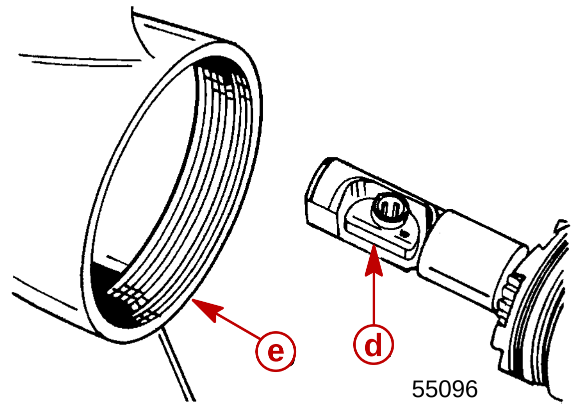
a. Install spring.

(1.) Spirally wrap spring into groove on sliding clutch.

(2.) Position spring in groove so that straight end of spring is against the side of groove.

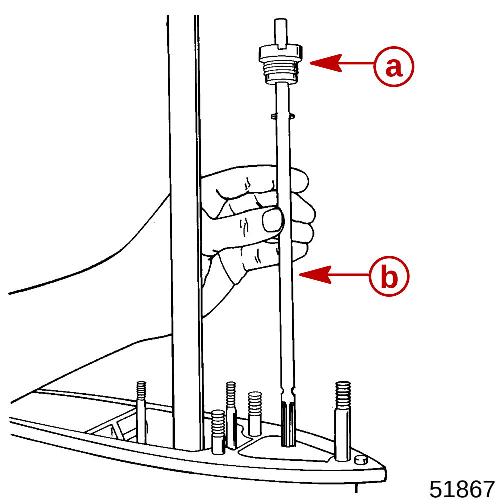
7. Place gear housing in a soft jaw vise with the driveshaft in a vertical position.
8. Coat cam pocket of cam follower with 2-4-C w/Teflon Marine Lubricant (92-90018A12).
9. Place shift cam into cam pocket of cam follower with numbered side of cam facing up.
10. Slide propeller shaft assembly into reverse gear assembly.





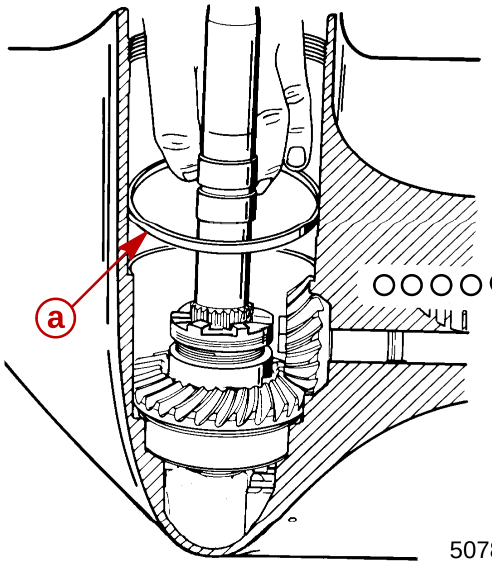
a - Cam Pocket
b - Cam Follower
c - Shift Cam
d - Shift Cam (Position as Shown)
e - Gear Housing

11. Apply a light coat of 2-4-C w/Teflon to the threads of the shift shaft bushing.
12. Insert shift shaft down shift shaft hole in gear housing and into shift cam. It may be necessary to rotate shift shaft back-and-forth slightly in order for splines of shift shaft to match up with splines of shift cam. Thread bushing into position, but do not tighten down at this time.



a - Shift Shaft Bushing
b - Shift Shaft

13. Install appropriate spacer shim into the gear housing.
14. Apply Quicksilver Super Duty Gear Lubricant to to thrust bearing and install thrust bearing and thrust race onto forward gear bearing adaptor.



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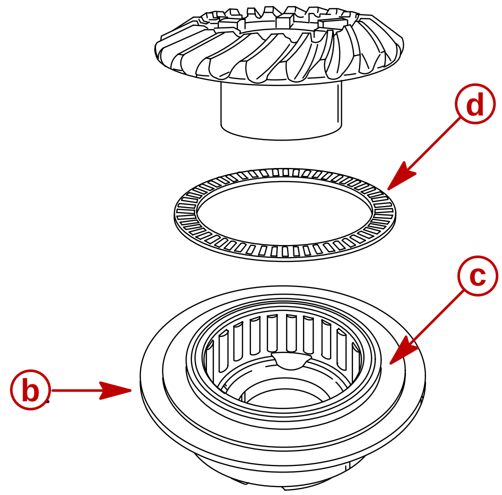

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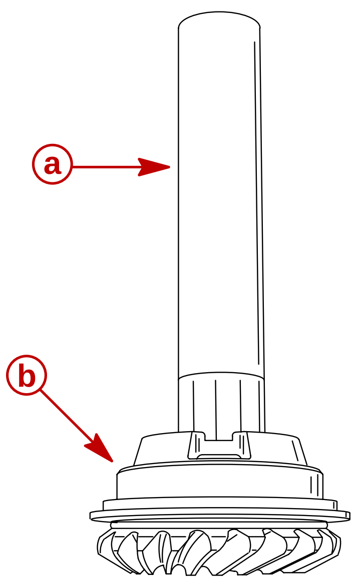
a - Shim
b - Bearing Adaptor
c - Thrust Washer
d - Thrust Bearing

15. Insert Forward Gear Installation Tool (91-815850) into forward gear/bearing adaptor assembly.
16. Install tool with adaptor assembly over propeller shaft and into gear housing. Applying downward pressure to bearing adaptor, remove installation tool from assembly.



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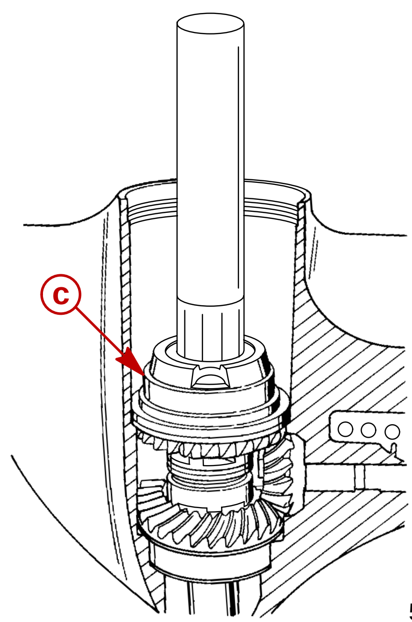

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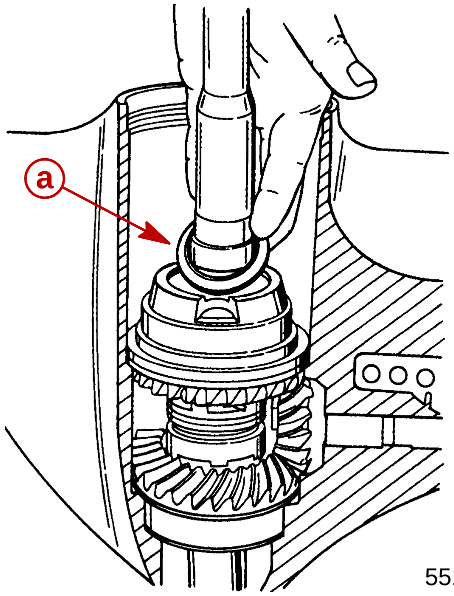
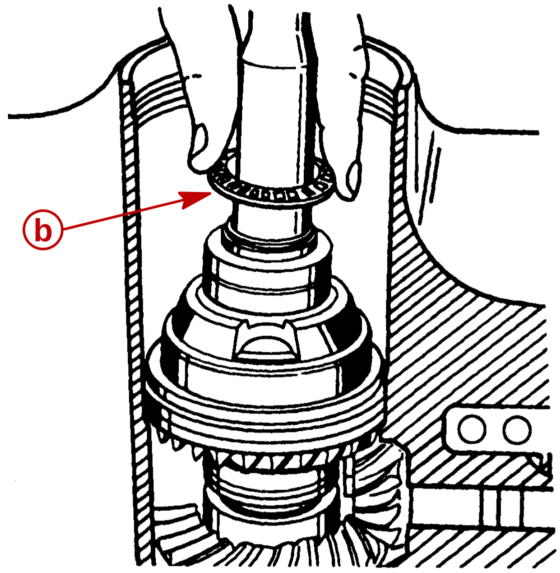
a - Forward Gear Installation Tool (91-815850)
b - Forward Gear/Bearing Adaptor Assembly
c - Forward Gear Bearing Adaptor

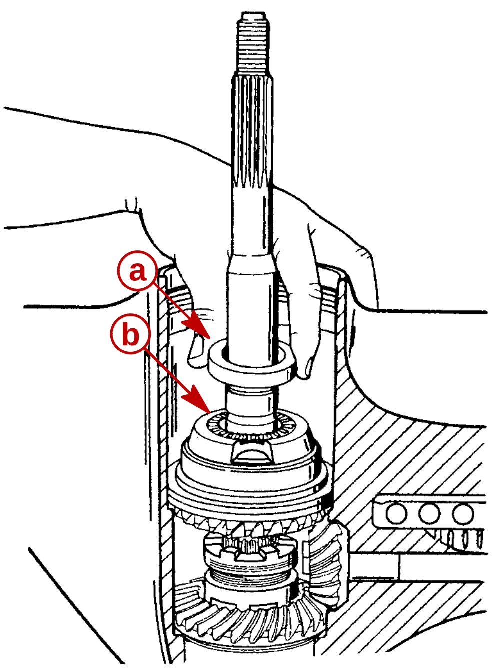
17. Install thrust race on top of bearing adaptor.
18. Apply Quicksilver Super Duty Gear Lubricant to small thrust bearing and install bearing on thrust race.

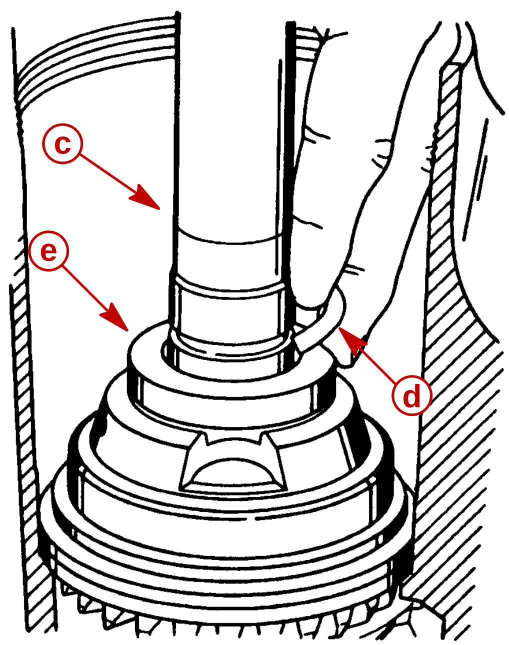




a - Thrust Race
b - Thrust Bearing

19. Install thrust collar with its **STEPPED SIDE DOWN** toward the small thrust bearing.
20. Pull up slightly on the propeller shaft to gain access to the groove on the shaft for the keepers. Install the 2 keepers into the groove and lower the propeller shaft.

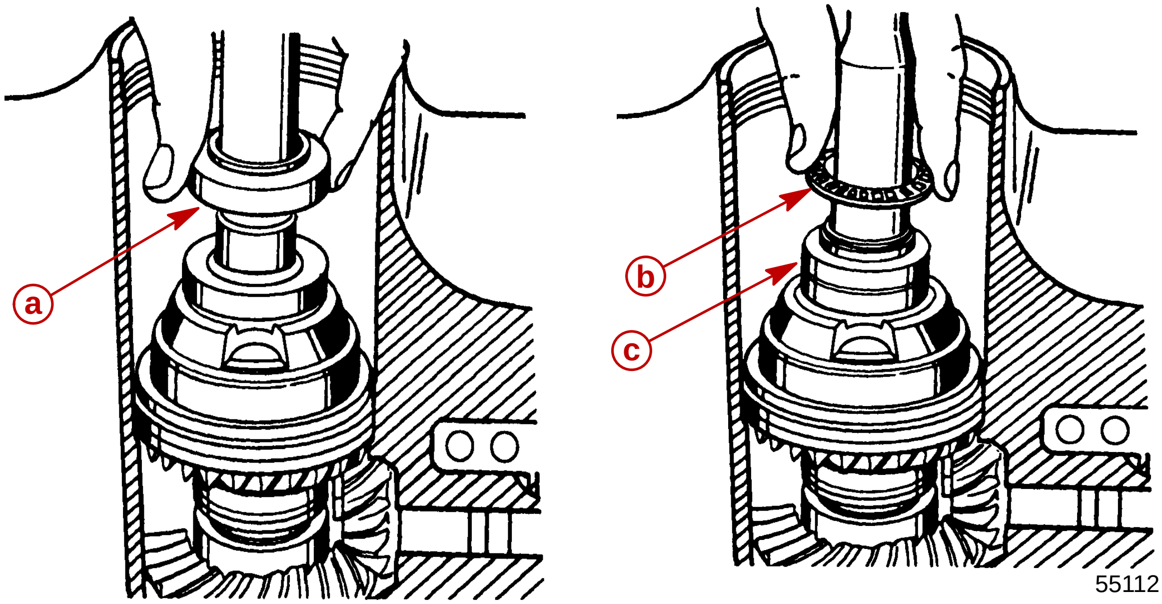




a - Thrust Collar
b - Thrust Bearing
c - Propeller Shaft
d - Keepers (2)
e - Thrust Collar

21. Install second thrust collar with its stepped side **UP**.

22. Apply Quicksilver Super Duty Gear Lubricant to the second thrust bearing and install it on top of the second thrust collar.



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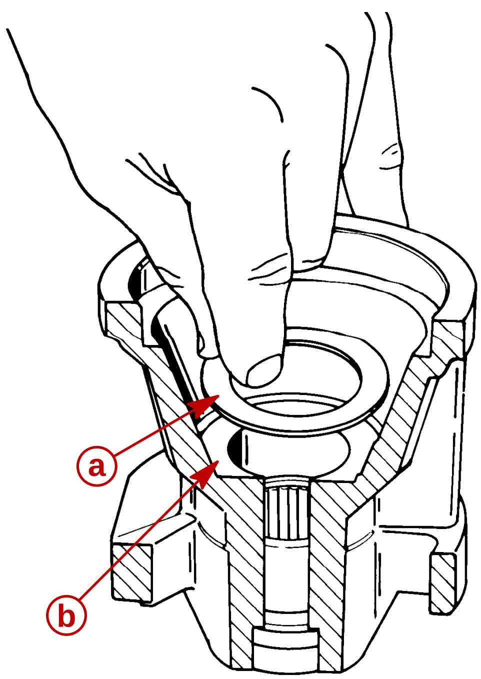
a - Thrust Collar
b - Thrust Bearing
c - Thrust Collar

23. Apply Quicksilver Super Duty Gear Lubricant to to second small thrust bearing race and install race to the surface inside of the bearing carrier.

24. Apply Quicksilver 2-4-C w/Teflon Marine Lubricant to bearing carrier O-ring. Install O-ring onto bearing adaptor.



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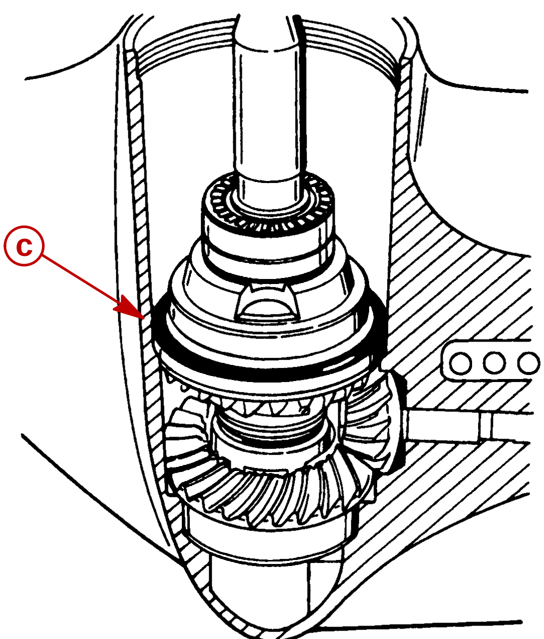

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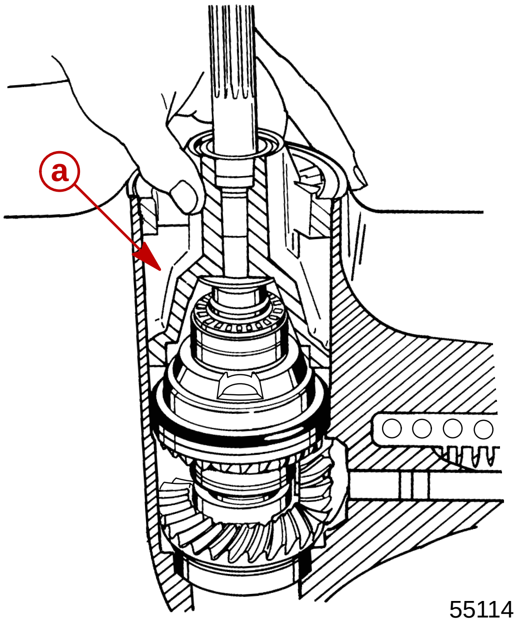
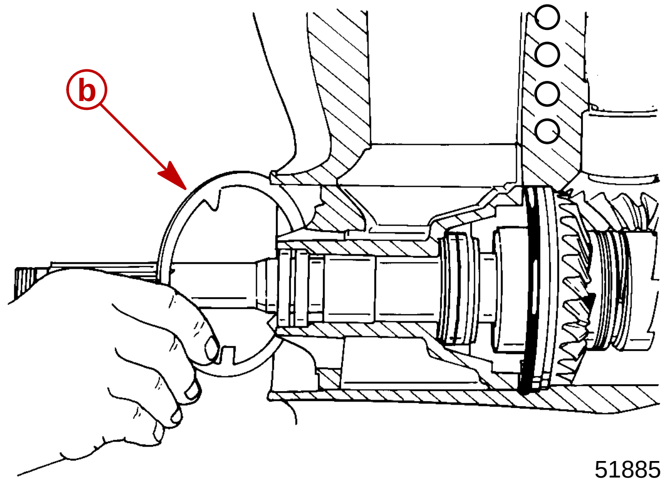
a - Thrust Race
b - Bearing Carrier Race Surface
c - O-ring

25. Apply Quicksilver 2-4-C w/Teflon Marine Lubricant to:
    a. Outer diameter of bearing carrier which contacts gear case.
    b. Space between carrier oil seals.
26. Apply Quicksilver Super Duty Gear Lubricant to bearing carrier needle bearing.
27. Install bearing carrier into gear housing.
28. Verify bearing carrier keyway is aligned with gear housing keyway and install bearing carrier key.
29. Place tab washer against bearing carrier.



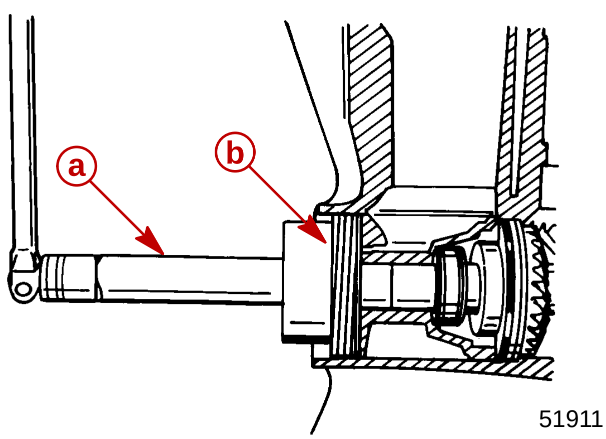


a - Bearing Carrier
b - Tab Washer

30. Apply 2-4-C w/Teflon to threads of cover nut and install cover nut in gear housing. Verify that the word “OFF” and arrow are visible.

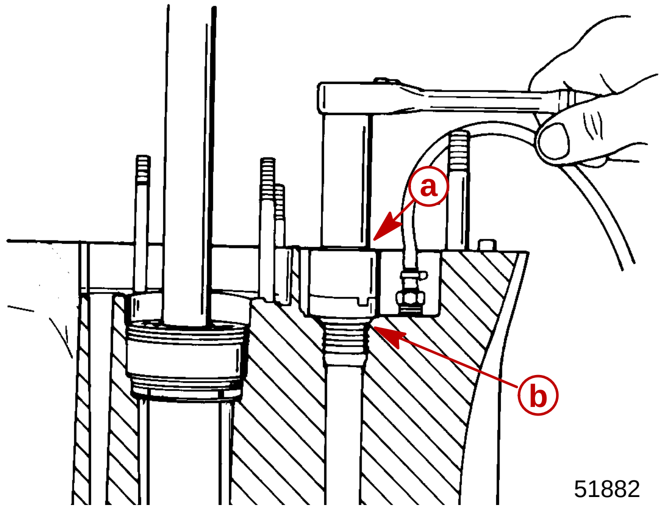
NOTE: *Before torquing bearing carrier cover nut, gear case should either be mounted in a stand specifically designed for holding gear cases or bolted to a driveshaft housing to avoid possible damage to the gear case.*

31. Using Cover Nut Tool (91-61069), torque cover nut to 210 lb. ft. (285 Nm).



a - Retainer Nut Tool (91-61069)
b - Retainer Nut

32. Bend one lock tab of tab washer into cover nut (only one will align).
33. Bend remaining tabs of tab washer toward front of gear housing.
34. Use Shift Shaft Bushing Tool (91-31107) and torque shift shaft bushing to 50 lb. ft. (68 Nm).

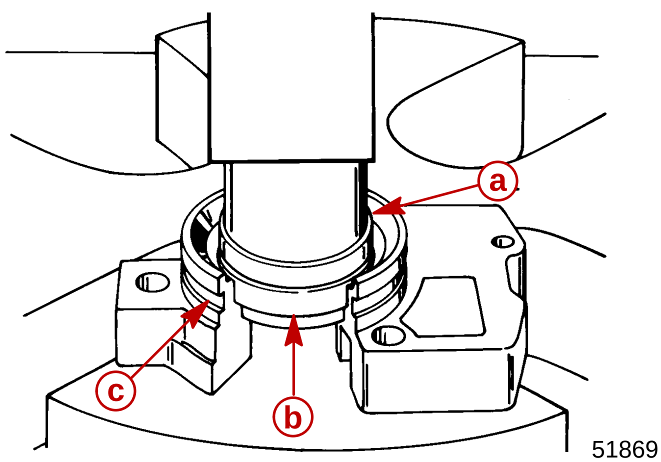


a - Shift Shaft Bushing Tool (91-31107)
b - Shift Shaft Bushing

Water Pump

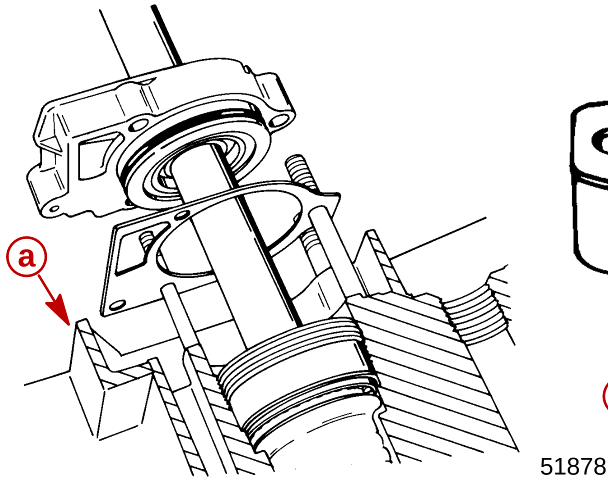
REASSEMBLY/INSTALLATION

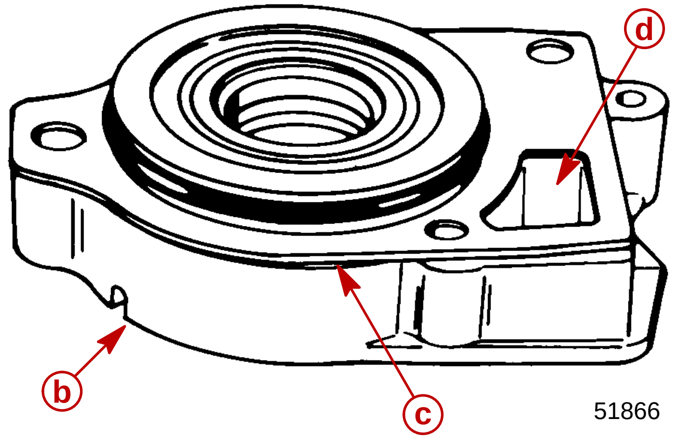
1. Install oil seals into water pump base, as follows:
   a. Place water pump base on a press.
   b. Just before installing each seal apply Loctite 271 on outside diameter of oil seal.
   c. With a suitable mandrel, press the smaller diameter oil seal into pump base with lip of oil seal toward impeller side of base.
   d. With a suitable mandrel, press the larger diameter oil seal into pump base with lip of oil seal toward gear housing side of base.
   e. Wipe any excess Loctite from oil seals and water pump base.
2. Install O-ring into O-ring groove of water pump base. Lubricate O-ring and oil seals with 2-4-C w/Teflon Marine Lubricant (92-90018A12).



a - Mandrel
b - Oil Seal (Smaller OD)
c - O-Ring Groove

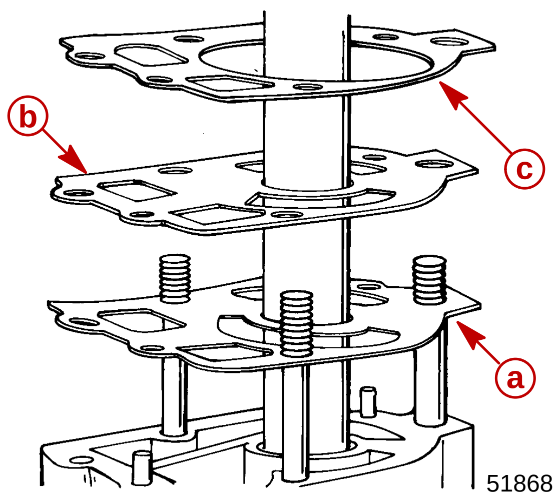
3. Install divider block if removed. Use RTV Sealer to seal seams between divider block and gear housing.
4. Install a new water pump base gasket and install water pump base.





a - Divider Block
b - Water Pump Base
c - Gasket
d - Hole (MUST be positioned as shown)

5. Install the following in order: Pump base to face plate gasket, face plate to pump cover gasket. Gaskets and face plate are indexed by dowel pin location and must be installed correctly.



a - Gasket (Water Pump Base to Face Plate)
b - Face Plate
c - Gasket (Face Plate to Water Pump Cover)

6. Place impeller drive key on flat of driveshaft. Hold key on driveshaft with a small amount of Quicksilver 2-4-C w/Teflon Marine Lubricant (92-90018A12).

IMPORTANT: When completing gear housing repair that requires removal of water pump impeller, it is recommended that the impeller be replaced. If it is necessary to reuse the impeller, DO NOT install in reverse to original rotation or premature impeller failure will occur. Original rotation is clockwise.

⚠ CAUTION

A visual inspection of impeller drive key MUST BE made to determine that drive key is on flat of driveshaft after impeller is installed. If key has moved off flat of driveshaft, repeat Steps 6 and 7.

7. Slide impeller down driveshaft to impeller drive key. Align drive key with keyway in the center hub of impeller, and slide impeller over drive key.
8. If removed, install new water pump insert into pump cover as follows:
    a. Apply Quicksilver Perfect Seal to water pump insert area of pump cover.
    b. Install water pump insert into pump cover, being sure that tab on insert enters recess in pump cover.
    c. Wipe any excess Quicksilver Perfect Seal from insert and cover.

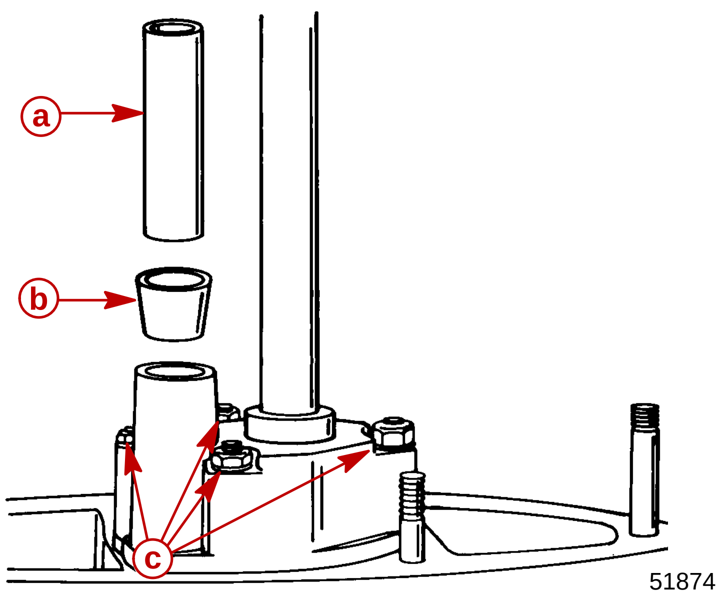
NOTE: *If 2 holes were drilled in top of water pump cover to aid in removal of insert, fill holes with RTV Sealer or equivalent. Allow to cure 24 hours prior to operating engine.*

9. Install water tube seal into pump cover. Plastic side of seal goes into cover first.
10. Reinstall water tube guide into water pump cover.
11. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant to inside of water pump insert.
12. Position assembled water pump cover over driveshaft and lower over water pump studs. Rotate driveshaft in a clockwise direction (viewed from top), while pushing down on pump cover to ease impeller entry into cover.
13. Install water pump cover retainer washers, nuts and bolt.

CAUTION

DO NOT over-torque nuts and bolt, as this could cause cover to crack during operation.

14. Torque water pump nuts to 50 lb. in. (6.0 Nm), and water pump bolt to 35 lb. in. (4 Nm).
15. Install centrifugal slinger over driveshaft and down against pump cover.



a - Water Tube Guide
b - Water Tube Seal
c - Nuts, Bolts and Washers

Gear Lubricant Filling Instructions

1. Remove any gasket material from “Fill” and “Vent” screws and gear housing.
2. Install new gaskets on “Fill” and “Vent” screws.

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

3. Slowly fill housing thru “Fill” hole with Quicksilver Super Duty Lower Unit Lubricant until lubricant flows out of “Vent” hole and no air bubbles are visible.
4. Install “Vent” screw into “Vent” hole.

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

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

Installing Gear Housing to Driveshaft Housing

WARNING

Disconnect high tension leads from spark plugs and remove spark plugs from engine before installing gear housing onto driveshaft housing.

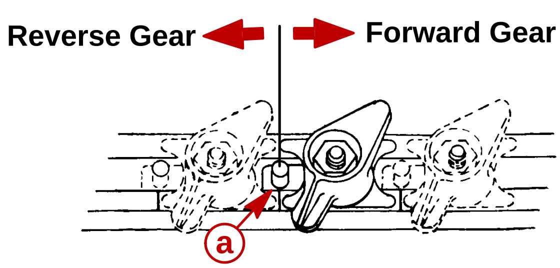
1. Tilt engine to full up position and engage the tilt lock lever.
2. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto driveshaft splines.

CAUTION

DO NOT allow lubricant on top of driveshaft. Excess lubricant, that is trapped in clearance space, will not allow driveshaft to fully engage with crankshaft. Subsequently, tightening the gear housing nuts (while excess lubricant is on top of driveshaft) will load the driveshaft/crankshaft and damage either or both the powerhead and gear housing. Top of driveshaft is to be wiped free of lubricant.

3. Apply a light coat of Quicksilver 2-4-C w/Teflon Marine Lubricant onto shift shaft splines. (DO NOT allow lubricant on top of shift shaft.)
4. Apply a thin bead of G.E. Silicone Sealer (92-90113--2) against the top of divider block.
5. Insert trim tab bolt into hole in rear of gear housing to driveshaft housing machined surface.
6. Shift gear housing into forward gear and place guide block anchor pin into forward gear position.

Counter Rotation Outboard



a - Guide Block Anchor Pin

7. Position gear housing so that the driveshaft is protruding into driveshaft housing.

NOTE: *If, while performing Step 8, the driveshaft splines will not align with crankshaft splines, place a propeller onto propeller shaft and turn it counterclockwise as the gear housing is being pushed toward driveshaft housing.*

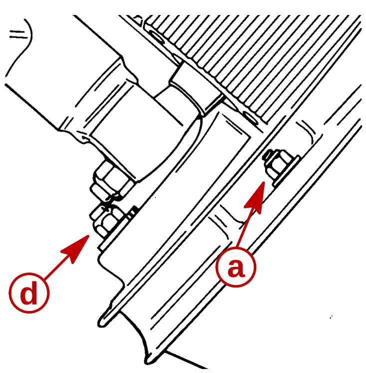
8. Move gear housing up toward driveshaft housing while aligning shift shaft splines and water tube with water tube guide (in water pump cover).
9. Place flat washers onto studs (located on either side of driveshaft housing). Start a nut (a) on these studs and tighten finger-tight.
10. Start bolt (b) 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 (a) which were started in Step 9. Torque to listing in **"Torque Specifications,"** preceding.
13. After 2 nuts (located on either side of driveshaft housing) are tightened, check shift operation as follows:
    a. Place guide block anchor pin into forward gear position while turning prop shaft. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate clockwise.
    b. Place guide block anchor pin into NEUTRAL position. Propeller shaft should rotate freely clockwise/counterclockwise.
    c. Place guide block anchor pin into REVERSE gear position. Rotate flywheel clockwise (viewed from top); propeller shaft should rotate counterclockwise.

IMPORTANT: If shifting operation is not as described, preceding, the gear housing must be removed and the cause corrected.

14. Install washers and nuts (c) onto studs (located on bottom center of anti-cavitation plate). Torque to listing in **"Torque Specifications,"** preceding.



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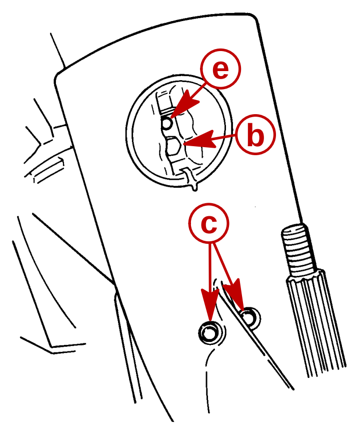

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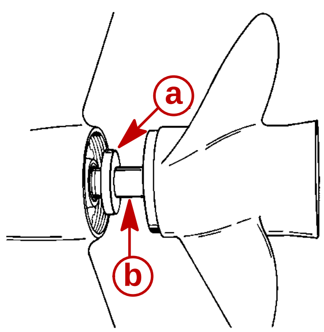
15. Install special flat washer and nut (d) on stud at leading edge of driveshaft housing. Torque to listing in **"Torque Specifications,"** preceding.
16. Torque bolt (started in Step 10) to listing in **"Torque Specifications,"** preceding.
17. Install trim tab, adjust to position in which it had previously been installed, and tighten bolt (e) securely.
18. Install plastic cap into trim tab bolt opening at rear edge of driveshaft housing.

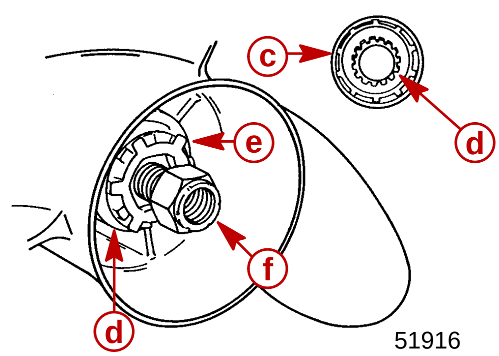
Propeller Installation

⚠ WARNING

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

1. To aid in future removal of the propeller, liberally coat the propeller shaft splines with one of the following Quicksilver products:
   -- Anti-Corrosion Grease (92-78376A6)
   -- Special Lubricant 101 (92-13872A1)
   -- 2-4-C Marine Lubricant (92-90018A12)
   -- Perfect Seal (92-34227--1)
2. Place forward thrust hub over propeller shaft with shoulder side toward propeller.
3. Place propeller on propeller shaft and slide it up against thrust hub.
4. Place continuity washer (if equipped) onto shoulder of rear thrust hub.
5. Place rear thrust hub, tab washer and propeller nut on propeller shaft.
6. Thread propeller nut onto propeller shaft until nut is recessed into tab washer.
7. After propeller nut is recessed into tab washer, tighten nut securely [minimum of 55 lb. ft. (74.5 Nm) torque].
8. Bend 3 of the tabs of tab washer down in grooves of rear thrust hub to secure propeller nut. (If tab washer tabs do not align with slots, continue to tighten propeller nut to obtain alignment. DO NOT loosen nut to align tabs.)





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

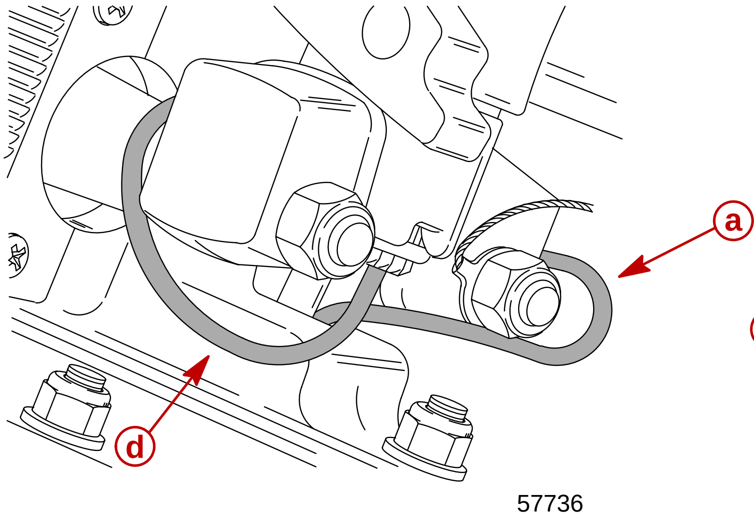
⚠ CAUTION

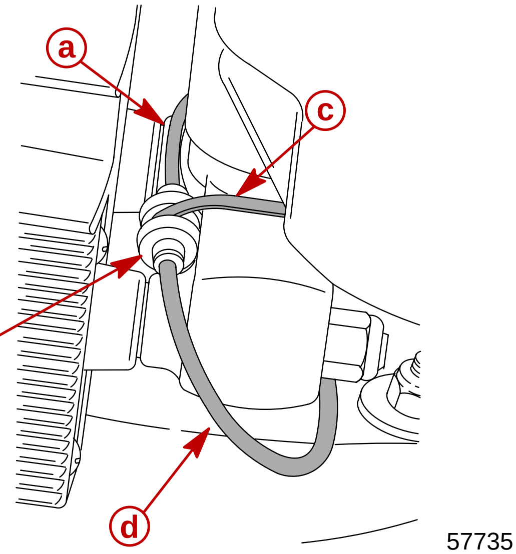
DO NOT misinterpret propeller shaft movement with propeller movement. If propeller and propeller shaft together move forward-and-aft, this is normal; however, propeller should not move forward-and-aft on propeller shaft.

9. After first use, retighten propeller nut and again secure with tab washer (Steps 7 and 8, preceding). Propeller should be checked periodically for tightness, particularly if a stainless steel propeller is used.

Speedometer Tube Installation

1. Route speedometer tube from gearcase around lower yoke and push into junction. Junction should be secured to yoke with sta-strap.
2. Route speedometer tube from swivel tube around lower yoke and push into junction. After insertion of speedometer tubes into junction, pull on each tube to verify that they are locked into junction. If tube pulls out, reinsert into junction.





a - Speedometer Tube from Gearcase
b - Junction
c - Sta-strap
d - Speedometer Tube from Swivel Tube

ATTACHMENTS / CONTROL LINKAGE

Section 7

Table of Contents

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.

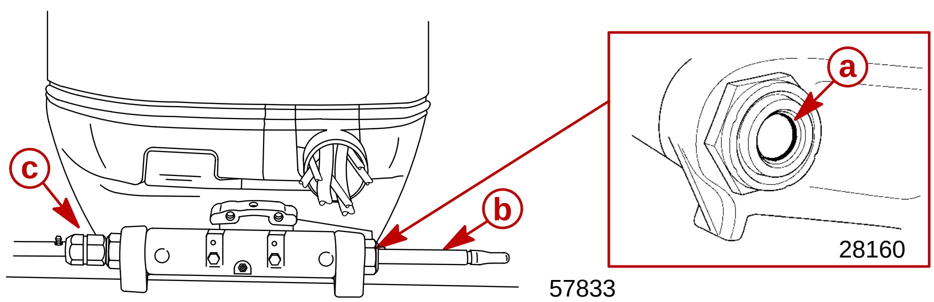
IMPORTANT: Steering cable and remote control cables must be the correct length, sharp bends on too-short cables result in “kinks”; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and will reduce the performance of the steering system.

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).

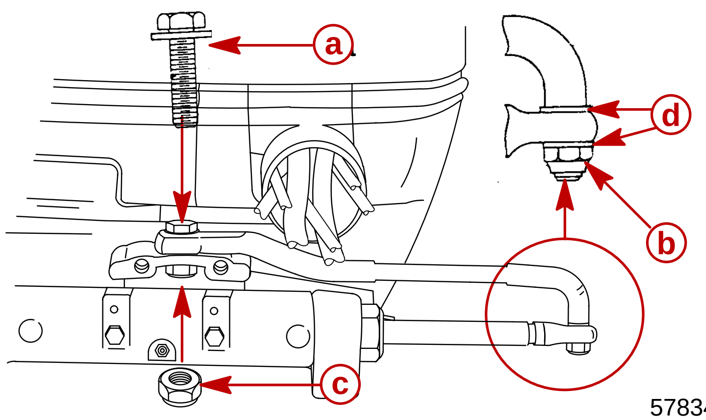


STEERING LINK ROD INSTALLATION

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.

3. Assemble steering link rod to steering cable with two flat washers (d) and nylon insert locknut ("b" - Part Number 11-34863). Tighten locknut (b) until it seats, then back nut off 1/4 turn.
4. **Production Outboards -** Assemble steering link rod to engine with special washer head bolt ("a" - Part Number 10-14000) and nylon insert locknut ("c" - Part Number 11-34863). First torque bolt (a) to 20 lb. ft. (27 Nm), then torque locknut (c) to 20 lb. ft. (27 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.



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

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service -** Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **"Severe Service."**

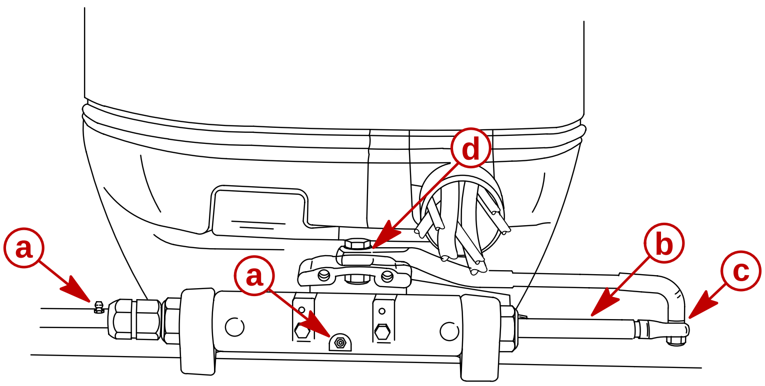
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

***NOTE:** Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

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

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable end (b) with 2-4-C w/Teflon.
4. Lubricate pivot point (c) of steering link rod and ball joint (d) of link rod with SAE 30 Weight Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



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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.

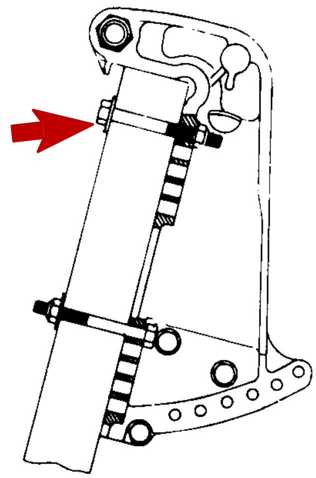
CAUTION

Marine sealer must be used on shanks of 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.

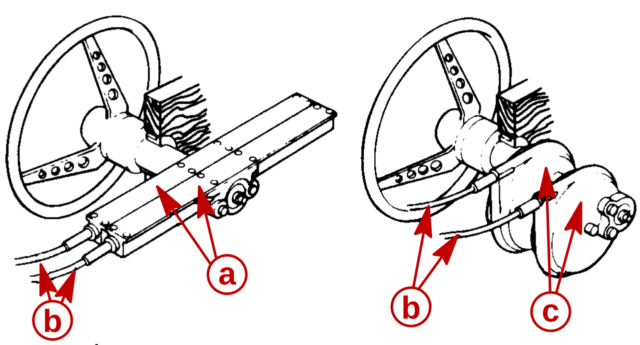
Install upper bolts so that hex head end of bolts is on the inside of boat transom.



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.

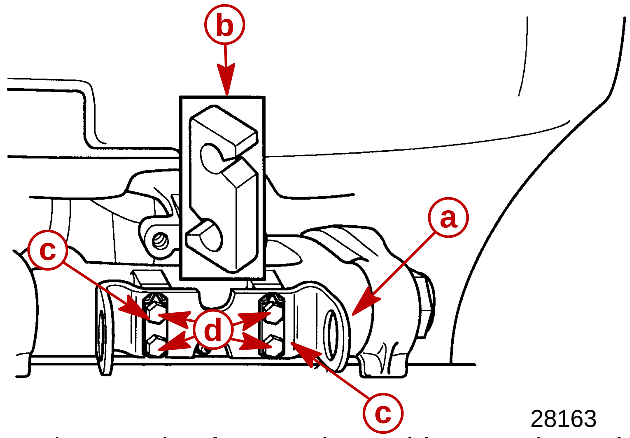


a - Gear Rack
b - Steering Cables
c - Rotary Steering Heads

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.

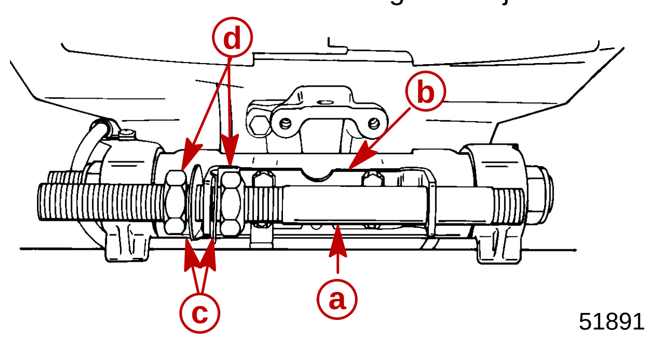


a - Mounting Bracket for Steering Cable Mounting Tube
b - Spacer (2)
c - Locking Retainer (2)
d - Bolts (4) - 7/8 in. (22 mm) Long - Torque to 100 lb. in. (11.5 Nm), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ 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.

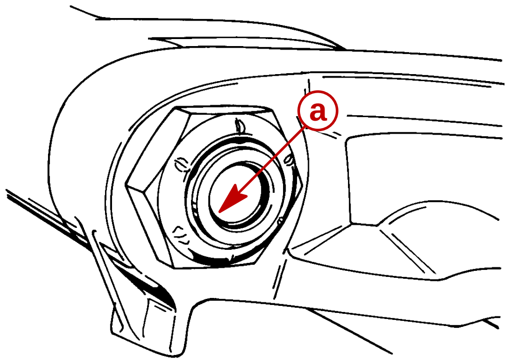


a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

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.



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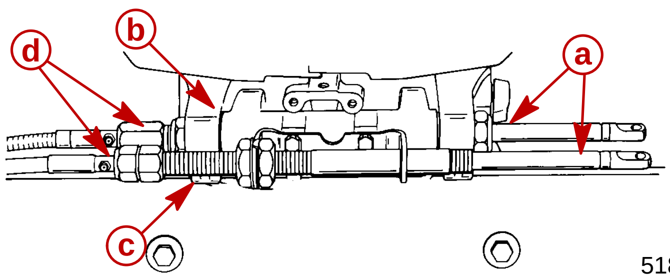
Insert steering cable ends (a) thru outboard tilt tube (b) and cable mounting tube (c). Thread steering cable attaching nuts (d) on to tubes hand tight.

NOTE: *Torque steering cable attaching nuts only after final steering adjustments have been made.*



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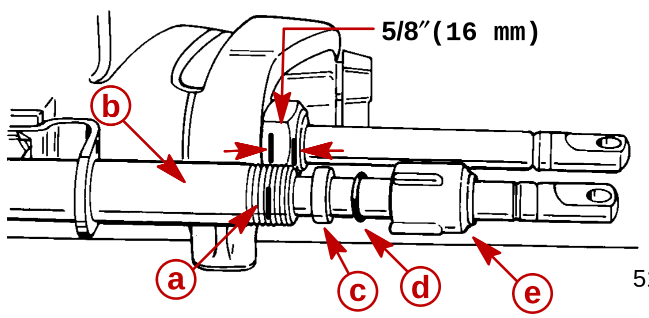
Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16 mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



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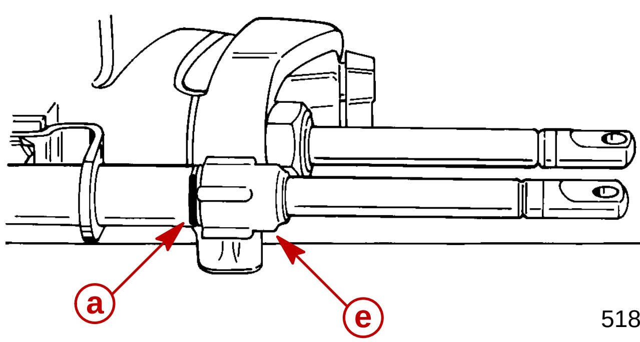
Thread cap (e) onto steering cable mounting tube, up to mark (a).



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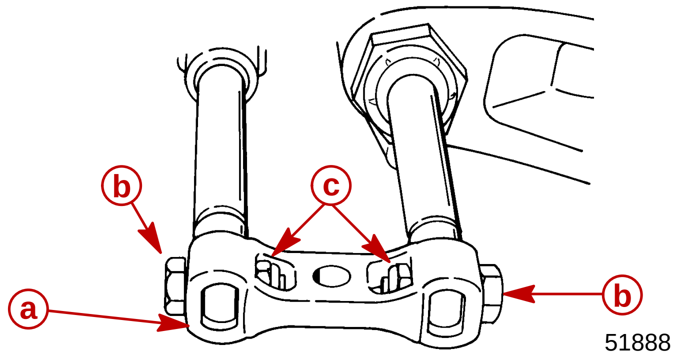
Coupler Installation

⚠ 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 Nm).



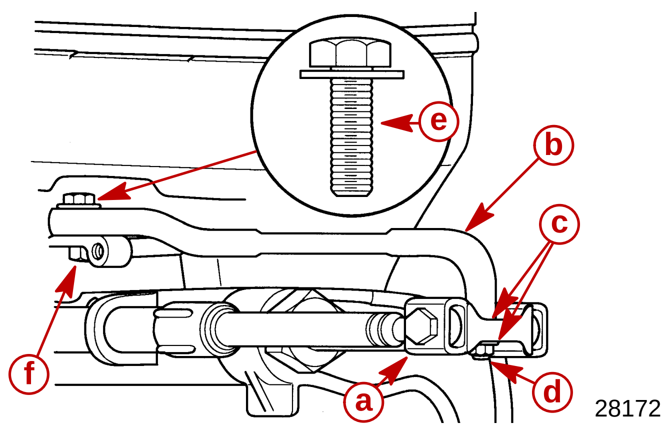
Installing Link Rod

⚠ WARNING

Steering link rod MUST BE secured between outboard steering arm and steering coupler, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.

Lubricate hole in steering coupler, with Quicksilver 2-4-C w/Teflon. Assemble steering link rod to steering coupler, using 2 flat washers (one each side of coupler) and nylon insert locknut. Tighten locknut until it seats [DO NOT exceed 120 lb. in. (13.5 Nm) 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 lock-nut as shown. Torque special bolt to 20 lb. ft. (27 Nm), then torque locknut to 20 lb. ft. (27 Nm).

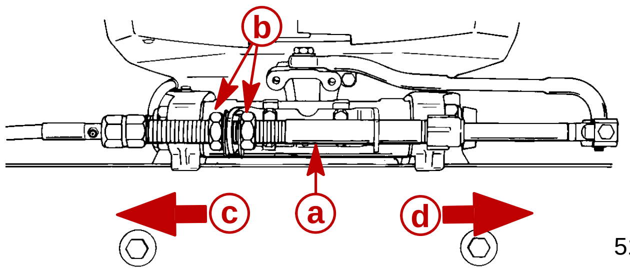


a - Steering Coupler
b - Steering Link Rod
c - Flat Washer (2)
d - Nylon Insert Locknut - Torque until it seats [DO NOT exceed 120 lb. in. (13.5 Nm) of torque], then back nut off 1/4 turn
e - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27 Nm)
f - Nylon Insert Locknut - Torque to 20 lb. ft. (27 Nm)

STEERING SYSTEM TENSION ADJUSTMENT

IMPORTANT: After this dual steering cable attachment kit is installed, there must be proper tension in forward mounted steering cable tor this attachment kit to operate properly. Not enough tension will cause slack (or play) in steering system. Too much tension will cause steering cables to bind. Perform the following steps to adjust for correct tension.

Loosen adjustment nuts and pull steering cable mounting tube (by hand) away from end of steering cable (to remove slack in steering system). Tighten adjustment nuts against mounting bracket and check system for slack (play.) If steering system is too tight, readjust tube toward end of steering cable or, if too much slack (play) exists in system, readjust tube away from end of steering cable. Tighten nuts against mounting bracket and readjust, if necessary.



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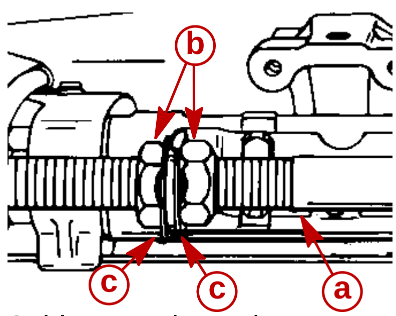
- **a** - Steering Cable Mounting Tube
- **b** - Adjustment Nuts
- **c** - Adjust Tube in This Direction to Remove Slack from Steering System
- **d** - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.5 Nm) and bend a tab lock washer against flat on each adjustment nut.



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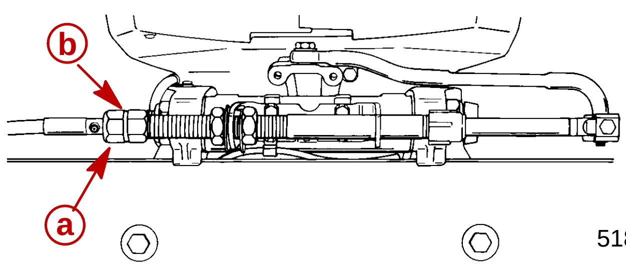
- **a** - Steering Cable Mounting Tube
- **b** - Adjustment Nuts; Torque to 35 lb. ft. (47.5 Nm)
- **c** - Tab Lock Washer (Bend Against Flat on Each Adjustment Nut)

Tighten steering cable attaching nuts of each steering cable to a torque of 35 lb. ft. (47.5 Nm).



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- **a** - Cable Attaching Nut
- **b** - "V" Groove

NOTE: *Cable attaching nuts with a "V" groove around the outer circumference of the nut are self locking and do not require locking sleeves.*

⚠ WARNING

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

Maintenance Instructions

Maintenance inspection is owner's responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)
***Severe Service -** Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered "Severe Service."

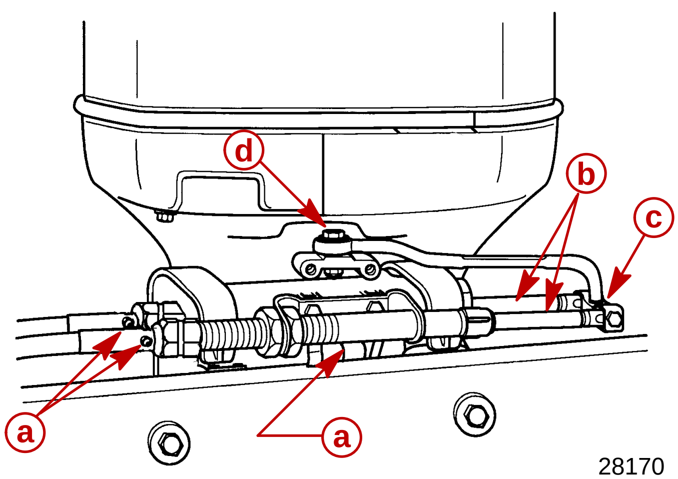
1. Carefully check steering system components for wear. Replace worn parts.
2. Check steering system fasteners to be sure that they are torqued to correct specifications.

NOTE: *Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

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

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings (a) with 2-4-C w/Teflon (92-825407A2). Lubricate exposed portion of cable ends (b) with 2-4-C w/Teflon.
4. Lubricate pivot point (c) of steering link rod and ball joint (d) of link rod/steering coupler with SAE 30W Motor Oil.
5. Inspection and lubrication of steering head assembly (rotary or straight rack) should be performed once each year (by your Authorized Dealer) or whenever steering mount and/or steering head are disassembled, or if steering effort has increased. Lubricate with 2-4-C w/Teflon.



Ride Guide Steering Cable/Attaching Kit Installation (92876A6)

Dual Cable - Dual Outboard

WARNING

Quicksilver Super Ride-Guide Steering (dual cables) MUST BE USED with this attaching kit. Failure to adhere to this requirement could result in steering system failure.

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

IMPORTANT: Steering cable and remote control cables MUST BE THE CORRECT LENGTH, sharp bends on too-short cables result in "kinks"; too-long cables require unnecessary bends and/or loops. Both conditions place extra stress on the cables and reduce the performance of the steering system.

Installation Requirements

IMPORTANT: The distance from each outboard's centerline to the side of transom opening MUST BE a minimum of 16 in. (406 mm).

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. (597 mm thru 699 mm) outboard centerline spacing. If outboard centerline distance is other then specified, refer to end of this instruction manual for optional extension couplers.

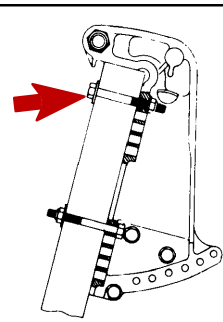
DETERMINE ROUTING OF STEERING CABLES

Use "1" or "2", following, to route steering cables:

1. **Parallel cable routing:** Cables routed together down starboard side of boat Refer to **"Parallel Routed Steering Cables and Attaching Kit Installation,"** immediately following.
2. **Opposite side cable routing:** One cable routed down starboard side of boat and one cable routed down port side of boat. Refer to **"Opposite Side Routed Steering Cables and Attaching Kit Installation,"** located on page 18 of this instruction manual.

CAUTION

With this kit installed, the upper (outboard) mounting bolts MUST BE installed so that hex head end of bolts is on the inside of boat transom, as illustrated. Failure to install upper mounting bolts, as shown in illustration, could result in interference between steering cable nut and ends of mounting bolts when outboard is tilted up.



Install upper bolts so that hex head end of bolts is on the inside of boat transom.

Parallel Routed Steering Cables and Attaching Kit Installation

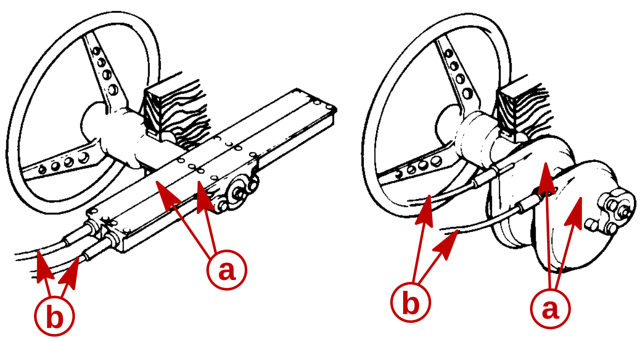
(Both Steering Cables Routed Together Down Starboard Side of Boat)

SUPER RIDE-GUIDE STEERING KIT INSTALLATION

IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

Both gear racks or rotary steering heads must be installed so that both steering cables will be routed together on the same side of the boat and will push- and-pull together.

1. Install Super Ride-Guide Steering Kit in accordance with instructions included with Super Ride-Guide Kit.
2. Make sure that both gear racks or rotary steering heads are installed so that both steering cables are routed together and will push-and-pull together.

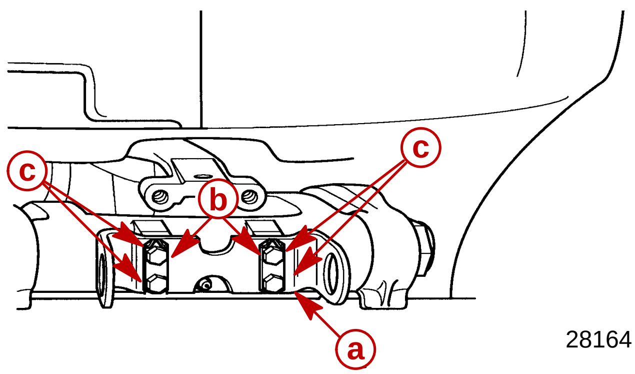


a - Straight Rack (Left); Rotary Steering (Right)
b - Steering Cables (Install so that Both Cables Will Push and Pull Together)

STEERING CABLE INSTALLATION STARBOARD OUTBOARD

IMPORTANT: Mounting bracket for steering cable mounting tube MUST BE secured to outboard swivel bracket, using 5/8 in. (16 mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



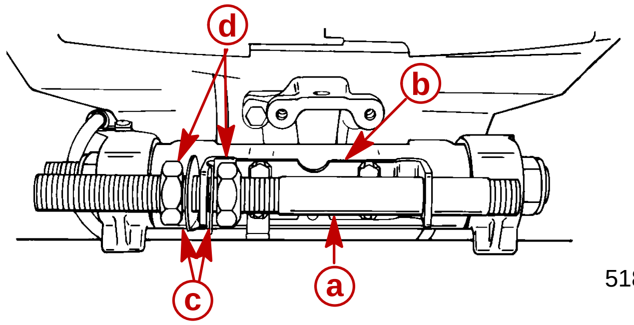
a - Mounting Bracket for Steering Cable Mounting Tube
b - Locking Retainers (2)
c - Bolts (4) - 5/8 in. (16 mm) Long - Torque to 100 lb. in. (11.5 Nm), then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt

⚠ 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.



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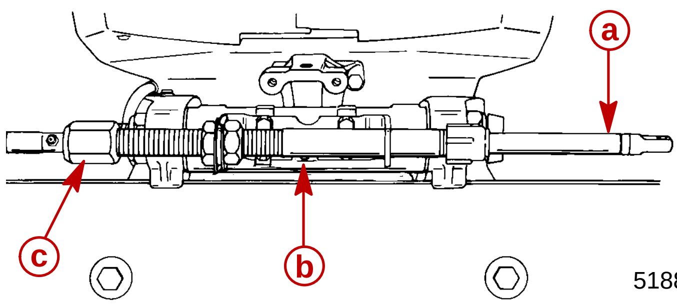
a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Starboard Side of Boat)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

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.*



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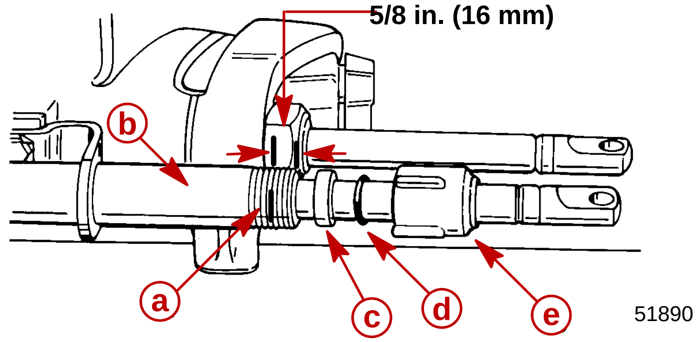
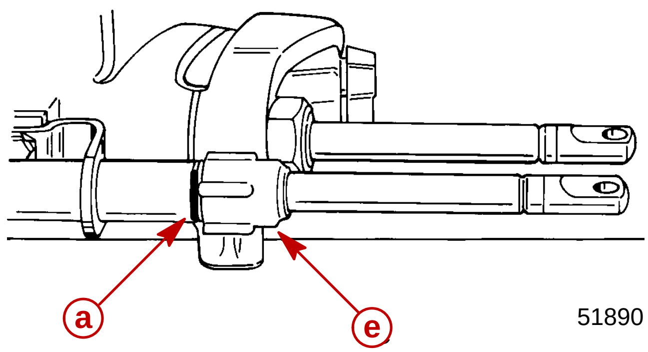
Place a mark (a) on steering cable mounting tube (b) 5/8 in. (16 mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



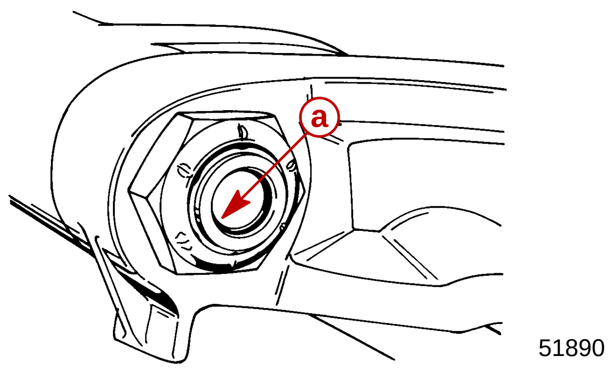
Thread cap (e) onto steering cable mounting tube, up to mark (a).



STEERING CABLE INSTALLATION - PORT OUTBOARD

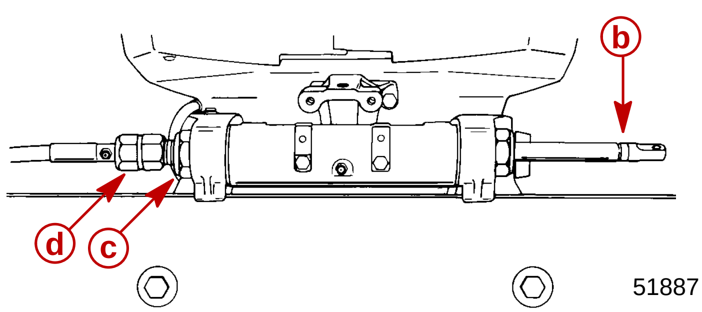
IMPORTANT: Lubricate inside of port outboard's tilt tube and rubber O-ring seal located inside tilt tube with 2-4-C w/Teflon, before installing steering cable.

Lubricate inside of port outboard's tilt tube and rubber O-ring seal (a) with 2-4-C w/Teflon.



Insert steering cable end (b) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

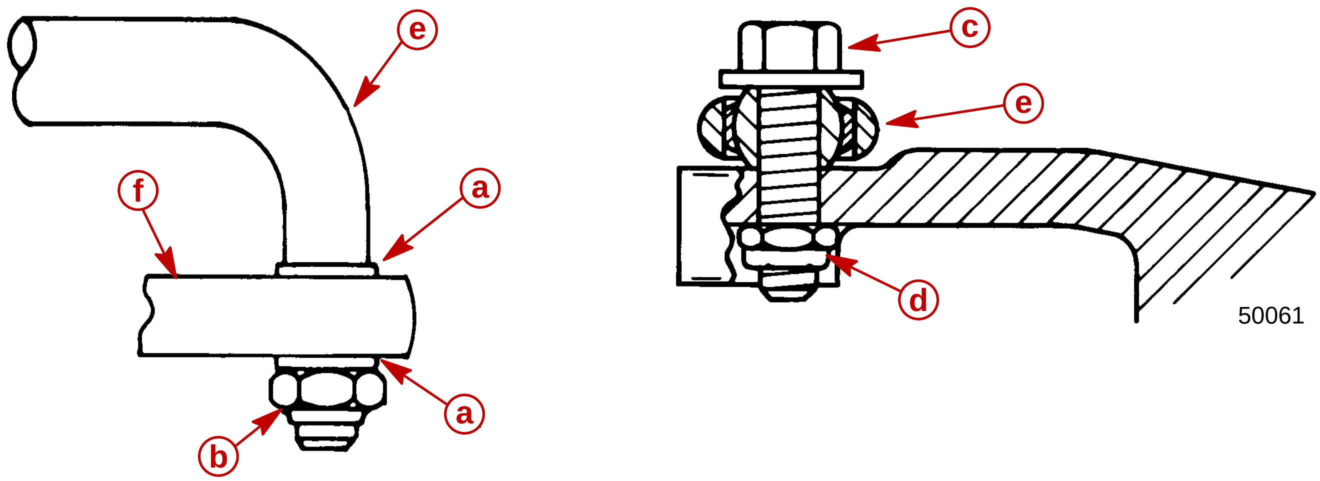
NOTE: *Torque steering cable attaching nuts only after final steering adjustments have been made.*

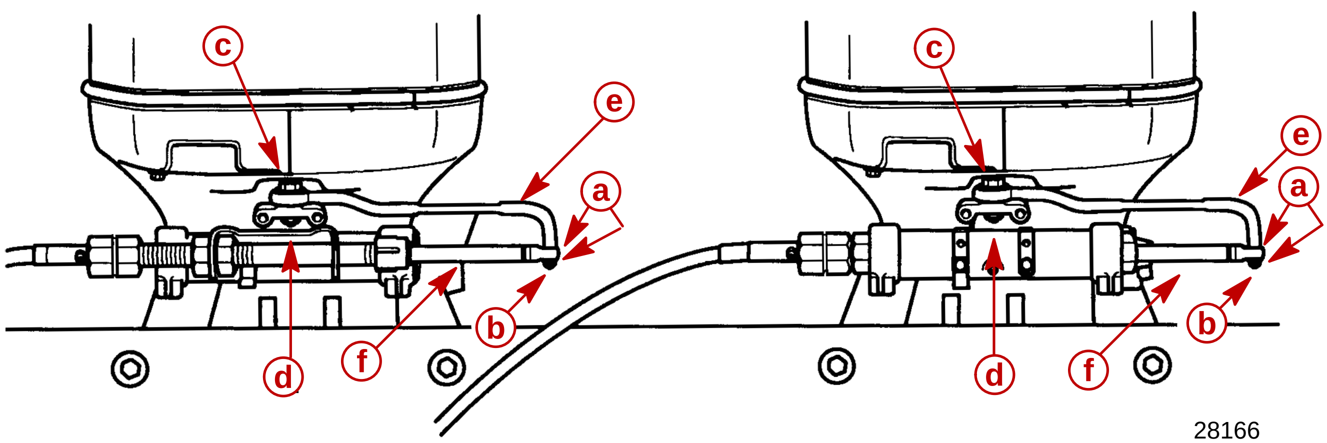


STEERING LINK ROD INSTALLATION

⚠ WARNING

Steering link rods MUST BE secured between outboard steering arm and steering cable end, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.





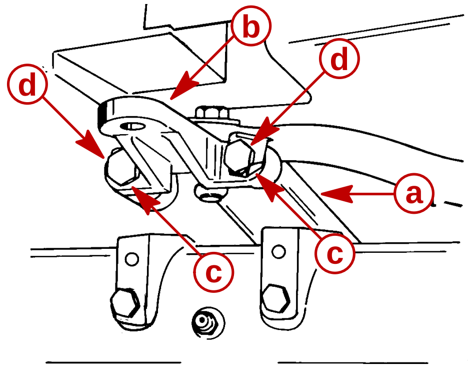
- **a** - Flat Washer (2 Each Link Rod)
- **b** - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.5 Nm) of Torque], Then Back Off 1/4 Turn
- **c** - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27 Nm)
- **d** - Nylon Insert Locknut - Torque to 20 lb. ft. (27 Nm)
- **e** - Steering Link Rod
- **f** - Steering Cable End

Lubricate holes in ends of steering cables, with Quicksilver 2-4-C w/Teflon Marine Lubricant. Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 lb. in. (13.5 Nm) 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 Nm) then torque locknuts to 20 lb. ft. (27 Nm).

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. (31.8 mm) Long - Torque to 23 lb. ft. (31 Nm), 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

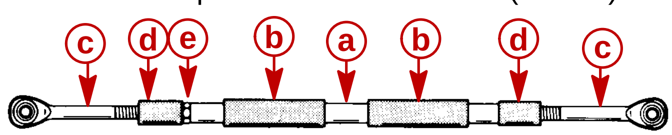
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions MUST BE equal to distance between propeller shaft centerlines.)

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. (70 mm).



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. (19 mm) minimum. Thread length of steering eye is 3-1/2 in. (89 mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (70 mm). 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.

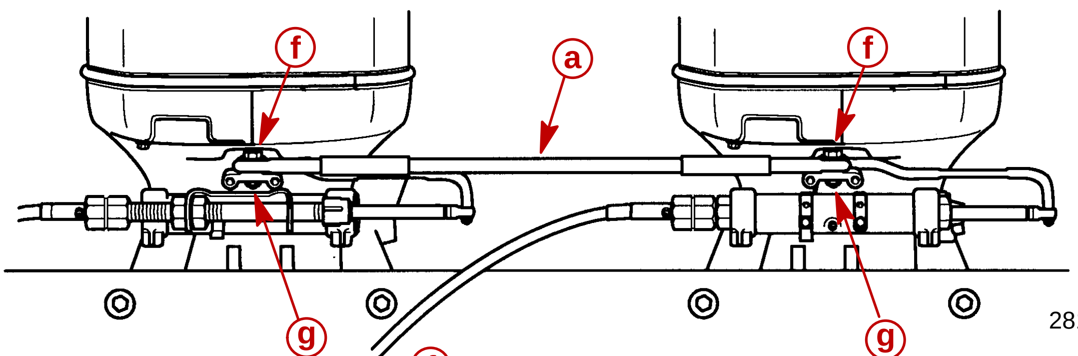
IMPORTANT: With assembled steering coupler installed and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts MUST BE equal to distance between propeller shaft center lines, for proper steering. It adjustment is necessary, temporarily remove special washer head bolt/locknut from one steering eye and turn eye in or out to correct alignment.

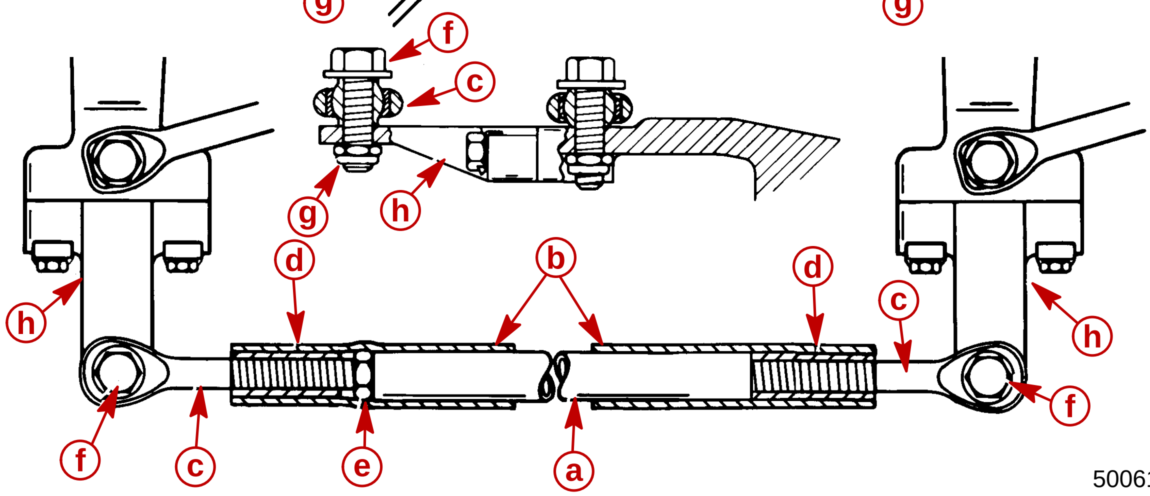
Torque special washer head bolts to 20 lb. ft. (27 Nm), then torque locknuts to 20 lb. ft. (27 Nm).

⚠ WARNING
Both steering eyes MUST BE threaded into coupler 3/4 in. (19 mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque “jam” nut to 20 lb. ft. (27 N·m).

Tighten “jam” nut against coupler. Torque “jam” nut to 20 lb. ft. (27 Nm).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.



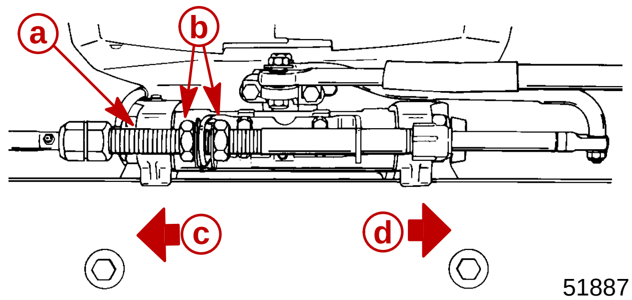


a - Coupler
b - Rubber Sleeve
c - Steering Eye
d - Rubber Bushing
e - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27 Nm)
f - Special Washer Head Bolt (10-14000) - Torque to 20 lb. ft. (27 Nm)
g - Nylon Insert Locknut - Torque to 20 lb. ft. (27 Nm)
h - Steering Arm Extension Bracket

STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

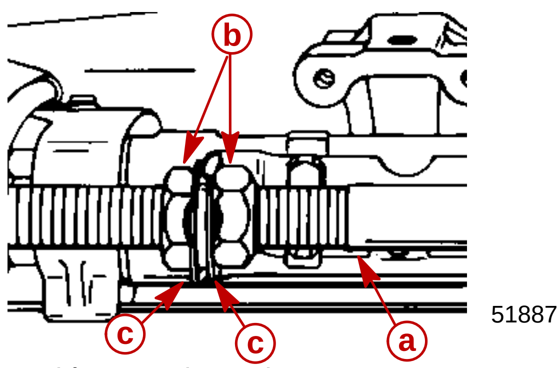
IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there MUST BE proper tension in the steering system. NOT ENOUGH tension will cause slack (play) in steering system. TOO MUCH tension will cause steering cables to bind. Perform the following steps to correctly adjust 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.



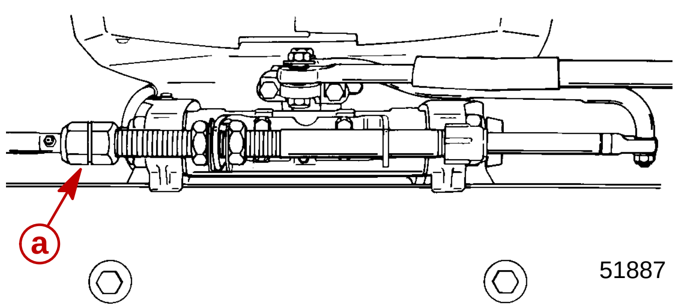
a - Steering Cable Mounting Tube
b - Adjustment Nuts
c - Adjust Tube in This Direction to Remove Slack from Steering System
d - Adjust Tube in This Direction to Reduce Tension from Steering System

After steering system tension is adjusted correctly, tighten adjustment nuts against mounting bracket, to a torque of 35 lb. ft. (47.5 Nm) 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 Nm)
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 Nm).



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

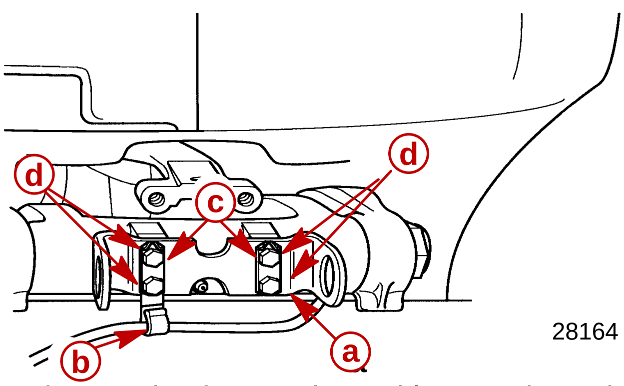
IMPORTANT: Steering cable must be installed into tilt tube of port outboard before outboard is mounted on boat transom.

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. (16 mm) long bolts supplied with this dual cable - dual outboard attaching kit.

Secure mounting bracket for steering cable mounting tube, onto swivel bracket of starboard outboard.



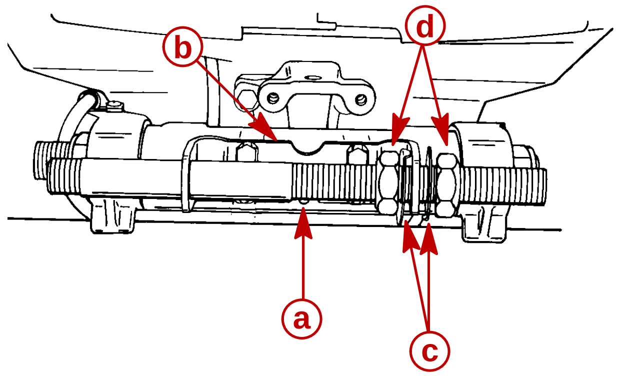
a - Mounting Bracket for Steering Cable Mounting Tube
b - "J" Clip - Supplied with Outboard
c - Locking Retainers (2)
d - Bolts (4) - 5/8 in. (16 mm) Long - Torque to 100 lb. in. (11.5 Nm), Then Bend Corner Tabs of Locking Retainers Up and Against Flats on Each Bolt.

⚠ 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.



51891

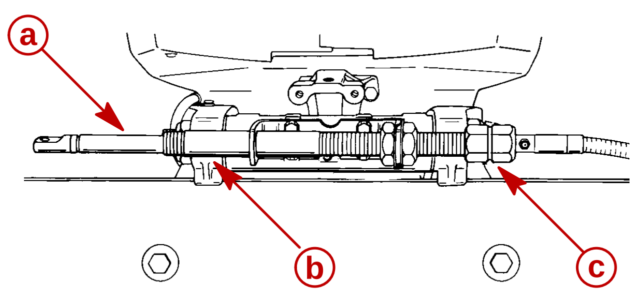
a - Steering Cable Mounting Tube (End of Tube with Longer Threads Toward Center of Boat Transom)
b - Mounting Bracket
c - Locking Tab Washers (2)
d - Adjustment Nuts (Flats of Nuts Facing Toward Locking Tab Washer)

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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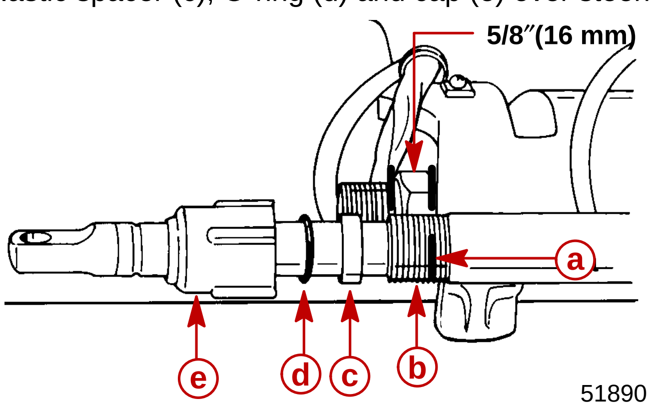
Place a mark (a) on steering cable mounting tube (b) 5/8 in (16 mm) from end of mounting tube. Slide plastic spacer (c), O-ring (d) and cap (e) over steering cable.



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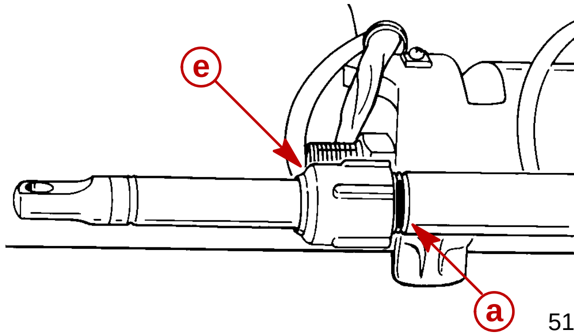
Thread cap (e) onto steering cable mounting tube, up to mark (a).



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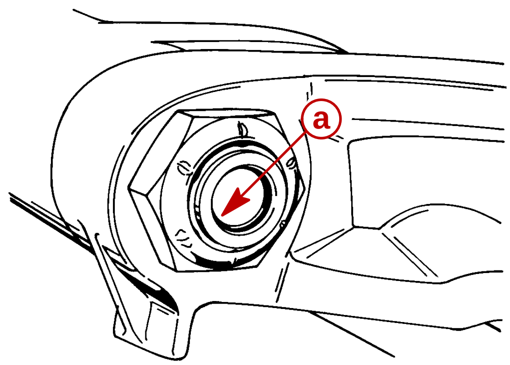
STEERING CABLE INSTALLATION - PORT OUTBOARD

IMPORTANT: Lubricate inside of port outboard's tilt tube and rubber O-ring seal located inside tilt tube with 2-4-C w/Teflon, before installing steering cable.

Lubricate inside of port outboard's tilt tube and rubber O-ring seal (a) with 2-4-C w/Teflon.



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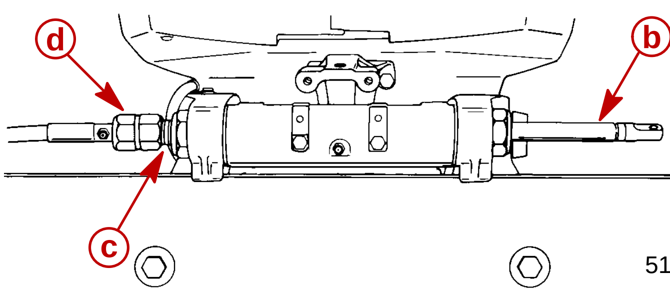
Insert steering cable end (b) (steering cable routed down starboard side of boat) thru tilt tube (c) of port outboard and thread steering cable attaching nut (d) onto tilt tube hand tight.

NOTE: *Torque steering cable attaching nut only after final steering adjustments have been made.*



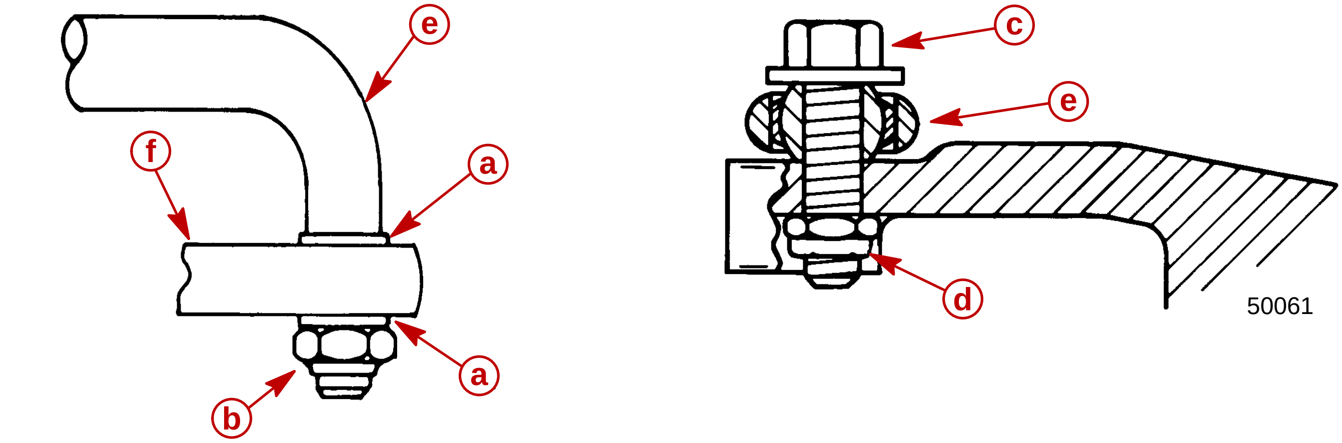
51887

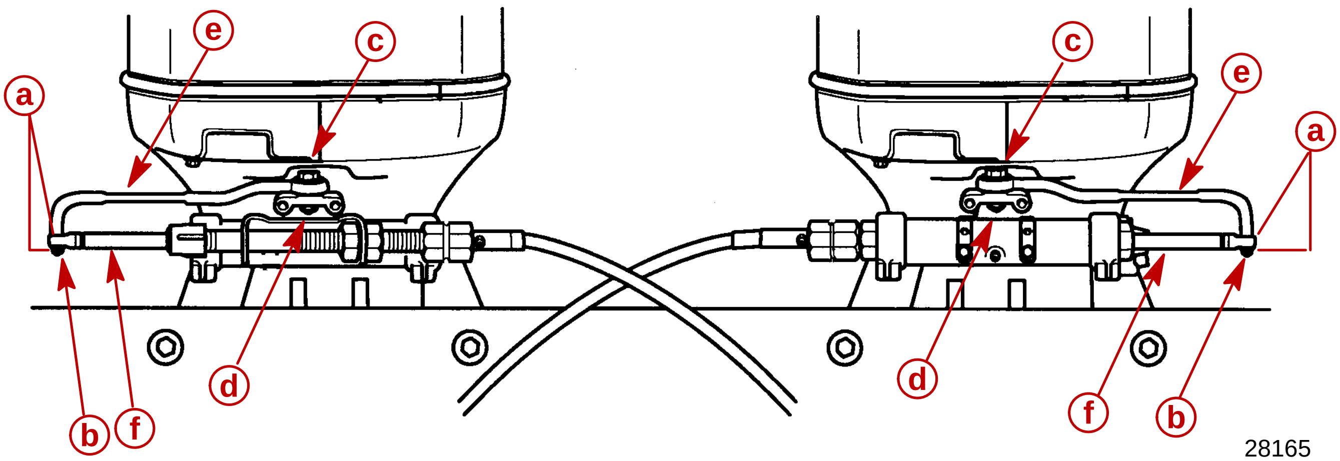
STEERING LINK ROD INSTALLATION

⚠ WARNING
Steering link rods MUST BE secured between outboard steering arm and steering cable end, using special washer head bolt (10-14000) and two nylon insert locknuts (11-34863), as shown. Both special washer head bolt and nylon insert locknuts MUST BE tightened as specified.

Lubricate holes in ends of steering cables, with Quicksilver 2-4-C w/Teflon (92-825407A12). Assemble steering link rods to steering cable ends of each outboard, using flat washers and nylon insert locknuts. Tighten locknuts until they seat [DO NOT exceed 120 lb. in. (13.5 Nm) 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 Nm) then torque locknuts to 20 lb. ft. (27 Nm).

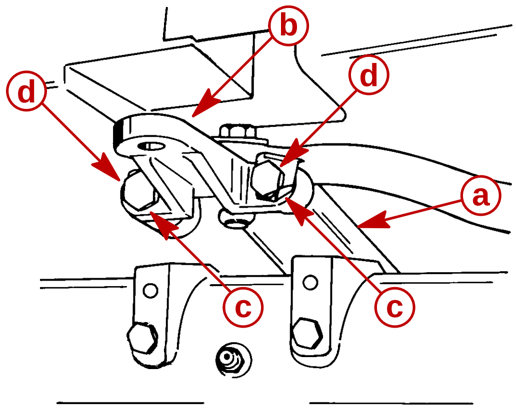




- **a** - Flat Washer (2 Each Link Rod)
- **b** - Nylon Insert Locknut - Torque Until it Seats [DO NOT Exceed 120 lb. in. (13.5 Nm) of Torque], Then Back Off 1/4 Turn
- **c** - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27 Nm)
- **d** - Nylon Insert Locknut - Torque to 20 lb. ft. (27 Nm)
- **e** - Steering Link Rod
- **f** - Steering Cable End

STEERING ARM EXTENSION BRACKET INSTALLATION

Secure a steering arm extension bracket to each out- board'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. (31.8 mm) Long - Torque to 23 lb. ft. (31 Nm), 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

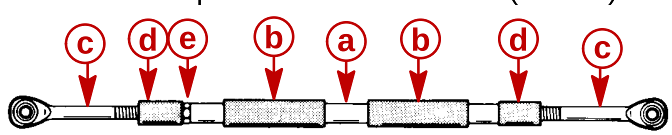
Position outboards so that they are facing straight forward. (Distance between threaded hole centers of steering arm extensions MUST BE equal to distance between propeller shaft centerlines.)

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. (70 mm).



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. (19 mm) minimum. Thread length of steering eye is 3-1/2 in. (89 mm), so exposed thread must not extend out of coupler more than 2-3/4 in. (70 mm). 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.

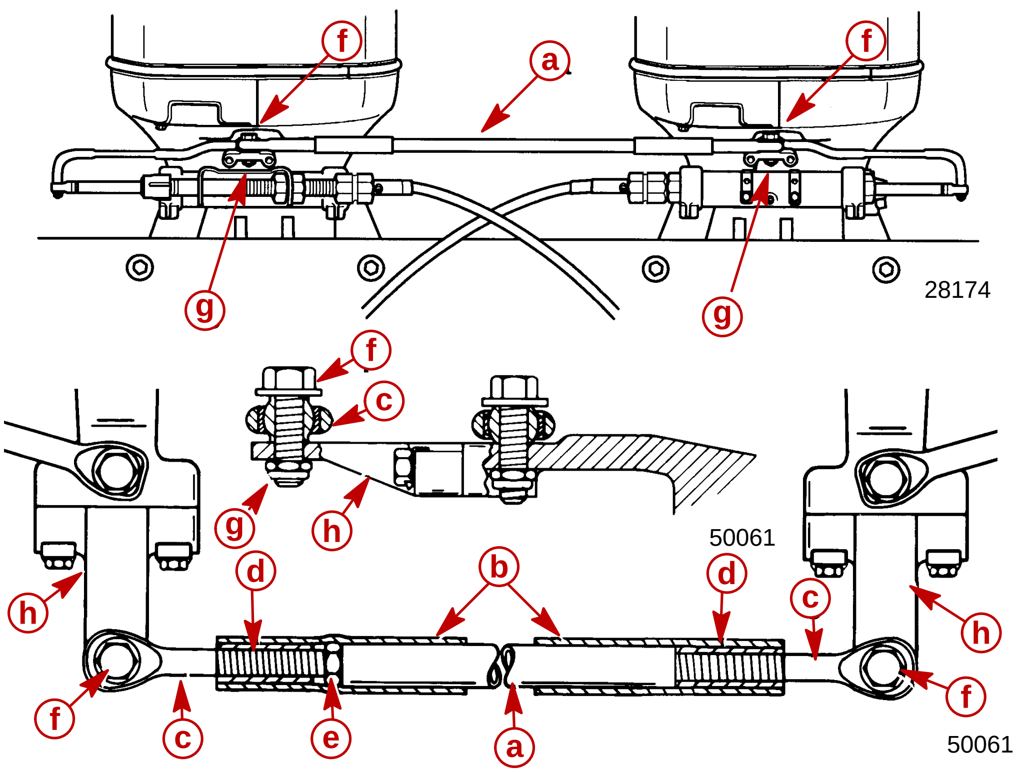
IMPORTANT: With assembled steering coupler installed and before tightening special washer head bolts/locknuts, check outboard alignment. Distance between centers of special washer head bolts MUST BE equal to distance between propeller shaft center lines, for proper steering. If adjustment is necessary, 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 Nm), then torque locknuts to 20 lb. ft. (27 Nm).

⚠ WARNING
Both steering eyes MUST BE threaded into coupler 3/4 in. (19 mm) minimum, and jam nut must be tightened against coupler to prevent coupler from turning. Torque "jam" nut to 20 lb. ft. (27 Nm).

Tighten "jam" nut against coupler. Torque "jam" nut to 20 lb. ft. (27 Nm).

Spray Quicksilver Corrosion Guard on exposed threads of steering eyes and position rubber bushings and rubber sleeves to cover exposed threads of steering eyes.

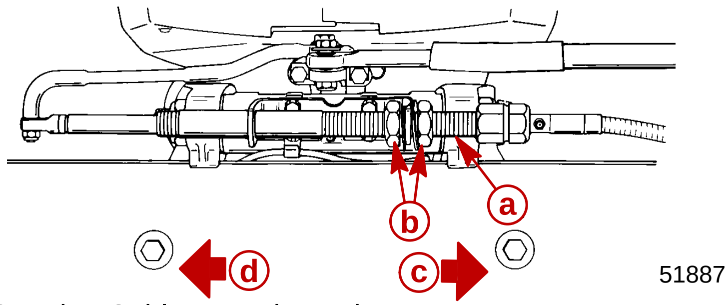


- **a** - Coupler
- **b** - Rubber Sleeve
- **c** - Steering Eye
- **d** - Rubber Bushing
- **e** - Jam Nut - Torque (Against Coupler) to 20 lb. ft. (27 Nm)
- **f** - Special Washer Head Bolt (10-14000) - Torque to 20 lb.ft. (27 Nm)
- **g** - Nylon Insert Locknut - Torque to 20 lb. ft. (27 Nm)
- **h** - Steering Arm Extension Bracket

STEERING SYSTEM TENSION ADJUSTMENT (PARALLEL ROUTED STEERING CABLES)

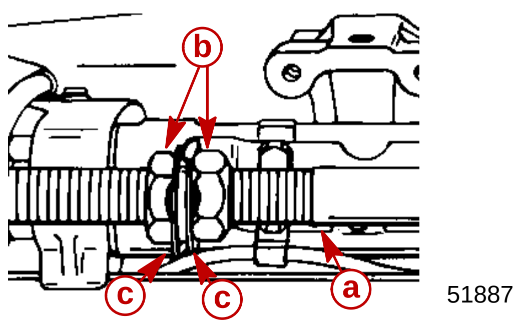
IMPORTANT: For proper operation of this dual cable - dual outboard steering installation, there MUST BE proper tension in the steering system. NOT ENOUGH tension will cause slack (play) in steering system. TOO MUCH tension will cause steering cables to bind. Perform the following steps to correctly adjust 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 Nm) 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 Nm)
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 Nm).

NOTE: *Cable attaching nuts with a "V" groove around outer circumference are self locking and do not require locking sleeves.*

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

Adjust trim tabs of both outboards, as outlined in **"Trim Tab Adjustment,"** following.

Trim Tab Adjustment

DUAL OUTBOARD - COUNTER ROTATION INSTALLATION

1. Shift outboard into neutral and make sure ignition key is at “OFF” position.
2. Remove plastic cap from rear of driveshaft housing and loosen bolt and trim tab.
3. Position trim tabs of both outboards straight to rear of outboard, so that tabs are aligned with gear housing centerline.
4. Tighten both trim tab bolts securely and replace plastic caps. No further adjustment will be required.

DUAL OUTBOARD - NON COUNTER ROTATION INSTALLATION

1. Check trim tab position as follows:

IMPORTANT: Initial trim tab setting for both outboards should be straight to rear of outboard, so that tabs are aligned with gear housing center line. Refer to “If necessary, adjust trim tab as follows,” following.

   a. Operate boat at normal cruise throttle setting and adjust trim to optimum setting.
   b. If boat pulls to the right (starboard), trailing edge of trim tab must be moved to the right (when viewing outboard from behind). If boat pulls to the left (port), trailing edge of trim tab must be moved to the left.

2. If necessary, adjust trim tab as follows:
   a. Shift outboard into NEUTRAL and make sure ignition key is at “OFF” position.
   b. Remove plastic cap from rear of driveshaft housing and loosen bolt and trim tab.

IMPORTANT: Trim tabs MUST BE set in the same position on both outboards.

   c. If boat pulls to the right, adjust trailing edges of both trim tabs to the right. If boat pulls to the left, adjust trailing edges of both trim tabs to the left.
   d. Tighten both trim tab bolts securely and replace plastic caps.
   e. Operate boat per **“Check trim tab position as follows,”** preceding, to check trim tab setting. Readjust trim tabs, if necessary.

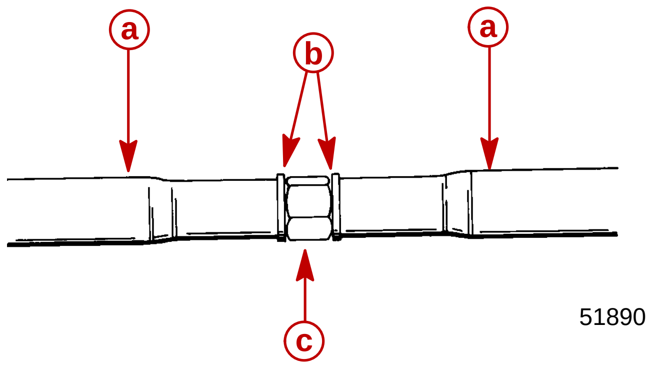
Ride Guide Steering Attachment Extension Couplers

Listed below are typical couplers available. Refer to the current Quicksilver Accessory Guide for specific coupler lengths and part numbers.

Outboard Center Line Distance	Required Coupler(s) Between Steering Eyes
22-1/2 in. thru 24-1/2 in. (572 mm thru 622 mm)	12″ (305 mm) Coupler
23-1/2 in. thru 27-1/2 in. (597 mm thru 699 mm)	15″ (381 mm) Coupler (Supplied with this kit)
26-1/2 in. thru 30-1/2 in. (673 mm thru 755 mm)	18″ (457 mm) Coupler
30 in. thru 34 in. (763 mm thru 864 mm)	9″ (229 mm) Coupler and 12″ (305 mm) Coupler (Connected together with coupler link rod)
33 in. thru 37 in. (838 mm thru 940 mm)	12″ (305 mm) Coupler and 12″ (305 mm) Coupler (Connected together with coupler link rod)

⚠ WARNING

When 2 couplers are connected together with coupler link rod, a lock washer must be used on each side of coupler link rod, and link rod must be torqued to 20 lb. ft. (27 Nm) into end of each coupler.



a - Couplers Connected Together
b - Lock washers
c - Coupler Link Rod [Torque to 20 lb. ft. (27 Nm) 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.

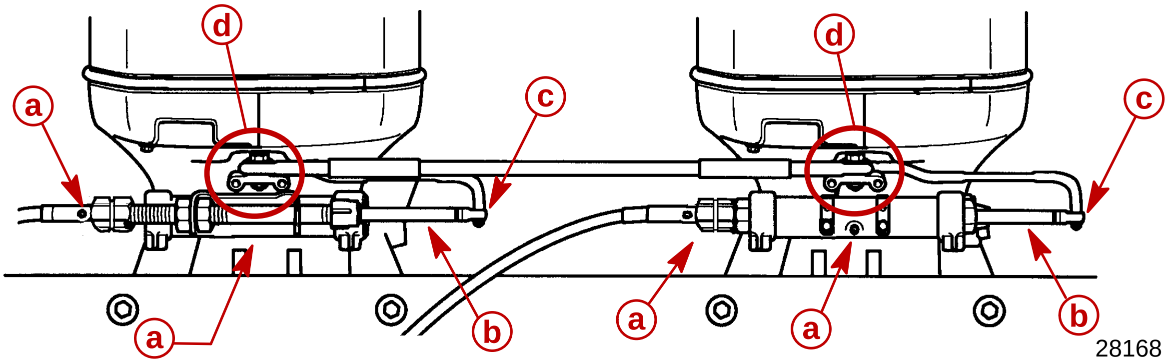
NOTE: *Ride-Guide Steering Cables are lubricated at the factory and require no additional lubrication at initial installation.*

⚠ WARNING

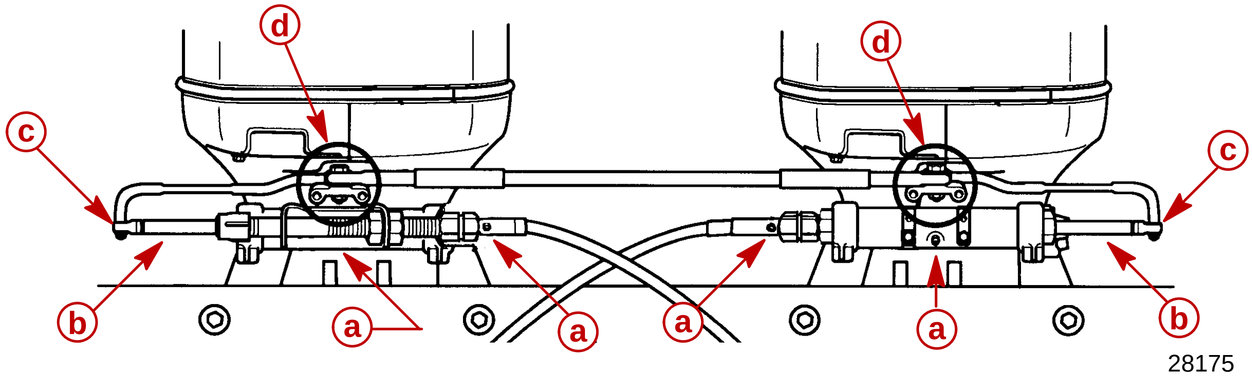
Core of each steering cable (transom end) must be fully retracted into cable housing before lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

3. With core of Ride-Guide Steering Cable (transom end) fully retracted, lubricate transom end of steering cables thru grease fittings with 2-4-C w/Teflon (92-825407A12). Lubricate exposed portion of cable ends with 2-4-C w/Teflon.
4. Lubricate pivot points of steering link rods and ball joints 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



Lubrication Points for Opposite Side Cable Routing Installations

a - Grease Fittings
b - Cable Ends
c - Pivot Points
d - Ball Joints

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. (9.5 mm x 63.5 mm) bolt, flat washer and locknut, as shown in Figure 1. Torque locknut to 20 lb. ft. (27 Nm).

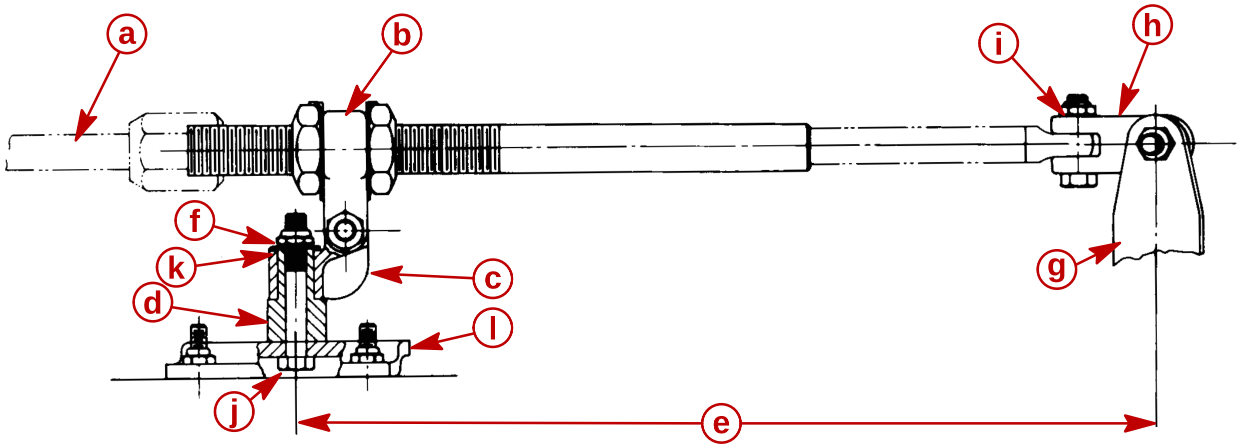


Figure 1

a - Ride-Guide Cable
b - Ride-Guide Yoke
c - Pivot Block
d - Pivot Spacer
e - 15 in. (381 mm) (Centerline of Attaching Kit Pivot to Centerline of Outboard)
f - Pivot Attaching Locknut [Torque to 20 lb. ft. (27 Nm)]
g - Outboard Steering Arm
h - "Clevis Kit"
i - Ride-Guide Cable Attaching Locknut [Torque to 10 lb. ft. (13.5 Nm)]
j - Bolt [3/8 in. x 2-1/2 in. (9.5 mm x 63.5 mm)]
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. (11.1 mm x 44.5 mm) bolt and locknut, as shown in Figures 1 and 2. Torque locknut to 10 lb. ft. (13.5 Nm), **then back off 1/4-turn.**

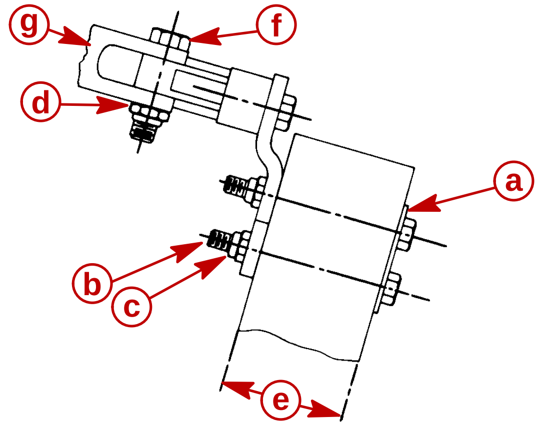


Figure 2

- **a** - Transom Backing Plate
- **b** - Bolt [5/16 in. x 3-1/4 in. (7.9 mm x 82.5 mm)]
- **c** - Locknut [Torque to 10 lb. ft. (13.5 Nm)]
- **d** - Ride-Guide Yoke Attaching Locknut [Torque to 10 lb. ft. (13.5 Nm)] **Then Back Off 1/4-Turn**
- **e** - 2-3/8 in. (60.3 mm) Maximum Transom Thickness
- **f** - Bolt [7/16 in. x 1-3/4 in. (11.1 mm x 44.5 mm)]
- **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 shown:
   a. Determine centerline of outboard, then measure 15 in. (38.1 cm) 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. (38.1 mm)** (Figure 1) at a height where the **center of Ride-Guide yoke is even with, or not more than 1/2 in. (12.7 mm)** above top edge of transom. (Figure 3)

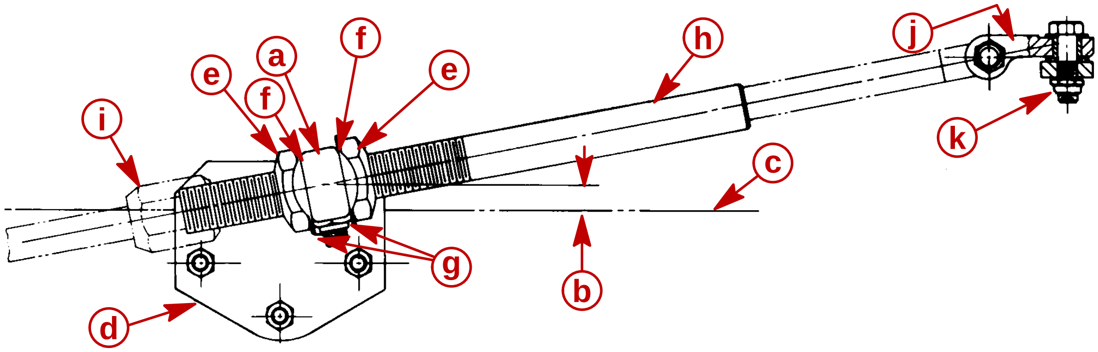


Figure 3

- **a** - Ride-Guide Yoke
- **b** - 0 in. to 1/2 in. (0 mm to 12.8 mm) (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 Nm)]
- **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 Nm)]
- **j** - “Clevis Kit”
- **k** - Clevis Attaching Locknut [Torque to 20 lb. ft. (27 Nm)]

***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. (8.7 mm) 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 Nm).

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 Nm), 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 Nm). (Figure 3)

⚠ WARNING

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

Maintenance Instructions

Lubrication and maintenance inspection is owner’s responsibility and must be performed at intervals specified, following:

Normal Service - Every 50 hrs. of operation or 60 days (whichever comes first)

***Severe Service -** Every 25 hrs. of operation or 30 days (whichever comes first)

*Operation in a salt water area is considered **“Severe Service.”**

⚠ CAUTION

Core of steering cable must be fully retracted into cable housing when lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

1. Lubricate outboard end of Ride-Guide steering cable (thru grease fitting - if equipped - next to cable attaching nut) with Quicksilver 2-4-C w/Teflon.

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

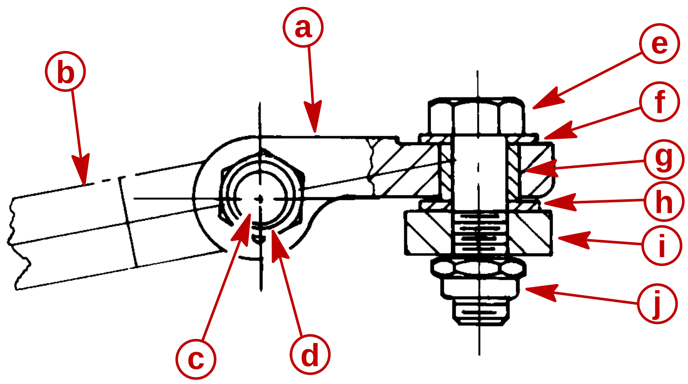
2. Lubricate all steering system pivot points (and exposed portion of steering cable core) with Quicksilver 2-4-C w/Teflon. Lubricate at intervals specified preceding.
3. Carefully check steering system components for wear (at intervals specified, preceding). Replace worn parts.
4. Check steering system fasteners (at intervals specified, preceding) to be sure that they are torqued to correct specifications. (Figures 1, 2 and 3)

Clevis Attaching Kit Installation (A-70599A5)

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. (9.5 mm x 34.9 mm) bolt (area without threads) with 2-4-C w/Teflon, then secure clevis to steering cable with this bolt and a locknut. Torque locknut (item "d") to 10 lb. ft. (13.5 Nm).



a - Clevis
b - Steering Cable
c - Bolt [3/8 in. x 1-3/8 in. (9.5 mm x 34.9 mm)]
d - Clevis to Steering Cable Locknut [Torque to 10 lb. ft. (13.5 Nm)]
e - Bolt [3/8 in. x 1-1/4 in. (9.5 mm x 31.8 mm)] [Torque to 20 lb. ft. (27 Nm)]
f - Thin Washer [1/16 in. (1.6 mm) Thick]
g - Spacer
h - Thick Washer [1/8 in. (3.2 mm) Thick]
i - Engine Steering Arm
j - Clevis to Engine Locknut [Torque to 20 lb. ft. (27 Nm)]

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. (9.5 mm x 31.8 mm) 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 Nm), then torque locknut (item "j") to 20 lb. ft. (27 Nm).

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.

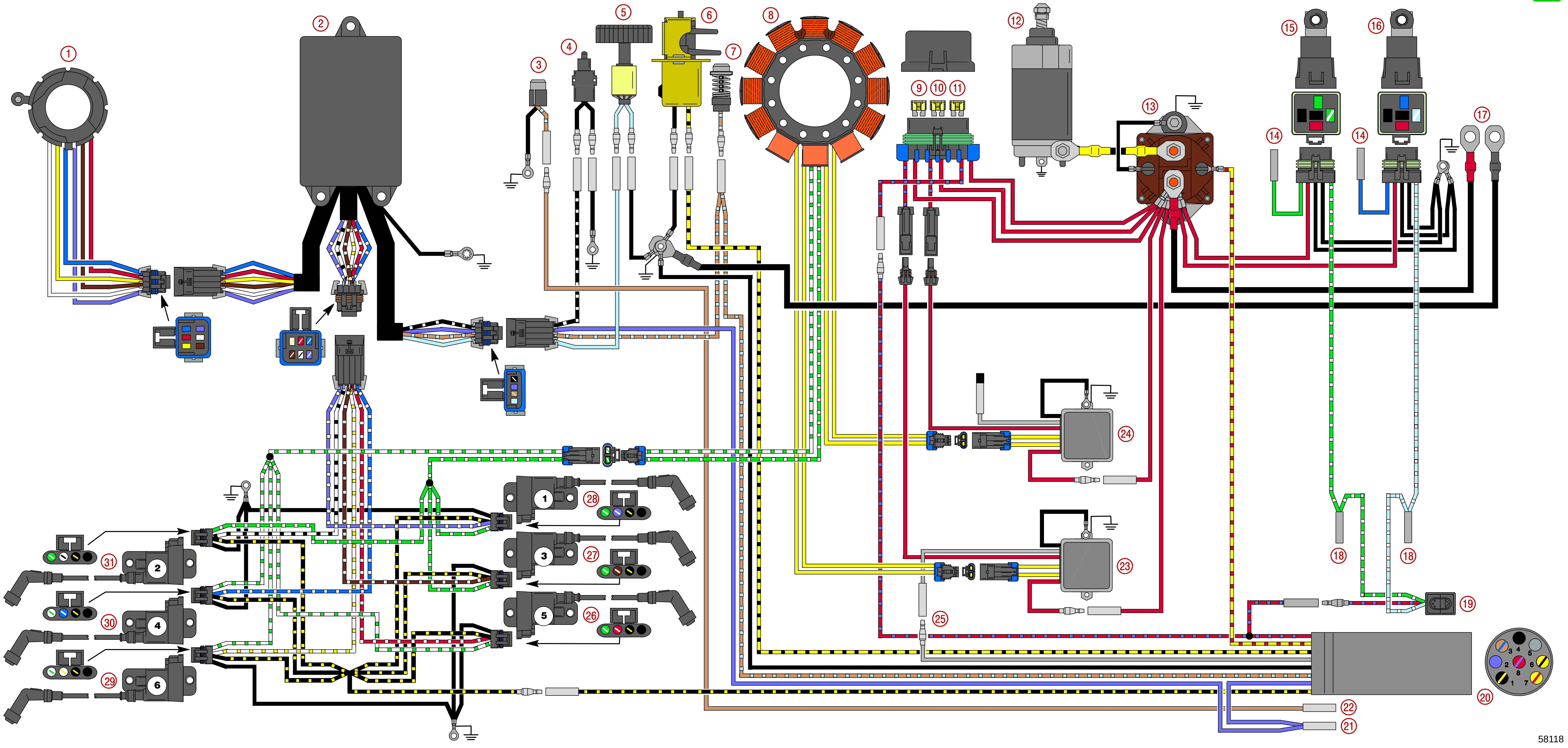
COLOR DIAGRAMS

Table of Contents

2.5 LITER V-6 CARBURETOR
COLOR WIRING DIAGRAM
2000 MODELS

1. Trigger
2. Control Module
3. Temperature Sensor
4. Shift Switch
5. Low Oil Switch
6. Fuel Enrichment Solenoid
7. Temperature Switch
8. Stator
9. 20 Ampere Fuse Lower Voltage Regulator
10. 20 Ampere Fuse Upper Voltage Regulator
11. 20 Ampere Fuse Accessories and Starting Circuit
12. Starter
13. Start Solenoid
14. To Trim Motor
15. Trim Down Relay
16. Trim Up Relay
17. To 12 Volt Battery
18. To Remote Control Trim Switch
19. Cowl Mounted Trim Switch
20. To Remote Control
21. Auxiliary Power
22. To Temperature Gauge
23. Lower Voltage Regulator
24. Upper Voltage Regulator
25. Tachometer Signal
26. CDM #5
27. CDM #3
28. CDM #1
29. CDM #6
30. CDM #4
31. CDM #2

2.5 Litre V-6 Carburetor 2000 Models



2.5 LITER V-6 150/175 EFI
COLOR WIRING DIAGRAM
2000 MODELS

1. Trigger
2. Control Module
3. Low Oil Sensor
4. Temperature Sensor
5. Stator
6. 20 Amp Fuse Lower Voltage Regulator
7. 20 Amp Fuse Upper Voltage Regulator
8. 20 Amp Fuse Accessories and Starting Circuit
9. Starter
10. Start Solenoid
11. To Trim Motor
12. Trim Down Relay
13. Trim Up Relay
14. To 12 Volt Battery
15. Air Temperature Sensor
16. Temperature Sensor
17. Water Sensing Module
18. Water Sensing Probe
19. #1 Fuel Injector
20. #2 Fuel Injector
21. #3 Fuel Injector
22. #4 Fuel Injector
23. #5 Fuel Injector
24. #6 Fuel Injector
25. Electronic Control Unit
26. Digital Diagnostic Terminal Connector
27. Electric Fuel Pump
28. Shift Switch
29. Cowl Mounted Trim Switch
30. Throttle Position Indicator
31. To Remote Control Trim Switch
32. To Remote Control
33. To Temperature Gauge
34. Auxiliary Power
35. Lower Voltage Regulator
36. Upper Voltage Regulator
37. Tachometer Signal
38. #5 CDM
39. #3 CDM
40. #1 CDM
41. #6 CDM
42. #4 CDM
43. #2 CDM

2.5 Litre V-6 150/175 EFI 2000 Models

2.5 LITER V-6 200 EFI
COLOR WIRING DIAGRAM
2000 MODELS

1. Trigger
2. Control Module
3. Low Oil Switch
4. Temperature Switch
5. Stator
6. 20 Amp Fuse Lower Voltage Regulator
7. 20 Amp Fuse Upper Voltage Regulator
8. 20 Amp Fuse Accessories and Starting Circuit
9. Starter
10. Start Solenoid
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16. Temperature Switch
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18. Water Sensing Probe
19. #1 Fuel Injector
20. #2 Fuel Injector
21. #3 Fuel Injector
22. #4 Fuel Injector
23. #5 Fuel Injector
24. #6 Fuel Injector
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33. To Remote Control
34. To Temperature Gauge
35. Auxiliary Power
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37. Upper Voltage Regulator
38. Tachometer Signal
39. #5 CDM
40. #3 CDM
41. #1 CDM
42. #6 CDM
43. #4 CDM
44. #2 CDM

2.5 Litre V-6 200 EFI 2000 Models

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2.5 LITER V-6
COLOR WATER FLOW DIAGRAM
2000 MODELS

1. Cylinder Head Cover – Removed from head for illustration, normally part of head casting.
2. Thermostat (2) 143° F (61.7° C) – If stuck closed, engine will over heat at low speed. If stuck open, engine will not warm up at idle speed.
3. Check Valve for powerhead flush.
4. 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.*
5. Primary Water Discharge into Driveshaft Housing.
6. Water passing through thermostats dump into the adaptor plate, then discharges down the exhaust.
7. Water Dump Holes for Exhaust Cooling (2 each) 1/8 in. (3.175 mm) – if holes are plugged, tuner pipe will melt and bearing carrier prop shaft seals will be damaged.
8. Tell-Tale Outlet
9. Water Tube
10. Wall of Water – If water level height is insufficient, water pump may draw in air resulting in an overheated engine.
11. Excess water from wall of water around exhaust bucket exits around anodes.
12. Water Inlet
13. Water exiting exhaust discharge.

2.5 Litre V-6 Water Flow Diagram 2000 Models